



**Specifiers Guide
to
Glassfibre Reinforced Concrete (GRC)**

**The International
Glassfibre Reinforced Concrete
Association (GRCA)**

August 2016

The International Glassfibre Reinforced Concrete Association (GRCA) has relationships with other associations connected with the GRC industry. Further information, together with a full list of GRCA Members, can be found on The International Glassfibre Reinforced Concrete Association (GRCA) website: www.grca.org.uk.

Membership of the GRCA is open to:

- Companies who manufacture or develop GRC products,
- Plant or material suppliers to the industry
- Professional partnerships or consultants
- Other interested parties.

Associate Membership is open to individuals with an interest in GRC who are not engaged in manufacture, other than at development or small company level.

Specifiers Guide to Glassfibre Reinforced Concrete (GRC).

Published by: The International Glassfibre Reinforced Concrete Association (GRCA)

This edition published: February 2016 (with address revisions August 2016)

© The International Glassfibre Reinforced Concrete Association (GRCA)

The International Glassfibre Reinforced Concrete Association

PO Box 1454,
NORTHAMPTON
NN2 1DZ
United Kingdom

Tel: +44 (0) 330 111 GRCA
+44 (0) 330 111 4 7 2 2

Web: www.grca.org.uk

Email: info@grca.org.uk

Any recommendations contained herein are intended only as a general guide and, before being used in connection with any report or specification, they should be reviewed with regard to the full circumstances of such use. Although The International Glassfibre Reinforced Concrete Association (GRCA) ensures every care has been taken in the preparation of this document, no liability for negligence or otherwise can be accepted by The International Glassfibre Reinforced Concrete Association (GRCA), or the members of its working parties, its servants or agents.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise without the prior permission in writing of The International Glassfibre Reinforced Concrete Association (GRCA).

SPECIFIERS GUIDE TO GLASSFIBRE REINFORCED CONCRETE (GRC)

CONTENTS

| | PAGE |
|--|------|
| WHAT IS - GLASSFIBRE REINFORCED CONCRETE (GRC), ALSO KNOWN AS - GLASS FIBER REINFORCED CONCRETE (GFRC)? | 4 |
| WHAT CAN GRC / GFRC BE USED FOR? | 4 |
| ARE THERE DIFFERENT TYPES OR GRADES OF GRC / GFRC? | 5 |
| DO THE ABOVE GRADES PROVIDE DIFFERENT STRENGTHS OF GRC / GFRC? | 5 |
| WHAT ARE THE KEY CONSIDERATIONS IN SPECIFYING OR ORDERING GRC / GFRC? | 6 |
| TABLE: MATERIAL STRENGTHS AND SUITABLE APPLICATIONS | 7 |
| FURTHER READING | 8 |

SPECIFIERS GUIDE TO GLASSFIBRE REINFORCED CONCRETE (GRC)

WHAT IS - GLASSFIBRE REINFORCED CONCRETE (GRC),

ALSO KNOWN AS - GLASS FIBER REINFORCED CONCRETE (GFRC)?

GRC is a composite material comprising of cement, fine aggregates, alkali resistant glass fibres, and admixtures.

WHAT CAN GRC / GFRC BE USED FOR?

Architectural Elements:

Claddings

Soffits

Column Encasements

Large Architectural Components & Embellishments

Built in Components:

Heads

Cills

Band Course

Civil Engineering Products:

Permanent Formwork

Drainage:

General, including Sewer Lining

Large Headwall

Retaining Structures

Decorative Products:

Plant Pots

Garden Ornaments

ARE THERE DIFFERENT TYPES OR GRADES OF GRC / GFRC?

There are basically three different types or grades of GRC which can be considered for different applications; all provide varying strengths both in tension and in compression.

The types or grades of GRC / GFRC are:-

1. A sprayable grade, containing a high alkali resistant (AR) glassfibre content which can be sprayed into a mould to form any shape, texture or feature required by the specifier.
2. A pourable premix grade, containing premixed chopped AR glassfibres which can be cast into a mould to form any shape, texture or feature required by the specifier.
3. A sprayable premix grade, similar to 2 above, which can be sprayed into a mould to form any shape, texture or feature required by the specifier.

DO THE ABOVE GRADES PROVIDE DIFFERENT STRENGTHS OF GRC / GFRC?

The strengths of the different grades are identified by the Modules of Rupture (MOR) which is defined by the GRCA as a value of 8, 10 or 18 – the higher the figure the stronger the GRC. Regular sample testing will confirm the MOR and the value given above will be obtained following polymer or moisture cure. (See the Table below for material strength and testing frequency).

1. The sprayable grade, containing a high AR glassfibre content provides a higher tensile strength and is more ductile than the other 2 grades given above. (See the Table for material strengths and suitable applications).
2. The pourable premix grade of premixed material containing chopped AR glassfibres provides a lower strength than the sprayable grade and is less ductile than the sprayable material. (See the Table for material strengths and suitable applications).
3. The sprayable premix grade again provides a lower strength than the sprayable grade material, as 1 above. (See the Table for material strengths and suitable applications).

WHAT ARE THE KEY CONSIDERATIONS IN SPECIFYING OR ORDERING GRC / GFRC?

1. All GRC grades should be chosen to suit the performance criteria of the component or project, by undertaking an analysis in accordance with the shape, size and required performance as specified by the Designer or end user.
2. For use in external elements such as cladding, formwork, architectural embellishments etc., the Designer should consider the imposed loading and the support and restraint of each element together with the allowance of both thermal and shrinkage movements. These considerations should be confirmed by a structural analysis. Such an analysis may not be necessary for non-structural cladding or formwork applications such as individually or small products and components utilising the pourable or sprayable premix grades.
3. A design warranty for the large external elements should be recommended.
4. When choosing a manufacturer it is advisable to choose a company that is a Member of The International Glassfibre Reinforcement Concrete Association (GRCA) and preferably a Member of the GRCA Approved Manufacturer Scheme (AMS) who has been audited by an independent certifying body appointed by The International Glassfibre Reinforced Concrete Association (GRCA).

To assist specifiers and designers the table given on Page 6 sets out the basic criteria for the information given above.

This “Specifiers Guide to Glassfibre Reinforced Concrete (GRC)” should be used in conjunction with the GRCA’s “Specification for the Manufacture, Curing and Testing of Glassfibre Reinforced Concrete (GRC) Products” and the GRCA’s “Methods of Testing Glassfibre Reinforced Concrete (GRC) Material”.

Further information and assistance in specifying GRC is provided by the GRCA at www.grca.org.uk.

There are also available specific specifications by the National Building Specification (NBS) and the GRCA as well as performance specifications that are provided by both Specialist GRC Consultants and Manufacturers who are members of the GRCA.

TABLE: MATERIAL STRENGTHS AND SUITABLE APPLICATIONS

Glassfibre Reinforced Concrete has many applications and can be used to manufacture products as diverse as Architectural Cladding for multi-story buildings, formwork for bridge decks or garden ornaments. It is important when considering the use of GRC that the correct mix design of GRC is used. Ultimately this needs to be confirmed by a competent design engineer but as an aid to specification the GRCA has prepared the guide document below.

| MARKET SECTOR | TYPICAL APPLICATION | APPROX COMPONENT SIZE | GRC GRADES | GRADE (MOR) | POLYMER CURING METHOD | MOISTURE CURING METHOD | TESTING SAMPLES |
|-----------------------------------|--|-------------------------------|------------------------------|-------------|-----------------------|------------------------|-----------------|
| Architectural | Claddings | > 1m ² (face area) | Sprayable | 18 | Yes | | Daily |
| | Soffits | > 1m ² (face area) | Sprayable | 18 | Yes | | Daily |
| | Column Encasements | > 1m ² (face area) | Sprayable | 18 | Yes | | Daily |
| | Large Architectural Components & Embellishments | > 1m ² (face area) | Sprayable | 18 | Yes | | Daily |
| | Claddings | < 1m ² (face area) | Pourable or Sprayable Premix | 10 | Yes | | Weekly |
| | Soffits | < 1m ² (face area) | Pourable or Sprayable Premix | 10 | Yes | | Weekly |
| | Column Encasements | < 1m ² (face area) | Pourable or Sprayable Premix | 10 | Yes | | Weekly |
| | Large Architectural Components & Embellishments | < 1m ² (face area) | Pourable or Sprayable Premix | 10 | Yes | | Weekly |
| | Architectural Perforated Sunscreen | < 1m ² (face area) | Pourable or Sprayable Premix | 10 | Yes | | Weekly |
| | Built in Components, Heads, Cills, Band Course | Self Supporting | Pourable or Sprayable Premix | 8/10 | Yes | | Weekly |
| | Architectural Perforated Sunscreens | > 1m ² (face area) | Pourable or Sprayable Premix | 8/10 | Yes | | Weekly |
| | Built in Components, Heads, Cills, Band Course | Non Load Bearing | Pourable or Sprayable Premix | 8 | Yes | | Weekly |
| | Architectural Perforated Sunscreens | > 1m ² (face area) | Pourable or Sprayable Premix | 8 | Yes | | Weekly |
| Civil Engineering Products | Permanent Formwork | All | Sprayable | 18 | | Yes | Daily |
| | Drainage – General | - | Pourable or Sprayable Premix | 8/10 | | Yes | Weekly |
| | Drainage – Large Headwalls, Retaining Structures | - | Sprayable | 18 | | Yes | Daily |
| Decorative Products | Plant Pots | - | Pourable or Sprayable Premix | 8 | | Yes | Weekly |
| | Garden Ornaments | - | Pourable or Sprayable Premix | * | | Yes | Weekly |

Note: These guidelines are based on UK experience and may vary for different countries. The information provided is for guidance only and the final specification should be agreed by the specifier, specialist GRC manufacturer and a competent engineer. This document should be used in conjunction with other GRC Specifications.

FURTHER READING

GRCA “Specification for the Manufacture, Curing and Testing of Glassfibre Reinforced Concrete (GRC) Products

GRCA “Methods of Testing Glassfibre Reinforced Concrete (GRC) Material”

GRCA “Assessment of GRC Test Results”

GRCA “Approved Manufacturer Scheme (AMS) Regulations”

Other GRCA Publications: See www.grca.org.uk for up to date list of publications.

NBS Specification H40 May 2002 *Glassfibre reinforced concrete cladding components.*

European Standards

BS EN 1169: 1999: *Precast concrete products — General rules for factory production control of glass-fibre reinforced cement products.*

BS EN 1170: 1998: *Parts 1-8 Precast concrete products: Test methods for glass-fibre reinforced cement.*

Part 1. Measuring the plasticity of the mortar— 'Slump test' method.

Part 2. Measuring the fibre content in fresh GRC, Wash out test'.

Part 3. Measuring the fibre content of sprayed GRC.

Part 4. Measuring bending strength — 'Simplified bending test' method.

Part 5. Measuring bending strength — 'Complete bending test' method.

Part 6. Determination of the absorption of water by immersion and determination the dry density

Part 7. Measurement of extremes of dimensional variations due to moisture content.

Part 8. Cyclic weathering type test

BS EN 14649: 2005 *Precast concrete products — Test method for strength retention of glass fibres in cement and concrete (SIC TEST).*

BS EN 15422: 2008 *Precast Concrete Products - Specification of glassfibres for reinforcement of mortars and concretes.*

BS EN 1169: 1999. *Precast concrete products – General rules for factory production control of glassfibre reinforced cement*

USA

Prestressed Concrete Institute (PCI) USA

Recommended Practice for Glass Fiber Reinforced Concrete Panels - Fourth Edition, 2001. Manual for Quality Control for Plants and Production of Glass Fiber Reinforced Concrete Products, 1991.

ACI 549.2R-04

Thin Reinforced Cementitious Products. Report by ACI Committee 549

ACI 549.XR. Glass Fiber Reinforced Concrete premix. Report by ACI Committee 549

ASTM

C948 Standard Test Method for Wet Bulk Density, Water Absorption and Apparent Porosity of Thin Section Glass Fiber Reinforced Concrete.

C1229 Standard Practice for Preparing Coupons for Flexural and Washout Test for Glass Fiber Reinforced Concrete.

C1229 Standard Test Method for Determination of Glass Fiber Content in Glass Fiber Reinforced Concrete

C1230 Standard Test Method for Performing Tension Tests on Glass Fiber Reinforced Concrete [GFRC] Bonding Pads

C1560 Standard Test Method for Hot Water Accelerated Aging of Glass Fiber Reinforced Concrete