Design Load Rating (DL) Process for Montana Department of Transportation's (MDT) Load Rating Manual

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Who We Are

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MBI and MDT Working Together



- Load Rating Contract 2021-2024
 - Throughout our Term Assignments we've load rated 545 bridges including:
 - Concrete
 - Prestressed Concrete
 - Steel (including curved)
 - Trusses
 - Timber
 - Culverts
- Load Rating Manual Update
- Inspection QA and Manual Update



Bridges Without Adequate Information

- Close to 400 bridges that can't be rated with information available
- 325 of those bridges are Concrete and Prestressed
- County Owned structures
- Low volume local roads





- A process to load rate concrete bridges without plans and/or shop drawings
- Better than the 'old-school' Rational Evaluation (Assigned Rating) method
- Develop a 'design' for the bridge with a design ratio close to 1.0
- More accurate ratings when including deterioration
- Cheaper than Load Testing and NDE

Condition Rating	LFR Des Rating	ign Load Factors	Load Posting (Tons)
NBI Condition Rating *	Inventory	Operating	
7 to 9 (Good to Excellent Condition no sign of deterioration or distress)	1.00	1.66	No posting required
5 to 6 (Fair Condition with minor or initial signs of deterioration or distress)	0.75	1.25	No posting required
4 (Poor Condition structural deterioration or distress present)	0.60	1.00	No posting required
3 (Serious condition major deterioration or signs of distress. See Note 1)	0.39 0.21	0.65 0.35	15 8
2 (Critical condition may need to consider closure)	0.13	0.22	5
0 or 1 (Bridge Closed)	0.0	0.0	Bridge Closed

*NBI condition rating is either NBI #59 (Superstructure) or #62 (Culvert)



Michael Baker

ΙΝΤΕΡΝΔΤΙΟΝΔΙ

DL Case Study

- MBI worked with MDT to identify a small sample set
- The purpose of the sample set is to help develop a DL procedure and best practices
- Focused on county-owned prestressed structures

- Exhausted all other avenues to find shop drawings:
 - Contacted Counties, Engineers, Fabricators, etc



DL Case Study Process

Found an Example

- Use MDT's AASHTOWare BrM database
- Search based on:
 - Age
 - Proximity
 - Span
 - "Sister Bridges" vs "Similar (Cousin) Bridges"
- Limited precast fabricators used in MT within recent history

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- Beunher
- Eagle Precast
- Central Pre-Mix (Oldcastle)
- Contech
- United Prestress
- Stanley Structures

DPOTTHAST, LUKE	Bridges > View Li	ist																
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DL Case Study Process

'Designed' the Bridge

- All bridges were designed in LFR
- Some bridges used non-standard live loads for design: H20 or HS15 vs HS20-44
- Used a combination of AASHTOWare BrD and BrR
 - BrD only uses LRFD code provisions
 - BrR uses LFR
- Recreated design using example and tweaking as needed
 - Used material properties from either MBE or Standard Specifications
 - Used strand patterns similar to the example, including harped strands
 - Included shear checks in our designs



Table 3.4.8.1.3-1 – Design Load, Year of Design & Facility Type Correlation

		E-12-76
4 H DOLETON	TVO BEIDGES	Date
Philothic	TANGLEVIOOD LAKE	RLE.

PRECAST SECTION NOTES :

THE PREAST SECTION SHOWN IS INTENDED TO BE A TYPICAL EXAMPLE ONLY. OTHER SECTIONS MAY BE USED PROVIDED DESIGN CALCULATIONS ARE SUPPLIED SHOWING ADEQUALY IN SUPPORTING HS-15 LOADILLA & ARE EQUAL IN ALL OTHER RESPECTS TO THE CHANNELS SHOWN. ALL SECTIONS MRYING FROM THE ONE SHOWL MUST BE RIOR TO BIDDING.





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DL Case Study Process

- Separate Design and Rating models in BrR
- Load rated bridges in LRFR
- Rating Refinements:
 - Rate in LFR for bridges built before 2010
 - Remove Service III limit state for legal vehicles

Load Rated the Bridge

• Reduced EV live load effects per NCHRP 20-07





DL Case Study Process









Identified Issues

Key Issues

- Difficulty getting design ratio within target range (0.98-1.0)
- Finding a design program that uses LFD
- Using the applicable version of the design code

Happy Little Accident

- MDT uses AASHTO Refined analysis for PS losses including elastic gains in load ratings
- Older designs more likely to use Approximate method for PS losses
- Resulted in higher design ratios with fewer strands resulting in lower load ratings
- Still no postings required

Results





- Design ratios ranged from 0.982-1.095
- Approximate methods for PS losses reduced design ratio 4% on average
- No postings required



Things to Consider

Develop standards upfront

• Search DOT archives and work with local fabricators to find historical standards

Accuracy vs Efficiency

- To recreate the assumed design \rightarrow use Strands in a Row method
- A 'design' ratio of 0.98-1.0 \rightarrow use P&CGS strand input method

Applicable Code Checks

• Use the 1979 AASHTO Interim Shear Provisions?







INTERNATIONAL

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