



OFFICE MEMORANDUM

DATE: March 28, 1978

TO: L. T. Oehler
Engineer of Research

FROM: R. W. Muethel

SUBJECT: Petrographic Analysis of Coarse Aggregate: U. S. Forest Service Pit No. 27-68 (Testing Laboratory Sample No. 75 A-1120). Research Report No. R-1086.

On July 7, 1975, a sample of combined crushed and natural gravel coarse aggregate was received by the Department's Testing Laboratory. Information accompanying the sample stated that the material was obtained from a stockpile at the A. Lindberg and Sons U. S. Forest Service Pit No. 27-68, location southeast of northeast, Section 24, T44N, R38W, Gogebic County. The material was submitted to the laboratory for freeze-thaw 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	49
Metamorphic	Hard to soft, fresh to highly weathered, and non-porous to slightly porous	49
Sedimentary	Hard to moderately hard, fresh to slightly weathered, and non-porous to porous	2

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 C 295, "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 C 127, "Specific Gravity and Absorption of Coarse Aggregate." Determinations included all material analyzed. The following pages contain the rock type descriptions.

TESTING AND RESEARCH DIVISION

R. W. Mueth

Geologist - Materials Research Unit

TABLE 1
 PETROGRAPHIC COMPOSITION
 Testing Laboratory Sample No. 75 A-1120

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	9.7	7.0	8.3	4.7	7.4
Diorite	0.7	0.3	1.0	2.0	1.0
Gabbro	15.0	13.7	14.7	13.0	14.1
Basalt	17.3	21.4	20.0	22.0	20.2
Felsite	7.7	8.3	5.3	3.0	6.2
Quartzite	3.6	5.0	3.7	4.0	4.1
Metasediments	1.3	1.3	0.7	1.3	1.1
Schists and Greenstone	41.0	40.4	42.3	44.7	42.1
Schistose Quartzite	2.0	---	1.7	3.3	1.7
Conglomerate	---	0.3	---	---	0.1
Sandstone	1.7	2.3	2.3	1.3	1.8
Chert	---	---	---	0.7	0.2
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-1120

Rock Type	Specific Gravity			Absorption, percent	Composition, Percent By Weight
	Bulk, dry	Bulk, ssd	Apparent		
Granite	2.64	2.66	2.68	0.48	8.2
Diorite	2.76	2.78	2.81	0.57	0.7
Gabbro	2.93	2.94	2.97	0.37	14.5
Basalt	2.84	2.85	2.88	0.45	20.5
Felsite	2.68	2.70	2.73	0.69	6.9
Quartzite	2.60	2.61	2.63	0.42	3.8
Metasediments	2.65	2.67	2.70	0.70	0.4
Schists and Greenstone	2.70	2.72	2.74	0.48	41.7
Schistose Quartzite	2.61	2.63	2.67	0.94	1.4
Conglomerate	2.44	2.51	2.62	2.88	0.2
Sandstone	2.53	2.58	2.65	1.73	1.7
Chert	*	*	*	*	TR
Total Sample	2.75	2.76	2.78	0.51	100.0

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

* Indicates insufficient material for accurate determinations.

IGNEOUS ROCKS

Rock Type	Granite	Diorite	Gabbro
Color	mottled buff to white, pink, and dark green to black; and mottled buff and pink to reddish brown	mottled buff to white, and gray to black; and mottled buff to reddish brown and dark green to black	mottled buff to white, and gray or dark green to black; and mottled white to buff, reddish to yellowish brown, and black
Texture	medium to fine grained	medium to fine grained	medium to fine grained
Luster	dull to subvitreous	dull	dull
Hardness	Mohs 6 to 7	Mohs 6 to 7	Mohs 5-1/2 to 6
Porosity	non-porous	non-porous	non-porous
Particle Shape	angular to rounded	angular to subrounded	angular
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 highly weathered, rough to moderately smooth, dented to ridged
Remarks	A number of syenite particles are included in this category.		

IGNEOUS ROCKS (Cont.)

Rock Type	Basalt	Felsite
Color	dark gray to black; purple; and mottled reddish brown and dark gray to green	pink to reddish brown; gray to green; and mottled buff to pink and reddish brown
Texture	very fine grained to micro-crystalline	very fine grained to micro-crystalline
Luster	dull	dull
Hardness	Mohs 5-1/2 to 6	Mohs 6 to 7
Porosity	non-porous	non-porous
Particle Shape	angular to rounded	angular to rounded
Particle Surface	fresh to highly weathered, rough to smooth, dented or pitted to ridged	fresh to slightly weathered, rough to smooth, dented or pitted to ridged
Remarks	A few particles are deeply weathered. A number of particles are amygdaloidal. A few dark porphyritic particles are included in this category.	A few particles are porphyritic.

METAMORPHIC ROCKS

Rock Type	Quartzite	Metasediments	Schistose Quartzite
Color	white; buff; gray to green; pink; and mottled buff and gray	gray to dark green; and purple	mottled buff or pink to white; and mottled white to gray and buff to yellowish brown or black
Texture	medium to fine grained; and massive	very fine grained to micro-crystalline	fine to very fine grained
Luster	vitreous to dull	dull	dull
Hardness	Mohs 7	Mohs 4-1/2 to 7	Mohs 7 to 2-1/2
Porosity	non-porous	non-porous	non-porous to slightly 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 highly weathered, rough, dented to ridged
Remarks	A few vein quartz particles are included in this category. A number of orthoquartzite particles are included in this category due to similar mineralogy.		Most particles contain deeply weathered micaceous material.

METAMORPHIC ROCKS (Cont.)

Rock Type	Schist and Greenstone
Color	medium to dark gray; and mottled gray and yellowish brown
Texture	very fine grained to micro-crystalline
Luster	dull to silky
Hardness	Mohs 2-1/2 to 5-1/2
Porosity	non-porous to slightly porous
Particle Shape	angular to rounded or tabular
Particle Surface	fresh to moderately weathered, rough to smooth, dented to ridged
Remarks	This category contains particles with highly to poorly developed slately structure. Many particles appear to be composed of highly altered gabbro or basalt.

SEDIMENTARY ROCKS

Rock Type	Conglomerate	Sandstone	Chert
Color	mottled white; buff; pink; and gray	buff; reddish brown; gray; and mottled buff and reddish brown	white; and mottled buff and gray
Texture	pebbly	medium to fine grained	microcrystalline
Luster	dull	dull	dull to subvitreous
Hardness	Mohs 4-1/2 to 7	Mohs 6 to 7	Mohs 7
Porosity	non-porous	non-porous to porous	non-porous to porous
Particle Shape	subrounded	angular to rounded	angular to rounded
Particle Surface	slightly weathered, rough, dented	fresh to slightly weathered, rough, dented to ridged	fresh to slightly weathered, smooth, dented to ridged
Remarks		Most particles are arkosic.	