6.1 Thermal-Boundary Decisions: Floor or Foundation

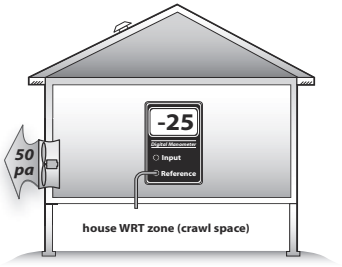
SWS Detail: 4.03 Floors; 3 Air Sealing; 3.0101 General Air Sealing; 3.0102 Specific Air Sealing; 3.0104 Foundation Spaces

The results of air-barrier tests can help in selecting the thermal boundary's location.

Before you can confidently air seal a building assembly, you must often decide which of two assemblies — the foundation walls or the floor for example — to air seal and insulate.

Moisture problems, the location of heating and cooling equipment, and the necessity of crawl-space venting are other important considerations.

House-to-crawl-space pressure: Many homes with crawl spaces have an ambiguous thermal boundary at the foundation. Is the air barrier at the floor or foundation wall? Answer: in this case, each forms an equal part of the home's air barrier.



The tables presented next summarize the decision factors for choosing between the floor and the foundation wall as the air barrier. You may also encounter situations that aren't addressed here.

When a home has a basement and crawl space connected, both *Table 6-1 shown next* and *Table 6-2 on page 216* are relevant to the decision-making process of selecting the air barrier and site for insulation, if insulation is cost-effective. A basement may even be divided from its adjoining crawl space to enclose the basement within the thermal boundary and to place the crawl space outside the thermal boundary.

Table 6-1: Crawl Space: Where Is the Thermal boundary?

Factors favoring foundation walls	Factors favoring floors
ground-moisture barrier and good perimeter drainage present or planned	Dry crawl space with ground-moisture barrier installed during weatherization
Foundation walls test tighter than floor	Floor air-sealing and insulation are reasonable options, considering access and obstacles
Vents can be closed off	Floor tests tighter than foundation walls
Furnace, ducts, and water pipes located in crawl space	No furnace or ducts present
Concrete or concrete block walls are easily insulated	Building code or code official forbids closing vents
Floor air-sealing and insulation would be more difficult than sealing and insulating the foundation	Rubble masonry foundation wall
Foundation wall is insulated	Floor is already insulated
Warm, damp homesite + climate	Cooler, drier homesite + climate

Table 6-2: Unoccupied Basement: Where Is the Thermal Boundary?

Favors foundation wall	Favors floor
Ground drainage and no existing moisture problems	Damp basement with no solution during weatherization
Interior stairway between house and basement	Floor air-sealing and insulation is a reasonable option, considering access and obstacles
Ducts and furnace in basement	No furnace or ducts present
Foundation walls test tighter than the floor	Floor tests tighter than foundation walls
Basement may be occupied some day	Exterior entrance and stairway only
Laundry in basement	Rubble masonry foundation walls
Floor air-sealing and insulation would be very difficult	Dirt floor or deteriorating concrete floor
Concrete floor	Cracked foundation walls

6.2 Air Sealing Foundations and Floors

SWS Detail: 3 Air Sealing; 3.0101 General Air Sealing; 3.0102 Specific Air Sealing; 3.0104 Foundation Spaces

The floor and foundation are complex structures that can be difficult to air seal. This section describes the most problematic air leakage locations in the floor and foundation, and how to seal them.

6.2.1 Garages Underneath Living Areas

SWS Detail: 3.0105.1 Isolating Garage From Living Space; 3.0102.3 Sealing Tongue and Groove Surfaces; 3.0102.2 Sealing High-Temperature Devices; 3.0102.1 Sealing Non-Insulation Contact (IC) Recessed Light

Whenever a garage is in a subspace below living areas, the effectiveness of air sealing is essential for three objectives.

1. Block air pollutants,
2. Create a fire barrier,
3. Save energy by separating the unconditioned garage from the building's conditioned zones.

Air-sealing a garage area is straightforward although this task can consume a lot of materials.

- For wood-frame structures, use fire-taped drywall throughout the surface area of the garage after sealing leaks in the floor above and the in the top plate of the walls.
- For concrete and masonry structures, carefully seal cracks and penetrations with compatible materials such as mortar and caulk designed for masonry joints.

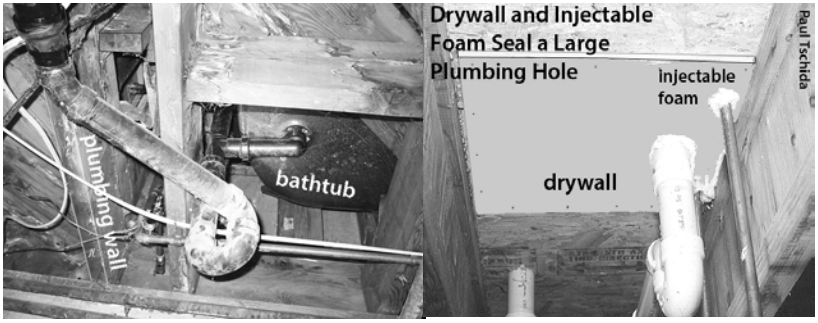
Note: To meet DOE Health & Safety Guidance and ASHRAE 62.2.16, All attached garages must be separated from the living space. DHCD requires that this is check by using a blower door and Zonal Pressure Diagnostics.

6.2.2 Plumbing Penetrations

SWS Detail: 3.0101.1 Air Sealing Holes; 3.0104.1 Closed Crawl-space Air Sealing; 3.0104.3 Slab Foundation Sealing; 3.0104.4 Covers for Intentional Slab Penetrations

Seal gaps with expanding foam or caulk. If the gap is too large, stuff it with fiberglass insulation, and spray foam over the top to seal the surface of the plug.

- ✓ Fit large openings with a rigid patch bedded in a sealant like latex caulk or foam tape, which isn't an adhesive.
- ✓ Screw the patch in place, so that a plumber can remove the screws if necessary for access.
- ✓ Seal holes and gaps around pipes with expanding foam or caulk.



Sealing large plumbing penetrations: Bed drywall or wood sheathing in sealant and fasten with nails or screws. Fill gaps around the penetrations with one-part foam to complete this airtight seal.

6.2.3 Stairways to Unconditioned Areas

SWS Detail: 3.0101.1 Air Sealing Holes

A variety of stairways and hatchways provide access from the building to an unconditioned basement.

The following components of these stairways may need air sealing and insulation depending on whether they are at the thermal boundary.

- The risers and treads of the stairways
- The surrounding triangular walls
- Vertical or horizontal doors or hatches
- The framing and sheeting surrounding the doors or hatches
- Sloping ceilings above the stairways

Consider the following air-sealing measures.

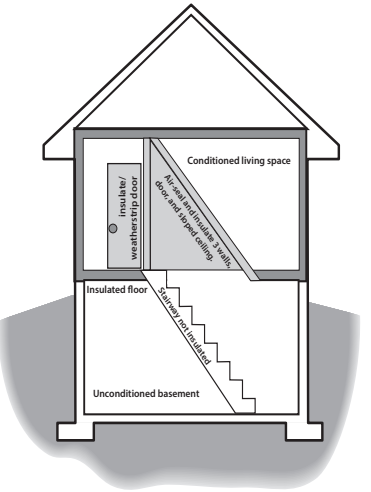
✓ Study the geometry of the stairway and decide where to establish the air barrier and install the insulation.

✓ Weatherstrip around doors and hatches if the door or hatch is at the thermal boundary.

✓ Seal the walls, stair-stringer space, and ceiling if they are at the thermal boundary.

✓ Seal gaps around door frame or hatch frame perimeters with one-part foam, two-part foam, or caulking.

Unfinished stairways: Unfinished spaces underneath stairs create major air leakage pathways between floors and between the attic and crawl space or basement.



Stairways at the thermal boundary: The stairway may be within the thermal boundary or outside it. Only walls, ceilings, doors, and hatches at the thermal boundary require thorough air sealing. The door as shown is open.

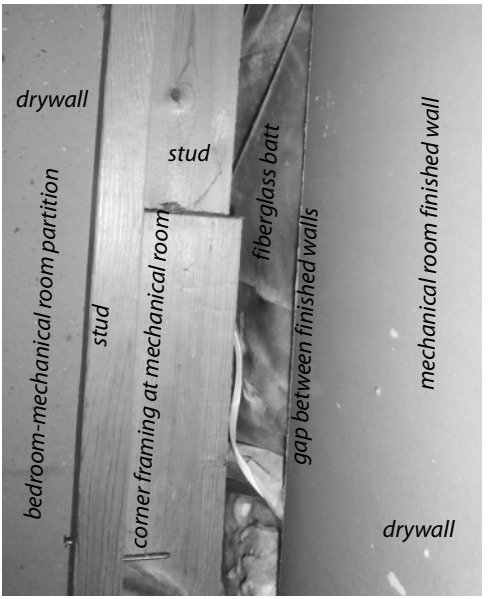
Stairway wall within the thermal boundary: Double wall forming the stairwell connects an unfinished area under the basement stairs with the living spaces, attic, and the space behind the finished basement walls.

6.2.4 Incomplete Finished Basements

SWS Detail: 3.0101.1 Air Sealing Holes; 4.0402.4 Basements - Without Groundwater Leakage;4.0402.5 Basements - With Groundwater Leakage

Discontinuous wall segments can allow heated basement air to circumvent the finished and insulated wall, carrying heat with it. Complete the finished walls or at least install air barriers between finished living area and unconditioned area between the insulated wall and the foundation wall. Here are two suggestions.

- ✓ Bridge the gap with wood sheeting, bedded in sealant, and caulk the crack around four sides of this long narrow patch.
- ✓ Stuff the gap with pieces of fiberglass batt and spray two-part foam over the gap, at least an inch thick.



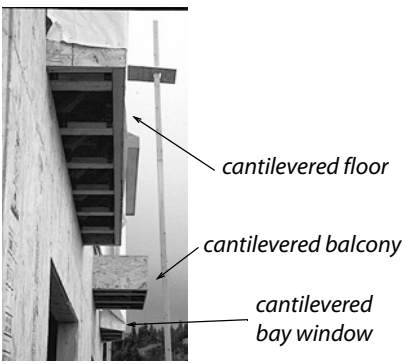
Large air leak in finished basement walls: Two finished basement walls meet inside a mechanical room and form a 2-inch gap from floor to ceiling connecting the finished basement with the space behind its finished walls.

6.2.5 Cantilevered Floors

SWS Detail: 4.0301.6 Cantilever Floor Joisted Cavities Batt Insulation; 3.0101.1 Air Sealing Holes; 3.0102.3 Sealing Tongue and Groove Surfaces; 4.0302 Exposed Floors; 4.0302.1 Batt Insulation With Rigid Barrier; 4.0302.3 Dense Pack with Rigid Barrier

Floors that hang over their lower story are called cantilevered floors. The underside of the overhanging floor can leak considerably. Many balconies and bay windows have cantilevered floors that leak air into a building's floor cavity.

Cantilevered floors under construction: Cantilevered floors allow air leakage into floor cavities because of the lack of sealant and dense-packed insulation.



Fill Cavities with Fibrous Batts

- ✓ Remove a piece of soffit under the overhanging floor to determine the condition of insulation and air barrier.
- ✓ Stuff the overhanging floor with fiberglass or rock wool batts.
- ✓ Bed the sheeting underneath the overhanging floor in sealant where possible. Caulk joints and seams where the sheeting isn't bedded in sealant.
- ✓ Seal any ducts you find in the cantilevered floor sections.

Dense-Pack Cavities from a Drilled Hole

- ✓ Drill a hole at least 1.5 inch in diameter.

✓ Dense-pack fibrous insulation into the cavity.

✓ Seal all holes and cracks with an appropriate sealant.

See also "Installing Floor Insulation" on page 224.

6.3 Preparing for Foundation or Floor Insulation

SWS Detail: 3 Air Sealing; 4.0401 Rim/Band Joist

Floor and foundation insulation can increase the likelihood of moisture problems. Installers should take all necessary steps to prevent moisture problems from ground moisture before installing insulation.

6.3.1 Rim-Joist Insulation and Air-Sealing

SWS Detail: 3 Air Sealing; 4.0401.1 SPF Insulation; 4.0401.2 Batt Insulation; 4.0401.3 Rigid Insulation

The rim-joist spaces at the perimeter of the floor are a major weak point in the air barrier and insulation. Insulating and air sealing both the rim joist and longitudinal box joist are appropriate either as individual procedures or as part of floor or foundation insulation.

Air seal stud cavities in balloon-framed homes as a part of insulating the rim joist. Air seal other penetrations through the rim before insulating. Two-part spray foam is the most versatile air sealing and insulation system for the rim joist because spray foam air seals and insulates in one step.

Polystyrene or polyurethane rigid board insulation are also good for insulating and air sealing the rim joist area. When the rim joist runs parallel to the foundation wall, the cavity may be air sealed and insulated with methods similar to those as shown here.