EVALUATION OF FINE AGGREGATE AND 3/4" CRUSHED GRAVEL FROM COLUMBIA SAND AND GRAVEL CORP. COLUMBIA, N.H. FOR USE IN STRUCTURAL CONCRETE

REPORT 92-1
JANUARY 1992

REPORTING ON WORK PLAN 91-C-6

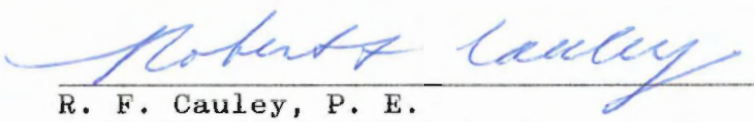
STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION

PATRICK J. GARAHAN, SECRETARY OF TRANSPORTATION
ROBERT L. MERCHANT, P. E., DIRECTOR OF CONSTRUCTION & MAINTENANCE
R. F. CAULEY, P. E., MATERIALS & RESEARCH ENGINEER
J. H. WEAVER, P. E., STRUCTURAL CONCRETE ENGINEER

Prepared by:

R. J. Holt, Technician C
Structural Concrete Subdivision

Reviewed By:



R. F. Cauley, P. E.
Materials & Research Engineer

Date: March 2, 1992

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

To produce the optimum structural concrete, aggregate must be tested and evaluated to assure conformance to required specifications.

This report documents results of tests performed on a proposed new source of fine aggregate and 3/4" crushed gravel for structural concrete. The materials tested were a fine aggregate and a 3/4" crushed gravel produced at the Columbia Sand & Gravel Corp. facilities in Columbia, New Hampshire.

Test results and evaluation confirm these materials meet the required specifications for fine aggregate and 3/4" crushed gravel for structural concrete.

INTRODUCTION

To provide an accurate evaluation of an aggregate for use in structural concrete, not only should tests be initiated to ensure compliance with required specifications, but a collation of test results for the new aggregate with those for a previously evaluated reference aggregate should be performed. This procedure compares both aggregates in concrete mixtures prepared and tested under the same conditions.

In February of 1991, Mr. Steven Persons, General Manager of Persons Concrete Inc. initially requested an evaluation of concrete sand and an evaluation of 3/4" crushed gravel processed at the Columbia Sand & Gravel Corp. facility, Columbia, NH. Following his request, samples of the materials were obtained by Materials and Research Division representatives on March 12, 1991 and evaluated for compliance with Sections 704.01, and 704.02 of the Vermont Agency Of Transportation (VAOT) Standard Specifications for Construction. The Agency's Chief Geologist also traveled to the site to obtain samples for petrographic analysis of the materials.

Testing indicated the materials were in compliance with specifications and materials were obtained for the performance-in-concrete phase of the evaluation which was conducted in the Central Laboratory of the Materials and Research Division.

PROCEDURES

PHASE I - SECTION 704.01 AND SECTION 704.02 TESTS

The proposed new aggregates were sampled by representatives of the Materials and Research Division, from a stockpile at Columbia Sand & Gravel, Columbia, NH. The fine aggregate was examined for gradation (AASHTO T 27-84), organic impurities (AASHTO T 21-86), sodium sulfate soundness (AASHTO T 104-86) and compressive strength of the mortar (Section 704.01 (c) of the VAOT Standard Specifications for Construction). The coarse aggregate (3/4" crushed gravel) was examined for gradation (AASHTO T 27-84), percent of wear (AASHTO T 96-83), thin and elongated pieces (VT AOT-MD 22), fractured faces (VT AOT-MD 23) and sodium sulfate soundness (AASHTO T104-86). Samples of each aggregate were found to be in compliance with requirements.

The reference aggregates were obtained on April 9, 1991 from stockpiles at the Miller ready-mix concrete plant in W. Lebanon, NH (See copies of Aggregate Report Nos. G9100062 & G9100063 in Appendix B). The reference aggregate source was Lebanon Crushed Stone, W. Lebanon, NH. The reference fine aggregate was examined for gradation (AASHTO T 27-84) and organic impurities (AASHTO T 21-86). The reference coarse aggregate was examined for gradation (AASHTO T 27-84), thin & elongated pieces (VT AOT-MD 22), fractured faces (VT AOT-MD 22) and percent of wear (AASHTO T 96-83).

The reference fine aggregate and coarse aggregate were found to comply respectively with Section 704.01 and Section 704.02 requirements. Fine aggregate test results are shown in Table 1 and Table 2. Coarse aggregate test results are shown in Table 3 and Table 4. Aggregate

test results are also shown in Laboratory Report Nos. A910183, A910266, G9100062, G9100063, G9100443, &G9100444 in Appendix B.

The Vermont Agency of Transportation Chief Geologist traveled to the facility in Columbia, N.H. to obtain samples for analysis. Copies of the geologist's petrographic analysis are shown in Appendix C.

TABLE 1

FINE AGGREGATE TEST DATA (Proposed New Aggregate)

	Columbia Sand & Gravel Columbia, NH Dates Sampled 03-12-91	04-04-91	V.A.O.T. Specification Requirements
Sieve Size	% Passing	% Passing	% Passing
3/8"	100	-	100
#4	100	-	95-100
#8	92	-	-
#16	71	-	50-80
#30	43	-	25-60
#50	16	-	10-30
#100	6	-	2-10
Fineness Modulus	2.72	-	2.60-3.10
Organic Impurities, color	1	-	2 maximum
Compressive Strength of Mortar, % of Standard Sand			
3 days	-	-	100 minimum
7 days	-	-	100 minimum
Soundness, % loss	-	4.73	8 maximum

* Compressive Strength of Mortar testing could not be completed at this time - The Cement Laboratory facilities are in a redesign and renovation stage.

TABLE 2

FINE AGGREGATE TEST DATA (Reference Aggregate)

Sieve Size	Lebanon Crushed Stone W. Lebanon, NH Date Sampled 04-09-91 % Passing	V.A.O.T. Specification Requirements % Passing
3/8"	100	100
#4	100	95-100
#8	89	-
#16	70	50-80
#30	48	25-60
#50	24	10-30
#100	6	2-10
Fineness Modulus	2.63	2.60-3.10
Organic Impurities, color	<1	2 maximum

TABLE 3

COARSE AGGREGATE TEST DATA (Proposed New Aggregate)

	3/4" Crushed Gravel Columbia Sand & Gravel Columbia, NH Dates Sampled 03-12-91	04-04-91	V.A.O.T. Specifications Requirements
Sieve Size	% Passing	% Passing	% Passing
1"	100	-	100
3/4"	100	-	90-100
3/8"	32	-	20-55
#4	4	-	0-10
#8	2	-	0-5
L. A. Abrasion, % loss	23.1	-	35 maximum
Thin and Elongated Pieces, %	4.3	-	10 maximum
Fractured Faces, %	87.0	-	50 minimum
Soundness, % loss	-	0.1	8 maximum

TABLE 4

COARSE AGGREGATE TEST DATA (Reference Aggregate)

Sieve Size	3/4" Crushed Stone Lebanon Crushed Stone W. Lebanon, NH Date Sampled 04/09/91 % Passing	V.A.O.T. Specification Requirements % Passing
1"	100	100
3/4"	99	90-100
3/8"	27	20-55
#4	6	0-10
#8	2	0-5
L. A. Abrasion, % wear	32.9	35 maximum
Thin and Elongated Pieces, %	1.7	10 maximum
Fractured Faces, %	100.0	100 minimum
Soundness, % loss	-	8 maximum

PHASE II PERFORMANCE-IN-CONCRETE TESTS

The performance-in-concrete tests were conducted on concrete prepared in the Central Laboratory. Mixtures were designed by Structural Concrete Subdivision personnel for Class A and Class B concrete, using the following materials:

Fine Aggregate

A. Proposed New Aggregate
Columbia Sand & Gravel Corp., Columbia, NH

B. Reference Aggregate
Lebanon Crushed Stone Corp., W. Lebanon, NH

Coarse Aggregate

A. Proposed New Aggregate
Columbia Sand & Gravel Corp., Columbia, NH

B. Reference Aggregate
Lebanon Crushed Stone Corp., W. Lebanon, NH

Cement

Type II
Northeast Cement Co., St. Constant, Quebec

Air Entraining Admixture

Daravair
W. R. Grace Co., Cambridge, MA

Water Reducing Admixture

WRDA with Hycol
W. R. Grace Co. Cambridge, MA

Aggregate Properties used for preparing mix designs are shown in Table 5 and Table 6.

TABLE 5

FINE AGGREGATE PROPERTIES

	Bulk Specific Gravity	Absorp., Percent	Fineness Modulus
Proposed New Aggregate Columbia Sand & Gravel Columbia, NH	2.59	1.7	2.72
Reference Aggregate Lebanon Crushed Stone W. Lebanon, NH	2.65	1.0	2.67

TABLE 6

COARSE AGGREGATE PROPERTIES

	Bulk Specific Gravity	Absorp., Percent	Dry Rodded Unit Weight, lbs/cu. ft.
Proposed New Aggregate Columbia Sand & Gravel Columbia, NH	2.65	1.0	99.74
Reference Aggregate Lebanon Crushed Stone W. Lebanon, NH	2.83	0.6	104.26

The concrete used in this evaluation was mixed in a Sears rotary drum mixer with batch size being 1.8 cubic feet. Aggregates were dried prior to the start of mixing operations.

Two batches each of Class A and Class B concrete containing the new fine aggregate and the new coarse aggregate were prepared as well as two batches each of the Class A and Class B concrete containing the reference aggregates.

The mix proportions used are shown in Table 7 and Table 8.

TABLE 7

NEW AGGREGATE MIX DESIGN
BATCH QUANTITIES PER C.Y.

	Class A		Class B	
	Batch 5	Batch 6	Batch 1	Batch 2
*Coarse Aggregate, lbs.	1697	1697	1697	1697
*New Fine Aggregate, lbs.	1171	1171	1289	1289
Cement, lbs.	660	660	611	611
Air Entraining Admixture, oz.	5.5	5.5	3.0	2.5
Water Reducing Admixture, oz.	19.8	19.8	18.3	18.3
Net Water, gal.	31.3	31.5	31.3	31.2

*Weights converted to saturated surface-dry condition

TABLE 8

REFERENCE AGGREGATE MIX DESIGN
BATCH QUANTITIES PER C.Y.

	Class A		Class B	
	Batch 7	Batch 8	Batch 3	Batch 4
*Coarse Aggregate, lbs.	1773	1773	1773	1773
*New Fine Aggregate, lbs.	1234	1234	1355	1355
Cement, lbs.	660	660	611	611
Air Entraining Admixture, oz.	5.0	5.0	4.0	3.5
Water Reducing Admixture, oz.	19.8	19.8	18.3	18.3
Net Water, gal.	31.4	30.7	31.6	31.4

*Weights converted to saturated surface-dry condition

Tests were performed on the fresh concrete to determine slump (AASHTO T 119-86), air content (AASHTO T 152-86) and unit weight (AASHTO T 121-86). Six test cylinders (6" x 12") and one 3" wide x 3" deep x 16" long freeze-thaw specimen were cast from each batch. The cylinders were tested for compressive strength (AASHTO T 22-86); two each at ages 7, 14 and 28 days. The freeze-thaw specimens were moist cured for 14 days, after which they were subjected to freezing and thawing (AASHTO T 161-86) in 3% NaCl solution.

RESULTS

Results of tests on the fresh concrete and compressive strength test results are shown in Table 9 and Table 10.

TABLE 9

PERFORMANCE TEST RESULTS
NEW AGGREGATE

	Class A		Class B	
	Batch 5	Batch 6	Batch 1	Batch 2
Slump, inches	2.75	2.75	3.00	2.00
Air Content, percent	6.0	5.7	5.9	5.2
Unit Weight, lbs/cu. ft.	144.72	144.97	143.92	144.20
Compressive Strength, psi				
7 days	3692	3979	3454	3712
14 days	4384	4474	4117	4410
28 days	4800	5026	4645	4839
(Design Compressive Strength, psi)	(4000)		(3500)	

TABLE 10

PERFORMANCE TEST RESULTS
REFERENCE AGGREGATE

	Class A		Class B	
	Batch 7	Batch 8	Batch 3	Batch 4
Slump, inches	2.50	2.50	3.00	2.50
Air Content, percent	5.9	5.5	5.7	5.8
Unit Weight, lbs/cu. ft.	147.06	149.59	148.42	148.62
Compressive Strength, psi				
7 days	3830	3800	3440	3628
14 days	4342	4595	3975	4175
28 days	4749	5063	4535	4551
(Design Compressive Strength, psi)	(4000)		(3500)	

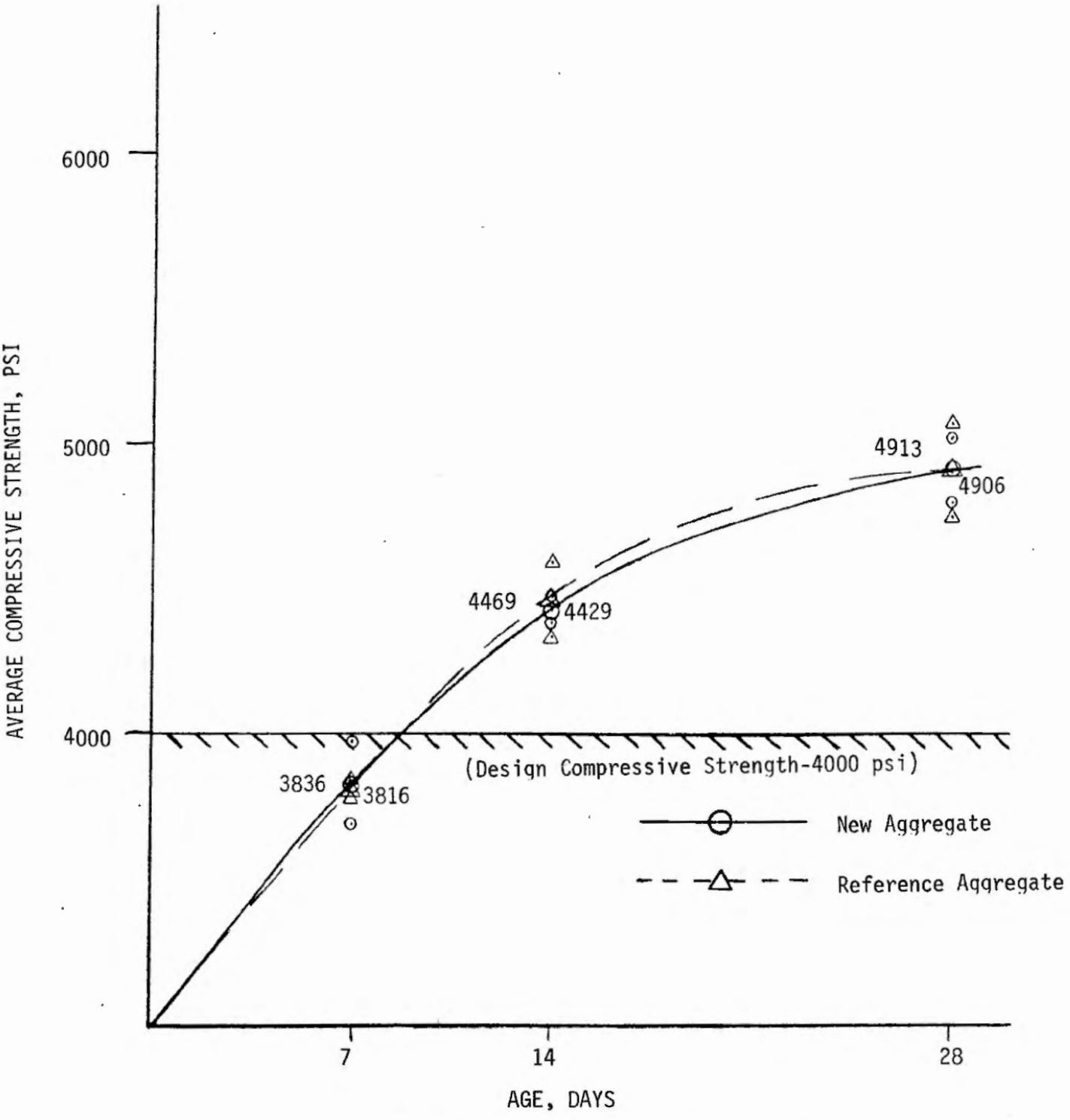
The results of compressive strength tests are also shown on Laboratory Report Nos. C91WP01 through C91WP08 in Appendix D. Strength vs. age plots illustrating average compressive strengths in psi over time in days are shown in Figure I and Figure II.

The results of dynamic testing of freeze-thaw specimens are shown in Table 11. The percent weight change resulting from freezing and thawing of specimens is shown in Table 12. Freeze-thaw test results are also summarized in Figure III and Figure IV. These figures show a comparison of results obtained with the reference aggregate and the new aggregate after 300 cycles of freezing and thawing.

TABLE 11

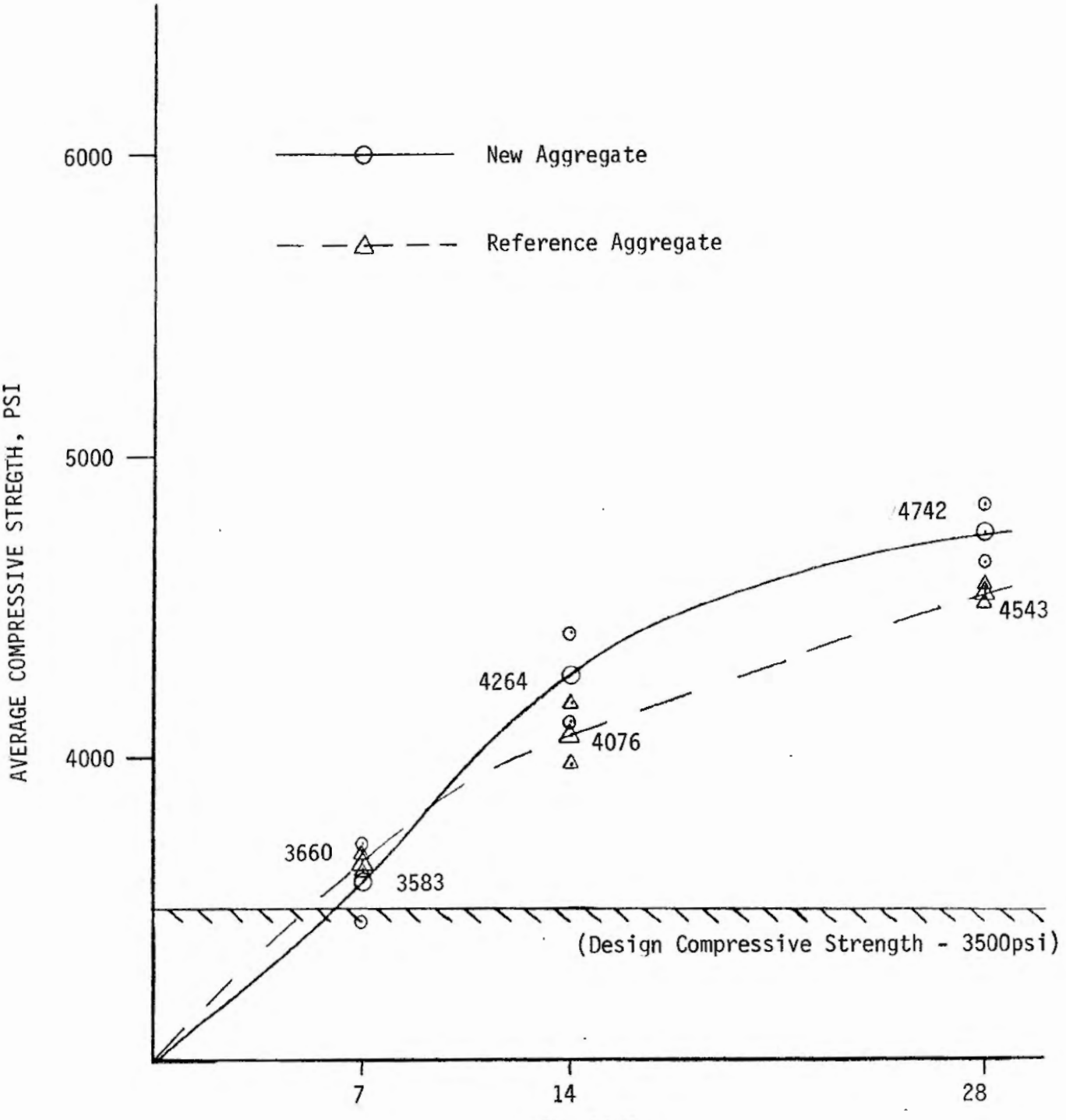
FREEZE-THAW TEST RESULTS - DURABILITY FACTOR

	New Aggregate				Reference Aggregate			
	Class A		Class B		Class A		Class B	
No. of Cycles	Batch 5	Batch 6	Batch 1	Batch 2	Batch 7	Batch 8	Batch 3	Batch 4
	Durability Factor							
50	97.8	99.3	103.6	100.1	98.9	96.8	100.1	97.8
100	98.3	100.6	104.0	100.4	98.0	95.9	100.1	97.6
150	99.1	100.7	104.0	99.0	99.0	96.1	100.2	98.3
200	99.1	100.9	103.6	99.2	100.0	96.5	101.8	97.7
250	99.5	102.0	106.6	101.8	104.5	94.4	104.1	100.6
300	97.5	101.2	104.3	100.6	99.0	97.4	102.1	97.5



AVERAGE COMPRESSIVE STRENGTH Vs. AGE
CLASS A

Figure I



AVERAGE COMPRESSIVE STRENGTH Vs. AGE
CLASS B

Figure II

Batch No.	No. Cycles	Weight Lbs.	Percent Weight Loss	Fundamental Transverse Frequency "N"	"N"	Individual Durability Factor DF	Average DF	Relative Durability Factor RDF
Reference Aggregate								
7	0	12.92	0.5	1674	2802276	99.0	98.2	
7	300	12.85		1666	2775556			
8	0	12.99	5.6	1677	2812329	97.4		
8	300	12.26		1655	2739025			
New Aggregate								98.8
5	0	12.50	8.2	1594	2540836	97.5	99.4	
5	300	11.48		1574	2477436			
6	0	12.65	7.3	1618	2617924	101.2		
6	300	11.73		1628	2650384			

SUMMARY OF FREEZE-THAW TEST RESULTS

CLASS A

FIGURE III

Batch No.	No. Cycles	Weight Lbs.	Percent Weight Loss	Fundamental Transverse Frequency "N"	"N"	Individual Durability Factor DF	Average DF	Relative Durability Factor RDF
Reference Aggregate								
3	0	12.86	1.0	1658	2748964	102.1	99.8	
3	300	12.73		1675	2805625			
4	0	12.86	1.3	1655	2739025	97.5		
4	300	12.69		1634	2669956			
New Aggregate								101.2
1	0	12.44	1.8	1562	2439844	104.3	102.5	
1	300	12.28		1595	2544025			
2	0	12.54	4.9	1591	2531281	100.6		
2	300	11.93		1596	2547216			

SUMMARY OF FREEZE-THAW TEST RESULTS

CLASS B

FIGURE IV

TABLE 12

FREEZE-THAW TEST RESULTS - PERCENT OF WT. CHANGE

	New Aggregate				Reference Aggregate			
	Class A		Class B		Class A		Class B	
No. of Cycles	Batch 5	Batch 6	Batch 1	Batch 2	Batch 7	Batch 8	Batch 3	Batch 4
	Percent Of Weight Change							
50	-2.0	-1.1	-0.2	-1.0	-0.1	-0.9	-0.0	-0.2
100	-3.7	-2.3	-0.5	-1.9	-0.1	-2.0	-0.1	-0.5
150	-4.6	-3.2	-0.8	-2.6	-0.2	-3.0	-0.2	-0.7
200	-5.5	-4.3	-1.0	-3.2	-0.2	-3.5	-0.5	-0.9
250	-6.7	-5.4	-1.3	-3.8	-0.4	-4.4	-0.8	-1.2
300	-8.2	-7.3	-1.8	-4.9	-0.5	-5.6	-1.0	-1.3

SUMMARY AND CONCLUSIONS

1. Initial samples of the proposed fine aggregate from the Columbia Sand & Gravel Corporation facility in Columbia, NH were found to be in compliance with VAOT Standard Specifications For Construction, Section 704.01.

2. Initial samples of the proposed coarse aggregate from the Columbia Sand & Gravel Corporation facility in Columbia, NH were found to be in compliance with VAOT Standard Specifications For Construction, Section 704.02.

3. The average 28 day compressive strengths of concrete containing the Columbia fine aggregate and 3/4" crushed coarse aggregate were approximately 2.5 percent greater than the strengths of concrete containing the reference aggregate. The Class A concrete containing the Columbia aggregates had an average compressive strength of 4913 psi at 28 days, while the Class A concrete containing the reference aggregates yielded an average 28-day compressive strength of 4906 psi. The Class B concrete containing the Columbia aggregates had an average compressive strength of 4742 psi at 28 days, while the Class B concrete containing the reference aggregates had an average 28-day compressive strength of 4543 psi.

4. Results of freezing and thawing tests indicated reduced performance for the Class A concrete containing the new aggregates as compared with Class A concrete containing the reference aggregate. The average durability factor for the Class A concrete with the new aggregate was 98.4 while the Class A concrete with

the reference aggregate had an average durability factor of 98.2. The Class A concrete containing the new aggregates, however, showed greater weight loss (7.8%) than the Class A concrete containing the reference aggregate (3.1%).

5. The Class B concrete containing the new aggregate performed slightly better in sonic testing than the Class B concrete containing the reference aggregate. The average durability factor was 102.5 for the Class B concrete with the new aggregate and 99.8 for the Class B concrete with the reference aggregate. The Class B concrete containing the new aggregate, however, showed greater average weight loss (3.4%) than the Class B concrete with the reference aggregate (1.2%).

6. Mix Design Tables, shown on page 11, indicate the Class A and Class B mixtures containing the new aggregates having quantities of water relatively comparable to the mixes containing the reference aggregate develop approximately equal slump and air content (slump & air content indicated in tables 9 & 10, page 12).

RECOMMENDATIONS

1. It is recommended that the present Columbia Sand & Gravel Corp. facilities in Columbia, NH be approved as a source of fine aggregate and coarse aggregate for use in structural concrete.

2. 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. Due to the range of results obtained in freeze-thaw tests, it is recommended that subsequent testing include fabrication of freeze-thaw specimens to permit further examination of this concrete property.

Prepared By: W. Meyer WLM

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION

VERMONT PROCEDURE FOR EVALUATING A NEW SOURCE OF STRUCTURAL CONCRETE AGGREGATE

VT-AOT-MRD 9-82

1. SCOPE

A procedure for evaluating new structural concrete aggregate sources by testing proposed new aggregates for compliance with Section 700 requirements and by comparing results of tests performed on concrete using the new aggregate with results obtained from concrete containing a reference aggregate.

2. PROCEDURE

General

The evaluation of a new structural concrete aggregate source (i.e., one on which the Materials and Research Division has no service-in-concrete data) shall be divided into two sections called:

Phase I Section 700 and related tests, and Phase II Performance-in-Concrete tests.

All requests for evaluation of new structural concrete aggregate sources shall be made, in writing, to the Materials and Research Engineer. Requests shall describe the type of material proposed for use as well as the location and quantity of available stockpiles.

Materials and Research Division personnel shall perform all work necessary for both the Phase I and Phase II sections of this evaluation process. The work will be performed in an expeditious manner consistent with availability of manpower. Evaluations may require 60 calendar days or more from the date the aggregate is available for testing (controlled by the availability of personnel to perform testing). Delays beyond the control of the Materials and Research Division shall be documented and notification given of the consequent extension of time required to complete the evaluation.

Test results shall be the basis for determining acceptance, further testing, or rejection of the proposed new material. Failure of the material to comply with all applicable requirements, during any phase of testing, may necessitate rescheduling or termination of the evaluation.

The cost of materials necessary to complete the evaluation will be borne by the requesting party.

A report shall be prepared documenting the Materials and Research Division's involvement in the evaluation. A copy of the report shall be forwarded with a cover letter, informing the requesting party of the acceptability or nonacceptability of the aggregate.

Phase I

1. Following receipt of the written request, the Structural Concrete Engineer will schedule a field petrographic examination of the proposed new aggregate source by the Vermont A.O.T. Chief Geologist.

2. The Structural Concrete Engineer or his representative will visit the site and determine:

   (a) Does a stockpile of at least 50 cubic yards of processed material exist?

   (b) Can samples be obtained in the standard manner from the stockpiles?

3. If 2(a) and 2(b) are yes, the Structural Concrete Engineer shall make necessary arrangements for obtaining samples from the designated stockpile.

4. The material shall be tested at the Central Laboratory using the Structural Concrete Subdivision Annual Aggregate Testing Program procedure.

5. Report the results (as an Evaluation Sample) on the Standard Materials and Research Division forms.

Phase II

1. The performance-in-concrete tests shall be performed on concrete prepared at the Central Laboratory. The proposed new aggregate will be evaluated by comparing results of tests performed on concrete using the new aggregate with results obtained from concrete containing a reference aggregate. Cement, admixtures, and aggregates, other than the proposed new aggregate, will be selected by the Structural Concrete Engineer. Normally, these materials will be the same as the materials currently in use at the Ready-mix plant where the proposed new aggregate will be used.

2. Mix proportions for each class of concrete required shall be designed or approved by the Materials and Research Division and shall conform to Table 501.03A of the Vermont Standard Specifications for Highway and Bridge Construction, current edition.

3. Test cylinders shall be fabricated and cured in accordance with AASHTO T23. They shall be tested for compressive strength at ages 7, 14, and 28 days in accordance with AASHTO T22.

4. Tests of Slump, Air Content, and Unit Weight shall be in accordance with AASHTO T119, AASHTO T152, and AASHTO T121, respectively.

EMABRRIS

APPENDIX B

VERMONT AGENCY OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION

DISTRIBUTION
Central Files

REPORT ON SAMPLE OF AGGREGATE
Preliminary Sample

Geologist

Weaver

Lab No: A910183 Corrected Copy: 1 Report Date: 12/18/91

Project: Possible Future Use

Sampled By: Kelly

Pay Item: CONCRETE, CLASS B 501.25

Date Sampled: 04/04/91

Material Name/Type: Gradation Requirements for 3/4" Stone

Sampled From: Stockpile

Material Spec. No: 704.02B

Date Received: 04/04/91

Sample Source: Persons Concrete Columbia N.H.

Tested By: M.Lavin

Material Source: Columbia Sand + Gravel Columbia N.H.

Test Complete: 05/07/91

Quantity Rep:

X-Ref No: CS:

Comment:

TEST RESULTS

SIEVE	TOTAL SAMPLE PASSING	OUTSIDE SPECS
4 1/2"		
3 1/2"		
3"		
2 1/2"		
2"		
1 3/4"		
1 1/2"		
1"		
3/4"		
5/8"		
1/2"		
3/8"		
No. 4(P)		
No. 4		
No. 8		
No. 16		
No. 30		
No. 40		
No. 50		
No. 100		
No. 200		

FINENESS MODULUS % COARSER THAN	
No. 4	
No. 8	
No. 16	
No. 30	
No. 40	
No. 50	
No. 100	

		OUTSIDE SPECS
Fineness =		
Color =		
Grading =		
Percent of Wear AASHTO T96 =		
Frac Face =		
Thine/Elon =		
Soundness =	0.1	

Remarks: Results of tests performed are in compliance with specificaitions.

Comments:

Reviewed By: R.J.O'Brien Chemist Testing Lab. Supervisor

RJO

For: R.F.Cauley Materials and Research Engineer

BC 18249

EMABER13

VERMONT AGENCY OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION

DISTRIBUTION
Central Files

REPORT ON SAMPLE OF AGGREGATE
Preliminary Sample

Geologist

Weaver

Lab No: A910266 Corrected Copy: 2

Report Date: 12/18/91

Project: Possible Future Use

Pay Item: CONCRETE, CLASS B 501.25

Material Name/Type: Fine Aggregate for Concrete

Material Spec. No: 704.01A

Sample Source: Persons Concrete Columbia N.H.

Material Source: Columbia S+G Columbia N.H.

Quantity Rep:

Comment:

Sampled By: Kelly

Date Sampled: 04/04/91

Sampled From: Stockpile

Date Received: 04/04/91

Tested By: M.Lavin

Test Complete: 05/28/91

X-Ref No: CS:

TEST RESULTS

SIEVE	TOTAL SAMPLE PASSING	OUTSIDE SPECS
4 1/2"		
3 1/2"		
3"		
2 1/2"		
2"		
1 3/4"		
1 1/2"		
1"		
3/4"		
5/8"		
1/2"		
3/8"		
No. 4(P)		
No. 4		
No. 8		
No. 16		
No. 30		
No. 40		
No. 50		
No. 100		
No. 200		

FINENESS MODULUS

% COARSER THAN			OUTSIDE SPECS
No. 4	Fineness	=	
No. 8	Color	=	
No. 16			
No. 30	Grading	=	
No. 40	Percent of Wear		
No. 50	AASHTO T96	=	
No. 100			
	Frac Face	=	
	Thine/Elon	=	
	Soundness	= 4.73	

Remarks: Results of tests performed are in compliance with specificaitions.

Comments:

Reviewed By: R. J. O'Brien, Chemist Testing Lab Supervisor

RJO

For: R. F. Cauley, Materials and Research Engineer

TA 419Rev. 2.5M 3/91

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION

STODDARD
WEAVER
C.F.

REPORT ON SAMPLE OF STRUCTURAL CONCRETE AGGREGATE

Laboratory Number G9100062 Pay Item 501.25
Project Name HARTFORD Project Number BRZ 1444(10)
Sampled By ARMSTRONG/ELLIS Date Sampled April 9 1991 Examined For 704.07
Sampled From STOCKPILE Plant MILLER WEST LEBANON NH
Source of Material LEBANON CRUSHED STONE WEST LEBANON NH
Quantity Represented 50½ CY Sample Type ACCEPTANCE
Sample Comparison NO Cross Reference Number

MATERIAL TESTED 3/4" CRUSHED STONE FOR CONCRETE

SIEVE SIZE	WEIGHT INDIV.	% RETAINED IND'V.	% RETAINED CUMUL.	% PASSING CUMUL.
RET ____				
RET 1"	—	—		100
RET 3/4"	0.4	1		99
RET 1/2"	20.5	44		55
RET 3/8"	13.2	28		27
RET 4	9.7	21		6
RET 8	1.7	4		2
RET —	—			
PAN	0.9	2		0
TOTAL	46.4	100		

Fineness Modulus
Cumul. Total Retained/100 ____

Organic Impurities: Color ____

T&E / Total Weight = 14 / 840 = 1.67 % Thin & Elongated Pieces

Fractures / Total Weight = 840 / 840 = 100 % Fractured Faces

Original Weight 5000 Grading B
Final Weight 3353 Percent Wear 32.9 AASHTO T96

(✓) Test results are in compliance with specifications.

( ) Test results are outside specifications.

Comments: ____

Tested By [signature]
Date Completed April 9, 1991

Reviewed By John H. Weaver, P.E. JHW
Initials
Date 25

TA 419Rev. 2.5M 5/91

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION

STODDARD
Weaver
CF

REPORT ON SAMPLE OF STRUCTURAL CONCRETE AGGREGATE

Laboratory Number G9100063 Pay Item 501.25
Project Name HARTFORD Project Number BRZ 1444(10)
Sampled By ACMSTRONG / ELLIS Date Sampled April 9, 1991 Examined For 704.01
Sampled From STOCKPILE Plant Miller West Lebanon
Source of Material LEBANON CRUSHED STONE, WEST LEBANON, NH
Quantity Represented 50 ½ Sample Type ACCEPTANCE
Sample Comparison NO Cross Reference Number

MATERIAL TESTED FINE Aggregate

SIEVE SIZE	WEIGHT INDIV.	% RETAINED INDIV.	% RETAINED CUMUL.	% PASSING CUMUL.
RET ____				
RET 3/8	—	—	—	
RET 4	—	—	—	100
RET 8	86	11	11	89
RET 16	144	19	30	70
RET 30	165	22	52	48
RET 50	183	24	76	24
RET 100	134	18	94	6
PAN	45	6	100	—
TOTAL	757	100		

Fineness Modulus
Cumul. Total Retained/100 2.63

Organic Impurities: Color <1

T&E / Total Weight = _____ = _____ % Thin & Elongated Pieces

Fractures / Total Weight = _____ = _____ % Fractured Faces

Original Weight _____ Grading _____
Final Weight _____ Percent Wear _____ AASHTO T96

(✓) Test results are in compliance with specifications.

( ) Test results are outside specifications.

Comments: _____

Tested By _____
Date Completed April 9, 1991

Reviewed By John H. Weaver, P.E. JHW
Initials
Date 26

TA 419Rev. 2.5M 7-89

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MATERIALS AND RESEARCH DIVISION

1

REPORT ON SAMPLE OF STRUCTURAL CONCRETE AGGREGATE

Laboratory Number G9100443 Pay Item 501.
Project Name WORK PLAN Project Number 91-C-6
Sampled By ALLEN Date Sampled 03/12/91 Examined For 704.01
Sampled From STOCKPILE Plant PERSONS CONCRETE, COLUMBIA NH
Source of Material COLUMBIA SAND + GRAVEL CO.
Quantity Represented — Sample Type PRELIMINARY
Sample Comparison N/O Cross Reference Number

MATERIAL TESTED FINE AGGREGATE FOR CONCRETE

	SIEVE SIZE	WEIGHT INDIV.	% RETAINED INDIV.	% RETAINED CUMUL.	% PASSING CUMUL.
RET					
RET	3/8				
RET	4	—			100
RET	8	53.7	8	8	92
RET	16	139.8	21	29	71
RET	30	183.2	28	57	43
RET	50	176.6	27	84	16
RET	100	67.8	10	94	6
PAN		39.5	6	100	
TOTAL		660.6	100		

Fineness Modulus
Cumul. Total Retained/100 2.72

Organic Impurities: Color 1

T&E / Total Weight = ____ = ____ % Thin & Elongated Pieces

Fractures / Total Weight = ____ = ____ % Fractured Faces

Original Weight ____ Grading ____
Final Weight ____ Percent Wear ____ AASHTO T96

(✓) Test results are in compliance with specifications.

( ) Test results are outside specifications.

Comments: ____

Tested By Joseph Kelley
Date Completed 03/28/91

Reviewed By C. C. Benda, P.E. J Weaver
Date 7/12/91

JHW
Initials

TA 419Rev. 2.5M 7-89

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION

REPORT ON SAMPLE OF STRUCTURAL CONCRETE AGGREGATE

Laboratory Number G9100144 Pay Item 501
Project Name WORK PLAN Project Number 91-C-6
Sampled By ALLEN + McBEAN Date Sampled 03/12/91 Examined For 704.02
Sampled From STOCKPILE Plant PERSONS CONCRETE COLOMBIA
Source of Material COLOMBIA STG
Quantity Represented — Sample Type PRELIMINARY
Sample Comparison NO Cross Reference Number

MATERIAL TESTED 3/4" CRUSHED GRAVEL FOR CONCRETE

	SIEVE SIZE	WEIGHT INDIV.	% RETAINED INDIV.	% RETAINED CUMUL.	% PASSING CUMUL.
RET					
RET					
RET	1"	—			
RET	3/4	—			100
RET	1/2	2880	28		72
RET	3/8	4006	40		32
RET	4	2879	28		4
RET	8	146	2		2
PAN		206	2		
TOTAL		10117	100		

Fineness Modulus
Cumul. Total Retained/100 _____

Organic Impurities: Color _____

T&E / Total Weight = 18 / 422 = 4.3 % Thin & Elongated Pieces

Fractures / Total Weight = 367 / 422 = 87.0 % Fractured Faces

Original Weight 5077 Grading "B"
Final Weight 3906 Percent Wear 23.1% AASHTO T96

(✓) Test results are in compliance with specifications.

( ) Test results are outside specifications.

Comments: _____

Tested By Joseph A. Wells Reviewed By C. C. Benda, P.E. J.Weaver JHW
Date Completed 03/28/91 Date 7/12/91 Initials

AGENCY OF TRANSPORTATION OFFICE MEMORANDUM

TO: John Weaver, Structural Concrete Engineer

FROM: Alan J. McBean, Chief Geologist AM

DATE: August 19, 1991

SUBJECT: Petrographic Analyses of Coarse and Fine Aggregates for Structural Concrete, Columbia Sand and Gravel, Colebrook, New Hampshire

The evaluation of aggregate from Columbia Sand and Gravel is based on a field visit on March 12, 1991 and a laboratory analysis completed on August 13, 1991.

Samples were taken from existing stockpiles at Columbia's plant in Colebrook, N.H. The stockpiles were generated to supply Persons Concrete with aggregates for structural concrete. Material was excavated from the stockpile, well blended with a loader and then sampled at several different points to assure a random and representative mixture of aggregate. The petrographic analyses (Tables 1 and 2) were done with a 10-70x stereozoom binocular microscope. The physical and chemical condition, lithologic variation and coatings of the aggregate were noted.

The Columbia pit in Colebrook is a well stratified, bouldery gravel. It appears to be either an ice contract kame or kame moraine deposit. The material is processed through a primary jaw crusher and then enters a cone crusher and wash plant. The products are well fractured and reasonably free of weak particles.

Tables 1 and 2 indicate the gravel is composed of a variety of rock types which appear to be derived from surrounding bedrock lithologies. Included are micaceous quartzite, granitic rock types, phyllite, porphyritic volcanics of felsic composition (felsite), siliceous limestone, gneiss and schist. Individual minerals which these rocks are composed of appear in the finer grain sizes. These include quartz, biotite, feldspar and pyroxene.

Table 1 indicates the lithographic variation seen in the coarse aggregate. The percent of phyllite increases with a decrease in grain size while both quartzite and felsite decrease. No trends are present for granite or quartz.

Table 2 indicates the distribution of various minerals and lithologies in the fine aggregate samples. As previously stated, individual minerals are most abundant in the fine sizes and appear to be generated by the disaggregation of the rock types present. Granite and phyllite fragments decrease in abundance as grain size decreases and the percent of quartz present increases in the finer sizes.

Most of the rock types and minerals present are characterized by equant particle shape. The phyllite tends to be oblong and the mica in the fine aggregate is platy. The material is subround to subangular. The noncrushed material increases in angularity with a decrease in grain size. Surface roughness varies with mineralogy and number of fractured faces. The only material which could provide structurally weak faces is the mica. This mineral is confined to the smallest sized particles and does not represent a significant proportion of the overall product.

Physical strength of all rock types appears good. There is no friable material present.

Chemically the aggregate appears moderately stable. Pyrite and biotite are the least stable minerals present but in general are fresh or only slightly weathered in the material examined. The degree of weathering of other rock types is slight or nonexistent.

Overall this material should make an excellent concrete aggregate. It is not anticipated that any adverse reactions with Portland cement will occur.

AJM:sls

cc: RFC/Lab
AJM File
Read File
CF

TABLE 1

Columbia Sand and Gravel
Coarse Aggregate For Structural Concrete

	% Mineral/Lithology Retained			
Mineral/Lithology	1/2	3/8	No.4	No.8
Granite	28.2	31.4	14.7	29.6
Quartzite	57.3	44.5	44.1	34.6
Phyllite	3.6	14.7	23.5	30.3
Felsite	4.5	3.7	6.7	1.0
Quartz	6.4	5.8	10.9	4.6

TABLE 2

Columbia Sand and Gravel
Fine Aggregate For Structural Concrete

% Mineral/Lithology Retained

Mineral/Lithology	NO.4	No.8	No.16	No.30	No.50	No.100
Granite	16.5	18.1	6.5	5.0	0.5	----
Quartzite	61.1	45.0	44.0	42.1	60.8	28.5
Phyllite	13.3	29.5	22.0	13.5	4.0	3.6
Felsite	1.8	0.6	0.3	----	----	----
Quartz	5.6	4.0	15.5	18.0	19.1	44.0
Siliceous Limestone	1.8	2.3	0.3	----	----	----
Gneiss	----	0.6	----	----	----	----
Schist	----	----	11.1	16.2	5.6	----
Mica	----	----	0.3	3.7	8.0	21.2
Feldspar	----	----	----	1.5	1.5	2.5
Pyroxene	----	----	----	----	0.5	0.2

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Report on Concrete Cylinders
Preliminary Sample

Lab No: C91WP01

Report Date: 07/19/91

Project: WORK PLAN 91-C-6

Sampled By:

Pay Item: Concrete, Class B 501.25

Date Sampled: 04/22/91

Material Name/Type: Concrete Class B 501.03A

Sampled From: LAB MIXER

Resident: J. WEAVER

Quantity Rep: 1.8 cf

Submitted By: J. KELLY LFP

Field Test By: CONCRETE DIV.

Material Source: MATERIALS+RESEARCH LAB

Tested By: CONCRETE DIV.

Location Used: PERFORMANCE IN CONCRETE EVALUATION

X-Ref No: CS:

Coarse Agg : COLUMBIA S&G
Fine Agg : COLUMBIA S&G
Cement Brand: NORTHEAST QUEBEC CA

Total Agg. Dry Wgt: 2986
Type: II Lbs: 611

A/E Admix: DARAVAIR
Admixture: WRDA / HYCOL
Admixture:

Dosage: 3 oz/cy
Dosage: 3 oz/cwt
Dosage:

Comments:

Test		Specs Min	Specs Max	Indicates if Outside of Specs
Unit Wgt of Fresh Concrete,pcf	143.9			
Air Content, Percent	5.9	4.	6.	
Slump, Inches	3.	2.	4.	
Total Water, Gal/cy	31.3		35.75	
W/C Ratio	0.428		0.49	
Concrete Temperature, Deg F.	76	50	80	
Ambient Temperature, Deg F.		10	85	

Specm. No.	Cyl Unit Wgt pcf	Date Received	Date Broken	Des Age	Age Brk	Cure Type	Brk PSI	Avg PSI	28 Day Spec	Indic. if Out. Specs
PC-B1	1		04/29/91	7	7	S	3477	3454	3500	
PC-B1	2		04/29/91	7	7	S	3431	3454	3500	
PC-B1	3		05/06/91	14	14	S	4234	4117	3500	
PC-B1	4		05/06/91	14	14	S	4000	4117	3500	
PC-B1	5		05/20/91	28	28	S	4613	4645	3500	
PC-B1	6		05/20/91	28	28	S	4676	4645	3500	

Remarks: Results of tests performed are in compliance with Specifications.
Comments:

Reviewed By: R. J. O'Brien, Testing Lab Supervisor
For: R. F. Cauley, Materials and Research Engineer

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Report on Concrete Cylinders
Preliminary Sample

Lab No: C91WP02

Report Date: 07/19/91

Project: WORK PLAN 91-C-6

Sampled By:

Pay Item: Concrete, Class B 501.25

Date Sampled: 04/22/91

Material Name/Type: Concrete Class B 501.03A

Sampled From: LAB MIXER

Resident: J. WEAVER

Quantity Rep: 1.8 cf

Submitted By: J. KELLY LFP

Field Test By: CONCRETE DIV.

Material Source: MATERIALS+RESEARCH LAB

Tested By: CONCRETE DIV.

Location Used: PERFORMANCE IN CONCRETE EVALUATION

X-Ref No: CS:

Coarse Agg : COLUMBIA S&G
Fine Agg : COLUMBIA S&G
Cement Brand: NORTHEAST QUEBEC CA

Total Agg. Dry Wgt: 2986
Type: II Lbs: 611

A/E Admix: DARAVAIR
Admixture: WRDA / HYCOL
Admixture:

Dosage: 2.5 oz/cy
Dosage: 3 oz/cwt
Dosage:

Comments:

Test		Specs Min	Specs Max	Indicates if Outside of Specs
Unit Wgt of Fresh Concrete,pcf	144.2			
Air Content, Percent	5.2	4.	6.	
Slump, Inches	2.	2.	4.	
Total Water, Gal/cy	31.2		35.75	
W/C Ratio	0.426		0.49	
Concrete Temperature, Deg F.	72	50	80	
Ambient Temperature, Deg F.		10	85	

Specm. No.	Cyl Unit Wgt pcf	Date Received	Date Broken	Des Age	Age Brk	Cure Type	Brk PSI	Avg PSI	28 Day Spec	Indic. if Out. Specs
PC-B2 1			04/29/91	7	7	S	3761	3712	3500	
PC-B2 2			04/29/91	7	7	S	3663	3712	3500	
PC-B2 3			05/06/91	14	14	S	4325	4410	3500	
PC-B2 4			05/06/91	14	14	S	4495	4410	3500	
PC-B2 5			05/20/91	28	28	S	4860	4839	3500	
PC-B2 6			05/20/91	28	28	S	4818	4839	3500	

Remarks: Results of tests performed are in compliance with Specifications.
Comments:

Reviewed By: R. J. O'Brien, Testing Lab Supervisor
For: R. F. Cauley, Materials and Research Engineer

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Report on Concrete Cylinders
Preliminary Sample

Lab No: C91WP03

Report Date: 07/19/91

Project: WORK PLAN 91-C-6

Sampled By:

Pay Item: Concrete, Class B 501.25

Date Sampled: 04/22/91

Material Name/Type: Concrete Class B 501.03A

Sampled From: LAB MIXER

Resident: J. WEAVER

Quantity Rep: 1.8 cf

Submitted By: J. KELLY LFP

Field Test By: CONCRETE DIV.

Material Source: MATERIALS+RESEARCH LAB

Tested By: CONCRETE DIV.

Location Used: PERFORMANCE IN CONCRETE EVALUATION

X-Ref No: CS:

Coarse Agg : LEBANON CRUSHED STON WEST LEBANON NH
Fine Agg : LEBANON CRUSHED STON WEST LEBANON NH Total Agg. Dry Wgt: 3127
Cement Brand: NORTHEAST QUEBEC CA Type: II Lbs: 611

A/E Admix: DARAVAIR Dosage: 3.5 oz/cy
Admixture: WRDA / HYCOL Dosage: 3 oz/cwt
Admixture: Dosage:

Comments:

Test		Specs Min	Specs Max	Indicates if Outside of Specs
Unit Wgt of Fresh Concrete,pcf	148.4			
Air Content, Percent	5.7	4.	6.	
Slump, Inches	3.	2.	4.	
Total Water, Gal/cy	31.56		35.75	
W/C Ratio	0.431		0.49	
Concrete Temperature, Deg F.	72	50	80	
Ambient Temperature, Deg F.		10	85	

Specm. No.	Cyl Unit Wgt pcf	Date Received	Date Broken	Des Age	Age Brk	Cure Type	Brk PSI	Avg PSI	28 Day Spec	Indic. if Out. Specs
R-B1 1			04/29/91	7	7	S	3396	3691	3500	
R-B1 2			04/29/91	7	7	S	3986	3691	3500	
R-B1 3			05/06/91	14	14	S	3986	3976	3500	
R-B1 4			05/06/91	14	14	S	3965	3976	3500	
R-B1 5			05/20/91	28	28	S	4535	4535	3500	

Remarks: Results of tests performed are in compliance with Specifications.
Comments:

Reviewed By: R. J. O'Brien, Testing Lab Supervisor
For: R. F. Cauley, Materials and Research Engineer

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Report on Concrete Cylinders
Preliminary Sample

Lab No: C91WP04

Report Date: 07/19/91

Project: WORK PLAN 91-C-6

Sampled By:

Pay Item: Concrete, Class B 501.25

Date Sampled: 04/22/91

Material Name/Type: Concrete Class B 501.03A

Sampled From: LAB MIXER

Resident: J. WEAVER

Quantity Rep: 1.8 cf

Submitted By: J. KELLY LFP

Field Test By: CONCRETE DIV.

Material Source: MATERIALS+RESEARCH LAB

Tested By: CONCRETE DIV.

Location Used: PERFORMANCE IN CONCRETE EVALUATION

X-Ref No: CS:

Coarse Agg : LEBANON CRUSHED STON WEST LEBANON NH
Fine Agg : LEBANON CRUSHED STON WEST LEBANON NH Total Agg. Dry Wgt: 3127
Cement Brand: NORTHEAST QUEBEC CA Type: II Lbs: 611

A/E Admix: DARAVAIR Dosage: 4 oz/cy
Admixture: WRDA / HYCOL Dosage: 3 oz/cwt
Admixture: Dosage:

Comments:

Test	Specs Min	Specs Max	Indicates if Outside of Specs
Unit Wgt of Fresh Concrete,pcf	148.6		
Air Content, Percent	5.8	4. 6.	
Slump, Inches	2.5	2. 4.	
Total Water, Gal/cy	31.41	35.75	
W/C Ratio	0.429	0.49	
Concrete Temperature, Deg F.	72	50 80	
Ambient Temperature, Deg F.		10 85	

Specm. No.	Cyl Unit Wgt pcf	Date Received	Date Broken	Des Age	Age Brk	Cure Type	Brk PSI	Avg PSI	28 Day Spec	Indic. if Out. Specs
R-B2 1			04/29/91	7	7	S	3606	3628	3500	
R-B2 2			04/29/91	7	7	S	3649	3628	3500	
R-B2 3			05/06/91	14	14	S	4155	4175	3500	
R-B2 4			05/06/91	14	14	S	4195	4175	3500	
R-B2 5			05/20/91	28	28	S	4581	4551	3500	
R-B2 6			05/20/91	28	28	S	4521	4551	3500	

Remarks: Results of tests performed are in compliance with Specifications.
Comments:

Reviewed By: R. J. O'Brien, Testing Lab Supervisor
For: R. F. Cauley, Materials and Research Engineer

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Report on Concrete Cylinders
Preliminary Sample

Lab No: C91WP05

Report Date: 07/19/91

Project: WORK PLAN 91-C-6

Sampled By:

Pay Item: Concrete, Class A 501.22

Date Sampled: 04/23/91

Material Name/Type: Concrete Class A 501.03A

Sampled From: LAB MIXER

Resident: J. WEAVER

Quantity Rep: 1.8 cf

Submitted By: J. KELLY LFP

Field Test By: CONCRETE DIV.

Material Source: MATERIALS+RESEARCH LAB

Tested By: CONCRETE DIV.

Location Used: PERFORMANCE IN CONCRETE EVALUATION

X-Ref No: CS:

Coarse Agg : COLUMBIA S&G
Fine Agg : COLUMBIA S&G
Cement Brand: NORTHEAST QUEBEC CA

Total Agg. Dry Wgt: 2868
Type: II Lbs: 660

A/E Admix: DARAVAIR
Admixture: WRDA / HYCOL
Admixture:

Dosage: 5.5 oz/cy
Dosage: 3 oz/cwt
Dosage:

Comments:

Test		Specs Min	Specs Max	Indicates if Outside of Specs
Unit Wgt of Fresh Concrete,pcf	145.			
Air Content, Percent	5.7	5.	7.	
Slump, Inches	2.75	2.	4.	
Total Water, Gal/cy	31.56		35.1	
W/C Ratio	0.399		0.44	
Concrete Temperature, Deg F.	70	50	80	
Ambient Temperature, Deg F.		10	85	

Specm. No.	Cyl Unit Wgt pcf	Date Received	Date Broken	Des Age	Age Brk	Cure Type	Brk PSI	Avg PSI	28 Day Spec	Indic. if Out. Specs
PA-2 1			04/30/91	7	7	S	3940	3979	4000	
PA-2 2			04/30/91	7	7	S	4018	3979	4000	
PA-2 3			05/07/91	14	14	S	4393	4474	4000	
PA-2 4			05/07/91	14	14	S	4555	4474	4000	
PA-2 5			05/21/91	28	28	S	4983	5026	4000	
PA-2 6			05/21/91	28	28	S	5068	5026	4000	

Remarks: Results of tests performed are in compliance with Specifications.
Comments:

Reviewed By: R. J. O'Brien, Testing Lab Supervisor
For: R. F. Cauley, Materials and Research Engineer

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Report on Concrete Cylinders
Preliminary Sample

Lab No: C91WP06

Report Date: 07/19/91

Project: WORK PLAN 91-C-6

Sampled By:

Pay Item: Concrete, Class A 501.22

Date Sampled: 04/23/91

Material Name/Type: Concrete Class A 501.03A

Sampled From: LAB MIXER

Resident: J. WEAVER

Quantity Rep: 1.8 cf

Submitted By: J. KELLY LFP

Field Test By: CONCRETE DIV.

Material Source: MATERIALS+RESEARCH LAB

Tested By: CONCRETE DIV.

Location Used: PERFORMANCE IN CONCRETE EVALUATION

X-Ref No: CS:

Coarse Agg : COLUMBIA S&G
Fine Agg : COLUMBIA S&G
Cement Brand: NORTHEAST QUEBEC CA

Total Agg. Dry Wgt: 2868
Type: II Lbs: 660

A/E Admix: DARAVAIR
Admixture: WRDA / HYCOL
Admixture:

Dosage: 5.5 oz/cy
Dosage: 3 oz/cwt
Dosage:

Comments:

Test	Specs Min	Specs Max	Indicates if Outside of Specs
Unit Wgt of Fresh Concrete,pcf	144.7		
Air Content, Percent	6.	5. 7.	
Slump, Inches	2.75	2. 4.	
Total Water, Gal/cy	31.32	35.1	
W/C Ratio	0.396	0.44	
Concrete Temperature, Deg F.	70	50 80	
Ambient Temperature, Deg F.		10 85	

Specm. No.	Cyl Unit Wgt pcf	Date Received	Date Broken	Des Age	Age Brk	Cure Type	Brk PSI	Avg PSI	28 Day Spec	Indic. if Out. Specs
PA-1	1		04/30/91	7	7	S	3657	3692	4000	
PA-1	2		04/30/91	7	7	S	3727	3692	4000	
PA-1	3		05/07/91	14	14	S	4386	4384	4000	
PA-1	4		05/07/91	14	14	S	4382	4384	4000	
PA-1	5		05/21/91	28	28	S	4789	4800	4000	
PA-1	6		05/21/91	28	28	S	4810	4800	4000	

Remarks: Results of tests performed are in compliance with Specifications.
Comments:

Reviewed By: R. J. O'Brien, Testing Lab Supervisor
For: R. F. Cauley, Materials and Research Engineer

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Materials and Research Division

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J. WEAVER

Report on Concrete Cylinders
Preliminary Sample

Lab No: C91WP07

Report Date: 07/19/91

Project: WORK PLAN 91-C-6

Sampled By:

Pay Item: Concrete, Class A 501.22

Date Sampled: 04/22/91

Material Name/Type: Concrete Class A 501.03A

Sampled From: LAB MIXER

Resident: J. WEAVER

Quantity Rep: 1.8 cf

Submitted By: J. KELLY LFP

Field Test By: CONCRETE DIV.

Material Source: MATERIALS+RESEARCH LAB

Tested By: CONCRETE DIV.

Location Used: PERFORMANCE IN CONCRETE EVALUATION

X-Ref No: CS:

Coarse Agg : LEBANON CRUSHED STON WEST LEBANON NH
Fine Agg : LEBANON CRUSHED STON WEST LEBANON NH Total Agg. Dry Wgt: 3007
Cement Brand: NORTHEAST QUEBEC CA Type: II Lbs: 660

A/E Admix: DARAVAIR Dosage: 5 oz/cy
Admixture: WRDA / HYCOL Dosage: 3 oz/cwt
Admixture: Dosage:

Comments:

Test	Specs Min	Specs Max	Indicates if Outside of Specs
Unit Wgt of Fresh Concrete,pcf	147.1		
Air Content, Percent	5.9	5. 7.	
Slump, Inches	2.5	2. 4.	
Total Water, Gal/cy	31.4	35.1	
W/C Ratio	0.397	0.44	
Concrete Temperature, Deg F.	72	50 80	
Ambient Temperature, Deg F.		10 85	

Specm. No.	Cyl	Unit Wgt pcf	Date Received	Date Broken	Des Age	Age Brk	Cure Type	Brk PSI	Avg PSI	28 Day Spec	Indic. if Out. Specs
R-A1	1			04/29/91	7	7	S	3750	3831	4000	
R-A1	2			04/29/91	7	7	S	3911	3831	4000	
R-A1	3			05/06/91	14	14	S	4269	4342	4000	
R-A1	4			05/06/91	14	14	S	4414	4342	4000	
R-A1	5			05/20/91	28	28	S	4811	4749	4000	
R-A1	6			05/20/91	28	28	S	4687	4749	4000	

Remarks: Results of tests performed are in compliance with Specifications.
Comments:

Reviewed By: R. J. O'Brien, Testing Lab Supervisor _____
For: R. F. Cauley, Materials and Research Engineer

LABRPT

Vermont Agency of Transportation
Materials and Research Division

Distribution
Central Files
J. WEAVER
J. WEAVER

Report on Concrete Cylinders
Preliminary Sample

Lab No: C91WP08

Report Date: 07/19/91

Project: WORK PLAN 91-C-6

Sampled By:

Pay Item: Concrete, Class A 501.22

Date Sampled: 04/23/91

Material Name/Type: Concrete Class A 501.03A

Sampled From: LAB MIXER

Resident: J. WEAVER

Quantity Rep: 1.8 cf

Submitted By: J. KELLY LFP

Field Test By: CONCRETE DIV.

Material Source: MATERIALS+RESEARCH LAB

Tested By: CONCRETE DIV.

Location Used: PERFORMANCE IN CONCRETE EVALUATION

X-Ref No: CS:

Coarse Agg : LEBANON CRUSHED STON WEST LEBANON NH
Fine Agg : LEBANON CRUSHED STON WEST LEBANON NH Total Agg. Dry Wgt: 3007
Cement Brand: NORTHEAST QUEBEC CA Type: II Lbs: 660

A/E Admix: DARAVAIR Dosage: 5 oz/cy
Admixture: WRDA / HYCOL Dosage: 3 oz/cwt
Admixture: Dosage:

Comments:

Test	Specs Min	Specs Max	Indicates if Outside of Specs
Unit Wgt of Fresh Concrete,pcf	149.6		
Air Content, Percent	5.5	5. 7.	
Slump, Inches	2.5	2. 4.	
Total Water, Gal/cy	30.69	35.1	
W/C Ratio	0.388	0.44	
Concrete Temperature, Deg F.	72	50 80	
Ambient Temperature, Deg F.		10 85	

Specm. No.	Cyl Unit Wgt pcf	Date Received	Date Broken	Des Age	Age Brk	Cure Type	Brk PSI	Avg PSI	28 Day Spec	Indic. if Out. Specs
R-A2 1			04/30/91	7	7	S	3876	3800	4000	
R-A2 2			04/30/91	7	7	S	3724	3800	4000	
R-A2 3			05/07/91	14	14	S	4591	4595	4000	
R-A2 4			05/07/91	14	14	S	4598	4595	4000	
R-A2 5			05/21/91	28	28	S	5125	5063	4000	
R-A2 6			05/21/91	28	28	S	5001	5063	4000	

Remarks: Results of tests performed are in compliance with Specifications.
Comments:

Reviewed By: R. J. O'Brien, Testing Lab Supervisor
For: R. F. Cauley, Materials and Research Engineer

TA 565 Rev. 4/79

APPENDIX E
Prepared By: R. M Holt
Date: 03/20/91
Sheet 1 of 1

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION

RESEARCH INVESTIGATION

Work Plan No. 91-C-6

Subject Evaluation of Fine Aggregate and 3/4" Crushed Gravel Coarse Aggregate From Columbia Sand & Gravel, Columbia , N.H.

Investigation Requested By Steven Persons Date 03/12/91

Date Information Required As soon as possible

Purpose of Investigation To evaluate a fine aggregate and a 3/4" crushed gravel coarse aggregate from the Columbia Sand & Gravel facility in Columbia, N.H., proposed for use as structural concrete aggregates.

Proposed Tests or Evaluation Procedure See Vermont Procedure for Evaluating a New Source of Structural Concrete Aggregate, VT-AOT-MRD 9-82.

1. ~~Performance-in-concrete tests will be performed using two batches each of~~ Class A & Class B concrete containing the proposed new aggregates and two batches each of Class A & Class B concrete containing a reference aggregate.

2. Prepare speciments from each batch of concrete to determine resistance to freezing and thawing.

Proposal Discussed With JHW John Weaver Projected Manpower Requirements 25 man-days

Investigation To Be Conducted By Structural Concrete Subdivision

Proposed Starting Date 03/25/91 Estimated Completion Date 05/24/91

Approval/~~Disapproval~~ by Materials & Research Engineer R. F. Cauley

Comments by Materials & Research Engineer

Materials & Research Division
Agency of Transportation
Date Typed: 03/28/91