

# Dynamic Loading of the Track Structure

## Part II – Lateral Loads

Last month's "Tracking R&D" introduced the topic of dynamic loading of the track, and presented some recent test data on the vertical loads introduced into the track structure. As was noted in that article, it is necessary to have some knowledge of the loads imposed by vehicular traffic onto the track, in order to understand the environment that the track structure must withstand. In this article, the lateral loading of the track structure, in particular the lateral loads generated by conventional freight cars, will be discussed. (Locomotives and other self-propelled vehicles generate a different set of lateral loads which will not be discussed in this article.)

Lateral forces which act upon the track structure are introduced by the curving of the freight equipment, the development of lateral instabilities or the response of the vehicle to lateral track irregularities. During curving, lateral forces can arise due to creep of the wheel set or to flanging of the wheel set, generally on the high rail of the curve. Lateral instabilities, most particularly truck hunting, are a function of the vehicle characteristics and speed. Finally, in a manner analogous to that of the vertical case, track irregularities can cause lateral loading. The amount of lateral force generated depends on the amplitude and shape of the defect, the speed of the vehicle and the track and vehicle characteristics.

As in the case of vertical loads, measurements of the lateral load environment have been extensively performed over the years. Recent research, however, has focused on the loading of the track structure under heavier, 100-ton and 125-ton, freight cars (1), using wayside (on the ground) load measurements (2) and vehicle-borne measurement techniques (3).

In the case of vehicle curving, standard North American freight cars equipped with conventional three-piece trucks rely on the flanging of the wheel sets to guide the vehicles around curves. This, in turn, generates significant wheel/rail forces which are related to the degree of curvature, the super-elevation of the curve, the speed of the equipment (or alternately the unbalanced super-elevation) and the condition of the wheel and the rail profiles.

Figure 1 presents the mean lateral loads (and corre-

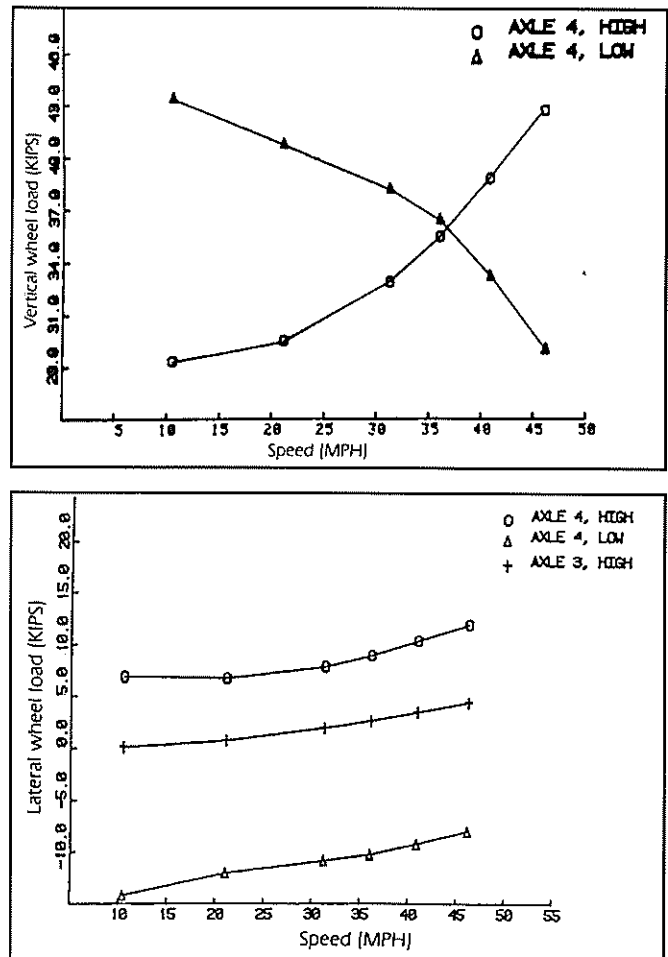


Figure 1 — Wheel loads versus speed, 100-ton loaded covered hopper car, 5-degree curve.

sponding vertical loads) generated by a 100-ton hopper car negotiating a 5-deg curve. Note that as the vehicle speed increases above balance speed, the lateral load on the high rail increases (as does the vertical load on the high rail) with a maximum measured value of approximately 13,000 lb. Also note that at speeds significantly below balance speed (10 mph), the lateral loads on the low rail were as high as 14,000 lb.

Figure 2 presents the maximum lateral loads (and corresponding vertical loads) generated by a 125-ton

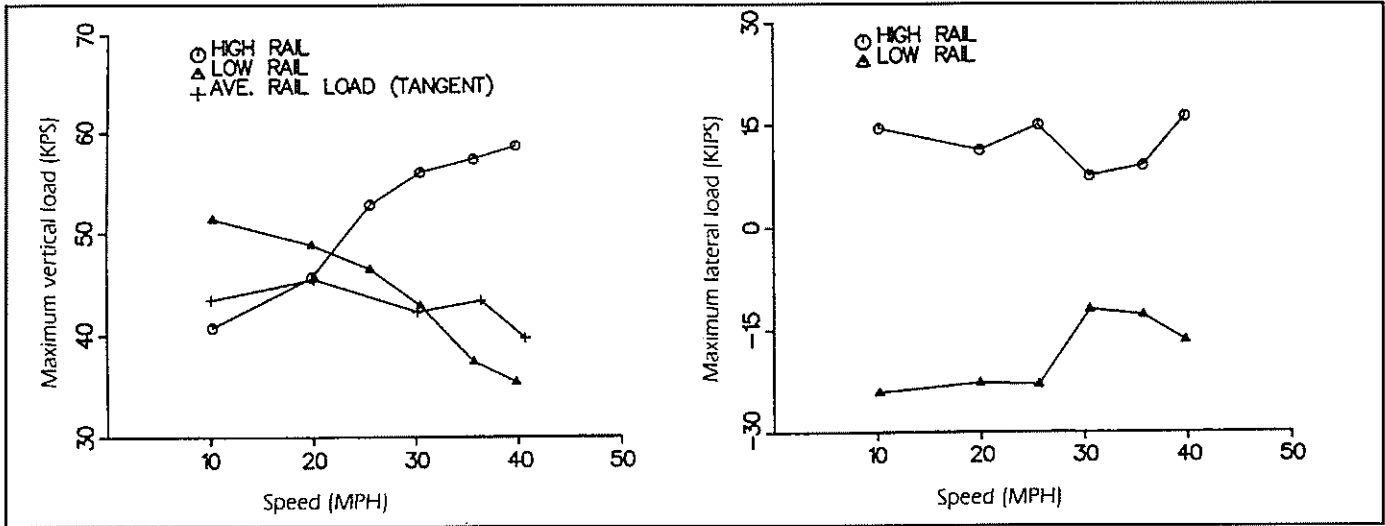


Figure 2—Maximum vertical and lateral rail loads versus speed, 125-ton covered hopper cars.

hopper car negotiating the same 5-deg curve. Note that the vertical loading on the high rail increases with speed, with a corresponding unloading of the low rail. The maximum lateral loads are of the order of 15,000 lb on the high rail and over 20,000 lb on the low rail. (These are dynamic loads and as such they include both steady-state and transient loadings.)

In the case of truck hunting above a “critical” speed, self-induced oscillations of the wheel set generate large lateral motions and corresponding large lateral forces, even on tangent track. These lateral loads, which occur under empty as well as loaded cars (though at different threshold speeds), have been measured at over 15,000 lb for empty 100-ton equipment. Figure 3 presents this behavior. Note the dramatic increase in lateral loads corresponding to the onset of hunting.

Although the values presented here are by no means an exhaustive set of lateral loadings, they indicate the magnitude of the loads imposed by conventional freight equipment onto the track structure. As with the vertical

loads discussed last month, an understanding of these lateral loads imposed onto the track will better help to define the structural requirements and maintenance needs of the track structure.

#### References

- (1) 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.
- (2) Ahlbeck, D.A. et al, “Measurement of Wheel/Rail Loads on Class 5 Track,” U.S. Department of Transportation Report FRA/ORD-80/19, February 1980.
- (3) Coltman, M. et al, “A Description of the Tests Conducted and Data Obtained During the Perturbed Track Tests,” U.S. Department of Transportation Report FRA/ORD-80/15, January 1980.

*Editor's note: The September and October Tracking R&D columns, “Dynamic loading of the track structure,” parts I and II, were based primarily on Transportation Research Board Paper No. 88-0598, “An Overview of Wheel/Rail Load Environment Caused by Freight Equipment Suspension Dynamics,” a report of research performed by Semih Kalay and Albert Reinschmidt of the Association of American Railroads. All figures used in the articles were similarly drawn from the report.*

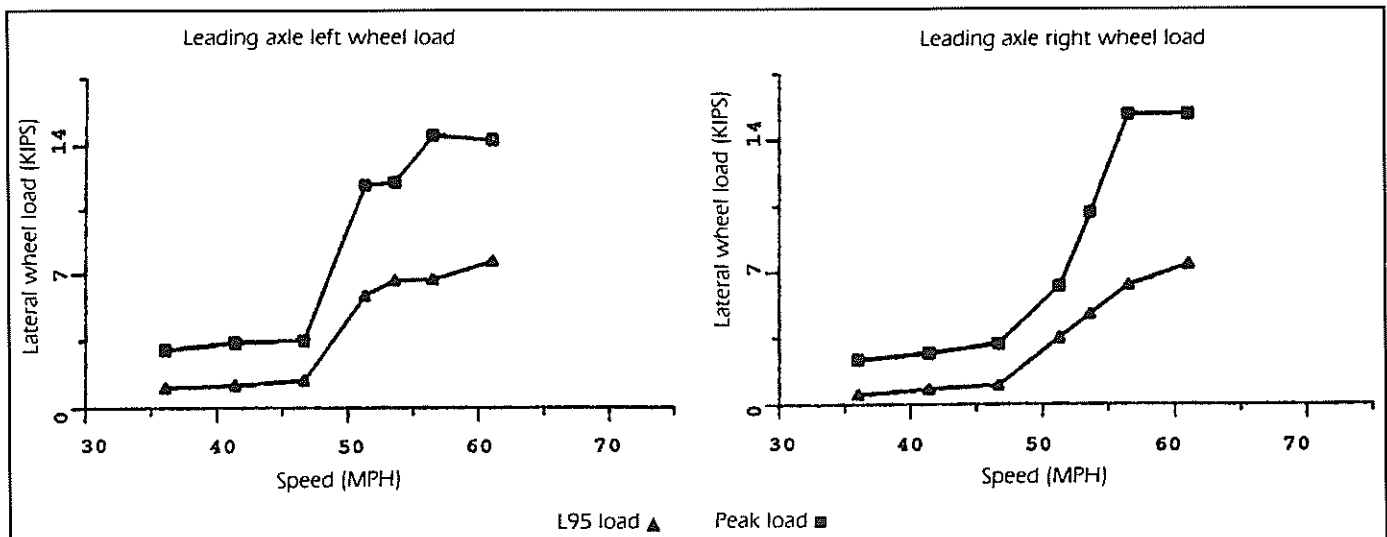


Figure 3—Hunting of empty covered hopper car.