DETERIORATION, HARM AND CONSERVATION OF BUILDING PLASTICS HERITAGE

Robert Loader

ABSTRACT: From the 1950s to 1970s a handful of architects and designers developed the use of glass-reinforced plastic (GRP) for external building skins that expressed the nature and possibilities of the material. External panels were designed as non-structural interchangeable cladding and also as structural folded plates and shells.
Many GRP buildings were designed as temporary structures and have long since disappeared. Some have survived and, in England, a few have been recognised with listed status for their architectural quality. At about fifty years of age the condition of polymeric components, such as external panels, fixings and joints, is beginning to present new problems in conservation. The case studies in this paper indicate that early estimates for the design life of GRP buildings and components have been surpassed, and that a range of approaches is available and necessary for their conservation.
Innovative plastic buildings and components also remain at risk of damage and demolition from a lack of awareness of their existence and value by heritage protection bodies.

KEYWORDS: GRP; United Kingdom; heritage listing; documentation; prototype

INTRODUCTION: The impetus for this research followed the two seminars in Delft and Antwerp organised by the Docomomo International Specialist Committees for Technology and Interior Design. The seminars addressed the problems of understanding the technical characteristics and performance of polymers in construction. This article focuses on 'architectural', external plastic elements, where large components enclose and define the character of a building, and it takes examples from the UK, where there are a few listed buildings with significant plastics content. As a note, GRP is the abbreviated term for glass-reinforced plastic/polymer, or, more precisely, glass-fibre reinforced polyester. The term, FRP refers more generally to fibre-reinforced plastic or polymer that could include reinforcement materials such as carbon fibre, Kevlar and graphite. Much of this article is informed by discussions with chemists, conservators and practitioners, but detailed descriptions of the chemical and physical properties of polymers in building should be sought elsewhere. Other uses of plastics, such as internal sanitary components, represent a rather different technology, and their life-cycle is outside the scope of this article.

EARLY DEVELOPMENT OF GRP BUILDINGS

In the 1930s the two main components of GRP, unsaturated polyester resin and woven glass fibre were sufficiently developed to enable commercial use, and by the early 1940s the composite material was in use for aircraft components. The 1950s was a period of wide experimentation: in 1954 Buckminster Fuller developed geodesic electromagnetically permeable radar domes in GRP. The use of GRP for small boats and vehicle bodies increased dramatically, and translucent, corrugated wall and roof panels such as *Kalwall* were marketed to immediate success.

Architectural development of prefabricated GRP buildings emerged in the mid to late 1950s with multiple experimental exhibition and holiday houses, most of which have not survived. In 1956 Ionel Schein, Yves Magnant and R. A. Coulon demonstrated the all-plastics *Snail Shell* house at the Paris Exhibition which proposed incremental extension around a central living space. At the end of the same year the group exhibited a motel cabin with double curvature forms designed for easy transportation and grouped assembly. In Germany in 1958 Rudolf Doernach showed a small weekend house of double-curved roof-wall shell panels and vertical fluid-filled, translucent, honeycomb-cored panels.

The best-known example from the period is the *Monsanto House of the Future* (sponsored by the Monsanto Chemical Company), which was designed by Hamilton & Goody with Professor Albert Dietz as engineer and completed in 1957. It featured four large GRP wings cantilevered from a central core. The shell sandwich panels that enclosed the 4-inch honeycomb core were 8ft x 16ft, and tests throughout its 10 years in Disneyland showed excellent structural performance.

Also, in 1957 an all-plastics house designed by Cesare Pea consisting of four GRP boxes to be assembled in different configurations was exhibited at the Milan Exhibition. Subsequently, at the 1962 International Prefabrication Exhibition in Milan a group comprising R. Piano, R. Foni, B. Huet and C. Ruggieri under the direction of Professor G. Forti of the Technical University of Milan showed a hexagonal holiday house comprising 12 floor and roof panels and 6 vertical wall units. Piano continued further experimental work with GRP wall and roof panels through the early 1960s, during which time he met engineering professor Z. S. Makowski, who was teaching in London at the Battersea Institute of Technology (later Sussex University). Makowski had contributed to the structural design of the (aluminium) stressed skin pyramidical roof of the UIA Pavilion erected in London in 1961, and over the next decade he continued to lead significant research and practice in GRP, space structures and structural panels.

None of the examples above prompted popular mass production of prefabricated GRP dwellings. However, in 1961, Mickleover Transport, a vehicle body manufacturer, began producing self-supporting wall and roof panels to enclose signal relay rooms for British Rail. There were three different panel types: a corner unit and two side units of different spans. Each phenolic-cored sandwich panel comprised wall and roof in a single double-curvature shell. They could be easily assembled on sites with difficult access and were later used for electricity sub-stations. Further variations included a two-storey telephone exchange for Bakelite in Tyesley and, in 1963, a research station for the British Antarctic Survey on Signy Island in the Antarctic [FIGURE 01]. None of these small functional enclosures are known to still exist.

In the late 1960s the development of the *Futuro* house, designed by Matti Suuronen and the *fg 2000* house by Wolfgang Feierbach achieved greater popularity and multiple production. Both were exhibited from 1971 at the IKA (International Plastic Housing Exhibition) in Ludenscheid, Germany - a high point in public enthusiasm for plastic buildings. After this, the decline in the viability of GRP buildings can be attributed to the massively increased costs of polyester resin following the oil crisis of 1973, and lingering, unresolved technical concerns of fire safety.

01 The Biological Research Laboratory at Signy Island, Antarctica, nearing completion in April 1964. Double curvature GRP panels produced by Mickleover Transport. © F. Topliffe, 26 February 1964. Reproduced courtesy of the British Antarctic Survey Archives Service. Archives ref. 2006/2.1

COMPOSITION AND DEGRADATION OF GRP

GRP is a composite material made of glass fibre reinforcement encased in a thermosetting resin, which, for building purposes, is generally polyester (epoxy, polyurethane and vinyl are also sometimes used). When suitably protected, GRP has good corrosion and weather resistance, making it suitable for long-term use in external conditions.

GRP panels and components for single building projects are usually fabricated by 'hand lay-up', rather than mechanised fabrication that would be more economic for longer production runs. Panels are formed by laying fibreglass and liquid polyester resin into moulds. The fibreglass is pressed in, and the resin is poured over and cured (hardened) by the addition of catalysts. Successive layers of glass fibre and polyester build-up tensile and compressive strength.

Within the range of glass fibre there are different weights and thicknesses of material, various weaves, or random chopped strands that are selected according to application. The resin may contain fillers and plasticisers, UV stabilisers and other additives for colour retention, toughness, surface quality and protection against flammability. Varying mechanical properties are created by different combinations of the polyester base components.

Degradation of polyester can be caused by physical forces, light, UV radiation, oxygen, water, contaminants, chemicals, temperature and humidity. The associated visual changes include loss of gloss, yellowing, surface cracking, loss of material (in the form of chalking – filler leaching out), deformation and delamination. There may also be loss of mechanical strength. Stability against these problems variously depends on the type of polyester, the application of the glass fibre and the workmanship.

Moisture will attack the interstices of glass fibre reinforcement, so the outside of a panel is protected by a layer of resin known as the gel-coat. This is a relatively

02 James Stirling in the Anmac factory, Nottingham. © R. Nicholson

03 Drain-pipes and vents cut through a GRP panel at the Olivetti Building, December 2018. © R. Loader

thick protective resin layer of about 0.5 mm that gives the characteristic high gloss finish of new, un-weathered GRP. It is applied as the first layer to the waxed and polished mould as a thick liquid, and while still tacky, the next layer of resin and fibreglass is applied. The gel-coat is usually pigmented in order to hide the substrate.

Research into the ageing and conservation of plastics is mostly located in the world of sculpture and furniture conservation. Prominent examples are the conservation of the GRP Panton chairs at the Vitra Design Museum as part of the Axa Art Conservation research programme.[1] Artists such as Nikki de St Phalle (1930-2002)[2] and Joep van Lieshout (*1963)[3] have produced large GRP outdoor sculptures that have undergone significant conservation interventions. In the case of museum and art objects, intensive investigations are carried out to identify the base components of the polyester and glass, the methods of polymerisation and manufacture.

Sculpture can be brought indoors, either for treatment, or to be permanently relocated away from the causes of degradation. The Floating Sculpture, Otterlo from 1961 by Marta Pan (1923-2008) in the Kröller-Müller Museum is brought inside each winter.[4] The Futuro house held by the Museum Boijmans van Beuningen in Rotterdam has been repaired, cleaned and waxed, but is now only displayed indoors. Clearly, this approach is not a solution to buildings in use. The following section describes the condition of five buildings, and the maintenance measures that are in place.

EXAMINATION OF FIVE GRP BUILDINGS

GRP buildings that survive from the 1950s or 1960s are virtually unknown. The section below describes the context and conclusions of visual assessments from 2018 to 2021 on the state of conservation of four buildings from the 1970s, three of which are listed:

- the Olivetti Building in Haslemere, Surrey (now the Jamia Ahmadiyya), completed in 1972,
- the Kennington Road Primary School classroom in Fulwood, Preston, completed in 1974,
- the Herman Miller Factory in Bath (now Bath Spa University), completed in 1978, and
- Yachtsmen's Showers and Lavatories at Brighton Marina, completed in 1978.
- Prototype acrylic bathrooms for ICI, ca. DATE

THE OLIVETTI BUILDING, HASLEMERE, SURREY

The Olivetti Training Centre (now the Jamia Ahmadiyya), designed by James Stirling and completed in 1972, is now listed Grade II*. This is a high level of heritage protection, though at nearly 50 years old, the building has not yet had major maintenance work.

The GRP panels at Olivetti are ambitious in terms of size and form: wide single panels merge from wall to roof and special panels project over window heads. Alternating coloured GRP panels were previously used at Stirling's Runcorn housing (now demolished) to line the sheltered deck access fronts and soffits, which emphasises the playful and 'artificial' nature of the material. The panels consist of 12 mm polyurethane foam faced each side with GRP and, for fire-resistance, mineral wool is attached to the inner face of the panel. The outer finish of the panels is not a typical gel coat, but a two-part polyurethane applied later and under more controlled conditions than were available at the time of manufacture. R. Nicholson, the project architect, has recounted that the 1972 miners' strike had disrupted supplies of heating coal to the Anmac factory in Nottingham [FIGURE 02], so conditions for curing panels with consistent colour were not reliable.[5] Walker described the polyurethane to have been badly weathered

04 Corner voids due to an absence of glass fibre matting behind the outer gel-coat layer at the Olivetti Building, December 2018. © R. Loader

05 The classroom at Kennington Road Primary School, October 2018. © R. Loader

after fifteen years.[6] Trial repairs were carried out using a two-part polyester spray filler as an isolator between the original surface and new coatings, but it is not evident that the whole building was treated.

The worst damage to the GRP is man-made, comprising various service and drainage connections that have been drilled through the panels [FIGURE 03]. These will compromise the fire protection to the panel and water penetration will result in delamination of the fibreglass. For minor mechanical damage to GRP there are well-tried techniques to rebuild solid fibreglass components, as previously recorded by Beerkens for the repair of the entrance steps to the Futuro House at the Boijmans Museum.[7] However, damage caused by pipe holes, especially through foamed sandwich panels, presents a more awkward problem. Face-fixed GRP disks would be a straightforward solution to seal the exterior and interior and, although visible, once painted, would then be relatively unobtrusive.

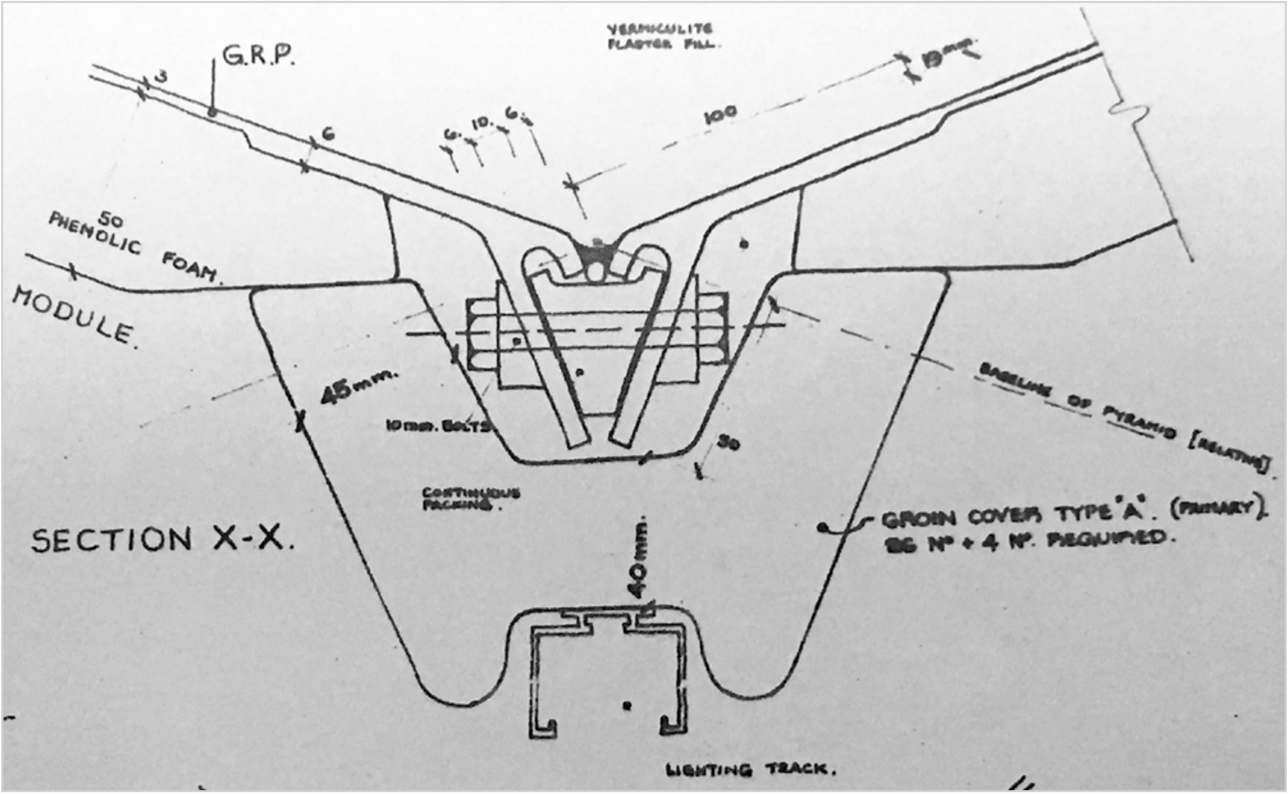
Along the external corners of many panels on the Olivetti building are small voids [FIGURE 04], similar to those found on the *Futuro* house held at the Boijmans Museum. This is a common problem with tightly radiused panel corners and is due to poor fabrication workmanship. If fibreglass is not sufficiently pressed into the corners during manufacture, a cavity is left between the fibreglass-polyester matrix and outer gel-coat which will eventually collapse. In the case of the *Futuro* house these voids were fairly easily treated by injecting gel-coat resin and filler into the void.[8] But if left untreated these voids provide an easy route for moisture to penetrate to the interior of the panel.

Orientation and surrounding flora may also have a significant impact on external GRP. The long east facade of the Olivetti building is close to a dense plantation of pine trees, and there is a build-up of algae on the parapets each winter. At the base of the building a small brick parapet (probably not original) inhibits air movement and evaporation from the bottom of the panels.

The outer coating of the GRP panels is clearly ageing with some small areas of delamination. Overall the surface is becoming progressively rougher, which in turn increases the retention of water and dirt on the panels, and thus increases the likelihood of water penetration and decay within the panels. Preliminary work with the new owners by the author suggests that future maintenance and recoating strategies will need to embrace the spirit of GRP amateur enthusiasts who, after some training, will be able to dedicate their own time and effort to maintaining the building.

EXPERIMENTAL CLASSROOM AT KENNINGTON ROAD PRIMARY SCHOOL, FULWOOD, PRESTON

The classroom at Kennington School in Preston is a sophisticated assembly in a modified icosahedron shape using tetrahedral folded-plate structural panels [FIGURE 05]. The building was designed by Lancashire County Council Architects Department (Architects: Ben Stephenson and Mike Bracewell under Roger Booth, County Architect, and Structural Engineer Roy Partington). It was completed in 1974 as a prototype for a full-sized primary school that was never built due to the rapid increase in oil and hydrocarbon prices in 1973. The classroom was listed Grade II in 2017. It is unusual to use GRP in this way, and the engineer, Roy Partington was an important figure in the design team in promoting folded plate construction. Z. S. Makowski with L. Holloway of the University of Surrey were later appointed as consultants to assist with detailed analysis of the structural design, and Holloway and Partington subsequently published their work.[9] The attention to economical structural design is exemplified in the very thin GRP walls: the main body of the panels is only 3 mm thick, increasing to 6 mm at edges and corners [FIGURE 06].



06 Panel to panel construction detail showing fixings through teak spacers and a phenolic groin cover to provide continuity of insulation and fire protection. Part of drawing titled, Prototype GRP Structure for Experimentation, file SMFu/1/4. © Lancashire County Council Archive

The panels at Kennington School had an intended structural design life of 40 years on the basis that excessive deflection due to assumed GRP deterioration would cause building failure.[10] The variability of initial assumptions regarding the durability of the material, combined with the rapid technical developments during this period makes a reliable estimate of the design life extremely difficult. However, after nearly 50 years the building appears to be in sound condition. and this observation was supported by the Building Research Establishment (BRE), which concluded that the potential design life of GRP components could be extended to up to 100 years.[11] Encouragingly, there have not yet been reports of structural failure in the many shell structure Futuro houses that exist, some of which are closely monitored by their private or institutional owners.

Phenolic foam was added to the Kennington School panels for thermal insulation and also to act as fire protection to the interior face of the single skin panels. After the outer face had been fabricated by hand lay-up, a timber form was located 50 mm away to create a two-sided mould for phenolic insulation to be injected between both skins.[12] An initial fire test found that the foam cracked and quickly caused the panel to fail.[13] To solve this problem, a 'veil' of chopped strand glass-fibre matting was attached to the inner former which bonded to the inner face of the phenolic foam. When set, the inner panel was lifted off and the foam exposed. This reinforced face performed very well in subsequent fire tests and is still in place as an exposed (now painted) finish [FIGURE 07].

07 Photo during construction showing the pink exposed phenolic insulation (subsequently painted). The panel to panel joints are yet to be clad with pre-formed phenolic groins. © M. Bracewell

The original, finely corrugated character of the outside of the panels (formed by an acrylic insert in the production mould) is no longer visible due to recent waterproofing work in which a thick, fibre-reinforced liquid resin, Acrypol+, has been applied over the panels. Previously, the fine, incised lines controlled and directed water run-off, while the new rough coating is quite effective at trapping the water, dirt and algae that accumulate every

08 The classroom panels in February 2019 before cleaning. A build-up of dirt and algae is trapped in the fibres of the new reinforced polymeric coating. © S. Pritchard

09 Cut-away section through a typical Herman Miller panel showing the double sandwich panels and air cavity. The panel face is painted, but the original gel-coat colour is visible around the perimeter edge. © R. Loader

winter [FIGURE 08]. Once applied this coating is practically impossible to remove.

While the owners of Futuro houses may often be willing to dedicate their spare time to applying a protective wax coating to the GRP shells of their homes, this technique may not be suitable for the owners of larger buildings. Where exposed to the weather the outer surface of GRP will, over time, become rougher and less able to shed water and dirt, at which point it is usually necessary to add a suitable and sympathetic secondary coating. Interesting new developments of more robust finishes that incorporate hydrophobic nano-coatings that accelerate water run-off may soon offer further enhanced protection to GRP.[14]

In terms of planned maintenance for the external skin of GRP buildings a few points are generally valid. The external coatings of all the examples here have been over-painted and have variable maintenance regimes. As a minimum, most are cleaned down regularly, the purpose being to remove dirt and algae that will retain water on the panel. The Olivetti building is pressure washed every spring, and, unsurprisingly, some leakage internally is sometimes noted. Pressure washing is not recommended. The Kennington Road School classroom is cleaned every spring with de-ionised water. This, too, is not usually recommended as de-mineralised water can more easily penetrate an exposed gel-coat. As a generalised and simple approach to cleaning, warm, soapy, ph-neutral water should be sufficient.

THE HERMAN MILLER FACTORY, BATH

The Herman Miller furniture factory in Bath by Farrell & Grimshaw Architects, was completed 1978, and listed Grade II 25 years later in 2013. It is recognised as an important early work by one of Britain's foremost Hi-tech architects. The building has recently been converted to a school of art for Bath Spa University under the supervision of Elyse Howell-Price and Allan Green of Grimshaw Architects and specialist facade consultant, Harry Montressor.

The outer envelope of the building was designed to provide a flexible building façade with standard and easily demountable and interchangeable units of insulated GRP panels, louvre panels or glazed panels. The panel thickness at the flange is 6 mm to match the glass thickness and to enable a universal joint for either GRP or glass. Neoprene cappings are pressed into aluminium top hat sections to hold the panels in place without mechanical fixings through the flanges. This protects the panel edges and allows thermal expansion of the GRP. The GRP panels have an elaborate construction: two separate sandwich panels were fabricated and then joined to form a captive air cavity between both [FIGURE 09]. The inner panel contains 25 mm polyurethane foam and the outer has 19 mm foam. Jeffrey Scherer, the project architect for the original building explained the rational:

We knew that there was a conundrum in having the panels all with a 6 mm flange. The thermal bridge at this pinch-point was not ideal. However, after calculating the relativeness of loss from this flange, we decided it was, in the end, a fairly minor element in the overall heat transfer values. We mitigated this loss by expanding the cavity (filled with foam insulation) and increasing the insulating capacity of each panel. Since we had a large number of repetitive panels, we could invest in high-quality moulds that were specifically tailored to the unique duality of demands: aesthetic and technical. In addition, the gel-coat could be custom color to give us the richness of "clotted cream" that we wanted. We also needed to have soft edges in the transition from the flange to the cavity to let the light refract. This, we felt, would help to transform a pre-engineered and manufactured "machine part" into a more human-scaled element.[15]

At an early stage of the renovation seven panels were removed for examination. The results showed them to be in reasonable condition with only two having some damage along edges. This led the design team to revise the initial working assumption of complete panel replacement to a strategy of retention and renovation whenever possible.[16] This approach was also encouraged by the local authority conservation officer. Subsequently the cost of replacement panels for the whole building was estimated at many times more than refurbishment, which helped ease the decision to support the potential risk and costs of more frequent maintenance of the older panels.

Subsequent and more detailed visual inspection of the internal and external condition of the GRP panels found that approximately 53% of the panels were classified as being in a 'Good' condition, 30% were 'Repairable' and 17% were classified as 'Condemned', to be removed and replaced. As seen at Olivetti the main cause of damage in condemned panels was deliberate interventions such as drilled services holes.

The original gel-coat on the Herman Miller panels had already been over-painted at least twice and probably three times. Anthony Walker records that in 1992 the original gloss finish had weathered to expose filler material which was leaching to the surface.[17] Degradation of the outer layer had also exposed pin holes in the face of the panel which was very conducive to algae growth. The cladding panels were retained in position on the building, sanded down and re-sprayed with two or three coats of two-part polyester, followed by a 30-50 microns fluoropolymer top-coat.

In the recent major renovation work (2018-19) all the panels were removed and completely sanded to avoid possible problems of adhesion with the new finishing paint. Three adjacent, temporary tents for sanding, cleaning and spraying were erected within the building. The finished coating comprised two coats of spray applied Selemix 7-532 polyurethane paint. A high gloss was not chosen in order to avoid highlighting imperfections in the substrate. By the end of the project, only about 50 new panels had been made which were all fabricated to the same double-panel design and also spray painted for uniformity. The neoprene gaskets that hold the panels in position had hardened over the years and were replaced with heat-cured silicone gaskets to the same profile.

While the Herman Miller panels were sized and designed for easy interchangeability, the panels at the Olivetti building are extremely large, and fixings are hidden behind internal casings. Until further investigation takes place it isn't clear how easy it would be to remove any individual panel for repair or replacement.

The external GRP skin on buildings such as Olivetti or Herman Miller is highly significant, and preserving the integrity of the GRP must be the priority in caring for the building. This usually means protecting it from water ingress by maintaining the outer coating. In an external environment it may be necessary to differentiate between the conservation of the finished coating and protection of the underlying panel, so where an original gel-coat exists, it is necessary to accept that it will only be temporary and sacrificial. However, it is also a reality that secondary paint coatings applied in-situ are not yet able to recreate the depth and smoothness of original gel-coats. Typically, a top-coat will have a thickness of up to 100 microns, and so cannot reproduce the very deep, polished appearance that is typical of gel-coats (500 microns thick). In addition, secondary coatings have to be re-applied regularly, especially if they are carried out on a building site where temperature and humidity cannot be well controlled.

Alternatively, if a highly polished and smooth finish is important for the significance of the building, it is possible, where an intact gel-coat still exists (and budget allows), to use a diamond paste (a fine abrasive) that will bring back the colour and polish. This removes about 10 microns of gel-coat (from 500 micron gel-coat thickness), so, even with repeated polishing it can be expected that the life of the gel-coat can be significantly extended. The choice between conserving the original gel-coat or accepting a gradual loss of gel-coat over the expected lifespan of the panel will be determined by an evaluation of the significance of the building and its components. It should be borne in mind that a renewed high-gloss appearance will, like the original, only last a few short years before it again dulls down.

10 Building for Yachtsmen's Showers and Lavatories at Brighton Marina. © R. Loader, October 2019

YACHTSMEN'S SHOWERS AND LAVATORIES, BRIGHTON MARINA

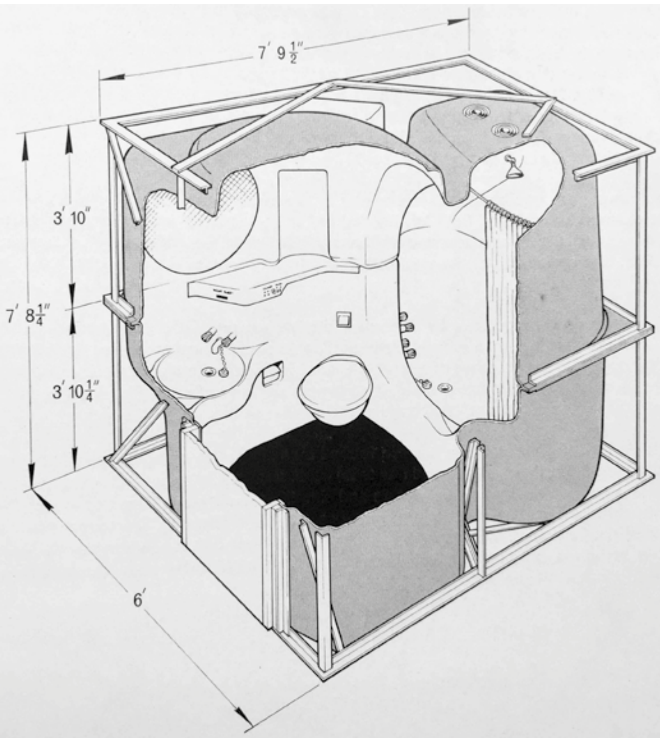
It is often assumed that the small surviving collection of plastic buildings has been completely documented.[18] However, two small buildings in Brighton Marina designed by Eva Jiricna while she worked at the Louis de Soissons Partnership in the 1970s were recently 'discovered' and documented by the author. These are small, utilitarian dock buildings for what was termed, 'yachtsmen's' showers and lavatories. The buildings are constructed from GRP, prevalent in boat-building, so a directly analogous and logical material choice for marina buildings (later structures by others using steel cladding show considerable deterioration in the sea-side environment).

The structure of the buildings is clearly expressed as deeply ribbed GRP sections that utilise the inherent properties of the material to form self-supporting composite wall and roof sections [FIGURE 10]. Panels are bolted together with cover strips over the joints between each segment. The deep corrugations span the full width over the building before neatly terminating at the bases above an elegantly recessed concrete upstand on each side. Doors and louvred vents are carefully set into specially designed panels. The structural design for the self-supporting segments was carried out by Arup, but as there were no published design codes at the time that were accepted by the local building control authorities a steel frame had to be introduced under the roof in case of panel failure.[19]

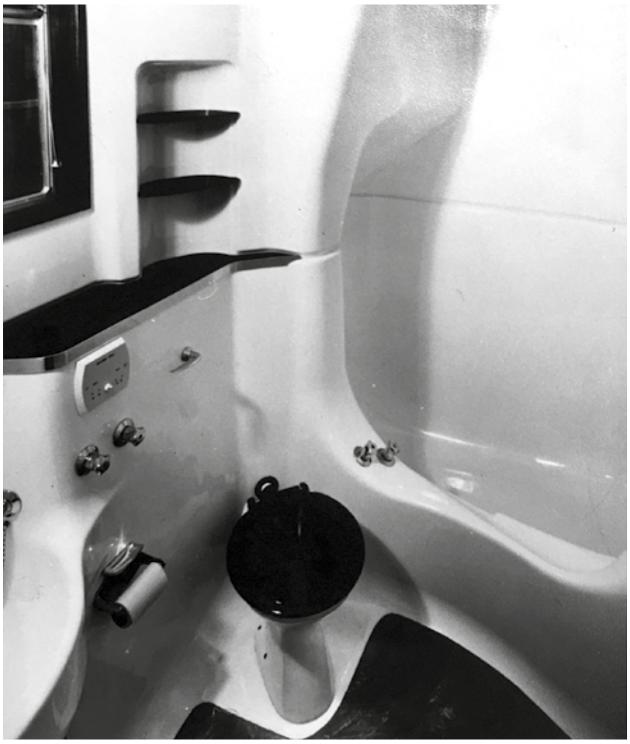
The building panels have been largely unmaintained over decades, but as they are located beneath the main jetty structure the GRP is largely protected from direct sunlight and rain, so is in quite good condition for its age. Nevertheless, the building owners have already demolished two similar unlisted structures, and the two surviving structures remain at risk. The author has proposed to the local authority that these buildings should be locally listed, which remains under consideration by the local authority at the time of writing.

RECENTLY LOST

A recent loss of plastics heritage is an early example of a full bathroom in vacuum-formed acrylic that was designed by David Kirby at ICI in the mid-1960s.[20] In 1962 Kirby joined the Building Development Group at ICI to explore commercial opportunities in the building industry. About twenty prototypes of domestic service cores were fabricated for new houses [FIGURE 11, FIGURE 12], and one installed



11 Drawing by David Kirby of the ICI acrylic bathroom and kitchen pod. © ICI Building Development Group, Bulletin 1, Service Cores and Prefabricated Bathrooms, June 1964


12 Photo of the ICI acrylic bathroom and kitchen pod. © ICI Building Development Group, Bulletin 1, Service Cores and Prefabricated Bathrooms, June 1964

13 Intact ICI prototype acrylic bathroom, Hartford, England. © R. Loader, November 2021

14 Remains of a prototype ICI acrylic bathroom pod recently removed from a house, Hartford, England. © R. Loader, November 2021

in Kirby's own house [FIGURE 13]. Development of these pods preceded some better-known examples of bathroom and kitchen modules that were produced in GRP such as Farrell and Grimshaw's bathroom tower in Paddington and in Charlotte Perriand's work at Les Arcs. ICI did not continue with the programme for fire safety reasons and because the economic viability for mass production was unlikely to be achieved. Sadly, at a recent visit we found the remains of the upper bathroom in the garden that had just been removed from the house and destroyed by new owners [FIGURE 14]. Some years ago the house and bathrooms were considered for local listing, but not included.

CONCLUSION

The recent 'discovery' of the Yachtsman's dock buildings in Brighton and the loss of the ICI prototype bathroom in Hatfield indicate that a comprehensive catalogue of significant plastic buildings has not been completed in the UK, so leave potentially important buildings at risk.

Relatively little attention has been given to the maintenance of GRP buildings, either in terms of reactive repairs or planned maintenance. External GRP panels do not survive external conditions without regular maintenance and occasional recoating, and various options for protecting GRP panels and preserving or renewing the outer coating exist. Where feasible, damaged cladding panels have been successfully replaced in facsimile. However, where a complete listed building comprises structural GRP panels, it may have to be envisaged that the solution will lie outside the usual range of conservation remedies and may even need to extend to complete replacement.

The topics and case studies above illustrate that the construction of plastics buildings of the 1960s-70s varies greatly, which reflects the experimental and inventive nature of the emergent technology. Substantial research is necessary to properly understand the unique structural and material characteristics of each building. Not only owners, but also the heritage authorities need to be more aware of the characteristics of GRP, how to care for it and that it is suitable for consideration as part of our conserved built heritage.

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Robert Loader *(Italy, 1960) Liverpool University (BA, BArch) and University College London (MSc, History of Modern Architecture). Robert Loader is an architect based in London with extensive experience in repairing and upgrading historic buildings and neighbourhoods. Current research focusses on the materials and conservation of building facade components developed in the twentieth century. He is Secretary of docomomo UK and Chair of the Docomomo International Specialist Committee on Technology.*