HiMax™ glass multiaxials

Dasyc building case study

Hexcel's non-crimp fabrics reinforce Dasyc's transportable composite hangars.

HEXCEL®

HiMax™ glass multiaxials
Dasyc building case study

Hexcel Reinforcements UK's glass fibre fabrics were selected by Greek company Dasyc for the manufacture of its Composite Modular Transportable Hangar (CMTH®). Constructed from prefabricated composite sandwich panels, this innovative structure can be employed as a temporary or permanent facility in a wide variety of civil or military applications. The use of Hexcel quadaxial reinforcements enabled Dasyc to manufacture a composite structure with a strength equivalent to that of a concrete or steel building.

Versatile and Mobile

Dasyc SA specialises in the processing of thermoplastics, bulk moulding compound and composites for the automotive, military, aerospace, electrical, and sports and leisure sectors. In 2010, the company launched the Composite Modular Transportable Hangar to address a need for mobile storage, parking and housing structures. The patented design enables rapid transportation and assembly in any location. Disassembly is equally straightforward. The modules which make up the hangar can be stacked and stored in a limited space, and are designed for easy transport by truck, sea or air.

Possible applications for the hangars range from housing aircraft, helicopters and military vehicles, to the storage of equipment at construction sites or airports. Field hospitals, on-site office space and disaster relief/emergency response facilities are just a few further examples.

Composite sandwich panels are ideal for this application since they provide strength, stiffness and excellent thermal insulation, as well as ease of manufacture and simplicity of assembly. The composite panels are lightweight, simplifying transportation and installation, and corrosion resistant, which results in minimal maintenance requirements. The installed structure also exhibits low infrared (IR) and radar signatures, key benefits for military applications. Unlike permanent metal or concrete constructions, the composite structure can be moved and adapted to new requirements, providing the user with increased flexibility on their investment.

The composite hangar has been tested and certified in cooperation with the National Technical University of Athens and is designed to withstand significant loads, offering a strength equivalent to that of traditional concrete or steel structures. Dasyc has already delivered three hangars to the Hellenic Air Force (HAF) and is now promoting the product internationally.

Constructed from prefabricated composite sandwich panels, the Composite Modular Transportable Hangar can be employed in a wide variety of civil or military applications.

Modular Composite Construction

To create the CMTH the composite panels are assembled together to form arches. Each arch is made up of a varying number of main panels (2.1 m x 3.7 m in size), one half-size panel (1.15 m x 3.7 m in size) and two edge panels (which interface with the ground). All panels have the same radius of curvature (approximately 16.9 m) and each arch is a geometric arc. The length of the arch can be adjusted by using a different number of main panels. The length of the hangar is dependent on the number of arches used – adding one arch increases the length by 3 m. For the hangars delivered to HAF, 10 arches (each constructed from 21 main panels) were employed to give a hangar with a maximum height of 10.6 m, a width of about 31 m and a length of 30.7 m.

The panels are manufactured at Dasyc's production plant in Markopoulo using a vacuum assisted resin transfer moulding (VARTM) process.

The 80 mm thick panels are sandwich structures consisting of a hard polyurethane (PU) core material (72 mm thick) between two laminate skins (each 4 mm thick) of glass fibre reinforced polyester resin. In order to improve the stiffness of the construction, the panels are corrugated with a wave length of 1.5 m and wave height of 380 mm.

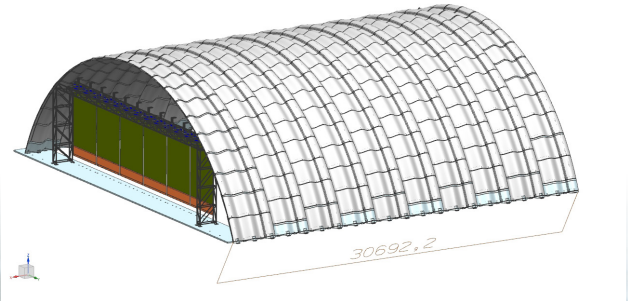
An extensive testing programme included bending tests on assembled composite panels.

For this project Dasyc required reinforcements that would form a composite structure with a strength similar to that of a concrete or steel building and capable of withstanding the same structural loads (wind load, snow load, working loads etc.) as specified by the Eurocodes building regulations.

To provide the required mechanical properties Hexcel Reinforcements UK (formerly Formax) supplied its FGE112 1200 g/m^2 quadaxial fabric, consisting of four layers of E-glass fibres aligned in the 0°/-45°/90°/+45° orientations and stitched together with polyester thread. Four layers of FGE112 were used in each skin. In addition to imparting excellent structural support and stiffness to the laminate, quadaxial fabric is a cost effective solution for reducing labour in the lay-up process as it is possible to apply multiple layers simultaneously. The isotropic properties exhibited by the quadaxial fabric also facilitated the development and analysis process for the hangar structure since it was easier to apply the standard building codes and gain customer acceptance.

To aid resin flow during the RTM process Hexcel supplied 450 g/m^2 continuous filament mat. Approximately 40 tonnes of Hexcel glass fibre reinforcement was used in the hangars delivered to HAF.

To validate the performance of the composite panels Dasyc completed an extensive testing programme. This included tests on standardised samples and small-scale panels, and finished with bending tests on assembled panels.



For the HAF hangars 10 arches were used, each constructed using 21 main panels.

Easy to Install and Customise

The outer surface of the panels is coated with an ISO-NPG gel-coat (available in a number of colours) which provides excellent weather resistance. The composite panels result in an installed structure with a long life expectancy that is essentially maintenance-free when compared to fabric or metal shelters. The PU core and composite skins provide thermal insulation to the overall structure resulting in an excellent overall heat transfer coefficient.

The hangars can be installed easily and quickly using standard tools and a crane. Panels are assembled together with the use of screws and bolts, and elastic gaskets are used to seal the joints.

Installation does not require any special subterranean preparation. Only two strips of concrete are needed for the footprint of the arches. The arches are anchored to these using metallic anchor plates. The first arch is assembled on the ground, erected using a crane and bolted on to the anchors. The remaining arches are assembled in groups of 3-6 panels which are placed in position using the previously erected arch as a guide. The total assembly (and disassembly) time is less than two weeks for a standard-size hangar, although actual assembly time depends on the available workforce.

Various options are available, enabling the customer to customise the hangar to their requirements. These include covers for the open sides of the hangar, electrical installation, a lightning protection system, and installation of photovoltaic panels. Dasyc can undertake the transportation, assembly and disassembly of the hangar at the customer's designated site and will train the customer in all these aspects.

The composite hangar is offered with a range of options, including side covers and access doors.

Installation is quick and easy.

Improved Design

Dasyc is currently working on a redesign of the CMTH in order to exploit the anisotropic properties of composite materials. The current use of quadaxial fabric leads to an isotropic composite structure exhibiting the same strength in the 0°, -45°, 90° and +45° directions. However, there is a non-uniform distribution of the stresses on the hangar structure, with more than 70% of the stresses concentrated in the 0° direction. The new laminate lay-up will employ unidirectional (UD) fabrics to strengthen this direction and eliminate unnecessary reinforcement from the other directions. Hexcel is working with Dasyc to trial a combination of UD, quadaxial and triaxial fabrics, enabling the structure's mechanical performance to be optimised in the required directions.

In June 2016 Dasyc received samples of Hexcel fabrics to start production of samples for verification of the optimised lay-up. Production is scheduled to resume in October. Dasyc is also improving its mould construction in order to enhance resin flow during the RTM process. In studies, the new fabric lay-up has also shown improved flow patterns. To further aid flow Dasyc and Hexcel will investigate the use of high drape fabrics and a quadaxial fabric with integrated chopped strand mat (CSM) layer to enhance flow and surface finish.

"We are very happy with our cooperation with Hexcel on this project," says Nikos Efentakis President & Managing Director of Dasyc SA. "Hexcel offered us the quality we expect, together with competitive pricing and a professional collaborative framework."

"We are very happy with our cooperation with Hexcel on this project. Hexcel offered us the quality we expect, together with competitive pricing and a professional collaborative framework."

Nikos Efentakis
President & Managing Director of Dasyc SA.

HiMax™ multiaxial reinforcements

Hexcel Reinforcements UK Ltd (formerly Formax) is a world leader in the supply of composite reinforcements, specialising in the production of ultra lightweight carbon fibre multiaxials and highly engineered glass fibres for the Automotive, Wind, Marine, Sports and Industrial markets.

Our goal is to deliver materials of the highest quality, specifically tailored for each unique application and customer requirement. Through continuous investment in product development and research technology, HiMax™ fabrics are lighter, stronger and cost effective.

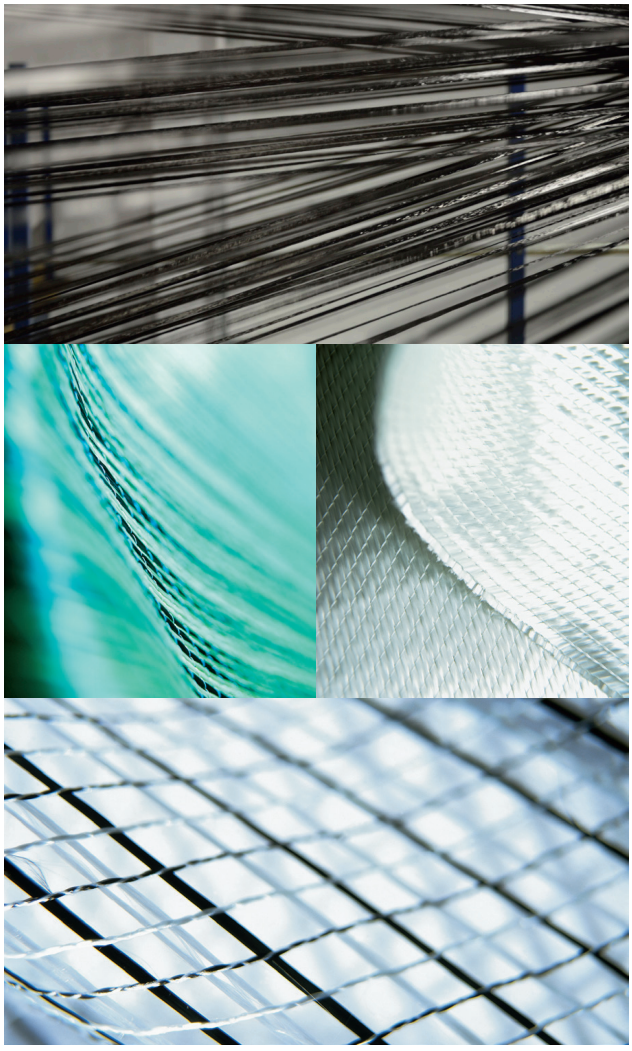
Our Customers
Hexcel acquired the Formax multiaxials business in 2016. Our heritage lies in the Marine industry and we have designed carbon fabrics for many America's Cup campaigns, luxury super yachts and military vessels. This experience of working with high performance structures, coupled with our ability to produce an array of bespoke reinforcements, means our products have evolved rapidly and today we supply to a huge variety of end-use applications across multiple sectors.

Dedicated Service
Individual Business Sector teams for Automotive, Marine and Industrial applications coordinate our client accounts to ensure customers receive a highly specialised service with dedicated support from market specific engineers, research technicians and sales staff.

Trusted technology
All Hexcel Reinforcements UK manufacturing processes adhere to ISO 9001 standards and our entire range of carbon multiaxial fabrics has been accredited with the renowned DNV qualification.

Our customers can be assured they are purchasing the highest quality reinforcements available.

Production Capabilities
Hexcel has an impressive range of specialist equipment and processing capabilities at its Leicester, UK manufacturing plant. Climate controlled production areas accommodate our machines that run glass and carbon lines 24/7 to support our customers' ever expanding supply schedules.



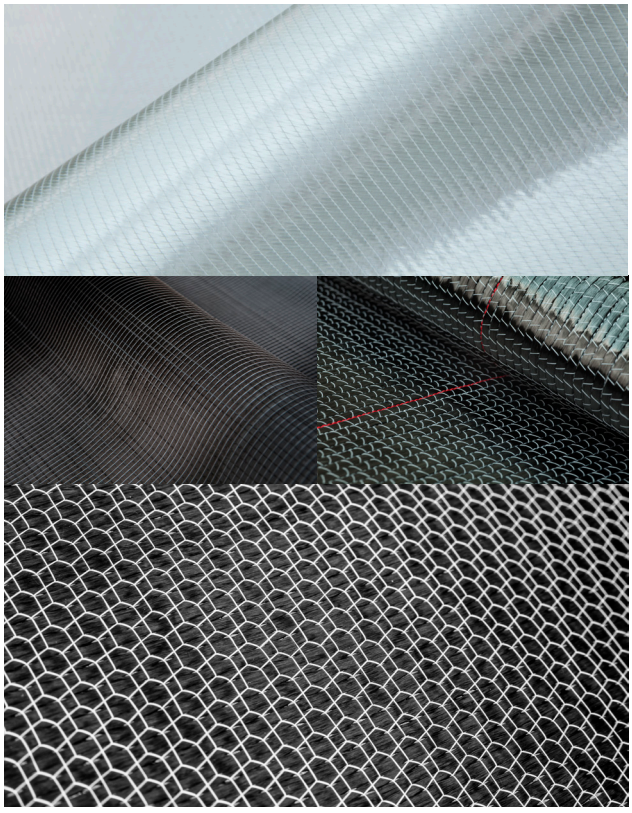
Our highly specialised machines are capable of variable widths from 1000mm to 1600mm, allowing us to offer unique new fabric constructions such as lightweight 0/90 fabrics, ply orientations from +/-22 and balanced biaxial fabrics (+/-/+) from 200 g/m^2 that ensure truly symmetrical fabrics.

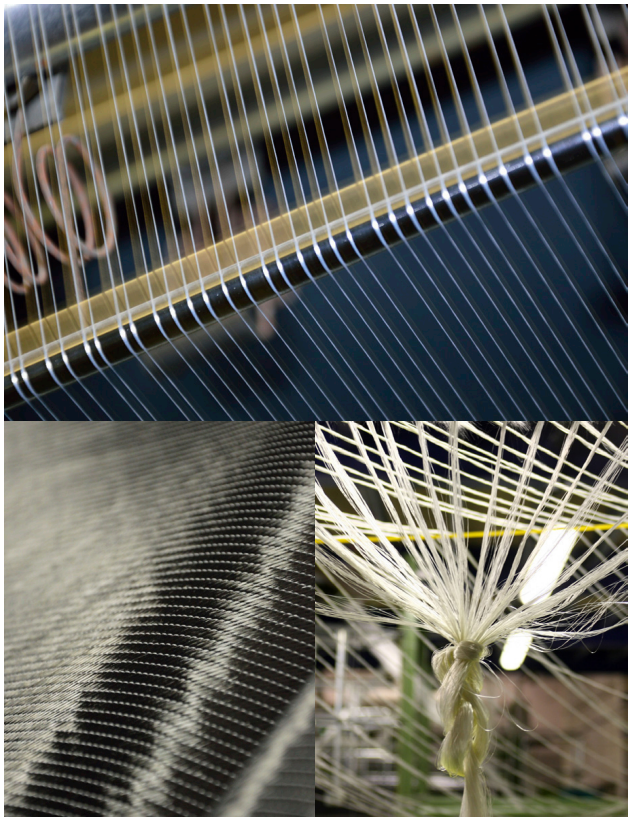
Lamination lines are also available for manufacturers wishing to create surface veils on existing fabrics. This is a popular production process for our Automotive customers where a Class A finish on all components is essential.

Innovations
Product development is integral to us. At the Hexcel Reinforcements UK Innovation Centre, our team of technicians is constantly striving to produce the next generation of reinforcement fabrics.

Working in partnership with organisations such as the internationally acclaimed Polymer Composites Group and the Imperial College London, we are confident our technologies will be utilised by some of the world's most prestigious manufacturers in years to come.

Drape Simulation Software
Hexcel has the capability to support customers with Drape Simulation Technology to improve quality prediction and the production speed of components. This specialist software enables the optimisation of fabric design by predicting how a material will perform during any given manufacturing process. For example, how successfully a fabric will drape or identify creasing and permeability issues.





Sustainability In Manufacturing
For all manufacturers, there is a percentage of waste inherent in the production of multiaxial fabrics. At our UK production facility, this waste amounts to under 7% of its total output. Whilst this percentage is low, recycling remains high on our agenda. We promote sustainable manufacturing methods wherever possible from a position of environmental responsibility and also in commercial terms.

The creation of our new Recycling Division has allowed us to devote considerable resource into optimising products for these processes and the installation of bespoke reprocessing machines means we are able to recycle the majority of our glass and carbon fibre waste. These materials are suitable for a variety of non-structural and structural applications across a range of industries.

A Global Approach

Hexcel Reinforcements UK Ltd is a trusted supplier worldwide. With short lead times and low minimum order quantities, we offer our customers complete flexibility wherever they are located.

For more information contact us at:

Hexcel Reinforcements UK Ltd
Cutters Close
Narborough
Leicester, UK LE19 2FZ

T: +44(0) 1162 752 200
F: +44(0) 1162 841 912
E: HRUK@hexcel.com

For other worldwide Hexcel sales office telephone numbers and a full address list, please go to:

http://www.hexcel.com/contact/salesoffice

www.hexcel.com

UBI 368 JY16