FIELD EVALUATION OF 3/4" CRUSHED GRAVEL FROM ALBERT S. NADEAU/JOHNSON, VERMONT FOR USE IN STRUCTURAL CONCRETE

REPORT 83-7
October 1983

REPORTING ON WORK PLAN 83-C-28

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION

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Date: Oct. 17, 1983

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ABSTRACT

Crushed gravel coarse aggregate from the Albert S. Nadeau facilities in Johnson, Vermont 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 gravel 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 82-6. Report 82-6 was an evaluation conducted during the summer of 1982, of 3/4 inch crushed gravel coarse aggregate, from the Albert S. Nadeau, Johnson, Vermont facility, for use in structural concrete. Report 82-6 recommended that the Johnson facility be approved as a source of crushed gravel coarse aggregate. Report 82-6 also established the requirement that "During the initial uses of concrete containing this aggregate on Agency projects, Materials and Research Division representatives shall conduct tests necessary to determine the performance of this aggregate in concrete under field conditions." This report, 83-7, fulfills this requirement.

The initial uses of this material on an Agency project occurred during the summer of 1983. Concrete containing the 3/4 inch crushed gravel coarse aggregate was supplied to the Johnson BRZ 1448(6) project from the A. G. Anderson Company, Inc. ready mixed concrete plant in Johnson, Vermont.

Representatives of the Materials and Research Division were present at the ready-mix plant and 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 Gravel
Albert S. Nadeau
Johnson, Vermont

FINE AGGREGATE: (SEE TABLE 2)

Albert S. Nadeau
Johnson, Vermont

CEMENT: (SEE TABLE 3)

Type II
Northeast Cement Co., Inc.
St. Constant, Que.

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, Massachusetts

CLASS B CONCRETE:

A. G. Anderson Company, Inc.
Johnson, Vermont

PROCEDURES

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

A. Coarse Aggregate - gradation, wear, fractured faces, and thin and/or elongated particles

B. Fine Aggregate - gradation

Tests were repeated, as necessary, to monitor aggregate properties during initial 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 Gravel, lbs.	1681
*Fine Aggregate, lbs.	1392
Cement, lbs.	611
Air Entraining Admixture, oz.	4
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 and Research Division for analysis.

For the two initial placing operations, June 29, 1983 and June 30, 1983, the inspector assigned to the plant also traveled to the project site to test the fresh concrete and make compressive strength test specimens. This was done following the completion of batching inspection.

Tests were performed on the fresh concrete to determine Slump (AASHTO T119), Air Content (AASHTO T152), Unit Weight (AASHTO T121), and temperature. Six 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 7, 14, and 28 days. Time constraints mandated the omission of 3 day test cylinder breaks.

On June 29, 1983, two additional cylinders were made by the Resident Engineer from a separate load of concrete. These 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). Cement test results are shown in Table 3.

TABLE 1

NADEAU COARSE AGGREGATE TEST DATA

Sampled At A. G. Anderson, Johnson, Vermont - 1983

	June 28	June 29	June 30	July 12	July* 12(SC)	July** 12	Specification Requirements
Sieve Size	% Passing	% Passing	% Passing	% Passing	% Passing	% Passing	% Passing
1"	100	100	100	100	100	100	100
3/4"	98	97	98	98	98	96	90-100
3/8"	25	20	23	30	29	32	20-55
#4	3	3	4	5	5	10	0-10
#8	2	2	3	2	2	5	0-5
Thin and/or Elongated Particles -(%)	1.5	2.0	-	1.0	-	3	10 maximum
Fractured Faces -(%)	63.7	65.0	-	68.0	-	75	50 minimum
L.A. Abrasion (T96) B Grading (% Loss)	31.8	33.0	-	-	-	33.4	35 maximum

* (SC) Indicates Job Sample taken from same sample locations at same time Progress Sample was obtained
** Progress Sample

TABLE 2

NADEAU FINE AGGREGATE TEST DATA

Sampled At A. G. Anderson, Johnson, Vermont - 1983

	June 28	June 29	June 30	July 12	July* 12(SC)	July** 12	Specification Requirements
Sieve Size	% Passing	% Passing	% Passing	% Passing	% Passing	% Passing	% Passing
3/8"	100	100	100	100	100	100	100
#4	98	98	97	99	99	96	95-100
#8	80	78	78	81	81	80	-
#16	61	58	59	61	61	59	50-80
#30	38	37	38	39	39	37	25-60
#50	19	18	19	19	19	18	10-30
#100	8	7	7	7	7	7	2-10
#200	2.0	2.3	2.0	2.0	2.0	3.0	-
Fineness Modulus	2.96	3.04	3.02	2.94	2.94	3.03	2.60-3.10
Organic Impurities (Color)	-	-	-	-	-	1	2 maximum

* (SC) Indicates Job Sample taken from same sample locations at same time Progress Sample was obtained.
** Progress Sample

TABLE 3

CEMENT TEST DATA

Sampled At A. G. Anderson, Johnson, Vermont - 1983

	June 29	June 30	July 12	July* 12	Specification Requirements
Air Content of Mortar, percent by volume	10.3	10.1	10.2	10.1	12 Maximum
Fineness - Specific Surface, Sq. cm. per gm.	3476	3630	3572	3564	2800 Minimum-4000 Maximum
Soundness - Autoclave Expansion, percent	0.05	0.04	0.07	0.07	0.8 Maximum
Normal Consistency - Vicat Needle	24.0	24.0	24.0	24.0	-
Time of Setting - Gillmore Needle					
Initial, Hours: Minutes	2:30	2:30	2:30	2:20	60 Minutes, Minimum
Final, Hours: Minutes	4:20	3:45	4:10	4:10	10 Hours, Maximum
Compressive Strength, psi					
3 days Cube No. 1	2775	2825	2975	3000	
Cube No. 2	2813	2713	2975	2875	
Cube No. 3	2913	2613	2950	2950	
Average	2834	2720	2970	2940	1500 Minimum
7 days Cube No. 4	3450	3338	3675	3688	
Cube No. 5	3475	3463	3675	3663	
Cube No. 6	3363	3513	3613	3600	
Average	3430	3440	3650	3650	2500 Minimum

*Progress Sample

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

TABLE 4

JUNE 29, 1983 TEST RESULTS

	Class B Concrete		
	*Load 2	Load 4	Specification Requirements
Slump, inches	3½	3	2 - 4
Air Content, percent	5.6	4.7	5 ± 1
Unit Weight, lbs./ft.^{3}	146.10	145.82	-
Temperature, ^oF	72	76	50 - 80
Compressive Strength, psi			
7 days	-	3453	-
14 days	-	3931	-
28 days	4404	4289	**3500

*Tests by Resident Engineer
** Design Compressive Strength, psi

TABLE 5

JUNE 30, 1983 TEST RESULTS

	Class B Concrete	
	Load 5	Specification Requirements
Slump, inches	3 3/4	2 - 4
Air Content, percent	6.0	5 ± 1
Unit Weight, lbs./ft.^{3}	144.10	-
Temperature, F	78	50 - 80
Compressive Strength, psi		
7 days	3303	-
14 days	3992	-
28 days	4599	*3500

*Design Compressive Strength, psi

CONCLUSIONS AND RECOMMENDATIONS

1) The 3/4 inch crushed gravel coarse aggregate complied with applicable requirements of Section 704.02 when tested in conjunction with this evaluation.

2) The 28 day compressive strengths obtained from the Class B concrete, in the field, were approximately equal to those obtained under laboratory conditions for Class B concrete using the same materials.

3) It is recommended that the present Albert S. Nadeau facility in Johnson, Vermont continue to be approved as a source of crushed gravel coarse aggregate for use in structural concrete. Future monitoring will continue as with other aggregates.

TA 565 Rev. 4/79

Prepared By: W. L. Meyer
Date: June 29, 1983
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APPENDIX A

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION

RESEARCH INVESTIGATION

Work Plan No. 83-C-28

Subject Field Evaluation of 3/4" Crushed Gravel From Nadeau/Johnson, Vt. in Structural Concrete

Investigation Requested By Structural Conc. Subdivision Date June 29, 1983

Date Information Required As soon as possible

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 82-6 dated July, 1982

Proposed Tests or Evaluation Procedure

1. The 3/4" crushed gravel will be examined for gradation, wear, thin and elongated particles and fractured faces.
2. Concrete will be batched for the Johnson BRZ 1448(6) project from A. G. Anderson Co., Inc., Johnson, Vermont.
3. The plastic concrete will be tested at the project site to determine slump, air content and unit weight. Test cylinders (6"x12") 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 D.C. Brown, R.I. Frascoia Projected Manpower Requirements 10 man days

Investigation To Be Conducted By Structural Concrete Subdivision

Proposed Starting Date June 29, 1983 Estimated Completion Date September 15, 1983

Approval/Disapproval by Materials Engineer R. F. Nicholson 7-1-83

Comments by Materials Engineer