U.S. Department of Transportation
Federal Highway Administration
Federal Lands Highway Office

552 STRUCTURAL CONCRETE MIX DESIGN SUBMITTAL

Project: _____ Date: _____

Contractor: _____ Class of concrete _____ Exposure Class: _____

Concrete producer: _____ Producer Mix designation: _____

Concrete for: _____

SPECIFIED CONCRETE COMPRESSIVE STRENGTH (@ 28 Days)…… (f'c) _____ psi

Required average concrete compressive strength used for mixture proportion selection[1] (f'cr) _____ **psi**

MIXTURE PROPORTIONS

Material	Specific Gravity	Mass lb/yd³	Absolute Volume ft³	Tolerance % (±)
Cement (Portland or Blended)				1
Supplementary Cementitious Material				
Select				1
Select				1
Water	1.000			1
Coarse aggregate 1 (SSD)				2
Coarse aggregate 2 (SSD)				2
Fine aggregate (SSD)				2
Lightweight fine aggregate (SSD)				2
Fibers				3
Color Pigments				3
Other _____				
Total air _____				
Theoretical unit mass:			Total	

Admixtures	Dosage fl oz/yd³ Do not enter oz/cwt
Air entraining	
Type A (Water Reducer -WR)	
Type B (Set Retarder - SR)	
Type C (Set Accelerator - SA)	
Type D (WR & SR)	
Type E (WR & SA)	
Type F (High Range WR)	
Type G (High Range WR & SR)	
Hydration Stabilizer (B or D)	
Other _____	
Other _____	

FRESH CONCRETE PROPERTIES

Water/cementitious materials ratio (by mass) [2] _____ Measured unit mass (AASHTO T 121): _____ lb/ft³

Measured air content (AASHTO T 152 or T 196): _____ %

Measured slump (AASHTO T 119): _____ 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: _____ % [3]

Signature _____ Print Name _____ Date _____

[1] Design in accordance with FP and specified ACI standards found in the contract.

[2] 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)).

[3] 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/yd^3

Will water be withheld at the batch plant? ☐ Yes ☐ No If yes, how much? _____ lbs/yd^3

CHEMICAL, COLOR PIGMENTS, FIBERS AND OTHER ADMIXTURES[4]

Admixture Type [5]	**Point Admixture Added** [6]	**Certification Attached**
Air entraining (AASHTO M 154)	_____	☐ Yes ☐ No
Type A – Water reducing	_____	☐ Yes ☐ No
Type B – Set Retarding (AASHTO M 194)	_____	☐ Yes ☐ No
Type C – Set Accelerating (AASHTO M 194)	_____	☐ Yes ☐ No
Type D – Water Reducing and Set Retarding (AASHTO M 194)	_____	☐ Yes ☐ No
Type E – Water Reducing and Set Accelerating (AASHTO M 194)	_____	☐ Yes ☐ No
Type F – High Range Water Reducing (AASHTO M 194)	_____	☐ Yes ☐ No
Type G – High Range Water Reducing and Set Retarding (AASHTO M 194)	_____	☐ Yes ☐ No
Type B – Hydration Stabilizing (AASHTO M 194) _____ hours	_____	☐ Yes ☐ No
Type D – Hydration Stabilizing (AASHTO M 194) _____ hours	_____	☐ Yes ☐ No
Color Pigments (ASTM C 979)	_____	☐ Yes ☐ No
Fibers (ASTM C 1116) Type: _____	_____	☐ Yes ☐ No
Other _____	_____	☐ Yes ☐ 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) Select **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	Select/Enter		

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) Select **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) (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	Select/Enter		

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552 STRUCTURAL CONCRETE MIX DESIGN SUBMITTAL (Continued)

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) (Specification)	Cumulative % Retained (CPR)	(1) Clay lumps and friable particles	AASHTO T 112	3.0% max	
	(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	☐ Yes ☐ 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 (∑CPR/100)			(9) Absorption	AASHTO T 84	--	
			(10) Alkali Silica Reactivity	Select/Enter		

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	
3/8 inch		(2) Minus No. 200	AASHTO T 11	3.0% max	
No. 4		(3) Organic Impurities	AASHTO T 21	Color not darker than standard	☐ Yes ☐ No
No. 8		(4) Bulk specific gravity	AASHTO T 84	--	
No. 16		(5) Bulk SSD specific gravity	AASHTO T 84	--	
No. 30		(6) Absorption	AASHTO T 84	--	
No. 50		(7) Alkali Silica Reactivity	Select/Enter		
No. 100		(8) Iron Staining Materials	ASTM C641	--	

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552 STRUCTURAL CONCRETE MIX DESIGN (Continued)
DATA FOR COMPUTING THE STANDARD DEVIATION[8]

Cylinder Size: ☐ 6 by 12-Inch ☐ 4 by 8-Inch

1 Test Group[9] ☐ **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					

$$\overline{X} = \frac{\Sigma\, Xi}{n} = \frac{\quad}{n} = \underline{\quad} \text{ psi}$$

For One Test Group:

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

For Two Test Groups:

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

Where:

$\overline{X}$ = 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
$\overline{S}_s$ = 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 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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552 STRUCTURAL CONCRETE MIX DESIGN SUBMITTAL (Continued)
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 ≤ 5000 psi	***Use the larger value computed from the following equations:*** $f'cr = f'c + 1.34ks_s$ (1) $f'cr = f'c + 2.33ks_s - 500$ psi (2)
f'c > 5000 psi	***Use the larger value computed from the following equations:*** $f'cr = f'c + 1.34ks_s$ (1) $f'cr = 0.90f'c + 2.33ks_s$ (3)
**** k is equal to 1.00 if the total number of tests are greater than or equal to 30***	

f'cr = _____ psi $\overline{X}$ = _____ psi $\overline{X} \geq$ **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 $\overline{X}$ = _____ psi $\overline{X} \geq$ **f'cr** ☐ **Yes** ☐ **No**

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

Table 3	
psi	**Required Average Compressive Strength psi**
f'c < 3000 psi	f'cr = f'c + 1000 psi
3000 psi ≤ f'c ≤ 5000 psi	f'cr = f'c + 1200 psi
f'c > 5000 psi	f'cr = 1.10f'c + 700 psi

f'cr = _____ psi $\overline{X}$ = _____ psi $\overline{X} \geq$ **f'cr** ☐ **Yes** ☐ **No**

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