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Final Report

**Method "A" Freeze - Thaw
Studies of Concrete Quality
Aggregates at Various
Moisture Contents**

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Method "A" Freeze-Thaw Studies of Concrete
Quality Aggregates at Various Moisture Contents

November 4, 1968

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METHOD "A" FREEZE-THAW STUDIES OF CONCRETE
QUALITY AGGREGATES AT VARIOUS MOISTURE CONTENTS

1.0 INTRODUCTION:

Durability of concrete aggregates is normally measured by determining the freeze-thaw resistance of the aggregate when measured in the following manner:

A 2500 gram sample, representative of the material as produced, except that all particles passing a No. 4 sieve are removed, is weighed into a metal pan. The original dry weight of this sample is computed from the percentage of moisture determined in a parallel sample of the same size. The prepared sample is saturated with water by subjecting it to an air pressure reduced to not more than one inch of mercury and then submerging it in water for 15 minutes.

A water-alcohol solution containing 0.5 per cent alcohol by weight is added to the sample pan to a depth of 0.25 inch. The sample is then frozen for 2 hours by placing it in a freezer where the air temperature is maintained at minus 5 to minus 15 degrees F. The sample is thawed by immersing it in a water-alcohol solution of 70 ± 5 degrees F. for 1/2 hour to complete the cycle.

After 16 freeze and thaw cycles, the sample is sieved on the No. 8 sieve. The percentage passing the No. 8 sieve, computed to a dry weight basis, is reported as the loss in the freezing and thawing test.

By specification all coarse aggregates to be used in portland cement concrete paving must have a freeze-thaw loss not greater than 6.0 per cent, unless concrete pave-

ments incorporating coarse aggregates from the same source have an acceptable service record.

Some concrete aggregates having a freeze-thaw loss of less than 6.0 per cent have been used in pavements which, unfortunately, have exhibited poor durability.

There is some feeling that possibly those aggregates which pass the freeze-thaw test, but still result in non-durable concrete, have such a pore structure whereby the preliminary vacuum saturation may not, in fact, truly saturate the specimen prior to the freeze-thaw test.

2.0 PURPOSE

The purpose of this project is to determine if these questionable aggregates are saturated and if they are not saturated if a prolonged soaking will saturate them sufficiently to yield different results in the method "A" freeze and thaw.

3.0 MATERIALS

Two crushed limestone samples were submitted from the following sources and were identified by the following laboratory numbers:

AAC7-127 Weaver Construction Company, East of Alden,
SW-1/4, 17-89-21, Hardin County.

AAC7-454 Schildberg Construction Company, Menlo Quarry,
SE-1/4, 17-77-31, Adair County (Argentine
Beds 3-6).

4.0 LABORATORY PROCEDURE

The testing procedure was as described in the introduction except for seven different methods of saturation prior to freezing and thawing. The seven methods of saturation are:

Method #1 Standard vacuum saturation.

Method #2 Standard vacuum saturation plus one week of soaking in water.

Method #3 Standard vacuum saturation plus two weeks of soaking in water.

Method #4 Standard vacuum saturation plus three weeks of soaking in water.

Method #5 Standard vacuum saturation plus four weeks of soaking in water.

Method #6 Standard vacuum saturation plus ninety days of soaking in water.

Method #7 One week of soaking in water followed by saturation in the high pressure meter for 3-1/2 hours at 5000 psi.

5.0 INTERPRETATION OF RESULTS

The crushed limestone from Weaver Construction Company's Alden quarry (Lab. No. AAC7-127) has a very good history with respect to durability in P.C. Concrete. The sample from Schildberg's Menlo Quarry (Lab. No. AAC7-454) has a poor history with respect to durability in concrete.

The results as shown in Table I exhibit more variation from sample to sample due to sample variation and testing accuracy than is shown due to the method of saturation. There

doesn't appear to be a trend in absorption or Method "A" freeze and thaw loss with regard to the method of saturation. There are, however, too few samples contained in this project to be completely conclusive.

6.0 SUMMARY

In summary, the following may be noted:

- (1) This project did not show that the questionable aggregates were not saturated nor did it show that prolonged soaking would acceptably saturate them.
- (2) This project did not exhibit any facts that would warrant a change in testing procedure.
- (3) In view of the purpose of this project, further study using saturation and prolonged soaking in the 0.5% by weight alcohol solution is recommended.
- (4) Another recommendation for additional study would be vacuum saturation followed by high pressure saturation.

TABLE I

Method of Saturation	AAC7-127			AAC7-454		
	Sp. Gr.	Absorption	Method "A" F & T Loss	Sp. Gr.	Absorption	Method "A" F & T Loss
1	2.551	1.70	1.4	2.639	1.50	2.9
	-	2.16	0.9	-	1.06	2.4
2	2.554	3.15	1.1	2.653	1.52	2.4
3	2.551	2.55	1.0	2.653	1.25	2.4
4	2.559	2.73	-	2.646	1.41	-
	2.562	2.36	0.9	2.655	1.09	3.0
5	2.559	2.15	-	2.660	1.46	-
	2.572	1.97	1.1	2.649	1.42	2.9
6	2.548	3.20	0.7	2.647	1.50	2.3
7	-	-	-	-	-	1.9*

*Lab. No. AAC8-2

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