

Tests and Standards for FRP Structures

Overview

Safety in the design, manufacture and application of structural components of any material is critical and hence highly regulated. Mature design and application standards exist for traditional construction materials that have been used for over 100 years such as steel, concrete and timber (e.g. Eurocodes and other national standards).

However, similar documentation for structural use of FRP composite materials is generally less developed and so requires additional consideration compared to other construction materials.



Standards for FRP Composites

Some aspects in the design and application of FRP composites, such as design basis and loads, and limits on the function of a component or structure, are adequately covered by existing standards and other documentation that is not material-specific. However, other aspects such as material types and properties, modes of failure, quality of materials and manufacture, and acceptable defects, are only described to a limited extent or require use of multiple design guidance documents and additional testing. There are a few FRP structure types in the construction industry that are covered by specific design standards, such as water-retaining structures, pressure vessels, and wind turbines. A list of design guidance documents is available on the Composites UK website.

For other FRP structures, such as buildings and bridges, it is particularly important that the design method and standards or guides used, and required tests, are clearly stated and agreed with relevant parties (e.g. local authority and/or asset owner) at an early stage. A particular aspect that requires extra effort when using FRP composite materials is in the detailed specification of materials and the required level of quality. Proprietary specification documents exist from suppliers and manufacturers of FRP composites that form a useful starting point, but these alone will not usually be adequate particular for public works.

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Testing of FRP Structures & Components

Due to the historic use of FRP composite material in the aerospace industry, which typically places a higher reliance on testing than other industries, national and international test standards (e.g. ASTM, ISO) for FRP composite materials are well developed. Such standards enable mechanical properties (strength and stiffness) and physical properties (thermal and fire resistance, weathering and durability) to be reliably confirmed. In the first instance and if suitable, these standards should be used for tests on FRP composite materials. Testing is usually undertaken at accredited organisations such as test-houses, universities and national test facilities.

FRP composite materials and structures exhibit a wider available range of material type (fibre, resin, core) than other construction materials, and test samples are usually used throughout the manufacturing stage to confirm that material properties are as expected and an adequate level of quality is achieved. Specific examples where small-scale and full-scale structural testing of FRP composites is often required include bonded joints, large-scale bolted joints, and areas that experience high fatigue. Tests to confirm resistance to vandalism may also be required where important structural FRP components are directly accessible by the public and unprotected, such tests have been previously successfully completed but need to be project-specific.

Although FRP composite structures can provide many benefits to the construction industry as described in this series of Composites UK Technical Sheets, the supply chain should be aware that typically a greater design effort and amount of testing is required for FRP composite structures. The first point of contact for any required additional guidance and advice regarding FRP structures should be the Composites UK Construction Group which has direct and authoritative experience of FRP structure design, manufacture and application, and use of suitable documents for design and testing for public and private organisations.

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