

2012 MSc Research Grant Scheme

Project title: Connections in Advanced Composite Materials

University: Coventry University

Supervisor: Mr David Trujillo

Student: Christopher Ranner

Aims of research: Advanced Composite Materials are currently used for strengthening existing structures but they are not understood as a primary structural material within the Construction Industry. The materials which can be achieved can be lightweight, strong, stiff, durable and robust when designed and applied correctly.

The proposed investigation is into the effect of the material specification on the strength and ductility of a bolted connection using Advanced Composite Materials.

The research project intends to provide calculative analysis and comparison to experimental data to add to the body of knowledge in this field.

Description of method: A series of sample materials will be created using Carbon, Aramid and Glass fibre fabrics with differing weaves, lay-up specifications, stacking sequences and production methods. The samples will be fabricated using two differing matrix materials, Epoxy and Polyester resins and subjected to controlled cure cycles.

The samples will be bolted to a mounting block of suitable material and thickness using a simple two bolt connection. The samples will be tested to destruction by introducing a moment into the connection. The failure modes will be observed and compared to the calculated models using the theoretical material properties.

Additional samples of each material specification will be tested to identify the actual material properties achieved, i.e. Tensile, Compressive, Shear and Young's Moduli and Poisson's Ratio. These results will be introduced into the theoretical calculations and compared to the results.

The analysis will be approached at three different levels:

- 1) The micromechanics of a single ply
- 2) The macromechanics of a single ply
- 3) The macromechanics of the laminate.

Benefits to structural engineering: There is a growing need for lighter and stiffer structures; Advanced Composite Materials are avoided mainly through lack of knowledge, their almost infinitely varied characteristics and cost. Most engineers avoid using the materials due to their potential orthotropic / anisotropic and heterogeneous nature.

The investigation proposed will provide some insight into the behaviour of the materials at stress riser points i.e. a bolt; and their failure modes.

The researcher hopes this will help promote the use of the materials through better understanding of their failure mechanisms.

Proposed finish date: 09/2012