

## **JSCE-E 710-2010**

### **Test method for the bond characteristics of plastic sheath for prestressed concrete (draft)**

#### **1 Scope**

This standard specifies the requirements for carrying out the test to check the bond characteristics of a plastic sheath used to form a duct to arrange inner cables of prestressed concrete structures. The plastic sheath considered in this standard should use high-density polyethylene or a material with performance not lower than that of high-density polyethylene.

#### **2 References**

By being cited herein, the following standards constitute part of the definition of this standard. This standard is based on the latest versions of these cited documents.

JIS A 1132 Method of making and curing concrete specimens

JIS G 3101 Rolled steels for general structure

JIS G 3109 Steel bars for prestressed concrete

JIS G 3536 Steel wires and strands for prestressed concrete

JIS G 3466 Carbon steel square and rectangular tubes for general structure

JSCE-G 531 Test method for compressive strength of grout for prestressing bar

JSCE-F 506 Method of making cylindrical specimens of mortar or cement paste for compressive strength

#### **3 Outline of test**

##### **3.1 Purpose of test**

The bond characteristics of a plastic sheath used for PC steel bars specified by JIS G 3109 and PC steel wires and PC steel strands specified by JIS G 3536 are examined.

##### **3.2 Conditions of testing room**

The standard temperature of the testing room is  $23 \pm 5$  °C unless otherwise specified. The relative humidity is not specified.

##### **3.3 Specimens**

a) The specimen should be a rectangular parallelepiped one with a side length  $a$  depending on the inner diameter of the sheath and height  $h$ , as shown in Table 1 and Fig.1. If the diameter of the sheath is greater than the value in Table 1 and the spacing<sup>(1)</sup> between the sheath and the square steel tube cannot be taken sufficiently, set  $a$  appropriately, and select the dimensions of the square steel tube.

Table 1 Dimensions of specimen for bond performance test

Inner diameter of Sheath	$a$ (mm)	$h$ (mm)	Dimensions of square steel tube(mm)
$\leq 80$ mm	150	No more than 3 times inner diameter of sheath	150×150×t4.5
$> 80$ mm	200		200×200×t4.5

**Note<sup>(1)</sup>:** The desirable spacing is 2 cm and no less than 4/3 times the maximum aggregate size ( $20 \times 4/3 = 27$  mm).

b) The specimen is composed of a square steel tube STKR 400 for general structures compatible with JIS G 3466, concrete, sheath and PC grout.

c) The number of specimens should be three.

d) At the same time of making the specimens for the bond performance test, the concrete specimens for compressive strength specified by JIS A 1132, and the PC grout specimens for compressive strength specified by JSCE-G 531 should be made.

e) The specimens should be cured in air after the placing of concrete until the testing time. The specimens for compressive strength should be cured under the same condition as the specimens for the bond strength test.

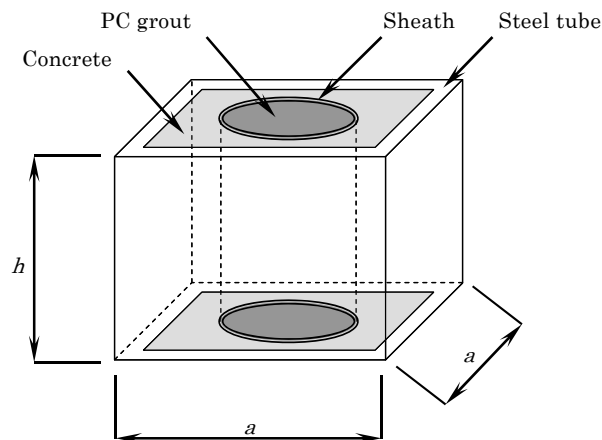


Fig.1 Bond performance test specimen

### 3.4 Mold

The mold should be as follows.

a) The bottom plate should be a metal plate and the flatness<sup>(2)</sup> should be no greater than 0.02 mm.

**Note<sup>(2)</sup>:** The flatness mentioned here is expressed as the distance between the parallel planes that pass the highest and the lowest points of the plane.

b) The side formwork, using the square steel tube of the specimen as a mold, should be used during the test without removing.

c) The mold should have a structure such that the sheath is placed at the center and set vertically.

- d) The mold should be constructed so that water leak from joints will not occur.

### 3.5 Quality of concrete

The concrete should be such that normal aggregate with the maximum coarse aggregate size of 20 mm is used and the slump is  $10 \pm 2$  cm. The compressive strength is no less than  $40 \text{ N/mm}^2$  at the age of 28 days. However, the test can be conducted before the age of 28 days if it is confirmed that the compressive strength during testing has reached  $40 \text{ N/mm}^2$ .

### 3.6 Placing of concrete

Concrete should be placed as follows.

- a) The surfaces of the square steel tube and the sheath should be cleaned to be clear of oil, stain, etc.
- b) The mold should be placed on a horizontal place during concrete placing and curing.
- c) Concrete should be packed symmetrically around the axis of the mold.
- d) When compaction is done using a rod for compaction<sup>(3)</sup>, the top surface of concrete should be flattened first with a rod, then concrete is poked with a rod at a rate of once for  $7 \text{ cm}^2$ . After the rodding is finished, spading is done along the mold surface depending on the necessity, and the holes created by rodding should be eliminated by tapping the side surface of the mold.

**Note<sup>(3)</sup>:** A rod for compaction should be a round steel bar with a semi-spherical tip, diameter of 16 mm, and length of 50 cm.

- e) After concrete placing is finished, the excessive concrete on the top surface should be removed to make the surface nearly flat. After two hours, re-finishing should be done to make a specimen with the specified correct dimensions.

### 3.7 Quality of grout

The quality of PC grout should be as follows.

- a) The materials used for PC grout should be compatible with 12.4.4 PC grout materials in Special Concrete, "JSCE Standard Specifications for Concrete Structures - 2007, Materials and Construction."
- b) The quality of PC grout should be compatible with the judgment criteria shown in 12.7.2 Examination of PC grout in Special Concrete, "JSCE Standard Specifications for Concrete Structures - 2007, Materials and Construction."
- c) The age at the bond performance test should be 28 days. However, the test can be conducted before the age of 28 days if it is confirmed that the compressive strength has reached  $30 \text{ N/mm}^2$ .

### 3.8 Injection of PC grout

The injection of PC grout should be done as follows.

- a) The injection of PC grout should be done at the age of 3 days. PC grout should be poured into the sheath calmly from the top surface. The entrapped air may be removed by rodding depending on the necessity.
- b) The finishing of the top surface of PC grout should be done in accordance with JSCE-F 506.

**3.9 Test apparatus**

- a) The test apparatus used should be such that the load can be measured with a margin of error of no more than ± 5%.
- b) The diameter of the hole of a bearing plate should be set at the external diameter of sheath plus 4 mm, and the diameter of the loading cylinder should be set at the inner diameter of sheath minus 4 mm.
- c) The size of the bearing plate should be determined by considering the size of the specimen and load cell. The thickness of the bearing plate is no less than the maximum displacement. The height of the loading cylinder should be set by considering the thickness of the bearing plate and the attachment condition of the displacement measuring plate.
- d) The loading cylinder and the bearing plate should use the rolled steel for general structures compatible with JIS G 3101.
- e) The loading cylinder and the bearing plate should have a polishing face. It is desirable to have a flatness of less than 0.01mm in 100 mm.

**4 Test method**

The test method should be as follows.

- a) The specimen, load cell, bearing plate, loading cylinder and spherical support should be set properly so that an eccentric load is not applied to the specimen.
- b) The items to be measured are the load and displacement of the loading cylinder. The measurement should be done at a displacement interval of no more than 0.1 mm. The measurement interval should be set so that at least 10 times of measurement can be done before the maximum load is reached.
- c) The load should be applied at a nearly constant rate to avoid giving impacts. The average loading rate should be no more than 5 mm/min.
- d) For measuring the displacement of the loading cylinder, a displacement transducer or a dial gage with a resolution of no more than 0.01 mm should be used. Those measuring devices are to be fixed properly so as to measure the relative displacement between the loading cylinder and the concrete specimen. An example of the loading apparatus is shown in Fig.2, and examples of the loading cylinder and the bearing plate with a hole in Fig.3.
- e) Loading should be finished when the load increase due to displacement increase cannot be confirmed due to specimen failure.

**5 Calculation**

Calculation should be done as follows.

- a) The bond stress should be calculated using the following equation by rounding off the fourth decimal place.

$$\tau = \frac{P}{\pi Dh} \dots\dots\dots (1)$$

where ,  $\tau$  : Bond stress (N/mm<sup>2</sup>)

$P$  : Load (N)

$D$  : Inner diameter of sheath (mm)

$h$  : Height of specimen (mm)

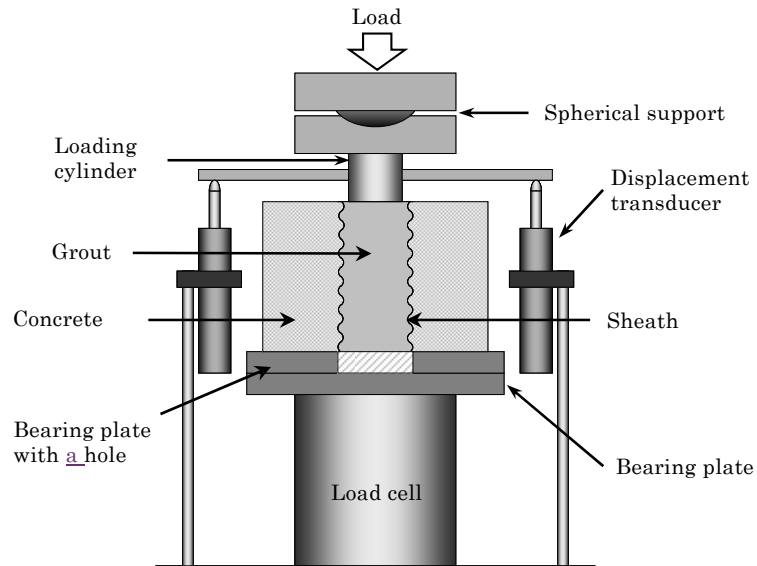


Fig.2 Example of bond performance test apparatus

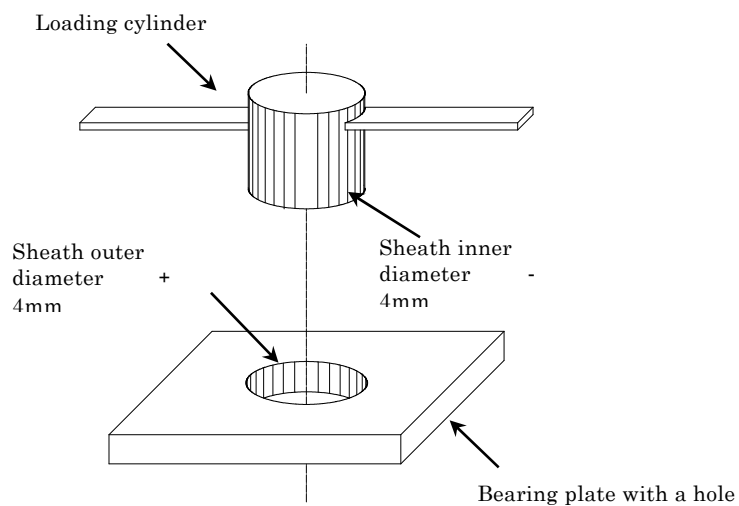


Fig.3 Example of loading cylinder and bearing plate

### **6.1 Compulsory reporting**

The report must provide the following information:

- a) Date of test
- b) Temperature of testing room
- c) Name, type and capacity of load cell and displacement transducer or dial gage
- d) Precision of test apparatus
- e) Material, inner diameter, outer diameter, shape and brand of sheath
- f) Number of specimens and specimen number
- g) Dimensions of specimen and square steel tube
- h) Mix proportions, slump (cm) and compressive strength of concrete
- i) Materials, mix proportions, funnel flow time and compressive strength of PC grout
- j) Load-displacement curve
- k) Maximum bond stress and failure condition of specimen

### **6.2 As-needed reporting**

The report should provide the following information where relevant:

- a) Name of testing organization
- b) Relative humidity of testing room