# Determination of mechanical properties of Glass-Epoxy composites and sandwich structures at elevated temperatures

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**Abstract**

Composite materials are widely used in in different structures due to their outstanding material properties. In the service condition, composite and sandwich structures are needed to endure elevated temperatures, this topic has been an area of many researches [1]. In this study mechanical properties of E-glass / epoxy composites and foam cored sandwich structures measured by performing 5 series of experiments inside of the environmental chamber followed by the relevant ASTM standards. The Environmental chamber can maintain temperatures from -60 $^{o}$C to +180 $^{o}$C. Tests for characterization of the mechanical properties were performed in different temperatures starting from room temperature and proceeding to elevated temperatures. In this study curve fitting function has been extracted based on tanh equation model and applied to all of the test

results. Tensile elastic modules of the tensile specimens were measured using one extensometer capable of working at maximum 180 $^{o}$C. To measure the compressive modulus of the specimens and control the bending ratio, two strain gauges suitable for working at high temperatures were installed on both sides of the specimen. The IITRI test fixture was used for this test. V-notched rail shear method was used to measure the shear properties of the composite specimens. To investigate the strain distribution and shear modulus in the test specimens, the DIC measurement technique is employed. The software used for processing is Aramis from GOM. The system uses two 12 megapixel digital cameras to determine the movement in the specimen by processing the deformation of the pattern. In the traditional method, two strain gauges were needed to be installed on each specimen which was more time consuming and always had the risk of deboning the strain gauges from the surface of specimen at higher temperatures. Using DIC system the strain distribution is recorded during the test, two virtual Extensometer introduced and centred between the notch tips in the gauge section of the specimen (see figure 1). Core compressive and shear properties of the sandwich structure is defined using flatwise compression and four-point bending test of the sandwich specimens. Deflection of the sandwich panels in both tests were measured using Aramis system.

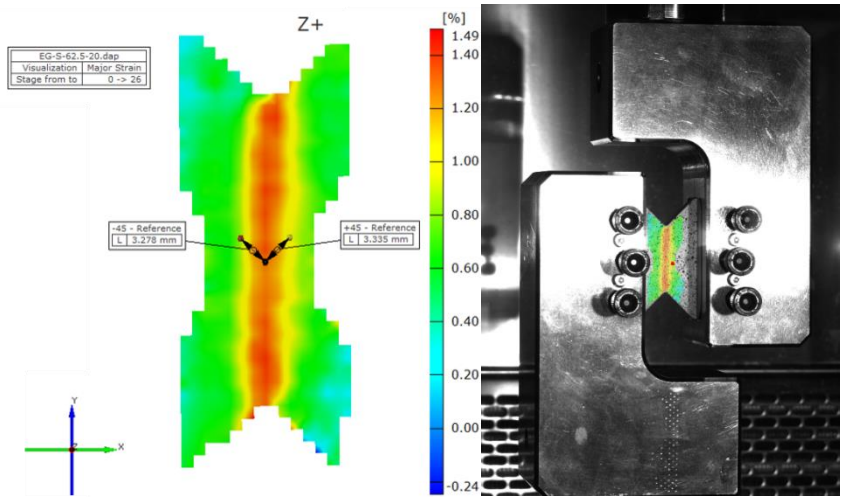


Figure 1. strain distribution and virtual extensometers presented at +45$^{o}$ and -45$^{o}$ orientations using DIC

The experimental results revealed general reduction for both modulus and strength of the materials at elevated temperatures. Tensile test showed less elastic modulus and ultimate strength reduction comparing other tests. The reduction of strength and elastic modulus were greater in case of compression and shear tests, both had similar trend in reductions and they showed dramatic decrease after 75 $^{o}$C which is above the matrix glass temperature transient. Curve fitting function which applied to the test results showed good agreement with the tanh equation.

## References

[1] Mehmet Aktas, Ramazan Karakuzu, Determination of Mechanical Properties of Glass-Epoxy Composites in High Temperatures, Volume 30, Issue 10, 11 SEP 2008.