OFFICE MEMORANDUM

DATE: December 14, 1976

TO: L. T. Oehler
Engineer of Research

FROM: R. W. Muethel

SUBJECT: Petrographic Analysis of Coarse Aggregate: Gaspardo Pit No. 31-65 (Testing Laboratory Sample 75A-1121). Research Report No. R-1032.

On July 7, 1975, a sample of 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 Gaspardo Pit No. 31-65, location SW of NW, Section 12, T55N-R34W, Houghton 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 November 15, 1976. The sample was found to have the following general petrographic composition:

Rock Class	Condition of Particles	Percent of Sample
Igneous	Hard to soft, slightly to highly weathered, and non-porous to highly porous	84
Metamorphic	Hard to soft, slightly to highly weathered, and non-porous to porous	9
Sedimentary	Hard to soft, slightly to highly weathered, and non-porous to highly porous	7

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 -- 200 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

Robert W. Mueller

Geologist
Materials Research Unit

IGNEOUS ROCKS

Rock Type	Granite and Syenite	Diorite	Gabbro
Color	mottled pink, buff to white, and black; and mottled pink and buff to white	mottled white to buff and dark green to black	mottled buff to white, dark green to black, and reddish brown; and mottled white and dark green
Texture	medium to very fine grained	medium to very fine grained	coarse to very fine grained
Luster	dull	dull	dull to earthy
Hardness	hard: Mohs range 6 to 7	hard: Mohs range 6 to 7	hard to soft: Mohs range 6 to 2-1/2
Porosity	non-porous to moderately porous	non-porous	non-porous to porous
Particle Shape	subangular to rounded	subangular to rounded	subangular to rounded
Particle Surface	slightly to highly weathered, rough to smooth, dented to ridged	slightly to moderately weathered, rough, dented to ridged	slightly to highly weathered, rough, dented or pitted to ridged
Remarks	A few particles are deeply weathered.		A number of particles are deeply weathered and easily broken.

Rock Type	Basalt	Felsite
Color	mottled buff to white, dark green to black, and reddish brown; dark brown or green to black; and purplish brown	pink; gray; and mottled pink, buff; and purplish brown
Texture	very fine grained to microcrystalline	very fine grained to microcrystalline; and porphyritic
Luster	dull to earthy	dull
Hardness	hard to soft: Mohs range 6 to 2-1/2	hard to moderately hard: Mohs range 6 to 4-1/2
Porosity	non-porous to finely porous	non-porous to slightly porous
Particle Shape	angular to rounded	subangular to subrounded
Particle Surface	slightly to highly weathered, rough to smooth, dented or pitted to ridged	slightly to moderately weathered, rough to smooth, dented or pitted to ridged
Remarks	A number of particles are deeply weathered and easily broken. Andesitic and doleritic particles are included in this category due to similar weathering characteristics. Many particles are amygdaloidal to porphyritic.	

METAMORPHIC ROCKS

Rock Type	Quartzite	Metasediments
Color	white; and mottled white and reddish brown	mottled gray to green and buff to reddish brown
Texture	medium to very fine grained	very fine grained to micro-crystalline
Luster	dull to vitreous	dull
Hardness	hard: Mohs 7	hard to moderately hard: Mohs 7 to 4
Porosity	non-porous to slightly porous	non-porous to moderately porous
Particle Shape	subangular to rounded	subangular to rounded
Particle Surface	slightly to moderately weathered, rough, dented	slightly to moderately weathered, rough to moderately smooth, dented to pitted

SEDIMENTARY ROCKS

Rock Type	Conglomerate	Sandstone	Siltstone
Color	mottled reddish brown and buff or gray	buff to reddish brown	reddish brown
Texture	coarse to fine grained; pebbly	medium to fine grained	fine to very fine grained
Luster	dull	dull	dull to earthy
Hardness	hard: Mohs 7 to 6	hard to moderately hard: Mohs 7 to 5	moderately hard: Mohs 4 to 5
Porosity	non-porous to slightly porous	porous	finely porous
Particle Shape	subrounded to rounded	subrounded to rounded	subangular to rounded
Particle Surface	slightly weathered, rough, dented	moderately to highly weathered, rough, dented	slightly to moderately weathered, rough to moderately smooth
Remarks	Particles contain predominantly felsitic pebbles.		

Rock Type	Chert
Color	buff
Texture	very fine grained to micro-crystalline
Luster	dull to earthy
Hardness	hard to soft: Mohs 7 to 2-1/2
Porosity	finely porous
Particle Shape	subangular to subrounded
Particle Surface	moderately to highly weathered, rough, dented or pitted to ridged
Remarks	Some particles are deeply weathered and chalky.

TABLE 1
PETROGRAPHIC COMPOSITION
Testing Laboratory Sample No. 75 A-1121

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 and Syenite	19.0	25.0	20.5	14.5	19.7
Diorite	2.0	1.0	3.0	0.5	1.6
Gabbro	12.0	8.0	6.0	16.5	10.6
Basalt	25.5	26.5	38.0	33.0	30.8
Felsite	29.5	19.0	19.5	18.0	21.5
Quartzite	--	0.5	1.0	0.5	0.5
Metasediments	8.5	9.5	5.5	7.5	7.7
Conglomerate	0.5	2.0	1.5	2.0	1.5
Sandstone	1.5	4.0	3.5	2.5	2.9
Siltstone	1.5	3.0	1.0	3.5	2.3
Chert	--	1.5	0.5	1.5	0.9
Totals, percent	100.0	100.0	100.0	100.0	100.0

Note: Computed sample composition is based upon counts of 200 particles contained in each of the sieve fractions noted.

TABLE 2
SPECIFIC GRAVITY AND ABSORPTION DATA
Testing Laboratory Sample No. 75 A-1121

Rock Type	Specific Gravity			Absorption, percent	Composition, Percent by Weight
	Bulk, dry	Bulk, ssd	Apparent		
Granite and Syenite	2.58	2.60	2.65	1.05	20.3
Diorite	2.64	2.66	2.70	0.78	1.5
Gabbro	2.70	2.75	2.84	1.81	10.3
Basalt	2.70	2.74	2.82	1.50	28.4
Felsite	2.62	2.65	2.68	0.88	26.5
Quartzite	2.63	2.64	2.67	0.58	0.3
Metasediments	2.64	2.66	2.72	1.17	8.3
Conglomerate	2.38	2.46	2.59	3.50	0.8
Sandstone	2.32	2.40	2.52	3.28	1.8
Siltstone	2.38	2.46	2.56	2.89	1.5
Chert	1.88	2.05	2.26	9.09	0.3
Total Sample	2.63	2.66	2.72	1.32	100.0

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

TABLE 3
ABSORPTION DATA, WEATHERED PARTICLES
Testing Laboratory Sample No. 75 A-1121

Degree of Weathering	Absorption, percent	Fraction of Sample, percent
Moderately Weathered	2.04	10.8
Deeply Weathered	3.01	20.5