Tex-448-A, Flexural Strength of Concrete Using Simple Beam Third-Point Loading

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Section 1

Overview

Effective Date: June 2000–June 2008.

This test method covers the determination of flexural strength of concrete by the use of a simple beam with third-point loading employing bearing blocks to ensure that forces applied to the beam will be perpendicular to the face of the specimen and applied without eccentricity. Except for editorial differences, this procedure is identical to ASTM C 78.

Units of Measurement

The values given in parentheses (if provided) are not standard and may not be exact mathematical conversions. Use each system of units separately. Combining values from the two systems may result in nonconformance with the standard.
Section 2

Apparatus

The following apparatus is required:

♦ Testing machine, which conforms to the requirements of ASTM E 4 sections in 'Basis of Verification, Corrections and Time Interval Between Verifications of Practices.'

NOTE: Do not use hand-operated testing machines with pumps that do not provide a continuous loading in one stroke. Motorized pumps or hand-operate positive displacement pumps should have sufficient volume, in one continuous stroke, to complete a test without replenishment, and be able to apply loads at a uniform rate without shock or interruption.

♦ Leaf type feeler gauges
  • 0.10 mm (0.004 in.)
  • 0.4 mm (0.015 in.)

♦ Carpenter square (1 ft.) with minimum divisions of 1/16 in., 0.05 in., or 1 mm

♦ Straight edge ruler

♦ Leather shims, 4 ea. 1/4 in. thick, 1 to 2 in. wide, 6-1/4 in. long.

All apparatus for making flexure tests of concrete should be able to maintain the specified span length and distances between load-applying blocks and support blocks constant within ± 1 mm (± 0.05 in.).
Section 3

Test Specimen

Described below are the requirements for test specimens:

The test specimen must conform to all applicable requirements of Test Method "Tex-447-A, Making and Curing Concrete Test Specimens." The specimen should have a test span within 2% of being three times its depth as tested, with sides of the specimen at right angles with the top and bottom. All surfaces in contact with load applying and support blocks must be smooth and free of indentations, scars, holes, or inscribed identifications.
Section 4

Procedure

The following table describes the steps used in performing the flexural strength test:

**CAUTION:** Between the times the specimen is removed from curing until testing is completed, drying of the surfaces shall be prevented. Relatively small amounts of drying of the surface of flexural strength specimens will induce tensile stresses in the extreme fibers that will markedly reduce the indicated flexural strength.

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Turn test specimen on its side with respect to its position as molded and center on the support blocks (upper blocks on the portable hydraulic beam tester).</td>
</tr>
<tr>
<td>2</td>
<td>Center the loading system in relation to the applied force (for compression machine only).</td>
</tr>
</tbody>
</table>
| 3 | ♦ Bring load applying blocks and the support blocks in contact with the surface of the specimen and apply a load between 3 to 6% of the estimated ultimate load.  
   ♦ Using the 0.10 mm (0.004 in.) and 0.4 mm (0.015 in.) leaf type feeler gauges, determine whether any gap between the specimen and the upper bearing blocks and lower loading blocks is less than the 0.10 mm (0.004 in.) gauge or more than the 0.4 mm (0.015 in.) gauge over a length of 25 mm (1 in.) or more.  
   • If the gap is more than 0.10 mm (0.004 in.) but less than 0.4 mm (0.015 in.), you may use the leather shims.  
   • If the gap is more than 0.4 mm (0.015 in.), you must grind or cap the ends until the gap is less than 0.4 mm (0.015 in.).  
   • If the gap is less than 0.10 mm (0.004 in.), the specimen shall be tested without shims. |
| 4 | Load the specimen continuously and without shock. The load shall be applied at a constant rate to the breaking point. Apply the load constantly at a rate of 860 to 1210 kPa/min (125 to 175 psi/min) until rupture occurs.  
   **NOTE:** When using a standard field flexural testing machine, the B spiral shall be used for 1993 specification projects (English values) and the IP spiral for the 1995 specification projects (Metric values).  
   **NOTE:** Reactions should be parallel to the direction of the applied forces at all times during the test and the ratio of distance between the point of load application and nearest reaction to the depth of the beam should not be less than one. |

**NOTE:** If an apparatus similar to that illustrated in 'Testing Machine' is used:

♦ The load applying and support blocks should not be more than 64 mm (2.5 in.) high, measured from the center or axis of pivot, and should extend entirely across or beyond the full-width of the specimen.

♦ Each case-hardened bearing surface in contact with the specimen shall not depart from a plane by more than 0.05 mm (0.002 in.) and should be a portion of a cylinder, the axis of which is coincidental with either the axis of the rod or center of the ball, whichever the block is pivoted upon.

♦ The angle subtended by the curved surface of each block should be at least 0.79 rad (45E).
The load applying and support blocks should be held in a vertical position, and in contact with the rod or ball by means of spring-loaded screws which hold them in contact with the pivot rod or ball.

Omit the uppermost bearing plate and center point ball in 'Testing Machine' when a spherically seated bearing block is used, provided one rod and one ball are used as pivots for the upper load-applying blocks.

Figure 1. Testing Machine.
Section 5

Measuring Specimens after Test

Measure specimens after the test as follows:

Take three measurements across each dimension (one at each edge and at the center) of the specimen at the section of failure, to the nearest 1 mm (0.05 in.) to determine the average width, average depth, and line of fracture location.
Section 6
Calculations

When using a field flexural test machine, calculate the Modulus of Rupture (MOR) as follows for a 1993 specification project:

♦ Record max load from "B" spiral
♦ Locate the correction factor from the 'Hydraulic Beam Breaker Factors for Calculating Modulus of Rupture (MOR)' table, if specimen is other than 6 in. x 6 in. measurement
♦ Multiply max reading by the factor from the 'Hydraulic Beam Breaker Factors for Calculating Modulus of Rupture (MOR)' table and record MOR to the nearest 5 psi.

When using a field flexural test machine, calculate Modulus of Rupture as follows for a 1995 specification project:

♦ Record max reading from the IP spiral
♦ Multiply max reading ($P$) by the nominal span length ($l$) and divide by the product of the multiplication of the depth squared by the width (see calculation below).

Use the following calculations to determine the modulus of rupture when using a compression machine, if the fracture begins in the tension surface within the middle third of the span length:

$$ R = \frac{Pl}{bd^2} $$

Where:
♦ $R =$ modulus of rupture, kPa, (psi)
♦ $P =$ maximum applied load indicated by the testing machine N (lbf)
♦ $l =$ span length, mm (in.)
♦ $b =$ average width of specimen, mm (in.)
♦ $d =$ average depth of specimen, mm (in.).

**NOTE:** If fracture occurs at a capped section, include the cap thickness in the measurement.

**NOTE:** The weight of the beam is not included in the above calculation.

If the fracture occurs in the tension surface outside of the middle third of the span length by not more than 5% of the span length, calculate the modulus of rupture as follows:

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

Where:
♦ $a =$ average distance between the line of fracture and the nearest support measured on the tension surface of the beam, mm, or (in.).
If the fracture occurs in the tension surface outside of the middle third of the span length by more than 5% of the span length, discard the results of the test.

**Hydraulic Beam Breaker Factors for Calculating Modulus of Rupture (MOR)**

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<th>5 3/4</th>
<th>5 13/16</th>
<th>5 7/8</th>
<th>5 15/16</th>
<th>6</th>
<th>6 1/16</th>
<th>6 1/8</th>
<th>6 3/16</th>
<th>6 1/4</th>
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</table>

Factors calculated from:

\[
F = \frac{27}{bd^2} \times 8
\]
Section 7

Report

Include the following in the report:

- Identification number
- Average width to the nearest 1 mm (0.05 in.)
- Average depth to the nearest 1 mm (0.05 in.)
- Span length in millimeters (inches)
- Maximum applied load in Newtons (pounds-force)
- Modulus of rupture calculated to the nearest 50 kPa (5 psi)
- Curing history and apparent moisture condition of the specimens at the time of test
- If specimens were capped, ground, or if leather shims were used
- Defects in specimens
- Age of specimens.
Section 8

Archived Versions

Archived versions of Test Method "Tex-448-A, Flexural Strength of Concrete Using Simple Beam Third-Point Loading" are available through the following links:

♦ Click on 448-0899 for the test procedure effective August 1999 through May 2000.