TECH NOTE

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Xypex for Waterproofing Suspended Slab Concrete

Xypex has been used in many horizontal suspended concrete applications (suspended slabs). Xypex provides both waterproofing and improved chloride resistance to concrete – a dual benefit that is clearly relevant in suspended slab applications. While flexible membranes for waterproofing suspended slabs are commonly used, their characteristics limit performance – drawbacks that the Xypex solution overcomes.

Compared to Xypex crystalline waterproofing, membrane waterproofing is typically much more expensive and ongoing maintenance requirements are more frequent and more costly. Membranes are also prone to installation errors such as poor surface preparation and poor seam and termination detailing, leading to early degradation and failure. This said, the procedure for using Xypex as a stand-alone waterproofing solution for suspended slabs requires careful attention. The specifics of a project must be reviewed against the technical requirements of crystalline waterproofing as well as the risks and costs associated should leakage occur. This document discusses the benefits and risks inherent in using crystalline waterproofing as a stand-alone solution for suspended slabs and how to mitigate those risks.

Xypex Crystalline Technology

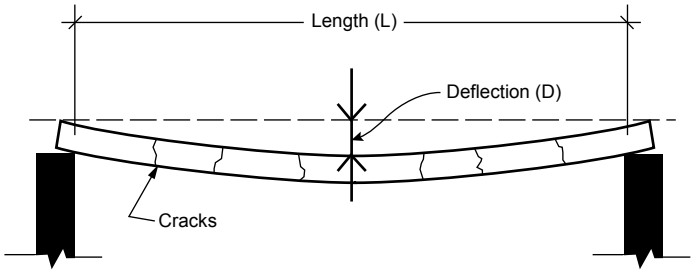
Xypex Coatings and Xypex Admixtures impart to concrete a unique blend of chemicals. These chemicals drive a process that causes the formation of a non-soluble, permanent crystal structure within the concrete. The crystal structure develops from a reaction between the Xypex chemistry, the constituents of hardened cement paste and water. This reaction will normally take days to weeks to create a crystal structure robust enough to heal hairline cracks and densify the matrix. At this point, water ingress through the concrete is stopped and prevented.

The image to the left shows a well-developed Xypex crystalline structure with interlaced crystals and air spaces between them. This dense yet random matrix of crystals creates such a tortuous pathway that water cannot penetrate the voids and cracks of the concrete.

While this technology is well proven to provide very effective waterproofing of stable, non-moving cracks in concrete, crack movement can cause the crystals to crush thus allowing a leak path to again form in the crack or void. Experience proves that the chemistry inherent in Xypex enables re-healing of these cracks over and over again, a process normally taking several days. During this time minor leakage of water through the crack may occur.

Concrete Cracking

Concrete cracks for a variety of reasons, the most common being short and long term shrinkage. All concrete will shrink at least to some degree and thus cracking will occur in almost all concrete elements. Concrete elements vary depending on their orientation and loading. Below grade walls, slabs on ground, walls of water holding structures and soil retaining walls are a few examples of concrete elements that are highly stable as they normally are fully supported or have no variable live loads or rapid thermal change. The cracks in these types of elements rarely move except when there is a seismic or other unusual event. Conversely, suspended slabs normally undergo variable live loading and may, if the loads are large enough, deflect or flex as shown below. They may also be subject to daily or seasonal temperature changes that can cause crack movement.



In the case of a parking slab or bridge deck there will likely be a blend of cracks – some that are stable and never move, others that move every time a vehicle passes over the area. Xypex crystalline waterproofing is very effective at healing non-moving cracks in a slab, but in cracks that move every day the crystals can break down faster than they form (Xypex crystals normally take several days to form); under this condition, these moving cracks will not be healed effectively by crystalline waterproofing.

Conversely, experience has shown that suspended slabs that have lighter live loads can be quite stable. Podium slabs over below grade parking areas that have pedestrian traffic only or have landscaping layers have been waterproofed with Xypex. These types of slabs often exhibit few or no moving cracks, with any leaking hairline cracks being healed by Xypex to produce a long term waterproof structure.

There are different strategies for constructing suspended slabs including traditionally reinforced slabs, precast structure slabs, post tensioned slabs and composite concrete/steel deck slabs. Each type of slab has unique characteristics.

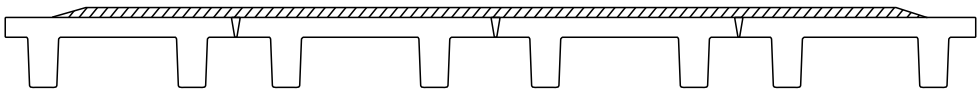
Traditionally Reinforced Slabs

In traditionally reinforced slabs, through-slab cracks are readily visible from the top and bottom of the slab. Suspended slabs, like most concrete, develop shrinkage cracks and normally some of these cracks may move under varying live loads, while some will not. When considering Xypex crystalline waterproofing for this type of slab, the probable locations where moving cracks may form should be identified during design. In these locations, control joints should be sawn into the slab shortly after placement. Saw-cutting draws movement and cracking to these precut locations. These control joints can then be filled with a flexible sealant to ensure waterproofing of moving joints/cracks in the slab. It is recommended that varying live loads similar to, but not in excess of expected long term design loads, should be introduced to the slab as early as possible. For instance light vehicles might be encouraged to park on the slabs of an underground parking area during the construction phase. This allows water from the vehicles to heal the cracks while encouraging any non-anticipated moving cracks to form. Any cracks

that don't heal can be identified from below and crack-chased to open them to an acceptable width and geometry. These moving cracks are then filled with a flexible sealant at the upper slab surface to waterproof them (maintenance of this flexible sealant will be required periodically). Other movement-accepting crack sealing methods such as polyurethane grout injection may also be effective. This process of using Xypex Crystalline Technology has proven successful in creating waterproof, chloride resistant, and low maintenance suspended slab.

Precast Plank and Double-T Structures

Precast plank and double-T structures will normally have significant movement at precast panel joints/edges. Cracks will telegraph up through the topping slab at the joints between the precast members. Properly timed saw cutting at these locations and filling with a flexible sealant will waterproof these moving control joints. The use of Xypex Admix in the topping slab along with the detailing of these joints will provide a waterproof, chloride resistant structure with very low maintenance requirements.

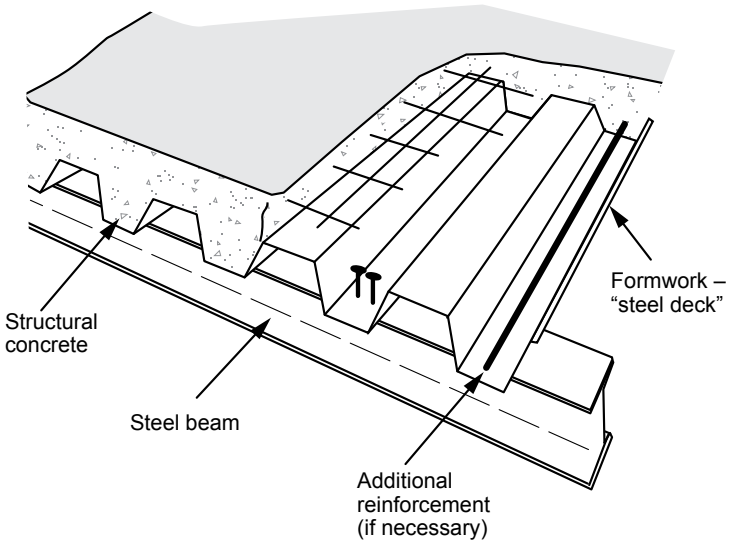


Post Tensioned Slabs

Post tensioned slabs generally have very little visible cracking as the post tensioning cables pull the slab together such that no part of the slab is ever in tension. This lack of significant cracking makes the use of Xypex an obvious choice and Xypex has been used successfully to waterproof and protect post tensioned slabs in the past. Cracking can occur however at locations where the slab is restrained from moving (around stair wells, elevators and large shear walls) and can result in visible, through-slab cracks. These may move on an ongoing basis under the live loads of the structure and thus should be crack-chased and sealed. One of the challenges of post tensioned slabs is that, while cracks may not be visible, they may nonetheless be present. Some of these cracks may experience ongoing movement and, if their location on the slab surface can't be identified, repair can prove challenging. It is critical in post tensioned slabs that all water be kept from getting into the post tensioning ducts and cables and this must be considered in the detailing of the waterproofing system used.

Composite Concrete Slab on Steel Decking

Xypex considers composite concrete slab on steel decking as one of the assemblies that needs more careful consideration. These types of slabs are similar to a traditionally reinforced slab for cracking and movement characteristics. However, as the bottom of the slab is a formed steel sheet, leaking will manifest itself as water dripping through a seam in the steel decking that forms the underside of the slab. As the in-place formed-steel sheet is covering the concrete from below, identification of the cracks which are leaking and require repair with a flexible sealant is next to impossible. Furthermore, any water that does get through the slab can become trapped against the steel causing corrosion damage. Issues regarding water infiltration between the upturned steel at the slab edges and the concrete has also been reported. In some markets, where a minimum slab thickness of six inches (150 mm) is maintained over the steel web, this application has a high success rate. Xypex strongly recommends consultation with local Xypex Technical Services Representatives if waterproofing of this type of assembly using Xypex is being contemplated.



Conclusions

In all suspended slab applications the risk associated with periodic leaking should be assessed and considered. There are low risk slab applications where occasional minor leaking is acceptable such as slabs over ground that are suspended on pile caps / grade / ground beams or industrial buildings containing weatherproof assemblies. There are also places where traditional roofing membranes will not be effective such as in areas with frequent violent storms, high UV exposure or extreme abrasion (snowplows, front end loaders, etc). In these instances Xypex crystalline waterproofing with its low cost, low maintenance requirements and highly robust nature may be the best choice. However, this is likely not true for suspended slabs that form the roof of high-end retail space, habitable spaces or other high-profile buildings. In these instances designers may choose to include Xypex crystalline waterproofing as a backup to the traditional movement-accepting membranes, providing low cost reinforcement to the primary waterproofing assembly.

The use of Xypex Crystalline Technology as a stand-alone solution in suspended slabs provides many benefits but must be carefully considered against the risks. Further, successful implementation depends on assessment of potential ongoing movement and a strategy for treatment of these locations. When implemented correctly a Xypex crystalline waterproofed slab can be the best solution for a project. When considering Xypex Crystalline Technology as a stand-alone system for waterproofing of suspended slabs it is recommended that the design team contact their local Xypex Technical Services Representative for guidance and assistance.