EVALUATION OF 3/4" CRUSHED STONE FROM CALKINS SAND & GRAVEL CORP. LYNDON, VERMONT FOR USE IN STRUCTURAL CONCRETE

> REPORT 93-2 AUGUST 1993

REPORTING ON WORK PLAN 92-C-17

STATE OF VERMONT AGENCY OF TRANSPORTATION MATERIALS AND RESEARCH DIVISION

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EXECUTIVE SUMMARY

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

This report documents results of tests performed on a proposed new source of 3/4" crushed stone for structural concrete. The material tested was a 3/4" crushed stone produced at the Calkins Sand & Gravel Corp. facility in Lyndon, Vermont.

Test results and evaluation confirm this material meets the required specifications as a 3/4" crushed stone, 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.

Mr. Michael Classen, in charge of quality control at Lawrence Sangravco, initially requested an evaluation of 3/4" crushed stone processed at Calkins Sand & Gravel facility, Lyndon, Vermont in May 1992. Following his request, samples of the new material were obtained by Materials and Research Division representatives on June 11, 1992 and evaluated for compliance with the requirements of Section 704.02 of the Standard Specifications for Construction. The Agency of Transportation's Chief Geologist also traveled to the site to obtain samples for petrographic analysis of the material.

One initial sample of 3/4" crushed stone obtained on June 11, 1992 failed to comply with gradation requirements and the manufacturer was informed of the problem. The manufacturer later reported the 3/4" crushed stone to be in compliance with specifications, and subsequent samples of the material were obtained on August 31, 1992. Tests confirmed the manufacturer's claims 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 aggregate was sampled on June 11, 1992, by representatives of the Materials and Research Division, from a stockpile at the Calkins Sand & Gravel facility in Lyndon, Vermont. Subsequent samples were obtained on August 31, 1992 from stockpiles at the Lyndon facility and from stockpiles at the Lawrence Sangravco, plant in St. Johnsbury, Vermont. The 3/4" crushed stone 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).

The fine aggregate and reference coarse aggregate were from the Lawrence Sangravco facility in Guildhall, Vermont. The reference aggregates were sampled from stockpiles at the Lawrence Sangravco ready-mix concrete plant in St. Johnsbury, Vermont. The fine aggregate was examined for Gradation (AASHTO T 27-84) and Organic Impurities (AASHTO T 21-86). The reference 3/4" crushed gravel coarse aggregate was examined for Gradation (AASHTO T 27-84), Thin & Elongated Pieces (VT AOT-MD 22), Fractured Faces (VT AOT-MD 23) and Percent of Wear (AASHTO T 96-83). The fine aggregate and reference 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. Coarse aggregate test results are shown in Table 2 and Table 3. Aggregate test results are also shown in Laboratory Report Nos. G9200334, G9200335, G9200983, G9201000, G9201347, G9201348 and A930096, in Appendix B.

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

TABLE 1

FINE AGGREGATE TEST DATA (Reference Aggregate)

	Date Sampled 08-31-92	VAOT Specification Requirements
Sieve Size	% Passing	% Passing
3/8"	100	100
#4	100	95-100
#8	89	-
#16	65	50-80
#30	39	25-60
#50	17	10-30
#100	6	2-10
Fineness Modulus	2.84	2.60-3.10
Organic Impurities, color	<1	2 maximum

Lawrence Sangravco, Guildhall, VT

TABLE 2

COARSE AGGREGATE TEST DATA (Proposed New Aggregate)

3/4" Crushed Stone Calkins Sand & Gravel Lyndon, VT

VAOT Dates Sampled Specification 06-11-92 06-11-92 08-31-92 08-31-92 08-31-92 Requirements

Sieve Size	% Passing	% Passing	% Passing	% Passing	% Passing	% Passing
1"	100	100	100	100		100
3/4"	91	100	96	96	-	90-100
3/8"	19	34	34	41	-	20-55
#4	3	2	6	8	-	0-10
#8	2	1	4	4	-	0-5
L.A. Abrasio % loss	n, 27.8	24.3	30.4	31.8	-	35 maximum
Thin and Elongated Pieces, %		4.2	5.8	6.6	-	10 maximum
Fractured Faces, %	100.0	100.0	100.0	100.0	-	50 minimum
Soundness, % loss	-	-	-	-	1.17	8 maximum

TABLE 3

COARSE AGGREGATE TEST DATA (Reference Aggregate)

3/4" Crushed Gravel Lawrence Sangravco, Guildhall, VT

	dullunall, vi	
		VAOT
	Date Sampled	Specification
	08-31-92	Requirements
	%	%
Sieve Size	Passing	Passing
1"	100	100
3/4"	96	90-100
3/8"	35	20-55
#4	3	0 - 1 0
#8	2	0-5
L. A. Abrasion, % wear	24.4	35 maximum
Thin and Elongated		
Pieces, %	1.8	10 maximum
Fractured Faces, %	86.6	50 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. <u>Reference Aggregate and Proposed New Aggregate</u> Lawrence Sangravco, Guildhall, VT

Coarse Aggregate

A. Proposed New Aggregate

Calkins Sand & Gravel Co., Lyndon, VT

B. <u>Reference Aggregate</u>

Lawrence Sangravco, Guildhall, VT

Cement

Type II Ciment Quebec Inc., Comte de Portneuf, QC, Canada

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 4 and Table 5.

TABLE 4

FINE AGGREGATE PROPERTIES

	Bulk Specific Gravity	Absorp., Percent	Fineness Modulus	
Reference Aggregate Lawrence Sangravco, Guildhall, VT	2.61	1.6	2.90	

TABLE 5

COARSE AGGREGATE PROPERTIES

	Bulk Specific Gravity	Absorp., Percent	Dry Rodded Unit Weight, lbs/ft ³
Proposed New Aggregate Calkins Sand & Gravel, Lyndon, VT	2.74	0.7	101.55
Reference Aggregate Lawrence Sangravco, Guildhall, VT	2.74	1.0	104.60

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 6 and Table 7.

TABLE 6

NEW AGGREGATE MIX DESIGN BATCH QUANTITIES PER C.Y.

	CI	ass A	Class B		
	Batch	7 Batch 8	Batch 3	Batch 4	
*Coarse Aggregate, lbs.	1685	1685	1685	1685	
*New Fine Aggregate, lbs.	1255	1255	1316	1316	
Cement, 1bs.	660	660	611	611	
Air Entraining Admixture, oz.	4	4	2	2	
Water Reducing Admixture, oz.	19.8	19.8	18.3	18.3	
Net Water, gal.	33.0	32.5	32.6	30.9	

*Weights converted to saturated surface-dry condition

TABLE 7

REFERENCE AGGREGATE MIX DESIGN BATCH QUANTITIES PER C.Y.

	Cla	ISS A	Class B		
	Batch 5	Batch 6	Batch 1	Batch 2	
*Coarse Aggregate, lbs.	1740	1740	1740	1740	
*Fine Aggregate, lbs.	1229	1229	1350	1350	
Cement, 1bs.	660	660	611	611	
Air Entraining Admixture, oz.	4	4	2.1	2.1	
Water Reducing Admixture, oz.	19.8	19.8	18.3	18.3	
Net Water, gal.	33.1	33.5	31.3	31.2	

*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 two 3"w x 3"d x 16"l freeze-thaw specimens 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 8 and Table 9.

TABLE 8

PERFORMANCE TEST RESULTS <u>NEW AGGREGATE</u>

	Clas	s A	Class B	
	Batch 7	Batch 8	Batch 3	Batch 4
Slump, inches	2	2 3/4	3 1/4	2 3/4
Air Content, percent	5.0	5.8	5.4	4.7
Unit Weight, lbs/ft ³	147.99	145.63	144.75	145.79
Compressive Strength, psi				
7 days	3957	3986	3745	3908
14 days	4319	4371	4335	4439
28 days	4909	4884	4655	4917
(Design Compressive Strength,	psi) (40	00)	(35	00)

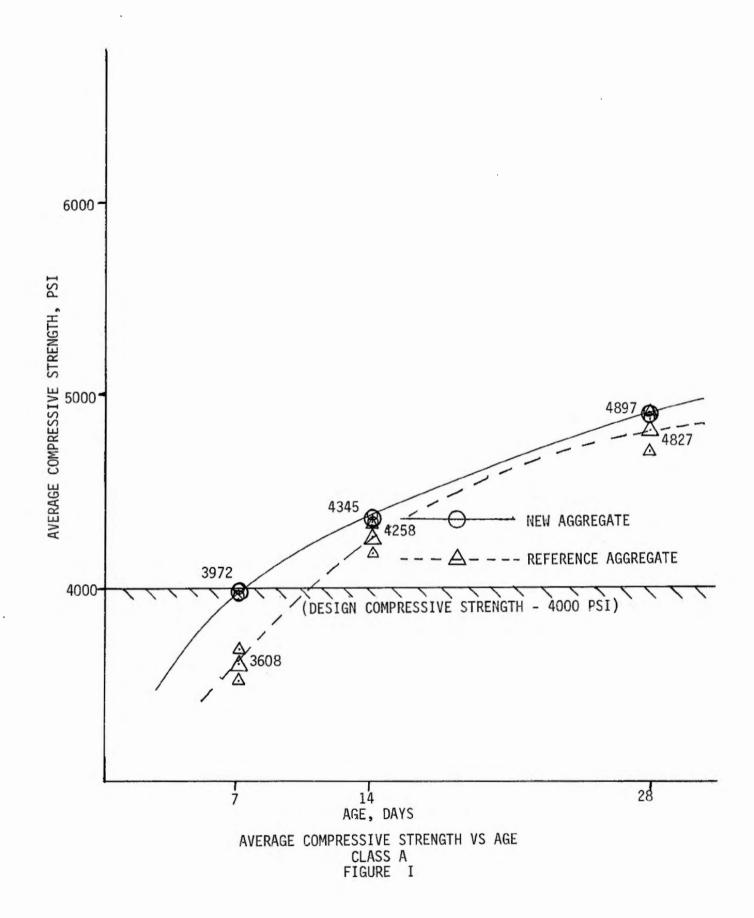
TABLE 9

PERFORMANCE TEST RESULTS REFERENCE AGGREGATE

	Clas	s A	Class B	
	Batch 5	Batch 6	Batch 1	Batch 2
Slump, inches	2 1/2	2 1/2	3 1/4	2 3/4
Air Content, percent	6.2	6.9	5.2	5.4
Unit Weight, lbs/ft ³	145.95	144.75	145.67	146.03
Compressive Strength, psi				
7 days	3694	3525	3784	3871
14 days	4328	4188	4225	4570
28 days	4932	4722	4861	4806
(Design Compressive Strength,	psi) (40	00)	(35	00)

The results of compressive strength tests are also shown on Laboratory Report Nos. C930016 through C930023 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 10. The percent weight change resulting from freezing and thawing of specimens is shown in Table 11. 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.



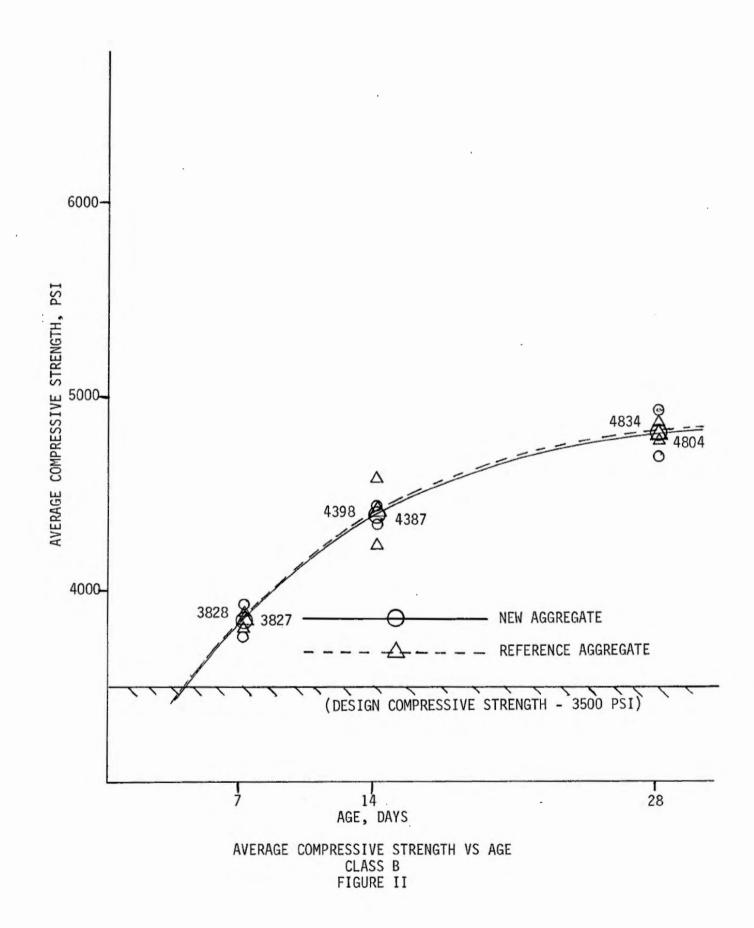


TABLE 10

FREEZE-THAW TEST RESULTS - DURABILITY FACTOR

	New Aggregate					Reference Aggregate		
	Class	s A	Clas	ss B	Class	A	Clas	ss B
No. of	Batch 7	Batch 8	Batch 3	Batch 4	Batch 5	Batch 6	Batch 1	Batch 2
Cycles			*Ave	erage Dura	ability Fa	letor		
50	98.4	99.3	95.4	92.8	100.9	100.6	99.9	101.4
100	100.3	99.9	94.0	90.8	97.5	100.3	103.6	99.3
150	95.0	95.8	91.6	92.4	94.5	97.0	102.1	95.4
200	98.3	100.0	90.7	86.5	100.8	98.6	105.4	95.4
250	98.5	99.4	93.1	87.2	94.5	98.8	107.1	92.8
300	97.1	99.4	96.5	83.7	96.0	98.2	108.1	96.3

*Values shown are the average results from two specimens.

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TABLE 11

FREEZE-THAW TEST RESULTS - PERCENT WEIGHT CHANGE

	New Aggreg Class A			te Refe Class B Class		erence Aggregate A Class B			
No. of Cycles	Batch 7	Batch 8	Batch 3					Batch 1	Batch 2
50	-0.8	-0.2	-3.6	-4.8		-0.3	-0.4	-2.8	-5.2
100	-2.8	-0.8	-7.8	-8.7		-0.9	-1.3	-5.7	-9.2
150	-4.6	-1.7	-11.0	-11.8		-1.6	-2.4	-7.5	-11.2
200	-6.4	-2.6	-13.8	-15.1		-2.2	-3.2	-8.6	-12.7
250	-7.8	-3.6	-16.2	-17.8		-2.9	-4.4	-10.0	-14.3
300	-9.1	-4.7	-18.4	-20.5		-3.5	-5.4	-10.2	-15.6

*Values shown are the average results from two specimens.

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
	ce Aggre							
5A	0	12.50	3.3	1615	2608225	101.2		
5A	300	12.09	3.3	1625	2640625	101.2		
5B	0	12.61	3.7	1664	2768896	90.7		
5B	300	12.14	0.1	1585	2512225	5011	97.1	
6A	0	12.43	5.1	1600	2560000	97.6	51.1	
6A	300	11.80	5.1	1581	2499561	97.0		
6B	0	12.56	5.6	1602	2566404	98.8		
6B	300	11.86	5.0	1592	2534464	98.8		
								101.2
New Agg	regate							
7A	0	12.76		1625	2640625			
7A	300	11.61	9.0	1600	2560000	97.0		
7B	0	12.80		1617	2614689	05.0		
7B	300	11.63	9.1	1594	2540836	97.2		
8A	0	12.58		1612	2598544		98.3	
8A	300	12.02	4.5	1616	2611456	100.5		
8B	0	12.56		1604	2572816			
8B	300	11.96	4.8	1590	2528100	98.3		
			SUMMARY	OF FREEZE-THA CLASS FIGURE	S A	ULTS		

.

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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
1A	nce Aggren 0	12.89		1664	2768896		,	
1A	300	11.57	10.2	1748	3055504	110.4		
1B	0	12.92		1688	2849344			
1B	300	11.61	10.1	1735	3010225	105.7	100.0	
2A	0	12.75		1630	2656900		102.2	
2A	300	10.67	16.3	1582	2502724	94.2		
2B	0	12.71		1635	2673225			
2B	300	10.81	14.9	1621	2627641	98.3		
								88.2
New Age 3A	<u>gregate</u> 0	12.83		1680	2822400			
3A	300	10.52	18.0	1705	2907025	103.0		
3B	0	12.77		1673	2798929			
3B	300	10.38	18.7	1586	2515396	89.9		
4 A	0	12.87		1690	2856100		90.1	
4 A	300	10.04	22.0	1623	2634129	92.2		
4B	0	12.78		1680	2822400			
4B	300	10.35	19.0	1456	2119936	75.1		
			SUMM	ARY OF FREEZE-		RESULTS		

CLASS B FIGURE IV

SUMMARY AND CONCLUSIONS

1. An initial sample of the proposed new coarse aggregate from the Calkins Sand & Gravel Corporation facility in Lyndon, VT failed to comply with gradation requirements. Subsequent samples of the proposed new coarse aggregate obtained from the same facility were found to be in compliance with the requirements of Section 704.02 when tested in conjunction with this evaluation.

2. The average 28 day compressive strengths of concrete containing the Calkins Sand & Gravel 3/4" crushed stone coarse aggregate were approximately equal to the strengths of concrete containing the reference aggregate. The Class A concrete containing the proposed new aggregate from Calkins Lyndon quarry had an average compressive strength of 4827 psi at 28 days, while the Class A concrete containing the reference aggregates yielded an average compressive strength of 4897 psi. The Class B concrete containing the new 3/4" crushed stone aggregate from Calkins quarry in Lyndon, VT had an average compressive strength of 4834 psi at 28 days, while the Class B concrete containing the reference aggregate had an average compressive strength of 4897 psi.

3. Results of freezing and thawing tests showed overall reduced performance for concrete containing the new aggregate, when compared with concrete containing the reference aggregate. The average durability factor for Class A concrete with the new aggregate was 98.3 while Class A concrete with the reference aggregate had an average durability factor of 97.1. The Class A concrete containing the new

aggregates, however, showed greater average weight loss (6.9%) than the Class A concrete containing the reference aggregate (4.4%). Class B concrete containing the new aggregate performed poorly in sonic testing when compared with Class B concrete containing the reference aggregate. The average durability factor was 90.1 for Class B concrete with the new aggregate and 102.2 for Class B concrete with the reference aggregate. Class B concrete containing the new aggregate also showed greater average weight loss (19.4%) than Class B concrete with the reference aggregate (12.9%).

4. Mix design tables, shown on page 9, indicate Class A and Class B mixtures containing the new aggregate required comparable quantities of mixing water to develop air contents and slumps equal to the mixes containing the reference aggregates.

RECOMMENDATIONS

1. It is recommended that the present Calkins Sand & Gravel Corp. facility in Lyndon, VT be approved as a source of 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.

3. Performance of additional petrographic evaluations of the new coarse aggregate is also recommended annually, as a minimum, to permit monitoring of any changes in the mineralogy of the material. Should examination reveal significant increases in the quantity of Phyllite present in the stone, the Materials and Research Division reserves the right to order use of the material discontinued.

APPENDICES A - E

APPENDIX A

Prepared By: W. Meyer&fm Date: March 26, 1982 Page: 1 of 2

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

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

		G9200	334	CTURAL CO	NCRETE AGGREGATE
Sampled From Source of Materia Quantity Represe Sample Comparis	on No	jile Kins Sa	<u>Adenville</u> ate Sample Plant <u>Lynden</u> mple Type	<u>At Calkin</u> Ville <u>Prefim</u> Cross Refered	ltem <u>501</u> Jumber <u>1992</u> Examined For <u>704.02</u> <u>5 Quarry Lyndsowille - Upper level</u> <u>mary</u> nce Mumber <u>Cor Concrete</u>
SIEVE	WEIGHT	% RET	AINED	% PASSING	AGGREGATE MOISTURE CONTENT
SIZE	INDIV.	IND'V.	CUMUL.	CUMUL.	
RET					WET WEIGHT
RET					DRY WEIGHT MOISTURE CONTENT %
RET	-			100	
RET -14	2.61	9.5		90,5	1 NOTE: MOISTURE CONTENT (%) ==
RET Z	14.61	53.1		37.4	ww ^{-w} p
RET 29_	5.22	18.9		(18.5)	X 100
RET 4	4.37	15.9		2.6	w _D
RET 8	.22	0.8		1.3	
PAN	.50	1.8			$\mathbf{w}_{\mathbf{w}} = \mathbf{W}\mathbf{E}\mathbf{T}$ WEIGHT
TOTAL	27.53	100.0			$W_{\mathbf{D}} = DRY WEIGHT$
Fineness Mo Cumu Organic Imp	l. Total Reta	-			(3/1" Sieve 1.3%
T&E		_=_5.0	% Thin	& Elongated H	Pieces (3/4" Sieve 1.3%
Total Weight Fractures		= 100) % Fract	ured Faces	3%" Sieve 8.2 "4 Sieve 7.9
Total Weight			_		(Januar Mil
Original Wei Final Weight () Test resu	138	8		"B" Vear <u>27.8</u>	AASHTO T96
(L) Test resu	lte are outsi	le enecificat	long		
		-		1 0	
Comments: _/	his Ma	teriu	1 tes	ted for	evaluation
Tested By Date Completed	2 Holt A	192		Reviewed By Date	John H. Weaver, P.E. JHW 3/17/92 Initials

REPORT ON SAMPLE OF STRUCTURAL CONCRETE AGGREGATE

Laboratory Numbe	er GS	20-1335		Pay 1	item <u>50/</u>
Project Name	alkins	Quarry	Lyndenur	We Project N	umber
Sampled By A.	Mr. Be	Di Di	ate Sample	June II	umber / 1992 Examined For 70 4.02
Sampled From	Stock Pil	P	Plant	At Colkie	is Pit Lyndonville - lower level
Source of Material	Call	Kins L	Yndony	ille	
Quantity Represen	ited	Sa	mple Type	Prelin	minary
Sample Compariso	n No	7			nce Number
MATERIA	AL TESTED	3/4" 0	rushe	d Stone	e) for concrete
SIEVE	WEIGHT	S RET	AINED	% PASSING	AGGREGATE MOISTURE CONTENT
SIZE	INDIV.	IND'V.	CUMUL.	CUMUL.	
					WET WEIGHT
RET					
RET					DRY WEIGHT
RET /	-	-		100	MOISTURE CONTENT %
RET -3/4	-	-		100	1 NOTE: MOISTURE CONTENT (%) ==
1/2	5,70	22.2		77.8	
RET -3/8	11.21	43.7		341	$\frac{w_w - w_D}{w} = x 100$
RET 70	8.34	32.5		1.6	X 100
RET				1.1	wp
RET _0	0.12	0.5			
PAN	0.29	1.1			$\mathbf{w}_{\mathbf{w}} = \mathbf{w} \mathbf{E} \mathbf{T} \mathbf{w} \mathbf{E} \mathbf{I} \mathbf{G} \mathbf{H} \mathbf{T}$
TOTAL	25.66				$w_{D} = DRY WEIGHT$
Fineness Moo					
Cumul	. Total Reta	ined/100 _			
Organic Impu	rities: Col	or	Totul S	umpie	Pieces $\begin{cases} \frac{1}{2} \text{ Sieve } \frac{19}{683} = 28\% \\ \frac{3}{8} \text{ Sieve } \frac{23}{514} = 4.5\% \\ \frac{3}{4} \text{ Sieve } \frac{13}{514} = 4.7\% \\ \frac{319}{319} = 4.7\% \end{cases}$
(1) 0. TO			Total D	& Flongatad I	683 683
T&E Total Weight		4.0	- 70 IIIII	& Elongated I	Heces 7 %" Sieve 23 = 4.5%
Fractures		= loc	% Fract	ured Faces	#4 Sieve 15 = 4.78
Total Weight	-		_		319 10
0.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1	a car		Con dia a	ก	
Original Weig Final Weight	370	6	Percent W	B lear 24.3	AASHTO T96
Final Weight	121	1		<u> </u>	
(2) Test result			ith specific	ations.	
() Test result	ts are outsid	de specificat	tions.		
Comments: TH	nis mat	eriali	s heir	g teste	d for evoluction
Puer poses	only.		· · · · · ·	1	
Tested By E	Auto.	cont k	PACIF	Reviewed By	John H. Weaver, P.E.
Date Completed	June	15, 19	92	Date	John H. Weaver, P.E. HW
		,	23	2	

--- ---- ---- ----

R. HOLT C.F

REPORT ON SAMPLE OF STRUCTURAL CONCRETE AGGREGATE

Laboratory Num	ber	G9200	983	Pay	Item 3	501	
Project Name	POSSIBLE	FUTUR	EUSE	Project N	lumber 1.4	CRK PLAN	92-6-17
Sampled By J.	KELY, S. A	LUCERENS	Date Sample	d 08/31/	92 Ex	amined For	704.02
Sampled From Source of Materia	al CRUK	LE OUN	Plant	CALKIN		NDONVILLE	
Quantity Represe		CY Sa	ample Type	Perini	VARY		
Sample Comparis	ion NO			Cross Refere	nce Numb	er N/A	
MATER	AL TECTED	21."		ROCK FOR	1 100	and i	
MATER	IAL TESTED	94 0	EDGE	KOCK POR	Connee		· · · ·
SIEVE	WEIGHT	% RE	AINED	% PASSING	AGGR	EGATE MOISTUR	E CONTENT
SIZE	INDIV.	IND'V.	CUMUL.	CUMUL.			
RET						WET WEIGH	IT
						DRY WEIGH	IT
RET	-			100	MOIS	TURE CONTENT	%
RET	520.5	4		96			
RET <u>-24</u>					1 NO	TE: MOISTURE C	ONTENT (%) $=$
RET h	3941.1	31		65	w.	w ^{-w} d	
RET 3/8"	30446	24		41		<u> </u>	100
RET 4	4191.3	33		8		wp	
RET 8	507.5	4		4		-	
PAN	569.5	4				$w_w = w_i$	ET WEIGHT
TOTAL	12,774.5	100				$W_{D} = DR$	Y WEIGHT
Fineness Mo							
	l. Total Retai	ned/100				17	118,7
One in the			_			(a)	19
	urities: Colo					AS 1	
T&E	= 47.8	= 6.4	% Thin a	& Elongated F	Pieces	101 I	RECEIVED 15
Total Weight	719.5	>				SEI	- 2 1992
Fractures	= 719.5	= 100	% Fractu	ired Faces		S MATER	ALS & RESEARCH
Total Weight	719.5					12	DIVISION
Original Wai	aht and		Grading	"R"		(c)	121
Original Wei Final Weight		79	Percent W	ear 31.8	Z AAS	нто туб	211111
(Test result	Its are in con	nliance w	ith specifics	tions			
	us are m con	apriance w	iui specifica				
() Test result	lts are outsid	e specificat	ions.				
Comments:							
	10 1 1	1.1			R.F	TOLT	ALA TX
Tested By Date Completed	Chad A.	allen		Reviewed By Date	John H. W	eaver, P.E.	Alt Louis
Date completed	09/0	192			116/9		

REPORT ON SAMPLE OF STRUCTURAL CONCRETE AGGREGATE

R. Holt C.F.

Laboratory Numb		201000		Dav	Item 501.
Project Name	JCI			Project 1	Number War Plan 92-C-17
Sampled By J.k.	E114\$ S.A.	mstrong Da	ate Sample	a 08/31/	Number Work Plan 92-C-17 92 Examined For 704.02
Sampled From	Stockp,	le 1	Plant	Lawren	ce, St. Johosbury
Source of Materia Quantity Represe	al Calk	ins Q	uarry,	Lyndoi	NILLE VE
Sample Comparis			nple Type	Cross Refer	ence Number
			ushed	ledge n	ock for concrete
	1				AGGREGATE MOISTURE CONTENT
SIEVE	WEIGHT	% RET	CUMUL.	% PASSING	AGGREGATE MOISTORE CONTENT
DILL					WET WEIGHT
RET					DRY WEIGHT
RET					
RET _/				100	MOISTURE CONTENT %
RET 3/4	455	4		96	NOTE: MOISTURE CONTENT (%) =
RET Z	4346	39		57	
3/0	2573	23		34	$w_w - w_D$
RET ZO		28			X 100
RET	3/88			6	w _D
RET 8	271	2		_ 7	
PAN	4.30	4			$w_w = WET WEIGHT$
TOTAL	11263	100			$W_{D} = DRY WEIGHT$
Fineness Mo	dulus				
	l. Total Retai	ned/100			111 121
					2111 12
Organic Imp	urities: Colo	r			Drat X
T&E	22		2 % Thin	& Elongated	Pieces E RECEIVED F
Total Weight			2 /0 11111	& Elongateu .	
	= 556	= 100)% Fractu	red Faces	MATLEIAL & RUSEARCH
Total Weight			_	a doct	DIVISION
				"O''	67
Original Wei			Grading	B	81TL
Final Weight	_3478	2	Percent W	ear <u>30</u> ,	4 AASHTO T96
	122				
() Test resul	ts are in con	ipliance with	in specifica	tions.	
() Test resul	ts are outside	e specificati	ons.		
Comments:					
	11/11	1			JKELLY A D.
Tested By	Hold	2.0			John II. Weaver, P.E.
Date Completed	9/2/	92		DateO	9/04/92 [Initials

REPORT ON SAMPLE OF STRUCTURAL CONCRETE AGGREGATE

Laboratory Numb	er G	9201.	,7	Pay I	item 50/
Project Name WC Sampled By EL	RK PLAN	92-0	C-17	Project N	umber
Sampled By	EY-ARMS	TEONOI	Date Sample	d 8/31/9	Examined For 704.01
Sampled From Source of Materia	18 PILE	HALL	Flant	LAWCENC	E-ST. JOHNSBURY
Quantity Represe	nted	Si	ample Type	ACCEPTA	ANCE
Sample Comparis		2	1 11	Cross Referen	nce Number
MATERI	AL TESTED	FINE	A66 F	OR CONCR	ETE
	1			1 1	
SIEVE	WEIGHT		TAINED	% PASSING	AGGREGATE MOISTURE CONTENT
SIZE	INDIV.	IND'V.	CUMUL.	CUMUL.	
RET					WET WEIGHT
RET 3/8				100	DRY WEIGHT
PET 4	-			100	MOISTURE CONTENT %
8	54.1	11	11	89	
RET	123.1	24	35	65	1 NOTE: MOISTURE CONTENT (%) ==
RET 16	136.1	26		39	w _w -w _p
RET 30			61	01	X 100
RET 50	111.8	22	83	11	w _D
RET 100	56.4		94	6	
	32.4	6			$w_{W} = WET WEIGHT$
PAN TOTAL	513.9		284		$W_{D} = DRY WEIGHT$
Fineness Mo	dulus			,	
Cumu	I. Total Retai	ned/100	2.84		
Organic Imp	urities: Colo	or			
T&E		-	% Thin	& Elongated P	lieces
Total Weight			_		
Fractures		_=	% Fract	ured Faces	
Total Weight	ţ				
Original Wei	ght		Grading		
Final Weight			Percent W	lear	AASHTO T96
,					
(V) Test resul	lts are in cor	npliance w	ith specific:	ations.	
() Test resul	Its are outsid	e specifica	tions		
() 1000 1000	to are outbru	o specifica			
Comments:					
·					
		1			
/	str.1	dias		-	D.F. HALE
Tested By	NOM	guer			John H. Weaver, P.E.
Date Completed	11/5/9	2	26	Date	12/402 111114

REPORT ON SAMPLE OF STRUCTURAL CONCRETE AGGREGATE

Laboratory Num	per (32	01.18		Pay	Item 50/ Jumber 92- Examined For <u>704.02</u> CE-ST. JOHNSBURY
Project Name	JORK PLAN	1 92-1	C-17	Project N	lumber
Sampled By EL	US-ARMS	TRONGD	ate Sample	a 8/31/	92 Examined For 704.02
Sampled From	TOCEPILE	1011	Plant	LAWRENC	CE-ST. JUHNSBURY
Quantity Represe	inted	Sa	mole Type	ACCEPTI	ANCE
Sample Comparis			imple 19pc	Cross Refere	nce Number
bumpio company	///	2/11			
MATER	IAL TESTED	14 G	RAVEL	FOR CO.	NCRETE
SIEVE	WEIGHT	% REI	AINED	% PASSING	AGGREGATE MOISTURE CONTENT
SIZE	INDIV.	IND'V.	CUMUL.	CUMUL.	
RET					WET WEIGHT
RET					DRY WEIGHT
	-			100	MOISTURE CONTENT %
3/4	360.0	4		96	
RET 1/2	3101.6	31		65	1 NOTE: MOISTURE CONTENT (%) $=$
RET 3/8	2989.4	30		35	ww-wp
RET //	3226.0	32		3	X 100
RET 7		1			w _p
RET 8	114.0	1		2	
PAN	241.7	2			$\mathbf{w}_{\mathbf{W}} = \mathbf{W}\mathbf{E}\mathbf{T}$ WEIGHT
TOTAL	10032.7				$\mathbf{w}_{\mathbf{D}} = \mathrm{DRY} \mathrm{WEIGHT}$
Fineness Mo	odulus				
Cumu	l. Total Retain	ned/100 _			
Organic Imp	urities: Color				
T&E	= 7.8	= /.8	% Thin	& Elongated I	Pieces
Total Weigh					
Total Weigh	= 3819	= 864	5 % Fract	ured Faces	
Total weigh	t 44/			~	
Original Wei		8	Grading	S.	
Final Weight	3780	2	Percent W	ear <u>24.4</u>	AASHTO T96
(V) Test resu	lts are in com	pliance w	ith specifica	ations.	
() Test resu	lts are outside	enecifica	tions		
() rest resu	its are outside	specifica			
Comments:					
<u> </u>					
1	di	20			D.F. HALE
Tested By	un ou	leever			John H. Weaver, P.E. DEH
Date Completed	11/5/92	-		Date _///	5/9.2 Initials
			27	7	

EMABRR11

VERMONT AGENCY, OF, TRANSPORTATION MATERIALS AND RESEARCH DIVISION

REPORT ON SAMPLE OF AGGREGATE Preliminary Sample

Lab No: A930096		Report Date: 04/20	3/93
Project: Possible future us	e		
	Sampled By: Kelly		
Pay Item: CONCRETE, CLASS B	591,25	Date Sampled: 08/3	1/02
Material Name: Gradation Re	guirements for 3/4	" Stone	
Material Spec. No: 704.02B		Sampled From: Stoc	kpile
Haterial Spect Wor 104.025		Date Received: 08/	31/92
Sample Source: CALKINS SAND	& GRAVEL LYNDONVI	LLE VT	
Material Source: CALEINS SA		Tested By: D.Felch VILLE VT	1
in the second		Tests Complete: 04	/23/93
Quantity Rep:			3 10
Comment:		X-Ref No:	CS:
TOTAL SAMPLE OUTSIDE SIEVE PASSING SPECS 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" Mo. 4(F) No. 4 No. 30 No. 40 No. 40 No. 50 No. 40	TEST RESULTS FINENESS MODULUS % COARSER THAN No. 4 No. 8 No. 16 No. 30 No. 40 No. 50 No. 100	Fineness - Color - Grading = Percent of Wear AASHTO T96 - Frac Faces = Thin/Elong = Soundness = 1.	
No. 100 No. 200	Remarks: Results compliance with	of tests performed specifications.	l are in
			0

Comments:

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

For: R.F.Cauley Materials & Research Engineer

RSO.

AGENCY OF TRANSPORTATION

OFFICE MEMORANDUM

TO: John H. Weaver, Structural Concrete Engineer

FROM: Alan J. McBean Wransportation Geologist

DATE: June 17, 1992

SUBJECT: Petrographic Analysis of Aggregate From Calkins Quarry Lyndon, Vermont

On June 11, 1992 Reginald Holt and I visited the Calkins Quarry in Lyndon, Vermont and inspected two stockpiles of material, which had been manufactured from ledge exposed in the gravel pit currently being operated on the site.

The exposed ledge consists of interbedded limestone and phyllite of the Waits River Formation. A petrographic analysis was conducted on samples from each stockpile to determine the percentages of each rock type present. Tables 1 and 2 summarize the results.

TABLE 1 Upper Stockpile

		Pe	rcent	Retained	
Lithology/Mineral	3/4	1/2	3/8	No. 4	No. 8
Quartz	4.1	7.0	4.9	5.9	7.5
Phyllite	44.3	45.6	42.2	42.8	46.5
Limestone	51.5	47.4	52.9	51.3	46.1
Total	100.0	100.0	100.0	100.0	100.1

TABLE 2 Lower Stockpile

Lithology/Mineral	1/2	Percent 3/8	Retained No. 4	No. 8
Quartz	11.2	10.4	8.8	15.8
Phyllite	36.6	49.4	52.6	50.6
Limestone	52.2	39.3	38.6	32.8
Gravel		0.8		
Pyrite	•			0.2
Calcite				0.6
Total	100.0	99.9	100.0	100.0

Of the rock types observed, phyllite is the material which has the potential to behave poorly in concrete. Due to the thinly layered, fine grained texture of the rock, freeze-thaw cycling could result in premature failure of the aggregate. This material also tends to produce thin and/or elongated particle shapes. Further testing is needed to determine the freeze-thaw characteristics and overall performance of this material in concrete.

AJM/slv

cc: Lab File Central Files Reading AJM

LABRPT	Vermont Agency of Trai Materials and Researc	
Lab No: C930016	Report on Concrete Preliminary Sa	
	0.0.17	Report Date: 02/05/93
Project: WORK PLAN S Pay Item: Concrete,		Date Sampled: 11/09/92
	Concrete Class A 501.03A	Time Sampled: 10:30
Resident:		Sampled From: LAB MIX BATCH 7
Quantity Represented	1: 1.8 CF	Field Test By: CONCRETE DIV
Material Source: MAT	FERIALS & RESRARCH LAB	Lab Tested By: CONCRETE DIV
Location Used: PERFO	DRMANCE IN CONCRETE EVALUA	X-Ref No: CS:
Fine Agg : LAWREN	NS SAND & GRAVE LYNDONVILI NCE SANGRAVCO GUILDHALL V FALLS GLENS FALLS NY	
A/E Admix: DARAVAIR Admixture: WRDA / HY Admixture:	COL	Dosage: 4.0 OZ/CY Dosage: 3 OZ/CWT Dosage:
Comments:		
Test	Mir	Specs Indicates if Max Outside of Specs

APPENDIX D

t of	F Fresh Co	oncrete, po	of ;	148	B. ¦					
tent	, Percent	t	1	!	5. :	5.		7. 1		
			1	1	2. 1	2.		4.		
			1	3:	3. 1		35	.1 1		
			i				0.	44		
	emperature	. Deg F.	i			50		80 1		
			- 1							
Cyl	Date	Date	Des	Age	Hour		Brk	Avg	28 Day	Indic. if
				-				PSI		Out. Specs
151	11/09/92	11/16/92	7	7		S	3985	3957	4000	
151	11/09/92	11/16/92	7	7		S	3929	3957	4000	
150	11/09/92	11/23/92	14	14		S	4146	4319	4000	
150	11/09/92	11/23/92	14	14		S	4492	4319	4000	
	11/09/92	12/07/92	28	28		S	4980	4909	4000	
		12/07/92	28	28		S	4838	4909	4000	
	Inch Inch Inch Inch Inch Inch Inch Inch	tent, Percent Inches Mater, Gal/cy Temperature Cyl Date Wgt Received 151 11/09/92 150 11/09/92 150 11/09/92 11/09/92	tent, Percent Inches Mater, Gal/cy To Temperature, Deg F. Cyl Date Date Wgt Received Broken 151 11/09/92 11/16/92 151 11/09/92 11/23/92 150 11/09/92 11/23/92 11/09/92 12/07/92	Inches Mater, Gal/cy Tio Temperature, Deg F. Cyl Date Date Des Wgt Received Broken Age 151 11/09/92 11/16/92 7 151 11/09/92 11/16/92 7 150 11/09/92 11/23/92 14 150 11/09/92 12/07/92 28	tent, Percent 1 Inches 3 /ater, Gal/cy 3 io 0.4 io 0.4 <td>tent, Percent 5. Inches 2. Vater, Gal/cy 33. vio 0.42 ce Temperature, Deg F. 64 Cyl Date Date Des Age Hour Wgt Received Broken Age Brk Break 151 11/09/92 11/16/92 7 151 11/09/92 11/23/92 14 150 11/09/92 11/23/92 14 150 11/09/92 12/07/92 28</td> <td>tent, Percent 5. 5. Inches 2. 2. /ater, Gal/cy 33. 0.42 io 0.42 0.42 io 0.42 10 ce Temperature, Deg F. 64 50 Temperature, Deg F. 62 10 Cyl Date Date Des Age Hour Wgt Received Broken Age Brk Break F/S 151 11/09/92 11/16/92 7 7 151 11/09/92 11/23/92 14 14 S 150 11/09/92 11/23/92 14 14 S 150 11/09/92 12/07/92 28 28 S</td> <td>tent, Percent 5. 5. Inches 2. 2. /ater, Gal/cy 33. 35 /o 0.42 0. /cio 0.42 0. /ce Temperature, Deg F. 64 50 /ce Temperature, Deg F. 62 10 Cyl Date Des Age Hour Brk Wgt Received Broken Age Brk Break F/S PSI 151 11/09/92 11/16/92 7 7 S 3985 151 11/09/92 11/16/92 7 7 S 3929 150 11/09/92 11/23/92 14 14 S 4146 150 11/09/92 11/23/92 14 14 S 4492 11/09/92 12/07/92 28 28 S 4980</td> <td>tent, Percent 5. 5. 7. Inches 2. 2. 4. Vater, Gal/cy 33. 35.1 io 0.42 0.44 ce Temperature, Deg F. 64 50 80 ce Temperature, Deg F. 62 10 85 Cyl Date Date Des Age Hour Brk Avg Wgt Received Broken Age Brk Break F/S PSI PSI 151 11/09/92 11/16/92 7 7 S 3985 3957 151 11/09/92 11/16/92 7 7 S 3929 3957 150 11/09/92 11/23/92 14 14 S 4146 4319 150 11/09/92 11/23/92 14 14 S 4492 4319 11/09/92 12/07/92 28 28 S 4980 4909</td> <td>tent, Percent 5. 5. 7. Inches 2. 2. 4. Vater, Gal/cy 33. 35.1 vio 0.42 0.44 ve Temperature, Deg F. 64 50 80 ve Temperature, Deg F. 62 10 85 Cyl Date Date Des Age Hour Brk Avg 28 Day Wgt Received Broken Age Brk Break F/S PSI PSI Spec 151 11/09/92 11/16/92 7 7 S 3985 3957 4000 151 11/09/92 11/16/92 7 7 S 3929 3957 4000 150 11/09/92 11/23/92 14 14 S 4146 4319 4000 150 11/09/92 11/23/92 14 14 S 4492 4319 4000 150 11/09/92 12/07/92 28 28 S 4980 4909 4000</td>	tent, Percent 5. Inches 2. Vater, Gal/cy 33. vio 0.42 ce Temperature, Deg F. 64 Cyl Date Date Des Age Hour Wgt Received Broken Age Brk Break 151 11/09/92 11/16/92 7 151 11/09/92 11/23/92 14 150 11/09/92 11/23/92 14 150 11/09/92 12/07/92 28	tent, Percent 5. 5. Inches 2. 2. /ater, Gal/cy 33. 0.42 io 0.42 0.42 io 0.42 10 ce Temperature, Deg F. 64 50 Temperature, Deg F. 62 10 Cyl Date Date Des Age Hour Wgt Received Broken Age Brk Break F/S 151 11/09/92 11/16/92 7 7 151 11/09/92 11/23/92 14 14 S 150 11/09/92 11/23/92 14 14 S 150 11/09/92 12/07/92 28 28 S	tent, Percent 5. 5. Inches 2. 2. /ater, Gal/cy 33. 35 /o 0.42 0. /cio 0.42 0. /ce Temperature, Deg F. 64 50 /ce Temperature, Deg F. 62 10 Cyl Date Des Age Hour Brk Wgt Received Broken Age Brk Break F/S PSI 151 11/09/92 11/16/92 7 7 S 3985 151 11/09/92 11/16/92 7 7 S 3929 150 11/09/92 11/23/92 14 14 S 4146 150 11/09/92 11/23/92 14 14 S 4492 11/09/92 12/07/92 28 28 S 4980	tent, Percent 5. 5. 7. Inches 2. 2. 4. Vater, Gal/cy 33. 35.1 io 0.42 0.44 ce Temperature, Deg F. 64 50 80 ce Temperature, Deg F. 62 10 85 Cyl Date Date Des Age Hour Brk Avg Wgt Received Broken Age Brk Break F/S PSI PSI 151 11/09/92 11/16/92 7 7 S 3985 3957 151 11/09/92 11/16/92 7 7 S 3929 3957 150 11/09/92 11/23/92 14 14 S 4146 4319 150 11/09/92 11/23/92 14 14 S 4492 4319 11/09/92 12/07/92 28 28 S 4980 4909	tent, Percent 5. 5. 7. Inches 2. 2. 4. Vater, Gal/cy 33. 35.1 vio 0.42 0.44 ve Temperature, Deg F. 64 50 80 ve Temperature, Deg F. 62 10 85 Cyl Date Date Des Age Hour Brk Avg 28 Day Wgt Received Broken Age Brk Break F/S PSI PSI Spec 151 11/09/92 11/16/92 7 7 S 3985 3957 4000 151 11/09/92 11/16/92 7 7 S 3929 3957 4000 150 11/09/92 11/23/92 14 14 S 4146 4319 4000 150 11/09/92 11/23/92 14 14 S 4492 4319 4000 150 11/09/92 12/07/92 28 28 S 4980 4909 4000

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

Flexural Strength Tests Conducted in accordance with AASHTO T97

LABRPT	Vermont Agency of Tra Materials and Resear		Distribution List Central Files R. HALE
	Report on Concrete Preliminary S		
Lab No: C930017			02/05/02
Project: WORK PLAN 92	-C-17	Report Date:	
Pay Item: Concrete, (lass A 501.22	Date Sampled:	11/09/92
Material Name/Type: (concrete Class A 501.034	Time Sampled:	11:15
Resident:			LAB MIX BATCH 8
		Field Test By:	CONCERTE DIV
Quantity Represented:	1.8 CF	Lab Tested By:	CONCRETE DIV
Material Source: MATE	RIALS & RESEARCH LAB		
Location Used: PERFOR	MANCE IN CONCRETE EVALU	JATION X-Ref No:	00.
Fine Agg : LAWRENC	SAND & GRAVE LYNDONVII E SANGRAVCO GUILDHALL V QUEBEC INC QUEBEC CANAI	LE VT /T Total Age	CS: g. Dry Wgt: 2908 Lbs: 660
A/E Admix: DARAVAIR Admixture: WRDA / HYC Admixture:	OL	Dosage: 4 Dosage: 3 Dosage:	
Comments:			
Test	м		Indicates if Outside of Specs
Unit Wgt of Fresh Cor Air Content, Percent Slump, Inches Total Water, Gal/cy W/C Ratio Concrete Temperature, Ambient Temperature,	Deg F. 146. 5.8 2.75 32.5 0.41 64	5. 7. 2. 4. 35.1 0.44 50 80 10 85	
Specm. Cyl Date No. Wgt Received E	Date Des Age Hour roken Age Brk Break f		8 Day Indic. if Spec Out. Specs
TA07 149 11/09/92 1 TA08 149 11/09/92 1 TA09 148 11/09/92 1 TA10 148 11/09/92 1 TA10 148 11/09/92 1 TA11 11/09/92 1 TA12 11/09/92 1 Remarks: Results of t Comments:	1/16/92 7 7 1/23/92 14 14 1/23/92 14 14 2/07/92 28 28	S 4040 3987 S 3933 3987 S 4331 4371 S 4411 4371 S 4870 4884 S 4898 4884	4000 4000 4000 4000 4000 4000 Specifications.
	Tests Conducted in acco	ordance with AASH	ITO T22

LABRPT	Vermont Agency of Tra Materials and Resear		Distribution List Central Files R. HALE
	Report on Concrete Preliminary S		
Lab No: C930018 Project: WORK PLAN 92- Pay Item: Concrete, Cl		Report Date: Date Sampled:	
Material Name/Type: Co Resident:			8:45 LAB MIX BATCH 5
Quantity Represented: Material Source: MATER		Field Test By: Lab Tested By:	
Location Used: PREFORM Coarse Agg : LAWRENCE Fine Agg : LAWRENCE Cement Brand: CIMENT Q A/E Admix: DARAVAIR Admixture: WRDA / HYCO	SANGRAVCO GUILDHALL V SANGRAVCO GUILDHALL V UEBEC INC QUEBEC CANAD	X-Ref No: T T Total Ag	g. Dry Wgt: 2933 Lbs: 660 4 OZ/CY
Admixture: Comments: Test	Mi	-	Indicates if Outside of Specs
Unit Wgt of Fresh Conc Air Content, Percent Slump, Inches Total Water, Gal/cy W/C Ratio Concrete Temperature, Ambient Temperature, D	6.2 2.5 33.1 0.42 Deg F. 62	$5. 7. 2. 4. 35.1 \\ 0.44 \\ 50 \\ 80 \\ 10 \\ 85 \\ 10 \\ 85 \\ 10 \\ 10 \\ 85 \\ 10 \\ 10 \\ 10 \\ 10 \\ 10 \\ 10 \\ 10 \\ 1$	
Specm. Cyl Date D No. Wgt Received Br	ate Des Age Hour oken Age Brk Break F		28 Day Indic. if Spec Out. Specs
RA114811/09/9211RA214811/09/9211RA314911/09/9211RA414911/09/9211RA511/09/9212RA611/09/9212	/16/92 7 7 /23/92 14 14 /23/92 14 14 /07/92 28 28	S 3645 3694 S 3743 3694 S 4296 4328 S 4359 4328 S 4948 4932 S 4916 4932	4000 4000 4000 4000 4000 4000
Remarks: Results of te Comments:	sts performed are in c	ompliance with	Specifications.

Flexural Strength Tests Conducted in accordance with AASHTO T97

LABRPT	Vermont Agency of Tran Materials and Researc		tion List Files
	Report on Concrete Preliminary Sa		
Lab No: C930019 Project: WORK PLA	N 92-C-17	Report Date: 02/05/93	
	e, Class A 501.22	Date Sampled: 11/09/92	
	e: Concrete Class A 501.03A	Time Sampled: 9:30 Sampled From: LAB MIX B	ATCH 6
Resident: Quantity Represen		ield Test By: CONCRETE	DIV
		ab Tested By: CONCRETE	DIV
Location Used: PE	RFORMANCE IN CONCRETE EVALUA	ION X-Ref No:	cs:
Fine Agg : LAW	RENCE SANGRAVCO GUILDHALL VT RENCE SANGRAVCO GUILDHALL VT ENT QUEBEC INC QUEBEC CANADA	Total Agg. Dry Wgt Type: 2 Lbs	: 2933
A/E Admix: DARAVA Admixture: WRDA / Admixture:		Dosage: 4 OZ/CY Dosage: 3 OZ/CWT Dosage:	
Comments:			
Test	Min	Specs Indicates Max Outside of	
Unit Wgt of Fresh Air Content, Perc Slump, Inches Total Water, Gal/ W/C Ratio Concrete Temperat Ambient Temperatu	cy 2.5 2 33.5 0.42 ure, Deg F. 65 5	4. 35.1 0.44 0 80	
Specm. Cyl Date No. Wgt Receiv	Date Des Age Hour ed Broken Age Brk Break F/	Brk Avg 28 Day Ind S PSI PSI Spec Out	lic. if . Specs

NO.	wgt Received	Broken	Age	Brk	Break	F/3	P51	P31	spec	out.	specs	
												-
	148 11/09/92					5		3521				
RA08	148 11/09/92	11/16/92	7	7		S	3533	3521	4000			
RA09	148 11/09/92	11/23/92	14	14		S	4163	4188	4000			
RA10	148 11/09/92	11/23/92	14	14		S	4212	4188	4000			
RA11	11/09/92	12/07/92	28	28		S	4722	4722	4000			
RA12	11/09/92	12/07/92	28	28		S	4722	4722	4000			

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

Compressive Strength Tests Conducted in accordance with AASHTO T22

LABRPT	Vermont Agency of Transpor Materials and Research Di	
Lab No: C930020	Report on Concrete Cyli Preliminary Sample	nder
Project: WORK PLAN 92		port Date: 02/05/93
Pay Item: Concrete, C	Dat	e Sampled: 11/16/92
	Timo oncrete Class B 501.03A	e Sampled: 9:00
Resident:		pled From: LAB MIX BATCH 3
Quantity Represented:	1.8 CF	d Test By: CONCRETE DIV
Material Source: MATE		Tested By: CONCRETE DIV
Location Used: PERFOR	MANCE IN CONCRETE EVALUATION	X-Ref No: CS:
Fine Agg : LAWRENC	SAND & GRAVE LYNDONVILLE VT E SANGRAVCO GUILDHALL VT QUEBEC INC QUEBEC CANADA	Total Agg. Dry Wgt: 2968 Type: 2 Lbs: 611
A/E Admix: DARAVAIR Admixture: WRDA / HYC Admixture:	OL	Dosage: 2 OZ/CY Dosage: 3 OZ/CWT Dosage:

	Specs Indicates if
Test	Min Max Outside of Specs
Unit Wgt of Fresh Concrete,pcf 14	5.
Air Content, Percent 5	.4 4. 6.
Slump, Inches 3.	25 2. 4.
Total Water, Gal/cy 32	.6 35.75
W/C Ratio 0.	45 0.49
Concrete Temperature, Deg F.	64 50 80
Ambient Temperature, Deg F.	69 10 85
Specm. Cyl Date Date Des Age	Hour Brk Avg 28 Day Indic. if
No. Wgt Received Broken Age Brk	Break F/S PSI PSI Spec Out. Specs
TB1 150 11/16/92 11/23/92 7 7	\$ 3683 3745 3500
TB2 150 11/16/92 11/23/92 7 7	S 3806 3745 3500
TB3 150 11/16/92 11/30/92 14 14	S 4322 4335 3500
TB4 150 11/16/92 11/30/92 14 14	S 4347 4335 3500
TB5 11/16/92 12/14/92 28 28	S 4726 4691 3500
TB6 11/16/92 12/14/92 28 28	

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

Compressive Strength Tests Conducted in accordance with AASHTO T22

LABRPT	Vermont Agency of Tra Materials and Resear	ch Division	Distribution List Central Files R. HALE
Lab No: C930021	Report on Concrete Preliminary S		
Project: WORK PLAN	92-C-17	Report Date: 0	2/05/93
Pay Item: Concrete,		Date Sampled: 1	1/16/92
	Concrete Class B 501.03A		
Resident:		Sampled From: L	
Quantity Represente	d: 1.8 CF	Field Test By: C Lab Tested By: C	
Material Source: MA	TERIALS & RESEARCH LAB	Lab rested by: 0	ONCRETE DIV
Location Used: PERF	ORMANCE IN CONCRETE EVALU	ATION X-Ref No:	CS:
Fine Agg : LAWRE	NS SAND & GRAVE LYNDONVIL NCE SANGRAVCO GUILDHALL V T QUEBEC INC QUEBEC CANAD	LE VT T Total Agg.	Dry Wgt: 2968 Lbs: 611
A/E Admix: DARAVAIR Admixture: WRDA / H Admixture:		Dosage: 2 Dosage: 3 Dosage:	

				Sp	ecs		Indicates if					
Test					1	Min	Ма	x	Outsid	e of S	pecs	
Air Cor Slump, Total W W/C Rat	Incl Incl Vate	f Fresh Co t, Percent hes r, Gal/cy emperature	t	of	4 2. 30 0.	.5 .7 .7 .9 .42 .66	4. 2. 50	35. 0.	6. 4. 75 49 80			
		mperature		ł		69	10		85			
	-	Date Received			-	Hour Break			Avg PSI	28 Day Spec		
TB07		11/16/92			7		S	3929	3908	3500		
TB08		11/16/92					S	3887	3908	3500		
TB09		11/16/92			14		S	4435	4439	3500		
TB10	152	11/16/92			14		S	4442	4439	3500		
TB11			12/14/92		28		S	5023	4917	3500		
TB12		11/16/92	12/14/92	28	28		S	4811	4917	3500		

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

Compressive Strength Tests Conducted in accordance with AASHTO T22

LABRPT	Vermont Agency of Tran Materials and Researd		Distribution List Central Files R. HALE
Lab No: C930022	Report on Concrete Preliminary Sa		
	29-0-17	Report Date:	02/05/93
Project: WORK PLAN S Pay Item: Concrete,		Date Sampled:	11/16/92
	Concrete Class B 501.03A	Time Sampled:	10:00
Resident:		Sampled From:	LAB MIX BATCH 1
Quantity Represented	d: 1.8 CF	Field Test By:	CONCRETE DIV
	TERIALS & RESEARCH LAB	Lab Tested By:	CONCRETE DIV
Location Used: PERF	DRMANCE IN CONCRETE EVALUA	TION	
Coarse Agg : LAWRE	NCE SANGRAVCO GUILDHALL VI	X-Ref No:	CS:
	NCE SANGRAVCO GUILDHALL VI T QUEBEC INC QUEBEC CANADA	•••	. Dry Wgt: 3052 Lbs: 611
A/E Admix: DARAVAIR Admixture: WRDA / H` Admixture:		Dosage: 2 Dosage: 3 Dosage:	

Test			I	Sp Min	ecs Ma	x	Indica Outsid	tes if e of Specs			
Air Con Slump, Total W/C Rat Concret	nten Incl Wate tio te Te	t, Percen	e, Deg F.	of	5 3.2 31 0.4	.3	4. 2. 50 10	35. 0.	49 80 85		
	-	Date Received			-	Hour Break		Brk PSI	Avg PSI	•	Indic. if Out. Specs
RB1 RB2 RB3 RB4 RB5 RB6	152 152	11/16/92 11/16/92 11/16/92 11/16/92	11/23/92 11/23/92 11/30/92 11/30/92 12/14/92 12/14/92	7 14 14 28	7 7 14 14 28 28	3:00 3:00	S S S S S S S	3768 3799 4241 4209 4786 4935	3784 3784 4225 4225 4861 4861	3500 3500 3500 3500 3500 3500 3500	

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

Compressive Strength Tests Conducted in accordance with AASHTO T22

LABRPT	Vermont Agency of Tra Materials and Resear		Distribution List Central Files R. HALE
Lab No: C930023	Report on Concrete Preliminary S		
Project: WORK PLAN	22-0-17	Report Date:	02/05/93
Pay Item: Concrete,		Date Sampled:	11/16/92
	Concrete Class B 501.03A	Time Sampled:	11:00
Resident:		Sampled From:	LAB MIX BATCH 2
Quantity Represented	d: 1.8 CF	Field Test By:	
Material Source: MA	TERIALS & RESEARCH LAB	Lab Tested By:	CONCRETE DIV
Location Used: PERF	DRMANCE IN CONCRETE EVALU	ATION X-Ref No:	cs:
Fine Agg : LAWRE	NCE SANGRAVCO GUILDHALL V NCE SANGRAVCO GUILDHALL V F QUEBEC INC QUEBEC CANAD	T T Total Agg	. Dry Wgt: 3052 Lbs: 611
A/E Admix: DARAVAIR Admixture: WRDA / H` Admixture:	YCOL	Dosage: 2 Dosage: 3 Dosage:	

			Specs			Indicates if	
Test			Min	Ма	x	Outsid	e of Specs
Unit Wgt of Fresh Concrete,pcf	146	6. ¦			:		
Air Content, Percent	5.	.4	4.		6.		
Slump, Inches	2.7	75	2.		4.		
Total Water, Gal/cy	31.	.2		35.	75		
W/C Ratio	0.4	43 ¦		0.	49 ¦		
Concrete Temperature, Deg F.	: 6	66	50		80		
Ambient Temperature, Deg F.	1 6	59 ¦	10		85 ¦		
Specm. Cyl Date Date De	s Age	Hour		Brk	Avg	28 Day	Indic. if
No. Wgt Received Broken Ag	e Brk	Break	F/S	PSI	PSI	Spec	Out. Specs
RB07 152 11/16/92 11/23/92 7			S	3848	3871	3500	
	7		S	3894	3871	3500	
RB09 151 11/16/92 11/30/92 1	4 14		S	4559	4570	3500	
RB10 151 11/16/92 11/30/92 1	4 14		S	4580	4570	3500	
RB11 11/16/92 12/14/92 2	8 28	3:00	S	4839	4806	3500	
RB12 11/16/92 12/14/92 2	8 28	3:00	S	4772	4806	3500	

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

Compressive Strength Tests Conducted in accordance with AASHTO T22

APPENDIX E

1A 565 Rev. 4/79	Prepared By: R.J. Holt W Date: 6/17/92 Sheet1 of 1
STATE OF VERMONT AGENCY OF TRANSPORTATION MATERIALS & RESEARCH DIVISIO	мС
RESEARCH INVESTIGATION	
Work Plan No. 92-C-17	
SubjectEvaluation of Crushed Stone Coarse Aggregate	
Investigation Requested By Michael Classen	St.Johnsbury, Vermont Date Received 5/12/1992
Date Information Required ASAP	
Purpose of Investigation To evaluate a crushed stone co	arse aggregate from the Calkins
Quarry, proposed for use as a structural concrete aggr	regate. Quarry is located in
Lyndon, Vermont.	
Proposed Tests or Evaluation Procedure See Vermont Proc	edure For Evaluating a New Source
of Structural Concrete Aggregate VT-AOT-MRD 9-82.	
1. Performance-in-concrete tests will be perfor	med using two batches each of
Class A and Class B concrete containing the	proposed new aggregate and two
batches each of Class A and Class B concrete	containing a reference
aggregate.	
2. Prepare specimens from each batch of concret	e to determine resistance to
freezing and thawing.	
Proposal Discussed With John Weaver Projected Manpow	er Requirements 25 man days
Investigation To Be Conducted By Structural Concrete Sub	odivision
Proposed Starting Date 06/22/92 Estimated Comple	tion Date 08/28/92
Approval/Disapproval by Materials & Research Engineer 10	Must Caufus
Comments by Materials & Research Engineer	
Materials & Research Division Agency of Transportation Date Typed:	