TECHNOLOGY DIGEST

Timely Technology Transfer

"TURNOUT MAINTENANCE - A REVIEW OF BEST PRACTICES,"

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Summary

As part of the Association of American Railroads' Special Trackwork Research Program, an extensive series of interviews and field visits of AAR member railroads was conducted. The objective of the study was to identify the "best [maintenance] practices" for mainline turnouts in heavy haul service using information gathered from maintenance planning, front line personnel and practices currently used on heavy haul track. Line segments and traffic conditions were also observed.

Turnout maintenance practices showing the most improvement are:

- the extended leg replacement frog for welded turnouts
- easily adjustable guard rails
- elastic fasteners, and
- switch point guards in yards

Each of these practices protects the critical components (i.e. frog or switch points) while reducing the amount of track time needed for maintenance. Several practices also offer significant savings in turnout life cycle cost over the typical practices.

Using an extended length frog for replacements is highly recommended for welded turnouts because it eliminates the need for rail plugs by allowing one to crop existing welds and reduces welding time to one day. One length of frog, which will fit any repair situation, reduces not only the required inventory of this expensive component, but also the amount of track time needed for a frog replacement.

Switch point guards on yard turnouts extend the life of switch points by 100 percent or more and help to prevent derailments from sharp flange "picking points." They are most effective in short, high-angle switches and are limited to low speed application because of the bump they make in the main route.

In addition to documenting the current best practices, a listing of recommended subjects for future research which includes known problem areas such as weld repair, is provided. The use of existing technology such as ballast stone injection or design lift tamping for application with turnout maintenance is also discussed.

Suggested Distribution:

- ❑ Maintenance of Way
- ❑ Research and Development
- ❑ Track Maintenance
- ❑ Maintenance Planning

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INTRODUCTION AND CONCLUSIONS

Maintenance of special trackwork is a great concern to North American railroads which spend about $98 million on turnout maintenance annually. At an additional cost of $120 million, 6,800 frogs are replaced each year. In fact, the load environment on these components is quite severe, making them the shortest-lived track in the system. Nearly 15-20 percent of track maintenance expenditures are for turnouts, which represent approximately 2 percent of the track mileage.

Special trackwork also plays a key role in train operations, service reliability turnouts, and crossing diamonds, which are the traffic control points. Their reliability is essential to train operations since they may affect more than one line.

While the average life of turnout components is quite short compared to standard track, the variability of component lives in special trackwork is very large. This is due to the relative complexity of the special trackwork and the dynamic behavior of vehicles traveling over them. A substantial portion of this variability may be due to the amount of maintenance performed and the maintenance practices used.

To develop the information presented in this TD, a three step approach was used:

(1) A literature review of participating railroad maintenance instructions, handbooks and standard practice circulars was conducted. Compilation and comparison of the literature formed the basis of a questionnaire, which was sent to railroad turnout maintenance experts.

(2) Questionnaire responses were later collected in a site interview. The practices were documented in more detail and, where possible, witnessed by the AAR representative in field visits and follow-up discussions.

(3) Finally, an analysis of the findings was performed. A list of recommended best practices for heavy haul operations was compiled by comparing and evaluating maintenance practices. Exhibit 1 displays this list along with a description and the advantages of the currently used "best" turnout maintenance practices.

The practices that show the most improvement over previous standards are (1) the use of the extended leg replacement frog for welded turnouts, (2) the use of easily adjustable guard rails, (3) the use of elastic fasteners and (4) the use of switch point guards in yards. All of these improvements have the dual purpose of protecting the critical components (i.e. frog or switch points) and reducing the amount of track time needed for maintenance.

Before implementing these best practices, an economic analysis should be performed using a systems approach. The design of the turnout, the type and quantity of traffic, and the resources available to the track maintenance forces are key factors in such an analysis.

Often there is no documented, clearly superior maintenance practice. In some cases this is because a practice is relatively new and without a "track record." For example, the former CNW removes rods and tamps through mainline turnouts on their Wyoming coal line, believing that this gives them a longer surface life than hand tamping the switch point area. However, the traffic rate has increased so rapidly on this line that it is difficult to make a valid comparison of the two practices. Often surfacing is done on a calendar basis, not a tonnage basis. Rising tonnage rates give the appearance that the maintenance practice has improved, whether it has or not.

Many practices are controversial, and there is a lack of evidence that one practice is truly better than another. In these cases more research and testing needs to be done.

Some suggested areas of maintenance and design for development are listed in Exhibit 2. Ideas that may be adapted to turnout maintenance are also included.

Exhibit 1. Identified Turnout Maintenance Best Practices

Activity	Best Practice	Minimum Track Time / Gang Total Time (hours)	Advantages
Undercutting and Surfacing	Undercut up to 16 inches in one pass. Keep turnout level on bagged good quality ballast that is subsequently left in track, followed by the standard surfacing operation.	4 / 24	New machines can undercut up to 16 inches in one pass; previous method required two 8-inch passes. Undercutting and use of good ballast reduces surfacing frequency and extends turnout component life.
Surfacing	Use specialized gang of switch tamper with liner and ballast regulator. Access tamp switch rod and other poorly accessible areas with hydraulic hand tools.	1 / 3	Minimum sized specialized gang assisted by assigned section gang most economical alternative when track occupancy is difficult.
Switch Tie Replacement	Replace defective ties when found using section gang and backhoe. Prolong tie life by using elastic fasteners throughout turnout.	Under traffic/ Variable depending on number of ties	-Requires no track time -Reduces spike killing of ties particularly where components such as the frog and switch points are replaced several times during the normal life of a tie.
Frog Replacement	Replace frog with an extended length frog and weld	2.5 / 15	- Extended rail leg eliminates need for rail plugs and reduces welding to one day. - One length frog reduces inventory. Fit is made ready on site, off track.
Frog Welding (Rail Bound Manganese Frogs)	Use electric welder plus ballast to cut out damaged metal. Build up with "stick" or "wire feed" welding. Monitor heat of casting with temperature crayon/ pyrometer. Keep interpass temperature as low as possible (not to exceed 500° F). Machine grind to profile. Finish with hand grinders.	2 / 4	-Practice is common to all. - Replacement of RBM inserts has been done on two railroads. One discontinued the practice as uneconomical, the other railroad removes frogs and rebuilds them at a central shop.
Grinding Frogs	Use hand held grinders as frequently as inspections detect need; New frogs are ground often in the first few weeks until the work hardening process slows the metal flow rates.	Under traffic / 40 minutes	Frequent grinding, as conditions develop, prolongs interval between frog welding and replacements.
Guard Rail Adjustment	Use adjustable guard rails where individual shim adjustment can be made progressively under traffic.	Under traffic 30 minutes / 1.5	Adjustment is made accurately and without traffic delay.
Bolt Maintenance	Track inspector or track maintainer adjusts when found. Equip track inspectors with hydraulic torque wrenches. Lubricate bolt threads.	Under traffic	Bolts are regularly inspected and adjusted to torque. Inspectors carry out adjustment when found. Lubricated threads allow force to stretch bolt, making it a more effective clamp.
Switch Point Adjustment	Adjust at regular joint inspections of power switches by signal and track maintainers	Variable as to which adjustments are needed	Work is done regularly during inspections.
Grinding Switch Points	Use a 4-wheel grinder for switch points and stock rail. Do both sides of switch points. It can be particularly difficult to get track time at cross-overs.	20 minutes / 40 minutes	Frequent grinding, as required, prolongs switch point and stock rail life. Switch points are not repaired by welding in Heavy Haul applications. Light-weight hydraulic grinders are in test.
Switch Point Guard	Install in yard turnouts.	Under traffic 1.5 / 3	Extends life of switch points up to two times. Guides wheels away from switch point, preventing high angle impacts.

Exhibit 2. Recommendations for Research on, or Implementation of Improved Practices

Activity	Research Topic	Possible Advantages
Surfacing*	- Stone Injection - Design Lift Tamping	- Ability to reach inaccessible areas; 2 to 3 times tamping life - Extended tamping life
Surfacing/ switch heater	"Ductwork" metal tie for carrying switch heater equipment	Will allow machine tamping at critical switch point ends
Switch rods	Locate switch rods inside conventional tie or Ductwork tie	Will allow machine tamping of currently inaccessible cribs
Switch point riser	Determine optimal riser height and taper	Lowering or eliminating the switch point riser will reduce impacts on turnout components in the switch point area
Switch point cross section	Analytical study of switch point cross section to find a more stable shape	Will reduce switch point related maintenance and derailments
Frog and switch point profiles*	Design running surface profiles for worn wheels	Will reduce metal flow and impact damage
Frog Weld Repair*	- Determine optimum limit weld interpass temperature - Alternate weld bead direction by layer - Work harden or "peen" weld bead - Develop harder weld consumables	- Will reduce embrittlement of MN steel in the heat affected zone -Will equalize weld properties in all directions -Will reduce cracking by relieving surface tensions -Will reduce required grinding maintenance
Bolts	- Redesign bolt locations in castings - Improve methods of tightening to insure proper force in bolts	- Will reduce stresses and bolt loosening - Will reduce required bolt tightening

* Current AAR Research Projects

Maintenance practice is highly dependant on the turnout design and materials. Design improvements will reduce the total required maintenance and can alter the types of maintenance needed. The operations requirements will also affect the amount and type of maintenance applied to the turnout. Many lines are at or near train capacity. Track time, as measured by train delay costs, is prohibitively expensive. In these cases an absolute minimum of turnout maintenance is performed. In essence, operating costs are minimized at the expense of track capital costs.

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REFERENCES

CANAC International, Inc., Special Trackwork Maintenance "Best Practices," Report to AAR, December, 1995.

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