

Quality Management

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Bridge Office | mndot.gov/bridge

Outline

- Quality Process
- Plan Development
- 3D Modeling



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Quality Process



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Quality Process

WHO?

- Originators and checkers
- Quality assurance managers
- Project managers
- Every person involved in the development of a bridge project

Quality Process

WHAT?

- Quality control (QC)
 - Checking assumptions, calculations, code checks, and plans
- Quality assurance (QA)
 - Verifying that the control process was followed



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Quality Process

WHERE?



- On every project in Minnesota
- MnDOT and local projects

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6

Quality Process

WHEN?



- At each stage of the project
- Not only when the project is complete

Quality Process

WHY?



Quality Process

WHY?

- Safety
- Minimize field changes
- Provide consistency across projects
- Reduce long term maintenance issues

HOW?

Quality Management Plans (QMPs) Standards

Quality Management Plans (QMPs)

QMPs must:

- Be project specific
- Address all deliverables for the project, including:
 - Calculations
 - Plans
 - Special provisions
 - Reports
- Include software that will be used
- Comply with Section 4.1 of the MnDOT Bridge Design Manual (BDM)

Quality Management Plans (QMPs)

- Element Types

- Basic

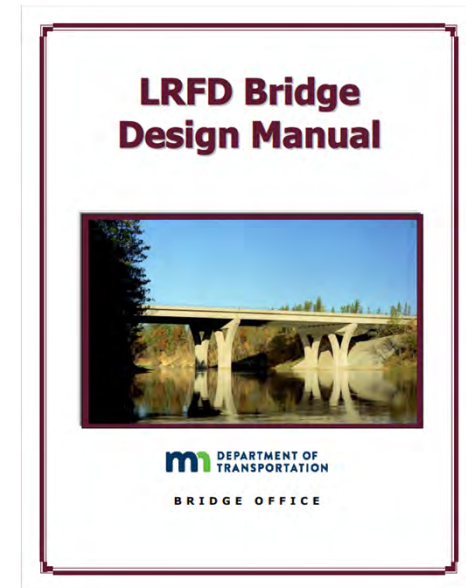
- Abutments, splices, bearings, most prestressed concrete beams

- Intermediate

- Piers, straight steel girders, steel box girders, prestressed beams with complex framing like variable overhangs or flares

- Complex

- Concrete box girders, curved steel girders, structures requiring a soil-structure interaction model



BDM 4.1

Quality Management Plans (QMPs)

- Checking Methods
 - Validated software
 - Hand check
 - Independent model/software
- The method used does not determine the complexity of the element.
- The complexity of the element determines the methods that can be used.

Quality Management Plans (QMPs)

- Validated software
 - Hand calculations
 - Replication of MnDOT design examples
 - Verification of each step in the design process must be done. Not enough to check the final answer.
 - Designers must confirm that validation remains current with new software versions or specification updates.



Quality Management Plans (QMPs)

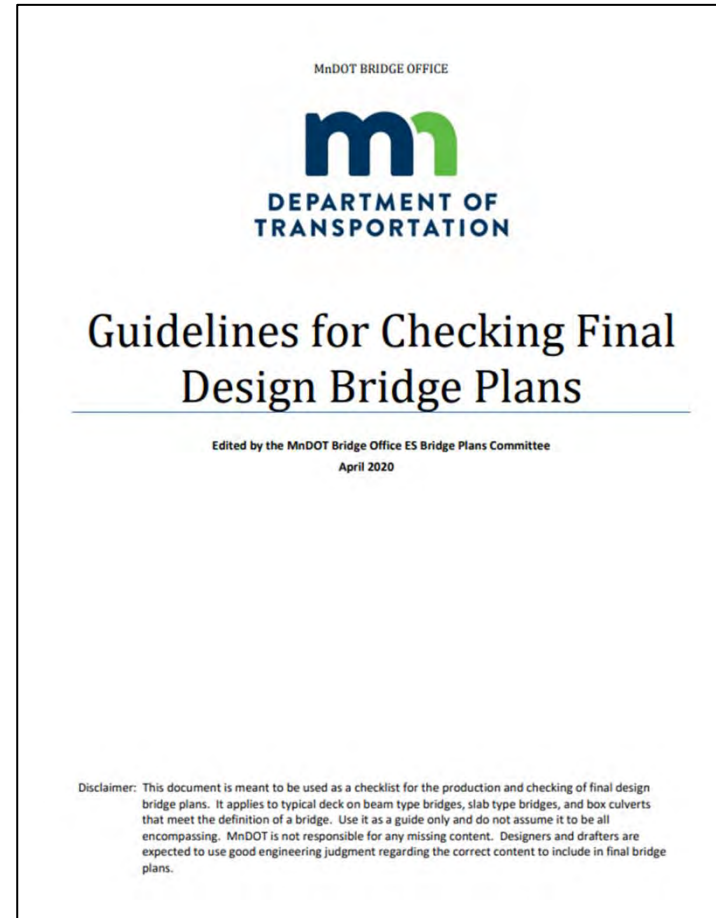
	Validated Software	Hand check	Independent Model/Software
Basic	✓	✓	✓
Intermediate	✗	!	✓
Complex	✗	✗	✓

Hand checks:

- Basic – line by line
- Intermediate – hand check using moderate simplifications with sound engineering judgment

Quality Management Plans (QMPs)

- Who
 - Who will be filling each role?
 - What qualifications are required to be in that role?
 - Do the people have the right experience?
 - Checkers should have as much or more experience on the element than the designer.

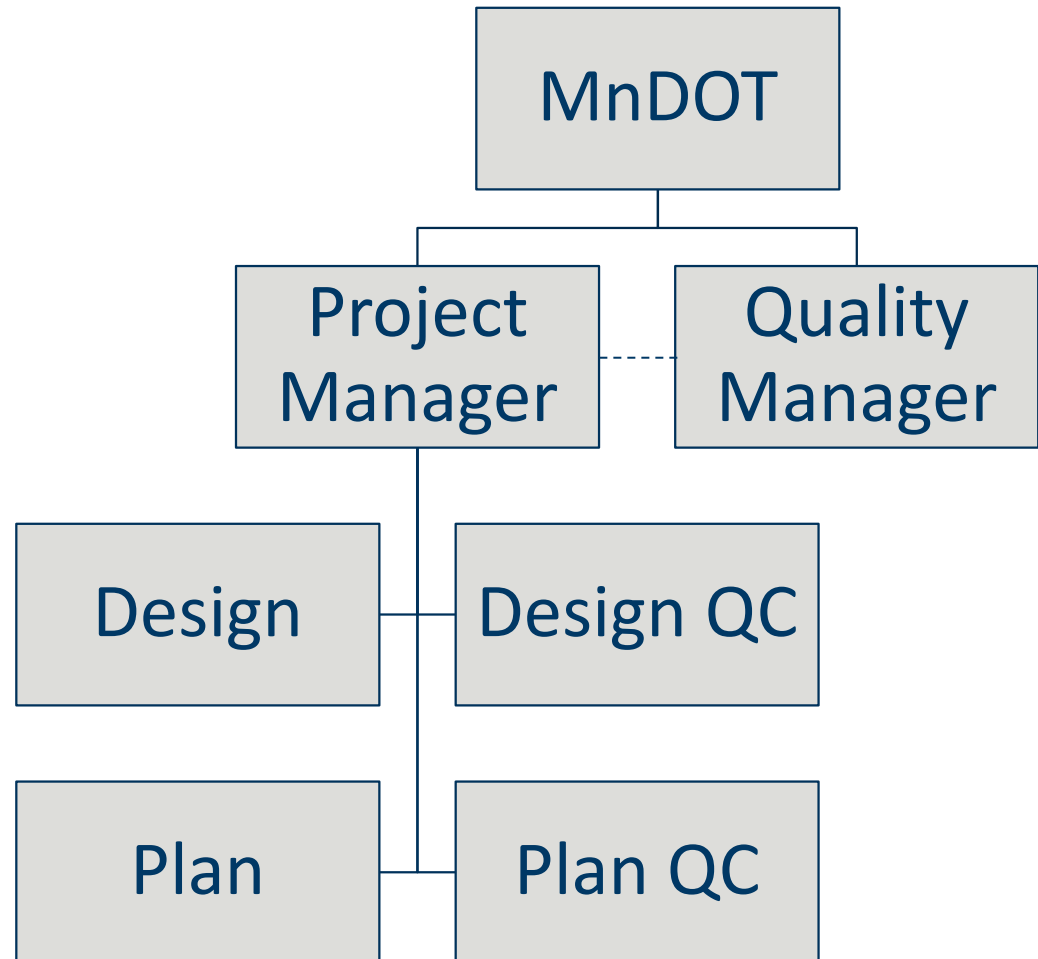


<http://www.dot.state.mn.us/bridge/drafting-aids.html>

Quality Management Plans (QMPs)

People involved:

- Designer (QC)
- Checker (QC)
- Quality Manager (QA)



Independent Technical Reviews (ITRs)

- Use ITRs for complex or unusual analysis methods or details.
- MnDOT staff involvement:
 - Unit Leader/Bridge Office Point of Contact
 - Regional Bridge Construction Engineer
 - Fabrication Methods Engineer
 - State Bridge Design Engineer
 - Others

Standards

- Standards have many benefits
 - Well tested
 - Consistency for contractors
 - Economical
- Any deviations from MnDOT Standards or the BDM need to be reviewed by MnDOT
- <http://www.dot.state.mn.us/bridge/standards.html>
- <http://www.dot.state.mn.us/bridge/lrfd.html>

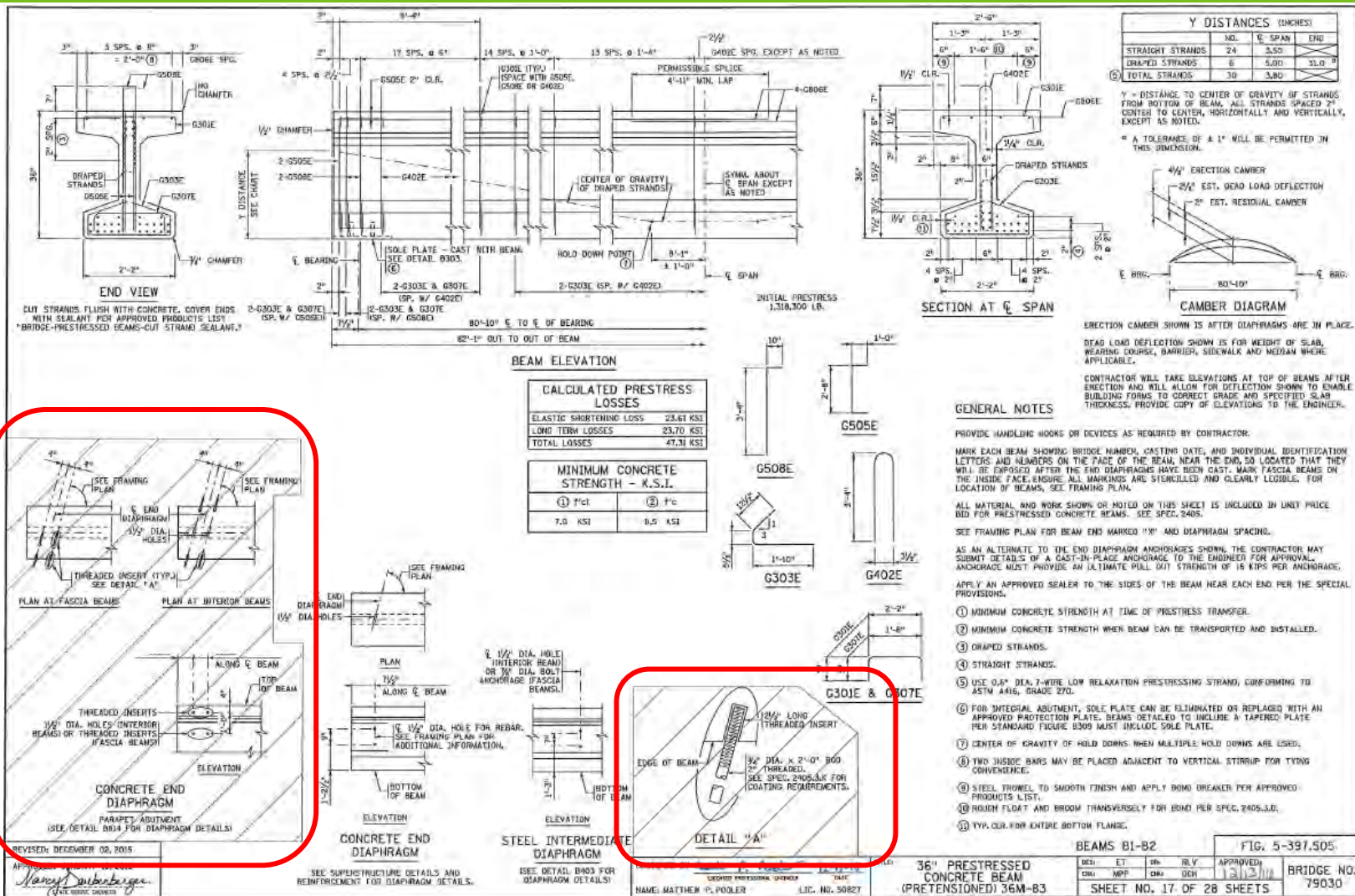
STANDARD IS UNMODIFIED:

Used as drawn with no changes, and with all blanks filled in where expected.

- Box out and place cross-hatching across details that do not apply. Do not remove details.

BDM 2.4.2.6

Standards



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21

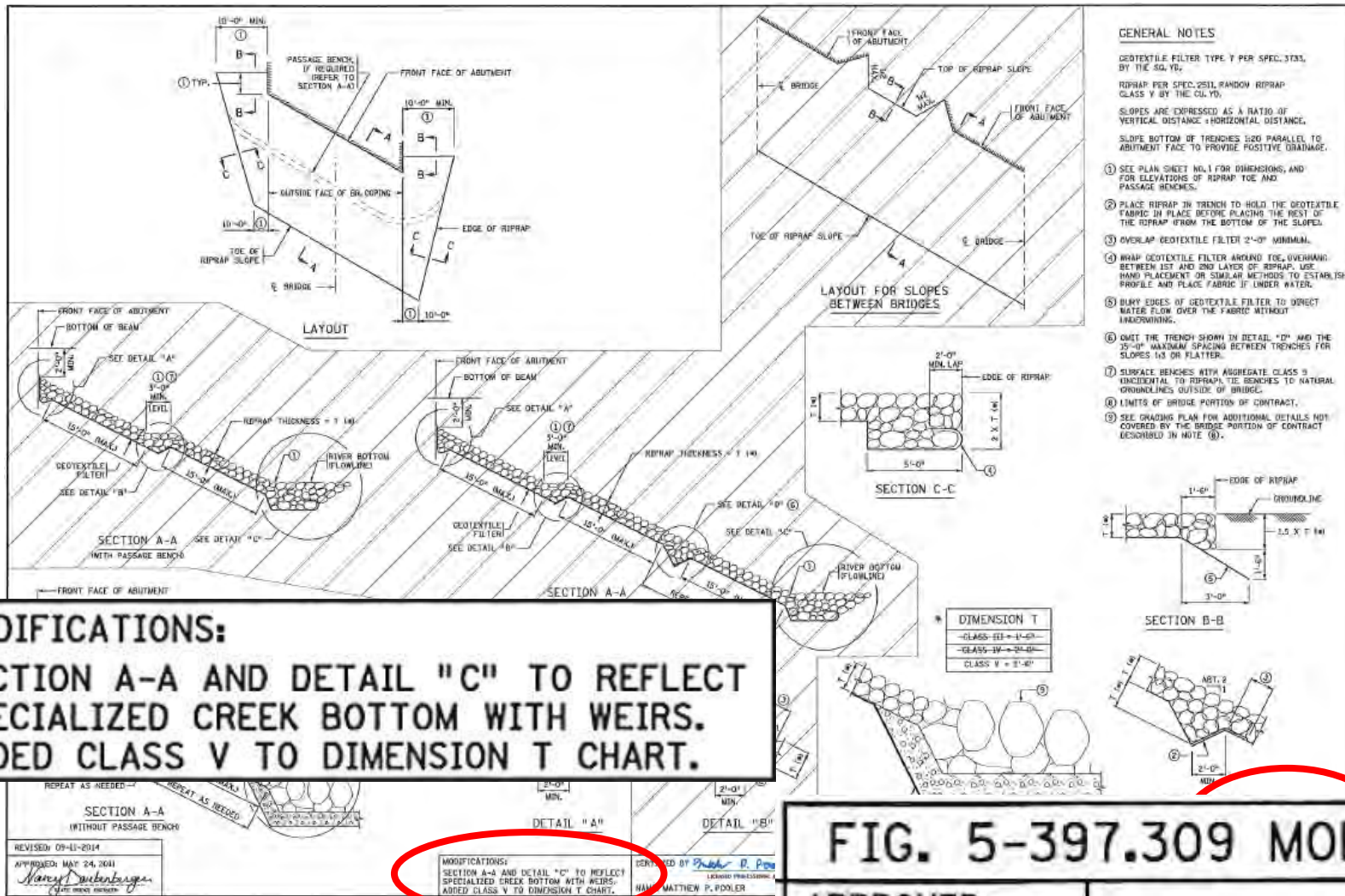
STANDARD IS MODIFIED:

Details, dimensions, or notes have specifically been modified from the standard.

- Place “MODIFIED” under B-Detail or after Figure Number
- Add a box stating what was modified.
- Do not “cloud” changes.

BDM 2.4.2.6

Standards



Standards

STANDARD IS SUBSTANTIALLY MODIFIED:

Extensive or numerous details, dimensions, or notes have been modified to an extent that ceases to reflect the standard.

- Judgment call on part of engineer if this category applies.
- Remove State Bridge Engineer approval block and figure number.
- Engineer of Record takes full responsibility for details shown.

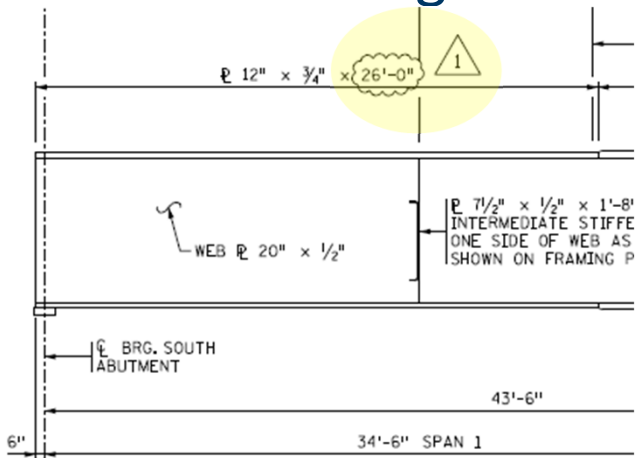
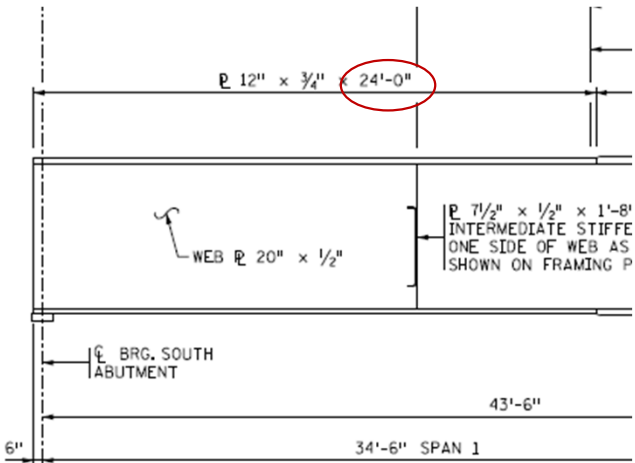
BDM 2.4.2.6

Plan Development

- Revised sheets
- Initials and signatures
- Plan Issues

Revised Sheets

1. Identify the error.
2. Fix the error, cloud the change, add revision triangle.

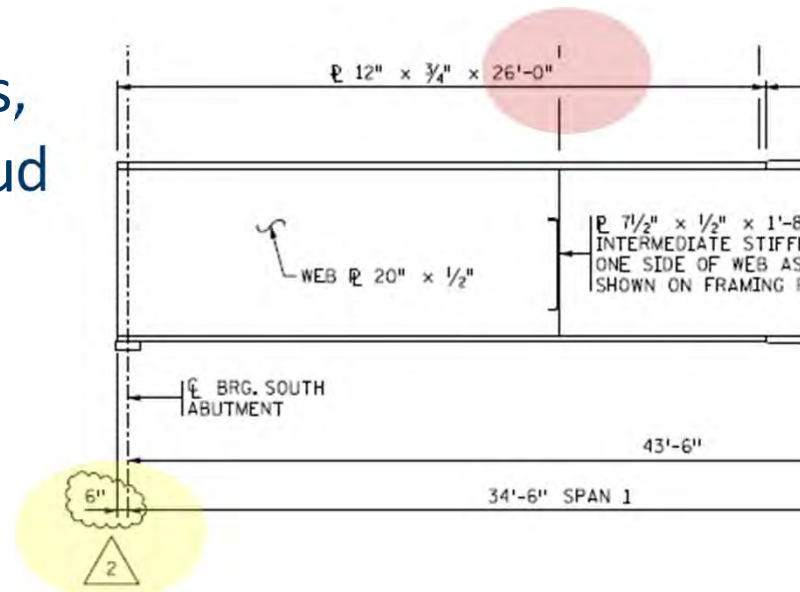


3. Update the revision block.

1	3/10/14	REVISED TOP PLAN SEGMENT LENGTH.	J.P.E.
REV. NO.	DATE	REVISION DESCRIPTION	APPROVED

Revised Sheets

4. For subsequent revisions, remove triangle and cloud from the previous, add triangle and cloud for the current revision.



5. Update the revision block.

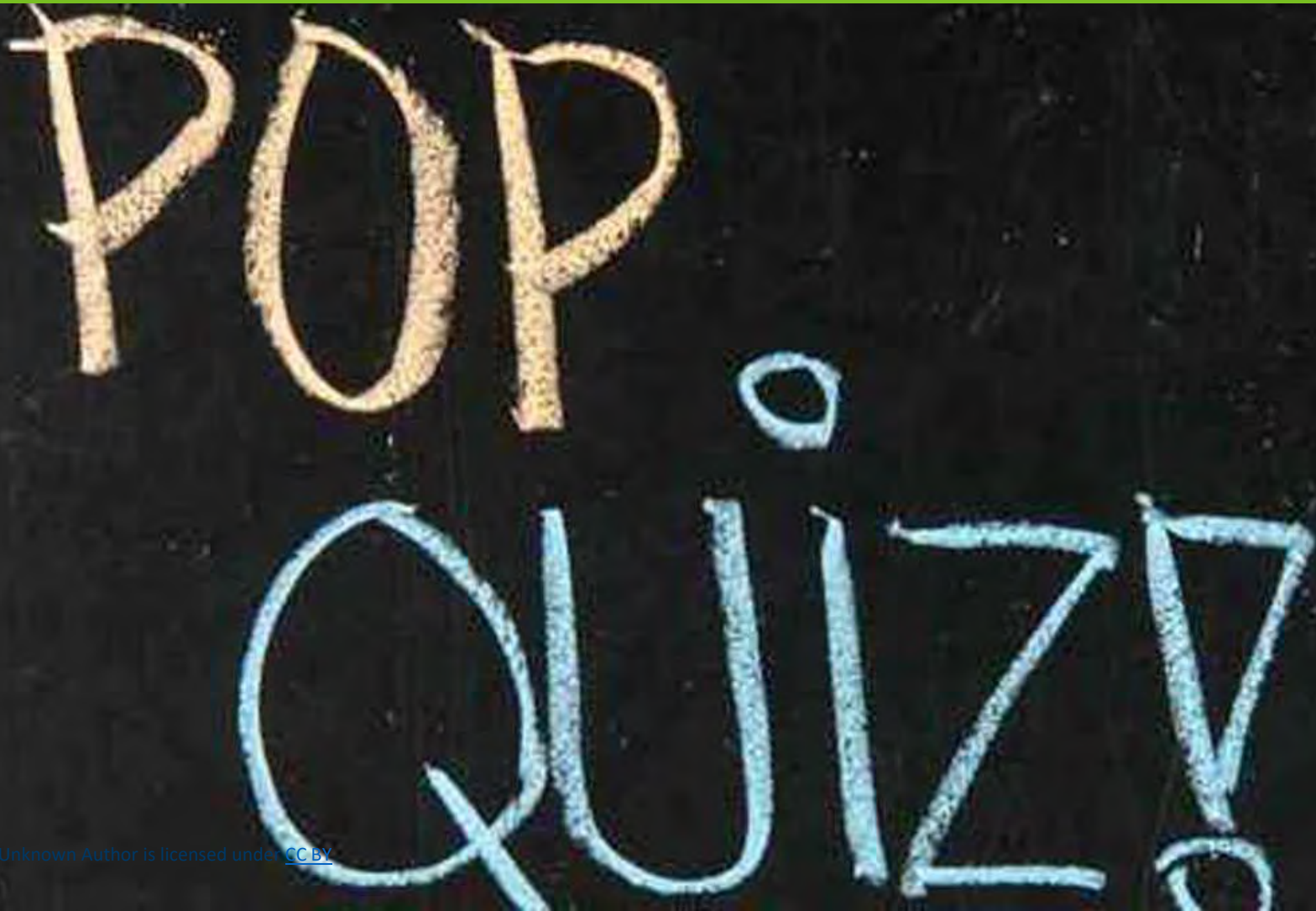
2	4/16/14	REVISED BEAM END EXTENSION AT ABUTMENTS.	J.P.E.
1	3/10/14	REVISED TOP PLAN SEGMENT LENGTH.	J.P.E.
REV. NO.	DATE	REVISION DESCRIPTION	APPROVED

BDM 2.4.3

Revised Sheets

- Since October 30, 2020:
 - 28 revision packets
 - 4 related to contractor/fabricator/field request
 - 1 due to delayed quality process
 - 23 due to plan errors, including 15 with quantity changes
 - 14 bridges
 - 124 total revised sheets, including 75 due to plan error

Initials and Signatures

A photograph of a chalkboard with the words "POP QUIZ!" written in chalk. "POP" is written in yellow chalk and "QUIZ!" is written in light blue chalk. The letters are large and stylized, with some overlapping and flourishes. The background is a dark, textured chalkboard surface.

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Initials and Signatures

When should checker initials appear on the plans?

A. When the plans are first drafted

B. When the drafter remembers

C. Only after the calcs or plan sheet has been checked

D. Who needs initials?!

DES: ALGE	DR: NAB
CHK:	CHK:

Initials and Signatures

- Initials for designer, drafter, design checker, and drafting checker are required on every sheet except:
 - As-builts
 - Surveys
 - Borings
 - Unrevised information sheets
- For boring sheets, show initials for drafter and drafting checker.

The form is a technical drawing specification sheet for bridge components. It is organized into several columns and rows of fields:

- BEARING COURSE:** Includes checkboxes for 'LIVE SLAB' and 'OTHER', and a field for 'TYPE OR MANUFACTURE'.
- EXPANSION JOINTS:** Contains fields for 'JOINT MANUFACTURE', 'SLAB MANUFACTURE', 'SIZE OF SLAB', and 'MANUFACTURE IDENTIFICATION'.
- ELASTOMERIC BEARING PADS:** Includes fields for 'PAD MANUFACTURE', 'SPECIAL SURFACE FINISH', and 'FINISHING ROADWAY FACES OF BARRIER OR PARAPET'.
- ANTI-GRAFFITI COATING:** Contains fields for 'MANUFACTURE' and 'PRODUCT NAME'.
- PAINT SYSTEM:** Includes fields for 'PAINT SYSTEM', 'PRIMER COAT', 'INTERMEDIATE COAT', 'FINISH COAT', 'PLUM QUALITY', and 'COMMENTS'.
- OTHER ITEMS:** A section for additional specifications and a 'SUMMARY OF SIGNIFICANT AS-BUILT CHANGES'.

At the bottom of the form, there is a section for 'AS-BUILT DETAILS' and a footer with the text: 'THIS FORM IS AVAILABLE IN AN ELECTRONIC FORMAT AT: https://www.dot.ny.gov/infocenter/infocenter.cfm?cid=1000&cid2=1000&cid3=1000&cid4=1000&cid5=1000&cid6=1000&cid7=1000&cid8=1000&cid9=1000&cid10=1000&cid11=1000&cid12=1000&cid13=1000&cid14=1000&cid15=1000&cid16=1000&cid17=1000&cid18=1000&cid19=1000&cid20=1000&cid21=1000&cid22=1000&cid23=1000&cid24=1000&cid25=1000&cid26=1000&cid27=1000&cid28=1000&cid29=1000&cid30=1000&cid31=1000&cid32=1000&cid33=1000&cid34=1000&cid35=1000&cid36=1000&cid37=1000&cid38=1000&cid39=1000&cid40=1000&cid41=1000&cid42=1000&cid43=1000&cid44=1000&cid45=1000&cid46=1000&cid47=1000&cid48=1000&cid49=1000&cid50=1000&cid51=1000&cid52=1000&cid53=1000&cid54=1000&cid55=1000&cid56=1000&cid57=1000&cid58=1000&cid59=1000&cid60=1000&cid61=1000&cid62=1000&cid63=1000&cid64=1000&cid65=1000&cid66=1000&cid67=1000&cid68=1000&cid69=1000&cid70=1000&cid71=1000&cid72=1000&cid73=1000&cid74=1000&cid75=1000&cid76=1000&cid77=1000&cid78=1000&cid79=1000&cid80=1000&cid81=1000&cid82=1000&cid83=1000&cid84=1000&cid85=1000&cid86=1000&cid87=1000&cid88=1000&cid89=1000&cid90=1000&cid91=1000&cid92=1000&cid93=1000&cid94=1000&cid95=1000&cid96=1000&cid97=1000&cid98=1000&cid99=1000&cid100=1000'.

BDM 2.4.2

Initials and Signatures

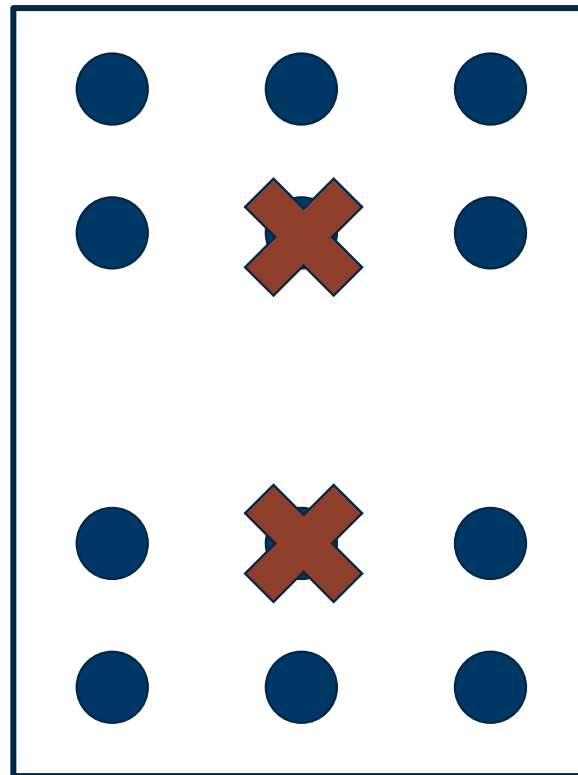
- Wet signatures or electronic signatures are acceptable.
- All signatures must follow the requirements of the Minnesota Board of Architecture, Engineering, Land Surveying, Landscape Architecture, Geoscience and Interior Design (AELSLAGID)
 - <http://mn.gov/aelslagid/rules.html>
- 1800.4200 Subpart 1: The certification and signature is of the person whose “professional skill and judgment are embodied in the document signed, and who assumes responsibility for the accuracy and adequacy thereof.”

Plan Issues

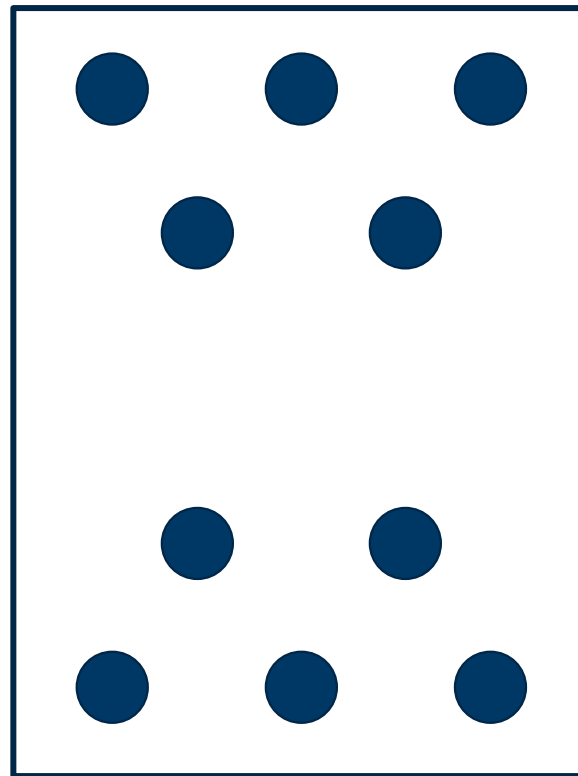
- Myth: When schedules are tight, it's acceptable to cut corners on the quality process.
- Truth: Quality is even more important when schedules are tight.
 - Make sure QC is done properly.
 - Make sure MnDOT has adequate time for review.
 - With good coordination, completing tasks in parallel can save time.



Plan Issues



Plan Issues



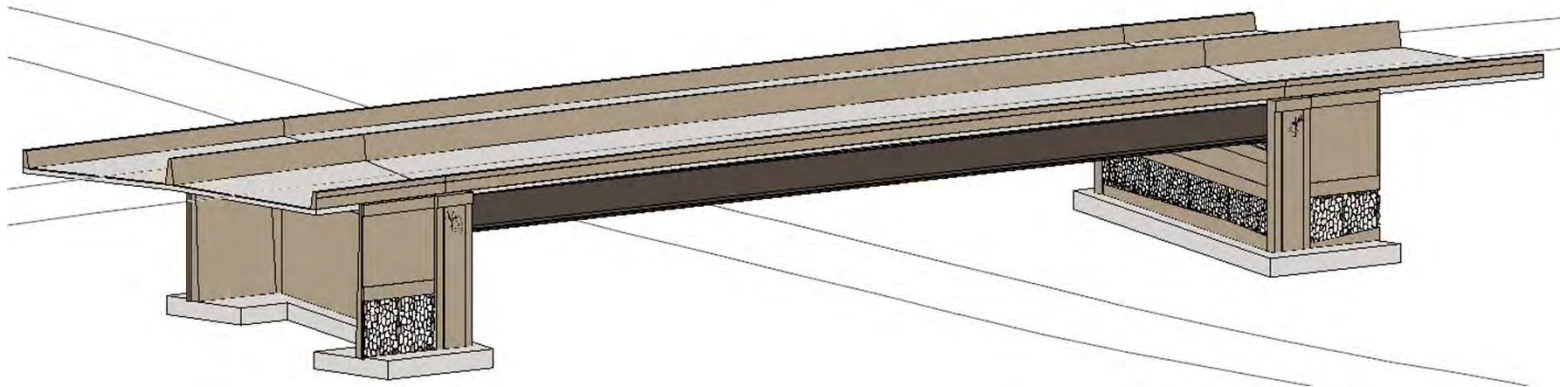
Ensuring designs are economical is a key part of the quality process.

Plan Issues

Plan Status	Expectations
30%	<ul style="list-style-type: none">• Everything included in the preliminary plan• Framing plan• Draft list of pay items
60%	<ul style="list-style-type: none">• All calculations complete and checked• Geometry fully defined• All sheets represented• Full list of pay items
95%	<ul style="list-style-type: none">• Ready for State Bridge Engineer signature (All QC/QA complete)
100%	<ul style="list-style-type: none">• Ready for State Bridge Engineer signature with 95% comments incorporated

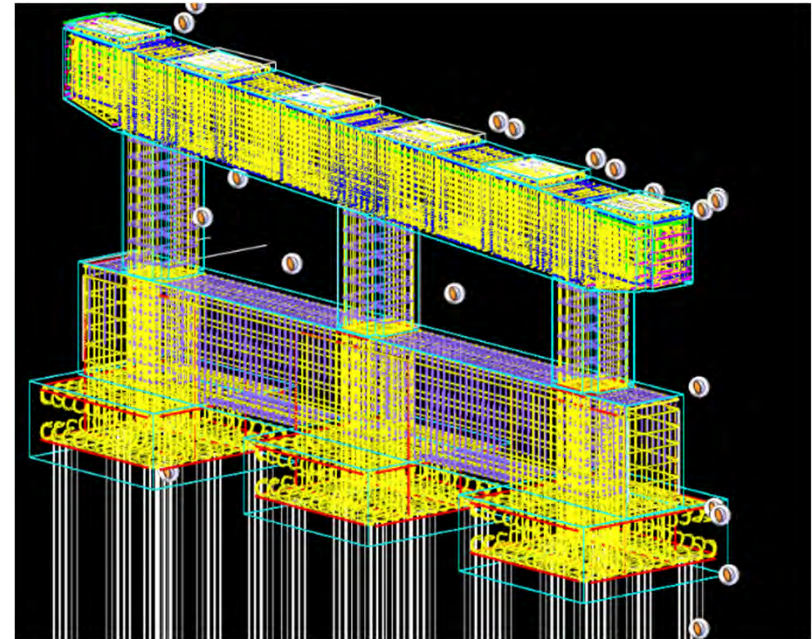
3D Modeling

- 3D modeling can mean many things:
 - 3D analysis model (e.g., 3D finite element model)
 - 3D CAD model for geometrics (clash detection)
 - 3D CAD model including rebar (whole bridge or details)
 - 3D contract documents



3D Modeling

- Pilot project
 - TH 169 (SP 7106-87)
 - 5 bridges
 - 2D plans as the deliverable
- Moving forward?
- Quality process benefits and challenges



Thank you!

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