ACCELERATED TESTING OF PAVEMENT WITH EMBEDDED DYNAMIC WIRELESS POWER TRANSFER COMPONENTS

by

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Abstract

This thesis investigates the embedment of Dynamic Wireless Power Transfer (DWPT) components within two pavement test sections, aiming to evaluate their mechanical and thermal responses. The integration of DWPT components into the pavement structure, while enabling dynamic power delivery to EVs, alters the conventional geometric design of pavements, potentially influencing their short-term and long-term durability and integrity. Hence, to ensure the integrity and efficiency of both the embedded system and the surrounding structure, it is essential to comprehend how integrating these components influences the pavement's responses under various conditions.

Conducted at the Accelerated Pavement Testing (APT) facility of the Indiana Department of Transportation (INDOT), the study evaluates over the course of 25,000 APT traffic passes, the structural responses of both, a flexible and rigid pavement test section, each incorporating a Charging Unit (CU) composed of Class A concrete and magnetic concrete, respectively. The construction of the flexible pavement involved milling down 2 inches of the existing pavement surface, while the rigid pavement required complete demolition. The rigid pavement's CU incorporated internationally sourced magnetized concrete, representing the first time this material was used for in-cast application. Combined with manual construction procedures to prevent disrupting embedded DWPT components and sensor instrumentation, and a one-week gap between casting the CU and the surrounding slab, these aspects potentially influenced the durability and adhesion strength of the rigid pavement section. The flexible pavement denoted no visible distress, while the rigid pavement developed a mid-panel crack. Several factors, including design and construction issues, inadequate adhesion between concrete interfaces, concrete mix segregation, material variations, and nonuniform load distribution, may have contributed to the crack formation.

By examining the construction techniques employed, challenges encountered, and resulting behavior of both pavement test sections, this study provides insights into the construction and performance implications of DWPT component integration into pavements, as evidenced by the responses observed in the test sections. This thesis thereby contributes to the ongoing research efforts on investigating the impact such integration has on the surrounding structure's integrity.