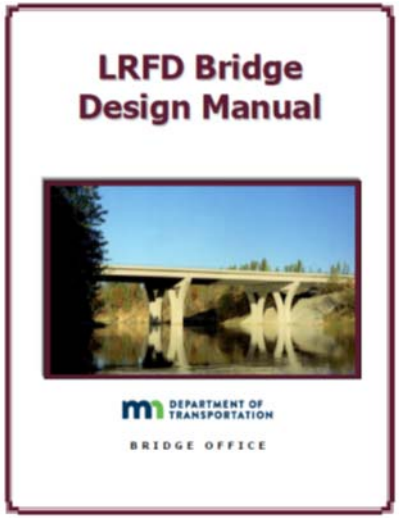


LRFD Bridge Design Manual Changes

Dave Dahlberg | Bridge Design Manual & Policy Engineer

May 17, 2017

DEPARTMENT OF TRANSPORTATION

Overview

1) Concrete mix designations
2) Reinforcing bar development and splice lengths
3) Modification to HL-93 double truck live load
4) Use of Strength IV load combination
5) Wood structures section
6) Design and evaluation for bridge repair projects
7) Integral abutments
8) Standard plan notes
9) Revised plan sheets
10) Other changes

Concrete Mix Designations – BDM 5.1.1

- Historically MnDOT Specs for concrete mixes were prescriptive
- Industry has been moving to performance specifications
- Contractor mix designs began with 2016 MnDOT Specs

Concrete Mix Designations – BDM 5.1.1

In August 2015:

- Changes to BDM 5.1.1
- Memo to Designers (2015-01)

Design Concrete Mix Summary

Location/Element	MnDOT Concrete Mix Designation	Design Compressive Strength (ksi)	Maximum Aggregate Size (in)
Cofferdam seals	1X62	5.0	1
Cast-in-place concrete piles and spread footing leveling pads	1P62	3.0	2
Drilled shafts	1X62 3X62	5.0 5.0	1 1
Footings and pile caps	1G52	4.0	1 ½ *
Abutment stems, wingwalls, cast-in-place wall stems, pier columns, and pier caps	3B52	4.0	1 ½ *
Integral abutment diaphragms and pier continuity diaphragms	Same mix as used in deck	4.0	1
Pretensioned superstructures	1W82 or 3W82	5.0 – 9.0 at final 4.5 – 7.5 at initial	1
Cast-in-place and precast box girders	3JM	6.0 or higher	1
Monolithic decks and slabs	3YHPC-M, 3YLCHPC-M or 3Y42-M	4.0	1
Decks and slabs that will receive a 2 inch concrete wearing course	3YHPC-S, 3YLCHPC-S or 3Y42-S	4.0	1
Barriers, parapets, medians, and sidewalks	3S52	4.0	1
Concrete wearing course	3U17A	4.0	$^{5}/_{8}$
MSE wall panels, PMBW blocks, and noisewall panels	3Y82	4.0	1
Precast box culverts, arches, and 3-sided structures	3W82	5.0 or higher	1*

Concrete Mix Designations – BDM 5.1.1

Design Concrete Mix Summary

Location/Element	MnDOT Concrete Mix Designation	Design Compressive Strength (ksi)	Maximum Aggregate Size (in)
Cofferdam seals	1X62	5.0	1
Cast-in-place concrete piles and spread footing leveling pads	1P62	3.0	2
Drilled shafts and rock sockets	1X62 3X62	5.0 5.0	1 1
Footings and pile caps	1G52	4.0	1 ½ *
Abutment stems, wingwalls, ~~cast-in-place wall stems~~, pier columns, pier struts, and pier caps	3B52	4.0	1 ½ *
Integral abutment diaphragms and pier continuity diaphragms	Same mix as used in deck	4.0	1
Pretensioned superstructures	1W82 or 3W82	5.0 – 9.0 at final 4.5 – 7.5 at initial	1
Cast-in-place and precast box girders	3JM	6.0 or higher	1
Monolithic decks and slabs	3YHPC-M, 3YLCHPC-M or 3Y42-M	4.0	1
Decks and slabs that will receive a 2 inch concrete wearing course	3YHPC-S, 3YLCHPC-S or 3Y42-S	4.0	1
Barriers, parapets, medians, ~~and~~ sidewalks, moment slabs, and approach panels	3S52	4.0	1
Concrete wearing course	3U17A	4.0	$^{5}/_{8}$
MSE wall panels, PMBW blocks, and noisewall panels	3Y82	4.0	1
Cast-in-place wall stems	3G52	4.5	1 ½ *
Precast box culverts, arches, and 3-sided structures	3W82	5.0 or higher	1*

Some changes are needed!

Concrete Mix Designations – BDM 5.1.1

Other things to note:

- Use the compressive strengths given in the BDM table for design and not the values found in MnDOT Spec 2461
- For concrete box girders, high performance mix (HPC) will be used, but the pay item will be:

  2401.607 STRUCTURAL CONCRETE (STRUCTURAL BOX) CU YD

Rebar Development and Splice Lengths
BDM 5.2.2

Major revisions occurred in 2015 interims of AASHTO LRFD Bridge Design Specs:

- New provisions more complex
- Class C splice length dropped, Class A and Class B retained

- Overall effect:
  - Development lengths increased
  - Splice length changes less drastic, with some increases and some decreases

Rebar Development and Splice Lengths
BDM 5.2.2

New development length equation in AASHTO LRFD Article 5.11.2.1.1 (2015 interim version):

$$\ell_d = \ell_{db}\left(\lambda_{rl} \times \lambda_{cf} \times \lambda_{lw} \times \lambda_{rc} \times \lambda_{er}\right)$$

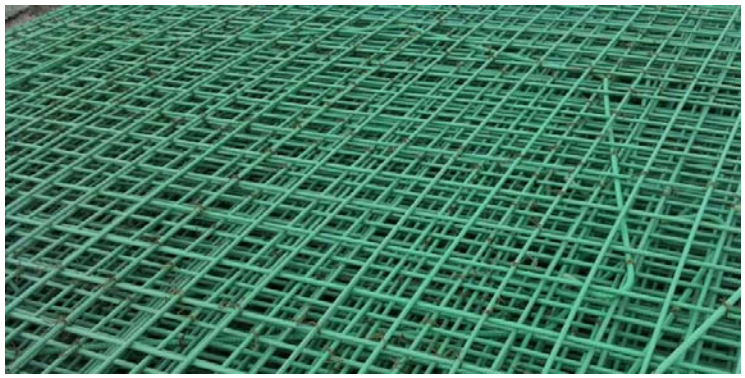
$$\ell_{db} = 2.4 d_b \frac{f_y}{\sqrt{f'_c}}$$

Rebar Development and Splice Lengths
BDM 5.2.2

λ_{lw} lightweight concrete factor

- Changed from an equation to 1.3

However…



… it did not stay this way for long!

Rebar Development and Splice Lengths
BDM 5.2.2

New development length equation (2016 interim version):

$$\ell_d = \ell_{db} \times \left(\frac{\lambda_{rl} \times \lambda_{cf} \times \lambda_{rc} \times \lambda_{er}}{\lambda} \right)$$

$$\ell_{db} = 2.4 d_b \frac{f_y}{\sqrt{f'_c}}$$

Rebar Development and Splice Lengths
BDM 5.2.2

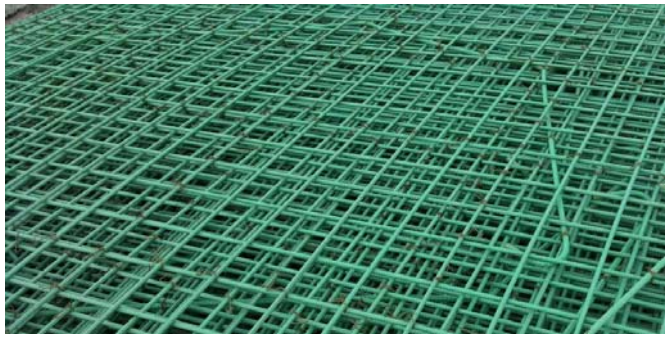
λ concrete density modification factor found in AASHTO LRFD Article 5.4.2.8
= 1.0 for normal weight concrete

λ_{rl} reinforcement location factor

- Changed from 1.4 to 1.3

λ_{cf} coating factor

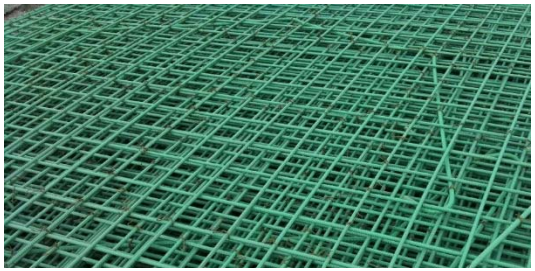
- For bars with epoxy coating
- No change



Rebar Development and Splice Lengths
BDM 5.2.2

λ_{er} excess reinforcement factor

- No change



λ_{rc} reinforcement confinement factor

- New factor, adds complexity to the calculation
- Dependent on bar diameter, bar spacing, concrete cover, and transverse reinforcement index k_{tr}

$$0.4 \le \lambda_{rc} = \frac{d_b}{c_b + k_{tr}} \le 1.0$$

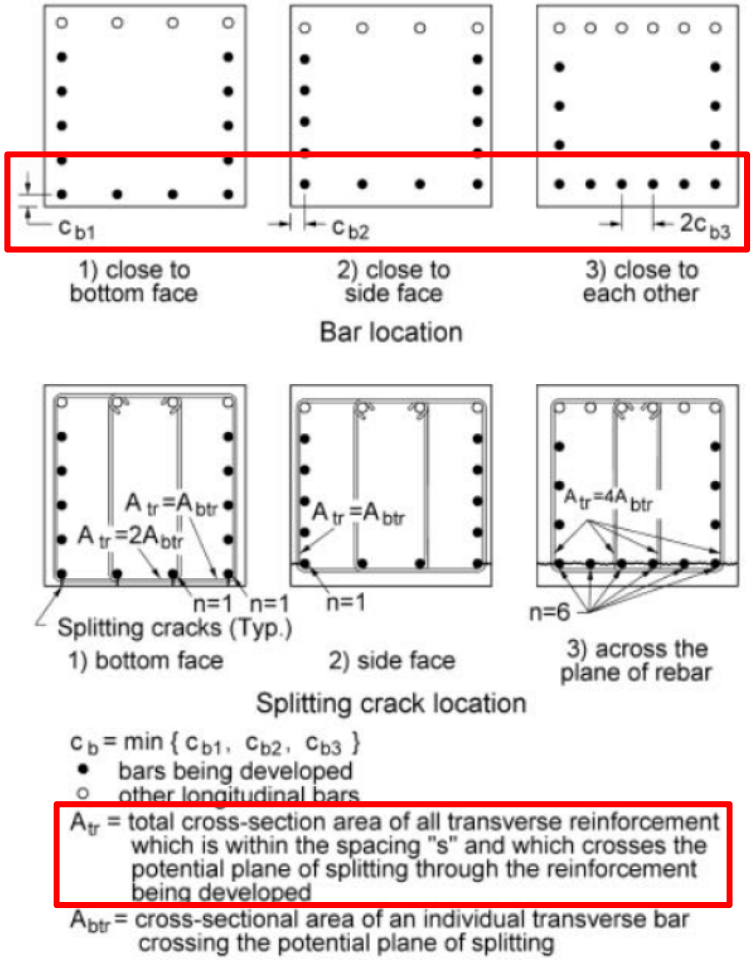
Rebar Development and Splice Lengths
BDM 5.2.2

- Transverse Reinforcement Index

$$k_{tr} = 40A_{tr}/(sn)$$

n = number of bars developed along plane of splitting

s = max center-to-center spacing of transverse reinforcement within development length



Rebar Development and Splice Lengths BDM 5.2.2

- For simplicity in developing BDM tables, transverse reinforcement index k_{tr} was set equal to zero.

$$0.4 \le \lambda_{rc} = \frac{d_b}{c_b + k_{tr}} \le 1.0$$

Rebar Development and Splice Lengths BDM 5.2.2

TENSION LAP SPLICES FOR EPOXY COATED BARS WITH >12″ CONCRETE CAST BELOW

f_y=60 ksi f_c'=4 ksi

Conc. Cover	Bar Size	Reinforcement Bar Spacing															
		4″		5″		5 1/2″		6″		6 1/2″		7″		7 1/2″		≥ 8″	
		Class A	Class B	Class A	Class B	Class A	Class B	Class A	Class B	Class A	Class B	Class A	Class B	Class A	Class B	Class A	Class B
2"	3	1'-5"	1'-10"	1'-5"	1'-10"	1'-5"	1'-10"	1'-5"	1'-10"	1'-5"	1'-10"	1'-5"	1'-10"	1'-5"	1'-10"	1'-5"	1'-10"
	4	1'-11"	2'-6"	1'-11"	2'-6"	1'-11"	2'-6"	1'-11"	2'-6"	1'-11"	2'-6"	1'-11"	2'-6"	1'-11"	2'-6"	1'-11"	2'-6"
	5	2'-7"	3'-4"	2'-5"	3'-1"	2'-5"	3'-1"	2'-5"	3'-1"	2'-5"	3'-1"	2'-5"	3'-1"	2'-5"	3'-1"	2'-5"	3'-1"
	6	3'-1"	4'-0"	3'-1"	4'-0"	3'-1"	4'-0"	3'-1"	4'-0"	3'-1"	4'-0"	3'-1"	4'-0"	3'-1"	4'-0"	3'-1"	4'-0"
	7	3'-11"	5'-1"	3'-7"	4'-8"	3'-7"	4'-8"	3'-7"	4'-8"	3'-7"	4'-8"	3'-7"	4'-8"	3'-7"	4'-8"	3'-7"	4'-8"
	8	5'-2"	6'-8"	4'-1"	5'-4"	4'-1"	5'-4"	4'-1"	5'-4"	4'-1"	5'-4"	4'-1"	5'-4"	4'-1"	5'-4"	4'-1"	5'-4"
	9	6'-6"	8'-6"	5'-3"	6'-9"	5'-1"	6'-7"	5'-1"	6'-7"	5'-1"	6'-7"	5'-1"	6'-7"	5'-1"	6'-7"	5'-1"	6'-7"
	10	8'-3"	10'-9"	6'-7"	8'-7"	6'-3"	8'-2"	6'-3"	8'-2"	6'-3"	8'-2"	6'-3"	8'-2"	6'-3"	8'-2"	6'-3"	8'-2"
	11	10'-2"	13'-3"	8'-2"	10'-7"	7'-6"	9'-9"	7'-6"	9'-9"	7'-6"	9'-9"	7'-6"	9'-9"	7'-6"	9'-9"	7'-6"	9'-9"
	14	N/A	N/A	11'-9"	15'-3"	10'-8"	13'-10"	10'-4"	13'-5"	10'-4"	13'-5"	10'-4"	13'-5"	10'-4"	13'-5"	10'-4"	13'-5"
$2\frac{3}{8}$"	3	1'-5"	1'-10"	1'-5"	1'-10"	1'-5"	1'-10"	1'-5"	1'-10"	1'-5"	1'-10"	1'-5"	1'-10"	1'-5"	1'-10"	1'-5"	1'-10"
	4	1'-11"	2'-6"	1'-11"	2'-6"	1'-11"	2'-6"	1'-11"	2'-6"	1'-11"	2'-6"	1'-11"	2'-6"	1'-11"	2'-6"	1'-11"	2'-6"
	5	2'-7"	3'-4"	2'-5"	3'-1"	2'-5"	3'-1"	2'-5"	3'-1"	2'-5"	3'-1"	2'-5"	3'-1"	2'-5"	3'-1"	2'-5"	3'-1"
	6	3'-1"	4'-0"	3'-1"	4'-0"	2'-10"	3'-8"	2'-10"	3'-8"	2'-10"	3'-8"	2'-10"	3'-8"	2'-10"	3'-8"	2'-10"	3'-8"
	7	3'-11"	5'-1"	3'-7"	4'-8"	3'-7"	4'-8"	3'-7"	4'-8"	3'-7"	4'-8"	3'-7"	4'-8"	3'-7"	4'-8"	3'-7"	4'-8"
	8	5'-2"	6'-8"	4'-1"	5'-4"	4'-1"	5'-4"	4'-1"	5'-4"	4'-1"	5'-4"	4'-1"	5'-4"	4'-1"	5'-4"	4'-1"	5'-4"
	9	6'-6"	8'-6"	5'-3"	6'-9"	4'-9"	6'-2"	4'-8"	6'-0"	4'-8"	6'-0"	4'-8"	6'-0"	4'-8"	6'-0"	4'-8"	6'-0"
	10	8'-3"	10'-9"	6'-7"	8'-7"	6'-0"	7'-10"	5'-6"	7'-2"	5'-6"	7'-2"	5'-6"	7'-2"	5'-6"	7'-2"	5'-6"	7'-2"
	11	10'-2"	13'-3"	8'-2"	10'-7"	7'-5"	9'-8"	6'-10"	8'-10"	6'-8"	8'-7"	6'-8"	8'-7"	6'-8"	8'-7"	6'-8"	8'-7"
	14	N/A	N/A	11'-9"	15'-3"	10'-8"	13'-10"	9'-9"	12'-9"	9'-1"	11'-10"	9'-1"	11'-10"	9'-1"	11'-10"	9'-1"	11'-10"
≥ 3"	3	1'-5"	1'-10"	1'-5"	1'-10"	1'-5"	1'-10"	1'-5"	1'-10"	1'-5"	1'-10"	1'-5"	1'-10"	1'-5"	1'-10"	1'-5"	1'-10"
	4	1'-11"	2'-6"	1'-11"	2'-6"	1'-11"	2'-6"	1'-11"	2'-6"	1'-11"	2'-6"	1'-11"	2'-6"	1'-11"	2'-6"	1'-11"	2'-6"
	5	2'-7"	3'-4"	2'-5"	3'-1"	2'-5"	3'-1"	2'-5"	3'-1"	2'-5"	3'-1"	2'-5"	3'-1"	2'-5"	3'-1"	2'-5"	3'-1"
	6	3'-1"	4'-0"	3'-1"	4'-0"	2'-10"	3'-8"	2'-10"	3'-8"	2'-10"	3'-8"	2'-10"	3'-8"	2'-10"	3'-8"	2'-10"	3'-8"
	7	3'-11"	5'-1"	3'-7"	4'-8"	3'-7"	4'-8"	3'-7"	4'-8"	3'-4"	4'-4"	3'-4"	4'-4"	3'-4"	4'-4"	3'-4"	4'-4"
	8	5'-2"	6'-8"	4'-1"	5'-4"	4'-1"	5'-4"	4'-1"	5'-4"	4'-1"	5'-4"	3'-9"	4'-11"	3'-9"	4'-11"	3'-9"	4'-11"
	9	6'-6"	8'-6"	5'-3"	6'-9"	4'-9"	6'-2"	4'-8"	6'-0"	4'-8"	6'-0"	4'-8"	6'-0"	4'-8"	6'-0"	4'-8"	6'-0"
	10	8'-3"	10'-9"	6'-7"	8'-7"	6'-0"	7'-10"	5'-6"	7'-2"	5'-3"	6'-9"	5'-3"	6'-9"	5'-3"	6'-9"	5'-3"	6'-9"
	11	10'-2"	13'-3"	8'-2"	10'-7"	7'-5"	9'-8"	6'-10"	8'-10"	6'-3"	8'-2"	5'-10"	7'-7"	5'-10"	7'-6"	5'-10"	7'-6"
	14	N/A	N/A	11'-9"	15'-3"	10'-8"	13'-10"	9'-9"	12'-9"	9'-0"	11'-9"	8'-5"	10'-11"	7'-10"	10'-2"	7'-8"	9'-11"

Rebar Development and Splice Lengths
BDM Appendix 5-A

APPENDIX 5-A
MnDOT BRIDGE OFFICE REBAR LAP SPLICE GUIDE

> Based on LRFD 5.11.2 and 5.11.5
> Use of epoxy coated bars is assumed
> Excess reinforcement factor λ_{er} is taken equal to 1.0

DECKS:

Top Transverse Deck Bars

See LRFD Bridge Design Manual Table 9.2.1.1 or Table 9.2.1.2 for bar size and spacing. A Class A splice is provided where all top transverse bar splices occur between beams, with 50% of the bars spliced at a given location. A Class B splice is provided where 100% of the bars are spliced at a given location between beams or where 50% of the bars are spliced at a given location over beams. Avoid splicing 100% of bars over beams.

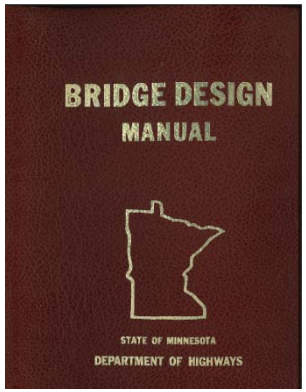
Top Transverse Deck Bar Lap Splice Lengths

Concrete Cover to Bar Being Considered	Bar Spacing	Bar Size	All Splices Between Beams and 50% are at Same Location *(preferred)*	100% of Splices at Same Location Between Beams or 50% of Splices Over Beams at Same Location
3"	> 5"	#4	1'-6"	1'-11"
		#5	1'-10"	2'-5"
		#6	2'-2"	2'-10"
	5"	#4	1'-6"	1'-11"
		#5	1'-10"	2'-5"
		#6	2'-9"	3'-7"

MnDOT Bridge Design Manuals

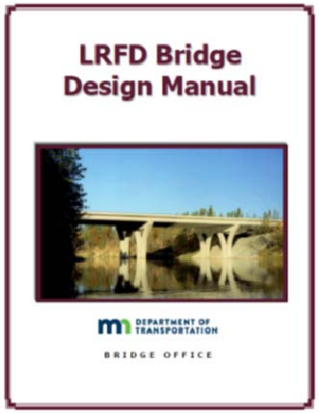
- In 1996, Mn/DOT Bridge Design Manual had:

  136 pages



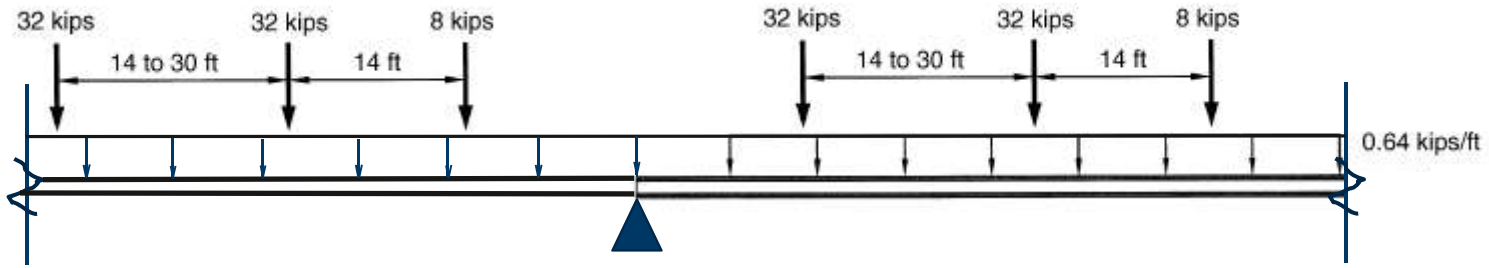
- In 2017, MnDOT LRFD Bridge Design Manual has:

  1154 pages



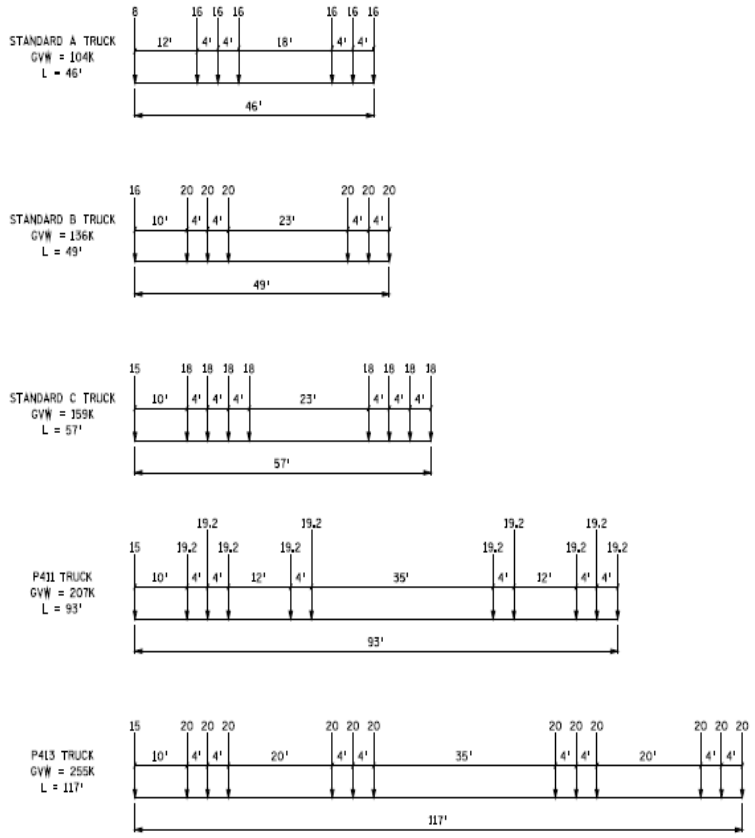
Modification to HL-93 Double Truck Live Load BDM 3.4.1

- AASHTO LRFD Art. 3.6.1.3.1
  - For negative moment between points of contraflexure under a uniform load on all spans, and reaction at interior piers only, [apply] 90% of the effect of 2 design trucks spaced a minimum of 50’ between the lead axle of one truck to the rear axle of the other truck, combined with 90% of the effect of the design lane load.



Modification to HL-93 Double Truck Live Load BDM 3.4.1

- Originally, MnDOT modified the double truck LL to ensure adequate LF ratings for bridges designed by LRFD.
- Since all new bridges are now rated using the LRFR method, an internal study was completed to ensure that AASHTO HL-93 envelopes the MnDOT standard permit trucks.



Modification to HL-93 Double Truck Live Load BDM 3.4.1

- MnDOT LRFD Bridge Design Manual Art. 3.4.1
  - For continuous beam spans, to determine negative moments and reactions at interior piers only:
    - For bridges with longest span ≤ 60 ft, apply 125% (HL-93 double truck with dynamic load allowance plus lane load)
    - For bridges with longest span > 60 ft, apply 110% (HL-93 double truck with dynamic load allowance plus lane load)
    - Do not apply LRFD Art. C3.6.1.3.1 double tandem load
  - For simple spans, to determine reactions at interior piers only:
    - Follow AASHTO LRFD Art. 3.6.1.3.1

Modification to HL-93 Double Truck Live Load BDM 3.4.1

- For Bridge Repair Projects
  - May analyze using AASHTO LRFD Art. 3.6.1.3.1, but must check for HL-93 and MnDOT standard permit trucks

Strength IV Load Combination – BDM 3.1

Found in AASHTO LRFD Article 3.4.1:

- **Strength IV:** Load combination relating to very high dead load to live load force effect ratios.

  1.5DC

  (was not calibrated)

- Calibration study was done by Modjeski & Masters
- Some past MnDOT projects used a modified Strength IV: 1.4DC + 1.4LL

Strength IV Load Combination – BDM 3.1

Strength IV: Load combination emphasizing dead load force effects in bridge superstructures.

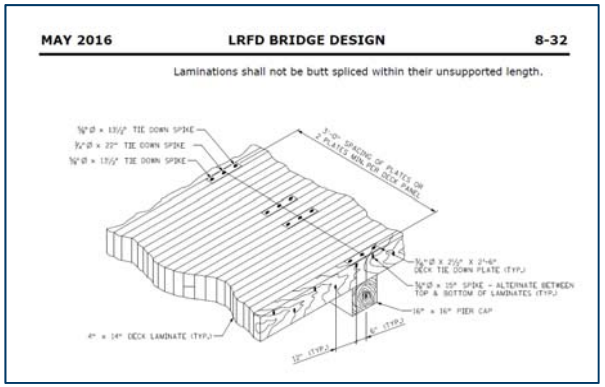
- For MnDOT projects, use a modified Strength IV load combination, given in AASHTO LRFD Article C3.4.1:

  1.4DC + 1.5DW + 1.45LL

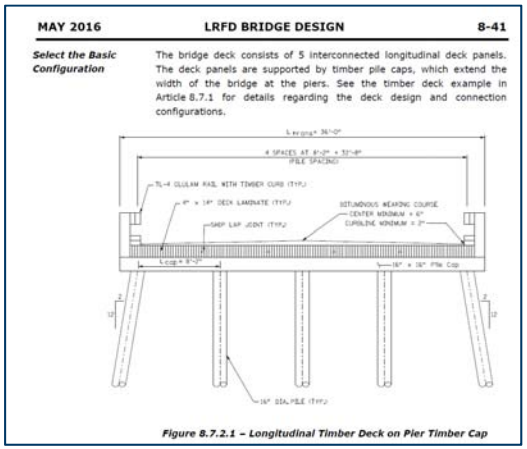
- Strength IV only applies to superstructures. It does <u>not</u> apply to investigation of construction stages, substructures, retaining walls, or bearings.

Wood Structures Section – BDM Section 8

- BDM Section 8 entirely updated in May of 2016
  - Includes design examples for:
    - Longitudinal spike laminated deck
    - Timber pile cap
    - Glulam beam superstructure
    - Transverse deck on glulam beams



- Spike laminated deck
- Glulam deck



Wood Structures Section – BDM Section 8

- Also includes load rating examples for the superstructure elements:
  - Longitudinal spike laminated deck
  - Glulam beam superstructure
  - Transverse deck on glulam beams
    - Spike laminated deck
    - Glulam deck

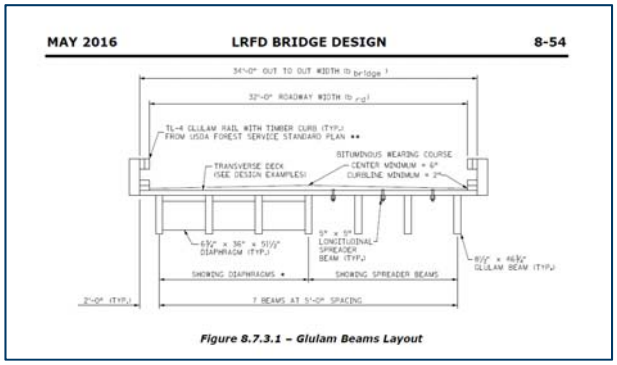
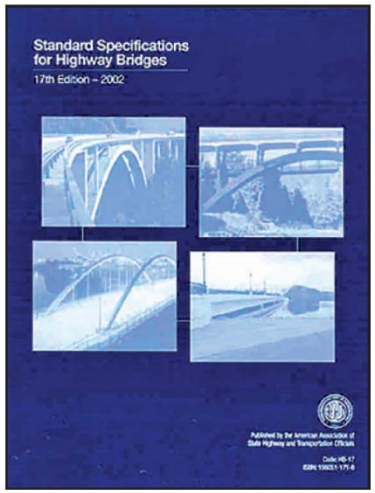


Figure 8.7.3.1 – Glulam Beams Layout

Design & Evaluation for Bridge Repair Projects BDM 4.6.2

- Existing bridges requiring repair raise some questions:
  - Bridge original design was done per *AASHTO Standard Specifications for Highway Bridges.* Should Std Specs or LRFD Specs be used for repairs?



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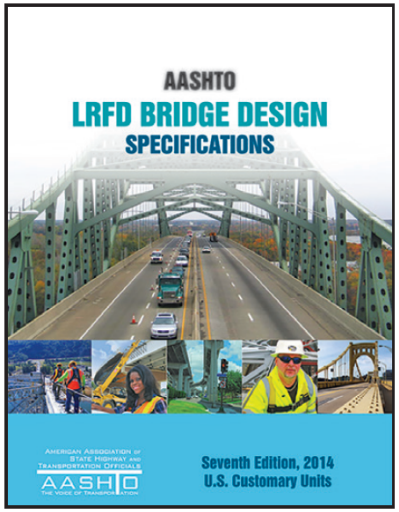
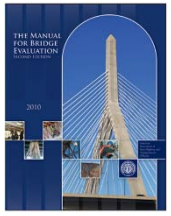


Design & Evaluation for Bridge Repair Projects BDM 4.6.2

- Bridge original rating was done using Load Factor Rating.

  Should LFR or LRFR be used for evaluating existing and repaired condition?



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PART B—ALLOWABLE STRESS RATING AND LOAD FACTOR RATING

6B.1—GENERAL

Section 6, Part B of this Manual provides a choice of load rating methods. Load ratings at Operating and Inventory levels using the allowable stress method can be calculated and may be especially useful for comparison with past practices. Similarly, load ratings at Operating and Inventory levels based on the load factor method can also be calculated. Each of these rating methods is presented below.

C6B.1

Bridge engineers have recognized that for the same bridge conditions a wide range of ratings may arise, depending on the rating method selected. Historically, several approaches have been used in rating bridges including Inventory and Operating rating levels and the use of allowable stress and load factor methods of analysis.

In recent years, methods have been developed to provide more uniform safety margins for structures in terms of a reliability index. For bridge evaluation, the load and resistance factor rating (LRFR) method contained in this Manual provides uniform reliability in bridge load ratings and load postings. See Section 6, Part A, for more information on LRFR.

PART A—LOAD AND RESISTANCE FACTOR RATING

6A.1—INTRODUCTION

6A.1.1—General

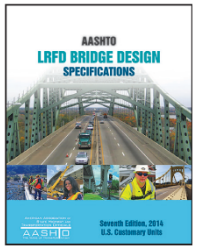
The load and resistance factor rating procedures of Part A provide a methodology for load rating a bridge consistent with the load and resistance factor design philosophy of the *AASHTO LRFD Bridge Design Specifications*.

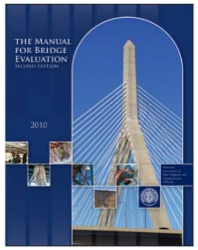
C6A.1.1

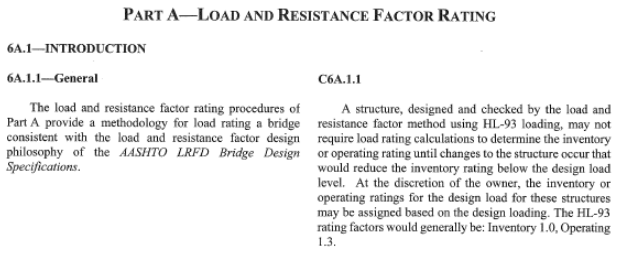
A structure, designed and checked by the load and resistance factor method using HL-93 loading, may not require load rating calculations to determine the inventory or operating rating until changes to the structure occur that would reduce the inventory rating below the design load level. At the discretion of the owner, the inventory or operating ratings for the design load for these structures may be assigned based on the design loading. The HL-93 rating factors would generally be: Inventory 1.0, Operating 1.3.

Design & Evaluation for Bridge Repair Projects BDM 4.6.2

- For MnDOT bridges, use LRFD for design and LRFR for evaluation of existing bridges that need repair.
  - Std Specs were last updated in 2002 & contain deficiencies.
  - LRFD Specs have been used nationally for 10 years and multiple changes based on latest research have helped make it more mature.







PART A—LOAD AND RESISTANCE FACTOR RATING

6A.1—INTRODUCTION

6A.1.1—General

The load and resistance factor rating procedures of Part A provide a methodology for load rating a bridge consistent with the load and resistance factor design philosophy of the *AASHTO LRFD Bridge Design Specifications*.

C6A.1.1

A structure, designed and checked by the load and resistance factor method using HL-93 loading, may not require load rating calculations to determine the inventory or operating rating until changes to the structure occur that would reduce the inventory rating below the design load level. At the discretion of the owner, the inventory or operating ratings for the design load for these structures may be assigned based on the design loading. The HL-93 rating factors would generally be: Inventory 1.0, Operating 1.3.

Design & Evaluation for Bridge Repair Projects BDM 4.6.2

- Does the entire bridge need to be evaluated?
  - For the superstructure, rerating is always required.

  - Substructure is typically only rated when significant additional loads will be applied due to the repair
    or
    inspections have noted deterioration or damage to the substructure.

<u>Always</u> use LRFR!

Design & Evaluation for Bridge Repair Projects BDM 4.6.2

- Minimum LRFR requirements:
  - For superstructures, minimum LRFR inventory rating factor = 0.9
  - For substructures of bridge rehabilitation projects, minimum LRFR inventory rating factor = 1.0

Design & Evaluation for Bridge Repair Projects BDM 4.6.2

- Minimum LRFR requirements (cont'd):
  - For substructures of major bridge preservation projects where bridge currently has permit restrictions, minimum LRFR inventory rating must be ≥ superstructure inventory rating.
  - For substructures of major bridge preservation projects where bridge does not have current permit restrictions, minimum LRFR inventory rating must be ≥ 1.0, but need not exceed the superstructure inventory rating.

Design & Evaluation for Bridge Repair Projects BDM 4.6.2

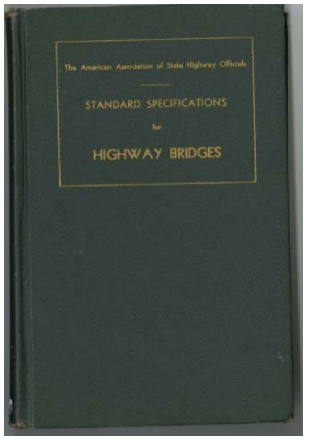
- If minimum LRFR requirements cannot be met?
  - Discuss options with Final Design Unit Leader

AASHTO Bridge Design Specifications

- In 1935, *AASHTO Standard Specifications for Highway Bridges, 2nd Edition* had:

  234 pages total

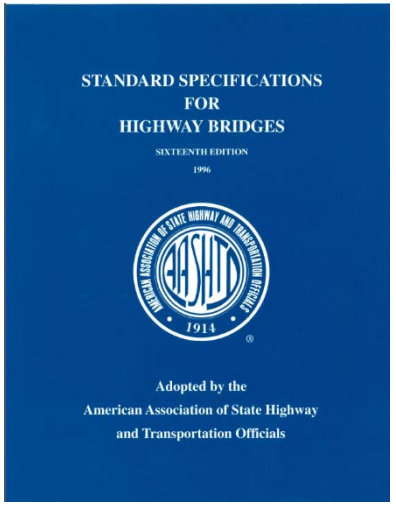
  69 pages on design



- In 1996, *AASHTO Standard Specifications for Highway Bridges* had:

  843 pages total

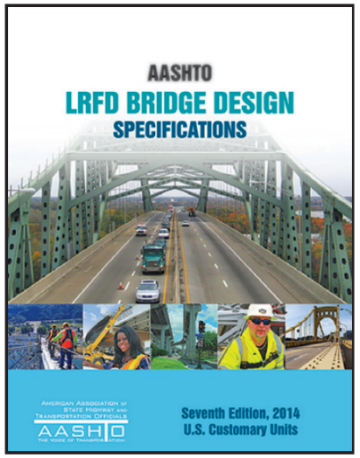
  425 on design



AASHTO Bridge Design Specifications

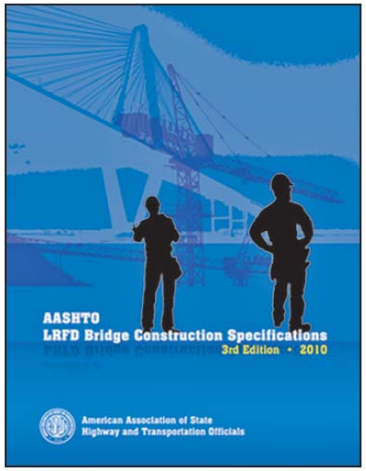
- Fast forward to 2016
  - *AASHTO LRFD Bridge Design Specifications* has:

    2150 pages



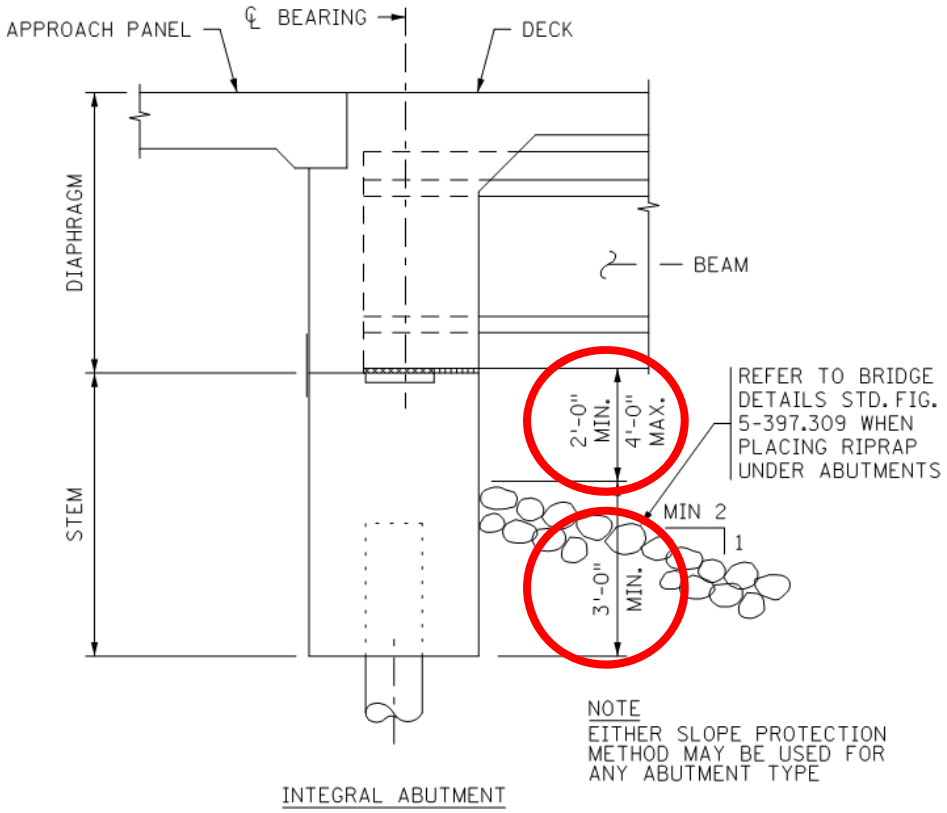
  - *AASHTO LRFD Bridge Construction Specifications* has:

    717 pages



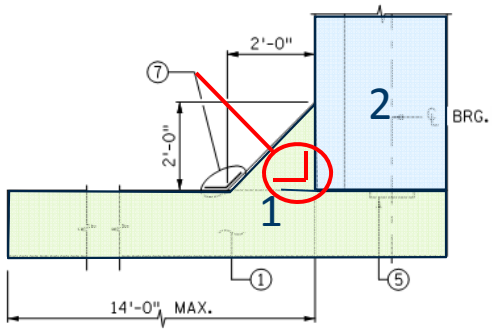
Integral Abutments BDM 11.6.2

- Stem height
  - Set abutment stem height as short as practical.
  - Preferred abutment stem height on the low side of the bridge is 5 feet, with 3 feet below grade and 2 feet exposure.



Integral Abutments BDM 11.6.2

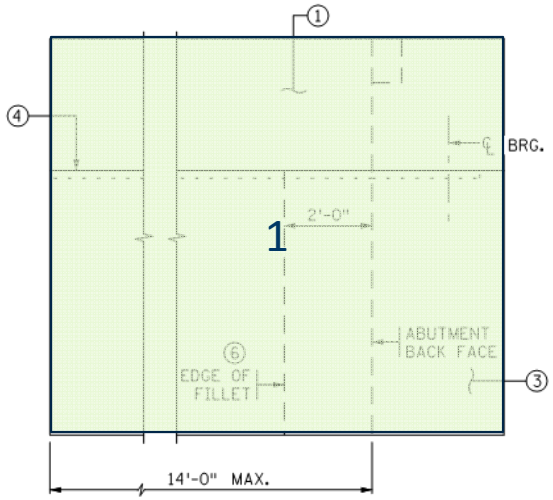
- Permissible construction joints - Contractor Option A



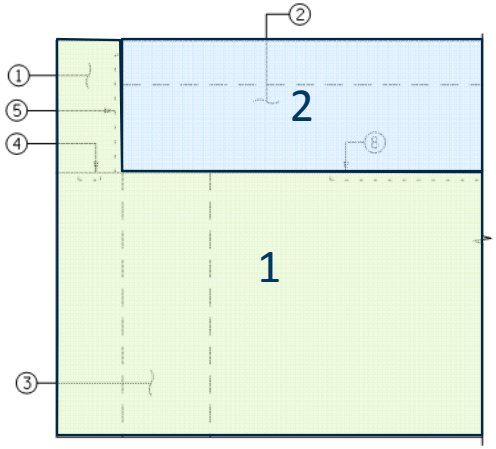
WINGWALL PLAN VIEW

NOTES:

1. UPPER PORTION OF WINGWALL MAY BE CONCRETE MIX 3B52 OR SAME AS DECK CONCRETE, BUT WILL BE PAID FOR AS 3B52 CONCRETE.
2. DIAPHRAGM TO BE SAME MIX AS DECK CONCRETE AND PAID FOR AS DECK CONCRETE.
3. ABUTMENT STEM AND LOWER PORTION OF WINGWALL TO BE CONCRETE MIX 3B52 AND PAID FOR AS 3B52 CONCRETE.
4. PERMISSIBLE CONSTRUCTION JOINT WITH KEYWAY, IF UPPER PORTION OF WINGWALL IS PLACED WITH DIAPHRAGM AND DECK.
5. PERMISSIBLE CONSTRUCTION JOINT WITH KEYWAY, IF UPPER PORTION OF WINGWALL IS PLACED WITH ABUTMENT.
6. 2'-0" × 2'-0" FILLET EXTENDS TO TOP OF STEM.
7. MEMBRANE WATERPROOFING SYSTEM IF CONSTRUCTION JOINT IS USED.
8. CONSTRUCTION JOINT WITH KEYWAYS BETWEEN BEAMS.



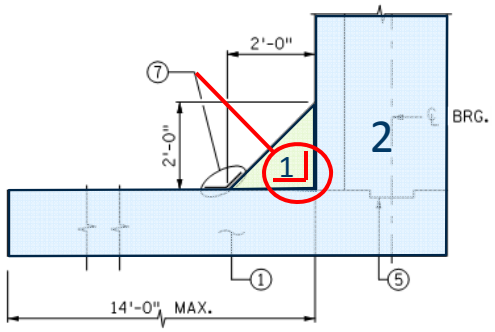
WINGWALL ELEVATION VIEW



ABUTMENT PARTIAL ELEVATION VIEW

Integral Abutments BDM 11.6.2

- Permissible construction joints – Contractor Option B



WINGWALL PLAN VIEW

NOTES:

1. UPPER PORTION OF WINGWALL MAY BE CONCRETE MIX 3B52 OR SAME AS DECK CONCRETE, BUT WILL BE PAID FOR AS 3B52 CONCRETE.
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3. ABUTMENT STEM AND LOWER PORTION OF WINGWALL TO BE CONCRETE MIX 3B52 AND PAID FOR AS 3B52 CONCRETE.
4. PERMISSIBLE CONSTRUCTION JOINT WITH KEYWAY, IF UPPER PORTION OF WINGWALL IS PLACED WITH DIAPHRAGM AND DECK.
5. PERMISSIBLE CONSTRUCTION JOINT WITH KEYWAY, IF UPPER PORTION OF WINGWALL IS PLACED WITH ABUTMENT.
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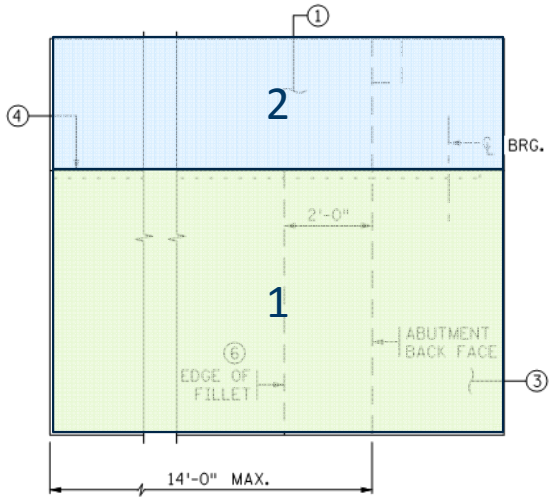
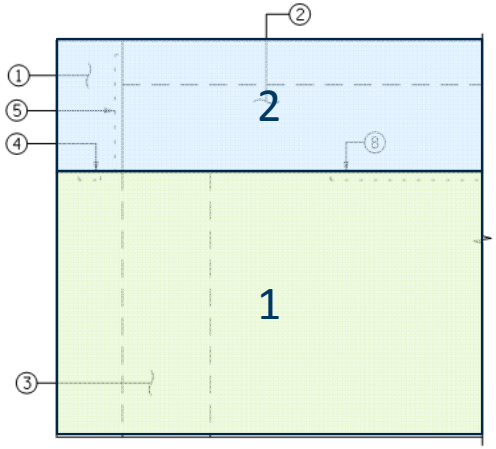
8. CONSTRUCTION JOINT WITH KEYWAYS BETWEEN BEAMS.



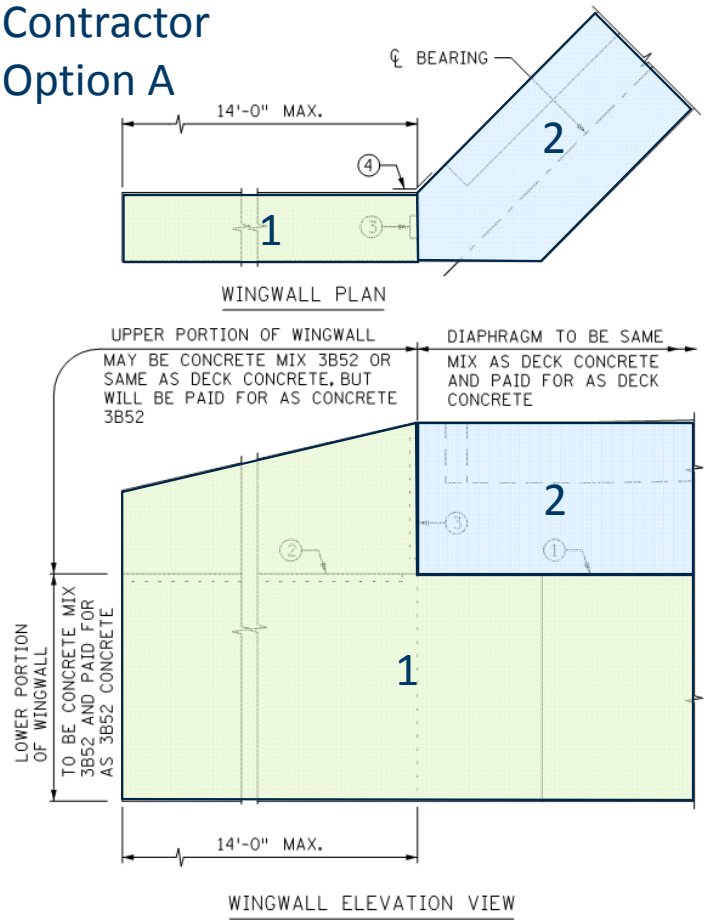
WINGWALL ELEVATION VIEW



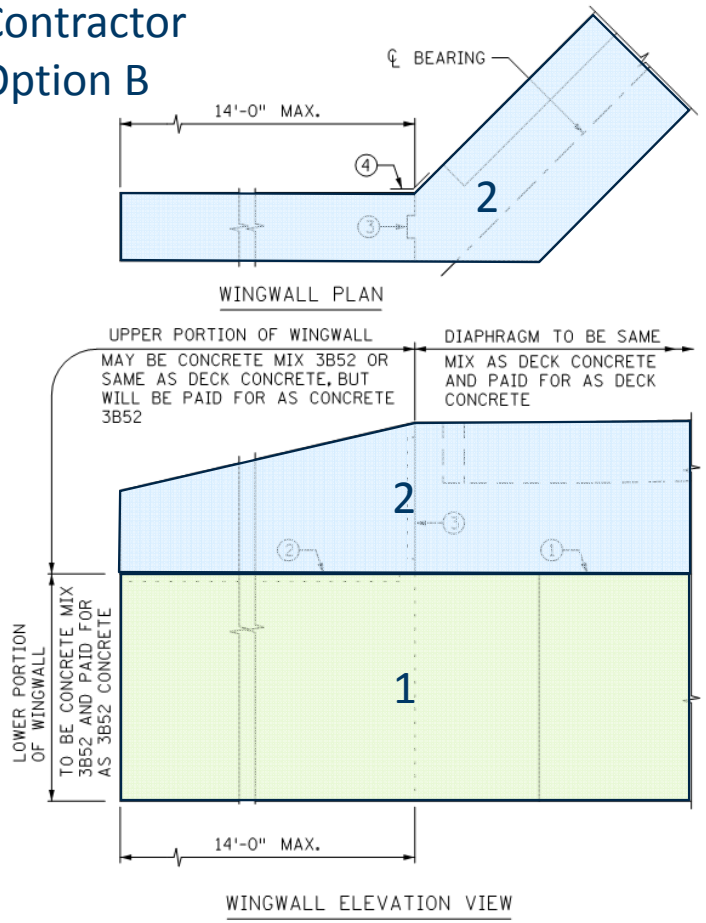
ABUTMENT PARTIAL ELEVATION VIEW

Integral Abutments BDM 11.6.2

Contractor Option A

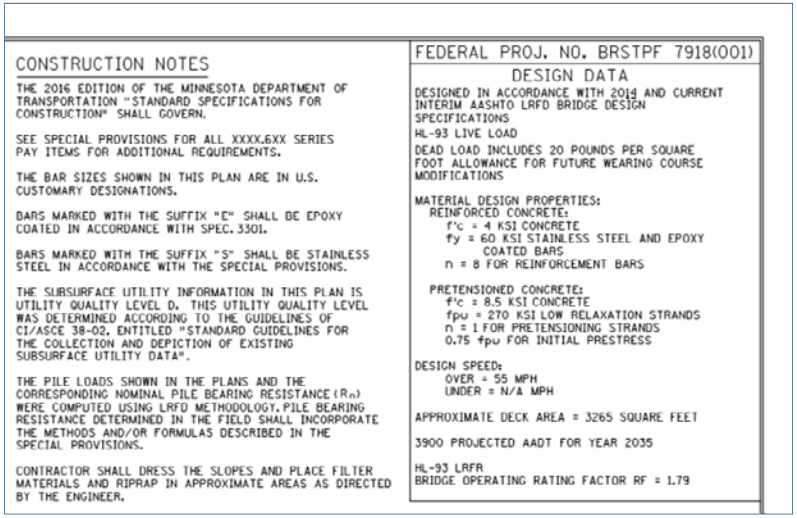


Contractor Option B



Standard Plan Notes – BDM Appendix 2-C

- Draft Standard Plan Notes sent out in January 2016
- Numerous changes



CONSTRUCTION NOTES

THE 2016 EDITION OF THE MINNESOTA DEPARTMENT OF TRANSPORTATION "STANDARD SPECIFICATIONS FOR CONSTRUCTION" SHALL GOVERN.

SEE SPECIAL PROVISIONS FOR ALL XXXX.6XX SERIES PAY ITEMS FOR ADDITIONAL REQUIREMENTS.

THE BAR SIZES SHOWN IN THIS PLAN ARE IN U.S. CUSTOMARY DESIGNATIONS.

BARS MARKED WITH THE SUFFIX "E" SHALL BE EPOXY COATED IN ACCORDANCE WITH SPEC. 3301.

BARS MARKED WITH THE SUFFIX "S" SHALL BE STAINLESS STEEL IN ACCORDANCE WITH THE SPECIAL PROVISIONS.

THE SUBSURFACE UTILITY INFORMATION IN THIS PLAN IS UTILITY QUALITY LEVEL D. THIS UTILITY QUALITY LEVEL WAS DETERMINED ACCORDING TO THE GUIDELINES OF CI/ASCE 38-02, ENTITLED "STANDARD GUIDELINES FOR THE COLLECTION AND DEPICTION OF EXISTING SUBSURFACE UTILITY DATA".

THE PILE LOADS SHOWN IN THE PLANS AND THE CORRESPONDING NOMINAL PILE BEARING RESISTANCE (R_n) WERE COMPUTED USING LRFD METHODOLOGY. PILE BEARING RESISTANCE DETERMINED IN THE FIELD SHALL INCORPORATE THE METHODS AND/OR FORMULAS DESCRIBED IN THE SPECIAL PROVISIONS.

CONTRACTOR SHALL DRESS THE SLOPES AND PLACE FILTER MATERIALS AND RIPRAP IN APPROXIMATE AREAS AS DIRECTED BY THE ENGINEER.

FEDERAL PROJ. NO. BRSTPF 7918(001)

DESIGN DATA

DESIGNED IN ACCORDANCE WITH 2014 AND CURRENT INTERIM AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS

HL-93 LIVE LOAD

DEAD LOAD INCLUDES 20 POUNDS PER SQUARE FOOT ALLOWANCE FOR FUTURE WEARING COURSE MODIFICATIONS

MATERIAL DESIGN PROPERTIES:
REINFORCED CONCRETE:
$f'c$ = 4 KSI CONCRETE
fy = 60 KSI STAINLESS STEEL AND EPOXY COATED BARS
n = 8 FOR REINFORCEMENT BARS

PRETENSIONED CONCRETE:
$f'c$ = 8.5 KSI CONCRETE
fpu = 270 KSI LOW RELAXATION STRANDS
n = 1 FOR PRETENSIONING STRANDS
0.75 fpu FOR INITIAL PRESTRESS

DESIGN SPEED:
OVER = 55 MPH
UNDER = N/A MPH

APPROXIMATE DECK AREA = 3265 SQUARE FEET

3900 PROJECTED AADT FOR YEAR 2035

HL-93 LRFR
BRIDGE OPERATING RATING FACTOR RF = 1.79

plan notes 5-1-2017.docx

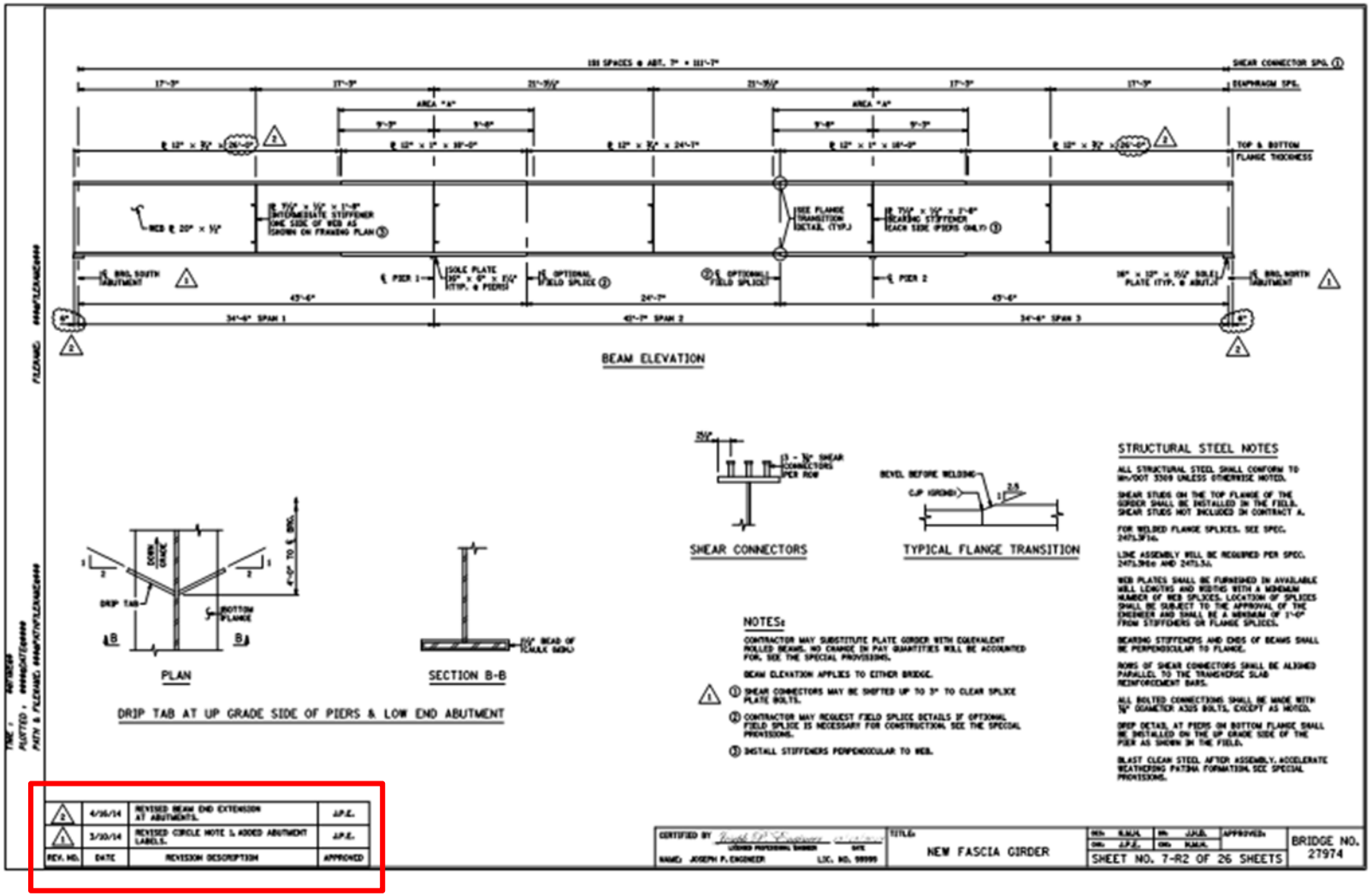
Revised Plan Sheets – BDM 2.4.3

- Clarifying changes were made to the guidance on revised sheets. New guidance is as follows:

  1) Make the necessary revisions

  2) Add a revision block that includes the revision number within a triangle border, the revision date, a description of the revision, and the initials of the engineer who approved the revision.

Revised Plan Sheets – BDM 2.4.3



Revised Plan Sheets – BDM 2.4.3

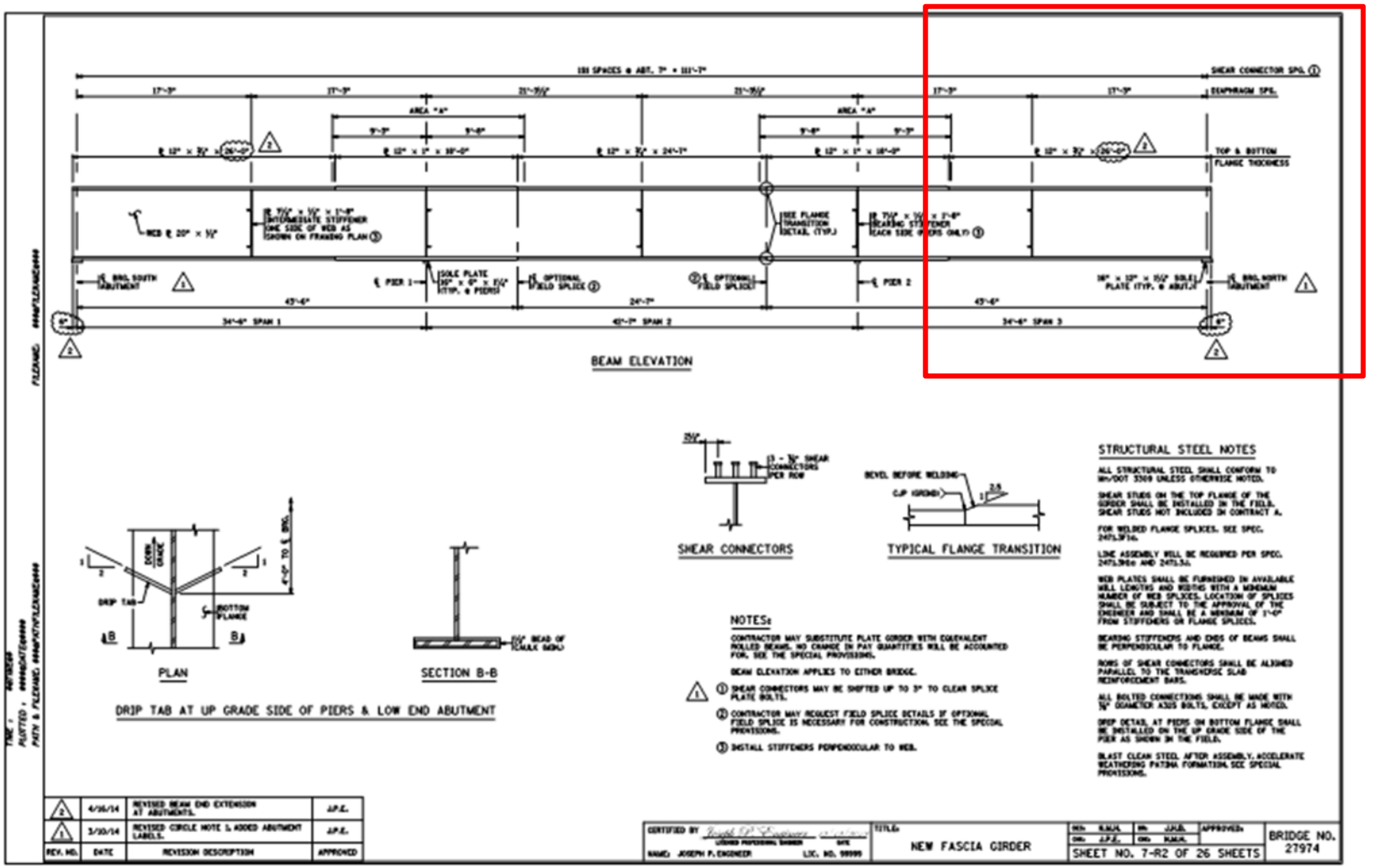
REV. NO.	DATE	REVISION DESCRIPTION	APPROVED
2	4/16/14	REVISED BEAM END EXTENSION AT ABUTMENTS.	J.P.E.
1	3/10/14	REVISED CIRCLE NOTE 1, ADDED ABUTMENT LABELS.	J.P.E.

Revised Plan Sheets – BDM 2.4.3

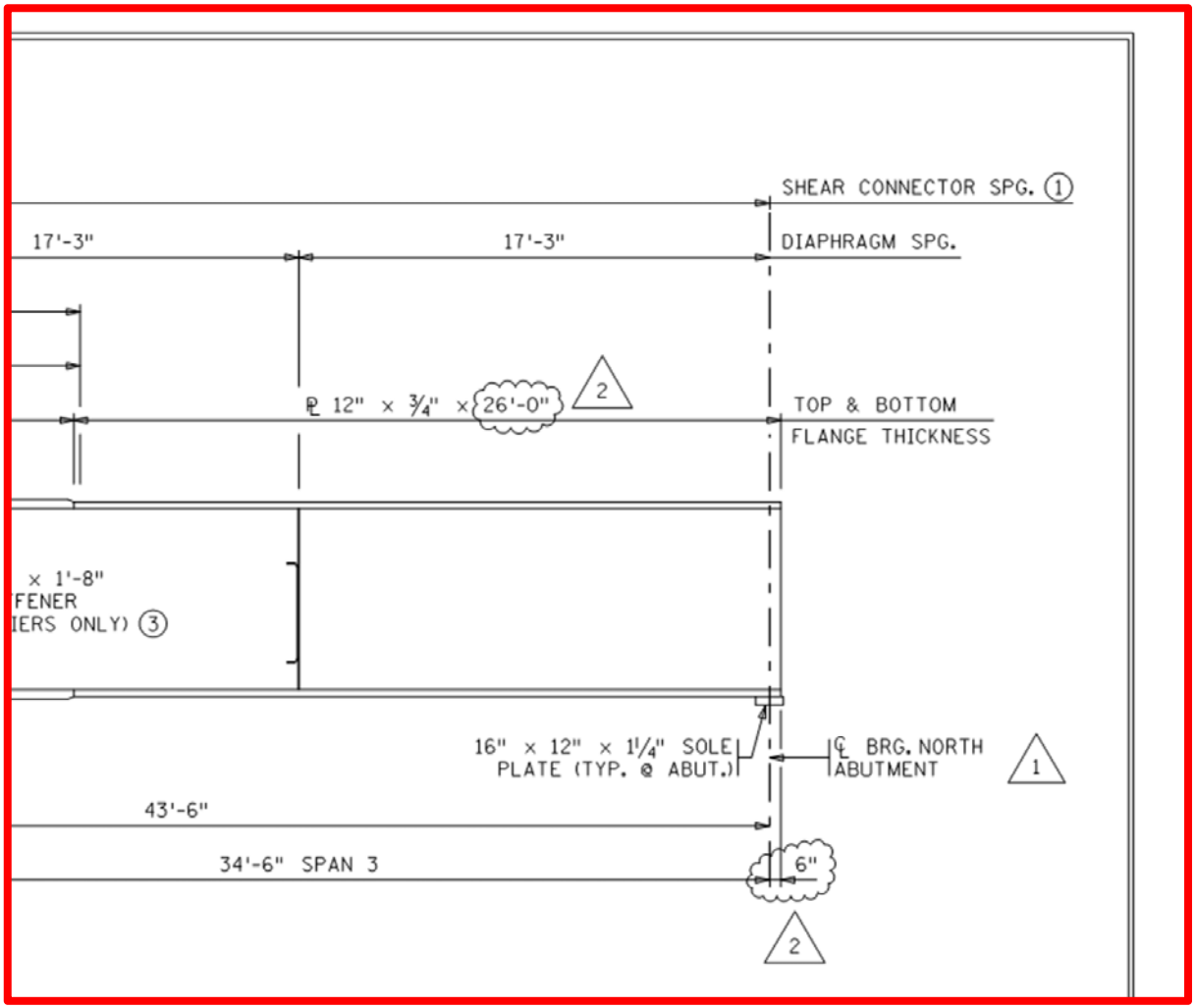
- New guidance (continued):

  3) "Cloud" the actual revisions to the sheet and include the revision number within a triangle border next to the "clouded" change. When sheets have been revised multiple times, remove previous revision "clouds", only "clouding" the current revisions. However, leave previous triangles with their revision numbers in place.

Revised Plan Sheets – BDM 2.4.3



Revised Plan Sheets – BDM 2.4.3

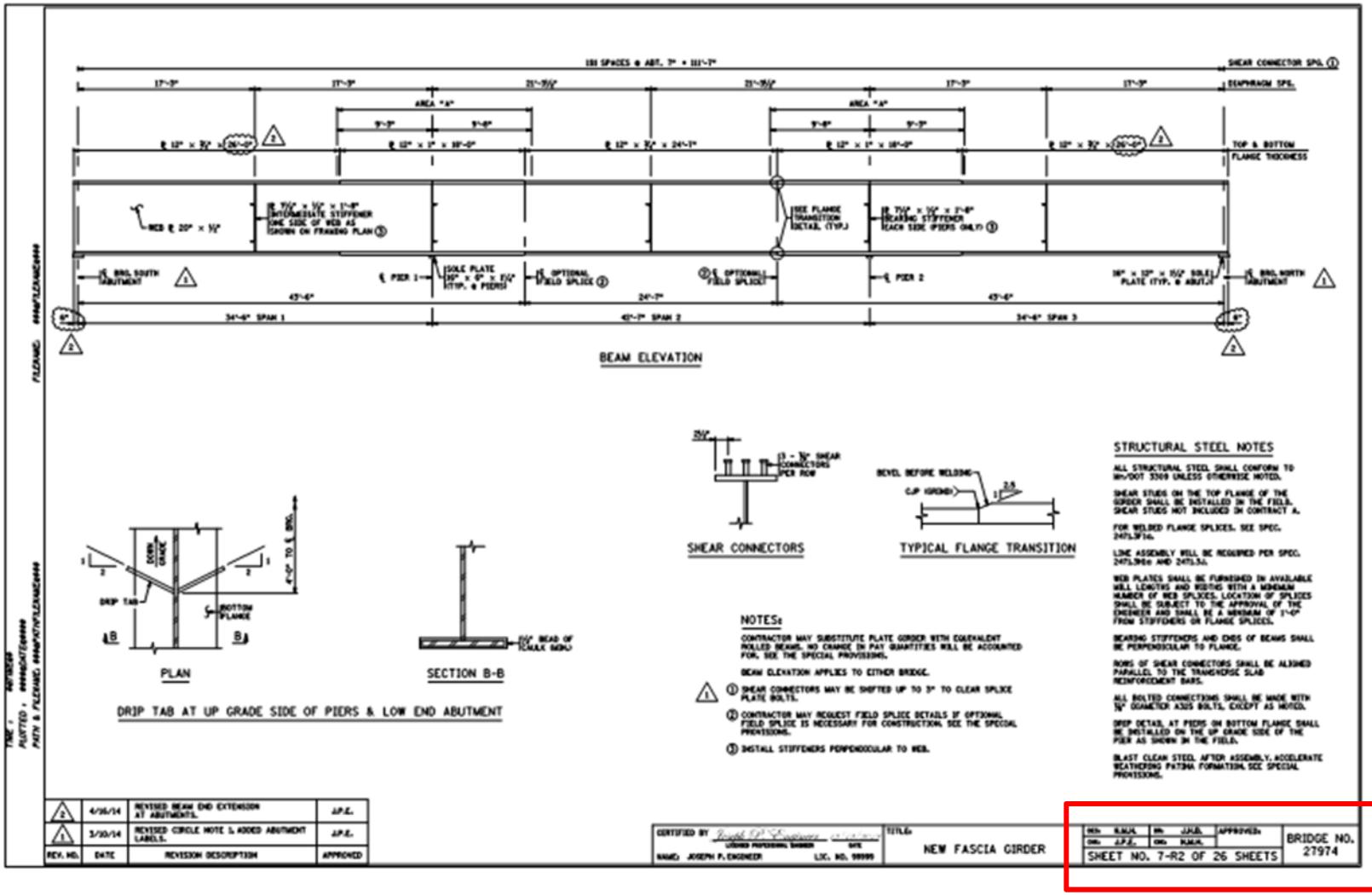


Revised Plan Sheets – BDM 2.4.3

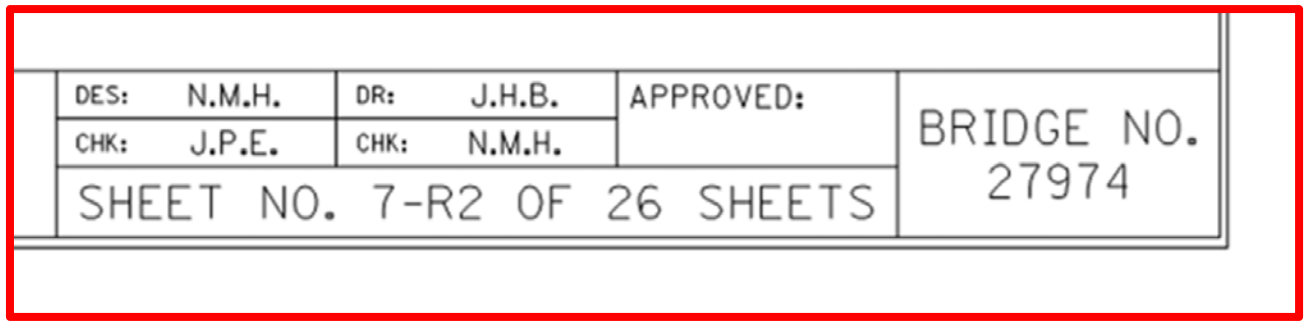
- New guidance (continued):

    4) Change the sheet number by placing a “-R” and the revision number after the original sheet number. For example, revision 1 to sheet 7 will be designated “SHEET NO. 7-R1”, revision 2 will be designated “SHEET NO. 7-R2”, etc.

Revised Plan Sheets – BDM 2.4.3



Revised Plan Sheets – BDM 2.4.3



Revised Plan Sheets – BDM 2.4.3

- New guidance (continued):

  5) For situations where an additional plan sheet must be inserted as part of the revision, repeat the preceding sheet number with an “A” after it. For example, as part of revision 1 where a sheet needs to be added between sheet 5 and 6, designate the revised sheet as “SHEET NO. 5A-R1”.

Other BDM Changes

Published:

- Single Slope Barrier (Memo to Designers)
- Deck Overhang Design (Memo to Designers)

Other BDM Changes

Future:

- Section 2 – geometrics, pay items, modifying standards, etc.
- Prestressed beam charts (Type S barrier)
- Section 14 – Bridge Joints and Bearings
- Section 13 – Bridge Railings
- Adhesive anchors
- Section 9 - Decks
- Remove Section 15 on Load Rating (when New Bridge Load Rating Manual is complete)

Thank you!

Dave Dahlberg

dave.dahlberg@state.mn.us

651.366.4491