

Fibre-reinforced concrete for structural toppings to beam-and-block floors

Figure 1 (above): Initial pass of the fibre-reinforced self-compacting concrete with dapple bar.

The use of beam-and-block systems for the construction of residential ground-floor properties is now a common method of construction across the UK. It also offers many technical benefits, including the ability to increase spans, floors that are unaffected by damp or rot, increased fire resistance and good thermal insulation properties. Simon Evans of Fibre Concrete Solutions reports.

A structural screed or topping is provided, not only to provide the finished floor, but also to act as an independent structural element, spanning between beams where the infill blocks are considered to act as non-load-bearing.

Typically, a topping thickness of 75mm is adopted. Using traditional fabric reinforcement was problematic in achieving appropriate cover, when placing and lapping reinforcement in a thin section of concrete.

Adopting a fibre-reinforced concrete allowed significant practical benefits in the replacement of this reinforcement and relieved the associated difficulties experienced on-site.

To improve further on the performance of toppings and screeds for beam-and-block floors, the guidance⁽¹⁾ from the National House Building Council (NHBC) was revised 1 January 2018, with regards the use of fibre-reinforced concrete, such that 'structural' fibre solutions were now to be adopted, replacing the use of 'non-structural' fibres.

Definition

The definition of a 'structural' fibre can be found in BS EN 14889 Parts 1 and 2⁽²⁾, and covers both steel and synthetic fibres, providing clear details on the material properties and performance of the fibre. This

Figure 2: Level checks of the floor surface.





Figure 3: Structural fibre-reinforced self-compacting concrete topping.



Figure 5: Curing compound applied to floor.

information is presented in a 'declaration of performance' (DoP), which allows the user to check the fibre's performance. Importantly, it identifies the 'effect on strength', which provides the user with the minimum dosage of fibres required to achieve structural performance and gain CE compliance, thus providing an indication of the dosage of fibres required to enhance the load-carrying capability of the fibre-reinforced concrete.

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To ensure that a fibre type and dosage provided this required 'structural' reinforcement, third-party certification was to be sought as a means of easily identifying the solution as being fit for purpose, allowing for compliance with NHBC Standards, Chapters 5.2 'Suspended ground floors' and 3.1 'Concrete and its reinforcement'.

Fibre Concrete Solutions (FCS) appreciated the importance of providing a structural solution to meet the requirements



Figure 4: Dapple bar.

of the different systems available to the market. To provide clarity to customers, it was important that the dosage of fibres corresponded with the individual products DoP and required performance – thus confirming the products' use as structural.

Knowledge

Using its knowledge of fibres and fibre-reinforced concrete, the company undertook the development of a solution adopting its Nexus 85 (Figure 7) synthetic macro fibre and Zenith 60 (Figure 8) steel fibre to offer a choice in terms of either a steel or synthetic fibre to the market.

Working closely with the British Board of Agrément (BBA), testing requirements and parameters were established to ensure compliance with all existing approved systems. Consideration was given to the different spans and load configurations to ensure that the most onerous conditions were evaluated.

It was identified that any guidance should be applicable for both self-compacting and standard mix designs, ensuring flexibility for the end user with regards the concrete and method of construction that could then be adopted. Experience in the industry has demonstrated the benefits of adopting self-compacting concrete (SCC) in this application, allowing the pouring of the slab to be simplified without a requirement to power-float, resulting in increased flexibility in the time of day for the concrete placement and significantly speeding up the concrete topping construction. It was therefore critical that any structural fibre solution could be easily incorporated in SCC.

Performance

The high performance of both fibre types allowed structural performance in accordance with BS EN 14889 to be achieved at 2.5kg/m³ for the Nexus 85 and 10kg/m³ for the Zenith 60. These dosage rates also



Figure 6: Beam-and-block floor system prior to membrane installation and structural concrete topping being poured.

met the performance requirements of the rigorous testing undertaken by the BBA and, importantly, met the guidelines stipulated by the NHBC for a structural solution.

The selections of the individual fibre type and dosage also have significant practical benefits for the user of the fibres.

Addition of fibres to ready-mixed concrete is typically through manual handling of the product, either by adding a degradable bag directly to the drum mixer of the truck or loading fibres via conveyor.

Solution

In both instances, providing a solution requiring a low dosage of fibres per cubic metre of concrete results in easier integration of the product, reducing risks associated with the lifting and handling of the products. Guidance shows that repetitive handling of a maximum load of 10kg will have a low level of risk, while heavier loads require further investigation of the task.

A reduced dosage of fibres, also makes mixing and distribution of the fibres into the concrete easier while improving the finishing characteristics of the fibre-reinforced concrete, particularly when considering SCC.

Certification from the BBA was awarded to FCS for both fibre solutions, together with approval for the use of the products on all systems approved by the BBA.

By providing a structural fibre solution that can be independently checked through inspection of the DoP and BBA certificate, clients and users are able to ensure the requirements for complying with NHBC Standards are met and take advantage of the practical use of the fibre solutions supplied by FCS to the construction industry. ■

References:

1. NATIONAL HOUSE BUILDING COUNCIL. *Guidance on the use of reinforcement to concrete toppings above beam and block floors*. Issue 8, 1 January 2018, available at: <https://bit.ly/3ftlFKz>.
2. BRITISH STANDARDS INSTITUTION, BS EN 14889. *Fibres for concrete. Part 1 – Steel fibres. Definitions, specifications and conformity. Part 2 – Polymer fibres. Definitions, specifications and conformity*. BSI, London, 2006.



Figure 7: Nexus 85 – provides structural reinforcement to the beam-and-block topping at 2.5kg/m³.

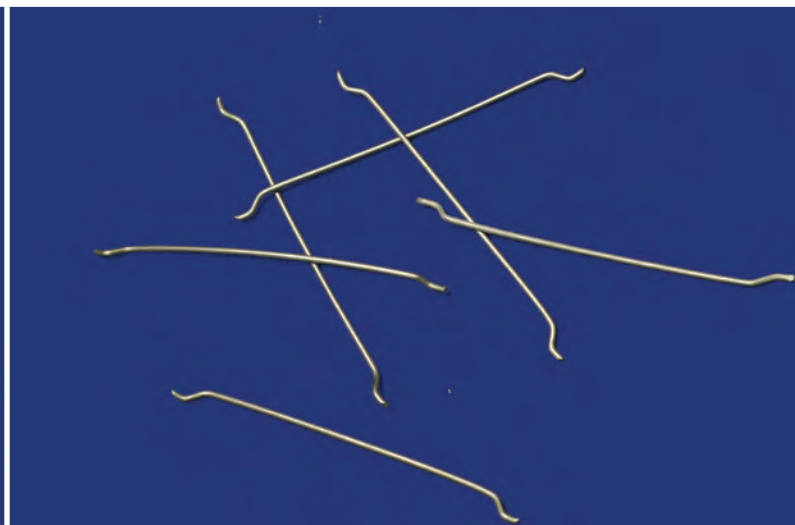


Figure 8: Zenith 60 – provides structural reinforcement to the beam-and-block topping at 10kg/m³.