



GRC PANELS

A lightweight advantage

Exterior panels on factories and office blocks, stone finish detail inside department stores, or flooring and bar units in a restaurant fitout: multi-use glassfibre reinforced concrete (or GRC) is a thinner, stronger, lighter weight product than traditional precast cladding systems.

In reality a range of high strength special concretes that can be engineered to suit particular products and applications, GRC was first developed as a building material in Britain by the Pilkington Glass Company in the sixties. GRC cladding products can be detailed as custom-made units for a specific design, used in modular units for system building, as overcladding to existing facades, or as studframe cladding. It's a lightweight system that allows internal finishes to be fixed direct and innerleaf walls eliminated, with a resulting increase in floor area.

GRC is a hydraulic cement and fine aggregate mortar reinforced with alkali resistant glassfibre. Additional filler materials can be added to aid characteristics such as workability and reduce curing requirements. Fibre content is typically 5% by weight. Manufacturing options include single skin panels with

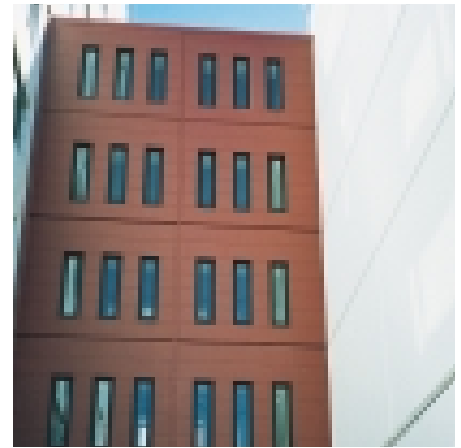
stiffening ribs, single skin panels mechanically linked to a steel stud frame and permanent formwork or shuttering with projecting cast in ties.

Research has shown GRC has a high compressive and impact strength with flexural and tensile strength being provided by the fibre reinforcing. It has good chemical resistance, will not corrode and is made of inorganic materials that do not burn. In some applications GRC contains polymer materials that might affect fire performance properties; in such cases, however, a proprietary coating can be applied to enhance fire resistance.

GRC products have a relatively thin cross section and low weight, which results in cost savings related to handling, transportation, storage and installation, in addition to the benefits that flow from a structural design based on a lightweight cladding system.



Fig 1: Behaviour of UFP



CASE STUDY 1: Centra Hotel extension, Auckland

The Auckland Centra Hotel used GRC panels to clad a four-storey extension built on top of the existing carpark. A lightweight design was specified to deal with access difficulties, caused by the location of the proposed levels 16-19, and weight restrictions (too much weight in the new structure threatened to make strengthening the existing building necessary). As a result, a structural steel framework clad in GRC panels was the preferred option ahead of large heavy conventional concrete panels.

In an innovative design solution, several sizes and shapes of cladding panel all shared the same basic concept of a thin GRC skin integrally supported by a steel backing frame, which was easily installed on site.

The frames were generally of RHS steel sections with 10 mm rods as 'twaggers'. The twaggers were welded to the frames and wads of GRC bandaged into the back surface of the skin on a

grid, generally at 600 mm centres across the panels (see Fig 1 detail). The panels had vertical pinned holes at the bases of the backing frames and a threaded screwed bolt arrangement at the top. Wind loads were a major design issue, answered by vertical members to the backing frames of the panels typically 75 x 38 x 2 RHS at 600 mm centres.

With installation a minimum of 16 floors up, the lightweight GRC panels had a significant impact on construction speed. In addition, the majority of the GRC panels for the project were window panels (which can be seen in the accompanying photographs and Fig 1 – panel type W1/2), which were all fixed and painted on the ground to reduce both crane time and the installation period. Surface finish and weathering requirements were successfully met by the system: panels were sealed on all vertical and horizontal joints, and the 'off the form' F5 surface finish was painted.



The completed Centra Hotel extension.

Panels joining the new extension on the right hand side of the existing hotel building

Installed GRC panels with windows.

Auckland Centra Hotel Extension

Number of GRC panels:	211
Surface area covered by GRC panels:	1988 m sq
Time period for manufacture and installation:	five months.

Acknowledgements

Building Owners:	Atrium Investments Ltd
Architects:	Peddle Thorpe & Aitken
Consultants:	Holmes Consulting Group
Main Contractor:	Hawkins Construction Ltd
GRC Supplier:	Pre-Cast Components (Wgtn) Ltd
GRC Designer:	Dunning Thornton Consultants Ltd

Thanks to Alun Hughes of Pre-Cast Components (Wgtn) Ltd for assistance with the article.

Case Study 2: Johnston St Apartments, 35 Johnston St, Wellington

“It went together like a Meccano set – the most common tool on site was a spanner.” Duncan Morrison, Stresscrete

On a tiny site, nestled behind Wellington’s well-known department store Kirkcaldies, an 18 storey apartment building has soared above its neighbours in what seems like a super-fast time of just under four months.

The 16-week site period included piling, foundations, 18 storeys of construction and the roof, and covered all glazing, joint sealing and a finished paint coat to cladding. And all that was done with just six men on site including the crane operator. The use of GRC panels for the cladding played a major part in the achievement.

The size of the site and its narrow frontage onto a busy inner city street dictated the form of construction. A small crane was also essential to avoid any illegal intrusion into the airspace of the adjacent building. Hence the need for lightweight panels which could be lifted by a small crane.

The modular design and construction processes developed by CDC Architects and engineers Connell Wagner, in association with Hartner Construction and subcontractors, simplified panel production, standardised frames and minimised wastage. More time was spent planning – in design, shop drawings, building moulds and manufacturing panels –

than in traditional construction, but that planning investment paid off handsomely in the reduced time on site.

The building is clad in GRC panels with precast unispan or (for wider spans) Dycore concrete floor slabs, with dramix fibre reinforced concrete topping. The floor area is 240 m² per level, with six apartments per floor. Specific attention was paid to tolerances to allow maximum off-site construction. Glazed windows were installed and fully sealed at the precaster’s yard, and all panels received an undercoat and first coat of paint before arriving on site. Then it was out with the spanner to bolt on the panels.

Significant advantages in cost, time and quality were gained as a result of:

- scaffolding and craneage charges being reduced;
- precasting of panels off-site allowing significant programming benefits (in this case, precasting in Otaki provided more reliable weather than Wellington);
- reduced need for specialist subtrades.

The mould manufacturer can create intricate patterns and shapes, to give a wide range of options for architects. For the Johnston St Apartments, Stresscrete manufactured rebate, sill and return details in GRC; the finish quality far exceeded any concrete code requirements, and minimal preparation was needed prior to painting.



Johnston St Apartments, Wellington

GRC Panels:	up to 5 m x 3 m
Number of panels:	247
Panel weight:	620 kg
Shop drawings:	75, including 50 panel drawings
Transport:	one truck load per floor
GRC rate of erection:	one floor every two days

Acknowledgements

Architect: CDC Architects, Wellington
Engineers: Connell Wagner, Wellington
Builder: Hartner Construction Ltd, Wellington
Precaster: Stresscrete, Otaki
Thanks to Duncan Morrison of Stresscrete for assistance with this article.



The Manufacturing Process

GRC is most commonly manufactured by a manual spray process (there are also mechanised systems available) in which the mortar and chopped fibre are applied in a to-and-fro movement across a mould. Roller compaction of each layer ensures compliance with the mould surface, that the fibre is impregnated by the slurry, air is removed, and adequate density develops. A pin gauge is used to check the required thickness. One surface of the product has an ex-mould finish, while the other is rolled or hand trowelled.

Curing of GRC product is very important. The most common method is to incorporate polymeric materials into the GRC mix: this forms a film around the mix particles, allowing moisture to be retained and hydration to continue. After being taken out of the mould, the product can be left to cure in ambient air conditions. **C**

GRC offers:

- Reduced product weight
- Reduced transport costs
- Low installation costs using non-specialist labour
- Edge and corner strength
- Improved surface detail and quality of finish
- Reduced maintenance – with no steel to corrode, it is unaffected by salt, extremes of temperature or biological attack
- Flexibility – easy to mould into complex shapes.

