

A STUDY OF THE RELIABILITY OF THE ASTM C-666 FREEZE-THAW TEST OF CONCRETE

1.0 INTRODUCTION

The Iowa State Highway Commission purchased a Conrad automatic freeze and thaw machine and placed it in operation during October 1961. There were a few problems, but considering the many electrical and mechanical devices used in the automatic system it has always functioned quite well.

Rapid freezing and thawing of 4"x4"x18" concrete beams has been conducted primarily in accordance with ASTM C-291 (now ASTM C-666 procedure B) at the rate of one beam per day. Over 4000 beams have been tested since 1961, with determination of the resulting durability factors. Various methods of curing were used and a standard 90 day moist cure was selected. This cure seemed to yield durability factors that correlated very well with ratings of coarse aggregates based on service records.¹ Some concrete beams had been made using the same coarse aggregate and the durability factors compared relatively well with previous tests.

Durability factors seemed to yield reasonable results until large variations in durability factors were noted from beams of identical concrete mix proportions in research projects R-234 and R-247. This then presents the question "How reliable is the durability as determined by ASTM C-666?"

This question became increasingly more important when a specification requiring a minimum durability factor for P.C. concrete made from coarse aggregates was incorporated into the 1972 Standard Specification for coarse aggregates for concrete.

2.0 PURPOSE

The purpose of this study is to determine the reliability of concrete durability factors by investigating the variables of air contents and fabrication methods. Variations within concrete batches and from batch to batch will also be studied.

¹ R-11-Z "A Study of Curing Methods and Type II Cements on the Durability of Concrete" by Vernon J. Marks & Ronald E. Grubb, June 17, 1969.

7.0 SUMMARY

From this project, we can conclude that:

1. The air content greatly affects the resulting durability factor and if it is to be used for a coarse aggregate specification it will have to be controlled or interpolated closer than 5-7% which is the present practice. More study should be conducted to determine if our 5-7% air in concrete is right for all coarse aggregates (R-258 is an additional study in this area).
2. Vibration with the laboratory facilities shows little affect on durability so a 10 second per lift standard should be continued.
3. The standard deviation of "sets" of beams is far lower than that for individual beams so durabilities should be determined for sets only. The standard deviation of individual beams was too much and more study should be conducted to determine ways to improve this (R-258 which is in progress will be an additional study in this area).