Monitoring The Railhead

Railroad maintenance officers continuously strive for maximum service life from their rail in mainline track. One of the techniques being used increasingly to help achieve this is the monitoring of the dimensions and shape of the railhead itself. This provides objective quantitative information about the condition of the rail in the field. By obtaining this information through actual field measurements, rather than relying on subjective judgments such as is represented by the traditional visual inspection, railroads can extract a more accurate picture of their rail conditions in the field. Consequently, they can plan more effectively their rail maintenance and replacement activities.

Three aspects of monitoring

The monitoring of the railhead profile, to include both the railhead dimensions and the railhead shape, provides the following information:

1. Wear.
2. Profile.
3. Metal Removal (by grinding or other non-wear mechanisms).

Rail wear is the loss of railhead section, as measured from the original new (or newly installed) rail section. This is illustrated in Figure 1. As can be seen in this figure, rail wear can include the following definitions: vertical head loss (h), side (gage face) loss (g), head area loss, and the maximum angle of side wear. The traditional North American railroad replacement or transposition judgments have generally been based on either vertical head loss, side or gage face loss, or a combination of these two values. Generally, values are set to avoid contact between the wheel flanges and the tops of the joint bars, or to maintain a minimum acceptable bending strength of the rail section in continuously welded rail track.

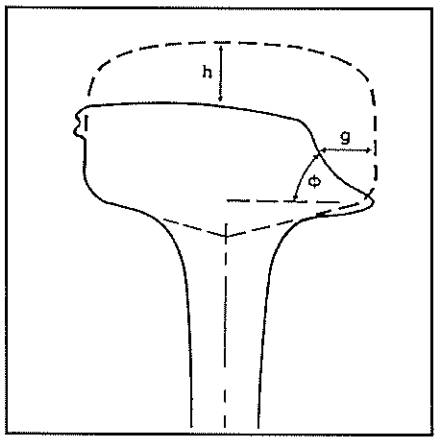

Figure 1 — Railhead Wear

Hand-held gages

Measurement of railhead wear (or its converse, the remaining rail section) has been carried out traditionally by using a variety of hand-held gages.

These instruments include hand gauges in the shape of a new railhead (with a different gage for each size of rail), along with a taper gage for inserting between the worn rail and the hand gage. Thus, wear at the top for head loss and at the side of the railhead for gage face wear can be measured. Alternatively, rail profilometers have been used to record the shape of the worn rail section. When the recordings are compared to a new rail section, the amount of rail wear is obtained. In general, both of the mentioned techniques provide wear values to within 1/16 inch. On the other hand, measurement gages that consist of a frame referenced to the base of the rail or to the underside of the railhead, and a micrometer or dial gauge to furnish measurement between the rail and the frame, can provide accuracies to several thousandths of an inch. One such measurement frame is shown in Figure 2 (see photo on page 124). By making repeated measurements at the same location in track, rail wear can be accurately monitored with this technique.

Mobile measurement

Since manual measurements of the railhead tend to be time consuming, techniques for measuring from a moving vehicle have received great interest. One such method, developed by a major U.S. railroad, employed a three-point, sliding contact procedure to define head and

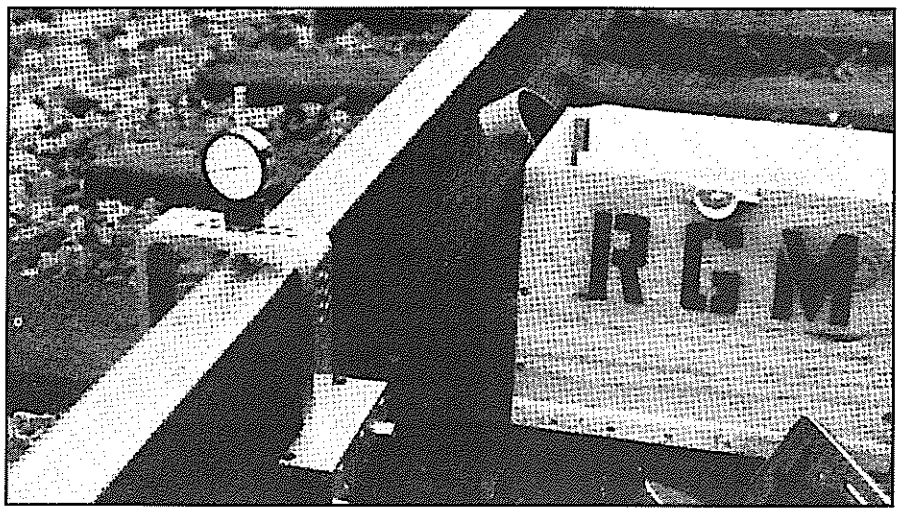

Figure 2 — Manual rail measuring gauge

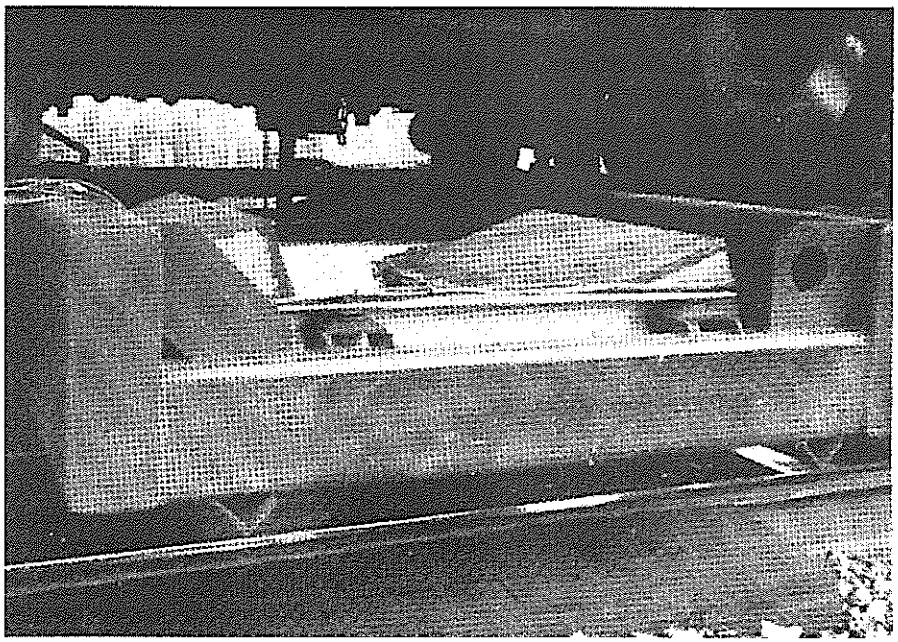

Figure 3 — Low-speed, non-contact device that uses optical imaging technology for measurement

gage face wear from a high rail vehicle. More recently, optical imaging technology has been applied to this problem, and a non-contact railhead profile system developed for monitoring rail wear. A low speed version of this system is illustrated in Figure 3 (see page 11). High-speed geometry car versions of this system, which analyze the rail condition and determine whether it requires replacement or transposition, are currently being built.

Rail profile or contour refers to the shape of the railhead, more specifically, it pertains to the radius of curvature at the top of the railhead, and at its transition and corner zones. With the increasing importance of proper wheel rail contact, and with maintenance techniques like profile grinding (see Tracking R&D, RT&S November, 1985) becoming accepted and implemented, the ability to monitor and measure the profile of the railhead becomes ever more significant.

As in the case of rail wear, rail profile can be measured by both hand-held devices as well as vehicle-mounted systems. The hand-held units used for measuring profiles include: the rail profilometer, which gives a complete profile of the railhead; and the measurement frames, which furnish a number of discrete measurement points along the head of the rail. These can range from 8 to 16 points, depending on the device used. Vehicle-mounted systems include both low-speed and high-speed versions of the non-contact, optical rail measuring systems.

Measuring grinding

Finally, metal removal from the railhead, such as through rail grinding, can be measured similarly. Since metal removal from rail grinding, is generally in the range of 1/64 inch, the accuracy of the technique must be on the order of several thousandths of an inch. This can be achieved by use of the measurement frames described above, with the differences in readings before and after grinding corresponding to the depths of metal removal across the railhead. Alternative manual techniques for the monitoring of metal removal involve the placement of a specified indentation, such as from a punch or a telebrineller, in the head of the rail, with measurement of this indentation before and after grinding.

In all of the above cases, hard measurement values are being used by railroads to carefully monitor the condition of the railhead. It is an effort that helps these companies make cost-effective decisions regarding the maintenance of their valuable rail assets.