
PERVIOUS PORTLAND CEMENT CONCRETE (PCC) PAVEMENT

These specifications compliment the pervious PCC pavement design portion of the Iowa Stormwater Management Manual in Chapter 2, Section 2J-2.

Sections of the following documents, as referenced within these specifications, are hereby made a part of these specifications:

- SUDAS Standard Specifications: The standard specifications issued by the Iowa Statewide Urban Design and Specifications Program effective at the date of publication of the Notice to Bidders, unless a different effective date is identified in the contract documents.
- Iowa DOT Standard Specifications for Highway and Bridge Construction: The Iowa Department of Transportation Standard Specifications for Highway and Bridge Construction and the General Supplemental Specifications effective at the date of publication of the Notice to Bidders unless a different effective date is identified in the contract documents.
- Iowa DOT Materials Instructional Memorandum: The Iowa Department of Transportation's Materials Instructional Memorandum effective at the date of publication of the Notice to Bidders, unless a different effective date is identified in the contract documents.
- American Concrete Institute, Specification for Pervious Concrete Pavement, ACI 522.1-08.
- American Society for Testing and Materials (ASTM) standards.
- American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications for Transportation Materials and Methods of Sampling and Testing.

PART 1 - GENERAL**1.01 SECTION INCLUDES**

- A. Subgrade Preparation for Pervious Portland Cement Concrete (PCC) Pavement
- B. Placement of Filter Aggregate
- C. Placement of Pervious PCC Pavement
- D. Testing of Pervious PCC Pavement

1.02 DESCRIPTION OF WORK

Construct pervious PCC pavement for treatment of stormwater runoff.

1.03 SUBMITTALS**A. Concrete Materials:**

1. Proposed concrete mixture proportions including all material weights, volumes, fresh design unit weight per 3.09, B, water-to-cement ratio, in-place design density, and in-place design void content.

1.03 SUBMITTALS (Continued)

2. Aggregate types, sources, and gradations from a qualified testing agency.
 3. Material certifications signed by manufacturers certifying that each of the following materials complies with the specified requirements:
 - a. Cement.
 - b. Supplementary cementitious materials.
 - c. Chemical admixtures.
 - d. Fiber reinforcement.
- B. Filter Aggregate:** Including aggregate type, source, gradation, and compacted void content.
- C. Project Details:** Including jointing plan, schedule, construction procedures, and quality control plan.
- D. Qualifications:** Comply with 1.07 below for contractor and concrete producer.
- E. Involved Parties:** Submit a list of all subcontractors, material suppliers, and testing laboratories.

1.04 SUBSTITUTIONS

Comply with the requirements of the contract documents.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with the requirements of the contract documents.

1.06 SCHEDULING AND CONFLICTS

Comply with the requirements of the contract documents.

1.07 SPECIAL REQUIREMENTS**A. Quality Control:**

1. **General:** Test and inspect concrete materials and operations as work progresses. Failure to detect defective work or material early could result in rejection if a defect is discovered later.
2. **Contractor Qualifications:**
 - a. Provide employees who have a minimum of one of the following National Ready Mixed Concrete Association (NRMCA) certifications:
 - 1) One certified Pervious Concrete Craftsman, or
 - 2) Two certified Pervious Concrete Installers, or
 - 3) Three certified Pervious Concrete Technicians.
 - b. Certified employees must be overseeing placement or working as part of the placement crew during all pervious PCC placement.

1.07 SPECIAL REQUIREMENTS (Continued)

- c. Alternative qualifications or previous project experience, in lieu of required certification, may be submitted to Engineer for approval prior to submitting the bid.
- 3. Ready Mixed Supplier Qualifications:**
- a. Manufacturer of ready mixed concrete products who complies with ASTM C 94 for production facilities and equipment.
 - b. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
 - c. Ready mixed plant must have current Iowa DOT plant calibration.
 - d. Provide at least one employee overseeing production of pervious PCC mix who is a NRMCA certified Pervious Concrete Technician.
- 4. Test Panel:**
- a. Prior to installation of pervious PCC at the site, construction of a test panel is required.
 - 1) Construct a minimum 10 foot by 15 foot pervious PCC panel equal to the proposed thickness.
 - 2) Install, consolidate, joint, and cure the test panel using the materials, mixture proportions, equipment, and personnel proposed for the project.
 - 3) During test panel installation, provide density and workability testing complying with 3.09.
 - 4) Test panel may be constructed on-site and demolished after test approval or may be constructed at an off-site location.
 - 5) Upon approval of the Engineer, the test panel may be constructed on-site and incorporated as part of the project. When the test panel is used as part of the project, it must be placed at least 7 days prior to placement of the main pervious PCC sections to allow for approval of the hardened section.
 - 6) Acceptance of the test panel will be based on the following:
 - a) Organized construction team with proper equipment and installation practices.
 - b) Unit weight of mixture within 5 pounds per cubic foot of the design weight, tested according to 3.09, B.
 - c) Acceptable surface finish, joint details, thickness, and curing procedures.
 - 7) If the Engineer determines the test panel is unacceptable, the test panel will be removed and redone until accepted.
 - b. Experienced pervious PCC contractors and suppliers may submit written documentation of previous successful pervious PCC installations. Based on experience, the Engineer may waive the requirement for test panel construction.
- 5. Pre-placement Conference:**
- a. Schedule a pre-placement conference with the Engineer and Concrete Supplier within one week prior to beginning placement. Preferably, the meeting will take place after the test section has been placed. The pervious PCC supplier and the placement crew supervisor, who will be on-site during pervious PCC placement, must be in attendance.
 - b. During the pre-placement conference, explain knowledge and understanding of how pervious PCC placement differs from traditional concrete. Explain how unexpected conditions (weather, equipment breakdowns, etc.) will be handled.

1.07 SPECIAL REQUIREMENTS (Continued)**B. Weather Restrictions:**

1. Do not place pervious PCC when the forecasted ambient air temperature is 40 °F or lower during the 7 days following the placement, unless a cold weather protection plan has been submitted and approved by the Engineer.
2. Do not place pervious PCC when the ready mixed supplier has switched to heated mixing water for winter production.
3. Do not place pervious PCC when the ambient air temperature is 90 °F or higher, unless a written hot weather plan has been submitted and approved by the Engineer.
4. Additional hydration stabilizing admixture is required in hot weather.

1.08 MEASUREMENT AND PAYMENT

A. Class 10, Class 12, or Class 13 Excavation: Refer to SUDAS Section 2010, 1.08, E for measurement and payment information for Class 10, Class 12, or Class 13 Excavation.

B. Engineering Fabric:

1. **Measurement:** Measurement will be in square yards for the surface area covered with engineering fabric. Both horizontal and vertical areas covered with engineering fabric will be measured.
2. **Payment:** Payment will be made at the unit price per square yard of engineering fabric.
3. **Includes:** Unit price includes, but is not limited to, placing and securing filter fabric and any overlapped areas.

C. Underdrain:

1. **Measurement:** Measurement will be in linear feet for each type and size of pipe installed. Pipe will be measured from end of pipe to end of pipe along the centerline of pipe, exclusive of outlets. The vertical height of cleanouts and observation wells will be included in the length of pipe measured. Lengths of elbows, tees, wyes and other fittings will be included in length of pipe measured.
2. **Payment:** Payment will be made at the unit price per linear foot for each type and size of pipe.
3. **Includes:** Unit price includes, but is not limited to, furnishing and placing pipe and pipe fittings.

1.08 MEASUREMENT AND PAYMENT (Continued)**D. Filter Aggregate:**

1. **Measurement:** Measurement will be in tons based upon scale tickets for the material delivered and incorporated into the project.
2. **Payment:** Payment will be made at the unit price per ton of filter aggregate.
3. **Includes:** Unit price includes, but is not limited to, engineering fabric and furnishing, hauling, and placing filter aggregate.

E. Pervious Portland Cement Concrete:

1. **Measurement:** Measurement will be in square yards for each thickness of pervious PCC pavement. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement area.
2. **Payment:** Payment will be made at the unit price per square yard for each thickness of pervious PCC pavement.
3. **Includes:** Unit price includes, but is not limited to, construction of test panel(s), mixture testing, final trimming of subbase, surface curing, pavement protection, safety fencing, and boxouts for fixtures.

PART 2 - PRODUCTS**2.01 ENGINEERING FABRIC**

Comply with Iowa DOT Section 4196, requirements for subsurface drainage.

2.02 UNDERDRAIN

- A. Provide slotted pipe(s) complying with the requirements for Type 1 Subdrain in SUDAS Section 4040.
- B. Provide 6 inch diameter collector pipes unless otherwise specified in the contract documents.
- C. Provide 4 inch diameter lateral pipes unless otherwise specified in the contract documents.

2.03 TYPE 1 FILTER AGGREGATE

Provide aggregate complying with Iowa DOT Section 4115, Gradation No. 3, Class 2 durability gravel or crushed stone (AASHTO M 43/ASTM D 448, Size 57).

2.04 PERVIOUS PORTLAND CEMENT CONCRETE

A. Portland Cement: Type I or Type II complying with Iowa DOT Section 4101 and Materials I.M. 401.

B. Supplementary Cementitious Materials:

- 1. Fly ash complying with Iowa DOT Section 4108.
- 2. Ground Granulated Blast Furnace Slag (GGBFS) complying with Iowa DOT Section 4108.

C. Aggregate:

1. Coarse Aggregate:

- a. With at least 36% voids calculated on a compacted dry bulk density basis complying with ASTM C 29.
- b. Washed, clean, and free of dirt and excess fines.
- c. Specific gravity greater than 2.5.
- d. Absorption of less than 2.5%.
- e. Aggregate should be in a saturated surfaced dry condition.

2. Fine Aggregate: Concrete sand complying with Iowa DOT Section 4110, Gradation No. 1 (ASTM C 33).

3. Combined Aggregate:

- a. Combine coarse and fine aggregate to comply with gradation limits in the table below.
- b. Provide at least 5% of combined aggregate weight from fine aggregate.

2.04 PERVIOUS PORTLAND CEMENT CONCRETE (Continued)

| Sieve Size | Percent Passing | |
|------------|-----------------|------|
| | Max. | Min. |
| 1 1/2" | 100 | --- |
| 3/4" | 100 | --- |
| 1/2" | 94 | 100 |
| 3/8" | 38 | 99 |
| No. 4 | 5.5 | 44 |
| No. 8 | 4.5 | 13 |
| No. 16 | 3.5 | 11 |
| No. 30 | 2 | 7 |
| No. 50 | 0.5 | 4 |
| No. 100 | 0 | 2 |

D. Admixtures:**1. Air Entraining Admixture:**

- a. Comply with ASTM C 260.
- b. Dosed at 2 oz/cwt.

2. Chemical Admixtures:

- a. Mid-Range Water Reducing Admixtures:
 - 1) Polycarboxylate type water reducer complying with ASTM C 494, Type A.
 - 2) Provide one of the following, or approved equal:
 - a) Catexol Hydrosense, Axim Concrete Technologies
 - b) Duralflex 77, Axim Concrete Technologies
 - c) Polyheed 1725, BASF Admixtures, Inc.
 - d) Sikaplast 500, Sika Corporation
- b. Extended Control Admixtures (hydration stabilizers):
 - 1) Comply with ASTM C 494, Type B (Retarding) or Type D (Water Reducing / Retarding).
 - 2) Provide one of the following:
 - a) Delvo Stabilizer, BASF Admixtures, Inc.
 - b) Recover, W.R. Grace & Company
- c. Make water reducer and hydration stabilizer available at the project site for re-dosing if required.

E. Fiber Reinforcement:

1. Comply with ASTM C 1116.
2. Provide fibers with a maximum length of 1 1/2 inches.

F. Water:

1. Comply with Iowa DOT Section 4102.
2. Do not use heated water.

2.04 PERVIOUS PORTLAND CEMENT CONCRETE (Continued)

G. Mixture Proportions: Develop and furnish a proposed concrete mixture complying with the requirements below. Trial mixtures should be placed to establish proper proportions and determine expected behavior.

1. Concrete mixture density between 115 pcf to 130 pcf determined by ASTM C 1688.
2. Volumetric void content from 15% to 25%.
3. Cementitious content from 500 pcy to 600 pcy.
4. Supplementary Cementitious Material (SCM):
 - a. Up to 50% replacement for cement.
 - b. Maximum of 25% for fly ash and 50% for GGBFS.
 - c. SCMs are recommended at 35% slag and 15% fly ash by weight of total cementitious materials.
5. Water-to-cementitious materials (w/c) ratio from 0.29 to 0.34.
6. Admixture Dosing (for all mixes):
 - a. Air Entraining Agent: Air content of pervious PCC cannot be measured. Dose according to admixture company recommendations for concrete exposed to severe freeze/thaw conditions.
 - b. Mid-range Water Reducer: Dose at 6 ounces per 100 pounds of cementitious material.
 - c. Hydration Stabilizer:
 - 1) Delvo: 6 to 12 ounces per 100 pounds of cementitious material.
 - 2) Recover: 7.5 to 15 ounces per 100 pounds of cementitious material.
 - 3) Use higher dosage rates for placement in hot weather.

2.05 ISOLATION JOINT MATERIAL

Comply with SUDAS Section 7010, 2.02, L.

2.06 CURING

- A. Polyethylene sheeting complying with ASTM C 171.
- B. Minimum 6 mil thickness.
- C. Provide sheeting with a width at least 2 feet wider than pavement being placed. Roll sheeting onto a tube prior to concrete placement.
- D. Provide 2 by 4 lumber and sand bags to anchor polyethylene sheeting.
- E. Provide soybean oil based concrete curing compound or equivalent.

PART 3 - EXECUTION**3.01 EQUIPMENT**

- A. **Forms:** Comply with SUDAS, Section 7010, 2.07.
- B. **Roller Screed:** Powered (hydraulic or electric) roller screed weighted with sand or water to achieve a weight of approximately 20 pounds per linear foot.
- C. **Cross Rollers:** Maximum weight of 100 pounds.
- D. **Rolled Joint Former:** Cross roller with a flange welded around its circumference at the midsection. Depth of the flange is between 1.5 and 2.0 inches.
- E. **Hand Tamper:** 8 inch by 8 inch cast iron.

3.02 PRE-INSTALLATION PROTECTION

- A. Complete grading, utility installation, and other earth disturbing operations prior to excavating for the permeable paver system.
- B. Prior to placing permeable interlocking concrete pavers, install sediment control practices upstream to protect the area from sediment in stormwater runoff from disturbed soil.

3.03 SUBGRADE PREPARATION FOR PERVIOUS PCC

- A. Do not compact or subject the subgrade area under the pervious PCC pavement to excessive construction equipment prior to placement of the engineering fabric.
- B. Excavate area to the elevations and grades specified in the contract documents.
- C. In areas where cuts are required, do not compact surface. After final elevation is achieved, scarify surface to a minimum depth of 3 inches to reduce compaction caused by construction equipment.
- D. Where fill materials are required, compact material to 92% of maximum Standard Proctor Density. Do not over-compact.
- E. Fill and lightly re-grade any areas damaged by erosion, ponding, or traffic compaction prior to placing the engineering fabric.

3.04 ENGINEERING FABRIC

- A. Install engineering fabric over completed subgrade, including trench for underdrain when specified in the contract documents.
- B. Overlap adjacent strips of fabric a minimum of 6 inches.
- C. Extend fabric up the sides of the subbase trench to the bottom of the proposed pavement.

3.05 UNDERDRAIN**A. Underdrain Collector Pipes:**

1. Place 2 inches of filter aggregate in the bottom of the underdrain trench over engineering fabric.
2. Begin underdrain collector installation at the outlet and continue upgrade.
3. Lay underdrain collector pipe to the proper line and grade. Place pipe with perforations down.
4. Place filter aggregate over installed pipe in layers not more than 6 inches thick. Thoroughly tamp each layer with mechanical tampers.
5. Provide cleanouts where specified in the contract documents. Comply with SUDAS Figure 4040.232.
6. Connect underdrain collector to outlet. Comply with SUDAS Figure 4040.233. Install rodent guard on all underdrain pipe 6 inches or smaller.
7. Install underdrain cleanout pipes and observation wells as specified in the contract documents.

B. Underdrain Lateral Pipes:

1. Place 2 inches of filter aggregate over the bottom of the prepared subgrade at lateral pipe locations specified in the contract documents.
2. Lay underdrain lateral over filter aggregate to the proper line and grade. Place pipe with perforations down.
3. Connect underdrain laterals to underdrain collector with wye or tee fitting.
4. Install plug or cap on upstream end of lateral pipe.

3.06 FILTER AGGREGATE

- A. Place filter aggregate in 6 inch maximum lifts. If underdrain system is specified, take care not to damage or displace pipe during placement of filter aggregate.
- B. Compact each lift with a maximum of two passes from a vibratory plate compactor or vibratory drum roller. Do not operate compaction equipment directly over underdrain, until a minimum of 12 inches of filter aggregate is placed over the underdrain.
- C. Install filter aggregate to the elevation specified in the contract documents.
- D. Proof roll completed filter aggregate subbase with a maximum 5 ton static roller.

3.07 PERVIOUS PCC PLACEMENT**A. Forms:**

1. The vertical face of previously placed adjacent concrete may be used.
 - a. Protect previously placed concrete from damage.
 - b. Do not apply form release agent to previously placed concrete.
2. Where adjacent pavement does not create a perimeter for the pervious PCC area, provide paving forms as follows:
 - a. Set, brace, and secure forms to the lines, grades, and elevations specified in the contract documents.
 - b. Extend forms to the full depth of the pavement.
 - c. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
 - d. Immediately before placing concrete, apply form release agent to form faces that will be in contact with concrete.

B. Mixing and Hauling: Batch, mix, and deliver in compliance with ASTM C 94, with the following exceptions.

1. Deliver and discharge mixture completely within 60 minutes of the addition of mix water to the cement.
2. Delivery time may be extended to 90 minutes when dosages of hydration stabilizer are increased.
3. After 30 minutes of mixing time, re-dosing of admixtures at project site may be required to achieve workability.

C. Initial Inspection and Adjustments:

1. Visually inspect each load for consistency and workability.
2. Perform inverted slump-cone test on each load as described in 3.09 until uniform consistency is achieved for all loads.
 - a. If mixture flows from cone, workability is acceptable and mix may be placed.
 - b. If mixture flow is unacceptable, adjust as follows:
 - 1) Add 1/2 gallon of water per cubic yard.
 - 2) Mix for 3 minutes.
 - 3) Retest mix for workability.
 - 4) If mixture is still unworkable, add 50% of the original dosage of hydration stabilizer and 1/2 gallon of water per cubic yard.
 - 5) Mix for 3 minutes.
 - 6) Retest mix for workability. If mixture is still unworkable, the load will be rejected.
 - 7) Adjust subsequent loads at the plant.
3. Perform at least one fresh density test according to 3.09 at the mid-point of the load for the first concrete truck and for every five loads thereafter.

3.07 PERVIOUS PCC PLACEMENT (Continued)

4. Perform at least one estimated in-situ unit weight test each day pervious PCC is placed and after each mix adjustment.

D. Placing and Finishing:

1. Moisten subbase thoroughly prior to placement.
2. Deposit concrete into the forms by mixer truck chute, conveyor, or buggy. Do not pump pervious PCC.
3. Do not place concrete on frozen subgrade or subbase.
4. Do not push or drag concrete into place or use vibrators to move concrete into place. Spread concrete with a square-ended shovel or rake.
5. Do not allow foot traffic on fresh concrete.
6. Strike off the surface and compact the concrete with a roller screed.
7. Maintain a 1 to 2 inch pile of concrete across the width of the front of the roller screed during the initial pass.
8. After the initial pass with the roller screed, hand place an additional 6 inch wide by 1/2 inch thick strip of loose mix around the perimeter of the pervious PCC surface. Fill the mix into the surface with a hand tamper until level with the adjacent surface. Additional passes of the roller will be allowed to smooth surface if necessary.
9. Roll the surface perpendicular to the direction of the roller screed with overlapping passes of the cross roller. Operate the cross roller on top of the polyethylene sheeting installed for curing.
10. Do not finish pervious PCC with floats or trowels.
11. Finish all edges of pervious PCC with a 1/2 inch radius edging tool.

E. Jointing:

1. Pre-mark joint locations prior to beginning paving.
2. Joints may be sawed into the hardened concrete 24 hours after placement or constructed immediately after finishing with roller screed. For sawed joints, limit the time polyethylene sheeting is removed in order to prevent excessive evaporation.
3. Soybean oil cure may be placed prior to forming joints.
4. Place formed joints with approved pizza-cutter type jointing roller. Only one pass of the roller is allowed for each joint.

3.07 PERVIOUS PCC PLACEMENT (Continued)

5. Install isolation (expansion) joints where the pavement abuts the fixed vertical structures such as buildings, manholes, and light poles.

F. Curing:

1. Begin curing procedures within 10 minutes of the concrete being discharged or within 10 feet behind the compaction roller, whichever comes first.
2. Apply soybean oil cure at rate recommended by manufacturer. Apply cure from two different directions to ensure complete coverage of porous surface.
3. Cover surface with polyethylene sheeting. Concrete must be covered within 10 minutes of discharging.
4. Additional rolling with cross roller, if necessary, may be completed after covering concrete with polyethylene sheeting.
5. Anchor sheeting by placing 2 by 4 lumber along the edge of the sheeting and weighting the lumber with sand bags. Do not place lumber or anchors directly on newly finished concrete.
6. Do not use mud clods, concrete chunks, or other debris to anchor the sheeting.
7. Additional anchoring will be required if the wind causes billowing of the sheeting during the curing period.
8. Keep the sheeting in place and maintain during the minimum 7 day curing period.
9. Do not allow vehicular traffic on the pavement until curing is completed.

3.08 POST PLACEMENT PAVEMENT PROTECTION

A. Erosion and Sediment Control: Maintain erosion and sediment control practices until vegetation is established to prevent sediment in stormwater runoff from clogging the concrete pores.

B. Pavement:

1. Keep polyethylene sheeting in place, properly secured, for at least 7 days after placement.
2. Protect the pavement from heavy construction traffic, including trucks, skid steers, loaders, and all tracked vehicles until project completion.
3. Do not stockpile soil, mulch, compost, sand, gravel, crushed stone, or other loose materials on pervious PCC, or in areas where uncontrolled stormwater runoff could carry these materials to the pervious PCC and contaminate the pervious surface.

3.09 TESTING

- A. Inverted Slump Cone Test:** The purpose of the inverted slump cone is to determine if the delivered pervious PCC has sufficient workability for rapid discharge and to achieve the desired compaction using methods outlined in 3.07, D.
1. Fill inverted slump cone with plastic pervious PCC. Do not rod or compact.
 2. Lift the cone to knee height with a smooth motion. If necessary, give the cone a jostle or mild shake to initiate flow.
 3. If material flows from the cone, its workability is acceptable.
 4. If material remains lodged in the cone, it does not have adequate workability. Remediation or rejection of the mix is required.
 5. Comply with 3.07, C for remediation of mixtures determined to be unworkable.
- B. Verification of Fresh Design Unit Weight:** After verifying correct workability using the inverted slump cone test in 3.09, A, determine the fresh concrete density and compare with the design density submitted by the concrete producer.
1. Fill a unit weight container (commonly the bottom 1/4 cubic foot of an air pressure meter) of known weight and volume with fresh pervious PCC in two lifts.
 2. Compact each layer with 20 drops of a standard proctor hammer.
 3. Strike off the surface flush with the top of the unit weight bucket.
 4. Calculate the fresh density.
 5. Compare fresh density to the ASTM C 1688 design density specified for the mixture proportions. The allowable variation is plus or minus 5 pounds per cubic foot from the design unit weight.
- C. Estimated In-situ Unit Weight:** Determine the estimated in-place, in-situ unit weight from the loose, uncompacted concrete state.
1. Fill a unit weight container (commonly the bottom 1/4 cubic foot of an air pressure meter) of known weight and volume with fresh pervious PCC concrete in two lifts.
 2. Evenly distribute the concrete in the container but do not compact or consolidate.
 3. Strike off the surface even with the top of the container.
 4. Weigh the filled container and determine the unit weight of the uncompacted mix.

3.09 TESTING (Continued)

5. Calculate the estimated in-situ density by multiplying the uncompacted unit weight by the appropriate compaction factor provided in the table below:

| Pavement Thickness (inches) | Compaction Factor |
|--|------------------------------|
| 4 | 1.25 |
| 6 | 1.17 |
| 8 | 1.13 |

6. Compare estimated in-situ density to the design unit weight specified for the mix design. The allowable variation is plus or minus 5 pounds per cubic foot from the design unit weight.