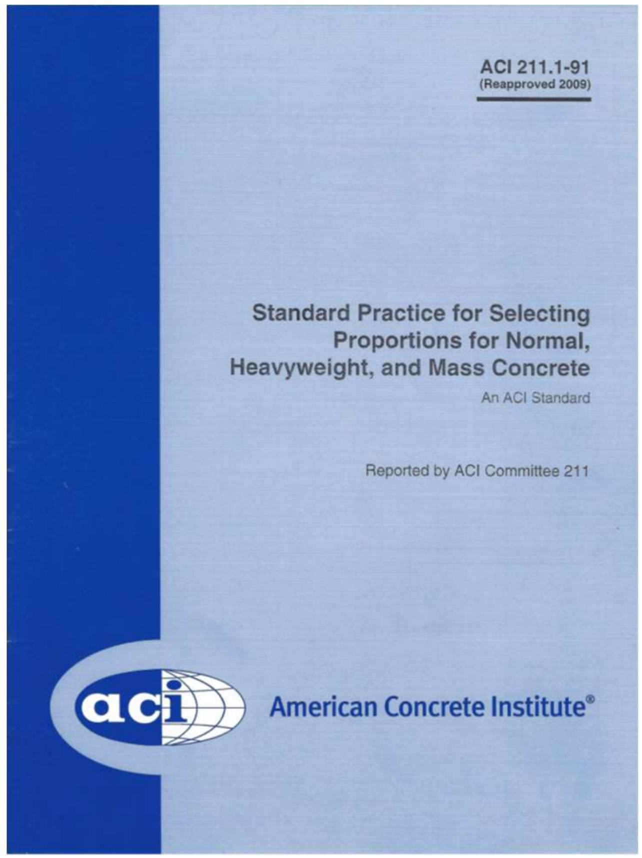
Fundamentals of Mix Proportioning

David Hollingsworth – Director of Technical Services/Training

PDF handouts of slides: https://info.miconcrete.org/virtual-learning

Fundamentals of Mix Proportioning



Fundamentals of Mix Proportioning

Absolute Volume Method

The mix is proportioned to yield 27 ft^3 or 1 yd^3. Each of the component materials occupies a portion of the overall volume that is determined by dividing the mass (weight) of each material in the mix by the relative density (specific gravity) multiplied by 62.4 lb/ft^3, the density of water.

Example: What is the absolute volume (AV) of 564 lbs of Portland cement?

$AV = 564\ lb/(3.15 \times 62.4\ lb/ft^3) = 2.87\ ft^3$

Fundamentals of Mix Proportioning

What information do you need to get started?

- specified compressive strength, f'_c
- w/c or w/cm ratio (possibly)
- what is being constructed
- where in the country is it being constructed
- contractor requirements
- aggregate properties - stone size, fineness modulus - sand, relative density - sand/stone, aggregate absorption, aggregate total moisture, bulk density - stone
- cementitious properties – relative density of fly ash, slag cement, silica fume

Fundamentals of Mix Proportioning

TABLE 4.2.1 — EXPOSURE CATEGORIES AND CLASSES

Category	Severity	Class	Condition	
F Freezing and thawing	Not applicable	F0	Concrete not exposed to freezing-and-thawing cycles	
	Moderate	F1	Concrete exposed to freezing-and-thawing cycles and occasional exposure to moisture	
	Severe	F2	Concrete exposed to freezing-and-thawing cycles and in continuous contact with moisture	
	Very severe	F3	Concrete exposed to freezing-and-thawing and in continuous contact with moisture and exposed to deicing chemicals	
S Sulfate			**Water-soluble sulfate (SO_4) in soil, percent by mass***	**Dissolved sulfate (SO_4) in water, ppm†**
	Not applicable	S0	$SO_4 < 0.10$	$SO_4 < 150$
	Moderate	S1	$0.10 \leq SO_4 < 0.20$	$150 \leq SO_4 < 1500$ Seawater
	Severe	S2	$0.20 \leq SO_4 \leq 2.00$	$1500 \leq SO_4 \leq 10{,}000$
	Very severe	S3	$SO_4 > 2.00$	$SO_4 > 10{,}000$
P Requiring low permeability	Not applicable	P0	In contact with water where low permeability is not required	
	Required	P1	In contact with water where low permeability is required.	
C Corrosion protection of reinforcement	Not applicable	C0	Concrete dry or protected from moisture	
	Moderate	C1	Concrete exposed to moisture but not to external sources of chlorides	
	Severe	C2	Concrete exposed to moisture and an external source of chlorides from deicing chemicals, salt, brackish water, seawater, or spray from these sources	

Fundamentals of Mix Proportioning

TABLE 4.3.1 — REQUIREMENTS FOR CONCRETE BY EXPOSURE CLASS

Exposure Class	Max. *w/cm**	Min. f'_c, psi	Additional minimum requirements			
			Air content			Limits on cementitious materials
F0	N/A	2500	N/A			N/A
F1	0.45	4500	Table 4.4.1			N/A
F2	0.45	4500	Table 4.4.1			N/A
F3	0.45	4500	Table 4.4.1			Table 4.4.2
			Cementitious materials†—types			Calcium chloride admixture
			ASTM C150	ASTM C595	ASTM C1157	
S0	N/A	2500	No Type restriction	No Type restriction	No Type restriction	No restriction
S1	0.50	4000	II‡	IP(MS), IS (<70) (MS)	MS	No restriction
S2	0.45	4500	V§	IP (HS) IS (<70) (HS)	HS	Not permitted
S3	0.45	4500	V + pozzolan or slag‖	IP (HS) + pozzolan or slag‖ or IS (<70) (HS) + pozzolan or slag‖	HS + pozzolan or slag‖	Not permitted
P0	N/A	2500	None			
P1	0.50	4000	None			
			Maximum water-soluble chloride ion (Cl^-) content in concrete, percent by weight of cement#		Related provisions	
			Reinforced concrete	Prestressed concrete		
C0	N/A	2500	1.00	0.06	None	
C1	N/A	2500	0.30	0.06	None	
C2	0.40	5000	0.15	0.06	7.7.6, 18.16**	

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What if two exposure categories are specified?

Example

Concrete needs to meet both exposure class F3 and C2?

F3 requires a maximum w/cm of 0.45 and minimum f'_c of 4500 psi while C2 requires a maximum w/cm of 0.40 and minimum f'_c of 5000 psi.

ALWAYS select the most restrictive for developing the mix i.e. C2.

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Step 1 Determine the required average compressive strength, f'_{cr}.

Once the licensed design professional has determined the specified compressive strength, f'_c, the next step is to determine the required average compressive strength, f'_{cr}. The required average compressive strength is the overdesign that is necessary to MINIMIZE the possibility of the cylinder strength falling below the specified compressive strength.

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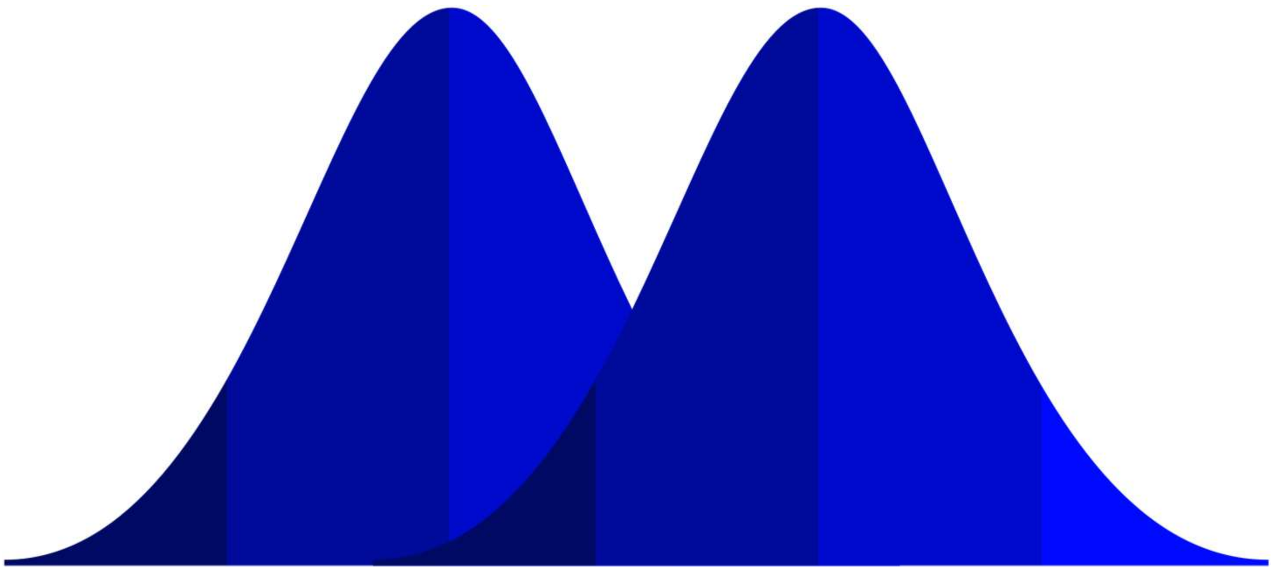

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When field strength test records are not available or you lack sufficient data, the required average compressive strength, f'_{cr}, is determined from Table 4.2.3.1 of ACI 301.

f'_c, psi	f'_{cr}, psi
Less than 3000	$f'_c + 1000$
3000 to 5000	$f'_c + 1200$
Over 5000	$1.1f'_c + 700$

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When field strength test records are available and are not older than 24 months and span no less than 45 calendar days for a class of concrete within 1000 psi of that required for the project, calculate the sample standard deviation, s_s, and determine the required average compressive strength, f'_{cr}, using Table 4.2.3.3(a)1 from ACI 301.

f_c', psi	f_{cr}', psi — Use the larger of:
5000 or less	$f_{cr}' = f_c' + 1.34ks_s$
	$f_{cr}' = f_c' + 2.33ks_s - 500$
Over 5000	$f_{cr}' = f_c' + 1.34ks_s$
	$f_{cr}' = 0.90f_c' + 2.33ks_s$

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If the number of field tests used in calculating the sample standard deviation, s_s, is not 30 or more (but 15 or greater), use Table 4.2.3.3(a)2 to increase the value of the sample standard deviation, s_s.

Total number of tests considered	*k*-factor for increasing sample standard deviation
15	1.16
20	1.08
25	1.03
30 or more	1.00

Note: Linear interpolation for intermediate number of tests is acceptable.

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ACI 211.1-91

1.2 The methods provide a first approximation of proportions intended to be checked by trial batches in the laboratory or field and adjusted, as necessary, to produce the desired characteristics of the concrete.

2.2 The selection of concrete proportions involves a balance between economy and requirements for placeability, strength, durability, density and appearance. The required characteristics are governed by the use to which the concrete will be put and by conditions expected to be encountered at the time of placement. These characteristics should be listed in the job specifications.

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Let's get started….

Type of structure warehouse floor, 5 inches thick, unreinforced

Specified strength, f'_c 3500 psi

Sample std deviation, s_s 644 psi, based on 30 tests

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Coarse aggregate properties		Fine aggregate properties	
Nominal maximum size	1 inch	Fineness modulus	2.80
Relative density (dry)	2.58	Relative density (dry)	2.64
Total moisture	3.5%	Total moisture	2.5%
Absorption	3.1%	Absorption	1.3%
Free moisture	0.4%	Free Moisture	1.2%
Bulk density	97 lb/ft^3		

Maximum vs Nominal Maximum Size

maximum size: the smallest sieve opening through which the entire amount of aggregate is **required** to pass.

nominal maximum size: the smallest sieve opening through which the entire amount of aggregate is **permitted** but not required to pass.

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Verify choice of nominal maximum aggregate size per ACI 211.1-91.

6.3.2 In no event should the nominal maximum aggregate size exceed:

a. 1/5 the narrowest dimension between sides of forms

b. 1/3 the depth of the slab

c. 3/4 the minimum clear spacing between individual reinforcing bars, bundles of bars or pretensioning strands

1/3 of 5 inches = 1.67 inches maximum > therefore, 1 inch proposed for use is OK

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Next, determine required overdesign, f'_{cr} for f'_c equal to 3500 psi:

f'_{cr} $= f'_c + 1.34\ ks_s$

$= 3500\text{ psi} + 1.34\ (1.0)\ 644\text{ psi} = 4363\text{ psi}$ (k=1.0 for 30 tests)

f'_{cr} $= f'c + 2.33ks_s - 500$

$= 3500\text{ psi} + 2.33\ (1.0)644\text{ psi} - 500 = 4501\text{ psi}$

ALWAYS select the larger of the two for proportioning the mix and round to the nearest 500 psi.

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To determine mix proportions for first approximation:

1. Complete ACI table information
2. Calculate dry batch weights
3. Calculate dry batch volumes
4. Calculate saturated-surface-dry (SSD) weights
5. Adjust batch for actual moisture conditions

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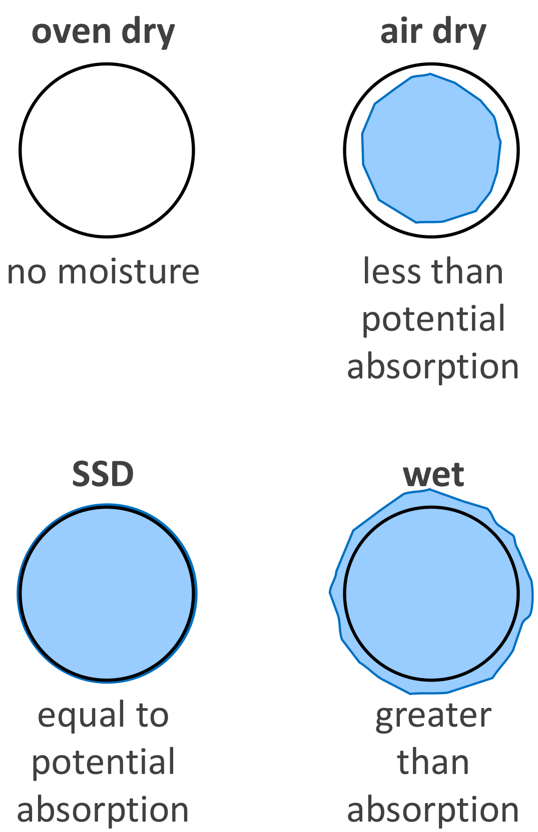

Aggregates have an internal void or pore structure that at any time may or may not contain water (absorbed water). Depending on the moisture content, the four possible conditions are as follows:

1. **oven dry** - no moisture present (only attainable in lab)
2. **air dry** - dry at surface, capable of absorbing additional water
3. **saturated-surface dry (SSD)** - fully saturated, neither absorbs nor contributes water to the mix
4. **wet** - contains an excess amount of surface moisture

Fundamentals of Mix Proportioning

DATE: ______________
PREPARED BY: ______________

ACI 211 CALCULATIONS FOR CONCRETE PROPORTIONS

STRUCTURE IDENTIFICATION ______________
SPECIFIED STRENGTH (f'c) ______________

REQUIRED STRENGTH (f'cr) [ ]

COARSE AGGREGATE

- A. CLASSIFICATION ______
- B. NOMINAL MAX. SIZE ______ in.
- C. RELATIVE DENSITY (dry), RDC ______
- D. TOTAL MOISTURE ______ %
- E. ABSORPTION ______ %
- F. FREE MOISTURE ______ %
- G. BULK DENSITY, M ______ lb/ft^3

FINE AGGREGATE

- A. CLASSIFICATION ______
- B. FINENESS MODULUS ______
- C. RELATIVE DENSITY (dry), RDF ______
- D. TOTAL MOISTURE ______ %
- E. ABSORPTION ______ %
- F. FREE MOISTURE ______ %

ACI TABLES

SLUMP	(Table 6.3.1)	______ in.	VOL C.A.	(Table 6.3.6)		
% AIR	(Table 6.3.3)	______ %	W/C RATIO	(Table 6.3.4(a))	______	STRENGTH
WATER	(Table 6.3.3)	______ lb.	W/C RATIO	(Table 6.3.4(b))	______	DURABILITY

1. DRY DESIGN WEIGHTS (per 27 CU.FT.)	2. DRY ABSOLUTE VOLUME	3. SSD DESIGN WEIGHTS (per 27 CU.FT.)
CEMENT Mix Water ( ) / W/C Ratio ( ) = ______ lb	( ) lb / 3.15 X 62.4 = ______ CU. FT.	CEMENT = ______ lb
WATER = ______ lb	( ) lb / 1.00 X 62.4 = ______ CU. FT.	WATER = ______ lb
COARSE ( ) x 27 x ( ) = ______ lb; VOL. C.A. M.	( ) lb / ( ) X 62.4 RDC = ______ CU. FT.	COARSE AGGREGATE (Dry Wt.) x (1 + (ABS)/100) = ______ lb
AIR (entrapped or total) (%) / (100 %) x 27 CU.FT. =	→ = ______ CU. FT.	FINE AGGREGATE (Dry Wt.) x (1 + (ABS)/100) = ______ lb
FINE ( ) x ( ) x 62.4 = ______ lb; ABS. VOL. RDF	SUB TOTAL = ______ CU. FT.	TOTAL WEIGHT = ______ lb
	27.0 - SUB TOTAL (ABS. VOL. FINE) = ______ CU. FT.	DENSITY (Total Wt./27.0 ft^3) = ______ lb/ft^3

4. MOISTURE CORRECTIONS: (DRY WEIGHT) x (%FREE MOISTURE) + SSD WEIGHT = WET WEIGHT (Batch Wts.)

						BATCH WTS.
CEMENT						= ______ lb
COARSE AGGREGATE	______ (DRY) x	______ (%FREE)	= ______ (lb WATER)	+ ______ (SSD)		= ______ lb (WET)
FINE AGGREGATE	______ (DRY) x	______ (%FREE)	= ______ (lb WATER)	+ ______ (SSD)		= ______ lb (WET)
WATER	______ (SSD WATER)		- ______ (lb WATER)			= ______ lb (NET) = ______ Gal.

Fundamentals of Mix Proportioning

DATE: ____________

PREPARED BY: ____________________

ACI 211 CALCULATIONS FOR CONCRETE PROPORTIONS

STRUCTURE IDENTIFICATION: warehouse floor, 5" thick

SPECIFIED STRENGTH (f'c): 3500 psi — S_s : 644 psi, n: 30 tests

REQUIRED STRENGTH (f'cr): 4500 psi

COARSE AGGREGATE		
A. CLASSIFICATION	6AA	
B. NOMINAL MAX. SIZE	1	in.
C. RELATIVE DENSITY (dry), RDC	2.58	
D. TOTAL MOISTURE	3.5	%
E. ABSORPTION	3.1	%
F. FREE MOISTURE	0.4	%
G. BULK DENSITY, M	97	lb/ft^3

FINE AGGREGATE		
A. CLASSIFICATION	2NS	
B. FINENESS MODULUS	2.80	
C. RELATIVE DENSITY (dry), RDF	2.64	
D. TOTAL MOISTURE	2.5	%
E. ABSORPTION	1.3	%
F. FREE MOISTURE	1.2	%

ACI TABLES				
SLUMP	(Table 6.3.1)	3 (4)	in.	
% AIR	(Table 6.3.3)	1.5	%	
WATER	(Table 6.3.3)	325	lb.	
VOL C.A.	(Table 6.3.6)	0.67		
W/C RATIO	(Table 6.3.4(a))	0.52	STRENGTH	
W/C RATIO	(Table 6.3.4(b))	N/A	DURABILITY	

Strength	W/C
4000	0.57
5000	0.48
∴ 4500	0.52

Fundamentals of Mix Proportioning

Table 6.3.1 — Recommended slumps for various types of construction*

Types of construction	Slump, in. Maximum†	Slump, in. Minimum
Reinforced foundation walls and footings	3	1
Plain footings, caissons, and substructure walls	3	1
Beams and reinforced walls	4	1
Building columns	4	1
Pavements and slabs	3	1
Mass concrete	2	1

*Slump may be increased when chemical admixtures are used, provided that the admixture-treated concrete has the same or lower water-cement or water-cementitious material ratio and does not exhibit segregation potential or excessive bleeding.

†May be increased 1 in. for methods of consolidation other than vibration.

Fundamentals of Mix Proportioning

Table 6.3.3 — Approximate mixing water and air content requirements for different slumps and nominal maximum sizes of aggregates

Water, lb/yd³ of concrete for indicated nominal maximum sizes of aggregate								
Slump, in.	3/8 in.*	1/2 in.*	3/4 in.*	1 in.*	1-1/2 in.*	2 in.*,†	3 in.†,‡	6 in.†,‡
Non-air-entrained concrete								
1 to 2	350	335	315	300	275	260	220	190
3 to 4	385	365	340	325	300	285	245	210
6 to 7	410	385	360	340	315	300	270	—
More than 7*	—	—	—	—	—	—	—	—
Approximate amount of entrapped air in non-air-entrained concrete, percent	3	2.5	2	1.5	1	0.5	0.3	0.2
Air-entrained concrete								
1 to 2	305	295	280	270	250	240	205	180
3 to 4	340	325	305	295	275	265	225	200
6 to 7	365	345	325	310	290	280	260	—
More than 7*	—	—	—	—	—	—	—	—
Recommended averages§ total air content, percent for level of exposure:								
Mild exposure	4.5	4.0	3.5	3.0	2.5	2.0	1.5**,††	1.0**,††
Moderate exposure	6.0	5.5	5.0	4.5	4.5	4.0	3.5**,††	3.0**,††
Severe exposure‡‡	7.5	7.0	6.0	6.0	5.5	5.0	4.5**,††	4.0**,††

Fundamentals of Mix Proportioning

Table 6.3.6 — Volume of coarse aggregate per unit of volume of concrete

Nominal maximum size of aggregate, in.	Volume of oven-dry-rodded coarse aggregate* per unit volume of concrete for different fineness moduli of fine aggregate†			
	2.40	2.60	2.80	3.00
3/8	0.50	0.48	0.46	0.44
1/2	0.59	0.57	0.55	0.53
3/4	0.66	0.64	0.62	0.60
1	0.71	0.69	0.67	0.65
1 1/2	0.75	0.73	0.71	0.69
2	0.78	0.76	0.74	0.72
3	0.82	0.80	0.78	0.76
6	0.87	0.85	0.83	0.81

*Volumes are based on aggregates in oven-dry-rodded condition as described in ASTM C 29.

These volumes are selected from empirical relationships to produce concrete with a degree of workability suitable for usual reinforced construction. For less workable concrete, such as required for concrete pavement construction, they may be increased about 10 percent. For more workable concrete see Section 6.3.6.1.

†See ASTM C 136 for calculation of fineness modulus.

Fundamentals of Mix Proportioning

Table 6.3.4(a) — Relationship between water-cement or water-cementitious materials ratio and compressive strength of concrete

Compressive strength at 28 days, psi*	Water-cement ratio, by weight: Non-air-entrained concrete	Water-cement ratio, by weight: Air-entrained concrete
6000	0.41	—
5000	0.48	0.40
4000	0.57	0.48
3000	0.68	0.59
2000	0.82	0.74

Fundamentals of Mix Proportioning

Table 6.3.4(b) — Maximum permissible water-cement or water-cementitious materials ratios for concrete in severe exposures*

Type of structure	Structure wet continuously or frequently and exposed to freezing and thawing†	Structure exposed to sea water or sulfates
Thin sections (railings, curbs, sills, ledges, ornamental work) and sections with less than 1 in. cover over steel	0.45	0.40‡
All other structures	0.50	0.45‡

*Based on report of ACI Committee 201. Cementitious materials other than cement should conform to ASTM C 618 and C 989.

†Concrete should also be air-entrained.

‡If sulfate resisting cement (Type II or Type V of ASTM C 150) is used, permissible water-cement or water-cementitious materials ratio may be increased by 0.05.

Fundamentals of Mix Proportioning

Note: When looking at the w/c (w/cm) ratio for both strength (Table 6.3.4 (a)) AND durability (Table 6.3.4 (b)) – for example an exterior slab in a cold weather environment - the w/c (w/cm) that is selected for mix proportioning will always be the one that is most restrictive.

Fundamentals of Mix Proportioning

1. DRY DESIGN WEIGHTS (per 27 CU.FT.)		2. DRY ABSOLUTE VOLUME	
CEMENT Mix Water (325) / W/C Ratio (0.52)	= 625 lb	(625) lb / 3.15 X 62.4	= 3.18 CU. FT.
WATER	= 325 lb	(325) lb / 1.00 X 62.4	= 5.21 CU. FT.
COARSE (0.67) x 27 x (97) VOL. C.A. M.	= 1755 lb	(1755) lb / (2.58) X 62.4 RDC	= 10.90 CU. FT.
AIR (entrapped or total) (1.5 %) / (100 %) x 27 CU.FT.	= →		= 0.41 CU. FT.
		SUB TOTAL	= 19.70 CU. FT.
FINE (7.30) x (2.64) x 62.4 ABS. VOL. RDF	= 1203 lb	27.0 - SUB TOTAL (ABS. VOL. FINE)	= 7.30 CU. FT.

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Fundamentals of Mix Proportioning

3. SSD DESIGN WEIGHTS (per 27 CU.FT.)

CEMENT	=	625	lb
WATER	=	325	lb
COARSE AGGREGATE (Dry Wt.) x (1 + (ABS)/100) 1755 x (1 + 3.1/100)	=	1809	lb
FINE AGGREGATE (Dry Wt.) x (1 + (ABS)/100) 1203 x (1 + 1.3/100)	=	1219	lb
TOTAL WEIGHT	=	3978	lb
DENSITY (Total Wt./27.0 ft^3)	=	147.3	lb/ft^3

Fundamentals of Mix Proportioning

4. MOISTURE CORRECTIONS: (DRY WEIGHT) x (%FREE MOISTURE) + SSD WEIGHT = WET WEIGHT (Batch Wts.)

								BATCH WTS.	
CEMENT							=	625	lb
COARSE AGGREGATE	1755 (DRY) x	(1.4/100) (%FREE)	=	7 (lb WATER)	+	1809 (SSD)	=	1816	lb (WET)
FINE AGGREGATE	1203 (DRY) x	(1.2/100) (%FREE)	=	14 (lb WATER)	+	1219 (SSD)	=	1233	lb (WET) ÷ 8.33
WATER	325 (SSD WATER)		-	21 (lb WATER)			=	304	lb (NET) = 36 Gal.

Fundamentals of Mix Proportioning

DATE: ______

PREPARED BY: ______

ACI 211 CALCULATIONS FOR CONCRETE PROPORTIONS

STRUCTURE IDENTIFICATION: warehouse floor, 5" thick

SPECIFIED STRENGTH (f'c): 3500 psi S_s = 644 psi, n = 30 tests

REQUIRED STRENGTH (f'cr): 4500 psi

COARSE AGGREGATE			FINE AGGREGATE		
A. CLASSIFICATION	6AA		A. CLASSIFICATION	2NS	
B. NOMINAL MAX. SIZE	1	in.	B. FINENESS MODULUS	2.80	
C. RELATIVE DENSITY (dry), RDC	2.58		C. RELATIVE DENSITY (dry), RDF	2.64	
D. TOTAL MOISTURE	3.5	%	D. TOTAL MOISTURE	2.5	%
E. ABSORPTION	3.1	%	E. ABSORPTION	1.3	%
F. FREE MOISTURE	0.4	%	F. FREE MOISTURE	1.2	%
G. BULK DENSITY, M	97	lb/ft³			

ACI TABLES

SLUMP	(Table 6.3.1)	3 (4) in.	VOL C.A.	(Table 6.3.6)	0.67		4000 0.57
% AIR	(Table 6.3.3)	1.5 %	W/C RATIO	(Table 6.3.4(a))	0.52	STRENGTH	5000 0.48
WATER	(Table 6.3.3)	325 lb.	W/C RATIO	(Table 6.3.4(b))	N/A	DURABILITY	∴ 4500 0.52

1. DRY DESIGN WEIGHTS (per 27 CU.FT.)	2. DRY ABSOLUTE VOLUME	3. SSD DESIGN WEIGHTS (per 27 CU.FT.)
CEMENT Mix Water / W/C Ratio (325 / 0.52) = 625 lb	(625 / 3.15 X 62.4) lb = 3.18 CU. FT.	CEMENT = 625 lb
WATER = 325 lb	(325 / 1.00 X 62.4) lb = 5.21 CU. FT.	WATER = 325 lb
COARSE (0.67) x 27 x (97) = 1755 lb (VOL. C.A., M.)	(1755 / (2.58) X 62.4 RDC) lb = 10.90 CU. FT.	COARSE AGGREGATE (Dry Wt.) x (1 + (ABS)/100) = 1809 lb; 1755 x (1 + 3.1/100)
AIR (entrapped or total) (1.5 %) / (100 %) x 27 CU.FT. =	= 0.41 CU. FT.	FINE AGGREGATE (Dry Wt.) x (1 + (ABS)/100) = 1219 lb; 1203 x (1 + 1.3/100)
	SUB TOTAL = 19.70 CU. FT.	TOTAL WEIGHT = 3978 lb
FINE (7.30) x (2.64) x 62.4 = 1203 lb (ABS. VOL., RDF)	27.0 - SUB TOTAL (ABS. VOL. FINE) = 7.30 CU. FT.	DENSITY (Total Wt./27.0 ft³) = 147.3 lb/ft³

4. MOISTURE CORRECTIONS: (DRY WEIGHT) x (%FREE MOISTURE) + SSD WEIGHT = WET WEIGHT (Batch Wts.)

					BATCH WTS.
CEMENT					= 625 lb
COARSE AGGREGATE	1755 (DRY) x	(.4/100) (%FREE)	= 7 (lb WATER)	+ 1809 (SSD)	= 1816 lb (WET)
FINE AGGREGATE	1203 (DRY) x	(1.2/100) (%FREE)	= 14 (lb WATER)	+ 1219 (SSD)	= 1233 lb (WET) ÷ 8.33
WATER	325 (SSD WATER)		- 21 (lb WATER)		= 304 lb (NET) = 36 Gal.

Fundamentals of Mix Proportioning

	Design Weights, lbs	Batch Weights, lbs
Cement	625	625
Water	325	304
Sand	1219 (SSD)	1233
Stone	1809 (SSD)	1816

Slump	3-4 inches
Air	1.5%
Density	147.3 lb/ft^3

Fundamentals of Mix Proportioning

Are we finished? Not quite.

The mix must ALWAYS be checked by trial batches in the laboratory or field and adjusted, as necessary, to produce the desired characteristics. Specifically, we will be evaluating slump (3-4 inches), air (1.5%), density (147.3 lb/ft^3), compressive strength (4500 psi), placeability and appearance (how does the mix look),

Questions?

dhollingsworth@miconcrete.net
734.216.1221

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For the current webinar schedule:
https://info.miconcrete.org/virtual-learning