THE MAGAZINE OF THE CONCRETE SOCIETY

CONCRETE

Volume 58, Issue 7 September 2024

EXTENDING BOUNDARIES

New technology provides the 'Level Best' for casting of a jointless industrial floor

A TEST OF METTLE

Significant Standards for testing fibre-reinforced concrete

ACHIEVING THE RIGHT MIX

The link between batching plant performance and operatives' well-being

A beautiful and practical completely joint-free concrete floor slab, for clients requesting a robust and practically maintenance-free warehouse floor.

Extending the boundaries – a warehouse floor without a single joint

(Photos: Andrew Crozier, Insight Photography.)

Level Best Concrete Flooring cast a completely seamless floor in one day. A single panel of 42 × 18m wide – beyond Technical Report 34's[1] aspect ratio guidance for standard jointless slabs – was made possible by SigmaSlab, a new concrete reinforcement technology. **Poppy Bake** reports.

Level Best Concrete Flooring wanted a robust concrete floor, ideally containing no troublesome movement joints, for their new headquarters in East Yorkshire. Due to the limitations on space, a building of 42 × 18m maximised the available land. The main client objectives for the floor were to:

- create minimal long-term maintenance issues
- withstand loads from a pallet racking system, heavy plant and associated mechanical handling equipment (MHE)
- ideally withstand heavy loads from an office mezzanine structure, without the need for additional pad foundations
- provide a 'green' solution, with a reduced carbon footprint.

Floor design construction in the UK is predominantly undertaken following the guidelines set out in The Concrete Society's TR34 (Fourth Edition). This manual gives clear instruction on how to design using basic traditional steel fabric reinforcement or with steel-fibre-reinforced concrete (SFRC) to create large area 'jointless' (saw-cut free) panels. Due to Level Best's extensive experience with SFRC and its appreciation of the benefits such solutions provide, this was

ABOVE:
A post-tensioning strand positioned at approximately mid-slab depth prior to concrete discharge was installed on two layers of polythene membrane to reduce slab friction over the compacted sub-base.

the chosen route. However, TR34 stipulates an ideal practical joint-free limit of around 35m and a length-to-width aspect ratio of 1:1.5, to avoid unwanted cracking. Due to the building being 42m long, it was deemed that the limitations of TR34 (last updated in 2018) made going 'jointless' beyond its current scope. This paved the way for the consideration of SigmaSlab; a patented technological innovation co-created by Bekaert and CCL to enable the creation of durable, strong and sustainable seamless floor slabs for ground-bearing or piled floors.

"SigmaSlab combines all the advantages of passive reinforcement (steel fibres) with those of active reinforcement (post-tensioning)," explains Hendrik Thooft, construction technology and value solutions manager at Bekaert. "The whole is clearly greater than the sum of its parts. After a long test phase, which mainly took place at Virginia Tech University in the USA, and after

> "Floor design construction in the UK is predominantly undertaken following the guidelines set out in The Concrete Society's TR34."

a number of very successful pilot projects, it is clear that SigmaSlab has started a revolution in the construction of concrete floors. Concrete floors with surfaces of 150 × 150m without any contraction joint have become a reality."

After discussions with both Bekaert and CCL's concrete reinforcement experts, Level Best discovered the possibility of a SigmaSlab solution to give them a floor with no joints at all. In addition, by not using traditional reinforcement, Level Best identified that the installation process could be faster than a conventional system, would use significantly less steel and would cut the carbon footprint. The installation process took place in three steps.

STEP 1 – PREPARATION

CCL supplied prefabricated post-tensioning tendons (pre-cut strands with anchors already fixed), which allowed the post-tensioning to be installed in less than a day. Due to restricted slab edge access and to avoid infill strips of floor area designated for the post-tensioning tendon stressing operation, pockets (similar to column isolation joints)

ABOVE:
After the stressing pockets were installed, the CCL XU2 anchors were installed and the post-tensioning strands inserted.

were located at one end of the building, to allow future access of a stressing jack. Due to the width of the building and the pour occurring in one single day, only longitudinal strands were required.

STEP 2 – CONCRETING

Bekaert's Dramix steel fibres were added to the concrete on-site. The fibres are glued in bundles that are gradually released during mixing to disperse evenly through the concrete without balling. The steel-fibre concrete was poured onto the ground by direct discharge from concrete trucks. The process for finishing the surface of the concrete slab to the required flatness and levelness was identical to typical flooring construction. Level Best also applied a dry-shake topping to the surface of the concrete to increase toughness and abrasion resistance.

STEP 3 – STRESSING

Prior to the stressing operation, the post-tensioning tendons were

ABOVE:
The finishing process.

checked and wedges were firmly installed into the anchors. As soon as the concrete achieved a compressive strength of 10MPa, 25% of the ultimate stress was applied. Once the compressive strength reached 25MPa, the final design stress was applied to the tendons. Initial stressing was done on day two after casting; final stressing a day later. The protruding strands were cut and the stressing pockets then filled with SFRC. Depending on the concrete strength maturity in the first days from casting, initial and final stressing can be done faster.

SIGNIFICANT BENEFITS

Compared with conventional reinforcement solutions, SigmaSlab reduced steel use in the building significantly; it was estimated that the overall carbon footprint of the seamless floor was reduced by 30% compared with a like-for-like conventional reinforcement system. This assessment of carbon savings was made possible by access to both Bekaert and CCL's Environmental Product Declarations (EPDs) – externally audited life-cycle analysis (LCA) reports that highlight the global warming potential (GWP) of the steel fibres and the post-tensioning strands.

By creating joint-free distances up to 150m in some cases, SigmaSlab reduces the number of joints and their associated weaknesses. Over time, this will diminish the maintenance and repair costs and increase floor durability.

The end result for Level Best Concrete Flooring was a floor with a low total cost of ownership, no joints and no reinforcement detailing, more spacious interiors, greater flexibility of layout and better aesthetics.

Jon Wilcox, managing director of Level Best Concrete Flooring, says, "We build enough internal floor slabs to understand the problems created for clients when troublesome floor joints begin to breakdown under heavy trafficking. We have our own floor repair and renovation division that is constantly busy maintaining floors for warehouse occupiers.

"When we first found out about this new floor slab technology, we didn't hesitate in being the first flooring contractor in the UK to try it out – after all, innovation in concrete flooring is our tag line and what better way to carry it out than in your own building. We see the benefit, not only for our own usage, where we will be installing racking, mezzanine floors and carrying out heavy-duty maintenance on our plant and equipment, but also for clients requiring floor slabs in rectangular buildings (out-of-aspect ratio) where joints will be heavily trafficked and downtime needs to be kept to a minimum. At Level Best, we also install and maintain a lot of cold-store concrete floor slabs and repairing the joints at extremely low temperatures is time-consuming, expensive and disruptive to warehouse operators; we see this floor slab design as a superb solution for new builds. C

Acknowledgement:

With thanks to David Clark of Bekaert for his input with this article.

Reference:

1. THE CONCRETE SOCIETY. *Concrete industrial ground floors. A guide to design and construction*. Technical Report 34, Fourth edition, Camberley, fourth impression January 2018.

ABOVE:
The levelling process using one of Level Best's lightweight remote-controlled laser screed machines in conjunction with an experienced concreting team.

BELOW:
The post-tensioning strand, ready to receive its first stress of 20% from the stressing jack when the concrete reached 10MPa compressive strength.