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

> REPORT 92-1 JANUARY 1992

REPORTING ON WORK PLAN 91-C-6

STATE OF VERMONT AGENCY OF TRANSPORTATION MATERIALS AND RESEARCH DIVISION

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#### EXECUTIVE SUMMARY

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

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

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

### INTRODUCTION

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

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

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

#### PROCEDURES

### PHASE I - SECTION 704.01 AND SECTION 704.02 TESTS

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

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

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

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

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

### TABLE 1

### FINE AGGREGATE TEST DATA (Proposed New Aggregate)

|   | Columbia S<br>Colum<br>Dates | Columbia Sand & Gravel<br>Columbia, NH<br>Dates Sampled |              |  |
|---|------------------------------|---|--------------|--|
|   | 03-12-91                     | 04-04-91  | Requirements |  |
|   | %                            | %   | %            |  |
| Sieve Size  | Passing                      | Passing   | Passing      |  |
| 3/8"  | 100                          | -   | 100          |  |
| #4  | 100                          | -   | 95-100       |  |
| #8  | 92                           | -   | -            |  |
| #16   | 71                           | -   | 50-80        |  |
| #30   | 43                           | -   | 25-60        |  |
| #50   | 16                           | -   | 10-30        |  |
| #100  | 6                            | -   | 2-10         |  |
| Fineness<br>Modulus                                     | 2.72                         | -   | 2.60-3.10    |  |
| Organic<br>Impurities, color                            | 1                            | -   | 2 maximum    |  |
| Compressive Strengt<br>of Mortar, % of<br>Standard Sand | h                            |   |              |  |
| 3 days  | -                            | -   | 100 minimum  |  |
| 7 days  | -                            | -   | 100 minimum  |  |
| Soundness, % loss                                       | -                            | 4.73  | 8 maximum    |  |

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

# FINE AGGREGATE TEST DATA (Reference Aggregate)

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

# COARSE AGGREGATE TEST DATA (Proposed New Aggregate)

|                                 | 3/4" Crush<br>Columbia San<br>Columbia | ed Gravel<br>nd & Gravel | V A O T                        |
|---------------------------------|--|--------------------------|--------------------------------|
|                                 | Dates Sa<br>03-12-91                   | ampled<br>04-04-91       | Specifications<br>Requirements |
| Sieve Size                      | %<br>Passing                           | %<br>Passing             | %<br>Passing                   |
| 1"                              | 100                                    | -                        | 100                            |
| 3/4"                            | 100                                    | _                        | 90-100                         |
| 3/8"                            | 32                                     | _                        | 20-55                          |
| # 4                             | 4                                      | -                        | 0-10                           |
| #8                              | 2                                      | 1                        | 0-5                            |
| L. A. Abrasion,<br>% loss       | 23.1                                   | -                        | 35 maximum                     |
| Thin and Elongated<br>Pieces, % | 4.3                                    | -                        | 10 maximum                     |
| Fractured Faces, %              | 87.0                                   | -                        | 50 minimum                     |
| Soundness, % loss               | _                                      | 0.1                      | 8 maximum                      |

# COARSE AGGREGATE TEST DATA (Reference Aggregate)

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

### PHASE II PERFORMANCE-IN-CONCRETE TESTS

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

### Fine Aggregate

- A. <u>Proposed New Aggregate</u> Columbia Sand & Gravel Corp., Columbia, NH
- B. <u>Reference Aggregate</u> Lebanon Crushed Stone Corp., W. Lebanon, NH

### Coarse Aggregate

- A. <u>Proposed New Aggregate</u> Columbia Sand & Gravel Corp., Columbia, NH
- B. <u>Reference Aggregate</u> Lebanon Crushed Stone Corp., W. Lebanon, NH

### Cement

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

### Air Entraining Admixture

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

### Water Reducing Admixture

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

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

### FINE AGGREGATE PROPERTIES

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

### TABLE 6

### COARSE AGGREGATE PROPERTIES

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

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

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

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

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### NEW AGGREGATE MIX DESIGN BATCH QUANTITIES PER C.Y.

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

\*Weights converted to saturated surface-dry condition

### TABLE 8

### REFERENCE AGGREGATE MIX DESIGN BATCH QUANTITIES PER C.Y.

|                               | Clas    | s A     | Class B |         |
|-------------------------------|---------|---------|---------|---------|
|                               | Batch 7 | Batch 8 | Batch 3 | Batch 4 |
| *Coarse Aggregate, lbs.       | 1773    | 1773    | 1773    | 1773    |
| *New Fine Aggregate, lbs.     | 1234    | 1234    | 1355    | 1355    |
| Cement, 1bs.                  | 660     | 660     | 611     | 611     |
| Air Entraining Admixture, oz. | 5.0     | 5.0     | 4.0     | 3.5     |
| Water Reducing Admixture, oz. | 19.8    | 19.8    | 18.3    | 18.3    |
| Net Water, gal.               | 31.4    | 30.7    | 31.6    | 31.4    |

\*Weights converted to saturated surface-dry condition

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

### RESULTS

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

### TABLE 9

## PERFORMANCE TEST RESULTS NEW AGGREGATE

|                            | Clas         | Class A |         | ss B    |
|----------------------------|--------------|---------|---------|---------|
|                            | Batch 5      | Batch 6 | Batch 1 | Batch 2 |
| Slump, inches              | 2.75         | 2.75    | 3.00    | 2.00    |
| Air Content, percent       | 6.0          | 5.7     | 5.9     | 5.2     |
| Unit Weight, 1bs/cu. ft.   | 144.72       | 144.97  | 143.92  | 144.20  |
| Compressive Strength, psi  |              |         |         |         |
| 7 days                     | 3692         | 3979    | 3454    | 3712    |
| 14 days                    | 4384         | 4474    | 4117    | 4410    |
| 28 days                    | 4800         | 5026    | 4645    | 4839    |
| (Design Compressive Streng | th, psi) (40 | 00)     | (35     | ;00)    |

### TABLE 10

### PERFORMANCE TEST RESULTS REFERENCE AGGREGATE

|                           | Class A |         | Class B |         |
|---------------------------|---------|---------|---------|---------|
|                           | Batch 7 | Batch 8 | Batch 3 | Batch 4 |
| Slump, inches             | 2.50    | 2.50    | 3.00    | 2.50    |
| Air Content, percent      | 5.9     | 5.5     | 5.7     | 5.8     |
| Unit Weight, 1bs/cu. ft.  | 147.06  | 149.59  | 148.42  | 148.62  |
| Compressive Strength, psi |         |         |         |         |
| 7 days                    | 3830    | 3800    | 3440    | 3628    |
| 14 days                   | 4342    | 4595    | 3975    | 4175    |
| 28 days                   | 4749    | 5063    | 4535    | 4551    |
|                           |         |         |         |         |

(Design Compressive Strength, psi) (4000) (3500)

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

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

### TABLE 11

### FREEZE-THAW TEST RESULTS - DURABILITY FACTOR

|           | New Aggregate |         |         | R       | eference | Aggregat | e       |         |
|-----------|---------------|---------|---------|---------|----------|----------|---------|---------|
|           | Clas          | as A    | Cla     | ss B    | Cla      | ss A     | Clas    | ss B    |
| No.<br>of | Batch 5       | Batch 6 | Batch 1 | Batch 2 | Batch 7  | Batch 8  | Batch 3 | Batch 4 |
| Cycles    |               |         |         | Durab   | ility Fa | ctor     |         |         |
| 50        | 97.8          | 99.3    | 103.6   | 100.1   | 98.9     | 96.8     | 100.1   | 97.8    |
| 100       | 98.3          | 100.6   | 104.0   | 100.4   | 98.0     | 95.9     | 100.1   | 97.6    |
| 150       | 99.1          | 100.7   | 104.0   | 99.0    | 99.0     | 96.1     | 100.2   | 98.3    |
| 200       | 99.1          | 100.9   | 103.6   | 99.2    | 100.0    | 96.5     | 101.8   | 97.7    |
| 250       | 99.5          | 102.0   | 106.6   | 101.8   | 104.5    | 94.4     | 104.1   | 100.6   |
| 300       | 97.5          | 101.2   | 104.3   | 100.6   | 99.0     | 97.4     | 102.1   | 97.5    |









| Batch<br>No. | No.<br>Cycles | Weight<br>Lbs. | Percent<br>Weight<br>Loss | Fundaments<br>Transvers<br>Frequency<br>"N" | al<br>e<br>"N" | Individual<br>Durability<br>Factor<br>DF | Average<br>DF | Relative<br>Durability<br>Factor<br>RDF |
|--------------|---------------|----------------|---------------------------|---|----------------|--|---------------|---|
| Referen      | nce Aggre     | gate           |                           |   |                |  |               |   |
| 7            | 0             | 12.92          | <u> </u>                  | 1674  | 2802276        | ;<br>                                    |               |   |
| 7            | 300           | 12.85          | 0.5                       | 1666  | 2775556        | 99.0                                     |               |   |
| 8            | 0             | 12.99          |                           | 1677  | 2812329        |  | 98.2          |   |
| 8            | 300           | 12.26          | 5.6                       | 1655  | 2739025        | 97.4                                     |               |   |
| New Ag       | gregate       |                |                           |   |                |  |               | 98.8                                    |
| 5            | 0             | 12.50          |                           | 1594  | 2540836        | 07.5                                     |               |   |
| 5            | 300           | 11.48          | 8.2                       | 1574  | 2477436        | 97.5                                     | 00.4          |   |
| 6            | 0             | 12.65          |                           | 1618  | 2617924        |  | 99.4          |   |
| 6            | 300           | 11.73          | 7.3                       | 1628  | 2650384        | 101.2                                    |               |   |

SUMMARY OF FREEZE-THAW TEST RESULTS

## CLASS A

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FIGURE III

| Datab   | N-        | Waisht | Percent | Fundament.<br>Transvers | al<br>e | Individual<br>Durability | A     | Relative<br>Durability |
|---------|-----------|--------|---------|-------------------------|---------|--------------------------|-------|------------------------|
| No.     | Cycles    | Lbs.   | Loss    | "N"                     | "N"     | DF                       | DF    | RDF                    |
| Referen | nce Aggre | gate   |         |                         |         |                          |       |                        |
| 3       | 0         | 12.86  |         | 1658                    | 2748964 |                          |       |                        |
| 3       | 300       | 12.73  | 1.0     | 1675                    | 2805625 | 102.1                    |       |                        |
| 4       | 0         | 12.86  |         | 1655                    | 2739025 |                          | 99.8  |                        |
| 4       | 300       | 12.69  | 1.3     | 1634                    | 2669956 | 97.5                     |       |                        |
| New Ag  | gregate   |        |         |                         |         |                          |       | 101.2                  |
|         |           | 10.11  |         | 1500                    | 0400044 |                          |       |                        |
| 1       | 0         | 12.44  | 1.8     | 1562                    | 2439844 | 104.3                    |       |                        |
| 1       | 300       | 12.28  |         | 1595                    | 2544025 |                          | 100 5 |                        |
| 2       | 0         | 12.54  | 4.9     | 1591                    | 2531281 | 100.6                    | 102.5 |                        |
| 2       | 300       | 11.93  |         | 1596                    | 2547216 |                          |       |                        |

SUMMARY OF FREEZE-THAW TEST RESULTS

### CLASS B

FIGURE IV

# FREEZE-THAW TEST RESULTS - PERCENT OF WT. CHANGE

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

### SUMMARY AND CONCLUSIONS

- 1. Initial samples of the proposed fine aggregate from the Columbia Sand & Gravel Corporation facility in Columbia, NH were found to be in compliance with VAOT Standard Specifications For Construction, Section 704.01.
- 2. Initial samples of the proposed coarse aggregate from the Columbia Sand & Gravel Corporation facility in Columbia, NH were found to be in compliance with VAOT Standard Specifications For Construction, Section 704.02.
- 3. The average 28 day compressive strengths of concrete containing the Columbia fine aggregate and 3/4" crushed coarse aggregate were approximately 2.5 percent greater than the strengths of concrete containing the reference aggregate. The Class A concrete containing the Columbia aggregates had an average compressive strength of 4913 psi at 28 days, while the Class A concrete containing the reference aggregates yielded an average 28-day compressive strength of 4906 psi. The Class B concrete containing the Columbia aggregates had an average compressive strength of 4742 psi at 28 days, while the Class B concrete containing the reference aggregates had an average compressive strength of 4742 psi at 28 days, while the Class B concrete containing the reference aggregates had an average 28-day compressive strength of 4543 psi.
- 4. Results of freezing and thawing tests indicated reduced performance for the Class A concrete containing the new aggregates as compared with Class A concrete containing the reference aggregate. The average durability factor for the Class A concrete with the new aggregate was 98.4 while the Class A concrete with

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

- 5. The Class B concrete containing the new aggregate performed slightly better in sonic testing than the Class B concrete containing the reference aggregate. The average durability factor was 102.5 for the Class B concrete with the new aggregate and 99.8 for the Class B concrete with the reference aggregate. The Class B concrete containing the new aggregate, however, showed greater average weight loss (3.4%) than the Class B concrete with the reference aggregate (1.2%).
- 6. Mix Design Tables, shown on page 11, indicate the Class A and Class B mixtures containing the new aggregates having quantities of water relatively comparable to the mixes containing the reference aggregate develop approximately equal slump and air content (slump & air content indicated in tables 9 & 10, page 12).

### RECOMMENDATIONS

- 1. It is recommended that the present Columbia Sand & Gravel Corp. facilities in Columbia, NH be approved as a source of fine aggregate and coarse aggregate for use in structural concrete.
- 2. During the initial uses of concrete containing this aggregate on Agency projects, Materials and Research Division representatives shall conduct tests necessary to determine the performance of this aggregate in concrete under field conditions. Due to the range of results obtained in freeze-thaw tests, it is recommended that subsequent testing include fabrication of freeze-thaw specimens to permit further examination of this concrete property.

### APPENDIX A

Prepared By: W. Meyer@f?M 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

### 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.

### 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

- 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 hew 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 TI19, AASHTO TI52, and AASHTO TI21, respectively.

EMARREL3

VERMONT AGENCY OF \* TRANSPORTATION MATERIALS AND RESEARCH DIVISION APPENDIX B DISTRIBUTION Central Files R

REPORT ON SAMPLE OF AGGREGATE Preliminary Sample

Geologist

Correct Copy: Lab No: A910183 1 Report Date: 12/18/91 Project: Possible Future Use Sampled By: Kelly Pav Item: CONCRETE, CLASS B 501.25 Date Sampled: 04/04/91 Material Name/Type: Gradation Requirements for 3/4" Stone Sampled From: Stockpile Material Spec. No: 704.02B Date Received: 04/04/91 Sample Source: Persons Concrete Columbia N.H. Tested By: M.Lavin Material Source: Columbia Sand + Gravel Columbia N.H. Test Complete: 05/07/91 Quantity Rep: X-Ref No: CS: Comment: TEST RESULTS TOTAL SAMPLE OUTSIDE FINENESS MODULUS OUTSIDE SPECS % COARSER THAN SIEVE PASSING SPECS 4 1/2" No. 4 Fineness No. 8 Color .... 3 1/2" No. 16 3"-No. 30 Grading 14 2 1/2" No. 40 Percent of Wear 2 " No. 50 AASHTO T96 = 1 3/4" No. 100 1 1/2" Frac Face 1" Thine/Elon = 3/4" Soundness = 0.1 5/8" 1/2"

> Remarks: Results of tests performed are in compliance with specificaltions,

Comments:

3/8" No. 4(P)

No. 1 No. 3 No. 16 No. 30 No. 40 No. 50 No. 100 No. 200

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

For: R.F.Cauley Materials and Research Engineer

187-

### EMABRE13

Lab No: A910266 .

Project: Possible Euture Use

Material Spec. No: 704.01A

Pay Item: CONCRETE, CLASS B 501.25

### VERMONT AGENCY OF TRANSPORTATION MATERIALS AND RESEARCH DIVISION

DISTRIBUTION Central Files

REPORT ON SAMPLE OF AGGREGATE Preliminary Sample

2

N.H.

Correct Copy:

Material Name/Type: Fine Aggregate for Concrete

Sample Source: Persons Concrete Columbia N.H.

Material Source: Columbia S+G Columbia

# Geologist

### Weaver

Report Date: 12/18/91

Sampled By: Kelly

Date Sampled: 04/04/91

Sampled From: Stockpile

Date Received: 04/04/91

Tested By: M.Lavin

X-Ref No:

Test Complete: 05/28/91

CS:

Quantity Rep:

Comment:

| 5 · · ·  |         |         | TEST R | ESULT | S .      |   |            |     |         |  |
|----------|---------|---------|--------|-------|----------|---|------------|-----|---------|--|
| TOTAL    | SAMPLE  | OUTSIDE | FINE   | NESS  | MODULUS. |   |            |     | OUTSIDE |  |
| SIEVE    | PASSING | SPECS   | % CO   | ARSER | THAN     |   |            |     | SPECS   |  |
| 4 1/2"   | 1       | •       | No.    | 4     |          | Fineness  | = '        | 1   |         |  |
|          | i i     |         | No.    | 8     |          | Color   | =          | 1   |         |  |
| 5 1/2"   |         |         | No.    | 16    |          |   | · · ·      | 1   |         |  |
| 3 **     | 1       |         | No.    | 30    |          | Grading   | =          | 1   |         |  |
| 2 1/2"   |         |         | No.    | 40    |          | Percent of  | Wear       | 1   |         |  |
| 2"       | 1       |         | No.    | 50    |          | AASHTO T96  | <b>z</b>   | - 1 |         |  |
| 1:3/4"   |         |         | No.    | 100   |          |   |            |     |         |  |
| 1 1/2"   | 1       |         | 1      |       |          | Frac Face   | 2          | 1   |         |  |
| 1"       | 1       | •       | 1      |       |          | Thine/Elon  | <b>a</b> . | 1   |         |  |
| 3/4"     | i i i   |         | 1      |       |          | Soundness   | = 4.73     | 1   |         |  |
| 5/8"     | 1       | •       | 1      |       |          | and the state of the |            |     |         |  |
| 1/2"     | 1       |         |        |       |          |   |            |     |         |  |
| 3/8"     | 1       |         | 1      |       |          |   |            | ,   |         |  |
| No. 4(P) |         |         | Rem    | arks: | Results  | of tests pe   | erformed   | are | in      |  |
|          |         |         | com    | plian | ce with  | specificait   | ions.      |     |         |  |
| No. 4    | 1       |         | ;      | -     |          |   |            |     |         |  |
| No. 8    | {       |         | 1      |       |          |   |            |     |         |  |
| No. 16   | 1       | ·       | 1      |       |          |   |            |     |         |  |
| No. 30   | 1       |         | 1      |       |          |   |            |     |         |  |
| No: 40   | 1       |         | 1      |       |          |   |            |     |         |  |
| No. 50   | 1       | ·       | 1.     |       |          |   |            |     |         |  |
| No. 100  | 1       |         | 1.     |       |          |   |            |     |         |  |
| No. 200  | :       |         | 1      |       |          |   |            |     |         |  |
|          |         |         |        |       |          |   |            |     |         |  |
| Comments | :       |         |        |       |          |   |            |     |         |  |
| 1. 11    |         |         |        |       |          |   |            |     |         |  |
| 1. ··· . |         |         |        |       |          | `   |            | 60  | 314     |  |

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

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

## STATE OF VERMONT AGENCY OF TRANSPORTATION MATERIALS AND RESEARCH DIVISION

| STODDARD |
|----------|
| WEAVER   |
| C.F.     |

| Project Name <u>MACTER 20</u><br>Sampled By <u>MACTER 20</u><br>Sampled By <u>MACTER 20</u><br>Plant <u>Matter 104 (10)</u><br>Sampled By <u>MACTER 2016</u><br>Plant <u>Matter 104 (10)</u><br>Source of Material <u>Leaders Cluster</u> Plant <u>Matter 104 (10)</u><br>Source of Material <u>Leaders Cluster 5 First Conservent</u><br>Quantity Represented <u>50% (2)</u> Sample Type <u>Macce 2000 (1)</u><br>Sample Comparison <u>Mo</u> <u>Cross Reference Number</u><br>MATERIAL TESTED <u>3/4</u> <u>COUSTIED STRUE First Conservent</u><br><u>MATERIAL TESTED <u>3/4</u> <u>COUSTIED STRUE First Conservent</u><br/><u>MATERIAL TESTED <u>3/4</u> <u>100</u> <u>Conservent</u><br/><u>Ret <u>4</u> <u>1,7</u> <u>4</u> <u>7</u> <u>1</u> <u>6</u><br/><u>Ret <u>4</u> <u>1,7</u> <u>7</u> <u>1</u> <u>6</u><br/><u>Ret <u>4</u> <u>1,7</u> <u>7</u> <u>1</u> <u>1</u> <u>6</u><br/><u>Ret <u>4</u> <u>1,7</u> <u>7</u> <u>1</u> <u>1</u> <u>6</u><br/><u>Ret <u>4</u> <u>1,7</u> <u>7</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u>   |
|---|
| Sampled By <u>decreptions</u> Date Sampled <u>Anil 9 /991</u> Examined For <u>TOULOT</u><br>Sampled From <u>specific</u> Plant <u>differ</u> <u>unst consumption</u> <u>unity</u> <u>Examined</u> For <u>TOULOT</u><br>Source of Material <u>Leadence crustico Stance</u> <u>unst consumption</u> <u>UII</u><br>Quantity Represented <u>SOUL CY</u> Sample Type <u>Acception</u> <u>UII</u><br>Sample Comparison <u>No</u> <u>Cross Reference Number</u><br>MATERIAL TESTED <u>3/4</u> ° <u>COUSTIED STONE For Concrete</u><br><u>MATERIAL TESTED 3/4</u> ° <u>TOUSTIED STONE For Concrete</u><br><u>Total Weight 8/40</u><br><u>Final Weight 5355</u> <u>Bretent Wear 37.5</u> <u>AASHTO T96</u>   |
| Sampled From <u>StarWeile</u> Plant <u>Miller</u> <u>UNET CEGEWERD UH</u><br>Source of Material <u>Leadmann Crustee Struct</u> <u>Leadmann HH</u><br>Quantity Represented <u>SOVALY</u> <u>Sample Type <u>Acce pravec</u><br/>Sample Comparison <u>Adv</u> <u>Crustee Struct</u> <u>Cross Reference Number</u><br/>MATERIAL TESTED <u>3/4</u> <u>CCUSHED STRUE For Concrete</u><br/><u>MATERIAL TESTED <u>3/4</u> <u>CCUSHED STRUE For Concrete</u><br/><u>RET <u>HNDV</u>, <u>RUDV</u>, <u>CUMUL</u>, <u>CUMU</u>, <u>CUMUL</u>, <u>CUMUL</u>, <u></u></u></u></u> |
| Source of Material Leaderson Crusted STRACE Later Leaderson MI<br>Quantity Represented SOLUY Sample Type Acception Material<br>Sample Comparison <u>No</u> Cross Reference Number<br>MATERIAL TESTED <u>3/4</u> COUSTRED STONE For CONCRETE<br>MATERIAL <u>100</u> <u>4/99</u><br>MATERIAL <u>100</u> <u>100</u><br>Fineness Modulus<br>Cumul. Total Retained/100<br><u>Take = <u>1/4</u> = <u>1/67</u> % Thin &amp; Elongated Pieces<br/>Total Weight <u>8/40</u><br/><u>Fractures = <u>840</u> = <u>100</u> % Fractured Faces<br/>Total Weight <u>5355</u> <u>Percent Wear <u>37.9</u> AASHTO T96</u></u></u>   |
| Sample Comparison <u>Mo</u><br>Sample Comparison <u>Mo</u><br>MATERIAL TESTED <u>3/4</u> <u>COUSTIED STOUE For Counter</u><br><u>SIEVE</u> <u>WEIGHT</u> <u>SRETAINED</u> <u>Spassing</u><br><u>SIEVE</u> <u>SRETAINED</u> <u>SRETAINED</u> <u>Spassing</u><br><u>SIEVE</u> <u>SRETAINED</u> <u>SRETAINED</u> <u>Spassing</u><br><u>SIEVE</u> <u>SRETAINED</u> <u>SRETAINED</u> <u>Spassing</u><br><u>SIEVE</u> <u>SRETAINED</u> <u>SRETAINED</u> <u>SPASSING</u> <u>SRETAINED</u> <u>SPASSING</u> <u>SRETAINED</u> <u>SRETAINED</u> <u>SRETAINED</u> <u>SRETAINES</u> <u>SR</u>  |
| MATERIAL TESTED $3/4^{\circ}$ (COSHED STONE For CONCRETE<br>MATERIAL TESTED $3/4^{\circ}$ (COSHED STONE For CONCRETE<br>RET $\frac{1}{100^{\circ}}$ $\frac{1}{100^{\circ}$  |
| MATERIAL TESTED $34^{\circ}$ COUSTED STONE For CONCRETE<br>SIZE WEIGHT SRETAINED SPASSING<br>CUMUL CUMUL CUMUL CUMUL CUMUL<br>RET $\frac{1}{100}$ $\frac{1000}{100}$ $\frac{1000}$  |
| SHEVE       WEIGHT       S RETAINED       S PASSING<br>CUMUL         RET             RET              RET               RET                RET                   RET  |
| SIZE INDIV. INDIV. CUMUL. CUMUL.<br>RET $\frac{1}{2}$ $\frac{1}{2$  |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$   |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$   |
| $\frac{34}{\text{Ret}} = \frac{34}{2} + \frac{94}{2} + \frac{99}{4} + 99$  |
| $\frac{y_{2}}{ReT} = \frac{10.5}{44} = \frac{44}{55}$ $\frac{36^{2}}{RET} = \frac{10.5}{44} = \frac{10.5}{44} = \frac{100}{44}$ $\frac{100}{100}$ $\frac{100}{ReT} = \frac{100}{46} = \frac{100}{100}$ $\frac{100}{100}$ $\frac{100}{ReT} = \frac{100}{100} = \frac{100}{100}$ $\frac{100}{ReT} = \frac{100}{100} = \frac{100}{100}$ $\frac{100}{ReT} = \frac{100}{100} = \frac{100}{100} = \frac{100}{100}$ $\frac{100}{ReT} = \frac{100}{100} = \frac{100}{100} = \frac{100}{100} = \frac{100}{100}$ $\frac{100}{ReT} = \frac{100}{100} =$  |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$   |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$   |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$   |
| NET       Image: Constraint of the second sec   |
| RET       D.9       Z       O         PAN       D.9       Z       O         TOTAL $\frac{46.4}{10.0}$ 100       O         Fineness Modulus       Cumul, Total Retained/100       O       O         Organic Impurities:       Color       O       O         Total Weight $\frac{840}{840}$ = 1.67       % Thin & Elongated Pieces         Total Weight $\frac{840}{840}$ = 100       % Fractured Faces         Total Weight $\frac{640}{840}$ Grading $\frac{32.9}{100}$ AASHTO T96  |
| FAN<br>TOTAL $46.4$ 100<br>Fineness Modulus<br>Cumul. Total Retained/100<br>Organic Impurities: Color<br>T&E = 14 = 1.67 % Thin & Elongated Pieces<br>Total Weight $840$<br>Fractures = $840$ = 100 % Fractured Faces<br>Total Weight $840$<br>Fractures = $840$ = 100 % Fractured Faces<br>Total Weight $840$<br>Fractures = $840$ = 100 % Fractured Faces<br>Total Weight $840$<br>Original Weight $5000$ Grading B<br>Percent Wear $37.4$ AASHTO T96   |
| Fineness Modulus<br>Cumul. Total Retained/100<br>Organic Impurities: Color<br>$\frac{T\&E}{Total Weight} = \frac{1.67}{840} \% \text{ Thin & Elongated Pieces}$ $\frac{T\&E}{Total Weight} = \frac{840}{840} = \frac{100}{700} \% \text{ Fractured Faces}$ $\frac{Fractures}{Total Weight} = \frac{840}{840} = \frac{100}{700} \% \text{ Fractured Faces}$ Original Weight $\frac{5000}{5353} \text{ Grading} = \frac{37.5}{100} \text{ AASHTO T96}$  |
| Theress modulus         Cumul. Total Retained/100         Organic Impurities:       Color $             \frac{T\&E}{Total Weight} = \frac{144}{840} = \frac{1.67}{70} \text{ \% Thin \& Elongated Pieces}         $ Total Weight $             Fractures = \frac{840}{840} = \frac{100}{70} \text{ \% Fractured Faces}         $ Total Weight $             Original Weight = \frac{5000}{5355} \text{ Grading } \frac{B}{Percent Wear} = \frac{37.51}{37.51} \text{ AASHTO T96}         $  |
| Organic Impurities: Color<br>$\frac{T\&E}{Total Weight} = \frac{167}{840} \% \text{ Thin \& Elongated Pieces}$ $\frac{Fractures}{Fractures} = \frac{640}{840} = \frac{100}{700} \% \text{ Fractured Faces}$ $\frac{Fractures}{Total Weight} = \frac{5000}{840} \text{ Grading} = \frac{2}{37.9} \text{ AASHTO T96}$   |
| $\frac{T\&E}{Total Weight} = \frac{14}{840} = \frac{167}{9} \% \text{ Thin \& Elongated Pieces}$ $\frac{TWE}{Total Weight} = \frac{100}{840} \% \text{ Fractured Faces}$ $\frac{TWE}{Total Weight} = \frac{100}{840} \% \text{ Fractured Faces}$ $\frac{TWE}{Final Weight} = \frac{5000}{3353} \text{ Grading} = \frac{32.9}{100} \text{ AASHTO T96}$   |
| Total Weight $840$ $100$ $\%$ Fractured FacesTotal Weight $840$ $= 100$ $\%$ Fractured FacesTotal Weight $840$ $= 100$ $\%$ Fractured FacesOriginal Weight $5000$ Grading $B$ Final Weight $5353$ Percent Wear $32.4$   |
| $\frac{\text{Fractures}}{\text{Total Weight}} = \frac{640}{840} = 100 \% \text{ Fractured Faces}$ $\frac{\text{Original Weight}}{\text{Sight}} = \frac{5000}{3353} \% \text{ Grading} = \frac{32.9}{100} \text{ AASHTO T96}$  |
| Total WeightE40Original Weight5000Final Weight5353GradingPercent Wear32.9AASHTO T96   |
| Original Weight 5000 Grading B<br>Final Weight 3353 Percent Wear 32.1 AASHTO T96  |
| Final Weight 3353 Percent Wear 32.1 AASHTO T96  |
|   |
|   |
| $(\checkmark)$ Test results are in compliance with specifications.  |
| ( ) Test results are outside specifications.  |
| Comments:   |
|   |
|   |
| that That   |
| Date Completed April 6 199 Date 25 John H. Weaver, P.E. 01/0/   |

### STATE OF VERMONT AGENCY OF TRANSPORTATION MATERIALS AND RESEARCH DIVISION

STODDARD weaver CF

| Labora   | atory Number   | 6910             | 0063       |             | Pay Item      | 501.25                   |  |  |
|----------|--|------------------|------------|-------------|---------------|--------------------------|--|--|
| Project  | t Name HARTFOR   | 2D               |            | Pro         | ject Number   | BR7 1444/10)             |  |  |
| Sample   | Sampled By Acoustrous ICHS Date Sampled Arel 9 1991 Examined For 7/14 01 |                  |            |             |               |                          |  |  |
| Sample   | ed From STOCK  | PILE             | · Pl       | ant mill    | 1111          |                          |  |  |
| Source   | Source of Material LeBanery Crushen Strate West Lebanos                  |                  |            |             |               |                          |  |  |
| Quanti   | ty Represented   | 50 1/2           | Sample T   | ype Au      | PATAKE        |                          |  |  |
| Sample   | Comparison   | Va               |            | Cross       | Reference Nu  | imber                    |  |  |
|          | MATERIAL TE  | sted <u>Fine</u> | Aggre      | gete        |               |                          |  |  |
|          | SIEVE  | WEIGHT           | % RE       | TAINED      | % PASSING     |                          |  |  |
|          | SIZE   | INDIV.           | IND'V.     | CUMUL.      | CUMUL.        |                          |  |  |
|          | RET  |                  |            |             |               |                          |  |  |
|          | 3/8  | -                | -          | -           |               | T                        |  |  |
|          | 4  | -                | -          | -           | 100           |                          |  |  |
|          | RET -  | 86               | 11         | 11          |               | t                        |  |  |
|          | RET  | 1/1/1            | 19         | 20          | 20            | +                        |  |  |
|          | RET  | 1721             | 22         | 50          | 10            |                          |  |  |
|          | RET 50   | 107              | 24         | 56          | 70            |                          |  |  |
|          | RET  | 182              | 10         | 16          | 64            |                          |  |  |
|          | RET 100  | 1.37             | 10         | 79          | 6             |                          |  |  |
|          | PAN  | -4.5             | 6          | 100         |               | -                        |  |  |
|          | TOTAL  | 75 1 1           | 100        |             |               |                          |  |  |
|          | Fineness Modu  | lus              |            |             |               |                          |  |  |
|          | Cumul. 7   | fotal Retained   | 1/100      | 2.63        |               |                          |  |  |
|          | Organic Impuri   | ties: Color _    | <1         | _           | -             |                          |  |  |
|          | T&E ==   | -                |            | % Thin & 1  | Elongated Pie | eces                     |  |  |
|          | Total Weight   |                  |            |             |               |                          |  |  |
|          | Fractures =  |                  | - 9        | % Fracture  | d Faces       |                          |  |  |
|          | Total Weight   |                  |            |             |               |                          |  |  |
|          | Original Weight  |                  | G          | rading      |               |                          |  |  |
|          | Final Weight   |                  | - Pe       | ercent Wear |               | AASHTO T96               |  |  |
|          | . –  |                  |            |             |               |                          |  |  |
| (1)      | Test results are in  | a compliance     | with speci | ifications. |               |                          |  |  |
| ( ) :    | Test results are of  | utside specific  | cations.   |             |               |                          |  |  |
| Commen   | ts:  |                  |            |             |               |                          |  |  |
|          | ····   |                  |            |             |               |                          |  |  |
|          |  | ··· ·            |            |             |               |                          |  |  |
|          | 110  | 11-              |            |             | 1.0.          | Tih.                     |  |  |
| Tested B | y land   | a 1001           |            | Data 2      | a By John     | H. Weaver, P.E. Initials |  |  |
| Date Con | apreney Apal   | 7,1991           |            | Date 2      | 0             |                          |  |  |

### STATE OF VERMONT AGENCY OF TRANSPORTATION MATERIALS AND RESEARCH DIVISION



|                       | C910044               | 13        |              |              |                      |
|-----------------------|-----------------------|-----------|--------------|--------------|----------------------|
| Laboratory Number     | 401001                | NO I      |              | Pay Item     | 501.                 |
| Project Name WORK     | CPIAN                 |           | Pro          | ject Number  | 91-C-6               |
| Sampled By ALLEH      | 100                   | Date Sa   | mpled 03     | 12.191       | Examined For 704.01  |
| Source of Material    | KPILE                 | P         | ant PER      | SONTS (      | ONCRETE, COLUMBIA NH |
| Quantity Represented  | OLOMISIA              | Sample 7  | DY GRA       | IVEL CO      |                      |
| Sample Comparison     | NO                    | Sumple 1  | Cross I      | Reference Nu | umber                |
| MATERIAL TE           | STED FIL              | IE AL     | 62ECA        | TE FOR       | (OLLRETE             |
|                       |                       |           |              |              |                      |
| SIEVE                 | WEIGHT                | % RE      | TAINED       | % PASSING    |                      |
| SIZE                  | INDIV.                | IND'V.    | CUMUL.       | CUMUL.       | +                    |
| RET                   |                       |           | 2            |              | +                    |
| RET 3/8               |                       |           |              |              |                      |
| 4                     |                       |           |              | 100          |                      |
| RET                   | 527                   | 8         | 8            | 91           | T                    |
| RET                   | 120.0                 | 21        | 20           | -11          | +                    |
| RET 16                | 137.0                 | 20        | 67           |              | +                    |
| RET 20                | 183.2                 | 68        | 57           | 45           | +                    |
| RET 50                | 176.6                 | 27        | 84           | 10           |                      |
| RET 100               | 67.8                  | 10        | 99           | le           |                      |
|                       | 39.5                  | 6         | 100          | 0            |                      |
| PAN                   | Laco.10               | 100       |              | 18           | Ť                    |
| IUIAL                 |                       |           |              | Less.        | ±                    |
| Fineness Mod          | ulus<br>Total Retaine | d/100     | 777          |              |                      |
| Cumur,                | Total Retaile         | u/100     | 6.14         |              |                      |
| Organic Impur         | rities: Color         | 1         | _            |              |                      |
| T&E =                 |                       | =         | % Thin &     | Elongated P  | ieces                |
| Total Weight          |                       |           | •            |              |                      |
| Fractures :           | -                     |           | % Fracture   | d Faces      |                      |
| Total Weight          |                       |           |              |              |                      |
| Oniginal Word         |                       |           | mading       |              |                      |
| Final Weight          | it                    | - 1       | Percent Wea  | r            | AASHTO T98           |
| r mur Weight          |                       | _ `       |              | ·            |                      |
| ( /) Test results are | in compliance         | with spe  | cifications. |              |                      |
| ( ) Test results and  | outside specif        | ications  |              |              |                      |
| ( ) rest results are  | outside spech         | ications. |              |              |                      |
| Comments:             |                       |           |              | 1            |                      |
|                       |                       |           |              | 1            |                      |
|                       |                       |           |              |              |                      |
| Λ                     |                       | ~         | 1.           | Th           | leaver +11.1         |
| Tested By             | of Vol                | Va        | Review       | ed By C. C.  | Benda, P.E. JHW      |
| Date Completed        | 3/28/91               | 1         | Date         | 7/12         | /91 Initials         |
|                       | ,                     |           | 27           | /            | 1 410                |

## STATE OF VERMONT AGENCY OF TRANSPORTATION MATERIALS AND RESEARCH DIVISION

| Tabanatan Marina                      | G9100444                  | 1                                     |                      | _             |                            |
|---------------------------------------|---------------------------|---------------------------------------|----------------------|---------------|----------------------------|
| Laboratory Number                     | 11 11 1.1                 |                                       |                      | Pay Item      | 501                        |
| Sampled Br All                        | RE PIAN                   | Data Cam                              | Proj                 | ject Number   | 91-6-6                     |
| Sampled By ALLEL                      | - MC BEAL                 | Date Sam                              | plea 03              | 12/91         | Examined For 104.02        |
| Sampled From 5100                     | KPILE_                    | Pla                                   | nt PER               | 50L15 (       | OLICETE COLOMBIA           |
| Quantity Danmagantad                  | OLOMBIA                   | StG                                   |                      |               | (10)                       |
| Sample Comparison                     |                           | sample Ty                             | pe FRE               | LININ         | ARY                        |
| Sample Comparison                     | NO                        |                                       | Cross r              | tererence in  |                            |
| MATERIAL T                            | ested <u>3/4</u> "        | CRUS                                  | HED G                | RAVEL         | FOR CONCRETE               |
| SIEVE                                 | WEIGHT                    | % RET                                 | AINED                | % PASSING     |                            |
| SIZE                                  | INDIV.                    | INDIV.                                | CUMUL.               | CUMUL.        |                            |
| RET                                   |                           |                                       |                      |               | -                          |
| RET                                   |                           |                                       |                      |               |                            |
| 111                                   |                           |                                       |                      |               |                            |
| RET                                   |                           | · · · · · · · · · · · · · · · · · · · |                      | 1000          |                            |
| RET 2/4                               |                           |                                       | ,                    | 100           |                            |
| 1/2                                   | 2880                      | 28                                    |                      | 72            | 1                          |
| RET 310                               | Anna                      | 10                                    | •                    | 37            | -                          |
| RET                                   | 7000                      | 40                                    |                      | JE            | +                          |
| RET 4                                 | LOM                       | 28                                    |                      | 4             |                            |
| 8                                     | 146                       | 2                                     |                      | 2             |                            |
| RET                                   | 201-                      | 2                                     | -                    |               | -                          |
| PAN                                   | inter                     | 6                                     |                      |               | -                          |
| TOTAL                                 | 10117                     | 100                                   |                      |               |                            |
| Fineness Moo<br>Cumul                 | dulus<br>. Total Retained |                                       |                      | _             |                            |
| Organic Impu                          | rities: Color             |                                       | _                    |               |                            |
| T&E                                   | = 18 =                    | - 4.3                                 | % Thin &             | Elongated P   | lieces                     |
| Total Weight                          | 422                       | 00.                                   |                      |               |                            |
| Fractures                             | = <u>367</u> =            | 81.0                                  | % Fracture           | ed Faces      |                            |
| Total Weight                          | 422                       |                                       |                      |               |                            |
| Original Weig<br>Final Weight         | ght <u>5077</u>           | - G                                   | rading<br>ercent Wea | 3"<br>r 23.19 | AASHTO T96                 |
| ( ) Test results are                  | e in compliance           | with spec                             | ifications.          |               |                            |
|                                       |                           |                                       |                      |               |                            |
| ( ) Test results are                  | e outside specifi         | cations.                              |                      |               |                            |
| Comments:                             |                           |                                       |                      |               |                            |
| · · · · · · · · · · · · · · · · · · · |                           |                                       |                      |               |                            |
|                                       |                           |                                       |                      |               |                            |
| Tested By<br>Date Completed           | ph A 1/1<br>03/28/91      | Velly                                 | Review<br>Date<br>28 | ed By C.C.    | Benda, P.E JAW<br>Initials |

AGENCY OF TRANSPORTATION

OFFICE MEMORANDUM

TO: John Weaver, Structural Concrete Engineer

FROM: Alan J. McBean, Chief Geologist

DATE: August 19, 1991

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

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

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

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

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

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

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

Page 2

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

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

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

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

AJM:sls

cc: RFC/Lab AJM File Read File CF

### Columbia Sand and Gravel Coarse Aggregate For Structural Concrete

# % Mineral/Lithology Retained

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

# Columbia Sand and Gravel Fine Aggregate For Structural Concrete

# % Mineral/Lithology Retained

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

| ·                        |   |                            | and the second second second                            |
|--------------------------|---|----------------------------|---|
| LABRPT                   | Vermont Agency of Tran<br>Materials and Researc | heportation<br>Ch Division | Distribution<br>Central Files<br>J. WEAVER<br>J. WEAVER |
|                          | Report on Concrete                              | Cylinders                  |   |
| Lab No. CONVICT          | Preliminary Sa                                  | ample                      |   |
| LAD NO: C91WPU1          |   | Poport Datas               | 07/10/01  |
| Project WORK DI MI OT    | 0.6   | Report Date:               | 07719791  |
| Project: WORK PLAN 91-   | -C-6  | Compled Dur                |   |
| Pay Itom: Concrete 01    | BAR B 501 25                                    | Sampled By:                |   |
| Pay Item: Concrete, Cl   | ass B 501.25                                    | Date Sampled.              | 04/22/91  |
| Material Name/Type: Co   | norete Class B 501,034                          | babe bampred.              | 04/22/01  |
| Haber far Hame, type: oc |   | Sampled From:              | LAB MIXER   |
| Resident: J. WEAVER      |   |                            |   |
|                          |   | Quantity Rep:              | 1.8 cf  |
| Submitted By: J. KELLY   | LFP   |                            |   |
|                          |   | Field Test By:             | CONCRETE DIV.   |
| Material Source: MATER   | IALS+RESEARCH LAB                               |                            |   |
|                          |   | Tested By:                 | CONCRETE DIV.   |
| Location Used: PERFORM   | ANCE IN CONCRETE EVALUA                         | TION Y Def No.             | <b></b>   |
|                          |   | X-RET NO:                  | <b>CS</b> :   |
| Eine Agg : COLUMBIA      | S&G   | Total Ago                  | Dry Wat . 2986  |
| Cement Brand NORTHEAS    | T OUEBEC CA                                     | Type II                    | ibs: 611  |
| Comerce Brand. Northers  | QUEBEC CA                                       |                            | 2001 011  |
| A/E Admix: DARAVAIR      |   | Dosage: 3                  | oz/cy   |
| Admixture: WRDA / HYCO   |   | Dosage: 3                  | oz/cwt  |
| Admixture:               |   | Dosage:                    |   |

Comments:

|                             |          |      | Specs |      |      |      | Indicates if |            |  |
|-----------------------------|----------|------|-------|------|------|------|--------------|------------|--|
| Test                        | Test     |      |       | in   | Max  |      | Outside      | of Specs   |  |
| Unit Wgt of Fresh Concrete  | ,pcf   1 | 43.9 | 1     |      |      | 1    |              |            |  |
| Air Content, Percent        | 1        | 5.9  | 1     | 4.   | 6    |      |              |            |  |
| Slump, Inches               | 1        | 3.   | 1     | 2.   | 4    |      |              |            |  |
| Total Water, Gal/cy         | 1        | 31.3 | 1     |      | 35.7 | 5    |              |            |  |
| W/C Ratio                   | 0        | .428 | 1     |      | 0.4  | 9    |              |            |  |
| Concrete Temperature, Deg I | F.       | 76   | 1     | 50   | 8    | 0    |              |            |  |
| Ambient Temperature, Deg F  | • •      |      | 1     | 10   | 8    | 5    |              |            |  |
| Specm. Cyl Unit Date        | Date     | Des  | Age   | Cure | Brk  | Avg  | 28 Day       | Indic. if  |  |
| No. Wgt pcf Received I      | Broken   | Age  | Brk   | Туре | PSI  | PSI  | Spec         | Out. Specs |  |
| PC-B1 1                     | 04/29/91 | 7    | 7     | S    | 3477 | 3454 | 3500         |            |  |
| PC-B1 2                     | 04/29/91 | 7    | 7     | S    | 3431 | 3454 | 3500         |            |  |
| PC-B1 3                     | 05/06/91 | 14   | 14    | S    | 4234 | 4117 | 3500         |            |  |
| PC-B1 4                     | 05/06/91 | 14   | 14    | S    | 4000 | 4117 | 3500         |            |  |
| PC-B1 5 (                   | 05/20/91 | 28   | 28    | S    | 4613 | 4645 | 3500         |            |  |
| PC-B1 6                     | 05/20/91 | 28   | 28    | S    | 4676 | 4645 | 3500         |            |  |

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

Reviewed By: R. J. O'Brien, Testing Lab Supervisor For: R. F. Cauley, Materials and Research Engineer 33

الجارية متحصرت والمتحمد سوالما مراجا المراجع والمراجع

| LABRPT   | Vermont Agency of<br>Materials and Res   | Transportation Distribution<br>earch Division Central Files<br>J. WEAVER<br>J. WEAVER   |  |  |  |  |  |
|--|--|---|--|--|--|--|--|
|  | Report on Concr<br>Preliminar  | ete Cylinders<br>v Sample   |  |  |  |  |  |
| Lab No: C91WP02  |  |   |  |  |  |  |  |
| Project: WORK PLAN 91-   | C-6  | Report Date: 07/19/91   |  |  |  |  |  |
| Pay Item: Concrete, Cla  | ass B 501.25   | Sampred By.   |  |  |  |  |  |
| Material Name/Type: Co   | ncrete Class B 501.  | Date Sampled: 04/22/91<br>03A   |  |  |  |  |  |
| Resident: J. WEAVER  |  | Sampled From: LAB MIXER   |  |  |  |  |  |
| Submitted By: J. KELLY   | LFP  | Quantity Rep: 1.8 cf  |  |  |  |  |  |
| Field Test By: CONCRETE DIV.   |  |   |  |  |  |  |  |
| Tested By: CONCRETE DIV.   |  |   |  |  |  |  |  |
| Location Used: PERFORM   | ANCE IN CONCRETE EV.   | ALUATION<br>X-Ref No: CS:   |  |  |  |  |  |
| Coarse Agg : COLUMBIA<br>Fine Agg : COLUMBIA<br>Cement Brand: NORTHEAS   | S&G<br>S&G<br>T QUEBEC CA  | Total Agg. Dry Wgt: 2986<br>Type: II Lbs: 611   |  |  |  |  |  |
| A/E Admix: DARAVAIR<br>Admixture: WRDA / HYCO<br>Admixture:  |  | Dosage: 2.5 oz/cy<br>Dosage: 3 oz/cwt<br>Dosage:  |  |  |  |  |  |
| Comments:  |  |   |  |  |  |  |  |
|  |  | Space Indicatos if  |  |  |  |  |  |
| Test   |  | Min Max Outside of Specs  |  |  |  |  |  |
| Unit Wgt of Fresh Conce<br>Air Content, Percent<br>Slump, Inches<br>Total Water, Gal/cy<br>W/C Ratio<br>Concrete Temperature, I<br>Ambient Temperature, De | rete,pcf   144.2  <br>5.2  <br>2.  <br>31.2  <br>0.426  <br>Deg F. 72  <br>eg F.     | 4. 6.<br>2. 4.<br>35.75<br>0.49<br>50 80<br>10 85   |  |  |  |  |  |
| Specm. Cyl Unit Date<br>No. Wgt pcf Receive  | Date Des Ag<br>ad Broken Age B   | ge Cure Brk Avg 28 Day Indic. if<br>rk Type PSI PSI Spec Out. Specs   |  |  |  |  |  |
| PC-B2 1<br>PC-B2 2<br>PC-B2 3<br>PC-B2 4<br>PC-B2 5<br>PC-B2 6   | 04/29/91 7<br>04/29/91 7<br>05/06/91 14<br>05/06/91 14<br>05/20/91 28<br>05/20/91 28 | 7       S       3761       3712       3500         7       S       3663       3712       3500         14       S       4325       4410       3500         14       S       4495       4410       3500         14       S       4495       4410       3500         28       S       4860       4839       3500         28       S       4818       4839       3500 |  |  |  |  |  |

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

LABREI Vermont Agency of Transportation Distribution Materials and Research Division Central Files J. WEAVER J. WEAVER Report on Concrete Cylinders Preliminary Sample Lab No: C91WP03 ..... Report Date: 07/19/91 Project: WORK PLAN 91-C-6 Sampled By: Pay Item: Concrete, Class B 501.25 Date Sampled: 04/22/91 Material Name/Type: Concrete Class B 501.03A Sampled From: LAB MIXER Resident: J. WEAVER Quantity Rep: 1.8 cf Submitted By: J. KELLY LFP Field Test By: CONCRETE DIV. Material Source: MATERIALS+RESEARCH LAB Tested By: CONCRETE DIV. Location Used: PERFORMANCE IN CONCRETE EVALUATION X-Ref No: CS: Coarse Agg : LEBANON CRUSHED STON WEST LEBANON NH Fine Agg : LEBANON CRUSHED STON WEST LEBANON NH Total Agg. Dry Wgt: 3127 Cement Brand: NORTHEAST QUEBEC CA Type: II Lbs: 611 A/E Admix: DARAVAIR Dosage: 3.5 oz/cy Admixture: WRDA / HYCOL Dosage: 3 oz/cwt Admixture: Dosage:

Comments:

|                                |       | Spec        | CS      | Indicates if     |  |  |
|--------------------------------|-------|-------------|---------|------------------|--|--|
| Test                           |       | Min         | Max     | Outside of Specs |  |  |
| Unit Wgt of Fresh Concrete,pcf | 148.4 | !           | :       |                  |  |  |
| Air Content, Percent           | 5.7   | 4.          | 6.      |                  |  |  |
| Slump, Inches                  | 3.    | 2.          | 4.      |                  |  |  |
| Total Water, Gal/cy            | 31.56 |             | 35.75   |                  |  |  |
| W/C Ratio                      | 0.431 |             | 0.49    |                  |  |  |
| Concrete Temperature, Deg F.   | 72    | 50          | 80      |                  |  |  |
| Ambient Temperature, Deg F.    | 1     | 10          | 85      |                  |  |  |
| Specm. Cyl Unit Date Date      | Des   | Age Cure    | Brk Avg | 28 Day Indic. if |  |  |
| Ma Mak web Deserved Dustra     |       | Durle Trees | DOT DOT | 0 0              |  |  |

| NO.  | wgt рст | Received. | Broken   | Age | вгк | type | PSI  | PSI  | Spec | out. | specs |
|------|---------|-----------|----------|-----|-----|------|------|------|------|------|-------|
| R-B1 | 1       |           | 04/29/91 | 7   | 7   | S    | 3396 | 3691 | 3500 |      |       |
| R-B1 | 2       |           | 04/29/91 | 7   | 7   | S    | 3986 | 3691 | 3500 |      |       |
| R-B1 | 3       |           | 05/06/91 | 14  | 14  | S    | 3986 | 3976 | 3500 |      |       |
| R-B1 | 4       |           | 05/06/91 | 14  | 14  | S    | 3965 | 3976 | 3500 |      |       |
| R-B1 | 5       |           | 05/20/91 | 28  | 28  | S    | 4535 | 4535 | 3500 |      |       |

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

Distribution LABRPT Vermont Agency of Transportation Materials and Research Division Central Files J. WEAVER J. WEAVER Report on Concrete Cylinders Preliminary Sample Lab No: C91WP04 Report Date: 07/19/91 Project: WORK PLAN 91-C-6 Sampled By: Pay Item: Concrete, Class B 501.25 Date Sampled: 04/22/91 Material Name/Type: Concrete Class B 501.03A Sampled From: LAB MIXER Resident: J. WEAVER Quantity Rep: 1.8 cf Submitted By: J. KELLY LFP Field Test By: CONCRETE DIV. Material Source: MATERIALS+RESEARCH LAB Tested By: CONCRETE DIV. Location Used: PERFORMANCE IN CONCRETE EVALUATION X-Ref No: CS: Coarse Agg : LEBANON CRUSHED STON WEST LEBANON NH Fine Agg : LEBANON CRUSHED STON WEST LEBANON NH Total Agg. Dry Wgt: 3127 Cement Brand: NORTHEAST QUEBEC CA Type: II Lbs: 611 A/E Admix: DARAVAIR Dosage: 4 oz/cy Admixture: WRDA / HYCOL Dosage: 3 oz/cwt Admixture: Dosage:

Comments:

|                           |         |       | Specs |       |      |      | Indicat | es if      |
|---------------------------|---------|-------|-------|-------|------|------|---------|------------|
| Test                      |         |       | м     | in    | Max  | :    | Outside | of Specs   |
| Unit Wgt of Fresh Concret | e,pcf ; | 148.6 | 1     |       |      | !    |         |            |
| Air Content, Percent      |         | 5.8   | 1     | 4.    | 6    |      |         |            |
| Slump, Inches             |         | 2.5   | i –   | 2.    | 4    |      |         |            |
| Total Water, Gal/cy       | - i     | 31.41 | 1     |       | 35.7 | 5    |         |            |
| W/C Ratio                 |         | 0.429 | 1     |       | 0.4  | 9    |         |            |
| Concrete Temperature, Deg | F.      | 72    | 1     | 50    | 8    | 0    |         |            |
| Ambient Temperature, Deg  | F.      |       | 1     | 10    | 8    | 5    |         |            |
| Specm. Cyl Unit Date      | Date    | Des   | Age   | Cure  | Brk  | Avg  | 28 Day  | Indic. if  |
| No. Wgt pcf Received      | Broken  | Age   | Brk   | Туре  | PSI  | PSI  | Spec    | Out. Specs |
|                           | 04/00/0 |       |       | <br>C | 2606 | 2620 | 2500    |            |

| 11 02       |   | 04/25/51 | ,  | 1  | 0 | 2000 | 0020 | 3300 |  |
|-------------|---|----------|----|----|---|------|------|------|--|
| R-B2        | 2 | 04/29/91 | 7  | 7  | S | 3649 | 3628 | 3500 |  |
| R-B2        | 3 | 05/06/91 | 14 | 14 | S | 4155 | 4175 | 3500 |  |
| R-B2        | 4 | 05/06/91 | 14 | 14 | S | 4195 | 4175 | 3500 |  |
| <b>R-B2</b> | 5 | 05/20/91 | 28 | 28 | S | 4581 | 4551 | 3500 |  |
| R-B2        | 6 | 05/20/91 | 28 | 28 | S | 4521 | 4551 | 3500 |  |

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

| LABRPT                | Vermont Agency of Tran<br>Materials and Researc | nsportation<br>ch Division | Distribution<br>Central Files<br>J. WEAVER<br>J. WEAVER |
|-----------------------|---|----------------------------|---|
|                       | Report on Concrete                              | Cylinders                  |   |
| Lab No: C91WP05       | Frei minary Sc                                  |                            |   |
|                       |   | Report Date:               | 07/19/91  |
| Project: WORK PLAN    | 91-C-6  | Sampled By:                |   |
| Pay Item: Concrete    | , Class A 501.22                                | Data Campled.              | 04/00/04  |
| Matorial Name/Type    | · Concrete Class & 501 034                      | Date Sampled:              | 04/23/91  |
| Mater fai Malley Type | . concrete crass A sorrosa                      | Sampled From:              | LAB MIXER   |
| Resident: J. WEAVER   | २   |                            |   |
|                       |   | Quantity Rep:              | 1.8 cf  |
| Submitted By: J. K    | ELLY LFP  | Field Test Due             | OONODETE DIV  |
| Matarial Courses M    | TEDTAL STRESEADON 1 AD                          | Field lest By:             | CONCRETE DIV.   |
| Material Source. M    | ATERIALSTRESEARCH LAB                           | Tested By:                 | CONCRETE DIV.   |
| Location Used: PERM   | FORMANCE IN CONCRETE EVALUA                     | TION                       |   |
|                       |   | X-Ref No:                  | CS:   |
| Coarse Agg : COLUN    | MBIA S&G  | T                          | Dury Mathematica  |
| Fine Agg : COLUN      | MBIA S&G  | Type: IT                   | . Dry Wgt: 2868   |
| Cement Brand: NORT    | TEAST QUEBEC CA                                 | Type. II                   | LDS. 000  |
| A/E Admix: DARAVAIR   | <del>۲</del>                                    | Dosage: 5                  | .5 oz/cy  |
| Admixture: WRDA / H   | HYCOL   | Dosage: 3                  | oz/cwt  |
| Admixture:            |   | Dosage:                    |   |

Comments:

|                                |       |     | Spe  | cs   |      | Indicates if |            |
|--------------------------------|-------|-----|------|------|------|--------------|------------|
| Test                           |       |     | in   | Max  |      | Outside      | of Specs   |
| Unit Wgt of Fresh Concrete,pcf | 145.  | ;   |      |      | 1    |              |            |
| Air Content, Percent           | 5.7   | 1   | 5.   | 7    |      |              |            |
| Slump, Inches                  | 2.75  | 1   | 2.   | 4    |      |              |            |
| Total Water, Gal/cy            | 31.56 | 1   |      | 35.  | 1    |              |            |
| W/C Ratio                      | 0.399 | 1   |      | 0.4  | 4    |              |            |
| Concrete Temperature, Deg F.   | 70    | 1   | 50   | 8    | 0    |              |            |
| Ambient Temperature, Deg F.    |       | 1   | 10   | 8    | 5    |              |            |
| Specm. Cyl Unit Date Date      | Des   | Age | Cure | Brk  | Avg  | 28 Day       | Indic. if  |
| No. Wgt pcf Received Broker    | n Age | Brk | Туре | PSI  | PSI  | Spec         | Out. Specs |
| PA-2 1 04/30/                  | /91 7 | 7   | s    | 3940 | 3979 | 4000         |            |
| PA-2 2 04/30/                  | 91 7  | 7   | S    | 4018 | 3979 | 4000         |            |
| PA-2 3 05/07/                  | 91 14 | 14  | S    | 4393 | 4474 | 4000         |            |
| PA-2 4 05/07/                  | 91 14 | 14  | S    | 4555 | 4474 | 4000         |            |
| PA-2 5 05/21/                  | 91 28 | 28  | S    | 4983 | 5026 | 4000         |            |
| PA-2 6 05/21/                  | 91 28 | 28  | S    | 5068 | 5026 | 4000         |            |

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

| LABRPT                 | Vermont Agency of Tran<br>Materials and Researc | Distribution<br>Central Files<br>J. WEAVER<br>J. WEAVER |               |
|------------------------|---|---|---------------|
|                        | Report on Concrete<br>Preliminary Sa            | Cylinders<br>ample                                      |               |
| Lab No: C91WP06        |   |   |               |
| Breisste WORK DIAN     | 1-0-6   | Report Date: (  | 07/19/91      |
| Project: WORK PLAN :   | -C-8  | Sampled By.   |               |
| Pay Item: Concrete.    | Class A 501.22                                  | bumprou by.   |               |
| ,,                     |   | Date Sampled: C   | 04/23/91      |
| Material Name/Type:    | Concrete Class A 501.03A                        |   |               |
|                        |   | Sampled From: L   | AB MIXER      |
| Resident: J. WEAVER    |   | Ourset days Dame in                                     | 00            |
| Submitted By I KEI     | IVIED   | Quantity Rep: 1   | .8 CT         |
| Subilituded by: J. Ker | LI LFF  | Field Test By C   | ONCRETE DIV   |
| Material Source: MAT   | ERIALS+RESEARCH LAB                             |   | CHOREFE DIT.  |
|                        |   | Tested By: C  | CONCRETE DIV. |
| Location Used: PERFC   | RMANCE IN CONCRETE EVALUA                       | TION  |               |
|                        |   | X-Ref No:   | CS:           |
| Coarse Agg : COLUME    | SIA S&G   | Tatal Ass   | Day Mate 0000 |
| Fine Agg : COLUME      | SIA S&G   | TVDO: IT  | Dry Wgt: 2868 |
| cellent Brand. Northe  | AST QUEBEC CA                                   | Type. II  | LDS. 000      |
| A/E Admix: DARAVAIR    | · · ·   | Dosage: 5.  | 5 oz/cy       |
| Admixture: WRDA / HY   | COL   | Dosage: 3   | oz/cwt        |
| Admixture:             |   | Dosage:   |               |

Comments:

.. . . . .

|                            |                |            |            | Spe          | cs         |            | Indicates if   |                         |
|----------------------------|----------------|------------|------------|--------------|------------|------------|----------------|-------------------------|
| lest                       |                |            | M          | in<br>       | max        |            |                | or specs                |
| Unit Wgt of Fresh Concrete | e,pcf   1      | 44.7       | 1          |              |            | 1          |                |                         |
| Air Content, Percent       | 1              | 6.         | 1          | 5.           | 7          |            |                |                         |
| Slump, Inches              | 1              | 2.75       | 1          | 2.           | 4          |            |                |                         |
| Total Water, Gal/cy        | 1 3            | 1.32       | Í.         |              | 35.        | 1          |                |                         |
| W/C Ratio                  | 1 0            | .396       | 1          |              | 0.4        | 4          |                |                         |
| Concrete Temperature, Deg  | F.             | 70         | 1          | 50           | 8          | 0          |                |                         |
| Ambient Temperature, Deg F | ⁼. ¦           |            | 1          | 10           | 8          | 5          |                |                         |
| Specm. Cyl Unit Date<br>No | Date<br>Broken | Des<br>Age | Age<br>Brk | Cure<br>Type | Brk<br>PSI | Avg<br>PSI | 28 Day<br>Spec | Indic. if<br>Out. Specs |
|                            |                |            |            |              |            |            |                |                         |
| PA-1 1                     | 04/30/91       | 7          | 7          | S            | 3657       | 3692       | 4000           |                         |
| PA-1 2                     | 04/30/91       | 7          | 7          | S            | 3727       | 3692       | 4000           |                         |
| PA-1 3                     | 05/07/91       | 14         | 14         | S            | 4386       | 4384       | 4000           |                         |
| PA-1 4                     | 05/07/91       | 14         | 14         | S            | 4382       | 4384       | 4000           |                         |
| PA-1 5                     | 05/21/91       | 28         | 28         | S            | 4789       | 4800       | 4000           |                         |
| PA-1 6                     | 05/21/91       | 28         | 28         | S            | 4810       | 4800       | 4000           |                         |

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

Vermont Agency of Transportation Distribution LABRPT Materials and Research Division Central Files J. WEAVER J. WEAVER Report on Concrete Cylinders Preliminary Sample Lab No: C91WP07 Report Date: 07/19/91 Project: WORK PLAN 91-C-6 Sampled By: Pay Item: Concrete, Class A 501.22 Date Sampled: 04/22/91 Material Name/Type: Concrete Class A 501.03A Sampled From: LAB MIXER Resident: J. WEAVER Quantity Rep: 1.8 cf Submitted By: J. KELLY LFP Field Test By: CONCRETE DIV. Material Source: MATERIALS+RESEARCH LAB Tested By: CONCRETE DIV. Location Used: PERFORMANCE IN CONCRETE EVALUATION X-Ref No: CS: Coarse Agg : LEBANON CRUSHED STON WEST LEBANON NH Fine Agg : LEBANON CRUSHED STON WEST LEBANON NH Total Agg. Dry Wgt: 3007 Cement Brand: NORTHEAST QUEBEC CA Type: II Lbs: 660 A/E Admix: DARAVAIR Dosage: 5 oz/cy Dosage: 3 oz/cwt Admixture: WRDA / HYCOL Dosage: Admixture:

Comments:

|                                  |       | Specs |      |      |      | Indicates if |            |  |
|----------------------------------|-------|-------|------|------|------|--------------|------------|--|
| Test                             |       | M     | in   | Мах  |      | Outside      | of Specs   |  |
| Unit Wgt of Fresh Concrete,pcf ; | 147.1 | 1     |      |      | 1    |              |            |  |
| Air Content, Percent             | 5.9   | 1     | 5.   | 7    |      |              |            |  |
| Slump, Inches                    | 2.5   | 1     | 2.   | 4    |      |              |            |  |
| Total Water, Gal/cy              | 31.4  | 1     |      | 35.  | 1    |              |            |  |
| W/C Ratio                        | 0.397 | 1     |      | 0.4  | 4 ¦  |              |            |  |
| Concrete Temperature, Deg F.     | 72    | 1     | 50   | 8    | 0    |              |            |  |
| Ambient Temperature, Deg F.      |       | 1     | 10   | 8    | 5 ¦  |              |            |  |
| Specm. Cyl Unit Date Date        | Des   | Age   | Cure | Brk  | Avg  | 28 Day       | Indic. if  |  |
| No. Wgt pcf Received Broken      | Age   | Brk   | Туре | PSI  | PSI  | Spec         | Out. Specs |  |
| R-A1 1 04/29/                    | 91 7  | 7     | S    | 3750 | 3831 | 4000         |            |  |
| R-A1 2 04/29/                    | 91 7  | 7     | S    | 3911 | 3831 | 4000         |            |  |
| R-A1 3 05/06/                    | 91 14 | 14    | S    | 4269 | 4342 | 4000         |            |  |
| R-A1 4 05/06/                    | 91 14 | 14    | s    | 4414 | 4342 | 4000         |            |  |
| R-A1 5 05/20/                    | 91 28 | 28    | S    | 4811 | 4749 | 4000         |            |  |
| R-A1 6 05/20/                    | 91 28 | 28    | S    | 4687 | 4749 | 4000         |            |  |

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

| LABRPT               | Vermont Agency of<br>Materials and Re | Transportation<br>search Division | Distribution<br>Central Files<br>J. WEAVER<br>J. WEAVER |
|----------------------|---------------------------------------|-----------------------------------|---|
|                      | Report on Conc<br>Prelimina           | rete Cylinders<br>ry Sample       |   |
| Lab No: C91WP08      |                                       |                                   |   |
|                      |                                       | Report Date:                      | 07/19/91  |
| Project: WORK PLAN   | 91-C-6                                |                                   |   |
|                      |                                       | Sampled By:                       |   |
| Pay Item: Concrete,  | Class A 501.22                        | Dete Complede                     | 04/00/01  |
| Material Name/Type:  | Concrete Class A 501                  | Date Sampred:                     | 04/23/91  |
| Mater fat Mane/Type. | Concrette trass A Sor                 | Sampled From:                     | LAB MIXER   |
| Resident: J. WEAVER  |                                       | camp rou ri omi                   |   |
|                      |                                       | Quantity Rep:                     | 1.8 cf  |
| Submitted By: J. KE  | LLY LFP                               |                                   |   |
|                      |                                       | Field Test By:                    | CONCRETE DIV.   |
| Material Source: MA  | FERIALS+RESEARCH LAB                  | Tested Due                        | CONODETE DIV  |
| Location Hoods DERE  | DRMANCE IN CONCRETE E                 | Iested By:                        | CONCRETE DIV.   |
| LOCACION USED. PERFC | DRMANCE IN CONORETE E                 | X-Ref No.                         | CS.   |
| Coarse Agg : LEBANG  | ON CRUSHED STON WEST                  | LEBANON NH                        |   |
| Fine Agg : LEBANG    | ON CRUSHED STON WEST                  | LEBANON NH Total Agg              | . Dry Wgt: 3007   |
| Cement Brand: NORTHE | EAST QUEBEC CA                        | Type: II                          | Lbs: 660  |
|                      |                                       |                                   |   |
| A/E Admix: DARAVAIR  |                                       | Dosage: 5                         | oz/cy   |
| Admixture: WRDA / H) | COL                                   | Dosage: 3                         | OZ/CWT  |
| Admixture:           |                                       | Dosage:                           |   |

Comments:

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| Test                                    |     |      |          |         |       |     | Specs   |      |      | Indicates if     |            |
|---|-----|------|----------|---------|-------|-----|---------|------|------|------------------|------------|
|   |     |      |          |         |       | М   | Min Max |      |      | Outside of Specs |            |
| Unit Wgt of Fresh Concrete, pcf   149.6 |     |      |          |         |       | 1   |         |      | ;    |                  |            |
| Air Content, Percent 5.5                |     |      |          |         |       | 1   | 5.      | 7    |      |                  |            |
| Slump, Inches 2                         |     |      |          |         | 2.5   | 1 1 | 2.      | 4    |      |                  |            |
| Total Water, Gal/cy 30.69               |     |      |          |         | 30.69 | 1   |         | 35.  | 1 1  |                  |            |
| W/C Ratio 0.388                         |     |      |          |         | 0.388 | 1   | 0.44    |      |      |                  |            |
| Concrete Temperature, Deg F             |     |      |          |         | 1     | 50  | 80      |      |      |                  |            |
| Ambient Temperature, Deg F.             |     |      |          |         |       | 1   | 10      | 85   |      |                  |            |
| Specm.                                  | Cyl | Unit | Date     | Date    | Des   | Age | Cure    | Brk  | Avg  | 28 Day           | Indic. if  |
| No.                                     | Wgt | pcf  | Received | Broken  | Age   | Brk | Туре    | PSI  | PSI  | Spec             | Out. Specs |
| R-A2 1                                  |     |      |          | 04/30/9 | 1 7   | 7   | S       | 3876 | 3800 | 4000             |            |
| R-A2 2                                  |     |      |          | 04/30/9 | 1 7   | 7   | S       | 3724 | 3800 | 4000             |            |
| R-A2 3                                  |     |      | •        | 05/07/9 | 1 14  | 14  | S       | 4591 | 4595 | 4000             |            |
| R-A2 4                                  |     |      |          | 05/07/9 | 1 14  | 14  | S       | 4598 | 4595 | 4000             |            |
| R-A2 5                                  |     |      |          | 05/21/9 | 1 28  | 28  | S       | 5125 | 5063 | 4000             |            |
| R-A2 6                                  |     |      |          | 05/21/9 | 1 28  | 28  | S       | 5001 | 5063 | 4000             |            |

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

Reviewed By: R. J. O'Brien, Testing Lab Supervisor For: R. F. Cauley, Materials and Research Engineer TA 565 Rev. 4/79

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

# STATE OF VERMONT AGENCY OF TRANSPORTATION MATERIALS & RESEARCH DIVISION

RESEARCH INVESTIGATION

Work Plan No. 91-C-6

| Subject Evaluation of Fine Aggregate and 3/4" Crushed Gravel Coarse Aggregate        |
|--|
| Investigation Requested Rue Steven Persons   |
| Investigation Requested By Steven Fersons Date 03/12/91                              |
| Date Information Required As soon as possible  |
| Purpose of Investigation To evaluate a fine aggregate and a 3/4" crushed             |
| gravel coarse aggregate from the Columbia Sand & Gravel facility in                  |
| Columbia, N.H., proposed for use as structural concrete aggregates.                  |
|  |
| Proposed Tests or Evaluation Procedure See Vermont Procedure for Evaluating          |
| a New Source of Structural Concrete Aggregate, VT-AOT-MRD 9-82.                      |
| 1. Performance-in-concrete tests will be performed using two batches each of         |
|  |
| Class A & Class B concrete containing the proposed new aggregates and two            |
| batches each of Class A & Class B concrete containing a reference aggregate.         |
| 2. Prepare speciments from each batch of concrete to determine resistance to         |
| freezing and thawing   |
|  |
|  |
|  |
| Proposal Discussed With John Weaver Projected Manpower Requirements 25 man-days      |
| Investigation To Be Conducted By Structural Concrete Subdivision                     |
| Proposed Starting Date 03/25/91 Estimated Completion Date 05/24/91                   |
| Approval/DIsapproval by Materials & Research Engineer N.F. Cauly                     |
| Comments by Materials & Research Engineer  |
| Materials & Research Division<br>Agency of Transportation<br>Date Typed: 03/28/91 41 |