EVALUATION OF
19.05 mm (3/4 IN) CRUSHED STONE
FROM CALKINS SAND & GRAVEL CORP.
COVENTRY, VERMONT
FOR USE IN STRUCTURAL CONCRETE

REPORT 94-10
DECEMBER 1994

REPORTING ON WORK PLAN 94-R-18

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION

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Date: 10 Jan 95

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Note: Values shown in the text are presented in SI (International System) units, with US customary units shown in parentheses. Generally, SI units are direct conversions and should not be considered as the standard, in referenced specifications.

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 19.05 mm (3/4 in) crushed stone produced at the Calkins Sand & Gravel Corp. facility in Coventry, Vermont. Prior to development and production of the crushed stone, the Coventry facility had been used for many years to produce fine aggregate and crushed gravel materials for a wide variety of applications.

Test results and evaluation confirm the new material meets the required specifications as a 19.05 mm (3/4 in) 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.

The Calkins Sand & Gravel, Inc. facility in Coventry, Vermont, for many years has produced fine aggregate and crushed gravel materials for use in highway, residential and many other applications. More recently, a ledge outcrop at the site has been developed by the company and crushed stone materials are now being processed at the facility, as well as the crushed gravel products.

During December 1993, Mr. Bruce Warner, Quality Control Manager of Calkins Redimix Concrete, requested the Materials and Research Division conduct an evaluation of the new 19.05 mm (3/4 in) crushed stone processed at the Coventry facility. Following his request, samples of the new material 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. The Agency of Transportation's Chief Geologist also traveled to the site to obtain samples for petrographic analysis of the material.

An initial sample of 19.05 mm (3/4 in) crushed stone obtained on December 21, 1993 complied with gradation, wear, fractured faces, thin and elongated pieces and soundness requirements. The Transportation Geologist performed a petrographic analysis and determined the material was similar to material generated at the Lebanon Crushed Stone Quarry in Lebanon, New Hampshire. The Geologist noted, however, that the Coventry material was variable and that less competent rock types were present in the quarry. Petrographic analyses were also performed by the Geologist on several sizes of coarse aggregate manufactured for use in bituminous concrete.

Conditional approval to use the crushed stone coarse aggregate in Vermont Agency of Transportation (AOT) structural concrete was granted on April 8, 1994. The approval was contingent upon successful completion of freeze-thaw tests of concrete containing the new aggregate. 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 December 21, 1993, by Materials and Research Division representatives, from a stockpile at the Calkins Sand & Gravel facility in Coventry, Vermont. The 19.05 mm (3/4 in) crushed stone was examined for Gradation (AASHTO T 27), Percent of Wear (AASHTO T 96), Thin and Elongated Pieces (VT AOT-MD 22), Fractured Faces (VT AOT-MD 23) and Sodium Sulfate Soundness (AASHTO T104). When newly produced material was desired for "Performance-in-Concrete Tests", subsequent samples of 9.5 mm (3/8 in) and 19.05 mm (3/4 in) material were obtained on June 30, 1994 and blended to produce the required grading.

The fine aggregate and reference coarse aggregate (19.05 mm [3/4 in] crushed gravel) are also produced at the Coventry facility and samples of these materials were obtained at that location. The fine aggregate and reference 19.05 mm (3/4 in) crushed gravel coarse aggregate are used routinely at the Coventry ready mix plant and were examined only for Gradation (AASHTO T 27).

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, Reference Coarse Aggregate and Proposed New Aggregate

Calkins Sand & Gravel, Coventry, Vermont

Cement

Type II
Ciment Quebec Inc., St. Basile, Quebec, Canada

Air Entraining Admixture

Darex II
W. R. Grace Co., Cambridge, Massachusetts

Water Reducing Admixture

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

Aggregate properties used for preparing mix designs are shown in Table 1 and Table 2, in Appendix A. Mix proportions used are shown in Table 3-SI and Table 3-US in Appendix B.

The concrete used in this evaluation was mixed in a Sears rotary drum mixer with batch size being 0.042 m^3 (1.5 ft^3). Aggregates were air dried prior to the start of mixing operations. Two batches each of Class A and Class B concrete containing 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.

Tests were performed on the fresh concrete to determine Slump (AASHTO T 119), Air Content (AASHTO T 152) and Unit Weight (AASHTO T 121). Six test cylinders, 152.4 mm x 304.8 mm (6 in x 12 in), and two freeze-thaw specimens, 76.2 mm wide x 76.2 mm deep x 406.4 mm long (3 in x 3 in x 16 in), were cast from each batch. The cylinders were tested for compressive strength (AASHTO T 22), two each at ages seven, 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) in 3% NaCl solution.

RESULTS AND DISCUSSION

1. Samples of the proposed new coarse aggregate obtained from the Calkins Sand & Gravel facility in Coventry, Vermont were found to be in compliance with the requirements of Section 704.02 when tested in conjunction with this evaluation. The fine aggregate and reference coarse aggregate were also found to comply respectively with Section 704.01 and Section 704.02 requirements. Fine aggregate test results are displayed in Table 4, in Appendix C. Coarse aggregate test results are also shown in Appendix C, in Table 5 and Table 6. Copies of the Chief Geologist's petrographic analyses are shown in Appendix D.

2. Test data for fresh and hardened concrete, for all batches, is exhibited in Tables 7-SI and 7-US in Appendix E.

3. The average 28 day compressive strengths of concrete containing the Calkins Sand & Gravel 19.05 mm (3/4 in) crushed stone coarse aggregate were approximately equal to the strengths of concrete containing the reference aggregate. Class A concrete containing proposed new aggregate from the Coventry quarry had an average compressive strength of 33.19 MPa (4814 psi) at 28 days, while the Class A concrete containing reference aggregate yielded an average compressive strength of 33.20 MPa (4815 psi). The Class B concrete containing the new 19.05 mm (3/4 in) crushed stone aggregate from Calkins quarry in Coventry had an average compressive strength of 32.01 MPa (4643 psi) at 28 days, while the Class B concrete containing the reference aggregate had an average compressive strength of 32.87 MPa (4768 psi).

4. Results of freezing and thawing tests showed reduced performance for concrete containing the new aggregate, when compared with concrete containing the reference aggregate. Both Class A and Class B concrete with the new aggregate had specimens which were too deteriorated for sonic tests to be completed through the entire 300 cycles. However, weight loss results were not significantly different from the concretes containing reference aggregates. The average weight loss of Class A concrete was 0.8% greater than the weight loss of concretes containing the reference aggregate. Class B concrete containing the new aggregate showed 4% greater average weight loss than Class B concrete with the reference aggregate.

5. Mix design tables (Appendix B) indicate Class A and Class B mixtures containing new aggregates required comparable quantities of mixing water to develop air contents and slumps similar to the mixes containing the reference aggregates.

RECOMMENDATIONS

1. It is recommended that the new crushed stone coarse aggregate produced at the Calkins Sand & Gravel Corp. facility in Coventry, Vermont be approved for use in structural concrete.

2. During the initial uses of concrete containing the crushed stone coarse aggregate on Agency projects, Materials and Research Division representatives shall conduct tests necessary to determine the performance of the material 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 - G

TABLE 1

FINE AGGREGATE PROPERTIES

	Bulk Specific Gravity	Absorption, Percent	Fineness Modulus
Calkins Sand & Gravel Coventry, Vermont	2.63	1.3	2.90

TABLE 2

COARSE AGGREGATE PROPERTIES

	Bulk Specific Gravity	Absorption, Percent	Dry Rodded Unit Weight, kg/m^3 (lbs/ft^3)
Proposed New Aggregate 19.05 mm (3/4 in) Crushed Stone Calkins Sand & Gravel, Coventry, Vermont	2.82	0.8	1648 (102.86)
Reference Aggregate 19.05 mm (3/4 in) Crushed Gravel Calkins Sand & Gravel, Coventry, Vermont	2.75	1.0	1701 (106.18)

TABLE 3-SI

CONCRETE MIX DESIGNS

BATCH QUANTITIES PER CUBIC METER

Material	New Aggregate Batch Numbers*1 Class A		Class B		Reference Aggregate Batch Numbers*2 Class A		Class B	
	1A-ST	2A-ST	1B-ST	2B-ST	1A-GR	2A-GR	1B-GR	2B-GR
*3 19.1 mm Stone, kg	996.12	996.12	996.12	996.12	1030.53	1030.53	1030.53	1030.53
*3 Sand, kg	792.03	792.03	865.01	865.01	737.45	737.45	810.42	810.42
Cement, kg	391.57	391.57	362.50	362.50	391.57	391.57	362.50	362.50
Darex II, L	0.34	0.34	0.23	0.23	0.33	0.33	0.23	0.23
WRDA/Hycol, L	0.77	0.77	0.71	0.71	0.77	0.77	0.71	0.71
Net water, L	163.88	165.37	158.93	164.38	163.88	164.38	160.91	160.42

*1 Batch numbers designated ST contain crushed stone coarse aggregate.
*2 Batch numbers designated GR contain crushed gravel coarse aggregate.
*3 Weights converted to saturated surface-dry condition.

TABLE 3-US

CONCRETE MIX DESIGNS

BATCH QUANTITIES PER CUBIC YARD

Material	New Aggregate Batch Numbers*1 Class A		Class B		Reference Aggregate Batch Numbers*2 Class A		Class B	
	1A-ST	2A-ST	1B-ST	2B-ST	1A-GR	2A-GR	1B-GR	2B-GR
*3 3/4 in. Stone, lbs	1679	1679	1679	1679	1737	1737	1737	1737
*3 Sand, lbs	1335	1335	1458	1458	1243	1243	1366	1366
Cement, lbs	660	660	611	611	660	660	611	611
Darex II, oz	8.8	8.8	6.0	6.0	8.6	8.6	6.0	6.0
WRDA/Hycol, oz	19.8	19.8	18.3	18.3	19.8	19.8	18.3	18.3
Net water, gal	33.1	33.4	32.1	33.2	33.1	33.2	32.5	32.4

*1 Batch numbers designated ST contain crushed stone coarse aggregate.
*2 Batch numbers designated GR contain crushed gravel coarse aggregate.
*3 Weights converted to saturated surface-dry condition.

TABLE 4

FINE AGGREGATE TEST DATA

Calkins Sand & Gravel
Coventry, Vermont

Sieve Size SI	(US)	Date Sampled 6/16/94 Percent Passing	AOT Specification Requirements
9.50 mm	(3/8")	100	100
4.75 mm	(No. 4)	100	95-100
2.36 mm	(No. 8)	85	-
1.18 mm	(No. 16)	60	50- 80
600 µm	(No. 30)	38	25- 60
300 µm	(No. 50)	20	10- 30
150 µm	(No. 100)	7	2- 10
Fineness Modulus		2.90	2.60-3.10

TABLE 5

COARSE AGGREGATE TEST DATA (Proposed New Aggregate)

19.05 mm (3/4 in) Crushed Stone
Calkins Sand & Gravel
Coventry, Vermont

Sieve Size SI	(US)	Dates Sampled 12/21/93 Percent Passing	6/30/94 Percent Passing	AOT Specification Requirements
25.40 mm	(1")	100	100	100
19.05 mm	(3/4")	99	96	90-100
9.50 mm	(3/8")	23	23	20- 55
4.75 mm	(No. 4)	6	7	0- 10
2.36 mm	(No. 8)	3	1	0- 5
L.A. Abrasion, % loss		28.6	-	35 maximum
Thin and Elongated Pieces, %		3.0	-	10 maximum
Fractured Faces, %		100.0	-	100 minimum
Soundness, % loss		0.57	-	8 maximum

TABLE 6

COARSE AGGREGATE TEST DATA (Reference Aggregate)

19.05 mm (3/4 in) Crushed Gravel
Calkins Sand & Gravel
Coventry, Vermont

Sieve Size SI	Sieve Size (US)	Date Sampled 6/16/94 Percent Passing	AOT Specification Requirements
25.40 mm	(1")	100	100
19.05 mm	(3/4")	100	90-100
9.50 mm	(3/8")	32	20- 55
4.75 mm	(No. 4)	3	0- 10
2.36 mm	(No. 8)	1	0- 5

Appendix "D"

DFH-3/28/94

AGENCY OF TRANSPORTATION OFFICE MEMORANDUM

TO: David F. Hale, Structural Concrete Engineer

FROM: Alan J. McBean, AJM Transportation Geologist

DATE: March 23, 1994

SUBJECT: Calkins Quarry, Coventry, Vt., Petrographic Analysis

On December 21, 1993, a site inspection was made at the Calkins Quarry in Coventry, Vermont.

The quarry is located in the Coburn Hill member of the Missisquoi Formation. The lithologies seen in the quarry are foliated (layered) greenstone and a more massive amphibolite. Typically, the foliated material forms layers 2 to 12 inches thick between thicker sections of the massive amphibolite. The foliated material is soft and incompetent and can be pulled from the quarry face by hand. The amphibolite is a hard, unweathered material which should produce excellent aggregate.

The coarse aggregate examined had an equant to tabular particle shape, 100% fractured faces, and was essentially unweathered. The massive amphibolite still exhibits some foliation, but this does not appear to adversely affect the aggregate quality. Wear and soundness tests will be key to evaluate this aggregate for the presence of incompetent material. If a significant quantity of the foliated greenstone is present in the coarse aggregates, percent wear and percent loss in the soundness test should increase. However, it appears that this soft material completely disintegrates and ends up in the crusher dust.

This massive amphibolite aggregate is similar to the material generated at the Lebanon Crushed Stone Quarry in Lebanon, N.H. However, due to the variability of the Coventry material and the presence of less competent rock types in the quarry, it may be prudent to perform a freeze-thaw test series to determine if enough of the poor quality material is present to affect the aggregate's performance.

etn

c AJM File
Project File
Read. File

AGENCY OF TRANSPORTATION OFFICE MEMORANDUM

TO: Charles Jerd, Bituminous Concrete Supervisor

FROM: Alan J. McBean, AJM Transportation Geologist

DATE May 27, 1994

SUBJECT Calkins Quarry - Coventry, Vermont

Petrographic analyses were performed on samples of 3/4", 1/2", and 3/8" aggregate manufactured for use in bituminous concrete. The results are as follows:

Lithology	Percent 3/4	Percent 1/2	Percent 3/8
Vein quartz/calcite	6.5	7.2	5.6
Medium grained, foliated amphibolite	78.6	81.6	70.4
Quartz-chlorite schist	14.9	11.3	23.9

The rock type of concern is the quartz-chlorite schist. This material was seen in a very weathered state in the cap rock when the quarry was first opened. Hence, it did not appear in the coarse aggregate being manufactured at that time as it was either being washed out as fines or exiting the crushing loop in size fractions not found in the coarse aggregate gradations. (See memo dated March 23, 1994 to David F. Hale).

At present, the working face of the quarry has increased in height and width and is producing much fresher material. The schist which was very weathered originally is now fresh rock which is durable enough to survive as coarse aggregate in the crushing circuit. The results of the petrographic analysis indicate that this material is still being preferentially concentrated in the finer size fractions as evidenced by a two-fold increase between the 1/2" and 3/8" samples. The LA Abrasion (AASHTO T-96) values seem to reflect this increase; the value for the B grading using a combined sample from the 3/4" and 1/2" materials was 25.4 and the value for the C grading, which uses just the 3/8" sample, was 29.9 percent loss. Therefore, the percent loss obtained by the wear test seems to be an indicator of the amount of schist in the sample. If the amount of schist gets too high, the wear will probably exceed the 35 percent allowed in the Standard Specifications.

Aggregate soundness results obtained from stone screenings manufactured from the less weathered parent rock also indicate an improvement in aggregate quality. Three Sodium Sulfate Soundness tests were run with the results ranging from 4.8 percent to 5.6 percent. The mean value was 5.23 percent with a standard error of 0.40 percent. Considering the poor repeatability of this test these are very consistent results and seem to indicate that the weathered material found in the first round of samples is not a factor at this time. The quarry operator will need to exercise care in the development of this source so that we do not see a repeat of poor quality material in the fine aggregates produced.

It is my opinion that both coarse and fine aggregates produced from the Calkins quarry are acceptable for use in bituminous concrete mixes.

clp

Nate Danforth
D.F. Hale
AJM File
Read File
Central File

MCBEAN\CALKINS.M27

TABLE 7-SI

CONCRETE TEST RESULTS

Test	New Aggregate Batch Numbers Class A 1A-ST	New Aggregate Class A 2A-ST	New Aggregate Class B 1B-ST	New Aggregate Class B 2B-ST	Reference Aggregate Batch Numbers Class A 1A-GR	Reference Aggregate Class A 2A-GR	Reference Aggregate Class B 1B-GR	Reference Aggregate Class B 2B-GR
Slump, mm	69.9	63.5	63.5	69.9	76.2	76.2	69.9	69.9
Air content, %	6.1	5.4	5.1	5.6	6.4	5.4	5.5	5.6
Temperature, ^{o}C	26.1	25.6	26.1	26.1	26.1	26.1	25.6	25.6
Weight, kg/m^3	2374	2364	2393	2380	2342	2361	2361	2372
Compressive strength, MPa								
7 days	25.78	25.46	24.29	24.30	24.78	25.05	24.22	24.54
14 days	29.19	28.90	28.87	26.90	29.17	29.25	28.82	28.24
28 days	33.41	32.96	33.40	30.63	32.93	33.46	32.95	32.79
*Freeze/thaw resistance:								
Weight loss, %								
50 cycles	1.3	3.5	3.1	3.2	1.7	2.8	2.9	2.7
100 cycles	3.2	7.0	6.3	7.2	3.6	6.2	6.7	6.7
150 cycles	6.8	9.7	10.3	10.3	5.8	9.8	9.9	10.3
200 cycles	9.4	11.9	14.3	14.0	8.0	12.1	12.6	13.1
250 cycles	11.0	13.8	16.7	18.7	9.5	13.8	14.8	14.8
300 cycles	12.3	15.4	20.3	21.5	10.7	15.4	17.0	16.7
Durability factor								
50 cycles	97.1	102.0	96.4	101.7	97.8	99.5	101.0	99.0
100 cycles	96.4	102.2	95.4	102.6	100.5	101.4	98.5	101.0
150 cycles	96.8	103.3	91.3	101.1	99.9	101.1	95.2	96.9
200 cycles	97.8	101.5[1]	91.1	94.1	100.4	99.0	92.9	96.3
250 cycles	96.9	97.5[1]	85.0	92.4	99.9	96.3	90.4	94.1
300 cycles	96.9	93.4[1]	****[2]	90.4	98.8	93.6	86.6	93.9

*Values shown are the average results from two specimens.

[1]Values shown are the results from one specimen. The remaining specimen was too deteriorated to conduct dynamic testing.

[2]Both specimens were too deteriorated to conduct dynamic testing.

TABLE 7-US

CONCRETE TEST RESULTS

Test	New Aggregate Batch Numbers Class A		Class B		Reference Aggregate Batch Numbers Class A		Class B	
	1A-ST	2A-ST	1B-ST	2B-ST	1A-GR	2A-GR	1B-GR	2B-GR
Slump, in	2.75	2.50	2.50	2.75	3.00	3.00	2.75	2.75
Air content, %	6.1	5.4	5.1	5.6	6.4	5.4	5.5	5.6
Temperature, ^{o}F	79	78	79	79	79	79	78	78
Weight, lb/ft^3	148.2	147.6	149.4	148.6	146.2	147.4	147.4	148.1
Compressive strength, psi								
7 days	3739	3693	3523	3525	3594	3633	3513	3559
14 days	4234	4192	4187	3902	4231	4242	4180	4095
28 days	4846	4781	4844	4442	4776	4853	4779	4756
*Freeze/thaw resistance:								
Weight loss, %								
50 cycles	1.3	3.5	3.1	3.2	1.7	2.8	2.9	2.7
100 cycles	3.2	7.0	6.3	7.2	3.6	6.2	6.7	6.7
150 cycles	6.8	9.7	10.3	10.3	5.8	9.8	9.9	10.3
200 cycles	9.4	11.9	14.3	14.0	8.0	12.1	12.6	13.1
250 cycles	11.0	13.8	16.7	18.7	9.5	13.8	14.8	14.8
300 cycles	12.3	15.4	20.3	21.5	10.7	15.4	17.0	16.7
Durability factor								
50 cycles	97.1	102.0	96.4	101.7	97.8	99.5	101.0	99.0
100 cycles	96.4	102.2	95.4	102.6	100.5	101.4	98.5	101.0
150 cycles	96.8	103.3	91.3	101.1	99.9	101.1	95.2	96.9
200 cycles	97.8	101.5[1]	91.1	94.1	100.4	99.0	92.9	96.3
250 cycles	96.9	97.5[1]	85.0	92.4	99.9	96.3	90.4	94.1
300 cycles	96.9	93.4[1]	****[2]	90.4	98.8	93.6	86.6	93.9

*Values shown are the average results from two specimens.

[1]Values shown are the results from one specimen. The remaining specimen was too deteriorated to conduct dynamic testing.

[2]Both specimens were too deteriorated to conduct dynamic testing.

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

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.

TA 565

Prepared By: W. Meyer
Date: 06/01/94
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STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION

RESEARCH INVESTIGATION

Work Plan No. 94-R-18

Subject Evaluation of Crushed Stone Coarse Aggregate From Calkins, Coventry, VT

Investigation Requested By Bruce Warner **Date** 12/07/93

Date Information Required ASAP

Purpose of Investigation To evaluate a crushed stone coarse aggregate proposed for use as a structural concrete aggregate. The proposed material is from Calkins quarry in Coventry, Vermont.

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

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

Note: Preliminary aggregate tests have been performed and a petrographic analysis has been conducted by Alan McBean.

Proposal Discussed With R. Hale, L. Willey **Projected Manpower Requirements** 30 days

Evaluation To Be Conducted By Structural Concrete Section

Proposed Starting Date 06/15/94 **Estimated Completion Date** 10/15/94

Approval/~~Disapproval~~ by Materials & Research Engineer [signature]

Comments by Materials & Research Engineer

Materials & Research Division
Agency of Transportation
Date Typed: June 1, 1994