



# Connecticut DOT & Industry Design-Build Workshop

## **PROJECT QUALITY ASSURANCE**

Presented by:

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**August 26, 2013**

**Newington, CT**



# Module Overview

- 1) QA Terminology and Responsibilities**  
(States and Industry not aware of current terms & roles)
- 2) D-B Procurement: QA Requirements in RFP**  
(Requirements often Not Clear in RFP and Contract)
- 3) Design QA: QC vs. Acceptance**  
(Recommended practices / Items to consider)
- 4) Construction QA: FHWA TechBrief (April 2012)**  
(23 of 60 RFPs examined, could not determine Acceptance responsibility – TRR 2081)





# Part 1

## Quality Assurance Terminology and Responsibilities





# Quality Assurance Definition

## AASHTO R10 & TRB Circular E-C173

**Quality Assurance** – *“(1) All those planned and systematic actions necessary to provide confidence that a product or facility will perform satisfactorily in service; or (2) making sure the quality of a product is what it should be ...*

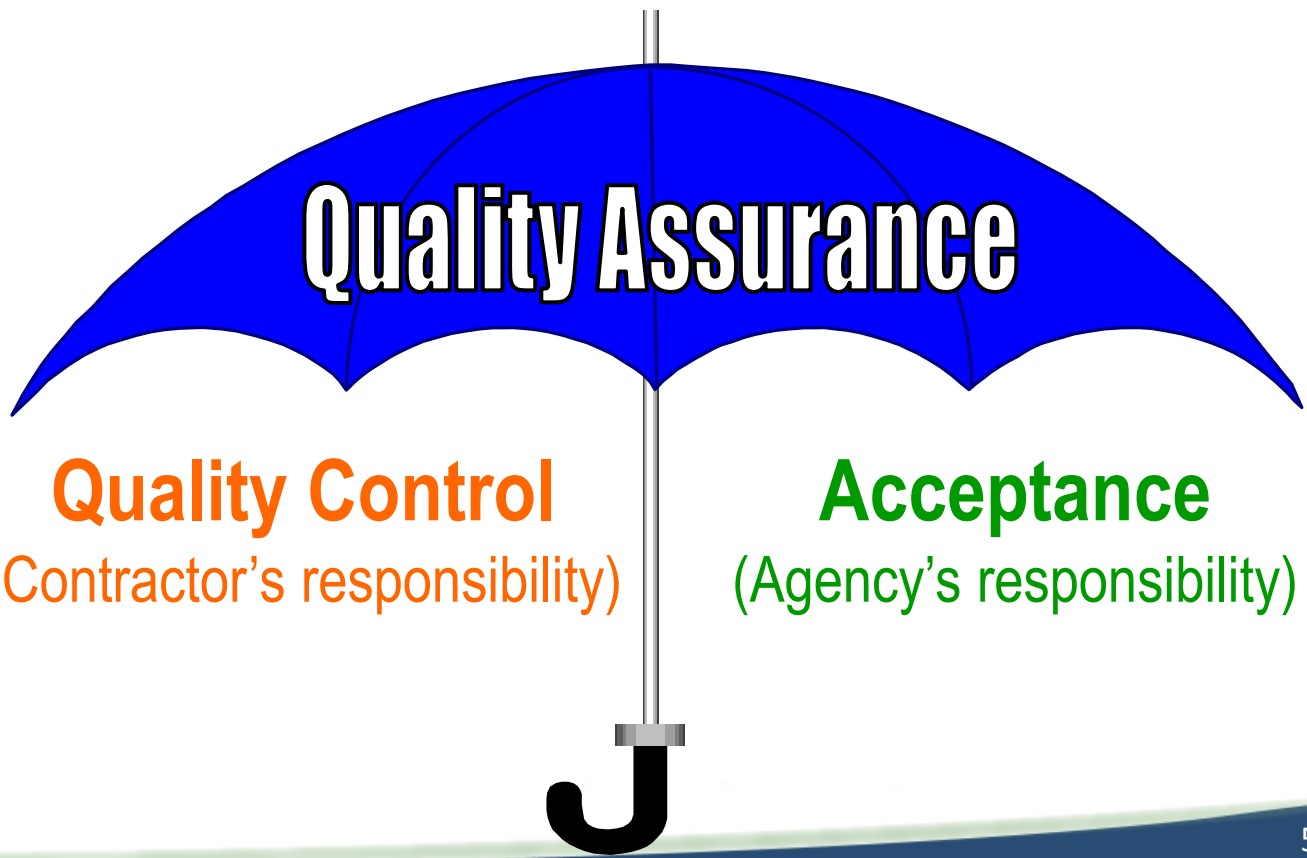
*The use of the term QA/QC or QC/QA is discouraged and the term QA should be used”.*





# Correct Use of the Term “Quality Assurance”

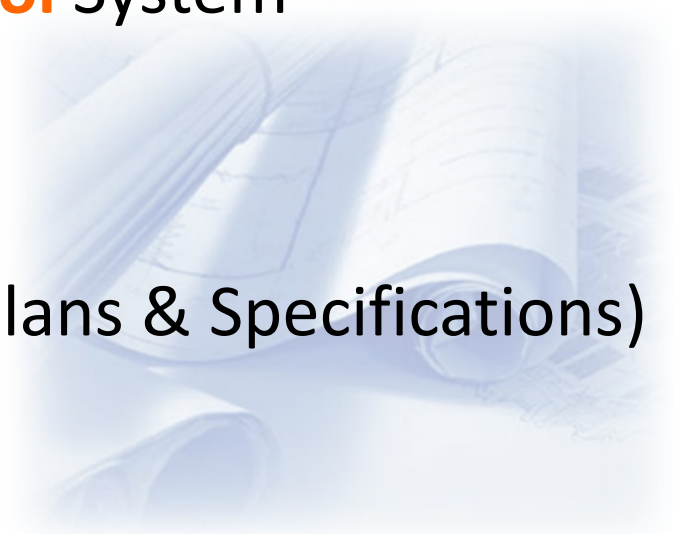
Per AASHTO, ANSI, ASQ, FHWA, NCHRP, TRB:





# Design-Builder's Responsibility

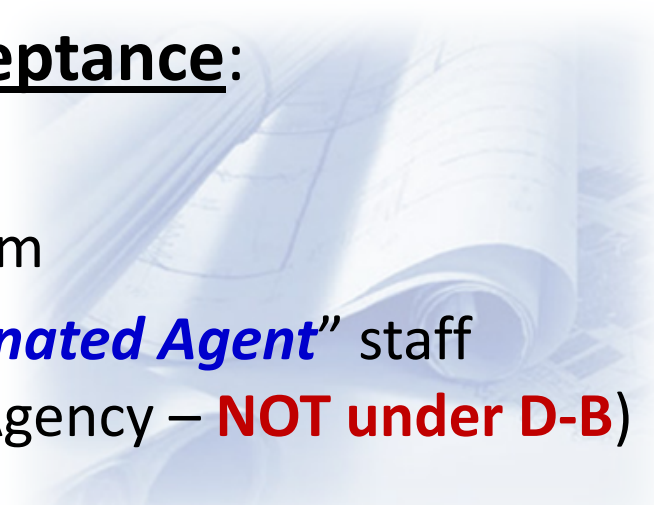
- Provide Quality Control (QC):
  - **Design Quality Control** System
  - **Construction Quality Control** System
- Complete Preliminary Design
- Prepare Final Design
- Issue Construction Documents (Plans & Specifications)
- Construct Project





# Agency's Responsibility

- Develop Concept/Preliminary Design (Pre-RFP)
- Establish Design criteria & Construction standards (in RFP and Contract)
- Provide Project Oversight & **Acceptance**:
  - **Design Acceptance** System
  - **Construction Acceptance** System
  - May augment staff with “**Designated Agent**” staff (Consultant under contract to Agency – **NOT under D-B**)





# Discussion - Questions

- QA Terminology
- Design-Builder Responsibility
- Agency Responsibility







# Part 2

## D-B Procurement:

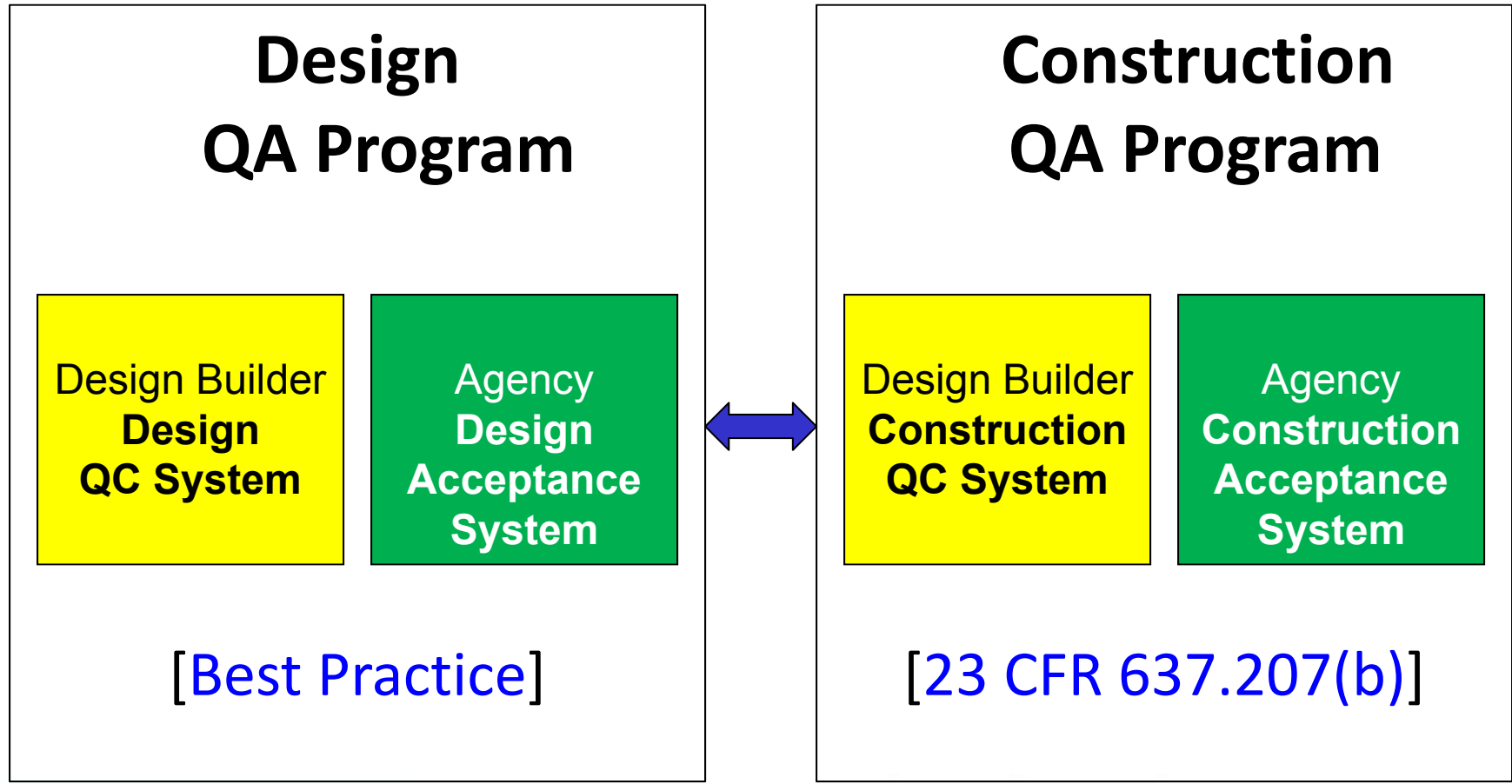
### QA Requirements in Request for Proposal (RFP)





# RFP

## QA Programs for Design-Build





# RFP

## Example Lead QC Personnel

**Design-Builder  
Quality Control Administrator**

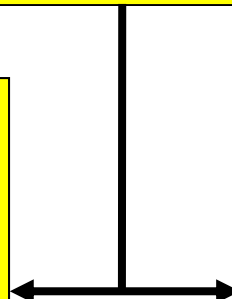
- Registered PE
- Minimum 10 Years Experience
- QA Training Certificate (NETTCP 1-Day Course)

**Design-Builder  
Design QC Manager**

- B.S. in Civil Engineering
- Min. 10 Years Experience
- QA Training Certificate (NETTCP 1-Day Course)

**Design-Builder  
Construction QC Manager**

- B.S. in Civil Engineering
- Construction QA Technologist Certification (NETTCP 3-Day)





# RFP

## D-B Quality Management Plan (QMP)

- Recommended practice to require single comprehensive Design-Builder QMP:
  - Documents all QC requirements and procedures (both **Design QC** & **Construction QC**)
  - Removes potential “stove-piping” between Design and Construction
- Should be reviewed and accepted by the Agency prior to starting work

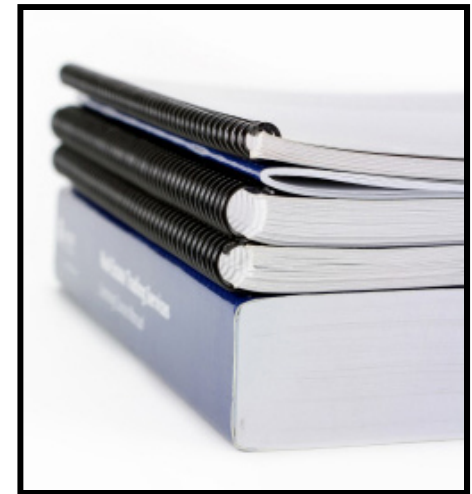




# RFP

## Design Quality Control Plans

- Agency may require QC Plans for complex design activities or features (examples):
  - **Cable-Stay Bridge Design Elements**
  - **Storm Water Siphon System**
- Identify Design QC Plan format & contents in RFP
- All QC Plans approved by D-B QC Administrator and accepted by Agency





# RFP

## Construction Quality Control Plans

- Identify **Major Work Items** requiring QC Plans:
  - **Earthwork**
  - **Bridge Substructure Elements**
  - **Bridge Superstructure Elements**
  - **Architectural Elements**
  - **HMA/PCC Pavement**
- Specify standard QC Plan format
- All QC Plans approved by D-B QC Administrator and accepted by Agency

State Route 99 Construction Project  
Anytown, USA  
Transportation Agency Contract #54321

ABC Contractors, Inc.

**NETTCP  
MODEL QC PLAN**

Construction Quality Control Plan  
Section 1 - Earthwork

December 2, 2002 Draft

Submitted By: \_\_\_\_\_ Date: \_\_\_\_\_  
ABC Contractors, Inc.

Approved By: \_\_\_\_\_ Date: \_\_\_\_\_  
Transportation Agency

December 2002 PLOD



# QC for D-B Pilot Project

The DB Entity develops a Comprehensive Quality Management Plan (QMP)

- The QMP contains the QC procedures for all design and construction activities and interactions
- The Department accepts the plan
- The DB Entity implements the plan as written
- The plan is expected to be revised if needed with the concurrence/acceptance of ConnDOT



## QC System Objectives

- Ensure all elements of the project work meet or exceed the quality requirements set forth in the RFP and Contract
  - Place the responsibility for achieving design and construction quality on the DB Entity
  - Establish procedures for coordinating and ensuring consistency and quality of work





# DB Entity QC Personnel

- **Quality Control Administrator**
  - Responsible for overall management of the QC System
- **Design Quality Control Manager**
  - Responsible for implementation of all Design QC procedures and activities
- **Construction Quality Control Manager**
  - Responsible for implementation of all Construction QC procedures and activities



# ConnDOT Responsibilities

- Review and acceptance of the QMP
- Monitor and ensure compliance with the QMP
- Participate in revision of the QMP if necessary
- Perform Design and Construction Acceptance activities



# Discussion - Questions

## D-B Procurement - RFP:

- D-B Entity QC Requirements
- Agency Acceptance Criteria





# Part 3

## Design Quality Assurance: Design-Builder QC System & Agency Acceptance System





# Design-Builder Design QC System

**Design  
Production  
Team**  
(Frontline QC)

**Design  
QC Team**  
(Formal QC)

## Informal QC (by Frontline Design Staff)

- QC “Self-Check” Activities
- Coordination Activities with Construction

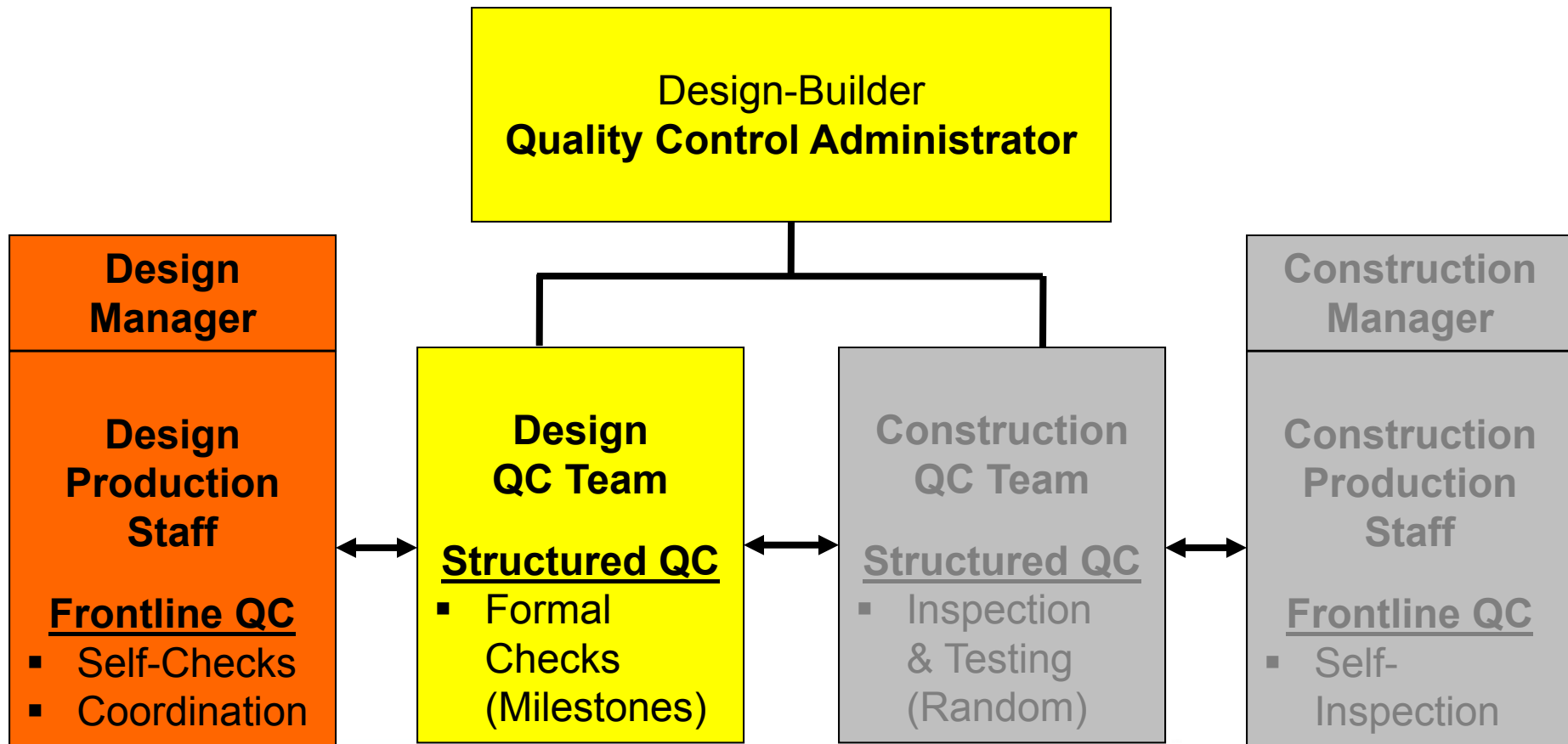
## Formal QC (by Design QC Staff)

- Inter-discipline Reviews
- Independent Structural Design Checks
- Design Package Review at Key Milestones  
(e.g., 75%, 100%)





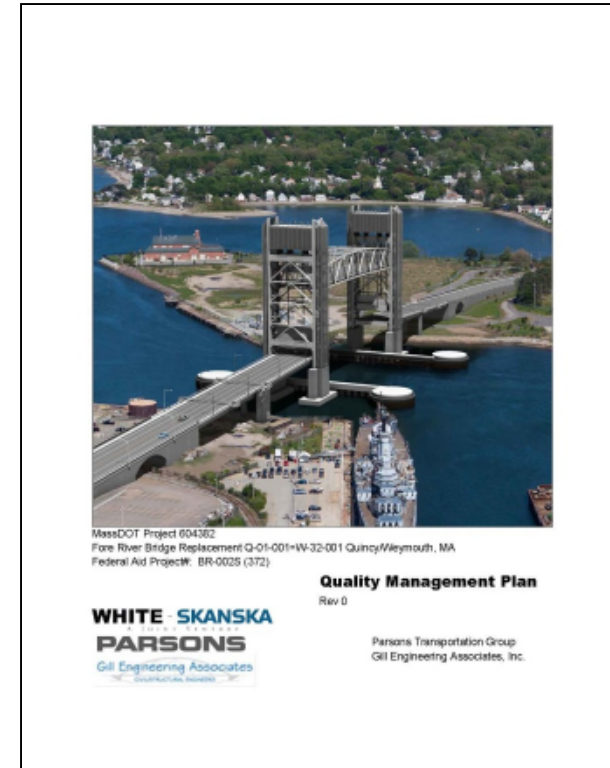
# Design QC Structure





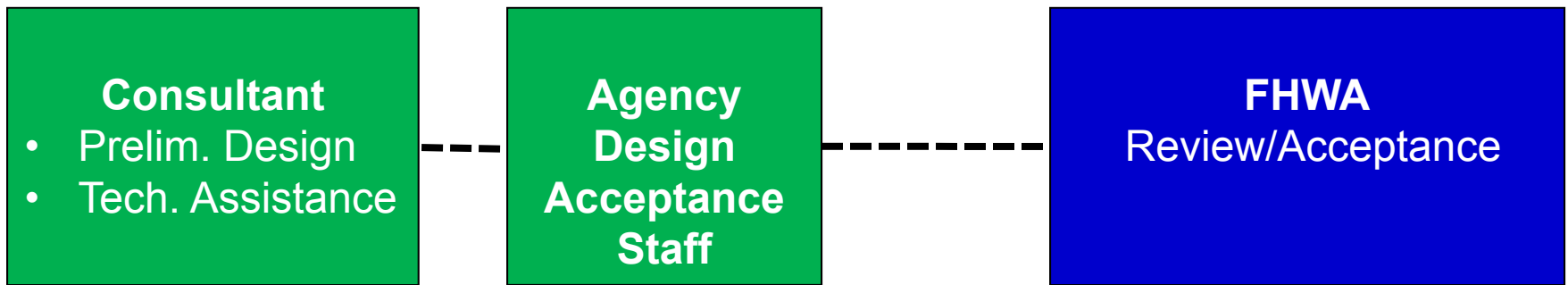
# Quality Management Plan (QMP)

- Documents all QC requirements and procedures (both **Design QC** & **Construction QC**)
- Recommended Sections:
  1. Introduction
  2. QC Organization & Roles
  3. Document Management Procedures
  4. **Design QC Procedures**
  5. Construction QC Procedures





# Agency Design Acceptance System



## In-Progress Acceptance Activity (by Agency & FHWA Staff)

- “Over-the-Shoulder” In-Progress Design Reviews / Audits

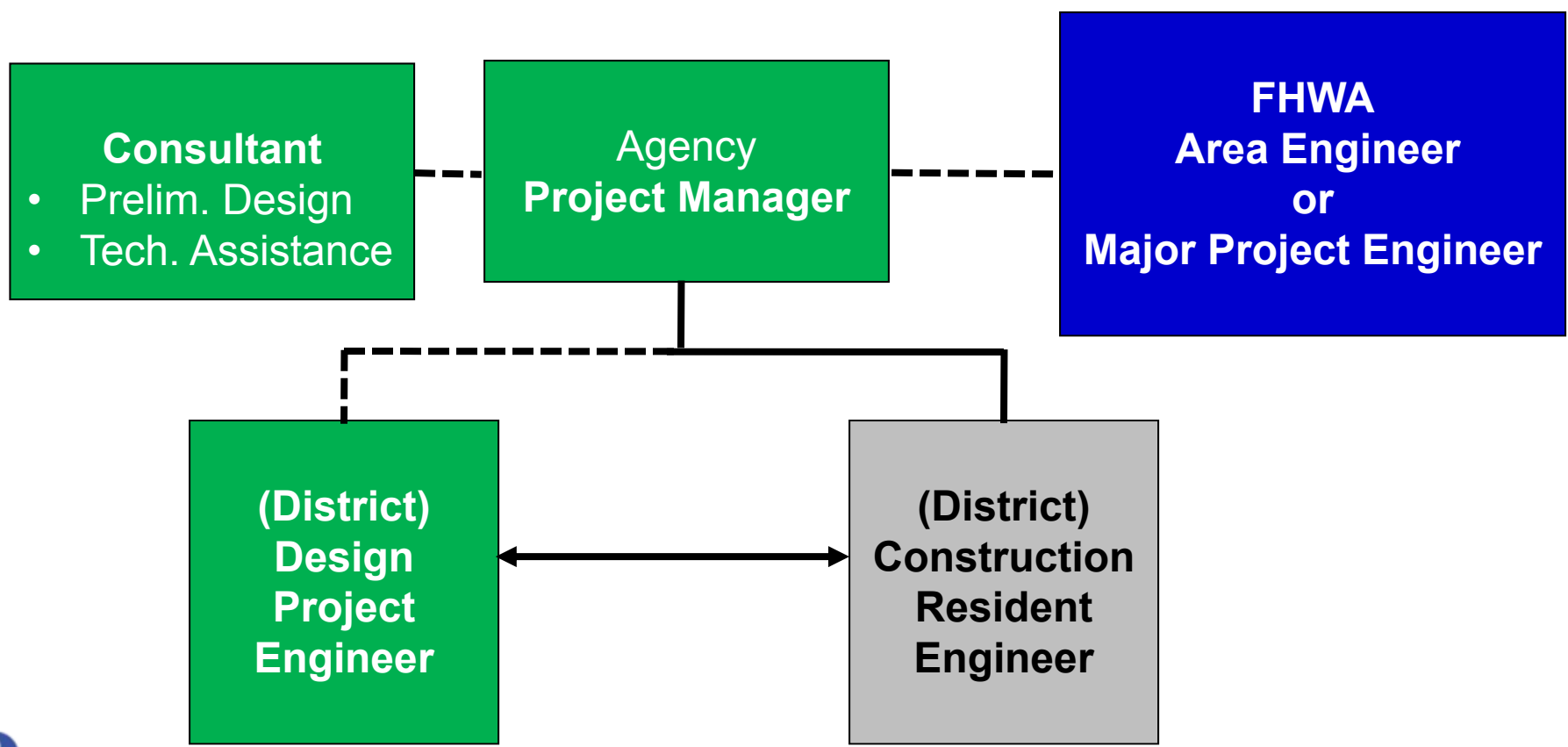
## Formal Acceptance (by Agency & FHWA Staff)

- Structure Type/Size/Location
- Design Packages - Formal Milestone Review & Acceptance  
(e.g., 75% Design, 100% Plans & Specs, Release for Const. Packages)





# Recommended Design Acceptance Staff





# Design Quality Process

- Quality Management Plan (QMP)**
  - Discipline Checklists
  - Designer QC process – checker, back checker
  - Inter-discipline review / Constructability review
  - Independent structural design check
  - Design QC Team (formal QC process)
  - Independent design input verification
  - Agency / 3<sup>rd</sup> party review
  - Comment Resolution



# Design Quality Process

- Quality Management Plan (QMP)**
  - Interim review (40-60%)
  - Final review (100%)
  - Released For Construction (RFC)
  - Notice of Design Change (NDC)
  - Field Design Change (FDC)
  - Request For Information (RFI)
  - Request For Information – Owner (RFIO)
  - As-built Record Plans



# ConnDOT Design Responsibilities

- Monitor DB Entity QC activity
- Design Acceptance actions



# Discussion - Questions

## Design Quality Assurance:

- Design-Builder QC System
- Agency Acceptance System
- Design Quality Issues





# Part 4

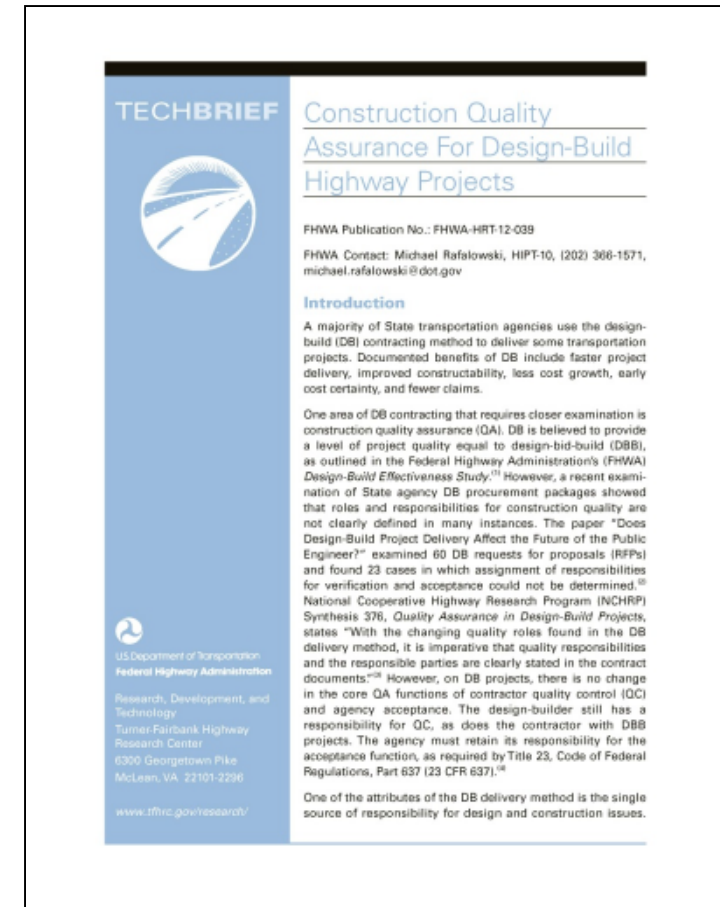
## Construction Quality Assurance: FHWA TechBrief (April 2012)





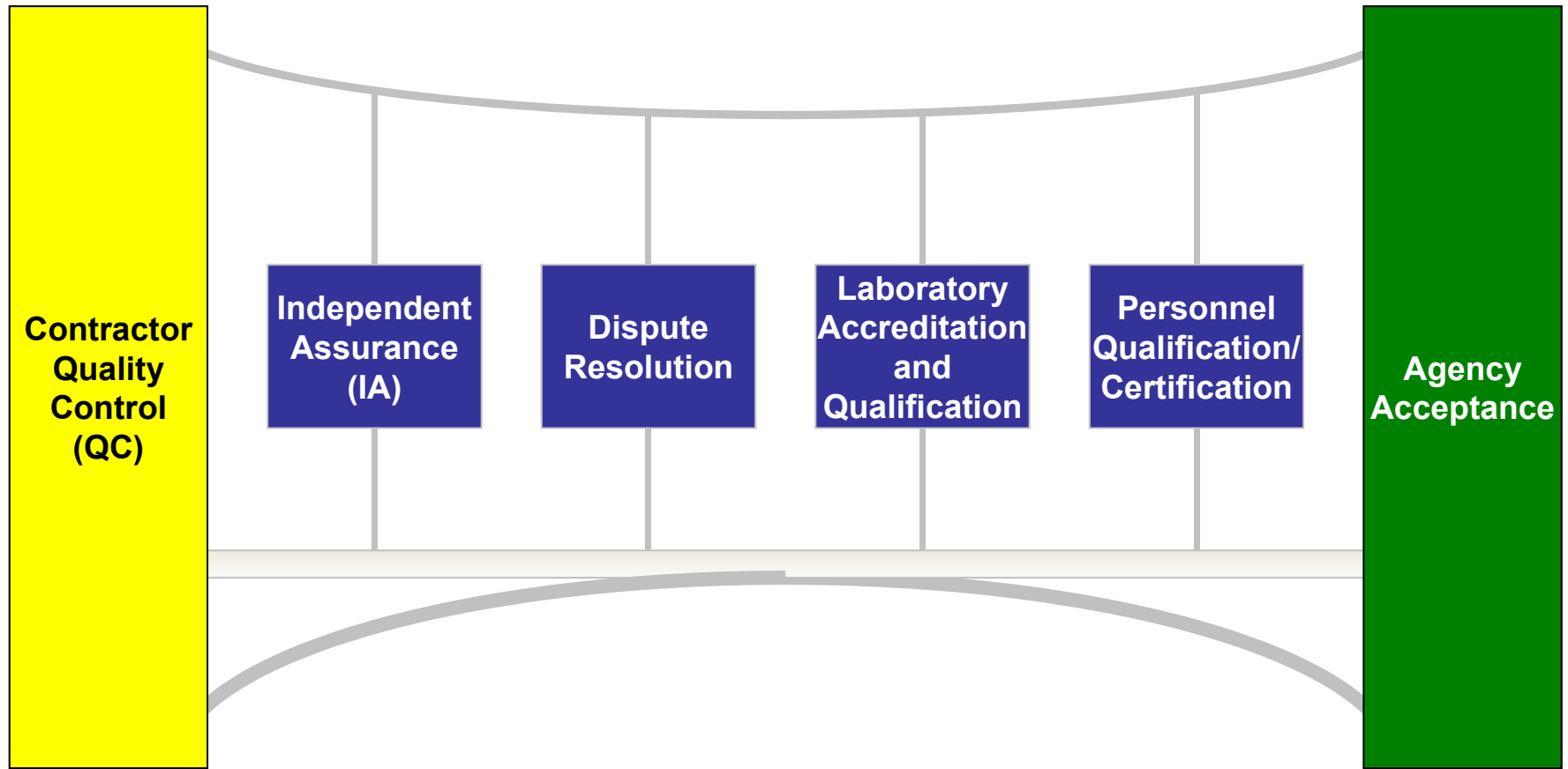
# Construction QA TechBrief (April 2012)

- **Quality Assurance (QA):**  
(**NOT** specific role of one entity)
- Design-Builder **Quality Control (QC)**
- Agency **Acceptance**
- Agency **Independent Assurance (IA)**





# Construction QA Program Core Elements







# Design-Builder Construction QC System

## Informal QC (by Frontline “Production” Staff)

- QC “Self-Inspection” Activities

## Formal QC (by Construction QC Staff)

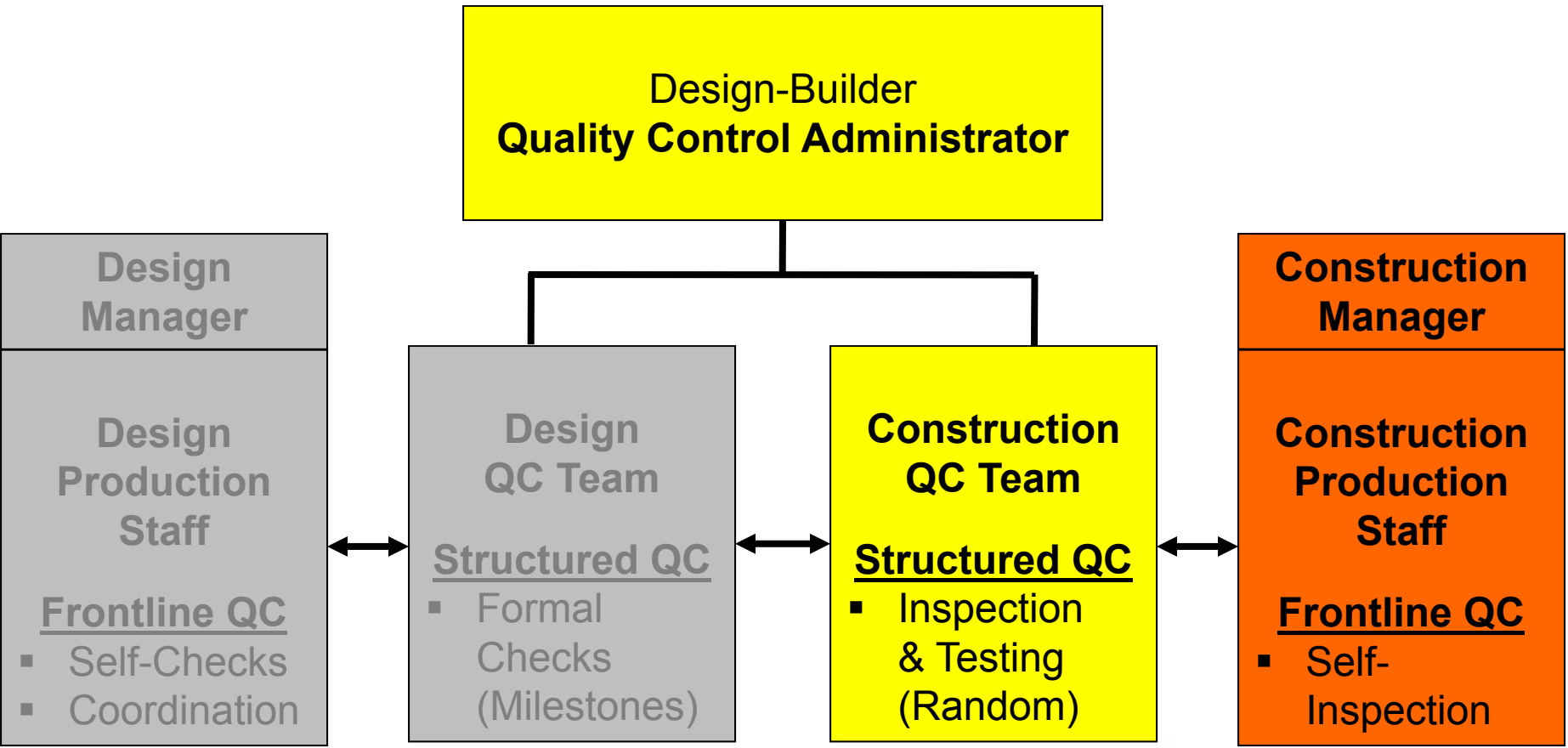
- QC of Project Produced Items
- QC of Fabricated Structural Items
- QC of Standard Manufactured Items
- Accredited/Qualified QC Laboratories
- Qualified/Certified QC Personnel

**Construction  
Production  
Team**  
(Frontline QC)

**Construction  
QC Team**  
(Formal QC)



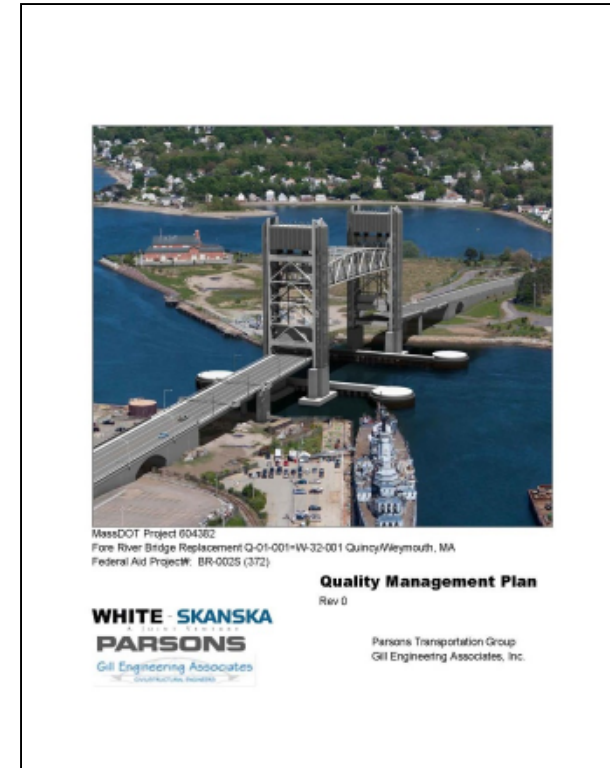
# Construction QC Organization





# Quality Management Plan (QMP)

- Documents all QC requirements and procedures (both **Design QC** & **Construction QC**)
- Recommended Sections:
  1. Introduction
  2. QC Organization & Roles
  3. Document Management Procedures
  4. Design QC Procedures
  5. **Construction QC Procedures**





# QMP

## 5.0 – Construction QC Procedures

- **Project Produced Materials**
  - QC Inspection Schedules (Attributes, Lot/Sublot Sizes)
  - QC Testing Schedules (Quality Characteristics, Lot/Sublot Sizes)
  - QC Documentation & Data Analysis
- **Fabricated Structural Materials**
  - Fabricator QSMs (Fabricator QC Inspection & Testing)
  - Project Site QC (Inspection & Testing Schedules)
- **Standard Manufactured Materials**
  - Manufacturer QSMs - AASHTO R38 (QC Inspection & Testing)
  - Project Site QC (Review of Manufacturer COCs)
  - QC Inspection (at Delivery, during Storage & Installation)





# QMP

## 5.0 – Construction QC Procedures

### Construction QC Plans

- Document project-specific Construction QC requirements for **Major Work Items**:
  - **Earthwork**
  - **HMA/PCC Pavement**
  - **Drilled Shafts**
  - **Bridge Superstructure**
  - **Architectural Elements**

State Route 99 Construction Project  
Anytown, USA  
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**NETTCP  
MODEL QC PLAN**

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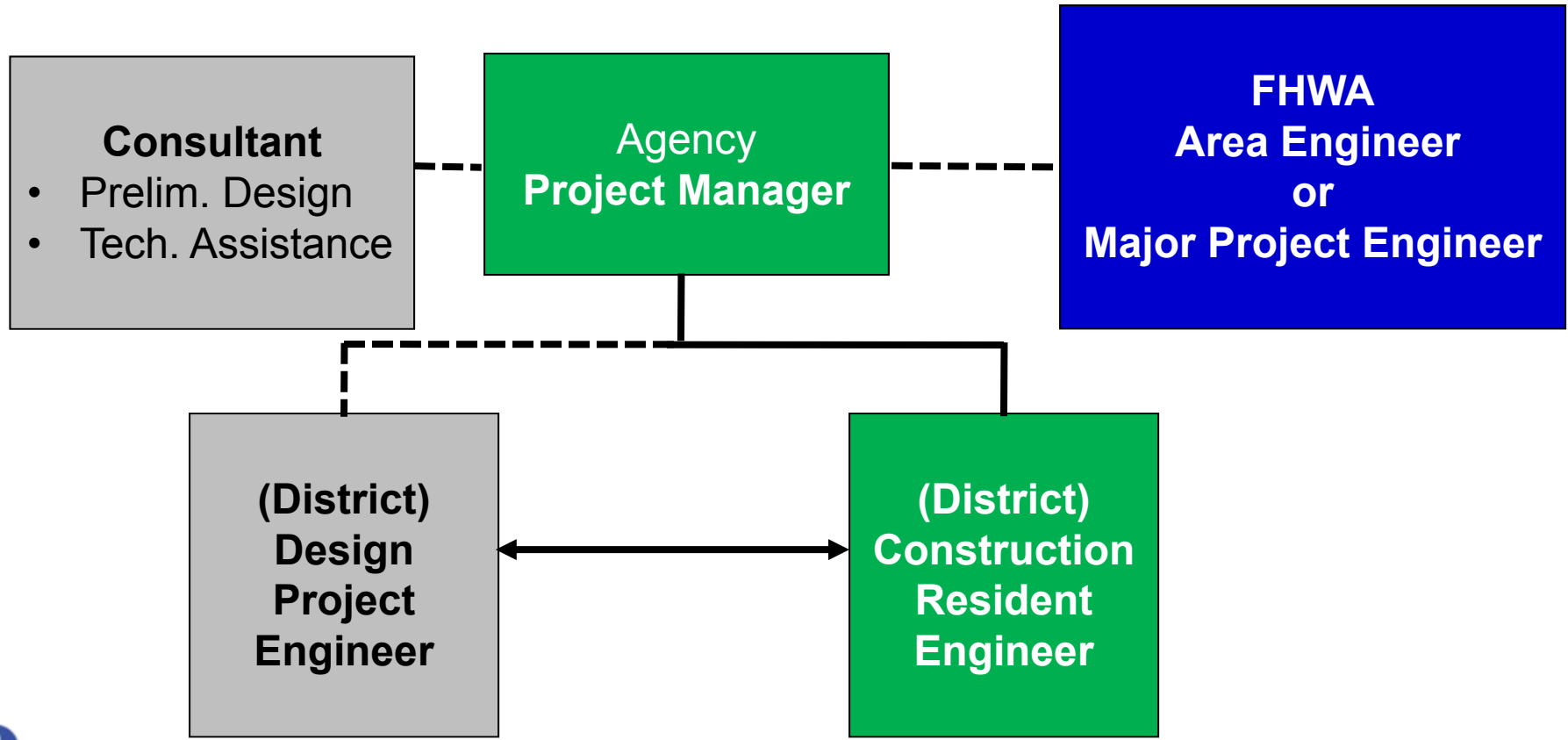
# Agency Construction Acceptance

- All acceptance activities must be carried out by the **Agency** or their “*Designated Agent*”
- Agency independently performs:
  - Acceptance Inspection
  - Acceptance (Verification) Testing
- Agency personnel Monitor/Audit Design-Builder QC activities:
  - Verify compliance with Quality Mgmt. Plan and QC Plans

Agency  
Construction  
Acceptance  
Staff



# Example Agency Acceptance Staff





# Inspection Attributes

- **Attributes** to be **inspected** which reflect quality of finished product **[637.207(a)(1)(i)(C)]**
- Attributes for:
  - **D-B Quality Control**
  - **Agency Acceptance**







# Inspection Attributes - Examples

Inspection Component	Quality Control Inspection Attributes	Acceptance Inspection Attributes
Equipment	Mixer Drum Blade Condition	N/A
	Vibrator Frequency	N/A
	Finishing Machine Settings	N/A
Environmental Conditions	Form Cleanliness	N/A
	Temperature of Air & Contact Surfaces	N/A
Materials	Aggregates & Cementitious Material (Correct Type)	Aggregates & Cementitious Material (Correct Type)
	Admixtures (Correct Type & Dosage)	Admixtures (Correct Type & Dosage)
	Epoxy Reinforcement Bar (Correct Type / Damage to Coating)	Epoxy Reinforcement Bar (Correct Type / Damage to Coating)
Workmanship	Form Dimensions	Form Dimensions
	Reinforcement Bar Layout	Reinforcement Bar Layout
	Finished Dimensions	Finished Dimensions
	Surface Defects (Honeycombing, Cracking)	Surface Defects (Honeycombing, Cracking)



# Testing Approaches for Acceptance

- Two general approaches:
  - A. Use Agency Acceptance (Verification) test data only for the acceptance determination
  - B. Include Validated Contractor QC test data in the acceptance determination





# Testing Frequency

- **Design-Builder Quality Control**
  - Test each Sublot per Lot
- **Agency Acceptance (Verification)**

## Approach A (Agency data only):

- Test each Sublot per Lot

## Approach B (Agency data + Validated QC data):

- Test only some Sublots per Lot (e.g. 25% - 50%)
- For very large Projects/Lots, some Agencies have used 10% - 20% frequency





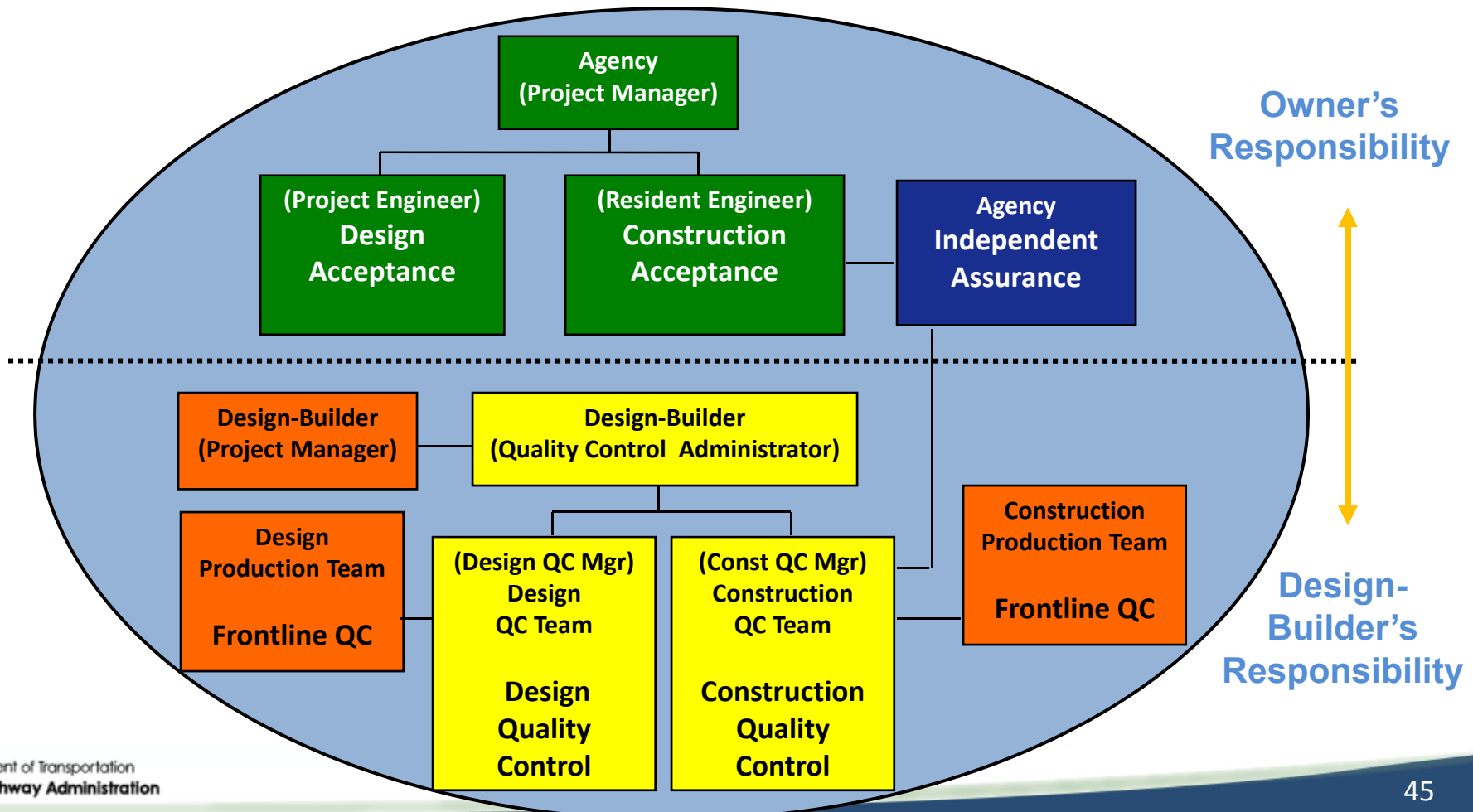
# Independent Assurance

- Performed by Agency or Designated Agent **personnel** who are **not directly responsible for project Acceptance** sampling and testing or inspection
- Provides periodic independent evaluation of QC and Acceptance personnel and their equipment
- **Not used to make a determination of work quality or acceptability**





# Example DB Project QA Organization





# Construction Quality

## D-B Quality Management Plan

- ✓ Pre-activity Work Plan
- ✓ Quality Task Force Meetings
- ✓ Mimic Safety Program success factors
- ✓ Sub-contractor Quality management
- ✓ Build pride in workmanship

## NOT

- ✓ “It’s good enough.”
- ✓ “We don’t have time for inspection or testing.”



# Material Sampling & Testing

- Purpose of Design-Builder QC sampling/testing
  - Ensure production/placement is “in control”
- Consistency of on-site material
- Statistical analysis of test data – risk of failure
- Concrete strength – 7 day vs. 28 day results
- Qualified Product List – or Approved Equal
- Reduced Agency sampling & testing rate?
  - (Typical 25-50% - Very large quantities may see 10-20%)



# Inspection of Workmanship

- Who should be inspecting work?
  - Foreman – completing standard checklist
  - QC Team Inspector – Daily Inspection Report
  - Agency managed CEI – or Agency staff
- Quality Check Point – Pass or Fail
- How much ‘Inspection’ is needed?
- Collect DATA to build confidence





# Construction Quality Wrap-Up

- Partnering between Agency and Design-Builder is the biggest boost to Quality
- Everyone has a role to play – understand your role and don't duplicate





## ConnDOT

# Construction Responsibilities

- Construction Acceptance actions
  - Monitor DB Entity QC activity
  - Inspection
  - Testing
- Independent Assurance (IA)
  - By ConnDOT Division of Material Testing
- Dispute Resolution system



# Discussion - Questions

## Construction Quality Assurance:

- Design-Builder QC System
- Agency Acceptance System
- Agency Independent Assurance
- Construction Quality Issues





# Summary ConnDOT Pilot Approach

- Promote DB Entity QC Procedures
- Provide sufficient data to ensure quality
- Review success and failures to improve future projects



**Thank You**