STRUCTURAL CONCRETE SUBDIVISION

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CONCRETE FOR THIN OVERLAYS

PRELIMINARY INVESTIGATION OF MIX DESIGN

Introduction

Bridge deck resurfacing with portland cement concrete has been used on several projects with satisfactory results being obtained in most cases. However, problems with finishing have arisen when the Class A concrete mixture was too coarse for the required depth of overlay. This report provides preliminary design information relative to concrete mixtures for thin overlays.

Two sizes of coarse aggregate (3/8 inch and 1/2 inch) were chosen for this investigation because of their availability in some areas of the state as bituminous concrete aggregates.

Materials

Following are listed the materials used in this investigation and their sources:

Aggregates:

1/2" stone, 3/8" stone and sand

Lebanon Crushed Stone, Inc.
West Lebanon, New Hampshire

Cement:

Type I

Glens Falls Portland Cement Company
Glens Falls, New York

Air Entraining Admixture:

NVX

Hercules Powder Company
Wilmington, Delaware

Silicone Admixture:

Dow Corning 777B

Dow Corning Corporation - Chemical Products Division
Midland, Michigan

Procedures

Mixes were designed following methods described in ACI 211.1-70, Recommended Practice for Selecting Proportions for Normal Weight Concrete.

The mix designs and data used in establishing them are noted in the following table:

	3/8" stone	1/2" stone
Coarse Aggregate lbs./cu.yd. (dry)	1261	1504
Fine Aggregate lbs./cu.yd. (dry)	1487	1415
Cement lbs./cu.yd.	708	677
Water-Cement Ratio	.48	.48
Slump (inches)	3-4	3-4
Air Content (percent)	8	7
Compressive Strength at 28 days (psi)	4000	4000

Three batches of each type of concrete were prepared and mixed in the laboratory under standard conditions. Each batch was tested for air content; slump; unit weight and relative yield; and 3, 7, and 28 day compressive strengths.

Additionally, a batch of concrete containing 3/8" stone and Dow Corning 777B (silicone admixture) was mixed and the plastic concrete tested as above. The compressive strength, however, was tested at ages of 7 and 28 days only.

Results

The results of all tests performed are shown in the following table:

	Slump Inches	Air Content Percent	Unit Weight PCF	Relative Yield Percent	Compressive Strength (PSI) 3 days	7 days	28 days
1/2" Stone							
Batch #1	4	7	141.16	103.06	2405	3042	3935
Batch #2	2 1/2	6 3/4	143.77	100.55	3059	3846	4669
Batch #3	3	7	142.85	101.58	2927	3581	4386
				Average	2797	3490	4330
3/8" Stone							
Batch #1	2 3/4	6 3/4	137.27	102.15	2927	3652	4501
Batch #2	3 1/4	6 1/2	137.75	102.12	2706	3519	4403
Batch #3	3	7 1/4	135.91	103.72	2785	3351	4386
				Average	2806	3507	4430
3/8" Stone w/777B							
Batch #1	4	8	135.95	103.60		3493	4439
						3652	4457
						3555	4442
				Average		3567	4448

Summary and Conclusions

Aggregates used in this investigation were manufactured primarily for use in bituminous concrete. Minor grading deficiencies occurred in the 3/8 inch stone when compared with ASTM specification requirements. Nevertheless, by using a cement content of 7 1/2 bags, compressive strengths in excess of 4000 psi were readily attainable.

Satisfactory results were also obtained using 1/2 inch aggregate. However, the need for both 3/8 inch and 1/2 inch aggregate for our standard specifications is unwarranted. Therefore, it is recommended that 3/8 inch stone (ASTM size number 8) be adopted and a corresponding class of 4000 psi concrete be specified for thin overlays.

Implementation

Action has been initiated based on the results of this investigation. The special provisions for several overlay projects specify the use of 3/8 inch aggregate. This gradation requirement, as well as 4000 psi (Class AA) concrete, shall be incorporated in the 1975 edition of the Vermont Standard Specifications for Highways and Bridges.