U.S. Department of Transportation
Federal Highway Administration
Office of Infrastructure

2024 RADBUG Meeting
FHWA Updates

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Buffalo, NY

FHWA is the source of all images in this presentation unless otherwise noted.

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- Non-Binding Contents

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Outlines

- National Bridge Load Rating Peer Exchanges
- FHWA NBIS Regulation Update 2022
- Fern Hollow Bridge Collapse
- Research Updates
- NBIP Updates

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Bridge Load Rating Peer Exchanges

Bridge Load Rating Peer Exchanges

Purposes and Objectives

- Support implementation of the updated regulation, National Bridge Inspection Standards (NBIS, 23 CFR 650 Subpart C).
- Help achieve and maintain compliance with the regulation.
- Facilitate the exchange of information pertaining to the state of the practice in load rating, posting, and permitting.
- Provide continued awareness, promote commendable practices, and advance the state of the practice.

Bridge Load Rating Peer Exchanges

Participants of the 2024 Salt Lake City and Pittsburgh Peer Exchanges:

State DOT participants were either load rating engineers or Program Managers who have the first-hand knowledge of State's load rating and posting policies, procedures and processes.

- Representatives from State DOTs
- FHWA Division Bridge Engineers
- FHWA Resource Centers (RC) and Office of Bridges and Structures (HQ)
- Iowa State University (Contractor)

Bridge Load Rating Peer Exchanges

April 24-25, 2024. Salt Lake City, UT

- 19 State DOTs
- 23 FHWA Division Offices
- 1 AASHTO Safety and Evaluation Subcommittee
- FHWA HQ and RC
- Iowa State University

Bridge Load Rating Peer Exchanges

May 8-9, 2024. Pittsburgh, PA

- 27 State DOTs
- 26 FHWA Division Offices
- 1 AASHTO Safety and Evaluation Subcommittee
- FHWA HQ and RC
- Iowa State University

Bridge Load Rating Peer Exchanges

Select Topics

- Truck Size and Weight Limits and State Legal Load Models
- Consideration of Deterioration in Bridge Load Rating Analysis
- Timely Load Rating, Re-rating, Posting and Closure
- Analysis for Routine and Special Permit Loads
- Research, Technology and Others

Bridge Load Rating Peer Exchanges

Each Topic

- Presentations
- Questions and Answers
- Breakout Session
- Report-out of Breakout Session

  Prompt Questions for Presenters

  Break-out Questions for Small Group Discussions

Bridge Load Rating Peer Exchanges

Reporting

- Presentations
- A report to provide a synthesis of the peer exchanges.

  90% draft - 6/15/2024 (anticipated)

  Final technical – 9/15/2024 (anticipated)

  Final report - 6/15/2025 (anticipated)

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FHWA NBIS Regulation Update 2022

FHWA NBIS Regulation Update 2022

- Published in the Federal Register May 6th, 2022
- Became effective June 6th, 2022
  - Load rating provisions effective as of that date
- Incorporation of the Specifications for the National Bridge Inventory (SNBI)
  - Supersedes the 1995 “Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation’s Bridges”
  - Full implementation by 2028

FHWA NBIS Regulation Update 2022

650.313(k), (l), (m) Load Rating, Load Posting, Closed Bridges

- Load rate within 3 months of initial inspection and when changes warrant re-rating
- Develop procedures for completion of new and updated load ratings
- Analyze for routine and special permit loads, and all legal vehicles
- Load post within 30 days of load rating or need is identified

FHWA NBIS Regulation Update 2022

Specifications for the National Bridge Inventory (SNBI)

- Without errata – published in 3/2022

  https://www.fhwa.dot.gov/bridge/snbi/snbi_march_2022_publication.pdf

- Errata Number 1 Specifications for the National Bridge Inventory (SNBI) – published in 3/2024

  https://www.fhwa.dot.gov/bridge/snbi/errata1_to_snbi_march_2022_publication.pdf

- SECTION 5: LOADS, LOAD RATING, AND POSTING

FHWA NBIS Regulation Update 2022

SUBSECTION 5.1: LOADS AND LOAD RATING

- B.LR.01 Design Load
- B.LR.02 Design Method
- B.LR.03 Load Rating Date
- B.LR.04 Load Rating Method
- B.LR.05 Inventory Load Rating Factor
- B.LR.06 Operating Load Rating Factor
- B.LR.07 Controlling Legal Load Rating Factor
- B.LR.08 Routine Permit Loads

SUBSECTION 5.2: LOAD POSTING STATUS

- B.PS.01 Load Posting Status
- B.PS.02 Posting Status Change Date

SUBSECTION 5.3: LOAD EVALUATION AND POSTING

- B.EP.01 Legal Load Configuration
- B.EP.02 Legal Load Rating Factor
- B.EP.03 Posting Type
- B.EP.04 Posting Value

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Fern Hollow Bridge Collapse

Fern Hollow Bridge Collapse

- January 28, 2022
- Pittsburgh, Pennsylvania
  - Forbes Avenue over Nine Mile Run in Frick Park
- 6 injuries (2 serious)
- 3-span rigid (K) frame 442’-8” in length
  - Constructed 1972-1973
- Fracture Critical (NSTM) Bridge
- Poor Condition (annual inspections)
- Posted at 26 tons

NTSB Interim Recommendation to FHWA

May 3, 2023 Interim Report – NTSB/HIR-23-07
"Improving the Identification, Prioritization, and Completion of Follow-up Actions on Bridges with Uncoated Weathering Steel Components"

Develop a risk-based, data-driven process and encourage its use by state Departments of Transportation, as well as highway-bridge-owning federal agencies and tribal governments, to help them identify, prioritize, and perform follow-up actions documented in inspections of bridges with uncoated weathering steel components. (H-23-13)

https://www.ntsb.gov/investigations/AccidentReports/Reports/HIR2307.pdf

July 19, 2023 FHWA Memorandum

- https://www.fhwa.dot.gov/bridge/inspection/Memo_July2023_UWS.cfm
- Background
  - Fern Hollow Bridge collapse
  - NTSB Interim report and recommendation
  - FHWA Technical Advisory 5140.22 (1989)
    - Application of UWS - Bridge location
    - Application of UWS - Design details
    - Inspection and maintenance
- Required actions for DOTs

Fern Hollow Bridge Collapse

- NTSB Virtual Board Meeting of February 21, 2024
  - https://www.youtube.com/watch?v=QP7eJQ59onE
  - Meeting Summary (https://www.ntsb.gov/investigations/Documents/Pittsburgh%20Board%20Meeting%20Summary%20%28ABSTRACT%29.pdf)

    This is a synopsis from the NTSB's report and does not include the Board's rationale for the findings, probable cause, and safety recommendations.

Fern Hollow Bridge Collapse

- NTSB Virtual Board Meeting of February 21, 2024
  - 19 Findings
  - Probable Cause:

    was the failure of the transverse tie plate on the southwest leg of the bridge, a fracture-critical member (nonredundant steel tension member), due to corrosion and section loss resulting from the City of Pittsburgh's failure to act on repeated maintenance and repair recommendations from inspection reports. Contributing to the collapse were the poor quality of inspections, the incomplete identification of the bridge's fracture-critical members (nonredundant steel tension members), and the incorrect load rating calculations for the bridge. Also contributing to the collapse was insufficient oversight by the Pennsylvania Department of Transportation of the City of Pittsburgh's bridge inspection program.

Fern Hollow Bridge – NTSB Final Report and Recommendations

- NTSB Virtual Board Meeting, February 21, 2024
  - (New) Recommendations
    - 5 for the Federal Highway Administration
    - 2 for the PennDOT
    - 2 for the City of Pittsburgh
    - 2 for the AASHTO
  - Previous Safety Recommendation H-23-13 to the Federal Highway Administration is classified Closed—Acceptable Action.

Fern Hollow Bridge Collapse

- NTSB Highway Investigation Report, HIR-24-02, February 21, 2024

  Collapse of the Fern Hollow Bridge

  Investigation ID: HWY22MH003

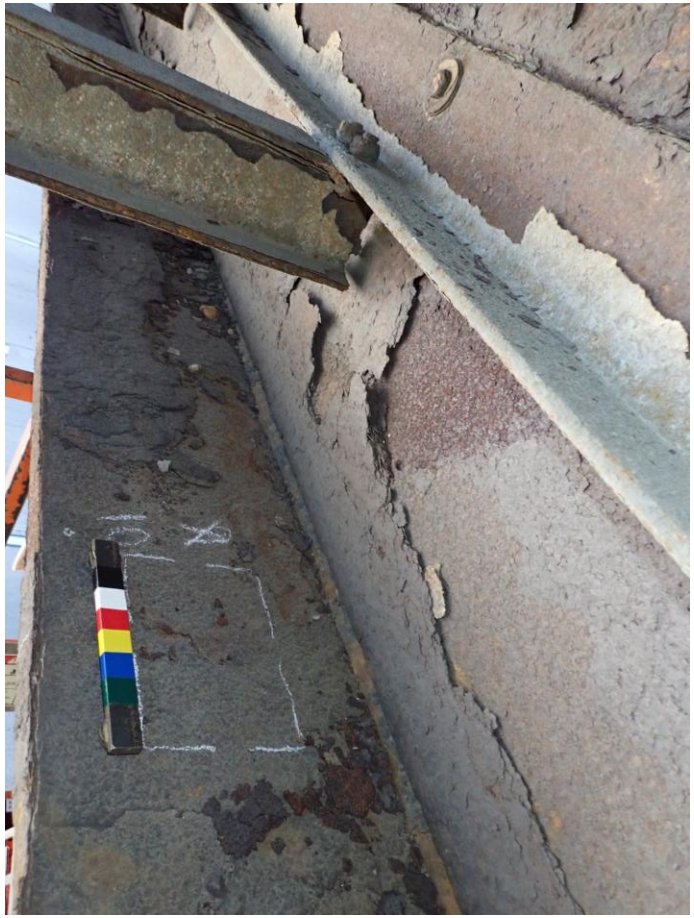
  Website: https://www.ntsb.gov/investigations/Pages/HWY22MH003.aspx

  Docket: https://data.ntsb.gov/Docket/?NTSBNumber=HWY22MH003

Documenting Deterioration

- Cleaning (MBE Article 4.3.5.21)

  Steel components exhibiting impacted crevice corrosion (pack rust) or corrosive delamination require chipping with a hammer or other means to remove corrosion down to the base metal in order to measure the remaining section of sound metal.



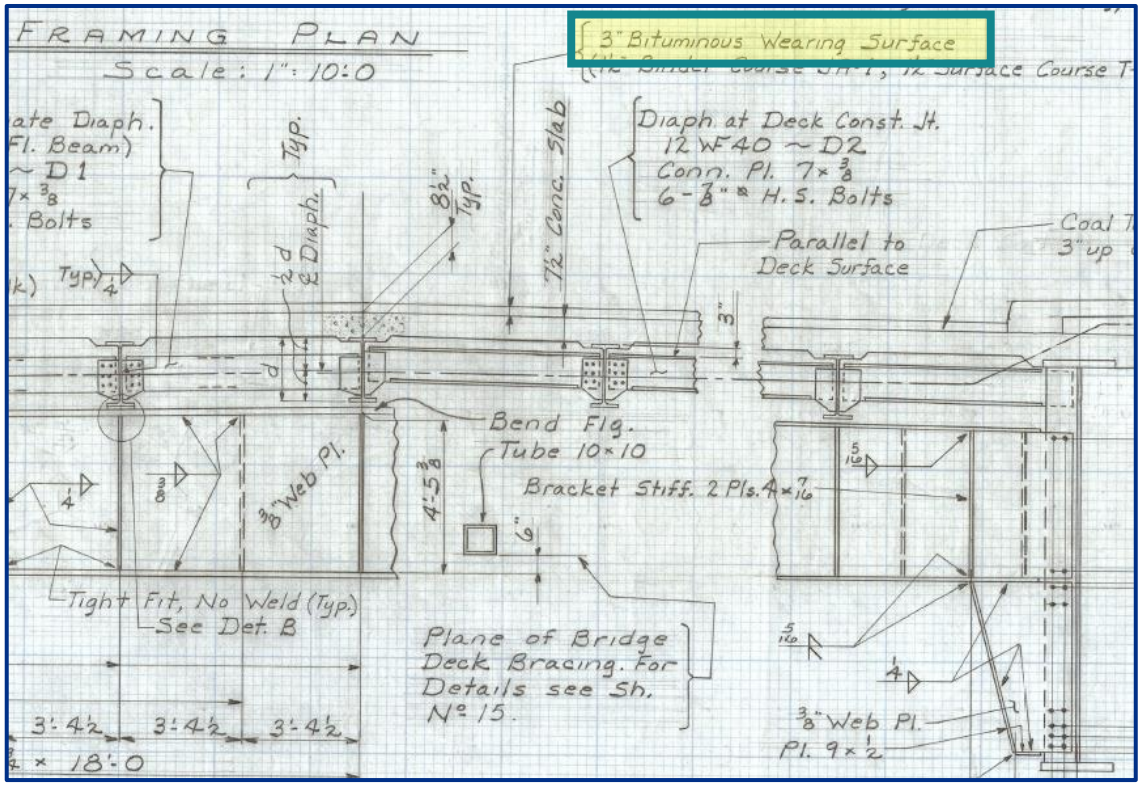
[1] *23 CFR 650.317(a)*

Documenting Deterioration

- Section Loss Measurement and Evaluation (MBE Article 4.3.5.6.12)
  - Inspect structural steel members for loss of section due to corrosion. Where a build-up of rust scale is present, a visual observation is usually not sufficient to evaluate section loss. Hand scrape areas of rust scale to base metal and measure the remaining section using calipers, ultrasonic thickness meters, or other appropriate method. Take sufficient measurements to allow the evaluation of the effect of the losses on member capacity.

[2] *23 CFR 650.317(a)*

Fern Hollow Bridge – Wearing Surface Thickness



Source: City of Pittsburgh

Fern Hollow Bridge – Wearing Surface Thickness

All images source: NTSB

Fern Hollow Bridge – Equivalent Section Loss

- Based on worst-case observation, an 11” wide hole
- Applied as a generalized 11” wide void along entire plate length
- Based on average plate width of 3’-0”, section thickness was reduced proportionately:

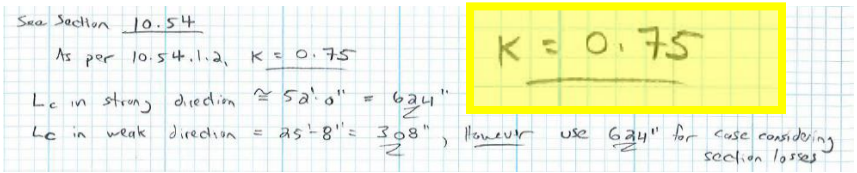
$$\frac{0.5"}{36"} = \frac{t_{eff}}{36" - 11"} \rightarrow t_{eff} = \frac{25"}{36"}(0.5") = 0.347"$$

- Flange losses similarly modeled
- Appropriate for global analyses, not for consideration of local effects

Source: PennDOT and City of Pittsburgh

Fern Hollow Bridge – Effective Length Factor

- From the 2014 Load Rating Calculations (#45 in NTSB Highway Investigation - 68 Docket HWY22MH003)



- From AASHTO Standard Specifications for Highway Bridges, 17th Ed., 2002

10.54.1.2 Effective Length

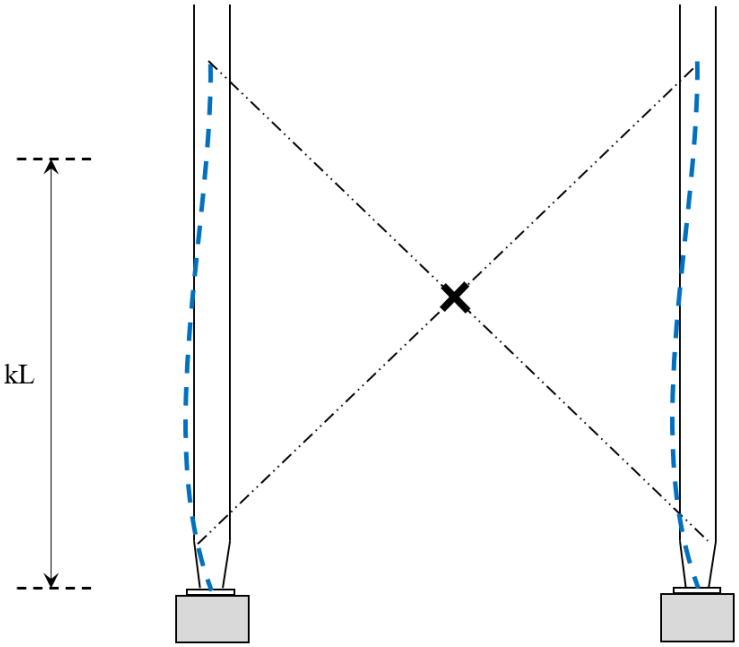
The effective length factor K shall be determined as follows

(a) For members having lateral support in both directions at its ends

K = 0.75 for riveted, bolted, or welded end connections;
K = 0.875 for pinned ends.

(b) For members having ends not fully supported laterally by diagonal bracing or an attachment to an adjacent structure, the effective length factor shall be determined by a rational procedure.**

- Assumes translation- and rotational restraint that the cable bracing could not provide:



Source: FHWA

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Research Updates

FHWA Loads and Load Rating

- Concrete Bridge Shear Load Rating Synthesis Report, Publication No. FHWA-HIF-18-061 (11/2018)
- Concrete Bridge Shear Load Rating Guide and Examples: Using the Modified Compression Field Theory, Publication No. FHWA-HIF-22-025 (04/2022)

- Reference Guide for Load Rating of Tunnel Structures, Publication No. FHWA-HIF-19-010 (05/2019)
- Tunnel Load Rating Examples: A Supplement to the Reference Guide for Load Rating of Tunnel Structures, Publication No. FHWA-HIF-20-058 (12/2020)

FHWA Loads and Load Rating

- Advancing Bridge Load Rating: State of Practice and Frameworks, Publication No. FHWA-HIF-22-059 (12/2022)
- Truck Platooning Impacts on Bridges: Phase I – Structural Safety, Publication No. FHWA-HIF-21-043 (7/2021)

Truck Platooning Bridge Impact

Truck Platooning Impacts on Bridges:
Phase II – Structural Serviceability

- Period of Performance: 09/27/2021 to 9/26/2025

The objective is to produce a report for FHWA that covers the technical aspects of truck platooning impacts on bridges with a focus on structural serviceability (service and fatigue limit states).

FHWA Loads and Load Rating

Broad Agency Announcement - 2020

Risk-Based Methodology for Structural Evaluation of Bridge-Sized Culverts

- Identification of key factors affecting culvert risks
- Uncertainty quantification and reliability analysis
- Proposing new target reliability indices for evaluation
- Calibrating risk-adjusted load and resistance factors
- Developing implementation strategies

- Period of Performance: 9/27/2021 – 9/27/2024

FHWA Loads and Load Rating

Broad Agency Announcement - 2023

Mobile Lab for Bridge Load and Performance Testing

- Investigate the feasibility of developing a state-of-the-art, rapidly deployable, Mobile Bridge Testing Lab (MBTL) for diagnostic and proof load testing to support the load rating of bridges.
  - State of Technology
  - Feasibility Study and Conceptual Design
- Period of Performance: 2/14/2024 –2/14/2027

FHWA Loads and Load Rating

Mobile Bridge Test Lab (MBTL): From Feasibility to Plans

- Short term –a “blueprint” for an MBTL
- Medium term - more of the Nation’s bridges load tested.
- Long term – fewer bridges load posted; rapid assessment of bridges post disaster for continued use and more informed rehabilitation plans; state-of-the art research “facility”
- Safer and better maintained bridges, economic savings

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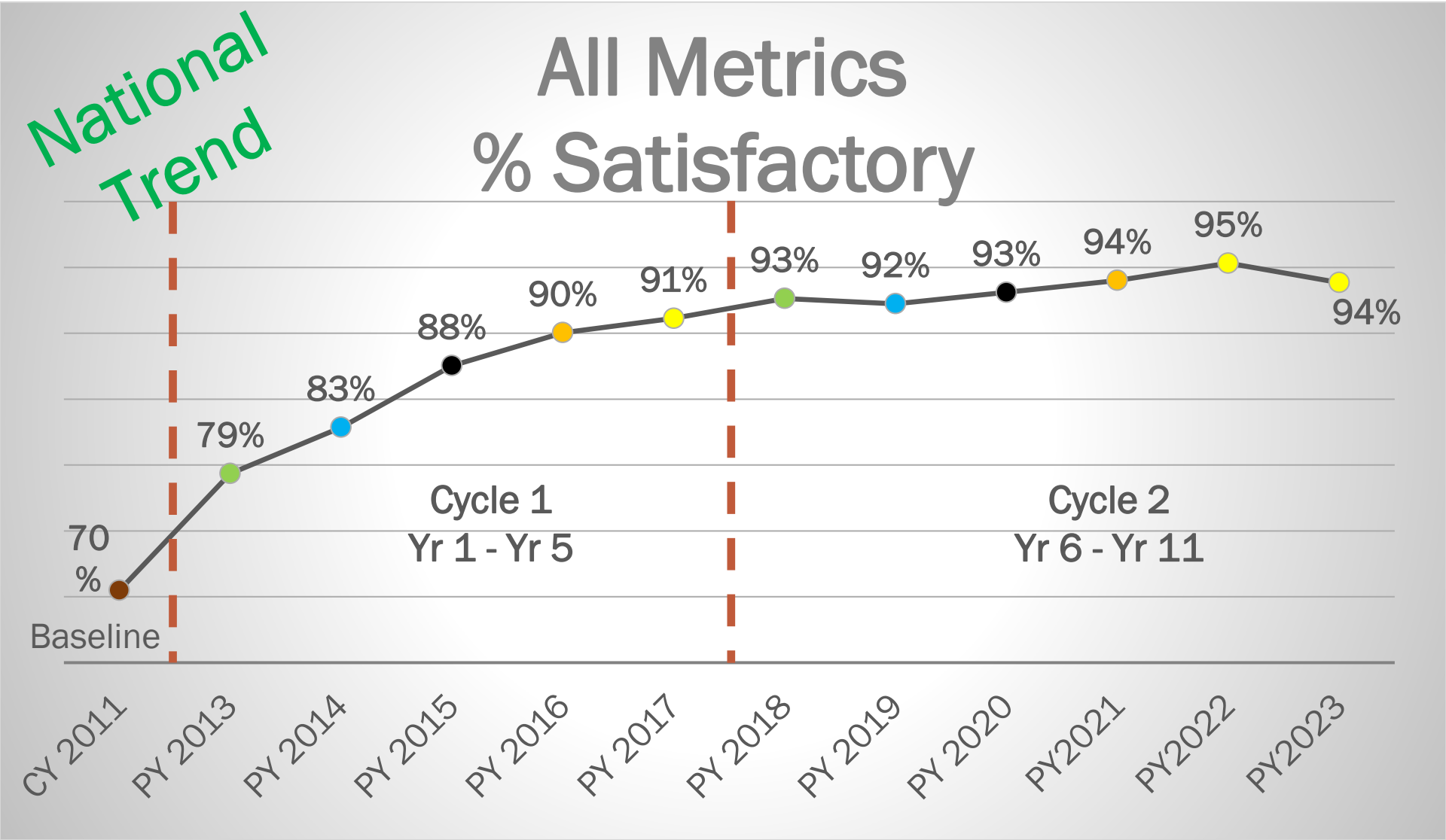
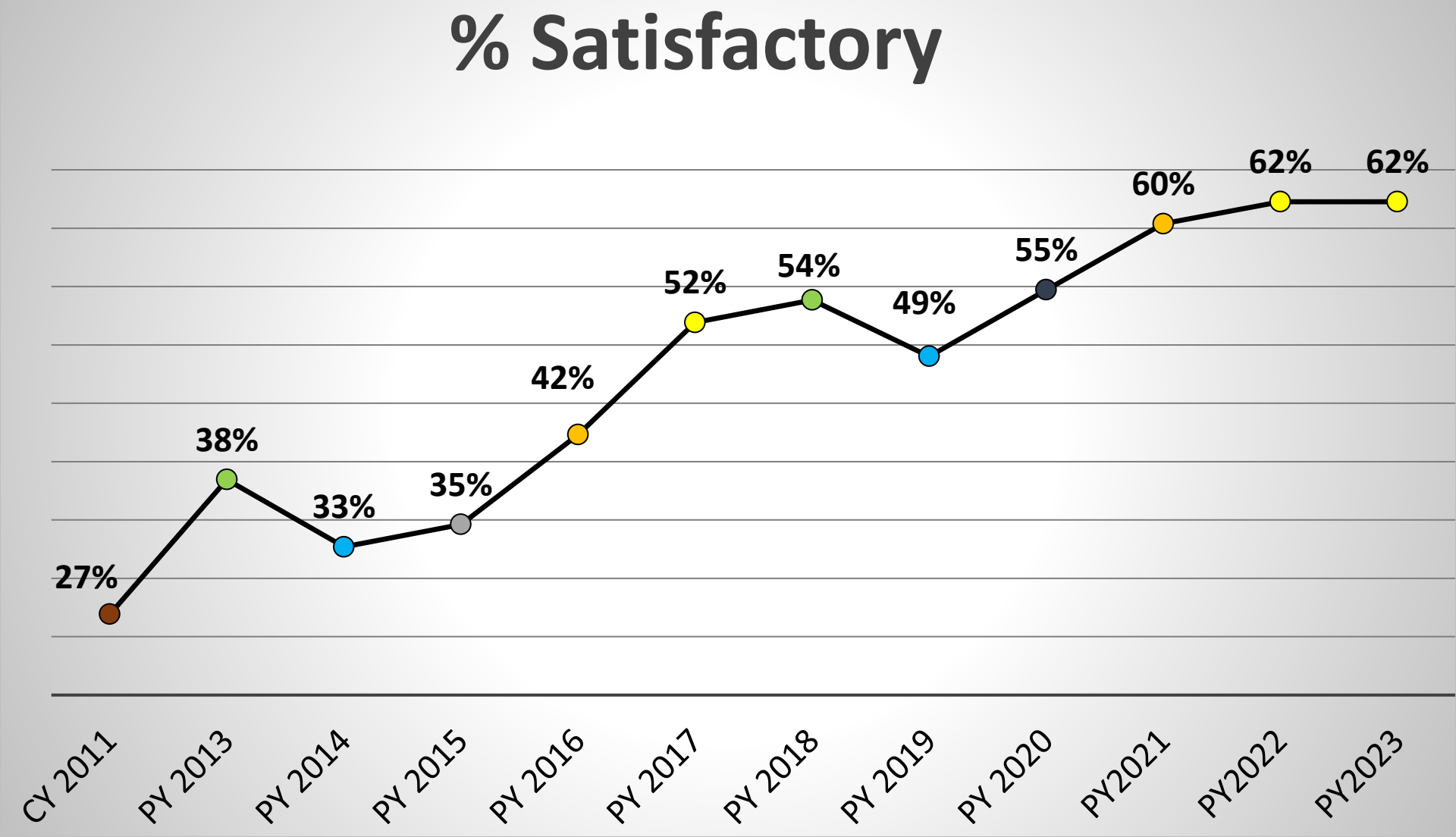
NBIP Updates

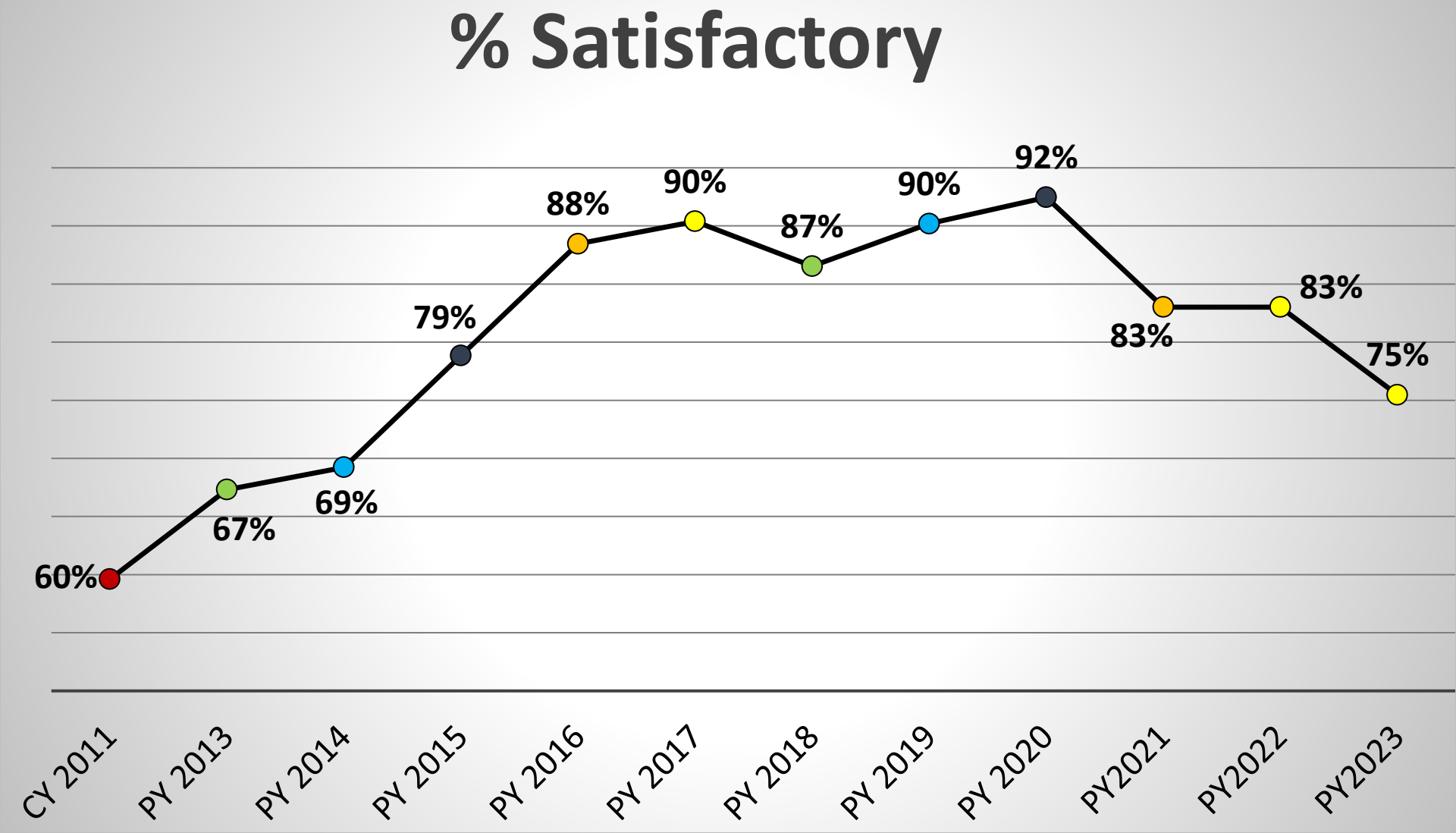
FHWA NBIP


National Trend
All Metrics
% Satisfactory
70 %
Baseline
79%
83%
88%
90%
91%
93%
92%
93%
94%
95%
94%
Cycle 1
Yr 1 - Yr 5
Cycle 2
Yr 6 - Yr 11
CY 2011
PY 2013
PY 2014
PY 2015
PY 2016
PY 2017
PY 2018
PY 2019
PY 2020
PY2021
PY2022
PY2023

FHWA NBIP Metric 13 Load Rating



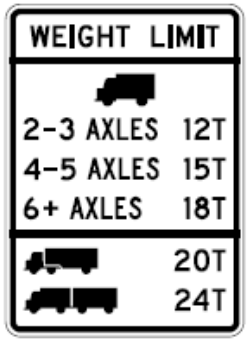
FHWA NBIP Metric 14 – Load Posting



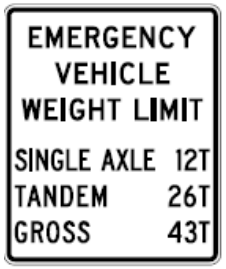
FHWA MUTCD Weight Limit Signs

MUTCD 11th Edition, effective Jan. 18, 2024

- New R12-6 and R12-7 Signs for SHV and Emergency Vehicles



R12-6



R12-7

R12-7aP

Notes:
1. Weights on all signs shown on this slide are examples only.
2. Image Source: FHWA

- New provision requiring the posting of an additional weight limit sign in advance (Section 2B.64 – Paragraph 14)
  - 5 year compliance date
  - with distance or directional legend

Questions and Answers

Questions?

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