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ABSTRACT:
There is a difference between Vapor Retarder, Vapor Barrier, and Waterproofing and why they are used under a slab on grade. This article addresses those differences and focuses on the use of vapor retarders.

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KEYWORDS:
Vapor Retarder, Vapor Barrier, Slab on Grade, Waterproofing, Cast-in-Place Concrete, permeance.

REFERENCES:
ACI 302.1R - Guide for Concrete Floor and Slab Construction
ACI 302.2R - Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials
ASTM E 1745 - Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs
ASTM E 1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
National Institute of Building Sciences (NIBS), Whole Building Design Guide, article "Building Envelope Design Guide - Floor Slabs" by Mark Postma, PE of Carl Walker, Inc.http://www.wbdg.org/design/env_bg_slab.php

The Where, When, and Why of Slab on Grade Vapor Retarders

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VR vs. VB?

Many use the terms vapor retarder (**VR**) and vapor barrier (**VB**) interchangeably. However, there is a difference. A vapor retarder RETARDS or slows (but does not prevent) the transmission of water vapor. A vapor barrier BLOCKS the transmission of water vapor.
VR is a material that has a permeance of 0.3 perms or less when tested in accordance with ASTM E 96. VB is a material that has a permeance of 0.00 perms.
VRs are made from a variety of materials including polyethylene sheets, asphalt/polyethylene composite sheets or polymer modified bitumen sheets.
Polyethylene sheets are often referred to informally as "Visqueen." However, "Visqueen" is a proprietary brand name and should not be used as a generic term.
Many sheet plastic VR products are high density polyethylene (HDPE). These products resist punctures during construction and help ensure the VR remains effective.

VR vs. WP?

The primary purpose of the VR under the slab is to prevent water vapor migrating from the soil, through the slab, and into the building.
The primary purpose of waterproofing (**WP**) is to prevent liquid water from entering the building.
In most cases, only a VR is required. However, where a soils report indicates there is liquid subgrade water present or if it is reasonable to anticipate liquid subgrade water may be present at some time during the life of the building, use waterproofing under the slab. A separate VR may be required, too, depending on the selected waterproofing product.

VR's Purpose

VRs are used under a concrete slab-on-grade to:

1. Restrict water vapor from entering a building.
2. Minimizes shrinkage stresses and cracking.
3. Prevent slab curling.
4. To keep soil gases, such as radon, from entering a building.

It is particularly important to restrict moisture entering the building through the slab where the floor finish will be a moisture-sensitive product such as:

1. Vinyl, linoleum, rubber, and other resilient flooring materials.
2. Wood.
3. Carpeting.
4. Sealers, epoxies, and other impermeable coatings.
5. Adhesives used to install finished flooring materials.

It is also important where there will be moisture-sensitive equipment, products, or environments.
Water vapor entering a building through a slab-on-grade can cause floor tile to dislodge, resilient sheet flooring to bubble, floor coatings to blister, and wood to warp.

Standards

ASTM E 1745 sets minimum product criteria for sheet membrane

VRs for use under slabs-on-grade. It limits the maximum water-vapor permeance to 0.3 perms and establishes three durability classes based on tensile strength and puncture-resistance: Class A (most durable), Class B, and Class C (least durable). ASTM E 1745 does not govern material type nor thickness. Most products offered as VRs will have perm ratings significantly less than the standard's maximum.
Not all polyethylene sheets have been tested according to ASTM E 1745. When specified, be sure to check submittals for this requirement before approving.
ASTM E 1643 sets minimum installation criteria for VRs for use under slabs-on-grade and includes details and checklists for the field, and pre-design and design considerations. VR installation recommendations below are based on this standard. ASTM E 1643 also recommends that slabs should be tested for moisture emissions prior to placement of finish flooring.
ACI 302.1R provides guidance for the materials and installation of concrete slabs in general. It requires VRs to comply with ASTM E 1745 and to have a minimum thickness of 10 mils (0.25 mm). This is thicker than the 6 mils (0.15 mm) traditionally specified for polyethylene VRs.
ACI 302.2R provides additional guidance on the materials properties and locations of VRs under concrete slabs that receive moisture-sensitive finish flooring. According to ACI302.2R, specifying a more stringent perm rating than the 0.3 standard maximum has advantages.

VR Installation

VRs should be placed directly over a compacted, well-drained granular fil (typically, gravel) which has been placed over unexcavated or undisturbed earth with the longest dimension parallel to with direction of slab pour. In addition to providing support for the slab, granular fill provides an area for moisture below the slab to accumulate and be dispersed.
The National Institute of Building Sciences (NIBS) Whole Building Design Guide www.wbdg.org recommends using 2 layers of 6 mils (0.15 mm) polyethylene sheets to reduce puncturing and provide redundancy at seams. This is a different system than the single layer of 10 mils (0.25 mm) VR recommended by ACI 302.1. However, NIBS recommendation may actually achieve better results since it addresses the same performance criteria as ACI 302.2R and includes built in redundancy.
VRs should lap over footings and foundation walls. Seams should overlap a minimum of 6 inches (150 mm) per ASTM E 1643. Seams, laps, and penetrations should be sealed with manufacturer's recommended adhesive, pressure-sensitive tape, or both. Attention to sealing seams and penetrations is critical to preventing soil gases, such as radon, from entering the building.
Care should be taken during the placement of reinforcement to prevent the VR from being punctured. Reinforcement supports should be bricks or should rest on protective pads. VR damaged during placement of reinforcement should be immediately repaired.

Cautions

A VR or VB under a slab-on-grade helps the concrete hydration process by limiting the surface area available for evaporation of water. However, if the evaporation rate on top of the slab is too high, the slab could curl and the surface can become dry and crusty while the concrete below the surface remains relatively soft. It is important to control the hydration process to assure the slab's proper appearance and performance.
Measures need to be taken immediately after concrete placement to assure the hydration process does not occur too rapidly.
Refer to ACI 308R "Guide to Curing Concrete" for recommendations of controlling concrete hydration.

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