COMMENTARY ON THE TEST METHOD FOR LONG-TERM RELAXATION OF CONTINUOUS FIBER REINFORCING MATERIALS (JSCE-E 534-1995)

INTRODUCTION

Tendon relaxation in prestressed concrete structures is an important factor that has to be considered in the design. relaxation measurements in keeping with the intended purpose therefore must be made for CFRM, according to the method given here.

In Japan, currently the only prescriptions for relaxation test of prestressing tendon are the 10-hour tests given in JIS G 3536 (Uncoated Stress-relieved Steel Wires and Strands for Prestressed Concrete), and in JIS G 3109 (Steel Bars for Prestressed Concrete). These deal only with mechanical properties as quality standards, and do not give meaningful data for design purposes, which can only be obtained from long-term test conducted at a constant, normal temperature and with constant strain. To meet this need, the JSCE and the AIJ have conferred to produce the “Relaxation Test Method for Prestressing Steels” (AIJ/JSCE, JSEC-E 502-1990), correlated with the JIS test methods.

A provisional long-term relaxation test method for CFRM based on the JSCE standard referred to above is proposed in Vol. 72 of the Concrete Library. The method presented here incorporates subsequent amendments made to ensure consistency with other test methods for CFRM.

1. SCOPE

These provisions relate to a test method for determining levels of long-term relaxation of CFRM under a given temperature and strain, in order to give design-relevant data relating to prestressed concrete structures. Relaxation testing outside of the normal temperature range, and relaxation under variable strain, are therefore outside the scope of this test method, the purpose of which is also different from the existing 10-hour relaxation tests conducted for quality control of prestressing tendon. "Normal temperature" is defined here as a range of 20±15°C, following the Standard Temperature Class 4 given in JIS Z 8703. The test described here may be conducted at any temperature within this range, provided the temperature variation for the duration of the test is not more than ±2°C.

2. DEFINITIONS

A definition is given here for the failure capacity, since this is required as the basis for determining the initial load applied to the test piece for the purposes of relaxation test.

3. TEST PIECES

(Comment on 3.1) Except for the requirement to maintain constant strain, the dynamic conditions for test pieces are identical to those for tensile test, therefore the test pieces for this test are to be as for the "Test Method for Tensile Properties of Continuous Fiber Reinforcing Materials".

(Comment on 3.2) Given the long periods of time required for relaxation test, it has been decided to specify 3 test pieces per test condition.

4. TESTING MACHINE AND DEVICES

(Comment on 4.1) The types of testing machine that may be used for this test include relaxation testing machines, hydraulically controlled loading machines etc.

5. TEST TEMPERATURE

Relaxation 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". As some of the constituent materials of CFRM are highly temperature-sensitive, however, provision has been made for additional tests to be carried out at 0°C and 60°C if necessary.

6. TEST METHOD

(Comment on 6.2) Prestretching is carried out prior to relaxation tests in order to attune the test piece to the testing machine and / or the strain gauge. It has been noted, however, that in Aramid fibers the relaxation rate is affected by the method of loading employed. In such cases, prestretching levels and times must be kept to a minimum.

(Comment on 6.3) The purpose of this test is to determine the relaxation rates required for design purposes, and the initial load must therefore be set to the rate in actual service conditions. This conditions may in some cases result in a load that falls within a range where creep failure occurs but not failure due to relaxation; in such cases, it must be confirmed under actual loading conditions that the load does not result in creep failure of the CFRM, increasing the initial load as necessary.

(Comment on 6.4) Application of initial load
The previous version of this proposed method gave the loading rate as a function of the fiber content by volume, but this has now been brought in line with the tensile test method.

7. CALCULATION AND EXPRESSION OF TEST RESULTS

A semi-logarithmic graph such as that shown in **Fig. C 1** is plotted, with the horizontal axis showing elapsed time in hours on a logarithmic scale, and the vertical axis showing relaxation rates on an arithmetic scale.

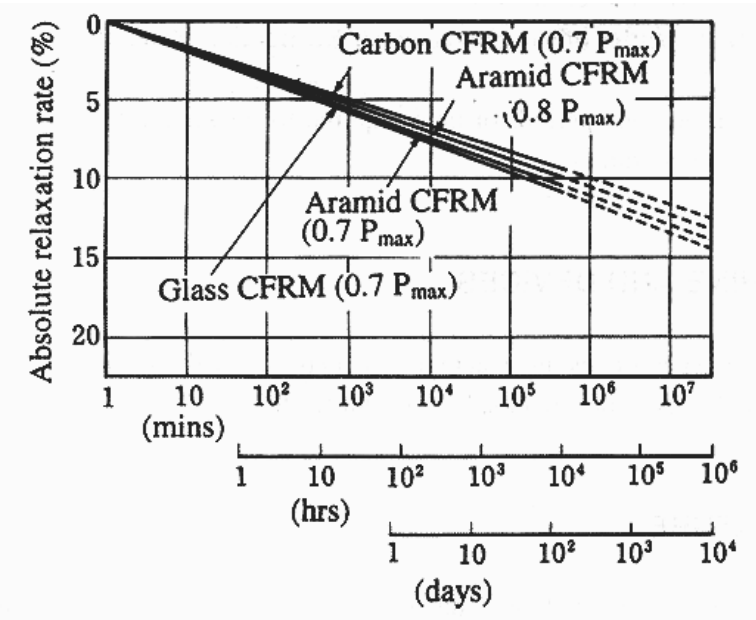

Fig. C 1 Typical relaxation test results

8. TEST REPORT

In normal testing, prestretching should not influence the results of the test, but if such influence is suspected, the report should include details of the level, time and method of prestretching.