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INVESTIGATION OF A GREY GRANITE FROM NEAR DISRAELI, QUEBEC

by

F. E. HANES

MINERAL PROCESSING DIVISION

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SUMMARY OF RESULTS

The rock is composed of a uniform mixture of orthoclase, plagioclase, quartz, and mafic minerals. Because its finer texture is finer than those of grey granites found in the Eastern Townships, its polished surface appears slightly darker.

The rock has no deleterious material such as pyrites or soft, friable, and talc-like minerals; it is free of knots and streaks of dark- or light-coloured minerals. The rock showed no staining on its surfaces.

Results of physical tests had established the soundness and durability of this granite for use as a building or ornamental monumental stone.

The rock takes a good polish with occasional silvery, chatoyant, crystal surfaces and has a texture that makes it aesthetically acceptable, particularly for those desiring less whiteness in their grey granites.

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*Engineer, Construction Materials Section, Mineral Processing Division, Mines Branch, Department of Energy, Mines and Resources, Ottawa, Canada.

INTRODUCTION

Mr. Laureat Lachance, President of Eternit Granite Ltée, 520 Rue Champoux, Disraeli Co., Wolfe, Que., requested the assistance of the Mineral Processing Division in assessing the suitability of a grey granitic rock, quarried in the Disraeli area, for its use as a building and/or ornamental stone.

The Eternit Granite Ltée quarry is located in Stratford municipality near Elgin Lake, approximately 13 miles south of the town of Disraeli. Quebec Highway No. 1, which passes through Disraeli, is five miles distant from the quarry. Access to the principal cities of Quebec (Sherbrooke, Quebec, and Montreal) is by principal highways and rail whereas access to the markets of the United States is by truck transportation south through Sherbrooke which is about 80 miles from the border.

Eternit Granite Ltée supplied two 5-inch cubes and other necessary samples of rock for the preparation of test specimens to be used in this investigation.

SCOPE OF INVESTIGATION

The investigation consisted of a petrographic study and the following physical tests made on specimens prepared by Mines Branch and by the client.

(1) Bulk specific gravity and absorption
(2) Freeze-thaw cycling
    (a) Length change
    (b) Weight change
    (c) Compressive strength
(3) Modulus of rupture (wet and dry)

(4) Combined temperature cycles and weak salt solutions
(5) Impact load test - "Toughness"
(6) Abrasion to footwear.

TEST PROCEDURES

Sample Preparation

Specimens were accurately cut and finished to precise parallel faces.

Eighteen two-inch cubes were made for - testing in freeze-thaw cycling and for determining specific gravity and absorption values.

A set of samples consisting of three parallel cores was cut in each of three directions at right angles to each other. Each core, which was one inch in length and one inch in diameter, was tested for toughness.

Three 2 x 2 x 1-in. samples were prepared for abrasion to footwear tests, and six 4 x 4 x 2¼-in. samples were submitted by the company for flexure tests. Volume and length changes were determined from measurements made on two-in. cubes which were also tested for compression strength.

A Petrographic Study

A thin section and polished rock specimen were prepared for petrographic study to determine the mineral composition and quality of the granite.

B Physical Tests

Procedures used for physical tests conform with the following standard test methods:

(1) Standard Method of Test for Absorption and Bulk Specific Gravity of Natural Building Stone (ASTM Designation: C97-47).

(2) The Tentative Method of Test for Resistance of Concrete Specimens to Rapid Freezing in Air and Thawing in Water (ASTM Designation: C291-61T). This method is used to determine the resistance of stone to rapidly repeated cycles of freezing in air and thawing

in water. The method as used here is not intended to provide a quantitative measure of the length of service that may be expected from the stone, but is used to provide comparative values for compressive strength after periods of freeze-thaw cycling.

(a) Measurement in in. on 2-in. cubes
(b) Weight in grams on 2-in. cubes
(c) Standard Method of Test for Compressive Strength of Natural Building Stone (Designation: C170-50), a method of testing for compressive strengths in wet and dry conditions. Additionally, compressive strength values were determined for samples tested after various periods of freeze-thaw cycling.

(3) Standard Method of Test for Modulus of Rupture of Natural Building Stone (ASTM Designation: C99-52). This method covers the test for determining the modulus of rupture of all types of natural building stone except slate.

(4) Test for Effect of Combined Temperature Cycles and Weak Salt Solutions on Natural Building Stone (ASTM Designation: C218-48%)*.

(5) Standard Method of Test for Toughness of Rock (ASTM Designation: D3-52)*. The parameter of toughness is taken to be the resistance to fracture offered by a standard specimen by a standard hammer.

(6) Standard Method of Test for Abrasion Resistance of Stone Subjected to Foot Traffic (ASTM Designation: C-241-51). This test method is a procedure for determining a value of abrasion resistance which can be compared with values for other rocks.

*Not required by present standards.

RESULTS

A Petrographic Study

The rock is a hypidiomorphic quartz monzonite with grain sizes between 2 and 3 mm. Its composition is as follows:

Quartz	27	per cent
Perthite and Microcline	22	" "
Biotite	20	" "
Orthoclase and Oligoclase	18	" "
Plagioclase	6	" "
Muscovite	7	" "
	100	" "

B Physical Tests

The following results of physical tests made on samples prepared from rock submitted by the company have reference only to the material as submitted; it is presumed that the material submitted is representative of the rock quarried from the company's deposit.

(1) Bulk specific gravity 2.66
Absorption .... 0.20 per cent
(both values represent the average of three tests)

(2) Freeze-Thaw Cycling

Test cubes exposed to freeze-thaw cycling were measured for changes in dimension (length and volume) and compressive strength after specific numbers of cycles.

(a) Length measurements taken on two-inch cubes periodically throughout the freeze-thaw cycling tests are shown in Table 1. Variations in these readings indicate the effect of freezing and thawing action on the granite.

TABLE 1

Length Determinations
(average of 3 cubes, in inches)

No. of Samples	4	3	3	3	3
Cycles					
Dry	2.0218	2.0160	2.0165	2.0129	2.0127
32		2.0219	2.0226	2.0176	2.0174
64		2.0219	2.0225	2.0176	2.0174
116		2.0216	2.0223	2.0174	2.0171
150		2.0223	2.0225	2.0175	2.0173
165			2.0224	2.0175	2.0173
322			2.0223	2.0175	2.0174
450				2.0176	2.0173
600					2.0173

(b) Weights were measured at specific cycles during freeze-thaw cycling on the two-inch cubes subjected to compressive tests. Table 2 shows the variations in weight that occurred during the cycling.

TABLE 2

Weight Determinations

(average of 3 cubes, in grams)

No. of Samples	4	3	3	3	3
Cycles					
Dry	256.21	268.23	265.00	266.26	265.17
(Sat Surf Dry)		268.77	265.55	266.77	265.67
116		268.75	265.52	266.76	265.67
165			265.54	266.77	265.68
322			265.57	266.79	265.71
450				266.79	265.71

(c) Compressive Strength - Table 3 shows the values for two-inch cubes tested during the freeze-thaw cycling.

TABLE 3

Compressive Strength (psi)

Sample No.	1	2	3	Average
Cycles				
Dry	24.125	29.250	26.125	26.500
150	23.500	23.375	24.675	23.850
322	21.000	17.675	19.125	19.270
450	24.750	26.625	26.625	26.000
600	24.375	25.375	23.625	24.458

(3) Modulus of Rupture

Six samples of rock were broken to determine the modulus of rupture. Three of the samples were tested dry and the remaining three were tested wet after soaking in water for 48 hr. The values shown in Table 4 were obtained from substituting test data in the formula:

$$R = \frac{3Wl}{2bd^2}$$

where R = modulus of rupture
W = breaking load in pounds
l = length of span in inches
b = width of specimen in inches
d = thickness of specimen in inches

TABLE 4

Modulus of Rupture (psi)

Sample No.	1	2	3	Average
Dry	3028	2335	1825	2300
Wet	2418	2418	1806	2215

(4) Effect of Combined Temperature Cycles and Weak Salt Solutions

No increase in volume

No increase in absorption

(5) Impact Load Test - Toughness

Table 5 shows the number of blows required to fracture the one-inch long cores. Each direction of coring is represented by three samples.

TABLE 5

Results of Impact Load Test
(number of blows)

Sample Orientation	'x'	'y'	'z'
1	15	16	12
2	14	14	13
3	12	13	11
Average	13.6	14.3	12.0

(6) Abrasion Resistance of Stone Subjected to Foot Traffic

The results of resistance-to-abrasion tests for three different samples tested in three different positions on the testing equipment are shown in Table 6.

TABLE 6

Abrasion Resistance of Stone (Ha)*

Sample:	1	2	3
Position of sample in machine	(A) 60.3 (B) 69.0 (C) 70.7	(B) 72.4 (C) 68.9 (A) 54.6	(C) 68.9 (A) 56.8 (B) 64.3
INDIVIDUAL AVERAGE (Ha)	66.67	65.30	63.33
AVERAGE (Ha)		65.1	

*Empirical number calculated from Kessler's formula $(Ha) = 10G\,\frac{(2000 + Ws)}{2000\,Wa}$,

where Ws = average weight of sample before and after test
Wa = loss in weight
G = specific gravity

DISCUSSION

The grey granite from the Disraeli area is not very dissimilar in appearance to the grey granites of the Beebe-Graniteville and St. Sebastian - St. Gerard areas in the Eastern Townships of Quebec. These areas have been known for many years for fine granite-stone production. Comparison of bush-hammered and honed surfaces of these rocks show remarkable similarities. Polished surfaces, on the other hand, bring out character and provide aesthetic comparison for the individual.

The acceptance of a granite is dependent on its aesthetic appeal and/or on the quality and rating it exhibits under physical tests of its soundness and durability.

The Disraeli rock is finer-grained than the other grey granites referred to and, on polished surfaces, appears darker and exhibits less inter-crystalline contrast. No deleterious minerals such as pyrite and soft particles were observed not were there black knots and streaks of black or white concentrations of minerals. The polished surface does show slight plucking of the mica and/or mafic minerals, otherwise the rock takes a very good polish. Rare occurrences of a silvery, schiller effect on some minerals enhance the appearance and the aesthetic appeal of this rock.

CONCLUSIONS

This grey granite rock, identified as a quartz monzonite, is finer grained than most of the grey granites produced in the Eastern Townships. Because of this textural variation it is slightly darker on the polished surface and, aesthetically, it compares very favourably with granites from the other areas in the Eastern Townships. The rock possesses no deleterious minerals or markings to detract from its quality. It is sound and durable and will meet specifications for use as building, ornamental, or monumental stone.

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