OFFICE MEMORANDUM

DATE: March 27, 1984

TO: L. T. Oehler
Engineer of Research

FROM: R. W. Muethel

SUBJECT: Petrographic Analysis of Dense-Graded Gravel Aggregate: Peters Pit No. 49-23 (Testing Laboratory Sample No. 83A-10140). Research Project 83 TI-916. Research Report No. R-1240(3).

In October 1983 a sample of dense-graded gravel aggregate was received by the Department's Testing Laboratory Section. Information accompanying the sample stated that the material was obtained from the Peters Pit No. 49-23, location NE of SE, Sec. 32, T44N, R7W, Mackinac County, by G. H. Gallup.

The material was submitted to the laboratory to be tested for information. Petrographic analysis of a portion of the sample was conducted for Research Project 83 TI-916, "Investigation of Freeze-Thaw durability for Aggregates in Bituminous Mixtures in the Upper Peninsula."

Summary

Rock Class	Condition of Particles	Percent of Sample
Igneous	hard, fresh to moderately weathered, and non-porous to finely porous	24.6
Metamorphic	hard to moderately hard, fresh to highly weathered, and non-porous to finely porous	3.5
Sedimentary	hard to soft, fresh to highly weathered, and non-porous to finely porous	71.9

Approximately 15 percent of the sample was found to be composed of material having absorption values greater than 2.0 percent.

Detailed tabulations of petrographic composition, specific gravity, and absorption are included in Tables 1 and 2.

Detailed Petrography

Petrographic examination was conducted in general conformance with ASTM C295, "Petrographic Examination of Aggregates for Concrete." Representative portions—300 particles—of the noted sieve fractions were identified megascopically along with acid testing and a scratch test for hardness, and microscopically with a stereomicroscope. Specific gravity and absorption determinations were performed in general accordance with ASTM C127, "Specific Gravity and Absorption of Coarse Aggregate." Determinations included all material of the rock types analyzed. The following pages contain the rock type descriptions.

TESTING AND RESEARCH DIVISION

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Attachments

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TABLE 1
PETROGRAPHIC COMPOSITION
(Testing Laboratory Sample No. 83A-10140)

Rock Type	Sieve Fraction Analysed				Computed Sample Composition
	1 to 3/4-in.	3/4 to 1/2-in.	1/2 to 3/8-in.	3/8 to No. 4	
Igneous					
Granite	18.4	16.7	12.3	15.0	15.6
Diorite	0.7	1.3	2.0	0.0	1.0
Gabbro	5.3	3.7	3.0	4.0	4.0
Basalt	1.3	2.3	2.3	2.3	2.0
Felsite	2.0	1.3	2.7	2.0	2.0
Metamorphic					
Quartzite	4.0	2.0	0.7	2.0	2.2
Metasediments	1.3	1.0	0.7	1.3	1.1
Schist	0.0	0.0	0.7	0.0	0.2
Sedimentary					
Limestone	22.0	28.0	28.6	30.3	27.2
Argillaceous limestone	0.7	1.3	1.7	1.0	1.2
Dolomitic limestone	6.0	3.0	1.7	3.3	3.5
Dolomite	28.0	26.0	28.6	26.7	27.3
Argillaceous dolomite	6.0	9.0	9.3	8.7	8.2
Sandstone	2.0	2.7	2.3	1.7	2.2
Siltstone	0.3	0.7	0.7	0.7	0.6
Shale	0.0	0.0	0.0	0.3	0.1
Chert	2.0	1.0	2.7	0.7	1.6
Totals, percent	100.0	100.0	100.0	100.0	100.0

NOTE: Computed sample composition is based upon counts of 300 particles contained in each of the sieve fractions noted.

TABLE 2
SPECIFIC GRAVITY AND ABSORPTION DATA
(Testing Laboratory Sample No. 83A-10140)

Rock Type	Specific Gravity			Absorption, percent	Composition, percent by weight
	Bulk, dry	Bulk, ssd	Apparent		
Igneous					
Granite	2.63	2.65	2.67	0.54	18.4
Diorite	2.79	2.80	2.82	0.40	1.1
Gabbro	2.97	2.98	3.00	0.36	5.2
Basalt	2.89	2.90	2.91	0.27	1.8
Felsite	2.50	2.54	2.61	1.76	1.7
Metamorphic					
Quartzite	2.66	2.68	2.69	0.40	3.2
Metasediments	2.67	2.69	2.71	0.53	1.1
Schist	*	*	*	*	0.1
Sedimentary					
Limestone	2.59	2.63	2.68	1.27	24.0
Argillaceous limestone	2.45	2.53	2.65	3.10	1.0
Dolomitic limestone	2.59	2.66	2.77	2.46	4.8
Dolomite	2.67	2.71	2.78	1.51	26.2
Argillaceous dolomite	2.59	2.66	2.78	2.57	7.2
Sandstone	2.55	2.60	2.69	1.98	2.3
Siltstone	2.13	2.32	2.64	8.95	0.4
Shale	*	*	*	*	TR
Chert	2.38	2.47	2.61	3.65	1.5
Total Sample	2.64	2.67	2.74	1.35	100.0

NOTE: Values are computed from determinations made on all sample material contained in the categories noted. Asterisks indicate no determination due to insufficient material in sample.

IGNEOUS ROCKS

Rock Type	Granite	Diorite	Gabbro
Color	mottled buff to white, pink, and dark green to black; and mottled white and dark gray to black	mottled white to buff, and dark gray to black	mottled dark gray or green to black, and white to buff
Texture	medium to fine grained	medium to fine grained	medium to fine grained
Luster	dull	dull	dull
Hardness	Mohs 5-1/2 to 7	Mohs 5-1/2 to 6	Mohs 5-1/2 to 6
Porosity	non-porous to slightly porous on weathered surfaces	non-porous to slightly porous on weathered surfaces	non-porous to slightly porous on weathered surfaces
Particle Shape	angular to rounded	angular to rounded	angular to rounded
Particle Surface	fresh to slightly weathered, rough to smooth, and dented to ridged	fresh to moderately weathered, rough to smooth, and dented or pitted to ridged	fresh to slightly weathered, rough to moderately smooth, and dented or pitted to ridged
Remarks	A few gneissic particles are included in this category.		

IGNEOUS ROCKS (Cont.)

Rock Type	Basalt	Felsite
Color	dark gray or green to black; and mottled white to buff and dark gray to black	pink to reddish brown; and gray
Texture	fine grained to micro-crystalline	fine grained to micro-crystalline
Luster	dull	dull
Hardness	Mohs 5-1/2 to 6	Mohs 7
Porosity	non-porous to slightly porous on weathered surfaces	non-porous to finely porous
Particle Shape	angular to rounded	angular to subrounded
Particle Surface	fresh to slightly weathered, rough to smooth, and dented to ridged	fresh to slightly weathered, rough to moderately smooth, and dented or pitted to ridged

METAMORPHIC ROCKS

Rock Type	Quartzite	Metasediments	Schist
Color	white; buff; pink; gray; and mottled white and gray	dark gray to black	mottled greenish gray and black
Texture	fine grained to micro-crystalline	fine grained to micro-crystalline	fine grained to micro-crystalline; foliated
Luster	dull	dull	dull
Hardness	Mohs 7	Mohs 5 to 7	Mohs 3 to 4
Porosity	non-porous to slightly porous on weathered surfaces	non-porous to slightly porous on weathered surfaces	finely porous
Particle Shape	angular to rounded	angular to rounded	subangular
Particle Surface	fresh to slightly weathered, rough to moderately smooth, and dented to ridged	fresh to slightly weathered, rough to moderately smooth, and dented to ridged	moderately to highly weathered, rough, and dented to ridged

SEDIMENTARY ROCKS

Rock Type	Limestone	Argillaceous limestone	Dolomitic limestone
Color	tan to buff or gray	tan to buff or gray	tan to buff or gray
Texture	very fine grained to micro-crystalline	very fine grained to micro-crystalline	very fine grained to micro-crystalline
Luster	dull	dull to earthy	dull
Hardness	Mohs 3	Mohs 2-1/2 to 3	Mohs 3 to 4
Porosity	non-porous to finely porous	finely porous	non-porous to finely porous
Particle Shape	angular to rounded	angular to rounded	angular to rounded
Particle Surface	fresh to highly weathered, rough to smooth, and dented or pitted to ridged	fresh to highly weathered, rough to smooth, and dented or pitted to ridged	fresh to highly weathered, rough to smooth, and dented or pitted to ridged
Remarks	A number of particles are deeply weathered.		Many particles contain deeply weathered zones and argillaceous exposures.

SEDIMENTARY ROCKS (Cont.)

Rock Type	Dolomite	Argillaceous dolomite	Sandstone
Color	tan to buff; gray; and mottled buff and gray	tan to buff	white; buff; and pink
Texture	very fine grained to micro-crystalline	very fine grained to micro-crystalline	medium to fine grained
Luster	dull	dull to earthy	dull
Hardness	Mohs 3-1/2 to 4	Mohs 3-1/2 to 4	Mohs 7
Porosity	non-porous to finely porous	finely porous	finely porous to porous
Particle Shape	angular to rounded	angular to rounded	angular to rounded
Particle Surface	fresh to highly weathered, rough to smooth, and dented or pitted to ridged	fresh to highly weathered, rough to smooth, and dented or pitted to ridged	fresh to moderately weathered, rough, and dented to ridged
Remarks	A few particles contain deeply weathered zones.	A number of particles are deeply weathered.	

SEDIMENTARY ROCKS (Cont.)

Rock Type	Siltstone	Shale	Chert
Color	buff to yellowish brown	dark brown	white; and mottled white and gray
Texture	very fine grained to micro-crystalline	very fine grained to micro-crystalline	very fine grained to micro-crystalline
Luster	dull to earthy	dull	chalky to dull or subvitrious
Hardness	Mohs 2-1/2 to 3	Mohs 2-1/2	Mohs 7
Porosity	finely porous	finely porous	finely porous
Particle Shape	angular to subrounded	angular	angular to subangular
Particle Surface	moderately to highly weathered, moderately smooth to smooth, and dented or pitted to ridged	slightly weathered, smooth, and dented to ridged	fresh to highly weathered, rough to smooth, and dented or pitted to ridged