NRMCA

What, Why & How?

Vapor Retarders Under Slabs on Grade

CONCRETE IN PRACTICE **CIP 29**

WHAT are Vapor Retarders?

Vapor retarders are materials that will minimize the transmission of water vapor from the soil support system through a concrete slab. Membrane materials with a permeance of less than 0.3 US perms (0.2 metric perms), when tested by ASTM E 96, are recommended for use as vapor retarders. Polyethylene film is commonly used and a minimum thickness of 10 mils (0.25 mm) is recommended for reduced vapor transmission and durability during and after its installation. Membrane material specifically designed for use as true vapor barriers with water transmission ratings of 0.00 perms per square foot per hour, as measured by ASTM E 96, are also available.

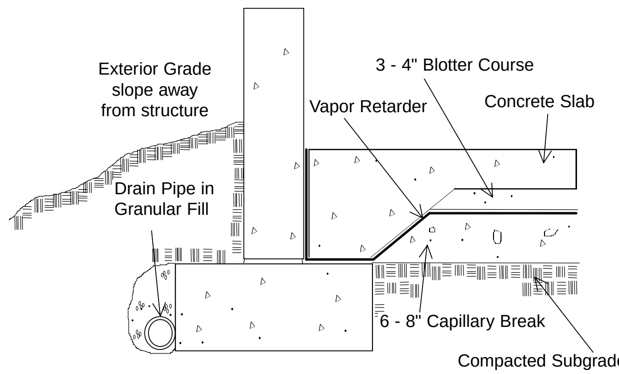

Figure 1 Typical Detail of Slab on Grade with Vapor Retarder

WHY are Vapor Retarders Used?

Vapor retarders are frequently specified for interior concrete slabs on grade where moisture protection is desired. Depending on existing subgrade soil characteristics and moisture conditions, protection from moisture may be desirable when floors will be covered with carpet, tile, wood or other impermeable floor coverings, or when moisture-sensitive equipment or products will be placed on the floor. Permeation of water vapor through concrete slabs can cause failure of moisture-sensitive adhesives or coatings resulting in delamination, distortion or discoloration of flooring products, and possibly fungal growth and odors.

Membranes below floor slabs on grade, in conjunction with sealed joints, also provide a barrier to radon penetration into enclosed spaces when such conditions exist.

WHAT Conditions Require Vapor Retarders?

The following conditions generally warrant the need for vapor retarders:

1. A high permanent or seasonal water table, free standing water, rainfall, and other runoff that result in levels of water above the existing slab level, will drive water through the concrete slab due to the hydrostatic pressure. Post-construction landscape grades, planting and irrigation need to be properly designed.
2. A fine-grained soil subgrade allows moisture to move up to the base of the slab by capillary flow. Coarse-grained soil that drains easily will not sustain capillary flow.
3. A vapor pressure gradient, where a higher concentration of water vapor (higher relative humidity) in a warm subgrade will cause water vapor to rise through the concrete to the slab surface when the ambient air is cool, dry, and at a lower relative humidity.

Vapor retarders under concrete slabs on grade should be used only when adverse moisture migration conditions can cause problems with the anticipated service conditions of a concrete floor.

Vapor retarders do not prevent migration of residual moisture from within the concrete slab to the surface. It is important to use a good quality concrete mixture with the lowest water content that will afford adequate workability. Water-reducing admixtures are generally used to minimize the water content in a concrete mixture and provide adequate workability for placement. After proper curing, the concrete slab should be allowed to dry out and tested to ensure that moisture is not being transmitted through the slab prior to installing flooring materials (CIP 28).

HOW to Place Concrete on Vapor Retarders?

Concrete should not be placed directly on vapor retarders. Research and experience have indicated that concrete, especially at a high slump due to a high water content, placed directly on a vapor retarder will be susceptible to surface crusting, cracking, and curling.

When concrete is placed directly on a vapor retarder membrane, the bleed water has to rise to the surface and this will delay finishing operations. Bleed water trapped below a finished surface can cause delaminations (CIP 20) or blisters (CIP 13). In cool, windy, or dry weather, surface crusting can result if the concrete does not lose water to the base and will set slower than the surface. Delayed setting can also cause plastic shrinkage cracking (CIP 5). Curling (CIP 19) can occur due to differential drying and related shrinkage at different levels in the slab.

The subgrade and base should be adequately compacted. The base should be well draining and stable to support construction traffic. A clean fine-graded, preferably crushed, material with about 10 to 30 percent passing the No. 100 [150-mm] sieve and free of clay or organic material is generally recommended. Use a 6 to 8 inch [150 to 200 mm] layer of coarse gravel or crushed stone as a capillary break in locations with fine-grained soil subgrades. Concrete sand should not be used as it is easily displaced during construction.

When used, place the vapor retarder membrane on a thin layer of compacted and leveled fine-graded material, over the base, to prevent damage. Membrane sheets should be overlapped by 6 inches [150 mm] at the seams and sealed around utility or column openings and to the foundation wall. Cover the vapor retarder with a minimum 4 inch [100 mm] layer of compactible, easy-to-trim, granular fill material. A “crusher-run” material graded from 1½ in. [37.5 mm] to dust size works well. If this is not practical, cover the vapor retarder with at least 3 inches [75 mm] of crushed stone sand. Do not use concrete sand. To reduce slab friction, top off the crusher-run layer with a layer of fine-graded material. The granular layer over a vapor retarder should ideally be placed under cover and should be dry prior to concrete placement to function as a blotter and remove water from the fresh concrete.

When restrictions to excavation require placing a slab directly on a vapor retarder, good concrete practice becomes very critical. Use a concrete mixture with a low water content. Using fly ash or slag as a cementitious ingredient will further reduce the permeability of concrete to moisture or water vapor transmission. Concrete slump, when placed, should not exceed 5 inches. Start finishing operations after the concrete has stopped bleeding. Finally, proper and adequate curing procedures (CIP 11) will ensure a good quality concrete slab.

References

1. *Guide to Floor and Slab Construction,* ACI 302.1R, American Concrete Institute, Farmington Hills, MI.
2. ASTM E 1643, *Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs,* ASTM, West Conshohocken, PA.
3. *Slabs on Grade,* Concrete Craftsman Series - CCS-1, 2nd edition, American Concrete Institute, Farmington Hills, MI.
4. R. H. Campbell, *Job Conditions Affect Cracking and Strength of Concrete In-Place,* et al., ACI Journal, Jan 1976, pp. 10 - 13.
5. C. Bimel, *No Sand, Please*, The Construction Specifier, June 1995, pp. 26.
6. Robert W. Gaul, *Moisture-Caused Coating Failures: Facts and Fiction,*Concrete Repair Digest, February – March, 1997.

Follow These Rules When Using Vapor Retarders

1. Use vapor retarders under slabs only when local soil and floor service conditions require its use.
2. Do not place concrete directly on a vapor retarder as this can result in cracking, curling, and delaminations.
3. Place the vapor retarder on a smooth base and ensure it is vapor tight to moisture sources below the slab and at its edges.
4. Place a 3 to 4 inch layer of self-draining and stable granular fill over the vapor retarder.
5. Order good quality concrete and follow good concrete practices for finishing and curing to reduce potential water vapor transmission.
6. Place concrete at a slump not exceeding 5 inches [125 mm].

NATIONAL READY MIXED CONCRETE ASSOCIATION

Technical information prepared by

National Ready Mixed Concrete Association
900 Spring Street
Silver Spring, Maryland 20910