

OFFICE MEMORANDUM



MICHIGAN

DEPARTMENT OF STATE HIGHWAYS

March 21, 1977

To: L. T. Oehler
Engineer of Research

From: R. W. Muethel

Subject: Petrographic Analysis of Coarse Aggregate: Mickelson No. 3 Pit No. 63-88 (Testing Laboratory Sample No. 75 A-2366). Research Report No. R-1055.

On November 7, 1975, a sample of combined crushed and natural gravel coarse aggregate was received by the Department's Testing Laboratory at Ann Arbor. Information accompanying the sample stated that the material was obtained from the Mickelson No. 3 Pit No. 63-88, location northeast 1/4 of Section 20, T5N-R10E, Oakland County. The material was submitted to the laboratory for freeze-thaw durability testing. Petrographic analysis of a portion of the sample was requested by G. H. Gallup.

Summary

Rock Class	Condition of Particles	Percent of Sample
Igneous	Hard, fresh to moderately weathered, and non-porous to slightly porous on weathered surfaces	16
Metamorphic	Hard to moderately hard, fresh to slightly weathered, and non-porous	21
Sedimentary	Hard to soft, fresh to highly weathered, and non-porous to porous	63

Approximately 19 percent of the sample was found to be contained in rock type categories having absorption values greater than 1.5 percent.

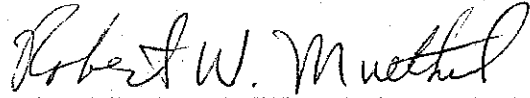
Detailed tabulations of petrographic composition, specific gravity, and absorption are included in Tables 1 and 2.

Detailed Petrography

Petrographic examination was conducted in general conformance with ASTM C295, "Petrographic Examination of Aggregates for Concrete." Repre-

sentative portions--300 particles--of each sieve fraction of the sample 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 analyzed. The following pages contain the rock type descriptions.

TESTING AND RESEARCH DIVISION



Geologist - Materials Research Unit

TABLE 1
 PETROGRAPHIC COMPOSITION
 Testing Laboratory Sample No. 75 A-2366

Rock Type	Sieve Fraction Analyzed				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	
Granite	8.0	10.0	7.3	6.3	7.9
Diorite	2.7	1.7	2.3	1.0	1.9
Gabbro	8.3	7.7	5.7	3.3	6.2
Basalt	2.3	4.3	1.0	3.0	2.7
Felsite	1.3	1.3	0.3	0.7	0.9
Quartzite	10.7	12.3	14.0	9.7	11.7
Metasediments	5.0	6.0	5.7	6.0	5.7
Tillite	2.7	3.0	3.7	4.0	3.3
Limestone	13.7	10.3	14.6	17.7	14.1
Argillaceous Limestone	2.7	0.7	0.7	--	1.0
Cherty Limestone	1.3	6.3	4.7	4.3	4.2
Dolomitic Limestone	3.3	1.3	2.7	2.0	2.3
Dolomite	24.4	20.7	20.0	17.3	20.6
Argillaceous Dolomite	1.3	2.0	2.3	1.3	1.8
Cherty Dolomite	2.3	4.3	4.7	7.7	4.7
Non-Friable Sandstone	2.0	2.7	2.0	1.7	2.1
Friable Sandstone	0.3	--	0.3	--	0.2
Siltstone	1.0	0.7	0.7	1.7	1.0
Clay Ironstones	--	--	0.3	--	TR
Porous Chert	5.0	4.0	4.3	9.0	5.6
Dense Chert	1.7	0.7	2.7	3.3	2.1
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. 75 A-2366

Rock Type	Specific Gravity			Absorption, percent	Composition, Percent by Weight
	Bulk, dry	Bulk, ssd	Apparent		
Granite	2.64	2.65	2.66	0.38	7.9
Diorite	2.86	2.87	2.89	0.32	2.4
Gabbro	2.96	2.97	2.99	0.33	9.1
Basalt	2.89	2.89	2.90	0.13	3.0
Felsite	2.78	2.78	2.79	0.13	1.0
Quartzite	2.65	2.66	2.67	0.26	11.1
Metasediments	2.71	2.71	2.73	0.26	5.5
Tillite	2.74	2.74	2.75	0.18	2.9
Limestone	2.66	2.68	2.71	0.67	13.3
Argillaceous Limestone	2.55	2.61	2.72	2.39	2.0
Cherty Limestone	2.57	2.61	2.68	1.57	2.8
Dolomitic Limestone	2.65	2.70	2.79	1.80	2.7
Dolomite	2.75	2.77	2.82	0.86	23.3
Argillaceous Dolomite	2.70	2.74	2.81	1.46	1.5
Cherty Dolomite	2.60	2.65	2.73	1.74	3.0
Non-Friable Sandstone	2.45	2.51	2.60	2.43	1.9
Friable Sandstone	2.36	2.47	2.64	4.49	0.2
Siltstone	2.31	2.47	2.77	7.23	0.7
Clay Ironstone	2.58	2.75	3.10	6.45	TR
Porous Chert	2.50	2.56	2.66	2.34	4.6
Dense Chert	2.56	2.60	2.66	1.54	1.1
Total Sample	2.70	2.72	2.76	0.86	100.0

Note: Values are computed from determinations made on all sample material contained in the categories noted.

IGNEOUS ROCKS

Rock Type	Granite	Diorite	Gabbro
Color	mottled pink, buff to white, and dark green to black	mottled buff to gray or pink, and dark green to black	mottled buff to white or gray, dark green to black; and mottled buff, dark green, and yellowish brown
Texture	coarse to very fine grained	medium to very fine grained	coarse to fine grained
Luster	dull to subvitreous	dull	dull
Hardness	hard: Mohs 7 to 6	hard: Mohs 7 to 6	hard: Mohs 6 to 5.5
Porosity	non-porous	non-porous	non-porous to slightly porous on weathered surfaces
Particle Shape	angular to subrounded	angular to subrounded	angular to subrounded
Particle Surface	fresh to slightly weathered, rough to moderately smooth, dented to ridged	fresh to moderately weathered, rough to moderately smooth, dented to ridged	fresh to moderately weathered, rough to moderately smooth, dented or pitted to ridged

IGNEOUS ROCKS (Cont.)

Rock Type	Basalt	Felsite
Color	dark gray to black	gray to green; and mottled buff and reddish brown
Texture	very fine grained to micro-crystalline	very fine grained to micro-crystalline
Luster	dull	dull
Hardness	hard: Mohs 6 to 5.5	hard: Mohs 7 to 6
Porosity	non-porous	non-porous
Particle Shape	angular to subrounded	angular to subrounded
Particle Surface	fresh to slightly weathered, rough to smooth, dented to ridged	fresh to slightly weathered, rough to smooth, dented to ridged

METAMORPHIC ROCKS

Rock Type	Quartzite	Metasediments	Tillite
Color	white to buff; pink; gray; green; and mottled buff and gray	dark gray to green, purplish brown; and mottled buff and gray to green	medium green or gray
Texture	coarse to very fine grained; and massive	very fine grained to micro-crystalline	microcrystalline ground-mass with a porphyritic appearance
Luster	vitreous to dull	dull	dull
Hardness	hard: Mohs 7	hard to moderately hard: Mohs 7 to 5	hard to moderately hard: Mohs 7 to 5
Porosity	non-porous	non-porous	non-porous
Particle Shape	angular to subrounded	angular to rounded	angular to subrounded
Particle Surface	fresh to slightly weathered, rough to smooth, dented to ridged	fresh to slightly weathered, rough to smooth, dented to ridged	fresh to slightly weathered, rough to smooth, dented to ridged
Remarks	A number of vein quartz particles are included in this category.		

SEDIMENTARY ROCKS

Rock Type	Limestone	Argillaceous Limestone	Cherty Limestone
Color	buff; gray; and mottled buff and gray	buff; and mottled gray and buff to brown	mottled buff and gray
Texture	fine grained to micro-crystalline	very fine grained to micro-crystalline	very fine grained to micro-crystalline
Luster	dull	dull to earthy	dull
Hardness	moderately hard: Mohs 3	moderately hard to soft: Mohs 3 to 2.5	hard to moderately hard; Mohs 7 to 3
Porosity	non-porous to slightly porous	finely porous	non-porous to finely porous
Particle Shape	angular to rounded	angular to rounded	angular to subrounded
Particle Surface	fresh to moderately weathered, rough to smooth, dented or pitted to ridged	fresh to moderately weathered, rough to smooth, dented or pitted to ridged	fresh to moderately weathered, rough to smooth, dented to ridged
Remarks	A few particles are fossiliferous. A few particles are partially lime incrustated.	A few particles contain shaley seams.	Particles contain cherty nodules, silicified fossils, or disseminated siliceous material.

SEDIMENTARY ROCKS (Cont.)

Rock Type	Dolomitic Limestone	Dolomite	Argillaceous Dolomite
Color	gray; buff; and mottled buff and gray	gray; buff; and mottled gray and buff	buff; and mottled buff and gray
Texture	very fine grained to micro-crystalline	fine grained to micro-crystalline	very fine grained to micro-crystalline
Luster	dull	dull	dull to earthy
Hardness	moderately hard: Mohs 4 to 3	moderately hard: Mohs 4 to 3.5	moderately hard: Mohs 3.5 to 3
Porosity	non-porous to finely porous	non-porous to slightly porous	finely porous
Particle Shape	angular to rounded	angular to rounded	angular to rounded
Particle Surface	fresh to moderately weathered, rough to smooth, dented or pitted to ridged	fresh to moderately weathered, rough to smooth, dented or pitted to ridged	fresh to moderately weathered, rough to smooth, dented or pitted to ridged
Remarks		A number of particles contain small solution cavities.	

SEDIMENTARY ROCKS (Cont.)

Rock Type	Cherty Dolomite	Non-Friable Sandstone	Friable Sandstone
Color	buff; gray; and mottled buff and gray	buff; gray; and mottled buff and reddish-brown	reddish brown; and gray
Texture	very fine grained to micro-crystalline	coarse to fine grained	medium to fine grained
Luster	dull	dull	dull
Hardness	hard to moderately hard: Mohs 7 to 3	hard to moderately hard: Mohs 7 to 5	hard to moderately hard: Mohs 7 to 5
Porosity	non-porous to finely porous	porous to slightly porous	porous
Particle Shape	angular to subrounded	angular to rounded	subrounded
Particle Surface	fresh to moderately weathered, rough to smooth, dented or pitted to ridged	fresh to moderately weathered, rough, dented to ridged	highly weathered, rough, dented
Remarks	A few particles contain small solution cavities. Particles contain cherty nodules, seams, or interstitial fillings.		Particles are ferruginous to argillaceous.

SEDIMENTARY ROCKS (Cont.)

Rock Type	Siltstone	Clay Ironstone	Porous Chert
Color	buff; and reddish brown	reddish brown	buff; gray to white; and mottled buff or white and gray
Texture	very fine grained to micro-crystalline	microcrystalline	very fine grained to micro-crystalline
Luster	dull to earthy	dull	dull to subvitreous
Hardness	moderately hard to soft: Mohs 3 to 2.5	moderately hard: Mohs 4	hard to moderately hard: Mohs 7 to 3
Porosity	finely porous	finely porous	non-porous to finely porous
Particle Shape	subrounded	subrounded	angular to subrounded
Particle Surface	moderately to highly weathered, smooth, dented	moderately weathered, smooth, dented	fresh to highly weathered, rough to smooth, dented
Remarks	A few particles are partially lime incrustated.	Material contains concentric laminations.	Some particles contain calcite exposures or disseminated calcite.

SEDIMENTARY ROCKS (Cont.)

Rock Type	Dense Chert
Color	medium to dark gray; white to buff; and mottled light and dark gray
Texture	very fine grained to micro-crystalline
Luster	dull to vitreous
Hardness	hard: Mohs 7
Porosity	non-porous to slightly porous
Particle Shape	angular to subrounded
Particle Surface	fresh to slightly weathered, rough to smooth, dented to ridged
Remarks	Material is composed of nodular chert.