UNIVERSITY TRANSPORTATION CENTER
RESEARCH BRIEF

PROJECT TITLE: Smart and Environmentally Friendly Winter Maintenance Solutions for Safe Winter Mobility

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INSTITUTION: SINGLE-INSTITUTION PROJECT
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Background

Ice and snow control during the winter is the top priority of roadway operation activities. Ice or snow make the roadways slippery, which reduces safety. Snow accumulation at airports can result in flight delays and economic losses. Deicing chemicals are commonly used to facilitate snow and ice melting on pavements and bridges. Yet, the use of chemical deicers can be harmful to pavements and the environment. Mechanical instruments are also used for snow or ice removal however, these operations are costly and not effective. Therefore, there is a need to develop new methods and technologies to replace the deteriorative deicing techniques. Electrically conductive concrete (ECC) presents a promising solution for anti-icing and deicing.

Conventional concrete has poor electrical conductivity. By introduction of conductive materials electrical conductivity of concrete increases and electrical current conduction becomes possible, resulting in heat generation and snow melt. Carbon fibers, steel fibers, graphite products, steel shavings, nickel particles are used in ECC. Higher conductive particles and fiber dosages produce higher conductivity, but may compromise concrete workability and perfromance. Several research studies successfully demonstrated the effectiveness of ECC in snow and ice removal. However, specific recommendations for paving ECC mixtures is lacking in the literature.

Research Project

The primary objective of this study is the investigation of different types of fibers and fiber dosages on conductivity properties of paving concrete, and ultimately evaluation of deicing efficiency. To do so, an experimental matrix with seven concrete mixtures was developed. A conventional paving mixture was selected as a Control mixture. The remaining six mixtures were designed with carbon and steel fibers at 0.25 %, 0.50% and 0.75% volumetric dosages. Carbon and steel fibers are presented in Figure 1. Concrete specimens will be cured for 28 days in a fog room after which they will be tested for compressive strength, flexural strength, and toughness index. To assess the electrical properties, electrical resistivity will be measured on 14-, 28-, 49-, 70-, and 90-days age. Additionally, a series of specimens will be cast with electrodes and connected to DC power supply to assess the current flow. This comprehensive experimental framework will enable to determine optimum percentages of carbon and steel fibers which will reduce the electrical resistivity of concrete significantly. As a result, the concrete will gain enough electrical conductivity that will enable current flow and heat development necessary for the intended purpose of pavement deicing.