# Section 9.3
# Volume II

# CONCRETE PAVEMENT PRODUCTION FACILITIES GUIDE

## 9.3.1 PURPOSE

This guide establishes policies governing the production of paving concrete produced by central mix plants, used by the Florida Department of Transportation (FDOT), herein after called the Department. The guide also provides the Concrete Pavement Production Facility (Plant) with information related to the methods and minimum requirements for a Producer Quality Control Plan (PQCP), as well as, the criteria by which the Department will review the PQCP for acceptance.

## 9.3.2 AUTHORITY

Sections 20.23(3)(a), 334.044 (2), 334.044(10)(a), and 334.048(3), Florida Statutes.

## 9.3.3 SCOPE

The principal users of this document are concrete paving contractors who produce their own paving concrete and Plants that supply paving concrete to Department projects.

## 9.3.4 REFERENCES

Code of Federal Regulations (CFR), Federal-Aid Policy Guide (FAPG), Subchapter G – Engineering and Traffic Operations, Part 637 – Construction Inspection and Approval, Subpart B – Quality Assurance Procedures for Construction

American Society for Testing and Materials (ASTM) Standard Test Methods and Specifications, Philadelphia, Pennsylvania.

American Association of State Highway and Transportation Officials (AASHTO), Part II Tests, Washington, D.C.

Florida Department of Transportation Standard Specifications for Road and Bridge Construction.

American Concrete Institute (ACI), Farmington Hills, Michigan. Reports of the Technical Committees 211, 214, 301 and 318.

Florida Department of Transportation Approved Products List (APL).

Florida Department of Transportation Sampling and Testing Methods (FSTM).

## 9.3.5 GENERAL INFORMATION

Plants that supply paving concrete to Department projects must have a PQCP accepted by the Department in accordance with the ***FDOT Specifications Sections 105*** and ***350***, and this Section. The Department maintains a list of the Plants with accepted PQCPs that meet the requirements of this guide.

Paving concrete produced in accordance with the ***FDOT Specifications Section 350*** and this guide will be accepted based on the proper certification and verification of the job site acceptance criteria.

Perform sampling and testing materials in accordance with the ***FDOT Specifications Section 6***.

The Department will inspect the Plants at least once every three months during periods of continual use of paving concrete on the Department projects, and before beginning work on any period of operation lasting less than three months. These inspections will assist in ensuring that the Plants continues to produce a materials that are in accordance with the accepted PQCP, ***FDOT Specifications***, and other ***Contract Documents***.

The Plant may request a reduced scheduling frequency for the Department's Plant inspections from the District Materials and Research Engineer (DMRE). A reduced scheduling frequency for the Department's Plant inspections shall be approved based on the parameters listed in ***Appendix "B"***.

If approved by the DMRE, the inspection frequency will be reduced to a minimum frequency of at least once every six (6) months.

## 9.3.6 CONCRETE PRODUCERS ROLES AND RESPONSIBILITIES

### 9.3.6.1 Material Requirements

Meet the requirements of ***FDOT Specifications Section 350,*** including the following:

#### 9.3.6.1.1 Cementitious Materials

Acceptance of the cementitious materials at the Plant shall be based upon the delivery ticket and mill certificate. As a check on current quality, samples may be obtained and tested by the Producer or the Department.

Each brand or type of cementitious material shall be stored in a separate and clearly labeled weatherproof facility. Provide suitable, safe, and convenient means of collecting cementitious material samples.

Measure the cementitious materials by mass within an accuracy of 1 percent of the required total amount. For concrete batches of 3 cubic yards or less, an accuracy of 2 percent is allowed. Weigh the cementitious materials separately from other materials. When weighing the cementitious materials in a cumulative weigh hopper, weigh the cement first.

#### 9.3.6.1.2 Aggregates

Aggregates used on Department projects must meet the requirements of the ***Florida Administrative Code Rule 14-103***. A list of approved sources will be maintained by the Department and made available from the State Materials Office (SMO).

As a minimum, provide suitable bins, stockpiles or silos to store and identify aggregates without mixing, segregating, degrading or contaminating of the different sources or grades. Each source must be properly marked and identified. Include the Department designated, approved source number and aggregate grade in the identification.

Measure the aggregates by mass within an accuracy of 1 percent of the required amount.

The concrete producer is responsible for handling of the aggregates, minimizing their segregation and recovering the material from the stockpile for use in the concrete mix so that it will remain within the requirements of the Specification limits. Maintain the stockpiles in a well-drained condition to minimize free water content and not promote algae/fungal growth. Quantities of aggregate necessary for sampling and testing shall be obtained where feasible from the recovery side of the stockpile to ensure compliance with the ***Specifications***, and other ***Contract Documents***.

##### 9.3.6.1.2.1 Wetting Coarse Aggregate Stockpiles, Storage Bins and Silos

Continuously and uniformly sprinkle the coarse aggregates with water for a period of 24 hours immediately preceding its introduction into the other

concrete mix ingredients. Any request for deviations from the 24-hour sprinkling requirement shall be addressed in the PQCP.

#### 9.3.6.1.3 Admixtures

Use only admixtures approved by the Department in the concrete mixes. A certification from the admixture supplier that the admixture meets the requirements of ***FDOT Specifications Section 924*** is required. The certification will include a statement from the admixture's supplier or an accepted independent testing laboratory that the proposed admixture is compatible with all other admixtures to be included in the concrete design mix. The admixture dosage rate of the product to be used shall be within the range of the admixture manufacturer's technical data sheet. Dosage rates outside of this range may only be used with written recommendation from the admixture Producer's technical representative.

Measure the admixtures by mass or volume. Use measuring equipment that has accuracy (under all operating conditions) within 3 percent of the quantity of admixture required for the batch. Measure each admixture separately and add it to the concrete mix in a manner that it meets the admixture manufacturer's approval.

Store the admixtures in accordance with the admixture manufacturer's recommendation.

### 9.3.6.2 Scales, Meters, and other Weighing or Measuring Devices

#### 9.3.6.2.1 General Requirements

Check the accuracy of all Plant scales, portable scales, meters, and other weighing or measuring devices, excluding admixture dispensers, prior to the production of concrete and, at a minimum, once every three months thereafter. Verify the accuracy of the moisture test method at least weekly. Verify that the moisture testing scale has been calibrated annually and ensure that the calibration has covered the full weighing range. Ensure that a qualified representative of a scale company registered with the Bureau of Weights and Measures, Division of Standards of the Florida Department of Agriculture and Consumer Services, checks the accuracy of these equipment. The Department reserves the right to be present during all accuracy checks.

Ensure that the report provided by the qualified company performing the equipment check includes the date of inspection, signature of the company representative, observed deviations for each quantity checked and a statement that the device conforms to the ***Contract Documents***. Maintain a copy of the report corresponding with the current certificate of inspection

at the Plant.

Affix a certificate of inspection bearing the date of the certification showing signature of the company representative to each weighing or measuring device.

#### 9.3.6.2.2 Scales

Maintain scales to an accuracy of 0.5 percent of the maximum load normally handled.

#### 9.3.6.2.3 Water Measuring Devices

Check the accuracy of water measuring devices by either mass or volume methods. Whichever method is used, ensure that the accuracy of measurement is not affected by pressure variations in the water supply line. Use a meter or weighing device capable of being set to deliver the required quantity and automatically cut off the flow when the required quantity has been discharged. Ensure that the measuring equipment has accuracy, under all operating conditions, within 1 percent of the quantity of water required as total mixing water for the batch. Ensure that total mixing water includes water added to the batch, ice added to the batch, surface moisture on the aggregates, and water introduced in the form of admixtures.

Use of flow meters mounted in series is acceptable provided the accuracy of the flow meters is traceable to the National Institute of Standards and Technology.

#### 9.3.6.2.4 Admixture Measuring Dispensers

Ensure that the admixture supplier complete the annual certification of admixture measuring dispenser. Calibrate the dispensing equipment for calcium nitrite quarterly.

### 9.3.6.3 Recorders

Plants equipped with recording mechanisms must provide records that are clear, complete, and with permanent indications of the Plant's performance. Recorder information may be supplemented by the batcher during the batching operation. The Department inspectors will review the recorder history during their Plant inspections.

### 9.3.6.4 Batching Accuracy

The failure to maintain batching operations of the plastic concrete within the tolerance for each component material requires immediate investigation

and corrective actions by the concrete producer. A failure to immediately investigate and implement corrective measures may be cause for suspension of the PQCP.

### 9.3.6.5 Batch Adjustments for Materials

Permissible adjustments to previously approved design mixes that may be made without a new design mix request are as follows:

(1) Allowable variation of coarse or fine aggregates: The variation for each aggregate can be ±75 pounds per cubic yard of concrete.

(2) Admixtures: Admixture dosage should be within the admixture manufacturer's technical data sheet range. Dosage rates outside of this range may be used with written recommendation from the admixture Producer’s technical representative. Mixes with adjustments falling outside the technical data sheet range shall be suspended when written recommendation from the admixture Producer’s technical representative has not been obtained.

(3) Allowable variation of Cementitious Materials: The variation for cementitious materials volumes can be ±6.5 percent per cubic yard but not less than the specified minimum.

The adjusted mix must meet the theoretical yield requirements of the approved mix design.

Inform the DMRE of any adjustments made to the concrete mix design. Do not adjust the batch for batch tolerances of aggregate and cementitious materials. Record the mix adjustments on the concrete delivery tickets.

### 9.3.6.6 Batch Adjustments for Moisture

Determine the free moisture of the coarse and fine aggregates within two hours prior to each day's batching, unless moisture meters are used. Determine the free moisture content of aggregates at 4-hour intervals during continuous batching operations, and at any time a change in moisture content becomes apparent. Adjust batch proportions using these values.

Use the following methods to determine aggregate free moisture:

(1) Use moisture meter readings, speedy moisture tester or Chapman flask for fine aggregate moisture. The moisture meter readings may be used for coarse or fine aggregate moistures. Verify the accuracy of the moisture meter at least weekly by the moisture meter manufacturer's recommended method and by method (2) below. Verify the accuracy of

the Chapman flask and speedy moisture tester at least weekly by method (2) below.

(2) Calculate the coarse and fine aggregate free moisture based upon dry sample weights and adjusting for absorption per ***AASHTO T 255***. Use the following minimum sample sizes in lieu of the sample sizes required in ***AASHTO T 255 Table 1***.
Fine Aggregate – 500 grams
Coarse Aggregate – 1500 grams

(3) Towel dry coarse aggregate to calculate free moisture on saturated surface dry aggregate. The accuracy of towel drying shall be verified weekly by method (2) above.

(4) The comparison criteria between any of these methods must be no more than 0.5%.

### 9.3.6.7 Optimized Aggregate Gradation

Determine the optimized aggregate gradation in accordance with ***FM 5-621***.

### 9.3.6.8 Substitution of Materials

Obtain the Department's approval for portland cement, aggregates, and supplementary cementitious materials substitutions before placing concrete.

At the discretion of the SMO Concrete Materials Engineer, concrete materials substitutions may be considered to prevent concrete placement delays on ongoing construction projects. The Department may take up to five working days to review any material substitution request. Ensure that the concrete producer submits the proposed material substitution to the appropriate District Materials and Research Office (DMRO) for verification. The concrete producer assumes all risks involved for ensuring that concrete plastic and hardened properties comply with the specifications at the time of placement.

Ensure that the substituted mix meets the theoretical yield requirements, does not exceed the maximum allowable water to cementitious materials ratio, and the amount of cementitious materials content of the mix is equal to the amount shown in the approved base mix design. The theoretical density (unit weight) of the proposed mix design shall be within 2.0 pounds per cubic foot of the originally approved theoretical mix design density (unit weight). The substitution of materials does not require chloride testing for mix design approval.

The Department may require a single 3.0 cubic yards minimum test batch at the Plant to demonstrate that the properties of the adjusted mix design are within the tolerances provided in ***FDOT Specifications Section 346***. The Department will rescind the mix design approval if determined that unsatisfactory results are obtained during production.

#### 9.3.6.8.1 Aggregates

Aggregate sources may be substituted within an approved base mix design provided that the aggregates are the same geological type, same size, and are from an approved source. The new aggregate must have a saturated surface dry (SSD) specific gravity within 0.08 of the SSD specific gravity of the original aggregate source.

#### 9.3.6.8.2 Portland Cement

Cement sources may be substituted within an approved mix design. The DMRO will ensure the replacement mix contains the same component materials as the replaced mix and only cement substitution is permitted.

#### 9.3.6.8.3 Supplementary Cementitious Materials

Fly ash from an approved source may be substituted within an approved base mix design. The mix design may contain only one fly ash source. When a fly ash is substituted in the mix design, a new mix number will be issued for that mix.

Slag substitutions may be considered and approved with a Cementitious Memorandum.

### 9.3.6.9 Equipment

Use equipment that has no detrimental effect on the plastic concrete for handling of concrete mix ingredients; and mixing, handling, transporting and depositing of the mixed concrete. Do not use equipment with aluminum surfaces in physical contact with the mixed product. As an exception, aluminum chutes, not longer than 20 feet, may be used for ready mixed concrete trucks.

## 9.3.7 DESIGN MIXES

Design mixes shall meet the requirements of ***Specifications Section 346.*** Plants may follow ***ACI 301*** Section 4, and ***ACI 211*** as guidelines to design the concrete mixes. Design a concrete mix to provide a required compressive strength ($f_{cr}'$) that exceed the specified strength ($f_c'$) by overdesign value.

$$f_{cr}' = f_c' + Overdesign$$

Select one of the following options to determine the overdesign value in concrete mixes:

(1) For a class of concrete, submit compressive strength field test data for the past 24 months and spanning no less than 45 calendar days, to determine the standard deviation. The ***f'c*** is required to be within 1,000 psi. The strength test data represents either a group of at least 30 consecutive tests or a statistical average for two groups totaling 30 or more tests.

$$Overdesign = 2.33\ x\ Standard\ Deviation - 500\ psi$$

(2) Use 1,200 psi when the Plant has no records of field strength tests performed within the past 24 months and spanning no less than 45 calendar days for a class of concrete within 1,000 psi of that ***f'c***.

The concrete producer shall submit design mix verification requests directly to the DMRO in the District where the design mix will be verified. If a design mix is to be verified at a location that is out-of-state, submit the proposed mix design to the DMRE closest to that location.

Ensure that the preparation and testing of the trial batch mixes are performed by a laboratory that is inspected and meets the requirements of ***ASTM C1077***. Personnel performing plastic or hardened concrete testing shall be qualified as described in ***Specifications Section 105***.

Make a separate submittal for each combination of component materials to be used at a trial mix concrete temperature of 68°F to 86°F, or for hot weather mixes at a minimum concrete temperature of 94ºF. Use only design mixes approved by the SMO for Department use. Ensure that the 28-day strength (or strength at any other designated age) of all trial mixes meets the overdesign requirement, of 1,200 psi.

Include the following information with the mix design submittal:

(1) The Department approved source identification number for coarse and fine aggregates, specific gravity, along with the grade of coarse aggregate and target Fineness Modulus for fine aggregate. Identify other component materials by manufacturer, brand name, and type or class. Provide specific gravity for all cementitious material except cement.

(2) Test data from a single trial mix which demonstrates that the produced concrete using the proposed mix, designated ingredients and designated water to cementitious materials ratio meet the plastic properties described in this guide. Apply an overdesign requirement, that is the minimum specified strength plus 1,200 psi for specified concrete strengths of 5,000 psi or less.

(3) As an option, strength test data for establishing the standard deviation of the Plant to meet the specified strength of the mix within 1,000 psi may be submitted for approval. The strength test data shall represent either a group of at least 30 consecutive tests or a statistical average for two groups totaling 30 or more tests. The strength test data from the trial batch is required to meet an overdesign, which is the minimum specified strength for the concrete plus 1.6 standard deviations.

(4) The admixture producer's technical representative's written recommendation when the admixture dosage rate of the product to be used is outside the range of the admixture manufacturer's technical data sheet.

(5) A copy of any changes to the Standard Specifications, to include the applicable documents, but not limited to Technical Special Provisions, Developmental Specifications, and Supplemental Specifications. Include any supporting documentation demonstrating compliance with the changes.

### 9.3.7.1 Acceptance of concrete at 56 days

The Department may approve specific mix designs for acceptance at 56 days. The mix design shall meet the durability requirements at 56 days when specified in the ***Contract Documents***. Submit the strength development plot (concrete cylinder compressive strength versus concrete age) for test cylinder ages of 3, 7, 28 and 56 days. Mix designs meeting the overdesign requirements at 28 days will not be approved.

### 9.2.7.2 Concrete mixes with reduced total cementitious materials content

The Department may approve Class I (Pavement) mix designs with the amount of total cementitious materials content below the minimum required in ***Specification Section 346*** provided the mix meets the compressive strength (***f'cr***) requirement.

### 9.3.7.3 Concrete trial mix temperatures between 68°F to 86°F (standard

**temperature mixes):**

(1) Ensure that preparation and testing of the trial mix is performed in accordance with ***ASTM C192***. Perform water to cementitious materials ratio calculations in accordance with ***FM 5-501***.

(2) On completion of the mixing period, ensure that the trial batch mix concrete has a slump within ±0.50 inch of the target value (±1.0 inch for mixes utilizing a High Range Water-Reducing admixture), and an air content less than or equal to 6.0 percent.

#### 9.3.7.4 Concrete trial Batch Mix temperature of 94°F (hot weather mixes):

(1) Ensure that preparation and testing of the trial batch mixes is performed in accordance with ***ASTM C192***, with the following exceptions:

(2) Perform initial mixing in accordance with ***ASTM C192***, except concrete materials shall be brought to a temperature that will ensure the mix temperature is not less than 94ºF at any time.

(3) Hold the trial batch mix in the mixer for 90 minutes after completion of initial mixing. During the extended mixing period, turn the drum intermittently for 30 seconds every five minutes. Cover the drum with wet burlap or an impermeable cover material during the rest periods. At the end of the 90-minute period, remix the trial batch mix for a minimum of one minute and make a slump test to verify that the concrete is within the specified range for slump. Ensure that the mix temperature is not less than 94ºF at any time.

(4) On completion of the extended mixing period, ensure that the trial batch mix concrete has a slump within ±0.75 inch of the target value (±1.0 inch for mixes utilizing a High Range Water-Reducing admixture), and an air content less than 6.0 percent. If below the target range, the producer may adjust the slump by a water addition. After the water addition, remix the concrete for a minimum of two minutes and perform slump and air content tests.

(5) The total water used in initial mixing and the final slump adjustment constitutes the design mix water content. Perform water to cementitious materials ratio calculations in accordance with ***FM 5-501***. Ensure that the total water to cementitious materials ratio does not exceed 0.50.

## 9.3.8 PLANT BATCHING REQUIREMENTS

#### 9.3.8.1 Bins

Provide bins of adequate capacity for the required concrete production. Support the bins upon a rigid framework founded upon a stable foundation capable of holding them in a safe and secure position. Design each compartment to discharge efficiently and freely into the weigh hopper. Provide positive means of control so that as the desired quantity in the weigh hopper is approached, the material can be added slowly and the addition of further material can be stopped precisely. Use a discharging mechanism that prevents loss of material when it is closed. Construct aggregate storage bins sufficiently tight to prevent leakage of material and divide them into at least one compartment for the fine aggregate and one compartment for each size of coarse aggregate to be used. Provide compartment partitions that are sufficiently tight and high enough to prevent intermingling of the different materials. Construct leak-proof and moisture-proof cementitious bins and provide them with vibrators or other means to aid the flow of cement from the bin.

#### 9.3.8.2 Weigh Hoppers

Provide weigh hoppers consisting of suitable containers freely suspended from scales. Ensure the elements do not adversely affect accuracy. Equip the hoppers with a discharge mechanism that prevents leakage or loss of material when closed. Vent hoppers to permit air to escape and equip them with vibrators or other equipment that ensures complete and efficient discharge of materials.

#### 9.3.8.3 Scales

Provide either beam type or springless dial type scales, or electronic devices such as load cells. Where using beam type scales, provide suitable means to hold poises securely in position after they are set. Keep scales clean and in good operating condition. Provide the scale operator with an unobstructed view of all indicating devices and convenient access to all controls. Use graduated weigh beam or dials to permit reading to 0.1 percent of the capacity of the scales. Check scales up to at least the maximum load normally handled on each respective scale.

### 9.3.9 MIXERS

#### 9.3.9.1 General Requirements

Provide mixers that can combine the components of the concrete into a thoroughly mixed and uniform mass, free from balls or lumps, which can discharge the concrete with a satisfactory degree of uniformity.

Inspect all mixers at least once each week for changes due to accumulation of hardened concrete or to wear of blades.

#### 9.3.9.2 Design

Use concrete Plant central mixers of the non-tilting, tilting, vertical or horizontal shaft types.

Make always available at the Plant a copy of the mixer manufacturer's design, showing dimensions and arrangement of blades. The concrete producer may use mixers that have been altered from such design in respect to blade design and arrangement, or to drum volume, when authorized by the mixer manufacturer and approved by the DMRE. For initial design changes, provide uniformity test data, based on ***ASTM C94*** testing.

The metal rating plates must be attached to each mixer to specify its mixing speed, agitating speed, rated capacity, and unit serial number. The unit serial number represents the entire mixing system. Mixer drum identification numbers or part numbers may or may not compare with the serial number on the rating plate. Should a drum be replaced, documentation from the mixer manufacturer must identify any deviations from the rating plate.

#### 9.3.9.3 Central Mixers

Use stationary type mixers equipped with a timing device which will automatically lock the discharge lever when the drum is charged and release it at the end of the mixing period. In the event of failure of the timing device, the Department may allow operations to continue during the day that failure was noticed for the first time. Do not extend such operations beyond the end of that working day. Operate the mixer at the speed recommended by the mixer manufacturer.

#### 9.3.9.4 Mixer Cleaning and Maintenance

Repair or adjust mixers of other designs per mixer manufacturer's instructions. Resolve questions of performance by performing mixer uniformity tests as described in ***ASTM C94***.

## 9.3.10 MIXING AND DELIVERING CONCRETE

#### 9.3.10.1 General Requirements

Operate all Plant mixers at speeds per the mixer manufacturer's design or

recommendation. Do not allow the volume of mixed concrete batch material to exceed the mixer manufacturer's rated mixing capacity.

Account for all water entering the drum as batch water.

When necessary, during cold weather conditions, heat either the mix water, the aggregates or both prior to batching. Apply the heat uniformly in a manner which is not detrimental to the mix. Do not heat the aggregates directly by gas or oil flame or on sheet metal over fire. Do not heat the aggregates or water to a temperature of over 150° F. If either component is heated to over 100° F, mix them together prior to the addition of the cement. The cement must not be in contact with the materials, which are more than 100° F. Include in the PQCP measures to maintain free moisture in a well-drained condition when heating aggregates.

#### 9.3.10.2 Central Mixing

After all materials are in the mixer, mix the concrete a minimum of two minutes, or the mixer manufacturer's recommended minimum mixing time. As an alternative uniformity results may be developed in accordance with ASTM C94 to determine the mixing time.

##### 9.3.10.2.1 Charging the Mixer:

Charge each batch into the drum so that some water enters both in advance of and after the cementitious material and aggregates. If using fly ash (other than ultra-fine fly ash) in the mix, charge it into the drum over approximately the same interval as the cement. The concrete producer may use other time intervals for the introduction of materials into the mix if the Plant demonstrates, using test requirements specified in ***ASTM C94***, that the uniformity of the concrete mix can be achieved.

For concrete mixes containing specialty ingredients, charge the batch materials into the mixer in a sequence recommended by the mixer manufacturer of the specialty ingredients. Adjust the weight of mixing water for a concrete mix containing a corrosion inhibitor and/or accelerator admixture. Account for water in the corrosion inhibitor and/or accelerator as described in the admixture manufacturer’s technical data sheet.

## 9.3.11 QUALITY CONTROL PROGRAM

The PQCP of any concrete producer shall meet the requirements of ***Specifications Sections 105***. The accepted PQCP shall be the minimum required control of concrete on all Department projects. The PQCP shall also address the following items:

(1) Describe how the concrete producer will maintain the properties of concrete to the point of discharge at the project site.

(2) Describe how the water to cementitious materials ratio and the plastic properties of concrete will be controlled to meet Specification requirements.

(3) Describe personnel qualifications of those who are involved in the operation and the quality control of concrete.

(4) Describe the source of concrete materials and equipment used to produce concrete.

## 9.3.12 PERSONNEL

Plants supplying concrete to Department projects shall have adequate qualified personnel. Concrete Batch Plant Operator, certified technicians and Concrete Production Facility Manager of Quality Control are required positions for a Plant. At the discretion of the Department, certain functions of the above positions may be combined when it can be demonstrated that the Plant's operation and quality of the concrete will not be detrimentally affected. Personnel shall be qualified through the Construction Training and Qualification Program (CTQP) or an equivalent ACI training program. Qualified technicians utilizing equipment with a valid calibration/verification will perform quality control sampling and testing. The qualification records of any Plant personnel shall be made available upon request.

### 9.3.12.1 Concrete Batch Plant Operator

Personnel who have quality control functions or who sign concrete certification/delivery tickets must demonstrate, through examination, adequate concrete related knowledge. Batch Plant Operators shall be present during batching operations. The Batch Plant Operator shall be qualified as a Concrete Batch Plant Operator.

### 9.3.12.2 Certified Technicians

The testing technicians shall be qualified according to ***Specifications Section 105***.

### 9.3.12.3 Concrete Production Facility Manager of Quality Control

Personnel who perform the duties of managing the quality control of the Plants shall have the duties, responsibilities, and be qualified as follows:

Duties and responsibilities:

(1) Implement policies and procedures of the PQCP.

(2) Maintain liaison with the Department on all activities related to quality control.

(3) Supervise the activities of all quality control technicians, ensuring sufficient manpower in all areas related to quality control testing and inspection.

(4) Review all quality control procedures to ensure compliance with the ***Specifications***, and other ***Contract Documents***.

(5) Ensure all quality control records are properly prepared and reviewed.

(6) Ensure that quality control activities are performed in accordance with documented instructions and procedures.

(7) Develop and maintain a filing, storage, and retrieval system for quality control records.

(8) Concrete Production Facility Manager of Quality Control or his/her qualified designee must be daily on-site at the Plant or always available on-site upon four hours' notice.

Qualification:

The Concrete Production Facility Manager of Quality Control shall be qualified according to ***Specifications Section 105***.

### 9.3.12.4 Concrete Mix Designer

Personnel who have quality control functions of designing a concrete mix must demonstrate, through examination, adequate concrete related knowledge. Such examinations will deal with Specifications and concrete quality control procedures. The Concrete Mix Designer shall be qualified according to ***Specifications Section 105***.

## 9.3.13 RECORDS

All records shall be kept on file and made available at each Plant upon request by the Department. The following updated information shall be available at each Plant:

(1) Accepted concrete producer PQCP.

(2) Approved concrete design mixes.

(3) Materials source/specification compliance (delivery tickets, certifications, miscellaneous test reports).

(4) Quality control data (aggregate gradation and Total Minus 200.

(5) Aggregate moisture control records including date and time of test.

(6) Annual calibration records for water sources for concrete water adjustments.

(7) Mixer manufacturer's design data.

(8) Federal Highway Administration poster shall be posted to be visible to all employees.

(9) A copy of the scale company's report corresponding with the current certificate of inspection, showing the date of inspection, signature of the scale company representative, and the observed scale deviations for the loads checked.

(10) Certification documents for admixture weighing and measuring dispensers.

(11) Weekly mixer inspection reports.

(12) A daily record of all concrete batched for delivery to Department projects, including respective design mix numbers and quantities of batched concrete.

(13) Recorder history, if the Plant is equipped.

## 9.3.14 SAMPLING AND TESTING OF MATERIALS

### 9.3.14.1 General

Sampling and testing of materials and concrete for quality control purposes is the responsibility of the concrete producer. The frequency of sampling must be designed to provide adequate data to operate within the PQCP for each design mix. Table 1 designates the minimum sampling and testing frequencies that will be performed in a well- controlled Plant. The PQCP

shall indicate an increased sampling rate when any PQCP limit is reached. All sampling and testing shall be conducted in accordance with the Department's current Florida Sampling and Testing Methods, AASHTO, or ASTM sampling and testing methods. For both coarse and fine aggregates being used, the specific gravity (saturated surface dry) and absorption values shall be provided to the Plant by the aggregate producers providing the coarse and fine aggregates.

| TABLE 1 – Concrete Material Components Sampling and Testing | |
|---|---|
| Material and Required Tests | Minimum Sampling Frequency for Each Source and Grade |
| Coarse Aggregate<br>Gradation (AASHTO T 27)<br>Total Minus 200 (FM 1-T011) | Certification |
| Fine Aggregate<br>Gradation (FM 1-T 027)<br>Total Minus 200 (FM 1-T011) | Certification |
| Cementitious Materials | Delivery Ticket and Mill Certificate |
| Water | As required in ***Specification Section 923*** |

## 9.3.15 DELIVERY TICKET/CERTIFICATION

The following information is required for each concrete delivery ticket and must be furnished with each load:

(1) Mix design number.

(2) Time all materials are introduced into mixer.

(3) Cubic yards in the load.

At the end of each paving production day provide a summary listing all the daily ticket numbers along with the materials and quantities incorporated into each load, water to cementitious materials ratio, and the signature of the plant operator. The original signature shall certify to the accuracy of the recorded information and compliance with the approved design mix. A sample of a summary delivery ticket is provided in Appendix "A". Use this form or a similar form containing the same information:

## 9.3.16 TRAINING

Training will be in accordance with Specifications Section 105 and the appropriate Materials Manual Volume II Sections.

## 9.3.17 FORMS

Example of a Summary Concrete Delivery Ticket – Appendix A.

# APPENDIX "A"
## Sample of a Summary Delivery Ticket for Pavement Concrete

| | |
|---|---|
| Financial Project No.: | |
| Plant No.: | |
| Concrete Plant: | |
| FDOT Class: | |
| Total Cubic Yards Delivered Today: | |

| | |
|---|---|
| Date: | |
| Delivered to: | |
| Phone Number: | |
| FDOT Mix No. | |

| Ticket Number | Time Loaded | Load Volume (Cubic Yards) | Batch Weights (pounds per cubic yard) | | | | | | | Water to Cementitious Materials Ratio |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Portland Cement | Supplementary Cementitious Materials | Coarse Aggregate | Fine Aggregate | Air Entrainment Admixture | Other Admixtures | Total Water | |
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| Moisture Contents (%) | |
|---|---|
| Coarse Aggregate | |
| Fine Aggregate | |

Issuance of this ticket constitutes certification that the batched concrete was produced and is in compliance with the ***Contract Document*** requirements for Concrete Pavement.

Signature of Batch Plant Operator

**APPENDIX "B"**

# Reduced Scheduling Frequency for the Plant Inspections

At the request of the Producer, the evaluation of the statistical parameters will be performed in accordance with ***ACI 214 Guide to Evaluation of Strength Test Result of Concrete***. The Department Materials Acceptance and Certification system (MAC) will provide a complete report of this information.

Parameters considered for reduced a Plants inspection frequency:

(1) The Plant's QC standard deviation (***S***) of the compressive strength tests shall be equal to or less than 600 psi. The calculation is based on at least 10 same age strength test results.

(2) The Plant's QC within-batch coefficient of variation (***$CV_1$***) of the paving concrete compressive strength test results is less than or equal to 5%.

$$\mathrm{CV}_1 = \frac{\mathrm{S}_1}{\bar{\mathrm{X}}}(100\%)$$

Where:

$\bar{\mathrm{X}}$ = Mean.

$S_1$ is the within-batch standard deviation.

$$\mathrm{S}_1 = \frac{\bar{\mathrm{R}}}{\mathrm{d}_2}$$

$\bar{\mathrm{R}}$ = Average range of at least 10 same age strength test results.

$\mathrm{d}_2$ = Factor for computing within-batch standard deviation (***ACI 214R Table 4.1).***

(3) Records of previous Plant inspections, correction of any deficiencies, and failing samples attributed to the Plant are provided.