

EXPECTED IMPLEMENTATION JULY 2018

346 PORTLAND CEMENT CONCRETE. (REV 11-7-17) (FA 1-2-18) (7-18)

SUBARTICLE 346-2.2 is deleted and the following substituted:

346-2.2 Types of Cement: Unless a specific type of cement is designated elsewhere, use Type I, Type IL, Type IP, Type IS, Type II, Type II (MH) or Type III cement in all classes of concrete. Use Type IL or Type II (MH) for all mass concrete elements.

Do not use high alkali cement in extremely aggressive environments or in mass concrete.

Use only the types of cements designated for each environmental condition in structural concrete. A mix design for a more aggressive environment may be substituted for a lower aggressive environmental condition.

TABLE 1			
BRIDGE SUPERSTRUCTURES			
Component	Slightly Aggressive Environment	Moderately Aggressive Environment	Extremely Aggressive Environment
Precast Superstructure and Prestressed Elements	Type I or Type III	Type I, Type IL, Type II, Type III, Type IP, or Type IS	Type II (MH), Type IL, or Ternary Blend
Cast In Place	Type I	Type I, Type IL, Type II, Type IP, or Type IS	Type II (MH), Type IL, or Ternary Blend
BRIDGE SUBSTRUCTURE, DRAINAGE STRUCTURES AND OTHER STRUCTURES			
All Elements	Type I or Type III	Type I, Type IL, Type II, Type IP, or Type IS	Type II (MH), Type IL, or Ternary Blend

Notes:
 1. Cements used in a more aggressive environment may also be used in a less aggressive environment.
 2. Type III cement may be used in an Extremely Aggressive Environment for precast superstructure and prestressed elements when the ambient temperature is 60°F and below.

SUBARTICLE 346-2.3 is deleted and the following substituted:

346-2.3 Pozzolans and Slag: Fly ash or slag materials are required in all classes of concrete except for the following when used in slightly aggressive environments: Class II 3400, Class I 3000, and concrete requiring a coloring agent. When a concrete requiring a coloring agent is used in a moderately or extremely aggressive environment, slag must be used. Use fly ash or slag materials as a cement replacement, on an equal weight replacement basis with the following limitations:

1. Mass Concrete:

a. Fly Ash - Ensure that the quantity of cement replaced with fly ash is 18% to 50% by weight, except where the core temperature is expected to rise above 165°F. In that case, ensure that the percentage of fly ash is 35% to 50% by weight.

b. Slag - Ensure that the quantity of cement replaced with slag is 50% to 70% by weight. Ensure that slag is 50% to 55% of total cementitious content by weight when used in combination with silica fume, ultrafine fly ash and/or metakaolin.

c. Fly Ash and Slag - Ensure that there is 10% to 20% fly ash by weight, 50% to 60% slag by weight, and minimum 30% portland cement by weight for mixes containing portland cement, fly ash and slag.

2. Drilled Shaft:

a. Fly Ash - Ensure that the quantity of cement replaced with fly ash is 33% to 37% by weight.

b. Slag - Ensure that the quantity of cement replaced with slag is 58% to 62% by weight.

c. Fly Ash and Slag - Ensure that there is 10% to 20% fly ash by weight, 50% to 60% slag by weight, and minimum 30% portland cement by weight for mixes containing portland cement, fly ash and slag.

3. Precast Concrete – Ensure that the precast concrete has a maximum of 30% fly ash or a maximum of 70% slag. In extremely aggressive environments, ensure that the precast concrete has a minimum of 18% fly ash or a minimum of 50% slag.

a. Fly Ash and Slag - Ensure that there is 10% to 20% fly ash by weight, 50% to 60% slag by weight, and minimum 30% portland cement by weight for mixes containing portland cement, fly ash and slag.

4. For all other concrete uses not covered in (1), (2) and (3) above,

a. Fly Ash - Ensure that the quantity of cement replaced with fly ash is 18% to 30% by weight.

b. Slag - Ensure that the quantity of cement replaced with slag is 25% to 70% for slightly and moderately aggressive environments and 50% to 70% by weight when used in extremely aggressive environments. Ensure that slag is 50% to 55% of total cementitious content by weight when used in combination with silica fume, ultra fine fly ash and/or metakaolin.

c. Fly Ash and Slag - Ensure that there is 10% to 20% fly ash by weight, 50% to 60% slag by weight, and minimum 30% portland cement by weight for mixes containing portland cement, fly ash and slag.

5. Highly Reactive Pozzolans: Highly reactive pozzolans are considered to be silica fume, metakaolin and ultrafine fly ash. When silica fume, metakaolin or ultrafine fly ash is used, it must be cured in accordance with the manufacturer's recommendations and approved by the Engineer.

a. Silica Fume - Ensure that the quantity of cement replaced with silica fume is 7% to 9% by weight of the total cementitious material.

b. Metakaolin - Ensure that the quantity of cement replaced with metakaolin is 8% to 12% by weight of the total cementitious material.

c. Ultrafine Fly Ash - Ensure that the quantity of cement replaced with ultrafine fly ash is 8% to 12% by weight of the total cementitious material.

SUBARTICLE 346-2.4 is deleted and the following substituted:

346-2.4 Coarse Aggregate Gradation: Produce all concrete using Size No. 57, 67 or 78 coarse aggregate. With the Engineer’s approval and input from the District Materials Office with Producer QC Plan acceptance authority, Size No. 8 , Size No. 89, or other gradations may be used either alone or blended with Size No. 57, 67 or 78 coarse aggregate. Submit sufficient statistical data to establish production quality and uniformity of the subject aggregates, and establish the quality and uniformity of the resultant concrete. Furnish aggregate gradations sized larger than nominal maximum size of 1.5 inch as two components.

For Class I and Class II, excluding Class II (Bridge Deck), the coarse and fine aggregate gradation requirements set forth in Sections 901 and 902 are not applicable and the aggregates may be blended; however, the aggregate sources must be approved by the Department. Do not blend the aggregate if the size is smaller than Size No. 78.

SUBARTICLE 346-2.5.4 is deleted and the following substituted:

346-2.5.4 Corrosion Inhibitor Admixture: Use only with concrete containing Type II cement, or Type II (MH) cement, and a water-reducing retardant admixture, Type D, or High Range Water-Reducer retarder admixture, Type G, to normalize the setting time of concrete.

ARTICLE 346-3 is deleted and the following substituted:

346-3 Classification, Strength, Slump and Air Content.

346-3.1 General: The separate classifications of concrete covered by this Section are designated as Class I, Class II, Class III, Class IV, Class V and Class VI. Strength and slump are specified in Table 2. The air content for all classes of concrete is less than or equal to 6.0%.

Substitution of a higher class concrete in lieu of a lower class concrete may be allowed when the substituted concrete mixes are included as part of the QC Plan, or for precast concrete, the Precast Concrete Producer QC Plan. The substituted higher class concrete must meet or exceed the requirements of the lower class concrete and both classes must contain the same types of mix ingredients. When the compressive strength acceptance data is less than the minimum compressive strength of the higher design mix, notify the Engineer. Acceptance is based on the requirements in Table 2 for the lower class concrete.

TABLE 2		
Class of Concrete	Specified Minimum Strength (28-day) (psi)	Target Slump Value (inches) (c)
STRUCTURAL CONCRETE		
I (a)	3,000	3 (b)
I (Pavement)	3,000	2
II (a)	3,400	3 (b)
II (Bridge Deck)	4,500	3 (b)
III (e)	5,000	3 (b)

III (Seal)	3,000	8
IV (d)(f)	5,500	3 (b)
IV (Drilled Shaft)	4,000	8.5
V (Special) (d)(f)	6,000	3 (b)
V (d)(f)	6,500	3 (b)
VI (d)(f)	8,500	3 (b)

(a) For precast three-sided culverts, box culverts, endwalls, inlets, manholes and junction boxes, the target slump value and air content will not apply. The maximum allowable slump is 6 inches, except as noted in (b). The Contractor is permitted to use concrete meeting the requirements of ASTM C478 4,000 psi in lieu of Class I or Class II concrete for precast endwalls, inlets, manholes and junction boxes.

(b) The Engineer may allow a higher target slump when a Type F, G, I or II admixture is used, except when flowing concrete is used. The maximum target slump shall be 7 inches.

(c) For a reduction in the target slump for slip-form operations, submit a revision to the mix design to the Engineer.

(d) When silica fume, ultrafine fly ash, metakaolin, or a ternary blend cement is used in Class IV, Class V, Class V (Special) or Class VI concrete, ensure that the concrete meets or exceeds a resistivity of 29 KOhm-cm at 28 days, when tested in accordance with AASHTO T358. Submit three 4 x 8 inch cylindrical test specimens to the Engineer for resistivity testing before mix design approval. Take the resistivity test specimens from the concrete of the laboratory trial batch or from the field trial batch of at least 3 cubic yards. Verify the mix proportioning of the design mix and take representative samples of trial batch concrete for the required plastic and hardened property tests. Cure the field trial batch specimens similar to the standard laboratory curing methods. Submit the resistivity test specimens at least 7 calendar days prior to the scheduled 28 day test. The average resistivity of the three cylinders, eight readings per cylinder, is an indicator of the permeability of the concrete mix.

(e) When precast three-sided culverts, box culverts, endwalls, inlets, manholes or junction boxes require a Class III concrete, the minimum cementitious materials is 470 pounds per cubic yard. Do not apply the air content range and the maximum target slump shall be 6 inches, except as allowed in (b).

(f) Highly reactive pozzolans may be used outside the lower specified ranges to enhance strength and workability. Testing in accordance with AASHTO T358 is not required.

346-3.2 Drilled Shaft Concrete: Notify the Engineer at least 48 hours before placing drilled shaft concrete. Obtain slump loss tests results demonstrating that the drilled shaft concrete maintains a slump of at least 5 inches throughout the concrete elapsed time before drilled shaft concrete operations begin. Ambient temperature conditions for placement of drilled shaft concrete for summer condition is 85°F or higher, and below 85°F for normal condition.

Perform the slump loss test at the anticipated ambient temperature for drilled shaft placements greater than 30 cubic yards and an elapsed time of greater than five hours.

Obtain slump loss test results from an approved laboratory or from a field demonstration. Slump loss test results for drilled shafts requiring 30 cubic yards of concrete or less and a maximum elapsed time of five hours or less may be done in a laboratory. Obtain all other slump loss test results in the field. Technicians performing the slump test must be ACI Field Grade I qualified.

The concrete elapsed time is defined in Section 455. Obtain the Engineer's approval for use of slump loss test results including elapsed time before concrete placement begins.

Test each load of concrete for slump to ensure the slump is within the limits of 346. Initially cure acceptance cylinders for 48 hours before transporting to the laboratory.

If the elapsed time during placement exceeds the slump loss test data, submit an Engineering Analysis Scope in accordance with 6-4 by a Specialty Engineer knowledgeable in the area of foundations, to determine if the shaft is structurally sound and free from voids. At the direction of the Engineer, excavate the drilled shaft for inspection. Obtain approval from the Engineer before placing any additional shafts.

346-3.3 Mass Concrete: When mass concrete is designated in the Contract Documents, use a Specialty Engineer to develop and administer a Mass Concrete Control Plan (MCCP). Develop the MCCP in accordance with Section 207 of the ACI Manual of Concrete Practice to ensure concrete core temperatures for any mass concrete element do not exceed the maximum allowable core temperature of 180°F and that the temperature differential between the element core and surface do not exceed the maximum allowable temperature differential of 35°F. Submit the MCCP to the Engineer for approval at least 14 days prior to the first anticipated mass concrete placement. Ensure the MCCP includes and fully describes the following:

1. Concrete mix design proportions,
2. Casting procedures,
3. Insulating systems,
4. Type and placement of temperature measuring and recording devices,
5. Analysis of anticipated thermal developments for the various mass concrete elements for all anticipated ambient temperature ranges,
6. Names and qualifications of all designees who will inspect the installation of and record the output of temperature measuring devices, and who will implement temperature control measures directed by the Specialty Engineer,
7. Measures to prevent thermal shock, and
8. Active cooling measures (if used).

Fully comply with the approved MCCP. The Specialty Engineer or approved designee shall personally inspect and approve the installation of temperature measuring devices and verify that the process for recording temperature readings is effective for the first placement of each size and type mass component. The Specialty Engineer shall be available for immediate consultation during the monitoring period of any mass concrete element. Record temperature measuring device readings at intervals no greater than six hours, beginning at the completion of concrete placement and continuing until decreasing core temperatures and temperature differentials are confirmed in accordance with the approved MCCP. Leave temperature control mechanisms in place until the concrete core temperature is within 50°F of the ambient temperature. Within three days of the completion of temperature monitoring, submit a report to the Engineer which includes all temperature readings, temperature differentials, data logger summary sheets and the maximum core temperature and temperature differentials for each mass concrete element.

Upon successful performance of the MCCP, reduced monitoring of similar elements may be requested. Submit any such requests to the Engineer for approval at least 14 days prior to the requested date of reduced monitoring. If approved, the Specialty Engineer may monitor only the initial element of concrete elements meeting all of the following requirements:

1. All elements have the same least cross sectional dimension,
2. All elements have the same concrete mix design,
3. All elements have the same insulation R value and active cooling measures (if used), and
4. Ambient temperatures during concrete placement for all elements is within minus 10°F or plus 5°F of the ambient temperature during placement of the initial element.

Install temperature measuring devices for all mass concrete elements. Resume the recording of temperature monitoring device output for all elements if directed by the Engineer.

The Department will make no compensation, either monetary or time, for any impacts associated with reduced monitoring of mass concrete elements.

Mass concrete control provisions are not required for drilled shafts supporting sign, signal, lighting or intelligent transportation (ITS) structures. At the Contractor's option, instrumentation and temperature measuring may be omitted for any mass concrete substructure element meeting all of the following requirements:

1. Least cross sectional dimension of six feet or less,
2. Insulation R value of at least 2.5 provided for at least 72 hours following the completion of concrete placement,
3. The environmental classification of the concrete element is Slightly Aggressive or Moderately Aggressive,
4. The concrete mix design meets the mass concrete proportioning requirements of 346-2.3, and
5. The total cementitious content of the concrete mix design is 750 lb/cy or less.

6. Temperature of the concrete is 95°F or less at placement.

If either the maximum allowable core temperature or temperature differential of any mass concrete element is exceeded, implement immediate corrective action as directed by the Specialty Engineer to remediate. The approval of the MCCP shall be revoked. Do not place any mass concrete elements until a revised MCCP has been approved by the Engineer. Submit an Engineering Analysis Scope in accordance with 6-4 for approval, which addresses the structural integrity and durability of any mass concrete element which is not cast in compliance with the approved MCCP or which exceeds the allowable core temperature or temperature differential. Submit all analyses and test results requested by the Engineer for any noncompliant mass concrete element to the satisfaction of the Engineer. The Department will make no compensation, either monetary or time, for the analyses and tests or any impacts upon the project.

346-3.4 Flowing Concrete for Precast/Prestressed Concrete: Produce flowing concrete mix with target slump of 9 inches.

Subsequent to the laboratory trial batch, perform a field demonstration of the proposed mix design by production and placement of at least three batches, 3 cubic yard minimum size each, of concrete containing flowing concrete HRWR admixture. Take representative samples from each batch and perform slump, air content, density (unit weight), and temperature tests on these samples. Cast specimens from each sample for compressive strength tests to verify the design mix trial. Record the ambient air temperature during the test. Ensure that the concrete properties are within the required specification limits. The plants that are producing concrete with batch sizes of less than 3 cubic yards are required to produce and place at least a total amount of 9 cubic yards and perform the aforementioned tests on at least three randomly selected batches.

Determine the workability of the demonstration concrete batches by performing the slump tests on the samples taken at 15 minute intervals from each batch. Continue sampling and testing until the slump measures 6 inches or less. From the plot of slump versus time, determine the time for each batch when the slump is at 7.5 inches. The shortest time period determined from three consecutive batches, at 7.5 inches slump, is considered the cutoff time of the proposed concrete mix. For production concrete, ensure that the time between the batching

and depositing of each load of concrete is less than the cutoff time of the mix and also does not exceed the allowable time limit specified in this Section.

Ensure that the demonstration concrete is mixed, delivered, placed, consolidated and cured in accordance with the proposed method and sequence. Produce the flowing concrete batches at slumps between 7.5 inches to 10.5 inches.

Perform inspection of the demonstration concrete during batching, delivery, placement and post placement. During placement, ensure that the concrete batches meet all plastic property requirements of the specifications and maintain their cohesive nature without excessive bleeding, segregation, or abnormal retardation.

Dispose of concrete produced for demonstration purposes at no expense to the Department. Subject to the Engineer's approval, the Contractor may incorporate this concrete into non-reinforced concrete items and may be included for payment, provided it meets Contract requirements for slump, entrained air, and strength.

After removal of the forms, perform the post-placement inspection of the in-place concrete. Observe for any signs of honeycombs, cracks, aggregate segregation or any other surface defects and ensure that the hardened concrete is free from these deficiencies. The Engineer may require saw cutting of the mock-up products to verify the uniform distribution of the aggregates within the saw cut surfaces and around the reinforcing steel and prestressing strands. The Engineer will require saw cutting of the demonstration mock-up products for plants that are demonstrating the use of the flowing concrete for the first time. Obtain core samples in accordance with FM 5-617, section 7 to inspect the aggregate distribution.

Submit the results of the laboratory trial batch tests and field demonstration of verified test data and inspection reports to the Engineer, along with certification stating that the results of the laboratory trial batch tests and field demonstration tests indicate that the proposed concrete mix design meets the requirements of the specifications. For the proposed mix design, state the anticipated maximum time limit between the batching and when the concrete of each batch is deposited during the production.

Upon the review and verification of the laboratory trial batch, field demonstration test data, inspection reports and contractor's certification statement, the Department will approve the proposed mix design.

The Department may approve proposed flowing concrete mixes, centrally mixed at the placement site, without the production of demonstration batches, provided that the proposed mix meets the following two criteria:

1. A previously approved flowing concrete mix of the same class has demonstrated satisfactory performance under the proposed job placing conditions with a minimum of fifteen consecutive Department acceptance tests, which met all plastic and hardened concrete test requirements.

2. The cementitious materials and chemical admixtures, including the flowing concrete HRWR admixture, used in the proposed mix are the same materials from the same source used in the previously approved mix, (1) above.

Do not produce or place concrete until the design mixes have been approved.

SUBARTICLE 346-4.1 is deleted and the following substituted:

346-4.1 Master Proportion Table: Proportion the materials used to produce the various classes of concrete in accordance with Table 3:

TABLE 3		
Class of Concrete	Minimum Total Cementitious Materials Content pounds per cubic yard	Maximum Water to Cementitious Materials Ratio pounds per pounds*
I	470	0.53
I (Pavement)	470	0.50
II	470	0.53
II (Bridge Deck)	611	0.44
III	611	0.44
III (Seal)	611	0.53
IV	658	0.41**
IV (Drilled Shaft)	658	0.41
V (Special)	752	0.37**
V	752	0.37**
VI	752	0.37**

*The calculation of the water to cementitious materials ratio (w/cm) is based on the total cementitious material including cement and any supplemental cementitious materials that are used in the mix.

**When silica fume or metakaolin is used, the maximum water to cementitious material ratio will be 0.35. When the use of ultrafine fly ash is required, the maximum water to cementitious material ratio will be 0.30.

SUBARTICLE 346-6.2 is deleted and the following substituted:

346-6.2 Concrete Design Mix: Provide concrete that has been produced in accordance with a Department approved design mix, in a uniform mass free from balls and lumps.

For slump target values in excess of 6 inches or self consolidating concrete, utilize a grate over the conveyance equipment to capture any lumps or balls that may be present in the mix. The grate must cover the entire opening of the conveyance equipment and have an opening that is a maximum of 2 1/2 inches in any one direction. Remove the lumps or balls from the grate and discard them. Discharge the concrete in a manner satisfactory to the Engineer. Perform demonstration batches to ensure complete and thorough placements in complex elements, when requested by the Engineer.

Do not place concretes of different compositions such that the plastic concretes may combine, except where the Plans require concrete with a surface resistivity value of 29 Kohm-cm or below and one with higher than 29 Kohm-cm values in a continuous placement. Produce these concretes using separate design mixes. For example, designate the mix with calcium nitrite as the original mix and the mix without calcium nitrite as the redesigned mix. Ensure that both mixes contain the same cement, fly ash or slag, coarse and fine aggregates and admixtures. Submit both mixes for approval as separate mix designs, both meeting all requirements of this Section. Ensure that the redesigned mix exhibits plastic and hardened qualities which are additionally approved by the Engineer as suitable for placement with the original mix. The Engineer will approve the redesigned mix for commingling with the original mix and for a specific project application only. Alternately, place a construction joint at the location of the change in concretes.

SUBARTICLE 346-7.2.2 is deleted and the following substituted:

346-7.2.2 Placement Time: All the concrete in a load must be in its final placement position a maximum of 15 minutes after the transit time has expired unless a time extension is approved by the Engineer.

ARTICLE 346-8 is deleted and the following substituted:

346-8 Plastic Concrete Sampling and Testing.

QC tests include air content, temperature, slump, and preparing compressive strength cylinders for testing at later dates. In addition, calculate the water to cementitious materials ratio in accordance with FM 5-501 for compliance to the approved mix design.

Ensure that each truck has a rating plate and a valid mixer identification card issued by the Department. Ensure that the revolution counter on the mixer is working properly, and calibration of the water dispenser has been performed within the last twelve months. Reject any concrete batches that are delivered in trucks that do not have mixer identification cards. Remove the mixer identification card when a truck mixer is discovered to be in noncompliance and the mixer deficiencies cannot be repaired immediately. When the mixer identification card is removed for noncompliance, make note of the deficiency or deficiencies found, and forward the card to the District Materials and Research Engineer who has Producer QC Plan acceptance authority.

Perform plastic concrete tests on the initial delivery from each plant of each concrete design mix each day. Ensure QC technicians meeting the requirements of Section 105 are present and performing tests throughout the placement operation. Ensure one technician is present and performing tests throughout the placement operation at each placement site. If a project has multiple concrete placements at the same time, identify the technicians in the Q C Plan to ensure minimum sampling and testing frequencies are met. Ensure that the equipment used for delivery, placement and finishing meets the requirements of this Specification.

When a truck designated for QC testing arrives at the discharge site, a subsequent truck may also discharge once a representative sample has been collected from the QC truck and while awaiting the results of QC testing. Reject non-complying loads at the jobsite. Ensure that corrections are made on subsequent loads. Immediately cease concrete discharge of all trucks if the QC truck has failing test. Perform plastic properties tests on all trucks prior to the first corrected truck and the corrected truck. When more than one truck is discharging into a pump simultaneously, only the truck designated for QC testing may discharge into the pump to obtain a representative sample of concrete from the QC truck only.

Furnish sufficient concrete of each design mix as required by the Engineer for verification testing. When the Engineer's verification test results do not compare with the QC plastic properties test results, within the limits defined by the Independent Assurance (IA) checklist comparison criteria, located in Materials Manual Chapter 5, disposition of the concrete will be at the option of the Contractor.

On concrete placements consisting of only one load of concrete, perform initial sampling and testing in accordance with this Section. The acceptance sample and plastic properties tests may be taken from the initial portion of the load.

If any of the QC plastic properties tests fail, reject the remainder of that load, and any other loads that have begun discharging, terminate the LOT and notify the Engineer. Make cylinders representing that LOT from the same sample of concrete.

Following termination of a LOT, obtain samples from a new load, and perform plastic properties tests until such time as the water to cementitious materials ratio, air content, temperature and slump comply with the Specification requirements. Initiate a new LOT once the testing indicates compliance with Specification requirements.

Suspend production when any five loads in two days of production of the same design mix are outside the specified tolerances. Increase the frequency of QC testing to one per load to bring the concrete within allowable tolerances. After production resumes, obtain the Engineer's approval before returning to the normal frequency of QC testing.

If concrete placement stops for more than 90 minutes, perform initial plastic properties testing on the next batch and continue the LOT. Cylinders cast for that LOT will represent the entire LOT.

When the Department performs Independent Verification, the Contractor may perform the same tests on the concrete at the same time. The Department will compare results based on the Independent Assurance Checklist tolerances.

SUBARTICLE 346-9.2 is deleted and the following substituted:

346-9.2 Sampling Frequency: As a minimum, sample and test concrete of each design mix for water to cementitious materials ratio, air content, temperature, slump and compressive strength once per LOT as defined by Table 8. The Engineer will randomly verify one of every four consecutive LOTs of each design mix based on a random number generator. The Department may perform Independent Verification testing to verify compliance with specification requirements. All QC activities, calculations, and inspections will be randomly confirmed by the Department.

TABLE 8	
Class Concrete*	LOT Size
I	one day's production
I (Pavement)	2,000 square yards, or one day's production, whichever is less
II, II (Bridge Deck), III, IV, V (Special), V, VI	50 cubic yards, or one day's production, whichever is less
IV (Drilled Shaft)	50 cubic yards, or two hours between the end of one placement and the start of the next placement, whichever is less
III (Seal)	Each Seal placement
*For any class of concrete used for roadway barrier wall, the lot size is defined as 100 cubic yards, or one day's production, whichever is less.	

346-9.2.1 Reduced Frequency for Acceptance Tests: The LOT size may represent 100 cubic yards when produced with the same mix design at the same concrete

production facility for the same prime contractor and subcontractor on a given Contract. As an exception, the requirements for the precast/prestressed production facility will only include the same mix design at the same concrete production facility. Submit test results indicating the average compressive strength is greater than two standard deviations above the specified minimum strength for that class of concrete. Base calculations on a minimum of ten consecutive strength test results for a Class IV or higher; or a minimum of five consecutive strength results for a Class III or lower.

The average of the consecutive compressive strength test results, based on the class of concrete, can be established using historical data from a previous Department project. The tests from the previous Department project must be within the last 60 calendar days or may also be established by a succession of samples on the current project. Only one sample can be taken from each LOT. Test data must be from a laboratory meeting the requirements of Section 105. Obtain Department approval before beginning reduced frequency LOT's.

If at any time a strength test is not verified or the average strength of the previous ten or five consecutive samples based on the class of concrete from the same mix design and the same production facility is less than the specified minimum plus two standard deviations, return to the maximum production quantity represented by the LOT as defined in Table 8. Notify the Engineer that the maximum production rate is reinstated. In order to reinitiate reduced frequency, submit a new set of strength test results.

SUBARTICLE 346-9.4 is deleted and the following substituted:

346-9.4 Acceptance of Concrete: Ensure that the hardened concrete strength test results are obtained in accordance with 346-9.3. Do not discard a cylinder strength test result based on low strength (strength below the specified minimum strength as per the provisions of this Section).

When one of the three QC cylinders from a LOT is lost, missing, damaged or destroyed, determination of compressive strength will be made by averaging the remaining two cylinders. If more than one QC cylinder from a LOT is lost, missing, damaged or destroyed, the Contractor will core the structure at no additional expense to the Department to determine the compressive strength. Acceptance of LOT may be based on verification data at the discretion of the Engineer. Obtain the approval of the Engineer to core, and of the core location prior to coring.

For each QC and each QC hold cylinder that is lost, missing, damaged or destroyed, payment for that LOT will be reduced by \$750.00 per 1,000 psi of the specified design strength [Example: loss of two Class IV (Drill Shaft) QC cylinders that has no verification data will require the element to be cored and a pay reduction will be assessed $(4,000 \text{ psi} / 1,000 \text{ psi}) \times \$750 \times 2 = \$6,000$]. This reduction will be in addition to any pay adjustment for low strength.

When QC compressive strength test results are not verified, the resolution procedure will be used to accept or reject the concrete. Maintain the "hold" cylinders until the verification of the compressive strength test results.

When QC test results are verified, the Engineer will accept the concrete based on QC test results. The Engineer will accept at full pay only LOTs of concrete represented by plastic property results which meet the requirements of the approved mix design and strength test results which equal or exceed the respective specified minimum strength.

