AGENCY OF TRANSPORTATION
VERMONT DEPARTMENT OF HIGHWAYS
MATERIALS DIVISION

CLASS B CONCRETE
USING CALEDONIA INC. AGGREGATES
WATERFORD, VERMONT

REPORT 77-6
MAY 1977

REPORTING ON WORK PLAN NO. 77-C-27

R.E.W. Crisman, Acting Commissioner
E.H. Stickney, Chief Engineer
R.F. Nicholson, P.E., Materials Engineer

Prepared by

J.L. Talbot, Structural Concrete Engineer
Structural Concrete Subdivision

Materials Division
Highway Department
Agency of Transportation
March 27, 1978

Reviewed By:

R.F. Nicholson

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

Date: March 30, 1978

Prepared by: J. Talbot
Date: 5/2/77

VERMONT DEPARTMENT OF HIGHWAYS
MATERIALS DIVISION - STRUCTURAL CONCRETE SUBDIVISION

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VERMONT DEPARTMENT OF HIGHWAYS
MATERIALS DIVISION - STRUCTURAL CONCRETE SUBDIVISION

ABSTRACT

Difficulties in obtaining a compressive strength of 3500 P.S.I. consistantly during the summer construction season has been experienced.

In order to achieve the desired strength the mix design must be capable of obtaining the specified strengths under conditions similar to those experienced in the field.

This evaluation is an attempt to obtain a Class B structural concrete mix design that will achieve a compressive strength of 3500 P.S.I. under field conditions and during temperatures experienced during summer placement.

VERMONT DEPARTMENT OF HIGHWAYS
MATERIALS DIVISION - STRUCTURAL CONCRETE SUBDIVISION

INTRODUCTION

A history of poor structural concrete strength has been experienced during periods of warm weather.

The principal supplier of the aggregates used during this time has been Caledonia, Incorporated, Waterford, Vermont.

The purpose of this evaluation is to obtain a mix design that will produce concrete meeting the requirements of Item 501.25 Concrete Class B during the warm summer months. Based on the data obtained during the 1976 construction season an average 28 day compressive strength of 4271 P.S.I. is required in order for Item 501.25 Class B concrete to meet the minimum strength requirement of 3500 P.S.I. ninty percent of the time. Determination of the 4271 P.S.I. average 28 day compressive strength was obtained through the use of the Vermont Department of Highways Concrete Compressive Tests Evaluation and Plot Program No. P609.

Materials Division - Structural Concrete Subdivision

PRODUCT EVALUATION WORK PLAN

Number 77-C-27

Product Class B Concrete using Caledonia Aggregates

Manufacturer Lawrence Sandgravco, Inc.
St. Johnsbury,
Vermont 05819

Distributor or Representative Lawrence Sandgravco, Inc.
St. Johnsbury,
Vermont 05819

Evaluation Requested By In House Date April 19, 1977

Date Information Required N/A

Date Product Data & Application Instructions Received N/A

Date Samples Received February 22, 1977

Sample Quantity N/A Were sufficient samples received yes

Purpose of Evaluation

To develop a mix design that will meet strength requirements, 3500 psi @ 28 days during summer temperatures.

Proposed Tests (Attach extra sheet if necessary)

1. Compressive Strengths 7, 14, 28 days using 6" x 12" cylinders
2. Air Content - Chace & Pressure Method
3. Controlled Temperatures
4. Unit Weight & Yield
5. Determine Water Cement Ratios

Proposal Discussed with following Sub-divisions None

Projected Manpower Requirements 35 man days including report

Evaluation to be Conducted by Structural Concrete Subdivision

Proposed Starting Date 2/22/77 Estimated Completion Date July, 1977

(Approval)/Disapproval by Materials Engineer R. T. Nicholson 5/3/77

Comments by Materials Engineer

VERMONT DEPARTMENT OF HIGHWAYS
MATERIALS DIVISION - STRUCTURAL CONCRETE SUBDIVISION

Report of Product Evaluation Work Plan No. 77-C-27
April 1977

Materials:

Product: Item 501.25 Concrete Class B - using Caledonia, Inc. Aggregates

Manufacturer of Concrete Aggregate: Caledonia, Inc. - Waterford, Vermont

Manufacturer of Air Entraining Admixture used:

Product - Darex AEA - manufactured by W. R. Grace & Co.
Cambridge, Massachusetts
Dosage - 5-12 oz. per yard, as necessary to obtain desired air content.

Manufacturers of Water Reducing Admixtures used:

Product - WRDA - manufactured by W. R. Grace & Co.
Cambridge, Massachusetts
Dosage - rate used 7 oz./100 wt.

Product - Pozzolith 122N - manufactured by Master Builders,
Cleveland, Ohio
Dosage - rate used 5 oz./100 wt.

Product - Daratard HC - manufactured by W. R. Grace & Co.
Cambridge, Massachusetts
Dosage - rate used 3 oz./100 wt.

Manufacturer of Portland Cement:

Product - Glens Falls Type II - manufactured by the Glens Falls Portland Cement Co.
Glens Falls, New York

Product - Northeast Cement Type II - manufactured by Canada Cement Lafarge LTD
Montreal, P.Q.

Producer of Concrete: Lawrence Sangravco, Inc. - St. Johnsbury, Vermont

Description of Product: A Portland Cement concrete containing a minimum of 610 lbs. of cement per cubic yard, having a maximum of 36.5 gallons of water per cubic yard, a slump range of 2 to 4 inches, an air content of 6.0±1 percent, containing a coarse aggregate and fine aggregate and possessing the ability to obtain a minimum 28 day compressive strength of 3500 P.S.I.

Vermont Department of Highways Specification: Item 501.25 Concrete, Class B

VERMONT DEPARTMENT OF HIGHWAYS
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Report of Product Evaluation Work Plan No. 77-C-27
April 1977

Procedure:

All aggregates were tested for compliance to Vermont Department of Highways Specifications (Appendix A). Mix designs were proportioned to ACI procedures (Appendix B). Several water reducing admixtures and a retarder were incorporated in our mix designs. A reference mix was also prepared for comparison. After preparing the mixes in the laboratory, 6 x 12 inch cylinders were cast.

Two methods of curing and two concrete mix temperatures were studied. Mix designs number 1 thru 48 were prepared and cured as follows: The concrete mix temperatures were raised to 80° by use of warm water. The purpose of this was to simulate warm weather concrete temperatures in the laboratory. The curing procedures for the cylinders made from these mixes were as follows: These cylinders were placed in a dry curing box for 24 hours prior to removal of their molds. The temperature in the curing box was allowed to rise to 90°F. The heat produced by hydration was sufficient to create the 90°F temperatures. This procedure was used because it was the best way to simulate the worst conditions that should occur in the field during the summer months. At the end of 24 hours, the cylinders were removed from the curing box, stripped of their molds and placed in the moist curing room to receive a standard cure until removal for capping and breaking at 7, 14 and 28 days.

Mix designs No. 49 thru 52 were selected after the results of mix designs No. 1 thru 48 were obtained. These mixes were proportioned using the water reducing admixture Pozzolith 122N. Mix designs No. 49, 49NE, 51, 53 and 55 were cast and cured using the same procedures that were followed for the mixes designs No. 1 thru 48.

Mix designs No. 50, 52, 54 and 56 were prepared using the same water reducing admixture, Pozzolith 122N, but were mixed having a concrete mix temperature of 70°F and were cured for the first 24 hours in a room at 72°F. The molds were then stripped and the cylinders placed in the moist curing room to receive a standard cure until removal for capping and breaking at 7, 14 and 28 days.

Three cement contents were used in our mix designs 610, 634 and 660 pounds per cubic yard. For each cement content three different blends of 1-1/2 and 3/4 inch coarse aggregate were proportioned for mix designs. These were, by percent of total coarse aggregate, 66-2/3%-1-1/2 inch stone to 33-1/3%-3/4 inch stone 50% 1-1/2 inch stone to 50% 3/4 inch stone, 33-1/3% 1-1/2 inch stone to 66-2/3% 3/4 inch stone. In addition to the mix designs with various blends of coarse aggregate a mix for each cement content was prepared using only 3/4 inch stone as the coarse aggregate.

Each of the above coarse aggregate gradations were then used in a mix design in combination with the following admixtures. Darex AEA and WRDA, Darex AEA and Pozzolith 122N, Darex AEA and Daratard HC and a reference mix with only Darex AEA.

All but one mix was proportioned using Glens Falls Type II cement. Mix No. 49NE was proportioned using Northeast Cement Type II.

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Results:

Trial mixes No. 1 thru No. 48 were designed in an effort to narrow the choice of designs and obtain a revised design that would produce satisfactory results. See Tables No. 1, No. 2 and No. 3.

These results show that none of the reference mixes obtained a 3500 P.S.I. compressive strength. Trial mixes containing Pozzolith 122N surpassed all other mix designs except for trial mix No. 43. As the cement content increased, most trial mixes showed an increase in compressive strength. The use of Daratard HC produced results with limited success and in some trial mixes resulted in a compressive strength lower than the reference mix.

In all mixes tested, the yield was higher than desired. The percent of air, when on the low side of our target aim, gave compressive strength results slightly higher than would be expected had the 6.0±1 percent air been obtained.

Based on the results shown on Tables No. 1, No. 2 and No. 3, mix designs were revised. For results of the revised mix designs see Table No.4. Because of the better performance obtained using Pozzolith 122N, the mix designs No. 49 thru No. 56 contained this water reducing admixture. Cement contents were held to 610 and 634 lbs. per cubic yard. The use of 66-2/3% 1-1/2 inch stone and 33-1/3% 3/4 inch stone as a blend was discontinued due to the coarse mixes this blend produced in trial mixes No. 1 thru 4, 17 thru 20 and 33 thru 36.

The revised trial mix designs No. 49 thru 56 corrected the high yield previously obtained in our trial mixes. Except for trial mix design No. 53, the 3500 P.S.I. compressive strength was obtained. However, only one mix design, No. 56, obtained our desired compressive strength of 4271 P.S.I.

Trial mix design No. 49 and No. 49 NE showed very little difference when different cements were used with the same design.

Except for trial mixes No. 51 and No. 52, the trial mixes proportioned at a 70°F temperature and standard cured at 72°F obtained higher compressive strengths than did the trial mixes proportioned at 80°F and cured at 90°F for the first 24 hours.

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Conclusions and Recommendations:

The purpose of this investigation was to obtain a Class B concrete mix design that would produce a minimum compressive strength of 3500 P.S.I. during the temperatures experienced in the summer. A maximum concrete temperature of 80°F and a maximum ambient temperature of 85°F is permitted for this class of concrete. It is therefore possible to achieve temperatures of 90°F adjacent to cylinder during the first 24 hours of curing during summer months. It was for this reason the above temperatures were created in the laboratory as a condition in our testing.

It was determined by analysis of cylinder strengths obtained during the summer of 1976, that it would be necessary to develop a mix design that would yield a minimum compressive strength of 4271 P.S.I. in the laboratory under temperatures simulating summer conditions in order to obtain a minimum compressive strength of 3500 P.S.I. in nine out of ten tests on concrete class B produced in the field.

Based on the results obtained in our laboratory tests, the mix design used for trial mix Nos. 55 and 56 produced compressive strengths that exceeded the 4271 P.S.I. desired compressive strength when tested under normal laboratory controlled temperatures of 73.3±3°F. This same mix design came within 27 P.S.I. of meeting our desired compressive strength of 4271 P.S.I. when tested in our laboratory under the maximum summer temperatures expected in the field (80°F concrete temperature and a 90°F curing temperature during the first 24 hours).

The results obtained by this mix design, under simulated summer temperatures, came within six-tenths of one percent of obtaining the desired compressive strenth of 4271 P.S.I. These results are considered to be within an acceptable tolerance of our desired aim. However, the design proposed herein shall be considered a minimum design for the ingredients proposed and is subject to revision based upon the results actually obtained in the field.

Based on the results of the tests performed, and subject to revisions based upon results obtained in the field, the following minimum mix design is hereby recommended.

Caledonia, Inc. - Aggregate

Item 704.02 - Coarse Aggregate - 1-1/2" Stone	660 lbs. (dry weight)
Item 704.02 - Coarse Aggregate - 3/4" Stone	1320 lbs. (dry weight)
Item 704.01 - Fine Aggregate - Sand	1083 lbs. (dry weight)
Glens Falls Type II minimum Cement Content	634 lbs./cubic yard
Pozzolith 122N Water Reducing Admixture	5 oz./100 cwt
A maximum water cement ratio of	0.42
Darex AEA 12 oz./cy. or as required to obtain	6 ± 1 percent air

VERMONT DEPARTMENT OF HIGHWAYS
MATERIALS DIVISION - STRUCTURAL CONCRETE SUBDIVISION

TABLE NO. I

Results of Trail Mixes using Caledonia, Inc. Aggregate

610 lbs. Cement/Cubic Yard
80°F Concrete Mix Temperature
90°F Cure for first 24 hours, Standard Cured in moist curing room thereafter until broken.

Trial Mix No.	Admixtures used in Addition to Darex	Percentage of Coarse Aggregate blend 1-1/2" to 3/4"	Average Compressive Strength of Two Cylinders broken at the following days			Percent of Air		Slump in Inches	Unit Weight	Yield	Water Cement Ratio
			7 days	14 days	28 days	P	C				
1	None(Reference Mix)	66-2/3-33-1/3	2317	2724	2824	4.5	7.0	3	149.36	27.25	.467
2	WRDA	66-2/3-33-1/3	2600	3086	3426	4.2	6.0	2-1/2	150.24	---	--
3	Pozzolith 122N	66-2/3-33-1/3	2989	3537	3599	3.4	4.5	2-3/4	152.53	27.14	.448
4	Daratard HC	66-2/3-33-1/3	2449	2856	2900	5.2	6.0	2-1/2	149.31	27.68	.448
5	None(Reference Mix)	50 - 50	2299	2609	2909	4.2	5.2	3	149.64	27.81	.489
6	WRDA	50 - 50	2444	2825	3099	4.8	6.0	3-1/4	148.95	27.81	.456
7	Pozzolith 122N	50 - 50	2851	3285	3488	4.4	5.0	2-3/4	150.08	27.65	.467
8	Daratard HC	50 - 50	2564	2962	3135	4.8	5.8	2-3/4	148.23	27.96	.459
9	None(Reference Mix)	33-1/3-66-2/3	2494	2821	3117	4.8	5.3	2-3/4	148.99	27.82	.464
10	WRDA	33-1/3-66-2/3	2374	2626	3157	5.3	7.0	2-3/4	147.03	28.23	.472
11	Pozzolith 122N	33-1/3-66-2/3	2750	3334	3205	5.1	6.0	4-1/2	148.03	27.99	.461
12	Daratard HC	33-1/3-66-2/3	2480	2781	3183	5.2	5.3	2-3/4	147.55	28.00	.441
13	None(Reference Mix)	0 - 100	2608	2932	3258	5.6	4.3	3-1/4	146.74	27.75	.472
14	WRDA	0 - 100	2418	2901	3329	6.0	6.0	3-1/4	144.90	28.07	.466
15	Pozzolith 122N	0 - 100	3015	3550	3652	5.3	5.0	2-3/4	146.26	27.83	.470
16	Daratard HC	0 - 100	2308	2980	2896	5.8	5.8	3	144.98	28.08	.470

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TABLE NO. 2

Results of Trial Mixes using Caledonia, Inc. Aggregate

634 lbs. Cement/Cubic Yard
80°F Concrete Mix Temperature
90°F Cure for first 24 hours, Standard Cured in moist curing room thereafter until broken.

Trial Mix No.	Admixtures used in Addition to Darex	Percentage of Coarse Aggregate blend 1-1/2" to 3/4"	Average Compressive Strength of Two Cylinders broken at the following days 7 days	14 days	28 days	Percent of Air P	C	Slump in Inches	Unit Weight	Yield	Water Cement Ratio
17	None(Reference Mix)	66-2/3-33-1/3	2577	2918	3422	5.3	5.8	2-1/2	150.89	27.42	.435
18	WRDA	66-2/3-33-1/3	2578	2936	3241	5.8	7.8	3	149.68	27.61	.427
19	Pozzolith 122N	66-2/3-33-1/3	3016	3307	4036	4.4	5.3	3	152.18	27.15	.426
20	Daratard HC	66-2/3-33-1/3	2524	2679	3369	5.6	5.5	3-1/4	149.28	27.76	.445
21	None(Reference Mix)	50 - 50	2600	2957	3183	5.3	6.0	3	150.49	27.53	.435
22	WRDA	50 - 50	2388	2789	3312	6.2	6.0	3	148.39	27.95	.443
23	Pozzolith 122N	50 - 50	3104	3471	3837	4.3	4.0	3	152.70	27.16	.443
24	Daratard HC	50 - 50	2410	2838	3435	5.7	5.5	2-3/4	149.28	27.76	.437
25	None(Reference Mix)	33-1/3-66-2/3	2595	2993	3276	4.8	5.0	2-3/4	149.24	27.77	.443
26	WRDA	33-1/3-66-2/3	2604	2856	3546	6.0	5.5	3	148.03	27.95	.432
27	Pozzolith 122N	33-1/3-66-2/3	2896	3311	3908	5.6	4.5	2-1/2	149.08	27.80	.442
28	Daratard HC	33-1/3-66-2/3	2440	2851	3488	6.2	6.8	3	147.71	28.03	.435
29	None(Reference Mix)	0 - 100	2626	3135	3369	5.7	5.3	3	147.67	27.58	.451
30	WRDA	0 - 100	2427	2909	3290	7.4	6.3	3	144.32	28.25	.457
31	Pozzolith 122N	0 - 100	2794	3060	3798	6.1	5.0	3-3/4	146.10	27.97	.472
32	Daratard HC	0 - 100	2454	2755	3307	7.2	6.0	3	144.52	28.22	.459

VERMONT DEPARTMENT OF HIGHWAYS
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TABLE NO. 3

Results of Trial Mixes using Caledonia, Inc. Aggregate

660 lbs. Cement/Cubic Yard
80°F Concrete Mix Temperature
90°F Cure for first 24 hours, Standard Cured in moist curing room thereafter until broken.

Trial Mix No.	Admixtures used in Addition to Darex	Percentage of Coarse Aggregate blend 1-1/2" to 3/4"	Average Compressive Strength of Two Cylinders broken at the following days 7 days	14 days	28 days	Percent of Air P	C	Slump in Inches	Unit Weight	Yield	Water Cement Ratio
33	None(Reference Mix)	66-2/3-33-1/3	2560	2790	3059	5.5	5.3	2-1/2	148.43	27.93	.426
34	WRDA	66-2/3-33-1/3	2608	3064	3554	6.0	6.0	3	146.30	28.31	.420
35	Pozzolith 122N	66-2/3-33-1/3	3241	3546	4068	5.4	6.0	2-1/2	149.08	27.77	.417
36	Daratard HC	66-2/3-33-1/3	2485	2980	3373	5.2	6.5	3-1/4	149.40	27.76	.427
37	None(Reference Mix)	50 - 50	2573	2940	3219	5.3	5.0	2-3/4	149.28	27.81	.426
38	WRDA	50 - 50	2646	3348	3608	5.0	5.0	2-1/2	149.80	27.70	.424
39	Pozzolith 122N	50 - 50	2979	3325	4098	5.0	5.0	2-3/4	150.08	27.67	.429
40	Daratard HC	50 - 50	2454	3121	3595	5.0	5.8	2-3/4	149.92	27.67	.421
41	None(Reference Mix)	33-1/3-66-2/3	2542	3030	3488	6.0	5.3	3	147.63	28.10	.427
42	WRDA	33-1/3-66-2/3	2895	3170	3895	5.3	5.0	2-1/2	148.27	27.98	.426
43	Pozzolith 122N	33-1/3-66-2/3	3024	3320	3568	5.4	6.3	3	**148.07**	28.14	.453
44	Daratard HC	33-1/3-66-2/3	2418	3051	3090	5.6	5.0	3-1/4	148.23	28.02	.435
45	None(Reference Mix)	0 - 100	2573	3020	3320	6.1	4.8	3	145.57	28.07	.450
46	WRDA	0 - 100	2847	3205	3661	6.0	5.0	2-3/4	146.94	27.75	.436
47	Pozzolith 122N	0 - 100	2755	3395	3935	6.2	5.0	3	145.05	28.18	.453
48	Daratard HC	0 - 100	2494	2918	3268	7.0	5.3	3-1/4	143.80	28.39	.444

VERMONT DEPARTMENT OF HIGHWAYS
MATERIALS DIVISION - STRUCTURAL CONCRETE SUBDIVISION

TABLE NO. 4

Results of Trial Mixes using Caledonia, Inc. Aggregate

Lbs. of Cement/Cubic Yard - Trial Mixes No. 49 thru No. 52 contain 610 Lbs./C.Y.
Trial Mixes No. 53 thru No. 56 contain 634 Lbs./C.Y.

Concrete Mix Temperature - Check Code (a) or (b) to note concrete mix temperature and conditions of cure.

(a) 70°F Concrete Mix Temperature
(a) 72°F Cure for first 24 hours, Standard Cured in moist curing room thereafter until broken.
(b) 80°F Concrete Mix Temperature
(b) 90°F Cure for first 24 hours, Standard Cured in moist curing room thereafter until broken.

Trial Mix No.	Admixtures used in Addition to Darex	Percentage of Coarse Aggregate blend 1-1/2" to 3/4"	Average Compressive Strength of Two Cylinders broken at the following days			Percent of Air		Slump in Inches	Unit Weight	Yield	Water Cement Ratio
			7 days	14 days	28 days	P	C				
	CEMENT CONTENT 610 Lbs./C.Y.										
(b) 49	Pozzolith 122N	50 - 50	2922	3444	3754	5.0	5.5	3	146.87	27.02	.425
(b) 49NE	Pozzolith 122N	50 - 50	3144	3590	3780	6.0	5.5	3	147.95	26.95	.456
(a) 50	Pozzolith 122N	50 - 50	2918	3639	4161	4.6	5.2	3	147.47	26.81	.400
(b) 51	Pozzolith 122N	33-1/3-66-2/3	2887	3528	3908	5.2	5.6	3	146.30	26.88	.407
(a) 52	Pozzolith 122N	33-1/3-66-2/3	2967	3458	3873	5.2	5.2	3-1/4	145.02	27.05	.392
	CEMENT CONTENT 634 Lbs./C.Y.										
(b) 53	Pozzolith 122N	50 - 50	3332	3528	3475	4.4	5.9	2-3/4	148.11	27.18	.385
(a) 54	Pozzolith 122N	50 - 50	2985	3559	4165	4.4	5.2	2-3/4	148.27	27.32	.424
(b) 55	Pozzolith 122N	33-1/3-66-2/3	3263	3665	4244	4.7	5.2	2-3/4	147.63	26.88	.369
(a) 56	Pozzolith 122N	33-1/3-66-2/3	2949	3568	4368	5.5	5.9	2-3/4	144.54	27.66	.416

STATE OF VERMONT
DEPARTMENT OF HIGHWAYS

MATERIALS DIVISION
Montpelier, Vermont 05602

REPORT ON SAMPLE OF AGGREGATE

Report April 28, 1977

Laboratory No. G77 0079 Tested By W. Meyer

Name Item 704.02 1-1/2" Stone

Identification Marks Lab Evaluation

Submitted by J. Talbot Title CLP Address

Sampled 12/23, 1976 Received 2/18, 1977

Sample from Stockpile at Lawrence Sandgravco St. Johnsbury, VT

Quantity Represented N/A

Source of Material Caledonia, Inc. Waterford, VT

Location used or to be used Laboratory Trial Mixes

Examined for Item 704.02

TEST RESULTS

Total Sample Sieve Size	% Passing
4 1/2"	
4"	
3 1/2"	
3"	
2 1/2"	
2"	
1 3/4"	100
1 1/2"	99
1"	52
3/4"	10
5/8"	
1/2"	
3/8"	1
No. 4	
No. 8	
No. 10	
No. 16	
No. 30	
No. 50	
No. 100	
No. 200 Dry	0.3

1jg

Fineness Modulus % Coarser Than	
No. 100	
No. 50	
No. 30	
No. 16	
No. 8	
No. 4	

Fineness Modulus =

Sand Portion

Percent of Wear	
AASHO T3	
AASHO T4	
AASHO T96	23.4

Fractured Faces, % 83

Thin & Elongated Pieces, % 6

Soundness, % Loss 2.35

Comments:

Meets requirements for Coarse Aggregate for Concrete - Item 704.02.

E. H. Stickney, Chief Engineer

By: R. F. Nicholson /BAT
R. F. Nicholson, Materials Engineer

STATE OF VERMONT
DEPARTMENT OF HIGHWAYS

MATERIALS DIVISION
Montpelier, Vermont 05602

REPORT ON SAMPLE OF AGGREGATE

Report April 28, 1977

Laboratory No. G77 0080 Tested By W. Meyer

Name Item 704.02 3/4" Stone

Identification Marks Lab Evaluation

Submitted by J. Talbot Title CLP Address

Sampled 12/23, 1976 Received 2/18, 1977

Sample from Stockpile at Lawrence Sandgravco St. Johnsbury, VT

Quantity Represented N/A

Source of Material Caledonia, Inc. Waterford, VT

Location used or to be used Laboratory Trial Mixes

Examined for Item 704.02

TEST RESULTS

Total Sample Sieve Size	% Passing
4 1/2"	
4"	
3 1/2"	
3"	
2 1/2"	
2"	
1 3/4"	
1 1/2"	
1"	100
3/4"	98
5/8"	
1/2"	
3/8"	33
No. 4	7
No. 8	3
No. 10	
No. 16	
No. 30	
No. 50	
No. 100	
No. 200 Dry	0.7

Fineness Modulus % Coarser Than		Sand Portion
No. 100		
No. 50		
No. 30		
No. 16		
No. 8		
No. 4		
Fineness Modulus =		

Percent of Wear

AASHO T3
AASHO T4
AASHO T96 27.3

Fractured Faces, % 88

Thin & Elongated Pieces, % 8

Soundness, % Loss 2.35

Comments:

Meets requirements for Coarse Aggregate for Concrete - Item 704.02.

E. H. Stickney, Chief Engineer

By: R. F. Nicholson RFN

R. F. Nicholson, Materials Engineer

ljg

STATE OF VERMONT
DEPARTMENT OF HIGHWAYS

MATERIALS DIVISION
Montpelier, Vermont 05602

REPORT ON SAMPLE OF AGGREGATE

Report April 28, 1977

Laboratory No. G77 0031 Tested By W. Meyer

Name Item 704.01 Fine Aggregate for Concrete

Identification Marks Lab Evaluation

Submitted by J. Talbot Title CLP Address

Sampled 12/23, 1976 Received 2/18, 1977

Sample from Stockpile Lawrence Sandgravco St. Johnsbury, VT

Quantity Represented N/A

Source of Material Caledonia, Inc. Waterford, VT

Location used or to be used Laboratory Trial Mixes

Examined for Item 704.01

TEST RESULTS

Total Sample Sieve Size	% Passing	Sand Portion
4 1/2"		
4"		
3 1/2"		
3"		
2 1/2"		
2"		
1 3/4"		
1 1/2"		
1"		
3/4"		
5/8"		
1/2"		
3/8"	100	
No. 4	100	
No. 8	92	
No. 10		
No. 16	78	
No. 30	39	
No. 50	13	
No. 100	5	
No. 200 Dry	2	

Fineness Modulus
% Coarser Than

No. 100	95
No. 50	87
No. 30	61
No. 16	25
No. 8	8
No. 4	

Fineness Modulus = 2.76

Color - 1

Comments:

Meets requirements for Fine Aggregate for Concrete - Item 704.01.

Percent of Wear

AASHO T3
AASHO T4
AASHO T96

Fractured Faces, %

Thin & Elongated Pieces, %

Soundness, % Loss 3.01

E. H. Stickney, Chief Engineer

By: R. F. Nicholson 1/8/77

R. F. Nicholson, Materials Engineer

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VERMONT DEPARTMENT OF HIGHWAYS

Prepared by J. Talbot

MATERIALS DIVISION - STRUCTURAL CONCRETE SUBDIVISION Date 5/2/77

MIX DESIGN SHEET - STRUCTURAL CONCRETE ITEM # 501.25 CONCRETE CLASS B

Ready Mix Supplier: Lawrence Sangravco Inc. - St. Johnsbury, Vermont

Aggregate Supplier:	Specific Gravity	Dry Rodded Unit Weight	Absorption
1-1/2" Stone Caledonia, Inc.	2.91	102.64	0.6
3/4 " Stone	2.91	106.15	0.9
Blend: 1-1/2" & 3/4" 2/3 - 1/3	2.91	106.06	N/A
Sand Caledonia, Inc.		F.M. 2.70	1.9

Cement 610 Lbs./Cu.Yd.

Water 32 Gals./Cu.Yd.

Air 6 Percent

VOLUME OF DRY RODDED COARSE AGGREGATE
PER UNIT VOLUME OF CONCRETE

Maximum size Aggregate	Sand F.M.					
	2.60	2.70	2.80	2.90	3.00	3.10
3/4"	0.64	0.63	0.62	0.61	0.60	0.59
1-1/2"	0.73	0.72	0.71	0.70	0.69	0.68

$\frac{106.06}{\text{(Dry Rodded Unit Weight)}} \times \frac{0.72}{\text{(Unit Volume)}} = 76.36 \times 27 = 2062$ Lbs./CY Coarse Aggregate

1. Volume of Water $\frac{\text{(Gals/CY)}\ 32}{7.48} = 4.278$ Cu. Ft.

2. Solid Volume of Cement $\frac{\text{(Lbs./CY)}\ 610}{196.56} = 3.103$ Cu. Ft.

3. Volume of Entrained Air $6 \times 27 = 1.620$ Cu. Ft.

4. Solid Volume of Coarse Aggregate $\frac{\text{(Lbs./CY}\ 2062}{\text{(SpGr)}\ 2.91 \times 62.4} = 11.356$ Cu. Ft.

5. Total Solid Volume of Ingredients Except Sand 20.357 Cu. Ft.

6. Solid Volume of Sand Required 27.00 - 20.357 Cu.Ft. (Line 5) = 6.643 Cu. Ft.

7. Required Weight of Sand:
(Solid Volume) 6.643 X (SpGr) 2.78 X 62.4 = 37 Lbs./Cu.Yd.

8. Ratio of Sand to Total Agg. Line 6 ÷ (Line 6 + Line 4) = _____ % by Vol.

SUMMARY OF QUANTITIES/CU. YD. (DRY WEIGHTS)

	Trial #1	Trial #2	Trial #3	
1-1/2 " Stone	1375			Lbs.
3/4" Stone	687			Lbs.
Sand	1152			Lbs.
Cement	610			Lbs.
Water	32			Gals.

(See Reverse Side for Results)

RESULTS OF TRIAL BATCHES

Air Admixture used: _____

Manufactured by: _____

Other Admixtures used: _____

Manufactured by: _____

	TRIAL #1	TRIAL #2	TRIAL #3
Air Admixture Dosage			
Other Admixture Dosage			
% Air			
Slump			
Unit Weight			
Yield			
W/C Ratio			

Average
Compressive Strengths - Standard Cured 6" x 12" Cylinders

7 Days			
14 Days			
28 Days			
___ Days			

Remarks: For results of Trial No. 1, see Table No. 1 Trial Mix No.'s 1-4. Trial mixes were too coarse to warrant its use.

Trial Mix Numbers		#1	#2	#3	#4
Admixtures	Dosage				
Darex AEA	oz./C.Y.	6	5	6	11
WRDA	oz./100 wt.	--	7	--	--
Pozzolith 122N	oz./100 wt.	--	--	5	--
Daratard HC	oz./100 wt.	--	--	--	3

VERMONT DEPARTMENT OF HIGHWAYS

MATERIALS DIVISION - STRUCTURAL CONCRETE SUBDIVISION

MIX DESIGN SHEET - STRUCTURAL CONCRETE ITEM # 501.25 CONCRETE CLASS B

Prepared by J. Talbot

Date 5/2/77

Ready Mix Supplier: Lawrence Sangravco Inc. - St. Johnsbury, Vermont

Aggregate Supplier:	Specific Gravity	Dry Rodded Unit Weight	Absorption
3/4" Stone Caledonia, Inc.	2.91	102.64	0.6
1-1/2" Stone Caledonia, Inc.	2.91	106.15	0.9
Blend: 1-1/2" & 3/4" 50-50	2.91	110.17	N/A
Sand Caledonia, Inc.	2.78	F.M. 2.70	1.9

Cement 610 Lbs./Cu.Yd.

Water 32 Gals./Cu.Yd.

Air 6 Percent

VOLUME OF DRY RODDED COARSE AGGREGATE PER UNIT VOLUME OF CONCRETE

Maximum size Aggregate	Sand F.M.					
	2.60	2.70	2.80	2.90	3.00	3.10
3/4"	0.64	0.63	0.62	0.61	0.60	0.59
1-1/2"	0.73	0.72	0.71	0.70	0.69	0.68

$\frac{110.17}{\text{(Dry Rodded Unit Weight)}} \times \frac{72}{\text{(Unit Volume)}} = 79.32 \times 27 = 2142$ Lbs./CY Coarse Aggregate

1. Volume of Water $\frac{\text{(Gals/CY)}\ 32}{7.48} = 4.278$ Cu. Ft.

2. Solid Volume of Cement $\frac{\text{(Lbs./CY)}\ 610}{196.56} = 3.103$ Cu. Ft.

3. Volume of Entrained Air $6 \times 27 = 1.620$ Cu. Ft.

4. Solid Volume of Coarse Aggregate $\frac{\text{(Lbs./CY}\ 2142}{\text{(SpGr)}\ 2.91 \times 62.4} = 11.796$ Cu. Ft.

5. Total Solid Volume of Ingredients Except Sand 20.797 Cu. Ft.

6. Solid Volume of Sand Required 27.00 - 20.797 Cu.Ft. (Line 5) = 6.203 Cu. Ft.

7. Required Weight of Sand: (Solid Volume) 6.203 X (SpGr) 2.78 X 62.4 = 1076 Lbs./Cu.Yd.

8. Ratio of Sand to Total Agg. Line 6 ÷ (Line 6 + Line 4) = 35 % by Vol.

SUMMARY OF QUANTITIES/CU. YD. (DRY WEIGHTS)

	Trial #1	Trial #2	Trial #3	
1-1/2" Stone	1071	1020		Lbs.
3/4" Stone	1071	1020		Lbs.
Sand	1076	1025		Lbs.
Cement	610	610		Lbs.
Water	32	32		Gals.

(See Reverse Side for Results)

RESULTS OF TRIAL BATCHES

Air Admixture used: _____

Manufactured by: _____

Other Admixtures used: _____

Manufactured by: _____

	TRIAL #1	TRIAL #2	TRIAL #3
Air Admixture Dosage			
Other Admixture Dosage			
% Air			
Slump			
Unit Weight			
Yield			
W/C Ratio			

Average
Compressive Strengths - Standard Cured 6" x 12" Cylinders

7 Days			
14 Days			
28 Days			
___ Days			

Remarks: For results of Trial No. 1 see Table No. 1. Trial mixes Nos. 5 - 8. For results of Trial No. 2 see Table No. 4, Trial Mix Nos. 49 thru 50.

Trial Mix Numbers		#5	#6	#7	#8	#49	#49NE	#50
Admixtures	Dosage							
Darex AEA	oz./C.Y.	6	6	10	11	11	11	11
WRDA	oz./100 wt.	--	7	--	--	--	--	--
Pozzolith 122N	oz./100 wt.	--	--	5	--	5	5	5
Daratard HC	oz./100 wt.	--	--	--	3	--	--	--

VERMONT DEPARTMENT OF HIGHWAYS

Prepared by J. Talbot

MATERIALS DIVISION - STRUCTURAL CONCRETE SUBDIVISION Date 5/2/77

MIX DESIGN SHEET - STRUCTURAL CONCRETE ITEM # 501.25 CONCRETE CLASS B

Ready Mix Supplier: Lawrence Sangravco Inc. - St. Johnsbury, Vermont

Aggregate Supplier:	Specific Gravity	Dry Rodded Unit Weight	Absorption
1-1/2" Stone Caledonia, Inc.	2.91	102.64	0.6
3/4" Stone Caledonia, Inc.	2.91	106.15	0.9
Blend: 1-1/2" & 3/4" 1/3 - 2/3	2.91	106.18	N/A
Sand Caledonia, Inc.	2.78	F.M. 2.70	1.9

Cement 610 Lbs./Cu.Yd.
Water 32 Gals./Cu.Yd.
Air 6 Percent

VOLUME OF DRY RODDED COARSE AGGREGATE PER UNIT VOLUME OF CONCRETE

Maximum size Aggregate	Sand F.M.					
	2.60	2.70	2.80	2.90	3.00	3.10
3/4"	0.64	0.63	0.62	0.61	0.60	0.59
1-1/2"	0.73	0.72	0.71	0.70	0.69	0.68

106.18 (Dry Rodded Unit Weight) X .72 (Unit Volume) = 76.45 X 27 = 2064 Lbs./CY Coarse Aggregate

1. Volume of Water $\frac{\text{(Gals/CY) } 32}{7.48}$ = 4.278 Cu. Ft.
2. Solid Volume of Cement $\frac{\text{(Lbs./CY) } 610}{196.56}$ = 3.103 Cu. Ft.
3. Volume of Entrained Air $\frac{6}{}$ X 27 = 1.620 Cu. Ft.
4. Solid Volume of Coarse Aggregate $\frac{\text{(Lbs./CY } 2064}{\text{(SpGr) } 2.91 \text{ X } 62.4}$ = 11.367 Cu. Ft.
5. Total Solid Volume of Ingredients Except Sand 20.368 Cu. Ft.
6. Solid Volume of Sand Required 27.00 - 20.368 Cu.Ft. (Line 5) = 6.632 Cu. Ft.
7. Required Weight of Sand: (Solid Volume) 6.632 X (SpGr) 2.78 X 62.4 = 1150 Lbs./Cu.Yd.
8. Ratio of Sand to Total Agg. Line 6 ÷ (Line 6 + Line 4) = 37 % by Vol.

SUMMARY OF QUANTITIES/CU. YD. (DRY WEIGHTS)

	Trial #1	Trial #2	Trial #3	
1-1/2" Stone	688	650		Lbs.
3/4" Stone	1376	1300		Lbs.
Sand	1150	1087		Lbs.
Cement	610	610		Lbs.
Water	32	32		Gals.

(See Reverse Side for Results)

RESULTS OF TRIAL BATCHES

Air Admixture used: _____

Manufactured by: _____

Other Admixtures used: _____

Manufactured by: _____

	TRIAL #1	TRIAL #2	TRIAL #3
Air Admixture Dosage			
Other Admixture Dosage			
% Air			
Slump			
Unit Weight			
Yield			
W/C Ratio			

Average
Compressive Strengths - Standard Cured 6" x 12" Cylinders

7 Days			
14 Days			
28 Days			
___ Days			

Remarks: For results of Trial No. 1, see Table No. 1 - Trial Mix Nos. 9 - 12.
For results of Trial No. 2, see Table No. 4 - Trial Mix Nos. 51 and No. 52.

Trial Mix Numbers		#9	#10	#11	#12	#51	#52
Admixtures	Dosage						
Darex AEA	oz./C.Y.	7	6	10	11	11	11
WRDA	oz./100 Wt.	--	7	--	--	--	--
Pozzolith 122N	oz./100 wt.	--	--	5	--	5	5
Daratard HC	oz./100 wt.	--	--	--	3	--	--

VERMONT DEPARTMENT OF HIGHWAYS

Prepared by J. Talbot

MATERIALS DIVISION - STRUCTURAL CONCRETE SUBDIVISION Date 5/2/77

MIX DESIGN SHEET - STRUCTURAL CONCRETE ITEM #501.25 CONCRETE CLASS B

Ready Mix Supplier: Lawrence Sangraveo Inc. - St. Johnsbury, Vermont

Aggregate Supplier:	Specific Gravity	Dry Rodded Unit Weight	Absorption
___" Stone	N/A	N/A	N/A
3/4" Stone Caledonia, Inc.	2.91	106.15	0.9
Blend: 1-1/2" & 3/4" 0 - 100	N/A	N/A	N/A
Sand Caledonia, Inc.	2.78	F.M. 2.70	1.9

Cement 610 Lbs./Cu.Yd.

Water 35 Gals./Cu.Yd.

Air 6 Percent

VOLUME OF DRY RODDED COARSE AGGREGATE PER UNIT VOLUME OF CONCRETE

Maximum size Aggregate	Sand F.M.					
	2.60	2.70	2.80	2.90	3.00	3.10
3/4"	0.64	0.63	0.62	0.61	0.60	0.59
1-1/2"	0.73	0.72	0.71	0.70	0.69	0.68

106.15 (Dry Rodded Unit Weight) X 0.63 (Unit Volume) = 66.875 X 27 = 1806 Lbs./CY Coarse Aggregate

1. Volume of Water (Gals/CY) 35 / 7.48 = 4.679 Cu. Ft.
2. Solid Volume of Cement (Lbs./CY) 610 / 196.56 = 3.103 Cu. Ft.
3. Volume of Entrained Air 6 X 27 = 1.620 Cu. Ft.
4. Solid Volume of Coarse Aggregate (Lbs./CY 1806) / (SpGr) 2.78 X 62.4 = 9.946 Cu. Ft.
5. Total Solid Volume of Ingredients Except Sand 19.348 Cu. Ft.
6. Solid Volume of Sand Required 27.00 - 19.348 Cu.Ft. (Line 5) = 7.652 Cu. Ft.
7. Required Weight of Sand: (Solid Volume) 7.652 X (SpGr) 2.78 X 62.4 = 1327 Lbs./Cu.Yd.
8. Ratio of Sand to Total Agg. Line 6 ÷ (Line 6 + Line 4) = 43.5 % by Vol.

SUMMARY OF QUANTITIES/CU. YD. (DRY WEIGHTS)

	Trial #1	Trial #2	Trial #3	
N/A " Stone	N/A			Lbs.
3/4 " Stone	1806			Lbs.
Sand	1327			Lbs.
Cement	610			Lbs.
Water	35			Gals.

(See Reverse Side for Results)

HD 560 5/77

RESULTS OF TRIAL BATCHES

Air Admixture used: _____

Manufactured by: _____

Other Admixtures used: _____

Manufactured by: _____

	TRIAL #1	TRIAL #2	TRIAL #3
Air Admixture Dosage			
Other Admixture Dosage			
% Air			
Slump			
Unit Weight			
Yield			
W/C Ratio			

Average
Compressive Strengths - Standard Cured 6" x 12" Cylinders

7 Days			
14 Days			
28 Days			
___ Days			

Remarks: For results of Trial No. 1, See Table No. 1 - Trial Mix Nos. 13 - 16.

Trial Mix Numbers		#13	#14	#15	#16
Admixtures	Dosage				
Darex AEA	oz./C.Y.	7	6	10	10
WRDA	oz./100 wt.	--	7	--	--
Pozzolith 122N	oz./100 wt.	--	--	5	--
Daratard HC	oz./100 wt.	--	--	--	3

VERMONT DEPARTMENT OF HIGHWAYS

Prepared by J. Talbot

MATERIALS DIVISION - STRUCTURAL CONCRETE SUBDIVISION Date 5/2/77

MIX DESIGN SHEET - STRUCTURAL CONCRETE ITEM # 501.25 CONCRETE CLASS B

Ready Mix Supplier: Lawrence Sangravco Inc. - St. Johnsbury, Vermont

Aggregate Supplier:	Specific Gravity	Dry Rodded Unit Weight	Absorption
1-1/2" Stone Caledonia, Inc.	2.91	102.64	0.6
3/4" Stone Caledonia, Inc.	2.91	106.15	0.9
Blend: 1-1/2" & 3/4" 2/3 - 1/3	2.91	106.06	N/A
Sand Caledonia, Inc.	2.78	F.M. 2.70	1.9

Cement 634 Lbs./Cu.Yd.
Water 32 Gals./Cu.Yd.
Air 6 Percent

VOLUME OF DRY RODDED COARSE AGGREGATE PER UNIT VOLUME OF CONCRETE

Maximum size Aggregate	Sand F.M.					
	2.60	2.70	2.80	2.90	3.00	3.10
3/4"	0.64	0.63	0.62	0.61	0.60	0.59
1-1/2"	0.73	0.72	0.71	0.70	0.69	0.68

$\frac{106.06}{\text{(Dry Rodded Unit Weight)}} \times \frac{72}{\text{(Unit Volume)}} = 76.36 \times 27 = 2062$ Lbs./CY Coarse Aggregate

1. Volume of Water $\frac{\text{(Gals/CY) } 32}{7.48} = 4.278$ Cu. Ft.
2. Solid Volume of Cement $\frac{\text{(Lbs./CY) } 634}{196.56} = 3.225$ Cu. Ft.
3. Volume of Entrained Air $\frac{6}{} \times 27 = 1.620$ Cu. Ft.
4. Solid Volume of Coarse Aggregate $\frac{\text{(Lbs./CY } 2062}{\text{(SpGr) } 2.91 \times 62.4} = 11.356$ Cu. Ft.
5. Total Solid Volume of Ingredients Except Sand 20.479 Cu. Ft.
6. Solid Volume of Sand Required 27.00 - 20.479 Cu.Ft. (Line 5) = 6.521 Cu. Ft.
7. Required Weight of Sand: (Solid Volume) 6.521 X (SpGr) 2.78 X 62.4 = 1131 Lbs./Cu.Yd.
8. Ratio of Sand to Total Agg. Line 6 ÷ (Line 6 + Line 4) = 36.5 % by Vol.

SUMMARY OF QUANTITIES/CU. YD. (DRY WEIGHTS)

	Trial #1	Trial #2	Trial #3	
1-1/2" Stone	1375			Lbs.
3/4" Stone	687			Lbs.
Sand	1131			Lbs.
Cement	634			Lbs.
Water	32			Gals.

(See Reverse Side for Results)

RESULTS OF TRIAL BATCHES

Air Admixture used: _____

Manufactured by: _____

Other Admixtures used: _____

Manufactured by: _____

	TRIAL #1	TRIAL #2	TRIAL #3
Air Admixture Dosage			
Other Admixture Dosage			
% Air			
Slump			
Unit Weight			
Yield			
W/C Ratio			

Average
Compressive Strengths - Standard Cured 6" x 12" Cylinders

7 Days			
14 Days			
28 Days			
___ Days			

Remarks: For results of Trial Mix No. 1, see Table No. 2 - Trial Mix Nos. 17 - 20. These mixes were too coarse to warrant their use.

Trial Mix Numbers:		#17	#18	#19	#20
Admixtures	Dosage				
Darex AEA	oz./C.Y.	11	8	11	14
WRDA	oz./100 wt.	--	7	--	--
Pozzolith 122N	oz./100 wt.	--	--	5	--
Daratard HC	oz./100 wt.	--	--	--	3

VERMONT DEPARTMENT OF HIGHWAYS

Prepared by J. Talbot

MATERIALS DIVISION - STRUCTURAL CONCRETE SUBDIVISION Date 5/2/77

MIX DESIGN SHEET - STRUCTURAL CONCRETE ITEM # 501.25 CONCRETE CLASS B

Ready Mix Supplier: Lawrence Sangravco Inc. - St. Johnsbury, Vermont

Aggregate Supplier:	Specific Gravity	Dry Rodded Unit Weight	Absorption
1-1/2" Stone Caledonia, Inc.	2.91	102.64	0.6
3/4" Stone Caledonia, Inc.	2.91	106.15	0.9
Blend: 1-1/2" & 3/4" 50 - 50	2.91	110.17	N/A
Sand Caledonia, Inc.	2.78	F.M. 2.70	1.9

Cement 634 Lbs./Cu.Yd.

Water 32 Gals./Cu.Yd.

Air 6 Percent

VOLUME OF DRY RODDED COARSE AGGREGATE PER UNIT VOLUME OF CONCRETE

Maximum size Aggregate	Sand F.M.					
	2.60	2.70	2.80	2.90	3.00	3.10
3/4"	0.64	0.63	0.62	0.61	0.60	0.59
1-1/2"	0.73	0.72	0.71	0.70	0.69	0.68

$\frac{110.17}{\text{(Dry Rodded Unit Weight)}} \times \frac{.72}{\text{(Unit Volume)}} = 79.32 \times 27 = 2142$ Lbs./CY Coarse Aggregate

1. Volume of Water $\frac{\text{(Gals/CY)}\ 32}{7.48} = 4.278$ Cu. Ft.

2. Solid Volume of Cement $\frac{\text{(Lbs./CY)}\ 634}{196.56} = 3.225$ Cu. Ft.

3. Volume of Entrained Air $6 \times 27 = 1.620$ Cu. Ft.

4. Solid Volume of Coarse Aggregate $\frac{\text{(Lbs./CY}\ 2142}{\text{(SpGr)}\ 2.91 \times 62.4} = 11.796$ Cu. Ft.

5. Total Solid Volume of Ingredients Except Sand 20.919 Cu. Ft.

6. Solid Volume of Sand Required 27.00 - 20.919 Cu.Ft. (Line 5) = 6.081 Cu. Ft.

7. Required Weight of Sand: (Solid Volume) 6.081 X (SpGr) 2.78 X 62.4 = 1055 Lbs./Cu.Yd.

8. Ratio of Sand to Total Agg. Line 6 ÷ (Line 6 + Line 4) = 34 % by Vol.

SUMMARY OF QUANTITIES/CU. YD. (DRY WEIGHTS)

	Trial #1	Trial #2	Trial #3	
1-1/2" Stone	1071	1042		Lbs.
3/4" Stone	1071	1042		Lbs.
Sand	1055	1028		Lbs.
Cement	634	634		Lbs.
Water	32	32		Gals.

(See Reverse Side for Results)

RESULTS OF TRIAL BATCHES

Air Admixture used: _____

Manufactured by: _____

Other Admixtures used: _____

Manufactured by: _____

	TRIAL #1	TRIAL #2	TRIAL #3
Air Admixture Dosage			
Other Admixture Dosage			
% Air			
Slump			
Unit Weight			
Yield			
W/C Ratio			

Average Compressive Strengths - Standard Cured 6" x 12" Cylinders

7 Days			
14 Days			
28 Days			
___ Days			

Remarks: For results of Trial No. 1, see Table No. 2 - Trial Mix Nos. 21 - 24.

For results of Trial No. 2, see Table No. 4 - Trial Mix No. 53 and No. 54.

Trial Mix Numbers		#21	#22	#23	#24	#53	#54
Admixtures	Dosage						
Darex AEA	oz./C.Y.	11	8	12	14	12	12
WRDA	oz./100 wt.	--	7	--	--	--	--
Pozzolith 122N	oz./100 wt.	--	--	5	--	5	5
Daratard HC	oz./100 wt.	--	--	--	3	--	--

VERMONT DEPARTMENT OF HIGHWAYS

Prepared by J. Talbot

MATERIALS DIVISION - STRUCTURAL CONCRETE SUBDIVISION Date 5/2/77

MIX DESIGN SHEET - STRUCTURAL CONCRETE ITEM # 501.25 CONCRETE CLASS B

Ready Mix Supplier: Lawrence Sangraveo Inc. - St. Johnsbury, Vermont

Aggregate Supplier:	Specific Gravity	Dry Rodded Unit Weight	Absorption
1-1/2" Stone Caledonia, Inc.	2.91	102.64	0.6
3/4" Stone Caledonia, Inc.	2.91	106.15	0.9
Blend: 1-1/2" & 3/4" 1/3 - 2/3	2.91	106.18	N/A
Sand Caledonia, Inc.	2.78	F.M. 2.70	1.9

Cement 634 Lbs./Cu.Yd.
Water 32 Gals./Cu.Yd.
Air 6 Percent

VOLUME OF DRY RODDED COARSE AGGREGATE PER UNIT VOLUME OF CONCRETE

Maximum size Aggregate	Sand F.M.					
	2.60	2.70	2.80	2.90	3.00	3.10
3/4"	0.64	0.63	0.62	0.61	0.60	0.59
1-1/2"	0.73	0.72	0.71	0.70	0.69	0.68

$\frac{106.18}{\text{(Dry Rodded Unit Weight)}} \times \frac{.72}{\text{(Unit Volume)}} = 76.45 \times 27 = 2064$ Lbs./CY Coarse Aggregate

1. Volume of Water $\frac{\text{(Gals/CY)}\ 32}{7.48} = 4.278$ Cu. Ft.
2. Solid Volume of Cement $\frac{\text{(Lbs./CY)}\ 634}{196.56} = 3.225$ Cu. Ft.
3. Volume of Entrained Air $6 \times 27 = 1.620$ Cu. Ft.
4. Solid Volume of Coarse Aggregate $\frac{\text{(Lbs./CY}\ 2064}{\text{(SpGr)}\ 2.91 \times 62.4} = 11.367$ Cu. Ft.
5. Total Solid Volume of Ingredients Except Sand 20.490 Cu. Ft.
6. Solid Volume of Sand Required 27.00 - 20.490 Cu.Ft. (Line 5) = 6.510 Cu. Ft.
7. Required Weight of Sand: (Solid Volume) 6.510 X (SpGr) 2.78 X 62.4 = 1129 Lbs./Cu.Yd.
8. Ratio of Sand to Total Agg. Line 6 ÷ (Line 6 + Line 4) = 36 % by Vol.

SUMMARY OF QUANTITIES/CU. YD. (DRY WEIGHTS)

	Trial #1	Trial #2	Trial #3	
1-1/2" Stone	688	660		Lbs.
3/4" Stone	1376	1320		Lbs.
Sand	1129	1083		Lbs.
Cement	634	634		Lbs.
Water	32	32		Gals.

(See Reverse Side for Results)

RESULTS OF TRIAL BATCHES

Air Admixture used: _____

Manufactured by: _____

Other Admixtures used: _____

Manufactured by: _____

	TRIAL #1	TRIAL #2	TRIAL #3
Air Admixture Dosage			
Other Admixture Dosage			
% Air			
Slump			
Unit Weight			
Yield			
W/C Ratio			

Average
Compressive Strengths - Standard Cured 6" x 12" Cylinders

7 Days			
14 Days			
28 Days			
___ Days			

Remarks: For results of Trial No. 1, see Table No. 2 - Trial Mix Nos. 25 - 28.
For results of Trial Mix No. 2, see Table No. 4 - Trial Mix No. 55 and No. 56.

Trial Mix Numbers:		#25	#26	#27	#28	#55	#56
Admixtures	Dosage						
Darex AEA	oz./C.Y.	11	8	13	14	12	12
WRDA	oz./100 wt.	--	7	--	--	--	--
Pozzolith 122N	oz./100 wt.	--	--	5	--	5	5
Daratard HC	oz./100 wt.	--	--	--	3	--	--

VERMONT DEPARTMENT OF HIGHWAYS

Prepared by J. Talbot

MATERIALS DIVISION - STRUCTURAL CONCRETE SUBDIVISION Date 5/2/77

MIX DESIGN SHEET - STRUCTURAL CONCRETE ITEM # 501.25 CONCRETE CLASS B

Ready Mix Supplier: Lawrence Sangravco Inc. - St. Johnsbury, Vermont

Aggregate Supplier:	Specific Gravity	Dry Rodded Unit Weight	Absorption
___" Stone	N/A	N/A	N/A
3/4" Stone Caledonia, Inc.	2.91	106.15	0.9
Blend: 1-1/2" & 3/4" 0 - 100	N/A	N/A	N/A
Sand Caledonia, Inc.	2.78	F.M. 2.70	1.9

Cement 634 Lbs./Cu.Yd.

Water 35 Gals./Cu.Yd.

Air 6 Percent

VOLUME OF DRY RODDED COARSE AGGREGATE PER UNIT VOLUME OF CONCRETE

Maximum size Aggregate	Sand F.M.					
	2.60	2.70	2.80	2.90	3.00	3.10
3/4"	0.64	0.63	0.62	0.61	0.60	0.59
1-1/2"	0.73	0.72	0.71	0.70	0.69	0.68

106.15 (Dry Rodded Unit Weight) X 0.63 (Unit Volume) = 66.875 X 27 = 1086 Lbs./CY Coarse Aggregate

1. Volume of Water (Gals/CY) 35 / 7.48 = 4.679 Cu. Ft.
2. Solid Volume of Cement (Lbs./CY) 634 / 196.56 = 3.225 Cu. Ft.
3. Volume of Entrained Air 6 X 27 = 1.620 Cu. Ft.
4. Solid Volume of Coarse Aggregate (Lbs./CY 1806) / (SpGr) 2.91 X 62.4 = 9.946 Cu. Ft.
5. Total Solid Volume of Ingredients Except Sand 19.470 Cu. Ft.
6. Solid Volume of Sand Required 27.00 - 19.470 Cu.Ft. (Line 5) = 7.530 Cu. Ft.
7. Required Weight of Sand: (Solid Volume) 2.530 X (SpGr) 2.78 X 62.4 = 1306 Lbs./Cu.Yd.
8. Ratio of Sand to Total Agg. Line 6 ÷ (Line 6 + Line 4) = 43 % by Vol.

SUMMARY OF QUANTITIES/CU. YD. (DRY WEIGHTS)

	Trial #1	Trial #2	Trial #3	
N/A " Stone	N/A			Lbs.
3/4 " Stone	1806			Lbs.
Sand	1306			Lbs.
Cement	634			Lbs.
Water	35			Gals.

(See Reverse Side for Results)

RESULTS OF TRIAL BATCHES

Air Admixture used: _____

Manufactured by: _____

Other Admixtures used: _____

Manufactured by: _____

	TRIAL #1	TRIAL #2	TRIAL #3
Air Admixture Dosage			
Other Admixture Dosage			
% Air			
Slump			
Unit Weight			
Yield			
W/C Ratio			

Average
Compressive Strengths - Standard Cured 6" x 12" Cylinders

7 Days			
14 Days			
28 Days			
___ Days			

Remarks: For results of Trial No. 1, see Table No. 2 - Trial Mix Nos. 29 - 32.

Trial Mix Numbers		#29	#30	#31	#32
Admixtures	Dosage				
Darex AEA	oz./C.U.	11	7	13	12
WRDA	oz./100 wt.	--	7	--	--
Pozzolith 122N	oz./100 wt.	--	--	5	--
Daratard HC	oz./100 wt.	--	--	--	3

VERMONT DEPARTMENT OF HIGHWAYS

Prepared by J. Talbot

MATERIALS DIVISION - STRUCTURAL CONCRETE SUBDIVISION Date 5/2/77

MIX DESIGN SHEET - STRUCTURAL CONCRETE ITEM #501.25 CONCRETE CLASS B

Ready Mix Supplier: Lawrence Sangravco Inc. - St. Johnsbury, Vermont

Aggregate Supplier:	Specific Gravity	Dry Rodded Unit Weight	Absorption
1-1/2" Stone Caledonia, Inc.	2.91	102.64	0.6
3/4" Stone Caledonia, Inc.	2.91	106.15	0.9
Blend: 1-1/2" & 3/4" 2/3 - 1/3	2.91	106.06	N/A
Sand Caledonia, Inc.	2.78	F.M. 2.70	1.9

Cement 660 Lbs./Cu.Yd.
Water 32 Gals./Cu.Yd.
Air 6 Percent

VOLUME OF DRY RODDED COARSE AGGREGATE PER UNIT VOLUME OF CONCRETE

Maximum size Aggregate	Sand F.M.					
	2.60	2.70	2.80	2.90	3.00	3.10
3/4"	0.64	0.63	0.62	0.61	0.60	0.59
1-1/2"	0.73	0.72	0.71	0.70	0.69	0.68

$\frac{106.06}{\text{(Dry Rodded Unit Weight)}} \times \frac{.72}{\text{(Unit Volume)}} = 76.36 \times 27 = 2062$ Lbs./CY Coarse Aggregate

1. Volume of Water $\frac{\text{(Gals/CY)}\ 32}{7.48} = 4.278$ Cu. Ft.
2. Solid Volume of Cement $\frac{\text{(Lbs./CY)}\ 660}{196.56} = 3.358$ Cu. Ft.
3. Volume of Entrained Air $\frac{6}{} \times 27 = 1.620$ Cu. Ft.
4. Solid Volume of Coarse Aggregate $\frac{\text{(Lbs./CY}\ 2062}{\text{(SpGr)}\ 2.91 \times 62.4} = 11.356$ Cu. Ft.
5. Total Solid Volume of Ingredients Except Sand 20.612 Cu. Ft.
6. Solid Volume of Sand Required 27.00 - 20.612 Cu.Ft. (Line 5) = 6.388 Cu. Ft.
7. Required Weight of Sand: (Solid Volume) 6.388 X (SpGr) 2.78 X 62.4 = 1108 Lbs./Cu.Yd.
8. Ratio of Sand to Total Agg. Line 6 ÷ (Line 6 + Line 4) = 36 % by Vol.

SUMMARY OF QUANTITIES/CU. YD. (DRY WEIGHTS)

	Trial #1	Trial #2	Trial #3	
1-1/2" Stone	1375			Lbs.
3/4" Stone	687			Lbs.
Sand	1108			Lbs.
Cement	660			Lbs.
Water	32			Gals.

(See Reverse Side for Results)

RESULTS OF TRIAL BATCHES

Air Admixture used: _____

Manufactured by: _____

Other Admixtures used: _____

Manufactured by: _____

	TRIAL #1	TRIAL #2	TRIAL #3
Air Admixture Dosage			
Other Admixture Dosage			
% Air			
Slump			
Unit Weight			
Yield			
W/C Ratio			

Average
Compressive Strengths - Standard Cured 6" x 12" Cylinders

7 Days			
14 Days			
28 Days			
___ Days			

Remarks: For results of Trial No. 1, see Table No. 3 - Trial Mix Nos. 33 - 36.

Trial Mix Numbers:		#33	#34	#35	#36
Admixtures	Dosage				
Daratard AEA	oz./C.Y.	12	9	13	13
WRDA	oz./100 wt.	--	7	--	--
Pozzolith 122N	oz./100 wt.	--	--	5	--
Daratard HC	oz./100 wt.	--	--	--	3

VERMONT DEPARTMENT OF HIGHWAYS

Prepared by J. Talbot

MATERIALS DIVISION - STRUCTURAL CONCRETE SUBDIVISION Date 5/2/77

MIX DESIGN SHEET - STRUCTURAL CONCRETE ITEM # 501.25 CONCRETE CLASS B

Ready Mix Supplier: Lawrence Sangravco Inc. - St. Johnsbury, Vermont

Aggregate Supplier:	Specific Gravity	Dry Rodded Unit Weight	Absorption
1-1/2" Stone Caledonia, Inc.	2.91	102.64	0.6
3/4" Stone Caledonia, Inc.	2.91	106.15	0.9
Blend: 1-1/2" & 3/4" 50 - 50	2.91	110.17	N/A
Sand Caledonia, Inc.		F.M. 2.70	1.9

Cement 660 Lbs./Cu.Yd.

Water 32 Gals./Cu.Yd.

Air 6 Percent

VOLUME OF DRY RODDED COARSE AGGREGATE PER UNIT VOLUME OF CONCRETE

Maximum size Aggregate	Sand F.M.					
	2.60	2.70	2.80	2.90	3.00	3.10
3/4"	0.64	0.63	0.62	0.61	0.60	0.59
1-1/2"	0.73	0.72	0.71	0.70	0.69	0.68

$\frac{110.17}{\text{(Dry Rodded Unit Weight)}} \times \frac{0.72}{\text{(Unit Volume)}} = 79.37 \times 27 = 2142$ Lbs./CY Coarse Aggregate

1. Volume of Water $\frac{\text{(Gals/CY)}\ 32}{7.48} = 4.278$ Cu. Ft.

2. Solid Volume of Cement $\frac{\text{(Lbs./CY)}\ 660}{196.56} = 3.358$ Cu. Ft.

3. Volume of Entrained Air $\frac{6}{100} \times 27 = 1.626$ Cu. Ft.

4. Solid Volume of Coarse Aggregate $\frac{\text{(Lbs./CY}\ 2142}{\text{(SpGr)}\ 2.91 \times 62.4} = 11.796$ Cu. Ft.

5. Total Solid Volume of Ingredients Except Sand 21.052 Cu. Ft.

6. Solid Volume of Sand Required 27.00 - 21.052 Cu.Ft. (Line 5) = 5.948 Cu. Ft.

7. Required Weight of Sand: (Solid Volume) 5.948 X (SpGr) 2.78 X 62.4 = 1032 Lbs./Cu.Yd.

8. Ratio of Sand to Total Agg. Line 6 ÷ (Line 6 + Line 4) = 33.5 % by Vol.

SUMMARY OF QUANTITIES/CU. YD. (DRY WEIGHTS)

	Trial #1	Trial #2	Trial #3	
1-1/2" Stone	1071			Lbs.
3/4" Stone	1071			Lbs.
Sand	1032			Lbs.
Cement	660			Lbs.
Water	32			Gals.

(See Reverse Side for Results)

RESULTS OF TRIAL BATCHES

Air Admixture used: _____

Manufactured by: _____

Other Admixtures used: _____

Manufactured by: _____

	TRIAL #1	TRIAL #2	TRIAL #3
Air Admixture Dosage			
Other Admixture Dosage			
% Air			
Slump			
Unit Weight			
Yield			
W/C Ratio			

Average
Compressive Strengths - Standard Cured 6" x 12" Cylinders

7 Days			
14 Days			
28 Days			
___ Days			

Remarks: For results of Trial No. 1, see Table No. 3 - Trial Mix Nos. 37 - 40.

Trial Mix Numbers:		#37	#38	#39	#40
Admixtures	Dosage				
Darex AEA	oz./C.U.	12	9	13	13
WRDA	oz./100 wt.	--	7	--	--
Pozzolith 122N	oz./100 wt.	--	--	5	--
Daratard HC	oz./100 wt.	--	--	--	3

VERMONT DEPARTMENT OF HIGHWAYS

Prepared by J. Talbot

MATERIALS DIVISION - STRUCTURAL CONCRETE SUBDIVISION Date 5/2/77

MIX DESIGN SHEET - STRUCTURAL CONCRETE ITEM # 501.25 CONCRETE CLASS B

Ready Mix Supplier: Lawrence Sangravco Inc. - St. Johnsbury, Vermont

Aggregate Supplier:	Specific Gravity	Dry Rodded Unit Weight	Absorption
1-1/2" Stone Caledonia, Inc.	2.91	102.64	0.6
3/4" Stone Caledonia, Inc.	2.91	106.15	0.9
Blend: 1-1/2" & 3/4" 1/3 - 2/3	2.91	106.18	N/A
Sand Caledonia, Inc.	2.78	F.M. 2.70	1.9

Cement 660 Lbs./Cu.Yd.

Water 32 Gals./Cu.Yd.

Air 6 Percent

VOLUME OF DRY RODDED COARSE AGGREGATE PER UNIT VOLUME OF CONCRETE

Maximum size Aggregate	Sand F.M.					
	2.60	2.70	2.80	2.90	3.00	3.10
3/4"	0.64	0.63	0.62	0.61	0.60	0.59
1-1/2"	0.73	0.72	0.71	0.70	0.69	0.68

$\frac{106.18}{\text{(Dry Rodded Unit Weight)}} \times \frac{.72}{\text{(Unit Volume)}} = 26.45 \times 27 = 2064$ Lbs./CY Coarse Aggregate

1. Volume of Water $\frac{\text{(Gals/CY)}\ 30}{7.48} = 4.278$ Cu. Ft.

2. Solid Volume of Cement $\frac{\text{(Lbs./CY)}\ 660}{196.56} = 3.358$ Cu. Ft.

3. Volume of Entrained Air $6 \times 27 = 1.620$ Cu. Ft.

4. Solid Volume of Coarse Aggregate $\frac{\text{(Lbs./CY}\ 2064}{\text{(SpGr)}\ 2.91 \times 62.4} = 11.367$ Cu. Ft.

5. Total Solid Volume of Ingredients Except Sand 20.623 Cu. Ft.

6. Solid Volume of Sand Required 27.00 - 20.623 Cu.Ft. (Line 5) = 6.377 Cu. Ft.

7. Required Weight of Sand: (Solid Volume) 6.372 X (SpGr) 2.78 X 62.4 = 1106 Lbs./Cu.Yd.

8. Ratio of Sand to Total Agg. Line 6 ÷ (Line 6 + Line 4) = 36 % by Vol.

SUMMARY OF QUANTITIES/CU. YD. (DRY WEIGHTS)

	Trial #1	Trial #2	Trial #3	
1-1/2" Stone	688			Lbs.
3/4" Stone	1367			Lbs.
Sand	1106			Lbs.
Cement	660			Lbs.
Water	32			Gals.

(See Reverse Side for Results)

SEE APPENDIX B SHEET 11 OF 12

RESULTS OF TRIAL BATCHES

Air Admixture used: _____

Manufactured by: _____

Other Admixtures used: _____

Manufactured by: _____

	TRIAL #1	TRIAL #2	TRIAL #3
Air Admixture Dosage			
Other Admixture Dosage			
% Air			
Slump			
Unit Weight			
Yield			
W/C Ratio			

Average
Compressive Strengths - Standard Cured 6" x 12" Cylinders

7 Days			
14 Days			
28 Days			
___ Days			

Remarks: For results of Trial No. 1, see Table No. 3 - Trial Mix Nos. 41 - 44.

Trial Mix Numbers:		#41	#42	#43	#44
Admixtures	Dosage				
Darex AEA	oz./C.Y.	12	9	13	13
WRDA	oz./100 wt.	--	7	--	--
Pozzolith 122N	oz./100 wt.	--	--	5	--
Daratard HC	oz./100 wt.	--	--	--	3

VERMONT DEPARTMENT OF HIGHWAYS

Prepared by J. Talbot

MATERIALS DIVISION - STRUCTURAL CONCRETE SUBDIVISION Date 5/2/77

MIX DESIGN SHEET - STRUCTURAL CONCRETE ITEM # 501.25 CONCRETE CLASS B

Ready Mix Supplier: Lawrence Sangravco Inc. - St. Johnsbury, Vermont

Aggregate Supplier:	Specific Gravity	Dry Rodded Unit Weight	Absorption
N/A " Stone	N/A	N/A	N/A
3/4" Stone Caledonia, Inc.	2.91	106.15	0.9
Blend: 1-1/2" & 3/4" 0 - 100	N/A	N/A	N/A
Sand Caledonia, Inc.	2.78	F.M. 2.70	1.9

Cement 660 Lbs./Cu.Yd.

Water 35 Gals./Cu.Yd.

Air 6 Percent

VOLUME OF DRY RODDED COARSE AGGREGATE PER UNIT VOLUME OF CONCRETE

Maximum size Aggregate	Sand F.M.					
	2.60	2.70	2.80	2.90	3.00	3.10
3/4"	0.64	0.63	0.62	0.61	0.60	0.59
1-1/2"	0.73	0.72	0.71	0.70	0.69	0.68

$\frac{106.15}{\text{(Dry Rodded Unit Weight)}} \times \frac{.63}{\text{(Unit Volume)}} = 66.875 \times 27 = 1806$ Lbs./CY Coarse Aggregate

1. Volume of Water $\frac{\text{(Gals/CY) } 35}{7.48} = 4.679$ Cu. Ft.

2. Solid Volume of Cement $\frac{\text{(Lbs./CY) } 660}{196.56} = 3.358$ Cu. Ft.

3. Volume of Entrained Air $6 \times 27 = 1.620$ Cu. Ft.

4. Solid Volume of Coarse Aggregate $\frac{\text{(Lbs./CY } 1806}{\text{(SpGr) } 2.91 \times 62.4} = 9.946$ Cu. Ft.

5. Total Solid Volume of Ingredients Except Sand 19.603 Cu. Ft.

6. Solid Volume of Sand Required 27.00 - 19.603 Cu.Ft. (Line 5) = 7.397 Cu. Ft.

7. Required Weight of Sand: (Solid Volume) 7.397 X (SpGr) 2.78 X 62.4 = 1283 Lbs./Cu.Yd.

8. Ratio of Sand to Total Agg. Line 6 ÷ (Line 6 + Line 4) = 42.7 % by Vol.

SUMMARY OF QUANTITIES/CU. YD. (DRY WEIGHTS)

	Trial #1	Trial #2	Trial #3	
N/A " Stone	N/A			Lbs.
3/4 " Stone	1806			Lbs.
Sand	1283			Lbs.
Cement	660			Lbs.
Water	35			Gals.

(See Reverse Side for Results)

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RESULTS OF TRIAL BATCHES

Air Admixture used: _____

Manufactured by: _____

Other Admixtures used: _____

Manufactured by: _____

	TRIAL #1	TRIAL #2	TRIAL #3
Air Admixture Dosage			
Other Admixture Dosage			
% Air			
Slump			
Unit Weight			
Yield			
W/C Ratio			

Average
Compressive Strengths - Standard Cured 6" x 12" Cylinders

7 Days			
14 Days			
28 Days			
___ Days			

Remarks: For results of Trial No. 1, see Table No. 3 - Trial Mix Nos. 45 - 48.

Trial Mix Numbers:

Admixtures	Dosage	#45	#46	#47	#48
Darex AEA	oz./C.Y.	11	9	12	12
WRDA	oz./100 wt.	--	7	--	--
Pozzolith 122N	oz./100 wt.	--	--	5	--
Daratard HC	oz./100 wt.	--	--	--	3