Bridge Rehabilitation Frequently Asked Questions

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What's new?

Proposed IDM Chapter is still Pending

Includes: 2R(Minor) / 3R(Major)

Many clarifications presented here

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What's new?

Bridge Asset Management Engineers

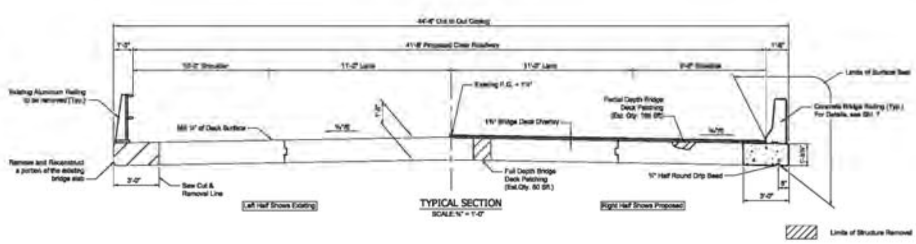
- New Position
- Programming/Scoping
- Attending Field Checks

Bridge and Culvert Preservation Initiative

- Collaborating with BAM Engineers on a development process

Rehab Terminology

"Existing Bridge to Remain in Place"
is DECK to remain in place



Geometry Requirements – Chapter 55

Minimum Horizontal Curve [55-4.03(01)]

No crash history

CEDS > 15 mph below design speed

AADT < 750

Crest Vertical Curve [55-4.04(03)]

No crash history

Doesn't hide a hazard

CEDS > 20 mph below design speed

AADT < 1500

What is CEDS?

Calculated Existing Design Speed

At what speed does the element meet the design criteria?

Design Speed (mph)	Brake Reaction Time (s)	Brake Reaction Dist. (ft)	Braking Distance (ft)	Minimum Calculated SSD (ft)	Rounded SSD for Design (ft)
15	2.5	55.1	21.6	76.7	80
20	2.5	73.5	38.4	111.9	115
25	2.5	91.9	60.0	151.9	155
30	2.5	110.3	86.4	196.7	200
35	2.5	128.6	117.6	246.2	250
40	2.5	147.0	153.6	300.6	305
45	2.5	165.4	194.4	359.8	360
50	2.5	183.8	240.0	423.8	425
55	2.5	202.1	290.3	492.4	495
60	2.5	220.5	345.5	566.0	570
65	2.5	238.9	405.5	644.4	645
70	2.5	257.3	470.3	727.6	730

STOPPING SIGHT DISTANCE
FOR PASSENGER CAR

Figure 42-1A

Reference: IDM 55-4.03

Geometry Requirements – Chapter 55

Sag Vertical Curve

No crash history

Meets comfort criteria in Fig. 55-4A

Design Speed (mph)	Calculated K Value ($K = V^2/46.5$)	K Value Rounded For Design
20	8.6	9
25	13.4	14
30	19.4	20
35	26.3	27
45	43.5	44
50	53.8	54
55	65.1	66
60	77.4	78
70	105.4	106
75	121.0	122

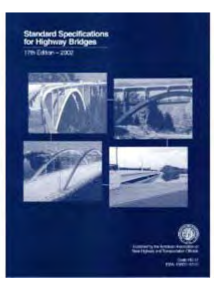
$$L = \frac{AV^2}{46.5} = KA$$

Where:

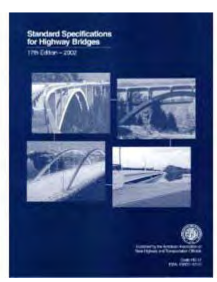
- L = *Length of vertical curve, ft.*
- A = *Algebraic difference between grades, %*
- K = *Horizontal distance required to effect a 1% change in gradient*
- V = *Design speed, mph*

What Loads and Codes?

Design code used for existing structure should be used for rehabilitation design



Existing Design



Rehabilitation Design

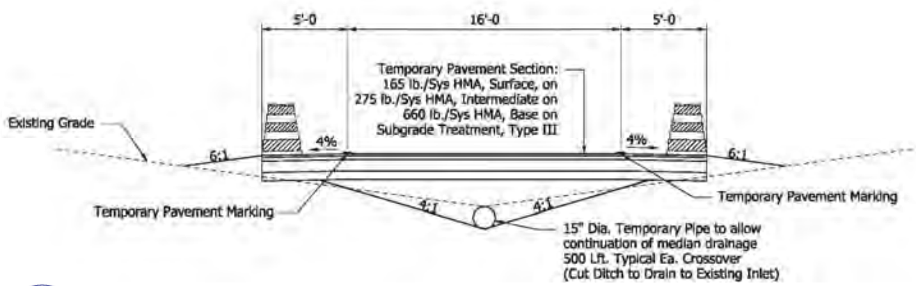
Reference: IDM 72-4.02

Pavement Considerations

Pavement designs are now required

- **HMA Wedge is exempt**
- **Contact the Pavement Design Section early!**

  Possibly use existing geotech data*



* If geotech not required for other aspects of the project

Pavement Considerations

Changes in the 402 items

- **No more HMA, type A, B, C, D**
- **Still have HMA, Wedge and Level**
- **Still have HMA, Temporary Pavement**

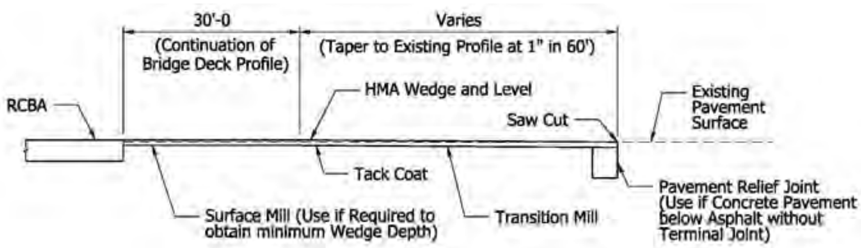
401.09

"Acceptance of mixtures…will be based on a type D certification in accordance with 402.09 for dense graded mixtures with original contract pay item quantities less than 300 t."

Wedge and Level Detail

Proposed deck higher than existing

- **Minimum wedge material thickness 1.5”**
- **Minimum grader taper 1” in 60’**



30’ Resurface when no elevation change

- **Mill 1.5”, place 1.5”**

Replacing Bridge Joints

Eliminate when possible

- **Semi-integral end bents**
- **Design beams continuous**

Replacing Bridge Joints

Expansion Joint Sealing System (XJS)

- Replaces most BS Joints
- Check opening width with specifications
- No new BS Joints*

Replacing Bridge Joints

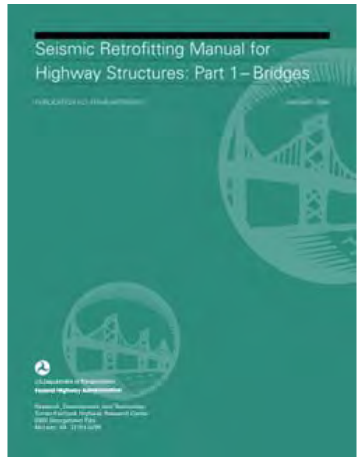
SS & Modular Joints are replaced in kind

- Limited success replacing seals
- Deck removal required
- Cost more than just the joint pay item

Policy on Seismic Retrofit

Proposed IDM Chapter 412

"The need for additional seismic retrofit measures will be discussed at the field check."



Considerations:

Location & Importance of Structure

Type & Magnitude of Project

Check Support Length

http://www.in.gov/dot/div/contracts/training/2010/SeismicRetrofit/Intro.pdf

Design Exception Justification

What makes a good design exception??

Design Exception Justification

Discuss risk associated with subject item…

- **How has element impacted crash history?**
- **How was severity of crashes affected?**

Can these be quantified?!

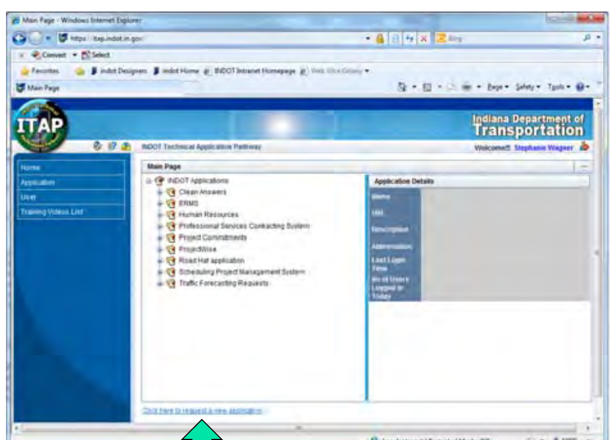
Design Exception Justification

Good Resource

HAT

Hazard Analysis Tool

https://itap.indot.in.gov/



Request a new application

Design Exception Justification

Input:

Crash Data from District

Don't filter crashes!

Output:

Index of Crash Frequency

$I_{CF} < 0$

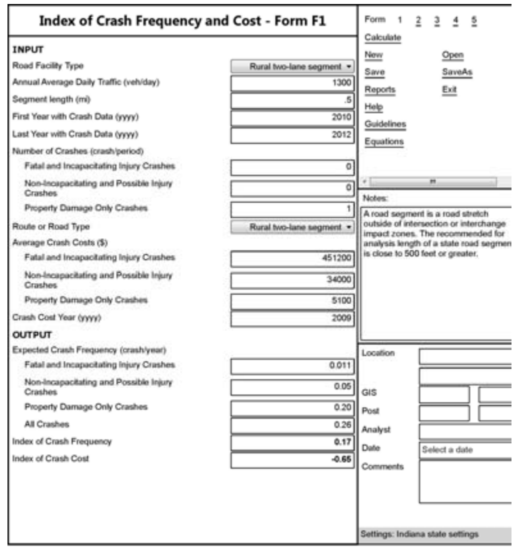
Fewer Crashes than Expected

$I_{CF} > 0$

More Crashes than Expected

$I_{CF} > 2$

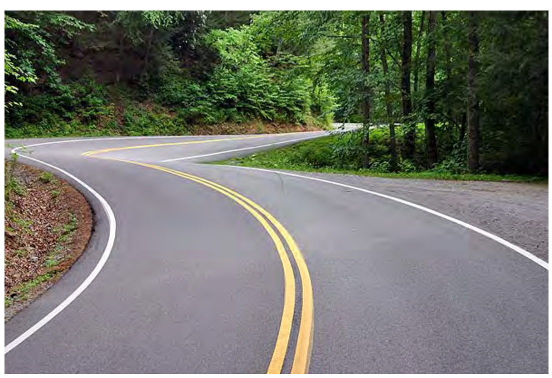
High Crash Location



https://itap.indot.in.gov/

Design Exception Justification

- **How does deficient feature compare with the rest of corridor?**



Design Exception Justification

Another use for Computed Existing Design Speed!

At what speed does the element meet the design criteria?

Is this similar to the rest of the corridor?

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STOPPING SIGHT DISTANCE
FOR PASSENGER CAR

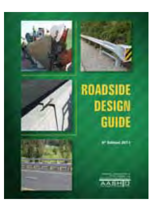
Figure 42-1A

Reference: IDM 55-4.03

Design Exception Justification

Other Resources

Free webinars thru NHI **www.nhi.fhwa.dot.gov**



Roadside Design Guide

Module 7: Bridge Railing

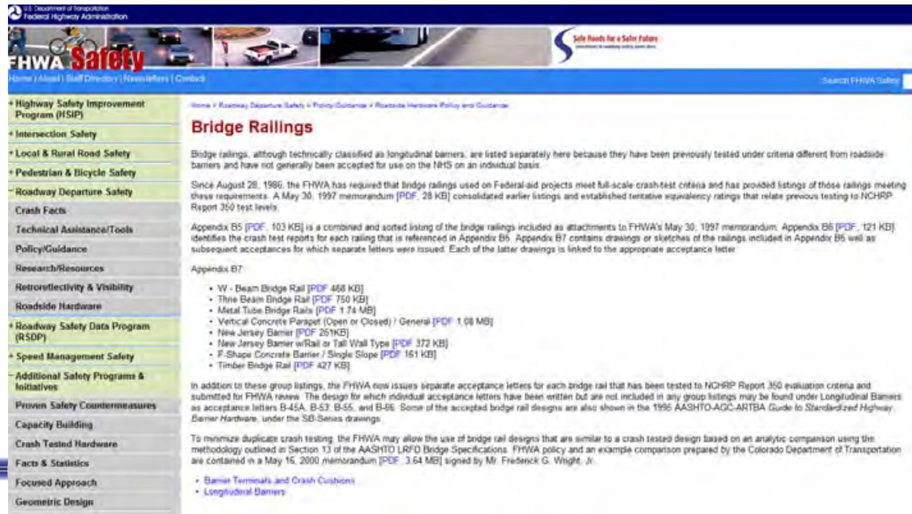
Highway Safety Manual

Chapters 5 & 6: Diagnosis and Countermeasure Selection

Crashworthiness of Existing Bridge Rails

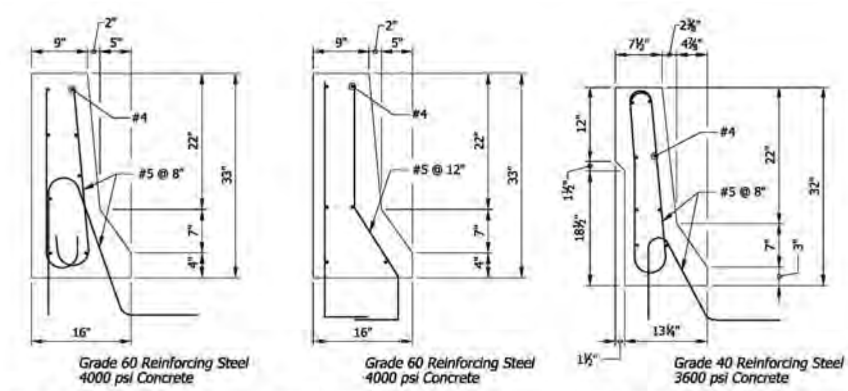
How to know: Compare to FHWA's list of crash tested bridge rails

http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/barriers/bridgerailings/



Crashworthiness of Existing Bridge Rails

Step 1. Geometry



Bridge Railing, Type FC (INDOT Current TL-4)

1989 F-Shape Bridge Railing

32-in F-Shape Bridge Railing (Comparison TL-4 Railing)

Demonstrate ability to redirect errant vehicles

Crashworthiness of Existing Bridge Rails

Step 2. Structural Capacity

Nominal Railing Resistance to Transverse Load

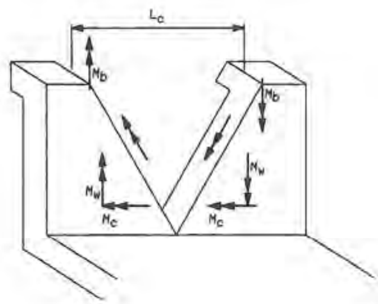
$$R_w := \left(\frac{2}{2L_c - L_t}\right)\left(8M_b + 8M_w + \frac{M_c \cdot L_c^2}{H}\right)$$

LRFD Eq. A13.3.1-1

Critical Wall Length

$$L_c := \frac{L_t}{2} + \sqrt{\left(\frac{L_t}{2}\right)^2 + \frac{8H(M_b + M_w)}{M_c}}$$

LRFD Eq. A13.3.1-2



LRFD CA13.3.1-1

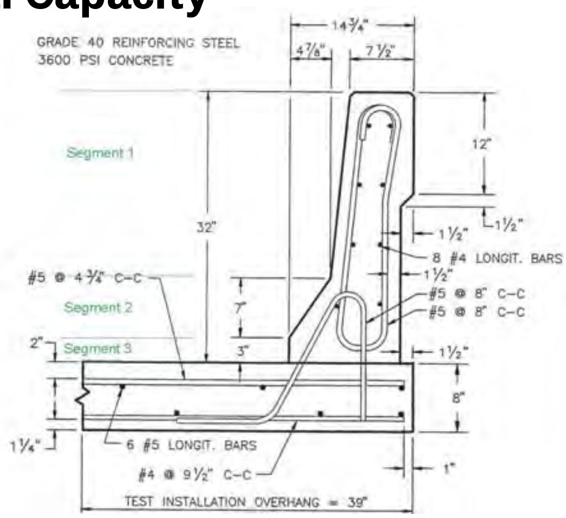
Demonstrate adequate railing resistance

Reference: LRFD Section 13

Crashworthiness of Existing Bridge Rails

Step 2. Structural Capacity

- **Divide Rail into Segments**
- **Calculate Moment Resistance for each Segment and each Direction (Mc & Mw)**
- **Weighted Average for Total Mc**



Reference: 32-in (813-mm) F-shape bridge railing (from FHWA site)

Crashworthiness of Existing Bridge Rails

Step 2. Structural Capacity

- **Compare resistance with crash tested rail**
- **Compare to design forces in table**

Table A13.2-1—Design Forces for Traffic Railings

Design Forces and Designations	Railing Test Levels					
	TL-1	TL-2	TL-3	TL-4	TL-5	TL-6
F_t Transverse (kips)	13.5	27.0	54.0	54.0	124.0	175.0
F_L Longitudinal (kips)	4.5	9.0	18.0	18.0	41.0	58.0
F_v Vertical (kips) Down	4.5	4.5	4.5	18.0	80.0	80.0
L_t and L_L (ft)	4.0	4.0	4.0	3.5	8.0	8.0
L_v (ft)	18.0	18.0	18.0	18.0	40.0	40.0
H_e (min) (in.)	18.0	20.0	24.0	32.0	42.0	56.0
Minimum H Height of Rail (in.)	27.0	27.0	27.0	32.0	42.0	90.0

Crashworthiness of Existing Bridge Rails

Step 3. Apply for Design Exception

(*FOR NOW…*)

Working with FHWA on:

State-wide approval for some old standard rails

Clarifying the 2R project approval process

Summary of Key Points

Bridge Rehabilitation Issues

- Policy Clarifications
- Pavement Considerations
- Joint Repairs
- Justifying Design Exceptions

Questions?