Standard Test Method for
Flexural Strength of Dimension Stone[1]

This standard is issued under the fixed designation C 880; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the procedure for determining the flexural strength of stone by use of a simple beam using quarter-point loading.

1.2 Stone tests shall be made when pertinent for the situation when the load is perpendicular to the bedding plane and when the load is parallel to the bedding plane.

1.3 As required, the flexural tests shall also be conducted under wet conditions.

1.4 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*
E 4 Practices for Force Verification of Testing Machines
C 119 Terminology Relating to Dimension Stone

3. Terminology

3.1 *Definitions*—All definitions are in accordance with Terminology C 119.

4. Significance and Use

4.1 This test method is useful in indicating the differences in flexural strength between the various dimension stones. This test method also provides one element in comparing stones of the same type.

5. Apparatus

5.1 *Testing Machine* (Fig. 1), conforming to the requirements of the applicable sections of Practices E 4. The quarter-point loading method shall be used in making flexure tests of stone employing bearing blocks which will ensure that forces applied to the beam will be vertical only and applied without

eccentricity. The apparatus should be capable of maintaining the span length and distances between load-applying blocks and support blocks constant within ±1.3 mm (±0.05 in.). The load should be capable of being applied at a uniform rate and in such a manner as to avoid shock.

6. Sampling

6.1 Select the sample to represent a true average of the type or grade of stone under consideration and of the quality supplied to the market under the type designation to be tested. The sample may be selected by the purchaser or his authorized representative from the quarried stone or taken from the natural ledge and shall be of adequate size to permit the preparation of the desired number of test specimens. When perceptible variations occur, the purchaser may select as many samples as are necessary for determining the variations in flexural strength.
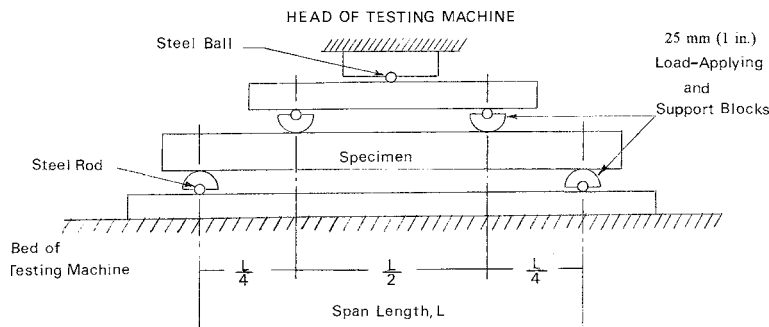
7. Test Specimen

7.1 The test specimens shall measure 102 mm (4 in.) wide by 32 mm (1.25 in.) thick by 381 mm (15 in.) long, with a span as tested of 318 mm (12.5 in.). The sides of the specimen shall be at right angles with the top and bottom. The specimens shall have a fine abrasive finish on the planes perpendicular to the load and a fine saw finish on the other four planes. The dimensions of the specimen shall be measured and recorded to the nearest 0.3 mm (0.01 in.). A minimum of five specimens shall be tested for each condition of test. The average value of the test results is reported as the flexural strength of the stone.

7.2 Where this test method is specified in the physical requirements of an ASTM C-18 Standard Specification for a dimension stone, the test specimens shall meet the requirements under 7.1.

7.3 Where the job thickness has been set (for example, the thickness of the stone panels for the project has been established), it is often requested to perform flexure tests at the job thickness. The following shall govern the specimen size where it is requested to test at the job thickness and the job thickness is other than 32 mm (1.25 in.). The span as tested shall be 10 times the thickness. The specimen lengths shall be not less than 51 mm (2 in.) and not more than 102 mm (4 in.) greater than the span as tested. Where the thickness is less than 68 mm (2.67 in.), the width of the specimen shall be 102 mm (4 in.). Where the thickness is greater than 68 mm (2.67 in.) the width shall be 1.5 times the thickness. Where the thickness is other

---

HEAD OF TESTING MACHINE

Steel Ball

25 mm (1 in.)
Load–Applying
and
Support Blocks

Steel Rod

Specimen

Bed of
Testing Machine

$\frac{1}{4}$ $\frac{1}{2}$ $\frac{1}{4}$

Span Length, L

NOTE—Apparatus may be used inverted.

FIG. 1 Diagrammatic View of a Suitable Apparatus for Flexure Test of Stone

than 32 mm (1.25 in.) and the specimen size is in accordance with the job thickness criteria noted in the foregoing, the average value of the test results shall be reported as the flexural strength of the stone at the job thickness. All other requirements shall be in accordance with 7.1.

7.4 Where the job surface finish has been set (for example, the architectural finish on the panels for the project has been established), it is often requested to perform flexure tests on specimens with the finish the same as on the job. The following shall govern when it is requested to test at the job surface finish. The specimens shall have a finish on one plane perpendicular to the load in accordance with the finish specified for the job. Unless there is data to the contrary, the positioning of the specimen should be with the finished face in flexural tension. The average value of the test results shall be reported as the flexural strength of the stone at the job surface finish. All other requirements shall be in accordance with 7.1 and 7.3.

7.5 Where the specimens conform to the requirements of 7.3 and 7.4, the average value of the test results shall be reported as the flexural strength of the stone at the job thickness and surface finish.

7.6 Test results obtained by this test method are those of flexural strength properties. In specific applications, test specimens of different geometry may give useful results in terms of a modulus of rupture value.

8. Conditioning

8.1 Before testing the specimens in a dry condition, dry them for 48 h at 60 ± 2°C (140°F ± 4°F). At the 46th, 47th and 48th hour, weigh the specimens to ensure that the weight is the same. If the weight continues to drop, continue to dry the specimens until there are three successive hourly readings with the same weight. After removing the specimens from the oven, cool them to room temperature in a desiccator before testing them.

8.2 Before testing the specimens in a wet condition, immerse them in water for 48 h at 22 ± 2°C (72 ± 4°F). Test them immediately upon removal from the bath, wiping the specimens free of surface water.

9. Procedure

9.1 Assemble the apparatus and place the specimen on the span supports and adjust the quarter point loading blocks into contact with the specimen.

9.2 Apply the load at a uniform stress rate of 4.14 MPa (600 psi/min.) to failure.

10. Calculation

10.1 Calculate the flexural strength, σ as follows:

$$\sigma = \frac{3WL}{4bd^2} \tag{1}$$

where:
σ = flexural strength, MPa (psi),
W = maximum load, N (lbf),
L = span, mm (in.);
L = 10d,
b = width of specimen, mm (in.); $b \geq 1.5d$, and
d = depth of specimen, mm (in.).

11. Report

11.1 The report shall include the following:
11.1.1 Stone type.
11.1.2 Sizes of the specimens used.
11.1.3 Preconditioning procedure used.
11.1.4 Individual test results for each specimen.
11.1.5 Average value of the test results for each group using the following relation:

$$\overline{\sigma} = \frac{\text{sum of observed values}}{\text{number of tests}}$$

11.1.6 Standard deviation, s, of the test results for each group using the following relation:

$$s = \sqrt{\frac{\text{sum of (observed value} - \overline{\sigma})^2}{\text{number of tests} - 1}}$$

11.1.7 Any variations from the above procedural techniques.

11.2 The following additional information shall also be reported: identification of the sample, including name and location of the quarry, name and position of the ledge, date when sample was taken, and trade name or grade of the slate.

2

12. Precision and Bias

12.1 Individual variations in a natural product may result in deviation from accepted values. A precision section will be added when sufficient data are available to indicate acceptable tolerances in repeatability and reproducibility.

13. Keywords

13.1 dimension stone; flexural strength; flexure; stone; test