NEW SECTION 9.36. ENERGY EFFICIENCY REQUIREMENTS

DECEMBER 19, 2014

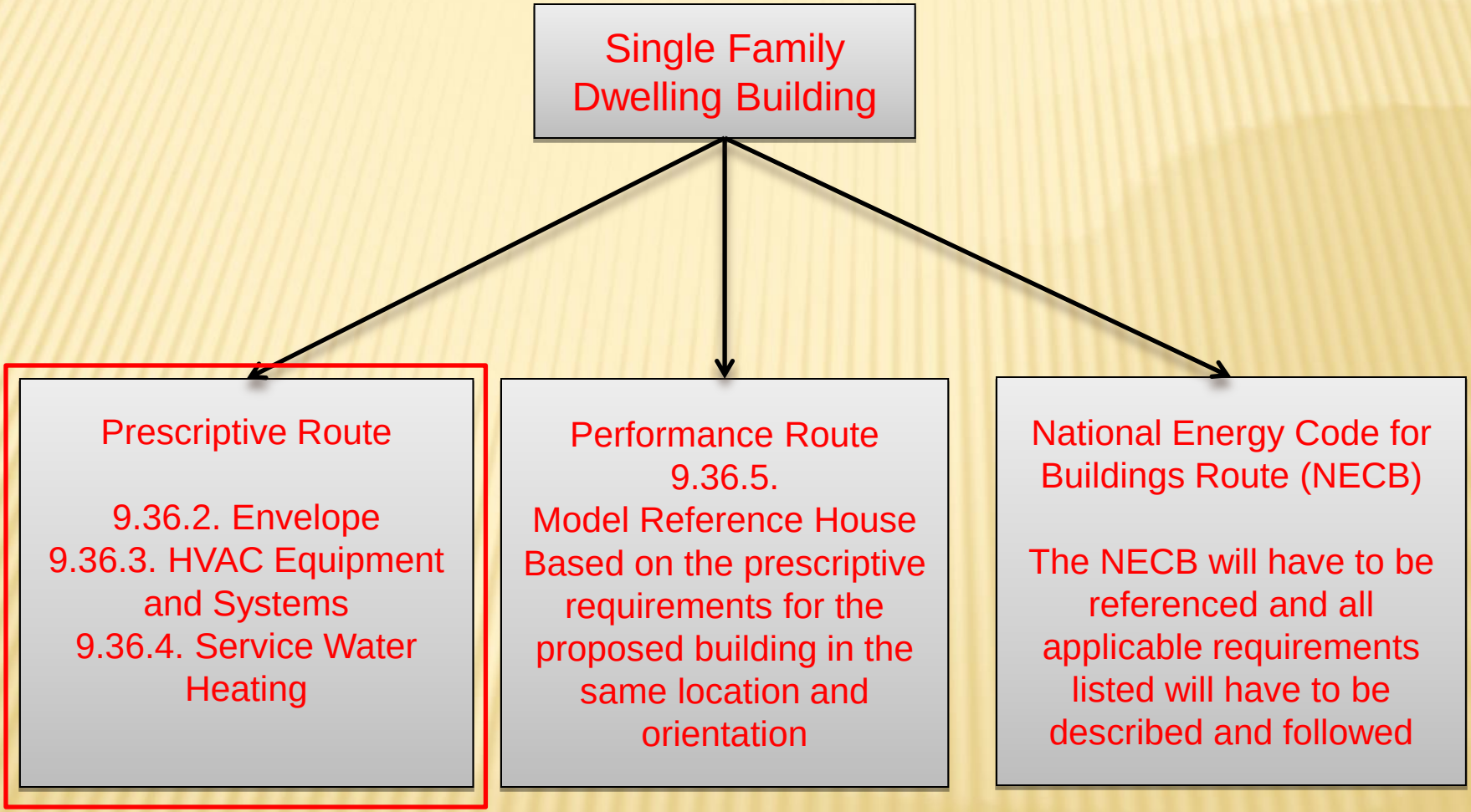
The requirements apply to all proposed Part 9 buildings applied for building permits from Dec. 19, 2014 onward.

Except:

a) ***buildings*** **or portions of** ***buildings*** **that are not** ***conditioned spaces***, and

b) *residential buildings* that are not intended for use in the winter months on a continuing basis.

The requirements allow three paths of compliance



The Code references for Section 9.36. for the prescriptive route:

9.36.2. Building Envelope

9.36.2.1. Scope and Application
9.36.2.2. Determination of Thermal Characteristics of Materials, Components and Assemblies
9.36.2.3. Calculation of Ceiling, Wall, Fenestration and Door Areas
9.36.2.4. Calculation of Effective Thermal Resistance of Assemblies
9.36.2.5. Continuity of Insulation
9.36.2.6. Thermal Characteristics of Above-ground Opaque Building Assemblies
9.36.2.7. Thermal Characteristics of Fenestration, Doors and Skylights
9.36.2.8. Thermal Characteristics of Building Assemblies Below-ground or in Contact with the Ground
9.36.2.9. Airtightness
9.36.2.10. Construction of Air Barrier Details
9.36.2.11. Trade-off Options for Above-ground Building Envelope Components and Assemblies

9.36.3. HVAC Requirements

9.36.3.1. Scope and Application
9.36.3.2. Equipment and Ducts
9.36.3.3. Air Intake and Outlet Dampers
9.36.3.4. Piping for Heating and Cooling Systems
9.36.3.5. Equipment for Heating and Air-conditioning Systems
9.36.3.6. Temperature Controls
9.36.3.7. Humidification
9.36.3.8. Heat Recovery from Dehumidification in Spaces with an Indoor Pool or Hot Tub
9.36.3.9. Heat Recovery from Ventilation Systems
9.36.3.10. Equipment Efficiency
9.36.3.11. Solar Thermal Systems

9.36. Energy Efficiency

9.36. 4. Service Water Heating Systems

9.36.4.1. Scope and Application
9.36.4.2. Equipment Efficiency
9.36.4.3. Solar Domestic Hot Water Systems
9.36.4.4. Piping
9.36.4.5. Controls
9.36.4.6. Indoor Swimming Pool Equipment Controls

Compliance with the Prescriptive Path

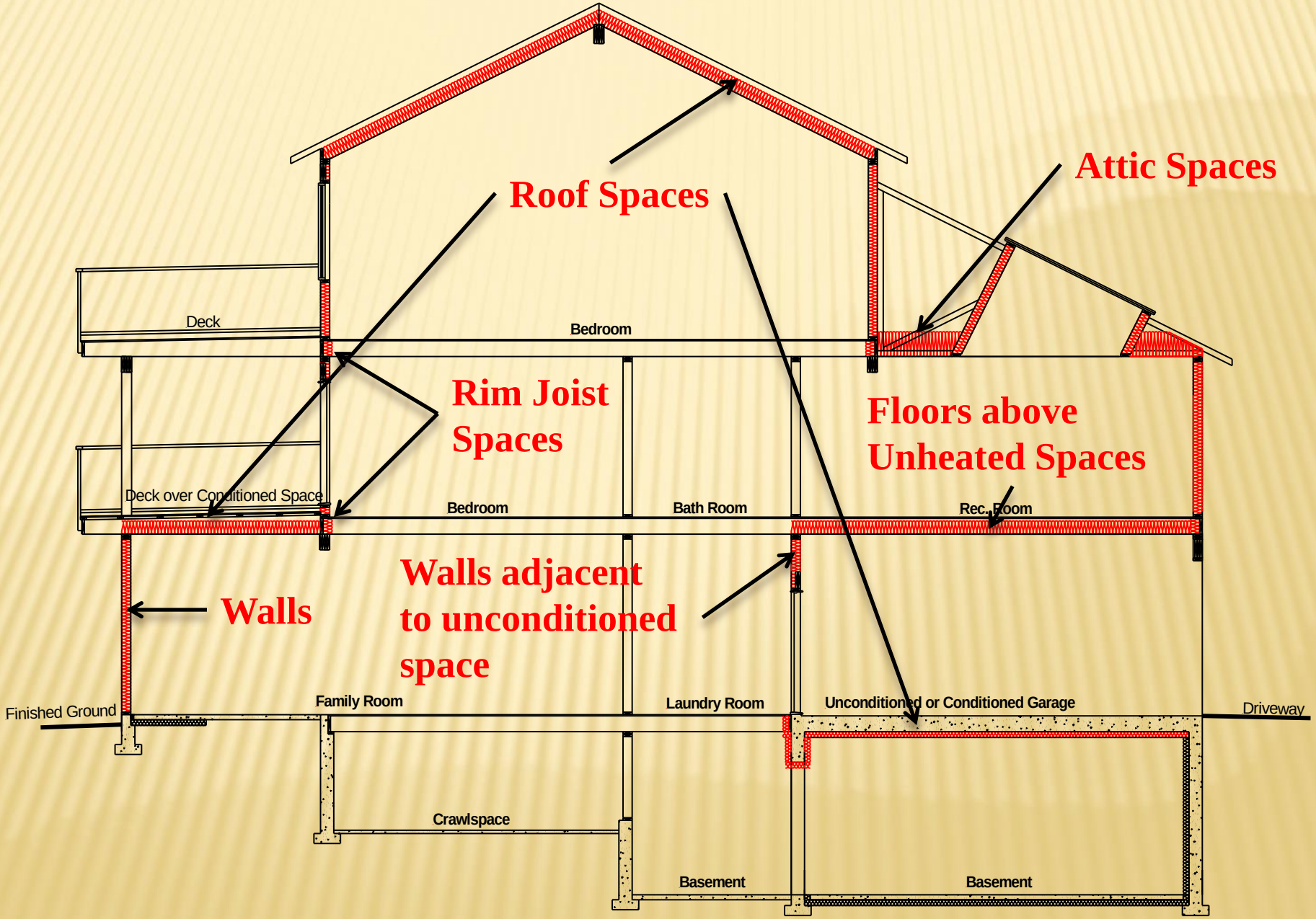
Designers will need to calculate the **effective thermal resistance** for an **envelope assembly** that separates conditioned space from:

- unconditioned space (unheated or cooled occupied space within a building)
- the exterior (above-ground space not in a building) and
- the ground (with some exceptions)

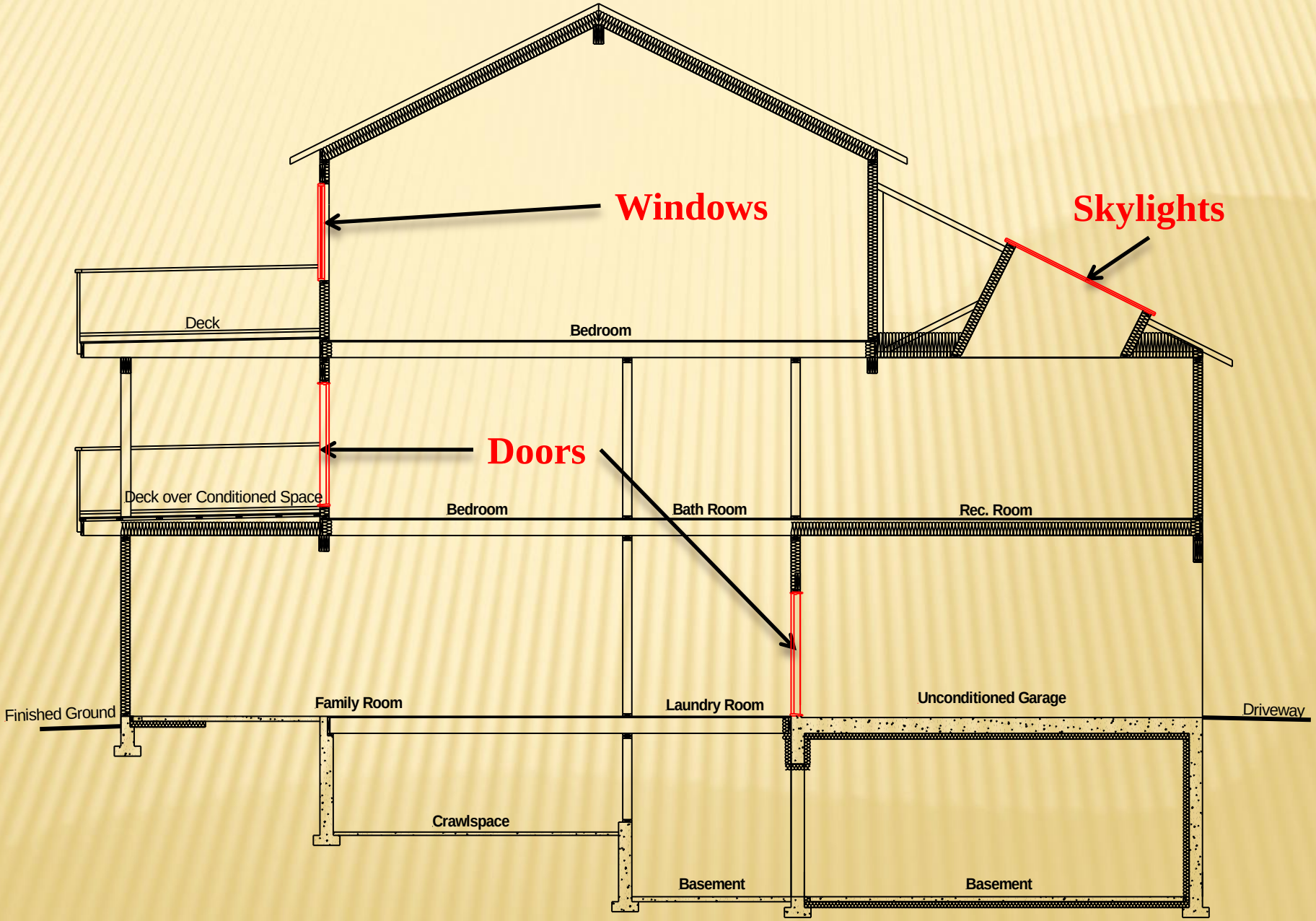
Envelope assemblies are categorised into three groups:

- Above-ground opaque assemblies,
- Fenestration and door assemblies, and
- Below-grade or in contact with the ground assemblies

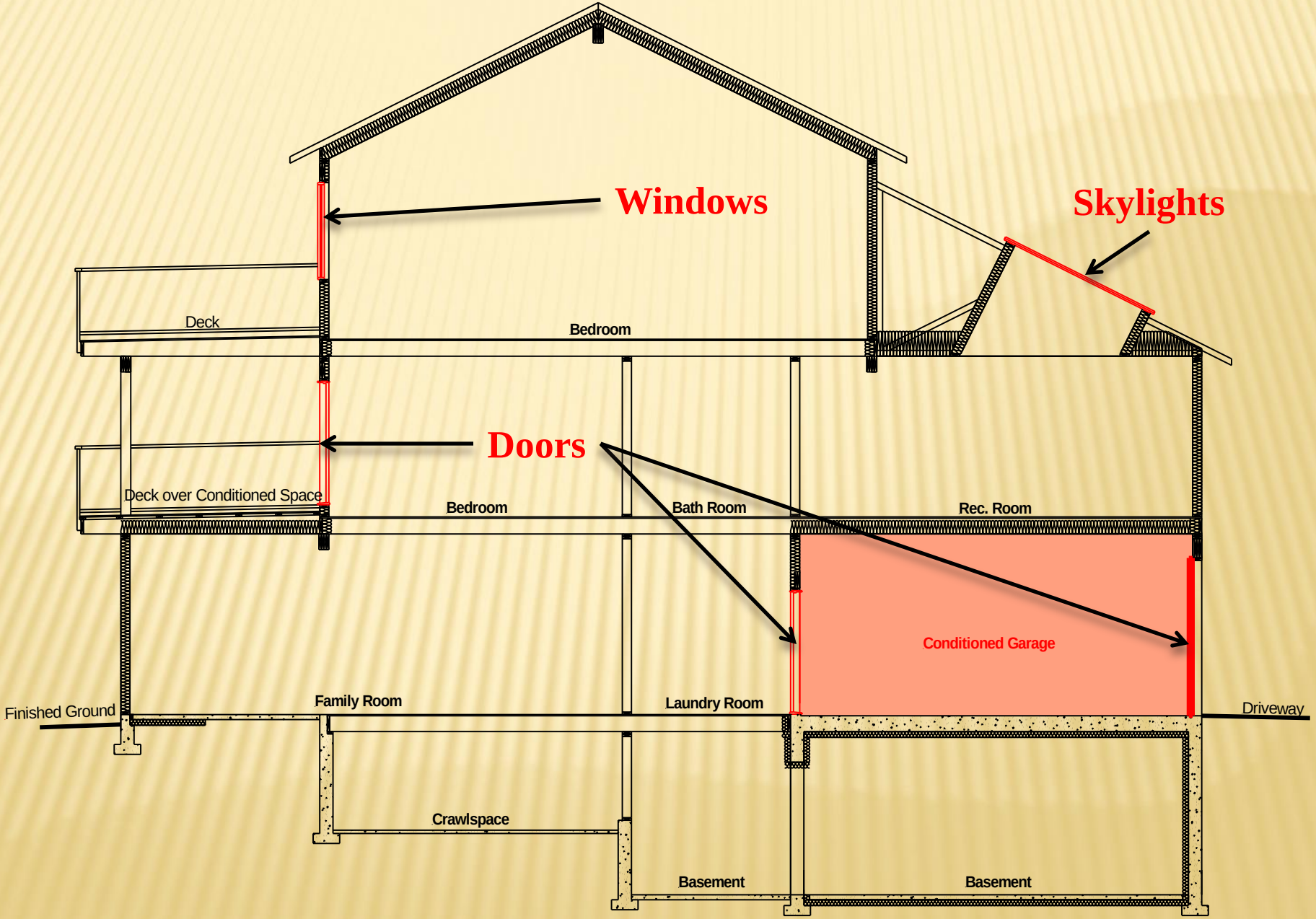
Common Above Ground Opaque Assemblies



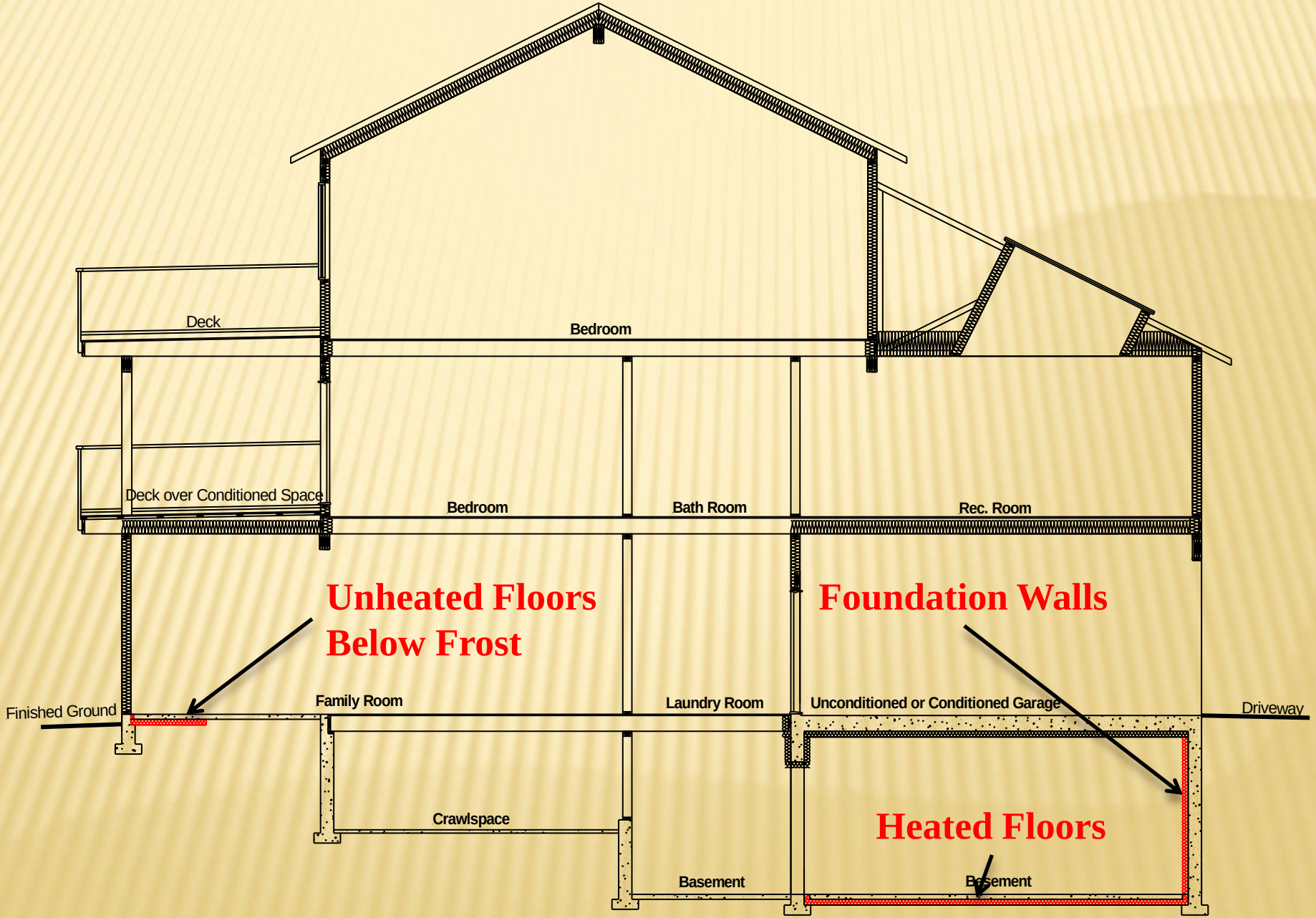
Common Fenestration, Door and Skylight Assemblies



Common Fenestration, Door and Skylight Assemblies



Common Below-Grade or In Contact with the Ground Assemblies



The Minimum Effective Thermal **Requirements for Surrey**:

(Values are the same **with or without a HRV** because we are in **Zone 4**)

Above-ground opaque assemblies (Tables 9.36.2.6.A. and B.),

Attic spaces	Min. 6.91 RSI (R-39.2)
Roof spaces	Min. 4.67 RSI (R-26.5)
Walls (framed)	Min. 2.78 RSI (R-15.8)
Floors above unheated space	Min. 4.67 RSI (R-26.5)
Rim Joist spaces	Min. 2.78 RSI (R-15.8)

Fenestration and door assemblies (Tables 9.36.2.7.A. and B.)

Fenestration and Doors	Max. 1.8 U-value
Skylights	Max. 2.9 U-value

Below-grade or in contact with the ground assemblies (Tables 9.36.2.8.A. and B.)

Walls (foundations)	Min. 1.99 RSI (R-11.3)
Unheated floors below frost	Not Regulated
Unheated floors above frost	Min. 1.96 RSI (R-11.1)
Heated floors (anywhere)	Min. 2.32 RSI (R-13.2)
Slabs-on-grade w/integral footing.	Min. 1.96 RSI (R-11.1)

How is Effective Thermal Resistance calculated?

Effective Thermal Resistance of an assembly is calculated based on two features:

Continuous elements such as interior and exterior air films, cladding, air cavities, sheathing, continuous insulation and interior finishes.

Values for these are available in the look-up Table A-9.36.2.4.(1)D provided in Appendix A.

Cavity elements such as spaced framing members and insulation materials within the cavities.

Calculated using a Parallel RSI equation based on percentage of framing member type (steel or wood), depth and spacing of the member and the insulation in the cavity created by the framing. There are look-up tables available for percentages in Table A-9.36.2.4.(1)A. for wood framing and Table A-9.36.2.4.(1)D for steel framing.

Effective Thermal Resistance = Sum of continuous elements + RSI (Parallel)

RSI (Parallel) is a calculation to determine the Parallel RSI for cavity elements;

- For wood framed assemblies using this equation:

$$\frac{100}{\frac{\%\ framing}{RSI\ framing}+\frac{\%\ cavity}{RSI\ cavity}}$$

The values for the % framing and % cavity can be found in:
Table A-9.36.2.4.(1)A for wood-frame assemblies
Table A-9.36.2.4.(1)B and C for steel-frame assemblies

- For steel stud framed assemblies the calculation is much more involved and is not covered here. Example calculations are available in Appendix A of the Code.

In an effort to harmonize the calculations with other jurisdictions, a standardised format was agreed upon.

Assembly Type and the Effective Thermal Resistance Required	
Assembly Description: _____ _____ _____ _____	
Continuous elements list: _____ _____ _____ _____	(RSI value for element ____ ____ ____ ____
Cavity RSI (Parallel) calculation $\frac{100}{\frac{\%\ framing}{RSI\ framing}+\frac{\%\ cavity}{RSI\ cavity}}$	____
Total	_____

See the City of Surrey Bulletin: Part 9 Energy Efficiency
http://www.surrey.ca/city-services/14532.aspx

Following slides work through the building from the ground up.

9.36.2.8. Thermal Characteristics of Building Assemblies Below-ground or in Contact with the Ground.

There are two major ‘below-ground’ or ‘in contact with the ground’ assemblies which are considered for thermal resistance in this Article:

- Heated or unheated floor-on-ground assemblies (concrete or wood) and
- Foundation wall assemblies

Floor-on-ground Assemblies

From Tables 9.36.2.8.A. and B.

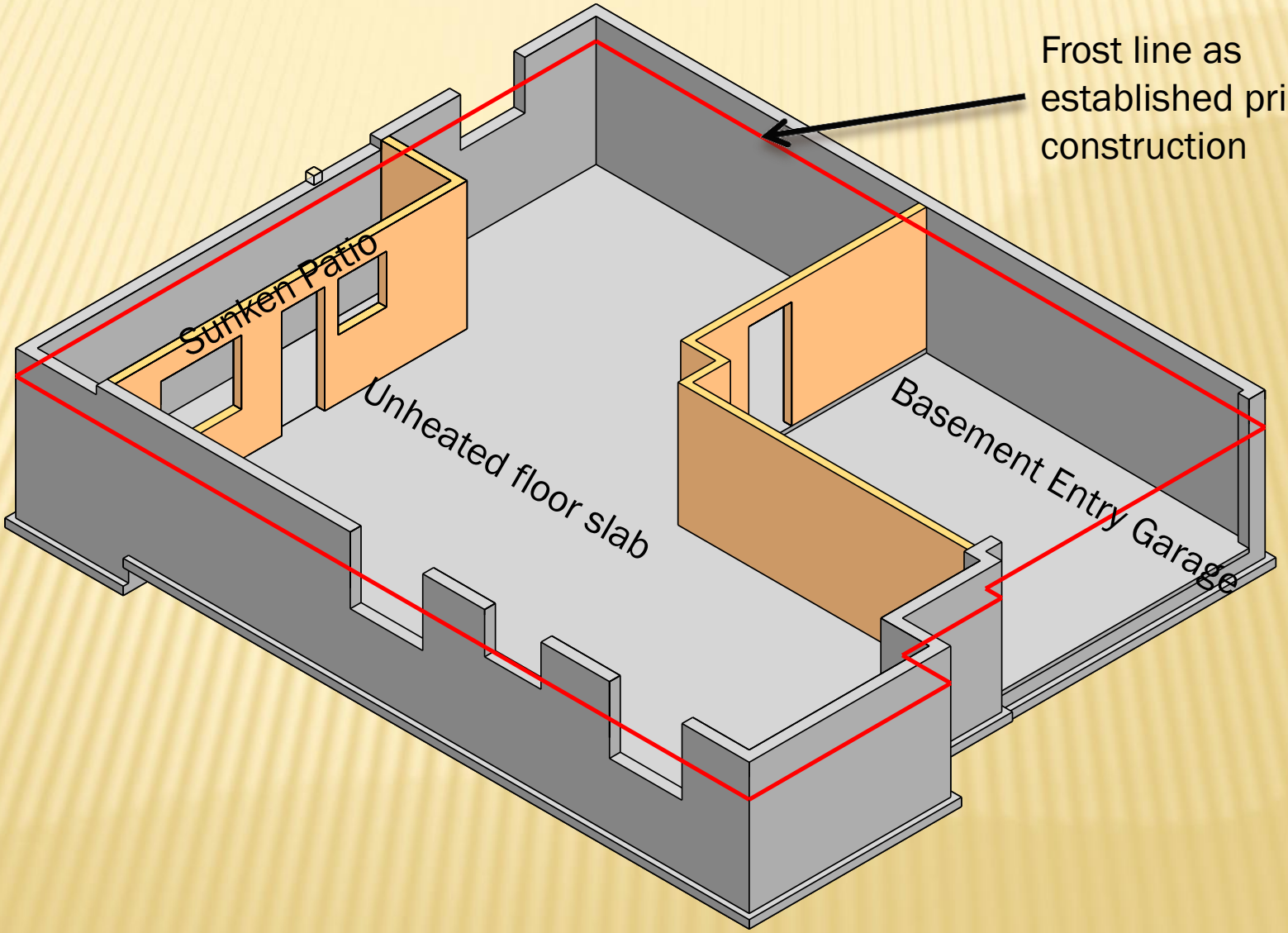
Unheated floors below ***frost**	Not Regulated
Unheated floors above ***frost**	Min. 1.96 RSI (R-11.1)
Heated floors (anywhere)	Min. 2.32 RSI (R-13.2)
Slabs-on-grade w/integral footing.	Min. 1.96 RSI (R-11.1)

*In the Notes to Table (5) there is a statement that the term **frost**;

“Refers to undisturbed frost line before house is constructed.”

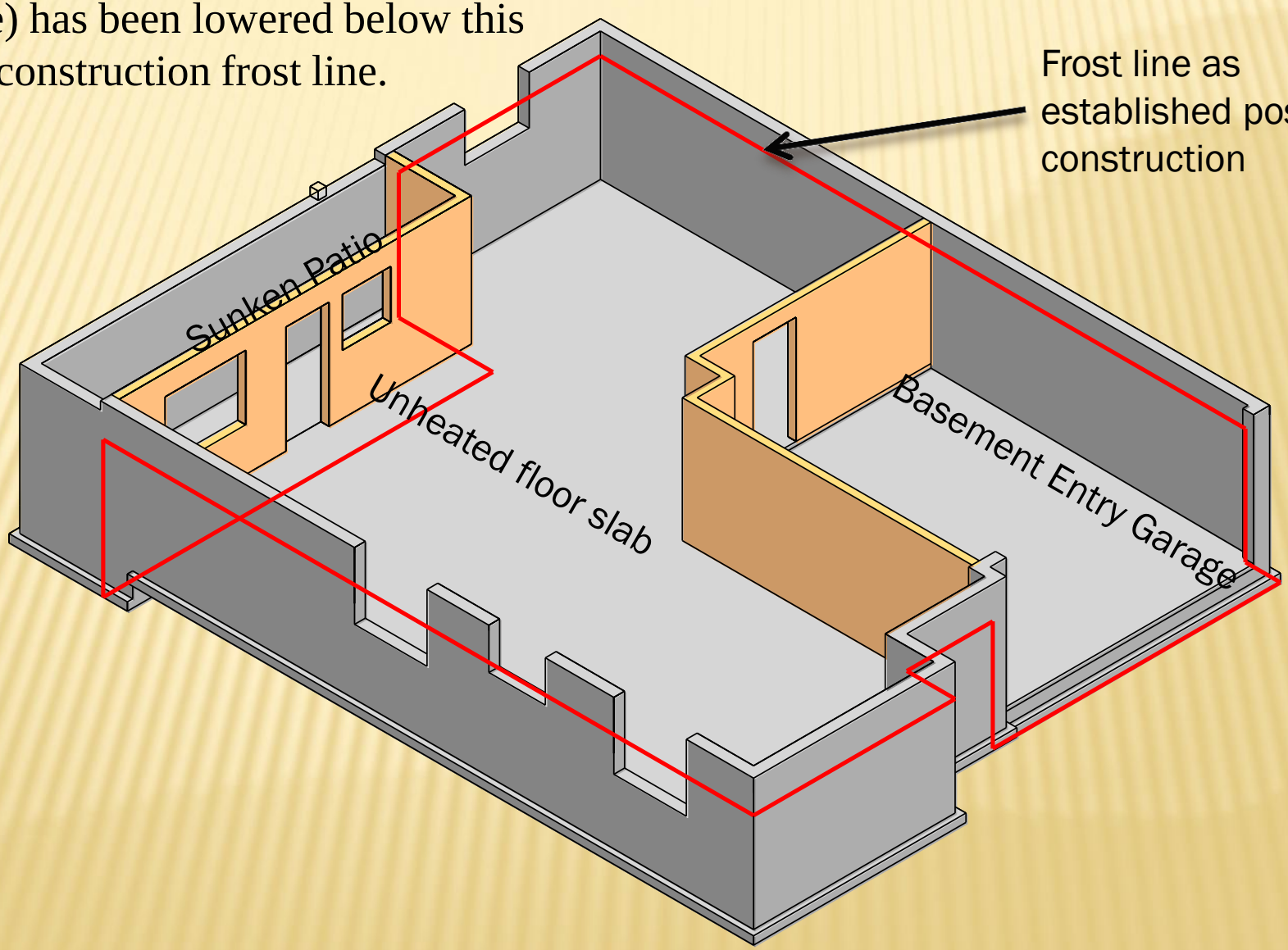
Floor-on-ground Assemblies

Unheated slabs (below frost line)



Floor-on-ground Assemblies

It is likely that the AHJ will insist on providing thermal resistance for a floor-on-ground in those locations where the ground level (and subsequent frost line) has been lowered below this preconstruction frost line.

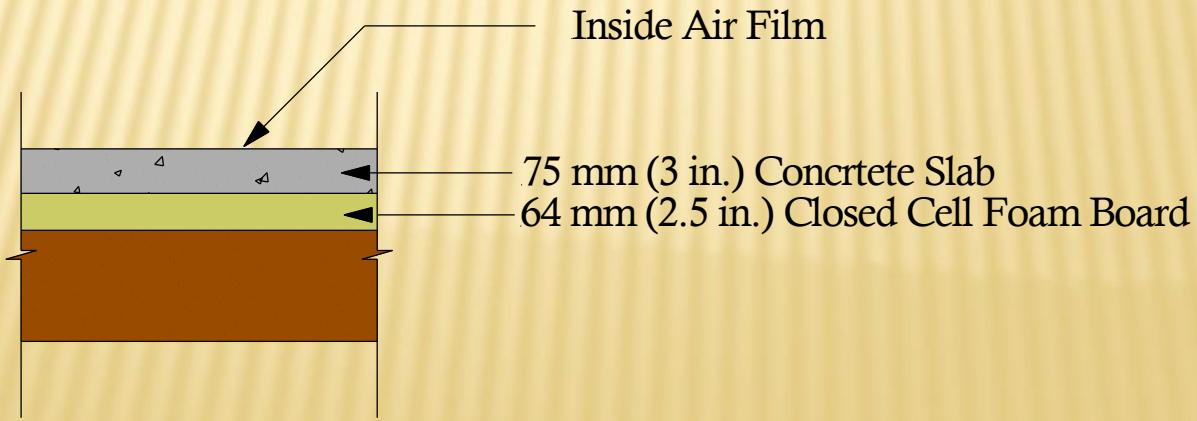


Floor-on-ground Assemblies

Unheated slabs above frost 1.96 RSI or R-11.1 required.

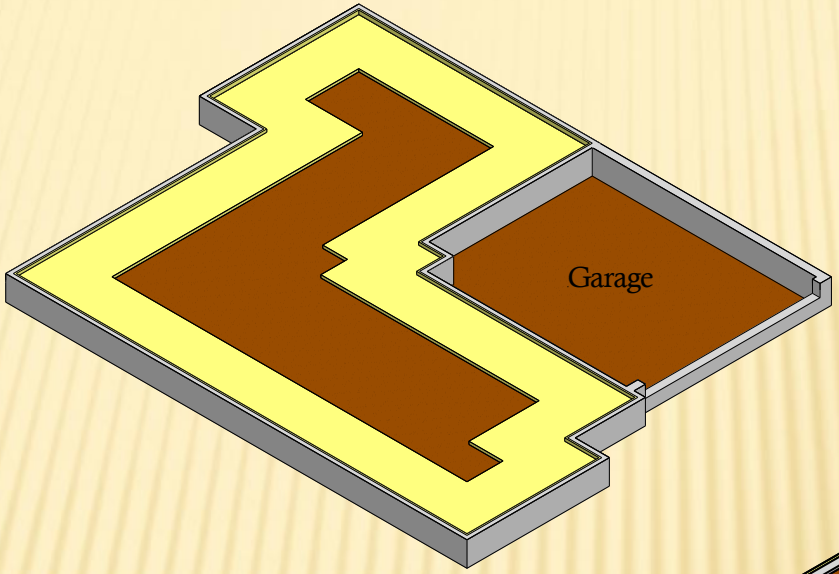
Example calculation:

Heated Slab-on-Ground (regardless of frost) 2.34 RSI or R-13.2	
Assembly Description: 75 mm (3 in.) Concrete Floor Slab 64 mm (2.5 in.) Closed Cell Foam Board	
Continuous elements: Interior air film 75 mm (3 in.) Concrete 70 mm (2,75 in.) Closed Cell Foam Board	 0.16 0.03 1.984
Cavity RSI (Parallel)	N/A
Total	**2.174 RSI OK**

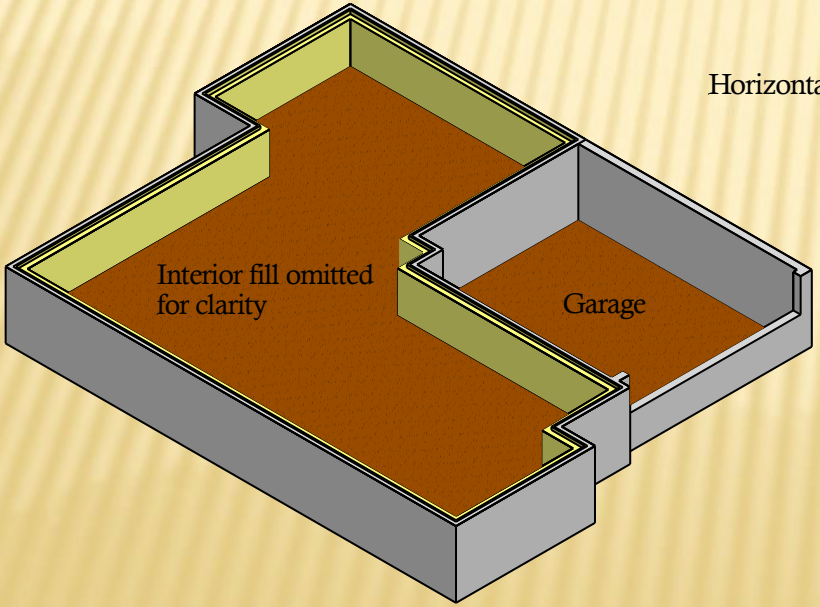


Floor-on-ground Assemblies

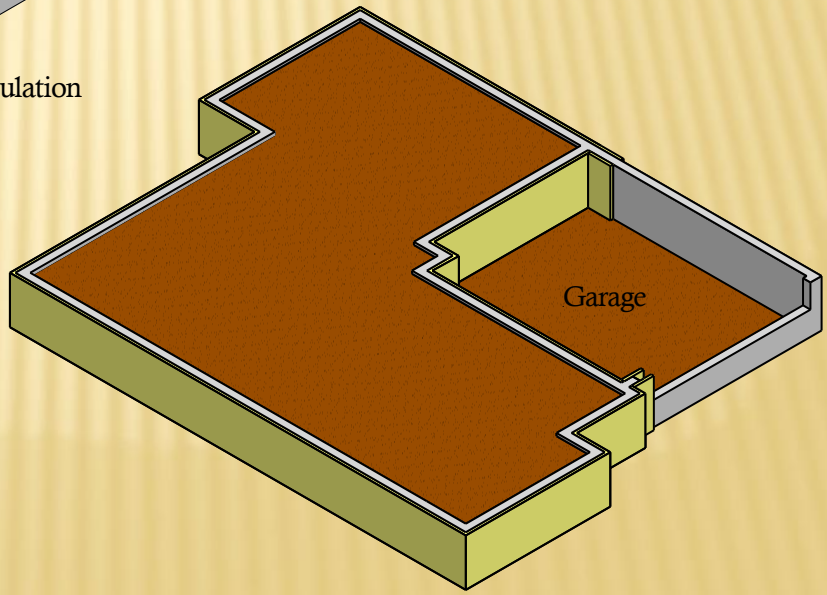
Thermal resistance may be applied to perimeter only and may be installed using three options:



Horizontally Applied Insulation



Vertically Applied Insulation Inside of Foundation

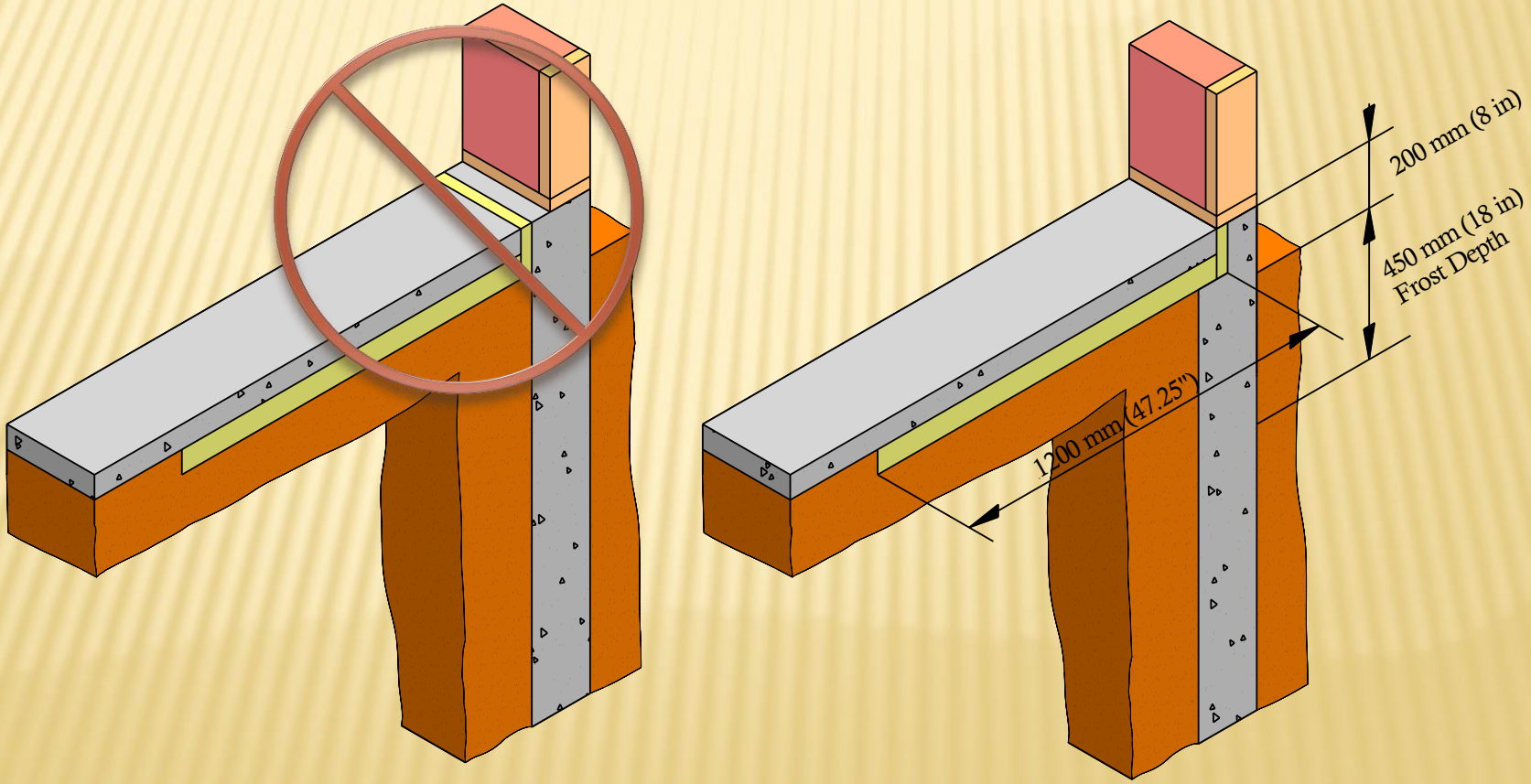


Vertically Applied Insulation Outside of Foundation

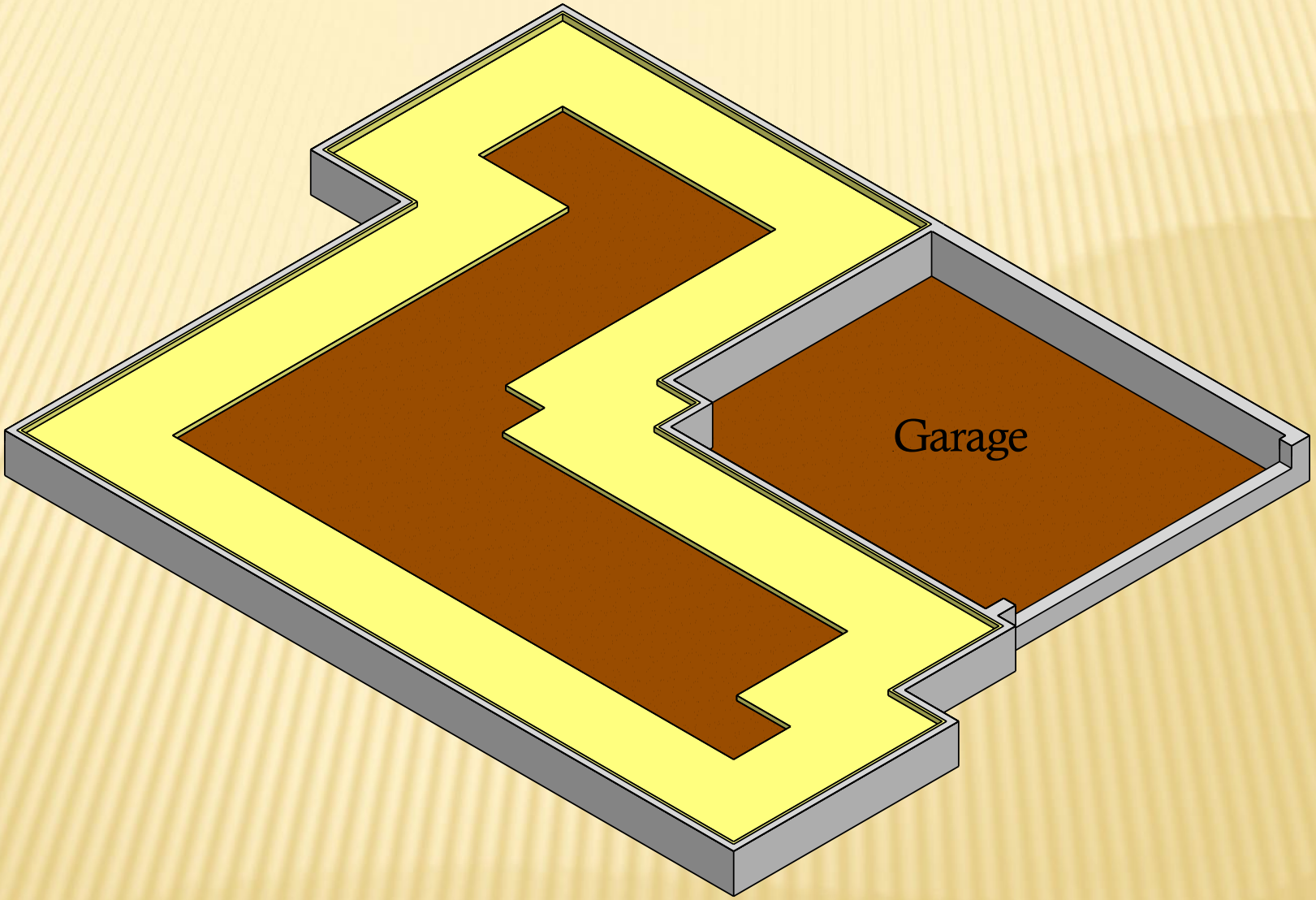
Floor-on-ground Assemblies

Installed horizontally.

- Insulation must run in 1.2 m (48 in) horizontally from slab edge.
- Slab edge permitted to be ½ the required value.
- Slab edge insulation will be roughly 40 mm or 1.5 in thickness and is not permitted to be replaced with a wood strip as previous code allowed. The foundation wall should be reduced in thickness at the top in order to accommodate the insulation.



Floor-on-ground Assemblies



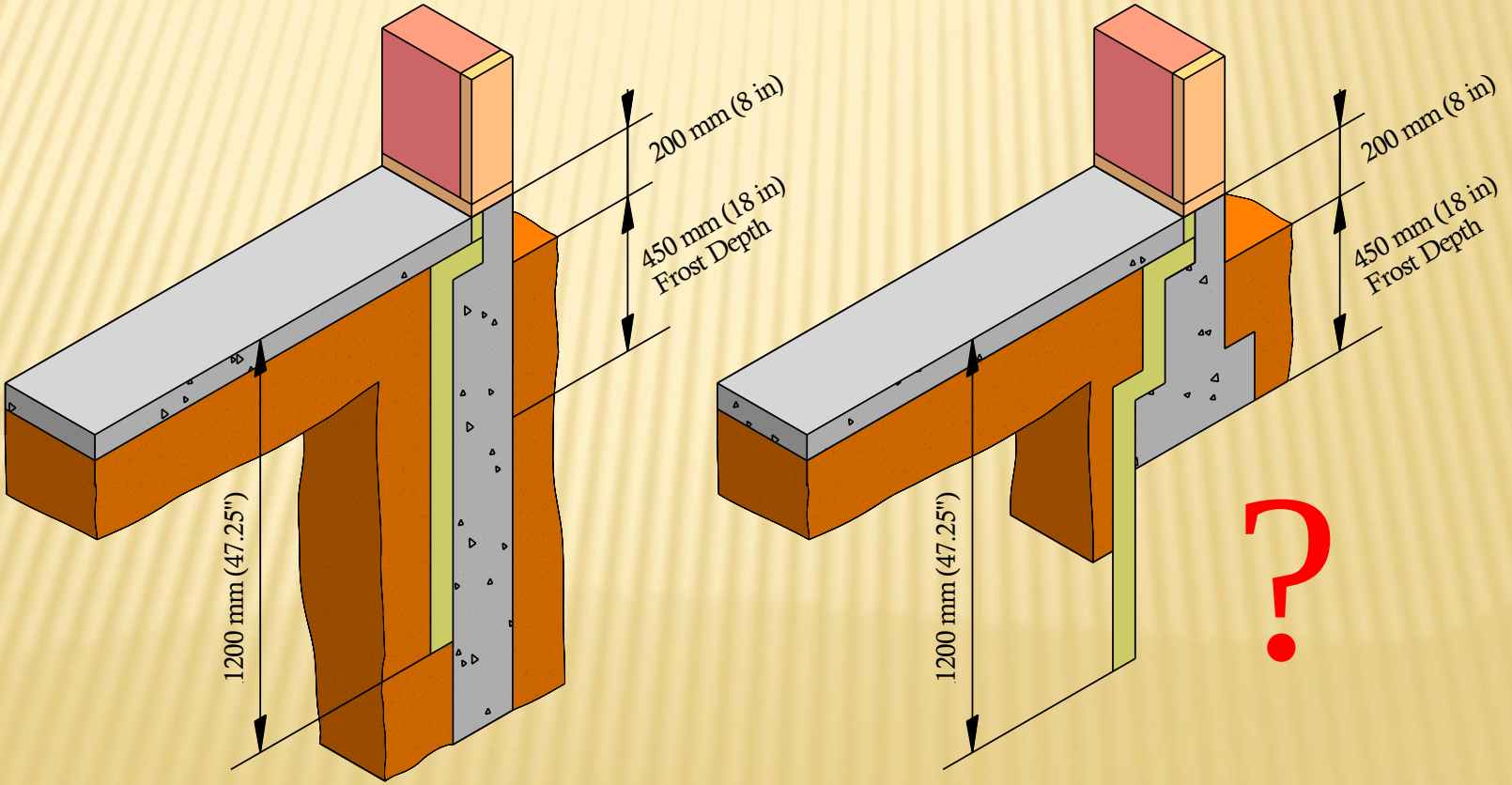
Horizontally Applied Insulation

Slab at ground level showing horizontal thermal insulation. 1.2 m in from edge of slab.

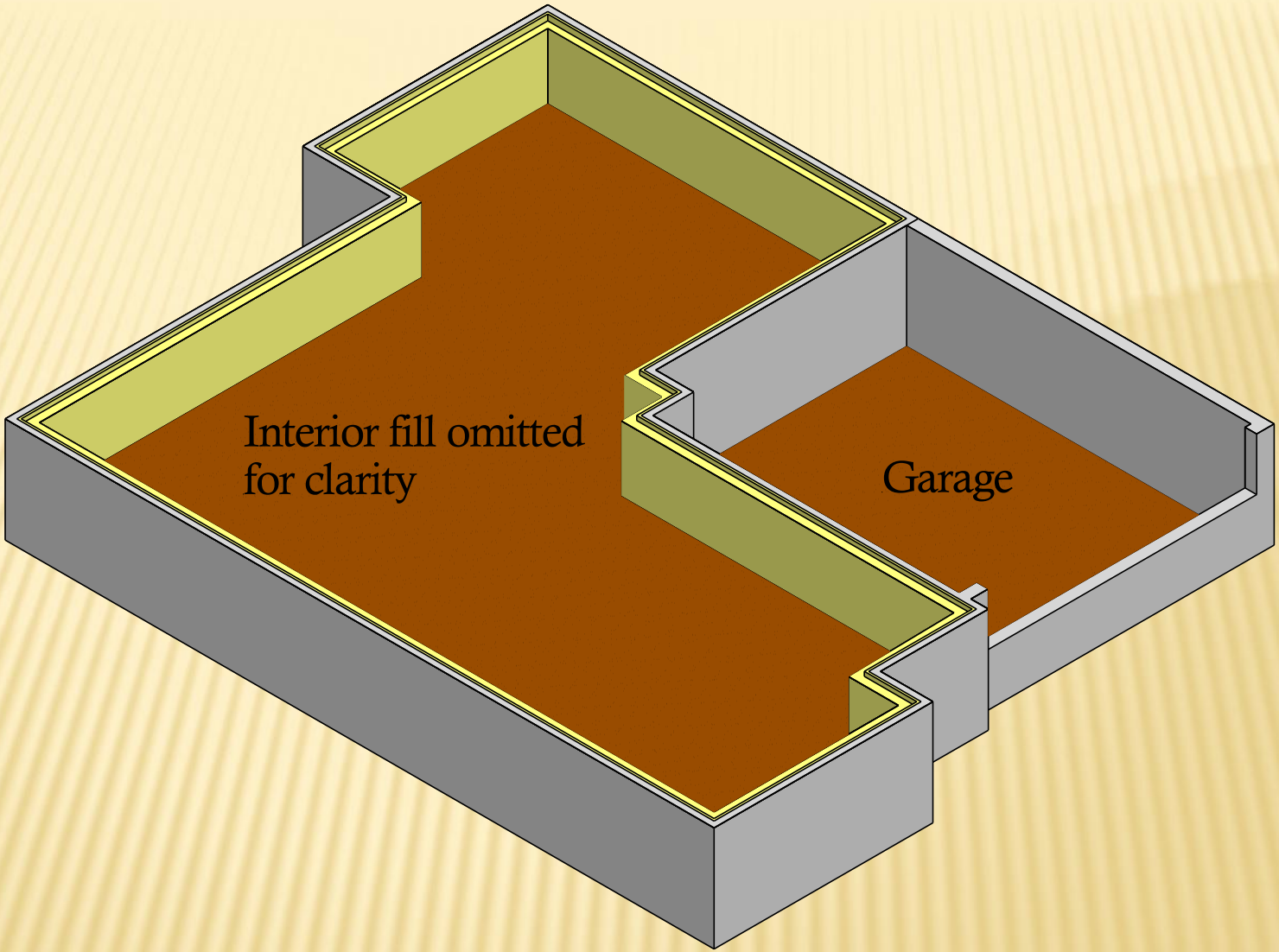
Floor-on-ground Assemblies

Installed vertically inside the foundation.

- Insulation must run 1.2 m (48 in) vertically from top of slab.
- Slab edge permitted to be ½ the required value.
- Slab edge insulation will be roughly 40 mm or 1.5 in thickness and is not permitted to be replaced with a wood strip as previous code allowed.
- The foundation wall should be reduced in thickness at the top in order to accommodate the insulation within the plane of the wall above it..



Floor-on-ground Assemblies



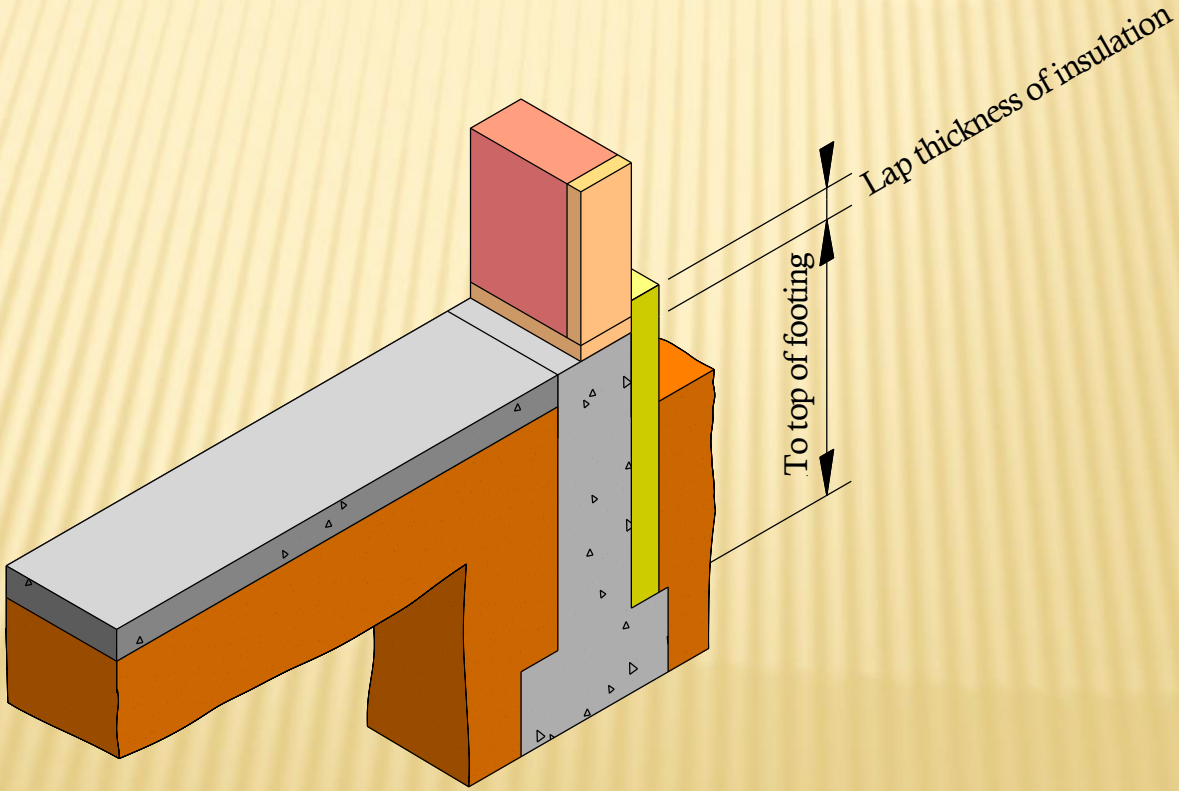
Vertically Applied Insulation Inside of Foundation

Slab at ground level showing vertical thermal insulation on interior (prior to fill). Minimum 1.2 m deep

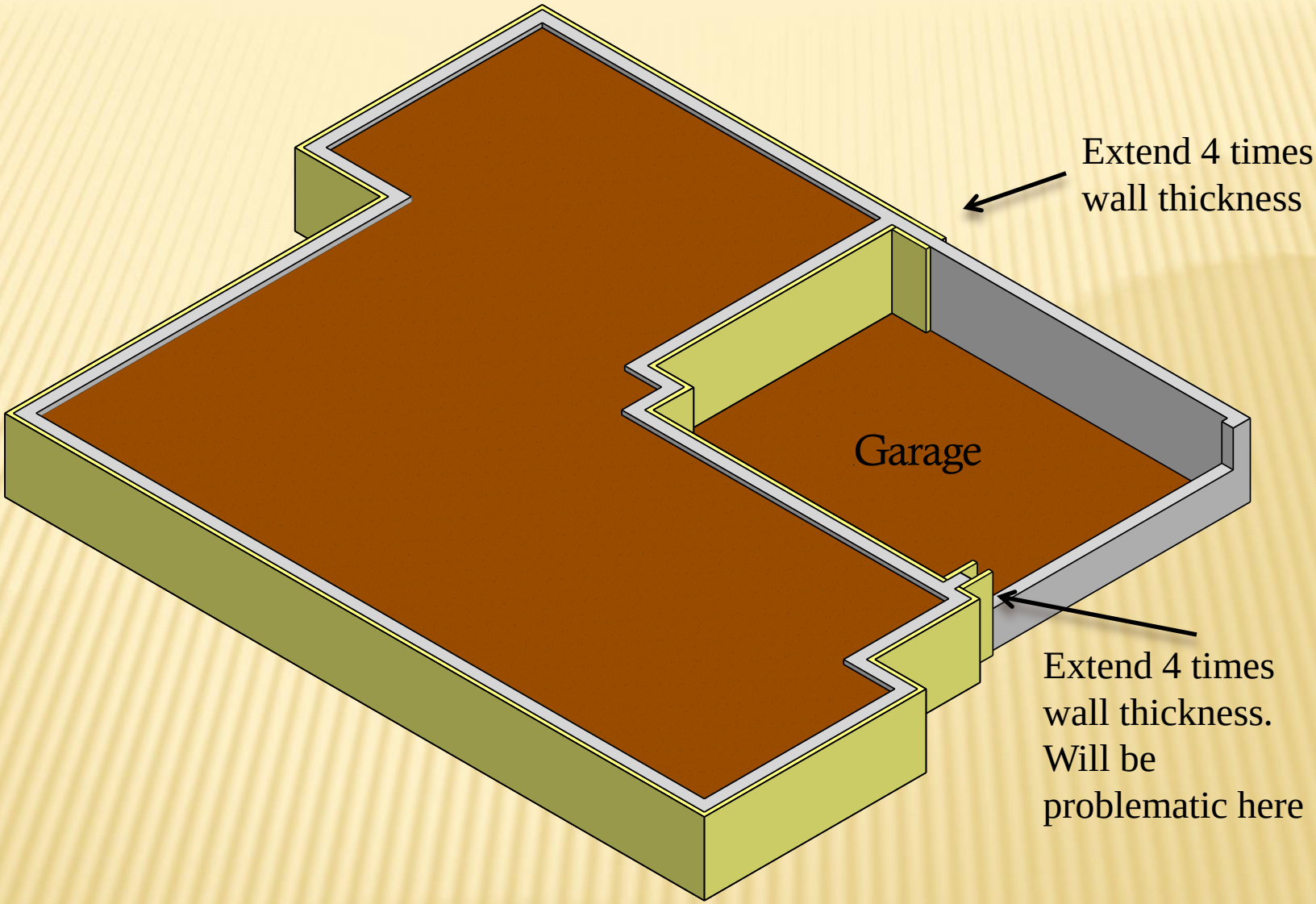
Floor-on-ground Assemblies

Installed vertically outside the foundation.

- Insulation must run vertically from top of slab to top of footing.
- Insulation must lap over wall frame at least the thickness of the insulation.
- The foundation wall need not be reduced in thickness at the top in order to accommodate the insulation.



Floor-on-ground Assemblies



Vertically Applied Insulation Outside of Foundation

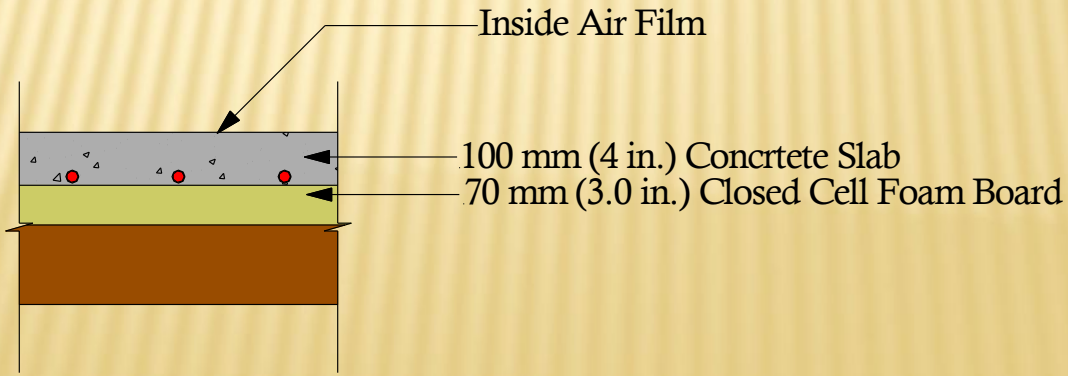
Slab at ground level showing vertical thermal insulation on exterior. Down to top of footing.

Floor-on-ground Assemblies

Heated slabs-on-ground (regardless of frost) 2.32 RSI or R-13.2 required.

Insulation is to be applied under the entire slab area

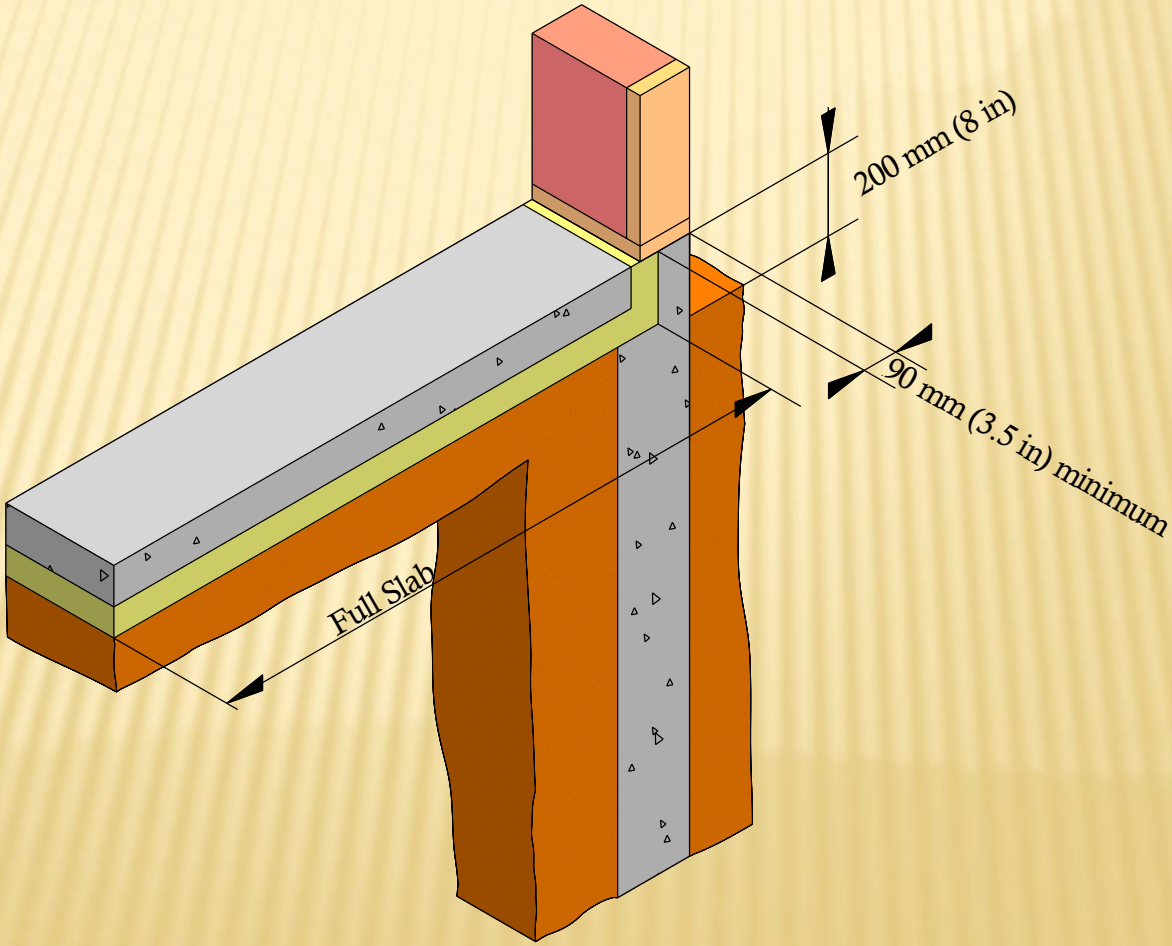
Heated Slab-on-Ground (regardless of frost) 2.34 RSI or R-13.2	
Assembly Description: 100 mm (4 in.) Concrete Floor Slab 70 mm (2.75 in.) Closed Cell Foam Board	
Continuous elements: Interior air film 100 mm Concrete 70 mm (2,75 in.) Closed Cell Foam Board	 0.16 0.04 2.18
Cavity RSI (Parallel)	N/A
Total	**2.38 RSI OK**



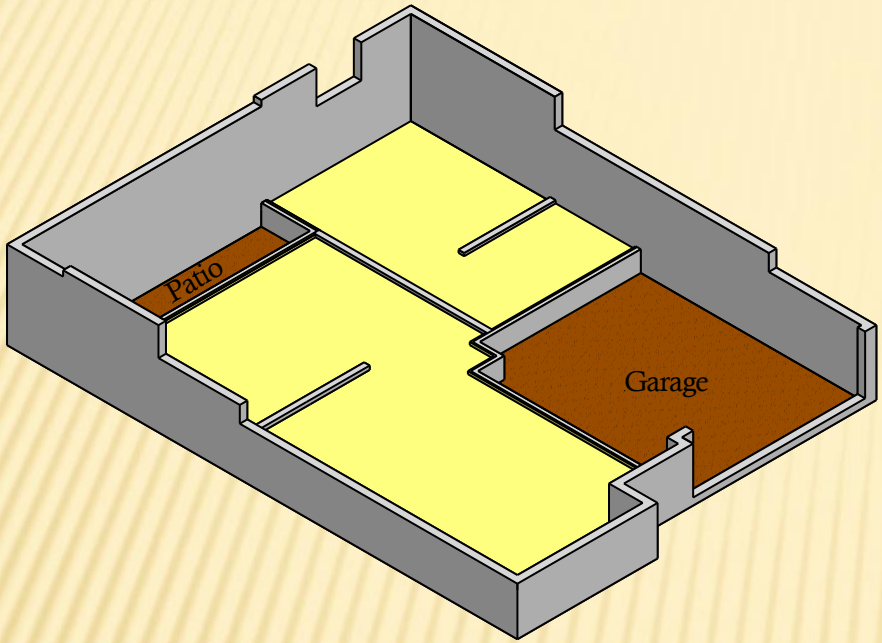
Floor-on-ground Assemblies

Installed horizontally under full slab.

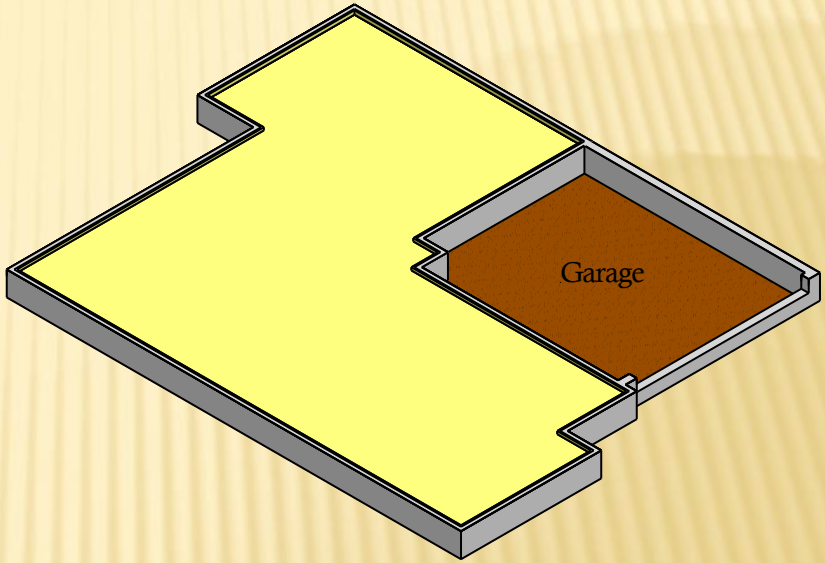
- Insulation must run horizontally under full slab area.
- Slab edge insulation **cannot be reduced** to ½ the required value.
- Slab edge insulation will be roughly 76 mm or 3.0 in thickness and is not permitted to be replaced with a wood strip as previous code allowed. The foundation wall should be reduced in thickness at the top in order to accommodate the insulation.



Floor-on-ground Assemblies



Heated Floors-On-Ground Require Full Insulation



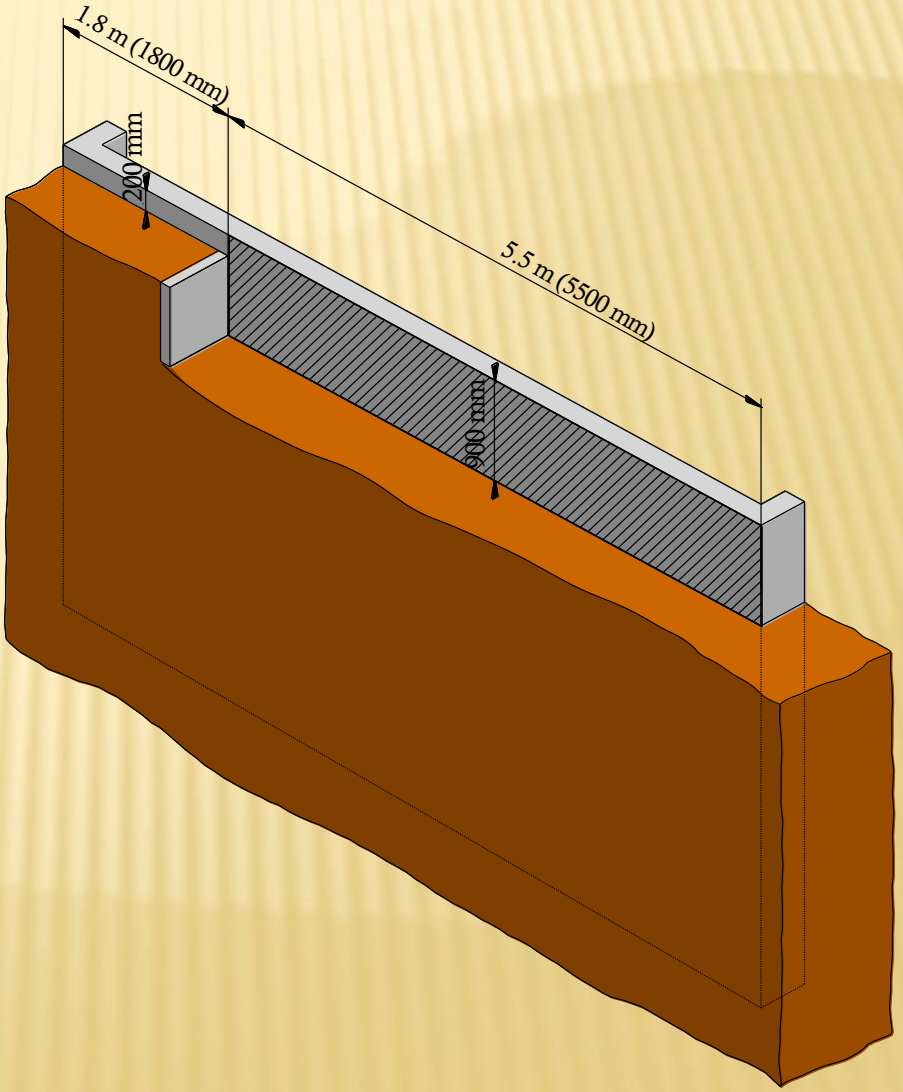
Heated Floors-On-Ground Require Full Insulation

Slab at basement level showing full horizontal thermal insulation for heated portions.

Thermal Characteristics of Building Assemblies Below-ground or in Contact with the Ground, (continued)

The second element for below ground assemblies are **foundation walls.**

New to the Code, the thermal resistance is required for the full height of the wall below ground.



Note:
Where the top of a section of foundation wall is on average less than 600 mm above the adjoining ground level, the above-ground portion of that section of wall shall be insulated to the effective thermal resistance required in Table 9.36.2.8.A. or 9.36.2.8.B.

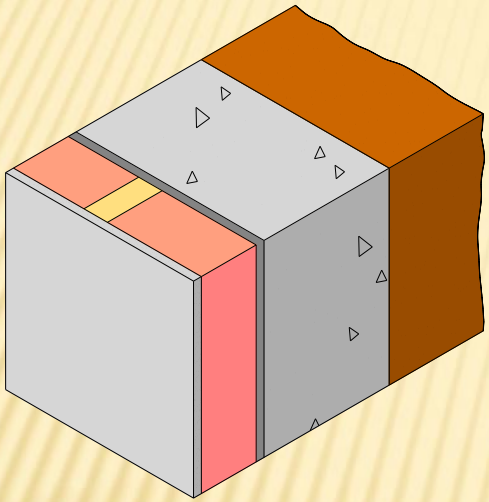
In the example on the right, the average height of foundation above ground is:

$$\frac{1800\ x\ 200 + 5500\ x\ 900}{1800 + 5500} = 683$$

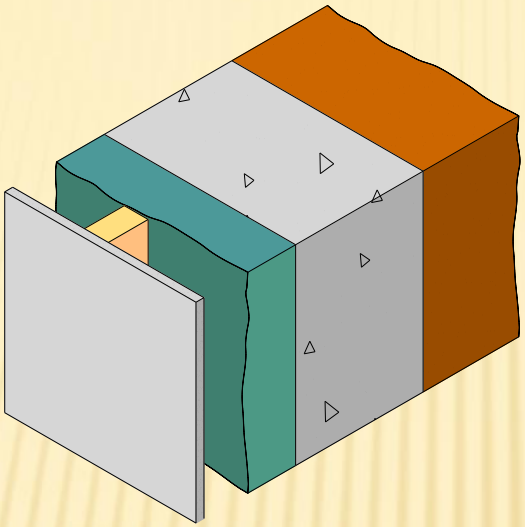
Therefore, the 900 mm high portion of this foundation wall will require Table 9.36.2.6.A or B compliance for the above ground portion of the wall.

Foundation Wall Assemblies

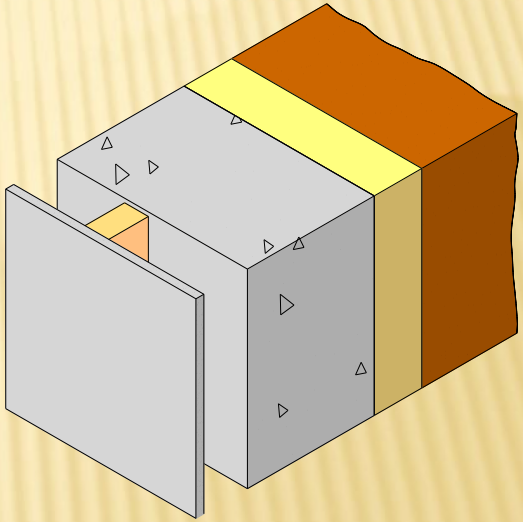
Three example methods that can be used to achieve thermal resistance



200 mm Concrete
Interior Framing for Insulation and Interior Finish.



200 mm Concrete
Spray Foam Insulation
Interior Framing for Interior Finish.

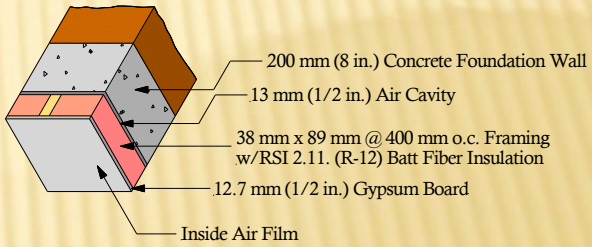


Exterior Foam board
200 mm Concrete
Interior Framing for Interior Finish.

Foundation Wall Assemblies

Walls (Foundations) 1.99 RSI or R-11.3 required

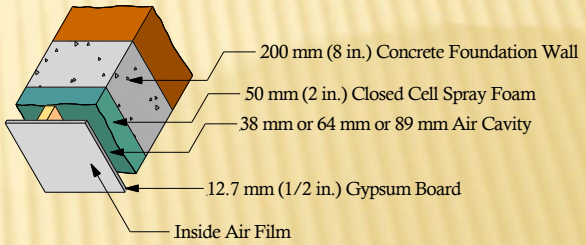
Example:

Walls (Concrete Foundations)	
Assembly Description: 200 mm (8 in.) Concrete Foundation Wall 38 mm x 89 mm @ 400 mm (16 in.) oc. Interior Frame Wall 2.11 RSI (R-12) Batt Fiber Insulation in Cavities 12.7 mm (1/2 in.) Gypsum Board	
Continuous elements: Interior Air Film 12.7 mm (1/2 in.) Gypsum Board 200 mm (8 in.) Concrete	 0.12 0.08 0.08
Cavity RSI (Parallel) $\frac{100}{\frac{16}{.76}+\frac{84}{2.11}}$	1.6430
Total	**2.083 RSI OK**

Foundation Wall Assemblies

Walls (Foundations) 1.99 RSI or R-11.3 required

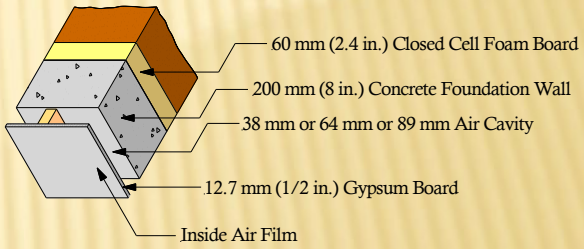
Example:

Walls (Concrete Foundations)	
Assembly Description: 200 mm (8 in.) Concrete Foundation Wall 50 mm (2 in.) Closed Cell Spray Foam Insulation 38 mm x 64 mm @ 400 mm (16 in.) oc. Interior Frame Wall 12.7 mm (1/2 in.) Gypsum Board	
Continuous elements: Interior Air Film 12.7 mm (1/2 in.) Gypsum Board 50 mm (2 in.) Closed cell Spray Foam 200 mm (8 in.) Concrete	 0.12 0.08 1.90 0.08
Cavity RSI (Parallel)	N/A
Total	**2.36 RSI OK**

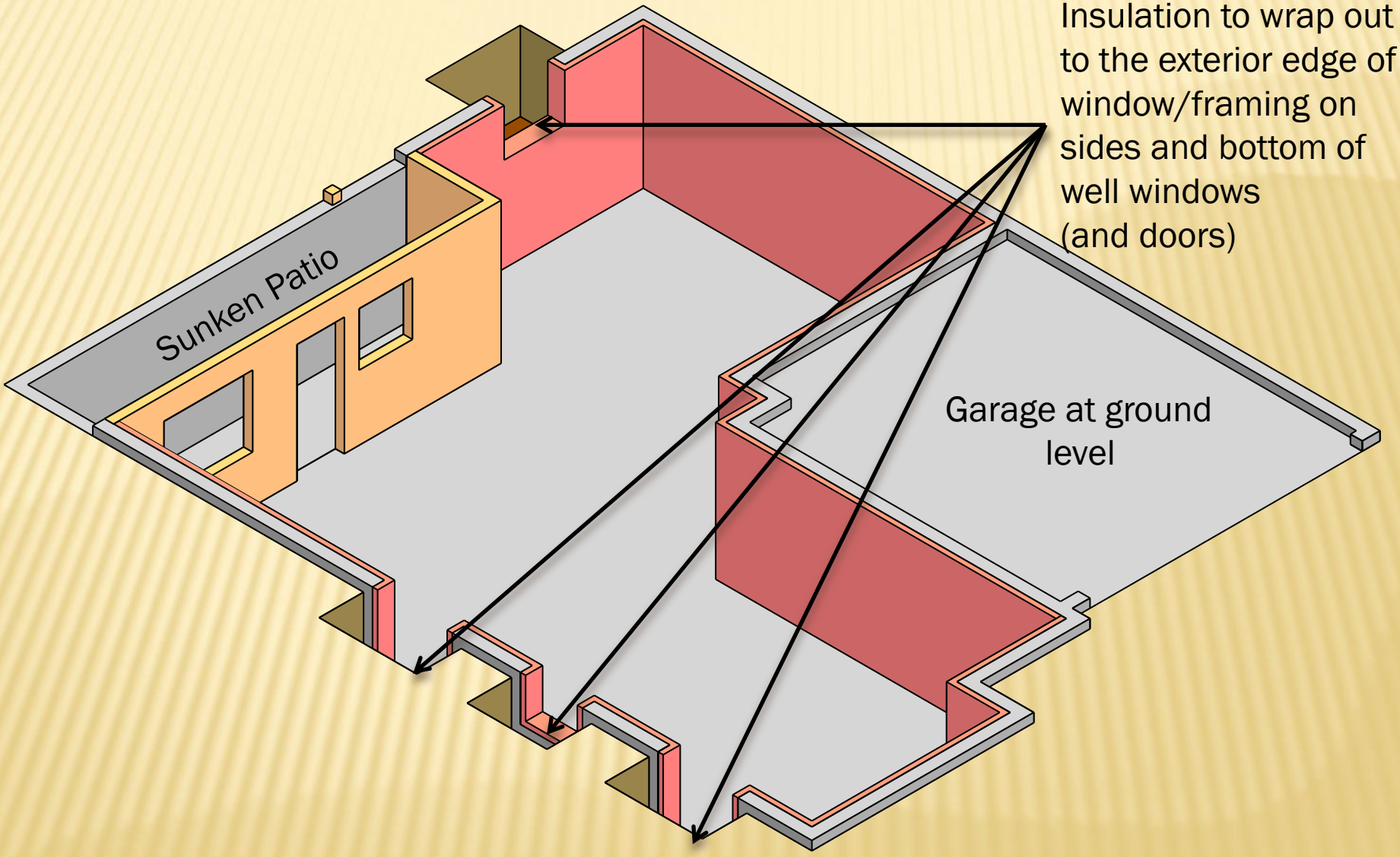
Foundation Wall Assemblies

Walls (Foundations) 1.99 RSI or R-11.3 required

Example:

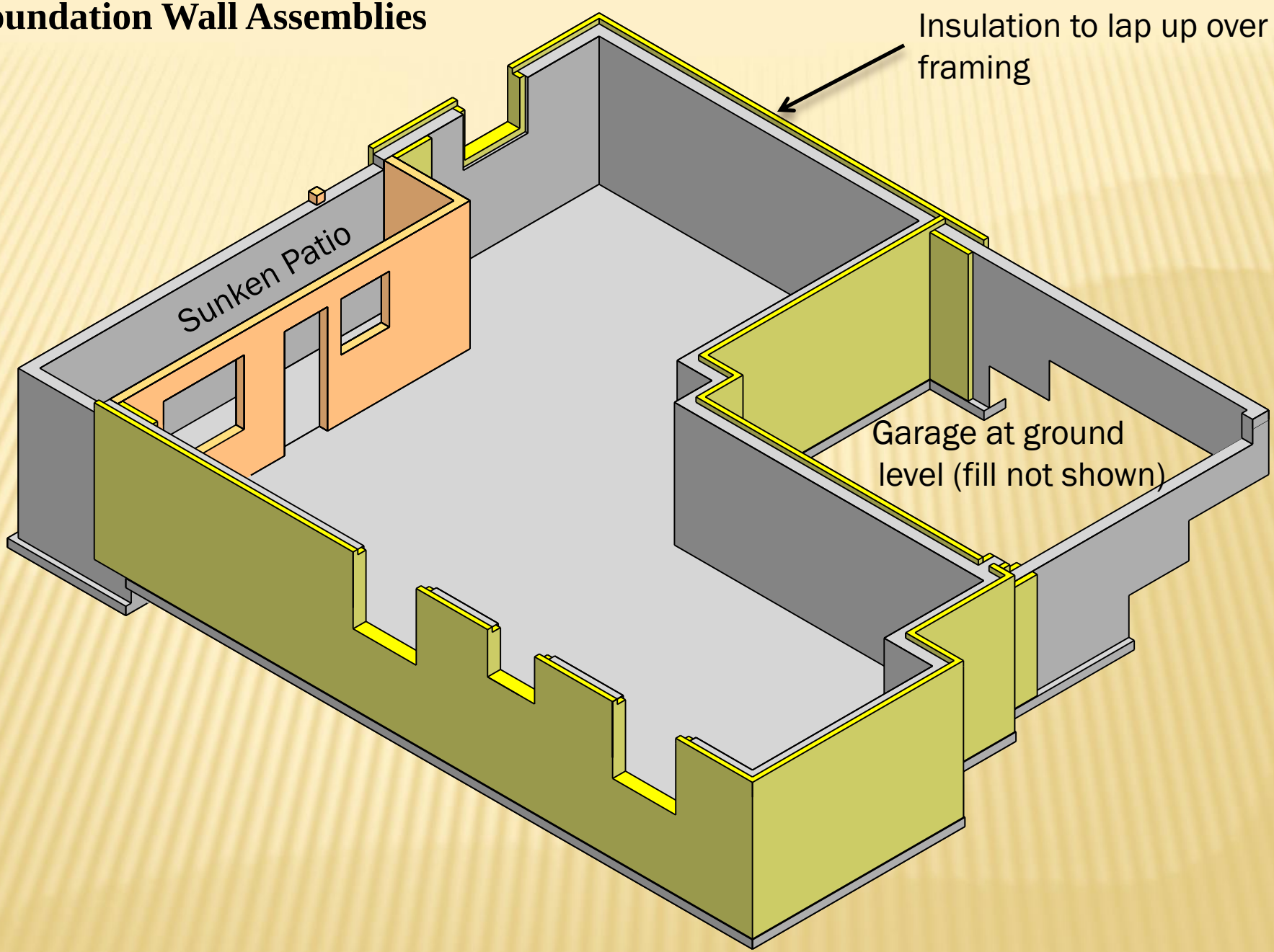
Walls (Concrete Foundations)	
Assembly Description: 60 mm (2.4 in.) Closed Cell Foam Board 200 mm (8 in.) Concrete Foundation Wall 38 mm x 64 mm @ 400 mm (16 in.) oc. Interior Frame Wall 12.7 mm (1/2 in.) Gypsum Board	
Continuous elements: Interior Air Film 12.7 mm (1/2 in.) Gypsum Board 200 mm (8 in.) Concrete 60 mm (2.4 in.) Closed Cell Foam Board	 0.12 0.08 0.08 1.74
Cavity RSI (Parallel)	N/A
Total	**2.20 RSI OK**

Foundation Wall Assemblies



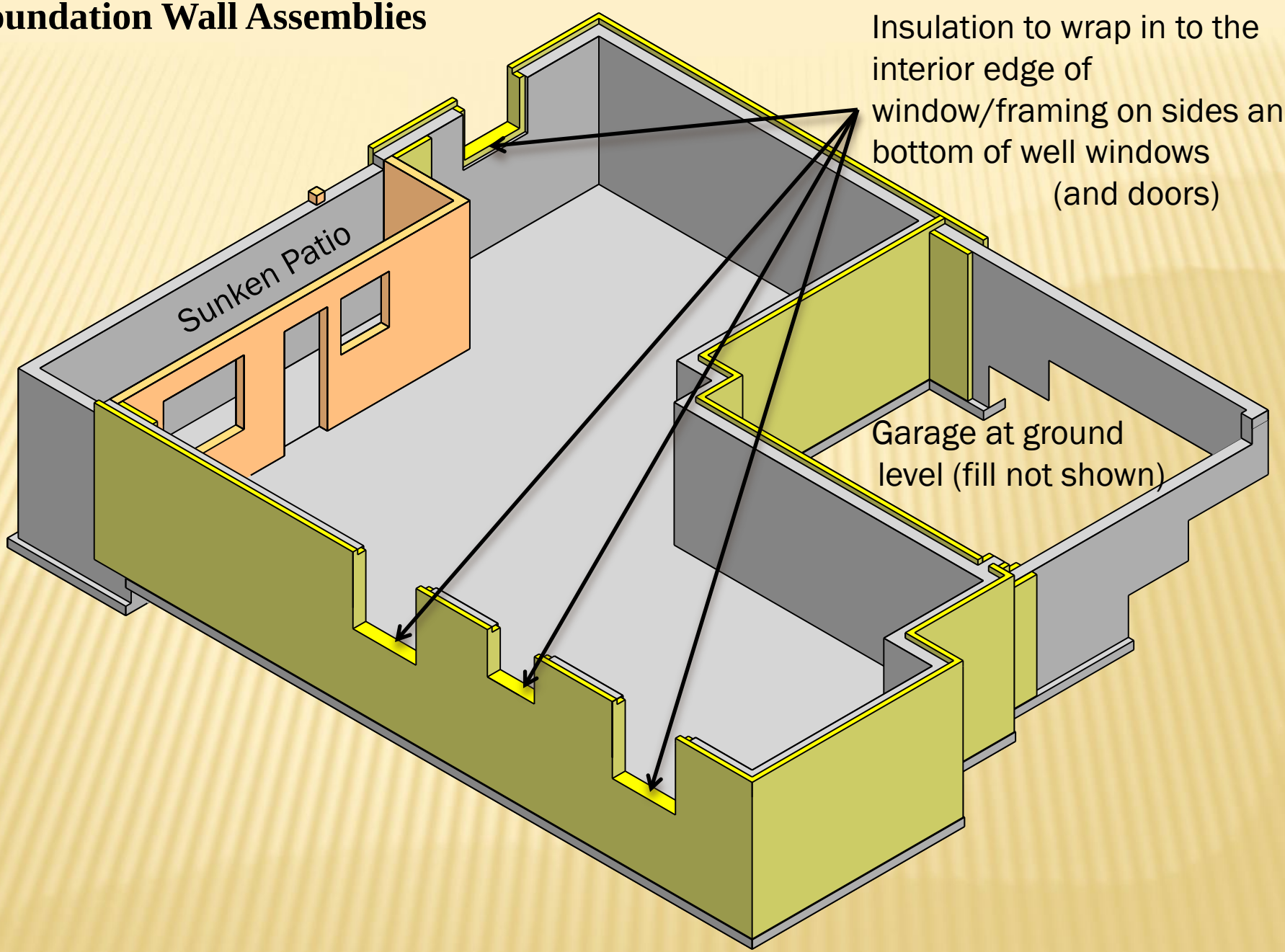
Basement level showing thermal insulation foundation walls on interior side.

Foundation Wall Assemblies



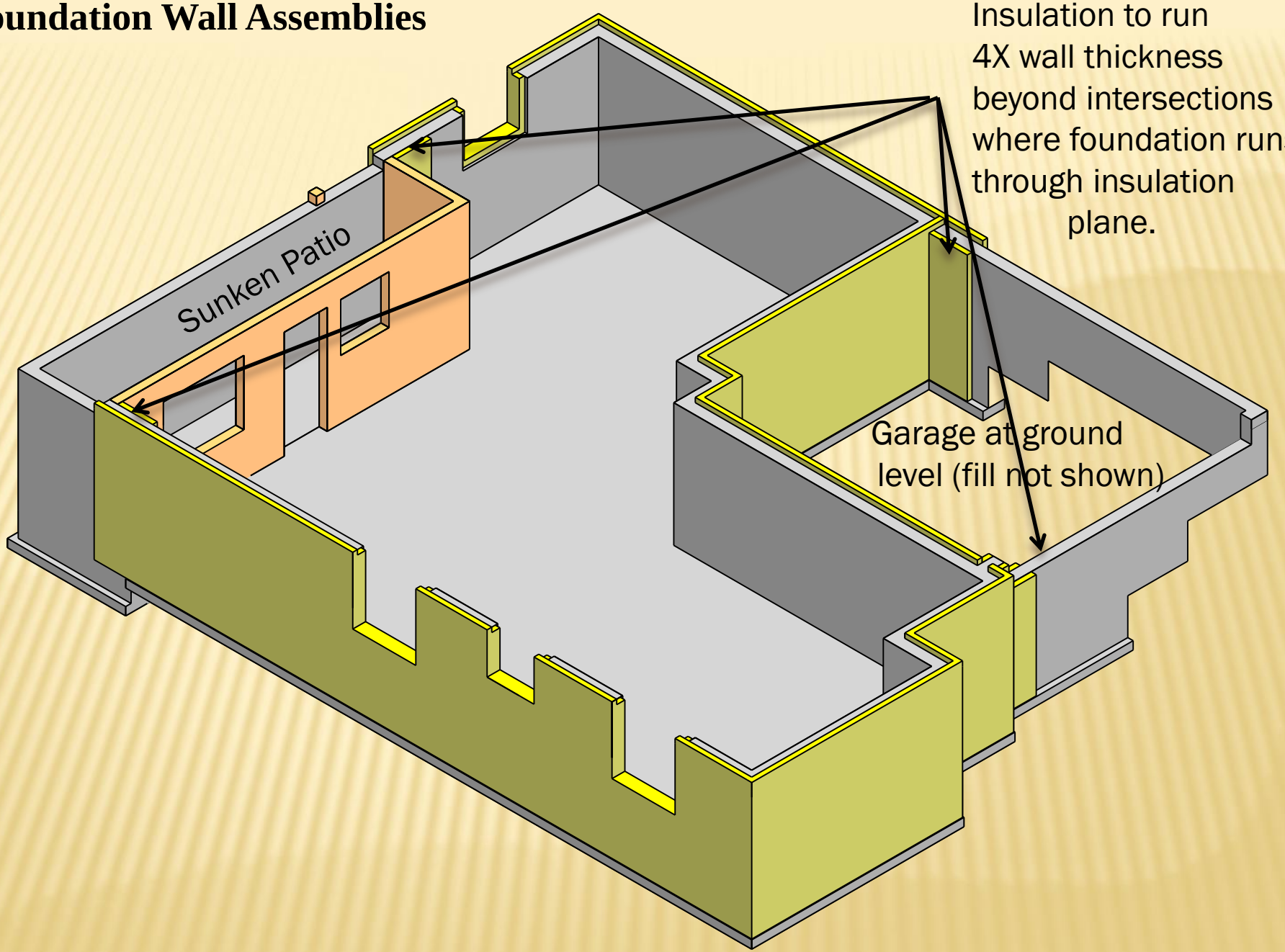
Basement level showing thermal insulation foundation walls on exterior side.

Foundation Wall Assemblies



Basement level showing thermal insulation foundation walls on exterior side.

Foundation Wall Assemblies



Basement level showing thermal insulation foundation walls on exterior side.

9.36.2.6. Thermal Characteristics of Above-ground Opaque Building Assemblies.

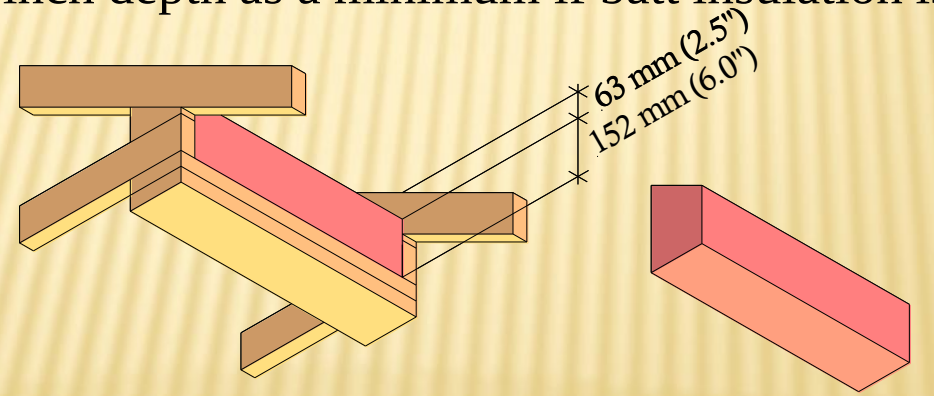
There are 4 assemblies considered in this Article.

1. Ceilings below attics. These are spaces created by conventional truss or rafter/ ceiling joist assemblies
2. Cathedral ceilings and flat roofs. These are roof spaces created by ventilated roof joist assemblies
3. Walls. These are the above ground walls and need not always be considered as vertical only (see skylight chase walls)
4. Floors over unheated space. These are insulated floor assemblies.

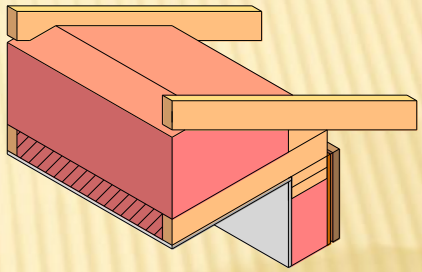
Ceiling below Attics-6.91 RSI required

There is an issue which needs to be addressed before we look at the actual attic space. This is due to 9.36.2.6.(3) which requires a minimum **nominal** RSI 3.52 (R-20) directly over the top of the wall.

Batt fiberglass insulation will need a 152 mm (6 in.) depth to achieve this value.
Polyisocyanurate/polyurethane-faced sheathing board can get this depth down to about 89 mm (3.5 in). The ventilation space of 63 mm (2.5 in) added to this will require:
3.5 + 2.5 = 6 inch depth as a minimum if high end foam board is used
6.0 + 2.5 = 8.5 inch depth as a minimum if batt insulation is used

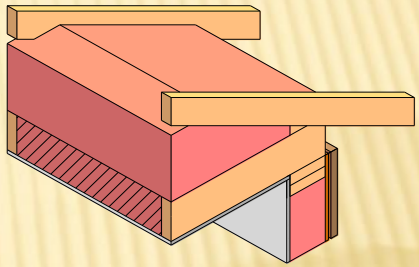


Raised heel truss depths will depend on the insulation type used. ☹

Ceilings Below Attics - 6.91 RSI (R-39.2)	**COMMON TRUSS @ 24” oc.**
Assembly Description: 15.9 mm (5/8 in.) gypsum board ceiling, Raised heel trusses at 600mm oc., w/**89 mm (3.5 in) bottom chord,** Cavity space filled with 89 mm **loose fill glass fiber,** Continuous layer of **loose fill glass fiber over cavities**.	
Continuous elements: *Exterior air film *Roofing (asphalt shingle) *Roof Sheathing 12.5 mm (1/2 in.) (Ply) Exterior air film applied to upper surface of insulation ****280mm** (11 in.) loose fill fiberglass 15.9 mm (5/8 in) Gypsum Board Inside air film	 N/A N/A N/A 0.03 5.25 0.097 0.11
Cavity RSI (Parallel) $\frac{100}{\frac{11}{.757}+\frac{89}{1.669}}$	1.475
Total	**6.962 OK**

*The “materials” outboard of a vented air space cannot be used in this calculation. See Note (5) in Table A-9.36.2.4.(D). The exterior air film is applied to the surface of the insulation within the space.

**Measured from top of the bottom chord of the truss

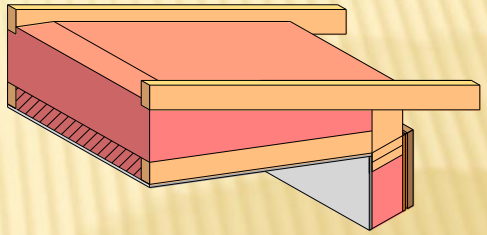
Ceilings Below Attics - 6.91 RSI (R-39.2)	**COMMON TRUSS @ 24” oc.**
Assembly Description: 15.9 mm (5/8 in.) gypsum board ceiling, Raised heel trusses at 600mm oc. w/**140 mm (5.5 in) bottom chord**, Cavity space filled with 140 mm **loose fill glass fiber**, Continuous layer of loose fill glass fiber over cavities,	
Continuous elements: *Exterior air film *Roofing (asphalt shingle) *Roof Sheathing 12.5 mm (1/2 in.) (Ply) Exterior air film applied to upper surface of insulation ****233mm** (9.17 in.) loose fill fiberglass 15.9 mm (5/8 in) Gypsum Board Inside air film	 N/A N/A N/A 0.03 4.37 0.097 0.11
Cavity RSI (Parallel) $\frac{100}{\frac{11}{1.19}+\frac{89}{2.625}}$	2.317
Total	**6.925 OK**

*The “materials” outboard of a vented air space cannot be used in this calculation. See Note (5) in Table A-9.36.2.4.(D). The exterior air film is applied to the surface of the insulation within the space.

**Measured from top of the bottom chord of the truss

Ceilings Below Attics – which are vaulted and exceed slope permitted in Sentence 9.25.2.4.(2) (for loose fill on sloped ceilings) but are considered unconfined sloped space.

6.91 RSI (R-39.2) **VAULTED TRUSS @ 24" oc.**

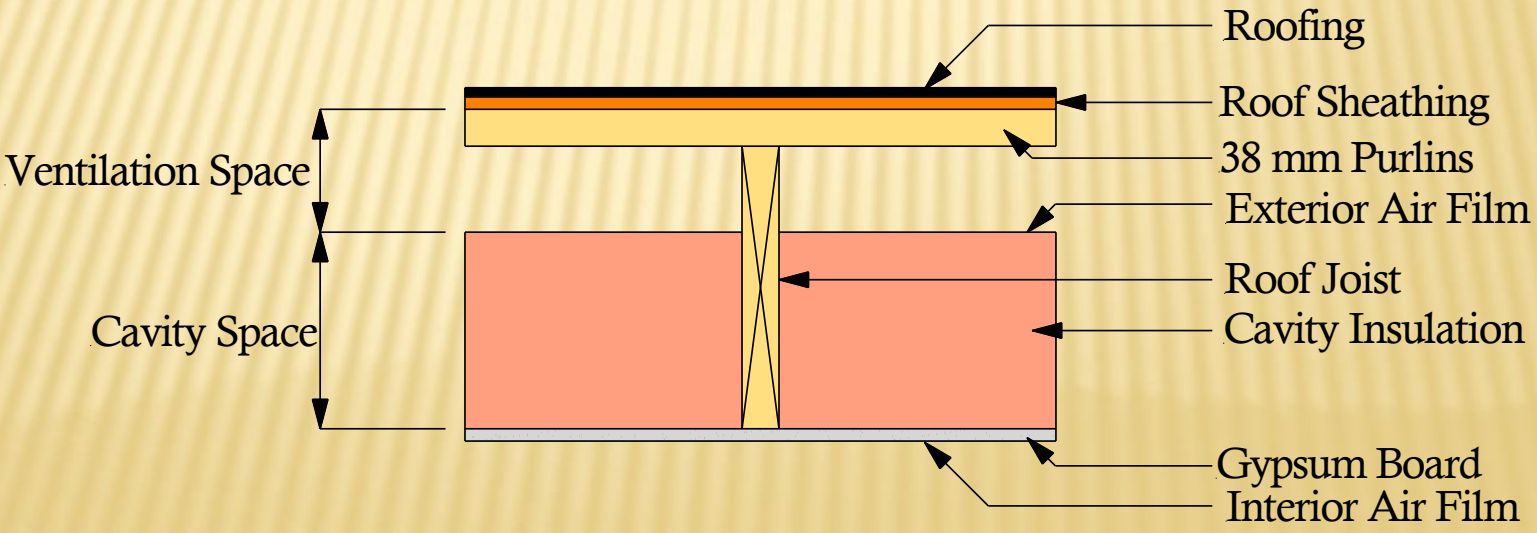
Assembly Description: Trusses at 600mm oc. w/**89 mm (3.5 in) bottom chord**, Cavity space filled with 89 mm RSI 2.46 (R-14) **batt glass fiber**, Continuous cross layer of batt glass fiber over cavities, 15.9 mm (5/8 in.) gypsum board ceiling.	
Continuous elements:	
*Exterior air film	N/A
*Roofing (asphalt shingle)	N/A
*Roof Sheathing 12.5 mm (1/2 in.) (Ply)	N/A
Exterior air film applied to upper surface of insulation	0.03
4.93 RSI (R-28) 178 mm (7.0 in.) **Batt glass fiber laid perpendicular to truss chords**	4.930
15.9 mm (5/8 in) Gypsum Board	0.097
Inside air film	0.11
Cavity RSI (Parallel) $\frac{100}{\frac{11}{0.757}+\frac{89}{2.46}}$	1.9720
Total	**7.139 OK**

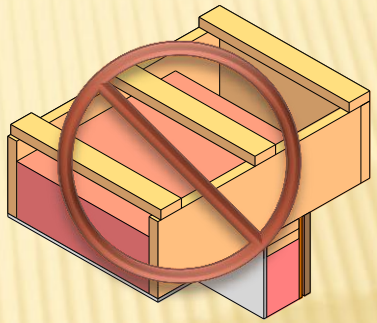
*The "materials" outboard of a vented air space cannot be used in this calculation. See Note (5) in Table A-9.36.2.4.(D). The exterior air film is applied to the surface of the insulation within the space.

Cathedral Ceilings and Flat Roofs. (roof joists)

Surrey requires ventilation space be provided in compliance with Section 9.19., that is, a 63 mm (2.5”) air space is required between the top of thermal insulation and the underside of roof sheathing.

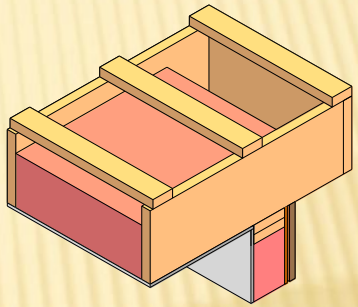
The calculation for roof joist assemblies is similar to common wall assemblies in that there are no continuous insulation elements. The insulation is fit into cavities and needs to be calculated using the parallel method. The air space and continuous elements outboard of the vented roof joist space is not permitted to be used in the calculation. See Note (5) in Table A-9.36.2.4.(D).



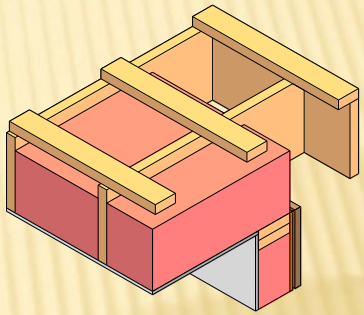
Roof Joist Spaces - 4.67 RSI (R-26.5)	**2 x 12 @ 24” o.c.**
Assembly Description: 63 mm vented air space, 38 mm x 286 mm lumber joists at 600 mm oc. **4.93 RSI (R-28)** batt glass fiber insulation in cavities. 15.9 mm (5/8 in.) gypsum board ceiling	
Continuous elements: *Exterior air film *Roofing (asphalt shingle) *Roof Sheathing 12.5 mm (1/2 in.) (Ply) *Exterior air film 15.9 mm (5/8 in) Gypsum Board Inside air film	 N/A N/A N/A 0.03 0.097 0.11
Cavity RSI (Parallel) $\frac{100}{\frac{10}{1.6745}+\frac{90}{4.93}}$	4.12748
Total	**4.36 RSI Not OK**

*The “materials” outboard of a vented air space cannot be used in this calculation. See Note (5) in Table A-9.36.2.4.(D). The exterior air film is applied to the surface of the insulation within the space.

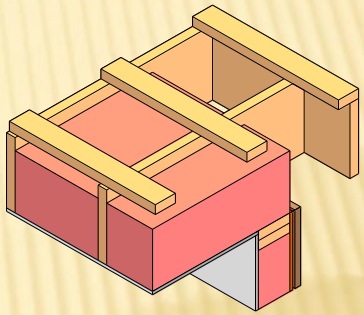
Lesser spacing's with same materials will also not work

Roof Joist Spaces - 4.67 RSI (R-26.5)	**2 x 12 @ 24” o.c.**
Assembly Description: 63 mm vented air space, 38 mm x 286 mm lumber joists at 600 mm oc. **5.46 RSI (R-31)** batt glass fiber insulation in cavities. 15.9 mm (5/8 in.) gypsum board ceiling	
Continuous elements: *Exterior air film *Roofing (asphalt shingle) *Roof Sheathing 12.5 mm (1/2 in.) (Ply) *Exterior air film 15.9 mm (5/8 in) Gypsum Board Inside air film	 N/A N/A N/A 0.03 0.097 0.11
Cavity RSI (Parallel) $\frac{100}{\frac{10}{2.0485}+\frac{90}{5.46}}$	4.68052
Total	**4.92 RSI OK**

*The “materials” outboard of a vented air space cannot be used in this calculation. See Note (5) in Table A-9.36.2.4.(D). The exterior air film is applied to the surface of the insulation within the space.

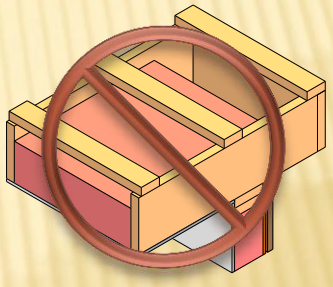
Roof Joist Spaces - 4.67 RSI (R-26.5)	**2 x 12 @ 16” o.c.**
Assembly Description: 63 mm vented air space, **38 mm x 286 mm lumber joists at 400 mm oc.** **5.46 RSI (R-31)** batt glass fiber insulation in cavities. 15.9 mm (5/8 in.) gypsum board ceiling	
Continuous elements:	
*Exterior air film	N/A
*Roofing (asphalt shingle)	N/A
*Roof Sheathing 12.5 mm (1/2 in.) (Plywood)	N/A
Exterior air film applied to upper surface of insulation	0.03
15.9 mm (5/8 in) Gypsum Board	0.097
Inside air film	0.11
Cavity RSI (Parallel) $\frac{100}{\frac{13}{2.0485}+\frac{87}{5.46}}$	4.48829
Total	**4.73 RSI OK**

*The “materials” outboard of a vented air space cannot be used in this calculation. See Note (5) in Table A-9.36.2.4.(D). The exterior air film is applied to the surface of the insulation within the space.

Roof Joist Spaces - 4.67 RSI (R-26.5)	**2 x 12 @ 12” oc.**
Assembly Description: 63 mm vented air space, **38 mm x 286 mm lumber joists at 400 mm oc.** **5.46 RSI (R-31)** batt glass fiber insulation in cavities. 15.9 mm (5/8 in.) gypsum board ceiling	
Continuous elements: *Exterior air film *Roofing (asphalt shingle) *Roof Sheathing 12.5 mm (1/2 in.) (Plywood) Exterior air film applied to upper surface of insulation 15.9 mm (5/8 in) Gypsum Board Inside air film	 N/A N/A N/A 0.03 0.097 0.11
Cavity RSI (Parallel) $\frac{100}{\frac{14.5}{2.0485}+\frac{85.5}{5.46}}$	4.39798
Total	**4.63 Not OK ?**

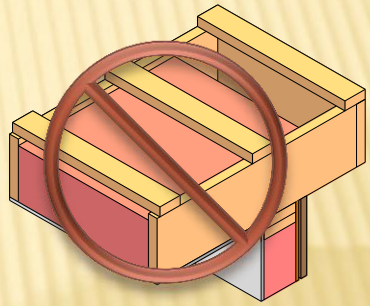
*The “materials” outboard of a vented air space cannot be used in this calculation. See Note (5) in Table A-9.36.2.4.(D). The exterior air film is applied to the surface of the insulation within the space.

Common 2 x 10 Roof Joist Framing has limitations

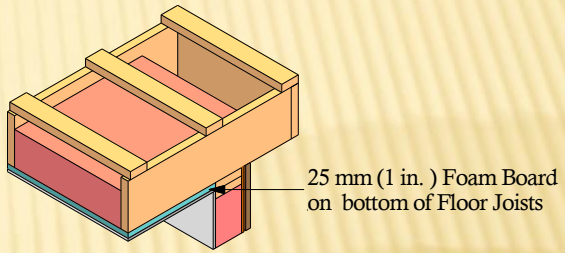
Roof Joist Spaces - 4.67 RSI (R-26.5)	**2 x 10 @ 24” oc.**
Assembly Description: 63 mm vented air space, **38 mm x 235 mm lumber joists at 600 mm oc.** **4.93RSI (R-28)** batt glass fiber insulation in cavities. 15.9 mm (5/8 in.) gypsum board ceiling	
Continuous elements: *Exterior air film *Roofing (asphalt shingle) *Roof Sheathing 12.5 mm (1/2 in.) (Ply) Exterior air film applied to upper surface of insulation 15.9 mm (5/8 in) Gypsum Board Inside air film	 N/A N/A N/A 0.03 0.097 0.11
Cavity RSI (Parallel) $\frac{100}{\frac{10}{1.6745}+\frac{90}{4.93}}$	4.12748
Total	**4.36448 Not OK**

*The “materials” outboard of a vented air space cannot be used in this calculation. See Note (5) in Table A-9.36.2.4.(D). The exterior air film is applied to the surface of the insulation within the space.

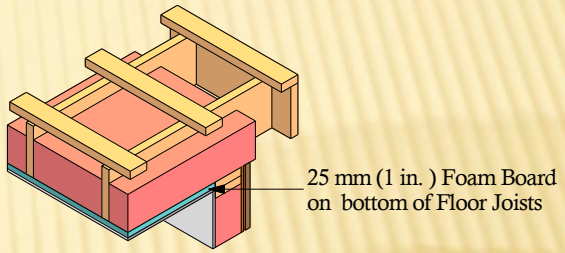
Lesser spacing's with same materials will also not work

Roof Joist Spaces - 4.67 RSI (R-26.5)	**2 x 10 @ 24” oc.**
Assembly Description: 63 mm vented air space, **38 mm x 235 mm lumber joists at 600 mm oc.** ****5.46 RSI (R-31)** batt glass fiber insulation in cavities. 15.9 mm (5/8 in.) gypsum board ceiling **** will not provide 63 mm (2.5 in) air space for ventilation**	
Continuous elements: *Exterior air film *Roofing (asphalt shingle) *Roof Sheathing 12.5 mm (1/2 in.) (Ply) *Exterior air film applied to upper surface of insulation 15.9 mm (5/8 in) Gypsum Board Inside air film	 N/A N/A N/A 0.03 0.097 0.11
Cavity RSI (Parallel) $\frac{100}{\frac{10}{2.0485}+\frac{90}{5.46}}$	4.6534
Total	**4.89 RSI OK (Thermal only)**
*The “materials” outboard of a vented air space cannot be used in this calculation. See Note (5) in Table A-9.36.2.4.(D). The exterior air film is applied to the surface of the insulation within the space.	

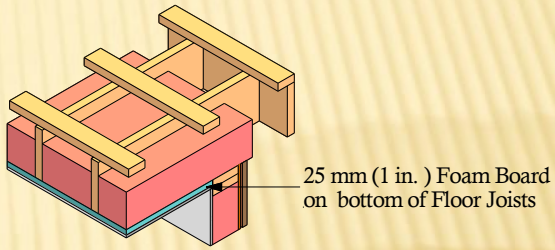
Lesser spacing's with same materials will also not work

Roof Joist Spaces - 4.67 RSI (R-26.5)	**2 x 10 @ 24” oc.**
Assembly Description: 63 mm vented air space, **38 mm x 235 mm lumber joists at 600 mm oc.** **4.93 RSI (R-28)** batt glass fiber insulation in cavities. **25 mm (1 in.) foam board on underside of joists** 15.9 mm (5/8 in.) gypsum board ceiling	
Continuous elements:	
*Exterior air film	N/A
*Roofing (asphalt shingle)	N/A
*Roof Sheathing 12.5 mm (1/2 in.) (Ply)	N/A
*Exterior air film applied to upper surface of insulation	0.03
25 mm (1 in.) foam board	0.65
15.9 mm (5/8 in) Gypsum Board	0.097
Inside air film	0.11
Cavity RSI (Parallel) $\frac{100}{\frac{10}{1.6745}+\frac{90}{4.93}}$	4.12748
Total	**5.01 RSI OK**

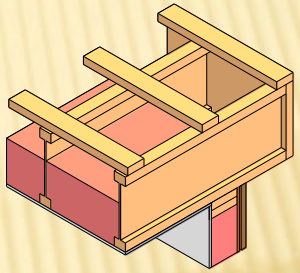
*The “materials” outboard of a vented air space cannot be used in this calculation. See Note (5) in Table A-9.36.2.4.(D). The exterior air film is applied to the surface of the insulation within the space.

Roof Joist Spaces - 4.67 RSI (R-26.5)	**2 x 10 @ 16” oc.**
Assembly Description: 63 mm vented air space, **38 mm x 235 mm lumber joists at 600 mm oc.** **4.93 RSI (R-28)** batt glass fiber insulation in cavities. **25 mm (1 in.) foam board on underside of joists** 15.9 mm (5/8 in.) gypsum board ceiling	
Continuous elements:	
*Exterior air film	N/A
*Roofing (asphalt shingle)	N/A
*Roof Sheathing 12.5 mm (1/2 in.) (Ply)	N/A
*Exterior air film applied to upper surface of insulation	0.03
25 mm (1 in.) foam board	0.65
15.9 mm (5/8 in) Gypsum Board	0.097
Inside air film	0.11
Cavity RSI (Parallel) $\frac{100}{\frac{13}{1.6745}+\frac{87}{4.93}}$	3.93527
Total	**4.82 RSI OK**

*The “materials” outboard of a vented air space cannot be used in this calculation. See Note (5) in Table A-9.36.2.4.(D). The exterior air film is applied to the surface of the insulation within the space.

Roof Joist Spaces - 4.67 RSI (R-26.5)	**2 x 10 @ 12” oc.**
Assembly Description: 63 mm vented air space, **38 mm x 235 mm lumber joists at 600 mm oc.** **4.93 RSI (R-28)** batt glass fiber insulation in cavities. **25 mm (1 in.) foam board on underside of joists** 15.9 mm (5/8 in.) gypsum board ceiling	
Continuous elements:	
*Exterior air film	N/A
*Roofing (asphalt shingle)	N/A
*Roof Sheathing 12.5 mm (1/2 in.) (Ply)	N/A
*Exterior air film applied to upper surface of insulation	0.03
25 mm (1 in.) foam board	0.65
15.9 mm (5/8 in) Gypsum Board	0.097
Inside air film	0.11
Cavity RSI (Parallel) $\frac{100}{\frac{14.5}{1.6745}+\frac{85.5}{4.93}}$	3.80136
Total	**4.69 RSI OK**

*The “materials” outboard of a vented air space cannot be used in this calculation. See Note (5) in Table A-9.36.2.4.(D). The exterior air film is applied to the surface of the insulation within the space.

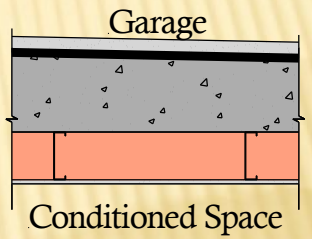
Roof Joist Spaces - 4.67 RSI (R-26.5)	**I-Joists @ 16” oc.**
Assembly Description: 63 mm vented air space, 355 mm (14 in) deep I-joists 400 mm oc. **5.46 RSI (R-31)** batt glass fiber insulation in cavities. 12.7 mm (1/2 in.) Gypsum Board	
Continuous elements:	
*Exterior air film	N/A
*Roofing (asphalt shingle)	N/A
*Roof Sheathing 12.5 mm (1/2 in.) (Ply)	N/A
*Exterior air film applied to upper surface of insulation	0.03
12.7 mm (1/2 in.) Gypsum Board	0.08
Inside air film	0.11
Cavity RSI (Parallel) $\frac{100}{\frac{9}{2.0485}+\frac{91}{5.46}}$	4.74831
Total	**4.97 RSI OK**

*The “materials” outboard of a vented air space cannot be used in this calculation. See Note (5) in Table A-9.36.2.4.(D). The exterior air film is applied to the surface of the insulation within the space.

CAUTION: Batt Insulation will need to be cut to fit between webs.
Batts cut for lumber spacing will not work for I Joists

Concrete Floor over Conditioned Space- 4.67 RSI (R-26.5)

Assembly Description:
50 mm (2 in.) Topping Concrete
Torch-on Roll Roofing Membrane
254 mm Concrete Suspended Slab
32 mm x 152 mm steel stud framing @ 600 mm oc.
4.23 RSI (R-24) batt glass fiber insulation in cavities.
12.7 mm (1/2 in.) gypsum board ceiling



$RSI_{eff} = K_1 \times RSI_{T1} + K_2 \times RSI_{T3}$
K_1 and K_2 value is 0.5

$$RSI_{T1} = \frac{100}{\frac{0.33}{0.3739}+\frac{99.67}{4.6016}} = 4.43608$$

$$RSI_{T2} = \frac{100}{\frac{0.33}{0.0023}+\frac{99.67}{4.23}} = 0.59865$$

RSI_{T3} = .03 + .02 + .03 + .1016 + .08 + .11 + .59865 = 0.97025

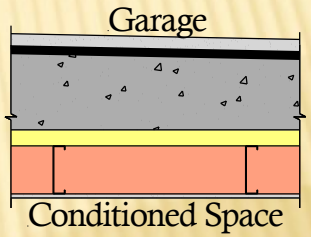
RSI_{eff} =0.5 x 4.73608 + 0.5 x 0.97025

2.70429

Total	**2.70 NOT OK**

Concrete Floor over Conditioned Space- 4.67 RSI (R-26.5)

Assembly Description:
50 mm topping Concrete
Torch-on Roll Roofing Membrane
254 mm Concrete Suspended Slab
50 mm (2 in.) polyisocyanurate foam board
32 mm x 152 mm steel stud framing @ 600 mm oc.
4.23 RSI (R-24) batt glass fiber insulation in cavities.
12.7 mm (1/2 in.) gypsum board ceiling



$RSI_{eff} = K_1 \times RSI_{T1} + K_2 \times RSI_{T3}$

K_1 and K_2 value is 0.5

$$RSI_{T1} = \frac{100}{\frac{0.33}{2.2439}+\frac{99.67}{6.7416}} = 6.69730$$

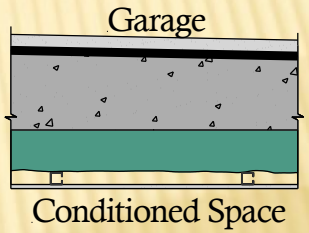
$$RSI_{T2} = \frac{100}{\frac{0.33}{0.0023}+\frac{99.67}{4.23}} = 0.59865$$

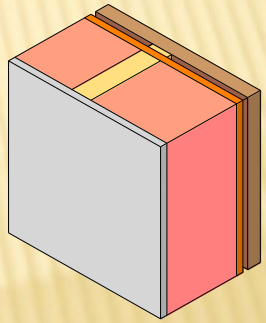
$RSI_{T3} = .03 + .02 + 0.3 + .1016 + 1.87 + .08 + .11 + .59865 = 2.84025$

$RSI_{eff} = 0.5 \times 6.69730 + 0.5 \times 2.84025$

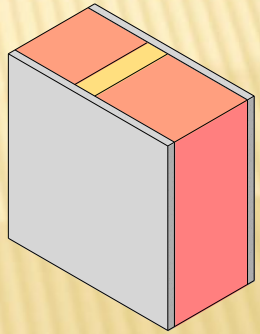
4.76877

Total	**4.77 OK**

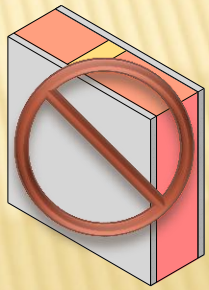
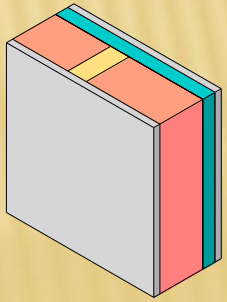
Concrete Floor over Conditioned Space- 4.67 RSI (R-26.5)	
Assembly Description: 50 mm topping Concrete Torch-on Roll Roofing Membrane 254 mm Concrete Suspended Slab 117 mm (4.6 in.) Continuous Closed Cell Spray Foam 32 mm x 32 mm sheet steel furring @ 600 mm oc. 12.7 mm (1/2 in.) gypsum board ceiling	
Continuous elements:	
Exterior Air Film	0.03
50 mm (2 in.) Concrete Topping	0.02
Torch-on Roll Roofing (Asphalt)	0.03
254 mm (10 in.) Concrete Suspended Slab	0.1016
117 mm (4.6 in.) Continuous Closed Cell Spray Foam	4.212
32 mm Air Cavity	0.15
12.7 mm (1/2 in) Gypsum Board	0.08
Inside Air Film	0.11
Total	**4.73 RSI OK**

Walls (Framed) 2.78 RSI (R-15.8)	**2 x 6 @ 12” oc.**
Assembly Description: 12.7 mm (1/2 in) gypsum board, 38 mm x 140 mm lumber studs at 300 mm oc. **3.34 RSI (R-19) (compressed R-20)** batt glass fiber insulation in cavities. 9.5 mm (3/8 in) OSB sheathing 9.5 mm (3/8 in) Capillary Break Space 6.35.mm (1/4 in) Fiber Cement Cladding	
Continuous elements:	
Interior air film,	0.12
12.7 mm (1/2 in) Gypsum board,	0.08
9.5 mm (3/8 in) OSB sheathing,	0.093
9.5 mm (3/8 in) air space,	0.15
6.35 mm (1/4 in) fiber cement cladding,	0.023
Exterior air film.	0.03
Cavity RSI (Parallel) $\frac{100}{\frac{24.5}{1.19}+\frac{75.5}{3.34}}$	2.3152
Total	**2.811 OK**

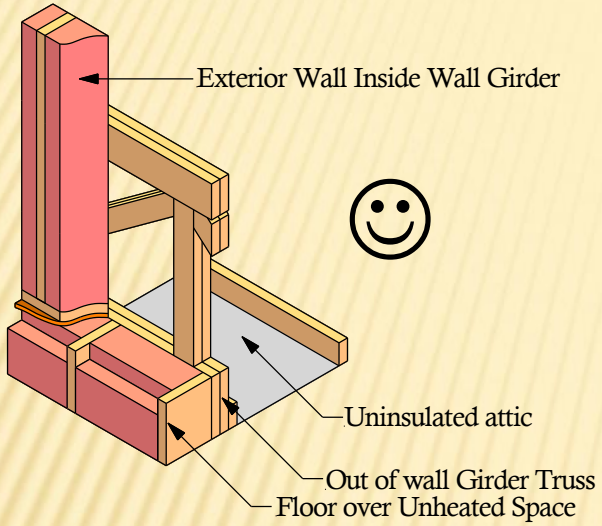
Sentence 9.36.2.4.(4) Where a component of the building envelope is protected by an enclosed unconditioned space, such as a sun porch, enclosed veranda, vestibule or attached garage, the required effective thermal resistance of the building envelope component between the building and the unconditioned enclosure is permitted to be reduced by 0.16 $(m^2 \cdot K)/W$.

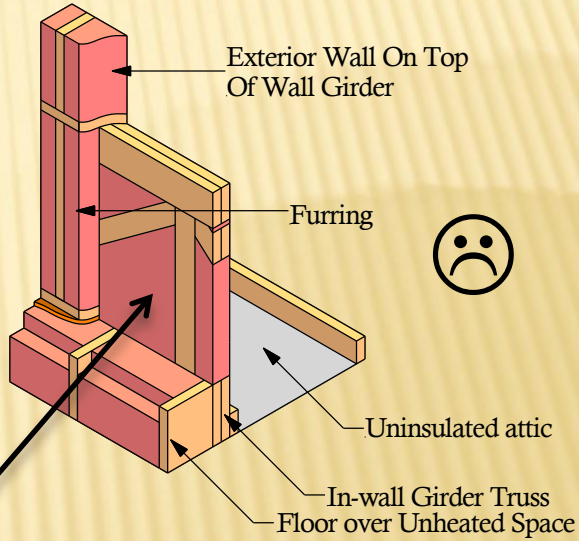
Walls (Framed) between conditioned and unconditioned spaces **2.78 – 0.16 = 2.62 RSI (R-14.87)**	**2 x 6 @ 12” o.c.**
Assembly Description: 12.7 mm (1/2 in) gypsum board, Vapour/air barrier, 38 mm x 140 mm lumber studs at 300 mm oc., 3.34 RSI (R-19) (compressed R-20) batt glass fiber insulation in cavities, 12.7 mm (1/2 in) gypsum board.	
Continuous elements: Interior air film 12.7 mm Gypsum Board (interior side) 12.7 mm Gypsum Board (exterior side) Exterior air film	 0.12 0.08 0.08 0.03
Cavity RSI (Parallel) $\frac{100}{\frac{24.5}{1.19}+\frac{75.5}{3.34}}$	2.3152
Total	**2.6252 OK**

Walls (Framed) between conditioned and unconditioned spaces
2.62 RSI (R-14.87) **Try 2 x 4 @ 24" oc.**

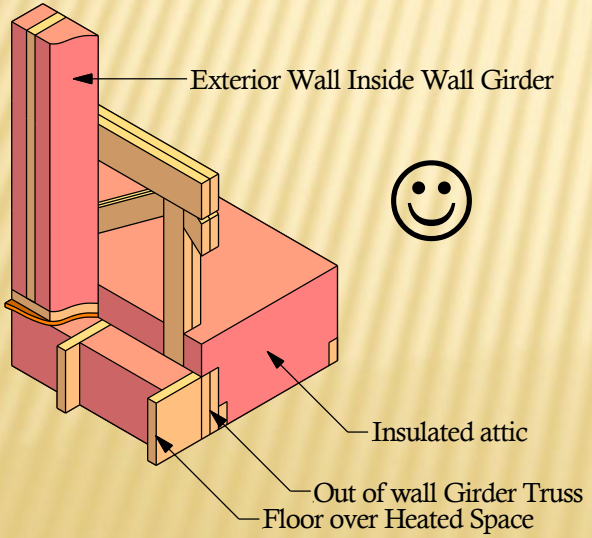
Assembly Description: 12.7 mm (1/2 in) Gypsum Board (conditioned side) 38 mm x 89 mm Lumber Studs at 600 mm oc., **2.46 RSI (R-14)** Batt Glass Fiber insulation in cavities, 12.7 mm (1/2 in) Gypsum Board (unconditioned side)	
Continuous elements: Interior air film 12.7 mm Gypsum Board (interior side) 12.7 mm Gypsum Board (exterior side) Exterior air film	 0.12 0.08 0.08 0.03
Cavity RSI (Parallel) $\frac{100}{\frac{20}{0.7565}+\frac{80}{2.46}}$	1.6961
Total	**2.0061 Not OK**
Note: Adding a 25 mm (1 in) of XPS foam board as a continuous layer either inside or outside side of the wall to the above wall will increase the RSI by 0.65 which will provide an RSI **2.6561 which does work.**	

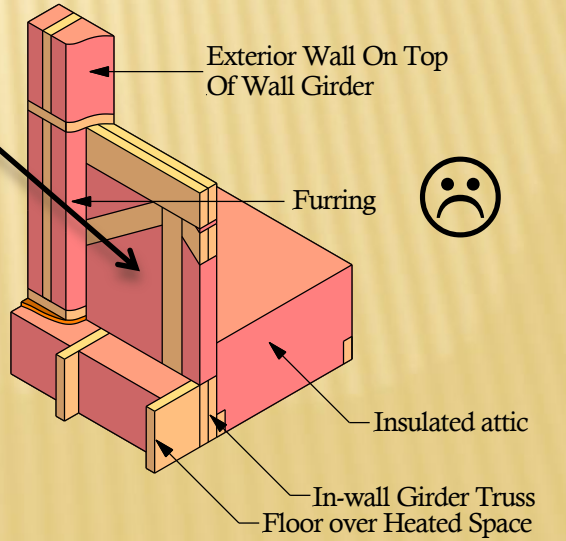
Walls (Framed) and Wall Girder Trusses





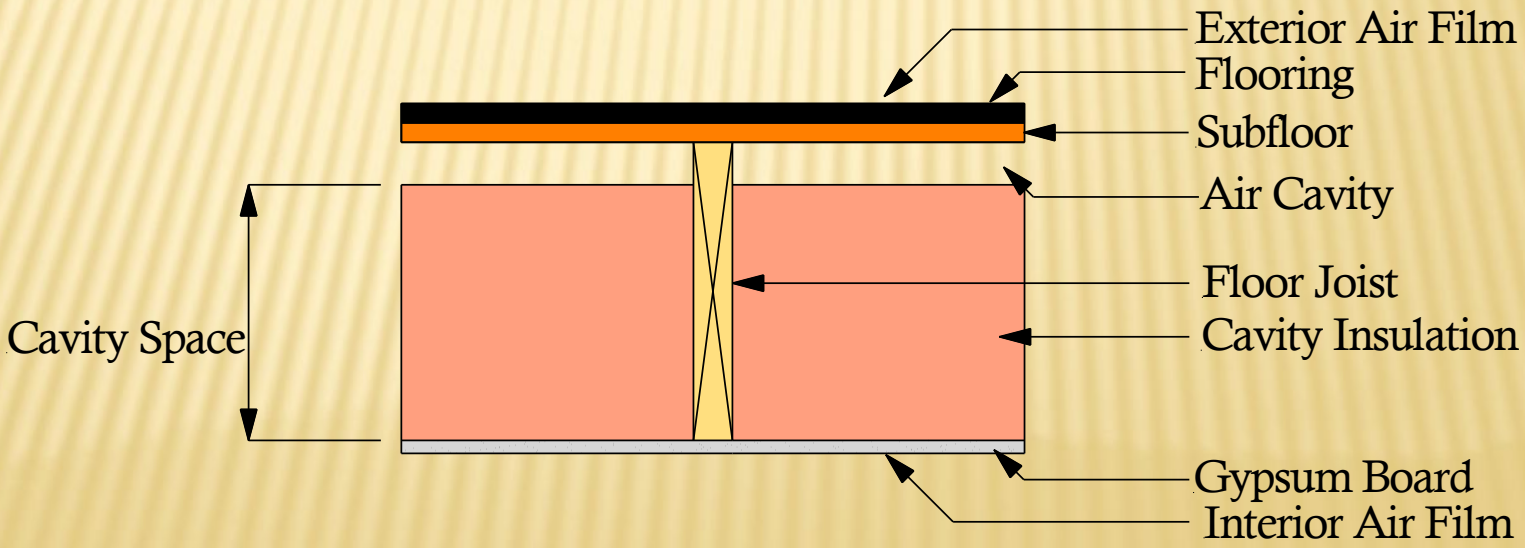
Difficult cavity calculation for in-wall girder space in these proposals

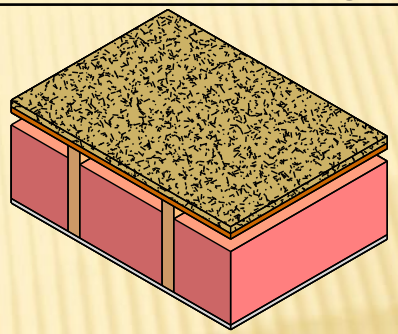




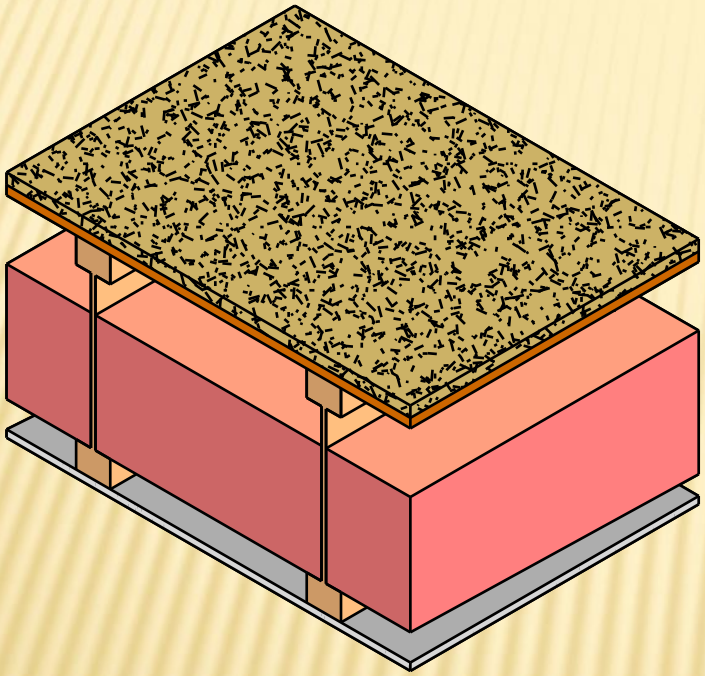
Floors above Unheated Space - 4.67 RSI or R-26.5

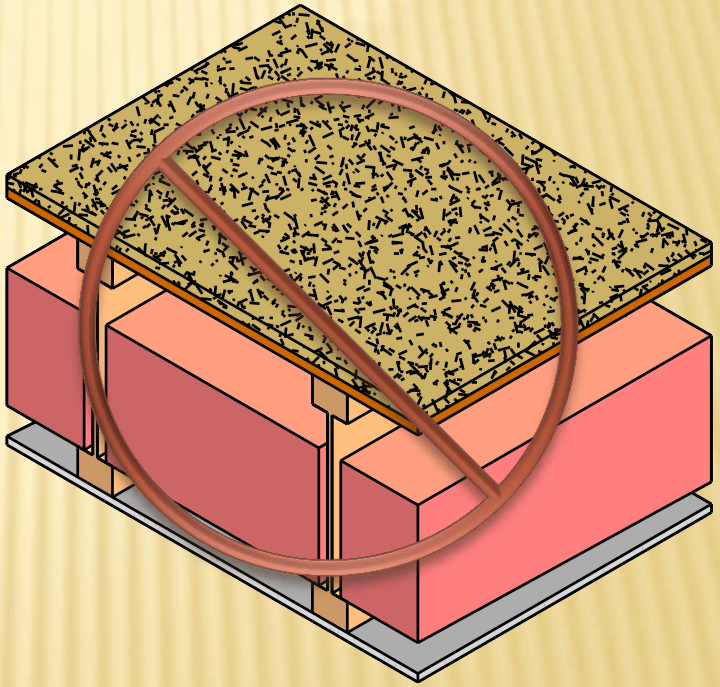
Where possible, the span over a garage may permit 2 x 10 framing, however, with the large span of a two car garage with living space above, a common current design, may not be adequate. Part 4 floor assemblies using double joists or engineered joists will require separate calculations.



Floors above Unheated Space - 4.67 RSI or (R-26.5)	**2 x 10 @ 12” o.c.**
Assembly Description: Carpet with fibrous pad 15.9 mm (5/8 in) D-Fir Plywood subfloor 38 mm x 235 mm lumber joists at 300 mm oc., 4.93 RSI (R-28) batt glass fiber insulation in cavities, 12.7 mm gypsum board ceiling over unheated space.	
Continuous elements:	
Interior air film	0.16
Carpet and underlay	0.370
15.9 mm (5/8 in) D-Fir Plywood Subfloor	0.172
51 mm (2 in.) air cavity	0.20
12.7 mm Gypsum Board (exterior side)	0.08
Exterior air film	0.03
Cavity RSI (Parallel) $\frac{100}{\frac{14.5}{1.513}+\frac{85.5}{4.93}}$	3.71382
Total	**4.735 RSI OK**

Note: special cut glass fiber insulation batts will be required for correct fit in I-joist assemblies.

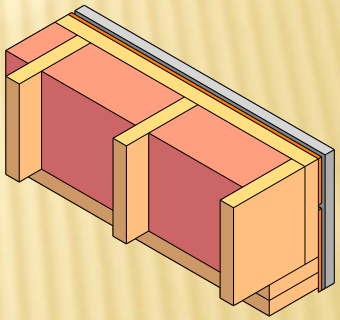




Batts cut for lumber spacing's will not be wide enough.

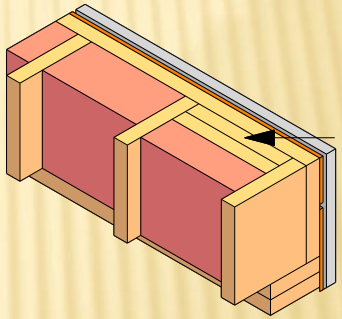
Rim Joist Space

We are required to calculate the effective thermal resistance through this space. The continuous elements on the exterior inward are easy enough to apply, however, the cavity insulated space is not spelled out. Hand calculated % of framing and cavity results in:

Rim Joist Space – 2.78 RSI or (R-15.8)	**2 x 10 @ 12" o.c.**
Assembly Description: 38 x 235 joists spaced at 304 mm oc. (the worst case) 3.52 RSI (R-20) batt insulation (R-14 does not work) 12.5 % framing and 87.5 % cavity	
Continuous elements: 38 mm (1.5 in) rim board 9.5 mm OSB Sheathing Vinyl (over sheathing) Exterior air film	 0.325 0.093 0.11 0.03
Cavity RSI (Parallel) $\frac{100}{\frac{12.5}{1.19}+\frac{87.5}{3.52}}$	2.676
Total	**3.234 RSI OK**

Rim Joist Space

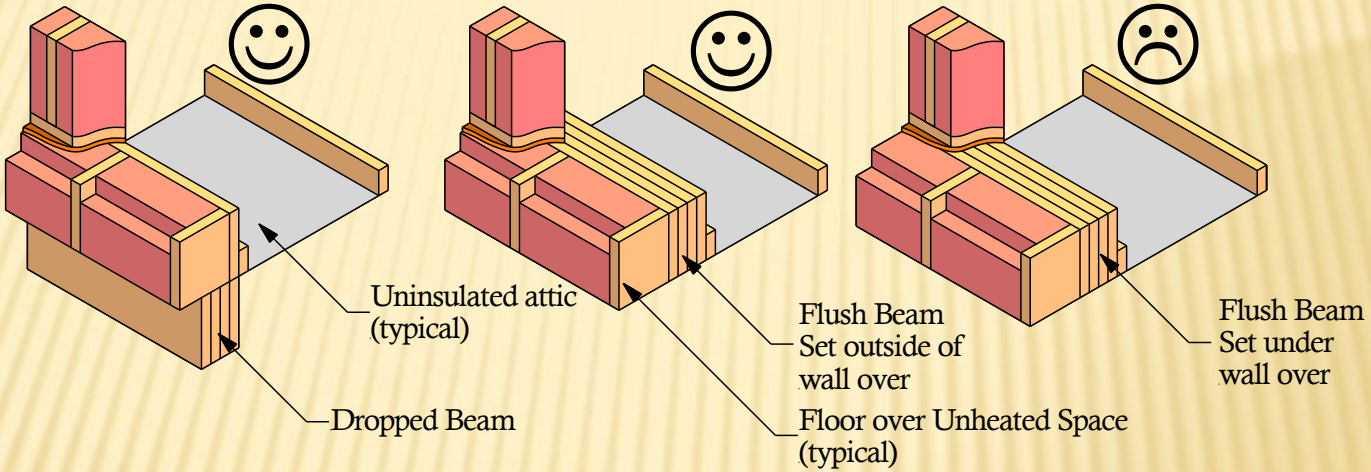
In those cases where for structural reasons bearing blocking is required in a rim joist space:

Rim Joist Space – 2.78 RSI or (R-15.8)	**2 x 10 @ 12" o.c.**
Assembly Description: 38 x 235 joists spaced at 304 mm oc. (the worst case) 2.46 RSI (R-14) batt insulation 12.5 % framing and 87.5 % cavity	 Bearing Blocks
Continuous elements: 38 mm (1.5 in) rim board 2 – 38 mm bearing blocks 9.5 mm OSB Sheathing Vinyl (over sheathing) Exterior air film	 0.325 0.65 0.093 0.11 0.03
Cavity RSI (Parallel) $\frac{100}{\frac{12.5}{1.19}+\frac{87.5}{2.46}}$	2.17
Total	**3.78 RSI OK**

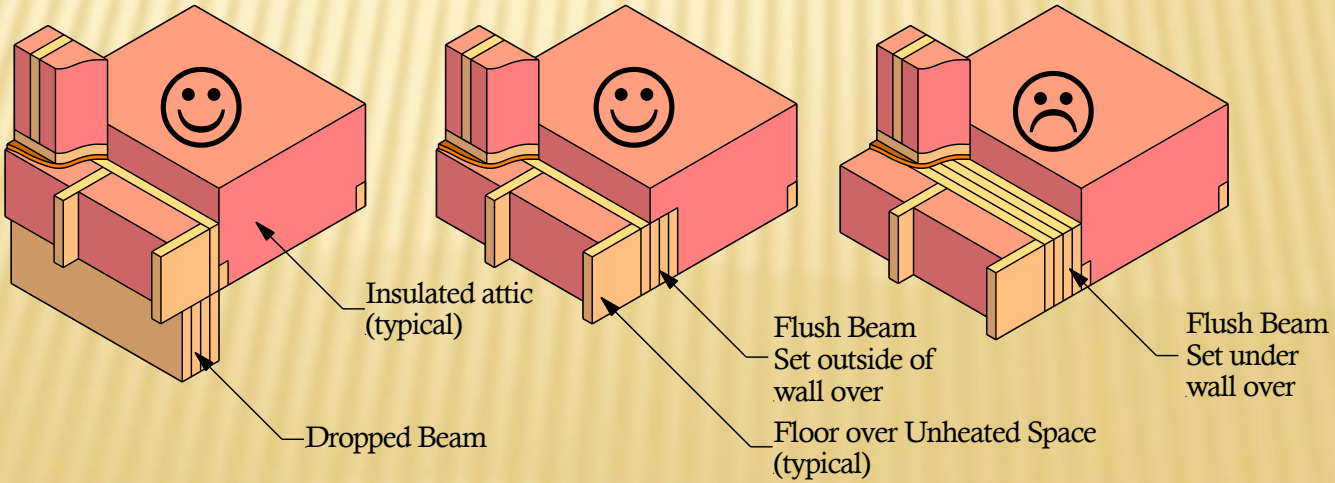
Rim Joist Space and Insulated/Uninsulated Floors

For continuity of effective thermal insulation where floor and rim joist spaces interface with a supporting beam:

- in the case where an **insulated floor meets an uninsulated ceiling.**

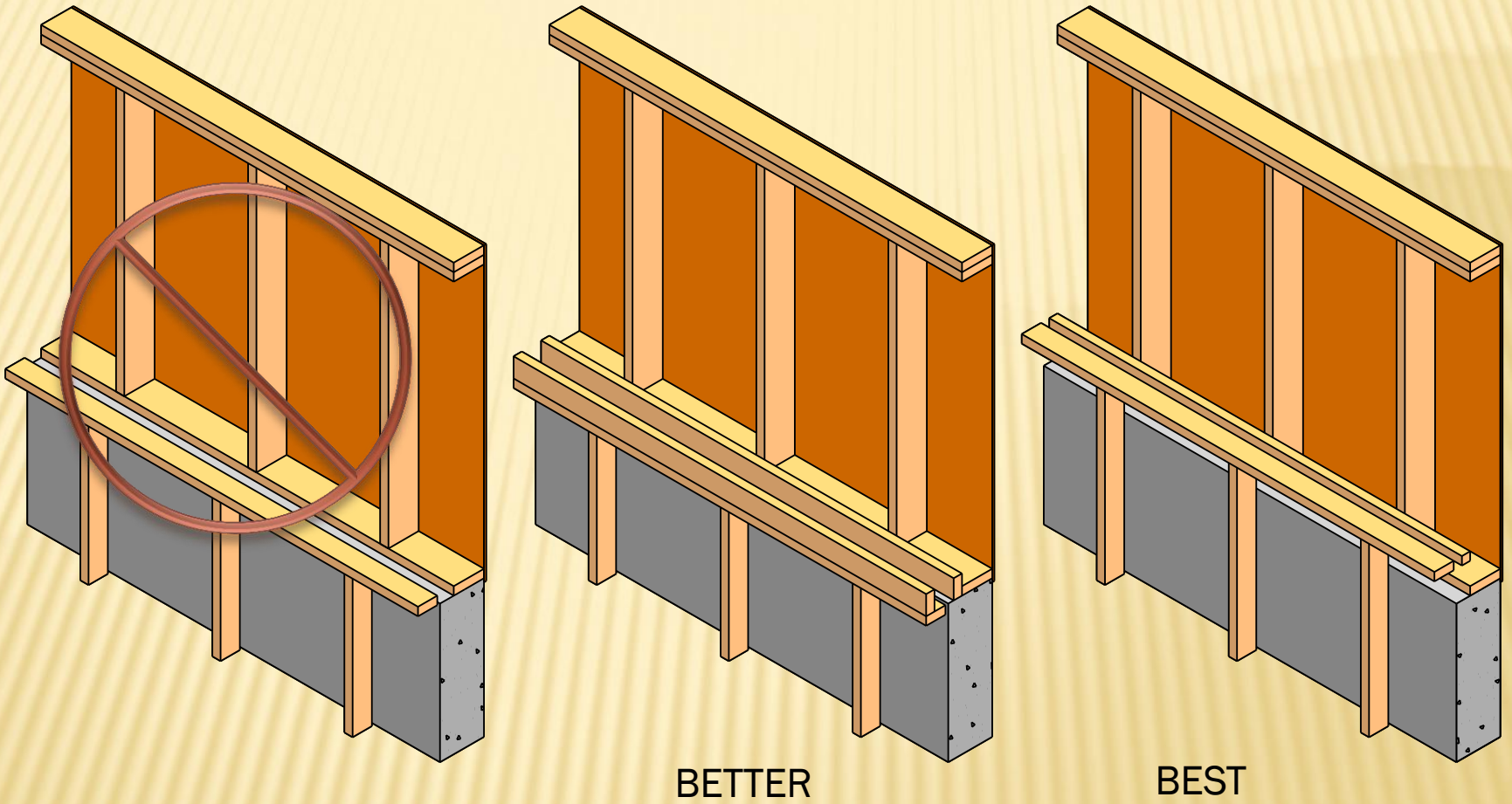


- in the case where an **uninsulated floor meets an insulated ceiling.**



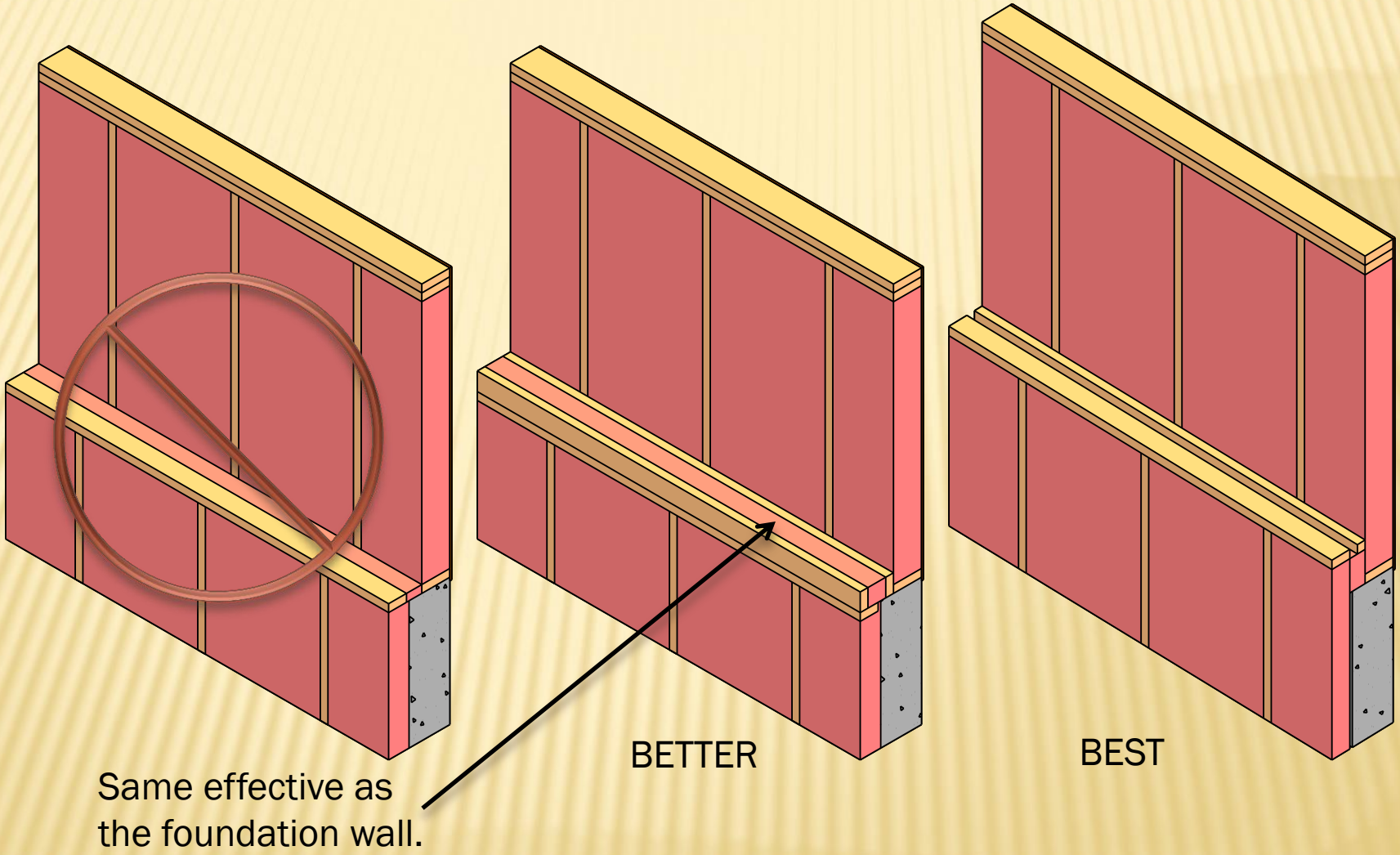
The following slides depict issues that need to be addressed in order to fulfill continuity of thermal insulation.

Continuity of Thermal Insulation.



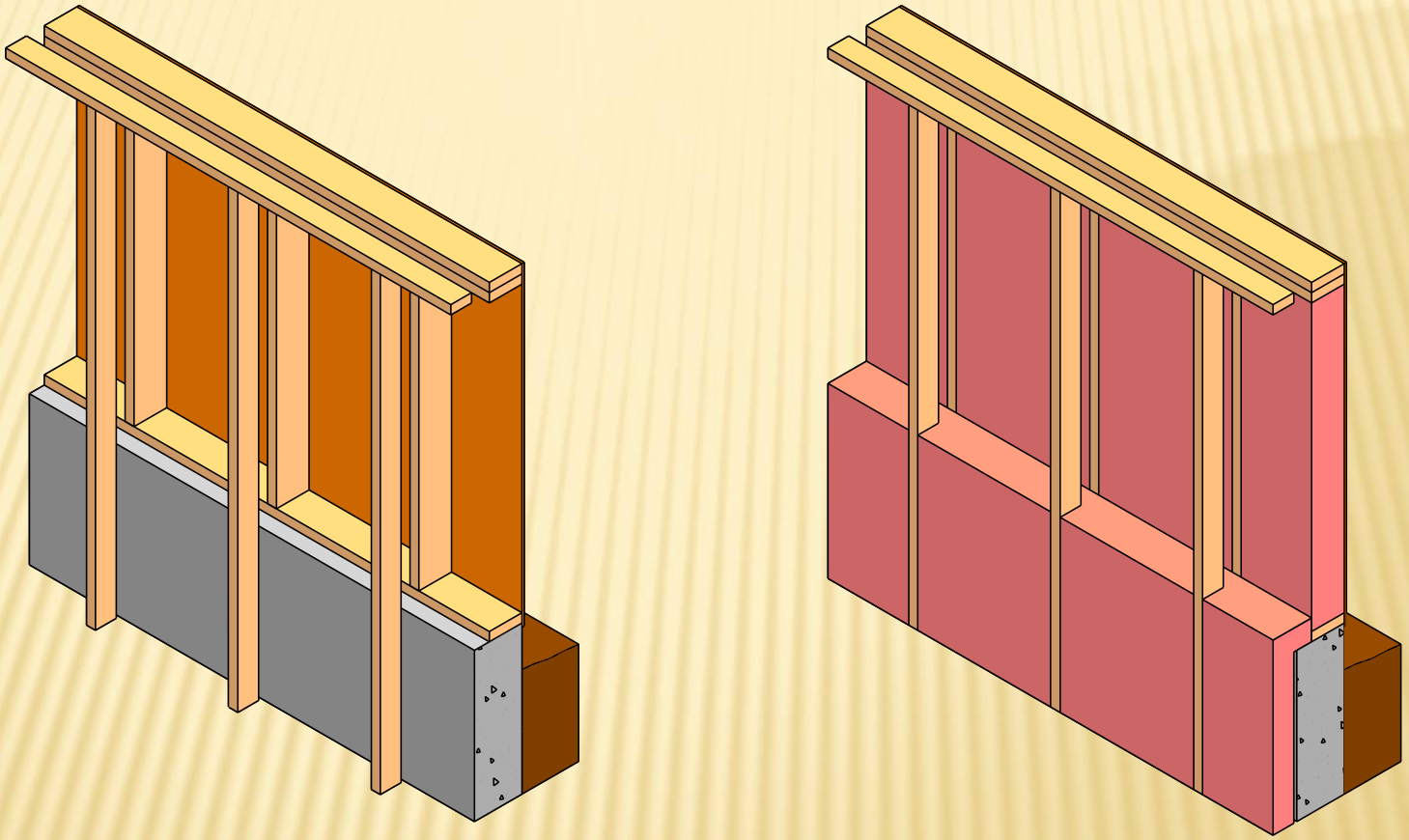
Framing the transition from foundation wall to framed wall in basements.

Continuity of Thermal Insulation.



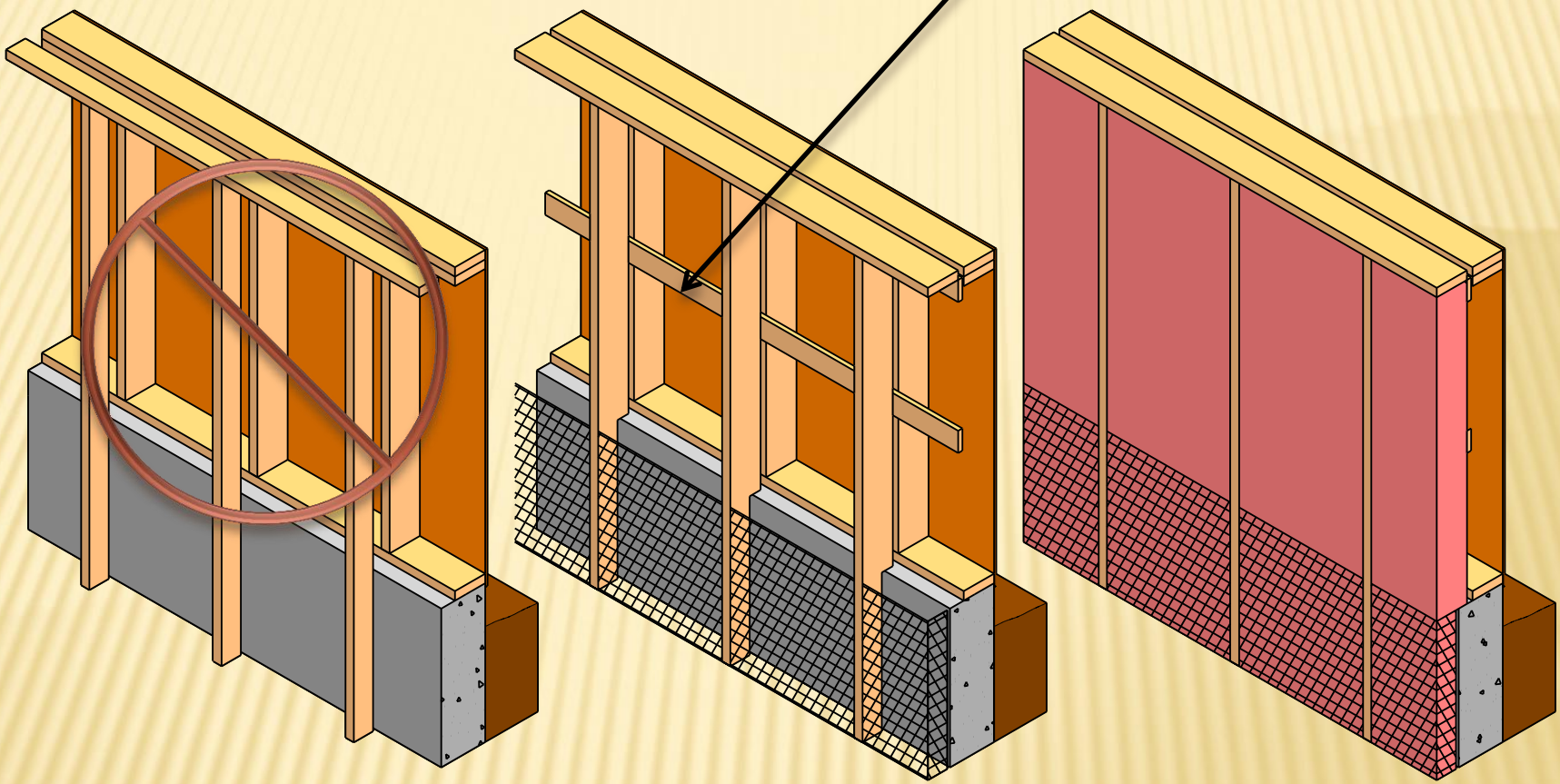
Insulating the transition from foundation wall to framed wall in basements.

Continuity of Thermal Insulation.



Insulating the transition from foundation wall to framed wall in basements where the inner wall framing runs full height for a flush wall finish.

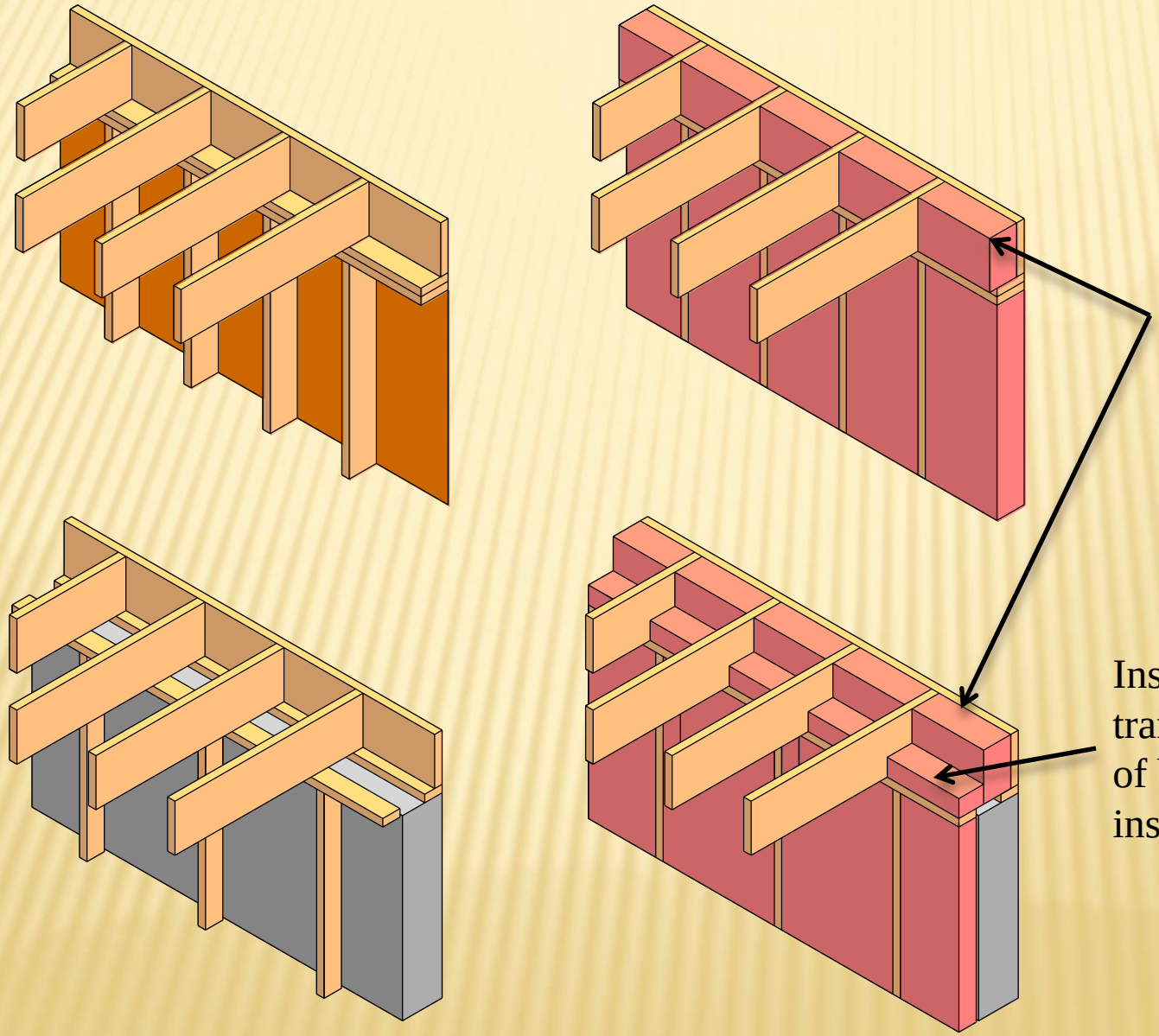
Continuity of Thermal Insulation.



Hatched area is insulated for below ground requirements and area above hatched area is insulated to above ground requirements

Insulating the transition from foundation wall to framed wall in basements where the inner wall framing **and insulation runs full height** for a flush wall finish.

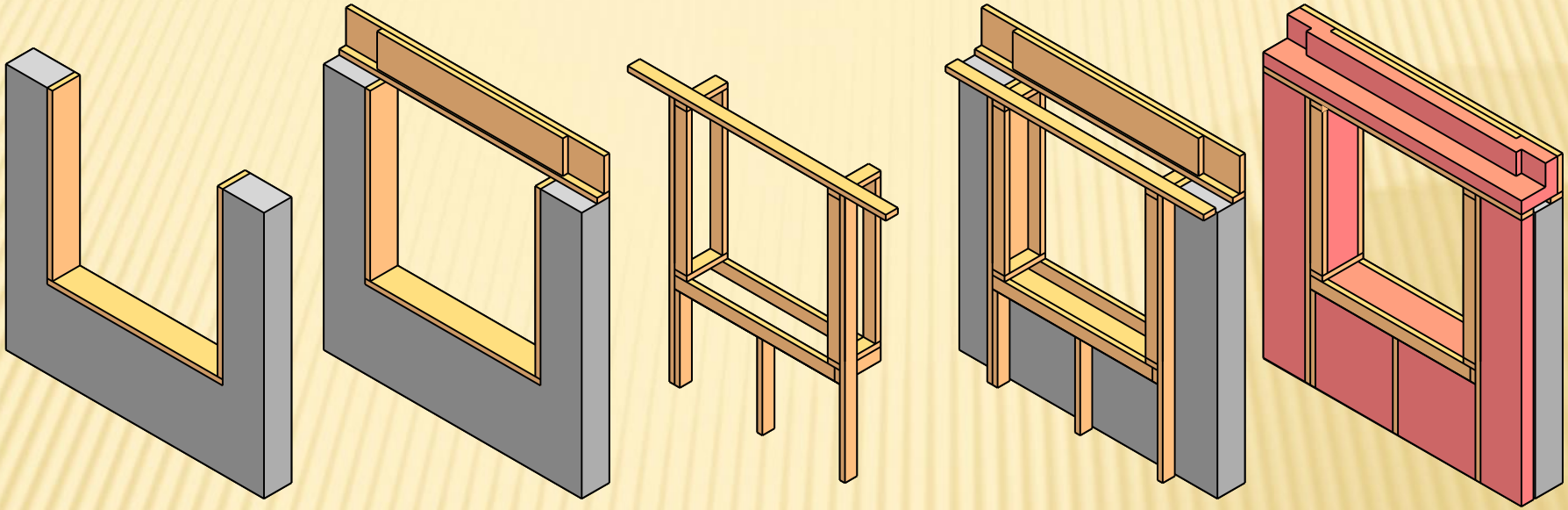
Continuity of Thermal Insulation.



Rim joist spaces require an effective thermal resistance not less than that required for above-ground walls.

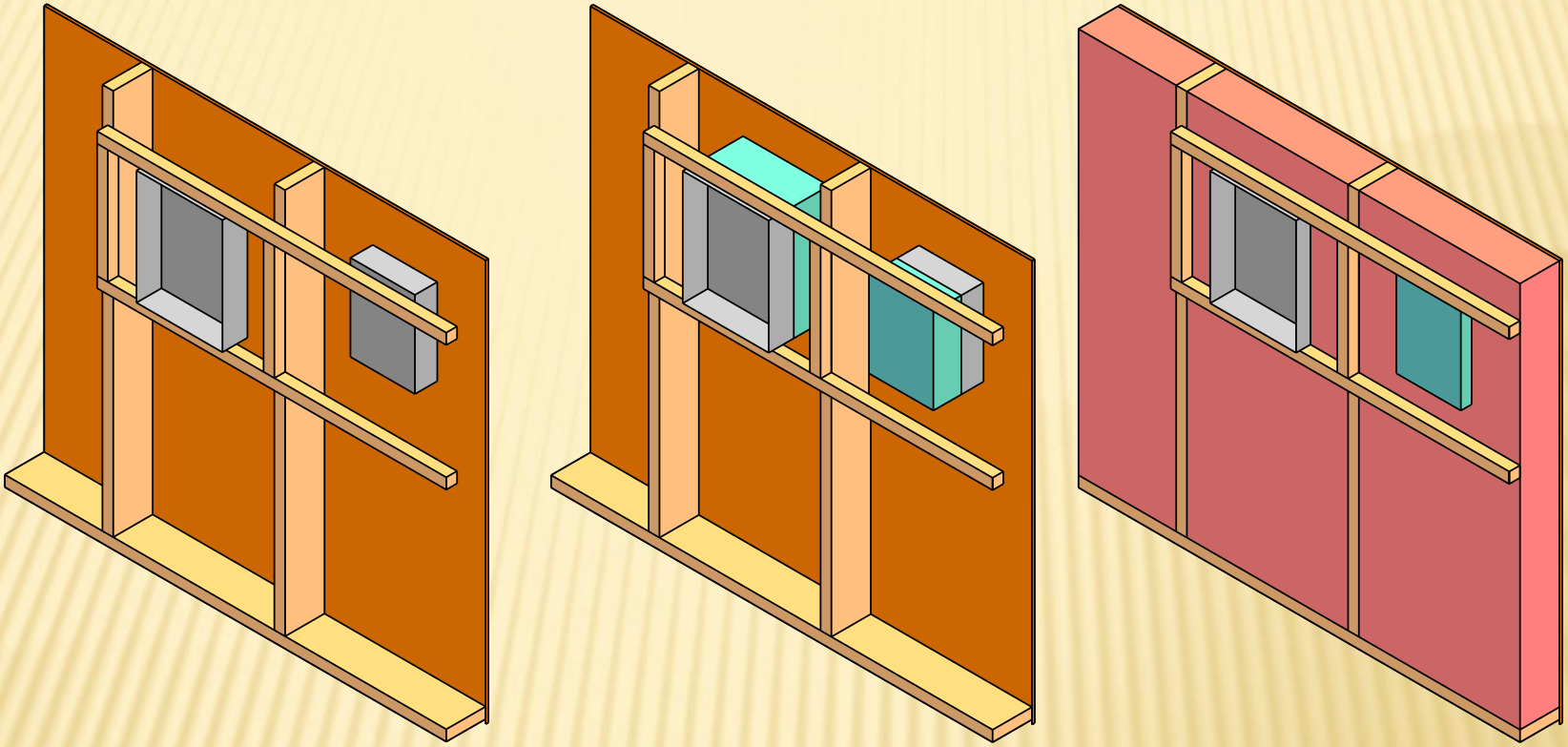
Insulation is to transition in to the plane of below-ground wall insulation.

Continuity of Thermal Insulation.



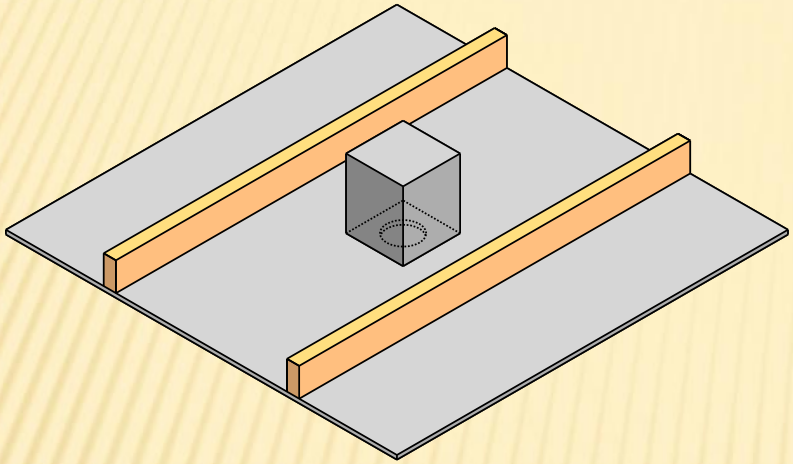
Window openings in foundation walls will require effective thermal insulation equal to the foundation wall around the perimeter.
The same applies to formed in door openings as well.

Continuity of Thermal Insulation.

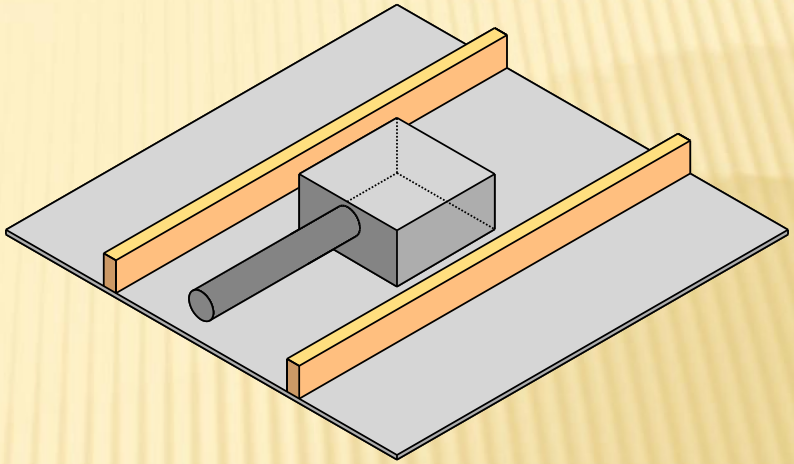


Minimum effective thermal insulation equal to the wall is required behind electrical circuit panel and meter boxes and any other similar service boxes. It is not clear as to why we need to calculate the effective rather than just specifying nominal insulation. The calculation will depend on the circuit panel and meter box value and where we get this information is unknown. It is likely the AHJ will use a nominal value equivalent to the effective required for the wall assembly.

Continuity of Thermal Insulation.



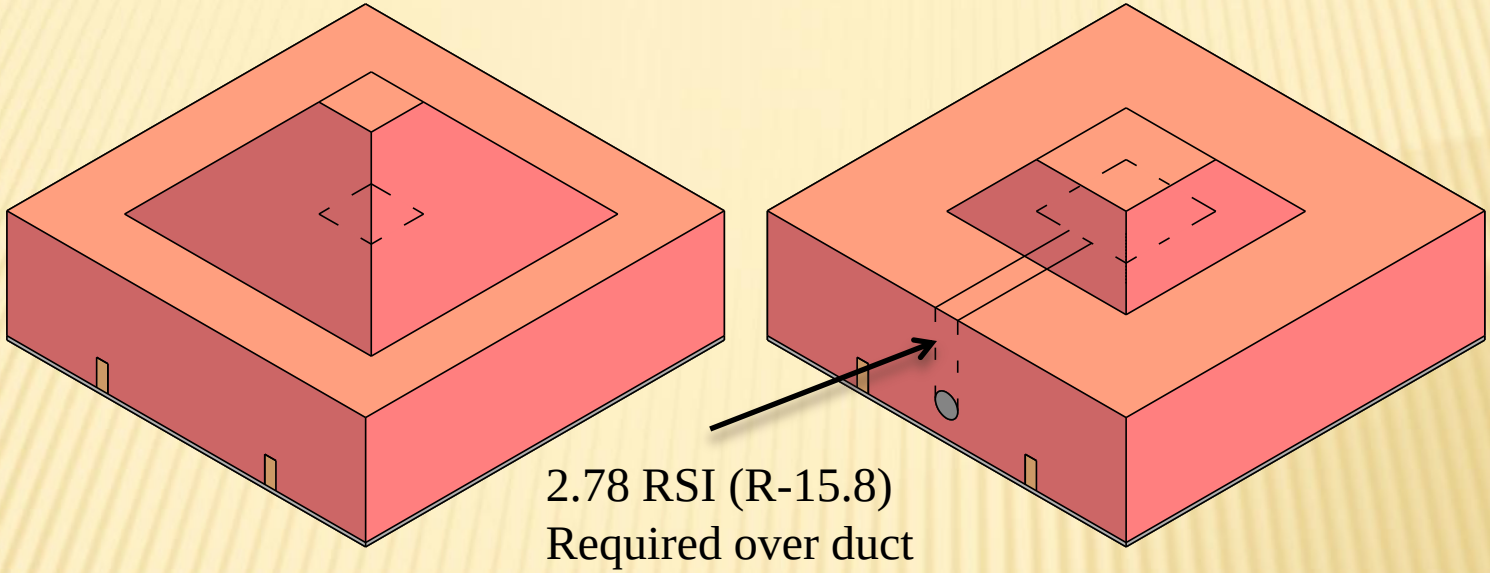
Pot Light Housing in
Truss System



Bath Fan Housing in
Truss System

Minimum effective thermal insulation of 2.78 RSI (R-15.8) is required over the **projected area** of ducts, pipes, conduits or cables. **Pot lights and bath fan housings are not permitted a reduction.** It is not clear as to why we need to calculate the effective rather than just specifying nominal. The calculation will depend on the properties of the thermal insulation alone above these services so why not just specify a nominal resistance value.

Continuity of Thermal Insulation.

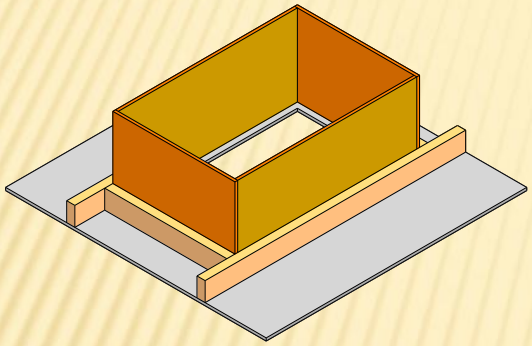


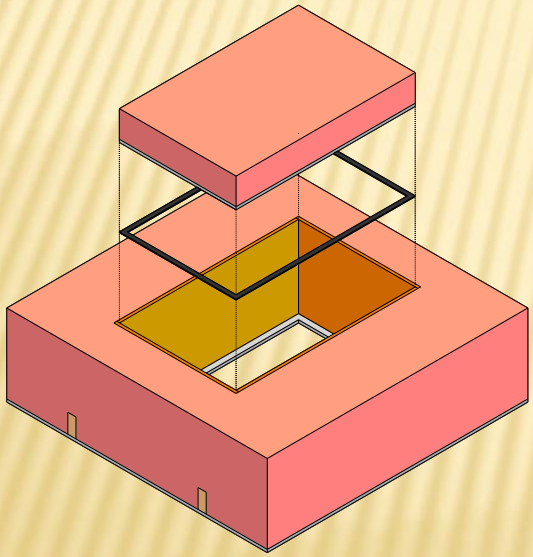
Pot Light Housing in Truss System

Bath Fan Housing in Truss System

Minimum effective thermal insulation of 2.78 RSI (R-15.8) required over the **projected area** of ducts, pipes, conduits or cables. Pot lights and bath fan housings are not permitted a reduction. It is not clear as to why we need to calculate the effective rather than just specifying nominal. The calculation will depend on the properties of the thermal insulation alone above these services so why not just specify a nominal resistance value.

Continuity of Thermal Insulation.





Attic access hatches are permitted a rather large reduction in the required thermal resistance. A meager **nominal** thermal resistance of 2.6 RSI (R-14.8) is permitted. Batt fiber insulation would need to be a minimum of 124 mm (4.88 in.) thick.

Caution, ensure that the batt is cut so that is fits snug into the insulation stop lining and is secured to the back side of the hatch.

Continuity of Air-Barrier

If the hatch is of gypsum board, it qualifies on its own, as an air barrier. The hatch must then seal to the ceiling board of the room the hatch is installed in. This is achieved by weatherstripping between the hatch and the ceiling stop and relies on the weight of the hatch assembly to seal the joint. There is no requirement to provide a latching mechanism although this is recommended.

Continuity of Vapour Barrier

The hatch will have to be painted with a vapour barrier paint and through the weather-strip to the ceiling vapour barrier in the ceiling of the room

Airtightness

Sentence (2) in this Article requires an air barrier to be continuous:

- across construction and control joints,
- across junctions between different build materials and assemblies, and
- around penetrations through all building assemblies.

The intent of this Sentence is to ensure that where different materials are used they are to be sealed to each other in a manner that will ensure continuity of the air barrier and be compatible with each element being sealed. It makes sense to suggest that the fewer joints in materials will result in a system less prone to failure. An air barrier applied to the exterior side of an envelope assembly will have far fewer joints than one installed on the interior side and designers should always explore this option.

Airtightness

Table A-9.25.5.1.(1) in Appendix A lists some materials that qualify as an air barrier or a vapour barrier based on their characteristics.

- An air barrier should have an leakage characteristic less than 0.1 L/(s•m^2) at 75 Pa,
- A vapour barrier should have a water vapour permeance less than 60 ng/(Pa•s•m^2)

Airtightness

A designer is going to have to choose an overall strategy for the envelope as the code will permit a vapour barrier to also act as an air barrier. Again, where a design incorporates a material that is acting as both an air and vapour barrier, the location of the vapour barrier in relation to the overall thermal resistance of the assembly must comply with Subsection 9.25.5.

In Surrey;
We are permitted to place a vapour barrier like material 80% of the way through an envelope assemblies overall effective thermal resistance value.

Construction of Air Barrier Details

An air barrier as a rigid panel product such as gypsum board, plywood, OSB, foam board or any other similar product will work.

If there are joints in the panels they are required to be sealed. We are referred to see A-9.36.2.10.(5)(b) and if we do there is a commentary on one example and that is tape used to seal joints in panel air barriers shall be not only of a material that meets the permeance rating for an air barrier but also be compatible with adjacent materials and not deteriorate. Easy to say but will be difficult to regulate in the field. There is no statement to require testing for the tape, therefore, the AHJ will have to rely on manufacturers documented performance literature and somehow confirm that the materials meet that literature. It should be noted here that the same issue applies to a sealant.

Construction of Air Barrier Details

Sealants can also be used for joints in air barrier materials.

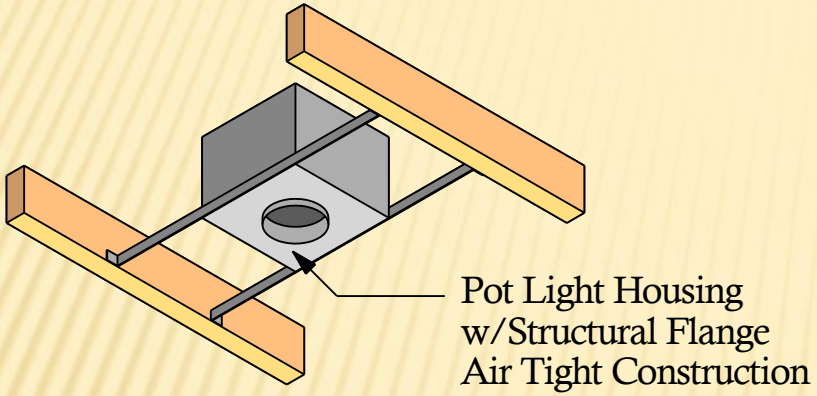
They shall be non-hardening or conform to Subsection 9.25.4. or either of two of the Standards listed for bead-applied one or two component polyurethane air sealant foams.

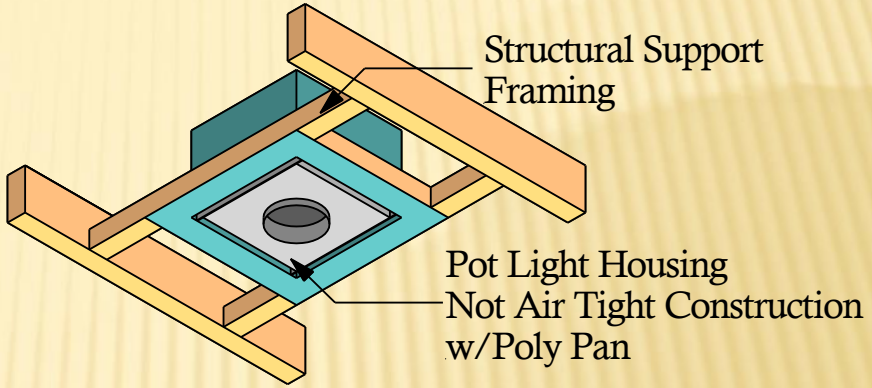
This is an odd set of choices. It would appear that a designer can use non-hardening sealant and only require the sealant to be flexible, whereas, if Subsection 9.25.4. is used Subsection 9.27.4. requires much more than just flexibility of the sealant.

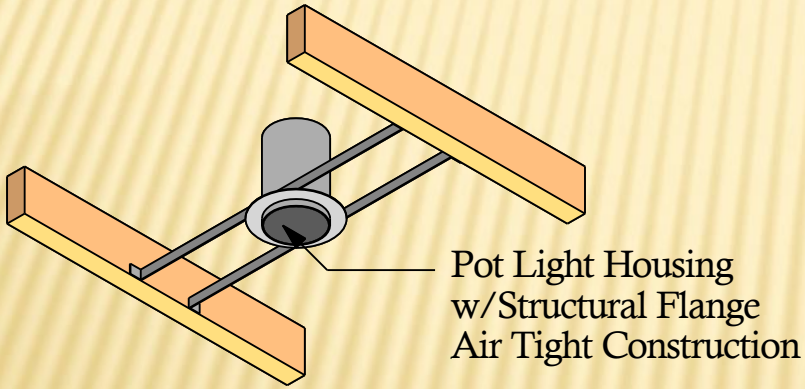
Construction of Air Barrier Details

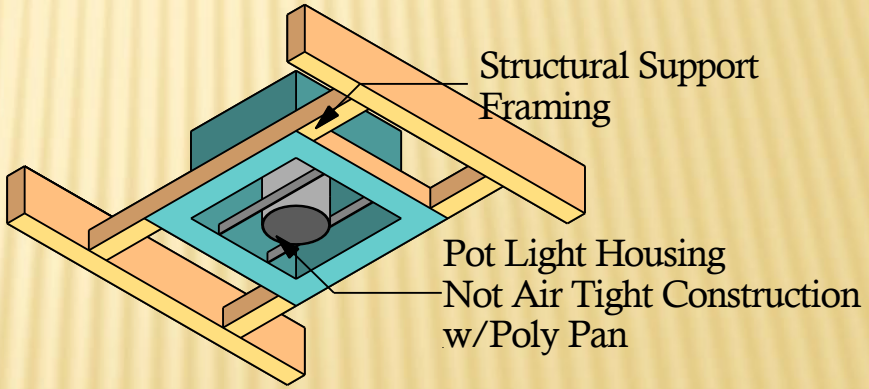
The requirement to structurally support a lapped and sealed joint in a flexible sheet air barrier needs to be addressed. How well the tape or sealant stays bonded to adjacent materials is of critical importance for longevity of a good air seal. The requirement to provide structural support at joints is to ensure that there is a measure of clamping force along the joint when a finish or cladding material is applied over the air barrier along joints. In the case where envelopes are constructed with an exterior air barrier of flexible sheet material behind a capillary break we should understand that the space created by the capillary break may require that the vertical battens used to create the space be placed over all vertical joints in the sheet material. This will ensure that when an air barrier experiences repeated positive and negative air pressures that the seal remain intact by this clamping effect.

Construction of Air Barrier Details

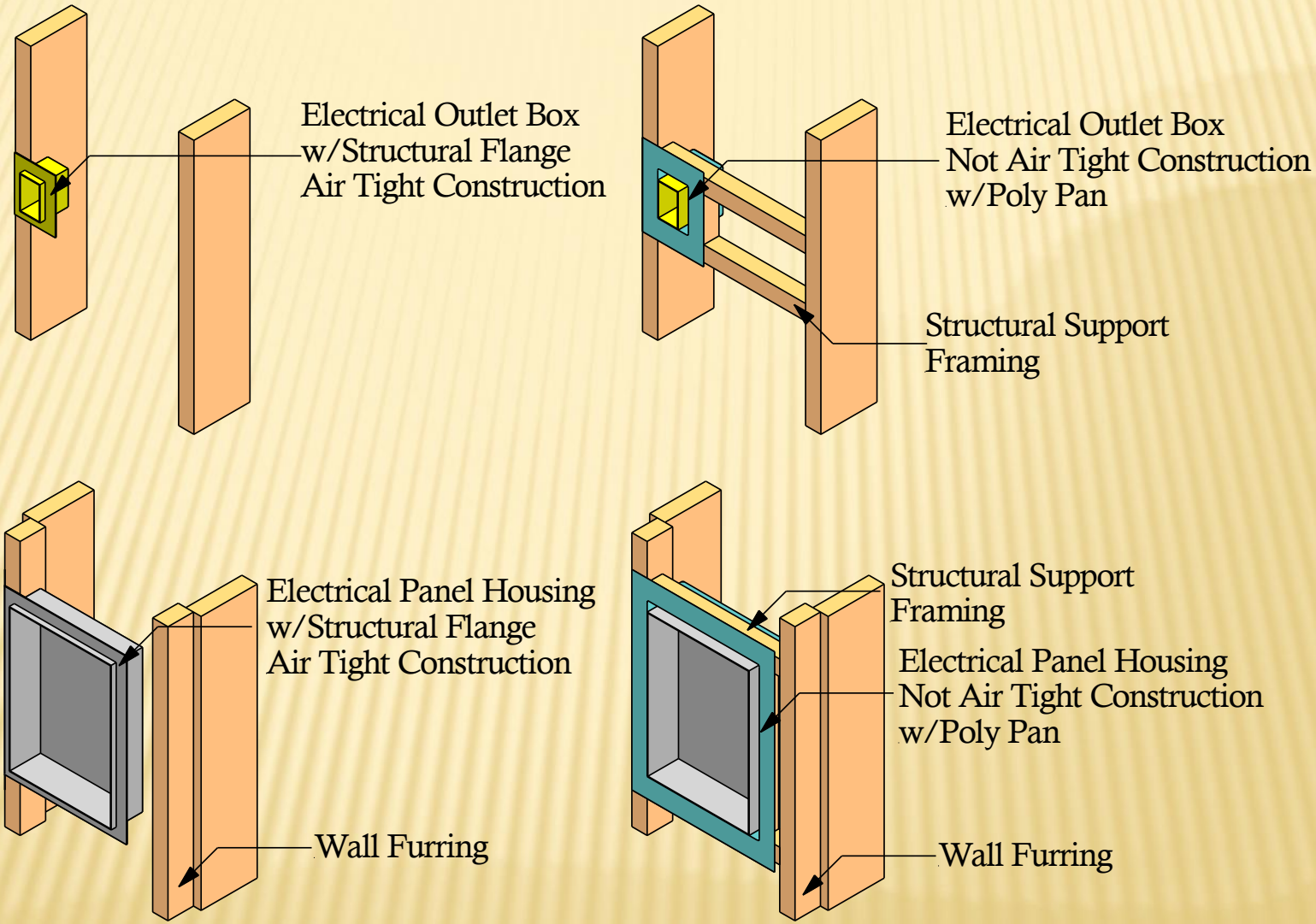






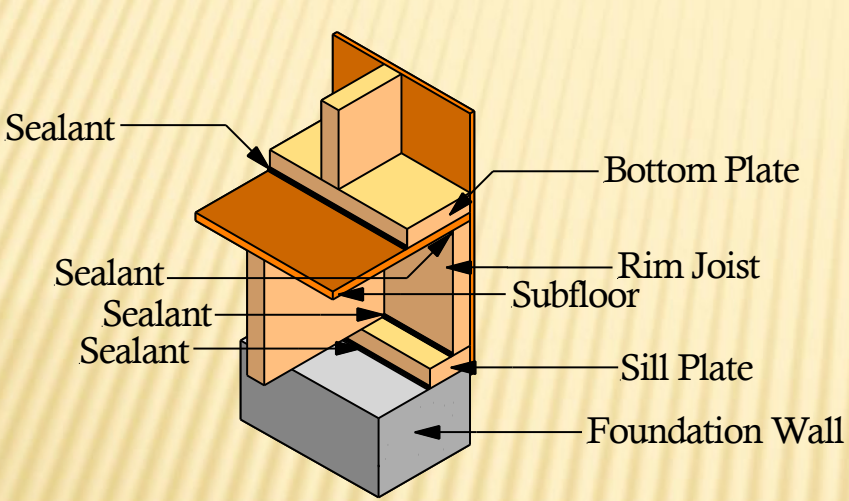


Construction of Air Barrier Details

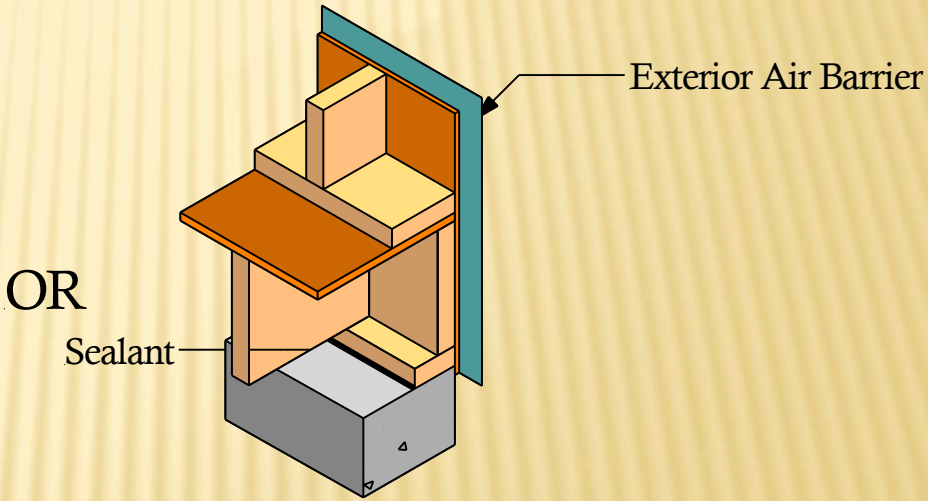


Construction of Air Barrier Details

Joints between the foundation and the sill plate, between the sill plate and the rim joist, between the rim joist and the subfloor and between the subfloor and the bottom plate of the wall above.



OR



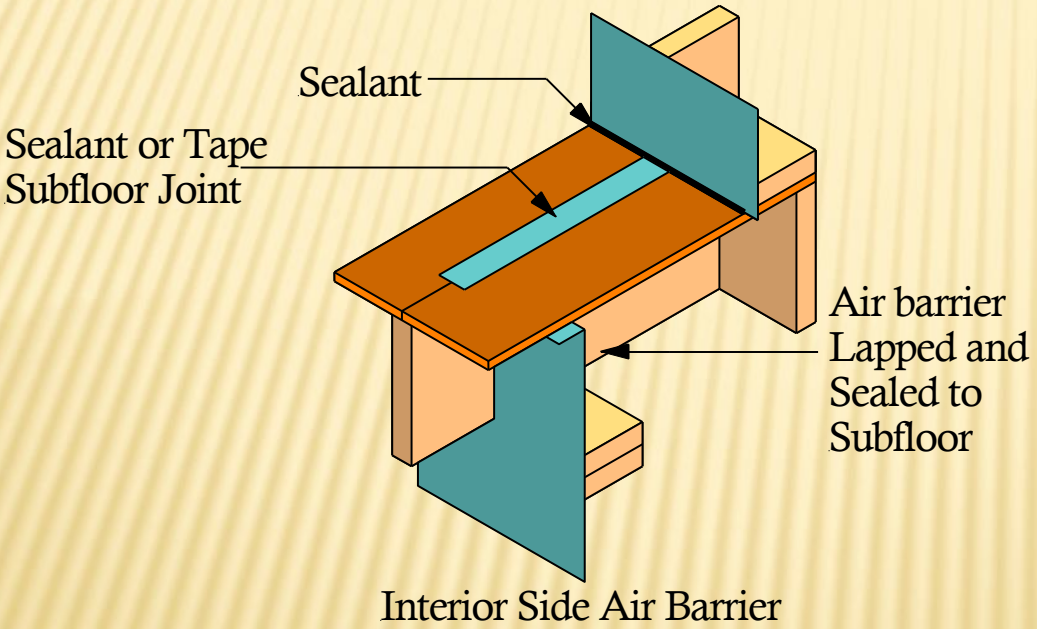
Construction of Air Barrier Details

Joints between windows, doors and skylights and wall/ceiling assemblies should not be much different that what we are currently doing.

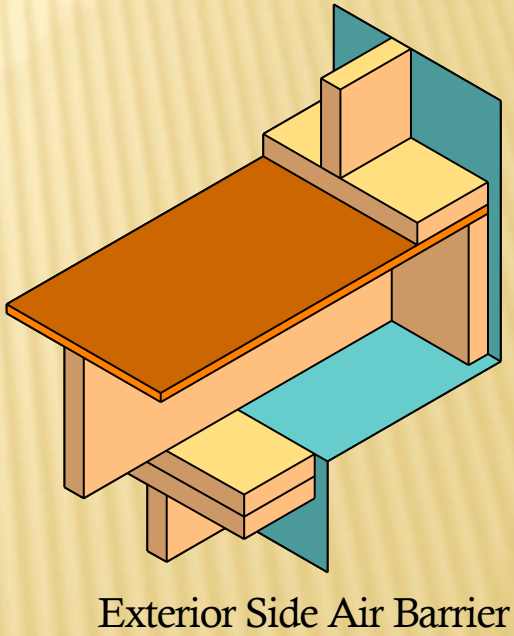
We will need to pay attention as to whether the air barrier is interior or exterior.

Construction of Air Barrier Details

Joints between cantilevered floors and floors over unheated space or exterior.

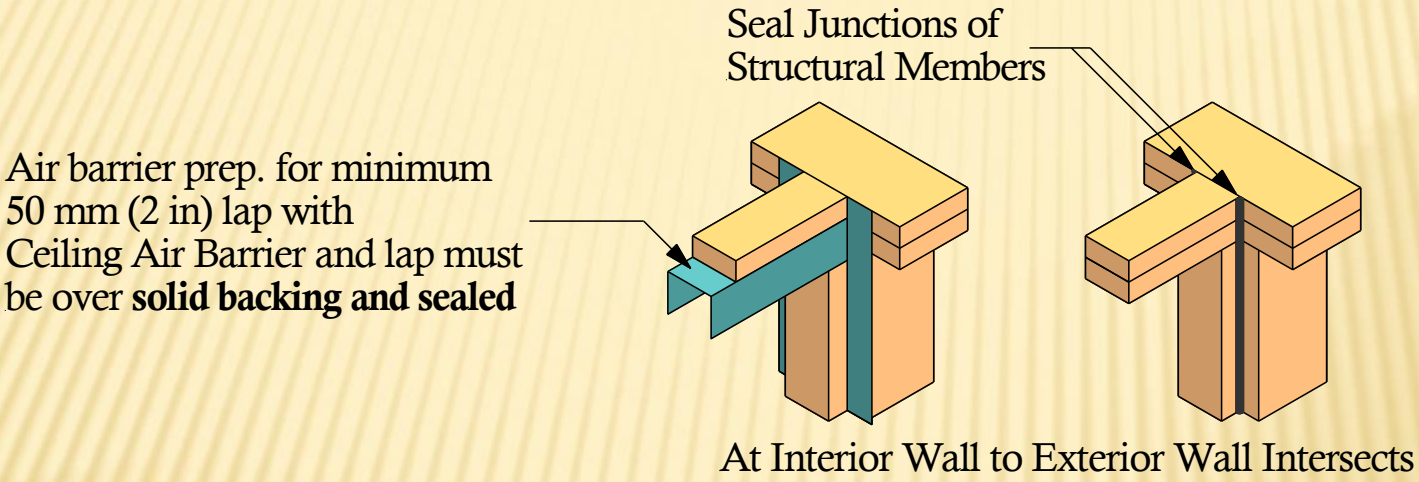


OR

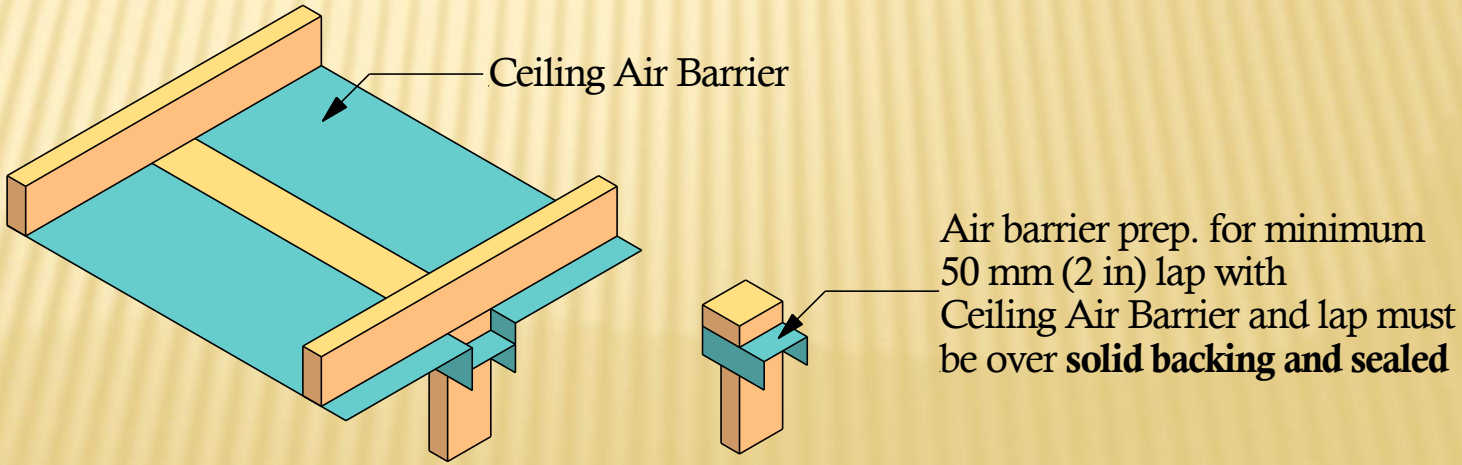


Construction of Air Barrier Details

Joints between interior walls meeting exterior walls or ceilings whose plane of **airtightness is on the interior**



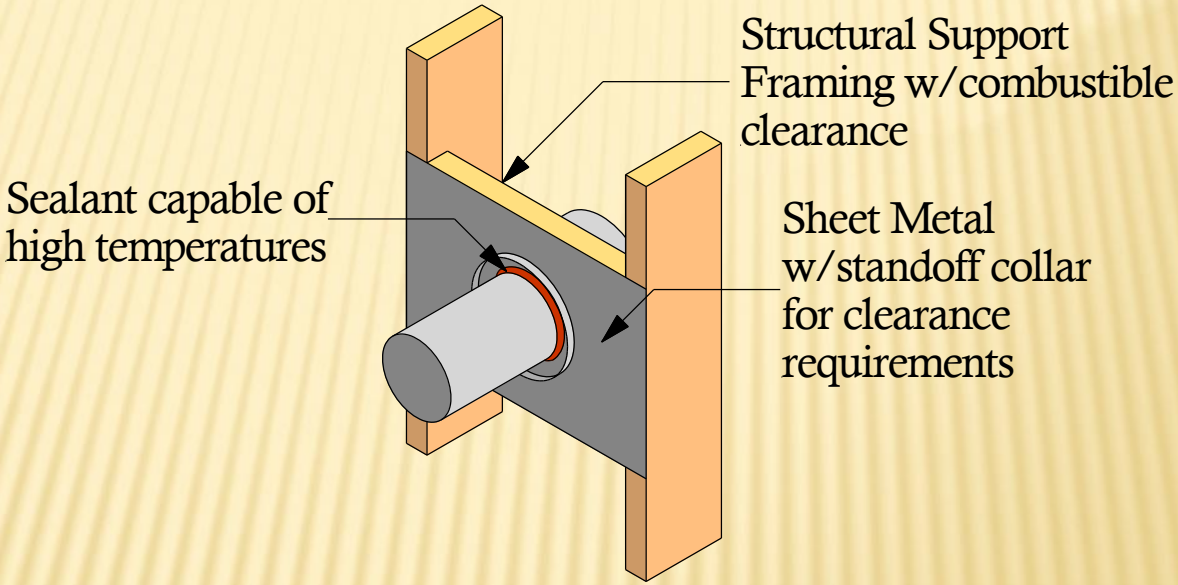
At Interior Wall to Exterior Wall Intersects



At Ceilings to Interior Wall Intersects

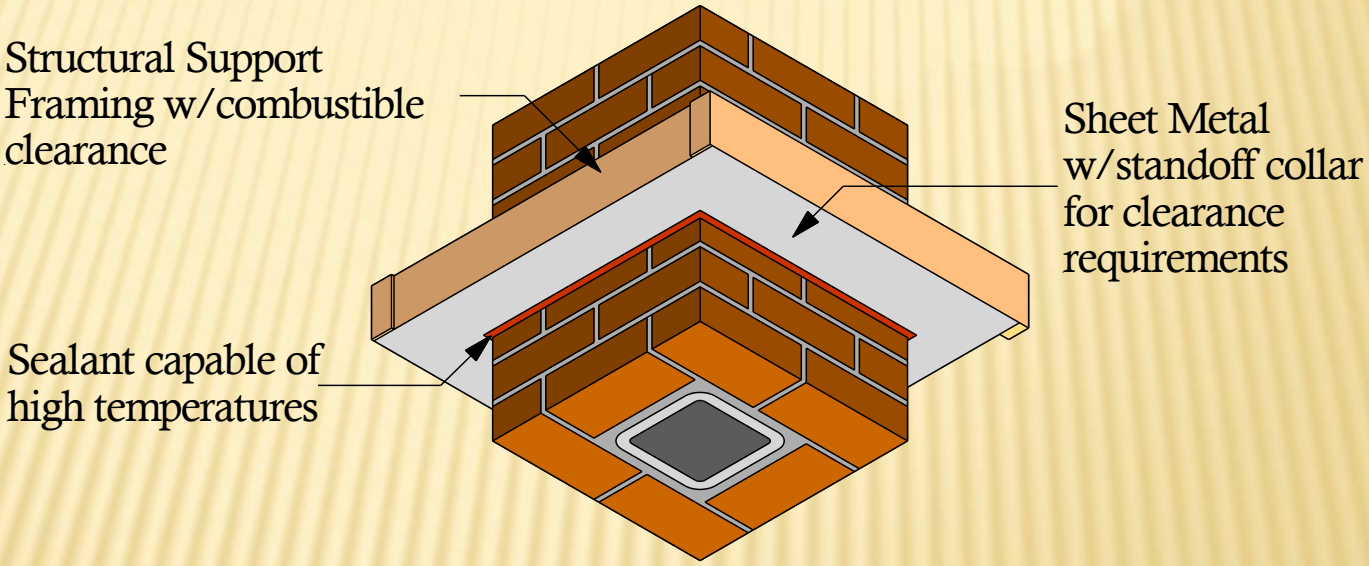
Construction of Air Barrier Details

Joints between steel-lined chimneys that penetrate the building envelope.



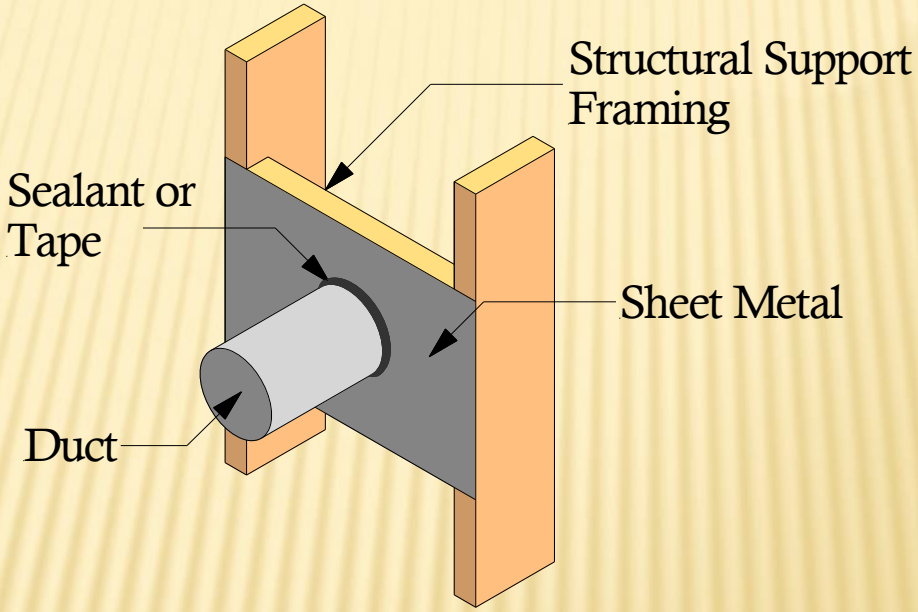
Construction of Air Barrier Details

Joints between masonry or concrete chimneys that penetrate the building envelope.



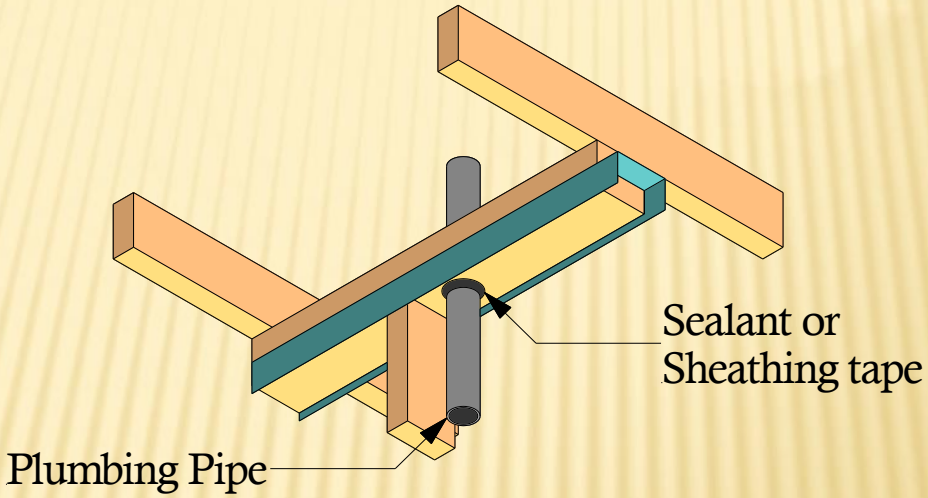
Construction of Air Barrier Details

Joints between ducts that penetrate the building envelope.



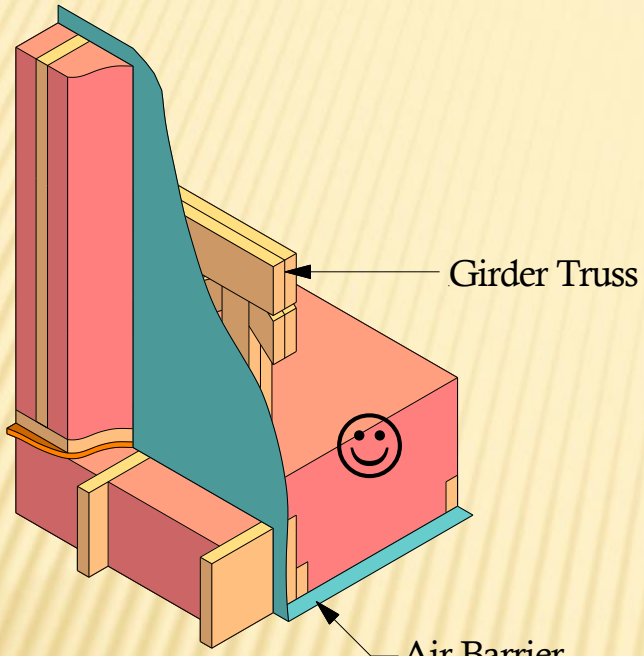
Construction of Air Barrier Details

Joints between plumbing stack vents that penetrate a building envelope.

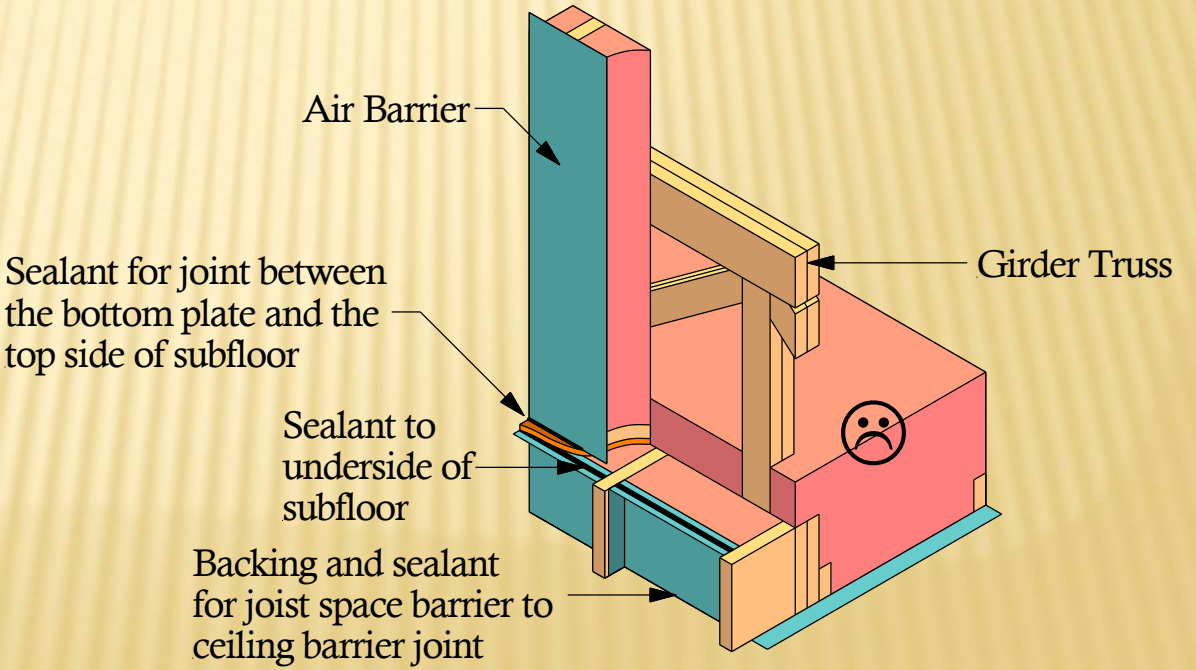


Construction of Air Barrier Details

Other critical joints that penetrate a building envelope.



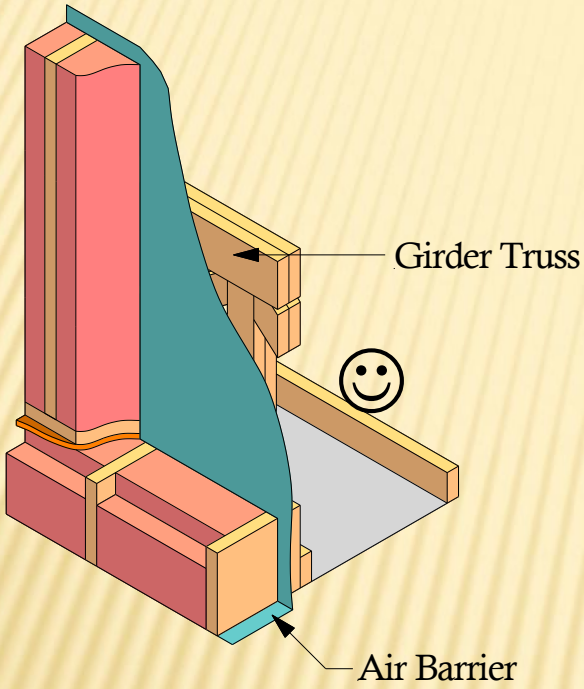
At Insulated Attic to Wall Intersects



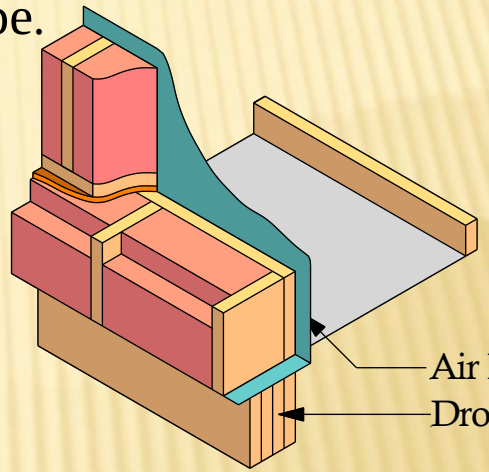
At Insulated Attic to Wall Intersects

Construction of Air Barrier Details

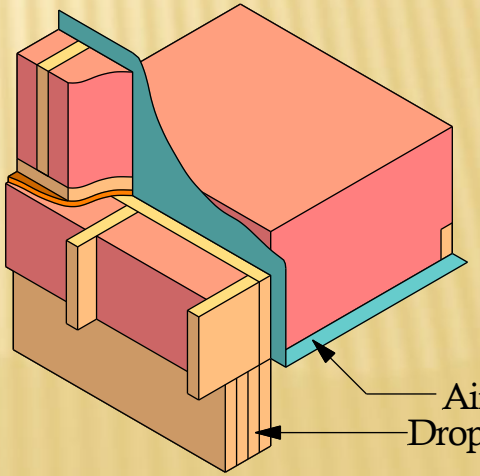
Other critical joints that penetrate a building envelope.



At Uninsulated Attic to Wall Intersects



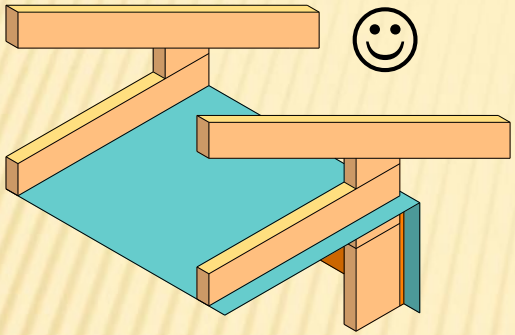
At Uninsulated Attic to Wall Intersects



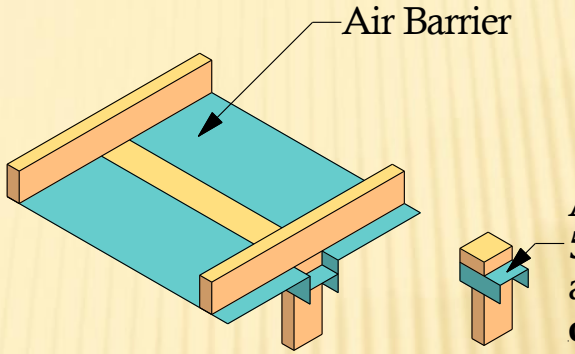
At Insulated Attic to Wall Intersects

Construction of Air Barrier Details

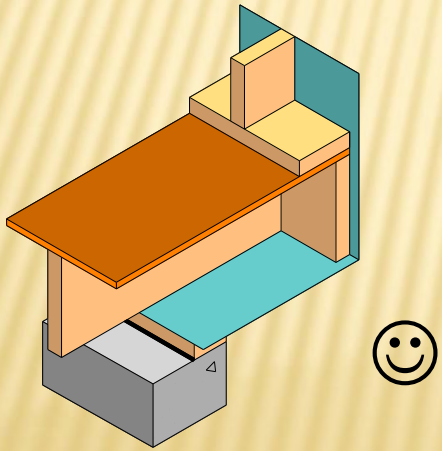
Other critical joints that penetrate a building envelope.



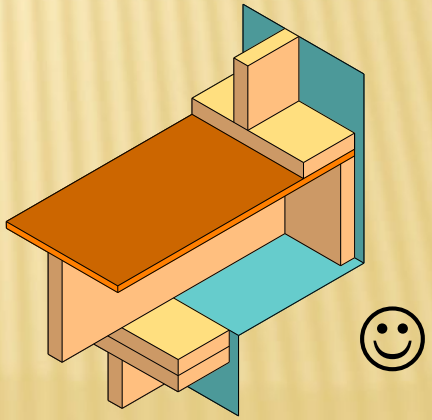
At Ceiling to Exterior Wall Intersects



At Ceiling to Interior Wall Intersects



At Cantilevered Floor to Foundation Wall Intersects



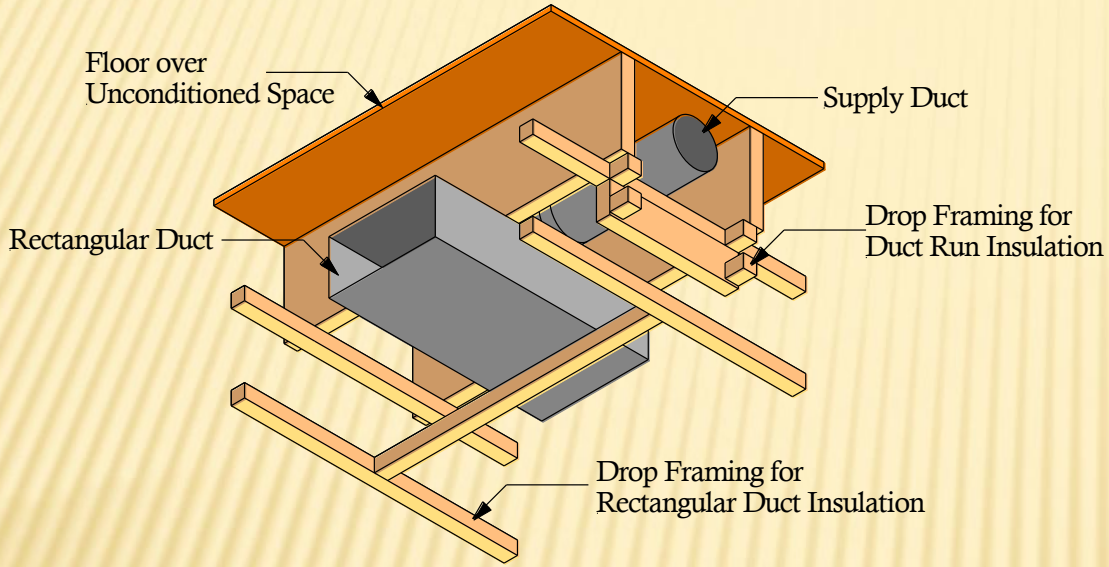
At Cantilevered Floor to Wall Intersects

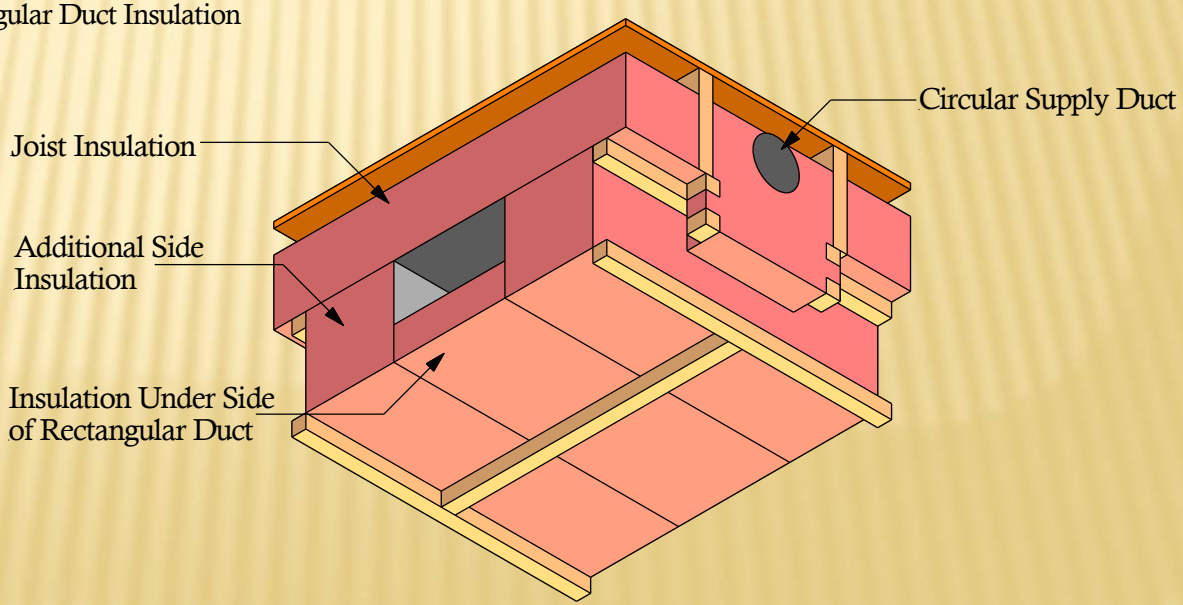
9.36.3. HVAC Requirements

Allows for a reduced level of insulation on the underside of rectangular ducts (assuming this to be for supply and return air ducts in a forced air heating and/or cooling system) located under an insulated floor over unconditioned space (does not include over exterior space) to not less than 2.11 RSI (R-12). This is permitted provided we insulate both sides of the duct to a higher thermal resistance. The Appendix A comment for this Sentence provides a Table to assist designers in determining the level of insulation required to compensate for the reduced under duct insulation, but unfortunately only considers one duct depth of 127 mm (5 in).
Example:
An exterior wall assembly in Zone 4 for a non HRV building in Table 9.36.2.6.A. requires and effective thermal resistance of 2.78 RSI (R-15.8).
The Table in Appendix A-9.36.3.2.(5) doesn't list a 2.11 RSI value therefore we will use 2.29 RSI (R-13)
If a 304 mm (12 in) wide duct is used then the side RSI value required would be 4.47 (R-25.4)

9.36.3. HVAC Requirements

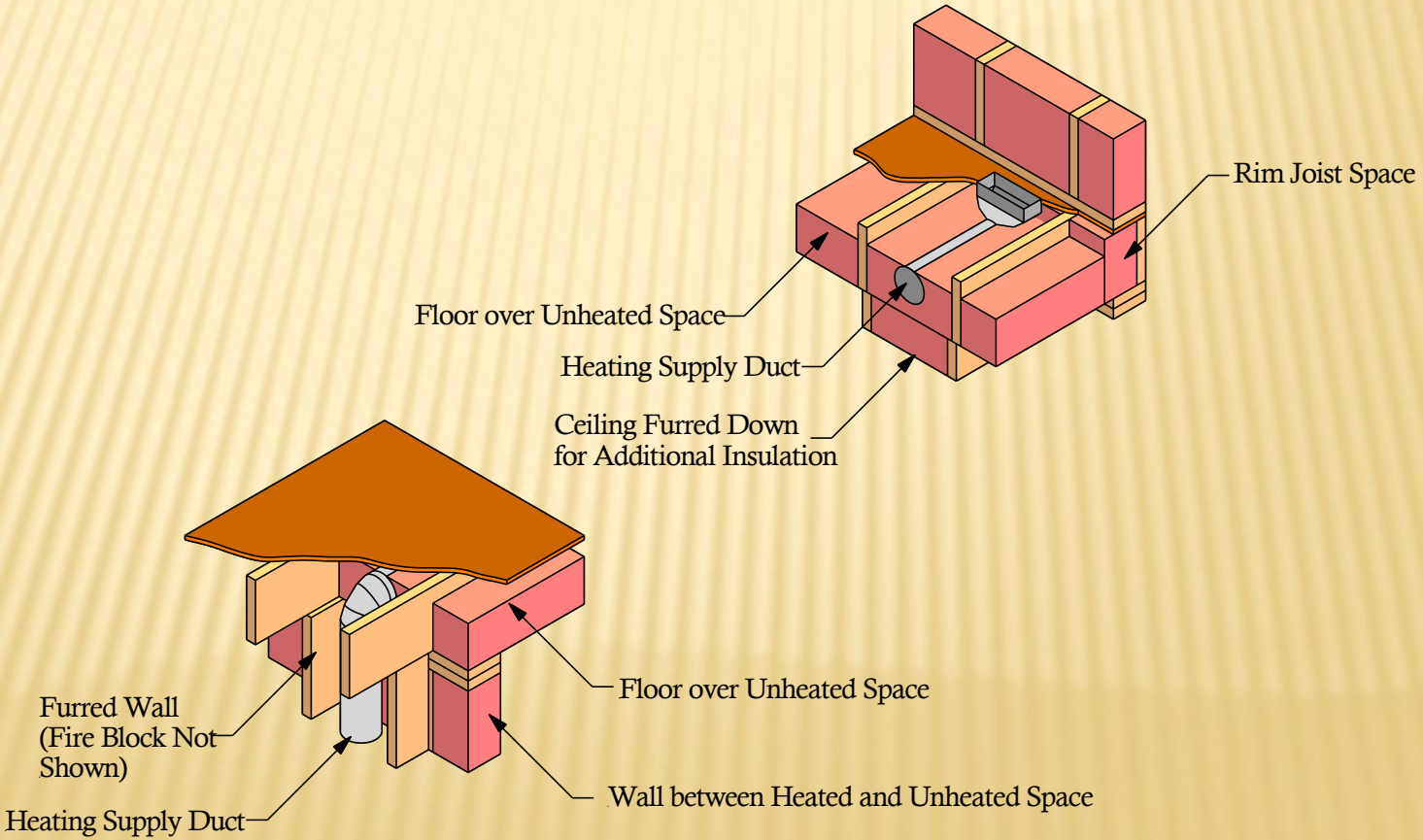
Insulation for HVAC ducting will require much more attention than in the past. Drop framing will be deeper under ducts and much wider on the sides of ducts.





9.36.3. HVAC Requirements

Insulation for HVAC ducting will require much more attention than in the past. Ducts running in joist spaces will now require drop framing beneath them in order to accommodate the thermal insulation required under them and will no longer fit in a wall frame required to be insulated.



END OF PRESENTATION