TECHSUMMARY October 2012

State Project No. 30000152 / LTRC Project No. 10-1C

Evaluation of Surface Resistivity Measurements as an Alternative to the Rapid Chloride Permeability Test for Quality Assurance and Acceptance

INTRODUCTION

Many contracting agencies currently use permeability specifications in Portland cement concrete (PCC) pavements and structures. This project followed the implementation of the surface resistivity test TR 233 on a field project in Louisiana. Additionally, a precision statement was developed for TR 233, and a ruggedness study was also conducted to determine influencing factors on the results of TR 233 testing.

OBJECTIVE

The objective of this research was to implement the surface resistivity meter, determine its precision, and conduct a ruggedness study.

SCOPE

To meet the objectives of this project, field samples from the Caminada Bay Bridge project were tested. Samples were produced under laboratory conditions for the precision study and were tested for surface resistivity at ages ranging from 28 days to one year. Samples were produced under laboratory conditions for the ruggedness study and were tested for surface resistivity at 14, 28, and 56 days of age. All precision and ruggedness data collection were performed using the surface resistivity meter model.

METHODOLOGY

Laboratory results from the implementation project were tracked noting cumulative savings.

ASTM C802 and ASTM C670 were used to analyze the data for the precision study. A total of 17 laboratories and 8 mixtures were tested. A sample was considered to be the average result of three specimens.

ASTM E1169 was used to analyze the data for the ruggedness study. Student t-tests were performed on the additional factorial to compare the effects of changing one of the factor levels against a control. The ruggedness factorial included 24 combinations of factors, while the extra factorial included 11 additional combinations, for a total of 35 unique combinations of factors. A sample was considered to be the average result of three specimens.

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CONCLUSIONS AND RECOMMENDATIONS

The single operator coefficient of variation of a single test result was found to be 2.2 percent. Therefore, the results of two properly conducted tests by the same operator on concrete samples from the same batch and of the same diameter should not differ by more than 6.2 percent.

The multilaboratory coefficient of variation of a single test result has been found to be 3.9 percent. Therefore, the results of two properly conducted tests in different laboratories on the same material should not differ by more than 11 percent.

The collected data only covered the moderate, low, and very low permeability classes; because of this, the precision statement should only be used for values within these ranges. Further testing is recommended to investigate values in the high and negligible permeability classes. The surface resistivity test shows lower variability than the rapid chloride permeability test.

The ruggedness study showed age and aggregate type as significant factors for surface resistivity. An additional factorial was used to compare individual factors against a control sample. The additional factorial suggested age, calcium nitrite, aggregate size, and aggregate type as significant factors for surface resistivity. However, comparative rapid chloride permeability testing on the same sample sets concluded that all significant factors determined will either affect the permeability of the sample in general or influence rapid chloride permeability as well.

The project specific cost benefit analysis showed that the Department saved about $10,000 in three months, or about $40,000 per year, for the Caminada Bay Bridge project after implementing the surface resistivity meter. Using an average of 50 bridge construction projects per year, the Department is conservatively projected to save about $1,000,000 annually.

Surface resistivity test being conducted on a 4- x 8-in. cylinder