COMMENTARY ON THE TEST METHOD FOR CREEP FAILURE OF CONTINUOUS FIBER REINFORCING MATERIALS (JSCE-E 533-1995)

INTRODUCTION

Unlike reinforcement or prestressing tendon, CFRM may fail (creep failure) at strengths below the maximum static strength when subjected to a significant sustained stress for long periods. This creep failure strength varies according to the type of CFRM, therefore the creep failure strength must be evaluated when determining the level of tension in CFRM used as tendons. This is the reason for the inclusion of the present test method. The following standards were referred to in relation to the development of this test:

-JSCE standard "Test Method for Tensile Properties of Continuous Fiber Reinforcing Materials"
-JSCE standard "Test Method for Long-term Relaxation of Continuous Fiber Reinforcing Materials"
JIS K 7115-1986 "Testing Method for Tensile Creep of Plastics"
JIS K 7108-1987 "Testing Methods for Chemical Resistance of Plastics under Constant Tensile Load""

As with the "Test Method for Tensile Properties of Continuous Fiber Reinforcing Materials", the object of this test is the CFRM itself, excluding the performance of the anchorage. For this reason, test data clearly showing failure or pull-out at the anchoring section is to be disregarded.

1. SCOPE

Test pieces shall be linear or meshed CFRM formed from fiber materials and matrices as defined elsewhere and acting mechanically as a monolithic body.

2. DEFINITIONS

The creep failure capacity and creep failure strength for the design of concrete structures using CFRM are defined.

3. TEST PIECES

(Comment on 3.1) Except for the fact that the load applied to the test piece is a constant, sustained load, the loading state is similar to that in tensile test, therefore the test pieces for this test are to be in accordance with the "Test Method for Tensile Properties of Continuous Fiber Reinforcing Materials".

(Comment on 3.2) Given the long periods of time required for creep test, it has been decided to

specify 3 test pieces per test condition.

4. TESTING MACHINE AND DEVICES

(Comment on 4.1) Various types of testing machine may be used, such as hydraulic servo load testers, dead-weight load testers etc. It should be noted, however, that in multiple creep testing machines the load applied to one test piece and the deformation, vibration etc. of the testing machine frame due to the load at the time of failure of one test piece are easily transmitted to other test pieces; the testing machine used should be designed and manufactured to eliminate this kind of interference.

5. TEST TEMPERATURE

Creep behavior is easily affected by temperature, therefore a test temperature of 20±2°C is required, in accordance with the specification for temperature-sensitive materials in "Test Method for Tensile Properties of Continuous Fiber Reinforcing Materials".

6. TENSILE FAILURE CAPACITY

This is the standard load from which the constant load to be applied continuously to the test pieces is determined; derived from the values for 5 test pieces.

7. TEST METHOD

7.3 Loads applied

(Comment on (1) & (2)) The aim of this test is to extrapolate the creep failure capacity ratio at 1 million hours from the approximation line plotted according to **8.3** on the basis of test results up to 1000 hours. This requirement is included to increase the accuracy of the approximation line.

Tensile creep failure curves for various types of FRP (fiber reinforced plastic) are shown in **Fig. C 1**. Creep failure strength is given as a stress ratio, based on the tensile strength. CFRP using carbon fibers show high creep failure strengths of around 90% at 1000 hours, while GFRP made from glass fiber show values of 65~70%. While these FRP are not used directly for reinforcement of concrete as CFRM, the values shown here are given for reference in setting the load ratio or sustained loads in creep failure test.

(Comment on 7.4) This section specifies the measurement intervals for creep strain if automatic recording is not available. The intervals specified are the same as those in the "Test Method for Long-Term Relaxation of Continuous Fiber Reinforcing Materials".

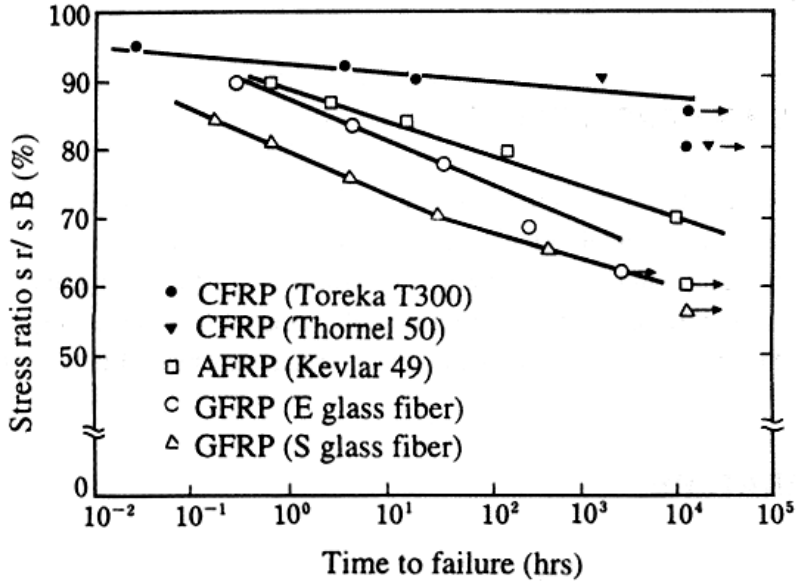

Fig. C 1 Tension creep failure curves for various FRP

8. CALCUALTION AND EXPRESSION OF TEST RESULTS

(Comment on 8.1) This provision is included to improve the accuracy of the approximation curve given in **8.3**.

(Comment on 8.2 & 8.3) A semi-logarithmic graph such as that shown in **Fig. C 2** is plotted, with a horizontal axis showing elapsed time in hours on a logarithmic scale, and a vertical axis showing stress ratio on an arithmetic scale.

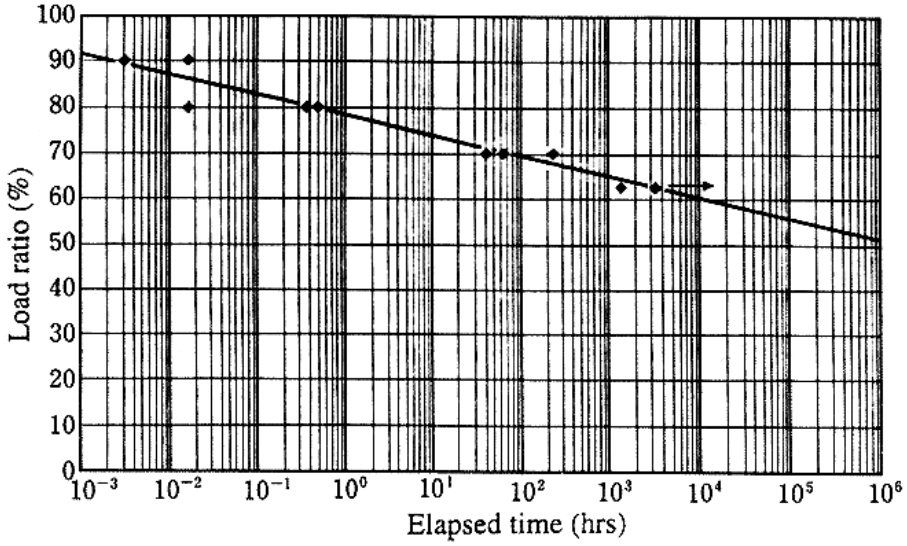

Fig. C 2 Creep failure curve

(Comment on 8.4) Creep failure capacity and creep failure strength normally refer to the values after 1 million hours (approximately 114 years), but if the service life of the proposed structure using

CFRM is determined in advance, the values correspond to this service life (i.e. the service life creep failure capacity and the service life creep failure strength).

REFERENCE

1) Introduction to FRP (revised), Reinforced Plastics Association, p.110, 1989