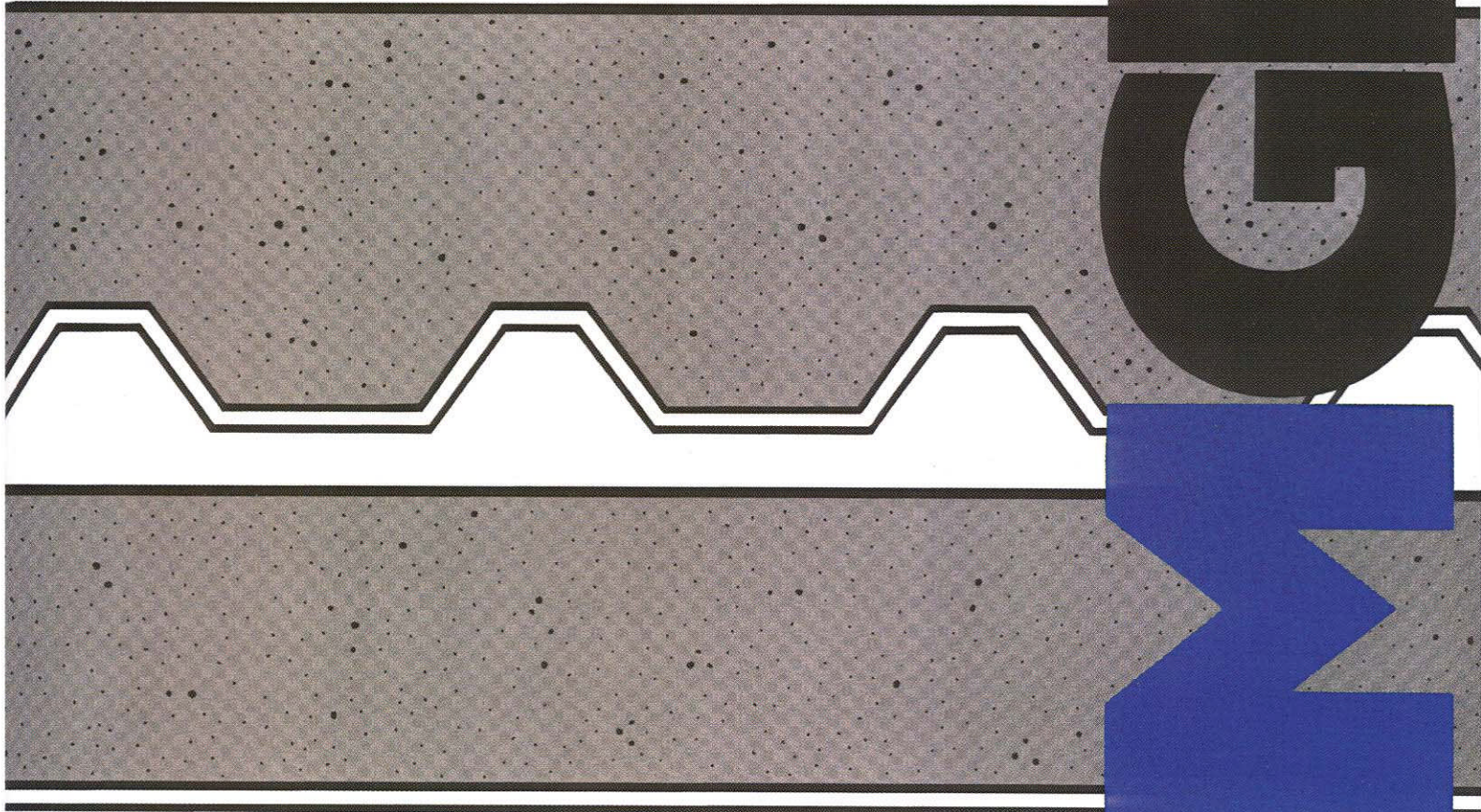


PERMANENT FORMWORK

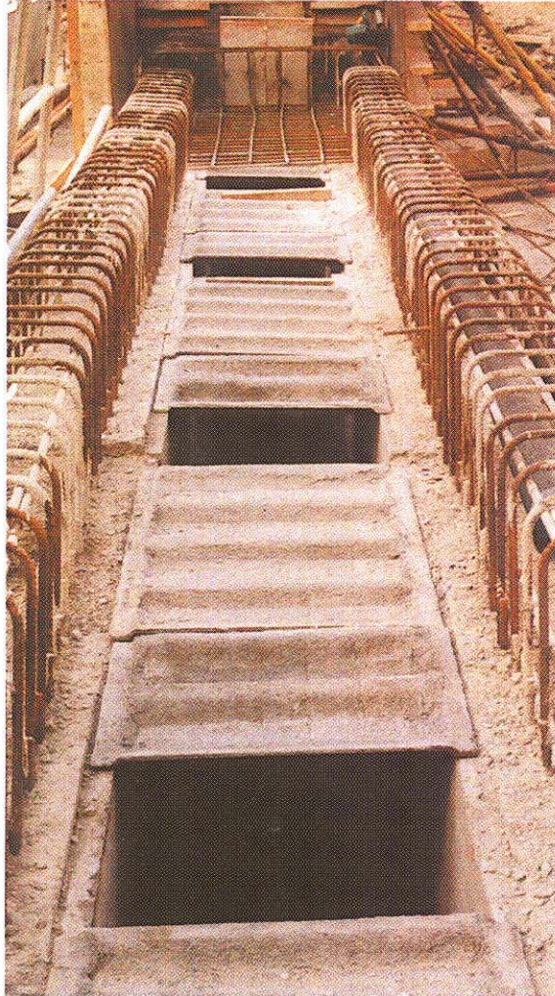


**CORRUGATED OR FLAT
TO SUIT ALL SUPPORTING
BEAM DESIGN**

**U
B
G
K
C
B**

A Tried & Tested Product

Glass reinforced cement (GRC) has been extensively used as permanent formwork for the past twenty years. The extent of its success and its practical application can be illustrated by the fact that more than 45,000 square metres were used on various bridge and tunnel contracts during the construction of the M25 alone and that many hundreds of thousands of square metres have been used world-wide.

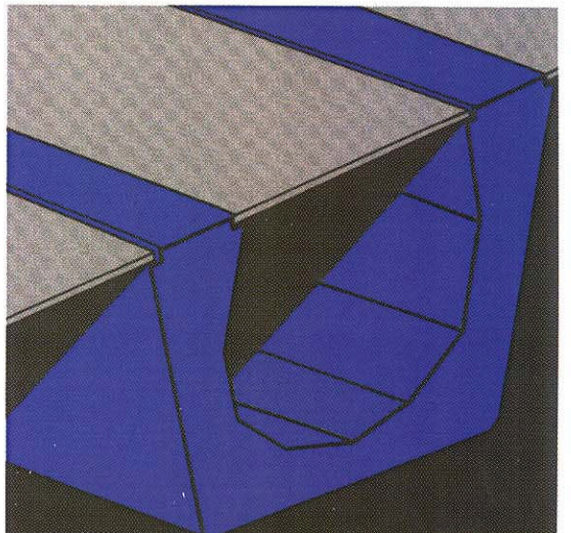
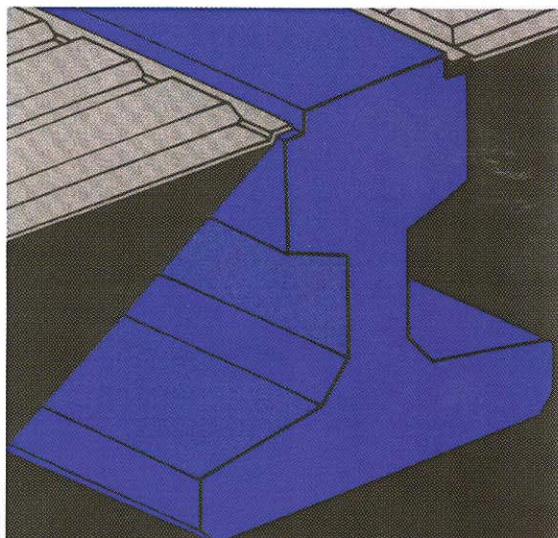
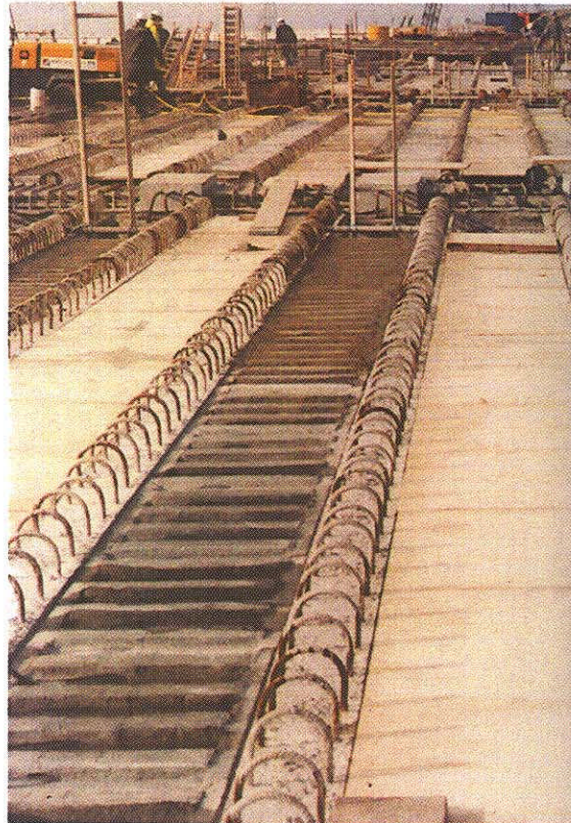


10mm thick corrugated panels used by Cementation to support 500mm of concrete on the A406.

Features

GRC formwork has excellent performance characteristics and its inherent material properties provide the specifier and contractor with a permanent surface skin to the bridge deck concrete which:

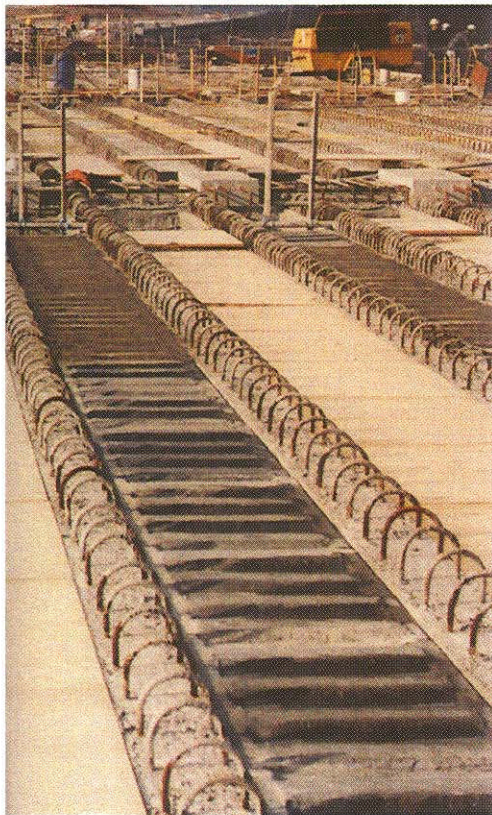
- has a thin cross section, yet provides durability and steel protection equal to much thicker concrete cover.
- has a high resistance to fire and will not emit toxic fumes.
- eliminates spalling of exposed faces.
- provides flexibility for pouring sequences and concreting schedules, which can reduce construction time.
- enables the final appearance of the deck structure to be assessed on-site before concrete is poured.



GRC
M
B

Practical & Economical

GRC permanent soffit formwork, produced specifically to suit all forms of structures, provides both a practical and economical way of supporting freshly poured in-situ concrete in composite bridge decks. Dependant upon the depth of the concrete deck formwork, spans up to 1200mm do not require temporary support. However, in the case of steel beam designs requiring greater spans, a specialised system for supporting the GRC formwork can be used. In either event, GRC panels - whether flat or corrugated - are designed to meet the stringent conditions laid down in DOT 36/90.

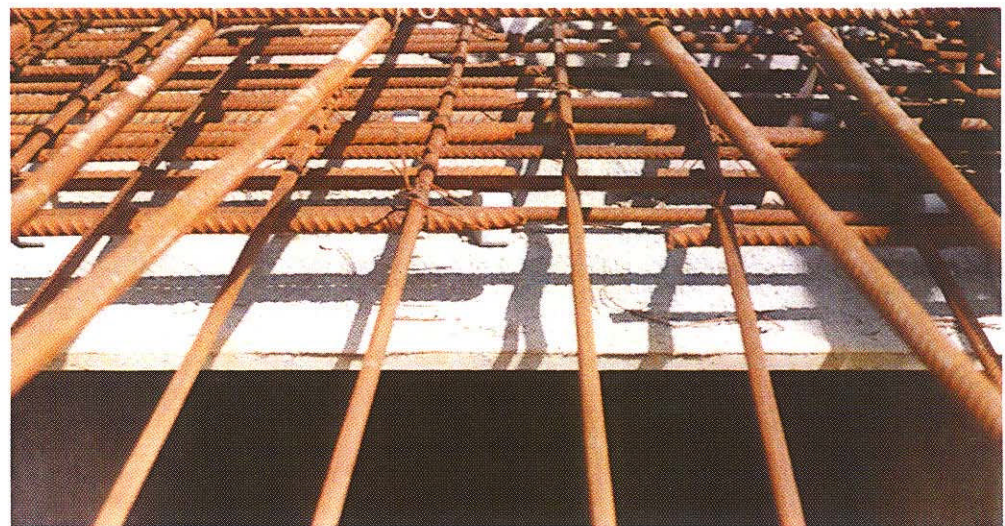
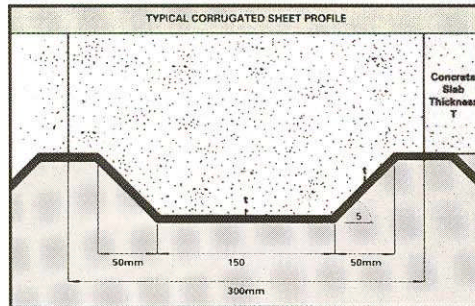


Flexible

Formwork manufactured from GRC is capable of supporting various slab thicknesses over a variety of spans between main bridge beams. In addition, it's characteristics allow it to behave as a composite part of the in-situ concrete under normal in-service dynamic loading.

Available in thin panels, in either flat sheet or corrugated form, GRC formwork remains in contact with and becomes bonded to the in-situ concrete over the full surface area of the panel.

Available in a standard range of panel sizes or produced specifically to suit individual projects, GRC formwork is delivered to site ready for use.



A GRC permanent formwork panel fitted to a centre span on the Tarmac A1-M1 Link contract.

Recommended

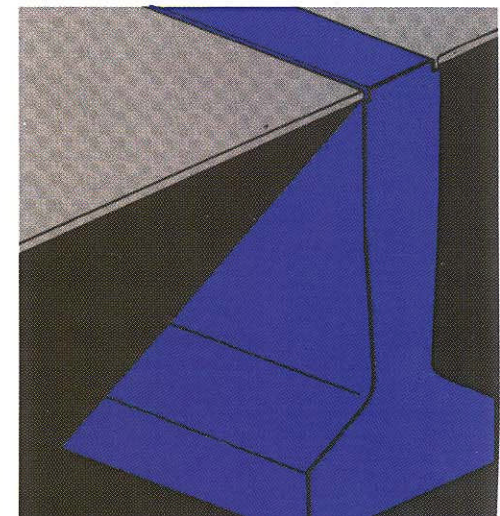
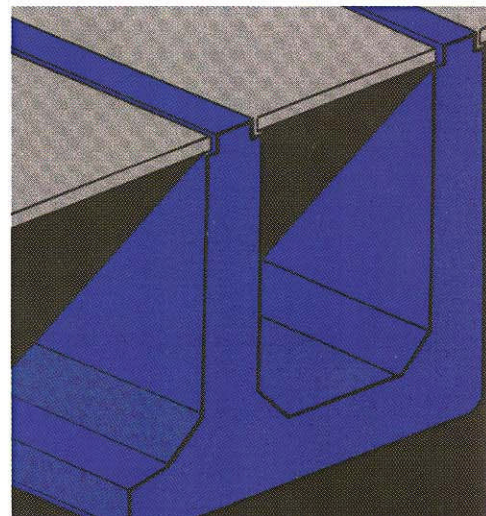
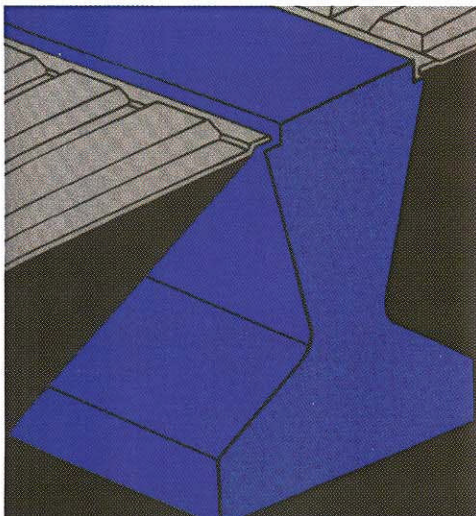
The use of GRC single skin bridge deck formwork is recommended in the Department of Transport's Highways & Transport Advice Note BA36/90.

Tested

Tensile tests carried out on specimens taken from actual contracts show that the bond between GRC permanent formwork and the concrete it supports, is generally stronger than either parent material.

This virtue was recognised by the Norwegian Roads & Bridges Department over twenty years ago when it approved the inclusion of GRC formwork within the specified cover thickness to reinforcement.

More recent tests, carried out in the UK in the late 1980's, confirmed the superior protection provided by GRC to steel reinforcement when compared with concrete. These tests also showed a greater resistance than concrete to chloride penetration.



TECHNICAL INFORMATION

Formwork Design

The design and final proportions of GRC permanent formwork takes into account factors such as the detail of the permanent works, the imposing loads from those permanent works and from construction operations, plus self-weight and other environmental factors.

Once this criteria has been decided, the formwork panels can be designed to accommodate any span width up to 1200mm - or wider by incorporating deeper corrugations - and in thicknesses capable of carrying varying depths of concrete to meet DOT requirements.

The table below provides typical examples:

Material Properties

GRC formwork combines the well-established compressive properties of cement-based mortars with the valuable flexural and tensile properties contributed by the glass fibre to give a material with the following characteristics:

- dense and crack resisting
- non-combustible with excellent resistance to fire and surface spread of flame
- low water, water vapour, and air permeability - contributing to low carbonation rates and resistance to both sulphate and chloride attack
- good abrasion resistance
- freedom from rot, corrosion, and UV degradation
- easy to handle on-site, yet heavy enough to be stable
- minimum maintenance

Strength & Deflection Criteria

GRC formwork is designed to support twice the sum of the following nominal loads:

- (i) self weight of formwork
- (ii) weight of wet concrete of deck slab (assumed concrete density of 2400 kg/cu.m)
- (iii) minimum superimposed load of 1.5KN/m²
- (iv) the effects of wind load where appropriate

The minimum superimposed load of 1.5N/m² covers situations described in Clause 27.3.1 of BS5975: 1982 and this means that the formwork is able to resist the effects of normal concentrated loading e.g. due to reinforcer spacer blocks or operatives walking on the reinforcement.

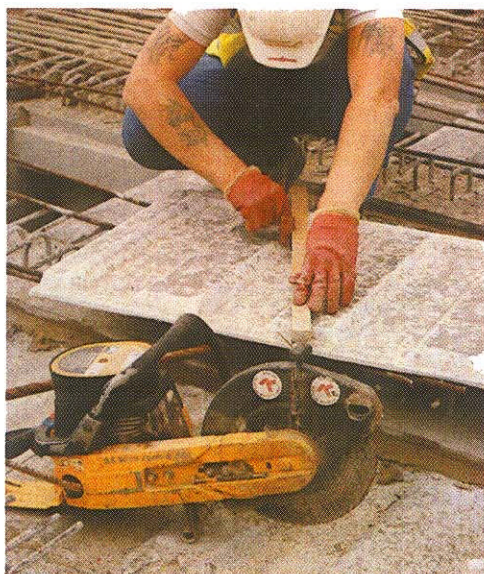
Deflections of the GRC permanent formwork four hours after completion of concreting will not exceed 1/300 of the span of the formwork unit.

If necessary, compliance with the strength and deflection criteria can be demonstrated by load testing.

Overall Span (1) (mm)	Concrete Depth (mm)	GRC Formwork			
		Style	Thickness (mm)	Corrugations (mm) (2)	Panel Weight (Kg) (3)
700	200	Flat	16	-	30
700	200	Corrugated	8	30	15
800	200	Flat	18	-	38
800	200	Corrugated	10	30	21
1000	200	Corrugated	8	40	21
1300	200	Corrugated	14	40	48

NOTES:

- (1) Clear span is normally 80-100mm less than overall span
- (2) Corrugation can be adjusted to vary the height/corrugation above or below horizontal.
- (3) All panels assumed to be 1200mm long



Sealing

GRC permanent formwork is sufficiently rigid to prevent the loss of grout during construction. This is subject to the use of approved methods of seating and sealing the panels, e.g. by bedding on mortar, taping the joints, or the use of compressive foam strip.

Far left: A GRC panel being marked prior to cutting on site.

Left: A GRC panel being sealed to prevent the loss of grout.

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