TECHNOLOGY DIGEST

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Performance Evaluation of Prototype Switch Point and Stock Rail for HAL Service

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Summary

A new switch point designed to prolong component life has shown encouraging performance in tests at the Facility for Accelerated Service Testing (FAST). This new switch point/stock rail pair was designed by Transportation Technology Center, Inc. (TTCI) with a 40 percent larger cross-sectional area to reduce stresses in the switch point to stock rail transition zone. A prototype curved switch point was installed in a Burlington Northern Santa Fe standard No. 20 turnout at FAST at the beginning of September 2000. Installation of the prototype posed no unique problems and initial maintenance has been minimal with negligible metal flow on the point and stock rail.

The prototype switch point and stock rail were machined from RE section rail, and designed to be interchangeable (as a pair) with existing switch designs and to be within the American Railway Engineering and Maintenance of Way Association (AREMA) lead length.

Initial performance results from the 39-ton axle load testing at FAST are very encouraging. While some of the concerns about the design will require significantly more tonnage to answer, several findings have already been made. These include:

- A reduction in initial maintenance has been noted. The initial flow grinding has been minimal with one application to the switch point and none to the stock rail. Typically, FAST grinds AREMA switch points twice and stock rails once in the first 50 million gross tons (MGT) of operation.
- Concerns of material flow interference between the stock rail and switch point have not been an issue in the first 55 MGT of operation. The wear band on the stock rail is still centered and has not spread to near the switch point undercut.
- The switch point has not developed any chipping or cracking near the point of switch. While it is still very early in the life cycle of the switch point, the initial results suggest the design will not be susceptible to low cycle fatigue.
- A slope was developed on the switch point from train operations. The point slope, 1 in 112 for 35 inches (5/16 inch in 35 inches), was generated from the actual train wear on the switch point, which was installed with a minimal point slope.

Suggested Distribution:

- ❑ Maintenance of Way
- ❑ Planning & Analysis
- ❑ Track Maintenance
- ❑ Safety

Work performed by Transportation Technology Center, Inc.
a subsidiary of the Association of American Railroads

INTRODUCTION

The need for a more durable switch point to reduce the life cycle costs of standard turnouts led to the development of a new switch point/stock rail design by TTCI engineers. Although the development was driven by economics and safety, performance and compatibility considerations also played key roles. The resulting design[1] was used to fabricate a prototype switch point/stock rail pair for testing at FAST.

Exhibit 1 shows the cross-sectional profile of the new prototype as installed vs. a standard American Railway Engineering and Maintenance of Way Association (AREMA) switch taken at the first tie behind the switch point.

Exhibit 1. TTCI Prototype Switch Profile vs. AREMA Switch Profile

The TTCI prototype switch point was designed and fabricated with about a 40 percent greater cross-sectional area at the point of switch. This increased area is intended to reduce the likelihood of head chipping and the possibility of splitting the switch, as well as lowering contact stresses in the switch point to stock rail transition area. These improvements should result in increased switch point life (at the possible expense of slightly reduced stock rail life) and reduced maintenance requirements. After 55 MGT of heavy axle load (HAL) traffic (24 MGT on the switch point and 31 MGT on the stock rail), the prototypes have performed satisfactorily. Other design requirements included:

- The switch point and stock rail were machined from RE section rail.
- The switch point and stock rail are interchangeable (as a pair) with existing switch designs.
- The switch is within the AREMA lead length.

FIELD OBSERVATIONS

The prototype was manufactured from standard RE section rail. Machining requirements posed no significant problems during fabrication. Additional machining was required on the stock rail to remove the base as well as provide the desired undercut. However, this extra expense should be offset by the reduction in machining required for the switch point. Total fabrication costs should be in line with current switch designs. Installation costs were consistent with current designs as no additional or special provisions were required. The prototype was fabricated with no point slope. The intent was to let traffic create a conformal point slope during initial break-in of the switch. Measurements were taken to determine the resulting slope.

The worn point slope is shown in Exhibit 2. This slope, with a 5/16-inch rise over 36 inches, is steeper and shorter compared to typically manufactured point slopes and top cuts. An AREMA

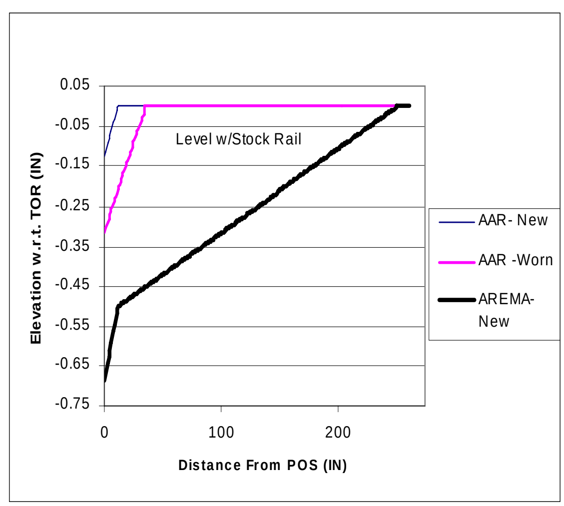

Exhibit 2. Comparison of AAR and AREMA Switch Point Slopes

TTCI = Transportation Technology Center, Inc.; AAR = Association of American Railroads type point slope and top cut may have a total rise of 3/4 inch in 20 feet. The differences in point slope reflect the difference in switch point design. The AREMA switch point is intended to be protected from vertical loading for a long distance, whereas the AAR switch point is intended to carry load (lateral and vertical) closer to the point of switch.

Early concerns of metal flow interference between the switch point and stock rail have so far proven unfounded. With the switch point undercut on the stock rail being so high into the expected running band, there was concern that the stock rail would flow from mainline traffic, preventing the switch from closing in the diverging position. This has not occurred in the first 55 MGT. There is still an “unworn” area between the stock rail wear band and the undercut.

Switch point wear performance also has been good. The switch point takes vertical loading earlier (i.e., at a shorter distance from the point of switch) than an AREMA switch point. However, it is better able to take loading with the larger base and head sections. Initial grinding on the switch point gage face was performed after a short break-in period (approximately 0.2 MGT of diverging traffic) and subsequent grinding has been required only once after an additional 2 MGT of diverging traffic. Exhibit 3 shows an overlay of the switch point/stock rail cross-sections comparing the initial profile to one taken after 20 MGT of combined traffic.

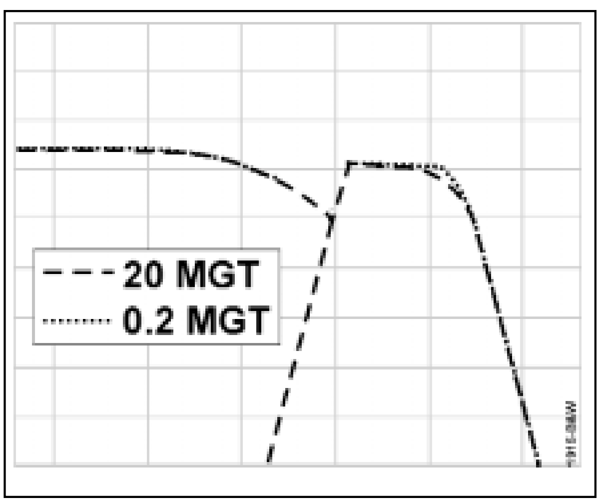

Exhibit 3. Switch Profile Overlay at 0.2 and 20 MGT

This grinding maintenance record compares favorably with the performance of conventional switch points under 39-kip wheel load traffic. The typical switch in FAST requires three or four grinds in the first 25 MGT.

Other longer term concerns will require more tonnage to assess. These include the effect of thermal expansion on the housed switch point/stock rail arrangement and fatigue of the stock rail at the point of switch. The stock rail head has about a 4-inch transition (or run out cut) from reduced section back to full section. Since installation in the fall, temperatures have decreased, precluding any interference problems.

SWITCH POINT/STOCK RAIL ECONOMICS

The TTCI switch point/ stock rail pair was designed with mainline heavy haul service in mind. Under these conditions, the switch point and stock rail are usually replaced as a pair when one fails. This is often the switch point as the thin section near the point of switch is prone to chipping and cracking. The new design was developed to provide the switch point with more structure and stability to withstand lateral loading, especially from trailing point movements. The objective is to extend the life of the pair by extending the life of the switch point.

First cost is of primary importance in analyzing life cycle costs of long-lived components. While TTCI is determining the likely effect of the new design on maintenance costs, by field testing the design, an analysis of manufacturability of this switch point/stock rail pair was made. Exhibit 4 shows a comparison of differences between the two designs and the likely effect of these differences on costs.

Production of the first prototype pair was accomplished with little difficulty through the expertise of the track-work supplier. The first cost of this design will be similar to the AREMA design.

CONCLUSIONS

Initial performance of TTCI’s prototype switch point/stock rail combination has met or exceeded expectations. Development of a more durable switch point will make low entry angle switches

TTC = Transportation Technology Center; FAST = Facility for Accelerated Service Testing

Item	AAR Design	AREMA Design	Comment	Likely Effect on Cost
Stock rail base cut	Vertical cut	None	Cut allows space for switch point base	+
Stock rail head cut	1:4 undercut	1:3 undercut	Steeper cut needed to avoid web	=
Switch point	Vertical cut made on field side of web	Series of cuts to match top of stock rail base	Point is independent of stock rail base; less material removed	-
Switch point	Completes rail head shape	Removes most of railhead at p.o.s.	Lower elevation and larger head require less metal removal	-
Plates	3 stock rail base widths	1 stock rail base width		+
Plates	Stock and point at same elevation at p.o.s.; separated by "tab" in plate	Point sits at 1/2- inch elevation above stock rail	More cuts in plates near p.o.s.	=
Point rail vertical bends	Four (Uniform riser)	Three (Uniform riser)	One additional bend needed	+

Exhibit 4. Comparison of AAR and AREMA Switch Point/ Stock Rail Designs

practical. The resulting decreases in forces will benefit both the train and the turnout, especially the switch ties and fasteners.

FUTURE WORK

Load data collection is scheduled using instrumented wheelsets as well as load cells mounted on the prototype stock rail. In addition, angle-of-attack data will be collected. The data will be analyzed and compared to existing switch performance data to determine how well the goal of stress reduction in the switch point to stock rail transition area has been met. Maintenance requirements will also continue to be closely monitored and recorded so that life cycle economics of the new design can be accurately estimated.

REFERENCES

1. Singh, S.; Davis, D. and Guillen, D., "Development of an Improved Switch Point for Heavy Axle Load Service," *Technology Digest* TD00-005, March 2000.

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