

# Developing a Materials Acceptance Program for Alternative Delivery Projects

To meet FHWA **23 CFR 637B** requirements

Katherine Holtz, PE  
Delcan Corporation

Reviewed by Tom Malerk, PE  
FDOT State Materials Engineer



*This presentation will cover:*

- Opportunities for improvement of Material Acceptance Programs
- Acceptance Program requirements
- Proposed MAP and Contract Requirements to obtain the desired Material Acceptance Program

# Opportunities for improvement

- Experience on past and ongoing projects
- FHWA Quality Assurance Stewardship Review(2003-2006)
- Technical Advisory T 6120.3
- Does Design-Build Project Delivery Affect the Future of the Public Engineer?  
Douglas D Gransberg and Keith Molenar

# Project Experience



# Experience from projects

1. Poorly written/non existing requirements
2. Improper or inadequate sampling approaches
3. Not setting up a program and processes
4. Quality is low bid.
5. No appropriately trained personnel
6. misunderstanding of new roles and actual culture differ

# Example of Cultural Shift

*Quality is the degree to which a product or service conforms with a given requirement.*

**Quality= Meets Requirement**

# Quality Assurance Stewardship

## Review - Summary Report for Fiscal Years 2003 Through 2006 (FHWA

August 2007)  
*The following opportunities for improvement on QCQA specifications and processes for pavements were noted:*

- a. Sampling Issues
- b. Control of Data, Security of Samples
- c. Improper Process

*Mike Rafalowski, FHWA, Office of Pavement Technology: Quality Assurance Stewardship Review - Summary Report for Fiscal Years 2003 Through 2006*

# Technical Advisory T 6120.3

- QC and acceptance functions often have been combined or intermingled. This has been a major source of confusion.
- Statistical QA specifications and acceptance procedures have been implemented without fully understanding the risks involved to both the STD and the contractor.
- It is estimated that few departments have developed and evaluated the risk levels associated with their acceptance plans.

*FHWA, HIPT-10(August 9, 2004): Use of Contractor Test Results in the Acceptance Decision, Recommended Quality Measures, and the Identification of Contractor/Department Risks, T6120.3*

***Opportunities for improvement of Material Acceptance Programs***

# Professor Douglas D. Gransberg from University of Oklahoma, Norman

*60 Design Build request for proposal documents:*

-23(38%) did not include language to clearly assign Quality Assurance responsibilities

-4(7%) of the documents had specific language that described the responsibilities for each of the elements of a QA program.

Gransberg, Douglas D.:Moenaar PhD, Keith R. Transportation Research Board Annual Meeting 2007 Paper #08-0251:*Does Design-Build Project Delivery Affect the Future of the Public Engineer?*

# What are the requirements?

- FHWA Title 23, Code of Federal Regulations (CFR), Subpart 637B, Quality Assurance Procedures for Construction
- FHWA Technical Advisory T 6120.3 - Use of Contractor Test Results in the Acceptance Decision, Recommended Quality Measures, and the Identification of Contractor/Department Risks

# FHWA 23 CFR 637

## Requirements

• originally developed for design bid build projects with Federal funding on the NHS, with pay incentives

- added the ability to include contractor's tests in acceptance process
- requires Material Acceptance Program and Independent Assurance Program
- requires SHA Labs to be accredited by the AASHTO Accreditation Program. All other labs and personal to be qualified in some manner
- Acceptance Program requirements
- specific terminology
  - Quality Control
  - Quality Assurance
  - Quality Acceptance
  - Owner Verification
  - Independent Assurance Program

23 CFR 637B

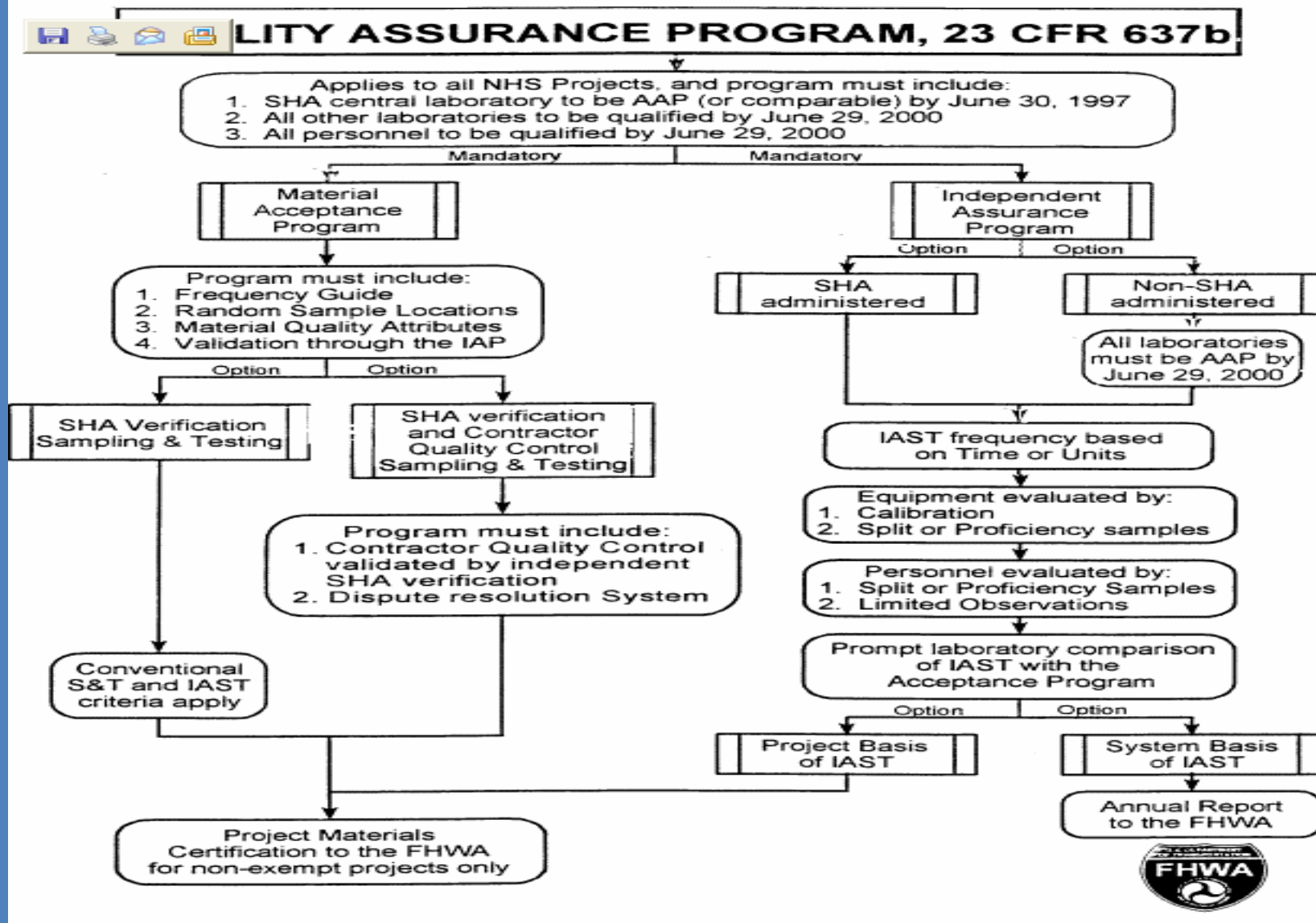
# An excellent flow chart.....

Optimal Acceptance Standards for Statistical Construction Specifications:

Appendix E Figure 47: Flowchart of 23 CFR 637B

<http://www.tfhrc.gov/pavement/pccp/pubs/02095/appe.htm>

# Acceptance Program requirements



# Technical Advisory 6120.3 Requirement

- The contractor is responsible for the QC and *the STD is responsible for obtaining and conducting verification tests and making the acceptance decision.*
- State planning and research pooled fund study SPR-2(199) "Optimal Acceptance Procedures for Statistical Construction Specifications" was conducted to provide recommendations for statistically sound QA procedures and balancing of risks.
- The *F*-test and *t*-test are the recommended methods because they have more power to detect actual differences than the method that relies on a single department test for the comparison.
- ***The method of comparing a single department test to a number of contractor tests should not be used***

# Technical Advisory 6120.3 Requirement

## Recommended Quality Measures

The percent within limits (PWL) or percent defective (PD)

- to measure both the center and spread
- use the mean and standard deviation
- estimate the percentage of the lot that is within, PWL, or outside of, PD, the specification limits

# Technical Advisory 6120.3 Requirements

For Independent Assurance Program tests:

- it is recommended that the paired  $t$ -test (compares contractor and department results from an equal number of split samples) be used on the total accumulated split sample results

# Framework of program

Clear Requirements in Contract Documents and provide Special Specifications

- Define and assign risk
- Define Roles (based on risk)
- Define Terminology
- Define components of the acceptance program
  - Establish random sampling plan, process and lot size
  - Establish Tracking and monitoring process
  - Establish Analysis Process
- Define components of the Independent Assurance program
  - Split samples from project or Proficiency sampling
  - Tracking and monitoring
  - Analysis
- Define “So What”
  - Specific actions to take by owner or Design Builder when specific items occur
    - Withholding payment, increase or decrease frequency of testing, replacing personnel

# Risk

- Design Builder's risk that conforming material will not be accepted
- Owner's risk that non conforming material will be accepted
- Determine acceptable risk Table 1 of R-9-97(2000)
- Larger sample quantities = less risk
- OC curves to establish risk

# Risk requirement

- The Design Builder's quality program shall ensure that the owner has less than a 5% risk of accepting materials that should be rejected. The Design Builder's quality program shall meet the requirements of AASHTO Materials Specification R 9-97(2000) Acceptance Sampling Plans for Highway Construction

# Variation of Roles

- QC- suppliers, construction subcontractor staff
- QA – Design Builder’s Quality team,
  - Acceptance or just Assurance?
- OVT- Owner
  - Acceptance or just Verification?

OR

- QC- suppliers only
- QA – Design Builder’s Quality team
  - Acceptance or just Assurance?
- OVT- Owner
  - Acceptance or just Verification?

OR

- QC- suppliers, Design Builder’s Quality team
- QA – Nobody
- OVT- Owner
  - Acceptance or just Verification?

# Roles Requirement

- The Design Builder shall perform Quality Control on all Design and Construction in accordance with.....
- The Design Builder shall develop a Quality plan that will include for each material a sampling plan, a tracking and monitoring process and an analysis process.
- The Quality Control Manager will be certified as a Quality Engineer by the American Society of Quality or equivalent.
- The Design Builder shall have a separate quality assurance team that performs assurance testing on all quality control testing performed by subcontractors, vendors, fabricators, and

# Define Terminology

- What is acceptance and when does it occur.
- Quality Assurance- is it a test or a program
- Quality Acceptance- is it a procedure or a process?
- Owner Verification Test- Is it quality assurance?

# Terminology Defined consistently in contract and reference documents

- Recommend using definitions straight from CFR 637

*Acceptance program.* All factors that comprise the State transportation department's (STD) determination of the quality of the product as specified in the contract requirements. These factors include verification sampling, testing, and inspection and may include results of quality control sampling and testing

*Quality assurance.* All those planned and systematic actions necessary to provide confidence that a product or service will satisfy given requirements for quality.

*Verification sampling and testing.* Sampling and testing performed to validate the quality of the product.

# Clearly define the acceptance process

- Final acceptance for “name material” will be based on QC testing, verification testing and final inspection.

# Define components for each material...

Determine frequency of testing (QC, QA, IA)

Determine allowable variability

Require producer to show process is in control-  
OC curves, Cpk, PWL

# Define Components for each Material

- How?
- Review data from past projects
- Determine risk- more risk more testing, less variability
- Contractor's capabilities
- Benchmarking, literature review, research

# Define Analysis Components and Process

All QC samples will be saved by the design builder in a location to be designated by the state.

If a test fails there will be no retesting of materials to replace that test. Tests may be run to identify the limits of the material to be rejected.

All QC test results will be submitted to the owner for statistical comparison to verification testing. The materials, their attributes, sampling locations, frequency of comparison, comparison deadline, specific analysis processes and allowable tolerances for each attribute are listed in Table X. The Design Builder shall produce control charts on the material and make the charts available to the owner daily.

# Define analysis process for every material

- Latex Modified Concrete
  - One sample, 2 qt minim of the latex emulsion shall be submitted to the Design Builder's Quality Manager daily for each lot of material used in a day's production.
  - A lot is defined as.... Sampling shall be in accordance with... The analysis to be performed is.... The tolerance between the QC test and verification test will be.....
  - The Owner will randomly select one sample weekly and perform the verification tests listed in Table XYZ

# Define “So What”

For example:

- If the Design Builder does not stay within the upper and lower PWL for 2 consecutive days, then process will stop and Design Builder will perform an investigation. Upon providing the investigation results to the owner, the Design Builder may begin production at a testing frequency of twice designated in the frequency table, until he has accomplished 2 consecutive days tests within the PWL.
- Concrete beam average of two must exceed minimum requirements and the spread ration of the beams running average may not exceed 500psi. If the spread ration is exceeded the Design Builder shall halt production, investigate the issue, and resolve issues. Production will continue at a rate of 2 times the frequency guide until the spread ratio falls with in 500psi for two consecutive days.

# Example Requirements-TxDOT

Comprised of three components:  
Quality Control Program  
Acceptance Program  
Independent Assurance program

Describes process for:  
Contractor Acceptance (QA) Test  
Owner Validation (OV)

Based on FHWA requirements



[http://www.txdot.gov/business/contractors\\_consultants/materials.htm](http://www.txdot.gov/business/contractors_consultants/materials.htm)

# New Approaches?

- Allowance for Quality- do not make it part of the low bid
- Specify size of QC staff and exact program they will have for quality and let them bid on that.
- Pay DB more directly for quality, tell DB how to earn the pay
- In the proposal have the DB address their Quality program in terms of your(the owner's) risk
- More effective measures to clearly outline what happens if they do not perform. (increase sampling)
- Prior Performance-have DB submit OC curves from previous projects for various materials
- Consider differences in QA program based on types of specifications. Can reduce QC effort if a warranty is given.

# References

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- AASHTO Implementation Manual for Quality Assurance, Feb 1996
- J.L. Burati, R.M. Weed, C.S. Hughes, and H.S. Hill, FHWA-HRT-04-046 EVALUATION OF PROCEDURES FOR QUALITY ASSURANCE SPECIFICATIONS, October 2004
- NHI Course NO. 134042 Materials Control and Acceptance- Quality Assurance, Publication NO. FHWA NHI-02-022.
- CHARLES S. HUGHES, NCHRP Synthesis 346 State Construction Quality Assurance Programs, 2005.
- J. L. Burati, R. M. Weed, C. S. Hughes, H. S. Hill FHWA-RD-02-095 Optimal Procedures for Quality Assurance Specifications

# Questions?

For Further Information Contact...  
Katherine Holtz,  
[k.holtz@delcan.com](mailto:k.holtz@delcan.com)