



TECHNICAL SUMMARY

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TOTAL PROJECT COST:

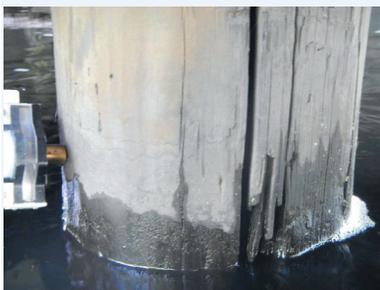
\$299,582

LRRB CONTRIBUTION:

\$209,582

IOWA DOT CONTRIBUTION:

\$90,000



Timber bridges often develop issues, such as pile splitting, at the waterline.



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Manual Gives Cost-Effective Techniques to Extend Timber Bridge Life Spans

What Was the Need?

Midwestern states have a large number of timber bridges, particularly on the secondary road system, with more than 1,500 in Minnesota alone. These timber bridges are low-cost and have performed well, but many are now aging and deteriorating, particularly at the waterline. Nearly one-third of slab and stringer timber bridge substructures in Minnesota are rated “fair” or worse under [National Bridge Inventory standards](#).

More than 1,000 of Minnesota’s timber bridges are load-posted to reduce the maximum weight of trucks crossing them. These postings can significantly increase freight costs by forcing trucks to take potentially lengthy detours.

Additionally, National Bridge Inventory data suggests that many other timber bridges are likely to require load postings in the next decade unless preventive maintenance efforts are taken. The average age of timber bridges in Minnesota with load postings is 52 years, which is only 10 years older than the average age of Minnesota timber bridges that do not have load postings.

Minnesota’s local agencies do not have the funds to rehabilitate or replace all of the timber bridges that need it. Proper inspection, maintenance and repair can help to reduce costs by extending a bridge’s functional life. A previous Local Road Research Board [project](#) investigated timber bridge inspection techniques, but there has not been a similar effort to synthesize information about their maintenance and repair.

What Was Our Goal?

This project, conducted in partnership with the Iowa Highway Research Board, developed a manual of timber bridge repair techniques, costs and economic impacts.

What Did We Do?

Researchers conducted a literature review; surveys of county engineers in Minnesota, Iowa and states known to have a large number of timber bridges; and on-site interviews with engineers in Aitkin and St. Louis counties in Minnesota to identify timber bridge maintenance and repair methods that are currently in use.

Researchers also provided information for use in calculating the cost-effectiveness of various maintenance activities. This includes an estimate of the costs of several repair types, a technique for calculating the cost of truck detours caused by load postings, and an estimate of whether it is more effective to repair or reconstruct a bridge based on relative costs and the bridge’s age.

Using this information, they created a manual of information for cost-effective timber bridge repairs.

What Did We Learn?

The manual provides information for assessing timber bridge condition and a series of recommended preventive maintenance practices. It also provides thorough documentation for several bridge strengthening and rehabilitation procedures suitable for address-

Proper timber bridge repair and rehabilitation practices can extend bridge life spans and reduce freight costs by minimizing detours due to bridge load postings. This project developed a manual of cost-effective repair practices suitable for Minnesota’s timber bridges.

“Minnesota has about 1,500 timber bridges and many are starting to get older. We’ve got a lot of rehabilitation and replacement needs, and not enough money to do them statewide. The way to get around that is to properly inspect and do temporary repairs to extend their life spans.”

—**Dave Conkel**,
State Aid Bridge Engineer,
MnDOT Bridge Office

“Maintenance and rehabilitation of timber bridges are necessary to keep them operational for as long as possible. State systems don’t use timber bridges often, so there aren’t a lot of resources available about how to maintain them.”

—**Brent Phares**,
Co-Director, National
Center for Wood
Transportation Structures,
Iowa State University

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Concrete pile jackets—concrete-filled steel shells installed to strengthen timber piles weakened by minor to moderate deterioration—are one of the rehabilitation procedures detailed in the timber bridge repair manual.

ing timber bridge concerns in Minnesota. These procedures should be applicable to a wide range of bridges, although engineers will need to adapt the plans and drawings included in the manual to specific bridges. These procedures include:

- Repair of laminated bridge decks.
- Strengthening of individual timber stringers.
- Addition of steel channels to piles.
- Addition of reinforced concrete jackets to piles.
- Encapsulation of pile groups.

The manual describes several other methods for strengthening superstructure and substructure elements in more general terms. Timber pile repair techniques include post-ing and splicing, mechanical splicing, splicing with fiber reinforced polymer wrapping, installing fiber reinforced polymer shells and replacing timber caps. Timber superstructure repair techniques include scabbing or splicing and replacement of flexural timber components.

The costs of truck detours due to load postings can be estimated using the length and speed of the detour, number of trucks per year, and operation costs provided in the report such as baseline vehicle operation costs and typical driver pay. The report includes graphs to help determine the turning point when it becomes more cost-effective to reconstruct a bridge rather than repair it, based on relative repair and reconstruction costs and whether the bridge is load-posted or not.

What’s Next?

Researchers conducted workshops in Bemidji, Carlton and Owatonna to help disseminate information about timber bridge repairs and demonstrate advanced inspection tools. They also conducted 10 one-hour webinars, which were recorded so they can be posted on the MnDOT Bridge Office website with the repair manual. LRRB hopes this information encourages timber bridge owners to conduct appropriate repairs to ensure public safety at reasonable costs.

LRRB is planning a follow-up project to develop a cost-effective timber bridge system that will make it feasible for counties to construct more timber bridges at costs that are competitive with other materials. LRRB has also contracted research to evaluate the impact of semitrucks with liftable axles on small bridges, including timber bridges.

This Technical Summary pertains to the LRRB-produced Reports 2015-45A, “Development of Cost-Effective Timber Bridge Repair Techniques for Minnesota,” and 2015-45B, “Cost-Effective Timber Bridge Repairs: Manual for Repairs of Timber Bridges in Minnesota,” both published in November 2015. The full reports can be accessed at mndot.gov/research/TS/2015/201545A.pdf and mndot.gov/research/TS/2015/201545B.pdf.