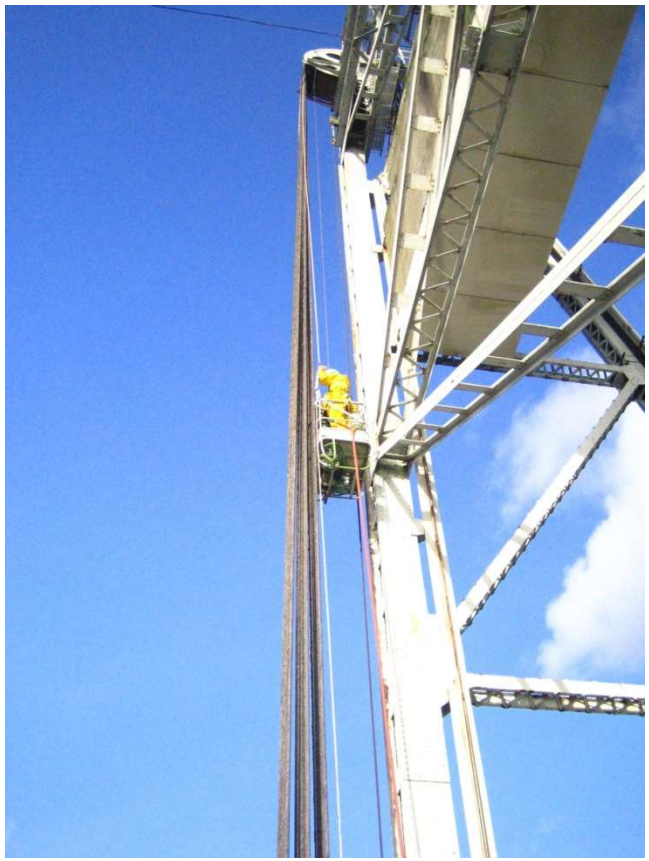
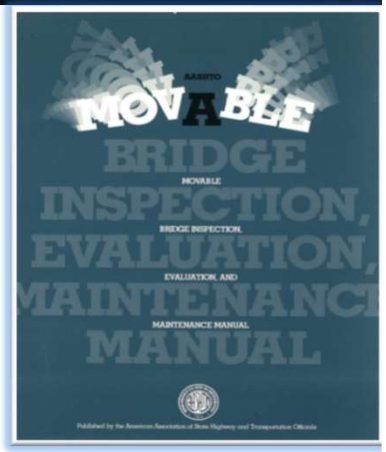
Infrastructure Inspection – Case Studies from the Field





PARSONS BRINCKERHOFF

Scott Snelling, P.E., December 16, 2014
Los Alamos National Labs, Engineering Institute

Presentation Outline

- America's Infrastructure Report Card
- Infrastructure Funding
- Inspection Case Studies
  - Bridge
  - Tunnel
  - Levee
  - Stadium

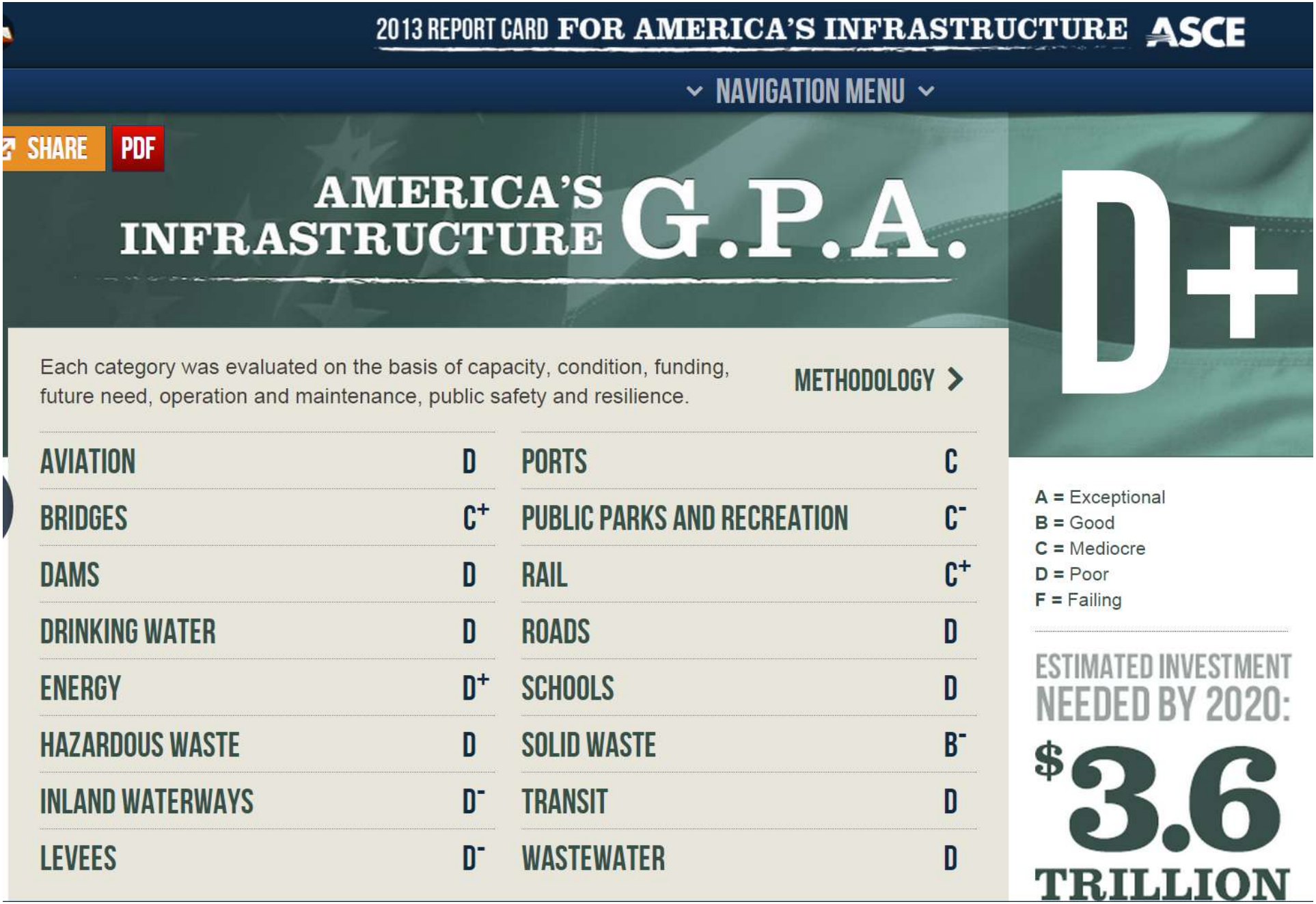
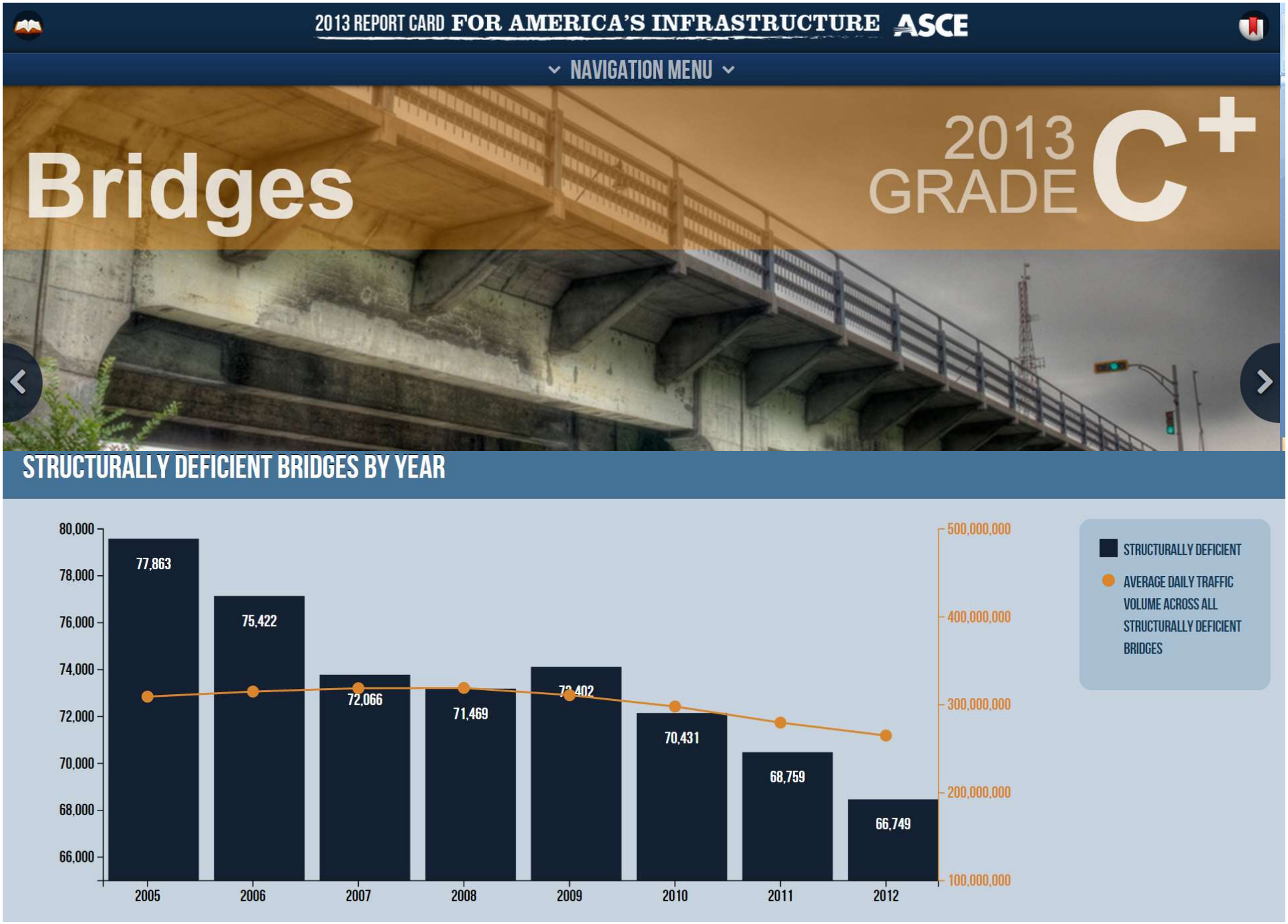


Image Reference: American Society Civil Engineers, infrastructurereportcard.org, accessed 12/12/2014



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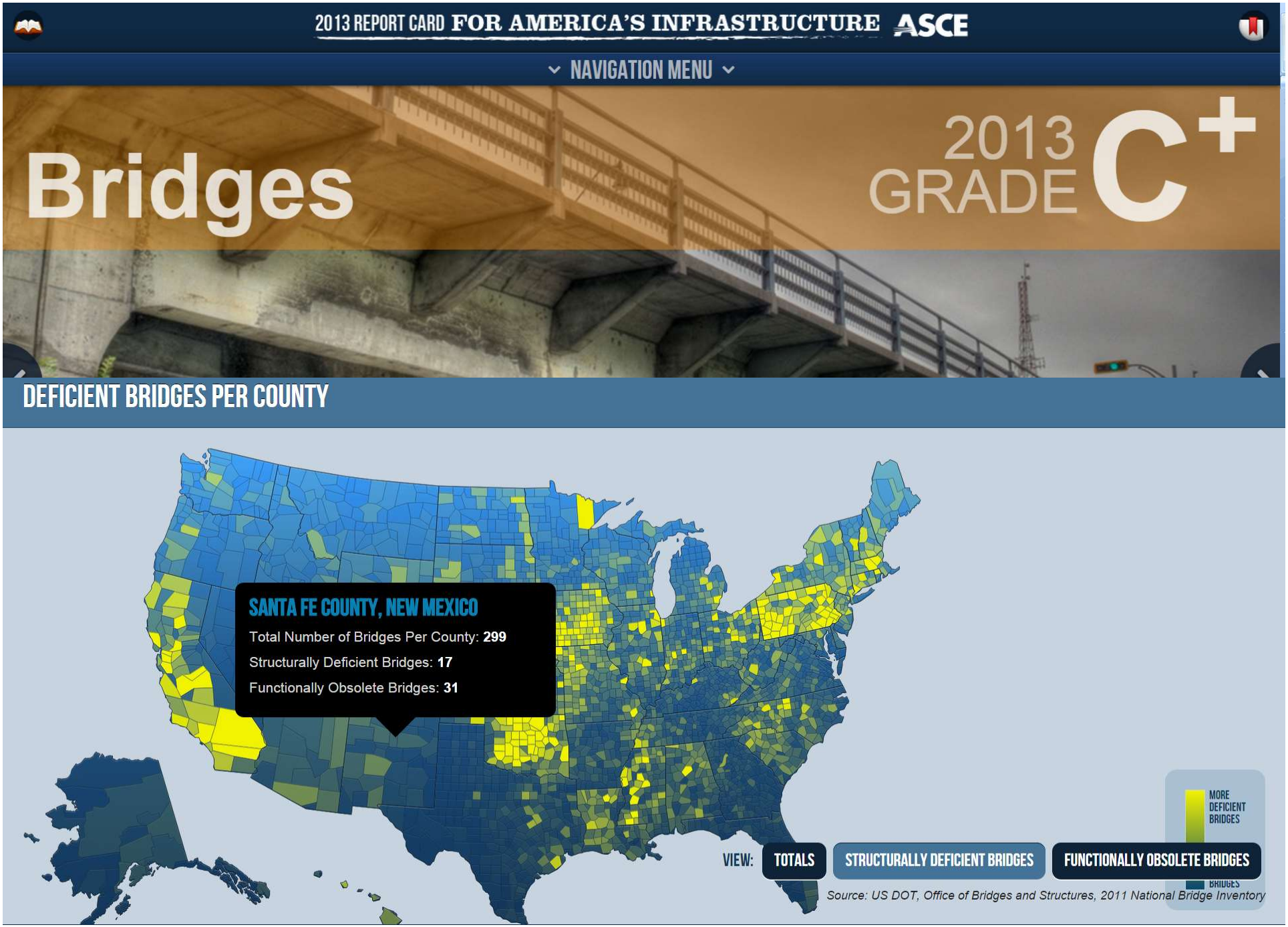
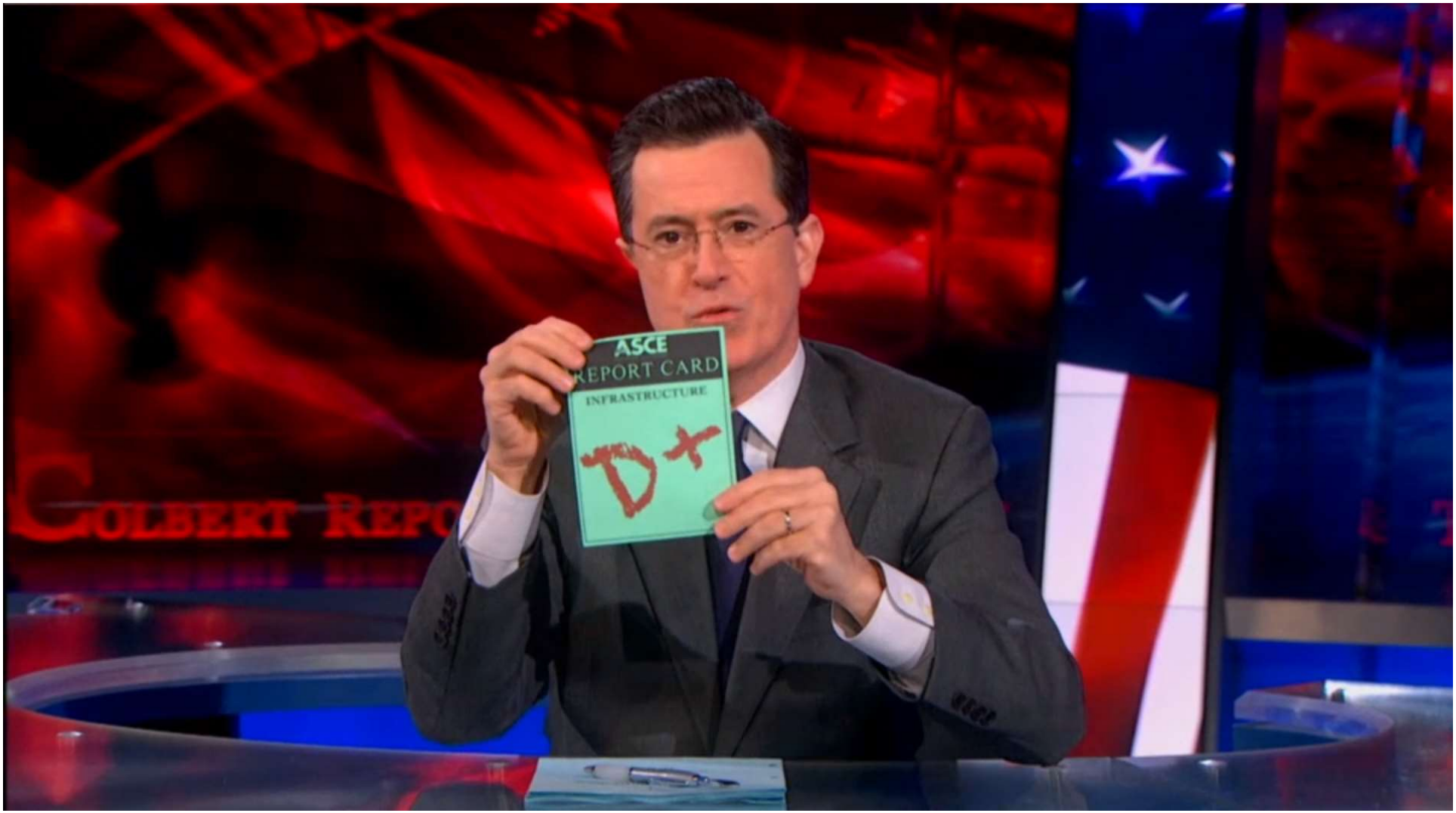


Image Reference: American Society Civil Engineers, infrastructurereportcard.org, accessed 12/12/2014



Reference: http://thecolbertreport.cc.com/videos/06tavh/tiny-triumphs---infrastructure---river-pollution, 12/12/2014

Receipts, Outlays, and Balance or Shortfall for the Highway Account, 1998 to 2024

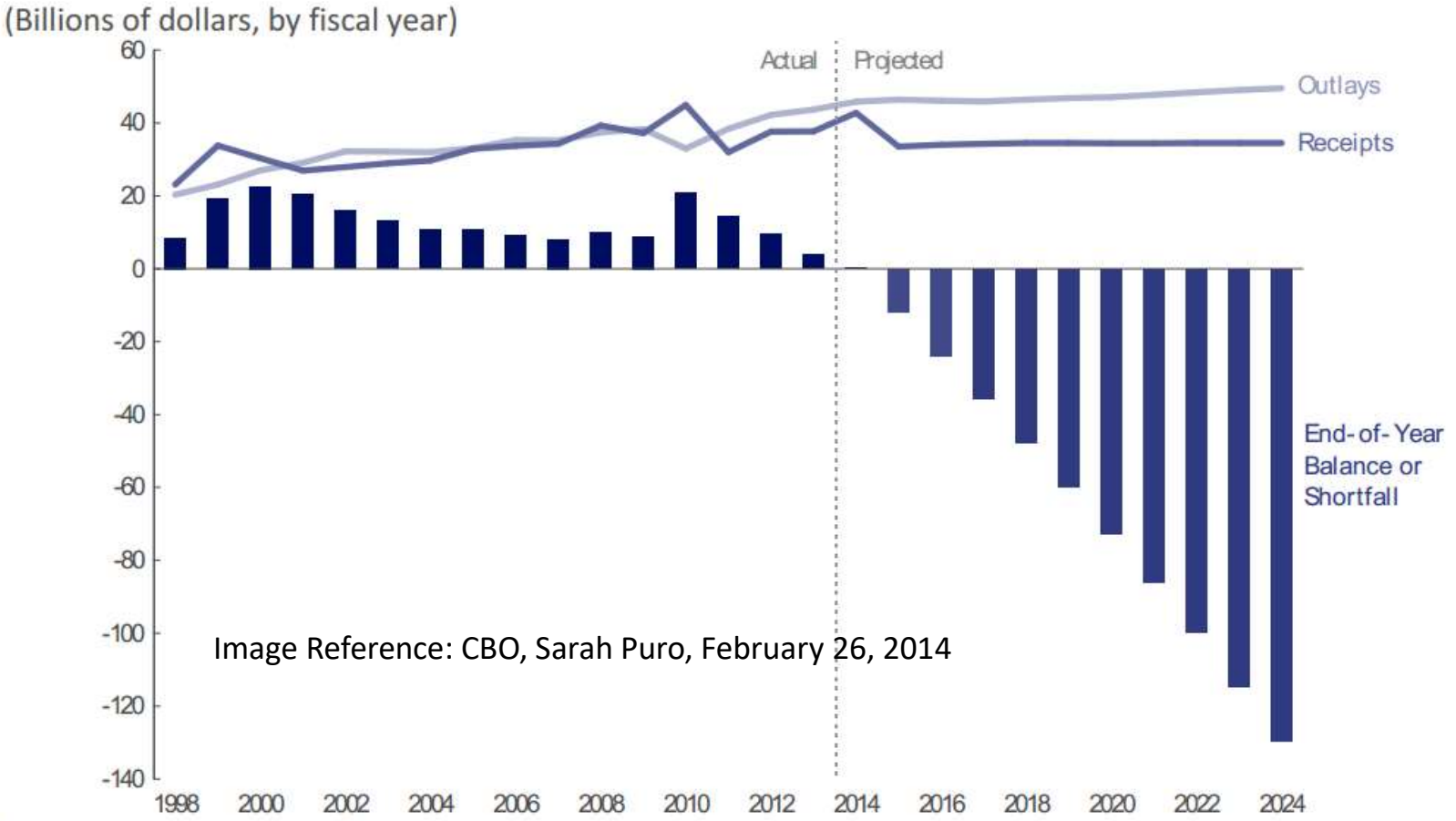


Image Reference: CBO, Sarah Puro, February 26, 2014

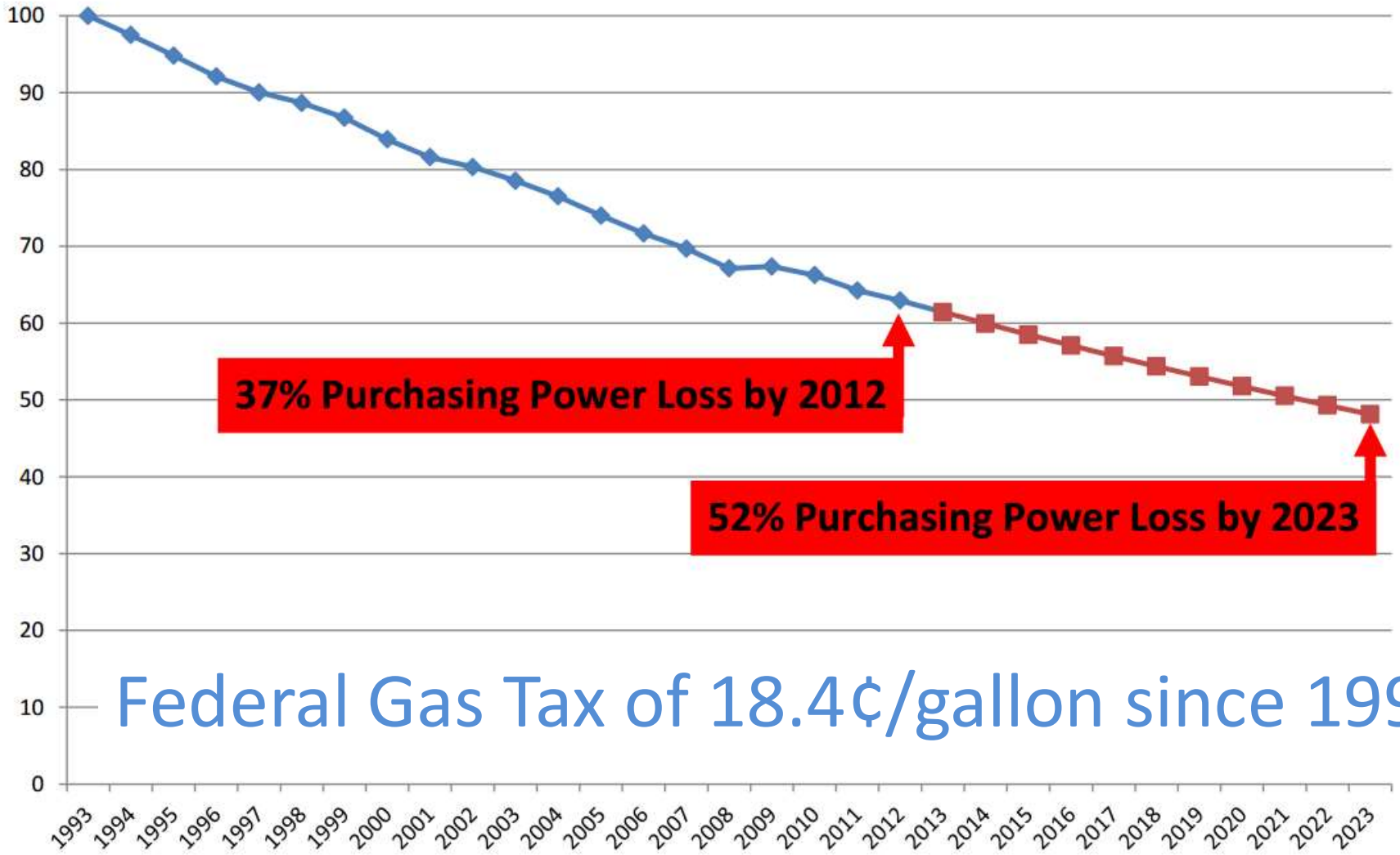
Source: Congressional Budget Office, February 2014 baseline projection

Notes: CBO's projection for outlays is calculated by increasing the obligation limits set for current year by a measure of projected inflation . CBO's projection for receipts is based on market conditions, and incorporates the assumption that the current tax on fuels and on heavy vehicles will be extended.

The receipts line includes revenues credited to the highway account of the Highway Trust Fund and intragovernmental transfers to the account. Those transfers have totaled about $46 billion since 2008, including the amounts transferred in October 2014.

The Highway Trust Fund cannot incur negative balances. Once account balances are exhausted, the chart illustrates the cumulative annual shortfalls for the highway account under CBO's baseline.

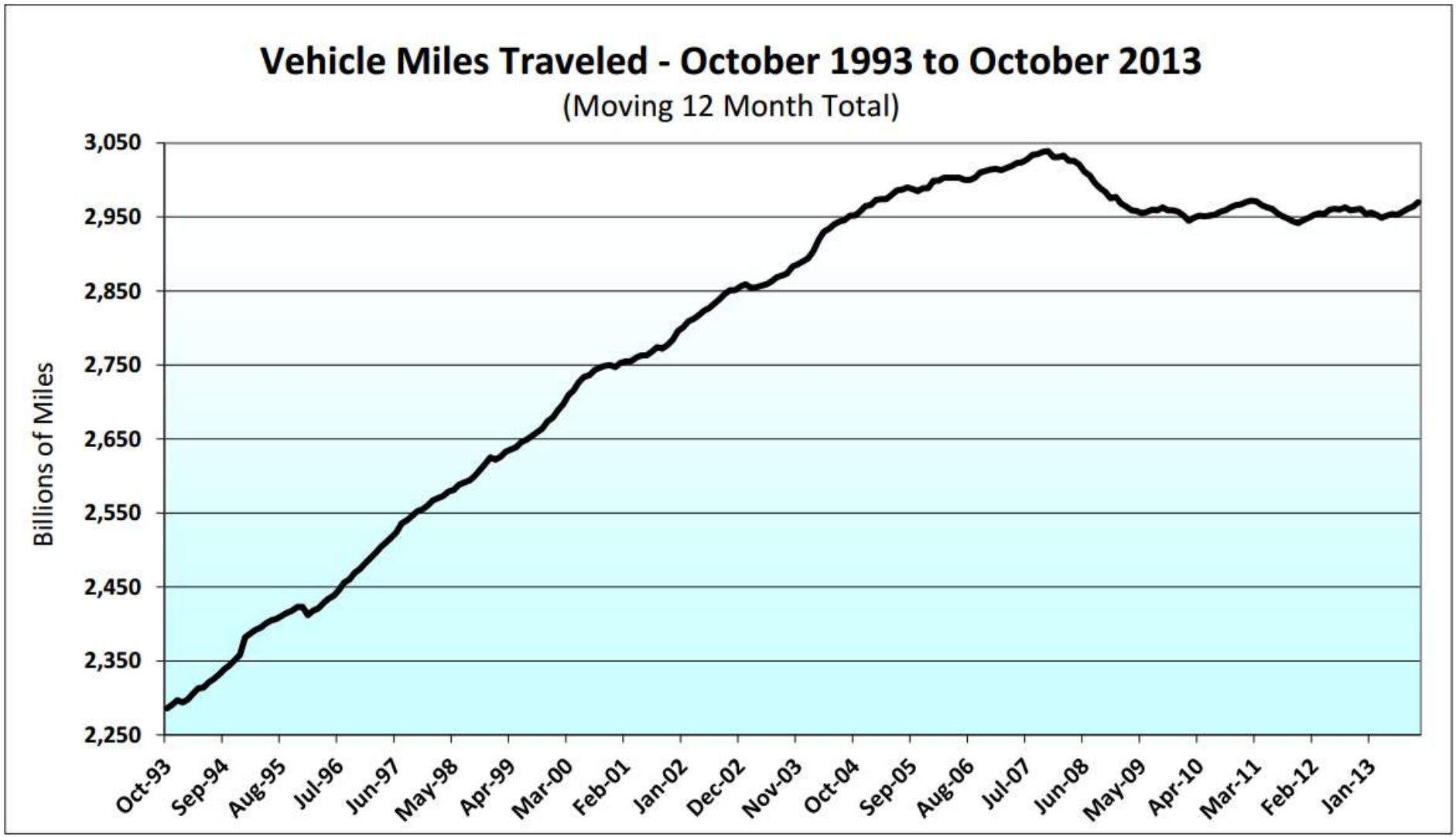
Highway Trust Fund – Headwinds
#1 – Gas Tax Not Indexed to Inflation



Federal Gas Tax of 18.4¢/gallon since 1993

Image Reference: AASHTO, Janet Oakley, January 9. 2014

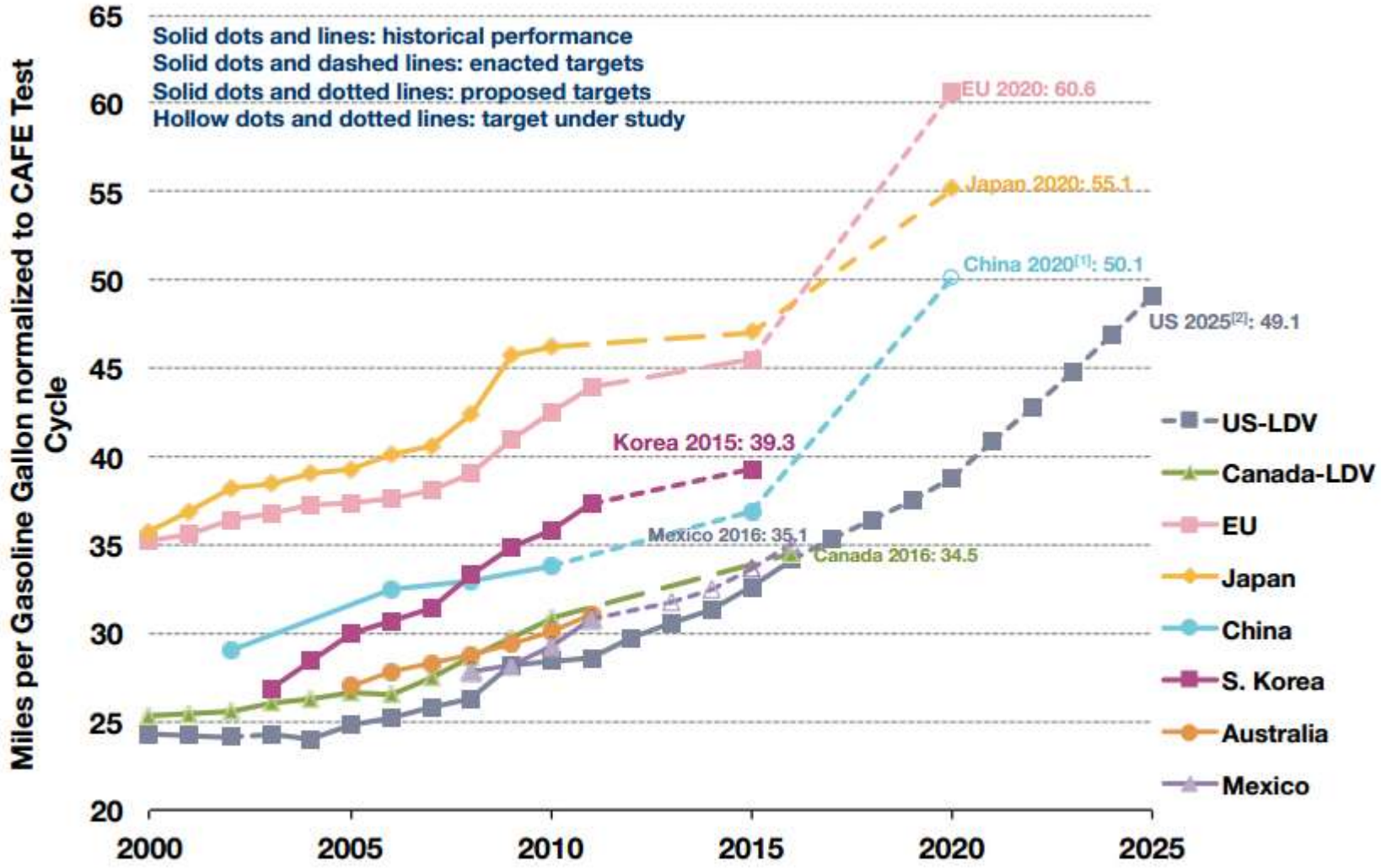
Highway Trust Fund – Headwinds
#2 – Americans Driving Less



Source: Federal Highway Administration

Image Reference: AASHTO, Janet Oakley, January 9. 2014

Highway Trust Fund – Headwinds
#3 – Increasing Vehicle Fuel Efficiency



[1] China's target reflects gasoline vehicles only. The target may be higher after new energy vehicles are considered.
[2] US , Canada, and Mexico light-duty vehicles include light-commercial vehicles.

Reference: http://www.c2es.org/federal/executive/vehicle-standards/fuel-economy-comparison, accessed 12/12/2014

Highway Account: End of Fiscal Year 2013

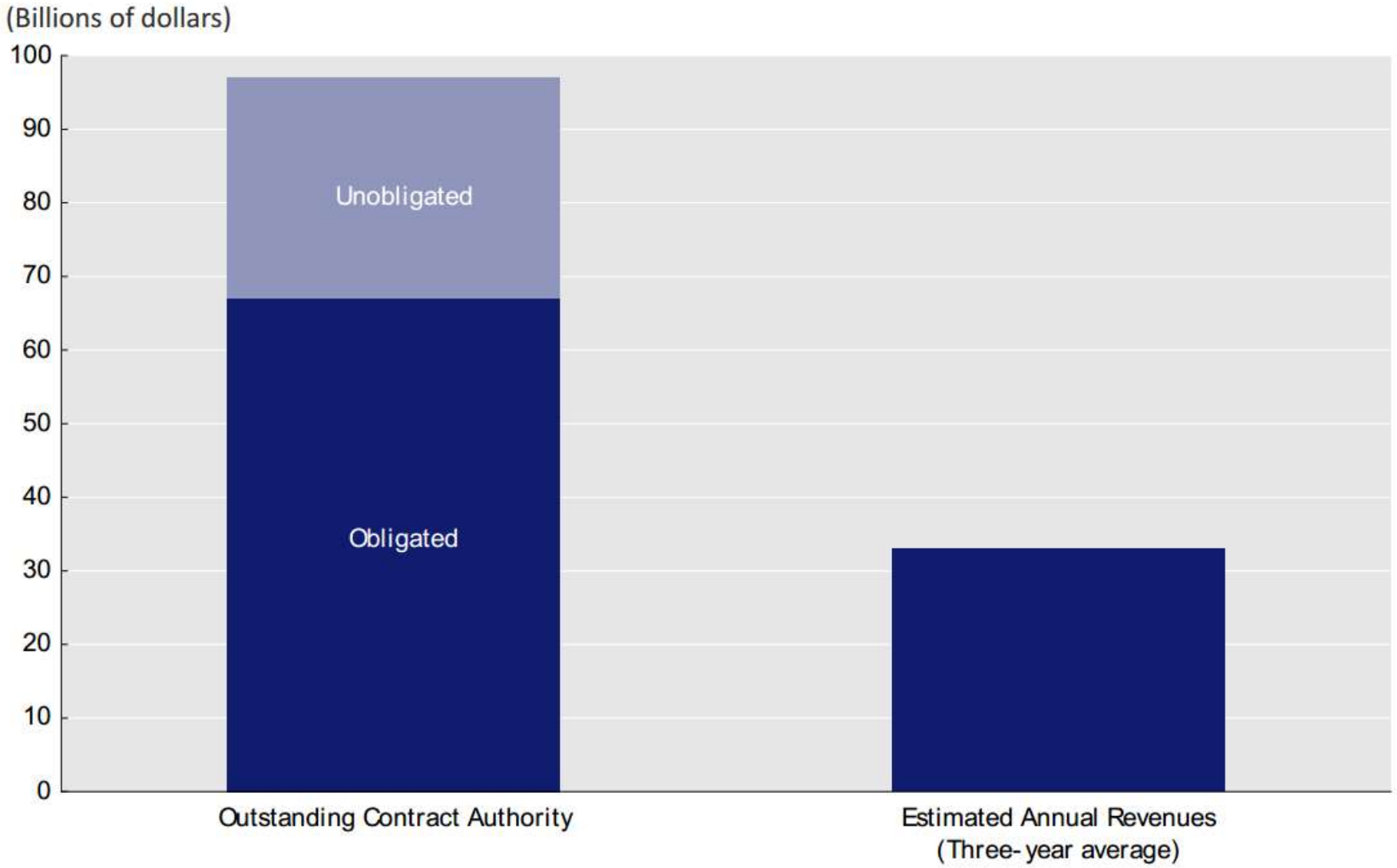


Image Reference: CBO, Sarah Puro, February 26, 2014

General Fund transfers have avoided the HTF "fiscal cliff."

- FY 2008: $8 billion General Fund transfer to HTF
- FY 2009: $7 billion General Fund transfer to HTF
- FY 2010: $19.5 billion General Fund transfer to the Highway Trust Fund
- FY 2012: $2.4 billion Leaking Underground Storage Tank Trust Fund transfer to HTF*
- FY 2013: $5.9 billion General Fund transfer to HTF**
- FY 2014: $11.7 billion General Fund transfer to HTF**

Total General Fund transfers to Highway Trust Fund: $52.1 billion since 2008

WWW.TRANSPORTATION.ORG

AASHTO
THE VOICE OF TRANSPORTATION

* This is not a transfer from General Fund as a portion of HTF receipts are normally deposited into Leaking Underground Storage Tank Trust Fund.
** Amount transferred after budgetary sequester.

Image Reference: AASHTO, Janet Oakley, January 9. 2014

Choices Facing the Congress

- Reduce spending
- Increase receipts
- Fund the program from general revenues
- A combination of the three

Short-term MAP-21 authorization, expires May 31, 2015

Image Reference: CBO, Sarah Puro, February 26, 2014

Presentation Outline

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  - Tunnel
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Case Study Bridge #1

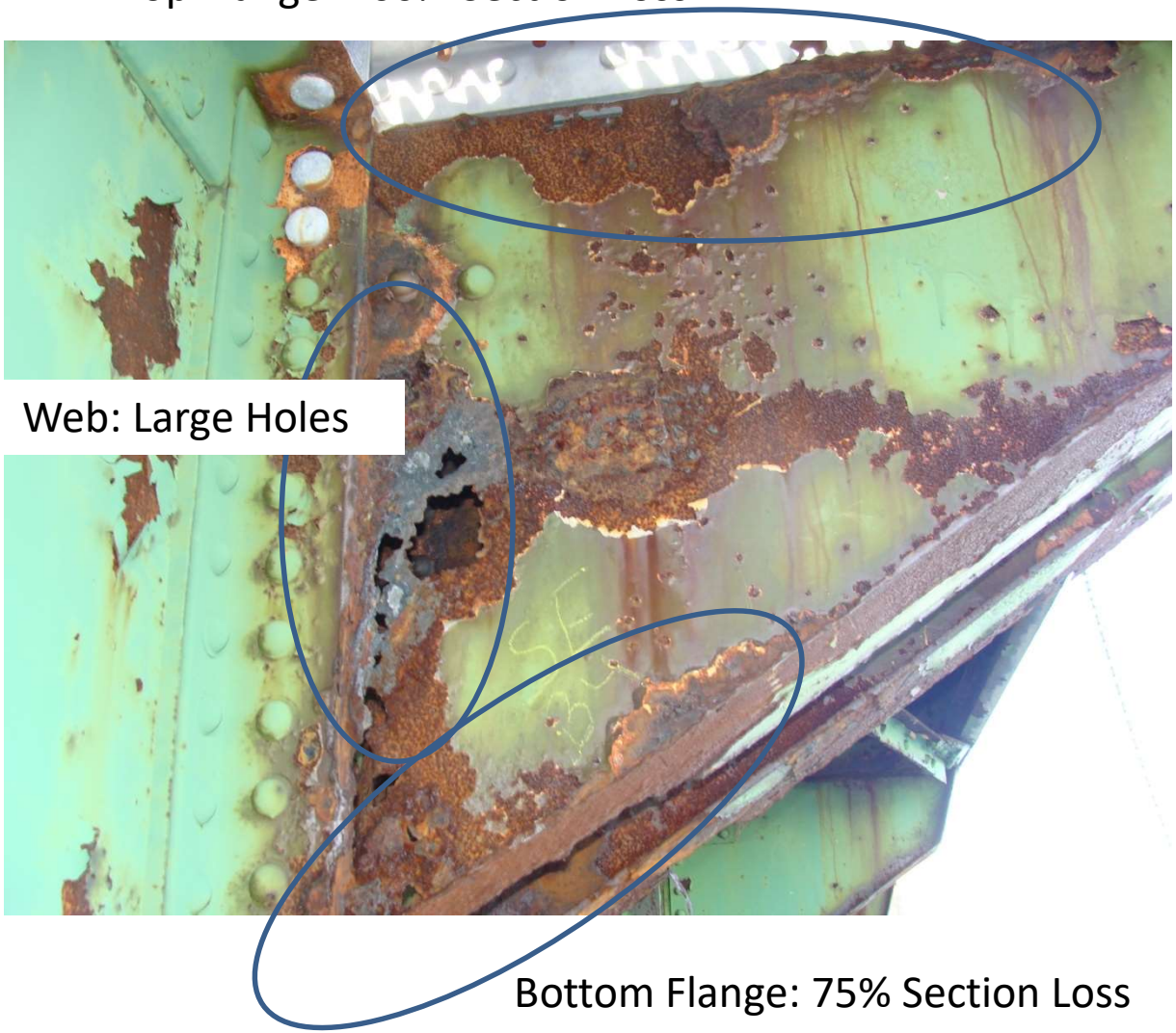
Image Reference: www.ironbc.com, accessed 12/12/2014

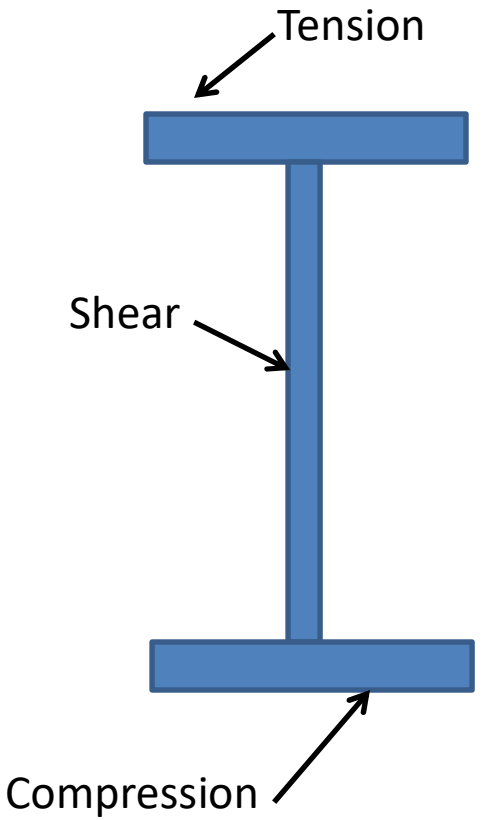
Case Study Bridge #1

Case Study Bridge #1

Case Study Bridge #1

Top Flange: 100% Section Loss





Bridge Inspection

- Why Inspect Bridges? → Required by law.

Two different laws, two different approaches:

National Bridge Inspection Standards (**NBIS**)
Code of Federal Regulations, Title 23, Part 650
"to ensure **safety** of the traveling public"
Inspection intervals "not to exceed twenty-four months"

Moving Ahead for Progress in the 21st Century Act (**MAP-21**)
National Bridge and Tunnel Inventory Inspection Standards
"provide a framework and direction for investment"
"**element-level** inspection data to develop risk- and performance-based asset management plans to systematically prioritize bridge preventative maintenance, rehabilitation, and replacement.

Bridge Condition Rating

NBIS Safety Inspection		MAP-21 Element Level Inspection
9	Excellent	1
7, 8	Good	2
5, 6	Fair	3
4, 3	Poor	4
2, 1, 0	Critical	5

Bridge Inspector Tools

-Personal Protective Equipment

-Masonry Hammer

-Tape Measure

-Calipers / Depth Meter

-Notebook

-Camera

Bridge Inspector Tools

Masonry Hammer –

Steel: clearing corrosion

Concrete: sounding for hallows and spalls

Image Reference: stanleytools.co.uk

Bridge Inspection Access

Concrete Spall

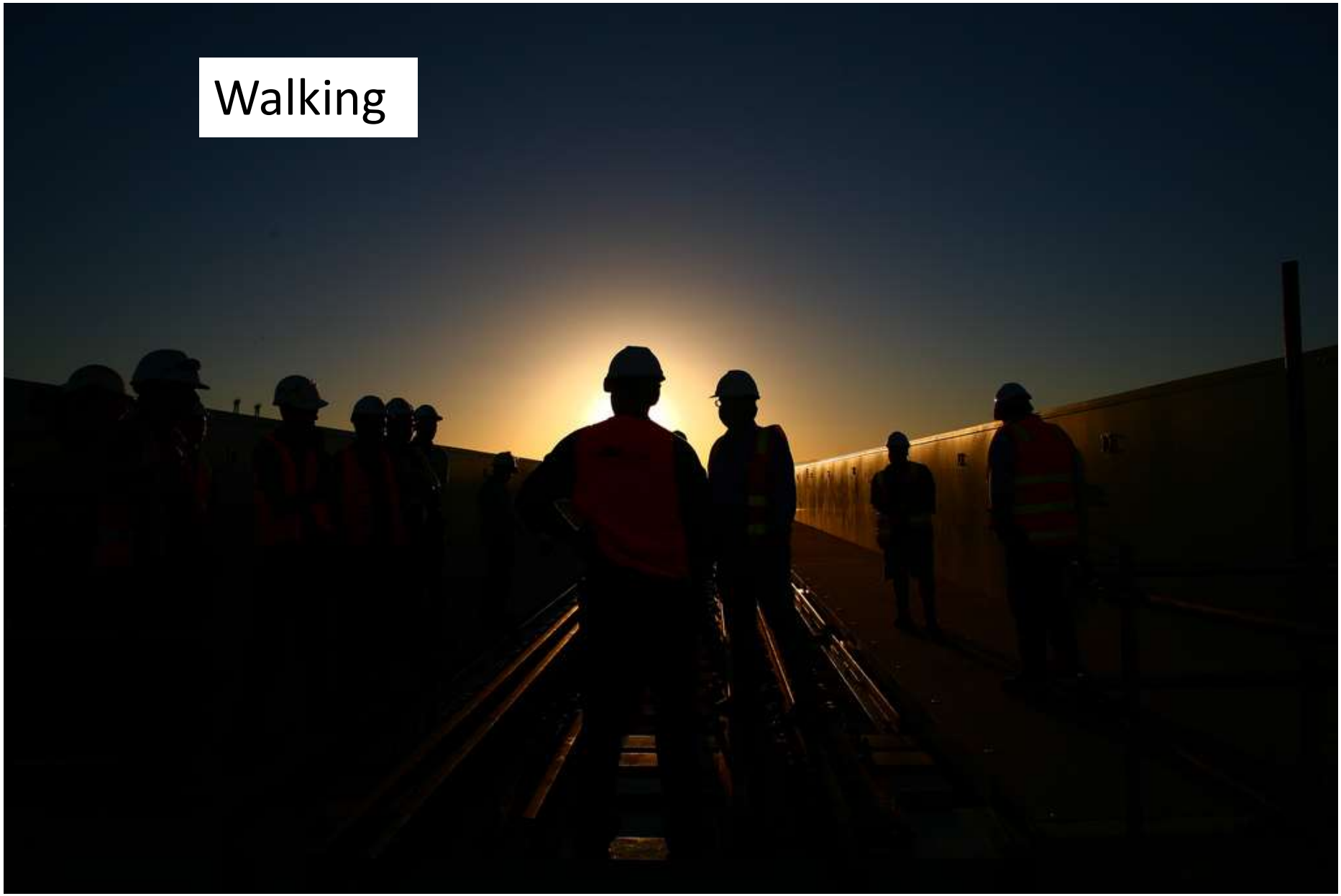
Bridge Inspection Work Conditions

Cold

Corrosion

Guano

Bridge Inspection Access



Bridge Inspection Access

Bridge Inspection Access

Pickboards

Bridge Inspection Access

Snooper Truck, UB-60

Image Reference: bridgeriggers.com

Bridge Inspection Access

Crash Attenuator Truck

Image Reference: dot.ny.gov

Bridge Inspection Access

Man Lift

Scissor Lift

Image Reference: downtown-towing.com, oilfield-generators.com

Bridge Inspection Access

Bucket Van

Bridge Inspection Access

Bridge Inspection Access

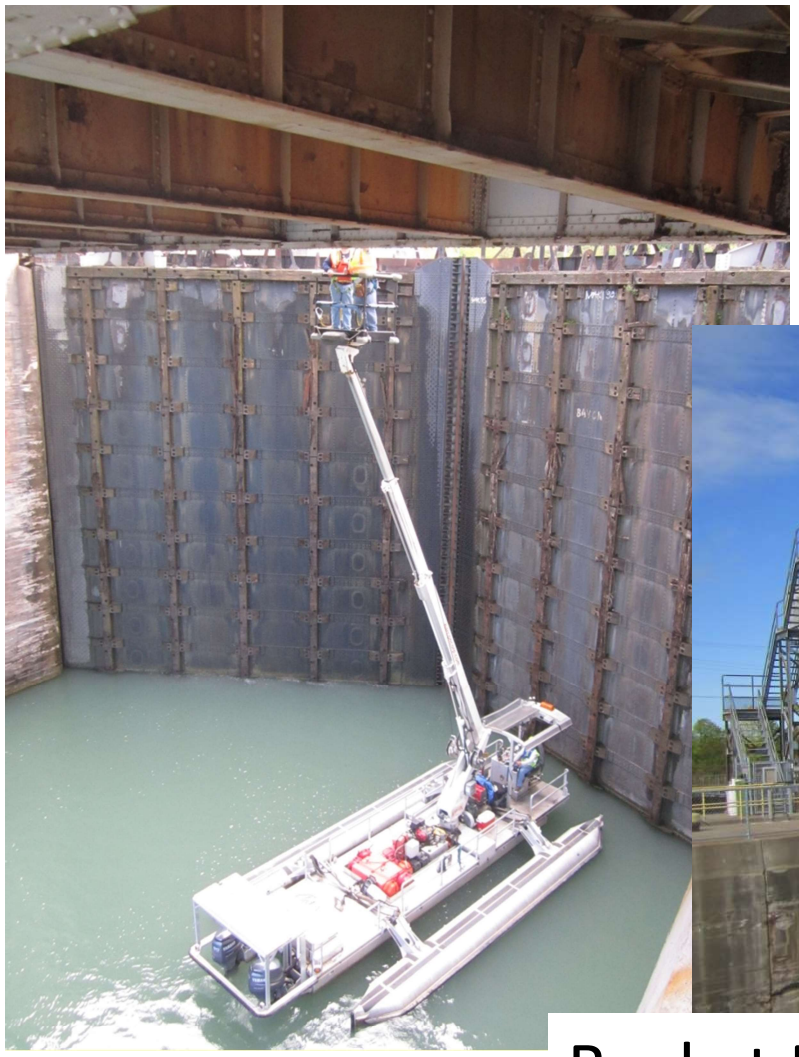
Rope Access

Image Reference: verticalaccess.co.uk, ropeworks.com

Bridge Inspection Access

Barge, Push boat, and Man Lift

Bridge Inspection Access



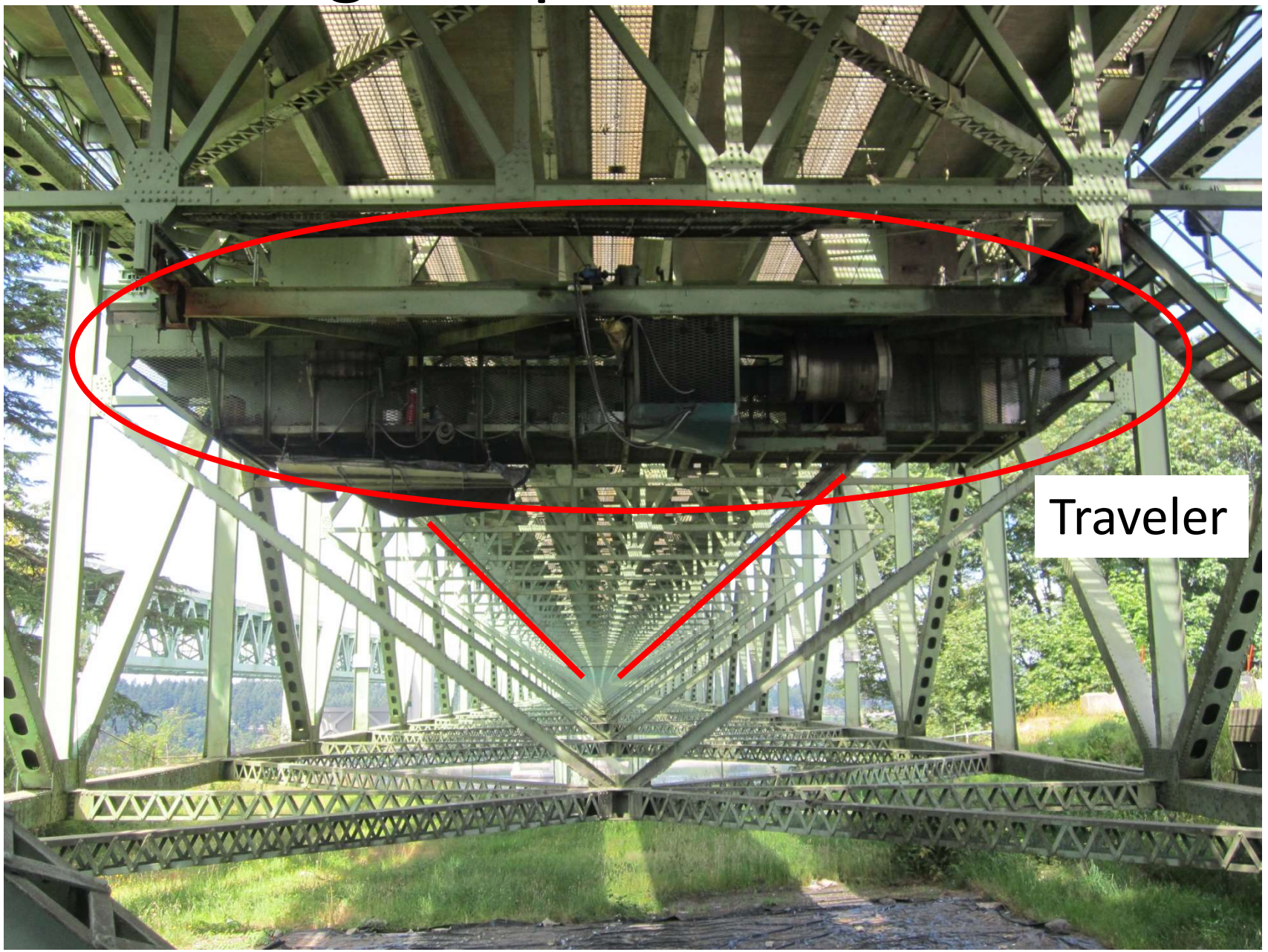
Bucket Boat

Bridge Inspection Access

Specialty Patented Vehicles

Image Reference: Harcon

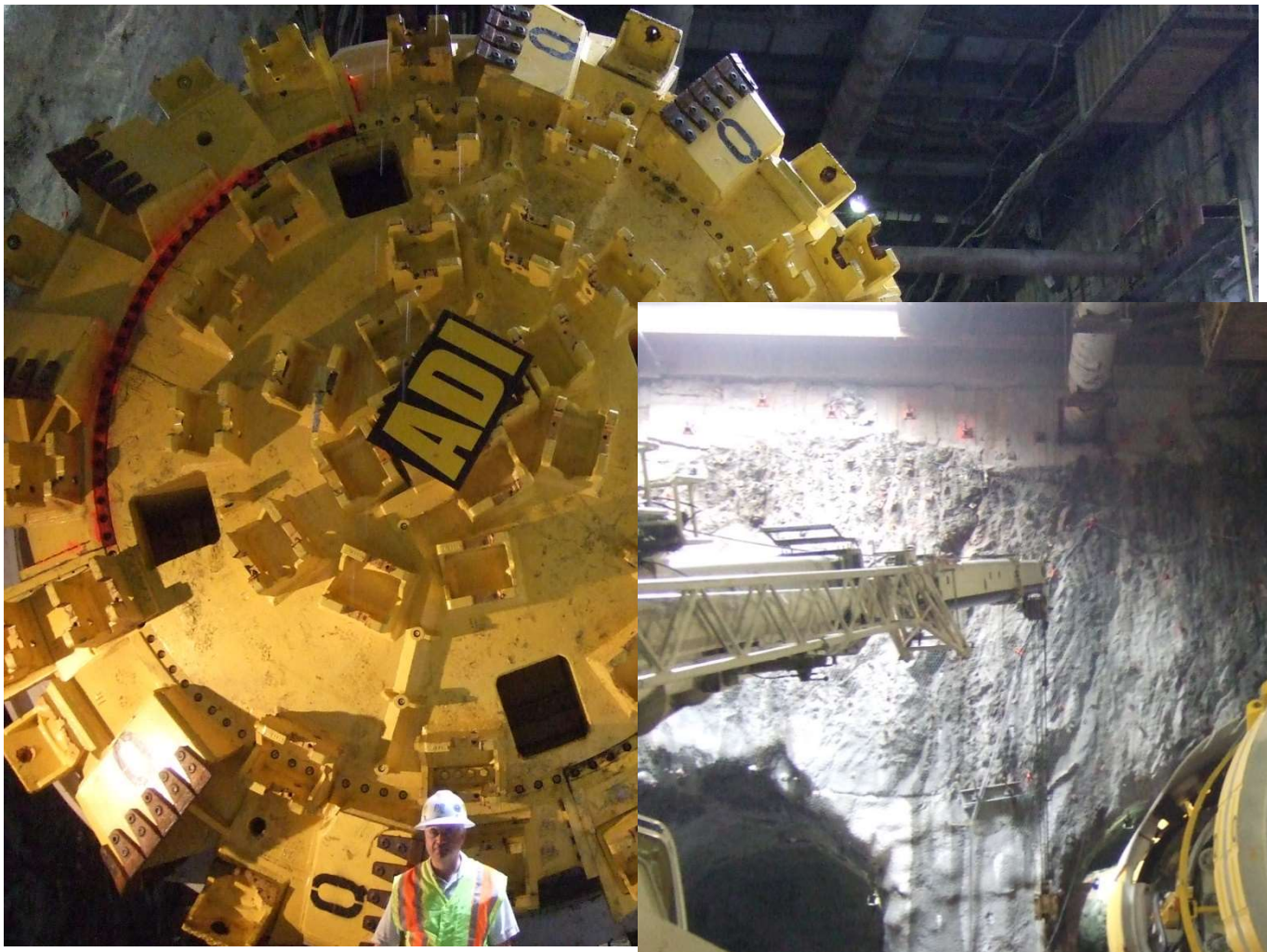
Bridge Inspection Access



Underwater Inspection

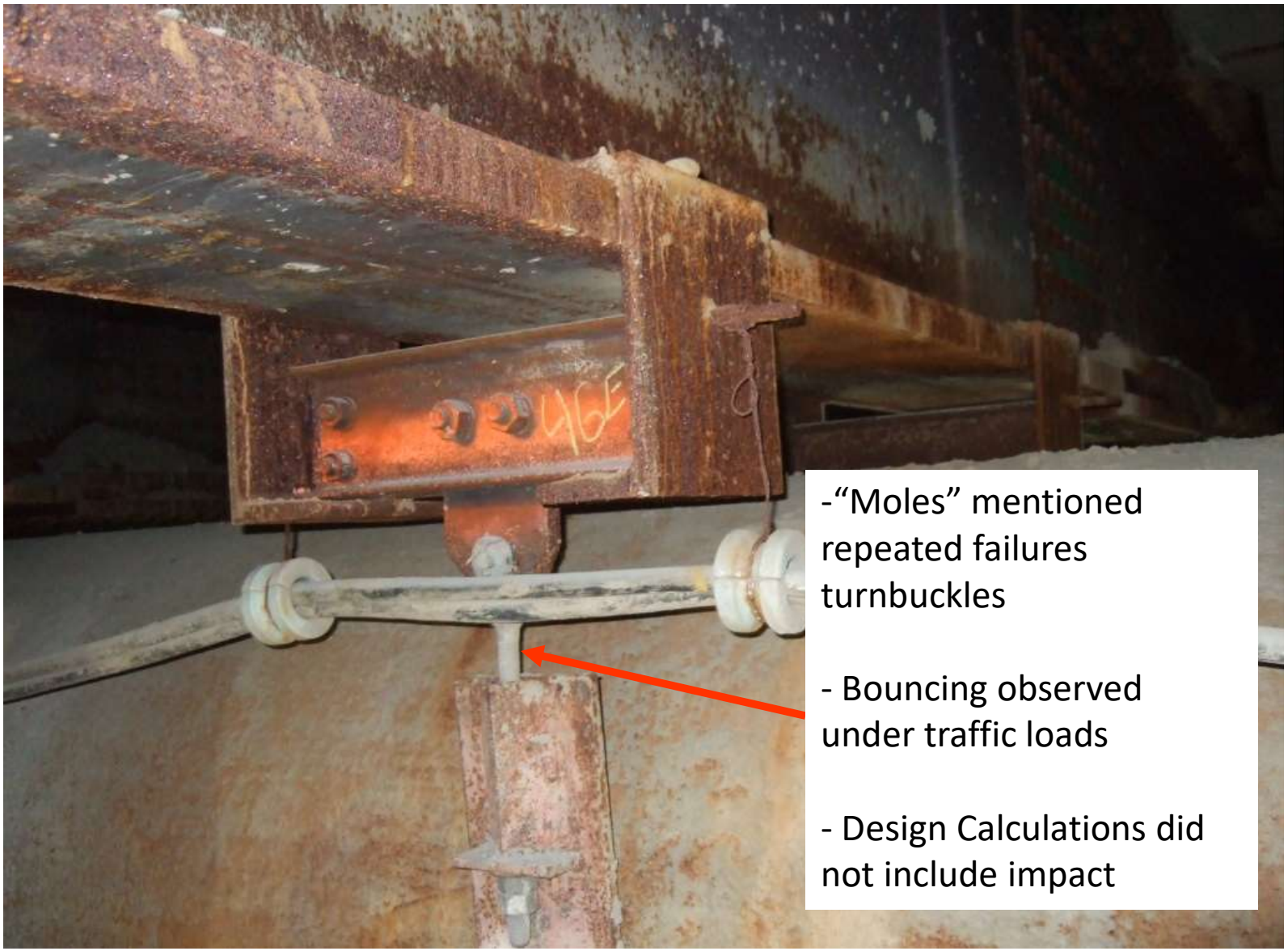
Case Study Tunnel #1

Case Study Bridge #1



Case Study Tunnel #1

Case Study Tunnel #1

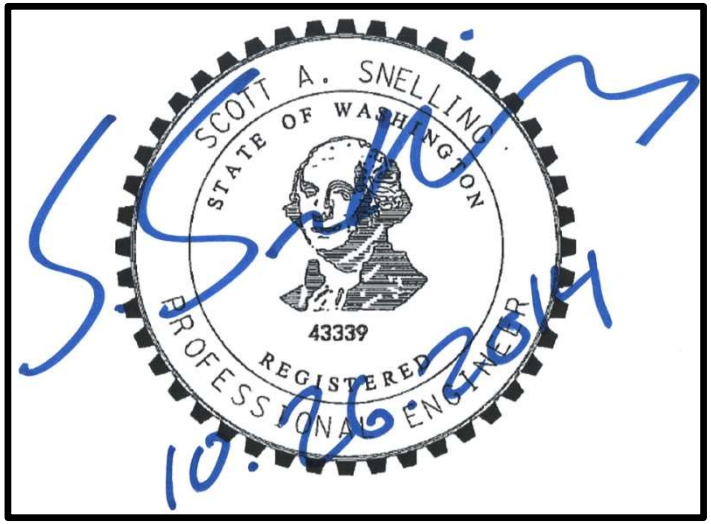


Inspector's Role:

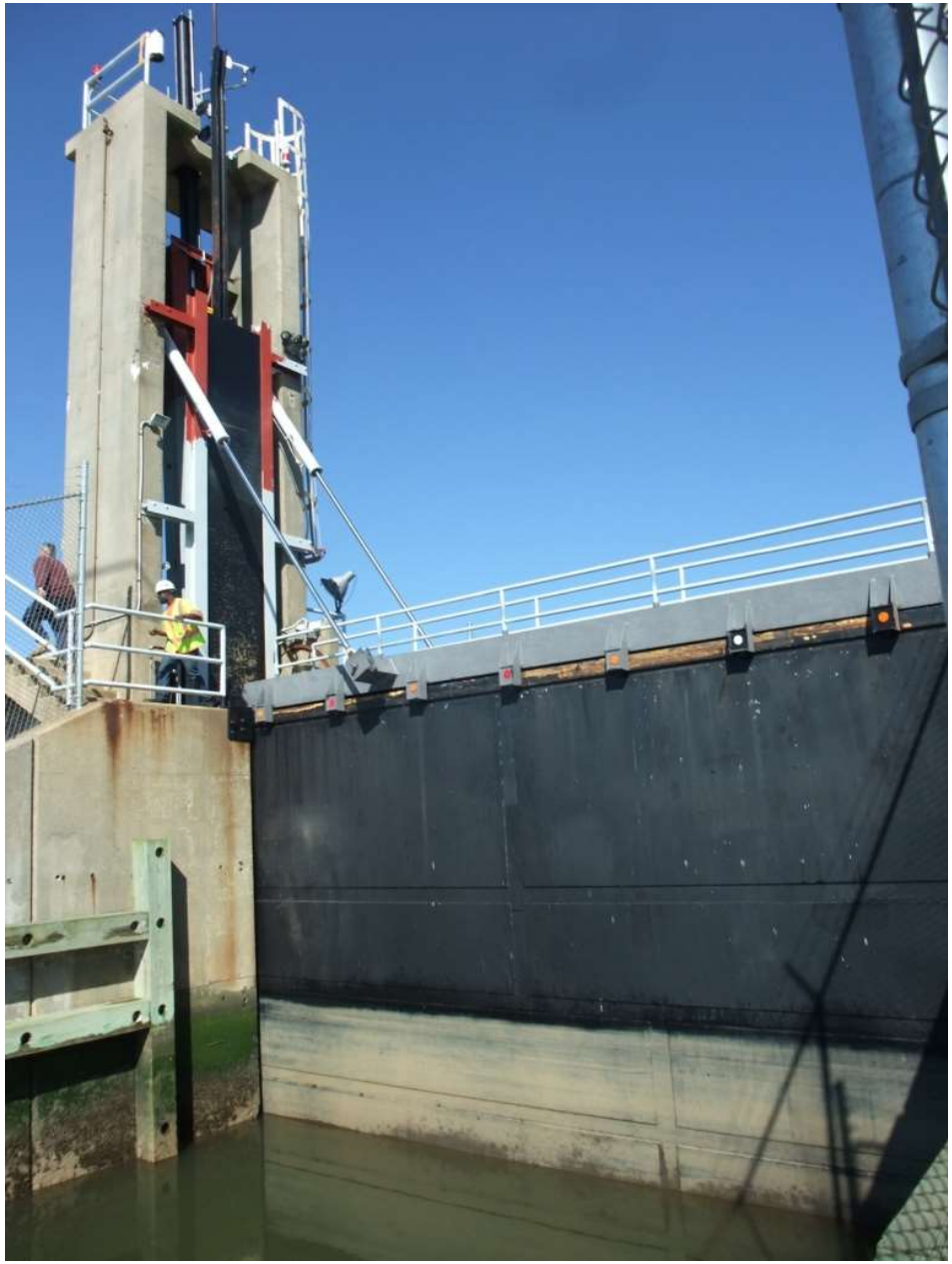
Per the FHWA Bridge Inspector's Reference Manual:

-To provide thorough inspections identifying conditions and defects.

- To prepare condition reports documenting deficiencies and alerting supervisors or engineers of **<u>any findings which might impact safety or integrity of the structure.</u>**



Case Study Levee #1



Case Study Stadium Roof #1

Case Study Stadium Roof #1

Snohomish River Bridge – 529/10W

Tower Drive Vertical Lift Bridge

Built in 1953, Owned By WSDOT

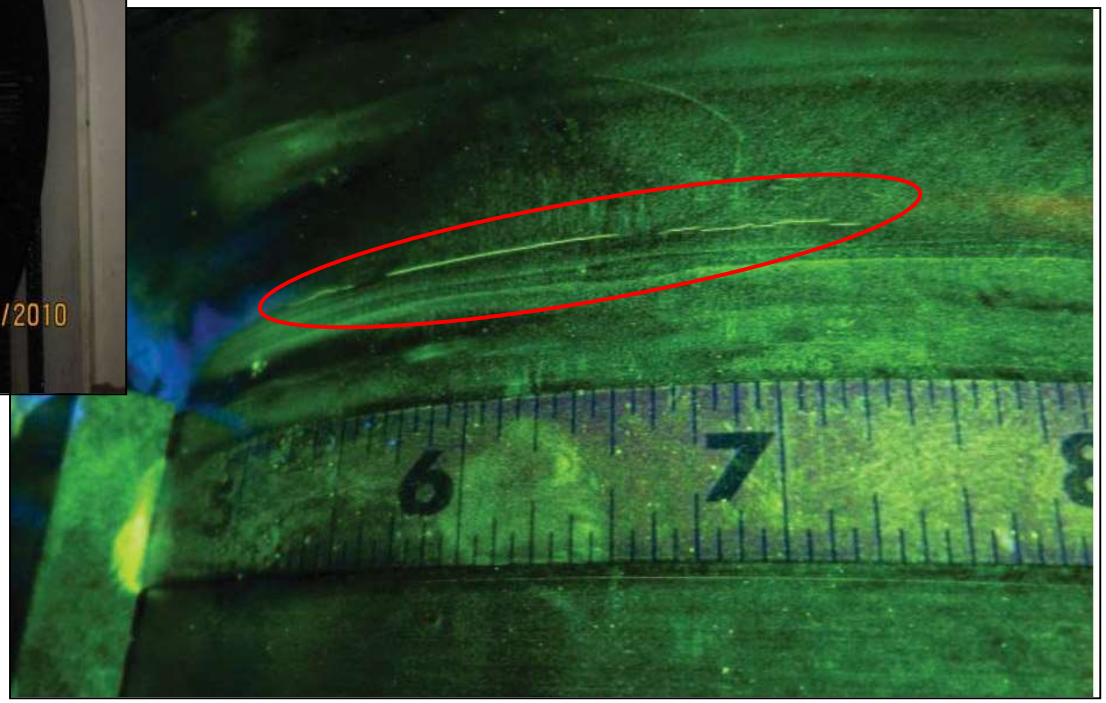
Span Length 180 ft, Lift 40 ft, Span Weight 800 kips

Fatigue Cracks in Trunnions

Discovered in 2008 using

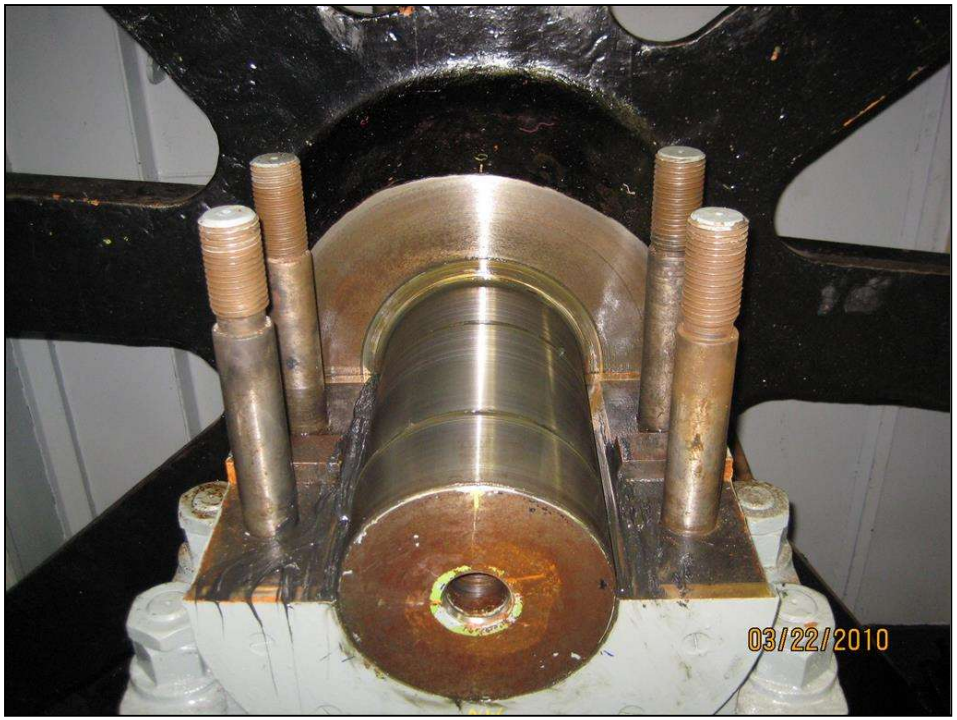
Wet Magnetic Particle

Ultrasonic Testing



Ref: Rob Gessel, WJE

Fatigue Cracks in Trunnions

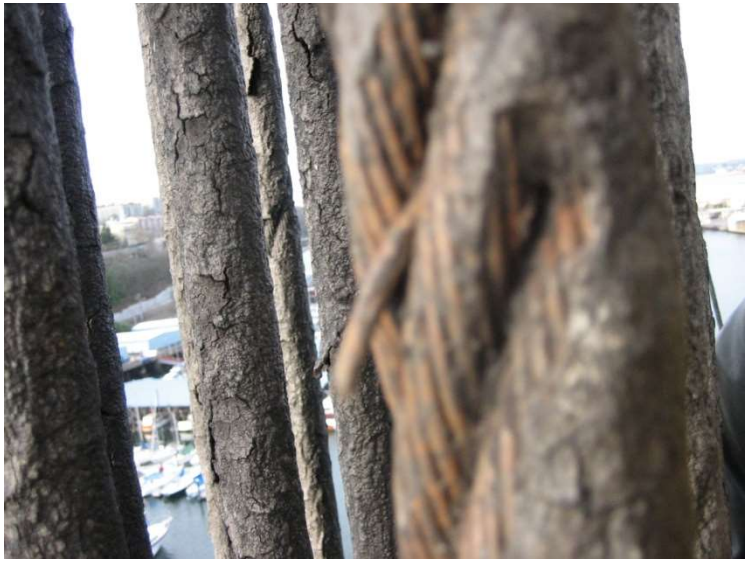


Cracked Trunnions – Factored Stress Ranges

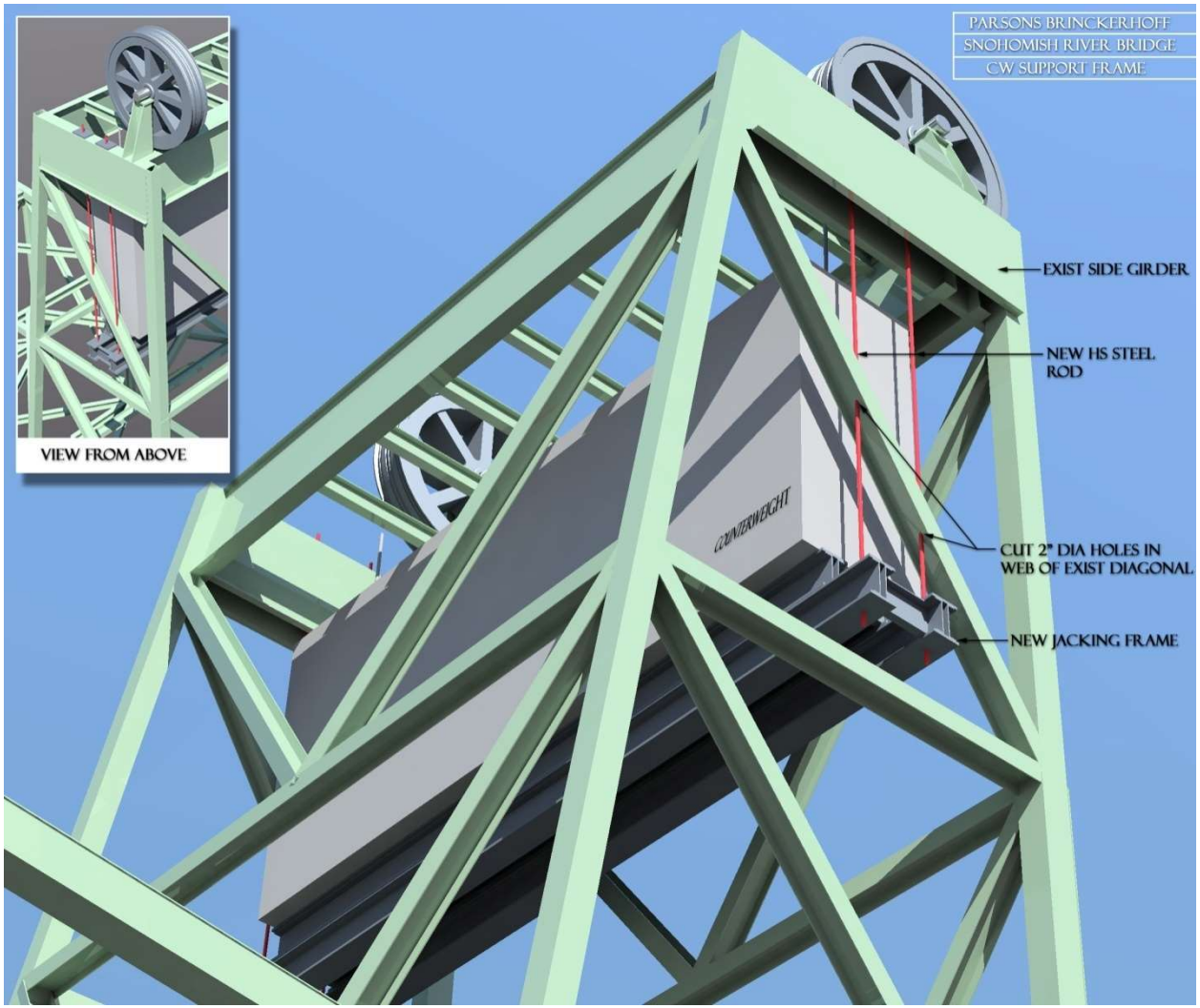
- **Snohomish River Bridge, WA: 84 ksi**
- Shippingsport Bridge, IL: 75.7 ksi (collapse)
- Valleyfield Bridge, Quebec: 56.2 ksi (collapse)
- Carlton Bridge, ME 72.8 ksi
- Duluth Aerial Bridge, MN 55.2 ksi
- Calumet River, IL 53.4 ksi
- PATH-Hackensack, NJ 44.7 ksi

Reference: Pete Roody, Heavy Movable Structures

Wire Rope Inspection

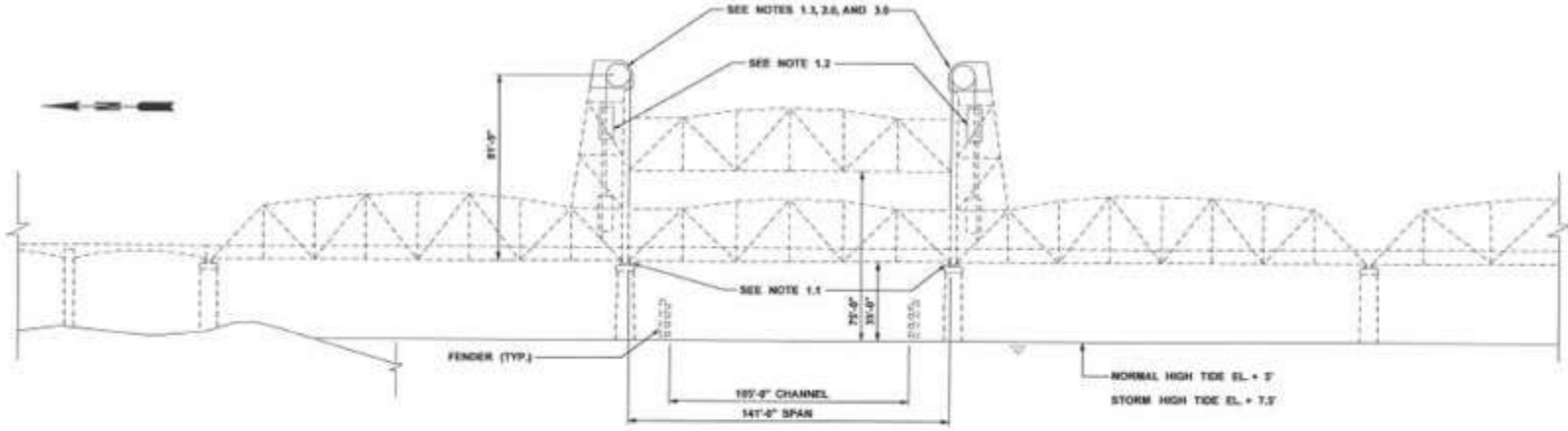


Temporary Counterweight Support



- Redundant for rod failure
- Walers to distribute point loads

Contract Documents



ELEVATION

MECHANICAL SUPPORT WORK

1.1 TEMPORARILY REMOVE EXISTING LIVE LOAD SHOES, INSTALL AND REMOVE TEMPORARY DEAD LOAD PLUS LIVE LOAD (DL + LL) SHOES, AND REHABILITATE AND REINSTALL THE EXISTING LIVE LOAD SHOES. SEE PLAN MS-1.

1.2 INSTALL AND REMOVE TEMPORARY COUNTERWEIGHT SUPPORTS. SEE PLANS MS-2, MS-3, MS-4.

1.3 TEMPORARILY REMOVE AND REINSTALL EXISTING MACHINERY ROOF SECTIONS. SEE PLAN MS-5.

MECHANICAL WORK

2.0 SEE PLAN MW1 FOR MACHINERY WORK IDENTIFICATION.

ELECTRICAL WORK

3.0 SEE PLAN E1 FOR ELECTRICAL WORK IDENTIFICATION.

GENERAL NOTES

4.1 ALL MATERIAL AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE WASHINGTON STATE DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATION FOR ROAD, BRIDGE AND MUNICIPAL CONSTRUCTION - DATED 2012 AND AMMENDMENTS AND THE AASHTO LRFD MOVABLE HIGHWAY BRIDGE DESIGN SPECIFICATIONS, 2ND EDITION, WITH INTERIM REVISIONS.

4.2 THE DIMENSIONS SHOWN IN THE PLANS ARE BASED ON ORIGINAL CONSTRUCTION RECORDS TOGETHER WITH THE FIELD SURVEY DATA. PRIOR TO PREPARING SHOP DRAWINGS AND FABRICATING ASSEMBLIES THE CONTRACTOR SHALL FIELD MEASURE ALL DIMENSIONS SHOWN IN THE PLANS REQUIRED TO ACCURATELY FABRICATE THE COMPONENTS.

4.3 THE MECHANICAL SUPPORT WORK AND MECHANICAL WORK SHALL BE PAID FOR UNDER THE LUMP SUM CONTRACT PRICE FOR "BRIDGE MACHINERY".

4.4 THE ELECTRICAL WORK SHALL BE PAID FOR UNDER THE LUMP SUM CONTRACT PRICE FOR "BRIDGE ELECTRICAL".

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DATE	4/11/2012
PLOTTED BY	Seabrook
DESIGNED BY	S. SNELLING
ENTERED BY	M. SEABROOK
CHECKED BY	A. GRAYBEAL
PROJ. ENGR.	G.L. McKEE

FED.AID PROJ.NO. 10 WASH 12A007

Washington State Department of Transportation

SR 529
SB SNOHOMISH RIVER BRIDGE
SPECIAL BRIDGE REPAIR

Plot 1 G1 5

Bids

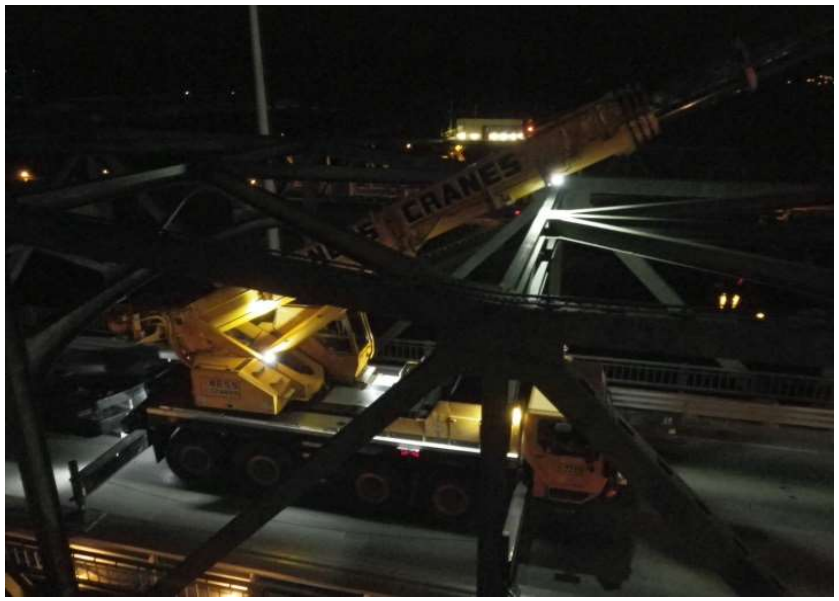
- Engineer’s Estimate: $2.9 Million

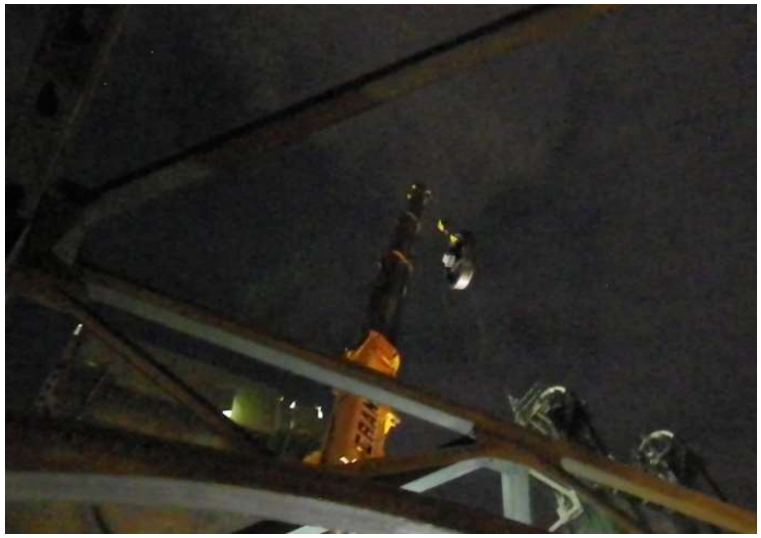
- Low Bid: $1.7 Million
- Second Bid: $2.2 Million

Temporary Counterweight Support

- Redundant for rod failure
- Bearing Stiffeners to distribute point loads

Sheave Lifts





Snohomish River Bridge

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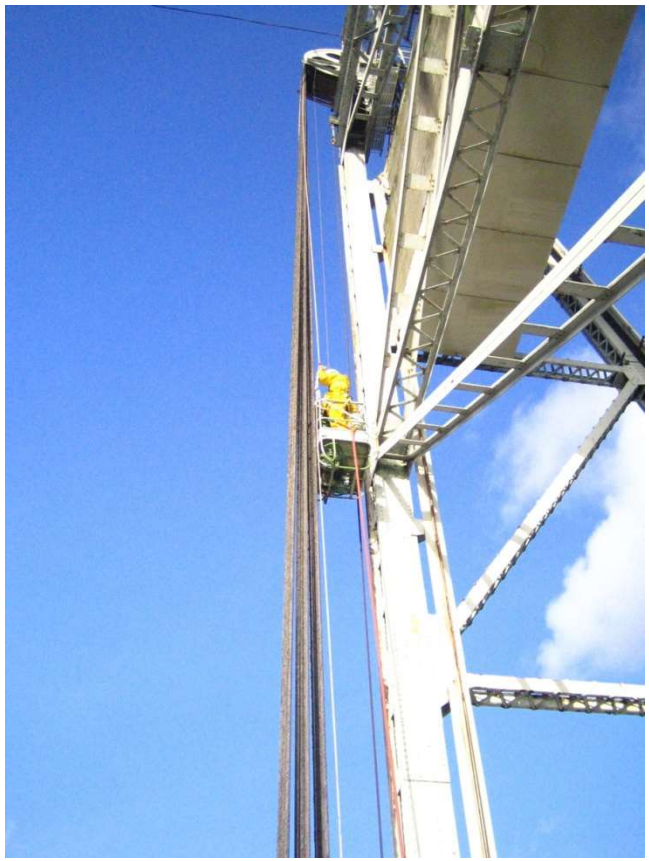

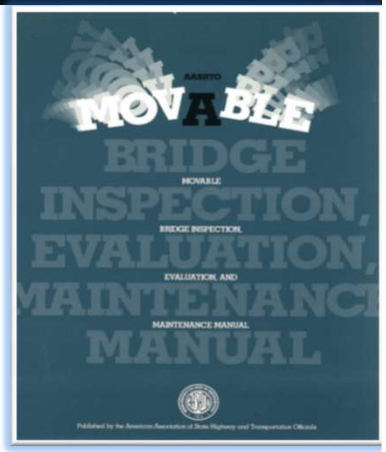

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