EPTA highlights opportunities for pultruded composites in energy-efficient building

Buildings are responsible for approximately 40% of all energy consumption and 36% of CO_2 emissions in the EU. Improving energy efficiency in buildings therefore has a key role to play in achieving the ambitious goal of carbon neutrality by 2050 set out in the European Green Deal. A new briefing from the European Pultrusion Technology Association (EPTA) discusses how composite materials can help improve the thermal performance of the building envelope to satisfy increasingly stringent energy efficiency regulations. The EPTA report, *Opportunities for pultruded composites in energy-efficient buildings*, explains how pultruded profiles offer durable, low maintenance solutions which can help reduce both operational and embodied carbon emissions from buildings in applications including energy-saving windows, thermal break connectors, and solar shading and cladding systems.

“Economic and population growth mean energy demand is set to rise, making energy efficiency measures even more critical,“ comments Dr Elmar Witten, Secretary of EPTA. “Regulations and standards will continue to push for lower U-values for building elements, driving the increased use of materials and designs which minimise operational carbon emissions. Pultruded profiles offer an attractive combination of properties for designers of energy-efficient buildings – low thermal conductivity to minimise thermal bridging, together with excellent mechanical performance, durability, and design freedom.“

It is estimated that today, roughly 75% of the EU building stock is energy inefficient, meaning that a large part of the energy used goes to waste. This energy loss can be minimised by improving existing buildings and striving for smart solutions and energy efficient materials for new builds. Areas of focus include improving glazing systems, better insulation of envelope components, and reducing unwanted solar heat gains. The low thermal conductivity of composites is being exploited in components and structures that help to minimise energy required for space conditioning.

Energy-saving windows and doors

Glass fibre composite is the material of choice for premium window systems that offer superior overall performance to wood, PVC and aluminium alternatives. Pultruded frames can deliver a service life of 50 or more years with minimal maintenance requirements and limit thermal bridging, allowing less heat transfer through the frame and reducing subsequent issues with condensation and mould. The pultruded profiles remain dimensionally stable and strong even in

extreme hot and cold temperatures, and expand and contract at a similar same rate as the glass, resulting in lower incidents of failure. Pultruded window systems with very low U-values deliver significant energy and cost savings.

Thermal break connectors and structural assemblies

Insulated concrete sandwich panels are widely used for constructing modern building facades. The external concrete layer is typically connected to the internal layer using steel rods, but these risk forming a thermal bridge allowing heat transfer between the interior and exterior of the building. When a high insulation value is demanded the steel connectors are replaced by pultruded composite bars which 'break' the heat flow and improve the U-value of the finished wall. The easy-to-install composite connector is corrosion resistant, suitable for supported and self-supporting facades, can be adapted to suit different insulation thicknesses, and facilitates large panel sizes. To prevent thermal bridging when connecting rainscreen cladding facades to insulated and non-insulated substrate walls of concrete or brick, the composite fasteners have an integrated stainless-steel threaded bar at one end to enable easy connection to the framework for the cladding panels. For applications such as cantilever balconies, where connections passing through the thermal insulation layer can lead to substantial energy losses, structural thermal break solutions are employed. These load-bearing insulation elements typically combine reinforcing steel bars and an insulating material such as EPS foam. In products designed for the highest insulation performance composite tension bars replace the steel. The lightweight, shorter pultruded bars reduce assembly weight and dimensions, facilitating installation.

Solar shading systems

Solar heat gain through extensively glazed areas can lead to overheating inside a building, necessitating the installation of energy-intensive air conditioning. Brise soleil ('sun breakers') on the building exterior control the amount of light and heat from the sun entering the building and can reduce energy requirements. Architects are also increasingly using brise soleil as a design feature enabling the creation of bespoke facades for commercial, public and residential developments. A great variety of designs and construction materials are possible. High strength and stiffness, lightweight for ease of installation, corrosion resistance and low maintenance requirements, plus dimensional stability over a large temperature range, make pultruded composites an attractive alternative to conventional construction materials. Approximately 750 pultruded brise soleil profiles were installed during the renovation of the facade of the Guynemer building in Issy Les Moulineaux, Paris. These included three different geometries with lengths ranging from 0.5 m to 13 m. They were bonded to specially designed aluminium elements to enable connection to the facade.

Rainscreen cladding and curtain wall facades

Rainscreen cladding is a popular, cost-effective way of providing insulation and weatherproofing to a building. Lightweight, corrosion resistant composites provide a durable solution for the outer 'skin' of panels that acts as the primary water shedding layer. Composite materials are also employed as infill panels in modern aluminium framed curtain wall systems. Projects utilising pultruded framing systems for glazed curtain walls are also being realised, where composite offers great potential to reduce the thermal bridging associated with conventional aluminium-glass curtain wall frames, improving the building's thermal performance without sacrificing glazing area. The 60 m high glass wall of the Neues Kranzler Eck building in Berlin was constructed using 9000 m of pultruded profiles. These were assembled on site and the glass panes then bonded to the frames.

Building a sustainable future

As operational carbon emissions are reduced through improved energy efficiency and use renewable energy, the impact of embodied carbon (that associated with materials and construction processes throughout the whole building lifecycle) will become more significant. A growing collection of life cycle assessment (LCA) and life cycle costing (LCC) studies are demonstrating the through-life sustainability and economic benefits of composites over conventional building materials, particularly in demanding environmental conditions. Lightweight, corrosion resistant pultruded profiles require less energy for transportation and installation, less maintenance resources over a long service life, and enable thin-walled designs and parts consolidation for efficient use of material.