member of the Structural Precast Association, supplied:

- 62 full-height columns in Type B finish to BS 8110[1], incorporating corbels to support the structural beams
- 147 beams spanning 15.6m, with service hole penetrations and erection safety netting sockets
- 540 pre-finished precast concrete rib slabs inclusive of lighting conduits and all interconnecting reinforcement
- 120 parapet units to Type C architectural finish, with cast-in sockets providing the main support for the waved vertical louvres
- 175 precast walls for the main and two escape staircases
- 178 precast terracotta-faced cladding panels from ground to first-floor level and around all three stair cores to roof level. These serve both as cladding and as structural members, assisting the value engineering of this type of construction.

Conclusion

The building has been carefully positioned to provide areas of public open space to the south and west. This creates the opportunity for public art, open-air displays and exhibitions, or simply space to sit and relax. All spaces around the site will accommodate areas of planting and hard/soft landscape treatment to provide the appropriate setting for this fine building. The uniformity and consistency of this system built car park is currently surpassing many of the project team's expectations. All initial objectives are being met and the team is confident that SCC will complete the project on time and to a very high quality. ■

(Photo: SCC Ltd.)

Figure 4: Interlocking precast terracotta panels with cross-flow ventilation apertures that are a feature throughout the ground floor.

Reference:

1. BRITISH STANDARDS INSTITUTION. BS 8110-1: *Structural use of concrete. Code of practice for design and construction*. 1997.

Acknowledgements:

Client:	Borough Council of King's Lynn & West Norfolk
Main contractor:	Alfred McAlpine Capital Projects
Architect:	Pulmann Associates Architects
Engineers and parking consultants:	Hill Cannon
Design-and-build:	SCC Ltd

Shopping centre car park, Wohlen, Switzerland

Car parks form a part of many modern structures, such as office buildings, hotels, convention centres, exhibition halls, shopping malls and many more and are very often below ground. They can suffer from groundwater, mechanical wear and de-icing salts brought in by cars during winter periods.

Cornelius Oesterlee, Vandex International Ltd, Solothurn, Switzerland

Mainly built in reinforced concrete, the structures often suffer problems such as unintended cracks and cracks exceeding the maximum permitted width. Water ingress leads to corrosion of the reinforcing steel, followed by spalling and carbonation of the concrete, which leads to the loss of the protective environment for the reinforcing steel, and so the structures slowly degrade.

Waterproofing at design stage

Car parks as secondary structures must have a high degree of usability and low building and maintenance costs. Therefore, the design engineer has to aim for an easy - to-build, cost-effective structure while maximising space, usability and durability. Typically, requirements for new-build car parks include waterproofing systems that can, by the use of a mechanically resistant screed, protect the concrete and provide a barrier to prevent the ingress of harmful salts into the structure. Waterproofing and protective measures should be incorporated at the design stage in order to achieve high quality and durability at the lowest cost. This may lead to a design concept that defines limits to cracks that are well within the self-healing capacity of the subsequent protective screed.

Renovation

The renovation of existing structures usually aims to restore the damaged concrete and to provide additional protection by increasing the concrete cover. Adding a waterproofing layer to walls and floors can renew waterproofing systems. Renovation also includes the renewal of access ramps, installation of sprinkler systems for fire safety and monitoring to detect toxic exhaust fumes connected to an automated alarm and ventilation system.

Special attention has to be given to all kinds of joints, especially expansion joints, which can be subjected to multiple loads such as movement, vertical loads from cars and water pressure.

Cracks that might have occurred during the first period of service may indicate the need for a joint in the structure and should therefore not simply be sealed but, after careful investigation, be turned into an expansion joint.

The interiors of car parks are very often connected to the waterproofing system. With waterproofing slurries based on white cement applied on the side of negative water pressure – the inside of the building – the interior receives an appealing appearance and does not require an additional coat of paint.

(Photos: Vandex International Ltd.)

Figure 1: Overview of the finished car park with a cementitious waterproofing screed on the floor.

Figure 2: Levelling and providing a slope with steel rails.

Figure 3: Trowelling the screed to a smooth and dense surface.

Case study

The Migros Shopping Centre in Wohlen, Switzerland features a below-ground parking area that is subjected to limited water pressure. The waterproofing system that was chosen for the horizontal areas also acts as the finishing screed. For a successful outcome, engineers coordinated the concrete design and the waterproofing screed so that the number and width of cracks in the concrete did not exceed the self-healing capacity of the waterproofing screed.

The screed that was used has special properties that enable it to it fulfil several functions. Due to the presence of finely graded quartz sand, the screed has a very compact structure with very low pore volume. The specified water/cement ratio ensures the mechanical and physical properties. Combined with special chemical additives a layer of 8–10 mm is sufficient for waterproofing against up to seven bars of positive or negative water pressure. High-quality, fast-setting cements give a high compressive strength and, together with the quartz sand, provide a surface that is highly resistant to mechanical wear. The fast-setting cement provides a walkable surface after a few hours, allowing other work to proceed. Most cementitious screeds, especially those for waterproofing, have the capacity to seal cracks that form after application. Cracks measuring up to 0.3mm can be sealed by the reaction of calcium hydroxide with the carbon dioxide in the air to form insoluble compounds of calcium carbonate.

Cementitious waterproofing screeds

Waterproofing screeds demonstrate a high compatibility with concrete in terms of mechanical and physical properties such as compressive and bending tensile strength, Young's modulus and thermal expansion. This allows an excellent bond with the prepared concrete surface.

Due to their water vapour permeability, cementitious waterproofing screeds do not trap water and humidity inside the host concrete. This is contrary, for example, to polyurethane or other polymer-based coatings, which face the risk of blistering. The permeability of water vapour also allows the application of these screeds on the side of negative water pressure, and this allows waterproofing to be carried out either after the concrete structure is completed, or during a stage of renovation many years later.

A correct application provides a seamless seal against water pressure from the outside and provides protection for the concrete from de-icing salts and water brought in by cars. This also applies to intermediate slabs. Local repairs, if ever necessary, are carried out easily by removing the damaged screed and patching with the same material. The joints between the existing screed and the patch will be waterproofed using the self-healing properties described previously.

Application

Prior to application the concrete surface needs to be prepared. For the best bond the surface has to be rough and the cement laitance and loose particles have to be removed. This is best achieved by using a mechanical grinder, which leaves a roughness of approximately 2mm. Alternatively, high-pressure water jetting or sand blasting could be used. The firm mechanical bond is strong enough to take the stress due to shrinkage of the screed without cracking. It is advisable to apply the waterproofing screed to a newly built structure as late as possible in order that the shrinkage of the concrete has reached optimal levels. The waterproofing screed will then seal potential cracks easily.

The prepared surface must be damp, but not wet. The dampness is required to prevent the concrete from absorbing water from the screed during the process of hydration which could disturb the specified water/cement ratio. Excess water would result in a separating layer and prevent a proper bond.

Conclusion

Waterproofing car park decks with cementitious screeds combines two main functions: the screed keeps water out of the structure and also provides the topcoat to drive on. As a final coat the seamless screed protects the concrete structure from damage by harmful salts carried in by cars. The coatings provide a high degree of mechanical resistance to wear by tyres. Due to the combined function, time and cost are reduced since waterproofing and screeding is done in one working cycle. ■