



OFFICE MEMORANDUM

DATE: June 4, 1976

TO: L. T. Oehler
Engineer of Research

FROM: R. W. Muethel

SUBJECT: Petrographic Analysis of Coarse Aggregate: Construction Aggregates Corp. Pit No. 70-9 (Testing Laboratory Sample 75 A-2162). Research Report No. R-1007.

On October 16, 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 by C. D. Wier from the Construction Aggregates Corp. Pit No. 70-9, location SE of SW, Section 16, T8N-R16W, Ottawa County. The sample 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

Petrographic analysis was completed on May 7, 1976. The sample was found to have the following general petrographic composition:

Rock Class	Condition of Particles	Percent of Sample
Igneous	Hard, fresh to highly weathered, and non-porous to slightly porous on weathered surfaces	22
Metamorphic	Hard to moderately hard, fresh to moderately weathered, and non-porous	21
Sedimentary	Hard to soft, fresh to highly weathered, and non-porous to porous	57

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

TABLE 1
 PETROGRAPHIC COMPOSITION
 Testing Laboratory Sample No. 75 A-2162

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	17.3	12.3	11.3	9.3	12.6
Diorite	1.0	1.3	1.0	1.7	1.2
Gabbro	3.0	5.0	3.7	2.0	3.4
Basalt	1.7	2.0	4.4	2.7	2.7
Felsite	2.0	1.7	2.3	1.7	1.9
Quartzite	21.7	10.7	11.3	10.7	13.6
Metasediments	5.0	6.0	3.7	6.6	5.3
Tillite	3.3	2.0	0.7	2.3	2.1
Limestone	4.7	11.3	11.3	12.7	10.0
Argillaceous Limestone	0.7	2.0	0.3	2.3	1.3
Siliceous Limestone	1.0	0.3	0.7	0.3	0.6
Dolomitic Limestone	2.3	2.7	2.3	3.0	2.6
Dolomite	12.4	20.4	18.4	18.7	17.5
Argillaceous Dolomite	11.7	13.3	11.3	7.7	11.0
Siliceous Dolomite	3.6	3.7	1.7	1.3	2.6
Sandstone	1.7	1.0	2.3	1.7	1.7
Siltstone	1.0	--	0.7	1.0	0.7
Clay Ironstone	0.3	0.3	0.3	0.3	0.3
Chert	2.3	1.7	8.3	11.0	5.8
Cherty Limestone	1.0	1.3	1.7	1.7	1.4
Cherty Dolomite	2.3	1.0	2.3	1.3	1.7
Total Sample	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-2162

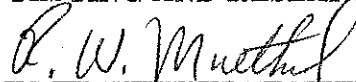
Rock Type	Specific Gravity			Absorption, percent	Composition, Percent by Weight
	Bulk, dry	Bulk, ssd	Apparent		
Granite	2.64	2.66	2.68	0.52	15.9
Diorite	2.86	2.87	2.88	0.33	1.1
Gabbro	2.94	2.96	2.99	0.54	3.5
Basalt	2.87	2.88	2.90	0.38	2.8
Felsite	2.73	2.74	2.76	0.40	2.1
Quartzite	2.63	2.64	2.66	0.36	18.0
Metasediments	2.69	2.70	2.72	0.41	5.3
Tillite	2.70	2.71	2.71	0.15	3.1
Limestone	2.64	2.66	2.69	0.74	6.3
Argillaceous Limestone	2.58	2.63	2.71	1.86	1.2
Siliceous Limestone	2.53	2.56	2.61	1.17	0.8
Dolomitic Limestone	2.58	2.64	2.73	2.12	2.5
Dolomite	2.75	2.77	2.81	0.84	14.9
Argillaceous Dolomite	2.65	2.71	2.81	2.04	11.5
Siliceous Dolomite	2.54	2.60	2.70	2.32	3.3
Sandstone	2.43	2.52	2.66	3.57	1.3
Siltstone	2.44	2.55	2.75	4.55	0.5
Clay Ironstone	2.28	2.63	3.52	15.38	0.3
Chert	2.41	2.46	2.53	2.01	2.7
Cherty Limestone	2.62	2.64	2.67	0.75	1.1
Cherty Dolomite	2.63	2.66	2.72	1.26	1.8
Total Sample	2.66	2.69	2.72	0.98	100.0

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

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

IGNEOUS ROCKS

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

IGNEOUS ROCKS (Cont.)

Rock Type	Basalt	Felsite
Color	dark gray or green to black; and mottled buff to reddish brown and green to black	light green; pink; and mottled buff and pink or green
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, general hardness 6
Porosity	non-porous	non-porous
Particle Shape	subangular to subrounded	subangular to rounded
Particle Surface	slightly weathered, rough to smooth, dented to ridged	slightly weathered, rough to smooth, dented to ridged

METAMORPHIC ROCKS

Rock Type	Quartzite	Metasediments	Tillite
Color	white to transparent; buff; pink; gray; green; and mottled buff to white, and pink, green, or gray	medium to dark gray, green, purple; and mottled buff to reddish brown and gray or green	grayish green
Texture	medium to very fine grained, and massive	very fine grained to micro-crystalline	microcrystalline groundmass with a porphyritic appearance
Luster	dull to vitreous	dull	dull
Hardness	hard: Mohs 7	moderately hard to hard: Mohs 4 to 7	moderately hard: Mohs 4 to 5
Porosity	non-porous	non-porous	non-porous
Particle Shape	angular to rounded	angular to rounded	angular to subrounded
Particle Surface	fresh to slightly weathered, rough to smooth, dented to ridged	slightly to moderately weathered, rough to smooth, dented to ridged	fresh to slightly weathered, rough to moderately smooth, dented to ridged
Remarks	Most particles are subrounded.	Most particles are subrounded to rounded. One particle of schist is included in this category.	

SEDIMENTARY ROCKS

Rock Type	Limestone	Argillaceous Limestone	Siliceous Limestone
Color	buff; medium to dark brown; and mottled buff and gray or brown	mottled buff or yellow, and gray	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 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	non-porous to finely porous	non-porous to finely porous
Particle Shape	angular to rounded	subangular to rounded	angular to subrounded
Particle Surface	fresh to highly weathered, rough to smooth, dented or pitted to ridged	moderately to highly weathered, rough to moderately smooth, dented to ridged	moderately to highly weathered, rough to smooth, dented to ridged
Remarks	Most particles are subrounded. Many particles emit petroliferous odor when scratched.		Siliceous material in the rock matrix is evidenced by metal mark when scratched with a file tang.

SEDIMENTARY ROCKS (Cont.)

Rock Type	Dolomitic Limestone	Dolomite	Argillaceous Dolomite
Color	buff; and mottled buff and gray	buff; gray; and mottled buff and gray	buff; 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	dull to earthy
Hardness	moderately hard: Mohs 3 to 3-1/2	moderately hard: Mohs 3 to 3-1/2	moderately hard to soft: Mohs 3-1/2 to 2-1/2
Porosity	non-porous to finely porous	non-porous to slightly porous	non-porous to finely porous
Particle Shape	subangular to rounded	subangular to rounded	subangular to rounded
Particle Surface	slightly to highly weathered, rough to smooth, dented or pitted to ridged	slightly to highly weathered, rough to smooth, dented or pitted to ridged	moderately to highly weathered, rough to smooth, dented or pitted
Remarks	A number of particles are slightly argillaceous.		Argillaceous material in most particles is disseminated throughout the rock matrix.

SEDIMENTARY ROCKS (Cont.)

Rock Type	Siliceous Dolomite	Sandstone	Siltstone
Color	buff; gray; and mottled buff and gray	buff; gray; and reddish to yellowish brown	buff; and gray
Texture	very fine grained to micro-crystalline	fine to very fine grained	very fine grained to micro-crystalline
Luster	dull	dull	dull to earthy
Hardness	moderately hard to hard; Mohs 3 to 7	hard to soft: Mohs 7 to 2-1/2, general hardness 7	moderately hard to soft: Mohs 3 to 2-1/2
Porosity	non-porous to finely porous	porous	finely porous
Particle Shape	angular to rounded	rounded	subrounded to rounded
Particle Surface	slightly to highly weathered, moderately smooth to smooth, dented or pitted to ridged	moderately to highly weathered, rough, dented	moderately to highly weathered, moderately smooth to smooth, dented
Remarks	Siliceous material in the rock matrix is evidenced by metal mark when scratched with a file tang.	Several particles are ferruginous.	

SEDIMENTARY ROCKS (Cont.)

Rock Type	Clay Ironstone	Chert	Cherty Limestone
Color	reddish to yellowish brown	white; buff; and mottled white or buff and gray	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 to earthy	dull to vitreous	dull
Hardness	moderately hard: Mohs 4	hard: Mohs 7	moderately hard to hard: Mohs 3 to 7
Porosity	finely porous	non-porous to finely porous	non-porous to slightly porous
Particle Shape	subangular to subrounded	subangular to subrounded	subangular to rounded
Particle Surface	slightly to moderately weathered, smooth, dented	slightly to moderately weathered, rough to smooth, dented to ridged	slightly to highly weathered, rough to moderately smooth, dented to ridged
Remarks	Particles are unbroken concretions.	A number of particles are mottled with exposures of vitreous chert.	Cherty exposures are silicified fossils and nodules.

SEDIMENTARY ROCKS (Cont.)

Rock Type	Cherty Dolomite
Color	mottled buff or gray and white
Texture	very fine grained to micro-crystalline
Luster	dull
Hardness	moderately hard to hard: Mohs 3 to 7
Porosity	non-porous to slightly porous
Particle Shape	subangular to rounded
Particle Surface	slightly to highly weathered, rough to moderately smooth, dented to ridged
Remarks	Cherty exposures are silicified fossils, nodules, and small seams.