Thermal Movement in Flooring

Thermal movement is a term that refers to the expansion or contraction of a substance in response to changes in temperature. All substances react to temperature changes. While all materials move in response to temperature, all materials also exhibit differences in both the speed of the reaction and the degree of movement when subjected to similar temperature changes. When two dissimilar materials react dramatically different in the same environment, their ability to maintain strong bonding potential through such challenges can be compromised. In these situations dis-bonding occurs and cracking or complete loss of bond is the likely consequence.

Resinous materials respond rapidly when challenged by temperature changes but concrete responds more slowly than resinous materials. Resinous products have higher tensile strengths than concrete. The result of stress applied to flooring at the bond line as a result of the rapid or continuous dissimilar movement is generally that the concrete cracks horizontally just below the bond line and the system fails at that point.

Thermal movement can be rapid or it can be less obvious but frequently repeated. It is easy to understand the effects of thermal "shock" as typified by rapid changes from instant exposure of a surface to steam and dry ice. Temperature changes do not have to be rapid. Slower more repetitive temperature changes are equally as destructive. In these situations there is a continuous challenge at the bond line caused by such things as daily cyclic temperature changes work with time to fatigue the weaker substrate at the bond line. Over time fatigue in the weaker substance, i.e. concrete, will cause a horizontal fracture just below the bond line in the same manner as if it were shocked rapidly. Conditions that can cause delaminating from thermal movement are not always obvious. Some to be aware of are:

1) Direct application of water at or above 180 degrees F
2) Direct application of steam
3) Areas under hot ovens or cookers
4) Direct application of dry ice
5) Exterior applications with direct sun exposure
6) Rapid or wide changes in ambient temperature (cold boxes brought to room temperature or the reverse)

When evaluating a potential flooring site, be aware of areas in the facility that fit the above criteria. Some examples are cage wash areas, kitchen cook lines and glassware areas, outdoor kennels, loading docks and manufacturing areas. Additionally, cleaning and disinfecting protocols requiring hot water or steam need to be considered, especially if the area being cleaned is normally kept cool as is the case in some controlled manufacturing processes i.e. food and pharmaceutical.

Conventional wisdom dictates that floor coverings in these areas need to be either thick or thin with no in between. Increasing the aggregate to resin ratio, known as aggregate loading, reduces thermal movement in resinous flooring. Thicker more heavily aggregate loaded flooring systems tend to dissipate heat before it reaches the bond line or at least reduce the heat intensity so as to minimize the energy created by differential movement at the bond line. In most cases systems that are 3/16" – ¼" thick and aggregate loaded are sufficient to achieve the desired effects.

In cases of extreme temperature changes it may be necessary to install a thicker flooring system or to use materials that are more compatible with the thermal exposure. Thinner coating systems react well to thermal stress since they are too thin to exhibit destructive energy on the bond line. In a conventional tug of war, coatings are more at the mercy of the concrete properties than the reverse. If the area in question receives heavy mechanical abuse however, thin coatings may not offer the required durability.

Many flooring installers cut corners on specifications with respect to thickness in an attempt to save costs and be more price competitive in the General Construction market. Concern over thermal movement as it relates to floor thickness is one of the reasons many specifications today require core sampling to verify floor thickness. Without the assurance afforded by core sampling you have no means to insure that the floor thickness meets your requirements. The initial cost savings offered by thinner floors is attractive at the time of installation, but very expensive to correct later.