APPRAISERS' AND ADJUSTERS' HANDBOOK

ARTHUR

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A Handbook for Engineers, Architects, Appraisers, Adjusters, Accountants, Lawyers, Realtors, Assessors, Builders, Building and Loan Associations, Insurance Companies, Investment Companies, Trust Companies, Banks, Manufacturing Establishments, Public Utilities, Technical Colleges, etc.

BY

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"Estimating Building Costs," "Home Builder's Guide,"
"Building Estimators' Handbook"

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PREFACE

A BOOK that is too large is hard to handle, especially when it is in constant use; and sometimes the purchasers pay for what they do not require. There is a clear distinction between the requirements of those engaged in regular building work, whether as architects, engineers, contractors, or estimators, and others making valuations only. It was for these reasons that when The New Building Estimators' Handbook was revised and enlarged to 1000 pages, the publishers concluded to issue two books of suitable size instead of one that would have been larger than convenient, and thus to put the valuation data by itself.

In almost all valuation work the original cost of buildings should be found if possible, which means that figures must be available for any year selected, within a reasonable period, so that they may be changed from the year of erection to suit the year of appraisal. A building contractor does not require such data for building new work.

The United States Bureau of Labor issues Index Numbers of wholesale prices month by month, and they run back to 1860. The revised numbers run from 1923 to 1890. To get clear of war confusion 1913 is taken as base of 100, and all years arranged up or down from that. In 1922 the figures from the 1910 census were dropped and the 1920 ones used. As the base year will be maintained in the future, changing or stationary costs can be marked down in this book, and comparative figures always kept up to date.

All through this Appraiser the year of construction is given, and from this date and the Index Numbers a fair value for any other year may be arrived at.

In the end of 1922 the Harvard Committee on Economic Research reported that there is no likelihood of a fall in prices for a decade. How can lumber come down with an increasing population and a decreasing forest area? The present rate of consumption is more than four times the annual growth of the forests. From 1916–20 inclusive, 160,319 fires burned over 56,500,000 acres. This is 88,300 square miles, or more than the area of either Utah, Idaho, Minnesota, or Kansas.

In the chapter on Depreciation it may be seen that houses are not necessarily "old" twenty years after erection. A well-built frame house should last for 75 years. Hundreds of millions of dollars might be saved to the people with better building, and the forest capacity would thus be increased at least 33 per cent.

Part I of this Appraiser deals largely with general principles, square and cubic foot costs, percentages of the various kinds of work, comparisons, and approximate estimating. Some of the railroad chapters have detailed costs of engine houses and machine foundations. It is shown that the physical valuation may be so increased by legal allowances after it is finished, and that depreciation so affects the total, that it is not worth while to try to get mathematical accuracy on small items.

Part II shows how the detailed costs may be found. Wages rise and fall, but when the amount of work done in a certain number of hours is given any rate can be applied. The tables were specially made for this book and for quick reference for any wage at any rate of labor per hour. Brickwork, for example, is tabulated at from 30 brick laid per hour to 390, and at wages from 50c. to $1.40. The tables are so made as to be permanent. Lumber is both high and low.

The regular stock tables of millwork are abbreviated, by giving square foot prices, enough for ordinary requirements. The Cost Book "A" of the Millwork Cost Bureau of Chicago has been used by permission. As the figures are the result of ten thousand tests by 500 of the leading millmen, it may be said that this chapter is as near perfection as anything in this difficult line can be.

Illustrations are given for ornamental iron and bronze work, and a square foot or complete price set. This is such a special line that all that can be expected is an approximate figure to serve for tablets, railings, and doors. Only a very small percentage of buildings, even of the best class, goes for ornamental work.

I was much pleased when my first Estimator of only 150 pages was issued to get an order for 25 copies from one of the leading appraisal companies. This seemed to indicate that the book was of the right kind, and did more good than larger orders since, one of which for a later edition of 750 pages was for 250 copies—The New Building Estimators' Handbook, 1922, and this one will make up more than ten times the size of the original.

Since the first book was issued I have valued about $6,000,000 worth of railroad and telephone buildings for the State of Nebraska, passed the United States Civil Service Examination as Senior Architect for the valuation of railroad buildings, was offered the opportunity of taking charge of the valuation of the buildings on

the Grand Trunk of Canada, and in 1921–22 appraised about $50,000,000 worth of Omaha buildings for taxation purposes.

A building contractor may put in bids on hundreds of buildings and get only a few. With an experience of years in that work, where all bids and sub-bids were detailed out as closely as possible, I saw variations from less than 1 per cent up to 20 and even beyond. When this is done on work closely detailed out from the plans and specifications, what is to be expected where there are no plans and much has to be guessed at in appraisals?

William Arthur

December, 1923.

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PART II

STANDARD KEY TABLES

BASIS OF COMPARISON WITH 1913 = 100

In Table A, last column, figures are given year by year according to the rise or fall of prices from 1913. A structure set at $100,000 in 1913 would be $82,000 in 1890, $100,000 in 1907, $264,000 in 1920, and so on. This for ordinary buildings without steel. See Table D for steel percentages.

BUREAU OF LABOR STATISTICS

United States Department of Labor

TABLE A

REVISED INDEX NUMBERS OF WHOLESALE PRICES WITH 1913 AS BASE OF 100

Year	Metals and metal products	Building materials	Year	Metals and metal products	Building materials	Year	Metals and metal products	Building materials
1890	116	82	1901	103	78	1912	99	99
1891	102	78	1902	100	80	1913	100	100
1892	92	74	1903	99	82	1914	85	92
1893	85	73	1904	88	79	1915	99	94
1894	72	70	1905	98	85	1916	162	120
1895	77	68	1906	113	95	1917	231	157
1896	78	68	1907	121	100	1918	187	172
1897	72	66	1908	95	92	1919	162	201
1898	72	70	1909	93	95	1920	192	264
1899	110	77	1910	94	98	1921	129	165
1900	108	81	1911	89	98	1922	116	168

The above table is based on the returns from the 1920 census, with 1919 data used instead of 1909, as with previous tables. The old series was discontinued, April, 1922.

The following table goes back to 1860, and up to 1914. In Bulletin 181, page 264, the figures are credited to the Senate Finance Committee. In 1890 the work was taken over by the Bureau of Labor. But the base is 1914 = 100 instead of 1913 as now. As 1913 is listed at 108 in Metal column, and 104 in Building Materials, all previous figures should be reduced in that proportion. If 104 in 1913 is reduced to 100, then 67 for building materials in 1860 comes to 64.4, and so with any year selected.

But the two tables do not correspond as they should, and the 1860 one is given here from 1890 only, and as an approximate guide. For example, building materials in the old table is 76 in 1890. Reduced in the proportion of 104 to 100 = 73, but table A gives 82. So with other numbers. As actual bids are occasionally 20 per cent apart some margin may be allowed in the tables also.

TABLE B

Revised Index Numbers of Wholesale Prices with 1914 as Base of 100

Year	Metals and metal products	Building materials	Year	Metals and metal products	Building materials	Year	Metals and metal products	Building materials
1860	136	67	1870	174	105	1880	147	86
1861	132	79	1871	169	107	1881	132	84
1862	147	107	1872	198	114	1882	134	87
1863	184	132	1873	196	116	1883	125	82
1864	294	182	1874	171	106	1884	108	79
1865	267	153	1875	163	97	1885	99	78
1866	237	140	1876	160	93	1886	97	81
1867	219	132	1877	145	87	1887	98	77
1868	202	127	1878	131	78	1888	99	77
1869	201	125	1879	128	79	1889	96	77

The compilers wrote: "An approximately correct continuous series (to 1860) with 1914 as the base has been obtained." The United States average figures are thus presented from 1860 to 1922.

INDEX NUMBERS FOR LUMBER, COMMON BRICK, STRUCTURAL STEEL, AND ALL BUILDING MATERIAL, 1913–1922

TABLE C

Year	Lumber	Common Brick	Structural steel	Other building materials	All Building materials
1913	100	100	100	100	100
1914	92	99	78	95	92
1915	89	99	85	102	94
1916	102	108	167	137	120
1917	135	132	247	172	157
1918	155	176	199	189	172
1919	210	206	167	195	201
1920	307	279	187	218	264
1921	163	232	135	169	165
1922	180	201	111	155	168

Standard. The last column, beginning at 100 and ending at 168, is the one to work from with ordinary construction. A building costing $100,000 in 1913 would be set at $165,000 in 1921, and so with other years.

But there are special buildings to which the table does not apply so well, such as reinforced concrete ones, and those with steel frames. There is no established proportion in the latter for the steel, even in the same class. One skyscraper might have such costly exterior or interior work as to run the steel percentage low compared with another; and so with varying requirements in large railroad buildings. Machine and erecting shops at terminals and small towns are not built from the same designs. The following figures, taken from Chaps. IV for a skyscraper, and VI for shops, are only average figures given to illustrate the principle of a proportionate rise, for which the last column is not adapted.

Structural steel on a skyscraper is set at 12 per cent of the total, nothing being allowed for architect's percentage, ornamental iron, or heavy piping. Some buildings might give 10 and others 14.

The average of two car shops is 30 per cent of the total, and a light blacksmith shop is down to 20; a foundry has 36; and a heavy machine shop, 55, no engineering percentage allowed. The machine shops as given in Chap. VI averaged 55 if the skylight frames are included among the steel at half their total, but the foundation is not included, costing about 20 per cent, and with engineering percentage besides, the 55 would be brought down to 45. Some shops

would have less; others might be more where light foundations were sufficient.

Structural steel at 100 in 1913 runs to 247 in 1917, and 135 in 1921, while ordinary building work in the last column begins, as always, at 100 in 1913, but is only 157 in 1917 and 165 in 1921. Based on the last column a $100,000 building in 1913 is $157,000 in 1917, and $165,000 in 1921. But assuming that 45 per cent of that building is structural steel, evidently the 1917 figure is too low.

On a $100,000 structure, 45 per cent steel, $45,000 would rise in the proportion of 100 to 247 = $111,150; while the $55,000 would take only 100 to 157 = $86,350, a total of $197,500 in 1917. If the last column had been taken for the entire $100,000 the total would be only $157,000. The difference is $40,500. As some machine shops cost $500,000 and others much more, it is clear that a distinction has to be made between classes of building when working out the totals for any particular year.

Worked out in the same way the 1921 total is $151,500, which happens to be closer than $40,500 to the $165,000,—"more by accident than good guiding." No depreciation is allowed in either case, but the principle is set forth to show the necessity for classification. The government final column merely gives the general rise or fall, and it suits all ordinary structures, such as the ones listed by Percentages near the end of Chap. V.

Approximate results, in much valuation work, have to be accepted as sufficient. When nearly 50 per cent is added to the physical valuation, as was done in one case and passed by the courts, there is no use wasting time and being too exact. "Getting the diameter of a circle by pacing and working out the circumference by decimals" is followed too often by the theorists.

It should be noted that the structural steel Index Numbers do not correspond with the ones given in Table A, which include all metal products—hardware, piping, etc.

Table D gives percentages to use for the years indicated on buildings with steel work, from 6 per cent to 50. They are worked out for this book from Table C. For 1914, as an example Steel is listed at 78 and all building materials at 92. On a 50 per cent basis, as in last column, steel would be 39 per cent of the building, and other materials 46, or an average of 85.

The Bureau of Labor, Table C goes back to 1913 only. If it is desired to get a proportionate figure for structures with steel before that date the regular table can be used, Table A. Other items than structural steel are included in the metals and metal products, but the totals will not be much changed on this account. If 1890 is wanted on a 50 per cent basis for steel and other materials 116 and 82 are taken. Half of each leaves the average 99; on a 10

per cent basis of steel the average is a little over 85. So with any year or proportion selected.

TABLE D

For Buildings with Steel

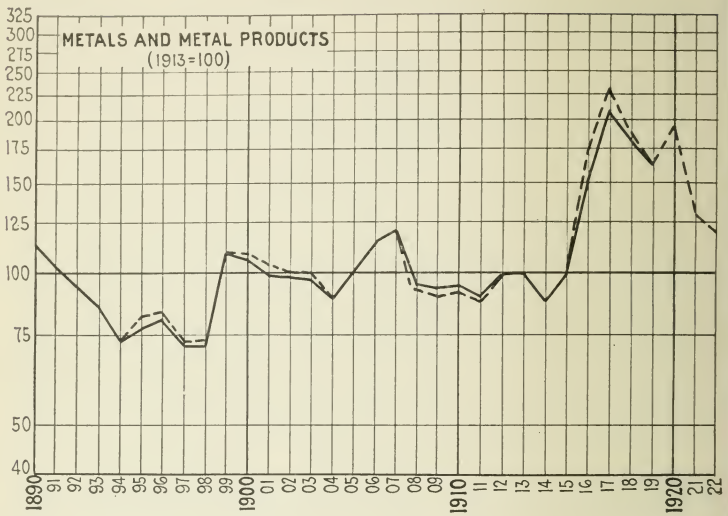
	Percentage of steel											
	6	8	10	12	15	20	25	30	35	40	45	50
1913	100	100	100	100	100	100	100	100	100	100	100	100
1914	91	91	91	90	90	89	89	88	87	87	86	85
1915	94	93	93	93	93	92	92	91	91	91	91	90
1916	123	124	125	126	127	130	132	134	137	139	141	144
1917	163	164	166	168	171	175	180	184	189	193	198	202
1918	174	174	175	175	176	178	179	180	182	183	184	186
1919	199	199	198	197	196	194	193	191	189	188	186	184
1920	260	258	256	255	253	249	245	241	237	233	229	226
1921	163	163	162	161	161	159	158	156	155	153	152	150
1922	163	162	161	160	158	155	152	150	147	144	141	139

In the Index Numbers the general Average is given for each year from the monthly records. The 1922 figures from January to October average 180 for lumber; 201 for brick; 111 for steel; and 166 for the all building materials column. To show the tendency at the October date the January and October figures are contrasted: Lumber, 166 and 203; common brick, 204 and 204; structural steel, 99 and 141; all materials, 157 and 166. Lumber rose 22 per cent: steel, 42; all materials, 17.

The United States Charts for Metals and Lumber are shown on two bases, each with 1913 = 100. The solid line runs to April, 1922, and the dotted one applies on the figures from the 1920 census. The solid line is on 1910 figures. The 1920 ones will be used until 1932.

Chameleons. Building contractors are bad enough, but statisticians lead the van when it comes to possible variations on the original composition or structure. The United States Bulletin, 181, gives four methods of finding the yearly averages of metals and building materials with a healthy difference of from 20 to 50 per cent between the methods. The best of the methods is the one that takes the weighted averages entering into construction. If 40 per cent of a building is masonry that item should be put in according to its proportion, as roughly found by wholesale exchanges over the whole country; and the averages in Table A are based upon this method. In Table D the reason for this is seen as to steel.

The Cleveland Trust Company sends out an excellent pamphlet on building, compiled by Leonard P. Ayres. The Relative Cost


METALS AND METAL PRODUCTS
(1913=100)
325
300
275
250
225
200
175
150
125
100
75
50
40
1890
91
92
93
94
95
96
97
98
99
1900
01
02
03
04
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07
08
09
1910
11
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13
14
15
16
17
18
19
1920
21
22

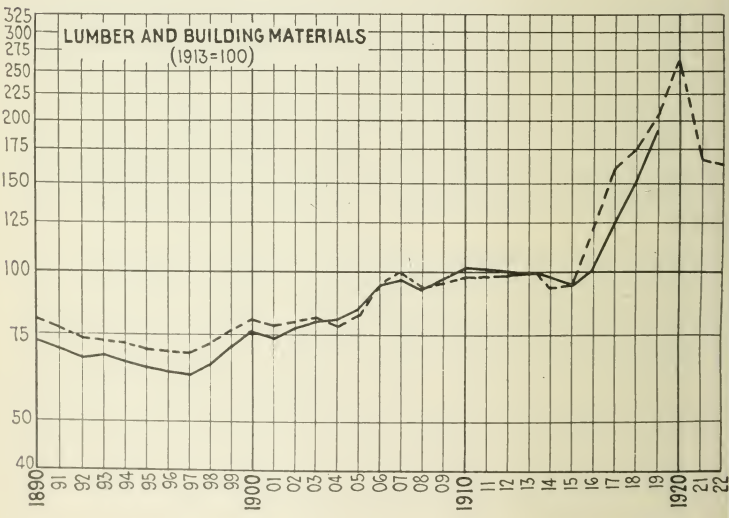

LUMBER AND BUILDING MATERIALS
(1913=100)
325
300
275
250
225
200
175
150
125
100
75
50
40
1890
91
92
93
94
95
96
97
98
99
1900
01
02
03
04
05
06
07
08
09
1910
11
12
13
14
15
16
17
18
19
1920
21
22

Table is given here to be compared with Table A, and the Main Table in Chap. IV. The figures are for ordinary construction, and not for steel frame buildings.

Relative Cost of Building Since 1840 if Costs in 1913 are Taken as 100

Final figure of date	1840 to 1849	1850 to 1859	1860 to 1869	1870 to 1879	1880 to 1889	1890 to 1899	1900 to 1909	1910 to 1919	1920 to 1929
0	55.3	52.5	53.6	88.3	70.7	69.2	75.1	98.9	247.1
1	56.2	50.6	60.7	88.8	72.1	68.3	76.3	97.6	189.0
2	55.1	51.9	77.5	93.2	74.5	66.4	79.2	97.6	
3	53.5	53.5	94.1	93.5	72.0	66.9	81.7	100.0	
4	52.7	58.3	126.6	87.7	70.7	64.4	82.1	97.6	
5	54.3	54.3	112.3	81.1	70.0	64.2	85.6	97.8	
6	54.6	54.4	105.9	77.0	71.8	64.4	92.4	108.1	
7	55.6	55.6	103.8	71.8	69.7	63.4	96.8	128.1	
8	54.6	54.8	100.9	65.7	69.8	65.3	91.4	143.2	
9	51.3	53.3	100.1	66.2	69.7	73.1	91.7	170.9	

The first line from 0 to 9 suits any year running downward. Thus 1 means 1841, 1871, 1921, etc.; and 8 suits 1868, 1908, 1918.

In August, 1922, metals and metal products are set at 126; in the same month of 1923, 145. Building materials, 172 and 186 for Aug. 1922 and 1923. (U. S.)

APPRAISERS' AND ADJUSTERS' HANDBOOK

PART I

CHAPTER I

PHYSICAL VALUATION. GENERAL PRINCIPLES

In constructing large buildings a double ladder is often made. It is wide enough for one man to go up while another is coming down.

If A stands at the foot of this ladder on the first floor, and B at the top on the second, and each begins to use it, it is clear that if A takes two steps while B takes only one he will be on the second floor at the time when his slower brother is but half-way down.

Rise and Fall. In this illustration A stands for an appreciation made by a rise in prices, and B for a depreciation caused by the law of natural decay. There is no fixed proportion as is indicated above, and, indeed, when prices are falling the operation of the law is totally changed. The depreciation would not be offset by any rise in the price list, and B would reach his floor, while A would have to remain stationary or descend into the cellar. But the principle of the forces working against each other holds on a rising market.

Owing to change in prices the physical valuation made the one year has to be revised the next no matter how carefully it is done. Everyone engaged in this kind of work should understand the causes that make careful computations out of date almost before they are summarized.

Unit. Of course a structure in itself does not become more valuable, but goes down hill from the day it is built. When we say that an $8,000 house is worth $8,300 the year after construction, all we mean is that wages and material have risen in price, and that we are regarding the dollar value only.

There may be some causes at work that seem to make buildings more valuable, as value is expressed in dollars, but this appreciation does not hold when a comparison is made with any other structures or commodities. One building worth 40, or any other, percentage of another still retains that relation regardless of whether prices are high or low.

High Prices. For an illustration of a period that was marked by a rise in prices, but that yet left structures on the same relative plane of values, we have the 21 years ending in 1910. The price of building materials rose, and so did the wages of mechanics. For the best class of fireproof structures, so built as to last, say, a couple of centuries, the dollar value was greater in 1910 than in the low price year of 1897. Lumber and building materials which were then listed at 94 were 196 in 1910; and wages had also gone up although not in the same proportion. The half of one per cent of depreciation in a structure fit to last for 200 years was made up, so far as is expressed in dollars, by the general rise in prices. It is therefore, not a safe guide to go to the books of a company or individual to find out the original cost of improvements, and work solely from that basis on any ordinary theory of depreciation to get present valuation.

The period from 1890 to 1910 shows that book values have been rendered worthless owing to the change in prices. If a detailed estimate is made of a structure at current rates, that is another matter.

From 1914 to 1920 another great rise took place. The U. S. figures set this as from 92 to 264. From 1920 the fall began, reaching a 1921 average of 165, but rising to 168 in 1922.

In the face of such forked lightning changes the best physical valuation that was ever made is good only for the month it was finished, and a year from date may be entirely obsolete. Before beginning depreciation the reproduction value must be first established.

The accompanying U. S. plate is not based on 1913 as 100, like the present Index numbers, but is shown here to illustrate the difference between such years as 1897 and 1910.

Many of the great strikes that have vexed this country, and European countries, have simply been the outburst of men and women who could not get the same allowance of things that their incomes formerly provided. The materials for a house, for example, cost far more than they used to. Boards listed in the government table at 98.1 in 1890, and at 90.6 in 1898, are 140.3 in 1903 and 200.1 in 1910. The wages or income would have to be more than twice as much in 1910 as in 1890 to get the same number of feet of boards for a cottage. And 1920 was worse.

The reason why so many fail to grasp the underlying principle of fluctuating values is that they assume the monetary standard to be fixed. Instead of being a "constant," however, it is a "vari-

RELATIVE PRICES OF ALL COMMODITIES, 1890 TO 1910.

[Average for 1890 to 1899=100.0.]

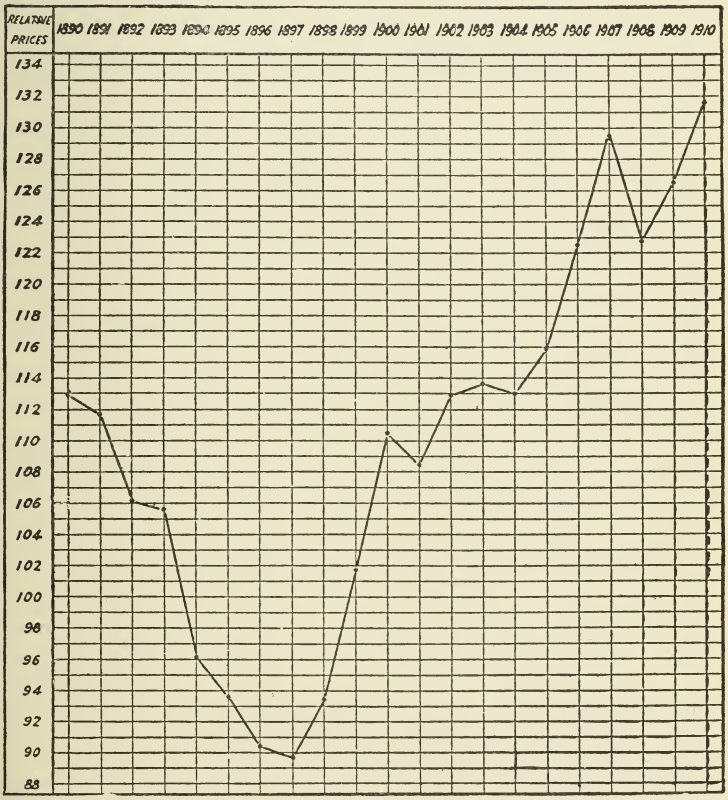


FIG. 1.

able," just like potatoes or boards. Gold buys brick, but brick and steel beams buy gold. A great flood of gold would change all our physical valuations. For this reason it is commonly agreed among the authorities of all nations that a commodity basis is the

best one for a currency. But it is hard to get one, and we have to keep to gold and watch it rise and fall.

If Book Values are taken, a start should be made on the basis of the figures given for the year of erection, and the rise or fall of prices made to suit the year of valuation. As many materials entering into a building are not listed in the Government Bulletin it would either be necessary to find out the percentage of rise or fall for them also, or to assume that the general average found for the 28 applied to all. When the difference in wages is considered, say, between 1893 and 1923 another factor comes in to make trouble, and modify original costs.

Bids. Of course, all through it has to be remembered that responsible bidders often vary on their bids from a few dollars to 20 per cent and over. How or why it would be hard to say, but we know that it is done; and thus book values "cooked" up to suit a percentage of rise or fall in prices would probably come as close to the real value as the bid of some contractor. Really, the only safe method is to take off a bill of material and figure up the building in the regular way, adding a contractor's profit, and an architect's percentage. But unless for special buildings this is not necessary for assessors or Railway Commissions.

The accompanying table on building material was used in the Cleveland Valuation that went into effect in December, 1911. It was compiled from the figures given by the Bureau of Labor. It is supposed to be used for a general figure, and not for 28 items only, as in the 1911 Bulletin. Thus, the material in a building valued at $111.8 in 1890 would be listed at $146.9 in 1907.

Relative Wholesale Prices of Building Material

Year	Relative price	Per cent of increase of 1907 prices over preceding years	Year	Relative price	Per cent of increase of 1907 price over preceding years
1890	$111.8	31.4	1899	$105.8	38.8
1891	108.4	35.5	1900	115.7	27.0
1892	102.8	42.9	1901	116.7	25.9
1893	101.9	44.2	1902	118.8	23.7
1894	9.63	52.5	1903	121.4	21.0
1895	94.1	56.1	1904	122.7	19.7
1896	93.4	57.3	1905	127.7	15.0
1897	90.4	62.5	1906	140.1	4.9
1898	95.8	53.3	1907	146.9	

"That is to say," explain the compilers of the table, "the 1907 prices are 4.9 per cent higher than the 1906 prices, 15 per cent higher than the 1905 prices, etc." The 1910 index prices on further investigation proved to be about the same as in the year of 1907.

Houses. In an investigation in Philadelphia of the cost of standard 2-story dwellings of a cheap type, apart from the value of the land, the following table was made out:

Year	Cost	Year	Cost	Year	Cost
1895	$1,458	1900	$1,712	1904	$1,981
1896	1,484	1901	1,746	1905	2,038
1897	1,567	1902	1,756	1906	2,500
1898	1,595	1903	1,821	1907	2,093
1899	1,588				

The general rise is seen in the table, which starts at practically $1,500 and ends at more than $2,000. In 1923, $3,200.

Architects. In addition to the increased cost of materials and labor, many architects have raised their percentage on small buildings, and especially on residences. Some charge as high as 10 per cent; but there are others who do work for as low as 3. All factors have to be taken into account before finishing a physical valuation.

Causes. One discouraging feature of this physical valuation of large properties is the continual change of prices. Everyone engaged in this work should understand some of the main causes for the changes, even if they lead into another field of investigation.

The Government Bulletin does not go very far into this side of the question. "The causes are too complex," it is said, "the relative influence of each too uncertain, in some cases involving too many economic questions, to permit their discussion in the present report."

Some of the influences are given, however. They are "variations in harvest, which contract or expand supply, and so increase and decrease price, not only of the particular commodity itself, but of others dependent upon it; changes in demand due to changes in fashions and seasons; inspection as to purity of food, etc.; improvements in methods of production; cheapening of transportation or handling; cornering of products; panics; expanding or contracting credit; unusual demand; short supply; organization or combination; and all hinging on one another."

Gold. But the chief cause of all is ignored. This is the startling increase in the supply of gold.

We are far enough away from the free silver, "16 to 1" days to look at this question in a somewhat more dispassionate manner than was then common. One of the main arguments against the theory was that all fixed incomes, salaries, returns from bonds, etc., would have had less purchasing power—in other words, that prices would have risen. The mortgage or bond would have been satisfied with the same number of dollars, but the owners of such securities would not have been able to get an equal number of feet of lumber, or quantity of other commodities. This theory was correct.

Contingencies. When making original estimates for groups of buildings it is customary to allow 10 per cent for contingencies. In making a valuation after they are built, however, there are no contingencies to be taken into account. In Minnesota an allowance of 5 per cent was nevertheless allowed by the State. This matter is settled when the general summary of all the factors in a complete railroad is made and the part of a building appraiser is to allow contractor's profit, architect's percentage, and end there.

Interest during construction and such items are all attended to in the general summary. There may be quite a few of such accounts that have to be added at the end. There are store expenses, for instance, sometimes set at 5 per cent on the material delivered, and use of tools and equipment on construction charged for at 2 per cent on the total.

Several Factors. After the physical valuation of a railroad is made the work is only well started. A celebrated Frenchman once gave the right rule for doing anything. It ran, "First of all, define your terms." The cost of a railroad is not its value, reproduction value is an indefinite term, there is, or there is not such a thing as depreciation, and so on, words without end, Amen.

The Supreme Court of Minnesota considered that the cost of reproduction is practically the only element necessary to be considered by the State in fixing rates; the Supreme Court of the United States declared this to be only one element of several. The Washington State Commission before determining the market value ascertained

(1) The original cost of construction.
(2) Cost of reproduction new.
(3) The depreciated value.
(4) The amount and market value of outstanding stocks and bonds.
(5) The density of population and traffic.
(6) The nature and permanency of population and traffic.
(7) Facilities for doing business.
(8) The physical conditions under which the road is operated.

RAILROAD INFORMATION

The act for the valuation of the railroads of the United States required (1) The original cost to date; (2) the cost of reproduction new; (3) the cost of reproduction less depreciation; (4) other values and elements of value.

An often quoted standard case is that of Smith *vs.* Ames. In this, the opinion of the Supreme Court of the United States names as items that must be considered: "Original cost, the amount expended in improvements, the amount and market value of bonds and stocks, the present cost of construction, the probable earning capacity, and the sum to meet operating expenses." The Court said besides: "We do not say that there may not be other matters to be regarded in estimating the value of the property."

As a contrast to this long and intricate list the Rock Island R. R. asked the Nebraska State tax commissioner to cut its valuation from $11,503,355 to $6,873,927 on the ground that earning capacity is the only true criterion of values. This in 1921. The I. C. C. valuation for the state was $7,937,874.

Original Cost

In the United States valuation of the railroads original cost must be ascertained. The Interstate Commerce Commission Report on the Texas Midland R. R. deals with the subject:

"The act requires us to ascertain original cost to date. This is a fact of prime importance. The experience of the bureau indicates that in most cases it will be impossible to report original cost to date from accounting records alone.

"We are prepared to state with considerable confidence that the cost of producing and equipping a railroad in most parts of the country on June 30, 1914, was a fair average for at least the 20 years preceding.

"Investigation shows that original cost is frequently, indeed almost invariably, more or less than a fair average cost. Many causes contribute to this result, as poor judgment, accidents, wet seasons, extravagance, dishonesty; or all conditions may have been favorable."

Reproduction New

In the Texas Midland Report the Interstate Commerce Commission deals with the subject thus:

"Cost of reproduction new is upon the assumed basis of the non-existence of the railroad while all other conditions in the same

territory were taken as existent on valuation date, that the most practicable and economical construction program is employed, and that to an inventory of items making up the physical property, shall be applied cost prices fairly representative of conditions on valuation date, with the addition of the estimated cost of placing the items in position as of valuation date, and including certain overhead charges.

"In ascertaining the cost of reproduction new the Commission is not to ignore expenses which would be incurred by reason of the fact that the physical plant, other than land, would have to be built, and is not limited merely to the reporting of an inventory value."

Interest During Construction

In the Texas Midland Report the I. C. C. says:

"The period used in determining interest during construction in estimating the cost of reproduction new is taken at one-half of the estimated construction period required for reproduction, plus three months, as to road and general expenditures; and at three months for equipment.

"Interest for one-half of the construction period has been generally allowed in the valuation of public utilities."

Engineering Expenses

The I. C. C. in a study of 124 projects found that this item ran from less than 1 per cent to almost 10 of the total amount shown as investment, not including land. The average was found to be 3.6 per cent. The engineers in the valuation were instructed to allow not less than 2 per cent nor more than 5 of the investment in road, exclusive of engineering itself and land.

U. S. Figures. The wholesale prices as given in 1911 are continued down in Bulletin No. 269, issued in 1920. "The base period has been shifted to the year 1913 in order to provide a prewar standard for measuring price changes."

TABLE 1

AVERAGE WHOLESALE PRICES OF COMMODITIES, 1890 TO 1919

Year	Hemlock	Maple: hard	Oak: white, plain	Oak: white, quartered	Pine: white, boards, No. 2 barn		Pine: white, boards, uppers		Pine: yellow, flooring
	Average price per M ft	Average price per M ft	Average price per M ft	Average price per M ft	Buffalo market, average price per M ft	New York market, average price per M ft	Buffalo market, average price per M ft	New York market, average price per M ft	Average price per M ft
1890	$12.583	$26.500	$37.875	$51.458	$16.792	.....	$44.083		
1891	12.458	26.500	38.000	53.583	17.000	.....	45.000		
1892	12.292	26.500	38.458	53.000	17.146	.....	46.142		
1893	12.000	26.500	38.750	53.000	18.625	.....	48.500		
1894	11.708	26.500	37.250	51.125	18.167	.....	46.417		
1895	11.146	26.500	36.250	53.250	17.250	.....	46.000		
1896	11.167	26.500	36.250	54.500	16.500	.....	46.625		
1897	11.000	26.500	36.250	53.833	15.833	.....	46.333		
1898	11.750	26.500	36.250	52.500	15.500	.....	46.083		
1899	13.521	26.542	38.958	60.521	18.292	.....	50.458		
1900	16.500	27.500	40.833	64.458	21.500	.....	57.500		
1901	15.000	26.708	36.771	59.167	20.875	.....	60.417		
1902	15.833	28.583	40.875	63.083	23.500	.....	74.833		
1903	16.792	31.667	44.833	74.792	24.000	.....	80.000		
1904	17.000	31.000	46.500	80.750	23.000	.....	81.000		
1905	17.875	30.500	47.333	80.250	24.167	.....	82.000		
1906	21.896	31.000	50.417	79.167	29.750	$33.250	84.750	$88.250	
1907	22.250	32.250	55.208	80.000	.....	37.417	.....	97.083	
1908	20.875	31.625	49.292	80.167	.....	36.375	.....	96.083	$43.917
1909	20.583	31.000	48.417	84.333	.....	37.104	.....	93.042	45.833
1910	20.625	31.800	54.250	87.750	.....	38.250	.....	98.800	46.300
1911	20.682	34.318	54.682	87.182	.....	38.346	.....	100.500	46.546
1912	21.455	36.455	56.227	86.500	.....	37.227	.....	101.046	44.546
1913	24.227	36.364	60.591	88.318	.....	36.864	.....	103.500	44.591
1914	24.396	38.500	60.042	88.333	.....	37.500	.....	103.500	42.750
1915	21.591	38.500	57.682	86.500	.....	37.500	.....	103.500	39.591
1916	23.542	40.583	61.333	86.500	.....	37.500	.....	103.500	39.375
1917	27.708	49.708	66.292	90.000	.....	49.125	.....	112.500	50.909
1918	33.929	60.125	75.625	104.271	.....	60.417	.....	130.792	60.750
1919	39.750	68.667	102.125	156.875	.....	63.792	.....	140.583	78.833

TABLE 2

AVERAGE WHOLESALE PRICES OF COMMODITIES, 1890 TO 1919

Year	Pine: yellow, siding		Poplar	Spruce
	New York market, average price per M ft	Norfolk, Va., market, average price per M ft	Average price per M ft	Average price per M ft
1890	$20.750	.....	$30.500	$16.292
1891	19.958	.....	30.500	14.218
1892	18.500	.....	30.604	14.854
1893	18.500	.....	33.625	13.771
1894	18.500	.....	31.750	12.708
1895	16.917	.....	31.000	14.250
1896	16.417	.....	31.000	14.250
1897	16.438	.....	30.667	14.000
1898	18.625	.....	30.000	13.750
1899	20.042	.....	34.021	15.396
1900	20.708	.....	37.688	17.375
1901	19.667	.....	36.708	18.000
1902	21.000	.....	42.104	19.250
1903	21.000	.....	49.646	19.188
1904	21.417	.....	50.329	20.500
1905	24.917	.....	48.208	21.417
1906	29.333	.....	50.958	25.542
1907	30.500	.....	58.083	24.000
1908	30.500	.....	58.292	20.702
1909	33.042	.....	57.625	25.250
1910	30.800	.....	61.500	24.600
1911	30.591	.....	61.591	24.273
1912	33.136	.....	61.500	26.955
1913	32.136	.....	61.727	27.864
1914	29.625	.....	60.667	27.417
1915	28.182	.....	58.909	27.000
1916	31.818	$26.917	60.292	28.250
1917	.....	36.208	63.458	35.000
1918	.....	42.917	84.708	39.625
1919	.....	54.500	110.000	45.625

TABLE 3

AVERAGE WHOLESALE PRICES OF BUILDING COMMODITIES, 1890 TO 1919

Year	Lead pipe	Nails: 8-penny	Pipe: cast iron, 6-inch	Brick: common. Red: domestic, New York	Doors: white pine
	Average price per 100 lbs	Average price per 100 lbs	Average price per short ton	Average price per M	Relative price
1890	$5.400	$2.288	.....	$6.563	86.5
1891	5.600	1.833	.....	5.708	78.7
1892	5.183	1.758	.....	5.771	78.7
1893	5.000	1.681	.....	5.833	77.1
1894	4.433	1.527	.....	5.000	66.0
1895	4.200	1.925	.....	5.313	57.4
1896	4.100	2.713	.....	5.063	52.7
1897	4.317	1.333	.....	4.938	51.1
1898	4.600	1.193	.....	5.750	58.2
1899	5.350	2.024	.....	5.688	81.2
1900	5.121	2.250	.....	5.250	100.0
1901	5.048	2.113	.....	5.766	119.0
1902	5.217	2.133	.....	5.385	133.4
1903	5.196	2.196	.....	5.906	108.7
1904	4.795	1.819	.....	7.495	106.3
1905	5.225	1.825	.....	8.104	112.3
1906	6.421	1.931	.....	8.547	105.6
1907	6.705	2.163	.....	6.156	115.2
1908	4.740	1.950	.....	5.104	110.9
1909	4.821	1.869	.....	6.385	112.9
1910	5.061	1.844	.....	5.719	106.4
1911	5.028	1.708	.....	5.891	102.0
1912	5.201	1.706	.....	6.760	96.2
1913	5.082	1.771	§23.370	6.563	100.0
1914	4.523	1.721	20.890	5.531	98.7
1915	5.301	1.721	22.943	6.052	96.6
1916	7.598	2.625	31.618	8.035	98.7
1917	10.068	4.130	55.369	8.885	111.0
1918	8.887	4.364	60.687	11.927	143.3
1919	7.266	4.863	57.501	15.958	195.6

INSURANCE VALUATIONS

Twenty Great Companies. The Associated Factory Mutual Fire Insurance Companies of the eastern states insure large isolated manufacturing properties above $75,000 in value. Appraisals have to be made before the policies are issued, and the conditions strictly adhered to. They have improved the construction of buildings, introduced better fire protection, and each risk is subject to expert inspection at least four times a year. With automatic sprinkler protection, fire pumps, at least two independent sources of water supply and private watchmen, the fire damage is reduced to a trifle of what it was under the old system. Since about 1840 the companies have been successfully operated. Their principal field is in cotton mills.

Method of Appraisal. This is worth examining in an Appraiser, for the benefit of insurance men.

(1) The experts of the companies object to going into detail in the way that some commercial appraisal concerns do. All minor details are eliminated as unessential.

"All appraisals rest largely on estimate. No appraisal can be made without incorporating many figures that are simply based on estimate."

Suppose all material in a structure to be listed carefully down to the last and smallest item, the waste and the labor have to be based on estimates. As market values change and depreciation has to be considered and guessed at the figures cannot remain standard long. Actual bids are often far apart.

"Moreover, it has been proved again and again that the great law of averages counterbalances minor errors."

(2) A plant is divided into buildings and machinery. Buildings are considered as empty structures. All elevators, piping, wiring, and, indeed, anything that can be removed without altering the building, are classed under machinery.

The figures are based at replacing new at to-day's market, regardless of original cost, and are then depreciated as judgment dictates.

(3) **Foundations.** One might cost heavily, the other be inexpensive. "An appraiser, however, to give a fair and reasonable estimate, must consider the buildings, if otherwise alike, as of the same value."

This means that Mill A does not serve its purpose any better than Mill B because the cost of its foundation was twice as much as B's. "In making insurance appraisals, the cost of foundations is not included as they are not liable to damage from fire. No time is wasted in ascertaining value of underground work."

(4) **Square Foot Basis.** All appraisals are made on this basis.

"Many architects and engineers use the cubic foot of contents. Both systems are good, but it is floor space rather than cubic contents which gives manufacturing facilities. As a groundwork, the tables prepared by Mr. Charles T. Main, the well-known engineer, are used for brick buildings with plank on timber floors and roofs, one to six stories high, with a wide range of lengths and widths." Judgment must be used when handling the tables to allow for special work. The price per square foot decreases as the length and width increase.

(5) **Piping.** "With automatic sprinkler piping it should be emphasized that it is foolish to waste time measuring each size of pipe, counting elbows, tees, etc., and then estimating the amount for erection. Nearly every sprinkler contractor risks his chance for profit by figuring at so much per sprinkler head for the work in place, and the same method is followed by the appraisers of the Department when the number of heads is easily obtainable. In most cases, however, there is an allowance of so many cents per square foot of floor area, as the result is the same. This applies to piping inside the building only."

For steam and hot-water heating piping, a similar method is used, except in unusual cases.

"Steam, water, gas, oil and air piping is treated on even broader lines; for a detailed inventory would take a prohibitive amount of time. Taking a factor for each machine supplied, and using as a cross check so much per horsepower for steam, and general factors for the others, a result is obtained which experience has shown is sufficiently accurate."

(6) **Electric Wiring.** "Electric wiring is figured at so much per light and so much per horse-power of motors, varying the factors for each variety of light and compiling the horse-power in groups, as the sizes range from small to large."

(7) **Depreciation.** "This subject has caused more argument and discussion than all others connected with making appraisals. The difference of opinion among competent men as to what percentage should be allowed commonly amounts to more in money value than any error that can be reasonably made in estimating the new value, regardless of the method used."

"When a building is more than three or four years old, has remained plumb, is kept in repair and is of such dimensions that it perfectly answers the purpose for which it is used, it is considered that the depreciation does not increase, but stands constant at five per cent of total new value for several years." The depreciation is increased for a building of obsolete dimensions. The annual deduction is from the net and not the gross.

"For piping, a depreciation of ten per cent of the parts affected is usually sufficient."

"Electric wiring wears little and the rigid rules of both local authorities and the insurance companies compel its being kept well up to date, so that the total depreciation is always slight."

In commenting upon the detailed system of making appraisals carried out by the commercial companies the Factory Mutual men say: "Opportunity presents itself again and again to examine the records of such appraisals. Invariably there is a finely prepared volume, giving in minute detail a list of substantially everything on the premises. This list is overburdened with extended descriptions of buildings and machinery, far beyond the extent necessary to determine value, and this has a tendency to confuse one who is searching for individual items. Where time is taken to make a detailed examination the usual proportion based on estimate is always found and also errors large enough to counterbalance the value of whole pages of minor items so laboriously collected. These errors do not materially affect the final result, because the law of averages takes care of that, but it leaves the final figures no more accurate than those of an appraisal made by the shorter method above described."

Leading Principles

The three leading theories of appraisal are:

(1) Reproduction cost new of the plant, less depreciation.

(2) Actual cost to date of the property, less depreciation.

(3) Capitalization of income, beyond fixed and operating costs, and a fair rate of return, less depreciation.

The reproduction cost new can be had from the figures given in this Appraiser based on many prices and for many years. The rates of depreciation are given in the tables.

Two Big Valuations

In Buffalo 450 industrial plants were appraised at $60,000,000 of depreciated value. The work cost 42c per $1000 on this basis, or 25c for reproduction cost. The depreciation was allowed at 2 per cent for buildings of permanent construction, and 3 for those of less permanent and frame. At 1916-1917 rates.

My valuation of Omaha buildings 1922 ran to $50,000,000.

Going Value

When Prof. Daniels was appointed Interstate Commerce Commissioner there was some objection, and several senators voted against him. They believed he had allowed too much for going

value when making a valuation of a gas company in New Jersey. "After counting up all the visible property, Prof. Daniels added to its total value 17.6 per cent for 'intangible values' and 30 per cent for extra value as a 'going concern.' He decided further that the company was entitled to earn 8 per cent per annum on the total appraisal. As a result the city of Passaic got 90-cent gas instead of 80, as some had hoped." This was in 1913-1914. The Canadian courts are said to allow 10 per cent for "going concerns."

Here is an increase of nearly 50 per cent to the actual physical value, and proves that the Mutual Fire Ins. Cos. are right when they refuse to waste time in going into petty detail on valuations for insurance purposes. The allowances for depreciation, intangible value and going value have all to be "estimated," or "guesstimated," and they make light of the best physical valuation.

FIRE INSURANCE

Physical valuations are often taken for purposes of fire insurance, and according to the reduced rate rule owners should change the valuation to correspond with the rise in prices.

Reduced Rate Contribution Clause

"In consideration of the rate at (and) or form under which this policy is written, it is expressly stipulated and made a condition of this contract, that this company shall be held liable for no greater proportion of any loss than the amount hereby insured bears to ....% of the actual cash value of the property described herein in the time when such loss shall happen; but if the total insurance upon such property exceeds....% at the time of such loss, then this company shall only be liable for the proportion which the sum hereby insured bears to such total insurance.

"If this policy be divided into two or more items, the foregoing conditions shall apply to each item separately."

Reduced Rate Contribution Clause Explained

(Using the 80% Clause)

It has no effect whatever when insurance is carried to the amount of 80 per cent of value or more. In this case insurance pays the entire loss not exceeding the amount of policy.

Example.

Value	Insurance	Loss	Ins. Pays
$100,000	$80,000	$60,000	$60,000
100,000	80,000	80,000	80,000
100,000	80,000	90,000	80,000

It has no effect whatever when the loss equals or exceeds eighty per cent of value, no matter what the insurance is. In this case, also insurance pays entire loss not exceeding amount of policy.

Example.

Value	Insurance	Loss	Ins. Pays
$100,000	$60,000	$80,000	$60,000

When both insurance and the loss fall below eighty per cent of the value, the assured becomes a contributor (that is, stands as an insurance company) to the amount of the difference between eighty per cent of the value and the actual insurance in force at the time of fire.

Example.

Value	Insurance	Loss
$100,000	$70,000	$50,000

Eighty per cent value is $80,000—insurance being $10,000 less than this sum, owner is a contributor to that amount and contributes to the loss in that proportion.

Insurance ($70,000), pays seven-eighths of loss ($50,000)	$43,750
Owner contributes one-eighth	6,250
Total amount of loss	$50,000

Another explanation of the effect of the 80% clause shows that it is dangerous not to keep insurance up to the limit. When prices increased in war times, as with cotton mill following, the policy should have been changed to correspond.

(1) Cotton Mill—Value $100,000. Insurance, $80,000. Loss, $50,000. Companies pay $50,000

(2) Cotton Mill—Value $150,000. Insurance, $80,000. Loss, $75,000. Assured should carry $120,000 insurance. He is therefore $\frac{1}{3}$ deficient and in case of 50% loss will stand $\frac{1}{3}$ of the loss himself as follows:

Companies pay $\frac{2}{3}$ of loss or $50,000.
Assured stands $\frac{1}{3}$ of loss or $25,000.

CHAPTER II

PHYSICAL VALUATION: DETAILS

Tools. When A B C is sent to measure up for appraisal railroad buildings stretching over several hundred miles of a state, he is almost sure to forget to take something with him that is as valuable as a tape line, a long rule, and a notebook. That is a kodak. Some one has said that an ounce of notes taken on the place is worth a pound of recollection; and a small picture brings back features of a building in a way that the memory alone can never do. With field notes, memory, and a picture of any special structure, or unusual part connected with it, the office work of figuring up and summarizing the items becomes almost as easy as if one were on the ground. It is quite often possible to get a picture of a railroad building for a few cents, as most towns have their prominent improvements photographed.

A good set of plans makes the best picture of any building, especially if there is a specification with them, but they are not always obtainable, and actual measurements have to be taken, often in the dark of a basement, or up in smoky roofs thick with the dust of a quarter century.

Changes. Even if plans are provided it is not safe to rely upon them without an examination of the special structures. Some buildings shown on a yard plan have been taken down or have been burned, and others have been added to until the original structure is scarcely recognizable from the plans.

Blanks. About the poorest way of conducting such an investigation is to oblige the valuator to make notes on everything connected with a building. The city of St. Paul, with about 25,000 buildings, and 150,000 lots, was measured for assessment about the beginning of this century under the Somers system; and the same system was used in Cleveland in 1910 to appraise 100,000 buildings, and 145,000 parcels of land. Blanks were provided in each case, and the descriptions of the buildings merely filled in with a circle over the selected word. This is not only a quicker way of getting the necessary information, but a surer, for it is hard for a man with a notebook to get all the hundreds of items in each building. It is true, as has been pointed out by one Railroad Com-

mission, that no one blank can be made to embrace everything, but it is easy to attend to any unusual features. There are so many items in a building connected with excavation, piling, concrete, steel frame, brickwork, cut stone, carpentry and millwork, plaster, plumbing, heating, paint, sheet metal, skylights, electrical work, floor and wall tile, roofing, piping under and over, floors and sidewalks, that it is not only wasteful of time to follow the notebook method alone, but decidedly unfair to the estimator. Printing is cheap, and blanks pay for themselves a hundred times over. In Cleveland, for example, a city badly cut up with creeks, rivers, runs, valleys, railroads, lake coast, and inequalities in general, and thus hard to value, the cost of making out an entirely new assessment roll for 145,000 parcels of land was only 87c each. Philadelphia pays $3.40; the New York yearly revision cost 99c.

When a physical valuation of this kind is once carried through it is an easy matter to keep it up to date. If prices rise a percentage can be added to the building; and the usual allowance deducted for depreciation. The people of Vancouver have ended the system of taxing buildings, and raise the necessary funds for city expenses from land values only. This is an excellent law for architects and builders, as it almost compels the owners of vacant property to build in order to get returns for the city treasurer, and it exempts their building when finished. In 1901 the population of Vancouver was about 26,000; in 1923, 165,000.

Here, then, we have some requirements for appraising almost any building or property—tape line, long rule to reach high, kodak, notebook, and above all, printed blanks.

A sample of the blanks used in Cleveland is given herewith. The small circles are put over the necessary word.

Dist. 29 Map 1 Blk. 2 Lot 4 Pg. 76 Line 14

Examined March 15 1910

By Robert Semple No.
Assistant Assessor

Single house — one side of double house — one of row — Duplex house

No. 10720 Ave. NE

Material—Siding drop, lap, shingles, brick, common, press, plaster, veneer-stone, cut, rough, concrete tile T. C. Trimmings plain, ornamental, stone, cut, rough T. C., brick, wood. Upon a foundation of stone, brick, tile, concrete, posts, main floor.....feet above ground

Dimensions—wide 26 deep 37 wide, deep, wide, deep, wide; deep.
2 story high wide, deep, wide, deep, wide, deep, story high

Projections—One story bay window — two story bay window — three story bay window — tower
13 front porch 6 — 10 side porch 22 — 5 rear porch 4 — (4) + 3

Roof—Shingles, slate, tile; gravel, composition, tin, copper. Hip, gable, flat, mansard dormers or gables. Cornice plain, ornamental, wood, metal, stone, T. C.

Divisions—basement, ceiling, under whole, front, middle, rear, containing storage room — water closet — heating plant — laundry tubs — bath

1st story, hall, parlor, sitting room, library, dining room, kitchen, bath room, bed room

2nd story, bed room 3, bath room, other rooms

3rd story, bed rooms, bath room, other rooms

4th story bed room, bath room, other rooms — Attic, rooms finished — unfinished

Inside Finish—Main part, lower story ornamental, plain, hardwood, pine oil paint. Upper story hardwood, pine oil paint.

Heating—Stoves furnace, hot water, steam, combination.

Water—Open well — city, in yard, basement, first story, second story, third story.

Bath rooms — water closet — wash basin — laundry tray — sink 2 — barn — plumbing open closed.

Lighting—Gas Electric Oil Fixtures Plain Ornamental

Drainage—Cesspool, sewer. Building in good fair, bad; repair.

Vacant, occupied, owner, tenant, who estimates, pays, rent at $35. per month. States buildings were constructed in 1909

1/480

Name of Owner, Agent Tenant.

FIG. 2.

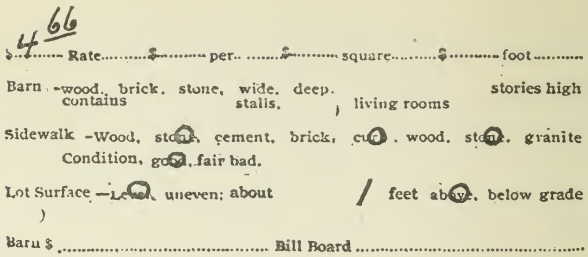


FIG. 2*a*.

A literal reading of these markings is as follows:

READING OF BUILDING SLIP.

District 29, Map 1, Block 2, Lot 4, Page 76, Line 14;

Examined March 15, 1910.

A single house, No. 10,720 Laurel Avenue, S. W. The lower story constructed of pressed brick; the upper story frame; covered with shingles. Plain cut stone trimmings on lower story and wood trimmings on the upper story. Built upon a foundation of brick, the main floor being 3′ above the surface of the ground.

Dimensions, 25 ft wide by 37 ft deep, 2 stories high. Projections, one 1-story bay window; a front porch 13×6, a side porch 10×22, and a rear porch 5×4. Roof slate in gable form containing 3 dormer windows and 2 gables. Finished with plain cornice of wood.

Cellar under the whole house, containing storage room, water closet, heating plant, and laundry tubs.

First floor has a hall, sitting room, dining room and kitchen; second floor has 3 bed rooms, 1 bath and 1 other room. There are 2 rooms finished in the attic. The main part of the lower story is finished in hard wood and pine, dressed in oil. Upper story the same.

It is heated by a hot water system. The house has city water in 1 bath room, 2 water closets, 2 wash basins, laundry tubs and 2 sinks. Plumbing is open.

The house is lighted by electricity and has both plain and ornamental fixtures. Drainage is by a sewer.

The building is in good condition, occupied by the owner, who estimates that it would rent for $35 per month, and states that the building was constructed in 1909.

The sidewalk in front of this property is stone with a stone curb in good condition. The lot surface is level about one foot above the grade of the street.

From the foregoing reading of the building slip, this building is placed in Class 4, of Building Schedule No. 1, as a two-story house, plus three points on account of the large porch areas and on account of the lower story being brick, making the price read $4.80 per sq ft; less depreciation for one year makes the net price $4.60 per sq ft. The area of the building being 962 sq ft, this gives $4483, as the present value of the building. As it is located in a district where dwelling houses are not depreciated, it is placed on the duplicate at that sum.

Square Foot. In city valuations for taxation the square foot method is the nearest approach to a detailed estimate that is used. In most cities the assessor merely guesses at the value, or takes a figure from the newspapers or other hearsay—and the department watches the transfers of real estate. Much railroad property in a physical valuation, in addition to standard buildings always taken by the square foot, has to be valued by this quick method to save time, but almost all builders would agree with the opinion that this system is not so accurate as the contractor's method of taking off quantities in detail. I used it for garages, and one-story buildings in the Omaha valuation, but always took the cubic foot system for large buildings as better.

Tables. There is another method that goes a little more into detail, but stops far short of taking off the quantities in the regular way. This is by using the tables, and figures as given in various parts of this Appraiser. Brick walls are not hard to estimate if the building is of masonry, and then floors, partitions, ceilings, roof and all plain work is measured up and a price per square set to suit local rates. Plaster is easily found by using the tables on pages 387–396, windows and doors are allowed at so much per opening, including hardware, painting can be guessed at in a lump sum, and so can plumbing, and usually heating, but the latter can be checked by the figures given elsewhere for the cubic feet of space. This method I used on many buildings to save time, and also to get a more reliable valuation than is possible under the square foot system.

Specials. Engine houses, ice houses, and platforms are so plain that there is usually no necessity of estimating them in detail, for the price per stall and per square foot is well enough known among railroad men. But, on the other hand, some small special buildings such, for example, as fireproof oil houses, may run to twice the cost that one would judge upon a first examination, and the only way to be safe is to follow the contractor's method. In the chapter on square foot costs it is pointed out that the smaller the building the greater is the unit in dollars per square foot. The detailed estimate is made up in rather a slow way. It has been calculated by a lumber

dealer that there are in a $3000 house from 45,000 to 50,000 separate pieces of wood. But this includes all millwork, with doors and sash estimated according to the number of pieces, shingles taken separately, floor and other boards the same way.

I have made out the following Schedule for more items than are usually met with in any one building, but the ones not required are to be left blank. To save confusion in valuing buildings in large railroad shop grounds, a strict line should be drawn between the buildings proper and the yard work. Everything inside of the structure should belong to it, but nothing outside, unless directly connected with the main unit. Sometimes there are concrete tanks, compressed air tanks, or subways that belong more properly to the building than to the yard systems. But as far as possible the yard work and building work ought to be listed separately.

Main Schedule

There is no space for contingencies. On a completed structure there is no percentage required for this item.

Most of the items in the main sheet have to be subdivided. The idea is not only to save time with such blanks, but to make sure that all items are included. It is not hard to overlook an important item when doing field work, and the necessary data can not afterwards be secured without expense. It would be easy to neglect to get the height of a wall, or to note down the fact that pressed brick were used, and so with other details.

Main Schedule

Name of architect
Date of erection
Date of erection of any additions
Grading of site
Grading of building proper
Filling of site
Filling building proper
Excavation
Piles
Concrete
Brickwork
Reinforced concrete
Granite, outside and inside
Stonework
Cut stone, or other trimming outside or inside
Carving
Fireproofing
Structural steel and iron
Ornamental iron
Lumber
Millwork and glass
Carpenter labor
Hardware
Roofing
Galvanized iron, or other sheet metal work
Skylights
Plaster
Floors, other than wood
Plumbing, to building lines only
Marble work
Clocks
Piping
Water filter

Main Schedule—*Continued*

Heating
Drinking fountains
Elevators and dumb waiters
Electrical work
Fire escapes
Fire shutters
Fire alarm systems
Telephone system, building only
Call buzzer system, building only
Vault doors
Lockers
Refrigerator
Scales, not portable
Painting
Papering and decorating
Tanks and vats
Awnings and shades
Platforms, directly connected only
Tracks, inside of building only
Turntables and pits
Removing old buildings
Fences, for building only
Retaining and other walls at building
Sidewalks, for building only
Paving, for building only
Curbing, for building only
Miscellaneous
Contractor's percentage
Architect's percentage

Detailed Schedule

Excavation.
- Engineer's fee
- Main
- Boiler room
- Special depths
- Pits, engine, coach, drop, etc.
- Subways and pipes
- Sump, cistern, well
- Steam hammer. (See pages 153–154)
- Machine foundations. (See pages 195–201)
- Footings
- Piers, inside and outside
- Backfilling
- Grading around building
- Nature of soil—rock, loose or solid, gravel, earth, mud
- Testing expense
- Blasting
- Disposing of dirt

Piling.
- Wood
- Concrete
- Sheet

Footings. (For all items under Excavation)
- Concrete
- Concrete forms
- Stone
- Brick
- Cement stone
- Plank
- Concrete ducts
- Dwarf walls
- Piers
- Drains
- Area walls
- Porches
- Chimneys
- Waterproofing

Basement Walls—to 1st floor level:—
- Concrete
- Rubble
- Cut stone
- Bricks
- Cement stone
- Hollow tile
- Plank
- Whitewashing

Detailed Schedule—*Continued*

Brickwork.
- Thickness of all walls, height, etc.
- Walls above basement—from floor to floor
- Garden walls, etc.
- Common
- Hollow tile
- Pressed, quality, how laid (ordinary bond, Flemish, etc.)
- Molded
- Reveals how deep
- Arch
- Arches, common
- Fire
- Fireplace
- Wall coping
- Enamel
- Enamel molded
- Pilasters
- Cornices
- Veneering
- Flue linings
- Sidewalk arches
- Boiler setting
- Cesspool
- Cistern
- Piers
- Waterproofing
- Pointing and washing
- Well
- Septic tank
- Paving
- Plastering walls with cement mortar, asphaltum, etc.
- Chimneys
- Anchors, tie-rods, ashpit doors. thimbles

Chimney Stacks.
- Common brick, round, square
- Radial brick
- Self-sustaining steel
- Guyed steel
- Reinforced concrete

Granite or marble.
- Plain
- Squared
- Molded
- Polished
- Columns
- Steps
- Fountains or ornamental work

Stonework.
- Kind of stone
- Rubble
- Ashlar, rock faced, squared
- Ashlar, smoothed
- Ashlar, hammer dressed
- Ashlar, 2 and 1 work
- Ashlar, thickness, average
- Ashlar, rustic
- Carvings
- Belt courses
- Columns
- Steps
- Sills
- Lintels
- Ornamental work
- Coping
- Caps
- Base
- Cornice
- Brackets
- Pointing
- Washing
- Backing

Trimmings— Outside and Inside
- Cut stone
- Terra cotta
- Artificial stone
- Water table
- Sills
- Lintels
- Coping
- Band courses
- Steps
- Ornamental

Detailed Schedule—*Continued*

Fireproofing.
- Doors and interior finish
- Floors
- Ceilings
- Roof
- Partitions
- Stairs
- Columns
- Beams
- Walls
- Plaster on outside
- Other finishes on outside
- Steel reinforcement
- Forms
- Concrete
- Nails and wire

Hauling or Freight Allowance for entire building

Steel and Iron.
- Grillage in concrete footings
- Columns, steel or cast iron
- Anchors and straps
- Stirrups
- Separators and bolts
- Tie rods and castings
- Columns, steel or cast iron
- Girders
- Trusses
- Lintels
- Runways for cranes, etc.
- Shelving
- Steps and railings
- Cast plates
- Column bases
- Floor beams
- Roof beams
- Ceiling framework
- Bracing
- Tanks
- Caps and bases
- Bolts
- Cleanout doors
- Coal hole covers

Steel and Iron.
- Coal chute
- Gratings
- Railings
- Entrance plates
- Threshold
- Safety treads
- Chimney caps
- Chimney anchors
- Metal doors and frames
- Metal shutters
- Wheel guards
- Sidewalk doors
- Sidewalk lights
- Flag poles
- Fire escapes
- Fire ladders
- Fire standpipes
- Fire brackets
- Shelving
- Erection

Ornamental Iron.
- Vault doors, etc., fixtures
- Grilles for windows, etc.
- Screens
- Elevator fronts, sides, grilles, glass, etc.
- Stairs and railings
- Gates
- Window guards
- Lamp posts
- Lamp brackets, standards
- Kick and push plates
- Cornices
- Posts
- Down spouts
- Mail chute
- Lockers
- Miscellaneous: canopies, marquises, heads, balconies

Lumber.
- Walls
- Post
- Sills

Detailed Schedule—*Continued*

Lumber.
- Girders
- Joists and sleepers
- Bridging
- Under floors
- Upper floors
- Partitions
- Ceilings, frame
- Ceilings, wood-covering
- Roof framing
- Roof covering
- Furring and grounds
- Corner boards
- Cornice, base, etc.
- Siding or shingles
- Asbestos shingles
- Asphalt shingles
- Other special covering
- Tower, flag pole
- Porches
- Special work
- Building papers
- Fences, sidewalks, etc. (temporary)
- Coal bins, basement work

Millwork.
- Outside finish
- Kind of wood
- Frames
- Doors, and finish
- W ndows, and finish
- Windows, including glass
- In terior partitions with glass
- Store front
- Ceiling sash
- Weather strips
- Transoms
- Bulletin boards
- All stairs or steps
- Base and picture mold
- Plate rail
- Chair rail
- Chalk rail
- Cornice, ceiling

Millwork.
- Beams, ceiling
- Glass, plate
- Glass, special (sideboard)
- Glass, leaded
- Glass, prism
- Glass, floor
- Upper floors (see lumber)
- Paneling, outside and inside
- Wainscoting in dining room, etc.
- Railings, outside and inside
- Blinds, outside and inside
- Columns, outside and inside
- Pantries
- Cases, drawer, book
- Mantels
- Sideboard
- Medicine cab
- Seats
- Clothes chute
- Refrigerator
- China closet
- Hook strips and shelving
- Storm doors and windows
- Fly screens
- Factory doors and windows
- Porches, and sash or screens
- Brackets
  (See Index for items)
- Revolving door

Hardware.

If work is figured by the square the tables do not include nails. Shelf hardware has to be added to doors and windows. (See Index.)

Roofing.
- Asbestos
- Slate
- Tile
- Gravel and slag
- Prepared
- Shingle (under lumber)

Detailed Schedule—*Continued*

Sheet Metal Work.
- Roof, tin, galvanized iron, copper, zinc, lead or shingles
- Ventilators and registers
- Ordinary skylights
- Speaking tubes
- Piping for ventilators and other systems
- Cornices
- Cresting and finials
- Metal ceilings
- Siding
- Fire windows and doors, covering
- Tin clad doors
- Metal windows and wire glass
- Gutters
- Valleys
- Conductors
- Flashing
- Painting

Skylights, Large.
- Copper ribs and frame
- Galvanized iron ribs and frame
- Charcoal iron ribs and frame
- Flashing
- Glass, wire
- Glass, common ribbed
- Netting

Plaster.
- On lath, metal
- On lath, wood
- On masonry
- Three-coat dry
- Two-coat
- Sand finish
- Cornices
- Centers
- Ornamental work
- Sackett board
- Other special finishes
- Compo board
- Outside plaster, kind of lath, etc.

Plaster.
- Outside columns, beams, etc.
- Wire lath
- Metal lath
- Wood lath
- Back plaster
- Basement and attic
- Wainscoting
- Blackboards
- Beams
- Corner beads, metal

Floors (Other Than Wood).
- Mosaic
- Tile
- Pulp
- Terazzo
- Concrete
- Rubber
- Special
- Fireplaces
- Bath rooms
- Concrete fill

Plumbing.
- Supply beyond building line
- Sewer beyond building line
- Supply and sewer inside
- Drains
- Soil pipes
- Closets
- Urinals
- Sinks
- Wash basins
- Baths
- Marble
- Slate
- Doors
- Meters
- Tubs
- Water heater
- Boiler
- Floor traps
- Grease traps
- Hydrant, small
- Pumps

Detailed Schedule—*Continued*

Plumbing.
- Tanks
- Valves
- Boilers
- Gas pipe
- Vacuum cleaner and piping
- Toilet doors
- Toilet hardware

Marble, etc.
- Partitions
- Wainscoting
- Base
- Ceilings
- Ceilings, mosaic or tile
- Casings
- Moldings
- Shelves
- Artificial marble
- Special ornamental
- Caps
- Thresholds
- Stair treads
- Stair soffits
- Stair balustrade
- Cornices and beams
- Columns
- Pilasters
- Scagliola
- Arches

Clocks.
- In large railways stations they may cost from $300 each to several thousands

Piping (except for plumbing and heating):—
- Fire pro ection system
- Compressed ai: system
- Gas system
- Oil system
- Steam, for mechani al use
- Sprinkler system
- Water filter supply
- Main supply pipes inside building
- (See cost for shops, Index)

Heating.
- Steam supply inside of building
- All galvanied or other piping, above or below floor
- Fans
- Coils
- Expansion tank
- Pipes
- Radiators
- Thermostat
- Motors
- Concrete ducts (to be taken in footings)
- Boiler, and covering
- Breeching
- Stack
- Furnace, complete
- Pipe covering
- Decoration
- Boiler foundation
- Valves

Elevators.
- Passenger
- Automatic
- Freight
- Dumb waiters
- Sidewalk lifts, for ashes, baggage, etc.

Electrical Work.
- Light
- Power
- Signal:—burglar, watchman, fire
- Switchboards
- Conduits, above and below floo s
- Cables
- Fans
- Window lights
- Cornice lights
- Fixtures
- Switches
- Cabinets
- Panels

Detailed Schedule—*Continued*

Electrical Work.
- Elevator lights
- Bells
- Telephones
- Clocks
- Pole lines

(Generators and heavy power house machinery are not included with the building. The modern system of electrical work is so complicated that it requires a special expert to get a fair valuation).

Tanks and Vats.

(These are not, strictly speaking, a part of a building, but rather belong to equipment. A builder, however, is usually better qualified to get at the value than a machinery expert).
- Oil house tanks
- Oil house piping, not including motive power machinery
- Oil tanks to serve various shops
- Oil furnaces, etc., when enclosed with masonry
- Lye and other vats

Platforms.

(All outside platforms to be included with building only when they might reasonably be considered a part of it).
- Gravel
- Wood
- Brick
- Concrete
- Cinder
- On ground level?
- Or 4 ft 6 in up?
- Gutters
- Sewers

Platforms.
- Curbing—wood, stone, concrete

Platform Frame Work.
- Posts
- Brackets
- Area of roof
- Rafters
- Roof covering
- Gutters
- Conductors
- Painting

Tracks (Inside of Buildings).
- Standard gage, lineal feet
- Narrow gage, lineal feet
- Turntables, small diameter

Turntables and Pits.
- Diameter
- Steel
- Wood
- Wall, concrete
- Wall, stone
- Wall, brick
- Wall, plank

Fences.
- Wood
- Iron
- Wire
- Gates

Paving.
- Brick on edge
- Brick on flat
- Concrete
- Stone
- Asphalt
- Creosoted block

Curbing.

Miscellaneous.
- Bins, racks, cases, small buildings in yard
- Bonds
- Building permits
- Insurance—fire and liability
- Patents—allowance for use of
- Water

It is impossible to get every item in a modern building listed, but by going over the foregoing lists as the work progresses nothing of importance will be omitted in even a large railroad shop yard or passenger station. A good deal of information can occasionally be obtained from local contractors or others as to the value of structures with which they have been connected; and an experienced builder knows what many items cost without figuring them.

A LIST OF SOME MAIN STRUCTURAL ITEMS REQUIRED FOR VALUING A SPECIAL BUILDING FROM FIELD NOTES

(1) A small plan in notebook with ground sizes, and sizes for floors above ground, if different. (If a set of plans is not given.)

(2) Depth of structure in ground, on an average, for excavation. If piles are used, approximate them at 3 ft centers, double row.

(3) Get width and thickness of footings obtainable.

(4) Height from top of footings to top of ground floor, if the thickness of wall is the same clear up.

(5) Thickness of walls below the top of ground floor.

(6) Complete height of walls above the top of ground floor to wall plate, if the thickness is the same all the way up; if not, the height of each thickness to be taken separately. The height of all ceilings in the clear to be taken as a check, and to serve for plaster. If the walls are too high to be conveniently measured, count the courses of brickwork, or siding boards, and average at the same number to 36 in, say, as those within reach. Get the thickness of all masonry walls, especially, and mark in the detailed sheet the quality of face brick or stone.

(7) Count all openings, and deduct the average size from each thickness of masonry to which it belongs, multiplied by the number.

(8) Get the area and thickness of gables. Include coping.

(9) Allow extra for all buttresses, pilasters, cornices, offsets, by actual measurement, and not by trade rules. If chimneys are of the ordinary size figure per lineal foot, including flue linings.

(10) Figure all inside walls, below or above ground, and watch each story for them. Be sure to mark thickness.

(11) List all piers with sizes, outside and inside. If small, set a price down for them on the spot. It is often impossible to get sizes without crawling below floors. On one shop I listed 150 stone piers, 8 ft deep, and 8 ft c to c. Even at the top where the wood girder rested they were 3 ft 6 in square. The entire cellar was full of stone, with only a passageway of about 3 ft between the piers at ground level. Through all the buildings of that particular shop yard the same

system of piers was used. It is unsafe to guess at what is below the main floor.

(12) Measure the surface of all pressed brickwork, and count an average of molded, arch, and enamel brick.

(13) Get the area, thickness, and description of all concrete and other floors.

(14) Keep the list of all outside work separate—such as paving, cesspool, retaining walls, etc., that do not strictly form a part of the building, and yet belong to it. Get heights, thicknesses, and sizes.

(15) Find the cost of the ordinary building materials, and the local rate of wages.

(16) List all trimmings, if they are many, apart from the brick or other masonry:—such as cut stone, terra cotta, etc.

(17) If walls are of stone write a short description of its quality and get the local price. Mark the thickness of walls. Estimate the value of carved pieces on the ground.

(18) Describe the kind of floors, and get area. Get posts, girders, sizes and centers of joists. So with ceiling joists, roof joists, and partitions.

(19) Figure the weight of one steel truss where there are several, and allow bracing to suit. A better idea may be had on the ground of weight, etc., than from notes. Consult Appraiser Index. Get diameter of cast-iron columns, and height from No. 6, this list. Give lintel widths, and depths. List thickness of sills.

(20) Price all ornamental iron on the spot, or take a photograph.

(21) Price counters, stairs, special openings, and such work on the ground.

(22) If a plan is made and the size of each room marked, all base, picture mold, and plaster, can be figured from it along with No. 6.

(23) For plumbing, heat, electric work, and other special installations try, locally or otherwise, to get a fair valuation from any one in the usiness.

(24) Mark down your idea of percentage of value as compared with a new structure.

(25) Mark down quality of glass—single strength, double strength, plate, etc., on a fine building. Get size of plate.

(26) Mark down price of racks, cases, etc., on the ground. (See chapter entitled, Short Cuts.)

(27) Get a set of plans if possible, and mark changes from them as made on the building.

Yard Work. The buildings of a modern shop plant are all connected with a network of subways, pipes and tracks. The trackage system and everything connected with it is entirely beyond the province of a builder, and is managed by engineers; but the sub-

ways and the piping systems are often left to him. Unless a plan can be seen, the best estimator is he who can guess easiest what lies below the ground, and how deep it is buried. Without a plan no one can tell the length, diameter or thickness of the heavy pipes, and when this uncertain kind of work is carried all through a modern railroad yard, the terminals of the two contending artists who make the estimates for the railroad company and the State Commission are apt to be beyond hailing distance.

As one illustration of the foregoing the cases of St. Paul and Minneapolis may be cited. The land values of the Great Northern, valued at millions of dollars, were appraised by two sets of men.

At St. Paul the estimates were 272 per cent apart, and 182 at Minneapolis.

CHAPTER III

DEPRECIATION

As a fair beginning, I have had a special experience in estimating the fall in the value of buildings, often according to their age, but occasionally due to other causes. During the greater part of a year, I valued practically all the large buildings north of the Platte River, and one far-spread group to the south, in Nebraska, for the State Railway Commission. This question, as always, gave more trouble than any other feature of the work.

I sent in between five and six million dollars' worth of appraisals. The $50,000,000 valuation I made in Omaha in 1921–22 carried the usual depreciation troubles. As set forth elsewhere, some of the property owners wanted from 4 to 5 per cent a year for depreciation and "obsolescence."

Decay. As noted on page 55, there are thousand-year old historic buildings in Europe, but they are mostly of a public character—structures built by the Romans, churches, castles, municipal halls, towers, and semi-public mansions. Ordinary houses even there seldom last more than two or three centuries. So good a judge as Macaulay, writing of London in his "Life," said that when he considered the fire of 1666 and the natural progress of demolition and rebuilding he doubted whether there were as many as fifty dwellings in that immense city dating as for back as 1550. He wrote in 1830. But up to the time of the fire, London was mostly built of wood and for that reason suffered like San Francisco in 1906. The same Macaulay, however, found that the buildings in Rouen were older than the London ones; and that the oldest mansion in London was modern as compared with many in Venice reaching as far back as the year 1400.

And frame houses well built will endure for centuries. In 1912, the oldest house in the United States was torn down, as it was considered unsafe. It was built in 1618 in Southampton, N. Y.

The Pierce house at Dorchester, Mass., dates from 1635. The Babcock house at Milton, Mass., from 1723. The Royall house at Medford, the same state, from 1732, and part of it from 1631. The Fairbanks house at Dedham, Mass., was built in 1636, and is still in use. These are all built of the old fine white pine.

The title of the oldest house in the United States given to the Southampton house is contested by an "old timer" in St. Augustine, Florida. It dates back from somewhere near 1566. A long list of cypress built houses runs back to the eighteenth century, and some to the seventeenth.

The Shakers of to-day build in the old fashion. An article written in 1921 says: "For the most part the buildings looked as if they might have been erected within the year. Yet all were anywhere from 40 to 70 years old. The Shakers build solidly and substantially to begin with, and then they religiously keep buildings in excellent repair and renewal."

Independence Hall, Philadelphia, was built in 1729, except the steeple. Faneuil Hall, Boston, was built in its original form in 1740. Jefferson's home at Monticello was built at least as early as 1772. St. John's Episcopal church, Richmond, Va., dates from 1740. Patrick Henry spoke in it in 1755.

There are stone and stucco houses in Germantown, Philadelphia, more than a hundred years old; and some of them dating back before the Revolution of 1776. New Jersey houses built by the Dutch settlers tell the same story.

These records show that depreciation tables might easily be changed, and that the capacity of the forests might consequently be doubled. With proper building laws and good workmanship the life period of all houses might be extended to 75 years, as a minimum, so far as the main structural parts go. Roofs would have to be recovered, plaster perhaps taken off, and upper floors modernized. The standard depreciation table for shingles—if they are still to be used—is, spruce, 5 to 7 years; cedar, 12 to 15; sawed pine, 30 to 50; cypress, 30 to 60. The labor cost on poor shingles is as great as for the best.

When an appraiser studies a frame house for the depreciation allowance it comes to be a question of construction. Each house has to stand on its own foundation in a double sense. From $1\frac{1}{2}$ per cent per annum to 10 gives a wide range.

Method. The matter of the great variation in the price list as shown in the chapter on "Physical Valuation, General Principles," being understood and remembered, there are two methods of finding values and depreciating—one to allow a certain number of years for the life of a group of buildings, classified according to their nature, or freight-cars, engines, or anything else, and to make a "mortuary" table, averaging the value according to the years of service; and the other, to inspect each structure or car individually to ascertain its value. For cars, passenger-coaches, engines, etc., the individual method is rather impracticable, although it is carried out with 40,000 freight-cars in the Michigan valuation. For such

work, and for ordinary standard buildings, the average age method of a table is preferable, and less costly than the other, although the appreciation in prices must be first applied. Apart from this ordinary classification, each building should be examined, estimated in detail, and the depreciation settled both from age and condition.

Limit. In the course of my work in Nebraska, I ran across only one individual building that is likely to stand for a century, according to the opinion of the architect and my own, but considered with reference to accommodation, it is likely to be worthless long before that. But a group of stone shops with extra heavy walls was set at a life period of a century. Still another group (two are shown in figures 7 and 14 of this book) was so built with pile and concrete foundations and steel superstructure that a life period of 100 years would have been reasonable, except for the fact that the brickwork and other subordinate features would not last half that time.

Contrast. Herein lies another trouble with depreciating buildings: In a case where a heavy concrete and pile foundation goes down, an allowance of 1 per cent would be ample, for such foundations last for centuries, but the superstructure may have to be set at a life of 40 or 50 years. Each case has to be considered on its own merits; and a table does not do justice to all structures, nor an average always suit.

Suitability. There is another feature in railroad valuations that makes them differ from such as the Cleveland one, for example, where 400 people were engaged: Perhaps a certain class of shops or stations, if considered merely as separate structures under our present conditions of use and population might last for a century, but who will guarantee that the runways for the traveling cranes of a shop, or the turntables in the yards will be sufficient for the engines in use in coming years? Or that the population of a city will not be multiplied several times over, just as Vancouver grew from 55,000 in 1906 to 165,000 in 1923.

The ordinary locomotive weighs, say, 100 tons; but in 1910 the Santa Fe road exhibited one weighing 420 all through the southwest, or at least where bridges would carry it on the main line. Bridges, runways, turntables, might be set at the longest life period so far as concerned the use for which they were designed, but they are useless for the new conditions. What value will be set on them? Salvage value? It all depends upon what the expert wants to prove.

The Grand Central Station, New York, was taken down long before the end of its natural life period, and this is but the history of hundreds of valuable railroad structures. On what basis, then, shall the life period be set? And if a railroad in a physical valuation is to be allowed the value of improvements necessarily thrown

aside by new inventions or increase of population, why should not the theory be applied in other fields? Many a man loses his whole investment of trade or professional skill through a new invention. In 1911, thousands of actors were deprived of their living on account of moving picture theatres; the linotype displaced printers by the carload, and in a score of lines, year after year, men and women are suffering the loss of their investments in certain callings through the work of the inventor. Are investors in railroad securities to be held safe through this class of depreciations?

Railroads have been practically reconstructed, so far as the main lines are concerned, since the end of the last century, and in some cities tracks have been raised and electrified. In the building field only stations and old shops have had to give way to new; and engine-houses have to be extended or taken down. In the motive power department the discovery of high-speed steel cutting made old machines worthless. Far heavier ones were required to stand the pressure. So on in every department. New tracks, bridges, buildings, equipment, etc., have been required; but all through, the old would not have been discarded unless the new had held out the certainty of better returns.

I once put up a building where the heating plant did not work. It was taken out and $10,000 put into a steam system. In making a valuation of the building would the owners have been credited with the value of the old plant? Certainly not. They would have had their building valued according to what it would have cost to reproduce it.

Importance. The question of depreciation is vital in any physical valuation. Suppose half a dozen good contractors agree that it would cost $100,000 to reproduce a certain building at current rates, but that it was 20 years old, how much would it be worth? Three of them might set a life-time at 40 years, and the other three at 50. In the one case there would be an annual depreciation of 2½ per cent to deduct, and in the other 2. Yet this would make one figure $50,000 and the other $60,000. What does the most exact detailed estimate amount to when there might honestly be such a great difference over the one factor that practically decides the amount? There is so much room for an honest and a dishonest difference of opinion on this question of depreciation in buildings, bridges, tracks, and rolling stock of a railroad that, at its best or worst, a physical valuation is but a drawn battle.

Method. In the Michigan and Wisconsin valuations of railroads the individual method was followed, and each structure, engine, or car, valued and depreciated according to condition; in the Washington valuation the original records were dug up, or the date of building or purchase ascertained and the depreciation done ac-

cording to a mortality table. A part of the Washington report says:

"It is a well-established fact that a freight-car has a useful life exceeding 20 or 25 years. If the average car has a life of 25 years, it loses 4 per cent of its life every year. Hence by multiplying its age in years by 4 per cent, its lost life or depreciation is accurately ascertained; and, by subtracting this depreciation from 100, the remainder will give its 'present value' expressed as a percentage of its value new."

"If practically all the structures shown in the accounting records are still in existence, and the money expended each year for each class of structure is known, it is very simple matter to figure the average age of money invested in estimating the present value. To illustrate, suppose there are a number of station buildings in existence, whose age is not known. Suppose, however, that $10,500 was spent for such buildings in 1896, $20,000 in 1900, and $5,000 in 1902. Then in 1906, the average age of the money invested in these buildings is ascertained thus:

$10,500 × 10 years	$105,000 one year
$20,000 × 6 years	120,000 one year
$ 5,000 × 4 years	20,000 one year

"This gives a total of $35,500 invested in 7 years for $245,000; divided by $35,500 gives 7 years approximately.

"The rule to be followed in all such cases is to multiply the money expended each year for structures of a given class by the age in years, add all these products together, and divide by the total cost of all the structures under consideration. The quotient is the average age of all of the structures, or, more strictly speaking, the average age of the money invested in the structures. If some of the structures are no longer in existence, this method can still be applied. Take railway crossties, for example. Ascertain the total value of crossties in the track, then go back through the records of the tie renewals, by years, until the total cost of renewals adds up to the total value of ties now in the track. Then compute the average age as above shown. If the price of ties has fluctuated, ascertain the actual price paid, and reduce all yearly expenditures for renewals to the present price."

Appreciation. On a railroad track for four or five years after it is built, there is a betterment owing to the "seasoning," or to what has been given the high-sounding name of Adaptation and Solidification. There is an appreciation of about 10 per cent, instead of a depreciation, as the road settles down and all the minor defects are put to rights; but this does not apply to buildings. If a building cracks, there is usually no way of making it as good as new,

and the rate of depreciation has to be raised. On a grain elevator alluded to on page 203, a special depreciation of $20,000 was made in addition to the regular one, on account of a settlement that made the structure lean 15 in out of plumb. Some buildings have such defects that a depreciation of 10 per cent per annum has to be used.

The Nebraska table is given in the following pages. It is only an approximate guide. Some of the building rates are too high.

Depreciation Tables—Physical Valuation of Railroads

	Item	Minimum usable value % of new	Depreciation rate per annum
1.	Right of way and station grounds	100	
2.	Real estate	100	
3.	Grading	100	
4.	Tunnels		
	Wooden lining		.05
	Brick lining		.02½
	Stone and concrete lining		.02
5.	Bridges		
	Steel for main line service	33⅓	.02
	Steel for branch line service	20	.02
	Steel salvage ½c per lb		
	Concrete and stone		.02
	Pile and timber trestles and wooden trusses	20	
	For main line		.12½
	For branch line		.03⅓
	Timber salvage $7.50 per M ft bm.		
	Culverts	20	
	Wooden box		.10
	Cast-iron pipe		.02
	Vitrified pipe		.05
	Cement pipe		.02
	Concrete and stone		.02
6.	Ties—Cross (In all old track determine by inspection)		
	For new track		

	Estimated average life	
Oak (white)	12 yrs	.08⅓
Oak (mixed)	7 yrs	.14 3/10
Fir and pine	6 yrs	.16⅔
Cedar	12 yrs	.08⅓
Tamarac	8 yrs	.12½

DEPRECIATION TABLES—*Continued*

Item	Estimated average life	Minimum usable value % of new	Depreciation rate per annum
Hemlock	6 yrs.....		.16⅔
Cypress	6 yrs.....		.16⅔
Treated—all kinds	12 yrs.....		.08⅓
All old side tracks	..25 yrs.....		
Switch (In all old track determine by inspection.)			
For new track ditto as for cross ties			

NOTE. Above depreciation of ties to apply in earth and poor grade of ballast. Where ties exist in good stone ballast increase the life of tie one-fifth, decreasing annual depreciation rate proportionately.

7.	Rail—Estimated average life 38 4-10 years	33⅓	.026
	Salvage, $10 per ton.		

NOTE. Above depreciation of rails is considered only under a proper balanced condition of traffic and use. Misused rail as per special instructions.

8.	Frogs and switches.....	33½	
	Stands and guard rail—conditions same as attending rail.		
	Frogs.....		.039
	Split points and attachments.....		.052
	Crossings—determine by inspection.		
	Salvage, $10 per ton.		
9.	Track fastenings.....	33⅓	
	Base plates, tie plates, angle bars, rail braces and bumping posts, condition same as attending rail.....		.026
	Salvage, $10 per ton.		
	Spikes.....		.08½
	Bolts and nut locks.....		.05
10.	Ballast.....	25	
	Cinders and sand.....		.15
	Crushed stone and granite.....		.02
	Gravel and burned clay (Nebraska and similiar products).....		.05

NOTE. This treatment of ballast only to be considered under proper balanced conditions of construction. Otherwise as per special instructions from investigation.

DEPRECIATION TABLES—*Continued*

	Item	Minimum usable value % of new	Depreciation rate per annum
11.	Tracklaying and surfacing	100	
12.	Roadway tools	$33\frac{1}{3}$	
	Hand cars		.07
	Section men's tools (average)		$.12\frac{1}{2}$
	Salvage of metal, $\frac{1}{2}$c per lb.		
13.	Fencing—Right of Way	20	
	Wooden fencing entire		$.06\frac{3}{4}$
	Wooden posts—wire panels		.05
	Cement and iron posts—wire panels		$.04\frac{1}{2}$
14.	Crossings and signs	20	
	Crossing plank		.25
	Roadway signs—posts and boards		$.08\frac{1}{2}$
15.	Interlocking and other signal apparatus —average	$33\frac{1}{2}$	.05
	Salvage value 5% of new.		
16.	Telegraph and telephone lines	20	
	Poles and pole attachments		.05
	Wire		.04
	Instruments		
	Telegraph (salvage val. 15% of new)		.04
	Telephone (salvage val. 8% of new)		$.08\frac{1}{3}$
	Switch boards (salvage val. 10% of new)		.04
	Battery	$33\frac{1}{3}$	
17.	Station buildings and fixtures	20	
	Wooden frame buildings		.03
	Brick (salvage material only 8%)		$.02\frac{1}{2}$
	Concrete and stone (salvage material only 8%)		.02
	Steel frame, brick and stone (salvage material only 10%)		.02
18.	General office buildings and fixtures—treat same as item 17.		
19.	Shops, engine houses and turntables:		
	Buildings—treat same as 17.		
	Turntables	20	
	Combination steel, iron and wood		.05
	Steel		.04
	Salvage of all metal $\frac{1}{2}$c per lb.		
20.	Shop Machinery and Tools	$33\frac{1}{3}$	
	Machinery		.05

DEPRECIATION TABLES—*Continued*

	Item	Minimum usable value % of new	Depreciation rate per annum
	Tools		.75
	Salvage of all metal ½c per lb		
21.	Water stations.		
	Pump house machinery	33⅓	.05
	Buildings treat same as item 17.		
	Water tanks		
	Wooden	20	.05
	Steel—including water softeners	20	.03
	Galvanized iron	20	.10
	Wind mills	33⅓	.12½
	Salvage, value all metal ½c per lb.		
22.	Fuel stations		
	Wooden structures	20	.03⅓
	Steel structures	20	.03⅓
	Machinery in above	33⅓	
	Salvage value all metal ½c per lb.		
23.	Grain elevators—treat same as item 17.		
24.	Storage Warehouses—treat same as item 17.		
25.	Dock and wharf—not treated.		
26.	Electric light plants	30	
	Boiler plant		.05
	Engine and dynamo		.08⅓
	Incidental apparatus		.08⅓
	Salvage value 10% of new.		
27.	Electric power plants	30	
	Boiler plant		.05
	Engine and dynamo		.08⅓
	Incidental apparatus		.08⅓
	Salvage value 10% of new.		
28.	Electric power transmission	30	
	Pole and wire attachments		.05
	Wire and cable (salvage value 33 1-3% of new)		.05
29.	Gas producing plants—not treated.		
30.	Miscellaneous structures.		
	Buildings—treat same as item 17.		
	Wooden platforms	20	.08⅓
	Cement platforms and walks	20	.03
	Brick platforms and walks	20	.03
	Concrete and stone curbing	20	.03

DEPRECIATION TABLES—*Continued*

Item	Minimum usable value % of new	Depreciation rate per annum
Wooden curbing		.05
Cinder and gravel platforms and walks	20	
No curbing		.04½
Wooden curbing		.08⅓
Stock yards fence	20	.06⅔
Stock scales	20	.06⅔
Salvage value all metal ½¢ per lb.		
31. Adaptation and solidification of roadway	100	
32. Engineering and superintendence	100	
33. Steam locomotives—including tanks	25	.04
Salvage value 5½% of new.		

Note. Special treatment should be made of this item considering wooden frame vs. steel frame of tanks.

34. Electric locomotives—not treated.		
35. Passenger cars	25	.04
Express, baggage and mail (salvage value 8% of new).		
Coach and chair cars (salvage value 6% of new).		
36. Freight cars (salvage value 20% of new)	20	.05½
37. Work equipment		
New equipment (salvage val. 6½% of new)	25	.05
Built up equipment (salvage value 20% of new)	25	.06¼
38. Rent and repairs of equipment during construction	100	
39. Inspection and purchase of equipment	100	
40. Transportation of material	100	
41. Stores and supplies for Nebraska new	100	
Not new—treat as under its proper class as herein above provided.		
42. General expenditures	100	

Boilers. The depreciation rates on boilers are given here from "Peabody and Miller," for a comparison with the Nebraska ones:

Description	Life in years
Lancashire, low pressure	15 to 20
Locomotive type, stationary	12 to 15
Locomotive	8 to 12
Vertical	10 to 15
Vertical with submerged tubes	14 to 18
Horizontal cylindrical tubular	15 to 20
Scotch marine	12 to 15
Water tube	12 to 16
Pipe or coil	5 to 8

Experts. The Machinery Handbook gives the average life of machines as follows:

	Years
Large machine tools—boring mills, planers, large lathes	25
Small machine tools—lathes, small drill presses, bench tools	20
Small parts—fixtures, etc	15
Small tools—reamers, drills, etc	10
Shop furniture—closets, tool stands, etc	15
Motors and electrical equipment	20
Shafting	15
Belting	10

	Depreciation to be deducted annually
Lathes and machine tools, first class	5 %
Engines, shafting, gearing	$7\frac{1}{2}$
Lathes and machine tools, second class	10
Machinery in general	10
Boilers	$12\frac{1}{2}$

Interstate Commerce Commission. The Engineering Board of the Interstate Commerce Commission set the life period on some large items as follows:

(*a*) Metal bridges shall be given a normal service life of 70 years, if suitable for modern loads.

(*b*) Masonry culverts shall be given a normal life of 100 years.

(*c*) Cast-iron culvert pipe shall be given a normal service life of 80 years and other iron or steel pipe 30 years.

(*d*) Vitrified and concrete culvert pipe shall be given a normal service life of 50 years.

(*e*) Masonry piers and abutments shall be given a normal service life of 100 years. Concrete and other masonry 100 years.

Timber structures shall be given a normal service life of 50 years, and masonry structures, 100 years; suitably modified where observation shows principal parts are new or in need of renewal.

Iron wire shall be given a normal life of 50 years and copper 100.

Railroad. A Chicago railroad allows the following figures for taxation returns—and the annual depreciation is made large enough to wipe the buildings off the slate in a few years—for taxable purposes—as they are not returned when down to 20 per cent of their value.

Pile and Timber Trestles.

Minimum condition	20%
Annual depreciation	12%

Coaling Stations.

Minimum condition	20%
Annual depreciation	5%

Steel Bridges.

Annual depreciation	2%

Steel Turntables.

Annual depreciation	5%

Bridges.

Howe Trusses, annual depreciation	6%
Howe Trusses, minimum condition	20%

Buildings.

Minimum condition	20%
Frame, annual depreciation	7%
Brick, annual depreciation	5%
Stone, annual depreciation	2%

Grain Elevators are allowed at about 3 per cent per annum.

Another Theory. After much is said and done on the theory of depreciation, and the one set of experts are agreed, another comes forward and says that there is no such thing as depreciation in the physical property of a railroad—owners of ordinary buildings might wish they could say the same of their investments. To quote the Minnesota Report, dissenting from this view:

"The opinion is entertained by some that there is no depreciation in the physical properties of a railroad, but that as a working tool its efficiency, as maintained, is at all times the equivalent of the new, and that a specific facility is in some instances worth less than its reproduction cost, only because in the progress of time and development it has become inadequate for the purposes required of it;

and again it is expressed that an old road through thorough maintenance and for other numerous and good reasons is more serviceable and valuable than a new road.

"It is entirely tenable that the value of an economically constructed, judiciously financed, and efficiently managed railroad property, or the contra thereof, is not measured by its cost, and, for the instant, it seems necessary to recur to the elementary that cost and value are not synonymous, and that the determination of the present value of the physical properties, using reproduction cost as a basis, bears no relation to value in the sense of utility, or as an investment."

The Washington Reports says: "The commission concluded that on an established road, maintained to a proper standard of efficiency, there would be no continuing depreciation; that on a newly constructed line there would be a rapid depreciation of certain elements during the first few years. This would apply particularly to ties, and, in a lesser degree, to wooden structures and equipment. On the other hand, there would be an appreciation of roadbed on a new line, due to the seasoning and hardening which follows its use. Such appreciated value of roadbed would largely offset the depreciation of the value of the other items. But the depreciated value of a road in profitable operation does not equal its market value. To this depreciated value must be added a sufficient amount to cover the enhanced value due to building up a successful transportation business." One of the Washington roads was put at a market value of only half its depreciated physical valuation. It was considered a bad investment.

Interstate Commerce Commission. The act for the valuation of the railroads required the Commission to give the "cost of reproduction less depreciation." Under this head the bureau treated depreciation as the exhaustion of capacity for service. The Texas Midland R. R. asserted this theory to be wrong, and said that so long as a property is 100 per cent efficient, or so long as there is no deferred maintenance, there can be no depreciation. There are the two theories and the I. C. C. bureau of valuation sets forth the reasons for the acceptance of the former:

"When the act was passed the phrases 'cost of reproduction new' and 'cost of reproduction less depreciation' had come to have a clearly defined and well understood meaning. The conception of depreciation as used in this connection was the equivalent of that put upon it by the bureau. There were differences of opinion as to the part which physical deterioration and functional depreciation should play and all persons were not agreed whether depreciation and life were essentially identical; that is, whether an article might not depreciate more rapidly in the first years of its existence than in

the last, or vice versa, but all were agreed upon the fundamental concept that depreciation means decline in value due to loss of capacity for service. An article was assumed to have incorporated in it a certain amount of use when new; a certain part of that use had gone; and so much remained.

"Reference might be made to hundreds of instances in which this idea of depreciation when the act was passed had been used in valuation proceedings by individuals, by commissions, and by courts. It is doubtful if any case can be found where it had been deliberately assumed that depreciation and deferred maintenance were synonymous.

"Not only have valuators and utility commissions adopted this view of depreciation, but the same definition has been assumed and acted upon by courts, including the Supreme Court of the United States.

"This question was first definitely before that court in Knoxville vs. Water Co., 212 U. S., 1."

"The carrier insists that this conception of depreciation is wrong, that the inquiry should be whether the property is in 100 per cent efficiency. So long as it is maintained at 100 per cent efficiency, or what comes to the same thing, so long as there is no deferred maintenance, there can be no depreciation.

"This is clearly stated in the brief of the carrier, where it is said:

"It is apparent, from the testimony received on the subject of depreciation and from the questions and statements of the Director during the introduction of the same, that *the principal difference is one of definition of depreciation.* The witnesses called by the carriers—men of candor, ability and experience—while fully recognizing deterioration from age and use and the necessity of repairs and replacements of perishable elements, state that *in the absence of deferred maintenance there is no depreciation.*

"It will be seen, therefore, that the question presented by the record in this case for determination touching depreciation is whether the theory of the bureau or that of the carrier is correct.

"It is clear that when the act was passed, the word 'depreciation' as used in the phrase 'cost of reproduction less depreciation' had acquired a definite meaning. It must be assumed that Congress used the word in that sense. Nor is there to-day any other recognized meaning. We approve and adopt the definition of depreciation which the bureau has applied in this case."

The depreciation tables used in the Cleveland valuation are given herewith:

Depreciation Tables

STORE BUILDINGS AND DWELLINGS

(Note. The percentage of depreciation is given under Good, Fair, Bad, as to quality of buildings.)

BRICK				FRAME			
Years	Good	Fair	Bad	Years	Good	Fair	Bad
1	2	3	6	1	3	4	10
2	4	5	11	2	6	7	17
3	6	8	15	3	8	10	23
4	8	10	18	4	10	12	27
5	10	12	21	5	13	15	31
6	12	13	24	6	15	17	34
7	13	15	27	7	13	15	27
8	14	17	29	8	18	21	40
9	16	18	32	9	20	23	42
10	17	20	34	10	22	25	45
11	18	21	36	11	23	26	47
12	19	22	38	12	25	28	49
13	20	23	40	13	26	30	51
14	21	24	41	14	28	31	53
15	22	25	43	15	29	32	55
16	23	26	45	16	30	34	57
17	24	27	46	17	31	35	58
18	25	28	47	18	32	36	60
19	25	29	49	19	33	37	61
20	26	30	50	20	34	38	63
21	26	30	51	21	34	39	65
22	27	31	53	22	35	40	66
23	27	32	54	23	36	41	68
24	28	32	55	24	37	42	69
25	28	33	56	25	37	43	71
26	29	34	57	26	38	44	72
27	29	34	57	27	39	45	74
28	30	35	58	28	39	46	75
29	30	35	59	29	40	47	79
30	31	36	60	30	41	48	80
31	31	36	31	31	41	48	80
32	32	37	61	32	42	49	82
33	32	37	61	33	42	50	83
34	33	38	63	34	43	51	85
35	33	38	64	35	43	52	86
36	33	39	65	36	44	53	88
37	34	40	65	37	45	53	90
38	34	40	66	38	45	54	91
39	34	41	67	39	46	55	93
40	35	41	68	40	46	56	95
41	36	42	68	41	47	57	
42	36	42	69	42	47	59	
43	37	43	70	43	48	59	
44	37	43	71	44	48	59	
45	38	44	72	45	49	60	
46	38	44	72	46	50	61	
47	39	45	73	47	50	61	
48	39	46	74	48	51	63	
49	40	46	75	49	51	64	
50	40	47	75	50	52	64	

Office Buildings

First Class, Steel Frame

Years	Depreciation	Years	Depreciation	Years	Depreciation
1	2%	10	13%	18	19%
2	4	11	14	19	19
3	6	12	15	20	20
4	7	13	15	21	20
5	8	14	16	22	21
6	10	15	16	23	21
7	10	16	17	24	22
8	12	17	18	25	22
9	13				

In addition to this depreciation on individual buildings there was often a special depreciation in Cleveland used for locations that had become undesirable for their original purpose, etc.; and there was usually a discount of 10 per cent on residence property facing street-car lines.

No Allowance. This question of depreciation is seldom understood or attended to by the average citizen when building for investment. He gets a rent that may return 10 per cent per annum on the cost of the property, but there are several items to be deducted before the net income is found. One of these items is depreciation.

Disregarding the value of the lot, which may increase or decrease in value, or be leased, let us consider a case where a $5000 house brings in $40 per month, and that a deduction has been made for the lease or return for the lot, leaving the $40 for the building proper. Rental agencies usually calculate one month per annum for vacancies, and there are also insurance, taxes and repairs to consider. A depreciation of $1\frac{1}{2}$ per cent per annum cuts off $75, or practically $6 per month. The net amount is really only $34. If depreciation is not allowed there will be nothing to show at the end of the $66\frac{2}{3}$ years. There will thus be a dead loss of $5000. The answer to that is that few of us look forward $66\frac{2}{3}$ years. We may take more thought for the morrow than we should, but not such a long look ahead as two generations.

Some Authorities

Modern Buildings. In discussing modern fireproof and other buildings Mr. J. E. Randall, president of the National Association of Building Owners, and manager of a $12,000,000 property in

Chicago, said that the life of the steel, terra cotta and masonry of a steel constructed fireproof building may reasonably be placed at 75 years. The life of the boilers, steam heating system, vacuum system, electric wires, elevator system and the operating equipment may be reasonably be placed at 10 years, because at the end of that period, and in many cases before, new boilers and pumps have become necessary, and the installation of electric wire has become ardened and useless, or new city requirements have caused their replacement.

Five years is a good life for an electric cable. Steam pipes installed in a horizontal position and where the action of the return of the distilled water is strongest, often do not last longer than 5 yrs. Elevator gates would not last 10 years except with the necessary repairs and replacement of parts. Plumbing requirements become very heavy in that time.

"I feel," Mr. Randall said, "that although the life of a structural part of a building might be 75 years, yet we must make a reduction of 25 for its becoming out of date and obsolete. Office buildings constructed 40 years ago are almost obsolete to-day, although considered the best of their kind at the time of construction. There is no reason to expect structural advancement to stand still in the next 50 yrs any more than it has in the past."

These figures show that the high buildings are not desirable in average cities and towns, no matter what the building managers may think. There is really no use for a building more than five stories above the sidewalk in any city, except a few of the largest, and even in them a limit of ten should be set. For most towns a three story limit would pay all around. When a building of that size becomes obsolete the loss is not great.

Near the end of 1921 the Building Managers' Association of Chicago issued a bulletin on the life of an office building which concluded as follows: "Six directors prepared individual opinions, the consensus of which was that it is not safe from an investment standpoint to assume that the profitable life of even the best fireproof office building in Chicago will exceed from 30 to 40 years from the date of its construction."

It is not that the structure is not strong enough to last twice as long, but it is not "up-to-date." It may be that we are getting too fastidious, and forgetting the difference between a parlor and an ordinary business office.

The bulletin gave a list of almost forgotten names of prominent office buildings which were removed after lives of less than 30 years to make room for "up-to-date" skyscrapers.

Steel Framework. When an 8-story building was taken down in Pittsburgh to make room for a larger, after a life period of 12 years,

architectural engineers and architects took a great interest in the condition of the steel. It showed no sign of deterioration. The rivets were tight, and even the underground work was in perfect order.

Mill Construction. The National Lumber Manufacturers' Association has issued a number of booklets in connection with the use of lumber, and one of these shows that in some ways lumber should not be held responsible for the fires that are charged against it, but bad building laws and other causes.

With respect to depreciation the "Structural" book says: "Many mill-constructed buildings in New England are practically as good to-day as when built a hundred years ago; while frame dwellings will last for generations, as evidenced by colonial homes which are still sound and comfortable after more than a century of use."

"In buildings of the standard mill construction type depreciation is commonly estimated at from 1 to 1½ per cent annually. This, of course, is based upon well designed buildings, properly constructed of good materials."

"Taking into consideration several principal factors, such as community changes, expansion of city growth, developments in architectural types, and housing requirements, a 30 to 40 year period is a fair estimate of the term of usefulness of any kind of structure. In view of this, well designed and properly built timber structures will in many cases meet all requirements of occupancy and use, and prove very economical, both in first cost, and in ultimate alterations and removal."

The mill construction rate is reasonable in giving a life period of from 100 to 67 years for the best buildings.

Experts. The National Association of Real Estate Exchanges adopted a schedule of annual depreciation as follows:

Steel and reinforced concrete buildings five years old or less, 1 per cent; more than five years, 2 per cent.

Mill constructed buildings and fireproof apartment buildings, 2 per cent on buildings five years old or less; 3 per cent above this.

Brick and lath buildings, including old flat buildings, 3 to 4 per cent.

Old frame and nearly obsolete buildings 5 per cent and up.

Planing Mills. The authorities allow on these 3 per cent on brick buildings, 5 per cent on wood buildings, and 10 per cent on equipment. This from the Millwork Cost Bureau, Chicago, with 500 members.

Realtors. The experts in real estate set forth some figures on ordinary dwellings of interest to investors:

"Depreciation is figured on the **useful** life of the building, not the **structural** life. A building might stand a hundred years, and

yet have a useful life of less than half that period." (But this simply means that a city plan was at fault, for it is possible to so plan as to make the useful life equal to the structural.)

"The average well built frame residence has a useful life of 40 yrs, according to the best authorities. They hold that the allowance, or deduction for depreciation should be 1.65 per cent per year for the first 25 years, 1.65 to 3.30 for the next 10 years, and 7 per cent for the last 5 years." (In a well planned city and with sound construction, especially as to sills on the frame house, the minimum might be 75 years, and the colonial houses more than prove it.)

"Let us take a practical example: A house that was built 25 years ago is offered for sale. To replace it at present cost of materials and labor would cost $4000. The depreciation for 25 years at 1.65 per cent per year would be 41.25 per cent. Deducting 41.25 per cent of $4000 from that amount leaves $2350, the actual value of the building."

Sinking Fund. This is meant to be ready to replace the building when its life period is ended.

"On a frame flat building 1.02 per cent of the value compounded annually at 4 per cent will yield the principle in 40 years, the commercial life of such a building. In the case of cement brick, or stone building, the percentage is .816 annually for 50 years."

"It is usual to deduct 10 per cent of the gross rentals for vacancies. The usual charge for managing properties is 5 per cent of the gross rental."

Approximately 1 per cent is allowed for a sinking fund. But this is on the basis of materials and labor about as when the buildings was erected. A reference to price list shows how materials rise in value. Steel beams were once set at $40 per ton in the building, for plain store fronts, under store floors, and such places; in war times they were $110 in some parts of the country. Lumber doubled in price. So with other materials, and the rates for labor also rose. The 1 per cent is too low to meet the rise. But from war prices to the future it may work well.

Depreciation

Several buildings in Europe are more than a thousand years old and from that down to a hundred the list is without end. Many frame houses in the United States are more than a century old, and will last for a long time to come. It is well to remember this in reading the following tables:

Table of Depreciation in Buildings—World Almanac

(By R. M. Hurd)

Construction and Occupancy	Term of life in years	Rate of fund proposed in per cent	Term of sinking fund at 3 per cent in years
Cheap frame, tenement.....	10 to 15	10 to 5	9 to 16
Cheap frame, residence.....	25 to 30	3 to 2	23 to 31
Better frame, residence.....	50 to 75	2 to 1	31 to 47
Cheap brick, tenement.....	25 to 30	3 to 2	23 to 31
Cheap brick, residence.....	35 to 50	2 to 1	31 to 47
Cheap brick, office building....	25 to 30	3 to 2	23 to 31
Better brick, residence.....	50 to 75	$1\frac{1}{2}$ to 1	37 to 47
Good brick or stone office bldg.	75 to 100	1	47

Economic Existence of Buildings

Type of Building	Life in years	Type of Building	Life in years
"Taxpayer".....	12 to 15	Office and business bldg.	27 to 33
Hotels.....	15 to 18	Lofts and factories.....	33 to 37
Apartment houses....	18 to 21	Residences.....	37 to 44
Store buildings.....	21 to 25	Banks and institutions.	44 to 50
Tenements and flats...	25 to 27		

Electrical Plants. Some of the experts set 3 per cent, which is too low; state commissions set about 5 and 6.

INSURANCE ADJUSTERS' ALLOWANCES AS COMPILED BY JAMES N. BROWN, ST. LOUIS

U. S. Base in 1913 = 100: This table = 80: Change to suit any year by U. S. Index Nos.

Farm and Country Property	Per cu ft, Cts
Dwellings, frame, small box house, no cornice	4
Dwellings, frame shingle roof, small cornice, plain	5 to 6
Dwellings, brick, same class	7 to 8
Dwellings, frame, shingle roof, good cornice, sash weights, blinds, good house	7 to 8
Dwellings, brick, same class, good house	9 to 10
Barns, frame, shingle roof, not painted, plain finish	$1\frac{1}{2}$ to $2\frac{1}{2}$
Barns, frame, shingle roof, painted, good foundation	$2\frac{1}{2}$ to 3
Stores, frame, shingle roof, painted, plain finish	5 to 7
Stores, brick, shingle roof, painted, good cornice and finish	7 to 9
Ordinary wood churches and schools	5 to 7
Ordinary brick churches and schools	8 to 10
If slate or metal roof add $\frac{1}{4}$c per ft.	
City and Village Property	
Dwellings, frame, shingle roof, pine floors and finish, no bath room or furnace, good house	6 to 7
Dwellings, brick, same class	8 to 9
Dwellings, frame, shingle roof, hardwood floor in hall and parlor, bath, furnace and fair plumbing	8 to 9
Dwellings, brick, same class	8 to 10
Dwellings, frame, shingle roof, hardwood first floor, good plumbing, furnace, artistic design, interior ornamentation, well painted	10 to 12
Dwellings, brick, good plumbing, bath, hot and cold water, pine finish, well painted, no hardwood finish	11 to 12

The Wear and Tear of Building Materials

At the tenth annual meeting of the Fire Underwriters' Association of the Northwest, held at Chicago in a low-price era, Mr. A. W. Spalding read a paper on the wear and tear of building materials, and tabulated the result of his investigations in the following form:

Material in Building	Frame Dwelling		Brick Dw'ng (Sh'gleRoof)		Frame Store		Brick Store (Sh'gleRoof)	
	Average Life Years	Per Cent of Depreciation Per Annum	Average Life Years	Per Cent of Depreciation Per Annum	Average Life Years	Per Cent of Depreciation Per Annum	Average Life Years	Per Cent of Depreciation Per Annum
Brick	..	...	75	$1\frac{1}{8}$	..	...	66	$1\frac{1}{2}$
Plastering	20	5	30	$3\frac{1}{3}$	16	6	30	$3\frac{1}{2}$
Painting, outside	5	20	7	14	5	20	6	16
Painting, inside	7	14	7	14	5	20	6	16
Shingles	16	6	16	6	16	6	16	6
Cornice	40	$2\frac{1}{2}$	40	$2\frac{1}{2}$	30	$3\frac{1}{3}$	40	$2\frac{1}{2}$
Weather-boarding	30	$3\frac{1}{3}$	..	...	30	$3\frac{1}{3}$	..	...
Sheathing	50	2	50	2	40	$2\frac{1}{2}$	50	2
Flooring	20	5	20	5	13	8	13	8
Doors, complete	30	$3\frac{1}{3}$	30	$3\frac{1}{3}$	25	4	30	$3\frac{1}{3}$
Windows, complete	30	$3\frac{1}{3}$	30	$3\frac{1}{3}$	25	4	30	$3\frac{1}{3}$
Stairs and newel	30	$3\frac{1}{3}$	30	$3\frac{1}{3}$	20	5	20	5
Base	40	$2\frac{1}{2}$	40	$2\frac{1}{2}$	30	$3\frac{1}{2}$	30	$3\frac{1}{2}$
Inside blinds	30	$3\frac{1}{3}$	30	$3\frac{1}{3}$	30	$3\frac{1}{3}$	30	$3\frac{1}{3}$
Building hardware	20	5	20	5	13	8	13	8
Piazzas and Porches	20	5	20	5	20	5	20	5
Outside blinds	16	6	16	6	16	6	16	6
Sills and first-floor joists	25	4	40	$2\frac{1}{2}$	25	4	30	$3\frac{1}{3}$
Dimension lumber	50	2	75	$1\frac{1}{3}$	40	$2\frac{1}{2}$	66	$1\frac{1}{2}$

These figures represent the averages deduced from the replies made by 83 competent builders unconnected with fire insurance companies, in 27 cities and towns of 11 Western states.

United States Government Allowance

The estimate used by the United States Government is as follows:

	Per Cent per Year
Brick, occupied by owner	1 to $1\frac{1}{4}$
Brick, occupied by tenant	$1\frac{1}{4}$ to $1\frac{1}{2}$
Frame, occupied by owner	2 to $2\frac{1}{3}$
Frame, occupied by tenant	$2\frac{1}{2}$ to 3

According to that a frame house occupied by a tenant will not last more than 40 years, so that the rent should be high enough, not only to pay interest on the investment, but to establish a sort of a sinking fund to replace the building. These figures allow for ordinary repairs. With care half of that depreciation is enough.

In "Work and Wages" the late Prof. Rogers, of Oxford, says: "Now the quality of the work in the old times of which I have written is unquestionable. It stands to this day a proof of how excellent ancient masonry was. The building....is still standing as it was left 4 centuries ago. I am persuaded that such perfect masonry would have been incompatible with a long hour's day. You may still see brickwork of the next century, which I venture on asserting no modern work would parallel and within 5 minutes' walk of it Roman brickwork, probably 16 centuries old, which is as solid and substantial as when it was first erected. The artizan who is demanding at this time an 8-hr day in the building trades is simply striving to recover what his ancestor worked by 4 or 5 centuries ago. It is only to be hoped that he will emulate the integrity and thoroughness of the work which his ancestor performed."

By this it may be inferred that there is something seriously wrong when the life of average brickwork is limited to 75 years.

Crossties. They are known as sleepers on the other side of the Atlantic, but under whatever name they rot too soon. The quality is not so good as formerly.

It takes 2880 ties to the mile of single track, or about eight carloads. But range is from 2720 to 3564.

The Division of Forestry, Washington, Roth report, sets the durability of ties as follows:

	Years
Redwood	12
Black locust	10
Cypress and red cedar	10
Oak (white and chestnut)	8
Chestnut	8

	Years
Tamarack	7 to 8
Cherry, black walnut, locust	7
Elm	6 to 7
Longleaf pine	6
Hemlock	4 to 6
Spruce	5
Red and black oaks	4 to 5
Ash, beech, maple	4

"Long experience has put the average life at eight years. In recent years the railroads have practically doubled the life period by a process of creosoting the tie before it is laid."

The creosoted tie is expected to last twenty years.

In England the rail is bolted down in a "carriage" instead of being spiked. A large American road has adopted the system of boring four holes for bolts and putting a plate on top and bottom of the tie. The rail is held down by the top plate on the carriage system.

Some roads are planting trees along their right of way for future supply. Steel ties and reinforced concrete ties are not suitable. They are not "resilient" enough. A good auto tire is resilient.

General Municipal. The Controller of Philadelphia reported as a general condition:

"The average life of each dollar's worth of city structures, non-structural improvements and equipment at present is 60.62 years Taking the property and equipment separately, the average life of each dollar's worth of structures and non-structural improvements is 62.72 years; while the average life of each dollar's worth of equipment is 21.92 years. The fact that the average life of the equipment and property combined is only 2.1 years less than the average life of the structures and non-structural improvements, apart from the equipment, is owing to the fact that the city, for every dollar that it has invested in its equipment, has $18.50 invested in its structures and non-structural improvements."

CAST-IRON PIPE

Source. Most of the following data are taken from "Pipe and the Public Welfare," by R. C. McWane, Secretary of the Cast-Iron Publicity Bureau, New York.

Some day we may come to an ideal civilization when the best in all lines will be so well known that difference of opinion will be at an end, just as it is with many products now. Portland cement has won as against lime for the best structural purposes. Civiliza-

tion is gradually crowding out the wood shingle on account of fire dangers. In railroad bridge work structural steel has won as against the former cast-iron kind. And so on, in many lines where experience has rendered a final verdict.

But the battle still rages around fireproofing; and the face brick men tell of granite and stone spalling in fires; and with electrolysis on the one hand and the decay of wood on the other, the pipe men have their innings. The reinforced concrete enthusiasts tell us that both iron and wood will have to give way to a better material; but the vitrified tile manufacturers show damaging photos of disintegrated concrete sewers, while the U. S. Reclamation men tell of the bad effect of alkali soils on all but the very best of concrete pipe.

Versailles. The cast-iron pipes to supply the water for that "abyss of expenses" were put down from 1664 to 1687, and are still in working order. There are more than a dozen miles of them. The sizes run as high as 13 in and 20 in, which were "whalers" for that age. The lengths were 1 meter, or about 3 ft 3 in, joined by means of bolted flanges. Any repairs have been at the joints and not in the pipes themselves. So far as depreciation goes this is a fair record.

At Rheims the water supply was laid down in 1748 by M. Godinet, canon of the cathedral. Most of the pipes in the system were of lead, but some were of cast iron, dug up in good condition in 1840. This is another good depreciation record for 8-in pipes 4 ft long.

Several other French cities have pipes that have lasted for longer than a century.

London and Glasgow have had cast-iron pipes in use for 100 to 125 years. Philadelphia has a century plant for a small part of the present distribution system. The older cities of this country and the cities of Europe have cast-iron pipe records that run back for a century also. This for gas as well as water, although the pipes do not, as a rule, last so long. New York up to the end of 1921 had 3600 miles of cast-iron gas pipes, and more than 3000 of water. Boston has 1100 miles of gas pipes; Philadelphia, 1500.

Depreciation. "Exhaustive tests have proven that cast-iron loses through corrosion approximately 1 per cent of its original thickness and strength in the first ten years underground. Should the same ratio of loss continue, the pipe would be entirely consumed in a thousand years. But further tests have proven that, under normal conditions, corrosion of cast-iron pipe ceases after the first ten years, so that its life may be said to be even larger."

After giving records from a score of European cities like Versailles with 250 years, Weilburg with 210, and others from these figures down to a century the conclusion is:

"Cast iron has of course been in use in this country a shorter time, but no cast-iron mains are now known here that have worn out, or rusted out.

"We thus see that the structure itself is practically everlasting. Reasons of expediency, increase of population requiring larger mains, and other contingencies may cause the obsolescence of cast-iron pipe before its physical deterioration. On account of these factors, which in most cases are remote, it is customary in calculating to assign a useful life of 100 years to cast-iron pipe."

The "American Gas Light Journal" under the heading of "External Corrosion of Cast-Iron Pipes," said: "Under ordinary conditions of soil, cast-iron pipe has a probable life of from one to three centuries, as far as external corrosion is concerned. (2) Under certain soil conditions, such as salt marshes or saline soils, cast-iron pipe may be rendered useless in from seven to twenty years. (3) At times cinders and slag fills may exert a strongly deleterious influence. (4) Substituting wrought-iron or steel pipe for cast iron is ineffectual. Cast iron will outlast the others."

An engineering authority said in a report to water commissioners: "The comparative life of steel and cast-iron pipe is taken by various authorities as 30 to 35 years for the former and from 70 to 90 for the latter material."

"At a diameter of 36 in the cost of steel and cast-iron pipes is about the same; for smaller diameters the cost of cast iron increases much more rapidly than that of steel. It appears generally good practice to use cast iron for pipes of diameter less than 36 in and steel for those of larger diameter than 48 in.

New York uses cast iron up to and including 48 in. Steel being thinner is often used to keep down freight charges.

Depreciation. Letters sent to various cities brought out the following replies:

New York. Based upon the usual life of the bond, which is 50 years, we use 2 per cent.

Chicago. Compounded at $2\frac{1}{2}$ per cent.

Philadelphia. No system adopted. "Pipe now in use nearly 100 years old."

Boston. No system yet adopted. "We usually consider a fair estimate of the life of our pipe to be 60 years."

St. Louis. "The life of cast-iron pipe is generally taken here at 100 years."

New Orleans. "Always assumed 80 years as life of cast-iron pipe."

Baltimore. No system of depreciation. "Cast-iron pipe first laid in 1805—condition still good."

Minneapolis. "Proceedings of the A. S. C. E. given by several

authorities on water works valuation, a range of 50 to 75 years of life of cast-iron pipe. This would be equivalent to from 2 to 1.33 per cent. Our soil is very favorable to long life and when figuring life of water mains as a whole, we generally say about 1 per cent."

Montreal. No rate adopted. "Pipes may become too small for population after 40 or 50 years. That condition is the greatest cause for depreciation in value of water mains. Cast iron itself in ordinary soils is well-nigh everlasting."

Toronto. No rate adopted. "Here we consider the pipe good for 100 years at least."

Scrap. In "Pipe and the Public Welfare," a long list of failures of steel and wrought-iron pipe is given. A few extracts are set down here to aid valuators in depreciation allowances:

From Cincinnati Water Works "With but few exceptions all cities having adopted in the original construction wrought pipe, are now using cast-iron pipes. It is yet to be proven that wrought-iron pipe, whether coated with asphaltum, enameled, galvanized or cemented can be relied on beyond ten years. In our practice five years is the limit of its durability."

Wentworth Report of Salem Fire: "The wrought-iron water mains did not burst until after the fire had spent its force, but the constant fear of their known weakness paralyzed all efforts to use water." Three other towns turned their supplies into Salem's, but under the fear that the pipes would burst. "With water enough to raft Salem out to sea her citizens on the borders of the fire zone threw away their garden hose and extinguished the sparks on their shingle roofs with tree-spraying outfits."

Rochester laid 26 miles of 38-in steel pipe. The best work was done, but in 7 years defects began to appear.

Troy laid steel pipe, and in 10 years it leaked 800,000 gals per day. Then 6,000 tons of cast-iron pipe were bought for its replacement.

Hammond, Ind., had to take up steel pipe.

Atlantic City laid a steel pipe across the salt meadows under strict specifications. The line rusted beyond repair, was abandoned in 13 years, and a 48-in iron pipe put in its place. A cast-iron pipe laid in the same salt marsh is still in use after 20 years.

From 10 to 30 years would thus seem to be the life period of steel pipe. The steel and wrought-iron men look upon the matter in a different light.

Wood Pipe. Denver has 100 miles of this, Seattle and Tacoma 40 miles each, Detroit, 100. New York, Philadelphia and Boston have bored trees. Pipes may be had from the 4-in bored kind to 14-ft diameter staved. The Remco supplied the United States with 438 miles for the cantonments. Diameter from 4 in to 48 in.

As to depreciation, the wood pipe companies say that if the pipes are kept full of water the life may run from half a century to two centuries. In London good pipe was dug up after 249 years of use.

Having thus given the views of the wood pipe men as to the life period of their product, it is necessary to set forth what the metal men have concluded as to wood pipe. In order that valuators get a fair idea of depreciation allowances it is well to give more than one point of view.

"This old wood pipe is of very small diameter, having in most cases an original wall thickness of 4 to 6 in. The modern stave pipe, wire wound or banded, is an entirely different article from the bored log of a century ago, and the various processes involved in its manufacture offer numerous points of weakness. It is already generally recognized that the use of wood-stave pipe is only for work of a temporary character.

"In the early development of domestic water supply throughout the Rocky Mountain and Pacific Coast States, large quantities of wood pipe were used, but this has been almost entirely replaced in recent years with cast-iron pipe. Wood pipe is shipped to eastern cities—and cast iron is sent to western ones. The western ones have had the experience that the eastern ones will get.

"A great danger is the destruction of the iron bands. None of the wood pipe installed during the past 20 or 25 years has a record of more than 6 or 8 years of uninterrupted satisfactory service."

A "Report on Life of Wood Pipe," by D. C. Henny, Consulting Engineer, U. S. Reclamation Service, gives the life period as follows:

Wood	Condition	Years
Fir.....	Uncoated, buried in tight soil.....	20
Fir.....	Uncoated, buried in loose soil.....	4–7
Fir.....	In air.....	12–20
Redwood....	Buried in tight soil, loam or sand, and gravel	25
Fir.....	Well coated, buried in tight soil.....	25
Fir.....	Well coated, buried in loose soil.....	15–20

"Under conditions interfering with the complete saturation of the wood, the life is cut down materially. This is serious in redwood, resulting in a life which may be shorter than 15 years, but is much more marked in fir, where it may be as low, in spite of coating, as 6 years."

Lynchburg, Va., had a collapse in a 30-in wood main that had been in about 10 years. Plans were made for a change to cast iron.

Conway, Ark., replaced wood pipe after a service of four years. The new system is of cast iron.

Rogers, Tex., had the same experience.

Tacoma laid a 14-in wire-wound stave pipe. It was replaced in 7 years with a cast-iron one.

After reading a long list of this kind it seems to those not directly interested in the pipe industry that there is a good deal to be said on both sides. Between electrolysis for the metal and lack of saturation and wealth of rust to attack the iron bands for the wood there would seem to be an opening for a pipe with the defects of neither and the virtues of both. Most of the electric dangers come from trolley lines. Motor buses may become fashionable.

Filling Up. The velocity and discharge of new, well laid cast-iron pipes is about 3 per cent less than that of wood pipe. While allowance must be made for deterioration in cast-iron pipes due to tuberculation, the life is from two to four times as long on conservative estimation, and with modern methods of pipe cleaning, the original capacity can be restored at very small expense."—Pipe and the Public Welfare.

CHAPTER IV

SQUARE AND CUBIC FOOT COSTS

Base. Unless otherwise stated this Chap. is 1913 = 100. Arrange prices up or down to suit year desired according to index numbers.

These government index numbers include labor, except for installation in building. But when materials rise in price the labor of installation usually rises also, as during the war. Any difference between the rate of increase for material laid down at the site and for installation does not affect the total for square or cubic foot records. Actual bids vary much more.

There are too many kinds of buildings to set a constant figure for labor and material proportions. In engine houses, for example, material may be 70 and labor 30 per cent. On large ice houses the record was 63 and 37. On some structures 50–50 might suit.

Assume a 60 and 40 proportion. Material rises 50 per cent and installation labor only 40. The $60 is $90, and the $40 only $56 instead of $60 had the rise been 50 per cent also, or a loss of $4 on $146 total = less than 3 per cent, while bids vary up to 10 and 20.

Approximation. Here it should be pointed out that only approximate figures can be obtained by either the square or cubic foot method; but even these are very useful, especially in physical valuations. All the city of Cleveland was valued on the square foot system. It is by far more accurate than the guessing contest used by assessors over all the country.

Exceptions. But too much reliance is often placed solely on this system. It needs to be checked by all ways we can think of, sometimes including the cubic foot one, and always by our experience.

Fig. 3.—Jog, but walls of same length.

Thus, I once ran across two passenger stations built from the same plan and specifications, and alike in every respect excepting one: the first had straight outside walls, and the other had a "jog" of 4′×40′, or 160 sq ft.

As the cost of the first ran to $4 per square foot, when estimated in detail, it would have seemed reasonable to make the other $640 less, but the difference came to only about $400. With such rectangular or square jogs the only gain is in the floors, ceiling and the roof. The outside walls have the same number of lineal feet, and so has the cornice.

We often see dwellings recessed in the same way, and the porch put in the jog. The gain as compared with a straight-line plan is never in proportion to the loss of floor space, for the walls cost just as much. Of course there is a saving in the cubic feet enclosed, and this counts in the heating.

In the case of the two stations the jog might have been 10′×40′, and at the unit rate of the straight-line one this would have made a valuation of $1600 less, but such an undue reduction is checked by noting that the outside walls are of the same length in both types. All factors have to be watched.

In another case of the same nature, applied to a large blacksmith shop, the Annex if taken alone was worth $2 per square foot, while the main structure that seemed to be far more expensive, was set at $1.60. But the Annex for 650 sq ft of floor space required 82 lin ft of wall, while the main building with 6000 measured only 320 ft around. Here, then, in both cases, is one check—the linear feet of outside wall.

Cubing. Then, with cubing to get a check on a valuation, it is clear that the smaller the building the higher ought to be the unit price. Take, for illustration, two 1-story buildings, to reduce the problem to an elementary proposition, the one 10′×10′×10′, and the other 20′×20′×10′. There are 100 sq ft in the first, and 400 in the second; and 1000 cu ft, and 4000. So far the parallel goes accurately enough; but we find that it takes 40 lin ft of expensive outside wall to enclose 100 sq ft of space; while 80 lin ft instead of enclosing only 200, take in twice as much.

Size Units. An interesting article from data compiled by Charles T. Main was given in the "Building Age" of New York upon this subject of difference of cost according to size. The cost decreases as the width is increased. This shows one more feature that those who rely exclusively upon the square foot method seldom think of. In fact, the more the subject is studied the clearer it becomes that the only accurate way is to take off a bill of material, and figure that and labor at current rates. This is not necessary for ordinary buildings when valued for assessment or physical purposes with rate making in view. Cleveland, St. Paul, Philadelphia, Columbus, O., Springfield, Joliet, East St. Louis, Denver, Houston, had all been valued on the square foot method up to 1918. See also my valuation of Omaha in 1922.

The figures from the Main article are based on a 3-story building with 30,000 sq ft on each floor, for illustration, but the principle is not tied to this particular size:

Size	Cost per sq. ft. in cents	Outside wall in feet
50×600	99	1300
75×400	87	950
100×300	83	800
125×240	80	730

"The exact figures will vary, but the relative values will remain practically unchanged.

"The minimum cost per square feet is reached with a 4-story building. A 3-story costs a trifle more than a 4-story, a 1-story is the most expensive, because:

"**a.** The cost of foundations does not increase in proportion to the number of stories.

"**b.** The roof is the same for 1-story as for more.

"**c.** The cost of columns, piers, and castings does not vary much per story as the stories are added.

"**d.** As the number of stories increases, the cost of the walls, owing to increased thickness, increases in a greater ratio than the number of stories, and this item is the one which in a 4-story building offsets the saving in foundations and roof.''

Saving. According to the table an investor by building a 3-story structure 125×240 instead of 50×600 would save about $17,000. In the suburbs of cities, or in country towns where many manufactures are now locating, land might be acquired to suit the one size about as cheaply as the other.

Data Wanted. This opens up a wide field for discussion. There ought to be a thorough investigation by some government body or responsible society to find the economical sizes, number of stories, heights of ceilings, of buildings of all kinds, and to give a description of the best qualities and quantities of materials that are often wasted as things now are. For example, it is pointed out on page 86 that the H school has been practically adopted by the city of New York as the most economical, and this after long experimenting. As may be noted in this chapter, the cost of the Boston schools, like that of all cities, is rising very high. The taxpayers there are objecting, and those in authority are trying to change from the first to the second class of construction for the sake of economy. These, and the mills investigated by Mr. Main, are but two classes of buildings. There are many others.

Total Value. As an investment, of course, the problem is further complicated by the cost of the lot. A 4-story building, according to

the figures just given, is the most economical for some purposes; but it has been found that an 8-story, fireproof one pays better returns upon the investment if the lot is high-priced. With a lot costing $40,000, for example, each floor in a 4-story structure has an investment of $10,000 upon which returns are expected, while an 8-story has only $5,000. With modern hoisting apparatus there is no such vital difference between the cost of the high stories over the low ones when we get above ground level, although every floor above the second costs more than the one below; yet the lot investment decreases in proportion to the number of stories by which the price is divided. Heavier foundations and walls are necessary, but even 9″ of extra thickness of common brick in a building measuring 200 ft. around, for an ordinary story, is only about $650. On high-priced land this is a small investment.

Summary. A general summary of the economical sizes of buildings is very desirable from dwellings to skyscrapers. There is not so much difference between the cost of a 1-story and a 2-story house containing the same number of rooms. If a high basement is used the 1-story type costs too much for this part, and the roof that requires even a greater area; while the 2-story has only about half the space to cover.

Skyscrapers. The square feet cost allowed in the Cleveland assessment for this class of buildings is given further on. It will be noticed that $3.50 is added per unit, per story. It really costs more on the upper stories, however. It has been estimated that the rentable—not the constructive—cost per square foot rises from $5.25 for the second and third floors to $6.30 for the fourth, and so on increasing to $124 for the sixty-fourth. The ground floor and basement combined are put at $10.

"The construction cost of the ground floor is $20 per rentable sq ft. The ratio of rentable area in a 20-story skyscraper to the total ground area is 60 per cent. The construction cost per rentable sq ft of the second story is $18.

Skyscraper Percentages. On pages 123 to 126 inclusive there are percentages given for various classes of buildings. The figures, page 66, are for a modern office building of the skyscraper class.

Another Skyscraper

In a case where a company was about to erect a building a visit was made to forty cities and towns to examine all the factors that enter into the problem. The building was then cut down from eight to five stories, as this was found to be the best type. It is being gradually discovered that very high buildings are not economical The average city does not require more than a five story height.

	Cost	Per cent
Wrecking	$ 4,158.00	.33
Excavating	47,990.00	3.79
Shoring	34,876.00	2.74
Steel work	156,563.00	12.33
Stone, cement, and concrete	95,525.00	7.52
Fireproofing	38,865.00	3.07
Brickwork	56,222.00	4.44
Metal lathing	9,100.00	.71
Plastering	39,560.00	3.11
Millwork	86,100.00	6.77
Carpenter work	117,000.00	9.22
Terra cotta	40,000.00	3.15
Heating	75,330.00	5.93
Elevators	106,200.00	8.36
Electric work	40,500.00	3.17
Sheet metal	21,840.00	1.72
Plumbing	51,520.00	4.06
Painting	20,335.00	1.60
Waterproofing	9,500.00	.75
Ornamental iron	75,900.00	5.98
Tile and marble	90,000.00	7.09
Weatherstripping	1,025.00	.08
Vaults	24,750.00	1.94
Hardware	1,500.00	.12
Vacuum systems	5,000.00	.36
Mail chute	2,250.00	.18
Revolving doors, etc	5,700.00	.45
Steel lockers	8,335.00	.66
Refrigerating machinery	3,827.00	.30
Roofing	950.00	.07
	$1,270,421.00	100.00

Architect's percentage has to be added; and some accountants would want an allowance for interest on money during construction. The figures are useful and interesting as showing relative costs of a modern structure.

Construction Costs of Fireproof Work

They differ in cities, owing to various causes—rates of material and wages, distance from supplies, etc. The following table is set forth as a fair allowance for 1923 if $\frac{1}{3}$ is added.

	Cents per cu. ft.		Cents per cu. ft.
Greater New York	53 to 63	New Orleans	45 to 56
San Francisco	48 to 60	Oakland	45 to 60
Chicago	45 to 60	Denver	45 to 60
Boston	45 to 60	New Haven	45 to 60
Pittsburg	45 to 60	Philadelphia	45 to 60

Office Buildings. About 1897 to 1905 several fine Chicago office buildings, fireproofed, were erected for 20 to 22¢ per cubic foot but this is too low a figure now; 60¢ is about right. Mr. Kidder gives a list of 20 fireproof buildings running from 25 to 63¢ with an average of 40¢. For wood construction, 18 to 25¢.

No. 3 taken at the level of the first floor cost complete $20 per sq ft. It is of wood construction, but fireproofed with tile throughout.

The following percentages relate to an office building; but prices have risen greatly.

	Cubic foot of building
The foundation cost	$1\frac{3}{4}$
Steel framing	$2\frac{1}{2}$
Granite and all masonry	$11\frac{1}{6}$
Cornice, roofs and skylights	$\frac{2}{3}$
Fireproof floors	$\frac{2}{3}$
Partitions (tile)	$\frac{2}{5}$
All plastering (plain and ornamental)	$1\frac{1}{4}$
Elevator fronts and all ornamental metal work	2
Marble work	$3\frac{1}{6}$
Hardware	$\frac{2}{15}$
Joiner work	$1\frac{1}{6}$
Glass	$\frac{5}{12}$
Painting and varnish	$\frac{7}{20}$
Electric wiring	$\frac{2}{3}$
Heating	$1\frac{1}{8}$
Plumbing	$\frac{1}{2}$
Elevators	1
Stairs, scenic structural framing, "making ends meet," lamp fixtures, etc. What might be called a fair amount for "contingencies" in such a building, including lesser items not mentioned here but grouped together	$4\frac{23}{120}$
Architect's fee	$1\frac{3}{5}$
In all	$34\frac{5}{12}$¢

a cubic foot for a building of that character ready to have furniture moved in.

In 1923 55 to 60¢ would be the figure.

To show that some of those figures remain pretty constant in the same relation to total size, the Chicago Post Office, a building of 12,000,000 cu ft and of monumental character and finish, costs, in some of its items, pretty nearly the same as that office building.

	Cubic foot of entire building
Its foundation cost	$1\frac{3}{4}$
The steel framing	$2\frac{1}{2}$
Granite and masonry	$13\frac{1}{2}$
Fireproof floors	$\frac{2}{3}$
Plaster, plain and ornamental	$1\frac{7}{8}$
Ornamental metal work	$2\frac{1}{8}$
Marble	$5\frac{2}{3}$
Plumbing	$\frac{1}{2}$
Heating	$1\frac{1}{8}$

Per Square Foot. An office building erected for a railroad with 2 stories, no basement, brick walls, tile roof, wood construction, 8500 sq ft, cost $7.50 per square foot of ground area which is far too high a figure for a plain building, especially when heated from a central plant.

The Ventilating System for above building cost, for pipes and ducts, $750; motor and fan, $850; registers, $75.

Frame Offices. Owing to the high cost of lumber in some sections of the country, 1-story frame office buildings, with shingle roofs, run from 8 to 12¢ per cubic foot, or $1.40 to $2.00 per square foot.

Vaults. Ordinary, with hollow brick walls. One 10′×10′×8′ 9″ with 13-in and 9-in walls, no shelving, but lining and door, $450. Steel shelving complete, $850.

Y. M. C. A.'s. From 12 to 24¢ per cubic foot in brick and wood The Omaha building finished in 1907 is 132′×157′, and 76 ft. above the ground in front. It contains 100,000 sq ft of floor space, and 1,768,000 cu ft. It cost $230,000 or $2.30 per square foot; 13¢ per cubic foot about $11 on area of street floor.

Post Offices. They run from 21¢ up to $1.23 per cubic foot at prewar figures.

Omaha, Neb.	$0.71	per cu ft	Fort Scott, Kans.	$0.31	per cu ft
So. Omaha	.25	"	St. Louis, Mo.	.97	"
Lincoln	.43	"	Kansas City, Mo.	.57	"
Beatrice	.31	"	Chicago, Ill.	.49	"

Nebr. City....	.21	per cu ft	Denver, Colo...	.50	per cu ft
Co. Bluffs, Ia ..	.45	"	St. Paul, Minn...	.65	"
Sioux City, Ia..	.17	"	New York.....	1.03	"
Wichita, Kans..	.23	"	Boston.....	1.23	"

Exposition Buildings.—At Chicago the Forestry Building cost 75¢ per square foot; the Administration, $9.18; 2 others $2.12 and $2.35; and the rest from $1.04 to $1.69.

At St. Louis the Art Pavilions, $5.45; Government buildings, $2.43; agriculture, 58¢; others from 77¢ to $1.38.

Cost of Telephone Buildings

Modern. For the regular, skyscrapers, fireproof type the cost is about the same as for any structure of such nature, used for other businesses. The rooms are larger, and thus the expense of partitions has not to be considered, but there are other requirements that offset this.

The following figures are for buildings of two and three stories, and are from actual valuations in detail, and from the bids of contractors.

The square foot cost is taken on the ground floor only. Thus a three story and basement building at $24 per square foot would be only $6 if the area of the basement and other floors were taken in. The first two are fireproofed, three stories and basement.

See Chapter XVI for the cost of a 15-story building.

Table of Cost

Number	Area of first floor in square feet	Cost per square foot	Cubic feet	Cost per cubic foot
1	4356	$20.00	279,000	$.31¼
2	4356	16.00	250,000	.28
3	3022	8.00	100,000	.24
4	2765	9.50	98,000	.27
5	3250	14.00	150,000	.30
6	8700	8.00	399,000	.17½

No. 1 is a corner building, and thus higher in cost than No. 2, an inside one. Nos. 3, 4, and 5 are of brick and wood construction of a better quality than ordinary; and No. 3 is the best of them, with a heavy trussed roof. They are two stories and basement in height.

No. 6 is a supply warehouse, 66′×132′, three stories and basement.

Street Car Barns.

	Per square foot
Timber barn, two-track bays, side covered with corrugated iron	$0.70 to $0.90
Timber barn, three-track bays, brick or stone walls.	1.40 to 1.70
Fireproof concrete barn, three-track bays, concrete or brick walls	1.75 to 2.50
Clear span steel roof, eight to ten tracks, brick walls	2.00 to 2.50

Railroad Shops. The most expensive ones in Nebraska are valued at $4.20 per square foot. This high price is on account of the heavy stone foundations and walls laid up in a first-class manner.

Which System? Here we run across the method of the Associated Factory Mutual Fire Insurance Co's in which foundations are not included for fire risk, as they are safe. But, as shown in Chapter I, heavy foundations are not considered as adding any value to a building. At the time the stone shops were appraised a modern machine shop cost $3 per square foot complete, even including pile and heavy concrete foundation. According to the theory no such building should be appraised at more, regardless of the physical units or totals. In crawling through the Grand Island, Neb., shops I saw quarries of stone in the cellars, with bases 8′×8′, and tops 3′×3′.

Industrial Buildings. Two examples are here given to show cost and insurance rates. The rate per square foot is actual surface on all floors, and not on ground alone. Both structures are of reinforced concrete.

Bush Terminal Co., buildings Nos. 5 and 6. Each building is 600′×75′ in plan, 82 ft high—6 floors. There is a connecting wing between the two buildings which is 100′×205′×94′ high—7 floors. Designed floor load, 200 lbs per sq ft; windows, 50 per cent of wall area; beam and girder construction; column spacing, approximately 25′×18′; concrete curtain walls; roof, concrete covered with Barrett roofing; floors, granolithic concrete; fire protective devices, sprinklers, hose, tanks, fire doors and wire glass; insurance rate varies from 8.4¢ to 11.9¢ per $100 on buildings. Cost of construction, 6¢ per cubic foot; 81¢ per square foot.

Sugar and coffee warehouse of Arbuckle Bros., Brooklyn, N. Y. Size 206′×200′ in plan, 162 ft high—12 floors. Designed floors load, 200 and 300 lbs per sq. ft. Windows, 50 per cent, of wall area, Beam and girder construction; column spacing, 18′ 2″×22′; concrete curtain walls; roofs, cold-twisted bars for reinforcing; roof, concrete covered with Barrett roofing; floors, granolithic and also maple flooring. Protective devices, sprinklers, hose, tanks, fire doors, wire glass and scuppers. Insurance rate, 14.6¢ per $100 on building and 46.6 per $100 on contents.

Unit Costs of Reinforced Concrete Structures

The following table is used by a large eastern designing firm. As an approximate allowance it is of value, but it will be noticed that the units are much lower on machine shops, power house, and store houses than those given elsewhere.

Type of building	Dimensions ft	Live load per square foot, lbs	Cost above foundation		Cost including foundation	
			Square foot	Cubic foot	Square foot	Cubic foot
Machine shop..	120×50 4-story	150	$1.05	$.008	$1.17	$0.09
Machine shop..	220×100 1-story sawtooth skylights	.....	1.65	0.09	1.75	0.10
Cartridge factory	223×56 2-story	300	1.40	0.09	1.55	0.10
Cotton mill....	550×129 2-story	75	0.99	0.07	1.06	0.05
Weave shed....	341×231 1-story sawtooth skylights	125	1.66	0.064	1.79	0.07
Power house...	90×62	.....	2.53	0.115	2.67	0.12
Store house....	181×56 4-story	150	1.08	0.065	1.15	0.07
Store house....	256×100 12-story	150	0.90	0.09	0.98	0.105
Store house....	223×56 2-story	300 and 1000	1.20	0.08	1.35	0.09

The "Building Age," New York, gave some good figures on a standard reinforced concrete building. W. P. Anderson, of the Ferro Concrete Construction Company of Cincinnati, assumed a typical structure, not including excavation, heat light and elevators, and made up some useful data:

The load was set at 150 lbs per sq ft, column spacing, 18-ft story heights, 12. The base cost on a structure 50×50 ft came to $1.55 per sq ft of floor space. At 50×100 ft the unit is $1.20. At 50×150, $1.12. At 50×200, $1.07. This illustrates the Main figures already given. Manufacturers going to the country towns may build cheaper than in the city.

The typical building was assumed to be from 4 to 10 stories high. A 3-story building would cost a trifle more per square foot of space. A 2-story would cost from 10 to 12 per cent more than the figures; and a 1-story, from 15 to 20 per cent more.

If the width is decreased from 50 to 25 ft the unit cost is increased from 35 to 45 per cent; while an increase in width cuts down the unit cost.

In a 6-story building the decrease in cost for a 75-lb load is about 12¢ per sq ft of floor space.

When columns are spaced about 15 ft apart both ways the cost is about 6 per cent greater than when they are set about 25 ft.

The whole estimate was based on plain factory styles, with no interior partitions except around stairs, elevator shafts, etc.

The percentage of window area to wall area has little effect on unit cost, when a steel sash window and ordinary glass were used; but with wire glass the cost is considerably more than for plain wall,—about twice as much per square foot.

War Work. On two large reinforced concrete buildings in Washington, D. C., 273×391, and with 192,000 sq ft of net floor area the cost per square foot was less than $1.25, including heating, lighting, plumbing and railway siding. This is $1.25 per foot of floor space, and not of ground floor only, for the buildings were two stories high. The cost would be about doubled if taken on ground area only. They were erected by the E. H. Mosher Company in about two months. The buildings are of reinforced concrete throughout, with 8-in walls and a gravel roof to make assurance doubly sure."

Warehouses. Three of the largest in Omaha, built when prices were low, cost from 6½ to 8¢ per cubic foot. They are of mill construction and from 5 to 6 stories high. Bids on two others ran under 7¢. One of the cheaper construction cost 5½¢. One story 12 ft high, no basement, $1.80 per square foot.

Another building with 600,000 cu ft cost 16¢, but this figure was reduced to 13¢, if heavy retaining wall,—not properly to be charged to structure,—steel roof, and piling were omitted. Partly used for office. Tile roof.

Factories. Cotton mills are usually estimated by the square foot taken on all floors. In New England the cost runs from 85¢ to $2.25, while in some southern states 70¢ is a large enough figure.

Approximate Cost of Mill Buildings

(Courtesy of Charles T. Main, Engineer, 201 Devonshire St., Boston)

NOTE. The tables are dated December, 1909. The 1922 Main chart gives an average of 90 for that year as compared with 100 for 1913 and 1914, in the same chart. These tables are not from the index numbers of the United States, but from independent sources and include labor, and the various proportions of material as they enter into a building. The index numbers are given in Table C.

Conditions. The cost given include plumbing, but no heating, sprinklers, or lighting. These three would add about 10¢ per square foot of floor area."

"The height of stories is varied, being set at 13 ft high if 25 ft wide, 14 ft if 50 wide, 15 ft for 75 wide, 16 for 100 ft and over."

Modifications. There are many, as all builders know. A few are noted:

(*c*) Buildings for storage with low stories and no top floors, cut off about 10 per cent for large low buildings, to 25 per cent for small high ones, about 20 per cent being fair.

If of wood, substantially built, 13 per cent for large 1-story buildings, to 50 for small high buildings, and 30 is usually fair. (These deductions are from the tables and curves. In some sections of the country wood is almost as expensive as masonry.)

(*f*) The floor loads are set at a total of 75 lbs per sq ft for brick buildings of the " slow burning " type.

(2) " A building, no matter how built nor how expensive it was to build, cannot be of any more value for the purpose to which it is put than a modern building properly designed for that particular purpose. The cost of such a modern building is then the limit of value of existing buildings." (This theory set forth by Mr. Main is worthy of note, as some of the railway valuators would not accept it. The Mutuals also stand by it.)

(3) **Foundations.** " The diagrams can be used as a basis for insurance valuations after deducting about 5 per cent for large buildings to 15 for small ones."

Unit Prices. " The cost of brick walls is based on 22 bricks per cubic foot, costing $18 per 1,000 laid."

" Openings are estimated at 40¢ per square foot, including windows, doors, and sills." (But steel lintels are not ordinarily used in cotton mills, and they must be added if required. The Main figures are for the ordinary arched top.)

" Ordinary mill floors, including timbers, planking, and top floor with southern pine at $40 per M ft B M and spruce planking at $30 per M ft B M, cost about 32¢ per square foot; 40¢ if columns are included.

" Ordinary mill roofs covered with tar and gravel, with lumber at the foregoing prices, cost about 25¢ to 30¢ per square foot."

" Add for stairways, elevator wells, plumbing, partitions, and special work."

Some of these prices were doubled and tripled in war times, but even then lumber close to the forests cost less than is given. Location, freight, labor, and all factors have to be considered.

Stairways and Elevator Towers. " Allow two stairways and one elevator tower in buildings over two stories high up to 150 ft long."

" Allow two stairways and two towers up to 300 ft."

" Allow three stairways and three towers over 300 ft."

Brick walls enclosing stairs and elevators, estimated as inside walls. Stairs, $100 per story, per flight. (Some kinds would cost $200.)

Plumbing. "Allow two fixtures on each floor up to 5000 sq. ft of area, and add one fixture for each additional 5000 or fraction. Allow $75 per fixture." (Double was scarcely enough in war times.)

Incidentals. "Add about 10 per cent."

Roof to project 18 in all around.

Height of Stories. The assumed height as already given should be remembered.

In the following Table A and Table B the figures are left as based on 1909. From the basis of an index number of 90 for that year they may be raised or lowered to suit any other year as shown by Table C. Thus, the $15 in last column of Table A for 1909 would be reduced to $11.67 for 1900, or in proportion to 90 and 70.

TABLE A

Prices and Other Data Used for Estimating the Cost of Buildings

	Foundations including excavations Cost per lin. ft.		Brick Walls Cost per sq. ft. of surface.		Col. including piers & castings
	for outside walls.	for inside walls.	outside walls.	inside walls.	Cost of one
One Story Building..	$2.00	$1.75	$.40	$.40	$15.00
Two " " ..	2.90	2.25	.44	.40	15.00
Three " " ..	3.80	2.80	.47	.40	15.00
Four " " ..	4.70	3.40	.50	.43	15.00
Five " " ..	5.60	3.90	.53	.45	15.00
Six " " ..	6.50	4.50	.57	.47	15.00

Add stairways, elevators, heat, incidentals, etc.

TABLE B

Table Showing Ratio of Cost of Buildings Designated, Compared with Brick Mills of Standard Construction

Superficial ft of Floor in one story	Frame Mills						Brick Store House						Frame Store House					
	1 Sto.	2 Sto.	3 Sto.	4 Sto.	5 Sto.	6 Sto.	1 Sto.	2 Sto.	3 Sto.	4 Sto.	5 Sto.	6 Sto.	1 Sto.	2 Sto.	3 Sto.	4 Sto.	5 Sto.	6 Sto.
1250	.86	.67					.80	.73					.70	.51				
2500	.86	.73					.85	.73					.75	.58				
5000	.89	.78	.75	.73	.70	.67	.83	.80	.78	.76	.76	.75	.74	.60	.56	.53	.51	.48
7500	.90	.79	.77	.74	.71	.69	.85	.81	.78	.77	.76	.76	.77	.63	.58	.55	.53	.51
10000	.90	.80	.78	.75	.73	.70	.87	.81	.79	.78	.77	.76	.78	.65	.60	.57	.55	.53
15000	.91	.82	.79	.77	.75	.72	.89	.83	.81	.79	.78	.78	.81	.67	.64	.61	.59	.56
20000	.92	.83	.81	.79	.77	.74	.90	.84	.82	.80	.80	.79	.82	.70	.67	.64	.61	.59
25000	.92	.85	.82	.80	.78	.76	.91	.85	.83	.82	.81	.80	.83	.72	.69	.66	.63	.61
30000	.93	.86	.84	.81	.80	.77	.91	.86	.84	.82	.81	.81	.84	.73	.70	.67	.65	.62
35000	.93	.87	.84	.82	.80	.78	.92	.86	.84	.83	.82	.81	.85	.74	.71	.68	.66	.63
40000	.93	.87	.85	.83	.81	.79	.92	.87	.85	.84	.83	.82	.86	.75	.72	.69	.67	.64
45000	.94	.87	.85	.83	.82	.79	.92	.87	.85	.84	.83	.82	.86	.76	.72	.70	.67	.65
50000	.94	.88	.86	.84	.82	.80	.92	.88	.86	.84	.83	.83	.87	.77	.73	.71	.69	.66

Add stairways, elevators, heat, incidentals, etc.

Index Numbers from the Charles T. Main Chart

These numbers are based on private data and include labor and materials in a building, according to the proportion in which they enter into construction. Table D at the beginning of this book shows that this proportion has to be taken into account. Up to 1915 the variations between January and December of any particular year are small; from 1915 to 1922 the low and high points are given, January, of course, being low up to 1920 and high from that down. The figures apply to cotton mills and such buildings.

TABLE C

Year	Index No.	Year	Index No.	Year	Index No.
1897	61	1903	73	1909	90
1898	65	1904	74	1910	93
1899	69	1905	77	1911	96
1900	70	1906	80	1912	98
1901	72	1907	83	1913	100
1902	72	1908	87	1914	100

	Low	High		Low	High		Low	High
1915	100	111	1918	147	180	1921	158	220
1916	111	123	1919	180	224	1922	158	164
1917	123	147	1920	222	280			

The peak was reached about July, 1920, rising from 224 in January and going down to 218 in December.

The six adjoining tables are made out on the base of 1913 = 100. That is, the original Main figures based on 1909 as 90 have been brought up to the standard year. The prices are given in dollars or cents per square foot.

One Story					
Length, feet	Width				
	25	50	75	100	125
50	2.11	1.69	1.57	1.51	1.47
100	1.85	1.45	1.33	1.27	1.21
150	1.76	1.36	1.25	1.18	1.13
200	1.71	1.32	1.20	1.13	1.09
250	1.69	1.29	1.17	1.11	1.07
300	1.66	1.28	1.16	1.09	1.05
350	1.64	1.27	1.15	1.08	1.03
400	1.63	1.26	1.14	1.07	1.03
450	1.63	1.26	1.13	1.07	1.02

Two Stories					
Length, feet	Width				
	25	50	75	100	125
50	2.25	1.67	1.50	1.42	1.37
100	1.81	1.35	1.21	1.13	1.08
150	1.69	1.26	1.12	1.06	1.00
200	1.64	1.21	1.08	1.01	.96
250	1.60	1.18	1.05	.98	.94
300	1.57	1.17	1.03	.97	.91
350	1.55	1.16	1.02	.96	.90
400	1.54	1.15	1.01	.95	.89
450	1.53	1.13	1.00	.95	.89

Three Stories					
Length, feet	Width				
	25	50	75	100	125
50	2.20	1.64	1.45	1.38	1.31
100	1.75	1.29	1.17	1.10	1.05
150	1.64	1.20	1.09	1.01	.96
200	1.58	1.16	1.05	.97	.92
250	1.55	1.12	1.01	.94	.89
300	1.52	1.11	.99	.92	.87
350	1.51	1.10	.98	.91	.86
400	1.50	1.10	.97	.90	.85
450	1.50	1.10	.97	.89	.85

Four Stories					
Length, feet	Width				
	25	50	75	100	125
50	2.25	1.38	1.47	1.39	1.34
100	1.79	1.31	1.18	1.10	1.03
150	1.67	1.23	1.67	1.00	.94
200	1.61	1.17	1.03	.96	.90
250	1.58	1.15	1.00	.94	.88
300	1.56	1.12	.99	.91	.86
350	1.53	1.11	.98	.90	.85
400	1.52	1.10	.97	.89	.84
450	1.51	1.10	.97	.89	.84

Five Stories					
Length, feet	Width				
	25	50	75	100	125
50	2.29	1.69	1.33	1.42	1.31
100	1.85	1.33	1.18	1.09	1.05
150	1.70	1.21	1.08	1.00	.96
200	1.64	1.17	1.03	.96	.91
250	1.60	1.15	1.01	.94	.88
300	1.58	1.12	.99	.91	.86
350	1.56	1.11	.98	.90	.85
400	1.55	1.11	.97	.89	.85
450	1.55	1.11	.97	.89	.84

Six Stories					
Length, feet	Width				
	25	50	75	100	125
50	2.32	1.70	1.51	1.44	1.37
100	1.91	1.35	1.20	1.11	1.06
150	1.76	1.25	1.10	1.02	.96
200	1.67	1.20	1.05	.97	.91
250	1.65	1.17	1.02	.94	.88
300	1.62	1.16	1.00	.92	.87
350	1.60	1.15	.99	.91	.86
400	1.59	1.13	.99	.90	.85
450	1.59	1.13	.99	.90	.85

Dry Kilns

Courtesy, L. Moore Dry Kiln Co., Jacksonville, Fla.

Experts. This company began business in 1879 and has made kilns ever since for all sections from the southeast to Seattle.

Material. A kiln building may be constructed of any good ordinary material—wood, brick, concrete, or tile. Most kilns are built of brick. "All that is required is a building that will hold the heat, and we do not lean to any particular style of construction."

What might be called temporary kilns are sometimes built close to the forests. When the trees are all cut the kiln is taken down. It does not pay to put the heaviest construction as to walls in a plant of this kind.

Some kilns are built on the laminated principle, like grain elevators. Plank 6 or 8 in wide are laid flat and nailed to one below. The roof is formed as for a mill constructed building with the plank on edge. See page 398 for labor time on work of this kind.

Size. There is no standard, but the average size dry kiln has about 2000 sq ft inside, or 20×100 ft. One battery of fourteen Moore kilns has a size of 20×104; some are 20×120; others 24×125. The height is about 15 ft above the floor with the heating pipes below this; and the railroad car height of 4 ft 6 in to top of platform is level with the floor tracks.

Specials. Hardwood and soft wood require different treatments. Different kinds of wood in these classes have special requirements.

Another authority writes: "Before any price can be given it is necessary to know what has to be dried—whether hard or soft woods, green or partially air-dried, oak or gum, staves or heading, lumber or shingles, as all of these different kinds require different equipment. There is no such thing as giving any price unless we know what the kiln is to do"

Cost. For the average size the cost is $1.25 per square foot; and the same for the inside iron material, heating apparatus and steel foundations. This is $2.50 per square foot complete, as an approximate figure or $5,000 in all. A smaller kiln costs more per square foot. This is on the basis of brick. The usual allowance has to be made for high cost of material and wages in large cities. The $5,000 is for average conditions.

Water. "Green lumber contains from 25 to 60 per cent of water, varying with the texture and density of the wood. Neither lumber manufacturer, middleman nor consumer can afford to pay freight on water."

Cost of Average Stores

It is often said by owners in cities of even 100,000 population, that a building with stores below and only one tory above pays best, for elevator space, operation, and repairs are saved. The value of the ground has to settle this, as well as the rents, but it is surprising how many low buildings are to be seen in the business districts of even large cities.

Comparison. Assume a building 50×130 ft for stores below and offices above. No. 1 has only the six stores and twenty offices. An average building is estimated. The detailed figures come to 14¢ per cubic foot. But it would be easy to make the cost 50 per cent more.

No. 2 with stores and two stories has to have an elevator. The U. S. laws forbid the delivery of mail above the second story if there is no elevator. But this causes a loss of space on the main floor that in all cities pays the heavy end of the investment. The loss of space and the operation and depreciation of the elevator have to be considered. In No. 1 the cubic footage ran to 227,500; in No. 2 299,000 at 15.5¢ per cubic foot.

No. 3 with stores and three stories above has 370,000 cu ft at 16¢.

Desco Store Fronts

Copper Only. The following prices do not include lumber or mill work which may be had in any location, according to the details. Glass is not supplied. Freight from Detroit has to be allowed. To any place east of the Mississippi river this does not amount to more than 2 to 3 per cent on the cost of the material.

Labor Erecting. On page 405, an approximate idea of the time required for ordinary fronts is given. Woodwork all covered with copper does not require so much care as that shown on Nos 5 and 6. In setting up the copper work this company allows 10 per cent extra on the cost of the material. This system is not altogether satisfactory, for when, as in war times, copper doubles in price the labor would naturally double also, and wages do not double. But it gives a fair approximate idea of the amount required for such work.

Numbers. The references are to the plans shown in the cuts.

Material. Standard material is used for covering all parts of the front. It is boxed and delivered f o b Detroit at prices in table.

Size 18 ft between brick piers, total height of opening 12 ft 6 in., including 18-in bulk heads. The material cost $104 boxed and delivered f o b Detroit.

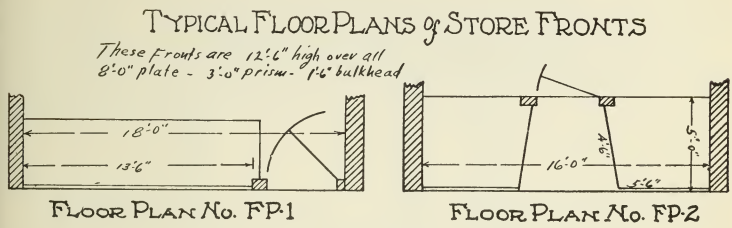


FIG. 4.

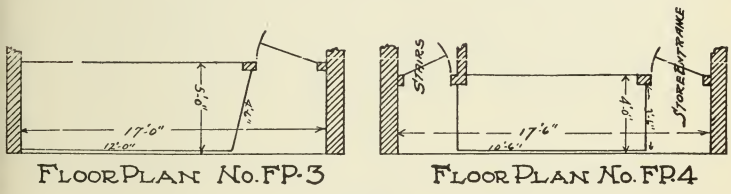


FIG. 5.

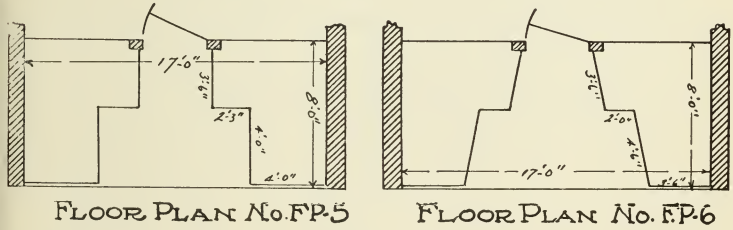


FIG. 6.

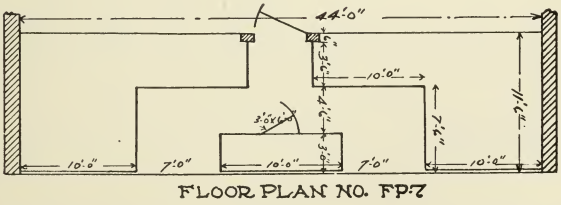


FIG. 7.

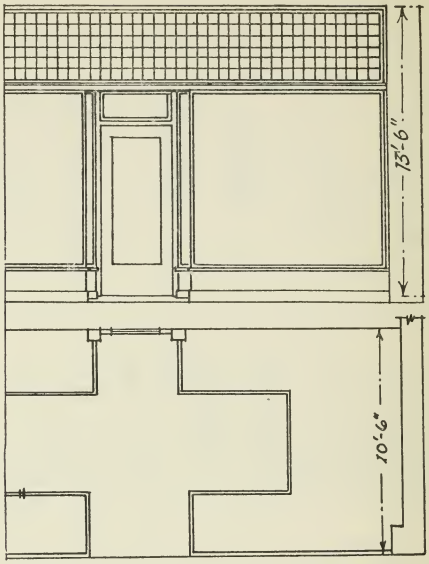


Fig. 8.—Front and Island Window.

Table of Store Front Data

Description	Size of opening	Height	Bulk head	Total cost
No. F. P. 1.....	18′ 0″	12′ 6″	18″	$104
No. F. P. 2.....	16′ 0″	12′ 6″	18″	121
No. F. P. 3.....	17′ 0″	12′ 6″	18″	95
No. F. P. 4.....	17′ 6″	12′ 6″	18″	105
No. F. P. 5.....	17′ 0″	12′ 6″	18″	172
No. F. P. 6.....	17′ 0″	12′ 6″	18″	170
No. F. P. 7.....	17′ 0″	12′ 6″	18″	413
No. (front illustrations.....	23′ 0″	13′ 6″	22″	294
No 13, double cross with island window.....	40′ 0″	.....	.....	465

Variety. There is no fixed standard or limit to the expense that may be put in fronts. The foregoing may be taken as a fair price

for ordinary fronts. An ideal building law would not allow large plate glass. The largest plates in the world are in Omaha about 24 ft long by the regular store height. A good building law would enforce mullions at least every 7 ft, and 4 would be better. Too many plates are blown out in windstorms.

Variation

Only approximate estimates can be taken from the following figures. Local conditions affect the result so much that one building might cost 25% more than another of the same size, in the same section of the country, and at the same rate for labor and material. In the one case the ground might be 12′ below grade, and in the other as much above; piling might be required in the one and rock blasting in the other. Sometimes 25% of the total cost of a building is expended before foundations are up to grade. But for average buildings approximate figures are useful.

As may be seen on page 15 the physical valuation of a property does not include all items in the complete returns. When this may be increased from 20 to 50 per cent it is hardly worth while being too exact with the building. Of course it is desirable to have valuations as close as possible, but if the final return of the physical part may be heavily increased, and a guessing contest made as to how much to allow for "going concern" and other factors, the builder or valuator should not have to count the nails and measure the dentils in the cornice. An allowance has also to be made for the period and location. There are low-priced years and war years; and in some sections even in high-priced times building costs remain low.

OBSERVE

1913 is base at 100, and figures are arranged for that year. To suit year of valuation use U. S. Index Nos. and raise or lower figures. See front of book. Table A, page xi.

Brick Stores and Flats Above. I have put in bids for a large number of these buildings, but have let the sizes slip. A figure of 10 to 14¢ per cubic foot seems about right. For frame buildings 7 to 10¢.

Flats. For double two-story and basement brick, hardwood finish on first floor, $210 per lineal foot from front to back; $5 per square foot on area of first floor, or 16¢ per cubic foot. For frame, 15 per cent less.

But what are known as flats in New York, with fine masonry, elevators and strictly modern equipment, run as high as 25 to 35¢ per cu ft for fire resisting floors and wood construction.

Tenements. Allow from $475 to $550 per room.

Hospitals. No. 2, strictly fireproofed, 14¢ per cubic foot; No. 1, of wood construction, about half as much; but both are only shells with practically no partitions. For fireproofed buildings fully equipped, 30 to 40¢. General hospitals per bed, $550 to $800. Cottage, $1,100 to $1,200. Complete hospital "plant," per bed, $1,800 to $2,400.

Hotels. From 20¢ for brick with ordinary construction to 50¢ per cubic foot for fireproof work.

Brown Palace Hotel, Denver, 30¢; fireproof hotel, New York, 44¢. Fontenelle, Omaha, 1915, 35¢.

Residences. Anywhere from 10¢ per cubic foot. One of the best houses in Omaha cost from 20 to 22¢, brick; a better one of stone, about 37¢, but neither is fireproofed. Chicago price for city dwellings, 17 to 20¢. For frame houses without modern improvements, with shingle roofs, $300 to $350 per room; with modern improvements, and part or all hardwood finish, slate roofs, $450 to $700. Brick houses, 8 to 10 rooms, 16¢, ordinary finish with hardwood on first floor.

Two-story flats as already given are $5 on ground area, or $2.50 if both floors are taken. Residence may run all the way from $1.50 per square foot of floor space to $10, and this without dealing with palaces.

Veneered houses 15 to 20¢ per cubic foot.

For a 2-story frame, brick basement, 27 ft×56 ft, finished for family on each floor, heated and modern, pitched roof, $3.60 per square foot of ground floor, and 10½¢ per cubic foot.

Concrete Cottages. The Atlas Portland Cement Co. sends out a pamphlet with many styles of dwellings of this kind. The walls are mostly monolithic, with reinforcements above openings. Some of them have studs with solid concrete filled in between, scoured to a sand finish while green, and bands nailed over the studs to make a panel in the half-timbered style. In this system the walls are 4 in thick to fill out the stud on both sides. In most of the other houses illustrated the basement walls are 10 in, and the ones above, 8.

Cost per Room. Of 12 cottages, not including bathroom or halls, there are 4 costing $600 per room, 2 at $640, and $645, 1 at $682, and the highest at $833; 2 of simpler construction cost $418, another, $566; and 1 is set at $226, which appears to be too low. Detailed estimates are given.

Slaughter Houses. 17¢ per cubic foot.

Drill Halls. 16 to 20¢ per cubic foot or $2 to $3 per square foot.

Fire Engine Houses. At low cost an Omaha house was built for 6¢ per cubic foot; at high, the city paid $4.25 per square foot for one; and 11¢ per cubic foot for another.

Public Baths. From 35 to 45¢ per cubic foot.

Theaters. Per chair, $60 to $120; per cubic foot, 30 to 50¢.

Ordinary City Halls. From 25 to 40¢ per cubic foot.

Court House. Cook Co., Chicago, said to be the largest in the United States, contains, $2,000,000 cu ft, and the unit cost was 35¢. Ordinary 25 to 30¢ per cubic foot.

The State capitol, Pennsylvania, built about 1906, cost 33¢ per cubic foot.

Stables. From 18 to 22¢ per cubic foot; $2.50 to $3.25; per animal $230 to $100 on ordinary building.

Dairy Barns. Large frame barns, $1.50 per square foot, 5 to 6¢ per cubic foot. Concrete basement. Brick, 7 to 8¢ per cubic foot.

Greenhouses. Ordinary construction, 50¢ per square foot; with brick foundations, 60¢. This is for the very cheapest style of construction, heated by supply from another building.

The following figures are from the leading greenhouse builder in the United States. At best they are approximate, because each installation has its own details and environments. Some require a temperature of 45 to 50°, others, 65 to 70°; there are all cypress wood benches; iron frame benches and with cypress sides and bottom; or cypress and porous or slate; and the same ground plan might have an elevation costing wice as much as another.

The first column gives the cost of house proper, the "extras" column is for excavation, foundation, boiler, cellar, work room, and hauling. No grading included, as that item is uncertain, water supply not brought to building, and no cement sidewalks included.

Area of house proper only is taken for both columns: work room is about 12′×20′.

The Cost is given within a hundred miles of New York.

The construction is of iron frame ventilated, heated, water piped, galvanized iron plant bench with cypress sides and porous tile bottoms for greenhouses; and the same with slate tops for palmhouses.

Garages. The old question of, How long is a string, might be amended by asking, What is the cost of a garage. It all depends upon the string, and the size and style of the building. There are hundreds of thousands of "autos" now in existence, and most of them have individual houses. Some with a few boards nailed together in Southern California or Florida may cost less than 30¢ per sq ft, and there are many at $5, with all kinds of prices between these limits, and many above the highest. There might be a score of classifications of these small buildings in a city valuation.

A garage 20×30, of 6-in terra cotta blocks plastered both sides, with auto space, bedroom, and bathroom, all on one floor in Boston, cost $3.35 per sq ft and 18.7¢ per cu ft from the bottom of the footings to the average height of the shingle roof, at 1919 prices. Heat is supplied from a small plant connected with the garage.

Description	House proper	Square foot price house proper	Extras	Square foot, price complete
No. 1, 18′×33′ 4″, shingles 3′ 0″ high on studs and boarding; above straight double slope roof.....	$1,500	$2.50	$380	$3.30
No. 2, 18′×66′ 8″, as above.....	2,700	2.25	460	2.64.
No. 3, 1,167 sq ft, curved roof, masonry walls about 3′ above ground...	3,100	2.66	900	3.43
No. 4, 1,000 sq ft, curved and straight roofs, masonry as on No. 3.....	3,300	3.30	1100	4.40
No. 5, 1,465 sq ft, otherwise as No. 4	4,300	2.94	1100	3.68
No. 6, 600 sq ft, curved and straight roofs, and masonry as No. 3	2,000	3.34	800	4.67
No. 7, 2,000 sq ft, curved and straight roofs, high palmhouse in center, masonry, as No.. 3.....	7,400	3.70	1400	4.40

Portable Fireproof Garages

Some companies make a specialty of manufacturing galv iron garages, hunting lodges, cottages, etc. Freight is paid east of the Rocky Mountains on the Pruden type. Concrete or other floors, erection, painting, if desired, hauling from the cars, and profit, have to be included.

Private Garage for Single Car

Standard equipment furnished with each building:

1 Pair double entrance doors with Yale locks; 1 Single entrance door; 3 Windows (wire glass, unless clear glass specified); 1 Ornamental gable; 2 Ventilators; 2 Ridge terminals; 2 Door stops for double doors; 4 Metal corner shelves; 2 Metal side shelves.

All bolts, nuts, screws, rods, etc., for the complete assembling of these buildings included.

Side walls are 8 ft to eaves. May be 10 ft, if desired, for 15 per cent extra.

NET PRICES

Length....	12	14	16	18	20	24	28	32	42
Width, 10..	$160	$175	$189	$204	$218				
Width, 12..	177	194	210	228	244	$278			
Width, 14..		212	232	252	272	308	$348		
Width, 16..			261	284	306	349	391	$455	
Width, 18..				316	340	388	436	484	$604
Width, 20..					375	427	480	533	665

Private Garage for Two Cars

Equipment same as for single garage, except that there are two pairs of double entrance doors with Yale locks.

NET PRICES

Length	18	20	22	24
Width, 18	$328	$352	$376	$400
Width, 20		387	413	439

Garage for Three or More Cars

Equipment same as for single garage, except that there are a pair of double entrance doors for each car capacity, as well as one window for each car capacity.

NET PRICES

	3 Cars	4 Cars	5 Cars	6 Cars
Length	26	34	42	50
Width, 16	$401	$497	$593	$680
Width, 18	432	540	648	756
Width, 20	461	582	702	822

Septic Tanks. On a style by the U. S. Government, $675 for 40 families. No piping leading to building.

A large manufacturer supplies the following prices for his system: Residences occupied by an average number of 8 people, $250; residences occupied by an average number of 10 people, $275; residences occupied by an average number of 12 people, $300. School buildings occupied by 300 people, $600; by 350 people $650; by 400 people, $700; by 500 people, $800.

Institutions occupied by an average number of 100 people, $600.

Another maker quotes $100 on steel tanks of 200 gal. each, for 10 people. Freight, brickwork, excavation, etc., would be about $100 more.

It has been proposed to put septic tanks in the basements of the skyscrapers. The United Gas Improvement Co. building, Philadelphia, has had a satisfactory one since 1901. In these tanks the sewage is changed by bacteriological action, and nothing left but comparatively pure water. Smaller sewers would serve under this system, and the disposal of the effluent be easier. Jerusalem was said to be a clean city because each householder swept before his own door. In the future each building may be made to purify its own sewage.

Schools (On a 1913 price base.)

Some Examples. No. 12 built at a low price, of plain design, $75 per scholar; 8 rooms, 400 seats; brick and wood construction. Another Omaha schoolhouse erected later of the same size costs $115. Material and labor are higher, and the design is more ornate. In the country the cost might be reduced from 10 to 15 per cent.

An addition to the Omaha high school, finished in 1913, strictly fireproofed, Bedford stone on three fronts, 16¢ per cubic foot. The complete cost was about $775,000. With four stone fronts the cost might have run to 18¢.

The H plan for schoolhouses has been adopted in New York. "Upwards of eighty school buildings have been constructed since 1896, and the average cost of buildings has been only 18¢ per cubic foot." They are fireproof. These 80 cost about $12,000,000.

A high school erected in Boston, Mass., cost 22.39¢ and another 24.98, both fireproof.

A number of schools in St. Louis, not fireproof, ran from 14 to 17¢ per cubic foot; and from $5,600 to $6,700 per room.

A fireproof school in Palo Alto, Cal., cost 18¢ per cubic foot.

From 10¢ per cubic foot up to 15¢ will build non-fireproof schools; and from 18 to 30¢ fireproof ones.

High Cost of School Buildings. The cost is mounting year by year. In the table of Boston schools there are some startling figures for the consideration of taxpayers. It is questionable if such expenditures are warranted. The tendency seems to be to make the casket so fine that there is a chance of forgetting what schools are built for. When $940 is required to accommodate each pupil it is time to do some thinking. According to the following extract a limit of $150 ought to be set. A 1923 Omaha high school cost $3,000,000 or $1,000 per pupil.

Woods Hutchinson, A. M., M. D., in "Good Housekeeping":

"In larger towns and cities quite an appreciable share of the additional money needed for the grounds could be saved on the building.

"The ideal schoolhouse is not a magnificent architectural triumph, nor a monument for future generations, but an inexpensively constructed, light roomy, day nursery, never exceeding two stories in height, with broad staircases, wide hallways, and at least one-third to one-half the wall space of each room in the shape of movable window sash or shutters, so that it can be converted into a porch or shed in fine weather.

"Thoughtful students of the health of the child are coming to the same conclusions as experts have come to, in regard to hospitals

TABLE SHOWING COST OF BUILDINGS, COST PER CUBIC FOOT, CHILDREN ACCOMMODATED AND COST PER PUPIL

Date	Name of School Building	Building, Heating, Plumbing and Electrical Contracts	Total Cost of Building	Percentage Contracts Bear to Total Cost of Building				Cubical Contents	Cost per Cubic Foot	Proportion Contracts Bear to Cost per Cubic Foot				Cubic Feet, Class Room	Children Accommodated	Cost per Pupil
				Bldg	Heat	Plumb	Elec			Bldg	Heat	Plumb	Elec			
'05	Samuel W. Mason ...	B., $99,527.64 H., 10,447.00 P., 4,990.00 E., 3,360.00	$118,324.64	84	9	4	3	438,223	27	23	2	1	1	31,000	700	$169.03
'05	Dearborn	B.,$182,240.82 H., 20,874.00 P., 8,929.50 E., 5,087.00	217,131.32	84	9	4	3	980,100	22	18	2	1	1	47,000	1,050	206.66
'05	John Greenleaf Whittier	B., $61,053.55 H., 7,540.70 P., 3,551.00 E., 2,590.90	74,736.15	82	10	5	3	325,051	23	19	2	1	1	32,000	500	149.47
'05	James Otis	B., $90,867.00 H., 8,767.00 P., 4,889.00 E., 3,295.00	$107,818.00	84	8	4	4	411,645	26	22	2	1	1	34,000	600	$179.70

BOSTON FIREPROOF SCHOOL BUILDINGS—*Continued*

Date	Name of School Building	Building, Heating, Plumbing and Electrical Contracts	Total Cost of Building	Percentage Contracts Bear to Total Cost of Building				Cubical Contents	Cost per Cubic Foot	Proportion Contracts Bear to Cost per Cubic Foot				Cubic Feet, Class Room	Children Accommodated	Cost per Pupil
				Bldg	Heat	Plumb	Elec			Bldg	Heat	Plumb	Elec			
'05	Joseph Tuckerman ..	B., $61,875.79 H., 8,422.00 P., 4,226.70 E., 2,898.76	77,423.25	80	11	5	4	330,171	23	18	3	1	1	33,000	500	154.89
'06	William E. Endicott..	B., $64,745.25 H., 7,951.00 P., 3,667.91 E., 2,693.61	79,057.77	82	11	4	3	348,883	23	18	3	1	1	35,000	500	158.11
'05	Sarah J. Baker	B.,$130,013.23 H., 18,675.00 P., 7,625.00 E., 4,880.00	161,194.23	81	11	5	3	702,384	23	18	3	1	1	29,009	1,200	134.32
'06	Nathaniel Hawthorne	B. $54,682.82 H., 7,518.00 P., 3,100.00 E., 2,611.25	67,912.07	80	11	5	4	281,305	24	19	8	1	1	31,000	450	150.92
'07	Charlestown High ...	B.,$253,157.94 H., 18,711.25 P., 13,970.00 E., 10,216.00	296,055.79	86	6	5	3	1,267,608	23	19	2	1	1	.....	540	548.25

Boston Fireproof School Buildings—*Continued*

	Normal and Latin Group.			%	%	%	%		Cts	Cts	Cts	Cts	Cts			
'07	Common Building.... Normal School	B.,$276,559.15 H., 26,338.97 P., 13,169.48 E., 13,169.48	$392,237.08	84	8	4	4	1,392,848	23	19	2	1	1	.....	350	$940.65
'07	Girls' Latin	B.,$249,577.77 H., 23,769.31 P., 11,884.66 E., 11,884.65	297,116.39	84	8	4	4	1,388,807	23	19	2	1	1	.....	600	495.19
'07	Patrick A. Collins ...	B.,$148,397.59 H., 14,133.10 P., 7,066.55 E., 7,066.55	$176,663.79	84	8	4	4	725,561	23	19	2	1	1	43,000	850	$207.84
'07	Edward Everett	B., 82,868.43 H., 15,542.00 P., 4,665.00 E., 4,440.00	107,515.43	77	15	4	4	516,678	21	16	3	1	1	32,000	560	191.99
'07	Nathan Hale	B., 54,599.35 H., 6,682.00 P., 3,397.47 E., 2,553.00	67,231.82	81	10	5	4	333,379	20	16	2	1	1	28,000	480	140.08
'09	Bishop Cheverus	B., 80,268.04 H., 11,975.00 P., 5,040.31 E., 4,793.00	102,706.35	78	12	5	5	535,474	19	15	2	1	1	30,000	640	159.18
'10	Peter Faneuil	B., 91,333.05 H., 7,977.00 P., 4,485.95 E., 4,283.50	108,079.50	84	8	4	4	431,886	25	21	2	1	1	24,000	750	144.10

for tuberculosis, that every dollar spent in constructing a building in excess of $150 a patient, is wasted—and worse!"

Open air, or forest schools, are becoming popular in all countries, especially in Germany. Even in the cold climate of Canada there are quite a few. They are naturally much cheaper than the classical type. The pupils have to be dressed to suit the weather. It is possible to overdo one style of building as much as the other, and make unnecessary suffering; but such extravagance as the Boston tables show is unwarranted.

Summary. The following summary is taken from the "Building Age" of New York.

"The cost per cubic foot of building averages for 30 buildings about 22.8¢. The building contract itself averages for the 30 buildings 83.7 per cent of the total cost of the structure, with extremes of 77 and 86 per cent.

"The heating and ventilating contract averages 9.5 per cent of the total cost of the building, with extremes of 15 and 7 per cent. The average cost of the plumbing contract amounts to 4.6 per cent of the total cost of the building, and the average cost of the electrical work amounts to 3.4 per cent of the total cost of the building. Three of the 30 buildings are high school structures, and for the 27 common schools the cost of building per pupil figures out at $178. One of the high school buildings, designed to accommodate 540 pupils, cost $548.25 per pupil; a normal school, $940.65; and another high school, $495.19."

A part of the Boston table is given on pages 87, 88, 89.

Pavilion or Unit Schools

New Old Style. The " little red schoolhouse " is coming back with modern improvements. Instead of one large school the modern idea, where there is plenty of land, is to build 1-story cottages, connected with covered cloisters, or even with only a cement sidewalk.

The cottage schools are built around a great central court, which is used as a playground, away f om street dangers, and not cut up into small areas, as when a building is set in the center of the school property. It is a reversal: the playground goes where the school went.

The first school of this kind was built in Providence, R. I., in 1908. Ten years later a hundred cities and towns adopted the idea. The model city of Letchworth, England, uses this type. At least in small cities and towns the Boston extravagance is out of date.

No matter whether the schools of this kind are built of wood or masonry, they are as good as fireproof. " There is no record in this

country of a school pupil losing his life by fire in a 1-story school building. The cottages may be heated from an independent central plant. There is no climbing of stairs. Units may be added as the population grows: under the usual system a school has sometimes to be built twice as large as present needs to make provision for future growth. The best light may be had, and always from the left if desired. A roof garden may be added, and a skylight put over the corner farthest away from the side light.

The Southern Pine Association, New Orleans, gave prizes aggregating $500 for the best types of Pavilion Schools. The units were designed at 25 ft apart. This provided an "anti-noise zone," and a fire zone, for in mild sections of the country the connecting corridors are not really necessary.

Three prizes were given and seven "Honorable Mentions," out of forty-three entries.

Cost. This may be made as high as for the present type if desired, or it may be cut in half. In a Colorado installation the cost was $5000 per room. Assuming forty pupils this is $125 each, or about the present figure for schools where the architect has to economize. But these cottages were built of fine brick and cut stone, and with modern lavatories.

The average of twenty-three schools of the ordinary type in Kansas City was $134 per pupil; in another Colorado unit system the cost was about $60. The central playground was 100×172′. The usual ventilating apparatus is not required.

Variation. In some of these pavilion types the toilet rooms may be all put in the central heating building. This suits in a mild climate, as in the south, but it is not so convenient as when each unit has its own arrangement of closets. The first prize has this unit system; the second was designed to have the toilets in the building with the heating plant. So far as northern cities are concerned, with blizzards to fight at times, the system that has the closets connected with each unit—the unit system here also, instead of the other—is better, some would say obligatory.

First Prize. Nevil C. Settoon of New Orleans took the lead with the design shown herewith. Like all of the designs except one, this school shows room for 35 pupils. The old unit was 50. The teachers believe that 25 is high enough. The designer writes:

"This school can be built complete, including heating system, for from 8 to 9¢ per cubic foot, and from $1.10 to $1.25 per square foot. The cost per pupil would be from $50 to $56.

This is the ideal system where land is cheap, and yet on a Nebraska prairie a school is standing two stories high with great chutes sticking out from the sides for fire escapes.

At $56 the total would be $3,920 for seventy pupils. Lumber is

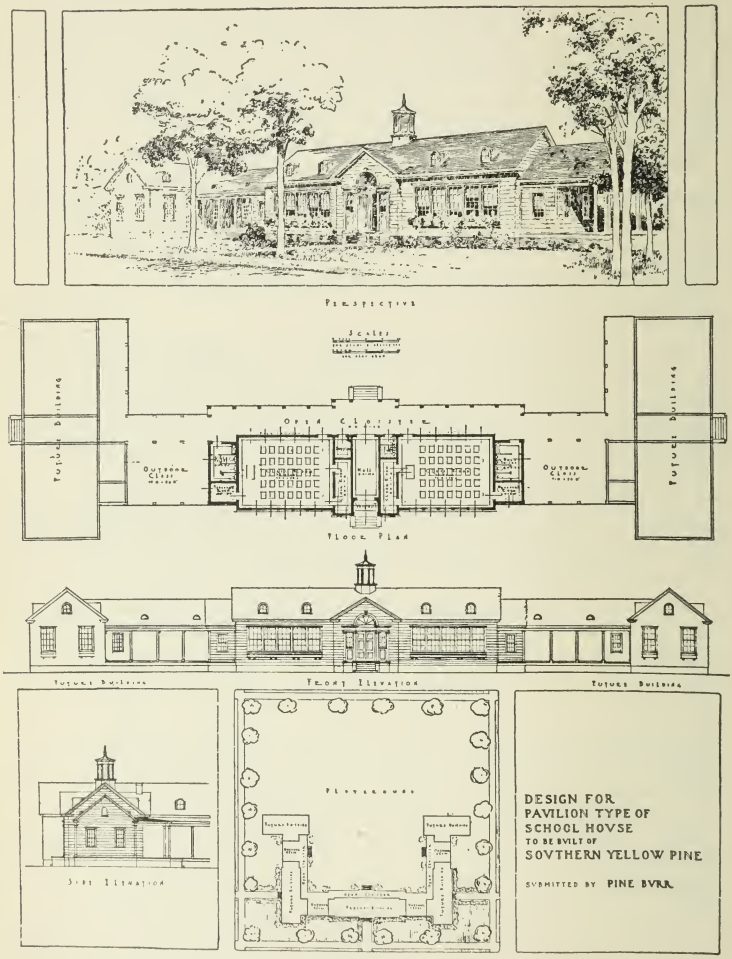


Fig. 9.—First Prize Pavilion School by Nevil C. Settoon.

cheaper in the south than in other sections, except the far west.

The building proper has 2,140 sq ft but cloister and outdoor classrooms make up the difference The inside classrooms are 22×29 between the walls, with 8 ft on each end for toilets, and 18 in the center for hall, cloak rooms and teachers' rooms.

Second Prize. Frederick G. Walker, Chicago, won the second prize. As an approximate idea of the cubic footage, the main units contain 21,000 ft, and the pavilion 4,000. The main buildings are each 29×34′, the pavilions, 20×25.

Third Prize. Clifford Evans, Birmingham, Ala., won this prize. The ground plan covers an area 500×875 ft, holding 12 buildings with 24 classrooms and an auditorium. A covered cloister 15 ft wide connects all buildings around a playground 210×400 ft. The unit buildings are 23×100 ft; the classrooms 22×30×12 ft high.

Honorable Mention. The second in this line was Wm. Leslie Welton, Birmingham, Ala. The units of this plan are so laid out that each contains 54,400 cu ft. The price was set in 1918 at 5¢ per cubic foot which seems too low; and 80¢ per square foot, not including porches.

With such designs and figures as these it is evident that the new type, or rather the old type, on new lines, is fit to take the place of the "monumental monstrosities," piled high with useless classical follies, costs to match.

Cost of Library Buildings

Snead & Company, Jersey City, are to be credited with the following cost data:

Nearly a hundred buildings are listed with cu ft costs. The total costs are also given, running from $4,500 up to $9,466,600.

Measurement. The method of taking the number of cubic feet varies with the architect. In this Appraiser the contents are usually taken from basement to roof ridge. But the library figures are taken from the basement floor to the top of the ceiling joists only. If an expensive pitched roof is put on the building the unit price is naturally raised, for the entire cost of the pitched roof, as compared with a flat one, has to be distributed.

Cost. A comparison should always be made among buildings of the same type. A small building costs more per cubic foot than a large one in this class of structures, as in other classes. The reason for this is given on page 63, under "**Cubing.**"

In order to get another check on probable cost of a projected building it is always well to consult the U. S. Index Numbers in com-

bination with the year in which the cubic foot costs were compiled. In 1898, for example, prices were low, while in 1923 they were high.

Ordinary construction is set at from 17 to 25¢ per cubic foot; for the classic style, 20¢ to 25¢. For fireproof work about 20 per cent more is allowed. In the prices most of the equipment is included.

But the range of costs runs from 17¢ to 87¢, in the fireproof libraries, and 11¢ to 47¢ in the ordinary kind, so that it appears to be a case of finding how much money is on hand and making the design such that none of it will be left, rather than of providing a place to hold books and accommodate readers.

FIREPROOF

Building	Year completed	Cubic feet	Cents
Library of Congress	1897	10,000,000	63
Washington Public	1902	960,000	39
Army War College	1907	2,500,000	28
Engineer's School	1914	477,000	21
New York Public	1911	10,382,000	87
Columbia Univ.., N. Y	1897	3,530,000	31
Columbia Kent Hall	1910	1,006,000	49
Union Theological Seminary, New York	1910	608,000	39
Syracuse Public	1905	916,700	24
N. H. Hist. Soc., Concord	1912	675,000	74
Blackstone Memorial, Branford, Ct.	1896	442,000	68
Brookline Public	1910	700,000	36
Whittinsville, Mass	1911	204,300	22
R. I. Medical, Providence	1912	174,500	24
College of Physicians, Phila	1909	955,400	32
Krauth Memorial, Mount Airy, Pa	1908	329,400	18
Loyola Univ., New Orleans	1911	765,300	20
Ohio State Univ., Columbus	1912	1,360,000	21
Univ. of Illinois, Urbana	1897	714,000	24
Univ. of Missouri, Columbia	1915	763,370	26
Univ. of Missouri, Columbia	1914	577,000	17
Denver Public	1910	805,000	38
Sioux City, Public	1912	348,900	22

NON-FIREPROOF

Building	Year completed	Cubic feet	Cents
Williamsburg Branch, Brooklyn	1905	247,300	47
Carroll Branch, Brooklyn	1905	223,500	36
Cornell Law, Ithaca	1893	350,000	22
Free, Montclair, N. J.	1914	85,600	36
Summit Free, N. J.	1911	112,500	24
Bangor Public, Maine	1913	361,000	38
Proctor, Vt.	1913	74,000	31
Fletcher, Westford, Mass.	1896	111,000	16
Caribou, Maine	1912	54,000	19
Newton, Pa.	1911	37,000	12
Medical, Baltimore	1909	572,000	11
Gary, Ind.	1912	297,000	24

Proportions. In the "Library Journal" some figures were given as to the proportion of costs in a library building. From 78 to 80 per cent is given to construction, including heating and lighting, and 20 to 22 for equipment, furniture and fees. The average fireproof building of two stories and basement is set at 25¢ to 40¢ per cubic foot; the non-fireproof, 15¢ to 30¢. As we have seen, the range is greater.

Assuming that $150,000 is on hand, the standard allowance would be 300 readers with 30 sq ft each, at a unit cost of $500. This includes general reading, reference, children's, periodical and newspaper rooms. About 150,000 volumes at $1 each are supposed to be taken care of. As detailed the cost would run as follows:

	Per cent
General construction	$72\frac{1}{4}$
Heating and limited ventilation	4
Electric work	$1\frac{3}{4}$
Stacks	$7\frac{1}{2}$
Furniture	6
Lighting fixtures	2
Contingencies	$\frac{1}{2}$
Architect	6
Total	100

(See Index for Library Fittings.)

Cost of Churches: 1913 Basis

No Limit. Or rather the sky is the limit. The pilots need vast equipment.

The following figures for churches are for ordinary construction:

The Judson Memorial Baptist, Minneapolis, seats 500 people, with extra accommodations in Sunday school for 500 more. The cost was $60,000, or about 20¢ per cubic foot. This is $120 or $60 per sitting

The chapel of Hayes Mechanics' Home, Philadelphia, seats 110 people, at $90 per seat. The cubic foot cost was 22¢.

The Church of the Messiah, St. Louis, has seats in the main auditorium for 540 people, but extra accommodations. The cost was $61,433, or at most, $114 per seat. The cubic foot unit was 28¢.

St. Francis Xavier's, Rochester, N. Y., has 770 seats, or about $70 each. The total cubic footage is 450,000 at 12¢.

The First Methodist Episcopal, Shenandoah, Iowa, has 610 seats in the main auditorium, and 560 in the Sunday school. The cost was $40,000, or $66 and $35; and 12¢ per cubic foot.

Lowe Avenue Presbyterian, Omaha, has 300 seats at $83 each.

All Saints, Omaha, seats 350 people at a cost of $185 per sitting.

The First Church of Christ, Scientist, New Orleans, has a seating capacity of 750 people at $60 each; and the cost per cubic foot was 18¢.

The Second Baptist, St. Louis, cost $200,000, and seats 1200 in the main auditorium, or $166 per seat. But as with many other modern churches there are parlors, dining rooms, Sunday schools extra.

Mount Calvary Episcopal, St. Louis, seats 300 at $25,000, or $83 each.

The Chapel for the Little Helpers of the Holy Souls, St. Louis, has 200 seats at $117 each.

The Sixth Church of Christ, Minneapolis, seats 800 people at $156 each.

The foregoing are all brick churches, faced with Hy-Tex brick. The figures are taken from the Hy-Tex book, "The Brick Church and Parish House," giving the results of a competition in designs for a small brick church and parish house.

It must be remembered that prices rise. The book is dated 1915, but the churches were built when lower prices were possible than in our time after the war.

Cleveland Valuation

The following square foot unit prices were used in the tax valuation of the above city. There are so many types of buildings classified

that the list suits for any city. Thus, there are 42 kinds of residences: 32 of flats and tenements; 29 of store buildings, hotels, banks, halls, etc.; 40 types of factories, warehouses, mills, etc.; and 25 of the highest class of office buildings.

The following schedules were used as the square foot value of the buildings in 1911: U. S. figure 98:

Schedule No. 1. Single house, one side of double house, one of row, duplex house.

Cheap construction, set on posts, only small cellar, no plumbing except kitchen sink and w. c. Plain pine finish.

Class 1—

	1-story	1½-story	2-story	2½-story	3-story
Frame	$1.00	$1.50	$1.80	$2.10	$2.60
Brick	1.20	1.70	2.00	2.30	2.80

Brick or stone foundation with full basement, with furnace.

Class 2—

	1-story	1½-story	2-story	2½-story	3-story
Frame	$1.60	$2.10	$2.40	$2.70	$3.20
Brick	2.30	2.30	2.60	2.90	3.40

Same as above, except medium porches (150 sq ft), laundry trays, two one-story bay windows. Plain pine finish and plain fixtures; open or closed plumbing.

Class 3—

	1-story	1½-story	2-story	3-story
Frame	$2.20	$2.70	$3.00	$3.90
Brick	2.40	2.90	3.20	4.20

Same as above, except plain hardwood finish. Plain electric or gas fixtures; more than two one-story bay windows; large porches, open plumbing; two baths.

Class 4—

	1-story	1½-story	2-story	3-story
Frame	$3.00	$3.80	$4.50	$5.60
Brick	3.20	4.00	4.80	6.00

Same as above, except two or more baths; ornamental trimming and cornices; ornamental inside finish and fixtures; hot water or steam heat.

Class 5—

	1½-story	2-story	3-story
Frame	$5.30	$6.30	$8.00
Brick or stone	6.00	7.00	10.00

Schedule No. 2. Flats for families, tenements and apartments.

Cheap construction, foundation piers or wall in trenches, small cellar, no plumbing except for kitchen and w. c.

Class 1—

	2-story	3-story	4-story
Frame	$1.90	$2.80	$3.70
Brick	2.10	3.00	3.90

Brick or stone foundation with full basement, with furnace, bath in common.

Class 2—

	2-story	3-story	4-story
Frame	$2.40	$3.20	$4.00
Brick	2.80	3.40	4.20

Same as above, with addition of bay windows. Porches or balconies, laundry trays and private baths. Plain pine finish; four one-story bay windows.

Class 3—

	2-story	3-story	4-story
Frame	$3.00	$3.90	$4.80
Brick	3.20	4.20	5.30

Same as above, except hardwood finish, electric lights, steam or hot water heat.

Class 4—

	2-story	3-story	4-story
Frame	$4.50	$5.60	$6.60
Brick	4.80	6.00	7.00

Same as above, except ornamental outside and inside finish and ornamental fixtures. Elevators; reinforced floors and other high-class features.

Class 5—

	2-story	3-story	4-story	5-story
Frame	$5.50	$6.60	.....	.....
Brick	5.80	7.00	$9.00	$12.00

Schedule No. 3. Store buildings, hotels, bank buildings, halls, etc.

Cheap construction; foundation of piers or walls in trenches; without basement; common glass; short floor spans; plain trimmings and cornice; plumbing, w. c., sink, wash basin.

Class 1—

	1-story	2-story	3-story	4-story
Frame	$1.00	$1.80	$2.60	$3.40
Brick	1.20	2.00	2.80	3.60

Ordinary construction; brick or stone foundation with full cellar (9-ft.), 12-foot ceilings; medium floor span; heating plant; common joist construction; plate glass front; plumbing open; w. c. for each floor; sink for each flat; plain trimmings and cornice; plain pine finish.

Class 2—

	1-story	2-story	3-story	4-story
Frame	$1.60	$2.40	$3.20	$4.00
Brick	1.80	2.60	3.40	4.20

Same as above; wall bearing; large floor spans; plumbing, private baths in each apartment; ornamental trimmings or cornice; steam heat; hardwood finish.

Class 3—

	1-story	2-story	3-story	4-story
Frame	$2.20	$3.00	$3.90	$5.80
Brick	2.40	3.20	4.20	6.10

	5-story	6-story	7-story	8-story	9-story
Brick	$7.20	$8.30	$9.40	$10.50	$11.60

The above schedule applies to buildings of ordinary construction and ornamentation. Special ornamental buildings, or massive construction, not coming into a class, are specially estimated.

Schedule No. 4. Warehouse, factory, mills, foundry, garage, stable, shed.

Class 1—

Cheap construction; pier foundation or walls in trenches; small basement; main floor near grade; composed of dirt; flat roof; plain trimmings and cornice; joist floor construction without trusses:

	1-story	2-story	3-story	4-story	5-story
Frame.....	$.60	$1.20	$2.00	$2.80	$3.50
Brick.....	.90	1.50	2.20	3.10	3.80

Class 2—

Ordinary construction; brick or stone foundation; full basement; main floor several feet above grade; wood floors; flat roof; joist floor construction without trusses; plain trimmings and cornice:

	1-story	2-story	3-story	4-story	5-story
Frame.....	$1.00	$1.80	$2.60	$3.40	$4.20
Brick.....	1.40	2.20	3.00	3.80	4.60

Class 3—

Same as above, except mill construction; wood trusses:

	1-story	2-story	3-story	4-story	5-story
Frame.....	$2.00	$2.90	$3.80	$4.70	$5.60
Brick.....	2.40	3.30	4.20	5.10	6.00

Class 4—

Modern fireproof manufacturing building; steel frame; one elevator; flat roof. Rate per sq ft:

1-story	2-story	3-story	4-story	5-story
$2.70	$3.80	$4.90	$6.00	$7.60
6-story	7-story	8-story	9-story	10-story
$9.00	$10.00	$11.80	$13.20	$14.60

Schedule No. 5. Office buildings, non-fireproof; steel floor construction; plain trimmings and cornice.

Class 1—

		1-story	2-story	3-story	4-story
Rate.....	.....	$3.60	$4.80	$6.00	$7.60
	5-story	6-story	7-story	8-story	9-story
Rate.....	$9.20	$10.80	$12.90	$15.00	$17.10

Additional points for outside and inside ornamentation.

Class 2—U. S. combined average 97 in 1911.

Best class: office buildings; steel frame; fireproof; including plumbing; heating; plain marble wainscoting and floors; plain cornice and trimmings. Ground floor area between 4,000 and 15,000 sq. ft. Rate per sq. ft.

	1-story	2-story	3-story	4-story
Rate	$6.15	$9.75	$13.25	$16.75
	5-story	6-story	7-story	8-story
Rate	$20.25	$23.75	$27.25	$30.75
	9-story	10-story	11-story	12-story
Rate	$34.25	$37.75	$40.25	$43.75
	13-story	14-story	15-story	16-story
Rate	$47.25	$50.75	$54.25	$57.75

This rate does not include deposit vaults. Additions must be made for more than ordinary marble floors or wainscoting; for ornamental exterior and ornamental interior finish, ranging from 10¢ to $1.50 per square foot per floor.

For construction not above fully provided for, modifications were specially estimated.

CHAPTER V

COMPARATIVE COSTS

(See beginning of Chapter IV. Here also 1913 equals base of 100, and figures are set to suit. Lower or raise to get valuation or approximate cost in year desired. See Index Numbers.)

In a discussion of the use of reinforced concrete buildings for textile mills before the Cotton Manufacturers, and also before the Machine Tool Makers, Mr. J. P. H. Perry of the Turner Construction Co., gave the following figures as to time of construction and cost:

Time:—One building 60×70×10-story took just 47 working days after the foundation was put in for erection. In all, the time of erection was three and a half months, before turning over to the owners.

Another 40×80×7-story and basement took only 48 working days to put on the roof after the excavation was finished, and three months in all before the owner moved in.

Still another 75×600×6-story and basement had the roof on in 63 working days after the piles were driven.

These are fast records—but builders have noticed that many reinforced structures have fallen on account of having the forms removed too soon.

The Cost Figures are as follows:

"**Reinforced Concrete** will generally run from 5 to 15 per cent higher in first cost than first-class 'mill construction,' and will be from 10 to 20 per cent lower than steel construction fireproofed. A large warehouse in Brooklyn was begun in May, 1908. At that time new construction work was scarce and all contractors figured very closely. The successful reinforced concrete figure was $30,000 lower than the best bid on the same plans in fireproofed structural steel. A large factory in Philadelphia was designed in steel. The architects considered an alternative in reinforced concrete and saved $60,000. A large publishing house and loft building was recently completed in Springfield, Mass., of reinforced concrete throughout, thereby saving $40,000 over the probable cost in steel. These three instances represent respectively savings of 12, 25 and 10 per cent.

In competition with mill construction the percentage depends almost entirely on the size of the building.

For structures costing $40,000 and less, and of a height of four stories or less, the brick and wood construction will run about 15 per cent less than concrete. On larger buildings, however, concrete gets closer to the cost of the mill construction. The designers of a very large hardware building in Minneapolis were surprised to find concrete figures slightly under those of mill construction. A similar case occurred in Toledo, Ohio. Both propositions exceeded $150,000 in value.

In considering the costs of different types of construction the initial cost should not be the only criterion. There are certain fixed charges which enter into the relative values of buildings. These may be briefly summarized as follows: Insurance, maintenance, depreciation, amount of available light, freedom from vibration, elimination of vermin and the assurance that fire cannot destroy the building. It is difficult to put an exact monetary value on these different items. Each plant manager would have his own views, and local conditions would alter materially any assumptions. If, however, due consideration be given to the saving obtained on each of these items by the use of reinforced concrete building, it will generally be found that even though the concrete structure cost complete 10 per cent more than mill construction, there will be a saving annually of from 1½ to 2 per cent."

The following table is presented in "Factories and Warehouses," by the Assoc. of Am. Portland Cement Manufacturers:

COMPARATIVE COST OF BUILDINGS OF MILL CONSTRUCTION AND CONCRETE

Initial Cost of Building	Mill Construction $100,000		Reinforced Concrete $115,000	
Yearly charges:—				
Interest at 6%		$6,000		$6,900.00
Taxes at 1%		1,000		1,150.00
Fire Insurance:				
Building	at 70c	700	at 25c	287.50
Contents	at 90c	1,800	at 60c	1,200.00
Depreciation	at 1.25%	1,250	at 0.25%	287.50
Items charged against mill construction only:				
(a) Loss due to vibration, assume		450		
(b) Increased light, 1% increase in efficiency of labor. Assume labor equal to ¼ value of contents or $50,000		500		
(c) Vermin losses		100		
(d) Heating charge		100		
(e) Protection against fire at 0.5% on value of 50% of building and contents.		750		
		$12,650		$9,825.00

Annual saving of concrete over mill construction.....$2,825

If the saving of $2,825 per year be capitalized at 6 per cent, it would represent an investment of $47,083. In other words, a concrete building, though 15 per cent higher in initial contract cost than a mill building of similar design, would save each year $2\frac{8}{10}$ per cent on all fixed charges. (But the depreciation on the concrete building is too low. A period of 400 years is unreasonable for a factory structure.)

Thickness:—In the early days of reinforced concrete several large buildings were erected with walls only 2 and 3 inches thick. San Francisco in the ordinance of 1910 sets the minimum thickness at 6 in when the wall space between the columns does not exceed 300 sq ft; between 300 and 400, 8 in thick; and 12 in when the area is over 400.

Warehouse. "The Railroad Gazette," in a good article, gives the comparative cost of slow burning wood, and a steel frame factory building with brick walls. The floors are designed for load of 100 lbs to sq ft. The size is 60′×100′, 7 stories high. Cost of slow burning construction, $35,000; fireproof, $57,000. Per cu ft 6.2¢ and 10.2¢; per sq ft of entire area 83¢ and $1.36. Cost of floors and cols per sq ft 27¢ and 75¢. But these are not war prices.

Slow Burning		Fireproof	
Excavation.....	1,800 cu yds	.....	1,800 cu yds
Cellar floor.....	6,000 sq ft	.....	6,000 sq ft
Foundation concrete..	150 cu yds	.....	150 cu yds
Brick.....	39,000 cu ft	.....	39,000 cu ft
Windows, 4′×7′.....	238	.....	238
Roofing.....	60 sqs	.....	60 sqs
Timber, yellow pine..	116,000 ft bm.	Steel columns.	105 tons
Flooring, yellow pine.	73,000 ft bm.	Steel beams...	252 tons
Flooring, $\frac{7}{8}$″ yellow pine	46,000 ft bm.	Concrete floors and roof....	42,000 sq ft
Iron work.....	46 tons		

The building is very plain. Basement walls, 24″; 17″ for next 4 stories; 13″ for 2 top stories.

For ordinary construction 22¢ is now (1923) a fair price in the up-to-date part of the continent; but 18¢ might be enough where material and wages are low. As to fireproof work it may run from 25¢ to 50¢. A fine building erected in 1904 in Atlanta, for example, cost 41c. The Leiter Building, Chicago, wholesale and retail store, with granite on 3 sides, 8 stories, cost in 1892, less than 20¢.

A very plain storehouse of 2 stories, no basement, brick walls, reinforced concrete floors, and galv iron frames in 1907 ran to $6.34 per sq ft of ground area, and 16¼¢ per cu ft, but this included $5,000

for shelving. Size 49′-4″ by 80′, and 153,900 cu ft to under side of first floor.

" **Concrete Buildings** are practically the same in cost as similar ones of steel frame construction up to about 6 stories in height in most parts of the United States.

"For warehouses and manufacturing buildings, concrete is as reasonable as timber in first cost, unless the latter is comparatively cheap. Late bids on 10 and more story loft and office buildings in New York City were approximately 10 per cent higher than bids for steel frame buildings received at the same time. On the other hand, bids for manufacturing buildings 6 stories high were the same percentage lower for concrete than for steel frames. First costs for mill construction warehouses up to 8 stories height were slightly less than for similar buildings of concrete. One story structures can be erected with flat concrete roofs under favorable circumstances as cheaply as in timber, unless the latter may be of open joist construction.

In general, little can be saved by building in concrete, except in liability of loss by fire and its attendant inconveniences, delays, etc.

In engine beds, col footings, etc., the old style unreinforced design, which has proved eminently satisfactory in the past, is often cheaper then the new style reinforced work."—Engineering Record.

Cotton Mills

The Main figures (see page 64), may be illustrated by data that Edward Atkinson compiled for "The Century." He showed the economy of one-story buildings where plenty of ground is available. Manufacturers are going to attend to this more than in the past, for the railroad rates are apt to be better equalized. Small towns where land is cheap are to be more attractive than large cities.

Mr. Atkinson:—"A mill of two or three stories in height can be constructed at less cost per square foot of floor than a mill of any greater number of stories; if you have room enough, even a one-story mill properly constructed may be built at as low a cost per square foot of floor as the mill of four or five stories, while it will be as warm in winter, cooler in summer, and lighter and better ventilated all the year round than any other type of mill can possibly be."

Since this was discovered the one-story type has become very common in New England. The ordinary size has an area of 60,000 sq ft; other mills cover from half an acre to three and a half acres. For spinning, the new types are only two and three stories instead of the old high fire traps. The one-story types are for weaving.

In one case a four-story building burned down, leaving its twin untouched. A one-story was erected, and 67 men did what took 100 in former mill. The remaining one was then taken down, and

the new type adopted. This shows that the subject of size and efficiency of all industrial buildings needs to be attended to.

Cost of Mill Construction Buildings

(Courtesy, National Lumber Manufacturers Association.)

One of the important advantages of mill construction is the relatively lower cost when compared with other types of buildings. This feature has been recognized from the early days of this type of construction. With the advance in the cost of building materials as a whole, the relative difference between timber, steel and concrete has changed slightly in favor of concrete, but the advantage as a whole is still with mill construction. The old custom of using girders 45 ft in length and spanning three bays of a building has passed, but the same strength is now obtained by using shorter lengths of larger material of a high bending strength. Large timbers of great strength in proportion to weight are obtainable in all markets, and there is an ample supply of all sizes and grades in several different species.

Mill construction buildings vary in cost with locality in which they are built. The cost per cubic foot will vary from 5¢ to 12¢, with an average of about 8¢. These costs are without the consideration of plumbing, heating, elevators or other equipment. Such extras will increase the cost per cubic foot by 1¢ or 2¢. The corresponding cost per square foot of floor area of building is from 50¢ to $1.50, with an average cost of about 90¢. In order to obtain these reasonable costs, standard-lengths and sizes of timber should be used, or else an extra amount will have to be charged for specials. The cost of such buildings may be kept to a minimum by careful decision in choosing length of spans and areas of floors. Each girder and floor plank should be used to its full capacity, as determined by the load rating of that floor. Areas of floors should be such that fire walls will not be needed between the different parts of a floor, thus keeping down the cost for protection of openings between rooms. A careful choosing of the sizes of bays will aid in the design of the sprinkler piping by making one or two lines of sprinklers do the work where more piping might be needed in case the spans were chosen without attention to this detail.

An investigation conducted by J. Norman Jensen, architectural engineer, Chicago, showed that the range of costs in the three types of construction is so great that no generalization can be made. By comparing the costs of a large number of different types of construction the following conclusions were reached:

"With column spacing not exceeding 16 ft, mill construction buildings designed for 100 lbs per sq ft live load cost 20 per cent less

than concrete buildings; for 150 lbs per sq ft live load, 15 per cent less, and for 200 lbs per sq ft live load, about 10 per cent less. When the live load was 350 lbs per sq ft or over, a concrete building was the cheaper."

This investigation showed also that when the column spacing in any building is greater than 16 ft, the relative economy of mill construction disappeared. It has been found, however, that a column spacing of 16 ft is ample for the majority of buildings devoted to manufacturing or other mercantile businesses. For most light manufacturing buildings a live load of 100 lbs per sq ft is sufficient, and for a large per cent of the buildings used for storage purposes, 200 lbs per sq ft is all that will ever be placed on the floors.

An investigation in regard to the cost of insurance on mill construction, steel and concrete buildings showed that in ordinary lines of business the rate of insurance on a sprinklered mill construction building and contents runs about 25¢ per $100 while the rate on a concrete building and contents unsprinklered runs about 45¢. The rate on both types of construction sprinklered is about the same, but the cost of installing the sprinkler system in the concrete building may make the total cost higher in comparison with a mill construction building.

The unit cost of a building varies considerably with the height of the structure. In connection with this point the following extracts from "Mill Buildings," by H. G. Tyrrell is of interest:

"Mill construction buildings of one and two stories cost more than buildings of three to five stories, the last being about 15 per cent less per sq ft of gross floor area than when all floor space is on the ground. For light products, it is therefore economical to make manufacturing buildings not less than three stories in height, for not only is the building itself less expensive, but it also occupies smaller ground space. The only possible reason that might cause the owner of a building for light manufacturing purposes to select one floor in preference to three or more would be the relative convenience and economy of carrying on the work on a single floor. Records of certain factories show that the cost of labor is from 5 per cent to 10 per cent less when work is all done on a single floor rather than on several floors."

A further comparison of the cost of wood, reinforced concrete and steel buildings is made by Mr. Tyrrell in his book "Engineering of Shops and Factories," as shown by the following extracts in which A is the greatest cost and G the least:

"Building types, arranged in order of their relative first cost, are as follows:

A. Compelte steel frame, fireproofed, with curtain walls and plank floor.

B. Interior steel frame, fireproofed, with solid brick walls and plank floor.

C. Complete steel frame, fireproofed, with curtain walls and reinforced concrete floors.

D. Interior steel frame, fireproofed, with solid brick walls and reinforced concrete floors.

E. Entire reinforced concrete building.

F. Part interior steel frame, not fireproofed, with solid brick walls and wood mill floors.

G. Entire wood mill construction.

"In comparing the first cost of buildings in wood mill construction and in reinforced concrete, it will be found that their relative cost varies with the location, size of building and the floor loads to be sustained. In the Southern States, or other regions where timber is abundant and cheap, wood construction will often cost 25 to 30 per cent less than reinforced concrete, while in districts where wood is scarce, the two types may be nearly equal. The comparison depends also on the size of the building, for large ones have often been found to cost about the same in either material, and small ones are sometimes more expensive by 30, 40 or 50 per cent in reinforced concrete than in wood. The required floor capacity also affects the comparison. Light loads with long spans are cheaper in wood mill construction than in reinforced concrete, the cost of the two types being nearly equal in large buildings with 200 lbs imposed loads per sq ft, and column spacing of 18 to 20 ft. With loads of 300 to 500 lbs per sq ft concrete becomes cheaper, and the saving increases rapidly with greater loads of 1,000 to 1,200 lbs per sq ft."

The following extracts taken from an address delivered before the Portland members of the West Coast Lumbermen's Association by C. J. Hogue, architect, Portland, Oregon, are of interest since they provide comparative data from that section of the country.

"As a result of twelve years' experience in New England I saw reinforced buildings (I am speaking from the standpoint of an engineer), concrete buildings constructed for within 5 to 15 per cent of the cost ef mill construction, and structural steel buildings at 10 to 25 per cent additional cost. Of course in the cheaper types of wood construction there were more differences than with an engineering type. At that time the cost for mill constructed buildings would have shown a greater difference than I found for reinforced concrete. As a matter of fact we could not obtain low enough rates in insurance on sprinklered reinforced concrete buildings over sprinklered mill construction to pay the difference in the interest on cost of the two types of buildings.

"Since my return to Portland I have been ostensibly practicing economy, so I can not give you the best of comparisons from my

experience. But in the recent effort to relieve building conditions in the inner fire district, which resulted in eliminating one-third from the inner into the outer district, we took comparative figures on two buildings, one mill constructed and one of reinforced concrete. The two buildings were to cover an area of 100 by 100—plastered throughout, as if they were to be used for retail stores. The figure we received, without heating, lighting, plumbing and elevator, for mill construction was $27,135 against $37,651 for the reinforced concrete building, an additional cost of 37 per cent. To those figures, add $6,000 to both buildings for plumbing, etc., and the additional cost of the reinforced concrete building was 31.7 per cent more than the cost of the mill constructed building. This is because lumber is cheaper in the West than it is in the East, and cement, sand and gravel are much more expensive.

"Now the best comparison of safe types of fire-resisting construction can perhaps be shown by the comparative insurance rates—from the judgment of men whose business it is to study this question. We in Portland have secured comparative insurance rates—assuming occupancy of a furniture store and the rate on the wood construction building was 47¢ and on the fireproof building 35¢ and with sprinklers the comparison was 28¢ on the mill and 21¢ on the fireproof. The rate was made on the building, not on the contents. The rate for the mill constructed building, sprinklered, 28¢, was less than on the unsprinklered fireproof building, 35¢.

"I also had copies of fire rates from the Chicago Board of Fire Underwriters, assuming a machine shop occupancy. The rate on a building not sprinklered, mill construction, was $1.11, as against 24¢ for fireproof construction; and sprinklered, 15¢ for mill construction as against 14¢ for fireproof material. The comparison between the sprinklered mill construction building shows 15¢ as against 24¢ for the non-sprinklered fireproof building; and where both are sprinklered only 1¢ difference, 15¢ for the mill construction and 14¢ for the fireproof. On the contents, the rate on non-sprinklered mill construction was $1.36 as against 64¢ for the fireproof; the rates on contents of sprinklered building were 30¢ for the mill as against 26¢ for the fireproof building. The comparison there for the sprinklered mill constructed is 30¢ as against 64¢ for the non-sprinklered fireproof building. This shows clearly that a sprinklered mill constructed building is a safer risk from a fire insurance standpoint than one of non-sprinklered fireproof construction.

"The sprinklered mill constructed building is safer both as to building and contents than is a fireproof building, non-sprinklered. In the same way a mill constructed building with properly constructed stairways and elevator shafts is safer as to contents than the non-sprinklered unprotected stairway of a fireproof structure. An-

other thing is the temperature which runs from 1,000° to 1,200° as compared to 1,800° in fireproof non-sprinklered buildings. The steel columns almost invariably buckle early in the game and are of no further support to the building.

"I believe, from my experience in both kinds of construction, that the mill constructed building, masonry walls, wire glass windows, equipped with a sprinkler system, would have almost as great effect in stopping a conflagration as if the interior was of so-called fireproof construction, that is, incombustible materials."

Relative Cost of Brick and Frame

On one small office building, 30×70, two stories, brick was 19 per cent more than frame. On a house 24×30, brick to top of second story but gables of frame, 8 per cent extra. This figure might be easily increased to 15 by using a fine pressed brick, and ornamental work.

The Bureau of Buildings, Borough of the Bronx, New York, estimates the difference in ordinary sized buildings at 18 per cent.

Small Dwellings. At a meeting of the National Building Brick Manufacturers' Association a paper was read by Mr. J. P. B. Fiske giving the result of a careful investigation of the cost of the average 8-room house when constructed of various materials. A set of plans was made, specifications prepared for the various types, and bids taken from five contractors on nine different styles of outside wall construction. One of the types was actually built.

Description

Type No. 1. Frame covered with boards and finished with clapboards over building paper; inside surface furred, lathed and plastered.

Type No. 2. Frame covered with boards and finished with shingles over building paper; inside surface furred, lathed and plastered.

Type No. 3. A 10-in brick wall, that is, two 4-in walls tied together with metal ties and separated by a 2-in air space; inside surface plastered directly on the brickwork.

Type No. 4. A 12-in solid brick wall, inside surface furred, lathed and plastered.

Type No. 5. Hollow terra cotta blocks, 8 in, stuccoed on the outside and plastered directly on the inside.

Type No. 6. Hollow terra cotta blocks, 6 in, finished with a 4-in brick veneer on the outside and plastered directly on the inside.

Type No. 7. Frame covered with boards and building paper, furred and covered with stucco on Clinton wire cloth; inside surface furred, lathed and plastered.

Type No. 8. Frame covered with boards (building paper omitted) and finished with a 4-in brick veneer on the outside; inside surface furred, lathed and plastered.

Type No. 9. Frame finished on the outside with a 4-in brick veneer tied directly to the studding (boarding omitted); inside surface furred, lathed and plastered.

(It is not usual to fur frame dwellings on the inside, and this is probably a misprint.)

Details Common to All Types

A. Foundations.....Local stone
B. Cellar floor.....Finished with 2-in concrete of Portland cement
C. Chimney.....Faced with brick costing $17.50 per M
D. Fireplaces.....Faced with brick costing $17.50 per M
E. Plastering.....First-class "two-coat" work
F. Exterior finish.....Cypress
G. Blinds.....White pine
H. Screens.....Copper bronze on white pine frames
I. Window frames.....Hard pine
J. Floors.....Double floors throughout, with paper between except in unfinished attic; Georgia pine upper floors; main hall on first floor of oak
K. Inside finish.....North Carolina pine
L. Doors.....Washington cedar
M. Hardware. Bronze finish of ordinary type, costing $60 for the job
O. Conductors.....Copper
P. Flashing.....Tin
Q. Electric fixtures.....Costing $80
R. Hot water heating.....Costing $250 complete
S. Wiring.....Costing $68
T. Plumbing.....Costing $370
U. Painting....Exterior and interior; clapboard house, $225; other houses, $130
V. Glazing.....Double thick glass

Note.—Shades, kitchen range and tile work not included.

Details. It is, of course, possible to increase the cost of any house by using expensive materials, such as the highest grades of pressed brick, or the more expensive tapestry qualities. And so on in other fields than masonry.

Tapestry bricks are of many styles and colors, but the tints are burned in instead of coming from artificial mixtures. There is a

Comparative Bids

Type No.	1	2	3	4	5	6	7	8	9
DESCRIPTION	Clapboard	Shingle	10-inch Brick Wall Hollow	12-inch Brick Wall Solid	Stucco on Hollow Block	Brick Veneer on Hollow Block	Stucco on Frame	Brick Veneer on Boarding	Brick Veneer on Studding
Bid No. 1	$6,732.00	$.....	$7,572.00	$.....	$7,416.00	$7,777.00	$6,857.00	$7,130.00	$7,080.00
Bid No. 2	6,235.76	6,370.40	6,736.43	7,105.00	6,491.23	6,762.83	6,410.00	6,746.20	6,664.88
Bid No. 3	6,692.00	6,786.00	7,118.00	7,418.00	7,179.00	7,238.00	6,847.50	6,970.00	6,895.00
Bid No. 4	6,690.00	.....	7,496.00	7,801.00	7,202.00	7,648.00	7,000.00	7,496.00	7,420.00
Bid No. 5	7,450.00	7,450.00	7,940.00	8,240.00	7,650.00	7,990.00	7,650.00	7,790.00	7,710.00
Average of bids	6,759.95	6,868.80	7,372.48	7,641.00	7,187.65	7,483.16	6,952.90	7,226.44	7,153.98

Comparative Bids

Percentage excess cost of each type over clapboards

Type No.	1	2	3	4	5	6	7	8	9
DESCRIPTION	Clapboard	Shingle	10-inch Brick Wall Hollow	12-inch Brick Wall Solid	Stucco on Hollow Block	Brick Veneer on Hollow Block	Stucco on Frame	Brick Veneer on Boarding	Brick Veneer on Studding
Bid No. 1	.0	..	12.5	...	10.2	15.5	1.9	5.9	5.2
Bid No. 2	.0	2.1	8.0	13.9	4.1	8.4	2.8	8.2	6.9
Bid No. 3	.0	1.4	6.4	10.8	7.3	8.2	2.3	.4.2	3.0
Bid No. 4	.0	..	12.0	16.6	7.7	14.3	4.6	12.0	10.9
Bid No. 5	.0	.0	6.6	10.6	2.7	7.2	2.7	4.6	3.5
Average of bids	.0	1.6	9.1	13.0	6.3	10.7	2.9	6.9	5.8

great variety of colors. The usual sizes are $8 \times 2\frac{1}{4} \times 3\frac{3}{4}$; $12 \times 2\frac{1}{4} \times 4$; $18 \times 2 \times 6$. The mortar joints run as wide as $1\frac{1}{8}$ in, so that a wall with this size has half the surface of mortar. The face patterns are of all kinds.

For the ordinary work with a rough joint, the laying is, if anything, easier than for common pressed brick; but the pattern work takes more time according to design.

Rivalry. The success of the reinforced system of construction has rather stirred up the "old line" fireproof companies and the brick manufacturers. Competition is the life of the interesting comparisons that are always being made between the costs of the various systems. It should be remembered that in an ordinary dwelling or structure it is principally the framework that is affected by the kind of material used. The newer fittings of fireproof finish for doors, base, etc., are not applied, even in a house that is called fireproof. Walls, floors, ceilings, partitions being attended to, the millwork, plumbing, plaster, electric fixtures, painting (inside) and other factors should not enter into a comparison. They are but slightly affected by the style of construction.

The National Fireproofing Co., dealing in hollow tile, publishes a table giving costs of various types of construction, based on an average frame dwelling costing $10,000 complete in the vicinity of New York City. The figures are based on averages taken from two architects and two builders with experience in the type selected.

Table of Cost

A. $10,000 frame.
B. 11,000 brick outside walls, wooden inside.
C. 10,000 brick outside wall, backed up with Natco hollow tile.
D. 10,250 stucco on expanded metal, wooden inside.
E. 10,500 Natco hollow tile, stuccoed, wooden inside.
F. 12,000 Natco hollow tile, stuccoed, fireproof throughout except roof.
G. 14,000 Natco hollow tile walls faced with brick, fireproof floors and roof.
H. 15,000 brick walls, fireproof floors and roof.

Insurance. The lower rate of fire insurance should always be considered in comparing the fireproof structure with the ordinary type. If an expense of $100 per annum has to be met this means an investment of $2,000, at the rate of 5 per cent. The difference in the yearly insurance bill should first of all be ascertained to see if the principal necessary to produce the amount would not be better put in a fireproof building.

Loss. Another danger is loss of business through a fire. This sometimes amounts to a great deal. Still another is loss of rentals, and one more is depreciation, which is more on ordinary structures than strictly fireproof ones.

Exterior Walls—Cost of Some Types per Square Foot

(On 1913 basis)

	With openings	Net area
Rubble with 16-in walls and cut stone trimmings for doors and windows	30¢	34¢
Rubble as above covered with rough cast	35¢	39¢

Common Brickwork

(On basis of 1,000 sq ft)

Thickness of wall	Number required in wall measure, (22½)	Number required in actual or kiln count (17)	Cost at $12 per M in wall measure
4½ Ins	7,500	5,667	9¢ per sq ft
9 "	15,000	11,334	18¢ "
13 "	22,500	17,000	27¢ "
17 "	30,000	22,668	36¢ "

Pressed Brickwork

(On basis of 1,000 sq ft)

Actual number required, 6,500 at $20	$130
Labor laying	75
Mortar	10
	$215.00
Profit	21.50
	$236.50
Allow per square foot	0.24

Common Brick Faced with $20 Pressed

Thickness over all	Per sq ft.
9″	33 cents
13″	42 "
17″	51 "
21″	60 "

Common Brick Faced with $40 Pressed

(Pressed brick alone, 39¢)

Thickness over all	Per sq ft.
9″	48 cents
13″	57 "
17″	66 "
21″	75 "

Moisture proofing. Add for this, per sq ft, 2 coats, 3 cents.
Furring. 16″ centers (no lath). Add per sq ft from 2 to 3¢.
Plaster. 2-coats on moisture proofing, per sq ft 3¢.
Plaster. 2-coat on wood lath, per sq ft 4¢.

Brick Veneering

(On basis of 1000 sq ft.)

Common Brick:—
Number required in wall measure, 7500.
Number required in actual or kiln count,

6000 at $8	$48	
Mortar	10	
Labor	78	
Profit, 10%	14	
Per sq ft 15¢		$150

Pressed Brick at $20—Veneering

6500 brick at $20	$130	
Mortar	12	
Labor	90	
Profit, 10%	23	
Per sq ft 26¢		$255

Pressed Brick at $40—Veneering

6500 brick at $40	$260	
Mortar	12	
Labor	100	
Profit	37	
Per sq ft 41¢	——	$409

Molded or other stone sills, clips, etc., not allowed.

Note.—In making a comparison of walls there is one point that has to be remembered with a 9″ brick one: When on an upper story it requires a 13″ wall below. That it does not always have a proper foundation is beside the question. It ought to have one.

For a stud wall on a common dwelling a 9″ foundation is usually made to serve, and it is strong enough if well laid in mortar with not less than half cement, and with an occasional buttress, bay extension or partition to brace it. A mortar of cement alone is naturally better.

Take, for illustration, the wall of a common flat. Assume that it is 8′ 6″ from the bottom of footings to the top of the first floor, 9′ 6″ clear, and 1 ft to top of second floor, a total of 19 ft high by 1 ft wide, or 19 sq ft at 13″. The second story 9 ft in clear, and averaged 2 ft for slope of roof, a total of 11 sq ft of 9″.

To 19 sq ft of 13″ common brick, at 27¢=$5.13; the 11 sq ft of 9″ at 18¢=$1.98, a total of $7.11. Dividing this by the total number of sq ft=23.7¢, or practically 24 averaged all over the wall. To get a fair average of a certain class of wall the necessary foundation ought to be included, and the price taken from footing to the coping, or plate.

Take next a building with one story and basement: Allow 8′ 6″×13″ from bottom of footings to top of floor as before; and 11′×9″ for the top story. On the same unit prices the cost of the basement wall, 1 ft wide, is $2.30; and of the top story, $1.98, a total of $4.28. This divided by the total sq ft gives an average of close to 22¢. In comparing a 9″ brick wall with a stud one, therefore, the foundation must be remembered, for a light 9″ may be used with frame construction. In all cases the figures should be from footing to top of wall.

Cement Block Walls

For 12″ and 8″, 2-story, averaged per sq ft at	30 cents
For 8″, 1-story	25 cents

Moisture Proofing or furring to be added the same as already given for brick.

Average. All that the figures are expected to give is an average. For example, the brickwork ought to be cheaper for a 17″ wall than for a 9″ per M, but there is no change in the table.

Frame Walls

DETAILED COST OF 1 SQUARE OF WALL WITH 2×4 STUDS AT 16″ CENTERS:

Studding, 80 ft bm at $24	$1.92	
Labor at $12 per M	.96	
Nails	.10	
		$2.98
Sheeting, 116 ft bm at $27	$3.14	
Labor at $7 per M	.82	
Nails	.10	
		$4.06
Paper		.25
Siding, 6″ plain work with corner boards, 120 ft at $34	$4.08	
Labor	1.60	
Nails	.10	
		$5.78
Painting, 3 coats		2.75
Profit, 10%		1.58
Total		$17.40

Per sq ft, 18 cents

Note. The cost of this wall is the same as the one with 9-in common brick, but the difference comes in the use of a 13-in wall for a basement in the brick building, while a 9-in serves in the frame. But the sill must be added for the frame.

Average. It would be easy to make a wall cost from 25 to 100 per cent more than the PLAIN one detailed above. Angles, bays, projections, etc. are costly. Corner boards, outside base, window or door frames, cornice, etc., are not included.

With the above detailed wall as a basis, the following figures are made:

	Per sq ft
Wall as given without plaster, (No. 1)	18¢
" " with inside 2-coat plaster, (No. 2)	22¢
" " with share of sill on 1-story building, add 2¢ per sq ft; for 2-story add 1¢.	
For No. 1	19 and 20¢
With inside plaster No. 1	23 and 24¢

(A 6×8 sill at 20¢ per lin ft is allowed)

	Per sq ft
Wall with angle sheeting instead of level	20¢
Wall with 2×4 studs set 12″ instead of 16″	19¢
Wall with 2×6 studs, 16″ centers, instead of 2×4	19½
Wall with 2x6 set 12″ centers	20½
Wall with 4″ siding instead of 6″, with corner boards	20½
Wall with 6″ mitered siding instead of corner boards	19½
Wall with 4″ mitered siding instead of cor. bd. and 6″	21½
Shingles, undipped, plain work	18
Shingles, dipped in creosote	21

Plaster on the inside is not given above except on the No. 2 wall. The allowance for sill is not included, except as noted.

For Plaster. Wall as above detailed out, without siding and paint, but including furring strips at 10″ centers on outside, metal lath and plaster.....24½

Add for sill, cornice, etc., as may be required.

There are some substitutes for metal lath on the market, but, in general, it is not advisable to use them on the outside.

U. S. Period. In 1913 the Chicago Face Brick Association had a competition, open to members of the Architectural Club for houses at $4,000 or less, built of brick. The Hy-Tex people published 25 of the best designs; and the costs submitted showed that a standard unit was 18¢ per cubic foot for the house, and 9¢ for the porches. Apply the U. S. index numbers for any year.

Change of Base. The millmen, glass men, machine bolt men, and hundreds of other manufacturers work their products and price lists by a discount sheet. This sheet is put on such a basis that no change of price can affect it, and the discount is changed to suit rise or fall in prices. So with the U. S. authorities in the choice of the unchanging base of 1913=100. Back to 1890, or forward to 1930 the cost of building in any year can be found by working the percentages.

Take the frame wall just set at 18¢ per square foot on the 1913 base. The 1919 index number is 201. By the simple "Rule of Three," or proportion, the cost of such a wall in 1919 is 36.18¢, or practically 36¢. But for 1894 the index number is only 70. The cost on this basis is 12.6¢ or 13¢, as it would be put.

The previous parts of this chapter are on the U. S. 1913 base system. What follows is on the dates as shown.

A building paper gave the following comparison to "boom" building, but the percentage of increase is kept far too low. The government reports are accurate.

Summary of Estimate on Twelve-room Two-family House Prices, New York Market, 1915—1919

	1915	1919	Ratio
Excavation	$199.23	$293.97	1.48
Masonry	573.37	847.09	1.48
Interior plaster	365.80	549.47	1.50
Exterior plaster	284.77	458.05	1.60
Rough carpentry	1,199.50	1,704.54	1.42
Finished flooring	170.67	224.18	1.31
Screens	37.90	48.00	1.27
Millwork (exterior)	241.25	386.08	1.60
Millwork (interior)	331.96	544.50	1.64
Roofing	120.57	198.96	1.65
Painting	138.88	243.05	1.75
Plumbing	311.84	410.00	1.35
Hot-air heating	373.94	528.00	1.41
Electric work	80.45	118.00	1.47
Finish hardware	45.70	80.00	1.75
Rough hardware	42.80	75.00	1.75
Total	$4,518.63	$6,708.89	.....
Per cent of increase 1919 over 1915	.....	.....	48.4

Itemized Costs of Houses Built in 1915, 1919 and 1920. In a letter in a recent issue of The Improvements Bulletin, H. A. Sullwold, Architect, St. Paul, Minn., gives the following figures as showing the comparative costs of houses, bids for which were taken in 1915, 1919 and 1920:

House A—1915. Cost, $4,250; 30,855 cu .ft; cost $.137 per cubic foot.

House B—1919. Cost, $8,399; 33,264 cu ft; cost, $.252 per cubic foot.

House C—1920. Cost, $11,820; 32,978 cu ft; cost, $.358 per cubic foot.

ITEMIZED COST

	House, 1915	House, 1919	House, 1920
Excavation, foundation, etc....	$750	$1,485	$1,950
Lumber.....	517	1,300	2,089
Millwork.....	915	1,790	2,950
Plastering and insulation.....	732	850	1,295
Tinning.....	70	100	136
Painting.....	280	300	895
Carpenter labor.....	700	1,200	1,800
Bond.....	25	125	230
Ironwork.....	51	125	None
Insurance (workmen's compensation).....	None	75	100
Tilework.....	None	675	None
Hardware....	200	375	*375
Totals.....	$4,240	$8,400	$11,820

* Poorer quality.

Comparative Stucco Costs at Omaha, Neb., June 26th, 1919

The following shows for comparison, the average approximate cost of 1,000 sq ft of outside wall construction, from studding out, nails not included, using retail prices of above date:

NO. 1 WEATHERBOARDING

1200 sq ft shiplap @ $50.00.....	$60.00
Labor to apply same.....	15.00
1000 sq ft 25-lb red rosin paper.....	3.00
1300 sq ft 6″ weatherboarding @ $48.00.....	62.40
Labor to apply same.....	20.00
3 coats paint, applied (111 yds @ 35¢ per yd).....	38.85
	$199.25

NO. 2 SHINGLES

Shiplap and paper applied.....	$78.00
10,000 6–2 random width shingles.....	55.00
Staining shingles.....	15.00
Labor to apply same.....	27.50
	$175.50

No. 3 Stucco Over Metal Lath

Shiplap applied			$75.00
1000 sq ft waterproof paper			4.80
117 yds 17 gauge metal lath @ 31¢ per yd			36.27
Labor to apply same			7.77
Cement Stucco	20 Sax cement @ 70¢	$14.00	
	2 yds sand	4.40	
	1 bu hyd lime	1.15	19.55
Labor to apply stucco @ 50¢ per yd			55.50
			$198.89

No. 4 Bishopric Board Stuccoed

1000 sq ft medium weight stucco board, creosoted			$45.00
Labor to apply same			5.55
Cement Stucco	14 Sax cement @ 70¢	$9.80	
	1½ yds sand	3.30	
	⅛ bu hyd lime	.85	13.95
Labor to apply stucco @ 50¢ per yd			55.50
			$120.00

No. 5 Shiplap and Bishopric Board Stuccoed

Shiplap applied	$75.00
Bishopric board stuccoed	120.00
	$195.00

No. 6 Back Plastered Stucco on Metal Lath

Metal lath, labor and cement stucco exterior			$119.09
Back plastering between studs			
Cement Stucco	5 Sax cement @ 70¢	$3.50	
	½ yd sand	1.10	
	½ bu hyd lime	.30	4.90
Labor to apply same @ 30¢ per yd			33.00
			$156.99

Cost Per Yard

No. 1 weatherboarding	$1.795
No. 2 shingle	1.581
No. 3 stucco over metal lath	1.791
No. 4 Bishopric board stuccoed	1.081
No. 5 Shiplap and Bishopric board stuccoed	1.756
No. 6 back plastered stucco on metal lath	1.413

In 1921 the Nebraska chapter of the American Institute of Architects gave the comparative cost of wall covering as follows: Painted siding, $340; stucco, $750; brick veneer, $1,275. This for a two-story house 24′×30′.

In a tornado brick veneering falls in the street. There is not a sufficient bond between the wood and the brick.

Frame or Brick. The Committee on Fire Protection of the Boston Chamber of Commerce gave the annual cost of repairing and painting the ordinary type of building as $250 on a $10,000 house, and $150 on a $6,500 one, or a tax of 2½ per cent per year on original cost. To the average person these figures look a little "steep" unless the frame has been poorly built, and has passed its best days.

The American Face Brick Association compiles figures to show that the difference between frame and brick is growing less every year.

Percentages of Differences

Year	Frame, per cent	Solid brick, 9-in wall, per cent
1910	0.0	9.1
1913	0.0	8.1
1915	0.0	6.9
1919	0.0	6.4

"The difference, then, in the first cost of a house," say the Common Brick Manufacturers, "costing $6,500 in frame would be but $416 on the basis of the 1919 figures. This would not pay for keeping a frame house painted four years."

It would, and more also, as the Bible says. But as lumber rises in price brick is going to gain. The inside of brick walls should be either furred or damp proofed, and this should be added to any comparison.

Cost data prepared by Lockwood-Greene Company, engineers, in cooperation with the estimating engineer for the Southern Ferro Concrete Company, in January, 1920, gives an interesting comparison. This particular operation involved over 400 dwellings of a large industrial development for Winnsboro cotton mills, Winnsboro, S. C., the costs ranging as follows:

On the 8-in tile with two coats of cement stucco waterproofed, $4.33 per square yard placed in the wall.

Studding, sheathing, tar paper and siding,—the siding to receive two coats of oil paint,—$3.76 per square yard.

Studding, ½-in furring strips, 26 gauge metal lath with two coats of exterior stucco thoroughly waterproofed and one coat of back-plaster waterproofed, $2.71 per square yard.

This information is exceedingly accurate and complete with the exception that it does not include the profit.

Percentages

I have taken 22 frame buildings of all sizes and styles, and from actual bids put in or work done, have made out the following average percentages. I meant to take more as a basis, but found that the result would have been practically the same with 44 as with the 22. Some of the buildings were let when prices were high, and some when they were low, so that a fair average is obtained. Of course, a little judgment is required to get good results from the tables for an approximate estimate,—on a church, for example, the brickwork is 23 and the millwork 16; on certain flats with hardwood finish,the figures are reversed. Coal-sheds, fences, sidewalks, furnaces, mantels, and such extra items are not included. The average in the brick buildings have been taken from a list of 36. They range in price from $5,000 to $50,000. All kinds are listed—private residences, stores, flats, warehouses, schools, hospitals, railway stations and stables. Heating is not included.

It is not always easy for architects, engineers, and others, who have to figure carpenter work to get at the labor. The lumber and plain millwork are often estimated fairly well, and then anywhere from 25 to 60 per cent of the total taken for labor. The following lists of different classes of buildings will give a better idea of what the figures should be. Percentages do not change even if cost doubles.

Class of work	Frame Buildings	Brick Buildings
Excavation, brick and cut stone	15.8	41.0
Plaster	8.3	5.6
Lumber	19.3	11.0
Millwork and glass	20.6	12.0
Carpenter labor	17.9	9.0
Hardware	3.5	2.5
Tin and galvanized iron	2.3	3.0
Plumbing and gas-fitting	6.8	4.3
Paint	5.5	3.4
Iron and steel		5.6
Roofing		2.6
	100.0	100.0

It will be observed that some of the items under "brick" are lower than the same items under "frame." Of course, the high percentages of mason work necessarily reduces the other figures, but part of the difference is due to the fact that warehouses are listed, and the inside finish is thus reduced. The other lists will give a better percentage, but it is well to take a general average of all kinds of buildings, and let the architect or contractor make an allowance for any departure from a normal type.

The tables may be used to estimate the cost of enclosing a building. By leaving out part of the millwork, paint, labor, hardware, etc., a fair idea may be obtained; and a certain item being known the value of the complete building may be found. Hardware at $350 means a $10,000 frame house, although this is figuring the wrong way—from the small to the large.

Uniformity. In the brick list there are 17 buildings, or about half, with iron and steel—for columns, beams, etc. The percentage varies more in this item than in any other—2, 7, 12, 3, 6.5, 5, 9, 7, 7, 4, 2.5, 1.5, 8, 4, 2, 7, 8. Brick and stone run steadily from 38 to 50 with most buildings about 44; but one house is only 25, as the inside finish, plumbing, etc., is of a superior quality. The millwork on the same building is 25. Carpenter labor, paint, hardware, plumbing, plaster, and tin, do not vary much, and when they do take a bound the reason is generally clear, so that in making an approximate estimate variations from what may be taken as a standard can easily be noted.

There is even less variation on frame than on brick buildings. Lumber, millwork, and brick, keep remarkably steady in the same class.

A Plain Building. When selecting the frame buildings I ran across one that could not be listed as there was no foundation or inside finish except that the walls and ceilings were sheeted and a floor laid. It may be taken as a type of plain construction. It is 30′-6″ by 150′, 2 stories high, with 2 × 6 studs and rafters covered respectively with drop siding, sheeting and shingles. The percentages are: Lumber, 56; millwork, 10.5; iron and hardware, 4.5; carpenter labor, 21; tin, 3.5; paint, 4.5.

On No. 3. Another building not listed owing to partial fireproofing is No. 3. The 2 fronts are built of a hard Wyo. pink stone. The stone is backed with brick, and the rear walls are of brick. Joists 3 × 14 rest on 2 lines of iron cols and steel I beams. The walls and ceilings are lined with fireproofing, and the partitions are built of hollow tile. Half the finish is oak, and the other half yellow pine. Without marble, elevators, heating, plumbing, electric work, and architect's percentage, the cost was $125,000. The bids were read in the presence of the contractors so that the cost is well enough

known, as indeed that of most buildings is among the elect. The building was publicly sold later, and the newspapers gave the price but not the percentages. We got the contract, and here are the figures:

Excavation and brick ..	28.15	Plaster.....	3.36
Stone.....	18.34	Tin and copper.....	1.65
Steel and iron	14.56	Gas-fitting.....	.60
Lumber.....	4.22	Gravel roof...	.20
Carpenter labor.....	4.55	Hardware.....	1.52
Millwork and glass.....	11.63	Painting.....	2.20
Fireproofing.....	9.02		
			100.00

Brick Buildings

The following list is taken from 5 good brick houses. No. 4 has gas but not plumbing:

Cost	Excavation Br'k & Stone	Plaster	Millwork and Glass	Lumber	Carpenter Labor	Paint	Hardware	Tin and Slate	Plumbing and Gas	Ornam'l Iron	Steel and Iron	Gravel Roof
RESIDENCES												
$38,000	51.8	8.3	13.0	7.1	8.3	3	3	5.5	...	..	...	...
18,600	36.5	6	21.8	13	10	4.7	3	5	...	..	...	...
19,500	35.2	5.2	19.1	12	11.3	9.2	3.5	4.5	...	..	...	...
8,200	25	5	25	14	10	6	2.5	2.5	5	..	...	...
24,400	34.4	5.4	19.5	12.7	10	5	3.5	5.5	1	3	...	...
Average	36.58	5.98	19.68	11.76	9.92	5.58	3.1	4.6	...	..	...	...
WAREHOUSES												
$34,000	53.3	....	4.1	21.9	9.2	1	2	.3	....	..	7.2	1
14,000	50	....	5	21.1	10	2.5	2	3	....	..	2	4.4
17,000	44.9	....	12.5	17.5	10	2.3	2.8	1.2	....	..	6.8	2
26,000	51.5	....	6.5	17	9	2.5	2.5	2	1.5		6.5	1
12,000	50	....	8	14.5	8.5	3	2.5	2.5	3	..	7	1
Average	50	....	7.2	18.4	9.3	2.3	2.4	1.8	....	..	5.9	1.9
$15,000	.....	....	19.5	22.4	19	2.4	3.7	3.6	10.4	..	19	...

without masonry.

BRICK BUILDINGS—*Continued*

Cost	Excavation Br'k & Stone	Plaster	Millwork and Glass	Lumber	Carpenter Labor	Paint	Hardware	Tin and Slate	Plumbing and Gas	Ornam'l Iron	Steel and Iron	Gravel Roof
STORES AND FLATS												
$36,000	36.9	6	15	13.8	10.2	3.5	2.8	5.8	...	..	4	2
34,000	40.1	6.5	18.8	12.2	9.7	5.9	2.2	2.3	...	..	1.3	1
44,500	32.2	6.6	20	14.1	12	6	3	5.1	...	..	...	1
29,000	36	8	20	7.5	9	3.5	3	5.5	4.5	..	3	...
11,000	25	6	20	12.5	9	4	2	3	4.5	..	12	2
12,500	38	7	12	10	9	6.5	2.5	4	4	..	7	...
12,000	40	5	13	10	10	3	2	8	4	..	5	...
Average	35.4	6.4	17	11.4	9.8	4.6	2.5	4.8	4.2	..	5.4	1.5
SCHOOLS												
Cost ran	46	6	12	10.5	9	4.5	2.5	4.5	5	..	...	Slate
from	48	6	9	10	9.5	3.5	2.5	3	3.5	..	...	5
$15,000 to	41	7	11	15	13	5	3	2	3	..	...	...
$45,000;	45	6	11	10.5	10	4	2	4.5	4	..	...	...
most	49	6.5	11.6	11.6	9.7	4.6	2	5	...	..	...	...
from	45	6	10	11	10	3	3	3	4	..	...	5
$22,000 to	45	6	10	11	10	3	3	3	4	..	...	5
$45,000	42	6	12	12	11	5	3	2	7	..	...	...
8 and 16	49	5	9.5	11	8	3	2	5	2.5	..	2	3
rooms	50.4	5.8	12	10.3	9.6	4.3	2.2	5.4	...	..	...	...
	54.6	4.8	9.2	12.4	11	3.8	2.1	2.1	...	..	...	...
Average	46.8	5.9	10.7	11.4	10.1	4	2.5	3.6	4.1	..	...	...

Remarks. In No. 3 of the "Warehouse" list a large plate glass front raises the millwork and reduces the masonry; in No. 2 the gravel roof has a high percentage, but the building is low, and the cost of a roof one story from the ground is, for our purposes, the same as for ten. In one building the percentage is given without masonry.

Variation. Under "Stores and Flats" it will be observed that the average line foots up 103 instead of 100. This is owing to dividing steel and iron, gravel roof, and plumbing by the number

of buildings instead of by 7. It is interesting to notice how closely the percentages run. A reasonable profit being allowed, one might almost be safe in estimating the hardware in a building and signing a contract based upon the proportions in a table. Judging from bids I have heard of and read, there be some who do not build upon so sure a foundation.

Silos. The field is large, and covered with all sizes and kinds of materials. The following comparison of costs was made in 1916, United States comparison with 1913 base year, 120—by the West Coast Lumbermen's Association, and has a lower cost for their material than an outsider would give:

Brick, solid wall	$450 to $700
Brick, air space, hollow wall	650 to 1,200
Cement block	450 to 800
Hollow tile, cement both sides	450 to 800
Stone, solid, no stone supplied	485 to 800
Stone, double lined, air spaced, no stone supplied	650 to 1,000
Concrete, solid, monolithic	300 to 600
Concrete, hollow wall, monolithic	650 to 1,000
Wooden stave	200 to 300

The same size was used as a basis of estimate—about 14′×36′.

CHAPTER VI

RAILROAD BUILDINGS PER SQUARE AND CUBIC FOOT

(Prices in this chapter are set to suit the United States base of 1913 = 100, unless otherwise stated. Use the index numbers and change to suit any other year.)

Stations and Depots

	Sq ft
Frame Stations with living rooms, pile foundations	$2.00
Frame Stations with brick or stone foundations	2.00
Passenger and Freight Depots, frame, pile foundations	1.70
Passenger and Freight Depots, frame, brick, or stone foundations	$3.00 to $4.00

If not a standard the cost might be increased from 10 to 50 per cent.

Passenger Stations, Modern. Brick, stone, slate roof, hardwood finish, average of six designs built, $3.60; running from $3.41 to $3.77. One of larger and better design cost $4.20.

A western station, with offices on second floor, cost $7.17 per square foot of ground area. It is of stone with a slate roof. This includes area of baggage room, etc.

Baggage Rooms, Express Rooms, and such minor parts of the main structure run from $3 to $4 per square foot if taken alone.

Frame Station. A small frame station built in 1903 cost $2.50 per square foot. The details of special work raised the cost.

Freight Depots. Brick, $3.25 to $3.75 per square foot with boiler room below. About 35¢ less without boiler room.

The foregoing is for ordinary depots in small towns. Two large buildings were erected in Omaha, one in 1911 and the other in 1917. The first, 60×552 = 33,120 sq ft, at the rate of 2.57¢; the second, 1917, 60×367 = 22,020 sq ft at $2.84. Both on pile foundations and 1 story high.

Signal Towers. These buildings are expensive when their small ground area is considered. For one 15′×25′, concrete basement, and 2 stories above, plate glass on second story, and furnace, but no equipment, $5.65 per square foot, or 18¢ per cubic foot.

Another of the same style ran to $7 and 23¢.
But these prices might be cut in two for some kinds of towers.
They might also be greatly increased.

Shop Plants

Power Houses. From $4 to $8 per square foot for shell of building only, without any equipment.

Coal Handling Plants. The designs and materials vary so much that it is hard to set even an approximate figure. A timber one with a capacity of 100 tons ran to $22,000, or $220 per ton; while a fireproof one of 2,000 tons was built for $265,000, or $132.50 per ton. This in 1918.

Chimney Stacks

Labor. A Custodis stack built for the Franklin Co., at Syracuse, took 25 days for 8 men, 4 laying the brick and the others as tenders, with help from an extra laborer or two on the lower part. The stack is 250 ft above ground, outside diam. 20 ft at bottom and 11 ft 3 in at top. The Custodis radial brick were used. The wall is 29 in at bottom and 8 in at top. This will give an approximate idea of labor costs on such work.

Brick Chimney Stacks. The cheapest one I know of is sq, 150′ high, and cost without profit, $35 per ft, foundation included. One of large radial brick, 175′, 10′ to 7′ core, $45; another 200, 11 to 9 core, $55; both circular, but foundations are not included. A stack of radial brick 100′×5′, $2,200; 125×6, $3,200, without foundations—but distance from yard, etc., affects price. On a 1902 date.

Foundations. On the 200′ stack the foundation would run about as follows:

Excavation	$210
Piling (if required)	600
Concrete	1,900
	$2,710

The foregoing prices given are for ordinary conditions, and this list below is on the same basis. Under 800° Fahrenheit stacks for boilers are of a standard type, but for high temperature work special designs are necessary for each installation, and approx prices are hard to set. No two cases are alike.

Foundations are not included on any of the sizes given. The

diams given below are the internal ones, at the top of the stack. The bottom diam is always greater.

Size	Cost	Size	Cost
80×4	$1,150	150×6	$3,600
90×4	1,350	175×7	5,150
100×4	1,600	200×9	6,850
125×5	2,500		

A comparison shows that the actual cost of two sizes was much more than above: 175×7 at top runs to $7,875; and 200×9 to $11,000. Temperature and other factors have to be taken into account.

Chimney Wrecking. Most wrecking has to be done on the piecemeal system, but occasionally a quicker method is possible. The common method of razing lofty chimneys now is to underpin one side with wood and afterwards set it on fire. The cut is made according to the direction in which the chimney is to fall. Up to 1921 one man had razed about a hundred by this manner in England. Some were from 200 to 250 ft high. There was not an accident connected with the work.

Comparative Approximate Cost of Chimneys—1913

Height in feet	Diam., feet	Horse-power	Brick	Concrete	Self-supporting steel		Guyed steel	
					Weight, lbs	Cost	Weight, lbs	Cos
100	42	258	$1,750	$1,625	.....	.....	8,250	$525
150	54	551	3,375	2,587	.....	.....	21,080	1,062
150	72	1,023	4,375	3,500	51,750	$2,640	31,450	1,537
175	84	1,531	5,375	4,375	76,250	4,062	53,230	2,590
200	96	2,167	7,000	5,625	108,100	5,750		
200	120	3,448	9,000	7,250	117,000	6,220		
225	132	4,455	10,875	8,750	155,900	8,312		
250	144	5,618	12,500	10,125	206,800	11,000		

Steel Stacks. The weight being given above the local prices must be applied with an extra allowance for erection of $20 per ton, wages being 70¢ per hour for mechanics and 40¢ for laborers. Also Foundation.

STACKS PER RATED HORSEPOWER

Height	Diameter	Cost	Height	Diameter	Cost
125′	6′ to 12′	$5 to $3	175′	10′ to 14′	$3 to $2.5
150′	8′ to 14′	4 to 2.50	200′	12′ and over	$3

Remarks. The diameter is inside at top. The costs are about 1912, from "Peabody and Miller," Steam Boilers, as well as the following: "A red brick chimney costs about 25 per cent more than a radial brick chimney of the same capacity; a self-supporting steel stack fully lined, about 23 per cent more; a self-supporting steel stack half-lined about 14 per cent more; a self-supporting steel stack unlined, about 14 per cent less; a steel stack guyed, about 40 per cent less than a radial brick chimney of the same capacity."

SIZES OF FOUNDATIONS FOR HALF-LINED STEEL CHIMNEYS
(Philadelphia Engineering Works)

Diameter, clear, ft.	3	4	5	6	7	9	11
Height, ft.	100	100	150	150	150	150	150
Least diam. foundation, ft and in.	15′ 9″	16′ 4″	.....	21′ 10″	....	23′ 8″	24′ 8″
Least depth, ft.	6	6	9	8	9	10	10
Height in ft.	.....	125	200	200	250	275	300
Least depth of foundation	.....	7	10	10	12	12	14

WEIGHT OF SHEET IRON SMOKESTACKS PER LINEAL FOOT
(Porter Mfg. Co.)

Diameter, inches	Thickness	Pounds per foot	Diameter, inches	Thickness	Pounds per foot
10	No. 16	7.20	10	No 14	9.40
12	"	8.66	12	"	11.11
14	"	9.58	14	"	13.69
16	"	11.63	16	"	15.00
20	"	13.75	20	"	18.33
22	"	15.00	22	"	20.00
24	"	16.25	24	"	12.66
26	"	17.50	26	"	23.33
28	"	18.75	28	"	25.00
30	"	20.00	30	"	26.66

Reinforced Concrete Stacks. For the following approximate figures I am indebted to the Weber Co., of Chicago. This company has built about 1,000 stacks. Under this system the foundation necessarily goes with the stack so that the reinforcement can be anchored.

On 1913 Basis

Height	Diameter	Foundation	Total cost
200 ft	10 ft	$400	$6,000
175	8	300	5,000
150	6	200	3,300
125	5	200	2,500

The foundations, on fair soil, go about 8 ft deep on a 200-ft stack to 6 ft on one of 175 ft high.

One reinforced stack in Butte is..... 350′×18′
One reinforced stack in Tacoma is..... 300′×18′
One reinforced stack in Georgetown is..... 275′×17′
One reinforced stack in New Orleans is.... 250′×15′
One reinforced stack in London, Eng..... 250′×20′

The largest reinforced stack in the world was built by Weber in Japan. Height 570 ft, inside diameter at top 26 ft 3 in.

A brick stack at Anaconda has 60-in walls at bottom, 22 in at top, is 570 ft above ground, 76 ft inside diameter at bottom, and 60 ft at top.

Weber Work. A reference to the foregoing will give the approximate cost of such chimneys in 1913 and normal times. The following figures are based on higher rates brought about by the war.

Special requirements have to be kept in mind. The price of cement is regulated by the distance from the factory, while many of these stacks are built for water power in mountainous regions where steel, lumber for forms, sand and gravel are necessarily high in price. This applies to brick and steel stacks as well.

In cities where wages are very high the cost of a stack is much more than in country districts. A special estimate for each stack has to be made after the prices of material are obtained. But for a fair approximate figure within a radius of 500 miles of Chicago, the Weber accompanying table is useful.

The internal diameter is given. The foundation is included but not the excavation.

Reinforced Chimney Costs, 1923

100′× 4′	diameter	$2,500
125′× 5′	"	3,300
150′× 6′	"	4,200
175′× 8′	"	6,000
200′× 9′	"	7,200
225′×12′	"	12,500

1913 Basis

Steel Stacks. Self-sustaining steel stacks, 7 ft diameter, 150 ft high, without foundation, $29; 9 ft and 200 ft, $33 set. For small guyed stacks allow per foot at factory as follows:

	24″	30[′	36″	42″	48″
No. 14 iron	$1.35	$1.71	$2.07	$2.43	$2.79
No. 12 iron	1.84	2.32	2.80	3.28	3.76
No. 10 iron	2.38	2.92	3.46	4.00	4.54

Allow setting extra at $15 to $40. Wire rope, $\frac{3}{8}$ in, 3¢ per foot; $\frac{1}{4}$ in, $1\frac{1}{2}$¢. For sizes not given allow 4¢ to $4\frac{1}{2}$¢ per pound at factory. In 1904 a short 10-in stack cost 80¢; 14-in, $1; 24-in, $1.15.

Lightning Rods. They are coming back again, but under scientific conditions. The United States uses copper rods on all powder houses and battleships. The National Capitol, the White House, Washington's Monument, the Statue of Liberty are all rodded with copper.

The returns from 48 Iowa Mutual Insurance companies showed losses of $15 where buildings were rodded, and $58,000 where they were not.

Sizes. For ordinary use there are three classes of rods: (1) 250 lbs per 1,000 ft=$140; (2) 190 lbs per 1,000 ft=$130; (3) 140 lbs per 1,000 ft=$115.

An approximate price for rodding is 20¢ per foot in place and $2 extra per point. Chimney rodding is heavier and more elaborate.

The regular large chimney builders recommend lightning rods. Heinicke says: "Owing to the numerous accidents and destruction of chimneys caused by lightning, we cannot help wondering why some people still do not use lightning rods. Of course, a rod must be of proper construction to fulfill its requirements, and proper care must be taken especially for the earth connection."

Kellog specifies two points for any diameter chimney up to 5 ft inside and one point extra for each 2 ft or fraction more. These points should be $\frac{3}{4}$ in diameter by 8 ft long, with $1\frac{1}{2}$ in platinum tips. Lower ends of points connected by loop of copper cable

around chimney. From this loop down, ½ in, 7-strand No. 10 Stubbs' wire gage copper cable to be connected to ground plate, fastened every 7 ft to brass anchors. These sizes will give a basis for an estimate.

Manufacturing Buildings

We live in an age of machinery; and the house that held the old anvil under that spreading chestnut tree is far too small for our requirements. A class of buildings has arisen that belong, like the skyscraper, to the American style of architecture. Like the skyscraper also they belong rather to the engineer than to the architect. The latter is merely called to hang a curtain over the framework to keep the cold and rain out—and the curtain in some of them is of expanded metal and concrete only 3 in thick. I made the estimates for Nos. 7, 8 and 14, and since they were built have made estimates and valuations on many others.

These buildings are now to be found all over the country for electric-light works, locomotive-shops, machine-shops, foundries, steel works, rolling-mills, tin-plate works, boiler-shops, bridge-building and ship-building establishments, pipe-foundries, and manufacturing plants of all kinds, which are equipped with electric traveling-cranes that lift anything from 100 lbs to 250 tons.

Percentages. The percentages on page 135 are from the under side of the water-table. Floors are included. It is seldom that two foundations are alike, and the only safe criterion is from the floor line up. Skylights cover from ⅓ to ½ of the roof surface. No. 8 is 150×500; No. 7, 150×400, No. 14, 150×310. Machine foundations tracks, heating, and lighting are not included. Extra cross walls account for the high rate of the brickwork in No. 8, and the cheap lumber and less of it in proportion, on account of leaving out gallery, etc., makes the difference in that item.

Wiring and Cold-water Painting are not included.

Machine and Erecting Shops. With areas of 50,000 to 100,000 sq ft the average of five built when prices were low was $1.80. The figures ran from $1.27 to $2.40. The Rock Island shop, 860 ft long, is given in "The Railway Age" of Chicago at $1.50. But cost of shops is heavily affected by foundations, and by style of construction. Foundations to grade may easily cost 25 per cent of the total; and the lean-to style of the R. I. shop is far cheaper than if the outside walls were carried to level of main roof. Everything is ready for cranes, but none included. Piling if required, 14¢ per square foot of total area. The highest price per cubic foot, heated, should not exceed 8¢.

MACHINE AND BOILER SHOPS

	No. 8	No. 7	No. 14
Brick	16.4	10.2	13.3
Cut stone	1.2	1.1	1.5
Lumber	6.2	10.0	6.4
Millwork and glass	5.5	6.0	6.0
Carpenter labor	4.1	5.3	4.0
Gravel roof	1.7	1.4	1.7
Skylights and glass	8.0	9.5	10.6
Tin, copper, gal. iron	1.1	1.1	1.5
Steel lintels for doors and windows, and hardware	5.2	5.0	7.0
Painting	2.4	2.3	1.9
Steam, water, and power piping	3.2	3.1	2.0
Structural steel	45.0	45.0	44.1
	100.0	100.0	100.0

A M. & E. shop erected in 1902 with piling and extra heavy concrete foundations cost $2.97 per square foot and 5.71¢ per cubic foot. Area 60,000 sq ft.

Boiler Shops. At $1.30 to $1.85 with average of $1.56 on four large ones built when prices were low. Piling about 9¢ if required per square foot of total area.

On one built in 1903 the square foot cost was $2.67, and cubic foot, 5.8¢. Area 46,000 sq ft.

Blacksmith Shops. The average of four of large area in widely separated parts of the country was $1.32 per square foot when prices were low. The figures ran from $1.15 to $1.70. Piling if required, 6¢ to 7¢.

A shop built in 1906 cost $2.20 per square foot. Area 34,000 sq ft.

Iron House. Per square foot, $2.00.

Coal Shed. From $1.00 to $1.50.

Weight of steel per square foot of ground area of shops:

Machine and erecting shop	25 lbs	Car shops	10 lbs
Blacksmith shop	10 lbs	Paint shops	10 lbs
Foundries	20 lbs		

For Shop Roofs, as on No. 7, etc., 6″×14″ purlins about 5 ft 0 in centers, 2 in T and G yellow pine flooring, 25¢ per square foot complete, but no steel trusses or gravel roof. (1913.)

Shop Lanterns, steel construction, glass roofs, sash on sides, as shown on Nos. 7, 8, 13, 14, $30 per linear foot extra as compared with flat roofs.

Relative Cost of Brick and Glass on R.R. Shops

In general glass costs twice as much as brick. In the preliminary study of a building it is often desirable to know how the total cost is affected by putting in or leaving out windows or doors.

In large manufacturing buildings with unplastered walls, where double and triple windows or wide doors take up from $\frac{1}{4}$ to $\frac{1}{2}$ the space, such as No. 7, common brick is to glass as 6 to 15 in 13″ walls; and as 1 to 2 in 17″. In the one case we have only the brick to consider; in the other, frames, sash, glass, labor, paint, hardware, stone sills, and steel lintels.

For the average single window with sills and lintels in a 13″ wall, 11 to 25; in 17″, 3 to 5.

In ordinary buildings with openings about 3×7, glass costs twice as much, and not only so, but the mason often forgets to deduct the brick and both prices go in. Here, in addition to the other items, we have jamb linings and inside finish.

Allow 11 to 28 in 13″, and 1 to 2 in 17″.

Detailed percentages of a modern Blacksmith shop and Foundry are given on page 137.

Square foot. Blacksmith shop, $2.20 per square foot; foundry, $3.25. Add from 50 to 75 per cent to cost of buildings proper for tools and equipment. No grading or filling. No fee or percentage. (1906.)

Bins. Outside foundry bins for coal, etc., 23¢ per sq ft on ground.

Labor. Carpenter labor on blacksmith shop, 5¢ per square foot of area over building; car shop, 4½¢; paint and wheel shop, 5.4¢; foundry, 5.6¢; mill, 6.6¢; all at 40¢ per hour.

Square and cubic foot cost. A comparison of square and cubic foot prices on actual cost of buildings proper runs as follows: Machine and erecting shop, $2.964 square, 5.71¢, cubic; boiler shop, $2.665, 5.78¢; storehouse, $3.99, 12.2¢; pattern shop, $2.863, 7.54¢; oil house, $2.03, 10.7¢. (1913.)

Storehouses. Of the heaviest construction, 2 stories, no basement, concrete, brick, steel, $3.80 square foot. Without electric elevators, fireproof shutters, etc., $3.50. Deduct 25¢ if platforms are not required. A large storehouse, 2 stories and basement, was built for $3.05. But I know of another building of the same nature and height with more and better outside and inside finish, plumbing elevators, electric wiring, etc., which ran to $5.25, or 13¢ per cubic foot. For shelving and uprights allow about 2¼ ft BM. for each square foot of total net floor space. Piling, if required, 13¢ square foot of ground floor. (1902.)

But the Rock Island storehouse at Moline, Ill., is given in the "Railway Age" at approximately $1.50 per square foot. It is a 3-story brick, wood construction inside, and the price is based on the ground area only. The total area is 5 times as large as that of present Union Pacific storehouse, Omaha. The size is 500′ × 100′; and the 3.6 per cubic foot matches the price given on the square foot basis. It seems too low a figure; but the cost is not official.

The storehouse for the Seaboard Air line at Portsmouth, Va., cost $1.17 per square foot on ground floor; but it is brick only to the window sill, and unsheeted frame above covered with galvanized iron. It is 2 stories and a basement.

Blacksmith Shop and a Foundry

	B'smith	Foundry
Excavation	.46	1.11
Piling	1.98	2.55
Concrete foundations and small floors	5.70	8.09
Concrete water table	.60	.52
Cut stone window sills	.60	.51
Brickwork	13.70	14.81
Lumber	3.25	2.94
Millwork and glass	3.52	3.29
Carpenter labor	2.31	2.19
Gravel roof	1.39	1.43
Skylights	7.20	3.11
Steel lintels	2.58	3.58
Floor track	1.40	.22
Hardware, ladders, lantern gearing	1.31	1.47
Painting	2.67	1.40
Galv iron and copper	1.79	.80
Lockers	1.15	.84
Plumbing	4.10	2.66
Plaster	.24	.07
Heating, blast, exhaust, sump	3.34	7.73
Structural steel	12.55	28.28
Structural steel, erecting	1.54	3.41
Piping for air, steam, water, oil	5.27	4.20
Bins, outside and motor platforms	3.70	4.79
Machine foundations	7.01	.....
Wiring, lighting, power	6.00	.....
Furnaces and foundations	4.24	.....
Water filter	.40	.....
	100.00	100.00

The frame building described on page 124 is a kind of a storehouse. It is sheeted inside on first story, and has shelving, refrigerator, and office in 1 end. Without any foundation, $1.16 per square foot.

Oil Houses and Platforms. From $2.50 to $4.50 per square foot of building, but this included platforms. Platforms are about 50 per cent more than buildings proper. Concrete and brick.

But here it may be worth while to say that to get good results from either the square or cubic foot basis it is necessary to have a building of reasonable size. An oil house might be 100′ long, or it might be 20, but in both cases 2 gables are required. The cost is distributed over a large area in the one case, and a small in the other.

Car Shops

The detailed percentages of two large buildings will serve as a guide for an approximate estimate. (1907.)

	No. 1	No. 2
Excavation	.66	.23
Concrete foundations	7.40	5.38
Concrete coach pits	3.73	
Concrete floor in coach repair shop	1.38	7.22
Concrete floors in two lavatories	.23	
Concrete water table and door sills	.38	1.29
Stone window sills	.28	
Brickwork	12.47	11.22
Lumber	5.56	3.68
Millwork and glass	2.68	2.84
Carpenter labor	2.67	2.73
Steel lintels	2.05	1.84
Structural steel (450 tons)	20.08	23.02
Unloading and setting steel	2.47	2.55
Galv iron and copper	1.58	1.73
Skylights	9.39	9.21
Gravel roof	1.58	1.93
Floor track	1.58	1.61
Hardware, ladders, lantern sash device	1.41	1.68
Lockers	.74	1.10
Painting	1.51	1.58
Plumbing	3.51	2.10
Heating	8.24	8.48
Air, steam and water pipe	8.24	8.52
Plaster in lavatories	.18	.06
	100.00	100.00

Remarks. In No. 1 the total area over the walls was 85,980 sq ft. The cost as above, without architect's fee or contractor's percentage, 6¢ per cubic foot; $1.70 per square foot. The height to eaves 25′ 4″. No grading or filling is allowed. Owing to nature of ground the foundations had to run deep—one-half the amount might be sufficient for foundations and pits. If piling is required allow 7¢ per square foot of total area. In some shops pits are not used.

The total area of No. 2 was 84,113 sq ft. The cost as on No. 1, $1.68. The height to eaves 25′ 4″. No grading or filling. Foundations were as deep as on No. 1, but did not have to be so far spread as there was no piling.

In both the figures for heating and piping are approximate and safe.

Woodworking. On three built, $1 to $1.40.

Car and Coach Shops. From $1.25 to $3 on several.

Paint and Freight. From $1.25 to $3 on several.

Dry Kiln. From $1.60 to $3.

Coach Shop. The Seaboard Line coach shop, brick to window sills, studs unsheeted, covered with galvanized iron, 68¢; planing mill of same style, $1.29.

The published figures of cost of the Wabash Plant at Decatur:

	Cu ft
Power house	3.4¢
Blacksmith and machine shop	3.0¢
Car shop	2.7¢
Store and office	5.5¢
Wood mill	2.9¢
Tin, cabinet and upholstery	4.5¢
Dry kiln	11.1¢
Lavatory	5.4¢
Dry lumber sheds	2.3¢
Iron, coal and coke	3.5¢

The buildings are of timber frames with No. 24 expanded metal and plaster 1½ in thick outside, 1 in inside, and an 8-in air space.

Lavatories. Separate 1-story brick buildings, with the finest plumbing, expanded metal lockers, etc., $3.70 to $4.25 per square foot. The average of three is $3.75. Inside of main building, $3. Approximate 12¢ per square foot of complete ground floor area of main buildings. Expanded metal lockers, $5 each.

All figures given are for best construction of concrete, brick and steel, but at pre-war rates, on the U. S. 1913 basis, as are the following figures.

Sand Houses. On two the estimates were 78¢ and 80¢ per square foot without crane. Size 14′×20′ and 16′×20′. Crane complete with base and labor, $156. On house proper labor is 50 per cent of material.

Lumber Sheds. Allow 58¢ per square foot of actual ground surface, with deep concrete piers set 16 ft centers. With piers about 4 ft deep instead of 9 ft, 50¢. About 16 ft high, with second story floor over one-third of area.

Bunk Houses. From $1.05 on pile foundations to $1.25 for stone or brick.

Ice Houses. On eight houses with floor space from 5,000 to 11,000 sq ft the estimated cost was from 80¢ to 96¢ per square foot, with an average of 89¢. Machinery, $600 to $900 each house extra. For double platforms $6.00 per linear foot.

On a house of later design, $1.30 per square foot; 57¢ per square foot of outside walls to level of wall plates, not including gables; 5.4¢ per cubic foot to level of wall plates. Material 63 per cent; labor 37 per cent of total. Size 24′×160′×24′. high to plates. No machinery or percentage.

For houses 32 ft high $1.80 to $3.

But sometimes the square foot cost is doubled, and the labor instead of being reasonable is several times higher than it should be.

An Artificial Ice Plant costs about $1,000 per ton capacity.

Yield of Ice. An acre of ice, 12 in thick, yields about 1,000 tons. It costs from 80¢ to $1 to put ice in house. The shrinkage from time of packing to August is about 12 per cent in an unopened house.

Ice Houses for private families, 8′×8′×8′, cost from $100 to $280.

Standpipe. One of reinforced concrete, 40′×100′, $34,000; in steel, $37,500 bid; Attleboro, Mass.

Shelter Sheds. Wood posts, flooring and gravel roof, no floor, two coats mineral paint, 33¢ to 45¢ per square foot of roof surface—depending upon length, etc.

Platforms. Warehouses of all kinds and depots usually have platforms about 4 ft 6 in above grade. For plank footings, 12″×12″ uprights and girders, braces, nails and bolts, allow $18.50 per square. For 3×12 joists, 12 in centers, $8 per square; for 3 in plank on top and 2 in to enclose front, $11.00 per square. With lumber at $20 make the complete figure at 39¢ per square foot, the extra allowance being for bridging, inclines, stairs, etc. For each dollar extra on the price of lumber, allow 1½¢ per square foot. Thus, at $24, the complete cost would be 45¢ for the heaviest style platform. But sufficiently strong platform of light construction can be built for 25¢—say 3×10 joists 24-in centers, and 2-in top; and for cedar pile heads, 6-ft centers, 8×10 sills 8 ft center to center 3×10 joists 16 in

centers 3×10 covering with lumber at $19, a western engineer gives the cost at 26¢.

On ground at $23 with 6×8 sleepers 4-ft centers, 3-in covering, 14¢; 2-in covering, 15¢. For other sizes, spacing of joists and covering (see under "Basement Sleepers and Covering"). Platform may require more labor than basement floors, owing to frost, grade, etc., and extra allowance must be made if required. The foregoing figures cover average work.

Roof. A plain roof covered with gravel may be put over platform for 50¢ per square foot. Long, plain umbrella-sheds with wood posts, wood framework, gravel roof, gutters, but no paving, 65¢ per square foot.

Wood Fences. In most cities they are limited to 8 ft high, for in the old days "spite fences" sometimes soared higher than the shingles.

With 8-in cedar posts, 10 ft long, about 6¢ per linear foot four rails in height close-sheeted, without paint or gates they are worth 65¢ to 70¢ per linear foot.

Mineral paint at 5¢ to 6¢ per square yard per coat is close enough. With one coat of paint 65¢ to 70¢. Large double wagon gates for such fences run from $30 to $40. The cost of boring post holes for lower fence is the same. For a 4-ft fence, unpainted, 35¢ to 40¢ per linear foot. It is well to remember that paint sometimes goes on one side, sometimes on both.

Picket Fences. There are so many different kinds that we must be content with the fair average of 75¢ per linear foot painted, for a reasonable number of feet; a short fence might cost twice as much.

The following useful figures are taken from the "Railroad Gazette" of July 1, 1904. They are compiled by Master Mechanics and show "Original Cost" for valuation purposes at that date and after. The U. S. 1904 index number is 79.

Cost of Locomotive Repair Shops

In selecting units on which to base cost figures the square foot and the cubic foot have generally been used for buildings; in power plants the engine horsepower, boiler horsepower and generator kilowatts have also been used; in roundhouses the stall has been taken as the proper unit. In computing the square feet of buildings, the outside dimensions have been used (giving the ground area covered); in computing the cubic feet of buildings, the average external height has been taken (giving the total volume occupied).

In the figures which follow, the different items are identified by reference numbers only, with such explanatory notes added as will interpret the unit prices; shops built prior to 1895 are designated

as "old," those built since 1895, as "modern," in a few cases the notes are based on uncertain information and are followed by an interrogation mark (?).

It is believed that in most cases the cost of a proposed shop will be asked for as soon as the layout plan has been completed, and that the following is the best basis for making an estimate: List up all the buildings, with their ground area in square feet, all the miscellaneous structures, either on the square foot, the linear foot, or the unit basis (as may appear best), all the track on the linear foot basis, the turnouts on the unit basis, etc.; assign a unit price to each item, as determined by the special local conditions, carry out the cost extensions and totalize; to the total thus obtained add a percentage to cover incidentals and items not shown by the layout plan; this percentage may vary from a minimum of 10 per cent to a maximum of 25 per cent, according to the completeness of the layout plan and the degree of confidence which may be felt in the unit prices assumed; the grand total should represent the approximate cost of the plant, exclusive of the cost of land and grading, which should be estimated separately, these two items not being susceptible of reduction in a unit basis. If the buildings have been designed in detail their cost may be checked upon the cubic foot basis.

The report is signed by R. H. Soule, Chairman; L. R. Pomeroy, T. H. Curtis, S. F. Prince, Jr., A. E. Manchester.

Erecting and Machine Shops

Item	Cost per Sq Ft of Ground Area				Cost per CF	
	Building only	Tools	Misc. Eqpt.	Total	Building only	Total
140	$3.50	$1.08	$.71	$5.34	$.076	$.115
141	1.03	2.49	.187	3.70	.034	.123
142	.706	1.78	...	....	.029	....
143	1.67	2.05	.086	3.79	.051	.118
144	2.43	.81	....	....	.051	....
145	1.65	2.69	....	....	.041	....
146	1.80	1.65	....	....	.046	....
147	1.82	....	....	....	.050	....
148	3.08	1.65	....	....	.073	....

140. East, modern; brick and steel tranverse shop, erecting shop has both heavy and light cranes; machine shop has crane service throughout, saw tooth roof.

141. Middle West, old; brick and wood, transverse shop in 2 parts, 1 part 1 story with slate roof, the other part 2 stories with gravel roof.

POWER PLANTS

Total cost

Item	Cost per Engine H P	Cost per Generator K W	Cost per Sq ft	Cost per CF	Notes
131	131.33	219.00	11.40	0.40	Far West, modern; a substantial effective plant devoid of ornamentation refinement; coal dumped from trestle and shoveled, ashes shoveled.
132	140.27	210.00	7.00	0.18	Middle West, modern; building has considerable ornamentation inside and out, but the equipment auxiliaries are simple; overhead crane in engine room.
133	115.00	167.00	12.20	0.28	East, modern; building has considerable ornamentation alternating current apparatus inside and out; principally with auxiliary direct current equipment.
134	185.06	278.00	11.50	0.36	Middle West, modern; includes (besides boilers, engine generators, and air compressors, induced draft apparatus, coal and ash handling apparatus, hydraulic plant, etc.)
135	129.28	210.60	14.62	0.33	Middle West, modern; a very complete plant both mechanically and architecturally. ..
136	123.00	191.00	14.30	0.36	Middle West, modern; large enough to allow for a one-third increase in capacity of plant.
137	129.00	225.00	10.40	0.58	East, modern; fireproof construction throughout.
138	90.90	151.50	10.40	0.24	West, modern; a simple but effective plant limited to direct current, no coal or ash handling apparatus.
139	128.60	211.00	10.55	0.31	Middle West, modern; condensing equipment.

142. Middle West, old; stone and wood, tranverse shop, gravel roof supported by posts.

143. Middle West, old; brick with wood and iron roof trussing and shingle roof, longitudinal shop, machine shop on one side, traveling cranes in erecting shop.

144. Middle West, modern; brick and steel, tranverse shop, high for $\frac{2}{3}$ of width with heavy crane, the remaining $\frac{1}{3}$ being low, with saw tooth roof.

145. Middle West, $\frac{3}{4}$ old, $\frac{1}{4}$ new, brick and steel, tranverse shop, new part 2 stories; no traveling cranes.

146. Pacific Northwest, modern; brick and steel, overhead crane.

147. Pacific Southwest, modern; brick and steel, overhead crane.

148. Far West, modern; brick and steel, overhead crane.

Machine Shop

Item	Cost per Sq Ft of Ground Area				Cost per CF	
	Building only	Tools	Misc. Eqpt.	Total	Building only	Total
157	$.952	...	...	....	$.038	...

157. Middle West, old; brick and wood, gravel roof supported by posts.

Boiler and Tank Shops

Item	Cost per Sq Ft of Ground Area				Cost per CF	
	Building only	Tools	Misc. Eqpt.	Total	Building only	Total
158	$2.98	$.72	$.84	$4.54	$.083	$.127
159	1.58	.40	....	....	.049	....
160	.84	.94	.076	1.87	.033	.075
161	1.66	.48	.083	2.24	.059	.080
162	.99	...	....	....	.025	....
163	1.53	.96	....	....	.095	....

158. East modern; brick and steel, cranes cover entire floor, saw tooth roof.

159. Middle West, modern; brick and steel, one-half width high for crane service, the other half lower and without crane.

160. Middle West, old; brick and wood with slate roof.

161. Middle West, old; brick and wood, shingle roof, gallery along one side, cranes over part of floor space.

162. Pacific Southwest, modern; brick and steel, overhead crane, smith shop in one end.

163. Middle West, $\frac{2}{3}$ old, $\frac{1}{3}$ new; brick and wood, new part 2 stories, no overhead cranes. (?)

Smith Shops

Item	Cost per Sq Ft of Ground Area				Cost per CF	
	Building only	Tools	Misc. Eqpt.	Total	Building only	Total
164	....	$.734	$.110	....	....	....
165	$2.63	.982	.171	$3.78	$.080	$.115
166	1.79	.144	....	....	.049	....
167	.432	2.26	.086	2.77	.019	.126
168	1.06	1.09	.050	2.22	.035	.074
169	2.25	....	....	....	....	....
170	1.43	.665	.435	....	.042	....
171	1.50	....	....	....	....	....
172	2.37	1.96	.348	4.68	.052	.104
173	1.21	....	....	....	.041	.055
174	1.38	....	....	....	....	....
175	.91	.60	....	....	.031	....

164. Middle West, old.

165. East, modern; brick and steel, high and light, thoroughly equipped.

166. Middle West, modern; brick and steel, 100′ wide, hip roof without posts.

167. Middle West, old; brick and wood with slate roof.

168. Middle West, old; brick and wood, shingle roof.

169. Southeast, modern; brick and steel, unusually high (33′ from floor to lower chord of roof truss).

170. Middle West, modern; brick and steel.

171. Middle West, modern; brick and steel, tile and gravel roof.

172. Middle West, modern; brick and steel, brass foundry and car machine shop under same roof, equipment very complete.

173. East, modern; concrete and steel, 80′ span, no posts.

174. Northeast, modern; brick and wood, 60′ span, no posts, simple construction.

175. Middle West, $\frac{2}{3}$ old, $\frac{1}{3}$ new; brick and wood (?).

Iron Foundry

Item	Cost per Sq Ft of Ground Area				Cost per CF	
	Building only	Tools	Misc. Eqpt.	Total	Building only	Total
176	$3.18	....	....	....	....	....

176. Brick and steel, modern; U. S. Navy Yard, Bremerton, Wash.

PATTERN AND UPHOLSTERY SHOP

Item	Cost per Sq Ft of Ground Area				Cost per CF	
	Building only	Tools	Misc. Eqpt.	Total	Building only	Total
178	$.857	....	$.131	$.988	$.043	$.050

178. Middle West, old; modern building, 2 stories.

PASSENGER CAR REPAIR SHOPS

Item	Cost per Sq Ft of Ground Area				Cost per CF	
	Building only	Tools	Misc. Eqpt.	Total	Building only	Total
179	$1.24	....	$.016	$1.25	$.042	$.043
180	1.20	....	....	....	....	....
181	2.64	$.044	.096	2.78	.099	.105
182	1.34	....	.015	1.35	.056	.057
183	.68	.003	.057	.74	.026	.028
184	.83	....	....	....	.029	....

179. Middle West, modern; longitudinal shop, brick and wood.

180. Southeast, modern; transverse shop, brick and wood, has upholstery and cabinet shops under same roof.

181. Middle West, modern; transverse shop, brick and steel, includes upholstery and trimming shop and hot air heating.

182. East, modern; transverse shop, brick and steel, with cement foundation, saw tooth, wooden roof.

PASSENGER CAR PAINT SHOPS

Item	Cost per Sq Ft of Ground Area				Cost per CF	
	Building only	Tools	Misc.Eqpt.	Total	Building only	Total
185	$1.24	....	$.044	$1.24	$.04	$.04
186	1.94	$.055	.092	2.09	.072	.178
187	1.02	....	....	....	.033	....
188	1.20	....	....	....	....	....
189	1.01	....	.039	1.05	.035	.036
190	.35	....	....	....	....	....
191	2.36	.009	.056	2.43	.081	.084
192	1.13	....	.009	1.14	.051	.052
193	.68	.003	.057	.74	.026	.028
194	.89	....	....	....	.032	....

183. Southeast, modern; transverse shop, brick up to window sills, corrugated galv iron sheathing on wooden frame above, gravel roof, granolithic floor, used also for painting and varnishing. (Identical with Passenger Car Paint Shop No. 193.)

184. Middle West, old; brick and wood (?).

185. Middle West, modern; longitudinal shop, brick and wood.

186. East, modern, longitudinal shop, brick and steel, saw tooth roof, hot air heating.

187. Pacific Southwest, modern; transverse shop, brick and steel.

188. Southeast, modern; transverse shop, brick and wood, has varnish room and pipe shop under same roof.

189. Northeast, modern; longitudinal shop, brick and steel, includes small paint, varnish and boiler rooms at one end.

190. South, old; wooden structure.

191. Middle West, modern; transverse shop, brick and steel, includes cleaning rooms, varnish room and hot air heating.

192. East, modern; transverse shop, brick and steel with cement foundations, saw tooth, wooden roof.

193. Southeast, modern; transverse shop, brick up to window sills, corrugated galv iron sheathing on wooden frame above; gravel roof, granolithic floor, used also for coach repairs. (Identical with Passenger Car Repair Shop No. 183).

194. Middle West, old; brick and wood (?).

Freight Car Repair Shops

Item	Cost per Sq Ft of Ground Area				Cost per CF	
	Building only	Tools	Misc.Eqpt.	Total	Building only	Total
195	$.40	....	$.016	$.415	$.022	$.023
196	2.12	$.123	.047	2.29	.075	.080
197	.29	....	....	.29	.015	.015

195 Middle West, old; wooden building, longitudinal, entirely enclosed.

196. Middle West, modern; brick and steel, longitudinal, includes cabinet shop and hot air heating.

197. Middle West, old; large shop, longitudinal, construction not known, but probably wood with partly open sides.

Car Smith and Car Machine Shops

Item	Cost per Sq Ft of Ground Area				Cost per CF	
	Building only	Tools	Misc. Eqpt.	Total	Building only	Total
199	$.77	$1.06	....	....	$.028	....

199. Middle West, old; brick and wood (?).

Wheel and Axle Shop

Item	Cost per Sq Ft of Ground Area				Cost per CF	
	Building only	Tools	Misc. Eqpt.	Total	Building only	Total
200	4.03	2.16	.72	6.91	.16	.276

200. West, modern; brick and steel, for car work only.

Car Repair Shop and Planing Mill

Item	Cost per Sq Ft of Ground Area				Cost per CF	
	Building only	Tools	Misc. Eqpt.	Total	Building only	Total
201	.975	....	....	....	.031	....

201. Pacific Southwest, modern; brick and steel, has intermediate 2-story section for sub departments.

Planing Mills

Item	Cost per Sq Ft of Ground Area				Cost per CF	
	Building only	Tools	Misc. Eqpt.	Total	Building only	Total
202	.487	.54	.010	1.04	.026	.056
203	1.15	1.18	.25	2.58	.045	.102
204	.76	1.21	2.92	2.26	.033	.098
205	1.85	....	....	....	....	....
206	.37	....	....	....	....	....
207	2.54	1.44	.082	4.06	.095	.153
208	2.53	.558	....	....	.057	....
209	.39	.50	....	....	.014	....
210	.74	.485	.239	1.47	.037	.073

202. Middle West, old; wooden building, tools and equipment very light.

203. Southeast, modern; brick up to floor line, then corrugated galv iron on insulated wooden frame, basement and 1 story, gravel roof, mechanical power in annex, cabinet shop in wing.

204. Middle West, old; brick and wood, slate roof.

205. Southeast, modern; steel and brick.

206. South, old; wooden structure.

207. Middle West, modern; brick and steel, does not include cabinet shop, which is separate.

208. Middle West, old; brick and wood, includes pattern shop (?).

210. West, modern; wooden (?).

Storehouses

Item	Cost per Sq Ft of Ground Area				Cost per CF	
	Building only	Tools	Misc. Eqpt.	Total	Building only	Total
211	1.142	....	.168	1.31	.044	.050
212	3.60	....	....	....	....	....
213	3.05	....	.67	3.72	.073	.089
214	2.40	....	....	2.72	.110	.124
215	2.00	....	....	....	.050	....

211. Southeast, modern; brick up to window sills, then corrugated galv iron on unsheathed wooden frame, 2 stories, gravel roof, platform, bins, shelves, etc., complete.

212. Southeast, modern; brick and steel, 2 stories and basement, extensive offices in 1 end on both floors.

213. Middle West, modern; brick and wood, 3 stories.

214. East, modern; concrete construction, 1 end 2 stories, upper floor used for offices.

215. Middle West, old; brick and wood, 2 stories (?).

Oil Houses

Item	Cost per Sq Ft of Ground Area				Cost per CF	
	Building only	Tools	Misc. Eqpt.	Total	Building only	Total
216	5.41	....	1.43	6.84	.208	2.63
217	3.52	....	1.55	5.07	.196	.302
218	1.33	....	....	....	.089	....
219	2.15	....	1.34	3.49	.097	1.59

216. Middle West, modern; brick and steel, basement and 1 story, full equipment of tanks, etc.

217. East, modern; concrete walls and roof, 1 story with deep basement.

219. West, modern; brick and steel, tile roof, 2 stories.

220. Middle West, old; 63′ span, brick and wood, slate roof, trussed (no posts).

221. Pacific Southwest, modern; 80′ span, brick and wood, roof supported by posts.

222. Far West, modern; part 75′ span, part 85′ span, brick and wood, gravel roof, supported by posts.

223. Far West, modern; 85′ span, brick and wood, gravel roof, supported by posts.

224. Middle West, old; 65′ span, brick and wood, gravel roof, supported by posts.

ROUNDHOUSES

Item	Cost per Stall				
	No. of Stalls	Building only	Tools	Misc. Eqpt.	Total
220	18	1,388.88	.....	.....	.....
221	46	1,155.00	.....	.....	.....
222	10	2,400.00	.....	.....	.....
223	10	1,757.70	.....	.....	2,090.00
224	30	.....	.....	.....	1,500.00
225	13	1,040.00	.....	.....	.....
226	8	2,750.00	.....	.....	.....
227	7	1,033.00	.....	.....	.....
228	33	.....	.....	.....	2,200.00
229	..	.....	.....	.....	1,845.00
230	44	1,998.00	133.00	328.00	2,459.00
231	30	4,150.00	.....	.....	.. ....
232	25	1,950.00	.....	.....	2,455.00
233	48	2,480.00	.....	.....	.....
234	25	1,719.00	.....	.....	.....
235	18	1,011.00	.....	.....	.....
236	23	1,065.00	.....	.....	.....
237	44	1,740.00	.....	.....	.....
238	40	1,875.00	87.50	787.50	2,750.00

225. Middle West, old; 78′ span, brick and wood, gravel roof, supported by posts.

226. Middle West, modern; 89′ span, brick and wood, gravel roof, supported by posts.

227. Middle West, old; 80′ span, brick and wood, gravel roof, supported by posts.

228. East, modern; 81′ span, brick and steel, gravel roof, supported by flat truss (no posts), rolling steel doors, cost does not include heating equipment.

229. Northwest, modern; 84′ span, brick and wood, gravel, roof supported by posts, cost does not include heating equipment.

230. Northeast, modern; 80′ span, brick and wood, gravel roof, supported by posts, annex with boilers, heating apparatus (hot air), and air compressor.

231. East, modern; 90′ span, brick and steel, slag roof, with crane runway covering outer half of span, has very heavy pile and stone foundation.

232. East, modern; 80′ span, concrete and wood, gravel roof, supported by posts.

233. Northeast, modern; 75′ span, brick and wood, gravel roof, supported by posts.

234. Northeast, modern; 75′ span, brick and wood, gravel roof, supported by posts.

235. Northeast, modern; 72′ span, brick and wood, gravel roof, supported by posts.

236. West, modern; 80′ span, brick and wood, gravel roof, supported by posts.

237. Middle West, part old, part modern; 70′ and 85′ spans, gravel roof, supported by posts (?).

LAVATORY

Item	Cost per Sq Ft of Ground Area				Cost per CF	
	Building only	Tools	Misc. Eqpt.	Total	Building only	Total
239	....	....	....	2.55	....	....

239. Middle West, modern; average of 3 large lavatories (including water closets, urinals, wash room and locker rooms); buildings of concrete and brick with tile roofs on wooden trusses; cement floors, complete with contents, ready to use.

OFFICE BUILDINGS

Item	Cost per Sq Ft of Ground Area				Cost per CF	
	Building only	Tools	Misc. Eqpt.	Total	Building only	Total
240	3.06	....	....	....	.030	....
241	8.01	.557	.295	8.86	.167	.187
242	1.04	....	....	....	.034	....

240. Middle West, old; frame building with brick foundation, includes M. M. Store department, steam heat.

241. Middle West, modern; brick and wood, basement, 2 stories and attic, ornamental architecture.

242. Middle West, old; wooden, 2 stories and basement (?).

TRACK

Item	Cost per LF	Add for each Switch	Notes
243	0.70	170.00	Based on use of "fit" (second hand) 67 lb rail.
244	1.00	180.00	Based on use of "fit" (second hand) 85 lb rail.
245	1.00 to 1.25	75.00 to 125.00	Based on use of new rail, according to weight.

Turntables

Item	Diameter	Cost	Notes
246	70 ft	$3,000	Exclusive of pit.
247	70 ft	5,091	Including pit (?).

Transfer Pits and Tables

Item	Cost Per Sq Ft of Pit			Notes
	Pit	Table	Total	
248	.31	.17	.48	Far West, modern; to handle the heaviest class of engines.
249	.43	.16	.59	East, modern; pit of concrete throughout; capacity of table, 200 tons.

Miscellaneous Structures

Item	Name	Cost
250	Ash pit	$30.00 per lf
251	Coal Chute	.65 per sq ft
252	Water Tank	1,900.00 total
253	Water Pipe, Underground Laid	1.43 per lf
254	Sewer Pipe, Underground Laid	2.88 per lf
255	Long Lines of Wrt Iron Pipe (for Air, Gas or Water), with Usual Proportion of Valves, Fittings, etc., in place.	25.00 per 100 lf 1″ diam 45.00 per 100 lf 2″ diam 85.00 per 100 lf 3″ diam 130.00 per 100 lf 4″ diam

Notes

251. Two sided with trestle approach (?)
252. Fifty thousand gall capacity on timber trestle (?)
253. Large system, pipes from 12″ down to 4″.
254. Large system, pipes from 24″ down to 12″.
255. Given by large pipe contracting firm of Pittsburg.

MINOR BUILDINGS

Item	Name	Cost Per S F	Cost PerCF	NOTES
256	Iron Storehouse.....	.24	.011	Old, Wooden (?)
257	Brass Foundry.....	1.96	.098	Old, Brick and Wood (?)
258	Upholstery Shop.....	.58	.029	Old, Brick and Wood (?)
259	Paint Mixing Shop...	.58	.029	Old, Brick and Wood (?)
260	Paint Storehouse.....	1.75	.087	Old, Brick and Wood (?)
261	Freight Repair Shed..	.11	....	New,Wooden,OpenSides(?)
262	Dry Kiln.....	.79	.039	Old, Wooden (?)
263	Lumber Shed.....	.21	....	Old,Wooden,OpenSides(?)
264	Storehouse Shed.....	.31	.015	Old, Wooden (?)
265	Coal Shed.....	.24	.020	Old, Wooden (?)
266	Coal Shed.....	.25	.021	Old, Wooden (?)
267	Charcoal Shed.....	.21	.017	Old, Wooden (?)
268	Ice House.....	.57	.028	Old, Wooden (?)
269	Ice House.....	.60	.030	Old, Wooden (?)
270	Crematory.....	2.52	.210	
271	Small Office Building.	.50	....	Old, Wooden, One Story

(The Report of the Master Mechanics ends here.)

Shop Equipment

Foundations for Steam Hammers. The following figures are approximate, as depth, soil and manufacturers' ideas differ. On good soil piles are unnecessary. Add profit. Change unit prices to suit local rates.

800 lb Hammer:

1,050′	lumber @ $36 and $8.00 for labor	$46.20
15	yds excavation	7.50
12	piles	72.00
12	cu yd concrete	96.00
	Bolts	10.00
		$231.70

1,100 lb:

1,650′	lumber	$72.60
15	yds excavation	7.50
12	piles	72.00
12	cu yd concrete	96.00
	Bolts	16.00
		$264.10

2,500 lb:

2,150′	lumber	$94.60
25	yds excavation	12.50
16	piles	96.00
25	cu yd concrete	200.00
	Bolts	24.00
		$427.10

5,000 lb:

3,350′	lumber	$147.40
30	yds excavation	15.00
22	piles	132.00
28	cu yd concrete	224.00
		$518.40

Cranes:

50 ton electric, 75′ span	$19,000
25 ton electric, 75′ span	12,000
10 ton electric	6,200
15 hand	1,000

Motors included. Prices vary according to span, etc.

15 ton electric, 50′ span and 5 ton auxiliary hoist	$4,800
10 ton electric, 53′	3,750
2 ton electric, 24′	2,000
20 ton electric, 50′	4,750
60 ton stationary, electric	7,000
2 ton jib, electric	450
5 ton jib, electric	1,300
1 ton wall, electric	150
10 ton gantry, 53′	4,600

No Freight or Erection. But all these cranes are based on figures for low-priced years. The following are 1923 figures. Most of them are from one of the leading manufacturers for use here. They are, of course, approximate, and an addition of from 5 to 10 per cent might be necessary in times when all materials are on the upgrade, or a similar cut in a lower-price era. They are not set. Add freight.

Erection. The cost of this was set in a low-priced era, with wages for laborers at 25¢ per hour, at $3 per ton when taken directly off the cars. With another crane in place for lifting this rate will serve even in high-priced years. Without this, $5. On the 100-ton, 75 ft, the installation was $340.

Approximate Cost of Electric Cranes

Capacity, tons	Span ft	No. motors	Crane cost	Motors and controllers	Electrical work	Total
5	60	3	$4,200	$1,200	$500	$5,900
10	60	3	5,300	1,500	500	7,300
15	60	3	5,700	1,500	500	7,700
20	60	3	6,900	1,800	600	9,300
30	60	3	8,500	2,100	600	11,200
40	60	4	11,000	2,700	800	14,500
50	60	4	12,500	3,000	800	16,300
75	60	4	19,500	3,500	1,000	24,000
15	48	....	....	....	....	4,800
20	76	....	....	....	....	6,500
20	67	....	....	....	....	5,800
		(In	1918)			
100	75	....	....	....	....	28,000
250	....	....	....	....	....	76,000

Freight. This might run from $1 to $10 per rated ton, depending on distance. A fair average, merely for guessing purposes, would be $5 per rated ton for 1,000 miles.

Sand Crane installed, $175.

Cupolas for Foundries. For 63 in, $975; 78 in, $1,380.

Condenser for 2,000 h p, $10,000.

Blue Printing. Electric machines (large) from $230 to $400.

Benches

Brazing with $\frac{1}{4}$-in steel top, 3-in plank, drawers and doors, $6 per linear foot.

Cabinet Makers' Bench fully equipped to special design, $75.

Machine Bench$_9$ covered with $\frac{1}{4}$-in steel top, 4 large drawers 15 trays, both of steel, and doors, $8 per linear foot.

Boilers

For 250 h p marine, $3,900, not set.

For 100 h p marine, $1,800, not set.

For two 42″×14′ set up, $2,450.

In 1912, horizontal multitubular boilers cost when set about $11.50 per horsepower, for sizes 60 in to 66 in. Water-tube, about

200 h p from $15.50 to $16.50 per horsepower set. Scotch, $16.50 in sizes from 100 to 150 h p.

But 1912 prices were lower than "after the war ones." In 1920, however, 400 h p boilers, equipped with stokers and superheaters, were put in place for $6,200. In 1919, 1,000 h p. $17,500.

Motors (1923)

Complete with base, pulley and starter

H.P.	Alternating current				Direct current			
	R.P.M.	Cost	R.P.M.	Cost	R.P.M.	Cost	R.P.M.	Cost
1	1,800	$80	1,200	$97	1,700	$80	1,150	$96
2	1,800	96	1,200	111	1,700	104	1,150	147
5	1,800	140	1,200	174	1,700	186	1,150	226
7½	1,800	231	1,200	266	1,700	283	1,150	294
10	1,200	330	900	380	1,150	335	850	395
15	1,200	380	900	450	1,150	409	850	487
20	1,200	450	900	550	1,150	492	800	682

Motors—Slip Ring Type

Where direct current is not available it becomes necessary to use a slip ring, alternating current motor, if the speed is to be variable. This is also a better motor, but the extra cost has to be considered when making an approximate estimate, or in putting a valuation on a machine.

For 5 h p, $350; 10, $400; 15, $550; 25, $800; 50, $1,200.

Fans

For 60-in..... $400 Chicago
For 45-in..... 330

With 4 and 3 h p motors:

For 36-in, with motor attached..... $180.00 net
For 30-in, with motor attached..... 140.00 net
For 24-in, with motor attached..... 110.00 net
For 18-in, with motor attached..... 85.00 net

WATER METERS

2-in	$ 66
3-in	140
Crown 4-in	251
Crown 6-in	500

Water Filters. For 240 men, $300 in place, 7 to 14 gals per minute. For 15 to 30 gals, $400 set up; 24 to 48 gals, $630; 100 to 200 gals, $1,700. For domestic use from $10 up.

Turnstiles. From $40 to $200.

Transfer Tables and Pits. Pits may cost from $25 to $35 per linear foot, depending upon depth and sections; for an 80-ft table, $6,600; 90-ft, $7,000 to $7,500.

Refrigerators. One 7′×10′×12′, $225.
One 9′×19′×12′, $460.

Or 27¢ and 23¢ per cubic foot for common work of three thicknesses of flooring 4 of paper, and 1½ in of mineral wool.

Heater Box. One 12′×14′×9′ 6′, high, ceiled both sides, and lined with No. 22 galvanized iron, heated by coils, $360, complete, or 23¢ per cubic foot. Coils 40¢ per square foot.

Silvering Table. Copper lined, $2 per square foot

Lightning Rods. They should weigh not less than 6 oz to the foot. They are worth in place for ordinary buildings 45¢ per foot; and for chimney stacks, $1.50.

Windmills. For 12-ft, $250; 20-ft, $400; 25-ft, $475.

Track. Standard gage, $2.00 per foot; 2-ft, gage light rails, $1.00. Turntables, $70.

WATER PIPE—ADD 40% FOR 1923

Laid, 6-in	$1.40 per foot	Laid, 18-in	$3.50 per foot
Laid, 8-in	1.60 per foot	Laid, 24-in	5.00 per foot
Laid, 10-in	1.80 per foot	Laid, 36-in	8.75 per foot
Laid, 12-in	2.20 per foot	Laid, 48-in	15.50 per foot

Labor on laying 18-in, 50¢; 24-in, 75¢; 36-in, $1; 48-in, $1.50, included in total.

But cast-iron pipe varies greatly in weight, according to use, pressure, etc. See table in index.

Shop Floors. For a damp-proof floor, 8 bbls cinders to 1 of coal tar, laid 6 in thick, allow 8¢ per square foot; and for the 3″×4″ bedded 16 in on centers in the mixture, and covered with 2-in flooring, 16¢, making a total of 24¢ per square foot. Various kinds of these floors run from 24¢ to 30¢. Mastic, 25¢ per square foot.

Coal Tar costs more than water-gas tar. Bids on a large quantity ran from $2.70 to $3.90 per barrel of 52 gals. Water gas, about $2.00 to $2.50. Coal tar is used on gravel roofs.

N. Y., N. H. & H. R. R.—Cost Data, Shop Buildings in New York, Connecticut, and Massachusetts
Tracks not included

Building	Construction	Area sq. ft.	Cu ft, contents	Cost			
				Date built	Total	Per square foot	Per cubic foot
Whiting hoist building	Brick walls, concrete foundation, floor and pits. Slag roofing on frame roof. Steam heat, electric lights, power wiring	10,578	323,395	1920	$90,982.44	$8.60	$0.281
Erecting shop, 376×80 (inspection shed)	Brick walls, slag roof on frame concrete foundations and pits. Steam heat and electric lights	30,130	815,281	1913	89,049.00	2.95	.109
Machine shop (repair shop 376×150)	Brick walls, slag roof on frame concrete foundations. Steam heat, electric lights and plumbing	56,360	2,821,705	1913	208,904.00	3.70	.074
Engine house, boiler house and machine shop	Brick and tile walls. Concrete foundation, floor and pits. Slag roofing. Steam heat, electric lights and plumbing	23,736	489,900	July, 1918 Feb. 1919	120,546.16	5.08	.245

"Down South"

A book on valuation goes to all sections of the country; and for comparison with northern states some figures on buildings in the southeast are given through the courtesy of the Central of Georgia Railway Co. In general, they are lower than for the northern states, but machine shop is more than No. 7.

M. & E. Shop. This shop, built in 1910, is 181′×514′ in round figures, and has some small extensions, making a total area in square feet of 97,738 at $3.384, and 4,728,738 cu ft at 7¢. Total cost, $330,752.

Standard construction, pile foundations, concrete spread work for all other piers, brick, steel framework, concrete floor with 3-in creosoted wood blocks, 120-ton crane, 20-ton, 10-ton and 7½-ton.

In round figures, foundation, $21,763; structure, $283,434; heat, $17,425; crane runways, $2,648; tracks in building, cross (23), $1,376; pipe tunnel, $4,100. Cranes not included in building costs.

Boiler and Tank. Square feet, 36,876, at $2,607; cubic feet, 1,638,766, at 5.9¢. Foundations, $10,296; structure, $76,726; heat, $8,576; runways, $444; tracks, $120.

Woodworking Shop. Of concrete, brick and steel, 53′×163′, 1910. Per square foot, $1.435 for 8,612 ft; per cubic foot, 5.45¢ for 226,746.

Car Shop. Size 198′×303′ 6″. Half the area on piles, the other half on spread concrete, brick walls, saw-tooth roof, wood trusses, per square foot, 91.2¢; per cubic foot, 2.6¢. Lumber is cheap in the south.

Blacksmith Shop. Size 103′ 6″×264′. Per square foot, $1.48 for 27,724; per cubic foot for 997,725, 4.11¢. Concrete, brick and steel. Foundations 8 ft deep.

Roundhouse. With 32 stalls and locker and washrooms at one end. About a third of the area is piled, and a 20-ft fill was required in some parts. Eight pits were piled. Size over all 87 ft 3 in, brick, wood roof, concrete base and creosoted wood floor. Per stall, $3,488; on basis of ordinary foundations, $3,091. Per square foot, $1.74 and $1.54. Heat, $6,831. Boiler washout system, $11,306. Turntable and tractor, $3,972 extra; pit for same, $3,889. All on 1910 basis, or, as shown in U. S. index numbers, 98.

Modern Power House. $31,795 complete. Per square foot, $3.31 for 9,602; per cubic foot for 424,621, 7.49¢. Per horsepower, $18.11 for 1,750 h p. Chimney stack extra, $41.14 per foot height for 103 ft, radial brick. Coal trestle extra, $2,024. Only 1,250 h p installed. Total cost of plant including machinery and equipment per horsepower (with provision for 500 h p more), $155. Per kilowatt, 1,425, $136. Concrete, brick and steel construction.

Passenger Station, 1912–1913. Concrete foundations, red tapestry brick walls, $\frac{3}{4}$-in mortar joints, flat clay tile roof. Total area, 5,664 sq ft at $3.47 each; $0.174 per cubic foot including cellar space. Heat, per square foot radiation, $1.108; $0.312 per square foot of floor space heated—express, baggage, loggia, no heat; $0.0226 per cubic foot of air heated. All under roof, 113,214 cu ft. Total cost, $19,643.

Another. Total cost, $13,896, per square foot, $3.60; cubic foot, $0.1636. In all, 3,860 sq ft, 84,920 cu ft. Press-brick walls, $\frac{3}{4}$-in mortar joints. Tile roof. 1913.

One More. Concrete foundations, brick walls, tile floor, 9,860 sq ft at $5.21; cubic foot, 20¢. As with the others, shelters and platform are not included.

U. S. Base Year, 1913. This station was finished in 1914 and cost $22,808, or 17¢ per cubic foot for building proper, 136,146 cu ft. Foundations of concrete, brick walls, tile roof. The shelter in front of station, 3,575 sq ft, cost per square foot, 38¢. An island shelter, 250 lin ft, wood, cost $4.57 per linear foot. Marquises, two, at 2′ 10″×30′, each $400.

Frame Station. Foundations of concrete, siding walls, metal shingles, 2,678 sq ft at $5.25 in 1914; 22¢ per cubic foot for 64,272.

CHAPTER VII

STANDARD 10-STALL 79.5, 85, 90 AND 114-FOOT ENGINE HOUSES: ALSO A 50-STALL RECTANGULAR ENGINE HOUSE

The standard engine house is now being increased from 90 to 100 ft and 114 ft on main lines of railroads.

Standards naturally differ on different roads, but a fair average may be had from the following figures. The 85-ft is old; the 114-ft house is of recent growth. The estimate will be of value, but a few remarks are necessary to remind the reader that all kinds of changes are possible and that local conditions might seriously affect the total. Length is over walls—not inside.

Excavation. The allowance is about 4 ft below base of rail. Instead of excavation a fill may be necessary, or the natural surface may be several feet too high, perhaps adding hundreds of dollars to the cost. Then the pits might not require to be excavated in the center, but only for footings run down on each side.

Concrete or Rubble. Quantity depends upon the section used, and the price upon locality. Footings are estimated 3 ft wide. The bottom of pits might be of same thickness full length; or might have to be level on base and the slope of solid concrete. There is more labor required on pits and angles than on a straight wall.

Cut Stone. Water table and sills are estimated at 8×8; for ordinary work 5×7 is used. Door sills are estimated stone. Water table might be of concrete. Window caps might be of stone, and not old rail to be cut and set. Pier blocks might be iron and not stone as below. A good local stone might be supplied for less than is estimated. Range work might have to be added.

Brick:—Walls ought to be 17″, but in a fit of economy they might be cut to 13″; and hight might be changed. Size and number of openings; price of brick, pilasters, and cornices are all subject to change. Pressed brick might be used. Number is given in wall measure.

Lumber:—This material is of various prices in different sections of the country; millwork varies by 20 to 30 per cent even in the same section; carpenters are paid 75¢ in one place and $1.10 per hour in another; and paving might be used in one house and left out in the next. An extra line of inside posts is used on the 90′ house.

Engine House of 10 Stalls

1922, U. S. Index No. 168

(Detailed estimate of cost without profit)

	Rate	79′-6″	85′	90′	79′-6″	85′	90′
Excavation	1.00	1,020	1,090	1,170	$1,020	$1,090	$1,170
Concrete	10.00	682	730	785	6,820	7,300	7,850
Cut stone, set	2.50	341	349	381	852	872	952
Brickwork	30.00	212,600	226,000	238,000	6,378	6,780	7,140
Coping and pit-pipe	.....	.....	.....	.....	190	195	200
Old rail	.....	.....	.....	.....	325	325	325
Lumber	60.00	100,300	112,500	124,500	6,018	6,750	7,470
Millwork and glass	.....	.....	.....	.....	1,400	1,400	1,400
Carp lab at $1 rate	.....	.....	.....	.....	2,300	2,500	2,750
Gravel roof	9.00	140	151	162	1,260	1,359	1,458
Hardware	.....	.....	.....	.....	500	510	520
Painting	.....	.....	.....	.....	450	450	450
Smoke jacks and ventilators	.....	.....	.....	.....	1,500	1,500	1,500
Track	2.00	800	850	900	1,600	1,700	1,800
Piping	.....	.....	.....	.....	2,200	2,270	2,340
Paving	3.00	952	1,040	1,111	2,856	3,120	3,333
Galv iron	.....	.....	.....	.....	100	110	120
Total	.....	.....	.....	.....	$35,769	$38,231	$40,778

Material, 72 to 74% of total. Labor, 28 to 26% of total.

There is no painting estimated on brick, posts or ceiling. Smoke jacks and ventilators are of wood—add $630 if steel is wanted.

Pits:—Pits are deducted from paving; and length is increased to correspond with house.

Piping is for air, steam and water. The low figure used calls attention to the fact that local prices must be filled in. See Heating of this house near end.

There is no gutter. Net prices are used.

Drop Pit:—If drop pit is used see the 114′ figures.

The average contractor would take such buildings for a profit of 6 per cent, or about $1400 additional; and out of this pay insurance, etc. If thrown open to bidding a cut of 10 to 15 per cent might be made—and the usual crop of accidents, liens, lawsuits, etc., spring up to vex the earth.

On the basis of 17 used on No. 2 (See Chap VI). 160,600, 170,700, and 179,800 actual brick are required; at 17½ to the cu ft as with very small brick, 165,350, 175,800, 185,100; at 15½ for very large, 146,500, 155,700, and 164,000, or a difference of about 20,000. On the 16¼ basis used on No. 8, 153,550, 163,200, 171,900 for the 3 different houses in round numbers, with brick clear to grade.

Inside Stalls

For inside stalls on same basis:

Excavation...	95 cu yd	103	113	$95.00	$103.00	$113.00
Concrete.....	61	68	75	610.00	680.00	750.00
Cut Stone....	25	25	28	63.00	63.00	70.00
Brick.....	11,500	11,800	12,100	345.00	354.00	363.00
Old rail.....				25.00	25.00	25.00
Lumber.....	10,200	10,700	11,500	612.00	642.00	690.00
Millwork.....				120.00	120.00	120.00
Carp labor...				220.00	238.00	262.00
Gravel roof...				126.00	136.00	146.00
Hardware....				48.00	48.00	48.00
Painting.....				37.00	37.00	37.00
Smoke-jack & vent.....				150.00	150.00	150.00
Track.....				150.00	160.00	170.00
Piping.....				220.00	227.00	234.00
Paving.....				285.00	312.00	333.00
Total.....				$3106.00	$3295.00	$3511.00

Add whatever profit is considered possible to total cost price.

For 8 inside stalls.....	$24,848	$26,360	$28,088
For 2 outside stalls.....	10,921	11,871	12,690
	$35,769	$38,231	$40,778
For 1 outside stall.....	$5,460	$5,935	$6,345
For 1 inside stall.....	3,106	3,295	3,511
Difference.....	$2,354	$2,640	$2,834

At 17 brick to the cu ft an inside stall requires 8,700, 8,900, 9,150.

Pit.—For the excavation of a standard pit allow 34 cu ft to each lin ft full length of pit, and add 3 cu yd for the deep end.

For concrete or rubble deduct the 2 ends, or 6′ 2″, from extreme length, and allow 184 cu ft for them; then multiply each lin ft of straight pit by 21.07, and add 184 to the result for the total in cu ft

Piles.—If piles are used, staggered about 4′ centers, allow for walls and piers, 64 for the 2 end stalls, and 14 for each inside stall. For each pit, 36. At $20 per pile, $1072 per stall on a 90′. 10 stall house.

If concrete is used instead of timbers, allow 2.5 cu ft to each lin ft of pit, a total of 23.57 cu ft

Light.—See Index for cost of Electric Lighting.

Change of Base. For a comparison the following figures are given, as compiled in 1904. The U. S. index number for that year is 79, as set in the revised list for 1922. The 1922 costs are more than double of the 1904 ones.

Ten Stalls

Detailed estimate of cost without profit

	Rate	79′ 6″	85′	90′	79′ 6″	85′	90′
Excavation...	.30	1,020	1,090	1,170	$306.00	$327.00	$351.00
Concrete.....	5.50	682	730	785	3,751.00	4,015.00	4,317.50
Cut stone, set.	1.61	341	349	381	549.00	561.90	613.40
Brickwork....	11.00	212,600	226,000	238,000	2,338.60	2,486.00	2,618.00
Coping and pit-pipe.....	...	.....	.....	.....	70.00	73.00	76.00
Old rail.....	...	.....	.....	.....	175.00	175.00	175.00
Lumber.....	18.00	100,300	112,500	124,500	1,805.40	2,025.00	2,241.00
Millwork and glass.....	...	.....	.....	.....	925.00	925.00	925.00
Carp. labor...	...	.....	.....	.....	920.00	1,000.00	1,100.00
Gravel roof...	4.50	140	151	162	630.00	679.50	729.00
Hardware....	...	.....	.....	.....	315.00	320.00	325.00
Painting.....	...	.....	.....	.....	250.00	250.00	250.00
Smoke jacks and ventilators.....	...	.....	.....	.....	550.00	550.00	550.00
Track.....	.60	800	850	900	480.00	510.00	540.00
Piping.....	...	.....	.....	.....	1,600.00	1,650.00	1,700.00
Paving.....	1.25	952	1,040	1,111	1,190.00	1,300.00	1,388.75
Galv. iron....	...	.....	.....	.....	37.00	40.00	43.00
Total.....	...	.....	.....	.....	$15,892.00	$16,887.40	$17,942.6

Material, 72 to 74% of total. Labor, 28 to 26% of total.

Inside Stalls

For inside stalls on same basis:

Excavation, cu yd	95	103	113	$28.50	$30.90	$33.90
Concrete.....	61	68	75	335.50	374.00	412.50
Cut stone.....	25	25	28	40.25	40.25	45.10
Brick.....	11,500	11,800	12,100	126.50	129.80	133,10
Old rail.....				12.00	12.00	12.00
Lumber.....	10,200	10,700	11,500	183.60	192.60	207.00
Millwork.....				80.00	80.00	80.00
Carpenter labor.				87.00	95.00	105.00
Gravel roof.....				63.00	67.95	72.90
Hardware.....				30.00	30.00	30.00
Painting.....				20.00	20.00	20.00
Smoke-jack & vent				55.00	55.00	55.00
Track.....				48.00	51.00	54.00
Piping.....				160.00	165.00	170.00
Paving.....				119.00	130.00	138.85
Total.....				$1,388.35	$1,473.50	$1,569.35

Add whatever profit is considered possible to total cost price.

For 8 inside stalls	$11,106.80	$11,788.00	$12,554.80
For 2 outside stalls	4,785.20	5,099.40	5,387.85
	$15,892.00	$16,887.40	$17,942.65
For 1 outside stall	$2,392.60	$2,549.70	$2,693.95
For 1 inside stall	1,388.35	1,473.50	1,569.35
Difference	$1,004.25	$1,076.20	$1,124.60

Rectangular Engine House.—When finishing the foregoing estimates I saw a plan of a rectangular engine house proposed by a R.R. worker as an improvement. This is rather an interesting substitute for the ordinary roundhouse, and as the cost was not given among the other advantages or drawbacks I made an estimate, as nearly as possible without working plans, so that a comparison might be had with the 85′ radial house. To correspond with that the size of the plan was changed to 85′ over walls instead of inside. The depth of footings and hight of walls are the same; roof is estimated at ½″ rise to the ft; prices are same. Steel lintels are put over triple openings, and that increases the cost; but there would not be sufficient light with 2 ordinary windows. Skylight and lantern are extra, and none too large.

The cost of a transfer pit might be set at $40 per lin ft but in some cases with deep concrete this might run as high as $95; with end walls not necessary in the proposed plan, and with 1 wall fewer in center the cost is $40 on same sections and depth. Pit is given separately, although enclosing walls necessarily go with building. Paving is not figured in pit. Traveling crane, drop pit, etc, are not estimated, but both buildings kept on same basis.

Summary of the plan of a 50 stall, 85′ rectangular engine house, 240′×471′:

Excavation	$5,300	Skylight	$8,000
Concrete	33,260	Hardware and lantern Gearing	1,875
Cut Stone	4,200	Painting	1,680
Brickwork	18,100	Smoke-jacks and vents	8,250
Steel lintels	4,200	Track	7,750
Lumber	41,300	Piping	10,300
Millwork	6,050	Paving	16,500
Carpenter labor	15,000	Flashing	500
Gravel roof	9,300		
			$191,565

Summary of transfer pit:

Excavation	$6,000	
Concrete	9,933	
Rail, bolts and clips	1,400	
Transfer table	12,000	
Side coping timber	700	
		$30,033
		$191,565
		$221,598

Summary of a 50-stall, 85-ft, radial engine house:

2 outside stalls	$11,871	
48 inside stalls	158,160	
1 turntable	8,000	
50 new frogs	3,500	
5000-ft track between table and doors	15,000	
		$196,531
Difference		$25,067

The roundhouse is 10 per cent cheaper than the rectangular plan. The plain L. S. D. "dollars and cents," argument is against a change unless some other reasons than cost carry the day. If the transfer table is cut out the walls can be materially shortened and the cost reduced, but a new method of working is required.

The 85-ft house is used as a basis, but the difference is about the same for other lengths.

Fire. Fire walls are not estimated on either plan. For a radial house, if used, see the 114-ft costs.

Heating. In these estimates the pipes are in place ready for steam heating; if the hot-blast system is used, instead, the supply has to be brought to the blower from which distribution is made. The cost is about the same as with the pipe system. Of six engine houses in different parts of the country heated by the blast system, the average of the work was $191 per stall; the price ranged from $165 to $245 in low-priced times. For 1923 allow $600 and $300 extra for a washout system.

Standard. The standard house is, of course, different on railroads, but the one from which the detailed figures are given is heavy enough to serve as a safe building to estimate from for an approximate figure.

Cost. On another plan an 8-stall 90-ft house cost $24,000 in one place, and $21,700 in another; and had 100,000 actual brick, with 15,000 for the two outside stalls. In the first case the cost per stall is $3,000.

A 90-ft Frame House should not cost over $3,550 per stall.

Reinforced Concrete Engine Houses. At Galewood, Ill., the estimated cost of 36 stalls was $80,000, or $2,200 per stall. This was for concrete up to the window sills and brick above. In 1923, $160,000.

Another of the same design and 30 stalls was built at West Milwaukee for $65,000, $2,167 per stall. Both were over 84 ft over all. In 1923, $130,000.

Smokejacks are of various styles and prices. A cast-iron fixed one is $180 f.o.b. Chicago; another $260; 3 styles of asbestos building lumber are $180, $250, $320. Wood, from $140 to $200.

Lighting. Allow in addition to all foregoing estimates $120 per stall for electric lighting, if required.

Turntables, 1923

For a 72-ft table allow $4,500 f.o.b. Chicago, weight 31 tons; 1,000 cu yds excavation; 127 cu yds concrete; 60 cu yds gravel for slope; 21 piles if any are used; $400 for ties, bolts, coping and labor; $190 for 70-lb pit rail; $80 for catch basin; $500 for bending rail and setting table, a total without the piles of $8,120.00, with excavation at $1.00, concrete at $10.00, and gravel at $3. Add profit, freight and piles, if required.

For a 75-ft table allow $5,500, Chicago; weight 38 tons; 1,070 cu yds excavation; 136 cu yds concrete; 66 cu yds gravel; 21 piles; $440 for ties, etc.; $200 for pit rail; $75 for catch basin, and $540 for bending unloading, setting; a total of $9,383. Add piles, etc., if necessary.

For an 80-ft table, 36 tons, and pit, allow $9,980.

For an 8-ft table, plain top, 5,800 lbs. $460 at Chicago.

Turntable Weights. For a 70-ft deck, 65,000 lbs; 80-ft deck, 72,000; 90-ft through, 175,000 lbs; 100-ft through, 190,000 lbs.

An approximate price at Chicago is 6¢ per pound for table alone.

The erection of a deck is about $12 a ton with ordinary railroad wages; and $17 for through, at 1923 rates.

Complete. With pit, all on the basis of the detailed ones above, allow for 90-ft, $18,000; for a 100-ft, $20,000.

The 1920 Detailed Cost of a 114-Foot Engine House

Two Styles. On branch lines and at ordinary towns the 90-ft roundhouse is still used; for terminals the large engines make longer houses necessary. The detailed costs of one type are given in order to supply a fair basis for an approximate estimate.

Special requirements might affect the total, as with the smaller houses—fills, piling, rock blasting, etc. Instead of the footings

being only 4 ft 6 in deep, as with the type here considered, they might be twice as much. On the other hand, steel columns and lintels might not be used.

The quantities being given local prices can be filled in to suit.

Length of Stall. In the type selected this is 114 ft inside the walls.

Outside Stall

Excavation, walls and heating duct, 107 cu yds	$ 107
Concrete, foundations and duct, 69 cu yds	690
150 lin ft cement water table, set, $1.50	225
17 lin ft concrete sills at main door, 12″×18″	25
Brickwork, 64,000 in wall measure, $30	1,920
165 lin ft cement molded coping, 6″×15″, $1.70	280
Lumber, 15,000 ft bm, $60	900
Carpenter labor on lumber, $20 per M	300
Carpenter labor on main doors, 1,900 sq ft windows, cornice, etc	300
Millwork and glass	1,100
Steel work, set at 10¢ per pound	1,343
Iron ladder on end wall	80
Cast-iron downspout, etc	40
Gravel roof, 27 squares at $9.00	243
Paving, 200 sq yds at $3.00	600
Painting, two coats	180
Piping, air, water, steam, heat washout	900
Flashing, side wall, rear, center, smokejack, 200 ft	80
Truss rods, castings, grating above steam duct, etc	140
Transite smokejack	220
Hardware—sash weights, door hinges, nails, etc	300
Track, 108 ft, $2.00	216
Pit, 95 ft, excavation, 120 cu yds at $1.00	120
Pit, concrete, 80 cu yds	800
Pit coping and bolts	114
Circular narrow gage track in rear, 30 ft	60
Engineering and contingencies, 10 per cent	1,128
Contractor's profit, 8 per cent	903
	$13,314

Actual Brick required on basis of 17 to cubic foot, 48,355. Bricklayer's wages, $1.25 per hour; laborer's, 60¢. For 8 hours 1,200 brick allowed to one bricklayer, and 1¼ laborer. Brick laid down at $20 per $1,000. The U. S. index number for 1920 is at the peak with 264, instead of 100 in base year of 1913.

INSIDE STALL

Excavation, 42 cu yds	$42
Concrete, foundations and duct, 25 cu yds	250
Cement water table, 30 lf, $1.50	45
Concrete sills under main door	25
Brickwork, 17,000, $30	510
Cement molded coping, rear and front, 47 lf	80
Lumber, 16,000 ft bm, $60.00	960
Carpenter labor on lumber, $20 per M	320
Carpenter labor on main doors, 544 sq ft windows, etc.	140
Millwork and glass	430
Steelwork, at 10¢ per lb, set	718
Cast iron downspouts	80
Gravel roof	243
Paving	600
Painting	90
Piping	900
Flashing	40
Truss rods, castings, gratings, etc	190
Smoke jack	220
Hardware	150
Track	216
Pit complete	1,034
Narrow gage track in rear	60
Engineering and contingencies, 10 per cent	734
Contractor's profit, 8 per cent	588
	$8,665

Difference.—The inside stall is thus $4,649 less than the outside one.

NOTE.—The carpenter labor is put at $1.00 per hour, the common at 60 cents.

The front steel columns are laced and surrounded with brick.

A ladder should be allowed every 10 stalls.

A fire wall should be put in every 7 stalls.

Trailer, pilot, and driver pits should be put in according to the requirements of the terminal. In the house under consideration the circular trailer pit was 55 ft long, the pilot, 68, one driver 62 and the other 67. All are circular, and run across three engine pits.

The extreme depth of the pilot and driver is 10 ft below bottom of rail, or floor line; the driver pits run down 19 ft. The rate given for excavation might easily be tripled if water were struck. So with the circular forms unless waterproof sheet piling were used or other means of keeping back the water. All that can be done here is to give quantities with a fair price for good soil, and leave local conditions for the engineers when making an approximate estimate.

The Fire Walls

In roundhouses of many stalls fire walls are built—one for about every seven stalls. The estimate on a wall 114 ft long is now given.

Excavation, 4 ft deep = 68 cu yds	$68
Concrete, 50 cu yds	500
Cement coping, 120 ft with upright parts, $1.70	204
Brickwork, 13″ wall with 7 double pilasters, 78,000 wall measure, $30	2,340
Flashing both sides	92
Fireproof metal clad door, 8×10′, track, etc	120
Engineering and contingencies, 10 per cent	332
Contractor's profit, 8 per cent	266
	$3,922

This runs close to $34.40 per lf; $1.17 per sq ft above the floor line; and 1.03 from the bottom of concrete foundation to cement coping above roof.

The Pits

Trailer Pit, Circular, 55 ft long.

Excavation, 70 cu yds, $3.00	$210
Concrete and circular forms, 50 cu yds. $20.00	1,000
Wood coping, cut to circle, 6″×12″, with bolts	80
Track, plates, clips, bolts, etc	180
Reinforced rails (6) and heavy castings	180
Engineering and contingencies, 10 per cent	165
Contractor's profit, 8 per cent	132
	$1,947

On a lin ft basis the cost is $35.40.

Pilot Pit, Same section, but 68 ft long $2,407

Driver Pit, (about 19 ft deep, 62 long, circular).

Excavation, 400 cu yds $4	$1,600
Concrete and forms, circular, 150 cu yds, $23	3,450
Coping, track, reinforced rails, etc	525
Engineering and contingencies, 10 per cent	558
Contractor's profit, 8 per cent	446
	$6,579

On a lin ft basis the cost is $106.11.

Driver Pit, No. 2 is 67 ft over all $7,110

COST OF A ROUNDHOUSE OF 14 STALLS×114 FEET INSIDE THE WALLS

Two end stalls at $13,314	$26,628
Twelve inside stalls at $8,665	103,980
One Fire Wall $3,922	3,922
Four pits	18,043
	$152,573

This is practically $10,900 a stall, which under former conditions seems twice as much as it should be. But when common brick sell at $18 per M, and masons' wages are $1.25 per hr; and other factors are in proportion the total figure has to rise.

On a house of seven stalls without a fire wall, with the same number of pits, the average cost per stall is $12,571. The high cost of the pits and end stalls is divided among five instead of twelve.

On a house of twenty-one stalls, with pits in one section only, and two fire walls, the average cost per stall is $9,481.

On some houses half the pits would serve, wood posts would be used in front instead of laced steel columns surrounded with brick, and the steel work in general would be eliminated. In some parts of the country lumber would cost only $35, and so on. But in an era of high prices the foregoing figures will serve for a fair approximate cost on the basis of the type selected.

With a standard plan in use the figure for engineering and contingencies might be cut in half.

Use Local Price.—Base estimates on the quantities.

Metal Windows. These might be used in place of wood, and higher price have to be set.

Altitude. The chief engineer of a large New York–Chicago road writes: "We have recently completed several reinforced concrete engine houses. Practically all of this work was done during the war period. The cost varied from $9,000 per stall to $30,000, the difference being due to the character of foundations of various houses, the higher cost houses being built on piles.

The following are extra good figures from the "New Haven":

N. Y., N. H. & H. R. R.—Cost Data, Engine Houses in New York, Connecticut, and Massachusetts

Tracks not included

Building	Construction	Stalls, feet	Area	Cubic feet, contents	Date built	Cost			
						Total	Per stall	Per square foot	Per cubic foot
Engine house	Brick walls, reinforced concrete roof. Concrete foundation, floor and pits. Plumbing, heating, lighting. Steam and air piping	10–87	20,000	455,000	1912	$ 85,040.00	$ 8,504.00	$4.25	$.187
Engine house ext.	Hollow tile walls, concrete floor. Slag roofing on frame roof. Concrete pits, steam heat, electric lights. Steam and air piping	10–103	22,000	503,852	May, 1918–1919	90,203.93	9,020.40	4.10	.180
Engine house	Brick walls and reinforced concrete roof, including plumbing and heating	10–87	16,960	440,336	1908	36,000.00	3,600.00	2.12	.082
Engine house ext.	Hollow tile and brick walls. Concrete foundations, floor and pits. Slag roofing on frame roof. Steam heat, electric lights. Steam and air piping	7–107	9,350	410,218	May–Nov., 1918	63,618.73	9,088.40	6.80	.156

Engine house	Pile and concrete foundation, concrete floor, 4 pits. Reinforced concrete walls and roof. Brick panels in walls. Slag roofing. Indirect heat, electric lights	43–87	74,616	2,024,108	1910	233,582.48	5,432.17	3.13	.115
Engine house	Hollow tile and brick walls on piles. Slag roofing, frame roof, heating, lighting and plumbing	18–97	34,400	824,120	April, 1918–1919	161,340.60	8,963.33	4.70	.196
Engine house	Hollow tile and brick walls. Slag roofing on frame roof. Concrete foundations, floor and pits. Steam heat, electric lights, plumbing. Steam and air piping	39–100	70,400	1,760,000	1917–1918	297,362.88 (Foundation cost $13,397.68)	7,624.66	4.22	.168
Engine house	Frame, novelty siding. Concrete foundations, floor and pits. Slag roofing. Steam and heat and electric lights	8–96	15,360	352,800	July, 1916–Dec., 1918	55,923.08	6,990.38	3.64	.159
Engine house	Frame, novelty siding. Concrete foundations, floor and pits. Plastic roof, steam heat, electric lights, plumbing. Steam and air lines.	4–107	8,828	203,967	April, 1917–Sept., 1920	42,994.90	10,748.70	4.87	.218

CHAPTER VIII

RAILROAD FIGURES

(The figures in this chapter are set to suit the U. S. base year, 1913, and apply to all such years, unless otherwise stated.)

Pump Houses, average of half a dozen, $1.40 per square foot.

Ordinary Water Tanks. Average of a score, $2,000, at 24 ft diameter. Prices from $1,800 to $2,500. Labor, 40 per cent of material. (See elsewhere in this chapter for tables of cost.)

Steel Water Tanks and Framework. An approximate price for elevated steel tanks as follows:

For 50,000 gal capacity, 100 ft to the top, erected complete, $4,000; for 100,000 gal, same height, $6,000.

Track Scales. For 50-ft, 80-ton, average of a dozen, $1,250; labor one-third of total. For (2) 40-ft, 80-ton, $1,500 each. For 40-ft, 100-ton, $2,600.

Turntables. The average of five built, 72 ft, was $5,000. An average price for half a dozen regular 66-ft tables, complete with pit walls, etc., was $4,000.

The following figures are kept, in order that an appraisal may be made for 70-ft sizes, found all over the country. The 1913 basis of 100 here may be changed to suit the year desired, or the quantities may be priced and depreciated from reproduction new.

70-Foot Table and Pit—Masonry on Piles and Pile Circle and Curb

2,500 lin ft cedar pile (40 tons) at 29¢	$ 725.00
10 cu yds cut stone (20 tons) at $5.40	54.00
5 cu yds crushed stone (6½ tons) at $1.75	8.85
10 bbls Port cement (2 tons) at $1.92	19.20
22 M lumber (36.7 tons) at $27.25	599.46
Bolts, rails, spikes and circle rail (7.14 tons)	214.43
1 70′ Lassig turntable (30.05 tons)	2,200.00
Total material	$3,820.94

Excav 1,175 cu yds at 50¢	$ 587.50
Shoring	51.56
Placing 5 cu yds concrete at $2	10.00
Setting 10 cu yds stone at $5	50.00
Driving 2,500 lin ft piling at 20¢	500.00
22 M lumber framed and placed at $15	330.00
Placing table and circle rail	100.00
Grand total (Lassig)	$5,450.00
Grand total (King)	5,100.00

70-Foot Turntable and Pit—Concrete Center and Circle

Material Weights for Above

400 lin ft piles at 20¢	$ 116.00
5,269 b m ties and floor	138.22
10 M b m 3″×8″ sheet piling at $25.60	256.00
1,792 b m circle wall coping, 3″x14″	49.26
1,480 b m 6″×8″ oak ties for circle rail	40.33
4,575 lbs circle rail and fastenings	58.43
640 lbs bolts, nails and castings	18.16
33 cu ft cut stone at 20¢	6.60
350 cu yds concrete at $3.98	1,393.00
1 70′ Lassig turntable	2,200.00
Total material	$4,276.00
*Excav 1,208 cu yds at 50¢	$ 604.00
Driving 400 lin ft piling at 20¢	80.00
Shoring 4,600 sq ft at 6½¢	300.00
Placing 350 cu yds concrete at $2	700.00
Setting center stone	5.00
Placing and framing 8,540′ lumber at $15	125.00
Putting in drain	10.00
Placing table	100.00
Grand total (Lassig)	$6,200.00
Grand total (King)	5,850.00

* For each foot less in depth deduct 165 cu yds.

Material Weights for Above

34.84 tons timber and piles.	2.48 tons cut stone.
2.78 tons oak ties.	109.50 tons crushed stone.
2.60 tons circle rail and hardware.	84.00 tons cement.
30.05 tons Lassig turntable.	262.5 tons sand.
26.25 tons King turntable.	

70-Foot Turntable and Pit—Masonry Center and Circle on Piles and Concrete

142 piles, 3,550 lin ft, at 29¢	$1,029.50
76 cu yds concrete at $3.98	302.48
10 cu yds 1st class masonry at $5.09	50.90
278 cu yds 2d class masonry	917.40
1 70′ Lassig turntable	2,200.00
4,968′ bm decking timber	125.00
200 lbs bolts and hardware	6.00
1,575 bm wall coping, 3″×14″, at $28	44.10
Turning levers and locks	18.41
3156′ bm circle rail ties at $27	85.21
Circle rail and fastenings	75.00
10 M. sheet piling, 3″×8″, at 25.60	256.00
Drain for pit	5.00
Total material	$5,115.00

800 cu yds excav between piles at 70¢	560.00
640 cu yds excav at 50¢	320.00
3550 lin ft piling driven at 20¢	710.00
3300 sq ft shoring at 6½¢	215.00
76 cu yds concrete placed at 2.00	152.00
10 cu yds 1st class masonry set at 4.00	40.00
278 cu yds 2d class masonry set at 3.50	973.00
9700 bm lumber set at 15.00	145.00
Placing table	100.00
Placing drain	10.00
Grand total (Lassig)	$8,340.00
Grand total (King)	7,990.00

Weights of Material

63.32 tons cement.
30.05 tons Lassig turntable.
26.25 tons King turntable.
4.3 tons circle rail, bolts and turning lever.
88.92 tons crushed rock.
383.00 tons stone.
89.64 tons lumber.
187.70 tons sand.

Ice Houses. A figure on large ice houses is given on page 140; the square-foot figures for a small house are given below:

Standard—4-in air space, pile head found, 12-in cinder floor, 6-in drain tile through center of house 2″×4″ studs separated by 1″×6″ fencing flooring, 1″×6″ lining fencing flooring, 1″×6″ drop siding on 1″×6″ fence floor, with tar paper between, shingle roof, floor to plate 16 ft.

28′×32′ House

Per square foot, $1.00. Per square foot for each additional 16 ft panel, 80¢. Capacity, 170 tons per 16 ft long.

Ice Houses. As a fair idea of the relative value of outside and inside houses of a larger type than the above, the following figures are given: Frame, 32′×112′×32′ high, outside houses, $4,800; inside, $3,800. The outside houses have an exterior wall, and the half of an inner; the inside houses have two half walls, or one whole, inside wall. The division walls are of cheaper construction than the outside ones, and are unpainted. A wall 112′×32′ is worth about $600, including foundation of pile heads and bases.

Board Park Fence

7-ft cedar posts, spaces 8 ft with 1″×6″ boards, two 1′×6′ braces. per panel with 1″×6″ face board on front of posts.

Cedar posts @ 10¢.....	0.41 ton	$1.30
312 ft bm 1″×6″ 16′ @ $24.60..	0.52 ton	7.69
12 lbs nails @ $2.20 per cwt.....	0.006 ton	0.26
Labor post holes @ 5¢.....		0.65
312 ft bm placed @ $8.....		2.50
Total for 100 lin ft.....		$12.40

Gas Pipe Park Fence

7-ft cedar posts, spaced 9′–3–1½″ wrought-iron pipe rails, cedar posts @ 10¢.....	$1.20
300′–1½″ wrought-iron pipe @ 7¢.....	21.00
Labor.....	2.80
Total for 100 lin ft.....	$25.00

Fences. Here it may be well to remind the reader that fences are built under various conditions, and on soils that change the labor cost considerably. It is easy to set posts on ordinary ground but difficult in a swamp or among rocks; and the weather has also to be taken into account.

Umbrella Sheds. A set of long ones on a large station had 100 lbs of steel to the linear foot. This is a hint for an approximate figure to save estimating laced columns, etc. The variety in this field is as great as in others.

The newest style of shed is wider than the ordinary one, and slopes from the coaches to the center of the platform.

The foregoing weights and figures apply only to what might be called ordinary construction. Such sheds as the "Northwestern" ones in Chicago with heavy framework and concrete roofs, occupy another field altogether.

Ordinary concrete sheds, $4 to $5 per square foot. From 12 to 16 lbs steel to the square foot of roof. This to include all framework. Reinforced concrete platforms extra, $2.50 per square foot. On a 1923 basis.

Approaches. Coaling stations of several types, and many power houses require approaches where the cars are backed up to the required height. A fair approximate valuation is $11 per linear foot without any masonry, but with piling; with masonry and piling, $12; without piling, $10. Add contractor's profit, and engineering percentage. But some approaches run as high as $19 net, without profit.

A detailed figure for one type of approach is as follows:

Length, 186 ft:

Excavation, no grading	$ 18.00
Masonry	198.00
Piling	120.00
Woodwork (bents, girders, ties, etc.)	1,600.00
Hardware	90.00
Rail (for approach and all structure)	176.00
Contractor's percentage, 10 per cent	220.00
Engineering and supervision, 5 per cent	121.00
	$2,543.00
Per linear foot	$ 13.67

Viaduct Platforms of the heaviest design, except for teaming, $5 to $7 per square foot. Steel beams, and the best of paving throughout.

Transfer Pit with walls of creosoted timber. Size, 92′×370″ Cost, $10,285. Table extra, $7,000.

Dry Kilns. The square foot costs of two were $2 and $2.33. The area in the one case was 1,700 sq ft and 1,900 in the other. See index.

Pits for coaches, engines, etc., are of various depths and thicknesses of walls, and thus have to be estimated to suit. A fair average is $9 per linear foot for coach pits, and $11 for the heavier class for engines. This does not include piling. Profit for contractor, and the usual allowance for making plans and supervision to be added at the final summary. (See the figures for 114-ft roundhouse.)

Cinder Pits in timber, $8 to $16 per linear foot; in masonry, $20 to $30.

Drinking Fountains in railroad shops may run from $5 to $100 each. A fair installation costs $85, not including supply and waste piping below floors, etc. Many shops have merely a faucet.

Folding Doors are much used now in freight houses. They are cut through the center like a Dutch door, and are worked with chains and weights. Sizes and special requirements regulate prices, but an ordinary door costs $85 f.o.b. cars at Chicago. This is about $1 per square foot. Allow from $15 to $20 for setting.

Sliding Doors lined all over with tin, 99¢ per square foot, on cars. Allow freight and hanging.

Coal Buckets used in the old style stations are mostly of a standard size, and weigh 1,000 lbs each.

Coal Bins are usually made on the basis of 40 cu ft to the ton. The city sealer of Chicago made out a table of 26 kinds of coal ranging from 34.30 cu ft to the ton to 45.61, Scranton nut being the low, and Indiana block the high. Coke required 76 cu ft. Scranton nut weighs 58.25 lbs to a cubic foot, and Indiana block 43.85. Coke, 26.30 lbs.

Cost of Bridges. In making a physical valuation of a railroad the buildings are kept separate from bridges, and the same valuator does not usually cover both. It sometimes happens, however, that an approach, small viaduct, etc., is so connected with the building that it is desirable to include it in the total. The following figures are for an approx estimate only, and for such cases, merely to supply a hint for an emergency in a field entirely apart from the one this book deals with. Most of the figures are taken from the "History of Bridge Engineering," by H. G. Tyrrell, Evanston, Ill., 1911.

Depreciation. "There are Roman and other bridges 2000 years old, and still likely to last for some time."

"A wooden bridge in Thibet was built in 1650, and lasted 150 yrs. Another in Bethlehem, Pa., was built in 1816." "But there are few wooden bridges now standing more than 100 yrs old. The normal duration of those which were roofed and protected from the weather was generally 30 to 40 yrs, while the open ones with-

out covering would last about one-third as long." But piles were found in good condition after 1100 yrs.

"Cast iron, though brittle, and less reliable than steel, has the merit of little or no corrosion from rust, and bridges of this material are still in use, long after later ones of wrought iron and steel have been destroyed." But "the failure of an iron Howe truss in 1876 with a span of 154 ft, in which accident 90 people were killed, resulted in discarding cast iron entirely by the railroad companies, and four or five years later it was also abandoned for highway bridges."

"In 1888 statistics showed that, for ten years or more, truss bridges on American railroads had been falling at the rate of 25 per year."

"On the 190,000 miles of railroad in the United States there are 80,000 metal bridges, not including wooden trestles, or 1,400 miles in all."

A table of viaducts given in the book shows lengths from 800 to 5,327 ft, heights from 180 to 435, and weight per ton per foot. On two about 200 ft high and 800 long the weight is approximately a ton to the foot; the heaviest 2.3 tons to the linear foot, 314 ft high, and 5,327 long.

Costs. "In the 1908 competition for the Connecticut Avenue viaduct at Washington, with steel arch spans from 282 to 410 ft, length of 1320 ft, and width of 70, the estimated cost was $4.00 to $5.00 per square foot of roadway.

"On a steel bridge in Pittsburg with a 400-ft. arch and a total length of 800 ft, the cost was $4.50 per square foot of deck."

On a station approach detailed as to cost in 1910 the figures ran to $4 per square foot, and this for the heaviest work with paving, etc., complete.

Sometimes the approx cost is given by profile area, as it naturally varies with the height. In two cases cited in "Bridge Engineering" this ran to $2.16 and $2 20 per square foot, but both examples are from European bridges, and lower than would ordinarily be the case here, although a Burmah bridge was built by Americans at $75 per ton, while the lowest bid from Europe ran to $130.

Solid Concrete. "The Walnut Lane bridge of Philadelphia has a clear span of 233 ft. The total length is 585 ft, by 60 wide. The cost, $7.40 sq ft of roadway. The height is 147 ft above the river.

"A Connecticut Avenue bridge in Washington is 120 ft above the valley, has five semi-circular arches of 150-ft span, and two of 82. The total length is 1341 ft. The false work cost $50,000, on which there was a salvage of $15,000. The framing of the false work cost $9 per M. The molded cement blocks cost $15 per cu yd. The

whole bridge cost $850, 000, equal to $639 per lin ft or $12.30 per square foot of surface.

Reinforced Concrete bridges naturally vary greatly in price according to purpose, profile, etc. A light bridge across a small ravine in a park does not belong in the same class as one for railroad traffic. For pedestrians a light park bridge may be built for $1.50 per square foot of roadway. Several river bridges built from 1902 to 1905 with seven spans cost about $2 per square foot. A bridge at Dallas, Texas 5106 ft long,with 51 arches cost $2.10 per square foot of roadway. A figure of $2.50 per square foot ought to cover this class of bridges under ordinary conditions.

Some Concrete Bridges. A concrete bridge 708 ft long was built in Cleveland for $210,000, or close to $300 per lin ft. It has one of the greatest concrete arches in the world, the span being 280 ft. The roadway is 40 ft wide, and on this basis the cost runs to $7.42 per square foot. There are two subways 3′ 3″×11′ 6″. It is a beautiful structure.

In 1909 a fine concrete bridge was thrown across the Arkansas River at Wichita, Kansas. It is 557 ft long, with a total width of 56′ and a roadway of 40′. The cost was $100,000, or about $180 per lin ft, $3.21 per square foot of width over all, and $4.48 per square foot of roadway width.

A beautiful iron and concrete bridge was built over the river Sitter in Switzerland in 1909. It has a clear span of 255 ft, and a total length of 459. It is 230 ft above water level. The bridge proper cost only $80,000, but wages are lower there than here. In round figures this is at the rate of $175 per lin ft.

A slab of concrete on ground level makes a cheap bridge. Water occasionally runs over the top. In some states this style is popular with farmers and taxpayers. A comparison was found when certain bids were taken: Steel, $1,400; slab, $400; steel, $3,000; slab, $666.

Wells and Roofs.—Many shop yards have large wells instead of a connection to the city supply. Here a detailed figure of one 16 ft. inside diameter×24 ft deep is given.

Allowing the stone walls 16″ thick, the total distance over them is 18′ 8″. The nearest figure in the table of areas on page 585 is 18′ 9″. This is close enough. The area in even figures is 276 sq ft, which multiplied by 24 gives a little over 245 cu yds. The unit price for excavation has to depend upon the local rate of wages, and the character of the soil. At a certain depth down mud might be reached instead of solid earth, and pumping be necessary. All that can be done is to use an average figure, say, in this case, of $1.25.

For the stone, the outside circumference is 58′ 8″, which multiplied

by the depth of 24 ft, and the thickness of 16″ = close to 70 cu yd. Around the top of most such wells the circle is squared to below the frost line to provide a base for a roof. At 18″ above ground, and 3′ 6″ below to fill out from the circle, an extra allowance of 8 cu yds is necessary.

Excavation, 245 yd at $1.25	$306.25
Stonework in cement mortar, 78 yd at $7	546.00
Roof and level floor under	80.00
Iron ladder	24.00
Painting	10.00
Contractor's profit, 10%	97.00
	$1063.25

No pumping machinery or piping. No allowance for cost of drawings. This is at the rate of $44 for each ft of depth. But some wells are only half of that depth— and in the Standard on Measurement we see that the Chicago rules allow four times the actual contents for depth between 20 and 25 ft; but only two and a half times between 10 and 15 ft. The masonry is also easier laid.

On another well 17 ft inside diameter, of the same depth and unit figures, the total is $1139. Per ft of depth, $47.50. Taken on the basis of the relative sq of diams—256 and 289—the figure would be $1200; in proportion to the circumference of a 16 ft and a 17 ft internal size—50.2 and 53.4—the figure is $1131.

On a 12 ft internal diam × 24 deep with unit figures, etc., as above, the total is:

Excavation, 152 cu yds at $1.25	$190.00
Stonework, 62 yd at $7	434.00
Roof, etc	60.00
Iron ladder	24.00
Painting	8.00
Contractor's profit, 10%	72.00
	$788.00

The cost per ft of depth is $32.82. Using the sq of the diam, and reducing in the proportion of 6 to 12—256 and 144—the total is $598; in proportion to the circumference of a 16 and a 12 ft—50.2 and 37.7—the figure is about $800.

Tanks and Towers

The following tables of cost are from the catalog of the W. E. Caldwell Co., Louisville, Ky. They are naturally approximate, as local conditions differ in many ways. They are priced f.o.b.

knock down at factory, and freight and erection must be added, as well as foundation. A barrel throughout is figured at 31½ gal.

Heavy Steel Tanks and Covers

(For storage of water, oil, turpentine, etc.)

Gallons	Diameter	Height	1923 Net Price. Tank	1923 Net Price. Cover
1,000	6 feet	5 feet	$42.00	$11.10
2,000	7 feet	7 feet	65.40	15.12
3,000	8 feet	8 feet	84.55	15.72
4,500	10 feet	8 feet	109.75	22.26
7,000	10 feet	12 feet	149.00	22.26
10,000	12 feet	12 feet	223.15	36.72
15,000	14 feet	14 feet	296.65	48.54
20,000	16 feet	14 feet	349.65	92.52
26,000	18 feet	14 feet	520.80	112.26
30,000	18 feet	16 feet	573.85	112.26
40,000	20 feet	18 feet	822.15	207.90
50,000	22 feet	18 feet	936.10	254.10
60,000	24 feet	18 feet	1,053.15	347.82
65,000	24 feet	20 feet	1,146.60	347.82
80,000	24 feet	24 feet	1,321.95	347.82
100,000	26 feet	26 feet	1,530.90	403.92

The smaller sizes of tanks are built of $\frac{1}{8}$-inch steel; the intermediate sizes of $\frac{3}{16}$-inch and $\frac{1}{8}$-inch, and the larger sizes of $\frac{1}{4}$-inch and $\frac{3}{16}$-inch.

Galvanized Steel Tanks

Galvanized round storage tanks

Diameter, Feet	Height, Feet	Capacity, Gallons	Price Net, 1923
2½	2½	78	$ 7.00
3	3	157	11.50
4	4	338	16.50
4	5	423	19.00
5	5	675	25.50
6	5	1,000	30.00
6	8	1,600	49.00
8	6	2,400	56.00
10	8	4,500	95.00
12	12	10,000	165.00
14	14	15,000	195.00
16	14	20,000	215.00
16	16	23,000	245.00

These capacities are, however, not meant to be absolutely exact but reasonably close.

Prices do not include covers.

List prices of all tanks are based on No. 20 Gauge. For tanks 6 ft diam, 6 ft high, to 8 ft diam, 8 ft high, inclusive, we recommend No. 18 Gauge; for tanks 10 ft diam, 8 ft high, and 10 ft diam, 10 ft high, No. 16 Gauge; for tanks 12 ft diam, 10 ft high, and 12 ft diam, 12 ft high, No. 14 Gauge. Larger tanks, No. 12 and No. 10 Gauge. No. 18 Gauge increases the price 30 per cent; No. 16, 60 per cent; No. 14, 90 per cent; No. 12, 140 per cent; No. 10, 200 per cent.

Rectangular Tanks cost a little more than the above round ones, and square ended rectangular cost more than round ended.

The following prices are for the steel towers only, and do not thus include tank. The panels are all cross braced with turn buckle rods. An iron ladder is supplied, also the wood base for the tank to rest on.

Gravity Tanks to Suit Insurance Requirements

These prices are for tanks built to suit the requirements of either the Factory Mutual Insurance Companies or any of the Stock Companies. Such tanks are required to be built of a certain size for a given capacity and to be provided with round iron (not steel) hoops of a specified number and size. They must be constructed of $2\frac{1}{2}''$ material if of 20,000 gal or less, and of $3''$ for larger sizes.

If furnished complete, the tanks must be provided with a shingled conical roof covered with shingles, ruberoid or metal, and an inside flat cover for frost proofing, together with an indicator or tank register, an inside wooden ladder, an outside iron ladder extending 3 ft above tank with ends curved over, and sub-joists or bed pieces for the support of the bottom tank.

Towers are not included, as these tanks quite often rest on the top of brick walls clear of the roof.

NOT GALVANIZED: PRICES NET, 1923

PRICES OF FOUR AND TWELVE COLUMN TUBULAR COLUMN STEEL TOWERS

FOUR-COLUMN TYPE

For 2,000 to 3,000 gallon tanks, not over 8 ft 0 in diameter, or 7 ft 6 in. deep, inside measurements

Hgt. in feet	Weight, pounds	Price with timber foundations under tank	Estimated cost of foundations in ground
15	2,226	$95.75	$20.00
20	2,756	129.80	20.00
39	3,714	198.60	20.00
63	5,436	315.45	20.00
75	6,361	378.25	20.00

For 7,000 to 10,000 gallon tanks, not over 12 ft 6 in diameter, or 13 ft 6 in deep, inside measurements

15	4,935	$180.75	$32.50
27	6,414	272.80	32.50
51	9,712	475.90	32.50
75	13,507	704.80	32.50

For 15,000 to 20,000 gallon tanks, not over 16 ft 0 in diameter, or 15 ft 6 in deep, inside measurements

Hgt. in feet	Weight, pounds	Price with timber foundations under tank	Estimated cost of foundations in ground
..	....	....	....
20	10,281	$ 397.25	$50.00
39	13,165	583.25	50.00
63	18,296	901.85	50.00
75	21,086	1,069.40	50.00

For 20,000 to 30,000 gallon tanks, not over 18 ft 0 in diameter, or 17 ft 6 in deep, inside measurements

15	10,515	$ 364.25	$60.00
27	13,083	582.55	60.00
51	18,677	882.15	60.00
75	24,939	1,268.50	60.00

Extra with I-beam caps, $70
Extra with all I-beam and wood dunnage, $166

TWELVE-COLUMN TYPE

For 40,000 to 50,000 gallon tanks, not over 22 ft 0 in diameter, or 19 ft 6 in deep, inside measurements

27	20,700	$ 851.25	
39	25,700	1,140.40	
51	30,825	1,435.30	
63	36,075	1,737.00	$110.00
75	41,430	2,044.65	
87	46,925	2,359.05	
100	52,525	2,680.15	

Extra with I-beam caps, $52
Extra with all I-beams and wood dunnage, $182

For 65,000 to 80,000 gallon tanks, not over 24 ft 0 in diameter, or 23 ft 6 in deep, inside measurements

27	28,750	$1,256.05	
39	36,000	1,673.95	
51	43,400	2,119.75	
63	51,000	2,572.30	$132.00
75	58,650	3,034.85	
87	66,400	3,501.40	
100	74,500	3,980.50	

Extra with I-beam caps, $110
Extra with all I-beams and wood dunnage, $280

For 50,000 to 65,000 gallon tanks, not over 24 ft 0 in diameter, or 19 ft 6 in deep, inside measurements

27	26,360	$1,090.80	
39	32,760	1,462.70	$132.00
51	39,300	1,842.05	
63	46,000	2,228.85	

For 50,000 to 65,000 gallon tanks, not over 24 in 0 ft diameter, or 19 ft 6 in deep, inside measurements

75	52,800	$2,623.75	
87	59,800	3,026.30	$132.00
100	67,000	3,437.80	

Extra with I-beam caps, $62
Extra with all I-beam and wood dunnage, $212

Net Prices, 1923, All-wooden Towers (No Tank)

Class A. Estimated Foundations, $20

Height in feet	Capacities of tanks towers will support	Shipping weight iron work, pounds	Cost iron work	Shipping weight tower complete, pounds	Cost of tower complete
15	2,000	412	$32.56	3,244	$85.57
39	to	646	54.66	6,070	157.22
63	3,000	920	77.38	9,889	247.65
75	gallons	1,082	91.08	12,206	302.67

Class C. Estimated Foundations, $33

15	7,000	572	44.91	5,945	145.38
39	to	908	73.31	10,211	249.10
63	10,000	1,331	110.89	15,611	382.08
75	gallons	1,561	130.41	18,481	452.20

Class E. Estimated Foundations, $50

15	15,000	796	62.28	9,568	227.18
39	to	1,197	98.43	15,912	377.23
63	20,000	1,768	140.18	23,620	555.78
75	gallons	1,925	165.26	27,965	655.38

Class F. Estimated Foundations, $60

15	20,000	988	76.96	13,053	306.63
27	to	1,213	95.70	17,085	398.35
51	25,000	1,806	148.15	26,576	621.35
75	gallons	2,484	206.48	37,590	877.75

List Prices of Round Tanks

Multiply prices by 2 for 1923

(These prices and weights are for 2-in tanks)

Gallons	Inside bottom diameter, ft in	Inside depth, ft in	Shipping weight, lbs	Price complete, riveted Hoops
74	3.0	1.5	146	$ 6.57
211	3.0	4.0	281	12.65
133	4.0	1.5	209	8.95
413	4.0	4.5	423	18.10
209	5.0	1.5	276	11.17
501	5.0	3.5	445	18.02
794	5.0	5.5	596	24.24
317	6.0	1.5	355	13.58
632	6.0	3.0	507	19.43
845	6.0	4.0	614	23.58
1,356	6.0	6.5	877	33.77
1,989	6.0	9.5	1,191	45.92
972	6.6	1.5	396	15.14
741	6.6	3.0	562	21.53
993	6.6	4.0	677	25.98
2,088	6.6	8.5	1,181	45.42
2,336	6.6	9.5	1,306	50.33
431	7.0	1.5	446	17.07
863	7.0	3.0	614	23.51
1,151	7.0	4.0	741	28.47
2,711	7.0	9.5	1,407	54.32
495	7.6	1.5	492	18.83
990	7.6	3.0	672	25.71
1,322	7.6	4.0	810	31.11
3,110	7.6	9.5	1,528	58.97
563	8.0	1.5	552	21.18
1,127	8.0	3.0	754	29.04
2,406	8.0	6.5	1,248	48.18
4,281	8.0	11.5	1,924	74.22
637	8.6	1.5	615	23.58
1,273	8.6	3.0	825	31.68
2,723	8.6	6.5	1,314	50.52
3,148	8.6	7.5	1,462	56.28
4,844	8.6	11.5	2,053	79.19
1,900	9.0	4.0	1,035	39.84
4,000	9.0	8.5	1,711	65.94
5,429	9.0	11.5	2,179	84.11
2,120	9.6	4.0	1,134	43.56
4,500	9.6	8.5	1,859	71.64
6,100	9.6	11.5	2,348	90.57

LIST PRICES OF ROUND TANKS—*Continued*

Gallons	Inside bottom diameter, ft in	Inside depth, ft in	Shipping weight, lbs	Price complete, riveted Hoops
3,182	10.0	5.5	1,454	$ 55.92
5,532	10.0	9.5	2,158	83.22
7,880	10.0	13.5	2,873	110.79
4,561	11.0	6.5	1,877	72.30
6,694	11.0	9.5	2,438	94.04
5,428	12.0	6.5	2,065	80.16
9,658	12.0	11.5	3,091	119.02
13,042	12.0	15.5	4,046	157.11
8,644	12.6	9.5	2,865	110.46
10,481	12.6	11.5	3,279	126.48
14,153	12.6	15.5	4,246	164.70
5,378	13.0	5.5	2,138	82.44
9,349	13.0	9.5	3,045	117.78
11,333	13.0	11.5	3,481	134.64
5,800	13.6	5.5	2,187	84.30
12,220	13.6	11.5	3,580	138.54
6,237	14.0	5.5	2,262	87.00
16,600	14.0	15.5	4,807	168.68
6,691	14.6	5.5	2,452	94.20
16,573	14.6	13.5	4,532	175.56
7,160	15.0	5.5	2,530	97.08
11,126	15.0	8.5	3,386	130.86
17,735	15.0	13.5	4,730	183.36
7,645	15.6	5.5	2,599	99.79
11,880	15.6	8.5	3,476	134.40
18,937	15.6	13.5	4,840	187.80
8,147	16.0	5.5	2,686	103.08
12,659	16.0	8.5	3,604	139.80
20,179	16.0	13.5	5,080	197.46
29,203	16.0	19.5	6,966	272.19
9,197	17.0	5.5	2,956	113.64
12,592	17.0	7.5	3,627	140.22
19,384	17.0	11.5	4,865	188.88
29,431	17.0	17.4	6,942	271.62
10,312	18.0	5.5	3,372	130.50
25,378	18.0	13.4	6,041	235.26
29,184	18.0	15.4	6,750	263.34
36,796	18.0	19.5	8,203	321.02
10,891	18.6	5.5	3,580	138.36
18,934	18.6	9.5	4,913	190.62
34,846	18.6	17.4	7,754	303.00

LIST PRICES OF ROUND TANKS—*Continued*

Gallons	Inside bottom diameter, ft in	Inside depth, ft in	Shipping weight, lbs	Price complete, riveted, Hoops
11,488	19.0	5.5	3,780	$146.58
17,852	19.0	8.5	4,830	187.80
24,212	19.0	11.5	5,890	229.50
32,520	19.0	15.4	7,366	287.82
12,729	20.0	5.5	4,036	157.02
19,779	20.0	8.5	5,072	197.34
26,830	20.0	11.5	6,160	240.00
36,035	20.0	15.4	7,734	302.40
45,435	20.0	19.4	9,281	362.46

NOTE. These prices on all tanks up to and including 20 ft in diameter are based on 2-in thick material; all tanks 22 ft in diameter and over are based on 2½- and 3-in thick material. All tanks above 20,000 gallons capacity are ordinarily made of thicker material than 2-in.

The following prices are for 3-in tanks:

15,402	22.0	5.4	7,773	$294.36
18,246	22.0	6.4	8,496	320.28
21,090	22.0	7.4	9,279	348.71
23,933	22.0	8.4	9,953	379.72
26,777	22.0	9.4	10,579	409.28
32,464	11.4	22.0	11,956	445.26
37,914	22.0	13.4	13,329	494.04
43,601	22.0	15.4	14,878	550.02
49,289	22.0	17.4	16,773	630.00
54,976	22.0	19.4	18,628	712.69
60,663	22.0	21.4	20,120	784.24
45,121	24.0	13.4	15,002	563.23
51,889	24.0	15.4	16,776	627.55
58,657	24.0	17.4	18,582	706.10
65,426	24.0	19.4	20,590	796.13
72,194	24.0	21.4	22,207	874.10
78,962	24.0	23.4	23,926	958.37
60,897	26.0	15.4	18,904	705.61
68,840	26.0	17.4	21,213	800.11
76,784	26.0	19.4	23,261	890.12
84,727	26.0	21.4	25,060	973.66
92,761	26.0	23.4	27,031	1,067.92
70,627	28.0	15.4	21,997	829.63
79,840	28.0	17.4	24,130	921.76
89,052	28.0	19.4	26,212	1,014.96
98,264	28.0	21.4	28,133	1,105.98
107,476	28.0	23.4	30,149	1,203.22
81,077	30.0	15.4	23,916	915.73
91,653	30.0	17.4	26,137	966.54
102,228	30.0	19.4	28,408	1,114.16
112,803	30.0	21.4	30,555	1,214.44
123,379	30.0	23.4	32,670	1,317.92

Tank with Plain Conical Cover, Cypress Shingles, Flat Cover, Ladders, Indicator and Dunnage.	Diameter Inside	Inside Depth	Shipping Weight	Price Complete
Gallons.	Ft. In.	Ft. In.	Lbs.	
5,000	10.0	11.4	5,451	$ 245.86
7,500	11.6	11.4	6,819	291.53
10,000	12.6	13.4	8,236	355.86
12,000	13.6	13.4	9,259	390.01
15,000	14.0	15.4	10,615	453.41
20,000	16.0	15.4	12,589	535.24
25,000	16.0	17.4	15,494	726.44
30,000	18.0	17.4	18,193	809.83
40,000	19.6	19.4	22,212	1,031.79
50,000	22.0	19.4	26,451	1,226.20
60,000	24.0	19.4	30,936	1,441.46
75,000	24.0	23.4	36,956	1,850.72
100,000	28.0	23.4	47,380	2,374.72

Key to Price List of Round Wooden Tanks

List Prices are for round tanks without a top head or cover. They are based on 2″ material for tanks up to and including 20′ 0″ in diam, and for 3″ above that.

Thickness of cypress tanks furnished is 1½, 2, 2½ and 3″. Of white pine and poplar thickness is 2″, and tanks of these woods are supplied over 16″ in diam.

Of yellow pine thickness is 2, 3, 4, 5, 6 and 8″.

We recommend 1½″ cypress for tanks as large as 8′ 0″ in diam and 8′ 0″ high, and it is often used in much larger tanks. 2″ material is used right along in tanks 16 and 18′ in diam, and sometimes 20′. We advise 2½″, however, for 17 to 20′ diam, and for larger sizes.

Shipping Weights for tanks 20′ in diam and less are based on 2″ material for either cypress, poplar, fir or white pine. 1½″ cypress tanks weigh about 20 per cent less; 2½ and 3″ about 40 per cent and 60 per cent more respectively.

Yellow pine tanks weigh about 40 per cent more than cypress.

For 1923. Wood tank, 200,00 gals., $14,500; steel, $18,500 erected. Foundation extra, $4,000.

List Prices of Round Tanks

(Cypress, White Pine, Yellow Pine, Fir and Poplar)

Number	Gallons	Inside Diameter Ft. In.	Inside Depth Ft. In.	Shipping Weight Lbs.	Price Louisville
1	127	3.0	2.5	199	$11.12
2	158	"	3.0	221	12.38
3	180	"	3.5	251	14.04
4	174	3.6	2.5	234	13.08
5	216	"	3.0	260	14.58
6	246	"	3.5	295	16.48
7	226	4.0	2.5	274	14.70
8	281	"	3.0	304	16.34
9	321	"	3.5	344	18.46
10	413	"	4.5	404	21.76
11	288	4.6	2.5	314	16.90
12	357	"	3.0	346	18.66
13	407	"	3.5	392	21.04
14	526	"	4.5	458	24.66
15	501	5.0	3.5	443	22.86
16	**587**	"	**4.0**	**479**	**24.74**
17	648	"	4.5	521	26.90
18	794	"	5.5	608	31.32
19	317	6.0	1.5	357	17.68
20	422	"	2.0	417	20.60
21	527	"	2.5	461	22.80
22	720	"	3.5	562	27.82
23	845	"	4.0	606	30.02
24	934	"	4.5	658	32.54
25	**1,145**	"	**5.5**	**768**	**37.92**
26	1,356	"	6.5	872	43.04
27	1,567	"	7.5	980	48.34
28	1,778	"	8.5	1,068	52.74
29	1,989	"	9.5	1,176	58.08
30	1,096	6.6	4.5	721	35.64
31	1,344	"	5.5	839	41.44
32	***1,592**	"	**6.5**	**950**	**46.90**
33	1,840	"	7.5	1,069	52.72
34	2,088	"	8.5	1,163	57.42
35	2,336	"	9.5	1,381	63.22
36	1,271	7.0	4.5	790	39.06
37	1,659	"	5.5	917	45.24
38	1,847	"	6.5	1,042	51.40
39	2,135	"	7.5	1,162	57.30
40	2,423	"	8.5	1,271	62.68
41	2,711	"	9.5	1,404	69.18
42	1,790	7.6	5.5	991	49.00
43	***2,120**	"	**6.5**	**1,128**	**55.56**
44	2,450	"	7.5	1,255	61.82
45	2,780	7.6	8.5	1,371	67.56
46	3,110	"	9.5	1,513	74.50
47	563	8.0	1.5	545	26.90
48	751	"	2.0	613	30.28
49	939	"	2.5	669	33.08
50	1,294	"	3.5	815	40.18
51	1,656	"	4.5	938	46.30
52	2,031	"	5.5	1,082	53.28

Sizes printed in black type are the standard sizes for the capacity mentioned.
*Sizes marked with a star preceding are the standard sizes used with towers.

LIST PRICES OF ROUND TANKS—*Continued*

Number	Gallons	Inside Diameter Ft. In.	Inside Depth Ft. In.	Shipping Weight Lbs.	Price Louisville
53	2,406	8.0	6.5	1,217	$59.96
54	***2,781**	"	**7.5**	**1,361**	**66.96**
55	**3,156**	"	**8.5**	**1,490**	**73.30**
56	3,531	"	9.5	1,669	81.90
57	4,281	"	11.5	1,971	96.56
58	2,299	8.6	5.5	1,163	57.28
59	2,723	"	6.5	1,306	64.30
60	3,148	"	7.5	1,459	71,76
61	3,572	"	8.5	1,597	78.56
62	3,696	"	9.5	1,784	87.48
63	4,844	"	11.5	2,106	103.10
64	2,577	9.0	5.5	1,259	61.92
65	3,053	"	6.5	1,420	69.74
66	3,529	"	7.5	1,580	77.56
67	**4,004**	"	**8.5**	**1,727**	**84.80**
68	4,479	"	9.5	1,865	93.36
69	5,429	"	11.5	2,242	109.72
70	881	10.0	1.5	758	37.40
71	1,175	"	2.0	862	42.44
72	1,468	"	2.5	934	46.04
73	2,006	"	3.5	1,113	54.70
74	2,592	"	4.5	1,255	61.80
75	3,182	"	5.5	1,450	71.26
76	3,770	"	6.5	1,631	80.02
77	4,357	"	7.5	1,809	88.64
78	4,945	"	8.5	1,969	96.56
79	***5,532**	"	**9.5**	**2,165**	**106.00**
80	6,706	"	11.5	2,539	124.08
81	7,880	"	13.5	2,897	141.50
82	**6,100**	**10.6**	**9.5**	**2,290**	**112.08**
83	1,269	12.0	1.5	1,004	49.66
84	1,692	"	2.0	1,133	55.88
85	2,115	"	2.5	1,217	60.08
86	2,891	"	3.5	1,431	70.50
87	3,737	"	4.5	1,623	80.00
88	4,582	"	5.5	1,837	90.44
89	5,428	"	6.5	2,050	100.86
90	6,274	"	7.5	2,284	112.24
91	**7,110**	"	**8.5**	**2,479**	**121.76**
92	**7,956**	"	**9.5**	**2,715**	**133.16**
93	9,658	"	11.5	3,164	154.96
94	11,350	"	13.5	3,637	177.84
95	13,042	"	15.5	4,154	202.62
96	7,726	12.6	8.5	2,602	127.78
97	**8,644**	"	**9.5**	**2,844**	**139.68**
98	***10,481**	"	**11.5**	**3,316**	**162.38**
99	12,317	"	13.5	3,717	186.10
100	14,153	"	15.5	4,345	211.88
101	10,080	13.6	9.5	3,122	153.04
102	**12,220**	"	**11.5**	**3,650**	**178.52**

Sizes printed in black type are the standard sizes for the capacity mentioned.
*Sizes marked with a star preceding are the standard sizes used with towers.

NOTE.—Tanks 14.0 and 16.0 foot diameter are usually built of 2 inch material and often 18-foot diameter tanks, but 2½ inch is advised for tanks over 16 feet diameter to 20 feet inclusive, and 3 inch for larger sizes.

LIST PRICES OF ROUND TANKS—*Continued*

No.	Gallons	Bottom Diameter Ft. In.	Inside Depth Ft. In.	Shipping Weight Lbs.	Price f. o. b. Louisville
103	8,540	14.0	7.5	2,766	$135.74
104	9,691	"	8.5	2,990	146.78
105	10,843	"	9.5	3,264	159.96
106	13,146	"	11.5	3,835	187.38
107	***15,449**	"	**13.5**	**4,382**	**213.76**
108	16,600	"	15.5	5,038	245.18
109	11,631	14.6	9.5	3,403	166.78
110	14,102	"	11.5	3,996	195.24
111	16,573	"	13.5	4,560	222.40
112	21,761	15.6	15.5	5,705	277.04
113	11,155	16.0	7.5	3,308	162.12
114	12,659	"	8.5	3,561	174.56
115	14,163	"	9.5	3,872	189.54
116	17,171	"	11.5	4,578	223.10
117	***20,179**	"	**13.5**	**5,319**	**258.36**
118	23,187	"	15.5	6,062	293.70
119	26,195	"	17.5	6,827	329.92
120	29,203	"	19.5	7,661	369.12
121	15,988	17.0	9.4	4,266	208.26
122	19,384	"	11.4	5,017	244.10
123	22,639	"	13.4	5,771	280.00
124	***26,035**	"	**15.4**	**6,532**	**317.28**
125	29,431	"	17.4	7,398	357.00
126	18,924	18.0	9.4	4,672	228.42
127	21,730	"	11.4	5,442	265.38
128	25,378	"	13.4	6,247	303.92
129	**29,184**	"	**15.4**	**7,128**	**346.68**
130	***32,990**	"	**17.4**	**8,050**	**389.48**
131	36,796	"	19.4	9,126	439.62
132	**34,252**	**19.6**	**15.4**	**7,828**	**379.60**
133	**38,726**	"	**17.4**	**8,927**	**431.06**
134	***43,200**	"	**19.4**	**10,023**	**482.26**
135	22,130	20.0	9.4	5,417	264.40
136	26,830	"	11.4	6,270	305.22
137	31,334	"	13.4	7,230	350.74
138	36,035	"	15.4	8,227	397.82
139	**40,725**	"	**17.4**	**9,417**	**453.12**
140	**45,435**	"	**19.4**	**10,558**	**506.32**

Sizes printed in black type are the standard sizes for the capacity mentioned.
*Sizes marked with a star preceding are the standard sizes used with towers.

Wire Fences *

(Courtesy of J. H. Downs, 39 Cortlandt St., New York)

Prices given are based on at least 2,000 lin ft of fence. A fair idea of cost can be had, and allowances made for special requirements.

Painting. The prices include painting, but for estimates at any future period the following figures will serve:

A good roofing paint should be used, and those who know what some roofing paints are will pay particular attention to the word "good." The brush should be about 7 in wide. "Where the woven wire is 84 in high, 1 gal of paint will cover about 80 lin ft, on both sides. A man will paint about 300 lin ft one side per day."

Number	Total cost per linear foot	Erection labor per linear foot	Number	Total cost per linear foot	Erection labor per linear foot
1	$1.35	$0.50	10	$1.15	$0.36
3	3.00	1.50	13	1.30	0.40
7	1.65	0.60	14	1.00	0.30
8	1.35	0.50	15	1.30	0.40
9	1.30	0.40			

Specifications. No. 1 is 99 in high, surrounding the Yale Bowl, New Haven. The woven wire is 84 in, of two 42-in sections, and barbed wire on top. Every third post on the curve is set in concrete. Other posts are anchored with vitrified clay collar. Posts are 10 ft apart.

No. 3 shows heavy non-climbable double gates.

No. 7 has woven wire 72 in high of No. 9 material with pickets $1\frac{7}{8}$ in apart.

No. 8 shows a double non-climbable fence for State Fair grounds.

No. 9 is 68 in high, posts 10-ft centers, and barbed wire on top.

No. 10 is nearly six miles long in all by 75 in high, posts 10-ft centers.

No. 13 is 73 in high, posts 10-ft centers. Straight top.

No. 14 is from 42 in to 58 in high.

No. 15 is 92 in high with posts spaced at 8 ft. The fence wire weighs 62 lbs per rod.

* These prices are on basis of 1923.

CHAPTER IX

RAILROAD MACHINE FOUNDATIONS

Workable Basis. The following tables will be of service to many who land in trouble when making up preliminary estimates for machines. The prices given are high enough to be safe. The shipping point and the weight settle the freight total when the rate is known. The installation cost per 100 lbs is from the Mid-Western Mechanical Valuation Committee, and the rate is based on average wages from 1910 to 1914 inclusive. An addition can be made for higher rates. See Installation in index.

It is, of course, much easier to put a machine on its foundation in a large shop with a traveling crane than in a small one with poor facilities. But the heaviest machines go only at the terminals where cranes are available.

The Committee says: "The cost recommended by the sub-committee is the average of the installing costs submitted, and has been given the individual approval of the sub-committee."

"Costs were gathered from private note books of members of engineering companies, and private data of engineers. They are only to be used as a guide and special allowances made where required. Costs include a charge for use of tools and supervision." (See Chapter II on I. C. C. Work.)

The installation applies to machine only, and does not include the motor. See the Electrical Chapter for the cost of wiring and putting motors in place.

The horsepower of the motors is given. In making up an estimate or valuation it should be remembered that there is a large addition to be made for slip-ring motors, as compared with the ordinary type.

The concrete foundation yardage will save a good deal of guessing. First of all comes the excavation which may be the same as the concrete, or a good deal more. In some hard soils, and with an untapered pier without extensions, excavation may be the same as concrete; in even hard soils with tapered piers, as for lathes and planers, the excavation may run from 25 to 50 per cent more than the concrete; and in soft soils with caving in banks it may be twice as much. Sheet piling may also be required.

Concrete. The depth is given usually from the floor line down to the bottom of the concrete. The area of the base is also given, so that any addition can be made for extra depth. The area has to suit the soil, and thus varies. So far as excavation goes the full area of the base has to be allowed, no matter what the depth, but with tapered piers the extra cubage, as compared with the concrete, comes above the base, assuming that to be wide enough to carry the load. For preliminary estimates close figures are not required. In the case of a driving-wheel lathe the area is sufficient to carry any load, and footing extension is not required, but the entire area has to go clear down to a solid bearing. The weight of concrete for foundation purposes may be set at 2 tons per cubic yard. In getting at the extra depth, however, it should be remembered that for some machines, as driving-wheel lathes and large cylinder planers, the concrete begins about a couple of feet below the floor level, except for retaining wall. See index for method of estimating concrete. Bolts should be allowed extra. The "Atlas" mixture for engine foundations is as follows:

Mixture. Use for the foundation a mixture of 1 part Atlas cement, $2\frac{1}{2}$ parts sand, and 5 parts gravel. Let the concrete harden at least a week before the engine is placed on it. "Don't begin using the engine until the concrete is two weeks old."

Another authority gives a proportion of 1 cement, 3 sand, and 7 of stone for machine foundations, by volume, as usual.

For ordinary work 1, 3, 6 is often used; and 1, 2, 5 for a better quality.

A dense mixture of 1, 2, 4 should be used where water may enter any pits.

Details for Machine Foundations. In general, the manufacturers send out a very poor quality of drawings, some of them with brick and stone construction in an age that uses concrete for this purpose. Then the drawing is so filled with wheels and bars and machine detail in general that an engineer in the field would have to spend too much time over it before getting his bearings. For this reason railroads usually have to remake plans for foundation purposes only.

1. The position of the operator should be shown by a small circle in both the main floor plan and the detailed one. Cases have been known where the machine was reversed.

2. Show the main parts of the machine base, at ends and sides in a dotted line on the detailed plans, and also mark the distance from the edge of the concrete or from the center line.

3. Bolt centers must be carefully marked as to distance, and provision made for adjustment. The conduits for wiring should be put in close to the machine, and not as foot traps.

4. Some machines get foundations where they are not required. An emery grinder weighs about a ton, and has an area of, say, 9 sq ft. On average soil the bearing power is from 2 to 4 tons. At 2, and for this kind of soil, an emery area would support 18 tons. Almost the poorest soil holds up $\frac{1}{2}$ ton to the square foot, or $4\frac{1}{2}$ on an emery base. If a shop floor is half way reasonable it will hold an emery, and all small lathes. The vibration for tool grinding is not so very much.

Machine Data
(Add excavation)

Description	Size	Weight, lbs	Price per lb, cents, 1923	Installation, cents per 100 lbs	Concrete, cu yds foundation	Depth, foundation, ft	Area of base, sq ft	Shipping point	Motor h p
Anvil	....	350	16½	25	....	...	..	New York	
Arbor press	No. 5	15,500	11	50	....	...	..	Nashua, N. H.	
Bolt cutter, Acme, 3-head	1½″	4,000	51	60	....	...	..	Cleveland, O.	5
" " " 3-head	2″	6,000	44	60	5	4	34	"	7½
Boring mill	44″	16,400	35	50	5½	4	36	Hamilton, O.	10 & 2
" "	44″	16,400	35	50	8	4	54	"	10 & 2
" "	53″	20,000	30	50	6	4	40	"	10 & 2
" "	36″–44″	....	35	50	5	5	30	"	10 & 2
" " vert. miller, driller	60″	16,460	28½	50	7	3	63	.....	10
" " double spindle	90″	55,000	14	50	20	4	121	.....	20 & 5
Bending rolls	9/16″×10′	25,000	23	30	7	4	..	Ridgeway, Pa.	15
Blower and exhauster	3 & 4	(2) 700	..	100	....	...	..	Buffalo	5 & 5
Babbitt melting furnace	No. 66	1,000	22	100	....	...	..	Baltimore	
Boiler feed pump, Deane	.....	4,800	15	50 t0 100	....	...	..	Holyoke, Mass.	
Crank slotting machine	24″	23,000	27	35	5½	4	38	Philadelphia, Pa.	10
" " "	30″	41,600	23½	35	5½	3	58	"	15 & 3
Cylinder planer and motor	60″	55,700	31	40	23	7	190	Muskegon Hts., Mich.	12
Crank shaper, heavy	26″	5,000	26	50	3¼	4	27	Worcester, Mass.	5
Centering machine, 2-sp. and motor.	6′	12,000	52	50	....	...	..	Hartford, Conn.	1
Cylinder boring bar	4½×6	1,510	28	50	....	...	..	Philadelphia, Pa.	3
Cotter and key seat drill, horizontal	No. 3	7,800	43½	75	1	...	..	"	1½ & 1½
Compressor, air, 1,470 c. f. m	.....	....	$7000	60	44	5	210		
Driving wheel lathe	90″	124,100	18½	25	40	5′–8″	240	Hamilton, O.	50 & 8
" " " "	90″	114,000	18½	25	36	6′	182	"	50 & 8
" " press	96″, 600T.	45,400	15½	40	14	5	100	"	15
" " "	96,′600T.	45,400	15½	40	13	5	74	"	15
" " "	48′, 500T.	....	..	35	8	4	48	"	15

MACHINE DATA—*Continued*

Description	Size	Weight, lbs	Price per lb, cents, 1923	Installation, cents per 100 lbs	Concrete, cu yds foundation	Depth, foundation, ft	Area of base, sq ft	Shipping point	Motor h p
Drill, radial, semi-univ.	4′	8,400	21	60 to 75	5	3	39	Hamilton, O.	5
" "	5′	10,300	23	60 to 75	7	4	47	"	5
" " (and pit 1¼ yd)	6′	15,500	19	60 to 75	8¼	5	60	Ridgeway, Pa.	10
" " (no pit)	6′	14,750	22½	60 to 75	6½	3	54	"	10
" " (no pit)	6′	14,450	22½	60 to 75	7	3	54	"	10
" " Morris	2½′	3,500	45	60 to 75	....	...	..	Cincinnati	3
" upright	22″	1,500	22	100 to 125	....	...	..	Aurora, Ill.	1
" "	24	2,150	17	100 to 125	....	...	..	"	2
" "	32	2.900	19	100 to 125	....	...	..	"	3
" "	36	3,200	20½	100 to 125	....	...	..	"	3
Emery grinder and motor	.....	1,975	35	100	2	4	14	Cincinnati	5
Forge, blacksmith's	.....	550	15½	35	....	...	..	Buffalo	
" rivet	.....	110	18	35	....	...	..	"	
Flanging clamp	12′	14,200	12	35	6	3′–6″	40	Ridgeway, Pa.	
Foot sq. shears, Hercules	30″	1,100	10	....	....	...	..	Buffalo	
Feed water heater	1250 h p	11,800	13	40	....	...	..	Philadelphia	
" " "	2000 h p	15,000	13	40	....	...	..	"	
Grinder, univ. tool and motor, Seller's	No. 1	5,000	42	100	....	...	..	"	7½
Grinder	18×30×96	16,500	31	100	2	4	24	Worcester, Mass.	15
" diamond, heavy face	84″	10,900	30	100	2	2	28	Providence, R. I.	30
" univ. and tool, B.&S. (motor)	.....	2,800	70	100	....	...	..	"	1
" drill, Yankee	.....	600	33	....	....	...	..	Grand Rapids	5
Hack saw	.....	300	52	....	....	...	..	Buffalo	½
Hammer, steam	1,100 lbs	20,000	9½	25 to 40	12&2,100 ft B M, 200 lbs bolts	...	..	Chambersb'g Pa.	
Hammer, steam	1,500 lbs	26,000	9½	25 to 40	15&2,100	...	..	Chambersb'g. Pa,	
Lathe	44×16	28,000	..	35	6	4	50	Plainfield, N. J.	15
" 3-gear	42×20	22,680	28	35	7	5	65	"	15

MACHINE DATA—*Continued*

Description	Size	Weight, lbs	Price per lb, cents, 1923	Installation, cents per 100 lbs	Concrete, cu yds foundation	Depth, foundation, ft	Area of base, sq ft	Shipping point	Motor h p
Lathe, 3-gear	36×19	20,175	29	35	7	5	50	Plainfield, N. J.	15
" "	36×16	18,900	30	35	4½	4½	50	"	15
"	36×14	20,000	..	35	5	4	60	"	15
" double gear	30×11½	13,520	30	35	5½	5	37	"	10
" " "	26×12	9,500	36	35	....	...	..	.....	10
" Le Blonde, heavy duty	17× 8	3,020	60	50 to 60	....	...	..	Cincinnati	3
" " " " "	19×10	3,960	60	50 to 60	....	...	..	"	5
" " " " "	25×12	8,680	41	50 to 60	....	...	..	"	10
" " "	14× 6	1,725	87	50 to 60	....	...	..	"	2
" Lodge & Shipley	16× 6	2,700	61	50 to 60	....	...	..	Chicago	3
" " "	18× 8	4,000	53	50 to 60	....	...	..	.....	7½
" flat turret	24″×24″	4,900	33	50	2	3	20	Springfield, Vt.	5
" " "	3×36	5,475	35	50	2½	4	16	"	7½
" turret, Gisholt	2¼× 6¼	11,500	45	50	.....	...	..	Madison, Wixs.	7½
" vertical turret, Bullard	24″	9,000	54	50	4½	4	32	Bridgeport, Conn.	7½
" " " "	36″	14,000	44	50	6	4	45	"	10
" full univ. monitor, Dresses	20″	3,150	52	50	....	...	..	Cincinnati	5
" big bore turret	6×28	16,000	..	50	4	4	34	.....	10
Locomotive boring bar	4½″×6′	1,510	28	$2 ea.	....	...	..	Philadelphia	3
Lucas press	36″×72″	6,200	23	40	4½	5	28	Cleveland	5
" "	.....	5,600	23	40	2½	3	28	"	5
Milling machine	No. 10, 66″	27,600	27	....	4	3	30	Philadelphia	10
" heavy, univ. and motor	34×12×20	7,500	50	....	....	...	..	Providence, R. I.	10
Planer	60×60×24	73,900	15	30	14	3	73	Plainfield, N. J.	20 & 3½
"	48×48×18	50,100	18½	30	21	5	143	"	15 & 2
"	42×42×16	30,800	20	40	11	3	130	"	10
"	42×42×14	30,200	19	40	11	4	90	"	10
"	36″	28,000	..	40	8	...	..	.....	10
" Gray	24×24×6	7,200	33	40	4	...	0	Cincinnati	5
Punch and shear	24″-36″	24,000	18	35	5	4	34	Hamilton, O.	5

MACHINE DATA—*Continued*

Description	Size	Weight, lbs	Price per lb, cents, 1923	Installation, cents per 100 lbs	Concrete, cu yds foundation	Depth, foundation, ft	Area of base, sq ft	Shipping point	Motor h p
Pipe threader	.....	3,200	28	25	....	...	..	Yonkers, N. Y.	5
Rod borer, heavy	No. 7	25,350	28½	50	6	6	56	Philadelphia	7½ & 7½
Slotter, double h'd loco frame	.....	105,000	27	35	41	6	225	"	15 & 15
" Dill	15″–18″	12,800	29½	35	5½	5	34	"	
See Crank Slotter									
Vise	No. 5	150	16	$1 ea.	....	...	..	Meriden, Conn.	

CHAPTER X

GRAIN ELEVATORS

(1913 = U. S. Base of 100 for Prices in this Chapter)

In a physical valuation of railroads there are many grain elevators to be taken care of, and it is quite an undertaking to get at the actual cost of reproduction, especially if time is limited. There are many types of these structures. The quantities and figures given in this chapter belong to the ordinary wood elevator only.

These figures are given here for a check when estimating other buildings of a similar nature, that can not be so detailed on account of a lack of plans, physical difficulties in getting below foundations, or of reaching in the air, or the impossibility of finding the thickness of cribbing, etc. In such cases even an approximate figure is valuable as a check. Multiply quantities by current and local prices.

No. 1. The ground size is 98′×200′, but the cribbing above is only 72′×200′. The capacity is 1,000,000 bushels. A dryer building, small power-house, and shop are attached.

Valuation of No. 1

Grading and excav (no hauling) 7,100 yd, 30¢	$ 2,100.00
Concrete footings, 1,071 yd, $6.50	6,962.00
Pier stones, 29,740 cu ft, 30¢	8,922.00
Rubble, 3,500 yd, $6	21,000.00
Brickwork, $134,000, $12	1,608.00
Cut stone	300.00
Concrete reservoir, 50,000 gal	1,500.00
Brick and pipe tunnels	850.00
Steel boot tanks (8)	1,100.00
Heavy timber, dimension and boards, 1,073,000 ft b m $42	45,066.00
Cribbing, 1,208,000 b m, $31	37,448.00
Doors and windows, 198 openings, $10	1,980.00
Roofing and wall covering, iron, 1,072 sqs, $6	6,432.00
Gutters and downspouts	400.00

Floors and roof of power-house	900.00
Garners, scale hoppers, and leg casings	2,900.00
Scales—8 at 1,000 bushels each	3,300.00
Distributing spouts, car-spouts, and bin-spouts	2,900.00
Passenger elevator and stairs	800.00
Office, and heating same	300.00
Hardware, blacksmith work, and painting	900.00
Power transmission machinery	13,000.00
Grain handling and cleaning machinery	12,000.00
Dust collecting system	4,600.00
Electric wiring and signals	560.00
Standpipe, hose, and water barrels	540.00
Hale sprinkler system	820.00
Journal alarm system	1,300.00
Hess dryer, and building	16,000.00
Workshop and tools	550.00
Boilers, (3) 60′×16′, and setting	4,100.00
Feed pumps (2) and heater	400.00
Deep well pump and well	360.00
Corliss engine, 18×42	4,400.00
Automatic engine 8′×10′	560.00
Automatic engine, 7′×8′	400.00
Standard pump, 16′×8′×12′	660.00
Steam and water piping	2,400.00
10 Kilowatt generator and switchboard	550.00
Liability insurance for construction	1,000.00
	$211,868.00

Contractor's profit is included. The rate of depreciation on such elevators is 3 per cent per annum. A special depreciation of $20,000 was allowed on this elevator on account of its leaning out of plumb.

Valuation of No. 2

In this elevator the ground size contains 29,850 sq ft; the power house, 2,840; the stack, 14′×14′ at base×165′ high; there is a frame shop of 800 sq ft; an office with 500 sq ft; a dryer building with 490 sq ft×50′ high; the capacity is 1,500,000 bushels; the cost per bushel approx 21¢. The sq ft costs are given on page 205.

Excavation, 6,256 cu yd at 30¢	$ 1,877.00
Piling, 98,400 lin ft, 30¢	29,520.00
Concrete footings, 790 cu yd, $6.50	5,135.00
Cap stones, 1,200 cu ft, 35¢	420.00
Pier stones, 68,200 cu ft, 30¢	20,460.00

Rubble, 526 yd, $6	3,156.00
Concrete floors, 800 sq yd, $1.80	1,440.00
Power-house	6,000.00
Stack	5,000.00
Shop and tools	500.00
Office building	600.00
Vault	650.00
Dryer building, dryer and purifier	13,000.00
Steel reservoir, 50,000 gal	1,800.00
Timber, dimension, boards, spikes, etc., 789,000 ft b m, $42	33,138.00
Cribbing and spikes, 2,987,000 ft b m, $31	92,597.00
Doors and windows	1,731.00
Rods, castings, blacksmith work and hardware	4,000.00
Roofing and iron covering	8,850.00
Gutters and downspouts	516.00
Structural and sheet steel	900.00
Passenger elevator and stairs	1,000.00
Steam heating	400.00
Posts and steel beams for scales	2,200.00
Liability insurance for construction	1,500.00
	$236,390.00

EQUIPMENT

Steel boot tanks (6)	$ 1,800.00
Garners, scale hoppers, and leg casings	3,045.00
1,400 bushel scales (6)	3,000.00
Spouts	3,705.00
Power transmission machinery	19,932.00
Grain handling and cleaning machinery	11,610.00
Dust collecting system	3,900.00
Electric wiring and signals	715.00
Standpipe, hose and water barrels	1,650.00
Sprinkler system, G. F. E. Co	10,000.00
Boilers (4) set, 60″×16′	6,000.00
Feed pump, heater and tank	900.00
Journal alarm system	1,600.00
Corliss engine, 24×48	5,000.00
Underwriters' fire pumps, (2) 100 g l	2,640.00
Electric generator, engine and switches	935.00
Steam and water piping, etc	2,600.00
	$79,032.00

Total for entire plant, $315,422.00.

Small Elevator. This one is given as a contrast to the large ones. The cost per bushel is a good deal higher, but the sq ft cost is less. The cost per bushel is 44¢; per sq ft, $6.51; per cu ft, 25¢. Elevator—26′×26′ 26′ studding, 10,000 bus, 20 h p boiler,

15 h p engine, 2 elevators, corn sheller, corn cleaner, grain separator, shipping scales, office and wagon scales, well and pump.....$4,400.00

Grain Elevators. To build an entire plant—dryer house, power house, coal sheds, office, etc., allow $14 per square foot of elevator proper taken on ground floor only. For elevator alone, $11. For equipment, allow about 30 per cent of total cost of all buildings. This plant cost nearly $220,000. Minor buildings of brick, main one of wood.

Another cost $14 on basis of square feet of elevators proper on ground floor; and $9.50 for elevators alone. About $320,000. Brick and wood as on first. (Both on 1913 basis.)

A leading fire insurance company, specializing in grain elevators, writes, on a 1923 basis: "For crib grain elevators allow about as follows:

Capacity 12,000 bushels or less.....	70¢ per bushel
Capacity 12,000 to 25,000.....	55¢ "
Capacity above 25,000.....	50¢ "

These costs include one elevator leg and the power to run it, a wagon scale and office. For extras add

Elevator leg.....	$ 500
Automatic scale.....	400 to $700
Sheller plant.....	1,200
Cleaner.....	400
Cob burner.....	500
Attrition mill.....	1,500

"The prices do not apply on the actual amount of grain the elevator will hold. Net measurement is used for this and not workroom area, etc. The number of bushels will be about four-fifths of the total number of cubic feet. The cost is practically the same whether for metal or wood sides. The depreciation rule is 2 per cent a year."

Heavy Concrete Elevators

In 1921, from September to December, the James Stewart Co. put up 60 reinforced concrete grain tanks near Baltimore. The capacity is 1,750,000 bushels, and the cost was $700,000, or 40¢ per bushel for the complete structures. The height is 97 ft. The concrete was 1 : 2 : 4; the total cubic yards, 11,891. The total steel, 361 tons. A reinforced concrete slab or mat was put under the buildings, 32 in thick. A basement is put above this with a roof 12 in, upon which the tanks stand. The walls are 7 in thick. For the hopper bottoms of the tanks, to cause the grain to clear itself, 3,000 cu yds of a lean mixture were put in. The entire work was finished in 65 working days.

CHAPTER XI

APPROXIMATE COST OF TRUSSES

(U. S. Base of 100 = 1913 and prices are so arranged here, if not otherwise stated.)

Scaffolding. No allowance is made. It might be necessary to erect a special scaffold in one case, and in another the scaffold in use might serve.

Profit. Net cost is given without profit, which ought to be added in a lump sum for all the building, and not separately for each part of it.

Legend. Lower chord, L. C.; top chord, T. C.; Rafters, R.; struts, S.

Truss A. Span 60 ft; height 13 ft.

Chords and rafters 12″×12″; struts, 8″×12″; including splices, waste lumber, etc, 2100 ft b m, Rods $1\frac{1}{2}$″ diam. Lumber, $30; labor, $25.

2100 ft at $55	$115.50
Rods, plates, bolts and nails	12.50
	$128.00

A similar truss to the above has a span of 100 ft, yet there are only about 500 ft, b m, of extra lumber in it. The labor is worth at least $10 per M more, for the cost of raising is greater in proportion to the amount of lumber. A figure of $175 is fair.

Prices. In all cases multiply quantities by current prices.

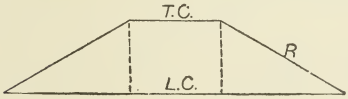


Fig. 10.—Truss A.

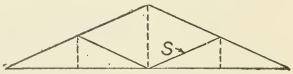


Fig. 11.—Truss B.

Truss B. Span 50 ft; height, 11 ft.

Chords, 8″×10″; struts, 8″×8″.
Center rod, $1\frac{1}{2}$″; side rods, 1″.
Lumber, $28; labor, $22.

900 ft b m at $50	$45.00
Rods, plates, etc	6.00
	$51.00

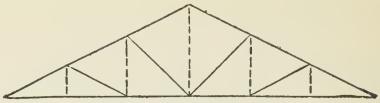


FIG. 12.—Truss C.

Truss C. Span 64 ft; height, 16 ft.
Chords and rafters, 10″×10″; struts, 8″×10″.
Center rod, $1\frac{3}{4}$; side rods, $1\frac{1}{4}$.
Lumber, $30; labor, $28.

1700 ft b m at $58	$98.60
Rods, plates, bolts, etc	16.40
	$115.00

FIG. 13.—Truss D.

Truss D. Span 84 ft; height, 19 ft.
Chord is 2 rods $1\frac{1}{2}$″ diam.
Rafters, 2 pieces 6″×12″; struts, 6″×8″.
Rods, 2″ diam.

1400 ft b m (lumber only) at $30	$42.00
Rods and eyes (1400 lbs) 3¢	42.00
Plates and bolts	8.00
Total labor	40.00
	$132.00

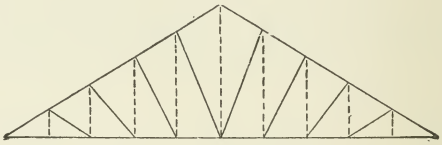


FIG. 14.—Truss E.

Truss E. Span 75 ft; height, 23 ft.
Lower chord 3 pieces, 3×10.
Rafters 10×12.
Struts (average) 8×8.
Rods, 2 center, $1\frac{1}{2}$; side, $\frac{7}{8}$.
Lumber, $30; labor, $35.

2300 ft b m at $65	$149.50
Rods, plates, bolts, shoes, etc	30.50
	$180.00

Truss F. Span 44 ft; height, 12 ft.

330 ft b m $27	$8.90
Labor	5.95
Bolts and nails	3.15
	$18.00

The truss F is merely a good strong rafter put together in a simple manner.

Fig. 15.—Truss F.

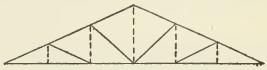


Fig. 16.—Truss G.

Truss G. Span 45; height, 10 ft.

520 ft b m at $28	$14.55
Labor, $25	13.00
Rods, plates, bolts, etc	6.45
	$34.00

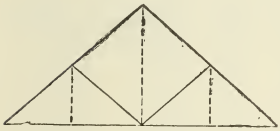


Fig. 17.—Truss 32×14.

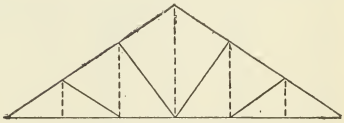


Fig. 18.—Truss 39×13.

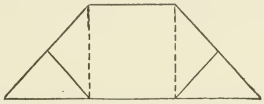


Fig. 19.—Truss 30×11.

Fig. 20.—Truss 50×12.

Truss 32′×14′ high	$65.00
Truss 39′×13′	80.00
Truss 30′×11′	55.00
Truss 50′×12′	90.00

The above 4 are strong trusses to carry purlins, and not of the light construction of trusses F. and G.

Fig. 21.—Howe Truss (Shown for double and single).

Howe Trusses

Lumber is allowed at $30, and labor, $45. Owing to different loads and conditions, the same span and height often have heavier timbers in given trusses. Type A in the following table is taken as an average standard; and an extra allowance made for a heavier truss under B.

Table of Net Cost of Howe Trusses, Including Rods

Span	Height	Chords	Braces	Cost, A	Cost, B	Lumber, A	Lumber, B
36′	6′	8″×8″	6′× 8″	$53	$73	600bm	730bm
42	7	8 ×10	8× 8	75	100	860bm	1080
48	8	8 ×10	8× 8	75	110	980	1240
54	9	10 ×10	8× 8	112	140	1340	1640
*60	10	10 ×10	8×10	130	160	1500	1880
70	11	10 ×12	10×10	175	215	2100	2640
80	13	10 ×14	10×10	240	280	2780	3450

* There is a description following of a truss with 60 ft. span, but only 6 ft. in height.

The high cost of the labor was owing to the construction. While the lower chord was made up of four timbers with the struts running down between, and thus easier handled than a solid one, there were many pieces 1 in thick bolted between, and also notched into both sides. Thus, for every upright piece there were several notches in the timbers. The rods were also double instead of single. Part of the extra cost was owing to high ceiling which made more scaffolding necessary than is usual. Each truss cost about $275, but this included the scaffolding. This illustration shows that the figures in the table have to be taken as average, and that special construction or conditions as to height of ceiling, etc., might raise the amount.

The design of the truss described was bad. It was too low, as there was plenty of chance to make it higher. The centers sank after a time, and posts had to be put in; and when an additional

story was added the trusses were removed. The contractors were scored for minor defects in the timbers, yet the whole design was spoiled. So it often is.

There were six of these Howe trusses. The timbers were 10″×12″ for the lower chord, made up of four pieces; 8″×12″ for top chord, solid; 4″×12″, 3″×10″, and 2″×6″ for cross braces. The chords were bolted together with double rods from 1 in to 2 in in diameter. Each truss contained 2,100 ft b m, and took 342 hours for one man to make and erect. All material came surfaced. The labor then was at 35¢ per hour, or to 40¢.

Trusses 100 ft span by 25 ft high in two long buildings were set at $275 each. They were supported in the center by two columns to each, and thus lighter timbers served than for a Howe truss of the same span. They were of the usual irregular style. Each contained about 3,500 ft b m.

Weight of some steel trusses:

For 53-ft span....	3.5 tons	For 125-ft span...	22 tons
For 80-ft span....	6.5 "	For 175-ft span...	10.3 "
For 105-ft span...	9.0 "		

The 125-ft span had some special floor weight.

CHAPTER XII

SHORT CUTS

(The U. S. Base of 1913 = 100 is used for prices here.)

Bins, Cases, etc. In making a physical valuation of such a great plant as a yard full of railroad shops there are many smaller items outside of the buildings proper that can not be neglected, because in the aggregate they run into a large sum of money; but they are of such a nature that a greater amount of time can be consumed in making a detailed estimate of them than is justified by the results. Such are boxes, bins, racks, cases, and shelving, the former covering large areas when considered collectively, and sometimes filling whole buildings, and the latter running into tens of thousands of sq ft. Whatever may be claimed, there is no one who can guess anywhere near the value of all these items. About the only way is to make a standard price for a certain size of opening and thickness of materials, and then to count the openings; and a price per sq ft for the shelving. With iron shelving, sizes have to be taken and the weights figured up. In a certain building I estimated in detail $10,000 worth of iron racks and shelving, and at a guess most men would have considered half that amount sufficient. But where hundreds of standard buildings are taken by the sq ft there is no reason for taking off carloads of lumber in racks and bins. The shorter way gives close enough results.

Depth. The depth of a large area of racks, or box-like openings, regulates the price to some extent, if there is a back, for this costs no more on a deep case than on a shallow one. In most yards the bins, shelving, and racks have been used so many years that while they can not be neglected it is easily seen by their condition that the best estimate can only be approximate, and that, therefore, a fair price per opening or per sq ft is all that can be reasonably expected to be set, and the depreciation allowed on the reproduction value after this is done.

Siamese Twins. Another trouble comes with the depreciation for this class of property: When a large set of new bins is attached to a building worth only 30 per cent of its value new, the bins have

to be depreciated with the building, for they are made useless by the removal or destruction of the main structure. So with platforms, except for the small allowance for salvage, when they are taken down. Each case has to be decided on its own merits, and can best be done on the ground.

Extras. Sometimes $\frac{7}{8}$ casings and ledges are nailed on the face of the bin openings. There might be such conditions attached to the building of a particular bin as to greatly increase the cost; or so much time wasted as to make the labor bill run to twice as much as it should do. It might be, again, that a man was sent a hundred miles to build a case worth $12, and that he might have to wait a day for material. No allowance is made for contingencies like this in the following estimates. They are based on the supposition that a good workable number of cases are to be built at the same time, and that the undertaking can be gone about systematically. Much railroad work is necessarily done under the piecemeal system, and costs more than it would if all done at once. Here is another factor that those who want a high valuation could properly urge in favor of a greater total than a contractor would allow.

No Profit. Cost price without profit is given. The labor is set at 40¢ per hr—and it would often pay railroads to employ 40 ¢ carpenters instead of 22½¢ men who "learned carpenter work on the farm with father." Lumber is set at $26. Some extra lumber is allowed for blocking. Nails are included. Change to suit local prices.

No. 1. Bin, 6 ft high×30 ft long×24 in deep with back. All of plain 2″ plank. Openings, 4 in height×18 in length—18″×20″ centers—72 in all. Lumber, 1550 ft b m. Total, $55. 31¢ per square foot, and 77¢ per opening. If bin is set on a platform and lower shelf is not required, make 29¢ per square foot, and 71 per opening.

No. 2. Same bin and conditions as No. 1, but only 18″ deep. Lumber 1250 ft b m, $44, 25¢ per square foot and 61 per opening, with bottom shelf included.

No. 3. Same as No. 1, but only 12″ deep. Lumber 970 ft b m $35, 20¢ per square foot, 49¢ per opening.

No. 4. Without a 2″ back for above bins the sq ft price would be 7¢ less; and 3½¢ for $\frac{7}{8}$ boards.

No. 5. Bin 6′×30′. No back; 12″ deep; 3 openings in height ×12 in length; 2″ plank; openings to centers, 24″×30″. Lumber, 450 ft b m; $16; 9¢ per square foot; 45¢ per opening.

For 18″ deep, and as above, add 50 per cent.

For 24″ deep, double the total. Add back if required at 7¢ per square foot for 2″, and 3½ for $\frac{7}{8}$.

No. 6. Bin 5′×20′×12″ deep. No back; 5 openings in height ×8 in length—12″×30″ centers—2″ plank, 370 ft b m; $13; 13¢ per square foot; 33¢ per opening.

For 18″ deep add 50 per cent.

For 24″ double. Add back if required.

No. 7. Bin as above and 12″ deep, but with $\frac{7}{8}$ uprights = 320 ft b m; $12; 12¢ per square foot; 30¢ per opening. Add for extra depth and back if required.

No. 8. Bin or counter, 3′×16′×12″ deep; 3 openings in height ×5 in length—12″×38″ centers—2″ plank; 170 ft b m; $7; 15¢ per square foot; 47¢ per opening. Add for extra depth or for back if required.

No. 9. Bin or counter on top of No. 8, 4′×16′×12″ deep; 4 openings in height×12 in length—12″×16″ centers—2″ uprights, $\frac{7}{8}$ shelving; 200 ft b m; $8; 13¢ per square foot 17¢ per opening. Add for extra depth or back if required.

Double. Many such bins are double, and thus require only one back between the two sides. After figuring according to width both bins—north and south—the back can be added.

Cheap. All of the above work is of the plainest character—merely rough planks and boards squared across and nailed into divisions for bolts, nuts, washers, hangers, hinges, and all the large and small miscellaneous equipment of railroad shops. There is no painted work included, nor is the lumber estimated to be of the kind that gets painted, except sometimes with the standard red mineral.

Boards. The following cases are made of ordinary $\frac{7}{8}$ boards squared and nailed together without dadoing. Like the plank bins, these are not for paint, but for the roughest work. They are not to be compared with such cases as are listed by millmen, for example, where from 3¢ to 5¢ per square foot is allowed for labor alone. The allowance here is $26 for lumber, and not more than $25 for labor, depending upon the size of the compartments, for the smaller ones take more time. A back is not allowed, but can be added at $3\frac{1}{2}$ to 4¢ per square foot, as the cases with most compartments take labor for nailing on back. A bottom shelf is allowed about 4″ up from the floor. If strips are nailed on the front add from 1 to 2¢ per linear foot. Add profit.

No. 10. Case 7′×20′×12″ deep; 10 openings in height×20 in length—8.4″×12″ centers—400 ft b m; $21; 15¢ per square foot; 10.5¢ per opening. Add for extra width if required.

No. 11. Case 7×20′×12″ deep×6 openings, in height×20 in length;—14″×12′ ′centers—320 ft b m; $16; 12¢ per square foot 14¢ per opening. Add for extra width or back if required.

No. 12. Case 7′×20′×12″ deep×5 openings in height×16 in length—17″×15″ centers—280 ft b m; $13; 10¢ per square foot; 16¢ per opening. Add for extra width or back if required.

No. 13. Case 3′×16′×12″ deep ×3 openings in height and 10

in length—12″ × 19″ centers—110 ft b m; $6; 13¢ per square foot; 20¢ per opening. Add for extra width or back if required.

Detailing. Nothing is allowed for detail drawings for the above work. The sizes are supposed to be given to a foreman as sufficient for such rough bins. When drawings are made for storehouse cases, as for the 60,000 ft b m used in one storehouse, the details are so different for each case, and there are so many compartments, that 10 per cent ought to be added for drafting. The two classes of work are entirely different.

The following case is also mill made:

No. 14. Case with back, 161 holes, $2\frac{1}{2}''\times10\frac{1}{2}''\times13''$ deep; 5′ 9″×6′ 6″ over all, dadoed, and painted, spruce, $53, or 33¢ per opening, including profit of millman.

Cases. For a case divided into holes 18 in square allow 20¢ per square foot at 12 in deep; and 33¢ at 24 in deep. With holes 3 ft square, 15¢ for 12 in, and 22¢ for 24 in.

A back of three-quarter ceiling is allowed in both cases; if left off, deduct 7¢ per square foot. Lumber is put at $40, labor, $50. Less than this may often be sufficient, but 25 per cent more might be wasted on labor. Face measure, not shelf measure, is taken. Thus a case to fill the end of a room 10′×20′, or 200 sq ft, would cost, at 18-in holes, 12 in deep, $40.

Add profit or percentage required. No paint.

The above figures may be supplemented by the following from actual work done:

A case 18′×13′ 6″ high, 33 in deep below counter shelf, and 16 in above was set in building, but not oiled for $165, or 68¢ per square foot of frontage.

All the front was covered with sliding doors, one below counter-shelf, two in height above. On a $\frac{7}{8}$ in basis there were about 1,400 ft. of lumber, including back. Below counter were shelves about 12 in apart; above were pigeon holes 6″×11″.

Another 9′-8″×9′-3″×3′-2″ deep, divided into 420 pigeon holes, was set in place for $197, 47¢ per hole, or $2.15 per square foot. The smallness of the holes and the extra depth account for high price, even although doors were not used.

Sliding Ladders. For such high cases cost about $25 with track. Cases of $\frac{7}{8}$ material from 12 to 16″ deep with doors, 80¢ per square foot of face surface; of $\frac{3}{8}$ stuff with pigeon holes about 4×8″, as in ticket-cases, etc., 45¢ per opening.

A case 2′-9″ by 7-9×18-0, filled with drawers, cost $300, or $2.15 per square foot.

Revolving Doors. Front doors from $300 up; pantry windows, $85 up; both f.o.b New York.

Cornice on Frame Buildings. A plain cornice without brackets

painted, and finished, runs to 50¢ per lin ft. From that we might go to $1.50, and still not be so very extravagant. For 30″ projection, $1.20 or 4¢ per inch. Brackets cost from 15¢ to $2.

Cornice boards, ridges and plain lumber may be put in, if of pine, $140 per M b m in place.

Profit must be added at the end of the summary of cost of all the cases, and there would have to be quite a few made at one time before a contractor could afford to fix a reasonable figure; and it must be also considered that drawings may have been required.

Racks. It is hardly possible to set a figure for racks. The posts are of all kinds, and are spaced closely in the one rack, and wide apart in the next, depending upon the load; the iron supports in one are light pipes, and in others solid rods 1 in in diameter; and the compartments are of all kinds of sections and lengths. Very often an approximate figure can be guessed at—and in a yard where the machine shop may run to $200,000 or twice as much, and the trackage to more, the proportion of wrong guessing on racks is easily swallowed up.

Fine Shelving, Cases and Counters. See the index for good approximate figures. The counters are as near as can be approximated for ticket offices in cities. The price might easily be doubled if the designer wants to. It is all matter of detail.

Counters. Take off all material and estimate labor in detail. Ceiling, shelving, etc., come under ordinary rules. For all circular millwork in general allow three times the price of straight. Money drawers, $1.50 each. Common drawers, average size, $1.50 to $2.

Plain pine counters with drawers, $2 to $3 per linear foot at 30 in wide, not set. Common oak counters for ticket offices, $5 per linear foot; good q s, $10 and up. Mahogany, $10 to $20, set in place. Lunch counters, oak, circle ends, $3.50 per linear foot. With brass foot rail, $1.25 more, set in place.

Office Partitions are of many varieties. There are usually some in ticket offices, and detail regulates price. As a mere hint of cost of equipment in ticket offices in cities of 50,000 to 150,000, of a half dozen the cheapest was worth $700 new, and the most expensive $2,000. But the latter with electric lighting system, and some other extras included, would have amounted to $2,500. This applies to offices in the city proper, and not at the station. These figures would be far too low for the finely equipped offices in the larger cities, some of them costing a small fortune.

Excavation. For an ordinary house wall allow $\frac{1}{3}$ cu yd to the linear foot. For a heavier factory wall allow $\frac{1}{2}$ cu yd.

The above will suit in northern climes to go below the frost line where the depth can not be ascertained, and allow a little for backfilling.

CHAPTER XIII

THE SPRINKLER SYSTEM AND CAST-IRON PIPES

U. S. Base of 100 = 1913, and prices are so arranged here. See Index Nos. and change prices to the year desired.

Sprinkler System. For a system installed in a 7-story building with 56,000 sq ft of ceiling, the cost was $5,500, or practically 10¢ per square foot.

The following extracts from a letter of an Eastern Mutual Fire Ins. Co., give some useful figures on sprinklers:

Cost. "In general the cost of automatic sprinkler system installed (wet pipe) is not less than $3 per sprinkler, this, however, in-including only the pipe inside the building. In large cities, where cost of labor is higher and hours shorter, this cost runs up to something over $4. If a dry pipe system is installed it will add about $1 for each sprinkler head.

Area. "The average area covered by one sprinkler is perhaps 75 sq ft. Under light forms of construction the area is not over 60 sq ft, whereas in the better types of fireproof and slow burning construction the area per sprinkler varies between 90 and 100 sq ft. This will give some idea as to the approximate cost of equipping the building.

Supply. "To these figures there has to be added the cost of the water supplies. In some cases elevated tanks are needed in connection with fire pumps and in other cases public service connections are made with either tank or pump as may be deemed best to suit the conditions.

"The cost of tanks and pumps varies considerably from time to time."

Cost. The systems differ so much, however, that to get the exact value, a plan and bill of material have to be made on the complete installation in the regular manner. Neither the square foot nor the cubic foot systems will work for anything else than an approximate idea of the cost; and a better way of getting this is to count the outlets.

In New England, where mill building has been reduced to a science, the cost is lower than elsewhere, being only about $4.00 per head or outlet. For fireproof work in the same section $6.00 is

sufficient. But in such cities as New York and Chicago mill outlets may run to $5.50, and in reinforced concrete buildings and other fireproof structures to $7 and $9.50.

A former fire chief of New York City gave the value of a complete sprinkler equipment as 4 per cent of the cost of the building. As may be judged by what has been already written, this is only an approximate figure.

What is said to be the largest system of sprinklers in the United States was installed in 1911 in the Armour packing plant in South Omaha. According to the newspaper report the cost was $160,000. In this system there are 50 miles of pipes, 28,000 sprinkler heads, high-pressure pumps, and a steel tank with a capacity of 100,000 gallons. A separate water system is used. When a sprinkler head is released it sounds an alarm in the engine room, and starts the fire pumps going. Every room in the plant, every bridge and platform is protected. The cost was about $6 per head.

A western planing mill has a system that takes care of 166,000 sq ft. The cost was 6¢ per square foot, but the installation was made when figures were low, or about $3 per head, not including tank and connections. For this kind of work a figure of $5 to $6 is not unusual.

The 6¢ per square foot in ordinary times should be set at 10¢ in such years as 1923, when prices of material reached a high point. For the most expensive class of work with concealed pipes in stores and office buildings 12¢ might be set; and with special installations this figure would be exceeded.

For an approximate estimate a figure of 8¢ per square foot is as low as can be set for the plainest work. This is on the basis of the ordinary wet pipe systems. The dry costs about 50¢ per head more. In buildings that are not heated it is impossible to have the wet pipe system, and dry installation is so arranged that a fire releases the water and fills the pipes.

These figures, with the exception of the Armour ones which are on the low priced basis, are for the building work only, and do not include supply piping outside, tanks, pumps or special equipment. The requirements are so varied that it is impossible to give a reliable figure. Approximately the supply piping, tank and auxiliary equipment will run to $2.50 per head extra.

Area. Each sprinkler head in an ordinary installation takes care of from 70 to 90 sq ft. On a basis of 9¢ per square foot this makes each sprinkler head come to $6.30 and $8.10 for a range. But neither square foot, sprinkler head, nor percentage of building cost can give more than an approximate figure. The fire chief's estimate of 4 per cent of the cost of the building is about as near as a guess can be. The range might be set from 3 to 5, but, on the

other hand, the structure might be so extravagantly built that this would not be a safe criterion. Carried all through a fine building the 4 per cent rate would allow too much money for the sprinklers, unless the pipes were of brass. The cost does not rise in proportion to the structure, and this is a strong point in favor of sprinklers. Approximately it does not cost much more to protect a fine building than a plain one.

The Boston Manufacturers' Mutual Fire Insurance Company, 31 Milk St., Boston, issues a pamphlet with full instructions for various layouts, with sizes of supply, etc. All plans are examined, criticised and approved, free of charge, before insurance is granted. By this system the best expert advice is obtained, and expensive changes are never necessary.

Automatic System. Some of the special rules of this company are given here, so that sizes of supply and other pipes may be judged for appraisal where plans are not obtainable.

Valve. First of all, there has to be a valve about 40 to 50 ft away from the building. In general, the supply or connecting pipes from the valve in to the building should not be more than 6″; but sometimes 8″ are used, with 2 risers of 6″. Small buildings with not more than 50 sprinkler heads may have a 4″ supply.

An independent system should be used if possible, and not one connected with the regular fire supply, especially when that comes from a tank. "Supplies from two independent sources are necessary, at least one of which should be automatic." It is considered a good idea to put up a tank discharging into the yard system and serving both fire hose and sprinklers. The capacity should not be less than 30,000 gallons, and the bottom of the tank should be from 75 to 100 ft above the yard level. The supply does not come directly from the tank, but from the yard system, which is reinforced by the extra pressure.

Hangers. They are made of round iron rod. The size for ¾′, to 2″ pipe is $\frac{5}{16}$″; 2½″ to 3″, $\frac{3}{8}$″; 3½″ to 6″, ½″; 7″ to 8″, $\frac{5}{8}$″. If the rods are threaded, they must be about ⅛″ more in diameter than the foregoing.

Pipe. The best is galvanized iron, painted every year with red lead and linseed oil.

Window, Cornices, and other parts of a building are often supplied with sprinklers to let down a sheet of water.

Danger. One of the dangers of the sprinkler system is the accidental release without any fire. This results in great damage from water. But the best modern systems are safeguarded against this contingency.

Efficiency. Manufacturers and merchants all over the country are now paying more attention to sprinklers than formerly. The

system has so many advantages that it is considered to pay for itself in six or seven years through the reduction in the rate of insurance. In first quarter of one year of 1,086 fires under sprinkler risks, 646 were practically or entirely extinguished, 403 were checked, and in only 37 did the system fail to give satisfaction. Sprinklers are ready all the time, start only when the head or outlet melts under a temperature of 140 to 160 degrees, throw the water only where needed as the fire spreads and melts new heads, and keep going in a heat and smoke where firemen could not live.

Special Conditions. In the case of an appraisal the size and distance of the inside pipes can be seen, as distinguished from those that are buried in the ground. If, in spite of the sprinkler system, the building is a total loss, and an estimate has to be made of the piping, it is rather hard to do anything without a plan or a knowledge of the number of outlets. The latter may have been 8′ apart in 12′ bays, or 12′ apart in bays of 6′ for ordinary hazard; and 7′ to 11′ if the hazard is special. According to the regular table this would be when the water pressure exceeded 20 lbs per sq in. When less, or supplied by a tank the figures for centers of outlets would be 7′ to 11′ for ordinary risk, and 6′ to 10′ for special.

The foregoing is for regular mill construction. For joisted ceilings the figures in the case would be 8′ to 10′ ordinary; 7⅓ to 9′ special; in the second with tank supply, 7⅓ to 9′; and 6½ to 8′.

Unless a plan is available or sizes and centers known, it is thus seen to be rather a difficult undertaking to get an accurate valuation of a sprinkler system if the building is burnt; and we must always remember that it was in Boston itself, the center of the best sprinkler installations, that the fire chief said he knew of only one really fireproof structure, and that was the reservoir.

For ordinary work without long runs or special requirements the sizes of pipe for a minimum number of automatic sprinklers are as follows:

¾-inch pipe,	1 Automatic Sprinkler
1 inch pipe,	2 Automatic Sprinklers
1¼ inch pipe,	3 Automatic Sprinklers
1½ inch pipe,	5 Automatic Sprinklers
2 inch pipe,	10 Automatic Sprinklers
2½ inch pipe,	20 Automatic Sprinklers
3 inch pipe,	36 Automatic Sprinklers
3½ inch pipe,	55 Automatic Sprinklers
4 inch pipe,	80 Automatic Sprinklers
5 inch pipe,	140 Automatic Sprinklers
6 inch pipe,	200 Automatic Sprinklers

Data. The size of the risers may be estimated from the table. The center of the system is naturally the best place to put the riser,

but sometimes it is put on the side when the branch lines are not too long. Not more than 6 sprinklers should be put on a branch. The size of the distributing pipe tapers from the riser down to the

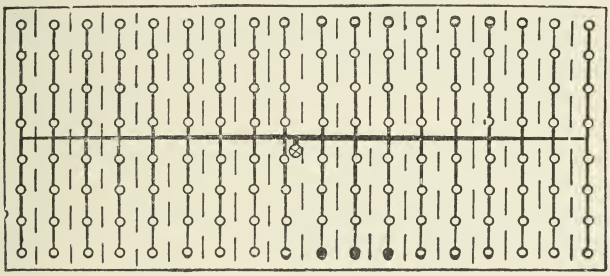


Fig. 22.

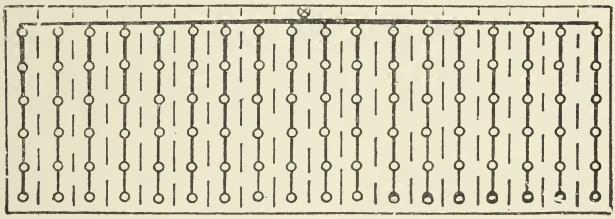


Fig. 23.

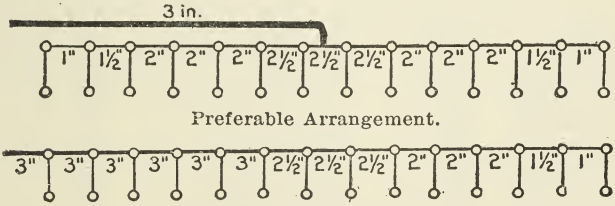


Fig. 24.

end of the run. The following figures show layouts from which a fair idea of systems and sizes may be obtained for valuation.

Cost of Insurance. When a good sprinkler system is installed the rates of insurance are lowered from 50 to 35 per cent, depending upon the character of the work. On the wet-pipe system, double supply, the above reductions are put in force in Boston. With

sprinkler Notification the rate is 35 per cent off; with Automatic Fire Alarm, Watch Supervision, and Sprinkler Notification, 50 per cent. The Boston Chamber of Commerce Committee set forth the advantages of the Sprinkler system, thus:

"The following illustration is typical of the cost of insurance before and after sprinkling. This illustration is taken for a building which was about 35,000 sq ft:

Value of building	$ 53,000.00
Value of contents	150,000.00
Five-year rate on building per $100 before sprinkling, $0.36 per annum, which makes the insurance	$ 190.80
Annual rate on contents, $1.15, which makes the cost of insurance of contents before sprinkling	1,725.00
Total cost of insurance per annum	$1,915.80

"The cost of the installation of sprinklers would be approxitely $1,750, and the reduction in insurance premiums would be 40 per cent. Forty per cent of $1915.80 is $766.32. That is, an investment of $1,750 would make a saving of $766.32 in insurance rates. If we charge 15 per cent interest and depreciation on the investment, it still leaves a net profit of $503.82, by which the sprinkler installation would pay for itself in three and a half years."

Effect of Sprinkler Equipments in Frame Buildings

Occupancy of Building	Insurance Rate		Occupancy of Building	Insurance Rate	
	Before	After		Before	After
Laundry....	$1.59	$0.40	Flour mill...	$4.00	$1.00
Laundry.....	3.00	.65	Flour mill...	1.40	.30
Laundry.....	3.40	.72	Flour mill...	3.65	.70
Metal worker	1.25	.30	Flour mill...	3.75	.65
Metal worker	1.00	.35	Flour mill...	2.02	.97
Metal worker	1.39	.35	Printing.....	2.35	.05
Metal worker	5.65	.53	Printing.....	1.08	.25
Metal worker	1.76	.20	Grocery.....	1.21	.17
Metal worker	1.25	.48	Grocery.....	3.25	.40
Flour mill...	4.75	1.60	Glass mfg...	2.50	.25

Average rate before installation, $2.51. Average rate after installation, 51 cents.

Cast-iron Water Pipes. For factory yards the sizes are given by the Mutual Fire Insurance Companies. To clear the frost the depth of earth covering over the top of the pipe should run from 2′ 6″ in the south to 5′ 6″ in Canada, New England, Northern New York. Local conditions have to settle this matter, which involves the cost of excavation.

Hydrants ought to be set about 50 ft away from the building protected, so that they will not be smashed by falling walls. They may be better protected from danger behind a low building or other barrier.

Length of pipe is 12 feet, exclusive of socket.

The three following tables give the sizes, etc., for pressures that do not ordinarily exceed 125 lbs, but may occasionally go as high as 150 without danger. The tables are those of the Water Works Associations:

CLASS E OF NEW ENGLAND W. W. ASSOC. SPECIFICATIONS

Nominal Inside diameter of pipe (inches)	Thickness of shell (inches)	Weight per length including socket (pounds)	Weight per ft including socket (pounds)	Weight per ft excluding socket (pounds)
4	.39	230	19	17
6	.46	380	32	29
8	.53	575	48	44
10	.60	810	67	64
12	.65	1040	87	82
14	.70	1310	109	103
16	.75	1600	133	125
18	.80	1910	159	148
20	.85	2260	188	176
24	.95	3000	250	234
30	1.10	4340	361	338
36	1.25	5900	492	460

CLASS C OF AMERICAN W. W. ASSOC. SPECIFICATIONS

Nominal inside diameter of pipe (inches)	Thickness of shell (inches)	Weight per length including socket (pounds)	Weight per ft including socket (pounds)	Weight per ft excluding socket (pounds)
4	.48	280	23	21
6	.51	430	36	33
8	.56	625	52	48
10	.62	850	71	65
12	.68	1100	92	85
14	.74	1400	117	108
16	.80	1725	144	133
18	.87	2100	175	162
20	.92	2500	208	191
24	1.04	3350	279	258
30	1.20	4800	400	367
36	1.36	6550	546	498

5. Lead and Jute. The approximate amount of lead and jute yarn required for making joints is shown in the table below. This

is based on pipe in twelve-foot lengths. Where many fittings and bends are required, larger amounts should be allowed. The lead in each joint should be run at a single pouring.

WEIGHT OF LEAD AND JUTE REQUIRED IN LAYING PIPE

Size of pipe (inches)	4	6	8	10	12	14	16	18	20	24	30	36
Lbs of Lead per ft of Pipe.....	0.5	0.8	1.0	1.3	1.5	1.8	1.9	2.3	2.5	3.0	3.8	4.5
Lbs of Jute per ft of Pipe.....	.020	.024	.028	.034	.041	.048	.052	.062	.069	.085	.105	.120

The following table from the Engineering News-Record gives a basis for arriving at Original Cost in any year listed. In 1868, "war prices" were high; and we see in our war times that the 1915 price of $17.05 was $45.18 in 1917—and from $55 to $60 in 1918. But as the 1868 prices fell, so will ours to some extent.

COST OF CAST-IRON WATER PIPE IN BOSTON FROM 1868 TO 1917

Year	20" and Larger		10" to 20"	
	Tons Purchased	Price per 2,000-lb Ton	Tons Purchased	Price per 2,000-lb Ton
1868	2,850	$67.65	1,430	$64.63
1870	1,310	47.50	2,732	47.04
1871	.....	.....	1,726	51.33
1873	.....	.....	1,652	54.48
1874	1,934	46.02	2,846	43.63
1875	336	41.07	3,858	37.50
1876	.....	.....	2,442	31.25
1877	3,808	25.83	605	26.78
1878	538	23.14	1,086	23.03
1880	5,624	36.56	778	37.50
1881	28	28.48	756	28.48
1882	.....	.....	908	34.82
1883	1,188	23.43	750	32.85
1885	3,158	23.62	1,160	25.93
1886	.....	.....	1,198	26.25
1887	2,906	29.84	2,218	28.26
1888	.....	.....	1,568	25.40
1889	1,624	24.51	930	24.60
1890	1,008	27.09	1,848	27.58
1891	1,456	24.95	1,848	24.82
1892	.....	.....	1,004	22.68
1893	1,668	22.51	112	23.16
1894	1,692	20.04	2,016	20.04
1895	12,152	20.65	.....	.....
1896	28,955	19.21	1,395	18.18
1897	22,837	17.56	376	16.82
1898	1,958	17.55	2,548	16.84
1899	1,708	18.76	.....	.....
1901	18,682	24.25	.....	.....
1902	.....	.....	417	25.40
1908	4,251	22.40	.....	.....
1909	9,736	24.37	753	22.98
1910	1,657	24.72	.....	.....
1911	2,429	21.60	60	21.60
1912	107	23.50	20	23.50
1913	403	23.00	.....	.....
1914	9,112	20.00	30	20.90

Change of Table Form

Year	Tons of Pipe Bought	Weighted Average Price per 2,000-lb Ton	Pounds of Fittings	Aaverge Price per lb cents	Ratio of Fittings to Pipe %	
					Weight	Cost
1912	3,335.	$20.95	340,854	2.28	5.1	11.1
1913	8,059	21.20	582,589	2.48	3.6	8.4
1914	3,620	21.10	953,477	2.49	13.1	30.8
1915	4,333	17.05	488,932	2.51	5.6	16.6
1916	2,506	29.15	619,188	2.88	12.2	24.4
1917	2,242	45.18	582,059	3.98	13.0	22.8

CHAPTER XIV

EQUIPMENT OF BUILDINGS

(1913 = base of 100 here for prices)

Furniture and Machines. In a physical valuation this is another feature that makes a good deal of work. Tables, desks, filing cases, safes, typewriters, adding machines and a hundred other items do not seem to be of much account in such a valuation, but taken in the aggregate they come to a large figure. Some of the newer style of electrically operated adding machines, etc., cost heavily. In one building the total, including the law library, ran to nearly $60,000; in another, $40,000; in still another, $10,000; and this at the depreciated figures. When new the cost would be much higher.

This kind of valuation is totally distinct from any motive power work. It related solely to what is connected with installations for clerical use, and warehouse work.

Generally speaking, the proper method of estimating the value of all such equipment is to put a present value price on it. It is not worth while, in nine cases out of ten, to put down an original cost. There is work enough connected with listing $40,000 to $60,000 worth of old and new furniture, wall cases and shelving by the thousand square feet, typewriters, and other machines, without putting down two valuations. There should be no such thing as averaging up the depreciation on equipment from a few months to forty years old. Each item, or each class, should be priced on the spot and finished.

Ordinarily the railroads are willing enough to render all assistance required. Their furniture expert is sent along, and the original cost figures given whenever possible. The law library is priced, and so are all expensive machines. Whatever law squabbles may be had over the main features of a railroad valuation running into millions, most recognize that this class of equipment bears a small proportion to the complete summary, and that the best way for all is to get through with it as easily as possible.

Law Libraries may run to any price—some I saw were listed, present value, at $9,000, and others at $14,000. A library was valued on the basis of $6 for recent textbooks, $5 for older, but still

standard works, and $2.50 for the oldest books. Some experts allow a rate of $2 per volume averaged over the whole library.

Engineering. In the engineering department of a railroad there are thousands of drawings, maps, building plans, and other data; and also costly instruments. There is no way of valuing the first lot. A road might put almost any figure upon it, within reason. Surveys are costly, the records are useful and remain so. Building plans of a standard type are used year after year; and the bills of material attached to them save the work of making new ones as often as another building is erected from the type. What would cost an architect a hundred or several hundred dollars, can often be done for a few cents in a railroad office by making a set of blueprints.

Hotels, etc. Monthly reports are made of all silverware, dishes, bedding, towels, napkins, and the whole equipment of such places. By far the easiest way of valuing such stock is to get the reports. Beds themselves, stoves, tables, benches, and all the larger items not included in the lists have to be valued on the ground. Furniture, carpets, and shades, may be taken at so much per room, unless they are of the more expensive kinds.

Telegraph and Telephone tables and equipment are not taken in the same classification as the other furniture, etc., but separately.

Refrigerators. Here we enter a field without bounds. We may have a refrigerator for $25 up to as high as we please. For a house planned to ice from the outside an allowance of $75 is fair. This might be increased to several hundreds, according to size, number of compartments, style of finish, etc.

One of the largest makers says that zinc lined refrigerators are poisonous. Wood lining is preferred to zinc.

As an approximate price per square foot the following figures will be useful: (Thus, the front size being 3 wide and 4 high = 12 sq ft. Only the front is estimated for size.)

Wood Lined, Antique Oak. From $4 to $6.

White Enameled Lined, Oak Finish. From $6 to $8.

Opal Glass Lined. Quartered Oak. $8 to $12.

Porcelain Tile Linings. No Wood Outside. $18 up.

Rudd Heaters. Dwelling size, $130 on cars, east of Mississippi River; $150 on the Pacific Coast.

Revolving Doors. There are scores of varieties in all styles of finish, and thus it is impossible to give a price without knowing the requirements. But for a physical valuation or an approximate estimate a fair idea is better than none. These doors run higher in cost than is commonly supposed.

About the cheapest door for a good front is $580 in New York City, or at factory. From this price to $800 may be said to cover ordinary requirements. Freight and setting have to be added. A

large collapsible door, electrically operated was installed in a skyscraper in the west in 1912 for $2,500. This price is greatly exceeded for the doors in fashionable hotels and department stores.

A revolving fire door is an excellent method of checking a fire. The cost varies with the style and finish. A wooden door, lined with tin, may be used in factories, but not in fine apartment houses. A price of $350 may be set for an ordinary installation.

Dahlstrom Doors, Etc. There are many kinds of fireproof doors and windows now on the market. An approximate price on one kind will serve for an estimate on all.

Doors range from $1.25 to $1.70 per square foot without glass or hardware, but with hardware fitted. The one panel doors are the cheapest. Jambs and casings are not included. For 6-in partitions with 5-in casings both sides, the cost is 95¢ per linear foot. These prices include a grained enamel finish; a plain color finish is 5 per cent less. For quantities of 25 deduct 10 per cent from above prices, which are f.o.b. New York.

Doors with five panels in the regular style naturally cost more than with one, as there is welding to do at all joints. The above prices are based on a door 3′×7′. Freight, hardware, glass and erection have to be added.

Office partitions and wainscoting are figured at the same price per square foot as doors.

The cost of erection is set by the manufacturers at from 20 to 30 per cent of the cost of material, under ordinary conditions.

Two sheets of asbestos are used inside the doors, with a sheet of felt between. A strip of cork 1½ in wide is used inside the hollow stile to reduce the metallic ring when shutting.

CHAPTER XV

BELLS, PEALS AND CHIMES, 1918

(U. S. Index No. for Metals in 1918, 187.)

(Courtesy McShane Bell Foundry Company, Baltimore.)

Approximate. The following data will give architects and appraisers a good idea of the cost, size, and weight of ordinary church bells, peals, and chimes. The regular table for the small bells runs from 300 to 1300 lbs; and for the large, 1400 to 7000. The small bells from 300 to 750 lbs increase 50 lbs each; from 800 to 7000 at rise of 100 lbs. The weight is usually from two to three per cent above the list. In both tables the intermediate sizes are usually omitted. Bells are made of 78 per cent copper, and 22 tin.

BELL			MOUNTINGS		Price of Mountings
Weight	Tone	Diameter	Outside Measurements	Diameter of Wheel	
300	D	25″	3′ 4″×2′ 8″	2′ 10″	$26
400	C#	27″	3′ 4″×2′ 10″	3′ 6″	30
500	C	29″	4′ 0″×2′ 10″	4′ 4″	32
600	B	31″	4′ 0″×2′ 10″	4′ 4″	35
700	Bb	33″	4′ 5″×3′ 3″	4′ 9″	40
800	A	34″	4′ 5″×3′ 3″	4′ 9″	40
900	A	35″	4′ 5″×3′ 3″	4′ 9″	45
1100	G#	37″	4′ 9″×3′ 4″	5′ 6″	45
1300	G	39″	4′ 9″×3′ 7″	5′ 6″	55
1400	F#	40″	5′ 0″×3′ 10″	6′ 3″	70
1600	F	42″	5′ 4″×4′ 0″	6′ 3″	70
1800	F	44″	5′ 4″×4′ 0″	6′ 3″	80
2000	E	46″	5′ 8″×4′ 6″	7′ 0″	90
2500	Eb	50″	6′ 1″×4′ 6″	7′ 0″	120
2800	Eb	52″	6′ 1″×4′ 6″	7′ 6″	120
3000	D	54″	6′ 8″×5′ 0″	7′ 6″	130
3800	C#	57″	7′ 0″×5′ 0″	7′ 6″	150
5000	B	62″	7′ 6″×6′ 0″	8′ 0″	180
6200	Bb	66″	7′ 6″×6′ 0″	8′ 6″	200
7000	A	72″	8′ 0″×7′ 0″	8′ 6″	260

Price. A fair allowance is 60¢ a pound for the bell, and the mountings to be added to this. A 300 lb. bell complete would thus cost $206 f.o.b, Baltimore, and a 7000 pounder, $4,460.

In general the mountings for single bells and peals, and the framing for chimes weigh about half as much as the bells themselves. A 500 pounder would thus be allowed 750 for freight.

Peals. The peals make a combination of two to five bells harmonized. The bells without mountings may be set at 65¢ per lb. The mountings to be added for each bell at the list price given in the tables.

Chimes are furnished with the framework complete, ready to be installed. When appraising a set of chimes, measure the diameter of each bell and refer to table for weight. Allow 85¢ per lb on the bells themselves, and this will cover the cost of the entire equipment. Chimes are furnished in sets of ten to fifteen bells. A set of chimes should be at least eight.

But the freight and hoisting have to be added to the foregoing figure. As will be noted in the Chime Table the weights of the largest bells run from 2,050 to 5,600 lbs. The smallest complete set of chimes consists of eight bells, the largest of which is 1,850 lbs., the total weight about 8,000 lbs., and 12,000 with the framing included. This allowance of 50 per cent of the bell weights for the framework must not be forgotten on account of freight and hoisting. The heaviest set of chimes in the following table weighs 26,350 lbs.; with framing the total weight is about 40,000.

Hoisting. A set of ten bells was hoisted and connected ready for use for $80, at ordinary wages for labor. The bells weighed 9,200 lbs, and the total weight was about 13,000. This is at the rate of $17.40 per ton for bells alone, or $12.30 on the basis of the total weight. This, however, was a plain hoisting proposition and a small set of chimes.

For hoisting and connecting a heavier set of chimes a fair allowance is $15 a ton on the total weight; or $22.50 on the weight of the bells alone.

Chimes. The following chimes have been installed in this country. They are set down here as a few out of many to give a fair idea of weights and costs. The largest set in the United States is last on the list. Philadelphia has the Liberty Bell and this one also.

CHIME TABLE

Number of Bells	Total weight, lbs	Heaviest	Lightest	Number of Bells	Total weight, lbs	Heaviest	Lightest
10	15,950	4,200	625	10	9,200	2,050	500
11	13,125	3,050	575	14	14,890	3,100	500
11	11,425	2,650	550	11	13,125	3,050	575
11	11,575	2,650	550	11	17,825	4,200	625
10	9,250	2,050	525	11	13,150	3,050	575
15	17,725	3,500	525	14	13,100	2,650	450
11	11,575	2,650	550	13	14,150	3,050	500
10	10,475	2,650	550	15	26,350	5,600	575
13	14,150	3,050	500				

The Liberty Bell is about 4 ft in diam and 3 ft high. The thickest metal is 3″, and the thinnest $1\frac{1}{4}$″. The total weight is a modest 2,080 lbs.

Big. The great bell of Moscow weighs 220 tons. It is 22 ft in diam and 19 ft high. The great bell of China weighs 60 tons, and is 12 ft in diam by 14 high. A bell in Japan weighs 83 tons. The largest bell in North America is at Montreal, 14.28 tons.

Smaller Bells

Chapel Bells range in weight from 100 to 250 lbs. The diameters are from 17 in to 24 in; the price of the mountings from $14 to $24. This is to be added to the regular cost of bells according to weight at 60¢ per pound.

Academy and school bells run from 50 to 500 lbs. Courthouse and tower clock bells from 100 to 10,000.

CHAPTER XVI

A LARGE BUILDING VALUATION

1921–1922. I was employed by the County Commissioners and the Assessor to value the large buildings of Omaha. I already had original cost figures of many, and got much information from realtors, contractors and architects, the latter usually having the cubic footage on record for buildings they had designed. Most of the owners were also willing to open their books. Figures given were checked in various ways. The work took a little more than six months.

The regular insurance plats usually give the size of the buildings, number of stories, and the height from the sidewalk. The latter is not very reliable, but often good enough for approximate figures. Assessors do not have to be as accurate as contractors.

The ground size being obtained, the easiest way of getting the height is to take the elevator to the top floor, measure that in the clear, make an allowance for the average height of the roof, and walk down the stairs from top floor to basement, counting the risers.

The data as given in this chapter may be used for any year as shown by assessors, as the wages and material costs apply in almost all cities. The large cities, such as New York, Chicago, Boston, St. Louis, have slightly higher rates, but when contractors' bids often vary 20 per cent in the same city mathematical accuracy is not obtainable in this line. Insurance offices can safely check the amount of policies from the data given.

Classes and Number of Buildings Valued

Apartments, 129; auto showrooms, 33; garages, public, 40; grain elevators, 5; hotels, 43; manufacturing buildings, 70; office buildings, 55; residences, 15; stores, first class, 10; stores, second class, 27; theaters, 6; warehouses, 110.

The hundreds of expensive residences were not even looked at, as the assessing period is fixed, and there was no time for one man to go over an entire county. An average for fine houses is 50¢ per cu ft, but there is no limit.

Total Valuation

This ran to about $50,000,000, and was $11,000,000 higher than the guessing contests. A great deal of time is wasted in such work by the necessity of getting the legal descriptions. A modern city plan lot and record system is more than enough to puzzle even the experts. It would pay some cities to replat and begin over again.

Description of Property: *Addition* *Lot* *Block*

Name of Building *Street and No.*

Class *No. Stories and Basement*

Contractor *Architect*

Year Finished	Year of Additions	Cubic Feet	Rate	Square Feet	Rate	Original Cost	Per Cent Depreciation	Total Depreciation	Per Cent Appreciation	Total Appreciation	Present Value	Year

Fig. 25.

The following form was used in filling out values:

Table of Depreciation Used, No. 1

For office buildings, warehouses and other structures, either with steel, frame or reinforced concrete. All fireproof work. No allowance for obsolescence, but physical valuation only.

Year	Depreciation, per cent	Year	Depreciation per cent	Year	Depreciation, per cent
1	2	18	32	35	57½
2	4	19	33½	36	59
3	6	20	35	37	60½
4	8	21	36½	38	62
5	10	22	38	39	63½
6	12	23	39½	40	65
7	14	24	41	41	66½
8	16	25	42½	42	68
9	18	26	44	43	69½
10	20	27	45½	44	71
11	21½	28	47	45	72½
12	23	29	48½	46	74
13	24½	30	50	47	75½
14	26	31	51½	48	77
15	27½	32	53	49	78½
16	29	33	54½	50	80
17	30½	34	56		

U. S. Basis. The Equitable, New York, is the largest office building in the country. The management sent a man to Washing-

ton, D. C., to find out what rate of depreciation should be applied. The income tax regulations do not now lay down any percentages, but each building is worked out to suit the owner at first and checked by the experts. On the Equitable a rate of $1\frac{1}{2}$ per cent a year was set for the building proper, and $7\frac{1}{2}$ per cent for the elevators, visible plumbing, visible piping, and such work. The building is thus supposed to last 67 years. It has 37 stories and is 486 ft high. The cost was $30,000,000.

On the basis of 90 per cent structural and 10 per cent for the $7\frac{1}{2}$ items, the average depreciation and obsolescence is 2.1 per cent per annum. The $7\frac{1}{2}$ items would be renewed every 13.3 years.

Table of Depreciation Used, No. 2

For the best class of mill-constructed buildings, semi-mill constructed, heavy girder and joist warehouses, and all such masonry wall and wood floor structures. Physical valuation only.

Year	Depreciation, per cent	Year	Depreciation, per cent	Year	Depreciation, per cent
1	$2\frac{1}{4}$	14	30	27	56
2	$4\frac{1}{2}$	15	32	28	58
3	$6\frac{3}{4}$	16	34	29	60
4	9	17	36	30	62
5	$11\frac{1}{4}$	18	38	31	64
6	$13\frac{1}{2}$	19	40	32	66
7	$15\frac{3}{4}$	20	42	33	68
8	18	21	44	34	70
9	20	22	46	35	72
10	22	23	48	36	74
11	24	24	50	37	76
12	26	25	52	38	78
13	28	26	54	39	80

Obsolescence. This means falling into disuse, getting out of date, and building owners claim remission of taxes on this account as well as for depreciation. As may be noted in this chapter the warehousemen allow 1 per cent a year for this factor. Some building owners ask 4 and 5 per cent a year for depreciation and obsolescence, even on the best buildings, but this is an effort to evade taxation. The best way to encourage building is to take off all taxes, but state laws do not yet allow this.

The trouble with the obsolescence demands is that if the ordinary rates of depreciation were applied to cottages thousands of them would be wiped off the books, and if obsolescence were also added the

case would be worse. Then the new property would have to be taxed heavier, and building would be further discouraged.

Table of Depreciation Used, No. 3

For the best class of non-fireproof residences, stores and flats, apartments, public garages, and similar structures. Physical valuation only.

Year	Depreciation, per cent	Year	Depreciation, per cent	Year	Depreciation, per cent
1	2½	14	31	27	57
2	5	15	33	28	59
3	7½	16	35	29	61
4	10	17	37	30	63
5	12½	18	39	31	65
6	15	19	41	32	67
7	17	20	43	33	69
8	19	21	45	34	71
9	21	22	47	35	73
10	23	23	49	36	75
11	25	24	51	37	77
12	27	25	53	38	79
13	29	26	55		

Another trouble is that the business center of cities has grown away from thousands of buildings. The physical structures may be perfect, but they are in the wrong location. The income from rents has to be considered, and the income from the business. This is a matter for accountants, and is distinct from the physical valuation, which gives the principal basis for assessment.

Building Valuation Data

Average Yearly Prices: 1913 is Always United States Base at 100.

The allowance in the last column is the basis for estimating changes in value of buildings for the year indicated as compared with 1913. Data are taken from the U. S. Report, but deductions made from the U. S. column for the high years 1916–22, in order that the assessments should not be excessive. Theoretically the figures previous to 1916 should also be cut; practically, with the final figures set by assessors and boards of equalization in view, this theory may be waived. The steel in modern office buildings runs from 10 to 12 t of the total cost: 12 is allowed in the following calculations

To get the average on the basis of 12 of steel and 88 of other materials multiply totals for the year required by the percentages. Thus for the year 1917, $208 \times .12 = 24.96$; $124 \times .88 = 109.12$, a total of 134 as shown. But in the case of railroad machine shops, for example, where steel is half of the total, the average would be 166. Each class of buildings should be valued to suit the percentage of materials, where there is a large difference in the yearly averages.

Materials are not, of course, installed in the buildings, but wages rose as high, and even higher, than the materials laid down at the site, in the high years, and they included all the wages necessary in preparation, so that for general purposes of assessment and rate-making the U. S. figures may be taken as for the materials installed.

The 1913 base is 100: in the 1922 line the 182 is cut to 127, or 55 deducted. But if 182 is cut 55, the real deduction from the U. S. figures is 30 per cent for that year. The figures had to be compiled in the end of 1921, and the assessment was to apply to the end of 1923, so that a guess had to be made, and the allowed column kept low enough.

The average is worked out for each year. Thus, 1920 shows 186 for steel and 308 for other materials. The average is given at 293, and the allowance at 205. The steel and other materials may be found in the regular tables if desired. Only the averages are given in the table.

Several months after the valuation was finished the Bureau of Labor index numbers were changed to suit the 1920 census instead of the 1910 one, but the allowance column had been cut low enough to take care of any variation. The 1922 numbers are found in front of the book, page xi.

TABLE FOR FIREPROOF STEEL FRAME BUILDINGS, No. 4

Year	U. S. figure	Allowance	Year	U. S. figure	Year	U. S. figure
1922	182	127	1911	99	1900	80
1921	197	138	1910	100	1899	76
1920	293	205	1909	96	1898	66
1919	188	132	1908	92	1897	62
1918	155	110	1907	100	1896	62
1917	134	100	1906	96	1895	64
1916	107	100	1905	87	1894	65
1915	95	....	1904	81	1893	68
1914	96	....	1903	82	1892	67
1913	100	....	1902	80	1891	71
1912	100	....	1901	76	1890	72

TABLE FOR ORDINARY BUILDINGS, WITHOUT STEEL, OR WITH A SMALL ALLOWANCE ONLY, No. 5

Year	U. S. figure	Allowance	Year	U. S. figure	Year	U. S. figure
1921	206	144	1910	101	1899	71
1920	308	216	1909	97	1898	65
1919	192	134	1908	92	1897	62
1918	151	105	1907	97	1896	63
1917	124	100	1906	94	1895	64
1916	101	....	1905	85	1894	66
1915	94	....	1904	80	1893	68
1914	97	....	1903	80	1892	67
1913	100	....	1902	77	1891	70
1912	100	....	1901	73	1890	72
1911	101	....	1900	76		

Modernism

The average city seems to be developing in two directions—garages and apartments. In even such a city as Omaha, with not more than 200,000 inhabitants, there were, up to 1922, 170 apartments, each holding from 6 to 180 families. It seems a poor way to breathe, except in winter. One company has erected about 5,000,000 cu ft of apartments, all fireproof. Garages are spread all over the face of the prairie. There are 29,000 autos and trucks in the county.

Car Area. The smallest space allowed in a public garage is 92 sq ft; the largest, used by the U. S. Post Office, is 194 sq ft. The average of 7 garages, accommodating from 100 to 150 cars each, is 140 sq ft. This allows for walls, driving space, etc. The total area over the walls is divided by the number of cars. The usual style of garage is known from coast to coast—brick or concrete walls, steel trusses, and concrete floor, costing about $2 per sq ft of total area. But some run as low as $1.25 and others go to $2.25.

On several with two to three stories and basement each car space averaged 1,750 cu ft—the lowest, 1,520; the highest, 2,160—with from 200 to 400 cars each. Cost, 9¢ to 12¢ per cubic foot, or $1.00 to $1.50 per square foot, gross, depending upon the height of the ceiling and the construction, the best being reinforced concrete. On a 2- and a 3-story the roof trusses do not cost any more than on a 1-story.

Loft Buildings

The foregoing figures are for ordinary garages only, and do not include fine show rooms with two to five stories above for storage,

repairing, painting, etc. Such reinforced buildings ran from 20¢ to 27¢ per cubic foot in 1917, 1918, 1921. 1920 was much higher. The Ford building, 1916, 15¢. 2,450,000 cu ft. A building in 1919 with 914,000 cu ft, 21¢. Another with 1,927,000 cu ft, 20¢ in 1920. In 1918–19 several low buildings with 300,000 to 1,000,000 cu ft went up at 13¢ to 18¢.

Averages. In the following lists a sufficient number of each kind of building has been selected to give figures for the years shown.

Office Buildings, First Class, Fireproof

No.	Stories	Cubic feet	Rate, cents	Original cost	Year
1	6	550,000	40	$220,000	1888
2	7	325,000	51	166,000	1888
3	8	1,710,000	28.4	486,000	1890
4	16	2,268,000	33.1	751,000	1910
5	12	4,227,000	28	1,183,000	1911
6	19	3,697,000	30	1,114,000	1912
7	6	974,000	27	263,000	1912
8	7	820,000	27	221,000	1912
9	8	1,465,000	29	425,000	1915
10	6	850,000	35	298,000	1916
11	8	848,000	42	356,000	1916
12	14	2,000,000	41	820,000	1916
13	15	3,000,000	62	1,862,000	1918
14	6	426,000	45	192,000	1922

Note.—No. 13 required heavy and special construction. It is a telephone building.

Office Buildings, Second Class, Masonry Walls and Wood Joists

1	4	350,000	18	$63,000	1888
2	6	400,000	15	60,000	1889
3	6	620,000	24.5	152,000	1891
4	6	613,000	20.4	125,000	1891
5	3	383,000	10	38,000	1892
6	3	394,000	12	47,000	1896
7	3	393,000	16	63,000	1903
8	4	524,000	19	100,000	1912

Stores, Fireproof, First Class

No.	Stories	Cubic feet	Rate, cents	Original cost	Year
1	4	1,237,000	16	$198,000	1906
2	8	4,723,000	25	1,180,000	1907
2	2	1,047,000	35	367,000	1921
3	5	715,000	15	107,000	1910
4	5	160,000	56	90,000	1920
5	8	2,100,000	50	1,050,000	1920
6	5	329,000	45	148,000	1921
7	6	480,000	30	144,000	1921

Stores, Masonry Walls and Wood Joists, First Class

1	5	465,000	12	$56,000	1886
2	5	834,000	9	74,000	1897
3	4	1,742,000	9.5	165,000	1901
4	6	1,795,000	10	179,000	1904
5	6	1,812,000	10	181,000	1907
6	6	784,000	15.2	119,000	1910

Warehouses, First Class, Reinforced

1	6	900,000	11	$99,000	1906
2	8	1,452,000	13	187,000	1907
3	9	1,705,000	12.5	213,000	1907
4	7	3,602,000	9	324,000	1908
4	3	443,000	16.5	73,000	1912
5	6	1,954,000	10.4	203,000	1910
6	8	1,230,000	22	271,000	1910
6	8	1,245,000	13.6	169,000	1913
7	6	694,000	11	76,000	1913
8	7	1,621,000	11.25	180,000	1914
9	6	815,000	19.6	160,000	1917
10	6	1,350,000	14.5	196,000	1918
11	8	1,324,000	22	292,000	1918
12	6	1,109,000	15.8	175,000	1919
13	6	485,000	28	135,000	1920
14	6	700,000	25.1	176,000	1920
15	8	1,120,000	20	224,000	1920
16	8	1,836,000	44.4	815,000	1920

LIGHTER MANUFACTURING BUILDINGS, REINFORCED

(For printing plants, etc.)

No.	Stories	Cubic feet	Rate, cents	Original cost	Year
1	5	494,000	19.4	$96,000	1913
2	3	116,000	21	25,000	1914
3	3	302,000	16.5	50,000	1914
4	4	610,000	14	85,000	1915
5	4	453,000	10.6	48,000	1918
6	5	450,000	25	110,000	1919
7	3	1,100,000	21.25	233,000	1920

WAREHOUSES, FIRST CLASS, MASONRY WALLS AND WOOD JOISTS OR MILL CONSTRUCTION

1	7	1,846,000	12	$222,000	1886
2	5	594,000	7	41,000	1886
2	5	731,000	9	66,000	1900
2	5	680,000	11	75,000	1912
3	6	1,310,000	12	157,000	1888
4	5	1,300,000	8	104,000	1902
5	5	523,000	8	42,000	1902
5	5	523,000	10	52,000	1912
6	6	1,675,000	10.4	168,000	1905
7	8	1,969,000	13	256,000	1906
8	7	4,361,000	11¼	490,000	1906
9	6	743,000	10	74,000	1908
10	7	2,430,000	8	194,000	1914

Standard Storage Warehouses

The American Warehousemen's Association met in 1921 and took up the 1920 Report. The approved standard in 1916 was slow burning mill construction, but in June, 1920, reinforced concrete was considered cheaper. This, however, would not apply close to the forests. The cost given was $3.75 per square foot, taken over the walls. The figure for New York City was put at $4.50, and $5.00 in 1920. This takes in the basement floor.

The type considered was 200′×100′ outside the walls, six story and basement. Cross walls, 3; enclosed concrete stairways, 2. Clearance between floors, 10 ft, but 15 ft on first. Rated floor load, 250 lbs per sq ft. Dry pipe sprinkler system, 2-source supply.

Tank of 50,000 gals. Elevators, 4 of 8,000 lbs, and 4 double whip hoists. Heating for office. Two railroad tracks. Telephones, etc.

DETAIL OF COST

Area outside walls, 100′×200′×7 = 140,000 sq ft @ $3.75..	$525,000
Extra for elevators whips, wiring, heat, telephones, partitions, plumbing, furniture for office.....	50,000
Organization and charter.....	2,000
Taxes and interest during construction.....	11,620
Interest on building during construction.....	10,000
	$598,620

On such a building the depreciation is allowed at 2 per cent per annum, and the obsolescence at 1 per cent. The depreciation is allowed above the foundation. The building proper takes in engineering and supervision and tank.

Area inside the walls, 98′×195′×7′ = 133,770 sq ft. Area available, taking out offices, shipping and laborers' rooms, elevators and stairs, 123,000 sq ft.

No. 2 example of standard warehouse: 50′×100′, 6 stories and basement, concrete skeleton, regular style of house, metal sash, one freight elevator, one combination freight and passenger. Gross contents, 425,000 cu ft at a construction cost without rooms of 35¢ per cubic foot, $148,750. Interest during construction, $3,470. Cut off 50 per cent gross space, leaving 212,500 cu ft available for storage. Depreciation, 2 per cent; obsolescence, 1 per cent.

No. 3 type was also based on 35¢ per cubic foot of gross contents. As storage space is what brings the revenue, the net has to be considered. Outside walls, floors for cubic data, partitions, rooms, corridors and halls, stairs and elevators, have all to be deducted. No rooms in No. 3. The cost rises when floors are subdivided into small fireproof rooms. The Cost-finding Committee also gave 35¢ per gross cu ft.

No. 4, Washington, D. C., 1919, 29¢ per cubic foot for a plain warehouse.

No. 5 in 1919, 3 floors, 150 rooms, 26¢ per cubic foot.

No. 6, 9 stories, 8,000 sq ft to a floor, $3 per square foot, basement included.

Small Rooms. In one Omaha case with a warehouse of 1,230,000 cu ft there were 1,100 small rooms, and an allowance of 8¢ per cubic foot extra was made as between this half of the warehouse and the other half of the same size without rooms, or about $90 each. This was "sight unseen" and merely for assessment purposes. Properly, one room should be measured and estimated and the others valued

from that. The partitions may be of tile, iron studs and wire lath, or reinforced. The regular insurance plats are handy for this kind of work, as the number of rooms is given. A modern city is platted out with every building colored to suit its material—wood, brick, fireproof, etc. This is done even for the smallest cottages, and the plats save an immense amount of labor in making an assessment. In a city of the size of Omaha four books were required, costing about $30 each. They are revised periodically.

Manufacturing Buildings. The regular warehouse lists may be used for many kinds of these, and the railroad shop square foot prices for the heavy structures, and the garage style for light work. The heaviest railroad style is not ordinarily used, as engines are not hoisted by cranes.

In a 1921 shop for materials of medium weight a square foot price of $3 was set. In ordinary times $2 would be enough. This for 28,000 sq ft. For another unit of the same plant with the same area $2.50 was used. Heating, plumbing, crane runways, all included. Concrete floor, brick walls and steel sash, Federal tile roof.

At another plant with 13,000 sq ft for light manufacturing, $2.50 was used.

But in two steel plants $1.50 was the unit, for only shells were to be considered, without heat, finished floors, etc. A machine shop was put at $2 and a foundry at $2.50. For the heaviest class of railroad structures, $4 and $5 would have been required in 1922.

For a heavy outside crane runway of 250 ft 80 tons of steel were used. Excavation and concrete bases have to be added.

Hotels, First Class, Fireproof

No.	Stories	Cubic feet	Rate, cents	Original cost	Year
1	4	1,281,000	22.5	$288,000	1907
2	7	512,000	26	133,000	1907
3	5	679,000	25	170,000	1912
4	6	600,000	20.8	125,000	1912
5	6	1,312,000	25	328,000	1915
6	15	2,703,000	34.1	922,000	1915
7	3	388,000	20.6	80,000	1915
8	8	1,342,000	40	537,000	1916
9	10	1,110,000	34	377,000	1918
10	8	1,316,000	36.7	483,000	1918
11	13	700,000	57	400,000	1920

Note.—No. 10 is an athletic club with rooms. No. 11 was built at the peak of prices, and the ground area is small; with a special foundation these factors raised the unit cost. In all cases, except one, there are stores on the street level.

Hotels, Second Class, Masonry Walls and Wood Joists

1	6	1,435,000	8	$114,000	1882
2	5	1,300,000	10	130,000	1884
3	5	689,000	11	76,000	1886
4	5	320,000	15	48,000	1886
5	5	470,000	20	94,000	1909
6	5	670,000	19.3	130,000	1911
7	3	300,000	18	54,000	1913

Theaters and Movies (No Organ)

	Seats	Per seat			
1	900	$39	.....	$35,000	1915
2	1,000	65	.....	65,000	1916
3	2,000	80	.....	160,000	1918
4	1,250	66	.....	82,000	1919
5	2,700	100	.....	270,000	1922

Apartments, First Class, Fireproof

No.	Number of apartments	Stories	Cubic feet	Rate, cents	Per apartment	Original cost	Year
1	31	4	250,000	30	$2,420	$75,000	1912
2	50	6	450,000	22	2,000	99,000	1912
3	53	4	430,000	30	2,450	130,000	1912
4	44	4	233,000	52	2,750	121,000	1917
5	30	4	735,000	30.6	7,500	225,000	1917
6	110	7	1,057,000	45	4,330	476,000	1917
7	19	4	251,000	38	5,000	95,000	1918
8	183	4	714,000	45	1,750	321,000	1919
9	56	4	671,000	50	6,000	335,000	1920
10	49	4	320,000	40	2,600	128,000	1921
11	146	4	563,000	50	1,920	280,000	1922

Note. Renters will not climb more than 4 stories without an elevator, even when houses are scarce. Few apartments up to 4 stories have an elevator. No. 7 is more on the hotel order than a regular apartment. Small apartments, low ceilings, and a few rooms in a suite run up the costs per cubic foot, as each suite must have plumbing for bath room and kitchen; also other equipment. An apartment with 14 suites was put up for 27¢, and $2,500 in 1917.

Apartments, Best Class, with Masonry Walls and Wood Joists

1	12	3	182,000	25.3	$3,830	$46,000	1907
2	28	3	313,000	22.4	2,500	70,000	1908
3	12	4	194,000	23.7	3,830	46,000	1914
4	14	3	360,000	22	5,700	80,000	1915
5	20	3	150,000	33⅓	2,550	51,000	1922

Note. Many buildings are divided into 6 suites: this size does not pay very well, as a janitor must be hired for too small a number. Occasionally one janitor takes care of several buildings in the same neighborhood.

PART II

CHAPTER I

RULES OF MEASUREMENT

There are thirty pages of rules in the New Building Estimators' Handbook, but they are mostly the old-style ones of Chicago, Missouri, etc. They are not required for appraisal work. What is standard in one place is not allowed in another. Unless for trifling exceptions actual measurement is followed in this book. The price is adjusted to suit difficult work instead of the measurement being increased. Quantities are taken net as left in the completed building.

Excavation. In all buildings an allowance has to be made for this by contractors, and consequently by valuators. The size over the footings by the depth gives the contents in cubic yards. This is for the necessary displacement, and not for caving in banks. The price should be raised to cover any special condition.

Piling. This is measured by the linear foot, wood or concrete.

Concrete. Actual contents as left in the structure in cubic yards for ordinary work, and square feet for thin walls, according to the thickness. Forms for a thin wall cost as much as for a thick one. Charge extra for special work on a net contents basis.

Floors and Sidewalks are taken by area, usually in square yards, the thickness being noted. Driveways are thicker than ordinary walks.

Rubble. It is better not to use perches and cords. A perch in Chicago is 25 cu ft, while the legal perch in Missouri is only 22. There is no standard rule.

A cord in the quarry or forest has 128 cu ft, but only 100 in the wall. It is safer to use cubic yards.

Deduct all but the very smallest openings in a wall. It is hardly worth while deducting a space 18 in square.

Cut Stone. Take ordinary work by the cubic foot and ashla by the square foot, both according to quality, and the latter to hav

thickness marked. Stone may be smooth, rock faced, bush hammered, plain or molded.

Granite. See Chapter V for details. This is the hardest material and also the hardest to value.

Marble is easier worked than granite, and is often estimated like the usual Bedford stone on ordinary work, with special price. Interior work for floors, wainscoting, partitions is taken by the square foot, and moldings by the linear foot.

Terra Cotta. This material is of such a special nature that the manufacturers are unwilling to give any cost figures. It is all special work. A drawing and mold may be used for a few pieces or for dozens. If for three pieces, suppose, the entire cost of the mold comes on them. Approximately allow the same prices as for cut stone, and lay the errors on the manufacturers.

Brickwork. The trade rule of 22½ to the cubic foot need not be used by an appraiser. The actual building is before him, and he can easily find the number of brick in the wall. A space should be laid off to get an average. All openings are deducted. Net wall area or contents considered. The number of brick to the cubic foot is given for all possible sizes in the Brickwork chapter.

For face brick the area is taken and the number per square foot found—usually about 7. Paving is taken by the square yard.

Cement Stone. This foundation material is taken by the square foot at the thickness of the various parts. All openings are deducted, corners are not doubled, but net surface only is measured. Chimneys are taken by the linear foot and size marked.

Fireproofing. Whether of tile or concrete, square foot measurement is used and net surface only taken. This cuts out elevator and stair openings. Beams, ceilings and partitions are measured by the square foot also, and a description of thickness or style marked, if price is not set down on the building. Columns may be taken by the linear foot if circular, and small beams also. Large straight-line columns and beams take square foot area.

Plaster. Net measurement is taken by the square yard. Solid partitions have thickness marked. Attics are also measured net, without extra allowance for work on slope. Measurement is taken down to floor, although the white or finish coat does not reach clear down. Outside work is also taken with net area, but where face timbers are used the space is so small that no deduction is made. In back plastered work between studs the latter would not be deducted.

Woodwork. Floors, walls, partitions, ceilings and roofs are all taken by the square, where a detailed bill of material is not made out. In the case of fine floors the square foot is the usual unit. The building square is an area of 100 sq ft.

Roofing of all kinds is taken by the square. Skylights and such openings are not included, but it is not worth while making a deduction for small chimneys.

Sheet-metal roofing is taken the same as the other kinds, while cornices, gutters, downspouts are taken by linear measure. Small work is figured by the square foot.

Painting is estimated wherever the brush touches, and nowhere else, as a general rule, with some trifling exceptions. Looked at from a practical standpoint it is scarcely to be expected that a painter will deduct the holes in lattice work.

Tiling. Net surface taken for ordinary work in square feet, and moldings, base, casings and such work by the linear foot. Angles in floors, on the wainscoting of a stair, and such places should be priced high enough.

Standard Rule. Measure by net surface or contents in all lines, and raise the price high enough to take care of special work.

CHAPTER II

INTERSTATE COMMERCE COMMISSION DATA

Eight Experts, Ten Railroads. For railroad-valuation work the Mid-Western Mechanical Valuation Committee compiled a Universal Cost Book with about 250 blue-print pages. Permission was given to use the parts of this relating to building work in this Appraiser. Information was gathered from many sources and after a careful study the figures were set down for railroad use over a large territory. The men worked in conjunction with the Western District of the Bureau of Valuation of the Interstate Commerce Commission.

The sub-committee was made up of the following men: W. L. Davis, Wabash; H. E. Anderson, M. K. & T.; E. F. Collins, St. Louis & San Francisco; E. F. Daily, C. B. & Q.; H. E. Forney, Southern Pacific; W. S. Lammers, Atchison, Topeka & Santa Fe; A. S. Ostberg, C. B. & Q.; G. W. Thomas, Sr., St. Louis & San Francisco.

The roads that contributed data for the Cost Book were: C. B. & Q., St. Louis & San Francisco, Southern Pacific, Wabash, M. K. & T., Atchison, Topeka & Santa Fe, Illinois Central, C. M. & St. Paul, Great Northern, Union Pacific.

The period of valuation was from 1910 to 1914, but the work was still being done in 1921. Appraisals have to be made for any date selected, and this illustrates what is pointed out in Chapter I, Part I, that original cost is a factor that has to be kept in view. Average prices are given for the selected period, but the figures are so arranged that prices can be carried down to subsequent years.

"The sub-committee was primarily interested in two phases of cost data: first, in the determination of the average actual price paid by carriers during the years 1910 to 1914 inclusive; and, second, the progress of prices of this same material during the years subsequent to 1914.

"Prices for the years subsequent to 1914 were necessary and with regard to this necessity the sub-committee has attempted to classify the items in the Cost Book according to their percentage increase in cost as compared to the average cost for the period 1910 to 1914. If the sub-committee has been successful in this attempt, obviously

the necessity of a complete compilation of costs for the years subsequent to 1914 will be eliminated."

F O B. The definite points from which prices were established were Chicago and St. Louis. There is no freight allowed from those points.

Arrangement. Net prices are usually given. The rise in all items is established for 1915, 1916, 1917, 1918, 1919. From the average base prices of 1910 to 1914 the items can be carried down through these years. As may be seen by the Index numbers given in Part I, the prices from 1910 to 1914 are practically on a level. This makes a good average to work from. In the U. S. Bulletin No. 269, except for a slight fall in 1911, the line from 1910 to 1914 is level for the All Commodities chart. In Building Materials the Index numbers show 101, 101, 100, 100, 97 for the five years, and 1913 is always base at 100. (The U. S. 1922 Revised Numbers are 98, 98, 99, 100, 92.)

This average base being established the committee made up averages for the succeeding years in the following manner: At Magnesia Boiler Lagging, 85 per cent, are seen the figures 00, 00, 118, 255, 234. These percentages of increase apply on that product from 1915 to 1919 inclusive. The price for 1915 and 1916 was the same as for the base period, while 1919 gave 234 per cent more. For each $1 of this material in 1910–14 the price in 1919 was $3.34. This system is carried all through the Cost Book.

Installation. The most valuable feature of the book is the Installation part. The foundation data that are lacking are supplied in a special chapter of this Appraiser. Millions of dollars worth of machines are put in railroad shops year after year, and weird guesses have hitherto been made at the cost of putting them in place. "The cost recommended by the sub-committee is the average cost of the installation costs submitted, and has been given the individual approval of the sub-committee."

An allowance has to be made for the increase in wages after the base period of 1910–14 for any part of the country.

Extras. A few percentages of increase from the Cost Book on materials not included in the part selected are given here:

Roofing	00, 20, 20, 74, 74
Steel and iron pipe	09, 63, 213, 131, 134
Blast, galvanized pipe	09, 50, 75, 103, 103
Sewer pipe	00, 19, 42, 88, 118
Cast-iron fittings	06, 43, 119, 119, 119

Valuation Department Cost Data

Magnesia Boiler Lagging, 85 per cent: 00, 00, 118, 255, 234

Thickness, in	Price, sq ft	Thickness, in	Price, sq ft	Thickness, in	Price, sq ft	Thickness, in	Price, sq ft
$\frac{1}{2}$	0.081	$1\frac{3}{8}$	0.126	$2\frac{1}{8}$	0.192	$2\frac{7}{8}$	0.261
$\frac{7}{8}$	.09	$1\frac{5}{8}$	.147	$2\frac{3}{8}$	.216	$3\frac{1}{4}$	.294
1	.09	$1\frac{3}{4}$	.159	$2\frac{1}{2}$	.225	$3\frac{1}{2}$	.315
$1\frac{1}{8}$	.102	$1\frac{7}{8}$	.171	$2\frac{5}{8}$	.237	4	.36

List Prices of J–M Sectional Pipe Covering and Fittings, Extra Thickness

Inside diameter of pipe, in	$1\frac{1}{2}$ inches thick per lin ft	2 inches thick per lin ft	Double standard thick per lin ft	3 inches broken joint lin ft
1	$0.52	$0.85	$0.75	$1.40
2	.64	1.00	.90	1.65
3	.76	1.15	1.10	1.90
4	.88	1.35	1.40	2.20
5	1.00	1.55	1.60	2.50
6	1.10	1.70	1.80	2.70
8	1.35	2.00	2.50	3.15
10	1.65	2.40	2.90	3.65
12	1.85	2.70	4.10	4.10
*16	2.35	3.30	5.10	5.10
*18	2.60	3.60	5.60	5.60
*20	2.85	4.00	6.00	6.00
*24	3.30	4.50	7.00	7.00
*30	4.00	5.50	8.40	8.40

* All magnesia coverings above 14 in furnished in segmental form; other coverings in sectional form in all sizes.

Boiler covering, 00, 00, 118, 255, 211. Per pound, $0.093.

Shingles, J–M Transite Fireproof, Standard Thickness $\frac{1}{8}$ In, per Hundred

Color	No. 1, 16″×16″	No. 2, 16″×16″	No. 3, 12″×12″	No. 4, 12″×12″
Gray.....	$5.83	$6.00	$3.33	$3.50
Slate.....	8.17	8.33	4.50	4.67
Red.....	8.17	8.33	4.50	4.67

BRICK

07, 09, 40, 67, 67

Brick, No. 1 common building only (f. o. b. point of origin)..... per M. $6.50
Brick, No. 1, common, laid in building wall, including average freight and all other expense..... " 20.00

Average cost of common brick laid in boiler settings or shop furnaces, including labor, freight and all other expenses, for the following states is:

	Common brick		Fire brick	
	No. 1	No. 2	No. 1	No. 2
North Dakota, per M..	$28.25	$25.08	$49.60	$43.90
South Dakota, " ..	29.40	25.69	53.92	47.92
Nebraska, " ..	26.19	23.29	50.38	44.63
Kansas, " ..	23.86	21.23	45.28	39.88
Missouri, " ..	23.14	20.60	45.15	39.75
Colorado, " ..	29.54	26.25	50.23	44.45
Oklahoma, " ..	22.79	20.34	53.98	47.98
Texas, " ..	24.37	21.74	46.72	41.22
Illinois, " ..	22.72	20.25	43.25	38.00
Iowa, " ..	22.53	20.10	43.84	38.54

NOTE. Fire brick listed as No. 1 are of the highest grade. No. 2 are of the grade ordinarily used.

Electrical Material and Supplies

ASBESTOS, TRANSITE OR ASBESTOS LUMBER

PLAIN FINISH			EBONY FINISH		
Thickness, in	Weight per square foot, lbs	Square foot	Thickness, in	Weight per square foot, lbs	Square foot
1/8	1	$0.10	1/4	2 1/2	$0.48
1/4	2	.20	1/2	5	.78
1/2	4	.40	3/4	7 1/2	1.02
1	8	.65	1	10	1.14
1 1/2	12	.80	1 1/2	15	1.74
2	16	1.00	2	20	2.58

Conduit, Bituminized Fiber

SOCKET JOINTS			FIBER ELBOW		
Inside diameter, in	Weight per foot lbs	Per foot	Inside diam. in.	Radius, inches	Each
1	1.24	$0.043	1	8″.....	$0.85
2	1.95	.048	2	12″.....	.95
3	2.08	.053	3	18″.....	1.10
4	4.25	.06	3¼	20″.....	1.20
			4	30″.....	1.40

			Each
Cover, manhole, with frames, cover	21-in diameter	540 lbs..	$17.50
" " " " "	24 " "	330 "..	9.75
" " " " "	30 " "	292 "..	5.85
" " " " "	20 " "	107 "..	1.20

Poles, white cedar, following sizes:

	Weight, lbs	Each		Weight, lbs	Each
20′×6″ top.....	190	$1.04	40′×7″ top.....	850	$8.40
22′×6″ "	225	1.64	45′×7″ "	1,100	10.89
25′×6″ "	250	1.85	50′×7″ "	1,350	13.79
30′×6″ "	350	3.00	55′×7″ "	1,700	15.95
35′×6″ "	450	4.89	55′×8″ "	2,200	20.33
35′×7″ "	600	7.54			

Posts, cutter ornamental "Riverside," base, 3 ft 6 in high by 18 in, largest diameter; column, 8½ in, largest diameter; pendant globe, 11 ft from ground; top globe, 14 ft from ground, distance c to c, globes 40 in, globes 8″×12″, sizes as follows:

	Weight, lbs	Each		Weight, lbs	Each
1 light post.....	450	$25.00	5 light post.....	85	$30.00
3 " "	500	27.50			

Note. For foot cast iron ground section for above posts, $6.50 added to above price.

Electrical Material and Supplies

Area in square feet	Imperial black electrical slate, plain finish				Monson black electrical slate, plain finish			
	1″ thick or less	1¼″	1½″	2″	1″ thick or less	1¼″	1½″	2″
1 to 3	0.52	0.58	0.66	0.82	0.72	0.90	1.08	1.44
8 to 12	.66	.72	.78	.94	1.08	1.26	1.44	1.80
15 to 20	.80	.86	.92	1.10	1.44	1.62	1.80	2.16
30 to 35	1.04	1.14	1.24	1.48	1.98	2.16	2.34	2.70

Note. Slate 1 in thick weighs 14 lbs per square foot.
Slate 1 in thick crated weighs 16 lbs per square foot.
Bevel, ¼ in is 1¢ per lin ft. Sand rubbing (2 faces), 4¢ per square foot
Bevel, ⅜ in is 2¢ per lin ft.up to 16 sq ft, and 6¢ per square foot
Bevel, ½ in is 3¢ per lin ft. for larger sizes.

Flues. Boiler, standard charcoal iron: 08, 49, 152, 152, 152:

Outside diameter, inches	Price per foot	Weight per foot, lbs	Birmingham Gauge
1½	.0113	1.40	13
2	.083	1.91	13
3	.146	3.33	12
4	.229	5.47	10

Installation

Boilers and Stacks

Labor unloading and erecting horizontal return tubular boilers, ready for brickwork	$5.00	per ton
For Heine & Murray type water tube boilers (400 h p and smaller)	6.00	"
For Stirling water tube boilers	8.00	"
For B. & W. water tube boilers	7.00	"
For Edgemore water tube boilers (400 h p and smaller)	7.00	"
Labor unloading setting material	.25	"
Labor placing fire brick in setting	12.00	per M.
Labor placing common brick in setting	10.00	"
Labor erecting one stack including all expense except for dead men for guy fastenings	.015	per lb.
For each additional stack, one-half of this amount, or	.0075	"

Painting Stationary Boiler Smoke Stacks

Size of stack	Square feet, surface	Labor	Material	Total
16″×20′.....	84	$0.34	$0.43	$0.77
16″×25′.....	105	.42	.53	.95
16″×30′.....	126	.51	.64	1.15
20″×20′.....	105	.42	.53	.95
20″×25′.....	135	.52	.67	1.19
20″×30′.....	157	.63	.80	1.43
24″×20′.....	126	.51	.64	1.15
24″×25′.....	157	.63	.80	1.43
24″×30′.....	188	.75	.96	1.71
30″×20′.....	157	.63	.80	1.43
30″×25′.....	196	.78	1.00	1.78
30″×30′.....	236	.94	1.20	2.14
36″×20′.....	188	.75	.96	1.71
36″×25′.....	235	.94	1.20	2.14
36″×30′.....	283	1.13	1.44	2.57

Material: Niles Structural Black Paint covers surface of 300 sq ft, per gallon, one coat; cost per sq ft, $.0051.
Labor: $.004 per sq ft. All before erection.

Conduit

Average labor cost per foot of installing metal conduit for electric power distribution and motor wiring in railway shops:

½″.....	$.02 per ft	2″	$.08 per ft
¾″.....	.03 "	2½″.....	.12 "
1″	.04 "	3″	.15 "
1¼″.....	.05 "	3½″.....	.18 "
1½″.....	.06 "	4″	.20 "

Above labor units do not include cost of installing cabinets, pull boxes, condulets, etc., and must be added according to judgment of engineers in the field.

Machinery—General Classification

Machine	Per cwt.
Accumulators	$0.60
Accumulator weights	.125
Anvils.....Each	.75
Boilers—Loco. type	.25
Boilers—Small vert	.35
Borer—Car wheel	.40 to .50
Borer—Car	.50
Borer—Loco. cyl	.40 to .50
Bar—Portable—Boring	2.00 ea.
Blower—Pres., small	1.00
Blower—Pres., large	.75
Bender—Eye	.75
Bender—Pipe	.50
Bender—Special	.50
Bulldozer—Small	.35
Bulldozer—Large	.25
Brake—Large	.50
Brake—Small	.50
Centering machine	6.00 ea.
Compressor—St. line	.40 to .50
Compressors—Others	.50 to .60
Cutter—Bolt	.60
Cutter—Flue	.75
Cutter—Staybolt	.60
Cutter—Pipe	.50
Cutter—Gear	.50
Crane—Bracket	.40
Crane—Jib	.40
Crane—Bridge	.30 to .60
Crane—Hyd. tower	.75
Crane—Gantry	.40 to .75
Crane—Runway	.50
Clamp—Hand	.40
Clamp—Power	.35
Drill—Sensitive	1.25
Drill—Upright	1.00 to 1.25
Drill—Radial	.60 to .75
Drill—Multi-spindle	.60 to .75
Engines—Gas	.50 to .75
Engines—High speed, auto	.50 to .60
Engines—heavy duty	.35 to .50
Engines—Girder frame	.50
Exhauster	.75
Facing machine	1.00 ea.
Forges	.35
Forgers—Large	.25
Forgers—Small	.35
Grinders—Tool	1.00
Grinders—Plain and Univ	1.00
Grinders—Tool and cutter	1.25
Grinders—Planer knife	.60
Gainers	.40
Generators—Electric	.50
Hammer—Helve	.40
Hammer—Steam	.25 to .40
Hoists—Locomotive	.60
Jacks, Hyd., drop pit	6.00 ea.
Jacks, Pneu., drop pit	6.00 ea.
Jointers	.75
Keyseaters	.75
Lathes—Brass	.50 to .60
Lathes—Eng. 16″–24″	.50 to .60
Lathes—Eng. 24″–48″	.35
Lathes—Eng. 48″–72″	.30
Lathes—Driving wheel	.25
Lathes—Axle	.35
Lathes—Car wheel	.30
Lathes—Turret	.50
Lathes—Journal	.35
Lathes—Automatic	.60
Mills—Boring, 36″–48″	.35
Mills—Boring, 50″ and up	.30
Millers—Planer type	.30
Millers—Column, large	.50
Millers—Column, small	.40
Millers—Vertical	.35
Motors—Electric	.50 to 1.25
Mortiser—Chisel	.50
Mortiser—Saw type	.50
Moulder	.50
Press—Hyd., large	.30
Press—Hyd., small	.30
Plates—Face, average	4.00 ea.
Planer—24″–42″	.40
Planer—48″–84″	.30
Planer—Crank	.40
Planer—Wood dimension	.30
Planer—Wood surface	.40
Planer—Matcher	.40
Pumps—Air	5.00 ea.
Pumps—Water	.50 to 1.00
Pumps—Water centrif	.50
Pumps—Vacuum	.50 to 1 00
Punches and shears	.35
Quartering machine	.30
Rolls—Bending, large	.25
Rolls—Bending, small	.35
Riveters—Hydr	.30
Rattlers—Flue	.25
Rattlers—Casting	.25
Resaw—Band	.50
Resaw—Circular	.40
Reservoir—Air	.25
Racks—Test	7.00 ea.
Saws—Cold cut	.35
Saws—Band	.60
Saws—Rip, hand feed	.60
Saws—Rip, self feed	.40
Saws—Cut off	.40
Saws—Cut off, auto	.40
Shapers—Pillar	.40
Shapers—Traverse	.30
Shapers—Draw cut	.50
Slotters—Double hd	.50
Slotters—Single hd	.35

MACHINERY—GENERAL CLASSIFICATION—*Continued*

Machine	Per cwt.	Machine	Per cwt.
Separators—Chip.....	$0.50	Welder—Flue.....	$0.40
Shaper, wood.....	.50	Welder—Electric.....	.50
Tenoners—Wood.....	.50	Welder—Oxy-acetylene.	2.00 ea.
Tapper—Nut.....	.35	Workers—Wood.....	.75

NOTE. Classification based on average-sized machine and ordinary floor-level installation.

In each case the above installation cost per hundredweight includes all items of expense, as follows: Unloading from car; moving to point of installation; cleaning; assembling in place; leveling and adjusting; grouting (on foundation already in place); applying nuts to foundation bolts; painting; hanging counter shaft (to structure already in place); material used to accomplish the above; and use of tools and supervision.

PIPE, IN YARDS

Basic Assumptions. Cost of delivering pipe from car or storehouse to place where made up, $4 per net ton.

No allowance had been made for supervision, use of tools or other overhead. Each carrier should use its own development; however, ordinarily this should amount to about 15 per cent of the labor.

Joints of pipe in commercial lengths average 16 ft long.

Costs per hour for piping gangs as shown below:

Gang for $\frac{1}{4}''$ to $1''$ pipe:

Pipe fitter.....	$0.38
Helper.....	.22
	$0.60

Gang for $3\frac{1}{2}''$ to $5''$ pipe:

Pipe fitter.....	$0.38
Helper.....	.22
2 laborers.....	.36
	$0.96

Gang for $1\frac{1}{4}''$ to $3''$ pipe:

Pipe fitter.....	$0.38
Helper.....	.22
Laborer.....	.18
	$0.78

Gang for $6''$ pipe and up:

Pipe fitter.....	$0.38
Helper.....	.22
4 laborers.....	.72
	$1.32

Pipe

The use of the costs shown in following tables is as follows:

Assume that it desired to compute the cost of labor for installing 200 ft of 2-in pipe laid on the surface of the ground. The computation would then be 200×.0155 for delivery and making up, plus the per cent developed by the carrier for supervision, plus $.07 for each cut and thread in excess of those provided on commercial length pipe, plus $.08 for each valve or fitting (not couplings) in the 2-in line.

Any cost for hangers, boxing, excavation of trench and similar work would be additional.

PIPE, SURFACE WORK

Size of pipe in.	Per cut and thread	Per foot of pipe			For making up per valve or fitting	Joints of pipe made up by gang per hour
		Delivery to place	Making up in place	Total delivery making up		
$\frac{1}{4}$	$0.03	$0.002	$0.0038	$0.0058	$0.04	10
$\frac{3}{4}$	.03	.002	.0038	.0058	.04	10
1	.04	.0034	.0038	.0072	.04	10
$1\frac{1}{4}$	.05	.0045	.005	.0095	.05	10
$1\frac{1}{2}$	.06	.0054	.0063	.0117	.06	8
2	.07	.0073	.0082	.0155	.08	6.1
$2\frac{1}{2}$	.09	.0116	.0098	.0214	.095	5.1
3	.12	.0152	.0098	.0250	.095	5.1
4	.20	.0216	.0120	.0336	.11	5.0
5	.30	.0292	.0158	.0450	.16	3.8
6	.39	.0379	.0159	.0538	.20	5.2
8	.60	.0494	.0275	.0769	.28	3.0

PIPE, OVERHEAD WORK

$\frac{1}{4}$	$0.03	$0.002	$0.0094	$0.0114	$0.095	4.0
$\frac{3}{4}$	.03	.002	.0094	.0114	.095	4.0
1	.04	.0034	.0094	.0128	.095	4.0
$1\frac{1}{4}$	.05	.0045	.0125	.0170	.120	4.0
$1\frac{1}{2}$	.06	.0054	.0167	.0221	.160	3.0
2	.07	.0073	.0250	.0323	.245	2.0
$2\frac{1}{2}$	.09	.0116	.0297	.0413	.290	1.7
3	.12	.0152	.0297	.0449	.290	1.7
4	.20	.0216	.0316	.0532	.320	1.9
5	.30	.0292	.0316	.0608	.320	1.9
6	.39	.0379	.0317	.0696	.320	2.6
8	.60	.0494	.0550	.1024	.56	1.5

Covering, Asbestos Pipe and Sheet-metal Jacket, Including Distribution. Jacket Made Up. No allowance made for supervision; however, ordinarily 10 per cent of labor should be allowed

Basis: One pipe fitter, $0.38
One laborer, .18

$0.56 per hour

Surface and Overhead Work, Straight

Asbestos pipe covering			Sheet metal jacket		
Size of pipe, inches	Linear foot applied per hour	Labor per foot	Size of pipe, inches	Linear foot applied per hour	Labor per foot
1 to 2½	40	$0.014	1 to 2½	40	$0.014
3 to 5	30	.0153	3 to 5	30	.0153
6 to 9	20	.028	6 to 9	20	.028

Painting Sheet Metal Jacket—Two Coats of Paint

Size of jacket, inches diameter	Per linear foot	Basis per square yard	Size of jacket, inches diameter	Per linear foot	Basis per square yard	Size of jacket, inches diameter	Per linear foot	Basis per square yard
3	$0.022	$0.25	7	$0.035	$0.17	11	$0.048	$0.15
4	.029	.25	8	.04	.17	12	.054	.15
5	.029	.20	9	.045	.17	13	.057	.15
6	.035	.20	10	.049	.17	14	.061	.15

Pipe, Vitrified Sewer

Size of pipe, inches diameter	Estimated weight per foot, pounds	Per foot for laying, including distribution and cement for joints
4	9	$0.023
6	16	.036
8	24	.055
10	32	.073
12	50	.10
15	70	.127

Poles, Wood, for Electric Power Distribution in Shop Yards of Railways

Size feet	Distributing	Shaving and gaining	Digging hole			Setting	Painting including paint	Totals		
			In sand	In earth	Earth and stone			In sand	In earth	Earth and stone
20	0.30	0.25	0.45	0.95	1.50	0.75	0.40	2.15	2.65	3.20
25	.35	.30	.55	1.20	1.80	1.00	.50	2.70	3.35	3.95
30	.40	.35	.75	1.55	2.40	1.25	.60	3.35	4.15	5.00
35	.50	.40	.90	1.95	3.00	1.50	.70	4.00	5.05	6.10
40	.60	.45	1.20	2.30	3.40	1.75	.80	4.80	5.90	7.00
45	.70	.50	1.50	2.70	3.90	2.10	.95	5.75	6.95	8.15
50	.80	.60	1.80	3.05	4.30	2.50	1.10	6.80	8.05	9.30
55	.90	.80	2.15	3.50	4.90	2.90	1.30	8.05	9.40	10.80

Note. Above units are for average conditions. Labor cost of installing cross-arms on poles, 25¢ to 35¢.

Shafting, Main Line

Diameter of shaft, inches	Weight of shaft per foot, pounds	Estimated cost of erecting when shaft is 16 feet overhead									
		One 20-ft length shafting 3 bearings	One hanger of average drop	One collar	One coupling			1 pulley 9-in face by 22-in diameter			
					Flange	Ribbed compression	Collins compression	Solid cast	Split cast	Split steel	Split wood
1½	6	$2.40	$0.80	$0.20	$0.60	$0.80	$0.80	$0.80	$1.20	$1.20	$1.40
2	11	3.20	1.00	.20	.60	.80	.80	.80	1.20	1.20	1.40
3	24	5.30	1.40	.20	.90	1.10	1.10	1.00	1.40	1.40	1.50
4	43	8.00	1.80	.30	1.20	1.60	1.60	1.40	1.60	1.60	1.70
5	67	11.20	3.50	.40	1.80	2.00	2.00	1.60	2.00	2.00	2.10
6	96	18.00	4.60	.50	2.80	4.00	4.00	1.80	1.80	2.80	2.80

This estimate includes all labor and all expense for special trestles or staging, use of tools and 10 per cent of the whole erecting cost for supervision. It is assumed that all overhead structural supports and hanger blocks are in place, bolt holes all drilled or bored, all keyways cut and all keys, set screws, bolts, nuts, washers, shafting, hangers, collars, couplings and pulleys provided and delivered on shop floor.

Wire, Rubber Covered, in Conduit for Electric Distribution and Motor Wiring in Railway Shops

Solid, per foot		Duplex, per foot		Stranded, per foot			
No. 14..	0.004	No. 14...	0.0065	No. 8....	0.0078	No. 3/0.....	0.0227
No. 12..	.005	No. 12...	.007	No. 6....	.01	No. 4/0.....	.0246
No. 10..	.006	No. 10...	.0088	No. 4....	.012	No. 250,000 CM.	.0262
				No. 2....	.0146	No. 300,000 CM.	.0277
				No. 1....	.0166	No. 400,000 CM.	.0299

Above labor units include cost of making splices and taps.

Wire, Exposed on Knobs and Cleats for Electric Power Distribution and Motor Wiring, as Found in Railway Shops

Solid, per foot		Solid per, foot		Stranded, per foot		Stranded, per foot	
No. 14..	0.0104	No. 6...	0.0240	No. 4...	0.0285	No. 2/0.	0.0454
No. 12..	.0128	No. 4...	.0285	No. 1...	.0375	No. 4/0.	.0537
No. 10..	.0147	No. 2...	.0337	No. 0...	.0413	No. 500M.CM	0.77
No. 8..	.0194	No. 1...	.0375				

Above labor units include labor cost of installing knobs, cleats, tubes, etc. Also include total cost of making splices and taps.

Lumber

	Percentage of raise, 1915 to 1919		
Ash, 1st or 2d clear, rough dry	00, 00, 00, 98, 95	M Bd ft	$60.90
Basswood, clear, dry, rough..	03, 11, 19, 42, 34	"	38.00
Birch, 1st or 2d clear, dry, rough.....	03, 11, 19, 42, 34	"	51.90
Cedar, piling (point of origin)	03, 11, 19, 42, 43	Lin ft	0.14
Cherry, 1st or 2d clear, dry, rough.....	00, 00, 40, 40, 40,	M Bd ft	125.90
Cypress (average).....	00, 00, 00, 23, 23	"	31.75
Fir, rough (average).....	00, 00, 25, 58, 58	"	23.05
Hickory, No. 1 common, rough (average).....	02, 09, 103, 103, 103	"	63.00
Mahogany, 1st or 2d clear, dry, rough (average).....	00, 12, 68, 69, 69	"	160.00
Maple, clear, 1st or 2d (aver.)	00, 00, 30, 42, 42	"	54.00
White oak crossing plank...	00, 00, 18, 49, 49	"	24.50
Oak, quarter sawed (average)	01, 05, 09, 75, 75	"	79.50
Oak, white post or burr, rough (average).....	00, 00, 18, 49, 49	"	25.75
Oak, white No. 1, car timber.	00, 00, 18, 49, 49	"	24.65
Pine, longleaf, yellow, heart grade, close grain, bridge and trestle timbers.....	00, 00, 23, 48, 48	"	27.00
Pine, longleaf yellow, No. 1 common (average).....	00, 00, 00, 12, 12	"	21.00
Pine, "A," select, white, dry, rough (ready for pattern making).....	00, 00, 00, 12, 12	"	74.80
Pine, Norway, rough (aver.).	00, 00, 23, 48, 48	"	30.00
Poplar, 1st or 2d clear, yellow, dry, rough.....	00, 00, 02, 54, 54	"	61.95
Walnut (average).....	00, 00, 00, —, —	"	125.30

CHAPTER III

EXCAVATION AND PILING

Original Surface. A contractor has usually to make an allowance for clearing off the site of a proposed building, but a valuator comes to a finished product that may be from a few months to fifty years old. The original surface may have been far above or below the established grade. This allowance, if any, has to be decided on locally.

Trees. In Salt Lake City, at the rate of about 60¢ per hour for common labor, bids were received for cutting down trees as follows: For 6 in or less, $4 to $5 each; greater than 6 in and less than 12 in, 3 bids, $7, $9, $10; 12 in and greater diameter, 2 bids, $5 and $10. For a 16-in tree 2 men should cut down, trim, take out root and load on wagon in 12 hr or 24 in all.

Trenches. For ordinary work in good soil, and throwing on bank only, allow 1 cu yd per hour for 1 man. This for cottage excavation. From this basis judgment must decide whatever more or less should be right. Half as much might be enough in winter with frozen soil; and also in summer with water to contend with and mud work to fight. Extreme heat and extreme cold cut down the normal output as much as 15 per cent, but how is a valuator to know when a building was erected and how the thermometer stood?

Large store excavations in cities under ordinary conditions of soil and weather run from 50 to 80 min per cu yd complete, that is, including teams and hauling a reasonable distance. Bad soil or conditions might run the time up to 100 and 120 min per cu yd. Averaging wages at 60¢ per hour, or 1¢ per minute, the cost per yard is easily found; or any rate of wages can be applied. On a very large, deep, wet job the contractor had a bill of 300 min per cu yd.

Machine Foundations. On these with all kinds of complicated shapes and angles allow from 200 to 250 min per yd, or at 60¢ per hour, $2.00 to $2.50. With the very large machines and continuous foundations, such as driving wheel lathes, and in good soil each man should be able to throw out 1 yd per hr, to the ordinary depth of not more than 5 ft. The 200- and 300-minute rates were taken from wet soil work.

TABLE 1

EXCAVATION TABLE PER CUBIC YARD ON BASIS OF COMMON LABOR AT 60 CENTS PER HOUR

	Cost per yard	Yard per hour, 1 man
Ordinary trenches	$1.05	0.57
For each 4 ft deep beyond the first 4 ft add to $1.05	.45	.40
Backfilling	.45	1.33
Spreading on lot	.18	3.33
Wheeling about 25 lin yds	.45	1.33
Carting away old building material	3.00	

Multiply the "Yd. per hr, 1 man" by any rate of wages. Thus, the first item allows 57 yd. which at 45¢ per hour comes to 79¢; at 80¢ per hour, $1.40.

Depth. With ordinary depths the foregoing figures will serve, as large excavations are handled by power machines that lift a yard onto a wagon as easily in a deep basement as on the surface, and what horses or trucks lose below is averaged with the gain at the start. For extraordinary depths only a special investigation can decide what rate should be used. For trenches, piers and pits the Chicago rules allow 75 per cent increase every 5 ft down. Either time or money allowance can be based on this. Down to 5 ft, actual contents, or 100 per cent; from 5 ft to 10 ft, actual contents of this part plus 75 equals 175; from 10 ft to 15 ft, actual contents of this part plus 150 equals 250.

Hauling. In case this has to be considered a team travels about 2 miles per hour with a load on a paved street; unpaved, $1\frac{1}{2}$. The load is from $1\frac{1}{4}$ to $1\frac{1}{2}$ cu yd. Trucks make 8 miles an hour and easily carry several times the load of a horse wagon.

Backfilling. For ordinary work allow 2 cu yd per hour for 1 man; if the soil is packed and has to be thrown 6 to 8 ft, 1 yd.

Filling and Tamping. Per man, $1\frac{1}{2}$ cu yd per hour for ordinary work with timbers at 5-ft centers. Where ties are set at about 2 ft, half that allowance.

Sheet Piling. If this had certainly been a part of the excavation the appraiser should make an allowance. It might have been only a few plank braced in, or all the surface might have been covered. On the basis of labor at 60¢ per hour allow for that and material at from 8¢ to 12¢ per sq ft wherever the plank touched, which means both sides. At best, this part of the work is only a guess.

Rock. On a 60¢ basis allow $2.40 per cu yd for ordinary work; on large work with air drills, $1.60. These figures might be doubled on some kinds of street work where protection is required.

Foundations. So far as fire insurance goes the excavation and the safe part of the basement do not need to be included, and, as noted elsewhere, the Factory Mutuals pay no attention to what is below the ground.

Caissons. Allow 8 hr per yd to a depth of 30 ft, and with large piers; for small, 10 hr. These figures might be doubled if very wet soil had to be handled.

TABLE 2

CIRCULAR OR CISTERN EXCAVATION TABLE PER FOOT OF DEPTH IN CUBIC YARDS

(The diameter in feet is given between the earth walls or outside of the masonry.)

Diameter in feet	Cubic yards taken out	Diameter in feet	Cubic yards taken out
2	12–100 or 0.12	10	2.91
3	26–100 or 0.26	11	3.52
3.5 or 3 ft 6 in	0.36	12	4.19
4	0.47	13	4.92
4.5 or 4 ft 6 in	0.59	14	5.70
5	0.73	15	6.55
5.5 or 5 ft 6 in	0.88	16	7.45
6	1.05	17	8.41
6.5	1.23	18	9.43
7	1.43	19	10.50
7.5	1.63	20	11.64
8	1.86	22	14.10
8.5	2.10	24	16.76
9	2.36	26	19.67
9.5	2.58	28	22.80
		30	26.18

Table for Conduits and Curbing is set on a 5 cu yd basis per 8 hours when a depth of 28 in is reached, and a little less as the surface is approached. It often happens that the hardest of the work is breaking through the surface in winter and down for a foot or even two feet. The "neutral axis" might be set at 3 ft down: from this level, up or down, the work is usually harder. With a depth of 3 ft to 6 ft an allowance of 5 cu yd may be made, and some men would exceed it from 10 to 50 per cent; and the digging from 3 down to 4 and 4 ft 6 in makes up for the extra labor to the 6-ft level, so that a 5 cu yd allowance is fair on ordinary soil.

TABLE 3

Excavation Table for Conduits and Curbing in Ordinary Soil, Linear Feet for One Man in 8 Hours

Depth	12″	16″	20″	24″	28″
Width 12 in.....	100	79	67	61	58
" 16 in.....	75	59	50	46	44
" 20 in.....	60	47	40	37	35
" 24 in.....	50	40	34	31	29
" 28 in.....	40	34	28	26	25

TABLE 4

Excavation Table for Sewers, Steam Mains, Gas and Water Pipes, Linear Feet for One Man in 8 Hours on a 5-Cubic Yard Basis for Ordinary Soil

Depth	3′	3′ 6″	4′	4′ 6″	5′	5′ 6″	6′
Width 2 ft 0 in.	23	19	17	15	14	12	11
" 2 ft 6 in.	18	16	14	12	11	10	9
" 3 ft 0 in.	15	13	11	10	9	8	7
" 3 ft 6 in.	13	11	10	9	8	7	6
" 4 ft 0 in.	11	10	9	8	7	6	6
" 5 ft 0 in.	9	8	7	6	6	5	4

TABLE 5

Trench or Sewer Excavation, Cubic Yards per Linear Foot

Width, ft in	Depth in feet												
	3	4	5	6	7	8	9	10	11	12	13	14	15
2 6	0.28	0.37	0.46	0.56	0.65	0.74	0.84	0.93	1.02	1.11	1.21	1.30	1.39
3 0	.34	.45	.56	.67	.78	.89	1.00	1.11	1.24	1.34	1.45	1.56	1.67
3 6	.39	.52	.65	.78	.91	1.04	1.17	1.30	1.43	1.56	1.69	1.82	1.95
4 0	.45	.59	.74	.89	1.04	1.18	1.34	1.48	1.63	1.78	1.93	2.08	2.22
4 6	.50	.67	.84	1.00	1.17	1.33	1.50	1.67	1.84	2.00	2.17	2.34	2.50
5 0	.56	.74	.93	1.11	1.30	1.48	1.67	1.85	2.04	2.22	2.41	2.60	2.78
5 6	.61	.82	1.02	1.22	1.43	1.63	1.83	2.04	2.24	2.45	2.65	2.85	3.06
6 0	.67	.89	1.11	1.33	1.56	1.78	2.00	2.22	2.44	2.67	2.89	3.12	3.33
6 6	.72	.96	1.20	1.45	1.69	1.93	2.17	2.41	2.66	2.89	3.14	3.38	3.61
7 0	.78	1.04	1.30	1.56	1.82	2.07	2.34	2.59	2.87	3.11	3.38	3.63	3.89
7 6	.83	1.11	1.39	1.66	1.95	2.22	2.50	2.78	3.05	3.33	3.61	3.89	4.17
8 0	.89	1.19	1.48	1.78	2.08	2.37	2.67	2.96	3.26	3.56	3.86	4.15	4.44

TABLE 6

Excavation Table: Cubic Yards per Foot Deep

Ft	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
10	4.1	4.5	4.8	5.2	5.6	5.9	6.3	6.7	7.1	7.4	7.8	8.2	8.5	8.9	9.3	9.6	10	10.4	10.8	11.1	11.5	11.9	12.2	11.6	13.0	13.4	13.7	14.1
11	4.5	4.9	5.3	5.7	6.1	6.5	6.9	7.4	7.8	8.2	8.6	9.0	9.4	9.8	10.2	10.6	11	11.4	11.8	12.2	12.6	13.1	13.5	13.9	14.3	14.7	15.1	15.5
12	4.9	5.4	5.8	6.2	6.7	7.1	7.6	8.0	8.5	8.9	9.4	9.8	10.2	10.7	11.1	11.6	12	12.5	12.9	13.3	13.8	14.2	14.7	15.1	15.6	16.0	16.5	16.9
13	5.3	5.8	6.3	6.8	7.2	7.7	8.2	8.7	9.3	9.6	10.1	10.6	11.1	11.6	12.0	12.5	13	13.5	14.0	14.5	14.9	15.4	15.9	16.4	16.9	17.3	17.8	18.3
14	5.7	6.2	6.8	7.3	7.8	8.3	8.8	9.3	9.8	10.4	10.9	11.4	11.9	12.4	13.0	13.5	14	14.5	15.1	15.6	16.1	16.6	17.1	17.6	18.2	18.7	19.2	19.7
15	6.1	6.7	7.2	7.8	8.3	8.9	9.5	10.0	10.6	11.1	11.7	12.2	12.8	13.4	13.9	14.4	15	15.6	16.1	16.7	17.2	17.8	18.3	18.9	19.5	20.0	20.6	21.
16	6.5	7.1	7.7	8.3	8.9	9.5	10.1	10.7	11.3	11.8	12.4	13.0	13.6	14.2	14.8	15.4	16	16.6	17.2	17.8	18.3	19.0	19.6	20.2	20.7	21.4	21.9	22.
17	6.9	7.6	8.2	8.8	9.5	10.1	10.7	11.4	12.0	12.6	13.2	13.8	14.5	15.1	15.8	16.4	17	17.6	18.3	18.9	19.5	20.2	20.8	21.4	22.1	22.7	23.3	23.
18	7.4	8.0	8.7	9.3	10.0	10.7	11.4	12.0	12.6	13.4	14.0	14.6	15.3	16.0	16.6	17.3	18	18.7	19.3	20.0	20.7	21.3	22.0	22.7	23.4	24.0	24.7	25.2
19	7.8	8.5	9.2	9.8	10.6	11.3	12.0	12.6	13.4	14.1	14.8	15.5	16.2	16.9	17.6	18.3	19	19.7	20.5	21.2	21.9	22.5	23.2	23.9	24.7	25.4	26.1	26.7
20	8.2	8.9	9.6	10.4	11.1	11.8	12.6	13.4	14.1	14.8	15.5	16.3	17.0	17.8	18.6	19.3	20	20.7	21.5	22.2	22.9	23.7	24.5	25.2	26.0	26.7	27.4	28.2
21	8.6	9.4	10.1	10.9	11.7	12.4	13.2	14.0	14.8	15.5	16.3	17.1	17.9	18.7	19.5	20.2	21	21.8	22.6	23.3	24.1	24.9	25.7	26.4	27.3	28.0	28.8	29.
22	9.0	9.8	10.6	11.4	12.2	13.0	13.8	14.6	15.5	16.3	17.1	17.9	18.8	19.6	20.4	21.2	22	22.8	23.7	24.5	25.3	26.1	26.9	27.7	28.6	29.4	30.2	31.0
23	9.4	10.2	11.1	11.9	12.8	13.6	14.5	15.3	16.2	17.0	17.9	18.8	19.6	20.4	21.3	22.1	23	23.8	24.7	25.5	26.4	27.3	28.1	29.0	29.8	30.7	31.5	32.3
24	9.8	10.7	11.6	12.4	13.4	14.2	15.1	16.0	16.9	17.8	18.7	19.6	20.4	21.3	22.2	23.1	24	24.9	25.8	26.7	27.6	28.5	29.3	30.2	31.2	32.0	32.9	33.8
25	10.2	11.1	12.0	13.0	13.9	14.8	15.8	16.6	17.7	18.6	19.5	20.4	21.3	22.2	23.1	24.0	25	25.9	26.9	27.8	28.8	29.6	30.6	31.5	32.5	33.4	34.3	35.2
26	10.6	11.6	12.5	13.5	14.4	15.4	16.4	17.3	18.3	19.3	20.2	21.2	22.1	23.1	24.0	25.0	26	27.0	27.9	28.8	29.8	30.8	31.8	32.7	33.7	34.7	35.6	36.6
27	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0	27	28.0	29.0	30.0	31.0	32.0	33.0	34.0	35.0	36.0	37.0	38.
28	11.4	12.5	13.5	14.5	15.6	16.6	17.6	18.7	19.7	20.7	21.8	22.8	23.8	24.9	25.9	27.0	28	29.0	30.2	31.2	32.2	33.2	34.2	35.2	36.4	37.4	38.4	39.
29	11.8	12.9	14.0	15.1	16.1	17.2	18.3	19.3	20.5	21.5	22.6	23.7	24.7	25.8	26.9	27.9	29	30.2	31.2	32.2	33.3	34.4	35.4	36.5	37.6	38.6	39.8	41.0
30	12.2	13.3	14.5	15.6	16.7	17.8	18.9	20.0	21.2	22.2	23.3	24.5	25.5	26.7	27.8	28.8	30	31.2	32.2	33.4	34.4	35.6	36.6	37.8	39.0	40.0	41.2	42.2
31	12.6	13.8	14.9	16.1	17.2	18.3	19.5	20.7	21.9	22.9	24.1	25.3	26.4	27.6	28.7	29.8	31	32.2	33.3	34.4	35.6	36.6	37.9	39.0	40.2	41.4	42.5	43.8
32	13.1	14.2	15.4	16.6	17.8	19.0	20.2	21.3	22.5	23.7	24.9	26.0	27.3	28.5	29.6	30.8	32	33.2	34.4	35.6	36.6	38.0	39.2	40.4	41.4	42.8	43.8	45.1
33	13.5	14.7	15.9	17.1	18.3	19.6	20.8	22.0	23.2	24.5	25.7	26.9	28.1	29.3	30.6	31.8	33	34.2	35.5	36.6	37.8	39.2	40.4	41.6	42.8	44.0	45.2	46.4
34	13.9	15.1	16.4	17.6	18.9	20.2	21.4	22.7	23.9	25.2	26.4	27.7	29.0	30.2	31.5	32.7	34	35.2	36.5	37.8	39.0	40.4	41.6	42.8	44.2	45.4	46.6	47.8
35	14.3	15.6	16.9	18.2	19.5	20.7	22.1	23.4	24.8	25.9	27.3	28.5	29.8	31.2	32.5	33.7	35	36.4	37.6	39.0	40.2	41.4	42.8	44.2	45.4	46.8	48.0	49.3
36	14.7	16.0	17.3	18.7	20.0	21.4	22.7	24.0	25.4	26.7	28.0	29.4	30.7	32.0	33.4	34.7	36	37.4	38.7	40.0	41.4	42.7	44.0	45.4	46.8	48.0	49.4	50.8
37	15.1	16.5	17.8	19.2	20.6	21.9	23.3	24.7	26.1	27.4	28.8	30.2	31.5	32.9	34.3	35.6	37	38.4	39.8	41.2	42.5	43.8	45.2	46.6	48.0	49.4	50.7	52.2
38	15.5	16.9	18.3	19.7	21.1	22.6	23.9	25.2	26.7	28.2	29.6	31.0	32.3	33.8	35.2	36.6	38	39.4	40.8	42.2	43.6	45.1	46.5	47.8	49.3	50.4	52.2	3.4

TABLE 6—*Continued*

Ft	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
39	16.0	17.4	18.8	20.2	21.7	23.1	24.6	26.0	27.5	28.9	30.3	31.8	33.2	34.7	36.3	37.6	39	40.5	41.9	43.4	44.8	46.2	47.7	49.2	50.6	52.0	53.5	55.0
40	16.4	17.8	19.2	20.8	22.2	23.6	25.2	26.7	28.2	29.6	31.0	32.6	34.0	35.6	37.2	38.6	40	41.6	43.0	44.4	45.8	47.2	48.8	50.4	52.0	53.4	55.0	56.4
41	16.8	18.3	19.7	21.3	22.8	24.2	25.8	27.4	28.9	30.3	31.8	33.4	34.9	36.5	38.1	39.5	41	42.6	44.1	45.6	47.0	48.4	50.0	51.6	53.2	54.8	56.3	57.8
42	17.2	18.8	20.2	21.8	23.4	24.8	26.4	28.0	29.6	31.0	32.6	34.2	35.8	37.4	39.0	40.4	42	43.6	45.2	46.8	48.2	49.6	51.2	52.8	54.4	56.0	57.6	59.2
43	17.6	19.2	20.7	22.3	23.9	25.4	27.0	28.6	30.3	31.8	33.4	35.0	36.7	38.3	39.9	41.4	43	44.6	46.2	47.8	49.3	50.8	52.4	54.0	55.6	57.2	58.9	60.6
44	18.0	19.6	21.2	22.8	24.4	26.0	27.6	29.2	31.0	32.6	34.2	35.8	37.6	39.2	40.8	42.4	44	45.6	47.2	48.8	50.4	52.0	53.6	55.2	56.8	58.4	60.2	62.0
45	18.4	20.0	21.7	23.3	25.0	26.6	28.3	29.9	31.7	33.3	35.0	36.7	38.4	40.0	41.7	43.3	45	46.6	48.3	50.0	51.6	53.2	54.9	56.6	58.2	59.8	61.6	63.4
46	18.8	20.4	22.2	23.8	25.6	27.2	29.0	30.6	32.4	34.0	35.8	37.6	39.2	40.8	42.6	44.2	46	47.6	49.4	51.2	52.8	54.4	56.2	58.0	59.6	61.2	63.0	64.8
47	19.2	20.9	22.7	24.3	26.2	27.8	29.6	31.3	33.1	34.8	36.6	38.4	40.0	41.7	43.5	45.2	47	48.6	50.5	52.4	54.0	55.6	57.4	59.2	60.9	62.6	64.4	66.2
48	19.6	21.4	23.2	24.8	26.8	28.4	30.2	32.0	33.8	35.6	37.4	39.2	40.8	42.6	44.4	46.2	48	49.6	51.6	53.6	55.2	56.8	58.6	60.4	62.2	64.0	65.8	67.6
49	20.0	21.8	23.6	25.4	27.3	29.0	30.9	32.6	34.6	36.4	38.2	40.0	41.7	43.5	45.3	47.1	49	50.8	52.7	54.6	56.3	58.0	59.9	61.8	63.5	65.2	67.2	69.2
50	20.4	22.2	24.0	26.0	27.8	29.6	31.6	33.2	35.4	37.2	39.0	40.8	42.6	44.4	46.2	48.0	50	52.0	53.8	55.6	57.4	59.2	61.2	63.2	64.8	66.4	68.6	70.8
51	20.8	22.7	24.5	26.5	28.3	30.2	32.2	33.9	36.0	37.9	39.7	41.6	43.4	45.3	47.1	49.0	51	53.0	54.8	56.6	58.5	60.4	62.4	64.4	66.1	67.8	69.9	72.0
52	21.2	23.2	25.0	27.0	28.8	30.8	32.8	34.6	36.6	38.6	40.4	42.4	44.2	46.2	48.0	50.0	52	54.0	55.8	57.6	59.6	61.6	63.6	65.6	67.4	69.2	71.2	73.2
53	21.6	23.6	25.5	27.5	29.4	31.4	33.4	35.3	37.3	39.3	41.2	43.2	45.1	47.1	49.0	51.0	53	55.0	56.9	58.8	60.8	62.8	64.8	66.8	68.7	70.6	72.6	74.6
54	22.0	24.0	26.0	28.0	30.0	32.0	34.0	36.0	38.0	40.0	42.0	44.0	46.0	48.0	50.0	52.0	54	56.0	58.0	60.0	62.0	64.0	66.0	68.0	70.0	72.0	74.0	76.0
55	22.4	24.5	26.5	28.5	30.6	32.6	34.6	36.7	38.7	40.7	42.8	44.8	46.8	48.9	50.9	53.0	55	57.0	59.1	61.2	63.2	65.2	67.2	69.2	71.3	73.4	75.4	77.4
56	22.8	25.0	27.0	29.0	31.2	33.2	35.2	37.4	39.4	41.4	43.6	45.6	47.6	49.8	51.8	54.0	56	58.0	60.2	62.4	64.4	66.4	68.4	70.4	72.6	74.8	76.8	78.8
57	23.2	25.4	27.5	29.6	31.7	33.8	35.9	38.0	40.2	42.2	44.4	46.5	48.5	50.7	52.8	54.9	57	59.1	61.3	63.4	65.5	67.6	69.7	71.8	73.9	76.0	78.2	80.4
58	23.6	25.8	28.0	30.2	32.2	34.4	36.6	38.6	41.0	43.0	45.2	47.4	49.4	51.6	53.8	55.8	58	60.4	62.4	64.4	66.6	68.8	71.0	73.2	75.2	77.2	79.6	82.0
59	24.0	26.2	28.5	30.7	32.8	35.0	37.2	39.3	41.7	43.7	45.9	48.2	50.2	52.5	54.7	56.7	59	61.4	63.5	65.6	67.8	70.0	72.2	74.4	76.5	78.6	81.0	83.4
60	24.4	26.6	29.0	31.2	33.4	35.6	37.8	40.0	42.4	44.4	46.6	49.0	51.0	53.4	55.6	57.6	60	62.4	64.6	66.8	69.0	71.2	73.4	75.6	77.8	80.0	82.4	84.8
61	24.8	27.1	29.4	31.7	33.9	36.1	38.4	40.7	43.1	45.1	47.4	49.8	51.9	54.3	56.6	58.6	61	63.4	65.6	67.8	70.1	72.2	74.5	76.8	79.1	81.4	83.8	86.2
62	25.2	27.6	29.8	32.2	34.4	36.6	39.0	41.4	43.8	45.8	48.2	50.6	52.8	55.2	57.6	59.6	62	64.4	66.6	68.8	71.2	73.2	75.6	78.0	80.4	82.8	85.2	87.6
63	25.7	23.0	30.3	32.7	35.0	37.3	39.7	42.0	44.4	46.6	49.0	51.3	53.7	56.1	58.4	60.6	63	65.4	67.7	70.0	72.3	74.6	77.0	79.4	81.7	84.0	86.4	88.8
64	26.2	28.4	30.8	33.2	35.6	38.0	40.4	42.6	45.0	47.4	49.8	52.0	54.6	57.0	59.2	61.6	64	66.4	68.8	71.2	73.6	76.0	78.4	80.8	83.0	85.2	87.6	90.0
65	26.6	23.9	31.3	33.7	36.1	38.6	41.0	43.3	45.7	48.2	50.6	52.9	55.4	57.8	60.2	62.6	65	67.4	69.8	72.2	74.7	77.2	79.6	82.0	84.3	86.6	89.0	91.4
66	27.0	29.4	31.8	34.2	36.6	39.2	41.6	44.0	46.4	49.0	51.4	53.8	56.2	58.6	61.2	63.6	66	68.4	70.8	73.2	75.8	78.4	80.8	83.2	85.6	88.0	90.4	92.8
67	27.4	29.8	32.3	34.7	37.2	39.8	42.2	44.7	47.1	49.7	52.1	54.6	57.1	59.5	62.1	64.5	67	69.4	72.0	74.4	77.0	79.6	82.0	84.4	86.9	89.4	91.8	94.2

Table. The number of cubic yards per foot deep for any size of building from 10′×11′ over all to 67′×38′ may be had without calculation. Sizes beyond the largest figures may be had by addition or by taking multiples: 65′×40′, for example, is 96.4′, or twice 65′×20′; and 66′×66′=161.6′, or twice 66′×33′. An area of 36′×120′=160′, or 36′×60′×2′. As a practical matter decimals would be disregarded and even figures, higher or lower, taken.

Piling

Labor Driving. With the engine and driver delivered on the ground it takes a crew of 6 to 8 men 1½ to 2½ days to erect them ready to work. This counts heavily where there are only a few piles, but the cost per pile is small on a large contract.

On a basis of 60¢ per hour and for thousands of lineal feet a 1918 record was made of 1¢ per ft driven. On another contract with 5,000 ft lin a record of 9¢ per ft was made on the same 60¢ wage. For average work, with no records to make, a figure of 15¢ to 20¢ per ft should be allowed, and preparation of driver additional, if there are only a few piles. The highest figure should not be more than 35¢—which is quite different from 1¢ and 9¢. On a contract of from 3,000 to 10,000 lin ft an allowance of 2¢ per ft is made for the use of the plant. Cutting off heads is included in foregoing figures.

If wages are a half or a third of the 60¢, or any rate between, the total is easily found by proportion.

Cost of Piles. In one period of valuation this might be 25¢, or even less per lin ft; and in 1923 creosoted piles cost $1 per ft in some sections. In one large contract, 100,000 lin ft, the cost in place was 28¢. This in a low-priced year.

The only way is to get the price delivered at site for the year of valuation and add driving at average wages for the same year. But if there is no foundation plan, as frequently happens, what length is to be allowed? Shall it be 20 ft, 25 ft, 30 ft or 40 ft?

Concrete Piles. The wood piles already given have been used for thousands of years, but the concrete ones are modern. They are of various kinds and run from $1.25 before the war on large contracts to $2.00 in 1923 per lin ft.

The concrete pile is of such a comparatively new style that plans are apt to be had for most foundations, and the lengths thus obtained.

CHAPTER IV

CONCRETE WORK

TABLE 1

Quantities of Material for Concrete

Based on 3.8 Cubic Feet per Barrel of Cement (4 Sacks per Barrel)
Sand and Stone Measured Loose

Proportions by Parts			Quantities per bbl of Cement			Quantities of Material for 1 yd of Rammed Concrete						Average Volume Wet Mixed Concrete per bbl of Cement	
						45% Voids Average Broken Stone			40% Voids Average Gravel				
Cement	Sand	Stone	Cement bbl	Sand cu ft	Stone cu ft	Cement bbl	Sand cu yd	Stone cu yd	Cement bbl	Sand cu yd	Gravel cu yd	45% Voids	40% Voids
1	1	1½	1	3.8	5.7	3.08	0.43	0.65	2.97	0.42	0.63	8.8	9.1
		2			7.6	2.73	0.38	0.77	2.62	0.37	0.74	9.9	10.3
		2½			9.5	2.45	0.34	0.86	2.34	0.33	0.82	11.0	11.5
		3			11.4	2.22	0.31	0.94	2.12	0.30	0.90	12.2	12.8
1	1½	2	1	5.7	7.6	2.40	0.51	0.68	2.31	0.49	0.65	11.3	11.7
		2½			9.5	2.18	0.46	0.77	2.09	0.44	0.74	12.4	12.9
		3			11.4	2.00	0.42	0.84	1.91	0.40	0.81	13.5	14.1
		3½			13.3	1.84	0.39	0.91	1.76	0.37	0.87	14.6	15.4
		4			15.2	1.71	0.36	0.96	1.63	0.34	0.92	15.8	16.6
1	2	3	1	7.6	11.4	1.81	0.51	0.76	1.74	0.49	0.74	14.9	15.5
		3½			13.3	1.68	0.47	0.83	1.61	0.45	0.79	16.0	16.8
		4			15.2	1.57	0.44	0.88	1.50	0.42	0.84	17.2	18.0
		4½			17.1	1.48	0.42	0.94	1.41	0.40	0.89	18.3	19.2
		5			19.0	1.39	0.39	0.98	1.32	0.37	0.93	19.4	20.4
1	2½	3½	1	9.5	13.3	1.55	0.55	0.76	1.49	0.52	0.73	17.4	18.1
		4			15.2	1.46	0.51	0.82	1.40	0.49	0.79	18.5	19.3
		4½			17.1	1.37	0.48	0.87	1.31	0.46	0.83	19.6	20.6
		5			19.0	1.30	0.46	0.92	1.24	0.44	0.87	20.8	21.8
		5½			20.9	1.23	0.43	0.95	1.17	0.41	0.91	21.9	23.0
		6			22.8	1.17	0.41	0.99	1.11	0.39	0.94	23.0	24.3
1	3	4	1	11.4	15.2	1.36	0.57	0.77	1.30	0.55	0.73	19.9	20.7
		4½			17.1	1.28	0.54	0.81	1.23	0.52	0.78	21.0	21.9
		5			19.0	1.22	0.52	0.86	1.17	0.49	0.82	22.1	23.2
		5½			20.9	1.16	0.49	0.90	1.11	0.47	0.86	23.3	24.4
		6			22.8	1.11	0.47	0.94	1.05	0.44	0.89	24.4	25.6
		6½			24.7	1.06	0.45	0.97	1.01	0.43	0.92	25.5	26.9
		7			26.6	1.01	0.43	0.99	0.96	0.40	0.95	26.7	28.1
1	4	5	1	15.2	19.0	1.08	0.61	0.76	1.04	0.59	0.73	24.9	25.9
		6			22.8	0.99	0.56	0.84	0.95	0.54	0.80	27.2	28.4
		7			26.6	0.92	0.52	0.91	0.88	0.50	0.87	29.4	30.8
		8			30.4	0.85	0.48	0.96	0.81	0.46	0.91	31.7	33.3
		9			34.2	0.80	0.45	1.01	0.76	0.43	0.96	33.9	35.8

(Courtesy of the Insley Manufacturing Co., Indianapolis)

Quality. Thousands of buildings are put up without specifications; and for thousands more of "old timers" the specifications have been lost or burned. How is an appraiser to know what proportions of foundation concrete were used? He assumes an average mix and goes ahead on that basis.

To illustrate how the proportions change the cost the following examples are given. For tanks and waterproof work the proportions from the first four lines of Table 1 are often used; and even the next five lines are too rich for ordinary building work. The richest mix for ordinary use is apt to be 1 : 2 : 4. That and two others are selected. By volume and not weight, 1 part cement, 2 parts sand, and 4 parts broken stone.

TABLE 2

AT A 1 : 2 : 4 PROPORTION

Cement, 1.57 bbl at $3	$4.71
Sand, ½ yd	1.20
Stone, 2,160 lbs at $3.50 per ton	3.78
Labor, 4½ hours at 60¢	2.70
Water	.10
	$12.49

COST OF A CUBIC YARD OF CONCRETE AT 1 : 3 : 6 PROPORTION

Cement 1.1. bbl, or 4.18 cu ft at $3	$3.30
Sand, 3.3 bbl, or 12.54 cu ft, allow ½ yd	1.20
Stone, 6.6 bbl, or 25.08 cu ft, 2,234 lbs, at $3.50 per ton	3.90
Labor at 60¢ an hour, 4½ hours	2.70
Water	.10
	$11.20

AT A 1 : 4 : 8 PROPORTION

Cement, 0.81 bbl at $3	$2.43
Sand, ½ yd	1.20
Stone, 2,430 lbs at $3.50 per ton	4.25
Labor, 4½ hours at 60¢	2.70
Water	.10
	$10.68

Profit. The difference between the highest and the lowest comes to quite an amount on a large contract. The local prices may be filled in to suit. Quite frequently the material will cost less than is set forth. Profit must be added.

Labor on Plain Concrete

Average. For ordinary concrete, under average conditions, allow from $3\frac{1}{2}$ to $4\frac{1}{2}$ hr per cu yd, and arrange wages to suit local rate. On several thousand yards in a large machine shop with nearly all tapered piers and walls the average was $4\frac{1}{2}$ hr. This was by hand-mixing. With straight work, good weather, and no trouble tamping among pile heads and angles the unit might have been $3\frac{1}{2}$ hr. All forms were set, and are not included in the $4\frac{1}{2}$ hr.

When mixing with a good machine the time may be averaged at $2\frac{1}{2}$ hr per cu yd. On some work this time is cut in half—and after the tower is in working order records have been made for as many as 450 yd in a 10-hr day for a crew of 15 men, and an average of 250. With foreman and engineers included this equals 25 yd per hour, or 1.66 yd per man, 13.3 yd. per man in 8 hr. This was on an 8-in floor. On heavy dam work 32 men with two mixers and two towers put in 600 yd in 10 hr. In both cases the erection of the tower has to be added.

But high records do not suit for an average. Even with a mixer the time per yard may be $3\frac{1}{2}$ hr instead of $2\frac{1}{2}$ as given.

For footings and mass foundations, the average of 10 buildings was 6 hr per yd; the highest was nearly 11 hr, and the lowest was $3\frac{1}{2}$. For foundation walls on 14 buildings the average was 10 hr per yd; lowest, $5\frac{1}{2}$ hr; highest, 29 hr. This was strictly for concrete labor. Varying conditions change the totals, such as impossibility of getting materials close to site, wet or frosty weather, heating of aggregates, delays, and many more reasons that sometimes make contracting a kind of a gamble.

How is an appraiser to know if concrete was hand or machine mixed, any more than what proportion was used, without a specification? All he can do is to shut his eyes and make an average guess.

Time and Measurement. The Chicago rules for measurement of concrete allow extras in the measurement, after the old fashion, instead of in the price. As an illustration, circular and polygon foundations are to be figured at double the actual contents. This extra, whether allowed by measurement or price, should go in the separate form cost, and not in concrete itself. There is more trouble tamping around angles than straight work, but not so very much if the concrete is wet enough to slide, in which case it fills up any kind of a shape of form as easily as a square or rectangular one.

Heating. If this has been used, allow from 1 to $1\frac{1}{2}$ hr per cu yd extra. An appraiser can only guess at many things.

Hoisting. Allow $\frac{1}{2}$ hr per cu yd extra for an average.

Machine Foundations

The average in a large railroad shop, full of the ordinary kind of machines, was 9 hr per cu yd; the lowest about $6\frac{1}{2}$ and the highest 13. It is all hand-mixing, and the quantities are small, the leveling and smoothing on top have to be carefully done, bolts are to be put in at the right centers and heights, and for some machines the angles and tapered work make trouble.

A little incident, even with a large machine weighing 28 tons, will show how some experts regard this work. The base had 196 sq ft, or a space 14′×14′, although it was not exactly a square. The factory expert had to be sent for, and after a long siege he was not quite satisfied with the result: "It is still $\frac{1}{32}$ of an inch out of level." Time is taken when wedging and grouting have to be done on a watch-making scale. But sometimes all kinds of experts like to pose.

On driving wheel lathes with about 40 yd of concrete the time should not be more than for ordinary mass work, say, 4 hr per yd to be safe, until the sloping parts are reached near the top. Quite a few machines get foundations that do not really require them. A good floor makes a strong enough base.

Stairs and such special work may be averaged at $\frac{3}{4}$ to 1 cu yd per 8 hr per man. The steps have to be smooth and fairly level, but a variation of $\frac{1}{32}$ in per 14 lin ft is permissible.

Forms

None of the foregoing work includes forms, and if they have been used the valuator should make an allowance for them. They are as hard to get at in some cases as depreciation.

On a large machine shop the labor on forms, as an average all through, ran to 1 hr per cu yd on the main foundations. But the right way to estimate forms is by the square foot in contact with the concrete. This for ordinary work, but with tapered piers the extra work comes on the angles, and the area does not count for much. Pier forms once made may be used a dozen times over if carefully handled. Square foot costs have to be modified to suit various kinds of shapes, and allowance made for using some shapes and all material several times, if this can be done, or could have been done, in the case of a valuation.

For some houses in good soil the inside form only is used and the concrete poured between that and the bank.

On the usual basis 3 sq ft of lumber are allowed for each square foot of concrete in contact—sometimes more or less. With plain

work two carpenters will erect from 640 to 800 ft B M in 8 hr. Averaging 700 ft and at $1 per hour the labor cost is $16, and 3 ft equals 7¢ per sq ft of finished form. Waste, studs, braces, etc., make up twice as much as the actual square foot of finished work.

With lumber at $50, the cost of 3 ft is 15¢; labor, 7; 3¢ for removal; nails and wire ties equal 25¢ per sq ft for one side of a wall. Special forms might cost two or three times as much if used only once, but both for plain and special costs might be cut by reuse.

Removable forms are often made for ordinary foundations, and used year after year. For unreinforced work the appraiser has to guess if a form allowance must be made.

Total. The proportions being decided upon, the allowances for concrete are given in the table at the beginning of this chapter; the labor is averaged; and material with labor for forms, if required, can be added.

Actual Costs per Square Foot. (1) On an average of 10 buildings the carpenter labor on footing and mass foundation forms ran to 30¢ for the highest and 4¢ for the lowest, with an average of 14⅓¢. This on the basis of labor at $1 per hour. Any rate of wages can be applied in proportion. The unit is based on square feet in actual contact with the concrete. This should be noted, as some trenches would have forms on both sides. The nails and wire came to an average of less than 1¢, 1923 rates. Lumber from 2¢ to 20¢ with an average of 10¢, 1923 rates.

(2) On the foundation walls of 14 buildings the carpenter labor on forms ran to 34¢ on the highest to 8¢ on the lowest, with an average of 17¢ per sq ft at $1 per hour—the bases used all through these figures. Nails and tie wire, 1¢ for the highest; lumber from 3¢ to 14¢; average, 10¢, at 1923 rates.

(3) On concrete column work the highest—an office building—came to 34¢ per sq ft, the lowest to 15¢, the average of 9 buildings to 20½¢. Nails and ties as usual, and 1½¢ covers this item in all cases. Lumber from 25¢ to 4¢; average 11¢.

(4) On walls above grade the highest labor was 27¢; the lowest, 11½¢; the average 21½, with 17 buildings. Lumber, from 22¢ to 5¢, with average of 11¢.

(5) On 3 flat slab floors the form labor ran from 19½ to 17¢. Lumber, 12¢.

(6) On 13 buildings the form labor for slabs between steel beams ran from 27½¢ to 7¢, with an average of 15⅓¢. Lumber, 21¢ to 4¢, with an average of 18¢.

(7) On 18 buildings with beam floors of reinforced concrete the highest form labor ran to 41⅓¢ per sq ft, the lowest to 9⅓¢, and the average to 17½¢. The lumber from 32¢ to 8¢; average, 13½¢.

Observe. On these 7 groups of buildings the labor is raised from the low period in which they were built to suit $1 per hour, and any other rate may be based on this. The lumber is a very uncertain item, as on some structures it may be used only once and on others several times. The 1923 average is used, but this differs in various parts of the country. At best, lumber has to be guessed at. Forms may be used from 6 times on floors to 10 times on beams and 16 times on walls—or only once.

Variations. The Blau-Knox Company, makers of steel forms to avoid the waste of time and lumber, say: "Every constructor dreads to estimate form work. Two constructors may be 100 per cent apart on the same job. Even the same contractor finding he has under-estimated forms on one job doubles his estimates on the next one."

All of the foregoing records were given by Mr. Wason of the Aberthaw Company, Boston, as well as the reinforced concrete figures following. Contractors might with general advantage follow this liberal policy of handing out their records instead of being old fashioned and very mysterious.

Steel Setting. On 21 buildings the highest price per ton ran to $16.47, the lowest to $2.54, the average to $8.52. These totals were summarized at a time when carpenters got 40¢ per hour, and should be multiplied by 2 to 2½.

The smallest quantity of steel on a building was 9 tons; the largest, 324. On small tonnage the cost ran from $5 to $8 on the old rate of wages; the heaviest to $8, $12, $16. The heaviest was structural steel rather than ordinary reinforcement. With laborers' wages at 60¢ per hour, or 1¢ per minute, a common figure for setting reinforcing steel is $13 to $15 per ton.

On 100 concrete cottages the labor on wall steel was $12, and on floor and beam, $7.50, with wages at 80¢ for tradesmen and 50¢ for laborers. The labor on wall forms was $4.30 per 100 sq ft; stripping, $2.10, and moving to next house, $1.25, a total of $7.65.

The placing of the concrete on the 6-in walls was $2.25 per cu yd, with 140 cu yd on double houses to 85 on single.

Labor on Reinforced Concrete

The figures on some buildings for mass foundations and walls have been already given, but the general labor required is given here as well as that for concrete; all based on a rate of hours per cubic yard.

(1) **Mass Foundations** per cubic yard on highest of 10 buildings, 13½ hr; the lowest, 3½ hr; the average, 7 hr. Allowance per yard for teams, miscellaneous and plant, $1.50, on a 1923 basis.

(2) **Foundation Walls.** On 14 buildings the highest was nearly 34 hr; the lowest, 5.67 hr; the average, 12.3 hr, per cu yd, as all through these records. Teams, miscellaneous and plant, $2.00 per yd, on a 1923 basis, as all through on these items.

(3) **Columns.** On 9 buildings the column work ran to 30 hr on the highest to 9 on the lowest; and the average was 16.6 hr. Teams, etc., $2.38.

(4) **Walls Above Grade.** Taken from 17 buildings the average was 14.2 hr; highest, 26.7 hr; the lowest, 6.2 hr. Team, etc., $2.38.

(5) **Flat Slabs.** Average, 14.3 hr; highest, 22 hr; lowest, 6.3. Team, etc., $2.32.

(6) **Slabs Between Steel Beams.** The average on 13 buildings was 16.3 hr; the highest, 21 hr; the lowest, 10½ hr. Team, etc., $2.21 average; the highest, $5.94; the lowest, 76¢.

(7) The average on 18 buildings with beam floors was 17.7 hr; the highest, 30 hr; the lowest, 6.4 hr. Team, etc., $2.65 average; highest, $5.78; lowest, 92¢.

Ordinary contractors sometimes forget to make allowances for plant, such as engines, mixers, hoists, trucks, wagons, etc. There should be an allowance for this "overhead."

Finals. With the figures already given a valuator can get a close enough total on any class of concrete work. The records show that there are great differences between high and low, and only theorists believe that mathematical accuracy is possible in appraisal work.

It is a simple enough matter getting the cubic yards, and the quantities may be had from the table if the proportions are known, and if not they may be guessed at.

Example. Taking No. 7 and assuming a floor 6 in thick, there are 54 sq ft in a cubic yard of concrete. This unit is taken to get even figures.

Labor on 54 sq ft of forms, $1 per hour, 17½¢.	$9.45
Lumber for 54 sq ft (use local rate)	7.29
Nails and tie wire, 1½¢ per sq ft	.81
Labor on concrete, 17.7 hr at 60¢	10.62
Team, etc	2.65
Cement (1 : 3 : 6), 1.1 bbl at $3	3.30
Sand, ½ cu yd	1.20
Crushed stone, .94 cu yd	3.90
Water	.10
	$39.32

Dividing the total by 54 equal 73¢ per sq ft without profit. If the high or low figures were used the outcome would be quite different. Reinforcement is not included.

While floors are often made of a 1 : 3 : 6 proportion, as in the foregoing example, columns are mixed 1 : 2 : 4. They are detailed at (3). Assuming a column 24″×18″×9′ gives a cubic yard, equals 63 sq ft for forms. By always taking an exact cubic yard the cost per linear foot of column can be established, and thus any number of linear feet.

Labor on 63 sq ft of forms, $1 per hour, 20½¢.	$12.92
Lumber for 63 sq ft	6.93
Nails and tie wire	.95
Labor on concrete, 16.6 hr at 60¢	9.96
Team, etc.	2.38
Cement, 1.57 bbls at $3	4.71
Sand, ½ yd	1.20
Stone, .88 cu yd	3.65
Water	.10
	$42.80

Dividing by 9 equals $4.76 per lin ft without profit or reinforcement.

The weight of reinforcing steel varies to suit the type of structure. The Truscon Company allows about 5 lbs per sq ft of floor for warehouses and factories with a live load of 150 lbs. This, as an approximate, includes footings, columns, beams and slabs. On this basis each floor takes care of its own structural work. The approximate total amount of concrete is about 1 cu ft per sq ft of floor. This reinforcing allowance is on the basis of a 4- to 6-story building; for an 8- or 10-story allow 7 to 8 lbs.

With a 6-story and a live load of 250 to 300 lbs, allow 7 to 8 lbs reinforcement per square foot. The lightest and lowest factory type is not likely to have less than 3½ to 4 lbs.

For office buildings, stores, apartment houses, hotels, from 4 to 5 lbs steel to each square foot of floor. Schools about 3 lbs.

This means, of course, reinforced work, and not the regular heavy steel-tile construction. The following rough approximate table shows that requires much heavier weights:

Weight of Steel on High Buildings

On buildings up to 11 stories high, an approximate weight of steel is as follows, per square foot of floor area, not ground area:

Apartment houses and hotels with outside frames	14 lbs
Office buildings as above	23 "
Warehouses as above	28 "
Apartment houses and houses without outside frames	9 "
Office buildings as above	15 "
Warehouses as above	18 "

Royalty. In some types of construction it is necessary to allow $\frac{1}{2}$¢ to 1¢ per sq ft for patented rights on plain slab work.

Column Steel. The Truscon tables in The New Building Estimator's Handbook give 735 different weights per foot of column. The cores run from 10 in to 30 in, the diameter of wire from $\frac{1}{4}$ in to $\frac{1}{2}$ in, and the pitches from $1\frac{1}{2}$ in to the foot to 3 in. How is an appraiser set down before a finished building to know which of the 735 to use? A few are given here for a guide.

TABLE 3

WEIGHT IN POUNDS OF STEEL IN REINFORCED COLUMNS—SQUARE OR ROUND

Core, in	3-in pitch			2-in pitch			$1\frac{1}{2}$-in pitch		
	$\frac{1}{4}$-in diam.	$\frac{3}{8}$-in diam.	$\frac{1}{2}$-in diam.	$\frac{1}{4}$-in diam.	$\frac{3}{8}$-in diam.	$\frac{1}{2}$-in diam.	$\frac{1}{4}$-in diam.	$\frac{3}{8}$-in diam.	$\frac{1}{2}$-in diam.
10	2.97	5.64	8.70	3.85	7.60	12.19	4.72	9.57	15.70
12	3.33	6.42	10.09	4.37	8.78	14.29	5.43	11.14	18.48
16	4.02	8.00	12.90	5.42	11.13	18.50	6.83	14.29	24.07
20	4.73	9.56	15.70	6.47	13.50	22.67	8.23	17.44	29.66
24	5.43	11.14	18.50	7.52	15.85	26.87	9.63	20.60	35.25

With a $\frac{1}{2}$-in diameter, 30-in core, and $1\frac{1}{2}$-in pitch the hooping weighs 43.65 lbs per lin ft. The price per pound being set and the installation the total can be added to the forms and the concrete.

CUBIC FEET OF CONCRETE IN ROUND COLUMNS PER LINEAR FOOT

Diameter, inches														
8	10	12	14	16	18	20	22	24	26	28	30	32	34	36
.35	.55	.79	1.07	1.40	1.77	2.18	2.64	3.14	3.69	4.28	4.91	5.59	6.31	7.07

Rectangular Beams or Columns. To get the cubic feet per linear feet multiply the width and depth of the beam in inches and divide by 144. Thus a beam or column 14″×22″=308, which divided by 144=2.14 cu ft to a foot of beam or column.

Sidewalks, Driveways and Floors

Thickness. The ordinary sidewalk is 4 in, the driveway 6 in, and some floors for special purposes, or to resist water pressure from

below, are as thick as 18 in. Regardless of thickness the surfacing is usually the same, so that the proper method of getting a valuation is to estimate the ordinary concrete in the ordinary way and allow extra for the top. But if a section or specification is not to be found how shall an appraiser tell if a floor in a power-house pit is 6 in thick or 12 in?

In all cities, and even in villages, there are men who make a specialty of putting down sidewalks and driveways, and they know the prices so well that they never need to make estimates, any more than the cistern builder did. The sidewalk men give the price either by the square foot or square yard of thickness to suit.

The sidewalk or basement floor cuts such a small figure in a total that the best way for an appraiser is to get the area and set what he considers a fair unit for reproduction cost or for the year in which the work was done. A local figure may often be obtained.

Prices. In the days before the war a common price for ordinary sidewalks was $1.25 per sq yd. In 1923 the same walks ran to $2.00. For a better class of work in a normal period, say, from 1910 to 1913, the price was $1.80, or 20¢ per sq ft.

Take a basement floor 66′×120′×6″ thick. There are 880 sq yd. Assume that a fair figure for this in 1923 was $3.00 per sq yd, and that an appraiser set a figure of only $2.75. The total would be $220 short, but the building might run to $120,000, and the shortage would be only one-fifth of 1 per cent of this. The Factory Mutual appraisers point out that the law of averages takes care of such items. The brick walls of the basement might be estimated $320 too high, or the guess made at the painting might just come to $220 too much.

One of the best things put forth in a barrowload of valuation literature was the summing up of the eight experts on the mechanical work of the railroads. After telling how small in comparison with the totals various items were the request was made to accept the work of the sub-committees "without quibbling."

On a basement with 1,150 sq yd the top dressing cost 28¢ per yd. As wages were based on 70¢ per hour for finisher and 45¢ for helper an 8-hour day cost $9.20. Divided by 28¢ this gives 33 sq yd for a man and a helper in 8 hours. On some floors and walks 50 per cent more surface can be covered.

"A crew of 6 men will mix by hand, place and finish 600 sq ft of 6′×4″ sidewalk in 10 hours. The same in a basement floor."

Excavation or filling may be required. Cinder fill may have been used.

TABLE 4

SURFACING OF FLOORS, ETC.

Allow concrete material as per list, and add for top of floor.

Sq yd	Proportion	Thickness	Cement, bbls	Sand, yd	Sq yd	Proportion	Thickness	Cement, bbls	Sand, yd
100	1 to 1	$\frac{1}{2}''$	6.6	0.9	100	1 to 2	$\frac{3}{4}''$	7.0	2.0
100	1 to $1\frac{1}{2}$	$\frac{1}{2}''$	5.5	1.2	100	1 to $2\frac{1}{2}$	$\frac{3}{4}''$	6.0	2.1
100	1 to 2	$\frac{1}{2}''$	4.6	1.3	100	1 to 1	$1''$	13.0	1.8
100	1 to $2\frac{1}{2}$	$\frac{1}{2}''$	4.0	1.4	100	1 to $1\frac{1}{2}$	$1''$	10.8	2.3
100	1 to 1	$\frac{3}{4}''$	10.0	1.4	100	1 to 2	$1''$	9.2	2.6
100	1 to $1\frac{1}{2}$	$\frac{3}{4}''$	8.1	1.7	100	1 to $2\frac{1}{2}$	$1''$	8.0	2.8

Atlas Portland Cement Company

This company sends out some good data, as may be seen from a few extracts following:

Concrete Sidewalks

One-Course Type

Mixtures: The one-course concrete sidewalk is constructed of a mixture of 1 part Atlas cement, 2 parts of sand, and 3 parts of broken stone or gravel. For each 100 sq ft of sidewalk, 4 in thick allow materials as follows: 9 bags Atlas cement, 18 cu ft sand, 27 cu ft of gravel or crushed stone—8 hours' labor of 2 men. Figure for any other thickness proportionately.

Two-Course Type

Proportioning: The two-course concrete walk is constructed of a concrete base-course mixture of 1 part Atlas cement, $2\frac{1}{2}$ parts sand, and 5 parts of broken stone or gravel; and of a top or surfacing coat of cement mortar, made of 1 part Atlas cement and 2 parts sand. Allow for each 100 sq ft (for example, a walk 25 ft long and 4 ft wide), 4 bags of Atlas cement and 8 cu ft of sand for the mortar top coat, 1 in thick; and for the base course, 3 in thick, $4\frac{1}{2}$ bags Atlas cement, $11\frac{1}{4}$ cu ft sand, and $22\frac{1}{2}$ cu ft gravel or crushed stone. To build 100 sq ft, allow the labor of 2 men for about 10 hours.

Thickness: The base-course is deposited first, 3 or 4 ins thick 4 ins, if the walk must sustain heavy loads—and then roughly

leveled off with a strike-board. Inside of thirty minutes the top or surfacing coat of mortar at least 1 in thick must be placed on the base-course. If the top course is not placed almost immediately after the base-course, the two will not knit or bind together in a solid mass.

Stairs. "For 10 steps, each with 7-in riser, 10-in tread, and 24-in long, allow ½ bbl or 2 sacks of Atlas cement, 4 cu ft of sand, and 8 cu ft of gravel."

TABLE 5

TABLE OF REINFORCEMENT FOR CONCRETE STEPS

No. of steps	Clear span Ft	Clear span In	Thickness slab In	Reinforcement. Diameter spacing rods In	No. of steps	Clear span Ft	Clear span In	Thickness slab In	Reinforcement. Diameter spacing rods In
4	2	2	4	½ 10 inches	8	5	6	5	¼ 5 inches
5	3	0	4	¼ 10 inches	9	6	4	6	¼ 5 inches
6	3	10	4	¼ 7 inches	10	7	2	6	⅜ 5 inches
7	4	8	5	¼ 7 inches	11	8	0	6	⅜ 6 inches

Concrete Driveways

"For a roadway 8 ft wide, 5 in thick on sides and 6 in in center, allow for each 20 ft in length 19 bags of Atlas cement (equals 4¾ bbls), 38 cu ft of sand and 57 cu ft of gravel or stone."

Barn and Stable Floors

Quantities required: "For each 100 sq ft of floor (10 ft wide, 10 ft long, for instance), 6 in deep, you will require 11 bags Atlas cement, 22 cu ft sand, and 44 cu ft broken stone or gravel at 1 : 2 : 4 proportions."

Basement or Cellar Floors

Mixture: For the one-course floor mix the concrete in the proportion of 1 part Atlas cement, 2 parts sand, and 4 parts crushed stone or gravel. Deposit it 4 in thick. Level it off and finish it immediately, first with a wooden float and then with a very few strokes of a steel trowel.

For the two-course floor the mixture should be 1 part Atlas cement, 2½ parts sand, and 5 parts crushed stone or gravel. Place this 3¼ in thick. As soon as this has been struck off, the top or surfacing coat of mortar—a mixture of 1 part of Atlas cement and 2 parts of

sand—should be deposited over the concrete base about $\frac{3}{4}$ in thick and should be troweled immediately to the desired surface with a steel trowel.

Material and labor required: For each 100 sq ft of one-course floor, 4 in thick, allow $7\frac{1}{2}$ bags Atlas cement, 15 cu ft sand, and 30 cu ft crushed stone or gravel, and the labor of 2 men for about 8 hours.

For a two-course floor, of the same dimensions allow 8 bags Atlas cement, 18 cu ft sand, and 25 cu ft gravel, and the labor for about 10 hours of 2 men.

TABLE 6

Amounts of Mortar and Concrete—Different Mixtures

MORTAR

Mixture		Volume of mortar
Cement	Sand	
1 bag.....	2 cu ft	Make $2\frac{1}{10}$ cu ft
1 "	$2\frac{1}{2}$ "	" $2\frac{1}{2}$ "
1 "	3 "	" $2\frac{4}{5}$ "

CONCRETE

Mixture			Volume of concrete
Cement	Sand	Gravel or stone	
1 bag.....	$1\frac{1}{2}$ cu ft	3 cu ft	Make $3\frac{1}{2}$ cu ft
1 "	2 "	3 "	" $3\frac{9}{10}$ "
1 "	2 "	4 "	" $4\frac{1}{2}$ "
1 "	$2\frac{1}{2}$ "	5 "	" $5\frac{2}{5}$ "
1 "	3 "	5 "	" $5\frac{4}{5}$ "

CHAPTER V

STONE, GRANITE, MARBLE

REMARKS ON THE TABLES

Table 1: Rubble. For ordinary walls 18″ to 20″ thick with two faces allow 3 cu yd per 8 hours for 1 mason and 1 laborer, or practically the 0.4 column in the table, which is set in tenths each hour $=0.4\times8=3.2$ cu yd. With many angles, 2 to $2\frac{1}{2}$ yd in 8 hours.

On a wall 12 in to 16 in thick with two faces use the 0.3 column, or 2.4 cu yd for 8 hours. With angles not more than 2 yd.

On walls 24 in with two faces use the 0.5 to 0.6 columns per hour, or 4 to 4.8 cu yd per 8 hours for 1 and 1—a contractor would say 4 to 5 yd, and 3 to 4 with angles.

On walls 28 in to 32 in with two faces use columns 0.6 to 0.8 per hour, or 4.8 to 6.4 cu yd—say, 5 to $6\frac{1}{2}$, and $4\frac{1}{2}$ to 6 with angles.

On walls 12 in to 16 in with only one face and the other against earth, or covered, use columns 0.5 and 0.6 per hour, or 4 to 5 cu yd; angles 3 to 4.

On walls 20 in to 24 in with only one face use columns 0.7 and 0.8 per hour, or 5.6 to 6.4 in 8 hours, and 5 to 6 with angles.

On walls 28 in to 32 in with only one face use columns 0.9 and 1 per hour, or 7.2 to 8 yd per 8 hours—$6\frac{1}{2}$ to $7\frac{1}{2}$ with angles.

All of the foregoing work to be in basements where walls do not run more than 10 ft below ground or 3 ft above, and where all material is dumped by wagons without wheeling, where stones are handled without a derrick, and where all conditions are favorable for the larger allowances. The 0.8, 0.9 and 1 columns would seldom be reached by 1 mason, and if scaffold work was required 2 masons would use 3 laborers. Table 2 is made out for this heavier work, unless in exceptional cases where long, straight, thick walls with one face and stone piled close by wagons make it possible for 1 man to lay up a heavy yardage with a laborer to assist him. As usual, any rate of wages can be applied from the first two columns.

Table 2. In this table 2 masons have 3 laborers to attend them. This allowance is required for almost all work above the ground level and for basements with stones of such a size that a derrick has to be used to lift them. The allowances are for buildings of

not more than two stories above the ground where all work is handled by hand derricks, or hoists run by gasoline or horse-power.

For straight walls, two faces, 12 in to 16 in, use the 0.3 column or 2.4 cu yd per 8 hours. If many angles and pitched gables are to be laid up allow half of the 0.4 column, which is equal to 0.2 or 1.6 cu yd. The amount for 0.2 is found by doubling the 0.4 figures. With bay windows and corners 1.6 cu yd is a fair day's work.

For 18 in to 20 in walls, straight, two faces, allow 0.4 cu yd per hour, or 3.2 yd per day, but only half of the 0.5 if bays and corners and gables are to be laid. This half of 0.5 = 2 yd per 8 hours. No walls thicker than 20 in are required when building is not more than two stories above the ground.

For heavy basement work, double faced, use from 0.6 to 0.8 columns as before, but with the extra laborers in Table 2. With angles, this work might not run more than column 0.5 or 4 cu yd in 8 hours.

On walls 20 in to 24 in, single faced, use columns 0.7 and 0.8 per hour; and for 28 in to 32 in use columns 0.9 and 1.

The assumption is that all the foregoing work is laid in a mixture of Portland cement and lime—say, three-quarters Portland and one-quarter good lime. The yardage would have to be cut about a tenth if Portland alone were used.

The usual contingencies have to be considered—bad weather, one of the most important in this work; high scaffolds; long wheeling distances; external and internal angles, etc.

High Work. In most parts of the country ashlar, with backing, Indiana stone, or other brick or reinforced concrete is used for buildings of more than a couple of stories, and the backing is of brick, as a rule, but of stone in parts where it is cheap. Rubble by itself is not very common.

On some classes of buildings, such as halls, a derrick is set up on a scaffolding and stone handled from all directions from basement to roof. It is clear that if a certain class of expensive scaffolding had to be used to do the work an allowance should be made, either in a lump sum or added to the unit cost of the work. Ordinary scaffolding is attended to in the cost of the various kinds of material, such as brick or concrete, but special installations are not. The erection of the derrick has also to be allowed, and changing from floor to floor.

On a building with 18,500 cu ft of Indiana stone and with laborers' wages at 40¢ per hour the cost per cubic foot for handling the derrick, erecting, moving from floor to floor, and dismantling ran to 2¢ per cu ft. The building was of a high basement and two high stories. With wages at 60¢ the rate would be 3¢ per cu ft; and with a higher building at this rate it might run to 4¢ or 5¢. But as a derrick

handles all other material—steel, brick, etc.—the entire cost should not be charged to stone or any one item. On a wage basis of 60¢ per hour for laborers a fair allowance for engine shelter, shed and complete handling on a six-story building would be $400 to $500. On such a building a scaffolding is not required, as the derrick is set on the floors.

In such cases as require a special scaffold it is hard to even guess the cost. Size and height have to be known. Approximately, for a ground size of 20′×20′ allow 200 ft B. M. for each foot in height, or 16,000 ft of framing for 80 ft high. At $50 lumber, $800; labor for 2 carpenters and 2 laborers, 600 ft B. M. in 8 hours at $1 and 60¢ rates about $700; bolts and spikes, $50; use of guy ropes, $20; dismantling, say, $100; equals in all, $1,670. But the salvage lumber should be worth at least half of its cost, and also the bolts.

Some could erect a much less expensive scaffold; but once a double one was blown down and I saw the wreckage. Lumber and labor rates might be less.

Actual Setting. The derrick being in place, Table 3 comes first. This rubble is at the same number of yards as 1 and 2, but the hour rate is higher, to allow for the engineer and extra laborers. On rubble work, perhaps faced with random rock-faced ashlar, the supplies can be dumped on the scaffolds for several masons, and the cost of engine work thus reduced, for ordinarily the stones can be handled by a mason and a laborer.

The same allowances as already given for various classes of work may be used, but with the higher rates, as shown in Table 3. Table 1, for example, at 0.5, or ½ cu yd per day, comes to $1.20; Table 2 at 0.5, $1.40; while Table 3 is $2.40. This on the low wage basis of 40¢ and 20¢. The engineer and extra laborers raise the unit, even although each mason lays as much. I have seen one derrick supply a whole large church, and in such a case the higher wage paid to the engineer is divided until practically it "cuts no figure."

Cobble stone Work. This is hard to estimate if not seen, and sometimes harder if seen.

On such work as chimneys and piers, where there are corners to be laid up, allow double the time.

Cobblestone Labor Table for an Average Wall, 60 Sq Ft, Single Face

Mason, 8 hours at $1.20, on 6-in face	$9.60
Laborer, 8 hours at 60¢	4.80
Mason on backing, 60 cu ft	8.00
Laborer on backing, 60 cu ft	4.00
	$26.40

The above wall is assumed to be about 18 in thick, with the 6-in cobbles and the 12-in backing. This is, for labor alone, at the rates given, about 44¢ per sq ft, and 29¢ per cu ft.

Cobblestone Labor Table for an Average Wall, 60 Sq Ft, Double Face

Mason, 10 hours at $1.20, on two 6-in faces..	$12.00
Laborer, 10 hours at 60¢.....	6.00
Mason on filling in 6 in=30 cu ft.....	4.00
Laborer on filling in 6 in=30 cu ft.....	2.00
	$24.00

The faces are set at about 6 in; the filling, 6 in, or in all an 18-in wall. Per square foot for labor alone, 40¢; cu ft, 27.

Setting Ashlar. The various quantities are given in Table 4. With long, straight walls on ground level, and everything handy, a mason can set from 18 to 22 sq ft per hour of full-length ashlar by hand-derrick work, and from 10 to 14 on shorter runs with angle work and openings. On such work as lining up the sides of stairs, fitting under balconies, pilaster work the first column of 8 per hour may not be reached whether by hand or power derrick. On the allowance of 18 to 22 close to the ground a derrick is not supposed to be used unless the stone is heavier than mason and laborers can lift.

As with rubble, a power derrick can serve more than one mason when setting ashlar, for the stones can be laid on the scaffold and set with a breast derrick, so that the engineer's time is cut among several. The same allowances can be used as for hand-derrick work, but the 24 column will not be often reached. For 4 masons the allowance is 14 laborers, and the engineer included.

For random ashlar allow for ordinary work about 6 to 8 cu ft per mason per hour.

Solid Walls. Table 5 gives the allowances for this, and "stone" is used to include granite and marble, as well as Indiana, the best-known material. If there is no cutting, masons can set granite about as easily as Bedford—"makes absolutely no difference," said a contractor for large work to me at this point, although I had allowed about 10 per cent in The New Building Estimator Handbook in case of any fitting.

Stones of the kind for which Table 5 was compiled go through the wall in many cases, and partly through backed up with brick or rubble in some sections. They are thus much heavier than ashlar, and the cubic footage soon counts up, but is checked because a derrick

has to be used to hoist them. This means that only one mason can work, and the whole equipment and force has to be at his service. With long stretches of heavy granite, Indiana stone, or marble, in basements with thick walls the cubic footage goes down rapidly. A basement examined has granite blocks 12 ft long by 6 ft high and 18 in thick, down to 12 ft long by 4 ft high. The first has 108 cu ft, and if laid close to the wall might be set in an hour. Piers 4′×4′ with stones 2 ft to 3 ft high are soon laid up, and so with much work that might be specified. But the average has to be taken. With the granite blocks the hand derrick, if used, has to be moved at each lift; and with both hand and power the whole force has to wait on the mason while he plumbs and levels—and sometimes has to do a little cutting. On this heavy kind of work the mason who put granite and Indiana on the same basis allowed from 200 to 250 cu ft per 8-hour day for a mason and a gang, but in some cases as high as 300. Close to the ground a hand derrick can set as cheaply as a power one, for an engineer is not required.

In Table 5 the lowest figure is set at 12 cu ft per hour, and this should be done on short runs with pilasters and openings, either with hand on low work or with power on high. But on such work as octagonal projections this would have to be cut to 8 and 10 cu ft. A good deal depends upon the class of work. With polished work, such as granite, marble, and Indiana more care has to be taken than when rock-faced and pitched from rough joints.

The 20 and 22 columns in Table 5 might be taken as a fair average for ordinary setting work, and the wage taken to suit the local rate as a basis for valuation.

There are six laborers allowed for each mason, the engineer being included among them, and his higher wage brings down the total a trifle. The mason has always a helper, at a little better wage than an ordinary laborer, if he is a good man, and there has to be a line man above to receive the material. For ordinary work a couple of laborers on the ground can get the stones ready for hoisting. An extra laborer would add about 13 per cent to the totals.

Columns. "By hand power 2 per 8 hours of about 24-in diameter by 16 ft to 20 ft long; by steam or electric power, 4 per day and perhaps 6." This for a mason and 4 to 6 laborers. It is thus cheaper to put columns in place in one piece than in drums. But the 6′×56′ granite columns for the New York cathedral broke in the lathe—two of them—and the length had to be cut.

Scaffolding is usually supplied by brick contractor.

Cut-stone Trimmings. The ordinary brick house has trimmings of stone, such as window and door sills, base courses, copings at areas and steps, sometimes pilasters and plain cornices. On ordinary work the bricklayer and a couple of laborers do the setting by hand

without even a derrick. Table 6 gives the range from 3 to 12 cu ft per hour. On such material as plain cornices run up by the brick hoist on a long straight wall and heavy base course allow from 10 to 12 cu ft per hour; on the same work with breaks and angles to fit, 6 to 8 cu ft; on pilasters and columns, from 3 to 4.

In Table 7 larger allowances are given, and they may be applied in the same proportion as set forth, but the totals are higher on account of the extra man or men at the derrick.

Floors, Etc. In Table 8 the unit is the square foot. For floor work with blocks about 12″×12″ use columns 8 to 10. For plain work 120 ft per day or 15 sq ft per hour might be done. Dividing the first figure of 60¢ by 15 equals 4¢ per sq ft. It is an unwritten rule with all floor work that the concrete base is supplied by another than the tile contractor, but an appraiser must include this part also.

For small rooms and angles use columns 5 to 7; and for the smallest, like bathrooms and closets with corners, 4 to 5 may be enough.

Treads and platforms take from 10 to 20 per cent more time than floors; wainscoting takes about the same as the treads; while fine marble ashlar wall facings may be allowed at from 2 to 4 sq ft per hour on cut-up work and 5 to 6 on plain. Base of an 8-in width takes about the same time as 12 in and may thus be put on a square-foot basis at 4 ft per hour by 1 and 1, as in Table 8, for cut-up work, and twice as much for long stretches.

Odd Sizes and Work. Marble base under 12 in costs as much for labor as full width, and sometimes a little more. A setter and laborer will lay from 6 to 8 lin ft in an hour, on straight work, and 5 to 6 on cut-up. Door and window finish if straight may be placed on the same linear-foot basis as base, unless the openings are extra high, in which case allow 10 per cent extra in money, or less in linear feet.

Cap. On plain straight work allow 7 ft per hour for man and helper. With short angles and rake work about half.

Terra Cotta. So far as hoisting to high buildings is concerned it is as easy to handle granite or Indiana as terra cotta, which weighs only half as much as solid material. The gain comes only in the handling by the mason and laborer. For contracting purposes and on work at ground level an allowance of 10 per cent of difference between the stone and terra cotta might be made, and 5 per cent on the high work, but for valuation purposes the figures in the tables may as well be used.

TABLE 1

Cost of Labor on Rubble per Cubic Yard

Rate per hour for mason	Rate per hour for laborer	Rate per hour for 1 with 1	Number of cubic yards laid in 1 hour							
			0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
$0.40	$0.20	$0.60	2.00	1.50	1.20	1.00	0.86	0.75	0.67	0.60
.50	.25	.75	2.50	1.88	1.50	1.25	1.07	.94	.83	.75
.60	.30	.90	3.00	2.25	1.80	1.50	1.29	1.12	1.00	.90
.70	.35	1.05	3.50	2.63	2.10	1.75	1.50	1.31	1.17	1.05
.80	.40	1.20	4.00	3.00	2.40	2.00	1.71	1.50	1.33	1.20
.90	.45	1.35	4.50	3.38	2.70	2.25	1.93	1.69	1.50	1.35
1.00	.50	1.50	5.00	3.75	3.00	2.50	2.14	1.88	1.67	1.50
1.10	.55	1.65	5.50	4.13	3.30	2.75	2.36	2.08	1.83	1.65
1.20	.60	1.80	6.00	4.50	3.60	3.00	2.57	2.25	2.00	1.80
For ea. 5¢ diff, in Col. 2.....			17¢	13¢	10¢	8¢	7¢	6¢	5¢	5¢

TABLE 2

Cost of Labor on Rubble per Cubic Yard

Rate per hour for mason	Rate per hour for laborer	Rate per hour for 1 with 1½	Number of cubic yards laid in 1 hour							
			0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
$0.40	$0.20	$0.70	2.33	1.75	1.40	1.17	1.00	0.88	0.78	0.70
.50	.25	.88	2.93	2.20	1.76	1.47	1.26	1.10	.99	.88
.60	.30	1.05	3.50	2.63	2.10	1.75	1.50	1.31	1.17	1.05
.70	.35	1.23	4.10	3.08	2.46	2.05	1.76	1.54	1.37	1.23
.80	.40	1.40	4.67	3.50	2.80	2.33	2.00	1.75	1.56	1.40
.90	.45	1.58	5.27	3.95	3.16	2.63	2.26	1.98	1.76	1.58
1.00	.50	1.75	5.83	4.38	3.50	2.92	2.50	2.19	1.95	1.75
1.10	.55	1.93	6.43	4.83	3.86	3.22	2.76	2.41	2.15	1.93
1.20	.60	2.10	7.00	5.25	4.20	3.50	3.00	2.62	2.34	2.10
For ea. 5¢ diff. in Col. 2.....			25¢	19¢	15¢	12¢	11¢	9¢	8¢	7¢

TABLE 3

Cost of Rubble Labor per Cubic Yard with Power Derrick

Rate per hour for mason	Rate per hour for laborer	Rate per hour for 1 with 4	Number of cubic yards laid in 1 hour							
			0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
$0.40	$0.20	$1.20	4.00	3.00	2.40	2.00	1.71	1.50	1.33	1.20
.50	.25	1.50	5.00	3.75	3.00	2.50	2.14	1.88	1.67	1.50
.60	.30	1.80	6.00	4.50	3.60	3.00	2.57	2.25	2.00	1.80
.70	.35	2.10	7.00	5.25	4.20	3.50	3.00	2.63	2.33	2.10
.80	.40	2.40	8.00	6.00	4.80	4.00	3.43	3.00	2.67	2.40
.90	.45	2.70	9.00	6.75	5.40	4.50	3.86	3.38	3.00	2.70
1.00	.50	3.00	10.00	7.50	6.00	5.00	4.29	3.75	3.33	3.00
1.10	.55	3.30	11.00	8.25	6.60	5.50	4.71	4.13	3.67	3.30
1.20	.60	3.60	12.00	9.00	7.20	6.00	5.14	4.50	4.00	3.60
For ea. 5¢ diff. in Col. 2.....			67¢	50¢	40¢	33¢	28¢	25¢	22¢	20¢

TABLE 4

Cost of Labor Setting Ashlar per Square Foot

Rate per hour for mason	Rate per hour for laborer	Rate per hour for 1 with 3	By hand derrick on low buildings — Number of square feet set in 1 hour					Rate per hour for 1 with 3½	By power derrick on high buildings — Number of square feet set in 1 hour				
			8	10	14	18	22		10	12	16	20	24
$0.40	$0.20	$1.00	.13	.10	.07	.06	.05	$1.10	.11	.09	.07	.06	.05
.50	.25	1.25	.16	.13	.09	.07	.06	1.38	.14	.11	.09	.07	.06
.60	.30	1.50	.19	.15	.11	.08	.07	1.65	.17	.14	.10	.08	.07
.70	.35	1.75	.22	.18	.13	.10	.08	1.93	.20	.16	.12	.10	.08
.80	.40	2.00	.25	.20	.14	.11	.09	2.20	.22	.18	.14	.11	.09
.90	.45	2.25	.28	.23	.16	.13	.10	2.48	.25	.21	.16	.13	.10
1.00	.50	2.50	.31	.25	.18	.14	.11	2.75	.28	.23	.17	.14	.12
1.10	.55	2.75	.35	.28	.20	.15	.13	3.03	.31	.25	.19	.15	.13
1.20	.60	3.00	.38	.30	.21	.17	.14	3.30	.33	.28	.21	.17	.14
For ea. 5¢ diff. in Col. 2.....			2¢	1½¢	1¢	1¢	¾¢		1¾¢	1½¢	1¼¢	1¢	¾¢

On such work as requires 4 laborers add 20 per cent to totals.

For an extra laborer add 18 per cent to totals.

TABLE 5

Cost of Labor Setting Stone per Cubic Foot by Power Derrick

Rate per hour for mason	Rate per hour for laborer	Rate per hour for 1 with 6	Number of cubic feet set in 1 hour							
			12	15	18	20	22	24	28	32
$0.40	$0.20	$1.60	0.14	0.11	0.09	0.08	0.07	0.07	0.06	0.05
.50	.25	2.00	.17	1.3	.11	.10	.09	.08	.07	.06
.60	.30	2.40	.20	.16	.13	.12	.11	.10	.09	.08
.70	.35	2.80	.23	.19	.16	.14	.13	.12	.10	.09
.80	.40	3.20	.27	.21	.18	.16	.15	.13	.12	.10
.90	.45	3.60	.30	.24	.20	.18	.16	.15	.13	.11
1.00	.50	4.00	.33	.27	.22	.20	.18	.17	.14	.13
1.10	.55	4.40	.37	.29	.24	.22	.20	.18	.16	.14
1.20	.60	4.80	.40	.32	.27	.24	.22	.20	.17	.15
For ea. 5¢ diff. in Col. 2.....			2½¢	2¢	1¾¢	1½¢	1½¢	1¼¢	1¢	1¢

TABLE 6

Cost of Labor per Cubic Foot Setting Cut Stone Trimmings by Hand

Rate per hour for mason	Rate per hour for laborer	Rate per hour for 1 with 2	Number of cubic feet set in 1 hour					
			3	4	6	8	10	12
$0.40	$0.20	$0.80	0.27	0.20	0.13	0.10	0.08	0.07
.50	.25	1.00	.33	.25	.17	.13	.10	.08
.60	.30	1.20	.40	.30	.20	.15	.12	.10
.70	.35	1.40	.47	.35	.23	.18	.14	.12
.80	.40	1.60	.53	.40	.27	.20	.16	.13
.90	.45	1.80	.60	.45	.30	.23	.18	.15
1.00	.50	2.00	.67	.50	.33	.25	.20	.17
1.10	.55	2.20	.73	.55	.37	.28	.22	.18
1.20	.60	2.40	.80	.60	.40	.30	.24	.20
For ea. 5¢ diff. in Col. 2			3½¢	2½¢	1¾¢	1¼¢	1¢	1¢

TABLE 7

Cost of Labor per Cubic Foot Setting Cut Stone Trimmings by Hand Derrick

Rate per hour for mason	Rate per hour for laborer	Rate per hour for 1 with 4	Number of cubic feet set in 1 hour						
			7	8	9	10	12	14	16
$0.40	$0.20	$1.20	0.17	0.15	0.13	0.12	0.10	0.09	0.08
.50	.25	1.50	.21	.19	.17	.15	.12	.11	.09
.60	.30	1.80	.26	.23	.20	.18	.15	.13	.11
.70	.35	2.10	.30	.26	.23	.21	.18	.15	.13
.80	.40	2.40	.34	.30	.27	.24	.20	.17	.15
.90	.45	2.70	.39	.34	.30	.27	.23	.19	.17
1.00	.50	3.00	.43	.38	.33	.30	.25	.21	.19
1.10	.55	3.30	.47	.41	.37	.33	.28	.23	.21
1.20	.60	3.60	.51	.45	.40	.36	.30	.26	.23
For ea. 5¢ diff. in Col. 2			3¢	$2\frac{1}{2}$¢	$2\frac{1}{5}$¢	2¢	$1\frac{3}{4}$¢	$1\frac{1}{2}$¢	$1\frac{1}{4}$¢

TABLE 8

Cost of Labor on Marble Floors, Platforms, Wainscot, Base and Facings per Square Foot

Rate per hour for mason	Rate per hour for laborer	Rate per hour for 1 with 1	Number of square feet laid per hour								
			2	3	4	5	6	7	8	9	10
$0.40	$0.20	$0.60	0.30	0.20	0.15	0.12	0.10	0.09	0.08	0.07	0.06
.50	.25	.75	.38	.25	.19	.15	.13	.11	.09	.08	.08
.60	.30	.90	.45	.30	.23	.18	.15	.13	.11	.10	.09
.70	.35	1.05	.53	.35	.26	.21	.17	.15	.13	.12	.11
.80	.40	1.20	.60	.40	.30	.24	.20	.17	.15	.13	.12
.90	.45	1.35	.68	.45	.34	.27	.22	.19	.17	.15	.14
1.00	.50	1.50	.75	.50	.38	.30	.25	.21	.19	.17	.15
1.10	.55	1.65	.83	.55	.41	.33	.28	.24	.21	.18	.17
1.20	.60	1.80	.90	.60	.45	.36	.30	.26	.23	.20	.18
For ea. 5¢ diff. in Col. 2.....			$2\frac{1}{2}$¢	$1\frac{3}{4}$¢	$1\frac{1}{4}$¢	1¢	1¢	$\frac{3}{4}$¢	$\frac{6}{10}$¢	$\frac{1}{2}$¢	$\frac{1}{2}$¢

Material

Rubble. The size of the joints and the nature of the work make a good deal of difference in the quantity of stone required. For valuation purposes allow 128 cu ft at the quarry to 100 of the finished wall actual contents. The local price has to govern. It might be 10¢ per 100 lbs and it might be twice as much.

Mortar for Rubble. Allow for an average 2 bbls of Portland cement and 1 cu yd of sand for each 100 cu ft—or 3.7 cu yds—of the finished wall, and about 2 hours' labor of a man to mix. Or $1\frac{3}{4}$ bbls of good lime and 1 yd of sand. The lime swells and goes further than the cement. The local prices can be applied to the quantities. Water is charged for in cities at from 6¢ to 8¢ per cu yd, or about 2¢ for each yard of the 4 above.

2 bbls cement at $3	$6.00
1 cu yd sand at $2.50	2.50
2 hours' mixing at 50¢	1.00
Water	.08
	$9.58

This is practically $2.60 per cu yd for mortar at the rates given, or 10¢ per cu ft, but prices may have been only half on a building, the original cost of which is wanted. The 27 cu ft of mortar divided by the 3.7 cu yd of finished wall gives 7.3 cu ft of mortar per yard.

$1\frac{3}{4}$ bbls lime at $2.50	$4.37
1 cu yd sand	2.50
2 hours' mixing at 50¢	1.00
Water	.08
	$7.95

Dividing by 3.7 = $2.15 per cu yd. In both cases, and with other tables also, the mixing labor is allowed. This is supposed to be included in the general allowance, but will cover up some small extras always uncounted—spoiled lime, cement wetted and made useless, etc. If the $1 is left out the cement mortar would be $2.32 at the rates given, and the lime, $1.88.

Indiana Oolitic Limestone. This imposing title is official. "Bedford" stone has almost monopolized the Indiana product, but Bedford is only one field of several.

Freight counts for a good deal with this splendid stone. From Indiana to Omaha, for example, the freight was 68¢ per cu ft in

1923. As 200 lbs is charged for by the railroad companies, instead of 150 to 155 per cu ft, the rate is thus 34¢ per 100 lbs.

The following two tables are given as a comparison of prices in normal times, such as from 1910 to 1914, and prices in war times:

TABLE A

1910–1914—Bedford Stone, Linear Foot, Prices, Unset

Description	Size, inches	Rate, cubic foot	Cost with profit
Window sills	5× 7	$1.75	$0.43
Window sills	5×11	1.70	.65
Window sills	7× 7	1.70	.58
Window sills	7×11	1.65	.89
Window sills	8× 8	1.60	.72
Door sills	8×11	1.50	.92
Door sills	8×15	1.45	1.21
Door sills	8×19	1.40	1.48
Lintels	4×10	1.65	.46
Lintels	8×12	1.50	1.00
Water table	6×10	1.55	.65
Water table	8×12	1.50	1.00
Coping	4×11	1.70	.52
Coping	4×15	1.55	.65
Coping	4×19	1.50	.80
Coping	8×15	1.45	1.21
Coping	8×19	1.40	1.48
Steps	7×14	1.50	1.02

Approximate. For the high-priced period 1918–23—but not 1920—$2.50 per cu ft might be set for cut stone averaged over an ordinary building with a reasonable proportion of common moldings; setting, freight, and profit not allowed. It should be remembered that moldings are now run by machines, and that the old expensive hand work is thus not required. But appraisers may be set down before a large building with heavily molded work in the old style to get original cost, knowing that it was erected before diamond saws and molders were in use. Is he to allow at the old rate, several times as high as the new? A hint is given by the New England authorities on cotton mills and similar structures. As stated elsewhere, foundation *A* is not valued at any more than *B*, if the latter is sufficient for its purpose, even although it is clear that by piling and deep,

TABLE B

1918–23—UNSET

Description	Size, inches	Rate, cubic foot	Rate, linear foot, with profit
Window sills, plain bevel face..	7× 5	$2.26	$0.55
Window sills, plain bevel face..	11× 5	1.83	.70
Window sills, plain bevel face..	7× 7	2.06	.70
Window sills, plain bevel face..	10× 7	2.06	1.00
Window sills, lugged.....	7× 5	2.65	.65
Window sills, lugged.....	11× 5	2.62	1.00
Window sills, lugged.....	7× 7	2.50	.85
Window sills, lugged.....	10× 7	2.57	1.25
Door sills, lugged.....	10× 7	2.57	1.25
Door sills, lugged.....	14× 7	2.63	1.65
Door sills, lugged.....	18× 7	2.57	2.25
Lintels.....	4×10	1.98	.55
Lintels.....	8×12	1.95	1.30
Watertable, 2″×2″ wash.....	6×10	2.88	1.20
Watertable, 2″×2″ wash.....	8×12	2.48	1.65
Coping.....	11× 4	2.29	.70
Coping.....	14× 4	2.06	.80
Coping.....	19× 5	1.97	1.30
Steps.....	14× 7	1.91	1.30

heavy walls *A* cost several times as much as *B*. The reproduction cost of molded work would be at modern rates; if the appraiser wanted to have a high original cost he would price the hand work; if a low, the moldings would be based on the new equipment. It should always be remembered that the Interstate C. Commission Report says that within reasonable limits any kind of a valuation may be had, depending upon what the expert is expected to prove.

The $2.50 rate as given above for an average might be cut to $2.00 and even less for a heavy bill of plain work. Such work as tracery, finials, corbels and brackets has almost to be priced by an expert if there is much of it; if a small amount, any appraiser can easily guess at it, as the total is a trifling percentage of the entire valuation.

For the best tracery as seen in large rose windows of churches allow $10 per cu ft of the rough blocks before being touched.

One of the largest contracts of Indiana stone was let by the State of Nebraska for the new $5,000,000 capitol in the middle of

1922. The stone in rough blocks at the quarry was set at 75¢ per cu ft. This to insure that the same kind and color of stone would be used for the entire building, with its 400-ft tower. Setting, on an average, 25¢ per cu ft, freight, profit and labor preparing the stone all to be added. Ozark marble was put at $1.35 at quarry.

Columns. Round columns are turned in a lathe the same as wood ones, and cost about $1.10 per cu ft, before being turned, without freight, setting and profit. The square bases run to 40 and 50 per cent per cu ft more than the round columns. If columns are fluted add about 6¢ per lin ft of each flute.

Moldings are as easily run on a wide stone as on a narrow one, and thus the cubic foot price depends upon the section. A cornice might be, say, 200 ft long with a molded edge. A part of this cornice might be 8 in high, molded, by 12 in wide equals 134 cu ft. With a stone 18 in wide the cubage is 144 ft; with 2 ft wide, 267.

Some Official Indiana Figures. (1) School, Kansas, 4,000 cu ft, not set, $2.06 per cu ft in 1919. Ordinary straight work, such as grade course, water table, steps, cornice. Freight included, all work.

(2) Church, Kansas, 2,134 cu ft, $2.30 without setting.

(3) College, Missouri, 2,512 cu ft, $2.18 not set.

(4) Bank, Missouri, 2,000 cu ft, good entrance and cornice, typical bank style, $2.09 cu ft, unset. Some carving.

(5) Cornice for mid-Western bank, 3 ft high, $6.25 per lin ft. Crown mold, 3 ft wide by 10 in high.

(6) Bridge balustrade, 3′ 4″ high; foot rail, 13″×10″, molded 2 sides; turned balusters, 7″×7″×2′; and hand rail, 13″×6″, molded 2 sides, $8.50 lin ft, no freight or setting.

(7) Columns: Doric shaft, base and capital, 3-ft diameter, fluted, 24 ft high over all, $330; Ionic, shaft, 32-in diameter, fluted, 24 ft high, $330; Corinthian, shaft, 29 in, capital carved, 24 ft, $390. No freight or setting.

Ashlar. The following abbreviated description is from the Indiana Limestone Quarrymen's Association: "Ashlar is any plain piece of stone with cut beds and joints only, but more particularly wall facings. It is kept separate on the estimating sheet, and figured on a different basis.

"The styles are: range or coursed ashlar; broken or random ashlar; hit-and-miss or irregular ashlar. Range is most generally used. It is laid up in courses which may be of various heights, but each course is carried through at the same height. Random was the style mostly used before machinery days. Each piece of stone was squared to its greatest size and so placed in the wall and sizes cut to fit unfilled spaces. In this, as in the coursed style, beds and joints are horizontal. Hit-and-miss has any kind of joints, some level, but most on irregular angles.

Cost. "To get at this from local quarries allow for a mason at hand work 30 face feet in 8 hours, if the blocks come nearly the size. This for 8-in rock-faced work and coursed work; for random add 10 per cent. Setting, 25¢ per sq ft for range; and 20 per cent more for random on the basis of 80¢ for setter and 45¢ for laborer.

"For smooth-face range strips may be had from the Indiana quarries sawed to height of course and ready to lay, except for some cutting to length. Without freight, unloading, hauling and profit, 25¢ to 30¢ per sq ft. Approximately, 65¢ complete per sq ft.

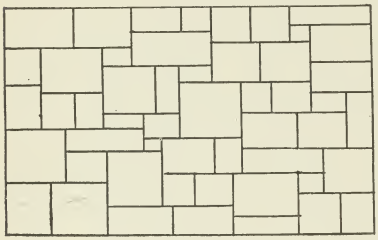


Fig. 26.—Broken.

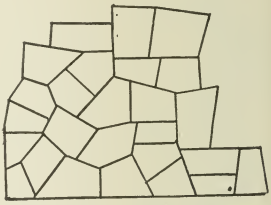


Fig. 27.—"Hit or Miss."

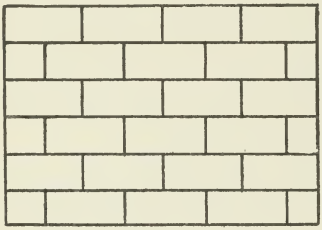


Fig. 28.—Range or C.

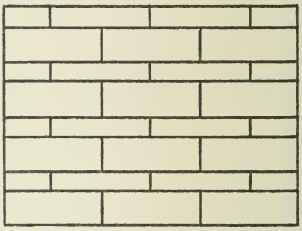


Fig. 29.—Coursed or R.

Where the work is taken from the mills with no hand cutting, allow about 50¢ Iron anchors should be provided in each piece from 3 ft to 4 ft long; more than 4 ft, 2 are required. Each anchor hole, 10¢ for cutting; and anchor about the same.

Hauling. On a 1923 basis allow about $1.50 per ton for hauling if a derrick is handy at the loading point. Nearly all stone yards are on the railroad tracks. In a ton there are 13 cu ft.

Cleaning Down. On a 6-story building in a low-price era and with large stones the pointing and cleaning came to only 1.6¢ per sq ft; with small stones it would have been 3¢ to 4¢. This, however, included the openings; net surface would have raised the unit 25 to 40 per cent more.

In our high-price era the cost would have been 5¢ to 6¢ per sq ft. Allow 250 sq ft for 8 hours for 1 mason, on the basis of 3 masons working and 1 laborer attending them. On surfaces with smaller stones and more angles, 180 sq ft; and half of that on surfaces with many moldings and tracery.

Taking 180 ft for each man as a base and allowing the laborer, at a wage of $1 and 60¢ per hour, the rate per square foot, not including mortar, is not quite 5½¢. With cold weather and bad conditions, double this might be required; about 7 should be the limit.

Mortar. The Indiana authorities object to the former custom of using compounds to paint the backs of stones, and prefer mortar only. Allow 5 cu ft of mortar ½ in thick for 100 sq ft of ashlar. The cost varies according to the price of the materials. The following is for a fair 1923 figure per cubic yard:

1 cu yd sand	$2.60
⅓ cu yd lime putty	2.80
3.6 cu ft. stainless cement	6.40
Labor mixing, 2 hours at 50¢	1.00
Water	.10
	$12.90

Another and richer mix is recommended, but the foregoing one is close enough for valuation work. The rate is 48¢ per cu ft for mortar alone, and as 100 sq ft at ½ in requires 5 cu ft the total is $2.40, or 24¢ per sq ft. The rule is: Take one-twentieth of the surface measure to get the number of cubic feet of plastering mortar on backs of stones. Some masons might try to use only ¼ in, but the Indiana specifications require ½ in.

An average thickness of ashlar is easily decided, but the size of the stones is not. They may be for 6-in or 12-in courses, or long blocks 2′×3′ or 4 ft. The mortar for the backing is easily found, for 100 sq ft at ½ in is 50 cu ft at 1 in, and dividing by 12 equals 4.17 cu ft, requiring at least 5 cu ft for waste, etc. But small stones require much more than large ones for setting mortar.

(1) Assume an average front of courses at 12 in high and blocks 24 in long. Each block has 2 sq ft and requires 6 lin ft of joint mortar averaging 6 in wide, or 3 sq ft. At this rate 100 sq ft require 150 sq ft of mortar, say, ⅜ in thick, and this is small enough, or 56 sq ft at 1 in equals 4.7 cu ft or for waste 5 cu ft per 100 sq ft, or, again, one-twentieth of the surface feet for cubic feet. For plastering on back at ½ in and for setting at ⅜ in allow one-tenth of the superficial feet in cubic feet. For 10 cu ft at 48¢ equals $4.80 for 100 sq ft, or 48¢ per sq ft for the plastering and setting. But use local prices for material and labor.

The brick backing for the first course next the stone is specified to be laid in the rich mortar; but mixing is allowed at $1 extra per yard, as it is supposed to be already included in general labor, and this covers some small extras and waste.

The cost of the brick mortar depends, like the others, on what the prices are. Using the same ones as for the rich mortar a cubic yard of lime mortar might be detailed thus:

$1\frac{3}{4}$ bbls lime at $2.50	$5.00
1 cu yd sand	2.60
Labor mixing, 2 hours at 50¢	1.00
	$8.60

This is close to 32¢ per cu ft for material. With a joint at $\frac{1}{2}$ in, and it should never be less, it takes about 19 cu ft to 1,000 actual brick, and as there are 460 bricks to the cubic yard, close to 9 cu ft are required for a cubic yard, at $9 \times 32¢ = \$2.88$, or nearly 11¢ per cu ft of brick at $\frac{1}{2}$-in joint.

With a 12-in backing the allowance would be 11¢; with 16-in, 15¢; with 20-in, 18¢.

For each square foot of wall with ashlar and 12-in backing the mortar comes to 59¢ at the prices given, but in some years they would be cut in two, and in some sections of the country in those years, in three.

(2) Setting the ashlar blocks at an average of 2 ft high and 3 ft long—and some granite work runs as long as $12' \times 6'$ high—6 sq ft requires 5 sq ft of mortar, $\frac{3}{8}$ in as before, 100 sq ft, 84. At 1 in instead of $\frac{3}{8}$ in there are $31\frac{1}{2}$ cu ft. The rate is $48¢ \times 31\frac{1}{2} = \$15.12$, or a little over 15¢ per sq ft, instead of 24¢. Long granite or marble slabs would require less, while 6-in courses of ashlar would require more than the 24¢.

On the second basis, 24¢ for plastering, 15¢ for setting, and 11¢ for backing equals 50¢ for a square foot of wall.

Granite Work

Setting. As already explained, the setting is about the same as for Indiana stone, a trifle more if there is cutting. But in 1920 the quarrymen allowed 75¢ and even $1 per cu ft.

Mortar. Use the same allowances as for stone, but half is sufficient if the blocks are of the large kind often seen.

Freight. As a rough approximation, a rate of $4 per ton from New England to points midway between that and Chicago; to Chicago, cut work, $5.25 per ton, and polished work, $6. About 13 cu ft to the ton.

National Building Granite Quarries Association, Inc.
Building Granite Estimate

The following article was contributed for this "Handbook" by The National Building Granite Quarries Association, 31 State St., Boston, and copyright reserved.

In my "Contractors' and Builders' Handbook," when discussing Mr. Edison's statement that we are foolish to build in anything but reinforced concrete, I said that there is room enough and glory enough for all—stone, granite, marble, brick, terra cotta and reinforced concrete. In the building just referred to with granite basement, the next two stories are of Indiana stone, and the ones above of brick, with terra cotta trimmings. "There is room enough and glory enough for all"—and the more granite we see in building work the better we shall be pleased, especially when the others are also forging ahead. We are after a better quality of building where fire will have less chance, and where the depreciation rate will be cut in half.

There is such a variation in the working qualities of the different granites produced for building work, that no set rules for estimating can be laid down, and no unit prices determined which would apply to all.

Granite work cannot be accurately estimated by either the cubic-foot or surface-foot method. Any attempt to gage the value of granite work by either of these methods is unsafe and should be discouraged. No practical method has been devised for classifying the work and gaging the value of same by quantity unit prices.

When men with long experience in producing and finishing granite for building work have been unable to devise any "short-cut" method of estimating, which will produce even a reasonably accurate approximation of the value of the work, it would surely be inconsistent to attempt to lay down any "short-cut" method for the use of others who have not that same experience.

In estimating granite work it is essential that the quantities be taken off in sufficient detail that a complete analysis can be made to which the unit prices must be applied in determining the total value. The estimate must be made with due regard to the methods employed in the cutting plants. Each stone or group of like stones must be figured separately, figuring each face, mould, head, check chamfer, wash, bed, and joint for each stone or group, and the proper cutting unit applied to each such sub-division of the work.

The following Procedure and General Rule is laid down as a guide by which the value may be approximated, somewhat in the manner in which a granite contractor would prepare his estimate. Much of the detail has been eliminated in this outline, as at best only approximations may be made and the actual value can only be determined by the producer of the particular granite finally selected.

Procedure and General Rules for Building Granite Estimating

Quantities. A detailed schedule of quantities is first made, either by separate stones, groups of similar stones, or lin ft of similar moulded courses, etc.

All measurements are taken on the least rectangular content, and fractions of an inch are raised to the next full inch in recording the dimensions and cubing the quantities.

In general, no stone is cubed as less than 1 cu ft to 1 lin ft in length; no stone is cubed as less than 8″ thick if less than 2′–0″ high, and not less than 1′–0″ thick if 2′–0″ high or higher.

The quantity schedule is cubed, usually by the duodecimal system, and the total cube thus obtained is used in conjunction with the rough stock unit and the freight unit in determining these two factors of value.

Cutting

Plane Work. a Plane exposed faces—Figure the sq ft at the surface cutting unit for grade of cut specified.

b Heads or Reveals—Figure the sq ft at one and one-half the proper cutting unit.

c Plane Beds and Joints—Figure as not less than 1′–0″ wide, —figure sq ft at the bed and joint unit.

Moulded Work. a Square the face of the moulded stone and figure at the surface cutting unit for grade of cut specified.

b Estimate the number of equivalent members (see member chart), and figure number of members at the proper member unit times the length of membered portion of stone.

c Beds and Joints—Figure same as on plane work.

d Moulded Heads—Figure sq ft of head at one and one-half the surface cutting unit,—figure number of members at member unit times length of the longest member, in no case less than 1′–0″.

e Breaks in Moulds—Figure members as double the length of longest member, but in no case less than 1′–0″.

Miscellaneous. a Washes—Ordinary washes,—8″ on or over, add drop of wash to width of wash, and figure as equivalent plane surface at the surface cutting unit.

4″ to 8″ on, add drop to width and figure at one and one-half the surface unit.

Under 4″ on, add drop to width and figure at twice the surface unit.

b Chamfers—Figure same as washes.

c Washes with Lugs or Seats—Figure actual surface over all at one and one-half the surface cutting unit.

d Checks or Rabbets—See table of Fine Rabbets.

e Circular Work—Ordinarily figure as equivalent to one and one-half straight work, varying more or less as the radius of curvature is smaller or greater.

f Checking for Steel—Must be figured according to judgment and experience. This work in many cases amounts to considerable value and must never be overlooked.

g Roughing for Carving—Must be figured according to judgment and experience, and depends largely on the character of model.

Columns. The ordinary method of figuring columns is as follows:

a Figure surface as equivalent to five times the greatest diam times the height at the proper surface cutting unit.

b Figure the beds as square at the surface cutting unit.

c Fillets and Mouldings—Figure as members, length equivalent to five times the diam.

d Flutes—Variable according to width, relative depth, and type of nosing. For rough approximating, figure no flute as less than two and one-half members. Figure a medium depth Corinthian flute as two and one-half members, if 4″ wide or less. Figure a deep flute as three and one-half members if 4″ wide or less. Flutes wider than 4″ increase in proportion over a 4″ flute. Figure a flat Doric flute as one and one-half member for each 4″ of flute surface or fraction thereof.

Polished Work. **a** Plane Surfaces, Large Enough to Polish by Machine—Figure the sq ft at plane polished surface unit.

b Members—Figure first as 8-cut, then add for hand polishing each equivalent member at the polished member unit. Polished members should not be counted as over 2″ wide..

c Polished work not included under plane machine work or members, may be approximated at twice the cost of eight cutting same.

Double Faced Stone. Figure first face as in plane cut work, and opposite side at one and one-half the surface cutting unit.

Large or Complicated Stones. Figure an increase over ordinary sizes or simpler stones, according to judgment and experience. The risk, and relative roughness of pattern must be considered here also.

Schedule of Units. These units are all f o b producing plant, and are intended to cover approximately the range for the more generally accepted building granites, and are for building work only.

These units are based on granite cutters' wages at $6.80 per eight-hour day. Present wage agreements with the granite cutters contemplate $6.80 per day as the minimum wage to April 1, 1922.

In using these unit prices proper allowances should be made for any change in the existing rate over or under $6.80. Average conditions and stock are assumed.

Rough Dimension Stock—$1.50 to $2.50 per cu ft.

Plane Surface Cutting Units—Medium pointed, $1.08 to $1.36 per surface ft. Four cut, $1.25 to $1.70 per surface ft. Six cut,

$1.45 to $2 per surface ft. Eight cut, 1.70 to $2.25 per surface ft.

Member Units—Coarse cut, $1.10 to $1.45 per lin ft. Fine cut, $1 25 to $1.70 per lin ft. .

Bed and Joint Units—Regular Commercial—60c to 80c per sq ft. If better than regular commercial beds and joints are called for, increase the above units accordingly.

Plane Polished Face Units—Machine Polished from Rough—$2.00 to $3.40 per sq ft.

Polished Member Units—Figure as not over two inches wide. First figure as eight cut. Then add for polishing, $1.40 to $2.25 per lin ft of member.

TABLE OF FINE RABBETS PER LINEAR FOOT

Inches	1″		2″		3″		4″		5″		6″	
	From	To	From	To	From	To	From	To	From	To	From	To
1″	$.60	$2.40	$1.70	$2.55	$1.80	$2.70	$1.90	$2.90	$2.05	$3.05	$1.90	$3.25
2″	.....	.....	1.80	2.70	1.90	2.90	2.05	3.05	2.15	3.25	2.25	3.40
3″	.....	.....	.....	.....	2.15	3.25	2.25	3.40	2.40	3.60	2.50	3.75
4″	.....	.....	.....	.....	.....	.....	2.60	3.90	2.70	4.10	2.80	4.25
5″	.....	.....	.....	.....	.....	.....	.....	.....	3.20	4.75	3.30	4.95
6″	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3.80	5.65

Member Chart

This member chart has been worked out by the experts and must be followed as a guide.

Moulded work is divided up into equivalent members, as illustrated in a general way by the chart and a few examples below.

In general, members are counted between lines and every four inches or fraction thereof shall be counted as one member.

Freight. The item of freight is too important to attempt to generalize, and is entirely dependent on the location of the quarry producing the granite selected with reference to the location of the building where the granite is to be used.

For very rough approximations, a minimum rate of $5 per net ton may be used on freight from quarries in New England to closely adjacent points outside of New England. From New England points to Chicago, cut work $6.25 per net ton, polished work $7 per net ton.

The above for carload shipments only. In calculating weight use 13 cu ft as equivalent to one net ton.

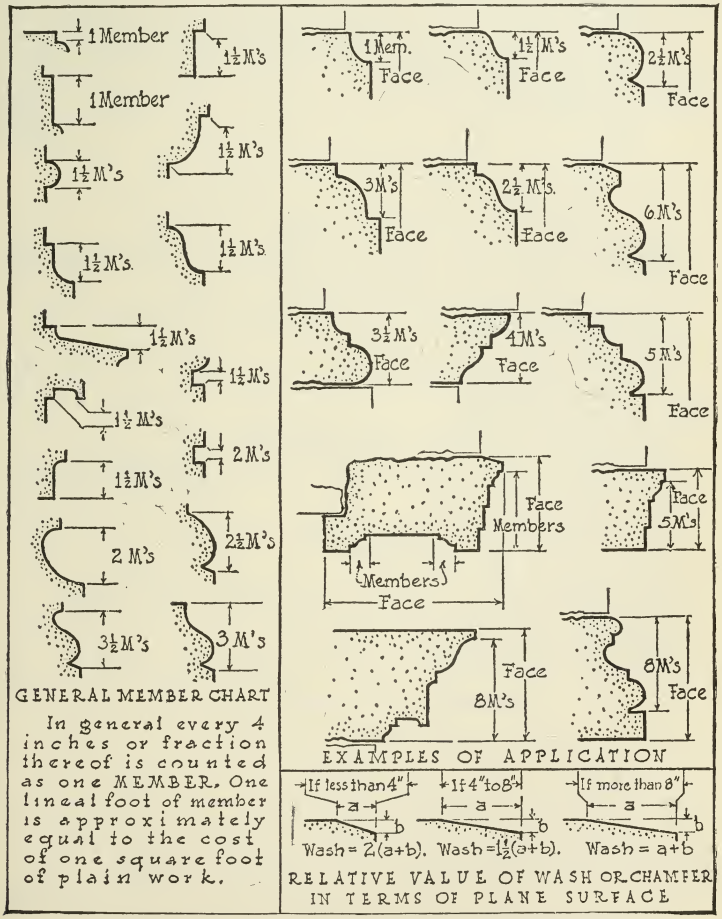
Carving and Models. No data can be given, as value depends entirely on models and character of carving required.

Turning. Turning enters into the estimate where balusters and columns occur, but no general data is available. Balusters will have to be judged by experience, and columns figured as outlined under cutting.

Lettering: Discount 20 Per Cent

Square Sunk, from ⅛ Inch to 1 Inch

Size	⅛″	¼″	½″	¾″	1″
1½″	$1.80	....	....	....	....
3″	2.30	$2.80	....	....	....
4″	....	3.50	....	....	....
5″	....	....	$7.00	....	....
6″	....	....	8.00	$ 9.50	....
7″	....	....	9.20	10.80	$12.00



Units used as Basis for Estimating of Granite Mouldings.

A Few Illustrations Showing Workings of Association System

Plain Work. Assume a block of granite 6′x4′x18″ =36 cu ft. The beds and joints =20′x18″. The face is polished =24 sq ft.

For the rough dimension stock, $2 at quarry	$ 72.00
30 sq ft of beds and joints, 70c	21.00
24 sq ft of polished surface from the rough, $3	72.00
Total	$165.00

If the same block had the beds and joints only 8″ wide the estimate would be based upon 12″.

Rough dimension as before	$ 72.00
20 sq ft of beds and joints, $0.70	14.00
24 sq ft polished surface, $3	72.00
Total	[illegible]

For the same block, 6-cut 18″ beds and joints and with reveal of 8″.

Rough dimension	$ 72.00
30 sq ft of beds and joints, $0.70	21.00
24 sq ft of 6-cut, $1.75	42.00
An 8″ reveal =12″x6′, $1.75	10.50
Total	$145.50

Carving Only: Discount 25 per cent

(To be added to cost of stock and other work.)

Rope, 1″ diam, per lin ft, $5; 2″, $6.50.

Dentils, 2″ wide, ½″ relief, $2 per lin ft; 3″ and 1″ relief, $3. Double dentils as above, $8 and $10.50.

Egg and Dart Molding, 2″, per lin ft, $8; 3″, $10.

Straight Relief Work, 4″ wide, $16 per lin ft; 8″, $25.

Leaf Pattern, 6″ wide, per lin ft, $20; 10″, $27.

Fleur de Lis, 4″ high, $8; 8″, $10.

Five Pointed Star, 3″, $6; 6″, $9; 8″x8″ ornamental, 1″ relief $55; 12″x12″x1½″, $75.

Angle Cross, 18″, relief, 1″, $55; 30″, $75.

Upright Cross, 18″ and 1″, $50; 30″ and 3″ relief, $115.

Eagle, 10″, relief 3″, $60; 12″, $75; on ball and pedestal, 5′x2′ 6″x 3′, $725; 3′x1′ 8″x2′, $450.

Cross Swords, 2′ R. 3″, $72; 3′, $85.

Flags, 3′ and 2″ R., $80; 4′, $100.

Monogram, 8″, $20; 12″, $30.

Mold, 4″, raised ½″, carved, per lin ft, $20; 8″ mold, $30.

Tracing, 3″ wide, $2 lin ft; 5″, $2.50.

Wreath, 8″ diam, $7.50; 12″, $10.

Figures of men and women run from $500 each to $750.

Lettering: Discount 20 per cent.

Round Raised from ⅛″ to 1″.

Size	⅛″	¼″	½″	¾″	1″
1½″	$1.20	....	....	....	....
3″	....	$1.50	....	....	....
4″	....	1.80	....	....	....
5″	....	....	$3.50	$5.50	....
6″	....	....	....	6.00	$6.75
7″	....	....	....	7.00	8.15

Square Raised from ⅛″ to 1″, 10% more than Round Raised.

Hauling from Depot. Approximately, $1.50 per ton to the job.

Quality. The gray granites are lower in price than the harder colored ones. Some of the fine grained grays are also high priced; and the colored ones are not all of the hardest kind. Only a granite expert can tell the qualities.

Price per Cubic Foot. The raw material might be $1.25 per cu ft or $3. Dark Barre in the rough was $3.10 in Jan., 1920, and light, $2.60, but more than three-fourths of this kind is used for monumental work. It is thus clearly impossible to set any price until the quality of the granite is known. This is required before any estimating or valuation can be done.

Hand and Machine Work. The following figures are given as an aid to getting labor cost, either by hand or machine, and are for granite:

Description	Quantity	Hours, hand	Hours, Machine
Balusters, 28″×4½″×6″ base, cap 3½×6	52	8,303	653
Carving block, 6″×⅜″ relief	14 lin ft	247	138
Tracing ivy-leaf design on polished block, 4 in wide	10 lin ft	31	19
Dressing, 6-cut work	48 sqft	76	39
Dressing, 6-cut work	100 sq ft	65	10
Groove, flashing, ½″×1½″	18 lin ft	60	22
Letters, 1 in and 2 in polished block	106	35	29
Letters, 10—cut finish in polished block	5	13	10
Polishing, square feet	8	60	10
Polishing, square feet	8	92	12
Polishing, square feet	35	21	7
Cutting urn, 20 in high, bowl, 18 in diameter, neck, 8 in	1	155	45
Cutting vase, 30″×18″×8″	1	234	105
Drilling holes, 2½″×18″ deep	30	89	15
Quarrying	100 cu ft	504	131
Quarrying	100 cu ft	36	12
Quarrying	100 cu ft	167	101

Marblework

Marble measurement is by the cubic foot, as a rule, except on plain ashlar 4 in or less thick, which is figured by the superficial foot.

Most of the following figures were supplied by The Georgia Marble Company, and are at 1923 rates:

Bank. Plain ashlar, 2,000 cu ft, $2.50 per cu ft at quarries. Heavily molded work, 2,030 cu ft at $3.50 per cu ft. Light molded and arches, $4.50. Average, $3.25 per cu ft. Freight, 28¢ per 100 lbs. equals 47¢ per cu ft. Hauling, setting, cleaning, pointing, 60¢ per cu ft. Average price complete in building, $4.51 per cu ft on $22,000.

Art Gallery. At quarries, 7,800 cu ft, $3.85; freight, 31¢; hauling and setting, 60¢; complete, $4.76 per cu ft.

Bank and Offices. 51,650 cu ft at $2.75; freight, 21¢.

Ashlar at quarries, 4-in, 75¢ to $1 per sq ft.

Quality. The foregoing prices are based on white or light-gray marble. Where darker colors are acceptable cut 25¢ per cu ft from prices.

Hauling. Average cost in cities, from $1.50 to $1.75 per ton. It may be as low as 40¢ in some sections with a short haul and as high as $3 in others.

Setting. At 1923 rates, from 60¢ to 65¢ per cu ft. Cleaning and pointing, 6¢ to 10¢ per sq ft.

Exterior. All of the foregoing is for exterior work.

Floor Tile. From 6″×6″ to 8″×12⅞″, 30¢ to 35¢ per sq ft at Nelson, Ga., where figures are based; 1¼ in, 40¢ to 45¢; 1½ in, 50¢ to 55¢. For larger sizes, 8″×16″ to 12″×24″, 32¢ to 36¢ per sq ft; 1¼ in, 42¢ to 46¢; 1½ in, 53¢ to 56¢. Selected white tile, 10 per cent extra. Crating tile, 3¢ per sq ft. All tile sawed and rubbed finish.

Stair Treads and Platforms. Light Cherokee, gray Cherokee or Creole, 1¼ in, 60¢ to 65¢ per sq ft; 1½ in, 80¢ to 85¢; 1¾ in to 2 in, $1.00 to $1.10. White Georgia, same thicknesses, 68¢ to 75¢, 85¢ to 95¢, $1.10 to $1.20. Lengths over 8 ft add 10 per cent; platforms with more than 20 sq ft add 6¢ per sq ft. O. G. mold on 1¼ in, 14¢ per lin ft; on other thicknesses, 24¢.

Wainscoting Slabs, etc., Polished One Face per Square Foot

Description	⅞″	1″	1⅛″–1¼″	1½″	1¾″–2″
Light Cherokee....	$0.70	$0.80	$0.95	$1.10	$1.30
Gray Cherokee....	.70	.80	.95	1.10	1.30
Creole.....	.70	.80	.95	1.10	1.30
Mezzotint.....	.68	.76	.91	1.05	1.25
White Georgia....	.77	.87	1.03	1.20	1.43
Pink Georgia.....	.87	.94	1.12	1.30	1.56

For two faces polished add 20¢ to 25¢ per sq ft. For slabs over 8 ft ong and 4 ft 6 in wide add 6¢ per sq ft for each 1 ft in length and

6 in in width. Sand-finished material, 10¢ per sq ft less than polished.

Weight Boxed. $\frac{7}{8}$ in, 15 lbs per sq ft; 1 in, 16; $1\frac{1}{8}$ in, 18; $1\frac{1}{4}$ in, 20; $1\frac{1}{2}$ in, 24; 2 in, 32; cu ft, 192. From 30,000 to 40,000 lbs make up a carload.

Hauling. Interior boxed marble usually costs $1.00 to $1.50 per ton.

Approximate. Add to cost of material at Nelson, Ga., freight charges and 30¢ to 40¢ per sq ft for all floor and slab work, and compute all base and other strips less than 12 in wide at same price per linear foot.

Profit is included in the foregoing marble prices, as also in the columns following. Fluted sand rubbed or axed columns, priced per cubic foot: Columns 14 in to 18 in in diameter, $7.00; 19 in to 24 in, $5.75; 25 in to 30 in, $5.00; 31 in to 36 in, $4.50; 37 in and up, $4.00. For shafts not over 12 ft long; from 12 ft to 15 ft, 50¢ per cu ft extra; 15 ft to 20 ft, $1.00 per cu ft extra; 20 ft to 25 ft, $1.50 per cu ft extra. The cost of plain columns without fluting would run from 75¢ to $2.00 per cu ft less. The larger the column the lower the cubic-foot cost for fluting. (The Georgia figures end here.)

Tennessee marble wainscoting on walls, complete, $1.20 per sq ft; on floors, 85¢.

Vermont marble on walls complete, $1.85.

Glens Falls, not installed, $1.65.

Verde Antique, not installed, $1.80.

Italian, on walls complete, $1.85. Sienna, $3.50.

Mexican Onyx, $2.75 per sq ft at San Diego, Calif.

All of the foregoing prices are per square foot.

Actual Data. The following figures are from work done as a comparison between machine and hand labor. They are reliable and useful.

Column. Cutting marble column, 15 ft 9 in long; diameter at base, 26 in; at top, 22 in; hand, 388 hours; machine, 321.

Cornice. Marble, 11 in, O. G., double fillet, quarter round section, 20 ft long; hand, 106 hours; machine, 31 hours.

Cap. Wainscoting, fillet and O. G., 112 lin ft; hand, 244 hours; machine, 59 hours.

Groove. Flashing, $\frac{3}{8}'' \times 1''$, 100 lin ft; hand, 134 hours; machine, 22 hours.

Slabs. Sawing, $8' 4'' \times 1''$, 25 in all; hand, 6,000 hours; machine, 11 hours.

Urn. Cutting, 24 in, 10 in, 5 in; hand, 83 hours; machine, 8 hours.

Quarrying. 216 cu ft; hand, 400 hours; machine, 78 hours.

Mortar. Allow as for Indiana stone.

A Few Combinations. An examination of the character of the work must be made, and time and wage to suit the requirements taken from the tables.

(1) Basement wall of rubble, finished two faces, 20 in thick. The total number of cubic yards are measured and multiplied by the unit cost of one, without profit. For this kind of work the .4 column of Table 1 is taken. Assuming wages to be at 90¢ and 45¢, the labor comes to $3.38. For 1 cu yd allow 35 cu ft of stone at, say, 15¢ = $5.25. Mortar, $2.60. Total, $11.23. As shown in the Material part of this chapter the mortar allowance may be cut to lime, and both lowered if the extra for mixing is cut out. The local rates may be lower than those given.

(2) Heavy basement rubble, double-faced, 24 in to 28 in, use .6 to .8 column in Table 2. Using 7 as an average, and assuming wages to have been $1.10 and 55¢, the rate per cu yd is $2.76. Setting the 35 cu ft of quarry stone at 12¢ per foot equals $4.20; mortar, $1.88, taking the lowest figure, equals $8.84. If the laborers' wage was at rate of 60¢ instead of 55¢, add the 11¢ at bottom of .7 column equals $8.95.

(3) On high, double-faced work with 20-in to 24-in walls and with power derrick a rate shown in column .6, or 4.8 cu yds per 8 hours, might be done on straight work. Setting wages at $1 and 50¢, the labor is $5; stone, say, $4.20; mortar, $2.32 equals $11.52 per cubic yard.

(4) Ashlar in Table 4. Setting labor at 18 sq ft per hour for hand derrick and wages at 85¢ and 42½¢, the rate is 12¢ per square foot. For plastering and setting mortar the rate given is 48¢; the material delivered at job may be $1.20 per cubic foot, or 60¢ for ashlar at 6 in thick, in all equals $1.20 without any backing, which is figured usually as brick, and according to rules laid down in the Brickwork chapter.

(5) For solid stone walls, except for a thinner backing than is used with ordinary ashlar Table 5 is used. Assuming a 12-in average thickness, instead of 6-in, as with common ashlar, each square foot of wall has 1 cu ft of stone at, say, $1.40 for plain work. The rich mortar for laying 6 in wide came to 24¢, and as this same material is to be twice as wide, and the first course of brick is also supposed to have it, at least 48¢ is required. Plastering the back of all stones as before, 24¢ equals 72¢ for mortar. Taking column 20, and with wages based on $1.30 and 65¢, the labor per cubic foot is 26¢, making a total of $2.38 without any backing per square foot or cubic foot in this case.

Heavy cut stone or long slabs of marble or granite can be set at the 32 rate given in Table 5, and even that might be exceeded.

(6) **Table 8.** Floor tile 8″×12″×$\frac{7}{8}$″, 35¢ per square foot for material, and freight to be allowed from point of purchase at marble works; for labor in small rooms and angles use column 6 sq ft per hour and wages $1.20 and 60¢, equals 30¢ per square foot; mortar, 2¢ equals 67¢ per square foot without freight or profit.

For $\frac{1}{2}$ in of cement mortar at a proportion of 1 cement to 2 sand allow 4.6 bbls cement and 1.3 cu yds sand to cover 900 sq ft. Cement at $3 equals $13.80; sand at $2.50 equals $3.25; and allow for labor mixing, $1 equals a total of $18.05 divided by 900 equals 2¢ per square foot.

The last line in all tables is an allowance for each 5¢ of difference in wages for laborer, as compared with column 2.

CHAPTER VI

BRICKWORK

In the chapter on Measurement the method of finding the actual number of brick in any wall is given. This being found and multiplied by the price per 1,000, the mortar and labor added, and profit in the summary, the matter is finished. The labor is the hardest part to settle, but sufficient illustrations are given of various kinds of work from 30 brick laid per hour to 390 to make sure that serious errors will not be made.

Molded Brick. A difficult part of an estimate is to get the cost of these, especially when too many have been used. A catalog at hand has 130 pages of molded shapes. Just a few hints may be given here for ordinary work:

Arch Brick. Each piece is counted as a brick. For grinding to the wedge shape required allow 10¢ each for plain and 15¢ for special brick. This means the lower edges are not molded, and is in addition to the regular cost of the brick. Quite frequently masons cut their own arch brick. This price is for the flat-top arches and for red brick; other colors are about 10 to 15 per cent extra.

If in addition to the wedge shape the brick have to be ground to go around a segmental shape or a circle, as in a tower or bay, double the prices.

The semi-circular or segmental arches are cheaper than the flat top; deduct about 40 per cent.

For brick with beads, coves, and plain molded edges the relation of the kinds runs about thus: stretcher, or common brick, at $60 means a header, or "end-on," at $50, and a return, or corner, at $100. If the stretcher should be $70 the header would be about $60 and the return $110. This for an approximate idea of relative cost per 1,000.

For a brick with the corner cut off at an angle of 45 degrees and about 2½ in back allow $65 per 1,000; returns, 75¢ each. Allow the same for one with a cove in the corner.

For brick with bull-nosed corner to run up jambs allow $65 per 1,000; starter and binder, $110 per 1,000.

The shapes are so many that only a regular catalog can take

them all in. As an approximate idea of cost: get the price per 1,000 of the ordinary brick of the same kind, and add from $20 to $30 extra per 1,000 for molded shapes, with more for headers, returns, and starters. The molded brick must, of course, be of the same kind or texture as the rest of the wall for ordinary work.

Face Brick, Common. For red allow $35 per 1,000 at 1923 rates, and $30 for streaked of the same kind.

For the rustic face brick, so much used in modern fronts, set a price of $34, $36, $38. These prices will suit almost any of the Hy-Tex varieties, or Rustico bricks.

A new brick is the Hy-Tex "Oak Bark," sold at $40 and $41 per 1,000. It is green, purple, brown, or autumn shade.

From the prices given there is a wide range up to the "Equitable" brick on the face of the great New York building. This costs $133 per 1,000 for headers and stretchers, $143 for quoins or corners, bullnose, $163, and double headers, $193. It is thus easily seen that a price to suit the face brick must be found before a valuation is made, but generally speaking $40 to $50 is safe.

Enameled brick are sold at the same price as the "Equitable" light gray.

Remarks on Tables

Original Cost. In valuations this has often to be set forth. The rates for labor vary in different parts of this continent, and at different periods, as pre-war and war times have shown. To arrange for this and make the tables perfect for any rate, the range is from 50¢ per hour for a mason to $1.40; and for a tender from 25¢ to 70¢. As a fair approximate the wages of the one are half of those of the other.

But with some classes of work one tender can serve two masons, while at the heaviest basement walls with brick going down at a fast rate three tenders may be required for two. This variation is arranged for the different classes of work in column 3. This column starts out "1 with $\frac{1}{2}$," which means one tender to two masons. Table 2 gives 1 with $\frac{3}{4}$, or 3 tenders to 4 masons. Tables 3 and 4 give man to man, and 5 and 6 show $1\frac{1}{4}$ laborers to 1 mason. The heaviest work in Table 7 is based on 3 tenders to 2 masons.

Under this tabulated presentation any rate at any place or period can be found, and original cost based upon it. Suppose it is decided upon an examination that a certain building, or part of any building, has been laid up at the rate of 150 brick per hour, or 1,200 in an 8-hour day, and that it is found the rate of wages was 90¢ and 45¢ per hour, the labor cost per 1,000 actual brick

in wall, without mortar, sand, or profit is $9. But if laid up in war times at the wage of $1.40 and 70¢ the unit would be $14.

With the highest wages and the lowest number of brick laid per hour, as on mantel facings and ornamental panels, the cost of labor alone is $58.34 per 1,000 brick; with the lowest wages and the greatest number laid per hour, as on heavy basement walls, the labor is only $2.26. And the number given, 390 per hour, is sometimes exceeded. It is seen that the high wage rate alone, apart from the number laid, is nearly three times as much as the low all through column 3, and before any valuation can be made this rate must be at least approximately found.

Number Laid. The smallest number is 30 and the largest 390, or 13 times as many. Tables 1 and 2 are arranged on a difference of 5 brick per hour, as these are for the higher-priced work; and the other tables on heavier work are set at 10, or 40 and 80 in an 8-hour day.

To set the number for valuation an examination of the building, or part of the building, should be had, and a comparison made with the allowance for various classes of work given in this chapter. Even the experts do not always agree.

Mortar. So far as the tables go, it does not matter which kind is used, as any number per hour can be set and cost per 1,000 arranged to suit. But fewer per hour would be allowed for pure cement mortar than for lime, and brick in lime alone are easier laid than in cement mixed with a proportion of the former. Brick laid in lime mortar merely "tempered" with cement are about as easily handled as when pure lime only is used.

Approximately, an allowance being set for lime mortar, deduct 10 per cent of number laid if pure cement mortar is used; 6 per cent for half and half and 3 per cent for tempered work.

If a wall is slushed or grouted in the usual way with pure cement mortar deduct 20 per cent of number per hour from the allowance. But unless original specifications are to be had a valuator can only make a fair guess at the mortar.

Proportions. The cement and lime mortars are given at various proportions, and where there are no specifications the valuator can choose to suit himself. If half and half cement and lime are specified, the allowances to suit can be added from each and divided by two. Thus, for a $\frac{1}{2}$-in joint, 1 to $2\frac{1}{2}$, cement at $2 and lime at $1.80 equals $3.26 and $2.03 equals $5.29 divided by 2 equals $2.65. Cement might be at $3 equals $4.89, and lime at $2.40 equals $2.70 equals $7.59 divided by two equals $3.80 per 1,000 brick.

As for the tempered work, the lime figures should be taken and from 5 to 7 per cent added.

There are several factors that make all nice calculations for

mortar of small account: (1) Rate of profit on entire building after net cost is found, as far as that may be done: this rate may be 6 per cent or 10. On a $100,000 contract the one is $6,000 and the other $10,000. (2) The rate of depreciation which may make a difference much larger than the profit item. (3) The fact that the bids of experienced contractors often vary from 1 per cent to 20. (4) The thermometer which causes a difference of 15 per cent on the labor cost at different seasons. Professor Daniels added nearly 50 per cent to a physical valuation for "going concern, etc." Why waste time on small items? On a $3,000,000 technical high school in Omaha the bids varied 14 per cent in the end of 1921; on another high school let in the end of 1922 the variation on $800,000 was 11 per cent.

Mortar Color is to be added to the other totals when used, without deduction for lime paste displaced. Whatever gain is made in this way is more than lost through extra work of mixing and laying.

Sand. The figures should be accepted without quibbling. The lowest price is 40¢ per cubic yard. Some railroads used to allow 15¢. During the war the price of sand delivered to contractors ran to more than $3 per ton in some cities. On a basis of 100 lbs per cu ft this is $4.05 per cubic yard. But allowances for mortar have to be made by volume and not by weight. Sand runs from 90 to 140 lbs per cu ft, but a 1 to 3 allowance, or any other, means volume.

Combinations

The tables are made out in detail, so that any combination can be arranged. The labor tables take in that item only, but include the mixing of the mortars of all kinds. Any local price of brick can be used. Water is not included as local prices vary. Add from 5¢ to 10¢ per 1,000 brick.

Building No. 1

1,000 common brick delivered to site	$ 6.50
220 per hour at 50¢ and 25¢ wages	3.73
Lime mortar, ½-in joint, 1 to 2½ mix, $1.60 rate	1.80
Sand, $1 rate	0.63
Net cost	$12.66

Building No. 2

1,000 common brick delivered to site	$18.00
270 per hour at $1.40 and 70¢	8.45
Cement mortar, 1 to 2, $\frac{5}{8}$-in joint, $2.80 rate	6.53
Sand, $2.60 rate	1.95
Total net cost	$34.93

Building No. 3. Face Brick

1,000 face brick delivered to site	$65.00
100 per hour at $1.50 and $0.75 wages	22.50
Lime mortar, $\frac{1}{4}$-in joint, 1 to 2 mix, $3 rate	1.98
Sand, $3 rate	0.90
Mortar color, moss green	4.80
Total net cost	$95.18

Building No. 3. Common Brick

1,000 brick delivered	$15.00
300 per hour, backing and walls, $1.50 and $0.75	8.13
Lime mortar, $\frac{5}{8}$-in joint, 1 to 3, $3 rate	3.64
Sand, $3 rate	2.50
Total net cost	$29.27

Building No. 3. Ornamental Paneling

1,000 face brick delivered	$100.00
30 per hour at $1.50 and $0.75 wages	62.67
Lime mortar, $\frac{1}{4}$-in joint, 1 to 2 mix, $3.00 rate	1.98
Sand, $3 rate	0.90
Total net cost	$165.55

No mortar color allowed except in No. 3. The joints are put at $\frac{1}{4}$ in even for pressed brick, and this is the smallest that should be used. There is no reason why common brick should have joints less than $\frac{1}{2}$ in. When tapestry joints run to 1 in and more it is evident that the $\frac{1}{8}$ in face brick and $\frac{3}{8}$ in common brick only waste time and add nothing to value.

Any allowance of mortar can be had by dividing or doubling. Half the $\frac{1}{4}$ in suits $\frac{1}{8}$ in, and twice the $\frac{1}{2}$ in makes 1 in.

The Common Brick Manufacturers' Association says: "The habit of making the mortar joint as fine as possible has happily passed, and the wide joint has been again restored to the prestige it commanded in ages past. It should always be made wide enough to be seen, even at a distance."

Labor of Face Brick. The Face Brick Association cuts show seven styles of ordinary front work, but there are many modifications possible. As a general statement, 1 man with $\frac{3}{4}$ time of 1 tender will lay from 50 to 90 brick per hour. On such work as the two Hy-Tex patterns allowed at 360 and 400 per 8 hours four experienced St. Louis brick contractors allowed from 300 to 500 in 8 hours for 1 bricklayer. This shows at once that practical men, estimating unknown to each other, will not come near "par," but the average came to 400, or 50 per hour. One laborer would be required for 2 masons.

If Portland cement mortar is used for face work the following figures should be cut about 15 per cent; and the same deduction should be made for raking out and making "fancy" joints. Lime mortar is assumed.

Running Bond. In favorable weather and conditions allow 90 to 100 per hour for 1 mason and 1 tender; in hot or frosty weather, from 75 to 85. In the finer classes of work these figures should be cut 10 per cent. In veneering on wood or concrete, 80 to 90 in the first case and 70 to 80 in bad weather. This veneering is usually done in such an unsatisfactory way that the building codes should forbid it unless a better system of ties is used.

English Bond. From 75 to 80 per hour in good weather for 1 mason and 1 laborer. This figure might be cut to 50 or 60 around pilasters and panels, which shows how impossible it is to set a number to suit all conditions.

Common Bond. The stretcher bond is not used now in good construction, but the common gives the same pattern with headers every sixth or seventh course. A superior wall is obtained. Allow 80 to 90 brick per hour for 1 and 1 under the best conditions.

Four of a Kind. For Dutch, Garden Wall, Header, and Flemish set 70 to 80 per hour for 1 mason and $\frac{3}{4}$ tender time. With the commonest kind of work and favorable conditions even more might be laid up, while with the finest work, bad weather, and pilaster trouble the number set might be cut in half.

The question an appraiser often has to ask himself is, "Approximately, what percentage of the total does this item I am valuing run to? And if I figure too low or too high what percentage will the difference between my figures and 'par' amount to?" The

Hy-Tex Cuts, Figs. 31–35.

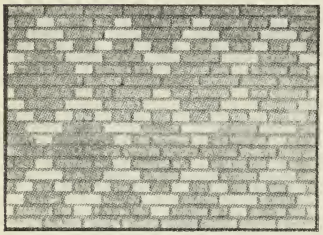


FIG. 31.—For such patterns allow 45 brick laid in 1 hour by 1 bricklayer and ½ tender =1 tender to 2 masons.

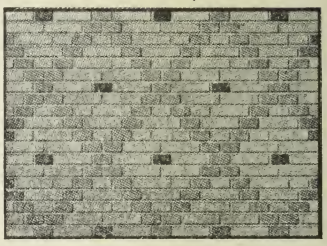


FIG. 32.—For such patterns allow 50 laid in 1 hour by 1 and ½.

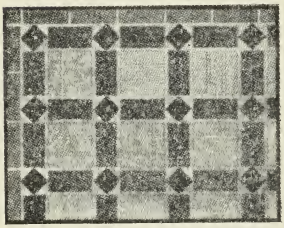


FIG. 33.—Panel: Allow 40 in 1 hour by 1 and ½.

FIG. 34.—Allow 60 in 1 hour by 1 and ½.

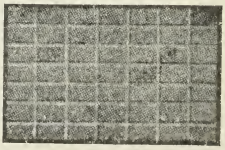


FIG. 35.—Allow 65 in 1 hour by 1 and ½

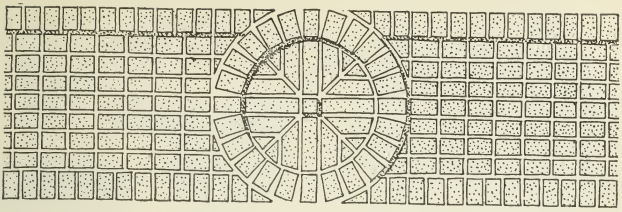


Fig. 36.—Circular part 20 per hour: sides 55 per hour by 1 and $\frac{1}{2}$.

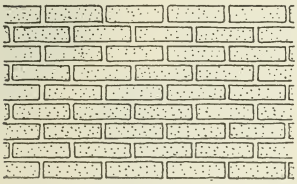


Fig. 37.—Running or stretcher.

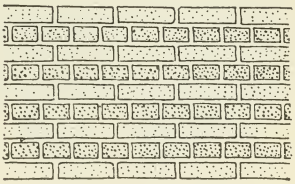


Fig. 38.—English.

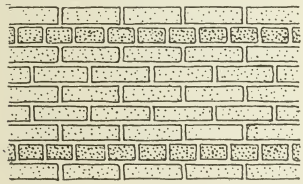


Fig. 39.—Common.

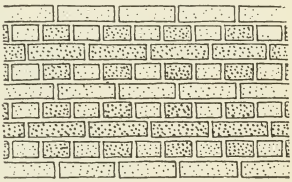


Fig. 40.—English Cross or Dutch.

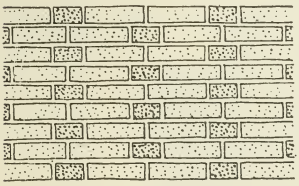


Fig. 41.—Garden wall.

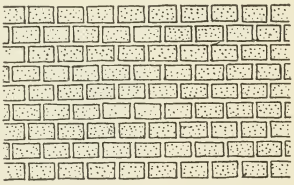
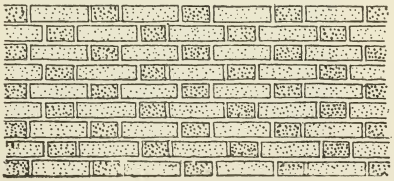
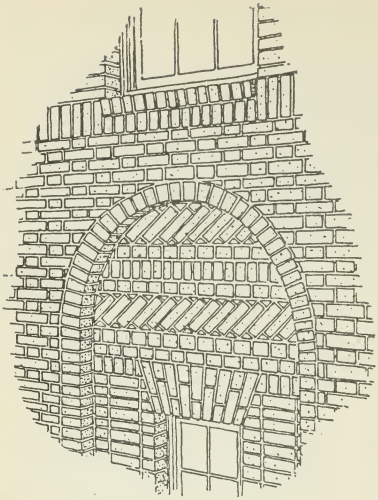


Fig. 42.—Header.



A·F·B·A
USE FACE BRICK
—it Pays

Fig. 43.—Flemish.



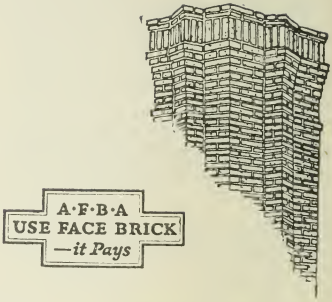


Fig. 44.—Allow 30 per hour, face work on inside of arch, on arch and trimming. Plain work 70, all for 1 and ½.

Fig. 45.—Allow 30 per hour for face and backing, 1 and ½.

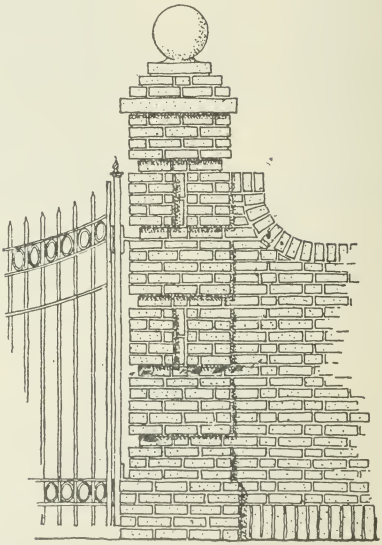


Fig. 46.—Allow for column and curve 40 per hour, both face and filling. Wall, 80, face alone. Both 1 and ½.

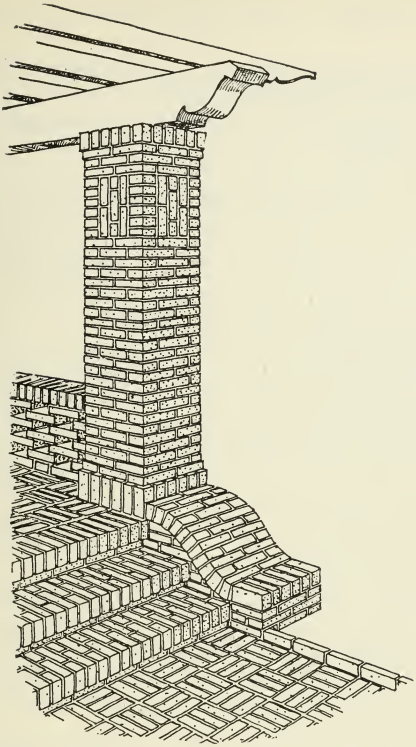


Fig. 47.—Allow for column and curve, face and filling, 60 per hour; balustrade, open work, 35, all for 1 and ½; paving 200 per hour for 1 and 2.

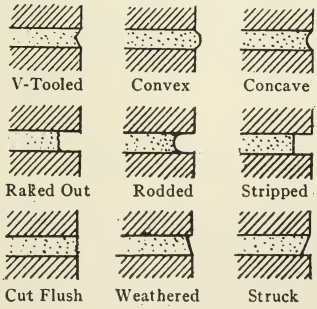


Fig. 48.—Mortar joints.

said "par" is hard to define. On a courthouse costing about $850,000 bids ran from 5 per cent to 30 more than the successful one. Why should several valuations come close together any more than the bids?

LABOR ON COMMON BRICKWORK

Class of work	Number laid per hour	Mason	Tender
Heaviest, plainest, thick basement walls, cement and lime	360 to 390	1	$1\frac{1}{2}$
Same with cement mortar only	340 to 360	1	$1\frac{1}{2}$
Grouted work as above	300 to 330	1	$1\frac{1}{4}$
Shoved work on cement and lime as above	280 to 300	1	$1\frac{1}{4}$
Heavy engineering work and large piers in cement	280 to 300	1	$1\frac{1}{4}$
Warehouse work above grade in cement mortar, 24-in walls, plain work	220 to 240	1	$1\frac{1}{4}$
Same in lime and cement	240 to 270	1	$1\frac{1}{4}$
Warehouse walls as above, 20 in and 16 in, upper stories, cement	180 to 220	1	$1\frac{1}{4}$
Same in lime and cement mortar	210 to 230	1	$1\frac{1}{4}$
One-story buildings, 12-in walls, cement	160 to 210	1	1
Same in lime mortar	190 to 240	1	1
Stores and flats, lime and cement	160 to 220	1	1
Railroad shop and manufacturing buildings, high walls, cement and lime	140 to 170	1	1
Dwellings, two-story and basement, 13-in and 9-in walls	100 to 120	1	1
Small passenger stations	80 to 90	1	1
Ordinary chimney stacks under 100 ft	90 to 100	1	1
Large and heavy chimney stacks under 150 ft	80 to 100	1	1
Boiler work	120 to 140	1	1

Labor Tables

The following tables are made out for all possible rates of wages from 50¢ per hour for bricklayer to $1.40; and 25¢ to 70¢ for tender. As number laid is also listed from 30 per hour on some classes of work, and through all classes at various numbers per hour clear up to 390, the tables are permanent. Practically everything connected with brickwork comes inside of wage and number limits as given.

Provision is made here, as in all tables, for a higher rate of wages to laborers. Any wage is found for tradesmen in the column, but laborers may have more than half. Rule: for each 5¢ difference per hour add or deduct amount given at bottom of table. In Table 1, at 60 brick per hour, the cost per 1,000 at 50¢ and 25¢ is $10.50; if laborers receive 30¢ instead of 25¢ while masons received the 50¢, an addition of 41¢ has to be made.

Hoisting. Buildings of two to four stories are usually put up with a brick hoist, sometimes in country towns operated by a horse, but oftener by a gasoline engine. High buildings have the regular hoisting engine. In neither case would power be used unless to save laborers' wages. As the stories go higher, the cost of labor increases a little, and the engineer's time, coupled with his machine, does away with the necessity of getting more laborers. In such cases where hoisting is necessary add to the total labor figures, as given in column 3, from 6 to 7 per cent. Quite frequently in two-story buildings a sloping runway is used; and even where a gasoline engine does the work a man at ordinary laborer's wages often attends to it, and extra hoisting time is not required.

Cost per 1000. In Table 1, col. 3, the wage of 1 bricklayer is taken and ½ the wage of a laborer. On a basis of 30 brick laid per hour at 50¢ and 25¢, the cost per 1000 is $21. In Table 4, at $1.40 and 70¢, 1 mason and 1 laborer laying 210 per hour the cost per 1000 is $10. If the laborer got 75¢ instead of 70¢ add 23¢ = $10.23; if 65¢ is the rate instead of 70¢ deduct 23¢ = $9.77. All through this book the Tables are arranged in this manner.

LABOR COST TABLES PER 1000 BRICK

TABLE 1

LABOR PER 1,000 ON BRICK LAID IN WALL

Rate per hour for mason	Rate per hour for laborer	Rate per hour for 1 with ½	Number of brick laid per hour						
			30	35	40	45	50	55	60
$0.50	0.25	0.63	21.00	18.00	15.75	14.00	12.60	11.46	10.50
.60	.30	.75	25.00	21.43	18.75	16.67	15.00	13.64	12.50
.70	.35	.88	29.34	25.15	22.00	19.56	17.60	16.00	14.67
.80	.40	1.00	33.34	28.57	25.00	22.23	20.00	18.18	16.67
.90	.45	1.13	37.67	32.29	28.25	25.11	22.60	20.55	18.83
1.00	.50	1.25	41.67	35.72	31.25	27.78	25.00	22.73	20.83
1.10	.55	1.38	46.00	39.43	34.50	30.67	27.60	25.10	23.00
1.20	.60	1.50	50.00	42.86	37.50	33.34	30.00	27.28	25.00
1.40	.70	1.75	58.34	50.00	43.75	38.89	35.00	31.82	29.16
For ea. 5¢ diff. in Col. 2			83¢	73¢	63¢	56¢	50¢	45¢	41¢

TABLE 2

LABOR PER 1,000 ON BRICK LAID IN WALL

Rate per hour for mason	Rate per hour for laborer	Rate per hour for 1 with ¾	Number of brick laid per hour						
			65	70	75	80	85	90	95
$0.50	0.25	0.69	10.62	9.86	9.20	8.63	8.12	7.67	7.27
.60	.30	.83	12.77	11.86	11.07	10.38	9.77	9.22	8.74
.70	.35	.96	14.77	13.72	12.80	12.00	11.30	10.67	10.11
.80	.40	1.10	16.93	15.72	14.67	13.75	12.94	12.22	11.58
.90	.45	1.24	19.08	17.72	16.53	15.50	14.59	13.78	13.06
1.00	.50	1.38	21.23	19.72	18.40	17.25	16.24	15.34	14.53
1.10	.55	1.52	23.39	21.72	20.27	19.00	17.88	16.89	16.00
1.20	.60	1.65	25.39	23.57	22.00	20.63	19.41	18.34	17.37
1.40	.70	1.93	29.70	27.57	25.74	24.13	22.71	21.44	20.32
For ea. 5¢ diff. in Col. 2			58¢	53¢	49¢	46¢	44¢	42¢	40¢

TABLE 3

Labor per 1,000 on Brick Laid in Wall

Rate per hour for mason	Rate per hour for laborer	Rate per hour for 1 with 1	Number of brick laid per hour					
			100	110	120	130	140	150
$0.50	0.25	0.75	7.50	6.82	6.25	5.77	5.36	5.00
.60	.30	.90	9.00	8.18	7.50	6.93	6.43	6.00
.70	.35	1.05	10.50	9.55	8.75	8.08	7.50	7.00
.80	.40	1.20	12.00	10.91	10.00	9.23	8.57	8.00
.90	.45	1.35	13.50	12.28	11.25	10.39	9.64	9.00
1.00	.50	1.50	15.00	13.64	12.50	11.54	10.72	10.00
1.10	.55	1.65	16.50	15.00	13.75	12.69	11.79	11.00
1.20	.60	1.80	18.00	16.37	15.00	13.85	12.86	12.00
1.40	.70	2.10	21.00	19.09	17.50	16.16	15.00	14.00
For ea. 5¢ diff. in Col. 2			50¢	45¢	42¢	38¢	35¢	33¢

TABLE 4

Labor per 1,000 on Brick Laid in Wall

Rate per hour for mason	Rate per hour for laborer	Rate per hour for 1 with 1	Number of brick laid per hour					
			160	170	180	190	200	210
$0.50	0.25	0.75	4.69	4.41	4.17	3.95	3.75	3.57
.60	.30	.90	5.63	5.30	5.00	4.74	4.50	4.29
.70	.35	1.05	6.56	6.18	5.84	5.53	5.25	5.00
.80	.40	1.20	7.50	7.06	6.67	6.32	6.00	5.72
.90	.45	1.35	8.44	7.94	7.50	7.11	6.75	6.43
1.00	.50	1.50	9.38	8.83	8.34	7.90	7.50	7.15
1.10	.55	1.65	10.31	9.71	9.17	8.69	8.25	7.86
1.20	.60	1.80	11.25	10.59	10.00	9.48	9.00	8.57
1.40	.70	2.10	13.13	12.35	11.67	11.05	10.50	10.00
For ea. 5¢ diff. in Col. 2			31¢	29¢	27¢	26¢	25¢	23¢

TABLE 5

Labor per 1,000 on Brick Laid in Wall

Rate per hour for mason	Rate per hour for laborer	Rate per hour for 1 with 1¼	Number of brick laid per hour					
			220	230	240	250	260	270
$0.50	0.25	0.82	3.73	3.57	3.42	3.28	3.16	3.04
.60	.30	.98	4.46	4.26	4.09	3.92	3.77	3.63
.70	.35	1.14	5.18	4.96	4.75	4.56	4.39	4.22
.80	.40	1.30	5.91	5.65	5.42	5.20	5.00	4.82
.90	.45	1.47	6.68	6.39	6.13	5.88	5.66	5.45
1.00	.50	1.63	7.41	7.09	6.79	6.52	6.27	6.04
1.10	.55	1.79	8.14	7.78	7.46	7.16	6.89	6.63
1.20	.60	1.95	8.87	8.48	8.13	7.80	7.50	7.23
1.40	.70	2.28	10.37	9.92	9.50	9.12	8.77	8.45
For ea. 5¢ diff. in Col. 2			28¢	27¢	26¢	25¢	24¢	23¢

TABLE 6

Labor per 1,000 on Brick Laid in Wall

Rate per hour for mason	Rate per hour for laborer	Rate per hour for 1 with 1¼	Number of brick laid per hour					
			280	290	300	310	320	330
$0.50	0.25	0.82	2.93	2.83	2.73	2.65	2.56	2.49
.60	.30	.98	3.50	3.38	3.27	3.16	3.06	2.97
.70	.35	1.14	4.08	3.93	3.80	3.68	3.56	3.46
.80	.40	1.30	4.65	4.48	4.34	4.20	4.07	3.94
.90	.45	1.47	5.25	5.07	4.90	4.75	4.60	4.46
1.00	.50	1.63	5.83	5.62	5.43	5.26	5.10	4.94
1.10	.55	1.79	6.40	6.17	5.97	5.78	5.60	5.43
1.20	.60	1.95	6.97	6.73	6.50	6.29	6.10	5.91
1.40	.70	2.28	8.15	7.86	7.60	7.36	7.13	6.91
For ea. 5¢ diff. in Col. 2			23¢	22¢	21¢	20¢	20¢	19¢

TABLE 7

LABOR PER 1,000 ON BRICK LAID IN WALL

Rate per hour for mason	Rate per hour for laborer	Rate per hour for 1 with 1½	Number of brick laid per hour					
			340	350	360	370	380	390
$0.50	0.25	0.88	2.59	2.52	2.45	2.38	2.32	2.26
.60	.30	1.05	3.09	3.00	2.92	2.84	2.77	2.71
.70	.35	1.23	3.62	3.52	3.42	3.33	3.24	3.16
.80	.40	1.40	4.12	4.00	3.89	3.79	3.69	3.59
.90	.45	1.58	4.65	4.52	4.39	4.27	4.16	4.05
1.00	.50	1.75	5.15	5.00	4.86	4.73	4.61	4.49
1.10	.55	1.93	5.68	5.52	5.36	5.22	5.08	4.95
1.20	.60	2.10	6.18	6.00	5.84	5.68	5.53	5.39
1.40	.70	2.45	7.21	7.00	6.81	6.62	6.45	6.28
For ea. 5¢ diff. in Col. 2			22¢	21¢	20¢	20¢	19¢	19¢

MORTAR

Allowances for mortar per 1,000 brick. Portland cement only. All allowances based on $1\frac{3}{4}$ bbls for $\frac{5}{8}$-in joint at a proportion of 1 part cement to 3 parts sand.

TABLE 8

NET COST PER 1,000 BRICK AT VARIOUS PRICES PER BARREL

1 part cement to 2 parts sand

Size of joint, inch	$1.00	1.20	1.40	1.60	1.80	2.00	2.20	2.40	2.60	2.80	3.00	3.20	3.40
$\frac{3}{8}$	1.40	1.68	1.96	2.24	2.52	2.80	3.08	3.36	3.64	3.92	4.20	4.48	4.76
$\frac{1}{2}$	1.87	2.25	2.62	3.00	3.37	3.74	4.12	4.49	4.86	5.24	5.61	5.99	6.36
$\frac{5}{8}$	2.33	2.80	3.26	3.73	4.20	4.66	5.13	5.60	6.06	6.53	6.99	7.46	7.92

1 part cement to $2\frac{1}{2}$ parts sand

$\frac{3}{8}$	1.22	1.47	1.71	1.95	2 20	2.44	2.69	2.93	3.17	3.42	3.66	3.91	4.15
$\frac{1}{2}$	1.63	1.96	2.28	2.61	2.94	3.26	3.59	3.91	4.24	4.57	4.89	5.22	5.54
$\frac{5}{8}$	2.04	2.45	2.86	3.27	3.67	4.08	4.49	4.90	5.31	5.71	6.12	6.53	6.94

1 part cement to 3 parts sand

$\frac{3}{8}$	1.05	1.26	1.47	1.68	1.89	2.10	2.31	2.52	2.73	2.94	3.15	3.36	3.57
$\frac{1}{2}$	1.40	1.68	1.96	2.24	2.52	2.80	3.08	3.36	3.64	3.92	4.20	4.48	4.76
$\frac{5}{8}$	1.75	2.10	2.45	2.80	3.15	3.50	3.85	4.20	4.55	4.90	5.25	5.60	5.95

Lime only: All allowances based on $1\frac{1}{8}$ bbl for $\frac{1}{2}$-in joint at a proportion of 1 part lime paste to $2\frac{1}{2}$ parts sand.

TABLE 9

Net Cost per 1,000 Brick at Various Prices per Barrel

1 part lime paste to 2 parts sand

Size of joint, inch	$1.00	1.20	1.40	1.60	1.80	2.00	2.20	2.40	2.60	2.80	3.00	3.20	3.40
1/8	0.33	0.40	0.46	0.53	0.60	0.66	0.73	0.80	0.86	0.93	0.99	1.06	1.12
1/4	.66	.80	.92	1.05	1.19	1.32	1.45	1.59	1.71	1.85	1.98	2.12	2.24
3/8	.99	1.20	1.38	1.58	1.79	1.98	2.18	2.39	2.57	2.78	2.97	3.18	3.36
1/2	1.32	1.59	1.85	2.11	2.38	2.64	2.90	3.17	3.43	3.70	3.96	4.23	4.49
5/8	1.65	1.99	2.31	2.64	2.98	3.30	3.63	3.96	4.29	4.63	4.95	5.29	5.61

1 part lime paste to 2½ parts sand

1/8	$0.28	0.34	0.40	0.45	0.51	0.56	0.62	0.68	0.73	0.79	0.85	0.90	0.96
1/4	.56	.68	.79	.90	1.01	1.13	1.24	1.35	1.46	1.58	1.69	1.80	1.91
3/8	.84	1.02	1.19	1.35	1.52	1.69	1.86	2.03	2.19	2.37	2.54	2.70	2.87
1/2	1.13	1.35	1.58	1.80	2.03	2.25	2.48	2.70	2.93	3.15	3.38	3.60	3.83
5/8	1.41	1.69	1.98	2.25	2.54	2.81	3.10	3.38	3.66	3.94	4.23	4.50	4.79

1 part lime paste to 3 parts sand

1/8	$0.24	0.30	0.34	0.39	0.44	0.48	0.53	0.58	0.63	0.68	0.73	0.78	0.82
1/4	.49	.59	.68	.78	.88	.97	1.07	1.17	1.26	1.36	1.46	1.56	1.65
3/8	.73	.89	1.02	1.17	1.32	1.45	1.60	1.75	1.89	2.04	2.19	2.34	2.47
1/2	.97	1.17	1.36	1.55	1.75	1.94	2.14	2.33	2.52	2.72	2.91	3.11	3.30
5/8	1.21	1.46	1.70	1.94	2.19	2.43	2.68	2.91	3.15	3.40	3.64	3.89	4.13

SAND

Sand only: All allowances based on $\frac{5}{8}$ cu yd. For $\frac{1}{2}$-in joint at a proportion of $2\frac{1}{2}$ parts by volume to 1 part of lime paste.

TABLE 10

NET COST PER 1,000 BRICK AT VARIOUS PRICES PER CUBIC YARD

2 parts sand to 1 part paste

Size of joint, inch	$0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.20	2.40	2.60	3.00
$\frac{1}{4}$	$0.12	0.18	0.24	0.30	0.36	0.42	0.48	0.54	0.60	0.66	0.72	0.78	0.90
$\frac{3}{8}$	.18	.27	.36	.45	.54	.63	.72	81	.90	.99	1.08	1.17	1.35
$\frac{1}{2}$	.24	.36	.48	.60	.72	.84	.96	1.08	1.20	1.32	1.44	1.56	1.80
$\frac{5}{8}$	.30	.45	.60	.75	.90	1.05	1.20	1.35	1.50	1.65	1.80	1.95	2.25

$2\frac{1}{2}$ parts sand to 1 part paste

$\frac{1}{4}$	$0.13	0.19	0.25	0.32	0.38	0.44	0.50	0.57	0.63	0.69	0.75	0.82	0.94
$\frac{3}{8}$	.19	.29	.38	.48	.56	.66	.75	.85	.94	1.04	1.13	1.23	1.41
$\frac{1}{2}$	.25	.38	.50	.63	.75	.88	1.00	1.13	1.25	1.38	1.50	1.63	1.88
$\frac{5}{8}$	.32	.48	.63	.80	.94	1.10	1.25	1.42	1.57	1.73	1.88	2.05	2.35

3 parts sand to 1 part paste

$\frac{1}{4}$	$0.14	0.20	0.27	0.33	0.40	0.47	0.54	0.60	0.67	0.75	0.81	0.88	1.00
$\frac{3}{8}$	.20	.30	.40	.50	.60	.70	.81	.90	1.00	1.12	1.21	1.32	1.50
$\frac{1}{2}$	.27	.40	.54	.67	.80	.94	1.08	1.20	1.34	1.49	1.62	1.76	2.00
$\frac{5}{8}$	.34	.50	.68	.84	1.00	1.18	1.35	1.50	1.68	1.86	2.03	2.20	2.50

TABLE 11

MORTAR COLOR ONLY PER 1,000 BRICK

	Size of joint, inch	Pounds	Price per Pound	Cost per 1,000
Double strength black	$\frac{1}{4}$	40	$4\frac{1}{2}$¢	$1.80
" " "	$\frac{1}{2}$	80	$4\frac{1}{2}$	3.60
" " "	$\frac{5}{8}$	100	$4\frac{1}{2}$	4.50
Standard black	$\frac{1}{4}$	45	4	1.80
" "	$\frac{1}{2}$	90	4	3.60
" "	$\frac{5}{8}$	113	4	4.52
Chocolate D.S.	$\frac{3}{8}$	100	$3\frac{1}{2}$	3.50
Brown or buff	$\frac{1}{4}$	90	3	2.70
" "	$\frac{5}{8}$	225	3	6.75
Red	$\frac{1}{4}$	90	$2\frac{1}{2}$	2.25
"	$\frac{5}{8}$	225	$2\frac{1}{2}$	5.63
Toch pulp standards, N. Y.	$\frac{1}{4}$	70	3	2.10
" " " "	$\frac{5}{8}$	175	3	5.25
" Edinburgh black	$\frac{1}{4}$	50	$5\frac{1}{2}$	2.75
" " "	$\frac{3}{8}$	75	$5\frac{1}{2}$	4.13
" " "	$\frac{5}{8}$	125	$5\frac{1}{2}$	6.88
" olive or moss green	$\frac{1}{4}$	60	8	4.80
" " " " "	$\frac{3}{8}$	90	8	7.20
" " " " "	$\frac{5}{8}$	150	8	12.00

Number of Brick Required

The regular way of estimating brickwork is to take each wall according to its thickness, and not by the cubic foot unless in the case of 12 in thick; but the number for various thicknesses is easily found from the cubic foot table. Each square foot of a 12-in or 13-in wall has a cubic foot—the architects mark either 12 in or 13 in for one brick and a half wide, or three courses. If a 12-in has 18 brick on a square foot basis an 8-in or 9-in will have 12, a 16-in or 17-in 24, and so on for any thickness, allowing 6 to a course per square foot.

TABLE 12

Number of Common Brick to Cubic Foot

Size of brick inches	Size of joint		
	½″	⅜″	⅝″
2¼x8¼	18	19	17
2¼x7¾	19	20	18
2¼x8	18.5	19.5	17.5
2¼x8½	17.5	18.5	16.5
2¼x8¾	17	18	16
2⅜x7¾	18.3	19.3	17.3
2⅜x8	17.7	18.7	16.7
2⅜x8¼	17.3	18.3	16.3
2⅜x8½	16.7	17.7	15.7
2⅜x8¾	16.3	17.3	15.3
2½x7¾	17.5	18.5	16.5
2½x8	17	18	16
2½x8¼	16.5	17.5	15.5
2½x8½	16	17	15
2½x8¾	15.6	16.6	14.6
2⅝x7¾	16.7	17.7	15.7
2⅝x8	16.3	17.3	15.3
2⅝x8¼	15.8	16.8	14.8
2⅝x8½	15.4	16.4	14.4
2⅝x8¾	15	16	14
2¾x7¾	16	17	15
2¾x8	15.7	16.7	14.7
2¾x8¼	15.2	16.2	14.2
2¾x8½	14.7	15.7	13.7

Brick required for Cisterns, Cesspools and Circular Work at Size of 2¼″×3¾″×8.

Inside diam in ft	Single ring	Double ring	Floor on flat	Inside Diam in ft	Single ring	Double ring	Floor on flat
2	40	100	14	10	189	392	330
3	60	135	30	11	207	428	400
3½	68	150	41	12	226	466	475
4	77	168	53	13	245	505	557
4½	85	185	66	14	264	542	640
5	94	200	83	15	283	580	735
5½	104	220	100	16	302	618	844
6	113	240	120	17	320	655	953
6½	123	260	140	18	340	698	1,070
7	132	278	162	19	358	724	1,192
7½	141	296	186	20	377	768	1,320
8	151	316	211	22	415	843	1,600
8½	160	334	238	24	452	930	1,900
9	170	354	268	26	490	994	2,230
9½	180	373	298	28	528	1,070	2,586

Now, the United States reports of the Baltimore and San Francisco fires showed that whole fronts of pressed brick fell in the streets. There was no tie to the main wall. Ashlar is sometimes put on in the same way. It is possible to tie the latter so that it will stay "put," and this without anything appearing on the surface to show the method. Bond stones have been heard of and seen. So far as the brick are concerned the building laws of all cities ought to forbid the usual stretcher construction, and compel headers to be honestly shown about as far apart as in common brickwork. The tornadoes at Omaha, and elsewhere, showed the same results as the fires. Whole fronts of pressed brick were sucked into the streets. Metal ties, and angle cutting of stretchers are not strong enough.

The popular way of constructing large buildings is to have the main wall of reinforced concrete with a facing of brick. Here, again, the metal ties are strong enough except at the time extra strength is required. Every seventh course or so there might be a strip of expanded metal lath fastened before the concrete is poured, and extending out from 4″ to 5″. The lath is flexible, and even if it came in the center of the course could be bent flat on the bricks and built in clear along. Those who have seen the result of a tornado, or read of fire destruction know that the present method is worthless just at the very time it should be something else. It makes a camouflage front.

Perhaps in an ordinary header course in a fine front every alternate brick would be sufficient for binding. With expensive material this would mean that one brick would serve two spaces when cut. If some say this is not strong enough, what shall be said of the metal tie or angle cutting systems?

TABLE 13

NUMBER OF ORDINARY FACE BRICK REQUIRED FOR ONE SQ FT

Size of brick inches	Size of joints					
	⅛″	¼″	⅜″	½″	⅝″	¾″
2¼x8	7.5	7	6.5	6.2	5.8	5.5
2¼x8¼	7.2	6.8	6.3	6	5.6	5.3
1⅝x11⅝	7	6.5	6	5.6	5.3	5
2½x12	4.6	4.3	4	3.8	3.6	3.4
2⅜x8⅜	6.8	6.5	6	5.6	5.3	5
3½x8½	4.7	4.5	4.2	4	3.8	3.6
3x9	5	4.8	4.6	4.3	4.1	4

Before an estimator can tell how many brick to use he must know how this header question is arranged. Unless an inspector saw the wall laid each "header" course might really be made a "bat" course. It is an age of deceit in peace as in war.

Headers. These are the principal sizes for face work. If full header courses are used, an extra course must be allowed where required. If every sixth course is a full header it is clear that twice as many bricks are required in that course. For each six courses with full headers allow $\frac{1}{6}$ extra; seven, $\frac{1}{7}$; eight, $\frac{1}{8}$; nine, $\frac{1}{9}$. If alternate headers and bats are allowed, or less than full course in any way, cut the number to suit.

The standard size of common pressed brick is $2\frac{1}{4}\times8$ in, and the Roman size, $1\frac{5}{8}\times11\frac{5}{8}$. With $\frac{1}{4}$-in joints a fair average allowance between would be $6\frac{3}{4}$ brick to the square foot.

Mortar. A fair allowance for 1,000 brick with $\frac{1}{4}$-in joints is 8 cu ft. Other sized joints should be arranged on this basis. It should be noted, however, that wide joints require a coarser mortar.

The following table gives a large enough allowance for a brick of a smaller than the national size.

"With bricks $8\frac{1}{4}\times4\times2''$, the following are the quantities of mortar as compared with the whole mass, and the number of bricks required for a cubic yard of massive work:

TABLE 14

Size of joint in	Amount of mortar in mass	Number of bricks in cubic yard	Number of bricks in cubic foot
$\frac{1}{8}$	$\frac{1}{9}$	638	23.63
$\frac{1}{4}$	$\frac{1}{4}$	574	21.26
$\frac{3}{8}$	$\frac{3}{10}$	522	19.33
$\frac{1}{2}$	$\frac{1}{8}$	475	17.60
$\frac{5}{8}$	$\frac{4}{10}$	433	16.04

"From the foregoing the bricklayer can easily figure out how much mortar he will want for each 1,000 bricks laid, knowing the price of lime and cement, for often he may be called upon to lay his bricks in cement."

Materials

Portland Cement. A bag contains 94 lbs net, and a barrel has 4 bags = 376 lbs. Packed weight per cubic foot, $108\frac{1}{2}$ lbs; loose, 92.

Natural Cement. A bag contains 94 lbs net, and a barrel, 282 net. At the end of a year a mix of 1 and 1 of this is about equal to a 1 and 3 of Portland cement and sand.

Lime. A bushel has 75 to 85 lbs net. A cubic foot weighs 60 to 65 lbs. A 180-lb barrel contains about 3 cu ft. A 280-lb barrel contains about $4\frac{3}{4}$ cu ft. The 180-lb barrel is standard in the Common Brick Manufacturers' Association book. As a rough average, a 180-lb. barrel of good lime makes about 7.05 cu ft of putty.

Hydrated Lime. Per cubic foot 40 lbs. A paper package has 50 lbs. net. A cloth, 100 lbs. The 50-lb bag makes about 1.14 cu ft of paste.

Sand. About 100 lbs to cubic foot.

Number of Bricks Required for Piers per Foot of Height

Sizes. The smallest pier that should be allowed in a city should not be less than 13×13, or 12×12, as some codes have it. Only a few brick more are required as compared with the 9×9, which is too small.

The size of bricks differs, and the mortar joints are not the same. On measuring some at hand of the national size of $2\frac{1}{4}$ it was found that with rough joints there were 4 to the foot in height. With very small brick and joints there might be 5, although this is seldom seen. The table is made out for five different sizes, and about 4 per cent allowed for waste.

TABLE 15

Solid Brick Pier Table per Foot High

Size, inches	4 to 12″	4¼ to 12″	4½ to 12″	4¾ to 12″	5 to 12″
9x9	9	9	10	10	11
9x13	13	13	14	15	16
9x17	17	18	19	20	21
9x21	21	22	23	25	26
13x13	19	20	21	23	23
13x17	25	27	28	31	31
13x21	31	33	35	37	39
13x25	38	40	42	45	47
17x17	34	36	38	40	42
17x21	42	44	47	49	52
17x25	50	53	56	59	62
17x29	58	62	66	69	73
21x21	52	55	58	62	65
21x25	63	67	70	74	78
21x29	73	77	82	87	91
21x33	83	88	94	99	104
25x25	75	79	84	89	94
25x29	88	93	99	104	109
25x33	100	106	112	119	125
25x37	112	120	127	134	141

Cubic Measure. Any piers above these last sizes are better taken by the cubic foot system.

A Brick Book

(Courtesy of the Common Brick Manufacturers' Association)

The makers of face brick are working together to set forth the qualities of their product, as The American Face Brick Association, Chicago; and now comes The Common Brick Manufacturers' Association of America, Cleveland. In 1921 the latter organization issued "Brick, How to Build and Estimate." This excellent book goes into the question of brickwork in a thorough manner, and is full of illustrations. What follows is by the courtesy of the Association, and may be compared with previous data.

The book is largely given over to the latest development in the brick world, spreading from the west coast to the east coast. This is the Ideal all-rolok wall and the Ideal rolok-bak wall. This is a hollow wall, not of the former type, but on a new principle. Metal ties are not used, and mortar joints are not carried across to give moisture a pathway. The face of the wall is of the Flemish bond type, but the brick are laid on edge instead of flat. There is thus a wall on outside and another on inside $2\frac{1}{4}''$ thick and cross brick running from one face to the other 8 in long, so that the hollow space is $3\frac{1}{2}$ in. The 12-in wall is also tied in the same manner, but has a double hollow space.

Labor. Bricklayers are not familiar with this new style, and more time is required than with common work, but if the same number of brick were laid as with solid walls the area would be greater, as brick on edge take up more space than on flat.

A bungalow $32' \times 30'$ with outside basement walls to grade of solid work, basement partitions 8-in all-rolok, walls above grade 8-in all-rolok faced with face brick, had 15,200 of the latter and 26,000 common, or 41,200 in all. Total bricklayers' time, 260 hours; total laborers' time, 240 hours, or practically man to man. Average number of brick laid by each mason in 8 hours, 1,268. This included chimneys, porch piers, porch walls, etc. With wages at $1.25 and 85¢, total $529, or $12.84 per 1,000. Basement partitions were laid at the rate of 1,349 brick in 8 hours. If this gait could be kept up the new style is about the same as the old, for on many bungalows and small work bricklayers do not reach this average.

Height. On the basis of the standard size, $2\frac{1}{4} \times 3\frac{3}{4} \times 8$, the height of from 1 to 100 courses of brick is given by the Association book, according to the width of the joint. The 10-course height is given here, and others can be easily found:

Joint, inch	Brick flat, inches	Brick on edge, inches
$\frac{3}{8}$	26.25	41.25
$\frac{1}{2}$	27.50	42.50
$\frac{5}{8}$	28.75	43.75
$\frac{3}{4}$	30.00	

Mortar Color. The all-rolok allowance is half that of the ordinary wall.

Mortar. "Portland cement mortar" is defined as with 10 per cent of the weight of the cement in dry hydrated lime or its equivalent in lime paste, while "pure Portland cement mortar" has no lime. First-class mortar is a 1 to 3 mix of Portland lime and sand. A good cement-lime sand mortar is 1 : 1 : 6.

Making Mortar. A good laborer should slack, sand, and stack 11 bbls of lime in 8 hours. For mixing and tempering mortar per 1,000 brick, allow from 1 to $1\frac{1}{2}$ hours, depending upon the thickness of the joints. This for both cement and lime, but includes the time to slack the lime. One mortar maker should supply 8 bricklayers. With a power-driven machine 1 laborer should supply from 30 to 50 men.

Grouted brickwork is less expensive than shoved brickwork and accomplishes the same purpose, but should not be used where there may be trickling on face work.

Damp-proofing. Coating 1,000 sq ft of brick wall with asphalt requires 200 lbs hot material and 8 hours' labor. For plastering $\frac{1}{2}$ in thick of 1 part Portland cement to 2 parts sand allow 20 bags cement, 40 cu ft sand, and 42 sq ft per hour for mason and helper.

Wedge-chipping for Arches, etc. Allow 40 brick per hour for a bricklayer.

Grout for basement brick paving, 1 part Portland cement and 3 parts sand requires 3 bags cement and $\frac{1}{3}$ cu yd sand for 1,000 brick laid with $\frac{3}{16}$-in to $\frac{1}{4}$-in joints.

Basement Paving. A laborer will spread, level, and tamp 125 sq ft sand cushion 2 in thick per hour, and grout 70 to 80 sq ft of brick paving in an hour.

A bricklayer laying brick on edge should finish an ordinary sized house in half a day with 2 laborers to help him.

Cleaning Down. For face brick allow 1 pint, and not more, of muriatic acid to 4 gals of water, and scrub with clean water. On ordinary work a man should cover about 95 sq ft per hour.

Chimney Work. For rough fireplaces and flues allow 14 hours per 1,000 brick for a bricklayer, including setting lining, and the same time for a laborer. But one laborer can serve two bricklayers at this work.

For an ordinary brick mantel and lining allow 12 hours for a brick mason and the same for a laborer. If 2 masons can work, 1 laborer can attend them.

On finer work than ordinary allow 400 brick in 8 hours for a man and a laborer. If 2 men work, allow half for laborer's time. Laying hearth, 4 hours for man and man.

Brick Walks. See Basement Paving for laborers' time. Allow 2,500 brick in 8 hours for a mason with 2 laborers. Add spreading of sand and grouting labor and material.

Deducting Openings. It is pleasant to see that the Association book stands for net measurement and deducts all openings. It is to be hoped that all bricklayers will get to this system.

Labor Tables

Brick footings, $\frac{1}{2}$-in joints, per linear foot. Mixing mortar included. For 8-in wall the footing is 20 in at base, 4 courses high; 12-in wall, 24″×4″ courses; 16-in wall, 32″ at base by 5 courses high. Material and labor given without overhead and profit. A unit of 10 ft is given, and any length can be had from this.

"A" Footings

Size, inches	Length, feet	Number brick	Cubic feet of mortar	Laborer's time, hours	Bricklayer's time, hours	
					Lime or cement	Cement
8	10	228	4	$1\frac{3}{4}$	$1\frac{1}{4}$	$1\frac{3}{4}$
12	10	282	5	$2\frac{1}{4}$	$1\frac{1}{2}$	2
16	10	460	8	$3\frac{3}{4}$	$2\frac{1}{2}$	3

Piers per foot high, solid and hollow. The 8×12, 12×12, and the 12×16 are solid with brick on flat; the $10\frac{3}{4}\times10\frac{3}{4}$ is hollow with brick laid on edge. As before, 10 ft is taken as a unit and any length can be based on this.

"B" Piers

Size, inches	Number of brick	Cubic feet mortar	Laborer's hours	Bricklayer's hours
8 ×12	124	$2\frac{1}{4}$	1	$1\frac{3}{4}$
12 ×12	185	$3\frac{1}{4}$	$1\frac{1}{2}$	$2\frac{1}{2}$
12 ×16	247	$4\frac{1}{2}$	2	$3\frac{1}{4}$
$10\frac{3}{4}\times10\frac{3}{4}$	113	1	$1\frac{1}{4}$	2

Exterior Ideal All-Rolok Walls. Material and labor per square foot: 10 is taken as the unit. Mortar-mixing is included.

"C"

Size, inches	Total number of brick including face brick	Number of face brick	Cubic feet of mortar	Laborer's hours	Bricklayer's hours
8	90	60	1	$\frac{1}{2}$	$\frac{3}{4}$
$12\frac{1}{2}$	143	60	$1\frac{1}{2}$	1	1

Exterior Ideal Rolok-bak Wall. Per 10 sq ft. Flemish headers every 3rd course.

"D"

Size, inches	All brick	Face brick	Cubic feet of mortar	Laborer's hours	Bricklayer's hours
8	108	68	1	$\frac{1}{2}$	$\frac{3}{4}$
$12\frac{1}{2}$	154	68	$1\frac{1}{2}$	1	$1\frac{1}{4}$

Solid Exterior Basement Walls, $\frac{1}{2}$-in Joint. Per 10 sq ft. Every 5th course a header. Mortar-making included.

"E"

Size, inches	Number of bricks	Cubic feet of mortar	Laborer's hours	Bricklayer's hours	
				Lime or Lime cement	Cement mortar
8	128	2	1	$\frac{3}{4}$	1
12	193	$3\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$
16	258	$4\frac{1}{2}$	2	$1\frac{1}{2}$	2

Solid Exterior Walls above Grade in Common Bond, $\frac{1}{2}$-in Joints. Header every 5th course. Per 10 sq ft. Mortar-mixing included.

"F"

Size, inches	Number of bricks	Cubic feet of mortar	Laborer's hours	Bricklayer's hours	
				Lime or Lime cement	Cement mortar
8	128	$1\frac{1}{2}$	1	1	1
12	193	2	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$
16	258	3	2	$1\frac{1}{2}$	2

Solid Exterior Walls in Flemish, English, and English Cross Bonds, $\frac{1}{2}$-in Joints. Per 10 sq ft. Mixing included.

"G"

Size, inches	Number of bricks	Cubic feet of mortar	Laborer's hours	Bricklayer's hours	
				Lime or Lime cement	Cement mortar
4	62	1	$\frac{1}{2}$	$\frac{3}{4}$	..
8	124	2	1	1	1
12	185	$3\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$
16	247	$4\frac{1}{2}$	2	$1\frac{1}{2}$	2

Quantities of Material for Cubic Feet of Mortar Found in the Foregoing Tables. In cement mortars $\frac{1}{10}$ is lime mixture. All per 10 cu ft. 1 : 3 etc. means 1 part cement or lime and 3 parts sand: 1 : 1 : 6 = cement, lime, sand parts.

"H" Lime Mortar

Mix	180 lb. bbls. of lump lime		50-pound sacks hydrated lime	Sand, cubic yards
1 : 2½	.6	or	3.5	.4
1 : 3	.5	or	2.9	.4

"I" Lime-Cement Mortar

Per 10 cu ft

Mix	Sacks of cement	Lime, barrels		Hydrated lime, sacks	Sand
1 : 1 : 6	1.3	.2	or	1.5	4

"J" Cement Mortar

Per 10 cu ft

Mix	Sacks of cement	Barrels of lime		Sacks of hydrated lime	Sand, cubic yards
1 : 2	4.4	.2	or	.9	.3
1 : 3	3.3	.1	or	.7	.4
1 : 4	2.6	.1	or	.6	.4

Flues Laid with ½-in Joint. Per 10 ft high. Mortar-mixing included. Linings not included, except setting them.

"K"

Size of flue	Size of chimney	Number of bricks	Cubic feet of mortar	Laborer's hours	Mason's hours
8× 8	17×17	259	$\frac{1}{2}$	2	$3\frac{1}{2}$
12×12	21×21	345	6	$2\frac{3}{4}$	$4\frac{1}{2}$
12×12 and 8×12	21×34	539	$8\frac{1}{2}$	4	$7\frac{1}{4}$
8× 8	13×17	173	3	$1\frac{1}{2}$	$2\frac{1}{4}$
12×12	17×21	238	4	$1\frac{3}{4}$	$3\frac{1}{4}$
12×12 and 8× 8	17×34	367	$6\frac{1}{2}$	$2\frac{3}{4}$	5

In the first three the brick go on four sides; in the second three, on three sides only, as they stand out from the face of a wall, while the others are clear.

Remarks on Tables. For table "E" the exterior 4 in has all joints filled with mortar, other brick laid on a full bed, but touching end to end. Vertical space between each 4-in course filled with mortar.

Table "F" same as "E," but vertical space between courses left open.

Table "G," 8 in, has as many vertical joints between courses left open as possible; 12 in and 16 in, bricks touch end to end, and space between courses left open.

Table "H" has all joints filled with mortar.

CHAPTER VII

CEMENT STONEWORK

Laid in Wall. So far as an appraiser is concerned with foundations of this material the easiest method of getting a fair value is the best. This is by the square foot. The local price must be obtained, and this varies. The following figures are presented as a guide and an average for ordinary material:

For 8-in foundation walls, 31¢ per square foot of finished work.

For 12-in foundation walls, 48¢ to 50¢ per square foot of finished work.

For 8-in walls, clear to roof including gables, 33¢ per square foot.

For 12-in walls, clear to roof including gables, 50¢ to 52¢ per square foot.

Chimneys, 8″×12″, $1.75 per linear foot.

For granite-faced stone, 40¢ per square foot for 8-in and 60¢ for 12-walls. Door sills, 8″×15″, 80¢ per linear foot; window sills, 50¢; wall coping, 10 in wide by 4½ in thick at center, 45¢; blocks, 8″×16″×8″, 19¢, and 20¢ for faced material; 6″×16″×12″, 21¢; porch pier blocks, 12″×12″×8″, 50¢; fluted porch column, common style, ordinary length, 9-in diameter, $6; window caps, 40¢ per linear foot. Garage walls are a trifle higher than basement ones—allow 35¢ per square foot for 8 in.

As a general rule an appraiser does not need to know the cost of making the blocks in the yard, any more than he needs to have the cost of making brick—clay, labor, fuel, etc. What he needs to know as to brick and blocks is the price of the finished product laid down at the site, but, better still, the cost per square foot laid in the wall, as in the foregoing.

Two-kind Work. The face of cement stone is made of a richer mix than the back; the first may be 1 part cement to 2 parts sand, and the second 1 to 4.

Labor Laying. This is included in the walls already given, but is put here separately in case of need. For a straight basement wall of the ordinary kind some men lay 250 blocks in 8 hours, but this is done as a spurt, seldom reached and never exceeded; the common allowance is 160 blocks, or 20 per hour. Each mason requires a helper. This is for the lighter hollow blocks; deduct 10 per cent

for the solid ones. Lighter blocks, 4 in to 6 in high can be laid at the rate of 25 to 30 per mason per hour, while the long 24's run to only 14 to 16. A good deal depends, with all blocks, on the kind of walls and as much on the kind of weather.

Sizes. The most common block is 8″×8″×16″ for the 8-in wall, and 8″×12″×16″ for the 12-in. On the face of both the area is 128 sq in. The following table gives useful data:

Concrete Block Table

Giving size and weight of blocks, the number 1 bbl of cement will make, the number to 1 cu yd of material, and the number per square of 100 superficial feet.

Height	Width	Length	Solid blocks			Hollow blocks			Number per square of 100 square feet
			Weight of block	Number per barrel of cement at 1 to 5	Number per cubic yard	Weight of block lbs	Number per barrel of cement at 1 to 5	Number per cubic yard	
8×	8×	16	73	34	48	50	49	71	112
8×	10×	16	92	27	38	67	37	53	112
8×	12×	16	109	22	32	80	31	44	112
4×	8×	16	35	68	99	24	100	144	224
4×	10×	16	44	54	79	32	76	109	224
4×	12×	16	53	44	66	39	63	91	224
8×	4×	16	37	68	95	.....	.....	.....	112
8×	8×	24	112	22	31	77	32	45	75
8×	10×	24	140	18	25	92	25	38	75
8×	12×	24	166	15	21	112	21	31	75
4×	8×	24	54	46	65	37	66	94	150
4×	10×	24	67	36	52	46	52	76	150
4×	12×	24	79	30	44	55	44	63	150
8×	4×	24	55	44	63	.....	.....	.....	75

Explanation. To find the number of blocks for a building, get the surface feet of the building by multiplying the length around the building by the height of the wall. Add to this the surface of gables, then deduct the surface feet of all the openings. Thus giving the actual surface to cover.

Rule. Multiply the number of squares to cover by the number in the last column for the size block to be used, which will give the number of blocks for any building.

DATA FOR 100 BLOCKS WITH 1 : 2 : 4 MIX

Size	Gravel, cubic yards	Sand, cubic yards	Cement, barrels	Labor, hours
8× 8×16	1.05	0.79	2.02	13
8×10×16	1.40	1.06	2.62	15
8×12×16	1.68	1.27	3.08	16
8× 8×24	1.62	1.23	3.12	20
8×10×24	2.02	1.53	3.80	21
8×12×24	2.43	1.82	4.46	22

This is by hand-mixing; by machine the number can be more than doubled. The blocks are faced with a mix of 1 part cement to 2 parts sand. The body is 1 : 3 : 4, the latter small gravel.

CHAPTER VIII

STEEL AND IRON

Weight. Per cubic foot, cast iron, 450 lbs; wrought iron, 480 lbs; steel, 490 lbs. Per cubic inch, .263, .281, .283; usually, .26, .28, or a little more than $\frac{1}{4}$ lb per cubic inch. Wrought iron multiplied by 1.082 gives brass; 1.444, copper; 1.471, lead. A stock pattern might be used a hundred times, and the cost of the work thus greatly reduced as compared with one column to a special pattern.

Rivets. Use 2 per cent of the weight of structural steel.

Labor Setting. Without plans it is hard to get weights, as columns and beams vary greatly. A 15-in beam may be 42 lbs or 100. So with others.

Ordinary Work. For store-front beams and such work, 12 to 15 hours per ton, half at tradesmen's wages of $1 per hour, and the other half at laborer's of 60¢—at 12 hours, $9.60, and at 15, $12. Ordinarily, $10 should be enough. The work can often be done with laborers and one tradesman to direct them. With a long stretch of plain work they can set for $8. All with hand derrick.

On column and beam work at the level of first floor, bolted, 12 hours per ton should be enough, and on a long stretch even less. This with tradesman to direct laborers.

On No. 2, clear to roof, with bolted work, set with laborers, the average rate ran to 25 hours. Ceiling with light sections reduced the average. At 60¢ this is $15 per ton. Hand derrick: steam, $12.

On railroad shop buildings, from 120 to 200 ft wide and 400 to 1,000 ft long, heavy trusses on steel columns, heavy crane runways, riveted connections, $20 per ton. The work is done with foreman, engineer, riveters, and laborers. In the former low-priced era the cost ran to $7 and $8. With the necessary proportion of skilled erectors and laborers, the former at $1 per hour, and the latter at 60¢, $20 is a fair allowance.

Machine shops should be less than car shops and lighter buildings, for the columns that support the crane girders are much heavier than for ordinary structures that carry only 10- and 20-ton cranes. With a 200- to 250-ton crane the columns and girders soon run up in tonnage, yet the steam derrick can lift them as easily as light

sectional work. The crane girders may be 3 ft 6 in wide, and the central columns about as much. A truss of 150-ft span for this kind of work weighs about 5 tons.

On the basis of 77½¢ per hour for steel erectors and 45¢ for laborers a large machine shop with 80,000 sq ft was studied by the general and sub-contractor with the agreement that the actual cost of setting would be from $14 to $15 per ton and that a profit of $3 per ton was fair to sub-contractor. On the $17 rate, but with wages of $1 and 60¢, the $20 total given for such work would run to about $22. The steel was set for less than $16, which overran the estimate. Winter work ran up the total.

But with train sheds and light work $30 per ton, on the same 60¢ wage rate, would be required. If laborers get only 20¢ per hour and erectors 60¢, the cost per ton is far less than with $1 to $1.10 and 60¢.

The weight of steel per square foot of shop buildings is given in another chapter, and also the percentage it bears to total cost. On some machine shops the cost of the steel is half of the complete structure; and on car shops and such buildings, 20 to 26.

Cranes. On the 60¢ basis for laborers, allow 10 hours per ton of actual weight to set large cranes. This on the basis of being taken directly from cars on shop tracks.

Skyscrapers. The following erection table is based on the labor required for 12 to 20 stories, one of them with 2,000 tons, and the other with 3,500. The 2,000 cost at the rate of $12.50, and the 3,000 one at the rate of $11 per ton. Heavier sections cut down the cost, for a modern derrick can hoist one beam as easily as another, and the riveting is practically the same. This was at the wage rate of 72½¢ for erectors and 40¢ for laborers. No profit, but net cost.

The table is based on general averages. On low buildings with heavy sections 3 tons might be the unit instead of 1.65.

Another 18-story building with ½-mile haul and a coat of paint on all steel after erection ran to $11.50, with wages at 60¢ and 35¢.

Many of the following items are so small that a fair price is better than none, and can be corrected by consulting the index numbers to see the difference between a 1923 unit and an earlier.

Prism Coal Hole Covers. $2.50 to $2.75 per square foot; 24-in, $8 to $12; solid, $3 to $8. Depth regulates price to some extent.

Wickets. For railroad windows, from $10 to $40 of ordinary style.

Gas-pipe Rail. Double, $2 per foot; single, $1.50; 3″×3″ posts, $6 to $7. Spike rail on top, 30¢ per foot. Standards for corners, etc., from $3 to $5 each.

Erecting Table, Based on 1.65 Tons in 8 Hours, for Skyscrapers

tradesmen, per hour	laborer, per hour	3 tradesmen, 1 laborer, per ton riveted	2 tradesmen, 2 laborers, per ton bolted
$0.60	$0.35	$10.43	$ 9.21
.65	.40	11.40	10.18
.70	.40	12.12	10.67
.75	.40	12.85	11.15
.80	.45	13.82	12.12
.85	.50	14.80	13.10
.90	.50	15.52	13.57
.95	.60	16.73	15.03
1.00	.60	17.45	15.52
1.05	.60	18.18	16.00
1.10	.65	19.15	17.00
1.15	.65	19.88	17.45
1.20	.70	20.85	18.43
1.25	.70	21.58	18.91

Fence. Gates, 25¢ per pound. Fences, 13¢ per pound, set in place; $1.30 to $1.70 in place, square pickets.

Shutters and Doors. From 90¢ to $1.10 per foot in place. Vault door linings from $120 up, 620 to 830 lbs.

Iron Ladders. $1.50 to $1.75 per foot high in place.

Fire-escapes. Stairs, $8 to $10 per foot on rake in place; small escapes, $2 per foot high set; platforms, $5 per linear foot. A good 3-ft stair, $350 per story, or about $18 per step.

Wrought Iron. In general, at 1923 rates, 9¢ to 10¢ per pound.

Anchors. Per linear foot, both shank and head included: $\frac{1}{4}$ in thick, $1\frac{1}{2}$ in, 13¢; 2 in, 17¢; $2\frac{1}{2}$ in, 22. For $\frac{3}{8}$ in thick, same widths, 20¢, 26¢, 32¢. For $\frac{1}{2}$ in thick, 2 in, $2\frac{1}{2}$ in, and 3 in equals 34¢, 42¢, 51¢. All at 10¢ per pound.

In 1923 stairs took 9¢ to 11¢ per pound for plain work, and $30 per ton allowed for erection besides, as well as painting.

Painting should be done by area, but sometimes it is figured by tonnage. For graphite in shop, $1.50 per ton; in field, $2.50; red lead, $2.75 in shop and $3.50 in field.

Hauling per ton about $1.50 to $2 when hoisted and unloaded by derrick. This for about a mile, although distance does not affect price so much as formerly if auto trucks are used.

Turntable for garage, 72 in, 1,820 lbs, $160 to $180.

Wrought-iron Gratings are of various weights, and weight must be had for a price, at 9¢ per pound. Allow $1.50 per square foot for $\frac{1}{2}'' \times 1\frac{1}{2}''$ outside frame, $\frac{3}{8}'' \times 1\frac{1}{2}''$ at 2-in centers for bars.

Jamb Guards, about 6¢ per pound. $4'' \times 4'' \times \frac{1}{2}'' \times 4' = \$3.25$; $6'' \times 8'' \times \frac{3}{4}'' \times 6' = \$12$.

Wheel Guards, $9'' \times 9'' \times 3' = \$10$ to $12.

Mason Safety Treads, $2.40 to $2.75 per square foot; brass base, $8.

Example. What is the weight per linear foot of a $12'' \times 16'' \times 1''$ thick column?

Answer. $2a + 2b = 24 + 32 = 56$. Opposite this number, under 1 in thick metal, we find 162.5, which is weight per linear foot in pounds for a column of this size.

WEIGHT OF CAST-IRON COLUMNS PER LINEAR FOOT

Diameter in	Thickness in	Weight lbs	Diameter in	Thickness in	Weight lbs	Diameter in	Thickness in	Weight lbs
6	$\frac{1}{2}$	26.95	8	$1\frac{1}{4}$	82.71	11	1	98.03
6	$\frac{3}{4}$	38.59	9	$\frac{3}{4}$	60.65	11	$1\frac{1}{4}$	119.46
6	$\frac{7}{8}$	43.96	9	1	78.40	11	$1\frac{1}{2}$	139.68
6	1	49.01	9	$1\frac{1}{4}$	94.94	11	$1\frac{3}{4}$	158.68
6	$1\frac{1}{8}$	53.76	9	$1\frac{1}{2}$	110.26	11	2	176.44
7	$\frac{3}{4}$	45.96	9	$1\frac{3}{4}$	124.36	12	1	107.51
7	1	58.90	10	1	88.23	12	$1\frac{1}{4}$	131.41
7	$1\frac{1}{8}$	64.77	10	$1\frac{1}{4}$	107.23	12	$1\frac{1}{2}$	154.10
8	$\frac{3}{4}$	53.29	10	$1\frac{1}{2}$	124.99	12	$1\frac{3}{4}$	175.53
8	1	68.64	10	$1\frac{3}{4}$	141.65	12	2	195.75

Weight of Square Cast-Iron Columns in Pounds per Linear Foot

(Birkmire)

a □ b	Thickness of Metal in In								
2a+2b	5/8	3/4	7/8	1	1 1/8	1 1/4	1 1/2	1 3/4	2
*12	18.6	21.1	23.3	25.0	26.4	27.3	28.1		
14	22.5	25.8	28.7	31.3	33.4	35.1	37.5		
16	26.4	30.5	34.2	37.5	40.4	43.0	46.9	49.2	50.0
18	30.3	35.2	39.7	43.8	47.4	50.8	56.3	60.2	62.5
20	34.2	39.8	45.1	50.0	54.5	58.6	65.6	71.1	75.0
22	38.1	44.5	50.6	56.3	61.5	66.4	75.0	82.0	87.5
24	42.0	49.2	56.1	62.5	68.5	74.2	84.4	93.0	100.0
26	45.9	53.9	61.5	68.8	75.6	82.0	93.8	103.9	112.5
28	49.8	58.6	67.0	75.0	82.6	89.8	103.1	114.8	125.0
30	53.7	63.3	72.5	81.3	89.6	97.7	112.5	125.8	137.5
32	57.6	68.0	77.9	87.5	96.7	105.5	121.9	136.7	150.0
34	61.5	72.7	83.4	93.8	103.7	113.3	131.3	147.7	162.5
36	65.4	77.3	88.9	100.0	110.7	121.1	140.6	158.6	175.0
38	69.3	82.0	94.3	106.3	117.8	128.9	150.0	169.5	187.5
40	73.2	86.7	99.8	112.5	124.8	136.7	159.4	180.5	200.0
42	77.1	91.4	105.3	118.8	131.8	144.5	168.8	191.4	212.5
44	81.0	96.1	110.8	125.0	138.8	152.3	178.1	202.3	225.0
46	84.9	100.8	116.2	131.3	145.9	160.2	187.5	213.3	237.5
48	88.8	105.5	121.7	137.5	152.9	168.0	196.9	224.2	250.0
50	92.8	110.2	127.2	143.8	159.9	175.8	206.3	235.2	262.5
52	96.7	114.8	132.6	150.0	167.0	183.6	215.6	246.1	275.0
54	100.6	118.5	138.1	156.3	174.0	191.4	225.0	257.0	287.5
56	104.5	124.2	143.6	162.5	181.0	199.2	234.4	268.0	300.0
58	108.4	128.9	149.0	166.8	188.1	207.0	243.8	278.9	312.5
60	112.3	133.6	154.5	175.0	195.1	214.9	253.2	289.8	325.0
62	116.2	138.3	160.0	181.3	202.1	222.7	262.5	300.8	337.5
64	120.1	143.0	165.4	187.5	209.2	230.5	271.9	311.7	350.0
66	124.0	147.7	170.9	193.8	216.2	238.3	281.3	322.7	362.5
68	127.9	152.3	176.4	200.0	223.2	246.1	290.6	333.6	375.0
70	131.8	157.0	181.8	206.3	230.3	253.9	300.0	344.5	387.5
72	135.7	161.7	187.3	212.5	237.3	261.7	309.4	355.5	400.0
74	139.6	166.4	192.8	218.8	244.3	269.5	318.8	366.4	412.5
76	143.5	171.1	198.3	225.0	251.3	277.3	328.1	377.3	425.0
78	147.4	175.8	203.7	231.3	258.4	285.2	337.5	388.3	437.5
80	151.3	180.5	207.2	237.5	265.4	293.0	346.9	399.2	450.0

* A and b = either side (outside measurement). 2a + 2b = number. Allowance has been made in above table for corners counted twice.

CHAPTER IX

FIREPROOFING

Labor per Hour in Square Feet

(Data through courtesy of the Nat'l Fireproofing Co., Pittsburgh, the "Natco")

For the regular flat arch tile floors allow as in the following table. Wages can be arranged to suit any local rate as the number of square feet laid in an hour is the important unit. The usual modifications have to be kept in mind, as bad weather, waiting on material, small cut-up or large spaces, etc. In the largest cities tile work is laid by experts; but in ordinary cities and towns bricklayers do the work and it takes some time to get them used to it. The 22,000 sq ft on one building was laid under an expert with ordinary tradesmen, and he soon noted the difference between the two classes.

The following table has the time of hoisting engineer included. On first floors and occasionally in 2-story buildings engineer labor is not required. Wheeling for the first floor and a gasoline engine with hoist run by a laborer for the second do the work. If necessary deduct approximately 12 per cent from the totals to get at the rate without engineer.

TILE LABOR

TABLE A

FLAT ARCHES

Depth, inches	Square feet per hour	Depth, inches	Square feet per hour
6	60	12	40
8	54	13	35
9	50	14	33
10	46	15	30

The proportion of time in the foregoing table might, for valuation purposes, be set at 1 mason, 1½ laborer, and 0.3 engineer.

Long Span segmental arches allow 30 sq ft per hour.

Mortar. This has to be richer than for ordinary masonry. For 100 sq ft at 1-in joint allow in cubic feet for depth of tile as stated: 6-in, 5; 9-in, 7; 12-in, 9; 14-in, 11; 15-in, 12.

TABLE B

Bakup Tile

Size, inches	Square feet per hour	Size, inches	Square feet per hour
4×5×12	29 large jobs	8×5×12	20 large jobs
4×5×12	23 residences, etc.	8×5×12	17 residences

Hoisting is not included. If required deduct about 7 per cent from total, which is on the basis of 1 mason to 1 tender.

Mortar for bakup tile: to 100 tile, with ½-in joint, 5 cu ft for 4″×5″, 12 in; for 8″×5″×12″, 6.25 cu ft.

TABLE C

Furring and Partition

Size, inches	Square feet per hour	Size, inches	Square feet per hour
2-in split furring	36	7-in partition	23
3-in partition	34	8-in "	18
4-in "	30	9-in "	17
5-in "	28	10-in "	16
6-in "	25	12-in "	15

Time of 1 laborer to 1 mason—no hoisting. Deduct 7 per cent for this if required.

Mortar. For 100 sq ft of partition tile at thickness stated allow in cubic feet as shown: 2-in, 1½ cu ft; 3-in, 2¼; 4-in, 3; 5-in, 3.8; 6-in, 4.6; 7-in, 5.4; 8-in, 6.1; 9-in, 6.9; 10-in, 7.6; 12-in, 9.7.

Columns. Where square or rectangular columns are 2 ft or more in size allow 28 sq ft per hour with ceiling heights 10 ft to 12 ft; for smaller columns 12 ft to 18 ft high, 23 sq ft. Round columns

not more than 2 ft diameter and 10 ft to 12 ft ceilings, 35 sq ft per hour; smaller columns and higher ceilings, 20 sq ft. In all cases 1 laborer to 1 mason.

Beams. Per linear foot, average, $8\frac{1}{2}$ minutes for 1 mason, and the same for 1 laborer. This for beams 15-in high and under, and for fireproofing top, bottom, and two sides, say, 3 sq ft to 1 lin ft = 18 sq ft per hour for the two men.

Wall Bearing Tile

TABLE D

12″×12″ Face

Thickness, inches	Square feet per hour	Thickness, inches	Square feet per hour
3	29	8	17
4	25	10	15
6	22	12	14

This Table D on the basis of 1 mason to 1 laborer, no hoisting. Deduct 7 per cent if this is required.

Book Tiles. Lengths, 17 in, 19 in, 21 in; 3 in thick; 12 in wide. Allow 38 sq ft per hour for 1 mason and 1 laborer. Deduct 7 per cent for hoisting if required, which equals adding for cost of engineer.

End Construction Arches

TABLE E

Depth, inches	Square feet per hour	Depth, inches	Square feet per hour
6	44	12	29
7	42	13	27
8	40	14	25
9	36	15	23
10	33	16	21

The proportion runs at 1 mason, $1\frac{1}{2}$ laborer, and 0.3 engineer. Add about 12 per cent if hoisting is not required.

Unloading. If the appraiser can get the cost of the material laid down on the job from wagons or trucks, unloading does not have to be allowed; but if the price is on railroad tracks an addition should be made per square foot. For the 10-in to 14-in allow 75 ft per hour for 1 man to unload and wheel about 10 yds; for 5-in to 8-in tile, 100 sq ft; for light book and thin partition, 150 sq ft. Incidentally, the United States experts sent to examine the San Francisco fire concluded that no partition less than 6 in should be allowed.

Labor on Gypsum Blocks

TABLE F

PARTITIONS

Thickness, inches	Square feet per hour	Thickness, inches	Square feet per hour
2-in furring	60	5-in partition	36
2-in partition	50	6-in "	32
3-in "	45	8-in "	25
4-in "	40		

The allowance is 1 mason to $1\frac{1}{2}$ laborer, and hoisting is included.

Mortar. Cubic feet per 100 sq ft of wall: 2 in, 1.2; 3 in, 1.8; 4 in, 2.4; 5 in, 3; 6 in, 3.6; 8 in, 4.8.

TABLE 1

COST OF LABOR ON FIREPROOFING PER 100 SQUARE FEET

Rate per hour for mason	Rate per hour for laborer	Rate per hour for 1 with 1	Number of square feet laid per hour								
			12	15	18	21	24	27	30	33	36
$0.50	0.25	0.75	6.25	5.00	4.16	3.57	3.13	2.78	2.50	2.27	2.08
.60	.30	.90	7.50	6.00	5.00	4.29	3.75	3.33	3.00	2.73	2.50
.70	.35	1.05	8.75	7.00	5.83	5.00	4.38	3.89	3.50	3.18	2.92
.80	.40	1.20	10.00	8.00	6.67	5.71	5.00	4.45	4.00	3.64	3.34
.90	.45	1.35	11.25	9.00	7.50	6.43	5.63	5.00	4.50	4.09	3.75
1.00	.50	1.50	12.50	10.00	8.34	7.14	6.25	5.56	5.00	4.55	4.17
1.10	.55	1.65	13.75	11.00	9.16	7.86	6.88	6.11	5.50	5.00	4.58
1.20	.60	1.80	15.00	12.00	10.00	8.57	7.50	6.67	6.00	5.45	5.00
1.40	.70	2.10	17.50	14.00	11.66	10.00	8.75	7.78	7.00	6.36	5.83
For each 5¢ diff. in Col. 2			42¢	34¢	28¢	24¢	21¢	19¢	17¢	15¢	14¢

See page 350 about hoisting.

On a 60¢ per hour basis the first allowance is $\frac{4}{5}$¢ per square foot; the second, $\frac{3}{5}$¢; the third, $\frac{2}{5}$¢. An appraiser would lump all at 1¢, and not be far from right.

Freight. This cannot even be guessed at until point of shipment, destination, weight and rate are known. Ordinary hauls run from $1 to $3 per ton. At $1 allow about 2¢ per square foot for freight; heavy tile more, light tile less. Breakage is about 3 per cent.

Hauling for about a mile may be $1.50 per ton with auto trucks. An average carload is 32 tons. Some cars hold 40 tons; others, 25.

TABLE 2

COST OF LABOR ON FIREPROOFING PER 100 SQUARE FEET

Rate per hour for mason	Rate per hour for laborer	Rate per hour for 1 with 1½	Number of square feet laid per hour								
			40	42	44	46	48	50	52	56	58
$0.50	0.25	0.88	2.20	2.10	2.00	1.92	1.84	1.76	1.70	1.57	1.52
.60	.30	1.05	2.63	2.50	2.39	2.28	2.19	2.10	2.02	1.88	1.81
.70	.35	1.23	3.08	2.93	2.80	2.68	2.56	2.46	2.37	2.20	2.12
.80	.40	1.40	3.50	3.33	3.18	3.05	2.92	2.80	2.70	2.50	2 41
.90	.45	1.58	3.95	3.76	3.59	3.44	3.29	3.16	3.04	2.82	2.73
1.00	.50	1.75	4.38	4.17	3.98	3.81	3.65	3.50	3.37	3.14	3.02
1.10	.55	1.93	4.83	4.60	4.39	4.20	4.02	3.86	3.71	3.45	3.33
1.20	.60	2.10	5.25	5.00	4.78	4.57	4.38	4.20	4.04	3.75	3.62
1.40	.70	2.45	6.13	5.83	5.57	5.33	5.11	4.90	4.71	4.38	4.23
For each 5¢ diff. in Col. 2			19¢	18¢	17¢	16¢	16¢	15¢	14¢	13¢	12¢

See page 350 about hoisting.

Combination Floors

A common method of putting down fireproof floors is to use both tile and reinforced concrete, the former to lighten the load. The mason work on the tile consists in laying it down in straight lines and fitting around any walls, stairs, pipes, etc. After the steel is placed the concrete is poured in the regular way: 1 : 2 : 4 proportions.

To get an approximate idea of the cost of the labor on a finished floor, assume a space of $60' \times 100' = 6{,}000$ sq ft. The Truscon Company has compiled a table, given in The New Building Estimator's Handbook, showing the percentage of tile in a floor of this kind from 62 per cent to 75. Experience has shown that 67 per cent is the average for reinforced buildings, or two-thirds of the area, and this will be taken in the following examples. The cubic

feet per square foot of floor area is given in the table, according to depth. Any depth can easily be estimated, as shown here:

Depth Complete, 12 Inches: Labor per 100 Square Foot

4,000 sq ft tile, 10 in.
Concrete, 2,000 sq ft of 12 in.
Concrete, 4,000 sq ft of 2 in covering.

Mason 120 sq ft per hour = 34 hours at $1	$ 34.00
Laborers wheeling and placing at 80 sq ft per hour, 50 hours, 60¢	30.00
100 cu yds concrete, 20 hrs per yard = 2,000 hrs at 60¢	1,200.00
	$1,264.00

Dividing by 6,000 sq ft = $210.66 = a little more than 21¢ per square foot for all labor except placing of steel, hoisting, and erection of supporting and planking, or flooring. For tile alone less than 1¼¢ per square foot, a unit so small that it might be doubled without doing much hurt to a valuation that may be increased from 30 to 40 per cent by lawyers after the total is found.

The steel labor may be approximated from the Truscon allowance, if exact details are not to be had. The allowance runs from 3 lbs per square foot on schools to 7 and 8 on high buildings, including all columns and beams, with 5 lbs as an average for buildings under 6 stories. On the 6,000 ft this is equal to 15 tons. The average labor is given in the concrete chapter for 21 buildings at $8.52 on a 40¢ basis, which comes to twice as much in 1923, taking both laborers and tradesmen together. Setting $17 = 4¼¢ per square foot; and at $20 less than 6¢. This class of tile goes down faster than the arch kind, and if hoisting is required allow about 10 to 12 per cent extra on the total labor. First floor work is run in by wheelbarrows, and if tile is laid close to the building a space is soon covered, especially with the short runs.

Same Area with Lighter Tile: Labor per 100 Square Feet

4,000 sq ft of 6-in tile; 2,000 sq ft of 8-in concrete; 4,000 sq ft of 2-in covering:

Mason 160 sq ft per hour = 25 hrs at $1	$25.00
Laborers placing, 100 ft per hour, 40 hrs at 60¢	24.00
75 cu yds concrete, 1,500 hrs at 60¢	900.00
	$949.00

Dividing by the area equals $158.17 or less than 16¢ per square foot for labor, as before, and less than 1¢ for the tile alone. The rate of 20 hrs for mixing and placing concrete is taken from the figures given in the concrete chapter for slab work, and as this class

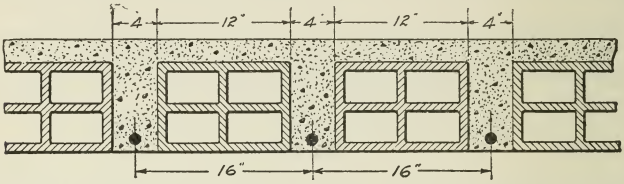


Fig. 49.—Natco "One Way" combination long span floor with 2" concrete top.

of work requires fewer cubic yards to the same area a figure above the average is taken.

Covering. This is set at 2 in, but it may be more or less. The Truscon table is made out for 1 in, 2 in, 3 in, 4 in on top of tile.

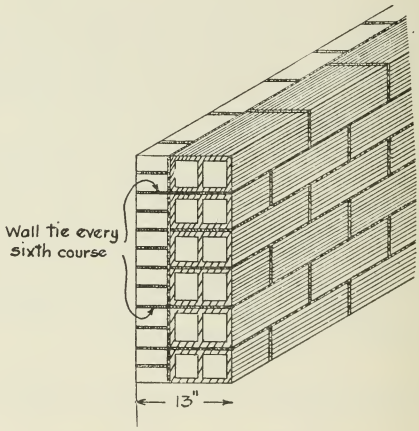


Fig. 50.—Natco Bakup Block.

Wood strips and floors were condemned by the United States experts after the San Francisco fire.

The Natco two systems are set forth in The New Building Estimator's Handbook for this combination floor, and they are the same as in general use. In the one case plank are laid for the floor

with a space between. The tile covers this space and the concrete is poured down on the plank. The Truscon average is two-thirds the area for tile, and thus only half the floor needs to be covered. But the plank is 2 in and in B. M. without waste runs to 6,000: with $\frac{1}{6}$ for waste on the new lumber = 6,600. For shores and beams, etc., allow 9,000 in all for a basis. At $50 per M. = $450, or less than 8¢ per square foot over the 6,000 for lumber. But using for two floors = 4¢ for material only; while if used for half a dozen floors the material by itself comes to a small figure per square foot. There is no waste for the plain work. There are not even supports required, as in cases where steel columns are used. This shows

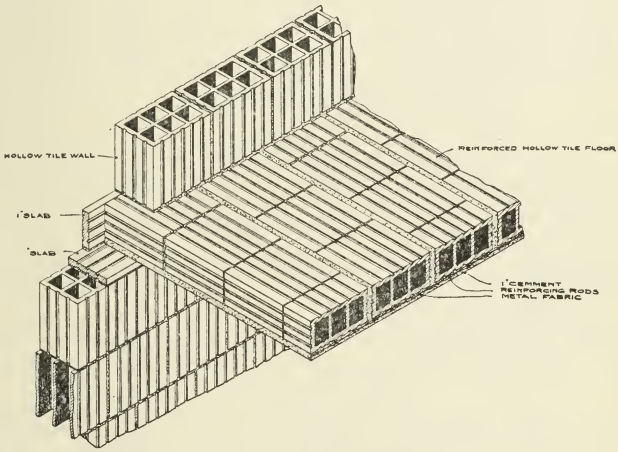


Fig. 51.—Johnson System Floor-Natco.

why the lumber in 16 Aberthaw buildings runs from 4¢ to 21¢ per square foot.

In the ordinary system of tile fireproofing the planks are hung to the steel beams by the standard apparatus carried from one building to another, just as ladders are; and planks may serve for a dozen structures.

On No. 2, 22,000 sq ft of regular floor and roof tile cost less than 2¢ per square foot for lumber, and salvage cut this down to perhaps $1\frac{1}{4}$¢, on a basis of $40 per M.

On the other system a floor is laid over the entire area. Lumber on this basis might be set at 12¢ instead of 8¢ for the other if only one floor is to be done. With more than one a cut can be made, although there is more waste than by the open system.

Approximate Price List

Natco tile and tile for combination floor	Contractor's price
2″×12″×12″ 3-cell, 15 lbs each.....	$71 per M. ft
3″×12″×12″ " 15 " "	71 "
4″×12″×12″ " 16 " "	76 "
5″×12″×12″ " 19 " "	90 "
6″×12″×12″ " 22 " "	104 "
7″×12″×12″ " 25 " "	119 "
8″×12″×12″ 4-cell, 30 " "	142 "
9″×12″×12″ " 31 " "	147 "
10″×12″×12″ " 35 " "	168 "
12″×12″×12″ " 40 " "	192 "

(Or about $9.60 per ton)

Natco XXX Tile

3″×12″×12″ 3-cell, 18 lbs each.....	$85 per M. ft
4″×12″×12″ " 20 " "	95 "
6″×12″×12″ 6-cell, 29 " "	137 "
8″×12″×12″ " 34 " "	161 "
10″×12″×12″ " 40 " "	192 "
12″×12″×12″ 9-cell, 52 " "	230 "
12″×12″×12″ 6-cell, 48 " "	250 "

Natco Bakup Tile

5″× 4″×12″ 1-cell, 10 lbs each.....	$36 per M. pieces
5″× 8″×12″ 2-cell, 16 lbs each.....	58 "

The prices herein named are for material only, f.o.b. cars our works.

Natco Furring Tile

1½″×12″×12″ 8 lbs each.....	$38
2 ″×12″×12″ 9 " "	43

Book Tile

3″×12″×less than 18 in in length 20 lbs per square foot.....	$104 per M. sq ft
3″×12″×18″ to 20 in long, inclusive, 20 lbs per square foot.....	113 "
3″×12″ and over 20 in, but not exceeding 24 in, 20 lbs per square foot.....	123 "

APPROXIMATE PRICE LIST—*Continued*

NATCO ARCHES, END CONSTRUCTION

Natco tile and tile for combination floor	Contractor's price
6-in, 26 lbs per square foot	$116.35 per M. pieces
7-in, 30 " "	134.25 "
8-in, 32 " "	143.20 "
9-in, 33 " "	147.70 "
10-in, 35 " "	165.40 "
12-in, 42 " "	198.45 "
13-in, 46 " "	224.25 "
14-in, 48 " "	240.00 "
15-in, 50 " "	263.75 "
16-in, 52 " "	274.30 "

Making Up Totals

The totals for 100 sq ft of 12-in flat arch tile floor may be assembled as follows:

Lumber for centering, allow per foot, 10¢	$10.00
Labor on centering (see Concrete chapter for slab floors), 20¢	20.00
12-in, 42 lbs at 20¢ per square foot, for tile	20.00
Labor on tile, Table 2, $1.10 and 55¢, 40 ft per hour plus 11 per cent for engineer, $4.83 and 53¢	5.36
Mortar, ½-in joint, 9 cu ft	3.00
	$58.36

Or close to 60¢ per square foot. Tile is supposed to be at site for the price stated. This price might be much lower close to the yard.

Mortar. Local prices have to govern. Change the following ones to suit. Price might be 50 per cent less.

2 bbls best lime at $2.50	$5.00
1 cu yd of sand	2.75
2 hrs labor mixing	1.20
70 gals. water	0.10
	$9.05

These allowances make a cubic yard of mortar. The lime paste fills up the voids in the sand, and thus the quantities do not make up when mixed the separate totals.

The Natco specification calls for 1 part Portland cement, 3 parts sand and 1 part lime paste. Starting with a cubic yard of sand and allowing the cement and mortar to fill the voids and make up fully a cubic yard:

27 cu ft sand = 1 cu yd	$ 2.75
9 cu ft Portland cement = 2.4 bbls, say, 2½ at $3	7.50
9 cu ft lime paste, at 8 ft to barrel, allow 1 bbl	2.50
Labor mixing, 2 hrs at 60¢	1.20
	0.10
	$14.05

At this mix the 9 cu ft would cost $4.68 instead of $3; and the 4.6 $2.40 instead of $1.54.

The foregoing is a liberal allowance. The Lazell tables in The New Building Estimator's Handbook, for a mix of 1 cement to 3 sand and 10 per cent of hydrated lime give the following: 1.97 bbls cement, 0.83 cu yd sand, and 74 lbs of hydrated lime for a cubic yard of mortar.

Partition. For 100 sq ft allow as follows—the combination floor tile is used for partitions and furring of straight column work:

6-in tile, $104.00 per M. square feet	$10.40
Labor on tile, Table 1, wages, $1.20 and 60¢, 25 sq ft per hour.	7.20
Mortar, 4.6 cu ft	1.54
	$19.14

Or close to 20¢ per square foot, all depending upon local prices for both material and labor. No hoisting.

Here it may be well to note that "25 ft per hour" is not found in Table 1. The cost for any number not shown is easily found by dividing the total per hour by that number, in this case $1.80. Carried out far enough the answer is $7.20, for as 24 gives $7.50 it is clear that 25 must be close to it. A still easier method is to use 24 at $7.50, a difference on only 30¢ per 100 sq ft. Owing to various factors the figure might run to $8.57 or $6.67, on either side of the 24 column. In this valuation work there is no use making a pretence of mathematical accuracy. I was once set down alone in two railroad yards with perhaps a million dollars worth each of buildings to be valued; and two fine passenger

stations worth then about $750,000 of detailed special work. What is to be done when a limited time is set to get a fair idea of values? A good deal of work must be done on wholesale and not retail lines. It was. Several car loads of ornamental iron were "wholesaled" on one building at a figure that would have shocked the manufacturer, as was found from his original bid when it finally came. Other items averaged up matters and buried this sorrow. The motto that suits an appraiser is, "Do your best and leave the rest," with the certainty that when the lawyers get the summaries of the physical valuation they will add from 10 to 50 per cent to it, and so make quibbling look as silly as it really is.

Steel Sash and Doors

In buildings of fireproof construction, and in many others, such as machine shops and roundhouses, steel sash and windows are used in place of wood, both for fire protection and wearing qualities.

The cost of the fixed light sash runs from 21¢ to 30¢ per square foot, at Detroit without freight allowance, and from 30¢ to 45¢ for the ventilated. The number ordered of stock sizes has some effect upon the price, as with all building work. These prices do not include glass, or erection. The best glass size is 14″×20″. The price depends upon the kind selected. Hardware is included with the price per square foot.

The erection costs about 8¢ per square foot on the basis of $1 per hour for tradesmen and 60¢ for laborers.

The labor of glazing comes to 10¢ or 12¢ per square foot, including the putty. Each square foot of sash requires about ½ lb of putty. The rabbets are deep. The sash gets one coat of paint before being shipped. The finishing coat, or coats, has to be allowed for,—$1 per yard per coat.

Factory ribbed glass may run from 15 to 18¢ per square foot unset. Some kinds might run from 20¢ to 30¢ per square foot. See Glass chapter.

For freight purposes the various types of sash, unglazed, range from nearly 3 lbs to 5 lbs per square foot.

Hung Windows. The foregoing is for the large sash used in warehouses and workshops, and sometimes taking up as much as 80 per cent of the wall space. Ordinary windows hung are in a special class apart from the large ones. The price may run from 75¢ to $1.50 per square foot, delivered at job, unglazed. Installation from 15¢ to 25¢ per square foot extra. Glazing as for others, according to quality of glass.

The Dahlstrom windows are made for about $1.75 per square foot with glass supplied but not set. Pivoted windows, $1.20. The

labor on setting frames and installation is put at about 10 per cent more than for wood. These prices are for quantities from 25 up to 100.

Jambs and casings two sides, ordinary sizes	$ 24.00
Doors per square foot from	75¢ to $2.00
Transom above complete, extra	$ 15.00
Base mold per 100 ft	52.00
Chair rail per 100 ft	29.00
Picture mold per 100 ft	33.00
Glass partitions, no glass included, per 100 sq ft	260.00
Wainscoting per 100 sq ft	195.00

The foregoing primed only. For enamel add 10 per cent for straight work and 15 for moldings, etc. Partition and wainscoting about 6 per cent.

Installation, 2 carpenters will erect in 8 hrs 3 doors on wood bucks, and 2 on metal; 150 ft chair rail or picture mold; 100 ft base mold, 250 sq ft partition, 75 sq ft wainscoting.

Steel Buildings. Several companies are now making steel buildings of standard sizes ready for erection. Without freight, at Detroit or Youngstown, Ohio, allow about $1.60 per square foot erected. They are of a low type so framed that they can be dismantled for use at any point.

The following list from Knapp Bros. Mfg. Co., Chicago, gives a fair idea of the fireproof inside finishing that is becoming popular. The work is all supposed to be erected in place, fittings included.

Metal Cove Base, per linear foot: 4 in, 20 gauge black iron and grounds, 41¢. 6-in, same, 51¢. 4-in, No. 20, galvanized, 45¢; 6-in, No. 18, galvanized, 65¢. 4-in, No. 18, black, 54¢.

Flush Door and Window Casings, per linear foot in place: about 3′×7′ size: 20 galvanized and 24 mold, 30¢ down to 15¢ for some styles.

Window Stool, 4′×3⅞″, $2.85.

School Chalk Trough, 36¢ per linear foot.

Galvanized Iron Chair Rail, 39¢.

All material with one coat of paint.

Asbestos lumber as made by Johns-Manville or Keasbey and Mattison may be included in fireproof work. In general, the list price is 15¢ per square foot for ⅛-in thick, 22½ for $\frac{3}{16}$, 30 for ¼-in, and so on, adding 15¢ for each ⅛ in additional. Discount about 20 per cent.

For labor on plain walls allow from 9 to 12 squares per 8-hour day for two carpenters. For extra long plain walls, 10 to 12 squares.

Ambler Asbestos Building Lumber

Standard sizes of sheets, 42″×48″ and 42″×96″; $\frac{1}{8}$ in to 1 in thick. Color, Newport Gray. Sheets $\frac{1}{8}$ in thick are too thin for most purposes.

$\frac{1}{8}$ in thick.....	15¢	sq ft.	Approx. weight,	$1\frac{1}{3}$ lbs sq ft
$\frac{3}{16}$ in thick.....	22.5¢	sq ft.	Approx. weight,	2 lbs sq ft
$\frac{1}{4}$ in thick.....	30¢	sq ft.	Approx. weight,	$2\frac{2}{3}$ lbs sq ft
$\frac{3}{8}$ in thick.....	45¢	sq ft.	Approx. weight,	4 lbs sq ft
$\frac{1}{2}$ in thick.....	60¢	sq ft.	Approx. weight,	$5\frac{1}{3}$ lbs sq ft
$\frac{5}{8}$ in thick.....	75¢	sq ft.	Approx. weight,	$6\frac{2}{3}$ lbs sq ft
$\frac{3}{4}$ in thick.....	90¢	sq ft.	Approx. weight,	8 lbs sq ft
$\frac{7}{8}$ in thick.....	$1.05	sq ft.	Approx. weight,	$9\frac{1}{3}$ lbs sq ft
1 in thick.....	1.20	sq ft.	Approx. weight,	$10\frac{2}{3}$ lbs sq ft

Corrugated sheathing 25¢ per square foot.

CHAPTER X

PLASTER

Use of the Tables 1 to 8. Wages are arranged to suit any period. Lathers, for example, never get below 30¢ per hour or above $1.30; when they do, as perhaps in dull times in small villages for the low rate, and in war times for the high, the cases are so few as to be negligible for practical valuations. Extremes of yards per man per hour are also given.

In getting at the cost of lathing the appraiser may examine a part of a building and set the usual allowance of $12\frac{1}{2}$ yds per hour per man for labor. The 12 column in the table is close enough. If wages were 40¢ each yard cost 3.34¢, or $3.34 per 100; but if wages at the period of erection were $1.10 the rate per yard would be 9.17¢; and 70¢ wages would give 5.84, or 6¢, as a contractor would call it, for the decimals in the table would in such cases be disregarded.

On prong studs the metal lath is set at only 3 yds; in such a case the 3 column is taken instead of the 12, and at 90¢ wages each yard costs 30¢ for labor alone. On the plainest work with long stretches a possible 20 might be done: the 20 column is taken and at 40¢ wages the rate is 2¢ per yard, and at $1.20 war rates, 6¢. If only $1\frac{1}{2}$ yds can be done in an hour divide the 3 column rate by 2; if 9 yds are set, as with the average plaster board, add the 8 and 10 columns and divide by 2.

The number of yards being set after examination and the wage rate found, the labor is settled for wood or metal lath or plaster board.

Plaster. The labor on plaster is found in the same way, either by the single coat or complete. In Table A, for example, the ordinary kind of scratch coat work is set at 17 hrs for 1 plasterer and 1 laborer; in Table 4 the figures are for 1 and 1. The difference for 1 yd is so small that odd numbers were not considered necessary, and to get the 17 rate 16 plus 18 in Table 4 can be divided by 2 according to the wage rate selected. The brown coat at 125 yds is so close to 16 this figure may be used; and the white coat at $100 = 8\frac{1}{2}$ per hour, but Table 2 has to be used for this part, as the laborer's time is only half of the plasterer's.

Setting wages at 80¢ and 40¢ the 17-yd scratch coat comes to $7.09 and the 16-yd to $7.50; the $8\frac{1}{2}$ yds per hour comes to $11.80 = a total of $26.39 for labor, or 27¢ per yard in close enough figures, at the wage rate selected. Odd figures are shown in this illustration, but as a practical matter an experienced appraiser soon makes them even and forgets decimals. in running down a column for the total.

Quite often the total may be found as easily as the separate coat. In the case given 136 and 125, for scratch and brown, in Table A, may be added and divided by 2, for plasterer's and laborer's time are the same, and thus 130 suits for 8 hours = 16 yds per hour, decimals being unknown as too trifling. Doubling the 16 column rate at 80¢ and 40¢ equals $15, instead of $14.59, or $\frac{4}{10}$¢ per yard of difference. But accident, bad weather, waiting for material, or other cause or causes may cut the 136 down to 111 and the 125 to 93. Then how does the $\frac{4}{10}$¢ look?

Or take the best class of exterior work in Table C: 80 and 85 = 165, or an average of $82\frac{1}{2}$ yds in 8 hrs = 10.3 yds an hour. The greater the number of hours the less is the rate, so that from the practical standpoint, the 0.3 would be discarded and 10 only taken. As this work also is for 1 and 1, Table 4 has to be used. Running down column 10 to 80¢ and 40¢ and doubling for the two coats we find that the rate is 20¢ per yard. Of course, any wage rate may be used as well as 80¢ and 40¢.

Using rough cast and the best class of work the number of yards is close to 4 with 1 laborer to 2 tradesmen. Table 2 at 4 yds gives 25¢ per yard = a total per yard for labor alone of 45¢.

Big Doings. Table 5 gives figures as high as 28 yds per hour for 1 plasterer, and as this means a good deal of material on the heavy coats, $1\frac{1}{4}$ laborers are allowed to 1 plasterer. If a valuator upon inspection thinks this allowance can be made the table is ready—but it is far more than an average hour's work. The following figures are nevertheless given from the Gypsum Company:

"In plastering Pyrobar tile a plasterer can do 150 yds a day"—which is close to 19 yds an hour. "A plasterer will apply 175 to 200 yds per day of gypsum cement plaster, to wood lath. This on double back work, scratch coat and brown coat being applied at the same time."

"On Sackett plaster board a plasterer will apply 225 yds gypsum plaster per day. The lather who can apply 100 yrds of wood lath in a day will do between 125 and 150 yds of Sackett board at the start, and later on 200." All of which shows that Table 5 may be used for "slugging" work, but not as a steady allowance.

Material

Wood Lath. The table shows the great difference in numbers required,—1,475 to 3,660. For average work 1,500 lath at $12 per M. = 18¢ per yard. But with Kellastone and an $\frac{1}{8}$-in spacing 1,700 are required = 20½¢. Extra time has to be allowed for the narrow lath.

Metal Lath may be 28¢ near the factory for the cheapest kind, or 50¢ for the best where freight counts. Use local figure and allow 4 to 5 per cent for waste.

Plaster Board may run from 3½¢ per foot to 6½¢ A local price must be had.

Caen Stone may be allowed for labor at 5 yds per man with 1 laborer to 2 plasterers. This comes under Table 2. For some kinds of surfaces 1½ yds or even less might be an hour's work. If 1 yd is considered enough divide the 3 column by 3; if 1½, divide by 2. On columns, pilasters, short stretches and angles allow from 1 to 1½ yds per man per hour, blocking into squares.

The material costs about $2.40 per 100 lbs, and at $\frac{1}{8}$ in thick, 125 lbs covers 11 yds. This means for the finish coat only, and must be added to the other coats on wood or metal lath or masonry, as may be. If $\frac{1}{4}$ in finish is used double the $\frac{1}{8}$-in allowance of about 30¢ per yard for $\frac{1}{8}$ in.

Compo Board material, 7¢ per foot; Cornell board, 5¢; Upson, 4¼¢. Allow labor as set forth elsewhere.

Blackboard Plaster. After allowing the regular price for all work except the finish substitute a mixture of $\frac{1}{3}$ lime paste, $\frac{1}{3}$ fine white sand, $\frac{1}{3}$ plaster of Paris and enough lampblack to color and put on like white finish. Add approximately 25¢ to 30¢ per yard for this work.

For Scagliola allow $1 to $1.20 per square foot finished on plain work; and for columns, pilasters and special work, $1.50 to $2.

Plain Caen Stone Work per 100 Yards

Metal lath, 105 yds at 40¢	$ 42.00
Labor on lath 10 yds per hour at $1.10	11.00
Staples, 16 lbs at 10¢ for 12-in centers	1.60
2,200 lbs hard wall plaster for scratch and brown coats,	22.00
3 yds sand	8.00
Labor, 16 yds per hour at $1.20 and 60¢, Table 4, for 2 coats.	22.50
Water	0.15
Caen material, $\frac{1}{8}$ in thick	30.00
Caen labor	30.00
	$167.25

Labor on Lath

Metal Lath. For plain work in ordinary rooms, 12 yds per man per hour. On long stretches from 16 to 18. In small rooms, closets, under stairs, and such places 6 to 8 yds per hour. Around beams, circular work, and such special installations, 3 to 4 yds per man per hour. With some kinds of ornamental beams and cornices $1\frac{1}{2}$ yds per hour, and even less. All on the basis of nailing to wood in the ordinary way.

On metal studs of the prong kind or for wiring allow per man per hour 3 to 4 yds. This does not include the setting of studs. For ordinary ceiling heights of 9 and 10 ft allow 4 studs per man per hour, or at 12-in centers about 4 yds per man. Unless the ceiling is of extra height a few feet do not make so very much difference, for the labor of fastening at top and bottom and plumbing is about the same.

Metal lath on suspended ceilings 40 to 30 hrs for 1 man to 100 yds as an average, or $2\frac{1}{2}$ to $3\frac{1}{2}$ yds per hour. This is on the basis of the lather putting up the framework, and for large spaces. For some work 4 yds would be done. In small rooms and closets $1\frac{1}{2}$.

An approximate valuation would allow from 7 to 10 lbs per square foot for the framework of a ceiling of this kind, not including metal lath.

On metal lath outside work 12 yds to 15 per man per hour for ordinary walls, and 6 to 8 in small gables and corners. Cornice soffits, long, plain, 7 yds. Ornamental work 1 to 2 yds per man per hour.

Wood Lath

For the standard lath $1\frac{1}{2}'' \times 4'$ allow 100 yds per man per 8-hr day on ordinary work. This is $12\frac{1}{2}$ yds per hour. On long stretches 15 to 18 might be done, and in closets and such spaces, 5.

For valuation purposes the figures on metal lath may be used for wood also. There are some kinds of lath that take extra time, but a valuator who looks at a finished ceiling is not supposed to know what length or width was used. The 32-in takes a little more time than the 48-in, the 1-in than the $1\frac{1}{2}$-in, and the Kellastone is supposed to be set at a spacing of $\frac{1}{8}$ in instead of the ordinary about $\frac{15}{16}$ in to $\frac{3}{8}$ in. Studs or furring strips may be 10-in, 12-in, or 16-in centers, and this makes a difference; $12\frac{1}{2}$ at 16 in would be reduced to 10 per hour at 12 in; and the same at $1\frac{1}{2}$ would come to between 8 and 9 at 1 in.

Plaster Board. As an average for ordinary work allow 9 yds per man per hour. Some of the manufacturers give 14 for plain

work, and one record is set at 17, but 9 to 11 is a fair standard, and half of this in closets and small spaces. This does not include joint strips which may be set extra at 30 to 50 lin ft per hour.

Plaster Labor

Quality. The average house, store, church, or school is not plastered in a first class manner, but good average work is done and that is all that is expected; the best work is insisted on in city halls, courthouses, fine residences and office buildings. In the following tables the average yardage is given under A and the allowance for the best class under B. All openings are deducted.

TABLE A

Plaster Table Showing 8 Hours' Work for One Tradesman

	Scratch coat		Brown coat		White coat		Sand finish		Keene's cement	
	A	B	A	B	A	B	A	B	A	B
Yards	136	125	125	115	100	75	85	65	60	50
Plasterer's hours	8	8	8	8	8	8	8	8	8	8
Laborer's hours	8	8	8	8	$3\frac{1}{2}$	$3\frac{1}{2}$	4	4	4	2

Blocking. The last column of the allowance under Keene's cement, and such hard plasters for wainscoting, is for dividing into blocks.

TABLE B

Plaster Table Showing 8 Hours' Interior Work for One Tradesman with Portland Cement Mortar

	Scratch coat		Brown coat		Surfacing		Blocking	
	A	B	A	B	A	B	A	B
Yards	90	80	82	75	60	50	55	45
Plasterer's hours	8	8	8	8	8	8	8	8
Laborer's hours	8	8	8	8	3	3	2	2

TABLE C

Plaster Table Showing 8 Hours' Exterior Work for One Tradesman with Portland Cement or Hard Plasters

	Scratch coat		Brown coat		Float finish		Rough cast	
	A	B	A	B	A	B	A	B
Yards	90	80	82	85	45	35	40	30
Plasterer's hours	8	8	8	8	8	8	8	8
Laborer's hours	8	8	8	8	4	4	4	4

Gables. These allowances are based on average work and surfaces. In some gables and corners from a half to a third only might be done.

Average Quantities Required

Lath. The waste in metal lath is not very much, as it bends around all corners. Allow per 100 yds 104 to 107. If the lengths suit there should not be more than 107 even around beams and such special work. See under Small Plaster Extras for nails and staples.

TABLE D

Wood Lath Table

Length in inches	Width, inches	Spacing, inch	Number to 100 yards
48	$1\frac{1}{2}$	$\frac{3}{8}$	1,475
48	$1\frac{1}{2}$	$\frac{1}{4}$	1,590
48	$1\frac{1}{2}$	$\frac{1}{8}$	1,700
48	1	$\frac{3}{8}$	2,000
48	1	$\frac{1}{4}$	2,220
48	1	$\frac{1}{8}$	2,440
32	$1\frac{1}{2}$	$\frac{3}{8}$	2,200
32	$1\frac{1}{2}$	$\frac{1}{4}$	2,370
32	$1\frac{1}{2}$	$\frac{1}{8}$	2,540
32	1	$\frac{3}{8}$	3,000
32	1	$\frac{1}{4}$	3,330
32	1	$\frac{1}{8}$	3,660

Plaster Board. There is little waste with this material if the ceiling height suits. An allowance of 4 per cent should cover if studs are set right and if lengths suit. Add 10 to 12 lbs of nails per 1,000 sq ft.

Plaster on 100 Yds.

Plymouth Rock. This Iowa brand requires for 100 yds 900 lbs for 2-coat work, with 150 lbs of finishing for the putty coat. This for wood fiber plaster, and on wood lath; for masonry walls, 600 to 900 and 150 lbs finish. With $\frac{5}{8}$-in grounds and $\frac{1}{4}$-in key allow 1 ton for 120 to 140 yds. Some surfaces take twice as much as others.

For finish any one of four Plymouth brands will cover 100 yds with 100 lbs mixed with two parts of lime putty. Or 4 sacks of prepared sand finish.

Plymouth exterior stucco, 1 in thick, requires 1 ton for 50 to 65 yds on wood lath or plaster board, and the same for 40 to 50 yds on wire lath.

Exterior Plaster. For 100 yds on metal lath the Atlas allowance is at 1 in thick, 10 bbls Portland cement for 2-coat work and $4\frac{1}{2}$ cu yds sand; 2 bbls white cement for finish coat and $\frac{3}{4}$ cu yd white sand; on the basis of 1 cement to 3 parts sand. For a 2-in partition double the quantities.

Kellastone Covering Capacity. One ton covers from 55 to 60 sq yds. Thickness, $\frac{1}{2}$ in. Brick walls, 65 yds may be covered if they are straight. The surface has always to be considered, as the figures are only approximate, and as a manufacturer's average. Openings not deducted.

TABLE E

Number of 100-pound Sacks to 100 Square Yards on

Wood lath	Metal lath	Plaster board	Brick or tile walls	American gypsum block
9 to 11 Sanded 2 to 1	17 to 20 Sanded 2 to 1	8 to 9 Sanded 2 to 1	16 to 17 Sanded 3 to 1	10 to 12 Sanded 3 to 1

Extras. If extra thickness is wanted, as with solid partitions on metal, for example, the quantities may easily be had in proportion to the table. As a rule, manufacturers are apt to keep the allowance down as low as possible.

Varying Thickness. Another standard table is listed as a comparison;

TABLE F

NUMBER OF SQUARE FEET OF WALL SURFACE COVERED PER SACK OF CEMENT, FOR DIFFERENT PROPORTIONS AND VARYING THICKNESS OF PLASTERING

Proportions of mixture	Materials			Total thickness of plaster				
	Sacks cement	Cubic feet sand	Bushels hair *	½ in Square feet covered	¾ in Square feet covered	1 in Square feet covered	1¼ in Square feet covered	1½ in Square feet covered
1 : 1	1	1	⅛	33.0	22.0	16.5	13.2	11.0
1 : 1½	1	1½	⅛	42.0	28.0	21.0	16.0	14.0
1 : 2	1	2	⅛	50.4	33.6	25.2	20.1	16.8
1 : 2½	1	2½	⅛	59.4	39.6	29.7	23.7	19.8
1 : 3	1	3	⅛	67.8	45.2	33.9	27.1	21.6

* Used in scratch coat only on lath.

NOTE. These figures are based on average conditions and may vary 10 per cent either way, according to the quality of the sand used. No allowance is made for waste.

Thick Partitions. For 1¾ in to 2 in allow 4,300 lbs of hard wall plaster, 4 yds sand, and 200 lbs white finish.

Two-coat Work. Allow 1,050 lbs of hard wall plaster and 100 lbs finish, on wood lath.

Three-coat Dry Work. Allow 1,600 lbs of hard wall plaster and 100 lbs white finish, on wood lath.

Three Coats on Metal Lath. Allow 2,200 lbs. hard plaster and 100 lbs. finish.

Sand. For two-coat work on wood lath or straight masonry walls allow 2 yds; for three-coat work on metal lath allow 3 cu yds. These are a trifle high, which suits for valuation.

Lime. If this is used for a white coat allow 2 bbls to 100 yds, or 150 lbs of plaster of Paris.

The old style of finish was by line. Allowance for 100 yds: 3½ bbls lime, 1½ to 2 yds sand, 2 bu hair, 100 lbs plaster of Paris.

TABLE G

Prices at $1.00 per Hour, with Profit

	Per yard
Two-coat work (white finish) on wood lath	$0.85
Three-coat dry (white finish) on wood lath	.95
Three-coat dry (white finish) on metal lath	1.35
Keene's cement (white finish) on wood lath	1.00
Keene's cement (white finish) on metal lath	1.40
For sand finish add	.08
For work on brick or tile deduct from wood lath price	.10
Without finish coat deduct	.15
For back plaster on wood lath	.80
Sackett board, brown and white coats	1.00
Pure or "Neat" Portland cement work, metal lath, on gables (reasonable quantities)	2.50
Neat Portland on plain walls, metal lath	1.75
Blocking to represent tile in bath rooms	2.50
Keene's cement base, 10 in linear foot	.35
Portland cement base, 10 in	.40
Plain plaster of Paris molds per inch of girt	.15
Metal lath on steel prong studs, plaster $1\frac{3}{4}$ in thick measured on one side only (no studs)	3.20
For heating allow	.07
Rough coat behind wainscot on wood lath	.65
Compo-board, material only	.60

Above prices are based on solid work, that is, openings deducted, but contractors' profit included.

Small Plaster Extras

Water. This item is not included in any of the summaries of cost. The price differs in cities. In some the rate is 15¢ per 100 sq yds for the ordinary thickness.

Heat. In making an appraisal the finished plaster is seen. It may have been on the wall a quarter of a century, and the season of the year is not considered. In the time of ordinary wages and prices of coal an allowance of 3¢ to 4¢ extra per yard was often made for heat, but war prices were twice as high.

Nails. Allow 10 lbs of 3d nails at about 7¢ per pound, for 100 yds; and about 40 per cent extra if the narrow lath is used. This for 16-in centers; with 12-in centers from 12 to 13 lbs for the

wide lath, and 40 per cent more for the narrow. With 70¢ in the first case this is less than a cent per yard; and even the narrow lath at 12 in comes to only 1¼¢ per yard. The short or 32-in lath requires more nails than the standard 48, but even with this, 12-in centers, and narrow lath, nails will not run to more than 1½¢ per yard.

Staples. Metal lath is stapled on, but some of the manufacturers are in favor of nails bent over. Allow 12 lbs of staples per 100 yds for the 16-in, and 16 lbs for the 12-in centers, at 10¢ per pound. Approximately, 1¼¢ to 1½¢ per yard.

Hair. Where used to the old extent of 2 bu to 100 yds the cost is about 2¢ per yard, or $1 per bushel. The labor of mixing is included in the general figure.

A Few 1923 Prices. Metal lath from 31¢ per yard to 41¢. Short wood lath, $6; 48-in, $11 per 1,000. Portland cement, $3.20 per barrel; Keene's cement, per sack, $1.30; lime, $2.20 to $2.95 per barrel of 200 lbs; plaster per sack of 100 lbs, $0.86; molding plaster, $1.05; hair, $1 per bushel; sand, $2.35 per ton; Sackett board, $40.00 per 1,000 ft, ⅜ in; Bishopric stucco board, 5½¢ to 6½¢ per foot—high price is creosoted.

Cornices

On the wage basis of $1 per hour for plasterer and 60¢ for laborer allow as follows for the finishing work of straight cornices. For 6-in girth per linear foot, 40¢; 9-in, 60¢; 12-in, 70¢; 16-in, $1; 24-in, $1.50. For wider cornices allow by the square foot price on the foregoing basis: For separate moldings make a separate allowance. The usual style of egg and dart molding runs to about 20¢ per foot. For circular cornices multiply by 4; for elliptical, by 6.

The foregoing figures are on the basis of all rough work being included with the ordinary plastering, and are thus for finishing only.

Ornamental Plastering

Prices on Cast Work. Plasterers usually buy egg and dart and such work already cast, and have only the labor of setting. A few prices on a 1923 basis are given here for material unset: Discount, as for capitals:

TABLE H

Size, inches	Price per foot	Size, inches	Price per foot
$2\frac{1}{2}\times2\frac{1}{4}$	30¢	$1\frac{1}{8}\times2$	20¢
$1\times\frac{3}{4}$	12	$\frac{1}{2}\times\frac{1}{2}$	8
$\frac{3}{4}\times1\frac{5}{8}$	30	$\frac{5}{8}\times1\frac{3}{8}$	20
$\frac{1}{2}\times4\frac{3}{4}$	50	$\frac{3}{8}\times5\frac{1}{2}$	50
$\frac{5}{8}\times13\times14$ wreath	50	$4\times2\frac{1}{8}$	36
$3\frac{1}{2}\times3\frac{1}{2}$	38	$2\frac{1}{4}\times12$	60
1×12	70		

The particular mold of this flat work does not matter so very much, as the soft material fits into any form.

Rolls for arches:

$6''\times13''$.....	\$1.00	$2''\times7\frac{1}{2}''$.....	\$0.40
$9''\times11''$.....	1.60	$3\frac{1}{2}''\times14''$.....	1.20

Frieze Ornaments. On 50 designs less than $\frac{3}{4}$ in thick by 4 in to 12 in high the undiscounted prices run from 10¢ per foot to 30¢; from 14 in to 18 in, 50¢ to 80¢.

Torches. 1 in to 20 in, \$1.30; $8\frac{1}{2}\times4'\,7''$, \$5; $5''\times37''$, \$2.50.

Wreaths, Ovals, Festoons. $1\frac{1}{2}''\times21''\times6'$, \$6; $\frac{1}{2}''\times6'\times6'$, \$6; $\frac{3}{4}''\times25''\times20''$, \$2; $\frac{3}{4}''\times4'\,5''\times4'\,7''$, \$12; $\frac{3}{8}$-in festoon by $8''\times28''$, \$1.50.

Corner and Center Ornaments. Corner, $1''\times4'\times4'$, \$9; $\frac{1}{2}''\times3'\times3'$, \$6; $\frac{3}{8}''\times22''\times17''$, \$2, center.

Rosettes. $1\frac{1}{2}''\times15''\times30''$, \$3; $1\frac{3}{4}''\times16''\times16''$, \$1.30; square center, $1\frac{1}{2}''\times4'\,6''\times4'\,6''$, \$20; $\frac{3}{4}''\times28''\times28''$, square, \$4; $\frac{1}{2}''\times4'\times4'$, semicircle, \$5.

Centers. $2\frac{1}{2}''\times4'\,10''$ radius, \$30; $\frac{3}{8}''\times31''$ diameter, \$6; $\frac{1}{4}''\times18''$, \$2; $\frac{3}{4}''\times48''$ diameter, feathery style, \$14.

Wreaths. $6''\times12''\times7'$ diameter, \$24; $4''\times4'\,2''$ diameter, \$9; $2''\times6'$ diameter, \$12.

Festoons. 1-in relief, 12 in to 20 in deep, 3 ft to 4 ft long, \$2 to \$4 each, not discounted.

Friezes. A large number 1-in to 2-in relief, 12 in to 24 in high, per linear foot, 60¢ to \$1. Coves about the same.

Balcony Fronts. From 21 in to 30 in high, \$1.30 to \$2 per linear foot.

Cornices. These are the cast kind—not run in place. With projections of 5 in to 9 in, and heights of 12 in to 20 in the undiscounted prices run from 75¢ to $1.20 per foot unset, as all this cast work is. One pattern, 15 in high by 20-in projection, $1.50.

Pilasters and Columns. For 3-in relief, 18 in wide by 6 ft high, $15; 2-in relief, 4 ft high by 9 in wide, $4.

Panel Work, Large. Per square foot, 70¢ to $1.

Labor on Cornices

Average rooms are assumed. Long stretches are easier to put in place than short ones with many miters.

The material is all cast as shown and set in place as if of wood. The joints are carefully filled at the ends and along the wall and ceiling. The time is given for one plasterer and one laborer on the basis of linear feet.

TABLE I

Labor Time on Cast Cornices				Labor Time on Pilasters and Paneling			
Size, inches	Plasterer hours	Laborer hours	Linear feet	Size, inches	Plasterer hours	Laborer hours	Linear feet
8×16	8	3	40	20 in wide	8	3	40
5×12	8	3	50	20 in wide	8	3	35
15×20	8	3	20	16 in wide	8	3	45
9×20	8	3	30	9 in wide	8	3	70
7×16	8	3	40				

Labor on Ornamental Plaster

General. Where there are flowers and ornamental work on half capitals and brackets going against the wall, add about a third extra time for plasterer only to that given for straight work in the table. Where there are many capitals and brackets to set deduct a fourth of the time in the table. Time is given for one plasterer and one laborer on one piece.

TABLE J

Labor Table on Capitals			Labor Time on Brackets		
Sizes, inches	Plasterer hours	Laborer hours	Sizes, inches	Plasterer hours	Laborer hours
3×4 high to 6×10	3	½	3×3×12 to 8×7×7	3	½
7×10 to 12×18	4	½	9×18×10 to 16×14×17	4	½
13×20 to 18×26	5	½			
19×27 to 24×36	6	¾			

TABLE K

Labor Time on Flat Wall Panel Strips and Moldings

¼″×2″ to ⅜″×5″	8	3	100 ft
3″×3″ to 4″×7″	8	3	100 ft
½″×¾″ to 1″×2″, 2″×2″	8	3	150 ft

Center Piece, 41-in diameter, 6 hours for plasterer and 2 for laborer.

Center Piece, 24-in diameter, 3 hours for plasterer and 1 hour for laborer.

Clock Ornament, 8′×4′, 12 hours for plasterer and 4 hours for laborer.

Festoons, 3′×18″, 4 hours for plasterer and 1 hour for laborer.

Festoons, 4 ft to 5 ft 8 in, light work, 3 hours for plasterer and 1 hour for laborer.

Composition Capitals and Brackets

Number Listed. In the standard catalogs each column and pilaster capital has 28 different sizes, most of the columns from 3 in diameter by 4 in high to 24 in diameter by 36 in high. The pilasters from 3 in wide by 4 in high to 24 in by 36 in. There are 32 styles represented, which multiplied by 28 different sizes of each means 896. The same applies to the pilaster capitals.

Material. Capitals and brackets are made in three different materials: (1) Exterior composition, weatherproof; (2) Interior

composition to match any wood; (3) Fibrous plaster for interior plaster finish. No. 2 costs 50 per cent more than No. 1.

Measurement. Capital, height over all; diameter, at neck of column; width, at neck of pilaster.

Prices. Pilaster capitals which are one-half or less of a full square capital are one-half the price of a full column capital. If more than one-half the price is the same as a full column capital.

Average. The prices for 27 sizes are given in the accompanying table, and they apply to all styles inside of such sizes. They are based for Nos. 1 and 3; for No. 2 add 50 per cent.

Lower Heights. The last column in the table is for capitals of columns and pilasters of less height than in the second column, but of the same width. The prices are lower for the small sizes, but not so much different for the large ones. The prices are based on the illustration Modern Ionic, and pilaster of same style. Some styles of the low capitals are cheaper. Most of the low capitals are entitled Modern Ionic. Two are shown.

Illustrations. A few are given out of a score of typical capitals of the heights given in the table.

Bases. For cast plain ones allow half the cost of the ornamental capitals. For setting see labor on capitals and allow one-half. For labor complete on a 12-in round column allow 16 to 24 hrs for 1 man. Molded work, not cast, but worked on job.

TABLE L

Column and Pilaster Capitals: Discount in 1923, 30 per cent

Diameter, inches	Height, inches	Price, each	Lower Height, inches	Price, each
$3\frac{3}{4}$	$5\frac{1}{4}$	\$2.15 to \$2.70	3	\$2.10
$4\frac{1}{2}$	7	3.30 " 4.15	$3\frac{1}{2}$	2.60
$5\frac{1}{2}$	$7\frac{7}{8}$	4.00 " 5.00	$3\frac{3}{4}$	3.50
$6\frac{1}{2}$	10	3.85 " 4.80	4	3.90
8	12	4.85 " 6.00	$5\frac{5}{8}$	5.25
9	$13\frac{7}{8}$	5.90 " 7.30	$6\frac{1}{4}$	6.75
10	$15\frac{3}{8}$	6.55 " 8.15	7	9.00
12	18	8.30 " 10.40	$8\frac{1}{8}$	11.90
14	21	10.40 " 13.00	$8\frac{3}{4}$	15.00
16	23	13.00 " 16.25	10	18.00
18	26	15.30 " 19.00	$11\frac{1}{2}$	19.00
20	29	19.65 " 24.55	13	22.00
24	36	30.50 " 38.00	$16\frac{1}{2}$	28.00

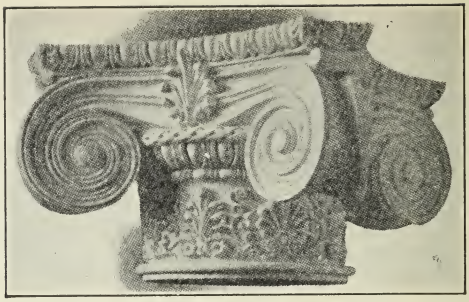


Fig. 52.—Modern Ionic Column Capital

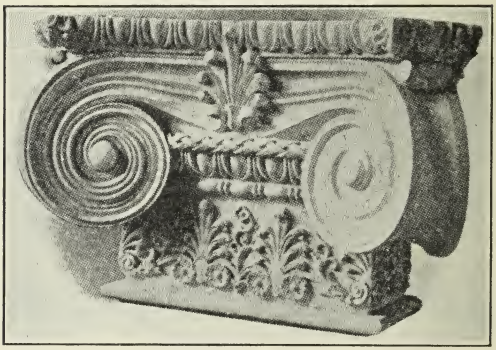


Fig. 53.—Modern Ionic Pilaster Capital.

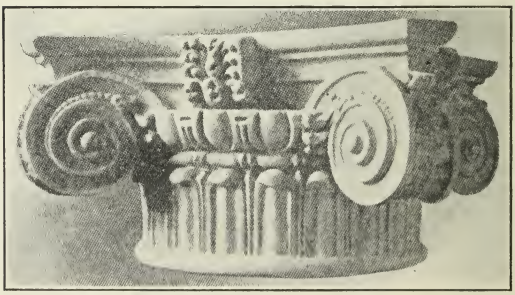


Fig. 54.—Modern Ionic Column Capital.

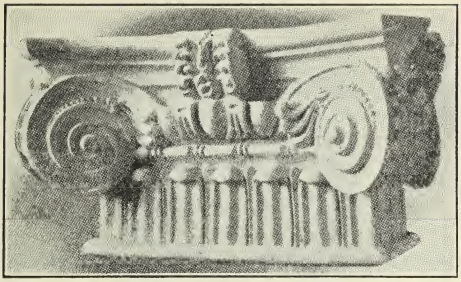


Fig. 55.—Modern Ionic Pilaster Capital.

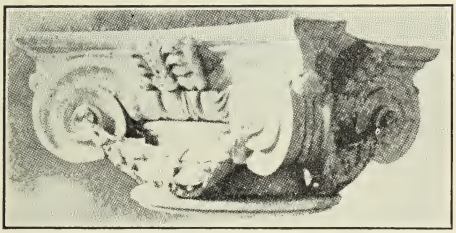


Fig. 56.—Modern Ionic Column Capital.

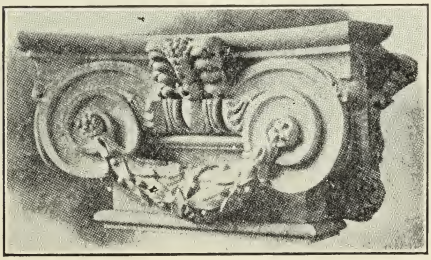


Fig. 57.—Modern Ionic Pilaster Capital.

BRACKETS

These are of many styles and sizes. As a fair average the illustrations A and B are given and priced.

TABLE M

BRACKET A: DISCOUNT 1923, 30 PER CENT

Face width, inches	Abacus width, inches	Projection, inches	Height, inches	Price	Face width, inches	Abacus width, inches	Projection, inches	Height, inches	Price
				$					$
3	$3\frac{3}{4}$	3	12	3.75	7	$8\frac{3}{4}$	7	24	5.40
4	5	4	14	4.15	8	10	8	28	5.85
$4\frac{7}{8}$	$5\frac{1}{2}$	$4\frac{7}{8}$	17	4.60	$10\frac{1}{2}$	12	$10\frac{1}{2}$	32	8.35
$5\frac{1}{2}$	$6\frac{1}{2}$	$5\frac{1}{2}$	20	5.00					

TABLE N

BRACKET B: DISCOUNT 30 PER CENT

Face width, inches	Abacus width, inches	Projection, inches	Height, inches	Price,	Face width, inches	Abacus width, inches	Projection, inches	Height, inches	Price
				$					$
3	4	$2\frac{3}{4}$	$3\frac{1}{2}$	1.80	12	14	9	12	4.00
4	$5\frac{1}{2}$	$3\frac{1}{2}$	$4\frac{1}{2}$	2.00	14	$15\frac{3}{4}$	12	$15\frac{1}{2}$	5.00
6	$7\frac{1}{2}$	$5\frac{1}{2}$	7	2.30	16	18	14	$17\frac{1}{2}$	6.00
9	12	$13\frac{3}{4}$	13	3.10					

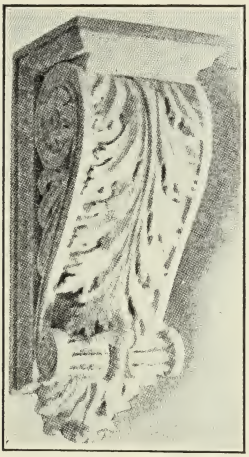


Fig. 58.—Bracket A.

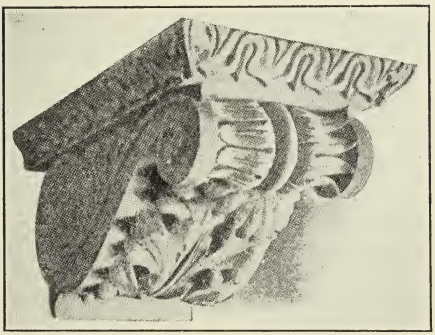


Fig. 59.—Bracket B.

TABLE 1

Cost of Labor on Wood or Metal Lath, Plaster Board or Wall Board per 100 Yards

Rate per hour	Number of yards nailed on per hour by 1 man												
	3	4	5	6	8	10	12	14	16	18	20	22	24
$0.30	$10.00	7.50	6	5.00	3.75	3	2.50	2.13	1.90	1.67	1.50	1.37	1.25
.40	13.34	10.00	8	6.67	5.00	4	3.34	2.86	2.50	2.23	2.00	1.82	1.67
.50	16.67	12.50	10	8.34	6.25	5	4.17	3.57	3.13	2.78	2.50	2.28	2.09
.60	20.00	15.00	12	10.00	7.50	6	5.00	4.29	3.75	3.34	3.00	2.73	2.50
.70	23.34	17.50	14	11.67	8.75	7	5.84	5.00	4.38	3.89	3.50	3.18	2.92
.80	26.67	20.00	16	13.34	10.00	8	6.67	5.72	5.00	4.45	4.00	3.64	3.34
.90	30.00	22.50	18	15.00	11.25	9	7.50	6.43	5.63	5.00	4.50	4.09	3.75
1.00	33.34	25.00	20	16.67	12.50	10	8.34	7.14	6.25	5.56	5.00	4.55	4.17
1.10	36.67	27.50	22	18.34	13.75	11	9.17	7.86	6.88	6.11	5.50	5.00	4.59
1.20	40.00	30.00	24	20.00	15.00	12	10.00	8.57	7.50	6.67	6.00	5.46	5.00
1.30	43.34	32.50	26	21.67	16.25	13	10.84	9.29	8.13	7.22	6.50	5.91	5.42

TABLE 2

Cost of Labor on Plaster per 100 Yards

Rate per hour for plasterer	Rate per hour for laborer	Rate per hour 1 with ½	Number of yards finished per hour by 1 man per coat or complete												
			3	4	5	6	8	10	12	14	16	18	20	22	24
$0.40	0.20	0.50	16.67	12.50	10.00	8.34	6.25	5.00	4.17	3.57	3.13	2.78	2.50	2.28	2.09
.50	.25	.63	21.00	15.75	12.60	10.50	7.88	6.30	5.25	4.50	3.94	3.50	3.15	2.87	2.63
.60	.30	.75	25.00	18.75	15.00	12.25	9.38	7.50	6.25	5.36	4.69	4.17	3.75	3.41	3.13
.70	.35	.88	29.34	22.00	17.60	14.67	11.00	8.80	7.34	6.29	5.50	4.89	4.40	4.00	3.67
.80	.40	1.00	33.34	25.00	20.00	16.67	12.50	10.00	8.34	7.15	6.25	5.56	5.00	4.55	4.17
.90	.45	1.13	37.67	28.25	22.60	18.83	14.13	11.30	9.42	8.07	7.07	6.28	5.65	5.14	4.71
1.00	.50	1.25	41.67	31.25	25.00	20.83	15.63	12.50	10.42	8.93	7.82	6.95	6.25	5.69	5.21
1.10	.55	1.38	46.00	34.50	27.60	23.00	17.25	13.80	11.50	9.86	8.63	7.67	6.90	6.28	5.75
1.20	.60	1.50	50.00	37.50	30.00	25.00	18.75	15.00	12.50	10.72	9.38	8.34	7.50	6.82	6.25
1.30	.65	1.63	54.34	40.75	32.60	27.17	20.38	16.30	13.59	11.65	10.19	9.06	8.15	7.41	6.80
1.40	.70	1.75	58.34	43.75	35.00	29.17	21.88	17.50	14.59	12.50	10.94	9.73	8.75	7.96	7.30
1.50	.75	1.88	62.67	47.00	37.60	31.34	23.50	18.80	15.67	13.43	11.75	10.45	9.40	8.55	7.84
For each 5¢ diff. in Col. 2			83¢	63¢	50¢	41¢	31¢	25¢	21¢	18¢	15¢	14¢	13¢	11¢	10¢

TABLE 3
Cost of Labor on Plaster per 100 Yards

Rate per hour for plasterer	Rate per hour for laborer	Rate per hour 1 with ¾	Number of yards finished per hour by 1 man per coat or complete												
			5	6	7	8	10	12	14	16	18	20	22	24	26
$0.40	0.20	0.55	11.00	9.17	7.86	6.88	5.50	4.59	3.93	3.44	3.06	2.75	2.50	2.30	2.12
.50	.25	.69	13.80	11.50	9.86	8.63	6.90	5.75	4.93	4.32	3.84	3.45	3.14	2.88	2.66
.60	.30	.83	16.60	13.83	11.86	10.38	8.30	6.92	5.93	5.19	4.62	4.15	3.78	3.46	3.20
.70	.35	.97	19.40	16.17	13.86	12.13	9.70	8.09	6.93	6.07	5.39	4.85	4.41	4.05	3.73
.80	.40	1.10	22.00	18.34	15.72	13.75	11.00	9.17	7.86	6.88	6.12	5.50	5.00	4.59	4.23
.90	.45	1.24	24.80	20.67	17.72	15.50	12.40	10.34	8.86	7.75	6.89	6.20	5.64	5.17	4.77
1.00	.50	1.38	27.60	23.00	19.72	17.25	13.80	11.50	9.86	8.63	7.67	6.90	6.28	5.75	5.31
1.10	.55	1.52	30.40	25.34	21.72	19.00	15.20	12.67	10.86	9.50	8.45	7.60	6.91	6.34	5.85
1.20	.60	1.65	33.00	27.50	23.57	20.63	16.50	13.75	11.79	10.32	9.17	8.25	7.50	6.88	6.35
1.30	.65	1.79	35.80	29.84	25.57	22.38	17.90	14.92	12.79	11.19	9.95	8.95	8.14	7.46	6.89
1.40	.70	1.93	38.60	32.17	27.57	24.13	19.30	16.09	13.79	12.07	10.73	9.65	8.78	8.05	7.43
1.50	.75	2.07	41.40	34.50	29.57	25.88	20.70	17.25	14.79	12.94	11.50	10.35	9.41	8.63	7.97
For each 5¢ diff. in Col. 2			75¢	62¢	53¢	46¢	38¢	31¢	26¢	23¢	20¢	19¢	17¢	15¢	14¢

TABLE 4
Cost of Labor on Plaster per 100 Yards

Rate per hour for plasterer	Rate per hour for laborer	Rate per hour 1 with 1	Number of yards finished per hour by 1 man per coat or complete												
			7	8	9	10	12	14	16	18	20	22	24	26	28
$0.40	0.20	0.60	8.57	7.50	6.67	6.00	5.00	4.29	3.75	3.34	3.00	2.73	2.50	2.31	2.15
.50	.25	.75	10.71	9.38	8.34	7.50	6.25	5.36	4.69	4.17	3.75	3.41	3.13	2.89	2.68
.60	.30	.90	12.86	11.25	10.00	9.00	7.50	6.43	5.63	5.00	4.50	4.09	3.75	3.47	3.22
.70	.35	1.05	15.00	13.13	11.67	10.50	8.75	7.50	6.57	5.84	5.25	4.78	4.38	4.04	3.75
.80	.40	1.20	17.14	15.00	13.34	12.00	10.00	8.57	7.50	6.67	6.00	5.46	5.00	4.62	4.29
.90	.45	1.35	19.29	16.88	15.00	13.50	11.25	9.64	8.44	7.50	6.75	6.14	5.63	5.19	4.82
1.00	.50	1.50	21.43	18.75	16.67	15.00	12.50	10.72	9.38	8.34	7.50	6.82	6.25	5.77	5.36
1.10	.55	1.65	23.57	20.63	18.34	16.50	13.75	11.79	10.32	9.17	8.25	7.50	6.88	6.35	5.90
1.20	.60	1.80	25.72	22.50	20.00	18.00	15.00	12.86	11.25	10.00	9.00	8.19	7.50	6.93	6.43
1.30	.65	1.95	27.86	24.38	21.67	19.50	16.25	13.93	12.19	10.84	9.75	8.87	8.13	7.50	6.97
1.40	.70	2.10	30.00	26.25	23.34	21.00	17.50	15.00	13.13	11.67	10.50	9.55	8.75	8.08	7.50
1.50	.75	2.25	32.15	28.13	25.00	22.50	18.75	16.08	14.07	12.50	11.25	10.23	9.38	8.66	8.04
For each 5¢ diff. in Col. 2			72¢	63¢	55¢	50¢	42¢	35¢	31¢	27¢	25¢	23¢	21¢	19¢	17¢

TABLE 5

Cost of Labor on Plaster per 100 Yards

Rate per hour for plasterer	Rate per hour for laborer	Rate per hour 1 with 1¼	Number of yards finished per hour by 1 man per coat or complete												
			7	8	9	10	12	14	16	18	20	22	24	26	28
$0.40	0.20	0.65	9.29	8.13	7.23	6.50	5.42	4.65	4.07	3.61	3.25	2.96	2.71	2.50	2.33
.50	.25	.82	11.72	10.25	9.11	8.20	6.83	5.86	5.13	4.56	4.10	3.73	3.41	3.16	2.93
.60	.30	.98	14.00	12.25	10.89	9.80	8.17	7.00	6.13	5.46	4.90	4.46	4.08	3.77	3.50
.70	.35	1.14	16.29	14.25	12.67	11.40	9.50	8.15	7.13	6.34	5.70	5.18	4.75	4.39	4.08
.80	.40	1.30	18.57	16.25	14.45	13.00	10.83	9.29	8.13	7.23	6.50	5.91	5.41	5.00	4.65
.90	.45	1.47	21.00	18.38	16.34	14.70	12.25	10.50	9.19	8.17	7.35	6.69	6.13	5.66	5.25
1 00	.50	1.63	23.29	20.38	18.11	16.30	13.59	11.65	10.19	9.06	8.15	7.41	6.80	6.27	5.83
1.10	.55	1.79	25.57	22.38	19.89	17.90	14.92	12.79	11.19	9.95	8.95	8.14	7.46	6.89	6.40
1.20	.60	1.95	27.86	24.38	21.67	19.50	16.25	13.93	12.19	10.84	9.75	8.87	8.13	7.50	6.97
1.30	.65	2.12	30.29	26.50	23.56	21.20	17.67	15.14	13.25	11.78	10.60	9.64	8.83	8.16	7.57
1.40	.70	2.28	32.57	28.50	25.34	22.80	19.00	16.29	14.25	12.67	11.40	10.37	9.50	8.77	8.15
1.50	.75	2.44	34.86	30.50	27.11	24.40	20.34	17.43	15.25	13.56	12.20	11.09	10.17	9.39	8.72
For each 5¢ diff. in Col. 2			89¢	78¢	69¢	63¢	52¢	44¢	38¢	35¢	31¢	28¢	26¢	24¢	22¢

TABLE 6
Hard Wall Plaster Only

Cost of material per 100 sq yds at various allowances, thicknesses, and prices per ton

Pounds per 100 yds	Prices per ton									
	$8	10	12	14	16	18	20	22	24	26
400	1.60	2	2.40	2.80	3.20	3.60	4	4.40	4.80	5.20
600	2.40	3	3.60	4.20	4.80	5.40	6	6.60	7.20	7.80
800	3.20	4	4.80	5.60	6.40	7.20	8	8.80	9.60	10.40
1,000	4.00	5	6.00	7.00	8.00	9.00	10	11.00	12.00	13.00
1,200	4.80	6	7.20	8.40	9.60	10.80	12	13.20	14.40	15.60
1,400	5.60	7	8.40	9.80	11.20	12.60	14	15.40	16.80	18.20
1,600	6.40	8	9.60	11.20	12.80	14.40	16	17.60	19.20	20.80
1,800	7.20	9	10.80	12.60	14.40	16.20	18	19.80	21.60	23.40
2,000	8.00	10	12.00	14.00	16.00	18.00	20	22.00	24.00	26.00
2,200	8.80	11	13.20	15.40	17.60	19.80	22	24.20	26.40	28.60
2,400	9.60	12	14.40	16.80	19.20	21.60	24	26.40	28.80	31.20
2,600	10.40	13	15.60	18.20	20.80	23.40	26	28.60	31.20	33.80
2,800	11.20	14	16.80	19.60	22.40	25.20	28	30.80	33.60	36.40

TABLE 7
Portland Cement Plaster Only

Cost of material per 100 sq yds at various allowances.

Pounds per 100 yds	Prices per barrel (Put at 400 lbs even figures)										
	$1.00	1.20	1.40	1.60	1.80	2.00	2.40	2.80	3.20	3.60	4.00
800	2.00	2.40	2.80	3.20	3.60	4.00	4.80	5.60	6.40	7.20	8.00
1,000	2.50	3.00	3.50	4.00	4.50	5.00	6.00	7.00	8.00	9.00	10.00
1,200	3.00	3.60	4.20	4.80	5.40	6.00	7.20	8.40	9.60	10.80	12.00
1,400	3.50	4.20	4.90	5.60	6.30	7.00	8.40	9.80	11.20	12.60	14.00
1,600	4.00	4.80	5.60	6.40	7.20	8.00	9.60	11.20	12.80	14.40	16.00
1,800	4.50	5.40	6.30	7.20	8.10	9.00	10.80	12.60	14.40	16.20	18.00
2,000	5.00	6.00	7.00	8.00	9.00	10.00	12.00	14.00	16.00	18.00	20.00
2,200	5.50	6.60	7.70	8.80	9.90	11.00	13.20	15.40	17.60	19.80	22.00
2,400	6.00	7.20	8.40	9.60	10.80	12.00	14.40	16.80	19.20	21.60	24.00
2,600	6.50	7.80	9.10	10.40	11.70	13.00	15.60	18.20	20.80	23.40	26.00
2,800	7.00	8.40	9.80	11.20	12.60	14.00	16.80	19.60	22.40	25.20	28.00

TABLE 8
Sand Only

Cost of material per 100 sq yds at various allowances and prices per cubic yard

No. of cubic yards per 100 sq yds	Prices per cubic yard													
	$0.30	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.20	2.40	2.60	3.00
¼	0.075	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.75
½	.15	.20	.30	.40	.50	.60	.70	.80	.90	1.00	1.10	1.20	1.30	1.50
¾	.225	.30	.45	.60	.75	.90	1.05	1.20	1.35	1.50	1.65	1.80	1.95	2.25
1	.30	.40	.60	.80	1.00	1.20	1.40	1.60	1.80	2.00	2.20	2.40	2.60	3.00
1¼	.375	.50	.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.75
1½	.45	.60	.90	1.20	1.50	1.80	2.10	2.40	2.70	3.00	3.30	3.60	3.90	4.50
1¾	.525	.70	1.05	1.40	1.75	2.10	2.45	2.80	3.15	3.50	3.85	4.20	4.55	5.25
2	.60	.80	1.20	1.60	2.00	2.40	2.80	3.20	3.60	4.00	4.40	4.80	5.20	6.00
2¼	.675	.90	1.35	1.80	2.25	2.70	3.15	3.60	4.05	4.50	4.95	5.40	5.85	6.75
2½	.75	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.00	6.50	7.50
2¾	.825	1.10	1.65	2.20	2.75	3.30	3.85	4.40	4.95	5.50	6.05	6.60	7.15	8.25
3	.90	1.20	1.80	2.40	3.00	3.60	4.20	4.80	5.40	6.00	6.60	7.20	7.80	9.00

PLASTER TABLES

Directions for using the following tables, which any builder and contractor will find very valuable as each table has been verified and can be relied upon as correct.

(These tables give the number of square yards and feet in several thousand sized rooms)

Example

To obtain the number of square yards in a room 12×15×7. Turn to the table giving measurement of rooms with 7-ft ceiling; follow down the column of figures on the left until you come to 12, then follow the figures to the right until you come to the figures directly under the figure 15, at the top of the page; the answer is 62 sq yds. When the half-foot comes in the dimensions of a room, both ways, take the next largest number on one side. When it comes on one side only, add 1 yd and it will be close.

For ordinary rooms the chances are that closer results will be obtained by using the tables than by tedious figuring. A single mistake in taking off quantities may spoil an estimate far more than any trifle of a few inches as to the width or length of a room.

It must be noted, however, that the rooms are figured "solid," or without any deductions for openings, which is a different method from the one in use all through the "Appraiser." Allowance can be made for this. No other method could be used in a table, as no two rooms are alike with respect to openings.

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NUMBER OF SQUARE YARDS AND FEET IN ROOMS WITH 7-FOOT CEILINGS

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
3..	10.3	12.2	14.1	16.0	17.8	19.7	21.6	23.5	25.4	27.3	29.2	31.1	33.0	34.8	36.7	38.6	40.5	42.4	44.3	46.2
4..	12.2	14.2	16.2	18.2	20.2	22.2	24.2	26.2	28.2	30.2	32.2	34.2	36.2	38.2	40.2	42.2	44.2	46.2	48.2	50.2
5..	14.1	16.2	18.3	20.4	22.5	24.6	26.7	28.8	31.0	33.1	35.2	37.3	39.4	41.5	43.6	45.7	47.8	50.0	52.1	54.2
6..	16.0	18.2	20.4	22.6	24.8	27.1	29.3	31.5	33.7	36.0	38.2	40.4	42.6	44.8	47.1	49.3	51.5	53.7	55.8	58.2
7..	17.8	20.2	22.5	24.8	27.2	29.5	31.8	34.2	36.5	38.8	41.2	43.5	45.8	48.2	50.5	52.8	55.2	57.5	59.8	62.2
8..	19.7	22.2	24.6	27.1	29.5	32.0	34.4	36.8	39.3	41.7	44.2	46.6	49.1	51.5	54.0	56.4	58.8	61.3	63.7	66.2
9..	21.6	24.2	26.7	29.3	31.8	34.4	37.0	39.5	42.1	44.6	47.2	49.7	52.3	54.8	57.4	60.0	62.5	65.1	67.6	70.2
10..	23.5	26.2	28.8	31.5	34.2	36.8	39.5	42.2	44.8	47.5	50.2	52.8	55.5	58.2	60.8	63.5	66.2	68.8	71.5	74.2
11..	25.4	28.2	31.0	33.7	36.5	39.3	42.1	44.8	47.6	50.4	53.2	56.0	58.7	61.5	64.3	67.1	69.8	72.6	75.4	78.2
12..	27.3	30.2	33.1	36.0	38.8	41.7	44.6	47.5	50.4	53.3	56.2	59.1	62.0	64.8	67.7	70.6	73.5	76.4	79.3	82.2
13..	29.2	32.2	35.2	38.2	41.2	44.2	47.2	50.2	53.2	56.2	59.2	62.2	65.2	68.2	71.2	74.2	77.2	80.2	83.2	86.2
14..	31.1	34.2	37.3	40.4	43.5	46.6	49.7	52.8	56.0	59.1	62.2	65.3	68.4	71.5	74.6	77.7	80.8	84.0	87.1	90.2
15..	33.0	36.2	39.4	42.6	45.8	49.1	52.3	55.5	58.7	62.0	65.2	68.4	71.6	74.8	78.1	81.3	84.5	87.7	91.0	94.2
16..	34.8	38.2	41.5	44.8	48.2	51.5	54.8	58.2	61.5	64.8	68.2	71.5	74.8	78.2	81.5	84.8	88.2	91.5	94.8	98.2
17..	36.7	40.2	43.6	47.1	50.5	54.0	57.4	60.8	64.3	67.7	71.2	74.6	78.1	81.5	85.5	88.4	91.8	95.3	98.7	102.2
18..	38.6	42.2	45.7	49.3	52.8	56.4	60.0	63.5	67.1	70.6	74.2	77.7	81.3	84.8	88.4	92.0	95.5	99.1	102.6	106.2
19..	40.5	44.2	47.8	51.5	55.2	58.8	62.5	66.2	69.8	73.5	77.2	80.8	84.5	88.2	91.8	95.5	99.2	102.8	106.5	110.2
20..	42.4	46.2	50.0	53.7	57.5	61.3	65.1	68.8	72.6	76.4	80.2	84.0	87.7	91.5	95.3	99.1	102.8	106.6	110.4	114.0
21..	44.3	48.2	52.1	55.8	59.8	63.7	67.6	71.5	75.4	79.3	83.2	87.1	91.0	94.8	98.7	102.6	106.5	110.4	114.3	118.2
22..	46.2	50.2	54.2	58.2	62.2	66.2	70.2	74.2	78.2	82.2	86.2	90.2	94.2	98.2	102.2	106.2	110.2	114.2	118.2	122.2
23..	48.0	52.2	56.3	60.4	64.5	68.6	72.1	76.8	81.0	85.1	89.2	93.3	97.4	101.5	105.6	109.7	113.8	118.0	122.1	126.2
24..	50.0	54.2	58.4	62.6	66.8	71.1	75.3	79.5	83.7	88.0	92.2	96.4	100.6	104.8	109.1	113.3	117.5	121.7	126.0	130.2

The amount indicated includes side walls and ceilings

NUMBER OF SQUARE YARDS AND FEET IN ROOMS WITH 7-FOOT 6-INCH CEILINGS

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
3..	11.0	13.0	15.0	17.0	19.0	21.0	23.0	25.0	27.0	29.0	31.0	33.0	35.0	37.0	39.0	41.0	43.0	45.0	47.0	49.0
4..	13.0	15.1	17.2	19.3	21.4	23.5	25.6	27.7	29.8	32.0	34.1	36.2	38.3	40.4	42.5	44.6	46.7	49.8	51.0	53.1
5..	15.0	17.2	19.4	21.6	23.8	26.1	28.3	30.5	32.7	35.0	37.2	39.4	41.6	43.8	46.1	48.3	50.5	52.7	55.0	57.2
6..	17.0	19.3	21.6	24.0	26.3	28.6	31.0	33.3	35.6	38.0	40.3	42.6	45.0	47.3	49.6	52.0	54.3	56.6	59.0	61.3
7..	19.0	21.4	23.8	26.3	28.7	31.2	33.6	36.1	38.5	41.0	43.4	45.8	48.3	50.7	53.2	55.6	58.1	60.5	63.0	65.4
8..	21.0	23.5	26.1	28.6	31.2	33.7	36.3	38.8	41.4	44.0	46.5	49.1	51.6	54.2	56.7	59.3	61.8	64.4	67.0	69.5
9..	23.0	25.6	28.3	31.0	33.6	36.3	39.0	41.6	44.3	47.0	49.6	52.3	55.0	57.6	60.3	63.0	65.6	68.3	71.0	73.6
10..	25.0	27.7	30.5	33.3	36.1	38.8	41.6	44.4	47.2	50.0	52.7	55.5	58.3	61.1	63.8	66.6	69.4	72.2	75.0	77.7
11..	27.0	29.8	32.7	35.6	38.5	41.4	44.3	47.2	50.1	53.0	55.8	58.7	61.6	64.5	67.4	70.3	73.2	76.1	79.0	81.8
12..	29.0	32.0	35.0	38.0	41.0	44.0	47.0	50.0	53.0	56.0	59.0	62.0	65.0	68.0	71.0	74.0	77.0	80.0	83.0	86.0
13..	31.0	34.1	37.2	40.3	43.4	46.5	49.6	52.7	55.8	59.0	62.1	65.2	68.3	71.4	74.5	77.6	80.7	84.8	87.0	90.1
14..	33.0	36.2	39.4	42.6	45.8	49.1	52.3	55.5	58.7	62.0	65.2	68.4	71.6	74.8	78.1	81.3	84.5	87.7	91.0	94.2
15..	35.0	38.3	41.6	45.0	48.3	51.6	55.0	58.3	61.6	65.0	68.3	71.6	75.0	78.3	81.6	85.0	88.3	91.6	95.0	98.3
16..	37.0	40.4	43.8	47.3	50.7	54.2	57.6	61.1	64.5	68.0	71.4	74.8	78.3	81.7	85.2	88.6	92.1	95.5	99.0	102.4
17..	39.0	42.5	46.1	49.6	53.2	56.7	60.3	63.8	67.4	71.0	74.5	78.1	81.6	85.2	88.7	92.3	95.8	99.4	103.0	106.5
18..	41.0	44.6	48.3	52.0	55.6	59.3	63.0	66.6	70.3	74.0	77.6	81.2	85.0	88.6	92.3	96.0	99.6	103.3	107.0	110.6
19..	43.0	46.7	50.5	54.3	58.1	61.8	65.6	69.4	73.2	77.0	80.7	84.5	88.3	92.1	95.8	99.6	103.4	107.2	111.0	114.7
20..	45.0	49.8	52.7	56.6	60.5	64.4	68.3	72.2	76.1	80.0	84.8	87.7	91.6	95.5	99.4	103.3	107.2	111.1	115.0	118.8
21..	47.0	51.0	55.0	59.0	63.0	67.0	71.0	75.0	79.0	83.0	87.0	91.0	95.0	99.0	103.0	107.0	111.0	115.0	119.0	123.0
22..	49.0	53.1	57.2	61.3	65.4	69.5	73.6	77.7	81.8	86.0	90.1	94.2	98.3	102.4	106.5	110.6	114.7	118.8	123.0	127.0
23..	51.0	55.2	59.4	63.6	67.8	72.1	76.3	80.5	84.7	89.0	93.2	97.4	101.6	105.8	110.1	114.3	118.5	122.7	127.0	131.2
24..	53.0	57.3	61.6	66.0	70.3	74.6	79.3	83.3	87.6	92.0	96.3	100.6	105.0	109.3	113.6	118.0	122.3	126.6	131.0	135.3

The amount indicated includes side walls and ceilings

NUMBER OF SQUARE YARDS AND FEET IN ROOMS WITH 8-FOOT CEILINGS

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
3.	11.6	13.7	15.8	18.0	20.1	22.2	24.3	26.4	28.5	30.6	32.7	34.8	37.0	39.1	41.2	43.3	45.4	47.5	49.6	51.7
4.	13.7	16.0	18.2	20.4	22.6	24.8	27.1	29.3	31.5	33.7	36.0	38.2	40.4	42.6	44.8	47.1	49.3	51.5	53.7	56.0
5.	15.8	18.2	20.5	22.8	25.2	27.5	29.8	32.2	34.5	36.8	39.2	41.5	43.8	46.2	48.5	50.8	53.2	55.5	57.8	60.2
6.	18.0	20.4	22.8	25.3	27.7	30.2	32.6	35.1	37.5	40.0	42.4	44.8	47.3	49.7	52.2	54.6	57.1	59.5	62.0	64.4
7.	20.1	22.6	25.2	27.7	30.3	32.8	35.4	38.0	40.5	43.1	45.6	48.2	50.7	53.3	55.8	58.4	61.0	63.5	66.1	68.9
8.	22.2	24.8	27.5	30.2	32.8	35.5	38.2	40.8	43.5	46.2	48.8	51.5	54.2	56.8	59.5	62.2	64.8	67.5	70.2	72.8
9.	24.3	27.1	29.8	32.6	35.4	38.2	41.0	43.7	46.5	49.3	52.1	54.8	57.6	60.4	63.2	66.0	68.7	71.5	74.3	77.1
10.	26.4	29.3	32.2	35.1	38.0	40.8	43.7	46.6	49.5	52.4	55.3	58.2	61.1	64.0	66.8	69.7	72.6	75.5	78.4	81.3
11.	28.5	31.5	34.5	37.5	40.5	43.5	46.5	49.5	52.5	55.5	58.5	61.5	64.5	67.5	70.5	73.5	76.5	79.5	82.5	85.5
12.	30.6	33.7	36.8	40.0	43.1	46.2	49.3	52.4	55.5	58.6	61.7	64.8	68.0	71.1	74.2	77.3	80.4	83.5	86.6	89.7
13.	32.7	36.0	39.2	42.4	45.6	48.8	52.1	55.3	58.5	61.7	65.0	68.2	71.4	73.6	77.8	81.1	84.3	87.5	90.7	94.0
14.	34.8	38.2	41.5	44.8	48.2	51.5	54.8	58.2	61.5	64.8	68.2	71.5	74.8	78.2	81.5	84.8	88.2	91.5	94.8	98.2
15.	37.0	40.4	43.8	47.3	50.7	54.2	57.6	61.1	64.5	68.0	71.4	74.8	78.3	81.7	85.2	88.6	92.1	95.5	99.0	102.4
16.	39.1	42.6	46.2	49.7	53.3	56.8	60.4	64.0	67.5	71.1	74.6	78.2	81.7	85.3	88.8	92.4	96.0	99.5	103.1	106.6
17.	41.2	44.8	48.5	52.5	55.8	59.5	63.2	66.8	70.5	74.2	77.8	81.5	85.2	88.8	92.5	96.2	99.8	103.5	707.2	110.8
18.	43.3	47.1	50.8	54.6	58.4	62.2	66.0	69.7	73.5	77.3	81.1	84.8	88.6	92.4	96.2	100.0	103.7	107.5	111.3	115.1
19.	45.4	49.3	53.2	57.1	61.0	64.8	68.7	72.6	76.5	80.4	84.3	88.2	92.1	96.0	99.8	103.7	107.6	111.5	115.4	119.3
20.	47.5	51.5	55.5	59.5	63.5	67.5	71.5	75.5	79.5	83.5	87.5	91.5	95.5	99.5	103.5	107.5	111.5	115.5	119.5	123.5
21.	49.6	53.7	57.8	62.0	66.1	70.2	74.3	78.4	82.3	86.6	90.7	94.8	99.0	103.1	107.2	111.3	115.4	119.5	123.6	127.7
22.	51.7	56.0	60.2	64.4	68.8	72.8	77.1	81.3	85.5	89.7	94.0	98.2	102.4	106.6	110.8	115.1	119.3	123.5	127.7	132.0
23.	53.8	58.2	62.5	66.8	71.2	75.5	79.8	84.2	88.5	92.8	97.2	101.5	105.8	110.2	114.5	118.8	123.2	127.5	131.8	136.2
24.	56.0	60.4	64.8	69.3	73.7	78.2	82.6	87.1	91.5	96.0	100.4	104.8	109.3	113.7	118.2	122.6	127.1	131.5	136.0	140.4

3 The amount indicated includes side walls and ceilings

NUMBER OF SQUARE YARDS AND FEET IN ROOMS WITH 8-FOOT 6-INCH CEILINGS

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
3.	12.3	14.5	16.7	19.0	21.2	23.4	25.6	27.8	30.1	32.2	34.5	36.7	39.0	41.2	43.4	45.6	47.8	50.1	52.3	54.5
4.	14.5	16.8	19.2	21.5	23.8	26.2	28.5	30.8	33.2	35.5	37.8	40.2	42.5	44.8	47.2	49.5	51.8	54.2	56.5	58.8
5.	16.7	19.2	21.6	24.1	26.5	29.0	31.4	33.8	36.3	38.7	41.2	43.6	46.1	48.5	51.0	53.4	55.8	58.3	60.7	63.2
6.	19.0	21.5	24.1	26.6	29.2	31.7	34.3	36.8	39.4	42.0	44.5	47.1	49.6	52.5	54.7	57.3	59.8	62.4	65.0	67.5
7.	21.2	23.8	26.5	29.2	31.8	34.5	37.2	39.8	42.5	45.2	47.8	50.5	53.2	55.8	58.5	61.2	63.8	66.5	69.2	71.8
8.	23.4	26.2	29.0	31.7	34.5	37.3	40.1	42.8	45.6	48.4	51.2	54.0	56.7	59.5	62.3	65.1	67.8	70.6	73.4	76.2
9.	25.6	28.5	31.4	34.3	37.2	40.1	43.0	45.8	48.7	51.6	54.5	57.4	60.3	63.2	66.1	69.0	71.8	74.7	77.6	80.5
10.	27.8	30.8	33.8	36.8	39.8	42.8	45.8	48.8	51.8	54.8	57.8	60.8	63.8	66.8	69.8	72.8	75.8	78.8	81.8	84.8
11.	30.1	33.2	36.3	39.4	42.5	45.6	48.7	51.8	55.0	58.1	61.2	64.3	67.4	70.5	73.6	76.7	79.8	83.0	86.1	89.2
12.	32.2	35.5	38.7	42.0	45.2	48.4	51.6	54.8	58.1	61.3	64.5	67.7	71.0	74.2	77.4	80.6	83.8	87.1	90.3	93.5
13.	34.5	37.8	41.2	44.5	47.8	51.2	54.5	57.8	61.2	64.5	67.8	71.2	74.5	77.8	81.2	84.5	87.8	91.2	94.5	97.8
14.	36.7	40.2	43.6	47.1	50.5	54.0	57.4	60.8	64.3	67.7	71.2	74.6	78.1	81.5	85.0	88.4	91.8	95.3	98.7	102.2
15.	39.0	42.5	46.1	49.6	53.2	56.7	60.3	63.8	67.4	71.0	74.5	78.1	81.6	85.2	88.7	92.3	95.8	99.4	103.0	106.5
16.	41.2	44.8	48.5	52.2	55.8	59.5	63.2	66.8	70.5	74.2	77.8	81.5	85.2	88.8	92.5	96.2	99.8	103.5	107.2	110.8
17.	43.4	47.2	51.0	54.7	58.5	62.3	66.1	69.8	73.6	77.4	81.2	85.0	88.7	92.5	96.3	100.1	103.8	107.6	111.4	115.2
18.	45.6	49.5	53.4	75.3	61.2	65.1	69.0	72.8	76.7	80.6	84.5	88.4	92.3	96.2	100.1	104.0	107.8	111.7	115.6	119.5
19.	47.8	51.8	55.8	59.8	63.8	67.8	71.8	75.8	79.8	83.8	87.8	91.8	95.8	99.8	103.8	107.8	111.8	115.8	119.8	123.8
20.	50.1	54.2	58.3	62.4	66.5	70.6	74.7	78.8	83.0	87.1	91.2	95.3	99.4	103.5	107.6	111.7	115.8	120.0	124.1	128.2
21.	52.3	56.5	60.7	65.0	69.2	73.4	77.6	81.8	86.1	90.3	94.5	98.7	103.0	107.2	111.4	115.6	119.8	124.1	128.3	132.5
22.	54.5	58.8	63.2	67.5	71.8	76.2	80.5	84.8	89.2	93.5	97.8	102.2	106.5	110.8	115.2	119.5	123.8	128.2	132.5	136.8
23.	56.7	61.2	65.6	70.1	74.5	79.0	83.4	87.8	92.3	96.7	101.2	105.6	110.1	114.5	119.1	123.4	127.8	132.3	136.7	141.2
24.	59.0	63.5	68.1	72.6	77.2	81.7	86.3	90.8	95.4	100.0	104.5	109.1	113.6	118.2	122.7	127.3	131.8	136.4	141.0	145.5

The amount indicated includes side walls and ceilings

NUMBER OF SQUARE YARDS AND FEET IN ROOMS WITH 9-FOOT CEILINGS

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
3.	13.0	15.3	17.6	20.0	22.3	24.6	27.0	29.3	31.6	34.0	36.3	38.6	41.0	43.3	45.6	48.0	50.3	52.6	55.0	57.3
4.	15.3	17.7	20.2	22.6	25.1	27.5	30.0	32.4	34.8	37.3	39.7	42.2	44.6	47.1	49.5	52.0	54.4	56.8	59.3	61.7
5.	17.6	20.2	22.7	25.3	27.8	30.4	33.0	35.5	38.1	40.6	43.2	45.7	48.3	50.8	53.4	56.0	58.5	61.1	63.6	66.2
6.	20.0	22.6	25.3	28.0	30.6	33.3	36.0	38.6	41.3	44.0	46.6	49.3	52.0	54.6	57.3	60.0	63.5	65.4	68.0	70.6
7.	22.3	25.1	27.8	30.6	33.4	36.2	39.0	41.7	44.5	47.3	50.1	52.8	55.6	58.4	61.2	64.0	66.7	69.5	72.3	75.1
8.	24.6	27.5	30.4	33.3	36.2	39. 1	42.0	44.8	47.7	50.6	53.5	56.4	59.3	62.2	65.1	68.0	70.8	73.7	77.6	79.5
9.	27.0	30.0	33.0	36.0	39.0	42.0	45.0	48.0	51.0	54.0	57.0	60.0	63.0	66.0	69.0	72.0	75.0	78.0	81.0	84.0
10.	29.3	32.4	35.5	38.6	41.7	44.8	48.0	52.0	54.2	57.3	60.4	63.5	66.6	69.7	72.8	76.0	79.1	82.2	85.3	88.4
11.	31.6	34.8	38.1	41.3	44.5	47.7	51.0	54.2	57.4	60.6	63.8	67.1	70.3	73.5	76.7	80.0	83.2	86.4	89.6	92.8
12.	34.0	37.3	40.6	44.0	47.3	50.6	54.0	57.3	60.6	64.0	67.3	70.6	74.0	77.3	80.6	84.0	87.3	90.6	94.0	97.3
13.	36.3	39.7	43.2	46.6	50.1	53.5	57.0	60.4	63.8	67.3	70.7	74.2	77.6	81.1	84.5	88.0	91.4	94.8	98.3	101.7
14.	38.6	42.2	45.7	49.3	52.8	56.4	60.0	63.5	67.1	70.6	74.2	77.7	81.3	84.8	88.4	92.0	95.5	99.1	102.6	106.2
15.	41.0	44.6	48.3	52.0	55.6	59.3	63.0	66.6	70.3	74.0	77.6	81.3	85.0	88.6	92.3	96.0	99.6	103.3	107.0	111.6
16.	43.3	47.1	50.8	54.6	58.4	62.2	66.0	69.7	73.5	77.3	81.1	84.8	88.6	92.4	96.2	100.0	103.7	107.5	111.3	115.1
17.	45.6	49.5	53.4	57.3	61.2	65.1	69.0	72.8	76.7	80.6	84.5	88.4	92.3	96.2	100.4	104.0	107.8	111.7	115.6	119.5
18.	48.0	52.0	56.0	60.0	64.0	68.0	72.0	76.0	80.0	84.0	88.0	92.0	96.0	100.0	104.0	108.0	112.0	116.0	120.0	124.0
19.	50.3	54.4	58.5	62.6	66.7	70.8	75.0	79.1	83.2	87.3	91.4	95.5	99.6	103.7	107.8	112.0	116.1	120.2	124.3	128.4
20.	52.6	56.8	61.1	65.3	69.5	73.7	78.0	82.2	86.4	90.6	94.8	99.1	103.3	107.5	111.7	116.0	120.2	124.4	128.6	132.8
21.	55.0	59.3	63.6	68.0	72.3	76.6	81.0	85.3	89.6	94.0	98.3	102.6	107.0	111.3	115.6	120.0	124.3	128.6	134.3	137.3
22.	57.3	61.7	66.2	70.6	75.1	79.5	84.0	88.4	92.8	97.3	101.7	106.2	111.6	115.1	121.5	124.0	128.4	132.8	137.3	141.7
23.	59.6	64.2	68.7	73.3	77.8	82.4	87.0	91.5	95.1	100.6	105.2	109.7	114.3	118.8	123.4	128.0	132.5	137.0	141.6	146.2
24.	62.0	66.6	71.3	76.0	80.6	85.3	90.0	94.6	99.3	104.0	108.6	113.3	118.0	122.6	127.3	132.0	136.6	141.3	146.0	150.6

The amount indicated includes side walls and ceilings

NUMBER OF SQUARE YARDS AND FEET IN ROOMS WITH 9-FOOT 6-INCH CEILINGS

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
3.	13.6	16.1	18.5	21.0	23.4	25.8	28.3	30.7	33.2	35.6	38.1	40.5	43.0	45.4	47.8	50.3	52.7	55.2	57.6	60.1
4.	16.1	18.6	21.2	23.7	26.3	28.8	31.4	34.0	36.5	39.1	41.6	44.2	46.7	49.3	51.8	54.4	57.0	59.5	62.1	64.6
5.	18.5	21.2	23.8	26.5	29.2	31.8	34.5	37.2	39.8	42.5	45.2	47.8	50.5	53.2	55.8	58.5	61.2	63.8	66.5	69.2
6.	21.0	23.7	26.5	29.3	32.1	34.8	37.6	40.4	43.2	46.0	48.7	51.5	54.3	57.1	59.8	62.6	65.4	68.2	71.0	73.7
7.	23.4	26.3	29.2	32.1	35.0	37.8	40.7	43.6	46.5	49.4	52.3	55.2	58.1	61.0	63.8	66.7	69.6	72.5	75.4	78.3
8.	25.8	28.8	31.8	34.8	37.8	40.8	43.8	46.8	49.8	52.8	55.8	58.8	61.8	64.8	67.8	70.8	73.8	76.8	79.8	82.8
9.	28.3	31.4	34.5	37.6	40.7	43.8	47.0	50.1	53.2	56.3	59.4	62.5	65.6	68.7	71.8	75.0	78.1	81.2	84.3	87.4
10.	30.7	34.0	37.2	40.4	43.6	46.8	50.1	53.3	56.5	59.7	63.0	66.2	69.4	72.6	75.8	79.1	82.3	85.5	88.7	92.0
11.	33.2	36.5	39.8	43.2	46.5	49.8	53.2	56.5	59.8	63.2	66.5	69.8	73.2	76.5	79.8	83.2	86.5	89.8	93.2	96.5
12.	35.6	39.1	42.5	46.0	49.4	52.8	56.3	59.7	63.2	66.5	70.1	73.5	77.0	80.4	83.8	87.3	90.7	94.2	97.6	101.1
13.	38.1	41.6	45.2	48.7	52.3	55.8	59.4	63.0	66.5	70.1	73.6	77.2	80.7	84.3	87.8	91.4	95.0	98.5	102.1	105.6
14.	40.5	44.2	47.8	51.5	55.2	58.8	62.5	66.2	69.8	73.5	77.2	80.8	84.5	88.2	91.8	95.5	99.2	102.8	106.5	110.2
15.	43.0	46.7	50.5	54.3	58.1	61.8	65.6	69.4	73.2	77.0	80.7	84.5	88.3	92.1	95.8	99.6	103.4	107.2	111.0	114.7
16.	45.4	49.3	53.2	57.1	61.0	64.8	68.7	72.6	76.5	80.4	84.3	88.2	92.1	96.0	99.8	103.7	107.6	111.5	115.4	119.3
17.	47.8	51.8	55.8	59.8	63.8	67.8	71.8	75.8	79.8	83.8	87.8	91.8	95.8	99.8	103.8	107.8	111.8	115.8	119.8	123.8
18.	50.3	54.4	58.5	62.6	66.7	70.8	75.0	79.1	83.2	87.3	91.4	95.5	99.6	103.7	107.8	112.0	116.1	120.2	124.3	128.4
19.	52.7	57.0	61.2	65.4	69.6	73.8	78.1	82.3	86.5	90.7	95.0	99.0	103.4	107.6	111.8	116.1	120.3	124.5	128.7	133.0
20.	55.2	59.5	63.8	68.2	72.5	76.8	81.2	85.5	89.8	94.2	98.5	102.8	107.2	111.5	115.8	120.2	124.5	128.8	133.2	137.5
21.	57.6	62.1	66.5	71.0	75.4	79.8	84.3	88.7	93.2	97.6	102.1	106.5	111.0	115.4	119.8	124.3	128.7	133.2	137.6	142.1
22.	60.1	64.6	69.2	73.7	78.3	82.8	87.4	92.0	96.5	101.1	105.6	110.2	114.7	119.3	123.8	128.4	133.0	137.5	142.1	146.6
23.	62.5	67.2	71.8	76.5	81.2	85.8	90.5	95.2	99.8	104.5	109.2	113.8	118.5	123.2	127.8	132.5	137.2	141.8	146.5	151.2
24.	65.0	69.7	74.5	79.3	84.1	88.8	93.6	98.4	103.2	108.0	112.7	117.5	122.3	137.1	131.8	136.6	141.4	146.2	151.0	155.7

The amount indicated includes side walls and ceilings

NUMBER OF SQUARE YARDS AND FEET IN ROOMS WITH 10-FOOT CEILINGS

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
3.	14.3	16.8	19.4	22.0	24.5	27.1	29.6	32.2	34.7	37.3	39.8	42.4	45.0	47.5	50.1	52.6	55.2	57.7	60.3	62.8
4.	16.8	19.5	22.2	24.8	27.5	30.2	32.8	35.5	38.2	40.8	43.5	46.2	48.8	51.5	54.2	56.8	59.5	62.2	64.8	67.5
5.	19.4	22.2	25.0	27.7	30.5	33.3	36.1	38.8	41.6	44.4	47.2	50.0	52.7	55.5	58.3	61.1	63.8	66.6	69.4	72.2
6.	22.0	24.8	27.7	30.6	33.5	36.4	39.3	42.2	45.1	48.0	50.8	53.7	56.6	59.5	62.4	65.3	68.2	71.1	74.0	76.8
7.	24.5	27.5	30.5	33.5	36.5	39.5	42.5	45.5	48.5	51.5	54.5	57.5	60.5	63.5	66.5	69.5	72.5	75.5	78.5	81.5
8.	27.1	30.2	33.3	36.4	39.5	42.6	45.7	48.8	52.0	55.1	58.2	61.3	64.4	67.5	70.6	73.7	76.8	80.0	83.1	86.2
9.	29.6	32.8	36.1	39.3	42.5	45.7	49.0	52.2	55.4	58.6	61.8	65.1	68.3	71.5	74.7	78.0	81.2	84.4	87.6	90.8
10.	32.3	35.5	38.8	42.2	45.5	48.8	52.2	55.5	58.8	62.2	65.5	68.8	72.2	75.5	78.8	82.2	85.5	88.8	92.2	95.5
11.	34.7	38.2	41.6	45.1	48.5	52.0	55.4	58.8	62.3	65.7	69.2	72.6	76.1	79.5	83.0	86.4	89.8	93.3	96.7	100.2
12.	37.3	40.8	44.4	48.0	51.5	55.1	58.6	62.2	65.7	69.3	72.8	76.4	80.0	83.5	87.1	90.6	94.2	97.7	101.3	104.8
13.	39.8	43.5	47.2	50.8	54.5	58.2	61.8	65.5	69.2	72.8	76.5	80.2	83.8	87.5	91.2	94.8	98.5	102.2	105.8	109.5
14.	42.4	46.2	50.0	53.7	57.5	61.3	65.1	68.8	72.6	76.4	80.2	84.0	87.7	91.5	95.3	99.1	102.8	106.6	110.4	114.2
15.	45.0	48.8	52.7	56.6	60.5	64.4	68.3	72.2	76.1	80.0	83.8	87.7	91.6	95.5	99.4	103.3	107.2	111.1	115.0	118.8
16.	47.5	51.5	55.5	59 5	63.5	67.5	71.5	75.5	79.5	83.5	87.5	91.5	95.5	99.5	103.5	107.5	111.5	115.5	119.5	123.5
17.	50.1	54.2	58.3	62.4	66.5	70.6	74.7	78.8	83.0	87.1	91.2	95.3	99.4	103.5	107.6	111.7	115.8	120.0	124.1	128.2
18.	52.6	56.8	61.1	65.3	69.5	73.7	78.0	82.2	86.4	90.6	94.8	99.1	103.3	107.5	111.7	116.0	120.2	124.4	128.6	132.8
19.	55.2	59.5	63.8	68.2	72.5	76.8	81.2	85.5	89.8	94.2	98.5	102.8	107.2	111.5	115.8	120.2	124.5	128.8	133.2	137.5
20.	57.7	62.2	66.6	71.1	75.5	80.0	84.4	88.8	93.3	97.7	102.2	106.6	111.1	115.5	120.0	124.4	128.8	133.3	137.7	142.2
21.	60.3	64.8	69.4	74.0	78.5	83.1	87.6	92.2	96.7	101.3	105.8	110.4	115.0	119.5	124.1	128.6	133.2	137.7	142.3	146.8
22.	62.8	67.5	72.2	76.8	81.5	86.2	90.8	95.5	100.2	104.8	109.5	114.2	118.8	123.5	128.2	132.8	137.5	142.2	146.8	151.5
23.	65.4	70.2	75.0	79.7	84.5	89.3	94.1	98.8	103.6	108.4	113.2	118.0	122.7	127.5	132.3	137.1	141.8	146.6	151.4	156.2
24.	68.0	72.8	77.7	82.6	87.5	92.4	97.3	102.2	107.1	112.1	114.8	116.6	121.7	131.5	136.4	141.3	146.2	151.1	156.0	160.8

The amount indicated includes side walls and ceilings

NUMBER OF SQUARE YARDS AND FEET IN ROOMS WITH 10-FOOT 6-INCH CEILINGS

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
3.	15.0	17.6	20.3	23.0	25.6	28.3	31.0	33.6	36.3	39.0	41.6	44.3	47.0	49.6	52.3	55.0	57.6	60.3	63.0	55.6
4.	17.6	20.4	23.2	26.0	28.7	31.5	34.3	37.1	39.8	42.6	45.4	48.2	51.0	53.7	56.5	59.3	62.1	64.8	67.6	70.4
5.	20.3	23.2	26.1	29.0	31.8	34.7	37.6	40.5	43.4	46.3	49.2	52.1	55.0	57.8	60.7	63.6	66.5	69.4	72.3	75.2
6.	23.0	26.0	29.0	32.0	35.0	38.0	41.0	44.0	47.0	50.0	53.0	56.0	59.0	62.0	65.0	68.0	71.0	74.0	77.0	80.0
7.	25.6	28.7	31.8	35.0	38.1	41.2	44.3	47.4	50.5	53.6	56.7	59.8	63.0	66.1	69.2	72.3	75.4	78.5	81.6	84.7
8.	28.3	31.5	34.7	38.0	41.2	44.4	47.6	50.8	54.1	57.3	60.5	63.7	67.0	70.2	73.4	76.6	79.8	83.1	86.3	89.5
9.	31.0	34.3	37.6	41.0	44.3	47.6	51.0	54.3	57.6	61.0	64.3	67.6	71.0	74.3	77.6	81.0	84.3	87.6	91.0	94.3
10.	33.6	37.1	40.5	44.0	47.4	50.8	54.3	57.7	61.2	64.6	68.1	71.5	75.0	78.4	81.8	85.3	88.7	92.2	95.6	99.1
11.	36.3	39.8	43.4	47.0	50.5	54.1	57.6	61.2	64.7	68.3	71.8	75.4	79.0	82.5	86.1	89.6	93.2	96.7	100.3	103.8
12.	39.0	42.6	46.3	50.0	53.6	57.3	61.0	64.6	68.3	72.0	75.6	79.3	83.0	86.6	90.3	94.0	97.6	101.3	105.0	108.6
13.	41.6	45.4	49.2	53.0	56.7	60.5	64.3	68.1	71.8	75.6	79.4	83.2	87.0	90.7	94.5	98.3	102.1	105.8	109.6	113.4
14.	44.3	48.2	52.1	56.0	59.8	63.7	67.6	71.5	75.4	79.3	83.2	87.1	91.0	94.8	98.7	102.6	106.5	110.4	114.3	118.2
15.	47.0	51.0	55.0	59.0	63.0	67.0	71.0	75.0	79.0	83.0	87.0	91.0	95.0	99.0	103.0	107.0	111.0	115.0	119.0	123.0
16.	49.6	53.7	57.8	62.0	66.1	70.2	74.3	78.4	82.5	86.6	90.7	94.8	99.0	103.1	107.2	111.3	115.4	119.5	123.6	127.7
17.	52.3	56.5	60.7	65.0	69.2	73.4	77.6	81.8	86.1	90.3	94.5	98.7	103.0	107.2	111.4	115.6	119.8	124.1	128.3	132.5
18.	55.0	59.3	63.6	68.0	72.3	76.6	81.0	85.3	89.6	94.0	98.3	102.6	107.0	111.3	115.6	120.0	124.3	128.6	133.0	137.3
19.	57.6	62.1	66.5	71.0	75.4	79.8	84.3	88.7	93.2	97.6	102.1	106.5	111.0	115.4	119.8	124.3	128.7	133.2	137.6	142.1
20.	60.3	64.8	69.4	74.0	78.5	83.1	87.6	92.2	96.7	101.3	105.8	110.4	115.0	119.5	124.1	128.6	133.2	137.7	142.3	146.8
21.	63.0	67.6	72.3	77.0	81.6	86.3	91.0	95.6	100.3	105.0	109.6	114.3	119.0	123.6	128.3	133.0	137.6	142.3	147.0	151.6
22.	55.6	70.4	75.2	80.0	84.7	89.5	94.3	99.1	103.8	108.6	113.4	118.2	123.0	127.7	132.5	137.3	142.1	146.8	151.6	156.4
23.	68.3	73.2	78.1	83.0	87.8	92.7	97.6	102.5	107.4	112.3	117.2	122.1	127.0	131.8	136.7	141.6	146.5	151.4	156.3	161.2
24.	71.0	76.0	81.0	86.0	91.0	96.0	101.0	106.0	111.0	116.0	121.0	126.0	131.0	136.0	141.0	146.0	151.0	156.0	161.0	166.0

The amount indicated includes side walls and ceilings

NUMBER OF SQUARE YARDS AND FEET IN ROOMS WITH 11-FOOT CEILINGS

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
3.	15.6	18.4	21.2	24.0	26.7	29.5	32.3	35.1	37.8	40.6	43.4	46.2	49.0	51.7	54.5	57.3	60.1	62.8	65.6	68.4
4.	18.4	21.3	24.2	27.1	30.0	32.8	35.7	38.6	41.5	44.4	47.3	50.2	53.1	56.0	58.8	61.7	64.6	67.5	70.4	73.6
5.	21.2	24.2	27.2	30.2	33.2	36.2	39.2	42.2	45.2	48.2	51.2	54.2	57.2	60.2	63.2	66.2	69.2	72.2	75.2	78.2
6.	24.0	27.1	30.2	33.3	36.4	39.5	42.6	45.7	48.8	52.0	55.1	58.2	61.3	64.4	67.5	70.6	73.7	76.8	80.0	83.1
7.	26.7	30.0	33.2	36.4	39.6	42.8	46.1	49.3	52.5	55.7	59.0	62.2	65.4	68.6	71.8	75.1	78.3	81.5	84.7	88.0
8.	29.5	32.8	36.2	39.5	42.8	46.2	49.5	52.8	56.2	59.5	62.8	66.2	69.5	72.8	76.2	79.5	82.8	86.2	89.5	92.8
9.	32.3	35.7	39.2	42.6	46.1	49.5	53.0	56.4	59.8	63.3	66.7	70.2	73.6	77.1	80.5	84.0	87.4	90.8	94.3	96.7
10.	35.1	38.6	42.2	45.7	49.3	52.8	56.4	60.0	63.5	67.1	70.6	74.2	77.7	81.3	84.8	88.4	92.0	95.5	99.1	102.6
11.	37.8	41.5	45.2	48.8	52.5	56.2	59.8	63.5	67.2	70.8	74.5	78.2	81.8	85.5	89.2	92.8	96.5	100.2	103.8	107.5
12.	40.6	44.4	48.2	52.0	55.7	59.5	63.3	67.1	70.8	74.6	78.4	82.2	86.0	89.7	93.5	97.3	101.1	104.8	108.6	112.4
13.	43.4	47.3	51.2	55.1	59.0	62.8	66.7	70.6	74.5	78.4	82.3	86.2	90.1	94.0	97.8	101.7	105.6	109.5	113.4	117.3
14.	46.2	50.2	54.2	58.2	62.2	66.2	70.2	74.2	78.2	82.2	86.2	90.2	94.2	98.2	102.2	106.2	110.2	114.2	118.2	122.2
15.	49.0	53.1	57.2	61.3	65.4	69.5	73.6	77.7	81.8	86.0	90.1	94.2	98.3	102.4	106.5	110.6	114.7	118.8	123.0	127.1
16.	51.7	56.0	60.2	64.4	68.6	72.8	77.1	81.3	85.5	89.7	94.0	98.2	102.4	106.6	110.8	115.1	119.3	123.5	127.7	132.0
17.	54.5	58.8	63.2	67.5	71.8	76.2	80.5	84.8	89.2	93.5	97.8	102.2	106.5	110.8	115.2	119.5	123.8	128.2	132.5	136.8
18.	57.3	61.7	66.2	70.6	75.1	79.5	84.0	88.4	92.8	97.3	101.7	106.2	110.6	115.1	119.5	124.0	128.4	132.8	137.3	141.7
19.	60.1	64.6	69.2	73.7	78.3	82.8	87.4	92.0	96.5	101.1	105.6	110.2	114.7	119.3	123.8	128.4	133.0	137.5	142.1	146.6
20.	62.8	67.5	72.2	76.8	81.5	86.2	90.8	95.5	100.2	104.8	109.5	114.2	118.8	123.5	128.2	132.8	137.5	142.2	146.8	151.5
21.	65.6	70.4	75.2	80.0	84.7	89.5	94.3	99.1	103.8	108.6	113.4	118.2	123.0	127.7	132.5	137.3	142.1	146.8	151.6	156.4
22.	68.4	73.3	78.2	83.1	88.0	92.8	97.7	102.6	107.5	112.4	117.3	122.2	127.1	132.0	136.8	141.7	146.6	151.5	156.4	161.3

The amount indicated includes sidewalls and ceilings

NUMBER OF SQUARE YARDS AND FEET IN ROOMS WITH 12-FOOT CEILINGS

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
3.	17.0	20.0	23.0	26.0	29.0	32.0	35.0	38.0	41.0	44.0	47.0	50.0	53.0	56.0	59.0	62.0	65.0	68.0	71.0	74.0
4.	20.0	23.1	26.2	29.3	32.4	35.5	38.6	41.7	44.8	48.0	51.1	54.2	57.3	60.4	63.5	66.6	69.7	72.8	76.0	79.1
5.	23.0	26.2	29.4	32.6	35.8	39.1	42.3	45.5	48.7	52.0	55.2	58.4	61.6	64.8	68.1	71.3	74.5	77.7	81.0	84.2
6.	26.0	29.3	32.6	36.0	39.3	42.6	46.0	49.3	52.6	56.0	59.3	62.6	66.0	69.3	72.6	76.0	79.3	82.6	86.0	89.3
7.	29.0	32.4	35.8	39.3	42.7	46.2	49.6	53.1	56.5	60.0	63.4	66.8	70.3	73.7	77.2	80.6	84.4	87.5	91.0	94.4
8.	32.0	35.5	39.1	42.6	46.2	49.7	53.3	56.8	60.4	64.0	67.5	71.1	74.6	78.2	81.7	85.3	88.8	92.4	96.0	99.5
9.	35.0	38.6	42.3	46.0	49.0	53.3	57.0	60.6	64.3	68.0	71.6	75.3	79.0	82.6	86.3	90.0	93.6	97.3	101.0	104.6
10.	38.0	41.7	45.5	49.3	53.0	56.8	60.6	64.4	68.2	72.0	75.7	79.5	83.3	87.1	90.8	94.6	98.4	102.2	106.0	109.7
11.	41.0	44.8	48.7	52.6	56.5	60.4	64.3	68.2	72.1	76.0	79.8	83.7	87.6	91.5	95.4	99.3	103.2	107.1	111.0	114.8
12.	44.0	48.0	52.0	56.0	60.0	64.0	68.0	72.0	76.0	80.0	84.0	88.0	92.0	96.0	100.0	104.0	108.0	112.0	116.0	120.0
13.	47.0	51.1	55.2	59.3	63.4	67.5	71.6	75.7	79.8	84.0	88.1	92.2	96.3	100.4	104.5	108.6	112.7	116.8	121.0	125.1
14.	50.0	54.2	58.4	62.6	66.8	71.1	75.3	79.5	83.7	88.0	92.2	96.4	100.6	104.8	109.1	113.3	117.5	121.7	126.0	130.2
15.	53.0	57.3	61.6	66.0	70.3	74.6	79.0	83.3	87.6	92.0	96.3	100.6	105.0	109.3	113.6	118.0	122.3	126.6	131.0	135.3
16.	56.0	60.4	64.8	69.3	73.7	78.2	82.6	87.1	91.5	96.0	100.4	104.8	109.3	113.7	118.2	122.6	127.1	131.5	136.0	140.4
17.	59.0	63.5	68.1	72.6	77.2	81.7	86.3	90.8	95.4	100.0	104.5	109.1	113.6	118.2	122.7	127.3	131.8	136.4	141.0	145.5
18.	62.0	66.6	71.3	76.0	80.6	85.3	90.0	94.6	99.3	104.0	108.6	113.3	118.0	122.6	127.3	132.0	136.6	141.3	146.0	150.6
19.	65.0	69.7	74.5	79.3	84.1	88.8	93.6	98.4	103.2	108.0	112.7	117.5	122.3	127.1	131.8	136.6	141.4	146.2	151.0	155.7
20.	68.0	72.8	77.7	82.6	87.5	92.4	97.3	102.2	107.1	112.0	116.8	121.7	126.6	131.5	136.4	141.3	146.2	151.1	156.0	160.8
21.	71.0	76.0	81.0	86.0	91.0	96.0	101.0	106.0	111.0	116.0	121.0	126.0	131.0	136.0	141.0	146.0	151.0	156.0	161.0	166.0
22.	74.0	79.1	84.2	89.3	94.4	99.5	104.6	109.7	114.8	120.0	125.1	130.2	135.3	140.4	145.5	150.6	155.7	160.8	166.0	171.1

The amount indicated includes side walls and ceilings

CHAPTER XI

WOODWORK

The Square Tables from 1 to 11 necessarily give averages which are ordinarily close enough for valuations. The following Labor Tables from A to H give actual records by which the Square Tables can be compared if desired. Practically every item in a building connected with woodwork is covered. Such Square Tables as 4, 5, and 6 show the quantities required for covering of all kinds.

The numbers, such as No. 10, No. 12, No. 4, refer to the buildings from which records were taken.

TABLE A

CARPENTER LABOR

Description	Ft B M for two men in 8 hours	Description	Ft B M for two men in 8 hours
No. 10, frame, all lumber, average	550	No. 4, joists and sizing	800
No. 10, if with plain fronts	750	Plank floor in a warehouse	1,000
No. 12, brick, all lumber except flooring	800	Bridging, 2″×4″	300
No. 4, brick, warehouse work	950	Bridging, 1″×4″ or 1″×3″	150
Heavy masonry warehouse mill construction	1,000	No. 7, brick, sleepers, 6″×8″, 60,000 ft	1,500
Heavy, plain, two-story warehouse, 2-in flooring on roof, plank under floors, all lumber except upper floor	770	No. 7, 3″×6″ plank floor, 190,000 ft	2,133
No. 3, stone and brick, for first 3 floors	1,000	No. 7, purlins on roof, 60 ft high	800
No. 3, 4th and 5th floors	800	No. 7, purlins on another roof	1,060
		Plank flooring covering, 2 in on above purlins	920
		Sheeting for floors	1,600
		Sheeting under best conditions	2,000

TABLE A—*Continued*

Description	Ft B M for two men in 8 hours	Description	Ft B M for two men in 8 hours
No. 3, sheeting on roof	1,000	Studding for frame house, 2″×4″	500
Sheeting on average frame building	1,000	Studding for frame house, 2″×6″	700
Sheeting on long stretches buildings	1,400	Sill and plates, plain, 6′×8″	640
Sheeting laid diagonally on walls, add 25 to 30 per cent; on floors, 10 per cent.		Sill gained for joists at 16-in centers	214
Rafters for plain gable roof, 2″×6″	600	Warehouse platform on posts with heavy girders and joists	800
Rafters for hip roof 2″×6″	250	Same, under better than average conditions	1,000
Roof boards on plain gable roof	1,200	Board fence	720
Roof boards on hip roof	800	Laminated work	1,200 to 1,600

TRUSSES

	(smoothed chamf'rd)		(smoothed chamf'rd)
Howe trusses, 6×60′	100	Trusses B, dressed and chamfered	200
Trusses A, light	360	Trusses A, heavy, d and c	200
Trusses B, light	270	Trusses B, heavy, d and c	150
Trusses A, heavy	300	Scissor trusses C, all smoothed and finished	128
Trusses B, heavy	200		
Trusses A, dressed and chamfered	250		

These figures are given for all trusses made and erected in place. With them, as with other work, more can be done when there are a reasonable number than when there are only a few. A short roof might require only two trusses, and they cost more proportionately than when there are six, as most of the trouble comes when laying out the first one.

No allowance is made for building scaffolding, upon which the trusses are made.

The hoisting, when the scaffold is level with the walls, is not so very difficult. The shape of the truss counts in the raising, as a Howe only 8 ft high is easier to handle than a scissor at 30 ft. Thus the number of feet B M is not a safe guide.

Approximately, three-fourths of the total time would be making and one-fourth raising. Most of the raising can be done with common labor.

Description. Truss A, like two rafters with tie at bottom, 3 rods, 2 to 6 struts, span from 25 ft to 60 ft, peak or short level beam on top.

Truss B, strong enough to hang a floor to. Lower and upper chord, 6 braces and tie rods. Also a Howe with 8 to 19 struts and rods.

Porch Work

Description	Hours for one man	Description	Hours for one man
Porch post, ordinary, setting	1½	Porch rail, ordinary, square balusters, 1½ in and 1½ in apart, top rail about 3″×4″, for 20 lin ft	8
Porch post, at wall, setting	2	Balustrade, heavily molded, for each 10 ft	8
Porch post, stay-locked, 20″×18′ to 24″×20′	6		

TABLE B

Labor on Ceiling, Wainscoting, and Siding

Description	Squares, two men in 8 hours	Description	Squares, two men in 8 hours
Wood ceilings on stores—bad for fire risk	3	Plain 4-in, mitered	2
Wainscoting on all walls of No. 12, 3 ft	3½	Drop siding with casings and corner boards nailed on face	4
Plain 6-in siding, 4½ in to weather	4½	Same with joints butted	3

Under fair conditions with long walls, and few openings, the drop siding can be put on much faster.

TABLE C

Labor on Shingling

Description	Two men in 8 hours	
	Number	Square
Plain roofs, average exposure of $4\frac{1}{2}$ in..	4,400	5
Cut-up roofs.....	3,080	$3\frac{1}{2}$
Plain side walls.....	2,640	3
Difficult side walls.....	1,760	2

Under the best conditions with favorable weather good workmen might exceed these allowances from 10 to 30 per cent.

If numbers are figured instead of squares the exposure does not matter.

Some good records have been made with the automatic nailer of the Pearson Mfg. Co., Robbinsdale, Minn. Two men put down 1,000 per hour on one contract, and another two 38,000 in 28 hours, or 1,357 per hour. This on roofs, but too fast for good work.

TABLE D

Labor on Base

Description	Linear feet per man for 8 hours	Description	Linear feet per man for 8 hours
YP in a building with many pilasters, 3-member.....	50	No. 3, four stories, one-piece YP, scribed to floor.....	80
Hardwood, 3-member, average miters on one story of No. 3.....	50	No. 9, birch, 1-piece, no fitting to floor, which was cut between.....	100
		Plain quarter-round base	100

Under good conditions these figures might be exceeded 40 per cent.

TABLE E

Labor on Doors, Windows, and Blinds

Description	Hours	Description	Hours
Window frames, putting together on bldg.....	$1\frac{1}{2}$	Same in hardwood.....	13
Window finishing complete, pine, frame bldg, plainest kind.....	5	Pair of sliding doors complete, no framing of partitions, pine, heavy.....	30
Same in oak, plain.....	$6\frac{1}{2}$	Same in oak or mahogany.....	40
Same in brick bldg, pine	$6\frac{1}{2}$	Pair outside doors, pine, 6′×8′ complete.....	10
Same in brick bldg, oak plain.....	9	Same in oak.....	14
Window, 30-lt, 10″×14″, no inside finish.....	7	Railroad shop double doors, extra heavy, 12′8″×18′4″.....	32
Window, 60-lt, 10″×14″, no inside finish.....	10	Sliding barn door, single, 12′×18′.....	18
Transom fixed.....	1	Outside blinds, if fitted before frames are set, per pair.....	$\frac{3}{4}$
Transom, hung.....	$1\frac{1}{2}$	Same after frames are set.....	1
Door complete, including grounds, common style with transom...	10	Plain inside blinds, pine	3
Door, birch, no transom	7	Same hardwood.....	5
Door, pine, no transom, common $1\frac{3}{8}$ in.....	5		
Door, swinging, pine...	4		
Door, yellow pine, school, 10 ft high, wide panel jambs, inside, transom.....	10		

TABLE F

Extras

Description	Linear feet in 8 hrs for one man	Description	Linear feet in 8 hrs for one man
Wood inside cornices, oak, 6-in to 8-in board, picture mold, small mold, no plugging	100	Plate rail, no plugging	50
Above when 2 in to 3 in out from wall	60	Chair rail, no plugging	160
Main beams between	40	Panel strips, under chair rail, no cross work, 40 pieces at 5 ft	200
Cross beams	50	Chair rail with one line of cross panels	120
With short runs and many miters and panels	25	Chair rail with loose mold, paneled at top, best work	80
With heavy beams and best class of work, long runs	20	Choir and altar railing, put together at mill	30
Heavy beams, best work, and short panels	15	Wainscoting, oak, put up at mill, long stretches	25
Plate rail, no plugging	70	Above, short lengths, miters	20

TABLE G

Special Installations

Allowed on basis of two men in days of 8 hours:

Description	Days	Description	Days
Sideboard, knockdown, ash	8	Sideboard, as above	2
Sideboard, oak, K. D.	6	Kitchen and pantry cupboards, to put in place, hang doors, fit hardware. All, from bookcase down, put together at mill	$1\frac{1}{4}$
Bookcase, put together, putting on base, etc.	$\frac{1}{2}$	Setting mantel, put together at mill	$\frac{1}{2}$
For buffets and china closets	$\frac{1}{2}$	Mantel	$\frac{3}{4}$
Allow extra if doors are not hinged and locks fitted	$\frac{1}{2}$	Console	$\frac{1}{2}$
Sideboard to put in recess, case, hang doors, and put on drawer pulls	$1\frac{1}{2}$	Colonnade opening, complete with casings, and jambs, and base	1

TABLE H

Labor on Floors

Description	Squares, two men in 8 hours
Yellow pine, $3\frac{1}{4}$-in face, laid on sheeting, paper put down, joints only smoothed.....	4
No. 3, same, all six stories well smoothed and sandpapered by hand.....	$3\frac{1}{2}$
Same laid on bare joists, no smoothing.	6
Maple, square-edged, $3\frac{1}{2}$ in.....	$4\frac{1}{2}$
Warehouse on under floor, $3\frac{1}{4}$ in, plain work.....	5
No. 9, cut in between base, well hand smoothed and sandpapered.....	3
No. 9, in small rooms, no floor mold.....	$2\frac{1}{2}$
Maple, tongued and grooved, warehouse, no smoothing, $2\frac{1}{4}$-in face.....	4
Maple for houses and offices, well smoothed by hand, $2\frac{1}{4}$ in.....	2
Maple, $1\frac{3}{4}$-in face, smoothed (all above flooring is $\frac{13}{16}$ in).....	$1\frac{1}{2}$
Smoothing old maple by hand.....	2
Oak, $2\frac{1}{4}$ in, best work, with border, $\frac{13}{16}$ in. (This was laid with special designs, and joints glued.).....	$\frac{1}{2}$
YP on under floor, $5\frac{1}{4}$-in face, no smoothing...	5
Same laid on bare joists	7
Same on plain pitched roof.....	4
Oak, plain, straight work, $2\frac{1}{4}$-in face, $\frac{13}{16}$, smoothed.....	3
Same with bay window, etc.....	$2\frac{1}{2}$
Same for straight work, $\frac{5}{16}$ in thick.....	$3\frac{1}{2}$
Same with bay window, etc., $\frac{5}{16}$ in.....	3
Oak, plain, straight work, $\frac{13}{16}'' \times 1\frac{1}{2}''$ face.	$2\frac{1}{4}$
Same with angles, as in bay window.....	$1\frac{3}{4}$
Allow $\frac{1}{2}$ sq extra if $\frac{5}{16}$ in.	
For hand planing oak, and sandpapering only, average quality	4
For a finer class of work	3
Herringbone oak, $\frac{13}{16}$ in, best work, laid, smoothed and papered.....	1

Parquetry

The $2\frac{1}{4}$-in oak already given ran to $\frac{1}{2}$ sq per 8-hour day for 2 men, complete. This was all laid in separate and short pieces. In such work much depends upon the detail. Many of the patterns come glued together in hexagons, borders are ready to lay, and this makes the work much easier than if in separate pieces, as herringbone. But if angled bay windows, projecting sideboards, hearths are to have border mitered around extra time is required. The filling in of ordinary fields comes under ordinary average time.

In the large eastern cities floor layers get from 90¢ to $1.20 an hour. In these cities it has been found that the cost of laying thin parquetry and wood carpet squares runs from 10¢ to 18¢ per square foot on medium-sized rooms. A fair average is from 14¢ to 18¢ for laying, scraping, filling, shellacking, and waxing.

The following is for laying, smoothing, and sandpapering:

Description	Lin ft for two men in 8 hours	Description	Lin ft for two men in 8 hours
Borders, mounted, straight work $4'' \times \frac{5}{16}''$	300	Border, mounted, straight $12'' \times \frac{5}{16}''$...	150
Same, straight work, $4'' \times \frac{13}{16}''$*.....	275	Border, mounted, straight $12'' \times \frac{13}{16}''$....	130
Border, mounted, straight $8'' \times \frac{5}{16}''$....	200	Allow extras as before.	
Border, mounted, straight $8'' \times \frac{13}{16}''$....	180	Border, mounted, straight $16'' \times \frac{5}{16}''$...	120
Allow extras as for the 4-in.		Border, mounted, straight $16'' \times \frac{13}{16}''$...	100
		Allow extras as for the others.	

* Border unmounted, and $\frac{13}{16}''$ separate, allow 10 per cent less linear feet. Where angle work and mitering is found allow from 10 to 40 per cent extra time.

Caution. In building, as in all lines, better results are to be had by the division of labor. In large cities there are tradesmen who do nothing but framing, others lay floors, and some pass their lives hanging doors. When living in New York I found that the experts were expected to do twice and sometimes three times as much as ordinary carpenters. The tables are made out from work done by good tradesmen, but not by what the New Yorkers call "lumpers." If anyone thinks it well to double the allowance for eight hours the way is open, but it is not always wise to expect too much. See Index for door labor.

Stairs. Setting only is allowed—not millwork. But which style shall be selected. I have known 2 men to set a stair in a forenoon and again, work on another for about 2 weeks.

On No. 12, with regular school stair, double flight, ceiling rail, about 6 ft wide, 3½ to 4 days for 2 men.

On No. 2 it took 233 hours for 1 man to set and finish 3 flights of oak stairs about 5 ft wide, with continuous rail.

On No. 9, with oak stairs, of a better design, it took 300 hours for 1 man to set 3 flights. Platforms allowed in framing lumber.

For a long box stair, without landing, 1 to 1½ days for 2 men. Box stair for cellar or attic, about the same if winders are used. For a plain 6- to 8-room house, 2 to 3 days. For a fine stair to a house of 8 to 10 rooms, 6 days.

Guess the rest; and remember that although the estimate may not be mathematically correct, you may add to or deduct from a reasonable percentage on complete bid enough to build the stair complete. While admitting that an estimate should be as nearly correct as possible, why insist on absolute accuracy on one small item, and then make a wild guess at the profit?

Revolving Doors. On a plain style allow 40 hours for installation, and from that up to 80.

Steel Doors. These are largely used for warehouses, rolling up to the top. For a 10′×10′ size, delivered, $200. Installation, 2 men per day, per opening. These figures for 1922.

Store Fronts. For an ordinary 21-ft width with recess door and two show windows, allow 4 to 5 days for 2 men, or in all, 64 to 80 hours. Some fronts require twice as long, and this without going into high-class work.

Costs per Square of 100 Sq Ft without Profit

Basis. In order to get the cost of a square it is best to take a larger surface and divide. The number of extra joists or studs can be had in this way. The tables in this chapter are therefore based on a space 22′×100, or 22 sqs, and 7 extra joists are allowed for doubling, etc.

Lumber. This is shown at various prices, ranging from low-year figures to war rates. In cases where Original Cost is necessary in valuations the low figures are often required. The quantity of lumber is given for each square, and it is thus easy to get the total for any price, as the labor per 100 is also given.

In the 2×6 list, for example, at 12-in. centers, joists and bridging make up 128 ft B M. If the cost of a square at $53 lumber is wanted add this amount to $25 per 1,000, the labor rate given, and multiply equals $9.984, or $10 for practical purposes. Or the Lumber

cents column can be used: For each dollar rise in the price of lumber 13¢ is to be added to the rate for $50; for example, equals 39¢ extra equals $9.60 and 39 equals $9.99.

A deduction is made in the same way. If a $48 lumber figure is wanted the deduction from the $50 rate is 26¢ equals $9.34. The 128 ft B M multiplied by $48 and $25 for labor equals $9.344.

Labor. This is based on $1 per hour per carpenter, and 2 men in 8 hours equals 16 hours of labor. By using this figure the number of dollars gives the number of hours, and this is an advantage. In the 2×6 list $25 per 1,000 means that 25 hours are required to put 1,000 ft B M in place. Any rate of wages can be applied to the hours. If the rate is 80¢ the 1,000 total is $20 instead of $25; if 60¢, $15; if 50¢, $12.50.

But the last column gives the number of cents to be added or deducted for each 1¢ of difference in the hourly rate of wages.

Example. In the 2×6 list, 24-in centers, the Labor cent column per square gives 2. If wages are $1.10 per hour, an addition of 20¢ per square must be made; and if 75¢ is the rate, 2×25 equals 50¢ must be deducted per square.

Combination. Assume a change in both lumber and labor, where the table does not show total: Take 2×10 joists set 20-in centers with lumber at $63 per 1,000 and labor at 87¢ per hour. How much per square? The ordinary system may be followed by multiplying 135 ft B M by $63, equals $8.51; the table rate is $20 per 1,000 for labor, which equals 20 hours at the basis of $1; 20×87¢ equals $17.40×135 equals $2.35, plus $8.51 equals $10.86, the total per square.

Following the table method and taking $60 lumber the shortage is $3 per 1,000. For each dollar of difference in price of lumber the cents column shows 14 to be added or deducted: 3×14 equals 42¢. Adding this to the $10.86 equals $11.28.

The figures vary a trifle because decimals are not carried out, and because of extra allowances. The 14¢ for lumber should be 13½, as the total feet figure is 135.

Labor Cents. To explain the column with this heading take as an illustration 2×10 joists set 22-in centers equals 126 ft B M. At $1 extra for lumber the lumber cents column should be 12.6 instead of 13. The labor on 126 ft at the rate given of $20 per 1,000 comes to $2.52. Adding for 1¢ extra per hour and raising $2.52 in the proportion of 100¢ to 101¢ the total is 2.5452¢. The difference between the one and the other is 2.52¢. But as one decimal is enough the figure is set at 2.5 extra per square for each 1¢ rise in labor per hour.

In this case lumber and labor figures are not exact to a fraction and this is not required on square valuations. Whenever $20 per

1,000 for labor is used the labor cents multiplied by 5 should equal the lumber cents. The first two lines in the 2×14 list are exact with both lumber and labor, and five times the labor equals the lumber.

Bridging. The number of linear feet per square is given, and either 1×4 or 2×4 may be used. The 1×3 costs as much for labor as the 1×4, and is not so good. The 2×2 should not be used. But while the linear feet are given, the figures are included in the totals as if B M. This means that with the 1×4 only a little more than a third of the allowance is required, and with the 2×4 two-thirds. Sufficient lumber is thus allowed for bracing the joists and for waste of this small material. In the space of 22×100 two rows are used, equaling 200 lin ft. This gives a fair average. See Bridging Table for price per linear foot or square if required.

In Table 10 it will be noticed that there are two cost lines—(1) and (2), even for the same size, centers, and depth of joists. In (1) the regular space of 22′×100′ is assumed for calculation, and this means two rows of bridging, or 200 lin ft for 22 sqs. But there are floors in dwellings, etc., with only 8 ft and 9 ft clear spans, and where bridged there are more linear feet to the square, and bridging should, of course, be taken by the linear foot, although for valuation the square system is best, as no one can tell how the lines are laid out. The cost under (2) is for this kind of work. The difference is so small that (2) might as well be taken for (1). In half the lines (2) is not figured out, but enough are given to show the additional cost.

Extras. The figures in the tables are for joists and bridging only in place. Stirrups, anchors, nails, are not included. Stirrups are shown in Millwork Construction table, but must be added or omitted as desired. Profit is not allowed, but net cost on basis as given. In figuring up a building it is always best to add profit at end of total and not on each separate item.

Nails. Most nails are required on the joists set closest together. The allowance is for 12-in centers, and for frame buildings, with nailings at both ends of joist. For joists, bracing, and bridging allow 55 lbs to 22 sqs, or 2½ to 3 lbs to square at whatever the local price is, and add this to the total lumber figure in place. For a masonry building 2½ lbs are enough. On a 6¢ basis per pound and starting at 18¢ per square a decrease of 1¢ per square brings the nail allowance to 12¢ for joists at 24-in span. For bridging alone 1 lb 10 d at 12-in centers per 100 lin ft; ⅔ lb. at 16 in.

Anchors. They are required on masonry buildings only. Side ones are usually put on at about 4-ft centers, and two long ones are enough on each end. The same number are required for 24-in centers as for 12-in. On a warehouse with several spans the anchors cost less per square, as only half the strap at centers are required.

For ordinary purposes this may be disregarded. The strap anchors for the supporting girders do not belong to the joist system.

For light joists $1\frac{1}{2}'' \times \frac{1}{4}''$ is heavy enough; and for heavy, $1\frac{3}{4}'' \times \frac{3}{8}''$. At 200 lin ft of each 256 lbs are required for light and 446 for heavy, say, 12 lbs per square in the first case, and 20 in the second. The local price might be 8¢, less or more. The labor of putting the anchors on is allowed in the lumber figure.

Variation. In some cases twice the allowance of lumber might be handled by 2 men in 8 hours, as in long, straight stretches; and in other cases as with fine oak floors and difficult patterns more time might be taken than is allowed. A fair average for average work is set down.

Wall Extra

The assumed space is 22′×100′. In many buildings the girders are set at 22-ft centers, and every part of the joists is covered with flooring. But in other buildings the ends of the joists go into the wall, usually 4 in, which for this purpose may be set at 6 in. In a building only 22 ft wide or so there is thus a difference between the area of the finished floor and that of the joists. The building may be only 21 ft in the clear, equaling the area of the floor; but the joist area should equal the length as bought from the lumber yard, in this assumed case 22 ft. At 100 ft long the area of joists would be 22 sqs, and of floor 21. The amount of lumber for each square is given in the columns on the left side of the tables, and this has to be allowed for wall and length waste. In the case of wall hangers being used there is no extra if the lengths suit.

Allowances

Number of Joists Allowed to 22 Squares

108 at 12-in centers	75 at 18-in centers	63 at 22-in centers
94 at 14-in centers	68 at 20-in centers	58 at 24-in centers
83 at 16-in centers		

Covering of Joists for 22 Squares

Sheeting 8 in.....2,550 ft B M	Flooring 4 in.....2,850 ft B M
Shiplap 8 in.....2,650 ft B M	Flooring $2\frac{1}{4}$.....2,950 ft B M
Flooring 6 ft.....2,650 ft B M	Flooring 2×6....5,200 ft B M

At usual $\frac{7}{8}$ in thickness when not otherwise specified.

Basement Sleepers for 22 Squares

Stake allowances to hold them down, included in square totals in table

16-in centers	300-ft B M	36-in centers	160-ft B M
20-in centers	250-ft B M	42-in centers	140-ft B M
24-in centers	220-ft B M	48-in centers	120-ft B M

Number of Basement Sleepers

81 at 16-in centers	40 at 36-in centers
66 at 20-in centers	35 at 42-in centers
56 at 24-in centers	31 at 48-in centers

Warehouse and Mill Construction

Posts and girders are not included in the lists. Allow at local price for lumber, and 50 hours per 1,000 ft B M for labor. Add stirrups, anchors, and nails to square totals, as beams only are included.

No Doubling. A floor with beams at 3-ft centers is not exactly twice the cost of one at 6-ft, for the extra beams come in both. So with the joist tables. Take the 2×14 joist list, for an illustration: The cost per square at $30 on 12-in centers is $14, but at $60 lumber is only $22.40 instead of $28. No matter what the price of lumber the labor is the same in the tables. Both for the extras and the changed price of lumber each size must be figured out by itself. The higher the price of lumber the greater is the difference. See the $100 and $200 column in the Hardwood Flooring table.

Railroad Shop Roofs

Slope. Ordinarily railroad shop roofs are covered with gravel. The ideal pitch for gravel, according to a roofer with long experience, is $\frac{1}{4}$ in per foot. The greatest pitch should not be more than $1\frac{1}{2}$ in. A large shop constructed with a 2-in slope lost so much gravel that the gutters and down spouts and sewers were filled.

On such roofs the carpenter labor does not cost any more than on the level, if the hoisting is done by power, as it almost always is and should be for economical reasons, and therefore the tables for Mill Construction can be used for shops.

These tables are made out on the basis of handling 1,000 ft B M in 20 hours, and any rate of wages can be adjusted to suit this. On a shop 150 ft wide by 500 ft long the entire footage of purlins

was placed for $6 per 1,000 on a 40¢ per hour basis, or $15 per 1,000 equals 15 hours at $1. But on another shop of the same width by 400 ft long 21 hours were required. The table is set at a fair allowance of time, and contractors know that special circumstances make a difference in results. In The New Building Estimators' Handbook there is a chapter on the influence of climate upon work, and a difference of 15 per cent is shown with the same men.

Covering. The 2×6 flooring in the table for the covering of joists is set at $3.84 per square, containing in this case 240 ft B M, or a rate of $16 equals 16 hours per 1,000. On the 500-ft shop with nailings 6 ft apart on purlins the labor at 40¢ per hour was $7 per 1,000, or at $1 $17.50 equals 17½ hours. With favorable conditions such work might be done in 14 hours.

For the covering of floors the allowance in the table is 1,300 ft of 3×6 ungrooved plank in 16 hours. On a shop with 190,000 ft the time taken was 7½ hours per 1,000. To suit such large floors the allowance should therefore be 2,133 instead of 1,300. But average work has to be considered, and basement floors or ordinary areas take more time than shops several hundred feet long.

Basement Sleepers. The allowance in the tables is 16 hours per 1,000, but on the 400-ft shop the time taken was not quite 11. The area of the floor, the shape of the rooms, the thermometer, and the quality of the material have to be considered.

Centers. It naturally takes more time to nail down covering with joists at 12-in centers than at 24-in. But ordinary construction is at 16-in centers, and averages may be based on this. Mill and purlin construction at 3-ft centers requires more nailing than at 6-ft. But when the heat of summer and the cold of winter may cause a variation in labor of 15 per cent from the normal rate of the best months the nailing matter is not of so much importance. Risks of variation should be covered up by the rate of profit, for contractors, as a rule, do not get large enough returns to allow a contingency fund.

Anchors. All that can be given is an approximate figure, as size and distance apart regulate the amount. All through these calculations the lumber is based on 22 squares, or a space 22′×100′. But ends at several places may be anchored, and stirrups may be required at stairs, elevator shafts, etc. To make up for these extras the 22-square basis is cut to 18 for this purpose only.

On 24-in centers the anchors would be placed every alternate joist, making about 50. With ⅝″×2½″ iron, 3-ft shank and 1-ft head, the weight is 13 lb, at 7¢ equals $0.91. With lag screws allow $1. For the 18 squares this is practically $3 per square.

On the 30-in space the number is 40, or $2.20 per square.

On the 36-in, with each beam anchored, the number is 66, or $3.66 per square.

On the 42-in, with each beam anchored, the number is 54, or $3 per square.

On the 48-in, with each beam anchored, except the two against wall, as usual, $48, close to $2.70.

On the 60-in, with $\frac{1}{2}'' \times 3''$ iron, equals 20 lb at 7¢ equals $1.40 times 38 equals $53.20, or $3 per square.

On the 72-in, equals 32 at $1.40 equals $2.49.

On the 84-in with $\frac{1}{2}'' \times 4''$ iron at 6.74 lbs times 4 ft equals 27 lbs at 7¢ equals $1.89, allow $2 times 30 equals $60 equals $3.33 per square.

On the 96-in equals 26 times $2 equals $52, or nearly $3 per square on the same basis as the others.

The heavier anchors for the wide spaces bring the total to about the same as the light ones spaced closer together. In the case of a wide warehouse the strap anchors at girders would be only half the cost of the ones given for the walls, as half the length goes to each beam.

Patent hangers may be used, such as the Duplex, and stirrups and anchors not be required. For this reason the stirrups and anchors are not included in the price per square.

Stirrups. Where the beams rest on the walls the stirrups are, of course, not required, and half the amount per square must be deducted. The number of stirrups required is given here for the different spaces: 6, 5, 4, 4, 3, 3, 2, 2, 2. This is from the 24-in to the 96-in centers.

Duplex Post Caps and Bases

For 3 way, add 25 per cent; 4 way, 50 per cent

	Caps	Bases
6× 6 two ways	$3.00	$2.60
8× 8 two ways	4.10	3.30
10×10 two ways	5.20	4.00
12×12 two ways	6.20	4.50
14×14 two ways	8.50	6.00
16×16 two ways	10.10	8.00

These prices are for girders same depth as size of posts: thus a 10×10 post cap is priced for a 10-in girder: for each 2 in of extra depth of girder add 10 per cent to price, making a 10×10 cap for a 14-in deep girder, $6.00. Duplex post bases are one way only.

Cast-iron caps, size 8″× 8″.....50 lbs at 5¢
Cast-iron caps, size 10″×10″.....60 lbs at 5¢
Cast-iron caps, size 12″×12″.....80 lbs at 5¢

Weight depends upon load, so that these figures are only approximate.

Mr. Tyrrell in "Architects and Builders Magazine" gives weights of heavy iron column bases for high buildings:

22×22	600 lbs	32×32	1,340 lbs
24×24	750 lbs	34×34	1,450 lbs
26×26	880 lbs	36×36	1,600 lbs
28×28	1,020 lbs	38×38	1,720 lbs
30×30	1,180 lbs	40×40	1,850 lbs

Nails. Scarcely any are required. A few stay braces hold the beams in position at the wall end, while the girder end is dropped into stirrups. Stay braced at each end and at 24-in centers 2 lbs 10d nails would be enough for 22 sqs, or a cent a square.

Stud Spacing. For wood lath the spacing is 12 in or 16 in. But walls are not always lathed, and for them the spacing is varied. Plates are allowed in the 22 sqs—one at bottom, two at top equals 300 lin ft, but on a wall of half the 22-ft height the same allowance is required. A 2×6 wall of a 2-story house or building with 22 sqs would thus have 300 ft B M for plates included, while a bungalow half the height but with 100 ft around the walls would have the same amount. The latter thus has about 7 ft extra per square. But some houses have only a single plate at top, and others have no plate at bottom, the sill being used for a base, and all that can be expected in a square estimate is a fair average.

The figures are based on average walls. For some kinds of cottages the labor might be increased from 20 to 50 per cent. A gable by itself costs much more than a long stretch of wall, but the whole surface is supposed to be taken together.

Nails. For each square of ordinary 2×4 to 2×6 wall add 2½ lbs. For heavy walls allow 5 lbs for the narrow spaces and 3½ for the wide.

Cost of Rafters per Square

Plates are not allowed for a brick building. Add a 2×8 all around the wall. The labor on cut-up roofs may run from 20 to 70 per cent higher than for the ordinary ones listed in the Rafter table. The figures are for rafters only. Collar beams or ceiling joists are found in the joist table.

Nails. Allow as for the walls. Add 15 per cent for cut-up roofs.

Nails. See the regular nail table for allowances in Hardware Chapter.

Nail Table

Of course the number of nails to pound varies; 106, 74, 10, are given in another list instead of 132, 87, 12, as below.

The price of nails changes as the days go by. At present the "base" is $4.50. From 60D to 20D is base. Add according to table for other kinds.

Wire Nails. Size, length, number to pound, and rate:

Size	Kind	Length, in	Number to pound	Advance on rate base
60	Common	6	12	
50	Common	5½	15	
40	Common	5	21	
30	Common	4½	27	
20	Common	4	35	
16	Common	3½	51	$0.05
12	Common	3¼	66	.05
10	Common	3	87	.05
8	Common	2½	132	.10
6	Common	2	252	.20
4	Common	1½	432	.30
3	Common	1¼	720	.45
3	Fine	1⅛	1140	.50
10	Casing	3	121	.15
8	Casing	2½	170	.25
6	Casing	2	310	.35
4	Casing	1½	584	.50
10	Finish	3	137	.25
8	Finish	2½	190	.35
6	Finish	2	350	.45
4	Finish	1½	760	.65

Galv Nails cost about $1.25 extra per keg.

Examples

To show the system of working the tables the following examples are given:

Cost of 1 Square on Masonry Building

3×12 joists at 16-in centers, lumber at $50	$19.25
Loss of 6 in each end in wall, $\frac{1}{22}$ of square	.88
Nails for stay bracing and bridging, at 6¢	.15
Anchors, $1\frac{3}{4}\times\frac{3}{8}$	1.60
Under floor, No. 1 Y. P. shiplap on angle at $45	8.21
Paper between floors	1.00
Top floor, Y. P., $3\frac{1}{4}$ face, at $100	18.34
Nails for both floors, at 6¢	.36
Total without profit or painter work	$49.79

Cost of 1 Square on Girders, Masonry Building

2×14 joists at 12-in centers, lumber at $65	$23.80
Nails for stay bracing and bridging at 6¢	.18
Anchors, $1\frac{1}{2}\times\frac{1}{4}$	.96
Under floor Y. P. sheeting No. 1, lumber, $55	8.24
Top floor, $2\frac{1}{4}$ face, factory maple at $140	26.00
Nails for both floors at 6¢	.48
	$59.66

Anchors are allowed as for masonry walls, but only a half strap anchor would really belong to girder work on each end.

Cost of 1 Square for Dwelling Work on Frame Building

2×10 joists at 16-in centers, lumber at $55	$12.15
Nails	.15
Sheeting, Y. P. No. 1 for under floor, $45	7.08
Paper between floors	1.00
Upper floor, best white oak, q s, $200, $2\frac{1}{4}$-in face	40.80
Nails for both floors	.48
	$61.66

Paper is set at $1, and half might be enough. Oak flooring may be had at a lower figure, but during the war it cost $395 per 1,000 ft. unlaid, so that $200 may be the unit in the future, as the oak forests will soon be exhausted. A house with 800 sq ft on the first story thus costs for floor alone about $500 without profit. This at $1 per hour labor, of course. If the $1\frac{1}{2}$-in face is used the cost is more. Formerly the standard width was $3\frac{1}{4}$-in face, then came $2\frac{1}{4}$-in, and now $1\frac{1}{2}$ in. The narrow boards are only half the width of the $3\frac{1}{4}$-in and shrinkage is consequently only half. The $3\frac{1}{4}$-in is safe enough if well dried, but it is often only half dried, and when put in buildings damp with new plaster the joints open after a winter's heat. Architects to be safe have been driven to the narrow brand. The $\frac{3}{8}$-in floor is too thin: $\frac{1}{2}$-in should be the minimum. Damp sometimes makes a thin floor buckle. If smoothing has to be done by hand instead of machine the labor is not so very much less than for the thick—about 15 per cent.

Doubling and taking proportions will not work with these tables, because labor rate is the same, no matter what the price of lumber. As the number of feet B M is given for 8 hours any labor rate per hour can be made to suit. Take the first figure in Table 1, for example: with labor at $29 and lumber at $25 the total per 1,000 installed is $3.89, for this is what 72 ft B M comes to when multiplied by $25 added to $29; but doubling the price of lumber gives only $5.69, or 72 times $29 added to $50.

TABLE 1

Price per Square of Joists Laid

2×4 list: 550 ft B M for 2 men in 8 hours = $29 per 1,000

Centers, inches	Quantity ft B M in 1 square	Lin ft bridging in 1 square	Price per M of lumber									Lumber, cts	Labor, cts
			$25	$30	$35	$40	$45	$50	$55	$60	$65		
12	72	..	3.89	4.25	4.61	4.97	5.33	5.69	6.05	6.41	6.77	8	2.1
14	63	..	3.40	3.72	4.03	4.35	4.66	4.98	5.29	5.61	5.92	7	1.8
16	56	..	3.03	3.31	3.58	3.86	4.14	4.42	4.70	4.98	5.20	6	1.6
18	50	..	2.70	2.95	3.20	3.45	3.70	3.95	4.20	4.45	4.70	5	1.5
20	46	..	2.49	2.72	2.95	3.17	3.40	3.63	3.86	4.09	4.32	5	1.4
22	42	..	2.27	2.48	2.69	2.90	3.11	3.32	3.53	3.74	3.95	5	1.2
24	39	..	2.11	2.30	2.50	2.69	2.89	3.08	3.27	3.47	3.67	4	1.1

2×6 list: 640 ft B M for 2 men in 8 hours = $25 per 1,000

12	108	20	6.40	7.04	7.68	8.32	8.96	9.60	10.24	10.88	11.52	13	3.2
14	94	20	5.70	6.27	6.84	7.41	7.98	8.55	9.12	9.69	10.26	12	2.9
16	83	20	5.15	5.66	6.18	6.69	7.21	7.72	8.24	8.75	9.27	11	2.6
18	75	20	4.75	5.23	5.70	6.17	6.65	7.13	7.60	8.07	8.55	10	2.4
20	68	20	4.40	4.84	5.28	5.72	6.16	6.60	7.04	7.48	7.92	9	2.2
22	63	20	4.15	4.57	4.98	5.39	5.81	6.23	6.64	7.05	7.47	9	2.1
24	58	20	3.90	4.29	4.68	5.07	5.46	5.85	6.24	6.63	7.02	8	2.0

2×8 list: 700 ft B M for 2 men in 8 hours = $23 per 1,000

12	145	21	7.97	8.80	9.63	10.46	11.29	12.12	12.95	13.78	14.61	17	3.8
14	126	21	7.06	7.79	8.53	9.26	10.00	10.73	11.46	12.20	12.94	15	3.4
16	111	21	6.34	7.00	7.66	8.31	8.97	9.63	10.29	10.95	11.61	13	3.0
18	100	21	5.81	6.41	7.02	7.62	8.23	8.83	9.44	10.04	10.65	12	2.8
20	91	20	5.33	5.88	6.44	7.00	7.55	8.10	8.66	9.21	9.77	11	2.6
22	84	20	4.99	5.51	6.03	6.55	7.07	7.59	8.11	8.63	9.15	11	2.4
24	78	20	4.70	5.19	5.68	6.17	6.66	7.15	7.64	8.13	8.62	10	2.3

2×10 list: 800 ft B M for 2 men in 8 hours = $20 per 1,000

			$30	$35	$40	$45	$50	$55	$60	$65	$70		
12	180	23	10.15	11.17	12.18	13.20	14.21	15.23	16.24	17.26	18.27	20	4.1
14	157	23	9.00	9.90	10.80	11.70	12.60	13.50	14.40	15.30	16.20	18	3.6
16	139	23	8.10	8.91	9.72	10.53	11.34	12.15	12.96	13.77	14.58	16	3.2
18	125	23	7.40	8.14	8.88	9.62	10.36	11.10	11.84	12.58	13.32	15	3.0
20	114	21	6.75	7.43	8.10	8.78	9.45	10.13	10.80	11.47	12.15	14	2.7
22	105	21	6.30	6.93	7.56	8.19	8.82	9.45	10.08	10.71	11.34	13	2.5
24	97	21	5.90	6.49	7.08	7.67	8.26	8.85	9.44	10.03	10.62	12	2.4

TABLE 1—*Continued*

Price per Square of Joists Laid

2×12 list: 800 ft B M for 2 men in 8 hours = $20 per 1,000

Centers, inches	Quantity ft B M in 1 square	Lin ft bridging in 1 square	Price per M of lumber									Lumber, cts	Labor, cts
			$30	$35	$40	$45	$50	$55	$60	$65	$70		
12	216	26	12.10	13.31	14.52	15.73	16.94	18.15	19.36	20.57	21.78	24	4.8
14	188	26	10.70	11.77	12.84	13.91	14.98	16.05	17.12	18.19	19.26	22	4.3
16	166	26	9.60	10.56	11.52	12.48	13.44	14.40	15.36	16.32	17.28	20	3.8
18	150	26	8.80	9.68	10.56	11.44	12.32	13.20	14.08	14.96	15.84	18	3.5
20	136	22	7.90	8.69	9.48	10.27	11.06	11.85	12.64	13.43	14.22	16	3.2
22	126	22	7.40	8.14	8.88	9.62	10.36	11.10	11.84	12.58	13.32	15	3.0
24	116	22	6.90	7.59	8.28	8.97	9.66	10.35	11.04	11.73	12.42	14	2.8

2×14 list: 800 ft B M for 2 men in 8 hours = $20 per 1,000

12	250	30	14.00	15.40	16.80	18.20	19.60	21.00	22.40	23.80	25.20	28	5.6
14	220	30	12.50	13.75	15.00	16.25	17.50	18.75	20.00	21.25	22.50	25	5.0
16	194	30	11.20	12.32	13.44	14.56	15.68	16.80	17.92	19.04	20.16	22	4.5
18	175	30	10.25	11.28	12.30	13.33	14.35	15.38	16.40	17.43	18.45	20	4.1
20	160	24	9.20	10.12	11.04	11.96	12.88	13.80	14.72	15.64	16.56	18	3.7
22	147	24	8.55	9.41	10.26	11.12	11.97	12.83	13.68	14.54	15.39	17	3.5
24	136	24	8.00	8.80	9.60	10.40	11.20	12.00	12.80	13.60	14.40	16	3.2

3×10 list: 800 ft B M for 2 men in 8 hours = $20 per 1,000

12	270	22	14.60	16.06	17.52	18.98	20.44	21.90	23.36	24.82	26.28	30	5.8
14	235	22	12.85	14.14	15.42	16.70	18.00	19.28	20.56	21.85	23.13	26	5.0
16	208	22	11.50	12.65	13.80	14.95	16.10	17.25	18.40	19.55	20.70	23	4.6
18	188	22	10.50	11.55	12.60	13.65	14.70	15.75	16.80	17.85	18.90	21	4.2
20	170	20	9.50	10.45	11.40	12.35	13.30	14.25	15.20	16.15	17.10	19	3.8
22	158	20	8.90	9.79	10.68	11.57	12.46	13.35	14.24	15.13	16.02	18	3.6
24	145	20	8.25	9.08	9.90	10.73	11.55	12.38	13.20	14.03	14.85	17	3.3

3×12 list: 800 ft B M for 2 men in 8 hours = $20 per 1,000

12	325	25	17.50	19.25	21.00	22.75	24.50	26.25	28.00	29.75	31.50	35	7.0
14	282	25	15.35	16.89	18.42	19.96	21.49	23.03	24.56	26.10	27.63	31	6.0
16	250	25	13.75	15.13	16.50	17.88	19.25	20.63	22.00	23.38	24.75	28	5.5
18	225	25	12.50	13.75	15.00	16.25	17.50	18.75	20.00	21.25	22.50	25	5.0
20	204	23	11.35	12.49	13.62	14.76	15.89	17.03	18.16	19.30	20.43	23	4.5
22	189	23	10.60	11.66	12.72	13.78	14.84	15.90	16.96	18.02	19.08	21	4.2
24	174	23	9.85	10.84	11.82	12.81	13.79	14.78	15.76	16.75	17.73	20	4.0

3×14 list: 800 ft B M for 2 men in 8 hours = $20 per 1,000

12	378	27	20.25	22.28	24.30	26.33	28.35	30.38	32.40	34.43	36.45	41	8.1
14	329	27	17.80	19.58	21.36	23.14	24.92	26.70	28.48	30.26	32.04	36	7.2
16	291	27	15.90	17.49	19.08	20.67	22.26	23.85	25.44	27.03	28.62	32	6.4
18	263	27	14.50	15.95	17.40	18.85	20.30	21.75	23.20	24.65	26.10	29	5.8
20	238	24	13.10	14.41	15.72	17.03	18.34	19.65	20.96	22.27	23.58	27	5.3
22	221	24	12.25	13.48	14.70	15.93	17.15	18.38	19.60	20.83	22.05	25	4.9
24	203	24	11.35	12.49	13.62	14.76	15.89	17.03	18.16	19.30	20.43	23	4.6

TABLE 2

Net Prices per Square of Basement Sleepers Laid

Centers, inches	Quantity ft B M in 1 square	Price per M of lumber									Lumber, cts	Labor, cts
		$25	$30	$35	$40	$45	$50	$55	$60	$65		
2×4 list: 400 ft B M for 2 men in 8 hours = $40 per 1,000												
16	68	4.42	4.76	5.10	5.44	5.78	6.12	6.46	6.80	7.14	7	2.7
20	56	3.64	3.92	4.20	4.48	4.76	5.04	5.32	5.60	5.88	6	2.2
24	49	3.19	3.43	3.68	3.92	4.17	4.41	4.66	4.90	5.15	5	2.0
4×4 list: 700 ft B M for 2 men in 8 hours = $23 per 1,000												
16	122	5.86	6.47	7.08	7.69	8.30	8.91	9.52	10.13	10.74	13	2.8
20	100	4.80	5.30	5.80	6.30	6.80	7.30	7.80	8.30	8.80	10	2.3
24	85	4.08	4.51	4.93	5.36	5.78	6.21	6.63	7.06	7.48	9	2.0
4×6 list: 800 ft B M for 2 men in 8 hours = $20 per 1,000												
24	122	5.49	6.10	6.71	7.32	7.93	8.54	9.15	9.76	10.37	13	2.5
30	100	4.50	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50	10	2.0
36	85	3.83	4.25	4.68	5.10	5.53	5.95	6.38	6.80	7.23	9	1.7
42	77	3.47	3.85	4.24	4.62	5.00	5.39	5.78	6.16	6.55	8	1.6
48	68	3.06	3.40	3.74	4.08	4.42	4.76	5.10	5.44	5.78	7	1.4
4×8 list: 890 ft B M for 2 men in 8 hours = $18 per 1,000												
30	131	5.64	6.29	6.94	7.60	8.25	8.91	9.56	10.22	10.87	13	2.4
36	114	4.90	5.47	6.04	6.61	7.18	7.75	8.32	8.89	9.46	12	2.1
42	100	4.30	4.80	5.30	5.80	6.30	6.80	7.30	7.80	8.30	10	1.8
48	83	3.57	3:99	4.40	4.82	5.23	5.65	6.06	6.47	6.89	9	1.5
6×6 list: 890 ft B M for 2 men in 8 hours = $18 per 1,000												
36	128	5.51	6.15	6.79	7.43	8.07	8.71	9.35	9.99	10.63	13	2.3
42	114	4.90	5.47	6.04	6.61	7.18	7.75	8.32	8.89	9.46	12	2.1
48	100	4.30	4.80	5.30	5.80	6.30	6.80	7.30	7.80	8.30	10	1.8
6×8 list: 1,000 ft B M for 2 men in 8 hours = $16 per 1,000												
36	168	6.89	7.73	8.57	9.41	10.25	11.09	11.93	12.77	13.61	17	2.7
42	147	6.03	6.76	7.50	8.23	8.97	9.70	10.44	11.17	11.91	15	2.4
48	130	5.33	5.98	6.63	7.28	7.93	8.58	9.23	9.88	10.53	13	2.1

TABLE 3

Mill Construction and R.R. Shop Roofs

Net prices per square of beams laid

Labor, 800 ft B M in 8 hours for 2 men = $20 per 1,000

6×12 list

Centers, inches	Quantity ft B M in 1 square	Price per M of lumber									Stirrups	Lumber, cts	Labor, cts
		$40	$45	$50	$55	$60	$65	$70	$75	$80	3/32″×3″		
24	318	19.08	20.67	22.26	23.85	25.44	27.03	28.62	30.21	31.80	6.60	32	6.4
30	258	15.48	16.77	18.06	19.35	20.64	21.93	23.22	24.51	25.80	5.50	26	5.2
36	216	12.96	14.04	15.12	16.20	17.28	18.36	19.44	20.52	21.60	4.40	22	4.3
42	192	11.52	12.48	13.44	14.40	15.36	16.32	17.28	18.24	19.20	4.40	20	3.9
48	168	10.08	10.92	11.76	12.60	13.44	14.28	15.12	15.96	16.80	3.30	17	3.4
60	138	8.28	8.97	9.66	10.35	11.04	11.73	12.42	13.11	13.80	3.30	14	2.8
72	120	7.20	7.80	8.40	9.00	9.60	10.20	10.80	11.40	12.00	2.20	12	2.4
84	108	6.48	7.02	7.56	8.10	8.64	9.18	9.72	10.26	10.80	2.20	11	2.2
96	96	5.76	6.24	6.72	7.20	7.68	8.16	8.64	9.12	9.60	2.20	10	2.0

6×14 list

24	371	22.26	24.12	25.97	27.83	29.68	31.54	33.39	35.25	37.10	7.20	37	7.4
30	301	18.06	19.57	21.07	22.58	24.08	25.59	27.09	28.60	30.10	6.00	30	6.0
36	252	15.12	16.38	17.64	18.90	20.16	21.42	22.68	23.94	25.20	4.80	25	5.0
42	224	13.44	14.56	15.68	16.80	17.92	19.04	20.16	21.28	22.40	4.80	23	4.5
48	196	11.76	12.74	13.72	14.70	15.68	16.66	17.64	18.62	19.60	3.60	20	4.0
60	161	9.66	10.47	11.27	12.08	12.88	13.69	14.49	15.30	16.10	3.60	16	3.2
72	140	8.40	9.10	9.80	10.50	11.20	11.90	12.60	13.30	14.00	2.40	14	2.8
84	126	7.56	8.19	8.82	9.45	10.08	10.71	11.34	11.97	12.60	2.40	13	2.6
96	120	7.20	7.80	8.40	9.00	9.60	10.20	10.80	11.40	12.00	2.40	12	2.4

6×16 and 8×12 list

24	424	25.44	27.56	29.68	31.80	33.92	36.04	38.16	40.28	42.40	8.40	43	8.5
30	344	20.64	22.36	24.08	25.80	27.52	29.24	30.96	32.68	34.40	7.00	35	6.9
36	293	17.58	19.05	20.51	21.98	23.44	24.91	26.37	27.84	29.30	5.60	29	5.9
42	256	15.36	16.64	17.92	19.20	20.48	21.76	23.04	24.32	25.60	5.60	26	5.2
48	224	13.44	14.56	15.68	16.80	17.92	19.04	20.16	21.28	22.40	4.20	23	4.5
60	184	11.04	11.96	12.88	13.80	14.72	15.64	16.56	17.48	18.40	4.20	19	3.7
72	160	9.60	10.40	11.20	12.00	12.80	13.60	14.40	15.20	16.00	2.80	16	3.2
84	144	8.64	9.36	10.08	10.80	11.52	12.24	12.96	13.68	14.40	2.80	15	2.9
96	128	7.68	8.32	8.96	9.60	10.24	10.88	11.52	12.16	12.80	2.80	13	2.6

TABLE 3—*Continued*

MILL CONSTRUCTION AND R.R. SHOP ROOFS

Net prices per square of beams laid

Labor, 800 ft B M in 8 hours for 2 men = $20 per 1,000

8×14 list

Centers, inches	Quantity ft B M in 1 square	Price per M of lumber									Stirrups	Lumber, cts	Labor, cts
		$40	$45	$50	$55	$60	$65	$70	$75	$80	⅜"×3"		
24	495	29.70	32.18	34.65	37.13	39.60	42.08	44.55	47.03	49.50	11.40	50	9.9
30	400	24.00	26.00	28.00	30.00	32.00	34.00	36.00	38.00	40.00	9.50	40	8.0
36	336	20.16	21.84	23.52	25.20	26.88	28.56	30.24	31.92	33.60	7.60	34	6.8
42	300	18.00	19.50	21.00	22.50	24.00	25.50	27.00	28.50	30.00	7.60	30	6.0
48	262	15.72	17.03	18.34	19.65	20.96	22.27	23.58	24.89	26.20	5.70	26	5.3
60	207	12.42	13.46	14.49	15.53	16.56	17.60	18.63	19.67	20.70	5.70	21	4.2
72	187	11.22	12.16	13.09	14.03	14.96	15.90	16.83	17.77	18.70	3.80	19	3.8
84	168	10.08	10.92	11.76	12.60	13.44	14.28	15.12	15.96	16.80	3.80	17	3.4
96	150	9.00	9.75	10.50	11.25	12.00	12.75	13.50	14.25	15.00	3.80	15	3.0

8×16 list

24	566	33.96	36.79	39.62	42.45	45.28	48.11	50.94	53.77	56.60	12.00	57	11.4
30	460	27.60	29.90	32.20	34.50	36.80	39.10	41.40	43.70	46.00	10.00	46	9.2
36	384	23.04	24.96	26.88	28.80	30.72	32.64	34.56	36.48	38.40	8.00	39	7.7
42	342	20.52	22.23	23.94	25.65	27.36	29.07	30.78	32.49	34.20	8.00	34	6.9
48	300	18.00	19.50	21.00	22.50	24.00	25.50	27.00	28.50	30.00	6.00	30	6.0
60	246	14.76	15.99	17.22	18.45	19.68	20.91	22.14	23.37	24.60	6.00	25	5.0
72	214	12.84	13.91	14.98	16.05	17.12	18.19	19.26	20.33	21.40	4.00	22	4.3
84	192	11.52	12.48	13.44	14.40	15.36	16.32	17.28	18.24	19.20	4.00	19	3.9
96	170	10.20	11.05	11.90	12.75	13.60	14.45	15.30	16.15	17.00	4.00	17	3.4

TABLE 4

Covering of Joists

Net prices per square

Description	Quantity B M laid by 2 men in 8 hrs.	Labor per square $	Quantity B M per square	Lumber per M									Lumber, cts.	Labor, cts.
				$35	$40	$45	$50	$55	$60	$65	$70	$75		
Sheeting Y. P. No. 1	1,000	1.86	116	5.92	6.50	7.08	7.66	8.24	8.82	9.40	9.98	10.56	12	1.9
" Y. P. No. 2	950	1.96	116	6.02	6.60	7.18	7.76	8.34	8.92	9.50	10.08	10.66	12	2.0
" on angle Y. P. No. 1	850	2.36	125	6.74	7.36	7.99	8.61	9.24	9.86	10.49	11.11	11.74	13	2.4
" " " Y. P. No. 2	800	2.50	125	6.88	7.50	8.13	8.75	9.38	10.00	10.63	11.25	11.88	13	2.5
Shiplap Y. P. No. 1	1,000	1.94	121	6.18	6.78	7.39	7.99	8.60	9.20	9.81	10.41	11.02	12	2.0
" Y. P. No. 2	950	1.96	121	6.20	6.80	7.41	8.01	8.62	9.22	9.83	10.43	11.04	12	2.0
" on angle Y. P. No. 1	850	2.36	130	6.91	7.56	8.21	8.86	9.51	10.16	10.81	11.46	12.11	13	2.4
" " " Y. P. No. 2	800	2.50	130	7.05	7.70	8.35	9.00	9.65	10.30	10.95	11.60	12.25	13	2.5
Sheeting W. P. or soft material	1,100	1.69	116	5.75	6.33	6.91	7.49	8.07	8.65	9.23	9.81	10.39	12	1.7
Same, angled	1,050	1.91	125	6.29	6.91	7.54	8.16	8.79	9.41	10.04	10.66	11.29	13	1.9
Shiplap, same	1,100	1.76	121	6.00	6.60	7.20	7.81	8.42	9.02	9.63	10.23	10.84	12	1.8
" same, angled	1,050	1.98	130	6.53	7.18	7.83	8.48	9.13	9.78	10.43	11.08	11.73	13	2.0
Plank 2″×6″, 8″, 10″ S. 1S. 2E. Y. P.	1,200	3.07	230	11.12	12.27	13.42	14.57	15.72	16.87	18.02	19.17	20.32	23	3.1
Same, 3″ material	1,400	3.95	345	16.03	17.75	19.48	21.20	22.93	24.65	26.38	28.10	29.83	35	4.0
Plank 2″ angled	1,100	3.61	250	12.36	13.61	14.86	16.11	17.36	18.61	19.86	21.11	22.36	25	3.6
" 3″ "	1,300	4.62	375	17.75	19.62	21.50	23.37	25.25	27.12	29.00	30.87	32.75	38	4.6
Flooring 2″×6″ T. and grooved Y. P.	1,000	3.84	240	12.24	13.44	14.64	15.84	17.04	18.24	19.44	20.64	21.84	24	3.8
Same, angled	875	4.90	260	14.00	15.30	16.60	17.90	19.20	20.50	21.80	23.10	24.40	26	4.9
" 3″×6″ T. and G	1,200	4.80	360	17.40	19.20	21.00	22.80	24.60	26.40	28.20	30.00	31.80	36	4.8
" 3″×6″ angled	1,100	5.68	390	19.33	21.28	23.23	25.18	27.13	29.08	31.03	32.98	34.93	39	5.7

TABLE 4—*Continued*

Covering of $\frac{7}{8}$-in flooring over under floor

Description	Quantity in sqs. for 16 hrs.	Labor per square $	Quantity B M per square	Lumber per M									Lumber, cts.	Labor, cts.
				$30	$40	$50	$60	$70	$80	$90	$100	$ 110		
4″ Y. P. $3\frac{1}{4}$″ face edge or flat grain	3	5.34	130	9.24	10.54	11.84	13.14	14.44	15.74	17.04	18.34	19.64	13	5.3
3″ same×$2\frac{1}{4}$″ face.....	$2\frac{1}{2}$	6.40	140	10.60	12.00	13.40	14.80	16.20	17.60	19.00	20.40	21.80	14	6.4
6″ flat grain×$5\frac{1}{4}$″ face Y. P.....	5	3.20	120	6.80	8.00	9.20	10.40	11.60	12.80	14.00	15.20	16.40	12	3.2

Covering of $\frac{7}{8}$-in flooring over bare joists

4″ Y. P. $3\frac{1}{4}$″ face edge or flat.....	$4\frac{1}{2}$	3.56	130	7.46	8.76	10.06	11.36	12.66	13.96	15.26	16.56	17.86	13	3.6
3″ same×$2\frac{1}{4}$″ face.....	$3\frac{1}{2}$	4.57	140	8.77	10.17	11.57	12.97	14.37	15.77	17.17	18.57	19.97	14	4.6
6″ flat×$5\frac{1}{4}$″ face.....	7	2.28	120	5.88	7.08	8.28	9.48	10.68	11.88	13.08	14.28	15.48	12	2.3

Covering of $\frac{3}{4}$-in ceiling overhead

4″ Y. P. $3\frac{1}{4}$″ face.....	$2\frac{1}{2}$	6.40	130	10.30	11.60	12.90	14.20	15.50	16.80	18.10	19.40	20.70	13	6.4
3″ Y. P. $2\frac{1}{4}$″ face.....	2	8.00	140	12.20	13.60	15.00	16.40	17.80	19.20	20.60	22.00	23.40	14	8.0

Hardwood flooring on under floor $\frac{13}{16}'' \times 2\frac{1}{4}''$ Face

				$40 $140	$50 $150	$60 $160	$70 $170	$80 $180	$90 $190	$100 $200	$110 $210	$120 $220		
Oak and maple, well laid.....	$1\frac{1}{4}$	12.80	140	18.40 32.40	19.80 33.80	21.20 35.20	22.60 36.60	24.00 38.00	25.40 39.40	26.80 40.80	28.20 42.20	29.60 43.60	14 14	12.8
Same, in small rooms and pantries.	1	16.00	140	21.60 35.60	23.00 37.00	24.40 38.40	25.80 39.80	27.20 41.20	28.60 42.60	30.00 44.00	31.40 45.40	32.80 46.80	14 14	16.0
Same, in large rooms or factories.	$2\frac{1}{2}$	6.40	140	12.00 26.00	13.40 27.40	14.80 28.80	16.20 30.20	17.60 31.60	19.00 33.00	20.40 34.40	21.80 35.80	23.20 37.20	14 14	6.4

Hardwood flooring on under floor $\frac{13}{16}'' \times 1\frac{1}{2}''$ face

Same as for $2\frac{1}{4}''$.....	1	16.00	150	22.00 37.00	23.50 38.50	25.00 40.00	26.50 41.50	28.00 43.00	29.50 44.50	31.00 46.00	32.50 47.50	34.00 49.00	15 15	16.0
Same as for $2\frac{1}{4}''$.....	$\frac{3}{4}$	21.33	150	27.33 42.33	28.83 43.83	30.33 45.33	31.83 46.83	33.33 48.33	34.83 49.83	36.33 51.33	37.83 52.83	39.33 54.33	15 15	21.4
Same as for $2\frac{1}{4}''$.....	$1\frac{3}{4}$	9.15	150	15.15 30.15	16.65 31.65	18.15 33.15	19.65 34.65	21.15 36.15	22.65 37.65	24.15 39.15	25.65 40.65	27.15 42.15	15 15	9.2

Covering of $\frac{7}{8}$-in flooring on under floor in warehouses, etc.

Square edge 4″ maple not smoothed $3\frac{1}{2}''$ face.....	$4\frac{1}{2}$	3.56	120	8.36 20.36	9.56 21.56	10.76 22.76	11.96 23.96	13.16 25.16	14.36 26.36	15.56 27.56	16.76 28.76	17.96 29.96	12 12	3.6
4″ maple tongued and grooved $3\frac{1}{4}''$ face partly smoothed.....	3	5.34	130	10.54 23.54	11.84 24.84	13.14 26.14	14.44 27.44	15.74 28.74	17.04 30.04	18.34 31.34	19.64 32.64	20.94 33.94	13 13	5.4

Hardwood flooring $\frac{3}{8}$ in thick by $1\frac{1}{2}$ in

Oak, well laid and smoothed.....	$1\frac{1}{2}$	10.67	150	16.67 31.67	18.17 33.17	19.67 34.67	21.17 36.17	22.67 37.67	24.17 39.17	25.67 40.67	27.17 42.17	28.67 43.67	15 15	11.0

Building paper of ordinary kind, tar paper, etc., $1 per square

TABLE 5

Net Prices per Square of Studs in Outside Walls, Gables, and Partitions

2×4 list: 640 ft B M for 2 men in 8 hours = $25 per 1,000

Centers, inches	Quantity ft B M in 1 square	Price per M of lumber									Lumber, cts.	Labor, cts.
		$25	$30	$35	$40	$45	$50	$55	$60	$65		
12	90	4.50	4.95	5.40	5.85	6.30	6.75	7.20	7.65	8.10	9	2.3
16	76	3.80	4.18	4.56	4.94	5.32	5.70	6.08	6.46	6.84	8	1.9
18	66	3.30	3.63	3.96	4.29	4.62	4.95	5.28	5.61	5.94	7	1.7
20	60	3.00	3.30	3.60	3.90	4.20	4.50	4.80	5.10	5.40	6	1.5
24	50	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	5	1.2

2×6 list: 800 ft B M for 2 men in 8 hours = $20 per 1,000

16	114	5.13	5.70	6.27	6.84	7.41	7.98	8.55	9.12	9.69	12	2.3
18	100	4.50	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50	10	2.0
20	90	4.05	4.50	4.95	5.40	5.85	6.30	6.75	7.20	7.65	9	1.8
24	75	3.38	3.75	4.13	4.50	4.88	5.25	5.63	6.00	6.38	8	1.5
28	64	2.88	3.20	3.52	3.84	4.16	4.48	4.80	5.12	5.44	7	1.3

2×8 list: 800 ft B M for 2 men in 8 hours = $20 per 1,000

18	132	5.94	6.60	7.26	7.92	8.58	9.24	9.90	10.56	11.22	13	2.6
24	100	4.50	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50	10	2.0
28	85	3.83	4.25	4.68	5.10	5.53	5.95	6.38	6.80	7.23	9	1.7
32	76	3.42	3.80	4.18	4.56	4.94	5.32	5.70	6.08	6.46	8	1.5
36	66	2.97	3.30	3.63	3.96	4.29	4.62	4.95	5.28	5.61	7	1.4

2×10 list: 800 ft B M for 2 men in 8 hours = $20 per 1,000

24	125	5.63	6.25	6.88	7.50	8.13	8.75	9.38	10.00	10.63	13	2.5
28	106	4.77	5.30	5.83	6.36	6.89	7.42	7.95	8.48	9.01	11	2.2
32	95	4.28	4.75	5.23	5.70	6.18	6.65	7.13	7.60	8.08	10	1.9
36	83	3.74	4.15	4.57	4.98	5.40	5.81	6.23	6.64	7.06	9	1.7

TABLE 6

Covering of Wall Studs and Rafters

Net prices per square

Description	Quantity B M laid by 2 men in 8 hrs.	Labor per square $	Quantity B M per square	Lumber per M									Lumber, cts.	Labor, cts.
				$35	$40	$45	$50	$55	$60	$65	$70	$75		
Sheeting Y. P. No. 1	900	2.07	116	6.13	6.71	7.29	7.87	8.45	9.03	9.61	10.19	10.77	12	2.1
" Y. P. No. 2	850	2.19	116	6.25	6.83	7.41	7.99	8.57	9.15	9.73	10.31	10.89	12	2.2
" on angle Y. P. No. 1	600	3.34	125	7.72	8.34	8.97	9.59	10.22	10.84	11.47	12.09	12.72	13	3.4
" " " Y. P. No. 2	550	3.64	125	8.02	8.64	9.27	9.89	10.52	11.14	11.77	12.39	13.02	13	3.6
Shiplap Y. P. No. 1	900	2.15	121	6.39	6.99	7.60	8.20	8.81	9.41	10.02	10.62	11.23	12	2.2
" Y. P. No. 2	850	2.28	121	6.52	7.12	7.73	8.33	8.94	9.54	10.15	10.75	11.36	12	2.3
" angled Y. P. No. 1	600	3.47	130	8.02	8.67	9.32	9.97	10.62	11.27	11.92	12.57	13.22	13	3.5
" " Y. P. No. 2	550	3.79	130	8.34	8.99	9.64	10.29	10.94	11.59	12.24	12.89	13.54	13	3.8
Sheeting W. P. or soft material	1,000	1.86	116	5.92	6.50	7.08	7.66	8.24	8.82	9.40	9.98	10.56	12	2.0
Same, angled	800	2.50	125	6.88	7.50	8.13	8.75	9.37	10.00	10.63	11.25	11.88	13	2.5
Shiplap W. P., etc	1,000	1.94	121	6.18	6.78	7.39	7.99	8.60	9.20	9.81	10.41	11.02	12	2.0
" angled	800	2.60	130	7.15	7.80	8.45	9.10	9.75	10.40	11.05	11.70	12.35	13	2.6
				$30	$40	$50	$60	$70	$80	$90	$100	$110		
Flooring 5¼″ face Y. P.	3½	4.57	120	8.17	9.37	10.57	11.77	12.97	14.17	15.37	16.57	17.77	12	4.6
" and ceiling 3¼″ face Y. P.	2½	6.40	130	10.30	11.60	12.90	14.20	15.50	16.80	18.10	19.40	20.70	13	6.4

TABLE 6—*Continued*

COVERING OF WALL STUDS AND RAFTERS

Net prices per square

Description	Quantity B M laid by 2 men in 8 hrs.	Labor per square	Quantity B M per square	Lumber per M									Lumber, cts.	Labor cts.
				$4	$6	$8	$10	$12	$14	$16	$18	$20		
Shingles, 5 to 2 wall	3½	4.57	900	8.17	9.97	11.77	13.57	15.37	17.17	18.97	20.77	22.57	90	4.6
" 6 to 2 wall	3¼	4.92	900	8.52	10.32	12.12	13.92	15.72	17.52	19.32	21.12	22.92	90	5.0
" 5 to 2 roof	4½	3.56	900	7.16	8.96	10.76	12.56	14.36	16.16	17.96	19.76	21.56	90	3.6
" 6 to 2 roof	4¼	3.77	900	7.37	9.17	10.97	12.77	14.57	16.37	18.17	19.97	21.77	90	3.8
Composition, small	5	3.20	.....	.....	9.20	11.20	13.20	15.20	17.20	19.20	21.20	23.20	.....	3.2
" large	7	2.27	.....	.....	8.27	10.27	12.27	14.27	16.27	18.27	20.27	22.27	.....	2.3

Covering of studs: net cost per square

				$30	$40	$50	$60	$70	$80	$90	$100	$110		
Siding 4"	2½	6.40	150	10.90	12.40	13.90	15.40	16.90	18.40	19.90	21.40	22.90	15	6.4
" 6"	4½	3.56	135	7.61	8.96	10.31	11.66	13.01	14.36	15.71	17.06	18.41	14	3.6
" 8"	6	2.67	125	6.42	7.67	8.92	10.17	11.42	12.67	13.92	15.17	16.42	13	2.7
" 10"	8	2.00	118	5.54	6.72	7.90	9.08	10.26	11.44	12.62	13.80	14.98	12	2.0
Siding drop, 5¼"	800′ B.M.	2.40	120	6.00	7.20	8.40	9.60	10.80	12.00	13.20	14.40	15.60	12	2.4

TABLE 7

Net Prices of Plaster or Paint per Square Actual Surface

Add or deduct 11¢ per square for each 1¢ difference per yard

Description	Rate per yard in cents										
	15 20 25	30 35 130	40 45 140	50 55 150	60 65 160	70 75 170	80 85 180	90 95 190	100 105 200	110 115 210	120 125 220
See Plaster or Paint Chapters for details	1.67 2.22 2.78	3.33 3.89 14.43	4.44 5.00 15.54	5.55 6.11 16.65	6.66 7.22 17.76	7.77 8.33 18.87	8.88 9.44 19.98	9.99 10.55 21.09	11.10 11.66 22.20	12.21 12.77 23.31	13.32 13.88 24.42

Cost of building paper per square, $1.00

TABLE 8

Net Prices per Square of Rafters

2×4 list: 400 ft B M for 2 men in 8 hours = $40 per 1,000

Centers, inches	Feet B M in 1 square	Price per M of lumber									Lumber, cents	Labor, cents
		$25	$30	$35	$40	$45	$50	$55	$60	$65		
12	81	5.27	5.67	6.08	6.48	6.89	7.29	7.70	8.10	8.51	9	3.2
16	68	4.42	4.76	5.10	5.44	5.78	6.12	6.46	6.80	7.14	7	2.7
18	58	3.77	4.06	4.35	4.64	4.93	5.22	5.51	5.80	6.09	6	2.3
20	51	3.32	3.57	3.83	4.08	4.34	4.59	4.85	5.10	5.36	6	2.0
24	41	2.67	2.87	3.08	3.28	3.49	3.69	3.90	4.10	4.31	5	1.6
2×6 list: 500 ft B M for 2 men in 8 hours = $32 per 1,000												
16	102	5.82	6.33	6.84	7.35	7.86	8.37	8.88	9.39	9.90	11	3.3
18	87	4.96	5.40	5.83	6.27	6.70	7.14	7.57	8.00	8.44	9	2.8
20	77	4.39	4.78	5.16	5.55	5.93	6.32	6.70	7.09	7.47	8	2.5
24	62	3.54	3.85	4.16	4.47	4.78	5.09	5.40	5.71	6.02	7	2.0
28	52	2.97	3.23	3.49	3.75	4.00	4.27	4.53	4.79	5.05	6	1.7
2×8 list: 500 ft B M for 2 men in 8 hours = $32 per 1,000												
18	116	6.62	7.20	7.78	8.36	8.93	9.51	10.09	10.68	11.25	12	3.7
24	82	4.68	5.09	5.50	5.91	6.32	6.73	7.14	7.55	7.96	9	2.6
28	68	3.88	4.22	4.56	4.90	5.24	5.58	5.92	6.26	6.60	7	2.2
32	60	3.42	3.72	4.02	4.32	4.62	4.92	5.22	5.52	5.82	6	1.9
36	52	2.97	3.23	3.49	3.75	4.00	4.27	4.53	4.79	5.05	6	1.7
2×10 list: 500 ft B M for 2 men in 8 hours = $32 per 1,000												
24	103	5.87	6.39	6.90	7.42	7.93	8.45	8.96	9.48	10.00	11	3.3
28	85	4.85	5.27	5.70	6.12	6.55	6.97	7.40	7.82	8.25	9	2.7
32	75	4.28	4.65	5.03	5.40	5.78	6.15	6.53	6.90	7.28	8	2.4
36	65	3.71	4.03	4.36	4.68	5.00	5.33	5.66	5.98	6.31	7	2.1

TABLE 9

Net Prices of Furring per Square

Centers, inches	Size, inches	Squares for 2 men in 8 hours	Labor per square	B M feet in 1 square	Place	Price of lumber per M							Lumber, cents	Labor, cents
						$20	$30	$40	$50	$60	$70	$80		
10	1×2	3	5.34	24	Wall—plugs.....	5.82	6.06	6.30	6.54	6.78	7.02	7.26	3	5.4
10	1×2	9	1 78	22	" on boards.....	2.22	2.44	2.66	2.88	3.10	3.32	3.54	3	1.8
10	1×2	8	2.00	24	Ceiling.....	2.48	2.72	2.96	3.20	3.44	3.68	3.92	3	2.0
12	1×2	3½	4.57	20	Wall—plugs.....	4.97	5.17	5.37	5.57	5.77	5.97	6.17	2	4.6
12	1×2	11	1.46	18	" on boards.....	1.82	2.00	2.18	2.36	2.54	2.72	2.90	2	1.5
12	1×2	9	1.78	20	Ceiling.....	2.18	2.38	2.58	2.78	2.98	3.18	3.38	2	1.8
13	1×2	12	1.34	17	Roof—on boards...	1.68	1.85	2.02	2.19	2.36	2.53	2.70	2	1.4
16	1×2	4½	3.56	15	Wall—plugs.....	3.86	4.01	4.16	4.31	4.46	4.61	4.76	2	3.6
16	1×2	15	1.07	14	" on boards.....	1.35	1.49	1.63	1.77	1.91	2.05	2.19	2	1.1
16	1×2	12	1.34	15	Ceiling.....	1.64	1.79	1.94	2.09	2.24	2.39	2.54	2	1.4
12	2×2	2½	6.40	37	Wall.....	7.14	7.51	7.88	8.25	8.62	8.99	9.36	4	6.4
12	2×2	7	2.29	37	Ceiling.....	3.03	3.40	3.77	4.14	4.51	4.88	5.25	4	2.3
16	2×2	3½	4.57	28	Wall.....	5.13	5.41	5.69	5.97	6.25	6.53	6.81	3	4.6
16	2×2	9	1.78	28	Ceiling.....	2.34	2.62	2.90	3.18	3.46	3.74	4.02	3	1.8
12	1×2	16	1.00	18	Floor.....	1.36	1.54	1.72	1.90	2.08	2.26	2.44	2	1.0
12	2×2	14	1.15	35	"	1.85	2.20	2.55	2.90	3.25	3.60	3.95	4	1.2
16	1×2	20	0.80	14	"	1.08	1.22	1.36	1.50	1.64	1.78	1.92	2	0.8
16	2×2	18	0.89	26	"	1.41	1.67	1.93	2.19	2.45	2.71	2.97	3	0.9

TABLE 10

Net Prices per Square of Joist Bridging in Place

Centers of joists, inches	Depth of joists, inches	Size of bridging	Squares for 2 men in 8 hrs.	Labor per square	B M feet in 1 square	Price of lumber per M							Lumber, cents	Labor, cents
						$20	$30	$40	$50	$60	$70	$80		
12	8	1×4	22	0.73	7	(1) 0.87	0.94	1.01	1.08	1.15	1.22	1.29	1	0.7
						(2) 0.96	1.04	1.12	1.19	1.27	1.34	1.42	1	
12	12	1×4	22	0.73	9	(1) 0.91	1.00	1.09	1.18	1.27	1.36	1.45	1	0.7
						(2) 1.00	1.10	1.20	1.30	1.40	1.50	1.60		
		2×4	17	0.94	18	(1) 1.30	1.48	1.66	1.84	2.02	2.20	2.38	2	0.9
						(2) 1.43	1.63	1.83	2.03	2.23	2.42	2.62		
12	16	2×4	17	0.94	21	(1) 1.36	1.57	1.78	1.99	2.20	2.41	2.62	2	0.9
						(2) 1.50	1.73	1.96	2.19	2.42	2.65	2.88		
16	8	1×4	26	0.62	7	(1) 0.76	0.83	0.90	0.97	1.04	1.11	1.18	1	0.6
						(2) 0.84	0.92	0.99	1.07	1.15	1.22	1.30		
16	12	1×4	26	0.62	8	0.78	0.86	0.94	1.02	1.10	1.18	1.26	1	0.6
		2×4	20	0.80	16	1.12	1.28	1.44	1.60	1.76	1.92	2.08	2	0.8
16	16	2×4	20	0.80	19	1.18	1.37	1.56	1.75	1.94	2.13	2.32	2	0.8
20	8	1×4	28	0.57	7	0.71	0.78	0.85	0.92	0.99	1.06	1.13	1	0.6
		2×4	21	0.76	14	1.04	1.18	1.32	1.46	1.60	1.74	1.88	2	0.8
20	12	2×4	21	0.76	15	1.06	1.21	1.36	1.51	1.66	1.81	1.96	2	0.8
20	16	2×4	21	0.76	16	1.08	1.24	1.40	1.56	1.72	1.88	2.04	2	0.8
24	8	1×4	28	0.57	6	(1) 0.69	0.75	0.81	0.87	0.93	0.99	1.05	1	0.6
						(2) 0.76	0.83	0.89	0.96	1.03	1.09	1.16		
		2×4	21	0.76	12	1.00	1.12	1.24	1.36	1.48	1.60	1.72	2	0.8
24	12	1×4	28	0.57	7	0.71	0.78	0.85	0.92	0.99	1.06	1.13	1	0.6
		2×4	21	0.76	14	(1) 1.04	1.18	1.32	1.46	1.60	1.74	1.88	2	0.8
						(2) 1.15	1.30	1.45	1.61	1.76	1.92	2.07		

(1) By squares. (2) By linear feet. (Cutting by hand.)

TABLE 11

Bridging for Joists

Lineal inches required per lineal foot at various centers and depths

Centers, inches	Depths, inches	Inches	Centers, inches	Depths, inches	Inches
12	8	28	20	8	26
12	12	34	20	12	29
12	16	42	20	16	32
16	8	27	24	8	25
16	12	30	24	12	27
16	16	35	24	16	30

Allow 5 per cent extra for waste and irregular spacing.

Price per lineal foot of wall and partition bridging in place—single, not X

Style	Centers of studs, inches	Width of studs, inches	Size of bridging	Linear feet of wall 2 men, 8 hours	Labor per 100 linear feet, wall	B M feet per 100 linear feet, wall	Price of lumber per M							Lumber, cents, 100 feet	Labor, cents, 100 feet
							$20	$30	$40	$50	$60	$70	$80		
Angle	12	4	1×4	350	4.57	40	0.54	0.58	0.62	0.66	0.70	0.74	0.78	40	4.6
"	12	4	2×4	300	5.34	78	.69	.77	.85	.93	1.00	1.08	1.16	78	5.4
Level	12	4	2×4	400	4.00	70	.54	.61	.68	.75	.82	.89	.96	70	4.0
Angle	16	4	1×4	400	4.00	43	.49	.53	.58	.62	.66	.70	.75	43	4.0
"	16	4	2×4	350	4.57	84	.63	.71	.80	.88	.96	1.05	1.13	84	4.6
Level	16	4	2×4	450	3.56	70	.50	.57	.64	.71	.78	.85	.92	70	3.6
"	16	6	2×6	350	4.57	100	.66	.76	.86	.96	1.06	1.16	1.26	100	4.6

CHAPTER XII

MILLWORK AND GLASS

Four Parts. The first part of this chapter is designed to give appraisers original cost of millwork on buildings erected in normal times, as from 1910 to 1914. The Index numbers given in the Physical Valuation chapter will show that values ran down from even these low costs in previous years, and appraisals can be made to suit.

The second part is for stock work on a 1923 list basis, to be discounted to suit any change of prices in the future: the list is permanent, but the discount changes. Sash and doors are made by hundreds at common sizes and prices cut accordingly. If at least a dozen sash or doors are made of the same sizes, stock prices are allowed.

The tables are abbreviated, but intermediate sizes may easily be approximated, as valuation work can never be mathematically correct.

The third part is Cost Book A for work that is much harder to estimate than stock. The Chicago discount on this is 60 per cent, but no profit or overhead is allowed the millman at this rate.

Part Four covers parquetry and hardwood flooring.

Delivery. In all four parts prices are at the mills, which for city trade means delivery at the building. Freight has usually to be added for country work.

PART ONE

This part is to be used only for such years as from 1906 to 1915, as the variation is not great from the U. S. data. The figures in this part were made out in 1912–13 and are thus suitable for the long course of years as indicated above.

Office Partitions. For y.p. office partitions 7′ to 7′ 6″ high with chipped or maze-glass panels above allow per lin ft $3 to $3.50; plain oak, $5 to $6; in mahogany, $8 and up.

Quartette Telegraph desk, set up, $35.

Wainscoting. Plain matched and b red oak wainscoting is worth $60 per M ft bm; machine sandpapered, $5 extra. For

plain oak finish allow $90 per M machine run and cleaned. The paneled oak wainscoting in No. 3 was put in at a trifle less than 50¢ per square foot. It was 8′ high.

Stairs. Box, average width, pine, housed, per step, $1.40; plain oak, $2.10. Open stair, pine, per step, $1.60; oak, $2.20; oak with paneled string, $2.85. And rail in yp, 15¢; oak, 25¢. Each crook in rail, $3.50. Paneling at regular price for square work, and 20 per cent more for work on rake. Winders in pine-40¢ extra; in oak, 60¢. For large, circle starting step, $5. Newels and balusters to be added.

These prices are for plain stairs; others have to be figured in detail. Cellar and plank stairs may be estimated by taking off the plain lumber and allowing labor at $30 per M in addition.

Chicago Millwork

The millmen and dealers of Chicago sell about $10,000,000 of millwork in a year. This city is a center for the millwork of the States on the north and west, and for the glass factories of Indiana. It has low freight rates and railroads to all sections. A few prices fob there will be of much value.

Front Doors. Size 3×7×1¾, with beveled plate, 22×52, piano veneered, q s, white oak, $15.50.

Same door with oval plate glass, $21.

Same, 3×7×1¾, 24×44, beveled plate, $15.

Same, 3×7×1¾, 24×36, beveled plate, $14.

Same, 3×7×1¾, 24×36, 16-oz glass, $10.50.

For several varieties of front doors, 3×7×1¾, red oak, or birch, $10 to $14, in beveled plate; $8 to $10 in com D S glass. About $1 less on plate, and 30¢ on com glass for next size, 2-10×6-10.

For red oak or birch veneer, 3×7×1¾, leaded with com. glass, 22×58, $11.50; beveled plate leaded, $21.75.

For leaded panel, 26×26, $8.75 and $14.50.

Grained Doors. These are inferior doors, but good enough for some purposes:

For 3×7×1⅜, four or five panel, $1.65 to $1.85. For 2-6×6-6, $1.30 to $1.45.

For sash doors, 3×7×1⅜, grained $2.85 to $3.50; 2–8×6–8, $2.35 to $2.90.

For sash doors with flowered panels, inferior quality, grained 3×7×1⅜, $3.75 to $4.10.

For same, better quality, not grained, 1¾ thick, $5.50 to $7.00; for 1⅜, plain glass, $4 to $5.

Inside Doors. Korelock veneered, two panel:

	Plain red oak	Birch
2–0×6–0×1⅜	$4.05	$3.25
2–6×6–6×1⅜	4.05	3.25
2–8×6–8×1⅜	4.20	3.40
2–6×7–0×1⅜	4.85	3.90
2–6×7–0×1¾	5.35	4.40
3–0×7–0×1¾	5.70	4.65
3–0×7–6×1¾	7.00	5.30

SIX CROSS PANEL KORELOCK

	Plain red oak	Birch
2–0×6–0×1⅜	$3.45	$2.70
2–8×6–8×1⅜	3.60	2.80
2–6×7–0×1⅜	4.25	3.30
2–6×7–0×1¾	4.75	3.80
2–10×7–0×1¾	5.05	4.00
3–0×7–0×1¾	5.15	4.20
3–0×7–6×1¾	5.90	4.70

Best quality for oil finish in 39 sizes, 5 yellow pine panels, western white pine frame for 1⅜ sizes on average 20¢ per square foot; for 1¾, up to 7–0 high, 24¢; for 7 ft 6 in, from 27 to 34, the 5×7–6 being 31¢, and the 2–6×8, 34¢.

Extras. For cypress doors allow from 40¢ to 50¢ extra on a door; for yellow pine 5-panel doors deduct from 15¢ to 25¢ per door, all from above list.

Cupboard Doors. 20¢ per square foot in yellow pine.

China Closet Doors.—Glazed with common glass, 25¢ per square foot in yellow pine.

FACTORY WINDOWS

Square foot cost of 60 light windows on Nos. 7 and 8 has already been given, but these were from 1¾ to 2 in thick and cost more on this account. So many buildings have been put up of late years with this class of windows that the mills now give a list on the common sizes:

For 15 light windows, S S, 1⅜ open, check rail, 5¢ per square foot; glazed, 11¢.

For 18 light, as above, same price.

For 20 light, as above, same price.

For 24 light, as above, same price.

For 30 light, as above, 5¢ and 12¢.

For 32 light, 5¢ and 13¢.

For windows $1\frac{3}{4}$ thick add to above, $\frac{3}{4}$ of the price of windows without glass to price of window wanted—thus a window with 32 sq ft at 5¢ would be $1.60 open, and $\frac{3}{4}$ of this being $1.20, the figure for $1\frac{3}{4}$ would be $2.80 open, $5.04 glazed.

These prices are fob Chicago, and do not include frames.

Cottage Windows.—From 3–8 to 5–2 wide and 5–2 to 6–2 long. With bottom light plate glass, 70¢ per square foot; 33¢ in plain D S glass. For $1\frac{3}{4}''$ thick add to window 75¢ to $1 net.

Gable Opening.—For a triple frame about 8 ft wide by 3–9 high over all, but center margin light sash semi-circular and running up above this height, side sash divided $1\frac{3}{8}$ poplar frame, $8.50, 3 sash, $8.50.

SASH AND WINDOW PRICES FOR COMMON WORK

A Chicago price is given on some standard size windows herewith. The list is not complete, but sufficiently so for most who will use it. For $1\frac{3}{4}$ in thick, see rule, page 196.

Transom Sash $1\frac{3}{8}$ Thick

Size of sash	One light				Size of sash	Two light		
Ft. Inches	Price per sash open	Price two light glazed	Price one light glazed	Price one light double strength	Ft. Inches	Price per sash open	Price two light glazed	One light glazed double strength
2 6×10	$0.23	.....	$0.39	.....	4 0×14	$0.50	$0.94	$1.23
2 6×16	.24	.....	.51	.....	4 0×20	.57	1.22	1.66
2 6×20	.36	.....	.80	.....	4 0×24	.60	1.48	2.05
2 8×10	.24	.....	.47	.....	4 4×14	.57	1.05	1.37
2 8×16	.25	.....	.53	.....	4 4×20	.59	1.40	1.91
2 8×20	.30	.....	.67	.....	4 4×24	.64	1.59	2.13
2 8×24	.43	.....	.97	.....	4 6×14	.59	1.14	1.57
2 10×14	.25	.....	.50	.....	4 6×20	.60	1.45	1.91
2 10×20	.30	.....	.70	.....	4 6×24	.66	1.65	2.47
2 10×24	.43	.....	1.01	.....	5 0×14	.64	1.23	1.77
3 0×14	.28	.....	.57	.....	5 0×20	.66	1.57	2.35
3 0×20	.33	.....	.77	.....	5 0×24	.70	1.79	2.84
3 0×24	.40	.....	.95	.....	5 0×26	.74	1.90	2.88
3 6×14	.37	$0.77	.78	$0.97	5 6×18	.74	1.68	2.53
3 6×20	.45	1.04	1.07	1.35	5 6×24	.78	2.08	2.95
3 6×24	.49	1.25	1.25	1.57	5 6×30	.86	2.49	3.61
3 8×14	.40	.82	.85	1.04	6 0×20	.82	1.94	2.82
3 8×20	.51	1.13	1.23	1.52	6 0×26	.89	2.41	3.62
3 8×24	.57	1.37	1.42	1.80	6 0×34	1.06	3.35	5.04

Cellar Sash. For cellar sash, attic sash, etc., the above prices are close enough if the outside measurement is the same, and at $1\frac{3}{8}$.

$1\frac{3}{8}''$, 1 Lt Sash with Plain Glass

Glass size	Price open	Price glazed single strength	Price glazed double strength	Price glazed plate	Glass size	Price open	Price glazed single strength	Price glazed double strength	Price glazed plate
16×20	$0.32	$0.51	$0.63	.....	36×36	$0.72	.....	$2.28	$5.80
20×20	.32	.59	.65	.....	36×44	.72	.....	2.85	8.62
24×24	.32	.70	.91	.....	38×42	.96	.....	2.65	8.90
24×30	.34	.83	1.09	.....	38×56	1.07	.....	4.20	11.65
26×30	.39	.93	1.20	.....	40×44	1.00	.....	3.16	10.50
28×32	.41	1.09	1.40	.....	40×60	1.14	.....	4.82	13.06
30×38	.47	1.35	1.74	.....	44×44	1.15	.....	3.65	11.85
32×32	.49	.....	1.79	.....	48×44	1.27	.....	4.71	12.75
32×40	.56	.....	2.34	.....	48×56	1.36	.....	5.75	14.70
34×36	.56	.....	2.11	.....					

No Window Frames Included

Net Prices of 8 Lt Check Rail $1\frac{3}{8}''$ Windows

Size of glass, inches	Price without glass	Price with glass	Net prices of outside blinds	Size of glass, inches	Price without glass	Price with glass	Net prices outside blinds
9×12	$0.44	$0.84	$1.26	12×14	$0.53	$1.12	$1.40
9×16	.64	1.33	1.53	12×20	.70	1.66	1.94
10×12	.46	.85	1.26	14×16	.63	1.47	1.66
10×16	.55	1.12	1.56	14×20	.74	1.77	2.10
10×20	.80	1.75	1.94	14×24	1.20	2.85	2.50

Net Prices of 12 Lt

8×10	$0.45	$0.85	$1.16	10×12	$0.56	$1.18	$1.46
8×14	.64	1.47	1.40	10×16	.66	1.52	1.76
9×12	.53	1.08	1.40	10×20	.94	2.40	2.16
9×14	.58	1.67	1.50	12×14	.68	1.72	2.03
9×16	.76	1.80	1.66	12×20	1.03	2.78	2.80

Net Prices of 4 Lt

Size of glass, inches	Price without glass	Glazed with single strength	Net prices of outside blinds	Size of glass, inches	Price without glass	Glazed with single strength	Glazed with double strength	Net prices outside blinds
10×16	$0.38	$0.71	$1.10	14×20	$0.49	$1.04	.....	$1.40
10×24	.43	.86	1.26	14×24	.49	1.14	.....	1.40
10×30	.50	1.14	1.50	14×28	.54	1.32	.....	1.50
10×36	.70	1.72	1.76	14×32	.60	1.53	2.24	1.66
12×16	.41	.80	1.10	14×36	.65	1.70	2.52	1.94
12×24	.46	1.03	1.26	14×40	.72	1.96	2.78	2.10
12×28	.50	1.14	1.40	14×44	1.00	2.83	3.75	2.33
12×36	.62	1.48	1.77	14×48	1.16	3.31	4.36	2.50
12×40	.68	1.75	1.94	15×20	.62	1.44	.....	1.54
12×44	.96	2.55	2.33	15×24	.62	1.60	2.09	1.54
12×48	1.12	2.80	2.50	15×30	.72	1.90	2.69	1.80
				15×34	.79	2.24	3.02	2.09
				15×38	.86	2.47	3.33	2.26
				15×42	.95	2.94	3.93	2.46
				15×48	1.19	3.61	4.70	2.75

Net Prices of 2 Lt

Size of glass, inches	Price window open	Glazed with single strength	Glazed with double strength	Net price outside blinds	Size of glass, inches	Price window open	Glazed with single strength	Glazed with double strength	Net price outside blinds
16×20	$0.40	$0.75	$0.95	$0.96	28×40	$0.67	$1.98	$2.56	$2.10
16×26	.42	.93	1.23	1.07	28×44	.80	2.65	3.36	2.33
16×30	.47	.98	1.38	1.11	28×48	1.10	3.75	4.75	2.50
16×36	.65	1.44	1.94	1.42	30×24	.57	1.40	1.95	1.46
18×20	.40	.80	1.04	1.10	30×32	.58	1.90	2.49	1.76
18×28	.44	.99	1.42	1.40	30×40	.70	2.32	3.04	2.16
18×32	.59	1.28	1.83	1.56	30×44	.98	3.20	.405	2.57
18×36	.65	1.57	2.17	1.76	30×50	1.21	3.82	4.86	2.94
18×40	.73	1.88	2.42	1.94	32×24	.71	1.60	2.03	1.69
20×20	.40	.88	1.18	1.10	32×30	.73	2.22	2.88	1.90
20×24	.40	.93	1.22	1.26	32×36	.77	.....	3.28	2.26
20×28	.44	1.04	1.36	1.40	32×40	1.00	.....	4.56	2.49
20×32	.49	1.22	1.61	1.56	32×44	1.15	.....	5.36	2.96
20×36	.55	1.38	1.79	1.76	32×50	1.40	.....	5.64	3.28
20×40	.73	1.91	2.48	1.94	34×24	.88	2.18	2.68	1.69
22×20	.41	.94	1.23	1.10	34×28	.89	2.48	3.16	1.73
22×26	.44	1.03	1.36	1.34	34×32	.89	.....	3.50	2.04
22×30	.49	1.20	1.55	1.50	34×36	.96	.....	4.25	2.26
22×34	.54	1.45	1.88	1.66	34×40	1.04	.....	4.59	2.50
22×40	.75	2.22	2.88	1.94	34×44	1.26	.....	7.25	3.46
22×44	.89	2.66	3.45	2.32	34×50	1.46	.....	6.75	3.45
22×48	1.04	2.80	3.58	2.48	36×24	.84	1.96	2.46	1.82
24×18	.43	.93	1.24	1.10	36×30	.85	2.41	3.06	2.12
24×24	.43	1.07	1.42	1.26	36×34	.90	.....	3.67	2.46
24×28	.48	1.19	1.58	1.40	36×38	.95	.....	4.52	2.68
24×32	.52	1.37	1.77	1.56	36×44	1.33	.....	5.60	3.04
24×36	.59	1.50	1.95	1.76	36×50	1.60	.....	7.52	3.46
24×40	.65	1.86	2.41	1.94	40×24	.94	.....	2.86	2.03
24×44	.91	2.68	3.46	2.32	40×34	1.00	.....	3.76	2.75
24×48	1.06	3.42	4.30	2.48	40×38	1.05	.....	4.62	2.99
26×20	.47	1.05	1.45	1.26	40×44	1.45	.....	6.81	3.38
26×26	.47	1.24	1.67	1.46	44×30	1.05	.....	4.07	2.62
26×30	.52	1.45	1.90	1.64	44×34	1.10	.....	4.65	3.04
26×34	.58	1.74	2.24	1.90	44×38	1.40	.....	6.75	3.30
26×38	.64	1.94	2.53	2.06	44×42	1.49	.....	7.72	3.58
26×42	.70	2.19	2.84	2.24	48×30	1.17	.....	4.71	2.87
26×48	1.08	3.43	4.33	2.50	48×36	1.23	.....	5.70	3.40
28×24	.51	1.28	1.77	1.40	48×40	1.55	.....	7.22	3.68
28×28	.51	1.45	1.90	1.50	48×44	1.171	.....	10.06	4.08
28×32	.56	1.72	2.23	1.69					
28×36	.62	1.93	2.52	1.94					

Net Prices of 2 Lt Pantry Windows

Size of glass, inches	Price per window open	Price per window glazed	Outside blinds	Size of glass, inches	Price per window open	Price per window glazed	Outside blinds
12×20	$0.35	$0.72	$0.84	14×20	$0.36	$0.74	$0.94
12×28	.40	.91	.94	14×26	.38	.91	.96
12×32	.54	1.22	1.06	14×30	.44	.96	1.10
12×36	.60	1.41	1.24	14×36	.62	1.42	1.26

RULE FOR $1\frac{3}{8}''$ ODD WINDOWS

For odd size windows $1\frac{3}{8}''$ thick, open or glazed, add to price of next larger listed size, 25% of the open price. If glazed, add to total 10%.

RULE FOR $1\frac{3}{4}''$ SASH AND WINDOWS

For price of $1\frac{3}{4}''$ open window add to price of $1\frac{3}{8}''$ open window 75%.

Example: A 2 light 12×28 $1\frac{3}{4}''$ window would take the $1\frac{3}{8}''$ open price of 40¢ as given above plus 75%, which is 30¢, making the price of the $1\frac{3}{4}''$ open window 70¢ net.

For price of $1\frac{3}{4}''$ glazed window add to $1\frac{3}{8}''$ glazed window price, single or double strength, 75% of the open window price, plus an extra 10% to the total.

Example: Follow example above adding the 30¢ to the glazed price of 91¢, which makes $1.21 then add 10% to this, making the price of the glazed window $1.33.

For 2″ or $2\frac{1}{4}$ sash the price is double that already given.

Hot Bed Sash

Size of sash, feet and inches	Thickness, inches	Price per sash without glass	Price per sash glazed
3 0×6 0.....	$1\frac{3}{8}$	$1.05	$1.95
3 4×6	$1\frac{3}{8}$	1.09	2.15

SASH EXTRAS TO BE ADDED TO PRICE

For half circle head inside and outside, $1.15.

For half circle inside and outside, $1\frac{3}{4}$, $1.65.

For half circle head inside and outside, but between 3′ 4″ and 5′ wide, $2.70.

For half circle outside, sq inside, $1\frac{3}{8}$, between 3′–4″ and 5′ wide $2.55
For same, $1\frac{3}{4}$..... 3.75
For segment head, $1\frac{3}{8}''$..... .50
For segment head, $1\frac{3}{4}''$..... .75
For segment head, $1\frac{3}{8}''$ from 3–4 to 5..... .90
For segment head, $1\frac{3}{4}''$ from 3–4 to 5..... 1.40

In addition to these figures add 20% to the total when they are combined with the window chosen. These prices are for the window or 2 sash, and do not include frame.

Oil Finish. For really good oil finish work add 20% to price.

NET PRICES ON WINDOW FRAMES

This table of prices can be used for 2 light, 4 light, 8 light, or 12 light windows, simply taking the exact size or the next largest window size.

Opening size of window for $1\frac{3}{8}''$ sash	Plain drip cap. No pulleys. Knock down	Moulded window frame. No pulleys. Knock down	Box window frame. No pulleys. Knock down
2 $4\frac{1}{8}\times5$ 8 and under.....	$1.40	$1.60	$2.10
2 $4\frac{1}{8}\times6$ 8 and under.....	1.57	1.89	2.31
2 $4\frac{1}{8}\times7$ 8 and under.....	1.73	2.10	2.52
2 $4\frac{1}{8}\times8$ 8 and under.....	1.89	2.25	2.75
2 $8\frac{1}{8}\times5$ 8 and under.....	1.40	1.60	2.10
2 $8\frac{1}{8}\times6$ 8 and under.....	1.57	1.89	2.31
2 $8\frac{1}{8}\times7$ 8 and under.....	1.73	2.10	2.52
2 $8\frac{1}{8}\times8$ 8 and under.....	1.89	2.25	2.75
3 $0\frac{1}{8}\times5$ 8 and under.....	1.57	1.80	2.21
3 $0\frac{1}{8}\times6$ 8 and under.....	1.73	2.10	2.42
3 $0\frac{1}{8}\times7$ 8 and under.....	1.89	2.25	2.63
3 $0\frac{1}{8}\times8$ 8 and under.....	2.00	2.42	2.84
3 $6\frac{1}{8}\times5$ 8 and under.....	1.57	1.89	2.21
3 $6\frac{1}{8}\times6$ 8 and under.....	1.73	2.10	2.42
3 $6\frac{1}{8}\times7$ 8 and under.....	1.89	2.25	2.63
3 $6\frac{1}{8}\times8$ 8 and under.....	2.00	2.42	2.84
4 $2\frac{1}{8}\times5$ 8 and under.....	1.73	2.10	2.52
4 $2\frac{1}{8}\times6$ 8 and under.....	1.89	2.25	2.75
4 $2\frac{1}{8}\times7$ 8 and under.....	2.00	2.42	3.00
4 $2\frac{1}{8}\times8$ 8 and under.....	2.15	2.63	3.21
4 $8\frac{1}{8}\times5$ 8 and under.....	1.80	2.15	2.63
4 $8\frac{1}{8}\times6$ 8 and under.....	1.95	2.34	2.84
4 $8\frac{1}{8}\times7$ 8 and under.....	2.10	2.52	3.10
4 $8\frac{1}{8}\times8$ 8 and under.....	2.25	2.70	3.30
5 $0\frac{1}{8}\times5$ 8 and under.....	1.80	2.15	2.63
5 $0\frac{1}{8}\times6$ 8 and under.....	1.95	2.34	2.84
5 $0\frac{1}{8}\times7$ 8 and under.....	2.10	2.52	3.10
5 $0\frac{1}{8}\times8$ 8 and under.....	2.25	2.70	3.30
6 $0\frac{1}{8}\times5$ 8 and under.....	1.95	2.34	2.84
6 $0\frac{1}{8}\times6$ 8 and under.....	2.10	2.52	3.10
6 $0\frac{1}{8}\times7$ 8 and under.....	2.25	2.70	3.30
6 $0\frac{1}{8}\times8$ 8 and under.....	2.40	2.89	3.52

Pulleys. Above prices do not include pulleys, pulley holes or pockets. If plain pulleys are wanted with pulley holes and pockets add 25¢ to each frame.

Moulded cap frames, add to price of plain drip cap, each frame, 20¢.

For $1\frac{1}{8}\times4\frac{1}{4}$ outside casings, add to each frame 15¢.

For nailing frames together add extra each frame 25¢ at mill; on building, 50¢ for frame building; 65¢ for box frames.

For frames made for sash $1\frac{3}{8}''$ thick add 15¢ each.

INSIDE DOOR JAMBS

Inside door jambs are furnished knock down in the white; carefully bundled for shipments. The jambs are $\frac{7}{8}\times5\frac{1}{2}''$ with sides dadoed for head. Prices do not include stops.

Prices of Inside Door Jambs

Size and width	Clear yp	Clear plain red oak	Clear birch	Clear cypress for oil	Gum for stain or paint	Clear q w oak
2 6×6 8 and smaller	$0.60	$0.95	$0.84	$0.70	$0.50	$1.63
2 6×7 8 and smaller	.63	1.05	.94	.75	.55	1.83
2 10×6 8 and smaller	.60	.95	.84	.70	.50	1.63
2 10×7 8 and smaller	.63	1.05	.94	.75	.55	1.83
2 10×8 8 and smaller	.70	1.15	1.05	.80	.58	1.93
3 10×6 8 and smaller	.60	1.10	.90	.75	.52	1.70
3 10×7 8 and smaller	.70	1.15	1.05	.80	.58	1.93
3 10×8 8 and smaller	.73	1.25	1.15	.84	.63	2.11
4 10×6 8 and smaller	.63	1.05	.94	.75	.55	1.83
4 10×7 8 and smaller	.73	1.15	1.10	.80	.60	2.00
4 10×8 8 and smaller	.77	1.26	1.20	.90	.65	2.21
5 10×6 8 and smaller	.70	1.15	1.05	.80	.58	1.93
5 10×7 8 and smaller	.73	1.26	1.15	.84	.63	2.11
5 10×8 8 and smaller	.80	1.36	1.30	.90	.69	2.31
6 10×6 8 and smaller	.73	1.15	1.10	.80	.60	2.00
6 10×7 8 and smaller	.77	1.26	1.20	.90	.65	2.21
6 10×8 8 and smaller	.84	1.40	1.36	1.00	.70	2.42
7 10×6 8 and smaller	.73	1.26	1.15	.84	.63	2.11
7 10×7 8 and smaller	.80	1.36	1.30	.90	.67	2.31
7 10×8 8 and smaller	.90	1.47	1.40	1.05	.73	2.52
8 10×7 8 and smaller	.84	1.40	1.36	1.00	.70	2.42
8 10×8 8 and smaller	.94	1.50	1.47	1.10	.75	2.57
8 10×9 8 and smaller	.96	1.60	1.57	1.15	.80	2.75

For plain white oak jambs add to plain red oak prices 10%.

For quartered red oak jambs deduct for quartered white oak prices 25%.

For jambs made $7\frac{1}{2}''$ wide add to above prices $33\frac{1}{3}$%.

For jambs made $1\frac{1}{8}''$ thick add to above prices $66\frac{2}{3}$%.

For jambs made $1\frac{3}{8}''$ thick add to above prices 100%.

Stock is only yellow pine and plain red oak jambs $\frac{7}{8}\times5\frac{1}{2}$ wide. All other jambs are special. For transom head jambs add for bar, 40¢. Take price of jamb required to make opening height plus 2″ for bar.

Example:	Door	3–0×7–0	Take price inside door jamb size, 3–10×8–8 and add 40¢ for bar.
	Transom	3–0×1–2	
	Base	2	
		8–4	

Casing, Hook Strip, Base and Mouldings—Standard Patterns

Net Prices per 100 linear ft.

Size	Clear y p	Clear plain red oak	Clear birch	Clear cypress	Clear gum for stain or paint	Clear q w oak
Size $\frac{13}{16}\times2\frac{1}{4}$	$1.05	$2.06	$1.78	$1.59	$1.05	$4.10
Size $\frac{13}{16}\times7\frac{1}{4}$	3.20	6.00	5.26	4.35	3.00	11.99
Size $\frac{13}{16}\times5\frac{1}{4}$	2.40	4.75	3.78	3.15	2.30	9.00
Size $\frac{1}{2}\times\frac{7}{8}$	.30	.73	.63	.57	.40	1.50
Size $\frac{13}{16}\times7\frac{1}{4}$	3.20	6.00	5.26	4.35	3.00	11.90
Size $\frac{5}{8}\times\frac{3}{4}$	.30	.73	.63	.57	.40	1.50
Size $\frac{3}{4}\times1\frac{3}{4}$	.80	1.50	1.40	1.10	.80	3.00
Size $\frac{13}{16}\times7\frac{1}{2}$	3.20	6.00	5.26	4.35	3.00	11.90
Size $\frac{13}{16}\times4\frac{1}{4}$	1.84	3.55	3.00	2.63	1.80	7.10
Size $\frac{13}{16}\times4\frac{3}{4}$	2.00	3.95	3.36	2.94	2.00	7.90
Size $\frac{13}{16}\times6$	2.73	5.30	4.63	3.90	2.60	9.75
Size $\frac{5}{8}\times3\frac{1}{2}$	1.60	3.00	2.80	2.40	1.60	6.00

Stock is only yellow pine and plain red oak. All other woods are special and take longer to ship.

For plain white oak add to plain red oak prices 10%.

For quartered red oak deduct from quartered white oak prices 25%.

Cut lengths or specified lengths add 10% extra.

Window Stools, Per 100′

	Clear y p	Clear plain red oak	Clear plain birch	Clear cypress	Clear gum	Clear q w oak
$1\frac{1}{8}\times3\frac{3}{4}$..	$2.36	$4.95	$4.21	$3.68	$2.52	$9.90
$1\frac{1}{8}\times4\frac{1}{4}$..	2.66	5.68	4.70	4.10	2.84	11.25

Plate Rail. 3 membered, $3\frac{1}{2}''$ level, $4\frac{1}{2}$ upright pieces, 5¢ in yellow pine; 8¢ in red oak per ft.

Quarter Round. Size $\frac{3}{8}$, yellow pine, 40¢ per 100; red oak, 80¢; $\frac{7}{8}$, 42¢ and 85¢.

Picture Mould. In yellow pine, 1¢; red oak, 2¢ per ft.

Door and Window Stops per 100

	Clear y p	Clear plain red oak	Clear plain birch	Clear cypress	Clear gum for stain or paint	Clear q w oak
$\frac{1}{2}\times2$....	$0.60	$1.60	$1.20	$1.10	$0.80	$3.00
$\frac{1}{2}\times1\frac{3}{4}$...	.48	1.20	1.12	.88	.64	2.40
$\frac{1}{2}\times1\frac{3}{8}$...	.36	.90	.84	.66	.48	1.80
$\frac{1}{2}\times1\frac{1}{8}$...	.30	.80	.70	.55	.40	1.50

Cap Trim Per 100′

Size	Clear y p	Clear plain red oak	Clear plain birch	Clear cypress	Clear gum for stain or paint	Clear q w oak
$1\frac{3}{8}\times2\frac{1}{2}$..	$2.11	$4.10	$3.80	$3.00	$2.00	$8.21
$\frac{13}{16}\times4\frac{1}{2}$..	2.00	3.75	3.50	2.75	1.90	7.50
$\frac{7}{16}\times1$...	.35	.84	.80	.63	.44	1.72
$1\frac{1}{8}\times2\frac{1}{4}$..	1.68	3.15	2.90	2.27	1.57	6.25
$1\frac{1}{8}\times2\frac{5}{8}$..	1.78	4.00	3.36	2.63	1.83	7.20
$\frac{13}{16}\times5\frac{1}{2}$..	2.26	5.00	4.20	3.30	2.26	9.00
$\frac{5}{8}\times\frac{3}{4}$..	1.20	1.30	1.30	1.30	1.30	1.50
$\frac{13}{16}\times2\frac{1}{2}$..	2.10	2.75	2.75	2.75	2.75	3.00

Plain Base and Corner Blocks

Carried $4\frac{1}{2}$ and 5 wide	Yellow pine	Plain red oak	Plain birch	Cypress	Quartered white oak
$1\frac{1}{8}\times10$.....	0.04\frac{1}{2}$	$0.08	$0.10	$0.06	$0.15
$1\frac{1}{8}\times10$.....	.04$\frac{1}{2}$	.08	.10	.06	.15
$1\frac{1}{8}$ thick.....	.02$\frac{3}{4}$	.05	.06	.04	.07$\frac{1}{2}$
$1\frac{1}{8}$ thick.....	.02$\frac{1}{2}$	.05	.06	.04	.07$\frac{1}{2}$

Plain Colonial Porch Columns. Built up plain cap and base base columns, 6″ diam, 30 to 40¢ per linear ft; 8″, 6′, 33 to 56; 8″, 10′, 27 to 42¢; 10″, 10′, 36 to 51¢. With carved wood caps add about $1.40 each.

With Composition Caps add from $1.50 to $3.00 for average work. Some styles and sizes run to $6 and $12.

Large Special Porch Columns

Diameter of shaft, inches	Height over all, feet	Plain shaft cap and base	Fluted shaft plain cap and base	Scamozzi cap fluted shaft plain base	Scamozzi cap plain shaft plain base	Corinthian cap plain shaft plain base	Corinthian cap fluted shaft plain base
12	8	$5.32	$6.82	$7.97	$6.47	$7.82	$9.32
12	9	5.95	7.45	8.60	7.10	8.45	9.95
12	10	6.78	8.28	9.38	7.93	9.28	10.78
12	12	8.48	10.48	11.63	9.63	10.98	12.98
12	14	11.45	13.95	15.10	12.60	13.95	16.45
16	8	13.70	14.80	17.80	16.70	17.70	18.80
16	10	14.55	15.80	18.80	17.55	18.55	19.80
16	12	16.25	17.65	20.65	19.25	20.25	21.65
16	14	18.45	20.00	23.00	21.45	22.45	24.00
16	16	20.90	22.65	25.65	23.90	24.90	26.65
16	18	23.60	25.60	28.60	26.60	27.60	29.60
16	20	26.50	28.80	31.80	29.50	30.00	32.80
18	12	22.00	24.00	28.00	26.00	27.50	29.50
18	14	24.00	26.25	29.25	28.00	30.00	31.75
18	16	26.50	28.10	32.10	30.50	32.00	34.60

LARGE SPECIAL PORCH COLUMNS—CONTINUED

Diameter of shaft, inches	Height over all, feet	Plain shaft cap and base	Fluted shaft plain cap and base	Scamozzi cap fluted shaft plain base	Scamozzi cap plain shaft plain base	Corinthian cap plain shaft plain base	Corinthian cap fluted shaft plain base
18	18	29.25	32.25	36.25	33.25	34.75	37.75
18	20	32.25	35.75	39.75	36.25	37.75	41.25
20	16	33.00	36.50	41.50	38.00	40.00	43.50
20	18	35.20	39.20	44.20	41.20	42.20	46.20
20	20	38.00	42.50	47.50	43.00	45.00	49.50
22	16	41.50	46.00	52.50	46.50	50.70	55.20
22	18	44.10	49.10	55.60	48.10	53.30	58.30
22	20	47.60	53.10	59.60	52.60	56.80	62.33
24	18	47.75	53.25	59.75	53.25	59.25	64.75
24	20	51.50	57.50	64.00	58.00	63.00	69.00
24	22	55.50	62.00	68.50	62.00	67.00	73.50
24	24	60.10	67.10	73.60	66.60	71.60	78.60
26	20	57.50	64.50	73.50	66.50	72.00	79.00
26	22	61.60	69.10	78.10	70.60	76.10	83.60
26	24	66.50	74.50	83.50	75.50	81.00	89.00
28	24	74.50	82.50	92.50	84.50	93.50	101.50
28	26	80.15	88.65	98.65	89.15	99.15	107.65
28	28	86.50	95.50	105.50	95.50	105.50	115.00
30	26	90.50	95.50	110.50	101.50	115.00	124.00
30	30	101.60	111.60	122.60	112.60	126.10	136.10

Pedestal Colonials. From 50¢ to 85¢ per linear ft, plain.

Solid Bored Colonials and Newels. 25¢ to 41¢, plain.

Porch Rail. Top $2\frac{1}{4}\times3\frac{1}{2}$, 9¢; bottom, $1\frac{3}{4}\times3\frac{1}{2}$, 4¢. Smaller top, $1\frac{3}{4}\times3\frac{1}{2}$, 4¢.

Porch Balusters. Size, $2\frac{1}{4}$ sq $\times$ 24, 9¢ turned; $1\frac{3}{4}$ sq, 5¢. Sq $1\frac{3}{8}\times1\frac{3}{8}\times24$, 3¢.

Pantry Drawer Cases. In yellow pine, not oiled, 40¢ per square foot, and 55¢ in red oak.

China Closets. Drawers below, glazed doors above, no hardware or oiling, 75¢ in yellow pine and $1 in red oak per square foot.

STAIRS NOT SET

Plain oak or birch, no paneling under, 3 to 4′ wide, no rough carriages, $70.

In Q S Red Oak	$80.00
In Q S White Oak	90.00
In Yellow Pine	60.00

For a fairly good stair that figure is enough. If soffits or walls are paneled, rails with crooks and newels of better than ordinary design an extra allowance must be made.

A stair with newels, walls, soffits, etc., paneled, runs in yellow pine to $210; and in Q S white oak to $260. The above figures do not include work of painter.

Parlor Columns. In red oak, from $7 to $8 each. Fluted $1 extra. About 7′ 6″ high.

Hardwood Flooring

Lengths, 2 ft 16 ft	$\frac{3}{8}\times\frac{7}{8}$ inch	$\frac{3}{8}\times1\frac{1}{2}$ or 2 in	$\frac{1}{2}\times1\frac{1}{2}$ or 2 in	$\frac{5}{8}\times1\frac{1}{2}$ or 2 in	$\frac{13}{16}\times1\frac{1}{2}$ or 2 in	$\frac{13}{16}\times2\frac{1}{4}$ inch
Clear maple flooring	$30.00	$37.50	$46.25	$47.50	$50.00	$50.00
Select No. 1 maple flooring	.....	31.00	39.00	41.00	44.00	44.00
Clear plain red or white oak flooring	45.50	48.00	60.00	65.00	62.00	62.00
Select No. 1 red or white oak flooring	32.00	34.00	.....	.....	48.00	48.00
Clear quarter sawed red oak flooring	63.00	65.00	.....	95.00	95.00	95.00
Clear quarter sawed white oak flooring	65.00	67.00	93.50	100.00	100.00	100.00
Select quarter sawed red or white oak flooring	.....	.....	.....	.....	70.00	70.00
Cherry	100.00	105.00	.....	.....	160.00	160.00

Strictly clear maple, $12 extra.

The supply of hardwood is being rapidly diminished. On these and all hardwood prices a gradual rise will take place.

Hardwood Lumber

Price rough or surfaced	Yellow pine	Plain white or red oak	Plain birch	Cypress	Gum	Quartered white oak
1 ×44 8′ to 16′	$48.00	$72.00	$46.00	$61.00	$42.00	$94.00
× 6 8′ to 16′	52.00	76.00	57.00	72.00	45.00	117.00
× 8 8′ to 16′	52.00	79.00	60.00	75.00	57.00	132.00
×10 8′ to 16′	55.20	87.00	72.00	79.00	61.00	169.00
×12 8′ to 16′	57.60	94.00	76.00	82.00	64.00	229.00
×14 8′ to 16′	60.80	97.00	87.00	87.00	72.00	229.00
1¼× 4 8′ to 16′	56.00	75.00	49.00	64.00	49.00	94.00
× 6 8′ to 16′	56.00	82.00	62.00	76.00	62.00	120.00
× 8 8′ to 16′	56.00	87.00	64.00	79.00	67.00	136.00
×10 8′ to 16′	56.00	102.00	72.00	87.00	72.00	229.00
×12 8′ to 16′	59.20	102.00	72.00	87.00	76.00	229.00
1½× 4 8′ to 16′	57.60	82.00	62.00	76.00	62.00	120.00
× 6 8′ to 16′	57.60	87.00	64.00	79.00	67.00	136.00
× 8 8′ to 16′	57.60	102.00	72.00	87.00	72.00	229.00
×10 8′ to 16′	57.60	102.00	72.00	87.00	76.00	229.00

If less than 500 ft and more than 250 ft add $5.00 per M.
If less than 250 ft add $10.00 per M.

PART TWO

Square Foot Prices of Stock Sizes of Windows, Based on the Standard Lists

All sash $1\frac{3}{8}$ in thick. Add per square foot for $1\frac{3}{4}$ in, 5¢ net: pine and similar woods: no hardwood. Discount, 45 per cent in 1923.

2-light. From 12″×14″ to 22″×32″ allow 53¢ per square foot for single strength. From 16″×16″ to 24″×28″ allow 67¢ per square foot for D S. From 26″×40″ to 30″×38″ allow 75¢. From 34″×40″ to 48″×40″, 81¢. These large sizes, D S.

These are the permanent list prices, close enough for valuation purposes, and must be discounted to suit the local or particular year rate. In the absence of a specification an appraiser cannot tell whether glass is S S or D S, and D S is safer to use.

The size given is for a single sash, and the window opening is twice as large. Thus a 48″×40″, 2-light, takes a frame 4′ 4″×7′ 2″ in the clear, where the square foot sizes in these tables are taken. Frames are not included.

4-light. From 10″×16″ to 15″×40″, S S, allow 53¢ per square foot. For D S, 14″×32″ to 15″×24″, allow 66¢; from 15″×30″ to 15″×40″, 71¢, all undiscounted.

8-light. For 10″×12″ to 14″×20″ allow 48¢ per square foot, all S S. For sizes smaller than 10″×12″, about 53¢.

12-light. All S S. For 10″×12″ to 12″×20″ allow 48¢. For smaller than 10″×12″, 53¢.

15-light. For 10″×12″ to 12″×18″, 50¢. For smaller than 10″×12″, 55¢. All S S.

18-light. All S S. Same sizes, 52¢; smaller, 57¢.

24-light. All S S. For 10″×12″, 55¢; 10″×18″ and 12″×18″, 51¢; smaller, 74¢.

40-light. All S S. For 10″×12″, 60¢; 10″×18″ and 12″×18″, 53¢; smaller, 85¢.

Single-sash. There are few on an ordinary building. A close enough figure may be had from the foregoing square foot lists. No frames included. A single sash may have one or more lights. These sash are used for transoms, in cellars, basements, etc.

Cottage Front Sash. 1-light. All D S. Net glass size is given, as all through these lists, according to the mill system, and the width always comes first. But measurement for valuation is taken inside the frames, or over the wood of the sash.

For 40″×40″, 82¢ per square foot; 40″×56″, $1.12; 40″×68″, $1.30; 44″×40″, 90¢; 44″×56″, $1.17; 44″×68″, $1.42; 48″×56″,

$1.32; 48″×68″, $1.87; 50″×40″, 89¢; 50″×56″, $1.41; 50″×68″, $1.81.

Each of these sash is supposed to fill an entire window, and as usual the thickness is $1\frac{3}{8}$ in.

When the same style of single sash for a window is divided to show a top light, as if there were two sash, the cost is less, as the large glass is what counts. Ordinary sizes with bar across, $1.05 per square foot; large sizes, $1.20. Discount from these list prices.

Cottage Check Rail Windows. For one style with the large sash below and small sash on top divided into 22 diamond lights, allow from $1.40 per square foot to $1.50. With the same style, but 52 diamonds, $2.10 per square foot for the small sizes to $1.90 for the large. The price is reversed in this case as the extra expense comes in the top sash, which is the same height for all sizes.

These figures are for wood divisions, and not for leaded ones.

Casement Sash. For $1\frac{3}{8}$ in thick, from 70¢ to 75¢ per square foot if double strength glass, as they should be: for S S, from 15 to 20 per cent lower.

Cupboard Sash. For $1\frac{1}{8}$ in, 75¢ per square foot, D S. For 2-lt, S S, 55¢.

Discount all foregoing 45 per cent in 1923.

Square Foot Prices of Stock Doors, Based on the Standard Lists

Ordinary material. Cove and bead, or bead and cove. The O.G. styles are a trifle less in cost. The 1923 discount, 40 per cent.

2′ 0″×6′ 0″ to 7′ 0″×$1\frac{3}{8}$″, 51¢
2′ 4″×6′ 6″, 47¢
2′ 4″×7′ 0″, 41¢
2′ 6″ and 2′ 8″ from 6′ 6″ to 8′ 0″ high by $1\frac{3}{8}$″, 47¢
2′ 6″ and 2′ 8″ from 6′ 6″ to 8′ 0″ high by $1\frac{3}{4}$″, 59¢
2′ 10″ and 3′ 0″ from 6′ 8″ to 8′ 0″ high by $1\frac{3}{8}$″, 45¢
2′ 10″ and 3′ 0″ from 6′ 8″ to 8′ 0″ high by $1\frac{3}{8}$″, 56¢

The foregoing doors are for 4 or 5 panels, arranged cross or vertical, or a combination. No. 1 quality is figured.

Sash Doors. There are 8 styles listed, 5 of them with single lights of D S glass—or should be so—1 with 2 upright lights, and 2 with 4 lights. For valuation purposes the prices do not vary much. The lists are based on $1\frac{3}{8}$ in thick, and all through 12¢ per square foot is added for $1\frac{3}{4}$ in. White pine or similar woods. The 1923 discount is 40 per cent. Local discount, No. 1 quality.

Ordinary Sizes, 68¢ to 70¢. For a 3′×8′, 76¢.

Paneled Cupboard Doors. Smallest sizes, 57¢; largest, 44¢. Discount, 40 per cent in 1923. Soft woods. This is for the standard door with 4 cross panels. For single panel, two cross panels, or two vertical and one cross, add 20 per cent. Thickness, $1\frac{1}{8}$ in; the $\frac{3}{4}$-in, 3¢ less before discounting.

Glazed Cupboard Doors. Glazed D S, ordinary styles, soft woods, $1\frac{1}{8}$ in, 80¢ for small sizes and 88¢ for large; in $\frac{3}{4}$ in, 63¢ and 72¢. But with each door divided in 15 lights, add $5.85 before discounting.

White Pine Front Doors per Square Foot

(A means D S glass; B, plate glass; C, beveled plate.)

Unless otherwise stated the doors are $1\frac{3}{4}$ in thick. The price is given per square foot undiscounted, so that any discount can be applied. The 1923 rate is 45 to 50 per cent, so that half the square foot price is about the actual one. Sizes are 2′ 8″×6′ 8″ and 3′×7″.

(1) Glass panel above, 24″×18″, average; 3 upright panels full length below—A, $1.28; B, $2.17; C, $2.36. This for both sizes.

(2) Six lights above, about 7×9, and 3 panels as on No. 1 A, $1.46; B, $2; C, $2.33, for both sizes.

(3) One large glass panel with ordinary frame, but very wide bottom rail—A, not used; B, $4; C, $4.41; B, $4.35; C, $4.71. last figures are for 3′×7″. Glass panel is 20″×56″ for small door; and 60″ for large. If stool or base mold is put at bottom, add 5¢ per square foot over entire door; and same if cap is put at top of glass.

(4) One wood panel below, and single light above, 22′×48″ and 26″×52″ for small and large doors—A, $1.53; B, $4.42; C, $4.80; A, $1.56; B, $4.71; C, $5.12.

(5) A common style of front door is 3 cross panels below and glass panel above. Of various sizes, but only $1\frac{3}{8}$ in thick, 92¢ per square foot. For $1\frac{3}{4}$ in add 28¢ equals $1.20. For sand glass patterns, in the old and not very desirable style, add 12¢, making a total of $1.32.

(6) This style has a very wide bottom rail and 10 small lights above—A, $2.42; B, $4.30; C, $5.31, for both sizes. All $1\frac{3}{4}$ in, as no one would put plate glass in a $1\frac{3}{8}$-in door, especially beveled plate.

(7) Same framework as (6), but 15 lights smaller—A, $2.03; B, $3.51; C, $4.61, for the smaller door. A, $2.04; B, $4; C, $4.97, for the larger.

(8) Same outside frame as (6) and (7), but 3 60-in glass panels above; no cross rails—A, $2.44; B, $3.92; C, $4.92. A, $2.50; B, $4.58; C, $5.43, for the larger size.

The foregoing prices will give a close enough figure on any white pine front door, from the cheapest to the best that is used in this line.

MIRROR DOOR—1¾ THICK

Panelled Back—Any Standard Arrangement of Panels

	W. P.		Birch		P. oak	
	P. P.	B. P.	P. P.	B. P.	P. P.	B. P.
2′ 0″×6′ 6″	$ 82.70	$ 94.60	$ 89.30	$101.30	$ 92.70	$104.60
6′ 8″	84.60	96.80	91.30	103.40	94.60	106.80
7′ 0″	89.80	102.70	94.90	107.80	98.20	111.10
2′ 4″×6′ 6″	97.90	109.80	104.60	116.40	107.90	119.80
6′ 8″	100.20	112.30	106.80	119.00	110.20	122.30
7′ 0″	106.40	119.20	111.40	124.20	114.80	127.60
2′ 6″×6′ 6″	113.20	129.00	119.80	135.70	123.20	139.00
6′ 8″	116.20	132.40	122.60	138.80	125.90	142.10
7′ 0″	123.00	140.20	128.10	145.20	131.40	148.60
2′ 8″×6′ 8″	125.50	141.80	131.70	147.90	135.10	151.40
7′ 0″	132.80	150.00	139.00	156.20	142.60	159.80
3′ 0″×7′ 0″	167.80	185.00	175.00	192.20	179.00	196.20

W. P. Mirror Door, 1⅜ thick, deduct $5

W. P., white pine; P. Oak, plain oak; P. P., plain plate; B. P., beveled plate Discount 45 per cent in 1923.

Plain Red Oak Front Doors per Square Foot, 1¾ in

(B, plate glass; C, beveled plate glass)

(1) Wide bottom rail and one glass panel—A, $4.90; B, $5.30, for both sizes.

(2) Wood panel below and glass panel above about 48 in long—A, $4.30; B, $4.90, both sizes.

(3) Craftsman style, long wood panel, glass panel above 18 in high, in one width or three—A, $2.60; B, $2.80, for both kinds and sizes.

(4) Several varieties of craftsman doors, long, high panels or panel below, 18 in high glass above divided 4, 6, 8 lights, or in 1 light—A, from $2.90 to $2.70; B, from $3.10 to $3.30 per square foot.

(5) With wide bottom rail, regular frame, center muntin and 2 glass panels, 60 in long—A, $4.40; B, $5.60, for small sizes. A, $4.86; B, $6.10, for 3′×7′.

(6) Same frame as (5), but 10 lights above—A, $4.60; B, $5.60, both sizes.

(7) Several varieties with 12 to 15 lights above—A, $4.90; B, $6.10. A, $5.20; B, $6.37, for the larger size. Doors with long, narrow lights are more expensive than where there are small ones, such as 8″×8″, 10″×10″, etc.

(8) Wide bottom rail and regular framework, 8 lights on top, and 4 long lights below them—A, $6; B, $7.32. A, $5.70; B, $7, for the large size.

French Doors per Square Foot

The following prices are given including glass. This will serve, as a rule, for ordinary valuations; but it often happens that the discount changes on plate glass, while it does not on the framework of the doors. Cost Book "A" can be consulted in such a case.

No. 1600 is the standard. Each half has 10 lights, or a double door to fill the usual opening has 20. The thickness priced in the following lists is $1\frac{3}{4}$ in, and doors should be at least this much. If white pine or soft wood doors are wanted $1\frac{3}{8}$ in deduct 20¢ per square foot from the small sizes and 15¢ from the large from the W. P. price.

Discount, 50 per cent in 1923.

No. 1600. W. P. small sizes, $1.20; large, $1.10 for D S; for plain plate, $1.62 and $2.04; for beveled plate, $2.69 and $2.62.

No. 1600. Plain red oak. D S, $1.74, $1.60, small and large; P. P., $2.55, $2.50; B. P., $3.12, $3.

For birch deduct 16¢ list from oak per square foot; for quartered oak, add 8¢. This rule applies all through the oak lists. Discounted equals 8¢ and 4¢.

No. 1605 has 30 lights in all, and runs about 10 per cent more than No. 1600.

No. 1615 has 30 lights, but the 6 center lights are long, and thus the price is higher.

For W. P., small sizes, $2 per square foot, and large $1.61 in D S; for P. P., $2.71 and $2.35; for B. P., $3.44 and $2.94.

For P. R. O.—plain red oak—$2.17 and $2.10 D S; for P. P., $2.93 and $2.78; for B. P., $3.66 and $3.38.

Office Partitions. Use "Interior Panelwork," Cost Book "A," and add for "Good 2 sides" according to the kind of wood desired. Add also for cap and base. Add glass according to quality, and allow from 75¢ to $1 per linear foot for erection, hanging doors, etc., on a 1923 wage basis of $1 per hour. Like all millwork, or most of it, this work comes in the natural wood, or "in the white," and varnishing has to be added.

Counters. Double the price given in Part One. For the installation allow $1 to $1.50 per linear foot if work comes in the knock down. This is for ordinary counters. The finer kind of work comes from the mill all varnished and ready to set on the floor without more labor than lifting into place. So with office partitions, which quite frequently are entirely finished before reaching the building. "In the white" means unvarnished.

Screen Work. The price of wire runs about in the following proportion: black, 4¢ per square foot; galvanized, 6¢; pearl, 7¢; copper bronze, 15¢. The standard is black and this is furnished unless otherwise specified.

For ordinary standard doors allow 15¢ per square foot without hardware. The largest doors are about 2¢ less per square foot. Special sizes, 80¢ per door for black, $1.10 for galvanized, and $1.60 for pearl. These prices are for the best pine or poorest oak.

The best oak doors may run to 85¢ per square foot, and ornamental iron grilles to be added to this, perhaps at $1 per square foot for grille size only. Also painting or varnishing for all doors.

Window Screens. Stock sizes, 15¢ for black per square foot to 18¢ for galvanized. Half screens, 2¢ more per square foot than whole ones. Segment top, $1 extra; Gothic top, $1.70 extra. Thickness, $1\frac{1}{8}$ in.

Odd sizes and specials, black, 20¢ per square foot; galvanized, 24¢; pearl, 32¢; copper bronze, 42¢.

Porch screens, $1\frac{1}{8}$ in, black, 24¢; pearl, 36¢; copper, 50¢ per square foot. These prices include a good profit to the millman.

Weather Strips. For the Athey allow $3 to $5 per window put in place. A 2-light window, 24″×30″, $3.20.

PART THREE

Cost Book "A"—the Standard List on Odd Millwork

Presenting a method of estimating that is neither guesswork nor experiment, but a practical and proven system based on actual tests of manufacture and reflecting average costs.

Cost Book " A " sets forth the best system of estimating special millwork that has ever appeared in print. It is published by the Millwork Cost Bureau, 605 North Michigan Ave., Chicago. The Bureau is supported by five hundred of the leading millmen from Utah on the west, Texas and Florida on the south, Georgia and Massachusetts on the east, to Montreal, Toronto, Winnipeg, and Regina on the north.

This is the best organization in the estimating line, and any planing-mill owner, large or small, not connected with it should write to headquarters for information.

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"The schedules have been compiled as the result of tens of thousands of tests by the various members. . . . The book is in general use by all the best concerns in their estimating departments."

Discount. Following the standard and excellent method of millmen, the prices in the book are raised so high that the tables, for valuation purposes, are permanent. The discount is changed to suit any period of high or low prices, or any part of the country where wages and material may be low even in high-priced times, such as in a city where lumber may be had without freight. The method for the appraiser is to establish a local or period discount based upon prices of various kinds of items all through the book and use that. All items marked * are subject to discount.

Method. From the thousands of tests, and by the average rate of wages of all the members, actual costs are established without profit and on the basis of material prices at Chicago. The costs thus obtained are multiplied by $2\frac{1}{2}$ for the list prices, as given in the following pages. When discounted 60 per cent, the original cost is thus obtained. Factory cost is given complete, but not with what is known as "overhead," for commercial purposes—rent, insurance, depreciation, clerical work, administrative expense, packing, etc. The usual extra allowance for this is 20 per cent on the total factory net cost. For $100 list, discounted 60 per cent, equals $40, plus 20 for overhead equals $48, so that practically the list is cut in two in the Chicago market. This 20 per cent allows for all costs except profit, which may be added at 10 per cent, or at 5 or 15,

For Figuring Price on Special Moldings

Handy Molding List
List Prices per 100 Lin Ft

3/8 in. Stops	1/2 in. Stops	Width	3/4 in.	1 1/8 in.	1 3/8 in.	1 3/4 in.	2 1/4 in.	2 3/4 in.
$1.00	$1.00	7/8	$1.00	....	....	....	.....	.....
1.00	1.25	1 1/8	1.25	$2.05	....	....	.....	.....
1.10	1.50	1 1/4	1.50	2.50	....	....	.....	.....
1.10	1.50	1 3/8	1.75	2.90	$3.50	....	.....	.....
1.40	1.75	1 1/2	1.75	2.90	3.50	....	.....	.....
1.40	2.00	1 3/4	2.00	3.30	4.00	$5.50	.....	.....
1.60	2.25	2	2.25	3.75	4.50	6.20	.....	.....
1.80	2.50	2 1/4	2.50	4.15	5.00	6.90	$13.75	.....
2.00	2.75	2 1/2	2.75	4.55	5.50	7.55	15.15	.....
		2 3/4	3.00	4.95	6.00	8.25	16.50	$19.80
CASING & BASE		3	3.25	5.35	6.50	8.95	17.90	21.45
3/4" thick		3 1/4	3.50	5.80	7.00	9.65	19.25	23.10
See Note A								
....	4.20	3 1/2	3.75	6.20	7.50	10.30	20.65	24.75
....	4.20	3 5/8	4.00	6.60	8.00	11.00	22.00	26.40
....	4.50	3 3/4	4.25	6.60	8.00	11.00	22.00	26.40
....	4.50	4	4.50	7.45	9.00	12.40	24.75	29.70
....	5.00	4 1/4	4.75	7.85	9.50	13.05	26.15	31.35
....	5.25	4 1/2	5.00	8.25	10.00	13.75	27.50	33.00
....	6.00	5	5.50	9.10	11.00	15.15	30.25	36.30
....	6.00	5 1/4	6.00	9.90	12.00	16.50	33.00	39.60
....	6.50	5 1/2	6.00	9.90	12.00	16.50	33.00	39.60
....	6.50	5 3/4	6.50	10.75	13.00	17.90	35.75	42.90
....	7.00	6	6.50	10.75	13.00	17.90	35.75	42.90
....	7.00	6 1/4	7.00	11.55	14.00	19.25	38.50	46.20
....	8.00	6 1/2	7.00	11.55	14.00	19.25	38.50	46.20
....	8.00	7	8.00	13.20	16.00	22.00	44.00	52.80
....	8.00	7 1/4	8.00	13.20	16.00	22.00	44.00	52.80
....	9.00	8 1/4	9.50	15.70	19.00	26.15	52.25	62.70
....	10.00	8 3/4	9.50	15.70	19.00	26.15	52.25	62.70
....	10.00	9 1/4	10.00	16.50	20.00	27.50	55.00	66.00
....	12.00	10 1/2	12.00	19.80	24.00	33.00	66.00	79.20
....	13.00	11 1/4	12.00	19.80	24.00	33.00	66.00	79.20

A—3/4-in head casing, side casing, apron, base, and jamb stock are figured on the 3/4-in casing and base list.

B—Rabbeted moulding—add to list 60c.

C—Grooved plate rail—for each in or fraction in width, add to list 60c.

D—Wider than listed sizes—combine the largest equal lists, the finished sizes of which equal the required width.

For a molding 1 1/8" wide and 3/4" thick the figure is $1.25 per 100 ft.

For 1 1/8"x1 1/8", $2.05; and 6" wide by 3/4" thick, $6.50. So with other sizes.

just as the mill may be short of work or crowded with it. At 10 per cent the total is $52.80.

Quantity. The tests are bases on ordinary quantities, and are not for stock work where thousands of doors or sash are made at once of the same size, and consequently at a lower rate.

Molding

Example

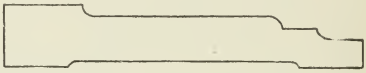


Fig. 60.—Casing

100 lin ft casing $\frac{3}{4}\times4\frac{1}{4}$ per detail

2 exposed edges	at *.80	*1.60
1 exposed face—5 in	at *.80	*4.00
Total per 100 lin ft for smoothing only		*5.60

Cap Trim Put Together.

Fig. 61
2 member

Fig. 62
3 member

Fig. 63
4 member

Fig. 64
4 member

Cap trim put together for window, sash or door openings up to 3 ft 0 in wide, add to Molding prices—per cap

	Opening 3 ft 0 in wide, solid returned	Opening 3 ft 0 in wide, miter returned	Each foot over 3 ft 0 in add
2 member.	* .66	* .96	*.08
3 member.	* .84	*1.14	*.10
4 member.	*1.14	*1.42	*.12

Radius Molding

Basis List Prices per 100 lin ft

Band-sawn Members. Figure each "band-sawn" member at 2 times the price of straight molding of kind desired and add for each such member, per 100 lin ft:

Radius	Under 4 ft 0 in		4 ft 0 in to 8 ft 0 in		Over 8 ft 0 in	
	Exterior	Interior	Exterior	Interior	Exterior	Interior
2 in wide.....	*18.00	*23.00	*16.00	*20.00	*14.00	*17.00
4 in wide.....	*25.00	*35.00	*22.00	*30.00	*19.00	*26.00
6 in wide.....	*32.00	*46.00	*28.00	*40.00	*24.00	*34.00
8 in wide.....	*39.00	*58.00	*34.00	*50.00	*29.00	*43.00

Bent Members. Figure each "bent" member at 3 times the price of straight molding and add for each such member, per 100 lin ft:

Radius	Under 4 ft 0 in		4 ft 0 in to 8 ft 0 in		Over 8 ft 0 in	
	Exterior	Interior	Exterior	Interior	Exterior	Interior
1 in wide.....	*23.00	*26.00	*20.00	*23.00	*17.00	*20.00
3 in wide.....	*35.00	*45.00	*30.00	*39.00	*26.00	*33.00
5 in wide.....	*46.00	*63.00	*40.00	*55.00	*34.00	*47.00
8 in wide.....	*63.00	*91.00	*55.00	*79.00	*47.00	*67.00

Radius head casings are "band-sawn," whereas radius head jambs are "bent."

Finish and Molded Lumber—Regular Discount

Line 1 is 1 in and less thick; line 2, 1¼ in.; line 3, 2 in.

Random or cut lengths—not stuck nor sanded—per M B M

		6 in and less	8 in	10 in	12 in
Basswood		* 290.00 * 338.00	* 300.00 * 348.00	* 318.00 * 370.00	* 336.00 * 390.00
Birch	Sel. red	* 536.00 * 616.00	* 576.00 * 664.00	* 658.00 * 756.00	* 738.00 * 832.00
Birch	Unsel.	* 462.00 * 538.00	* 492.00 * 572.00	* 552.00 * 640.00	* 610.00 * 710.00
Cypress		* 308.00 * 356.00	* 316.00 * 366.00	* 336.00 * 388.00	* 354.00 * 410.00
Fir	Unsel.	* 262.00 * 310.00	* 274.00 * 322.00	* 296.00 * 348.00	* 318.00 * 374.00
Gum	Red	* 428.00 * 482.00	* 446.00 * 502.00	* 482.00 * 542.00	* 518.00 * 582.00
Gum	Sap	* 238.00 * 284.00 * 302.00	* 248.00 * 296.00 * 314.00	* 268.00 * 320.00 * 340.00	* 288.00 * 344.00 * 366.00
Mahogany	Plain	* 860.00 * 932.00	* 896.00 * 970.00	* 968.00 * 1048.00	* 10.4000 * 1126.00
Oak	Pl. red	* 462.00 * 538.00 * 558.00	* 492.00 * 572.00 * 594.00	* 552.00 * 640.00 * 664.00	* 610.00 * 710.00 * 728.00
Oak	Pl. white	* 516.00 * 594.00	* 562.00 * 646.00	* 650.00 * 750.00	* 740.00 * 812.00
Oak	Qr. red	* 518.00 * 598.00 * 616.00	* 550.00 * 636.00 * 656.00	* 616.00 * 712.00 * 736.00	* 684.00 * 788.00 * 796.00
Oak	Qr. white	* 612.00 * 698.00	* 658.00 * 750.00	* 750.00 * 856.00	* 842.00 * 926.00
Pine	W. white	* 374.00 * 426.00	* 386.00 * 438.00	* 408.00 * 464.00	* 432.00 * 490.00
Pine	Yellow	* 236.00 * 280.00	* 242.00 * 286.00	* 250.00 * 298.00	* 260.00 * 310.00
Poplar	Unsel.	* 374.00 * 426.00 * 444.00	* 394.00 * 448.00 * 468.00	* 434.00 * 494.00 * 516.00	* 472.00 * 538.00 * 562.00
Spruce		* 262.00 * 310.00	* 274.00 * 322.00	* 296.00 * 348.00	* 318.00 * 374.00
Sycamore	Quartered	* 444.00 * 538.00	* 472.00 * 572.00	* 530.00 * 640.00	* 586.00 * 704.00
Walnut	Native	* 1008.00 * 1122.00	* 1084.00 * 1206.00	* 1234.00 * 1376.00	* 1316.00 * 1430.00

Store Fronts. Figure all straight members of jambs, sill, transom course, imposts, etc., at the following prices per 100 lin ft—Tables 1 and 2—which include material and mill labor:

TABLE 1—STORE FRONTS

CYPRESS, FIR, PINE, OR SPRUCE

Width	$\frac{7}{8}$ in thick	$1\frac{1}{8}$ in thick	$1\frac{3}{8}$ in thick	$1\frac{3}{4}$ in thick	$2\frac{1}{4}$ in thick	$2\frac{3}{4}$ in thick
$\frac{7}{8}$ in....	* 4.20	* 5.40	* 6.50	* 8.50	* 10.60	* 12.90
$1\frac{3}{4}$ in....	* 6.80	* 9.00	*11.00	*14.80	* 18.80	* 23.20
$2\frac{3}{4}$ in....	* 9.50	*12.60	*15.50	*21.10	* 27.00	* 33.40
$4\frac{1}{2}$ in....	*14.70	*19.80	*24.60	*33.70	* 43.40	* 54.00
$5\frac{1}{2}$ in....	*17.30	*23.40	*29.10	*40.00	* 51.70	* 64.30
$6\frac{1}{2}$ in....	*19.90	*27.00	*33.60	*46.30	* 59.90	* 74.50
$9\frac{1}{2}$ in....	*27.80	*37.70	*47.10	*65.20	* 84.50	*105.40
$11\frac{1}{2}$ in....	*33.00	*44.90	*56.20	*77.80	*100.90	*125.90

Hardwoods. Figure each straight member at the Basis Prices given above—Table 1—and add: plain red oak, 25 per cent; unselected birch, 40 per cent.

Panels. See Index.

Porch and Cornice Work. Figure all straight members of porch rail and porch beams at the following prices per 100 lin ft—Table 1—which include material and mill labor:

TABLE 1—PORCH AND CORNICE

CYPRESS, FIR, PINE, OR SPRUCE

Width	$\frac{7}{8}$ in Thick	$1\frac{1}{8}$ in Thick	$1\frac{3}{8}$ in Thick	$1\frac{3}{4}$ in Thick	$2\frac{1}{4}$ in Thick	$2\frac{3}{4}$ in Thick
$\frac{7}{8}$ in....	* 3.40	* 4.50	* 5.50	* 7.40	* 9.40	* 11.60
$1\frac{3}{4}$ in....	* 6.00	* 8.10	*10.00	*13.70	*17.60	* 21.90
$2\frac{3}{4}$ in....	* 8.70	*11.70	*14.50	*20.00	*25.80	* 32.10
$4\frac{1}{2}$ in....	*13.90	*18.90	*23.60	*32.60	*42.20	* 52.70
$6\frac{1}{2}$ in....	*19.10	*26.10	*32.60	*45.20	*58.70	* 73.20
$9\frac{1}{2}$ in....	*27.00	*36.80	*46.10	*64.10	*83.30	*104.10
$11\frac{1}{2}$ in....	*32.20	*44.00	*55.20	*76.70	*99.70	*124.60

Extras. Radius—K. D.:

Band-sawn—Figure all "band-sawn" members at 2 times the Basis List Prices—Table 1— and add for each such member, per 100 lin ft..... *24.00

Minimum per members (linear feet)..... 5

Bent —Figure all "bent" members at 3 times the Basis List Prices—Table 1—and add for each such member, per 100 lin ft..... *36.00

Porch and Cornice Work. Figure material for rafter ends, verge boards, brackets, and solid newels at the following prices per 100 lin ft—Tables 2 and 3—and add mill labor per unit:

TABLE 2—PORCH AND CORNICE

CYPRESS, FIR, PINE, OR SPRUCE

Width	$\frac{7}{8}$ in Thick	$1\frac{1}{8}$ in Thick	$1\frac{3}{8}$ in Thick	$1\frac{3}{4}$ in Thick	$2\frac{1}{4}$ in Thick	$2\frac{3}{4}$ in Thick
$\frac{7}{8}$ in....	* 2.70	* 3.70	* 4.60	* 6.40	* 8.40	* 10.50
$1\frac{3}{8}$ in....	* 4.00	* 5.50	* 7.00	* 9.70	* 12.60	* 15.80
$1\frac{3}{4}$ in....	* 5.40	* 7.40	* 9.30	*12.90	* 16.80	* 21.00
$2\frac{1}{4}$ in....	* 6.70	* 9.20	*11.60	*16.10	* 21.00	* 26.30
$2\frac{3}{4}$ in....	* 8.10	*11.10	*13.90	*19.40	* 25.30	* 31.50
$3\frac{3}{4}$ in....	*10.80	*14.70	*18.60	*25.80	* 33.70	* 42.00
$4\frac{1}{2}$ in....	*13.50	*18.40	*23.20	*32.20	* 42.10	* 52.50
$5\frac{1}{2}$ in....	*16.20	*22.10	*27.80	*38.70	* 50.50	* 63.00
$6\frac{1}{2}$ in....	*18.80	*25.80	*32.50	*45.10	* 58.90	* 73.50
$7\frac{1}{2}$ in....	*21.50	*29.50	*37.10	*51.60	* 67.30	* 84.00
$9\frac{1}{2}$ in....	*26.90	*36.90	*46.40	*64.50	* 84.20	*105.00
$11\frac{1}{2}$ in....	*32.30	*44.30	*55.70	*77.40	*101.00	*126.00

TABLE 3

FIR SQUARES

Size.....	$3\frac{1}{2}\times3\frac{1}{2}$	$3\frac{1}{2}\times5\frac{1}{2}$	$4\frac{1}{2}\times4\frac{1}{2}$	$5\frac{1}{2}\times5\frac{1}{2}$	$5\frac{1}{2}\times7\frac{1}{2}$	$7\frac{1}{2}\times7\frac{1}{2}$
	*30.00	*44.50	*46.50	*67.00	*91.50	*122.00

Rafter Ends. Figure the required material at the Basis List Prices given in Tables 2 and 3 and add each sawn end.. * .18

Verge Boards. Figure the required material at the Basis List Prices given above—Tables 2 and 3—and add for each sawn or drop end..... * .72

Brackets. Boxed up or hollow: Figure the required material at the Basis List Prices given above—Table 2—and add for each "boxed up or hollow" section..... *1.24

Built up or ply: Figure the required material at the Basis List Prices given above—Table 2—and add for each "built up or ply" section..... *1.00

Solid brackets: Figure the required material at the Basis List Prices given above—Tables 2 and 3—and add for each "solid" section..... * .80

Solid Newels. Figure the required material at the Basis List Prices given above—Table 3—and add per newel:

Turned head and plain shaft..... *1.80

Turned head and turned shaft..... *4.00

Other common types..... * .60

Exterior Panelwork. Solid panels, $\frac{3}{4}$ in or less; solid sticking or with flush mold applied on one side; machine sanded; cypress, fir, pine, or spruce.

Basis List Prices per Square Foot. Figure the square footage of each section—breaking on 6 in each way—as follows: $1\frac{3}{8}$ in thick or less, per square foot, *1.16; $1\frac{3}{4}$ in thick, per square foot, *1.30; minimum per section, 4 sq ft.

Porch Steps—Put Together. Treads, $1\frac{1}{8}$ in; risers, $\frac{7}{8}$ in; strings, $1\frac{3}{4}$ in; no spandril panels, cypress, fir, pine, or spruce.

Each linear foot or part thereof of riser, *2.20; $1\frac{3}{4}$-in treads—add to above for each linear foot or part thereof of riser, *.30; spandril panels—ceiling spandril panels add per square foot, *1.20.

BALUSTERS

Basis List Prices, Each—Cypress, Fir, Pine, or Spruce

Plain turned	$1\frac{3}{8}+1\frac{3}{8}$	$1\frac{3}{4}\times1\frac{3}{4}$	$2\frac{1}{4}\times2\frac{1}{4}$	$2\frac{3}{4}\times2\frac{3}{4}$	$3\frac{1}{2}\times3\frac{1}{2}$
1′ 6″ long...	*0.56	*0.68	*0.86	*1.08	*1.54
2′ 6″ long...	* .72	* .90	*1.22	*1.54	*2.28
3′ 0″ long...	* .82	*1.04	*1.40	*1.78	*2.66
2′ 0″ long...	* .24	* .36	* .54	* .76	*1.30
2′ 6″ long...	* .28	* .42	* .68	* .94	*1.60
3′ 0″ long...	* .32	* .50	* .80	*1.12	*1.92

Exterior Staved Columns

Shaft—round, staved, tapered regular or not tapered. Staves—$1\frac{3}{8}$ in thick. Cap—wood, not to exceed 3 members. Base—wood, not to exceed 4 members. Wood—cypress, fir, pine, or spruce.

Basis List Prices per Column.

Diameter at base	Length over all	Plain shaft	Regular fluted shaft	Featheredge fluted shaft
6″	6′ 0″	*13.20	*19.10	*22.10
	10′ 0″	*17.30	*24.40	*28.00
8″	6′ 0″	*15.90	*22.90	*26.40
	10′ 0″	*21.50	*30.10	*34.40
10″	6′ 0″	*18.60	*26.40	*30.30
	10′ 0″	*25.70	*35.10	*39.80
12″	6′ 0″	*21.50	*30.40	*34.90
	10′ 0″	*30.10	*41.00	*46.50
	12′ 0″	*34.40	*46.30	*52.30

Exterior Square Posts

Shaft—$\frac{7}{8}$ in thick for 6-in, 8-in, and 10-in posts; $1\frac{1}{8}$ in thick for 12-in, 14-in, and 16-in posts; $1\frac{3}{8}$ in thick for 18-in posts; tapered or not tapered, not paneled. Cap and base—wood, 2 members each. Wood—cypress, fir, pine, or spruce.

Basis List Prices per Post

Diameter at base	Length over all	Plain shaft	Regular fluted shaft	Featheredge fluted shaft
6″	3′ 0″	*10.50	*16.80	*20.00
	4′ 0″	*11.50	*18.10	*21.40
	6′ 0″	*13.50	*20.90	*24.60
	8′ 0″	*15.50	*23.60	*27.70
	10′ 0″	*17.50	*26.40	*30.90
8″	3′ 0″	*12.00	*19.30	*23.00
	4′ 0″	*13.30	*21.10	*25.00
	6′ 0″	*15.80	*24.60	*29.00
	8′ 0″	*18.30	*28.10	*33.00
	10′ 0″	*20.80	*31.60	*37.00
10″	3′ 0″	*13.50	*21.80	*26.00
	4′ 0″	*15.00	*23.80	*28.20
	6′ 0″	*18.10	*27.90	*32.80
	8′ 0″	*21.10	*31.90	*37.30
	10′ 0″	*24.10	*35.90	*41.80
12″	3′ 0″	*16.70	*26.00	*30.70
	4′ 0″	*19.00	*28.90	*33.90
	6′ 0″	*23.50	*34.60	*40.20
	8′ 0″	*28.00	*40.40	*46.60
	10′ 0″	*32.50	*46.10	*52.90
14″	3′ 0″	*20.90	*31.20	*36.40
	4′ 0″	*24.30	*35.20	*40.70
	6′ 0″	*30.90	*43.00	*49.10
16″	3′ 0″	*24.00	*35.30	*41.00
	4′ 0″	*27.90	*39.90	*45.90
	6′ 0″	*35.60	*49.10	*55.90
18″	3′ 0″	*27.90	*40.20	*46.40
	4′ 0″	*32.60	*45.60	*52.10
	6′ 0″	*42.10	*56.60	*63.90

Paneled shaft: Add for each side paneled, per linear foot or part thereof in height..... * .30

Posts with more than four corners: Figure as a four-cornered post of equal perimeter and add for each extra corner, per linear foot of part thereof in height..... * .50

Pilasters—half posts or less: Two pilasters—made by splitting full posts, figure as a full post and add 10 per cent of the plain shaft price. One pilaster—built up special, figure at 80 per cent of a full post.

Pilasters—over half post: Figure as a full post.

SPECIAL EXTERIOR FRAMES—STANDARD DETAIL

Frame Wall Frames—Basis List Prices

Window Frames—Frame Wall—"A" Specification

Molded cap, consisting of drip cap and bed mold, $1\frac{1}{8}$-in outside casings, $\frac{7}{8}$-in pulley stiles, 4-in stud, pockets cut and standard steel pulleys set, put together—no inside stops nor trim, not primed.

24×24 2 lt. *10.60	30×24 2 lt. *11.40	36×24 2 lt. *12.20	48×24 2 lt. *13.80
30 " *11.80	30 " *12.60	30 " *13.40	30 " *15.00
36 " *13.00	36 " *13.80	36 " *14.60	36 " *16.20

Stationary Sash Frames—Frame Wall—"B" Specification

Molded cap, consisting of drip cap and bed mold, $1\frac{1}{8}$-in outside casings, $\frac{7}{8}$-in jambs, 4-in stud, put together—no pockets nor pulleys, no inside stops nor trim, not primed.

2-4×3-6..* 9.00	2-10×3-6..* 9.80	3-4×3-6..*10.60	4-4×3-6..*12.20
4-6..*10.10	4-6..*10.90	4-6..*11.70	4-6..*13.30
5-6..*11.20	5-6..*12.00	5-6..*12.80	5-6..*14.40
6-6..*12.30	6-6..*13.10	6-6..*13.90	6-6..*15.50

Casement Sash Frames—Frame Wall—"C" Specification

Molded cap, consisting of drip cap and bed mold, $1\frac{1}{8}$-in outside casings, $1\frac{3}{8}$-in jambs, 4-in stud, put together—no inside trim, not primed.

2-4×2-6..* 8.20	2-10×2-6..* 8.90	3-4×2-6..* 9.60	4-4×2-6..*11.00
3-6..* 9.40	3-6..*10.10	3-6..*10.80	3-6..*12.20
4-6..*10.60	4-6..*11.30	4-6..*12.00	4-6..*13.40

Door Frames—Frame Wall—"D" Specification

Molded cap, consisting of drip cap and bed mold, $1\frac{1}{8}$-in outside casings, 4-in stud, softwood sill, put together—no inside trim, not primed.

Door opening up to 3-0×7-0..... Jambs $1\frac{3}{8}$ in thick, *14.70
" $1\frac{3}{4}$ " " *16.90

Head casing, drip and bed mold omitted: Deduct from molded cap list—per single frame..... *2.40

Plain cap—drip cap only: Deduct from molded cap list—per single frame..... * .90

Outside casings $\frac{7}{8}$ in thick: Deduct from $1\frac{1}{8}$ in casing list—per single frame..... * .80

Stucco Wall Frames—Basis List Prices

Window Frames—Stucco Wall—"A" Specification

24×24 2 lt. *13.10	30×24 2 lt. *14.00	36×24 2 lt. *14.90	48×24 2 lt. *16.70
30 " *14.60	30 " *15.50	30 " *16.40	30 " *18.20
36 " *16.10	36 " *17.00	36 " *17.90	36 " *19.70

Stationary Sash Frames—Stucco Wall—"B" Specification

2-4×3-6..*11.00	2-10×3-6..*11.90	3-4×3-6..*12.80	4-4×3-6..*14.60
4-6..*12.50	4-6..*13.40	4-6..*14.30	4-6..*16.10
5-6..*14.00	5-6..*14.90	5-6..*15.80	5-6..*17.60
6-6..*15.50	6-6..*16.40	6-6..*17.30	6-6..*19.10

Casement Sash Frames—Stucco Wall—"C" Specification

2-4×2-6..*10.30	2-10×2-6..*11.20	3-4×2-6..*12.10	4-4×2-6..*13.90
3-6..*12.00	3-6..*12.90	3-6..*13.80	3-6..*15.60
4-6..*13.70	4-6..*14.60	4-6..*15.50	4-6..*17.30

Door Frames—Stucco Wall—"D" Specification

Door opening up to 3-0×7-0..... Jambs $1\frac{3}{8}$ in thick, *19.30
" $1\frac{3}{4}$ " " *21.80

Head casing, drip cap and bed mold omitted: Deduct from molded cap list—per single frame..... *2.40

Plain cap—drip cap only: Deduct from molded cap list—per single frame..... * .90

Outside casings $\frac{7}{8}$ in thick: Deduct from $1\frac{1}{8}$-in casing list—per single frame..... * .80

Veneered Wall Frames—Basis List Prices

Window Frames—Veneered Wall

Brick mold $1\frac{1}{8}\times2$, $\frac{7}{8}$-in blind stop, $\frac{7}{8}$-in pulley stiles, 4-in stud, pockets cut and standard steel pulleys set, put together—no inside stops, trim, nor segment board, not primed.

24×24 2 lt. *10.30	30×24 2 lt. *11.00	36×24 2 lt. *11.70	48×24 2 lt. *13.10
30 " *11.50	30 " *12.20	30 " *12.90	30 " *14.30
36 " *12.70	36 " *13.40	36 " *14.10	36 " *15.50

Stationary Sash Frames—Veneered Wall

Brick mold $1\frac{1}{8}\times2$, $\frac{7}{8}$-in blind stop, $\frac{7}{8}$ jambs, 4-in stud, put together—no pockets nor pulleys, no inside stops, trim, nor segment board, not primed.

2-4×3-6..* 8.50	2-10×3-6..* 9.20	3-4×3-6..* 9.90	4-4×3-6..*11.30
4-6..* 9.70	4-6..*10.40	4-6..*11.10	4-6..*12.50
5-6..*10.90	5-6..*11.60	5-6..*12.30	5-6..*13.70
6-6..*12.10	6-6..*12.80	6-6..*13.50	6-6..*14.90

Casement Sash Frames—Veneered Wall

Brick mold $1\frac{1}{8}\times2$, $1\frac{3}{8}$-in jambs, 4-in stud, put together—no inside trim nor segment board, not primed.

2-4×2-6..* 7.60	2-10×2-6..* 8.30	3-4×2-6..* 9.00	4-4×2-6..*10.40
3-6..* 8.90	3-6..* 9.60	3-6..*10.30	3-6..*11.70
4-6..*10.20	4-6..*10.90	4-6..*11.60	4-6..*13.00

Door Frames—Veneered Wall

Brick mold $1\frac{1}{8}\times2$, 4-in stud, put together—no sill, segment board nor inside trim, not primed.

Door opening up to 3-0×7-0..... Jambs $1\frac{3}{8}$ in thick, *11.80
" $1\frac{3}{4}$ " " *14.30

Segment board:

With straight brick molding—add per single frame ..... * .70
With segment " " " " " " *3.30

Brick mold $1\frac{3}{4}\times2$: Add per single frame..... *1.20

Masonry Wall Frames—Basis List Prices

Box Window Frames—Masonry Wall

Brick mold, $1\frac{1}{8}\times2$, $\frac{7}{8}$-in outside casing, $\frac{7}{8}$-in pulley stile, jamb $6\frac{1}{2}$ in wide exclusive of brick mold, pockets cut and standard steel pulleys set, put together—no inside stops, trim, nor segment board, not primed.

24×24 2 lt. *11.50	30×24 2 lt. *12.00	36×24 2 lt. *12.50	48×24 2 lt. *13.50
30 " *13.20	30 " *13.70	30 " *14.20	30 " *15.20
36 " *14.90	36 " *15.40	36 " *15.90	36 " *16.90

Plank Window Frames—Masonry Wall

Brick mold $1\frac{1}{8}\times2$, jambs $1\frac{3}{4}$ in thick and $5\frac{1}{2}$ in wide including blind stop, put together—no segment board, pulleys, pockets, inside stops nor trim, not primed.

2-4×3-6..* 8.80	2-10×3-6..* 9.40	3-4×3-6..*10.00	4-4×3-6..*11.20
5-6..*11.60	5-6..*12.20	5-6..*12.80	5-6..*14.00
6-6..*13.00	6-6..*13.60	6-6..*14.20	6-6..*15.40

Plank Casement Sash Frames—Masonry Wall

Brick mold $1\frac{1}{8}\times2$, jambs $1\frac{3}{4}\times9\frac{1}{2}$, put together—no segment board nor inside trim, not primed.

2-4×2-6..*10.00	2-10×2-6..*10.90	3-4×2-6..*11.80	4-4×2-6..*13.60
4-6..*13.80	4-6..*14.70	4-6..*15.60	4-6..*17.40

Plank Door Frames—Masonry Wall

Brick mold $1\frac{1}{8}\times2$, put together—no sill, segment board nor inside trim, not primed.

Door opening up to 3-0×7-0.....Jambs $1\frac{3}{4}\times9\frac{1}{2}$ *17.00
" $1\frac{3}{4}\times5\frac{1}{2}$ *11.00

Cellar Sash Frames—Masonry Wall

Brick mold $1\frac{1}{8}\times2$, put together—no segment board nor inside trim, not primed.

Jambs $1\frac{3}{4}\times5\frac{1}{2}$

2-4×1-6..* 5.30	2-10×1-6..* 5.90	3-4×1-6..* 6.50	4-4×1-6..* 7.70
3-6..* 7.70	3-6..* 8.30	3-6..* 8.90	3-6..*10.10

Jambs $1\frac{3}{4}\times7\frac{1}{2}$

2-4×1-6..* 6.80	2-10×1-6..* 7.60	3-4×1-6..* 8.40	4-4×1-6..*10.00
3-6..* 9.80	3-6..*10.60	3-6..*11.40	3-6..*13.00

Jambs $1\frac{3}{4}\times9\frac{1}{2}$

2-4×1-6..* 8.30	2-10×1-6..* 9.20	3-4×1-6..*10.10	4-4×1-6..*11.90
3-6..*11.90	3-6..*12.80	3-6..*13.70	3-6..*15.50

Segment board:
With straight brick molding—add per single frame..... * .70
With segment " " " " " " *3.30

Brick mold $1\frac{3}{4}\times2$:
Cellar sash frames—add per single frame . * .70
All other frames " " " " *1.20

General Extras—All Frames—No Priming

Larger than listed sizes: Add for each extra foot or part thereof either in width or height..... *1.40
Transom head: Add for extra height—then for each foot or part thereof of transom bar..... * .90
Mullion frames: Twin, figure as to singles; triple, three singles and so on; also add for each mullion..... *1.00
Octagon bay frames: Add for all mullions and also add to total group price..... *3.70
Knock down:
Cellar sash frames—deduct per single frame..... * .60
Box frames " " " " *1.40
All other frames " " " " *1.10

Window and Stationary Sash Frames Extras

Box or slip head: Add per single frame, including pockets and pulleys..... *6.30
Pulley stiles $1\frac{1}{8}$ in thick: Add per single frame..... *1.00
Wide jambs: Each extra 2 in or part thereof—add per single frame..... *1.30
Pulleys omitted: Deduct per single frame..... * .60
Pockets not cut: Deduct per single frame..... * .40
Metal pendulum strips:
Single frames—add each..... *1.00
Mullion frames—add for all single frames and also add for each wide center division in the mullion—where of metal *1.00

Casement Sash Frame Extras

Jambs $1\frac{3}{4}$ in Thick: Add to $1\frac{3}{8}$-in list—per single frame.... *1.80
Jambs of different width: For each 2 in—add or deduct per single frame..... *1.60

Door Frame Extras

Jambs of different width: For each 2 in—add or deduct per single frame..... *2.20
Oak sill:
Veneered and masonry wall frames—add per single frame *5.40
Frame and stucco wall frames " " " " *1.60
Softwood sill: Veneered and masonry wall frames—add per single frame..... *3.20
Sill omitted: Frame and stucco wall frames—deduct per single frame..... *2.50

Irregular Head and Bow Face Extras

These extras do not apply to other than Standard Detail Frames. Extras for single frames—sash, window or door opening up to 3′ 0″ wide.

	Moulded cap	Plain cap	Brick mould cap
Segment Out—Segment In...	* 9.00	* 6.30	* 6.30
Square In...	* 7.20	* 4.50	* 3.60
Circle Out—Circle In...	*13.50	* 9.90	* 9.90
Square In...	*10.80	* 8.10	* 7.20
Gothic Out—Gothic In...	*13.50	* 9.90	* 9.90
Square In...	*10.80	* 8.10	* 7.20
Peak head.....	* 5.40	* 3.60	* 3.60
Bow face.....	*18.00	*14.40	*14.40

Each extra 6 in or part thereof in width, add 15 per cent.

Special Exterior Frames—Odd Detail

Hardwood frames: Figure each straight member at the Basis List Prices for "box frames—softwood" and add: plain red oak, 65 per cent; unselected birch, 75 per cent.

Curved members:

Band-sawn—Figure all "band-sawn" members at 2 times the Basis List Prices and add for each such member, per 100 linear feet.....*24.00
Minimum per member, 5 linear feet

Bent— Figure all "bent" members at 3 times the Basis List Prices and add for each such member, per 100 linear feet.....*36.00
Minimum per member, 5 linear feet

Louvre frames: Figure all members at the Basis List Prices and add per slat..... * .50

Peak head frames: Figure all members at Basis List Prices and add for each peak head..... *4.00

Pilaster Casings with cap and base: Figure all members, including pilaster casings, caps and bases at the Basis List Prices and add for each pilaster:

Plain face..... *1.50
Paneled face..... *3.00
Fluted face..... *4.50

Metal pendulum strips:

Single frames—add per frame..... *1.00
Mullion frames—add for all single frames and also add for each wide center division in the mullion, if of metal.... *1.00

Gable and Louvre Frames

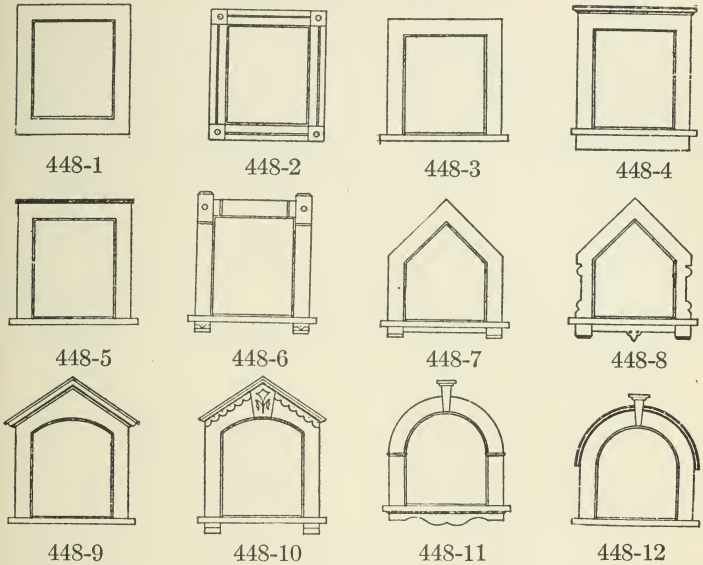


Fig. 65

Price, Each Complete

	Sash size	Square inside 5½ in jambs	Extra 2 in in width of jambs	Same inside as outside 5½ in jambs	Extra 2 in in width of jambs
448-1	2-0×2-0	*3.00	*0.40	.....	.....
448-1	2-0×2-5	*3.00	* .40	.....	.....
448-2	2-0×2-0	*4.50	* .40	.....	.....
448-2	2-0×2-5	*4.50	* .40	.....	.....
448-3	2-0×2-5	*3.20	* .50	.....	.....
448-4	2-0×2-5	*3.80	* .50	.....	.....
448-5	2-0×2-5	*3.40	* .50	.....	.....
448-6	2-0×2-5	*4.50	* .50	.....	.....
448-7	2-0×2-5	.....	.....	* 5.00	*0.50
448-8	2-0×2-5	.....	.....	* 5.50	* .50
448-9	2-0×2-5	*6.00	* .50	* 7.50	* .90
448-10	2-0×2-5	*7.50	* .50	* 9.00	* .90
448-11	2-0×2-2	*7.50	* .50	* 9.50	*1.00
448-11	2-0×2-5	*7.50	* .50	* 9.50	*1.00
448-12	2-0×2-3	*8.50	* .50	*10.50	*1.00

Gable and Louvre Frames

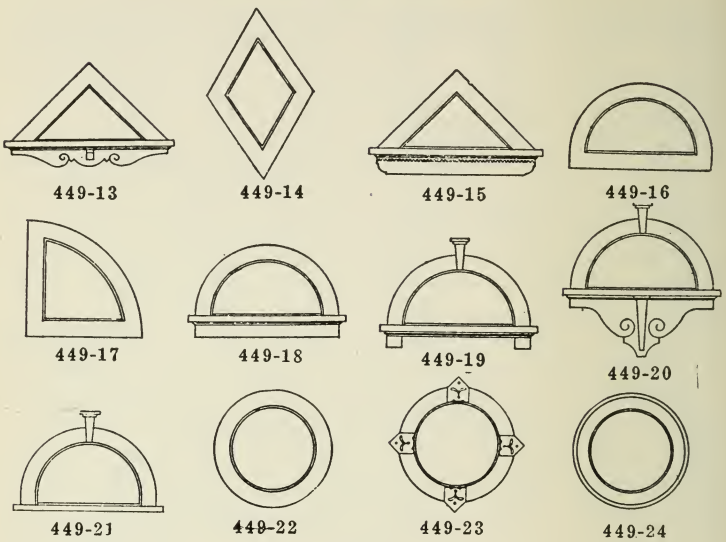


FIG. 66

PRICE EACH, COMPLETE

	Sash size	Square inside 5 in jambs	Extra 2 in in width of jambs	Same inside as outside 5½ in jambs	Extra 2 in in width of jambs
449-13	2-8×1-4	.....	.....	* 5.50	*0.50
449-14	1-8×2-8	.....	.....	* 4.50	* .40
449-14	2-0×2-5	.....	.....	* 4.50	* .40
449-15	2-8×1-4	.....	.....	* 6.50	* .50
449-16	2-8×1-4	*5.50	*0.40	* 7.50	* .90
449-17	2-0×2-0	*5.30	* .40	* 7.00	* .80
449-18	2-8×1-4	*6.00	* .50	* 8.00	*1.00
449-19	2-6×1-4	*6.70	* .50	* 8.70	*1.00
449-19	2-8×1-4	*6.70	* .50	* 8.70	*1.00
449-20	2-8×1-4	*8.00	* .50	*10.00	*1.00
449-21	2-6×1-6	*6.40	* .50	* 8.40	*1.00
449-22	2-0×2-0	*7.50	* .40	*10.50	*1.20
449-23	2-0×2-0	*8.50	* .40	*11.50	*1.20
449-24	2-0×2-0	*8.00	* .40	*11.00	*1.20

Gable and Louvre Frames

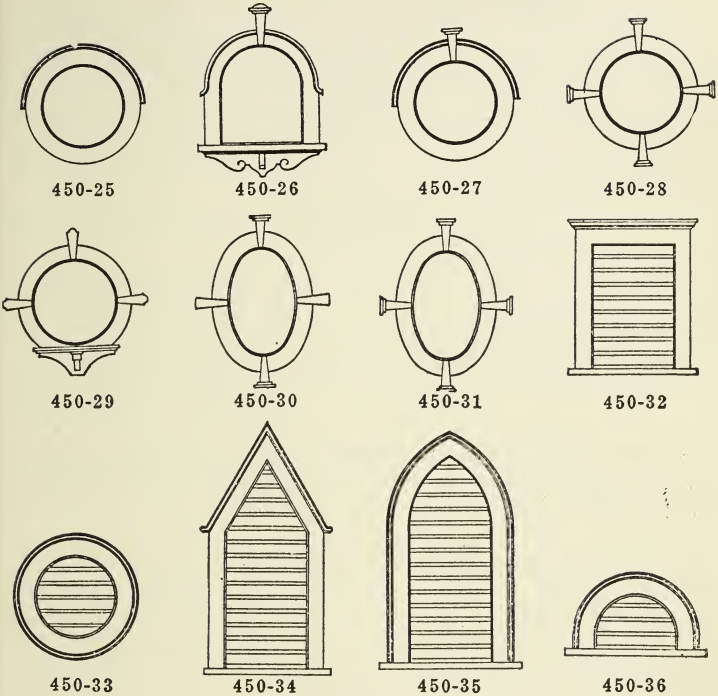


Fig. 67

Price, Each Complete

	Sash size	Square inside 5½ in jambs	Extra 2 in in width of jambs	Same inside as outside 5½ in jambs	Extra 2 in in width of jambs
450-25	2-0×2-0	* 9.00	*0.40	*12.00	*1.20
450-26	2-0×2-5	*10.00	* .40	*12.00	*0.90
450-27	2-0×2-0	*10.00	* .40	*13.00	*1.20
450-28	2-0×2-0	*10.00	* .40	*13.00	*1.20
450-29	2-0×2-0	*10.50	* .40	*13.50	*1.20
450-30	1-8×2-8	*11.00	* .40	*14.50	*1.40
450-30	2-0×3-0	*11.00	* .40	*14.50	*1.40
450-31	1-8×2-8	*11.30	* .40	*14.80	*1.40
450-31	2-0×3-0	*11.30	* .40	*14.80	*1.40
450-32	2-0×3-0	* 8.00	.....	.....	.....
450-33	2-0×2-0	*14.00	.....	.....	.....
450-34	2-0×5-0	*15.00	.....	.....	.....
450-35	2-0×5-0	*20.00	.....	.....	.....
450-36	2-0×1-6	*10.00	.....	.....	.....

French Doors, Solid One-ply—Softwoods

Wood—cypress, fir, pine, or spruce. One light—rectangular, open for glass, stops tacked in loosely. Stiles and top rail—$3\frac{1}{2}$ in or less over all, solid sticking, square head. Bottom rail—$12\frac{1}{2}$ in or less over all, solid sticking. Minimum, per door, 12 sq ft.

Basis List Prices per square foot: $1\frac{3}{8}$ in thick, *0.80; $1\frac{3}{4}$ in thick, *0.90; $2\frac{1}{4}$ in thick, $1.10.

Wider stiles and top rail: For each 1 in or part thereof wider than the foregoing specifications, add 10 per cent.

Wider bottom rail: For each 2 in or part thereof wider than the foregoing specifications, add 5 per cent.

	$1\frac{3}{8}''$	$1\frac{3}{4}''$	$2\frac{1}{4}''$
Divided lights—with stops:			
Add for each light—rectangular	* .70	* .80	* .90
diamond	*1.30	*1.40	*1.50
curved	*2.80	*3.00	*3.30

Caution: Add extra for all glass and glazing at prevailing prices.

Other types: Figure according to schedule "special veneered doors," using a minimum per door of 12 sq ft.

Small Doors

Panel Doors—Veneered. Size—not exceeding 5 ft 6 in high or 14 sq ft of surface. Veneers—$\frac{1}{8}$ in thick before sanding. Panels—flat, 3- or 5-ply, $\frac{1}{2}$ in thick or less, any arrangement. Stiles and top rail—5 in or less over all, cored up and veneered, solid stuck. Bottom rail—12 in or less over all, cored up and veneered, solid stuck. Bench cleaned, in the white, no hardware.

Basis List Prices per square foot: Figure square footage—breaking on 2 in each way—at the following prices and add for each door *2.00

	$1\frac{3}{4}$ in thick	$1\frac{3}{8}$ in thick	$1\frac{1}{8}$ in thick
1. Sap gum or yellow pine	*1.20	*1.10	*1.00
2. Basswood or white pine	*1.30	*1.20	*1.10
3. Cypress, fir, poplar, or red gum	*1.40	*1.30	1.20
4. Unselected birch or plain red oak	*1.60	*1.50	*1.40
5. Plain white oak	*1.70	*1.60	*1.50
6. Red birch, quartered red oak, or quartered sycamore	*1.80	*1.70	*1.60
7. Quartered white oak	*2.10	*1.90	*1.80
8. Native walnut	*2.80	*2.50	*2.40
9. Plain Mexican mahogany	*3.00	*2.70	*2.60

Extras:

Thick veneer: Veneer $\frac{1}{4}$ in thick before sanding, add to Basis Prices 10 per cent.

Rabbeting and beading: In pairs, add per pair..... *1.00

Scrolled top or bottom rails: Add per rail scrolled..... * .80

Lug or horn stiles: Add per lug..... * .20

Stationary slats: Add per panel..... *4.00

Garage and Factory Doors

Wood—cypress, fir, pine, or spruce. Stiles and rails—solid, mortised, tennoned and stuck, not chamfered, square head. Panels—one thickness of ceiling or partition, set with stops on one side. Lights—open rectangular lights with glass bead tacked in loosely included in "sash door" prices. Minimum, per door, $17\frac{1}{2}$ sq ft.

Basis List Prices per Square Foot

	Panel doors	Open sash doors
$1\frac{3}{4}$ in stiles and rails	*1.26	*1.52
$2\frac{1}{4}$ in " " "	*1.44	*1.74
$2\frac{3}{4}$ in " " "	*1.68	*2.00

Double thick stiles and rails: Add to Basis Prices per square foot..... * .16

Rabbeting in pairs: Add per pair..... *2.40

Chamfered stiles and rails:

One side—add for first panel..... *2.00

" " each extra panel..... * .50

Two sides—add for first panel..... *2.50

" " each extra panel..... *1.00

Caution: Add extra for all glass and glazing, astragals, unusual construction, etc.

Special Veneered Doors

Size—not over 3′ 0″ wide, 8′ 0″ high, $1\frac{3}{4}$″ thick

Basis List Prices per Square Foot

Minimum square footage—doors.....$17\frac{1}{2}$ sq ft
sidelights.....10 " "

	Panel doors	Long light sash doors	Short light sash doors
1. Sap gum or yellow pine.....	*1.20	*1.00	*1.20
2. Basswood or white pine.....	*1.30	*1.10	*1.30
3. Cypress, fir, poplar, or red gum....	*1.40	*1.20	*1.40
4. Unselected birch or plain red oak..	*1.60	*1.40	*1.60
5. Plain white oak.....	*1.70	*1.50	*1.70
6. Red birch, quartered red oak or quartered sycamore.....	*1.80	*1.60	*1.80
7. Quartered white oak.....	*2.10	*1.80	*2.10
8. Native walnut.....	*2.80	*2.40	*2.80
9. Plain Mexican mahogany.....	*3.00	*2.50	*3.00

For flush or slab doors add 15 per cent to 1, 2, 3, 4, 5, 6, and use same price for 7, 8 and 9.

General Extras—All Doors

Two kinds of wood: Use average price and add per door.... * 1.80
Selected woods: Veneers selected as to color or figure or both, add to Basis Prices..... 20%

Doors over 3 ft 0 in wide
Over 3 ft 0 in to 3 ft 6 in add per door *1.00
Over 3 ft 6 in to 4 ft 6 in " " " *2.00
Over 4 ft 6 in to 5 ft 10 in " " " *4.00
Over 5 ft 10 in " " " *8.00

Doors over 8 ft 0 in high: Not over 10 ft 0 in high—each extra 6 in or part thereof, add per door..... * 1.00
Doors over $1\frac{3}{4}$ in thick: Each extra $\frac{1}{4}$ in or part thereof, add per square foot..... * .10

Double thick stiles and rails—plowed out and splined with hardwood, add per door:

Woods 1, 2, 3	* 7.00
Woods 4, 5	* 8.00
Woods 6, 7, 8, 9	*10.00
Screwed together and plugged, add to above	* 8.00

Banding sliding doors:

Double sliding doors, add per pair	*23.00	*25.00	*27.00
Single sliding doors, add each	*12.00	*14.00	*15.00

Sliding door astragals:

$1\frac{3}{4}$ in door, not over 8 feet, per pair	* 4.70	* 5.40	* 6.00
$2\frac{1}{4}$ in " " " " " " "	* 5.00	* 5.80	* 6.40
Two kinds of wood, figure highest and add per pair	* 1.80	* 1.80	*1.80

Fancy heads—solid sticking—not over 3 ft 6 in wide:

Gothic, circle or elliptic head, add per door	*12.00
Segment head, add per door	*10.00
Peak head, add per door	*10.00
Head on rake, add per door	* 5.00
Square head with segment or circle corners	* 7.00

EXTRAS—PANEL DOORS

	Woods		
	1, 2, 3	4, 5	6, 7, 8, 9
Large panels:			
4 flat panels, add per door	* .80	*1.10	*1.50
3 " " " " "	*1.20	*1.50	*1.90
2 " " " " "	*1.60	*1.90	*2.30
1 " " " " "	*2.00	*2.30	*2.70

Two-faced doors:

Doors paneled differently on each side—any arrangement of flat panels, add per door	*12.00

Mirror doors—open:

Doors prepared for mirror one side—any arrangement of flat panels other side, add per door	*7.00
Closet doors prepared for mirror on face side and plain laminated back, add per door	*4.50

EXTRAS—SASH DOORS AND SIDELIGHTS—NO GLASS

	Woods		
	1, 2, 3	4, 5	6, 7, 8, 9
Short lights and vertical panels:			
3 long panels and 1 short light, add per door	* .80	*1.10	*1.50
2 long panels and 1 short light, add per door	*1.20	*1.50	*1.90
1 long panel and 1 short light, add per door	*1.60	*1.90	*2.30
Divided lights—with stops:			
Rectangular, add for each light in door	* .70	* .80	*1.00
Diamond, add for each light in door	*1.30	*1.40	*1.60
Curved, add for each light in door	*2.70	*3.00	*3.60
Glass frames with solid sticking, set in sash doors, add:			
Rectangular, per frame	*5.00	*6.00	*7.50
Oval, gothic, or circular, per frame	*8.00	*9.00	*10.50

Interior Sash—No Glass

All sash—1 light, open for glass, glass bead included. Stiles and top rail—2 in to glass. Bottom rail—3 in to glass. Check rails—$1\frac{3}{4}$ in over all.

Basis List Prices per Perimeter Foot

Figure the perimeter feet around each sash breaking on 2 in each way.
Minimum—per window.....20 perimeter feet
per sash.....10 " "

	1-ply $1\frac{1}{8}$ in	1-ply $1\frac{3}{8}$ in	1-ply $1\frac{3}{4}$ in	2-ply $2\frac{1}{4}$ in
1. Yellow pine or sap gum.....	*0.32	*0.34	*0.38	*0.44
2. Fir or spruce.....	* .34	* .36	* .42	* .46
3. Cypress or white pine.....	* .36	* .40	* .46	* .52
4. Red gum or basswood.....	* .40	* .44	* .52	* .58
5. Plain red oak or unselected poplar	* .42	* .46	* .54	* .62
6. Unsel, birch, plain white oak or quartered sycamore.....	* .46	* .50	* .58	* .66
7. Quartered red oak or red birch..	* .50	* .54	* .64	* .74
8. Quartered white oak.....	* .54	* .58	* .70	* .82
9. Plain mahogany.....	* .66	* .74	* .90	*1.06
10. Native walnut.....	* .72	* .80	* .98	*1.16
Two-ply or veneered, add per perimeter foot.....	* .10	* .10	* .10	* .00

	Woods		
	1, 2, 3	4, 5, 6, 7,	8, 9, 10
Divided lights—with stops:			
Add for each light—rectangular	* .70	* .80	*1.00
diamond ..	*1.30	*1.40	*1.60
curved....	*2.70	*3.00	*3.60

Rabbeting and beading in pairs: Add per pair—all woods.... *1.00
Bent stiles and rails: Figure double the price of straight and add per perimeter foot..... *1.00

Special Interior Frames

Molding grade, drum sanded, dadoes cut, KD and bundled. Jambs, $\frac{3}{4}'' \times 5\frac{1}{2}''$ or less, S4S, cut to length. Stops, $\frac{1}{2}'' \times 1\frac{3}{4}''$ or less, S4S, cut to length.

Basis List Prices per Frame—Not Put Together

		2-6×6-8	3-0×7-0
Basswood	.....	* 4.40	* 5.10
Birch	Selected red.....	* 7.70	* 9.00
	Unselected for color.....	* 6.80	* 7.80
Cypress	.....	* 4.60	* 5.40
Fir	Unselected for grain.....	* 4.10	* 4.80
Gum	Red.....	* 6.10	* 7.10
	Sap.....	* 3.90	* 4.40
Mahogany	Plain.....	*11.40	*13.30
Oak	Plain red.....	* 6.80	* 7.80
	Plain white.....	* 7.60	* 8.80
	Quartered red.....	* 7.40	* 8.60
	Quartered white.....	* 8.70	*10.10
Pine	Western white.....	* 5.40	* 6.30
	Yellow.....	* 3.70	* 4.30
Poplar	Unselected for color.....	* 5.60	* 6.50
Spruce	.....	* 4.10	* 4.80
Sycamore	Quartered.....	* 6.50	* 7.60
Walnut	Native.....	*13.60	*15.90

Two kinds of wood—3′ 0″×7′ 0″ or less: Figure highest-priced wood and add per frame..... *2.30

Openings larger than 3′ 0″×7′ 0″:

Add to price of 3′ 0″×7′ 0″ frame of same description, for each extra foot or part thereof in width..... 5%

in height..... 15%

Stops rabbeted in—mitered and glued:

Add per single opening—no transom head *1.50

with " " *2.70

Stair Body

The "Basis List Prices per Riser" are based on specifications as follows:

All stairs: Knock down, ready to put together. Smoothed for painter's finish. None of the following included: Well hole skirting. Platform flooring nor base. Base molding for strings. Rough carriages. Newels, rail, nor balusters.

Box stairs: Strings housed—$\frac{3}{4}$ in thick. Treads and risers cut to approximate length, coves loose.

Open stairs: Wall string housed—$\frac{3}{4}$ in thick. Face string cut and mitered—$\frac{3}{4}$ in thick. Treads mitered and cut to approximate length—bored, slotted, or dove-tailed for balusters; nosings fitted; coves loose. Risers mitered and cut to approximate length.

Curb stairs: Wall string housed—$\frac{3}{4}$ in thick. Face string housed, either $1\frac{1}{2}$-in two-ply or $1\frac{1}{8}$-in one-ply, shoe rail and fillet included—glued together. Treads and risers cut to approximate length; coves loose.

String Types

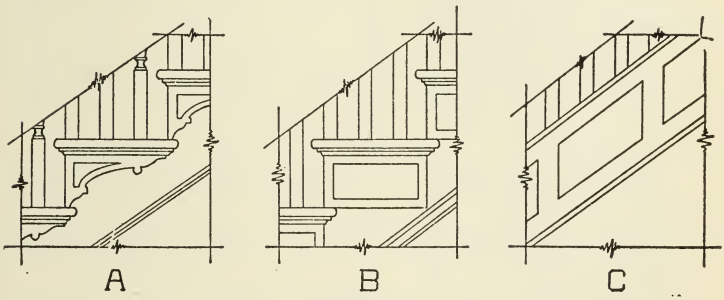


Fig. 68

The designs illustrated above are:

"A"..... Bracketed open string
"B"..... " " "
"C"..... Paneled curb string

Stair Body

The "total" includes strings; treads, $1\frac{1}{8}$ in; and risers, $\frac{3}{4}$ in. Stairs are counted by the riser.

Basis List Prices per Riser

3 ft 6 in wide or less. See Specifications	Box	Plain open 1 side	Bracketed open 1 side	Plain curb 1 side	Panel curb 1 side
1. Yellow pine or sap gum					
Total	* 5.00	* 6.90	* 8.20	* 6.00	* 7.30
Open or curb 2 sides, add	.....	* 1.90	* 3.20	* 1.00	* 2.30
2. Fir or spruce					
Total	* 5.50	* 7.40	* 8.70	* 6.60	* 7.90
Open or curb 2 sides, add	.....	* 1.90	* 3.20	* 1.10	* 2.40
3. Cypress or white pine					
Total	* 6.10	* 8.10	* 9.50	* 7.30	* 8.70
Open or curb 2 sides, add	.....	* 2.00	* 3.40	* 1.20	* 2.60
4. Red gum or basswood					
Total	* 7.00	* 9.20	*10.70	* 8.40	* 9.90
Open or curb 2 sides, add	.....	* 2.20	* 3.70	* 1.40	* 2.90
5. Plain red oak or unselected poplar					
Total	* 7.40	* 9.60	*11.20	* 8.80	*10.40
Open or curb 2 sides, add	.....	* 2.20	* 3.80	* 1.40	* 3.00
6. Unselected birch, plain white oak, maple or quartered sycamore					
Total	* 8.10	*10.40	*12.00	* 9.60	*11.20
Open or curb 2 sides, add	.....	* 2.30	* 3.90	* 1.50	* 3.10
7. Quartered red oak or red birch					
Total	* 9.20	*11.60	*13.40	*10.80	*12.60
Open or curb 2 sides, add	.....	* 2.40	* 4.20	* 1.60	* 3.40
8. Quartered white cak					
Total	*10.10	*12.70	*14.50	*11.90	*13.70
Open or curb 2 sides, add	.....	* 2.60	* 4.40	* 1.80	* 3.60
9. Plain mahogany					
Total	*13.50	*16.40	*18.60	*15.80	*18.00
Open or curb 2 sides, add	.....	* 2.90	* 5.10	* 2.30	* 4.50
10. Native walnut					
Total	*14.70	*17.70	*19.90	*17.20	*19.40
Open or curb 2 sides, add	.....	* 3.00	* 5.20	* 2.50	* 4.70

Winders with straight string—any width stair: Figure the entire flight as above and add extra for each "winder tread" at the total per riser for a 3-ft 6-in basis box stair.

Example—1 flight stairs plain open 1 side, 3 ft 6 in wide, 16 risers high, of which 3 have winder treads, plain red oak.

16 risers—plain open 1 side.....	@	*9.60	*153.60
3 winder treads—box, add.....	@	*7.40	* 22.20
Total.....			*175.80

Long strings: Stairs having 16 or more risers in one straight run, add for each such run..... *8.00

Thick treads and strings: Treads or strings for 3-ft 6-in stairs, if thicker than "Basis" specifications, add to Basis Price per riser, as follows:

	Tread, $1\frac{3}{8}$ in.	Tread, $1\frac{3}{4}$ in	Strings—Each $\frac{3}{8}$ in. Thicker—per string
1. Yellow pine or sap gum.....	*0.26	*0.90	*0.12
2. Fir or spruce.....	* .30	*1.06	* .14
3. Cypress or white pine.....	* .38	*1.26	* .16
4. Red gum or basswood.....	* .46	*1.50	* .20
5. Plain red oak or unselected poplar.....	* .50	*1.66	* .24
6. Unselected birch, plain white oak, maple, or quartered sycamore.....	* .58	*1.90	* .26
7. Quartered red oak or red birch..	* .68	*2.18	* .30
8. Quartered white oak.....	* .78	*2.50	* .34
9. Plain mahogany.....	*1.10	*3.46	* .42
10. Native walnut.....	*1.26	*3.94	* .52

Stairs wider than 3 ft 6 in: Add to Basis Prices per riser for each 6 in or part thereof over 3 ft 6 in wide, as follows:

	Treads $1\frac{1}{8}$ in thick, total	Treads $1\frac{3}{8}$ in thick, total	Treads $1\frac{3}{4}$ in thick, total
1	*0.36	* .42	* .52
2	* .42	* .48	* .62
3	* .48	* .56	* .70
4	* .56	* .64	* .82
5	* .62	* .72	* .90
6	* .70	* .80	*1.02
7	* .80	* .92	*1.16
8	* .90	*1.04	*1.30
9	*1.26	*1.44	*1.80
10	*1.38	*1.58	*1.98

Example—Stairs 4 ft 6 in wide, plain open 1 side, $1\frac{1}{8}$-in strings, $1\frac{3}{8}$-in treads—yellow pine:

Basis Price per riser, $\frac{3}{4}$-in strings, $1\frac{1}{8}$-in tread, 3 ft 6 in wide	*6.90
Extra for $1\frac{1}{8}$-in strings (2 times *.12)	* .24
Extra for $1\frac{3}{8}$-in tread	* .26
Extra for 4 ft 6 in wide $1\frac{3}{8}$-in tread (2 times *.42)	* .84
Total List Price per riser	*8.24

Starting and Bow Face Steps

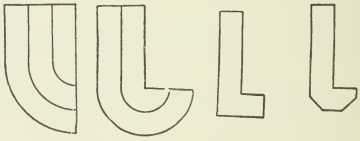


FIG. 69

"G" 3 Risers — "H" 2 Risers — "I" 1 Riser — "J" 1 Riser

Figure the entire flight at the proper Basis Price per riser and add extra for each starting step, in all woods, as follows:

	1 riser	2 risers	3 risers
Quarter circle "G"—per end.....	* 9.00	*21.00	*36.00
Half circle "H" " "	*12.00	*30.00	*60.00
Half square "I" " "	* 5.00	*12.00	*24.00
Half Octagon "J" " "	*10.00	*24.00	*48.00

Bow face—per riser for each 6 in or part thereof in width of stair straight across tread..... *1.80
Minimum, per riser..... *9.00

Well hole skirting: The following prices include nosing, scotia, gallery board 14 in or less and soffit mold:

	Plain	Paneled	Shoe rail, add
Straight skirting—per linear foot:			
1. Yellow pine or sap gum.....	*1.20	*2.20	*0.40
2. Fir or spruce.....	*1.30	*2.30	* .42
3. Cypress or white pine.....	*1.40	*2.50	* .44
4. Red gum or basswood.....	*1.70	*2.80	* .50
5. Plain red oak or unselected poplar.....	*1.80	*3.00	* .52
6. Unsel. birch, plain white oak or quartered sycamore.....	*1.90	*3.10	* .54
7. Quartered red oak or red birch..	*2.20	*3.60	* .60
8. Quartered white oak.....	*2.40	*3.80	* .64
9. Plain mahogany.....	*3.30	*5.00	* .80
10. Native walnut.....	*3.50	*5.20	* .86

	Plain	Paneled
Radius skirting—all woods		
Figure double the price of straight and add per linear foot.....	* 1.40	* 2.10
Minimum—$\frac{1}{4}$ circle or less.....	*21.00	*30.00
" $\frac{1}{2}$ " " "	*30.00	*42.00

Spandril and soffit panels: Figure according to "Interior Panelwork."

Rough horses and common plank stairs—KD: Yellow pine

No. 1 common, per M. B. M. *220.00

Radius Strings

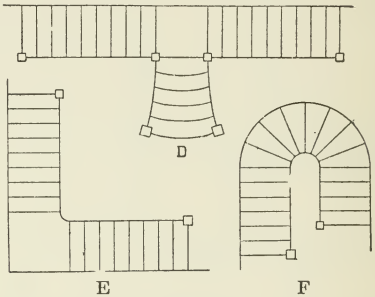


Fig. 70

Figure the entire flight at the proper Basis Price per riser and add extra for each radius string—either face or wall string—as follows:

Radius 3 ft 6 in or less:		
Turnout at start	—first tread	*38.00
	each extra tread	*15.00
Quarter turn	—first tread	*55.00
	each extra tread	*18.00
Half turn	—first tread	*72.00
	each extra tread	*18.00
Radius over 3 ft 6 in:		
All types	—first tread	*38.00
	each extra tread	*15.00

NOTE. The foregoing prices include soffit mold for face string if required.

Example—see Design "D":

1 flight stairs 26 risers high, 3 ft 6 in wide above landing, $1\frac{1}{8}$-in treads, plain open—unselected birch—KD—no rough carriages.

2 risers	4 ft 6 in wide, open 2 sides, straight	@ *14.10	* 28.20
3 "	4 ft 0 in " " " " "	@ *13.40	* 40.20
21 "	3 ft 6 in " " 1 side "	@ *10.40	*218.40
2 bow face steps, add	(9 times *1.80)	@ *16.20	* 32.40
3 " " " "	(8 " *1.80)	@ *14.40	* 43.20

Radius face string—radius over 3 ft 6 in:

One side, add			
First tread		*38.00	
4 extra treads	@ *15.00	*60.00	
			* 98.00
Other side, add			*98.00
Total List Price for stair body			*558.40

Example—see Design "E":

1 flight stairs 18 risers high, 3 ft 6 in, $1\frac{1}{8}$-in treads, plain curb 1 side—red birch—KD—no rough carriages.

18 risers	@ *10.80	*194.40
Radius face string—radius under 3 ft 6 in:		
First tread—quarter turn, add		* 55.00
Total List Price for Stair body		*249.40

Example—see Design "F":

1 flight stairs, 19 risers high, 3 ft 6 in wide, $1\frac{1}{8}$-in treads, panel curb 1 side—quartered white oak—KD—no rough carriages.

19 risers	@ *13.70	*260.30
8 winder treads, add	@ *10.10	* 80.80
Radius face string—radius under 3 ft 6 in:		
First tread—half turn, add		* 72.00
7 extra treads, add	@ *18.00	*126.00
Radius wall string—radius over 3 ft 6 in:		
First tread, add		* 38.00
7 extra treads, add	@ *15.00	*105.00
Total List Price for stair body		*682.10

Special Stair Newels

Specifications:

Starting newels—shaft 6″×6″ or less at top, height 4 ft 6 in or less over all.

Angle newels—shaft 6″×5″ or less at top, height 4 ft 6 in or less over all.

Basis List Prices per Newel—Not Housed

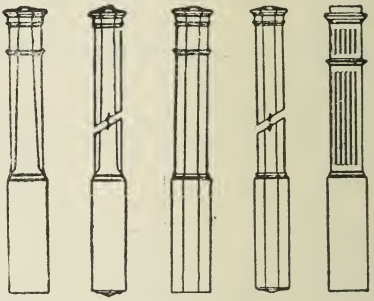


Fig. 71

	Starting "A"	Angle "B"	Starting "C"	Angle "D"	Starting "E"
1. Yellow pine or sap gum.....	*48.50	*48.50	*39.00	*39.00	*21.00
2. Fir or spruce.....	*49.00	*49.00	*40.00	*40.00	*21.50
3. Cypress or white pine.....	*49.50	*49.50	*41.00	*41.00	*22.50
4. Red gum or basswood.....	*54.00	*54.00	*45.00	*45.00	*24.50
5. Plain red oak or unsel. poplar.	*54.50	*54.50	*45.50	*45.50	*25.00
6. Unselected birch, plain white oak or quartered sycamore..	*55.50	*55.00	*46.50	*46.50	*26.00
7. Quartered red oak or red birch.	*60.00	*60.00	*50.50	*51.00	*28.50
8. Quartered white oak.....	*61.00	*60.50	*52.00	*52.50	*30.00
9. Plain mahogany.....	*68.50	*68.00	*59.50	*60.50	*35.50
0. Native walnut.....	*69.50	*69.00	*61.00	*62.50	*37.50

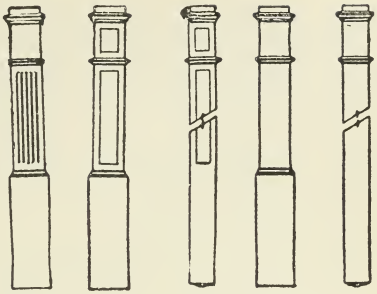


FIG. 72

	Starting "F"	Starting "G"	Angle "H"	Starting "I"	Angle "J"
1. Yellow pine or sap gum	*19.50	*24.00	*16.50	*15.50	*13.50
2. Fir or spruce	*20.00	*24.50	*17.00	*16.00	*14.00
3. Cypress or white pine	*21.00	*25.50	*18.00	*17.00	*15.00
4. Red gum or basswood	*23.00	*27.50	*20.00	*19.00	*17.00
5. Plain red oak or unsel. poplar	*23.50	*28.00	*20.50	*19.50	*17.50
6. Unselected birch, plain white oak or quartered sycamore	*24.50	*29.00	*21.00	*20.50	*18.00
7. Quartered red oak or red birch	*27.00	*31.50	*23.00	*23.00	*20.00
8. Quartered white oak	*28.50	*33.00	*24.50	*24.50	*21.50
9. Plain mahogany	*34.00	*38.50	*29.50	*30.00	*26.50
10. Native walnut	*36.00	*40.50	*31.00	*32.00	*28.00

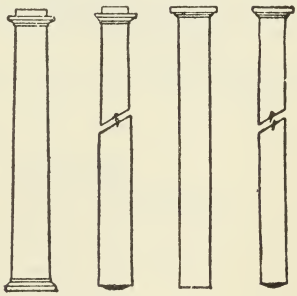


FIG. 73

	Starting "K"	Angle "L"	Starting "M"	Angle "N"
1. Yellow pine or sap gum	*14.50	*14.50	*12.50	*12.50
2. Fir or spruce	*15.00	*15.50	*13.00	*13.00
3. Cypress or white pine	*16.00	*16.50	*14.00	*14.00
4. Red gum or basswood	*18.50	*18.50	*15.50	*15.50
5. Plain red oak or unselected poplar	*19.00	*19.00	*16.00	*16.00
6. Unselected birch, plain white oak or quartered sycamore	*20.00	*20.00	*16.50	*17.00
7. Quartered red oak or red birch	*22.00	*22.50	*18.50	*19.00
8. Quartered white oak	*23.50	*24.00	*19.50	*20.00
9. Plain mahogany	*29.50	*30.50	*24.00	*25.00
10. Native walnut	*31.50	*32.00	*25.50	*26.50

Height: Newels higher than "Basis" specifications, add to Basis Prices for each foot or part thereof of extra height.. 10%

Girth: Newels of larger girth than "Basis" specifications, add to Basis Prices for each inch or part thereof of extra girth..... $2\frac{1}{2}$%

NOTE. Starting newels are based on 6×6 shaft at top, or 24 perimeter inches in girth; angle newels on 5×5 shaft at top or 20 perimeter inches in girth.

Housing: Newels housed to receive tread and riser or prepared to receive well-hole skirting, add per newel..... *3.80

Example—1 angle newel 5″×10″×7′ 4″, Design "N", yellow pine, housed:

Basis Price, Design "N", 5″×5″×6′ 0″.....	*12.50
Extra height, add—2 ft @ 10% each or 20%..	* 2.50
	*15.00
Extra girth, add—10 in @ $2\frac{1}{2}$% each or 25%..	* 3.75
Housing, add.....	* 3.80
Total List Price.....	*22.55

Half newels: Two halves—made by splitting a full newel, figure as a full newel and add..... * 1.20

One-half—built up special, figure at 80 per cent of the full newel.

Special Stair Rail and Crooks

STRAIGHT RAIL—LIST PRICES PER LINEAR FOOT

	$3\frac{1}{2}$″×$3\frac{1}{2}$″ "A"	3″×4″ "B"	$2\frac{3}{4}$″×$3\frac{1}{2}$″ "C"	$2\frac{1}{4}$″×$3\frac{3}{4}$″ "D"	$1\frac{3}{4}$″×$3\frac{1}{2}$″ "E"	$2\frac{1}{4}$″×$2\frac{1}{4}$″ "F"	$1\frac{3}{4}$″×2″ "G"
1. Yellow pine or sap gum.....	*0.94	*1.00	*0.88	*0.86	*0.80	*0.52	*0.44
2. Fir or spruce.....	* .98	*1.04	* .92	* .90	* .84	* .56	* .46
3. Cypress or white pine.....	*1.06	*1.12	* .98	* .96	* .90	* .60	* .48
4. Red gum or basswood.....	*1.16	*1.24	*1.08	*1.04	* .96	* .68	* .54
5. Plain red oak or unselected poplar.....	*1.18	*1.28	*1.10	*1.08	*1.00	* .70	* .56
6. Unselected birch, plain white oak or quartered sycamore..	*1.26	*1.38	*1.16	*1.14	*1.04	* .74	* .58
7. Quartered red oak or red birch.	*1.36	*1.50	*1.26	*1.24	*1.12	* .82	* .64
8. Quartered white oak.....	*1.46	*1.62	*1.36	*1.32	*1.20	* .88	* .68
9. Plain mahogany.....	*1.82	*2.02	*1.68	*1.62	*1.46	*1.14	* .84
10. Native walnut.....	*1.94	*2.18	*1.78	*1.74	*1.56	*1.20	* .90

Bent rail: Figure all lengths—breaking on full feet—at double the price of straight rail and add per linear foot for all woods:

	On level	Up rake
Round wall rail	*1.50	*3.00
All other designs	*3.00	*5.30

Crooks—bolted to rail: Figure 1 lin ft of straight rail for each riser requiring rail, including those that involve crooks, and add for each crook, as follows:

Round wall rail crooks:

		All woods
Quarter turn	Rake or level	* 7.50
Half turn	Level	* 11.50
	Double rake	* 45.00

All other rail design crooks:

Easement	Straight—over or under	* 12.00
"	Turnout—over or under—first riser	* 36.00
	each extra riser	* 10.50
Quarter turn	Level	* 12.00
" "	Rake and level—first riser	* 36.00
	each extra riser	* 10.50
" "	Double rake —first riser	* 45.00
	each extra riser	* 10.50
Half turn	Level	* 30.00
" "	Rake and level—first riser	* 45.00
	each extra riser	* 10.50
" "	Double rake —first riser	* 68.00
	each extra riser	* 10.50
Spiral or wreath	Spiral or wreath—Flat	* 75.00
" " "	Twisted	*150.00
Gooseneck		* 23.00

Special Stair Balusters

Length, 2 ft 0 in to 2 ft 9 in inclusive. Turnings and sawings of ordinary design. Cabinet finish—dovetailed for tread.

First line is turned; 2d, tapered; 3d, plain; all S4S.

Basis List Prices per Baluster

Square end designs:

	$\frac{3}{4}'' \times \frac{3}{4}''$	$1\frac{1}{8}'' \times 1\frac{1}{8}''$	$1\frac{3}{8}'' \times 1\frac{3}{8}''$	$1\frac{3}{4}'' \times 1\frac{3}{4}''$
1. Yellow pine or sap gum				
	.....	.....	*0.78	*0.94
	.....	*0.52	* .56	* .68
	*0.22	* .28	* .32	* .42
2. Fir or spruce				
	.....	.....	*0.80	*0.98
	.....	*0.54	* .60	* .72
	*0.24	* .30	* .34	* .46
3. Cypress or white pine				
	.....	.....	*0 84	*1.06
	.....	*0.58	*0.64	*0.80
	*0.26	* .32	* .38	* .54
4. Red gum or basswood				
	.....	.....	*0.92	*1.16
	.....	*0.62	* .70	* .88
	*0.28	* .36	* .44	* .62
5. Plain red oak or unselected poplar				
	.....	.....	*0.94	*1.20
	.....	*0.64	* .72	* .92
	*0.30	* .38	* .46	* .66
6. Unselected birch, plain white oak or quartered sycamore				
	.....	.....	*1.00	*1.28
	.....	*0.68	* .78	*1.00
	*0.32	* .42	* .50	* .74
7. Quartered red oak or red birch				
	.....	.....	*1.08	*1.40
	.....	*0.74	* .84	*1.10
	*0.34	* .46	* .56	* .82
8. Quartered white oak				
	.....	.....	*1.14	*1.50
	.....	*0.78	* .92	*1.20
	*0.38	* .50	* .64	* .94
9. Plain mahogany				
	.....	.....	*1.40	*1.88
	.....	*0.96	*1.16	*1.58
	*0.48	* .68	* .86	*1.30
10. Native walnut				
	.....	.....	*1.48	*2.02
	.....	*1.02	*1.24	*1.72
	*0.52	* .72	* .94	*1.42

Flat designs: First line sawed; 2d, plain; both S4S.

	$\frac{3}{4}'' \times 4''$	$\frac{3}{4}'' \times 5\frac{1}{2}''$	$1\frac{1}{8}'' \times 4''$	$1\frac{1}{8}'' \times 5\frac{1}{2}''$
1. Yellow pine or sap gum				
	*0.82	*0.94	*0.94	*1.08
	* .36	* .44	* .48	* .58
2. Fir or spruce				
	*0.86	*1.00	*0.98	*1.14
	* .40	*0.48	* .52	*0.64
3. Cypress or white pine				
	*0.94	*1.10	*1.08	*1.28
	* .48	*0.58	*0.62	*0.78
4. Red gum or basswood				
	*1.04	*1.22	*1.20	*1.44
	*0.56	*0.70	*0.72	*0.92
5. Plain red oak or unselected poplar				
	*1.06	*1.24	*1.24	*1.50
	*0.58	*0.72	*0.76	*0.96
6. Unselected birch, plain white oak or quartered sycamore				
	*1.14	*1.34	*1.36	*1.64
	*0.66	*0.82	*0.86	*1.10
7. Quartered red oak or red birch				
	*1.24	*1.48	*1.48	*1.82
	*0.74	*0.92	*0.98	*1.26
8. Quartered white oak				
	*1.34	*1.62	*1.62	*2.00
	*0.84	*1.06	*1.12	*1.44
9. Plain mahogany				
	*1.76	*2.16	*2.12	*2.64
	*1.22	*1.58	*1.58	*2.06
10. Native walnut				
	*1.84	*2.28	*2.28	*2.88
	*1.32	*1.70	*1.76	*2.28

Interior Staved Columns

Specifications: Cabinet finish.

Shaft—round, staved, tapered regular or not tapered, not fluted. Staves—$1\frac{1}{8}$ in thick for 6-in, 8-in, and 10-in columns; $1\frac{3}{8}$ in thick for 12-in columns. Cap—wood, not to exceed 3 members. Base—wood, not to exceed 4 members.

Basis List Prices per Column for 4 Sizes—6″, 8″, 10″, 12″

Shaft	3′ 0″	4′ 0″	5′ 0″	6′ 0″	7′ 0″	8′ 0″	9′ 0″	10′0″
1. Yellow pine or sap gum								
	*12.00	*13.40	*14.90	*16.30	*17.70	*19.20		
	*13.70	*15.50	*17.30	*19.20	*21.00	*22.80	*24.60	
	*15.80	*18.00	*20.20	*22.40	*24.60	*26.80	*29.00	*31.20
	*19.10	*22.10	*25.20	*28.20	*31.30	*34.30	*37.40	*40.40
2. Fir or spruce								
	*12.50	*14.10	*15.60	*17.20	*18.80	*20.30		
	*14.40	*16.40	*18.30	*20.30	*22.30	*24.30	*26.20	
	*16.70	*19.10	*21.50	*23.90	*26.30	*28.70	*31.10	*33.50
	*20.40	*23.70	*27.00	*30.30	*33.60	*37.00	*40.30	*43.60
3. Cypress or white pine								
	*13.20	*15.00	*16.70	*18.40	*20.20	*21.90		
	*15.30	*17.50	*19.70	*21.90	*24.10	*26.30	*28.50	
	*17.90	*20.60	*23.20	*25.90	*28.50	*31.20	*33.80	*36.50
	*22.10	*25.80	*29.50	*33.20	*36.90	*40.60	*44.30	*48.00
4. Red gum or basswood								
	*14.70	*16.70	*18.70	*20.60	*22.60	*24.60		
	*17.10	*19.60	*22.10	*24.60	*27.10	*29.60	*32.10	
	*20.10	*23.10	*26.10	*29.20	*32.20	*35.20	*38.30	*41.30
	*24.90	*29.10	*33.40	*37.60	*41.90*	46.10	*50.40	*54.60
5. Plain red oak or unselected poplar								
	*15.10	*17.20	*19.30	*21.40	*23.50	*25.60		
	*17.70	*20.30	*23.00	*25.60	*28.30	*30.90	*33.60	
	*20.80	*24.00	*27.20	*30.40	*33.70	*36.90	*40.10	*43.30
	*25.90	*30.40	*35.00	*39.50	*44.00	*48.50	*53.00	*57.50
6. Unselected birch, plain white oak or quartered sycamore								
	*16.00	*18.30	*20.60	*22.90	*25.20	*27.50		
	*18.80	*21.70	*24.60	*27.50	*30.40	*33.30	*36.20	
	*22.30	*25.80	*29.30	*32.80	*36.30	*39.80	*43.30	*46.80
	*27.90	*32.90	*37.80	*42.80	*47.70	*52.70	*57.60	*62.50
7. Quartered red oak or red birch								
	*17.50	*20.10	*22.70	*25.30	*27.80	*30.40		
	*20.70	*23.90	*27.20	*30.40	*33.60	*36.90	*40.10	
	*24.60	*28.50	*32.40	*36.40	*40.30	*44.20	*48.20	*52.10
	*31.00	*36.60	*42.10	*47.60	*53.20	*58.70	*64.30	*69.80
8. Quartered white oak								
	*18.60	*21.40	*24.30	*27.10	*30.00	*32.80		
	*22.10	*25.60	*29.20	*32.80	*36.40	*39.90	*43.50	
	*26.50	*30.80	*35.10	*39.40	*43.70	*48.00	*52.30	*56.70
	*33 60	*39.70	*45.80	*51.90	*58.00	*64.20	*70.30	*76.40

9. Plain mahogany

*22.70	*26.40	*30.10	*33.80	*37.50	*41.20		
*27.30	*31.90	*36.60	*41.30	*45.90	*50.60	*55.20	
*33.10	*38.80	*44.40	*50.00	*55.60	*61.20	*66.90	*72.50
*42.80	*50.80	*58.80	*66.80	*74.80	*82.80	*90.80	*98.80

10. Native walnut

*24.20	*28.30	*32.40	*36.50	*40.60	*44.70		
*29.20	*34.40	*39.50	*44.70	*49.80	*54.90	*60.10	
*35.70	*41.90	*48.10	*54.30	*60.50	*66.60	*72.80	*79.00
*46.30	*55.20	*64.00	*72.90	*81.70	*90.60	*99.40	*108.30

Regular fluting, add to plain shaft prices:

3′ 0′	4′ 0″	5 0″	6′ 0″	7′ 0″	8′ 0″	9′ 0″	10′ 0″
*5.00	*5.30	*5.60	*5.90	*6.20	*6.50		
*5.80	*6.20	*6.60	*7.00	*7.40	*7.80	* 8.20	
*6.60	*7.00	*7.40	*7.80	*8.20	*8.60	* 9.00	* 9.40
*7.40	*7.90	*8.40	*8.90	*9.40	*9.90	*10.40	*10.90

Featheredge fluting, add to regular fluting..... 50%

Split columns: Full column price, plus 10 per cent of yellow pine Basis Price.

Caution: Add extra for composition caps where they occur.

Interior Square Posts

Specifications: Put together—cabinet finish.

Shaft—1-in stock, plain tapered or not tapered, not fluted nor paneled. Cap and base—wood, two members each.

Basis List Prices per Post for 4″, 6″, 8″, 10″, 12″

Shaft 3′ 0″	4′ 0″	5′ 0″	6′ 0″	7′ 0″	8′ 0″	9′ 0″	10′ 0″
1. Yellow pine or sap gum							
* 9.80	*10.60	*11.30	*12.10	*12.80	*13.50	*14.30	*15.00
*11.10	*12.00	*12.90	*13.90	*14.80	*15.70	*16.60	*17.60
*12.50	*13.60	*14.70	*15.90	*17.00	*18.10	*19.20	*20.30
*13.80	*15.10	*16.40	*17.70	*19.10	*20.40	*21.70	*23.00
*15.20	*16.70	*18.20	*19.70	*21.20	*22.70	*24.10	*25.60
2. Fir or spruce							
*10.00	*10.80	*11.60	*12.40	*13.10	*13.90	*14.70	*15.50
*11.40	*12.30	*13.30	*14.30	*15.30	*16.30	*17.30	*18.30
*12.90	*14.10	*15.30	*16.50	*17.70	*18.90	*20.10	*21.30
*14.30	*15.80	*17.20	*18.60	*20.00	*21.40	*22.80	*24.30
*15.80	*17.50	*19.10	*20.70	*22.30	*24.00	*25.60	*27.20
3. Cypress or white pine							
*10.40	*11.30	*12.10	*13.00	*13.90	*14.70	*15.60	*16.50
*11.90	*13.10	*14.20	*15.30	*16.40	*17.60	*18.70	*19.80
*13.70	*15.10	*16.50	*17.90	*19.30	*20.70	*22.10	*23.40
*15.40	*17.10	*18.70	*20.40	*22.00	*23.60	*25.30	*26.90
*17.20	*19.10	*21.00	*22.90	*24.80	*26.70	*28.60	*30.50
4. Red gum or basswood							
*11.50	*12.50	*13.50	*14.50	*15.50	*16.40	*17.40	*18.40
*13.40	*14.70	*16.00	*17.30	*18.60	*19.90	*21.20	*22.50
*15.50	*17.10	*18.70	*20.30	*21.90	*23.50	*25.10	*26.70
*17.40	*19.30	*21.20	*23.20	*25.10	*27.00	*28.90	*30.80
*19.90	*22.20	*24.50	*26.90	*29.20	*31.60	*33.90	*36.30

5. Plain red oak or unselected poplar

*11.60	*12.60	*13.60	*14.60	*15.60	*16.60	*17.60	*18.60
*13.50	*14.80	*16.10	*17.40	*18.80	*20.10	*21.40	*22.70
*15.60	*17.30	*18.90	*20.60	*22.20	*23.80	*25.50	*27.10
*17.70	*19.60	*21.60	*23.50	*25.50	*27.40	*29.40	*31.30
*21.10	*23.80	*26.50	*29.20	*31.80	*34.50	*37.20	*39.90

6. Unselected birch, plain white oak or quartered sycamore

*12.00	*13.10	*14.20	*15.20	*16.30	*17.40	*18.50	*19.60
*14.10	*15.50	*17.00	*18.50	*19.90	*21.40	*22.80	*24.30
*16.50	*18.30	*20.20	*22.00	*23.80	*25.60	*27.40	*29.30
*18.80	*21.00	*23.20	*25.30	*27.50	*29.70	*31.90	*34.10
*22.50	*25.50	*28.50	*31.50	*34.50	*37.50	*40.50	*43.50

7. Quartered red oak or red birch

*13.60	*15.00	*16.30	*17.70	*19.00	*20.40	*21.80	*23.10
*16.00	*17.70	*19.50	*21.30	*23.00	*24.80	*26.60	*28.30
*18.70	*20.90	*23.10	*25.30	*27.50	*29.70	*31.90	*34.10
*22.80	*25.90	*29.00	*32.10	*35.20	*38.30	*41.40	*44.50
*25.50	*29.00	*32.50	*36.00	*39.50	*43.00	*46.50	*50.00

8. Quartered white oak

*14.20	*15.70	*17.20	*18.70	*20.20	*21.70	*23.20	*24.70
*16.80	*18.80	*20.80	*22.70	*24.70	*26.70	*28.60	*30.60
*20.00	*22.40	*24.90	*27.30	*29.80	*32.30	*34.70	*37.20
*24.40	*27.90	*31.30	*34.80	*38.20	*41.70	*45.10	*48.60
*27.40	*31.40	*35.30	*39.20	*43.10	*47.10	*51.00	*54.90

9. Plain mahogany

*17.10	*19.20	*21.20	*23.30	*25.30	*27.40	*29.40	*31.50
*20.90	*23.70	*26.40	*29.20	*32.00	*34.80	*37.50	*40.30
*25.30	*28.80	*32.20	*35.70	*39.20	*42.70	*46.20	*49.70
*29.40	*33.60	*37.90	*42.10	*46.30	*50.50	*54.70	*58.90
*33.70	*38.70	*43.60	*48.50	*53.50	*58.40	*63.40	*68.30

10. Native walnut

*17.70	*19.80	*22.00	*24.20	*26.40	*28.50	*30.70	*32.90
*21.70	*24.70	*27.60	*30.50	*33.50	*36.40	*39.40	*42.30
*26.40	*30.20	*33.90	*37.60	*41.30	*45.00	*48.80	*52.50
*30.90	*35.40	*39.90	*44.40	*48.90	*53.40	*57.90	*62.40
*35.50	*40.80	*46.10	*51.40	*56.70	*62.00	*67.20	*72.50

Regular fluting, add to plain shaft prices:

3′ 0″	4′ 0″	5′ 0″	6′ 0″	7′ 0″	8′ 0″	9′ 0″	10′ 0″
* 4.20	* 4.50	* 4.80	* 5.10	* 5.40	* 5.70	* 6.00	* 6.30
* 5.00	* 5.30	* 5.60	* 5.90	* 6.20	* 6.50	* 6.80	* 7.10
* 5.80	* 6.20	* 6.60	* 7.00	* 7.40	* 7.80	* 8.20	* 8.60
* 6.60	* 7.00	* 7.40	* 7.80	* 8.20	* 8.60	* 9.00	* 9.40
* 7.40	* 7.90	* 8.40	* 8.90	* 9.40	* 9.90	*10.40	*10.90

Featheredge fluting, add to regular fluting..... 50%

Paneled shaft: Add for each side paneled per linear foot or part thereof in height..... * .30

Pilasters—half post or less: Two pilasters—made by splitting full posts, figure as a full post and add 10 per cent of the yellow pine Basis Price. One pilaster—built up special, figure at 80 per cent of a full post.

Interior Paneled Pedestals

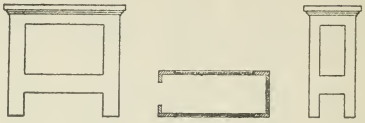


Fig. 74

Specifications: Put together—cabinet finish—no room base included.

Cap—solid, $1\frac{3}{8}$ in thick or less. End—plain or paneled, 12 in deep or less. Sides—paneled. Sticking—solid. Panels—rectangular, flat or raised, veneered or solid.

Basis List Prices per Pedestal for 18″, 24″, 30″, 36″

2′ 0″ high	2′ 6″ high	3′ 0″ high	3′ 6″ high	4′ 0″ high	4′ 6′ ′ high	5′ 0″ high
3. Cypress or white pine:						
*19.20	*20.40	*21.60	*22.80	*24.10	*25.30	*26.50
*20.90	*22.50	*24.00	*25.60	*27.10	*28.70	*30.20
*22.50	*24.30	*26.20	*28.00	*29.80	*31.60	*33.50
*24.20	*26.30	*28.50	*30.70	*32.90	*35.00	*37.10
4. Red gum or basswood:						
*21.40	*22.80	*24.20	*25.60	*27.00	*28.40	*29.80
*23.40	*25.20	*27.00	*28.80	*30.60	*32.40	*34.20
*25.20	*27.30	*29.40	*31.60	*33.70	*35.80	*37.90
*27.20	*29.70	*32.10	*34.70	*37.20	*39.70	*42.10
6. Unselected birch, plain white oak, or quartered sycamore:						
*22.70	*24.30	*25.80	*27.40	*29.10	*30.60	*32.20
*24.90	*26.90	*29.00	*31.00	*33.10	*35.10	*37.20
*27.00	*29.40	*31.80	*34.20	*36.50	*38.90	*41.30
*29.20	*32.10	*34.90	*37.70	*40.50	*43.40	*46.20
8. Quartered white oak:						
*26.20	*28.30	*30.30	*32.30	*34.30	*36.30	*38.30
*29.10	*31.70	*34.20	*36.80	*39.30	*41.90	*44.50
*31.70	*34.70	*37.70	*40.70	*43.60	*46.60	*49.60
*34.50	*38.10	*41.60	*45.10	*48.60	*52.10	*55.60
10. Native walnut:						
*33.50	*36.50	*39.50	*42.50	*45.50	*48.50	*51.40
*37.80	*41.60	*45.30	*49.20	*52.90	*56.70	*60.50
*41.60	*46.00	*50.40	*54.80	*59.10	*63.50	*67.90
*45.80	*51.00	*56.10	*61.30	*66.50	*71.70	*76.80

Bookcase Pedestals

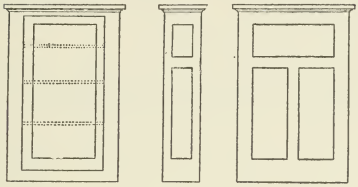


Fig. 75

Specifications: Put together—cabinet finish—no glass, room base nor hardware included.

Basis List Prices per Pedestal for 24″, 30″, 36″, 42″

	3′ 0″ high	3′ 6″ high	4′ 0″ high	4′ 6″ high	5′ 0″ high
3. Cypress or white pine:					
	*33.80	*35.40	*37.20	*38.80	*40.60
	*36.10	*37.80	*40.00	*41.70	*43.90
	*38.50	*40.40	*42.90	*44.80	*47.30
	*41.60	*43.90	*46.80	*49.10	*52.10
5. Plain red oak or unselected poplar:					
	*37.90	*39.60	*41.80	*43.50	*45.70
	*40.50	*42.50	*44.90	*46.90	*49.40
	*43.20	*45.40	*48.30	*50.50	*53.40
	*46.80	*49.50	*52.90	*55.60	*58.90
8. Quartered white oak:					
	*45.50	*47.90	*50.70	*53.10	*55.90
	*48.90	*51.60	*54.80	*57.50	*60.70
	*52.60	*55.60	*59.20	*62.20	*66.00
	*57.40	*61.00	*65.30	*68.90	*73.20
9. Plain mahogany:					
	*55.30	*58.60	*62.40	*65.60	*69.30
	*59.90	*63.50	*67.80	*71.40	*75.60
	*64.80	*68.90	*73.70	*77.70	*82.60
	*71.30	*76.10	*81.70	*86.50	*92.20

Interior Panelwork

Stiles and rails—solid stuck. Panels—$\frac{1}{4}$ in, 3-ply, good 1 side, no panel to exceed 36″×72″. Assembled in sections, cabinet finish. No cap nor base moldings included.

Interior panelwork includes such items as stair spandrils, stair soffits, paneled wainscoting and ceiling panels. Paneled wainscot height is figured from top of paneling to floor. Do not deduct for window openings that cut into the paneled sections. Panelwork with entire top rail on rake, figure actual square footage breaking on 6-in each way and add extra given below. Panelwork with entire top and bottom rail on rake, figure actual square footage breaking on 6 in each way and add extra given below. All other odd-shaped sections, figure as if rectangular.

Basis List Prices per Square Foot

Figure the square footage; width times height, breaking on 6 in each way—minimum per section 4 sq ft—at the following prices:

	Good one side				Good two sides add
	$\frac{3}{4}$″ S & R	$1\frac{1}{8}$″ S & R	$1\frac{3}{8}$″ S & R	$1\frac{3}{4}$″ S & R	
1. Yellow pine or sap gum	*1.12	*1.18	*1.24	*1.34	*0.14
2. Fir or spruce	*1.14	*1.22	*1.28	*1.40	* .14
3. Cypress or white pine	*1.20	*1.30	*1.36	*1.50	* .14
4. Red gum or basswood	*1.34	*1.46	*1.54	*1.72	* .16
5. Plain red oak or unselected poplar	*1.36	*1.48	*1.56	*1.76	* .16
6. Unselected birch, plain white oak or quartered sycamore	*1.42	*1.58	*1.68	*1.90	* .16
7. Quartered red oak or red birch	*1.58	*1.74	*1.86	*2.12	* .18
8. Quartered white oak	*1.68	*1.88	*2.00	*2.30	* .22
9. Plain mahogany	*2.02	*2.28	*2.48	*2.88	* .26
10. Native walnut	*2.16	*2.46	*2.68	*3.16	* .30

Extras—cap and base moldings:

Loose—Figure according to "molding" and add for each machine set up, except S3S and S4S *3.30

In addition to above, add per linear foot for each mold to cover cleaning and attaching ..... * .16

Sections too wide for drum sanding:

Good 1 side, add per square foot ..... * .06

Good 2 sides, " " " " ..... * .12

Thicker panels:

$\frac{5}{16}''$ 3-ply panels, add per square foot	* .04
$\frac{5}{16}''$ 5 " " " " " "	* .08
$\frac{3}{8}''$ 5 " " " " " "	* .12
$\frac{7}{16}''$ 5 " " " " " "	* .16

Bent panelwork—Figure double the price of straight and add per square foot:

$\frac{3}{4}''$ stiles and rails	*1.40
$1\frac{1}{8}''$ " " "	*1.50
$1\frac{3}{8}''$ " " "	*1.60
$1\frac{3}{4}''$ " " "	*1.70

Casework

Case—12 in deep inside, adjustable wood shelves every 12 in in height, plain partitions every 24 in in width. Front—consisting of paneled doors, no drawers nor bins. Ends—plain exposed or unexposed. Back—ceiling, 3-ply or plain 1-ply. Cornice—1 member not exceeding $\frac{7}{8} \times 3\frac{5}{8}$. Set up in sections, cabinet finish. No glass, mirrors nor hardware included.

Basis List Prices per Square Foot

Figure square footage of front breaking on 6 in each way at the following prices:

	Body			Total	Each 2″ deeper
	Front	12″ deep	Back		
Front $\frac{3}{4}$ in or $\frac{7}{8}$ in thick:					
1. Yellow pine or sap gum	*1.52	*1.04	* .40	*2.96	* .18
2. Fir or spruce	*1.58	*1.10	* .42	*3.10	* .20
3. Cypress or white pine	*1.68	*1.24	* .48	*3.40	* .22
4. Red gum or basswood	*1.88	*1.40	* .56	*3.84	* .24
5. Plain red oak or unselected poplar	*1.92	*1.42	* .58	*3.92	* .26
6. Unselected birch, plain white oak, or quartered sycamore	*2.02	*1.56	* .66	*4.24	* .28
7. Quartered red oak or red birch	*2.24	*1.74	* .74	*4.72	* .32
8. Quartered white oak	*2.40	*1.90	* .82	*5.12	* .36
9. Plain mahogany	*3.04	*2.58	*1.12	*6.74	* .50
10. Native walnut	*3.18	*2.72	*1.22	*7.12	* .54

Front $1\frac{1}{8}$ in thick: add 10 per cent to $\frac{3}{4}$ in.

	Woods		
	1, 2, 3	4, 5, 6, 7	8, 9, 10
Sash doors:			
One-light open sash door with stops, deduct per square foot of glass size..	* .50	* .60	* .70
Divided lights—with stops:			
Figure as one-light open sash doors, and add per light—rectangular.....	* .70	* .80	*1.00
diamond.....	*1.30	*1.40	*1.60
curved.....	*2.70	*3.00	*3.60

Casework KD—skeleton front put together, doors, drawers and bins put together but not fitted, balance KD not fitted, figure as set up and deduct:

From basis per square foot..... * .80
From extras for drawers, bread boards, and bins..... 20%
From other extras.....nothing

Special Drawers and Bins

These prices apply only to drawers and bins when furnished separately—not as part of a case or cabinet.

Basis List Prices

Figure each drawer:

	Single faced	Double faced	
Plain front—not lipped.....	*2.00	*2.30	and add per square foot
" " lipped.....	*2.40		
Paneled front—not lipped.....	*2.70	*3.70	
" " —lipped.....	*3.10		
Figure each bin:			
Plain front or paneled.....	*6.50		

1. Yellow pine or sap gum..... * .30
2. Fir or spruce..... * .36
3. Cypress or white pine..... * .42
4. Red gum or basswood..... * .48
5. Plain red oak or unselected poplar..... * .52
6. Unselected birch, plain white oak, or quartered sycamore * .58
7. Quartered red oak or red birch..... * .66
8. Quartered white oak..... * .76
9. Plain mahogany..... *1.08
10. Native walnut..... *1.18

Example—1 single-faced drawer 1 ft 6 in wide, 3 in high, and 1 ft 3 in deep; front, plain red oak, paneled and lipped; balance, yellow pine.

Figure 1′ 6″×4″×1′ 6″.

1 drawer, front paneled and lipped		*3.10
½ square foot front, plain red oak	@ * .52	* .26
3¾ square foot sides, back and bottom yellow pine	@ * .30	*1.13
Total List Price		*4.79

Special Medicine Cases

Door—open, prepared for mirror. Shelves—wood, ordinary arrangement. Depth—6 in or less inside. Back—M & B, V-joint or 3-ply. Face trim—attached, ordinary designs. Set up, cabinet finish, no mirror nor hardware included.

Basis List Prices per Case—No Mirror

No drawer.

	Glass size		
	16″×20″	20″×24″	24″×28″
1. Yellow pine or sap gum	*25.20	*27.00	*29.00
2. Fir or spruce	*25.50	*27.30	*29.40
3. Cypress or white pine	*25.90	*27.80	*29.90
4. Red gum or basswood	*28.20	*30.30	*32.60
5. Plain red oak or unselected poplar	*28.40	*30.50	*32.80
6. Unselected birch, plain white oak or quartered sycamore	*28.90	*31.10	*33.40
7. Quartered red oak or red birch	*31.30	*33.60	*36.20
8. Quartered white oak	*31.90	*34.30	*37.00
9. Plain mahogany	*35.80	*38.70	*41.80
10. Native mahogany	*36.50	*39.50	*42.70

With drawer, add 50 per cent.

Interior Seats

Basis List Prices per square foot: Figure square footage of each part extreme width and length, breaking on 6 in each way—minimum per section, 4 sq ft—at the following prices. Back, seat, riser, and ends—loose.

	Good 1 side		Good 2 sides		
	$\frac{3}{4}''$	$1\frac{1}{8}''$	$1\frac{1}{8}''$	$1\frac{3}{8}''$	$1\frac{3}{4}''$
1. Yellow pine or sap gum	*1.12	*1.18	*1.32	*1.38	*1.48
2. Fir or spruce	*1.14	*1.22	*1.36	*1.42	*1.54
3. Cypress or white pine	*1.20	*1.30	*1.44	*1.50	*1.64
4. Red gum or basswood	*1.34	*1.46	*1.62	*1.70	*1.88
5. Plain red oak or unselected poplar	*1.36	*1.48	*1.64	*1.72	*1.92
6. Unselected birch, plain white oak or quartered sycamore	*1.42	*1.58	*1.74	*1.84	*2.06
7. Quartered red oak or red birch	*1.58	*1.74	*1.92	*2.04	*2.30
8. Quartered white oak	*1.68	*1.88	*2.10	*2.22	*2.52
9. Plain mahogany	*2.02	*2.28	*2.54	*2.74	*3.14
10. Native walnut	*2.16	*2.46	*2.76	*2.98	*3.46

(Cost Book "A" ends here.)

All Planing Mills should belong to the Millwork Cost Bureau.

PART FOUR

HARDWOOD FLOORS

Parquetry. The designs are many, and there is a price list to suit. A few approximate figures are given here. The 1923 discount is 30 per cent. Laying and varnishing are extra. Thickness, $\frac{5}{16}$ in first:

For 2-in strips per linear foot, 3 kinds, 19¢ to 39¢. For 3-in, 21¢ to 37¢. For 4-in, 46¢. For 6-in, 7 kinds, highest, 80¢; lowest, 51¢; average, 61¢. For 8-in, 7 kinds, highest, $1.04; lowest, 56¢; average, 75¢. For 10-in, 7 kinds, highest, $1.17; lowest, 70¢; average, $1. The 12-in goes by the square foot; 27 kinds and combinations; highest, $1.75; lowest, 82¢; average, $1.13.

The foregoing are all for borders. Curved borders cost five times as much as straight

Fields, or centers of floors, per square foot, highest, $1.14; lowest, 80¢; average, 91¢.

Wood carpets and herringbone designs, 5 kinds, prices about the same for each kind. For $\frac{5}{16}$ in thick, average per square foot, 47¢; $\frac{3}{8}$ in, 60¢ $\frac{1}{2}$ in, 66¢; $\frac{5}{8}$ in, 75¢; $\frac{13}{16}$ in, 81¢.

Bringing up to various thicknesses from thin borders or fields, from 20¢ to 40¢ per square foot.

Oak Floors

Oak floors are used everywhere, and in order that an appraiser may be able to decide upon the grade, or get near it, the following official rules are given. Also the measurement, quantity, rules, and weight.

How to Arrive at the Amount of Oak Flooring Required

To cover a certain space, figure the number of square feet, which means the width multiplied by the length; for instance, a room 12 ft wide by 15 ft long would contain 12×15 or 180 sq ft. Add to the square feet of surface to be covered, the following percentages:

50% for..... $\frac{13}{16}'' \times 1\frac{1}{2}''$
$37\frac{1}{2}$% for..... $\frac{13}{16}'' \times 2''$
$33\frac{1}{3}$% for..... $\frac{13}{16}'' \times 2\frac{1}{4}''$
$33\frac{1}{3}$% for..... $\frac{3}{8}'' \times 1\frac{1}{2}''$
25% for..... $\frac{3}{8}'' \times 2''$

The above figures are based on laying flooring straight across the room. Where there are bay windows, hearths, and other projections, allowance should be made for excessive cutting.

Standard Thicknesses and Widths

$\frac{13}{16}''$ thickness; widths, $1\frac{1}{2}''$ face, $2''$ face, and $2\frac{1}{4}''$ face
$\frac{3}{8}''$ thickness; widths, $1\frac{1}{2}''$ face and $2''$ face

Tongued and Grooved and End Matched

Standard Weights and Counts of Oak Flooring

$\frac{13}{16}''\times2\frac{1}{4}''$ face,	2,000 lbs per 1,000 ft.	Counted $1''\times3''$
$\frac{13}{16}''\times2''$ face,	1,900 lbs per 1,000 ft.	Counted $1''\times2\frac{3}{4}''$
$\frac{13}{16}''\times1\frac{1}{2}''$ face,	1,800 lbs per 1,000 ft.	Counted $1''\times2\frac{1}{4}''$
$\frac{3}{8}''\times2''$ face,	1,000 lbs per 1,000 ft.	Counted $1''\times2\frac{1}{2}''$
$\frac{3}{8}''\times1\frac{1}{2}''$ face,	900 lbs per 1,000 ft.	Counted $1''\times2''$

Some manufacturers use a heavier allowance:

Standard Weights of Oak Flooring

$\frac{13}{16}''\times2\frac{1}{4}''$ face	2,200 lbs per 1,000 ft
$\frac{13}{16}''\times2''$ face	2,100 lbs per 1,000 ft
$\frac{13}{16}''\times1\frac{1}{2}''$ face	2,000 lbs per 1,000 ft
$\frac{3}{8}''\times2''$ face	1,200 lbs per 1,000 ft
$\frac{3}{8}''\times1\frac{1}{2}''$ face	1,000 lbs per 1,000 ft

In appraising oak flooring be sure and see whether it is plain or quarter-sawed red or white.

For $\frac{13}{16}$ in use eightpenny steel cut flooring nail.

For $\frac{3}{8}$ in use threepenny wire finishing nail.

The maximum distance between the nails should be:

For $\frac{13}{16}$ in thickness	16 in
For $\frac{3}{8}$ in thickness	10 in

For even better results, it is recommended that the nails be driven closer than indicated.

The nails are not hard to figure. Assume a room $10'\times20'$, or 120 in wide by 240 in long. At 16 in apart there are 15 nails and 1 at end equals 16. At $2\frac{1}{2}$-in face there are 48 boards in the width equals 48×16 equals 768 plus 10 per cent for waste and end nailing equals 845 divided by 132, the number per pound, although some lists are different, equals $6\frac{1}{2}$ lbs for 2 squares, say, at 7¢ equals 46¢ or 23¢ per square.

For a 2-in face, 1,056 nails, or 8 lbs equals 4 lbs per square, or 28¢.

For $1\frac{1}{2}$-in face equals 1,408 nails equals 10.7 lbs equals 75¢ for 2 squares.

Arrange the price of nails to suit the local rate.

For the 2-in face and $\frac{3}{8}$ in thick there are 25 nails per board at 10-in centers and 60 boards equals 1,500 nails and 10 per cent extra equals 1,650, or about 2 lbs at, say, 10¢, or 20¢ for 2 squares. For the $1\frac{1}{2}$-in face 2,220 nails or about 3 lbs equals 30¢ for 2 squares, or 15¢ per square.

For the heavy nails a fair allowance on this small item would be $1 per square, or 1¢ per sq ft; and for the light, 50¢ per square and $\frac{1}{2}$¢ per sq ft.

Labor. For installation of fine floors see Labor Table H, Chapter XI, and also Table 4, along with all kinds of flooring.

Material. The parquetry figures have been given, but flooring laid in the ordinary manner comes under another classification. Referring to Table H, Chapter XI, oak flooring, $\frac{13}{16}'' \times 1\frac{1}{2}''$ face, plain work, is set at $2\frac{1}{4}$ squares per day of 8 hours for 2 men. The table of allowance sent out by the manufacturers sets 50 per cent extra for this width. The price is set here at $100, and in 1919 was $395. The total per square should be:

150 ft at $100	$15.00
Labor on basis of $1 per hour	7.11
Nails	.38
	$22.49

This is without profit, and the price of flooring might be much more. Varnishing is not included. With $395 per 1,000 and $1.25 per hour, the rate is $48.77. If $2\frac{1}{4}$ squares take $16\frac{2}{3}$ hours 1 square will take 7.11, and at $1 per hour this is $7.11; at $1.25, $8.89.

CHAPTER XIII

GLASS

The United States base figure is 100 in 1913. Variations from that are seen in the Relative price columns.

Year	Glass: window		Glass: plate	Year	Glass: window		Glass: plate
	Average price per 50 sq ft	Relative price	Relative price		Average price per 50 sq ft	Relative	Relative
1890	$1.768	$ 80.4	$179.8	1905	$2.137	$ 96.2	$ 95.8
1891	1.770	79.7	177.2	1906	2.256	101.6	103.7
1892	1.595	71.8	141.3	1907	2.242	101.0	106.8
1893	1.710	77.0	141.3	1908	1.881	84.7	86.4
1894	1.633	73.5	115.6	1909	1.849	83.3	88.5
1895	1.392	62.7	123.3	1910	2.338	105.3	109.2
1896	1.600	72.0	138.7	1911	1.796	80.9	99.2
1897	1.963	88.4	82.2	1912	1.785	80.4	93.2
1898	2.343	105.5	110.5	1913	2.221	100.0	100.0
1899	2.399	108.0	123.3	1914	2.168	97.6	91.4
1900	2.319	104.4	138.7	1915	2.423	109.1	79.6
1901	3.282	147.8	125.9	1916	2.494	112.3	106.0
1902	2.565	115.5	105.7	1917	3.325	149.7	123.3
1903	2.160	97.3	110.8	1918	5.689	256.2	142.2
1904	2.328	104.8	93.8	1919	6.772	305	183.0

Quality. There are three grades of common window glass—AA, A, and B. The standard is A. For AA add 10 to 12 per cent to A; for B, deduct 6 to 7 per cent. B is used for cellar lights and a cheap class of work. AA is never used unless for specially good installations.

Weight. Common glass, single strength, 1.25 lbs to the square foot; D.S., 1.6 lbs; plate, 3.6; but the weight varies.

Table 1 following is close enough to be used for net figures in such years as 1913, 1910, 1900, etc., as the variation is not much on an ordinary installation of glass.

Table 2 is based on 1923 rates, and to be discounted according to local figure, say, 80 per cent. Both tables give prices unset.

TABLE 1 (ON 1913 = 100 BASIS)

Net Prices of Common Window Glass

Sizes	Number of Lights in Box	Price per Box, Single Strength	Price per Box, Double Strength	Price per Light, Single Strength	Price per Light, Double Strength	Sizes	Number of Lights in Box	Price per Box, Single Strength	Price per Box, Double Strength	Price per Light, Single Strength	Price per Light, Double Strength
7× 9	115	$2.30	.....	$0.02 1/23	.....	18×30	14	$2.85	$4.45	$0.26	$0.42
8×10	90	2.30	.....	.03 7/9	.....	18×32	13	2.85	4.45	.28	.44
8×12	75	2.30	.....	.04	.....	18×48	8	.....	5.10	.....	.81
8×14	64	2.30	.....	.04 4/9	.....	18×56	7	.....	5.65	.....	1.03
9×12	67	2.30	.....	.04 1/3	.....	20×20	18	2.85	4.45	.20	.32
9×14	57	2.30	.....	.05 1/3	.....	20×22	16	2.85	4.45	.23	.36
10×12	60	2.30	.....	.05	.....	20×24	15	2.85	4.45	.24	.38
10×14	52	2.30	.....	.05 5/8	.....	20×26	14	2.85	4.45	.26	.41
10×16	45	2.40	.....	.07	.....	20×28	13	2.85	4.45	.28	.44
10×18	40	2.40	.....	.08	.....	20×30	12	2.85	4.45	.30	.48
10×20	36	2.40	.....	.08 2/3	.....	20×32	11	2.94	4.55	.34	.53
10×22	33	2.40	.....	.09 1/11	.....	20×36	10	3.12	4.70	.40	.54
10×24	30	2.40	.....	.10	.....	22×22	15	2.85	4.45	.24	.38
10×26	28	2.52	.....	.11 1/13	.....	22×24	14	2.85	4.45	.26	.41
10×28	26	2.52	.....	.12 1/13	.....	22×26	13	2.85	4.45	.28	.44
10×30	24	2.52	.....	.13 1/12	.....	22×28	12	2.85	4.45	.30	.48
12×14	43	2.40	.....	.07 1/2	.....	22×30	11	2.94	4.55	.34	.53
12×16	38	2.40	.....	.08	.....	22×32	10	2.94	4.55	.38	.58
12×18	34	2.40	.....	.09	.....	22×36	9	3.12	4.70	.44	.67
12×20	30	2.40	.....	.10 1/3	.....	24×24	12	2.85	4.45	.30	.48
12×24	25	2.52	.....	.13	.....	24×26	12	2.85	4.45	.31	.49
12×26	23	2.52	.....	.14	.....	24×28	11	2.94	4.55	.34	.53
12×28	22	2.52	.....	.15	.....	24×30	10	2.94	4.55	.38	.58
12×30	20	2.65	.....	.17	.....	24×32	10	3.12	4.70	.40	.60
12×32	19	2.65	.....	.18	.....	24×36	9	3.12	4.70	.44	.67
12×34	18	2.65	.....	.19	.....	24×40	8	3.35	5.05	.55	.81
12×36	17	2.65	.....	.20	.....	26×26	11	2.94	4.55	.34	.53
12×40	15	2.70	.....	.23	.....	26×28	10	2.94	4.55	.40	.60
14×16	32	2.40	.....	.10	.....	26×30	9	3.12	4.70	.44	.67
14×18	29	2.40	.....	.11	.....	26×32	9	3.12	4.70	.45	.68
14×20	26	2.40	.....	.12	.....	26×34	8	3.12	4.70	.55	.80
14×22	24	2.52	.....	.13 1/12	.....	26×36	8	3.35	5.05	.56	.81
14×24	22	2.52	.....	.14 2/7	.....	26×38	7	3.35	5.05	.63	.92
14×26	20	2.52	.....	.16	.....	26×40	7	3.35	5.05	.64	.93
14×28	19	2.65	.....	.18	.....	28×28	9	3.12	4.70	.44	.66
14×30	17	2.65	.....	.20	.....	28×30	9	3.12	4.70	.45	.67
14×32	16	2.65	.....	.21	.....	28×32	8	3.12	4.70	.55	.80
14×34	15	2.65	.....	.23	.....	28×34	8	3.35	5.05	.56	.81
14×36	14	2.65	.....	.24	.....	28×36	7	3.35	5.05	.63	.92
14×40	13	2.70	.....	.27	.....	28×38	7	3.35	5.05	.64	.93
16×20	23	2.70	$4.10	.14	$0.23	28×40	7	3.35	5.05	.65	.94
16×24	19	2.70	4.10	.17	.28	30×30	8	3.35	5.05	.55	.81
16×26	17	2.86	4.45	.20	.34	30×32	7	3.35	5.05	.63	.92
16×28	16	2.86	4.45	.21	.36	30×34	7	3.35	5.05	.64	.93
16×30	15	2.85	4.45	.24	.38	30×36	7	3.35	5.05	.65	.94
16×40	11	.....	4.70	.....	.54	30×40	6	.....	5.05	.65	1.07
16×44	10	.....	4.70	.....	.60	30×44	6	.....	5.52	.....	1.18
18×20	20	2.70	4.10	.22	.26	30×48	5	.....	5.52	.....	1.42
18×22	18	2.85	4.45	.20	.32	32×32	7	.....	5.04	.....	.92
18×24	17	2.85	4.45	.22	.34	32×34	7	.....	5.04	.....	.93
18×26	16	2.85	4.45	.23	.36	32×36	6	.....	5.04	.....	1.07
18×28	14	2.85	4.45	.26	.41	32×40	6	.....	5.52	.....	1.18
32×44	5	.....	5.52	.....	1.42	40×46	4	.....	6.00	.....	1.92
32×48	5	.....	5.52	.....	1.43	40×48	4	.....	6.00	.....	1.93
34×40	6	.....	5.52	.....	1.18	40×50	4	.....	6.00	.....	1.94
34×44	5	.....	5.52	.....	1.42	44×44	4	.....	6.60	.....	2 12
34×48	5	.....	5.64	.....	1.45	44×46	4	.....	6.60	.....	2.13
36×36	6	.....	5.52	.....	1.18	44×48	3	.....	6.75	.....	2.87
36×40	5	.....	5.52	.....	1.42	44×50	3	.....	6.75	.....	2.88
36×44	5	.....	5.52	.....	1.43	46×48	3	.....	6.75	.....	2.87
36×48	4	.....	5.64	.....	1.81	48×48	3	.....	7.90	.....	3.38
40×40	5	.....	5.52	.....	1.42	48×50	3	.....	7.90	.....	3.39
40×44	4	.....	5.64	.....	1.81	50×56	3	.....	9.60	.....	4.11

TABLE 2

Price List of Common Window Glass

SINGLE			Sizes	DOUBLE		
AA	A	B		AA	A	B
30	25	24	6x8	39	34	33
69	59	56	8x14	90	80	76
1 02	87	83	20	1 39	1 24	1 16
73	62	60	10x12	96	85	81
1 02	87	84	16	1 39	1 24	1 17
1 53	1 30	1 25	24	2 09	1 86	1 75
2 66	2 31	2 16	36	3 82	3 41	3 19
3 44	2 97	2 74	44	4 89	4 38	4 07
80	68	65	11x12	1 04	93	88
1 39	1 18	1 14	20	1 90	1 69	1 60
88	75	72	12x12	1 15	1 02	97
1 21	1 02	99	16	1 65	1 47	1 39
1 53	1 30	1 25	20	2 09	1 86	1 75
3 67	3 17	2 92	40	5 21	4 67	4 34
7 13	6 57	5 88	60	9 32	8 50	7 75
1 24	1 05	1 02	14x14	1 70	1 51	1 43
2 96	2 58	2 40	28	4 24	3 79	3 55
3 80	3 31	3 09	36	5 45	4 87	4 56
6 00	5 44	4 88	52	8 50	7 63	7 00
7 92	7 30	6 53	60	10 35	9 44	8 61
1 63	1 39	1 34	16x16	2 24	1 99	1 88
2 12	1 80	1 69	20	2 99	2 64	2 42
3 55	3 09	2 88	30	5 09	4 55	4 25
4 23	3 65	3 37	36	6 01	5 39	5 00
6 67	6 05	5 42	48	9 44	8 48	7 78
			60	11 65	10 63	9 69
			72	16 36	15 00	13 86
2 22	1 88	1 77	18x18	3 13	2 76	2 53
3 80	3 31	3 09	28	5 45	4 87	4 56
4 09	3 56	3 32	32	5 87	5 25	4 91
5 00	4 32	3 98	36	7 11	6 37	5 92
7 50	6 80	6 10	48	10 63	9 54	8 75
			64	15 53	14 17	12 92
2 96	2 58	2 40	20x20	4 24	3 79	3 55
3 55	3 09	2 88	24	5 09	4 55	4 25
5 00	4 32	3 98	32	7 11	6 37	5 92
7 50	6 80	6 10	44	10 63	9 54	8 75
			56	15 53	14 17	12 92
			72	20 00	18 25	17 00
			82	27 02	24 80	22 92
3 55	3 09	2 88	22x22	5 09	4 55	4 25
4 43	3 86	3 60	28	6 36	5 68	5 32

SINGLE			Sizes	DOUBLE		
AA	A	B		AA	A	B
6 25	5 56	5 00	22x36	8 89	7 92	7 30
8 58	7 77	6 97	44	12 15	10 90	10 00
			60	18 63	17 00	15 50
			80	30 40	27 90	25 79
4 43	3 86	3 59	24x24	6 36	5 68	5 32
5 00	4 32	3 98	28	7 11	6 37	5 92
7 04	6 25	5 63	36	10 00	8 91	8 21
11 25	10 32	9 07	48	15 21	13 86	12 61
			62	19 63	18 00	16 63
			72	29 07	26 57	25 00
			82	38 58	35 72	33 31
			88	43 31	39 47	37 15
5 00	4 32	3 98	26x26	7 11	6 37	5 92
11 25	10 32	9 07	48	15 21	13 86	12 61
			60	19 63	18 00	16 63
			66	25 00	22 82	21 25
6 25	5 56	5 00	28x28	8 89	7 92	7 30
7 50	6 80	6 10	32	10 63	9 54	8 75
13 50	12 38	10 88	48	18 25	16 63	15 13
			58	24 54	22 50	20 79
			74	34 74	31 88	29 47
7 50	6 80	6 10	30x30	10 63	9 54	8 75
13 50	12 38	10 88	48	18 25	16 63	15 13
			62	25 00	22 82	21 25
			70	38 75	35 42	33 33
8 58	7 77	6 97	32x32	12 15	10 90	10 00
10 00	9 07	8 13	36	14 17	12 71	11 67
13 50	12 38	10 88	42	18 25	16 63	15 13
			32x60	25 00	22 82	21 25
			70	40 53	37 19	34 38
			84	71 25	64 63	61 25
11 25	10 32	9 07	36	15 21	13 86	12 61
13 50	12 38	10 88	40	18 25	16 63	15 13
17 82	16 41	14 69	48	23 29	21 25	19 38
			52	24 54	22 50	20 79
			68	40 53	37 19	34 38
			78	60 63	55 25	52 00
			86	71 25	64 63	61 25
13 50	12 38	10 88	40	18 25	16 63	15 13
13 50	12 38	10 88	44	18 25	16 63	15 13
17 82	16 41	14 69	48	23 29	21 25	19 38

Sizes	DOUBLE			Sizes	DOUBLE			Sizes	DOUBLE		
	AA	A	B		AA	A	B		AA	A	B
36x52	24 54	22 50	20 79	42x48	26 99	24 75	22 87	50x60	59 40	55 00	51 29
60	38 75	35 42	33 33	60	44 58	40 92	37 82	66	97 88	88 87	84 23
70	45 00	41 67	38 86	80	107 25	98 15	93 50	52x52	53 49	49 09	45 38
80	71 25	64 63	61 25	44x44	26 99	24 75	22 87	60	66 69	60 78	57 20
38x38	18 25	16 63	15 13	48	36 68	33 47	31 18	70	107 25	98 15	93 50
48	24 54	22 50	20 79	68	66 69	60 78	57 20	54x54	78 38	71 09	67 38
60	38 75	35 42	33 33	70	66 69	60 78	57 20	60	97 98	88 87	84 23
70	54 00	50 00	46 63	46x46	36 68	33 47	31 18	70	107 25	98 15	93 50
80	71 25	64 63	61 25	60	59 40	55 00	51 29	56x56	78 38	71 09	67 38
40x40	18 25	16 63	15 13	76	107 25	98 15	93 50	66	107 25	98 15	93 50
52	25 00	22 82	21 25	48x48	42 63	38 97	36 68	58x58	97 98	88 87	84 23
62	40 53	37 19	34 38	60	59 40	55 00	51 29	72	155 38	143 24	137 05
72	60 63	55 25	52 00	72	97 98	88 87	84 23	60x60	97 98	88 87	84 23
42x42	25 62	23 39	21 33	50x50	42 63	38 97	36 68	70	155 38	143 24	137 05

Setting. For an ordinary store front, wood construction, 21 ft wide by the common height, allow 12 hours in all for setting the plate glass. Laborers can do most of the work, so that a figure of $1 per hour is safe. This would include hauling for a short distance, usually done by auto truck. For a metal front double this allowance. For some kinds of fronts twice as long would be taken. The largest lights used are in Omaha—about 24 ft long by the regular height. One broke in setting, and two since setting. Special work of this kind has to have a special allowance.

On the basis of 50¢ per hour allow 7¢ each for ordinary house lights and 10¢ if wood stops are used. For metal frames allow 15¢. On a basis of 40¢ labor 20,000 lights were set and puttied for 1½¢ each, or 27 lights per hour. For large cottage lights, in lower sash usually, allow 5 to 6 per hour for 1 man. So far as valuation is concerned, most common glass comes already set from the mill, and it is a case of using the ordinary lists.

Plate Glass List. The sizes are given in inches. Sufficient sizes are given from the standard list for ordinary use. The 1923 discount is 75 per cent, or one-fourth of list prices is net: in some places, 80. Local discount should be found. A square foot price cannot be set: the variation is too great. Glazing is usually set at 10 per cent of the glass price. It is not merely the labor that has to be considered, but risk and insurance.

Length	Width					Length	Width			
	6	7	8	9	10		12	14	16	18
12	1.25	1.45	2.00	2.25	2.50	24	7.00	8.75	10.00	12.00
24	2.50	4.10	4.65	5.25	5.85	36	12.00	14.90	17.00	20.25
36	5.25	6.15	7.00	8.45	9.40	48	17.00	21.00	25.40	28.50
48	7.00	8.75	10.00	12.00	14.15	60	22.50	27.80	32.70	37.20
60	9.40	11.65	14.15	15.95	18.75	72	28.50	34.30	39.60	47.30
72	14.25	17.15	19.80	23.65	26.25	84	34.30	42.50	48.60	54.60
84	17.15	21.25	24.30	27.30	30.35	96	39.60	48.60	55.50	62.40

Length	Width					Length	Width				
	20	22	24	26	28		30	32	34	36	38
28	16.55	19.25	21.00	24.10	25.90	36	37.20	39.60	44.20	48.20	
40	26.40	30.00	32.70	35.80	38.50	60	66.90	69.40	75.10	80.30	84.00
52	35.80	39.40	46.40	48.90	52.60	80	89.20	95.20	103.00	109.00	116.00
64	46.70	51.40	57.10	60.10	64.80	98	112	119	127	134	145
84	60.70	66.80	74.90	80.40	87.40	120	139	150	159	168	178
100	72.30	81.00	89.20	98.50	106.00						

Length	Width					Length	Width				
	40	42	44	46	48		50	52	54	56	58
60	89.20	93.70	100	105	111	60	114	119	123	128	132
72	111	115	120	126	131	84	164	170	182	183	190
100	156	164	172	179	187	100	195	203	210	218	226
120	187	196	206	215	224	120	234	243	252	262	271
140	228	239	251	262	273	180	485	504	524	543	562

Length	Width					Length	Width				
	60	62	64	66	68		70	72	74	76	78
68	159	164	170	175	180	80	218	227	231	237	246
84	202	203	210	222	223	96	262	276	277	304	312
108	252	261	269	278	306	108	315	324	333	342	351
120	280	310	320	330	340	132	385	396	407	418	429
144	372	385	397	410	422	180	679	698	717	737	756

Length	Width				Length	Width			
	130	132	134	136		138	140	142	144
136	1,167	1,185	1,203	1,221	144	1,587	1,610	1,704	1,728
148	1,537	1,561	1,584	1,608	160	2,147	2,178	2,209	2,240
160	1,734	1,760	1,787	2,116	172	3,132	3,178	3,223	3,268
172	2,174	2,208	3,042	3,087	180	3,278	3,325	3,373	3,420
210	3,792	3,850	3,909	3,967	200	3,834	3,889	3,945	4,000

Price per Plate for Beveling

United, inches	Size of bevel						
	½ in	¾ in	1 in	1¼ in	1½ in	1¾ in	2 in
30	$1.94	$2.24	$2.98	$ 3.58	$ 4.32	$ 4.92	$ 5.52
50	3.34	3.84	5.20	6.18	7.52	8.52	9.52
80	....	9.62	11.22	13.18	15.08	17.08	19.08
120	....	....	24.00	28.82	33.64	38.46	43.28
150	....	....	45.00	54.00	63.00	72.00	81.00
180	....	....	....	129.76	151.32	172.88	194.44

For 2¼-in bevel add ⅛ in to 2 in; 2½-in, add ¼ in; 2¾-in, add ⅜ in; 3-in, add ½ in. Discount the beveling table same as plate glass one.

CHAPTER XIV

SHEET METAL WORK

(A reasonable profit is included unless otherwise mentioned.)

The first two tables are given as an aid to getting original cost in such years as 1910 to 1913—and 1913 is the U. S. base year at 100. The prices are: 20″×28″ IC, per box, $10; IX, $13; IC Old Style, $14; IX Old Style, $17.

Itemized Actual Cost of a Square of Tin Roofing

	IC Common	IX Common	IC Old style	IX Old style
29 sheets, 20×28	$2.59	$3.37	$3.63	$4.41
5 lbs solder	1.30	1.30	1.30	1.30
Charcoal and rosin	.25	.25	.25	.25
Nails	.07	.07	.07	.07
Labor	1.60	1.60	1.60	1.60
Paint on under side, one coat	.40	.40	.40	.40
Drayage	.15	.15	.15	.15
Actual cost	$6.36	$7.14	$7.40	$8.18
With contractor's profit, shop rent, tools, etc., 20 per cent	7.65	8.57	8.88	9.82

	IC Common	IX Common	IC Old style	IX Old style
63 sheets, 14×20	$2.77	$3.60	$3.87	$4.70
7½ lbs solder	1.95	1.95	1.95	1.95
Charcoal and rosin	.40	.40	.40	.40
Nails	.10	.10	.10	.10
Labor	2.30	2.30	2.30	2.30
Paint, one side	.40	.40	.40	.40
Drayage	.15	.15	.15	.15
Actual cost	$8.07	$8.90	$9.17	$10.00
With contractor's profit	9.68	10.68	11.00	12.00

Two tables follow for high years, as 1919 and 1923, and the prices upon which they are based are 20″×28″ IC Common, $20; same, IX, $23; same, IC Old Style, $23; same, IX Old Style, $25. Any local or period prices can be filled in by proportion.

Itemized Actual Cost of a Square of 20″×28″ Tin Roofing

	IC Common	IX Common	IC Old style	IX Old style
29 sheets, 20″×28″	$5.18	$5.96	$5.96	$6.47
5 lbs solder at 60¢	3.00	3.00	3.00	3.00
Charcoal and rosin at 50¢	.50	.50	.50	.50
Nails	.15	.15	.15	.15
Labor, 5 hours at $1	5.00	5.00	5.00	5.00
Paint on under side, one coat	1.00	1.00	1.00	1.00
Drayage	.25	.25	.25	.25
Actual cost	$15.08	$15.86	$15.86	$16.37
With contractor's profit, shop rent, tools, etc. (see Overhead), 25 per cent	18.85	19.82	19.82	20.46

Itemized Actual Cost of a Square of 14″×20″ Tin Roofing

	IC Common	IX Common	IC Old style	IX Old style
62 sheets, 14″×20″	$5.54	$6.37	$6.37	$6.92
7½ lbs solder at 60¢	4.50	4.50	4.50	4.50
Charcoal and rosin	.80	.80	.80	.80
Nails	.20	.20	.20	.20
Labor, 7 hours at $1	7.00	7.00	7.00	7.00
Paint, one side	1.00	1.00	1.00	1.00
Drayage	.25	.25	.25	.25
Actual cost	$19.29	$20.12	$20.12	$20.67
With contractor's profit, 25%	24.11	25.15	25.15	25.84

Standing Seam. Sheets 20″×28″. These standing seams do not require soldering, but more tin is used to make the lap. Deduct

about $1.50 per square from the 20″×28″ list. Quantity, 31 sheets with seams on narrow edge, and 32 on long edge.

Galvanized Iron. The standard quality is No. 26. If there is no specification, 26 is always understood. The lower numbers are heavier: No. 22, for example, is heavier than 26. A 1906 price for hundreds of squares of 26 was $8.60 laid complete.

For One Square of No. 26—1910–1913

Galvanized iron (including waste)	$4.00
Solder	.80
Charcoal and rosin	.15
Nails	.05
Paint on under side, one coat	.40
Drayage	.15
Labor	1.00
Actual cost	$6.55
With profit, 20%	1.30
	$7.85

For One Square of No. 26 Galvanized Iron—1919–1923; Not 1920

Galvanized iron (including waste), 105 sq ft = 95 lbs, 10¢	$9.50
Solder, 3 lbs at 60¢	1.80
Charcoal and rosin	.30
Nails	.10
Paint on under side, one coat	1.00
Drayage	.25
Labor, 4 hours at $1	4.00
Actual cost	$16.95
With profit, 25%	4.25
	$21.20

No. 22 is worth $2 per square more than No. 26.

For corrugated galvanized iron allow about same price, rather less than more.

For black sheets the cost is about $2 per 100 lbs less than for galvanized.

Cost Table Including Profit Work Set in Place—1923

Flashing, gutters, downspouts, are now usually made of galvanized iron instead of tin, but in most cases the following prices will serve for both:

Plain Flashing. For No. 26 galvanized iron 14 in wide, 35¢ per linear foot; 20 in, 50¢; 28 in, 62¢; No. 24 same widths, 38¢; 22 in, 67¢. For counterflashing—9 in and 9 in—50¢. For wide long flashing of No. 26, 25¢ per square foot; for No. 24, 30¢. Around chimneys, etc., two to three times these prices. Copper flashing costs per square foot about 60¢, but copper often changes in price.

No. 22 galvanized iron costs about 13¢; 24, 12¢; 26, which is the kind usually specified, is about 10¢ per square foot. Zinc, which is occasionally used, runs to 13¢ per square foot. Copper, 30. Material only.

Gutters. Allow 3¢ per inch of girth per foot for gutters hung in place. For lined gutters, 20¢ to 25¢ per square foot of material used.

Downspouts. For 2-in, 20¢ per foot; 3-in, 25¢; 4-in, 35¢; 5-in, 45¢; 6-in, 50¢; all corrugated.

Finials. They may be had at $5 or $40, and even beyond. A plain one about 3 or 4 ft high costs $10.

Cresting. From 50¢ to $1 per linear foot.

Low and High. As a general rule, shown in the itemized tables, the prices for low years are just about doubled for the high ones. For the items given—downspouts, etc.—an appraiser cannot go far wrong if he cuts them in half for the low years.

Cornices

A plain cornice 24 in deep on the plumb and 15-in projection, with complete girth of 72 in, including part under slate, cost $2.16 per linear foot set. This is exactly 3¢ per inch of girth of No. 26 galvanized iron for 450 ft.

Price. For a general rule take the girth of a galvanized iron cornice and allow 3¢ per inch per foot long set in place. Thus if the front measured 36 in following the curve of all moldings, and the distance back to the wall was 14 in with an allowance of 3 in each into wall for top and bottom, the price would be $1.68 per linear foot. This includes the straight work only. Add end-trusses, dentils, brackets, and all extra work. There is an endless variety of ornamental work which has to be priced according to detail. The foregoing price includes setting. No. 26 iron is standard. The price of several sizes is here given without setting. The plumb height is taken, not the width of the metal.

Height	Projection	Price per foot	Height	Projection	Price per foot
26	12	$0.80	24	10	$0.60
24	12	.80	24	12	.70
26	12	1.50	28	14	1.60
28	15	.80	.30	15	2.00
36	15	1.70	36	20	1.50
48	24	3.60	32	14	1.20
44	20	3.00	48	24	4.40
40	24	2.70	48	26	3.70
36	24	2.60	45	24	3.00
60	30	6.50	60	26	4.70
84	36	7.00			

These prices include brackets, dentils, etc., but no end trusses. Ends run from $4 to $14. Miters are extra, ranging from $3 to $6; a miter is usually put on same price as 12 in of straight cornice. Pediments are extra and may run from $10 to $20. Ordinary letters are extra at 50¢ each. If the girth system is taken and dentils, etc., added, the price has to be set for each item. A dentil may cost from 50¢ to 70¢; egg and dart molding, 30 to 60¢ per foot. A bracket according to size and detail, from $1 to $2; balusters, 4″×4″×24″, $1.50; medallions, $1.20 per foot. Urns cost from $6 to $25. Crown and belt moldings from 15¢ to 50¢ without setting, but it is possible to make them cost several times as much. In all cornice makers' work detail is of vital importance.

Labor. Setting of cornices, 35¢ to $1 per linear foot, at $1 per hour.

Half. A 1913 cost of the foregoing cornices cuts the prices in half.

Copper, 1923

The cornices of Nos. 3, 5, and 6 are of copper, and the towers are covered with the same material; all the skylights of No. 7 are flashed with it.

Kind of Material. 16-oz soft, 14-oz soft, 16-oz cold-rolled, 14-oz cold-rolled, 20-oz copper on sinks.

Cornices. For copper cornices complete in place allow about $1.20 per square foot of actual material on straight work, and $1.80 to $2.00 on curved. Labor on straight work, about 30¢ per square foot. Take actual surface as if moldings, dentils, etc., were spread out flat.

Gutters. For gutters allow $1 per square foot in place on straight work.

Conductors. For 4″×6″ square, $1 per linear foot in place.

Goosenecks. Price at $10 each.

Conductor Heads. From $10 to $15.

Siding Roofing. Pressed steel brick siding and rock-faced siding $7 per square for material; standing seam roofing and crimp roofing of the same material, $6.75 to $8. The labor runs on an average from 9 to 12 squares for one man and helper in 8 hours.

Heavy Pipes. For heavy iron, about No. 16 to 18, and 4-in to 12-in diameter, allow 25¢ per pound in place. Labor 10¢ per pound on a basis of wages at $1 for tradesman and 60¢ per hour for laborer. Based on a 60,000-lb contract.

Ornamental Shingles. There are so many styles that it is hard to set a standard as to cost or labor. Approximately, $9 per square for material.

Measurement. Some manufacturers send enough to lay a square while others instruct the contractor to allow from 4 to 6 per cent, extra per square.

For 14″×20″ sheets, 68 to square; for 10″×14″ sheets, 148 to square; for 7″×10″ sheets, 319 to square.

Labor. For the small shingles, like the 7×10, give same allowance as for wood shingles, see Index. For large sheets allow 8 to 10 squares for 2 men in 8 hours on plain work, and 6 to 7 on cut-up.

Window and Door Caps. Of ordinary length, $5 to $10; with pediments, $10 to $12.

Copper Eagles. Five-feet spread, $150; 3-ft, $110; zinc eagles, 30 per cent less.

From "Cornices" to "Eagles" cut the prices in half for the low-priced years.

One-quarter-inch Glazed Ordinary Skylights of No. 26 Galvanized Iron Set, 1919–1923

Size of ceiling hole in feet	Gable style	Single slope	Hip or 4-slope
2× 4	$8.00	$7.00	$12.00
2× 6	12.00	11.00	17.00
3× 4	12.00	11.00	17.00
4× 6	22.00	20.00	28.00
5× 8	35.00	30.00	42.00
6× 8	42.00	35.00	52.00
8×10	70.00	60.00	87.00
8×14	100.00	90.00	125.00
10×12	100.00	90.00	125.00
10×16	125.00	100.00	150.00

Some contractors charge as much for single slope as for gable style.

For a copper skylight of average size double pitch roof, $2 per square foot of area of roof curb; for single pitch, $1.75.

Large Skylights

The following figures are based on installations of more than 200,000 sq ft on large shops. The weight, including glass, is about 8 lbs to the square foot. The 1923 setting price, about 20¢, to be cut in half for 1913. The following costs are given with setting included.

No. 1 Style. For steel channels, copper caps, and roofing glass, $1.25 per square foot, 1919–23 rates; 1910–13 basis, 55¢. Glass is unwired. In some building codes skylight glass above elevator shafts must not be of the wire kind, but plain, so that perhaps it may be broken to let the smoke out. There are makers, however, who use wire glass for shop work. Also some who set their high figure at $1.50 per square foot complete, with copper work for caps and flashing.

Saw-tooth roofs with copper, $1.10 per square foot.

For large skylights with galvanized ribs and flashing, and putty joints, 75¢ per square foot, and 35¢ for low-priced years. On 10,000 sq ft, ribs 18-in centers, 2,400 lbs of putty were used. The steel-ribbed skylights have no putty.

Sash operators for the clearstory or monitor sash, 85¢ to 95¢ per linear foot, 1923, and $25 to $30 for each station. Erection extra, 45¢ per linear foot.

Painting has to be allowed extra on the galvanized iron work while copper does not require it.

Wire guards below the skylight cost from 50¢ to 70¢ per square foot in place, running from No. 14 wire to No. 10, the heaviest, 1923. Standard is No. 11, 1½-in mesh, 60¢ Unwired glass may be broken with flying bolts, heavy hail, etc., and injure men.

Ventilators

For 2-in to 3½-in, $1.50; 4½-in to 5½-in, $2.85; 6-in to 7-in, $3.40 to $4; 8-in to 11-in, $4.65 to $6; 12-in and 13-in, $6.75 to $9; 14-in to 16-in, $13 to $20; all Globe, complete, 1923.

Metal Ceilings

(The Berger Company, Canton, Ohio)

Prices. Of seven 1923 models, the price per square ran from $8.10 to $8.55. Four were $8.10; one, $8.25; one, $8.50; and one, $8.55. Special nails, 10¢ per square extra.

This is on the basis of five squares or more f o b at Canton. In the lists there is a difference made of from $1.30 to $2.20 for quantities, a room 20′×60′ costing this much less per square than one 12′×15′, and graduated to sizes between.

Weight. About 65 lbs per square crated for shipment.

Labor. The Berger experience shows that one erector and one helper can put up from 4 to 5 squares of any of the designs given here in a day of nine hours, providing that the space is not broken up by numerous beams and projections. No scaffold or painting included, except shop coat. But 3 to 4 squares is a fair allowance. On large rooms and plain work. 6 to 7.

Furring. Allow extra. See Index.

Plates and Panels. They are usually about 24″×24″, but on cheap grades are also sent 96 in long.

Price per Square

Plates	$8.50
Labor, 4 squares, 1 man, 8 hours @ $1	2.00
Labor, 4 squares, 1 man, 8 hours @ 60¢	1.20
	$11.70

Furring belongs to carpentry. If required, consult Index. Painting 1 coat would add for the 11 yds in a square $2.50; for 2 coats, $4.40. But this is not properly a part of the metal work. Add profit and overhead.

Measurement. The foregoing prices include an average cornice around the wall, so that for this estimate the surf between the walls is close enough. For an order the level part has to be taken, and cornices, coves, beams, corners, centers, etc., attended to by linear feet measurement or separately.

CHAPTER XV

ROOFING

Gravel Roofing. In such years as from 1910 to 1913 a standard price for a good gravel roof was $5 per square, and various kinds ran down to as low as $3.50. The $5 one should be set at a 1923 rate of $8.50 to $9, and the others in proportion downward to $6. Profit is included on a roof of fair size at these figures. The following tables give the 1923 cost without profit. Freight for a long distance changes figures—and also hauling.

Net Cost of a Square of Barrett Composition Roofing on Boards

Red rosin, dry sheet		$ 0.20
1½ rolls of felt		4.50
150 lbs pitch at $35 per ton		2.62
400 lbs gravel at $4.50 per ton		.90
Nails and caps		.18
Labor on basis of 4 squares per man in 8 hours:		
1 foreman, $1.20 per hour	$0.48	2.08
4 men $1 per hour	1.60	
		$10.48

Net Cost of a Square of 4-ply Ordinary Composition Roof on Boards

Red rosin dry sheet	$ .20
3 sheets of felt mopped at joints only, 1 roll	3.00
80 lbs composition at $35 per ton	1.40
Nails and caps	.18
Gravel	.90
Labor on basis of 7 squares per man per day	1.19
	$6.87

NET COST OF A SQUARE OF 5-PLY GOOD COMPOSITION ROOF ON BOARDS

Red rosin dry sheet	$ .20
4 sheets of felt, $1\frac{1}{3}$ roll	4.00
125 lbs composition mopped all over sheets	2.19
Gravel	.90
Nails and caps	.18
Labor on basis of $5\frac{1}{2}$ squares per man per day	1.52
	$8.99

Prepared Roofing. There are scores of different kinds, and prices are hard to set. The best ones are high priced, and many of the other qualities are not worth putting on a roof, for labor costs as much on a cheap brand as on the best.

Carey roofing is an excellent covering. The raw material costs from $5 to $5.75 per 108 sq ft, according to freight, etc. Allow $1\frac{1}{2}$ square per man per hour on plain work.

Ruberoid, 3-ply, costs $3 to $4.25 per 108 sq ft, which is the standard allowance for 100, or 1 square, the extra being allowed for laps and waste. On this allow $1\frac{1}{2}$ square per man per hour. There are also 2-ply and 1-ply ruberoid coverings.

These prices give a fair idea of the good class of patented roofing materials, and $3 per square may be said to be as low as any material should be bought at. This is close enough for a valuation, as no one can tell from an old roof how many plies have been used. A dozen of Barrett prepared roofings run from $2.75 to $4 per square unlaid.

Some roofs are so plain and long that almost twice as many squares can be laid as on an ordinary structure. Allowance can be made for this. All material, such as nails and paste, comes in the 108 square feet at the price set per square.

Slate Roofs, Material: 1923 Prices

The size regulates the price to some extent. The larger slates, as a rule, cost more than the smaller.

Genuine Bangor, No. 1 certificate, price at quarries, from $9 to $11 per square.

Bangor Ribbon, certificated, as the first is also, $8 per square.

Jackson Bangor; Albion Bangor, $7.50 to $9.

Gray Slate, $8 to $9 per square.

Franklin Tunnel, No. 1, $6 for the smaller sizes, and $7.50 to $8.50 for the larger.

Slatington, Big Bend A. Per square, $7 to $8.

Birmingham, Va. Blue black. For the smaller sizes, 7″×12″, 6″×10″, etc., $7.50. Larger sizes, $10 to $11. An unfading slate.

The foregoing figures are high enough to include punching, which costs about 15¢ per square for the large slate, 20¢ for the medium, and 30¢ for the small. Drilling, 45¢ to 90¢ per square.

Full $\frac{3}{16}$ in thick costs 50¢ per square extra, and full $\frac{1}{4}$ in, $2.50.

Webb Bangor. Per square for small sizes, $6; large sizes, $8 to $9. With certificate.

Peach Bottom, No. 1, certificate, $9.50 to $11.50 per square.

Monson, Maine, $\frac{3}{16}$ in, $11; $\frac{1}{4}$ in, $14; $\frac{3}{8}$ in, $20.

Red and Mottled Red. Small sizes, 6″, 7″, 8″×10″, $13; 6″ to 10″×12″, $17; various widths by 14″, 16″, 18″, 20″ long, $20.

Sea Green, No. 1. Small sizes, $5 to $6; large, $6.50 to $7.50.

Unfading Green, No. 1. Per square, $11 to $13. $\frac{3}{16}$ in, $15; $\frac{1}{4}$ in, $19.

TABLE 1

SLATE DATA

Size of slate, inches	Number in each square	Exposed when laid and distance of lath, inches	Nails to square, 3d galvanized, lbs.	ozs.	Size of slate, inches	Number in each square	Exposed when laid and distance of lath, inches	Nails to square, 3d galvanized, lbs.	ozs.
24×14	98	$10\frac{1}{2}$	1	0	16×10	222	$6\frac{1}{2}$	2	3
22×12	127	$9\frac{1}{2}$	1	4	16× 8	277	$6\frac{1}{2}$	2	12
20×12	142	$8\frac{1}{2}$	1	6	14×8	328	$5\frac{1}{2}$	3	3
18×12	160	$7\frac{1}{2}$	1	9	12× 7	457	$4\frac{1}{2}$	4	8
18×10	192	$7\frac{1}{2}$	1	14	12× 6	534	$4\frac{1}{2}$	5	4
18× 9	214	$7\frac{1}{2}$	2	1					

Freight. This depends largely upon distance. For 1,000 to 1,200 miles it might run to $3.50 per square; to some points it might be only $1; to others, $6.

Labor. On plain straight work with gables a fair average is 7 squares per man, and sometimes 8. About 1 square per hour per man. Allow time on the basis of 13 hours of a slater to 8 of a laborer to attend him. On the same proportion the 8 hours means 5 for a laborer. For 8 squares equals 8 hours for tradesman, add 5 hours of laborer to get the cost at the local rate. At $1 and 60¢ for laborer slater gets $8 and laborer $3, or $11 for 8 squares equals $1.38 per square.

On some roofs with hips and valleys a day's work for a slater is 4 squares, or $\frac{1}{2}$ square per hour. On a complicated roof, covered with hips and valleys and dormers, in all 65 squares, 2 slaters laid 3.6 squares per 8 hours, or 144 hours in all, but with 100 laborers'

hours. In this case the proportion is about 7 for tradesman and 5 for laborer. All on No. 11.

Round towers may be set at 1 to ½ squares for 1 man in 8 hours, and half the ordinary time of a laborer.

Hauling. This may have to be considered in an appraisal, and also the unloading. The hauling might be $1 per square, or twice as much in a country location. Allow 1 laborer's hour per square for unloading.

Nails. If of copper, allow 25¢ per pound. See table for quantity. Small slate require more nails than large. In the table it may be seen that 1 lb may be enough for the galvanized nails, and more than 5 for a small slate.

With the quality of slate selected, the freight and hauling allowed, labor added and nails, the total is found. There may be a layer of paper at $1 to $2 per square if waterproofed. Allow profit.

Measurement. The roofer's system is to get the actual area, but to add 1 ft extra for each linear foot of hips and valleys, also what the first course at eaves shows to the weather times length of eaves. No deduction is made for dormers, skylights, chimneys, etc., unless they measure more than 4 ft square, then half is allowed. If more than 8 ft square the whole is deducted. The standard lap is 3 in.

Quick System. For an appraiser, especially, it is a slow and useless process to get the area of a roof in the common way. The following method is quick and safe, as nothing can be missed:

Example. Take a house 30′×30′ over walls, and 34′×34′ clear out to gutter or cornice line and assume half pitch: 34′×34′= 1,156 sq ft: 42%=486 added=1,642 sq ft, or 16½ squares, close enough. This takes in all possible surfaces except dormer cornices, etc., which really give a double roof surface, as the surface below them, on a line looking down, is already included.

If there is a deck it is easily deducted. On a half-pitch roof, for example, 100 sq ft of deck means 142 sq ft less of pitched surface. The percentage should not be allowed on the area of the deck, whatever it is.

Pitch	Percentage to add	Pitch	Percentage to add
One-half.....	42	Three-eighths..	25
One-third.....	20	Five-eighths...	60
One-fourth	12	Three-fourths..	80

This system gives net measurement, while a roofer's rule or the trade system gives the extras already set forth. The price per square must be raised to suit the net system, and the material figures given are high enough to cover the difference.

Blackboards

The standard widths of slate blackboards are 3 ft, 3 ft 6 in, 4 ft, 5 ft. The thickness is $\frac{1}{4}$ in to $\frac{1}{2}$ in. The price runs from 35¢ per square foot on the narrowest to 45¢ on the widest. Add freight, 60¢ per hundredweight. Setting is worth 6¢ per square foot.

Tile Roofs

Interlocking tile may be set at $32 per square laid with profit included. This on a plain roof; small surfaces, $36. Shingle tile, $34 on large surfaces and $37 on cut-up work. Towers and dormers, $60. Green tile run about $6 to $7 per square extra. Glass tile run to $1 each. These figures do not include strips to hold tile. See furring in Index.

Tile Alone. The factory price may be $10 per square and it may be $20, without any extra allowance for green tile. Some kinds of interlocking tile may be had for $12 at the factory; hips, 35¢ per foot; ridging, 80¢ per foot; finials, $5 each for two-way, and 75¢ for each additional hip run.

Labor. For interlocking or Spanish tile allow 1 to $1\frac{1}{4}$ squares per hour for 2 slaters and 1 laborer to attend them. Allow man to man on ordinary long straight work. On a shingle roof, 6 to 8 squares in 8 hours for the same force. On a roof like No. 11, 4 squares for 2 men and 1 to help them. For towers and dormers, 2 squares.

If wiring has to be done to rafters instead of nailing half to five-eighths the allowances already given are enough. Allow nails as for slate.

Quantity. About 440 shingle tile are required to the square at an exposure of $5\frac{1}{4}$ in with tile $12\frac{1}{2}$ in long; at 5 in with 12-in tile, 480. Each tile requires 2 nails, $1\frac{1}{2}$ in, galvanized or copper. With 2 nails and 10 per cent for waste the number is, for 480, 1,056, or less than 3 lbs to the square. No. 20 copper wire is used if wiring is done.

Roofing Papers. All kinds and qualities are on the market. Ordinary paper may run to $1 for 500 sq ft, or $2 for waterproof for the same area. And insulating papers of the red rope kind run from $3 to $5 per 500 square feet.

Some Varieties. The Barrett Tylike individual shingles, red or green, $9 per square; Everlasting, 4-in-1, $8.50.

Flex-a-Tile, $7.50 per square. This is a Standard Asphalt shingle. Asphalt Giant, $9 at Chicago. The 4-in-1, $5 per square.

Flintkote, Boston. Rex, 9″×14″, $7. Same slate surfaced, $9.

Neponset twin shingles, $10; American twin, $7.50.

Johns-Manville Transite Asbestos shingle, 12″×12″, for diagonal work, $15.75 in gray. American method, $20 gray and $28 colored, all per square. The Colorblende, f o b Chicago, is $33 per square. The colors are always more than the grays—red or brown, 12″×12″

diagonal, for example, would be about $22, with gray at $15.75. Add about 27 per cent.

When copper storm nails are used—160 per square—$1 extra is allowed per square. The ordinary allowance is from $1\frac{1}{2}$ to 2 lbs of nails.

Keasbey & Mattison asbestos shingles are about the same price as the Johns-Manville ones.

Truscon. The ordinary composition shingle is the same thickness all over, but the Truscon asbestos is made like the wood shingle, $\frac{1}{8}$ in at top and $\frac{7}{16}$ in at bottom. This would seem to be an improvement. The size is 8″×16″, laid 7 in to the weather, requiring 260 shingles to the square. The weight is 700 lbs to square. The 1923 price per square at Detroit was $31 for the gray and $36.40 for the colors.

Shingles

See Table C, Chapter XI, for labor on shingling, and Table o for material at various prices for any kind of wood or composition. Table in Chap. XVI gives the nails required. This is sufficient for any valuation, if the right value can be placed upon the material. The following labor table is given for large composition shingles, and covers the field with the other.

Composition Shingle Labor Table for 2 Men in 8 Hours

American Style

Description	Size	Number	Squares	Cost per square at	
				$0.50 per hour	$0.70 per hour
Plain roofs	6×12	3,840	8	$1.00	$1.40
" "	8×16	3,120	12	.67	.94
Cut-up roofs.....	6×12	2,700	5.6	1.43	2.00
" "	8×16	2,200	8.4	.96	1.34
Plain sidewalls....	6×12	2,300	4.8	1.67	2.34
" "	8×16	2,000	7.7	1.04	1.46
" "	6×12	1,600	3.4	2.35	3.30
" "	8×16	1,500	5.8	1.38	1.94
French or Diagonal Style					
Plain roofs	12×12	1,920	12	.67	.94
" "	16×16	1,300	15	.54	.75
Cut-up roofs.....	12×12	1,350	8.4	.96	1.34
" "	16×16	900	10.4	.77	1.08

Federal Cement Tile. An immense acreage of this covering has been used on industrial buildings. The tile is $1\frac{1}{8}$ in thick, and 12 of them cover a square. The color is red. The price on the roof complete is $32 per square at Chicago. This does not include any glass tile. Add twice the price of regular wire glass to the ordinary tile. Get a special price on a large quantity.

The Federal channel tile are used for long spans—from 5 ft to 10 ft. Allow $36 complete on roof at Chicago. They weigh about 20 lbs to the square foot.

Gypsum Roofing Tile is another long-span covering. Weight, 14 lbs. On roof complete, $40 per square. The labor on such long-span work is approximately 350 sq ft for 1 layer and $1\frac{1}{2}$ laborers—not that the laborer himself is cut in half here any more than elsewhere in the book on the $\frac{3}{4}$ to $1\frac{1}{2}$ to 1 tradesman, but the time is so arranged.

Canvas roofs cost from $20 to $30 per square, depending upon the quality of the material, all thoroughly painted and finished.

Thatched Roofs. Find the cost of an ordinary roof and multiply this by 3 to 2—preferably 3—for the cost of a Tonawanda.

CHAPTER XVI

HARDWARE

Nail Allowance by the Square

3″×6″ double-nailed to bearing at 4-ft centers allow 13 lbs of 60d spikes. At 4 ft 6 in, 11½ lbs. At 5 ft, 10 lbs.

3″×8′, 4-ft centers, double-nailed, allow 9 lbs of 60d spikes. At 4 ft 6 in, 8 lbs. At 5 ft, 7¼ lbs.

2″×6″ floor, 5¼-in face, allow 5 lbs of 20d spikes with single nailing and joists at 24-in centers. At 30-in centers, 4 lbs. At 36-in, 3½ lbs.

If the 2′×6″ is to be nailed on the back double these quantities which are practically the same for grooved or square-edged material.

2″×8″, 7¼-in face, with joists at 24-in allow 4 lbs. At 30-in centers, 3¼ lbs. At 36-in centers, 2¾ lbs. If nailing on both edges is required double the quantities.

⅞″×5¼″ face with joists at 16-in centers allow 2¼ lbs. If nailed on the back, as ordinary boarding has to be, double quantity. For joists at 12-in centers, 3 lbs. For 20-in centers, 2 lbs. Double quantities for sheeting and shiplap, not more than 8 in wide.

⅞″×3½″ face at 16-in centers for joists, 3 lbs. For 2¼-in face, 4½ lbs, on a 16-in center basis.

For Joists Only. For braces on joists alone and nailing to wall plates, etc., at 16-in centers, allow 2½ lbs; 12-in, 3½ lbs; 20-in, 2 lbs.

Laminated Nail Table for One Square

The choice is given between two kinds of nails. For the 2-in lumber the table is made out for either 16d or 20d; the 3-in, 40d or 50d; the 4-in, 50d or 60d.

Two-in thick lumber, 16-in centers for nails, 26 and 37 lbs; 24-in centers, 18 and 27 lbs; 30-in, 16 and 23 lbs; 36-in, 15 and 21 lbs.

Three-in lumber, 16 in, 40 and 56 lbs; 24 in, 28 and 40 lbs; 30 in, 25 and 35 lbs; 36 in, 22 and 31 lbs.

Four-in lumber, 40 and 50 lbs at 16-in centers; 29 and 36 lbs at 24 in; 26 and 32 at 30 in; 23 and 29 lbs at 36 in.

Nail Allowances

Quantity	Description	Kind	Quantity in Lbs Centers 12″	16″	20″	36″	48″	60″
1000′ bm	3″x6″ Plank, 2 nailings....	60d	...	...	...	51	40	34
1000′ bm	3″x8″ Plank, 2 nailings....	60	...	...	...	39	30	26
1000′ bm	3″x10″ Plank, 2 nailings...	60d	...	...	...	31	24	20
1000′ bm	3″x12″ Plank, 3 nailings...	60d	...	...	...	39	30	26
1000′ bm	2″x6″ Plank, 2 nailings....	20d	...	51	42	27	21	18
1000′ bm	2″x8″ Plank, 2 nailings....	20d	...	39	31	20	16	13
1000′ bm	2″x10″ Plank, 2 nailings...	20d	...	30	25	16	13	11
	(Use same allowance for	flooring)						
1000′ bm	Oak Plank, Bridges, Boat Spikes, allow 100 lbs....	$\frac{3}{8}$″x8″	...	...	...	...	...	...
1000′ bm	Joists on Frame Bldg.....	20d	20	16	14	...	...	...
1000′ bm	Joists on Brick Bldg.....	20d	12	10	8	...	...	...
	For Bracing, add $2\frac{1}{2}$ lbs perM	8d	...	...	...	...	...	...
1000 pcs	Bridging 1″x4″, 35 lbs.....	8d	...	...	...	...	...	...
1000 pcs	Bridging 2″x4″, 50 lbs.....	10d	...	...	...	...	...	...
1000′ bm	Studs, Walls and Partitions	20d	15	12	...	...	...	...
1000′ bm	Studs, Walls and Partitions	10d	5	4	...	...	...	...
1000′ bm	Sheeting or Shiplap, 8″....	8d	26	20	17	...	...	...
1000′ lin.	Furring, 1″x2″, Wall.....	8d	6	6	6	...	...	...
1000′ lin	Furring, 1″x2″. Ceilings....	8d	8	7	6	...	...	...
1000 lf	Furring, 2″x2″, Wall.....	20d	...	...	20	...	...	...
1000 lf	Furring, 2″x2″ Ceilings....	20d	33	25	20	...	...	...
1000′ bm	Siding 6″.....	6d	...	18	...	...	...	...
1000′ bm	Siding 4″.....	6d	...	25	...	...	...	...
1000 pcs	Shingles.....	4d	$4\frac{1}{2}$	(any	cen	ter)	...	...
1000 pcs	Shingles.....	3d	$3\frac{1}{2}$	″	′	′	...	...
1000′ bm	Flooring $\frac{7}{8}$″x6″.....	8d	17	13	11	...	...	...
1000′ bm	Flooring $\frac{7}{8}$″x6″.....	10d	26	20	17	...	...	...
1000′ bm	Flooring $\frac{7}{8}$″x4″.....	8d	26	22	...	...	...	...
1000′ bm	Flooring $\frac{7}{8}$″x4″.....	10d	40	32	...	...	...	...
1000′ bm	Flooring $\frac{7}{8}$″x3″.....	8d	36	26	...	...	...	...
100 sq ft	Thin Oak Flooring.....	.....	$2\frac{1}{2}$	lbs	$1\frac{1}{4}$	finis	hng	brds
1000′ bm	$\frac{3}{4}$″x4″ Ceiling.....	6d	15	11	...	...	...	...
1000′ bm	Finishing.....	8d	...	20	...	...	...	...
100 lf	Base.....	8 & 6d	...	1	...	...	...	...
1	Door, all kinds.....	8 & 6d	...	$\frac{1}{2}$	...	...	...	...
1	Window, all kinds.....	8 & 6d	...	$\frac{3}{8}$	...	...	...	...
100 yds	Metal Lath.....	$\frac{3}{4}$″ sta	ple	s 9	...	...	...	...
100 yds	Wood Lath 48″.....	3d fine	12	to	13	9	to	10
100 yds	Wood Lath 32″.....	3d fine	$10\frac{1}{2}$	to	$11\frac{1}{2}$	...	...	...
100 cy	Concrete Forms.....	20d	30	(of c	on c	rete	in w	all)
100 cy	Concrete Forms.....	10d	5	″	″	″	″	″
100 cy	Concrete Forms.....	8d	3	″	″	″	″	″

Cast Washers

Price: $7\frac{1}{2}$ per pound.

$\frac{1}{2}''$– $\frac{1}{2}$ lb each	$1\frac{1}{2}''$– 6 lbs each
$\frac{5}{8}''$– $\frac{3}{4}$ lb each	$1\frac{3}{4}''$– $9\frac{1}{2}$ lbs each
$\frac{3}{4}''$–$1\frac{1}{4}$ lbs each	2 ″–$17\frac{1}{4}$ lbs each
$\frac{7}{8}''$–$1\frac{1}{2}$ lbs each	$2\frac{1}{4}''$–20 lbs each
1 ″–$2\frac{1}{2}$ lbs each.	$2\frac{1}{2}''$–$27\frac{1}{4}$ lbs each
$1\frac{1}{8}''$–3 lbs each	$2\frac{3}{4}''$–36 lbs each
$1\frac{1}{4}''$–$5\frac{3}{4}$ lbs each	3 ″–46 lbs each

Shop Doors. Hardware for large doors of No. 7, etc., from $65 to $76; for windows, $9.

Sash Weights. The weights of cast iron carried in stock run from 3 to 24 lbs. Price, about $4\frac{1}{2}$¢. Standard weight is round. Square weights are special and cost about 5¢ per pound, and round weights over 22 lbs are same price. If few, allow $5\frac{1}{2}$¢.

Lead weighs about 50 per cent more than iron. Allow 12¢ per pound if lead weights are used.

Sash Cord. There are many kinds, and each manufacturer says his is the best. The usual hank contains 100 ft, and weighs from 2 lbs up to 3 lbs. A $\frac{3}{16}$-in cord weighs $1\frac{1}{2}$ lbs to the 100 ft; and a $\frac{3}{8}$-in, 5 lbs. Average price, $1.30 per pound.

Sash chain costs per foot 12¢ in genuine copper, for weight up to 125 lbs.

Sash chain, copper steeled, 8¢. Steel retinned chain, 9¢. Steel ribbon, 10¢ up to 125 lbs.

Dumbwaiters. Without rope or car, to carry weights up to 100 lbs, $45 to $60. Cars, $28 to $60. This is for a good, strong, ordinary installation, but $300 could be invested in some kinds.

Inside Sliding Door Hangers. An average hanger is worth $9 single door and $10 to $15 double with track and bolts complete; with some hangers a wide opening runs to $18. A Coburn, $4.60 for single door 4–6; $9.20 for 6-ft double door.

Coburn Barn Door Hangers are worth $3.25 without track; track, 25¢ per foot.

A Wilcox, average size, $3 per pair; track, 30¢ per foot; brackets, 40¢ each.

Jamb Guards. For 8 ft long, $3\frac{1}{2}$ in wide, with anchors, $4 each.

Wire Panels. For No. 10″×$1\frac{1}{4}$″ mesh, 40¢ per square foot.

For No. 9, $1\frac{1}{2}$-in mesh	$ .55
For No. 8, 2-in mesh	.55
For No. 12,$1\frac{1}{2}$-in mesh	.50
Heavy wire window guards	1.25

Hinges or Butts

4 ″×4 ″, jap'd, $0.45 per pr; $0.60, bronze finish; $4.00, real bronze
4½″×4½″, jap'd, $0.70 per pr; $0.80, bronze finish; $5.00, real bronze
5 ″×5 ″, jap'd, $1.05 per pr; $1.10, bronze finish; $5.50, real bronze

Double-acting Chicago butts, jap'd, per pair, 1¼-in door, $3.60; 1¾-in to 2-in, $9; bronze-plated, etc., $9 for 1¼-in; $17 for 1¾-in to 2-in; old copper finish, unpolished, $6 and $13; antique finish, sandblast, $9 and $15 for same thicknesses. But a blank is often used with a butt as 1 is strong enough for the door, and this reduces the price. Blanks are about half the price of butts. Real bronze butts of this kind are seldom used.

The Chicago floor hinge is used with spring at bottom and plate at top. For thin doors, $5 for each door; for 2-in doors, $5.50, jap'd; in plated, antique copper, $6.

These hinges must not be confused with screen-door goods which are sold from $2 to $3.50 per dozen pairs.

Large Size. A price on some large common hinges may be of service. Steel, antique brass, sand finish, 7″×10″, extra heavy, ball-bearing, $14 per pair. For 8″×8″ real bronze, $40.

Locks. A Good Rim Lock with knobs and plain, japan trim, 75¢. Inside good door lock fit for any door, $2.50 with real bronze trim complete; a larger size, $3.50. Front door lock, $8; but a good one may be had for half that figure if real bronze is not desired. There are others that cost $10, and without much searching of shelves $40 could be spent on a front door.

Sliding-door Locks. $3 to $6 and upward. Sliding-door latches are a trifle cheaper, just as they are for ordinary doors.

It is not necessary to pay even $2.50 for a mortise lock. With jet knobs and bronze-plated trimmings a lock good enough for cottages may be bought for $1.50.

Unit. The Corbin "Unit" lock is made in one piece, and is merely cut in the edge of the door and the long escutcheons screwed in place. It looks well, but a carpenter might object to weakening the framework of the door. The lock costs $12 to $14. With complete and good-looking trim, $15 to $18.

A Store Door Lock with trimmings complete may be bought for $10 in bronze; but $16 is the least that should be estimated for a good building. From this price we may run as high as we choose. A bronzed lock complete may be bought for $3. Dead locks for stores, without trimmings, $2 each.

Master Keyed Locks, $4 each without trimmings. Trimmings, $2 to $3.

Drawer Locks. A really good article is worth $1; from that they are sold down to 50¢. A good cupboard lock is worth $1.

Escutcheons. Real bronze for key only, $1 to $1.50 per dozen; imitation, 75; jap'd, 35¢. For key and knob, real, 5½ in to 6 in, $4 to $7; in various sizes with imitation finishes, $1.50 to $1.80 per dozen.

Push Plates. 3½″×10″, $15 to $20 per dozen, real; imitation, $10. Persian bronzed, $6. Larger sizes run from 70¢ each in imitation to $4 in bronze metal.

Door Knobs. Mineral, porcelain, and jet knobs, with jap'd mountings, run from $2 to $3 a dozen; wrought bronze metal, $11 to $15; jet knobs with bronze mountings, $5; bronzed wrought-iron knobs, $8. Better qualities of standard bronze metal knobs run to $18 per dozen.

Door Springs and Checks. Blount, $10 to $12, according to thickness of door. Corbin combined, $4 to $11; Eclipse check, $3 to $5; Eclipse springs, $2 to $4. Eclipse spring and check go together.

Transom Lifts. Bronze iron, ¼″×3′ and 4 ft, 50¢ each; 5/16×4″, 70¢; ⅜″×5′, $1.20 each. With copper finish, add from 15¢ to 25¢ each.

Flush Bolts. $1.10 to $1.75 each in imitation; $2.50 to $4 in real. There are smaller and cheaper flush bolts.

Sash Balances. They rise according to weight of sash. For ordinary 20-lb sash, $3.50 to $5 per set for 1 window complete. They run as high as $30 for large sizes.

Rope. Manila, 33¢ per pound; sisal, 30¢. The relative strength of Manila and sisal is 7 to 5. Approximate weight of 1,200 ft—a full coil:

3/16″	¼″	⅜″	½″	⅝″	¾″	⅞″	1″	1¼″	1½″	1¾″	2″
18 lb.	25	45	100	160	200	300	360	570	800	1,200	1,500

Steel Wire Rope. For ⅝ in, $12 per 100 lbs net.

Ash Pit or Flue Doors. For cast iron, jap'd.

8″× 8″	$1.55	10″×14″	$2.05
8″×10″	1.60	12″×15″	2.35
10″×12″	1.85		

Shelf Brackets. Light and heavy.

	Per pair	Dozen pairs		Per pair	Dozen pairs
4″× 5″	$ .15	$1.35	5″× 6″	$ .36	$3.75
5″× 6″	.18	1.68	5″× 7″	.45	4.50
5″× 7″	.21	1.80	6″× 8″	.66	6.30
6″× 8″	.24	2.25	7″× 9″	.69	6.60
7″× 9″	.27	2.70	8″×10″	.75	6.90
8″×10″	.30	3.00	10″×12″	.90	9.00
10″×12″	.42	4.30	12″×14″	1.05	10.00
12″×14″	.69	6.40			

Louden Garage 1923 Door Hanger. It operates on the inside. Price, $9; $9.50 west of the mountain region.

Building Directory. Complete with plain unlettered black cards. All quotations are f o b Chicago.

Space size	Tiers	Spaces each	Width–Height	
50	1		$11\frac{5}{8}'' \times 26\frac{1}{4}''$—Single door....	$15.00
100	2	50	$19\frac{1}{8}'' \times 26\frac{1}{4}''$—Single door....	30.00
150	3	50	$26\frac{3}{4}'' \times 26\frac{1}{4}''$—Single door....	45.00
200	4	50	$38\frac{1}{4}'' \times 26\frac{1}{4}''$—Double door...	60.00
300	6	50	$53\frac{3}{8}'' \times 26\frac{1}{4}''$—Double door...	90.00
75	1		$12\frac{1}{8}'' \times 36\frac{1}{4}''$—Single door....	22.00
150	2	75	$19\frac{3}{4}'' \times 36\frac{1}{4}''$—Single door....	44.00
225	3	75	$27\frac{1}{2}'' \times 36\frac{1}{4}''$—Single door....	66.00
300	4	75	$39\frac{1}{2}'' \times 36\frac{1}{4}''$—Double door...	88.00
450	6	75	$54\frac{7}{8}'' \times 36\frac{1}{4}''$—Double door...	132.00

CHAPTER XVII

PAINTING

TABLE 1—Painting

(On basis of $1 per hour, with profit included. Eight-hour day.)

Description	Cost of material per gallon or pound	Per yard	Per square	Yards per day, 1 man
Priming on wood, lead and oil	$0.12 lead 1.73 oil	$0.25	$2.75	80 plain work
Priming mineral, metal.....	$0.04 lead 1.73 oil	.20	2.20	80 "
Priming red lead, metal.....	.....	.30	3.30	80 "
Priming of ochre.....	.....	.20	2.20	80 "
Second coat, lead and oil, wood	.....	.23	2.53	70 "
Priming rough masonry, lead and oil.....	.....	.35	3.85	70 "
Priming smooth masonry, lead and oil.....	.....	.30	3.30	80 "
Coating shingles, brush.....	.....	.....	4.50	.....
Cold water paint, hand work, 1 coat.....	6¢ lb	.15	1.65	110 "
Cold water paint, finer work, 2 coats.....	.....	.22	2.42	.....
Sizing.....	.....	.15	1.65	180 "
Calcimine in residences.....	.....	.30	3.30	72 "
Calcimine in residences on sand finish.....	.....	.32	3.52	65 "
Lead and oil on plaster, each coat	.....	.25	2.75	90 "
Stippling, extra.....	.....	.08	.....	.....
Enameling plaster walls, 3 coats	.....	.70	7.70	80 "
Paste filler on floors.....	12¢ lb	.15	1.65	100 "
Paste filler on doors, etc.....	.....	.25	2.75	80 "
Waxing floors.....	45¢ lb	.15	1.65	150 "
Shellac, each coat, wood alcohol	$3.40	.30	3.30	80 "
Varnish, each coat.....	4.00	.30	3.30	80 "
Varnish, outside work.....	5.50	.35	3.85	75 "
Rubbing down varnish, pumice stone and oil.....	.....	.25	2.75	80 "
Rubbing down with steel wool..	.....	.17	1.87	100 "
1 coat filler, 1 shellac, 2 varnish, and rubbing down.....	.....	2.00	22.00	.....
Enameling woodwork, 4 coats in all.....	.....	2.00	22.00	.....

Floors, ceiling, and such plain work can naturally be done cheaper than sash, grilles, etc. Rubbing down ornamental work costs three or four times as much as plain work.

TABLE 2

Inside Work for One Man—8 Hours

Paste filling	20 yds fancy work
Paste filling	60 yds plain work
Liquid filling	100 to 125 yds plain work
Liquid filling	40 to 50 yds fancy work
Graining	20 to 30 yds
Varnish, each coat	50 yds plain
Varnish, each coat	30 yds balusters, etc.
Varnish, each coat	80 yds floor
Varnish removing	8 yds on old oak
Weather oak staining	28 yds on old oak
Shellac	100 yds on old oak
Varnish	37 yds on old oak
Rubbing down	32 yds on old oak
Staining sash	30 sash

To use Table 3 divide the last columns of Tables 1 and 2 by 8 to get the number of yards for 1 hour, and take the column of 3 to suit for any rate of wages at which the work was done. The first figure, for example, is 80 yds = 10 for 1 hour. Column 10, Table 3, is to be used.

TABLE 3

COST OF LABOR FOR PAINTING OR VARNISHING PER 100 YARDS

Rate per hour	3	4	5	6	8	10	12	14	16	18	20	22	24
$0.30	$10.00	7.50	6	5.00	3.75	3	2.50	2.13	1.90	1.67	1.50	1.37	1.25
.40	13.34	10.00	8	6.67	5.00	4	3.34	2.86	2.50	2.23	2.00	1.82	1.67
.50	16.67	12.50	10	8.34	6.25	5	4.17	3.57	3.13	2.78	2.50	2.28	2.09
.60	20.00	15.00	12	10.00	7.50	6	5.00	4.29	3.75	3.34	3.00	2.73	2.50
.70	23.34	17.50	14	11.67	8.75	7	5.84	5.00	4.38	3.89	3.50	3.18	2.92
.80	26.67	20.00	16	13.34	10.00	8	6.67	5.72	5.00	4.45	4.00	3.64	3.34
.90	30.00	22.50	18	15.00	11.25	9	7.50	6.43	5.63	5.00	4.50	4.09	3.75
1.00	33.34	25.00	20	16.67	12.50	10	8.34	7.14	6.25	5.56	5.00	4.55	4.17
1.10	36.67	27.50	22	18.34	13.75	11	9.17	7.86	6.88	6.11	5.50	5.00	4.59
1.20	40.00	30.00	24	20.00	15.00	12	10.00	8.57	7.50	6.67	6.00	5.46	5.00
1.30	43.34	32.50	26	21.67	16.25	13	10.84	9.29	8.13	7.22	6.50	5.91	5.42

TABLE 4

PAINT AND VARNISHING ONLY. COST OF MATERIAL PER 100 YARDS AT VARIOUS PRICES PER GALLON

Gals. per 100 yds	$1.50	$2.00	$2.50	$3.00	$3.50	$4	$4.50	$5.00	$5.50	$6.00	$6.50	$7.00
1¼	1.88	2.50	3.13	3.75	4.38	5	5.63	6.25	6.88	7.50	8.13	8.75
2	3.00	4.00	5.00	6.00	7.00	8	9.00	10.00	11.00	12.00	13.00	14.00
2½	3.75	5.00	6.25	7.50	8.75	10	11.25	12.50	13.75	15.00	16.25	17.50
3	4.50	6.00	7.50	9.00	10.50	12	13.50	15.00	16.50	18.00	19.50	21.00
4	6.00	8.00	10.00	12.00	14.00	16	18.00	20.00	22.00	24.00	26.00	28.00
4½	6.75	9.00	11.25	13.50	15.75	18	20.25	22.50	24.75	27.00	29.25	31.50
5	7.50	10.00	12.50	15.00	17.50	20	22.50	25.00	27.50	30.00	32.50	35.00
7	10.50	14.00	17.50	21.00	24.50	28	31.50	35.00	38.50	42.00	45.50	49.00
9	13.50	18.00	22.50	27.00								
15	22.50	30.00	37.50	45.00								
18	27.00	36.00	45.00	54.00								

Labor Remarks

Averages only can be given in a table, and allowances made for exceptions. At plaster, Table 1, for example, 90 yds are allowed for 8 hours, but contractors on plain work sometimes expect 150 per day, or nearly 19 yds per hour instead of 11. The figures on cold-water paint were taken from 33,500 yds, but while 110 is listed in Table 1 per coat at about 14 yds per hour, 50 per cent more might be done, and much more with spray work. Indeed, the Barreled Sunlight Company sends me a figure of 4,000 to 6,000 sq ft a day with the priming coat, and the finishing coat 20 to 30 per cent more. The highest yardage given in the table is 24 per hour, or 192 in 8 hours; but even on the basis of 10 hours' work 5,000 sq ft equals 556 sq yds equals 55 yds per hour, and about 70 yds per hour on the finish coat. It has been found, however, that for hand-mixing as much time is taken at that as in putting on the work. Mixing with compressed air and spraying with the same goes faster, but 55 yds per hour per man is reasonably fast.

Mineral paint might run from 8 per hour to 20 yds; lead and oil, plain work, 10 yds per hour; floors, 17; angle work, porch corners, dormers, 4 to 5 yds. So all through tables for outside and inside work.

MATERIAL

TABLE 5

PAINT QUANTITY TABLE FOR 100 ACTUAL YARDS

Kind of work	Pounds	Gallons
Lead and oil priming (own mixing)	40	$2\frac{1}{2}$
Lead and oil priming, and 1 coat (own mixing)	56 to 80	$3\frac{1}{2}$ to 5
Lead and oil priming average 1 coat (own mixing)	72	$4\frac{1}{2}$
Lead and oil priming, and 2 coats (own mixing)	100	$6\frac{1}{4}$
Allow 7% to 10% more for common brick work.		
Size on plaster	1 glue	1
Lead and oil on plaster, 2 coats	56	$3\frac{1}{2}$
Enamel on plaster, 1 coat	...	$3\frac{1}{2}$
Mineral on rough wood, 1 coat	21	2
Mineral on smooth wood, 1 coat	15.7	$1\frac{1}{2}$
Mineral on tin, 1 coat	13	$1\frac{1}{4}$
(For compressed air quantities, see Index.)		
Graphite	...	$1\frac{1}{2}$ to $2\frac{1}{2}$

TABLE 6

INSIDE WORK FOR 100 ACTUAL YARDS

Kind of work	Pounds	Gallons
Liquid filler	...	2
Paste filler (reduced for last column)	20 to 25	3
Water stain, open wood	...	$1\frac{1}{2}$
Water stain, close hardwood	...	$1\frac{1}{5}$
Water stain, soft wood	...	$2\frac{1}{4}$
Spirit stain, as above	...	3
Spirit stain, as above	...	$2\frac{2}{5}$
Spirit stain, as above	...	$4\frac{1}{2}$
Oil stain, all woods	...	$1\frac{1}{2}$
Varnish, etc., 1 coat	...	2 to $2\frac{1}{2}$
Varnish, etc., 2 coats	...	4
Varnish, etc., 3 coats	...	$5\frac{1}{2}$
Shellac, 1 coat	...	$1\frac{1}{4}$ to $1\frac{1}{2}$
Wax	7	...
Graining (color in oil)	4	...
Calsomine	...	6
Varnish remover	...	6

Paint on Steel Work. First coat, 1 gal to 500 to 700 ft; second coat, 650 to 800 ft; third, 700 to 850. Thus 1 shop coat and 1 field

coat takes about a gallon to 300 to 400 sq ft; and 3-coat work a gallon to 215 to 245 sq ft.

The Boston manufacturers of the Bay State brick and cement coating reverse the ordinary method of the makers of area brands and give the maximum limit:

"The following table shows requirements for first coat under differing conditions for good work:

Bay State Brick and Cement Coating:

"On brick, hard finish, 1 gal not to cover more than 20 sq yds.

"On brick, rough and porous, 1 gal not to cover more than 17 sq yds.

"On concrete, hard finish, 1 gal not to cover more than 20 sq yds.

"On concrete, rough and porous, 1 gal not to cover more than 17 sq yds.

"On plaster, exterior rough, 1 gal not to cover more than 17 sq. yds.

"On plaster, interior, hard finish (over first coater), 1 gal not to cover more than 40 sq yds.

"Bay State First Coater: On plaster, hard finish, 1 gal not to cover more than 50 sq yds.

"Bay State Enamel No. 2. Over under coat of Bay State brick and cement coating, 1 gal not to cover more than 50 sq yds."

There are so many preparations for masonry waterproofing that no standard price can be given, and even if an appraiser sees that a wall has been treated, it is almost impossible to tell what brand has been used. In a list at hand the prices run from $1.25 per gallon to $3. Some kinds cover only 50 sq ft per gallon, others, 200, and up to 600. For the thicker waterproofing an approximate figure would be $1.50 per gallon for material, covering, say, 10 yds, or 15¢ per yard; labor, 60¢ per hour, 5 yds per hour equals 12¢ per yard, a total of 27¢ per yard.

For the thin, far-spreading finishes, such as go on concrete floors, $2 per gallon covering about 25 yds, equals 8¢ for material; and labor at $1 for regular painters, 100 yds in 8 hours, or 12½ per hour, equals 8¢, at total of 16¢ per yard without profit.

Shingles. For well-dipped shingles allow 2¾ gals per 1,000. The stain may cost $1 per gallon or more. Allow 1,000 per hour for a laborer. If the bunches are slightly loosened and put in a trough with stain running through them 15,000 to 20,000 may be done in a day by a man. Here, as elsewhere, good work takes time. The Creo-Dipt shingles are expensive because of the labor put on them.

The Truscon Company makes a full line of waterproofing compounds.

Cold-water Paint. On 33,500 yds 15,500 lbs were used, or about ½ lb per yard, which is twice what some manufacturers allow. The

roughness of the surface naturally takes more material than when boards or walls are smooth. In estimating this kind of work the sides of the joists should always be included, as where they are close they often have about as much area as the ceiling itself. In low-priced years the cold-water material ran to 5¢ per pound in large quantities, and twice as much in war times. Get local price.

Finally, some fine work, such as that in banking rooms, comes outside of the regular standards, and often costs twice as much. In a low-priced period the finest kind of work was done on a large residence, hardwood finish all rubbed down, for $1.25 per yard, and this was looked upon, with wages about 35¢, as "the limit." In war time the cost would have been doubled—and $2.50 in the first case to $5 in the second might have been put upon semi-public buildings and some residences. I have at hand a description of doors covered with gold leaf.

CHAPTER XVIII

PLUMBING

Labor. For sewers allow 18 in wide, and in average ground 5 cu yds for 1 laborer in 8 hours if depth is not more than 5 ft; in soft ground to 6 ft, 6 cu yds; to a depth of from 6 to 10, 4 cu yds after 6 ft is reached; from 10 ft down to 14 ft allow 2 cu yds. Boring often cuts time.

Laying of 6-in and 8-in pipe, 6 ft per hour for 1 laborer. Water-pipe digging is about the same as for sewer, but as the lengths are 12 ft there is more chance for boring.

From thousands of feet of 6-in to 10-in water pipe the labor time gave 6 in to 9 in per man per hour for excavation, laying, and backfilling. In some cases laborers alone do the work without a plumber. Metalium is the modern joint filler.

Gas pipes should be allowed in winter at 20 ft per laborer per 8 hours with excavation 3 ft 6 in deep; and 35 ft in summer, complete. This for fair ground and cement joints.

Allow complete for gas-supply pipes 8¢ in low-priced time to 16¢ on a war basis. This from main to house, and such work. Allow paving repairs if required. On 300 ft of this work a laborer made 8 ft per hour, and a plumber took 3 hours to make connections. Inside the building a plumber may string 100 ft in 8 hours.

For soil pipe inside of a building a plumber and helper will handle from 50 ft to 100 ft in 8 hours.

Vent pipes are placed at about 75 ft of 2 in per 8 hours for a plumber; 45 ft of 4 in; 40 ft of 6 in.

Heavy bathtubs 4 to 5 hours for plumber and helper to install, all supply and other pipes being already in place; water closet, 4 hours should be enough, and this also for an ordinary bathtub. An average allowance for small fixtures is 4 hours for a plumber, and sometimes with all things favorable and fixtures on floor ready to set, from 2 to 3 hours. A laborer's time is usually required to carry material to place, or a plumber's helper.

Roughing In for Cottages

A large manufacturer says: "We estimate the time of one man and helper to rough in new work under average conditions, including all from the basement floor up with necessary venting as follows:

TABLE GIVEN IN HOURS FOR TWO MEN

	Bungalow		Two story	
	Hot and cold	Cold only	Hot and cold	Cold only
Bathroom tub, lavatory, closet.....	35	28	40	32
Kitchen, one sink.....	10	9	10	9
Laundry in basement or, two trays, slop sink.....	15	12	15	12
Boiler in basement or first floor, connected to furnace or range.....	15	.....	15	.....
	75	49	80	53

This is on the basis of sewer and supply mains all in place, and thus is for work inside the building lines only.

Slate. The setting of this material may be allowed at 8 to 10 sq ft per hour for a plumber and helper on ordinary partitions, and such work.

Material Only

As a rule, the prices in 1923 as given here are twice as high as during the U. S. base period of 1913, and the years before and after that date, as shown in charts. Use local discounts.

CAST IRON SOIL PIPE

Five-foot lengths, single hub. Discount 20%

Size in inches	2	3	4	5	6	8	10	12
Price, standard, per length...	$1.30	$1.75	$2.30	$2.90	$3.50	$7.00	$12.00	$15.00
Price, extra heavy.....	2.00	3.10	4.20	5.50	6.50	11.00	18.00	22.00

Extra heavy is almost always used, so that the calking can be done without bursting the pipe.

Both single and double hub pipe come in 5-ft lengths. On average work allow 30 per cent of straight pipe for all fittings; water pipe, from 38 to 40 per cent; vent, 45.

Five-foot lengths, double hub. Discount 20 per cent

Price, standard,	$1.40	$1.85	$2.40	$3.10	$3.70	$8.00	$13.00	$16.00
Price, extra	2.10	3.25	4.40	5.70	6.80	12.00	19.00	23.00

Cellar Drainers. Supply, ½ in, waste, 1 in equals $14; 1¼ in and 2 in, $22; 2 in and 3 in, $36.

Iron Cellar and Stable Drains. $1.50 to $2.

Gas Heaters. Ordinary, single coil, $14 to $18; dbl., $16 to $22.

Ruud Heaters. 5-room cottage, $150; 7-r., 2-story house, $200.

New Premier, Crane. 23 gal., $130; 31, $165; 48, $255.

Water Closets. For an ordinary closet allow $40 with wood tank, and $10 extra for china tank. The Si-wel-clo, $60, $75, and up. Before the war, prices ran to about $42 and $55.

Range Closets. For an average in an industrial plant, $30 each with all pipes and fittings.

Range Lavatories. Allow $60 each with complete fittings; for a plain installation, $40.

Wall Lavatories. From $20 to $50. Pedestals, $60 up.

One-piece Kitchen Sink. From $90 to $100.

Sinks. From $3 to $6. These are of the cheapest variety.

Bath Tub. From $45 for the common kind to any reasonable figure for the porcelains. Solid porcelains run from $110 to $180 complete with fittings, but "accessories" may raise the limit. Showers may be had for $10, and also for several hundreds of dollars. A good shower may be set at $75. A "Standard" shower over a bath, $46.

Laundry Trays or Tubs. From $30 per section to twice as much.

The difference between ordinary enameled goods and solid porcelain should be kept in mind. A kitchen sink in porcelain with legs might be as high as $100 to $180 for a small size.

Medicine Cabinets. With mirrors, $30.

Range Boilers. For 24 gal, $25; for 52, $40; for 82, $55; for 144, $100.

Urinals. From $8 to $15 each for the ordinary kind. If slate ones are used take the slate by the square foot. Porcelain, $75 to $100 each division.

Doors. For water closets, allow $9 per pair finished by painter, and $4 extra for each pair of hinges.

Partition Fittings. To support slate from floor, $2 each. Rail on top, $1 per foot. Angles and bolts, $1 each, and less for a quantity.

Labor. Add to all material as on pages 535, 536.

Slate Slab Price List

No discount on Ribbon; for Clear add 10 per cent to list
Covering all classes regular slab work

Ribbon and Clear Black Stock

Group No.	Area in Sq Ft	Price in cents per square foot				
		1 in	1¼ in	1½ in	1¾ in	2 in
1	1 to 5 ft inclusive....	24	28	32	38	44
2	5 to 10 ft inclusive....	30	34	40	44	50
3	10 to 16 ft inclusive....	36	40	46	52	60
4	16 to 22 ft inclusive....	44	48	52	60	68
5	22 to 28 ft inclusive....	52	56	62	70	76
6	28 to 35 ft inclusive....	62	66	72	80	86
7	35 to 40 ft inclusive....	77	81	87	95	101
8	40 to 45 ft inclusive....	90	100	110	120	130

Vitrified Salt Glazed Sewer Pipe

Western List

Inside diameter, inches	Straight pipe per foot	Curves and elbows, each	T and Y junctions, each, if 2 ft long	Traps, each	Double junctions and breeches if 2 ft long	Increasers, decreasers and slants
3	$0.15	$0.50	$0.60	$1.70	$0.90	$0.45
4	.20	.60	.80	2.10	1.20	.60
5	.25	.75	1.00	2.50	1.50	.75
6	.30	1.00	1.20	2.90	1.80	.90
7	.35	1.25	1.40	3.50	2.10	1.05
8	.45	1.65	1.80	4.50	2.70	1.35
9	.50	1.75	2.00	5.00	3.00	1.50
10	.60	2.10	2.40	6.00	3.60	1.80
12	.75	2.75	3.00	8.50	4.50	2.25
15	1.00	3.75	4.00	.....	6.00	3.00
18	1.50	4.75	6.00	.....	9.00	4.50
20	1.75	5.75	7.00	.....	10.50	5.25
21	2.00	6.75	8.00	.....	12.00	6.00
24	2.50	8.00	10.00	.....	15.00	7.50
27	3.25	10.00	13.00	.....	.....	9.75
30	4.00	12.50	16.00	.....	.....	12.00
33	5.00	16.00	20.00			
36	6.00	20.00	24.00			

A Table with Net Price per 100 Feet of Full Weight Standard Pipe (1922), Crane)

Size, inches	Black	Galvanized	Lb. wt. per foot	Size, inches	Black	Galvanized	Lb. wt. per foot
$\frac{1}{8}$	$3.62	$5.16	0.245	$3\frac{1}{2}$	$ 57.78	$ 70.66	9.202
$\frac{1}{4}$	3.95	5.63	.425	4	68.45	83.71	10.889
$\frac{3}{8}$	3.95	5.63	.568	$4\frac{1}{2}$	79.76	97.54	12.642
$\frac{1}{2}$	5.25	6.61	.852	5	92.94	113.66	14.610
$\frac{3}{4}$	6.76	8.49	1.134	6	120.60	147.46	19.185
1	10.00	12.55	1.684	7	161.36	.....	23.769
$1\frac{1}{4}$	13.52	16.97	2.281	8	169.50	.....	25.000
$1\frac{1}{2}$	16.17	20.30	2.731	9	233.91	.....	34.188
2	21.76	27.31	3.678	10	237.30	.....	35.000
$2\frac{1}{2}$	34.40	43.17	5.819	12	305.10	.....	45.000
3	44.98	56.46	7.616				

Pipe Reamed and Drifted

Sizes, inches	Galvanized	Pound, weight per foot
2	$28.05	3.678
$2\frac{1}{2}$	44.34	5.819
3	57.99	7.616

Extra strong carried in sizes from $\frac{1}{8}$ in to 8 in inclusive. Double extra strong from $\frac{3}{4}$ in to 4 in. All prices are for random lengths.

Wrought Iron Pipe for Steam, Gas and Water

Inside diam.	Standard		Extra strong		Inside diam.	Standard		Extra strong	
	Wt per ft in lbs	Rate	Wt per ft in lbs	Rate		Wt per ft in lbs	Rate	Wt per ft in lbs	Rate
$\frac{1}{8}$	0.24	3.0	0.29	7	$1\frac{1}{2}$	2.68	11.0	3.63	15
$\frac{1}{4}$	.42	3.0	.54	7	2	3.61	14.5	5.02	20
$\frac{3}{8}$	.56	3.0	0.74	7	$2\frac{1}{2}$	5.74	23.0	7.67	33
$\frac{1}{2}$	.84	4.0	1.09	7	3	7.54	30.0	10.25	42
$\frac{3}{4}$	1.12	4.7	1.39	7	4	10.66	44.0	14.97	60
1	1.67	6.6	2.17	9	6	18.76	76.0	28.58	1.20
$1\frac{1}{4}$	2.24	9.0	3.00	12					

The prices are given in the Crane table for standard; for extra strong increase in proportion as shown under "Rate" this table.

CHAPTER XIX

HEATING IN 1923

Approximate only. For ordinary buildings divide the net cubic feet by 45 and multiply the square feet of radiation thus obtained by $2 to $2.25 for the cost with boiler. "Net" takes out walls, floors, partitions, and thus includes only space to be heated. On a line of apartment houses the net ran to 55 and 65 per cent of the gross.

Plain buildings are sometimes heated for as low as 3¢ to 5¢ per cubic foot without boiler.

The $2 basis is for ordinary steam heat; hot water runs to at least 50 per cent more. With steam, allow 35 per cent of the cost of straight pipe for fittings; with hot water, 40 per cent.

The following table shows, however, that 45 cu ft does not suit all classes of buildings. There is a great difference between frame residences, many of them built in a careless way, and factories.

Steam Heating—Direct Radiation

Frame residences, down stairs	1 sq ft to	50 cu ft air
Frame residences, up stairs	1 sq ft to	60 cu ft air
Brick residences, down stairs	1 sq ft to	60 cu ft air
Brick residences, up stairs	1 sq ft to	70 cu ft air
Office buildings	1 sq ft to	60 cu ft air
Factories	1 sq ft to	125 cu ft air
Churches and Assembly Halls	1 sq ft to	200 cu ft air

Indirect Radiation, 50 per cent more surface.

Direct-Indirect Radiation, 25 per cent more surface.

Hot Water Heating—Direct Radiation

Frame residences, down stairs	1 sq ft to	25 to 30 cu ft air
Frame residences, up stairs	1 sq ft to	30 to 40 cu ft air
Brick residences, down stairs	1 sq ft to	28 to 35 cu ft air
Brick residences, up stairs	1 sq ft to	40 to 45 cu ft air
Office buildings	1 sq ft to	40 cu ft air
Factories	1 sq ft to	70 cu ft air
Churches and Assembly Halls	1 sq ft to	100 cu ft air

Indirect Radiation, 50 per cent more surface.

Direct-Indirect Radiation, 25 per cent more surface.

Cottage-heating by Steam. The American Radiator Company gave the following prices for material only complete in 1922: 3-room, $182; 4-room, $254; 5-room, $300; 6-room, $358.

Radiators. There are about 37,000 different sizes and styles of these. The American Radiator Company "Ideal Fitter" is required by those who want details. As an approximate figure only, allow 30¢ per square foot of heating surface for ordinary types, to 42¢ and 50¢ for low styles to go below windowsills, etc., and for special makes in 1923.

Radiators, Weight. About 7 lbs per square foot; on a 60¢ per hour basis for laborers allow $10 per ton for hoisting in a building of three to 4 stories. The measurement is based on the heating surface.

Radiator Valves. From $1.50 for ½ in to $3 for 1¼ in.

Expansion Joints. These are of many kinds and prices. From $2 at 1 in to $14 at 3 in for a brass joint up to 125 lbs pressure; with short traverse of 2 in to 3 in. For a 2-in with 6-in traverse, $7; 12-in traverse, $10; 18-in, $15. For 6-in and 5-in diameter, $27; 12-in and 5-in, $42. For a flanged 5-in with 8-in traverse, $60.

Boilers. For the American Radiator Company's Ideal boilers allow approximate figures as follows: rating of 385, steam, 33¢ per unit equals list price of $127.50; 610 rating, 26¢ equals list of $161; 1,375 rating, 23¢; 410, 35¢; 650, 28¢; 1,465, 25¢; 1,615, 27¢.

These figures are for steam, and different makes. The range runs 38¢ for the smaller sizes to 23¢ for the larger. But the August, 1922, discount was 33 per cent. The net price for the 1,615 was thus 18¢.

The rating as listed is large enough to take care of 60 per cent more radiation in square feet. The 1,615, for example, would heat 2,584 sq ft of radiation as shown in radiators, pipes, and all heating surface.

The hot-water boilers are cheaper than for steam. The expense with this system comes with the piping and the extra large radiators.

The rating of the small boilers times 20¢ equals list price, and 15¢ for the larger sizes. These figures are an average, and to be discounted a third. The rating will take care of 60 per cent more radiation in square feet than the figure given, that is, 1,000 sq ft of rating will heat 1,600. The radiation being known for both steam and hot water a fair approximate figure of the boiler, delivered, but not installed, may be had.

Some of the heavier tubular boilers are listed at 60¢ per unit of rating, to be discounted 40 per cent equals net 36¢ for steam; water, 24¢ to 18¢, undiscounted. Add the 60 per cent for square feet of radiation.

Hot Blast. For large shops allow from 2¢ to 2½¢ per cubic foot of space heated. Each installation is a "special," and the manufacturers generally refuse to be quoted on any standard price.

Table No. 1

Price Lists

85% Carbonate of Magnesia Pipe-Covering for Wrought Iron Pipes

Nominal Pipe Size	Thickness of Standard Covering	Price per Lineal Foot Canvas Jacketed	Thickness of Covering	Price per Lineal Foot Canvas Jacketed	Thickness of Covering	Price per Lineal Foot Canvas Jacketed	Double Layer Double Standard Thickness	Price per Lineal Foot Canvas Jacketed	Double Layer Total Thickness 3 Inches	Price per Lineal Foot Canvas Jacketed
Inches	Inches		Inches		Inches		Inches		Inches	
½	⅞	$0.22	1½	$0.46	2	$0.75	1¾	$0.65	3	$1.20
¾	⅞	.24	1½	.49	2	.80	1¾	.70	3	1.35
1	⅞	.27	1½	.52	2	.85	1¾	.75	3	1.40
1¼	⅞	.30	1½	.56	2	.90	1¾	.80	3	1.45
1½	⅞	.33	1½	.60	2	.95	1¾	.85	3	1.55
2	1 1/32	.36	1½	.64	2	1.00	2 1/16	.90	3	1.65
2½	1 1/32	.40	1½	.70	2	1.05	2 1/16	1.00	3	1.75
3	1 1/32	.45	1½	.76	2	1.15	2 1/16	1.10	3	1.90
3½	1 1/32	.50	1½	.82	2	1.25	2 1/16	1.20	3	2.05
4	1⅛	.60	1½	.88	2	1.35	2¼	1.40	3	2.20
4½	1⅛	.65	1½	.94	2	1.45	2¼	1.50	3	2.35
5	1⅛	.70	1½	1.00	2	1.55	2¼	1.60	3	2.50
6	1⅛	.80	1½	1.10	2	1.70	2¼	1.80	3	2.70
7	1¼	1.00	1½	1.20	2	1.85	2½	2.25	3	2.90
8	1¼	1.10	1½	1.35	2	2.00	2½	2.50	3	3.15
9	1¼	1.20	1½	1.50	2	2.20	2½	2.70	3	3.40
10	1¼	1.30	1½	1.65	2	2.40	2½	2.90	3	3.65
*12	1½	1.85	1½	1.85	2	2.70	3	4.10	3	4.10
14	1½	2.10	1½	2.10	2	3.00	3	4.60	3	4.60
16	1½	2.35	1½	2.35	2	3.30	3	5.10	3	5.10
18	1½	2.60	1½	2.60	2	3.60	3	5.60	3	5.60
20	1½	2.85	1½	2.85	2	4.00	3	6.00	3	6.00
24	1½	3.30	1½	3.30	2	4.50	3	7.00	3	7.00
30	1½	4.00	1½	4.00	2	5.50	3	8.40	3	8.40

*All coverings larger than 10″ furnished in segment form; jackets and bands not included.

Double standard thickness—the inner layer is furnished in sections for pipe sizes up to and including 10″, and in curved blocks for larger sizes. The outer layer is furnished in sections for pipe sizes up to and including 8″, and in curved blocks for larger sizes.

See Index for Sturtevant Table 17 with weight of large pipes.

Furnaces. Allow from $30 to $40 per room complete; one-pipe style, $25. On a basis of $1 per hour an average house of 7 rooms takes $70 for labor.

Hot Water. This system takes about $90 per room in a house of ordinary size, and some reach beyond that.

Asbestos Cement. For boiler covering allow on the basis of 6 lbs to the square foot at 1¼ in thick; price, 2¢ net per pound for the material.

Labor. For laying 3-in or 4-in pipe in a box several hundred feet long without a turn, allow from 5 ft to 6 ft per man per hour including the digging of a shallow trench. The lengths are merely to be screwed together. No. 2 has about 300 ft of 6 in hung to girders in a tunnel; allow about 5 ft per hour per man and helper. When such lengths are used an expansion joint is necessary.

For inside of a building allow for risers, etc., from 8 ft to 10 ft per hour for man and helper. The lengths are short and require extra labor. A radiator should be connected in 3 hours for steam, which is usually connected at only one end; for hot water 4½ hours, man and helper ought to be sufficient.

As with all kinds of work short material and angles take most labor. The estimator must make allowance for the character of the job. Approximately allow 25 per cent of price of material for labor. Wages are $1 per hour for fitters, and 60¢ for helpers.

From 5 ft to 6 ft per hour per man ought to cover digging and laying of box for pipe, or for Wyckoff covering, as trench does not require to be deep. Allow for pipe. Pipe covering ought to be put on at 10 ft per hour for two men, for small pipe, to 6 ft for the largest sizes; but everything depends upon the number of angles.

CHAPTER XX

ELECTRIC WORK

General. For brickwork, stonework, carpentry, and the main features of a building, standard rules can be laid down, subject to variations as may be required. Electric work is of a more special nature, and is left for experts to deal with. Two buildings of similar size and design may differ greatly in their electrical equipment.

Some figures for this work may be found in Chapter II, Part Two, and a few are given here; but it is not expected that the ordinary appraiser will deal with this branch. In the railroad valuation work special men are hired by the Interstate Commerce Commission.

Manholes. For 5′×5′×7′ in clear, $250 to $300; 7′×7′×7′, $450 to $500; 7′×10′×7′, $700 to $800. These prices were based on actual 1919 records, and for several of each size. Replacement of paving is included.

For a manhole with 1 to 3 ducts, 5′×3′ 6″×4′ in clear, $168; for 4 to 8 ducts, 5′×3′ 6″×5′, $186; 9 to 12 ducts, 6′×4′×6′, $240; 13 to 24 ducts, 7′×5′×6′, $300. These figures apply to 1923 conditions, replacing paving not included. With a concrete base this may be set at $3 to $4 per square yard.

Engine Houses. On a 1923 basis allow for light wiring 30 hours labor for an electrician and the same for his helper. Total cost per stall, $130; per outlet, $28.

Machine Shops. Allow on a 1923 basis 11¢ per square foot of ground area for light and power on average sizes from 18,000 to 24,000 sq ft. For a shop of 85,000 sq ft, and heavier cranes, machines, etc., 15¢.

In both engine houses and machine shops wages were 75¢ per hour for railroad electricians and 50¢ for helpers.

Motor Wiring. For machines, mains being already put in, allow for wiring material and labor $126 for 1 to 5 h p; for 7½ to 10 h p, $20 per horsepower; for 15 to 30, $18; for 35 to 50, $10 per horsepower. Labor, 50 per cent, and material, 50. Motor not included, but the setting put in with the wiring.

Passenger Station. For an average station 100 ft to 125 ft long, with plain fixtures, allow $250 to $300.

Freight Depots. For 100 ft long, plain fixtures or drops, $175 to $200.

Wiring per Outlet. Exposed, $4 to $5; with wood mold, $5 to $5.50; concealed knob and tube work, $5.50 to $6; add $2 for each switch; for iron conduit in new building, $8 to $9; same in a concrete building, $9 to $10.

For a house of 7 to 8 rooms allow $75 for knob and tube and $100 for conduit wiring, without fixtures. For each duplex switch add $8. For factory lights with ordinary drops allow $4 each.

Relative Costs. Rigid conduit set at 100; flexible, 80; fireproof wood mold, 80; armored cable, 70; hardwood mold, 65; soft wood mold, 50; flexible tubing, 40; clay work, 40; knob and tube, 35.

CHAPTER XXI

INTERIOR TILING, 1923

The general contractor usually prepares the base for tile, leavin only the necessary thickness for mortar and finish, floor or wall The figures that follow are based upon this system, unless otherwise stated. In bathrooms the tiler lays the base.

Hearths. Allow from $2 to $2.50 per square foot for the average style complete with border.

Floors. Marble tile, 10″×10″, $1 per square foot. Tennessee marble, 6″×6″, with concrete base, $1.10.

Cement tile and 2 in of concrete base, 10″×10″, 60¢ per square foot.

Hexagon, white, vitreous, 3 in and concrete base, $1 to $1.10.

Hex., buff, unglazed, and concrete base, 90¢ per square foot.

Terrazzo floors from 45¢ to 55¢ per square foot.

Glazed tile are worth from 40 to 60 per cent more than unglazed.

Glazed wall tile, 3″×6″, $1 to $1.20 per square foot.

Ceramic mosaic floor tile, $1.25 to $1.50 per square foot.

Letters or numbers, 20¢ each extra.

Mantel facings might run from $5 to $100.

Marble base, $1 to $2 set in place.

Brass foot rail, $3 per foot.

Bathroom base and cove, $1.20 per square foot.

Rubber tile from $1.60 to $2.50 per square foot in place.

Rubber step nosings, $1.50 per linear foot.

Domes, from $2 to $2.75 per square foot.

Flat arches lined underneath, $1.90 to $2.25 per square foot.

Caps for wainscoting, 55¢ per linear foot; base, $1.

Green tile costs about 20 per cent more than white.

Welsh quarry tile, $1 per square foot laid; domestic, 75¢.

Linoleum, $1.80 per square yard.

Marble, Tennessee, on walls, complete, $1.30 per square foot.

Marble, Tennessee, on floors, complete, 90¢ per square foot.

Marble, Italian, on walls, complete, $2.10.

Setting of interior marble, 1923, as all foregoing figures are, came to 22¢ for floors, 24¢ for treads and platforms, 24¢ for plain wainscot, all per square foot. Base, 6 in to 12 in, 30¢ per linear foot. Net costs without profit.

CHAPTER XXII

ORNAMENTAL IRON WORK

A description is of no use in estimating this class of work. The eye has to be appealed to, and so the illustrations are given. If an *approximate* idea is placed before a valuator he can arrive at a fair estimate of even work that varies considerably in design from the cut presented. A square or lineal foot price is thus of great value in making up preliminary estimates or valuations.

Prices based on 1913 = 100: See U. S. Table A for metals for other years: but Tyler cuts are for 1923 prices.

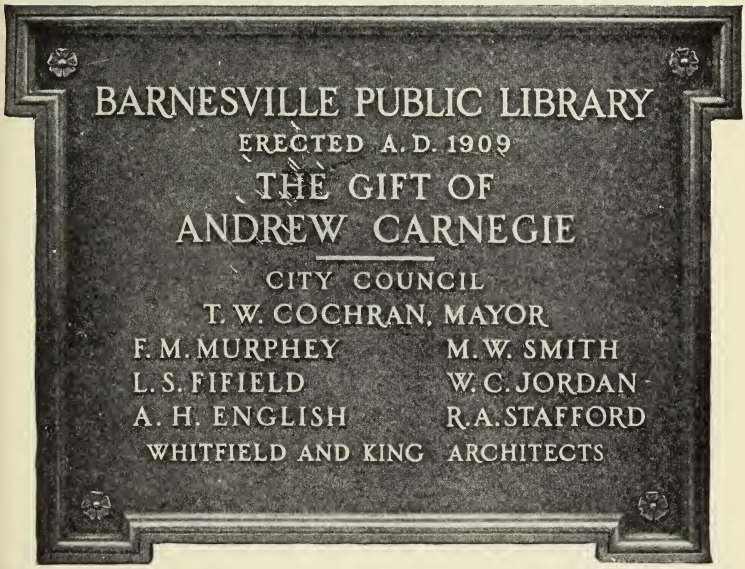


FIG. 76.—"Barnesville" Tablet, Size 2′ 6″×1′ 10″, $20.00 per Sq. Ft.

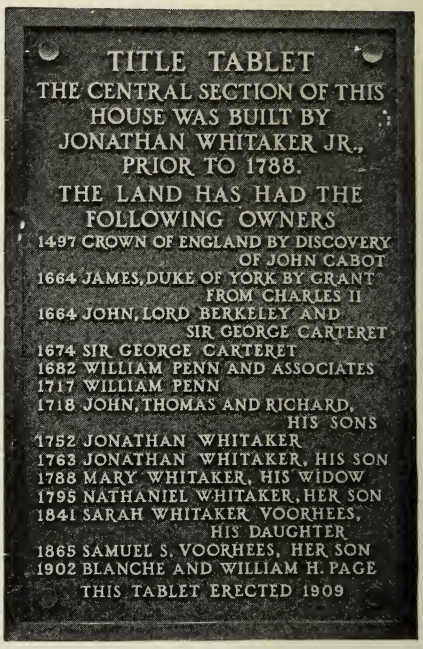


FIG. 77.—Cast Bronze Electric Light Standard, Size 8′ 10″ High Over All. Including Globe, $250 each. In Cast Iron, $150.00 each.

"Title"Tablet, Size 1′ 6″×2′ 4″, $24.00 per Sq. Ft.

The prices given cover only the sizes of work as stated. Each piece of work is specially designed and the right prices for larger or smaller construction cannot, therefore, be reckoned pro ratio from the sizes given.

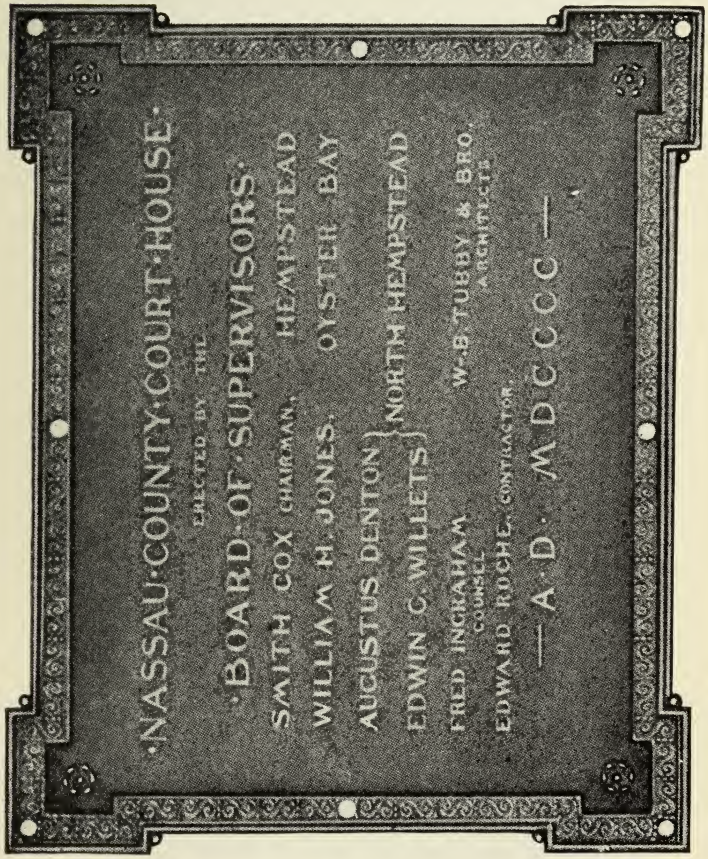


Fig. 78.—"Nassau County Court House," Size 4′ 6″×3′ 6″, $50.00 per Sq. Ft.

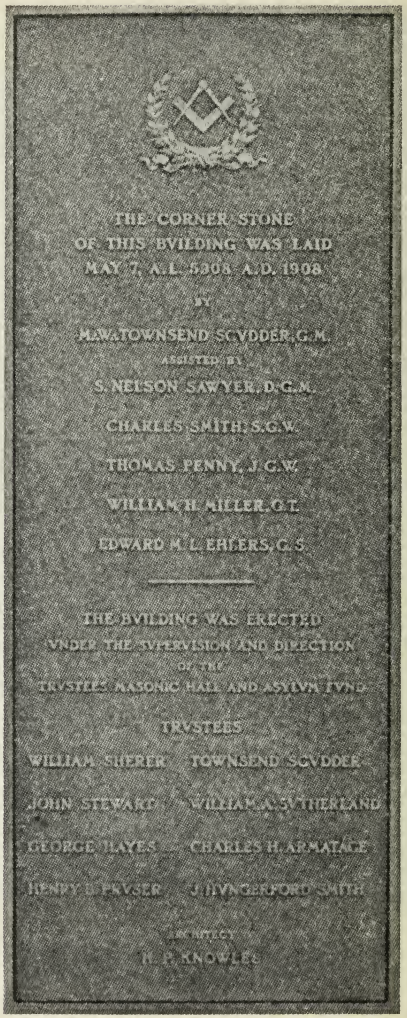


Fig. 79.—"Masonic" Tablet, Size 2′ 5½″×6′ 2″, $15.00 per Sq. Ft.

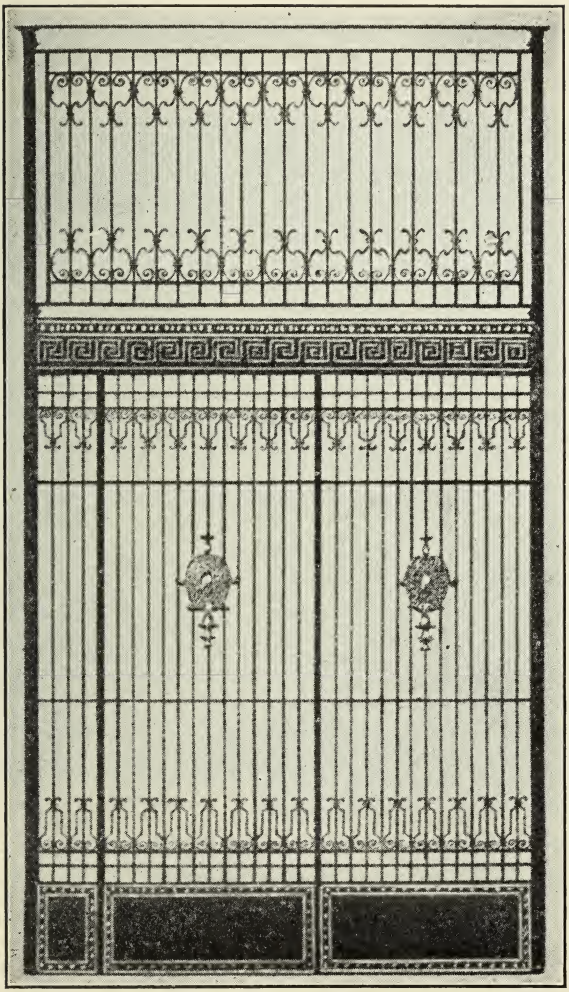


Fig. 80.—In Ordinary Black Finish, $2.50 per Sq. Ft.

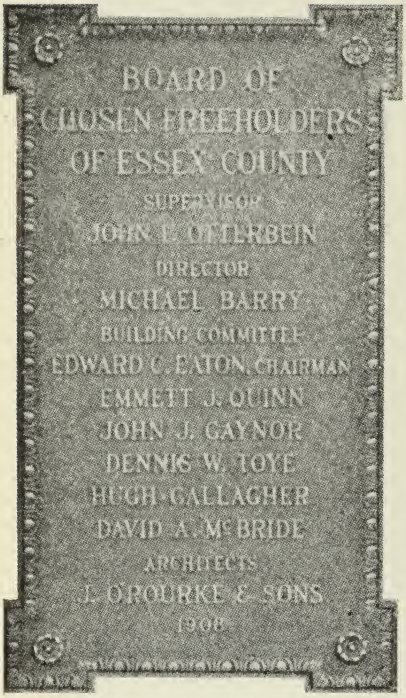


FIG. 81.—"Freeholder" Tablet, Size 2′ 1″×3′ 8″, $25.00 per Sq. Ft.

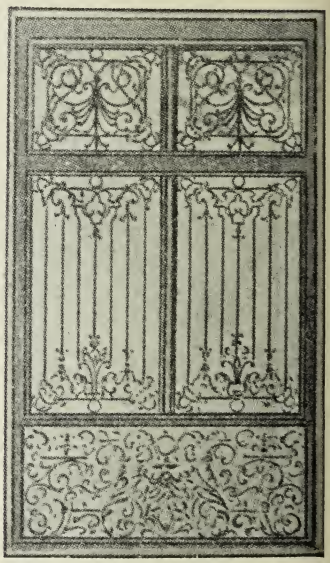


FIG. 82.—Iron Grille Doors, Size 6′ 0″×10′ 0″, $20.00 per Sq. Ft.

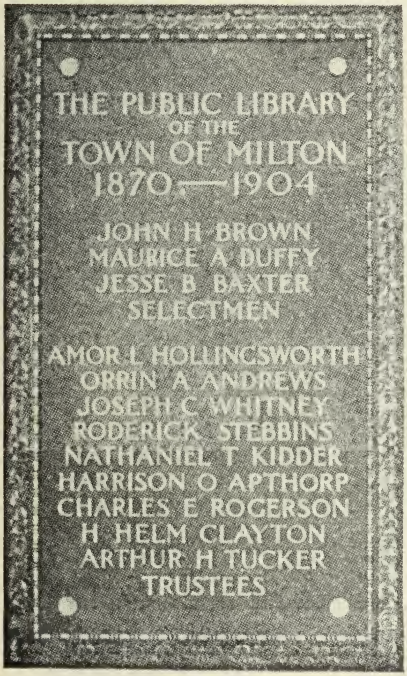


Fig. 83.—"Town of Milton" Tablet, Size 2′ 10″×3′ 4½″, $30.00 per Sq. Ft.

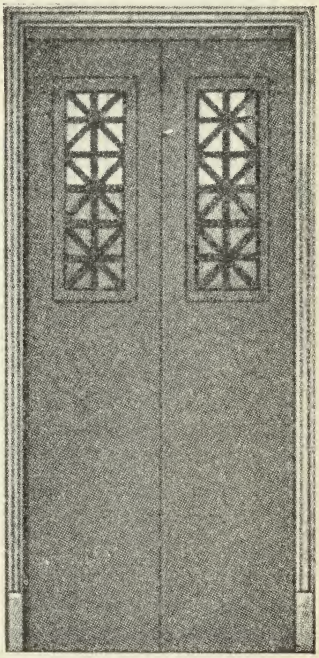


Fig. 84.—Eaton Mausoleum Door (Cast Bronze), Size 3′ 9″×8′ 5″, $35.00 per Sq. Ft.

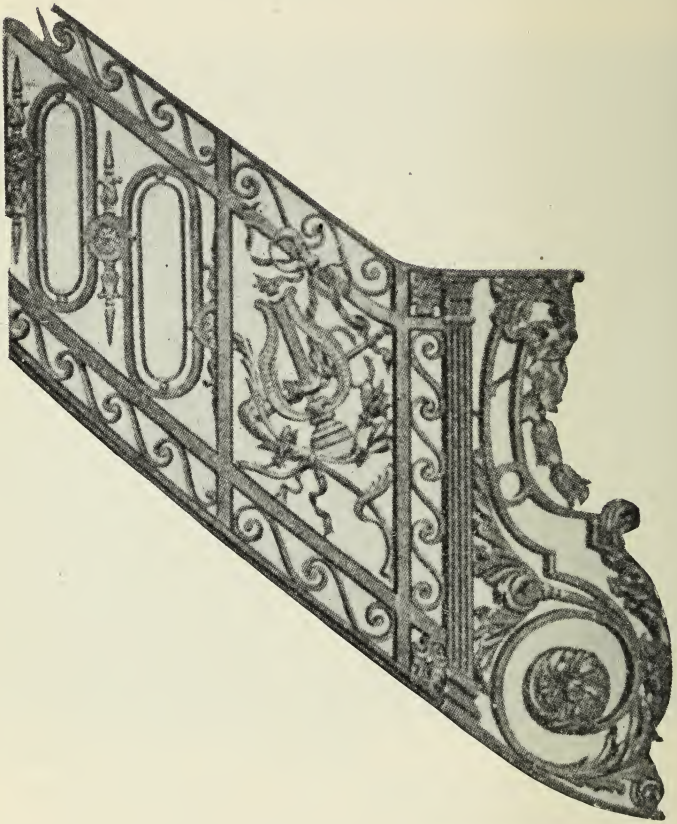


Fig. 85.—Wrought Iron Stair Railing, Residence J. C. Tomlinson, $27.00 per Lineal Foot, Including Newel.

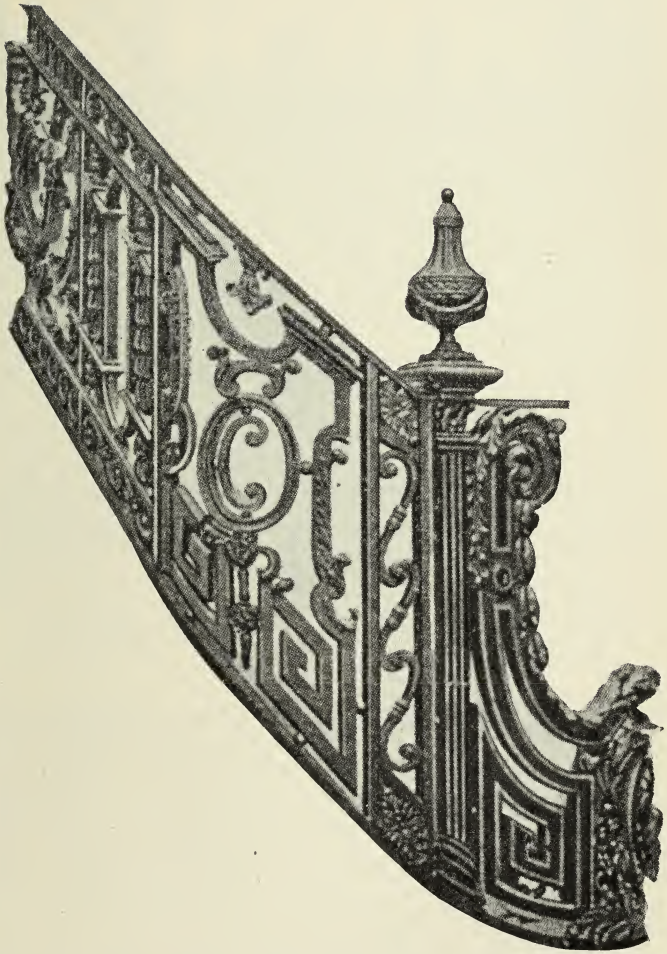


Fig. 86.—Stair Railing (Wrought Iron), Residence R. Fulton Cutting, New York. Wrought Iron Newels, $225.00 each; Stair Railing, $30.00 per Lineal Foot.

Fig. 87.—Wrought Iron Area Fence, about 5′ 0″ High
$3.00 per Sq. Ft.

Fig. 88.—Wrought Iron Stair Railing, Residence F. W. Vanderbilt,
$13.00 per Sq. Ft.

Fig. 89.—Wrought Iron Transom Grille, Size 5′ 4″×3′ 0″ High, $9.00 per Sq. Ft.

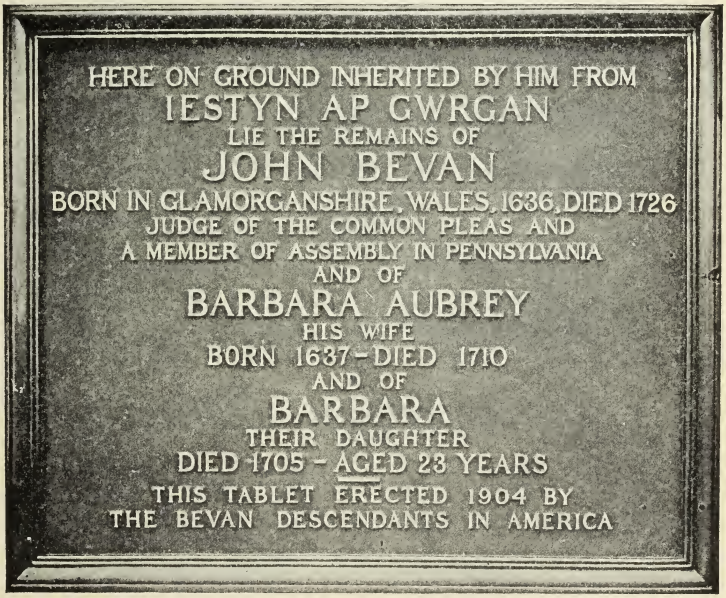


Fig. 90.—"Bevan" Tablet, Size 2′ 6″×2′ 0″, $25.00 per Sq. Ft.

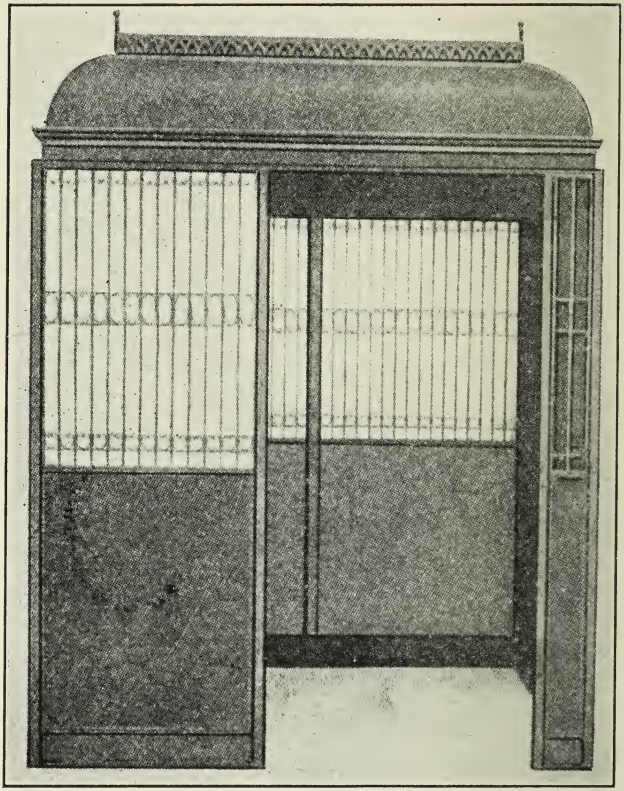


Fig. 91.—Elevator Car, $300.00 in Black Finish; in Bronze Finish 30 cents per Sq. Ft. Extra.

The prices for the following grilles, counter railings, etc., are based on the ordinary finishes such as nickel plate, bright silver, electro bronze, etc. Silver plating costs more. The material estimated on is polished steel. Brass costs about 20 per cent more.

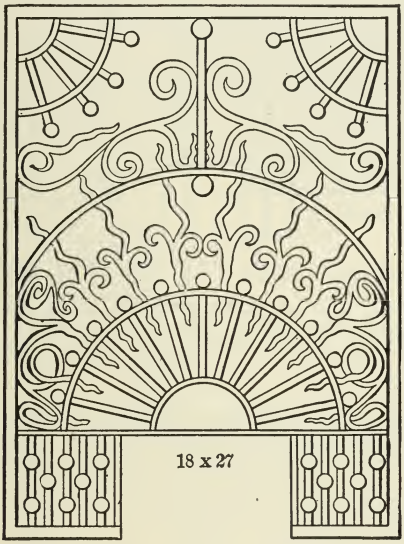


Fig. 92.—18×27, $21.00.

Fig. 93.—$5.40 per Sq. Ft.

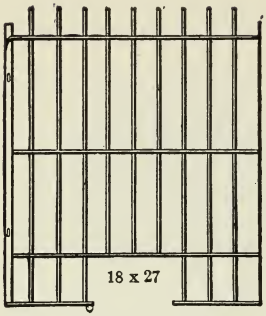


Fig. 94.—18×27, $5.60.

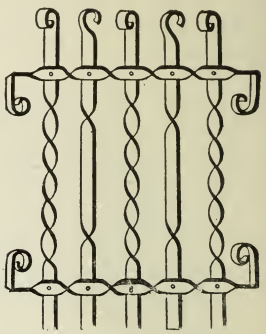


Fig. 95.—$2.70 per Sq. Ft.

Fig. 96.—18×27, $19.60.

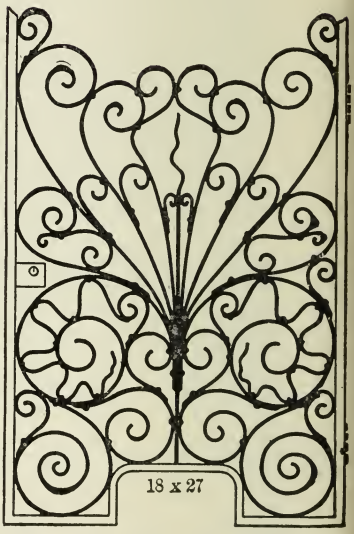


Fig. 97.—18×27, $12.60.

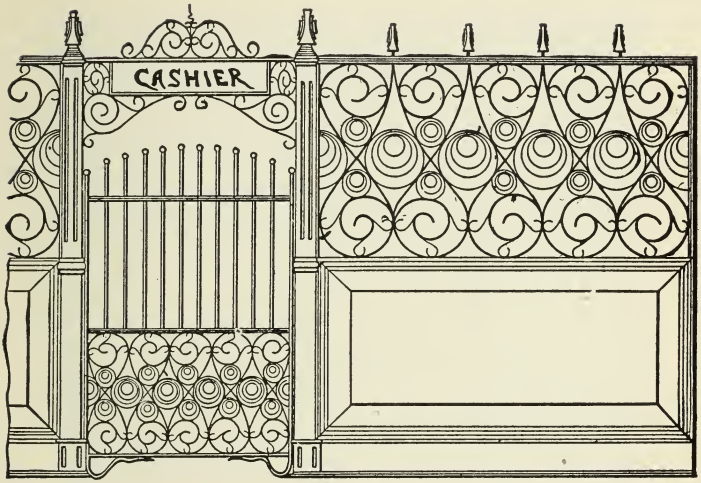


Fig. 98.—Wicket, $15.40. Posts, $9.45 each. Grilles up to 18″ high. Entire Rails, 36″ High. Balance of Metal Work $9.45 per Lineal Foot.

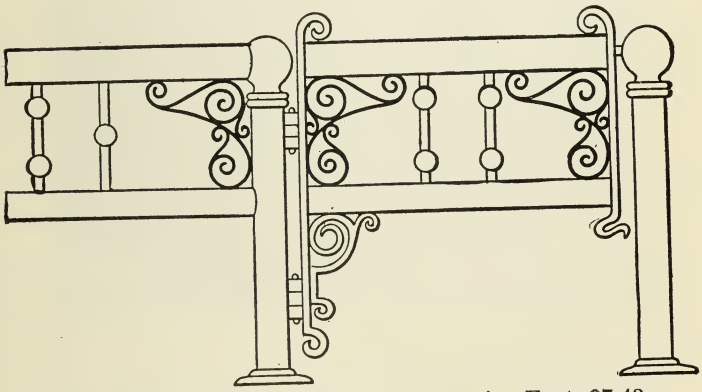


Fig. 99.—30″ High, 2″ Tubes, per Running Foot, $7.43. Gates, $6.75 Each.

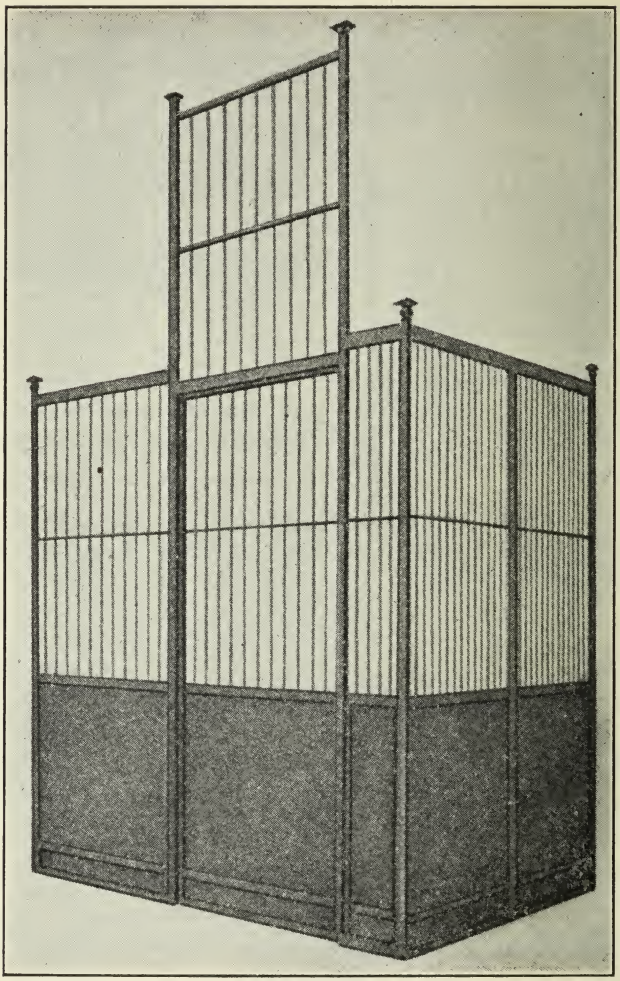


Fig. 100.—With Bars $\frac{3}{8}''$ Square, Jet Black Finish, 70 cents per Square Foot. Door, $10.00 Extra. Approximately, $1.00 per Sq. Ft., Including Everything. Elevator Enclosures Run from $1.00 per Sq. Ft. to $5.00, Without Reaching Fine Ones of Special Design.

LIBRARY FITTINGS

The following figures are given by Snead & Co., Jersey City, for this book. As with all such work the conditions in the specifications, local wages, freight, etc., change the prices, but a fair idea may be gained for a preliminary estimate or a physical valuation from the data.

For straight stack work the price may run from 50 cents to $1 per lineal foot of shelving. This is when not exceeding the standard height of 7′ 6″ or 7′.

Sheet metal wall shelving without any ornamentation, about 8″ deep and 10′ high, costs from $3 to $5 per lineal foot set in places Fig. 101 shows this type. The finish is enamel. The rolling ladders cost about $15 each, f.o.b., and the track 25 cents per lineal foot, set in place.

Double faced shelving as shown in Figs. 102 and 103 set in place, $8 to $9 per lineal foot at 16″ wide, and 7′ to 7′ 6″ high. For 10″ width, or 20″, counting both sides, $9 to $10. If stock designs are followed it makes little difference whether the ends are plain or ornamental.

Fig. 104 shows a typical example of multiple tier stack construction. Plain straight work, tiers 7′ to 7′ 6″, 6 rows of adjustable shelves, and one row of solid plate shelves in the height of each tier, set in place, $10 to $11 per lineal foot of double range 8″ shelves; and $11 to $12 for 10″.

Plain sheet steel warehouse shelving about 8″ with angle and tee iron uprights can be installed for as low as 25 to 30 cents per lineal foot of shelving.

A hand power booklift for three or four stock tiers costs about $125 set in place, but not including the enclosure. Per tier of extra high, add about $10. Figures based on 1913 rates. Change to suit other years by U. S. Metal Table.

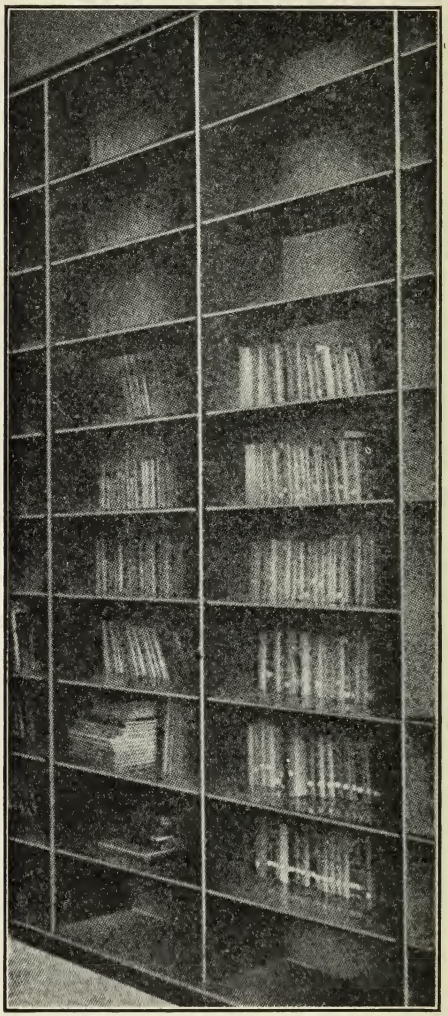


Fig. 101.—Type A.

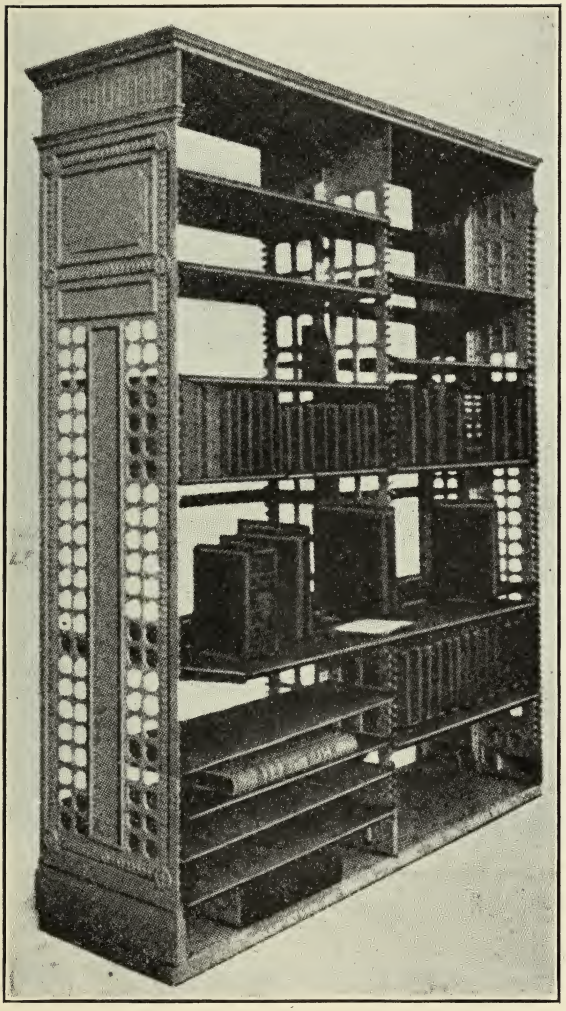


Fig. 102.—Type B.

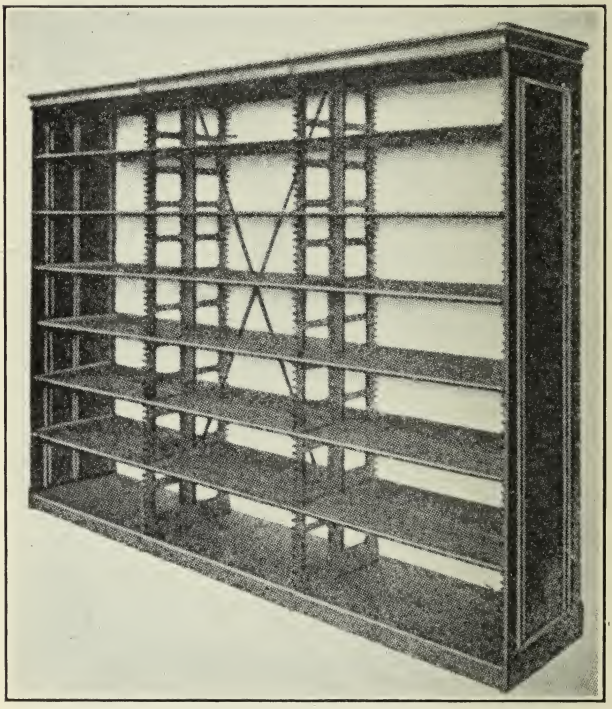


Fig. 103.—Type C.

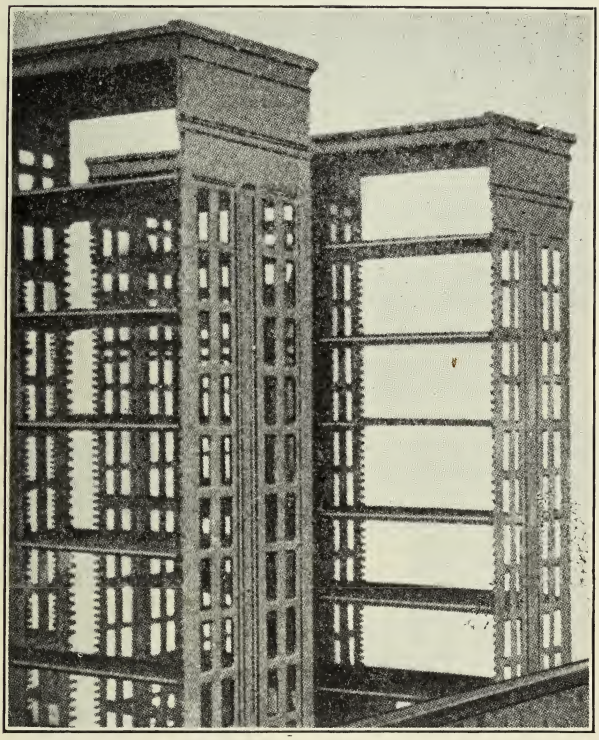
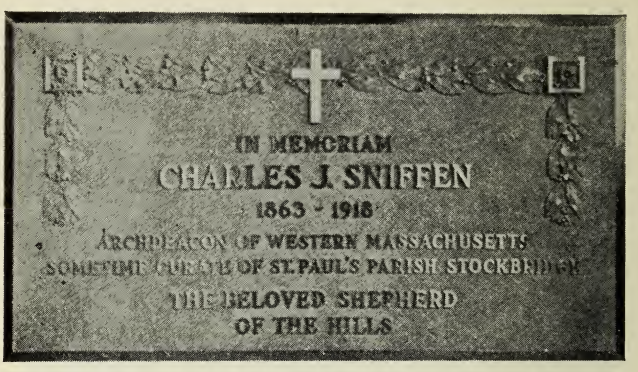
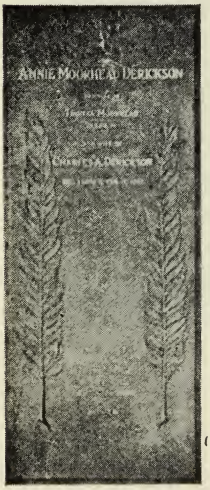


Fig. 104.—Type D.

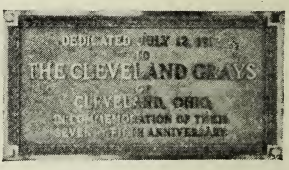
The following cuts were supplied by the courtesy of The W. S. Tyler Company, Cleveland, Ohio. They are based on 1922–23 prices, and may be adjusted to suit other years by using the U. S. Table showing the rise or fall of metal. See page xi.



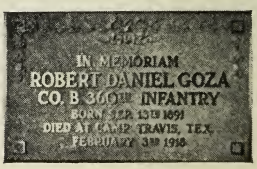
24″×17½″, $110.



18″×42″, $250.

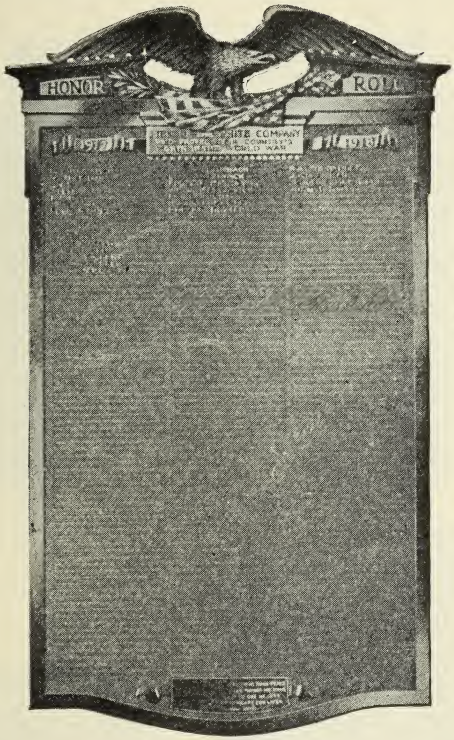


37″×22″, $180.



18″×11″, $54.

Fig. 105.

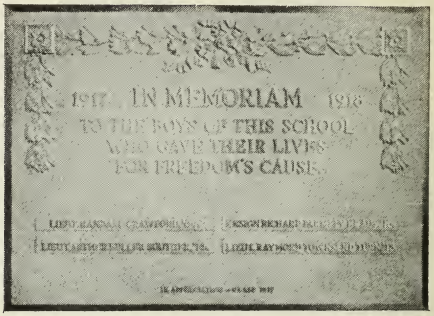


28″×43″, $300.

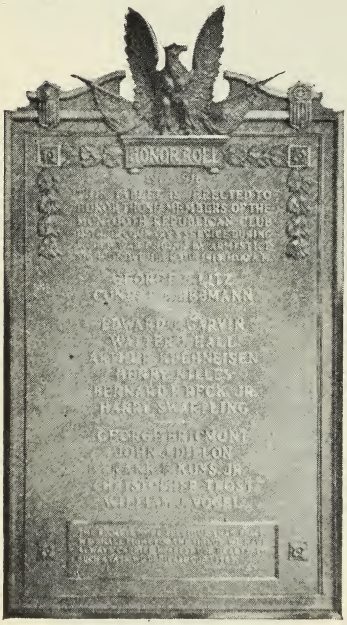
9″ diam., $34.

30″ diam., $160.

Fig. 106.



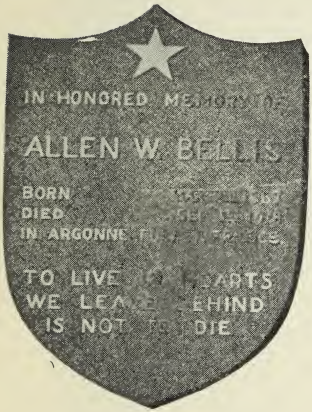
24″×17½″, $90.



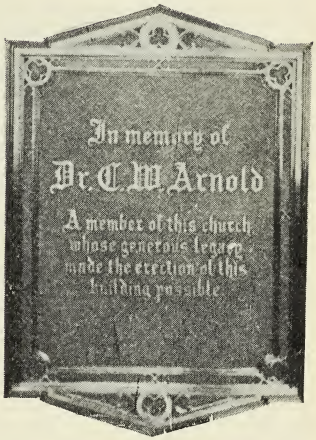
24″×44″, $203, (6).

24″×39″, $269.

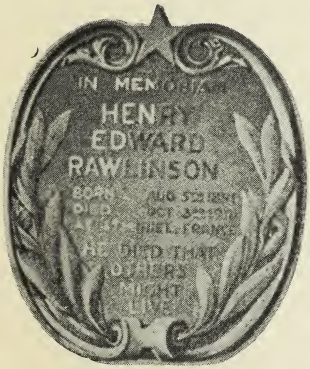
FIG. 106.—*Continued.*



8″×11″, $31.



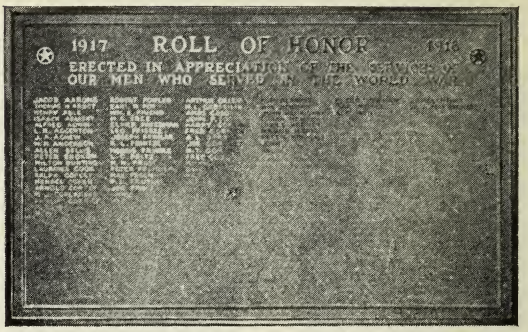
27″×34″, $215.



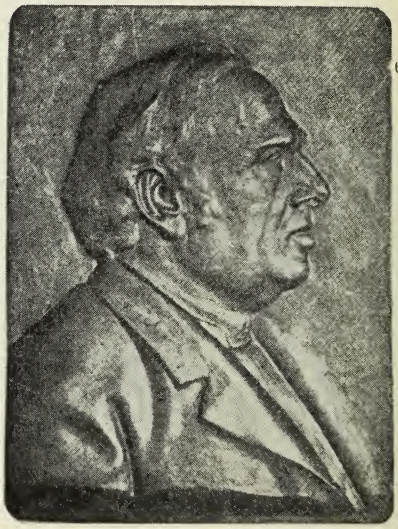
9″×10″, $59.

16″×20″, $74.

Fig. 106.—*Continued.*

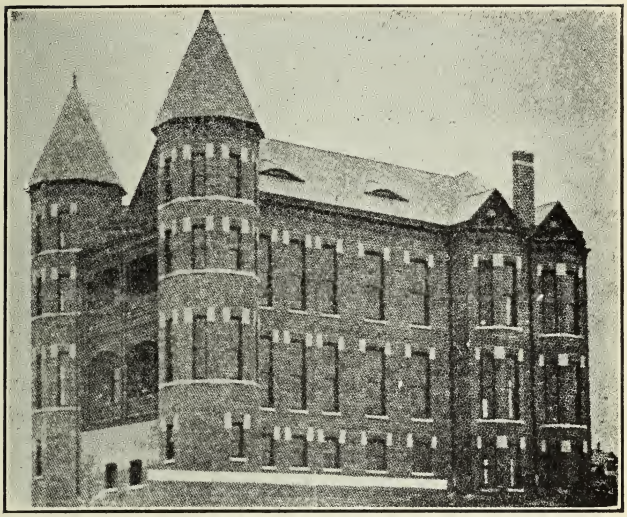


36″×24″, $149.

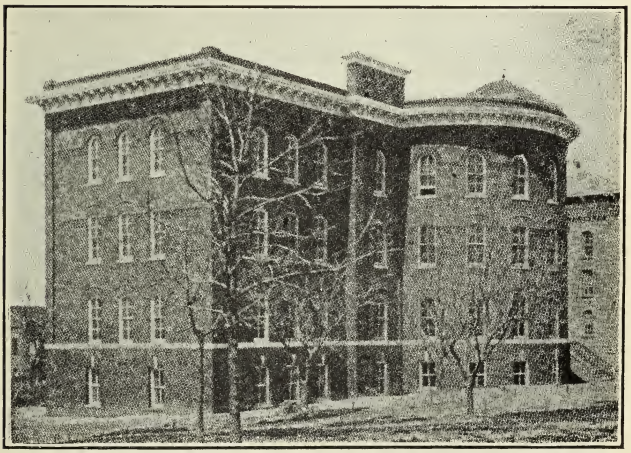


15″×19″, $255.

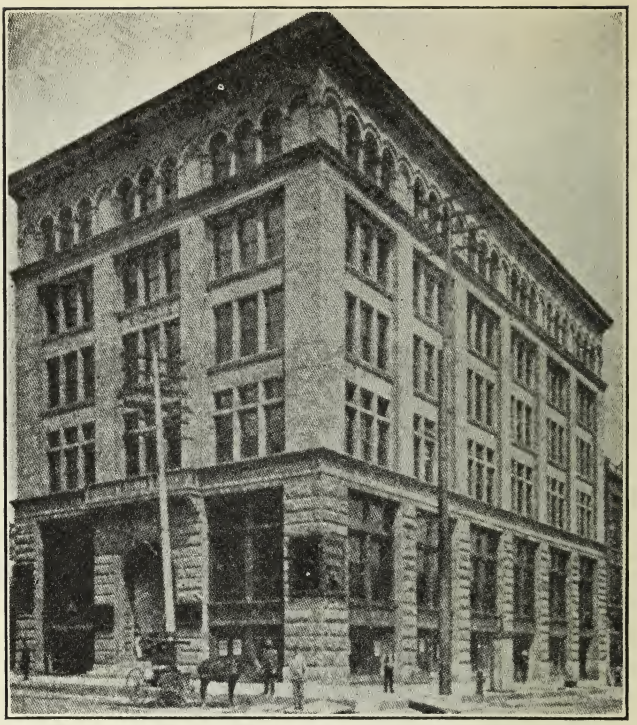
Fig. 106.—*Continued.*



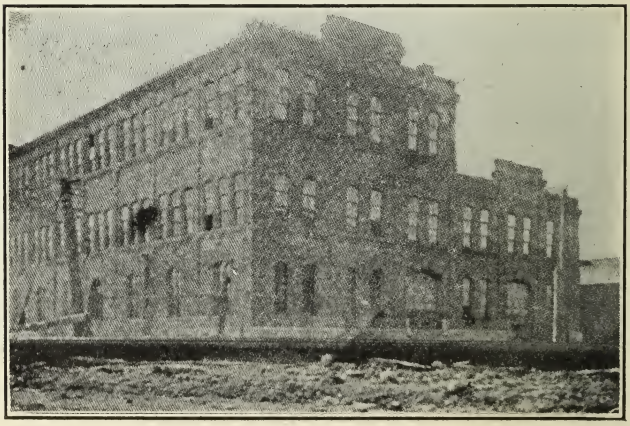
No. 1.—Immanuel Hospital, Omaha, Neb.



No. 2.—Fire-proof Wing to State Hospital, Lincoln, Neb.



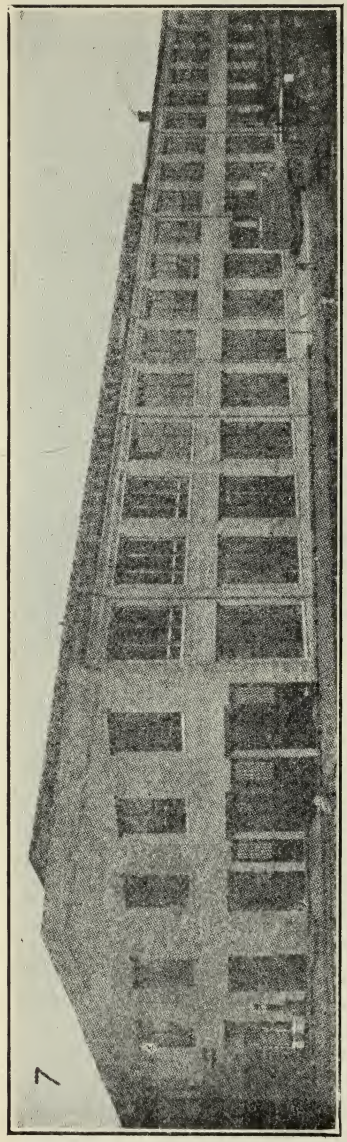
No. 3.—McCague Building, Omaha.

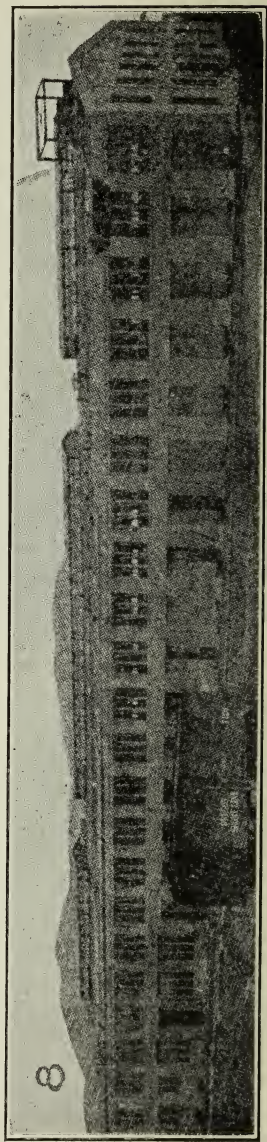


No. 4.—Electric Light Building, Omaha.

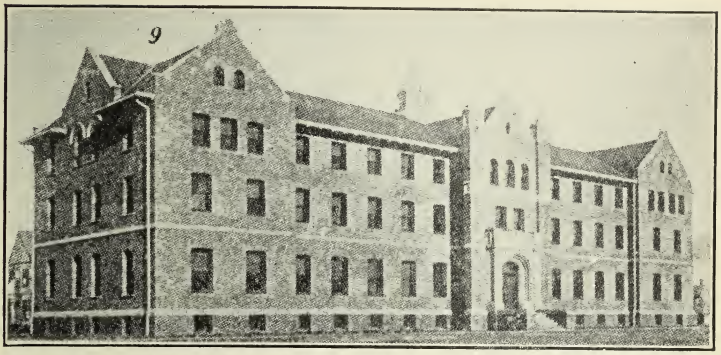
No. 5.—Manderson Block, Omaha.

No. 6.—Harris and Fisher Blocks, Omaha.



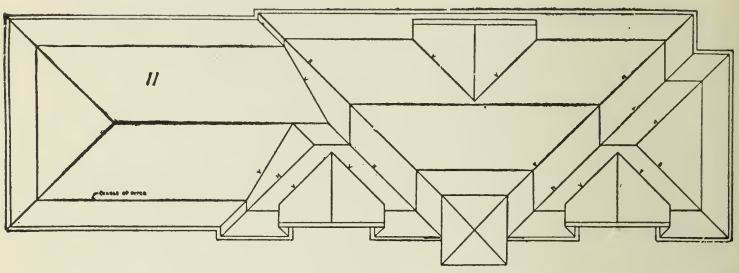


No. 8.—O. S. L. Machine, Boiler and Blacksmith Shop, Pocatello, Ida. 150'×486'.

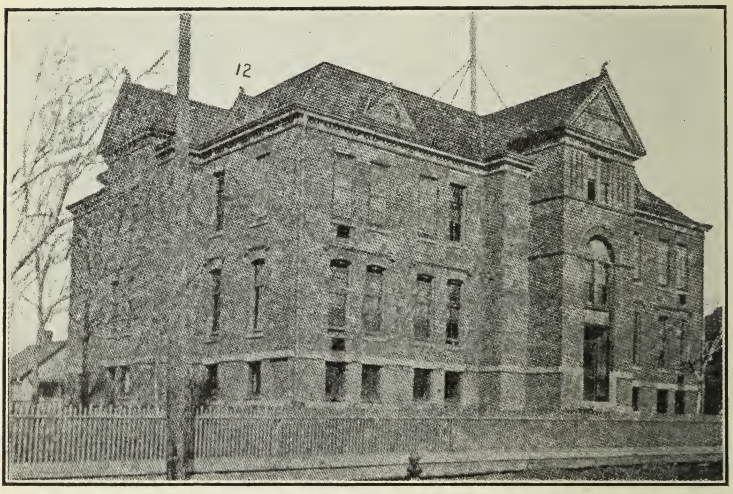


No. 9.—Presbyterian Seminary, Omaha.

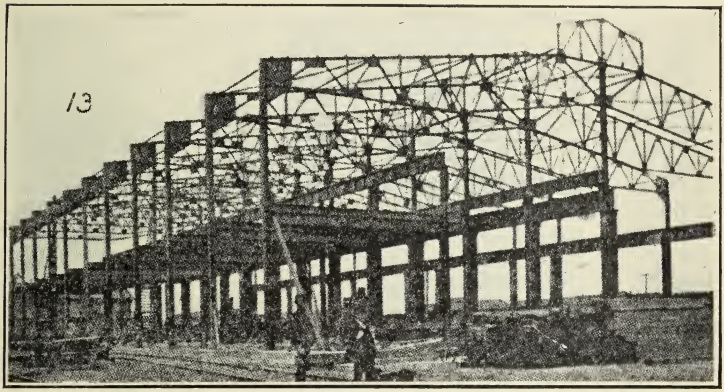
No. 10.—Block of Flats, Omaha.



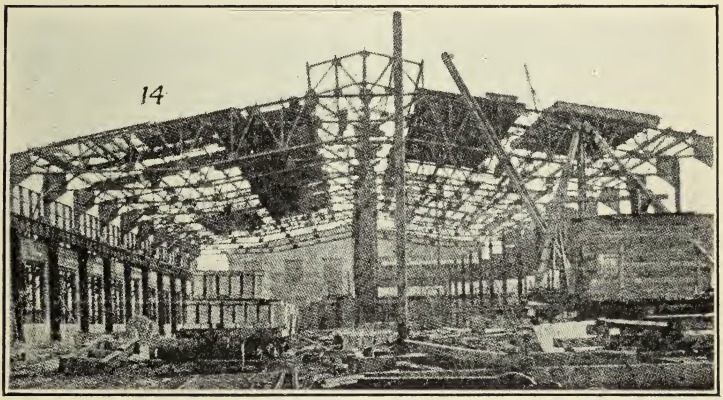
No. 11.—Roof of Passenger Station.



No. 12.—Bancroft School, Omaha.



No. 13.—Half of Steel Framework of U. P. R. R. Machine Shop, Omaha. 150′×398′.



No. 14.—Part of Steel Framework of U. P. R. R. Boiler Shop, Omaha.

CHAPTER XXIII

WEIGHTS AND MEASURES

PROPERTIES OF THE CIRCLE

Diam $\times$ 3.14159 = circumference.
Diam $\times$ .8862 = side of an equal sq.
Diam $\times$ .7071 = side of an inscribed sq.
Diam^2 $\times$ .7854 = area of a circle.
Radius $\times$ 6.28318 = circumference.
Circumference $\div$ 3.14159 = diam.

1st. The circle contains a greater area than any plane figure, bounded by an equal perimeter or outline.

2d. The areas of circles are to each other as the sq of their diam.

3d. Any circle whose diam is double that of another contains four times the area of the other.

4th. Area of a circle is equal to the area of a triangle whose base equals the circumference, and perpendicular equals the radius.

TABLE OF DECIMAL EQUIVALENTS

8THS

1/8 equals	.125	5/8 equals	.625
1/4 equals	.250	3/4 equals	.750
3/8 equals	.375	7/8 equals	.875
1/2 equals	.500		

16THS

1/16 equals	.0625	9/16 equals	.5625
3/16 equals	.1875	11/16 equals	.6875
5/16 equals	.3125	13/16 equals	.8125
7/16 equals	.4375	15/16 equals	.9375

32DS

1/32 equals	.03125	17/32 equals	.53125
3/32 equals	.09375	19/32 eqpals	.59375
5/32 equals	.15625	21/32 equals	.65625
7/32 equals	.21875	23/32 equals	.71875
9/32 equals	.28125	25/32 equals	.78125
11/32 equals	.34375	27/32 equals	.84375
13/32 equals	.40625	29/32 equals	.90625
15/32 equals	.46875	31/32 equals	.96875

Table of Decimal Equivalents—Continued

64THS

1/64 equals	.015625	33/64 equals	.515625
3/64 equals	.046875	35/64 equals	.546875
5/64 equals	.078125	37/64 equals	.578125
7/64 equals	.109375	39/64 equals	.609375
9/64 equals	.140625	41/64 equals	.640625
11/64 equals	.171875	43/64 equals	.671875
13/64 equals	.203125	45/64 equals	.703125
15/64 equals	.234375	47/64 equals	.734375
17/64 equals	.265625	49/64 equals	.765625
19/64 equals	.296875	51/64 equals	.796875
21/64 equals	.328125	53/64 equals	.828125
23/64 equals	.359375	55/64 equals	.859375
25/64 equals	.390625	57/64 equals	.890625
27/64 equals	.421875	59/64 equals	.921875
29/64 equals	.453124	61/64 equals	.953125
31/64 equals	.484375	63/64 equals	.984375

USEFUL MEMORANDA AND TABLES

1 ci of Cast Iron weighs	0.26	lbs
1 ci of Wrought Iron weighs	0.28	lbs
1 ci of Water weighs	.036	lbs
1 cf of Water weighs	62.321	lbs
1 United States gall weighs	8.33	lbs
1 Imperial gall weighs	10.	lbs
1 United States gall equals	231.	ci
1 Imperial gall equals	277.274	ci
1 cf of Water equals	7.48	U. S. gall

CONVENIENT MULTIPLES

For the side of an equal sq of a circle, mult diam by .8862. For the surf of a sphere, mult sq of diam by 3.1446. For the Solidity of a sphere, mult cube of diam by .5236. For the side of an inscribed cube, mult the radius of a sphere by 1.1547. The area of the base of a pyramid, or cone, whether round, sq or triangular, mult by one-third of its height, equals the solidity. The base of a triangle mult by half the height equals the area.

RULE

For finding the weight of castings or forgings by the weight of their patterns.

Mult the weight of the wp pattern by

16 for cast iron,	25 for lead,
17.1 for wrt iron,	12.2 for tin,
17.3 for steel,	13 for brass,
18 for copper,	11.4 for zinc,

and the product is the weight of the casting.

CIRCUMFERENCES AND AREAS OF CIRCLES

Diam	Circum	Area	Diam	Circum	Area
1	3.1416	.7854	64	201.06	3216.99
2	6.2832	3.1416	65	204.20	3318.31
3	9.4248	7.0686	66	207.34	3421.19
4	12.5664	12.5664	67	210.49	3525.65
5	15.7080	19.635	68	213.63	3631.68
6	18.850	28.274	69	216.77	3739.28
7	21.991	38.485	70	219.91	3848.45
8	25.133	50.266	71	223.05	3959.19
9	28.274	63.617	72	226.19	4071.50
10	31.416	78.540	73	229.34	4185.39
11	34.558	95.033	74	232.48	4300.84
12	37.699	113.1	75	235.62	4417.86
13	40.841	132.73	76	238.76	4536.46
14	43.982	153.94	77	241.90	4656.63
15	47.124	176.71	78	245.04	4778.36
16	50.265	201.06	79	248.19	4901.67
17	53.407	226.98	80	251.33	5026.55
18	56.549	254.47	81	254.47	5153.
19	59.690	283.53	82	257.61	5281.02
20	62.832	314.16	83	260.75	5410.61
21	65.973	346.36	84	263.89	5541.77
22	69.115	380.13	85	267.04	5674.50
23	72.257	415.48	86	270.18	5808.80
24	75.398	452.39	87	273.32	5944.68
25	78.540	490.87	88	276.46	6082.12
26	81.681	530.93	89	279.60	6221.14
27	84.823	572.56	90	282.74	6361.73
28	87.965	615.75	91	285.88	6503.88
29	91.106	660.52	92	289.03	6647.61
30	94.248	706.86	93	292.17	6792.91
31	97.389	754.77	94	295.31	6939.78
32	100.53	804.25	95	298.45	7088.22
33	103.67	855.30	96	301.59	7238.23
34	106.81	907.92	97	304.73	7339.81
35	109.96	962.11	98	307.88	7542.96
36	113.10	1017.88	99	311.02	7697.69
37	116.24	1075.21	100	314.16	7853.98
38	119.38	1134.11	101	317.30	8011.85
39	122.52	1194.59	102	320.44	8171.28
40	125.66	1256.64	103	323.58	8332.29
41	128.81	1320.25	104	326.73	8494.87
42	131.95	1385.44	105	329.87	8659.01
43	135.09	1452.20	106	333.01	8824.73
44	138.23	1520.53	107	336.15	8992.02
45	141.37	1590.43	108	339.29	9160.88
46	144.51	1661.90	109	342.43	9331.32
47	147.65	1734.94	110	345.58	9503.32
48	150.80	1809.56	111	348.72	9676.89
49	153.94	1885.74	112	351.86	9852.03
50	157.08	1963.50	113	355.	10028.75
51	160.22	2042.82	114	358.14	10207.03
52	163.36	2123.72	115	361.28	10386.89
53	166.50	2206.18	116	364.42	10568.32
54	169.65	2290.22	117	367.57	10751.32
55	172.79	2375.83	118	370.71	10935.88
56	175.93	2463.01	119	373.85	11122.02
57	179.07	2551.76	120	376.99	11309.73
58	182.21	2642.08	121	380.13	11499.01
59	185.35	2733.97	122	383.27	11689.87
60	188.50	2827.43	123	386.42	11882.29
61	191.64	2922.47	124	389.56	12076.28
62	194.78	3019.07	125	392.70	12271.85
63	197.92	3117.25	126	395.84	12468.98

Table No. 19

(Sturtevant)

Areas of Circles and lengths of the sides of squares of the same area

Diam. of Circle in Inches	Area of Circle in Square Inches	Sides of Square of Same Area in Square Inches	Diam. of Circle in Inches	Area of Circle in Square Inches	Sides of Square of Same Area in Square Inches	Diam. of Circle in Inches	Area of Circle in Square Inches	Sides of Square of Same Area in Square Inches
1.	.785	.89	21.	346.36	18.61	41.	1320.26	36.34
.½	1.767	1.33	.½	363.05	19.05	.½	1352.66	36.78
2.	3.142	1.77	22.	380.13	19.50	42.	1385.45	37.22
.½	4.909	2.22	.½	397.61	19.94	.½	1418.63	37.66
3.	7.069	2.66	23.	415.48	20.38	43.	1452.20	38.11
.½	9.621	3.10	.½	433.74	20.83	.½	1486.17	38.55
4.	12.566	3.54	24.	452.39	21.27	44.	1520.53	38 99
.½	15.904	3.99	.½	471.44	21.71	.½	1555.29	39.44
5.	19.635	4.43	25.	490.88	22.16	45.	1590.43	39.88
.½	23.758	4.87	.½	510.71	22.60	.½	1625.97	40.32
6.	28.274	5.32	26.	530.93	23.04	46.	1661.91	40.77
.½	33.183	5.76	.½	551.55	23.49	.½	1698.23	41.21
7.	38.485	6.20	27.	572.56	23.93	47.	1734.95	41.65
.½	44.179	6.65	.½	593.96	24.37	.½	1772.06	42.10
8.	50.266	7.09	28.	615.75	24.81	48.	1809.56	42.58
.½	56.745	7.53	.½	637.94	25.26	.½	1847.46	42.98
9.	63.617	7.98	29.	660.52	25.70	49.	1885.75	43.43
.½	70.882	8.42	.½	683.49	26.14	.½	1924.43	43.87
10.	78.540	8.86	30.	706.86	26.59	50.	1963.50	44.31
.½	86.590	9.30	.½	730.62	27.03	.½	2002.97	44.75
11.	95.03	9.75	31.	754.77	27.47	51.	2042.83	45.20
.½	103.87	10.19	.½	779.31	27.92	.½	2083.08	45.64
12.	113.10	10.63	32.	804.25	28.36	52.	2123.72	46.08
.½	122.72	11.08	.½	829.58	28.80	.½	2164.76	46.53
13.	132.73	11.52	33.	855.30	29.25	53.	2206.19	46.97
.½	143.14	11.96	.½	881.41	29.69	.½	2248.01	47.41
14.	153.94	12.41	34.	907.92	30.13	54.	2290.23	47.86
.½	165.13	12.85	.½	934.82	30.57	.½	2332.83	48.30
15.	176.72	13.29	35.	962.11	31.02	55.	2375.83	48.74
.½	188.69	13.74	.½	989.80	31.46	.½	2419.23	49.19
16.	201.06	14.18	36.	1017.88	31.90	56	2463.01	49.63
.½	213.83	14.62	.½	1046.35	32.35	.½	2507.19	50.07
17.	226.98	15.07	37.	1075.21	32.79	57.	2551.76	50.51
.½	240.53	15.51	.½	1104.47	33.23	.½	2596.73	50.96
18.	254.47	15.95	38.	1134.12	33.68	58.	2642.09	51.40
.½	268.80	16.40	.½	1164.16	34.12	.½	2687.84	51.84
19.	283.53	16.84	39.	1194.59	34.56	59.	2733.98	52.29
.½	298.65	17.28	.½	1225.42	35.01	.½	2780.51	52.73
20.	314.16	17.72	40.	1256.64	35.45	60.	2827.74	53.17
.½	330.06	18.17	.½	1288.25	35.89	.½	2874.76	53.62

SQUARE FEET OF RADIATING SURFACE OF PIPE PER LINEAL FOOT

On all lengths over one foot, fractions less than tenths are added to or dropped.

Length of Pipe	Size of Pipe											
	¾	1	1¼	1½	2	2½	3	4	5	6	7	.8
1	.275	.346	.434	.494	.622	.753	.916	1.175	1.455	1.739	1.996	2.257
2	.5	.7	.9	1.	1.2	1.5	1.8	2.4	2.9	3.5	4.	4.5
3	.8	1.	1.3	1.5	1.9	2.3	2.7	3.5	4.4	5.2	6.	6.8
4	1.1	1.4	1.7	2.	2.5	3.	3.6	4.7	5.8	7.	8.	9.
5	1.4	1.7	2.2	2.4	3.1	3.8	4.6	5.8	7.3	7.7	10.	11.3
6	1.6	2.1	2.6	2.9	3.7	4.5	5.5	7.	8.7	10.5	12.	13.5
7	1.9	2.4	3.	3.4	4.4	5.3	6.4	8.2	10.2	12.1	14.	15.8
8	2.2	2.8	3.5	3.9	5.	6.	7.3	9.4	11.6	13.9	16.	18.
9	2.5	3.1	3.9	4.4	5.6	6.8	8.2	10.6	13.1	15.7	18.	20.3
10	2.7	3.5	4.3	4.9	6.2	7.5	9.1	11.8	14.6	17.4	20.	22.6
11	3.	3.8	4.8	5.4	6.8	8.3	10.	12.9	16.	19.1	22.	24.9
12	3.3	4.1	5.2	5.9	7.5	9.	11.	14.1	17.4	20.9	24.	27.1
13	3.6	4.5	5.6	6.4	8.1	9.8	11.9	15.3	18.9	22.6	26.	29.4
14	3.8	4.8	6.1	6.9	8.7	10.5	12.8	16.5	20.3	24.3	28.	31.6
15	4.1	5.2	6.5	7.4	9.3	11.3	13.7	17.6	21.8	26.1	30.	33.9
16	4.4	5.5	6.9	7.9	10.	12.	14.6	18.8	23.2	27.8	32.	36.1
17	4.7	5.9	7.4	8.4	10.6	12.8	15.5	20.	24.7	29.5	34.	38.4
18	5.	6.2	7.8	8.9	11.2	13.5	16.5	21.2	26.2	31.3	36.	40.6
19	5.2	6.6	8.3	9.4	11.8	14.3	17.4	22.3	27.6	33.1	38.	42.9
20	5.5	6.9	8.7	9.9	12.5	15.	18.3	23.5	29.1	34.8	40.	45.2
21	5.8	7.3	9.1	10.4	13.	15.8	19.2	24.7	30.5	36.5	42.	47.4
22	6.	7.6	9.6	10.9	13.7	16.5	20.2	25.9	32.	38.3	44.	49.7
23	6.3	8.	10.	11.3	14.3	17.3	21.1	27.	33.5	40.	46.	52.
24	6.6	8.3	10.4	11.9	14.9	18.	22.	28.2	34.9	41.7	48.	54.2
25	6.9	8.6	10.9	12.3	15.6	18.8	22.9	29.3	36.3	43.5	50.	56.4
26	7.1	9.	11.3	12.8	16.2	19.5	23.8	30.5	37.8	45.2	52.	58.6
27	7.4	9.4	11.7	13.3	16.8	20.3	24.7	31.7	39.3	47.	54.	61.
28	7.7	9.7	12.2	13.8	17.4	21.	25.6	32.9	40.7	48.7	56.	63.2
29	8.	10.	12.6	14.3	18.	21.8	26.6	34.1	42.2	50,4	58.	65.5
30	8.3	10.4	13.	14.8	18.7	22.5	27.5	35.3	43.6	52.1	60.	67.7
31	8.5	10.7	13.5	15.3	19.3	23.3	28.4	36.4	45.1	53.9	62.	70.
32	8.8	11.1	13.9	15.8	19.9	24.1	29.3	37.6	46.5	55.6	64.	72.2
33	9.1	11.4	14.3	16.3	20.5	24.8	30.2	38.8	48.	57.4	66.	74.4
34	9.4	11.7	14.7	16.8	21.2	25.6	31.1	40.	49.5	59.1	68.	76.7
35	9.6	12.1	15.2	17.3	21.8	26.3	32.	41.1	50.9	60.8	70.	79.
36	9.9	12.5	15.6	17.8	22.4	27.	33.	42.3	52.4	62.6	72.	81.3
37	10.2	12.8	16.1	18.3	23.	27.8	33.9	43.5	53.8	64.3	74.	83.5
38	10.5	13.2	16.5	18.8	23.7	28.5	34.8	44.6	55.2	66.	76.	85.8
39	10.7	13.5	16.9	19.3	24.3	29.3	35.7	45.8	56.7	67.8	78.	88,
40	11.	13.8	17.4	19.8	24.9	30.1	36.6	47.	58.2	69.5	80.	90.2
41	11.3	14.2	17.8	20.3	25.5	30.8	37.6	48.2	59.6	71.3	82.	92.5
42	11.5	14.5	18.2	20.8	26.1	31.6	38.5	49.4	61.1	73.	84.	94.8
43	11.8	14.9	18.7	21.3	26.8	32.3	39.4	50.6	62.5	74.8	86.	97.
44	12.1	15.2	19.1	21.8	27.4	33.1	40.3	51.7	64.	76.5	88.	99.3
45	12.4	15.6	19.5	22.2	28.	33.8	41.2	52.9	65.5	78.2	90.	101.6
46	12.7	15.9	20.	22.7	28.6	34.6	42.2	54.	67.	80.	92.	103.8
47	12.9	16.3	20.4	23.2	29.2	35.3	43.	55.2	68.4	81.7	94.	106.
48	13.2	16.6	20.8	23.7	29.9	36.1	43.9	56.4	69.8	83.5	96.	108.4
49	13.5	17.	21.3	24.2	30.5	36.8	44.8	57.6	71.2	85.1	98.	110.5
50	13.8	17.3	21.7	24.7	31.1	37.6	45.8	58.7	72.7	87.	100.	112.8

NOTE: The figure given after the decimal point represents so many inches and not the decimal part of feet.

U. S. GALL IN ROUND TANKS

For One Ft in Depth

Diam of Tanks	No. U. S. Gall	CF and Area in SF	Diam of Tanks	No. U. S. Gall	CF and Area in SF	Diam of Tanks	No. U. S. Gall	CF and Area in SF
1′	5.87	.785	5′ 8″	188.66	25.22	19′	2120.90	283.53
1′ 1″	6.89	.922	5′ 9″	194.25	25.97	19′ 3″	2177.10	291.04
1′ 2″	8.	1.069	5′ 10″	199.92	26.73	19′ 6″	2234.	298.65
1′ 3″	9.18	1:227	5′ 11″	205.67	27.49	19′ 9″	2291.70	306.35
1′ 4″	10.44	1.396	6′	211.51	28.27	20′	2350.10	314.16
1′ 5″	11.79	1.576	6′ 3″	229.50	30.68	20′ 3″	2409.20	322.06
1 6″	13.22	1.767	6′ 6″	248.23	33.18	20′ 6″	2469.10	330.06
1′ 7″	14.73	1.969	6′ 9″	267.69	35.78	20′ 9″	2529.60	338.16
1′ 8″	16.32	2.182	7′	287.88	38.48	21′	2591.	346.36
1 9″	17.99	2.405	7′ 3″	308.81	41.28	21′ 3″	2653.	354.66
1′ 10″	19.75	2.640	7′ 6″	330.48	44.18	21′ 6″	2715.80	363.05
1′ 11″	21.58	2.885	7′ 9″	352.88	47.17	21′ 9″	2779.30	371.54
2′	23.50	3.142	8′	376.01	50.27	22′	2843.60	380.13
2′ 1″	25.50	3.409	8′ 3″	399'88	53.46	22′ 3″	2908.60	388.82
2′ 2″	27.58	3.687	8′ 6″	424.48	56.75	22′ 6″	2974.30	397.61
2′ 3″	29.74	3.976	8′ 9″	449.82	60.13	22′ 9″	3040.80	406.49
2′ 4″	31.99	4.276	9′	475.89	63.62	23′	3108.	415.48
2′ 5″	34.31	4.587	9′ 3″	502.70	67.20	23′ 3″	3175.90	424.56
2′ 6″	36.72	4.909	9′ 6″	530.24	70.88	23′ 6″	3244.60	433.74
2′ 7″	39.21	5.241	9′ 9″	558.51	74.66	23′ 9″	3314.	443.01
2′ 8″	41.78	5.585	10′	587.52	78.54	24′	3384.10	452.39
2′ 9″	44.43	5.940	10′ 3″	617.26	82.52	24′ 3″	3455.	461.86
2′ 10″	47.16	6.305	10′ 6″	640.74	86.59	24′ 6″	3526.60	471.44
2′ 11″	49.98	6.681	10′ 9″	678.95	90.76	24′ 9″	3598.90	481.11
3′	52.88	7.069	11′	710.90	95.03	25′	3672.	490.87
3′ 1″	55.86	7.467	11′ 3″	743.58	99.40	25′ 3″	3745.80	500.74
3′ 2″	58.92	7.876	11′ 6″	776.99	103.87	25′ 6″	3820.30	510.71
3′ 3″	62.06	8.296	11′ 9″	811.14	108.43	25′ 9″	3895.60	520.77
3′ 4″	65.28	8.727	12′	846.03	113.10	26′	3971.60	530.93
3′ 5″	68.58	9.168	12′ 3″	881.65	117.86	26′ 3″	4048.40	541.19
3′ 6″	71.97	9.621	12′ 6″	918.	122.72	26′ 6″	4125.90	551.55
3′ 7″	75.44	10.085	12′ 9″	955.09	127.68	26′ 9″	4204.10	562.
3′ 8″	78.99	10.559	13′	992.91	132.73	27′	4283.	572.66
3′ 9″	82.62	11.045	13′ 3″	1031.50	137.89	27′ 3″	4362.70	583.21
3′ 10″	86.33	11.541	13′ 6″	1070.80	143.14	27′ 6″	4443.10	593.96
3′ 11″	90.13	12.048	13′ 9″	1110.80	148.49	27′ 9″	4524.30	604.81
4′	94.	12.566	14′	1151.50	153.94	28′	4606.20	615.75
4′ 1″	97.96	13.095	14′ 3″	1193.	159.48	28′ 3″	4688.80	626.80
4′ 2″	102.	13.635	14′ 6″	1235.30	165.13	28′ 6″	4772.10	637.94
4′ 3″	106.12	14.186	14′ 9″	1278.20	170.87	28′ 9″	4856.20	649.18
4′ 4″	110.32	14.748	15′	1321.90	176.71	29′	4941.	660.52
4′ 5″	114.61	15.321	15′ 3″	1366.40	182.65	29′ 3″	5026.60	671.96
4′ 6″	118.97	15.90	15′ 6″	1411.50	188.69	29′ 6″	5112.90	683.49
4′ 7″	123.42	16.50	15′ 9″	1457.40	194.83	29′ 9″	5199.90	695.13
4′ 8″	127.95	17.10	16′	1504.10	201.06	30′	5287.70	706.86
4′ 9″	132.56	17.72	16′ 3″	1551.40	207.39	30′ 3″	5376.20	718.69
4′ 10″	137.25	18.35	16′ 6″	1599.50	213.82	30′ 6″	5465.40	730.62
4′ 11″	142.02	18.99	16′ 9″	1648.40	220.35	30′ 9″	5555.40	742.64
5′	146.88	19.63	17′	1697.90	226.98	31′	5646.10	754.77
5′ 1″	151.82	20.29	17′ 3″	1748.20	233.71	31′ 3″	5737.50	766.99
5′ 2″	156.83	20.97	17′ 6″	1799.30	240.53	31′ 6″	5829.70	779.31
5′ 3″	161.93	21.65	17′ 9″	1851.10	247.45	31′ 9″	5922.60	791.73
5′ 4″	167.12	22.34	18′	1903.60	254.47	32′	6016.20	804.25
5′ 5″	172.38	23.04	18′ 3″	1956.80	261.59	32′ 3″	6110.60	816.86
5′ 6″	177.72	23.76	18′ 6″	2010.80	268.80	32′ 6″	6205.70	829.58
5′ 7″	183.15	24.48	18′ 9″	2065.50	276.12	32′ 9″	6301.50	842.39

31½ Gall to 1 Bbl

To find the capacity of tanks greater than the largest given in the table, look in the table for a tank of one-half of the given size and mult its capacity by 4, or one of one-third its size and mult its capacity by 9, etc.

Capacity in Gals per Lin Ft of Cylinders

Diam.	Capacity	Diam.	Capacity	Diam.	Capacity	Diam.	Capacity
33	6398	50	14688	67	26374	84	41455
34	6792	51	15281	68	27167	85	42488
35	7197	52	15887	69	27972	86	43453
36	7614	53	16503	70	28788	87	44469
37	8043	54	17132	71	29617	88	45498
38	8484	55	17772	72	30457	89	46537
39	8936	56	18425	73	31309	90	47589
40	9400	57	19089	74	32173	91	48653
41	9876	58	19764	75	33048	92	49727
42	10364	59	20452	76	33935	93	50815
43	10863	60	21151	77	34834	94	51913
44	11374	61	21862	78	35745	95	53024
45	11897	62	22584	79	36667	96	54146
46	12432	63	23319	80	37601	97	55280
47	12978	64	24065	81	38547	98	56425
48	13536	65	24823	82	39505	99	57583
49	14106	66	25592	83	40474	100	58752

Capacity in Gals of Tank Bottoms

Diam. Feet	Hemispherical Bottom	Elliptical Bottom	Diam. Feet	Hemispherical Bottom	Elliptical Bottom
13	4303	2151	32	64170	32085
14	5376	2688	33	70378	35189
15	6610	3305	34	76976	38488
16	8021	4011	35	83965	41983
17	9622	4811	36	91368	45684
18	11424	5712	37	99197	49599
19	13433	6717	38	107464	53732
20	15666	7833	39	116168	58084
21	18137	9069	40	125333	62667
22	20856	10428	41	134972	67486
23	23828	11914	42	145096	72548
24	27072	13536	43	155703	77851
25	30600	15300	44	166819	83410
26	34424	17212	45	178455	89228
27	38547	19274	46	190624	95312
28	42989	21495	47	203322	101661
29	47763	23881	48	216576	108288
30	52880	26440	49	230398	115199
31	58342	29171	50	244800	122400

The capacities for elliptical bottoms hold good only when the depth is one quarter the diameter.

NUMBER OF U. S. GALL IN RECTANGULAR TANKS

For One Ft in Depth

Width of Tank	Length of Tank																				
	ft 2	ft in 2 6	ft 3	ft in 3 6	ft 4	ft in 4 6	ft 5	ft in 5 6	ft 6	ft in 6 6	ft 7	ft in 7 6	ft 8	ft in 8 6	ft 9	ft in 9 6	ft 10	ft in 10 6	ft 11	ft in 11 6	ft 12
Ft In																					
2	29.82	37.40	44.88	52.36	59.84	67.32	74.81	82.29	89.77	97.25	104.73	112.21	119.69	127.17	134.65	142.13	149.61	157.09	164.57	172.05	179.53
2 6	.....	46.75	56.10	65.45	74.80	84.16	93.51	102.86	112.21	121.56	130.91	140.26	149.61	158.96	168.31	177.66	187.01	196.36	205.71	215.06	224.41
3	.....	.....	67.32	78.54	89.77	100.99	112.21	123.43	134.65	145.87	157.09	168.31	179.53	190.75	202.97	213.19	224.41	235.63	245.86	258.07	269.30
3 6	.....	.....	.....	91.64	104.73	117.82	130.91	144.00	157.09	170.18	183.27	196.36	209.45	222.54	235.63	248.73	261.82	274.90	288.00	301.09	314.18
4	.....	.....	.....	.....	119.69	134.65	149.61	164.57	179.53	194.49	209.45	224.41	239.37	254.34	269.30	284.26	299.22	314.18	329.14	344.10	359.06
4 6	.....	.....	.....	.....	.....	151.48	168.31	185.14	201.97	218.80	235.63	252.47	269.30	286.13	302.96	319.79	336.62	353.45	370.28	387.11	403.94
5	.....	.....	.....	.....	.....	.....	187.01	205.71	224.41	243.11	261.82	280.52	299.22	317.92	336.62	355.32	374.03	392.72	411.43	430.13	448.83
5 6	.....	.....	.....	.....	.....	.....	.....	226.28	246.86	267.43	288.00	308.57	329.14	349.71	370.28	390.85	411.43	432.00	452.57	473.14	493.71
6	.....	.....	.....	.....	.....	.....	.....	.....	269.30	291.74	314.18	336.62	359.06	381.50	403.94	426.39	448.83	471.27	493.71	516.15	538.59
6 6	.....	.....	.....	.....	.....	.....	.....	.....	.....	316.05	340.36	364.67	388.98	413.30	437.60	461.92	486.23	510.54	534.85	559.16	583.47
7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	366.54	392.72	418.91	445.09	471.27	497.45	523.64	549.81	575.99	602.18	628.36
7 6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	420.78	448.83	476.88	504.93	532.98	561.04	589.08	617.14	645.19	673.24
8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	478.75	508.67	538.59	568.51	598.44	628.36	658.28	688.20	718.12
8 6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	540.46	572.25	604.05	635.84	667.63	699.42	731.21	763.00
9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	605.92	639.58	673.25	706.90	740.56	774.23	807.89
9 6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	675.11	710.65	746.17	781.71	817.24	852.77
10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	748.05	785.45	822.86	860.26	897.66
10 6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	824.73	864.00	903.26	942.56
11	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	905.14	946.27	987.43
11 6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	989.29	1032.3
12	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1077.2

Weights of Lead Pipe

Caliber	Weight per Ft		Caliber	Weight per Ft	
	Lbs	Oz		Lbs	Oz
3/32-inch Tubing	..	1¼	7/8-inch Medium	3	..
1/8-inch Tubing	..	3	Strong	3	8
3/16-inch Tubing	..	4	1-inch Aqueduct	1	8
¼-inch Tubing	..	6	Ex. Light	1	..
Fish Seine	..	15	Light	2	8
⅜-inch Aqueduct	..	8	Medium	3	4
Ex. Light	..	9	Strong	4	..
Light	..	12	Ex. Strong	4	12
Medium	1	..	Ex. Ex. Strong	5	8
Strong	1	8	1¼-inch Aqueduct	2	..
Ex. Strong	2	..	Ex. Light	2	8
½-inch Aqueduct	..	10	Light	3	..
Ex. Light	..	12	Medium	3	12
Light	1	..	Strong	4	12
Medium	1	4	Ex. Strong	6	..
Strong	1	12	Ex. Ex. Strong	6	12
A. A.	2	..	1½-inch Aqueduct	3	..
Ex. Strong	2	8	Ex. Light	3	8
Ex. Ex. Strong	3	..	Light	4	..
⅝-inch Aqueduct	..	12	Medium	5	..
Ex. Light	1	4	Strong	6	..
Light	1	12	Ex. Strong	7	8
Medium	2	..	Ex. Ex. Strong	9	..
Strong	2	8	1¾-inch Ex. Light	3	12
Ex. Strong	3	..	Light	4	8
Ex. Ex. Strong	3	8	Medium	5	8
¾-inch Aqueduct	1	..	Strong	6	8
Ex. Light	1	8	Ex. Strong	8	..
Light	2	..	2-inch Waste	3	..
Medium	2	4	Ex. Light	4	..
Strong	3	..	Light	5	..
Ex. Strong	3	8	Medium	7	..
Ex. Ex. Strong	4	..	Strong	8	..
7/8-inch Aqueduct	1	8	Ex. Strong	9	..
Ex. Light	2	..	Ex. Ex. Strong	10	8
Light	2	8	.....	....	....

LEAD PIPE

Weight per LF

Inside Diam.	Thickness in In							
	1/16	1/8	3/16	1/4	3/8	1/2	5/8	3/4
in	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs
3/8	427	.97	1.65	2 44	4.38	....	....	....
1/2	.548	1 21	2 01	2.93	5 11	7.79	....	....
5/8	.670	1.46	2 38	3.42	5.85	8.77	12.2	....
3/4	.791	1 70	2.74	3.90	6 58	9.75	13.4	17.6
7/8	.911	1.95	3.11	4.39	7.31	10.7	14.6	19.1
1	1 03	2.19	3.47	4.88	8.04	11.7	15.8	20.5
1/4	1.28	2.69	4.21	5.85	9.5	13.7	18.3	23.4
1/2	1.52	3.18	4.94	6.83	11.	15.6	20.7	26.3
3/4	1.76	3.67	5.67	7.81	12.4	17.6	23.2	29.3
2	2.01	4.16	6.40	8.78	13.9	19.5	25.6	32.2
1/4	2.25	4.65	7.13	9.76	15.4	21.5	28.1	35.1
1/2	2.49	5.14	7.86	10.7	16.8	23.4	30.5	38.
3/4	2.73	5.63	8.59	11.7	18.3	25.4	32.9	41.
3	2.98	6.12	9.32	12.7	19.7	27.3	35.4	43.9
1/2	3.46	7.10	10.8	14.6	22.7	31 3	40.3	49.7
4	3.95	8.08	12.2	16.6	25.6	35.2	45.2	55.6

CAST IRON PIPES

Weight of a LF

Bore in In	Thickness of Metal in In									
	1/4	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 1/2
	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs
2	5.52	8.74	12.27	16.11	20.25	24.70	29.45	34.52	39.88	51.54
2 1/2	6.75	10.58	14.73	19.18	23.95	28.99	34.36	40.04	46.02	58.91
3	7.93	12.43	17.18	22.24	27.61	32.29	39.27	45.56	52.16	66.27
3 1/2	9.20	14.27	19.64	25.31	31.29	37.58	44.18	51.08	58.29	73.63
4	10.43	16.11	22.09	28.38	34.98	41.88	49.09	56.60	64.43	80.99
4 1/2	11.66	17.95	24.54	31.45	38.66	46.18	54.00	62.13	70.56	88.36
5	12.89	19.79	27.00	34.52	42.34	50.47	58.91	67.65	76.70	95.72
5 1/2	14.11	21.63	29.45	37.58	46.02	54.76	63.81	73.17	82.84	103.08
6	15.34	23.47	31.91	40.65	49.70	59.06	68.72	78.69	88.97	110.45
7	17.79	27.15	36.82	46.79	57.06	67.65	78.54	89.74	101.24	125.17
8	20.25	30.83	41.72	52.92	64.43	76.24	88.36	100.78	113.52	139.90
9	22.70	34.52	46.63	59.06	71.79	84.83	98.18	111.83	125.79	154.63
10	25.16	38.20	51.54	65.19	79.15	93.42	107.99	122.87	138.06	.....
11	27.61	41.88	56.45	71.33	86.52	102.01	117.81	133.92	150.33	.....
12	30.07	45.56	61.36	77.47	93.88	110.60	127.63	144.96	162.60	.....
13	32.52	49.24	66.27	83.60	101.24	119.19	137.45	156.01	174.87	.....
14	34.98	52.92	71.18	89.74	108.61	127.78	147.26	167.05	187.15	.....
15	.....	56.60	76.09	95.87	115.97	136.37	157.08	178.10	199.42	.....
16	.....	60.29	80.99	102.01	123.33	144.96	166.90	189.14	211.69	.....
18	.....	67.65	90.81	114.28	138.06	162.14	186.53	211.23	236.23	.....
20	.....	.....	100.63	126.55	152.79	179.32	206.17	233.32	260.78	.....
22	.....	.....	110.45	138.83	167.51	196.50	225.80	255.41	285.32	.....
24	.....	.....	120.26	151.10	182.24	213.68	245.44	277.50	309.87	.....

Note. For each joint add a ft in length of the pipe.

WEIGHT OF FLAT BAR IRON PER LF

Width in In.	Thickness in In.											
	1/16	1/8	3/16	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1
	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs
1.....	.21	.42	.63	.84	1.05	1.26	1.47	1.68	2.11	2.53	2.95	3.37
1⅛....	.24	.47	.71	.95	1.18	1.42	1.66	1.90	2.37	2.84	3.32	3.79
1¼....	.26	.53	.79	1.05	1.32	1.58	1.84	2.11	2.63	3.16	3.68	4.21
1⅜....	.29	.58	.87	1.16	1.45	1.74	2.03	2.32	2.89	3.47	4.05	4.63
1½....	.32	.63	.95	1.26	1.58	1.90	2.21	2.53	3.16	3.79	4.42	5.05
1⅝....	.34	.68	1.03	1.37	1.71	2.05	2 39	2.74	3.42	4.11	4.79	5.47
1¾....	.37	.74	1.11	1.47	1.84	2.21	2.58	2.95	3.68	4.42	5.16	5.89
1⅞....	.40	.79	1.18	1.58	1.97	2.37	2.76	3.16	3.95	4.74	5.53	6.32
2	.42	.84	1.26	1.68	2.11	2.53	2.95	3.37	4.21	5.05	5.89	6.74
2⅛....	.45	.90	1.34	1.79	2.24	2.68	3.13	3.58	4.47	5.37	6.26	7.16
2¼....	.47	.95	1.42	1.90	2.37	2.84	3.32	3.79	4.74	5.68	6.83	7.58
2⅜....	.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	5.00	6.00	7.00	8.00
2½....	.53	1.05	1.58	2.11	2.63	3.16	3.68	4.21	5.26	6.32	7.37	8.42
2⅝....	.55	1.11	1.66	2.21	2.76	3.32	3.87	4.42	5.53	6.63	7.74	8.84
2¾....	.58	1.16	1.74	2.32	2.89	3.47	4.05	4.63	5.79	6.95	8.10	9.26
3	.63	1.26	1.90	2.5	3.16	3.79	4.42	5.05	6.32	7.58	8.84	10.10
3¼....	.68	1.37	2.05	2.74	3.42	4.11	4.79	5.47	6.84	8.21	9.58	10.95
3½....	.74	1.47	2.21	2.95	3.68	4.42	5.16	5.89	7.37	8.84	10.32	11.79
4	.84	1.68	2.53	3.37	4.21	5.05	5.89	6.74	8.42	10.10	11.79	13.47
4½....	.95	1.90	2.84	3.79	4.74	5.68	6.63	7.58	9.47	11.38	13.26	15.16
5	1.0	2.11	3.16	4.21	5.26	6.32	7.37	8.42	10.53	12.63	14.74	16.84
5½....	1.16	2.32	3.47	4.63	5.79	6.95	8.10	9.26	11.58	13.89	16.21	18.52
6....	1.26	2.53	3.79	5.05	6.32	7.58	8.84	10.10	12.63	15.16	17.68	20.21
6½....	1.36	2.73	4.10	5.47	6.84	8.21	9.58	10.94	13.68	16.42	19.16	21.88
7	1.47	2.94	4.42	5.90	7.36	8.84	10.32	11.79	14.74	17.68	20.64	23.58
7½....	1.58	3.16	4.74	6.32	7.90	9.48	11.06	12.64	15.78	18.94	21.11	25.50
8	1.68	3.36	5.05	6.74	8.42	10.10	11.78	13.48	16.84	20.20	23.58	26.34
8½....	1.79	3.58	5.36	7.16	8.94	10.74	12.52	14.32	17.90	21.48	25.06	28.53
9	1.90	3.79	5.68	7.58	9 48	11.36	13.26	15.16	18.95	22.75	26.52	30.32
9½....	2.00	4.00	6.00	8.00	10.00	12.00	14.00	16.00	20.00	24.00	28.00	32.00
10	2.10	4.21	6.32	8.42	10.52	12.64	14.74	16.84	21.05	25.26	29.48	33.68
10½....	2.21	4.41	6.64	8.84	11.05	13.26	15.48	17.68	22.10	26.52	30.95	35.36
11	2.32	4.64	6.95	9.26	11.58	13.90	16.21	18.52	23.16	27.78	32.42	37.04
11½....	2.42	4.84	7.26	9.68	12.10	14.52	16.94	19.36	24.20	29.06	33.90	38.74
12	2.52	5.05	7.58	10.00	12.64	15.16	17.68	20.20	25.26	30.32	35.36	40.40

WEIGHTS AND DIMENSIONS OF ROUND AND SQ BAR IRON PER RUNNING FT IN LBS

Diam	Wt per ft, lbs		Diam	Wt per ft, lbs		Diam	Wt per ft, lbs		Diam	Wt per ft, lbs	
In	Rd	Sq	In	Rd	Sq	In	Rd	Sq	In	Rd	Sq
1/16..	.01	.0131	1 1/16..	2.975	3.80	2 1/8...	11 9	15.15	4 1/8...	44.85	57.2
1/8...	.0411	.0525	1 1/8...	3.338	4.25	2 1/4...	13 3	17.	4 1/4...	47.54	60.75
3/16..	.0925	.1182	1 3/16..	3.725	4.73	2 3/8...	14.75	18 5	4 3/8...	50.33	64.35
1/4...	.1651	.2103	1 1/4...	4.12	5.25	2 1/2...	16.41	20.5	4 1/2...	53.32	68.
5/16..	.2573	.3200	1 5/16..	4.545	5.78	2 5/8...	18.1	23 1	4 5/8...	56.34	72.
3/8...	.371	.4735	1 3/8...	5.	6.35	2 3/4...	19.85	25.2	4 3/4...	59.44	75.65
7/16..	.505	.6445	1 7/16..	5.455	6.95	2 7/8...	21.5	27.5	4 7/8...	62.62	79.80
1/2...	.657	.84	1 1/2...	5.945	7.55	3 ...	23.7	30.05	5 ...	65.88	83.8
9/16..	.835	1.063	1 9/16..	6.445	8 2	3 1/8...	25.55	32.75	5 1/8...	69.23	88.25
5/8...	1.031	1.314	1 5/8...	6 975	8.85	3 1/4...	27.81	35.5	5 1/4...	72.65	92.5
11/16..	1.235	1.59	1 11/16..	7.52	9.57	3 3/8...	29.85	38.25	5 3/8...	76.18	97.15
3/4...	1.475	1.891	1 3/4...	8.05	10.30	3 1/2...	32.25	41.15	5 1/2...	79 75	101.
13/16..	1.74	2.221	1 13/16..	8.65	11.05	3 5/8...	34.45	44.15	5 5/8...	83.45	105.8
7/8...	2.015	2.575	1 7/8...	9.25	11.83	3 3/4...	37.1	47.20	5 3/4...	87.20	110.5
15/16..	2 317	2.95	1 15/16..	9.9	12.62	3 7/8...	39 5	50.25	5 7/8...	91.50	115.15
1 ...	2.625	3.35	2 ...	10.55	13.4	4 ...	41.95	53.75	6 ...	95.	120.25

For steel, mult tabular number above (for size) by 1-01.

WEIGHT OF MACHINE BOLTS PER HUNDRED

Length	Diameter								
	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1
	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs
1½	3.37	6.00	9.68	13.81	17.62	33.87	.....	.....	.....
1¾	3.81	6.50	10.43	14.68	21.25	35.81	.....	.....	.....
2	4.12	7.00	11.18	15.68	22.43	38.25	59.31	.....	.....
2¼	4.38	7.50	11.68	16.68	23.87	40.25	61.87	.....	.....
2½	4.85	8.00	12.25	17.68	25.37	42.25	65.00	103.12	.....
2¾	5.30	8.50	13.68	18.68	26.50	44.25	68.12	109.38	.....
3	5.80	9.00	14.06	19.68	27.80	46.25	70.62	115.00	.....
3½	6.30	10.00	15.68	21.68	30.40	50.25	76.62	123.00	.....
4	7.25	11.00	17.20	23.68	33.00	54.25	82.62	131.00	177.50
4½	7.90	12.00	18.73	25.68	38.08	58.25	88.62	139.00	188.04
5	8.80	13.00	20.26	27.68	35.48	62.25	94.62	147.00	198.58
5½	9.70	14.00	21.70	29.68	40.68	66.25	100.62	155.00	209.12
6	10.60	15.00	23.20	31.68	43.28	70.25	106.62	163.00	219.66
6½	.....	.....	24.73	33.68	45.88	74.25	112.62	171.00	230.20
7	.....	.....	26.26	35.68	48.48	78.25	118.62	179.00	240.74
7½	.....	.....	27.80	37.68	50.08	82.25	124.62	187.00	251.28
8	.....	.....	29.32	39.68	52.68	86.25	130.62	195.00	261.82
9	.....	.....	.....	43.68	57.88	94.25	142.92	212.00	283.82
10	.....	.....	.....	47.68	63.08	102.25	155.22	229.00	305.82
11	.....	.....	.....	51.68	68.28	110.25	167.52	246.00	327.82
12	.....	.....	.....	55.68	73.88	118.25	179.82	263.00	349.82
13	.....	.....	.....	.....	79.48	126.25	192.12	280.00	371.82
14	.....	.....	.....	.....	85.08	134.25	204.42	297.00	393.82
15	.....	.....	.....	.....	90.68	142.25	216.72	314.00	415.82
16	.....	.....	.....	.....	96.28	150.25	229.02	331.00	437.82
17	.....	.....	.....	.....	101.88	158.25	241.32	348.00	459.82
18	.....	.....	.....	.....	107.48	166.25	253.62	365.00	481.82
19	.....	.....	.....	.....	113.08	174.25	265.92	382.00	503.82
20	.....	.....	.....	.....	118.68	182.25	278.22	399.00	525.82

WEIGHT OF LAG SCREWS PER HUNDRED

Length	Diameter								
	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1
	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs
1½	4.75	7.10	9.88	13.90	.....	.....	.....	.....	.....
1¾	5.25	7.60	10.87	14.95	.....	.....	.....	.....	.....
2	5.75	8.10	11.63	15.80	24.	26.25	.....	.....	.....
2¼	6.25	8.70	12.50	16.90	25.	27.75	.....	.....	.....
2½	6.75	9.35	13.40	17.90	26.	29.25	46.50	.....	.....
3	7.75	10.65	15.10	19.87	28.	33.50	51.50	73.	.....
3½	8.75	11.95	16.50	22.	31.	36.50	56.50	79.	103.
4	9.75	13.30	18.60	24.30	34.	39.50	61.50	85.	112.
4½	10.75	14.70	20.40	26.87	37.	42.20	67.	91.	121.
5	11.75	16.10	22.10	29.	40.	46.	72.25	97.	130.
5½	12.75	17.50	23.80	31.50	43.	49.40	78.	103.	140.
6	13.75	18.90	25.50	34.	46.	53.	83.50	110.	150.
7	.....	.....	29.25	39.	52.	60.	94.	125.	170.
8	.....	.....	33.00	44.	58.	67.50	104.50	140.	190.
9	.....	.....	.....	49.	64.	75.	115.	156.	210.
10	.....	.....	.....	54.	70.	82.50	126.	172.	230.
11	.....	.....	.....	.....	76.	90.	137.	188.	250.
12	.....	.....	.....	.....	82.	98.	148.	204.	270.

MACHINE BOLTS

With Square Heads, Square Nuts and Finished Points
List Aug. 1, 1912. Price per 100. Discount Aug., 1913, 75 per cent.

Length Inches	¼	5/16	⅜	7/16	½	9/16 and ⅝	¾	⅞	1	1⅛	1¼
¾ to 1½	$1.70	$2.00	$2.40	$2.80	$3.60	$5.20	$7.70	$10.50	$15.10	$22.50	$30.00
2	1.78	2.12	2.56	3.00	3.86	5.58	8.25	11.20	16.00	23.70	31.50
2½	1.86	2.24	2.72	3.20	4.12	5.96	8.80	11.90	16.90	24.90	33.00
3	1.94	2.36	2.88	3.40	4.38	6.34	9.35	12.60	17.80	26.10	34.50
3½	2.02	2.48	3.04	3.60	4.64	6.72	9.90	13.30	18.70	27.30	36.00
4	2.10	2.60	3.20	3.80	4.90	7.10	10.45	14.00	19.60	28.50	37.50
4½	2.18	2.72	3.36	4.00	5.16	7.48	11.00	14.70	20.50	29.70	39.00
5	2.26	2.84	3.52	4.20	5.42	7.86	11.55	15.40	21.40	30.90	40.50
5½	2.34	2.96	3.68	4.40	5.68	8.24	12.10	16.10	22.30	32.10	42.00
6	2.42	3.08	3.84	4.60	5.94	8.62	12.65	16.80	23.20	33.30	43.50
6½	2.50	3.20	4.00	4.80	6.20	9.00	13.20	17.50	24.10	34.50	45.00
7	2.58	3.32	4.16	5.00	6.46	9.38	13.75	18.20	25.00	35.70	46.50
7½	2.66	3.44	4.32	5.20	6.72	9.76	14.30	18.90	25.90	36.90	43.00
8	2.74	3.56	4.48	5.40	6.98	10.14	14.85	19.60	26.80	38.10	49.50
9	2.90	3.80	4.80	5.80	7.50	10.90	15.95	21.00	28.60	40.50	52.50
10	3.06	4.04	5.12	6.20	8.02	11.66	17.05	22.40	30.40	42.90	55.50
11	3.22	4.28	5.44	6.60	8.54	12.42	18.15	23.80	32.20	45.30	58.50
12	3.38	4.52	5.76	7.00	9.06	13.18	19.25	25.20	34.00	47.70	61.50
13	3.54	4.76	6.08	7.40	9.58	13.94	20.35	26.60	35.80	50.10	64.50
14	3.70	5.00	6.40	7.80	10.10	14.70	21.45	28.00	37.60	52.50	67.50
15	3.86	5.24	6.72	8.20	10.62	15.46	22.55	29.40	39.40	54.90	70.50
16	4.02	5.48	7.04	8.60	11.14	16.22	23.65	30.80	41.20	57.30	73.50
17	4.18	5.72	7.36	9.00	11.66	16.98	24.75	32.20	43.00	59.70	76.50
18	4.34	5.96	7.68	9.40	12.18	17.74	25.85	33.60	44.80	62.10	79.50
19	4.50	6.20	8.00	9.80	12.70	18.50	26.95	35.00	46.60	64.50	82.50
20	4.66	6.44	8.32	10.20	13.22	19.26	28.05	36.40	48.40	66.90	85.50
21	....	....	....	....	....	....	29.15	37.80	50.20	69.30	88.50
22	....	....	....	....	....	....	30.25	39.20	52.00	71.70	91.50
23	....	....	....	....	....	....	31.35	40.60	53.80	74.10	94.50
24	....	....	....	....	....	....	32.45	42.00	55.60	76.50	97.50
25	....	....	....	....	....	....	33.55	43.40	57.40	78.90	100.50
26	....	....	....	....	....	....	34.65	44.80	59.20	81.30	103.50
27	....	....	....	....	....	....	35.75	46.20	61.00	83.70	106.50
28	....	....	....	....	....	....	36.85	47.60	62.80	86.10	109.50
29	....	....	....	....	....	....	37.95	49.00	64.60	88.50	112.50
30	....	....	....	....	....	....	39.05	50.40	66.40	90.90	115.50

The following extras are to be understood as a part of the above list:
Bolts with Hexagon Heads or Hexagon Nuts, 10 per cent. extra.
If both Hexagon Heads and Hexagon Nuts, 20 per cent. extra.
Joint Bolts with Oblong Nuts, 10 per cent. extra.
Bolts with Tee Heads, Askew Heads and Eccentric Heads, 20 per cent. extra.
Key Bolts, 20 per cent. extra.
Bolts with Cotter Holes, 25 per cent. extra.
Special bolts with irregular Threads and unusual dimensions of Heads or Nuts wil be charged extra, at the discretion of the manufacturer.
Machine Bolts when fitted with U. S. Standard Square Nuts, add 5 per cent.
Machine Bolts when fitted with U. S. Standard Hexagon Nuts, add 15 per cent.
Machine bolts packed other than standard packing to be charged extra at discretion of manufacturer.

NUMBER OF RIVETS IN 100 LBS

Length Rivets	Diameter of Rivets											
	1/8	3/16	1/4	5/16	3/8	7/16	1/2	5/8	11/16	3/4	7/8	1
1/2	17500	15900	8000	5100	3200	1900	.....	.....	.....	.....	.....	.....
5/8	16000	13800	7000	4500	2900	1800	.....	.....	.....	.....	.....	.....
3/4	14400	12200	6300	4100	2373	1476	1103	642	.....	.....	.....	.....
7/8	13500	10900	5700	3700	2190	1371	1030	604	.....	.....	.....	.....
1	12000	9800	5200	3400	2034	1280	968	571	400	345	.....	.....
1 1/8	11600	9000	4700	3100	1898	1200	910	541	382	322	208	.....
1 1/4	10800	8300	4400	2900	1780	1129	862	514	365	311	206	.....
1 3/8	10000	7600	4100	2700	1675	1066	815	489	350	295	204	.....
1 1/2	9300	7100	4000	2500	1582	1010	776	462	335	284	201	.....
1 5/8	8700	.....	3800	2300	1498	960	740	446	324	275	199	132
1 3/4	8100	6300	3500	2200	1424	914	707	428	311	266	192	128
1 7/8	.....	.....	3400	2000	1356	872	672	411	302	257	185	124
2	.....	5600	3000	1900	1295	834	648	395	293	249	178	120
2 1/8	.....	.....	.....	.....	1238	800	623	381	285	240	172	116
2 1/4	.....	5000	2800	1800	1187	768	599	367	277	233	167	112
2 3/8	.....	.....	.....	.....	1139	738	577	354	269	226	162	108
2 1/2	.....	4600	2500	1700	1095	711	556	343	261	219	157	104
2 5/8	.....	.....	.....	.....	1052	687	537	332	253	212	152	100
2 3/4	.....	4200	2300	1500	1017	662	519	321	245	206	148	96
2 7/8	.....	.....	.....	.....	982	636	503	311	237	201	144	92
3	.....	3900	2200	1400	949	611	487	302	230	196	140	88
3 1/4	.....	3600	2000	1300	890	581	459	285	218	186	132	85
3 1/2	.....	3400	1900	1200	837	548	433	270	208	177	126	82
3 3/4	.....	3200	1800	1175	791	519	411	257	198	168	120	79
3 7/8	.....	.....	.....	.....	.....	.....	395	250	195	165	119	.....
4	.....	3000	1700	1100	749	400	390	244	189	161	115	77
4 1/4	.....	.....	1600	1050	700	.....	372	233	180	155	111	75
4 1/2	.....	.....	1500	1000	650	.....	355	223	172	149	105	73
4 3/4	.....	.....	1475	925	625	.....	339	214	166	143	101	71
5	.....	.....	1400	900	600	.....	325	205	160	136	97	69
5 1/4	.....	.....	1350	850	575	.....	312	197	154	131	94	67
5 1/2	.....	.....	1300	825	550	.....	300	190	149	127	91	65
5 3/4	.....	.....	1250	775	525	.....	289	183	144	123	88	63
6	.....	.....	1200	750	500	.....	279	177	139	118	85	61
6 1/4	.....	.....	.....	.....	.....	.....	.....	171	135	114	82	59
6 1/2	.....	.....	.....	.....	.....	.....	.....	165	131	110	79	57
6 3/4	.....	.....	.....	.....	.....	.....	.....	160	127	107	77	55
7	.....	.....	.....	.....	.....	.....	.....	155	123	104	75	53
7 1/4	.....	.....	.....	.....	.....	.....	.....	150	119	100	73	51
7 1/2	.....	.....	.....	.....	.....	.....	.....	146	116	97	71	49
7 3/4	.....	.....	.....	.....	.....	.....	.....	142	113	94	69	47
8	.....	.....	.....	.....	.....	.....	.....	138	110	92	67	45

The measure of countersunk head rivets is over all. All other styles are measured from under the head. Boiler rivets less than 1 inch long are ½ cent per lb extra. Tank rivets 7/16 inch in diam and less are sold at a list price and subject to discount.

ESTABLISHED WEIGHTS OF GALV SHEETS

U. S. Stand Gauge	10	12	14	16	18	20	22	24	25	26	27	28	29	30
Wgt. per sf lbs	5.781	4.531	3.281	2.656	2.156	1.656	1.406	1.156	1.031	.9062	.8437	.7812	.7187	.6562
Wgt. per sf oz	92.5	72.5	52.5	42.5	34.5	26.5	22.5	18.5	16.5	14.5	13.5	12.5	11.5	10.5
Size of Sheet	Weight of Sheet—Pounds													
24x 72	69	54	39	32	26	20	17	14	12	11	10	9	9	8
24x 84	81	63	46	37	30	23	20	16	14	13	12	11	10	9
24x 96	93	73	53	43	35	27	23	19	17	15	14	13	12	11
24x120	116	91	66	53	43	33	28	23	21	18	17	16	14	13
26x 72	75	59	43	35	28	22	18	15	13	12	11	10	9	9
26x 84	88	69	50	40	33	25	21	18	16	14	13	12	11	10
26x 96	100	79	57	46	37	29	24	20	18	16	15	14	12	11
26x120	125	98	71	58	47	36	30	25	22	20	18	17	16	14
28x 72	81	63	46	37	30	23	20	16	14	13	12	11	10	9
28x 84	94	74	54	43	35	27	23	19	17	15	14	13	12	11
28x 96	108	85	61	50	40	31	26	22	19	17	16	15	13	12
28x120	135	106	77	62	50	39	33	27	24	21	20	18	17	15
30x 72	87	68	49	40	32	25	21	17	15	14	13	12	11	10
30x 84	101	79	57	46	38	29	25	20	18	16	15	14	13	11
30x 96	116	91	66	53	43	33	28	23	21	18	17	16	14	13
30x120	145	113	82	66	54	41	35	29	26	23	21	20	18	16
36x 72	104	82	59	48	39	30	25	21	19	16	15	14	13	12
36x 84	121	95	69	55	45	35	30	24	22	19	18	16	15	14
36x 96	139	109	79	64	52	40	34	28	25	22	20	19	17	16
36x120	173	136	98	80	65	50	42	35	31	27	25	23	22	20
42x 72	121	95	71	56	45	34	29	24	22	19	18	16	15	14
42x 84	142	111	80	65	53	41	34	28	25	22	21	19	18	16
42x 96	162	127	92	74	60	46	39	32	29	25	24	22	20	18
42x120	202	159	115	93	75	58	49	41	36	33	29	27	25	23
48x 72	139	109	79	64	52	40	34	28	25	22	20	19	17	16
48x 84	162	125	92	74	60	46	39	32	29	25	24	22	20	18
48x 96	185	145	105	85	69	55	45	37	33	29	27	25	23	21
48x120	231	181	131	106	86	66	56	46	41	36	34	31	29	
Price per lb	12c	12c	12c	12c	13c	13c	14c	14c	15c	15c	16c	17c	19c	21c

LARGE SIZES

No. 18 and heavier. Extra	
Over 36″ to 40″ wide, inc.....	$0.01
Over 40″ to 44″ wide, inc.....	.01½
Over 44″ to 48″ wide, inc.....	.02½

No. 19 and lighter. Extra	
Less than 24″ wide to 12″.....	$0.01
Over 32″ to 36″ wide, inc.....	.01
Over 36″ to 40″ wide, inc.....	.02
Over 40″ to 44″ wide, inc.....	.03
Over 44″ to 48″ wide, inc.....	.05

WEIGHT OF CORRUGATED SHEETS

Per Sq

BLACK			GALVANIZED		
Gauge No.	2″ 2½″ 3′ Corrug	1¼″ Corrug	2″ 2½″ 3″ Corrug	1¼″ Corrug	
16	271 lbs	.....	286 lbs	.....	Sheets 25″ and 26″ wide after corrugating cover 24″ (approximately). 2″ corrugations furnished in No. 18 and lighter. ⅝″ corrugations furnished in No. 24 and lighter. 3/15″ corrugations furnished in No. 26 and lighter.
18	217 lbs	.....	232 lbs	.....	
20	163 lbs	170	178 lbs	185	
21	150 lbs	156	165 lbs	.....	
22	136 lbs	142	151 lbs	157	
23	123 lbs	128	138 lbs	.....	
24	110 lbs	114	124 lbs	129	
25	96 lbs	100	111 lbs	.....	
26	83 lbs	86	98 lbs	101	
27	76 lbs	79	91 lbs	94	
28	68 lbs	72	85 lbs	87	

NUMBER OF SHEETS IN 1 SQ

100 Sq Ft

Corrug	Width Flat	Width after Corrug	Length of Sheet				
			72″	84″	96″	108″	120″
2″ 2½″ 3″	28″	26″	7.692	6.593	5.769	5.128	4.616
1¼″	28″	25″	8.000	6.857	6.000	5.333	4.800

TABLE NO. 17

(Courtesy Sturtevant Co.)

WEIGHT OF ROUND GALVANIZED STEEL PIPE AND ELBOWS, OF THE PROPER GAUGES FOR HEATING AND VENTILATING SYSTEMS

Gauge and Wt. per Sq. Foot	Diam of Pipe	Area in Sq Ins	Weight per Running Foot	Weight of Full Elbow	Gauge and Wt. per Sq. Foot	Diam of Pipe	Area in Sq Ins	Weight per Running Foot	Weight of Full Elbow
	3	7.1	0.7	0.4		36	1017 9	17 2	124.4
	4	12.6	1.1	0.9		37	1075.2	17.8	131.4
No. 24	5	19.6	1.2	1.2		38	1134 1	18 2	139.4
	6	28.3	1.4	1.7		39	1194.6	18.7	146.0
0.78	7	38.5	1.7	2.3	No. 20	40	1256.6	19.1	152.9
	8	50.3	1.9	2.9		41	1320.3	19.6	160.7
					1.66	42	1385.4	20.1	168.6
	9	63.6	2.4	4.3		43	1452.2	20.6	176.7
No. 26	10	78.5	2.7	5.3		44	1520.5	21.0	185.0
	11	95.0	2.9	6.4		45	1590.4	21.5	193 4
0.91	12	113.1	3.2	7.6		46	1661.9	22.0	202.2
	13	132.7	3.4	8.9					
	14	153.9	3.7	10.4		47	1734.9	29.2	274 3
						48	1809.6	29.8	286.6
						49	1885.7	30.4	298 8
	15	176.7	4.5	13.5		50	1963.5	31.0	309.9
	16	201.1	4.7	15.1		51	2042.8	31.6	322.5
No. 25	17	227.0	5.0	17.0		52	2123.7	32.2	335.1
	18	254.5	5.3	19.1	No. 18	53	2206.2	33 0	349.7
1.03	19	283.5	5.6	21.4		54	2290.2	33.6	363.4
	20	314.2	6.0	23.9	2.16	55	2375.8	34.4	377.2
						56	2463.0	34.9	390.7
						57	2551.8	35.6	405.1
	21	346.4	7.0	29.6		58	2642.1	36.1	418.8
	22	380.1	7.3	32.3		59	2734.0	36 7	433 1
No. 24	23	415.5	7.7	35 6		60	2827.4	37.4	448.6
	24	452.4	8.0	38 6					
1.16	25	490.9	8.3	41.7					
	26	530.9	8.7	45.1		61	2922.5	46.7	569.7
						62	3019.1	47.5	589.0
						63	3117.3	48.3	608.6
	27	572.6	10.9	59.1		64	3217.0	49.1	628.5
	28	615.7	11.4	64.2	No. 16	65	3318.3	49.8	647.4
	29	660.5	11.8	68.6		66	3421.2	50.5	666.6
No. 22	30	706.9	12.2	73.4	2.66	67	3525.7	51.3	687.4
	31	754.8	12.6	78.3		68	3631.7	52.1	708.6
1.41	32	804.3	13.0	83.4		69	3739.3	52.8	728.6
	33	855.3	13.5	88.9		70	3848.5	53.6	750.4
	34	907.9	13.9	94.3		71	3959.2	54.3	771.0
	35	962.1	14.3	99.9		72	4071.5	55.1	793.4

Table No. 18

(Courtesy Sturtevant Co.)

Factors for Reducting the Weight of Galvanized Steel Pipe of one Gauge to that of another Gauge

Gauge	Gauge and Weight in Pounds per Square Foot																
	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	4.53	3.91	3.28	2.97	2.66	2.41	2.16	1.90	1.66	1.53	1.41	1.28	1.16	1.03	0.91	0.84	0.78
12	1.00	0.86	0.72	0.66	0.59	0.53	0.48	0.42	0.37	0.34	0.31	0.28	0.26	0.23	0.20	0.19	0.17
13	1.16	1.00	0.84	0.76	0.68	0.62	0.55	0.49	0.43	0.39	0.36	0.33	0.30	0.26	0.23	0.22	0.20
14	1.38	1.19	1.00	0.91	0.81	0.74	0.66	0.58	0.51	0.47	0.43	0.39	0.35	0.32	0.28	0.26	0.24
15	1.53	1.32	1.10	1.00	0.90	0.81	0.73	0.64	0.56	0.52	0.48	0.43	0.39	0.35	0.31	0.28	0.27
16	1.70	1.47	1.23	1.11	1.00	0.91	0.81	0.71	0.62	0.58	0.53	0.48	0.44	0.39	0.34	0.32	0.29
17	1.88	1.62	1.36	1.23	1.10	1.00	0.90	0.79	0.69	0.63	0.59	0.53	0.48	0.43	0.38	0.35	0.32
18	2.10	1.81	1.52	1.38	1.23	1.12	1.00	0.88	0.77	0.71	0.65	0.59	0.54	0.48	0.42	0.39	0.36
19	2.38	2.06	1.73	1.56	1.40	1.27	1.14	1.00	0.87	0.81	0.74	0.67	0.61	0.54	0.48	0.44	0.41
20	2.72	2.36	1.98	1.79	1.60	1.45	1.30	1.16	1.00	0.92	0.85	0.77	0.70	0.62	0.55	0.51	0.47
21	2.96	2.56	2.14	1.94	1.74	1.57	1.41	1.24	1.09	1.00	0.92	0.84	0.76	0.67	0.59	0.55	0.51
22	3.21	2.77	2.32	2.10	1.89	1.71	1.53	1.35	1.18	1.08	1.00	0.91	0.82	0.73	0.65	0.60	0.55
23	3.54	3.07	2.56	2.32	2.08	1.88	1.69	1.49	1.30	1.20	1.10	1.00	0.91	0.81	0.71	0.66	0.61
24	3.90	3.37	2.82	2.56	2.29	2.08	1.86	1.61	1.43	1.32	1.22	1.10	1.00	0.89	0.78	0.72	0.67
25	4.40	3.79	3.18	2.88	2.58	2.34	2.10	1.86	1.61	1.49	1.37	1.24	1.12	1.00	0.88	0.82	0.76
26	4.98	4.30	3.60	3.26	2.92	2.65	2.37	2.10	1.82	1.68	1.55	1.41	1.27	1.13	1.00	0.92	0.86
27	5.40	4.66	3.90	3.54	3.17	2.87	2.57	2.28	1.96	1.82	1.68	1.52	1.38	1.23	1.08	1.00	0.93
28	5.81	5.01	4.20	3.80	3.41	3.09	2.77	2.45	2.13	1.96	1.81	1.64	1.49	1.32	1.17	1.08	1.00

Note. In table 17 the weight as given include the weights of rivets and solder, and due allowance has been made for laps and trimmings. The elbows have the internal radius equal to the diameter of the pipe. Rectangular pipes are usually made of the same gauge as round pipes of equivalent area.

The table above serves for the estimation of weights of pipe of gauges other than those given in table 17. Thus, suppose it is desired to find the weight of 28 inch pipe made of No. 16 gauge. From table 17, pipe of this size made of No. 22 gauge weighs 11.4 pounds per running foot. By the table above, the figure found at the junction of the column headed 16 and the line designated 22 is 1.89; therefore, the weight per foot of No. 16 gauge is 11.4x1.89=21.55 pounds.

In ordinary heating and ventilating practice, it is customary to make round pipe in its various sizes upon gauges as follows:

Under 9 in, No. 28 gauge; 9 to 14 in, No. 26; 15 to 20 in, No. 25; 21 to 26 in, No. 24; 27 to 35 in, No. 22; 36 to 46 in, No. 20; 47 to 60 in, No. 18, and all sizes above 60 in of No. 16 gauge. If the pipe is made much lighter, particularly in the larger sizes, it will not keep its shape when laid horizontally, thereby seriously affecting the tightness of the joints and decreasing the area.

ESTIMATED WEIGHTS OF BLACK SHEETS

U. S. Standard Gauge. Weight per Sheet in Lbs.

U. S. Gauge	10	12	14	15	16	18	20	22	24	26	27	28	29	30
Lbs per SF	5.625	4.375	3.125	2.812	2.50	2.00	1.50	1.25	1.00	.75	.6875	.625	.5625	.50
Thickness In	1/64	1/64	1/64	9/128	1/16	1/20	3/80	1/32	1/40	3/160	11/640	1/64	9/640	1/80
24x 96	90.00	70.00	50.00	45.00	40.00	32.00	24.00	20.00	16.00	12.00	11.00	10.00	9.00	8.00
101	94.69	73.65	52.60	47.34	42.08	33.67	25.25	21.04	16.84	12.63	11.57	10.52	9.47	8.42
108	101.25	78.75	56.25	50.63	45.00	36.00	27.00	22.50	18.00	13.50	12.38	11.25	10.13	9.00
120	112.50	87.50	62.50	56.25	50.00	40.00	30.00	25.00	20.00	15.00	13.75	12.50	11.25	10.00
138	129.38	100.63	71.88	64.69	57.50	46.00	34.50	28.75	23.00	17.25	15.81	14.38	.....	.....
144	135.00	105.00	75.00	67.50	60.00	48.00	36.00	30.00	24.00	18.00	16.50	15.00	.....	.....
26x 96	97.50	75.83	54.17	48.75	43.33	34.67	26.00	21.67	17.34	13.00	11.92	10.83	9.75	8.67
101	102.58	79.78	57.00	51.29	45.59	36.47	27.35	22.79	18.24	13.68	12.54	11.40	10.26	9.12
108	109.69	85.31	60.94	54.84	48.75	39.00	29.25	24.37	19.50	14.63	13.41	12.19	10.97	9.75
120	121.88	94.79	67.71	60.94	54.17	43.33	32.50	27.08	21.67	16.25	14.90	13.54	12.19	10.83
138	140.16	109.01	77.87	70.08	62.29	49.83	37.38	31.15	24.92	18.69	17.13	15.57	.....	.....
144	146.25	113.75	81.25	73.13	65.00	52.00	39.00	32.50	26.00	19.50	17.88	16.25	.....	.....
28x 96	105.00	81.67	58.33	52.50	46.67	37.33	28.00	23.33	18.67	14.00	12.83	11.67	10.50	9.33
101	110.47	85.92	61.37	55.23	49.09	39.28	29.46	24.55	19.64	14.73	13.50	12.27	11.05	9.82
108	118.13	91.88	65.63	59.06	52.50	42.00	31.50	26.25	21.00	15.75	14.44	13.13	11.81	10.50
120	131.25	102.08	72.92	65.63	58.33	46.67	35.00	29.17	23.33	17.50	16.04	14.58	13.13	11.67
30x 96	112.50	87.50	62.50	56.25	50.00	40.00	30.00	25.00	20.00	15.00	13.75	12.50	11.25	.....
101	118.36	92.06	65.76	59.18	52.60	42.08	31.56	26.30	21.04	15.78	14.47	13.15	.....	.....
108	126.56	98.44	70.31	62.69	56.25	45.00	33.75	29.12	22.50	16.88	15.47	14.06	.....	.....
120	140.63	109.38	78.13	70.31	62.50	50.00	37.50	31.25	25.00	18.75	17.19	15.63	.....	.....
138	161.72	125.78	89.84	80.86	71.88	57.50	43.13	35.94	28.75	21.56	19.77	17.97	.....	.....
144	168.75	131.25	93.75	84.38	75.00	60.00	45.00	37.50	30.00	22.50	20.63	18.75	.....	.....
36x 77	108.28	84.22	60.17	54.14	48.13	38.50	28.88	24.06	19.25	14.44	13.23	12.03	.....	.....
96	135.00	105.00	75.00	67.50	60.00	48.00	36.00	30.00	24.00	18.00	16.50	15.00	.....	.....
108	151.88	118.13	84.38	75.94	67.50	54.00	40.50	33.75	27.00	20.25	18.56	16.88	.....	.....
120	168.75	131.25	93.75	84.38	75.00	60.00	45.00	37.50	30.00	22.50	20.63	18.75	.....	.....
138	194.06	145.47	107.81	97.03	86.25	69.00	51.75	43.13	34.50	25.88	23.72	21.56	.....	.....
144	202.50	157.50	112.50	101.25	90.00	72.00	54.00	45.00	36.00	27.00	24.75	22.50	.....	.....
42x 77	126.33	98.26	70.18	63.16	56.14	44.92	33.69	28.07	22.46	16.84	15.44	14.04	.....	.....
96	157.50	122.50	87.50	78.75	70.00	56.00	42.00	35.00	28.00	21.00	19.25	17.50	.....	.....
108	177.19	137.81	98.44	88.59	78.75	63.00	47.25	39.37	31.50	23.63	21.66	19.69	.....	.....
120	196.88	153.13	109.38	98.44	87.50	70.00	52.51	43.75	35.00	26.25	24.06	21.88	.....	.....
138	226.41	176.09	125.78	113.20	100.63	80.50	60.38	50.31	40.25	30.19	27.67	25.16	.....	.....
144	236.25	183.75	131.25	118.13	105.00	84.00	63.00	52.50	42.00	31.50	28.88	26.24	.....	.....
48x 77	144.38	112.29	80.21	72.19	64.17	51.33	38.50	32.08	25.67	19.25	17.65	16.04	.....	.....
96	180.00	140.00	100.00	90.00	80.00	64.00	48.00	40.00	32.00	24.00	22.00	20.00	.....	.....
108	202.50	157.50	112.50	101.25	90.00	72.00	54.00	45.00	36.00	27.00	24.75	22.50	.....	.....
120	225.00	175.00	125.00	112.50	100.00	80.00	60.00	50.00	40.00	30.00	27.50	25.00	.....	.....
138	258.75	201.25	143.75	129.38	115.00	92.00	69.00	57.50	46.00	34.50	31.63	28.75	.....	.....
144	270.00	210.00	150.00	135.00	120.00	96.00	72.00	60.00	48.00	36.00	33.00	30.00	.....	.....
54x 77	162.42	126.33	90.26											
96	201.50	157.50	112.50											
108	227.82	177.20	126.57											
120	253.13	196.88	140.63											
138	291.09	218.21	161.71											
144	303.75	236.25	168.75											
60x 77	180.48	140.36												
96	225.00	175.00												
108	253.12	196.88												
120	281.26	219.36												
138	328.44	251.56												
144	337.50	262.50												

NOTE

Above estimated weights are based on U. S. standard gauge for Iron. For steel, add 2%. These figures are given for convenience in estimating only, and may vary somewhat in actual practice. The sizes below the heavy black line will probably considerably exceed the weights given, and it is safe, therefore, to allow for an overweight of at least 10%.

ROUND COPPER RODS

Weight per Ft

Diameter	Wgt per ft in length	Diameter	Wgt per ft in lengths
3/8"	.424 lbs.	1 1/4"	4.71 lbs.
1/2"	.755 lbs.	1 3/8"	5.71 lbs.
5/8"	1.19 lbs.	1 1/2"	6.79 lbs.
3/4"	1.69 lbs.	1 5/8"	7.94 lbs.
7/8"	2.31 lbs.	1 3/4"	9.21 lbs.
1"	3.02 lbs.	1 7/8"	10.61 lbs.
1 1/8"	3.82 lbs.	2"	12.08 lbs.

METALS

Weight per Sq Ft

Thickness	Wro't Iron	Cast Iron	Steel	Copper	Brass	Lead	Zinc
	lbs	lbs	lbs	lbs	lbs	lbs	lbs
1/16"	2.51	2.34	2.55	2.89	2.67	3.69	2.34
1/8"	5.03	4.69	5 10	5.78	5.35	7.38	4.68
3/16"	7.58	7.03	7.66	8.67	8.02	11.07	7.02
1/4"	10.07	9.38	10.21	11.56	10.7	14.76	9.36
5/16"	12.58	11.73	12.71	14.45	13.37	18.45	11.7
3/8"	15.10	14.07	15.31	17.34	16.05	22.14	14.04
7/16"	17.62	16.42	17.87	20.23	18.72	25.83	16.34
1/2"	20.14	18.77	20.42	23.12	21.4	29.53	18.72
9/16"	22.65	21.11	22.97	26.01	24.07	33.22	21.08
5/8"	25.17	23.46	25.52	28.90	26.75	36.91	23.44
11/16"	27.69	25.81	28.08	31.97	29.42	40.60	25.80
3/4"	30.21	28.15	30.63	34.68	32.1	44.29	28.13
13/16"	32.72	30.50	33.18	37.57	35.19	47.98	30.49
7/8"	35.24	32.85	35.73	40.69	38.28	51.67	32.81
15/16"	37.76	35.19	28.28	43.35	41.37	55.37	35.17
1"	40.28	37.54	40.83	46.25	43.75	59.06	37.50

BRICK:—Common brick of the national size weigh from 4½ to 5 lbs; pressed and paving, from 6 to 7, depending upon clay, burning and size.

LIME:—On the basis of 53 lbs to the cf lime weighs about 66 lbs to the bushel, but in bulk it is often sold on the basis of 80 lbs or 200 lbs to the bbl of 2½ bushels.

WEIGHTS OF VARIOUS SUBSTANCES PER CU FT

Names of Substances	Average Wgt, Lbs
Ash, American White, Dry	38
Asphaltum	87
Brass (Copper and Zinc) Cast	504
Brass Rolled	524
Brick, Best Pressed	150
Brick, Common Hard	125
Brick, Soft, Inferior	100
Brick, Fire	137
Brickwork, Pressed Brick	140
Brickwork, Ordinary	112

Names of Substances	Average Wgt. Lbs
Cement, Hydraulic, Ground, Loose, American, Rosendale	56
Cement, Hydraulic, Ground, Loose, American, Louisville	50
Cement, Hydraulic, Ground, Loose, English, Portland	90
Cherry, Dry	42
Chestnut, Dry	41
Concrete	140
Copper, Cast	543
Copper, Rolled	548
Ebony, Dry	76
Elm, Dry	35
Flint	162
Glass, Common Window	157
Gneiss, Common	168
Granite	170
Gravel, about the same as Sand, which see	
Hemlock, Dry	25
Hickory, Dry	53
Ice	50 to 58
Iron, Cast	450
Iron, Wrt, Purest	485
Iron, Wrt, Average	480
Lead	711
Lime, Quick, Ground, Loose, or in Small Lumps	53
Lime, Quick, Ground, Loose, Thoroughly Shaken	75
Lime, Quick, Ground, Loose, Per Struck Bushel	66
Limestones and Marbles	168
Limestones and Marbles, Loose, in Irregular Fragments	96
Mahogany, Spanish, Dry	53
Mahogany, Honduras, Dry	35
Maple, Dry	49
Marbles, see Limestones.	
Masonry, of Granite or Limestone, well dressed	165
Masonry, of Mortar Rubble	154
Masonry, of Dry Rubble (well Scabbled)	138
Masonry, of Sandstone, well dressed	144
Mortar, Hardened	103
Oak, Live, Dry	59
Oak, White, Dry	52
Oak, Other Kinds	32 to 45
Pine, White, Dry	25
Pine, Yellow, Northern	34
Pine, Yellow, Southern	45
Plaster of Paris	74
Quartz, Common, Pure	165
Sand, of Pure Quartz, Dry, Loose	90 to 106
Sand, Well Shaken	99 to 117
Sand, Perfectly Wet	120 to 140
Sandstones, Fit for Building	151
Shales, Red or Black	162
Slate	175
Snow, freshly fallen	5 to 12
Snow, Moistened and Compacted by Rain	15 to 50
Spruce, Dry	25
Steel	490
Sycamore, Dry	37
Tar	62
Tin, Cast	459
Walnut, Black, Dry	38
Water, Pure Rain or Distilled, at 60° Fahrenheit	62½
Water, Sea	64
Zinc or Spelter	437

Green Timbers usually weigh from one-fifth to one-half more than dry.

WEIGHT OF WINDOWS

There are so many scores of different sizes and thicknesses that it is best to refer to millbook for weight. A fair idea is given in chapter on millwork.

WEIGHTS OF FOUR PANEL PINE DOORS

SIZE	THICKNESS			
	1″	1⅛″	1⅜″	1¾″
2′0″x6′0″	17	22	33	45
2′4″x6′4″	21	27	35	48
2′6″x6′6″	23	29	36	53
2′8″x6′8″	24	31	42	56
2′10″x6′10″		33	44	53
3′0″x7′0″		35	42	
3′0″x7′6″				

For moulded doors add to above five pounds for each side moulded.

Approx weights of veneered hardwood doors.
1⅜″ thick, 3 lbs to the sf 1¾″ thick, 3½ lbs to the sf 2¼″ thick, 4½ lbs to the sf

SQUARE COLUMNS

	4x4	4x4	4x4	5x5	5x5	5x5	6x6	6x6	6x6
	8–0	9–0	10–0	8–0	9–0	10–0	8–0	9–0	10–0
Poplar....	18	24	27	38	44	52	50	70	79
Fir.....	22	25	28	42	49	65	56	75	82

BUILT UP COLS

	8x8	8x8	8x8	10x10	10x10	10x10
	8–0	9–0	10–0	8–0	9–0	10–0
Poplar.....	65	73	80	70	88	100
Fir.....	75	78	85	75	93	105

PORCH NEWELS

	4x4	5x5	6x6
	4–0	4–0	4–0
Poplar.....	6½ lbs	11 lbs	16 lbs.
Fir.....	7 lbs	11½ lbs	16½ lbs.

Balusters—Poplar about 1 lb each
Spindles—Poplar about ½ lb each.

MANTELS

The Woodwork for 1 Mantel will weigh about 300 lbs.
The Tile for 1 Mantel will weigh about 75 lbs.
The Grate for 1 Mantel will weigh about 75 lbs.

STAIRWORK

6x6 Starting Newels about 30 lbs.
Stair Rail per ft about 2½ lbs.
5x5 Angle Newels about 25 lbs.
Stair Balusters each about 2 lbs.

WEIGHT OF LUMBER

Southern Lumber Manufacturers' Association

WEIGHTS OF YELLOW PINE. The schedule marked "A" applies from short leaf pine district. The schedule marked "B" applies from long leaf district. Revised and adopted at Memphis, Jan. 15, 1902.

"Schedule "A"	Lbs
Flooring $\frac{13}{16}$ Plain Back	2,000
Flooring $\frac{13}{16}$ Hollow Back	1,900
Ceiling, $\frac{3}{8}''$	1,000
Ceiling, $\frac{1}{2}''$	1,300
Ceiling, $\frac{5}{8}''$	1,500
Ceiling, $\frac{3}{4}''$	1,800
Siding from 1″ stock	1,000
Siding from $1\frac{1}{4}''$ stock	1,250
Drop Siding and Moulded Casing	1,800
Moulded Base	2,000
Finish, inch, S 2 S	2,500
Finish, $1\frac{1}{4}$, $1\frac{1}{2}$ & 2″, S 2 S	2,700
Finish, 1, $1\frac{1}{4}$, $1\frac{1}{2}$ and 2″, Rough	3,100
Shiplap, D & M	2,300
Grooved Roofing	2,400
Com. Boards and Fencing, S 1 S or 2S	2,500
Com. Boards, and Fencing, Rough	3,200
2x4, 2x6 and 2x8, S 1 S 1 E, to $1\frac{5}{8}$	2,500
2x4, 2x6 and 2x8, Rough	3,200
2x10 and 2x12, S 1 S 1 E, to $1\frac{5}{8}$	2,600
2x10 and 2x12, Rough	3,200
2x14 and 3x12, S 1 S 1 E	3,200
2x14 and 3x12, Rough	3,700
4x4 and 6x6, S 1 S 1 E	3,200
4x4 and 6x8, Rough	4,000
8x8 and Over, Rough	4,000

Schedule "B"	Lbs
Flooring, $\frac{13}{16}$x$3\frac{1}{4}$	2,100
Flooring, $\frac{13}{16}$x$5\frac{1}{4}$	2,300
Ceiling, $\frac{3}{8}''$	1,000
Ceiling, $\frac{1}{2}''$	1,300
Ceiling, $\frac{5}{8}''$	1,600
Ceiling, $\frac{3}{4}''$	1,900
Bevel Siding, from 1″ stock	1,000
Bevel Siding, from $1\frac{1}{4}''$ stock	1,400
Drop Siding, $\frac{3}{4}$x$5\frac{1}{4}''$	2,000
Moulded Casing, $\frac{13}{16}$x$4\frac{1}{2}$ to $5\frac{1}{4}''$	2,000
Moulded Base $\frac{13}{16}''$ from 8, 10 and and 12″, Stock	2,100
Finish, inch S 2 S to $\frac{13}{16}$	2,600
Finish, $1\frac{1}{4}$, $1\frac{1}{2}$, and 2″, S 2 S to Standard Thickness	2,800
Finish, Rough	3,400
Shiplap, D. & M., $\frac{13}{16}$	2,500
Grooved roofing $\frac{13}{16}''$	2,600
Common Boards, S 1 S or 2 S to $\frac{13}{16}''$	2,700
Fencing, S 1 S to $\frac{13}{16}''$	2,700
Common Boards and Fencing, Rough	3,400
2x2, 2x6 and 2x8, S 1 S 1 E, to $1\frac{5}{8}$	2,700
2x4, 2x6 and 2x8, Rough	3,400
2x10 and 2x12, S 1 S 1 E, to $1\frac{5}{8}$	2,800
2x10 and 2x12, Rough	3,400
2x14 and 3x12, S and E, $\frac{1}{4}$ off g'n	3,600
2x14 and 3x12 Rough, Green	4,200
4x4 and 6x6, S and E, Green	3,600
4x4 and 6x6, Rough, Green	4,200
6x8 and Over, Rough	4,300
6x8 and Over, S 4 S, Green	3,800

NORTHERN WEIGHTS

	Dry	Partly Seasoned	Green
Pine and Hemlock	2500	2700	3000
Norway and Y P	3000	4000	5000
Oak and Walnut	4000	5000	
Ash and Maple	3500	4000	
Oregon and Wash. Fir	2800	3000	3300

WEIGHTS OF LUMBER, ETC, DRY

Flooring, Dressed and Matched, per 1,000′	1,800 lbs
Poplar Box Boards, per 1,000′	2,000 lbs
Siding, Dressed, per 1,000′	800 lbs
Ceiling, $\frac{3}{8}''$ Thick, per 1,000′	800 lbs
Ceiling, $\frac{1}{2}''$ Thick, per 1,000′	900 lbs
Boards, Dressed, One Side, per 1,000	2,000 lbs

Weights of Lumber, Etc., Dry—Continued

Boards, and Dimension, Rough, per 1,000′	2,400 lbs
Shingles, per 1,000 pcs	240 lbs
Lath, per 1,000′pcs	500 lbs
Pickets, Dressed, per 1,000 pcs	1,800 lbs
Pickets, Rough, per 1,000 pcs	2,400 lbs

Weight of Mouldings, 1x1″, per 100 lf, 15 lbs.

WEIGHTS OF HARDWOOD FLOORING

⅜″ Flooring Weighs, per 1,000′	1,000 lbs
½″ Flooring Weighs, per 1,000′	1,200 lbs
⅝″ Flooring Weighs, per 1,000′	1,500 lbs
¾″ Flooring Weighs, per 1,000′	2,000 lbs
⅞″ and Thicker Weighs, 1,000′	2,500 lbs

LUMBER RECKONER

Size in In	Length in Feet										
	10	12	14	16	18	20	22	24	26	28	30	32
2 x 4	6⅔	8	9⅓	10⅔	12	13⅓	14⅔	16	17⅓	18⅔	20	21⅓
2 x 6	10	12	14	16	18	20	22	24	26	28	30	32
2 x 8	13⅓	16	18⅔	21⅓	24	26⅔	29⅓	32	34⅔	37⅓	40	42⅔
2 x10	16⅔	20	23⅓	26⅔	30	33⅓	36⅔	40	43⅓	46⅔	50	53⅓
2 x12	20	24	28	32	36	40	44	48	52	56	60	64
2 x14	23⅓	28	32⅔	37⅓	42	46⅔	51⅓	56	60⅔	65⅓	70	74⅔
2 x16	26⅔	32	37⅓	42⅔	48	53⅓	58⅔	64	69⅓	74⅔	80	85⅓
2½x12	25	30	35	40	45	50	55	60	65	70	75	80
2½x14	29⅙	35	40⅚	46⅔	52½	58⅓	64⅙	70	75⅚	81⅔	87½	93⅓
2½x16	33⅓	40	46⅔	53⅓	60	66⅔	73⅓	80	86⅔	93⅓	100	106⅔
3 x 6	15	18	21	24	27	30	33	36	39	42	45	48
3 x 8	20	24	28	32	36	40	44	48	52	56	60	64
3 x10	25	30	35	40	45	50	55	60	65	70	75	80
3 x12	30	36	42	48	54	60	66	72	78	84	90	96
3 x14	35	42	49	56	63	70	77	84	91	98	105	112
3 x16	40	48	56	64	72	80	88	96	104	112	120	128
4 x 4	13⅓	16	18⅔	21⅓	24	26⅔	29⅓	32	34⅔	37⅓	40	42⅔
4 x 6	20	24	28	32	36	40	44	48	52	56	60	64
4 x 8	26⅔	32	37⅓	42⅔	48	53⅓	58⅔	64	69⅓	74⅔	80	85⅓
4 x10	33⅓	40	46⅔	53⅓	60	66⅔	73⅓	80	86⅔	93⅓	100	106⅔
4 x12	40	48	56	64	72	80	88	96	104	112	120	128
4 x14	46⅔	56	65⅓	74⅔	84	93⅓	102⅔	112	121⅓	130⅔	140	149⅓
6 x 6	30	36	42	48	54	60	66	72	78	84	90	96
6 x 8	40	48	56	64	72	80	88	96	104	112	120	128
6 x10	50	60	70	80	90	100	110	120	130	140	150	160
6 x12	60	72	84	96	108	120	132	144	156	168	180	196
6 x14	70	84	98	112	126	140	154	168	182	196	210	224
6 x16	80	96	112	128	144	160	176	192	208	224	240	256
8 x 8	53⅓	64	74⅔	85⅓	96	106⅔	117⅓	128	138⅔	149⅓	160	170⅔
8 x10	66⅔	80	93⅓	106⅔	120	133⅓	146⅔	160	173⅓	186⅔	200	213⅓
8 x12	80	96	112	128	144	160	176	192	208	224	240	256
8 x14	93⅓	112	130⅔	149⅓	168	186⅔	205⅓	224	242⅔	261⅓	280	298⅔
10 x10	83⅓	100	116⅔	133⅓	150	166⅔	183⅓	200	216⅔	233⅓	250	266⅔
10 x12	100	120	140	160	180	200	220	240	260	280	300	320
10x 14	116⅔	140	163⅓	186⅔	210	233⅓	256⅔	280	303⅓	326⅔	350	373⅓
10 x16	133⅓	160	186⅔	213⅓	240	266⅔	293⅓	320	346⅔	373⅓	400	426⅔
12 x12	120	144	168	192	216	240	264	288	312	336	360	384
12 x14	140	168	196	224	252	280	308	336	364	392	420	448
12 x16	160	192	224	256	288	320	352	384	416	448	480	512
14 x14	163⅓	196	228⅔	261⅓	294	326⅔	359⅓	392	424⅔	457⅓	490	522⅔
14 x16	186⅔	224	261⅓	298⅔	336	373⅓	410⅔	448	485⅓	522⅔	560	597⅓

There are several books and devices which save the trouble of using the above table. I have used a little book sold by B. L. Jenks, Cleveland, O., for several years.

TABLE OF BOARD MEASURE

Width	Length 10	12	14	16	18	20
4	$3\frac{1}{3}$	4	$4\frac{2}{3}$	$5\frac{1}{3}$	6	$6\frac{2}{3}$
5	$4\frac{1}{6}$	5	$5\frac{5}{8}$	$6\frac{2}{3}$	$7\frac{1}{2}$	$8\frac{1}{3}$
6	5	6	7	8	9	10
7	$5\frac{5}{6}$	7	$8\frac{1}{6}$	$9\frac{1}{3}$	$10\frac{1}{2}$	$11\frac{2}{3}$
8	$6\frac{2}{3}$	8	$9\frac{1}{3}$	$10\frac{2}{3}$	12	$13\frac{1}{3}$
9	$7\frac{1}{2}$	9	$10\frac{1}{2}$	12	$13\frac{1}{2}$	15
10	$8\frac{1}{3}$	10	$11\frac{2}{3}$	$13\frac{1}{3}$	15	$16\frac{2}{3}$
11	$9\frac{1}{6}$	11	$12\frac{5}{6}$	$14\frac{2}{3}$	$16\frac{1}{2}$	$18\frac{1}{3}$
12	10	12	14	16	18	20
13	$10\frac{5}{6}$	13	$15\frac{1}{6}$	$17\frac{1}{3}$	$19\frac{1}{2}$	$21\frac{2}{3}$
14	$11\frac{2}{3}$	14	$16\frac{1}{3}$	$18\frac{2}{3}$	21	$23\frac{1}{3}$
15	$12\frac{1}{2}$	15	$17\frac{1}{2}$	20	$22\frac{1}{2}$	25
16	$13\frac{1}{3}$	16	$18\frac{2}{3}$	$21\frac{1}{3}$	24	$26\frac{2}{3}$
17	$14\frac{1}{6}$	17	$19\frac{5}{6}$	$22\frac{2}{3}$	$25\frac{1}{2}$	$28\frac{1}{3}$
18	15	18	21	24	27	30

FORM SHEET FOR BILLS OF MATERIAL

No. of Pieces	Description	Size	Length	Quan'y	Rate	Amount Material	Amount Labor
40	Sills	6 x 8	20	3200	$25	$80.00	
100	Joists	2 x 12	16	3200	23	73.60	
180	Studs	2 x 6	18	3240	21	68.05	
				9640	8		$77.15
						$221.65	$77.15
100	Bbls Portland				$1.80	$180.00	
	Crushed Stone			100 tons	1.75	175.00	
	Sand			55 yds	1.00	55.00	
						$410.00	$135.60
	White Lead			400 lbs	$0.07	$28.00	

WAGES TABLE

The Division of Building and Housing, Department of Commerce, Washington, found that percentages of labor ran about as follows:

Wages paid to carpenters represent ½ of the entire labor on a frame house. Other classes of labor on a frame house run as follows:

Bricklayers, 6.2 per cent; hod carriers, 2.2; plasterers, 7.9; plumbers, 8.7; electricians, 2.6; painters, 10; common laborers, 6.3; all others, 6.5.

For a brick house allow: Carpenters, 32.2; bricklayers, 21.5; hod carriers, 6.7; plasterers, 8.8; plumbers, 7.6; electricians, 2.5; painters, 6.3; common laborers, 9.9; all others, 4.5. Averages were made from reports covering a large number of 6-room brick and frame cottages throughout the United States, about the end of 1921.

The Omaha, 1922, wage scale as issued by the government to the builders exchange is as follows:

Carpenters, 90 cents an hour; cement finishers, 90 cents; electricians, $1.12½; hod carriers, 55-60 cents; common laborers, 35-45 cents, lathers, $1; painters, 90 cents; plasterers, $1.25; plaster helpers, 35-45 cents; brick layers, $1; elevator constructors, $1; gas fitters, $1.12½; hoisting engineers, $1; marble cutters, 87½ cents; marble setters, $1; masons, $1; ornamental iron workers, $1; pipe covers, $1; plumbers $1; roofers, $1; sheet metal workers, $1; steam fitters, $1; steam fitter helpers, 75 cents; stone cutters, $1; structural iron workers, $1 and tile setters, $1.

WEIGHTS AND MEASURES

LENGTH

12 inches	=	1 foot
3 ft.	=	1 yd.
5½ yds.	=	1 rod
40 rods	=	1 furlong
8 fur.	=	1 mile

SURFACE

44 square inches	=	1 sq. ft.
9 sq. ft.	=	1 sq. yd.
640 acres	=	1 sq. mile

SQUARE

A square in the building trades is 100 sq. ft.

CUBIC OR SOLID

1728 cu. in.	=	1 cu. ft
27 cu. ft.	=	1 cu. yd.
128 cu. ft.	=	1 cord
2150.42 cu. in.	=	1 bushel

WEIGHT

16 ounces	=	1 pound (lb.)
2000 pounds (lbs.)	=	1 ton
2240 pounds	=	1 long ton

DECIMAL EQUIVALENTS OF INCHES, FEET, AND YARDS

Frac. of an Inch		Dec. of an Inch		Dec. of a Foot
1–16	=	.0625	=	.00521
⅛	=	.125	=	.01041
3–16	=	.1875	=	.01562
¼	=	.25	=	.02083
5–16	=	.3125	=	.02604
⅜	=	.375	=	.03125
7–16	=	.4375	=	.03645
½	=	.5	=	.04166
9–16	=	.5625	=	.04688
⅝	=	.625	=	.05208
11–16	=	.6875	=	.05729
¾	=	.75	=	.06250
13–16	=	.8125	=	.06771
⅞	=	.875	=	.07291

Ins.		Feet		Yards
1	=	.0833	=	.0277
2	=	.1666	=	.0555
3	=	.25	=	.0833
4	=	.3333	=	.1111
5	=	.4166	=	.1389
6	=	.5	=	.1666
7	=	.5833	=	.1944
8	=	.666	=	.2222
9	=	.75	=	.25
10	=	.8333	=	.2778
11	=	.9166	=	.3055
12	=	1.	=	.3338

Metric System and English Equivalents

The Metric System is based on the meter, which was designed to be one ten-millionth ($\frac{1}{10000000}$) part of the earth's meridian, passing through Dunkirk and Formentera. Later investigations, however, have shown that the meter exceeds one ten-millionth part by almost one part in 6400. The value of the meter, as authorized by the U. S. Government is 39.37 inches. The metric system was legalized by the U. S. Government in 1866.

The three principal units are the meter, the unit of length; the liter, the unit of capacity; and the gram, the unit of weight. Multiples of these are obtained by prefixing the Greek words: deka (10), hekto (100), and kilo (1000). Divisions are obtained by prefixing the Latin words: deci ($\frac{1}{10}$), centi (100), and milli ($\frac{1}{1000}$). Abbreviations of the multiples begin with a capital letter, and of the divisions with a small letter, as in the following tables:

Measures of Length

10 millimeters (mm.) = 1 centimeter (cm.) = .3937 in
10 centimeters = 1 decimeter (dm.)
10 decimeters = 1 meter (m.) = 3.28083 ft. = 39.37 in
10 meters = 1 dekameter (Dm.)
10 dekameters = 1 hektometer (Hm.)
10 hektometers = 1 kilometer (Km.) = 0.62137 mile
1 foot = .3048 meter
1 inch = 25.4 millimeters

Measures of Surface (not Land)

100 square millimeters (mm.^{2}) = 1 square centimeter (cm.^{2}) = 0.155 sq in
100 square centimeters = 1 square decimeter (dm.^{2})
100 square decimeters = 1 square meter (m.^{2}) = 10.764 sq ft
1 square yard = .836 square meter
1 square foot = .0929 square meter
1 square inch = 645.2 square millimeters

Measures of Volume

1000 cubic millimeters (mm.^{3}) = 1 cubic centimeter (cm.^{3}) = .061 cu in
1000 cubic centimeters = 1 cubic decimeter (dm.^{3}) = 1 liter = 61.023 cu ins
1000 cubic decimeters = 1 cubic meter (m.^{3}) = 35.314 cu ft = 264.2 gallons
1 cubic yard = .7645 cubic meter
1 cubic foot = .02832 cubic meter
1 cubic inch = 16.387 cubic centimeters

Measures of Capacity

10 milliliters (ml.) = 1 centiliter (cl.)
10 centiliters = 1 deciliter (dl.)
10 deciliters = 1 liter (l.) = 1.0567 qts. (U.S.) = 61.023 cu ins
10 liters = 1 dekaliter (Dl.)
10 dekaliters = 1 hektoliter (Hl.)
10 hektoliters = 1 kiloliter (Kl.)
1 gallon (U. S.) = 3.785 liters
1 gallon (British) = 4.543 liters

Measures of Weight

10 milligrams (mg.) = 1 centigram (cg.)
10 centigrams = 1 decigram (dg.)
10 decigrams = 1 gram (g.) = 15.432 grains
10 grams = 1 dekagram (Dg.)
10 dekagrams = 1 hektogram (Hg.)
10 hektograms = 1 kilogram (Kg.) = 2.2046 pounds
1000 kilograms = 1 ton (T) = .9842 ton of 2240 pounds

Note. The gram is the weight of one cubic centimeter of pure distilled water at a temperature of 39.2°F.; the kilogram is the weight of 1 liter of water; the ton is the weight of 1 cubic meter of water.

1 grain = .0648 gram
1 pound = .4536 kilograms
1 ounce (Adv.) = 28.35 grams
1 ton of 2240 pounds = 1.016 metric tons

Decimal Equivalents of Millimeters and Fractions of Millimeters

1/100 mm. = .0003937″.

mm.	Inches	mm.	Inches	mm.	Inches	mm.	Inches
1/50 =	.00079	39/50 =	03071	27 =	1.06299	64 =	2.51968
2/50 =	.00157	40/50 =	.03150	28 =	1.10236	65 =	2.55905
3/50 =	.00236	41/50 =	.03228	29 =	1.14173	66 =	2.59842
4/50 =	.00315	42/50 =	.03307				
		43/50 =	.03386	30 =	1.18110	67 =	2.63779
5/50 =	.00394	44/50 =	.03465	31 =	1.22047	68 =	2.67716
6/50 =	.00472			32 =	1.25984	69 =	2 71653
7/50 =	.00551	45/50 =	.03543	33 =	1.29921	70 =	2.75590
8/50 =	.00630	46/50 =	.03622	34 =	1.33858	71 =	2.79527
9/50 =	.00709	47/50 =	.03701				
		48/50 =	.03780	35 =	1.37795	72 =	2 83464
10/50 =	.00787	49/50 =	.03858	36 =	1.41732	73 =	2.87401
11/50 =	.00866			37 =	1.45669	74 =	2.91338
12/50 =	.00945	1 =	.03937	38 =	1.49606	75 =	2.95275
13/50 =	.01024	2 =	.07874	39 =	1.53543	76 =	2.99212
14/50 =	.01102	3 =	.11811				
		4 =	.15748	40 =	1.57480	77 =	3.03149
15/50 =	.01181			41 =	1.61417	78 =	3.07086
16/50 =	.01260	5 =	.19685	42 =	1.65354	79 =	3.11023
17/50 =	.01339	6 =	.23622	43 =	1.69291	80 =	3.14960
18/50 =	.01417	7 =	.27559	44 =	1.73228	81 =	3 18897
19/50 =	.01496	8 =	.31496				
		9 =	.35433	45 =	1.77165	82 =	3 22834
20/50 =	.01575			46 =	1.81102	83 =	3 26771
21/50 =	.01654	10 =	.39370	47 =	1.85039	84 =	3.30708
22/50 =	.01732	11 =	.43307	48 =	1.88976	85 =	3.34645
23/50 =	.01811	12 =	.47244	49 =	1.92913	86 =	3.38582
24/50 =	.01890	13 =	.51181				
		14 =	.55118	50 =	1.96850	87 =	3.42519
25/50 =	.01969			51 =	2.00787	88 =	3.46456
26/50 =	.02047	15 =	.59055	52 =	2.04724	89 =	3.50393
27/50 =	.02126	16 =	.62992	53 =	2.08661	90 =	3.54330
28/50 =	.02205	17 =	.66929	54 =	2.12598	91 =	3.58267
29/50 =	.02283	18 =	.70866				
		19 =	.74803	55 =	2.16535	92 =	3.62204
30/50 =	.02362			56 =	2.20472	93 =	3.66141
31/50 =	.02441	20 =	.78740	57 =	2.24409	94 =	3.70078
32/50 =	.02520	21 =	.82677	58 =	2.28346	95 =	3.74015
33/50 =	.02598	22 =	.86614	59 =	2.32283	96 =	3.77952
34/50 =	.02677	23 =	.90551				
		24 =	.94488	60 =	2.36220	97 =	3.81889
35/50 =	.02756			61 =	2.40157	98 =	3.85826
36/50 =	.02835	25 =	.98425	62 =	2.44094	99 =	3.89763
37/50 =	.02913	26 =	1.02362	63 =	2.48031	100 =	3.93700
38/50 =	.02992						

Miscellaneous

1 kilogram per meter = .6720 pounds per foot.
1 gram per square millimeter = 1.422 pounds per square inch.
1 kilo gram per square meter = 0.2084 pounds per square foot.
1 kilogram per cubic meter = .0624 pounds per cubic foot.
1 degree centigrade = 1.8 degrees Fahrenheit.
1 pound per foot = 1.488 kilograms per meter.
1 pound per square foot = 4.882 kilograms per square meter.
1 pound per cubic foot = 16.02 kilograms per cubic meter.
1 degree Fahrenheit = .5556 degrees centigrade.
1 Calorie (French Thermal Unit) = 3.968 B. T. U. (British Thermal Unit).

1 Horse Power = { 33,000 foot pounds per minute. / 746 Watts }

1 Watt (Unit of Electrical Power) = { .00134 Horse Power / 44.24 foot pounds per minute. }

1 Kilowatt = { 1000 Watts / 1.34 Horse Power / 44240 foot pounds per minute }

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