Quality Assurance Programs for Innovatively Financed Projects

Design-Bid-Build, Design-Build, and Concession Projects for TxDOT and Local Governments Including Pass-Through Financing

David B. Belser
QAP Program Manager
Materials & Pavements Construction Division
Presentation Outline

- Types of Projects / Delivery Methods
- Quality Assurance Program (QAP) Overview
- QAPs for Different Alternate Delivery Methods
  - Design-Bid-Build (D-B-B)
  - Design-Build (D-B)
  - Concession
- Pass-Through Finance & LG Projects
Innovatively Financed Projects...
What are We Talking About?

- Projects that use new or non-traditional transportation funding sources or financing techniques, as well as any existing funding source, to deliver projects more expeditiously and cost-effectively.

  - **Design-Bid-Build (D-B-B)**
    - SH 45 N & Loop 1
    - PGBT Eastern Extension (NTTA)
    - PTF Projects – most all PTFs to date have been D-B-B

  - **Design-Build (D-B)**
    - SH 130, Segments 1-4
    - 183 A (CTRMA)
    - DFW Connector
    - PGBT Western Extension - SH 161 (NTTA)
    - US 281/Loop 1604 Interchange (Alamo RMA)
    - ELP Spur 601 (PTF, CRRMA)
    - ELP Americas Interchange (PTF, CRRMA)

  - **Concession**
    - SH 130, Segments 5-6
    - North Tarrant Express (NTE)
    - LBJ 635
Quality Assurance Program (QAP) Overview

The QA Program utilizes a combination of quality components to meet program goals:

- Quality Control Testing (QC)
- Quality Assurance Testing (QA)
- Owner Verification Testing (OVT) (D-B & Concessions only)
- Referee Testing (RT)
- Independent Assurance Testing (IA)
Quality Assurance Program Overview

Definitions

- **Quality Control (QC)** – Internal procedures used by the Contractor, Suppliers, and Subcontractors to ensure that development work meets project plans and specifications

- **Quality Assurance (QA)** – Inspection, testing, auditing, documenting and reviewing of all materials, operations, and processes

- **Owner Verification Testing (OVT)** – Sampling and testing performed to validate the results of the QA acceptance sampling and testing, using statistical analysis

- **Referee Testing (RT)** – Dispute resolution tests using split samples to resolve testing discrepancies

- **Independent Assurance Testing (IA)** – An unbiased and independent evaluation of the sampling and testing procedures and equipment used in the Acceptance Program
Quality Assurance Program Summary

design-build

- Traditional TxDOT Quality Assurance Program for Construction – deviations must be approved by TxDOT
- Typically, no contractor QC for acceptance
- Acceptance testing performed per Guide Schedule by independent QA laboratory
- Personnel & equipment must be qualified/certified
- System approach independent assurance (IA) program – annual personnel & equipment evaluations
- Materials Certification to FHWA at project end
Quality Assurance Program Structure
DESIGN-BID-BUILD

* Modeled after 23 CFR 637 B and TxDOT Quality Assurance Program

**Independent Assurance Program**

**System Approach**
- Testing personnel and equipment must be qualified under the Quality Assurance Program
- Evaluates sampling, testing, personnel, equipment used as a part of the acceptance decision
- Annual evaluations by split or proficiency sample testing
- Performed by Designated IA Laboratory (must be AASHTO accredited)

**Acceptance Program**

**Project Testing**

**Job Control**
- (Quality Control) No Location or Frequency defined
- Performed by Contractor

**Acceptance**
- Location and Frequency defined in Guide Schedule of Sampling & Testing
- Performed by Independent QA Laboratory

**Referee**
- As necessary for dispute resolution
- Performed by CSTM&P
Quality Assurance Program Summary
DESIGN-BUILD

- “Quality Assurance Program for Design-Build Projects with an Optional 15-Year Capital Maintenance Agreement”
- Developer Construction Quality Management Plan (CQMP)
- Developer/contractor acceptance testing per Guide Schedule by independent Construction Quality Acceptance Firm (CQAF)
- Owner verification testing (OVT) by the Owner’s independent OVT testing firm
  - Required by 23 CFR 637 B & FHWA Technical Advisory 6120.3
  - Minimum 10% frequency of QA testing
  - Statistical validation of QA testing using F- and t-testing analysis
  - Quarterly statistical validation report to FHWA
- Owner Verification Testing & Inspection Plan (OVTIP)
- Dispute resolution (referee)
- Personnel & equipment certification
- System approach independent assurance (IA) program – annual personnel & equipment evaluations
Contractor Acceptance

- Utilized on Design-Build & Concession projects having substantial schedule acceleration
- Not recommended for small quantity projects, of any type, due to insufficient data populations for F- and t-test statistical analysis
  - Lessons learned from PTF project
Quality Assurance Program Structure
DESIGN-BUILD

* Ref. 23 CFR 637 B, TxDOT Quality Assurance Program, & TA 6120.3

**Independent Assurance Program**

- **System Approach**
  - Testing personnel and equipment must be qualified under the project Quality Assurance Program
  - Evaluates sampling, testing, personnel, equipment used as a part of the acceptance decision
  - Annual evaluations by split or proficiency sample testing
  - Performed by Designated IA Laboratory (must be AASHTO accredited)

**Acceptance Program**

- **Project Testing**
  - **Job Control**
    - (Quality Control) No Location or Frequency defined
  - **Acceptance**
    - Location and Frequency defined in Guide Schedule of Sampling & Testing
  - **Verification**
    - Validates Acceptance Testing using statistical analysis, when contractor’s results used for acceptance
  - **Referee**
    - As necessary for dispute resolution

- **Performed by**
  - Contractor
  - Independent CQAF Lab
  - OVT Laboratory
  - CSTM&P
Owner Verification Approach
DESIGN-BUILD

- Three-Tiered Verification Approach
  - Level 1: Continuous F- & t-test analysis
    - Almost real-time verification
    - ~10% of QA test frequency
    - Allows for $\alpha = 0.01, 0.025, 0.05$ based on importance
  - Level 2: Independent Verification
  - Level 3: Observation Verification
- Start-up and quarterly split-sample tests
- Quarterly FHWA reporting
Appendix D – OVT Levels for Materials Testing Validation

Start-Up Requirements

During start-up operations, the CQAF (Construction Quality Acceptance Firm) and OV (owner verification) firm will perform split sample testing for all tests listed as Level 1 or Level 2. The OV firm will evaluate split sample results against TxDOT’s split sample tolerance limits contained in Appendix B. For those test methods that do not validate during start-up operations, both the CQAF and OV firm will collaborate to determine the cause(s) of the non-validation and will both take appropriate corrective actions during the early phases of material production to align the testing operations. For tests listed as Level 3, the OV firm will observe and review the CQAF’s initial start-up testing operations.

The level of significance ($\alpha$) used for statistical analyses are provided below unless otherwise approved in writing by TxDOT.

<table>
<thead>
<tr>
<th>MATERIAL CATEGORY</th>
<th>LEVEL OF SIGNIFICANCE ($\alpha$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Embankment, Subgrades, Backfill, and Base Courses</td>
<td>0.01</td>
</tr>
<tr>
<td>Asphalt Stabilized Base (Plant Mix)</td>
<td>0.01</td>
</tr>
<tr>
<td>Surface Treatments</td>
<td>0.01</td>
</tr>
<tr>
<td>Hydraulic Cement Concrete – Structural</td>
<td>0.025</td>
</tr>
<tr>
<td>Hydraulic Cement Concrete – Non Structural</td>
<td>0.01</td>
</tr>
<tr>
<td>Hydraulic Cement Concrete Pavements</td>
<td>0.025</td>
</tr>
<tr>
<td>Asphalt Concrete Pavement (Items 341, 342, 344, and 345)</td>
<td>0.025</td>
</tr>
<tr>
<td>Asphalt Concrete Pavement (Items 330 and 334)</td>
<td>0.01</td>
</tr>
<tr>
<td>Asphalt Concrete Pavement (Item 340)</td>
<td>0.025</td>
</tr>
</tbody>
</table>

Level 1 Tests: F & t-test and Split Samples

F- and t-Tests: The OV firm will perform continuous F- and t- test analyses on Level 1 tests with the OV testing frequency at approximately ten percent of the QA testing frequency. The continuous analysis, as described in Appendix I – I2MS 3.0 Continuous Analysis Algorithm, will be run daily with new OV test results being added to the OV sample population as older OV test results are removed. The analyses will be performed against the corresponding QA CQAF sample population.

Level 2 Tests: Independent Verification and Split Samples

Independent Verification: The OV firm will perform independent verification on Level 2 tests with the OV testing frequency once per quarter with lower frequency tests missed during one quarter being specifically targeted the next quarter. This verification shall be performed by comparing the independent OV test results with a group of corresponding QA test results as an independent check of the QA test results.

Level 3: Observation Verification

The OV firm will observe and review the CQAF’s initial start-up testing operations and periodically during ongoing production operations to verify compliance with test procedures.
### OVT Analysis Levels for Materials Validation (cont.)

<table>
<thead>
<tr>
<th>Material or Product</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Embankment (Cuts &amp; Fills)</strong></td>
<td>TEST FOR</td>
<td>TEST NO.</td>
<td>TxDOT Recommended</td>
</tr>
<tr>
<td>Liquid Limit</td>
<td>Tex-104-E</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>Tex-106-E</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Linear Shrinkage</td>
<td>Tex-107-E</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Gradation</td>
<td>Tex-110-E</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Moisture/Density</td>
<td>Tex-114-E</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>In-Place Density</td>
<td>Tex-115-E (See NOTE)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Retaining Wall (Non-Select Backfill)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquid Limit</td>
<td>Tex-104-E</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>Tex-106-E</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Linear Shrinkage</td>
<td>Tex-107-E</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Gradation</td>
<td>Tex-110-E</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Moisture/Density</td>
<td>Tex-114-E</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>In-Place Density</td>
<td>Tex-115-E (See NOTE)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Retaining Wall (Select Backfill)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquid Limit</td>
<td>Tex-104-E</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>Tex-106-E</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Linear Shrinkage</td>
<td>Tex-107-E</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Gradation</td>
<td>Tex-110-E</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Moisture/Density</td>
<td>Tex-113-E</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Wet Ball Mill</td>
<td>Tex-116-E</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Triaxial</td>
<td>Tex-117-E</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>In-Place Density</td>
<td>Tex-115-E (See NOTE)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Untreated Base Courses</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moisture Content</td>
<td>Tex-103-E</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Thickness</td>
<td>Tex-140-E</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Liquid Limit</td>
<td>Tex-104-E</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>Tex-106-E</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Linear Shrinkage</td>
<td>Tex-107-E</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Gradation</td>
<td>Tex-110-E</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Moisture/Density</td>
<td>Tex-113-E</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Wet Ball Mill</td>
<td>Tex-116-E</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Triaxial</td>
<td>Tex-117-E</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>In-Place Density</td>
<td>Tex-115-E (See NOTE)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Treated Subgrade and Base Courses</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Base Material</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulverization Gradation</td>
<td>Tex-101-E, Part III</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Moisture Content</td>
<td>Tex-103-E</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>In-Place Density</td>
<td>Tex-115-E (See NOTE)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Thickness</td>
<td>Tex-140-E</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Complete Mixture</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulverization Gradation</td>
<td>Tex-101-E, Part III</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Moisture Content</td>
<td>Tex-103-E</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>In-Place Density</td>
<td>Tex-115-E (See NOTE)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Thickness</td>
<td>Tex-140-E</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>
Inspection and Materials Management System (I2MS)

- Owner Verification application developed collaboratively by TxDOT, HDR, and FHWA
  - Testing and Inspection Verification
  - Automated Statistical, Data, and Trend Analysis
  - Web-Base Application
  - Robust Security Features
  - Robust Search Features
- Satisfies all FHWA requirements
Design-Build vs. Concession

**DESIGN-BUILD**

- TxDOT & GEC (OV, IA, REF)
- Design-Builder
- Design Subs
- Construction Subs (CQAF)

**CONCESSION**

- TxDOT
- Design-Builder
- Financial Markets Furnish Money
- Concessionaire
- Design Subs
- Construction Subs (CQAF)
- Independent Engineer (OV, IA)
- 3rd Party Independent Engineer for Referee
Quality Assurance Program Summary

CONCESSION

- Variation of the QAP for Design-Build Projects
- Developer Facility Management Plan (FMP)
- 52-year Maintenance Agreement
- QC testing by Concessionaire
- Design-Builder Construction Quality Management Plan (CQMP)
- Acceptance testing per Guide Schedule by Design-Builder (AASHTO or ISO 17025 accredited)
- Owner verification testing (OVT) by Independent Engineer (IE) firm
  - Required by FHWA Technical Advisory 6120.3
  - ~10% frequency of QA testing
  - Validation of QA testing using F- and t-test statistical analysis
  - Quarterly statistical validation report to FHWA
- Dispute resolution (referee) and independent assurance (IA) by IE firm
- Personnel & equipment certification
Quality Assurance Program Structure
CONCESSION

---

**Independent Assurance Program**

**System Approach**
- Testing personnel and equipment must be qualified under the project Quality Assurance Program
- Evaluates sampling, testing, personnel, equipment used as a part of the acceptance decision
- Annual evaluations by split or proficiency sample testing
- Performed by IE Firm (AASHTO accredited)

---

**Acceptance Program**

**Project Testing**

**Job Control**
- (Quality Control)
- No Location or Frequency defined
- Performed by Concessionaire

**Acceptance**
- Location and Frequency defined in Guide Schedule of Sampling & Testing
- Performed by Concessionaire

**Verification**
- Validates Acceptance Testing using statistical analysis, when contractor’s results used for acceptance
- Performed by IE Firm (AASHTO accredited)

**Referee**
- As necessary for dispute resolution
- Performed by IE Firm (AASHTO Accredited)
Since most TxDOT D-B projects have similar risk profiles (toll component & optional 15-yr. Maintenance agreement), TxDOT’s programmatic QAP for D-B has already been approved and a risk assessment workshop is usually not needed.

Concession projects more customized (% public vs. private funds, TIFIA loans, long-term Maintenance agreement requirements, etc.) and project-specific workshops are held to determine, among other things, the appropriate levels of analysis (1, 2, or 3) for different materials.
Owner Verification Approach

CONCESSION

- Three-tiered verification approach similar to Design-Build
- Modify analysis levels and/or alpha table based on each project’s specific risk profile (per Risk Assessment Workshop)
  - e.g., some Level 1 analysis categories may be moved to Level 2
- Quarterly FHWA reporting
Where We’re Headed with Concessions (Maybe, Hopefully…)

- SEP-15 Request to FHWA for OVT Exception
  - Goal 1: Removal of OVT altogether
  - Fallback: Limit OVT to Embankment & Structural Concrete
  - Based on risk profile & lessons learned

- Material Quality
  - Has been largely good on current Concessions
  - Does not equate to statistical validation

- New QAP for Concession Projects
  - Draft is complete, to be submitted soon
  - Written around primary objective above
  - Heavier emphasis on IE audit function
For all projects with state or federal funds, adopt TxDOT QAP or submit a program through TxDOT meeting requirements of 23 CFR 637 B
- Designate QA testing & inspection laboratory
- Designate IA laboratory
- For D-B using contractor acceptance, employ independent lab (OVT) to verify contractor’s tests in accordance with TA 6120.3
- Assure compliance with approved program
- Submit Material Certification to TxDOT when construction is complete
- For off-system projects funded by local or private funds, LG may use their own QAP
Pass-Through Finance (PTF) & LG Projects

DISTRICT RESPONSIBILITIES

- For projects w/ state or federal funds and projects on state system regardless of funding source:
  - Submit LG’s QAP to CSTM&P for approval
  - Spot check compliance with approved program during periodic inspections (See Form 2423, LG Inspection Checklist)
  - Receive LG’s Material Certification letter and retain with official project records.
- No monitoring required on projects without state or federal funds off the state system
Questions?

- David Belser, CST
  (512) 506-5803
- Brett Haggerty, P.E., CST
  (512) 506-5841
- Darren Hazlett, P.E., CST
  (512) 506-5816