

Appendix B

Quality Control Elements And Example Plans

Elements of a QC Plan

- **Example QC Plan for Hot Mix Asphalt**
- **Example QC Plan for Structural Concrete**
- **Example List of QC Requirements for
PCC Transport and Placement**

ELEMENTS OF A QUALITY CONTROL PLAN

The Contractor's QC Plan for both production facilities and field operations should contain appropriate information identifying the contract for which the production and/or construction is intended. Each of the items discussed below should be included in the plan when appropriate along with supporting documentation.

DESCRIPTIVE INFORMATION

For production facilities, descriptive information should contain such information as make, type, location, frequency of inspection of the facility, frequency and procedures used for calibration of weighing and metering devices, frequency and procedures used for verification of valid calibration, and any certification(s) that have been issued for the facility.

For field operations, descriptive information should contain such information as the equipment to be used such as make, type, frequency of inspection or maintenance, frequency and procedures used for calibration of control and metering devices, frequency and procedures used for verification of valid calibration, and any certification(s) that have been issued for the equipment.

PERSONNEL

A QC plan is applicable to both production facilities and field operations. It may be well designed and theoretically correct; however, its eventual success will depend on the people assigned by the Contractor to implement the plan. Employees qualified for the assignments should be carefully selected and provided full support by the Contractor's management and policy. The name, qualification, and telephone number of the employee designated to be responsible for the Contractor's QC Program, and the name, and qualification numbers of employees designated to perform sampling, testing, and inspection that is required by the QC Plan should be included. Employees designated for any QC activity should be qualified in accordance with UDOT's Qualification Programs.

MIX DESIGN

UDOT requires contractor performed mix designs. The mix design for items such as concrete and hot mix asphalt is a necessary and critical part of the effort to control the quality of items into which such materials are incorporated. The development of a mix design should be done in a qualified laboratory by qualified personnel. Tests should be performed during the mix design development to ensure that material manufactured in accordance with the mix design specifications will perform as required by the contract. It is mandatory that controls be imposed by the Contractor's plan to ensure that the material produced will comply with the accepted mix design for the contract. The type of mix, mix design identification, and supporting test data should be part of the QC Plan. Mix designs that have been previously accepted by the agency may be resubmitted for use on other contracts when applicable. It is important that the mix produced in the plant be the same as that designed in the laboratory.

QC TEST FREQUENCY

During both production and construction operations, QC tests should be performed at or exceeding the minimum frequency set forth in the Contractor's QC Plan. UDOT has outlined minimum frequencies for control testing in project specifications and/or Minimum Sampling and Testing Guide. Frequency schedules for QC may be derived in terms of time, quantity, or a combination of the two. When UDOT

has a preference, it should be included in the contract. Statistically, schedules derived using either approach can be equally valid.

NOTIFICATION OF PRODUCTION OPTIONS

For both production and construction, at least 24 hours prior to beginning scheduled work, the Contractor must notify UDOT that production or construction will begin, to allow appropriate UDOT personnel the opportunity to be present when start-up occurs.

CONTROL CHARTS

The QC Plan should contain the manner in which the Contractor will establish, display, and use control charts for both production facilities and field operations. The need for Contractors to use statistical control charts to control the process cannot be overemphasized. A control chart provides a visual indication of whether a process is in control. Timely reaction to the QC chart can prevent the production of nonconforming material.

QC TEST RESULT REPORTING

Timely evaluation and reporting of test results obtained on the QC samples is very important so that the Contractor's organization can react to the results and the department can be kept fully informed. The Contractor should make adjustments to the plant production process when the QC data indicate an adjustment is necessary. If an adjustment is not made when warranted, the reason for the lack of action should be documented by the QC employee to the Department representative.

INSPECTION

Inspection is an activity that is as important to QC as it is to acceptance for both production facilities and field operations. It is necessary in order to minimize visually detectable problems in the production facility, such as stockpile or equipment maintenance practices or needs, that may eventually affect the quality of the material produced. The QC Plan should indicate inspection activities that will be performed by the Contractor's QC personnel.

NONCONFORMING MATERIAL AND CONSTRUCTION

It is important that the occurrence of nonconforming material or work indicated by QC test data is addressed. Although such an occurrence is undesirable, it may happen. If the QC tests results are used for acceptance, the acceptance procedure will address the manner in which nonconforming material or work will be handled. If the QC tests are not used for acceptance, a plan identifying the defective material or construction and its disposition will be submitted for UDOT concurrence.

SAMPLE STORAGE AND RETENTION

When the contract requires that QC samples be stored and retained for a specific purpose during the contract period, the Contractor's QC Plan should contain a description and location of the facility where the samples will be held.

Quality Control Plans

Example QC Plan for Hot Mix Asphalt

This Hot Mix Asphalt (HMA) QC Plan is submitted for Project xxxxx, Item xxx.

HMA Plant Production

1. Plant (Enter make, type and location of plant).
 - 1.1 Frequency of plant inspection, calibration, verification of calibration, and any plant certification. (Include documentation).
2. Personnel.
 - 2.1 Enter name, certification number and telephone number of employee responsible for QC.
 - 2.2 Enter name, and certification no. of sampling & testing technician(s).
 - 2.3 Enter name and telephone no. of employee responsible for making plant production changes when necessary as a result of QC data.
3. Enter the type and mix design identification of mixes to be used in the contract.
4. Prior to production the Job Mix Formula for each type of mix included for use on the contract will be submitted to UDOT. Only materials from sources acceptable to UDOT will be used in the mix design.
5. During mix production operations, QC tests will be performed at or exceeding the minimum frequency in the attached schedule.
6. All testing and evaluation will be completed within hours of sampling and all documentation will be completed and submitted to UDOT on approved processing forms within _____ hours or production will be halted until these item are current.
7. Material found to be noncomplying shall not be incorporated into the work.
8. Appropriate UDOT personnel will be notified at least 24 hours before the scheduled work is to begin.
9. In the event QC test data indicates that noncomplying material has been incorporated into the work, UDOT will be notified immediately and a plan will be submitted for approval, identifying the defective material and its disposition.

HMA Field Operations OC

1. Personnel.
 - 1.1 Enter name, qualification, and telephone number of employee directing the field operations.

- 1.2 Enter name, and qualification, of employee responsible for insuring that all items of work will comply with agency specifications.
- 1.3 Enter name and certification number of employee(s) responsible for sampling and testing.
2. During placement operations of the asphalt concrete pavement, QC tests will be performed at or exceeding the minimum frequency in the attached schedule.
3. All testing and evaluation will be completed within the time limits specified by the contractor or the work will be halted.
4. Material found to be noncomplying will not be incorporated into the roadway.
5. Notification will be given to appropriate UDOT personnel at least 24 hours before work is scheduled to begin.
6. In the event that test data or inspections indicate that noncomplying material has been incorporated into the work, UDOT will be notified immediately and a plan will be submitted for approval, identifying the defective material and its disposition.
7. Indicate method to be followed to prevent segregation and visual pavement deformities.

**EXAMPLE TABLE FOR FREQUENCY AND DOCUMENTATION
OF SAMPLING AND TESTING ASPHALT CONCRETE**

Asphalt Concrete		
Test	Frequency	Documentation
Combined Cold Feed Gradation	As required to control production	Forms as required by contract
Moisture Content	As required to control production	Forms as required by contract
Asphalt Content	As required to control production	Forms as required by contract
Tack/Prime if used	As required to control operation	Diary
Correlation of nuclear asphalt gauge	1 per mix or project	Forms as required by contract
Face fracture on crushed gravel	Lot size to be determined. 5 per lot	Forms as required by contract
Temperature of mix	As required to control production	Diary
Temperature of base or air	As needed	Diary

Asphalt Concrete		
Test	Frequency	Documentation
Temperature of mat	As required to control operation	Diary
Density	Lot size to be designated. 5 per lot	Forms as required by contract
Skid resistance	As required to control operation	Forms as required by contract
Smoothness	As required to control operation	Forms as required by contract
Thickness	Lot size to be designated. 5 per lot	Forms as required by contract
Pavement application rate	As needed	Diary
Distribution of test data	Within 24 hours	Forms as required by contract

Use sampling and testing standards required by the contract.

EXAMPLE QC PLAN FOR STRUCTURAL CONCRETE

1. The following outlines the contractor's plan for insuring QC in accordance with contractual requirements for the production, shipment, placement, and curing of PCC which will be used in the listed contract items.
 - 1.1 Item xxxx - Bridge xxx.
 - 1.2 Item xxxx - Headwalls.
 - 1.3 Item xxxx - Curb & gutter.
2. Personnel.
 - 2.1 Qualified sampling, testing and inspection personnel who are certified through agency accepted programs will be used.
 - 2.2 Technicians (enter name and certification number of technician(s)).
 - 2.3 The QC Liaison with the agency (enter name, certification number and telephone number).
 - 2.4 The QC Supervisor (enter name, qualification and telephone number).
3. Recognized statistical concepts for material data analysis as allowed by UDOT specifications will be used.
4. Documentation of QC activities will be available at (enter the location at which the documentation will be maintained).
5. A copy of typical report forms used documenting QC work are attached. [The Agency should attach appropriate forms.] These forms will include:
 - 5.1 Identification - Name of material, equipment, or process being evaluated.
 - 5.2 Location of sample procurement or inspection or testing.
 - 5.3 Type of test or inspection.
 - 5.4 Name of inspector, sampler, tester and reviewer.
 - 5.5 Results - Observation of inspection or test value result.
 - 5.6 Analysis of Acceptability.
 - 5.7 Action taken and results.
 - 5.8 Signature of QC supervisor.

6. Typical control charts used for documenting QC work are attached. [Agency should attach appropriate forms.] These charts will include the following data:
 - 6.1 Identification - Name of material, equipment, or process being evaluated.
 - 6.2 Results - Date, and report number of data used on chart.
 - 6.3 Upper & lower control limits.
 - 6.4 Analysis of acceptability.
 - 6.5 Action taken and results.
 - 6.6 Signature of responsible QC lead employee.
7. Other documentation used for QC analysis will include the following:
 - 7.1 Batch tickets.
 - 7.2 Other records not addressed above.
8. In the event QC test data indicates that noncomplying material has been incorporated into the work, UDOT will be notified immediately and a plan will be submitted for concurrence, to identify the defective material and determine its disposition.
9. Mix Design(s), (enter class and identification of mix designs to be used on items in the contract).

**EXAMPLE TABLES FOR FREQUENCY
OF SAMPLING AND TESTING FOR
QC OF PORTLAND CEMENT CONCRETE COMPONENTS**

Fine and Coarse Aggregates

Item	Test	Frequency
Gradation	T 27	As required for control

**EXAMPLE TABLES FOR FREQUENCY OF
QC INSPECTION, SAMPLING, AND TESTING
FOR PRODUCTION OF PORTLAND CEMENT CONCRETE**

Plant and Trucks

Item Identification	Item to Check	Frequency
Mixer Blades	Wear and alignment	Daily
Scales	Static check	Weekly
Belts & rollers	Wear and alignment	Weekly
Calibration Gauges	Verify calibration	Monthly

Concrete production - stockpile maintenance

Item Identification	Test	Frequency
Moisture	Determine moisture content	As needed to control production
Contamination	Visual	Daily
Segregation	Visual	Daily

Concrete production - concrete

Item	Test	Frequency
Yield	T 121	As required to control production
Slump	T 119	As required to control production
Air	T 152 or T 196	As required to control production
Strength	T 22 or T 276	As required to control production
Temperature	T 309	As required to control production
Mixing Time	Visual	Weekly / daily per batch size

Example List of QC Requirements for PCC Transport and Placement

10. Bid Item xxxx - Bridge xxx.
 - 10.1 Slump - At the start up and after each failed batch, test every batch until two consecutive batches pass. Then take one test per 50 yd³.
 - 10.2 Air content - At the start up and after each failed batch, test every batch until two consecutive batches pass. Then take one test per 50 yd³.
 - 10.3 Compressive strength - 1 per 50 yd³ (3 cyl).
 - 10.4 Placement and consolidation.
 - 10.4.1 Form work - Tightness, bracing, etc., visual.
 - 10.4.2 Vibration - Visual per specification.
 - 10.4.3 Rate of pour - Visual per specification.
 - 10.4.4 Placement equipment - Condition visual.
 - 10.4.5 Finishing equipment - Condition visual.
 - 10.4.6 Staffing - # for production, ability visual.
 - 10.4.7 Texturing - Visual per specification.
 - 10.4.8 Thickness - Measure.
 - 10.4.9 Rebar cover - Measure.
 - 10.4.10 Smoothness - Measure.
 - 10.4.11 Concrete surface conditions - Visual perspective.
11. Bid item xxxx - Head walls.
 - 11.1 Slump - Daily or 1 per 50 yd³
 - 11.2 Air - Daily or 1 per 50 yd³
 - 11.3 Compressive Strength - 1 per 50 yd³
 - 11.4 Placement and Consolidation.
 - 11.4.1 Form work - Tightness, bracing, etc., visual.

- 11.4.2 Vibration - Visual per specification.
- 11.4.3 Rate of pour - Visual per specification.
- 11.4.4 Placement equipment - Condition visual.
- 11.4.5 Finishing equipment - Condition visual.
- 11.4.6 Staffing - Number for production, ability visual.
- 11.4.7 Texturing - Visual per specification.
- 11.5 Curing - Visual per specification.
- 11.6 Weather - Protection - Visual.
- 12. Bid Item xxxx - Curb & gutter.
 - 12.1 Slump - Daily or 1 per 50 yd³
 - 12.2 Air - Daily or 1 per 50 yd³
 - 12.3 Compressive Strength - 1 per 50 yd³
 - 12.4 Placement and Consolidation.
 - 12.4.1 Form work - Tightness, bracing, etc., visual.
 - 12.4.2 Vibration - Visual per specification.
 - 12.4.3 Rate of pour - Visual per specification.
 - 12.4.4 Placement equipment - Condition visual.
 - 12.4.5 Finishing equipment - Condition visual.
 - 12.4.6 Staffing - Number for production, ability visual.
 - 12.4.7 Texturing - Visual per specification.
 - 12.5 Curing - Visual per specification.
 - 12.6 Weather - Protection - Visual.