STEGO WRAP VAPOUR BARRIER

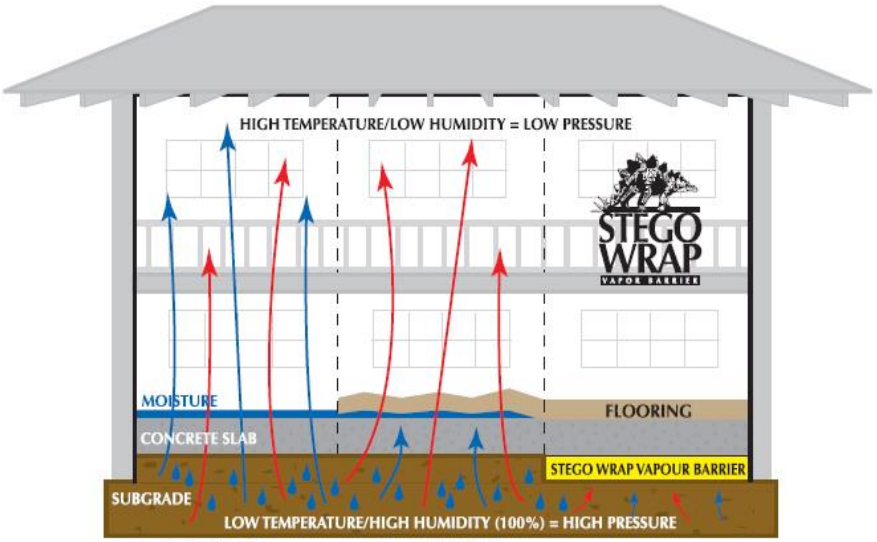
ASTM E 1745 Class A-B-C Compliant

STEGO WRAP VAPOUR BARRIER

is made with our proven trade secret blend of prime virgin resins and additives. Stego Wrap Vapour Barrier is an ASTM E 1745 Class A Vapour Barrier (below 0.01 perms). We focus on producing a product that will maintain its extremely low permeance for the life of a building. The protection of Stego Wrap Vapour Barrier provides the flexibility to change flooring types and overall building use without worrying about below-slab moisture vapour.

FEATURES & BENEFITS

- Unsurpassed Permeance Characteristics
- Life of the Building Protection
- Exceptional Tear and Puncture Resistance
- Easy, Reliable Installation
- Competitively Priced



Regardless of the location of the water table, humidity below concrete slabs approximates 100%. Typical below slab vapour pressure is more than twice that of building interiors at room temperature, creating vapour drive from the substrate, up through the slab, and into the building.

THE STEGO ADVANTAGES

SUPERIOR DEFENSE Against Floor Failures:

Experts say "the need for a vapor barrier (as opposed to a vapor retarder) is becoming increasingly clear." Concrete Construction Magazine, August 2003, p.18.

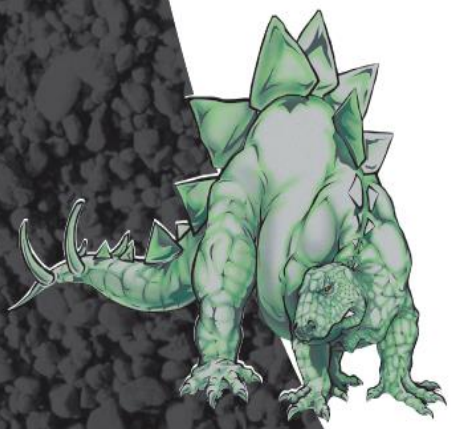
Infiltration of moisture through concrete slabs is a major building defect liability. Stego Wrap Vapour Barrier has an extremely low permeance preventing water vapour, soil gases (i.e. Radon), alkaline salts and soil sulfates from compromising the integrity of the building envelope and leading to serious problems with the concrete slab, floor coverings and indoor air quality. Stego Wrap Vapour Barrier is the best protection against these costly failures.

MOULD PREVENTION:

Mould needs three things to survive: moisture, sustained temperature (between 10° and 50° C), and a food source (dust, drywall, etc.). In any given building environment, contractors can only control one of these variables: moisture. Mould spores are present in 100% of building interiors. If moisture is allowed into your building environment, mould can and will grow. Toxic moulds like Stachybotyrus can be fatal for nearly 5% of people (Institute of Medicine 1993), and cause a variety of serious health problems in others. Several recent well-publicized cases involving toxic mould have resulted in multimillion-dollar insurance settlements. Many insurance companies have severely limited or removed coverage for mould claims fearing that these claims will bankrupt their companies. Now more than ever, it is critically important that extra attention be paid to preventing the intrusion of moisture vapour from your below-slab environment. Stego Wrap Vapour Barrier offers the level of protection that many architects are now seeking and is considered to be inexpensive insurance against these costly failures.

LONGEVITY AND STRENGTH:

Stego Wrap Vapour Barrier is NOT made with recycled materials and will not degrade. Prime, virgin resins are the key. Molecules within Stego Wrap "interlock" to provide strength, durability and unprecedented resistance to moisture vapour and radon gas. Stego Wrap's puncture resistance is excellent. Stego Wrap will not tear, crack, flake, snag or puncture, even when 8,000 kg laser-screed machines are driving directly across the barrier (see the reverse side for Stego Wrap Vapour Barrier's specifications).



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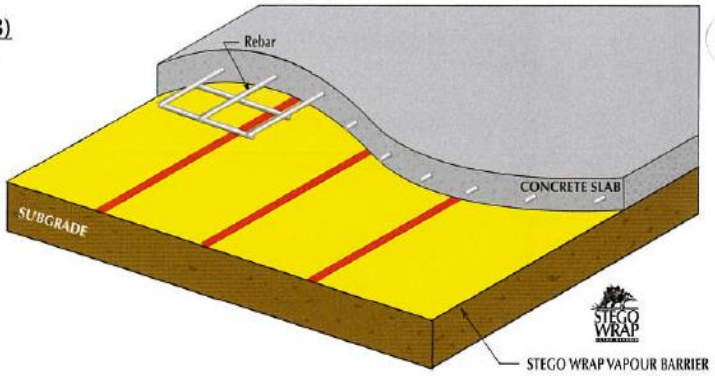
STEGO WRAP VAPOUR BARRIER SPECIFICATIONS

PROPERTIES	ASTM TEST METHOD	ASTM E 1745 CLASS A REQUIREMENTS METRIC	ASTM E 1745 CLASS A REQUIREMENTS IMPERIAL	TEST RESULT METRIC	TEST RESULT IMPERIAL	EXPLANATION
Permeance (perms)	F 1249	6 ng/m²/s/Pa	0.1 gr/sf/hr/in-Hg	0.48 ng/m²/s/Pa	0.0084 gr/sf/hr/in-Hg	Very impermeable to water vapour
Water Vapour Transmission Rate	F 1249	N/A		0.12 ng/m²/s	0.0035 gr/sf/hr	Very impermeable to water vapour
Puncture Resistance	D 1709	2,200 grams		2,326 grams		Resistant to puncturing from construction abuse
Tensile Strenth	D 882	7.9 kN/m	45.0 lbf/in	13.94 kN/m	79.6 lbf/in	Will not tear easily
Permeance After Conditioning (ASTM E 1745 Sections 7.1.2 - 7.1.5)	E 154 Section 8	6 ng/m²/s/Pa	0.1 gr/sf/hr/in-Hg	0.52 ng/m²/s/Pa	0.0091 gr/sf/hr/in-Hg	Permeance after wetting, drying and soaking
	E 154 Section 11	6 ng/m²/s/Pa	0.1 gr/sf/hr/in-Hg	0.53 ng/m²/s/Pa	0.0092 gr/sf/hr/in-Hg	Permeance after heat conditioning
	E 154 Section 12	6 ng/m²/s/Pa	0.1 gr/sf/hr/in-Hg	0.51 ng/m²/s/Pa	0.0089 gr/sf/hr/in-Hg	Permeance after low temperature conditioning
	E 154 Section 13	6 ng/m²/s/Pa	0.1 gr/sf/hr/in-Hg	0.53 ng/m²/s/Pa	0.0092 gr/sf/hr/in-Hg	Permeance after soil organism exposure
Methane Transmission Rate	D 1434	Gas transmission rate: Permeance:		149.6 GTR 0.05	2.12 x 10^{-6}	Greatly impedes the transmission of methane gas
Radon Diffusion Coefficient	N/A	N/A		1.3 x 10^{-13} m²/second		Greatly impedes the transmission of radon gas
Thickness	N/A			0.38 mm	15 mil	Stronger, tougher and less permeable than much thicker membranes
Roll Dimensions	N/A	width x length: area:		4.3m x 42.7m 180 m²	14ft x 140ft 1,960 sf	Allows for a minimum of seams
Roll Weight	N/A	N/A		63 kg	140 lbs	Easy to unroll and install

INSTALLATION INSTRUCTIONS: (Based on ASTM E 1643)

Unroll Stego Wrap over the area where the slab is to be placed. Stego Wrap should completely cover the concrete placement area. Overlap seams 150 mm (6 in) and tape using Stego Tape. All penetrations and blockouts should be sealed using a combination of Stego Wrap, Stego Tape and/or Stego Mastic. If the Stego Wrap is damaged, cut a piece from the Stego Wrap roll, place over the damaged area, and tape around all edges. Concrete may be placed directly on Stego Wrap.



STEGO TAPE:

STEGO WRAP RED POLYETHYLENE TAPE (10 cm x 55 m; 4 in x 180 ft) is specially designed to seal seams and penetrations on Stego Wrap installations. The acrylic, pressure-sensitive adhesive provides permanent bonding and quick-stick properties. The area to be bonded should be free of dust, dirt and moisture. If properly installed Stego Tape will provide years of continuous protection.

WARRANTY:

STEGO INDUSTRIES, LLC believes, to the best of its knowledge, that specifications and recommendations herein are accurate and reliable. However, since site conditions and installations are not within our control, STEGO INDUSTRIES, LLC does not guarantee results from use of the information provided and disclaims all liability from any loss or damage. NO WARRANTY EXPRESS OR IMPLIED IS GIVEN AS TO THE MERCHANTABILITY, FITNESS FOR PARTICULAR PURPOSE, OR OTHERWISE WITH RESPECT TO THE PRODUCTS REFERRED TO.

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STEGO DATA

Stego Wrap Vapour Barrier

STEGO INDUSTRIES, LLC

Vapour Retarders

1. Product Name

Stego Wrap Vapour Barrier

2. Manufacturer

Stego Industries, LLC
216 Avenida Fabricante, Suite 101
San Clemente, CA 92672
Sales, Technical Assistance
Ph: (877) 464-7834
Fx: (949) 257-4113
www.stego.ca

3. Product Description

USES: Stego Wrap Vapour Barrier is used as a true below-slab vapour barrier, and as a protection course for below grade waterproofing applications.

COMPOSITION: Stego Wrap Vapour Barrier is a multi-layer plastic extrusion manufactured with only the highest grade of prime, virgin, polyolefin resins.

ENVIRONMENTAL FACTORS:
Stego Wrap Vapour Barrier can be used in systems for the control of soil gases (radon, methane), soil poisons (oil by-products) and sulfates.

5. Installation

UNDER SLAB: Unroll Stego Wrap Vapour Barrier over an aggregate, sand or tamped earth base. Overlap all seams a minimum of 150 mm (6 in) and tape using Stego Tape. All penetrations must be sealed using a combination of Stego Wrap Vapour Barrier, Stego Tape and/or Stego Mastic.

VERTICAL WALL: Install Stego Wrap Vapour Barrier over the waterproofing membrane while still tacky. Mechanically fasten Stego Wrap Vapour Barrier to the wall at the top with termination bar and concrete nails. Drape Stego Wrap Vapour Barrier down across the footer and under the french drain.

6. Availability & Cost

Stego Wrap Vapour Barrier is available nationally via building supply distributors. For current cost information, contact your local Stego Wrap distributor or Stego Industries' sales department.

7. Warranty

Stego Industries, LLC believes to the best of its knowledge, that specifications and recommendations herein are accurate and reliable. However, since site conditions are not within its control, Stego Industries does not guarantee results from the use of the information provided and disclaims all liability from any loss or damage. No warranty, express or implied, is given as to the merchantability, fitness for a particular purpose, or otherwise with respect to the products referred to.

8. Maintenance

None required.

9. Technical Services

Technical advice, custom CAD drawings, and additional information can be obtained by contacting Stego Industries' technical assistance department or via the website.

10. Filing Systems

- Stego Industries' website
- Buildsite
- GreenFormat
- 4Specs

4. Technical Data

TABLE 1: PHYSICAL PROPERTIES OF STEGO WRAP VAPOUR BARRIER

PROPERTY	TEST	METRIC	IMPERIAL
Under Slab Vapour Retarders	ASTM E 1745 Class A, B & C – Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs	Exceeds Class A, B & C	
	Permeance Units (perms):	**ng/m2/s/Pa**	**gr/ft2/hr/in-Hg**
Water Vapour Permeance	ASTM F 1249 – Test Method for Water Vapour Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor	0.48	0.0084
Permeance After Conditioning (ASTM E 1745 Sections 7.1.2 - 7.1.5)	ASTM E 154 Section 8, F 1249 – Permeance after wetting, drying, and soaking	0.52	0.0091
	ASTM E 154 Section 11, F 1249 – Permeance after heat conditioning	0.53	0.0092
	ASTM E 154 Section 12, F 1249 – Permeance after low temperature conditioning	0.51	0.0089
	ASTM E 154 Section 13, F 1249 – Permeance after soil organism exposure	0.53	0.0092
Water Vapour Transmission Rate (WVTR)	ASTM F 1249	0.12 $ng/m^2/s$	0.0035 $gr/ft^2/hr$
Methane Transmission Rate	Gas Transmission Rate (GTR):	149.6	
	Permeance:	0.05	2.12×10^{-6}
Radon Diffusion Coefficient		$1.3 \times 10^{-13} m^2/second$	
Puncture Resistance	ASTM D 1709 – Test Methods for Impact Resistance of Plastic Film by Free-Falling Dart Method	2,326 grams	
Tensile Strength	ASTM D 882 – Test Method for Tensile Properties of Thin Plastic Sheeting	13.94 kN/m	79.6 lbf/in
Thickness	ACI 302.1R-04 – Minimum Thickness (0.25 mm/10 mils)	0.38 mm	15 mils
Roll Dimensions	width x length:	4.3 m x 42.7 m	14 ft x 140 ft
	area:	180 m^2	1,960 sf
Roll Weight		63 kg	140 lbs

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Stego Wrap Class A Vapour Retarder

STEGO INDUSTRIES, LLC

Vapour Retarders

1. Product Name

Stego Wrap Class A Vapour Retarder

2. Manufacturer

Stego Industries, LLC
216 Avenida Fabricante, Suite 101
San Clemente, CA 92672
Sales, Technical Assistance
Ph: (877) 464-7834
Fx: (949) 257-4113
www.stego.ca

3. Product Description

USES: Stego Wrap Class A is used as an exceptional vapour retarder, and as a protection course for below grade waterproofing applications.
COMPOSITION: Stego Wrap Class A is a multi-layer plastic extrusion manufactured with only the highest grade of prime, virgin, polyolefin resins.
ENVIRONMENTAL FACTORS:
Stego Wrap Class A can be used in systems for the control of soil gases (radon, methane), soil poisons (oil by-products) and sulfates.

5. Installation

UNDER SLAB: Unroll Stego Wrap Class A over an aggregate, sand or tamped earth base. Overlap all seams a minimum of 150 mm (6 in) and tape using Stego Tape. All penetrations must be sealed using a combination of Stego Wrap Class A, Stego Tape and/or Stego Mastic.

VERTICAL WALL: Install Stego Wrap Class A over the waterproofing membrane while still tacky. Mechanically fasten Stego Wrap Class A to the wall at the top with termination bar and concrete nails. Drape Stego Wrap Class A down across the footer and under the french drain.

6. Availability & Cost

Stego Wrap Class A is available nationally via building supply distributors. For current cost information, contact your local Stego Wrap distributor or Stego Industries' sales department.

7. Warranty

Stego Industries, LLC believes to the best of its knowledge, that specifications and recommendations herein are accurate and reliable. However, since site conditions are not within its control, Stego Industries does not guarantee results from the use of the information provided and disclaims all liability from any loss or damage. No warranty, express or implied, is given as to the merchantability, fitness for a particular purpose, or otherwise with respect to the products referred to.

8. Maintenance

None required.

9. Technical Services

Technical advice, custom CAD drawings, and additional information can be obtained by contacting Stego Industries' technical assistance department or via the website.

10. Filing Systems

- Stego Industries' website
- Buildsite
- GreenFormat
- 4Specs

4. Technical Data

TABLE 1: PHYSICAL PROPERTIES OF STEGO WRAP CLASS A VAPOUR RETARDER

PROPERTY	TEST	METRIC	IMPERIAL
Under Slab Vapour Retarders	ASTM E 1745 Class A, B & C – Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs	Exceeds Class A, B & C	
	Permeance Units (perms):	**ng/m2/s/Pa**	**gr/ft2/hr/in-Hg**
Water Vapour Permeance	ASTM F 1249 – Test Method for Water Vapour Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor	1.27	0.0223
Permeance After Conditioning (ASTM E 1745 Sections 7.1.2 - 7.1.5)	ASTM E 154 Section 8, F 1249 – Permeance after wetting, drying, and soaking	1.39	0.0243
	ASTM E 154 Section 11, F 1249 – Permeance after heat conditioning	1.51	0.0264
	ASTM E 154 Section 12, F 1249 – Permeance after low temperature conditioning	1.28	0.0223
	ASTM E 154 Section 13, F 1249 – Permeance after soil organism exposure	1.47	0.0257
Puncture Resistance	ASTM D 1709 – Test Methods for Impact Resistance of Plastic Film by Free-Falling Dart Method	2,266 grams	
Tensile Strength	ASTM D 882 – Test Method for Tensile Properties of Thin Plastic Sheeting	9.32 kN/m	53.2 lbf/in
Thickness	ACI 302.1R-04 – Minimum Thickness (0.25 mm/10 mils)	0.25 mm	10 mils
Roll Dimensions	width x length:	4.3 m x 64 m	14 ft x 210 ft
	area:	273 m^2	2,940 sf
Roll Weight		63 kg	140 lbs

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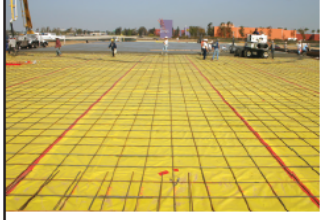
Stego Wrap Class C Vapour Retarder

STEGO INDUSTRIES, LLC



Vapour Retarders

1. Product Name

Stego Wrap Class C
Vapour Retarder

2. Manufacturer

Stego Industries, LLC
216 Avenida Fabricante, Suite 101
San Clemente, CA 92672
Sales, Technical Assistance
Ph: (877) 464-7834
Fx: (949) 257-4113
www.stego.ca

3. Product Description

USES: Stego Wrap Class C is used as an exceptional vapour retarder, and as a protection course for below grade waterproofing applications.
COMPOSITION: Stego Wrap Class C is a multi-layer plastic extrusion manufactured with only the highest grade of prime, virgin, polyolefin resins.
ENVIRONMENTAL FACTORS:
Stego Wrap Class C can be used in systems for the control of soil gases (radon, methane), soil poisons (oil by-products) and sulfates.

5. Installation

UNDER SLAB: Unroll Stego Wrap Class C over an aggregate, sand or tamped earth base. Overlap all seams a minimum of 150 mm (6 in) and tape using Stego Tape. All penetrations must be sealed using a combination of Stego Wrap Class C, Stego Tape and/or Stego Mastic.

VERTICAL WALL: Install Stego Wrap Class C over the waterproofing membrane while still tacky. Mechanically fasten Stego Wrap Class C to the wall at the top with termination bar and concrete nails. Drape Stego Wrap Class C down across the footer and under the french drain.

6. Availability & Cost

Stego Wrap Class C is available nationally via building supply distributors. For current cost information, contact your local Stego Wrap distributor or Stego Industries' sales department.

7. Warranty

Stego Industries, LLC believes to the best of its knowledge, that specifications and recommendations herein are accurate and reliable. However, since site conditions are not within its control, Stego Industries does not guarantee results from the use of the information provided and disclaims all liability from any loss or damage. No warranty, express or implied, is given as to the merchantability, fitness for a particular purpose, or otherwise with respect to the products referred to.

8. Maintenance

None required.

9. Technical Services

Technical advice, custom CAD drawings, and additional information can be obtained by contacting Stego Industries' technical assistance department or via the website.

10. Filing Systems

- Stego Industries' website
- Buildsite
- GreenFormat
- 4Specs

4. Technical Data

TABLE 1: PHYSICAL PROPERTIES OF STEGO WRAP CLASS C VAPOUR RETARDER

PROPERTY	TEST	METRIC	IMPERIAL
Under Slab Vapour Retarders	ASTM E 1745 Class A, B & C – Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs	Exceeds Class A, B & C	
	Permeance Units (perms):	**ng/m2/s/Pa**	**gr/ft2/hr/in-Hg**
Water Vapour Permeance	ASTM F 1249 – Test Method for Water Vapour Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor	1.03	0.018
Permeance After Conditioning (ASTM E 1745 Sections 7.1.2 - 7.1.5)	ASTM E 154 Section 8, F 1249 – Permeance after wetting, drying, and soaking	1.26	0.022
	ASTM E 154 Section 11, F 1249 – Permeance after heat conditioning	1.14	0.020
	ASTM E 154 Section 12, F 1249 – Permeance after low temperature conditioning	1.14	0.020
	ASTM E 154 Section 13, F 1249 – Permeance after soil organism exposure	1.54	0.027
Puncture Resistance	ASTM D 1709 – Test Methods for Impact Resistance of Plastic Film by Free-Falling Dart Method	1,456 grams	
Tensile Strength	ASTM D 882 – Test Method for Tensile Properties of Thin Plastic Sheeting	9.86 kN/m	56.3 lbf/in
Thickness	ACI 302.1R-04 – Minimum Thickness (0.25 mm/10 mils)	0.25 mm	10 mils
Roll Dimensions	width x length:	4.3 m x 64 m	14 ft x 210 ft
	area:	273 m^2	2,940 sf
Roll Weight		63 kg	140 lbs

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Stego Mastic

STEGO INDUSTRIES, LLC

Vapour Retarders

1. Product Name
Stego Mastic

2. Manufacturer
Stego Industries, LLC
216 Avenida Fabricante, Suite 101
San Clemente, CA 92672
Sales, Technical Assistance
Ph: (877) 464-7834
Fx: (949) 257-4113
www.stego.ca

3. Product Description
USES: Stego Mastic is designed to be used as a waterproofing and vapour retardant membrane for use in conjunction with Stego Wrap 10-mil and 15-mil Vapour Retarder/Barrier. Stego Mastic can be used as an alternate to boots for pipe penetrations in Stego Wrap Vapour Barrier. Stego Mastic can also be used as a primary waterproofing for below grade walls.
COMPOSITION: Stego Mastic is a medium-viscosity, water-based, polymer-modified anionic bituminous/asphalt emulsion, which exhibits bonding, elongation and waterproofing characteristics.
SIZE: Stego Mastic comes in 19-litre (5-gal) buckets.

4. Technical Data
APPLICABLE STANDARDS:
American Society for Testing and Materials (ASTM)

- ASTM D 412 Standard Test Method for Vulcanized Rubber and Thermoplastic Elastomers - Tension
- ASTM E 154 Standard Test Methods for Water Vapor Retarders Used in Contact with Earth under Concrete Slabs, on Walls, or as Ground Cover
- ASTM G 23 Practice for Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials (Withdrawn 2000)
- ASTM E 96 Standard Test Methods for Water Vapor Transmission of Materials
- ASTM D 751 Standard Test Methods for Coated Fabrics
- ASTM D 1434 Standard Test Method for Determining Gas Permeability Characteristics of Plastic Film and Sheeting
- ASTM C 836 Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course.
- ASTM E 1643 Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.

5. Installation
PREPARATION:

- A test application simulating the project environment should always be done prior to final usage of Stego Mastic.
- All Surfaces should be dry and free of loose materials, oils and other contaminants. The surfaces should be cleaned in the same fashion as the test surface in order to ensure proper results.
- Store above 4°C

PENETRATIONS:
For small pipe and rebar penetrations in Stego Wrap Vapour Barrier cut Stego Wrap just big enough for the penetration. Liberally apply Stego Mastic around the penetration to keep the integrity of the membrane intact. Stego Mastic can be applied by brush, roller, or sprayer.
NOTES: 1) For larger penetrations or wide cut-outs of Stego Wrap, use Stego Wrap and Stego Red Polyethylene Tape to repair and seal. 2) Solvent-based products should not be applied over this product.

CLEANING:
Clean all tools with kerosene and/or oil-based cleaners.

6. Availability & Cost
Stego Mastic is available nationally via building supply distributors. For current cost information, contact your local Stego distributor or Stego Industries' sales department.

7. Warranty
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8. Maintenance
None required.

9. Technical Services
Technical advice, custom CAD drawings, and additional information can be obtained by contacting Stego Industries' technical assistance department or by visiting the website.

10. Filing Systems
- Stego Industries' website
- Buildsite

TABLE 1: PHYSICAL PROPERTIES OF STEGO MASTIC

PROPERTY AND TEST RESULTS		METRIC	IMPERIAL
Tensile/Elongation, ASTM D 412		221 kPa	32 psi
Resistance to Decay, ASTM E 154		9% perm loss	
Accelerated Aging, ASTM G 23		No Effect	
Permeance, ASTM E 96 (perms)		9.7 $ng/m^2/s/Pa$	0.17 $gr/ft^2/hr/in\text{-}Hg$
Hydrostatic Water Pressure, ASTM D 751		193 kPa	28 psi
Methane Transmission Rate, ASTM D 1434		0	
Adhesion to Concrete & Masonry, ASTM C 836		1.2 kN/m	7 lbf/in
Hardness, ASTM C 836		85	
Crack Bridging, ASTM C 836		No Cracking	
Low Temp Flexibility, ASTM C 836		No Cracking at -20°C	
Resistance to Acids:	Acetic	30%	
	Sulfuric and Hydrochloric	15%	
Temperature Effect:	Stable	120°C	248°F
	Flexible	-11°C	13°F

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Stego Tape

STEGO INDUSTRIES, LLC

Vapour Retarders

1. Product Name

Stego Tape

2. Manufacturer

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216 Avenida Fabricante, Suite 101
San Clemente, CA 92672
Sales, Technical Assistance
Ph: (877) 464-7834
Fx: (949) 257-4113
www.stego.ca

3. Product Description

USES: Stego Tape is a low permeance tape designed for protective sealing, hanging, seaming, splicing, and patching applications where a highly conformable material is required. It has been engineered to bond specifically to Stego Wrap, making it ideal for sealing Stego Wrap seams and penetrations.

COMPOSITION: Stego Tape is composed of polyethylene film and an acrylic, pressure-sensitive adhesive.

SIZE: Stego Tape is 10 cm (3.75 in) wide and 55 m (180 ft) long. Stego Tape ships 12 rolls in a case.

4. Technical Data

APPLICABLE STANDARDS:

Pressure Sensitive Tape Council (PSTC)

- PSTC 101 – International Standard for Peel Adhesion of Pressure Sensitive Tape

American Society for Testing & Materials (ASTM)

- ASTM E 1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs

5. Installation

SEAMS:

Overlap Stego Wrap 150 mm (6 in) and seal with Stego Tape. Make sure the area of adhesion is free from dust, dirt and moisture to allow maximum adhesion of the pressure sensitive tape.

PIPE PENETRATION SEALING

1) Install Stego Wrap around pipe by slitting/cutting material
2) If void space around pipe is minimal, seal around base of pipe with Stego Tape (Stego Mastic can be used for additional coverage)

DETAIL PATCH FOR PIPE PENETRATION SEALING

1) Cut a piece of Stego Wrap that creates a 150 mm (6 in) overlap around all edges of the void space
2) Cut an "X" in the centre of the detail patch
3) Slide detail patch over pipe, secure tightly
4) Tape down all sides of detail patch with Stego Tape
5) Seal around base of pipe with Stego Tape (Stego Mastic can be used for additional coverage)

Stego Tape should be installed above 4°C

NOTE: See Stego's installation instructions for complete instructions and detailed drawings. Each user should make their own tests to determine the products suitability for their own intended use and shall assume all risks and liability in connection therewith.

6. Availability & Cost

Stego Tape is available nationally via building supply distributors. For current cost information, contact your local Stego distributor or Stego Industries' sales department.

7. Warranty

Stego Industries, LLC believes to the best of its knowledge, that specifications and recommendations herein are accurate and reliable. However, since site conditions are not within its control, Stego Industries does not guarantee results from the use of the information provided and disclaims all liability from any loss or damage. No warranty, express or implied, is given as to the merchantability, fitness for a particular purpose, or otherwise with respect to the products referred to.

8. Maintenance

None required.

9. Technical Services

Technical advice, custom CAD drawings, and additional information can be obtained by contacting Stego Industries' technical assistance department or by visiting the website.

10. Filing Systems

- Stego Industries' website
- Buildsite

TABLE 1: PHYSICAL PROPERTIES OF STEGO TAPE

PROPERTY	METRIC	IMPERIAL
Total Thickness	0.15 mm	6 mils
Permeance (perms)	1.7 ng/m²/s/Pa	0.03 gr/ft²/hr/in-Hg
Tensile Strength	3 kN/m	17 lbs/in
Elongation (at break) MD	1060%	
Adhesion (20 min dwell ss, PSTC 101)	1 kN/m	95 oz/in
Ultraviolet Resistance	Excellent	

UNDER-SLAB VAPOUR BARRIER

PART 1 - GENERAL

1.1 SUMMARY
- .1 Products Supplied Under This Section
  - .1 Vapour Barrier, seam tape, mastic, pipe boots, detail strip for installation under concrete slabs.
- .2 RELATED SECTIONS
  - .1 Section 03 30 00 Cast-in-Place Concrete
  - .2 Section 07 26 00 Vapour Retarders

1.2 REFERENCES
- .1 American Society for Testing and Materials (ASTM); use most current versions
  - .1 ASTM E 1745 Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs
  - .2 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

1.3 SUBMITTALS
- .1 Quality Control / Assurance
  - .1 Full set of test results as per paragraph 8.3 of ASTM E 1745.
  - .2 Manufacturer's samples, literature
  - .3 Manufacturer's installation instructions for placement, seaming and pipe boot installation

PART 2 - PRODUCTS

2.1 MATERIALS
- .1 Vapour Barrier membrane must have the following properties:
  - .1 Permeance as tested after conditioning (ASTM E 1745 paragraphs 7.1.2 – 7.1.5): less than 0.01 perms (gr/ft^2/hr/in-Hg) [0.57 ng/(Pa * s *m2)]
  - .2 Other performance criteria
    - .1 Strength: Class A (ASTM E 1745)
    - .2 Minimum thickness of the plastic retarder material: 0.38 mm [15 mils]
- .2 Acceptable products:
  - .1 Stego Wrap Vapour Barrier 15 mil (0.38 mm) from Stego Industries LLC (877-464-7834; www.Stego.ca).
  - .2 Or approved equal, (request to be accompanied by documentation, as per section 1.3.1.1 above).

2.2 ACCESSORIES
- .1 Seam Tape: Use tape provided by vapour barrier manufacturer.
- .2 Vapour-proofing Mastic: Use mastic provided by vapour barrier manufacturer

PART 3 - EXECUTION

3.1 PREPARATION
- .1 Ensure that subsoil is approved by architect or geotechnical firm
  - .1 Level and tamp or roll aggregate, sand or tamped earth base.

3.2 INSTALLATION
- .1 Install Vapour Barrier/Retarder in accordance with manufacturer's instructions and ASTM E 1643:
  - .1 Unroll vapour barrier/retarder with the longest dimension parallel with the direction of the pour.
  - .2 Lap vapour barrier/retarder over footings and seal to foundation walls.
  - .3 Overlap joints 150 mm [6 inches] and seal with manufacturer's tape.
  - .4 Seal all penetrations (including pipes) per manufacturer's instructions.
  - .5 No penetration of the vapour barrier/retarder is allowed except for reinforcing steel and permanent utilities.
  - .6 Repair damaged areas by cutting patches of vapour barrier/retarder, overlapping damaged area 150 mm [6 inches] and taping all four sides with tape.

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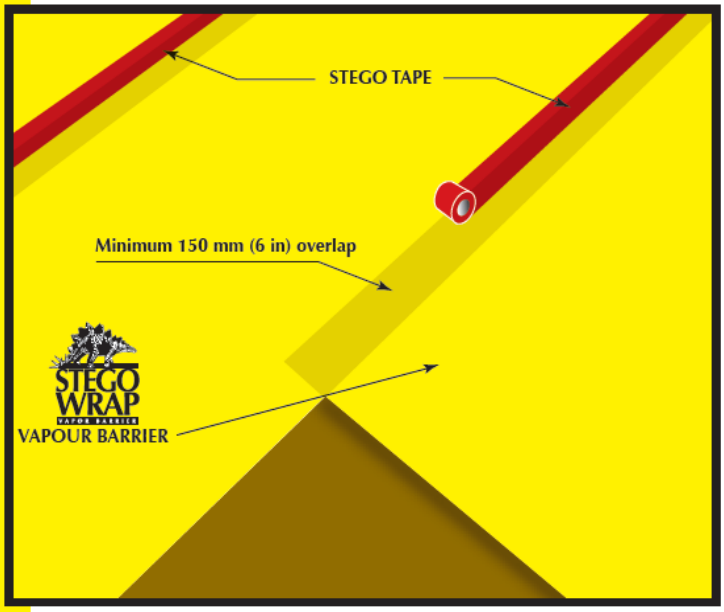
PART 1

STEGO WRAP VAPOUR BARRIER/RETARDER INSTALLATION INSTRUCTIONS

IMPORTANT: Please read these installation instructions completely, prior to beginning any Stego Wrap installation to ensure suitable use of the product. The following installation instructions are based on ASTM E 1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.

FIGURE 1: UNDER-SLAB INSTALLATION



UNDER-SLAB INSTRUCTIONS:

1. Stego Wrap can be installed over an aggregate, sand, or tamped earth base. It is not necessary to have a cushion layer or sand base, as Stego Wrap is tough enough to withstand rugged construction environments.

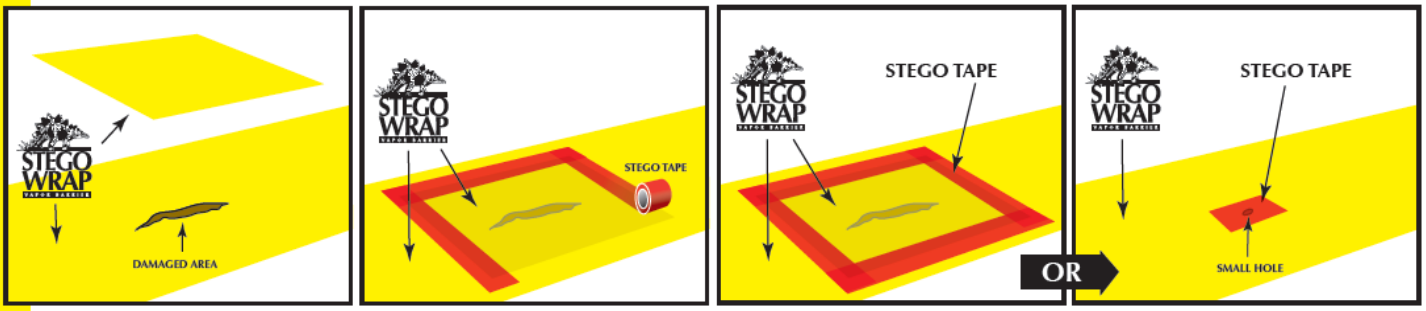
2. Unroll Stego Wrap over the area where the slab is to be placed. Stego Wrap should completely cover the concrete placement area. All joints/seams both lateral and butt should be overlapped 150 mm (6 in) and taped using Stego Tape.

NOTE: The area of adhesion should be free from dust, dirt and moisture to allow maximum adhesion of the pressure sensitive tape.

3. The most effective installation method includes positioning Stego Wrap on top of the footing and against the vertical wall. Stego Wrap will then be sandwiched between the footing, vertical wall and placed concrete floor (see part 2, figure 6a, Basement/Below Grade Wall Installation). This method will help protect the concrete slab from external moisture sources after the slab has been placed.

4. In the event that Stego Wrap is damaged during or after installation, repairs must be made. Stego Tape can be used to repair small holes in the material. For larger holes, cut a piece of Stego Wrap to a size and shape that covers any damage by a minimum overlap of 150 mm (6 in) in all directions. Clean all adhesion areas of dust, dirt and moisture. Tape down all edges using Stego Tape (see figure 2, Sealing Damaged Areas).

FIGURE 2: SEALING DAMAGED AREAS



NOTE: These installation instructions are based on practices outlined in ASTM E 1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs. These instructions are meant to be used as a guide, and do not take into account specific job site situations. Consult local building codes and regulations along with the building owner or owner's representative before proceeding. If you have any questions regarding the above mentioned installation instructions, Stego products, or a specific job site situation, please call us at 877-464-7834 for technical assistance.

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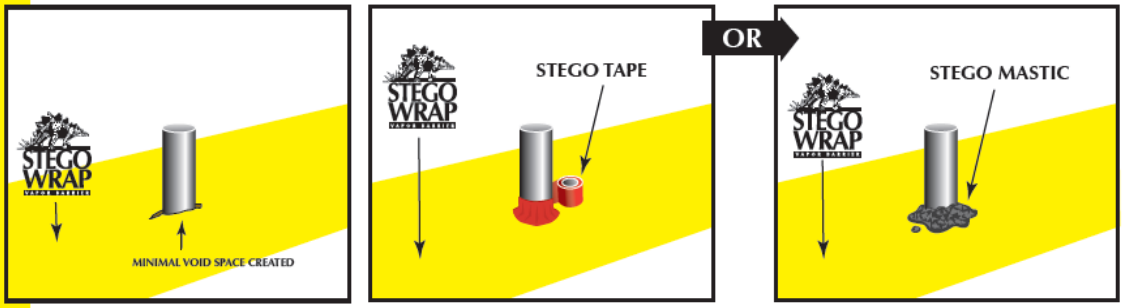
5. **IMPORTANT: ALL PENETRATIONS MUST BE SEALED.** All pipe, ducting, rebar, wire penetrations and block outs should be sealed using Stego Wrap, Stego Tape and/or Stego Mastic (see figure 3a, Pipe Penetration Sealing).

FIGURE 3a: PIPE PENETRATION SEALING



STEGO WRAP PIPE PENETRATION REPAIR DETAIL:

1: Install Stego Wrap around pipe penetration by slitting/cutting material as needed. Try to minimize the void space created.

2: If Stego Wrap is close to pipe and void space is minimized then seal around pipe penetration with Stego Tape and/or Stego Mastic. **(See Figure 3a)**

3: If detail patch is needed to minimize void space around penetration, then cut a detail patch to a size and shape that creates a 150 mm (6 in) overlap on all edges around the void space at the base of the pipe. Stego Pre-Cut Pipe Boots are also available to speed up the installation.

4: Cut an "X" the size of the pipe diameter in the centre of the pipe boot and slide tightly over pipe.

5: Tape down all sides of the pipe boot with Stego Tape.

6: Seal around the base of the pipe using Stego Tape and/or Stego Mastic. **(See Figure 3b)**

FIGURE 3b: DETAIL PATCH FOR PIPE PENETRATION SEALING

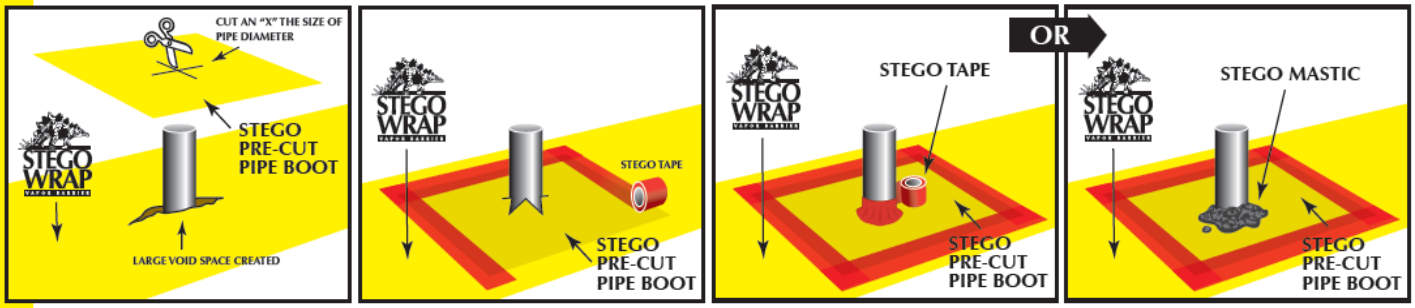
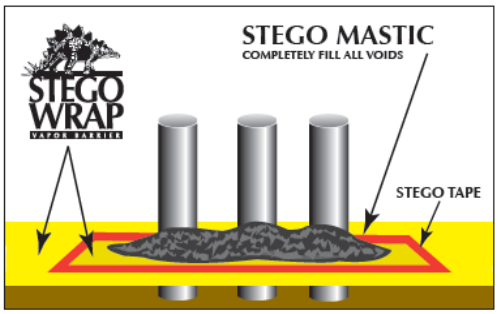


FIGURE 4: MULTIPLE PIPE PENETRATION SEALING



MULTIPLE PIPE PENETRATION SEALING:

Multiple pipe penetrations in close proximity and very small pipes may be sealed using Stego Wrap and Stego Mastic for ease of installation (see figure 4, Multiple Pipe Penetration Sealing).

6. Many vapour retarder manufacturers recommend a cushion layer (fine washed gravel or sand) on top of the retarder before the concrete placement to guard against the possibility of damage due to construction traffic. **This is permissible, but not a necessity with Stego Wrap.** Stego Wrap is strong enough to withstand normal construction traffic without a protective layer. In fact, ACI guidelines and many flooring companies recommend placement of the concrete slab directly on the vapour barrier/retarder. This eliminates the potential for water to be trapped in the blotter layer and ultimately resurfacing through the slab adversely effecting the flooring system.

NOTE: These instructions are meant to be used as a guide, and do not take into account specific job site situations. Consult local building codes and regulations along with the building owner or owner's representative before proceeding.

REMEMBER: If damaged, Stego Wrap must be repaired using the techniques outlined above.

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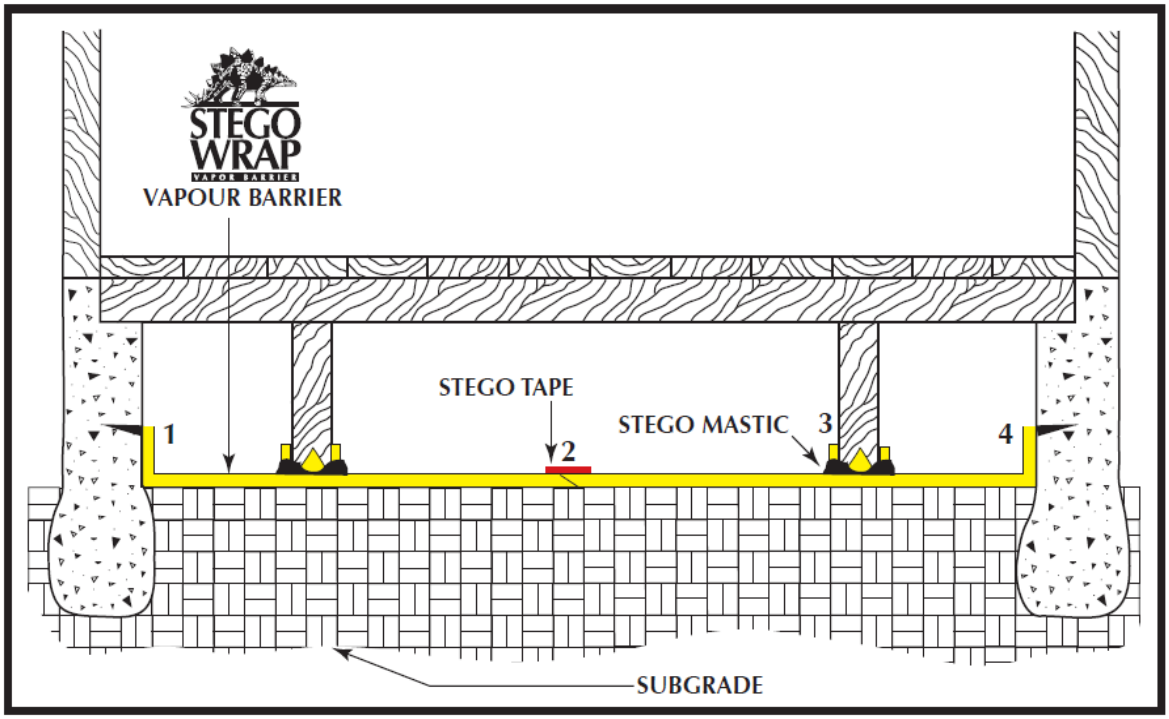
PART 2

STEGO WRAP VAPOUR BARRIER/RETARDER INSTALLATION INSTRUCTIONS

CRAWL SPACE INSTALLATION INSTRUCTIONS:

1. Place Stego Wrap directly over the crawl space floor. If rigid insulation is to be used, install Stego Wrap prior to insulation (under insulation and between the foundation wall and insulation).
2. Overlap seams a minimum of 150 mm (6 in) and seal with Stego Tape.
3. Seal Stego Wrap around all penetrations and columns using Stego Tape and/or Stego Mastic.
4. Turn Stego Wrap up the foundation wall to a minimum height of 150 mm (6 in) above the outside/exterior grade or in compliance with local building codes and terminate with pressure treated nail strip/termination bar or construction adhesive. If using a nail strip/termination bar, extend Stego Wrap above termination bar and fold back over nail strip/termination bar and tape with Stego Tape to seal nail holes.

FIGURE 5: CRAWL SPACE INSTALLATION



INSTALLATION TIPS:

1. For a cleaner look and to prevent against tenting of Stego Wrap at the foundation wall/foundation floor intersection, consider mechanically fastening Stego Wrap to base of foundation wall in addition to the above mentioned wall termination.
2. To provide additional protection against moisture migration through nail holes, consider applying a layer of Stego Mastic to the foundation wall prior to installing nail strip/termination bar. Allow one hour for Stego Mastic to cure prior to installing nail strip/termination bar.

NOTE: There are well-publicized pros and cons regarding different approaches to vapour barrier placement. Consult local building codes, regulations and ACI guidelines along with the design or architectural firm's recommendations before proceeding.

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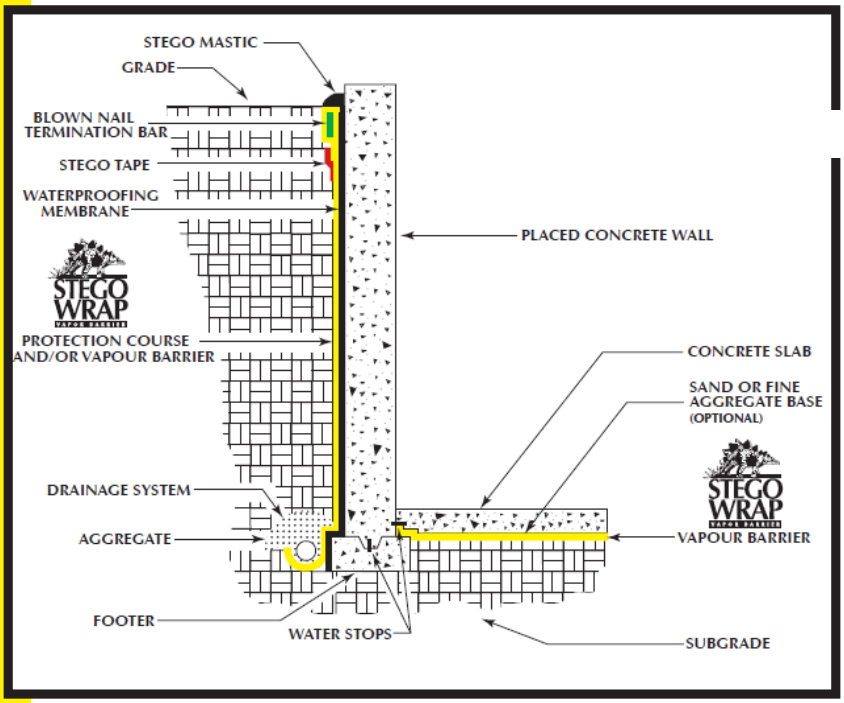
FIGURE 6a: BASEMENT/BELOW GRADE WALL INSTALLATION

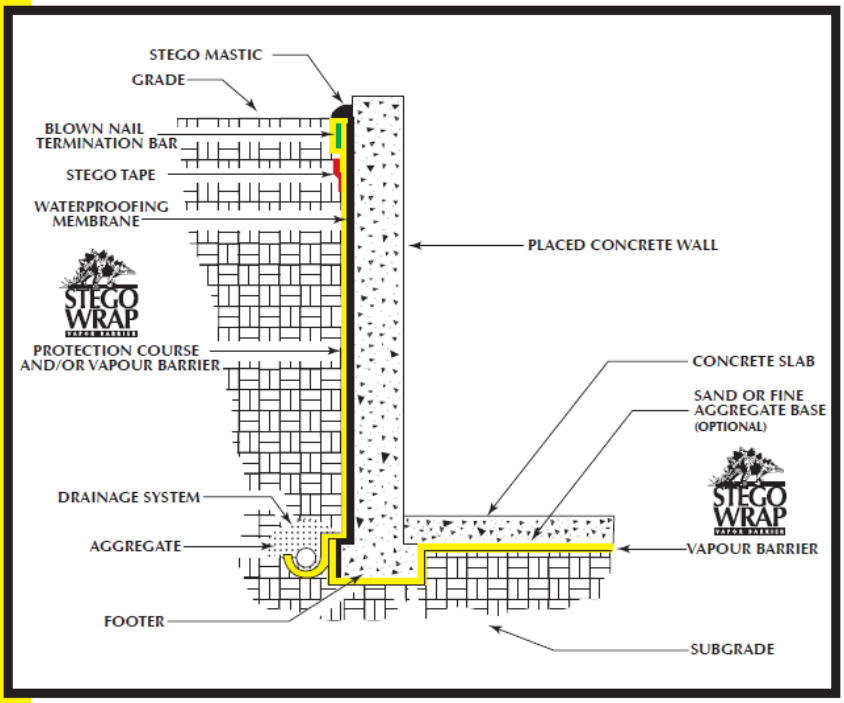


BASEMENT/BELOW GRADE WALL INSTALLATION:

1. Install an approved waterproofing membrane liquid applied membranes be they roll, brush or spray.
2. While the membrane is still tacky, install Stego Wrap as a protective course/vapour barrier over the applied waterproofing membrane. Using a termination bar with concrete nails at the termination of the waterproofing membrane is advisable in some applications (see figure 6a, Basement/ Below Grade Wall Installation).
3. Supervised care must be taken during back filling against the material so that it is not damaged or punctured. If damage occurs, patch using the techniques outlined in part 1.

WARNING: Any untreated punctures, tears or damage during back filling will greatly reduce the effectiveness of Stego Wrap as a protection course/vapour barrier.

FIGURE 6b: OPTIONAL INSTALLATION FOR FOOTING ENCAPSULATION AND WATERPROOFING TIE-IN



OPTIONAL INSTALLATION FOR FOOTING ENCAPSULATION AND WATERPROOFING TIE-IN:

1. Install Stego Wrap into footing depression prior to concrete placement.
2. Leave outside edge of footing exposed to allow for primary waterproofing application and tie-in (see figure 6b, Optional Installation For Footing Encapsulation and Waterproofing Tie-In).

NOTE: Consult Structural Engineer prior to footing encapsulation.

NOTE: These installation instructions are based on practices outlined in ASTM E 1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs. These instructions are meant to be used as a guide, and do not take into account specific job site situations. Consult local building codes and regulations along with the building owner or owner's representative before proceeding. If you have any questions regarding the above mentioned installation instructions, Stego products, or a specific job site situation, please call us at 877-464-7834 for technical assistance.

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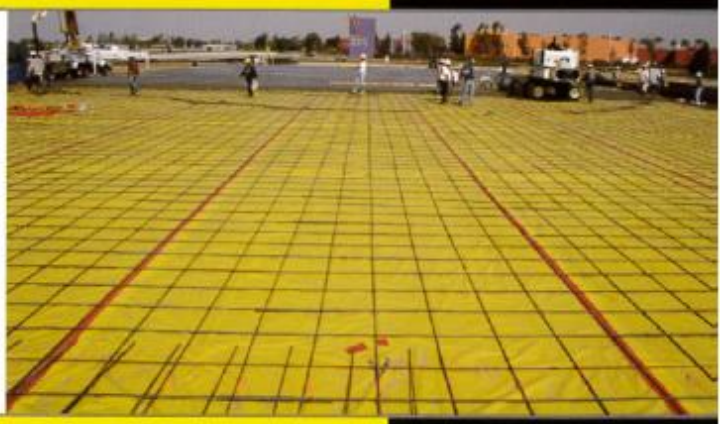
Stego Wrap On The Job

Rolling out Stego Wrap on the jobsite. Stego Wrap comes in 4.3 meter-wide (14 foot-wide) rolls to help minimize the number of seams in the overall system. For easy handling, place a piece of rebar through the roll core, or simply kick out the roll to desired length. Stego Wrap can be cut with a utility knife or scissors.

Taping Stego Wrap seams. Stego Tape is a one-sided, pressure-sensitive tape with a field-tested adhesive designed for use with Stego Wrap. Overlap Stego Wrap 150 mm (6 in) and tape using Stego Tape. Stego Tape is 10 cm (3.75 in) for a reason. A 10 cm (3.75 in) width gives installers a chance to tape seams without spending a lot of time with alignment. A Stego Wrap installation is fast and easy.

A properly sealed group of pipe penetrations. A combination of Stego Tape and Stego Mastic make it possible to properly seal even the most difficult jobsite situations. In this picture, Stego Tape is used to reduce the void space around and between the group of pipes, and then Stego Mastic is used as the final seal.

A completed Stego Wrap installation. Stego's Technical Department is available to answer project-specific questions. There are many different types of slab construction, and our people are trained to help with each.



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Pouring concrete directly on Stego Wrap. Stego Wrap is tough enough to withstand chaired rebar, construction traffic and the pouring of concrete directly on the vapor barrier. This eliminates the need for a cushion/blotter layer of sand or granular fill on top of the plastic that, if saturated, may contribute to moisture issues. Also, removal of this top sand layer can save considerable time and money for the project.

An 8,000 kg laser screed machine with outrigger on rebar over Stego Wrap. This is an incredible picture proving Stego Wrap has outstanding puncture resistance. The screed machine pushing on number four rebar does not puncture Stego Wrap. This shows unprecedented performance with "real world" job conditions.

Stego Wrap turned up a stem wall. There are a variety of ways to design a concrete slab, and there are many ways to terminate Stego Wrap to optimize the moisture protection. Here, Stego Wrap is turned up the stem wall and secured against Stego Mastic prior to the concrete placement to protect against exterior moisture migrating under the slab. Our technical support team can help determine the best installation for your project.

Stego Wrap installed in a crawl space. Stego Wrap is perfect for slab-on-grade, basement, or crawl space applications. Here a termination bar is used to secure Stego Wrap to a crawl space wall. Stego Mastic was brushed on the wall prior to the installation of the "term" bar to help create a better seal around the concrete nails.

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About Stego Industries

Stego Industries, LLC is involved in the research, design, development, production and distribution of the highest quality construction products in the industry with a steadfast commitment to marketing with integrity and ethics, while providing solutions through education to help sustain the built environment.

Stego Wrap has become the most widely specified vapour barrier in North America by earning the respect, trust and recommendation from the design and construction community. We will be pleased to share our expertise with you through our AIA-accredited educational programs, as well as to help you reliably address any aspect of our products' selection, location and installation.

We have an established nationwide network of Stego representatives and distributors to serve you. Please call Stego Industries, LLC for the distributor(s) and/or representative(s) nearest you.

We appreciate your interest in our company and products. We strive to offer a partnering relationship with the ultimate goal of helping you find workable solutions for your problems.

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Vapor Barriers:

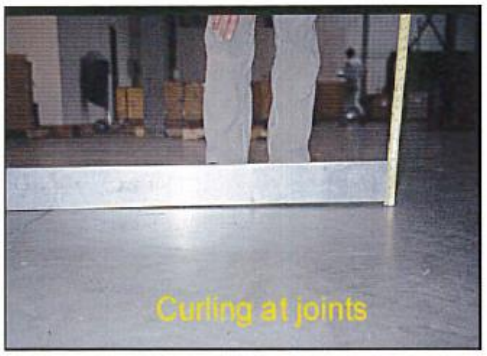
Nuisance or Necessity?

3rd Edition, Feb 2002

By: **Peter A. Craig**
Concrete Floor Specialist

Introduction:

The subject of vapor barriers or retarders beneath concrete slabs-on-ground has long been one of great controversy. On one side of the issue are those who justifiably argue that slabs cast in direct contact with a vapor barrier or retarder are more susceptible to a number of slab-related problems and to a greater magnitude of slab curl than those cast on a granular base. This group will, without hesitation, take the position that a vapor barrier or retarder is a downright nuisance.


Curling at joints

On the other side of the issue however are those who have either experienced or witnessed the devastating effect that moisture can have on modern day floor coverings, adhesives, coatings and building environments. Those in this group will also quite justifiably argue, that from their perspective, a vapor barrier or retarder is often an absolute necessity.

That a single answer to the vapor barrier/retarder controversy has not been found should not be surprising. Both sides raise arguments that are real and simply cannot be dismissed if a trouble-free concrete slab-on-ground is to be constructed and successfully receive subsequent floor coverings or coatings.

The question as to whether or not a vapor barrier/retarder is a nuisance or necessity can however be answered in a single word. The answer is quite simply **yes!**

To better understand the issues of why moisture in concrete slabs has today become such a problem and why an effective vapor barrier/retarder is often an essential design component, one needs to examine moisture, is origin, its movement and its effects upon floor coverings, adhesives and coatings.

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Where does the moisture come from?

Ruling out all other contributing sources, the first moisture that is always a challenge to a floor covering or coating installation is the free moisture within the concrete itself.

In order to make concrete, placeable and workable, all concrete used for flatwork contains more water than is necessary simply to satisfy hydration. This free water, or water of convenience needs to be lost to a level of compliance with the moisture requirements or limits of the floor covering, adhesive or coating.

The time rate of moisture loss from a concrete floor is affected by the density of the concrete, ambient conditions above the slab, and moisture below the slab. The following table helps illustrate the time necessary for a 4" thick concrete slab, under ideal drying conditions, to reach a commonly required moisture emission limit of 3.0 lbs/1000 sq. ft /24 hrs.

Table 1.

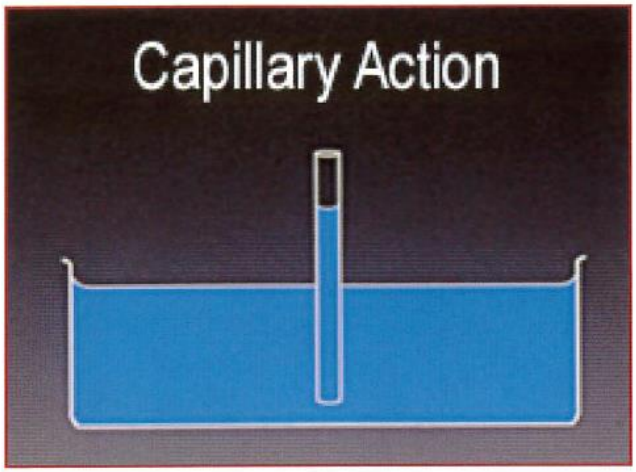
Drying Time to reach 3.0 Lbs/1000 sq ft / 24 hrs			
Water-Cement Ratio	Bottom Sealed	Bottom Exposed to Water Vapor	Bottom In Contact with Water
0.40	46	52	54
0.50	82	144	199
0.60	117	365	>> 365
0.70	130	>> 365	>> 365
0.80	148	>> 365	>> 365
0.90	166	>> 365	>> 365
1.0	190	>> 365	>> 365
4 inch thick specimen dried at 73 F and 50% relative humidity			

The table above reinforces the importance of eliminating or significantly reducing sub-slab moisture from entering a concrete slab-on-ground if a 3.0 lb or 5.0 lb emission requirement is to be reached within any practical construction schedule or length of time.

It should also be noted that the drying period should not be considered to begin until the slab is protected by a watertight roof and the ambient environment above the slab is conducive to drying. Re-wetting of the slab will significantly lengthen drying times.

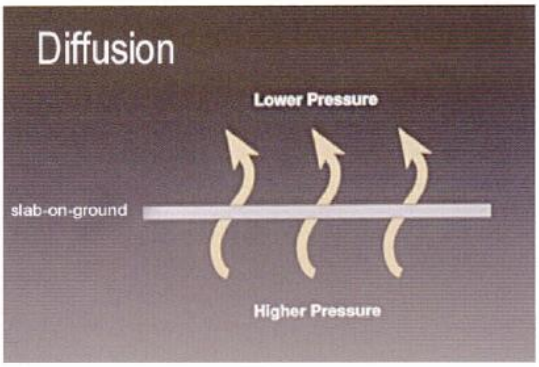
Next we will consider how moisture originating well below the floor can rise, contact, and enter a concrete slab-on-ground.

Moisture Migration 101:



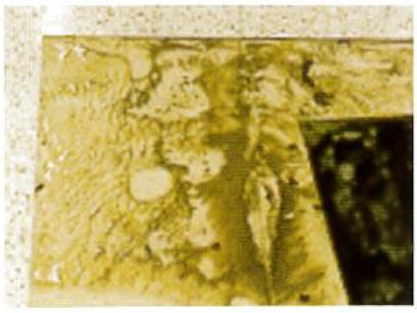
Somewhere below most building sites water can be found. It may be near the surface or well below it. Regardless of where the water table is found, there are two basic ways in which moisture can rise upward through soils and reach the underside of a concrete slab-on-ground. The first method is that of **capillary action.** Through the forces of adhesion and cohesion, water can rise well above the water table through very narrow passageways found in many soils. An example of capillary action would be water rising to a higher elevation within a narrow glass straw placed into a beaker of water.

Capillary action can easily be interrupted through the use of a layer of coarse gravel or crushed stone placed between the slab and the sub-grade. However, while stopping the capillary rise of water in its liquid state is a most important step, it does not eliminate the potential for moisture reaching the underside of the slab in vapor form.



Water changes in state from a liquid to a gas when it evaporates. Water as a vapor will move from areas of high concentration to areas of lower concentration by the process of **diffusion** seeking to establish equilibrium across the zones.

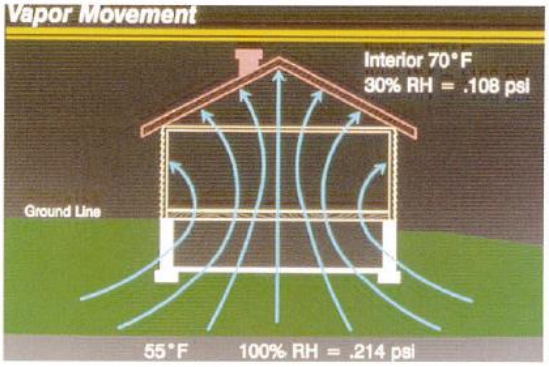
Findings from numerous investigations of flooring failures have demonstrated that the relative humidity of the soil directly beneath covered slabs will approximate 100% even when the moisture content of free draining soil directly below the slab is low, and the water table is many feet below the slab. Given enough time, without an effective vapor barrier or retarder directly beneath the slab, the internal relative humidity of the concrete will also rise (ref: 1). At condensate levels, (100% RH), moisture within the slab can lead to alkali induced degradation of adhesives and to the osmotic blistering of polymer coatings.



Vapor Pressure
For Various Temperatures And Relative Humidities
(Pounds Per Square Inch)

Dry Bulb Temperature	Relative Humidity (in percent)									
	100	90	80	70	60	50	40	30	20	10
°F.										
100	0.948	0.854	0.758	0.663	0.569	0.474	0.379	0.284	0.189	0.095
90	.698	.628	.558	.489	.419	.349	.279	.209	.140	.070
80	.506	.455	.405	.357	.303	.253	.202	.152	.101	.051
75	.429	.386	.343	.300	.258	.214	.172	.129	.086	.043
70	.362	.326	.290	.253	.217	.181	.145	.108	.072	.036
65	.305	.274	.244	.213	.183	.152	.122	.091	.061	.030
60	.256	.230	.205	.179	.153	.128	.102	.077	.051	.026
55	.214	.192	.171	.149	.128	.107	.085	.064	.042	.021
50	.178	.160	.142	.124	.107	.089	.071	.053	.036	.018
45	.147	.132	.118	.111	.088	.073	.059	.044	.029	.015
40	.122	.110	.098	.085	.073	.061	.049	.037	.024	.012
35	.100	.090	.080	.070	.060	.050	.040	.030	.020	.010
30	.080	.072	.064	.056	.048	.040	.032	.024	.016	.008
25	.063	.057	.050	.044	.037	.032	.025	.019	.012	.006
20	.052	.047	.042	.036	.031	.026	.020	.015	.010	.005
10	.031	.028	.025	.022	.018	.015	.012	.009	.006	.003
0	.018	.016	.014	.013	.010	.009	.007	.005	.003	.002
-10	.011	.010	.009	.008	.007	.006	.004	.003	.002	.001
-15	.008	.007	.006	.005	.005	.004	.003	.002	.002	.001

Table 2 (HUD, Research Paper #28)



Moisture migration through soils and concrete slabs-on-ground is not only a problem for the performance of floor covering and coating systems but also can contribute to indoor air quality issues. When spores are present, there are three conditions necessary for the further development of mold, mildew and other forms of microbial life. They are moisture, a suitable temperature (40-100F) and a food source (adhesives, gypsum, backing material etc.). Moisture condensed beneath floor coverings or within adhesives or carpets can often provide a suitable environment for the development of microbial life which in turn can adversely affect indoor air quality. The installation of an effective vapor barrier or retarder directly beneath floor covering greatly reduces the source of moisture needed to initiate or promote such growth

Vapor Barrier or Retarder:

A vapor barrier or retarder is a material designed to block or slow down the passage of moisture from the ground into a concrete slab–on-ground. Such materials are typically sheeting materials based on polyethylene or polyolefin technology. For many years all such materials were referred to as vapor barriers. However, because very few such materials are of low enough permeance to be considered as true barriers, the term vapor retarder is a far more accurate expression of the capabilities of most commercially available materials.

How low should the permeance of a vapor retarder be? Current ASTM E-1745 class A, B & C standards require that a vapor retarder have a permeance not exceeding 0.3 perms. Many however believe that the performance of many types of extremely low permeance floor coverings such as sheet vinyl, vinyl backed carpet tiles, rubber or urethane warrant a level of moisture protection well below 0.3 perms. Extremely moisture sensitive flooring materials such as linoleum or wood will also benefit from a greater level of protection.

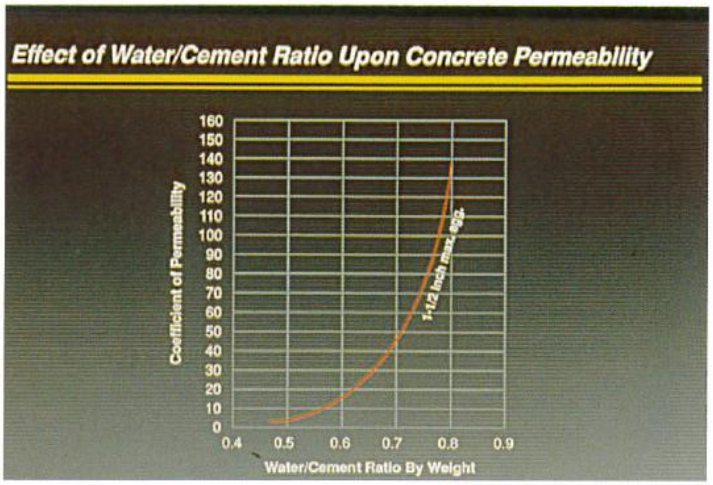
In short, if the permeance of the material on top of the floor is considerably lower than the permeance of the vapor barrier or retarder protecting the slab, the potential exists for moisture to build up within the slab (ref: 1). In such cases it can take months or even years for problems to develop.

The American Concrete Institute's Guide for Concrete Floor and Slab Construction, 302.1R-96 , currently recommends that the thickness of the vapor retarder itself be not less than 10 mils.

Recent puncture studies of vapor retarder materials conducted by Concrete Construction Magazine further support the ACI recommendation (ref: 2 & 3).

Concrete's role:

Concrete with a low water to cement ratio can be considered waterproof. However, even when the water to cement ratio is low enough for concrete to be considered watertight, the concrete is not impermeable to the passage of moisture. In general, as the water to cement ratio of the concrete increases so does the permeability of the concrete.



Many argue that the permeability of low water to cement ratio concrete is low enough by itself to satisfy the moisture emission requirements currently set forth by the floor covering industry. After a sufficient drying period, and in a perfect world, this can be a true statement. However, in reality, seldom is every yard of concrete placed exactly as designed. In addition, purposely sawn contraction joints and or random cracks provide open passageways for moisture to rise within or near to the surface of the slab.

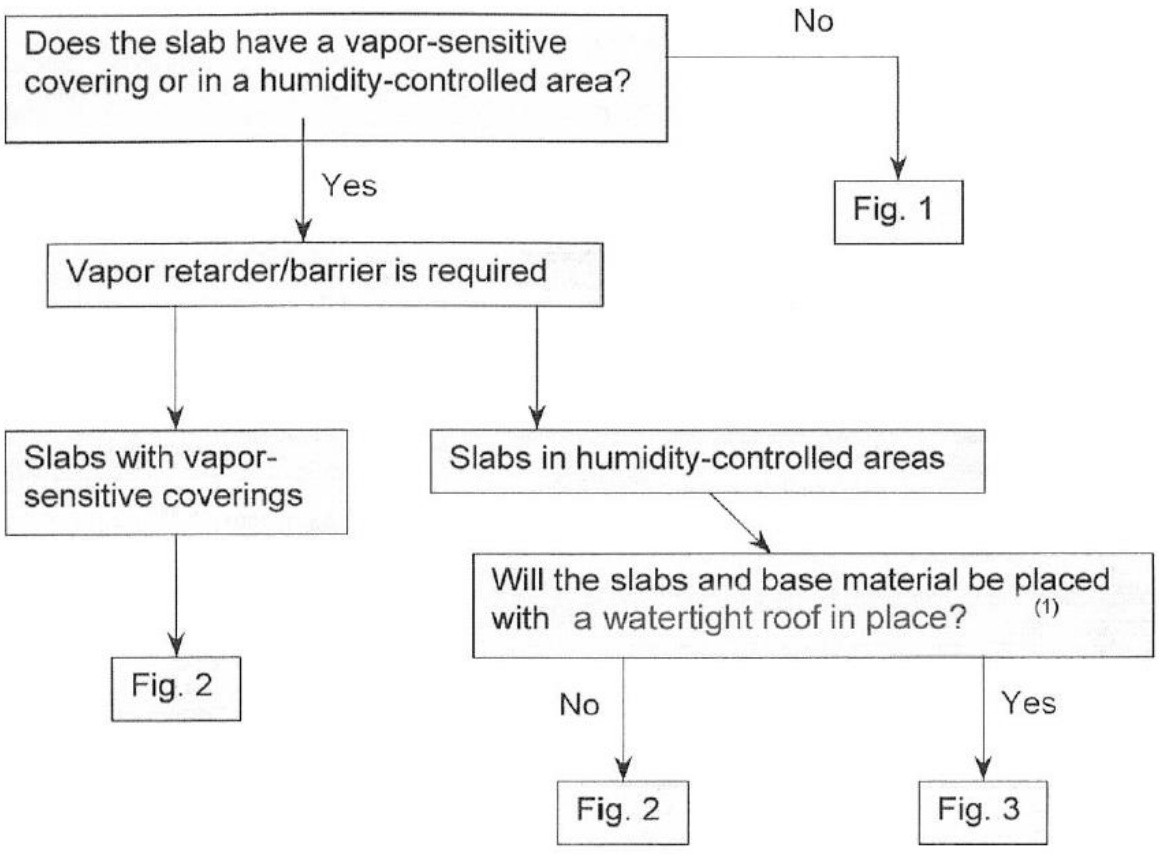
By all means, floors to receive floor coverings or coatings will benefit from the use of low water to cement ratio concrete and some admixtures. However to omit a vapor barrier or retarder, and depend solely upon the concrete to provide protection from moisture migration, places the success of the flooring installation or environment at risk and does not conform with published recommendations from the floor covering industry and many flooring manufacturer's (ref: 4).

Where to place the vapor retarder:

Until April of 2001, published guidelines from ACI lead slab designers to place a 4" layer of granular fill over the vapor retarder when a vapor retarder was required. While this detail has proven successful on many projects, many other projects have experienced problems.

In April of 2001, ACI published and update as to vapor retarder location in Concrete International magazine, (pages 71 & 72). The text of the update informs the reader of instances where fill courses, above the vapor retarder, had taken on water from rainfall, curing or sawcutting and may have subsequently contributed to flooring problems. As a result of these findings the following flow chart was developed and will be published in the next revision of ACI 302.

Flow Chart for Location of Vapor Retarder/Barrier



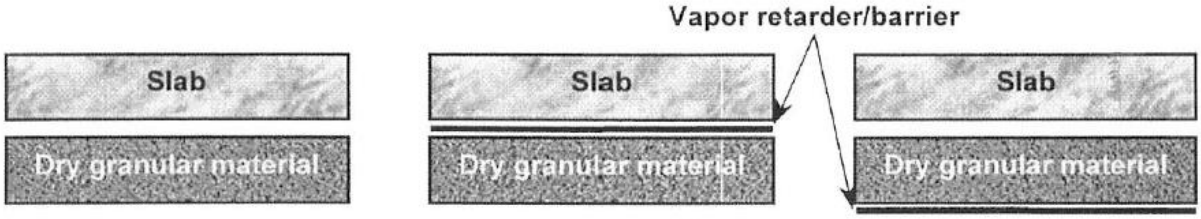


Figure 1 Figure 2 (2) Figure 3

(1) If granular material is subject to future moisture infiltration, use Fig. 2

(2) If Fig. 2 is used, reduced joint spacing, low shrinkage mixture design, or other measures to minimize slab curl will likely be required.

Summary:

1. An effective, low permeance vapor barrier or retarder is necessary to protect many modern day floor coverings, adhesives, coatings and building environments and to conform to published guidelines of the floor covering industry.

2. A capillary break is an essential design component. However, a capillary break will not prohibit moisture from reaching and entering the slab in vapor form.

3. Low water to cement ratio concrete and certain admixtures can reduce concrete permeability. However, concrete alone should not be relied upon as the sole deterrent to moisture migration.

4. For most floor covering or coating applications the vapor barrier or retarder should be placed directly beneath the slab. Additional slab design considerations such as continuous reinforcement may need to be used to offset the increased tendency for the slab to curl.

5. For moisture and alkali sensitive flooring applications such as sheet vinyl, rubber, vinyl backed carpet tile, urethane, linoleum, VCT or wood, select a vapor barrier/retarder material with a water vapor transmission rate (WVTR) no greater than 0.01 grains/sq. ft/ hour. The thickness of the vapor retarder itself should be no less than 10 mils.

6. Homogeneous vapor retarder materials, where the physical properties are consistent across the entire body of the material, are preferable to those that use reinforcing strands or fabric to meet the current strength and puncture requirements of ASTM E-1745.

7. **There is but one opportunity to select the level of below slab moisture protection, and that is before the slab is placed.**

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1. Moisture Migration- Concrete Slab-On-Ground Construction H.W. Brewer, PCA, May 1965
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4. Examining Puncture Resistance, B. Suprenant & W. Malisch, Concrete Const. July, 2000
5. Resilient Floor Covering Institute, Addressing Moisture-Related Problems Relevant to resilient Floor Coverings Installed Over Concrete, Section II, Concrete Floor and Slab Construction.

Table 1: Moisture Movement Through Concrete Slabs, B. Suprenant, Concrete Const. Nov. 1997
Table 2: Hud Research Paper # 28, Moisture Migration From The Ground.

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FOCUS ON RESILIENT

Understanding Cause and Effect of Moisture

BY RAY THOMPSON JR.

Reprinted from the March issue INSTALLATION & CLEANING SPECIALIST MAGAZINE

Few people in the floor covering business will dispute that moisture is the single greatest cause of installation failure. While there are many factors, the main reason for the failure is that the cause-and-effect is not fully understood. In all concrete, the forms of water to be aware of are as follows.

Moisture Vapor Migration. Moisture vapor is not pure water vapor; it is a mixture of water vapor and air. It is driven by the pressure differential from areas with high moisture vapor pressure (beneath a concrete slab) to areas with low vapor pressure (area above the concrete slab). Of the two factors affecting moisture vapor migration – relative humidity and temperature – temperature is the most critical.

For example, the recommended installation temperature is 65 degrees, relative humidity 30%. From available vapor pressure tables (HUD moisture migration 28), you find that the vapor pressure in the building is .091 pounds per square inch. A realistic temperature for the soil beneath the concrete would be 55 degrees but as a result of the capillarity, the relative humidity of the soil would be approximately 100%.

Again, from the vapor pressure table, you find that the vapor pressure below the slab is .214 pounds per square inch. As a result the pressure below the slab is more than double the above the slab. The result; moisture, in the form of vapor will travel through the slab from below attacking the bond or drastically retarding the setting of aqueous adhesive systems.

Capillary Action. Moisture can travel from a lower to a higher elevation. The amount of moisture that can migrate from the ground by capillary action, often underestimated, can be a serious problem. Capillary is movement of a liquid upward through a soil. Soil with a higher percentage fines content is an excellent medium for capillary action. There are cases of soil with 56% fines content that show moisture constantly rising to the surface and evaporating at the rate of 12.1 gallons per 1,000 square feet, per 24 hours with a water table 30 inches below the surface.

However, tests have shown that moisture can migrate upward from a water table 20 feet below ground level. It is suspected that this amount of travel from this depth may not be capillary alone, but a combination of capillarity, absorption and gaseous diffusion. Nevertheless, moisture can migrate from that depth. Capillary is ongoing (24 hours a day) over a slab's entire area.

Hydrostatic Pressure. This is water pressure beneath a below-grade slab. It is moving water or a hydraulic action when the soil is saturated with water (I.e., rainfall, sprinkler systems, poor grading of surrounding soil, improper or broken drainage systems). Water is forced up through the slab by the weight of the water in the soil surrounding the foundation. If there is no effective barrier under the slab, or relief through drains, large quantities of water will pass through the slab.

Leakage. This is simply liquid water traveling from a higher to a lower elevation due to the force of gravity. It is generally identified by an area that is wet or damp. Very often driveways and/ or paved walks are pitched toward a building, thus directing free water to those areas. Another common source is planters, both inside and outside, that are constantly being watered.

Green Slab (Uncured Concrete). During concrete's curing process, a large amount of moisture, primarily excess water, is created. (A mix is easier for a cement finisher to work if it contains excess water). Excess water not used in the curing process will eventually evaporate. How long does it take for concrete to cure? There are many variable; no blanket statement can be made as to the drying time. Eight factors must be considered.

1) Thickness of the slab. 2) Time of the year slab is poured (a slab poured in the spring will cure faster than one poured in the fall). 3) the amount of water used in the mix (5-6 gallons per cubic foot of cement for normal aggregate concrete). 4) Whether or not the slab dries from both sides (slabs poured on metal decks or waterproof membranes take many times longer to cure).

5) Is the building heat turned on? 6) Is there adequate ventilation to permit moisture to escape? 7) Is there a sealer or curing compound used to retard evaporation? 8) What are the climactic conditions during the curing process?

You need to be aware of all eight factors. Very often the success or failure of an installation depends on them. A slab in contact with the ground has the potential for an inexhaustible supply of moisture beyond the water used in the mix. Moisture can penetrate the slab through cracks and pores left from the evaporation of the original mix water. The concrete should be separated from the ground water by by a capillary break (a 4" to 8" coarse washed gravel bed) and a vapor barrier (.004 or heavier plastic membrane).

Because the gravel bed might not drain well or the vapor barrier could be damaged during the pouring of the concrete, neither are total insurance against moisture migration. The water cement ratio – which is higher than in the past to allow the cement to be pumpable and more manageable – should be as low as possible. The reason; to reduce porosity in the concrete and the amount shrinkage, which reduce cracking.

The American Floor Covering Association recommends testing on all concrete slabs less than 2 years old for moisture, and because moisture migration is retarded by low temperature, tests should be not be conducted at temperatures less than 50 degrees. There are types of tests available, 1) Hygrometer – 24 hours and measure the results. 2) Calcium chloride crystal test – 60 hours minimum to measure qualitative and quantitative. 3) Phenolphthalien test to measure the presence of alkali and moisture.

4) Delmhurst electrical probe to measure bide bomb – measures moisture conductivity. 5) The mat test – a rubber mat taped down for 24 hours for visual moisture inspection. 6) Calcium carbide bomb – measures moisture in concrete chips removed from the slab. 7) The adhesive mat bond test – a one square yard piece of the material to be used, installed with the adhesive to be used, for 72 hours then torn up and evaluated for bond strength.

Ironically, all of these tests have a margin for error, and I have learned to place my trust in the adhesive mat bond test. While it is not foolproof, it does tell you what will happen to the adhesive bond. The critical time occurs between 48 and 72 hours; again, temperature is important.

Do we need these tests? Can we afford not to? What is the cost of non-conformance? Where does the responsibility lie? It is the floor covering contractor's responsibility to determine whether the concrete is sufficiently dry the day the floor is to be installed. This needs to be documented. If tests show excess amounts of moisture prior to installation, then it is the responsibility of the owner, developer or general contractor.

If you can show that the slab is dry enough on the day you install the floor covering, and if moisture appears in the future, causing a failure, you should be relieved of responsibility. Floor covering contractors should not be held responsible for future moisture problems. Many contractors submit a combination report and disclaimer upon completion of the moisture tests.

About the Author: Ray Thompson, a monthly Installation and Cleaning Specialist columnist, is Installation Services manager of Sea-Pac Sales, Seattle headquartered multi-branch, full-line floor covering distributor. He is responsible for planning and conducting ongoing installation training programs and seminars for installers, retailers, contractors. He is on constant demand by floor covering associations as a speaker and seminar leader.

Ray began as an apprentice installer in 1964 with a Portland retailer/contractor where he held key installation posts until 1977. For nine of those years he was also an instructor for the local Joint Apprentice Training Committee. From 1981 to 1988 he was an installation specialist for Armstrong, and prior to joining Sea-Pac, was co-owner of a carpet retail operation for two years.

RAY THOMPSON
FLOOR COVERING INSTITUTE

MICROORGANISMS AND HEALTH EFFECTS

With a stronger emphasis on the molds and mildew in floor covering installations do to moisture intrusion into and under installed flooring materials. I had the opportunity to discuss this concern with Mr. Hank Bruflodt of Floor Seal Technology. He indicated some of the concerns confronting the flooring industry. These are as follows.

Mold, mildew and fungi are essentially the same thing. These are more plant in nature, than animal. Other microorganisms are viruses which are free standing chemicals and bacteria which are more animal in nature, than plant. A fungi is actually neither pure plant nor pure animal, and falls into a kingdom of its own.

While viruses and bacteria are dangerous organisms, they are low on the Indoor Air Quality (IAQ) scale. Even second hand smoke is higher on the IAQ scale than bacteria. However, fungi ranks number one as the most problem IAQ component.

When a construction product like carpeting or drywall is maintained at a relative humidity of 70%or higher for a 2-day period or longer, fungal spores that are present in all indoor and most exterior environments, and will begin to multiply. In the beginning, there may be as many as 2,000 different species of fungal spores beginning to grow in a given saturation area.

In order for one species of fungi to compete with another for the water and the food source, each species produces toxins that are designed to poison the other species. Eventually a few powerful species overtake the others by producing very compound toxin chains.

These toxins are called "Mycotoxins" and they are very compound chemicals. The formal name is "Trichothecene Mycotoxins" (tri ko tha seen) and are several different chemical agents. The most popular Trichothecene Mycotoxins are "Satratoxin-H, Satratoxin-G, and T-2 among others.

According to one source from Florida, who was the head of the US Army Biological Weaponry for 20 plus years, these three Mycotoxins listed (Satratoxins) are banned by international peace treaty to be used as biological weapons. A biological weapon is essentially a concentrated amount of Trichothecene Mycotoxins.

Several fungal species produce Trichothecene Mycotoxins, but the most popular fungal species found in IAQ studies are:

- Stachybotrys (stackie bot ter us) Atra (at tra) or Chartarum (shar tar um) (Atra and Chartarum are the same).
- Aspergillus (asper jill us)
- Cladosporium (clad o spor i um)
- Alternaria (alter nar e a)
- Penicillium (penny silly um)

All these produce Trichothecene Mycotoxins. The toxins created by each fungi have different unspecified health effects on humans and animals. Much depends on whether it was inhaled, ingested or contacted by skin. Primarily, the health affects are related to asthma allergy, upper respiratory tract problems ((runny nose, watery eyes) and shin rashes.

There is also a belief that certain toxins can produce malaise, chronic fatigue, difficulty in concentration, gastrointestinal disorder, and other unspecific health effects.

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Please keep in mind, there is no evidence of casualty. There is a correlation between Trichothecene Mycotoxicosis, and these health effects. There is enough evidence to suggest that they are extremely dangerous and must be removed properly, but no cause and effect proof. Generally, a human subject has to be exposed to Trichothecene Mycotoxins for sometime in order to experience the health effects.

The body is resistant to them initially, but then loses its ability to withstand exposure. Some researchers say 3 to 6 months but much depends on the immuno system of the victim, their overall health and age. Infants who have died from mold exposure were found to have bleeding in the lungs (pulmonary hemorrhage) because certain Mycotoxins attack rapidly expanding cells. Immuno-compromised people and the elderly suffer from Mycotoxicosis due to cell structures that do not rebuild themselves quickly.

There are no standards or laws concerning acceptable mold spore counts yet established. The state of New York has written their own IAQ guidelines but there is no federal standard, and scientists argue just how one can quantify the amount of mold. Generally, if mold spore counts measured in CFU (colony forming units per square meter) are higher on the interior of the building than on the exterior, it is considered to be a problem. If you can see mold or smells musty odors, it is typically enough indication to say that there is a serious problem. Mold species generally grow on nitrogen-free materials and those that are cellulose in structure. Mold spores are present in all interior environments, live in the same temperature range as people and find nutrients in anything organic from cotton fibers to human skin follicle. Human skin follicle constitutes over 90% of household dust. The only thing that can control mold proliferation is control of humidity.

When first presented with the ideas on slab moisture emissions to the California Department of Health, said they did not think that a 3 or 12 pounds of moisture vapor emissions was enough to support a microorganism problem. Later, a scientist who is studying moisture emissions in concrete slabs said, "I think the volume of water is insignificant, but the degree of sustained humidity at the slab line is enough to allow microorganisms to develop". Studies into mold infested homes and condominiums showed moisture emissions under carpet to achieve 100% relative humidity. Therefore, we should be cautious of installations of floor coverings over concrete slabs to prevent the growth of any types of microorganisms at the juncture of the slab line.

Anybody who experiences mold growth to a serious level, one warranting demolition, should contact their county health office immediately and file a report. An industrial hygienist can often make an assay of the situation, but a lab, which specializes in diagnostics, should be employed. Remediation requires formal abatement using negative air ventilation, Tyvek suits and respirators. I have encountered installers that have been unknowingly been involved with removal of mold and mildew infested materials without any type of protection only to have a respiratory disorder arise.

The flooring industry needs to be extra cautious when dealing with any type of moisture condition that may lead to mold, mildew or fungus. And failure to do so could lead to serious personal liability litigation.

Ray Thompson
Floor Covering Institute

UNDERSTANDING ALKALINE EFFLORESCENCE IN CONCRETE

In the past many floor-covering failures were thought to be moisture related when the real cause was alkaline efflorescence. For example, the moisture emissions for VCT tile are at 4 pounds; the manufacturer's recommendation is at 5 pounds, yet the installation failed. The common thought is that the moisture emissions must have increased, but further testing indicates the moisture is still below the 5 pound level. A pH test would have revealed the real culprit, alkaline efflorescence. Alkaline efflorescence is a crystalline residue of an evaporated salt solution from the lime in Portland cement.

The chemistry of alkaline efflorescence

There are basically three by-products of Portland cement creating alkalis sodium oxide (Na20), potassium oxide (K20) and calcium oxide (Ca (OH)2.

When mixed with moisture migrating, the water will convert sodium oxide into sodium hydroxide (NaOH), or a caustic soda. The hydroxide then migrates to the surface of the slab where it evaporates leaving an alkali deposit. Another form of efflorescence is sodium carbonate, which is sodium hydroxide mixed with carbon dioxide from temporary heat. This is also referred to as soda ash.

Potassium oxide is dissolved by water to form potassium hydroxide (KOH), or lye. Potassium hydroxides will migrate to the surface of the slab to create another form of efflorescence. This type of hydroxide can also mix with carbon dioxide from temporary heat to form potassium carbonate, also known as potash.

The hydration of Portland cement can be another source of alkaline efflorescence. Excess water added to the Portland cement in concrete forms calcium hydroxide (Ca(OH)2. Water migrating can dissolve the hydroxide and carry it in a solution to the surface of the slab. Where the water evaporates leaving a white crystalline residue, also known as hydrated lime.

Temporary heat, especially heat sources that produce high amounts of carbon dioxide, that mixes with either sodium hydroxide, potassium and/or calcium hydroxide can create either sodium carbonate, potassium carbonate, calcium carbonate or all, each can have an impact on floor covering adhesives.

Testing for Alkalinity

Only until recently has the floor covering industry became aware of the fact that moisture vapor migration is not always the cause of flooring failure, but the vehicle, which carries the destructive alkaline salts to the surface of the slab. This is why we are starting to see more pH test kits in with the androus calcium chloride test kits. This added to the moisture vapor emissions test allows a more complete analysis of the concrete's condition and it's suitability for the installation of flooring materials. The best time to do such tests is immediately upon retrieval of the moisture emissions test. The concrete was cleaned prior to the setting of the test and the concrete's surface will tell the amount of alkaline salts that have been brought to the surface by the migrating moisture.

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With the concrete already clean, pour about two tablespoons of distilled water onto the surface of the concrete. Leave set on the concrete for about 3 minutes. While waiting, lightly stir water to help it absorb any of the salts. After the allotted time place a pH paper into the water solution and then compare the color changes in the paper and compare the color changes with the color chart for the results. Another alternative is to purchase a pH tester with a surface probe and place the tip of a surface probe into the distilled water solution to obtain the results. The pH tester will give you greater accuracy of your test results.

Analysis of the pH test results

The test results will determine the degree of alkalinity from a numeric scale ranging from 7 to 14, and is sometimes confusing. The scale is a logarithmic scale with each value ten times greater than the previous number. The following is an analysis of each numeric compared to 7 which is neutral:

7= neutral
8= 10 times greater than neutral
9= 100 times greater than neutral
10= 1,000 times greater than neutral
11= 10,000 times greater than neutral
12= 100,000 times greater than neutral
13= 1,000,000 times greater than neutral
14= 10,000,000 times greater than neutral

Alkaline salts start to impact flooring adhesives at a pH of 9 and almost always destroy an adhesive at a pH of 10. Because of the caustic nature of the hydroxides, very few adhesives can survive a pH of 10 or greater. Some other interesting facts about pH are as follows:

- When alkali salts reach the surface of the concrete and start to dry they tend to expand exerting a pressure in excess of 3 tons on adhesives bond to the concrete.
- The pH of concrete as it comes out of a cement truck is about a pH of 12-13.
- If you were to dig down into concrete and do a pH test you will get a pH reading of around 12.
- A pH of 13 will dissolve glass.
- A pH of 13-14 will start to decompose some certain types of sand and aggregate in the concrete mix.

The flooring contractor and installer not only have to have a good knowledge of floor covering materials, adhesives, and installation, but they have to have knowledge of chemistry as well. The changing world of floor covering is starting to dictate it.

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