TECH NOTE

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Bonding Procedures for Multilayer Flooring, Wall Systems and Related Points When Using Xypex Waterproof Coating

The steps needed to achieve a successful bonding of layers in a multiple-layer-system can be challenging and require the special attention of everyone involved, including specifying engineers, architects, builders and owners.

Xypex coatings such as Xypex Concentrate and Xypex Modified are regularly used as the waterproofing component in multilayer flooring and wall systems. Examples of flooring systems include concrete overlays (toppings, screeds), tile and other solid flooring, and liquid applied coatings such as epoxy. Xypex waterproofing is used in vertical multilayer systems from simple painted walls, through heavier epoxy coatings to cement plasters (renders) and solid adhered finishes such as tile.

A successful multilayer system requires consideration, planning and execution of many steps and procedures. This work will involve many members of the construction team including the architect/designer, the general contractor and each of the sub-trades involved in the various components.

Design considerations include stresses on the multilayer system from gravity and structural loads, and strains related to thermal differentials, drying shrinkage and creep. These need to be accommodated by adequate strength of the materials, good material compatibility (between layers), provisions for movement such as control joints and adequate measures to obtain sufficient bond via good surface preparation, bonding agents etc. Other issues can also be important such as end use and serviceability issues, water vapor transmission and durability factors.

Construction issues are also critical. Design requirements need to be met or rationally modified through on-site trial testing and performance approval procedures. The staging or timing of the various trades needs to be planned with overlapping responsibilities of the sub-trades carefully delineated. Timing needs to be considered relative to the overall project schedule. Protection of the various exposed layers from damage between subsequent operations also needs to be considered.

Surface Preparation and Bond

For each layer in the system there are two bond lines to consider: the line to the layer below and the line to the layer above. In addition, the strength of the material within the layer itself must be reviewed.

There are many factors that go into achieving good bond in cementitious materials such as Xypex coatings. The concrete or block surface to which the Xypex is applied will need to be prepared. Xypex literature provides guidance on methods to remove weak mortar layers (laitance) and other surface contaminants (dirt, oil, old coatings etc) by various means and creating an open or more porous surface texture with sufficient roughness for bonding. Xypex literature describes a properly prepared surface as having “tooth and suction”. Methods discussed include water blasting, grit blasting and acid etching methods (see Xypex literature for more details). This is followed by

water saturation prior to coating application. The chief intent is to provide enough “tooth” such that the coating will key into the substrate and enough “suction” such that you will have an open-pored texture to allow intimate contact so crystalline chemicals transfer to the substrate and complete the waterproofing action. In a bonded multilayer system, the bond strength of the Xypex to the layer below will also need to be sufficient to meet the requirements of the system design. It is important to note that this “system bond requirement” may be different than the minimal “waterproofing bond requirement”. In fact for waterproofing purposes it is possible to completely remove the Xypex coating after sufficient time has passed for the chemical transfer to take place. In critical high-bond applications where the inherent bond strength of Xypex to the substrate is not capable of withstanding the system forces, the complete removal of the Xypex coating is sometimes chosen by the system designer.

Next is the consideration of the bond to the Xypex coating by the subsequent layers. These subsequent layers can include paints, coatings, mortar plasters (stucco), concrete overlays or floor materials. The requirement for surface preparation and timing of the application of subsequent applied layers will be different depending on the type of material being applied and the project circumstances. Moisture and pH sensitive applications such as paints, epoxies and other similar coatings may require a minimum of 21 days prior to application and may require further precautions to ensure sufficient dryness and pH neutralization. Generally, for any bonding requirement to the Xypex coating, proper cleaning of accumulated construction debris and contaminants is vital. In fact protection from damage during any delay periods is important and the best practice is not to allow any construction activity to take place until subsequent layers are applied. As in any cement system, removal of any weak surface layers (laitance) may be needed if present to a sufficient degree to interfere with bond. This may need to be completed by acid etching, water blasting, grit blasting or other methods depending on the “system bond requirements”. As noted in the Xypex literature, it is often necessary to use a suitable bonding agent applied to the Xypex surface to achieve sufficient bond.

Even though the Xypex coating normally requires 2 to 3 days of moist curing to facilitate chemical transfer, it is not necessary to wait this long before application of subsequent cementitious coatings. Cementitious systems applied over Xypex coatings usually provide some moisture while also preventing the escape of moisture, making possible the earlier application of subsequent cementitious layers. In fact, it has been found that for some systems an optimum bond can be achieved when subsequent layers are bonded while the Xypex coating is still relatively “green” or between 8 and 48 hours after application.

This also allows for less effort in surface preparation as the surface is still damp and clean and other surface preparation and cleaning steps can be eliminated. In addition, early application can enhance the rate of movement of the crystalline chemistry as it is now moving in two directions (down to the substrate and upward into the cementitious overlay) which may be an advantage in certain circumstances. This short delay period is not often possible when coordinating sub-trade timing and a longer delay period – 2 to 3 days or more – between the Xypex coating application and the application of subsequent layers is often required.

As is the case where any combination of layers is combined into a multilayer system, it is recommended that bonding agents be considered and that trial applications be completed to ensure “system bond requirements” are met.

Loads and Strains on the Multilayer System

There are many other considerations that must be taken into account for the overall system that are related to the bond between layers. These typically involve in-plane shear stresses caused by gravity and structural loads, thermal movement, and shrinkage.

Structural loads are of particular concern in suspended slab construction and long precast beams can have sufficient deflection to cause stresses in adhered layers. Gravity loads need to be considered in vertical applications as do out of plane loadings in seismic zones. In most regions attachment of cladding to a building is carefully regulated and anchored systems are required that do not rely on bond.

Thermal movement can occur from daily or yearly fluctuations in temperature and will result in substantial shear strains being transferred between the layers in a multilayer system. These strains will need to be resisted by the bond strength of each layer. The problem can be made worse by differing thermal coefficients of the layers. For example coatings such as epoxy will have a much higher thermal coefficient and will expand more than cementitious materials for the same temperature change. This causes a sharp change in strain right at the bond line.

Most cementitious materials and some coatings will shrink as they cure. Different rates of shrinkage between the layers will cause differential strains that must be accommodated at the bond line. Creep within a material will provide some relaxation of these stresses that build up. Stiffer materials will absorb more strain than softer materials and thus the different elastic modulus of the materials can be a factor. It is also well know that clay-based tile materials will grow and increase in volume over very long periods.

Designing for these and other stresses can be a challenge as the properties are often not well known and cannot be easily modeled. Typically designers will rely on rules of thumb and trade knowledge to choose compatible materials, design joints and other stress relief methods, and specify needed bond strengths and other material properties.

Even after following the above procedures diligently, occasional de-bonding between layered materials can still occur, and while the reasons can sometimes be determined in hindsight, rarely are they reasons that even the foresight of seasoned experts could have anticipated. And, in some instances, the reason for debonding may simply remain a mystery.

Finally, verification of systems performance through trial applications should be undertaken to provide confirmation that everything is working well together.