ANALYSIS OF THE SHEAR BEHAVIOR OF RAIL PAD ASSEMBLIES AS A COMPONENT OF THE CONCRETE SLEEPER FASTENING SYSTEM

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INTRODUCTION

- Rail seat deterioration (RSD) is the degradation of material immediately beneath the rail base and rail pad assembly that serves as the bearing surface on concrete crossties
- Surveys conducted by UIUC show that North American Class I Railroads and other railway infrastructure experts ranked RSD as the most critical problem associated with concrete crosstie and fastening system performance
- The rail pad assembly is the component responsible for providing a protective layer between the sleeper and the rail base distributing the loads to acceptable stress levels
- Analyzing the mechanistic behavior of rail pad assemblies is critical to improving component performance and life cycle
- This study focuses on the shear behavior of rail pad assemblies, combining laboratory and field experimentation in an attempt to analyze how surfaces interact, show how materials deform, and quantify the amount of relative displacement

LABORATORY AND FIELD INSTRUMENTATION

- Development of a representative laboratory experiment and field test protocol to quantify the total lateral displacement of rail pad assemblies is critical to the understanding of the mechanistic behavior of this component
- The Amsted RPS Pulsating Loading Testing Machine (PLTM) was used to execute the laboratory experiments
- Realistic service conditions were represented by applying full-scale static and dynamic loads with hydraulic actuators
- Field tests performed at the Transportation Technology Center (TTC) on a curve (HTL) and tangent (RTT) section
- Field loading applied by the Track Loading Vehicle (TLV), passenger consist, and freight consist

RAIL PAD ASSEMBLY LATERAL DISPLACEMENT

Failure Modes
- Tearing (A, B, C)
- Crushing (A, B, C)
- Abrasion (A)
- Rail Pad “walk out” (D)

Failure Causes
- Relative Displacement
- High Compressive Stress
- High Shear Stress

CONCLUSIONS

- Relative displacements between the pad assembly and the rail seat were measured successfully
- These experiments verified the hypothesis that lateral displacements increase as the lateral wheel load increases
- Only high magnitudes of vertical loads appeared to affect the lateral displacement of the rail pad assemblies
- Larger lateral and longitudinal displacements are less likely to occur when the rail pad fits tightly within the rail seat
- Additional research should focus on the relationship between component tolerances and geometry and its impact on life cycle of the fastening system and potential mitigation of RSD
- Future investigations should focus on the shear capacity of current and innovative materials to optimize the design of rail pad assemblies to efficiently resist shear forces and protect critical interfaces

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