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

552 STRUCTURAL CONCRETE MIX DESIGN SUBMITTAL

Project: _____ Date: _____

Contractor: _____ Concrete for _____ Concrete producer: _____

Class of concrete: _____ Exposure Class: _____ Producer Mix designation: _____

☐ **METRIC** ☐ **ENGLISH**

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

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

MIXTURE PROPORTIONS

Material	Specific Gravity	Mass	Absolute Volume	Tolerance % (±)
Cement (Portland or Blended)				1
Fly Ash (Class F or C)				1
Water	1.0			1
Coarse aggregate (SSD)				2
Fine aggregate (SSD)				2
Fibers				3
Color Pigments				3
Other _____				
Total air _____				
Totals		0.0	0	

Admixtures	Dosage
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 _____	

FRESH CONCRETE PROPERTIES

Water/cementitious materials ratio (by mass) [2] _____ Theoretical unit mass: _____

Measured unit mass (AASHTO T 121): _____ Measured air content (AASHTO T 152 or T 196): _____%

Concrete Temperature (AASHTO T 309): _____ Measured slump (AASHTO T 119): _____

HARDENED CONCRETE PROPERTIES

Average 28 day strength designated in specifications, : _____ Average 7-day strength, : _____

If the concrete is subjected to elevated temperature curing, note the maximum curing temperature: _____

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 reinforced and prestressed concrete when required in accordance with contract specifications.

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552 STRUCTURAL CONCRETE MIX DESIGN SUBMITTAL (Continued)

CEMENT (AASHTO M 85 – TYPES I, IA, II, IIA, III, IIIA or V OR AASHTO M 240 – TYPES I(PM), IP, P, I(SM) or IS) [4]

Certification attached : ☐ Yes ☐ No _____

FLY ASH (AASHTO M 295 – CLASS C or F) [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 _____

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? _____

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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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: _____

Material type: Manufactured sand ☐ _____ % **Natural sand** ☐ _____ % **Blend** ☐ _____ %

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	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[7]	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) ∑ (1) + (2)	AASHTO T 112 & T 113	3.0% max	
			(4) Minus	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) Adherent coating	ASTM D 5711	1.0% max	
			(9) Dry rodded unit mass	AASHTO T 19	--	
			(10) Mass of insoluble residue (bridge decks or surface courses)	ASTM D 3042	25% min	
			(11) Bulk specific gravity	AASHTO T 85	--	
			(12) Bulk SSD specific gravity	AASHTO T 85	--	
			(13) Absorption	AASHTO T 85	--	
			(14)Alkali Silica Reactivity[7]	Select/Enter		

[7] See specific contract requirements for ASR test methods and limits..

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

Cylinder Size: ☐ **or** ☐

1 Test Record[8] ☐ **or 2 Test Records** ☐

Consecutive Strength Test	Date Batched[8]	Compressive Strength - at 28 days			
		Cylinder 1	Cylinder 2	Cylinder 3	Strength Test X_i[9]
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					

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

For One Test Record:

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

For Two Test Records:

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

Where:

$\overline{X}$ = average of n strength test results n = number of consecutive strength tests s_{s1}, s_{s2} = sample standard deviations (1 & 2)
X_i = individual strength tests s_s = sample standard deviation, n_1, n_2 = number of tests in each test record
$\overline{s}_s$ = statistical average standard deviation where two test records are used to estimate the sample standard deviation.

[8] The test records must be no more than 12 months old and consist of at least 30 consecutive tests or two groups of consecutive tests totaling at least 30 tests. If 15 to 29 consecutive test records are provided, they must represent a single record of consecutive tests that span a period of not less than 45 calendar days. All test records must also represent materials, quality control procedures and conditions similar to those expected and changes in materials and proportions within the test records must not have been more restricted than those for proposed work. In addition, they must represent concrete produced to meet a specified strength or strengths within of f'c.

[9] A strength test shall be the average of at least two 6 by 12-inch cylinders or at least three 4 by 8-inch cylinders made from the same sample of concrete and tested at 28 days or at test age designated in the specification for f'c.

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552 STRUCTURAL CONCRETE MIX DESIGN SUBMITTAL (Continued)
DETERMINATION OF REQUIRED AVERAGE COMPRESSIVE STRENGTH

REQUIRED AVERAGE COMPRESSIVE STRENGTH (f_{cr})[10]

☐ **Case 1 – Required Average Compressive Strength with Test Records of 30 or More Consecutive Tests:**

Table 1	
Specified Compressive Strength, f'c,	**Required Average Compressive Strength* f'cr,**
f'c ≤	***Use the larger value computed from the following equations:*** f'cr = f'c + 1.34ks_s (1) f'cr = f'c + 2.33ks_s – (2)
f'c >	***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 = _____ $\overline{X}$ = _____ $\overline{X} \geq$ **f'cr** ☐ **Yes** ☐ **No**

☐ **Case 2 – Required Average Compressive Strength with Test Records of 15 to 29 Consecutive 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 = _____ $\overline{X}$ = _____ $\overline{X} \geq$ **f'cr** ☐ **Yes** ☐ **No**

☑ **Case 3 – Required Average Compressive Strength with Test Records less than 15 Consecutive Tests:**

Table 3	
	Required Average Compressive Strength
f'c <	f'cr = f'c +
≤ f'c ≤	f'cr = f'c +
f'c >	f'cr = 1.10f'c +

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

[10] Required concrete proportions may be established by interpolation between strengths and proportions of two or more test records. When an acceptable record of field test results is not available, concrete proportions shall be established from trial mixtures or based upon experience or information, if approved by the Materials Engineer. Submit documentation of test records, trial mixtures or information.

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