Expansion of Conditioned Space

- Conditioned space boundaries moving towards exterior surfaces of building
- Garage isolated from house by air barrier/pressure boundary
- Garage ventilated and conditioned independently of rest of conditioned spaces
Mechanisms of Flow

- Liquid
  - Gravitational Hydrostatic Pressure
  - Capillary Suction Pressure
  - Osmosis Solute Concentration

- Vapor
  - Diffusion Vapor Pressure
  - Convective Air Pressure
Roof overhang screens wall (deflects rain)

Site grading slopes ground away from building over entire perimeter
Rain water falling on roof is collected in gutters

Overhang protects the ground around the foundation from getting saturated

Down spouts carry rainwater from the roof away from the foundation

Capillary break under plate

Polyethylene vapor diffusion retarder in direct contact with concrete slab

Ground slopes away from the foundation

Granular drainage pad (coarse gravel, no fines)

- Keep rain water away from the foundation perimeter
- Do not place sand layer over polyethylene vapor diffusion retarder under concrete slab
- Where vinyl flooring is installed over slabs, a low water-to-cement (w/c) ratio (≤ 0.45 or less is recommended) to reduce water content in the concrete; alternatively, the slab should be allowed to dry (less than 0.3 grams/24 hrs/ft²) prior to flooring installation
Rain water falling on roof is collected in gutters

Overhang protects the ground around the foundation from getting saturated

Flash roof into gutter

Down spouts carry rainwater from the roof away from the foundation

Capillary break under plate

Ground slopes away from the foundation

Conditioned space

Polyethylene ground cover acting as both an air barrier and a vapor barrier

- Keep rain water away from the foundation perimeter
- If the interior crawlspace is lower than the exterior grade, a sub-grade perimeter footing drain is necessary as in a basement foundation
- The crawlspace is conditioned space; it is part of the "interior" of the building and should be heated, cooled and ventilated as part of the building's heating, cooling and ventilating strategy

Interior grade of crawlspace higher than surrounding grade
Rain water falling on roof is collected in gutters.

Overhang protects the ground around the foundation from getting saturated.

Flash roof into gutter.

Down spouts carry rainwater from the roof away from the foundation.

Ground slopes away from the foundation.

- Keep rain water away from the foundation perimeter.
- Drain groundwater away in sub-grade perimeter footing drains before it gets to the foundation wall.
- Continuous air seal
- Drainage matt
- Concrete “patch”
- Existing slab
- Filter Fabric
- Interior perimeter drain (connected to sump)
- Crushed stones (no fines)
Roof flashing

Vent stack

Continuous polyethylene vapor barrier/air barrier (all joints taped)

Polyethylene mechanically attached to foundation wall perimeter and sealed

Perforated drain pipe trench covered with course gravel (no fines)

Sealant at all penetrations in air barrier

Perforated drain pipe at perimeter connected to vent stack
Roof flashing

Vent stack

Polyethylene vapor barrier

Sealant at all penetrations in air barrier

Concrete slab

Perforated drain pipe added to "T" in order to couple sub-slab pressure field to vent stack
**Concrete Porch Slab with Housewrap**

- **Wood stud wall**
- **Subfloor**
- **Band joist**
- **Treated mudsill**
- **Foundation wall**
- **Exterior sheathing**
- **Housewrap, WRB or building paper**
- **Waterproof membrane**
- **Sealant**
- **Tar paper as bond break**
- **Concrete porch**
- **4” stone pad (no fines)**
- **Undisturbed/compacted earth**
**Concrete Porch Slab with Insulating Sheathing**

- Exterior finish
- 1" insulating sheathing
- Waterproof membrane
- Tar paper as bond break
- Sealant
- Concrete porch
- 4" stone pad (no fines)
- Undisturbed/compacted earth

Diagram labels:
- Wood stud wall
- Subfloor
- Band joist
- Treated mudsill
- Foundation wall
CONCRETE PORCH/Foundation Intersection

- Foundation wall for concrete porch dropped below foundation wall for house
- Subfloor framing/rim joist
- Waterproof membrane
- Exterior sheathing
- Housewrap, WRB, or building paper
- Tar paper bond break
Control joint at steps in foundation wall

Control joints at corners

Control joints are sealed with flexible sealant at the exterior prior to backfilling

Control joints at window openings

Sealant

Diagonally cut 2 x 2’s in forms provide goose neck joint

Saw cut joint
Garage foundation
(Isolated from basement foundation for frost heave protection)

Perimeter drain pipe around exterior of garage foundation

Bond break material

See Figure 4.4
Isolation joint between garage foundation and basement foundation

The diamond shaped joints may be omitted if column footings are below floor level and the column is wrapped with two layers of sheathing membrane or joint filler to break the bond

Concrete foundation wall control joints

Slab control joints

Exterior insulation can act as garage foundation isolation joint

Column isolation joints

Column

Sump (airtight cover)

Bond break between slab and foundation wall at slab perimeter

Perimeter drain pipe connected to sump

Through footing pipes connect granular drainage pad under slab to perimeter drain pipe
Calculating capillary rise

\[ h = \frac{2 \sigma \cos \theta}{g \rho r} \]
Capillary rise versus diameter
Capillary Flow

Siding laps
Diagram showing moisture flow and prevention measures in a foundation system:

- Dampproofing
- Filter fabric
- Coarse gravel (no fines)
- Perforated drain pipe
- Concrete footing
- Polyethylene vapor barrier
- Granular capillary break and drainage pad (no fines)
- Concrete slab
Capillary break on exterior foundation wall

Capillary break under slab

Capillary break on top of footing
Continuous fillet bead of urethane sealant between 2” XPS bond break and foundation wall
Continuous fillet bead of urethane sealant between 2” XPS bond break and concrete slab
2” XPS bond break
4” concrete slab with welded wire mesh placed at mid-depth
6 mil polyethylene vapor barrier
2” XPS rigid foam slab insulation
Embedded hydronic tubing

Free-draining backfill
Liquid-applied capillary break (must dry tack-free) applied on top of footing prior to placing/casting concrete foundation wall
Keyway
Filter fabric placed under perimeter drain and wrapped around gravel
Coarse gravel (no fines)
4” PVC pipe through bottom of footing connecting interior and exterior gravel beds
4” perforated perimeter drain

4” gravel pad (no fines)
Filter fabric
Undisturbed native soil or engineered fill as determined by soil conditions
Continuous concrete footing 2’-0” wide and 10’ deep
Vapor semi-permeable assembly allows moisture to pass in a slow, controlled manner.
Carpet or wood floor (avoid vinyl flooring as vinyl flooring does not breathe)

3/4" plywood (T&G — narrow edges “biscuit” joined)

Rigid insulation (extruded polystyrene — unfaced, no polypropylene or foil facers)

Airspace

Dimpled plastic sheet membrane (air tight and gas tight)

Existing slab

Damp ground
(no capillary break, no polyethylene ground cover)

Vapor pressure on top of slab and under slab equalizes, thereby stopping capillary transfer of water and soluble mineral salts (moisture content in air space and under slab remains the same; i.e. “wet”)

Building Science Corporation
Wood floor

Topside fluid-applied vapor barrier

Concrete slab

Polyethylene vapor barrier

Granular base
Hollow Back