



OFFICE MEMORANDUM

DATE: August 22, 1977

TO: L. T. Oehler
Engineer of Research

FROM: R. W. Muethel

SUBJECT: Petrographic Analysis of Coarse Aggregate: Pickitt No. 1 Pit No. 34-26 (Testing Laboratory Sample No. 76 A-1265).
Research Report No. R-1071.

On July 12, 1976, 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 Pickitt and Schreur, Pickitt No. 1 Pit No. 34-26, location northwest 1/4 of southeast 1/4, Section 21, T7N, R6W, Ionia 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 highly weathered, and non-porous to slightly porous on weathered surfaces	28
Metamorphic	Hard to moderately hard, fresh to moderately weathered, and non-porous to finely porous	15
Sedimentary	Hard to soft, fresh to highly weathered, and non-porous to porous	57

Approximately 20 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." Representative 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

RWM:bf

TABLE 1
 PETROGRAPHIC COMPOSITION
 Testing Laboratory Sample No. 76 A-1265

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	11.7	10.7	8.7	7.0	9.5
Diorite	0.7	1.3	1.7	0.7	1.1
Gabbro	11.7	12.7	9.3	8.3	10.5
Basalt	4.6	4.7	6.0	7.0	5.6
Felsite	0.7	2.3	1.7	1.3	1.5
Quartzite	11.7	8.7	8.0	6.7	8.8
Metasediments	4.0	3.3	6.0	4.7	4.5
Tillite	2.7	2.7	1.7	1.3	2.1
Schist	--	--	0.3	--	TR
Limestone	8.3	11.7	15.3	16.3	12.9
Argillaceous Limestone	3.3	1.7	1.7	3.7	2.6
Cherty Limestone	2.3	1.3	2.7	3.0	2.3
Dolomitic Limestone	4.7	4.3	3.0	4.0	4.0
Dolomite	16.7	23.0	18.7	17.6	19.8
Argillaceous Dolomite	6.6	1.3	3.7	4.7	3.3
Cherty Dolomite	2.3	2.3	3.0	2.7	2.6
Sandstone	2.0	1.3	0.6	1.0	1.2
Siltstone	1.0	1.7	0.7	2.0	1.4
Shale	--	--	0.7	--	0.2
Clay Ironstone	--	0.3	0.7	0.7	0.4
Porous Chert	4.0	3.7	5.3	5.3	4.6
Dense Chert	1.0	1.0	0.5	2.0	1.1
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. 76 A-1265

Rock Type	Specific Gravity			Absorption, percent	Composition, Percent by Weight
	Bulk, dry	Bulk, ssd	Apparent		
Granite	2.67	2.68	2.70	0.38	10.5
Diorite	2.94	2.95	2.96	0.12	1.1
Gabbro	2.97	2.98	3.00	0.43	13.3
Basalt	2.94	2.95	2.96	0.22	5.3
Felsite	2.88	2.89	2.90	0.26	1.5
Quartzite	2.65	2.66	2.68	0.24	9.9
Metasediments	2.72	2.73	2.75	0.36	4.2
Tillite	2.74	2.74	2.75	0.14	2.6
Schist	*	*	*	*	TR
Limestone	2.64	2.66	2.69	0.67	9.8
Argillaceous Limestone	2.51	2.58	2.68	2.52	2.4
Cherty Limestone	2.57	2.61	2.67	1.47	2.1
Dolomitic Limestone	2.68	2.72	2.80	1.69	4.5
Dolomite	2.74	2.77	2.82	0.99	20.1
Argillaceous Dolomite	2.64	2.69	2.78	2.00	3.2
Cherty Dolomite	2.59	2.63	2.70	1.68	2.6
Sandstone	2.58	2.62	2.69	1.60	1.4
Siltstone	2.19	2.34	2.59	7.06	1.0
Shale	2.23	2.32	2.45	4.08	0.1
Clay Ironstone	2.93	3.08	3.44	5.13	0.1
Porous Chert	2.35	2.45	2.61	4.24	3.5
Dense Chert	2.47	2.52	2.60	2.11	0.8
Total Sample	2.71	2.73	2.79	0.95	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 buff to white, pink, and dark green to black	mottled buff to gray and dark green to black	mottled buff to gray, dark green to black, and yellowish brown; and mottled greenish gray and black
Texture	coarse to very fine grained	medium to very fine grained	medium to very fine grained
Luster	dull to subvitreous	dull	dull
Hardness	hard: Mohs 6 to 7	hard: Mohs 6 to 7	hard: Mohs 5.5 to 6.0
Porosity	non-porous	non-porous	non-porous to slightly porous on weathered surfaces
Particle Shape	subrounded to subangular	angular to subrounded	angular to rounded
Particle Surface	slightly to moderately weathered, rough to smooth, dented to ridged	fresh to slightly weathered, rough to moderately smooth, dented to ridged	fresh to highly weathered, rough to smooth, dented or pitted to ridged
Remarks			many particles are deeply weathered

IGNEOUS ROCKS (Cont.)

Rock Type	Basalt	Felsite
Color	dark green or gray to black; and mottled green and black	light gray to green; and buff to reddish brown
Texture	very fine grained to micro-crystalline	very fine grained to micro-crystalline
Luster	dull	dull
Hardness	hard: Mohs 6	hard: Mohs 6 to 7
Porosity	non-porous	non-porous
Particle Shape	angular to subrounded	angular to subangular
Particle Surface	fresh to slightly weathered, rough to smooth, dented to ridged	fresh to slightly weathered, rough to smooth, dented to ridged
Remarks	a few particles are partially lime-incrusted	

METAMORPHIC ROCKS

Rock Type	Quartzite	Metasediments	Tillite
Color	white to buff; pink to purple; gray; green; and mottled buff; green, and gray	gray; green; and mottled or banded gray and green	light gray to green; and mottled buff and green
Texture	medium to very fine grained; and massive	very fine grained to micro-crystalline	microcrystalline ground mass with a porphyritic appearance
Luster	dull to vitreous	dull	dull
Hardness	hard: Mohs 7	moderately hard to hard: Mohs 5-1/2 to 7	moderately hard to hard: Mohs 5 to 7
Porosity	non-porous	non-porous	non-porous
Particle Shape	subangular to rounded	angular to rounded	angular to subrounded
Particle Surface	fresh to slightly weathered, rough to smooth, dented to ridged	fresh to slightly weathered, rough to moderately smooth, dented to ridged	slightly weathered, rough to smooth, dented
Remarks		a few particles are partially lime-incrusted	

METAMORPHIC ROCKS (Cont.)

Rock Type	Schist
Color	mottled buff and green
Texture	fine grained
Luster	dull to silky
Hardness	moderately hard; Mohs 3
Porosity	finely porous
Particle Shape	subangular
Particle Surface	moderately weathered, rough, dented to ridged

SEDIMENTARY ROCKS

Rock Type	Limestone	Argillaceous Limestone	Cherty Limestone
Color	buff; brown; and mottled buff to gray and brown	buff; and mottled buff and gray to yellowish brown	mottled buff and gray to brown
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	moderately hard: Mohs 3	moderately hard to soft: Mohs 3 to 2-1/2	moderately hard to hard: Mohs 3 to 7
Porosity	non-porous to slightly porous	finely porous to non-porous	non-porous to slightly porous
Particle Shape	angular to rounded	subrounded to rounded	subangular to subrounded
Particle Surface	fresh to moderately weathered, rough to smooth, dented to ridged	slightly to highly weathered	slightly to moderately weathered, rough to moderately smooth, dented
Remarks	a few particles are fossiliferous		chert is present as siliceous nodules or fossils, and disseminated material

SEDIMENTARY ROCKS (Cont.)

Rock Type	Dolomitic Limestone	Dolomite	Argillaceous Dolomite
Color	buff, gray; and mottled buff and gray	buff; gray; and mottled buff and gray	buff; gray; and mottled buff and gray
Texture	very fine grained to micro-crystalline	very fine grained to micro-crystalline	very fine grained to micro-crystalline
Luster	dull	dull	dull to earthy
Hardness	moderately hard; Mohs 3 to 3-1/2	moderately hard; Mohs 3-1/2 to 4	moderately hard to soft; Mohs 3-1/2 to 2-1/2
Porosity	slightly to finely porous	non-porous to slightly porous	slightly to finely porous
Particle Shape	subrounded to rounded	subangular to rounded	subangular to rounded
Particle Surface	slightly to moderately weathered, rough to smooth, dented	fresh to moderately weathered, rough to smooth, dented or pitted to ridged	slightly to highly weathered; rough to smooth, dented or pitted to ridged

SEDIMENTARY ROCKS (Cont.)

Rock Type	Cherty Dolomite	Sandstone	Siltstone
Color	mottled buff and gray	buff; gray; and reddish to yellowish brown	buff; gray; and brown
Texture	very fine grained to micro-crystalline	fine to very fine grained	very fine grained
Luster	dull	dull	dull to earthy
Hardness	moderately hard to hard: Mohs 3-1/2 to 7	hard to moderately hard: Mohs 7 to 5	soft: Mohs 2-1/2
Porosity	non-porous to slightly porous	porous to slightly porous	finely porous
Particle Shape	angular to rounded	angular to rounded	subrounded to rounded
Particle Surface	fresh to moderately weathered, rough to smooth, dented to ridged	fresh to moderately weathered, rough, dented	moderately to highly weathered, dented to pitted
Remarks	cherty material is present as siliceous nodules, seams, fossils, or disseminated material	one particle of friable sandstone is included in this category	

SEDIMENTARY ROCKS (Cont.)

Rock Type	Shale	Clay Ironstone	Porous Chert
Color	dark brown	reddish brown	buff to white; and mottled buff to white and gray to brown
Texture	very fine grained to micro-crystalline	very fine grained to micro-crystalline	very fine grained to micro-crystalline
Luster	dull	dull	dull to earthy
Hardness	soft: Mohs 2-1/2	moderately hard: Mohs 3-1/2 to 4	hard: Mohs 7
Porosity	non-porous to finely porous	finely porous	finely porous to slightly porous
Particle Shape	subrounded	angular to rounded	angular to subrounded
Particle Surface	slightly weathered, smooth, dented	fresh to moderately weathered, rough to smooth, dented to ridged	slightly to highly weathered, rough to smooth, dented or pitted to ridged
Remarks		particles are concretions or fragments of concretions	particles are composed of nodular chert

SEDIMENTARY ROCKS (Cont.)

Rock Type	Dense Chert
Color	mottled white to gray and pink to gray, and reddish brown
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 subangular
Particle Surface	fresh to slightly weathered, rough to smooth, dented to ridged