



FIG. 76. (See important rules below, also examples on page 226, and formula (7) on page 224.)

1. *Dotted cross section lines* represent barrels or parts of sand and stone to one barrel (4 bags) Portland cement weighing 375 lb. and measuring (assumed) 3.8 cu. ft.  
 2. *Full cross section lines* represent cubic feet of sand and stone to one barrel (4 bags) Portland cement.  
 3. *Diagonal lines* represent number of barrels of Portland cement in one cubic yard of compacted concrete.

4. To find number of cubic yards of sand or stone per cubic yard of concrete, multiply number of barrels cement, as above, by 0.141 times the number of parts of sand or stone.  
 5. To find number of cubic feet of concrete, in any proportions, made from one barrel of cement, divide 27 by the number of barrels of cement per cubic yard, obtained as above.

MORTAR WITH ORDINARY COARSE BANK SAND

Volume of Plastic Mortar and Quantities of Materials per Cubic Yard. (See p. 226.)

Relative proportions by volume*	Volume of Compacted Plastic Mortar						Materials for 1 cu. yd. Compact Plastic Mortar Based on barrel of						
	from 1 cu. ft. Cement			from 1 bbl. Cement			3.5 cu. ft.		3.8 cu. ft.†		4 cu. ft.		
	Based on Portland Cement weighing			Based on barrel of			Packed Cement	Loose Sand	Packed Cement	Loose Sand	Packed Cement	Loose Sand	
Cement	Sand	108 lbs. per cu. ft.	100 lbs. per cu. ft.†	95 lbs. per cu. ft.	3.5 cu. ft.	3.8 cu. ft.†	4 cu. ft.	Packed Cement	Loose Sand	Packed Cement	Loose Sand	Packed Cement	Loose Sand
		cu. ft.	cu.ft.	cu. ft.	cu. ft.	cu.ft.	cu. ft.	bbl.	cu. yd.	bbl.	cu. yd.	bbl.	cu. yd.
1	0	0.93	0.86	0.80	3.2	3.2	3.2	8.31		8.31		8.31	
1	1/4	1.12	1.06	1.02	3.9	4.0	4.1	6.92	0.46	6.73	0.47	6.61	0.40
1	1/2	1.43	1.42	1.38	5.2	5.4	5.5	5.22	0.68	5.01	0.71	4.88	0.72
1	3/4	1.84	1.78	1.74	6.4	6.7	7.0	4.20	0.81	4.00	0.84	3.87	0.86
1	2	2.20	2.14	2.11	7.7	8.1	8.4	3.51	0.91	3.32	0.93	3.21	0.91
1	2 1/2	2.56	2.50	2.47	9.0	9.5	9.9	3.01	0.98	2.84	1.00	2.74	1.01
1	3	2.92	2.86	2.83	10.2	10.9	11.3	2.64	1.03	2.48	1.05	2.39	1.06
1	3 1/2	3.28	3.23	3.19	11.5	12.2	12.8	2.35	1.06	2.20	1.08	2.12	1.10
1	4	3.64	3.59	3.55	12.8	13.6	14.2	2.12	1.10	1.98	1.11	1.90	1.13
1	4 1/2	4.01	3.95	3.91	14.0	15.0	15.6	1.92	1.12	1.80	1.14	1.72	1.15
1	5	4.37	4.31	4.28	15.3	16.4	17.1	1.77	1.15	1.65	1.16	1.58	1.17
1	5 1/2	4.73	4.67	4.64	16.6	17.7	18.5	1.63	1.18	1.52	1.18	1.46	1.19
1	6	5.09	5.03	5.00	17.8	19.1	20.0	1.52	1.18	1.41	1.19	1.35	1.20
1	6 1/2	5.45	5.39	5.36	19.1	20.5	21.4	1.41	1.19	1.32	1.21	1.26	1.21
1	7	5.81	5.75	5.72	20.3	21.9	22.9	1.33	1.21	1.23	1.21	1.18	1.22
1	7 1/2	6.18	6.12	6.08	21.6	23.2	24.3	1.25	1.21	1.16	1.22	1.11	1.23
1	8	6.54	6.48	6.44	22.9	24.6	25.8	1.18	1.22	1.10	1.24	1.05	1.24

NOTE. — Variations in the fineness of the sand and the cement, and in the consistency of the mortar may affect the values by 10% in either direction.  
 \*Cement as packed by manufacturer, sand loose.  
 †Use these columns ordinarily.

MORTAR WITH VERY FINE SAND

Volume of Plastic Mortar and Quantities of Materials per Cubic Yard. (See p. 226.)

Relative proportions by volume*	Volume of Compacted Plastic Mortar						Materials for 1 cu. yd. Compact Plastic Mortar Based on barrel of						
	from 1 cu. ft. Cement			from 1 bbl. Cement			3.5 cu. ft.		3.8 cu. ft.†		4 cu. ft.		
	Based on Portland Cement weighing			Based on barrel of			Packed Cement	Loose Sand	Packed Cement	Loose Sand	Packed Cement	Loose Sand	
Cement	Sand	108 lbs. per cu. ft.	100 lbs. per cu. ft.†	95 lbs. per cu. ft.	3.5 cu. ft.	3.8 cu. ft.†	4 cu. ft.	Packed Cement	Loose Sand	Packed Cement	Loose Sand	Packed Cement	Loose Sand
		cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	bbl.	cu. yd.	bbl.	cu. yd.	bbl.	cu. yd.
1	1/2	1.26	1.19	1.15	4.4	4.5	4.6	6.16	0.40	6.01	0.42	5.91	0.44
1	1	1.62	1.56	1.51	5.7	5.9	6.0	4.78	0.62	4.59	0.65	4.48	0.66
1	1 1/2	1.98	1.92	1.88	6.9	7.3	7.5	3.79	0.76	3.72	0.78	3.61	0.80
1	2	2.35	2.28	2.24	8.2	8.6	8.9	3.29	0.85	3.12	0.88	3.02	0.90
1	2 1/2	2.71	2.65	2.51	9.5	10.0	10.4	2.85	0.92	2.69	0.95	2.60	0.96
1	3	3.08	3.01	2.97	10.8	11.4	11.8	2.51	0.98	2.37	1.00	2.28	1.01
1	3 1/2	3.44	3.38	3.33	12.0	12.8	13.3	2.24	1.02	2.11	1.04	2.03	1.05
1	4	3.80	3.74	3.70	13.3	14.2	14.8	2.03	1.03	1.90	1.07	1.83	1.08
1	4 1/2	4.17	4.10	4.06	14.6	15.6	16.2	1.85	1.08	1.74	1.10	1.67	1.11
1	5	4.53	4.47	4.43	15.9	16.9	17.7	1.70	1.10	1.59	1.12	1.53	1.13
1	5 1/2	4.90	4.83	4.79	17.1	18.3	19.1	1.58	1.12	1.47	1.14	1.41	1.15
1	6	5.26	5.20	5.15	18.4	19.7	20.6	1.47	1.14	1.37	1.16	1.31	1.17

\*Cement as packed by manufacturer, sand loose.  
 †Use these columns ordinarily.



Quantities of Materials for One Cubic Yard of Rammed Concrete. Based on a Barrel of 3.5 Cubic Feet. (See important foot-notes, also p. 225.)

Table with columns for Proportions by Parts (Cement, Sand, Stone), Proportions by Volumes (Packed Cement, Loose Sand, Loose Stone), Percentages of Voids in Broken Stone or Gravel (50%, 45%, 40%, 30%, 20%), and Volume of Mortar in terms of percentage of volume of stone.

NOTE.— Variations in the fineness of the sand and the compacting of the concrete may affect the quantities by 10% in either direction. \*Use 50% columns for broken stone screened to uniform size. †Use 45% columns for average conditions and for broken stone with dust screened out. ‡Use 40% columns for gravel or mixed stone and gravel. §Use these columns for scientifically graded mixtures.

USE THIS TABLE ORDINARILY.

Quantities of Materials for One Cubic Yard of Rammed Concrete. Based on a Barrel of 3.8 Cubic Feet. (See important foot-notes, also p. 225.)

Table with columns for Proportions by Parts (Cement, Sand, Stone), Proportions by Volumes (Packed Cement, Loose Sand, Loose Stone), Percentages of Voids in Broken Stone or Gravel (50%, 45%, 40%, 30%, 20%), and Volume of Mortar in terms of percentage of volume of stone.

NOTE.— Variations in the fineness of the sand and the compacting of the concrete may affect the quantities by 10% in either direction. \*Use 50% columns for broken stone screened to uniform size. †Use 45% columns for average conditions and for broken stone with dust screened out. ‡Use 40% columns for gravel or mixed stone and gravel. §Use these columns for scientifically graded mixtures.

Vertical handwritten notes on the right margin of page 231, including calculations and instructions like 'multiplicar cualquier de las columnas (bbl.) x 1.3'.



Quantities of Material for One Cubic Yard of Rrammed Concrete.

Based on a Barrel of 4 Cubic Feet.

(See important foot-notes, also p. 225.)

Table with multiple columns: PROPORTIONS BY PARTS, PROPORTIONS BY VOLUMES, PERCENTAGES OF VOIDS IN BROKEN STONE OR GRAVEL (50%, 45%, 40%, 30%, 20%), and Volume of mortar. Rows show various mixtures of cement, sand, and stone.

NOTE. — Variations in the fineness of the sand and the compacting of the concrete may affect the quantities by 10% in either direction.

- \*Use 50% columns for broken stone screened to uniform size.
†Use 45% columns for average conditions and for broken stone with dust screened out.
‡Use 40% columns for gravel or mixed stone and gravel.
§Use these columns for scientifically graded mixtures.

Volume of Concrete Based on a Barrel of 3.5 Cubic Feet.

(See important foot-notes, also p. 225.)

Table with columns: PROPORTIONS BY PARTS, PROPORTIONS BY VOLUME, AVERAGE VOLUME OF RAMMED CONCRETE MADE FROM ONE BARREL CEMENT, and Percentages of Voids in Broken Stone or Gravel. Rows show concrete volume for various mixtures.

NOTE. — Variations in the fineness of the sand and the compacting of the concrete may affect the volumes by 10% in either direction.

- \*Use 50% column for broken stone screened to uniform size.
†Use 45% column for average conditions and for broken stone with dust screened out.
‡Use 40% column for gravel or mixed stone and gravel.
§Use these columns for scientifically graded mixtures.



USE THIS TABLE ORDINARILY.

Volume of Concrete Based on a Barrel of 3.8 Cubic Feet.

(See important foot-notes, also p. 225.)

Table with columns: PROPORTIONS BY PARTS (Cement, Sand, Stone), PROPORTIONS BY VOLUME (Cement, Sand, Stone), Volume of mortar in terms of percentage of volume of stone, and AVERAGE VOLUME OF RAMMED CONCRETE MADE FROM ONE BARREL CEMENT (Percentages of Voids in Broken Stone or Gravel: 50%\*, 45%†, 40%‡, 30%§, 20%¶).

NOTE. — Variations in the fineness of the sand and the compacting of the concrete may affect the volumes by 10% in either direction.

- \*Use 50% column for broken stone screened to uniform size.
†Use 45% column for average conditions and for broken stone with dust screened out.
‡Use 40% column for gravel or mixed stone and gravel.
§Use these columns for scientifically graded mixtures.

Volume of Concrete Based on a Barrel of 4 Cubic Feet.

(See important foot-notes, also p. 225.)

Table with columns: PROPORTIONS BY PARTS (Cement, Sand, Stone), PROPORTIONS BY VOLUME (Cement, Sand, Stone), Volume of mortar in terms of percentage of volume of stone, and AVERAGE VOLUME OF RAMMED CONCRETE MADE FROM ONE BARREL CEMENT (Percentages of Voids in Broken Stone or Gravel: 50%\*, 45%†, 40%‡, 30%§, 20%¶).

NOTE. — Variations in the fineness of the sand and the compacting of the concrete may affect the volumes by 10% in either direction.

- \*Use 50% column for broken stone screened to uniform size.
†Use 45% column for average conditions and for broken stone with dust screened out.
‡Use 40% column for gravel or mixed stone and gravel.
§Use these columns for scientifically graded mixtures.



MATERIALS FOR RUBBLE CONCRETE.

Quantities of Materials for One Cubic Yard Based on a Barrel of 3.8 Cubic Feet. (See important footnotes, also pp. 238 and 296).

Table with 19 columns: (1) Percentage of Rubble in Total Volume of Concrete, (2) Cement, (3) Sand, (4) Stone, (5) Packed Cement, (6) Loose Sand, (7) Loose Stone, and columns 8-19 for Percentages of Voids in Broken Stone or Gravel (50%, 45%, 40%, 30% for Cement, Sand, Stone).

NOTE.—Variations in the fineness of the sand and the compacting of the concrete may affect the quantities by 10% in either direction. \* Use 50% columns for broken stone screened to uniform size. † Use 45% columns for average conditions and for broken stone with dust screened out. ‡ Use 40% columns for gravel or mixed stone and gravel. § Use 30% columns for scientifically graded mixtures.

VOLUME OF RUBBLE CONCRETE

Based on a Barrel of 3.8 Cubic Feet (see important footnotes, also pp. 238 and 296).

Table with 11 columns: (1) Percentage of Rubble in Total Volume of Concrete, (2) Cement, (3) Sand, (4) Stone, (5) Cement, (6) Sand, (7) Stone, (8) 50%\*, (9) 45%†, (10) 40%‡, (11) 30%§. Includes sub-headers for proportions of plain concrete by parts and average volume of rubble concrete made from one barrel cement.

NOTE.—Variations in the fineness of the sand and the compacting of the concrete may affect the quantities by 10% in either direction.

\*Use 50% column for broken stone screened to uniform size.

†Use 45% column for average conditions and for broken stone with dust screened out.

‡Use 40% column for gravel or mixed stone and gravel.

§Use 30% column for scientifically graded mixtures.



## TABLES OF RUBBLE CONCRETE

The tables on pages 236 and 237 give the quantities of materials and the volumes of concrete mixed in different proportions and with different percentages of rubble. The values are made up as described on pages 298 and 299, where illustrations are given of the methods of computing the cost.

The percentages of rubble are based on the ratio of the volume of the concrete after it is laid to the actual volume of the large stone contained in it. In other words, it is the percentage of the finished concrete occupied by the large stone.



BIBLIOTECA

## CHAPTER XIII

## PREPARATION OF MATERIALS FOR CONCRETE

The various operations relating directly to the laying of concrete are discussed in detail in this and several succeeding chapters. While the selection of the special methods and machinery, which are described at length in the succeeding chapters, are determined by local conditions, certain general principles apply to all classes of work. The preparation of the materials relates to the storing of cement, the screening of sand and gravel, and the crushing of stone.

## STORING CEMENT

Portland cement is not injured by storing in a dry place for an indefinite length of time; in fact, contrary to former belief, instead of deteriorating, the quality is often improved by storage. Cement manufacturers when rushed with orders sometimes ship material which, not being sufficiently air-slaked, contains free lime that exposure to air may change to a hydrate and thus render harmless.

Recognition of the fact that exposure to dry atmosphere does not injure cement has led to packing it in bags instead of in barrels, thus saving both the cost of the barrel and the extra freight upon it. If, however, the work is in a damp location, as in marine construction, barrel shipments are advisable.

The economy of storing the cement as near as possible to the mixing platform or mixing machine is obvious, but since, on the other hand, it is more easily handled and is always less in volume than sand and stone, these should be given the preference in the matter of location.

## SCREENING SAND AND GRAVEL

The three most common methods of screening are (1) by hand, that is, by throwing shovelfuls of the material on to an inclined screen, (2) by dumping or hoisting the material on to a fixed inclined screen, (3) by a revolving screen.

**Cost of Hand Screening.** The cost of hand screening depends upon the total amount of material handled rather than upon the quantity of sand or gravel produced. A material most of whose particles run through the screen can be most cheaply screened, because the screen can be moved,