Rail Corrugations on Freight Roads

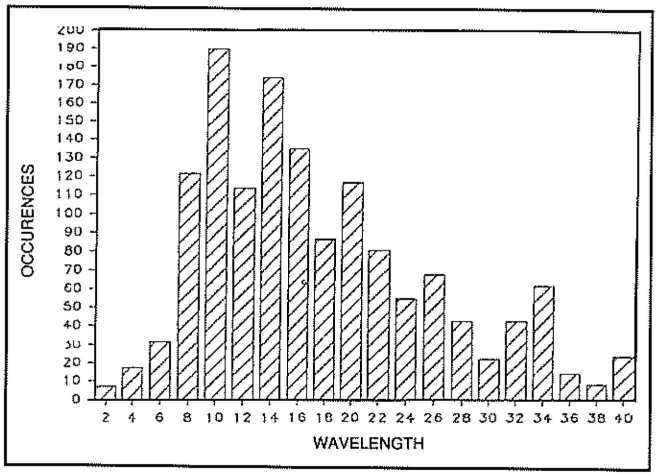

Figure 1 — Corrugation Data (Railroad A)

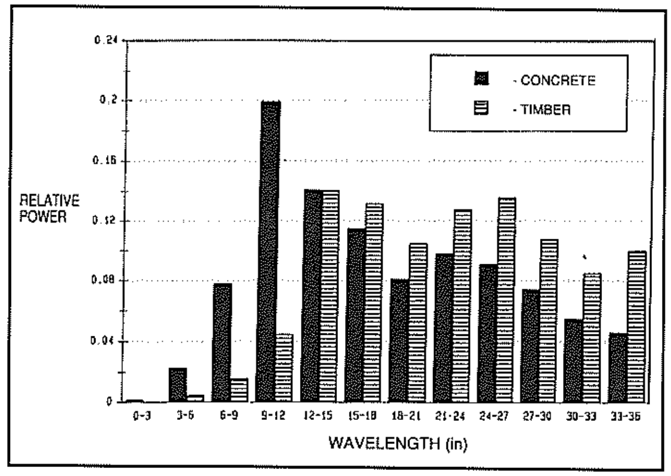

Figure 2 — Corrugation on the Tracks, Timber Versus Concrete Ties

Rail corrugations have been defined as "anomalies that appear on the surface of the rail in a repeatable manner along the length of the rail[1]." Such corrugations, particularly those occurring under heavy axle loads in freight operations, are not always uniformly spaced along the head of the rail. Instead, they tend to vary in spacing about some average "wave length" — a *wave length* being defined as the distance between adjacent corrugation peaks.

The depth of a corrugation is the distance between the corrugation's peak and its valley. This depth is a measure of great significance to maintenance-of-way personnel. It relates directly to dynamic wheel impacts, and thus to associated track damage.

The wave-length patterns of corrugations have also been studied to permit a characterizing of the nature of the corrugation phenomenon. One such study recently examined the distribution and depths of heavy axle load corrugations on several mainline North American railroads.[2] This investigation also explored the existence of similarities in heavy axle load corrugations for different operating railroads, even though these exhibited a variety of track and traffic conditions.

Different measuring methods

Several different techniques were used to measure corrugation 'amplitude' (depth) and wave length. These included manual as well as measurement-vehicle methods.

During the investigations, an extensive set of corrugation measurements obtained from five North American railroads was analyzed for information about distribution of corrugation wave lengths and amplitudes. Figure 1 presents data taken from a large number of measurement sites on one of these railroads.

Note that an "occurrence" represents an individual corrugation. Figure 1, then, is a representation of over 1200 measured corrugations. Examination of this data reveals that these corrugations are not of any one wave length. Rather, they are distributed along a range of wave lengths from 8 inches to over 30 inches. This is significantly different from traditional thinking about corrugations where these were thought to be of the same wave length throughout. In fact the type of broad distribution in corrugation wave lengths, noted above, was found to exist even at localized rail corrugation sites, such as individual curves.

Information from other railroads paralleled these findings. Thus, researchers concluded that the overall distribution of the wave lengths-that is, the wave length 'signature'—was similar for all of the five railroads studied.[2]

However, when the corrugation distributions for rail seated on wood ties were compared against those for concrete tie track, it was found that the corrugation 'signatures' differed noticeably.

Figure 2 illustrates such a comparison. It can be seen that the concrete tie track corrugations tend to be distributed about a wave length range that is shorter than for timber tie track. This is significant since the two sets of track sites presented by Figure 2 were on the same railroad. They were thus subject to the same traffic and M/W philosophies.

In examining the distribution of rail corrugation depths between the freight railroads studied, no clear cut relationship between each emerged.

The study concluded with an examination of the relationship between dynamic wheel/rail forces and corrugation depth. Results indicated that there is a strong correlation between increased wheel/rail forces and increased corrugation depth. For instance, as the corrugation depth increased, it was observed that the corresponding wheel/rail impact forces increased similarly. This agrees with earlier studies.[3]

Continuance of this type of research can be of great value in helping M/W personnel understand rail surface imperfections such as corrugations, and thus in developing appropriate and effective maintenance techniques for its control and correction.

1. "Definitions of Rail Surface Conditions,"AREA Manual for Railway Engineering, 1987, Chapter 2.
2. Zarembski, A. M.; Izbinsky, G.; Handal, S. N., and Worthington, W. W., "Corrugation Behavior in the Freight Railroad Environment," AREA Bulletin No. 714, Volume 88, 1987.
3. Zarembski, A. M.: "The Impact of Rail Surface Defects," RT&S, November 1984.