

Rapid Repair of Low Volume Bridges: Mechanically Fastened FRP Strips

By:

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Logging trucks represent heavy loads on bridges while being essential to the local economy



5 axle tractor-trailer



Logging trucks represent heavy loads on bridges while being essential to the local economy



6 axle tractor-trailer



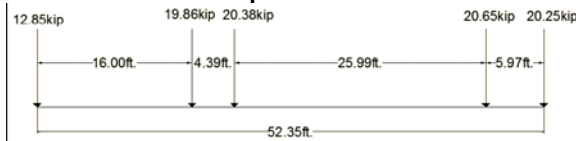
5 axle truck and pup



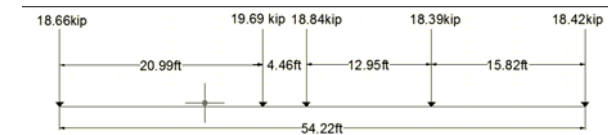
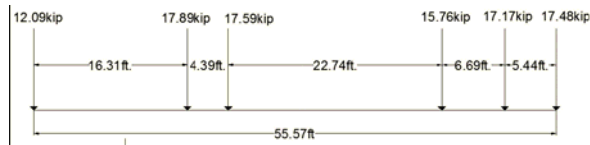
Measured logging truck weights



5 axle tractor-trailer – 94kip

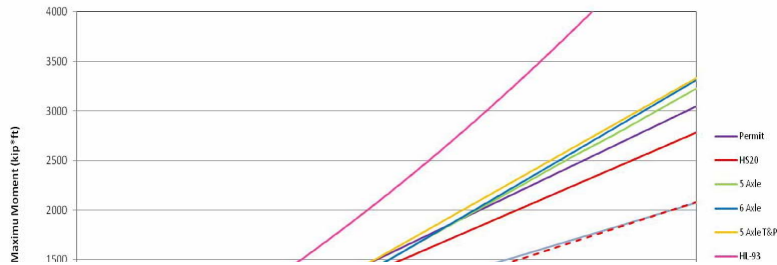


6 axle tractor-trailer – 98kip



5 axle truck and pup – 94kip





Michelle –

Can you excel a figure that just has the moments of 3 trucks on previous slide combined with HS20 and HS15? than add note showing that all short span bridges built to HS15 won't carry logging trucks

Then do the same on a following slide with shear and note that HS15 designed bridges won't be able to carry logging trucks

Need to use much bigger fonts for axes and legend



In the North-west and in Wisconsin the local economy is strongly dependent on logging.

Current load posting of older bridges adds million dollar costs to the timber industry in Wisconsin.

Can bridges be quickly and economically strengthened to allow short term logging truck movement?



Mechanically Fastened Fiber Reinforced Polymer (MF-FRP) Strips

- Common way of attaching strips is with the use of epoxy



- Advantages of MF-FRP Strips
 - Very little surface prep is necessary
 - Can be attached to surfaces in poor condition
 - Can be completed by unskilled labor
 - No curing time; bridge can be immediately opened to traffic after installation is completed

MF-FRP Strips

- Uses a powder actuated fastener system (PAFS) to attach strips to external side of concrete
- Strips and concrete are predrilled and then fasteners inserted using a gunpowder gun



(Bank, 2004)



(Arora, 2003)



Previous MF-FRP Applications

- Application tested at the University of Wisconsin
 - Ultimate Load Test on bridge in Edgerton, WI
- Implemented on three bridges in Missouri with plans to strengthen up to 31 more bridges



(Bank, Nanni, & Arora, 2004)



(Rizzo A. , Galati, Nanni, & Jones, 2005)

9

Cost of Previous Strengthening Projects

Bridge	Total Cost	Length of FRP Used
Missouri Bridge No. 1330005	\$16,502	688 ft
Missouri Bridge No. 3855006	\$13,115	666 ft
Missouri Bridge No. B2210010	\$11,200	502 ft

	Cost of Materials	Installation Time
Edgerton Bridge (WI)	\$7,572	3 days

10

Edgerton, WI Bridge

- Concrete slab bridge built in 1930
- 2 Main Purposes of bridge project:
 - Demonstrate the real world application of this process
 - Full scale testing to show increase of flexural capacity as a result of applying the MF-FRP strips

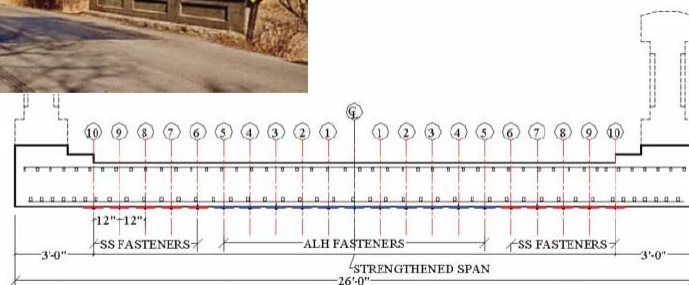


(Arora, 2003)



Bridge Strengthening

- 21 FRP Strips spaced 12in on center
- Strengthening increased bridge from HS17 to HS25 capacity



Edgerton Bridge Full Scale Testing

- Strengthening resulted in an increase of flexural capacity:
- West section (3 strips): 25.2% higher at 2 inches deflection ($L/125$),
- East section (5 strips) was 47.7% greater at the same deflection.



Environmental Effects

- Strengthening system endured a Wisconsin winter and was then inspected



(use stainless steel fasteners!)

Flexural strengthening is successfully used in concrete beam and slab type bridges



Shear strengthening?

Michelle-
Maybe show pic of Wauzaukee bridge
then describe that load capacity is controlled by beam shear

Future: MF-FRP strips
for shear strengthening

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- System doesn't require skilled labor or surface preparation to the concrete underside of the bridge
- Strong potential to alleviate problems rural commerce industries have with old deteriorated bridges

Summary of MF-FRP system

- Software is available to make design simple and straight-forward

Questions?

