Holland

Using Reserve Gage Strength Data to Enhance Tie-Replacement Planning

RMSS White Paper Series

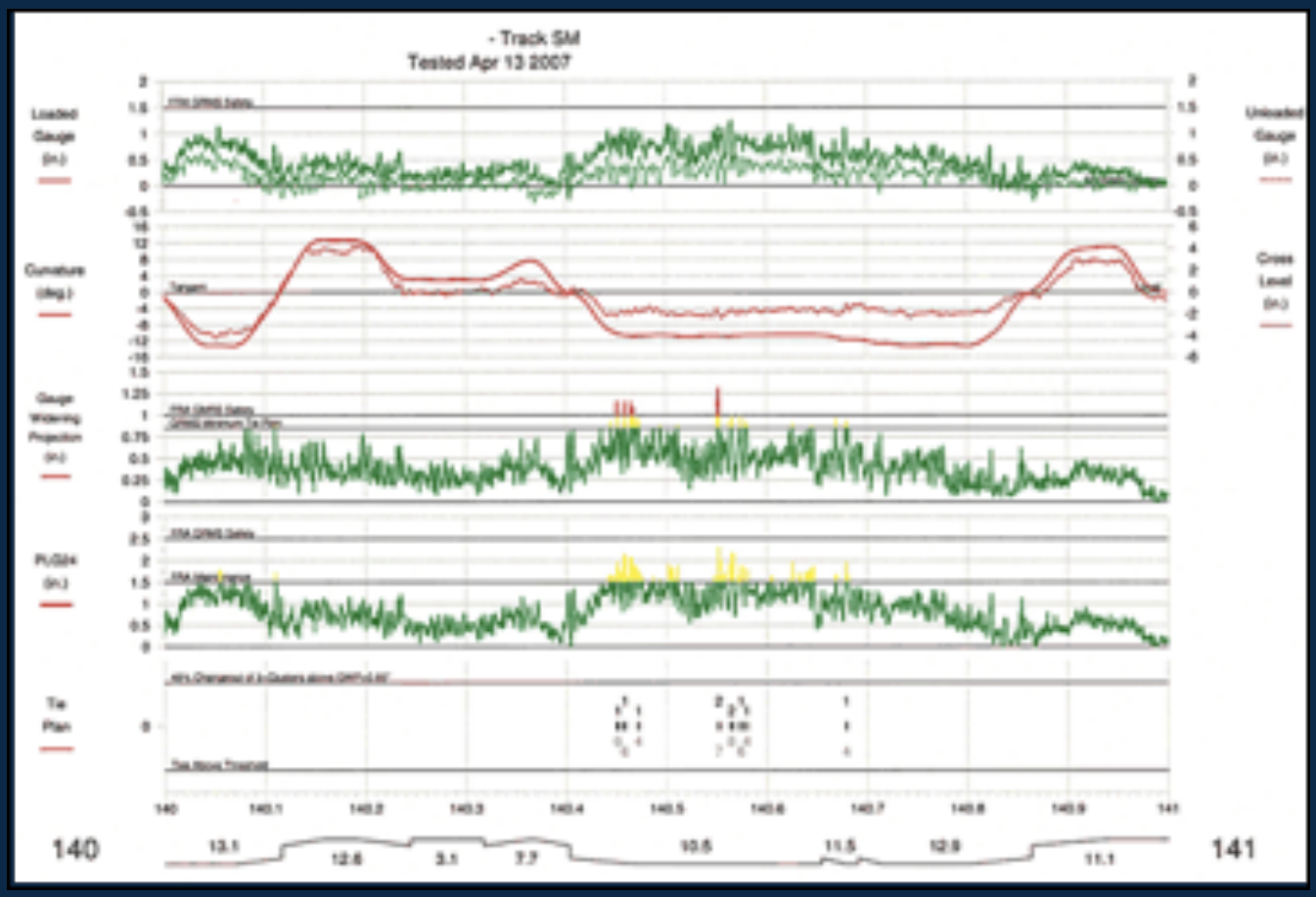

Figure 1a. Visual Tie Plan developed to improve track strength condition for one mile of Class 4 track. The thresholds are: GWP> 0.85", clustersof 4 or more consecutive ties exceeding the GWP threshold, and a replacement rate of 33% within clusters.

Technology has enhanced the ways in which railroads plan track maintenance. Laser and optical systems that measure wheel and rail wear have been adopted industry-wide to plan maintenance and replacement programs. But for much of the industry, tie- replacement, which represents a significant portion of maintenance budgets, is still based on visual inspection.

While some railroads have begun using vision systems to identify poor tie conditions, most rely on visual inspection by walking tie inspectors to assess tie conditions and to plan spot maintenance and out-of-face renewals. Visual assessments can be subjective, however, with inspectors' tie counts varying by as much as 20% — a margin of error that can negatively impact the effectiveness of tie replacement programs. If too many ties are replaced, budget dollars are wasted. If too few ties are replaced, the track will under- perform, requiring additional monies to achieve the desired condition.

Since most railways devote 25% - 30% of their maintenance budgets to tie activities, the value of optimizing a tie renewal program can be significant. Technology, in the form of Gage Restraint Measurement Systems (GRMS), which measure track/tie conditions under "dynamic," loaded conditions, can help quantify track gage strength — a key parameter in identifying poor tie or fastener conditions. Used in conjunction with visual tie- assessment data, it can help railroads put their maintenance dollars where they're most needed.

The key measurement for GRMS-based tie-replacement plans is “Gage Widening Projection” (GWP), an objective, performance-based measurement of the ability of ties and fasteners to hold gage. The strip chart shown in Figure 1a shows the measurements of unloaded and loaded gage, curvature and cross level, along with GWP and “Projected Loaded Gage” (PLG), which are GRMS measurements. The bottom line on the chart represents tie counts selected on the basis of the measured reserve gage-strength performance. This chart, generated by Holland’s Rangecam® software, is essentially a visual tie plan for one mile of track. The thresholds selected for this mile are: GWP> 0.85”, cluster lengths of 4 or more consecutive ties that exceed the GWP threshold, and an estimated replacement rate of 33% within the clusters that are found. This represents a plan that was developed to improve track strength with minimal tie replacement on a Class 4 track.

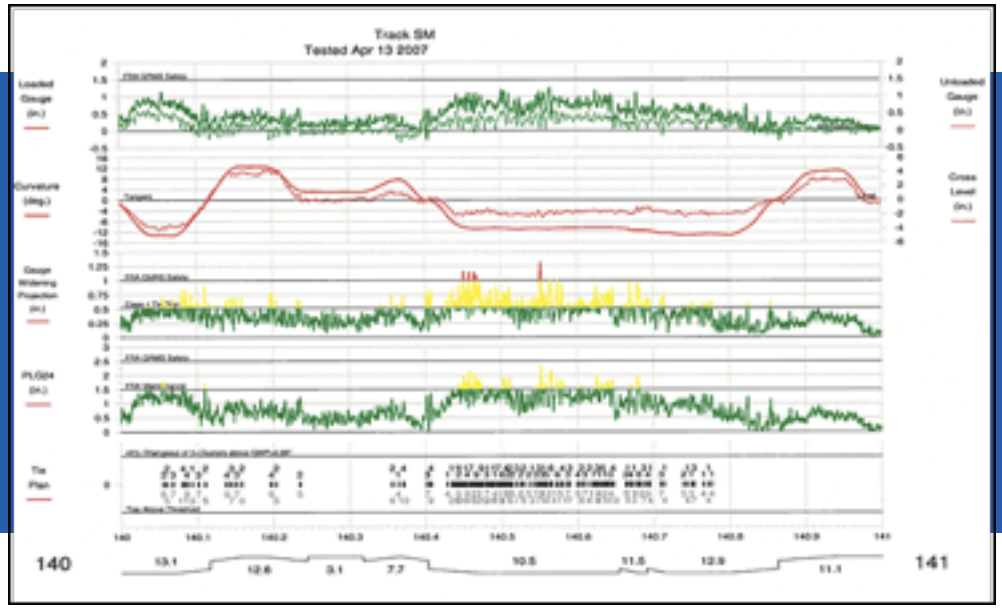

Figure 1b. This Visual Tie Plan was developed around the same mile of track shown in Figure 1a. The thresholds are: GWP > 0.525”, clusters of 3 or more ties, and a replacement rate of 45% within the clusters.

Figure 1b illustrates the same track with a major tie replacement plan. This visual tie plan was developed around the following parameters: GWP > 0.525” (which is well below the minimum safety standard), clusters of 3 or more ties (to focus in on short lengths of track that are weak), and a higher estimated replacement rate of 45% with the clusters. As expected, much more track requires replacement ties on the basis of the thresholds featured in figure 1b.

While realistic, both of the preceding results are theoretical; they do not include visual inspection data. The plans are based on the assumption that poor track gage strength in wood-tie track is almost always associated with the need to replace crossties. To verify the assumptions, results from a replacement plan based on track gage strength measurements was evaluated against data from visual inspection.

Data was collected on 57 miles of class 3 and 4 track with curves of up to 6 degrees and annual tonnage of approximately 15 mgt. A cluster length of 4 or more consecutive ties, and 45% replacement logic was used for the comparison. A GWP threshold that matched the tie inspector's overall tie-replacement count of 7.981 ties was used to compare and evaluate the results. Figure 2 shows the 57 track miles in a mile-by-mile comparison.
GRMS-based tie counts were very close to those of the visual inspector's tie counts over many miles. But they varied significantly within several miles.

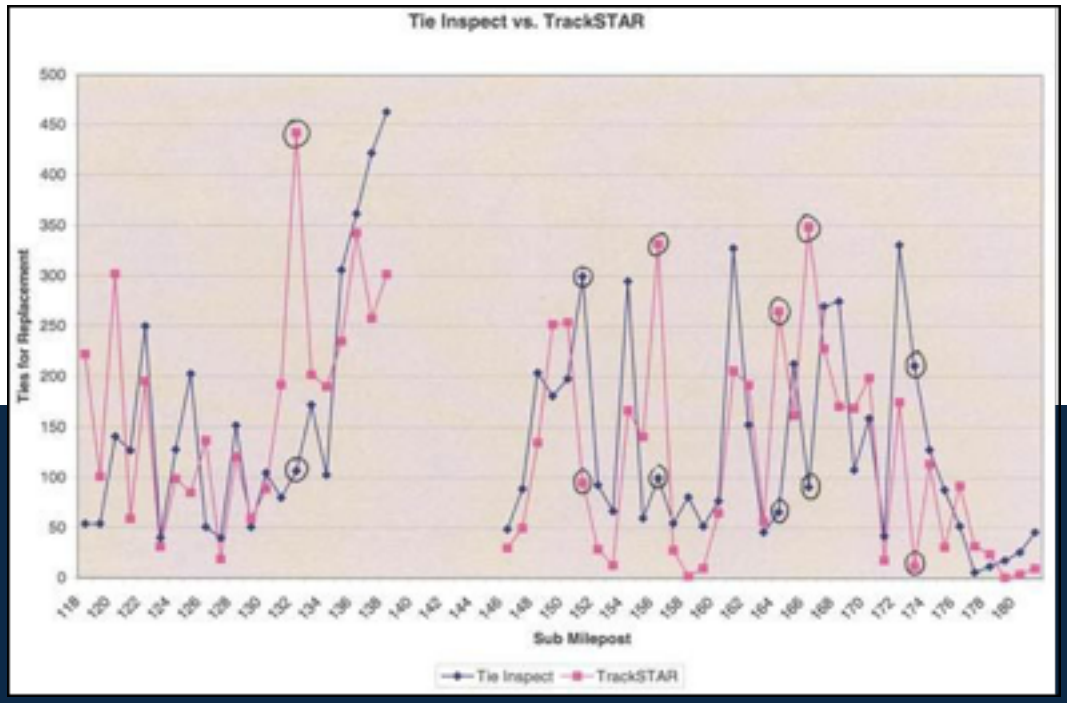

Figure 2. Visual inspection reports and performance-based GRMS data were compared for 57 miles of track.

Fifteen track segments were inspected to sort out the differences. The data for mile 173 (shown in Figure 3a) indicates that the track is quite strong, based on the relatively low GWP readings throughout most of the mile. ("TS" represents performance-based TrackSTAR® data generated by the GRMS system. "TI" represents the visually assessed condition, and tie counts generated by the TieInspect® program.) The chief tie inspector concluded that although this section of track exhibited excellent reserve gage strength, tie inspectors tend to alter their grading standards when they have walked long lengths of track without classifying ties as "failed" or "weak." This might have accounted for part of the 211 ties selected by the visually based method.

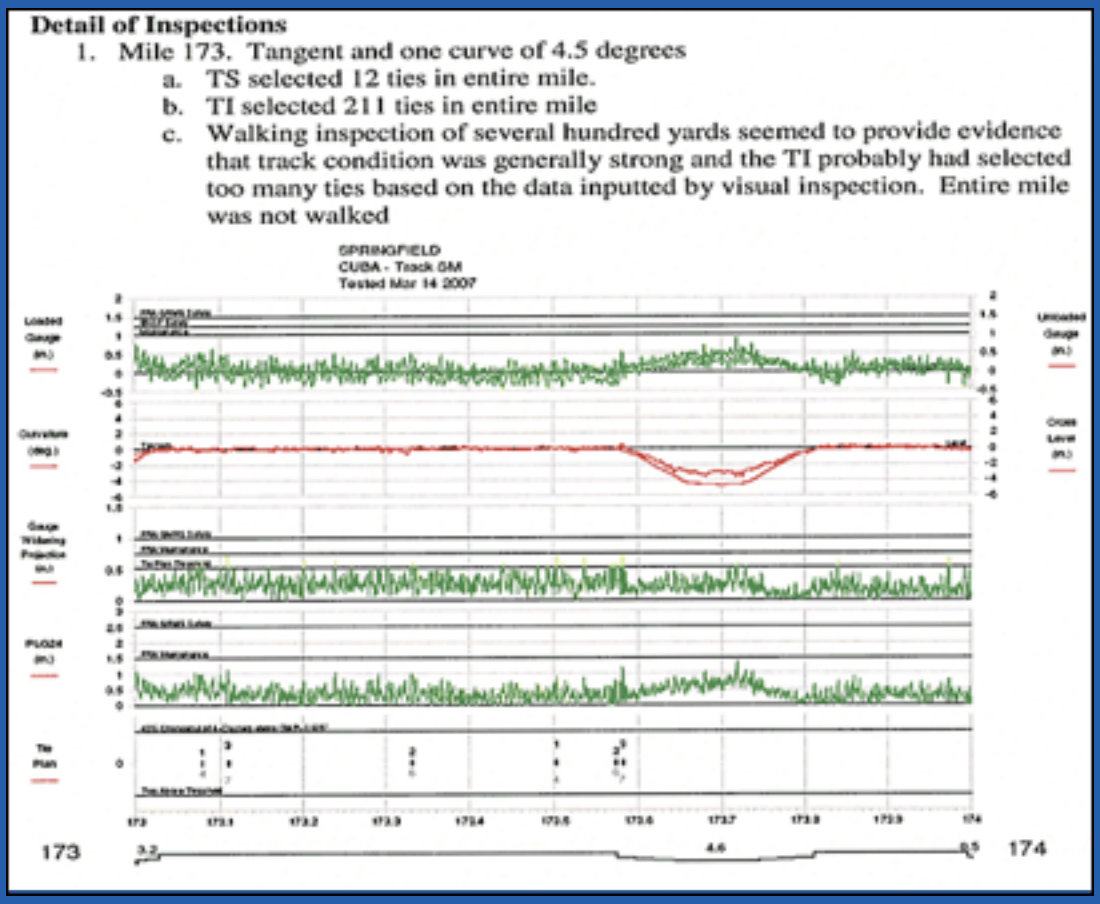

Figure 3a. Fifteen track segments were evaluated. Performance-based TrackSTAR® data (TS) generated by the GRMS system was compared to visually assessed condition, and tie counts generated by Zeta-Tech Associates, Inc.'s TieInspect® program to obtain detailed tie replacement count for the entire length of the track. The relatively low GWP indicates that the track is strong throughout most of the mile. The curve, which is stronger than the tangents, most likely had been recently maintained.

A walking inspection was performed on the entire length of the tangent section at Site 11, between MP 138.3 and 138.6 (see Figure 3b). As the Figure indicates, there was good agreement on tie counts between the visual inspection and the performance-based assessment. The Figure shows that there was a lot of weak track in this tangent segment. The 3-degree curve beginning at 138.6 is clearly stronger than the preceding tangent and 1-degree curve, indicating that the 3-degree curve had undergone maintenance prior to the inspection.

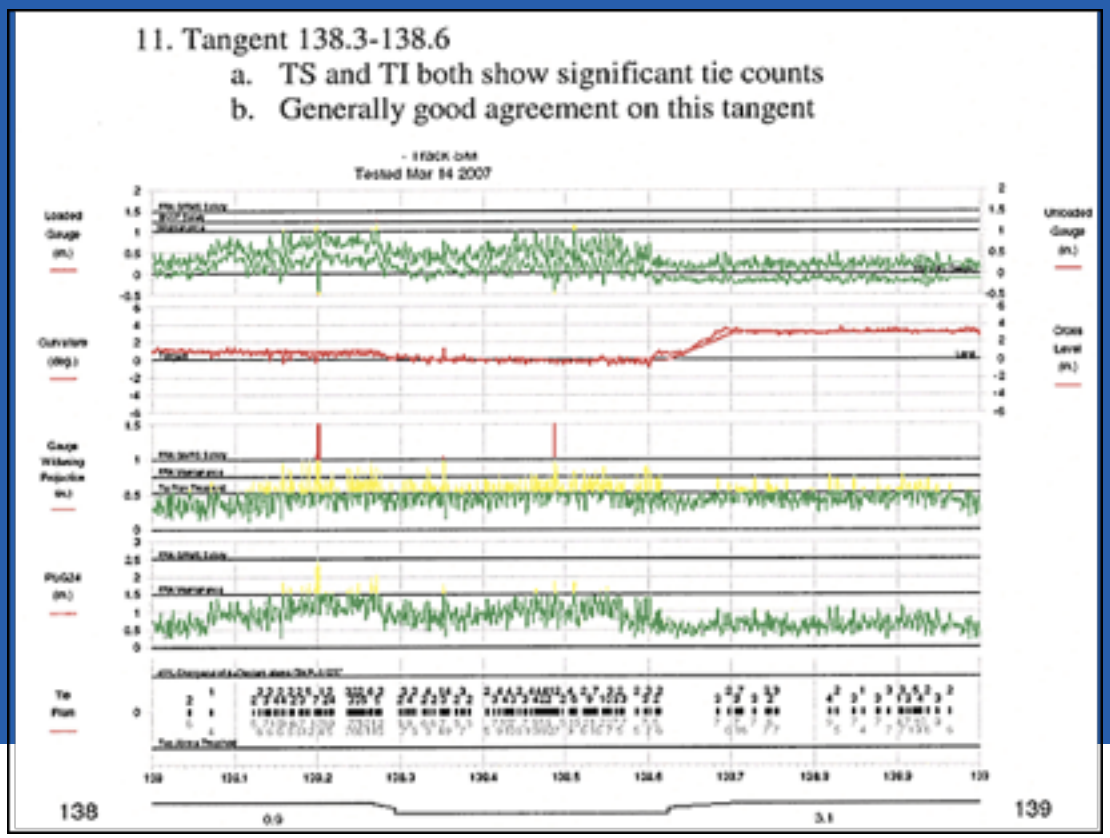

Figure 3b. A walking inspection of the entire length of the tangent between MP 138.3 and 138.6 yielded good agreement on tie counts between the visual inspection and the performance-based assessment. The 3-degree curve beginning at 138.6 is stronger than the preceding tangent and one-degree curve, indicating that it had been maintained prior to the inspection.

The 3-degree curve at site 12 was also chosen for further inspection because there were significantly different tie counts produced by the two methods (see Figure 3c). After a follow up walking inspection of the entire curve, the chief tie inspector agreed that the GRMS, performance-based tie count at 375 ties was much closer to what was actually required than the 89 ties counted by the standard, visual method.

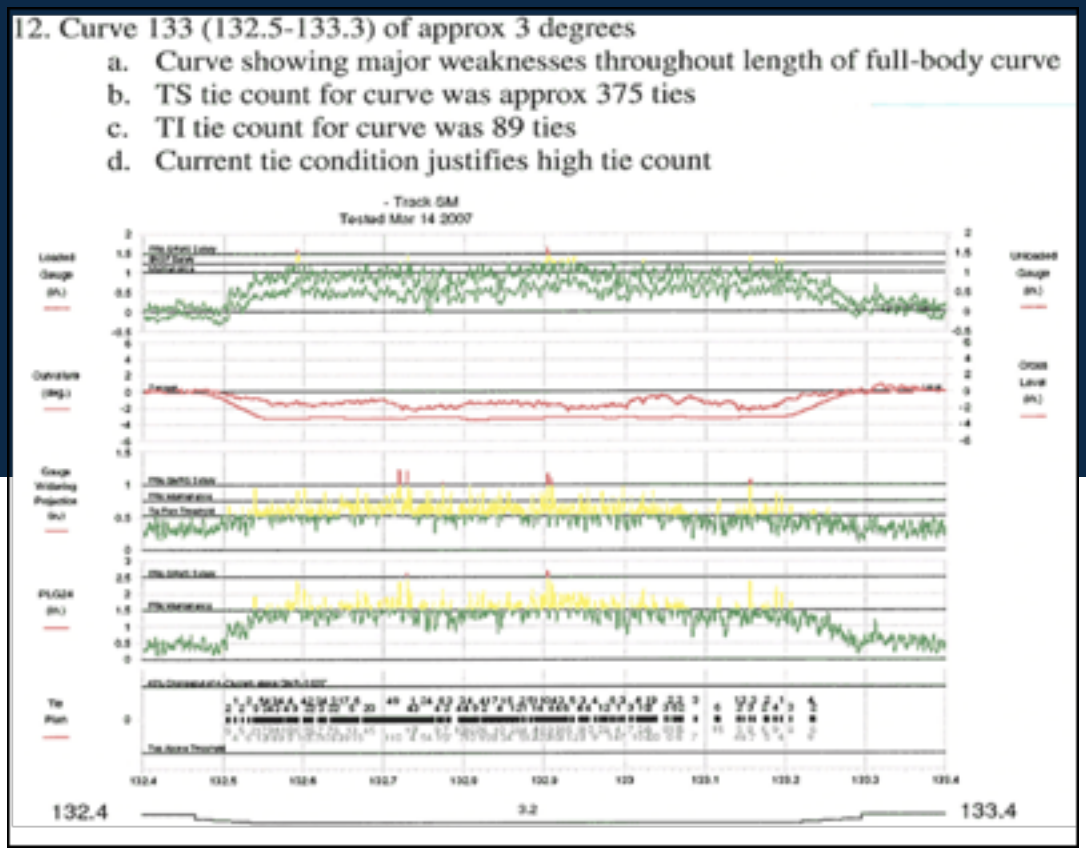

Figure 3c. The GRMS, performance-based assessment selected 375 ties for replacement in this approximately 3/4-mile curve, compared to 89 ties selected by the standard, visual-inspection method. A walking inspection by the chief tie inspector agreed that the performance-based tie count was much closer to what was actually required.

Field inspection of 15 sites within the 57 miles of track that was analyzed showed that there is significant variability between the reports by trained walking inspectors.
Reducing this variability is key to improving tie renewal programs. Also shown is that the performance-based track-strength assessment provided by GRMS, at the very least, provides quantitative data that can be used to correlate and improve the information derived from visual inspection. While visual inspection is still required to identify tie conditions that are not strictly related to gage strength, there are weak tie conditions that are not found by walking inspectors. Performance-based assessment offers the potential to identify weak tie conditions that are not readily apparent to the naked eye.

Holland's fleet of track testing vehicles is designed to satisfy the track geometry and rail profile measurement requirements of Class 1, Regional, Short Line, and Transit properties in North America.

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