Section 9.2
Volume II

CONCRETE PRODUCTION FACILITIES GUIDE

9.2.1 PURPOSE

This guide establishes policies that govern the production of concrete used by the Florida Department of Transportation (FDOT), herein after called the Department. The guide also provides a concrete producer with information related to the methods and the minimum requirements for Quality Control Programs (QCP), and the criteria by which the Department will maintain that acceptance.

9.2.2 AUTHORITY

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

9.2.3 SCOPE

The principal user of this document is a concrete producer.

9.2.4 GENERAL INFORMATION

Concrete production facilities that supply concrete to Department projects must have a QCP accepted by the Department in accordance with the ***Florida Department of Transportation Specifications, Section 105***. A list of concrete production facilities, herein after called plants, with accepted QCPs that meet the requirements of this guide, will be maintained by the Department.

Concrete produced in accordance with the ***Florida Department of Transportation Specifications, Section 346*** and this guide shall be accepted with the proper certification and verification of job site acceptance criteria.

Methods of sampling and testing materials shall be in accordance with the ***Florida Department of Transportation Specifications, Section 346***. References to the sampling and testing methods shall be construed to mean the most current issuance, including interims or addenda.

The Department will inspect the plants every three months or less. The concrete producer may request a reduced scheduling frequency for the plant inspections from

the District Materials and Research Engineer (DMRE). The reduced scheduling frequency shall be based on the plant coefficient of variation (Cv=σ/μ: σ=standard deviation; μ=mean), previous plant inspections, failing samples attributed to the production facility, and a request from the producer. Upon meeting all criteria, the plant may be changed to a reduced inspection frequency. If approved by the DMRE, the inspection frequency shall be a minimum frequency of once every six (6) months or less. These inspections will assist in ensuring that the plant continues to produce a material that is in accordance with the accepted QCP, Specifications, and other Contract Documents.

9.2.5 REFERENCES

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.

Florida Department of Transportation Qualified Products List

Florida Department of Transportation Sampling and Testing Methods (FSTM)

9.2.6 CONCRETE PRODUCERS ROLES AND RESPONSIBILITIES

9.2.6.1 Material Requirements

Meet the following requirements found in the Specifications:

Coarse Aggregate	Section 901
Fine Aggregate	Section 902
Portland Cement	Section 921
Water	Section 923
Admixtures	Section 924
Pozzolans and Slag	Section 929

Use materials containing no hard lumps, crusts, frozen matter, or that are not contaminated with dissimilar material.

9.2.6.1.1 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. Suitable, safe, and convenient means of collecting cementitious material samples will be provided.

Measure the cementitious materials by mass within an accuracy of 1 percent of the required total amount. For concrete batches of 3 yd^3 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.

If bagged cementitious material is permitted, proportion the batch to use only whole bags. Store the silica fume, metakaolin and ultra fine fly ash in accordance with the manufacturer's recommendation.

9.2.6.2 Aggregates

Aggregate used on Department projects must be accordance with ***Rule 14-103, FAC***. A list of approved sources will be maintained by the Department and made available from the State Materials Office (SMO).

As minimum suitable bins, stockpiles or silos will be provided to store and identify aggregates without mixing, segregating, degradation or contaminating the different sources or grades. Department designated, approved pit number and aggregate grade shall be included in the identification.

Aggregates shall be measured by mass or volume within an accuracy of 1 percent of the required amount.

The handling of the aggregates, so as to minimize segregation and to recover the material from the stockpile for use in the mix so it will remain within Specification limits, is the responsibility of the concrete producer. Stockpiles shall be maintained in a well drained condition to minimize free water content and not promote algae/fungal growth. The plant shall make available to the Department, from the recovery side of the stockpile where feasible, the quantities of aggregate necessary for sampling and testing to ensure compliance with the Specifications and other Contract Documents.

9.2.6.2.1 Wetting Coarse Aggregate Stockpiles, Storage Bins and Silos

The coarse aggregate shall be continuously and uniformly sprinkled with water for a period of 24 hours immediately preceding introduction into the concrete. Any request for deviations from the 24-hour sprinkling requirement shall be addressed in the Producer's QCP for consideration by the DMRE.

9.2.6.3 Admixtures

Concrete mixes shall use only admixtures approved by the Department. A certification from the admixture supplier that the admixture meets the requirements of ***Florida Department of Transportation Specifications, Section 924*** is required. The certification will include a statement from the admixtures' 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 manufacturer's technical data sheet.

Measure the admixtures by mass or volume. Use measuring equipment that has accuracy (under all operating conditions) within 3percent of the quantity of admixture required for the batch. Measure each admixture separately, and add it to the mixing water in a separate sequence as the mixing water is introduced into the mix.

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

9.2.6.4 Scales and Meters

The accuracy of all scales, meters, and other weighing or measuring devices, excluding admixture dispensers, shall be checked prior to the production of concrete and, at a minimum, once every three months thereafter. 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, shall conduct the check for accuracy.

The Department reserves the right to be present during all scale checks.

9.2.6.4.1 Water Measuring Devices

Water measuring devices used during batching operations will be checked for accuracy. The check for accuracy will be by weight or volume, and at least quarterly. The container used for accuracy verification must be capable of holding the maximum quantity of water normally used during the batching sequence.

If accuracy is checked by volume, the maximum capacity of the container in use must be specified in gallons. To ensure accurate volume determination to the nearest 0.5 gallon, the graduation marks must be readily visible at each level checked. The accuracy of the container must be documented by a scale company registered with the Bureau of Weights and Measures, Division of Standards of the Florida Department of Agriculture and Consumer Services.

Use of a flow meter mounted in series is acceptable provided the accuracy of the flow meter is traceable to the National Institute of Standards and Technology. The calibration device shall be checked annually for accuracy.

Measure the water by volume or weight. Whichever method is used, construct the equipment so that the accuracy of measurement is not affected by variations in pressure in the water supply line. Use a meter or weighing device capable of being set to deliver the required quantity and to automatically cut off the flow when the required quantity has been discharged. Ensure that the measuring equipment has accuracy, under all operating conditions, within 1percent of the quantity of water required for the batch.

The following guidelines will apply when measuring devices are checked for conformity with the accuracy requirements of the Specifications or as specified herein:

(1) Devices will be checked up to the maximum quantity normally required for a batch.

(2) As a minimum four-step checks will be made at approximately equal intervals. This will include the maximum quantity normally required for a batch.

(3) The date of inspection, signature of the agency representative, observed deviations for each quantity checked and a statement that the device conforms to the Specifications and other Contract Documents shall be included in the report provided by the qualified agency performing the check.

A copy of the report corresponding with the current certificate of inspection shall be available at the plant where the device is located.

(4) A certificate of inspection bearing the date of certification and signed by a representative of the qualified agency shall be affixed to the measuring device.

(5) Methods not specifically detailed above are considered acceptable if the District Materials Office (DMO) verifies compliance with the Specifications and other Contract Documents.

9.2.6.4.2 Admixture Measuring Dispensers

Annual certification of admixture measuring dispenser accuracy shall be completed by the admixture supplier. Calibrate the dispensing equipment for calcium nitrite quarterly.

9.2.6.4.3 Recorders

Plants equipped with recording mechanisms must provide records that are clear, complete, and with permanent indications of the plants performance. Recorder information may be supplemented by the batcher during the batching operation. The Department shall be allowed to review recorder history at any time.

9.2.6.5 Batching Accuracy

The failure to maintain batching operations of the plastic concrete within the tolerance for each component material requires immediate investigation and corrective action by the concrete producer. A failure to immediately investigate and implement corrective measures may be cause for suspension of the QCP.

9.2.6.6 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 and/or Fine Aggregate: for a total of ±75 lbs/yd^3 of concrete.

(2) Admixtures: Shall be within the manufacturer's technical data sheet range. Adjustments falling outside the technical data sheet range shall require design mix re-verification.

(3) Allowable variation of Cementitious Materials: ±6.5percent per cubic yard but not less than the specified minimum for that class of concrete.

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

The DMRE will be advised of any adjustments to the concrete mix design. Batch adjustments shall not be used for batch tolerances of aggregate and cementitious materials. The adjustments shall be noted on the concrete delivery tickets.

9.2.6.7 Batch Adjustments for Moisture

Free moisture for the coarse and fine aggregates will be determined within two hours prior to each day's batching. Approximately half way through the batching operations additional moisture tests shall be required on continuous concrete placements expected to exceed three hours. Adjustment of batch proportions will be made using these values.

One or more of the following methods shall be used to determine aggregate free moisture:

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

(2) Calculate both coarse and fine aggregate free moisture based upon dry sample weights and adjusting for absorption per ***AASHTO T 255***. The following minimum sample sizes shall be used 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.

9.2.6.8 Substitution of Materials

Aggregate sources may be substituted within an approved base mix design provided that the aggregate are the same geological type and are from an approved source. The new aggregate source shall have a specific gravity (saturated surface dry) within 0.08 of the original aggregate source. Obtain the Department’s approval for any material substitutions before beginning concrete placement. Provide a new base mix design for any cementitious material or admixture substitution. The Department may take up to five working days to review any material substitution request.

When more than one concrete mix design is being substituted and the concrete design mixes use the same cementitious materials, admixtures, coarse and fine aggregates, the concrete producer has the option to only test for chlorides of the mix design which has the greatest cementitious content to represent all such mixes. Perform testing for chlorides and assure

compliance with ***Florida Department of Transportation Specifications, Section 346***. Ensure that the substituted mix meets the theoretical yield requirements, does not exceed the maximum water to cementitious materials ratio, and the cement content equals or exceeds the approved base mix design.

The Department may require a single 3.0 yd^3 minimum test batch at the plant to demonstrate that the plastic properties of the adjusted mix design is within the slump and air tolerances provided in ***Florida Department of Transportation Specifications, Section 346***. The theoretical unit weight of the proposed mix design will be within 2.0 lbs/ft^3 of the originally approved theoretical mix design unit weight. Approved adjusted mixes may be transferred. When the Engineer determines that unsatisfactory results are obtained during production, the concrete producer shall return to the originally approved base mix design or obtain approval of a new mix design.

9.2.6.9 Equipment

Use equipment that has no detrimental effect on the plastic concrete for handling ingredients, mixing concrete, handling the mixed concrete, transporting and depositing the mixed concrete. Do not use equipment with aluminum surfaces in physical contact with the mixed product.

9.2.7 DESIGN MIXES

Design mixes shall meet the requirements of ***Florida Department of Transportation Specifications, Section 346. Appendix B Proposed Concrete Design Mix***, or a similar form containing the same information shall be used for design mix submittals.

Plants furnishing concrete to multiple projects may use approved concrete mix designs on different projects, provided component materials and project requirements of the approved mix design remain the same. The concrete producer shall submit mix design requests directly to the DMRE in the District that the plant is located.

If a plant is located out-of-state, submit the mix design to the DMRE with Quality Control Plan acceptance authority.

Ensure that preparation and testing of the trial mixes is performed by a laboratory that is inspected and meets the requirements of ***ASTM C1077***. The testing laboratory shall be capable of performing the required ASTM test methods for laboratories testing concrete and concrete aggregates and may request evaluation for the optional methods. Personnel performing plastic or hardened concrete testing shall be qualified as described in this guide.

Make a separate submittal for each class of concrete and each particular combination of component materials to be used at a trial mix temperature of 68°F to 86°F, and for hot weather mixes at a minimum temperature of 94ºF. Use only design mixes approved by the SMO for Department use.

Concrete trial mix temperature between 68°F to 86°F:

(1) Ensure that preparation and testing of the trial mix is performed in accordance with ***ASTM C192***.

(2) On completion of the mixing period, ensure that the trial 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 between 2.5 percent and 5.0 percent.

Concrete trial mix temperature of 94°F:

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

(2) Initial mixing shall be done 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 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 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 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 between 2.0 percent and 5.0 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.

(5) The total water used in initial mixing and the final slump adjustment constitutes the design mix water content. Ensure that the total water to cementitious materials ratio does not exceed the maximum water to cementitious materials ratio in the ***Florida Department of Transportation Specifications, Section 346***, for the respective class of concrete. The Department may require extended mixing for precast/prestressed concrete when centrally mixed at the placement site.

Ensure that the 28-day strength (or strength at any other designated age) of trial mixes meets the below stated over design requirements to ensure that concrete sampled and tested at the point of placement has a strength exceeding the specified minimum strength.

Include the following 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) The actual proportions of raw materials intended to be combined to produce the concrete with a theoretical yield of 27 ± 0.02 ft^3.

(3) 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 will meet the plastic properties described in this guide. Strength data is required to meet an over design, which is the minimum required strength for that class of concrete plus 1.6 standard deviations.

(4) The chloride content of the proposed design mix. The Department will not approve mix designs when the chloride content of the trial mix exceeds the limits shown in ***Florida Department of Transportation Specifications, Section 346***.

(5) For design mixes proposed for use in wet drilled shafts, demonstrate the additional requirements in ***Florida Department of Transportation Specifications, Section 346***.

(6) Submit strength test data for establishing the standard deviation of the plant to meet the specified strength of the mix submitted for approval within 1,000 psi. 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.

(7) Provide a copy of any changes to the ***Standard Specifications***, to include but not limited to ***Technical Special Provisions*** and ***Supplemental Specifications***. Include any supporting documentation demonstrating compliance with the changes.

When the Department cannot determine the plants standard deviation from historical data, apply an over design requirement, based on a singular trial mix, that is the minimum required strength plus 1,200 psi for minimum required concrete strengths of 5,000 psi or less. For minimum required concrete strengths above 5,000 psi, apply an over design requirement that is the minimum required strength plus 1,400 psi.

9.2.8 BATCHING REQUIREMENTS OF THE CONCRETE PRODUCTION FACILITY

9.2.8.1 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 quantity desired 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.

9.2.8.2 Weigh Hoppers

Provide weigh hoppers consisting of suitable containers freely suspended from scales and protected from the elements so that accuracy is not adversely affected. 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.

9.2.8.3 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 0.1percent of the

capacity of the scales.

Any scale can be required to be rechecked if it is deemed necessary by the Department. Check scales up to at least the maximum load normally handled on each respective scale.

Maintain cement scales, pozzolan scales, slag scales, and coarse and fine aggregate scales to an accuracy of 0.5percent of the maximum load normally handled.

Affix a certificate of inspection bearing the date of the certification showing signature of the scale company representative to each weighing device. Make available at the plant a copy of the scale company's report which corresponds with the current certificate of inspection showing the date of inspection, signature of the scale company representative, the observed scale deviations for the loads checked, and a statement that the scale meets the accuracy requirements for commercial scales as identified in ***Chapter 531 of the Florida Statutes (F.S.)***, pertaining to specifications, tolerances and regulations, as administered by the Bureau of Weights and Measures, Division of Standards of the Florida Department of Agriculture and Consumer Services.

9.2.9 MIXERS

9.2.9.1 General Requirements

Provide mixers that are capable of combining the components of the concrete into a thoroughly mixed and uniform mass, free from balls or lumps, which are capable of discharging the concrete with a satisfactory degree of uniformity.

9.2.9.2 Design

Use truck mixers of the inclined axis revolving drum type, or concrete plant central mixers of the non-tilting, tilting, vertical or horizontal shaft types.

Make available at the plant at all times a copy of the 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 manufacturer and approved by the DMRE. For initial design changes, the producer shall 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. The metal rating plate may be located on the inside of the driver's door. Mixer drum Id 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 manufacturer must identify any deviations from the rating plate.

9.2.9.3 Truck Mixers

Use truck mixers with a drum that is actuated by a power source independent of the truck engine or by a suitable power take-off. Either system must provide control of the rotation of the drum within the limits specified on the manufacturer's rating plate, regardless of the speed of the truck. Use truck mixers of the revolving drum type that are equipped with a hatch in the periphery of the drum shell which permits access to the inside of the drum for inspection, cleaning and repair of the blades.

Use truck mixers equipped with revolution counters and mounting, by which the number of revolutions of the drum may be readily verified.

Ensure that the water supply system mounted on truck mixers is equipped with a volumetric water gauge or a water meter in operating condition. Annually calibrate water measuring devices on truck mixers or other water sources used for concrete water adjustments.

Where a truck mixer volumetric gauge controls job site water additions, ensure that the truck mixer is parked in a level condition during on-site water adjustments so that the gauge is indicating a specific tank volume before and after the concrete adjustment. Ensure that the water measuring equipment has an accuracy of within 3 percent of the indicated quantity.

Truck mixers meeting these requirements and ***Florida Department of Transportation Specifications, Section 346*** will be issued an identification card by the DMRE upon request from the concrete producer. Identification cards shall be displayed in the truck cab when delivering concrete for Department use. Failure to display the identification card in the truck cab shall be cause for rejection of the delivered concrete. The Contractor may remove the identification cards when a truck mixer is discovered to be in noncompliance. When the identification card is removed for noncompliance, the Contractor shall forward the identification card to the DMRE in the District that the plant is located.

As an exception to the above, when the deficiency involves only an inoperable revolution counter, the truck mixer identification card will not be removed. However, the Contractor will note the deficiency on the card. The concrete producer will be allowed to deposit the concrete in the mixer, and the truck mixer will then be removed from use until the revolution counter is

repaired or replaced.

On the next delivery to any Department project, following the repair or replacement of the counter, the truck mixer operator shall make known that the revolution counter is operable and obtains the Contractor's initial on the truck mixer identification card. Without such inspection and documentation of corrective action, the Contractor may reject the truck mixer at any time it is again found to have an inoperable revolution counter. The revolution counter will be set to zero prior to mixing each load.

The concrete producer shall inspect all truck mixers at least once each week for changes due to accumulation of hardened concrete or to wear of blades or chutes. The blades or chutes shall be repaired or replaced as necessary to meet these requirements. Any appreciable accumulation of hardened concrete shall be removed before any mixer may be used.

Copies of the most recent water measuring equipment calibration shall be kept in the truck cab and made available upon request.

9.2.9.4 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. The mixer shall be operated at the speed recommended by the manufacturer.

The concrete producer shall inspect all mixers at least once each week for changes due to accumulation of hardened concrete or to wear of blades.

9.2.9.5 Cleaning and Maintenance of Mixers

Repair or replace mixer blades of revolving drum type mixers when the radial height of the blade at the point of maximum drum diameter is less than 90percent of the design radial height. Repair or adjust mixers of other designs per manufacturer's instructions. Resolve questions of performance by performing mixer uniformity tests as described in ***ASTM C 94***.

9.2.10 MIXING AND DELIVERING CONCRETE

9.2.10.1 General Requirements

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

recommendation. Do not allow the volume of mixed batch material to exceed the manufacturer's rated mixing capacity. Mix concrete containing silica fume, metakaolin or ultra fine fly ash in accordance with their supplier's recommendations.

When necessary and in order to produce concrete of the specified temperature during cold weather conditions, heat either the mix water or the aggregates or both prior to batching. Apply the heating 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 come in contact with the materials, which are in excess of 100° F. Include in the QCP measures to maintain free moisture in a well drained condition when heating aggregates.

9.2.10.2 Central Mixing:

After all materials are in the mixer, mix the concrete a minimum of two minutes or the manufacturer's recommended minimum mixing time, whichever is longer.

9.2.10.3 Transit Mixing:

Initially mix each batch between 70 and 100 revolutions of the drum at mixing speed. When water is added at the job site, mix the concrete 30 additional mixing revolutions. When mixing for the purpose of adjusting consistency, do not allow the total number of revolutions at mixing speed to exceed 160. Discharge all concrete from truck mixers before total drum revolutions exceed 300. Count all revolutions of the drum in the total number of revolutions.

Do not haul concrete in mixer trucks loaded with more than the rated capacity shown on their attached plates.

9.2.10.4 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 when the concrete producer demonstrates; using test requirements specified in ***ASTM C 94***, that he can achieve uniformity of the concrete mix.

For concrete mixes containing specialty ingredients (silica fume, metakaolin,

ultra fine fly ash, corrosion inhibitor calcium nitrite, accelerators, high range water reducers, etc.), charge the batch materials into the mixer in a sequence recommended by the supplier 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 manufacture's technical data sheet.

9.2.11 QUALITY CONTROL PROGRAM

The QCP of any concrete producer shall meet the requirements of ***Florida Department of Transportation Specifications, Sections 105***. The QCP is used to describe how the concrete producer will maintain the properties of concrete to the point of discharge at the project site. The QCP shall address how the water to cementitious materials ratio and the plastic properties tests of concrete will be controlled to meet Specification requirements. The qualification of personnel, source of materials, and equipment used to produce concrete shall be addressed in the QCP. Quality control of the concrete shall be achieved through statistical evaluation of test results. The concrete producer shall use a Department approved laboratory and qualified personnel to test concrete.

The plant shall be on the Department's list of Producers with Accepted QC Program prior to production of concrete for Department projects. The accepted QCP shall be the minimum required control of concrete on all Department projects.

9.2.12 PERSONNEL

Plants supplying concrete to Department projects shall have adequate qualified personnel. Batch Plant operator, certified technicians and 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 plants operation and quality of the concrete will not be detrimentally affected. Technicians shall be qualified through the Construction Training and Qualification Program (CTQP) or an equivalent training program as defined in ***Florida Department of Transportation Specifications, Section 105***. Qualified technicians utilizing equipment with a valid calibration/verification will perform quality control sampling and testing. This qualification of any technician shall be made available upon request.

9.2.12.1 Batch Plant Operator

Personnel who have quality control functions or who sign concrete certification/delivery tickets must demonstrate, through examination, adequate concrete related knowledge. Plant Operators shall be present during batching operations. The Plant Operator shall be qualified by CTQP or an equivalent training program as defined in ***Florida Department of***

Transportation Specifications, Section 105.

9.2.12.2 Certified Technicians

Personnel who perform the tests on the plastic properties of concrete, such as slump, temperature, air content, making/curing concrete cylinders, and calculating the water to cementitious materials ratio, shall be qualified as an ***ACI Concrete Field Testing Technician Grade I***.

Personnel who perform the tests on the hardened properties of concrete, such as strength determination of cylinders or beams, shall be qualified as an ***ACI Concrete Strength Testing Technician***.

9.2.12.3 Mix Design Technician

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 Mix Design Technician shall be qualified as a ***CTQP Concrete Laboratory Technician Level II***.

As an alternative to the ***CTQP Level II*** qualification, for concrete pipe and precast/prestressed concrete products, the Department will accept the following qualification:

(1) PCI Quality Control Personnel, Level III Certification, for concrete mix designs of the prestressed products.

(2) Level II Quality Control Inspectors Qualification for concrete mix designs of the pipe and dry-cast concrete box culverts meeting the requirements of ***Materials Manual Volume II Section 6.2***.

(3) Level II Quality Control Inspectors Qualification for concrete mix designs of the precast concrete drainage structures and incidental precast concrete products, meeting the requirements of ***Materials Manual Volume II Section 6.3.***

9.2.12.4 Manager of Quality Control

Personnel who perform the duties of managing the quality control of the plant shall be qualified as outlined in ***Florida Department of Transportation Specifications, Section 105*** and have the following duties and responsibilities:

(1) Implement policies and procedures of the QCP.

(2) Maintain liaison with Project Manager and 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 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.

9.2.13 RECORDS

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

(1) Accepted concrete producer QCP.

(2) Approved concrete design mixes.

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

(4) Quality control data (aggregate gradation and absorption worksheets & concrete chloride test data).

(5) Aggregate moisture control records including date and time of test. Verify the accuracy of the moisture test method at least weekly. Is the scale calibrated annually and does it cover the full weighing range?

(6) Annual calibration records for water measuring devices on trucks or other water sources for concrete water adjustments.

(7) Manufacturer's mixer design data.

(8) Federal poster.

(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, 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.

9.2.14 SAMPLING AND TESTING OF MATERIALS

9.2.14.1.1 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 the QCP for each design mix. Table 1 designates the minimum sampling and testing frequencies that will be performed in a well controlled plant. The QCP shall indicate an increased sampling rate when any QCP 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 aggregate being used, the specific gravity (saturated surface dry) shall be provided to the concrete production facility by the aggregate producer providing the coarse and fine aggregate.

TABLE 1

Material and Required Tests	Minimum Sampling Frequency For Each Source and Grade
Coarse Aggregate*	
Gradation	1 every 30 days
Absorption	1 every 30 days
Total Minus 200	1 every 30 days
Fine Aggregate*	
Gradation	1 every 30 days
Absorption (Screenings only)	1 every 30 days
Total Minus 200	1 every 30 days
Cementitious Materials	Delivery Ticket and Mill Certificate
Admixtures	Certification
Water	As required in ***FDOT Specification Section 923****
Chlorides	1 every 30 days or in accordance with this guide

Materials Certification and Delivery Tickets must be kept on file for three years from date of materials receipt at the plant.

* Minimum sampling frequency may be reduced

9.2.14.1.2 Chloride Testing

It is the responsibility of the concrete producer to make sure chloride content of all reinforced concrete produced for the Department does not exceed the maximum allowable limits indicated in ***Florida Department of Transportation Specifications, Section 346***.

The sampling for chloride determination shall start on the first day of production of each mix design at the plant and repeat every 30 calendar days or less thereafter, as necessary to produce concrete meeting ***Florida Department of Transportation Specifications, Section 346.***

Chloride test results shall be obtained within 10 calendar days of sampling from a laboratory meeting and maintaining at all times the qualification requirements in ***Florida Department of Transportation Specification Section 105***. Determine the chloride content of each mix design in production at the plant or as described in this section. Concrete sampling for a mix design shall restart any time concrete production is suspended for any reason for more than 30 calendar days.

When more than one mix design uses the same cement, aggregates, admixtures, and has similar proportions, the concrete producer has the option to only test for chlorides of the mix design with the most amount of cementitious content to represent all such mixes. The test report shall clearly indicate all mix designs covered by the test.

If chloride test results exceed the limits shown in ***Florida Department of Transportation Specifications, Section 346***, suspend concrete production immediately for every mix design using the same component materials, including admixtures, until corrective measures are made. A copy of the sample information and chloride test report for the failed sample shall be sent to the DMRE and the State Materials Office Corrosion Research Laboratory as soon as the test results are available.

If the chloride test results are not obtained within 10 calendar days of concrete sampling, the Engineer may suspend concrete production until corrective measures are made.

When the source of any component material, including admixtures, for the concrete is changed, sampling for chloride determination shall restart the first day of production of the mix with the new component material.

9.2.15 DELIVERY TICKET/CERTIFICATION

The following information is required information for each concrete delivery. All information shown on the delivery ticket/certification must be furnished with each load. The information contained within ***Florida Department of Transportation Specifications, Section 346*** is required information on each delivery ticket/certification. The original signature on the delivery ticket shall certify to the accuracy of the recorded information and compliance with the approved design mix including the chloride content requirements. A sample of a delivery ticket is provided in ***Appendix "A"***, and must contain:

(1) Serial number of delivery ticket.

(2) The plant number as assigned by the Department.

(3) Date of batching.

(4) Contractor's name.

(5) FDOT Financial Project Number.

(6) Truck number making the concrete delivery shall match the truck number on the delivery ticket.

(7) Class of concrete.

(8) Design mix number.

(9) Time all materials are introduced into mixer.

(10) Cubic yards in this load.

(11) Cumulative total cubic yards batched for job on date of delivery.

(12) Chloride test date and test results

(13) Maximum allowable water addition at the job site.

(14) Number of revolutions at mixing speed before leaving for job site.

(15) Amount of mixing time for central mixer.

(16) Coarse and fine aggregate sources (Department assigned Pit No.).

(17) Actual amount of coarse and fine aggregates batched in pounds.
(18) Percent of free moisture in coarse and fine aggregates.

(19) Cement producer and type.

(20) Total amount of cement batched in pounds.

(21) Producer, brand name and class (whichever might apply) of Pozzolan or Slag.

(22) Total amount of pozzolan or slag batched in pounds.

(23) Producer, supplier, type and total amount of air entraining agent used.

(24) Producer, supplier, type and total amount of admixtures used.

(25) Total amount of water batched at the plant in gallons or pounds.

(26) Statement of compliance with the Specifications and other Contract Documents.

(27) Original signature of Batch Plant Operator and technician identification number.

9.2.16 TRAINING

Training will be in accordance with ***Florida Department of Transportation Specifications, Section 105*** and the appropriate sections of the Materials Manual Volume II

9.2.17 FORMS

Example Concrete Delivery Ticket – Appendix A, Materials Manual Volume II, Section 9.2
Example Proposed Concrete Design Mix Form – Appendix B. Materials Manual Volume II, Section 9.2

APPENDIX "A"
Sample Delivery Ticket for Structural Concrete

Financial Project No.: _____ Serial No.: _____

Plant No.: _____ Date: _____

Concrete Supplier: _____ Delivered to: _____

Phone Number: _____ Phone Number: _____

Address: _____ Address: _____

_____ _____

Truck No.	DOT Class	DOT Mix No.	Cubic Yards This Load
Allowable Jobsite Water Addition	Time Loaded	Mixing revolutions or time	Cubic Yards Total Today
Chloride Test Results		Chloride Test Date	

Cement _____ _____ _____ Source Type Amount	Fly Ash or Slag _____ _____ _____ Source Class Amount
Coarse Agg. _____ _____ _____ Pit Num. Moisture (%) Amount	Air Entrainment Admixture _____ _____ _____ _____ Source Brand Type Amount
Fine Agg. _____ _____ _____ Pit Num. Moisture (%) Amount	Admixture _____ _____ _____ _____ Source Brand Type Amount
Batch Water (gals. or lbs.) _____ Amount	Admixture _____ _____ _____ _____ Source Brand Type Amount

Issuance of this ticket constitutes certification that the batched concrete was produced and information recorded is in compliance with the ***Specification*** and other C***ontract Document*** requirements for Structural Concrete.

_____ _____

Technician Identification Number Signature of Batch Plant Operator

Arrival time at job site		Number of revolutions upon arrival at job site	
Water added at job site (gal. or lbs.)		Additional mixing revolutions with added water	
Time concrete completely placed		Total number of revolutions	
Initial Slump	Initial Air	Initial Concrete Temp.	Initial w/cm Ratio
Acceptance Slump	Acceptance Air	Acceptance Concrete Temp.	Acceptance w/cm Ratio

Signature on this ticket constitutes certification that the maximum specified water cementitious materials ratio was not exceeded and the batch was delivered and placed in compliance with ***Specification*** and other ***Contract Document*** requirements.

_____ _____

Technician Identification Number Signature of Contractor's Representative

APPENDIX B
PROPOSED CONCRETE DESIGN MIX

REVIEWED BY: _____

DATE: _____

FDOT Assigned Plant No.:			Financial No.:		
Slip Form Mix	Yes	No	Mix Designer (TIN):		
Transferable Mix	Yes	No	Hot Weather Mix	Yes	No
			CONCRETE CLASS:		
Cement (Plant No.):			Type:	SpGr:	
Pozzolan (Plant No.):			Class:	SpGr:	
Pozzolan (Plant No.):			Class:	SpGr:	
Slag (Plant No.):			Type:	SpGr:	
Air-Entraining Admixture			QPL No.:		
Admixture (QPL No.):			Type:		
Admixture (QPL No.):			Type:		
Admixture (QPL No.):			Type:		
Admixture (QPL No.):			Type:		
Coarse Aggregate (Pit No.):			Grade:	SpGr(SSD):	
Coarse Aggregate (Pit No.):			Grade:	SpGr(SSD):	
Coarse Aggregate (Pit No.):			Grade:	SpGr(SSD):	
Fine Aggregate (Pit No.):			Grade:	SpGr(SSD):	
Fine Aggregate (Pit No.):			Grade:	SpGr(SSD):	

Remarks: _____

Cement (lbs):			Slump Range (in):	From	To
Pozzolan (lbs):			Air Content Range (%):	From	To
Pozzolan (lbs):			Theo Unit Weight (wet) (PCF):		
Slag (lbs):			W/CM Ratio (lbs/lb):		
Air-Entraining Admixture (oz):			Theo Yield (CuFt):		
Admixture (oz):					
Admixture (oz):			Water in Corrosion Inhib. (lbs):		
Admixture (oz):			Aggregate Correction Factor:		
Admixture (oz):					
Water (gals):					
Water (lbs):			**Lab Test Data**		
Coarse Aggregate (lbs):					
Coarse Aggregate (lbs):			Chloride (lb/cy):		
Coarse Aggregate (lbs):			Slump (in):		
Fine Aggregate (lbs):			Air Content (%):		
Fine Aggregate (lbs):			Temperature (°F):		
			Compressive Strength (PSI)		
			Day	Day	
			Day	Day	