New Ikea warehouse gets floored

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(Photos: Twintec)

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The opening this year of a new Ikea distribution centre in Peterborough afforded Twintec Industrial Flooring the opportunity to expand its specialisation of installations using steel-fibre-reinforced concrete technology. The building, which is nearly 30m high and stretches for over 1km with a footprint of nearly 20 football pitches, is one of the largest structures in the UK.

Project challenges

The new centre incorporates a 60,000m² distribution centre to serve Ikea stores throughout the UK and a 26,000m² customer distribution centre for packing and distributing orders direct to Ikea customers via a network of UK distribution hubs.

Considerable challenges were presented to the installation team. The entire slab was suspended on 250mm² or 300mm² driven precast concrete piles on a grid greater than 4×4m. Geotechnical conditions were poor, as the site was founded on a filled lagoon. An automated system of storage and retrieval was to be installed in the high bay, measuring over 20m to the eaves, which required a floor that could carry racking end frame loads of 160kN. A standard racking configuration was to be installed in the low bay, with a 100kN end frame.

The flatness tolerance for the whole of the floor area was completed to 'FM2' as specified in the 1994 edition of Concrete Society Technical Report 34 *Concrete industrial ground floors – a guide to their design and construction*[1], with an additional client requirement for level of ± 10mm from datum.

Design solution

To comply with the specification, it was decided to adopt a simply supported, jointless design. A 310mm-thick floor slab was specified for the high bay with a 260mm-thick slab for the low bay and customer distribution centre. Designs for the ultimate state were verified by yield-line theory along with a finite element/grillage analysis to identify the behaviour at the serviceability limit state. In both areas, the concrete was a C40 mix incorporating superplasticiser and 50kg/m³ of steel fibres; water/cement ratio was 0.5. The sub-base was required to be exceptionally level and trimming/compacting to a level of ±5mm was comfortably achieved using Twintec's own laser control system. In addition, the 6000 driven precast piles needed to be cut down to compatible tolerance. This could not have been achieved manually, so a specialist contractor created a machine-mounted saw with a diamond blade enabling each pile to be trimmed to a tolerance of ±3mm in less than a minute.

The production process

A guaranteed high volume rate of delivery and consistent quality of concrete were required to make this project a success. Twintec worked with partner company Sitebatch Technologies and an on-site concrete batching facility was installed. Up to 810m³ of concrete a day was produced,

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which translates to 80–90m³/h. Six concrete agitator trucks with capacities of 6, 9 and 12m³ were used to transfer concrete to the fibre integration machines, then on to the workface, the short distance ensuring that control was maintained over concrete quality, consistency and supply.

Two specially developed Twintec integration machines were permanently based on site to ensure that the high-tensile, undulated steel fibres were integrated into the concrete properly. The machines blow the fibres into the agitator trucks at 60m/s, after which they are mixed for eight minutes to achieve uniform distribution. The agitator trucks were then able to discharge the steel-fibre-reinforced concrete directly to the workface as no beams or shear mats over piles were required. Compared to combination steel bar or steel fibre methods, this significantly increases productivity and avoids compaction problems over the piles.

Conclusion

The steel-fibre-reinforced concrete (SFRC) design eliminated any need for steel fixing, saving a great deal of time and checking. The "jointless" floor contained only day joints at approximately 50m c-c; this dramatic reduction in joints led to a more durable floor, and one that was more flexible to the client. The onerous "FM2" tolerance (to the 1994 edition of TR34) was comfortably achieved with several areas of the floor achieving FM1 levels of flatness. ■

Reference

1. THE CONCRETE SOCIETY Technical Report 34: *Concrete industrial ground floors – a guide to their design and construction*. The Society, Crowthorne, 1994.