Outline

1. The need for QA/QC
2. Definitions
3. QC as it applies to bridge design
4. QA for the Bridge Division – Design Section
5. Records retention
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So, why do we care about Quality Assurance & Quality Control?
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I-35W Bridge Over the Mississippi River

August 1st, 2007
NTSB Highway Accident Report

• Probable Collapse Causes
  – Insufficient bridge design firm quality control
  – Lack of guidance on placement of construction loads
  – Exclusion of gusset plates in load rating
  – Lack of inspection guidance
  – Inadequate use inspection technology
NTSB Highway Accident Report

- Probable Collapse Causes
  - Insufficient bridge design firm quality control
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NTSB Highway Accident Report

Report Recommendations

- Implement a design QA/QC program
- Require load ratings of new bridges
- Evaluate gusset plates in load rating
- Control construction activities to avoid overloading structures
NTSB Highway Accident Report

• Report Recommendations
  – Implement a QA/QC program
  – Require load ratings of new bridges
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New London, Texas School Explosion

- March 18, 1937
- Natural gas explosion
- 300 deaths
- Resulted in the Engineering Registration Act, now rewritten as the Texas Engineering Practices Act
Route 35 Silver Bridge Collapse

- December 15, 1967
- Stress corrosion cracking in a non-redundant member
- 46 deaths
- In 1968 Congress passed the Federal Highway Act: US Code Title 23 Section 151 that set forth the requirement to establish National Bridge Inspection Standards (NBIS)
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quality (qual-i-ty) /ˈkwɒlətē/

the standard of something as measured against other things of a similar kind; the degree of excellence of something; general excellence of standard or level
assurance (as-sur-ance) /əˈSHooəns/  

a positive declaration intended to give confidence; a promise; confidence or certainty in one’s own abilities
control (con-trol) /kənˈtrōl/

the power to influence or direct people’s behavior or the course of events; the restriction of an activity, tendency, or phenomenon
What’s the difference?

Quality Assurance
• The planned and systematic activities implemented in a quality system so that quality requirements for a product or service will be fulfilled

Quality Control
• The observation techniques and activities used to fulfill requirements for quality
What’s the difference?

Quality Assurance
• QA is a **failure prevention system**
• QA **defines** the standards/methodology
• QA activities are done **before** the product is manufactured

Quality Control
• QC is a **failure detection system**
• QC **ensures** that the standards are followed
• QC activities are done **during** the manufacturing process
What’s the difference?

Quality Assurance
• QA is \textbf{process} oriented
• QA \textbf{makes sure} you are doing the right things, the right way
• QA tasks are \textbf{conducted by} managers

Quality Control
• QC is \textbf{product} oriented
• QC \textbf{makes sure} the results of what you've done are what you expected
• QC tasks are \textbf{executed by} experts who are directly involved with the design
Behold the BRG QA/QC Guide!

Stated Goals

• **Communicate openly** to solve problems immediately
• **Plan, coordinate, supervise**, and provide technical direction
• **Employ skilled personnel** to produce a quality product
• **Produce quality work** through review and checking by individuals not directly responsible for the initial work product
• **Take responsibility** for the QA/QC of a project, regardless of role
Objective is to produce plans that:

- Are designed **free of errors and omissions**
- Contain all design elements to be **complete and thorough**
- Are **appropriately designed**
- **Conform** to the policies and procedures defined in the relevant TxDOT manuals, and to the guidelines on the TxDOT website
- **Clearly define** the sources of information for the calculations and the interface with related documents
- Result in **constructible plans**
Participants, BRG Style

- Supervisor/Group Leader
- Design Engineer
- Checker
- Technician
- Engineer-of-Record
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How do we get Quality Control in bridge design?

- **Designer**
  - Prepare relevant, appropriate calculations and sketches
  - Present the calculations and sketches in a neat and logical manner that is conducive to checking
  - Conform the calculations and design sketches to the policies and procedures defined in the relevant TxDOT Manuals
  - Perform all calculations on TxDOT calculation sheets, on spreadsheet equivalents or with TxDOT approved software
How do we get Quality Control in bridge design?

• **Checker**
  - Check each component to ensure compliance with the policies defined in TxDOT Manuals and guidelines on the TxDOT website
  - Check the calculations for internal consistency and traceability of sources
  - Check the calculations, assumptions, given values, formulas, omissions, and accuracy
  - Check methodology, reasonableness of results, and constructability
Close the Loop

Design

Designer

Check

Correct

Verify

Checker
What about the Plan Sheets?

• **Technician**
  – Develop all details in accordance with Bridge Detailing Manual and applicable Bridge Division policies and practices

• **Designer**
  – Check the details for completeness, technical adequacy and conformity to applicable standards, and for consistency with the corresponding calculations
  – Check individual drawings using appropriate checklists for errors, completeness, conformance, and consistency
Close the Loop, deux

Check → Designer → Technician → Correct

Detail

Verify
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Quality Assurance

- The supervisor/group leader **is responsible** for Quality Assurance.
- The supervisor/group leader **confirms the QC process** by reviewing the QC cover sheet and the detail title block.
- The supervisor/group leader **completes a review** of the details for constructability, applicability, completeness, and conformity.
Quality Control Cover Sheet

<table>
<thead>
<tr>
<th>Patient</th>
<th>Location</th>
<th>Name</th>
<th>Diagnosis</th>
<th>Plan</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>John Doe</td>
<td>Hospital A</td>
<td>John</td>
<td>Cancer</td>
<td>Surgery</td>
<td>12/01/2023</td>
</tr>
</tbody>
</table>

Figure 1: Quality Control Cover Sheet

QA/QC Guide 12 August 2013

Texas Department of Transportation
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Records

- Design Request Submittal
- Correspondence
- Calculations
- Details
- Any other documents required for design, such as existing plan sheets and review comments
Design Notes Required

- Calculations establishing the bridge’s superstructure design satisfies controlling load cases and limit states for:
  - Girders or beams
  - Stringers
  - Floor beams
  - Trusses
  - Arches and hangers
  - Cable stays
Design Notes Required

• Calculations establishing the bridge’s substructure design satisfies controlling load cases and limit states for:
  – Cap beams
  – Columns, Towers, and Pylons
  – Other elements not specifically excluded
Design Notes Required

• Calculations establishing the bridge’s foundation design satisfies design requirements for
  – Piling
  – Drilled shafts
  – Spread footings
  – Other elements not specifically excluded
Design Notes NOT Required

- Elements excluded if per current TxDOT Manuals and standard drawings
  - Decks
  - Bearings
  - Railings
  - Expansion joints
  - Standard round columns if column height and diameter is within prescribed limits
  - Abutment design
  - Pile and/or Footing design
Questions?

Thanks for your attention.

Tom Stout  
TxDOT Bridge Division – Design  
512-416-2228