Gage Widening Strength

The ability of the tie and fastening system to maintain track gage, even under high lateral train loadings, is an important consideration in the design of a track structure that will experience conditions of severe loading. Thus, gage-widening strength is an important factor in defining the overall strength of the track structure.

The previous *Tracking R&D* (see RT&S July '86) discussed the results of a recent series of AAR Track Laboratory tests that compared three different track configurations from the point of view of lateral track resistance (lateral track strength) and vertical track modulus (vertical track strength). The following, however, will discuss the results of the comparison of gage-widening strength between three track designs: conventional wood ties with cut spike fasteners, wood ties with elastic fasteners[1], and concrete ties with elastic fasteners.[1]

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

In the case of gage strength, it is not sufficient to simply measure the initial strength of the structures, since the gage strength can deteriorate under repeated loadings. This had been observed in the earlier tests as well.[2] Consequently, in carrying out the comparative gage widening tests, a series of 25 loading cycles were applied to each of the three track structures mentioned above, in order to obtain a defined rail head displacement (gage widening). The results of these tests are presented in Figure 1.

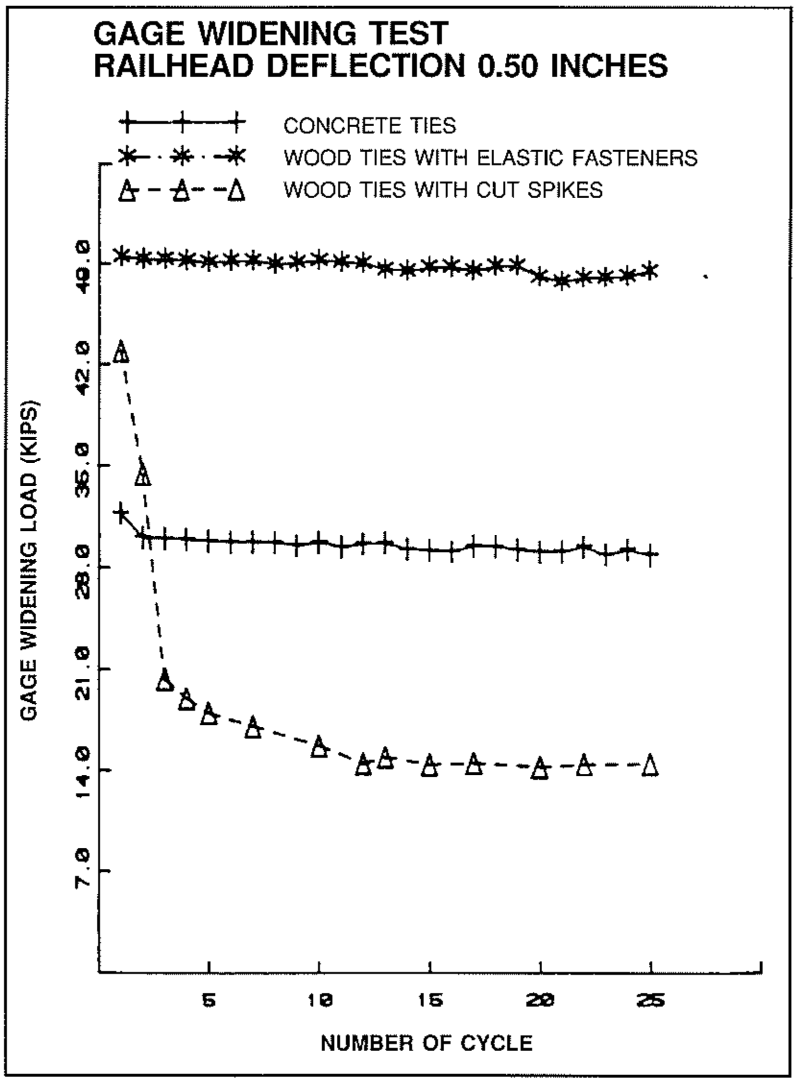

Figure 1 — Load required to displace the rail head 0.50 inch, as a function of the applied lateral load, for the different track structures tested.[1]

Initial damage

The tests revealed that an initial level of "damage" occurred within the first few cycles of loading, particularly for the conventional wood tie-cut spike track structure. After these first few damaging cycles, the "strength" of the structure stabilized for the remainder of the loading cycles. While initial damage was relatively small for the elastic fastener systems, it was approximately 50 percent of the initial loading strength for the wood tie-cut spike track configuration at the 0.50-inch railhead displacement level of loading. This behavior appears to be in agreement with previous test results[2] which show that the strength of "weakened" wood tie-cut spike track can be less than half that of new track. This is illustrated in Figure 2, which depicts both the vertical and lateral loadings necessary to obtain 0.50 inches of gage widening for new, 'slightly weakened' and 'weakened' wood tie-cut spike track.

The results shown in Figure 1 also indicate that while *new* conventional wood tie-cut spike track can be as strong as, if not stronger than, concrete tie track with elastic fasteners, this behavior quickly deteriorates under repeated loadings. As a consequence, the gage strength of the concrete tie track was approximately twice that of the wood tie-cut spike track. For the case of the wood ties with elastic fasteners, the gage-widening strength was approximately 3.5 times that of the wood tie-cut spike track, after repeated loadings.

It should be noted here, that these results indicated that the wood ties with elastic fasteners provided greater gage widening strength than did the concrete ties with the *identical* fastener system. It is not clear at this time why this should be the case, since the fastening system is the primary gage restraining portion of the tie-fastener system (see Tracking R&D, RT&S August 1985). However the same behavior manifested itself in both the .025 inch and the 0.50 inch gage widening series of tests.[1]

Finally, the tests evaluated also the rail head deflection wave along the track. This provided an examination of the differences in the mechanisms by which adjacent ties help pick up the lateral railhead loadings. It found that for the first loading cycle on new track, the deflection wave shapes were nearly identical for all three of track configurations mentioned. However, as the number of loading cycles increased to 10 and then 25 (approximately the repeated load environment in the field), the wood tie-cut spike track exhibited progressive damage outward from the point of loading.

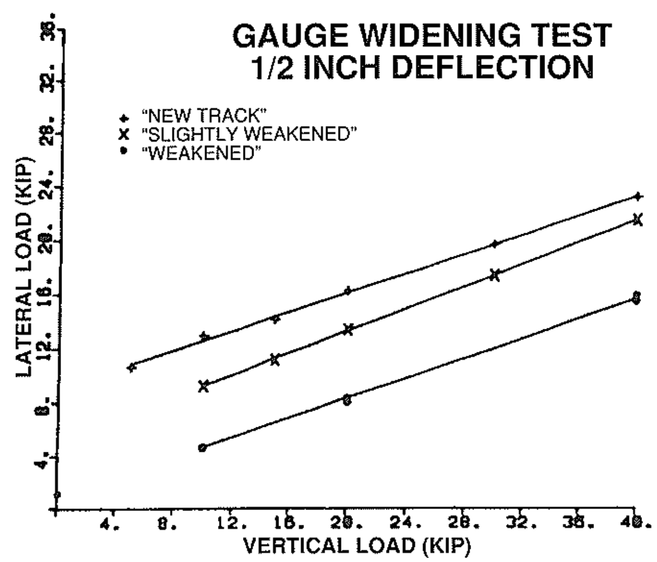

Figure 2 — Vertical load vs lateral load. For ½ inch rail head deflection and different levels of damaged track.[2]

This phenomenon manifested itself at locations away from the actual point of loading, with the deflection at a location, such as four ties away from the loading point, becoming larger with each additional loading cycle. In the cases of elastic fasteners on both wood and concrete, the deflection wave shape remained the same, and appeared to exhibit an elastic behavior under repeated loading.

Once again, as noted in the last Tracking R&D article, these results offer quantitative information as to the relative performance of the three track configurations, and are useful in making engineering decisions.

References:

1. Choros, J., "Laboratory Tests on Three Alternate Track Structures", AAR Report R-614, September 1985.
2. Zarembski, A. M., and Choros, J., "Laboratory Investigations of Track Gage Widening", AAR Report R-395, Sept. 1979.