

BRIDGE MAINTENANCE COSTS ON A HAL COAL ROUTE: A CASE STUDY

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Summary

The Association of American Railroads (AAR) is studying the effects of introducing heavy axle load (HAL) traffic (286,000 lbs. gross rail load) on the North American railway infrastructure. As part of the HAL Implementation program, AAR is monitoring bridge maintenance costs on two segments of a 271-mile coal route as the amount of HAL traffic increases on the line.

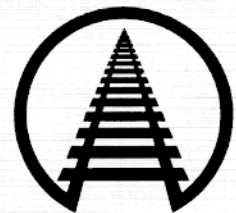
Preparatory work performed by the railroad in anticipation of heavier HAL traffic is likely responsible for keeping bridge maintenance costs from rising. Over the past five years, no increasing trend of traffic-related bridge maintenance spending has been noted, in spite of additional traffic and increased wheel loads. Other findings include:

- ▶ Bridge maintenance costs for the segment of the line originally constructed around 1910 were more than twice as high as those for the segment constructed around 1984.
- ▶ Maintenance costs were highest for concrete bridges as a result of two major repairs.
- ▶ Maintenance costs were higher for timber bridges than for steel bridges.
- ▶ A noticeable share of the bridge maintenance costs were for track-related items such as ballast retainers, deck ties, and raising of approach track—particularly on steel and timber bridges.

Bridge maintenance costs are very specific to particular lines and railroads; the findings of this case study should not be generalized. Costs will vary depending on maintenance policies and practices, as well as type, quantity, age, and length of bridges on a line. This cost data is being used to complement various HAL economic analyses by the AAR and to determine the costs and benefits of running HAL traffic.

Suggested Distribution:

- Maintenance of Way
- Planning and Analysis
- Bridges and Roadway
- Track Maintenance
- Structures



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INTRODUCTION AND CONCLUSIONS

As a part of the Heavy Axle Load (HAL) Implementation program, the Association of American Railroads (AAR) has been monitoring the effects of HAL (286,000 lbs. gross rail load) traffic introduction on the North American railway infrastructure. The program includes monitoring bridges, turnouts, ties, subgrade, wheel loads, and the rate of HAL traffic introduction. This information is being used to analyze the economic benefits of HAL traffic, identify problem areas quickly, and promote the development of improved materials and maintenance practices. The AAR is monitoring bridge maintenance costs on two segments of a 271-mile coal route as the amount of HAL traffic increases on the line. This cost study supplements other HAL data obtained from tests at the Facility for Accelerated Service Testing (FAST) at the Transportation Technology Center (TTC), Pueblo, Colorado.

Preparatory work performed by the railroad in anticipation of the added HAL traffic is likely responsible for keeping bridge maintenance costs from rising. Over the past five years, no increasing trend in traffic-related bridge maintenance spending has been noted, in spite of more traffic and increased wheel loads. A 1995 AAR study predicted a 15 to 30-percent rise in bridge maintenance costs for a line operating only HAL traffic of 286,000 pounds per car.¹ It should be noted that these bridges were strengthened to handle 286,000-pound traffic before the introduction of HAL traffic on this line. The 1995 study dealt with bridges that were not strengthened. True fatigue-related costs may not be included in the present data, as cracks may not be visible until later stages of growth.

MAINTENANCE COSTS

Exhibit 1 shows annual traffic-related bridge maintenance costs for all bridges on a 164-mile segment of the Union Pacific Railroad's (UP) North Platte subdivision.

This line carries unit coal trains almost exclusively. The annual costs are normalized by the total bridge length in feet. At this point, it is difficult to state any definite trends in costs. Some of the higher costs in early

years of HAL traffic introduction may reflect a proactive approach by UP to prepare for the coming increases in HAL traffic. The lack of trends may be due, in part, to the relatively small sampling of data; the study contains only 5 years of data while the life of a railway bridge is often 80 years or more. Trends may become visible as data is gathered over the coming years.

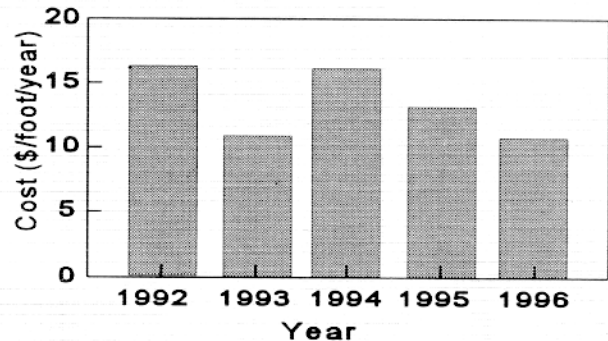


Exhibit 1. Annual Bridge Maintenance Costs During Introduction of HAL Traffic on 164-mile Segment

Costs in Exhibit 1 do not include work such as clearing obstructed channels or adding rip-rap for scour protection, which is independent of the amount of traffic carried by the bridges. An attempt was made to include only those maintenance items performed as a result of the traffic demands of the line. It should also be noted that this is a case study of only one line on one railroad. Other lines and railroads may have variations in maintenance policies and practices, as well as different categories of capital and maintenance work. They may also have different distributions of work between track and bridge departments. Variations in bridge types, quantity, age, and length of bridges on a line also may affect bridge maintenance costs. This UP line averages about 40 feet of bridge per mile, which is significantly lower than the national average of about 67 feet per mile.

Exhibit 2 shows the annual tonnage in million gross tons (MGT) and percent of HAL traffic on this line for the past five years. Both the total tonnage and the amount of HAL traffic have increased significantly during this period.

Exhibit 3 shows annual maintenance costs normalized by the annual tonnage. The decreasing trend in the cost per MGT of traffic is due primarily to the increased annual tonnage over the line.

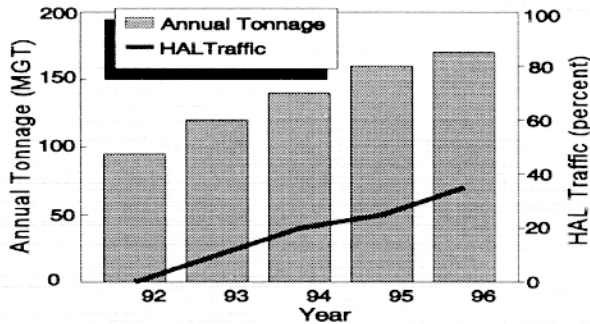


Exhibit 2. Annual Traffic Volume and Introduction of HAL Traffic

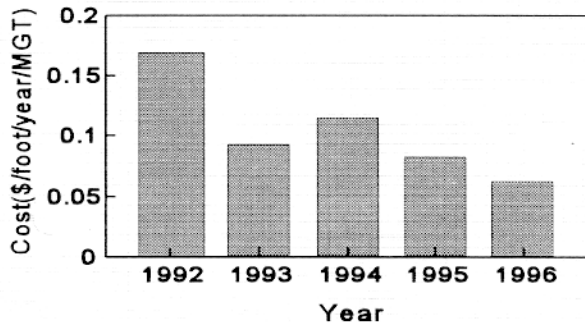


Exhibit 3. Bridge Maintenance Cost per Annual Traffic Volume on 164-mile Segment

Exhibit 4 illustrates the bridge superstructure type (by total length of each type) on the 164-mile segment of the UP line.

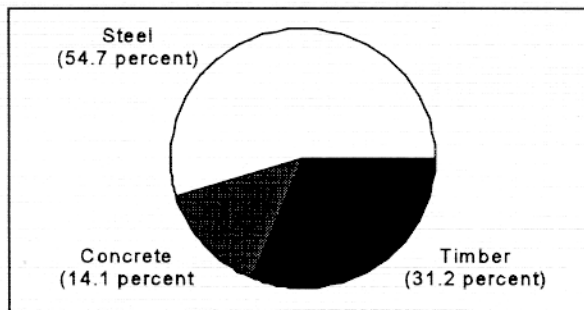


Exhibit 4. Bridge Type by Length (Percent)

MAINTENANCE ITEMS

Exhibit 5 compares averaged annual traffic-related bridge maintenance costs by bridge type for 1992 through 1996. Surprisingly, the concrete bridge maintenance costs are highest. Concrete bridges are generally regarded as having the lowest maintenance of any type of railway structure. Two major repairs, the epoxy injection of a cracked girder

and the repair of a cracked curb, constituted more than half the bridge maintenance expenses. Without these two repairs, maintenance costs would have been considerably less than those for steel and timber bridges. This indicates that while concrete bridge maintenance may normally be low, certain repairs can be very costly.

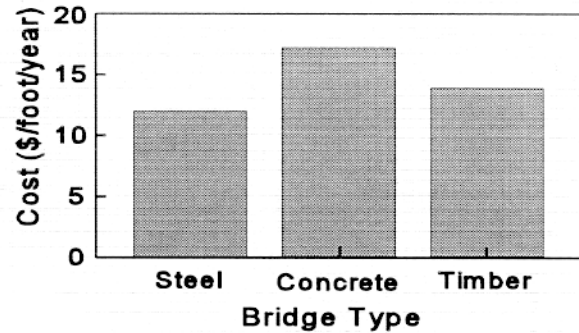


Exhibit 5. Comparison of Bridge Maintenance by Bridge Type on 164-mile Segment

Exhibits 6, 7, and 8 show maintenance items and their proportion of the total cost for concrete, steel, and timber bridges, respectively. Notice that track-related items such as ballast retainers, deck ties, and track raising make up a good share of the costs—particularly for steel and timber bridges.

On some lines, this work and the associated costs might be assigned to track maintenance rather than bridge maintenance.

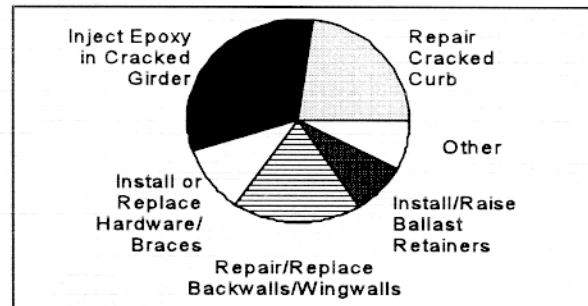


Exhibit 6. Maintenance Items for Concrete Bridges

Most of the 164-mile segment was originally constructed between 1907 and 1913. An adjacent 107-mile segment was constructed during 1983 and 1984; it has only steel bridges.

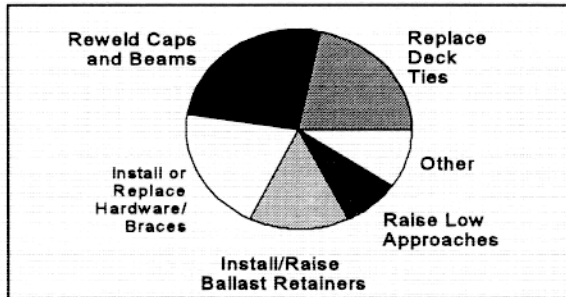


Exhibit 7. Maintenance Items for Steel Bridges

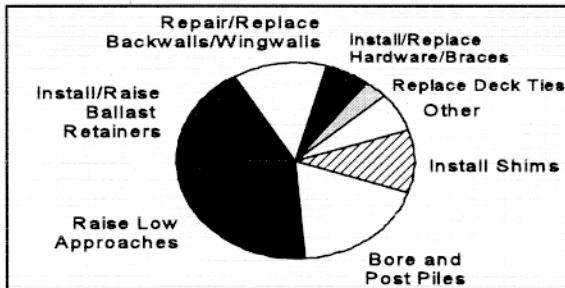


Exhibit 8. Maintenance Items for Timber Bridges

Exhibit 9 shows average maintenance costs per foot of bridge on the newer segment were less than half of those of the older segment based on data from 1995 and 1996. Comparable costs from prior years were not available, as the newer segment was not operated by UP at that time. The fact that maintenance costs on the newer segment were less than half those on the older segment illustrates the case-by-case nature of bridge costs, as well as the influence of newer construction.

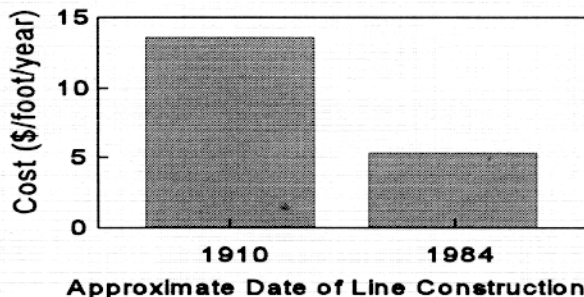


Exhibit 9. Comparison of Bridge Maintenance Costs by Date of Line Construction

BACKGROUND

This study is one of several being conducted on the UP's North Platte subdivision. The line studied carries unit coal train traffic almost entirely. Loaded trains run eastbound, empty trains run westbound. The speed limit on the line is 60 mph. In addition to information provided by the UP, traffic and wheel load information is being monitored using a load measuring station at Lusk, Wyoming.

The eastern 164-mile segment of this line was constructed by UP between 1907 and 1913. This line was primarily an agricultural area branch line prior to the early 1980's. During 1983 and 1984, UP-predecessor Chicago & North Western constructed a new connector line to provide the adjacent 107-mile segment, which accesses the Powder River Basin coal area. All bridges on the new segment are ballasted deck steel, while the older segment has a mixture of steel, concrete, and timber bridges. About 30 percent (by length) of the steel bridges on the older segment have open decks. The bridges on this line are primarily short span trestles. There are no truss spans and includes only five steel girder bridges.

ACKNOWLEDGMENT

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REFERENCE

- Hargrove, M., T. Guins, D. Otter, S. Clark, and C. Martland, "Economics of Increased Axle Loads: FAST/HAL Phase II Results," First Annual AAR Research Review Proceedings, Pueblo, Colorado, November 1995.

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