EVALUATION OF 3/4" CRUSHED GRAVEL FROM H. A. MANOSH CORP. - HYDE PARK, VERMONT FOR USE IN STRUCTURAL CONCRETE

REPORT 86-4
MARCH 1986

Report on Work Plan 85-C-22

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION

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Date: 03-19-86

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ABSTRACT

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

This report documents results of tests performed on a proposed new coarse aggregate source. The material is 3/4" crushed gravel from the H. A. Manosh Corporation gravel pit in Hyde Park, Vermont.

Test results and evaluation confirm this material meets the required specifications as a coarse aggregate source for structural concrete.

INTRODUCTION

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

A request was received from Gary Nolan, Construction Manager of the H. A. Manosh Corporation, to evaluate a crushed gravel. Mr. Nolan expressed the Manosh Corporation's desire to use this crushed gravel in ready mixed structural concrete produced for future Agency of Transportation projects.

Samples of the coarse aggregate were obtained by Materials and Research Division representatives and evaluated for compliance with the requirements of Section 704.02 of the Standard Specifications for Construction. Materials were obtained and the performance-in-concrete phase of the evaluation 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 coarse aggregate was sampled by representatives of the Materials & Research Division from a stockpile at the H. A. Manosh gravel pit in Hyde Park, Vermont. The material was examined for gradation, percent of wear, fractured faces, thin and elongated pieces, and soundness. It was found to comply with Section 704.02 requirements. The reference coarse aggregate was sampled from a stockpile at the A. G. Anderson ready mix concrete plant in Johnson, Vermont. The reference coarse aggregate was examined for gradation, percent of wear, thin and elongated pieces, and fractured faces. The fine aggregate was also sampled from the A. G. Anderson ready mix concrete plant in Johnson, Vermont. The fine aggregate was examined for gradation and organic impurities. The reference coarse and fine aggregates comply with the requirements of Sections 704.02 and 704.01 respectively. Fine aggregate test results are shown in Table 1. Coarse aggregate test results are shown in Table 2. Aggregate test results are also shown on Laboratory Reports G8500783, G8500784, G8500839, G8500840, and A851152 in Appendix B.

TABLE 1

FINE AGGREGATE TEST DATA

	Fine Aggregate A. S. Nadeau - Johnson, VT. Date Sampled: 09/10/85	VT A.O.T. Specification Requirements
Sieve Size	% Passing	% Passing
3/8"	100	100
#4	99	95-100
#8	77	-
#16	55	50-80
#30	34	25-60
#50	18	10-30
#100	8	2-10
Fineness Modulus	3.09	2.60-3.10
Organic Impurities, Color	<1	2 Maximum

TABLE 2

COARSE AGGREGATE TEST DATA

	Proposed New Aggregate 3/4" Crushed Gravel H. A. Manosh Hyde Park, Vermont		Reference Aggregate 3/4" Crushed Gravel A. S. Nadeau Johnson, Vermont	VT. A.O.T. Specification Requirements
	Dates Sampled 09/05/85	09/05/85	Date Sampled 09/10/85	
Sieve Size	% Passing	% Passing	% Passing	% Passing
1"	100	100	100	100
3/4"	100	100	99	90-100
3/8"	26	25	34	20-55
#4	7	6	7	0-10
#8	4	3	5	0-5
L.A. Abrasion Percent Loss B Grading	30.1	29.7	31.6	35 Maximum
Thin & Elongated Pieces,%	2.0	2.2	1.5	10 Maximum
Fractured Faces, %	87.2	83.8	65.1	50 Minimum

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:

Coarse Aggregate

A. Proposed New Aggregate

3/4" Crushed Gravel
H. A. Manosh - Hyde Park, Vermont

B. Reference Aggregate

3/4" Crushed Gravel
A. S. Nadeau - Johnson, Vermont

Fine Aggregate

A. S. Nadeau - Johnson, Vermont

Cement

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

Air Entraining Admixture

Daravair
W. R. Grace & Company
Cambridge, Massachusetts

Water Reducing Admixture

WRDA with Hycol
W. R. Grace & Company
Cambridge, Massachusetts

Aggregate properties used for preparing mix designs are shown in Table 3 and Table 4.

TABLE 3

COARSE AGGREGATE PROPERTIES

	Bulk Specific Gravity	Absorp. Percent	Dry Rodded Unit Weight Lbs./Ft.^{3}
New Aggregate H. A. Manosh Hyde Park, Vermont	2.64	1.3	101.71
Reference Aggregate A. S. Nadeau Johnson, Vermont	2.65	0.9	105.38

TABLE 4

FINE AGGREGATE PROPERTIES

	Bulk Specific Gravity	Absorp. Percent	Fineness Modulus
A. S. Nadeau Johnson, Vermont	2.66	1.1	3.09

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

The mix proportions used are shown in Table 5 and Table 6.

TABLE 5

NEW AGGREGATE MIX DESIGN
BATCH QUANTITIES PER C.Y.

	Class A		Class B	
	Batch 1	Batch 2	Batch 3	Batch 4
*New Coarse Aggregate, lbs.	1641	1641	1641	1641
*Fine Aggregate, lbs.	1265	1265	1410	1410
Cement, lbs.	660	660	611	611
Air Entraining Admixture, oz.	5.0	5.0	4.6	4.6
Water Reducing Admixture, oz.	19.8	19.8	18.3	18.3
Net water, gal.	31.0	31.3	31.5	30.8

*Weights converted to saturated surface-dry condition.

TABLE 6

REFERENCE AGGREGATE MIX DESIGN
BATCH QUANTITIES PER C.Y.

	Class A		Class B	
	Batch 5	Batch 6	Batch 7	Batch 8
*Reference Coarse Aggregate, lbs.	1694	1694	1694	1694
*Fine Aggregate, lbs.	1211	1211	1357	1357
Cement, lbs.	660	660	611	611
Air Entraining Admixtures, oz.	5.0	5.0	6.5	4.6
Water Reducing Admixtures, oz.	19.8	19.8	18.3	18.3
Net Water, gal.	31.6	31.3	30.9	31.5

*Weights converted to saturated surface-dry condition.

Tests were performed on the fresh concrete to determine Slump (AASHTO T 119-82), Air Content (AASHTO T 152-84I) and Unit Weight (AASHTO T 121-82). Six test cylinders (6" x 12")and one 3"w x 3"d x 16"l freeze-thaw specimen were cast from each batch. The cylinders were tested for compressive strength (AASHTO T 22-85I), two each at ages 8, 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 161-83I) in a 3% NaCl solution.

RESULTS

Results of tests on the fresh concrete and compressive strength test results are shown in Table 7 and Table 8.

TABLE 7

PERFORMANCE TEST RESULTS
NEW AGGREGATE

	Class A		Class B	
	Batch 1	Batch 2	Batch 3	Batch 4
Slump, inches	2 1/2	2 3/4	2 3/4	3
Air Content, percent	6.2	6.3	6.8	6.8
Unit Weight, lbs./ft.^{3}	145.01	145.11	144.15	144.15
Compressive Strength, psi				
8 days	3431	3396	3117	3011
14 days	3864	3661	3626	3590
28 days	4425	4420	4217	4235
(Design Compressive Strength, psi)	(4000)		(3500)	

TABLE 8

PERFORMANCE TEST RESULTS
REFERENCE AGGREGATE

	Class A		Class B	
	Batch 5	Batch 6	Batch 7	Batch 8
Slump, inches	2 3/4	2 1/2	2 1/4	2 3/4
Air Content, percent	6.0	6.0	7.5	6.3
Unit Weight, lbs/ft^3	145.35	145.35	145.85	144.15
Compressive Strength, psi				
8 days	3404	3466	3095	3166
14 days	3758	3696	3493	3626
28 days	4323	4138	4120	4292
(Design Compressive Strength, psi)	(4000)		(3500)	

The results of compressive strength tests are also shown on Laboratory Report Nos. C85 1302 through C85 1309 in Appendix C. Strength age plots illustrating average compressive strengths are shown in Figure I and Figure II.

The results of dynamic testing of freeze-thaw specimens are shown in Table 9. The percent weight loss resulting from freezing and thawing of specimens is shown in Table 10. 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 450 cycles of freezing and thawing.

TABLE 9

FREEZE-THAW TEST RESULTS - DURABILITY FACTOR

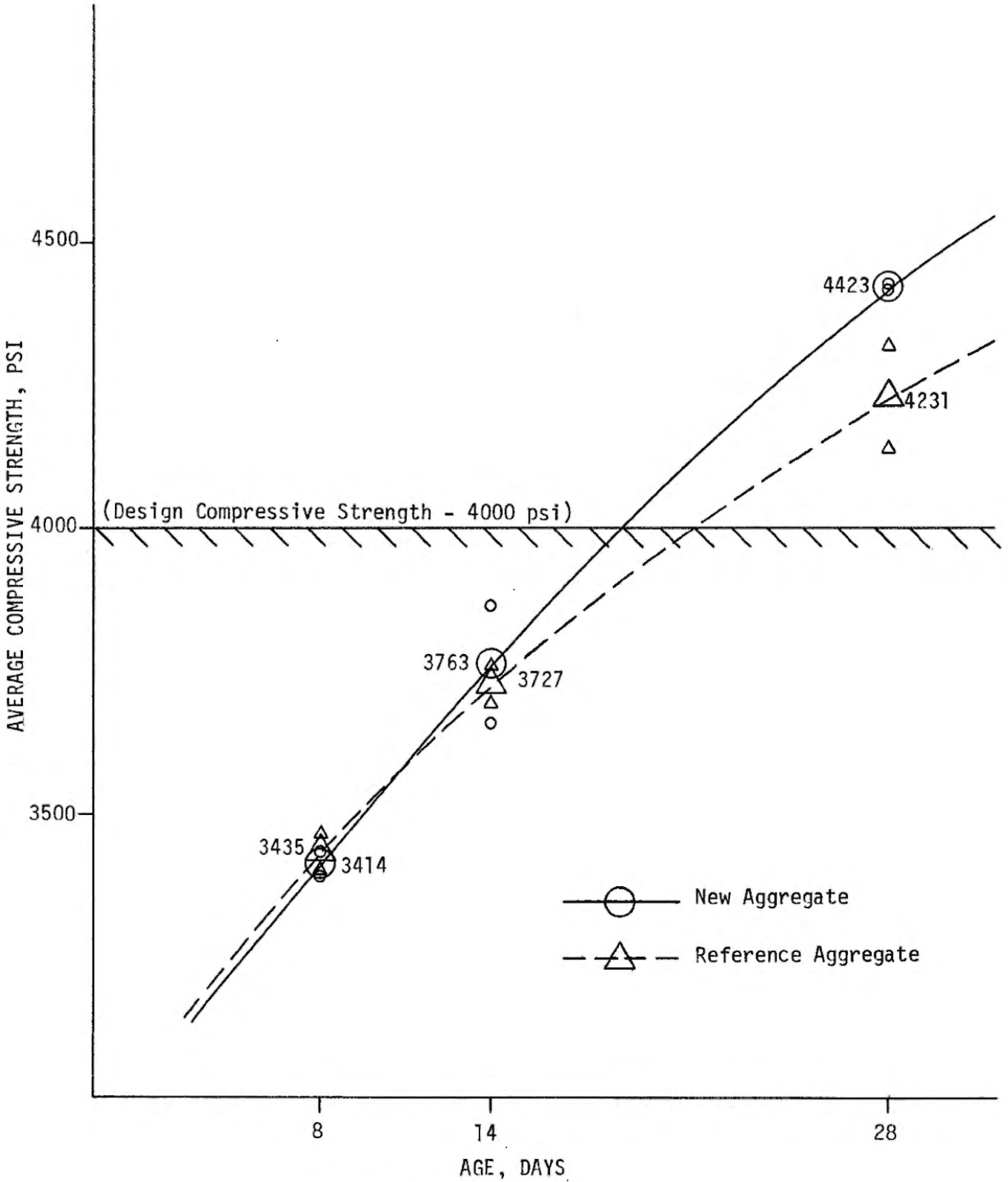
		New Aggregate				Reference Aggregate			
		Class A		Class B		Class A		Class B	
		Batch 1	Batch 2	Batch 3	Batch 4	Batch 5	Batch 6	Batch 7	Batch 8
		Durability Factor							
Number of Cycles	50	100.0	99.3	100.0	99.3	100.7	100.0	100.0	99.3
	100	100.0	100.0	100.0	98.5	100.7	98.6	100.0	99.3
	150	99.3	100.0	99.3	99.3	100.0	97.8	100.0	99.3
	200	99.3	100.0	93.5	99.3	100.7	96.4	100.0	99.3
	250	100.0	100.7	100.0	100.7	101.5	97.8	101.5	99.3
	300	100.0	100.0	100.7	99.3	100.7	97.8	101.5	98.5
	350	100.0	100.0	100.0	99.3	100.0	97.1	100.0	98.5
	400	100.0	99.3	100.0	97.1	100.0	96.4	100.0	97.8
	450	99.3	99.3	100.0	99.3	98.5	95.7	100.0	99.3

TABLE 10

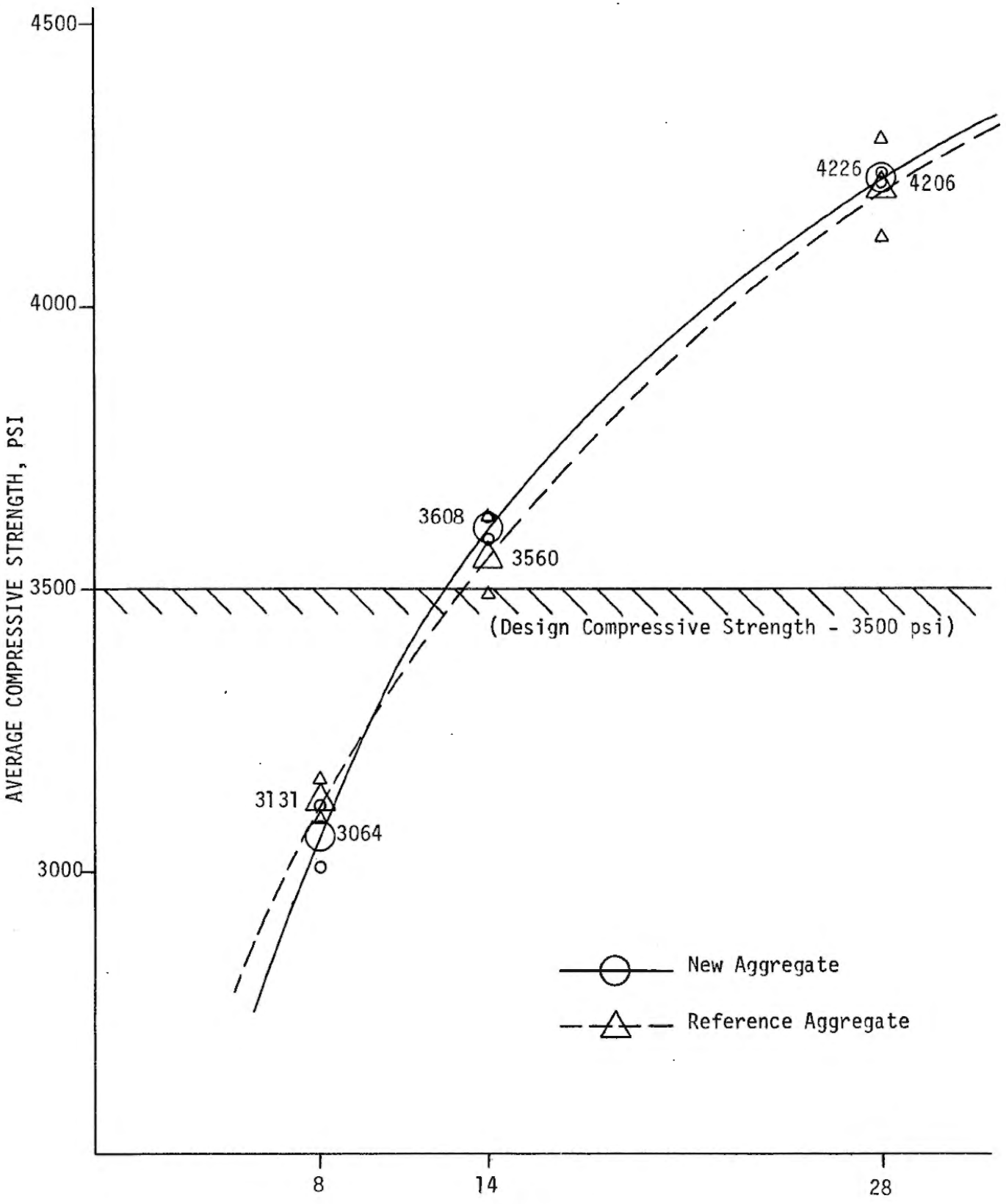
FREEZE-THAW TEST RESULTS - PERCENT WEIGHT LOSS

		New Aggregate				Reference Aggregate			
		Class A		Class B		Class A		Class B	
		Batch 1	Batch 2	Batch 3	Batch 4	Batch 5	Batch 6	Batch 7	Batch 8
		Percent Weight Loss							
Number of Cycles	50	+0.1	0.1	0.2	0.0	0.1	0.2	0.1	0.1
	100	0.6	0.7	0.2	0.2	0.5	0.6	0.6	1.1
	150	1.0	1.5	0.7	0.7	0.9	0.9	1.0	2.0
	200	1.4	2.2	0.8	1.1	1.0	1.2	1.2	3.1
	250	1.9	2.9	1.2	1.6	1.5	1.6	1.7	3.8
	300	2.7	3.7	1.7	2.7	2.6	2.7	2.6	5.2
	350	3.1	4.2	2.4	2.8	2.6	3.0	2.9	5.7
	400	3.6	4.9	3.6	4.2	3.9	3.6	3.4	7.1
	450	4.2	5.7	3.8	4.3	4.0	4.5	4.3	8.0

A (+) INDICATES WEIGHT GAIN



AVERAGE COMPRESSIVE STRENGTH VS AGE
CLASS A
FIGURE I



AVERAGE COMPRESSIVE STRENGTH VS AGE
CLASS B
FIGURE II

Batch Number	No. Cycles	Weight Lbs.	Percent Weight Loss	Fundamental Transverse Frequency "N"	"N"^{2}	Individual Durability Factor DF	Average DF	Relative Durability Factor RDF
Reference Aggregate								
5	0	12.33		1355	1836025			
			4.0			98.5		
5	450	11.84		1345	1809025			
							97.1	
6	0	12.38		1380	1904400			
			4.5			95.7		
6	450	11.82		1350	1822500			
New Aggregate								102.3
1	0	12.34		1355	1836025			
			4.2			99.3		
1	450	11.82		1350	1822500			
2	0	12.27		1350	1822500		99.3	
			5.7			99.3		
2	450	11.57		1345	1809025			

SUMMARY OF FREEZE-THAW TEST RESULTS

CLASS A

FIGURE III

Batch Number	No. Cycles	Weight Lbs.	Percent Weight Loss	Fundamental Transverse Frequency "N"	"N"^{2}	Individual Durability Factor DF	Average DF	Relative Durability Factor RDF
Reference Aggregate								
7	0	12.19		1355	1836025			
			4.3			100.0		
7	450	11.66		1355	1836025			
							99.7	
8	0	12.30		1360	1849600			
			8.0			99.3		
8	450	11.31		1355	1836025			
New Aggregate								100.0
3	0	12.24		1355	1836025			
			3.8			100.0		
3	450	11.78		1355	1836025			
							99.7	
4	0	12.23		1350	1822500			
			4.3			99.3		
4	450	11.70		1345	1809025			

SUMMARY OF FREEZE-THAW TEST RESULTS

CLASS B

FIGURE IV

SUMMARY and CONCLUSIONS

1. The coarse aggregate from the H. A. Manosh gravel pit in Hyde Park, Vermont complied with all requirements of Section 704.02 when tested in conjunction with this evaluation.

2. The average 28 day compressive strengths of Class A concrete containing the Manosh coarse aggregate (4423 psi) were slightly better than the average 28 day compressive strengths of Class A concrete containing the reference coarse aggregate (4231 psi). The average 28 day compressive strengths of Class B concrete containing the Manosh coarse aggregate (4226 psi) were approximately equal to the average 28 day compressive strengths of Class B concrete containing the reference coarse aggregate (4206 psi).

3. Overall, the performance of the concrete specimens containing the new aggregate was slightly better than the concrete specimens containing the reference aggregate when subjected to 450 cycles of freezing and thawing. Results of sonic testing showed an increase in performance of Class A concrete containing the new aggregate (average durability factor 99.3) when compared to Class A concrete containing the reference aggregate (average durability factor 97.1) with a relative durability factor of 102.3. For the Class B concretes containing the new and reference aggregates, the performance was the same with average durability factors of 99.7 and a relative durability factor of 100.0. The average weight loss for the Class A concrete containing the new aggregate (5.0 percent) was 0.7 percent greater than the average weight loss of the Class A concrete containing

the reference aggregate (4.3 percent). The average weight loss for the Class B concrete containing the new aggregate (4.1 percent) was 2.1 percent less than the average weight loss of the Class B concrete containing the reference aggregate (6.2 percent).

The Manosh gravel consists of two rock types composed of minerals containing iron, namely greenstone and amphibolite. A small fraction (less than one percent by weight) of these stones had iron oxide weathering to the extent that they became softer and tended to crumble more easily. After immersion in the salt water (3% NaCl) solution and repeated cycles of freezing and thawing, a few of these stones on the surface of the concrete specimens broke up and were washed away, leaving pebble-size holes or depressions. Although weathered iron residue was apparent in some of the holes, there was no indication as to exactly which stones produced them. In conclusion, the small proportion of these stones in the gravel should not adversely affect the structural integrity or durability of the concrete.

RECOMMENDATIONS

1. It is recommended that the H. A. Manosh gravel pit in Hyde Park, Vermont be approved as a source of coarse aggregate for use in structural concrete.

2. During 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.

Prepared By: W. Meyer WFM
Date: March 26, 1982
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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.

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2M 6/85

STATE OF VERMONT
AGENCY OF TRANSPORTATION

MATERIALS & RESEARCH DIVISION
Montpelier, Vermont 05602

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. Benda
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REPORT ON SAMPLE OF AGGREGATE

Report October 11, 1985

Laboratory No. G8500783 Tested By Heckenberger

Name Coarse Aggregate for Concrete Item 501

Identification Marks Evaluation Sample, 3/4" Crushed Gravel

Submitted by Benda Title SCE Address

Sampled 9/5, 1985 Received 9/5, 1985 Testing Completed 9/9, 1985

Sample from H. A. Manosh Pit, Garfield, Vermont

Quantity Represented

Source of Material H. A. Manosh Pit, Garfield, Vermont

Project Name & Number Possible Future Use

Examined for 704.02

TEST RESULTS

Total Sample Sieve Size	% Passing	Sand Portion
4 1/2"		
4"		
3 1/2"		
3"		
2 1/2"		
2"		
1 3/4"		
1 1/2"		
1"		
3/4"	100	
5/8"		
1/2"		
3/8"	26	
No. 4	7	
No. 8	4	
No. 10		
No. 16		
No. 30		
No. 50		
No. 100		
No. 200		

Fineness Modulus
% Coarser Than

No. 100	
No. 50	
No. 30	
No. 16	
No. 8	
No. 4	

Fineness Modulus =

Color =

Comments:

Test #2 - This material was examined for wear, fractured faces, thin and elongated pieces and gradation. The results are as indicated.

Percent of Wear

AASHTO T3
AASHTO T4
AASHTO T96 30.1
B Grading
Fractured Faces, % 87.2

Thin & Elongated Pieces, % 2.0

Soundness, % Loss

Frank E. Aldrich, P.E., Chief Engineer

By: R. F. Nicholson 10/17
R. F. Nicholson, P.E., Materials & Research Engineer

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Rev. 2M 4/83
2M 6/84
2M 6/85

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STATE OF VERMONT
AGENCY OF TRANSPORTATION

MATERIALS & RESEARCH DIVISION
Montpelier, Vermont 05602

REPORT ON SAMPLE OF AGGREGATE

Report October 11, 1985

Laboratory No. G8500784 Tested By Heckenberger

Name Coarse Aggregate for Concrete Item 501

Identification Marks Evaluation Sample, 3/4" Crushed Gravel

Submitted by Benda Title SCE Address

Sampled 9/5, 1985 Received 9/5, 1985 Testing Completed 9/9, 1985

Sample from H. A. Manosh Pit, Garfield, Vermont

Quantity Represented

Source of Material H. A. Manosh Pit, Garfield, Vermont

Project Name & Number Possible Future Use

Examined for 704.02

TEST RESULTS

Total Sample Sieve Size	% Passing	Sand Portion
4 1/2"		
4"		
3 1/2"		
3"		
2 1/2"		
2"		
1 3/4"		
1 1/2"		
1"		
3/4"	100	
5/8"		
1/2"		
3/8"	25	
No. 4	6	
No. 8	3	
No. 10		
No. 16		
No. 30		
No. 50		
No. 100		
No. 200		

Fineness Modulus
% Coarser Than

No. 100	
No. 50	
No. 30	
No. 16	
No. 8	
No. 4	

Fineness Modulus =

Color =

Comments:

Test #1 - This material was examined for wear, fractured faces, thin and elongated pieces and gradation. The results are as indicated.

Percent of Wear

AASHTO T3
AASHTO T4
AASHTO T96 29.7
B Grading
Fractured Faces, % 83.8

Thin & Elongated Pieces, % 22

Soundness, % Loss

Frank E. Aldrich, P.E., Chief Engineer

By: R. F. Nicholson RFN
R. F. Nicholson, P.E., Materials & Research Engineer

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2M 6/85

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MATERIALS & RESEARCH DIVISION
Montpelier, Vermont 05602

REPORT ON SAMPLE OF AGGREGATE

Report October 8, 1985

Laboratory No. G8500839 Tested By Holt

Name Fine Aggregate For Concrete Item 501.

Identification Marks Preliminary Sample

Submitted by Holt Title PFP Address

Sampled 9/10, 1985 Received 9/10, 1985 Testing Completed 9/11, 1985

Sample from Stockpile @ Anderson, Johnson, Vermont

Quantity Represented

Source of Material Nadeau, Johnson, Vermont

Project Name & Number Work Plan 85-C-22

Examined for 704.01

TEST RESULTS

Total Sample Sieve Size	% Passing	Sand Portion
4 1/2"		
4"		
3 1/2"		
3"		
2 1/2"		
2"		
1 3/4"		
1 1/2"		
1"		
3/4"		
5/8"		
1/2"		
3/8"	100	
No. 4	99	
No. 8	77	
No. 10		
No. 16	55	
No. 30	34	
No. 50	18	
No. 100	8	
No. 200 dry	3	

Fineness Modulus
% Coarser Than

No. 100	92
No. 50	82
No. 30	66
No. 16	45
No. 8	23
No. 4	1

Fineness Modulus = 3.09

Color = <1

Comments:

This material meets the requirements for the tests indicated for Item 704.01.

Percent of Wear

AASHTO T3
AASHTO T4
AASHTO T96
Grading
Fractured Faces, %

Thin & Elongated Pieces, %

Soundness, % Loss

ACCEPTED
Frank E. Aldrich, P.E., Chief Engineer

By: R. F. Nicholson 9/17
R. F. Nicholson, P.E., Materials & Research Engineer

srq

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2M 6/84
2M 6/85

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REPORT ON SAMPLE OF AGGREGATE

Report October 8, 1985

Laboratory No. G8500840 Tested By Armstrong

Name Coarse Aggregate For Concrete Item 501

Identification Marks Preliminary Sample 3/4" Crushed Gravel

Submitted by Meyer Title PFP Address _____

Sampled 9/10, 1985 Received 9/10, 1985 Testing Completed 9/16, 1985

Sample from Stockpile @ Anderson, Johnson, Vermont

Quantity Represented _____

Source of Material Nadeau, Johnson, Vermont

Project Name & Number Work Plan 85-C-22

Examined for 704.02

TEST RESULTS

Total Sample Sieve Size	% Passing	Sand Portion
4 1/2"		
4"		
3 1/2"		
3"		
2 1/2"		
2"		
1 3/4"		
1 1/2"		
1"	100	
3/4"	99	
5/8"		
1/2"		
3/8"	34	
No. 4	7	
No. 8	5	
No. 10		
No. 16		
No. 30		
No. 50		
No. 100		
No. 200		

Fineness Modulus
% Coarser Than

No. 100	
No. 50	
No. 30	
No. 16	
No. 8	
No. 4	

Fineness Modulus = _____

Color = _____

Comments:

This material meets the requirements for the tests indicated for Item 704.02

Percent of Wear

AASHTO T3 _____
AASHTO T4 _____
AASHTO T96 31.6
___ Grading
Fractured Faces, % 65.1

Thin & Elongated Pieces, % 1.5

Soundness, % Loss _____

ACCEPTED
Frank E. Aldrich, P.E., Chief Engineer

By: R. F. Nicholson 10/7
R. F. Nicholson, P.E., Materials & Research Engineer

srq

TA 182F Rev. 2M 3/82
Rev. 2M 4/83
2M 6/84
2M 6/85

STATE OF VERMONT
AGENCY OF TRANSPORTATION

Benda
CF

MATERIALS & RESEARCH DIVISION
Montpelier, Vermont 05602

CORRECTED COPY
OCT. 17, 1985

REPORT ON SAMPLE OF AGGREGATE

Report 10-8, 19 85

Laboratory No. A85 1152 Tested By Lavin

Name Coarse aggregate for concrete 501.

Identification Marks Evaluation sample crushed gravel

Submitted by Benda Title SCE Address

Sampled 9-5, 1985 Received 9-5, 1985 Testing Completed 9-26, 19 85

Sample from H. A. Manosh pit Garfield, Vt.

Quantity Represented

Source of Material H. A. Manosh pit Garfield, Vt.

Project Name & Number Possible Future Use

Examined for Item 704.02

TEST RESULTS

Total Sample Sieve Size	% Passing
4 1/2"	
4"	
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	
No. 8	
No. 10	
No. 16	
No. 30	
No. 50	
No. 100	
No. 200	

Sand Portion

Fineness Modulus % Coarser Than

No. 100	
No. 50	
No. 30	
No. 16	
No. 8	
No. 4	

Fineness Modulus =

Color =

Percent of Wear

AASHTO T3
AASHTO T4
AASHTO T96
Grading
Fractured Faces, %

Thin & Elongated Pieces, %

Soundness, % Loss 1.39

Comments:
This material was examined for soundness. The results are as indicated.

Frank E. Aldrich, P.E., Chief Engineer

By: R. F. Nicholson 10/17

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

mlm

Project Name: Work Plan
Project Number: 85-C-22

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION
Montpelier, Vermont 05602

Meyer
CF
Benda

Report on Concrete Test Beam or Cylinders

Laboratory No. C85 1302 (28) Report of 28 Day Breaks Date typed 10-24-85

Pay Item Performance in Concrete Type of Sample Evaluation

Submitted by Meyer Title PFP Address

Source of Material Mat. & Research Lab Quantity Represented 1.8 c.f.

Coarse Aggregate Manosh, Garfield Fine Aggregate Nadeau - Johnson

Cement Brand Northeast Type II Lbs. 660

Air Entraining Admixture Daravair Dosage 5 oz/cy Admixture WRDA Hycol Dosage 3 oz/cwt

Total Aggregate Dry Wgt: 2871 Admixture Dosage

Field Tested by Structural Concrete Subdivision Lab. Tested by Boyle

Sampled from Laboratory Mixer Date Sampled: 9-25-85

Location Used or to be Used Test Mix - Batch # 1

Examined for Mod. of Rupture Compressive Strength

TEST RESULTS

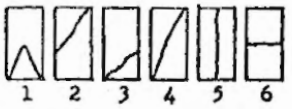
Unit Weight Fresh Concrete 145.01 Air: Pressure 6.2 Chace Slump 2 1/2

Total Water, Gal/Cy Used 31.0 w/c Ratio .392 Temperature, Concrete 75 Ambient

Specimen No.	Cyl. Unit Wgt. P.C.F.	Date Rec'd	Date Broken	Desired age at break	Age at Break	Type* S - F	Break 1 P.S.I.	Break 2 P.S.I.	Ave. P.S.I.	Break Type 1	Break Type 2
M-3-A 1	148	9-25	10-3	7	8	S	3422	3440	3431		
2	148										
3	148	9-25	10-9	14	14	S	3837	3890	3864		
4	148										
5	148	9-25	10-23	28	28	S	4509	4341	4425		
6	148										

*S = Standard Cured; F = Field Cured

Types of Breaks:



Comments:

Frank E. Aldrich, P.E., Chief Engineer

By: R. F. Nicholson, P.E., Materials & Research Engineer

mlm

TA 1831 Rev.
2M 4/81
2M 8/83
1M 11/84

Project Name: Work Plan
Project Number: 85-C-22

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION
Montpelier, Vermont 05602

Meyer
CF
Benda

Report on Concrete Test Beam or Cylinders

Laboratory No. C85 1303 (28) Report of 28 Day Breaks Date typed 10-24-85

Pay Item Performance in Concrete Type of Sample Evaluation

Submitted by Meyer Title PFP Address

Source of Material Mat. & Research Lab Quantity Represented 1.8 c.f.

Coarse Aggregate Manosh - Garfield, Vt. Fine Aggregate Nadeau - Johnson

Cement Brand Northeast Type II Lbs. 660

Air Entraining Admixture Daravair Dosage 5 oz/cy Admixture WRDA Hycol Dosage 3 oz/cwt

Total Aggregate Dry Wgt: 2871 Admixture Dosage

Field Tested by Structural Concrete Subdivision Lab. Tested by Boyle

Sampled from Laboratory Mixer Date Sampled: 9-25-85

Location Used or to be Used Test Mix - Batch # 2

Examined for Mod. of Rupture Compressive Strength

TEST RESULTS

Unit Weight Fresh Concrete 145.11 Air: Pressure 6.3 Chace Slump 2 3/4

Total Water, Gal/Cy Used 31.3 w/c Ratio .395 Temperature, Concrete 75 Ambient

Specimen No.	Cyl. Unit Wgt. P.C.F.	Date Rec'd	Date Broken	Desired age at break	Age at Break	Type* S - F	Break 1 P.S.I.	Break 2 P.S.I.	Ave. P.S.I.	Break Type 1	Break Type 2
M-4-A 1	147	9-25	10-3	7	8	S	3431	3360	3396		
2	147										
3	147	9-25	10-9	14	14	S	3678	3643	3661		
4	147										
5	147	9-25	10-23	28	28	S	4367	4473	4420		
6	147										

*S = Standard Cured; F = Field Cured

Types of Breaks:

Comments:

Frank E. Aldrich, P.E., Chief Engineer

By: R. F. Nicholson 1/87

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

mlm

TA 1831 Rev.
2M 4/81
2M 8/83
1M 11/84

Project Name: Work Plan
Project Number: 85-C-22

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION
Montpelier, Vermont 05602

Meyer
CF
Benda

Report on Concrete Test Beam or Cylinders

Laboratory No. C85 1304 (28) Report of 28 Day Breaks Date typed 10-24-85

Pay Item Performance in Concrete Type of Sample Evaluation

Submitted by Meyer Title PFP Address

Source of Material Mat. & Research Lab Quantity Represented 1.8 c.f.

Coarse Aggregate Manosh - Garfield, Vt. Fine Aggregate Nadeau - Johnson

Cement Brand Northeast Type II Lbs. 611

Air Entraining Admixture Daravair Dosage 4½ oz/cy Admixture WRDA Hycol Dosage 3 oz/cwt

Total Aggregate Dry Wgt. 3015 Admixture Dosage

Field Tested by Structural Concrete Subdivision Lab. Tested by Boyle

Sampled from Laboratory Mixer Date Sampled: 9-25-85

Location Used or to be Used Test Mix - Batch # 3

Examined for Mod. of Rupture Compressive Strength

TEST RESULTS

Unit Weight Fresh Concrete 144.15 Air: Pressure 6.8 Chace Slump 2 3/4

Total Water, Gal/Cy Used 31.5 w/c Ratio .430 Temperature, Concrete 76 Ambient

Specimen No.	Cyl. Unit Wgt. P.C.F.	Date Rec'd	Date Broken	Desired age at break	Age at Break	Type* S - F	Break 1 P.S.I.	Break 2 P.S.I.	Ave. P.S.I.	Break Type 1	Break Type 2
M-1-B 1	146	9-25	10-3	7	8	S	3121	3112	3117		
2	145										
3	145	9-25	10-9	14	14	S	3714	3537	3626		
4	146										
5	145	9-25	10-23	28	28	S	4181	4252	4217		
6	146										

*S = Standard Cured; F = Field Cured

Types of Breaks:

Comments:

Frank E. Aldrich, P.E., Chief Engineer

By: Ruth F. Nicholson 10/87
R. F. Nicholson, P.E., Materials & Research Engineer

mlm

TA 1838 Rev.
2M 4/81
2M 8/83
1M 11/84

Project Name: Work Plan
Project Number: 85-C-22

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION
Montpelier, Vermont 05602

Meyer
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Benda

Report on Concrete Test Beam or Cylinders

Laboratory No. C85 1305 (28) Report of 28 Day Breaks Date typed 10-24-85

Pay Item Performance in Concrete Type of Sample Evaluation

Submitted by Meyer Title PFP Address

Source of Material Mat. & Research Lab Quantity Represented 1.8 c.f.

Coarse Aggregate Manosh - Garfield, Vt. Fine Aggregate Nadeau - Johnson

Cement Brand Northeast Type II Lbs. 611

Air Entraining Admixture Daravair Dosage 4½ oz/cy Admixture WRDA Hycol Dosage 3 oz/cwt

Total Aggregate Dry Wgt: 3015 Admixture Dosage

Field Tested by Structural Concrete Subdivision Lab. Tested by Boyle

Sampled from Laboratory Mixer Date Sampled: 9-25-85

Location Used or to be Used Test Mix - Batch # 4

Examined for Mod. of Rupture Compressive Strength

TEST RESULTS

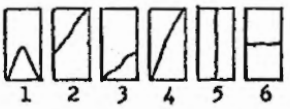
Unit Weight Fresh Concrete 144.15 Air: Pressure 6.8 Chace Slump 3

Total Water, Gal/Cy Used 30.8 w/c Ratio .421 Temperature, Concrete 74 Ambient

Specimen No.	Cyl. Unit Wgt. P.C.F.	Date Rec'd	Date Broken	Desired age at break	Age at Break	Type* S - F	Break 1 P.S.I.	Break 2 P.S.I.	Ave. P.S.I.	Break Type 1	Break Type 2
M-2-B 1	146	9-25	10-3	7	8	S	3263	2759	3011		
2	146										
3	146	9-25	10-9	14	14	S	3625	3554	3590		
4	147										
5	147	9-25	10-23	28	28	S	4155	4314	4235		
6	146										

*S = Standard Cured; F = Field Cured

Types of Breaks:



Comments:

Frank E. Aldrich, P.E., Chief Engineer

By: Ruth Nicholson /RAF
R. F. Nicholson, P.E., Materials & Research Engineer

mlm

TA 1831 Rev.
2M 4/81
2M 8/83
1M 11/84

Project Name: Work Plan
Project Number: 85-C-22

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION
Montpelier, Vermont 05602

Meyer
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Benda

Report on Concrete Test Beam or Cylinders

Laboratory No. C85 1306 (28) Report of 28 Day Breaks Date typed 10-24-85

Pay Item Performance in Concrete Type of Sample Evaluation

Submitted by Meyer Title PFP Address

Source of Material Mat. & Research Lab Quantity Represented 1.8 c.f.

Coarse Aggregate Nadeau - Johnson Fine Aggregate Nadeau - Johnson

Cement Brand Northeast Type II Lbs. 660

Air Entraining Admixture Daravair Dosage 5 oz/cy Admixture WRDA Hycol Dosage 3 oz/cwt

Total Aggregate Dry Wgt: 2877 Admixture Dosage

Field Tested by Structural Concrete Subdivision Lab. Tested by Boyle

Sampled from Laboratory Mixer Date Sampled: 9-25-85

Location Used or to be Used Reference Mix - Batch # 5

Examined for Mod. of Rupture Compressive Strength

TEST RESULTS

Unit Weight Fresh Concrete 145.35 Air: Pressure 6.0 Chace Slump 2 3/4

Total Water, Gal/Cy Used 31.6 w/c Ratio .400 Temperature, Concrete 72 Ambient

Specimen No.	Cyl. Unit Wgt. P.C.F.	Date Rec'd	Date Broken	Desired age at break	Age at Break	Type* S - F	Break 1 P.S.I.	Break 2 P.S.I.	Ave. P.S.I.	Break Type 1	Break Type 2
R-3-A 1	148	9-25	10-3	7	8	S	3448	3360	3404		
2	147										
3	146	9-25	10-9	14	14	S	3749	3767	3758		
4	146										
5	148	9-25	10-23	28	28	S	4296	4349	4323		
6	146										

*S = Standard Cured; F = Field Cured

Types of Breaks:

Comments:

Frank E. Aldrich, P.E., Chief Engineer

By: R. F. Nicholson 10/24/85
R. F. Nicholson, P.E., Materials & Research Engineer

mlm

TA 1838 Rev.
2M 4/81
2M 8/83
1M 11/84

Project Name
Work Plan
Project Number
85-C-22

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION
Montpelier, Vermont 05602

Meyer
CF
Benda

Report on Concrete Test Beam or Cylinders

Laboratory No. C85 1307 (28) Report of 28 Day Breaks Date typed 10-24-85

Pay Item Performance in Concrete Type of Sample Evaluation

Submitted by Meyer Title PFP Address

Source of Material Mat. & Research Lab Quantity Represented 1.8 c.f.

Coarse Aggregate Nadeau -Johnson Fine Aggregate Nadeau - Johnson

Cement Brand Northeast Type II Lbs. 660

Air Entraining Admixture Daravair Dosage 5 oz/cy Admixture WRDA Hycol Dosage 3 oz/cwt

Total Aggregate Dry Wgt: 2877 Admixture Dosage

Field Tested by Structural Concrete Subdivision Lab. Tested by Boyle

Sampled from Laboratory Mixer Date Sampled: 9-25-85

Location Used or to be Used Reference Mix - Batch # 6

Examined for Mod. of Rupture Compressive Strength

TEST RESULTS

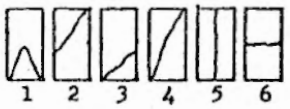
Unit Weight Fresh Concrete 145.35 Air: Pressure 6.0 Chace Slump 2½

Total Water, Gal/Cy Used 31.3 w/c Ratio .395 Temperature, Concrete 73 Ambient

Specimen No.	Cyl. Unit Wgt. P.C.F.	Date Rec'd	Date Broken	Desired age at break	Age at Break	Type* S - F	Break 1 P.S.I.	Break 2 P.S.I.	Ave. P.S.I.	Break Type 1	Break Type 2
R-4A 1	147										
2	147	9-25	10-3	7	8	S	3484	3448	3466		
3	147										
4	147	9-25	10-9	14	14	S	3696	3696	3696		
5	147										
6	147	9-25	10-23	28	28	S	4102	4173	4138		

*S = Standard Cured; F = Field Cured

Types of Breaks:



Comments:

Frank E. Aldrich, P.E., Chief Engineer

By: R. F. Nicholson 10/17

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

mlm

TA 1830 Rev.
2M 4/81
2M 8/83
1M 11/84

Project Name: Work Plan
Project Number: 85-C-22

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION
Montpelier, Vermont 05602

Meyer
CF
Benda

Report on Concrete Test Beam or Cylinders

Laboratory No. C85 1308 (28) Report of 28 Day Breaks Date typed 10-24-85

Pay Item Performance in Concrete Type of Sample Evaluation

Submitted by Meyer Title PFP Address

Source of Material Mat. & Research Lab Quantity Represented 1.8 c.f.

Coarse Aggregate Nadeau - Johnson Fine Aggregate Nadeau - Johnson

Cement Brand Northeast Type II Lbs. 611

Air Entraining Admixture Daravair Dosage 6½ oz/cy Admixture WRDA Hycol Dosage 3 oz/cwt

Total Aggregate Dry Wgt: 3021 Admixture Dosage

Field Tested by Structural Concrete Subdivision Lab. Tested by Boyle

Sampled from Laboratory Mixer Date Sampled: 9-25-85

Location Used or to be Used Reference Mix - Batch # 7

Examined for Mod. of Rupture Compressive Strength

TEST RESULTS

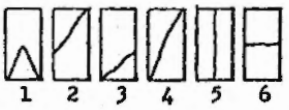
Unit Weight Fresh Concrete 145.85 Air: Pressure 7.5 Chace Slump 2 1/4

Total Water, Gal/Cy Used 30.9 w/c Ratio .422 Temperature, Concrete 72 Ambient

Specimen No.	Cyl. Unit Wgt. P.C.F.	Date Rec'd	Date Broken	Desired age at break	Age at Break	Type* S - F	Break 1 P.S.I.	Break 2 P.S.I.	Ave. P.S.I.	Break Type 1	Break Type 2
R-1-B 1	146										
2	146	9-25	10-3	7	8	S	3042	3148	3095		
3	146										
4	146	9-25	10-9	14	14	S	3466	3519	3493		
5	147										
6	148	9-25	10-23	28	28	S	4137	4102	4120		

*S = Standard Cured; F = Field Cured

Types of Breaks:



Comments:

Frank E. Aldrich, P.E., Chief Engineer

By: R. F. Nicholson, P.E., Materials & Research Engineer

mlm

TA 1838 Rev.
2M 4/81
2M 8/83
1M 11/84

Project Name
Work Plan
Project Number
85-C-22

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION
Montpelier, Vermont 05602

Meyer
CF
Benda

Report on Concrete Test Beam or Cylinders

Laboratory No. C85 1309 (28) Report of 28 Day Breaks Date typed 10-24-85

Pay Item Performance in Concrete Type of Sample Evaluation

Submitted by Meyer Title PFP Address

Source of Material Mat. & Research Lab Quantity Represented 1.8 c.f.

Coarse Aggregate Nadeau - Johnson Fine Aggregate Nadeau - Johnson

Cement Brand Northeast Type II Lbs. 611

Air Entraining Admixture Daravair Dosage 4½ oz/cy Admixture WRDA Hycol Dosage 3 oz/cwt

Total Aggregate Dry Wgt: 3021 Admixture Dosage

Field Tested by Structural Concrete Subdivision Lab. Tested by Boyle

Sampled from Laboratory Mixer Date Sampled: 9-25-85

Location Used or to be Used Reference Mix - Batch # 8

Examined for Mod. of Rupture Compressive Strength

TEST RESULTS

Unit Weight Fresh Concrete 144.15 Air: Pressure 6.3 Chace Slump 2 3/4

Total Water, Gal/Cy Used 31.5 w/c Ratio .430 Temperature, Concrete 71 Ambient

Specimen No.		Cyl. Unit Wgt. P.C.F.	Date Rec'd	Date Broken	Desired age at break	Age at Break	Type* S - F	Break 1 P.S.I.	Break 2 P.S.I.	Ave. P.S.I.	Break Type 1	Break Type 2
R-28	1	148										
	2	147	9-25	10-3	7	8	S	3254	3077	3166		
	3	148										
	4	147	9-25	10-9	14	14	S	3608	3643	3626		
	5	148										
	6	147	9-25	10-23	28	28	S	4314	4270	4292		

*S = Standard Cured; F = Field Cured

Types of Breaks:

Comments:

Frank E. Aldrich, P.E., Chief Engineer

By: R. F. Nicholson 10/17

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

mlm

TA 183H Rev.
2M 4/81
2M 8/83
1M 11/84

AGENCY OF TRANSPORTATION **OFFICE MEMORANDUM**

TO: C. C. Benda, P.E., Structural Concrete Engineer

FROM: Frank J. Lanza, Chief Geologist

DATE: October 8, 1985

SUBJECT: Petrographic Field and Office Examination of H. A. Manosh, Hyde Park, Vermont 3/4" Crushed Gravel for Possible Use in Structural Concrete

At the request of the Structural Concrete Engineer, a petrographic field examination of the H. A. Manosh Corporation gravel in Hyde Park, Vermont was conducted on September 5, 1985 as a supplement to the evaluation and possible acceptance of a new aggregate source for use in structural concrete.

Representative samples of washed, crushed 3/4" gravel were taken from a stockpile designated by Gary Nolan, Construction Manager of H. A. Manosh Corporation, for possible use in structural concrete.

A petrographic examination of the samples was made in the office in Berlin, Vermont, with the aid of a hand lens. The relative abundance of rock types, coatings and physical conditions was noted.

The H. A. Manosh Corporation gravel deposit in the hamlet of Garfield (Hyde Park) is mapped by Dr. D. P. Stewart as an ice contact stratified feature called a kame terrace. The feature is a well graded stratified gravel and sand deposit with predominant gravel size (stones) under 4" and 5". As is true with all glacio-fluvial deposits, the gravel is a heterogenous mixture of various rock types derived from the surrounding countryside bedrock and transported by the glacial melt waters.

The gravels in the deposit consist of greenstone, amphibolite, quartz-sericite-albite-chlorite schist, quartzites, gneisses and white to milky quartz. The white to milky quartz (SiO_2) constitutes 18 to 20% of the total rock types.

The particle shape of the uncrushed gravel is round to sub-round, becoming angular to sub-angular when crushed. The sub-angular particle shape is due to the small size of the gravel prior to crushing. The smooth, water-worn texture of the rounded gravel particles has the appearance of being hard. The flatter shaped particles are fresh and not weathered and are free from internal fractures. No deleterious particles, clay or organic matter was found.

Chemically, the gravel is predominantly silicates (greenstone, amphibolite, schist, gneisses) and silica dioxides (quartzites and quartz).

A fine silt coating or dusting is present on a small percentage of the processed crushed gravel. No alkali reactive minerals such as chert was observed in the gravel. No chemical tests were performed in the identification of the rock types and minerals, only those that could be identified by macroscopic examination with a hand lens have been noted and discussed.

FJL:etn
cc: RFN/Lab File
F. Lanza
R. Fraser

TA 296A 20M 11/84

TA 565 Rev. 4/79

Prepared By: R. Holt
Date: 09/03/85
Sheet 1 of 1

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION

RESEARCH INVESTIGATION

Work Plan No. 85-C-22

Subject Evaluation of Coarse Aggregate, H. A. Manosh Corp., Morrisville, Vermont

Investigation Requested By Gary Nolan Date Received 08/28/85

Date Information Required As soon as possible

Purpose of Investigation To evaluate the "crushed gravel coarse aggregate" from the H. A. Manosh, Corp. Gravel Pit, located in Garfield, Vermont, proposed for use as a structural concrete aggregate

Proposed Tests or Evaluation Procedure

See Vermont Procedure for Evaluating a New Source of Structural Concrete Aggregate, VT A.O.T. - M.R.D. 9-82

1. Performance-in-concrete tests will be performed, using two batches each of Class A and Class B concrete containing the new aggregate, and two batches each of Class A and Class B concrete containing a reference aggregate.
2. Prepare specimens from each batch of concrete to determine resistance to freezing and thawing.

Proposal Discussed With C. C. Benda CB Projected Manpower Requirements 25 man days

Investigation To Be Conducted By Structural Concrete Subdivision

Proposed Starting Date 09/06/85 Estimated Completion Date 12/06/85 - including report

Approval/Disapproval by Materials & Research Engineer R. F. Nichols 09-05-85

Comments by Materials & Research Engineer

Materials & Research Division
Agency of Transportation
Date Typed: September 4, 1985