



Figure 1: Schematic of the floor slab design.

ProLogis Distribution Centre, Peterborough

“This particular project uses the latest advances in materials and equipment to overcome challenging site conditions, a tight programme and onerous operational requirements.”

This project involves the design and construction of a steel-fibre-reinforced concrete (SFRC) pile supported ground floor slab. In the summer of 2006, Twintec completed the installation of a concrete floor slab for Winvic Construction who were contracted to construct a new distribution facility for ProLogis.

ProLogis is the largest developer worldwide of industrial/distribution warehouses, building speculatively to a very high quality, retaining a long-term interest in business/distribution parks and the communities they serve. Winvic specialises in the construction of such developments and has earned a reputation for delivering such schemes on time and within budget.

Concrete has long been the material of choice for warehouses and is the most suitable material for such facilities' floors, where the floor is subjected to extreme levels of abrasion and wear, and long life/low life cost is an absolute prerequisite. The floor also represents the most important feature of the building to the operators; it must remain fully operational continuously. Total flexibility of use is also required to accommodate variations in storage and use, therefore keeping joints to a minimum is of great benefit.

This particular project uses the latest advances in materials and equipment to overcome challenging site conditions, a tight programme and onerous operational requirements. The ground conditions and intensity of loading prevented the use of a ground-bearing floor slab and the pro-

ject team decided that a suspended ground floor slab was required.

Twintec, together with Winvic, the design team and piling subcontractor Stent, then undertook an integrated and detailed planning process that considered techniques and materials that could provide better performance and better value. This included options for pile type and spacing, slab thicknesses and reinforcement types; these were all reviewed until the most appropriate option was selected.

The selected design option was a steel-fibre-reinforced concrete (SFRC), 'joint-free' Freeplan S floor slab, details of which are summarised below:

- area = 48,384m²
- concrete volume = 12,096m³
- reinforcement = 545 tonnes AFT +1/60 steel fibres at 45kg/m³
- ten days' preparation (sub-base trimming followed by joint installation)
- no steel fixing required
- 21 days' pouring using flood pour/laser screed
- total time on-site – six weeks
- dry-shake topping/fibre suppressant Twintop 4kg/m²
- FM2 special flatness tolerance
- piles: 250mm² piles, 3.5m × 3.5m grid with 900mm pile caps
- loadings: UDL: 50kN/m² and also 90kN individual racking leg load (180kN back to back).

Adopting this system completely eliminated the need for detailing, procurement, site storage, fixing and checking of steel, more than halving the programme time that would have been needed for a traditionally reinforced concrete floor slab. Using SFRC also reduces slab thickness, saves on excavation and waste disposal costs and reduces

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Figure 2 below: Completed final regulating layer showing pile heads.

Figure 3 bottom: The completed floor at ProLogis’ distribution centre, Peterborough.

the demand for cement and aggregates needed for the concrete. Other benefits of this technology include: proven technology; widely accepted design methodology; improved productivity; reduced tripping and handling hazards; and improved quality.

Twintec carries out all aspects of the work from budget proposals through to detailed design along with full supply

and installation. The company’s preferred option is fibre-only, simply supported two-way spanning (see Figure 1).

The design methodology for the fibre-only systems combines the yield line theory (eg, Johansson) together with other well-established industry touchstones such as Meyerhoff and Westergaard. The theories were put to the test in 1994 when a full-scale testing of a fully suspended fibre-reinforced concrete slab was carried out on a job site in Belgium.

The designs use structural steel fibres, which have both a high tensile strength (typically 1200–1400N/mm²) and special profiles designed to maximise anchorage within the concrete.

These design methods have been developed in conjunction with steel producers and independent consulting engineers for over 20 years. In total, the volume of jointless ground-bearing floors laid throughout Europe using these design methods since 1982 exceeds 60 million m². The total volume of slabs suspended on piles throughout Europe since 1992 designed in accordance with these design methods (SFRC without any form of steel bar) exceeds 60 million m².

This technology, along with the use of ‘laser screed’ machines, has transformed the concrete flooring industry, increasing output from a few hundred square metres per day to outputs in excess of 3000m² per day. SFRC has eliminated induced contraction joints within slabs on grade and this too has provided versatile storage space to the logistics industry, which seems to be demanding bigger, better warehouses with higher quality, flatter floors.

This project showcases the perfect match SFRC offers to the high demands of developers such as ProLogis and the distribution centres they build. ■



ProLogis Distribution Centre, Peterborough

Flooring contractor:	Twintec Industrial Flooring
Owner:	ProLogis Developments
Architect:	Alan Johnson Associates
Consulting engineer:	Nolan Associates
Contractor:	Winvic Construction
Steel-fibre reinforcement:	Propex Concrete Systems
Admixtures, curing agent and dry-shakes:	Sika
Ready-mixed concrete:	Hanson Premix
Piling:	Stent Foundations

Judges’ comments

The distribution centre is an impressive warehouse in terms of size. It is one of the largest of its kind and stretches steel-fibre concrete and floor technology.

The concrete slab and pile elements of the structure (not to mention extensive areas of external concrete paving) have been well executed. They have been innovatively designed to take into account local terrain and geology, predicted movement in service criteria and the varied potential needs of distribution centre clients.

What makes the project special is the use of steel-fibre concrete in a suspended slab design, with significant savings from the avoidance of conventional steel fixing. The benefits of steel-fibre-reinforced slabs have been proven in ground-bearing situations, offering rapid, low-cost construction. This application in suspended slab design proves the technology can also be applied successfully. The design does not require that the piles are tied to the slab, which avoids the additional congestion that this will cause.

Following the successful application on this project, it can be expected that further applications of this type will follow.