

FIELD EVALUATION OF 3/4" CRUSHED STONE
FROM FRANK W. WHITCOMB/NO. WALPOLE, N.H.
FOR USE IN STRUCTURAL CONCRETE

REPORT 82-9
DECEMBER 1982

REPORTING ON WORK PLAN 82-C-22

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION

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ABSTRACT

Crushed stone coarse aggregate from the Frank W. Whitcomb Construction Corporation quarry in North Walpole, New Hampshire was previously evaluated in the laboratory and found to comply with applicable requirements. This follow up investigation examines the use of this material in concrete in the field.

The 3/4 inch crushed stone used in this investigation was tested for compliance with Section 700 requirements. Concrete was tested in the field and cylinders prepared for compressive strength testing.

Results of this evaluation indicate that the material performs satisfactorily in the field.

INTRODUCTION

This report is a follow up to Materials and Research Division Report 82-4. Report 82-4 was an evaluation conducted in early 1982 of 3/4" crushed stone coarse aggregate from the North Walpole, N. H. quarry operated by the Frank W. Whitcomb Construction Corporation, for use in structural concrete. Report 82-4 recommended that the North Walpole quarry be approved as a source of crushed stone coarse aggregate. Report 82-4 also established the requirement that "During the initial uses of concrete containing this aggregate on Agency projects, Materials & Research Division representatives shall conduct tests necessary to determine the performance of this aggregate in concrete under field conditions." This report, 82-9, fulfills this requirement.

The initial use of this material on an Agency project occurred during the fall of 1982. Concrete containing the 3/4 inch crushed stone coarse aggregate was supplied to the Rockingham TH 3039 project from Charlestown Ready-Mix Inc. in Charlestown, New Hampshire.

Representatives of the Materials and Research Division were present at the ready-mix plant and at the project site to perform batching and field inspection of the concrete and its structural components.

This report documents the results of tests performed and will make recommendations relative to continued use of the aggregate source.

MATERIALS

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

COARSE AGGREGATE: (SEE TABLE 1)

3/4 inch Crushed Stone
F. W. Whitcomb
No. Walpole, New Hampshire

FINE AGGREGATE: (SEE TABLE 2)

F. W. Whitcomb
No. Walpole, New Hampshire

CEMENT:(SEE TABLE 3)

Type II
Glens Falls Portland Cement Co.
Glens Falls, New York

AIR ENTRAINING ADMIXTURE: (NOT TESTED)

Darex AEA
W. R. Grace & Co.
Cambridge, Massachusetts

WATER REDUCING ADMIXTURE: (NOT TESTED)

WRDA with Hycol
W. R. Grace & Co.
Cambridge, Massachusetta

CLASS B CONCRETE

Charlestown Ready-Mix, Inc.
Charlestown, New Hampshire

PROCEDURES

Preliminary samples of aggregates were obtained, prior to the start of batching operations, and tests were performed as follows:

- A. Coarse Aggregate - gradation, wear, and thin and/or elongated particles.
- B. Fine Aggregate - gradation, organic impurities.

Tests were repeated, as necessary, to monitor aggregate properties for all placing operations.

Following notification by the Resident Engineer on the project, an inspector was assigned to the ready mix plant to sample materials and inspect batching and mixing of the concrete. The mix proportions used were as follows:

Class B Concrete - Batch Quantities Per C.Y.

*3/4 inch Crushed Stone, lbs.	1747
*Fine Aggregate, lbs.	1407
Cement, lbs.	611
Air Entraining Admixture, oz.	3
Water Reducing Admixture, oz.	18.3

*Weights converted to saturated surface-dry condition.

Aggregate weights were adjusted at the plant to compensate for changes in moisture content.

Cement samples were submitted to the Compliance Testing Subdivision of the Materials & Research Division for analysis. Results are shown in Table 3.

For the two initial placing operations November 2, 1982 and November 8, 1982, a Materials and Research Division inspector was also assigned to the project site to test the fresh concrete and make compressive strength test specimens.

Tests were performed on the fresh concrete to determine slump, air content, unit weight, and temperature. Eight test cylinders (6"x 12") were made from one load of concrete each day. The cylinders were tested for compressive strength, two each, at ages 3, 7, 14, and 28 days.

On November 2, 1982, two additional cylinders were made from a load of concrete which had a 5 1/4 inch slump. The two additional cylinders were tested for compressive strength at 28 days.

RESULTS

The results of aggregate tests are shown in Table 1 (Coarse Aggregate) and Table 2 (Fine Aggregate).

TABLE 1

COARSE AGGREGATE TEST DATA

		Dates Sampled						Specification Requirements
		October 26	November 2	November 4	November 8	November 16	November 22	
		% Passing	% Passing	% Passing	% Passing	% Passing	% Passing	% Passing
Sieve Size	1"	100	100	100	100	100	100	100
	3/4"	98	96	97	98	98	97	90-100
	3/8"	23	17	27	37	33	20	20-55
	#4	3	3	5	7	6	4	0-10
	#8	1	2	2	3	1	2	0-5
Thin and/or Elongated Particles - (%)		1.7	1.8	-	1.0	-	3.5	10 maximum
L.A. Abrasion (T96) B Grading (% Loss)		33.2	28.3	34.3	30.6	31.5	32.3	35 maximum

TABLE 2

FINE AGGREGATE TEST DATA

		Dates Sampled					Specification Requirements
		October 26	November 2	November 8	November 16	November 22	
		% Passing	% Passing	% Passing	% Passing	% Passing	% Passing
Sieve Size	3/8"	100	100	100	100	100	100
	#4	97	98	98	97	98	95-100
	#8	86	86	87	88	86	-
	#16	69	70	72	71	70	50-80
	#30	44	45	46	39	45	25-60
	#50	19	17	24	14	26	10-30
	#100	6	9	6	4	9	2-10
	#200	1.5	1.1	1.0	0.6	1.1	-
Fineness Modulus		2.79	2.65	2.67	2.87	2.66	2.60-3.10
Organic Impurities (Color)		1	1	1	1	1	2 maximum

TABLE 3

CEMENT TEST DATA

	Dates Sampled			Specification Requirements
	November 2	November 8	November 22	
Air Content of Mortar, percent by volume	10	10.2	11.2	12 Maximum
Fineness - Specific Surface, Sq. cm. per gm.	3772	3707	3680	2800 Minimum-4000 Maximum
Soundness - Autoclave Expansion, percent	-0.02	0.00	0.01	0.8 Maximum
Normal Consistency - Vicat Needle	25.0	25.0	25.0	-
Time of Setting - Gillmore Needle				
Initial, Hours: Minutes	3: 20	3: 20	3: 00	60 Minutes, Minimum
Final, Hours: Minutes	4: 50	4: 50	4: 20	10 Hours, Maximum
Compressive Strength, psi				
3 days Cube No. 1	2900	2950	2488	
Cube No. 2	2888	3000	2450	
Cube No. 3	2888	2925	2438	
Average	2890	2960	2460	1500 Minimum
7 days Cube No. 4	3588	3725	3425	
Cube No. 5	3438	3825	3438	
Cube No. 6	3688	3950	3363	
Average	3570	3830	3410	2500 Minimum

The results of tests on the fresh and hardened concrete are shown in Table 4 and Table 5.

TABLE 4

NOVEMBER 2, 1982 TEST RESULTS

	Class B Concrete		
	Load 1	Load 2	Specification Requirements
Slump, inches	5 1/4	2 1/4	2 - 4
Air Content, percent	5.3	4.6	5±1
Unit Weight, lbs/ft ³	149.33	150.09	-
Temperature, °F	70	70	50-80
Compressive Strength, psi			
3 days	-	3108	-
7 days	-	4333	-
14 days	-	5204	-
28 days	4082	6008	*3500

*(Design Compressive Strength, psi)

TABLE 5

NOVEMBER 8, 1982 TEST RESULTS

	Class B Concrete		
	Load 1	Load 2	Specification Requirements
Slump, inches	2	2 1/2	2 - 4
Air Content, percent	4.6	-	5±1
Unit Weight, lbs/ft ³	149.80	-	-
Temperature, °F	64	63	50-80
Compressive Strength, psi			
3 days	2865	-	-
7 days	4470	-	-
14 days	5133	-	-
28 days	5579	-	*3500

*(Design Compressive Strength, psi)

CONCLUSIONS AND RECOMMENDATIONS

- 1) The sample of 3/4 inch crushed stone taken on November 2, 1982 did not have the required minimum 20% passing the 3/8 inch sieve. All other aggregate test results complied with specification requirements.
- 2) The 3/4 inch crushed stone exhibited variations in wear values over the relatively short period of time during which the tests were performed.
- 3) The compressive strengths obtained from the Class B concrete were quite high. This may be due, in part, to the favorable concrete and ambient temperatures experienced at this time of the year.
- 4) It is recommended that the present Frank W. Whitcomb Construction Corporation quarry in North Walpole, New Hampshire continue to be approved as a source of crushed stone coarse aggregate for use in structural concrete. Future monitoring will continue as with other aggregates.

APPENDIX A

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION

RESEARCH INVESTIGATION

Work Plan No. 82-C-22

Subject Field Evaluation of 3/4" Crushed Stone From Whitcomb/No. Walpole, N.H. in
Structural Concrete

Investigation Requested By Structural Concrete Subdivision Date October 29, 1982

Date Information Required December 20, 1982

Purpose of Investigation This investigation is being conducted to determine the
performance of this aggregate in concrete under field conditions. It is a follow
up of a laboratory evaluation of this material documented in Materials &
Research Division Report 82-4 dated March, 1982

Proposed Tests or Evaluation Procedure _____

1. The 3/4" crushed stone will be examined for gradation, wear and thin and
elongated particles.
2. Concrete will be batched for the Rockingham TH 3039 project from Charlestown
Ready Mix, Charlestown, N. H.
3. The plastic concrete will be tested at the project site to determine Slump,
Air Content, and Unit Weight. Test cylinders (6" x 12") will be molded for
testing at ages of 3, 7, 14 and 28 days.
4. A report documenting results of tests will be prepared.

Proposal Discussed With R. Frascoia ^{PLC/RIE} Projected Manpower Requirements 8 man days

Investigation To Be Conducted By Structural Concrete Subdivision

Proposed Starting Date November 1, 1982 Estimated Completion Date December 20, 1982

Approval/Disapproval by Materials & Research Engineer *R. J. Nicholson 11/2/82*

Comments by Materials & Research Engineer _____