

# Specifiers Guide to Glassfibre Reinforced Concrete (GRC)

# The International Glassfibre Reinforced Concrete Association (GRCA)

May 2021

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.online.

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 and associated industry trades.

All GRC manufacturing GRCA Full Members are annually assessed by an independent external assessor and must demonstrate that they have sufficient resources in plant, equipment and labour to consistently design and manufacture high quality GRC in accordance with the GRCA Full Member Regulations and the GRCA Specification.

#### Specifiers Guide to Glassfibre Reinforced Concrete (GRC).

Published by: The International Glassfibre Reinforced Concrete Association (GRCA) This edition published: May 2021 © 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.online

Email: info@grca.online

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 MANUFACTURING METHODS FOR GRC / GFRC?	5
DO THE DIFFERENT GRADES OF GRC/GFRC PROVIDE DIFFERENT STRENGTH GRC / GFRC?	IS OF 5
WHAT ARE THE KEY CONSIDERATIONS IN SPECIFYING OR ORDERING GRC / GFRC?	6
TABLE 1: 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, or Surface Fixed, Components:

Heads

Cills

Band Course

Civil Engineering Products:

Permanent Formwork

Drainage:

General, including Sewer Lining Large Headwall Retaining Structures

**Decorative Products:** 

Planters & Urns Garden Ornaments

#### ARE THERE DIFFERENT MANUFACTURING METHODS FOR GRC / GFRC?

There are three main manufacturing methods for GRC products which can be considered for different applications; all provide varying strengths both in tension and in compression.

The three main manufacturing methods for GRC / GFRC products are:-

- 1. Simultaneously sprayed GRC manufacturing method where the cementitious slurry and the AR glassfibre, are simultaneously sprayed into a mould, using a concentric GRC spray gun, to form any shape, texture or feature required by the specifier.
- 2. Poured premix GRC manufacturing method where pre-cut AR glassfibres and the cementitious slurry are blended during mixing. The mix is then poured into a mould to form any shape, texture or feature required by the specifier.
- 3. Sprayed premix GRC manufacturing method similar to 2 above, except the blended mix is then sprayed into a mould, using a GRC spray gun, to form any shape, texture or feature required by the specifier.

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

The different strength grades of GRC are identified by the characteristic Modulus 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 characteristic MOR and the values given above will be obtained following polymer or moisture cure.

(See the GRCA Specification for GRC for material strength testing frequency requirements).

- The simultaneously sprayed method of production, which normally contains a high AR glassfibre content produces a higher tensile strength and is more ductile than the other 2 methods given above. (See Table 1 for suitable applications for the different material strengths).
- 2. The poured premix method of production, using premixed material containing chopped AR glassfibres normally produces a lower strength than the simultaneously sprayed method, in 1. above, and is less ductile than the sprayable material. (See Table 1 for suitable applications for the different material strengths).
- The sprayed premix method again normally produces a lower strength than the simultaneously sprayed method, in 1. above. (See Table 1 for suitable applications for the different material strengths).

#### WHAT ARE THE KEY CONSIDERATIONS IN SPECIFYING

#### OR ORDERING GRC / GFRC?

- 1. All GRC strength 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 GRC manufacturer it is advisable to choose a GRC manufacturing company that is a Full Member of The International Glassfibre Reinforcement Concrete Association (GRCA) and is annually assessed by an independent external assessor, appointed by The International Glassfibre Reinforced Concrete Association (GRCA), for compliance with the GRCA Full Member Regulations and the GRCA Specification.

To assist specifiers and designers Table 1, given on Page 7, sets out the guidelines for 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.online.

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

#### TABLE 1: 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	APPROXIMATE COMPONENT SIZE	GRC MANUFACTURING METHOD	GRADE (MOR)	POLYMER CURING	MOIST CURING	TESTING SAMPLES
Architectural	Claddings	$> 1m^2$ (face area)	Simultaneously Sprayed	18	Yes		Daily
	Soffits	$> 1m^2$ (face area)	Simultaneously Sprayed	18	Yes		Daily
	Column Encasements	$> 1m^2$ (face area)	Simultaneously Sprayed	18	Yes		Daily
	Large Architectural Components & Embellishments	$> 1m^2$ (face area)	Simultaneously Sprayed	18	Yes		Daily
	Claddings	< 1m <sup>2</sup> (face area)	Poured or Sprayed Premix	10	Yes		Weekly
	Soffits	< 1m <sup>2</sup> (face area)	Poured or Sprayed Premix	10	Yes		Weekly
	Column Encasements	< 1m <sup>2</sup> (face area)	Poured or Sprayed Premix	10	Yes		Weekly
	Large Architectural Components & Embellishments	< 1m <sup>2</sup> (face area)	Poured or Sprayed Premix	10	Yes		Weekly
	Architectural Perforated Sunscreens	$> 1m^2$ (face area)	Poured or Sprayed Premix	10	Yes		Weekly
	Built in Architectural Components - Heads, Cills, Band Course	Self Supporting	Poured or Sprayed Premix	8/10	Yes		Weekly
	Architectural Perforated Sunscreens	< 1m <sup>2</sup> (face area)	Poured or Sprayed Premix	8/10	Yes		Weekly
	Built in or Surface Fixed, Components - Heads, Cills, Band Course	Non Load Bearing	Poured or Sprayed Premix	8	Yes		Weekly
Civil Engineering Products	Permanent Formwork	All	Sprayed	18		Yes	Daily
	Drainage - Large Headwalls, Retaining Structures	All	Sprayed	18		Yes	Weekly
	Drainage - General	All	Poured or Sprayed Premix	8/10		Yes	Daily
Decorative Products	Planters, Urns & Fountains	All	Poured or Sprayed Premix	8		Yes	Weekly
	Garden Ornaments	All	Poured or Sprayed Premix	8		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 sizes may differ from the dimensions given above. The final specification and unit sizes, even if within the guidelines given above, must be agreed by the specifier, the specialist GRC manufacturer and a competent design engineer. This document should be used in conjunction with the GRCA Specification and Methods of Testing documents.

Specifiers Guide to Glassfibre Reinforced Concrete (GRC), May 2021

#### FURTHER READING

GRCA Specification: "Specifiers Guide to Glassfibre Reinforced Concrete (GRC)".

GRCA MOT: "Methods of Testing Glassfibre Reinforced Concrete (GRC) Material".

GRCA Design Guide: "Practical Design Guide for Glassfibre Reinforced Concrete (GRC)".

GRCA Fixing Guide: "Practical Fixing Guide for Glassfibre Reinforced Concrete (GRC)".

GRCA Full Member Grade: "Regulations, Membership Procedure and Assessment".

GRCA techNOTEs: A series of technical notes are available on most aspects of GRC.

**GRCA Congress Proceedings:** The International Glassfibre Reinforced Concrete Association (GRCA) holds a database of past GRCA Congress Proceedings, and many other GRC related publications, which are generally available to download free at **www.grca.online**.

**GRCA Publications:** See *www.grca.online* for up to date list of GRCA Publications.

#### The Concrete Bookshop

Web: www.concretebookshop.com

NBS Specification H40: Glassfibre reinforced concrete cladding components.

**European Standards** (*NB: British versions of European Standards will be prefaced BS EN*)

EN 197: Parts 1 & 2: Cement.

EN 480: Various Parts: Admixtures for concrete, mortar and grout. Test methods.

EN 934: Various Parts: Admixtures for concrete, mortar and grout. Requirements.

EN 1008: Mixing water for concrete.

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

**EN 1170:** 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
- EN 13139: Aggregates for mortar. NB: 2013 version is currently withdrawn.
- **EN 14649:** Precast concrete products Test method for strength retention of glass fibres in cement and concrete (SIC TEST).
- **EN 15191:** Precast concrete products. Classification of glassfibre reinforced concrete performance.

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