Understanding the Paradigm Shift in Underlayment Technology

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Today's installation systems allow the incorporation of ceramic and stone tile on virtually any surface. In addition to traditional projects such as bathrooms and kitchens, popular tile applications now include countertops, exterior balconies, and even bedrooms. However, an historic analysis of the development of these contemporary systems reflects a dramatic shift in accepted wisdom regarding the physical dynamics of the floor assembly that comprises this ideal and popular surface covering. It's actually quite easy to understand how this shift in accepted wisdom occurred.

Ancient Wisdom

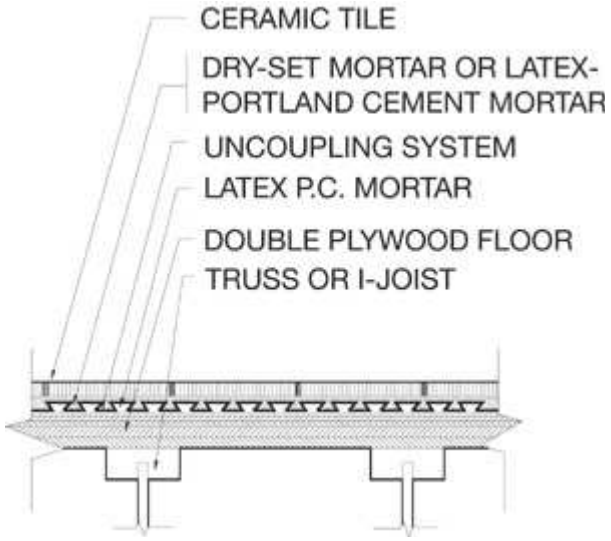
Thousands of years ago, European builders developed a successful means of installing tile that eliminated the transfer of stresses within the layers of the assembly, thereby eliminating failures.

Floor, Interior Wood Subfloor Cement Mortar

Evidence of their success can be seen today in the elaborate yet flawless tile installations found in many of the ancient European cathedrals. These builders understood that a forgiving shear interface between the building structure and the tiled surface was necessary in order to allow the two elements to move independently.

The installation method that the European builders utilized was a "sandwich" comprised of a structural base and a layer of sand, upon which the mortar bed (a mixture of sand, cement, or other binder, and water) and tile was adhered. The critical component in this sandwich was the layer of sand, which uncoupled the tile covering from the structure, allowing the two to move independently. The layer of sand could support the tile covering under heavy loads and, at the same time, provide a forgiving shear interface that effectively prevented movement forces (which emanated from the structural base) from transmitting into the tiled surface.

For many reasons, the use of the sand strata method is virtually extinct today. To begin, this type of assembly requires installer expertise, and these trained experts are few in number. Additionally, this type of assembly doesn't fit our current construction environment where there are considerable height and weight limitations.



Floors, Interior Wood Subfloor, 24'' o.c. Joist Spacing, with Uncoupling System Latex-Portland Cement

And yet, the "ancients" understood the physical dynamics of a composite floor covering assembly.

The Shift

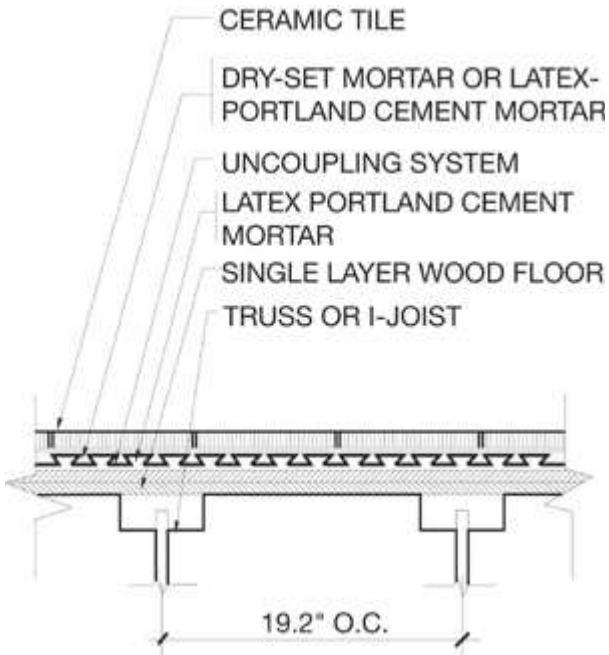
New technology often precipitates a shift in accepted wisdom. Sometimes the shift can be dramatic. For example, the 1960's ushered in a new era of tile installation with the introduction of thin-set mortar. In a thin-bed installation, the tile is bonded directly to the building structure; e.g., concrete, plywood, etc. It can be argued that the most monumental change our industry has undergone in the last millennium has been the shift from a system approach that incorporates a mechanism for uncoupling the surface covering from the building structure to a direct-bond approach, where the tile is directly bonded to the building structure.

The latter is based on the theory that the principle element needed in a direct-bond system to achieve a problem-free tile installation is an extremely strong bond between the tile and the substrate. This approach quickly gained popularity, because the ease of installation now allowed anyone, not just trained installers, to set tile. The mortar bed was eventually perceived as unnecessary.

The problem with this line of reasoning, of course, is that the contribution of each layer in the "sandwich" to the system's overall mechanical viability was now being ignored. Why is this a problem?

Bonding tile directly to the structure results in a force-transfer assembly. The physical dynamics of each layer in a tile assembly are vastly different from each other. The substrate material, whether it is plywood, OSB, concrete, cement

backerboard, or gypsum-based screed, expands and contracts due to changes in moisture and temperature levels. Ceramic tile, on the other hand, is a very brittle substance. In fact, an installed tiled surface can be compared to a large sheet of glass. In addition to being a hard, brittle material, the tile also expands and contracts in reaction to environmental changes.



Floors, Interior Wood Subfloor, 19.2'' o.c. Joist Spacing, with Uncoupling System Latex-Portland Cement

Since the substrate materials and the tile expand at very different rates, the two, when strongly bonded directly together, result in a force-transfer assembly whereby movement forces manifest themselves as cracks in the finished tiled surface.

Back to Basics - The Paradigm Shift

The methods of installing ceramic tile have changed over the years. However, the physical dynamics of a tile assembly have not. Traditional installation methods addressed these dynamics by uncoupling the tile from the structural base through the use of a forgiving shear interface in the form of a layer of sand. Today, the Tile Council of America’s Handbook for Ceramic Tile Installation contains two methods that are based on this theory.

1. Mortar bed over a cleavage membrane In this assembly, a structural base (concrete) is separated from the mortar bed by a cleavage membrane, or slip-sheet. The cleavage membrane provides the required shear interface as it isolates

the wire-reinforced mortar bed and tiles from movement forces within the structural base.

2. Uncoupling System This detail incorporates an uncoupling membrane, which was developed in the late 1980's specifically for tile and stone installations (Photo 1). This method effectively mimics the sand strata method by providing a forgiving shear interface within the tile assembly, allowing the substrate and the hard surface covering to move independently. And, taking contemporary lightweight construction methods into consideration, the membrane provides additional functional benefits that the sand strata method was unable to achieve. The uncoupling membrane is comprised of a thin, polyethylene sheet with a grid structure of square, cutback cavities and an anchoring fleece laminated to its underside. It is simply installed by embedding the anchoring fleece in thin-set mortar. The tiles are then laid using thin-set mortar on top of the polyethylene sheet.

The uncoupling membrane offers many advantages over the reinforced mortar bed with a cleavage membrane, in that it is lightweight and easy to install (Photo 2). The configured membrane not only uncouples the substrate from the finished tiled surface, it also supports the tile covering under heavy loads. And because of its polyethylene composition, it functions as a waterproofing membrane, effectively protecting the substrate from moisture penetration. This is particularly important in today's building environment where most substrates are moisture sensitive. Additionally, the configured channels on the underside of the membrane create free space. Since 44-50 percent of the uncoupling membrane's total volume is free space, moisture from the setting materials and substrate is allowed to escape and vapor pressure is allowed to equalize.

Understanding the Shift

Today's tile installers have an array of materials and installation systems at their disposal to meet the growing demand for this ideal surface covering. Setting materials are available in an ever-increasing number to address the varieties of substrates and tiles commonly used today. Underlayments continue to be developed in order to facilitate successful tile installation, including cementitious-coated foam backer boards, a substrate that is dimensionally stable and inherently waterproof. Other developments include drainage, waterproofing, and uncoupling membranes for use in both interior and exterior applications.

It is crucial that today's installers understand the physical dynamics of the entire tile assembly in order to achieve consistent viable results. Accepted wisdom regarding tile installation is quickly shifting from the direct-bond mindset back to an understanding of the need for a forgiving shear interface to absorb stresses. This shift, with its resulting successful installations, represents a great deal of potential for the entire industry.