

# Direct-finished concrete – the ideal sustainable floor for large retail environments

**Cost considerations and sustainability requirements are expected to impact strongly over the next few years, to the advantage of those who design, supply and deliver precision direct-finished concrete floors. That is the conclusion drawn from the evidence of leading retail operations in the UK and North America.**

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In recent years, the use of industrial building technology for large out-of-town retail environments has emerged and come to prominence due to the low capital cost, design flexibility and short project build timescales. The issue of sustainability and minimum environmental impact is also becoming a major consideration for large national and international retailers whose public image is so critical to their success.

The design, specification and quality of the floor are arguably the most critical features in such buildings due to the fact that trading operations, which are increasingly seven days per week, are inevitably in contact with the floor. Any problems with the floor not only have an immediate aesthetic impact but remedial work will also have a major impact on operations. In severe instances the removal of stock and fixtures may be required, with the associated substantial downtime and loss of revenue.

The biggest sector of these large out-of-town retail premises in the UK is currently the DIY retailers, such as B&Q, Wickes, Focus and Homebase, who have selected a floor specification that is not only aesthetically pleasing but very quick to install, extremely durable, environmentally sustainable and is the most economic solution, both in installed and time/life cost, compared with any other system (see Figure 1).

## Specification

The current dominant specification comprises large-area, laser-screed installed concrete floor slabs in accordance with The Concrete Society's Technical Report (TR) 34<sup>(1)</sup> nominally reinforced with bottom mesh. (Although fibre reinforcement is widely adopted for industrial applications, the risk of fibre protrusion at the surface makes it less

attractive for retail environments where the surface is not subsequently covered.)

High-precision, leave-in-place AlphaJoint formwork set to a precise level with the AlphaFix micro-adjustable installer at approximately 40m centres provides the principal free-movement joints. The AlphaJoint formwork system incorporates a 50 × 10mm, cold-drawn, sharp-edged steel strip for the joint arris protection and Diamond or Alpha tapered plate dowels provide the load transfer across the joint. The AlphaJoint system for the free-movement joint, together with the provision of in-slab saw cuts, again conforming to TR 34, permits full shrinkage movement of the slab and thus significantly reduces any cracking forces (see Figure 2).

The specification, which has been used in over 400 UK stores to date, also typically calls for a light-coloured, dry-shake surface applied at around 5–7kg/m<sup>2</sup> in-situ with the concrete, to not only provide an aesthetically pleasing surface but also an extremely tough, durable one with a design life of many decades. Indeed, with an appropriate cleaning and care regime the surface appearance and uniformity improves over time, unlike the case of resin or other surface types, which deteriorate over time.

## Critical care in construction

A critical feature of current specifications, which is not always fully appreciated, is the overall careful management of the floor-laying and finishing processes. This includes careful control of the localised construction environment, including a completely weatherproof building, and a high level of skill and experience within the floor-laying team. This is especially important given the long life expectancy.

The resulting floor structure is not only cost-effective, durable and aesthetically pleasing but, from an environmental perspective, scores very highly due to the elimination of subsequent processes and materials. The concrete floor slab, which is essential for the structure of the building, also provides the floor surface without the need for additional tiles, coatings or fabrics.

## Crack control

Although this broad floor specification is well understood and widely implemented, there is still the small risk of defects, including cracking of the concrete slab and surface appearance variation, due to the many influences that affect concrete while curing.

Of these, the occurrence of cracking is by far the most challenging and in the absence of gross contributory factors, such as concrete mix problems or excess loading, the most likely factor is the environmental conditioning of the slab in the critical initial 12–24 months after pouring when the rate of shrinking and curing is highest.

Research work carried out at Loughborough University<sup>(2)</sup> has demonstrated the critical relationship between temperature and humidity conditions and its effect on the curing of concrete slabs. It is well understood that high temperatures and low humidity accelerate concrete curing and drying and that such acceleration can, and often does, lead to shrinkage cracking of the slab (see Figure 3). Many forward thinking developers are now specifying



**Figure 1: Direct-finished concrete is an ideal floor solution for large retail environments.**

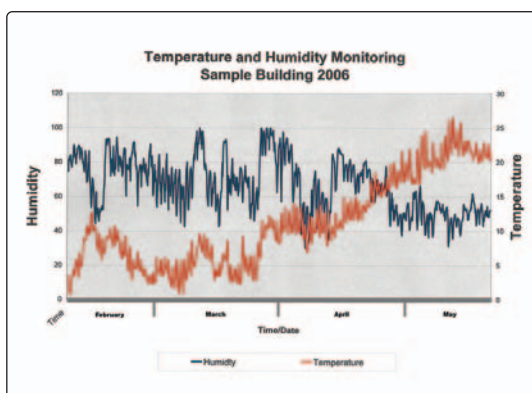
Photos: Permaban

**Figure 2: Current specifications call for a precision approach to all aspects of floor installation, including formwork, laser-screeding and dry-shake application.**





**Figure 3 far left: Poor control of localised temperature and humidity conditions can lead to in-panel cracking, which spoils an otherwise excellent floor.**



**Figure 4 left: Monitoring and control of localised conditions during the critical slab curing and drying period can help prevent problems such as cracking.**

both monitoring and control of the localised environmental conditions with the aim of eliminating such cracking completely. This monitoring is being done in conjunction with consultants such as Permaban who can provide constant monitoring, feedback and guidance (see Figure 4).

### Durability of concrete

In the DIY sector, a less than perfect floor appearance is less problematic due to the utilitarian nature of the product offering, but substantial efforts are nevertheless made to ensure the best possible surface appearance. Tiled floors quickly show grout damage and deterioration, resins very quickly abrade, accumulate damage and lose their gloss and the repairs that inevitably follow stand out from the surrounding area.

In other sectors, such as food and general retailing, many companies still specify floors with tile, resin or fabric coverings, mainly for aesthetic reasons. Under most conditions, none of these solutions will offer the toughness or durability of an in-situ concrete surface. Fabrics and resins do not have the abrasion or damage resistance of well-designed cementitious materials and, although tiles themselves may offer comparable performance, the overall surface invariably deteriorates due to failure of the grout between the tiles.

### Future specifications and sustainability

As sustainability becomes more important to international companies, the use of high environmental impact approaches, such as tiling or resin coatings, will increasingly be questioned. The specification that currently predominates in the DIY sector is already crossing into other sectors. An example of this is Wal-Mart in the USA, one of the world's largest companies and certainly the world's largest retailer with over 6500 stores.

The Wal-Mart stores feature multiple product lines with both food and general merchandise and are now employing a floor specification close to that outlined previously. In the UK, Wal-Mart is beginning to experiment with this specification for their ASDA branded stores. As the adoption of this approach becomes more widespread it will certainly evolve in a number of areas:

- Joint design – increased use of inert materials, such as stainless steel, for food hygiene applications.
- Reinforcement – 'strategic' reinforcement with bottom mesh being replaced by localised load transfer plate dowels at saw cuts, leaving the remainder of the slab unreinforced.
- Temperature/humidity control for the initial slab curing period, which may be up to 24 months depending on slab depth.
- Surface materials – heavier dry-shake or monolithic in-situ surface applications to give wider options for colour control and improved aesthetics.

- Wider adoption of water-based, in-situ curing and surface hardening materials in lieu of solvent-based systems.
- Final surface conditioning, such as diamond grinding/polishing to produce a terrazzo effect, further enhancing the appearance and surface uniformity without requiring additional coating processes or materials (see Figure 5).

### Concluding remarks

It is clear that the current flooring specification adopted by many large retailers offers an extremely cost-effective, durable and aesthetically pleasing floor, which also has very low environmental impact. These approaches will certainly find wider adoption in light of the current requirement for large companies to demonstrate greater sustainability. However, it is incumbent on the key suppliers to continue their development to meet the diverse requirements of all sectors. ■



**Figure 5: Finishing processes, such as diamond grinding and polishing, offer resilient and sustainable floors for almost any application.**

### References:

1. THE CONCRETE SOCIETY. Technical Report 34, *Concrete industrial ground floors – a guide to design and construction*, Third Edition. Camberley, 2003.
2. AUSTIN, S., ROBINS, P. and BISHOP, J. *Behaviour and design of concrete industrial ground floor slabs*. Loughborough University, Department of Civil and Building Engineering, December 2000.