

# The causes of delamination in self-leveling underlayments

Although MAPEI self-leveling underlayments (SLUs) are designed to succeed within a wide range of application and service environments, from time to time complaints arise about the underlayment pulling away (delaminating) from the substrate below it. Imagine an installation where the installer follows their usual routine but the assembly fails, requiring quick decisions about what went wrong so that repairs will be successful.

In determining what went wrong, the following aspects should be considered:

- The condition and stability of the original substrate
- Industry-approved moisture testing
- Mechanical profiling, such as shotblasting or grinding
- Surface preparation, such as patching and priming
- Mixing of the SLU product
- Application method for the SLU, such as pouring or pumping

Concrete is the most widely used substrate and often requires the application of an SLU for proper preparation before receiving a floor covering. Sometimes, there may be a need to level a wood subfloor or an existing flooring material such as ceramic tile, vinyl composition tile (VCT) or non-cushioned sheet vinyl.

## Concrete substrates: Conditions and preparation

Because of its nature, concrete has great potential for issues that can lead to delamination.

### New/green concrete

With the fast-track construction and shortened timeframes in which contractors are asked to complete their installations, some basic requirements may be overlooked. Being pressured to adhere to a rigid time schedule is no excuse for applying SLUs over green concrete (less than 28 days old) unless indicated in the Technical Data Sheet for the SLU.

In many cases, cracks caused by the normal volumetric changes that take place during cement hydration in new/green concrete can be observed through the underlayment. This condition can sometimes cause the underlayment to shear from the concrete. Wait until the minimum cure time indicated by the



SLU manufacturer is achieved. At this point, if dynamic or out-of-plane cracks appear, they should be reported to the general contractor or the owner (or his/her representative) so they can be properly evaluated by the design professional of record and a repair strategy can be implemented before any work begins in the area. Moisture conditions also must be taken into account to ensure that moisture limitations for a given product in the system are not exceeded.

### Unstable concrete

Over time, a concrete slab may have issues with its sub-grade due to improper soil compaction or erosion and may then become unstable due to lack of proper support. This usually shows up in the form of a damaged slab that may move when subjected to heavy static load or loads. If the slab is not stable, this structural issue can commonly cause out-of-plane cracking, and self-leveling materials will not fix the problem.

### Unsound concrete

This problem has more to do with the actual integrity of the concrete. In other words, an unsound slab does not have the strength that it should under normal circumstances and would likely not support an SLU or allow it to gain proper

bond strength to the concrete, resulting in delamination. Indications of unsound concrete can include spalling, scaling, delamination, crumbling, cracks and laitance. If only the surface has been affected, it must be mechanically prepared down to a solid and clean surface before the application of an underlayment.

#### Contamination of concrete

Improper substrate preparation is the first factor to consider when dealing with a bonding problem, and part of the solution is to remove any contamination. A myriad of contaminants on or in an existing concrete substrate can reduce or prevent adhesion of an SLU. The usual jobsite culprits are dirt, dust, oil, grease, paint, wax, drywall compounds and old adhesives. Other materials that can negatively impact the bond are products commonly placed on the concrete, such as curing compounds, sealers, densifiers and fibers, as well as unintentional contaminants like calcium carbonate from the use of improperly vented, temporary heat sources.



Many times a simple water test (see ASTM F3191-16) can indicate if a contaminant is on the slab and whether it has porosity. Sometimes, acid etching may have been used to clean and profile concrete as part of the surface preparation process. Unfortunately, the acid can soak into the slab, and procedures to neutralize the acid may not reach deeply

penetrated acid, which may migrate back to the surface to cause later bonding issues. The acid also may continue to deteriorate the substrate, causing other issues in the future. For this reason, acid etching as a form of surface preparation is not recommended by MAPEI.

#### Moisture in concrete

Excessive moisture in the substrate can lead to failures. Among the many possible sources of moisture emissions are a high water table, lack of or a damaged vapor retarder, residual moisture in the substrate, perimeter landscaping and improper drainage away from a structure. Because self-leveling underlayments are intended for interior use only, all excessive moisture issues must be mitigated before application of the SLU to ensure proper performance. Refer to each system component's Technical Data Sheet for moisture limitations and conform to the most stringent limitations. Also, SLUs cannot be installed in areas with hydrostatic pressure.

#### Improper profiling of concrete

Surface preparation also includes ensuring that the proper International Concrete Repair Institute (ICRI) concrete surface profile (CSP) has been achieved and that an appropriate primer has been selected.

The CSP specified (usually #2 to #3) indicates how rough or smooth the concrete must be in order to get the desired bond of the primer and self-leveling underlayment. The International Concrete Repair Institute has 10 rankings of

concrete surface profiles, ranging from smooth (CSP #1) to very rough (CSP #10), to help clarify which particular floor preparation is required.

#### Improper priming of concrete

Primers are required every time a self-leveling underlayment is used. Because several different types are made specifically for certain applications, it is important to use the right one for the job at hand. Check with the underlayment manufacturer for any questions you might have.

Some primers are for porous surfaces, others are for nonporous surfaces, and a few can handle both types. A more tenacious bond, such as an epoxy with sand broadcast into it, may be needed for applications subject to frequent, heavy dynamic loading. In the case of a lightweight gypsum substrate, the primer must be diluted and at the right dilution rate. Applying the primer properly to the floor will not only help to ensure proper bonding of the underlayment, it will allow the primer to cure properly or to dwell on the floor for an adequate amount of time without exceeding open times, all of which become important factors in properly installing the primer.



Always read the data sheet for each product to determine thickness or coats required.

### **Wood substrates: Conditions and preparation**

To prevent issues with a wood subfloor, conduct a thorough inspection to address some of the following concerns.

#### Incorrect wood types

Verify that the type of wood subfloor being installed or that is already installed is recommended by the SLU manufacturer as well as by industry guidelines. Some woods are too dimensionally unstable, and their expansion and contraction could cause the underlayment to delaminate from the subfloor.

#### Unstable wood subfloors

The wood subfloor needs to be solid and stable. In other words, the subfloor should be well fastened to adequate framing members and be of a sufficient thickness (sometimes requiring more than one sheet of wood) in order to properly support the SLU and other flooring system components. The entire weight of the system must be considered and constructed in such a way as to not allow excessive deflection of the subfloor (generally no more than L/360). If these limitations are exceeded, delamination will likely occur.

#### Unsound wood subfloors

A sound wood subfloor is properly made and void of defects. Ensure that the integrity of any existing wood subfloor has not been compromised due to flooding, chemical attack, fire, demolition, exposure to weather or any other factor that could weaken the floor. A subfloor with adequate strength is crucial for supporting the entire flooring system.

### Contamination of wood subfloors

As with concrete, it becomes imperative to remove any condition or material that can reduce or prevent the SLU from bonding with the wood substrate. Common construction contaminants like dirt, dust, oil, grease, paint, wax, drywall compounds and old adhesives could be on or in an existing wood substrate. Also of concern are spilled chemicals and even products placed on the wood subfloor by the manufacturer, like sealers, that help protect the wood from the elements at the construction site. The bottom line is to be diligent in ensuring that the SLU does not delaminate from the wood substrate due to some form of contamination compromising the bond of the primer.

### Moisture in wood subfloors

A wood subfloor should remain dry at all times after the initial installation of a self-leveling underlayment. If there is a known source of moisture, such as a leaky pipe, repair the problem before the installation. If the SLU is being used in an area adjacent to a wet area, use a waterproofing membrane over the SLU to help protect it from degradation over time. If previous issues with moisture existed, ensure that the wood subfloor and other flooring components have not been compromised. If so, replacement of any damaged portions should be seriously considered.

### Improper priming/preparation of wood subfloor

As stated before, primers are required every time that an SLU is installed. Because several formulas are available, it is important to use the right one for the job at hand, so read the corresponding data sheets and consult the primer/underlayment manufacturer about any questions you might have. This includes questions concerning proper mixing, cure times, open times and application procedures. Most manufacturers recommend plastic or metal lath over the primer when an SLU is installed over a wood subfloor.

## **Other flooring materials as substrates: Conditions and preparation**

Some approved, existing flooring materials like ceramic tile, VCT, non-cushioned sheet vinyl and cement terrazzo can also receive self-leveling underlayments. Contact the underlayment/primer manufacturer concerning possibilities for these and other existing flooring materials. As with the requirements for concrete and wood, all of these floors must be sound, solid and stable. Existing flooring materials must be well bonded, properly prepared and primed before the installation of the SLU. Follow all installation guidelines contained in the Technical Data Sheet for the SLU being used.

## **Mixing the SLU**

An often overlooked step in the installation process is mixing. Proper mixing of the SLU is critical to the success of the installation. Careful consideration should be taken when calibrating a pump or measuring water to allow the SLU to mix and perform properly. Using more than the required amount of water will compromise the water-to-cement ratio and make the material weak by inviting segregation of the raw materials and also impacting the performance characteristics.

Using the right mixing equipment is also crucial. This includes the recommended mixing paddle and a drill that will give the correct rpm's for the stated amount of mixing time. Inadequate mixing, by using the incorrect equipment or not mixing

long enough, can lead to dry (under-hydrated) material. Overmixing can also lead to problems as well, the most common of which is air trapped in the material. This can result in excessive pinholing at the surface of the SLU.

Always keep the materials, substrate and ambient temperatures within the range acceptable for the SLU. Warmer temperatures can decrease setting times, and cooler temperatures can increase setting times. Materials, including the mixing water, should be stored out of direct sunlight. Staging of materials and equipment should be well planned in order to minimize effects from temperatures and distance.

## **Applying the SLU**

As a reminder, the substrate must be solid, sound, clean and free from oil or grease, wax, dirt, dust, paints, old adhesives, any other potential bond-breaking contaminants and any condition that may affect overall product performance.

Before SLU installation, close all doors and windows and turn off HVAC systems to prevent drafts during application and until the self-leveling underlayment has properly cured. Protect the application area from direct sunlight until cured. Drafts and direct sunlight can cause the SLU to dry rapidly and can create performance issues caused by inconsistent drying of the underlayment. Thicker areas can also dry faster due to the exothermic heat generated during the hydration of the cement, possibly causing cracking in these areas and subsequent delamination of the underlayment.



More and more contractors are making SLUs a standard for substrate preparation.

Always install an SLU within its stated limitations for thickness. Applying a material thicker than recommended can cause excessive shrinkage, leading to cracks and/or delamination from the substrate. Always install SLUs within the application range of the primer. Applying a leveler too soon into a primer can cause the primer to migrate into the SLU, affecting performance. Applying a

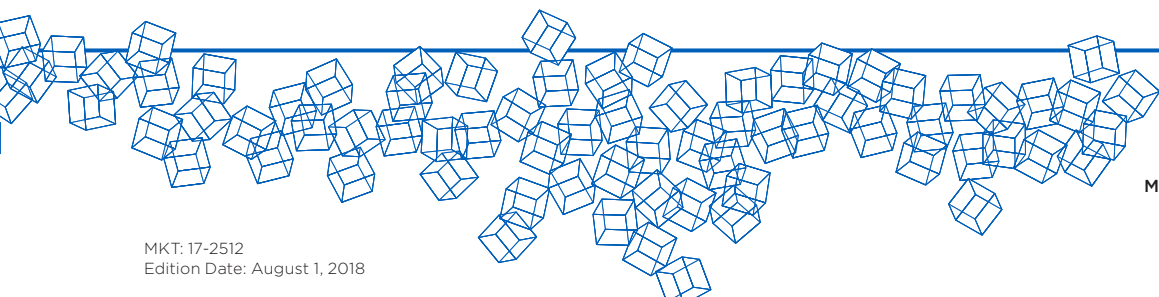
leveler outside of the primer's application range for thickness can lead to failures due to the primer skimming and not allowing the SLU to adequately bond.

Finally, ensure that the primer has not become contaminated by dust, dirt and other construction debris during its open time. If a leveler is placed over a dirty primer, this will likely lead to delamination of the self-leveling underlayment.

Self-leveling underlayments have enjoyed an impressive track record in the floor covering and concrete resurfacing industries. With the advent of more specialized self-leveling underlayments in the marketplace, more and more contractors are embracing this technology and are making SLUs a standard for substrate preparation. Paying close attention to the characteristics and physical condition of the substrate will help in material selection, substrate preparation and underlayment application. The material selected will only perform as well

as the surface to which it is bonded, so when considering which SLU to use, be sure to follow the underlayment manufacturer's guidelines for preparing these surfaces. Don't let improper planning ruin an otherwise successful installation. To confirm the desired results, conduct a project-specific mockup.

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