

## **Manufacturing and Characterization of Carbon Fibre Reinforced Polymer Laminates**

Carbon fibre reinforced polymer (CFRP) laminate is an advanced engineering material with superior mechanical properties like high specific strength/stiffness, fatigue life and tailorability. It is widely used in the aerospace, automotive, sports and civil engineering fields.

Unlike metals, during fabrication of CFRP laminates, the engineer can design the microstructure as well as the macroscopic mechanical properties by choosing appropriate combination of fibre and matrix. Different techniques are available for the manufacturing of CFRP laminates, namely, hand layup, resin transfer moulding, pultrusion etc. At IITH, I had been given hands on training in the fabrication of CFRP flat laminates using hand layup and vacuum bagging technique. The reinforcement used is a carbon fiber of 200 GSM supplied by Hindoostan Composite Solutions Ltd (HinFab<sup>®</sup> - Uni-directional fabric) and matrix is an epoxy-based resin of Araldite<sup>®</sup> CY230 mixed with hardener Araldite<sup>®</sup> HY951 (mixed with 10:1 ratio by weight). The panels were allowed to cure for 24 h under vacuum and later machined to the required dimensions.

Mechanical characterisation of composites is challenging and requires more number of tests to determine the stiffness and strength properties. At IITH, I had visited the Material characterisation lab and given demonstration on the 100 KN fatigue testing machine supplied by MTS. Composite coupons were tested as per the ASTM standards. I have been exposed to the different fixtures available for the testing of composite coupons. Also, the strain gages used and instrumentation to measure the strain data in different direction in the composite coupons.

Subsequently, I had visited the Non-destructive testing and evaluation lab for the inspection of fabricated composite specimens. I had been given the demonstration of using ultrasonic based NDE techniques like immersion ultrasonics, Phased array ultrasonics and Air coupled ultrasonic testing. Composites subjected to impact loading were assessed using the ultrasonic techniques to locate and quantify the delamination type of damage. Also, I have been introduced to ABAQUS finite element software for modelling and analysis of composite laminates.

The TEQIP faculty training at IITH had been given a holistic view of the research challenges in the area of composite structures. This training will pursue me to do research in composites for my PhD.