

# Dynamic Loading of the Track Structure Part III – The Effect of Premium Suspensions . . .

In previous Tracking R&D articles (September 1989, October 1989), recent test data depicting the magnitude of the vertical and lateral loads imposed onto the track structure were presented. These loading values were obtained for representative North American freight equipment with conventional suspensions, i.e. with standard three-piece trucks. However, recent testing of similar freight equipment, using premium suspensions, indicates that the magnitude of the imposed *dynamic* loadings can be significantly reduced.

As was discussed in the earlier Tracking R&D articles, the magnitude of the dynamic loadings, which includes the vertical dynamic augment as well as the lateral dynamic forces, are related to several factors, including the characteristics of the suspension system of the vehicle. By proper design and use of improved vehicle-suspension systems, such as the use of a new primary-suspension system (1), the very large dynamic loads, such as presented previously, can be reduced.

## Dynamic tests

For example, recent vehicle/track dynamics tests, carried out by the Association of American Railroads' Transportation Test Center (2), showed loads under a 125-ton car equipped with a primary suspension system to be 40% lower than those under a similar 125-ton car without the primary suspension. During these "rock and roll" tests, the maximum dynamic load factor for the standard truck was 2.8 times the static load, while for the premium truck, it was 1.8 times the static load (2).

Similar results were obtained from a different set of tests, also carried out at the Transportation Test Center. These results, presented in Figure 1, show the effect of introducing a primary suspension into a 125-ton ("VIP") truck—the type used under articulated double-stack cars (1). The dynamic loads were measured (for half-staggered jointed track) using wayside instrumentation and compared with the loadings under conventional 100-ton and 125-ton covered-hopper cars. As can be seen in Figure 1, the dynamic vertical loads under the 125-ton car with the primary suspension were comparable to the dynamic loads under the conventional 100-ton

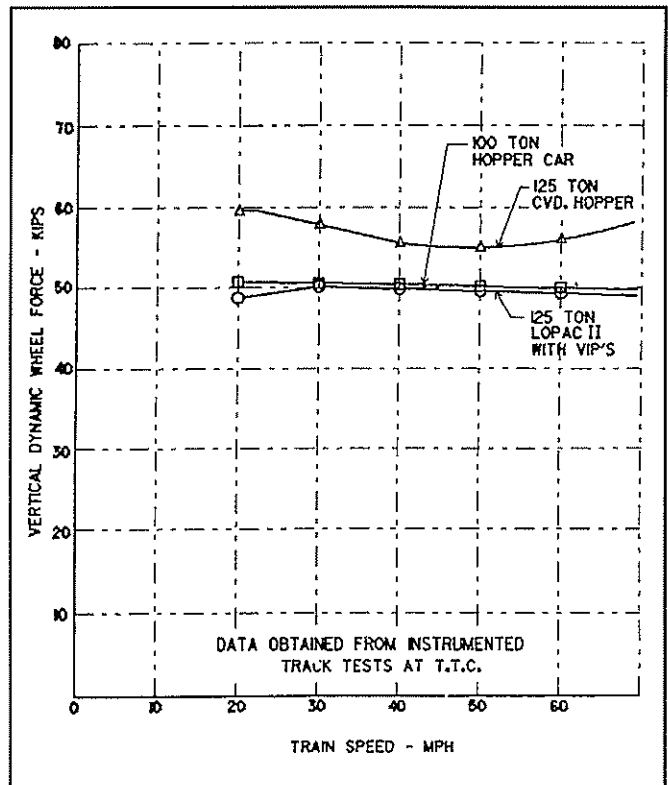


Figure 1 — Vertical dynamic wheel force vs. speed on jointed track!

car and significantly less than the conventional 125 ton car loadings.

## Vertical tests

Similar results were obtained for vertical bounce tests, where the bounce is excited by parallel ("square") joints. These results are presented in Figure 2. In this case, the 125-ton car with the primary suspension had significantly lower vertical dynamic loadings than either the conventional 100-ton car or the conventional 125-ton car, in the 50-to 70-mph range. (Note, this speed range appeared to excite a vertical bounce resonance in the conventional 100-ton hopper car. At lower speeds, 40 to 50 mph, the 100-ton car dynamic loadings were comparable to the 125-ton car with VIPs.)

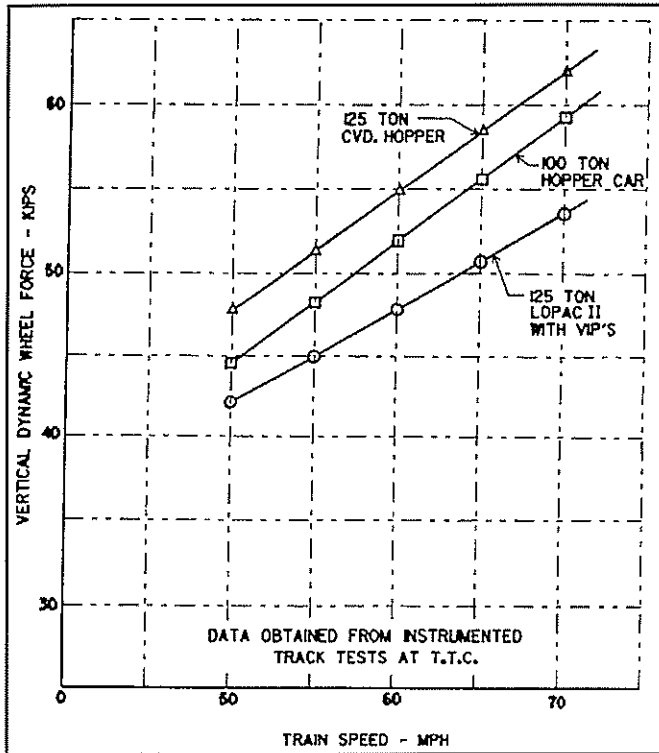


Figure 2—Vertical dynamic wheel force vs. speed on bounce track<sup>1</sup>

### Lateral tests

Finally, for the lateral case, and in particular for lateral loadings in curves, the same type of behavior was observed. As shown in Figure 3, on a 7 1/2-deg test curve, the use of the primary suspension resulted in significantly lower lateral curving forces than for either of the two hopper cars equipped with conventional trucks.

While these results must be used with caution, noting that different car types were compared and that limited speed regimes were examined, these results strongly suggest that the very high dynamic loads, such as those presented in the earlier Tracking R&D articles, can be controlled through the introduction of improved vehicle and truck suspension systems. Whether or not these systems are in fact cost-effective, remains an unanswered

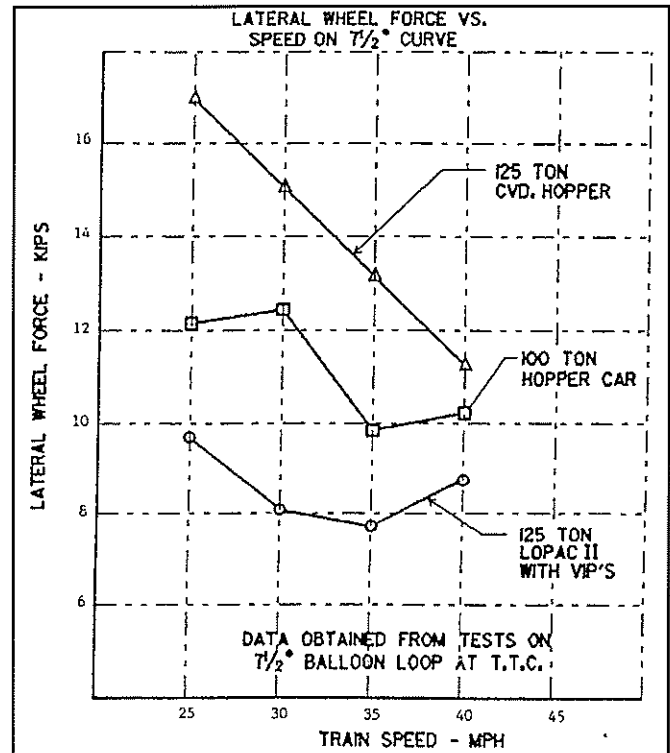


Figure 3—Lateral wheel force vs. speed on 7 1/2-deg curve<sup>1</sup>

question. However, as with most such applications, the costs and economic benefits of premium systems are dependent on the specific conditions, such as type of service, operating speed, lading and track characteristics. By carrying out a suitable life-cycle cost analysis (See *RT&S* Sept. 1988, p. 9), the relative costs of such premium systems can be compared to their true benefits, and their economic viability can be determined.

### References:

- (1) Pavlick, M. J. and McNally, G. S., "A Primary Suspension System for Articulated 125-Ton Double Stack Cars," American Society of Mechanical Engineers Winter Annual Meeting, (paper 88-WA/RT-9), Chicago, November 1988.
- (2) Kalay, S. and Reinschmidt, A., "An Overview of Wheel/Rail Load Environment Caused by Freight Equipment Suspension Dynamics," Transportation Research Board Paper No. 88-0598, presented at the 68th Annual TRB meeting, Washington, D. C., January 1989.