27 GRC – STANDING THE TEST OF TIME

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SUMMARY: This paper demonstrates how GRC has been used for more than 30 years to create a variety of unique architectural buildings that have stood the test of time in a wide range of climatic conditions throughout the world.

Specific contracts are discussed from around the world focusing on old buildings and emphasising that, even after 30 years of exposure with little maintenance, the GRC is still in excellent condition. In many cases the buildings have been recently visited to assess how the GRC panels have performed.

Part of the reason for this paper is to counteract the continuing suggestions that GRC does not last.
Keywords: GRC, GFRC, AR glass fibre, durable architecture, life cycle, cladding, architectural elements, lightweight building material.

INTRODUCTION

Introduced more than 30 years ago, glassfibre reinforced concrete (GRC or GFRC) is now established worldwide as a proven alternative building material with a blend of properties that helps to create unique new or restored buildings.

For architects and engineers, glassfibre reinforced concrete offers a unique opportunity as an alternative material for cladding new or existing buildings. It is substantially lighter than precast concrete and it is ideally suited as an original or complementary material. Complex, sculptured panels can be made more economically than precast and their reduced weight makes fixing and transport easier for these complex shapes. Being relatively light, they also minimise the additional load on the structure during re-modelling of existing buildings. However, since the finish on GRC can be identical to any structural or non-structural precast panels, they are frequently used in conjunction with the latter on the same building. GRC can also reproduce, in texture and colour, most natural stones whether coral, granite, limestone or sandstone.

Many specifiers already fully appreciate these benefits but others may have been misinformed about GRC's potential and benefits especially about its life cycle and architectural durability with minimum maintenance.

This paper looks at some of the applications of GRC, focusing on its ability to create interesting but durable buildings or products. In particular, it refers to projects completed a number of years ago that meet these criteria. Some have been re-visited recently to qualitatively assess their condition.

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GRC – A DURABLE CLADDING MATERIAL

One of the earliest contracts in GRC was a small extension to the Boots Building at St Helens, Lancashire in northern England. In total, 70 single-skin ribbed panels coated in Mineralite were installed to form the top storey of the building. The architects were Seymour Harris.

Figure 1: 1974 Boots building, St Helens seen in July 2003.

In 1974, the architects, Owen Luder Partnership, built the 12- storey Fairfield West office complex in Kingston, London. In all, 516 window units and 270 mullion panels were made in sandwich panel construction with styropore concrete. The panels sat on the floor slabs with the outer section cantilevered out, resulting in increased usable floor area inside the building. The panels had a fire rating specification of 120 minutes for stability and insulation and 60 minutes integrity.

In 1997, this site was re-visited as the building was being refurbished. There were no major problems with the GRC panels except that the appearance of the building had deteriorated in London's aggressive atmosphere and it was decided to paint the panels, as Figure 2 shows.

1974 was a good year for GRC in the UK since it was also used to spectacular effect by the architects Whinney Son & Austin Hall, when they created the seven-storey Credit Lyonnais bank premises in the City of London: 1900 double-skin GRC panels were made using a plain white cement finish. The building inclines outward by 5 degrees, possible because of the light weight of the GRC panels, thus gaining extremely valuable floor space in the centre of the expensive City of London. As can be seen from this recent picture, Figure 3, it is still a landmark building.

In 2003, this building was examined by the internationally renowned consultants Arup, and the positive report of Arup Materials Consulting is presented in detail in another paper at this congress.

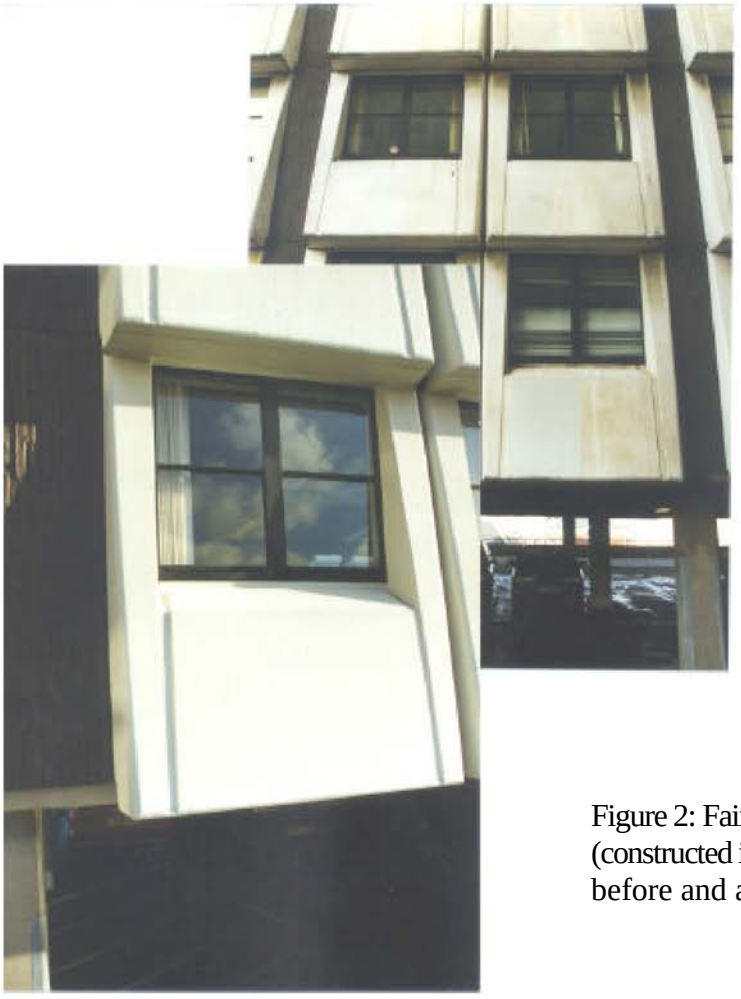

Figure 2: Fairfield West offices (constructed in 1974) in Kingston, London before and after painting in 1997.

Figure 3: The light weight of GRC panels allowed this building in the City of London to incline outwards by 5 degrees thus increasing usable floor space. Nearly 30 years on, it is still a landmark building in excellent condition.

In the USA, 20 years ago, the light weight of GRC panels combined with their ability to be moulded into complex but durable shapes was used to good effect by the architects Daniel, Mann, Johnson & Mendenhall on the 32-storey Parc Fifty Five building in San Francisco. Originally constructed in 1984 as the Ramada Renaissance Hotel, it has survived the aggressive San Francisco urban environment for 20 years without a single refurbishment of the exterior and it still looks as pristine as the day that it was erected, as can be seen from the recent photograph in Figure 4.

Figure 4: Parc Fifty Five, San Francisco. A variety of sculptured panels were created in GRC – from fluted, circular and oval column covers to delicately combed, three-dimensional spandrels panels and large arches with deep rustic joints: 3624 GRC panels cover 17,000 m^2 in total.

Also in the United States, there is another fine example of how GRC was extensively laboratory tested and then used to good effect more than 10 years ago for the refurbishing of a building in the aggressive urban environment of New York City. In 1991, GRC was approved by the architect, Carl Stein, for use on the prestigious refurbishment of Shepard Hall after completing the following battery of standard ASTM tests methods:

G-23	Accelerated weathering for 2000 hours
D-2249	Humidity resistance for 1000 hours
B-117, modified	Acid-rain resistance for 2000 hours
C-67	Freeze–thaw resistance for 50 cycles
C-666, modified	Rapid freeze–thaw for 100 cycles
C-67	Water absorption
C-67	Efflorescence
D-3273	Mildew resistance.

This testing programme required 4–5 months to complete. These tests were aimed at predicting the long-term effects of the New York environment on the appearance and stability of the panels over a predicted life of more than 50 years

Phase 1 was completed in 1992, and required 12,000 replacement units. The project replaced the upper 20 m of the main tower, clerestory window surrounds, copings and finials. In Phase 2, a further 6200 units were used to replace tracery and window surrounds for 12 stained glass windows 11 m high, ten highly decorated finials 7 m high, and various copings, mouldings and quoins. Phase 3 (see Figure 5) required about 11,500 replacement units, involving the reconstruction of a 35 m-tall tower, six projecting bay windows, each 11 m high × 6.7 m, numerous moulding surrounds, copings and quoins.

Figure 5: The reconstruction of the exterior of Shepard Hall, built in 1907, is a multi-phase project that will eventually lead to the replacement of 72,000 units and over 4000 shapes, including many ornate sculptures. The project is still on-going and it is a tribute to GRC that many of the new elements are being fixed next to 10-year-old pieces with no discernable differences being visible.

Middle Eastern countries have, for more than 20 years, also created a large number of architecturally individual buildings using GRC panels and decorative details. Figure 6 is a fine example of this. Completed in the early 1984, the Corniche Towers was, at the time, the tallest building in Abu Dhabi. The GRC was specified from the outset and considerable savings were achieved in the main structure and foundations because of the light weight of the GRC panels. In total, 1532 panels with 26 variations were rapidly hoisted into place with a tower crane and later manhandled to their final position. 9736 m^2 of GRC that has given 20 years of trouble-free performance.

Figure 6: Corniche Towers, Abu Dhabi: nearly 10,000 m^2 of GRC has given 20 years of trouble - free performance in the Middle East' s hot, salty and sandy environment.

Even earlier, in 1981, the Arab Bank for Investment was built, with the architects, ACG, demanding " narrow, soaring arches in smooth white GRC " (Figure 7). A total of 4970 m^2 using 864 panels were used. Because of the fine airborne sand in the region, the building has been re-painted but other than that, the GRC has performed extremely well.

Figure 7: Arab Bank for Investment and Foreign Trade. The architects demanded "narrow soaring arches", which have stood the test of time over the past 22 years.

SUMMARY

One could continue with examples from South East Asia and Japan, to Australia and New Zealand, where there are countless examples of building clad in GRC. There is the rest of Europe. There is also the vast range of other GRC applications – agricultural products, ducts and channels, dry bag mixes, permanent formwork, noise barriers – many made for 25 years or more and nearly all performing well. Like other materials, GRC has had its share of troubles but these, as is often the case, were caused by factors such as poor fixing or poor quality control and not with the inherent material itself. There are sufficient examples of old GRC in use around the world, and this paper has only looked at a minute portion of them, to pronounce without a shadow of doubt, that GRC has truly stood the test of time!

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