

JSCE-SF5 METHOD OF TESTS FOR COMPRESSIVE STRENGTH AND COMPRESSIVE  
TOUGHNESS OF STEEL FIBER REINFORCED CONCRETE

1. SCOPE

This standard specifies the methods of tests for compressive strength and compressive toughness of steel fiber reinforced concrete.

2. TESTING MACHINE AND APPARATUS

2.1 Testing Machine

The testing machine shall be as specified in JIS B 7733 (Compression Testing Machines) and as a standard shall be a hydraulic type having maximum capacity not more than 200 tonf.

2.2 Bearing Block

The pressing surfaces of the upper and lower bearing blocks shall be polished with planeness within 0.02 mm, and shore hardness shall not be less than Hs 70.

2.3 Deformation Measurement Apparatus

The specimen deformation measurement apparatus<sup>1)</sup> is a device for measuring deformation in the direction of loading when the specimen is loaded. It shall consist of not less than two dial gauges or electrical linear variable differential transformers (LVDT) of accuracy not less than 1/1,000 mm<sup>2)</sup> and jigs for holding, and shall be capable of measuring deformation of a specimen to the specified accuracy<sup>3)</sup>.

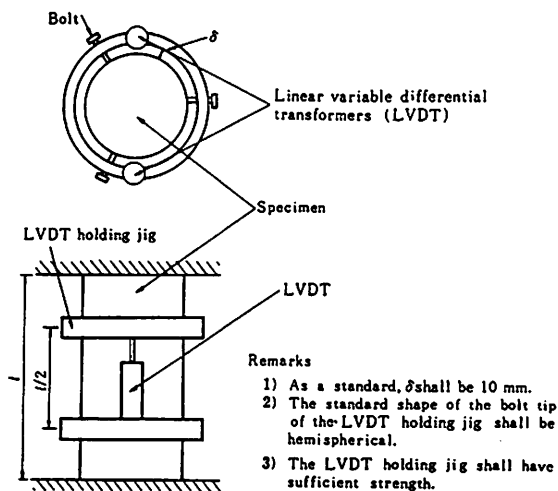


Fig. 1 Example of deformation measurement apparatus.

The deformation measurement apparatus shall directly measure the deformation at the middle of the specimen (a section equal to 1/2 the height of the specimen), and shall not be substituted with an apparatus measuring deformation between the bearing blocks.

Note 1) Fig. 1 gives an example of a deformation measurement apparatus.

Note 2) The accuracy not less than  $1 \times 10^{-5}$  in terms of strain is required.

Note 3) The specified extent of deformation shall be a quantity satisfying section 5 "Calculation", and 0.75% converted to strain. It will be desirable for continuous measurement of load and deformation as much as possible.

### 3. SPECIMENS

3.1 Specimens shall be made in accordance with the Japan Society of Civil Engineers standard, JSCE-SF2 (Method of Making Specimens for Strength and Toughness Tests of Steel Fiber Reinforced Concrete), or JSCE-SF3 (Method of Making Specimens for Strength and Toughness Tests of Shotcreted Steel Fiber Reinforced Concrete).

3.2 Specimens shall be tested immediately after completion of the prescribed curing.

### 4. METHOD OF TESTING

4.1 Prior to loading tests, the diameters in two perpendiculary-crossing directions at mid-height of specimen shall be measured to the nearest 0.2 mm, and the average value shall be taken as the diameter of the specimen.

4.2 The compression testing machine<sup>4)</sup> shall be used in a range from 1/5 to full capacity. When it is possible to change capacity with the same testing machine, the range shall be considered for each capacity separately.

Note 4) Care shall be taken since there are cases when results obtained will differ depending on the rigidity of the testing machine.

4.3 The specimen with the deformation measurement apparatus attached at the specified location<sup>5)</sup> shall be set in a manner that its central axis will coincide with the centers of the bearing blocks. The bearing blocks of the testing machine and the end faces of the specimen shall be in direct contact and any cushioning materials shall not be inserted between them.

Note 5) There will be no necessity to attach the deformation measurement apparatus to the specimen in case only compressive strength is required.

4.4 Load shall be applied to the specimen continuously without impact. The rate of loading shall be such that the increase in compressive stress will be 2 to 3 kgf/cm<sup>2</sup> (0.2 to 0.3 N/mm<sup>2</sup>) per second. In case of measuring deformation beyond maximum load, adjustment of the rate of loading shall be discontinued and load shall continue to be applied without any adjustment after the maximum load<sup>6)</sup>.

Note 6) When the testing machine can automatically control the displacement rate, loading shall be performed in a manner to maintain the displacement rate constant.

4.5 The maximum load indicated by the testing machine until failure of the specimen shall be read to three significant digits.

4.6 Loading of the specimen shall be continued until the specified deformation<sup>7)</sup> has been attained<sup>8)</sup>.

Note 7) The specified deformation is used in calculation of the compressive toughness and equivalent compressive strength (section 5.2)

Note 8) When the specimen should fail before the specified deformation is reached, loading shall be discontinued.

4.7 The compressive strength, compressive toughness and equivalent compressive strength shall be indicated by the average of not less than three specimens.

## 5. CALCULATION

### 5.1 Compressive Strength

Compressive strength shall be calculated by the equation below and be determined to three significant digits.

$$\sigma_c = 4 P / (\pi d^2)$$

where,  $\sigma_c$ : compressive strength (kgf/cm<sup>2</sup>) [N/mm<sup>2</sup>]

P : maximum load obtained in accordance with section 4.5 (kgf) [N]

d : diameter of specimen obtained in accordance with section 4.1 (cm) [mm]

### 5.2 Compressive Toughness

- (1) Compressive toughness shall be expressed compressive toughness factor.
- (2) As shown in Fig. 2, compressive toughness shall be determined to three significant digits from the area below the load-deformation curve. The maximum deformation is selected, so that the strain is 0.75%<sup>9)</sup>.
- (3) Compressive toughness factor shall be calculated by the equation below and shall be determined to three significant digits.

$$\overline{\sigma_c} = 4 T_c / (\pi d^2 \cdot \delta_{tc})$$

where,  $\bar{\sigma}_c$  : compressive toughness factor (kgf/cm<sup>2</sup>) [N/mm<sup>2</sup>]  
 $T_c$  : compressive toughness (kgf.cm) [J]  
 $\delta_{tc}$  : deformation corresponding to 0.75% converted to strain<sup>10)</sup>  
 (cm) [mm]  
 0.75 mm when specimen dimensions are  $\phi 10 \times 20$  cm  
 1.125 mm when specimen dimensions are  $\phi 15 \times 30$  cm

Note 9) When the specimen fails before reaching the specified deformation the area immediately before failure shall be considered as  $T_c$ .

Note 10) Even when the specimen fails before reaching  $\delta_{tc}$ , the deformation shall be 0.75% converted to strain.

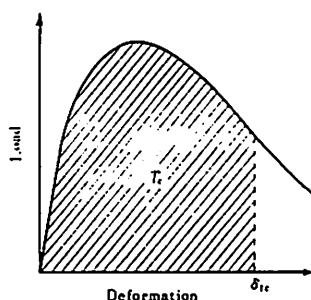


Fig. 2 Compressive toughness.

## 6. REPORT

The report shall include necessary items from the following:

- 1) Mix proportions of concrete,
- 2) Age,
- 3) Number of specimens,
- 4) Diameter of specimen,
- 5) Maximum load,
- 6) Compressive strength,
- 7) Compressive toughness factor,
- 8) Curing method and curing temperature,
- 9) State of failure of specimen,
- 10) Others.