

Part 1 General Provisions

Section 1- TERMS, DEFINITIONS, ABBREVIATIONS, UNITS OF MEASURE, AND SYMBOLS

(Add the following to 1-3.2)

SCCP.....Steel cylinder concrete pipe
SCMs.....Supplementary Cementitious Materials
SD.....Storm Drain

SECTION 201 – CONCRETE, MORTAR, AND RELATED MATERIALS

201-1 PORTLAND CEMENT CONCRETE.

201-1.1 Requirements.

201-1.1.1 General. Concrete shall consist of portland cement, concrete aggregates, water, and when ~~required~~ specified or approved for use, chemical admixtures, and/or ~~fly ash SCMs, fibers, color,~~ and/or reclaimed concrete material ~~in accordance with these provisions~~. Concrete ~~will~~ shall be specified by class, ~~by~~ alternate class, ~~by~~ special exposure, or ~~by~~ compressive strength. ~~When concrete is specified by class, alternate class, or special exposure, a mix design shall be submitted to the Engineer for approval. The mix design shall show the aggregate, water, and where applicable, fly ash admixtures, and reclaimed concrete material. The mix design submittal shall also include the size and source of aggregate, the type and source of portland cement and fly ash the brand and designation of admixtures, slump requirement, and the type of construction for which the concrete is to be used.~~

Concrete specified by compressive strength shall be designed by the Contractor in accordance with 201-1.1.4.

~~Approved chemical~~ Chemical admixtures shall be used in accordance with 201-1.2.4 ~~and 201-1.2.5~~ and at the manufacturer’s ~~recommended~~ specified dosage rate. Additional portland cement or SCMs ~~cementitious material is permitted~~ may be used to obtain high early strength in concrete, except that the total amount of portland cement shall not exceed ~~415 kg per m³ (700 lbs. per yd³)~~ 700 lbs. per yd³ (415 kg per m³) unless otherwise approved by the Engineer.

Color concrete shall conform to 303-7.

Fiber reinforcement shall conform to 201-2.3 and be added at the rate specified in the Special Provisions.

Reclaimed concrete ~~Concrete~~ material conforming to 201-1.2.6 may be incorporated into concrete mixtures when so specified in the Special Provisions or approved by the Engineer ~~in accordance with section 201-1.2.6~~.

When concrete is specified by class, alternate class, or special exposure, a mix design shall be submitted to the Engineer for approval in accordance with 2-5.3. The mix design shall specify the proportions of aggregate, water, and when applicable, SCMs, chemical admixtures, and reclaimed concrete material. The mix design shall also include the gradation and source of aggregate, the type and source of portland cement and SCMs, the brand and designation of chemical admixtures, and slump requirement. If so specified in the Special Provisions, the fiber

type, fiber manufacturer and rate of addition, and the brand and amount of color, and the type of construction for which the concrete is to be used shall also be included in the mix design.

201-1.1.2 Concrete Specified by Class and Alternate Class. When the specified by class, ~~the~~ concrete will be designated by a number, one or two letters, and a number. The first number is the weight of ~~Portland~~ portland cement conforming to 201-1.2.1 in ~~kg per m³ (lb. per yd³)~~ lbs per yd³ (kgs per m³), the first letter is the combined aggregate gradation conforming to 201-1.3.2 and the second letter (W) designates the required use of a water reducing admixture conforming to 201-1.2.4. The last number is the minimum compressive strength at 28 days in ~~MPa (psi)~~ psi (MPa). A water reducing admixture conforming to 210-1.2.4 may be used in any concrete specified by class and is required in all ~~28 MPa (4000 psi)~~ 4000 psi (28 MPa) compressive strength concrete specified by class.

When specified by alternate class, ~~the~~ concrete will be designated by a number, three letters, and a number. The first number is the weight of cementitious material in ~~kg per m³ (lb. per yd³)~~ lbs per yd³ (kgs per m³) which consists of 85% ~~percent~~ percent Portland cement conforming to 201-1.2.1 and 15% ~~percent~~ percent fly ash SCMs by weight. The first letter is the combined aggregate gradation, conforming to 201-1.3.2, the second letter (F) designates the required use of fly ash SCMs conforming to 201-1.2.5, ~~and~~ the third letter (W) designates the required use of a water reducing admixture conforming to 201-1.2.4. ~~The~~ ~~the~~ last number is the minimum compressive strength at 28 days in ~~MPa (psi)~~ psi (MPa).

The concrete class, alternate class, and maximum slump for the various types of construction shall be as ~~designated~~ specified in Table 201-1.2.2(A).

TABLE 201-1.1.2(A)

Type of Construction	Concrete Class ^{7,5,6,7} Metric Units (U.S. Standard Measures) U.S. Standard Measures (Metric Units)	Alternate Class Metric Units (U.S. Standard Measures) U.S. Standard Measures (Metric Units)	Maximum Slump Millimeters (Inches) Inches (Millimeters)
<i>Street Surface Improvements</i>			
Concrete Pavement (not integral with curb)	310-A-17 (520-A-2500) <u>520-A-2500</u> (<u>310-A-17</u>)	295-AFW-17 (494-AFW-2500) <u>494-AFW-2500</u> (<u>295-AFW-17</u>)	75 (3) <u>3</u> (<u>75</u>)
Curb, Integral Curb and Pavement, Gutter, Walk, Alley Aprons	310-C-17 (520-C-2500) 310-C-17P ⁺ (520-C-2500P⁺) <u>520-C-2500</u> (<u>310-C-17</u>)	295-CFW-17 (494-CFW-2500) 295-CFW-17P ⁺ (494-CFW-2500P⁺) <u>494-CFW-2500P⁺</u> (<u>295-CFW-17P⁺</u>)	100 (4) 100 (4) <u>4</u> (<u>100</u>)
Type of Construction	Concrete Class ^{7,5,6,7}	Alternate Class	Maximum

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	Metric Units (U.S. Standard Measures) U.S. Standard Measures (Metric Units)	Metric Units (U.S. Standard Measures) U.S. Standard Measures (Metric Units)	Slump Millimeters (Inches) Inches (Millimeters)
Curb, Integral Curb and Pavement, Gutter, Walk, Alley Aprons	<u>520-C-2500P¹</u> <u>(310-C-17P¹)</u>	<u>494-CFW-2500</u> <u>(295-CFW-17)</u>	<u>4</u> <u>(100)</u>
<i>Street Surface Improvements</i>			
Extruded Curb, Curb and Gutter	310-C-17 (520-C-2500) 310-D-17 (520-D-2500) <u>520-C-2500</u> <u>(310-C-17)</u> <u>520-D-2500</u> <u>(310-D-17)</u>	295-CFW-17 (494-CFW-2500) 295-DFW-17 (494-DFW-2500) <u>494-CFW-2500</u> <u>(295-CFW-17)</u> <u>494-DFW-2500</u> <u>(295-DFW-17)</u>	50 (2) 50 (2) <u>2</u> <u>(50)</u> <u>2</u> <u>(50)</u>
<i>Sewer²-& Storm Drainage Facilities</i>			
Pipe Collars, Beam Support for Pipe, Pre-Cast Manhole Components, Catch Basins, Sidewalk Culverts	330-C-23³ (560-C-3250²) 335-C-23P⁺ (565-C-3250P⁺) <u>560-C-3250²</u> <u>(330-C-23²)</u> <u>565-C-3250P¹</u> <u>(335-C-23P¹)</u>	315-CFW-23³ (532-CFW-3250²) 320-CFW-23P⁺ (537-CFW-3250P⁺) <u>532-CFW-3250²</u> <u>(315-CFW-23²)</u> <u>537-CFW-3250P¹</u> <u>(320-CFW-23P¹)</u>	125 (5) 100 (4) <u>5</u> <u>(125)</u> <u>4</u> <u>(100)</u>
Sidehill Surface Drainage Facilities	295-C-17 (500-C-2500) 310-C-17P⁺ (520-C-2500P⁺) 330-E-17P⁺ (560-E-2500P⁺) <u>500-C-2500</u> <u>(295-C-17)</u> <u>520-C-2500P¹</u> <u>(310-C-17P¹)</u> <u>560-E-2500P¹</u> <u>(330-E-17P¹)</u>	280-CFW-17 (475-CFW-2500) 295-CFW-17P⁺ (494-CFW-2500P⁺) 315-EFW-17P⁺ (532-EFW-2500P⁺) <u>475-CFW-2500</u> <u>(280-CFW-17)</u> <u>494-CFW-2500P¹</u> <u>(295-CFW-17P¹)</u> <u>532-EFW-2500P¹</u> <u>(315-EFW-17P¹)</u>	75 (3) 100 (4) 100 (4) <u>3</u> <u>(75)</u> <u>4</u> <u>(100)</u> <u>4</u> <u>(100)</u>
Pipe Bedding and Encasement, Anchors and Thrust Blocks, Wall Support for Pipe ⁴³	265-C-14³ (450-C-2000²) 335-E-14P⁺ (565-E-2000P⁺)	320-EFW-14P⁺ (537-EFW-2000P⁺)	100 (4) 150 (6)
	Concrete Class^{7,5,6,7}	Alternate Class	Maximum

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Type of Construction	Metric Units (U.S. Standard Measures) U.S. Standard Measures (Metric Units)	Metric Units (U.S. Standard Measures) U.S. Standard Measures (Metric Units)	Slump Millimeters (Inches) Inches (Millimeters)
Pipe Bedding and Encasement, Anchors and Thrust Blocks, Wall Support for Pipe ^{4,3}	<u>450-C-2000²</u> <u>(265-C-14²)</u> <u>565-E-2000P¹</u> <u>(335-E-14P¹)</u>	<u>537-EFW-2000P¹</u> <u>(320-EFW-14P¹)</u>	<u>4</u> <u>(100)</u> <u>6</u> <u>(150)</u>
Tunnel Backfill ⁵	<u>285-C-14</u> <u>(480-C-2000)</u> <u>290-C-14P⁺</u> <u>(490-C-2000P⁺)</u> <u>480-C-2000</u> <u>(285-C-14)</u> <u>490-C-2000P¹</u> <u>(290-C-14P¹)</u>		<u>125</u> <u>(5)</u> <u>125</u> <u>(5)</u> <u>5</u> <u>(125)</u> <u>5</u> <u>(125)</u>
Trench Backfill ⁵	<u>60-E-0.7</u> <u>(100-E-100)</u> <u>100-E-100</u> <u>(60-E-0.7)</u>		<u>125</u> <u>(5)</u> <u>5</u> <u>(125)</u>
Reinforced Structures			
Bridges, Buildings, Retaining Walls, and Tunnels	<u>330-C-23³</u> <u>(560-C-3250³)</u> <u>335-C-23P⁺</u> <u>(565-C-3250P⁺)</u> <u>385-C-28⁷</u> <u>(650-CW-4000⁷)</u> <u>390-CW-28P^{+,7}</u> <u>(660-CW-4000P^{+,7})</u> <u>560-C-3250²</u> <u>(330-C-23²)</u> <u>565-C-3250P¹</u> <u>(335-C-23P¹)</u> <u>650-CW-4000^{5,7}</u> <u>(385-C-28^{5,7})</u> <u>660-CW-4000P^{1,5,7}</u> <u>(390-CW-28P^{1,5,7})</u>	<u>315-CFW-23³</u> <u>(532-CFW-3250³)</u> <u>320-CFW-23P⁺</u> <u>(537-CFW-3250P⁺)</u> <u>370-CFW-28</u> <u>(618-CFW-4000⁺)</u> <u>370-CFW-28P⁺</u> <u>(618-CFW-4000P⁺)</u> <u>532-CFW-3250²</u> <u>(315-CFW-23²)</u> <u>537-CFW-3250P¹</u> <u>(320-CFW-23P¹)</u> <u>650-CFW-4000^{7,5}</u> <u>(385-CFW-28¹)</u> <u>660-CFW-4000P^{1,5,7}</u> <u>(390-CFW-28P^{1,5,7})</u>	<u>100</u> <u>(4)</u> <u>100</u> <u>(4)</u> <u>100</u> <u>(4)</u> <u>100</u> <u>(4)</u> <u>4</u> <u>(100)</u> <u>4</u> <u>(100)</u> <u>4</u> <u>(100)</u> <u>4</u> <u>(100)</u> <u>4</u> <u>(100)</u>
Cast-In-Place piles	<u>330-C-23³</u> <u>(560-C-3250³)</u> <u>335-C-23P⁺</u> <u>(565-C-3250P⁺)</u>	<u>315-CFW-23³</u> <u>(532-CFW-3250³)</u> <u>320-CFW-23P⁺</u> <u>(537-CFW-3250P⁺)</u>	<u>100</u> <u>(4)</u> <u>100</u> <u>(4)</u>
	Concrete Class^{7,5,6,7}	Alternate Class	Maximum

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Type of Construction	Metric Units (U.S. Standard Measures) <u>U.S. Standard Measures (Metric Units)</u>	Metric Units (U.S. Standard Measures) <u>U.S. Standard Measures (Metric Units)</u>	Slump Millimeters (Inches) <u>Inches (Millimeters)</u>	
Cast-In-Place piles	<u>560-C-3250²</u> (330-C-23²)	532-CFW-3250 ² (315-CFW-23²)	<u>4</u> (100)	
	<u>565-C-3250P¹</u> (335-C-23P¹)	537-CFW-3250P ¹ (320-CFW-23P¹)	<u>4</u> (100)	
Channels and Boxes, Inverts	330 B 23 (560 B 3250)	315 BFW 23 (532 BFW 3250)	100 (4)	
	335 B 23P⁺ (565 B 3250P⁺)	320 BFW 23P⁺ (537 BFW 23P⁺)	100 (4)	
	385 BW 28⁷ (650 BW 4000⁷)	370 BFW 28 (618 BFW 4000⁺)	100 (4)	
	390 CW 28P^{+,7} (660 CW 4000P^{+,7})	375 CFW 28P⁺ (627 CFW 4000P⁺)	100 (4)	
	<u>560-B-3250</u> (330-B-23)	<u>532-BFW-3250</u> (315-BFW-23)	<u>4</u> (100)	
	<u>565-B-3250P¹</u> (335-B-23P¹)	<u>537-BFW-3250P¹</u> (320-BFW-23P¹)	<u>4</u> (100)	
	<u>650-BW-4000^{5,7}</u> (385-BW-28^{5,7})	<u>650-BFW-4000⁵</u> (385-BFW-28⁵)	<u>4</u> (100)	
	<u>660-CW-4000P^{1,5,7}</u> (390-CW-28P^{1,5,7})	<u>660-CFW-4000P^{1,5}</u> (390-CFW-28P^{1,5})	<u>4</u> (100)	
	Walls and Deck	330 C 23 (560 C 3250)	315 CFW 23 (532 CFW 3250)	125 (5)
		335 C 23P⁺ (565 C 3250P⁺)	320 CFW 23P⁺ (537 CFW 3250P⁺)	125 (5)
		385 CW 28⁷ (650 CW 4000⁷)	370 CFW 28 (618 CFW 40⁺00⁺)	100 (4)
		390 CW 28P^{+,7} (660 CW 4000P^{+,7})	375 CFW 28P (627 CFW 4000P⁺)	100 (4)
		<u>560-C-3250</u> (330-C-23)	<u>532-CFW-3250</u> (315-CFW-23)	<u>5</u> (125)
		<u>565-C-3250P¹</u> (335-C-23P^{1,5})	<u>537-CFW-3250P¹</u> (320-CFW-23P^{1,5})	<u>5</u> (125)
<u>650-CW-4000^{5,7}</u> (385-CW-28^{5,7})		<u>650-CFW-4000⁵</u> (390-CFW-28⁵)	<u>4</u> (100)	
<u>660-CW-4000P^{1,5,7}</u> (390-CW-28P^{1,5,7})		<u>660-CFW-4000P^{1,5}</u> (390-CFW-28P^{1,5})	<u>4</u> (100)	
Type of Construction		Concrete Class ^{7,5,6,7} Metric Units (U.S.)	Alternate Class Metric Units (U.S.)	Maximum Slump

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	Standard Measures) U.S. Standard Measures (Metric Units)	Standard Measures) U.S. Standard Measures (Metric Units)	Millimeters (Inches) Inches (Millimeters)
<i>Miscellaneous</i>			
Street Light and Traffic Signal Foundations, Survey Monuments	330-C-23 (560-C-3250) <u>560-C-3250</u> (330-C-23)	315-CFW-23 (532-CFW-3250) <u>532-CFW-3250</u> (315-CFW-23)	100 (4) <u>4</u> (100)
Fence and Guardrail Post Foundations	295-C-17 (500-C-2500) <u>500-C-2500</u> (295-C-17)	280-CFW-17 (475-CFW-2500) <u>475-CFW-2500</u> (280-CFW-17)	125 (5) <u>5</u> (125)
Concrete Not Otherwise Specified	330-C-23 (560-C-3250) 335-C-23P⁺ (565-C-3250P⁺) <u>560-C-3250</u> (330-C-23) <u>565-C-3250P¹</u> (335-C-23P ¹)	315-CFW-23 (532-CFW-3250) 320-CFW-23P⁺ (537-CFW-3250P⁺) <u>532-CFW-3250</u> (315-CFW-23) <u>537-CFW-3250P¹</u> (320-CFW-23P ¹)	125 (5) 100 (4) <u>5</u> (125) <u>4</u> (100)
Air Placed Concrete, Method B	385-D-23P⁺ (650-D-3250P⁺) 385-E-23⁺P (650-E-3250P⁺) <u>650-D-3250P¹</u> (385-D-23P ¹) <u>650-E-3250P¹</u> (385-E-23P ¹)	370-DFW-23P⁺ (618-DFW-3250⁺P) 385-EFW-23P⁺ (650-EFW-3250P⁺) <u>650-DFW-3250P¹</u> (385-DFW-23P ¹) <u>650-EFW-3250P¹</u> (385-EFW-23P ¹)	100 (4) 100 (4) <u>4</u> (100) <u>4</u> (100)
Coarse Masonry Grout	360-E-14G⁶ (610-E-2000G⁶) <u>610-E-2000G⁴</u> (360-E-14G ⁴)	345-EFW-14G⁶ (580-EFW-2000G⁶) <u>580-EFW-2000G⁴</u> (345-EFW-14G ⁴)	250 (10) <u>10</u> (250)

1. Concrete mixes followed by a "P" have been designed to accommodate placement by a concrete pump. A pump mix may be substituted for a similar class or alternate class mix and placed utilizing standard placement methods by the Contractor at its option. Said substitution, if made, shall be at the Contractor's expense.
- ~~2. The Engineer should consider sulfide resistance of mix prior to use in sewers or appurtenant structures.~~
- ~~2.3.~~ Use B Aggregate gradation when placing conditions permit.
- ~~3.4.~~ Use limited to bedding concrete over which backfill will be placed not less than 40 hours after placement. For backfill after 24 hours, add 31 milliliters per kilogram of cement (3 pints per 100 pounds of cement) of calcium chloride. For backfill after 16 hours and removal of sheeting after 18

hours, use 390-C-26 (660-C-3750) with 31 milliliters per kilogram of cement (3 pints per 100 pounds of cement) calcium chloride solution. ***(This superscript does not appear in the table.)***

- ~~5. Controlled Low Strength Material (CLSM) conforming to Section 201-6 may be used when approved by the Engineer, except the maximum slump requirement in the table does not apply.~~
- ~~4.6. Concrete mixes followed by a "G" have been designed to accommodate the grout requirements of Section 202, Masonry Materials.~~
- ~~5.7. A water reducing admixture conforming to 201-1.2.4 may be used in any concrete specified by class and is required in all 28 MPa (4000 psi) compressive strength concrete specified by class.~~
- ~~6. Fibers conforming to 201-2.3 may be used in any concrete specified by class.~~
- ~~7. Color conforming to 303-7 may be added to any concrete specified by class.~~

201-1.1.3 Concrete Specified by Special Exposure. ~~When~~ Concrete specified by special exposure, ~~the concrete~~ shall be designated by a number, followed by three letters and a number. The first number is the minimum weight of cementitious material in ~~kg per m³ (lb. per yd³)~~ lb per yd³ (kg per m³) as ~~prescribed~~ specified in Table 201-1.1.3 (A). The first letter is the combined aggregate gradation ~~per~~ conforming to 201-1.3.2. The second and third letters (LE, ME, or SE) ~~designate~~ designates the level of exposure (Low Exposure, Moderate Exposure or Severe Exposure). The last number is the minimum compressive strength at 28 days in ~~psi (Mpa)~~ Mpa (psi).

Concrete specified by special exposure shall contain Class F fly ash or other SCMs conforming to 201-1.2.5 and a water-reducing admixture conforming to 201-1.2.4, and shall conform to the water-cementitious material ratio specified in Table 201-1.1.3(A).

~~Special Exposure mixes should~~ Concrete specified by special exposure shall be proportioned in accordance with ACI 318, Chapter 4, Durability Requirements. Air entraining admixtures may be incorporated ~~into the concrete mix~~ at the manufacturer's ~~suggested recommended~~ rates to produce ~~4% percent +/- 1% percent~~ 4% percent +/- 1% percent air content in the concrete mix ~~to help reduce permeability~~. Admixtures containing calcium chloride are prohibited for use in concrete exposed to sulfates. ~~The Engineer must then specify the method and level of protection for the concrete shall be as specified in the Special Provisions or shown on the Plans.~~ Special Exposure mixtures ~~A mix of more severe exposure~~ greater severity may be substituted for a mix of ~~less severe exposure~~ lesser severity.

~~All Special Exposure Concrete shall contain fly ash conforming to 201-1.2.5 and a water-reducing admixture conforming to 201-1.2.4, and shall comply with water-cementitious ratio per specified Table 201-1.1.3(A).~~

TABLE 201-1.1.3(A)

Special Exposure Mixes	Maximum Water – Cementitious Ratio ²	Special Exposure Metric Units (U.S. Standard Measure)	Cementitious Material Requirement
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		U.S. Standard Measure (Metric Units)	
LOW EXPOSURE – (% water soluble SO ₃ in soil samples 0.10 to 0.20) (Sulfate SO ₄ in water samples, PPM – 150 to 1,500)	0.50	370-BLE-28P⁺ (618-BLE-4000P⁺) 370-CLE-28P⁺ (618-CLE-4000P⁺) 440-DLE-28P⁺ (740-DEL-4000P⁺)	80% Type II or V portland cement with 20% Class F fly ash
LOW EXPOSURE – (% water soluble SO ₃ in soil samples 0.10 to 0.20) (Sulfate SO ₄ in water samples, PPM – 150 to 1,500)		650-BLE-4000P¹ (385-BLE-28P¹) 650-CLE-4000P¹ (385-CLE-28P¹) 740-DEL-4000P¹ (440-DLE-28P¹)	
MODERATE EXPOSURE – (% water soluble SO ₃ in soil samples 0.20 to 2.00) (Sulfate SO ₄ in water samples, PPM – 1500 to 10,000)	0.45	390-BME-P⁺ (658-BME-4500P⁺) 390-CME-31P⁺ (658-CME-4500P⁺) 480-DME-35P⁺ (815-DME-4500P⁺) 658-BME-4500P¹ (390-BME-31P¹) 658-CME-4500P¹ (390-CME-31P¹) 815-DME-4500P¹ (480-DME-35P¹)	80% Type II or V portland cement with 20% Class F fly ash
SEVERE EXPOSURE – (% water soluble SO ₃ in soil samples 2.00 or more) (Sulfate SO ₄ in water samples, PPM – 10,000 or more)	0.40	450-BSE-35P⁺ (750-BSE-5000P⁺) 450-CSE-35P⁺ (750-CSE-5000P⁺) 520-DSE-35P⁺ (875-DSE-5000P⁺) 750-BSE-5000P¹ (450-BSE-35P¹) 750-CSE-5000P¹ (450-CSE-35P¹) 875-DSE-5000P¹ (520-DSE-35P¹)	80% Type II or V portland cement with 20% Class F fly ash

1. Concrete mixes followed by a "P" have been ~~designated~~ designed to accommodate placement by a concrete pump.
2. Maximum slump is determined by placement conditions so long as water-cementitious ratio is not exceeded.

201-1.1.4 Concrete Specified by Compressive Strength. The Contractor shall determine the mix proportions of concrete specified in the Special Provision or shown on the Plans by its 28-day compressive strength within the minimum cement, maximum size coarse aggregate and admixture limitations ~~designed herein or specified herein or otherwise specified in the Special Provisions~~ Specifications. ~~The concrete~~ Concrete specified by compressive strength shall contain not less than ~~330 kg of cement, or cement and fly ash per m³ (560 pounds of cement, or cement and fly ash per cubic yard)~~ 560 pounds of cement, or cement and SCMs per cubic yard (330 kg of cement, or cement and SCMs per m³), in accordance with 201-1.2.5, for concrete strengths of ~~23 MPa (3,250 psi)~~ 3,250 psi (23 MPa) or greater. The Contractor may submit

mix designs specified by compressive strength in excess of 28 days with the approval of the Engineer. ~~Such mix designs Submittals designated by compressive strength in excess of 28 days are not subject to the fly ash SCMs limitations of 201-1.2.5~~

~~**201-1.2.5 Fly Ash.** Fly ash is specified in alternate class and special exposure mixes. Fly ash may be used in any other mix when approved by the Engineer. The amount of fly ash and portland cement used shall be based upon trial batches in accordance with 201-1.1.4. Fly ash shall not be used with Type IP (MS) or Type III portland cement.~~

~~Class C fly ash shall not be used where sulfate resistant concrete is required. Except for special exposure mixes, whenever Type V portland cement is specified Type II portland cement and Class F fly ash may be used or Class F fly ash may be used as an addition to Type V portland cement.~~

~~The Contractor shall furnish a Certificate of Compliance conforming to 4-1.5 as specified in 2-5.3. The Certificate of Compliance shall be signed by the supplier identifying the type of fly ash, stating that the fly ash complies with ASTM C 618 and the Specifications. Supporting test data shall be furnished when requested by the Engineer. All testing and sampling procedures shall conform to ASTM C 311.~~

~~Separate silo storage facilities shall be provided. Suitable facilities shall be provided to discharge the fly ash into the cement hopper in accordance with 201-1.3.1. Fly ash shall be stored in such a manner as to permit ready access for the purpose of inspection, sampling and be suitably protected against contamination or moisture. Should any fly ash show evidence of contamination or be otherwise unsuitable, the Engineer may reject it and require that it be removed from the site.~~

~~All fly ash used in concrete for any individual structure shall be from the same source and of the same class in combination with the same source and type of portland cement, unless otherwise approved by the Engineer.~~

~~(a) **Class F Fly Ash.** Class F fly ash shall conform to ASTM C 618 and the following:~~

Loss of ignition	4% maximum
SO₂ content	3% maximum
Moisture content	1% maximum

~~When sulfate resistant or special exposure concrete is specified, test results shall be submitted to the Engineer as specified in 2-5.3. The test result shall show that the fly ash to be used is effective in contributing to sulfate resistance in conformance with ASTM C 618, Table 3 (optional requirements) as tested in accordance with ASTM C 1012. The data submitted shall be less than 6 months old.~~

~~Class F fly ash, as a percent by weight of total cementitious material, may exceed 20 percent, when approved by the Engineer.~~

~~(b) **Class C Fly Ash.** Class C fly ash shall conform to ASTM C 618 and the following:~~

Loss of ignition	2% maximum
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SO₃ content	4% maximum
Moisture content	1% maximum

~~Class C fly ash, as a percent by weight of total cementitious material, shall not exceed 30 percent, unless otherwise approved by the Engineer.~~

~~Class C fly ash shall not be used where sulfate resistant concrete is required.~~

201-1.2.5 Supplementary Cementitious Materials.

201-1.2.5.1 Definitions.

SCMs - Materials that are by products of other processes or natural materials. SCMs may or may not be furthered processed for use in concrete and distribute pozzolanic and/or cementitious reactions.

Pozzolans - Materials that possess little or no cementitious value, but are capable of reacting chemically with calcium hydroxide at ambient temperatures to form compounds with cementitious properties.

Cementitious Materials - Materials that react in the presence of water or calcium hydroxide to form complex silicates having the characteristics of cements.

201-1.2.5.2 General.

SCMs shall be cementitious and/or pozzolanic materials as specified in the Special Provisions.

Bulk SCMs shall be stored in silo storage facilities. SCMs shall be stored in such a manner as to permit ready access for the purposes of inspection, and sampling and provide suitable protection against contamination or moisture. The Engineer may reject SCMs that show evidence of contamination or are otherwise unsuitable, and require that they be removed from the storage site. Facilities shall be provided to discharge the SCMs into the cement hopper in accordance with 201-1.3.1.

SCMs used in concrete for any individual structure shall be from the same source in combination with the same source and type of portland cement, unless otherwise approved by the Engineer.

201-1.2.5.3 Fly Ash. Fly ash shall be incorporated into the alternate class mixes specified in 201-1.1.2, and special exposure mixes specified in 201-1.1.3. Fly ash may also be used in other mixes when approved by the Engineer. The amount of fly ash and portland cement used shall be based upon trial batches in accordance with 201-1.1.4.

The Contractor shall furnish a Certificate of Compliance conforming to 4-1.5 signed by the supplier. The certificate shall identify the type of fly ash, and state that the fly ash conforms to ASTM C618 and the Specifications. Supporting test data shall be furnished when requested by the Engineer. Testing and sampling procedures shall conform to ASTM C-311.

~~(a)~~ **a) Class F Fly Ash.** Class F fly ash shall conform to ASTM C 618 and the following:

<u>Loss of ignition</u>	<u>4% maximum</u>
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<u>SO₃ content</u>	<u>3% maximum</u>
<u>Moisture content</u>	<u>1% maximum</u>

Test results for special exposure mixes shall be submitted to the Engineer in accordance with 2-5.3. The test results shall show the fly ash to be used is effective in contributing to sulfate resistance in conformance with ASTM C 618, Table 3 (optional requirements) as tested in accordance with ASTM C 1012. The data submitted shall be less than 6 months old.

Class F fly ash, as a percent by weight of total cementitious material, may exceed 20 percent, when approved by the Engineer.

~~(b)~~ b) **Class C Fly Ash.** Class C fly ash shall conform to ASTM C 618 and the following:

<u>Loss of ignition</u>	<u>2% maximum</u>
<u>SO₃ content</u>	<u>4% maximum</u>
<u>Moisture content</u>	<u>1% maximum</u>

Class C fly ash, as a percent by weight of total cementitious material, shall not exceed 30 percent, unless otherwise approved by the Engineer.

Class C fly ash shall not be used where sulfate resistant concrete is required.

201-1.2.5.4 Class N Pozzolans. Class N pozzolans shall comply with the applicable requirements for the class specified herein and conform to ASTM C 618.

Class N pozzolans are:

- a) some diatomaceous earths;
- b) opaline cherts and shales;
- c) tuffs and volcanic ashes or pumicites, calcined or uncalcined; and
- d) various materials requiring calcination to induce satisfactory properties, such as some clays and shales.

Class N pozzolans may be used in any mix when approved by the Engineer.

The Contractor shall submit a Certificate of Compliance conforming to 4-1.5, signed by the supplier. The certificate shall identify the type of pozzolan, and state that the pozzolan conforms to ASTM C618 and the Specifications. Supporting test data shall be furnished when requested by the Engineer. Testing and sampling procedures shall conform to ASTM C311.

Class N pozzolan, as a percent by weight of total cementitious material, may exceed 20 percent when approved by the Engineer.

Special exposure mixes specified in 201-1.1.3, shall be proportioned in accordance with ACI 318, Chapter 4. Class N pozzolan shall comply with ASTM C 618 Table 3. All test data shall be made available upon the Engineer's request.

In any other mix, the amount of Class N pozzolan and portland cement used shall be determined by trial batches in accordance with 201-1.1.4.