

2012 Hagwilget Suspension Bridge Refurbishment

New Hazelton, BC, Canada

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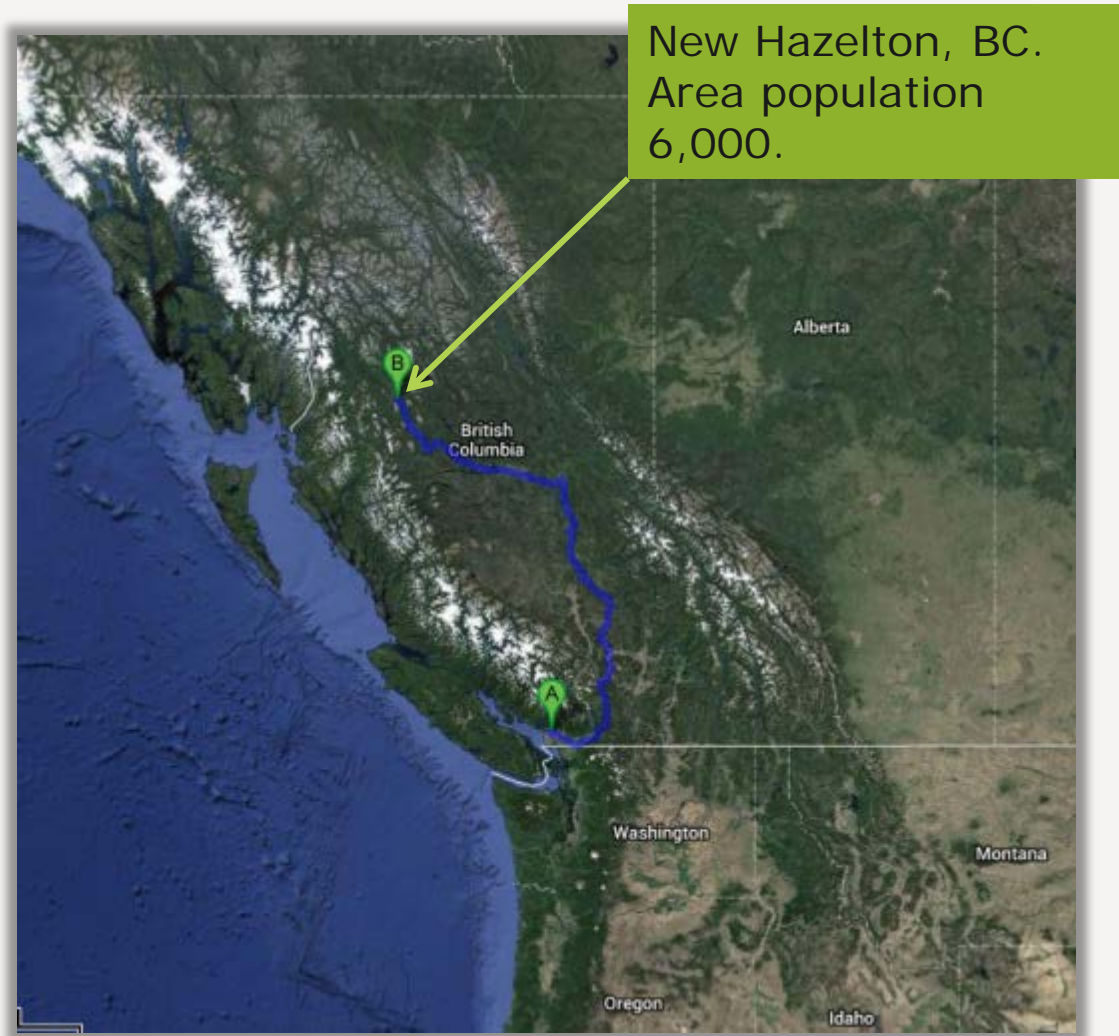
Hagwilget Suspension Bridge

- › Opened to traffic 1932.
- › Single Lane, grating deck.
- › 640' long, 460' between towers.
- › 250' above the Bulkley River.



Works Location & Constraints

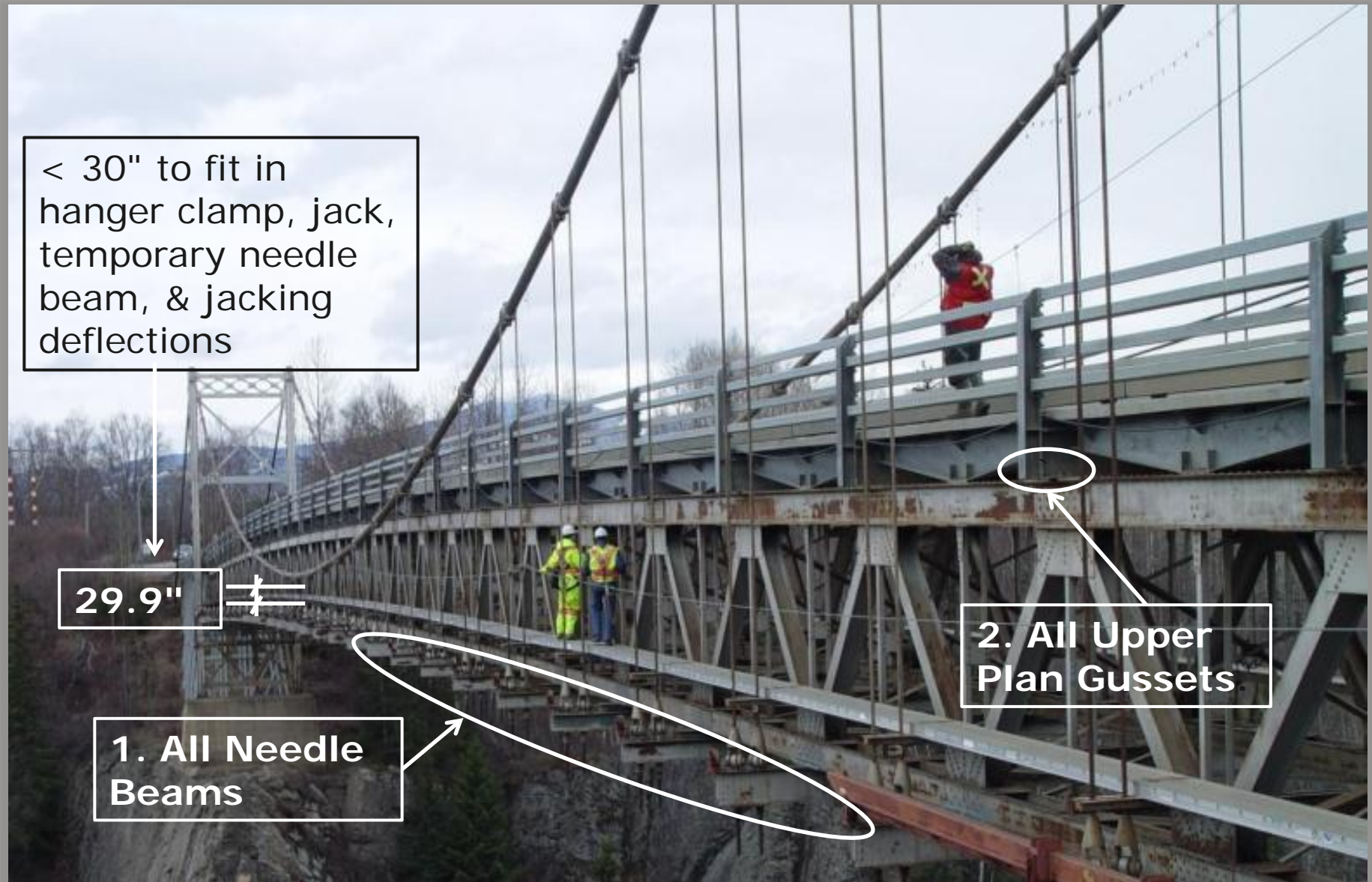
- Town split by the Bulkley River & crossed by the Hagwilget Bridge.
- Regional hospital on far side.
- 5-7 hour detour if bridge closed.
- Bridge closures limited to 15 minutes.
- Significant commercial traffic including double logging trucks.



Refurbishment Works Summary

- **Works Done with Live Traffic:**
 - Replace all 31 Needle Beams supporting truss.
 - Unwrap, wedge, inspect and re-wrap Main Cable at (10) locations.
- **Works Done with 15 Minute Closures:**
 - Replace all Upper Plan Gussets.
- **Two Night Closures Used:**
 - Remove & replace (6) hangers to check capacity by destructive testing.
- **Other Works:**
 - Replace all sway bracing.
 - Replace all upper plan bracing.
 - Replace cap beams at Bents 8, 9

Needle Beams & Upper Gussets



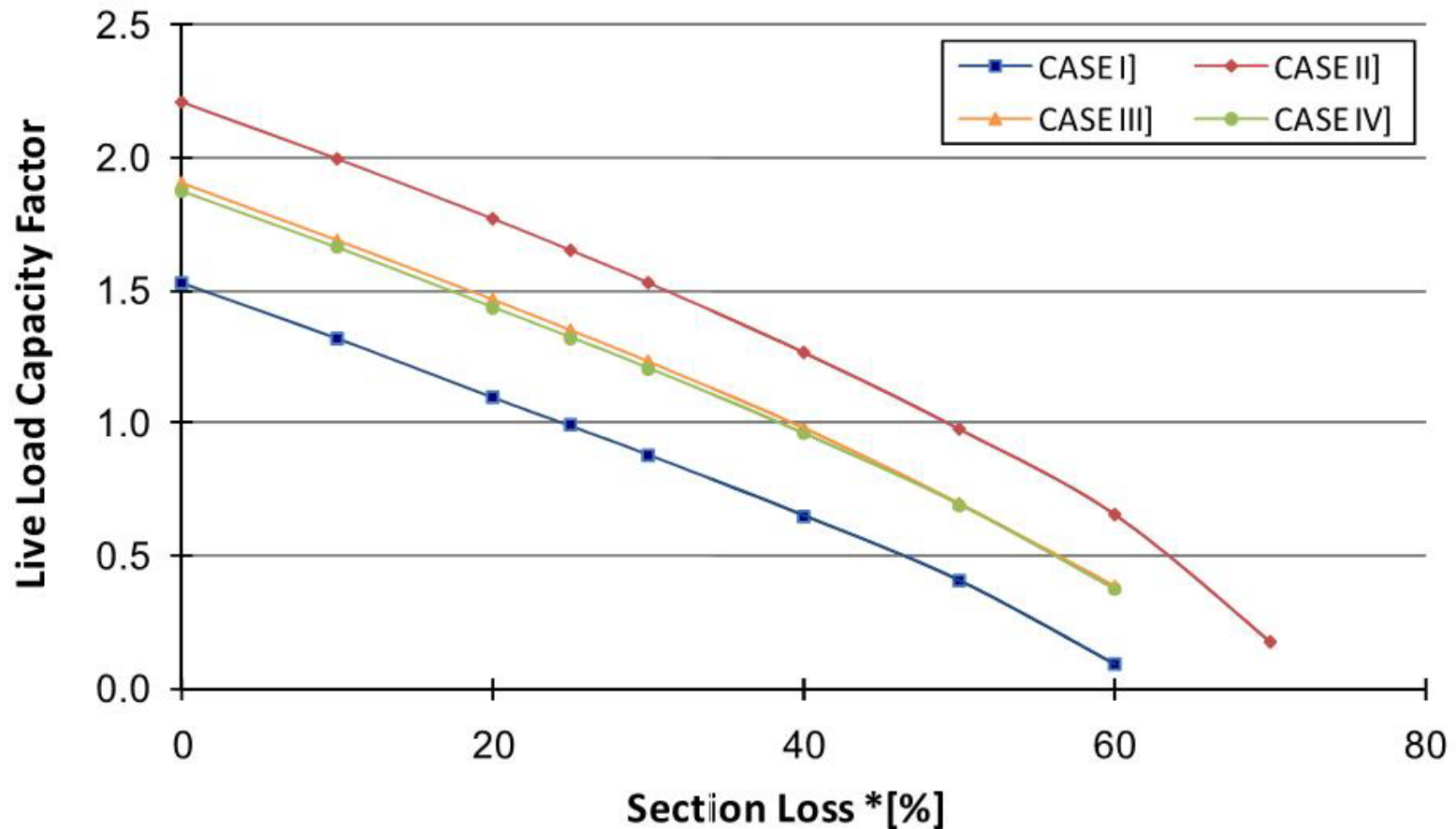
Why Replace the Needle Beams?

- Significant section loss to flanges.
- Significant web section loss with through holes.
- D/C estimated 1.15-1.39 in worst areas.



Buckling Analysis

Live Load Capacity Factor vs. Section Loss



* Reduction in thickness of both flanges and web

Buckling Analysis

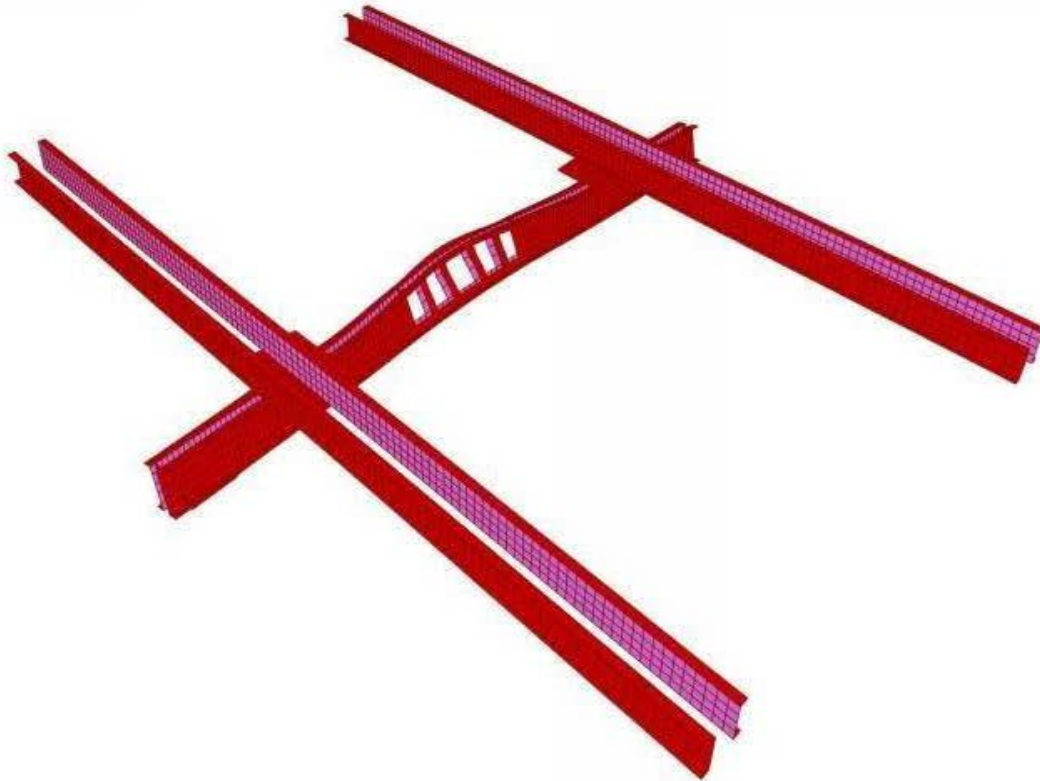
CSiBridge

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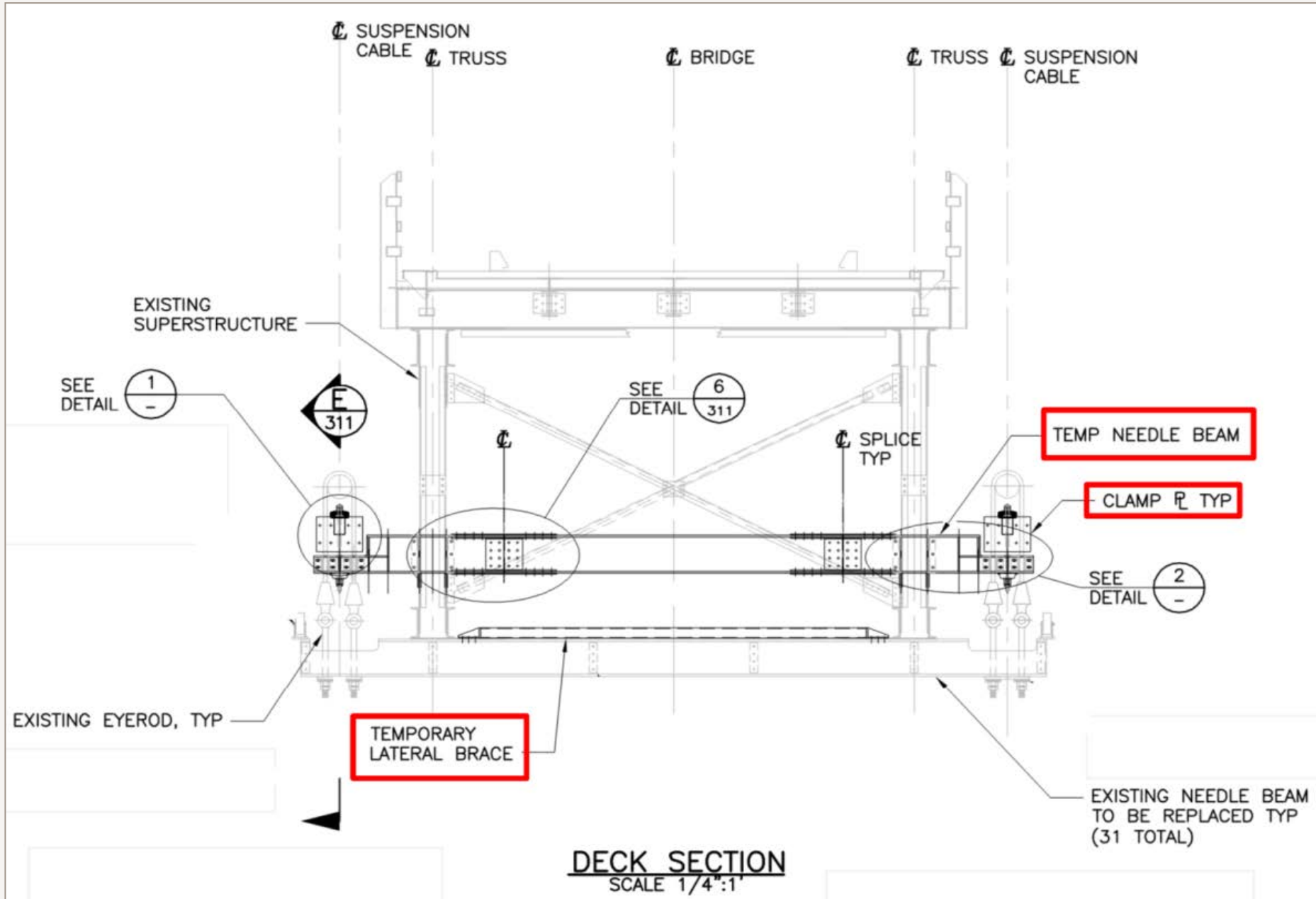
▶ Case III

D/C : 1.15

LLCF : 0.76



Needle Beam Replacement – Temporary Works



Needle Beams: Preliminary Works

- Measuring eyerod extension.
- Drilling vertical gussets for temporary needle beam connection.



Temporary Works Installation



- $< 30''$ between highest spelter socket top & lowest point of main cable hanger clamp at midspan.
- Temporary Needle Beam limited to 7" at spleters & jack fully inset into hanger clamp.
- Temporary Needle Beam halves spaced to allow spelter tops to come up in between.

Temporary Works Complete



Lowering New Needle Beams Over the Side



Just Clearing...

- Bearing bar chamfered to clear spelters.
- Spelters up in between the 7" temporary needle beams.
- Varying hanger skew eccentrically positions spelters to centerline of the temporary needle beam.
- Box diaphragms between temporary needle beams visible.



Needle Beam Exchange



Old Needle Beam Removal



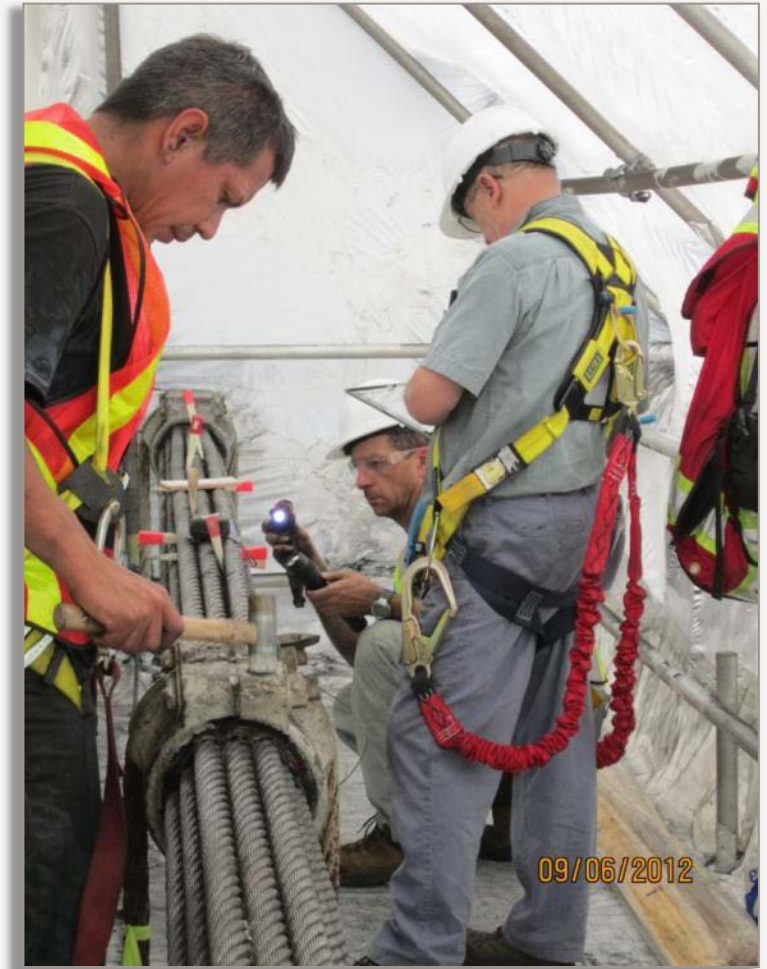
Main Cable Enclosures

- 130' inspected out of 1540' of main cable
 - 4 Anchorages
 - 4 Tower Saddles
 - 2 Midspan

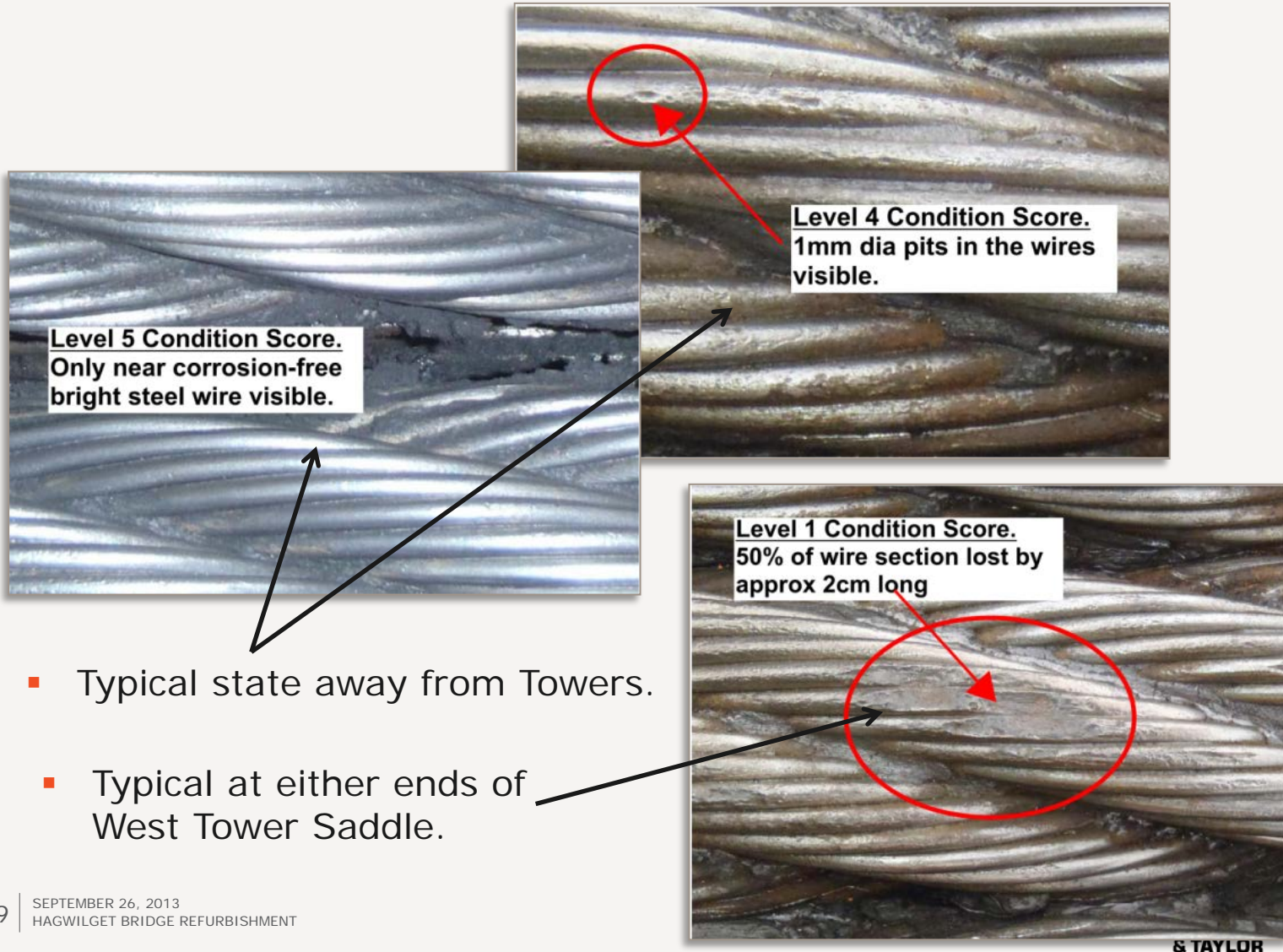


Main Cable Inspection

- Un-galvanized 19 x 1-1/2" wire rope.
- Packed in raw linseed oil & graphite.
- Generally, minimal corrosion & pitting.
- Tower saddles showed most severe loss.



The adjusted D/C for the range of section loss noted during the inspection is 0.51 to 0.65.

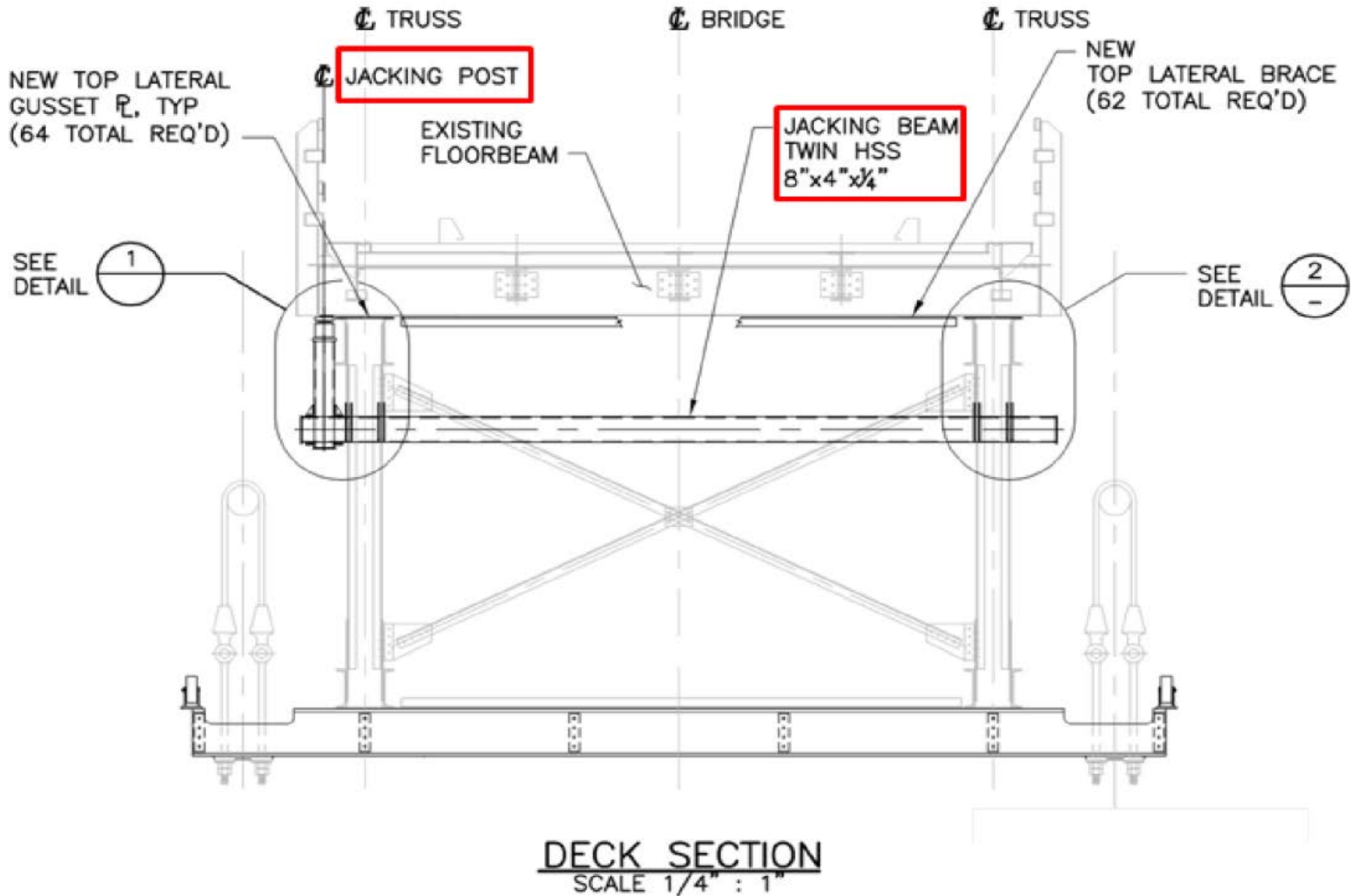


- Typical state away from Towers.
- Typical at either ends of West Tower Saddle.

Main Cable Re-Wrapping



Upper Plan Gusset Replacement – Temporary Works

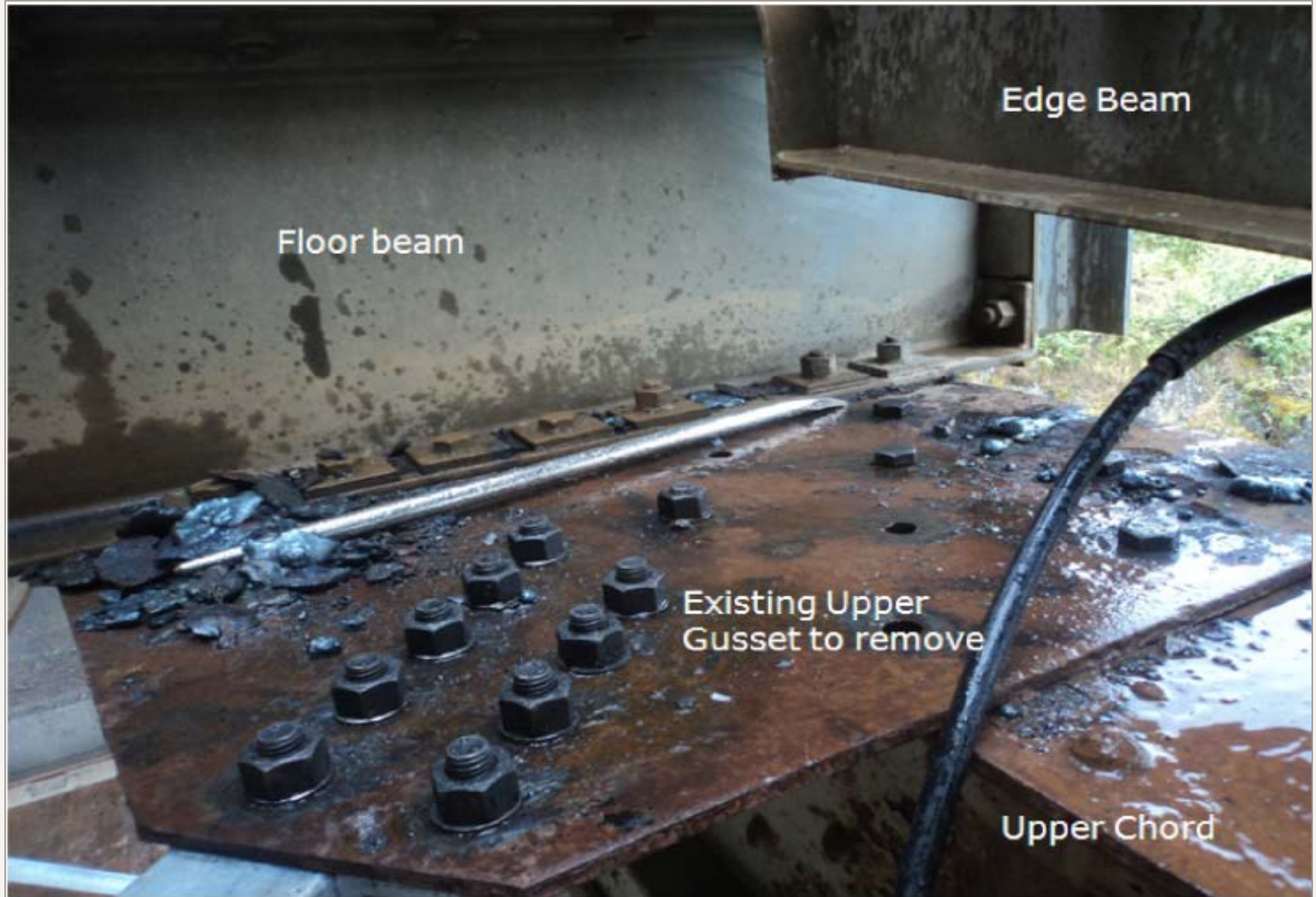


Upper Gusset Jacking Beam Installation

- Paired 8" x 4" HSS sections.
- Connected to new holes in the upper vertical gussets.



Bolts Substituted for Existing Rivets



Jacking Post in Position

- Single jacking post fabricated for use on both truss lines.
- Jack raised end of floor beam $\frac{1}{4}$ " & elastically deflected the edge beams (stringers).



Truss After Steelwork Replacement



- New Upper Gussets & Plan Laterals
- New Sway Bracing
- New Needle Beams

2013 Works: Full Coating Now In Progress

**2014 Works (estimated):
Lower Chord Vertical Gusset Replacement**

Questions?

