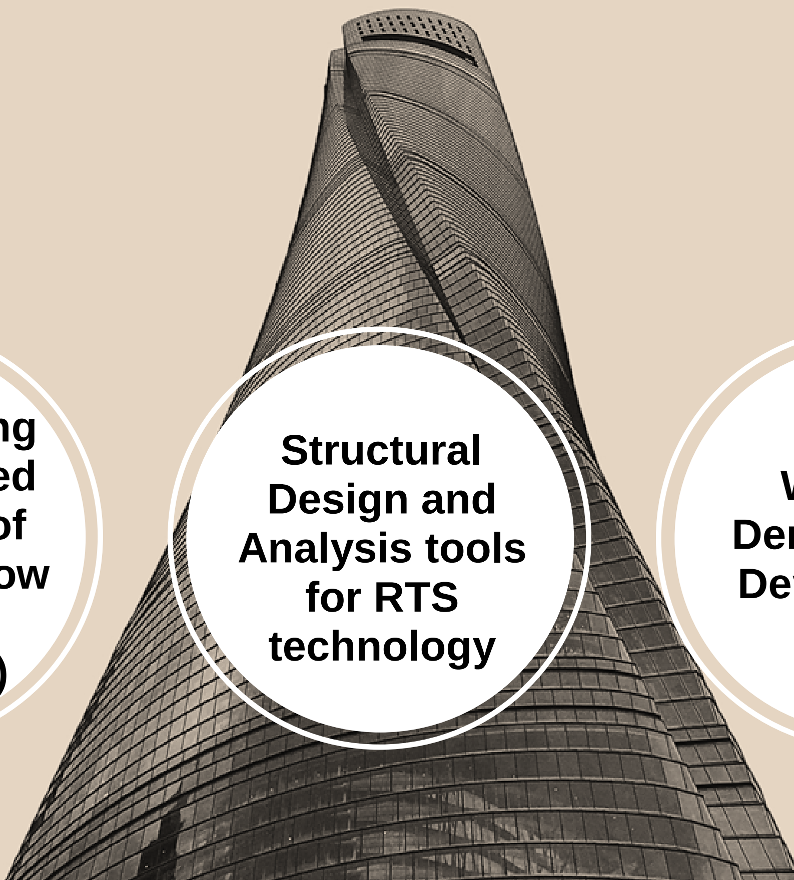
Project Newsletter

April 2021



Manufacturing and Advanced Simulation of Composite Tow Shearing (MASCoTS)

Structural Design and Analysis tools for RTS technology

Wingbox Demonstrator Development

Manufacturing and Advanced Simulation of Composite Tow Shearing (MASCoTS)

MASCoTS is an Aerospace Technology Institute project launched in September 2020 funded through Innovate UK under reference number 113298.

The Manufacturing and Advanced Simulation of Composite Tow Shearing project focuses on the development of hardware as well as design and analysis tools for the commercialization of the innovative technology of rapid composite tow shearing (Figure 1) developed by the partner iCOMAT. This patented manufacturing method utilizes fibre steering for placement of carbon tapes along curved paths to create composite parts with minimal defects thus ensuring their increased structural performance.

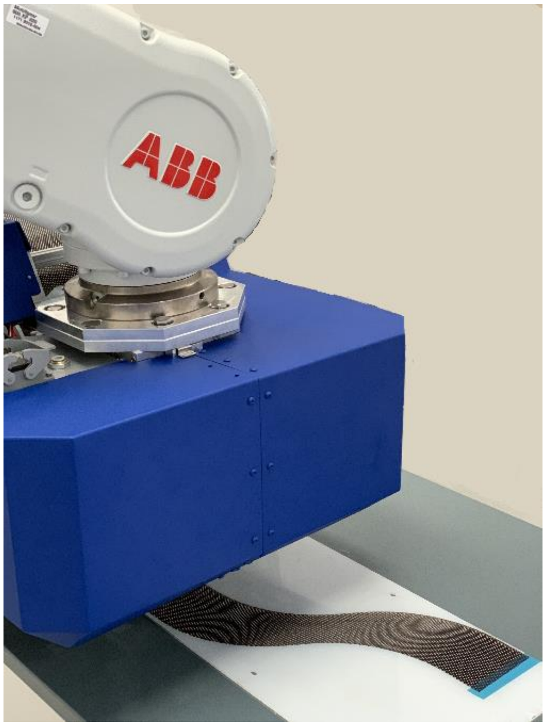


Figure 1: The innovative technology of rapid tow shearing (RTS) developed by iCOMAT

Manufacturing and testing of structural panels and of a wingbox demonstrator will be performed as part of the project. iCOMAT have already initiated the shear assessment of the material that will be used by developing a test rig to perform the shearing testing (Figure 2). In addition to the shear assessment, an optimization of the tape laying system is in progress to improve speed and reliability for industrial applications.

Figure 2: Shear rig developed by iCOMAT for the assessment of material characteristics for iCOMAT's process, i.e. shear rate, maximum shear angle etc.

Structural Design and Analysis tools for RTS technology

Structural design and analysis tools will be developed as part of MASCoTS project dedicated to fibre steering technology. These tools will be integrated in existing software products

The traditional approach to composites manufacture is to lay material on a mould without distorting it. This approach is easy but restricts what can be done. To improve performance, fibres can be steered. This can happen with the use of tape laying machines which can steer but at the same time there are some process implications. Through Rapid Tow Shearing, the tow is sheared and not bended and minimal manufacturing defects are created.

The aforementioned approach will be captured in a design tool that is going to be developed through the MASCoTS project. More precisely, our partner MSC have developed a novel approach to look at the laminate which is called Composite Design Explorer (CDE) (Figure 3). Through this approach rather than trying to design around plies, the tool looks at the laminate holistically. The output will be related to stiffness plots and strength envelopes that will show the laminate performance as a whole.

A new tool to increase engineer understanding of composite behaviour is in progress. This tool gives plots of laminate stiffness and strength as a function of load direction in both membrane and bending. It also provides a holistic understanding of ply stack.

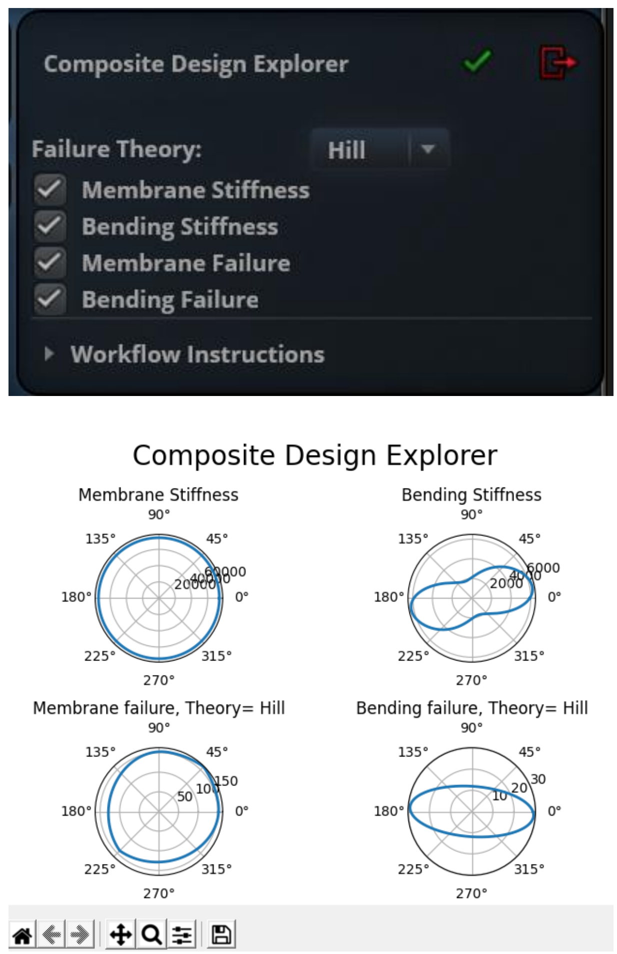


Figure 3: Composite Design Explorer tool.

Wingbox Demonstrator Development

A dedicated box demonstrator will be prepared as part of the project to verify the principle of rapid tow shearing.

A demonstrator design is going to be manufactured using the rapid tow shearing approach as part of the MASCoTS project thus enabling the development of new opportunities for wing tailoring (Figure 4). The design objectives and constraints must be considered for the successful development of the demonstrator.

Figure 4: Boeing's SUGAR Volt Hybrid Electric Aircraft.

DaptaBlade are developing simulation workflow automation tools, which create a collaborative design environment with access to advanced engineering techniques that help engineers design better products faster.

For MASCoTS, DaptaBlade will address the three main challenges related to the design of the wing box demonstrator:

- Coupling multiple disciplines (aero structures, control systems)
- Automating the design process
- Steered fibre composite design

The steered fibre composite design through the rapid tow shearing method can be used to tailor the wing with a view to enable high-aspect-ratio wings which increase aircraft efficiency and reduce fuel burn.

This is achieved by tailoring the passive stiffness properties of the wing skins so as to optimise the deflected shape of the wing in flight (Figures 5 and 6).

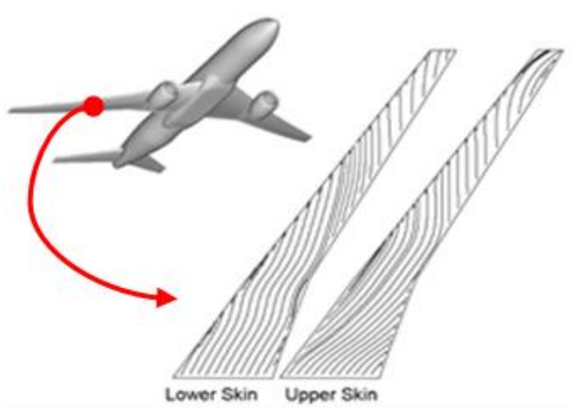


Figure 5: Optimised curved fibre directions.

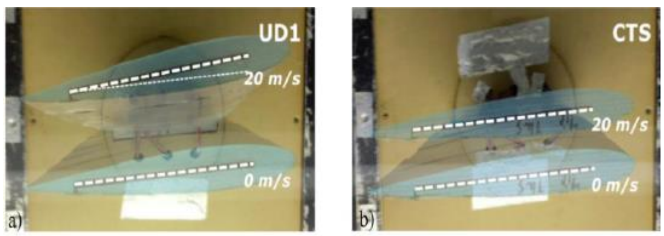


Figure 6: Bend twist response in wind tunnel: a) straight fibre, b) CTS.