5.9.23 FLEXURAL STRENGTH OF CONCRETE (THIRD-POINT LOADING METHOD)
(Kansas Test Method KT-23)

1. SCOPE

This method of test covers the procedure for determining the flexural strength of concrete by test of a sample beam with third-point loading. KT-23 reflects testing procedures found in AASHTO T 97.

2. REFERENCED DOCUMENTS

2.1. KT-22; Making and Curing Compression and Flexural Test Specimens in the Field
2.2. AASHTO T 23; Making and Curing Concrete Test Specimens in the Field
2.3. AASHTO T 97; Flexural Strength of Concrete (Using Simple Beam with Third Point Loading)

3. APPARATUS

3.1. A testing machine which will apply a measured load to the beam at the third points of the span. The machine will have a span length of 18 in (460 mm). Suitable machines are made available to the Field Engineer by the District Materials Engineer.

3.2. Caliper and a 12 in (300 mm) steel rule graduated in 0.01 in (0.1 mm).

3.3. Leather shims, 1/4 by 1 1/2 by 6+ in (6.4 by 38 by 160 mm). The shim must be slightly longer than the 6 in (160 mm) width of the test specimen.

3.4. Feeler gauges.

4. TEST SPECIMEN

4.1. A nominal 6 by 6 by 21 in 1 (152.4 by 152.4 by 530 mm) concrete beam, molded and cured according to KT-22 of this manual. The beam must be kept moist until time of test.

5. TEST PROCEDURE

5.1. Age of testing:

5.1.1. Beams tested to determine the safe date for removal of forms from structures shall be tested at ages mutually agreed upon by the Engineer and the Contractor. Other times for testing are contained in the standard specifications.

5.2. Install specimen:

5.2.1. Place the specimen on its side, centered in the machine in such a manner that a minimum of 1 in (25 mm) of the beam extends outside the support rollers. Apply a load of between 3 and 6% of the expected ultimate load. If full contact is obtained between the specimen and the load-applying blocks and the supports so that there is no gap longer than 1 in (25 mm) or the gap is less than 0.004 in (0.1 mm) deep, test the specimen without further preparation. If full contact is not obtained between the specimen

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1 The length dimension is 1 in (25.4 mm) longer than AASHTO T 23.
and the load-applying blocks and the supports so that there is a 1 in (25 mm) or longer gap in excess of 0.004 in (0.1 mm) and not more than 0.015 in (0.38 mm) deep, grind or cap the contact surfaces of the specimen, or shim with leather strips.

5.2.1.1 If full contact is not obtained between the specimen and the load-applying blocks and the supports so that there is a 1 in (25 mm) or longer gap in excess 0.015 in (0.38 mm), grind the contact surfaces of the specimen until it complies with the requirements stated in Section 5.2.1 above.

5.2.1.2. If the specimen is twisted or warped 1/8 inch (3.2 mm) or more in any plane, discard the specimen and repair or replace the mold.

5.3. Application of load:

5.3.1. The load may be applied rapidly until approximately 50% of the breaking load has been reached. Beyond that point, reduce the rate of loading so that the rate of increase in extreme fiber stress remains within 125 to 175 psi (861 to 1207 kPa) per minute until the specimen breaks, (1500 to 2100 lbf per minute).

5.3.1.1. Chart No. 01085, Figure 1 is the correct chart to use on the Rainhart Beam Breaker. This chart loads at a rate of 1746 lbf/min (1016 kpa/min).

Note and record the total load required to break the beam.

5.4. Measurement:

5.4.1. Take and record three measurements at the fracture across each dimension (one at each edge and at the center) to the nearest 0.05 in (1.3 mm) to determine the average width, average depth and line of fracture location of the specimen at the section of failure.

5.4.2. If the fracture occurs at a capped section, include the cap thickness in the measurement.
Figure 1 Chart No. 01085

CONCRETE BEAM FLEXURAL STRENGTH TEST - A.S.T.M. PROCEDURE C78

CONTRACTOR: ______________________  PROJECT: ______________________
BEAM NO. ______________________  MADE: ______________________  TESTED: ______________________  AGE: ______________________
LOAD: _______ LBS.  WIDTH: _______ IN.  DEPTH: _______ IN.  FACTOR: ______________________
FLEXURAL STRENGTH: _______ PSI.  SPECIFICATION: _______ PSI.
REMARKS: ______________________

TESTING AGENCY: ______________________
TESTED BY: ______________________
CHECKED BY: ______________________

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6. CALCULATIONS

6.1. If the fracture initiates in the tension surface within the middle third of the span length, calculate the modulus of rupture to the nearest 5 psi as follows:

\[(\text{ENGLISH})\]
\[
R = \frac{(P)(L)}{bd^2}
\]

\[(\text{SI})\]
\[
R = \frac{1000(P)(L)}{bd^2}
\]

Where:
- \(R\) = Modulus of rupture in psi (kPa)
- \(P\) = Maximum applied load in lbf (newtons) (N)
- \(L\) = Span length in (mm)
- \(b\) = Avg. Width of specimen in (mm) (as tested)
- \(d\) = Avg. Depth of specimen in (mm) (as tested)

Sample Calculations (English):

Depth of beam = 5.70 in  
Width of beam = 6.12 in  
Load at break = 4800 lbf

\[
R = \frac{4800 (18)}{6.12 (5.70)(5.70)} = 435 \text{ psi}
\]

Sample Calculations (SI):

Depth of beam = 145 mm  
Width of beam = 155 mm  
Span length = 460 mm  
Load at break = 21400 N

\[
R = \frac{1000 (21400)(460)}{155 (145)(145)} = 3020 \text{ kPa}
\]
6.2 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:

(ENGLISH)

\[ R = \frac{3(P)(a)}{bd^2} \]

(SI)

\[ R = \frac{3000(P)(a)}{bd^2} \]

Where: \( a = \) average distance between line of fracture and the nearest support measured on the tension surface of the beam, in (mm).

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.