Testing Track Strength

As the loadings imposed by freight trains have increased, the ability of track structures to withstand these (often called the "strength" of the track) without excessive deformation has risen in the concerns of track maintenance officers. Their interest has specifically been directed to the question of whether the traditional wood tie and cut spike track can withstand today's greater loadings.

As a result, railroads have been examining to a greater degree alternative track structures to determine whether "new" structural configurations can increase track strength under their most severe loading environments. Among the new configurations introduced are: conventional wood ties with non-conventional fastenings, such as elastic fasteners or rigid fasteners; non-conventional wood ties, such as the reconstituted wood ties; concrete ties with elastic fasteners, and steel ties. As these new tie and fastener configurations have proliferated, the ability to define their strength capabilities and to compare these, and hence performances, has proven to be difficult.

Direct lab comparison

One recently reported test program, however, has attempted to directly compare three track structure configurations in a controlled laboratory environment.[1] Using the facilities of its Track Laboratory, in Chicago, Illinois, the Association of American Railroads conducted a comparison test for the following track designs: conventional North American wood tie track with cut spike fastenings, wood tie track with elastic fasteners, and monoblock concrete tie track with elastic fasteners. The tests measured the strength of these track structures under loads and conditions representative of heavy axle-load mainline service.

Specifically, the investigations sought to evaluate the track configurations' lateral resistance (that is, the lateral track strength), the track configurations' vertical modulus (the vertical track strength), and gage widening resistance (again, the gage strength of the track). What follows will briefly describe the results of the first two track strength comparison tests. The third series of tests, gage widening resistance, will be treated in an upcoming *Tracking R&D.*

Replicating field conditions

The test procedures used in these comparative tests were based on earlier AAR tests that attempted to define the track strength parameters under loading conditions that were representative of the actual field environment[2,3]. As a result, these laboratory tests provided useful information relative to the performance of the track structures in the field.

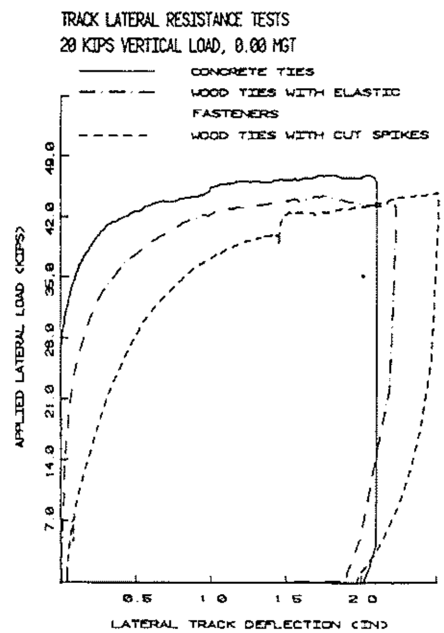

Figure 1 — Load Deflection Curves from the Lateral Track Resistance Tests, for 0.0 MGT and a 20.0 Kip Vertical Load

In the first, the lateral resistance for each of the three track structures was compared for different levels of consolidation, as simulated by the loading vehicle at the track laboratory, and for different levels of vertical loading. Figure 1 presents one such comparison for unconsolidated track, such as would be found immediately after a maintenance operation like tamping which disturbs the traffic consolidated ballast.

The report notes that for unconsolidated track, the concrete tie track configuration had the highest level of lateral track resistance. It was followed by the wood ties with elastic fasteners, then the wood ties with cut spikes. This behavior is represented in Fig. 1. However, as the level of consolidation increased, the differences measured between the three types of track structures de-

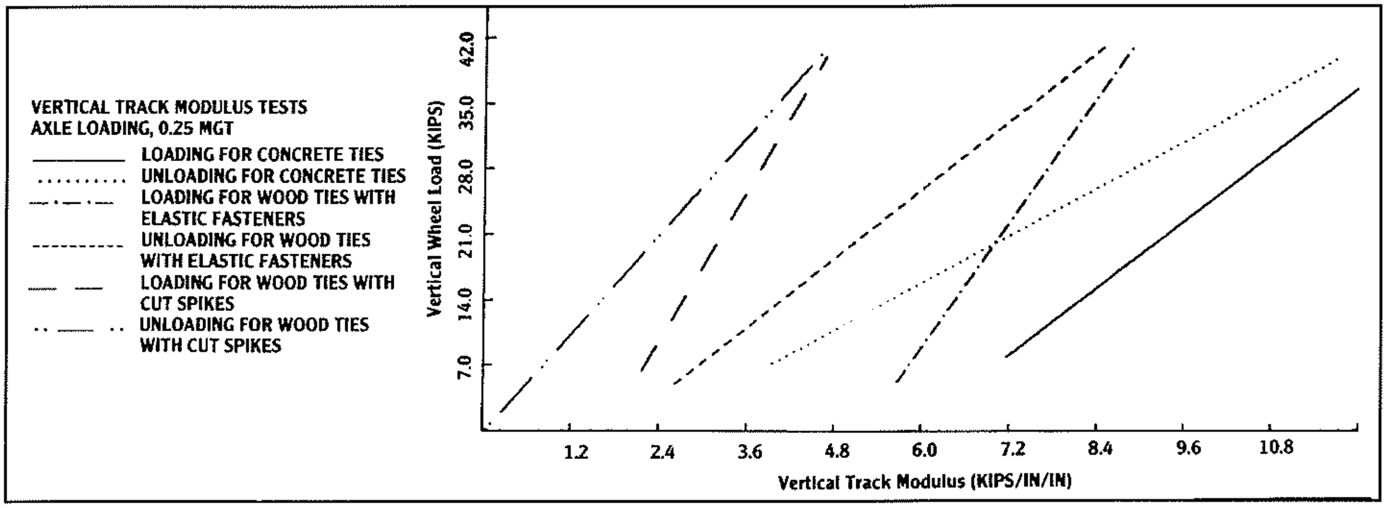

Figure 2 — Comparison of the Vertical Moduli for the different track structures, from the Axle Loadings at 0.25 MGT

creased significantly. Thus, it was pointed out that the type of track construction was most significant for new or poorly consolidated track. It was also observed that as a vertical load(s) is applied to the track structure, the lateral track stiffness increases significantly, regardless of the type of track construction or the level of consolidation.

Vertical strength

In the case of the vertical strength of the track structure, the vertical track modulus[3] was measured for each of the three different track configurations, at different levels of track consolidation and loading conditions, to include measurement under simulated axle loadings and simulated truck loadings. Figure 2 presents the results of one such comparative loading sequence. It should be noted that the actual track modulus, which is calculated from the measured deflection under load, varies with the level of loading itself and the loading vs. unloading cycle. This variation has been observed, as well, in earlier test results.[3]

The results of this test series revealed that the concrete tie track structure had the highest vertical track modulus, and at a factor of two (or more) greater than the corresponding modulus of the conventional wood tie-cut spike track. The wood tie-elastic fastener track had a track modulus that was *consistently* about 1.5 times stiffer than the conventional wood tie-cut spike track. In all cases, this occurred with *identical* ballast, subballast and subgrade conditions. Moreover, these ratios appeared to hold constant for all levels of track consolidation. It should be stressed that while high vertical modulus values, which correspond to small deflections, are generally considered desirable, "excessively" high modulus values can have an adverse effect on overall track behavior because of the vehicle-track dynamics encountered.

The report concludes by noting that "these results are by no means conclusive, relative to which track structure is optimal. Nonetheless, they do offer a first-order approximation as to the characteristics of each type of track." As such, they present additional *quantitative* information regarding the relative performance of differing track structures to help maintenance officers make an appropriate engineering decision.

References

1. Choros, J.; "Laboratory Tests on Three Alternate Track Structures," Association of American Railroad Report R-614, September 1985.
2. Choros, J., Zarembski, A. M., and Gitlin, I., "Laboratory Investigation of Lateral Track Shift," Federal Railroad Administration Report FRA/ORD-80/27, August 1980.
3. Zarembski, A. M. and Choros, J; "On the Measurement and Calculation of Vertical Track Modulus," Association of American Railroads Report R-392, Chicago, IL, 1979.