TECHNOLOGY DIGEST

Timely Technology Transfer — 00-006

Effects of Heavy Axle Loads in Freight Service

by Ryan McWilliams

Summary

The 1999 revenue service Heavy Axle Load (HAL) program has been monitoring conditions and components subjected to HAL (286-kip) traffic on mainline, Class 1 railroads. This research, performed under the guidance of the AAR Heavy Axle Load Research Committee, complements information obtained from the Facility for Accelerated Service Testing (FAST) at the Transportation Technology Center.

The turnout frog evaluation concluded in 1999 with findings supporting the fact that improvements in materials have more than compensated for the increased axle loads. It was also observed that these frogs were able to remain in service for longer periods of time with minor changes in maintenance practices. The high integrity castings allow Union Pacific to maintain these components longer in track than they had previously, and this is being accomplished even as axle loads and total tonnage increase.

Bridge maintenance reports from the Union Pacific's South Morrill, and Powder River Subdivisions are showing that even though overall annual bridge maintenance expenditures have only shown a slight increase since 1997, the mix of repairs has shifted in recent years toward categories related to axle loads. Trestle pile pumping seems to be the most prevalent of this category. This pile pumping problem has consumed nearly 88 percent of the total budget related to traffic over this line in the past two years. Floor beams also have a high repair frequency on this line.

The Union Pacific purchased 315-kip Gross Rail Load (GRL) open top gondolas in 1997 with the intent of operating them between the Colorado coal fields and the new LAXT export facility. The equipment is currently being loaded to 286 kips due to infrastructure limitations with no immediate plans to move to the 315-kip level.

The tie/fastener gage strength test has been informative for comparison to conditions at FAST. The Norfolk Southern wood tie/fastener site in West Virginia has shown the effects of smaller tie plates in a more humid/moist environment on a high-degree curve. Tie plate cutting became evident at this test site, and those plates were consequently replaced with larger footprint plates. Plate cutting has not been significant in the dry climate at FAST.

Suggested Distribution:

- ❑ Maintenance of Way
- ❑ Planning & Analysis
- ❑ Track Maintenance
- ❑ Safety
- ❑ Mechanical
- ❑ Bridges & Structures

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BACKGROUND

The Association of American Railroads and the Federal Railroad Administration have jointly funded a research program to evaluate the safety and performance of operating heavy axle load trains for freight service. This program has evaluated the effect of 315-kip cars on track, track components and track maintenance at FAST since 1989. The AAR has funded companion efforts to evaluate the economics of HAL service and to monitor the effects of, and the rate of introduction of, 286-kip cars in revenue service. Exhibit 1 lists these revenue service test sites for 1999.

These sites supplement the data collected at FAST and focus on areas that are not sufficiently represented. Among these are bridges, special track work and wet climates for wood ties.

TURNOUT FROGS

The turnout frog evaluation concluded in 1999 with findings supporting the fact that improvements in design and materials have more than compensated for the increased axle loads. The high integrity No. 20 casting has increased its life cycle from 346 to 595 million gross tons (MGT) over the same period HAL traffic has increased from 0 to 40 percent of the total traffic. The implementation of design and maintenance improvements in turnout frogs during this time includes the use of elastic fasteners, gage plates, independent guard rails, low impact heel joints, as well as high integrity castings. These factors have strengthened frogs while also reducing the impact loading.

The use of high integrity castings has had the largest positive effect on frog life. The high integrity castings make weld repairs more likely to be successful. Thus, while the increased impacts due to higher loads have kept the life of the casting running surface (or time to first weld repair) about constant at 100 MGT over the period of the study, the average life of weld repairs has increased from 22 MGT to 39 MGT. About the same number of repairs were made on standard and high integrity frog castings.

It was also observed that higher integrity cast frogs were able to remain in service for longer periods of time with minor changes in maintenance practices. The better quality castings were expected to be maintained in track longer than previously. This was being accomplished even as axle loads and total tonnage increased.

BRIDGE MAINTENANCE EXPENDITURES

Bridge maintenance reports from the Union Pacific's South Morrill, and Powder River Subdivisions are showing that even though overall annual bridge maintenance expenditures have only shown a slight increase since 1997, the mix of repairs has shifted in recent years toward categories related to axle loads on steel structures. Trestle pile pumping seems to be the most prevalent of these categories. This steel structure pile pumping problem has consumed nearly 88 percent of the total budget related to traffic over these lines in the past two years. Floor beams also have a high repair frequency on this line.

All pile pumping repairs over the South Morrill and Powder River subdivisions have been performed on steel bridges. Exhibit 2 shows traffic related expenditures for steel bridges since 1992.

Exhibit 1. 1999 HAL Revenue Service Test Sites

Location	Railroad	Test Component	Annual Tonnage Rate	Percent HAL Traffic
North Platte Sub	Union Pacific	Turnout Frogs	Approx. 178 MGT	Approx. 68
North Platte Sub	Union Pacific	Bridge Maintenance	Approx. 178 MGT	Approx. 68
Marysville Sub	Union Pacific	Bridge Approaches	Approx. 165 MGT	Approx. 60
Oakvale, WV	Norfolk Southern	Wood Ties and Fasteners	Approx. 60 MGT	Estimated 20

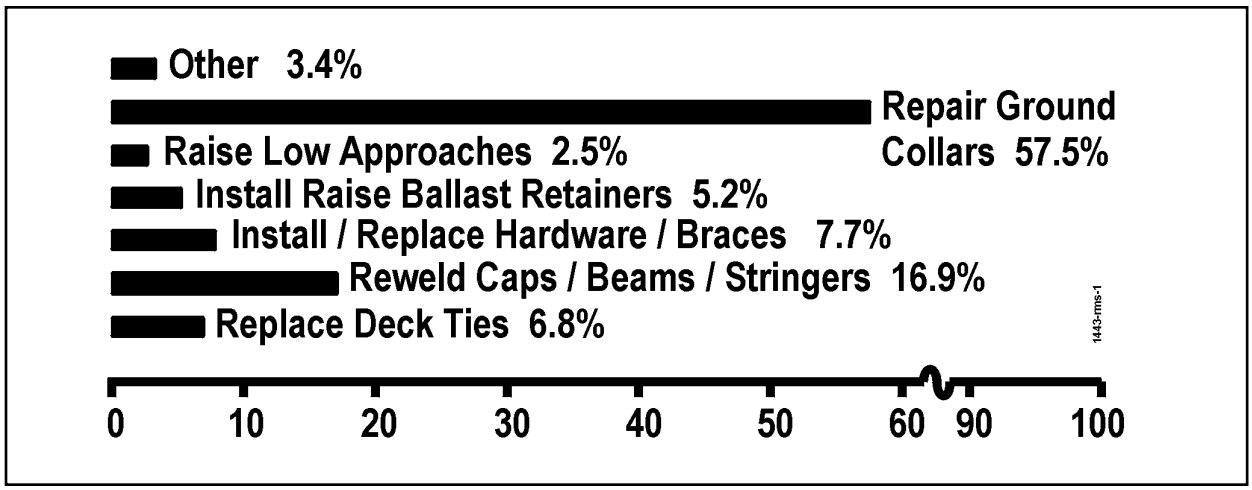

Exhibit 2. Steel Bridge Expenditures for Traffic Related Repairs

BRIDGE APPROACHES

A study to observe bridge approaches under heavy haul traffic has begun on the Marysville subdivision through Alexandria, Nebraska. With the cooperation of the Union Pacific Railroad, three test approaches and one control approach have been installed on a new main line over concrete span ballasted deck bridges (Exhibit 3).

The three test cases consist of a cement stabilized soil approach, a Hot Mix Asphalt (HMA) approach, and a Geoweb® approach. All four bridges, including the control approach, were constructed and initial mesurements were taken in 1999. Traffic is scheduled to begin over all locations by the beginning of February 2000. Performance measurements will be published in a future *Technology Digest*.

Exhibit 3. Installation of Concrete Stabilized Soil Approach

315-KIP COAL CARS

The Union Pacific purchased 315-kip GRL open top gondolas in 1997 with the intent of operating them between the Colorado coal fields and the new LAXT export facility. Due to braking restrictions on the BNSF's Cajon Hill and UP bridge restrictions in the Colorado coal fields, the equipment is currently being loaded to 286 kips with no immediate plans to move to the 315-kip level. In addition, the utility's car unloaders are not rated to handle the increased weight so these cars are not being loaded to their full capacity.

These cars were equipped with either swing-motion or FRAME BRACE™ trucks. The swing-motion equipped cars have seen 70,000 to 90,000 miles and were loaded only to 263 kips prior to November 1999. The FRAMEBRACE™ trucks have seen about 100,000 to 130,000 miles, and were also loaded only to 263 kips prior to November 1999.

Exhibit 4 shows the maintenance repairs made to date. All of the reported wheel repairs have been hand brake related, and the brake shoe key problem is related to either a bad batch of keys, or the possibility of the wheel flange contacting the brake shoe due to out of dimensional specification trunion castings.

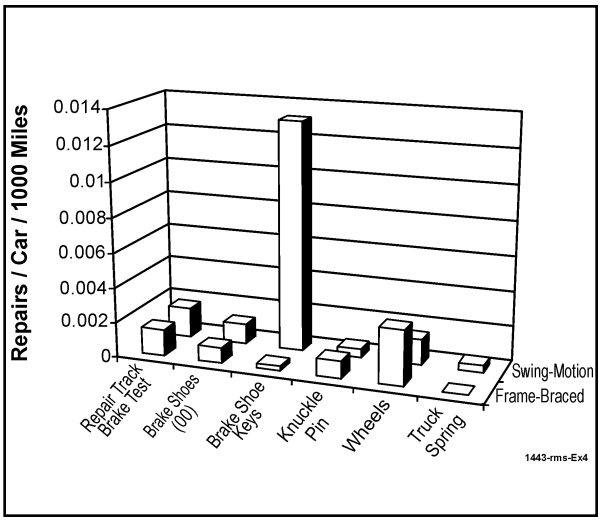

Exhibit 4. Truck Repairs on 315-kip Gondolas per 1,000 miles

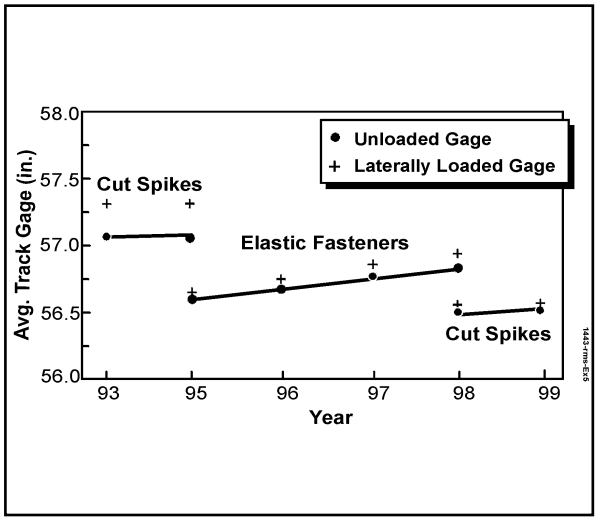

Exhibit 5. Track Gage under Loaded and Unloaded Conditions

WOOD TIE GAGE WIDENING STRENGTH

The wood tie gage strength test site at Oakvale, West Virginia, has provided a good comparison to tests performed at FAST. The observations have shown the effects of smaller tie plates in a more humid/moist environment on a high-degree curve. Tie plate cutting became evident at this test site, and those plates were consequently replaced with larger footprint plates and cut spikes.

The effect of HAL on gage widening in wood tie track on Norfolk Southern was relatively low with a rate of 0.128 inch per 100 MGT with elastic fasteners. The rate was higher than it had been with cut spike fasteners and large (18-inch) tie plates. And, although the smaller elastic fastener plates suffered from a higher rate of plate cutting, the elastic fastener ties had a higher gage widening strength than the ties with cut spikes. Exhibit 5 shows relative gage widening strength as the difference between loaded and unloaded gage.

ACKNOWLEDGEMENT

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