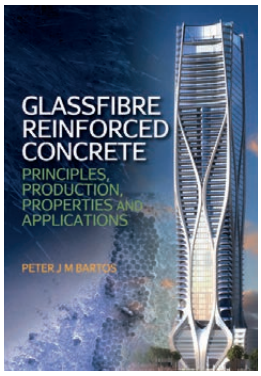
Review

This book provides an unbiased, informative and up-to-date account of glass fibre-reinforced concrete for anyone new to the material, concludes Graham True.

Glassfibre reinforced concrete – principles, production, properties and applications



Author: Peter J.M. Bartos
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This informative, compact book by Professor Peter Bartos, who has been involved with glass fibre-reinforced concrete (GRC) developments for many years, follows the four-stage format given in the title. Each section provides sufficient detail to clearly inform the reader without overburdening them.

A brief historical account is given of how the material was developed using E-glass with high-alumina cement, followed by the commercial development of alkali-resistant (AR) fibres, incorporating zirconium dioxide with silicate glass, at the Building Research Station together with Pilkington Glass Co. GRC production has since spread worldwide from a UK base with the Glassfibre Reinforced Cement Association (GRCA) becoming the International GRCA.

When reviewing a book, one first tends to dip into specific sections to see how certain aspects may have changed. I was much involved in the production and development of the material – alas, last century – and it is surprising to see that production methods have not changed much. One significant change is to the title – from glass fibre-reinforced cement to glass fibre-reinforced concrete.

GRC is a combination of a cementitious matrix and fibrous glass reinforcement. The book clearly updates the reader on the inclusion of significant amounts of sand into the matrix to reduce intrinsic drying shrinkage and crazing/cracking of the surface (a practice which Pilkington emphatically banned). Explanation is given of the glass fibre being incorporated in the form of a roving containing approx. 200 individual fibre filaments (9–20μm diameter), coated with a size to keep them in loosely bound strands. It is explained that the coating holds the fibres together not in a firm lock, but first to assist handling in production and then to provide a degree of interlock as well as interaction with the matrix within the composite. A different size is used for spray-applied fibre to that used on premix fibres.

Account is given of new admixtures (polycarboxylate ethers to replace melamine sulphonates and lignosulphonates) that provide high workability of the cementitious matrix both in spray-up and premix uses, and viscosity-modifying agents that provide a 3D structure to the matrix to prevent segregation during and following manufacture. One further admixture that apparently has great potential is titanium dioxide (TiO_2), in the form of nano-scale particles of the anatase-type. These produce what is called photocatalytic GRC (eGRC). When originally developed in Italy, it was found that 5% of the cement content of the matrix needed replacing with TiO_2. However, it was later discovered in China that a mist coating of the surface of the GRC, first spray-applied into the mould, is sufficient, thereby making the use economic.

The purpose of incorporating TiO_2, just on the surface, is twofold. Under UV light and surface moisture from rainfall, the surface undergoes photocatalytic activity that oxidises and de-pollutes the air. Typical pollutants affected are nitrogen oxides, sulphur oxides and volatile organic compounds. The secondary benefit is that the surface becomes self-cleaning due to the shedding of particulates that do not adhere to the surface. It has been calculated from trials that if 15% of external surfaces were photocatalytic, then this would reduce pollution by 50%.

Numerous examples of the use of GRC are given. A significant number are in China and Turkey and these include very large cladding contracts with highly textured, colourful and ornate surfaces. Repeat contracts in those countries suggest they have perfected the manufacture and have probably learned from the early disasters that befell some manufacturers in the UK. Perhaps a more detailed presentation of some of the examples would have benefited the reader. The honest and informative section on potential defects will jog the memory of some practitioners and hopefully instil a warning in any newcomers.

The summary of benefits could have made more reference to the use of GRC as permanent formwork, since the highly alkaline surface provided by GRC far outclasses conventional concrete cover to reinforcement. This has led to reduced cover when used on concrete bridges in Norway, for example.

In summary, this book provides an unbiased, informative and up-to-date account of GRC for anyone new to the material or considering using it. It will therefore become a reference source for the product.

Graham True

Graham True is a part-time lecturer and runs GFT Materials Consultancy, providing litigation expert witness services for various clients. He has undertaken consultancy for RIBA and a is member of the Materials Standing Committee of the Concrete Society.