This series of Technical Notes covers issues which manufacturers, users and specifiers may wish to consider in their approach to the application of manufactured GRC elements for façade cladding

Bob Faulding December 2022

GRC TECHNICAL NOTE 2

SIGNIFICANCE OF GRC DENSITY TEST

Background

Testing the density of manufactured GRC is an accepted part of quality control within any manufacturing operation.

In the UK and Europe, the test methods are described in BS EN 1170-6:1998[1] whilst in the United States the applicable standard is C948-81 (Reapproved 2016)[2]. The GRCA also publish a simplified test method described in GRCA Methods of Testing Part 2[3].

There is however no alignment of the frequency of the test method.

BS EN 1169:1999[4] requires the test carrying out as part of factory quality control on a weekly basis. The GRCA Specification[5] requires one test per month. For those companies manufacturing to the Prestressed/Precast Concrete Institute standards (MNL-130)[6] the frequency is stipulated as weekly. As with many other quality control requirements the differentials in testing frequency can cause confusion in the minds of manufacturers, specifiers, and users alike. It is difficult to understand what testing regime should be adopted and why.

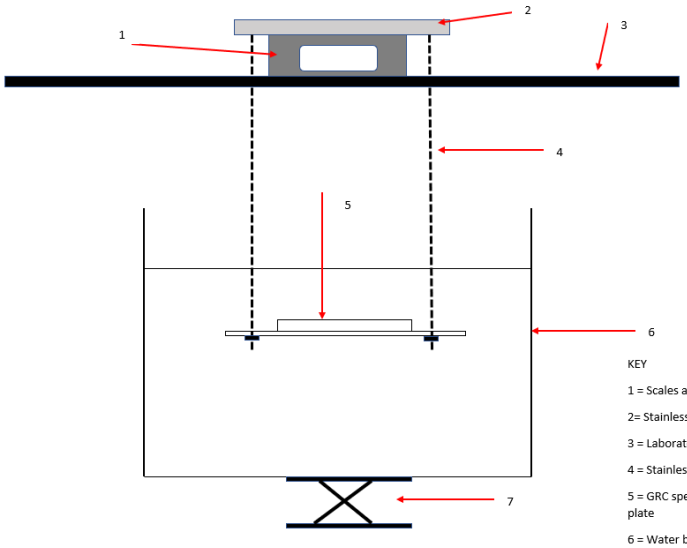
.

Test Methods.

There are essentially two test methods to determine density. One is based on weighing samples both in water and in air. This is commonly known as the hydrostatic weighing method. This testing convention is adopted by both the GRCA and the ASTM (formerly known as the American Society for Testing and Materials). The other is based on determining the actual volume by measuring the specimen and is the default test method detailed in the BS/EN standard. It is however useful to note that the BS/EN standard also has a provision for the volume to be determined by the hydrostatic method.

The hydrostatic method is most used by most manufacturers as part of their quality control system. This test method is the more accurate as definitive measurements of the thickness of sprayed GRC specimens are extremely difficult

Figure 1 below shows the simple equipment needed to perform the hydrostatic weighing of GRC samples.



KEY

1 = Scales accurate to 0.1g

2= Stainless steel U channel

3 = Laboratory Worktop

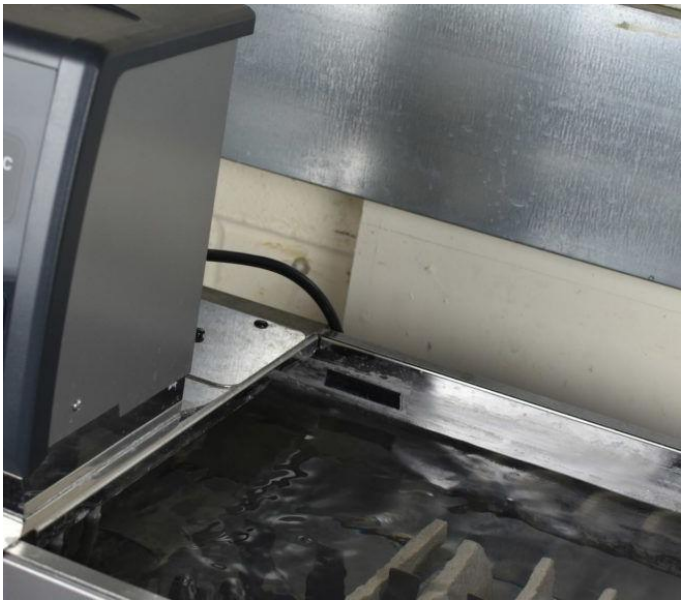
4 = Stainless steel all-thread

5 = GRC specimen on flat stainless-steel plate

6 = Water bath

7 = Laboratory scissor lift

Figure 1



Immersion of specimens to constant mass state BS EN 1170 Part 6

Significance of Test

The general conception of the test is that minimum material densities are attained, and of course derived weights can be used for calculating dead load.

However, the information derived from the test data has a much more useful purpose which can be used by the manufacturer to both improve quality and reduce costs.

The density of GRC is driven by not only the corresponding density of the constituent raw materials but the compaction of those materials. This is particularly true of Spray Process GRC which is sprayed and compacted in several layers.

Deviations in density can indicate a non-consistency in both the raw material content and general quality of workmanship. This is especially true with Spray Process GRC where inconsistent calibration, spray techniques and compaction will be easily identified by frequent test data analysis.

Consistent densities are a good indicator of high quality GRC and the effectiveness of plant quality control processes and procedures. Such information can be used to both reassure specifiers and users, but more importantly, can help in reducing costs.

The primary quality of any manufactured GRC is its flexural strength. Assuming consistent densities are achieved the manufacturer can rely on more consistent flexural capacity at both elastic and ultimate level. This approach ensures that widely differing bending strengths do not have a negative effect when calculating the characteristic strength used in the design engineering inputs.

Summary

By taking the approach of increased density testing and an analytical approach to resultant data manufacturers can make cost effective changes to mix designs.

Further Help

We offer a full consultancy-based service to anyone involved in the GRC industry – manufacturers, specifiers, users and end clients. We can assist with any aspect of the full GRC supply chain from initial concept designs to final on-site installation activities

Please note the information provided is on a general and advisory basis only. GRC is a complex composite material and project specific application advice should be obtained from suitably experienced professionals.

References

1. BS EN 1170-6. Precast concrete products – Test method for glass-fibre reinforced cement. Part 6 Determination of the absorption of water by immersion and determination of the dry density. Publication date November 1997
2. ASTM C948-81 Standard test method for dry and wet bulk density, water absorption and apparent porosity of thin sections of glass-fiber reinforced concrete. Publication Date 2018
3. GRCA Methods of Testing Glassfibre Reinforced Concrete (GRC) Material. Publication Date February 2021
4. GRCA Specification for the Manufacture, Curing & Testing of Glassfibre Reinforced Concrete (GRC) Products. Publication Date February 2021
5. BS EN 1169. Precast concrete products – General rules for factory production control of glass-fibre reinforced cement. Publication Date November 1999
6. PCI Manual for Quality Control for Plants and production of Glass Fiber Reinforced Concrete Products. Second Edition. Publication Date 2009