

552 STRUCTURAL CONCRETE MIX DESIGN SUBMITTAL

Project: _____ Date: _____
 Contractor: _____ Class of concrete: _____ SCC Mix: No Yes
 Concrete for ¹: _____ Producer Mix designation: _____
 Concrete producer (name and address): _____

SPECIFIED CONCRETE COMPRESSIVE STRENGTH (@ 28 Days)..... (f'c): _____ psi
 Required average concrete compressive strength used for mixture proportion selection ² (f'cr): _____ psi

MIXTURE PROPORTIONS

Material	Specific Gravity	Mass lb/yd ³	Absolute Volume ft ³	Tolerance % (±)	Admixtures	Dosage fl oz/yd ³ Do not enter oz/cwt
Cement (Portland or Blended)				1		
Supplementary Cementitious Material				1	Air entraining	
				1	Type A (Water Reducer -WR)	
				1	Type B (Set Retarder - SR)	
Water				1	Type C (Set Accelerator - SA)	
Coarse aggregate 1 (SSD)				2	Type D (WR & SR)	
Coarse aggregate 2 (SSD)				2	Type E (WR & SA)	
Fine aggregate (SSD)				2	Type F (High Range WR)	
Lightweight fine aggregate (SSD)				2	Type G (High Range WR & SR)	
Fibers				3	Hydration Stabilizer (B or D)	
Color Pigments				3	Other	
Other				3	Other	
Target Air Content						

Theoretical unit mass: _____ Total _____

FRESH CONCRETE PROPERTIES

Water/cementitious materials ratio (by mass) ³: _____ Unit mass (AASHTO T 121): _____ lb/ft³
 _____ in Air content (AASHTO T 152 or T 196): _____ %
 Target value for slump: _____ in Proposed range of air content: _____ %
 Target value for slump (without high range WR): _____ in

HARDENED CONCRETE PROPERTIES

If the concrete is subjected to elevated temperature curing, note the maximum curing temperature: _____ °F
 Water-soluble chloride-ion (Cl⁻) in hardened concrete by weight of cement: _____ % ⁴

Signature _____ Print Name _____ Date _____

¹ Examples include decks, abutments, drilled shafts, and precast girders

² Design in accordance with FP and specified ACI standards found in the contract.

³ The ratio of the mass of water, exclusive only of that absorbed by the aggregate, to the combined mass of cementitious materials (i.e. cement, fly ash, silica fume and ground granulated blast furnace slag (GGBFS)).

⁴ Provide for prestressed concrete.

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CEMENT (AASHTO M 85 OR AASHTO M 240)⁴

Certification attached : Yes No

FLY ASH (AASHTO M 295 – CLASS C, F or N)⁴

Certification attached : Yes No

SILICA FUME (AASHTO M 307 – RAW, SLURRIED OR DENSIFIED)⁴

Certification attached : Yes No

GROUND GRANULATED BLAST FURNACE SLAG (GGBFS) (AASHTO M 302 – GRADE 100 or 120)⁴

Certification attached : Yes No

HIGH REACTIVITY POZZOLANS (AASHTO M 321)

Certification attached : Yes No

OTHER:

Certification attached : Yes No

WATER (AASHTO M 157 AND AASHTO T 26)

Reclaimed water or water of questionable quality will be used? Yes No

Will water be added at the discharge site? Yes No If yes, how much? lbs/yd³

Will water be withheld at the batch plant? Yes No If yes, how much? lbs/yd³

CHEMICAL, COLOR PIGMENTS, FIBERS AND OTHER ADMIXTURES⁴

Admixture Type⁵	Point Admixture Added⁶	Certification Attached
Air entraining (AASHTO M 154)		<input type="checkbox"/> Yes <input type="checkbox"/> No
Type A – Water reducing		<input type="checkbox"/> Yes <input type="checkbox"/> No
Type B – Set Retarding (AASHTO M 194)		<input type="checkbox"/> Yes <input type="checkbox"/> No
Type C – Set Accelerating (AASHTO M 194)		<input type="checkbox"/> Yes <input type="checkbox"/> No
Type D – Water Reducing and Set Retarding (AASHTO M 194)		<input type="checkbox"/> Yes <input type="checkbox"/> No
Type E – Water Reducing and Set Accelerating (AASHTO M 194)		<input type="checkbox"/> Yes <input type="checkbox"/> No
Type F – High Range Water Reducing (AASHTO M 194)		<input type="checkbox"/> Yes <input type="checkbox"/> No
Type G – High Range Water Reducing and Set Retarding (AASHTO M 194)		<input type="checkbox"/> Yes <input type="checkbox"/> No
Type B – Hydration Stabilizing (AASHTO M 194) hours		<input type="checkbox"/> Yes <input type="checkbox"/> No
Type D – Hydration Stabilizing (AASHTO M 194) hours		<input type="checkbox"/> Yes <input type="checkbox"/> No
Color Pigments (ASTM C 979)		<input type="checkbox"/> Yes <input type="checkbox"/> No
Fibers (ASTM C 1116) Type:		<input type="checkbox"/> Yes <input type="checkbox"/> No
Other		<input type="checkbox"/> Yes <input type="checkbox"/> No

⁴ Certifications documentation is required prior to approval of a mix design.

⁵ Admixtures must be compatible and of the same type as those used in the mixtures from which strength data were obtained. Do not use chloride accelerators. Do not use set accelerating admixtures with Class P (Prestressed Concrete).

⁶ Each point where admixture is added must be noted (i.e. concrete batching facilities, project site, etc) as well as the corresponding dosage.

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COARSE AGGREGATE (FP SECTION 703.02 AND AASHTO M 80, CLASS A)

Name and phone number of coarse aggregate supplier/producer:

Grading number (AASHTO M43)

Location of material source:

Material type:

Sieve Analysis: (AASHTO T 27)			Property	Specification	Specification	Value
Sieve Size	Percent Passing	AASHTO M 43 Specification ⁴	(1) Clay lumps and friable particles	AASHTO T 112	2.0% max	
			(2) Deleterious chert	AASHTO T 113	3.0% max	
			(3) Σ (1) + (2)	AASHTO T 112 & T 113	3.0% max	
			(4) Minus No. 200	AASHTO T 11	1.0 or 1.5% max	
			(5) Coal and lignite	AASHTO T 113	0.5% max	
			(6) LA abrasion Grading	AASHTO T 96	40% max	
			(7) Sodium sulfate soundness, 5 cycles	AASHTO T 104	12% max	
			(8) Mass of insoluble residue (bridge decks or surface courses)	ASTM D 3042	25% min	
			(9) Bulk specific gravity	AASHTO T 85		
			(10) Bulk SSD specific gravity	AASHTO T 85		
			(11) Absorption	AASHTO T 85		
			(12) Alkali Silica Reactivity			

COARSE AGGREGATE (FP SECTION 703.02 AND AASHTO M 80, CLASS A)

Name and phone number of coarse aggregate supplier/producer:

Grading number (AASHTO M43)

Location of material source:

Material type:

Sieve Analysis: (AASHTO T 27)			Property	Specification	Specification	Value
Sieve Size	Percent Passing	AASHTO M 43 Specification ⁴	(1) Clay lumps and friable particles	AASHTO T 112	2.0% max	
			(2) Deleterious chert	AASHTO T 113	3.0% max	
			(3) Σ (1) + (2)	AASHTO T 112 & T 113	3.0% max	
			(4) Minus No. 200	AASHTO T 11	1.0 or 1.5% max	
			(5) Coal and lignite	AASHTO T 113	0.5% max	
			(6) LA abrasion Grading	AASHTO T 96	40% max	
			(7) Sodium sulfate soundness, 5 cycles	AASHTO T 104	12% max	
			(8) Mass of insoluble residue (bridge decks or surface courses)	ASTM D 3042	25% min	
			(9) Bulk specific gravity	AASHTO T 85		
			(10) Bulk SSD specific gravity	AASHTO T 85		
			(11) Absorption	AASHTO T 85		
			(12) Alkali Silica Reactivity			

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FINE AGGREGATE (FP SECTION 703.01 AND AASHTO M 6, CLASS B)

Name and phone number of fine aggregate supplier/producer:

Location of material source:

Sieve Analysis: (AASHTO T 27)			Property	Specification	Specification	Value
Sieve Size	% Passing (P)	Cumulative % Retained (CPR)	(1) Clay lumps and friable particles	AASHTO T 112	3.0% max	
	(Specification)					
	(100)		(2) Coal and lignite	AASHTO T 113	1.0% max	
	(95-100)		(3) Minus No. 200	AASHTO T 11	3.0% max	
	(80-100)		(4) Organic Impurities	AASHTO T 21	Color not darker than standard	<input type="checkbox"/> Yes <input type="checkbox"/> No
	(50-85)		(5) Sodium sulfate soundness, 5 cycles	AASHTO T 104	10% max	
	(25-60)		(6) Sand Equivalent. Alt method 2, referee method	AASHTO T 176	75% min	
	(10-30)		(7) Bulk specific gravity	AASHTO T 84		
	(2-10)		(8) Bulk SSD specific gravity	AASHTO T 84		
Fineness modulus ($\sum \text{CPR}/100$)			(9) Absorption	AASHTO T 84		
			(10) Alkali Silica Reactivity			

**LIGHTWEIGHT FINE AGGREGATE FOR INTERNAL CURING
(FP SUBSECTION 552.03(b) AND AASHTO M 195, CLASS B)**

Name and phone number of fine aggregate supplier/producer:

Location of material source:

Sieve Analysis: (AASHTO T 27)		Property	Specification	Specification	Value
Sieve Size	% Passing (P)	(1) Clay lumps and friable particles	AASHTO T 112	3.0% max	
		(2) Minus No. 200	AASHTO T 11	3.0% max	
		(3) Organic Impurities	AASHTO T 21	Color not darker than standard	<input type="checkbox"/> Yes <input type="checkbox"/> No
		(4) Bulk specific gravity	AASHTO T 84		
		(5) Bulk SSD specific gravity	AASHTO T 84		
		(6) Absorption	AASHTO T 84		
		(7) Alkali Silica Reactivity			
		(8) Iron Staining Materials	ASTM C641		

552 STRUCTURAL CONCRETE MIX DESIGN (Continued)
DATA FOR COMPUTING THE STANDARD DEVIATION⁸

Cylinder Size: 6 by 12-Inch

r 4 by 8-Inch

1 Test Group⁹ or 2 Test Groups

Consecutive Strength Test	Date Batched ⁹	Compressive Strength - psi at 28 days			
		Cylinder 1	Cylinder 2		Strength Test X_i^{10}
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					

$$\bar{X} = \frac{\sum X_i}{n} = \frac{\quad}{n} = \quad \text{psi}$$

For One Test Group:

$$s_s = \sqrt{\frac{\sum (X_i - \bar{X})^2}{(n - 1)}} = \quad$$

For Two Test Groups:

$$\bar{s}_s = \sqrt{\frac{(n_1 - 1)(s_{s1})^2 + (n_2 - 1)(s_{s2})^2}{(n_1 + n_2 - 2)}} = \quad$$

Where:

\bar{X} = average of n strength test results n = number of strength tests

S_{s1}, S_{s2} = sample standard deviations (1 & 2)

X = individual strength tests s_s = sample standard deviation, psi

n_1, n_2 = number of tests in each test group

\bar{S}_s = statistical average standard deviation where two test groups are used to estimate the sample standard deviation.

⁸ Based on Section 4 of ACI 301.

⁹ The test results must be less than 12 months old from date of submittal. A test result consists of a minimum of three 4x8 cylinders tested or a minimum of two 6x12 cylinders tested from a load of concrete sampled according to ASTM C172. All test results must also represent materials, quality control procedures, and conditions similar to those expected for the proposed work. A group of test results must be from a single project without a break in production of more than 3 months and groups shall not consist of fewer than 10 tests. Changes in materials and proportions within the test records must not be more restricted than those for proposed work. In addition, they must represent concrete produced to meet a specified strength f_c .

¹⁰ When an acceptable record of field tests is not available, concrete proportions shall be established from trial mixtures according to ACI 301 4.2.3.4 (c). Submit documentation of test results, trial mixtures and determination of compressive strength that meets f_{cr} . Pending 28-day strength results, a mix design may be approved on the basis that 7-day compressive strength results are at least 85 percent of the required average strength (f_{cr}) at 28 days.

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DETERMINATION OF REQUIRED AVERAGE COMPRESSIVE STRENGTH

REQUIRED AVERAGE COMPRESSIVE STRENGTH (f_{cr})

Case 1 – Required Average Compressive Strength with Test Groups of 30 or More Tests:

Table 1	
Specified Compressive Strength, f'_c , psi	Required Average Compressive Strength* f'_{cr} , psi
$f'_c \leq 5000$ psi	<i>Use the larger value computed from the following equations:</i> $f'_{cr} = f'_c + 1.34k_s$ (1) $f'_{cr} = f'_c + 2.33k_s - 500$ psi (2)
$f'_c > 5000$ psi	<i>Use the larger value computed from the following equations:</i> $f'_{cr} = f'_c + 1.34k_s$ (1) $f'_{cr} = 0.90f'_c + 2.33k_s$ (3)

* k is equal to 1.00 if the total number of tests are greater than or equal to 30

$f'_{cr} =$ _____ psi $\bar{X} =$ _____ psi $\bar{X} \geq f'_{cr}$ Yes No

Case 2 – Required Average Compressive Strength with Test Groups of 15 to 29 Tests:

Table 2 (k-modification Factor for use in Table 1)	
Number of Tests*	k-modification Factor for Sample Standard Deviation ⁺
15	1.16
20	1.08
25	1.03
30 or more	1.00

*Interpolate for intermediate numbers of tests
⁺k-modified sample standard deviation used to determine required average strength f'_{cr} in Table 1

$f'_{cr} =$ _____ psi $\bar{X} =$ _____ psi $\bar{X} \geq f'_{cr}$ Yes No

Case 3 – Required Average Compressive Strength with Test Groups less than 15 Tests:

psi	Required Average Compressive Strength psi
$f'_c < 3000$ psi	$f'_{cr} = f'_c + 1000$ psi
$3000 \text{ psi} \leq f'_c \leq 5000$ psi	$f'_{cr} = f'_c + 1200$ psi
$f'_c > 5000$ psi	$f'_{cr} = 1.10f'_c + 700$ psi

$f'_{cr} =$ _____ psi $\bar{X} =$ _____ psi $\bar{X} \geq f'_{cr}$ Yes No