

ESTIMATING BUILDING COSTS

(PART 3)

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ESTIMATING CARPENTRY COSTS

INTRODUCTION

1. General.—It is almost impossible for one to make a dependable estimate without a thorough knowledge of the processes, materials, and labor that are used in the principal building trades, as well as of the customary forms of construction used in building. Before attempting to study the subject of estimating, the Sections treating of these matters should be studied thoroughly, unless the estimator already has a practical knowledge of building matters. The estimator should add to his knowledge by frequently inspecting buildings in course of erection.

2. Factors Involved in Estimating.—In estimating carpenter work, as in estimating work of other kinds, there are two factors involved; the *cost of the materials* that are to be used, and the *cost of the labor* required to install these materials.

The amounts of materials can be calculated with reasonable accuracy, and the prices of the materials can be determined readily. But the cost of labor is uncertain and can only be learned by experience. One mechanic can do more than another, and the work of one man will vary at different times. A good mechanic should, however, do a certain quantity of any kind of work in a day or an hour.

COST OF MATERIALS

MEASURING LUMBER

3. Board Measure.—Before considering the matter of the cost of materials, the subject of measuring lumber and the unit of material to be used, will be considered.

Most lumber is measured by the board foot, which is the equivalent of a piece of material 12 inches square and 1 inch thick. Lumber is sold on a basis of one thousand board feet, or one thousand feet board measure. This is the unit of material that is used in measuring lumber. The term board measure is abbreviated B.M. Thus, 5,000 feet board measure is generally written 5,000' B.M. The expression 5,000 feet board measure at \$50 per thousand, would be abbreviated to read 5,000' B.M. @ \$50 per M.

The following rule for calculating the contents of lumber in board feet is used by contractors and lumber dealers: *Multiply the length of the piece, in feet, by its thickness and width, in inches, and divide the product by 12.* Thus, a plank 26 feet long, 2

inches thick, and 6 inches wide will contain $\frac{26 \times 2 \times 6}{12} = 26'$ B.M.

The rule may be expressed in another way as follows: *Divide the product of the width and thickness, in inches, by 12 and multiply the quotient by the length, in feet.* A plank 26 feet

long, 2 inches thick, and 6 inches wide will contain $\frac{2 \times 6}{12} \times 26 = 26'$ B.M.

4. Table of Board Measure.—In Table I the number of feet board measure for various commercial sizes and lengths of lumber has been tabulated for reference. When the number of feet in a piece contains a fraction equal to $\frac{1}{2}$ or more, a single piece is counted as containing the next whole number of feet, and when the fraction is less than $\frac{1}{2}$ foot it is disregarded. When a number of such pieces are required, however, the exact number of feet board measure in a single piece

TABLE I

TABLE OF BOARD MEASURE

Size Inches	Length, in Feet											
	10	12	14	16	18	20	22	24	26	28	30	32
	Number of Feet, Board Measure											
2 × 4	6 $\frac{2}{3}$	8	9 $\frac{1}{3}$	10 $\frac{2}{3}$	12	13 $\frac{1}{3}$	14 $\frac{2}{3}$	16	17 $\frac{1}{3}$	18 $\frac{2}{3}$	20	21 $\frac{1}{3}$
2 × 6	10	12	14	16	18	20	22	24	26	28	30	32
2 × 8	13 $\frac{1}{3}$	16	18 $\frac{2}{3}$	21 $\frac{1}{3}$	24	26 $\frac{2}{3}$	29 $\frac{1}{3}$	32	34 $\frac{2}{3}$	37 $\frac{1}{3}$	40	42 $\frac{2}{3}$
2 × 10	16 $\frac{2}{3}$	20	23 $\frac{1}{3}$	26 $\frac{2}{3}$	30	33 $\frac{1}{3}$	36 $\frac{2}{3}$	40	43 $\frac{1}{3}$	46 $\frac{2}{3}$	50	53 $\frac{1}{3}$
2 × 12	20	24	28	32	36	40	44	48	52	56	60	64
2 × 14	23 $\frac{1}{3}$	28	32 $\frac{2}{3}$	37 $\frac{1}{3}$	42	46 $\frac{2}{3}$	51 $\frac{1}{3}$	56	60 $\frac{2}{3}$	65 $\frac{1}{3}$	70	74 $\frac{2}{3}$
2 × 16	26 $\frac{2}{3}$	32	37 $\frac{1}{3}$	42 $\frac{2}{3}$	48	53 $\frac{1}{3}$	58 $\frac{2}{3}$	64	69 $\frac{1}{3}$	74 $\frac{2}{3}$	80	85 $\frac{1}{3}$
2 $\frac{1}{2}$ × 12	25	30	35	40	45	50	55	60	65	70	75	80
2 $\frac{1}{2}$ × 14	29 $\frac{1}{6}$	35	40 $\frac{5}{6}$	46 $\frac{2}{3}$	52 $\frac{1}{2}$	58 $\frac{1}{3}$	64 $\frac{1}{6}$	70	75 $\frac{5}{6}$	81 $\frac{2}{3}$	87 $\frac{1}{2}$	93 $\frac{1}{3}$
2 $\frac{1}{2}$ × 16	33 $\frac{1}{3}$	40	46 $\frac{2}{3}$	53 $\frac{1}{3}$	60	66 $\frac{2}{3}$	73 $\frac{1}{3}$	80	86 $\frac{2}{3}$	93 $\frac{1}{3}$	100	106 $\frac{2}{3}$
3 × 6	15	18	21	24	27	30	33	36	39	42	45	48
3 × 8	20	24	28	32	36	40	44	48	52	56	60	64
3 × 10	25	30	35	40	45	50	55	60	65	70	75	80
3 × 12	30	36	42	48	54	60	66	72	78	84	90	96
3 × 14	35	42	49	56	63	70	77	84	91	98	105	112
3 × 16	40	48	56	64	72	80	88	96	104	112	120	128
4 × 4	13 $\frac{1}{3}$	16	18 $\frac{2}{3}$	21 $\frac{1}{3}$	24	26 $\frac{2}{3}$	29 $\frac{1}{3}$	32	34 $\frac{2}{3}$	37 $\frac{1}{3}$	40	42 $\frac{2}{3}$
4 × 6	20	24	28	32	36	40	44	48	52	56	60	64
4 × 8	26 $\frac{2}{3}$	32	37 $\frac{1}{3}$	42 $\frac{2}{3}$	48	53 $\frac{1}{3}$	58 $\frac{2}{3}$	64	69 $\frac{1}{3}$	74 $\frac{2}{3}$	80	85 $\frac{1}{3}$
4 × 10	33 $\frac{1}{3}$	40	46 $\frac{2}{3}$	53 $\frac{1}{3}$	60	66 $\frac{2}{3}$	73 $\frac{1}{3}$	80	86 $\frac{2}{3}$	93 $\frac{1}{3}$	100	106 $\frac{2}{3}$
4 × 12	40	48	56	64	72	80	88	96	104	112	120	128
4 × 14	46 $\frac{2}{3}$	56	65 $\frac{1}{3}$	74 $\frac{2}{3}$	84	93 $\frac{1}{3}$	102 $\frac{2}{3}$	112	121 $\frac{1}{3}$	130 $\frac{2}{3}$	140	149 $\frac{1}{3}$
6 × 6	30	36	42	48	54	60	66	72	78	84	90	96
6 × 8	40	48	56	64	72	80	88	96	104	112	120	128
6 × 10	50	60	70	80	90	100	110	120	130	140	150	160
6 × 12	60	72	84	96	108	120	132	144	156	168	180	192
6 × 14	70	84	98	112	126	140	154	168	182	196	210	224
6 × 16	80	96	112	128	144	160	176	192	208	224	240	256
8 × 8	53 $\frac{1}{3}$	64	74 $\frac{2}{3}$	85 $\frac{1}{3}$	96	106 $\frac{2}{3}$	117 $\frac{1}{3}$	128	138 $\frac{2}{3}$	149 $\frac{1}{3}$	160	170 $\frac{2}{3}$
8 × 10	66 $\frac{2}{3}$	80	93 $\frac{1}{3}$	106 $\frac{2}{3}$	120	133 $\frac{1}{3}$	146 $\frac{2}{3}$	160	173 $\frac{1}{3}$	186 $\frac{2}{3}$	200	213 $\frac{1}{3}$
8 × 12	80	96	112	128	144	160	176	192	208	224	240	256
8 × 14	93 $\frac{1}{3}$	112	130 $\frac{2}{3}$	149 $\frac{1}{3}$	168	186 $\frac{2}{3}$	205 $\frac{1}{3}$	224	242 $\frac{2}{3}$	261 $\frac{1}{3}$	280	298 $\frac{2}{3}$
10 × 10	83 $\frac{1}{3}$	100	116 $\frac{2}{3}$	133 $\frac{1}{3}$	150	166 $\frac{2}{3}$	183 $\frac{1}{3}$	200	216 $\frac{2}{3}$	233 $\frac{1}{3}$	250	266 $\frac{2}{3}$
10 × 12	100	120	140	160	180	200	220	240	260	280	300	320
10 × 14	116 $\frac{2}{3}$	140	163 $\frac{1}{3}$	186 $\frac{2}{3}$	210	233 $\frac{1}{3}$	256 $\frac{2}{3}$	280	303 $\frac{1}{3}$	326 $\frac{2}{3}$	350	373 $\frac{1}{3}$
10 × 16	133 $\frac{1}{3}$	160	186 $\frac{2}{3}$	213 $\frac{1}{3}$	240	266 $\frac{2}{3}$	293 $\frac{1}{3}$	320	346 $\frac{2}{3}$	373 $\frac{1}{3}$	400	426 $\frac{2}{3}$
12 × 12	120	144	168	192	216	240	264	288	312	336	360	384
12 × 14	140	168	196	224	252	280	308	336	364	392	420	448
12 × 16	160	192	224	256	288	320	352	384	416	448	480	512
14 × 14	163 $\frac{1}{3}$	196	228 $\frac{2}{3}$	261 $\frac{1}{3}$	294	326 $\frac{2}{3}$	359 $\frac{1}{3}$	392	424 $\frac{2}{3}$	457 $\frac{1}{3}$	490	522 $\frac{2}{3}$
14 × 16	186 $\frac{2}{3}$	224	261 $\frac{1}{3}$	298 $\frac{2}{3}$	336	373 $\frac{1}{3}$	410 $\frac{2}{3}$	448	485 $\frac{1}{3}$	522 $\frac{2}{3}$	560	597 $\frac{1}{3}$

is multiplied by the number of pieces, and any fraction is then treated as before. Thus, a 2"×4" piece 16 feet long contains $10\frac{2}{3}$ feet B.M., and a single piece would be counted as 11 feet B.M. Ten pieces would contain $10\times 10\frac{2}{3}$ feet = $106\frac{2}{3}$ feet B.M., and would be counted as 107 feet B.M.

COSTS OF LUMBER

5. Schedule of Prices.—The cost of framing lumber is figured in the lumber yard according to grades, sizes, and lengths. For certain sizes and lengths in different grades a base price per M feet board measure is used. For other grades, sizes, and lengths certain amounts are added to, or deducted from, the base price per M feet.

A typical schedule is shown in Table II. This schedule is for hemlock lumber, and is a portion of a schedule prepared by a lumber company for the benefit of its customers. The base price, as well as the prices to be added or deducted, varies from time to time for different woods and for different localities.

6. Use of Table II.—In the first column are shown the various sizes of framing lumber of No. 1 grade from 2 in.×3 in. to 12 in.×12 in., also sizes of boards of different grades, such as No. 1, No. 2, etc. In the second column are shown the various lengths to which the lumber is cut. In the third column are the amounts to be added to or deducted from the base price per M feet board measure.

For example, hemlock lumber 2 in.×8 in., 2 in.×10 in., or 2 in.×12 in. in cross-section and 12 feet or 14 feet in length takes the base price. If the base price is \$50 per M feet board measure this lumber will cost \$50 per M feet B.M. For the same lumber 10 feet in length, a deduction of \$1 per M feet board measure is made, making the price \$49 per M feet board measure. For the same pieces 16 feet long, an addition of \$1.50 is made, making the price \$51.50 per M feet board measure. For the same pieces 22 to 24 feet long, the price will be base \$7.50 or \$57.50 per M. feet B.M.

TABLE II

APPROXIMATE PRICES OF HEMLOCK LUMBER PER M. FEET B.M.

Inches	Feet	Price
No. 1 SIZES		
2× 3	10, 12, and 14	Base less \$1.00
	16	Base plus 3.00
	18 and 20	Base plus 5.50
2× 4	8	Base less 1.00
	9	Base plus 1.00
	10, 12, and 14	<i>h</i> Base less 1.00
	16	Base plus 3.00
	18 and 20	<i>g</i> Base plus 4.00
	22 and 24	Base plus 7.50
2× 6	10, 12, and 14	Base less 1.00
2× 8 to 2×12	10 12 and 14	Base less 1.00 <i>e</i> Base
2× 6 to	16	Base plus 1.50
	18 and 20	<i>f</i> Base plus 3.50
2×12	22 to 24	Base plus 7.50
	26 to 32	Base plus 9.50
	34 to 40	Base plus 13.50
3× 4 to	10 to 14	Base
	16	<i>d</i> Base plus 1.50
3×12	18 and 20	<i>c</i> Base plus 3.50
	22 and 24	Base plus 7.50
	26 to 32	Base plus 9.50
	34 to 40	Base plus 13.50
<i>a</i> 4× 4 to 12×12	<i>b</i> Add \$1 per M to prices of 3 in.× 4 in. to 3 in.×12 in. for same lengths.	

SPECIAL SIZES

For each inch over 12 inches in width in timber and plank add \$1 per M to price of sizes and lengths above.

For 5, 7, 9, and 11 inches sawed to order, add \$2 per M extra.

TABLE II—(Continued)

Inches	Feet	Price
No. 1 BOARDS		
1×6	10, 12, and 14	Base plus \$1.00
	16	Base plus 5.00
	18 and 20	Base plus 4.00
1×8	10, 12, and 14	Base plus 1.50
	16	Base plus 4.00
	18 and 20	Base plus 4.00
1×10	10, 12, and 14	Base plus 2.50
	16	Base plus 5.00
	18 and 20	Base plus 5.00
1×12	10, 12, and 14	Base plus 4.00
	16	Base plus 6.00
	18 and 20	Base plus 6.00
$\frac{5}{4}$ and $\frac{6}{4}$	Add \$2 to price of boards of same width.	
No. 2 BOARDS		
1×6	8 to 18, Rough, SIS, or D. & M.	<i>i</i> Base less 4.00
1×8	8 to 18, Rough, SIS, or D. & M.	Base less 4.00
1×10 and 1×12	8 to 18, Rough, SIS, or D. & M.	Base less 3.00
No. 3 BOARDS		
1×6	8 to 18, Rough, or SIS	Base less 9.00
1×8	8 to 18, Rough, or SIS	Base less 8.00
1×10 and 1×12	8 to 18, Rough or SIS	Base less 7.00
LOG RUN BOARDS		
1×4	8 to 16, Rough or SIS	Base less 6.00
1×6 to 1×12	8, SIS	Base less 4.00
ROOFING LATH		
1×2	10 to 16	Base plus 5.00
1×2½		
1×3		

The same general principle is followed in figuring the costs of other woods. This schedule is typical only, and should not be used in estimating unless verified for the wood or locality where the lumber is to be purchased.

COST OF LABOR

7. Table III shows a list of different kinds of work, the number of feet B.M. that can be put in place in a day of 8 hours, the time of a carpenter and helper required to handle 1,000 feet B.M. and the cost of labor per unit of material, which is 1,000 feet B.M. These prices are not fixed, but are given only for use in studying the principles of estimating.

8. Table IV shows a list of kinds of work in which the unit of material is mostly 100 linear feet, and the approximate unit price for installing one unit of material.

9. Table V gives a list of items of work, each of which is a completed job. The probable time required to install each item and the cost, are also given.

These tables are given at this point so that they may be used for reference in the following articles. The information in the tables is obtained from experience but is subject to variations. The costs given are calculated upon the basis of \$1.25 per hour for a carpenter, and \$1 per hour for a carpenter's helper. One helper can generally provide all the assistance that will be needed for two, three, or four carpenters. This has been taken care of in the tables.

ESTIMATING COSTS OF FRAMING

10. **Framing.**—The items to be considered in estimating framing are the sills, joists, studs, ribbons, plates, rafters, etc. These timbers are estimated by the 1,000 feet B.M. The labor is calculated at a given price per 1,000 feet B.M.

Framing plans are rarely supplied, and the estimator must know how the building should be framed and be able to

TABLE III

AMOUNT OF WORK DONE BY A CARPENTER, AND COST PER M FEET B.M.

Kind of Work	Number of Feet B.M. Placed in 8 Hours	Hours Required per M Feet B.M.		Cost of Labor per M Feet B. M.
		Carpenter	Helper	
Framing, etc.				
Sills and girders, 4"×4", 4"×6", 2"×10", etc.....	400	20	10	a \$35
Studs, 2"×4" or 2"×6", walls and partitions 16" on centers	300	28	10	e 45
Ribbons, 1"×5"	250	32	8	48
Plates, 2-2"×4"	350	24	10	40
Floor joists, 2"×6", 2"×8", 16" on centers.....	350	24	10	d 40
Floor joists, 2"×10", 2"×12", 16" on centers.....	357	20	10	c 35
Posts and girders.....	500	16	10	b 30
Rafters, 2"×8", 2"×10", flat roofs.....	400	20	10	35
Rafters, 2"×6", 2"×8", simple gables...	300	28	5	40
Rafters, 2"×6", 2"×8", complex gables	250	32	5	45
Ceiling beams, 2"×4" and 2"×6".....	300	28	10	45
Roof trusses, up to 40' span.....	200	40	10	60
Sheathing and under flooring				
Sheathing matched, 1"×6" and 1"×8" on walls horizontal.....	400	20	10	h 35
Sheathing matched, 1"×6" and 1"×8" on walls diagonal.....	325	24	10	i 40
Sheathing unmatched, 1"×6", 1"×8", and 1"×10" on walls horizontal.....	500	16	10	f 30
Sheathing unmatched, 1"×6", 1"×8" and 1"×10" on walls diagonal.....	400	20	10	g 35

take off the quantities of framing timber from a regular drawing or blueprint. The method may be approximate, but should cover fully all the material required.

11. Cost of Sills.—The sill is measured from the plan. The outside line of the wall on which the sill rests will give