

Steel-fibre-reinforced pile-supported car park in Belfast

Gregor Cameron, A. J. Clark Group

New Quay Developments was appointed main contractor for the construction of a new Lidl Store in Dundonald, Belfast, a development of 1200m² of retail space with 4800m² heavy goods access roads and car parking. Geotechnical site investigations revealed a peat layer beneath the site, which presented long-term settlement problems. In view of this, Armstrong & Taylor, the design-and-build engineer, adopted a piled solution to support both the superstructure and the internal floor slab, fulfilling the client's design brief. Since it was neither economical nor practical to remove and replace the peat to alleviate excessive settlement in the external areas, a pile-supported base slab was chosen, overlaid with a traditional flexible road construction.

The design-and-build engineer had recently attended a seminar on fast-track installation methodology for pile-supported concrete floor slabs. The construction team contacted A.J. Clark with a view to providing an economic solution for the internal floor slab, external hardstanding and car parking areas.

A suspended two-way-spanning internal and external concrete slab was proposed, laid using a laser screed and reinforced with steel fibre. Design and slab details were provided by the Wood Boyle Partnership using Bekaert design methods.

Key elements in the design included:

- pile size and centres
- heavy-goods vehicle loading in external areas
- traditional flexible road construction on external slab
- ability to withstand an imposed load on the ground floor of 100kN/m²
- position of formed day contraction joints – there were no other joint requirements
- no requirement for fibre suppressants and specialised finishing techniques.



The laser screed being used to lay the external hardstanding.

Early consultation between Wood Boyle and Armstrong & Taylor allowed the ground beams around the building perimeter to be designed and detailed to incorporate an edge support for the external car park slab. This reduced the cost of the piling operations by eliminating one line of piles.

Armstrong & Taylor was able to incorporate the drainage lines within the flexible construction, which assisted slab design and installation, as there was no requirement for penetrations. The pile loading and layout, finished levels and construction details were assessed by the design team, and rationalised to minimise cost and time. It was estimated that site work would not exceed ten working days.

The Bekaert design system applies the inherent strength of steel fibres to produce a reinforced concrete slab capable of spanning in two directions between beams that are integral to the slab depth. The beams, in turn, span between piles, and are reinforced with prefabricated mesh strips, installed directly ahead of the laser screed. The reinforcement strips were made by ROM, which specialises in detailing and manufacturing reinforcement for this system.

This specialised design system negates the requirement for enlarged pile heads to combat the effects of punching shear, and allows the concrete slab to 'float' on the pile head and the slab. The design aspects enable large pour laser screed techniques to be adopted.

This technique requires operatives to work immediately in advance of the laser screed, installing the slip membrane and reinforcement, providing clear access for the concrete truck mixers and laser screed. High-flow concrete is discharged directly from the truck mixer into the localised area, at which point the laser screed levels and compacts the concrete. This operation is repeated along the length of the panel until the line is complete. At this point the laser screed returns to its starting edge, to begin the next section.

Following the installation and testing of piles, and the preparation of the sub-base, the 6000m² concrete floor slab was completed within five working days – a considerable benefit to a tight construction programme.

This project demonstrates the potential to save significant time and cost by involving a specialist flooring contractor early in the programme. ■