GRC or GFRC (as known in North America) is a modern composite consisting of a cement based matrix reinforced with alkali resistant (AR) glass fibre strands.

The addition of the fibres increases both flexural and tensile strengths over more traditional pre-cast concrete. As the basic matrix composition is very similar to pre-cast concrete the resultant compressive strengths are also very similar. GRC is however not generally used in compressive load applied situations, its primary use being a lightweight concrete cladding material.

The action of the AR fibres being spread throughout the concrete matrix and the resultant higher flexural and tensile strengths allows the material to be used in the manufacture of products with a typical thickness of 12-15mm.

It is however generally not possible to produce flat sheets in large format at this thickness using established and standard compliant GRC production methods. It is therefore necessary to provide further rigidity through the use of either profile geometry or the addition of steel stud frames.

The design of the GRC and the choice of stiffening methodology is very much dependant on panel size and associated imposed loads. These loads are applied both during demoulding, finishing in the factory, transportation and ultimately when installed on the building. In GRC cladding the primary load once installed is wind pressure.

Profile Geometry.

The addition of return flanges will provide additional strength however this is generally not sufficient and additional strengthening is required to give the panel rigidity.

Such stiffening is generally in the form of expanded polystyrene placed onto the rear of the GRC skin and then sprayed over to provide a suitable geometry. This principle is known as “box rib” strengthening and is the most common form used in the UK and Europe.

The design and positioning of the box ribs is a function of engineering calculations based on the elastic and ultimate bending strengths provided by the manufacturer. All such design is based on imposed live loads being maintained below the elastic limit of the material and is the reason such testing must form an important part of the manufacturing process.

Panels manufactured using the box rib method would generally require an overall thickness of 75-100mm. As such the finished product would be identical in appearance to a natural stone or precast panel when viewed from front or side. Only when viewed from the rear (generally cavity side) would there be any visible difference.

Where the form of the GRC follows a curve the box ribs can equally follow the architectural face where the receiving structure dictates this approach.

It is a common misconception that GRC is lighter than precast concrete. This is not factual with the density of both materials being similar at approximately 2200kg/m³. The weight saving over pre-cast is a result of material removal rather than matrix weight. Nevertheless a GRC panel will generally weigh
only 10-25% of a comparable sized component in either natural stone or pre-cast concrete.

**Stud Frames**

As an alternative to strengthening using box ribs a steel stud frame can be incorporated into the panel at the point of manufacture.

This method provides the necessary strength through the attachment of the frame to a 12-15mm GRC skin using a system of gravity and flex anchors. These are bonded to the GRC skin at intervals determined by the design calculations to provide necessary restraint against bending forces. The action of the flex anchors allows a full range of movement for the GRC for both shrinkage and thermal expansion/contraction. Given the movement is accommodated in this manner the frame can then be directly attached to either the main structure or any suitable receiving unitized walling system.

Stud frames offer a quicker form of installation given the sub-contractor never has to touch the architectural GRC skin. All lifting (including initial de-mould) is to the steel frame through strops or fabricated lifting loops forming part of the frame.

Equally any slight dimensional errors to the receiving structure can be quickly and easily corrected on site.

The use of stud frames allows separately cast GRC elements to be easily bolted together at the factory to check for alignment etc. They can then be quickly disassembled, shipped and re-assembled on site. As such this method is very suitable for large independent architectural elements such as bays, spandrel/mullion assemblies etc.

The use of steel stud frames is recommended for very large panels and using this method it is possible to manufacture components in excess of 20m² although factory layout will dictate maximum panel size.

**Conclusion**

Whatever the format of the strengthening, it is important that the design and associated engineering calculations are carried out by suitably experienced and qualified technicians and engineers.

For this reason this publication is intended as purely an advisory document for initial design concept only. We recommend we are involved from an early stage to provide the specialist design input required.

More detailed information in the form of the GRCA publication entitled “GRCA Design Guide” is available free of charge from the Concrete Society.

Our design work is carried out fully in accordance with the quality management principles of ISO 9001: 2008 and is covered by suitable professional indemnity insurance.