Changing Face of Rail Replacement

Over the last ten years, there have been significant revisions in the criteria used to determine when rail should be replaced in mainline track. These stem directly from changes in maintenance-of-way practices and materials that have occurred during the past two decades. While the effects of these have resulted in alleviating one set of rail maintenance "problems", others have emerged — usually at a later point in the life of the rail. Thus, the net result of changing practices has been the extension of the service life of the rail, and often an overall reduction in rail maintenance costs over that life.

The first shift in rail replacement criteria, which was observed in the mid '70s, occurred as a result of the increasing use of continuously welded rail on mainline track, which began in earnest during the late '60s. This acceptance of continuously welded rail reduced significantly rail-end batter at joints, resulting in the emergence of wear as a primary rail replacement criterion for both tangent (rail-head wear) and curved (gage-face wear) track.

Emergence of fatigue

Concurrent with the rise of CWR, there was an industry trend towards increasing traffic and wheel loadings, particularly in the use of 100-ton cars having 33,000-lb. (static) wheel loads. As a result of these greater traffic loadings, rail fatigue defects began to emerge as a major replacement criterion for mainline tangent track. This trend is illustrated in Figure 1. Based on this, maintenance and safety criteria for rail replacement began to focus on fatigue defect occurrence for mainline tangent track. However, curved track still utilized rail gage-face wear as a primary replacement criterion (Figure 2).

Lubrication-plusses, minuses

Subsequent to this, detailed studies of rail wear at the Facility for Accelerated Service Testing (FAST), together with field observations, showed that effective lubrication of standard carbon rail can significantly extend the life of the rail in the high wear environment of curved mainline track. This, in turn, led to an increased emphasis on rail lubrication in mainline curves, with a resulting reduction in gage-face wear. This lessening of gage-face wear, and the corresponding increase in the time rails remained in track without transposition or relay, brought about an increasing incidence of gage corner shelling and an associated class of rail fatigue defects, this time on curves.

It appeared that as lubrication became more effective, and the life of the rails in curved track increased, an accumulation of fatigue damage in the gage corner of the rail head was taking place. This fatigue damage man-

Rail Life Fatigue vs. Wear, 136 RE Rail

Figure 1

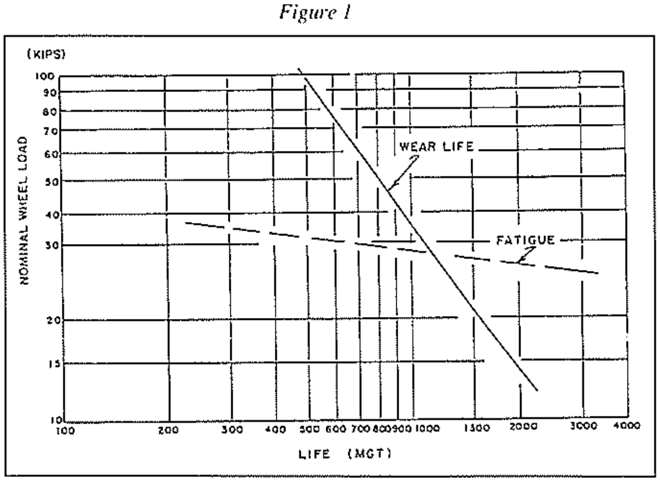
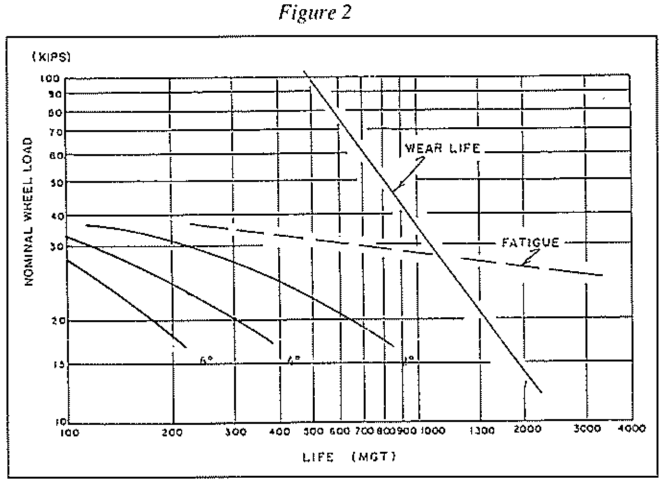


Figure 2



ifests itself initially as gage corner shelling. However, there seems to be a high degree of correlation between these gage corner shells and a class of detail fracture type of fatigue defects that appears to emanate from the shells. This fatigue damage had not been observed in the earlier, unlubricated environments, because the gage face of the rail had been worn at a rate that was faster than the accumulation of the fatigue. It took a reduction in the wear rate, as obtained by improved lubrication, to permit the growth of the fatigue related defects. A new rail replacement criterion for curved track then began to emerge, namely, gage corner shells and their associated fatigue defects. However, a net increase in the life of rail in curves was observed.

Attention is now being focused on techniques to further extend the life of rail in both curved and tangent track. These include the use of improved strength rails, either through heat treatment or advanced metallurgy. The objectives are to not only improve the wear resistance, but also the fatigue strength of the rail, which can also be interpreted as including cleanliness, such as elimination of inclusions. In addition, newer techniques of rail maintenance, such as gage corner and profile grinding, are being used to alleviate the fatigue defects which now appear to be a major rail replacement criterion.

It is expected that as these efforts become effective in further extending the life of rail in track, new criteria for rail replacement (or perhaps old criteria) will arise. However, providing that these techniques prove themselves to be economical over the life of the rail, the railroad industry can only gain from improvements in the service life of their rails.