

10. TEST METHOD FOR FLEXURAL TENSILE STRENGTH OF CONTINUOUS FIBER SHEETS (DRAFT)

1. Scope

This test method specifies the flexural tensile strength of continuous fiber sheets used to upgrade concrete members.

2. Normative Reference

The following standards, by being referenced herein, form a portion of these specifications. The most recent version of each standard should be used.

JSCE-E 541 Test method for tensile properties of continuous fiber sheets

JIS Z 8401 Guide to the significant digits

3. Definitions

a) Test portion

The section of the test specimen on which the test is conducted, between the anchorage portion and the fastening portion

b) Anchorage portion

The section on the end of the test specimen to which the anchorage is attached in order to transmit the load from the testing machine to the test portion

c) Fastening portion

The section on the end of the test specimen to which the pin anchorage is attached in order to transmit the load from the testing machine to the test portion

d) Anchorage

A device attached to the anchorage portion on the test specimen in order to transmit the load from the testing machine to the test portion

e) Pin anchorage

A device, provided with an aperture to accommodate a fastening pin, that is attached to the fastening portion on the test specimen in order to transmit the load from the testing machine to the test portion

f) Maximum flexural capacity

The maximum tensile load applied to the test portion during the flexural tensile strength test

g) Loading rate

The rate at which the knobs move during the test

4. Test specimens

4.1 Preparation

The tensile strength test specimen, with a bent portion at the prescribed curvature, is made by impregnating continuous fiber sheets with impregnation resin and is prepared using the following procedure.

- a) Prepare continuous fiber sheets coated and impregnated with impregnation resin in accordance with the preparation for the Type A or Type B test specimens specified in Section 4.2 of JSCE-E 541 [Section 4.2.1 a)-b) in JSCE-E 541 for Type A test specimens; Section 4.2.2 a)-e) in JSCE-E 541 for Type B test specimens].
- b) Cut the semi-hardened test specimen to a width of 12.5 mm (for Type A test specimens) or in fiber bundles measuring 10-15 mm (for Type B test specimens). The cut test specimens shall be cured and hardened for not less than seven days on a plate with corners at the prescribed curvature at room temperature ($23 \pm 2^\circ\text{C}$). The standard corner angle shall be 90° .

4.2 Anchorage portion

As a rule, the anchorage portion of the test specimen shall conform to Section 4.2 in JSCE-E 541 and shall be capable of accommodating a suitable anchorage.

4.3 Fastening portion

The fastening portion of the test specimen shall be provided with an aperture to accommodate a fastening pin inserted after a steel anchorage measuring no less than 1-2 mm (depth) x 50 mm (width) x 100 mm (length) has been fastened so that the continuous fiber sheet is in the center. If the flexural tensile strength is high and the

anchorage comes apart from the fastening portion, a steel pipe shall be used for the anchorage and the end of the test specimen fastened using expansive concrete.

4.4 Number of test specimens

A number of test specimens suitable for the test objective shall be determined. However, there shall be no fewer than five.

5. Testing Machine

The testing machine used for the flexural tensile strength test shall be one that has a load capacity greater than the maximum tensile capacity of the test specimen and is capable of applying loads at the prescribed loading rate. As shown in Figure 1, its configuration shall enable tensile force to be applied by pressing with a bending device at the prescribed curvature on the test specimen bent to a 90° angle.

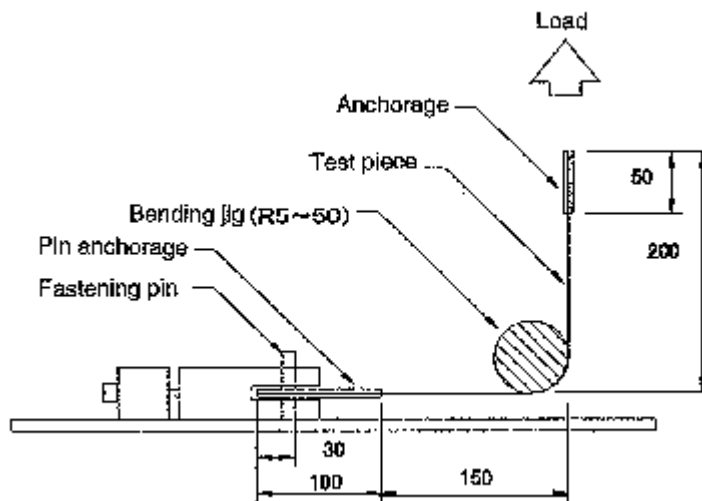


Figure 1 Outline of test method (unit: mm)

6. Test Method

6.1 Dimensions of test specimens

The width of the straight portion of the test specimen shall be measured to within approximately 0.1 mm at two locations on the anchoring side and two locations on the fastening side.

6.2 Attaching test specimens

The test specimen shall be attached by fastening the pin anchorage in the fastening portion to a special device and applying a bending device with the same curvature as the bending portion of the test specimen to the bending portion of the test specimen, and then fastening the anchorage of the anchorage portion to the device of the tensile testing machine. The test specimen shall be fastened so that the longer axis of the test specimen coincides with the loading axis, and that the bending portion of the test specimen and the bending portion of the device overlap. However, from past results it is known that the bending portion of the test specimen moves a minute distance toward the anchorage portion before failure, due to expansion of the test specimen itself, loosening of the device, etc. Therefore, the test specimen should be positioned on the fastening portion side so that the bending portion of the test specimen comes in contact with the device during failure.

6.3 Test temperature

The test temperature shall be $20 \pm 5^{\circ}\text{C}$. However, if the test specimen is not sensitive to changes in temperature, the test may be conducted at a temperature of $5-35^{\circ}\text{C}$. When the specimen is to be used under special work conditions or in special environments, these shall be taken into consideration when determining the test temperature.

6.4 Loading rate

The loading rate shall be adjusted so that the strain rate in the test portion is approximately 1.0-2.0% per minute.

6.5 Scope of test

The loading test shall be performed until the test portion fractures and measurements shall be made and recorded continuously or at regular intervals until the maximum capacity.

7. Calculation and Expression of Test Results

7.1 Handling of data

The test data shall be assessed on the basis only of test specimens undergoing failure in the test portion. In cases where failure or slippage has clearly taken place at the anchorage portion, the data shall be disregarded and additional specimens from the same lot shall be tested until the number of test specimens experiencing failure in the test portion exceeds the prescribed number.

7.2 Flexural tensile strength

The flexural tensile strength shall be calculated using Eq. (1) and rounded off to three significant digits in accordance with JIS Z 8401.

$$f_{fur} = \frac{F_u}{A} \dots\dots\dots(1)$$

where

- f_{fur} : Flexural tensile strength (N/mm²)
- F_u : Maximum flexural tensile capacity (N)
- A : Cross-sectional area of test specimen (mm²) (calculated with the method specified in Section 7.3 of JSCE-E 541)

8. Report

The report shall include the following items.

- a) Type of continuous fiber sheet
- b) Type of impregnation resin
- c) Radius of curvature of bending portion

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- d) Fabrication method for test specimen (dimensions of each test specimen, dimensions of bonded portion, hardening conditions, etc.)
- e) Number of test specimens
- f) Loading rate or rate of crosshead movement during test
- g) Flexural tensile strength for each test specimen and average of these values
- h) Failure status
- i) Other special notes