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Derailment of Transit Vehicles in Special Trackwork

This TCRP digest provides a summary of the findings from TCRP Project D-2, "Derailment of Transit Vehicles in Special Trackwork, " conducted by Zeta-Tech Associates, Inc.

INTRODUCTION

This digest presents guidance in selecting procedures for reducing derailment incidents in special trackwork.

Derailment of transit vehicles in special trackwork--all rails, track structures, and fittings other than plain unguarded track that are neither curved nor fabricated before laying (e.g., turnouts)--both in yards and on mainline track, is a major concern to transit agencies because of safety and economic considerations. Transit agencies employ different design and maintenance practices and use various methods to reduce such occurrences. However, there is a need to investigate the parameters that contribute to derailments in special trackwork, to evaluate current mitigation methods, and to develop better means for reducing such derailments. TCRP Project D-2 was conducted to address this need.

The research was conducted under TCRP Project D-2, "Derailment of Transit Vehicles in Special Trackwork," by Zeta-Tech Associates, Inc. This research, completed in 1996, recommended procedures to reduce derailment occurrences. This digest provides a summary of the work performed in this research. The materials in this digest are extracted from the final report on TCRP Project D-2.

FINDINGS

As part of this project, factors that affect occurrence of derailments in special trackwork and methods currently used to reduce derailment incidents were identified, and suitable methods and actions for mitigating derailments were recommended. This was accomplished by reviewing pertinent literature, gathering information on transit agencies' practices, evaluating current practices, conducting field measurements, and performing simulation modeling.

FACTORS AFFECTING DERAILMENTS

Derailments in special trackwork are influenced by factors related to trackwork design, trackwork maintenance, vehicle characteristics, and operating conditions. These include trackwork details such as switch point configuration, radius of closure rail, and switch geometry; trackwork maintenance conditions such as fit with stock rail, out of adjustment, and rail wear; vehicle characteristics such as wheel profile; and operating conditions such as speed restrictions.

CURRENT METHODS OF DERAILMENT MITIGATION

Current methods used by transit agencies to prevent or reduce derailments were identified from information provided by 14 agencies and other sources. These methods involve use of the following design and maintenance features:

1. Curved switch points,
2. Improved guarding of turnouts (e.g.,

extended guard rail turnout, fully guarded crossover, and house-top point protection),

3. Stringent maintenance and inspection standards,
4. Standards for gauge face wear angle for switch and closure rails,
5. Lubrication,
6. Switch point protectors, and
7. Elimination of mismatch between wheel and rail.

The evaluation conducted in this research has shown that use of house-top point guard, fully guarded turnouts, and curved switch points should be the most effective in reducing the potential for derailments.

MODIFIED AND NEW METHODS FOR DERAILMENT MITIGATION

Methods that involve modification of current design and maintenance practices to reduce derailment potential in special trackwork were identified and evaluated. These included improvements to curved switch points, guarding of turnouts, maintenance and inspection standards, gauge face wear angle for switch and closure rails, lubrication, switch point protectors, and mismatch between wheel and rail.

Turnouts and turnout components with improved features and capabilities that offer potential for reducing derailments in special trackwork were also proposed and evaluated. These included a tangential geometry turnout--a design that attempts to reduce lateral wheel/rail forces, associated wear, and derailment risk--and improved switch design such as asymmetrical switch points, spiral switch points, stepped point slide plates, non-riser plate points, and fully gauge plated switch-point areas.

ANALYSIS AND RECOMMENDATIONS

In order to determine the potential for reducing derailment for new mitigation techniques that could not be physically tested, simulation modeling was used. The model, using the lateral to vertical force ratio as a measure of derailment potential, was calibrated using field data obtained from two turnouts. As part of evaluating the alternative methods for derailment mitigation, consideration was given also to cost and maintenance requirements.

Based on the results of the simulation analysis, several methods were found to provide an effective means for reducing derailment potential. The following methods provide a highly effective and economic means for reducing derailment potentials:

- Use of pre-point guards,
- Use of point protectors,
- Adoption of comprehensive maintenance and inspection standards,
- Use of lubrication,
- Use of spring frogs,
- Use of fully gauge plated switch-point areas,
- Use of spiral switch points, and
- Use of house-top point guards.

The following methods provide an effective, but more costly, means for reducing derailment potential:

- Use of extended frog guards,
- Use of curved points,
- Use of fully guarded turnouts,
- Use of asymmetric points, and
- Use of extended house-top point guards.

In addition to the increased safety resulting from the potential reduction in derailment occurrences, these methods provide economic benefits through the elimination of the restoration needed following derailments, reduced maintenance, and increased service life of trackwork components.

CONCLUSIONS

The need to identify means to reduce the potential for derailments in special trackwork has been recognized by transit agencies in North America. This research identified and evaluated, using simulation modeling, different methods for reducing derailment potential and resulted in preliminary recommendations for means to reduce such derailments. However, field evaluation of the recommended methods may be necessary to confirm the results of computer simulation.

FINAL REPORT

The agency final report, titled "Derailment of Transit Vehicles in Special Trackwork," gives a detailed account of the project and its findings and conclusions. The report is available on request to the Transit Cooperative Research Program, Transportation Research Board, 2101 Constitution Avenue, N.W., Washington, DC 20418.

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