TEST METHOD FOR FLEXURAL TENSILE PROPERTIES OF CONTINUOUS FIBER REINFORCING MATERIALS (JSCE-E 532-1995)

1. SCOPE

This specifications specifies mainly the test method for flexural tensile properties of bent CFRM used in place of steel reinforcement or prestressing tendon in concrete.

2. DEFINITIONS

The following terms are defined for general use in this Specifications, in addition to the terms used in the "Recommendation for Design and Construction for Concrete Structures using Continuous Fiber Reinforcing Materials", the "Quality Specifications for Continuous Fiber Reinforcing Materials" and the "Test Method for Tensile Properties of Continuous Fiber Reinforcing Materials":

(1) Deflected section: Section of a CFRM which is bent and maintained at the required bending angle and bending diameter ratio

(2) Deflector: Device used to maintain the position, alter the bending angle, or alleviate the stress concentrations in the CFRM; sometimes installed in the deflected section

(3) Bending angle: Angle formed by the straight sections of a test piece on either side of the deflector

(4) Bending diameter ratio: Ratio of the external diameter of the deflector surface in contact with the CFRM, and the nominal diameter of the CFRM

(5) Bending tensile capacity: Tensile load at the moment of failure of the test piece

3. TEST PIECES

3.1 Preparation and handling of test pieces

Test pieces shall be prepared and handled in accordance with the "Test Method for Tensile Properties of Continuous Fiber Reinforcing Materials".

3.2 Length of test pieces

The length of the test piece shall be the length of the test section added to the length of the anchoring section. The length of the test section shall not be less than 100mm from the anchorages to the deflected section, and not less than 40 times the nominal diameter of the CFRM. For CFRM in strand form, as an additional condition, the length shall be not less than 2 times the strand pitch.

3.3 Number of test pieces

The number of test pieces shall not be less than three for each test condition (combination of bending diameters and bending angles). If the test piece is found clearly to have failed at the anchoring section, or to have slipped out of the anchoring section, an additional test shall be performed on a separate test piece taken from the same lot.

4. TESTING MACHINE AND DEVICES

4.1 Testing machine

The testing machine must include a loading device, load indicator, anchorages holder and deflector. The testing machine must also have a structure capable of continuing the test up to the tensile failure.

4.2 Loading device

The loading device shall have a loading capacity in excess of the tensile capacity of the test piece, and shall be capable of applying loading at the required loading rate.

4.3 Load indicator

The load indicator must be capable of displaying loads with an accuracy of not less than 1% of the failure load, up to failure of the test piece.

4.4 Anchorage holder

The anchorage holder must be suited to the geometry of the test piece, and must be capable of accurately transmitting loads from the testing machine to the test piece. It must be structured so as to transmit axial loads only to the test piece, without transmitting either torsion or flexural force.

4.5 Deflector

The deflector must be capable of maintaining the required bending angle and bending diameter during the test until failure of the test piece. The surface of the deflector in contact with the test piece must be robust and smooth.

5. TEST TEMPERATURE

The specifications test temperature shall generally be within the range 5~35°C. The test temperature for test pieces sensitive to temperature variations shall be 20±2°C.

6. TEST METHOD

6.1 Test preparation

The bending diameter and bending angle shall be set appropriately for the test. This combination then forms a single test condition. As a specifications configuration, only one deflected section shall be set up in the test piece.

6.2 Mounting of test piece

Care shall be taken when mounting the test piece on the testing machine to maintain the required bending angle and bending diameter at the deflected section during the test.

6.3 Loading rate

The specifications rate of loading the test piece shall be between 100~500 N/mm^2 per minute.

6.4 Scope of test

Loading shall be applied until failure of the test piece. Load and failure location shall be measured and recorded at the time of failure.

7. CALCULATION AND EXPRESSION OF TEST RESULTS

7.1 Handling of data

The material properties of CFRM shall be assessed on the basis only of test pieces undergoing failure in the test section. In cases where tensile failure or slippage has clearly taken place at the anchoring section, the data shall be disregarded and additional tests shall be performed until the number of test pieces failing in the test section is not less than three.

7.2 Bending tensile capacity

The average, maximum, minimum, and specifications deviation of the bending tensile capacity for each set of test conditions shall be calculated.

7.3 Failure patterns

The location and mode of failure shall be observed and recorded for each test piece.

8. TEST REPORT

The test report shall include the following items:
(1) Name of CFRM
(2) Type of fiber and fiber binding material, volume ratio of fiber
(3) Numbers or identification marks of test pieces
(4) Designation, nominal diameter, maximum cross sectional area
(5) Date of test, test temperature, loading rate
(6) Condition of surface of CFRM (material, thickness, configuration etc. of any coating, etc.)
(7) Bending angle, external diameter of surface position of deflected section, bending diameter ratio, material and surface configuration
(8) Bending tensile capacity for each test piece
(9) Location and mode of failure for each test piece
(10) Numbers of test pieces for each set of conditions in (7); average, maximum, minimum, and specifications deviation of the bending tensile capacity