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**Compression after Impact Behaviour and Failure Analysis of Nanosilica-Toughened Thin Epoxy / GFRP Composite Laminates**

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**Abstract**

Nanosilica particles were utilized as secondary reinforcement to enhance the strength of the epoxy resin matrix. Thin glass fibre reinforced polymer (GFRP) composite laminates of 3 ± 0.25 mm were developed with E-Glass mats of 610 GSM and LY556 epoxy resin. Nanosilica fillers were mixed with epoxy resin in the order of 0.25, 0.5, 0.75 and 1 wt% through mechanical stirring followed by an ultrasonication method. Thereafter, the damage was induced on toughened laminates through low-velocity drop weight impact tests and the induced damage was assessed through an image analysis tool. The residual compression strength of the impacted laminates was assessed through compression after impact (CAI) experiments. Laminates with nanosilica as secondary reinforcement exhibited enhanced compression strength, stiffness, and damage suppression. Results of Fourier-transform infrared spectroscopy revealed that physical toughening mechanisms enhanced the strength of the nanoparticle-reinforced composite. Failure analysis of the damaged area through scanning electron microscopy (SEM) evidenced the presence of key toughening mechanisms like damage containment through micro-cracks, enhanced fiber-matrix bonding, and load transfer.

**Keywords:**

[GFRP composites](https://www.mdpi.com/search?q=GFRP%20composites); [secondary reinforcement](https://www.mdpi.com/search?q=secondary%20reinforcement); [nanosilica fillers](https://www.mdpi.com/search?q=nanosilica%20fillers); [CAI behaviour](https://www.mdpi.com/search?q=CAI%20behaviour); [damage assessment](https://www.mdpi.com/search?q=damage%20assessment)

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