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Bridge Capital Spending on Three Heavy Axle Load Routes

by Duane Otter and Brian Doe

Summary

Transportation Technology Center, Inc. (TTCI), a subsidiary of the Association of American Railroads (AAR), recently studied bridge capital spending on selected heavy axle load (HAL) routes of three major railroads. While there were significant differences in territory, bridges, and traffic history on these routes, the following trends were observed:

- The effects of HAL traffic are evident in that significant capital expenditures continue to be made in addition to earlier upgrades to handle 100-ton unit train traffic on these lines.
- The upgrades included new construction, rehabilitation or strengthening, and replacement of significant numbers of spans.
- The majority of bridge capital expenditures were on new spans and structures, rather than the rehabilitation of existing structures.
- On two routes, the vast majority of new spans were built in concrete. On a third route, steel spans, including some secondhand spans, were preferred.
- While many timber bridges have been replaced, there are still several that remain in service on these HAL routes.
- Rehabilitation work included new decks, open deck-to-ballast deck conversions, and floor system replacement — all on steel bridges. In recent years, no strengthening or rehabilitation of timber or concrete bridges was reported for any of these routes.
- On two routes for which bridge maintenance spending information was also available, there has been a decrease in traffic-related maintenance spending as older, high-maintenance bridges have been replaced with newer ones.
- Annual capital spending for bridges on these routes varied greatly, ranging from \$0 for 1 year on one railroad, up to an average of \$60,000 per track mile in periods of significant capacity expansion on one railroad.

This study follows up on previous studies of bridge maintenance costs on a HAL coal route.^{1,2,3} Capital and maintenance spending on non-traffic-related items, such as pier protection or walkways, was not included. This study was performed as part of the AAR's program to monitor revenue service implementation of HAL traffic.



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- Safety
- Maintenance-of-Way
- Bridge Maintenance
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INTRODUCTION AND CONCLUSIONS

The effects of HAL traffic are evident in the trends for capital spending on bridges for heavy haul routes on three railroads. Heavy haul lines on Burlington Northern Santa Fe (BNSF), Canadian Pacific (CP), and Union Pacific (UP)—either upgraded or constructed new in the 1970’s or 1980’s for 100-ton unit coal train traffic—continue to require capital investment in bridges in order to handle increasing amounts of HAL traffic. While some of that investment was in the form of rehabilitation or upgrade of existing bridges, the majority of it was in new spans. Concrete was the material of choice for the bulk of the new spans on two of the lines, while steel was preferred on the other. Only steel bridges were upgraded or rehabilitated. Timber and concrete bridges that had become obsolete or required extensive maintenance were simply replaced on the BNSF.

FINDINGS

The types of work performed on each line are shown in Figures 1 through 3. The breakdowns are shown based on both length of bridge and expense. For the BNSF work, the breakdowns are nearly identical, indicating that the relative cost of each type of work was similar. The only upgrade work performed to existing spans was the conversion of open deck steel spans to ballast deck spans. All other capital work was replacement. Also note the large portion of steel spans replaced with concrete spans on the BNSF.

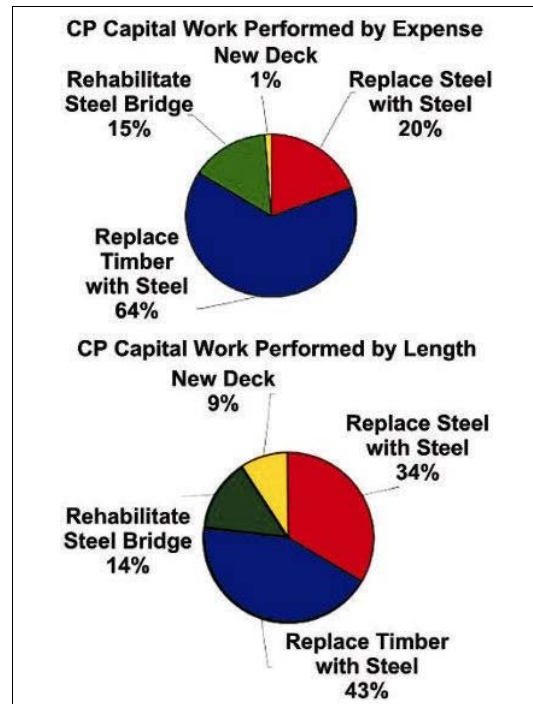


Figure 2. Bridge Capital Work on CP Coal Route

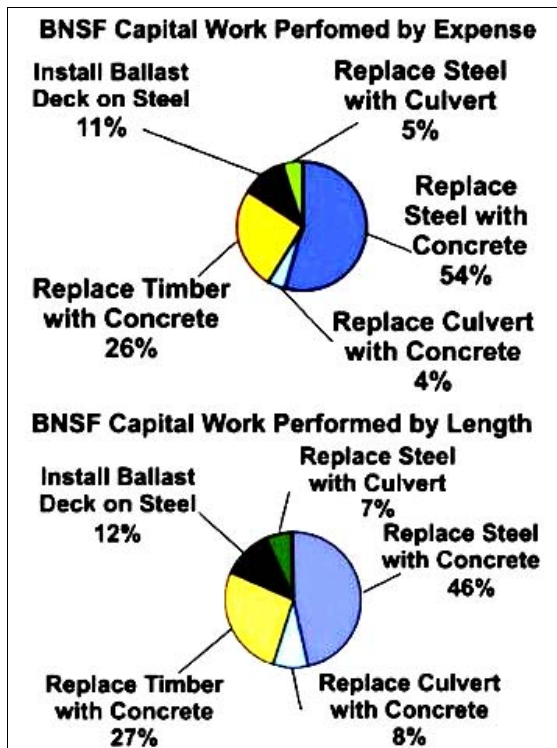


Figure 1. Bridge Capital Work on BNSF Coal Route

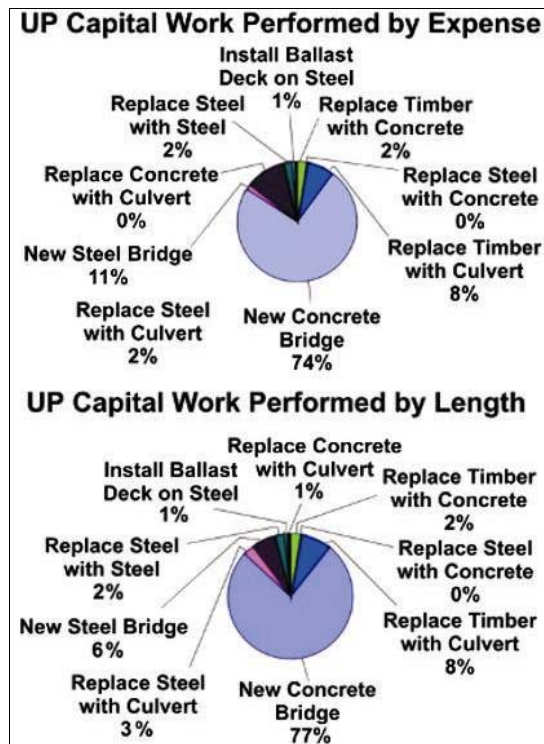


Figure 3. Bridge Capital Work on UP Coal Route

For the CP bridge work, there are some significant differences. The installation of new decks was much less costly per foot than some of the other work. Also note that replacing timber bridges was more costly than replacing steel bridges in kind. This is because the foundations of existing steel bridges could often be used again. In comparison, new foundations were required when a timber bridge was replaced. Also note that for the work performed on steel bridges, replacement was less costly than rehabilitation on a per-foot basis. This observation could be misleading, as the bridges that were rehabilitated were longer truss spans. These tend to be much more costly to replace than the shorter steel girder spans that were replaced. It is very likely that replacement of these longer truss spans would have been much more costly than the rehabilitation work that was performed.

The largest portion of the UP capital work on this line in the past five years has been the addition of a second main track, which has required many new bridges. Concrete was used much more than steel for the new construction. The steel bridges tended to be used where longer spans were required.

Figure 4 shows cost per bridge foot for various types of bridge capital work performed. These costs are averages for all three lines. There are several items of note.

- The most expensive work was construction of new steel bridges. For larger structures with long spans, steel is typically the only economical alternative. The relatively high expense is probably related more to the span and bridge lengths than the choice of material.
- Replacing steel spans tends to be much cheaper than replacing timber bridges. This is likely because the steel bridge foundations can be rehabilitated and reused. When a timber trestle is replaced with either concrete or steel spans, new foundations are required and the old timber piles must be removed.
- Culverts are generally more economical than bridges. The relative low cost is probably related more to the short spans and overall lengths involved. Culvert lengths stated are for the spans that were replaced.

Span replacements, rehabilitation, and deck improvements are all cheaper than new bridge construction.

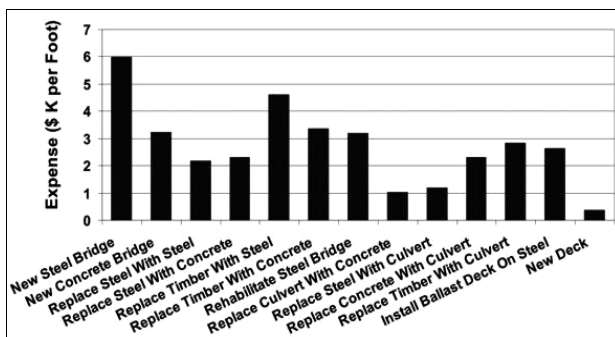


Figure 4. Cost for Bridge Capital Work

Figure 5 shows the relative amounts of steel, concrete, and timber of bridges on each coal route as well as the North American average (BNSF, CN, CP, CSXT, NS, and UP entire systems).

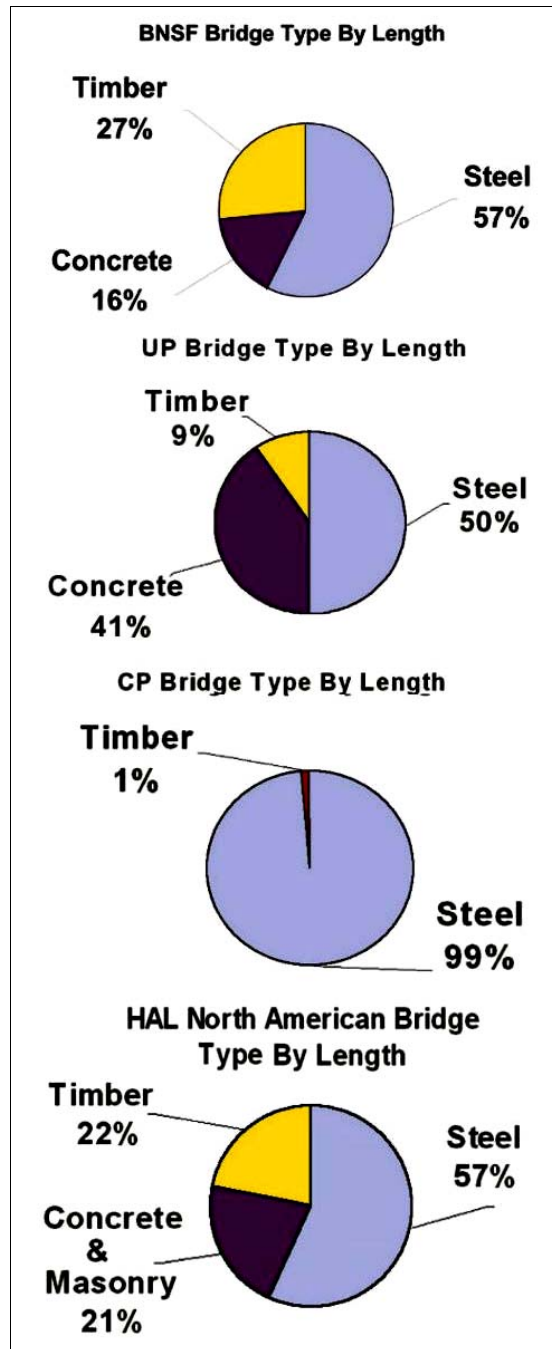


Figure 5. Type of Bridges on Each Line

Steel spans are the most common on all three lines, in spite of the large numbers of new concrete spans being installed on two of the lines. Note that timber bridges are still in use on all lines, even though many have been replaced. North American averages are also shown for reference.

Figure 6 shows that all three routes have similar length of bridge per mile of track. These values are about half of the average value for major North American railroads. It should be noted that for the double mainline track UP route, each track typically has its own bridge. The figure shown reflects feet of bridge per track mile rather than route mile for that line. On lines with more bridges, capital expenditures for heavy haul routes would be expected to rise accordingly. None of the routes studied contained any major bridges (more than \$20 million replacement value).

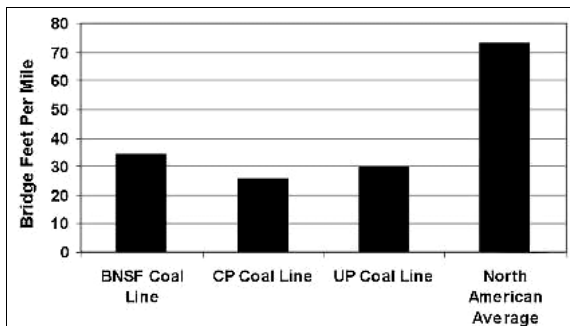


Figure 6. Bridge Feet per Mile for Three Heavy Haul Routes

BACKGROUND

The BNSF route studied runs from Walsenburg, Colorado to Fort Worth, Texas — a distance of about 630 miles. Annual tonnage is about 50 MGT, generated by mostly unit coal trains with about two daily mixed freight trains. The route is single track. Speed limits on the line range from 35-60 mph.

The CP route studied runs from Fording to Golden, British Columbia, a distance of about 270 miles. Nearly 80 miles of this route carry grain, potash, and mixed

freight traffic in addition to coal. Annual coal tonnage is about 40 MGT. Grain and mixed freight add about 10 MGT for that 100-mile segment of the route. The line is single track. Speed limits on the line range from 20 to 45 mph.

The UP route studied runs from Shawnee Junction, Wyoming to O'Fallons, Nebraska — a distance of about 270 miles. Annual tonnage is about 230 MGT, generated almost exclusively by unit coal trains. The line has two main tracks. Speed limit on the line is 60 mph. The second main track has been added over the past 10 years. The westernmost 107 miles of this segment were built new in 1983 and 1984.

This study was undertaken as part of the AAR program to monitor revenue service implementation of HAL traffic.

Acknowledgements

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