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Application News

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Material Testing System

Compression Test of Composite Material

Introduction

Even among composite materials, carbon fiber reinforced plastic (CFRP) has a particularly high specific strength, and is used in aeroplanes and some transport aircraft to improve fuel consumption by reducing weight. Compressive strength is an extremely important parameter in the design of composite materials that is always tested. However, due to the difficulty of testing compressive strength there is a variety of test methods. A major compression test method is the combined loading compression (CLC) method found in ASTM D6641. The CLC method can be performed with a simple jig structure, untabbed strip specimens, and can be used to simultaneously evaluate strength and measure elastic modulus. We performed compression testing of CFRP according to ASTM D6641.

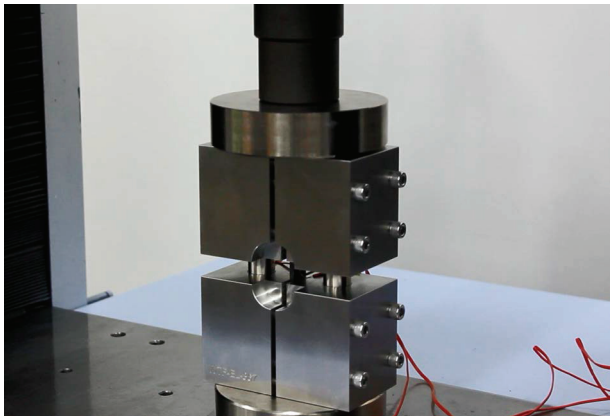

Fig. 1 Test Fixture

Measurement System

A CFRP specimen of T800S/3900 was used. Other information on the specimen is shown in Table 1. The test equipment used is shown in Table 2. Based on the CLC method in ASTM D6641, the specimen was attached to the jig shown in Fig. 1 and compressed using compression plate. Fig. 2 shows a photograph of the specimen. As shown in Fig. 2, a strain gauge was attached on the front and rear in the middle of the specimen. Outputs from the front and rear strain gauges confirmed that the specimen was aligned straight in the jig during specimen attachment. The specimen was attached using a torque wrench to fasten it in place uniformly. The test was performed with the test speed set to 1.3 mm/min.

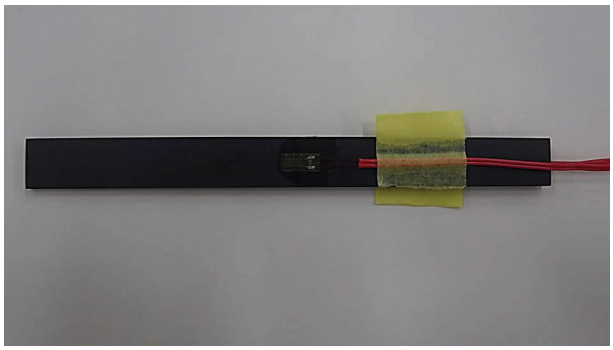

Fig. 2 Specimen

Table 1 Specimen Information

Length	: 140 mm
Width	: 13 mm
Thickness	: 3 mm
Lamination Method	: $[90/0]_{4S}$

Table 2 Experimental Equipment

Testing Machine	: AG-Xplus
Load Cell	: 50 kN
Test Jig	: CLC test fixture

Test Results

Measurements were performed twice, and stress-strain curves are shown in Fig. 3. The strain used is the mean strain taken from the front and rear sides of the specimen. The relationship between the first strain measurement and time is shown in Fig. 4 to show the outputs obtained from the strain gauges. Fig. 4 shows the outputs from both strain gauges were almost the same up to around 40 seconds, which is evidence that the test was successful. A small amount of deviation between the strain gauges arises after around 0.5 % strain, which is caused by a small amount of specimen flexure. Table 3 shows the test results. The mean compressive strength was 640.7 MPa, and the mean elastic modulus was 72.9 GPa. Elastic modulus was calculated using the mean of the strain gauge outputs.

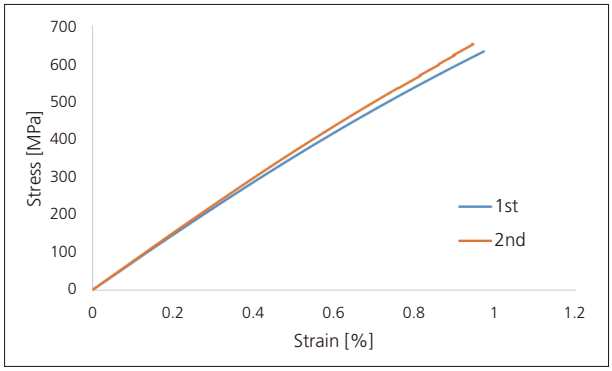

Fig. 3 Stress-Strain Curves (n = 2)

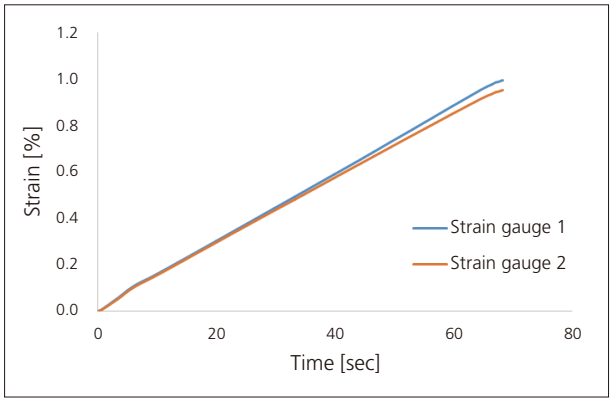

Fig. 4 Displacement-Time Curves (1st)

Table 3 Test Results

	Compressive Strength [MPa]	Elastic Modulus [GPa]
1st	629.9	71.4
2nd	651.4	74.3
Mean	640.7	72.9

Conclusion

Using this test system, compression testing of a CFRP was successfully performed according to ASTM D6641. Because this standard test method allows the testing of untabbed strip specimens, compressive strength and elastic modulus can be determined relatively easily for CFRPs.

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