COMMENTARY ON THE TEST METHOD FOR SHEAR PROPERTIES OF CONTINUOUS FIBER REINFORCING MATERIAL BY DOUBLE PLANE SHEAR (JSCE-E 540-1995)

INTRODUCTION

Shear in CFRM is investigated in relation to lifting wire rods, or to the reinforcement effect of shear reinforcement. The former case concerns shipping or transportation, storage and stages in construction and is regarded as a construction condition. The latter case concerns shear in members, and needs to be studied in order to establish design standards.

With the above in mind, the present test method is proposed as a method for determining the shear strength of materials. The test method given is simple but involves the possibility of compressive and shear deformation of test pieces. Unless test pieces are infinitely thin, the stresses causing failure are complex and do not correspond to shear in the strictest sense, but the present test is proposed nevertheless, given the current lack of a suitable alternative. “JSCE standard JSCE-G 553 1983: Shear Strength Test Method for Steel Fiber Reinforced Concrete” was referenced in drawing up this test.

1. SCOPE

The test method given here is for an average shear strength of CFRM materials by shear cutting.

There is currently no standard method for evaluating shear strength of wires such as CFRM, and so no standard have been set, but a method involving shear cutting of bar-shaped test pieces have been described [1,2]. The test method for shear given here, as stated in the Introduction above, cannot be said to evaluate shear strength in the strict sense owing to the complex stress situation, but the method has the advantage of simplicity and of using existing test apparatus.

It should therefore be noted that the test method given here evaluates average shear strength when cutting CFRM.

2. TEST PIECES

Test pieces should be longer than the shear testing apparatus, not less than 5 times the distance between shear planes and not more than 30 cm. Use of bent test pieces may result in splitting of the resin or damage to the fibers themselves when the test piece is set in the metal holders, thus test pieces must have good parallelism.

3. TESTING MACHINE AND DEVICES

The testing machine for shear test, illustrated in **Fig. C 1**, consists of a push-in cutting device and a test piece holder. The gap between the two parts must be as small as possible to enable cutting of test pieces.

The surfaces contacting the test piece, illustrated in **Fig. C 2**, may be (**a**) push-in semi-circular cutter with circular holder; (**b**) flat cutter with circular holder; or (**c**) both cutter and holder flat. A comparison using rod-shaped test pieces found that cutting strength for (**b**) and (**c**) was slightly greater than for (**a**). This is thought to be due to the smaller contact area between a rod-shaped test piece and a flat device, thus the test piece is cut while subject to compression. Type (**a**) is thus preferred for rods, and type (**c**) for strips.

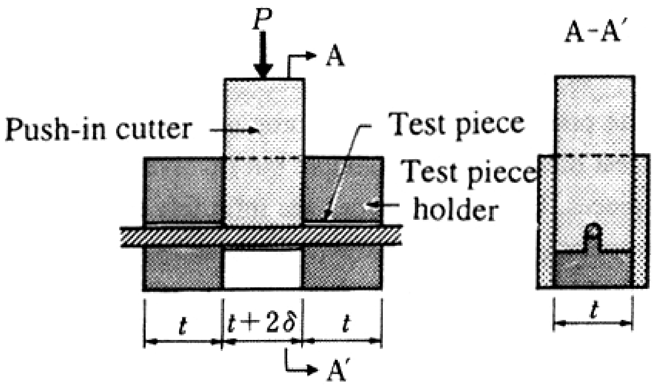

Fig. C 1 Double shear test machine

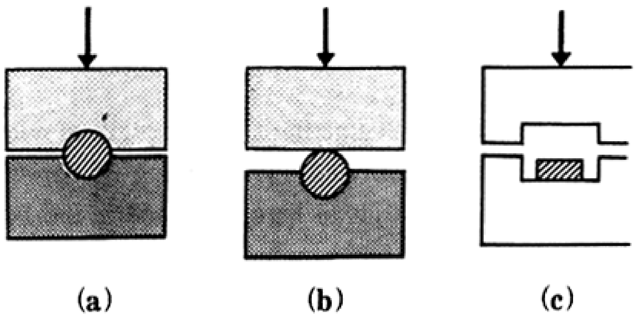

Fig. C 2 Combinations of test pieces and test machine contact surfaces

If the distance between the shear faces t is too large, flexing action takes place, which in some CFRM types was found to result in pull-out of fibers. Relatively uniform results for shear strength were obtained at shear face distances of 2~3 times nominal diameter although the value t = 50 mm that has been adopted here as the variation coefficient is small for different nominal diameters.

4. CALCULATION AND EXPRESSION OF TEST RESULTS

The ideal test apparatus for this test would have no gap between the push-in cutter and the holder, but as this is impossible for practical purposes, the test piece is subjected not only to shear stress, but also to flexural stress and the fracture face may exhibit pull-out of fibers due to flexure as well as shear. The fracture face should be examined after testing, and if significant fiber pull-out is found, the test should be treated as invalid, and repeated after adjustment of the testing machine.

This test method subjects the test piece to compression force in addition to shear force due to contact stress with the metal fittings. This compression force is not uniform along the axis of the test piece; it is thought to be distributed as shown in **Fig. C 3**. The test is in fact carried out under these stress conditions, although for practical purposes, shear strength is to be derived from the average stress calculated by dividing the maximum load *P* in the shear test by the total nominal sectional area.

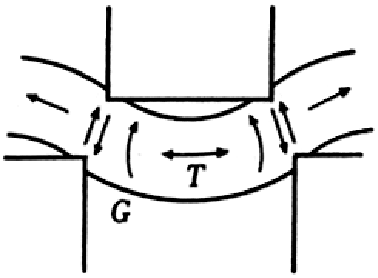

Fig. C 3 Conceptual diagram of contact stresses from the test apparatus acting on the test piece

REFERENCES

1] Kawamoto, M.: Materials Testing, Chap 5, "Shear Testing", Asakura Shoten Pub., 8th ed., pp.54~56, 1970

2] Japan Plasticity Processing Association (ed.): Plasticity Processing Series No. 12 "Shear Processing: The Basics of Press Working", Corona Pub., 1st ed., 1992