CONNECTICUT RIVER FLOOD CONTROL

CONANT BROOK DAM

CONANT BROOK, MASSACHUSETTS

CHICOPEE FALLS

LOCAL PROTECTION PROJECT

CHICOPEE RIVER, MASSACHUSSETTS

WESTFIELD

LOCAL PROTECTION PROJECT

WESTFIELD RIVER, MASSACHUSETTS

DESIGN MEMORANDUM NO.4

CONCRETE AGGREGATES

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS WALTHAM, MASS.

NOVEMBER 1962

33

ENGCW-EE (9 Nov 62) 1st Ind
SUBJECT: Conant Brook Dam, Chicopee Falls Local Protection Project, Westfield Local Protection Project, Massachusetts Design Memorandum No. 4 - Concrete Materials

Office, Chief of Engineers, Washington 25, D. C., 23 November 1962

TO: Division Engineer, U. S. Army Engineer Division, New England

Subject design memorandum is approved.

FOR THE CHIEF OF ENGINEERS:

Incl w/d

For WENDELL E. JOHNSON
Chief, Engineering Division
Civil Works

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM 54, MASS.

ADDRESS REPLY TO:
DIVISION ENGINEER

REFER TO FILE NO.
NEDGW

9 November 1962

SUBJECT: Conant Brook Dam, Chicopee Falls Local Protection Project, Westfield Local Protection Project, Massachusetts Design Memorandum No. 4 - Concrete Materials

TO: Chief of Engineers
ATTENTION: ENGCW-E
Department of the Army
Washington 25, D.C.

There is submitted for review and approval Design Memorandum No. 4 - Concrete Materials for the Conant Brook Dam and the Chicopee Falls Local Protection Project, Chicopee River Basin, Massachusetts, and the Westfield Local Protection Project, Westfield River, Massachusetts, in accordance with EM 1110-2-1150.

FOR THE DIVISION ENGINEER:

John Wm. Leslie

JOHN WM. LESLIE
Chief, Engineering Division

Incl (10 cys)
Design Memo No. 4

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND
OFFICE OF DIVISION ENGINEER
WALTHAM 54, MASSACHUSETTS

FLOOD CONTROL PROJECTS

CONANT BROOK DAM AND RESERVOIR - CONANT BROOK
CHICOPEE FALLS LOCAL PROTECTION PROJECT - CHICOPEE RIVER
WESTFIELD LOCAL PROTECTION PROJECT - WESTFIELD RIVER

CONNECTICUT RIVER BASIN - MASSACHUSETTS

DESIGN MEMORANDUM NO. 4
CONCRETE MATERIALS

NOVEMBER 1962

1. General. Construction of the subject projects which are located in the same river basin, approximately seventeen (17) miles apart, will be concurrent. The approximate quantities of concrete required for construction of walls, intake and outlet works and spillway for the dam project and flood walls for the local protection projects are as follows:

a. Conant Brook Dam, 3,000 cubic yards.

b. Chicopee Falls Local Protection, 8,000 cubic yards.

c. Westfield Local Protection, 5,000 cubic yards.

In view of the small quantities involved, it is not considered economically feasible to process aggregates on any of the sites; and, therefore, aggregate investigations have been confined to established commercial sources. There are six (6) commercial sources within a 25-mile haul distance. Two commercial sources each within a four-mile haul distance of a project site have been recently investigated and tested. Four (4) additional commercial sources were previously tested and approved for civil works construction. Location of projects and sources of aggregate are shown on Plate 4-1.

2. Investigations. Selection of sources for testing was based on plant facilities and characteristics of materials as determined by visual examination and local usage. All of the commercial sources investigated are developed in traprock or glacial deposits of sand and gravel.

3. Tests. Results of aggregate tests are summarized in Table Nos. 4-1 and 4-2.

4. Relative Cost Estimates. Estimated delivered prices of aggregates, based on quoted plant prices and Massachusetts Department of Public Utilities minimum trucking rates, which are currently twenty-five cents per ton for the first mile and five cents per ton for each additional mile, and plant locations are as follows:

a. Monson Sand & Gravel Company. The processing plant is located in Monson, Massachusetts about a two (2) mile haul distance to the Conant Brook Damsite. Quoted plant prices are $1.50 per ton to $2.25 per ton for gravel, depending on size group, and $0.90 per ton for concrete sand. The delivered price to the Conant Brook Damsite will average $2.15 per ton for gravel and $1.20 per ton for sand.

b. North Wilbraham Sand & Gravel, Incorporated. The processing plant and transit-mix plant are located in North Wilbraham, Massachusetts. Quoted plant prices are $1.90 per ton to $2.40 per ton for gravel, depending on size group and $1.20 per ton for concrete sand. The approximate haul mileages and estimated average prices for gravel and concrete sand to the various sites are shown in the following table:

Site	Haul Mileage	Price per Ton	
		Gravel	Sand
Chicopee Falls	5	$ 2.60	$ 1.65
Conant Brook	10	2.85	1.90

c. A. Giard & Sons, Incorporated. The processing plant and transit-mix plant are located in Ware, Massachusetts, about twelve (12) miles haul distance to the Conant Brook Damsite. Quoted plant prices are $1.35 per ton for gravel and $0.80 per ton for concrete sand. The delivered price to the Conant Brook Damsite will be $2.15 per ton for gravel and $1.60 per ton for sand.

d. John S. Lane & Sons, Incorporated. The sand and gravel processing plant is located in Westfield, Massachusetts. Quoted plant prices are $1.70 per ton to $2.15 per ton for gravel, depending on size group and $1.10 per ton for concrete sand. The approximate haul mileages and estimated average prices for gravel and concrete sand to the various sites are shown in the following table:

Site	Haul Mileage	Price per Ton	
		Gravel	Sand
Westfield	4	$ 2.30	$ 1.50
Chicopee Falls	14	2.80	2.00

e. John S. Lane & Sons, Incorporated. The crushed stone processing plant is located in Westfield, Massachusetts. Quoted plant prices are $1.40 per ton to $2.75 per ton for crushed stone, depending on size group. The approximate haul mileage and estimated average price for crushed stone to the various sites are shown in the following table:

Site	Haul Mileage	Price per Ton Crushed Stone
Westfield	1	$ 2.05
Chicopee Falls	11	2.55

f. Bill Willard, Incorporated. The processing plant and transit-mix plant are located in Northampton, Massachusetts. Quoted plant

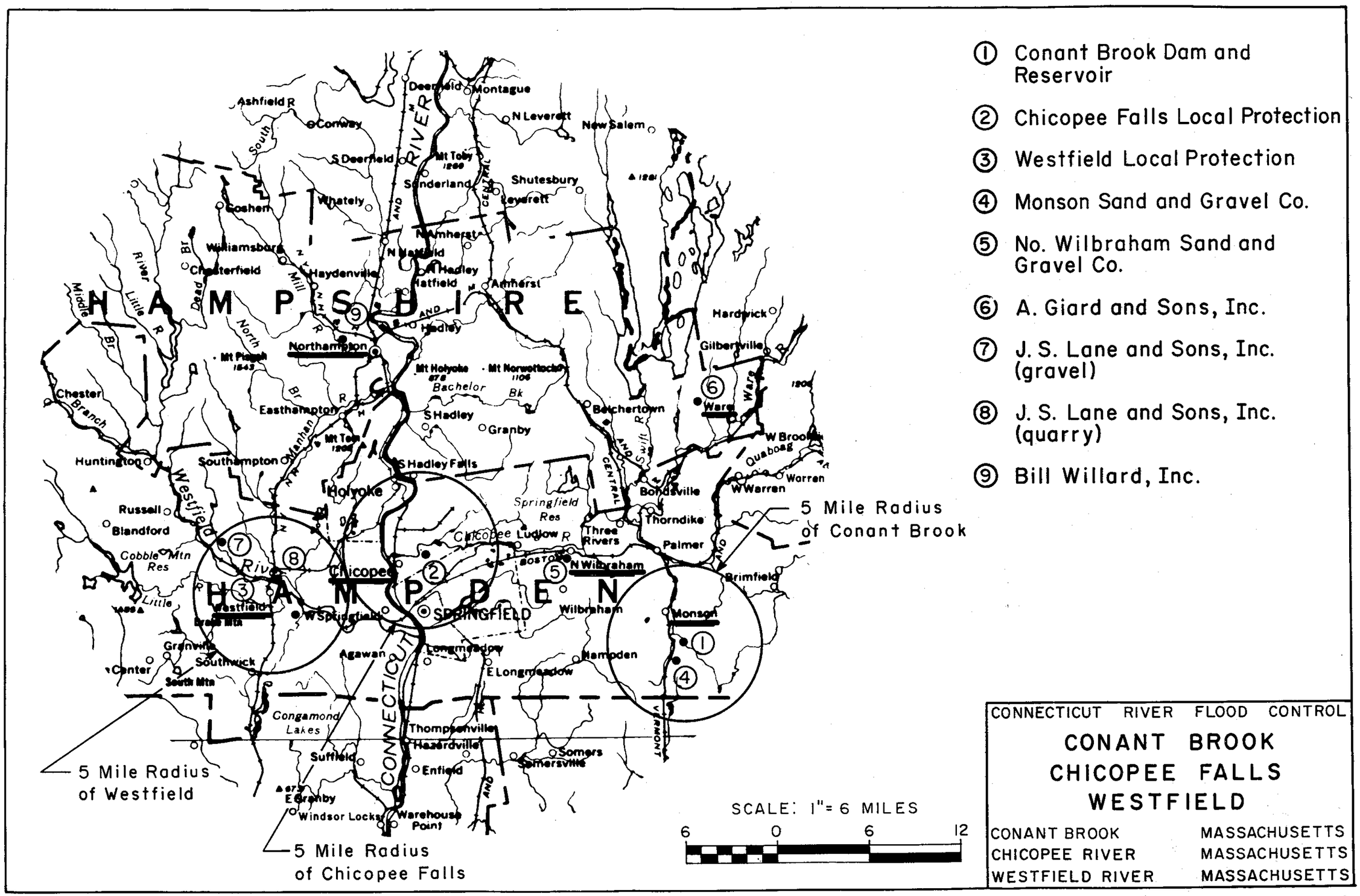
prices are $1.55 per ton for gravel and $0.50 per ton for concrete sand. The approximate haul mileage and estimated average price for gravel and sand at the various sites are shown in the following table:

Site	Haul Mileage	Price per Ton Gravel	Price per Ton Sand
Chicopee Falls	14	$ 2.45	$ 1.40
Westfield	21	2.80	1.75

5. Service Records for Aggregates. The concrete aggregates from the above listed sources have been used in a number of Federal, State and local projects except John S. Lane & Sons, Incorporated sand and gravel which is a recently developed source. The quarry stone coarse aggregate from John S. Lane & Sons, Incorporated has been used for more than twenty years in Corps of Engineers civil works and military projects and its service record is excellent. The performance of aggregates from sources other than John S. Lane & Sons, Incorporated is satisfactory; although it must be noted that these materials have not been used extensively in important structures and the period of record is less than ten years. The fine and coarse aggregates from Monson Sand & Gravel Company, although used in state and local building construction, are not approved for Commonwealth of Massachusetts Department of Public Works highway construction, because of non-conformance to resistance to abrasion requirements.

6. Recommendations and Conclusions. Based on the data presented herein, it is considered that all sources are acceptable except Monson Sand & Gravel Company. The aggregate test results and comparative costs indicate for the Conant Brook Dam and Reservoir project that aggregates from the North Wilbraham Sand & Gravel Company and A. Giard & Sons,

Incorporated are superior in quality and economically competitive with Monson Sand & Gravel Company. It is recommended all sources as listed be approved except Monson Sand & Gravel Company



CONNECTICUT RIVER FLOOD CONTROL

CONANT BROOK
CHICOPEE FALLS
WESTFIELD

CONANT BROOK	MASSACHUSETTS
CHICOPEE RIVER	MASSACHUSETTS
WESTFIELD RIVER	MASSACHUSETTS

PLATE 4-1

ITEM NUMBER	SOURCE AND LOCATION	REMARKS AND SOURCE	HAUL IN MILES	MATERIAL TESTED (PROCESSED)	NOMINAL SIZE	TESTING LABORATORY AND DATE OF TESTS	SAMPLE NUMBER	SIEVE ANALYSIS OF AGGREGATE - U.S. STANDARD SIEVE PERCENT PASSING - BY WEIGHT: SIEVE SIZE IN INCHES							U.S. STANDARD SIEVES NUMBERS							FINENESS MODULUS	LA ABRASION TEST 500 REVOLUTIONS PERCENT LOSS	SOUNDNESS TEST 5 CYCLES - $MgSO_4$ PERCENT LOSS	ORGANIC IMPURITIES (PPM) ASTM PLATE I	MORTAR STRENGTH PERCENT OF STANDARD			FLAT AND ELONGATED PERCENT BY WEIGHT	ALKALI REACTIVITY	DELETERIOUS MATERIALS	ABSORPTION PERCENT	SPECIFIC GRAVITY			COMPRESSIVE STRENGTH, PSI: 7 DAY AVERAGE			14 DAY AVERAGE			28 DAY AVERAGE			LINEAL COEFFICIENT THERMAL EXPANSION X10 — 6/°F	DURABILITY FACTOR (DFE) 300 CYCLES
								2½	2	1½	1	¾	½	⅜	4	8	16	30	50	100	200					3 DAY	7 DAY	28 DAY					BULK	BULK SS DRY	APPARENT	CEMENT FACTOR 5.0	CEMENT FACTOR 6.0	CEMENT FACTOR 7.0	CEMENT FACTOR 5.0	CEMENT FACTOR 6.0	CEMENT FACTOR 7.0	CEMENT FACTOR 5.0	CEMENT FACTOR 6.0	CEMENT FACTOR 7.0		
1.	Monson Sand and Gravel Company Monson, Massachusetts	Operating Pit	2 CB	Crushed Gravel	1½" 7/8" 1/2"	NED September 1962	71-16-1 71-16-2 71-16-3	- - -	- - -	100 - -	83 100 -	24 96 100	3 35 99	- 9 87	- - 17	- - 9	- - -	- - -	- - -	- - -	0.4 0.8 1.1	7.76 6.25 5.88	52	10 10 -	-	-	-	-	3 3 4	Innoc	None	0.9 1.0 1.4	2.67 2.67 2.64	2.70 2.69 2.68	2.74 2.74 2.74	1830	2510	3170	2470	3300	3880	3360	4250	4320	5.2	50
2.				Processed Sand	No. 4		71-16-4	-	-	-	-	-	-	100	97	86	73	51	20	4	1.3	2.69	-	19	< 500	-	116	125		Innoc	None	0.6	2.69	2.71	2.74											
3.	North Wilbraham Sand and Gravel Company North Wilbraham, Massachusetts	Operating Pit	10 CB 5 CF	Crushed Gravel	1½" 1" 3/8"	SAD September 1956	82-440 82-399 82-398	- - -	- - -	100 - -	64 100 -	14 93 -	2 42 -	- 13 100	- 2 11	- 1 2	- - -	- - -	- - -	- - -	- - -	7.86 6.91 5.87	38	6	-	-	-	-	-	Innoc	None	1.2		2.69											4.4	77
4.				Processed Sand	No. 4		82-397	-	-	-	-	-	-	100	99	88	68	45	21	6	-	2.73	-	10	< 500	-	-	-	-	Innoc	None	0.8		2.71											5.1	
5.	A. Giard and Sons, Inc. Ware Massachusetts	Operating Pit	12 CB	Crushed Gravel	1½" 3/4"	SAD September 1956	82-403 3-856-2	- -	- -	110 -	78 100	16 90	2 28	- 7	- 2	- -	- -	- -	- -	- -	- -	7.81 6.95	38	5	-	-	-	-	-	Innoc	None	2.2		2.58											4.7	78
6.				Processed Sand	No. 4	NED October 1956	82-401	-	-	-	-	-	-	100	99	88	43	15	4	-	-	2.82	-	14	< 500	-	-	-	-	Innoc	None	0.9		2.67											5.4	

PETROGRAPHIC ANALYSIS

1. GRAVEL: The coarse aggregate is composed of about 47% Quartz-Biotite Gneiss, 16% Granite, 11% Quartz and Quartzite, 5% Schist, 9% Amphibolite and Hornblende Gneiss, 4% Basalt, 5% Diorite and 3% Miscellaneous with 20% highly weathered.
2. SAND: The fine aggregate is composed of about 68% Quartz and Quartzite, 11% Gneiss, 12% Dark Basic Rock Types, 3% Feldspar, 2% Granite and 4% Miscellaneous with 11% weathered.
3. GRAVEL: The coarse aggregate is composed of about 66% Granite and Gneiss, 15% Hornblende Gneiss, 8% Quartz and Quartzite, 9% Miscellaneous Rock Types, with 11% excessively weathered.
4. SAND: The fine aggregate is composed of about 49% Quartz, 29% Granite and Granite Gneiss, 22% Miscellaneous Rock Types with 7% excessively weathered.
5. GRAVEL: The coarse aggregate is composed of about 82% Granite and Gneiss, 8% Hornblende Gneiss, 7% Mica Schist, 3% Quartz and Quartzite with 14% excessively weathered.
6. SAND: The fine aggregate is composed of about 57% Quartz and Quartzite, 26% Granite Gneiss, 17% Miscellaneous Rock Types with 7% excessively weathered.

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CONANT BROOK	MASSACHUSETTS
CHICOPEE RIVER	MASSACHUSETTS
WESTFIELD RIVER	MASSACHUSETTS

TABLE 4-1

ITEM NUMBER	SOURCE AND LOCATION	REMARKS AND SOURCE	HAUL IN MILES	MATERIAL TESTED (PROCESSED)	NOMINAL SIZE	TESTING LABORATORY AND DATE OF TESTS	SAMPLE NUMBER	SIEVE ANALYSIS OF AGGREGATE – U.S. STANDARD SIEVE PERCENT PASSING – BY WEIGHT: SIEVE SIZE IN INCHES							U.S. STANDARD SIEVES NUMBERS							FINENESS MODULUS	L.A. ABRASION TEST 500 REVOLUTIONS PERCENT LOSS	SOUNDNESS TEST 5 CYCLES – $MgSO_4$ PERCENT LOSS	ORGANIC IMPURITIES (PPM) ASTM PLATE I	MORTAR STRENGTH PERCENT OF STANDARD			FLAT AND ELONGATED PERCENT BY WEIGHT	ALKALI REACTIVITY	DELETERIOUS MATERIALS	ABSORPTION PERCENT	SPECIFIC GRAVITY			COMPRESSIVE STRENGTH, PSI: 7 DAY AVERAGE, CEMENT FACTOR			14 DAY AVERAGE, CEMENT FACTOR			28 DAY AVERAGE, CEMENT FACTOR			LINEAL COEFFICIENT THERMAL EXPANSION X10 – 6/°F	DURABILITY FACTOR (DFE) 300 CYCLES
								2½	2	1½	1	¾	½	⅜	4	8	16	30	50	100	200					3 DAY	7 DAY	28 DAY					BULK	BULK SS DRY	APPARENT	5.0	6.0	7.0	5.0	6.0	7.0	5.0	6.0	7.0		
7.	J. S. Lane and Sons, Inc. Westfield, Massachusetts	Operating Pit	W 4	Crushed Gravel	1½"	NED September 1962	71-18-1	-	-	100	80	31	9	7	-	-	-	-	-	-	1.0	7.42		8	-				4			0.9	2.66	2.68	2.72											
					3/4"		71-18-2	-	-	-	100	97	49	28	10	-	-	-	-	-	1.0	6.49	40	11	-				8	Innoc	None	1.2	2.63	2.66	2.73											
					3/8"		71-18-3	-	-	-	-	-	100	96	19	7	5	-	-	-	1.1	5.62										1.7	2.61	2.69	2.73	1800	2330	2980	2430	3020	3630	3290	3880	4560	4.7	78
			CF 14																																											
8.				Processed Sand	No. 4		71-18-4	-	-	-	-	-	-	100	99	88	75	48	24	9	2.5	2.57	-	8	<500	-	136	136				1.2	2.81	2.84	2.91											
9.	J. S. Lane and Sons, Inc. Westfield, Massachusetts	Operating Quarry	W 1	Crushed Stone	1½"	WES July 1947		-	100	97	37	7	1	-	-	-	-	-	-	-	-	7.96	13	1					10	Innoc	None	0.5		2.96		2460	2910	3560	3390	3760	4290	4280	4680	5350		85
					3/4"			-	-	-	100	97	59	30	1	-	-	-	-	-	-	6.72		1					19			0.8		2.95												
			CF 11																																											
10.	Bill Willard, Inc. Northampton, Massachusetts	Operating Pit	CF 14	Crushed Gravel	1½"	NED February 1961	71-5-1	-	-	100	87	19	2	-	-	-	-	-	-	-	-	7.81		5					0			1.0	2.63	2.66	2.70											
					7/8"		71-5-2	-	-	-	100	98	12	4	3	-	-	-	-	-	-	6.95	44	3					0	Innoc	None	1.3	2.62	2.65	2.71											
					5/8"		71-5-3	-	-	-	100	83	27	2	-	-	-	-	-	-	-	7.15														1790	2210	2840	2450	2940	3710	3430	3580	4410	5.9	49
			W 21																																											
11.				Processed Sand	No. 4		71-5-4	-	-	-	-	-	-	100	98	88	74	49	18	4	1	2.69		3	<500	-	130	158				0.9	2.67	2.69	2.73											

PETROGRAPHIC ANALYSIS

7. GRAVEL: The coarse aggregate is composed of about 37% Gneiss, 23% Quartzite, 13% Granite, 13% Schist, 7% Vein Quartz, 6% Basic Rock Types, 1% Miscellaneous with 8% Highly Weathered.
8. SAND: The fine aggregate is composed of about 52% Quartz and Quartzite, 14% Granite and Gneiss, 12% Schist and Mica, 7% Garnet, 7% Feldspar, 4% Basic Rock Types, 3% Miscellaneous, with 12% Weathered.
9. STONE: The coarse aggregate is composed of about 92% Dense, Fresh, Diabase and 8% Altered Diabase containing up to 20% Clay and Clay-like materials.
10. GRAVEL: The coarse aggregate is composed of about 57% Granite, 15% Quartz and Quartzite, 16% Schist, 8% Feldspar, 2% Basic Rock Type, and 2% Miscellaneous with 5% Highly weathered.
11. SAND: The fine aggregate is composed of about 72% Quartz and Quartzite, 12% Feldspar, 3% Granite, 5% Schist, 2% Basic Rock Types, 6% Miscellaneous with 28% Slightly weathered.

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TABLE 4-2