TECHNOLOGY DIGEST

Timely Technology Transfer

"PRELIMINARY ANALYSIS OF WOOD TIE PERFORMANCE IN A HEAVY AXLE LOAD ENVIRONMENT UNDER IMPROVED SUSPENSION TRUCKS"

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Summary

Overall preliminary results from the Association of American Railroad's (AAR) Heavy Axle Load (HAL) Wood Tie and Fastener experiment at the Transportation Technology Center (TTC) indicate the use of improved suspension trucks will lower track maintenance requirements and could improve some aspects of track safety. Results show a significant reduction in gage widening and an improved gage restraint during the first 100 million gross tons (MGT) of testing as compared to the performance of identical ties under the standard suspension trucks. Overall gage widening was reduced 50 percent or more with the use of improved suspension trucks.

The third phase of this ongoing HAL testing program, sponsored by the AAR and the Federal Railroad Administration, is evaluating the effects of improved suspension trucks on the performance of selected wood ties and fasteners. Tests are being conducted on the High Tonnage Loop (HTL) at TTC's Facility for Accelerated Service Testing (FAST), Pueblo, Colorado.

Ties and fasteners used in the tests are being evaluated in Section 25, a 6-degree curve of the HTL. Tie species including Southern yellow pine, Douglas fir, and oak have been installed to study the performance of improved suspension trucks under the HAL train.

Suggested Distribution:
- ❑ Maintenance of Way
- ❑ Maintenance Planning
- ❑ Track Maintenance
- ❑ Equipment/Rolling Stock

Association of American Railroads
Railway Technology Department

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INTRODUCTION AND CONCLUSIONS

The Association of American Railroad's (AAR) Heavy Axle Load (HAL) program continues to evaluate the effects of improved suspension trucks on the performance of selected wood ties and fasteners. Overall preliminary results from the third phase of this ongoing experiment indicate the use of improved suspension trucks will lower track maintenance requirements and increase track safety.

At the conclusion of the second phase of testing at the Transportation Technology Center's (TTC) Facility for Accelerated Service Testing (FAST) in Pueblo, the train was fitted with improved suspension trucks designed to reduce the dynamic forces transmitted to the track. At the beginning of the third phase of HAL testing, several wood tie species and fastener configurations were installed in the same location of FAST's High Tonnage Loop (HTL) to measure the effects of the improved suspension trucks on tie fastener performance. Preliminary results show that the reduction in overall gage widening under the improved trucks is 50 percent or more. Current wood tie and fastener test zones are shown in Exhibit 1 .

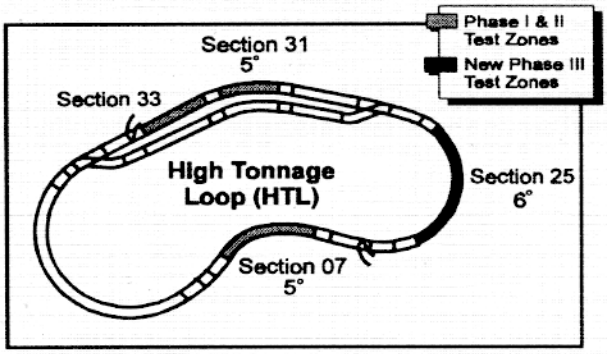

Exhibit 1. Test Zone Locations

Different configurations of Southern yellow pine, Douglas fir, oak, spruce, and yellow poplar tie species were installed in Section 25, a 6-degree curve of the HTL. The Douglas fir, oak, and Southern yellow pine ties will provide long term track degradation comparison between Phases II and III. The Southern yellow pine ties will not only provide long term degradation but will be used in the "quick look" test. The test will compare tie degradation for 100 million gross tons (MGT) of HAL traffic under conventional truck suspension (Phase II) with that of 100 MGT of improved truck suspension traffic (Phase III). The spruce and yellow poplar ties will provide performance data of the under-utilized species under HAL traffic. Exhibit 2 shows the test zone layout of the new ties installed in Section 25.

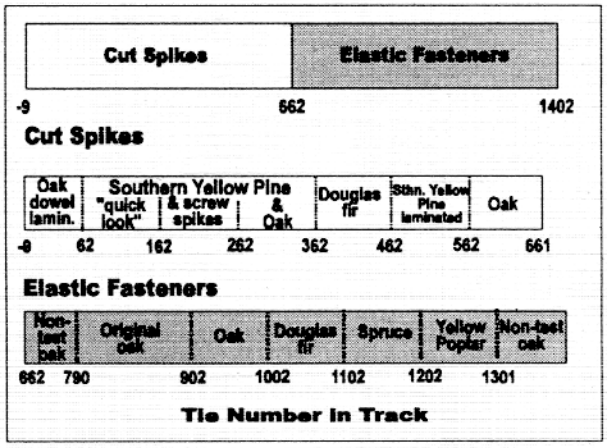

Exhibit 2. Section 25—Test Zone Layout

SOUTHERN YELLOW PINE TIES

Southern yellow pine ties, the softwood species in test that exhibited gage widening after 100 MGT of conventional HAL traffic, have been installed with four different configurations. The first configuration is the "quick look" tie performance comparison. As in Phase II, the ties are equipped with cut spikes and spaced at 19.5 inches on center. The second Southern yellow pine tie configuration has cut spikes for the rail hold down and screw spikes for the plate hold down. The third configuration is also equipped with cut spikes; however, there is a mix of oak ties in the test zone. Every fourth tie is oak. The fourth configuration will be installed with elastic fasteners in 1997.

SPRUCE AND YELLOW POPLAR

The two under-utilized species selected for test in Phase III are spruce and yellow poplar. These two species were also installed in Section 25 using the Pandrol fastening system.

DOUGLAS FIR TIES

During Phases I and II of the HAL program, the softwood species that accrued the most tonnage before requiring re-gaging was Douglas fir. In order to assess the long term performance of the improved suspension trucks, two test zones using Douglas fir ties were installed in Section 25. The first test zone was installed with the cut spike fastening system, while the second zone was installed using the Pandrol fastening system. The second test zone will provide a relative comparison of the use of elastic fasteners versus cut spikes on a better performing softwood tie under the improved suspension trucks.

OAK TIES

There are three different oak tie configurations in Section 25. The first configuration uses oak ties that were installed at the start of the HAL program. These ties were re-gaged and retrofitted with Pandrol plates after 530 MGT of HAL traffic. Two new oak tie configurations were installed during Phase III. The first new zone has ties equipped with cut spikes, while the second zone is equipped with Pandrol fasteners.

RESULTS

Tie degradation on the HTL occurs primarily in the form of gage widening. Significant gage degradation was evident on the softwood species in Section 25 during the second phase of testing. All ties in this section, with the exception of the oak ties, were removed from test due to gage widening tie degradation. The ties were removed prior to the start of improved suspension train operation. The accrued tonnage over the different wood tie species varied from 300 MGT to 460 MGT. The Southern yellow pine was one of the tie species that exhibited the most gage widening. An average of 0.5 inch of gage degradation was measured after 100 MGT of conventional HAL traffic over these ties. Measured tie degradation during the first 100 MGT of improved suspension train operation was only about 0.1 inch. The reduction in overall gage widening in the 6-degree curve is 50 percent or more for all species.

Lateral forces measured under the improved suspension trucks are significantly less than that of standard trucks. The reduction in dynamic forces is evident in the lateral rail force cumulative distribution shown in Exhibit 3. Fifty percent of the measured lateral forces under the standard trucks exceeded 13.5 kips, while 50 percent of the lateral rail forces measured under the improved trucks are under 7.5 kips.

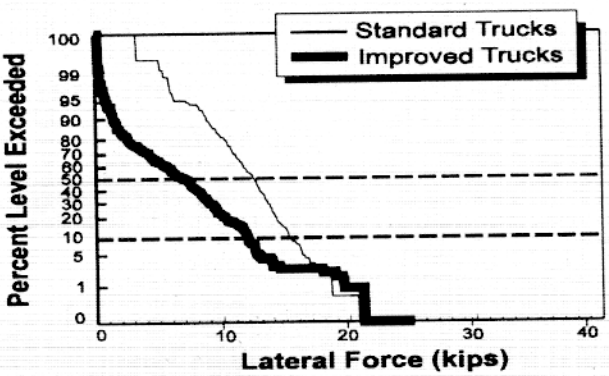

Exhibit 3. Lateral Force Distribution.

The track gage measured with an EM80 geometry car shows a significant reduction in gage widening on both the softwoods and hardwoods installed in the curve. The Southern yellow pine ties selected for the "quick look" test show a significant reduction in gage widening. As shown in Exhibit 4, the EM80 was used to measure gage over a 100-tie test zone during the first 100 MGT of HAL traffic under both standard and improved suspension trucks. There is an improvement of more than 50 percent in gage retention.

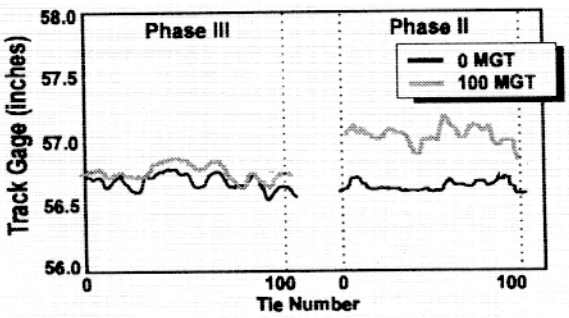

Exhibit 4. Southern Yellow Pine—Track Gage

Exhibit 5 shows the high and low railhead displacement measured on the Southern yellow pine ties. The data, collected under a 0.5 (statically applied loads of 20 kips lateral/40 kips vertical) L/V loading ratio, indicates that an improvement in static gage restraint is also evident. Gage restraint, a measurement used to monitor tie and fastener degradation, is determined by statically applying known vertical and lateral loads to the rails while measuring the lateral railhead and rail base displacement. Lateral railhead displacement decreased approximately 25 percent with the introduction of the improved trucks.

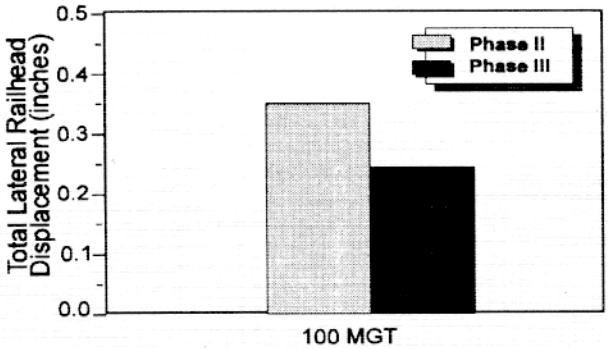

Exhibit 5. Combined High and Low Railhead Displacement

The Douglas fir ties, another softwood specie in test, also show a significant reduction in gage widening. Exhibit 6 depicts the average gage degradation for both the Douglas fir and Southern yellow pine tie species in test under the improved suspension trucks. Gage degradation was calculated from track geometry data collected between 0 MGT and 100 MGT of HAL traffic.

A noticeable improvement in track gage degradation was also measured on the oak ties after 42 MGT of HAL traffic. Exhibit 7 illustrates a 50 percent or better reduction in the average track degradation under the improved trucks. Overall, preliminary results indicate that the improved suspension trucks will lower track maintenance requirements and increase track safety.

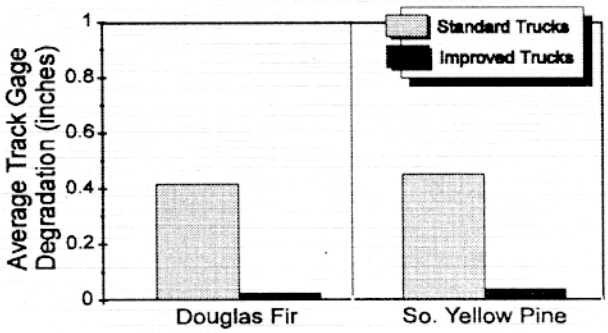

Exhibit 6. Average Track Degradation

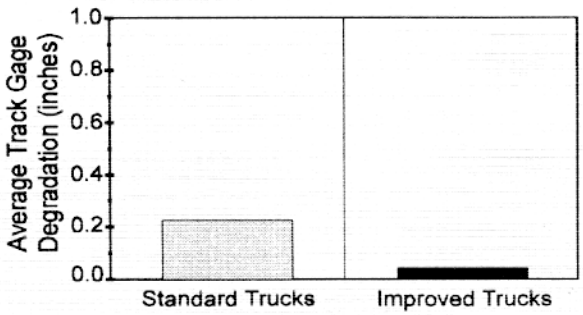

Exhibit 7. Average Track Degradation for Oak Ties

Spruce ties, one of the under-utilized tie species, were removed from test after 1.2 MGT of HAL traffic. Some of the hold down coach screws used on these ties had worked out of the tie. Since the same installation procedure and coach screws were used on all the softwood species in test, and such a rapid failure occurred, the ties were removed from test for safety reasons. The yellow poplar ties are still in test and exhibit performance comparable to the other ties in test.

ACKNOWLEDGMENT

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