

TL-0014 — Minimizing Concrete Shrinkage and Curling

Technical Letter (US Version)

Introduction

PREPRUFE® waterproofing systems are commonly used in horizontal applications under concrete slabs. PREPRUFE® waterproofing membranes are impervious to water. Therefore, all the excess water leaving the concrete must exit the concrete slab from the top surface.

Shrinkage cracks and slab curling can result during the drying process of the concrete if conditions are not properly controlled. If water is allowed to evaporate too quickly from the top surface of the slab, shrinkage cracks can result. Concrete curling, the phenomena of the corners and perimeter turning upward during the drying process, can result from the uneven loss of water from the top and bottom of the concrete slab.

Below Grade Construction

In general, the use of impervious membranes under slabs in below grade construction will not promote shrinkage cracking or slab curling. Heavy steel reinforcement, careful consideration of the concrete mix design, the slab thickness and the spacing of construction joints, will minimize shrinking and curling in this type of construction.

Slab-On-Grade Construction

Shrinkage cracking and slab curling may occur in slab-on-grade construction where impervious membranes are used. Shrinkage and curling has been observed in these applications when a thin 2-3 in. (50-75 mm), poorly reinforced (wire mesh), high slump concrete mix is used. The problem is intensified by having little or no aggregate in the mix, using set accelerators and not providing adequate construction joints.

There are many variables that may be controlled during the construction process to minimize concrete shrinkage and slab curling when pouring a slab directly over an impervious membrane such as PREPRUFE®. Some of these are described below.

Minimizing Shrinkage and Curling In Slab-On-Grade Applications

Minimizing shrinkage cracking and slab curling is achieved by lowering the rate of water loss from the top surface of the poured concrete slab. Water loss occurs by evaporation and is a function of temperature, relative humidity and wind velocity. The rate of evaporation can be lowered by decreasing the temperature, increasing the relative humidity or decreasing the wind velocity. This can be accomplished on the construction site by using sunshades, keeping the surface of the concrete moist by placing white polyethylene or wet burlap on the concrete surface and erecting windbreaks respectively.

In addition, shrinkage cracking and concrete slab curling can be minimized by following the recommendations proposed by the American Concrete Institute, as in ACI 302.1R, "Guide for Concrete Floor and Slab Construction." Some of these include:

- **Low shrinkage concrete mix** — the concrete mix design should utilize a non-shrinking cement, a reduced sand level (high enough to permit workability and water requirements), and proper aggregate. The aggregate should be large, well-graded, round or cube shaped, non-shrinking material.
- **Low slump concrete** — the water level in the concrete mix should be minimized.
- **Avoid concrete accelerators** — the use of accelerators to promote a faster gain in the concrete compressive strength are known to increase shrinkage and slab curling.
- **Steel reinforcement** — steel reinforcement, especially within the top 2 in. (50 mm) of the slab, is known to reduce shrinkage and curling.
- **Concrete placement** — avoiding delays in concrete placement, postponing concrete finishing steps as long as possible and vacuum dewatering of fresh concrete surfaces help minimize shrinkage and curling.
- **Slab Thickness** - A min. 4" of adequately reinforced concrete is required over PREPRUFE® Membranes.

Conclusion

PREPRUFE® waterproofing systems are inherently water impervious and have been successfully used under structural concrete slabs in below grade construction for many years.

Concrete shrinkage and slab curling may be minimized in slab-on-grade applications where PREPRUFE® membranes are used by following the recommendations set forth in ACI 302.1R, "Guide for Concrete Floor and Slab Construction."