Better Bridges
Keeping America Connected

NESMEA – October 6, 2009

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Purpose and Need

- Infrastructure decaying at a rate outpacing rehabilitation.
- “40 Percent of all bridges are more than 40 years old. When these bridges were constructed, design life was often 50 years.”
- “Congestion Relief” is necessary to promote economic growth
- Safety of traveling public at risk

Bridge


W0531 Cedar Rt.Z 10/06/05
east side
2" X 16" hole rusted thru north outside stringer @ bt. 2

Condition


A3015 02-28-06
Span 3, underdeck. Close
up of girder deterioration.

Critical

Service Life - Expired

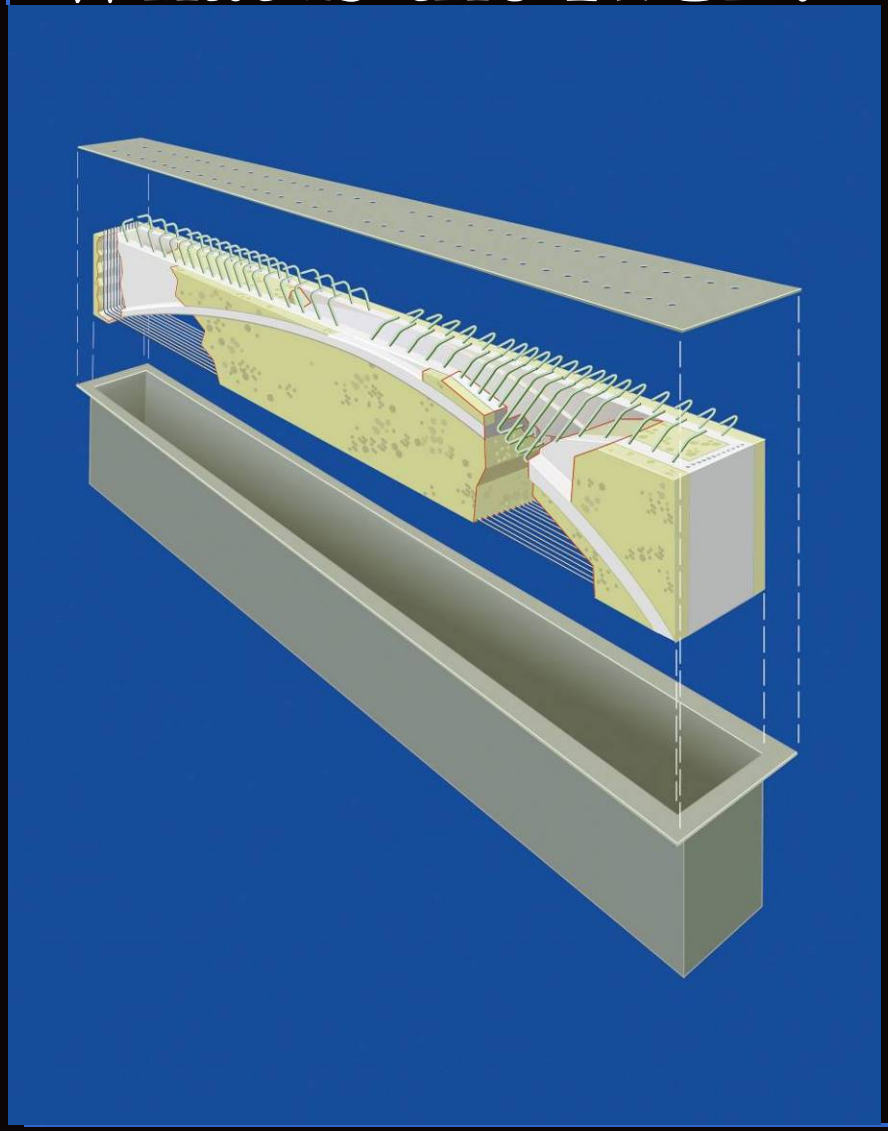
The Strategy for Success

- “Accelerated Bridge Construction (ABC)”
- “Bridges for Service Lives Beyond 100 Years”
- Innovative delivery systems
- Replicate this model nationwide to eliminate structurally deficient and functionally obsolete bridges with a more efficient use of resources

The Solution for Success

- Build Better Bridges with Sustainable Structural Solutions
- Hybrid-Composite Beam (HCB) provides a cost effective solution to achieve the Strategy for Success

What is the HCB?



- A structural member using several different building materials resulting in a cost effective composite beam designed to be stronger, lighter, and more corrosion resistant

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Inspiration for Optimization

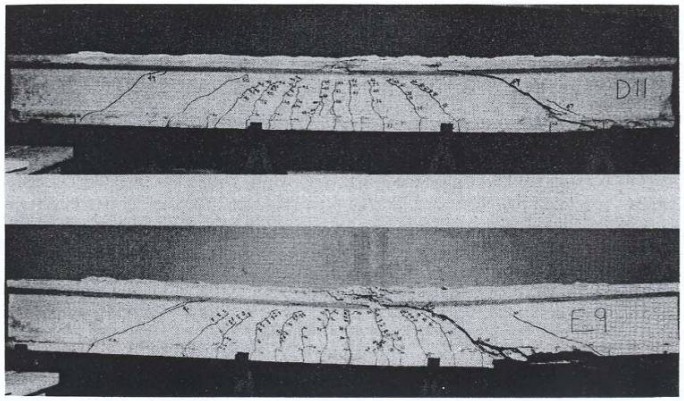
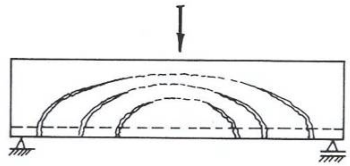
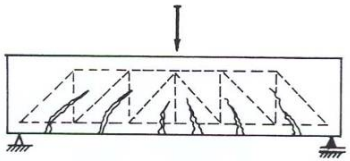


Figure 6.7 Typical shear failure in prestressed beams without web reinforcement. *(Courtesy Prestressed Concrete Institute.)*



(*a*) Arch analogy



(*b*) Truss analogy

Figure 6.8 Typical analogies for shear failure mechanisms.

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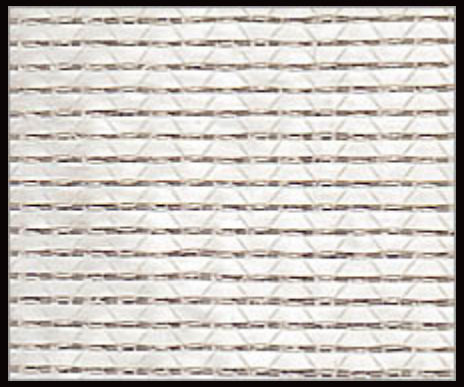
Fiberglass Box

- Quad weave fabric with fibers that are horizontal (0^o), vertical (90^o) and ($\pm$ 45^o)
- infused in an epoxy vinyl ester resin matrix



Tension Reinforcing

- Tension reinforcing consisting of 270 ksi galvanized prestressing strand along bottom of beam

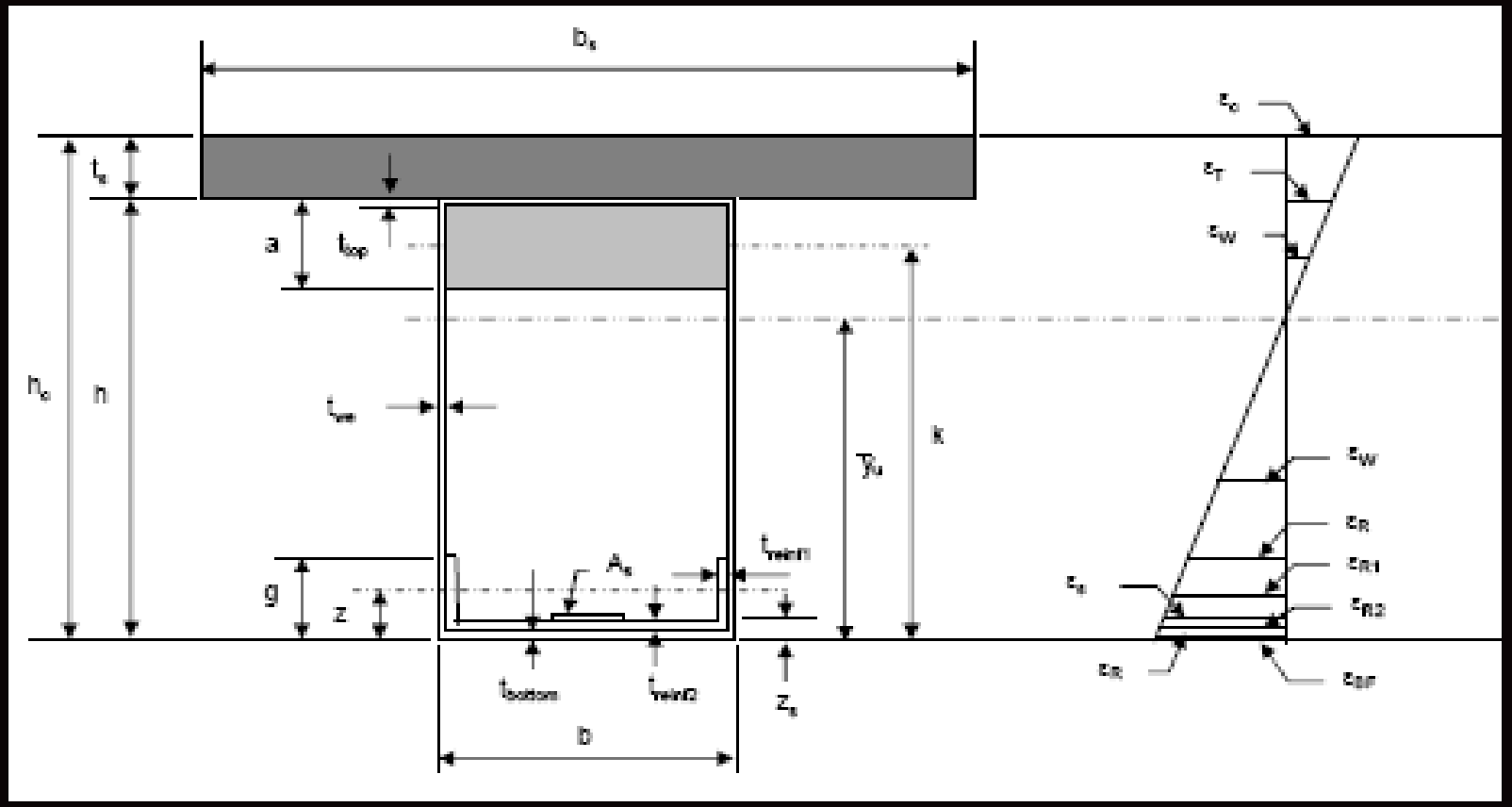
SCC - Compression Reinforcing

- Compression reinforcing consisting of 6,000 psi Self-Consolidating Concrete (SCC) pumped into internal arch-shaped conduit
- Modulus of Elasticity = 4.4 MSI

Benefits of the HCB

- Sustainability: (100+ year service life)
- Congestion Relief: (perfectly suited for modular bridge installation “ABC”)
- Lightweight: (10% of Concrete)
- Safer: (consistently exceeds code requirements for strength)
- Reduced Carbon Footprint: (uses 80% less cement than concrete structure)

Section Analysis for Design



Strain Compatibility for Typical X-Section

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Simplified Bending Capacity

- $C=T$
- $C=0.85f_c'ab$
- $\Phi M_n=\Phi C(d-a/2)$

Use Simplified Approximate Method for Calculation of Ultimate Bending Capacity using Whitney's Equivalent Stress Block

Typical HCB Load Path

Force in Arch During Deck Casting

Forces in HCB Subject to Live Load

Shear Connector Detail

Current HCB Installations

- High Road Bridge – Lockport Township, IL – 57 ft span, Aug 2008

Current HCB Installations

- Route 23 – Cedar Grove, NJ – 31 ft span, July 2009

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Another Happy HCB Customer!

Ritacco Superintendent, Ron Allen, demonstrating simplicity of arch casting

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Precast Planks? Fuggedaboutit!

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Current HCB Installations

- TTCI-Pueblo, CO – 30 ft span designed for Class 1 RR loads (320,000 lbs), Nov 2007

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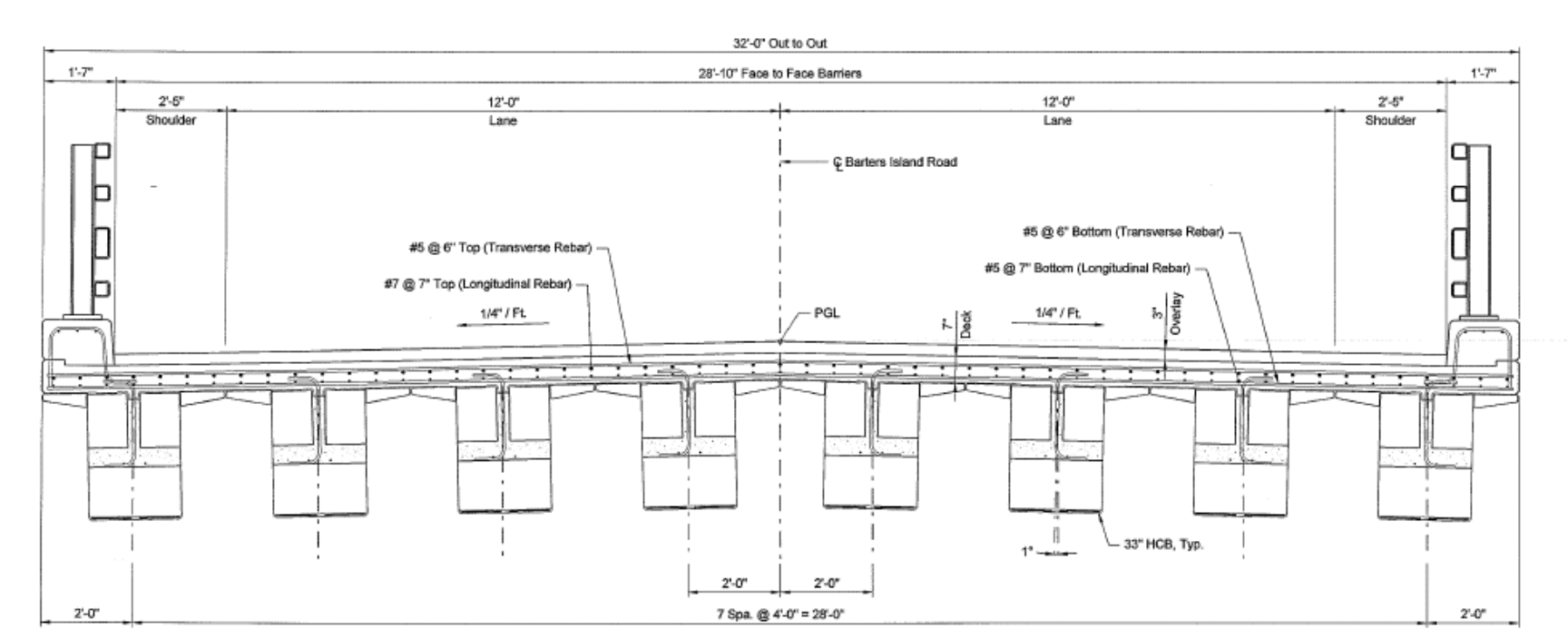
2010 HCB Installations



- Knickerbocker Bridge – Boothbay, ME, 8-span, 540-ft bridge
- Bridge over Little Spring River – MO, 3-span

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Weight Comparison

- 33” Precast Box Beam
  784 lbs/ft

  70 ft = 27.4 Tonnes

  1 Beam/truck

- 33” HCB
  77 lbs/ft – empty

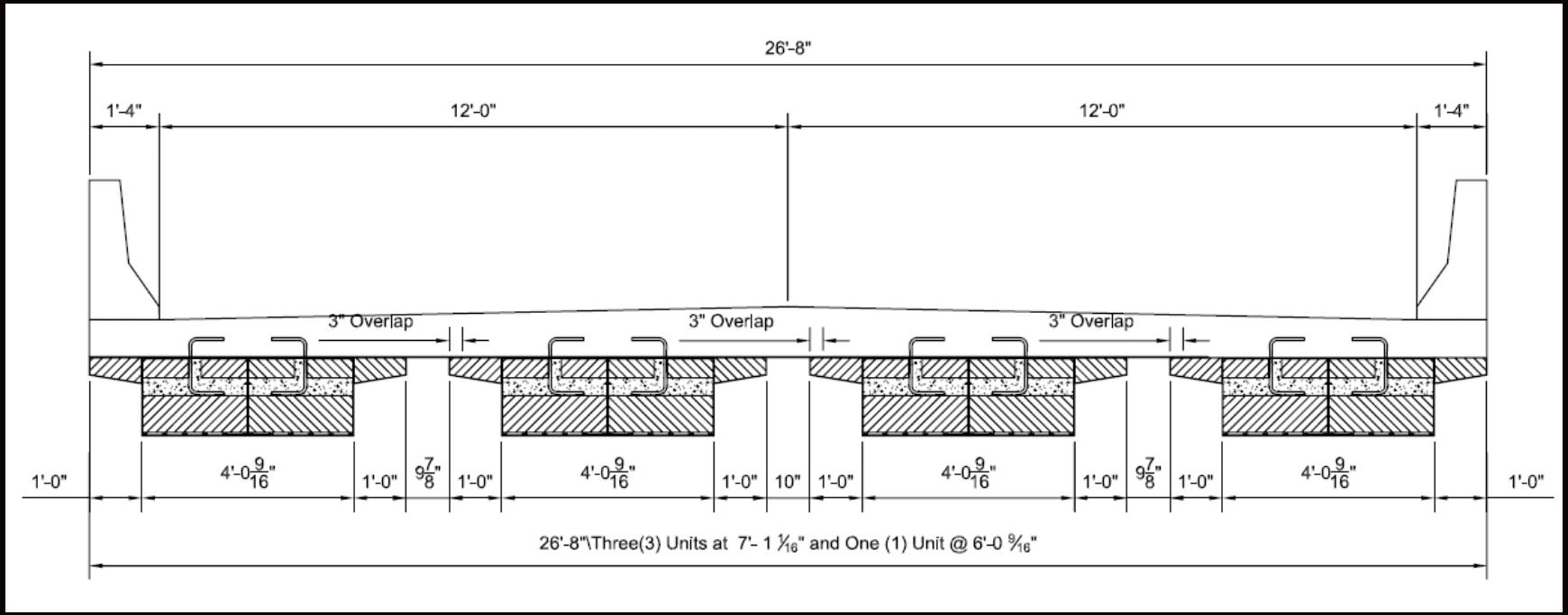
  70 ft = 2.7 Tonnes

  6 Beams/truck

Crane Comparison

- 30 ton crane vs. 200 ton crane

Next Generation – Version 2.2



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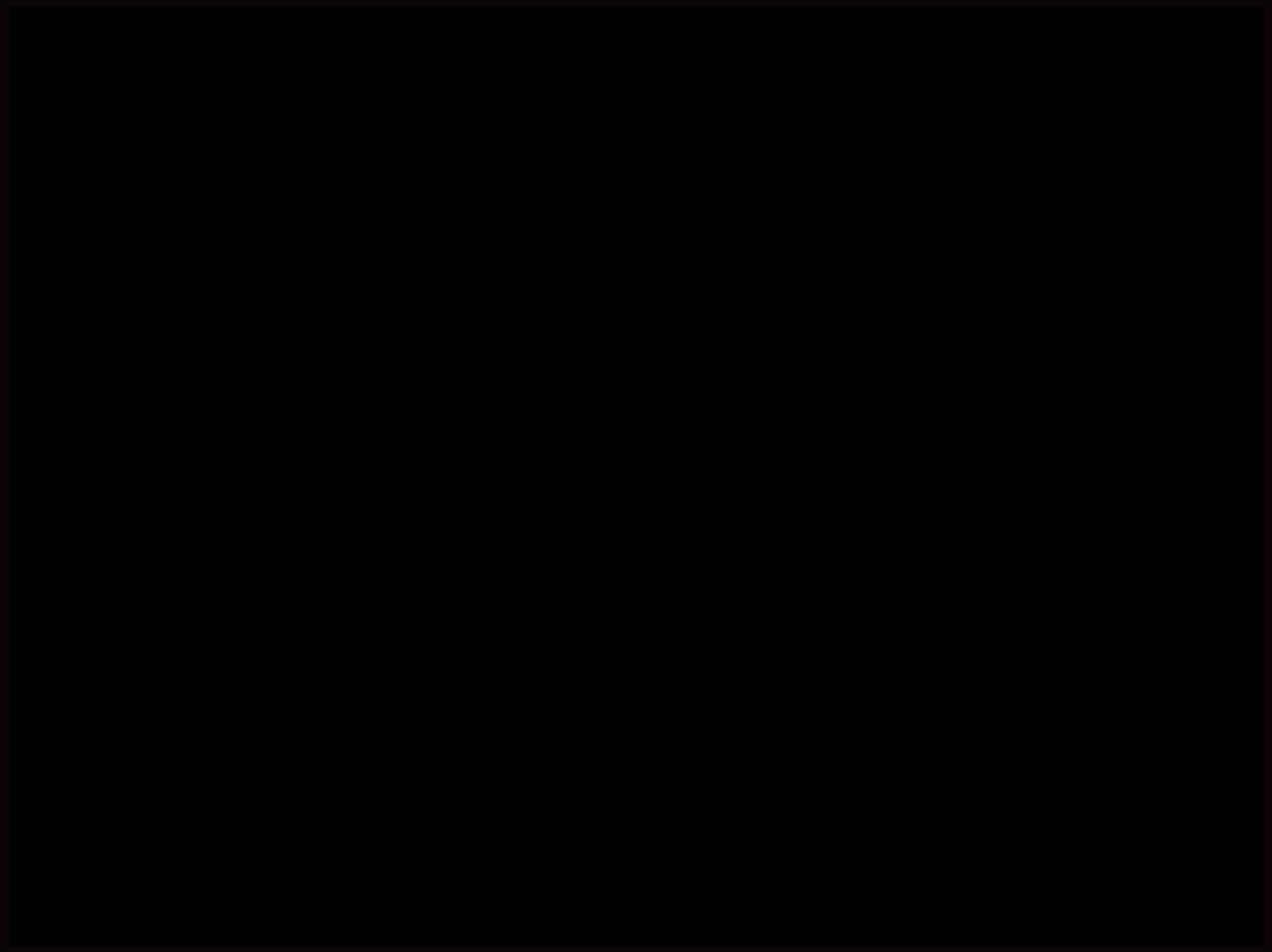
HCB Validation

- Route 23 & Knickerbocker Load Ratings
- Operating = 2.68 (HS-54)
- Inventory = 3.47 (HS-69)

HCB Endurance



- 95 Million Gross Tons to Date

HCB Recognition

- World's 1st Composite Railroad Bridge
- National "Grand Award" – ACEC Engineering Excellence Awards
- Top 25 Inventions – 2007 Modern Marvels Invent Now Competition
- Top 10 Inventions of 2008 – Popular Science Magazine

The Objective

- To create a paradigm shift in bridge construction through the deployment of safe, sustainable structures that can withstand extreme environmental conditions at a better value through the deployment of advanced composite materials.
- "**Build Better Bridges**"

The Benefit

- Reaffirm America's position as the world leader in bridge innovation
- Accelerate standardization of bridge technology applicable to all 50 states – NOW!
- Provide the traveling public with safer bridges
- Reduce the burden of infrastructure maintenance and reconstruction for our grandchildren and generations beyond

The Opportunity

- Accept the challenge of embracing change!

Questions?

- www.hcbridge.com
- www.harbortech.us

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