

Effects of Curing Methods and Supplementary Cementitious Material Use on Freeze Thaw Durability of Concrete Containing D-Cracking Aggregates

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Introduction

For concrete pavements in Kansas, the most effective method of increasing their sustainability is to increase the service life. One of the principle mechanism of concrete pavement deterioration in Kansas is freezing and thawing damage. Some Kansas limestone aggregates are known to be very susceptible to D-cracking and have resulted in millions of dollars in maintenance costs. The Kansas Department of Transportation (KDOT) has developed rigorous testing procedures for limestone aggregate use in concrete pavement, including that they pass the KT-MR-22 concrete prism freezing and thawing test, which can take up to 6 months to complete. This project aimed to 1) shorten significantly the total time needed to perform the KT-MR-22 test method by changing the curing methods used and 2) determine any change in concrete freeze-thaw resistance as a result of a change in the concrete permeability from the use of supplementary cementitious materials (SCMs).

Project Objective

The research objectives of this study were as follows:

- Freeze thaw testing was conducted on concrete made from the same aggregate source but with different amounts of wet curing at elevated temperatures to determine if accelerated curing with no drying period would give comparable durability to beams tested using the standard KDOT curing method of 67 days in the 100% moisture room, 21 days in a 50% relative humidity room, 2 days in a tempering tank, and finally 24 hours at 40°F.
- To determine any increase in freeze-thaw durability of concrete containing poor quality aggregates through a decrease in concrete water absorption and permeability by the use of supplementary cementitious materials (SCMs).

Project Description

This research project is composed of three tasks.

- Task 1 focused on comparing the freeze thaw testing procedures and laboratory equipment between KDOT and KSU's laboratories.
- Task 2 the effect of accelerating curing procedures in the KT-MR-22 test on freeze thaw durability was examined.
- Task 3 focused on testing whether SCMs could improve freeze-thaw resistance by lowering water absorption rates

Project Results

This study found that long periods of soaking in lime water produced more damage during freezing and thawing than standard KDOT curing methods. Curing for shorter period of time in a lime water bath at 100°F however gave comparable freeze thaw results to that seen with the longer standard KDOT curing regime.

Increasing the concretes resistance to water penetration can greatly increase the freeze thaw durability of concrete containing D-cracking susceptible aggregates. It was seen that the concrete volume of permeable voids and water absorption rate correlated well with the freeze thaw durability of concrete made with a poor quality aggregates. It is recommended that KDOT continue to enforce concrete permeability and volume of permeable voids specifications to improve the service life of Kansas concrete pavements.

Project Information

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