June 13, 2024

Welcome to Bridge Briefings

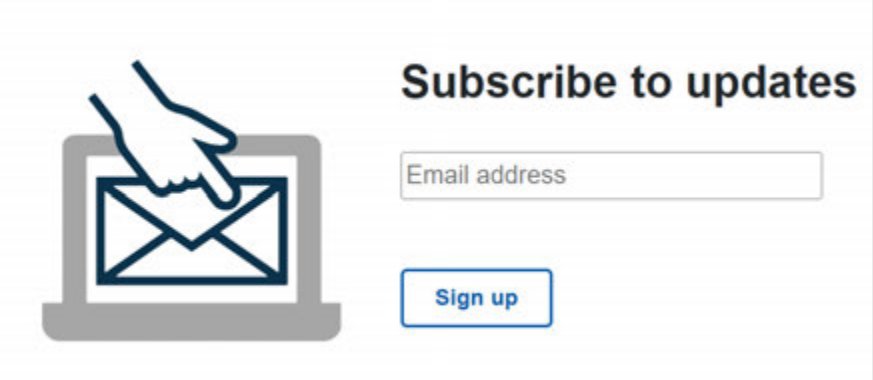
We will begin at 11:30 am

Reminders

- Place questions in the Q&A box and for us to answer at the end
- Slides will be posted on the Bridge Website

  https://www.txdot.gov/business/resources/highway/bridge/webinar-presentations.html
- Please sign up for updates here

  https://www.txdot.gov/about/divisions/bridge-division.html



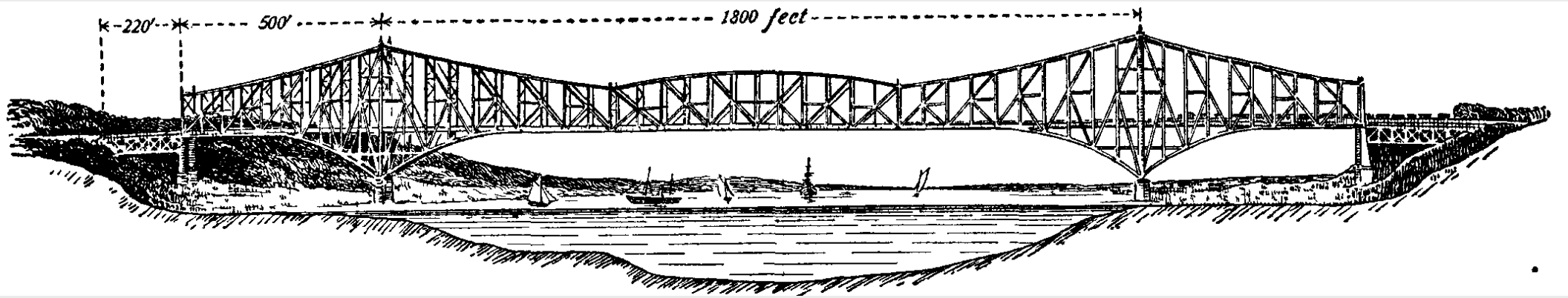
Results of FHWA QA/QC Audit

Robert Owens, P.E. – TxDOT Bridge Division

June 13, 2024

Quebec Bridge

Quebec City, Canada

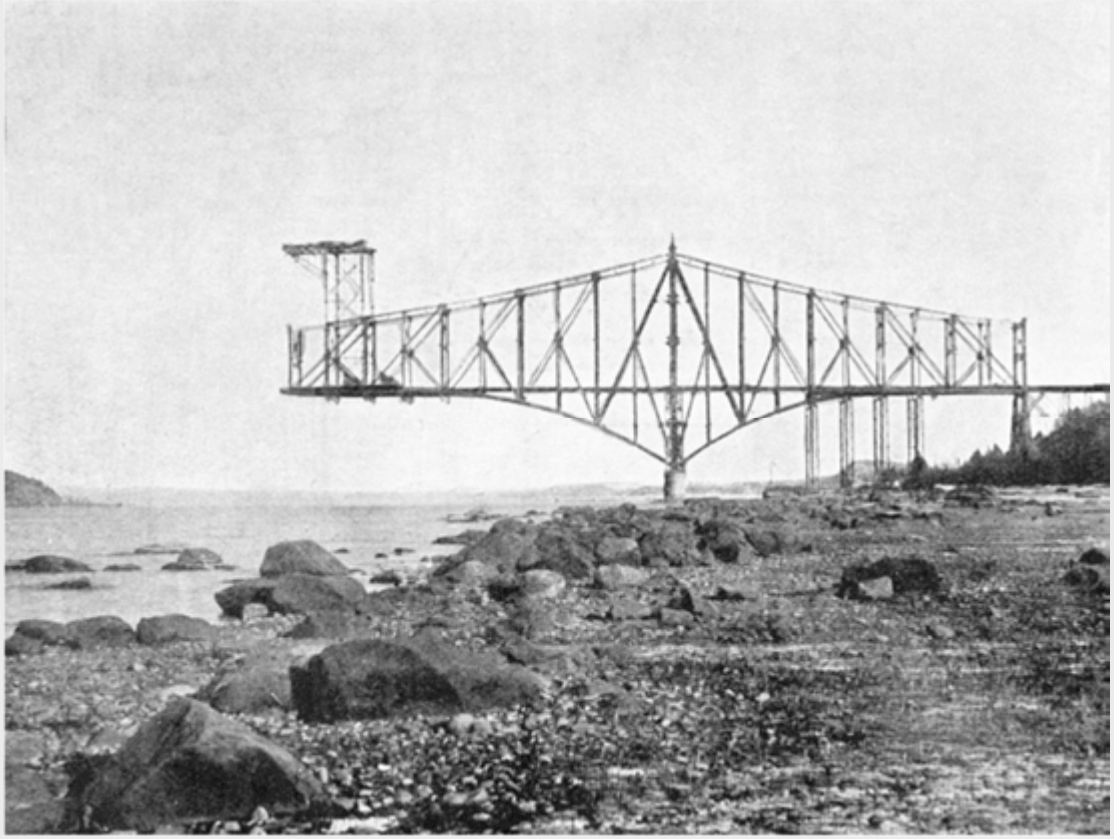


Quebec Bridge Drawing of Original Design
1903

Quebec City, Canada

Credit: Wikipedia

- By 1904, the Southern half of the structure was taking shape.
- However, preliminary calculations during the design were never checked.
- The bridge's own deadload was more than the load carrying capacity.
- By the summer of 1907 large deformations were noticed when the bridge was near completion.
- Quebec Bridge and Rail Company consulting engineer Theodore Cooper, who at first replied that the problems were minor.
- Near quitting time on the afternoon of August 29, after four years of construction, the south arm and part of the central section of the bridge collapsed into the St. Lawrence River in 15 seconds.
- 75 workers were killed.

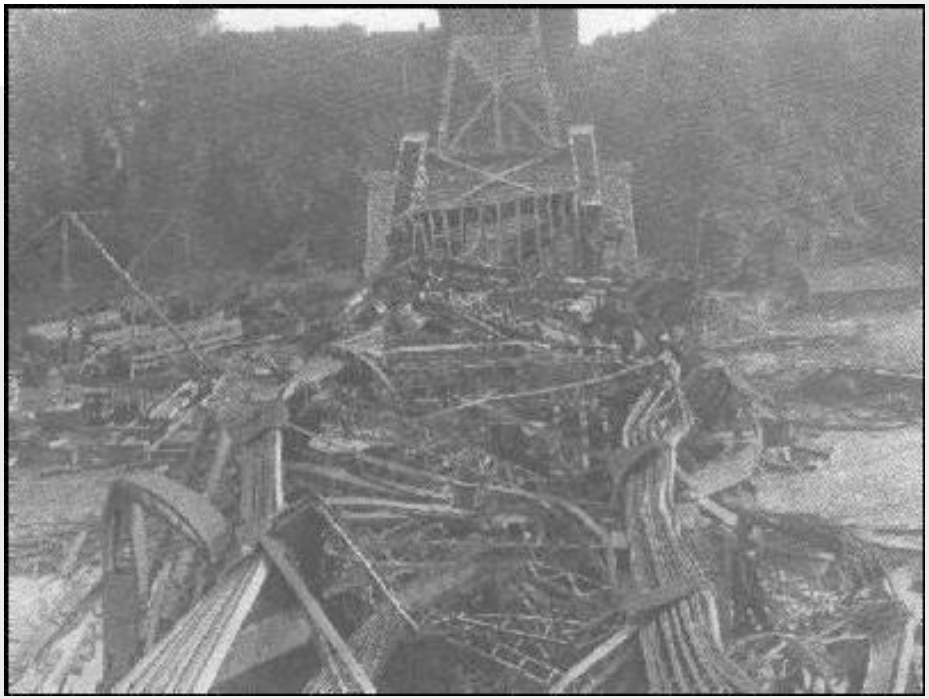


View of Cantilever Arm

Credit: Wikipedia

EDUCATION & CAREER

Disastrous Engineering Failures Due to Unethical Practices of Engineers



1907 Wreckage

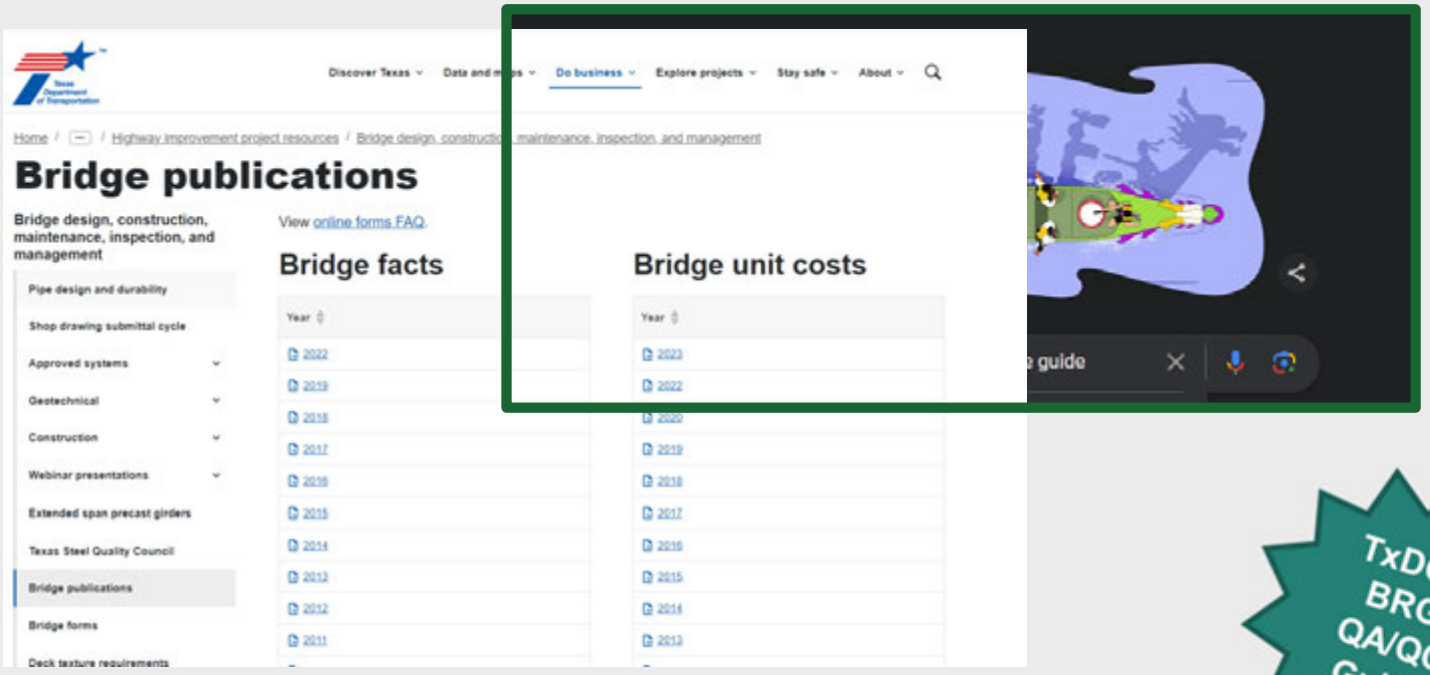
Credit: Wikipedia

TxDOT Quality Control and Quality Assurance Guide

Purpose

The Texas Department of Transportation (TxDOT) Bridge Division, Design Section has developed and implemented this **Quality Control** and **Quality Assurance** (QC/QA) guide to provide the highest **Quality Products** to TxDOT divisions and districts, other state agencies, federal agencies, consultants, and contractors.

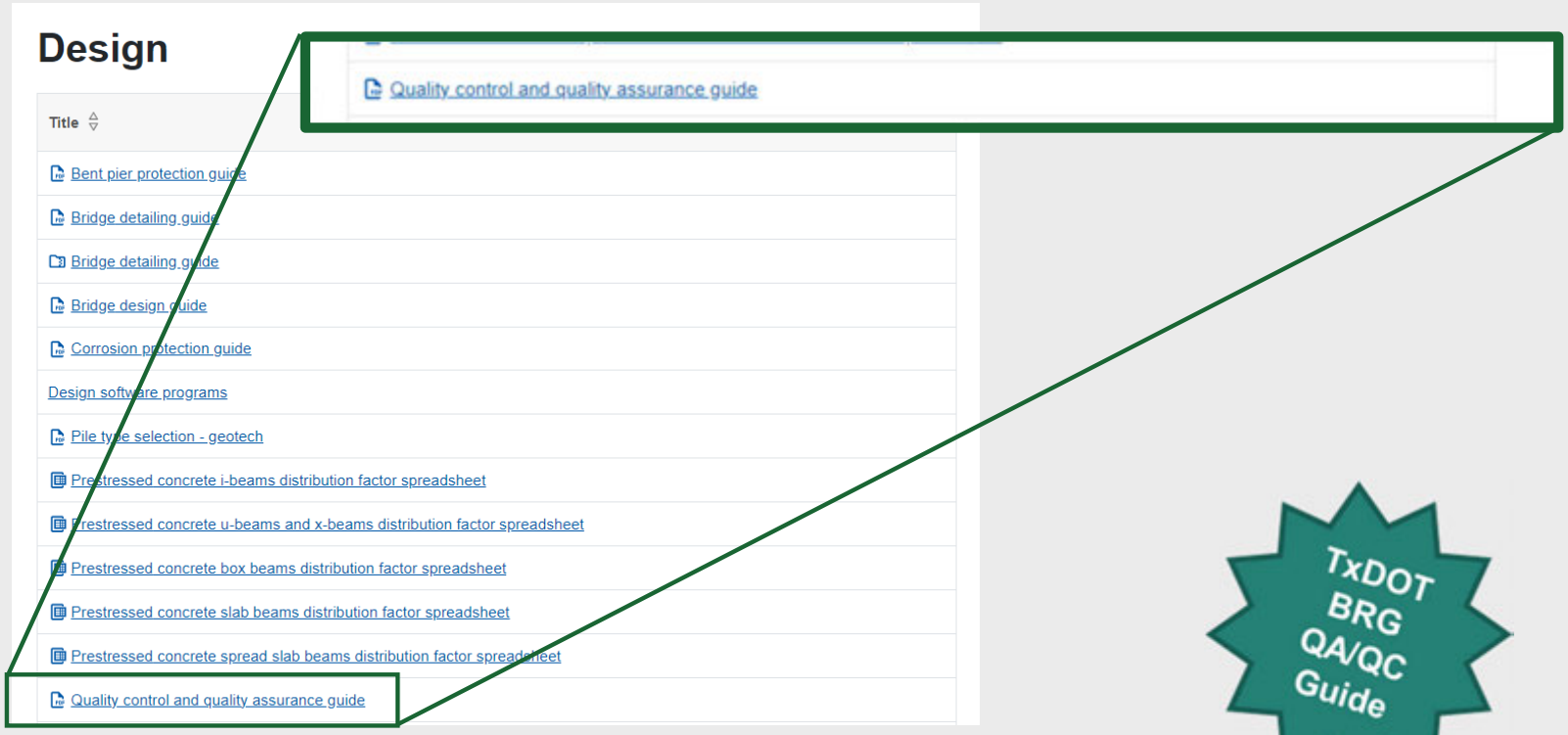
TxDOT Quality Control and Quality Assurance Guide



TxDOT BRG QA/QC Guide

https://www.txdot.gov/business/resources/highway/bridge/bridge-publications.html

TxDOT Quality Control and Quality Assurance Guide



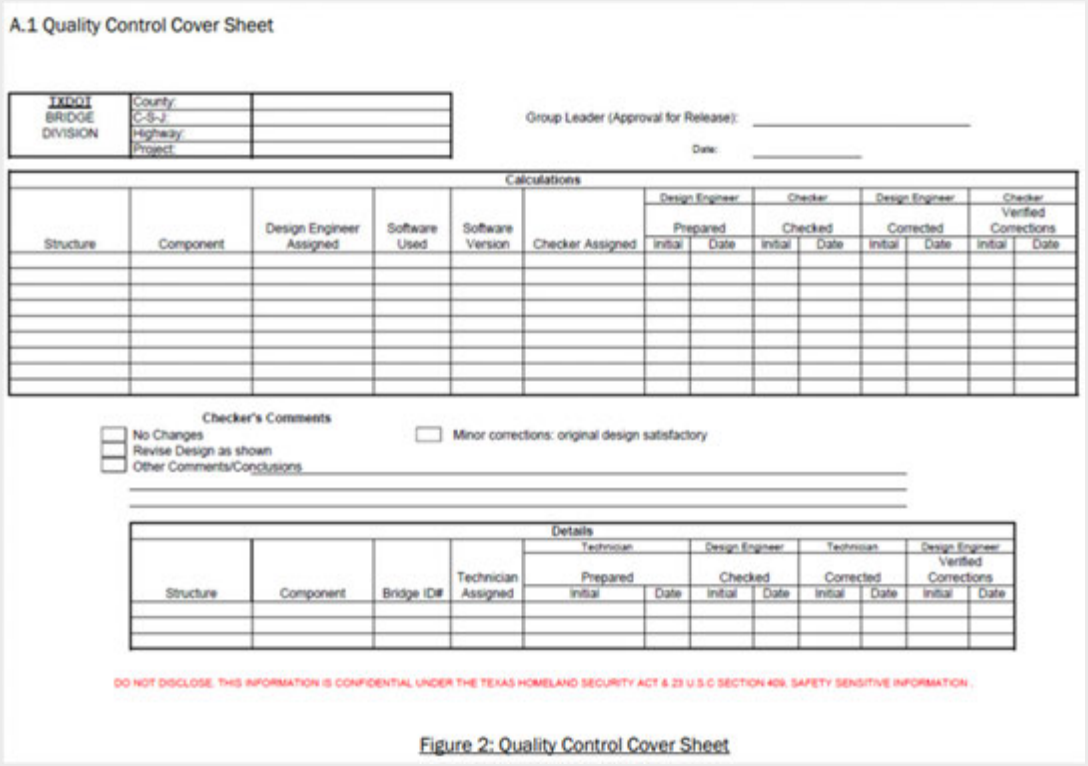
https://ftp.txdot.gov/pub/txdot-info/library/pubs/bus/bridge/qa_qc_guide.pdf

TxDOT Quality Control and Quality Assurance Guide

TxDOT Quality Control and Quality Assurance Guide

The Quality Control/Quality Assurance (QC/QA) program establishes the following goals:

- Communicate to address concerns and solve problems immediately.
- Plan, coordinate, supervise, and provide technical direction.
- Employ skilled personnel who perform their work with care 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.



A.1 Quality Control Cover Sheet

TXDOT BRIDGE DIVISION | County: | C-S-J: | Highway: | Project:

Group Leader (Approval for Release): _____ Date: _____

Calculations

Structure	Component	Design Engineer Assigned	Software Used	Software Version	Checker Assigned	Design Engineer Prepared Initial	Design Engineer Prepared Date	Checker Checked Initial	Checker Checked Date	Design Engineer Corrected Initial	Design Engineer Corrected Date	Checker Verified Corrections Initial	Checker Verified Corrections Date

Checker's Comments

☐ No Changes
☐ Revise Design as shown
☐ Other Comments/Conclusions

☐ Minor corrections: original design satisfactory

Details

Structure	Component	Bridge ID#	Technician Assigned	Technician Prepared Initial	Technician Prepared Date	Design Engineer Checked Initial	Design Engineer Checked Date	Technician Corrected Initial	Technician Corrected Date	Design Engineer Verified Corrections Initial	Design Engineer Verified Corrections Date

DO NOT DISCLOSE. THIS INFORMATION IS CONFIDENTIAL UNDER THE TEXAS HOMELAND SECURITY ACT & 23 U.S.C SECTION 409. SAFETY SENSITIVE INFORMATION.

Figure 2: Quality Control Cover Sheet

A.1 Quality Control Cover Sheet

TXDOT BRIDGE DIVISION		
	County:	
	C-S-J:	
	Highway:	
	Project:	

Group Leader (Approval for Release): _____

Date: _____

Calculations

Structure	Component	Design Engineer Assigned	Software Used	Software Version	Checker Assigned	Design Engineer Prepared Initial	Design Engineer Prepared Date	Checker Checked Initial	Checker Checked Date	Design Engineer Corrected Initial	Design Engineer Corrected Date	Checker Verified Corrections Initial	Checker Verified Corrections Date

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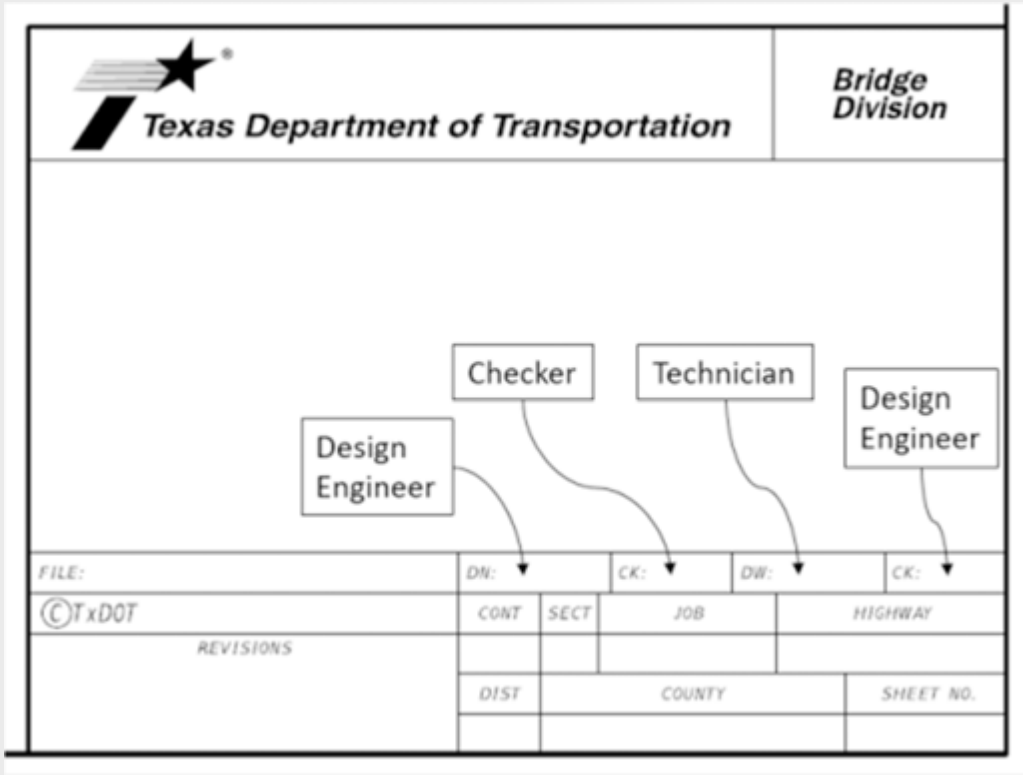
Figure 2: Quality Control Cover Sheet

TxDOT Quality Control and Quality Assurance Guide

The Quality Control/Quality Assurance (QC/QA) program establishes the following goals:

- Are designed free of errors and omissions.
- Contain designs for all elements and are 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.



TxDOT Quality Control and Quality Assurance Guide

Consultant Prepared Plans

For consultant-prepared plans, the consultants are required to submit their **Quality Control Plan** in writing prior to starting work or as otherwise directed in the contract. TxDOT reserves the right to review the consultants' quality control process.

Federal Highway Administration (FHWA) Review


U.S. Department of Transportation
Federal Highway Administration

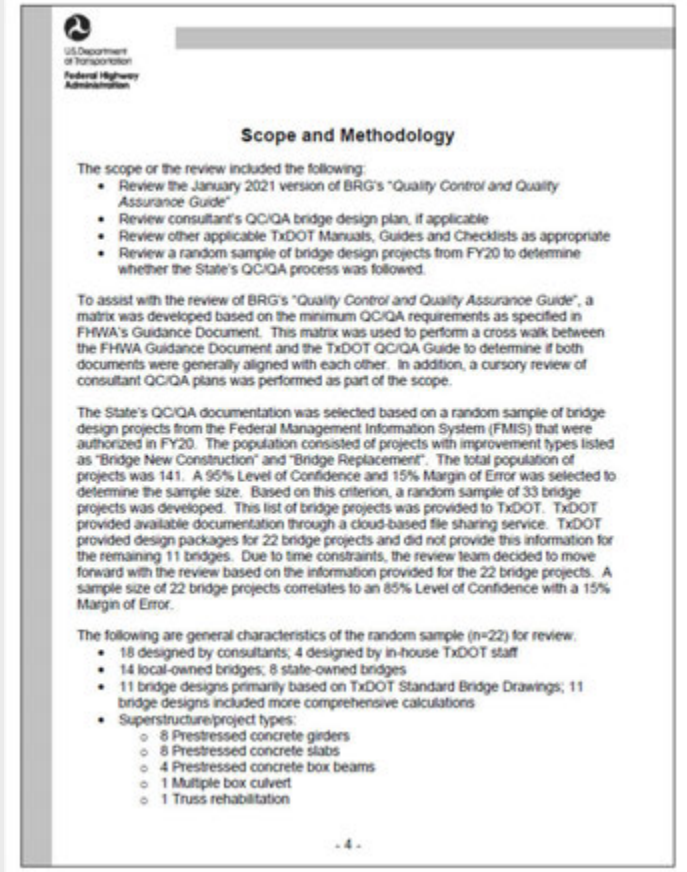
FHWA Texas

Program Review

Bridge Design Quality Control Quality Assurance Process Review

January 2022

FINAL REPORT


U.S. Department of Transportation
Federal Highway Administration

Scope and Methodology

The scope or the review included the following:

- Review the January 2021 version of BRG's "*Quality Control and Quality Assurance Guide*"
- Review consultant's QC/QA bridge design plan, if applicable
- Review other applicable TxDOT Manuals, Guides and Checklists as appropriate
- Review a random sample of bridge design projects from FY20 to determine whether the State's QC/QA process was followed.

To assist with the review of BRG's "*Quality Control and Quality Assurance Guide*", a matrix was developed based on the minimum QC/QA requirements as specified in FHWA's Guidance Document. This matrix was used to perform a cross walk between the FHWA Guidance Document and the TxDOT QC/QA Guide to determine if both documents were generally aligned with each other. In addition, a cursory review of consultant QC/QA plans was performed as part of the scope.

The State's QC/QA documentation was selected based on a random sample of bridge design projects from the Federal Management Information System (FMIS) that were authorized in FY20. The population consisted of projects with improvement types listed as "Bridge New Construction" and "Bridge Replacement". The total population of projects was 141. A 95% Level of Confidence and 15% Margin of Error was selected to determine the sample size. Based on this criterion, a random sample of 33 bridge projects was developed. This list of bridge projects was provided to TxDOT. TxDOT provided available documentation through a cloud-based file sharing service. TxDOT provided design packages for 22 bridge projects and did not provide this information for the remaining 11 bridges. Due to time constraints, the review team decided to move forward with the review based on the information provided for the 22 bridge projects. A sample size of 22 bridge projects correlates to an 85% Level of Confidence with a 15% Margin of Error.

The following are general characteristics of the random sample (n=22) for review.

- 18 designed by consultants; 4 designed by in-house TxDOT staff
- 14 local-owned bridges; 8 state-owned bridges
- 11 bridge designs primarily based on TxDOT Standard Bridge Drawings; 11 bridge designs included more comprehensive calculations
- Superstructure/project types:
  - 8 Prestressed concrete girders
  - 8 Prestressed concrete slabs
  - 4 Prestressed concrete box beams
  - 1 Multiple box culvert
  - 1 Truss rehabilitation

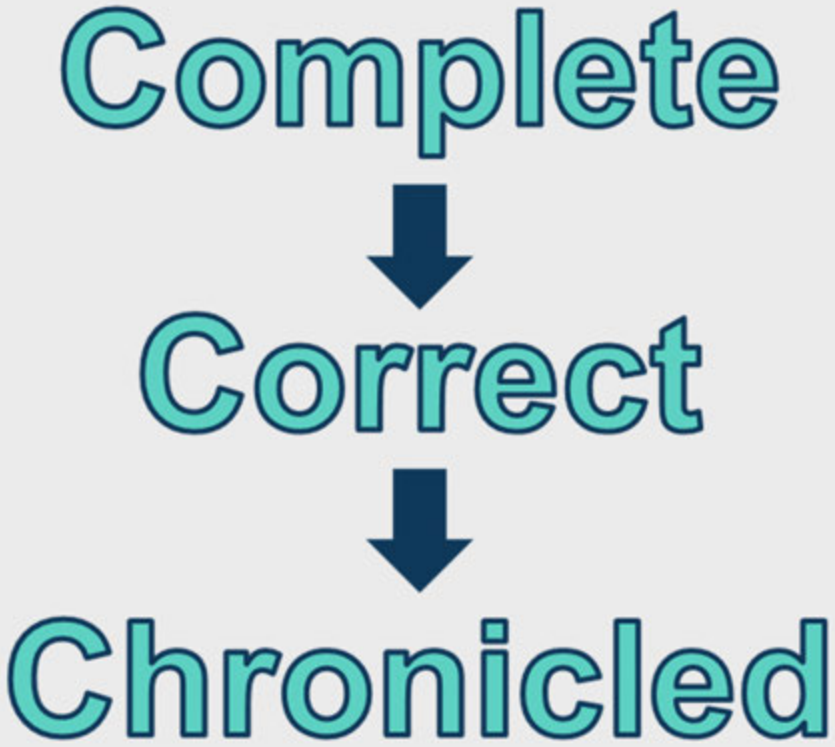
- 4 -

Federal Highway Administration (FHWA) Review

Purpose and Objective of the Review

The purpose of the review was to evaluate the TxDOT Bridge Division's (BRG) "Quality Control and Quality Assurance Guide" and to review the current practice used by bridge designers to carry out the State's QC/QA process. The objectives of the review are:

- Determine if BRG's "Quality Control and Quality Assurance Guide" is in alignment with FHWA's "Guidance on QC/QA in Bridge Design in Response to NTSB Recommendation (H-08-17)" https://www.fhwa.dot.gov/bridge/h0817.pdf
- Determine if bridge designers for TxDOT projects are adhering to BRG's "Quality Control and Quality Assurance Guide"
- Determine areas for improvement in the bridge design QC/QA process.



Six General Outcomes/Recommendations

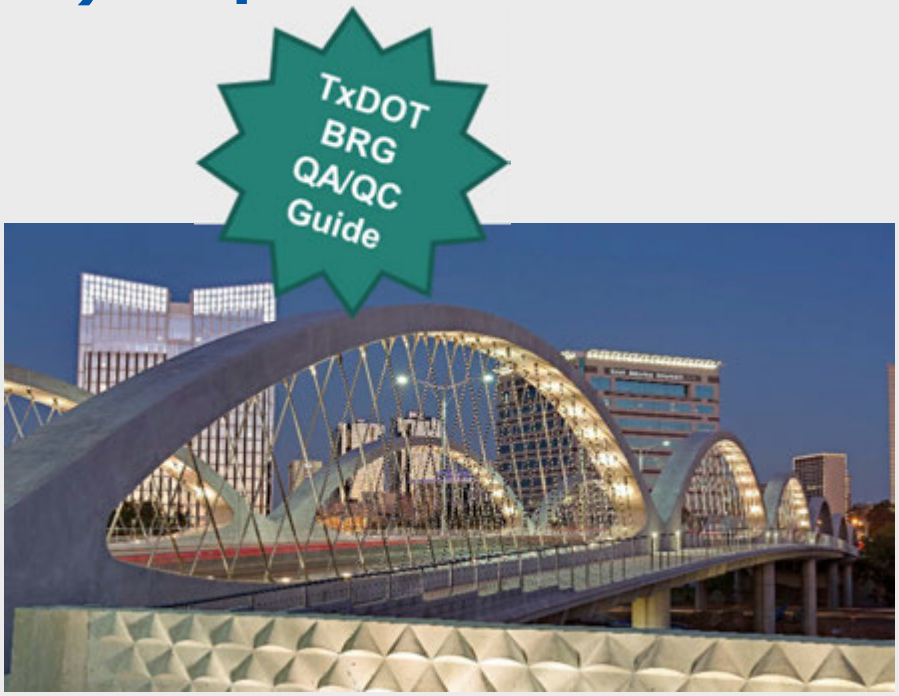
- 1: Independent Design Checks (IDC) for complex structures
- 2: **Consultant QC Processes on File**
- 3: Some Projects **Lacking QC Coversheets or Not Filled Out Properly**
  - QA Verifications
  - Includes "standard" bridges
- 4: **QC Coversheet Consistency**
  - Varied among consultants
  - Address design calcs and detail checks
- 5: **Titleblocks filled out on detail sheets including bridge layouts**
- 6: **Designer and checker initials** on all design calc packages

1: Independent Design Check (IDC) Requirements

- Complex Structure Definition
  - Bridges having a difficult or unique foundation problem
  - New or complex designs with unique operational or design features such as:
    - Cable-stayed
    - Suspension
    - Arch
    - Post-tension box girder
    - Segmental concrete
    - Moveable bridges
    - Truss bridges

1: Independent Design Check (IDC) Requirements

- **Requirements can be found in the QA/QC Guide Chapter 6, Section 2**
- In addition to meeting the QC/QA process when designing ordinary bridges:
  - IDC to validate complex or exotic structures or structural elements
  - Completed by a license professional engineer in the State of Texas
  - Be conducted without the aid of the original design calculations
  - Independent verification of the design using different analysis and design software packages than what was used during initial design
  - Generate a separate set of design calculations that are documented in a report. The report shall document any changes or recommendations regarding the original plans.
- IDC shall be
  - Performed by an engineering firm independent from the engineer responsible for the initial design
  - Performed by an engineering firm having no other project involvement
  - Performed by an engineer pre-certified in work category 5.2.1 Bridge Design
  - Designated by TxDOT for both Design-Build and Design-Bid-Build



2: Consultant QA/QC Processes on File

- Required to have the firm's general current documented QC/QA process on file stored in a central location
- Information would be treated as confidential
- Needs to be in consultant contracts

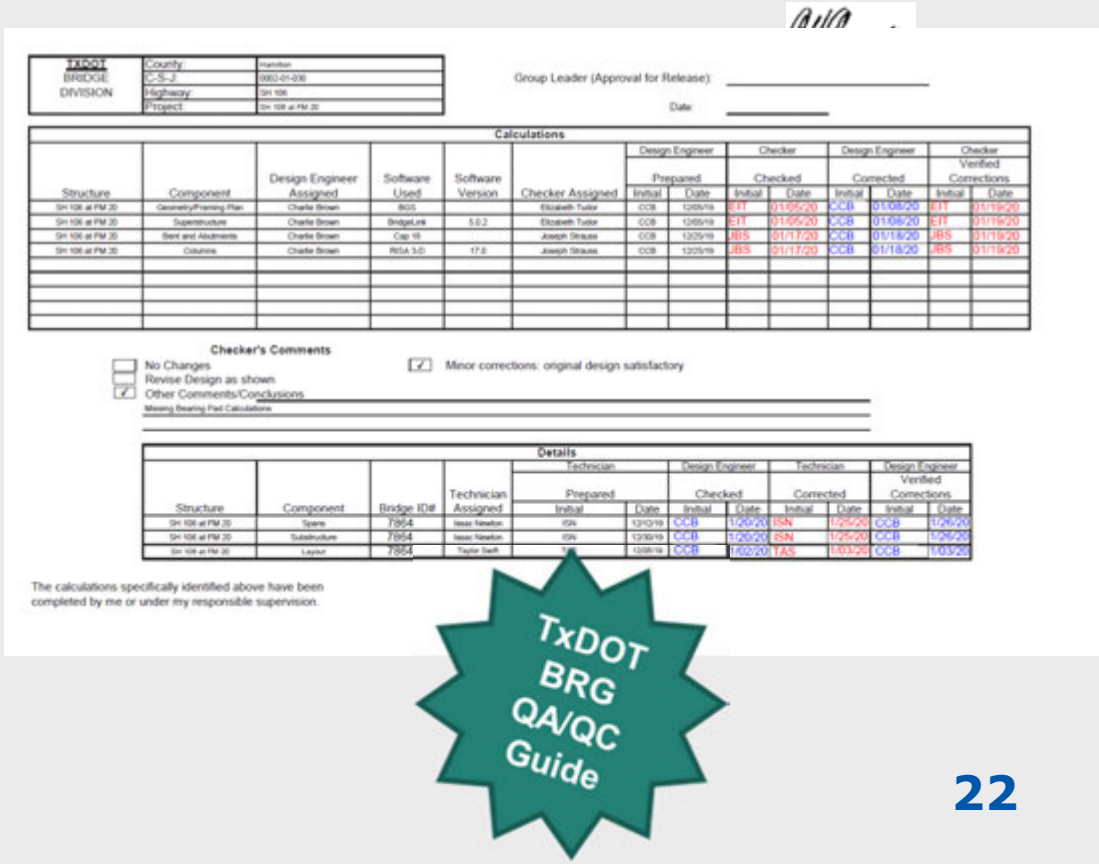
TxDOT BRG QA/QC Guide

Consultant Prepared

For consultant-prepared plans, the consultants are required to submit their Quality Control Plan in writing prior to starting work or as otherwise directed in the contract. TxDOT reserves the right to review the consultants' quality control process.

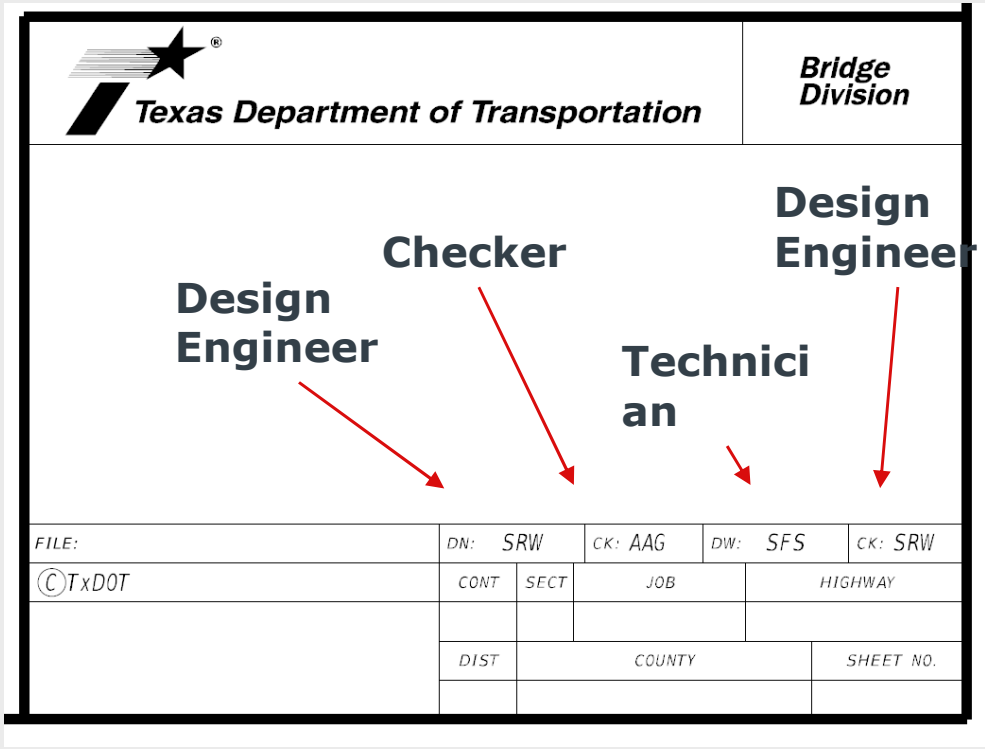
3 & 4: QA/QC Coversheets

- Need to **consistently** have on design notes packages
- Need to have **completely filled out**
- Potential need for a **consistent** form (range of consultants, TxDOT, etc)
- Checking of **calculations and details**
- **Include for standards bridges**
  - Geometry
  - Foundation design notes
- **Store with calcs in central location**



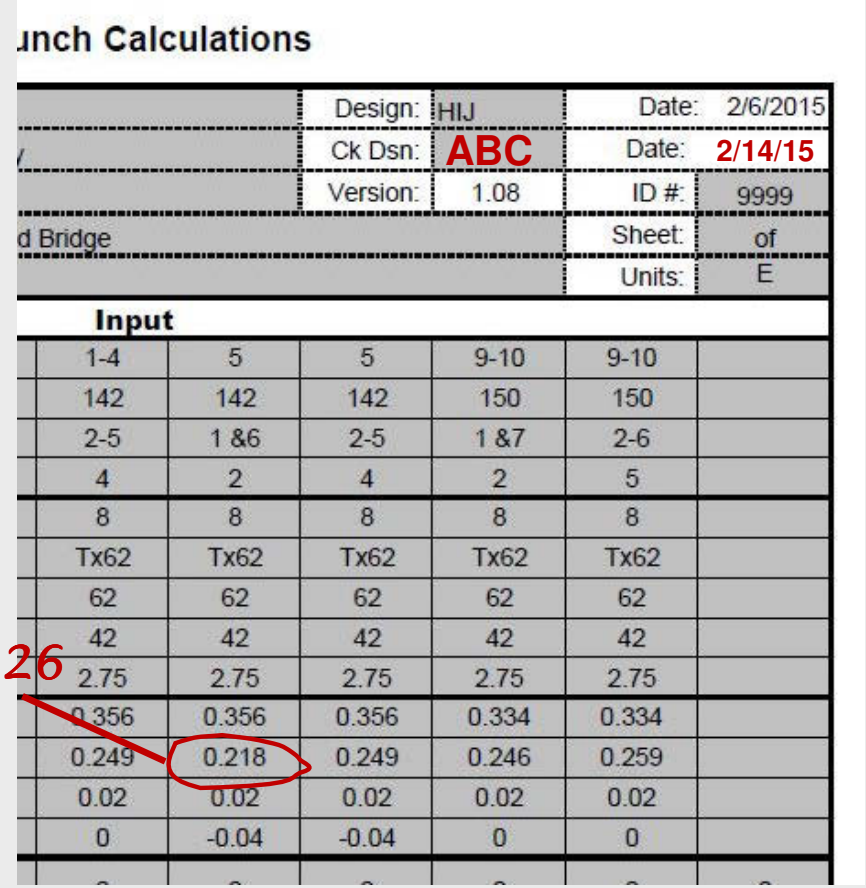
5: Titleblocks

- Need designer/technician/checker/detail check boxes on **bridge layouts and bridge details**
- Multi-disciplinary review essential
  - Roadway design…e.g. does the layout match the P&P
  - Bridge design…consistency with structural details, etc.
  - Hydraulics…e.g. does the bridge info match the Hydraulic Data Sheet, frequency & freeboard?, etc.



6: Designer and Checker Initials on All Calculations

- Checker initials and checks clearly identified in calculations.



ınch Calculations

		Design:	HIJ	Date:	2/6/2015
		Ck Dsn:	ABC	Date:	2/14/15
		Version:	1.08	ID #:	9999
d Bridge				Sheet:	of
				Units:	E
Input					
1-4	5	5	9-10	9-10	
142	142	142	150	150	
2-5	1 &6	2-5	1 &7	2-6	
4	2	4	2	5	
8	8	8	8	8	
Tx62	Tx62	Tx62	Tx62	Tx62	
62	62	62	62	62	
42	42	42	42	42	
2.75	2.75	2.75	2.75	2.75	
0.356	0.356	0.356	0.334	0.334	
0.249	0.218	0.249	0.246	0.259	
0.02	0.02	0.02	0.02	0.02	
0	-0.04	-0.04	0	0	

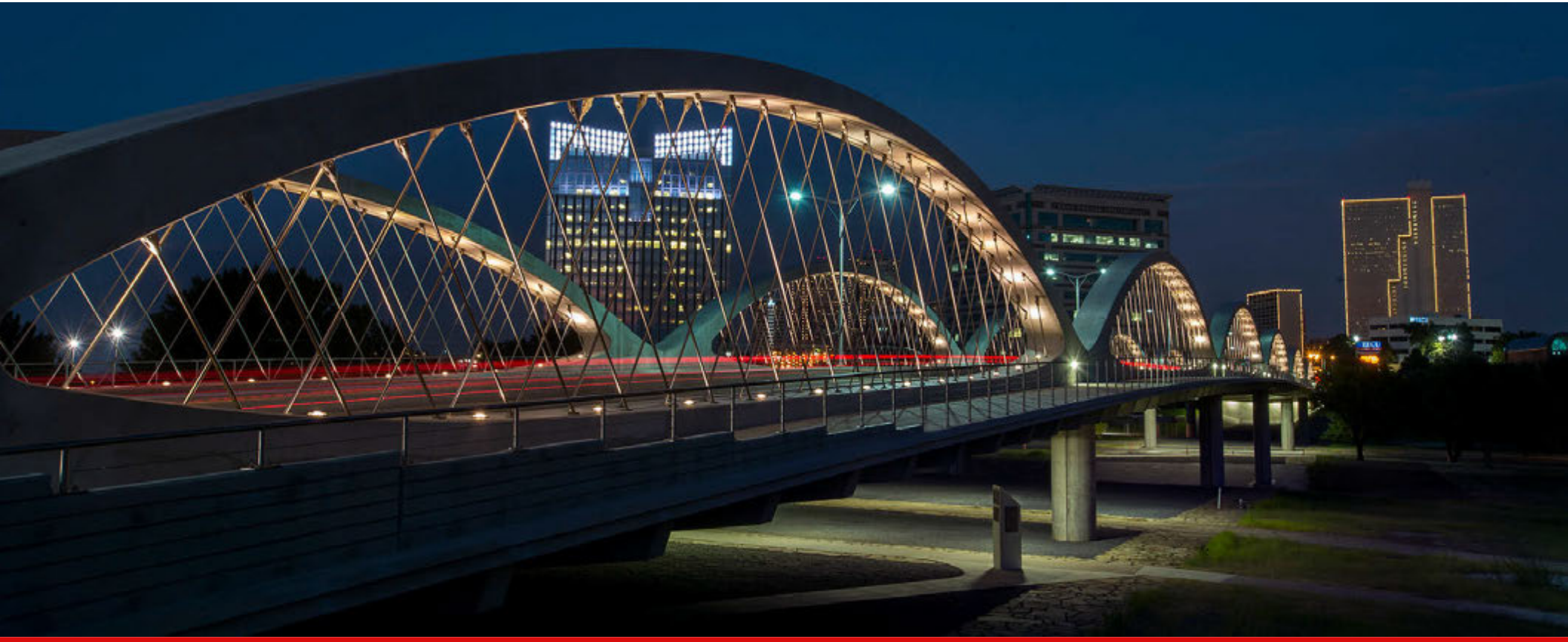
HIJ ✓0.26

Conclusion

- This effort will continue to improve the quality control and quality assurance in the design of new bridges and the widening/rehabilitation of existing bridges in Texas.
- TxDOT needs Consultant partners to help with this effort.

- Questions?

Robert.Owens@txdot.gov



Next Bridge Briefing: July 10th Bridge Layouts

Texas Department of Transportation

June 13, 2024