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Application Data Sheet

No. 32

Autograph Precision Universal Testing Machine

AUTOGRAPH Precision Universal Testing Machine

Compression Testing of Composite Materials

Standard No. ASTM D6641/D6641M-09

■ Introduction

Carbon fiber reinforced plastic (CFRP) is a composite material with particularly high specific strength that are used in aircraft and some transportation equipment to improve fuel costs through weight saving. Compressive strength is an extremely important property when it comes to designs that include composite materials. Consequently, compression testing has always been performed. However, a variety of test methods exist due to the difficulties of performing compression testing. The most common compression test method is the combined loading compression (CLC) method of ASTM D6641. This CLC method can be performed with a simple jig construction, without tabs, and with a strip specimen, and is able to evaluate strength and measure elastic modulus simultaneously. We performed compression testing of a CFRP according to ASTM D6641.

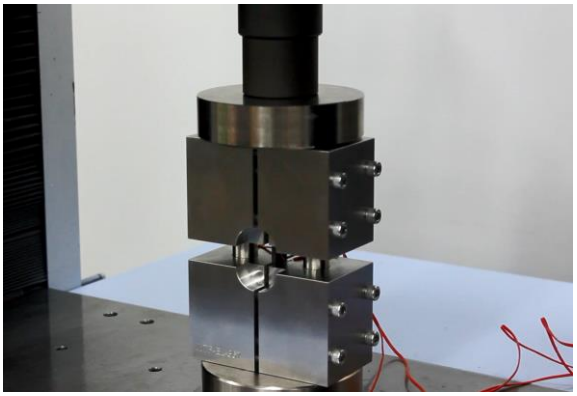

Fig. 1 Test Jig

■ Measurement and Jigs

The CFRP specimen used was made from T800S/3900. Other information about the specimen is shown in Table 1. The test was performed with the test speed set to 1.3 mm/min. The specimen was attached to the jig as shown in Fig. 1, and compressed using compression plates according to the CLC method of ASTM D6641. A photograph of the specimen is shown in Fig. 2. Strain gauges were attached in the center on both sides of the specimen as shown Fig. 2. The outputs from the strain gauges on both sides of the specimen were used to confirm the specimen was attached straight on the jig. A torque wrench was used to tighten the specimen into the jig with uniform tightness. Elastic modulus was calculated from the mean value of the strain gauge readings.

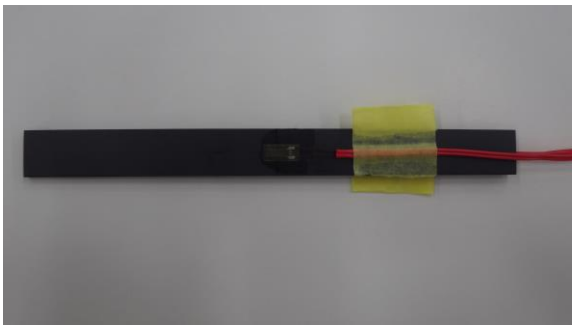

Fig. 2 Test Specimen

■ Measurement Results

A stress-strain curve is shown in Fig. 3. The strain shown is the mean strain of the strain gauge readings on both sides. As an example of the output from both strain gauges, the relationship between displacement and time is shown for CFRP_1 in Fig. 4. Looking at Fig. 4, the outputs of the strain gauges are almost the same up to 40 seconds, which shows the test was performed successfully. At higher displacement readings from 40 seconds onward, a small difference arises between the stain gauges due to a small amount of deflection of the specimen. Test results are shown in Table 2. The mean values obtained for compressive strength and elastic modulus were 640.7 MPa and 72.9 GPa, respectively.

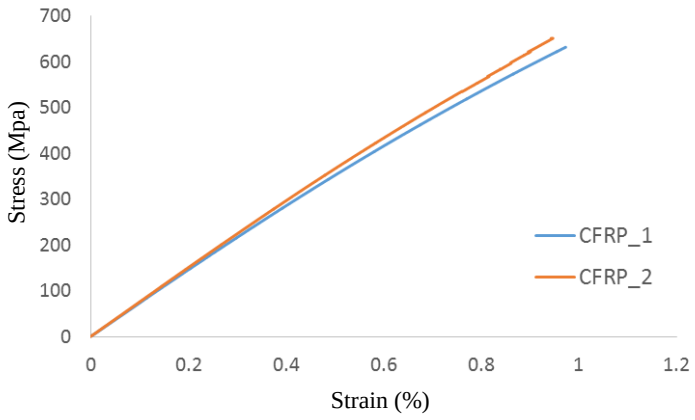

Fig. 3 Stress-Strain Curve (n = 2)

Table 1 Test Specimen Information

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

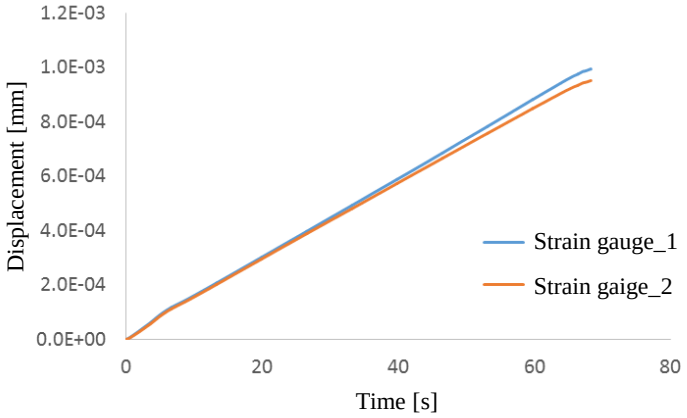

Fig. 4 Displacement-Time Curve (CFRP_1)

Table 2 Test Results

	Compressive Strength (MPa)	Elastic modulus (GPa)
CFRP_1	629.9	71.4
CFRP_2	651.4	74.3
Average	640.7	72.9

■ Conclusion

We were able to use this testing system to perform compression testing of CFRP specimen according to ASTM D6641. This standard can be used to calculate the compressive strength of CFRP relatively easily since it allows for testing without tabs and with a strip specimen.

Compression Testing System for Composite Materials

Testing Machine: AG-Xplus
Load Cell: 50 kN
Test Jig: Compression test jig for composite materials
Software: TRAPEZIUM X (single)

AG-Xplus Floor-Type Precision Universal Testing Machine

Features

■ A high-precision load cell is adopted. (The high-precision type is class 0.5; the standard-precision type is class 1.)
Accuracy is guaranteed over a wide range, from 1/1000 to 1/1 of the load cell capacity. This supports highly reliable test evaluations.

■ Crosshead speed range
Tests can be performed over a wide range from 0.0005 mm/min to 1,500 mm/min.

■ High-speed sampling
Ultrafast sampling, as fast as 0.2 msec. Sudden changes in test force, such as when brittle materials fracture, can be assessed.

■ TRAPEZIUMX X operational software
The software offers a variety of convenient and user-friendly features. It is designed for intuitive operation.

■ Smart controller
Real-time test force and position data is readily confirmed, and the manual dial can be used for fine adjustments to jig positioning.

■ Optional Test Devices
A variety of tests can be accommodated by switching between an abundance of jigs in the lineup.

First Edition: July, 2015

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