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Building Science

Adventures In Building Science

www.buildingscience.com

What is a Building?

A Building is an Environmental Separator

- Control heat flow
- Control airflow
- Control water vapor flow
- Control rain
- Control ground water
- Control light and solar radiation
- Control noise and vibrations
- Control contaminants, environmental hazards and odors
- Control insects, rodents and vermin
- Control fire
- Provide strength and rigidity
- Be durable
- Be aesthetically pleasing
- Be economical

Arrhenius Equation

For Every 10 Degree K Rise
Activation Energy Doubles

$$k = Ae^{-E_a/(RT)}$$

Damage Functions

Water

Heat

Ultra-violet Radiation

2nd Law of Thermodynamics

Heat Flow Is From Warm To Cold

Moisture Flow Is From Warm To Cold

Moisture Flow Is From More To Less

Air Flow Is From A Higher Pressure to a
Lower Pressure

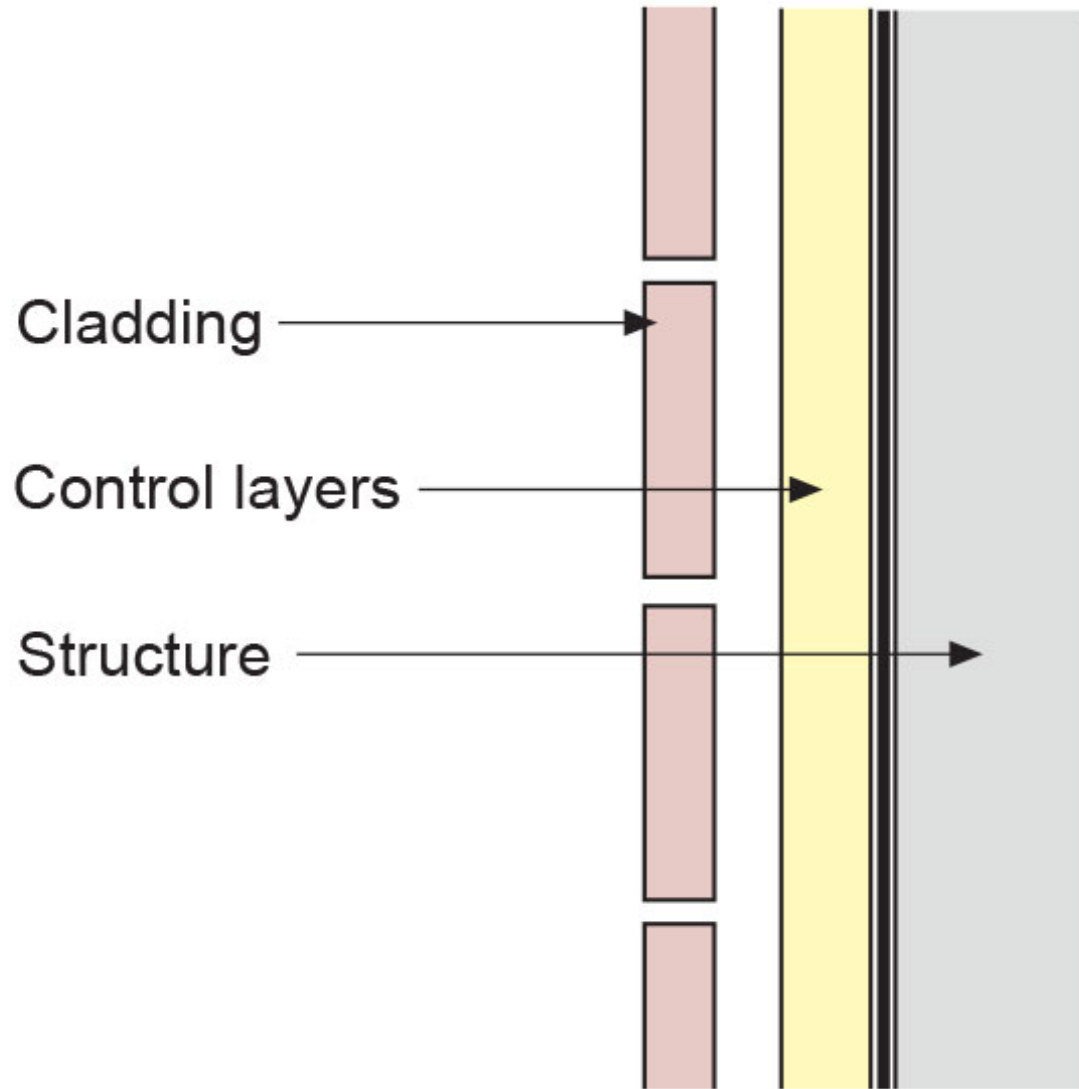
Gravity Acts Down

Water Control Layer

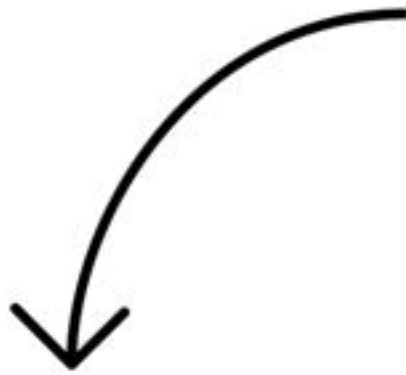
Air Control Layer

Vapor Control Layer

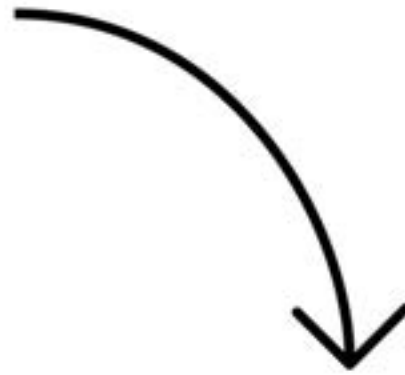
Thermal Control Layer



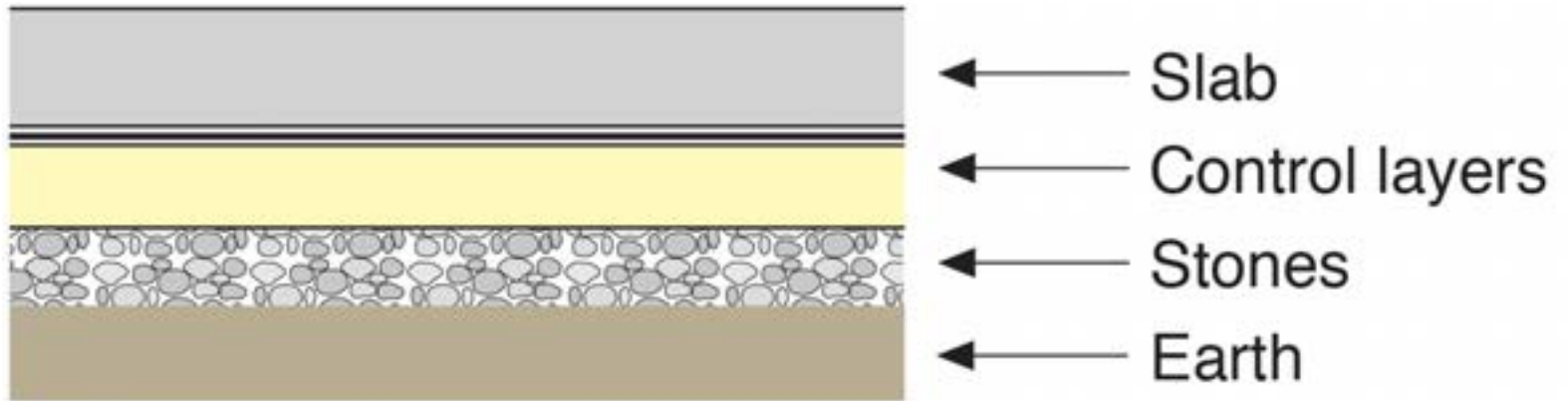
Wall



Slab

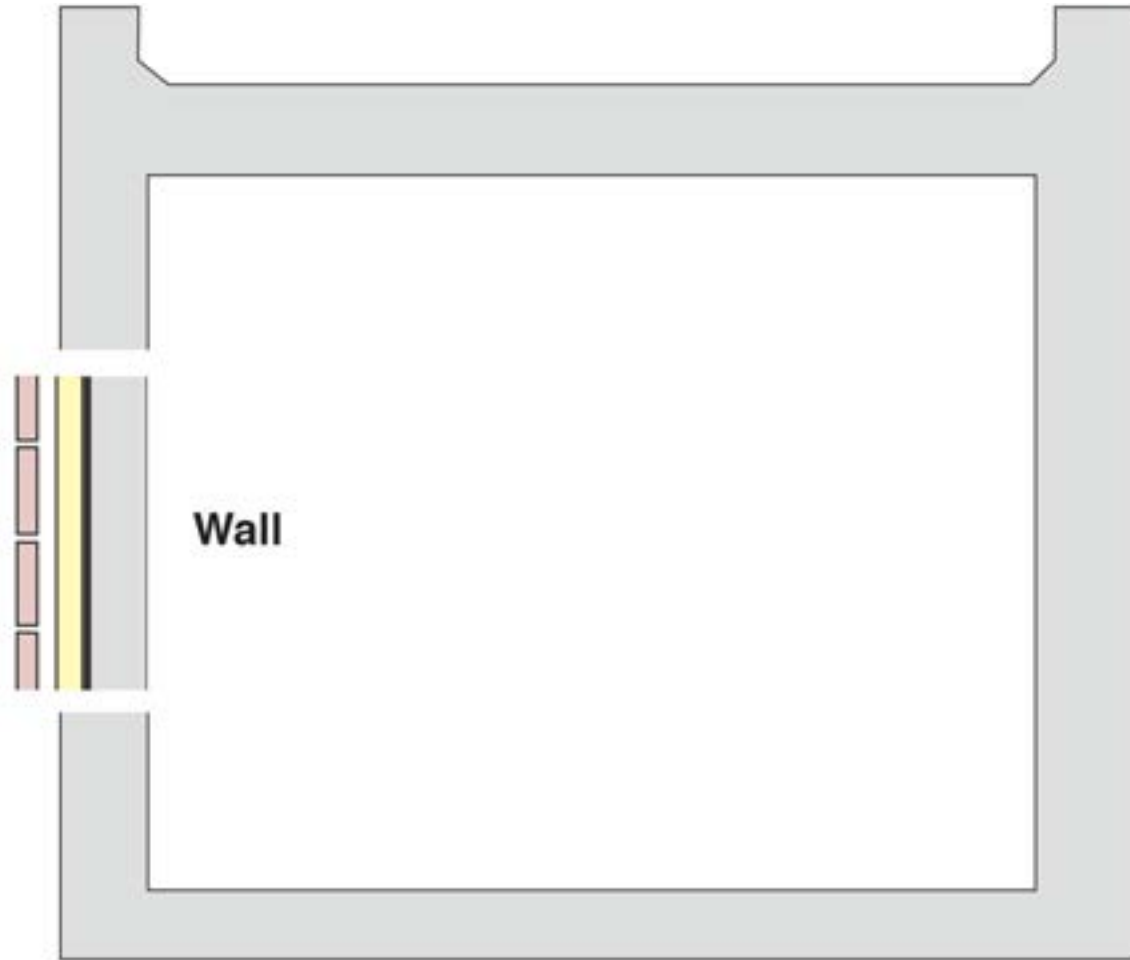


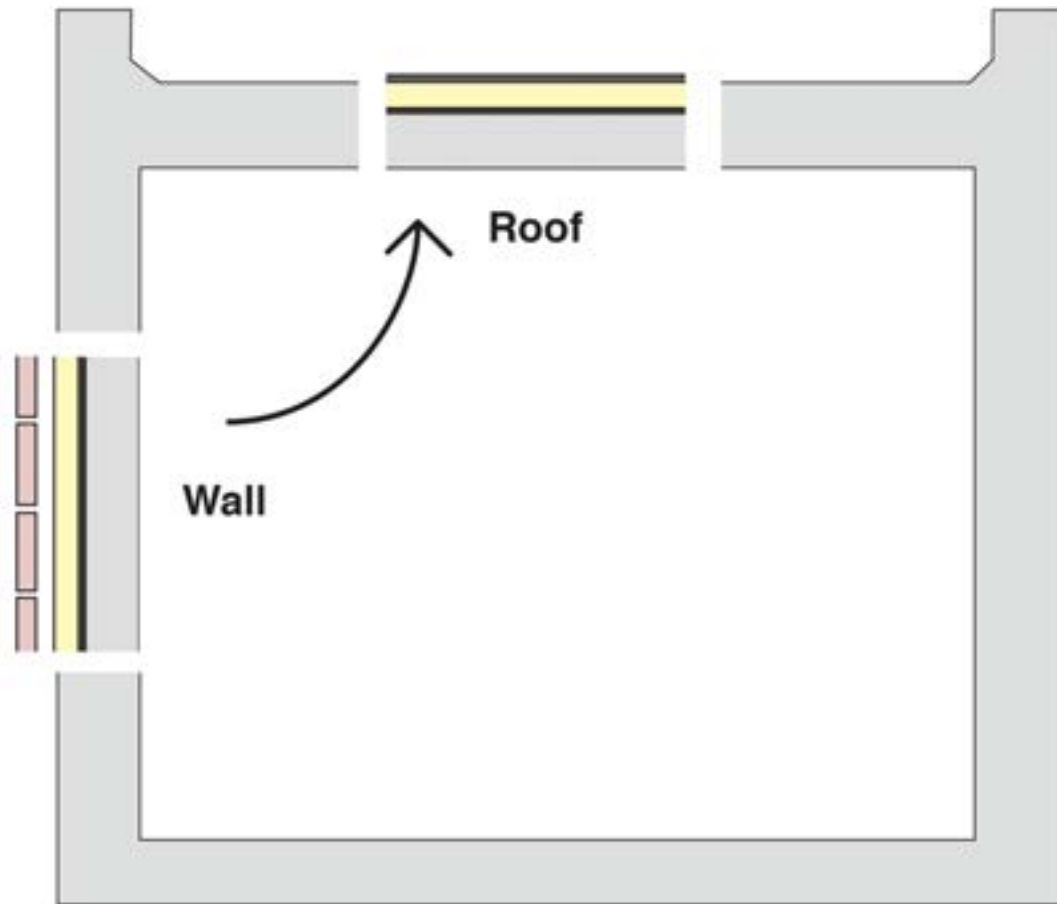
Roof

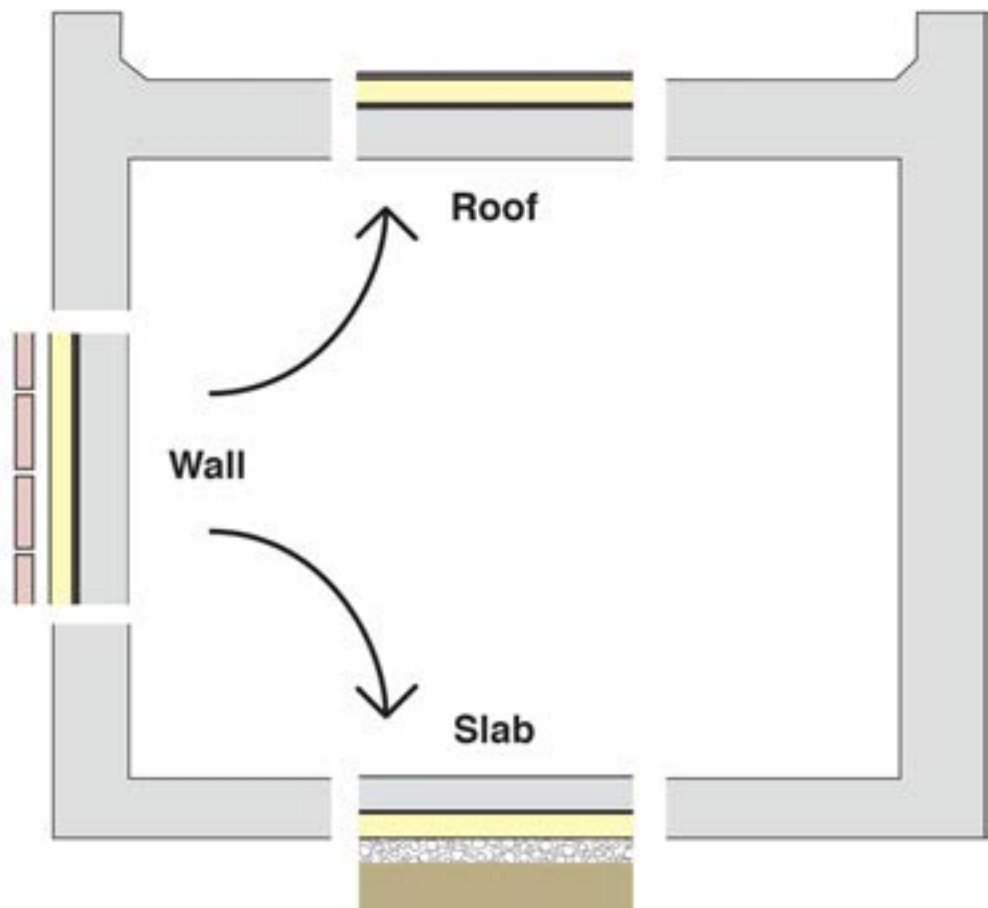


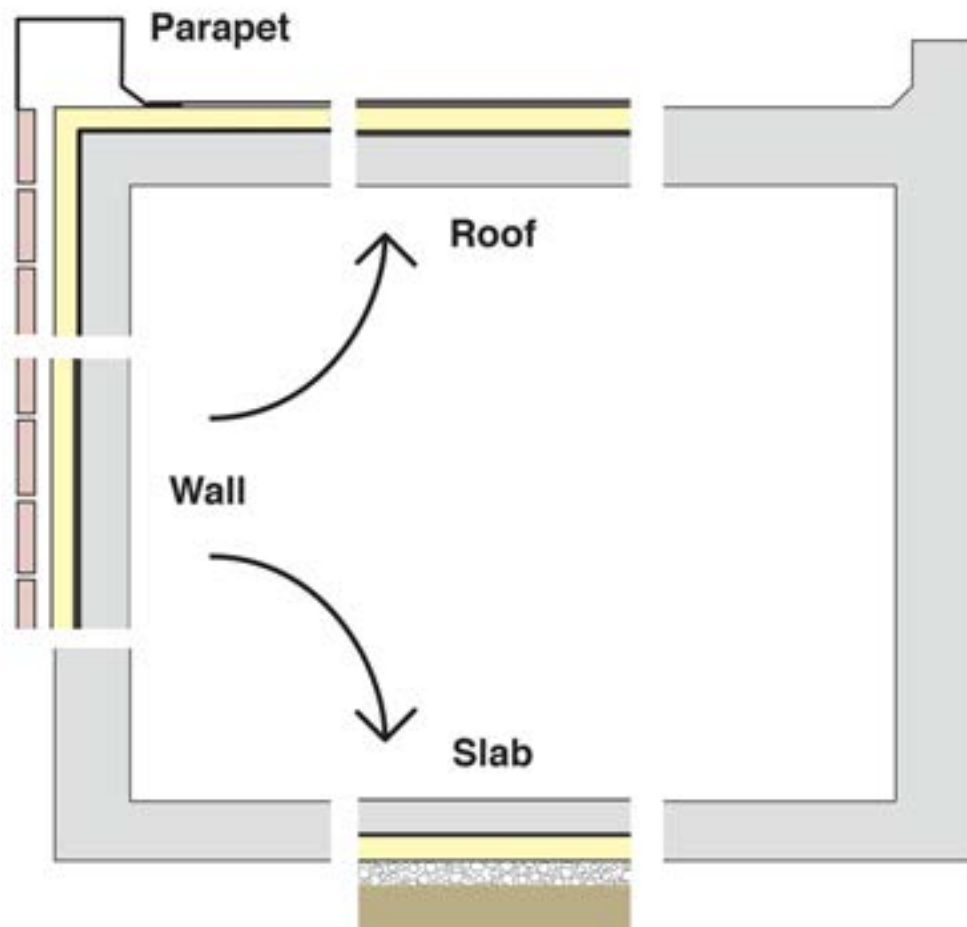


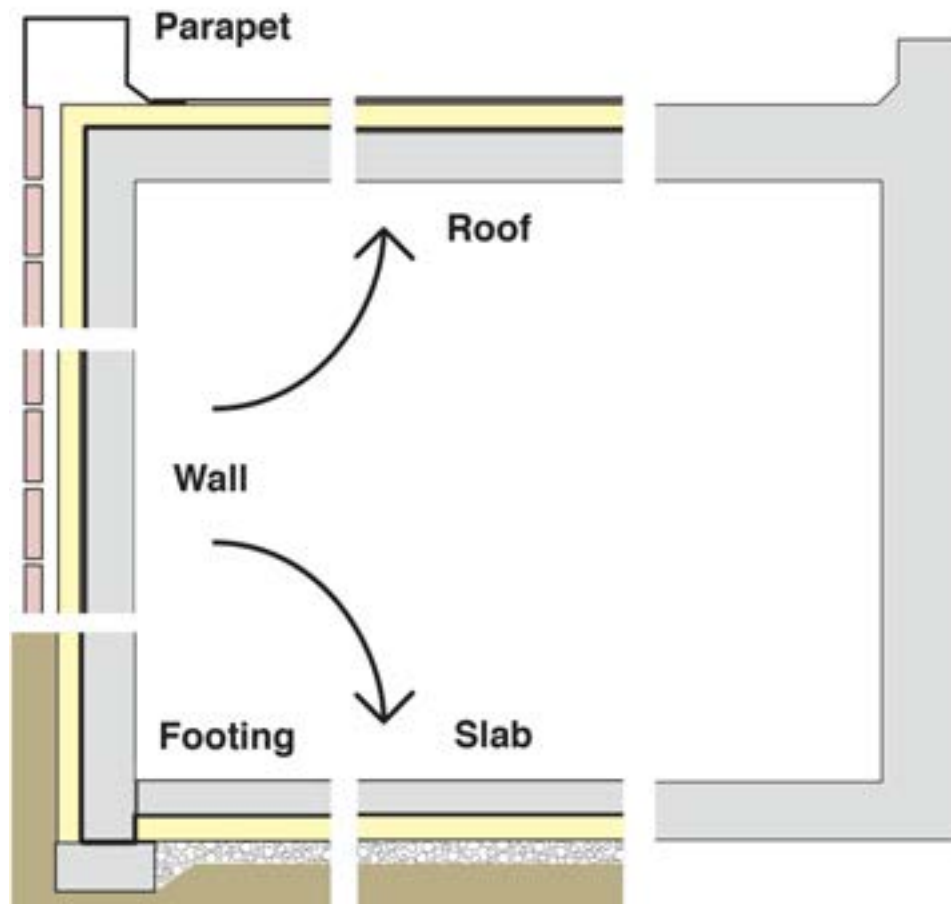


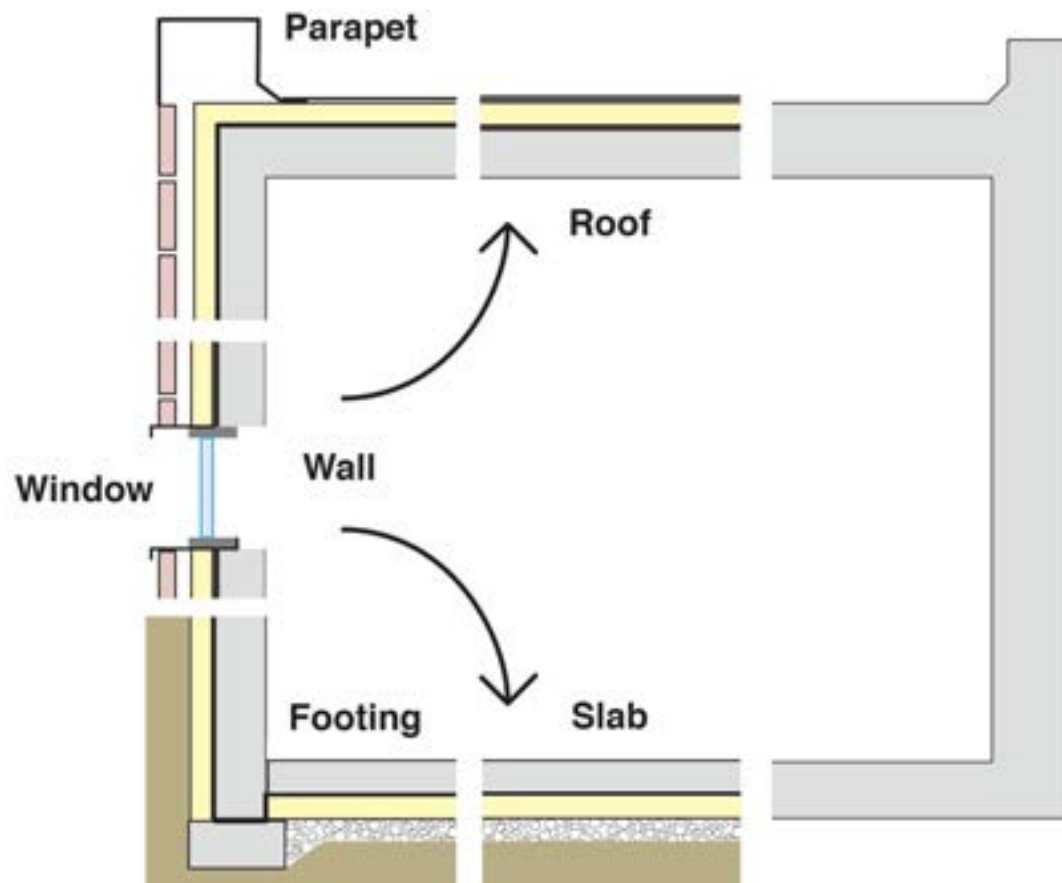


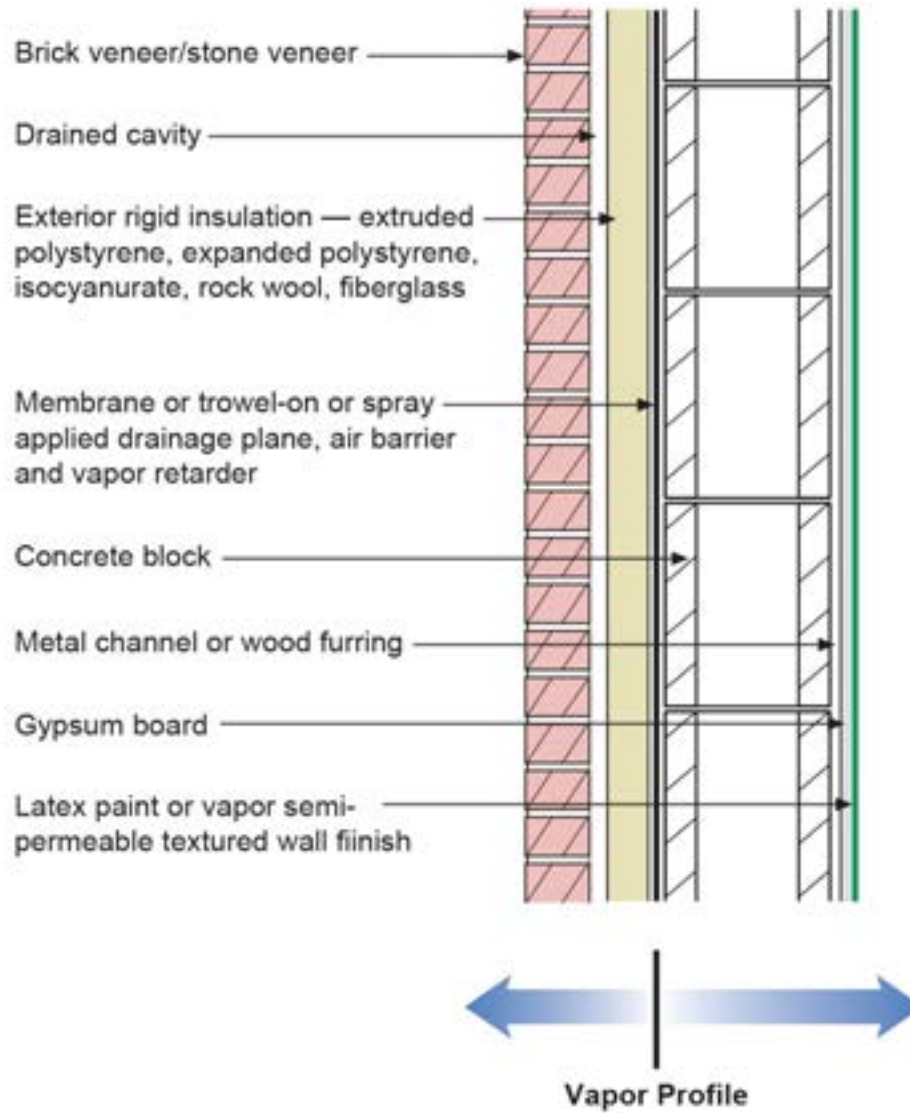


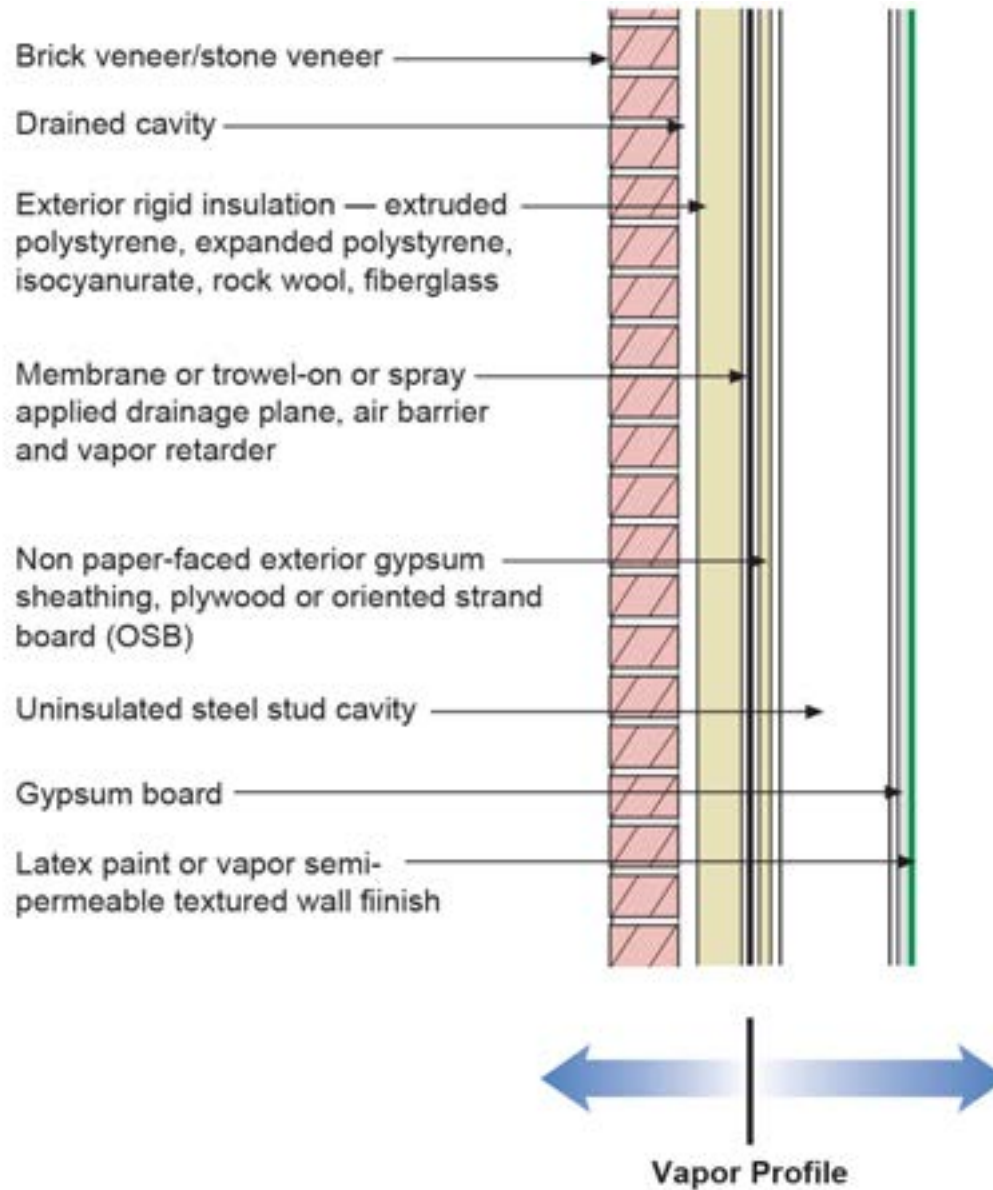


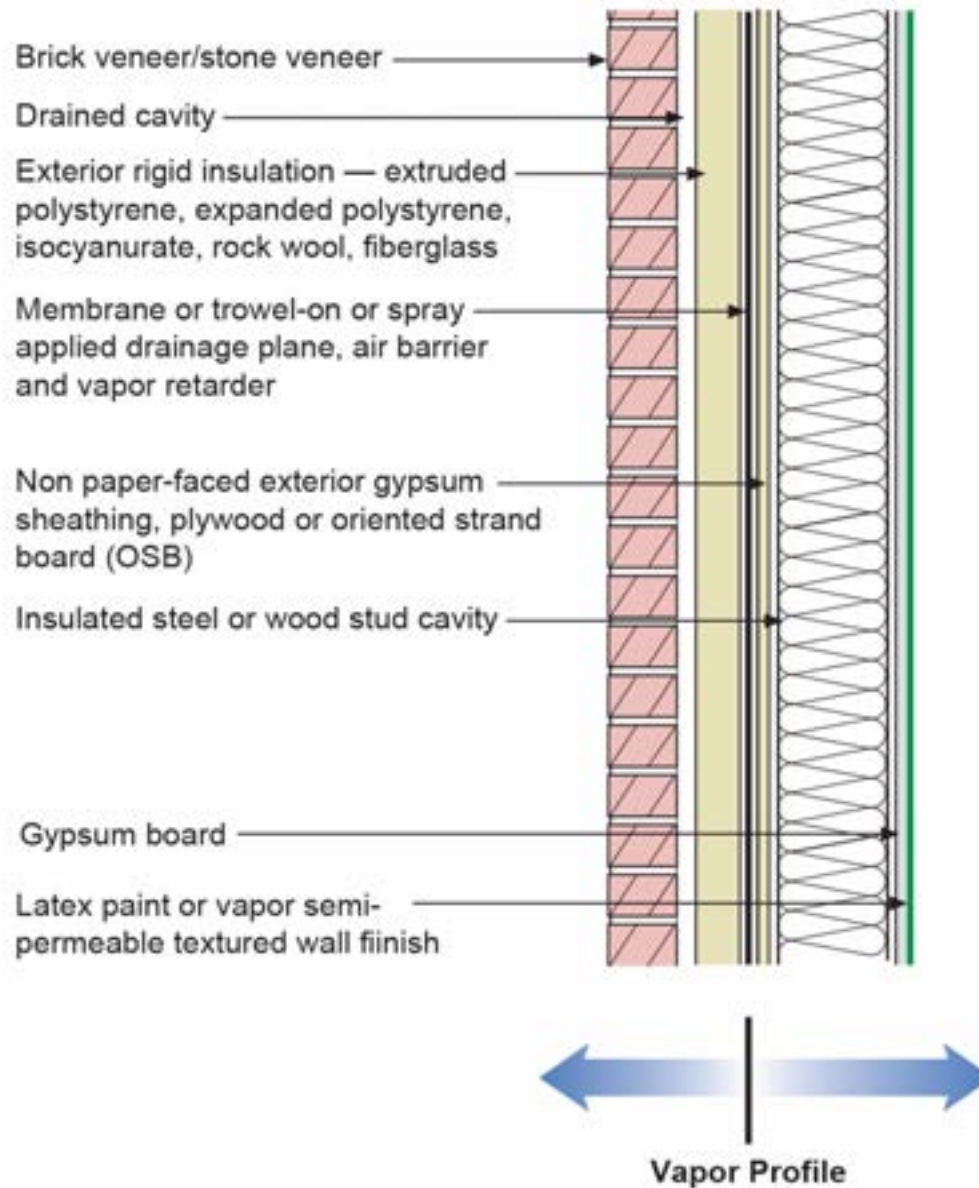












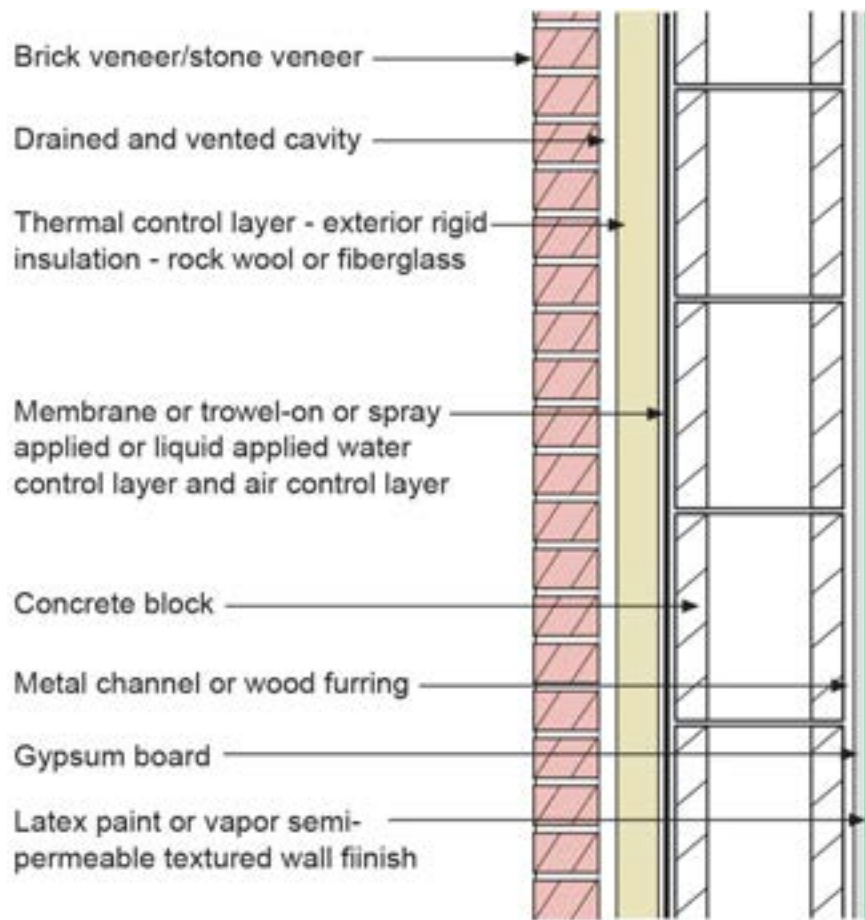


Figure 2a



Vapor Profile

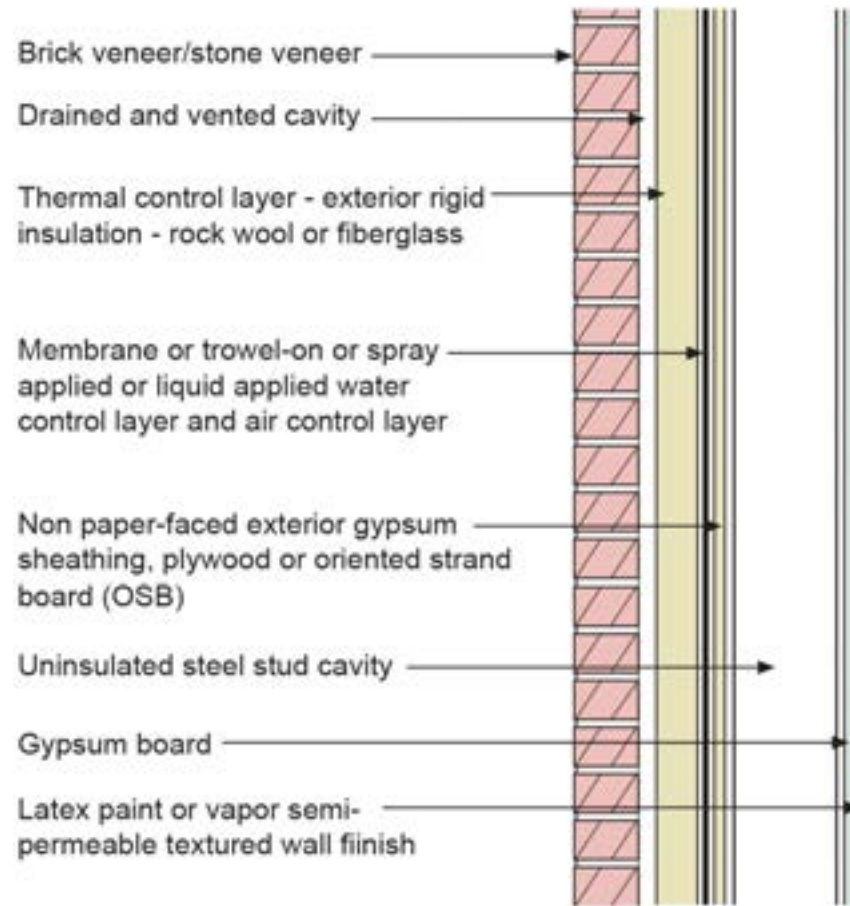


Figure 2b



Vapor Profile

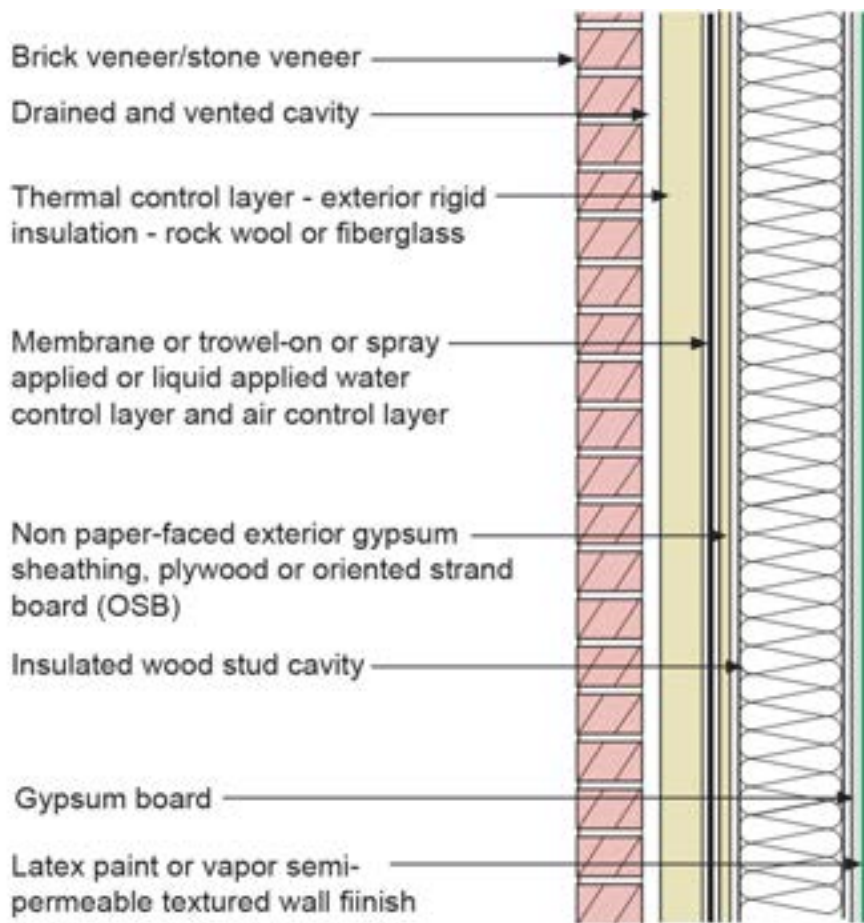
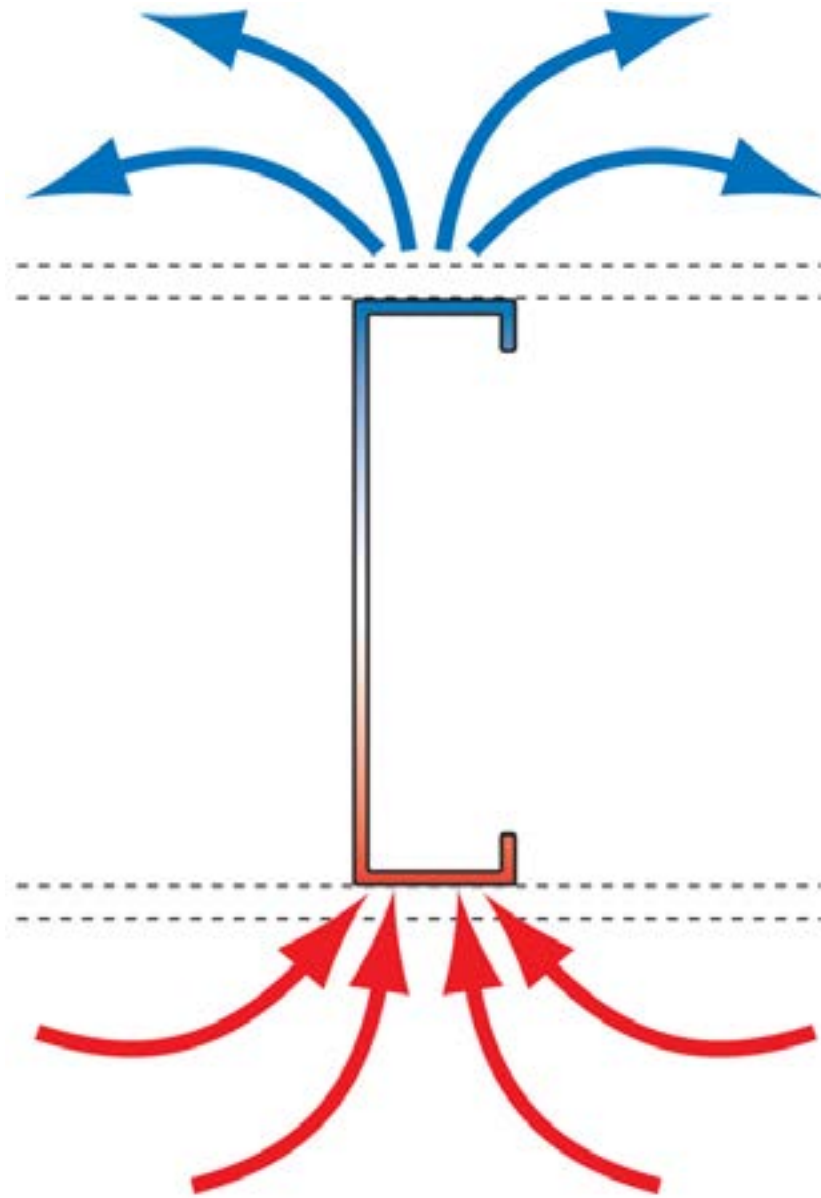


Figure 2c

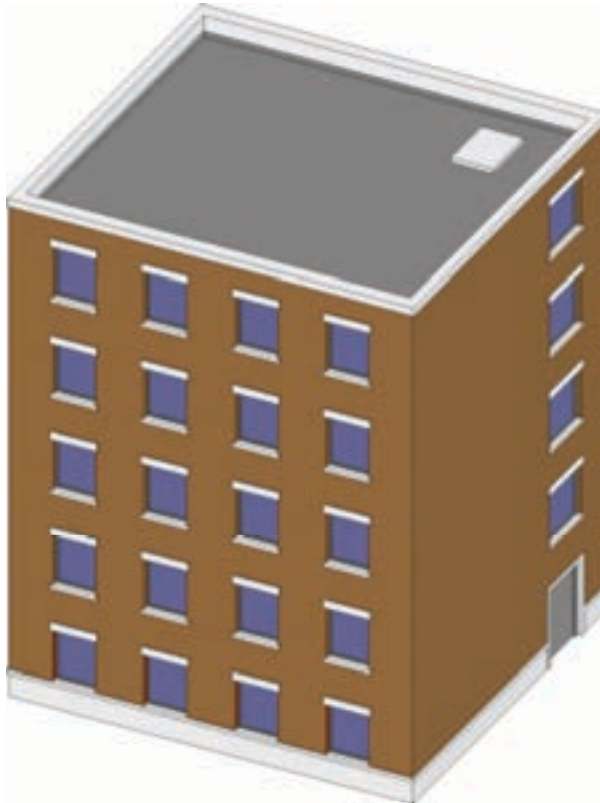


Vapor Profile

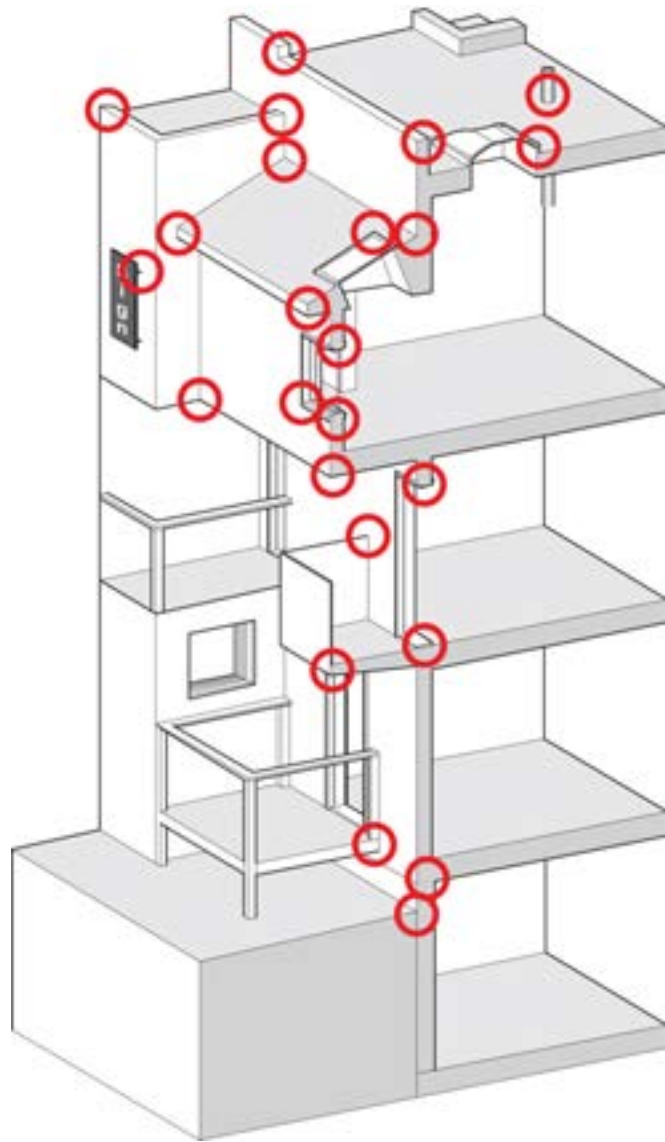




Commercial Enclosure: Simple Layers



- Structure
- Rain/Air/Vapor
- Insulation
- Finish













































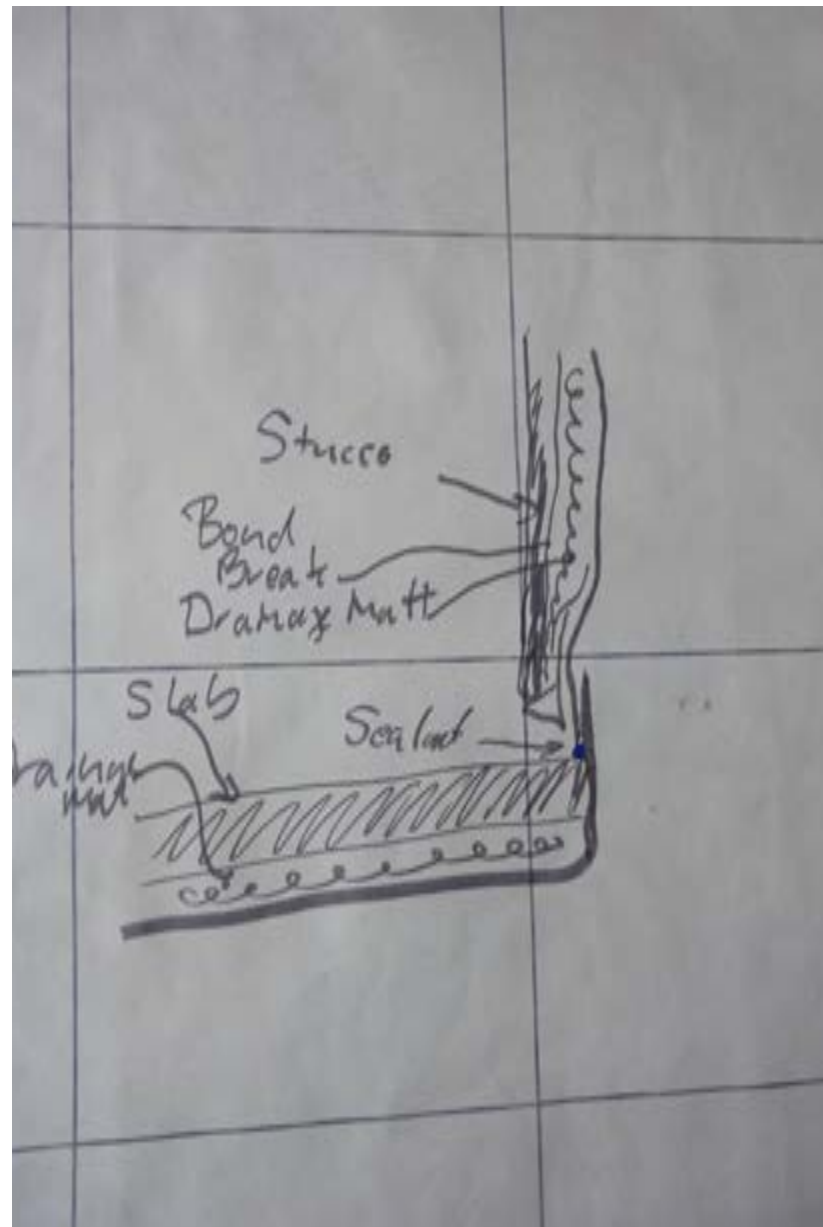














































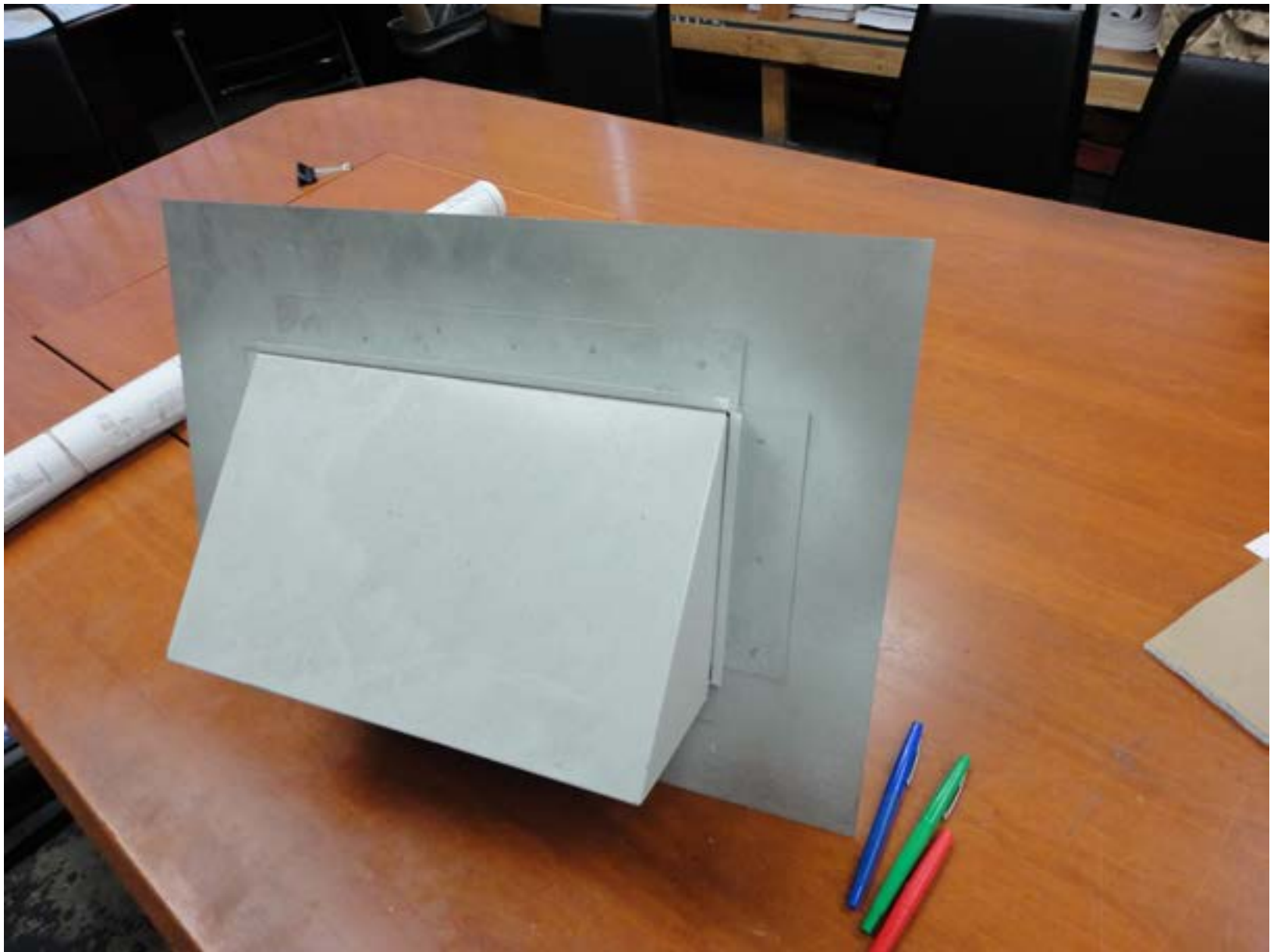




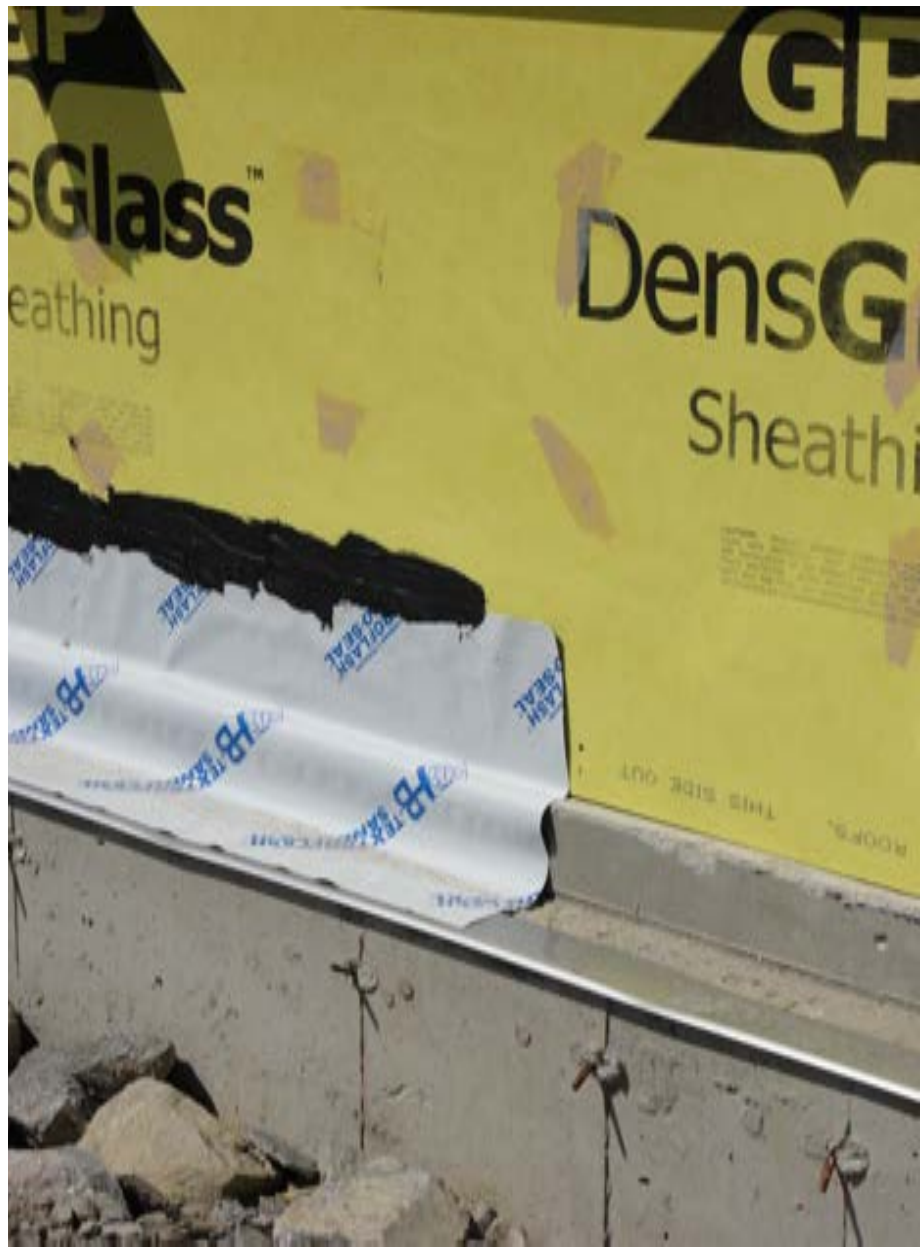




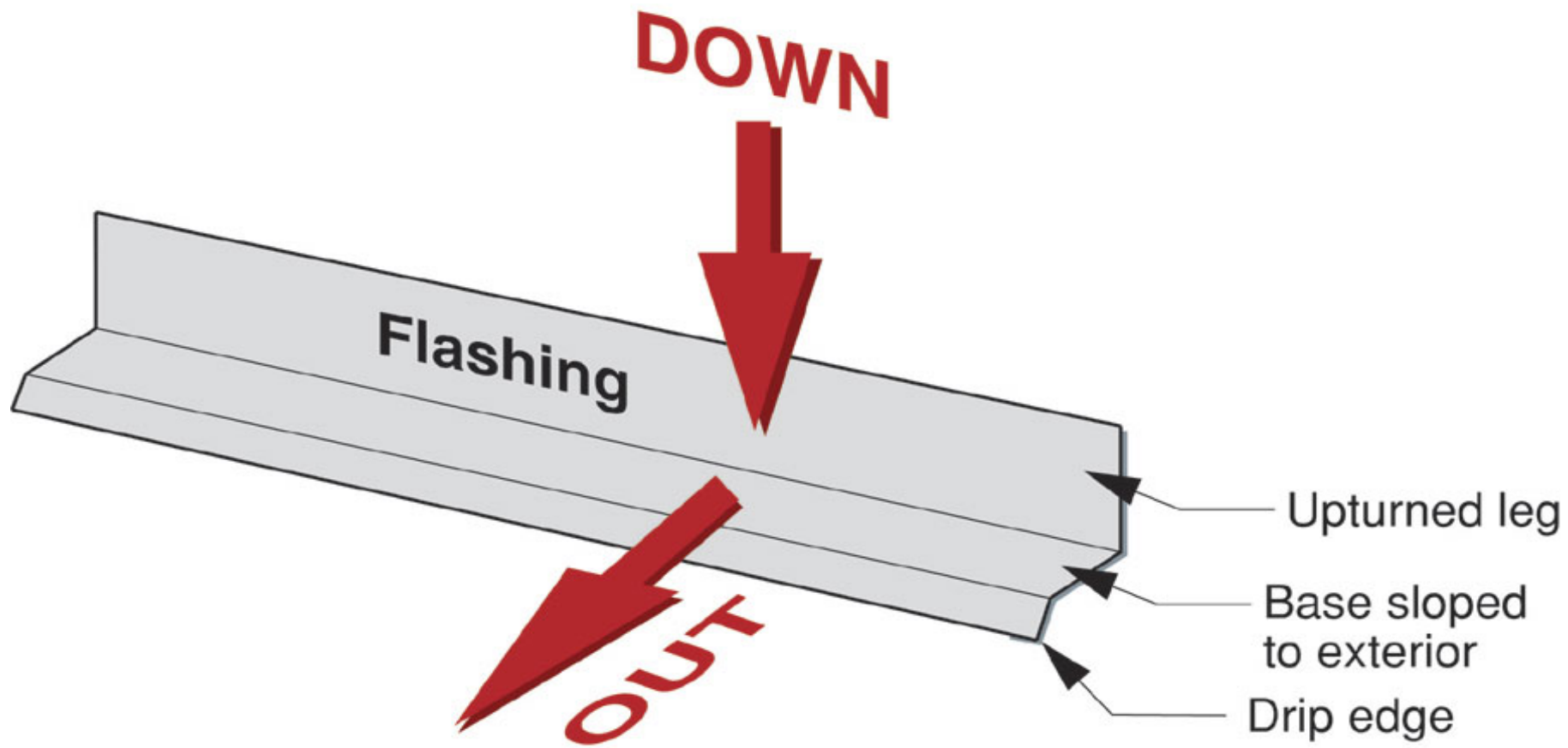


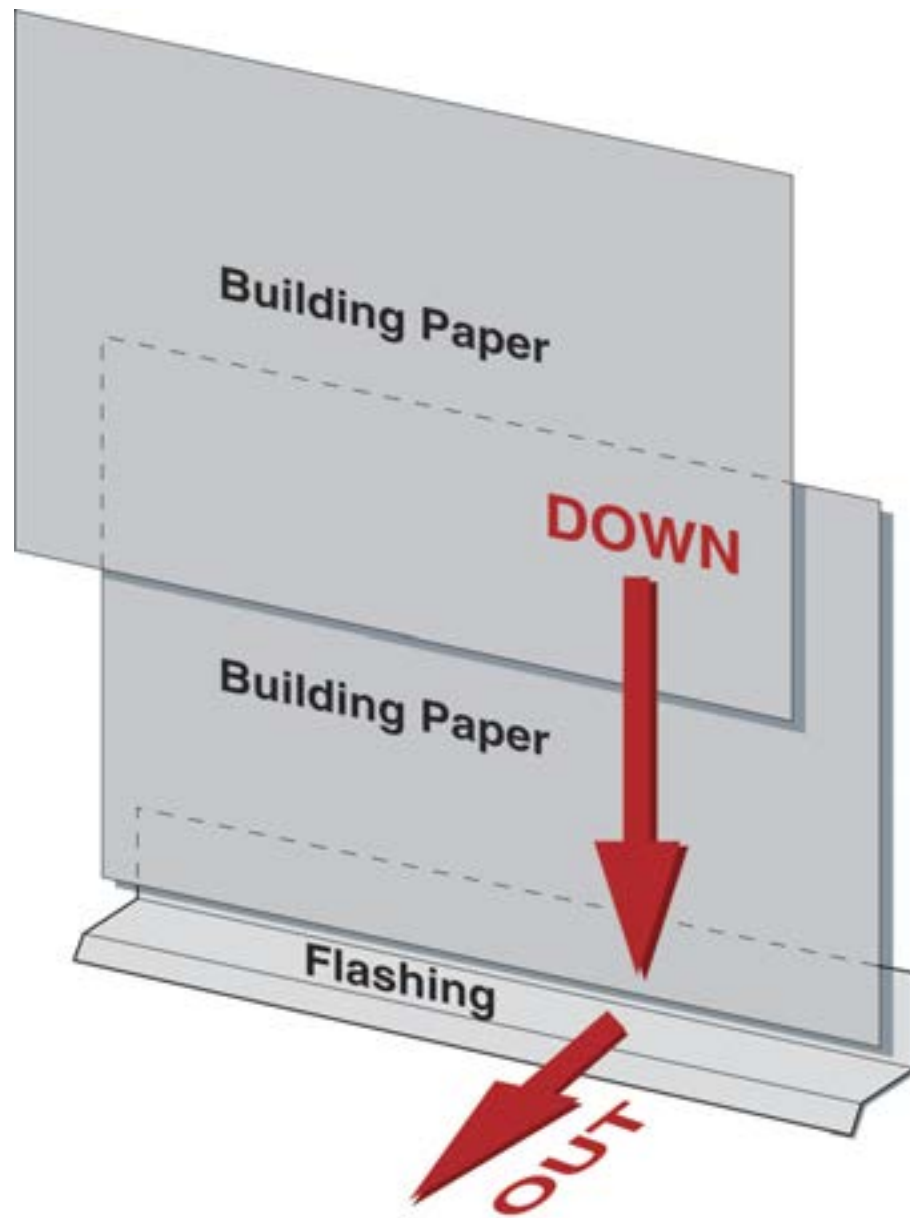


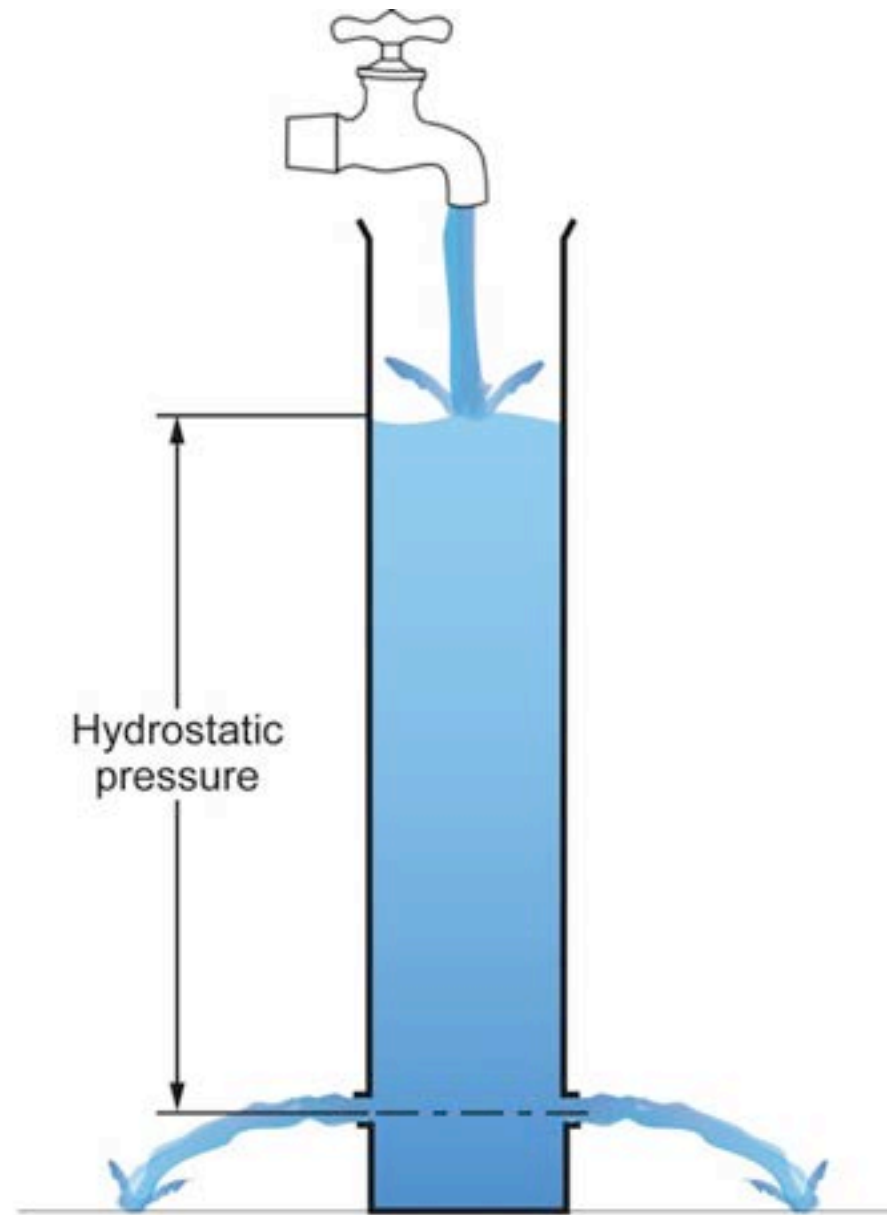
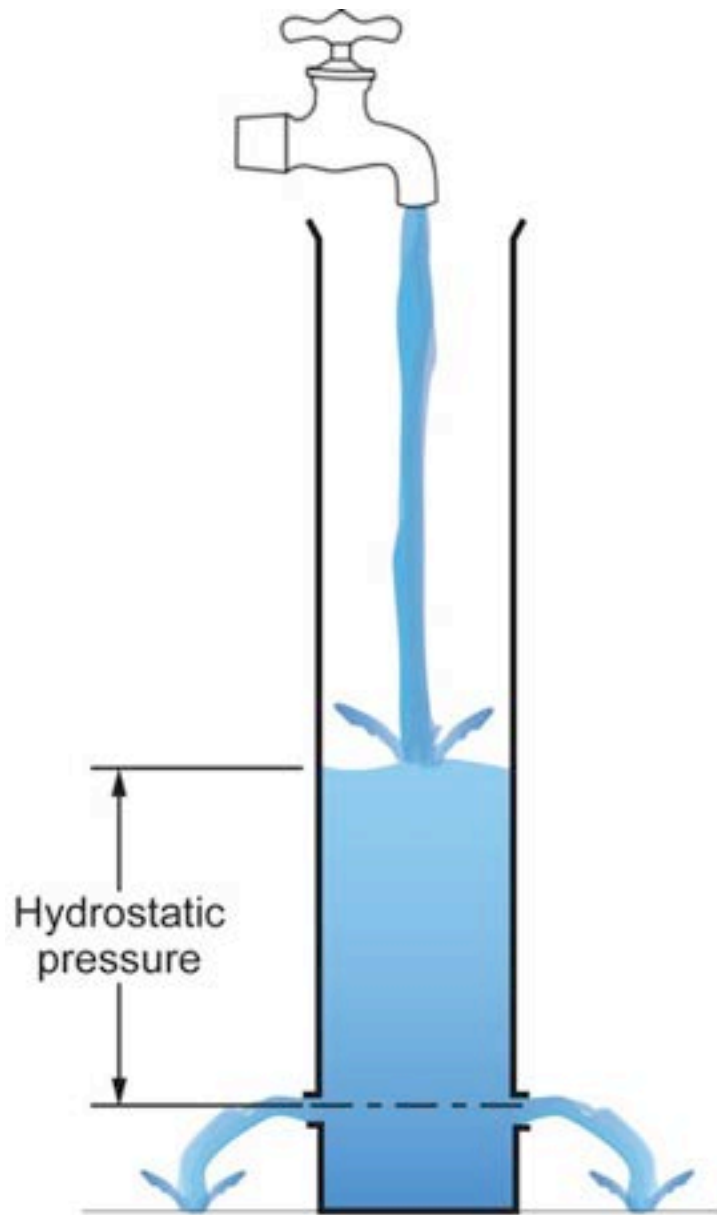




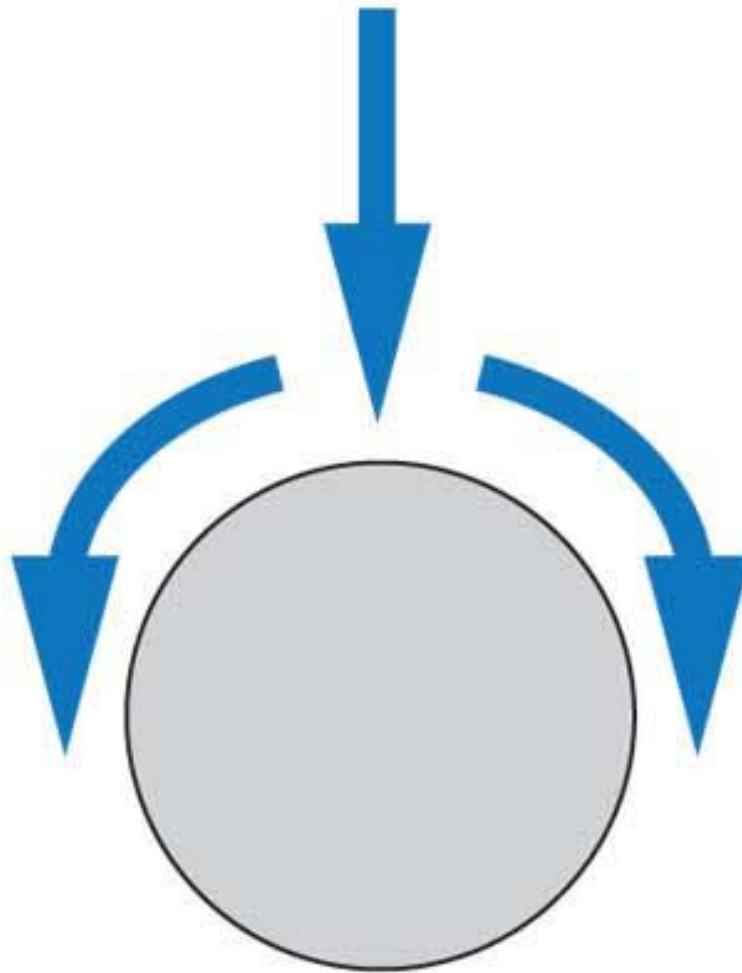


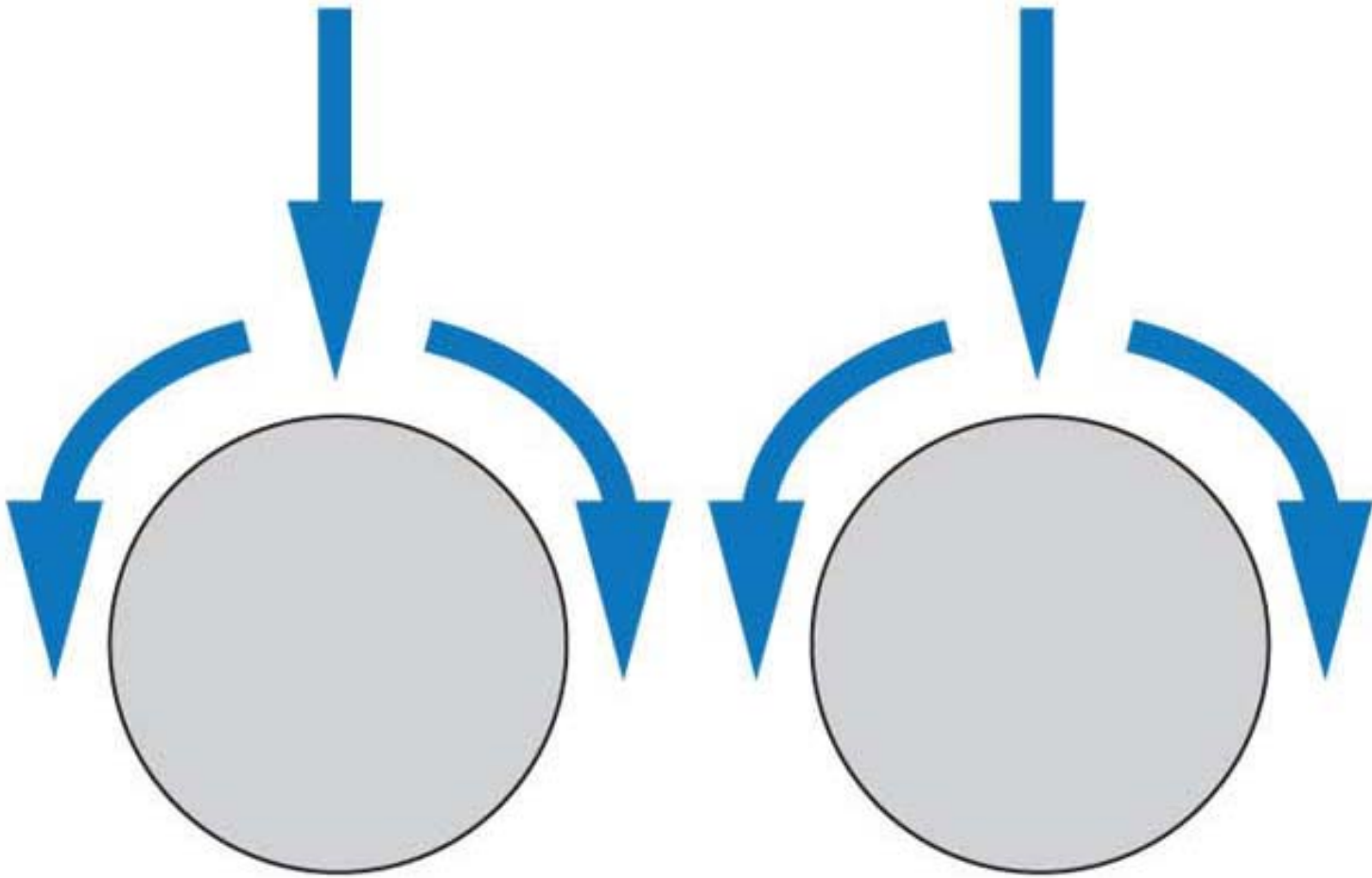


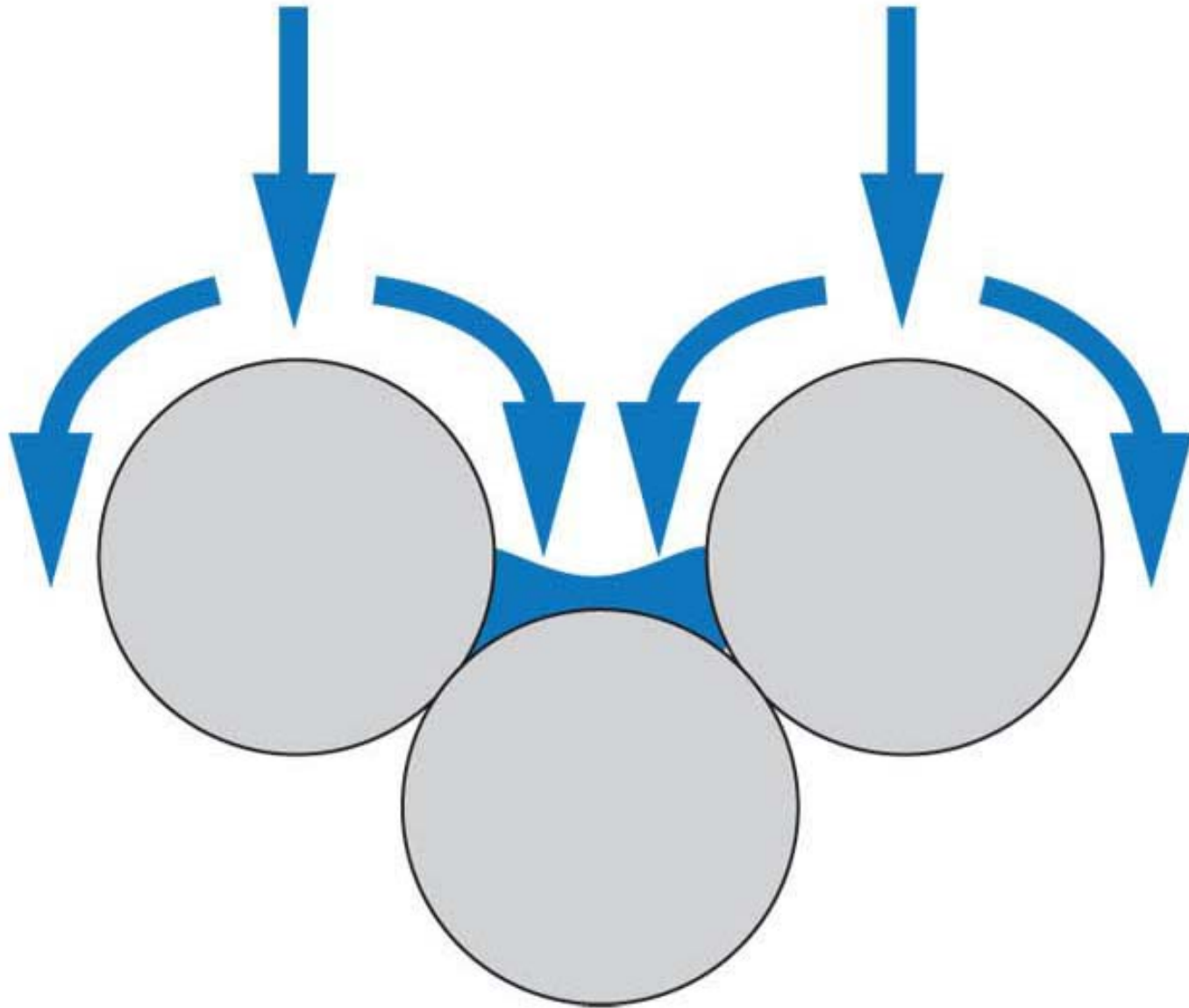


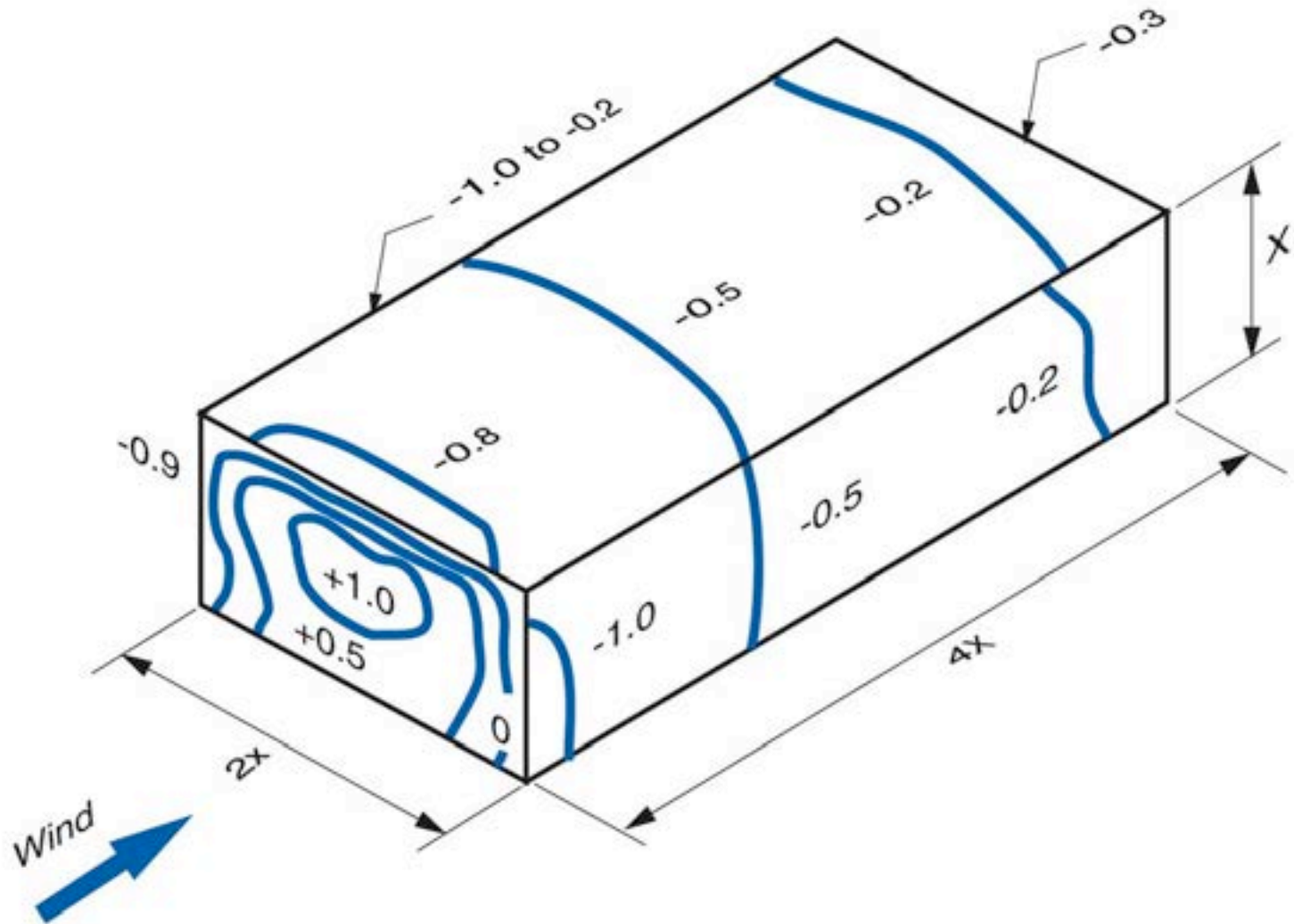






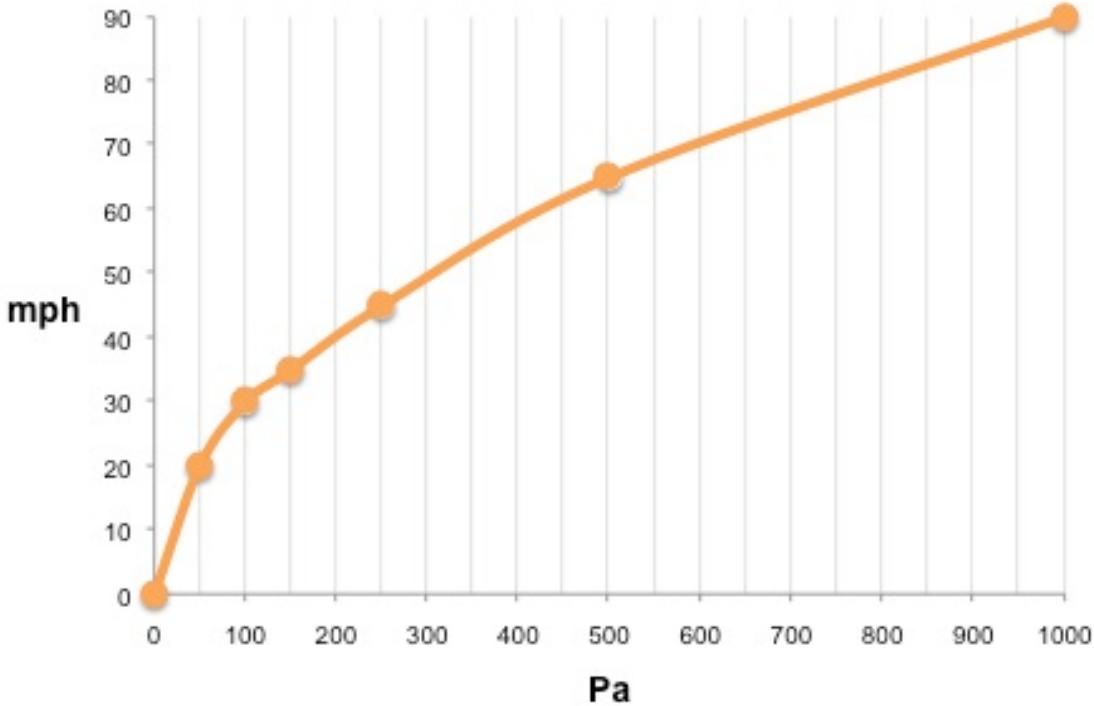






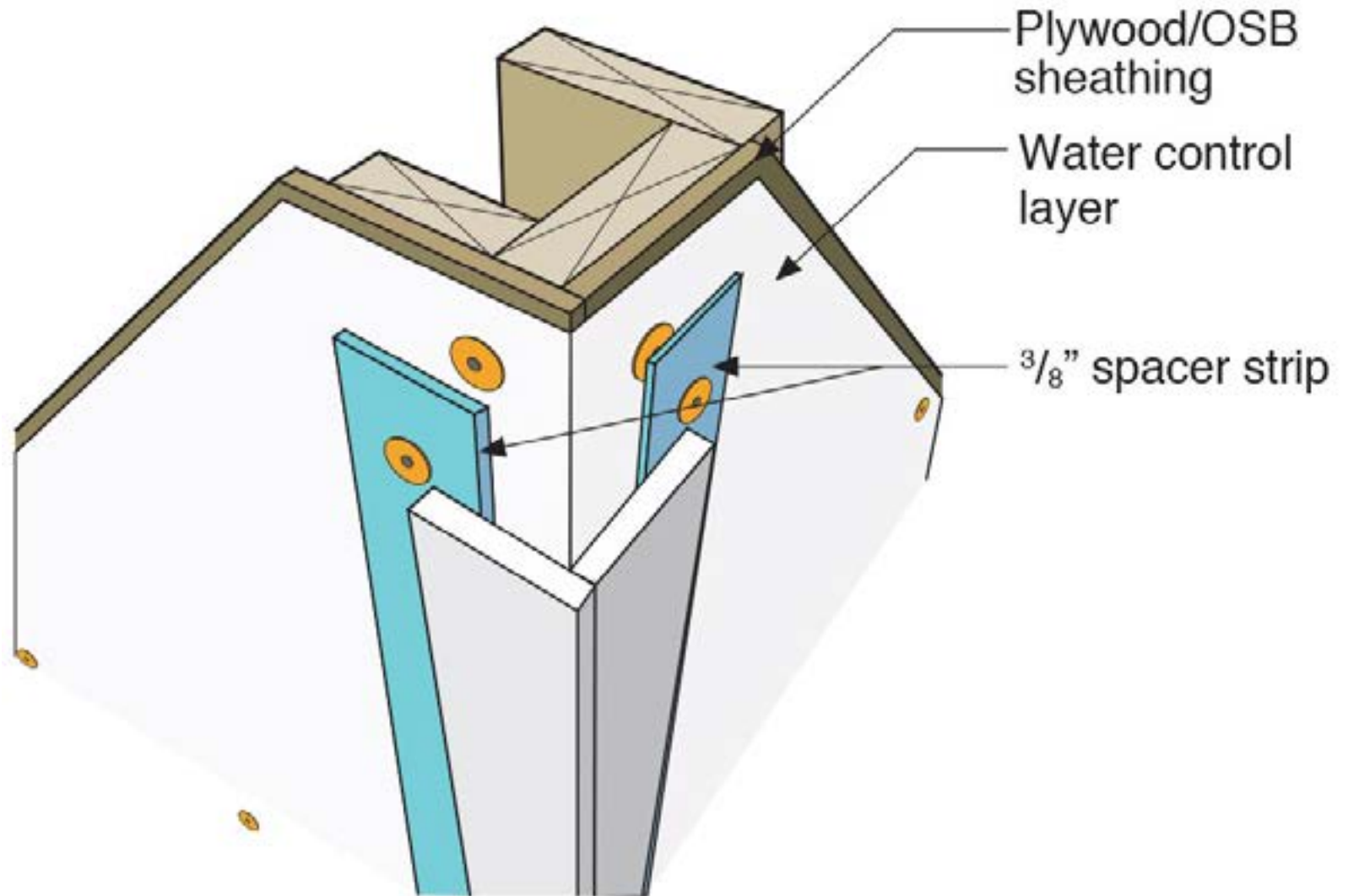
| Pascals | mph |
|---------|-------------|
| 50 | Pa = 20 mph |
| 100 | Pa = 30 mph |
| 150 | Pa = 35 mph |
| 250 | Pa = 45 mph |
| 500 | Pa = 65 mph |
| 1,000 | Pa = 90 mph |

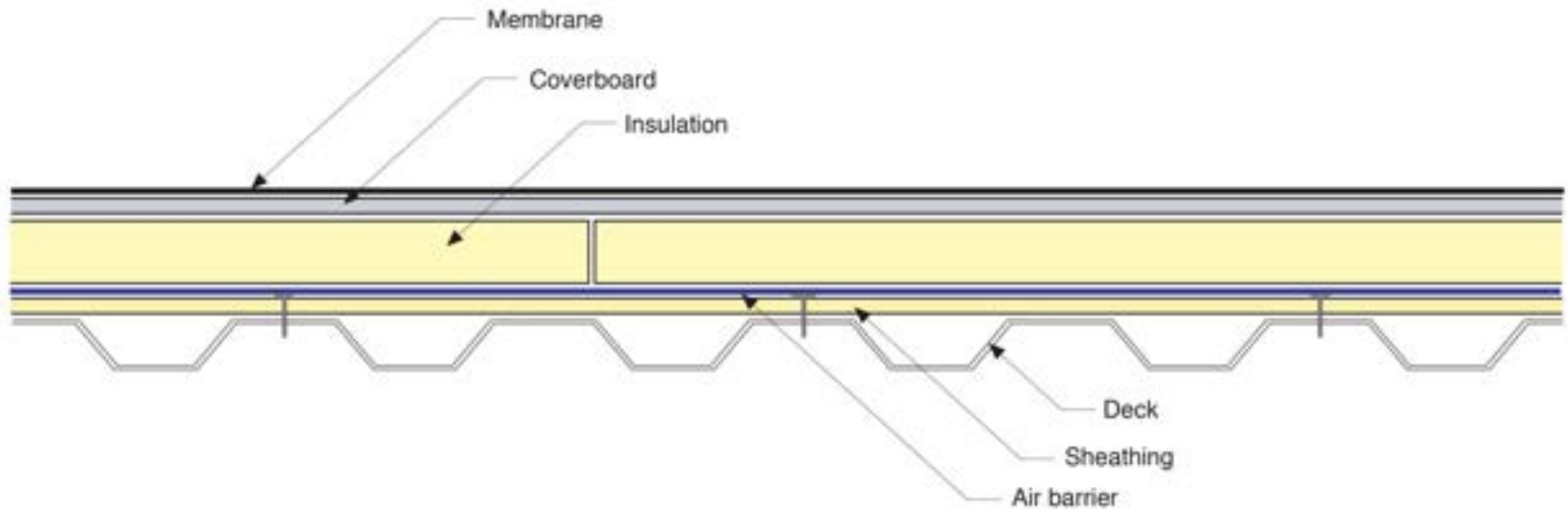
Wind Speed (mph) vs. Stagnation Pressure (Pa)









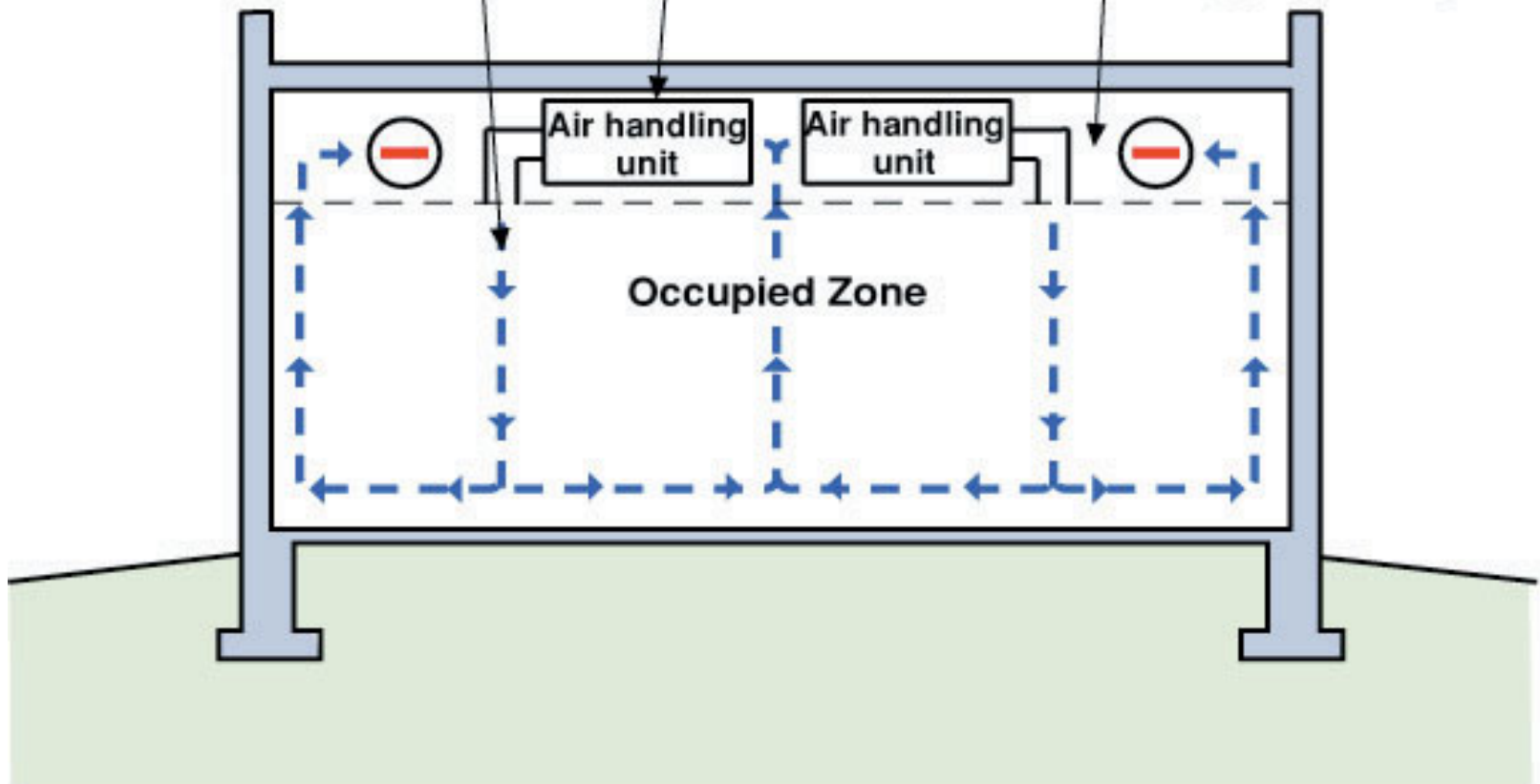


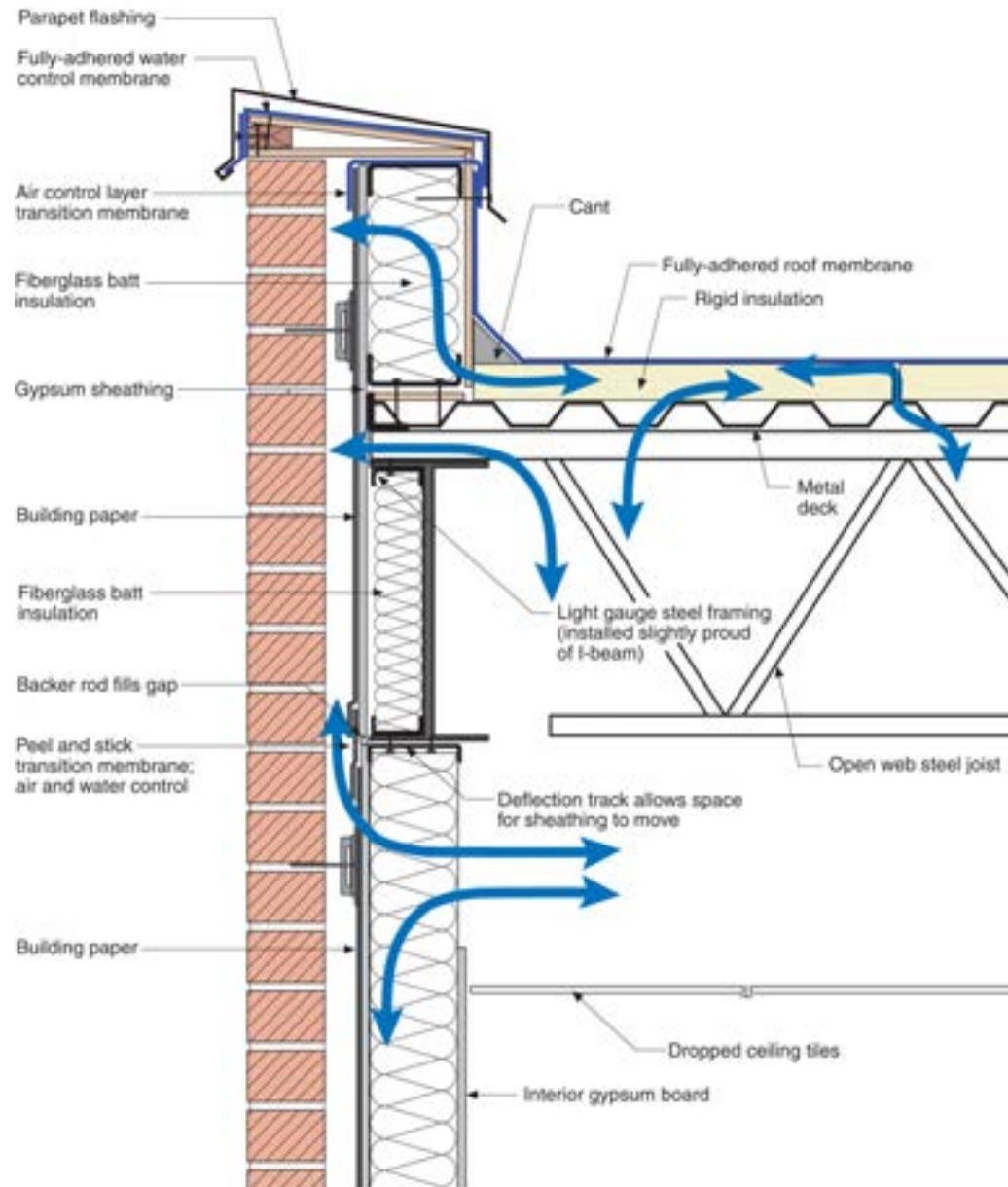
Air Leakage

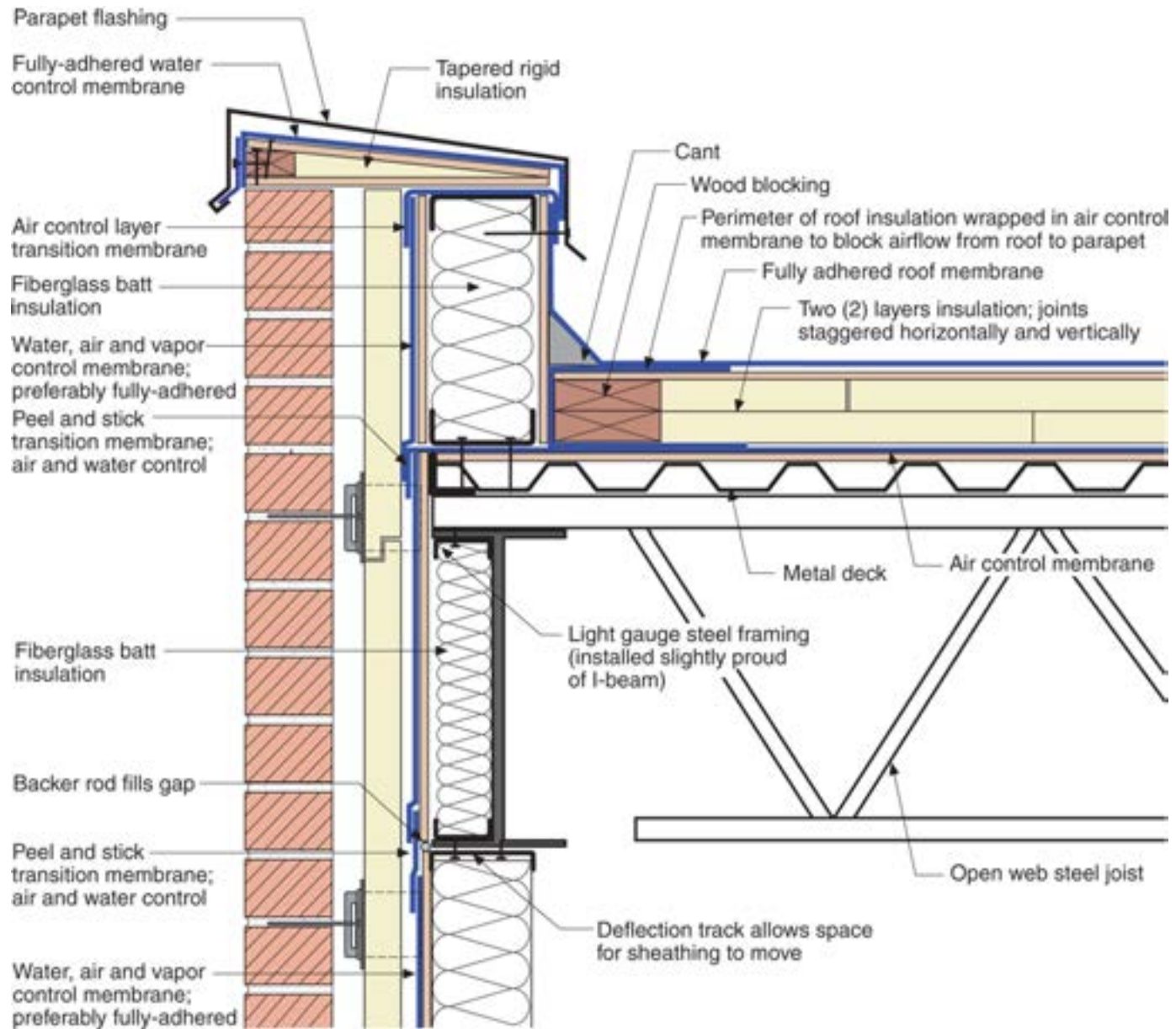
Supply air into occupied zone returns to AHU by passing through deliberately porous dropped ceiling or through return grilles installed in dropped ceiling

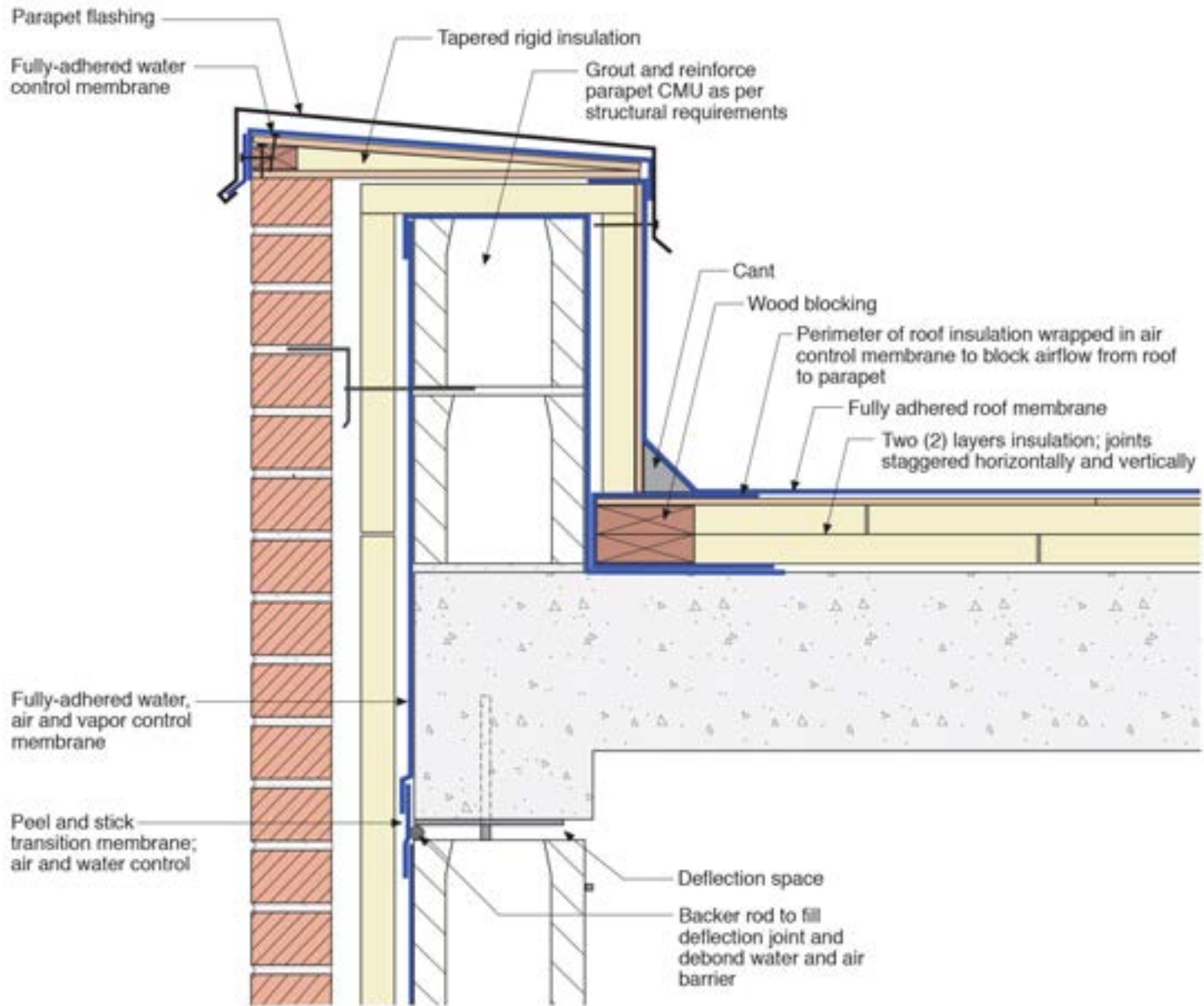
Air handling unit extracts air from dropped ceiling, conditions it and injects it into the occupied zones via supply ductwork

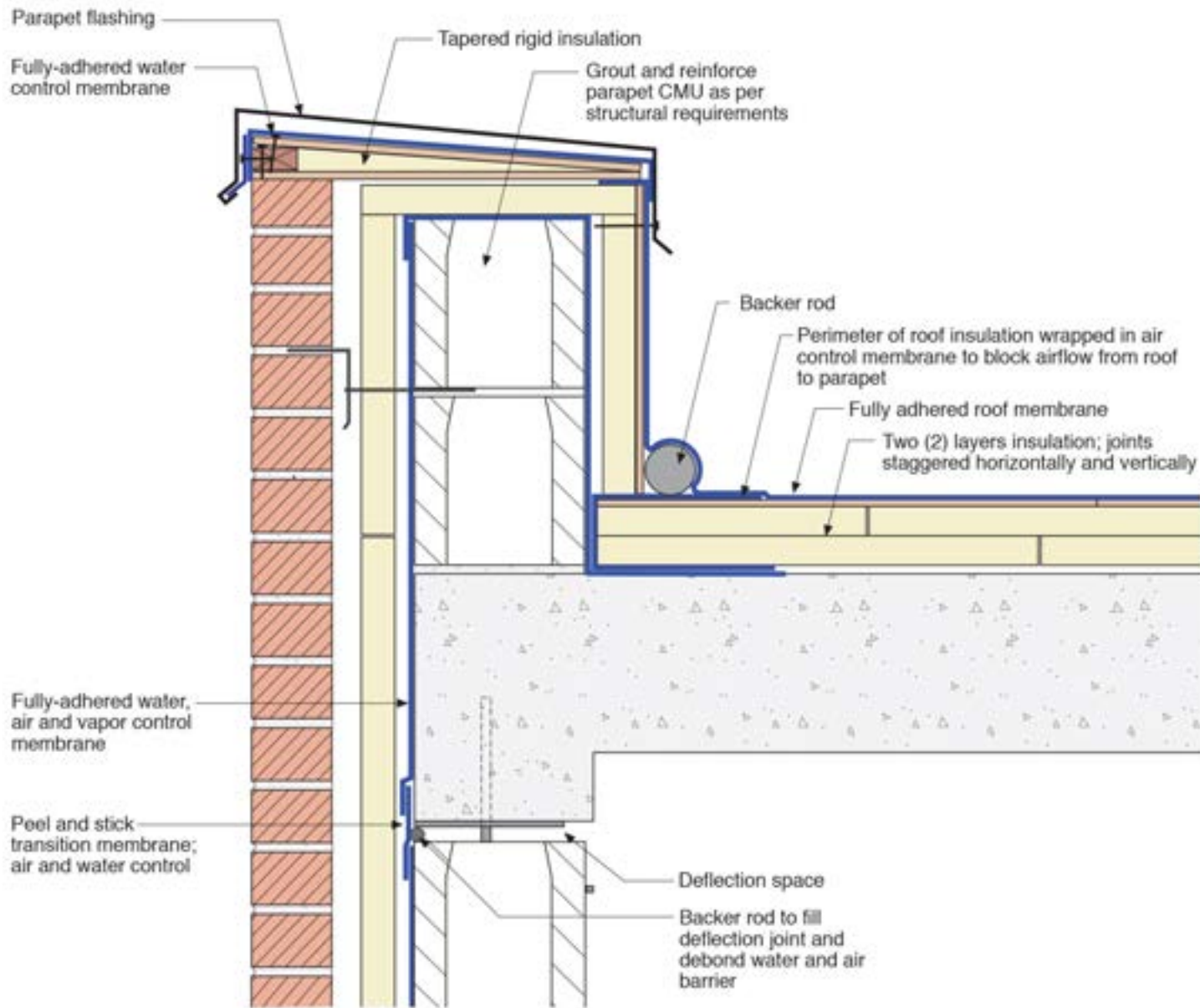
Dropped ceiling depressurized by air handling units extracting air from dropped ceiling

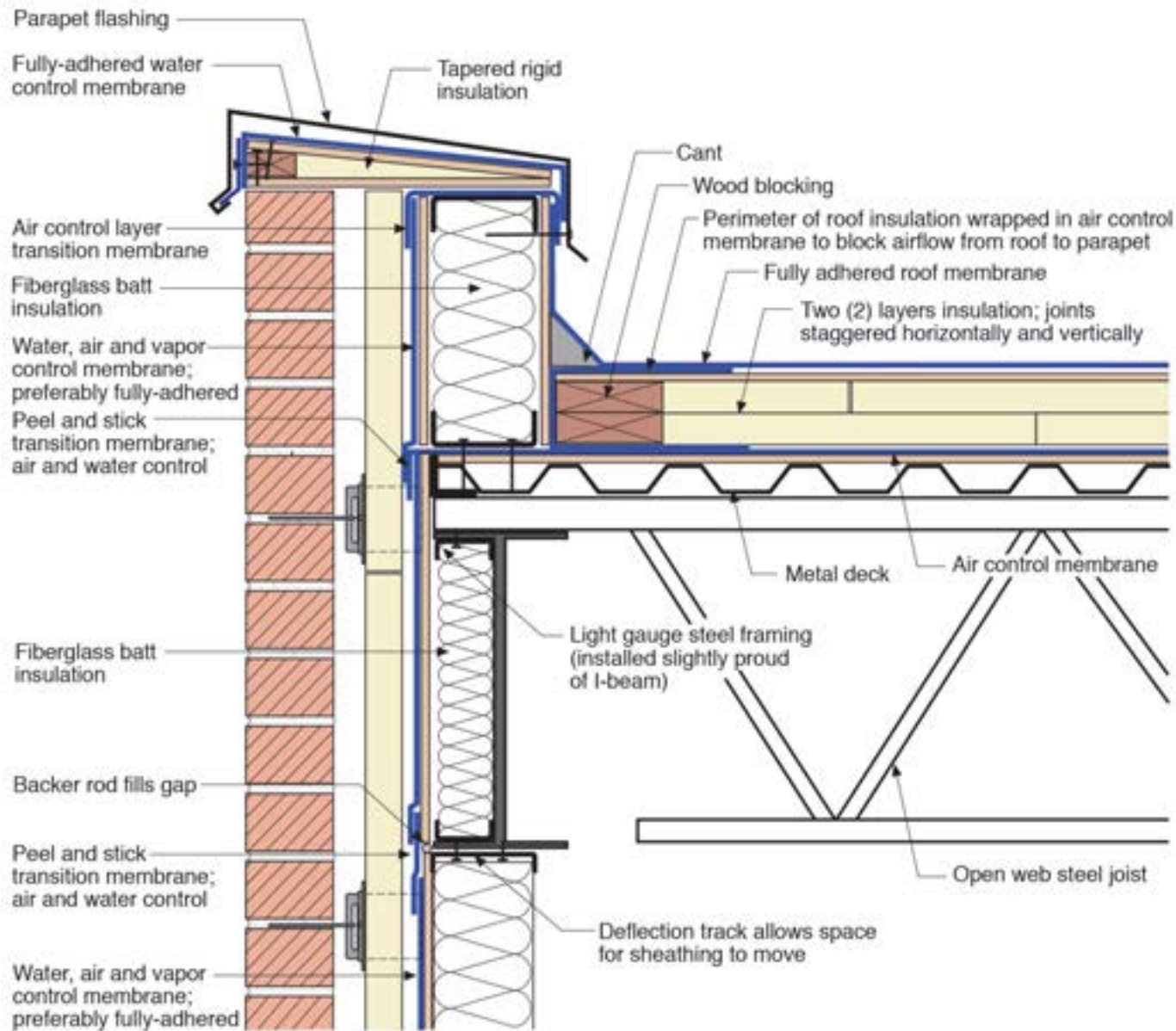


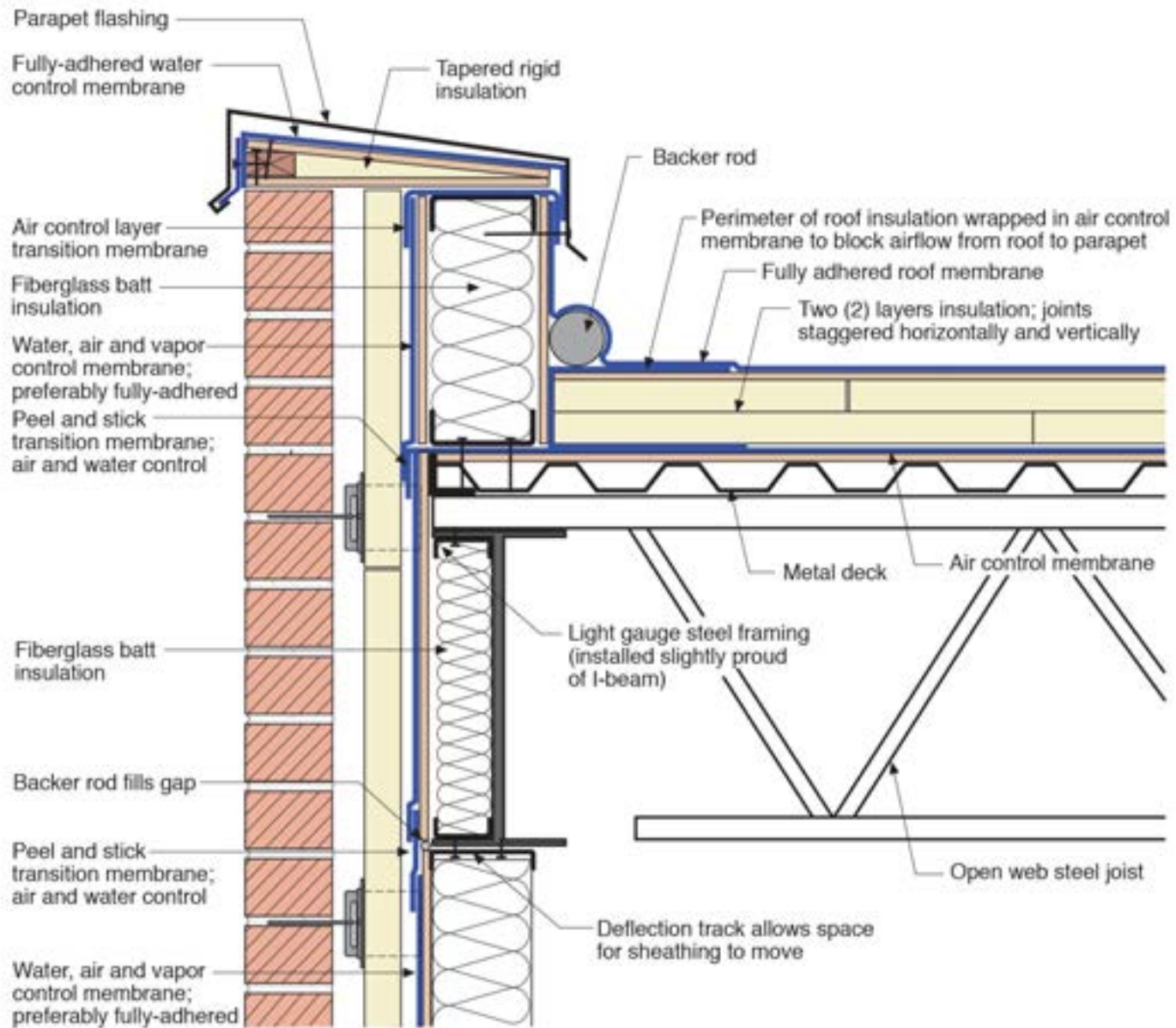


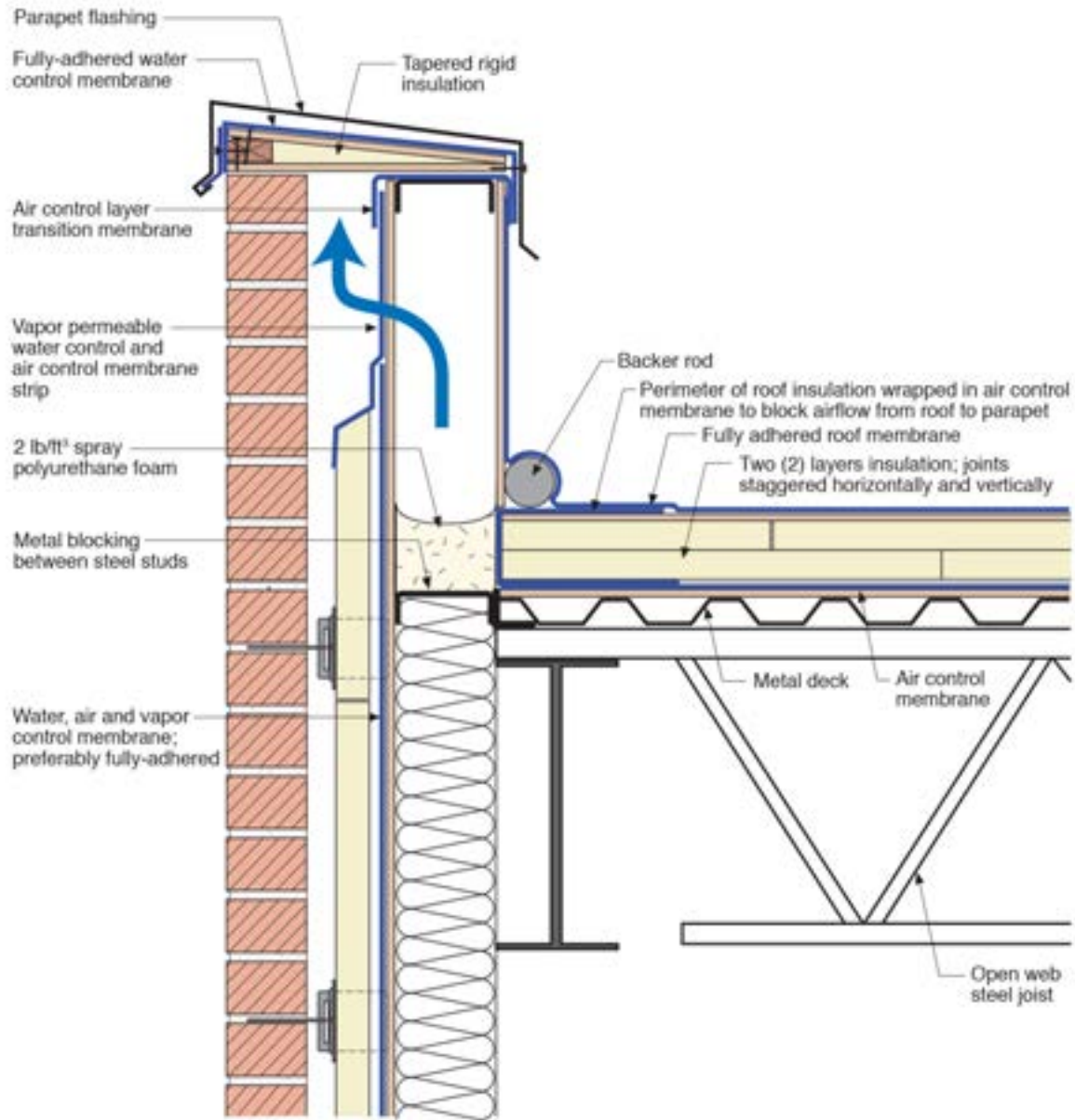


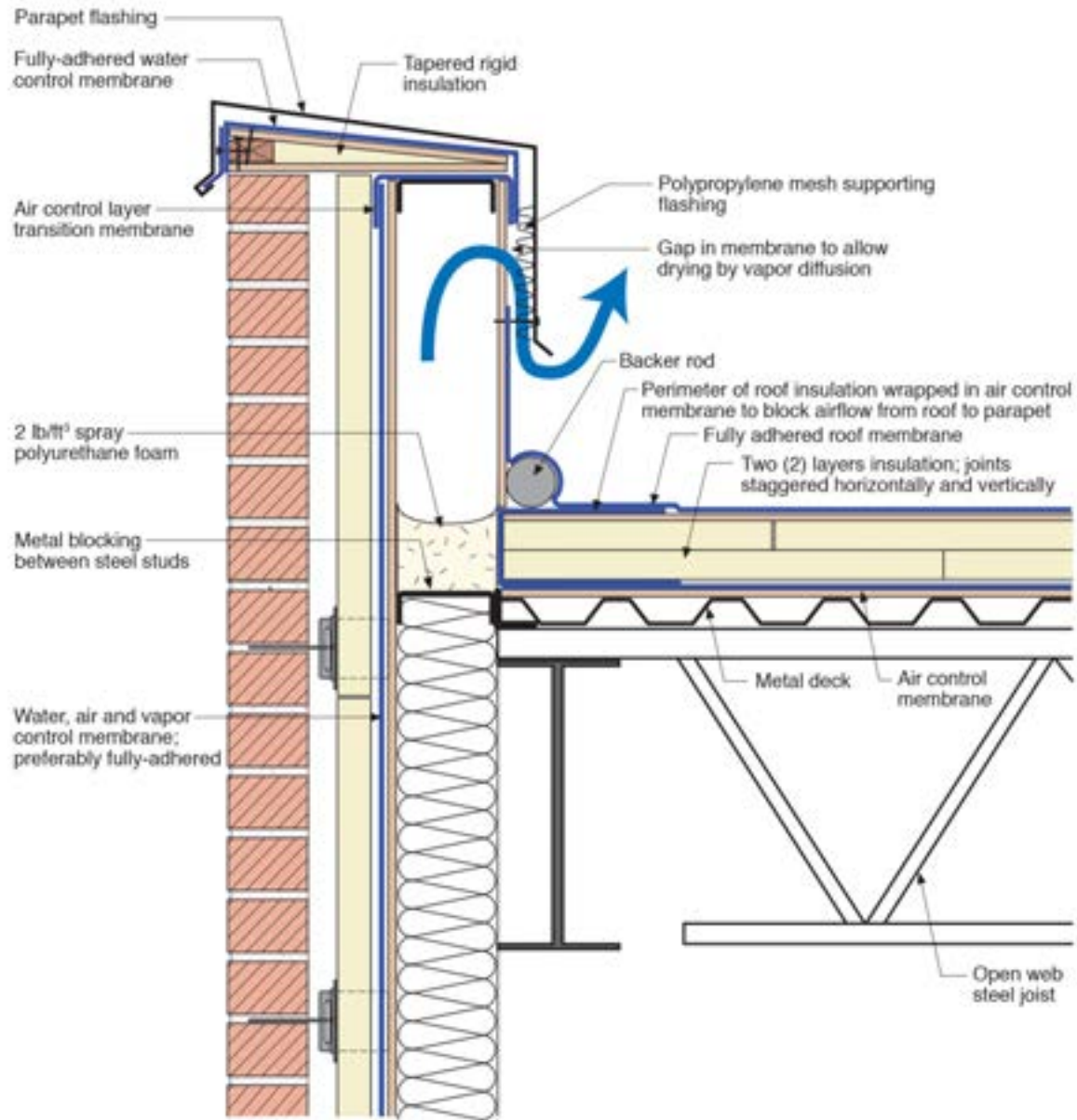


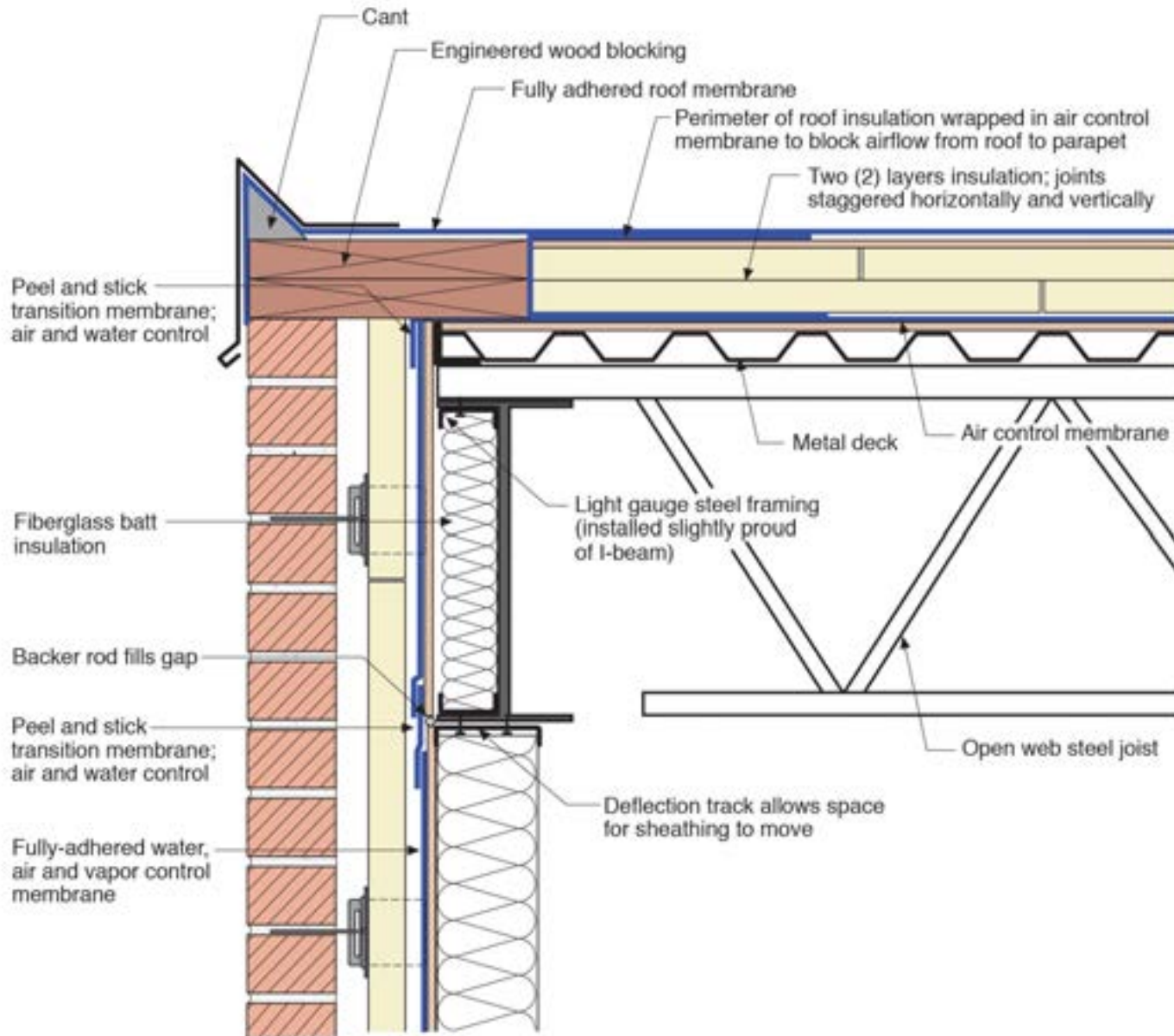


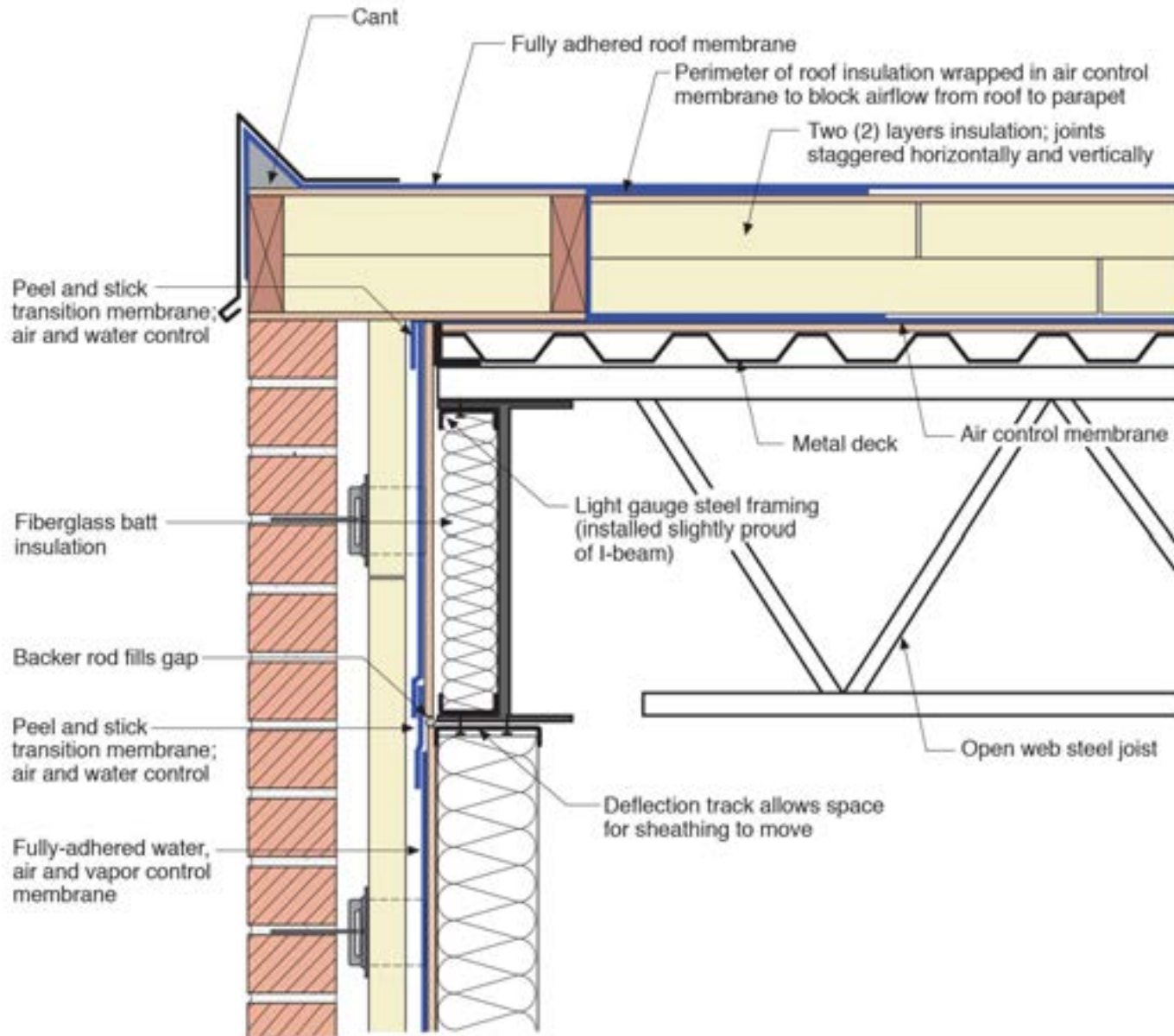


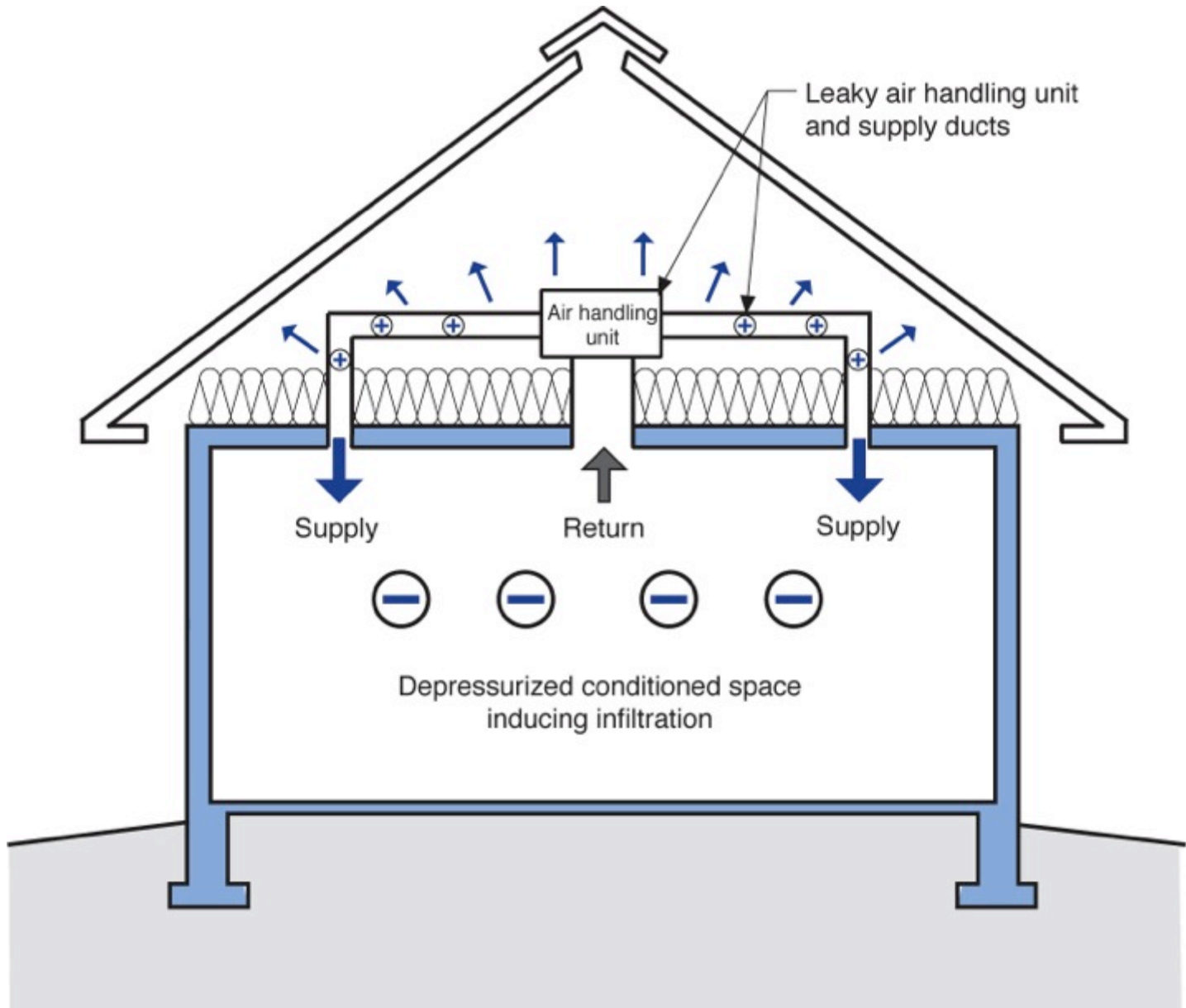










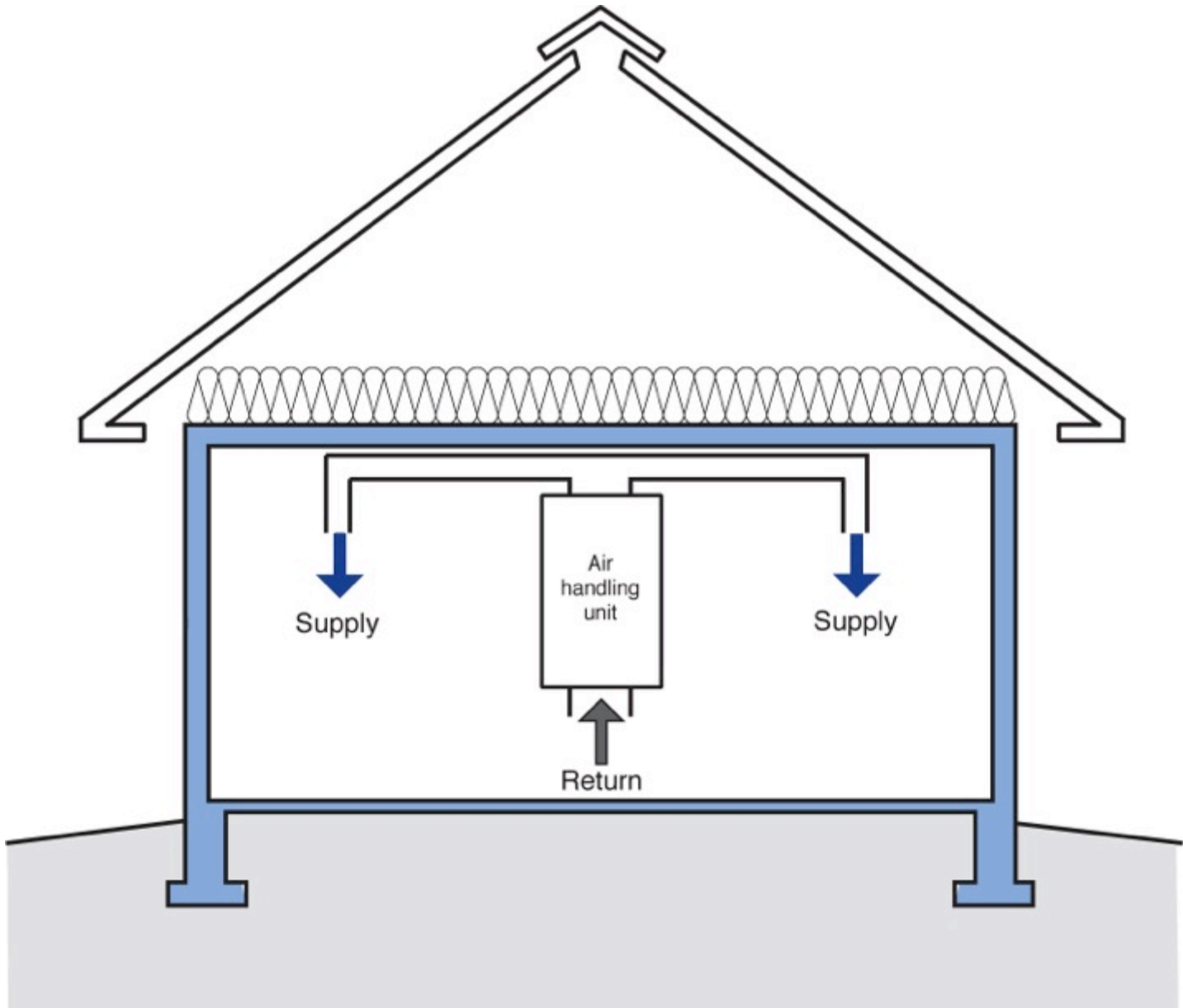


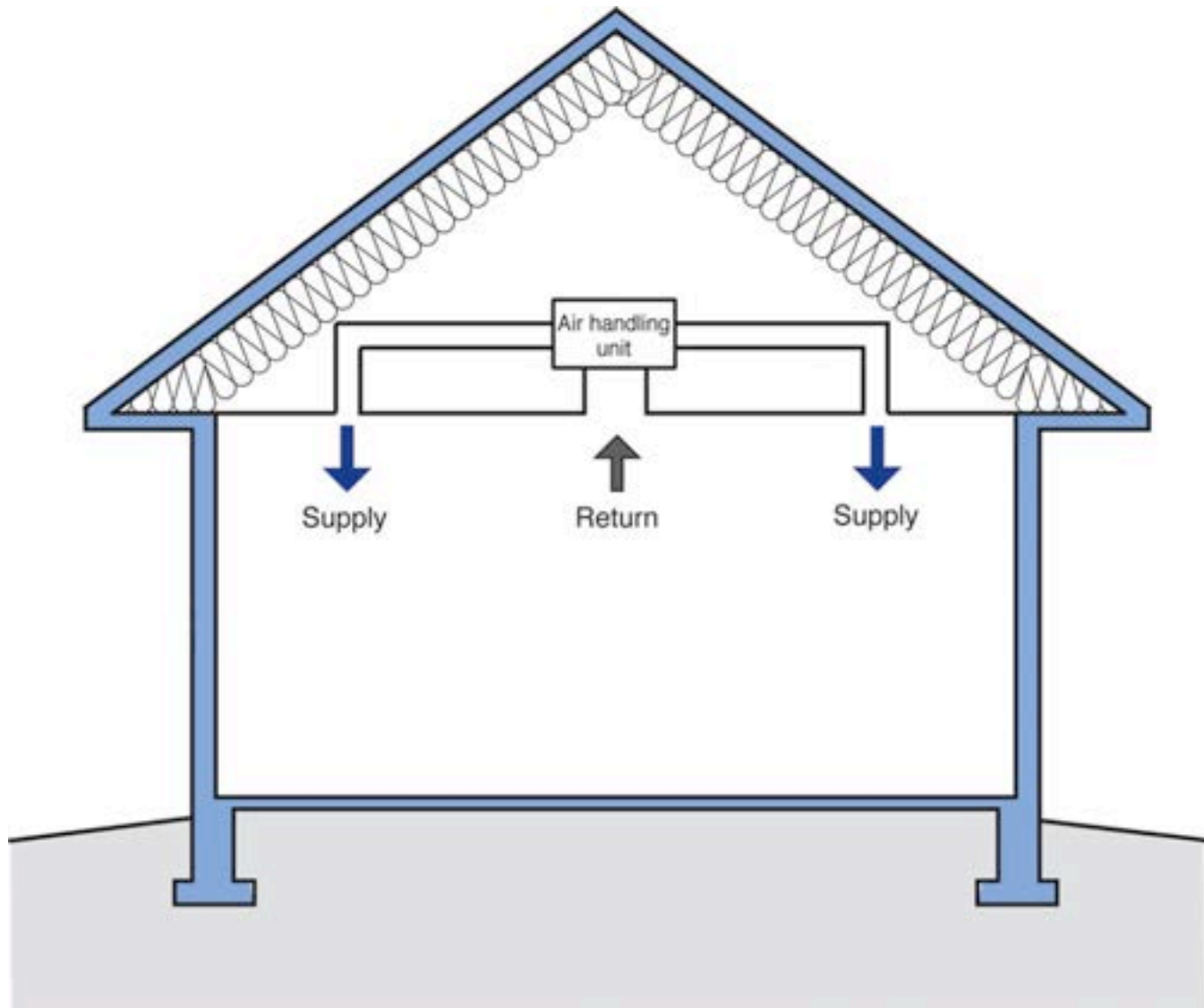




Houses With Vented Attics Suck

Houses With Vented Attics Suck
Not all the Time.....but.....

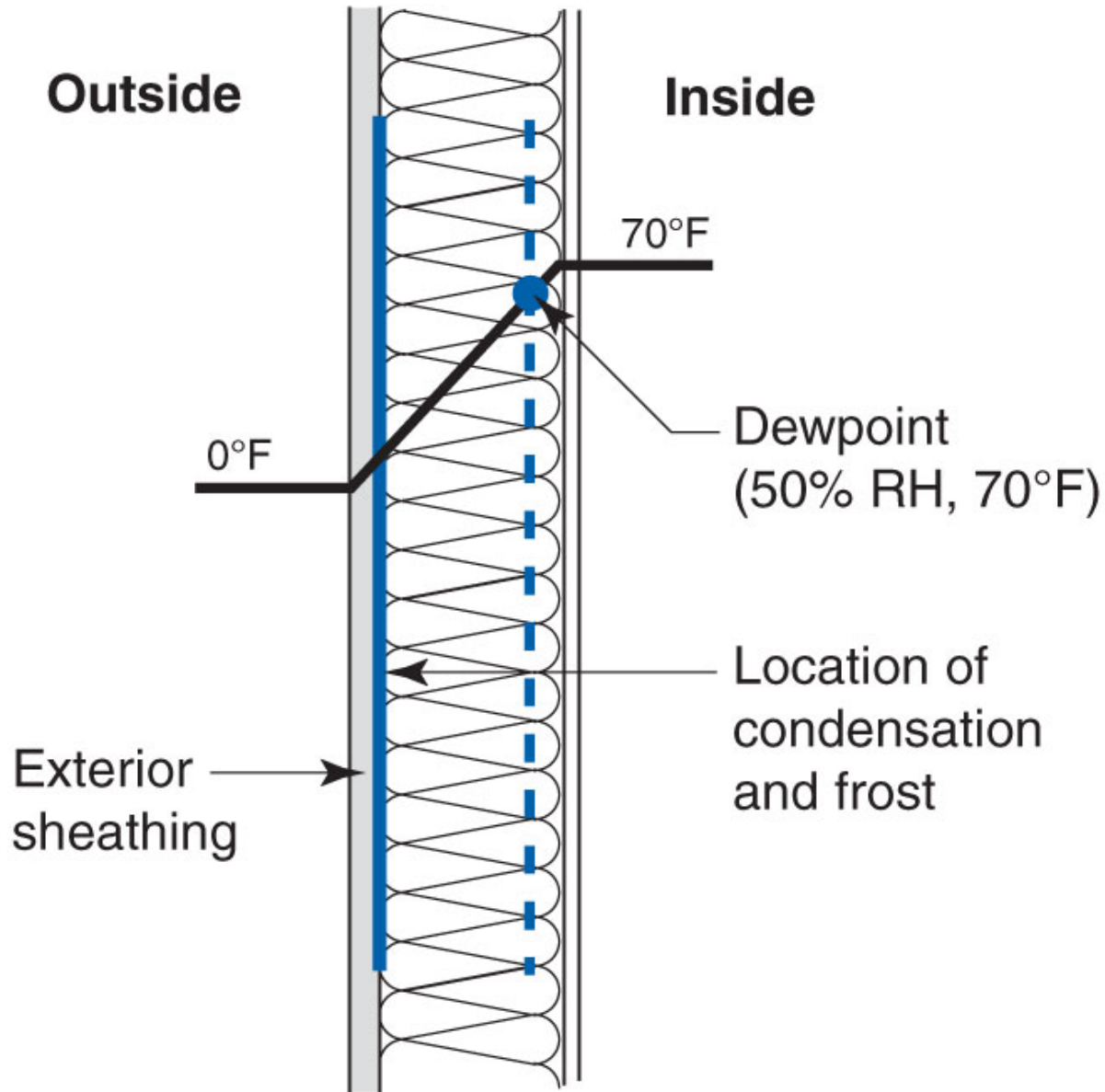




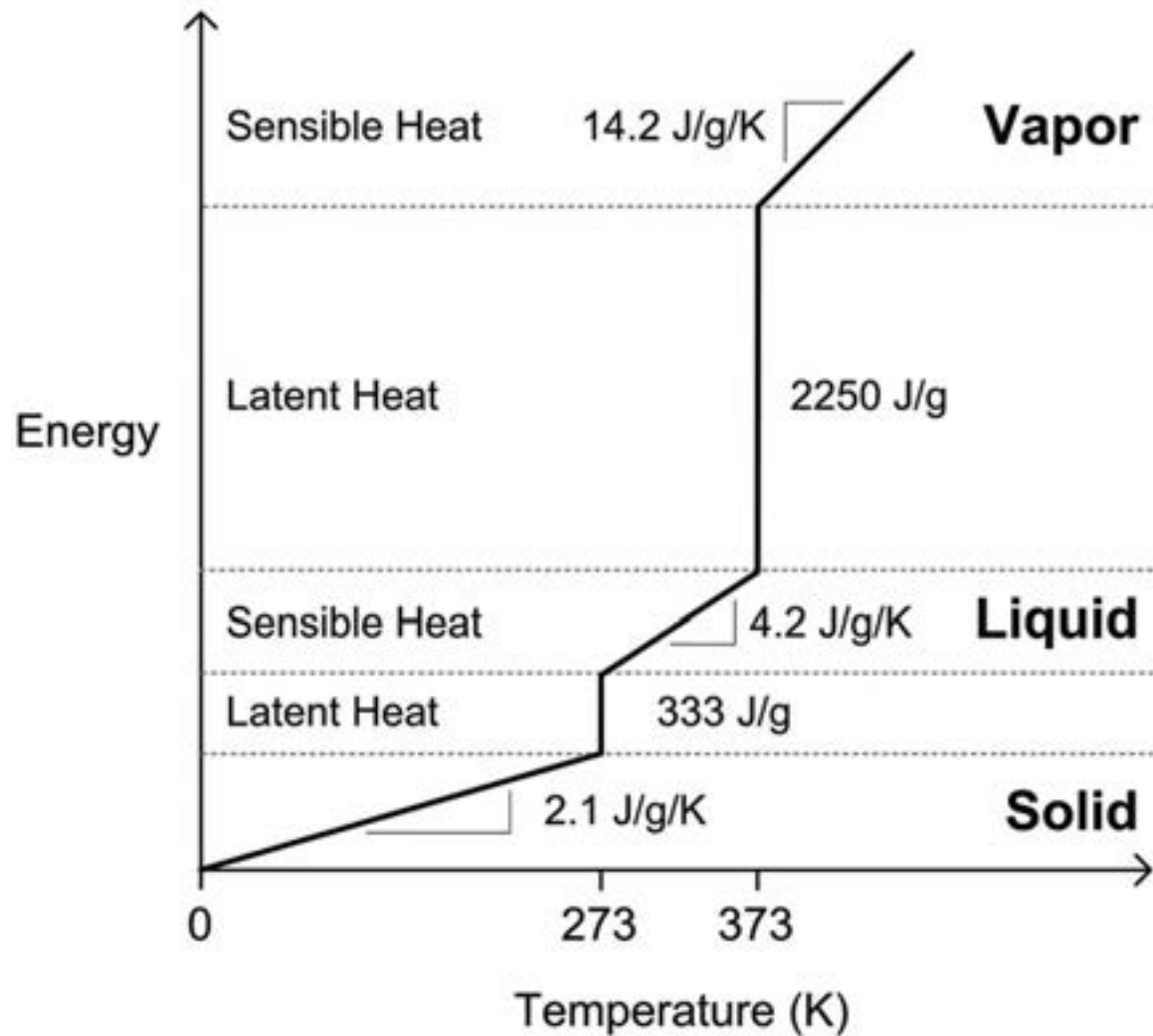






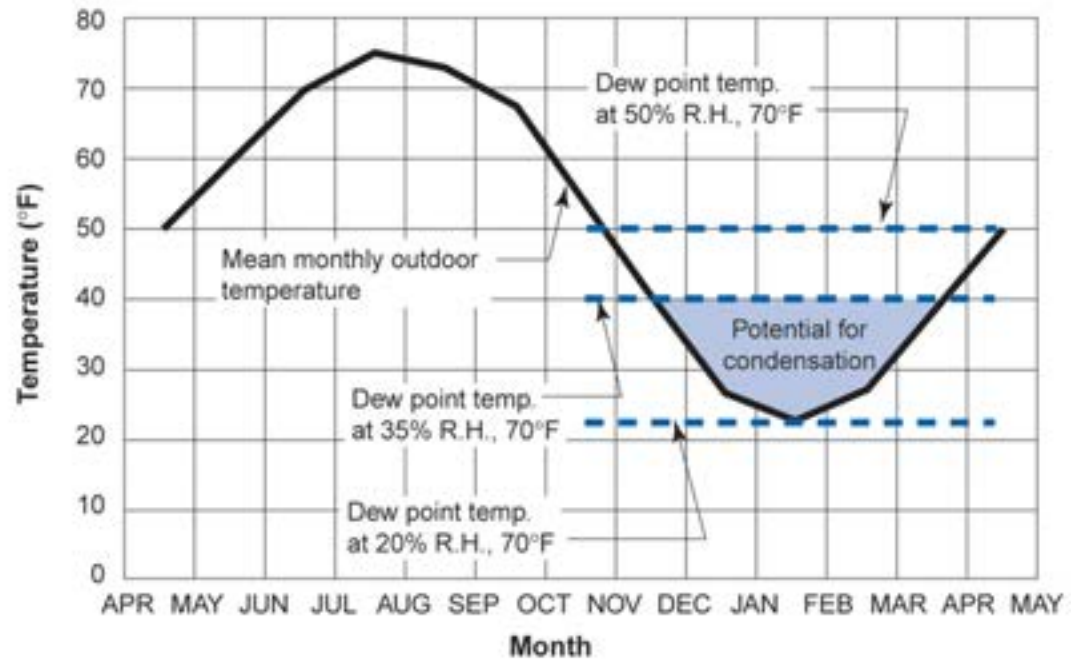
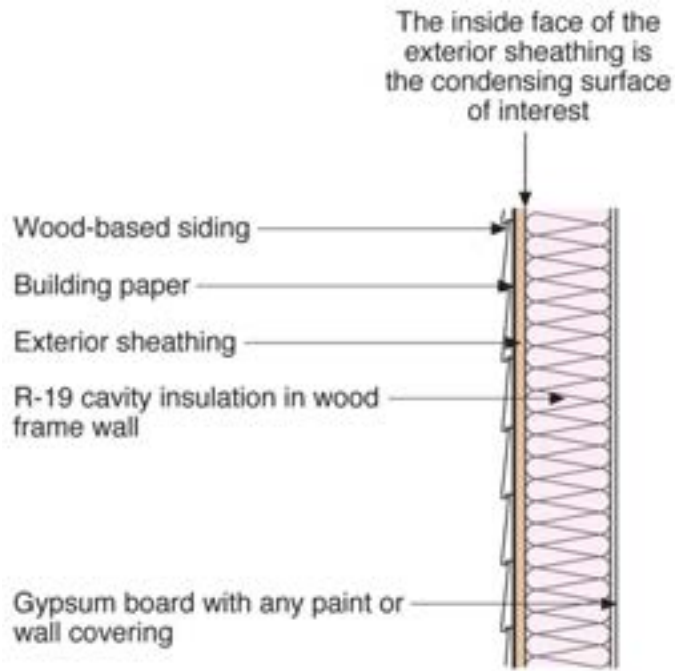


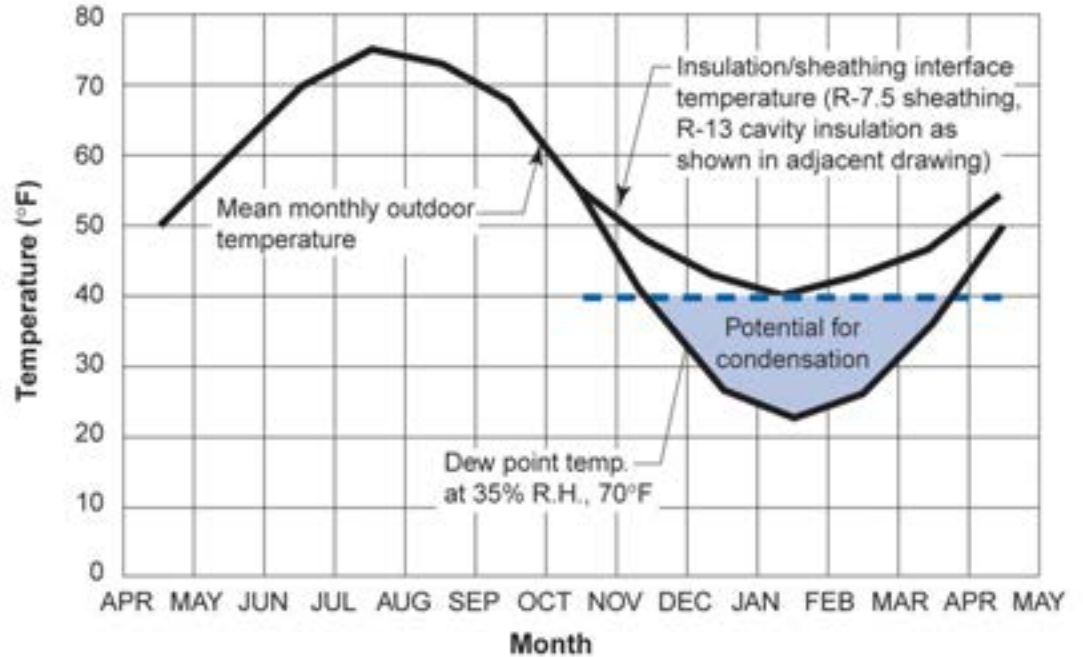
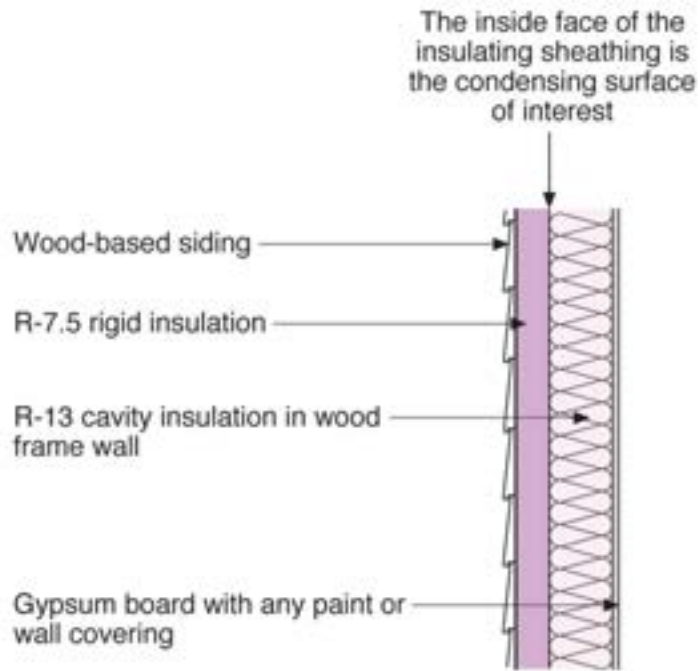




Simple linearized energy-temperature relation for water

From Straube & Burnett, 2005





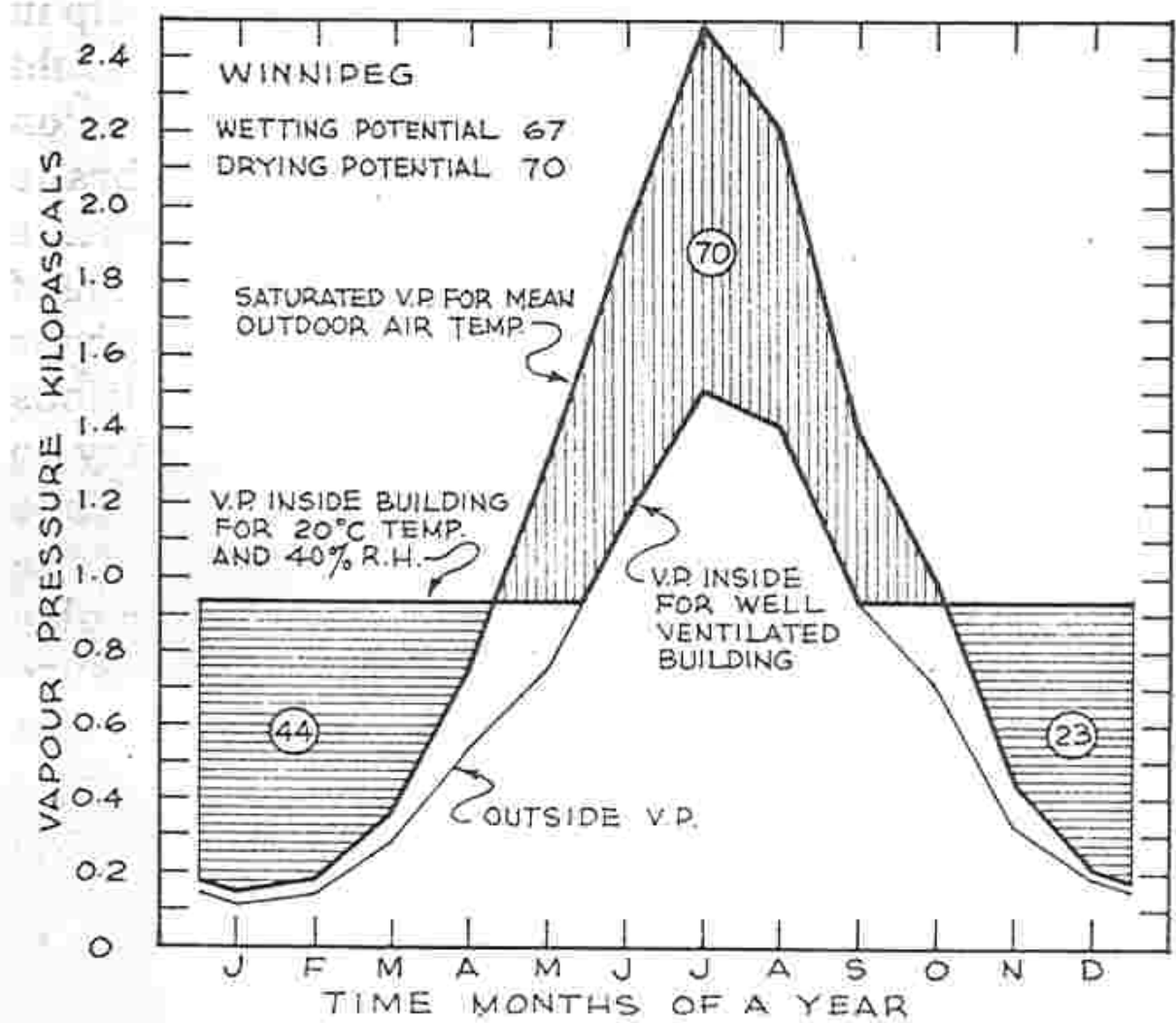
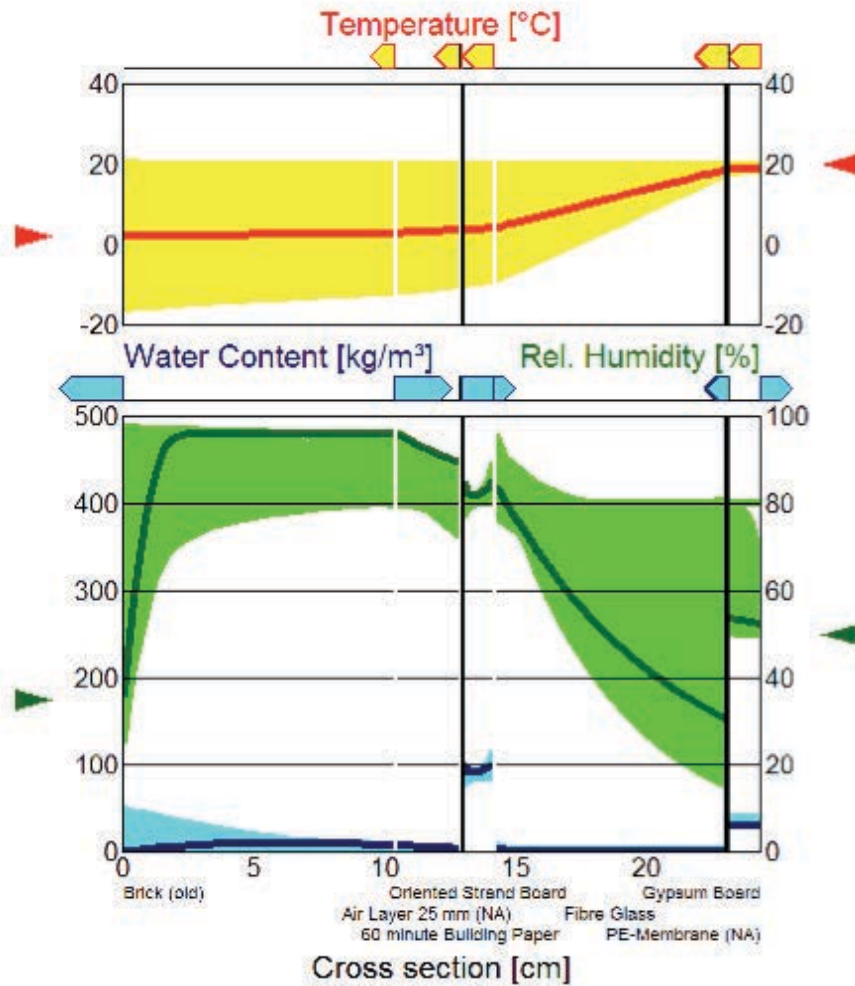


Figure 8-7. Outside vapour pressure, saturated vapour pressure and inside vapour pressure for Winnipeg.



WUFI® 3.3 Pro. IBP
Run

16 Feb
2001

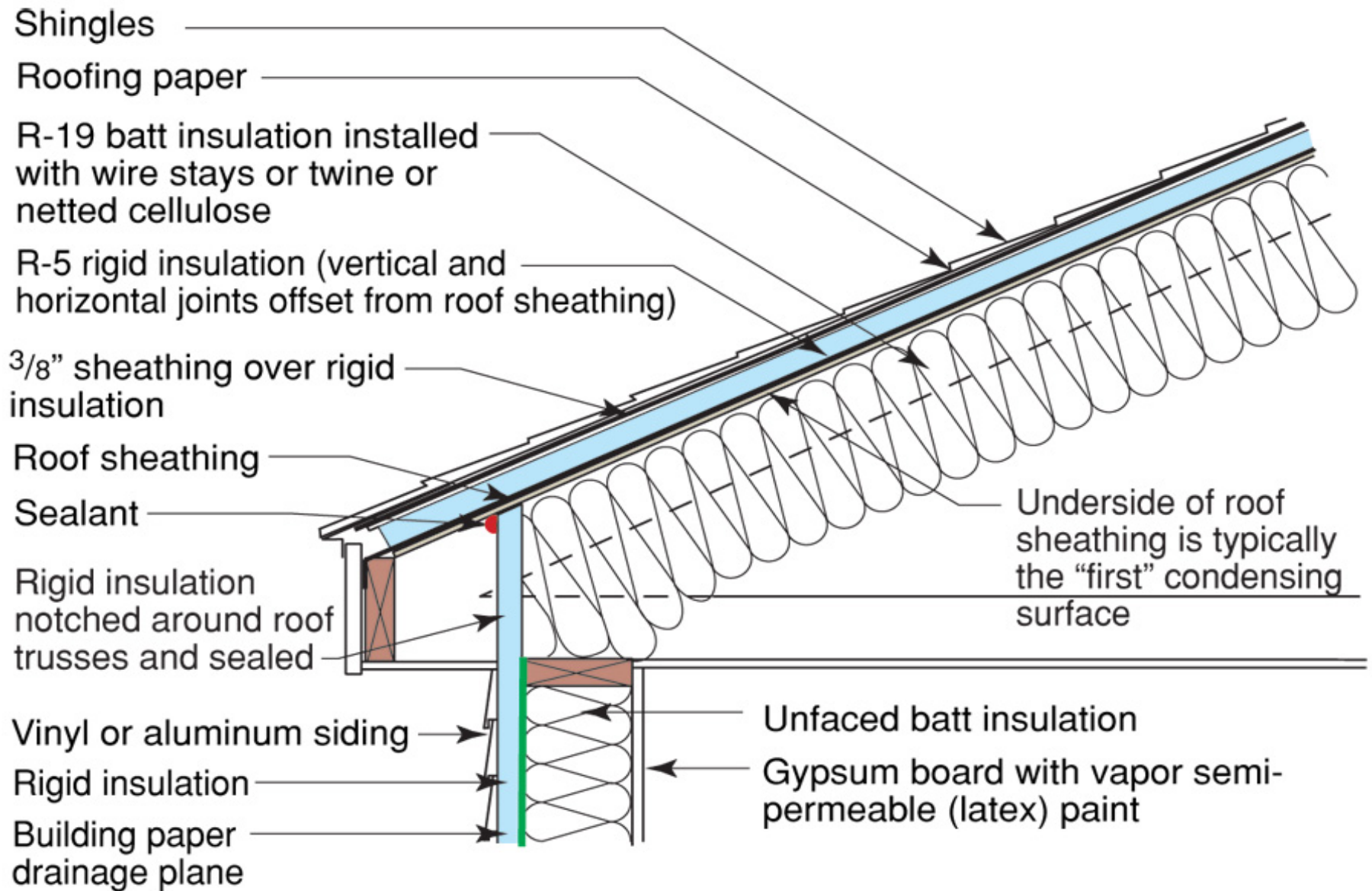
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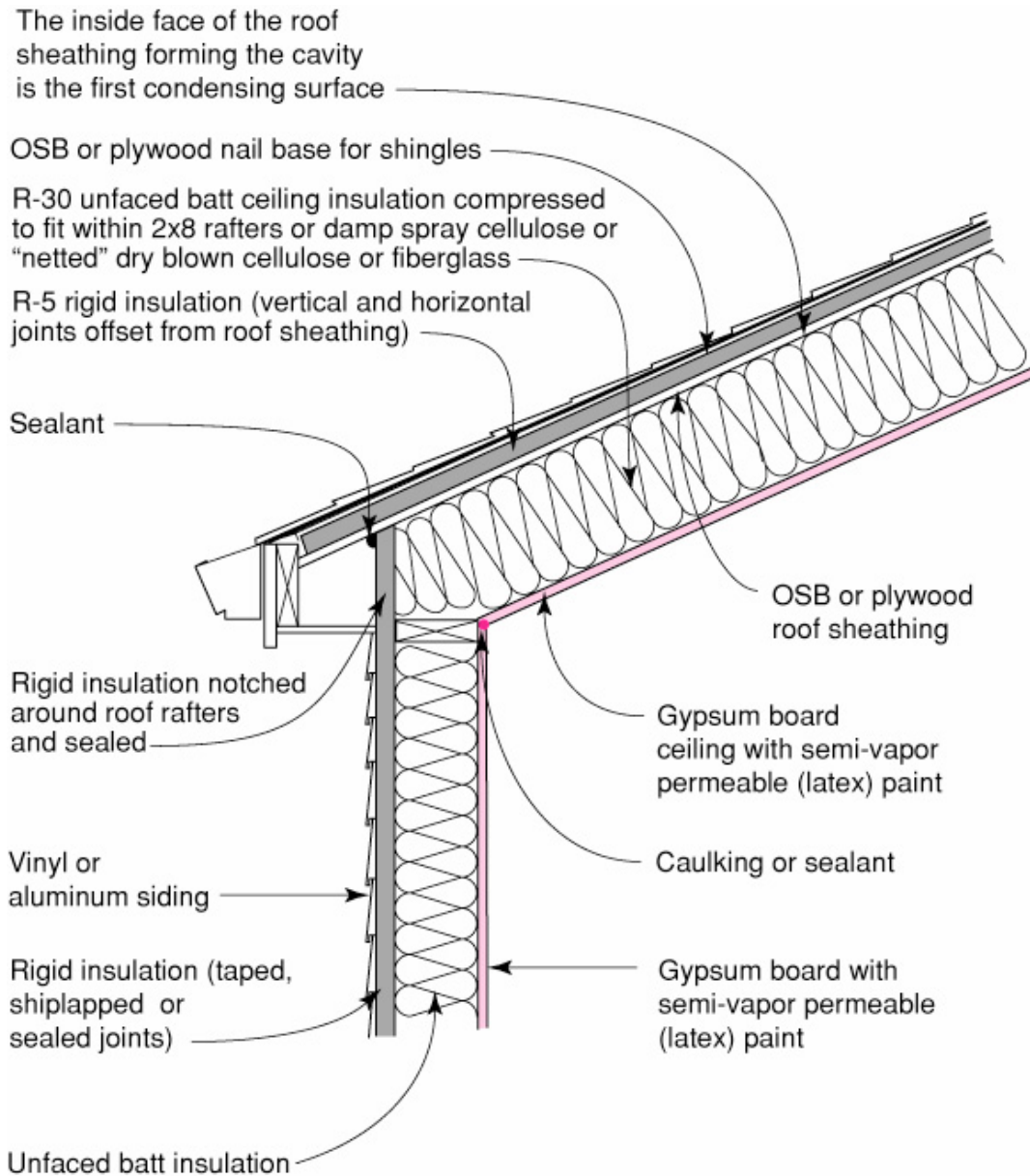
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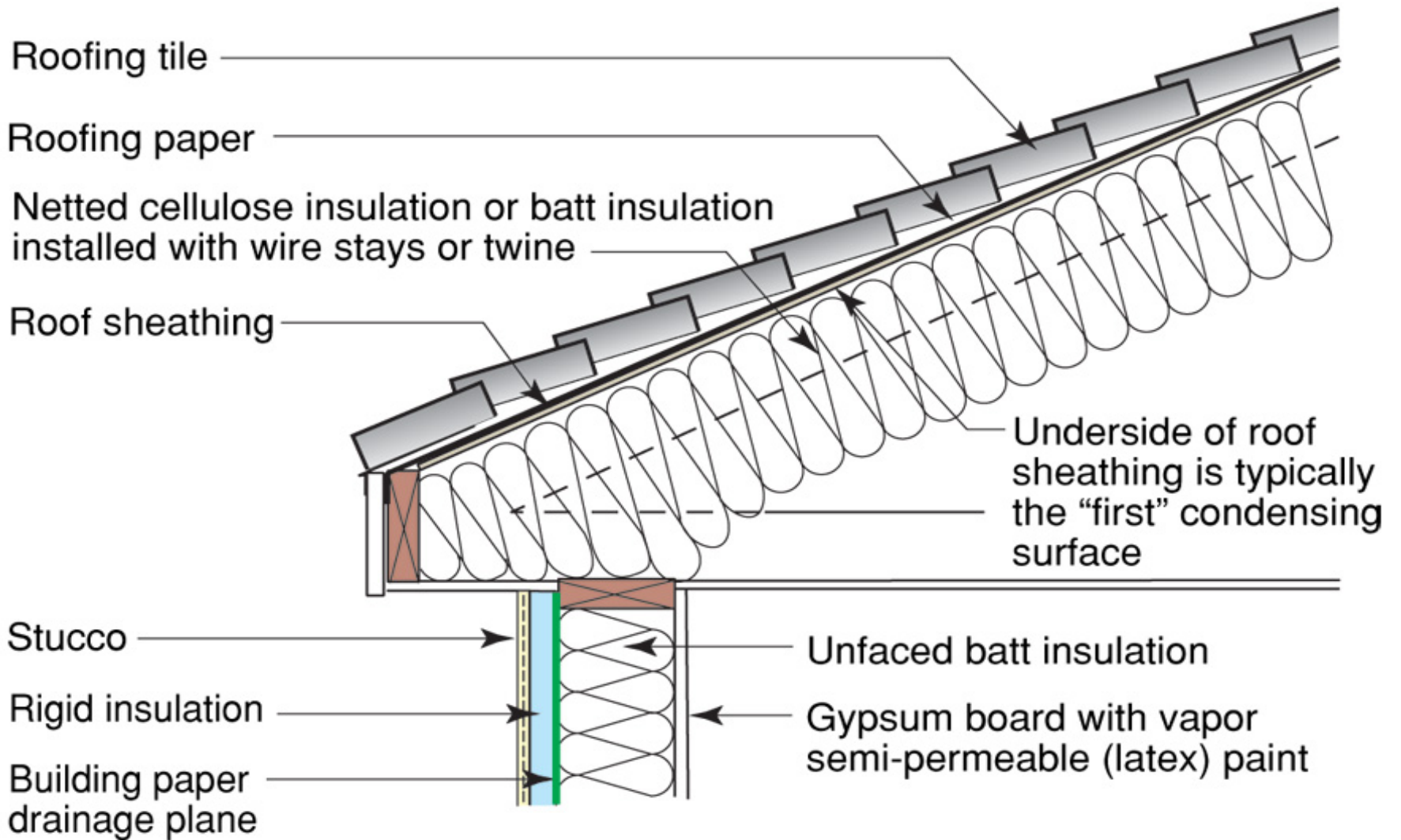
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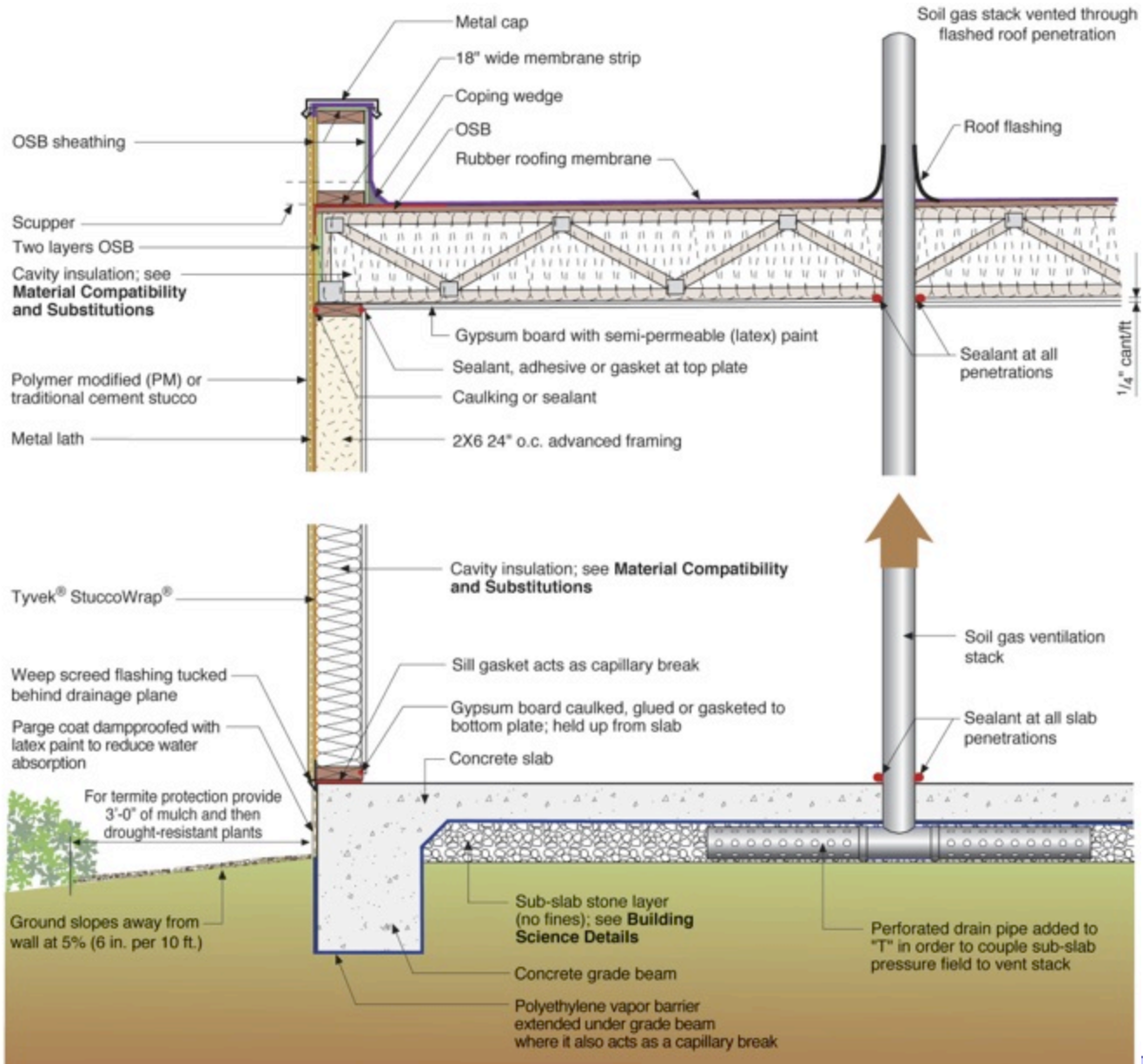


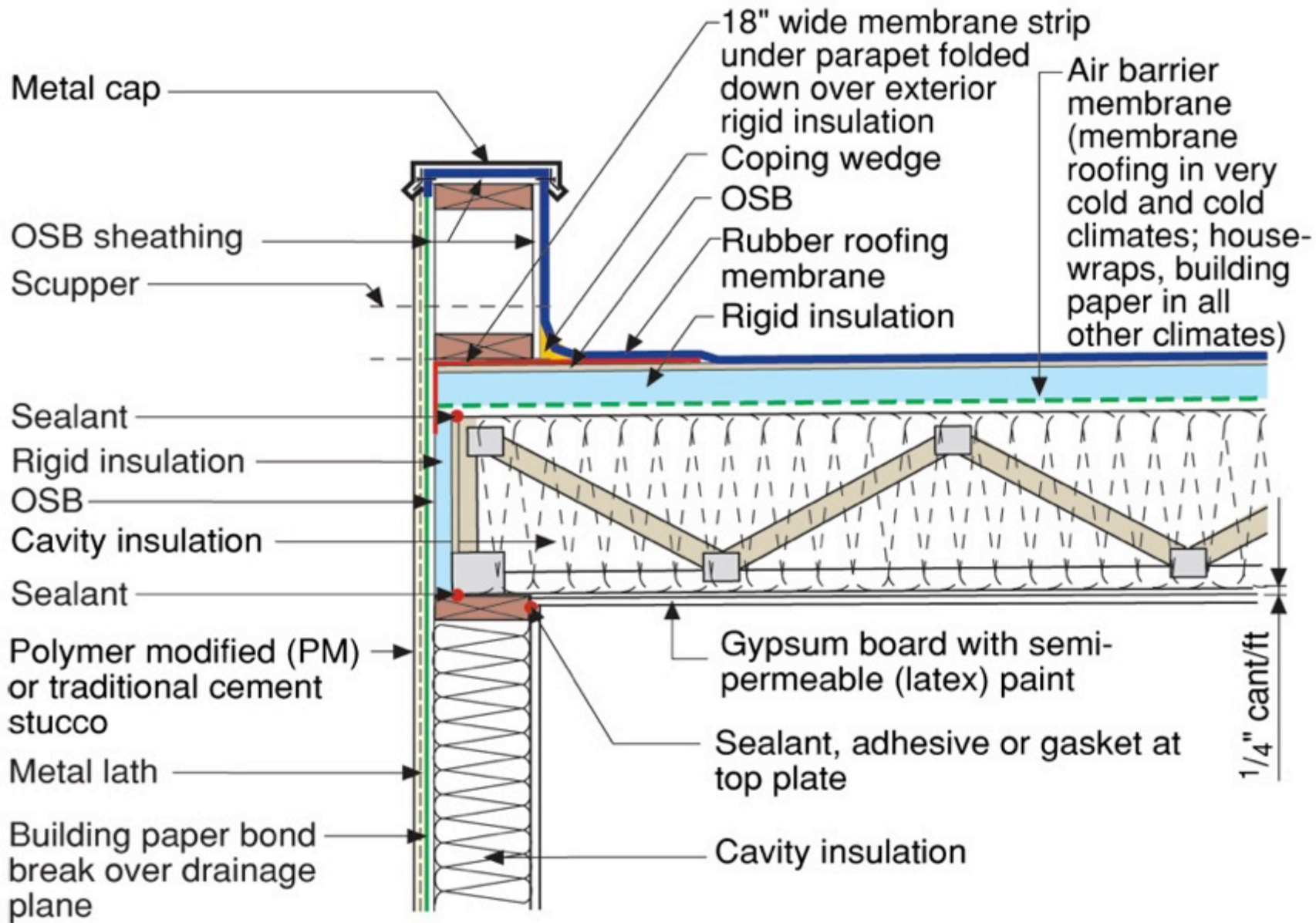


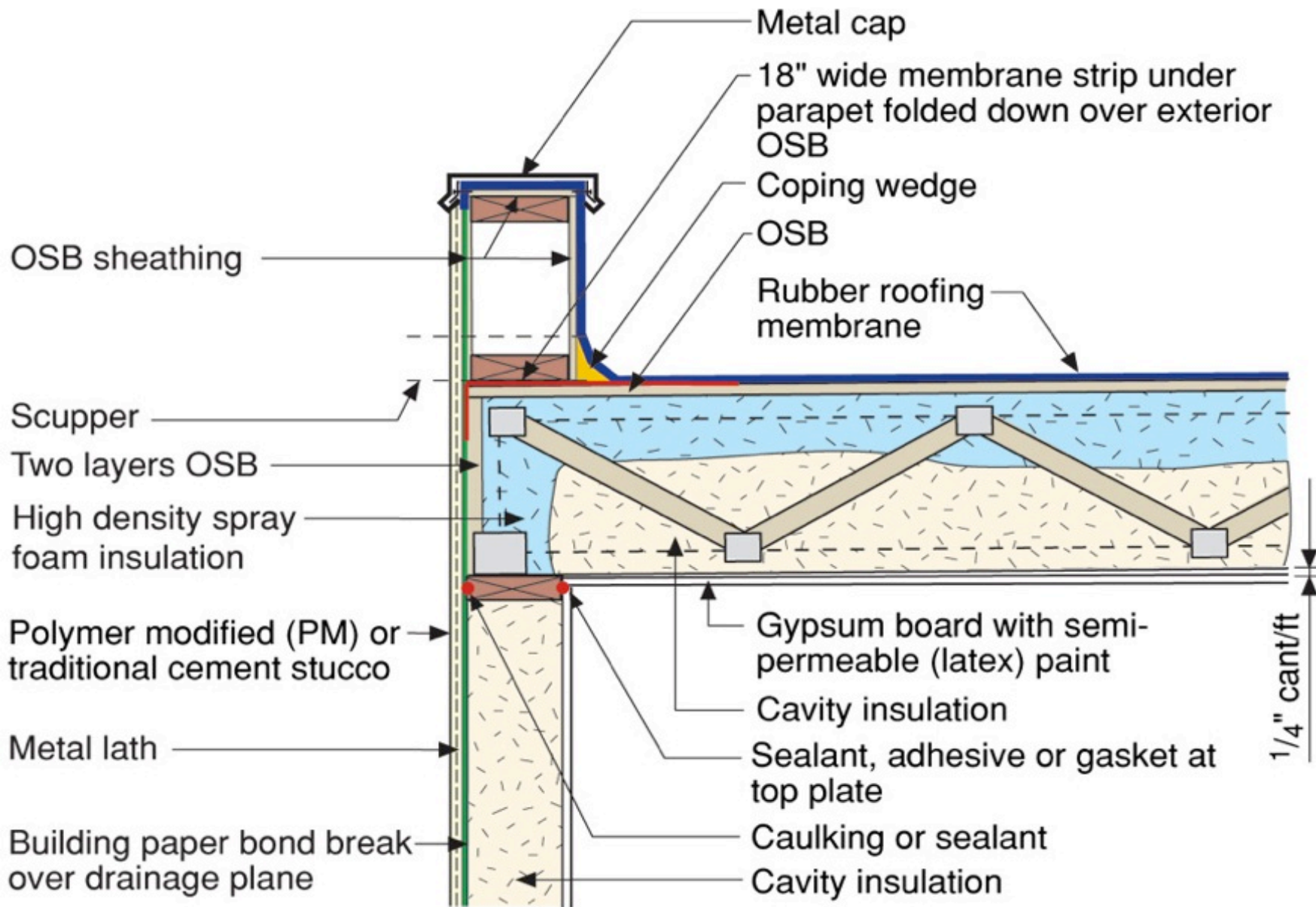


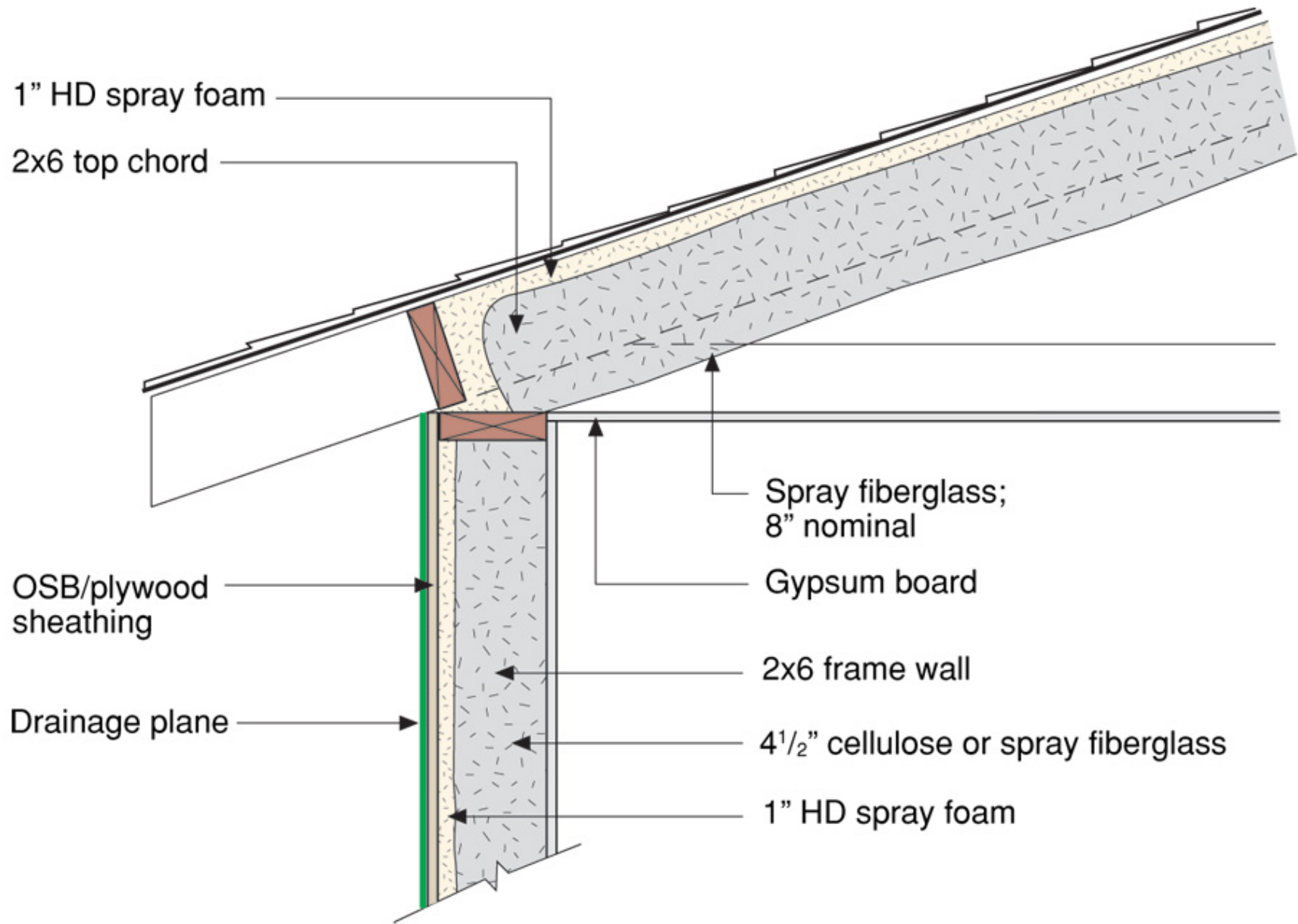


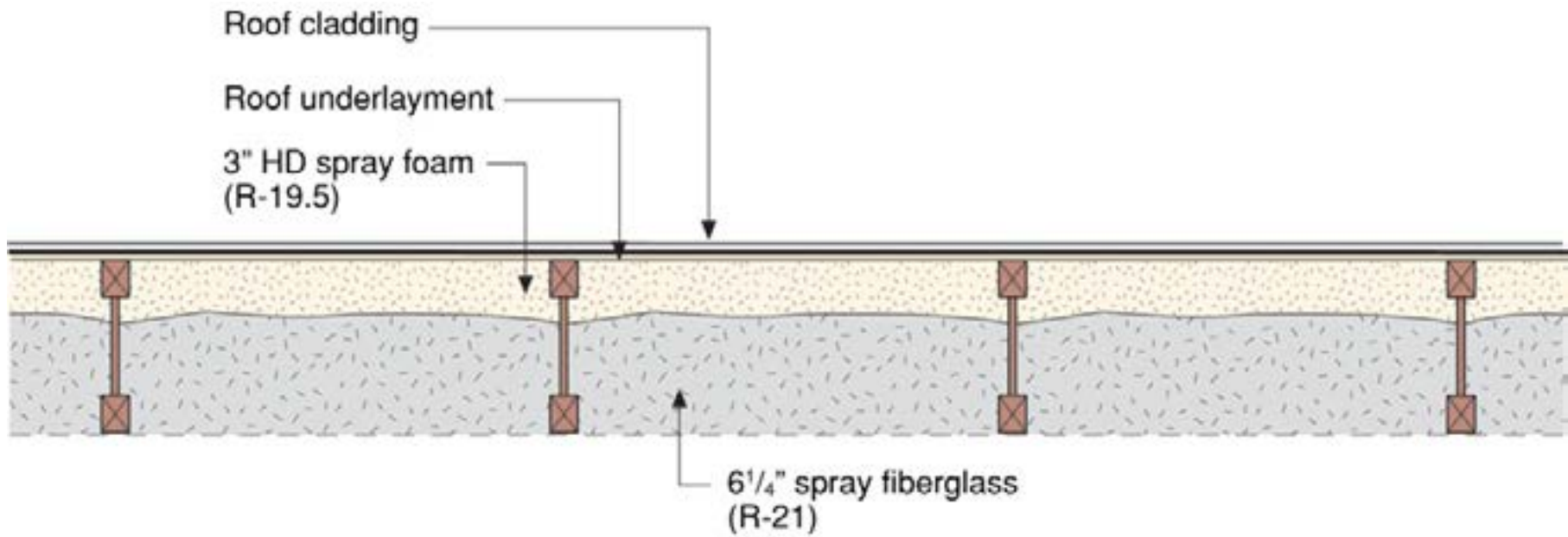


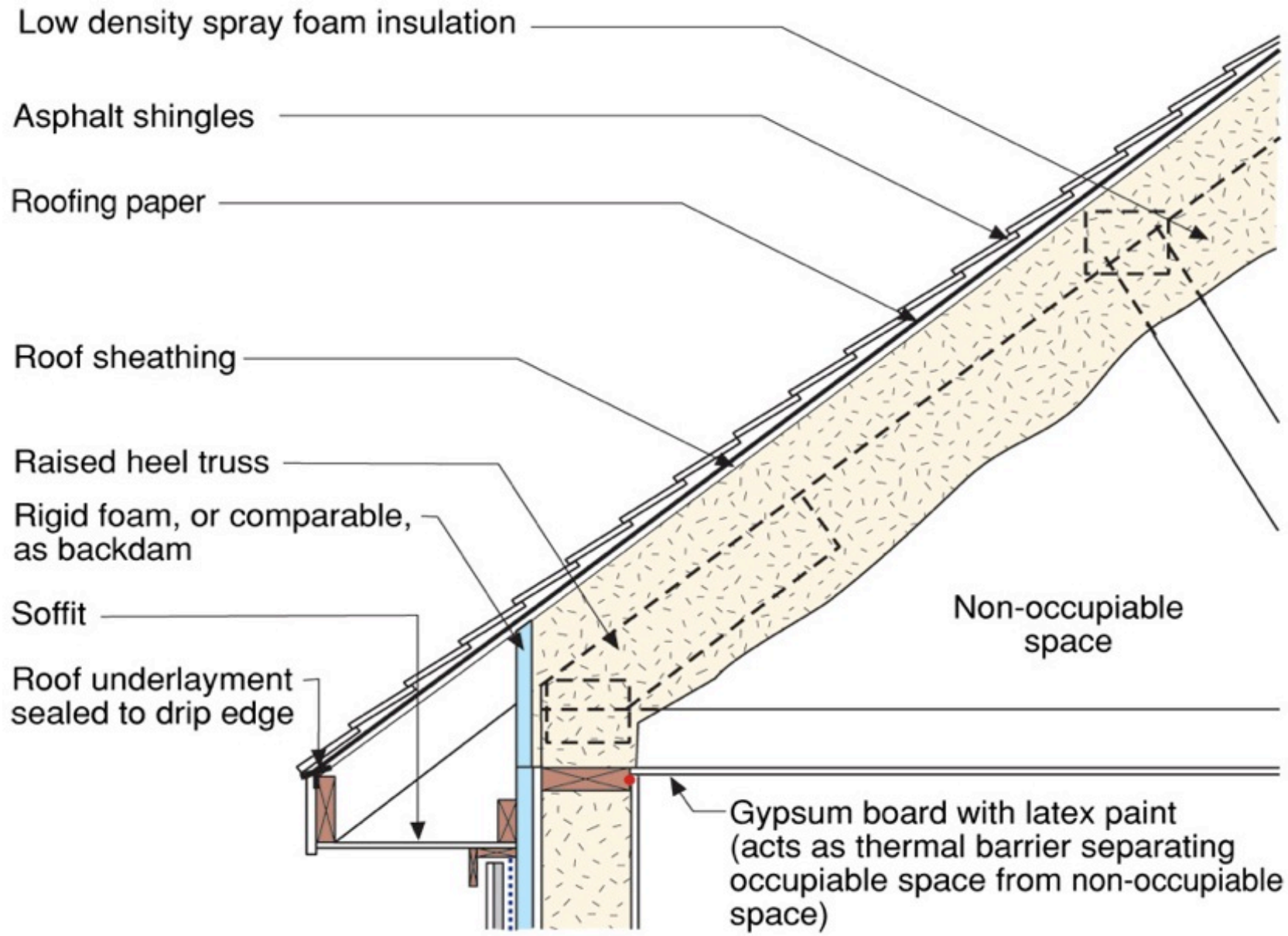






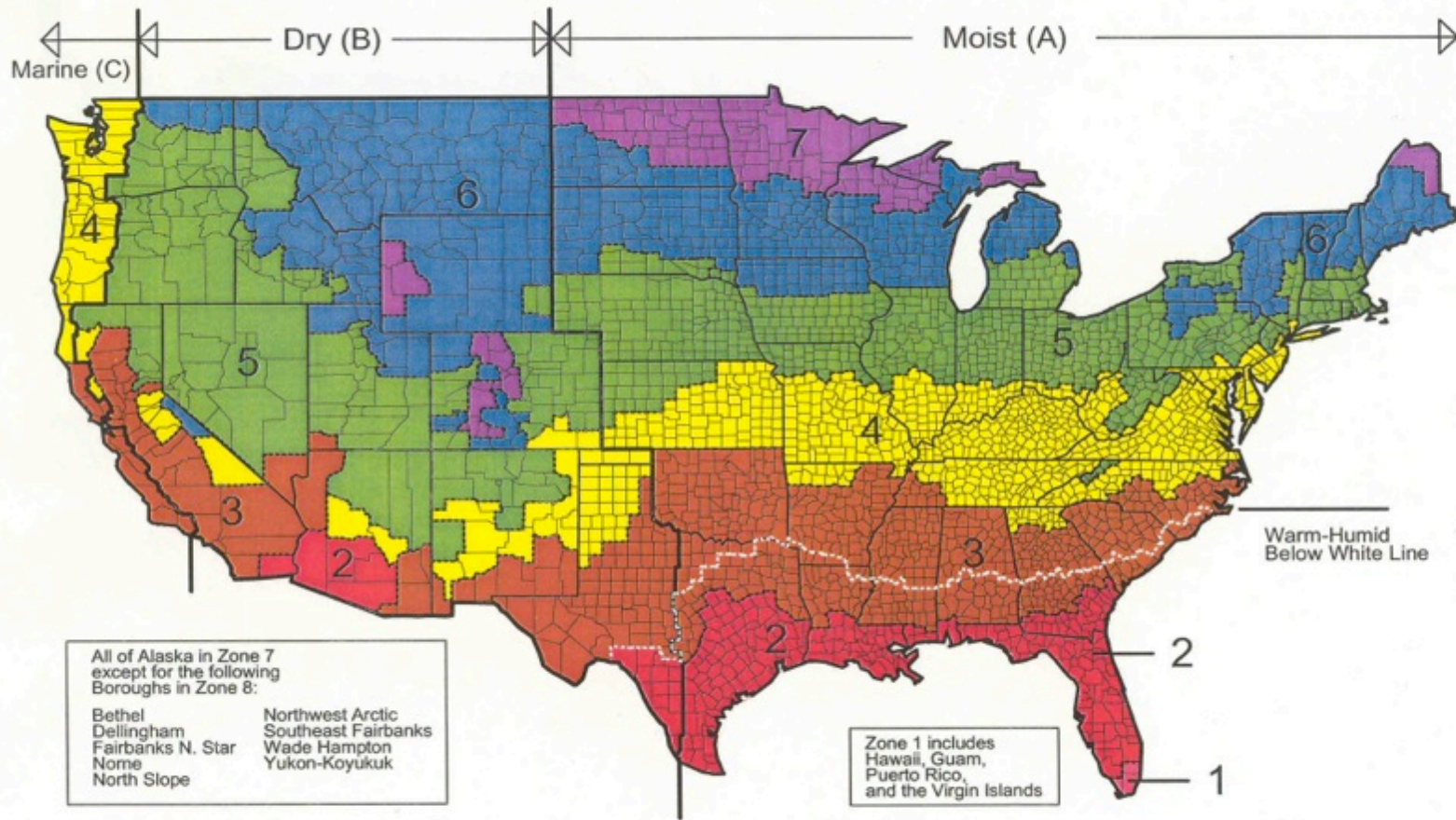








Map of DOE's Proposed Climate Zones



March 24, 2003







Conditioned Attics Not Unvented Attics

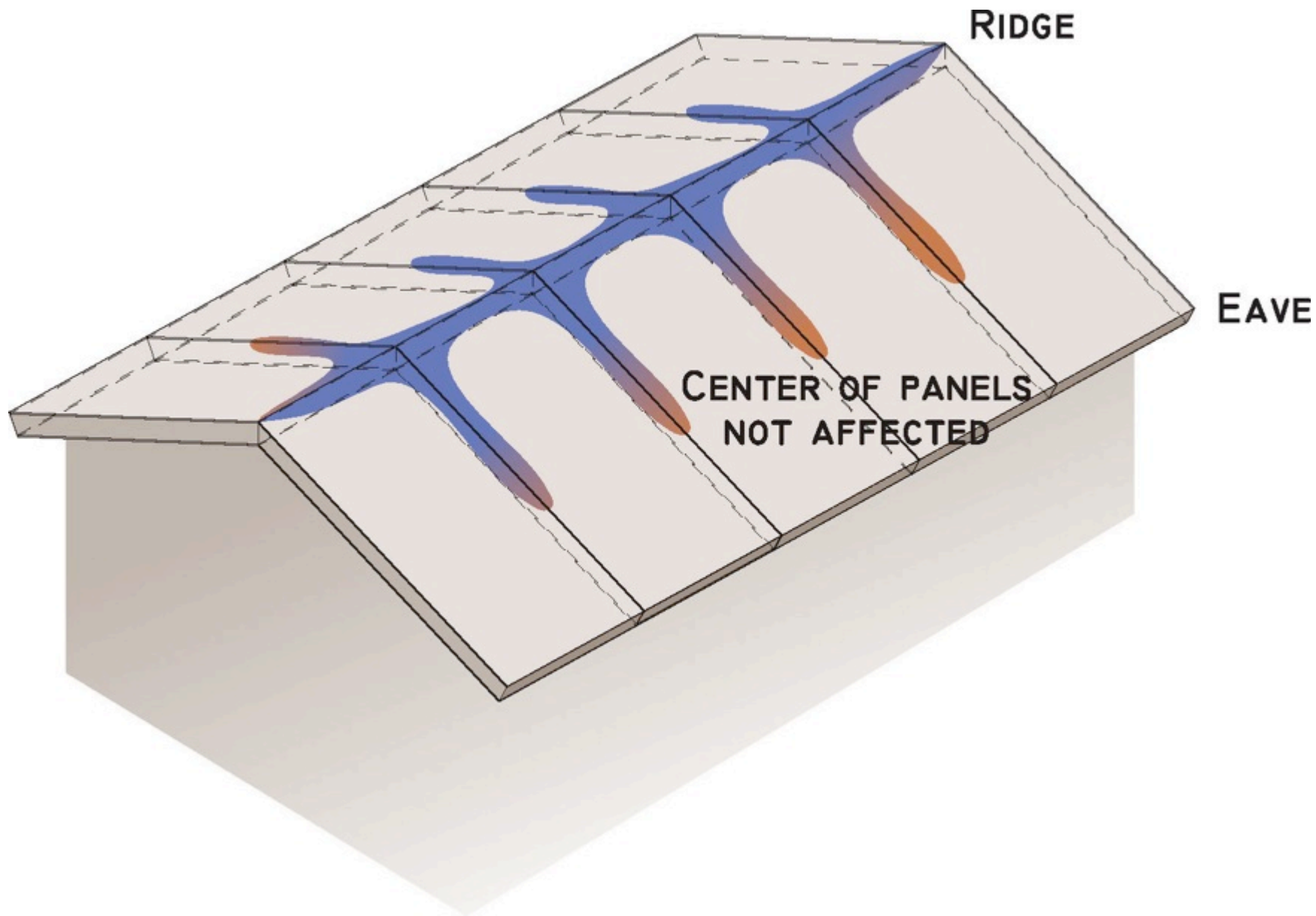














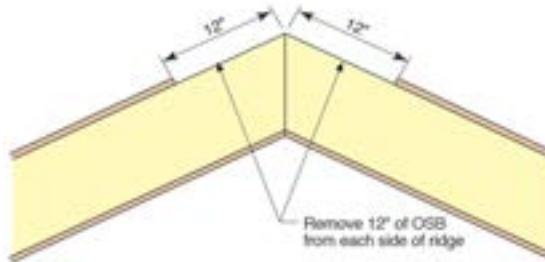






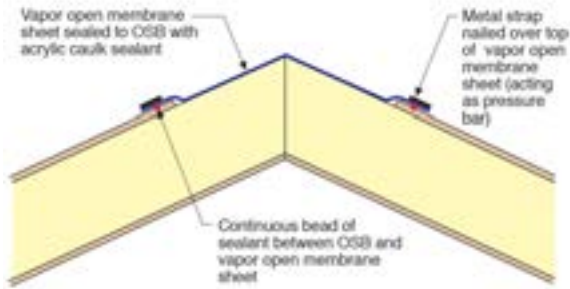
Step 1

- Remove strip of OSB from each side of ridge



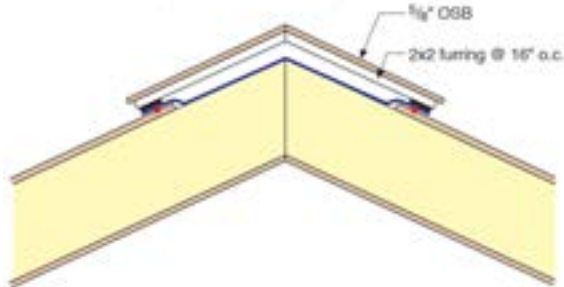
Step 2

- Create air seal with strip of vapor open membrane (tape seams)
- Vapor open membrane sheet sealed to OSB with acrylic caulk sealant
- Hold vapor open membrane sheet in place with metal strapping



Step 3

- Construct wood ridge vent with 2x2 furring









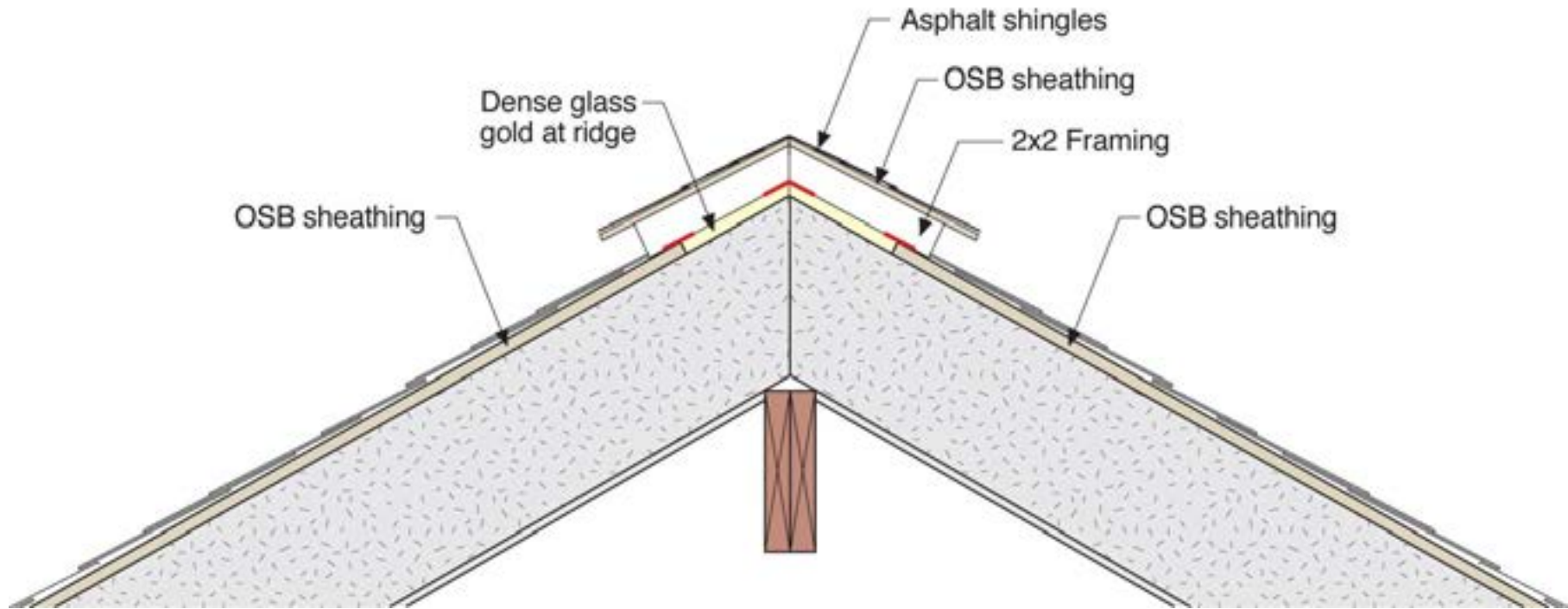


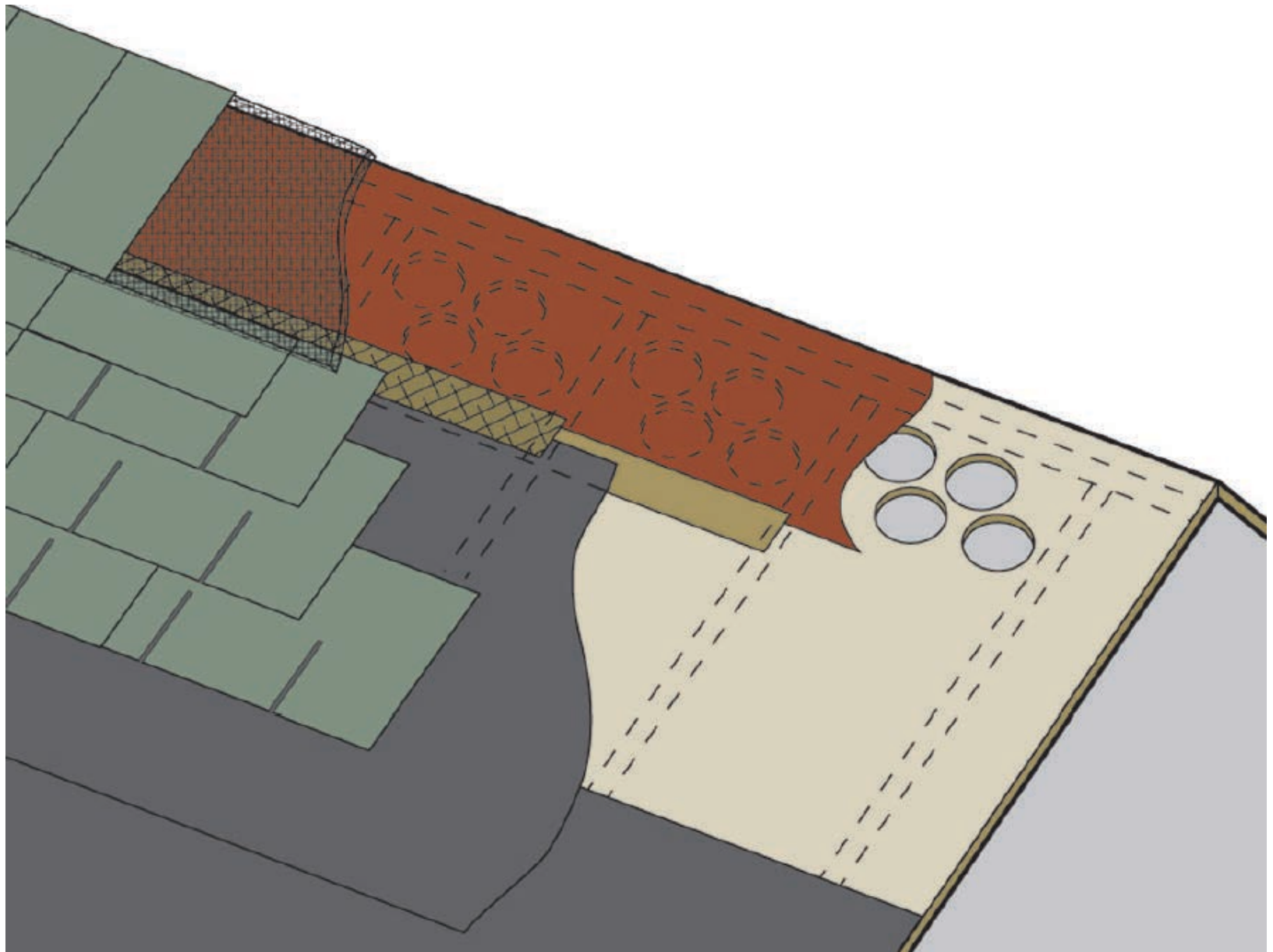


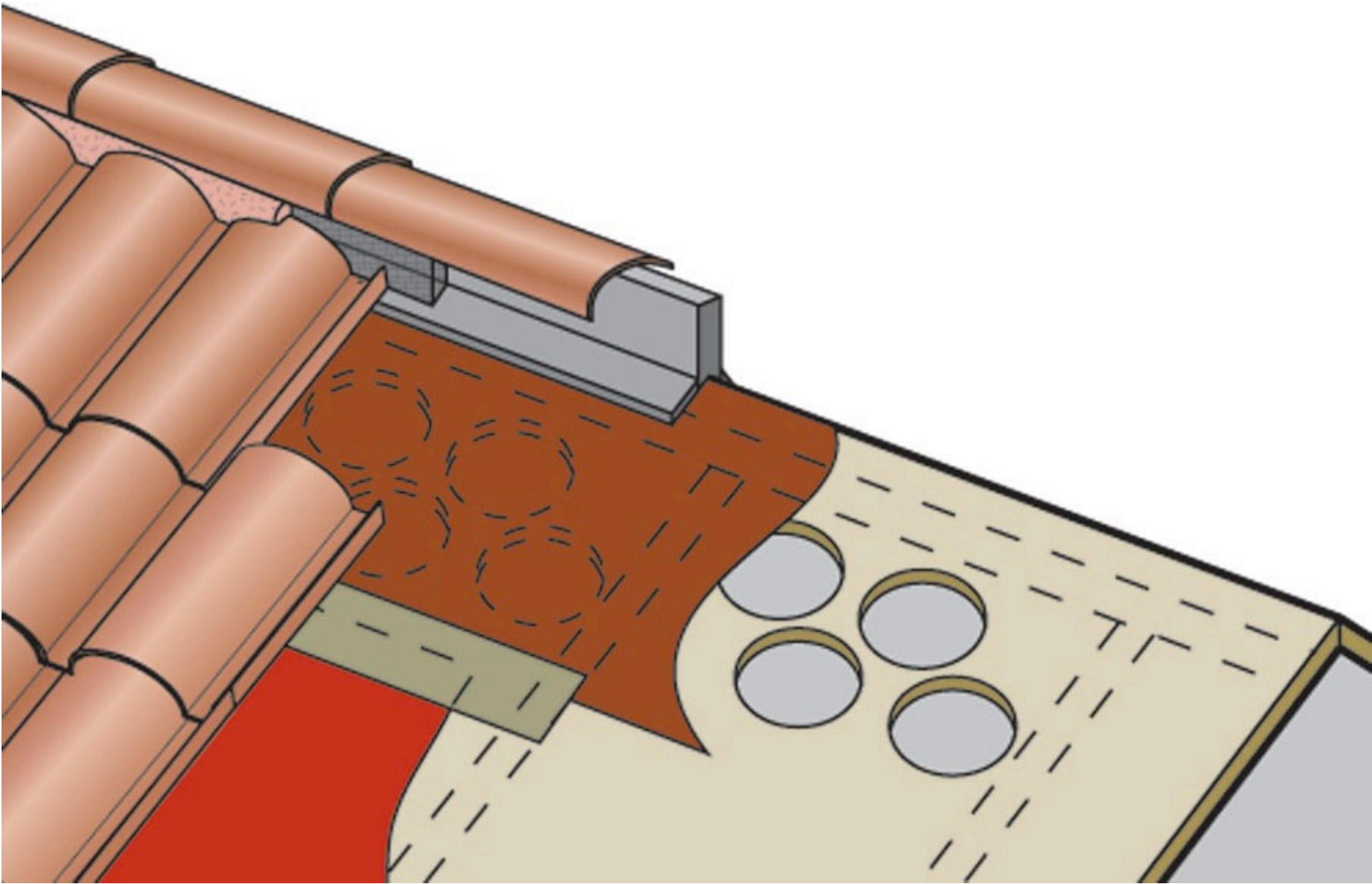


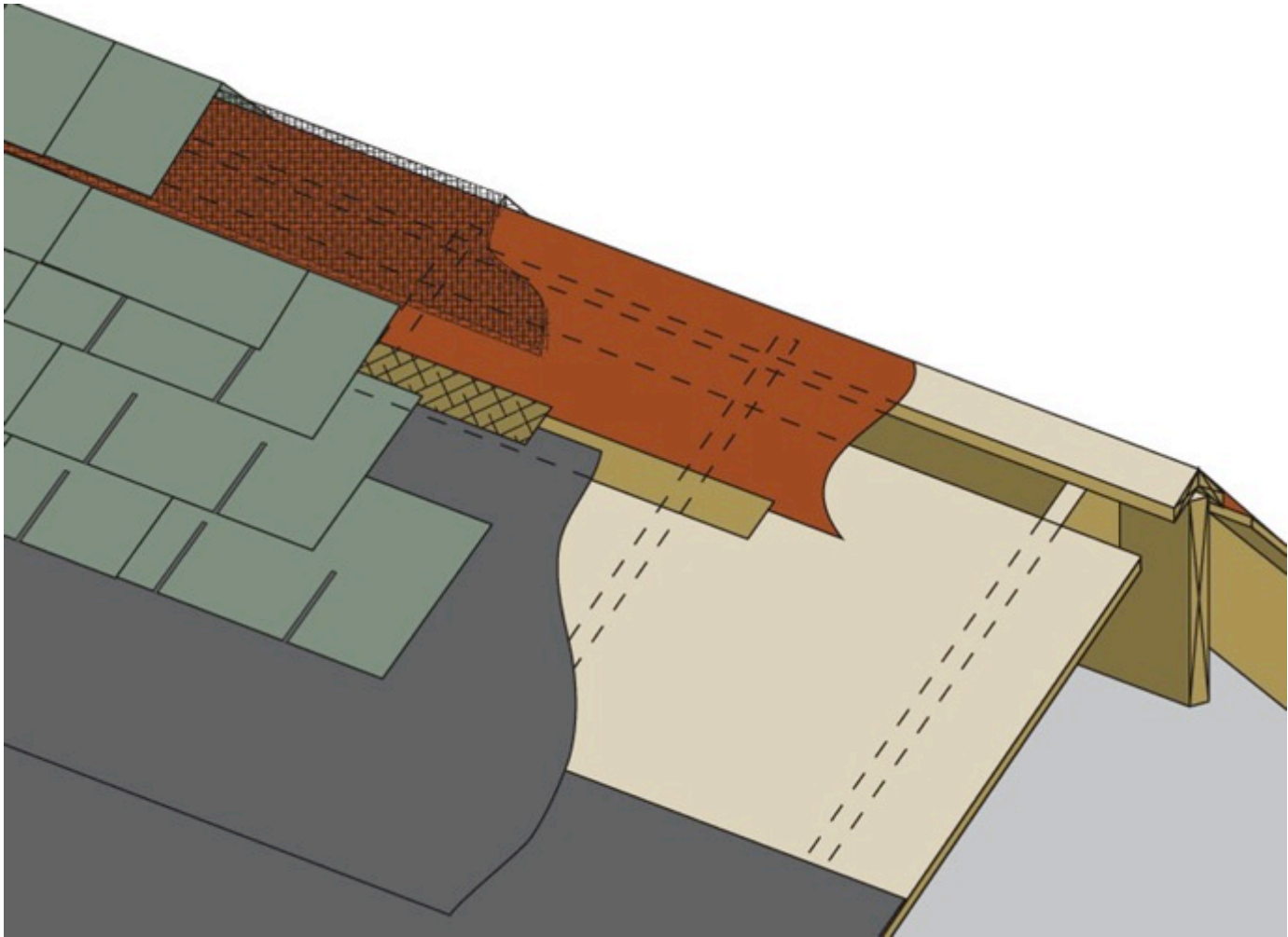


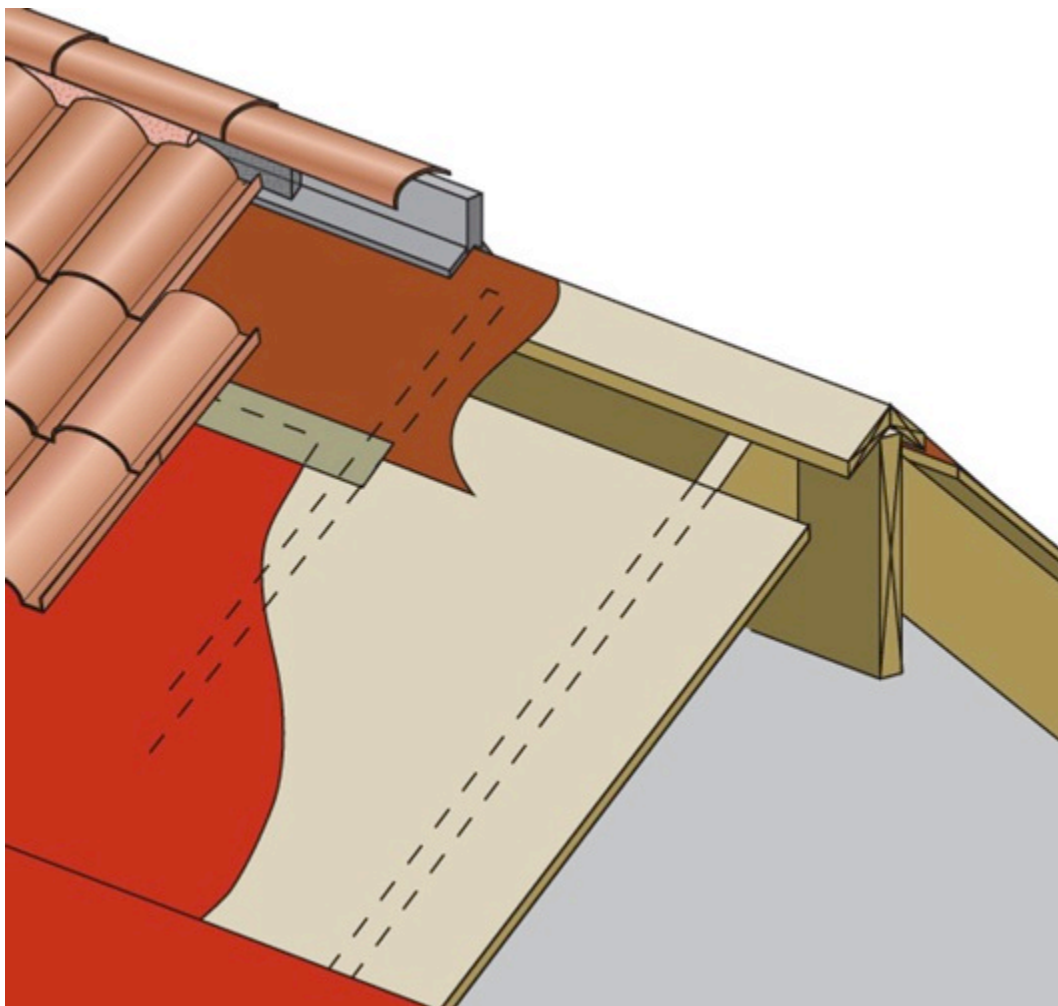










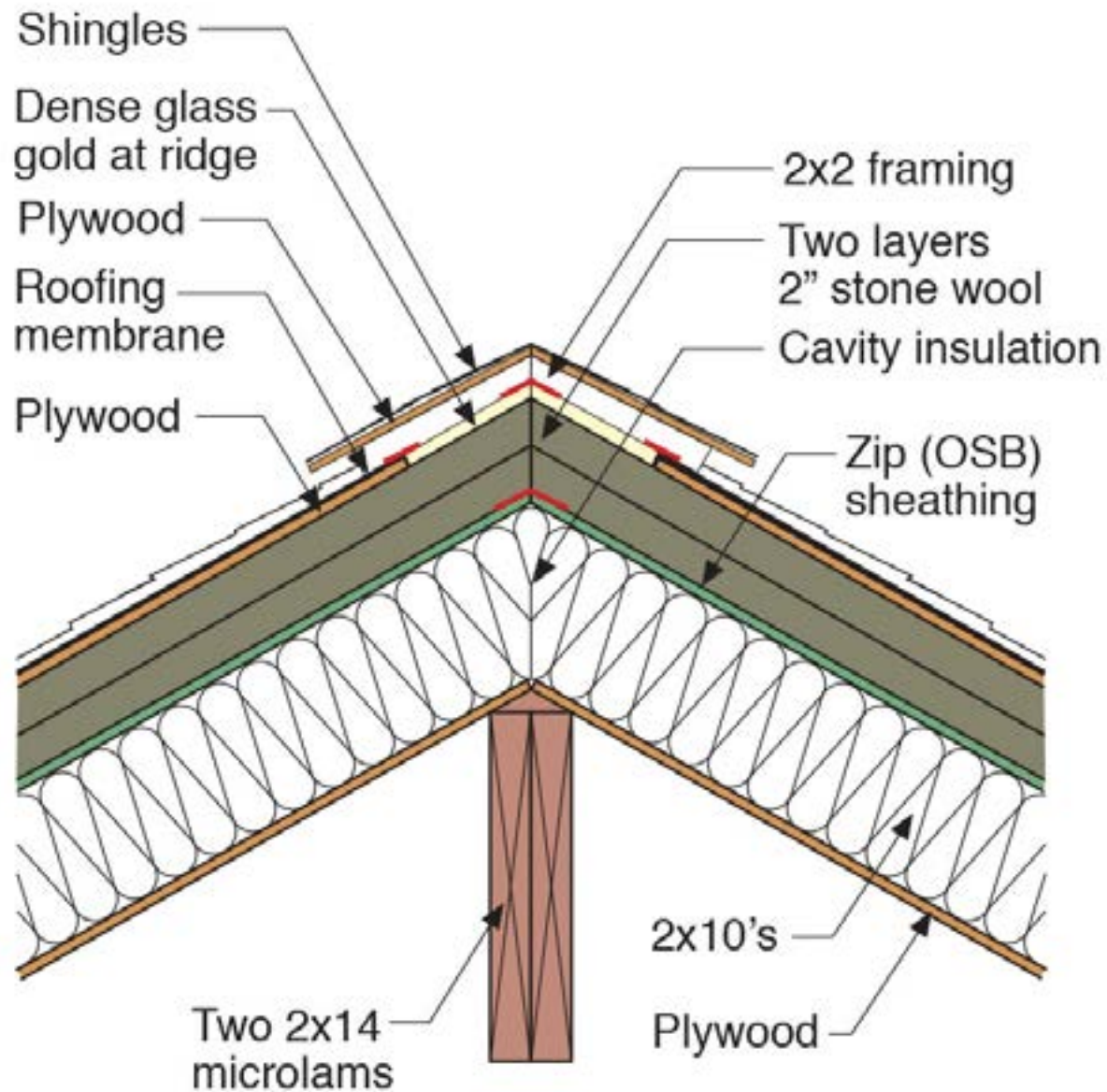




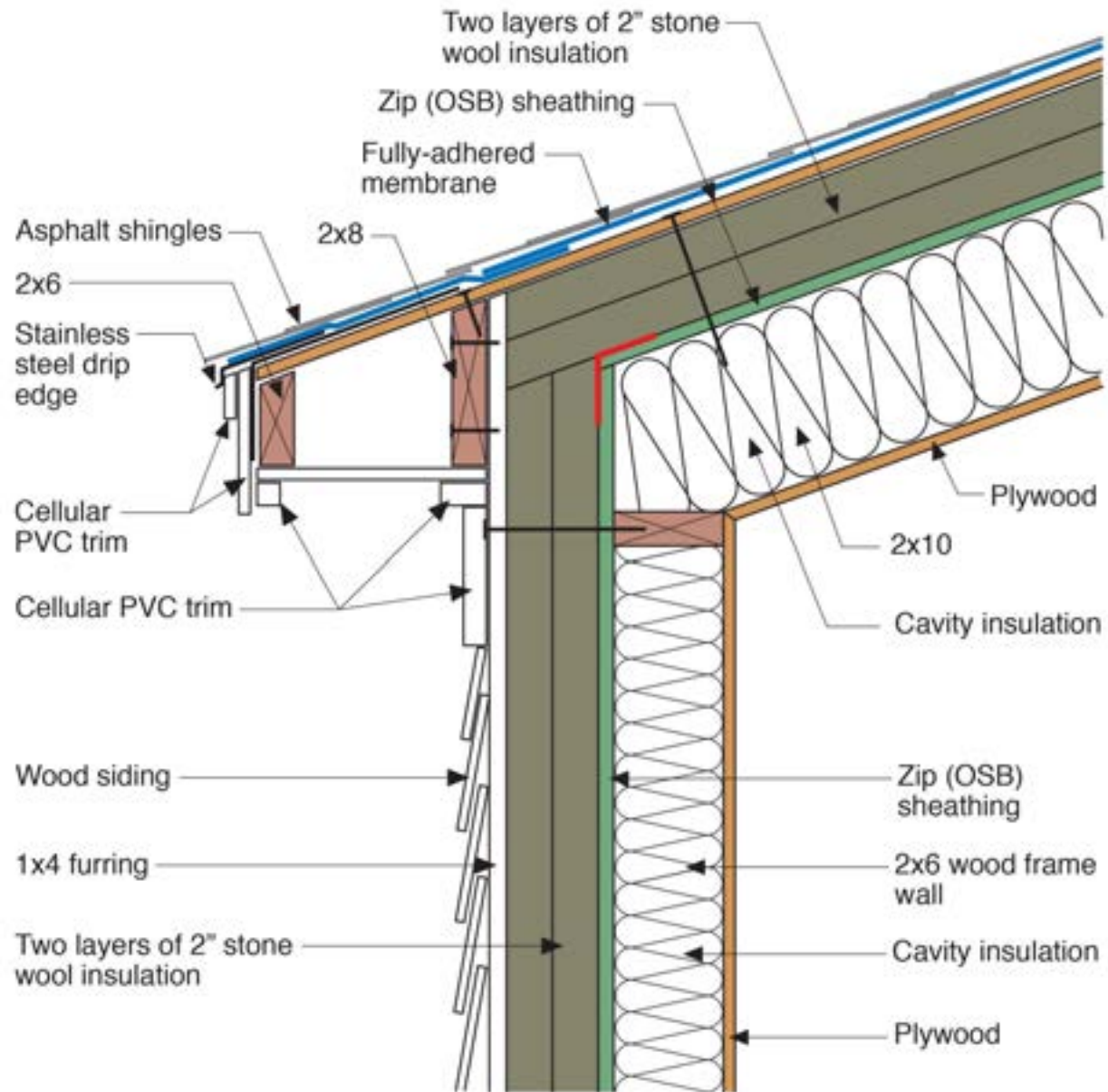


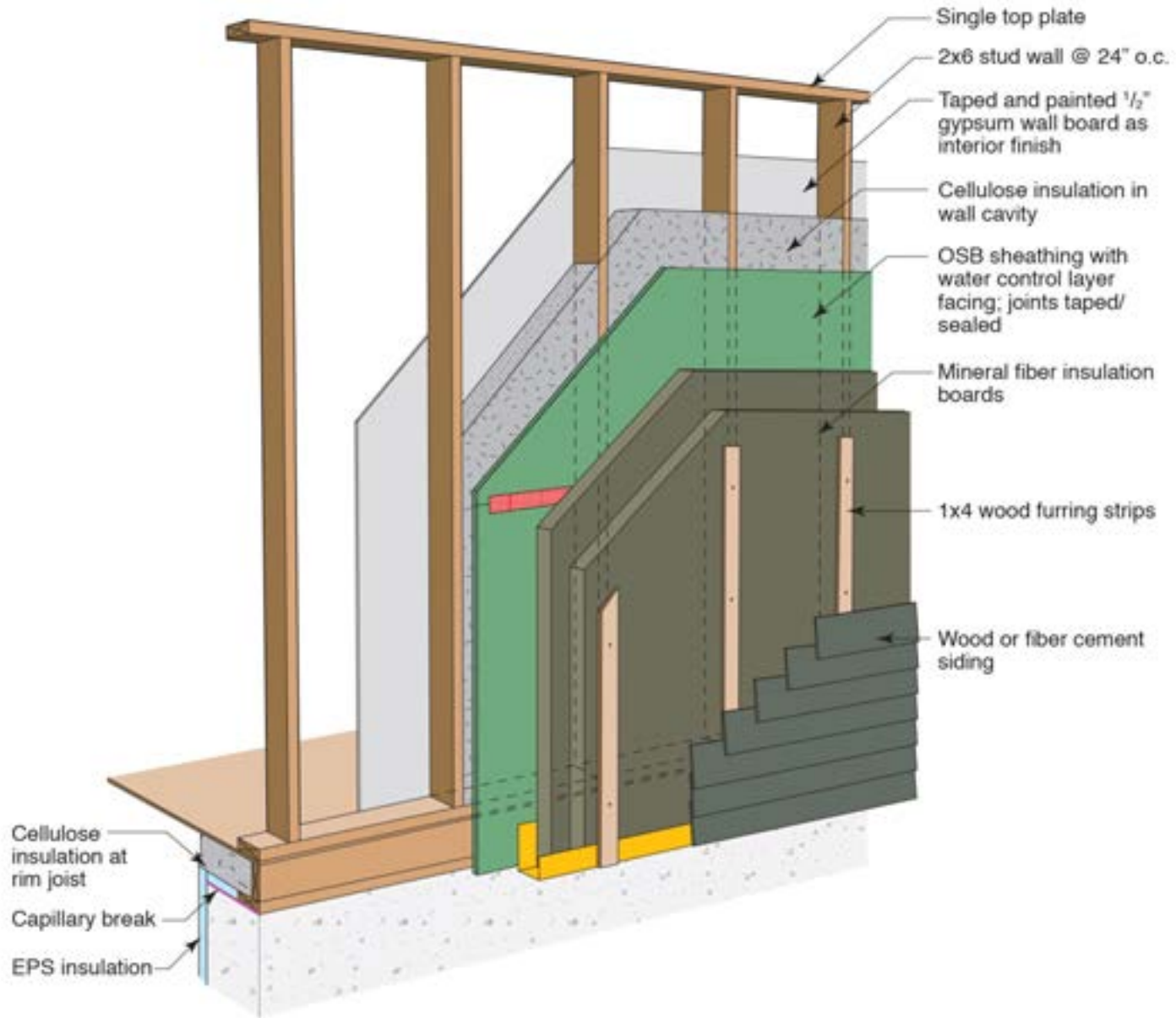


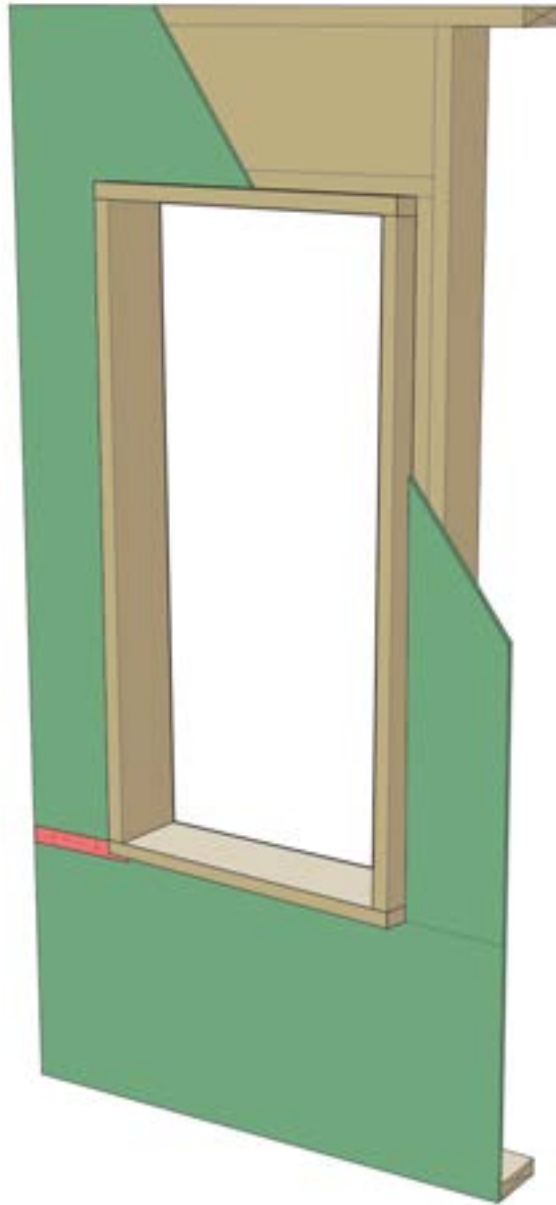


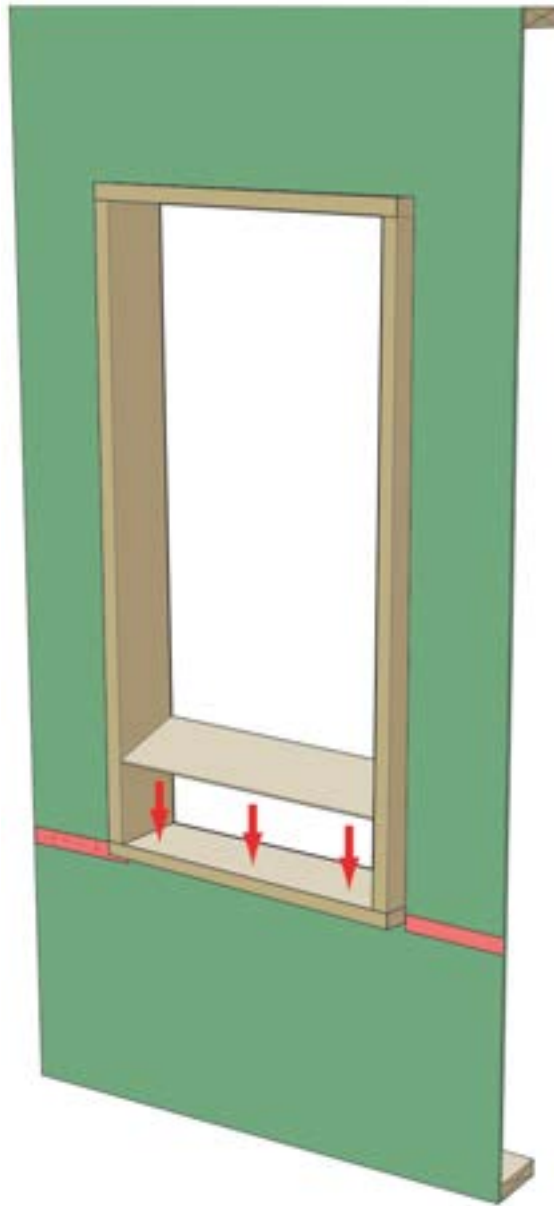


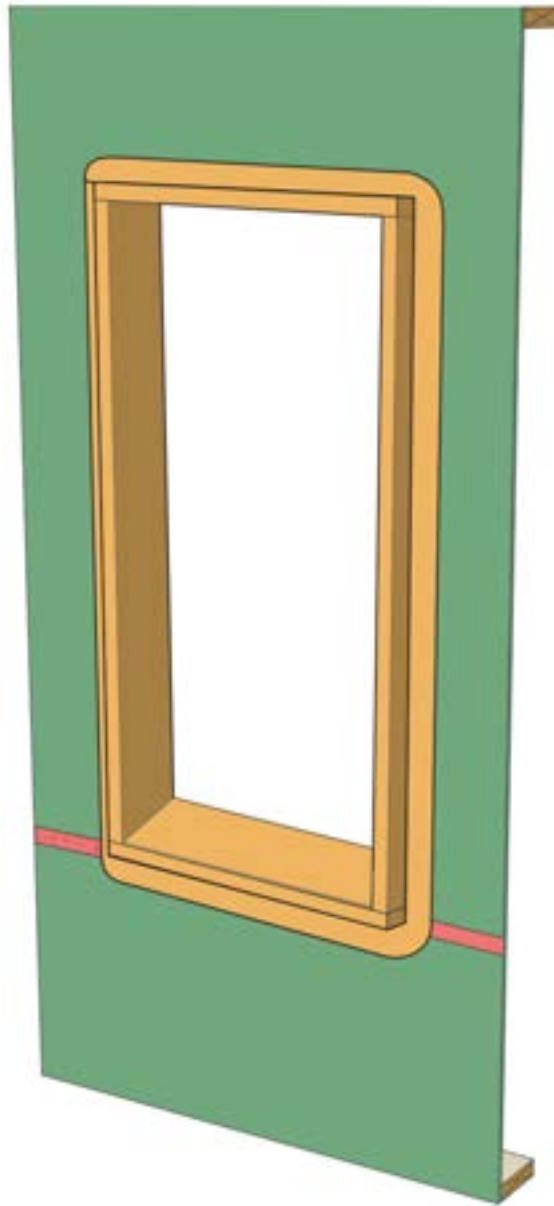


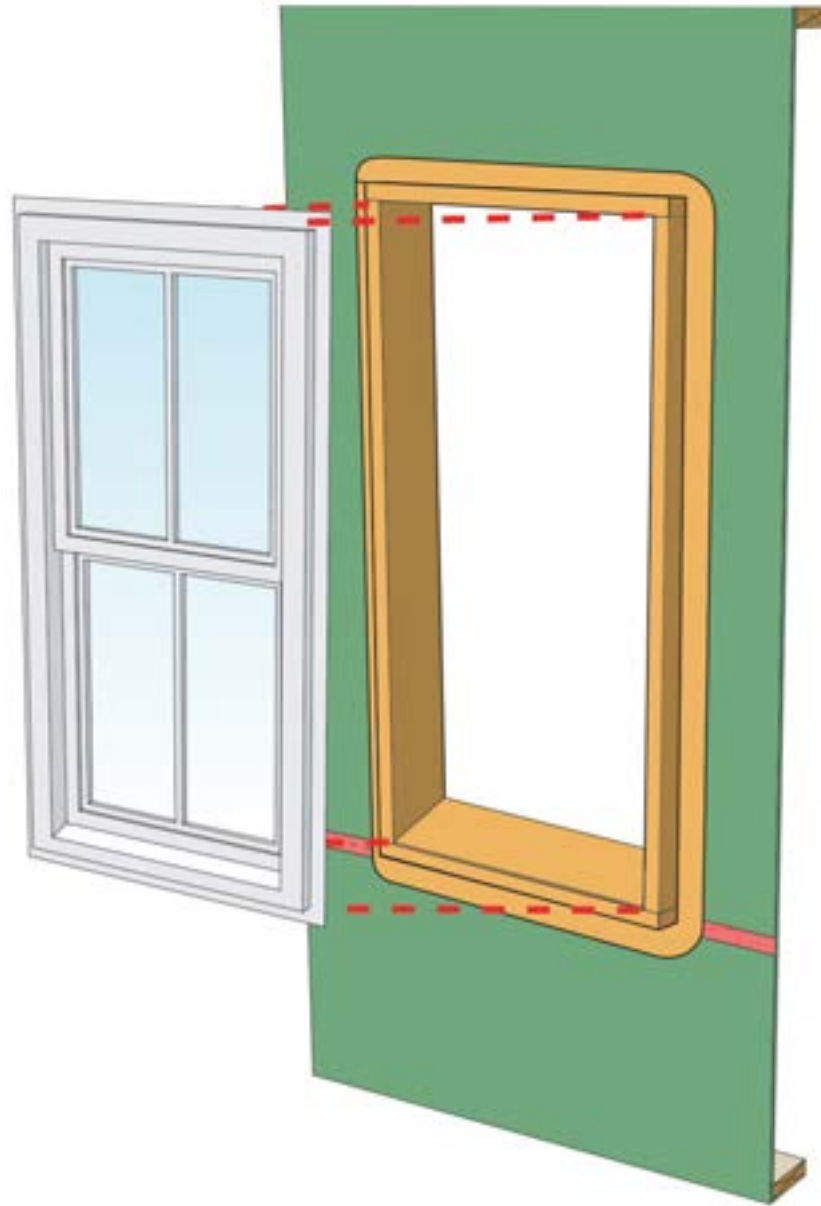






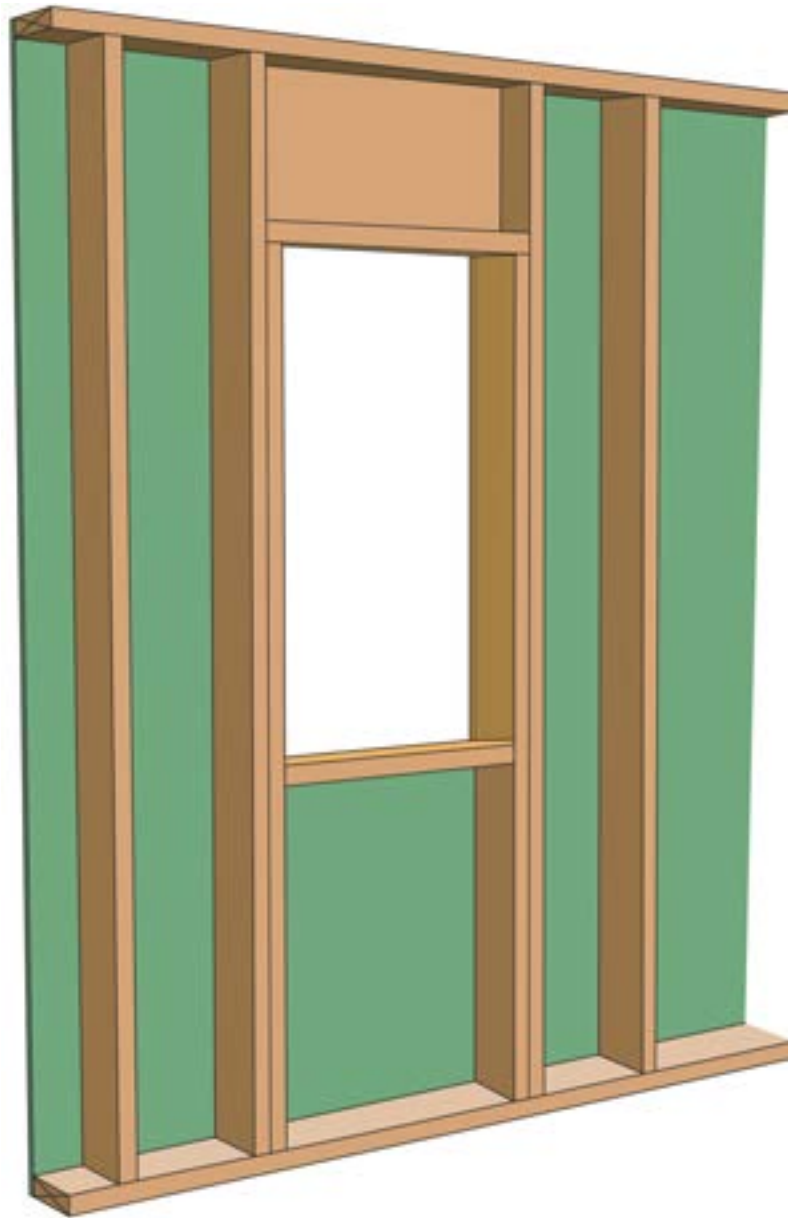








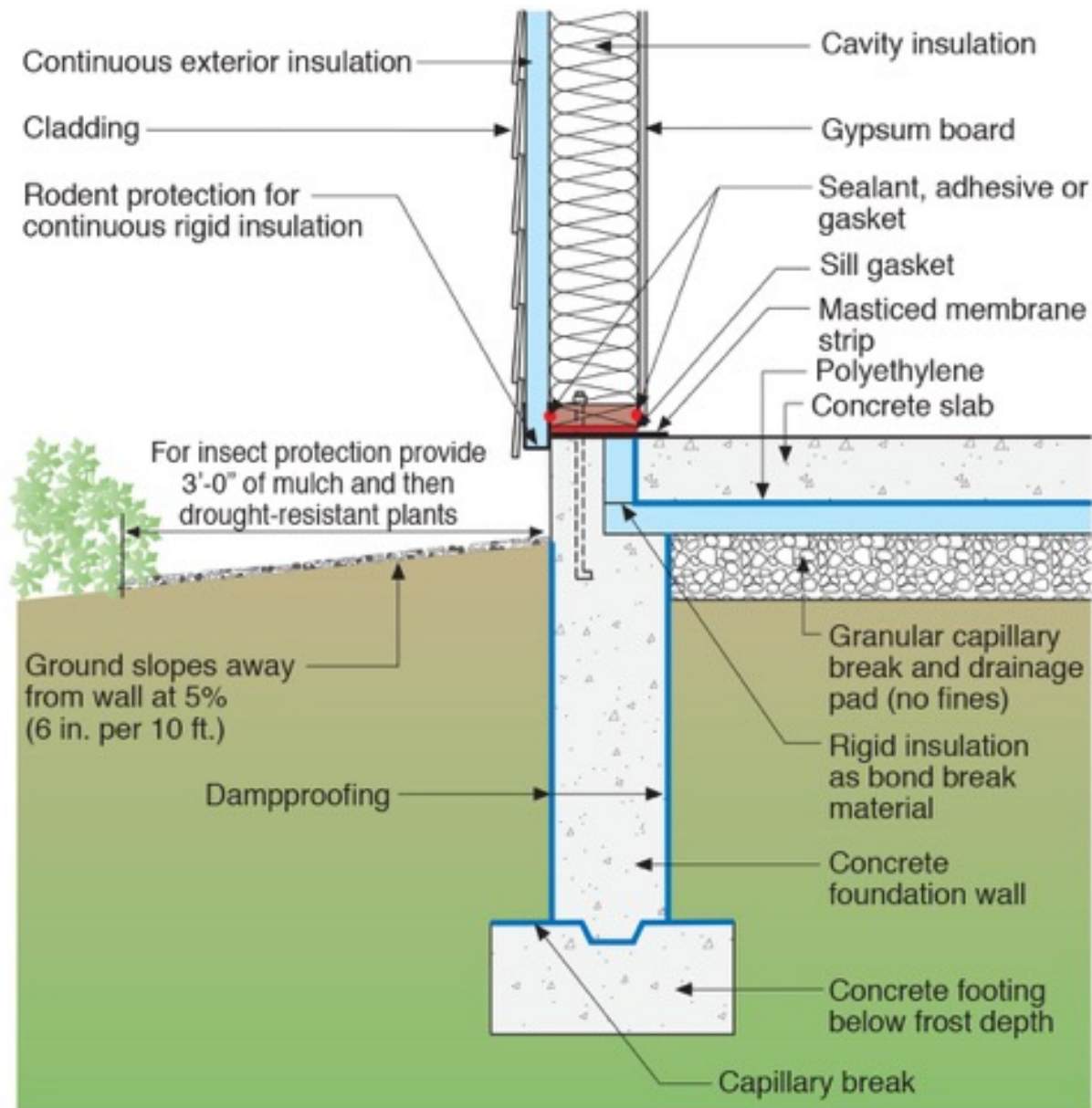


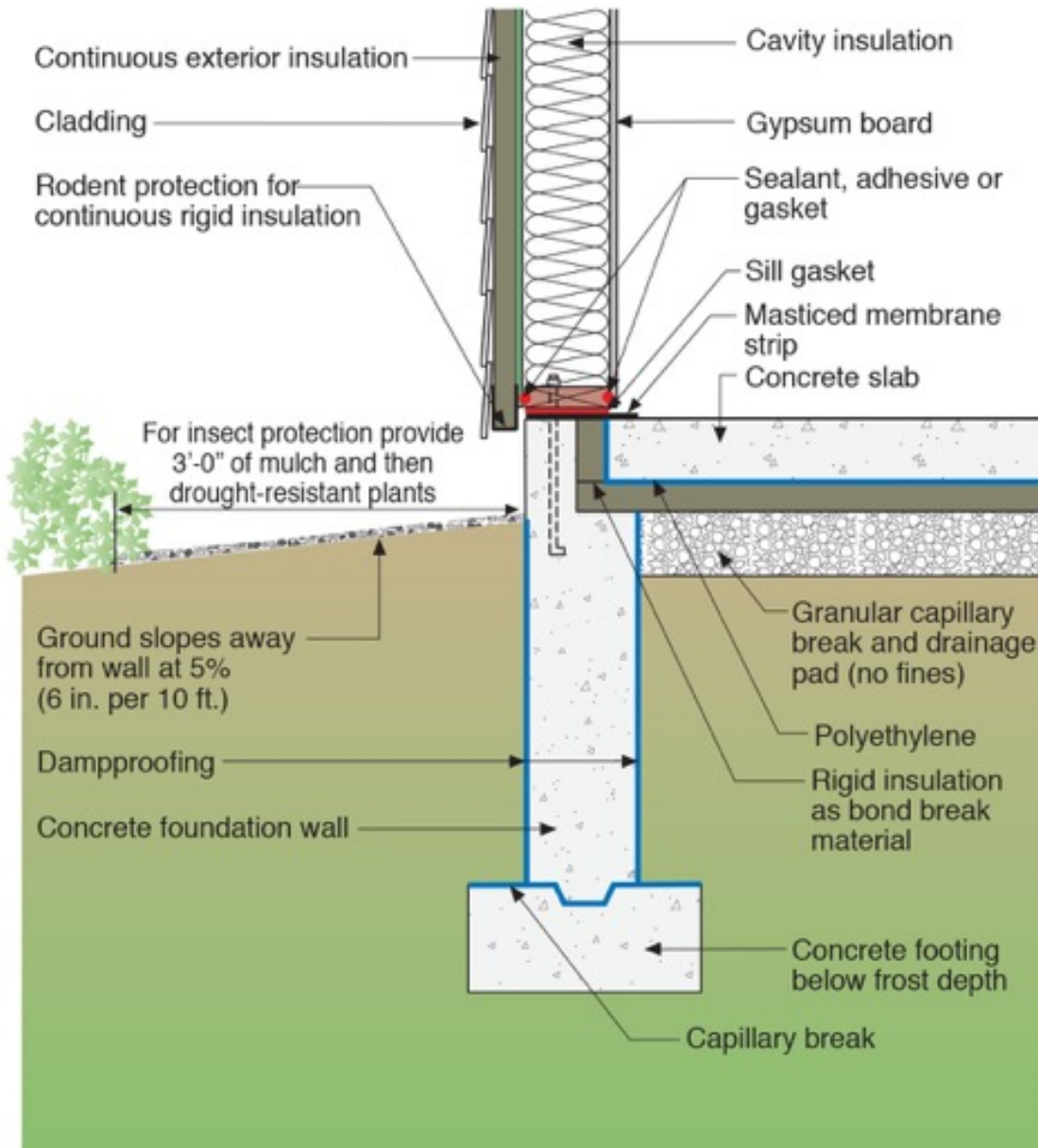


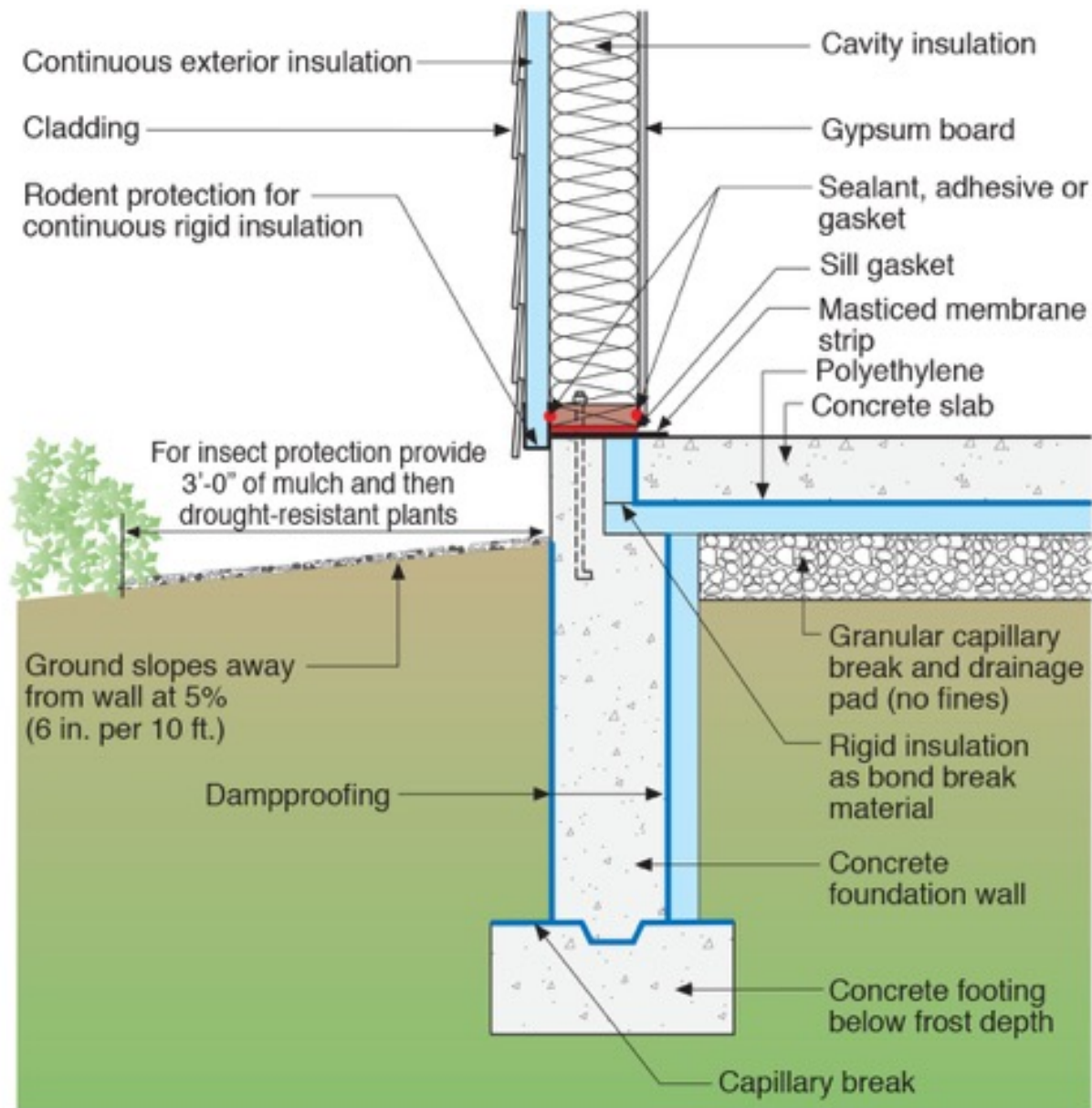


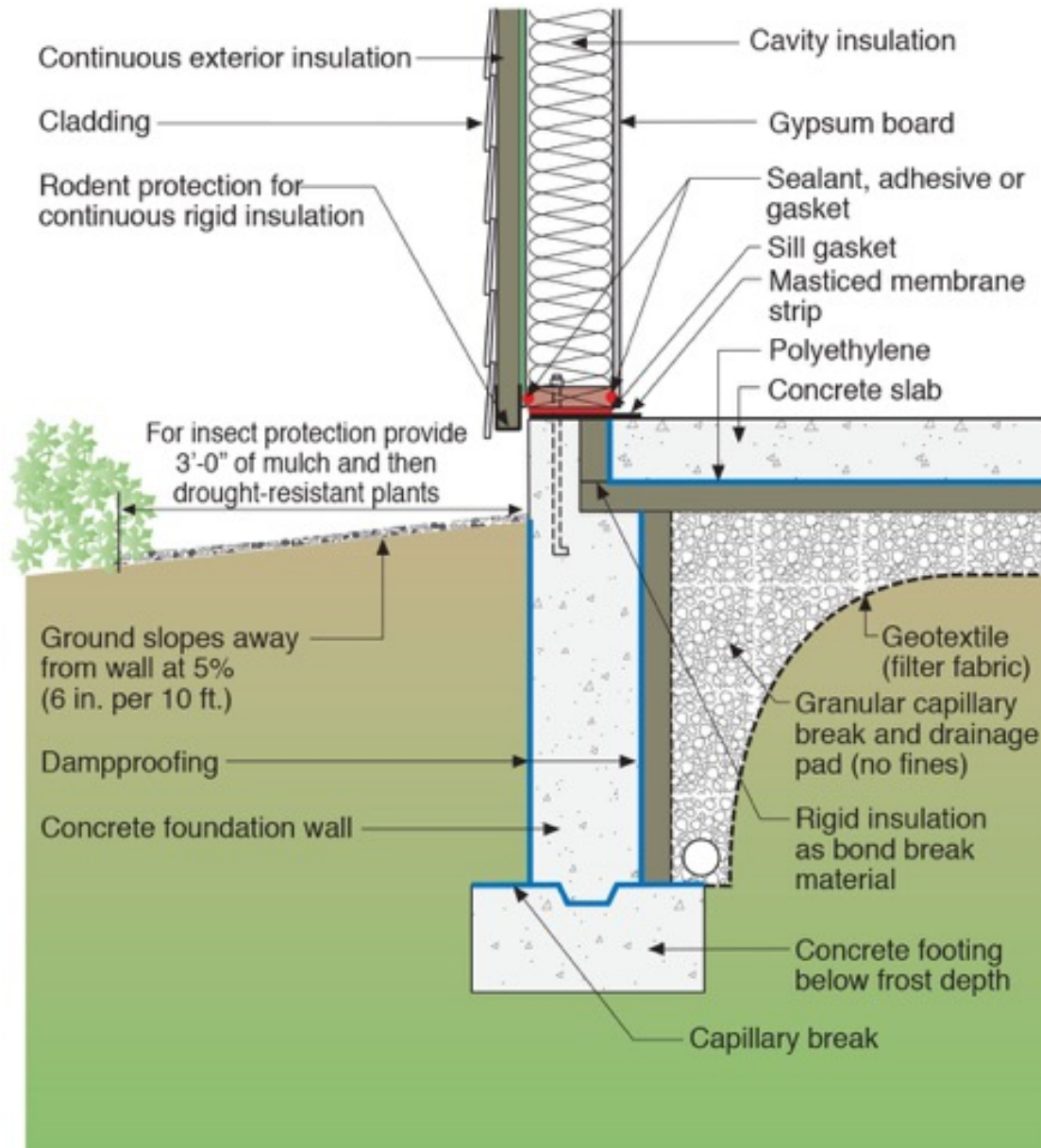


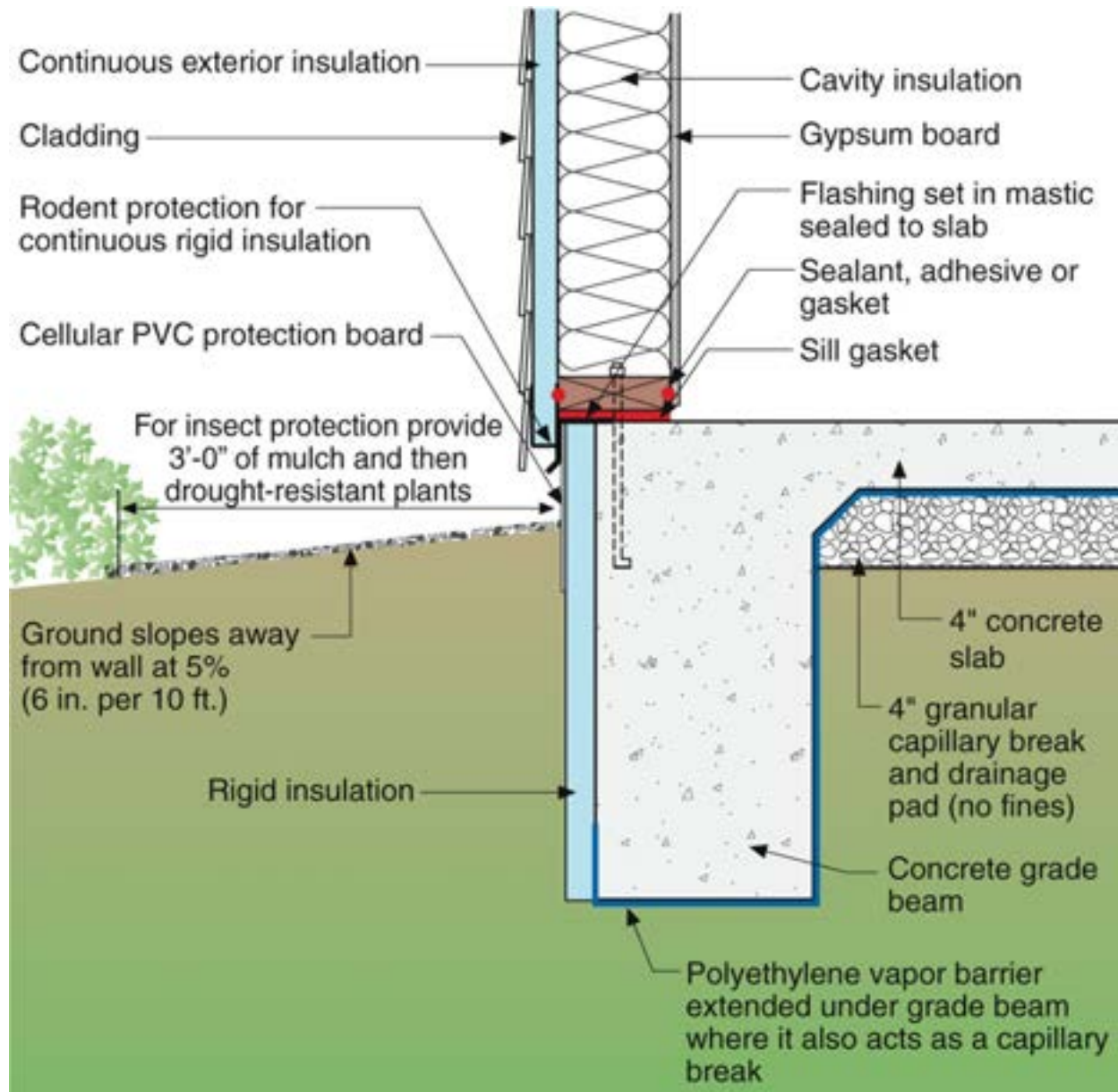


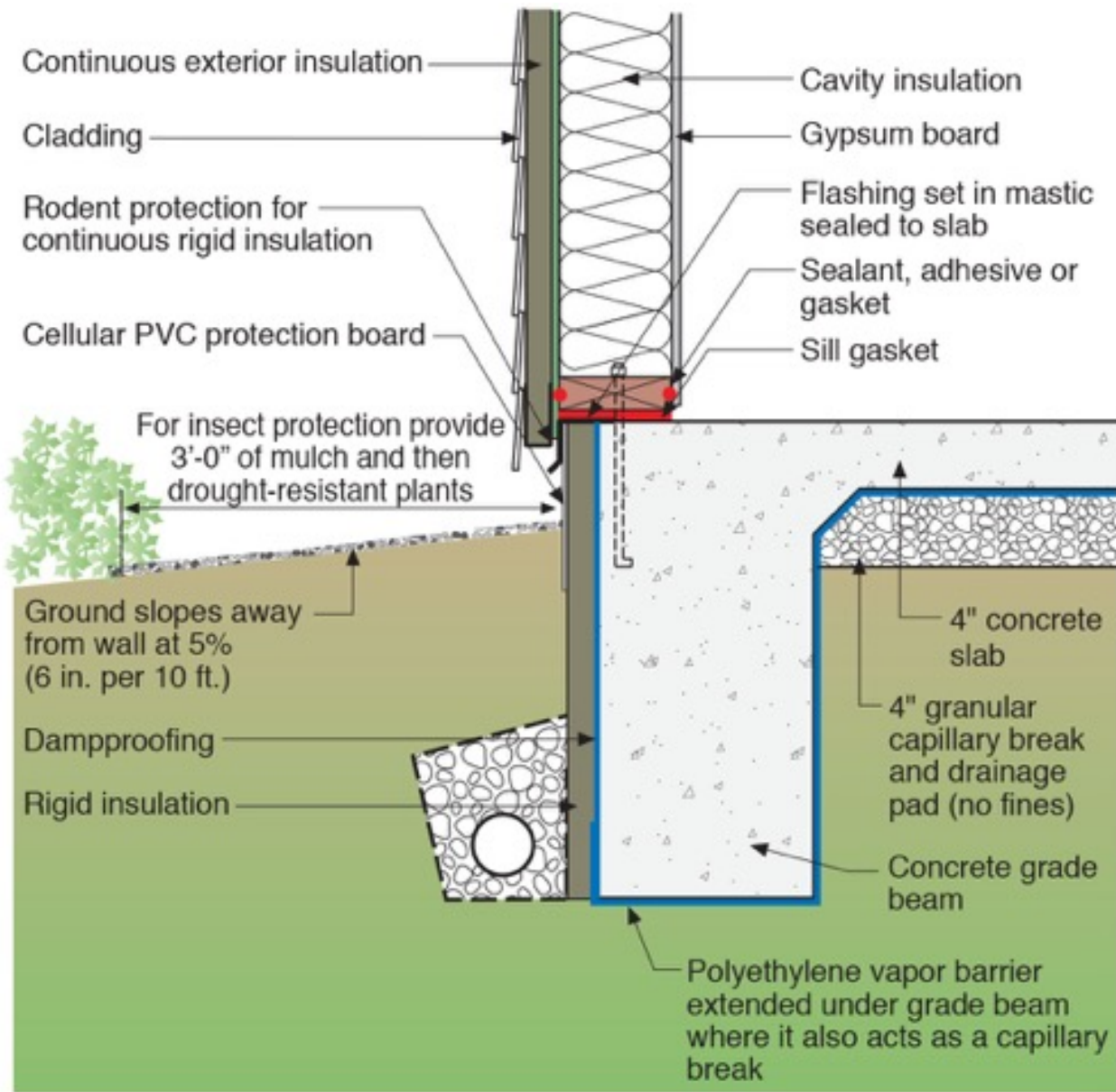


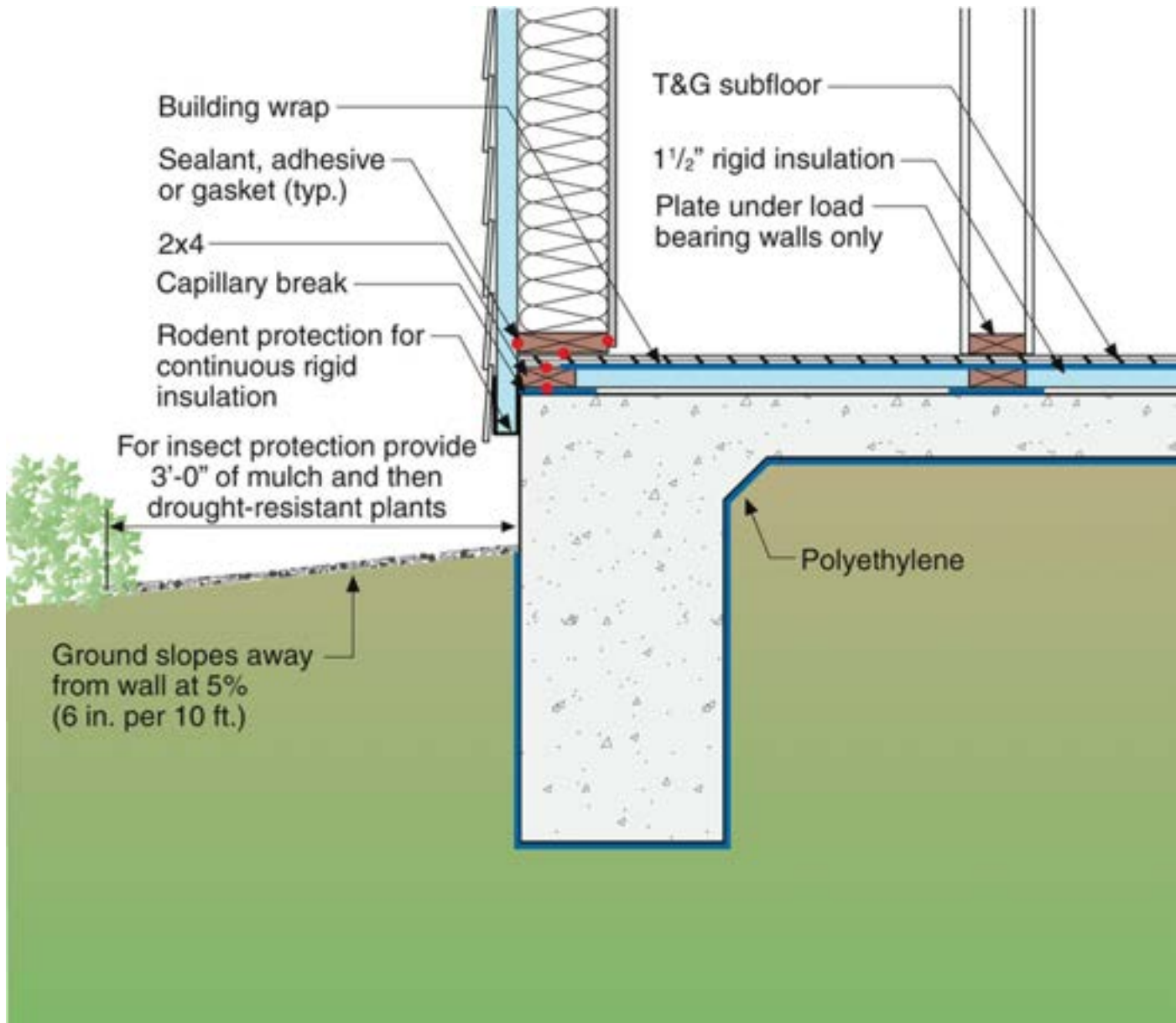


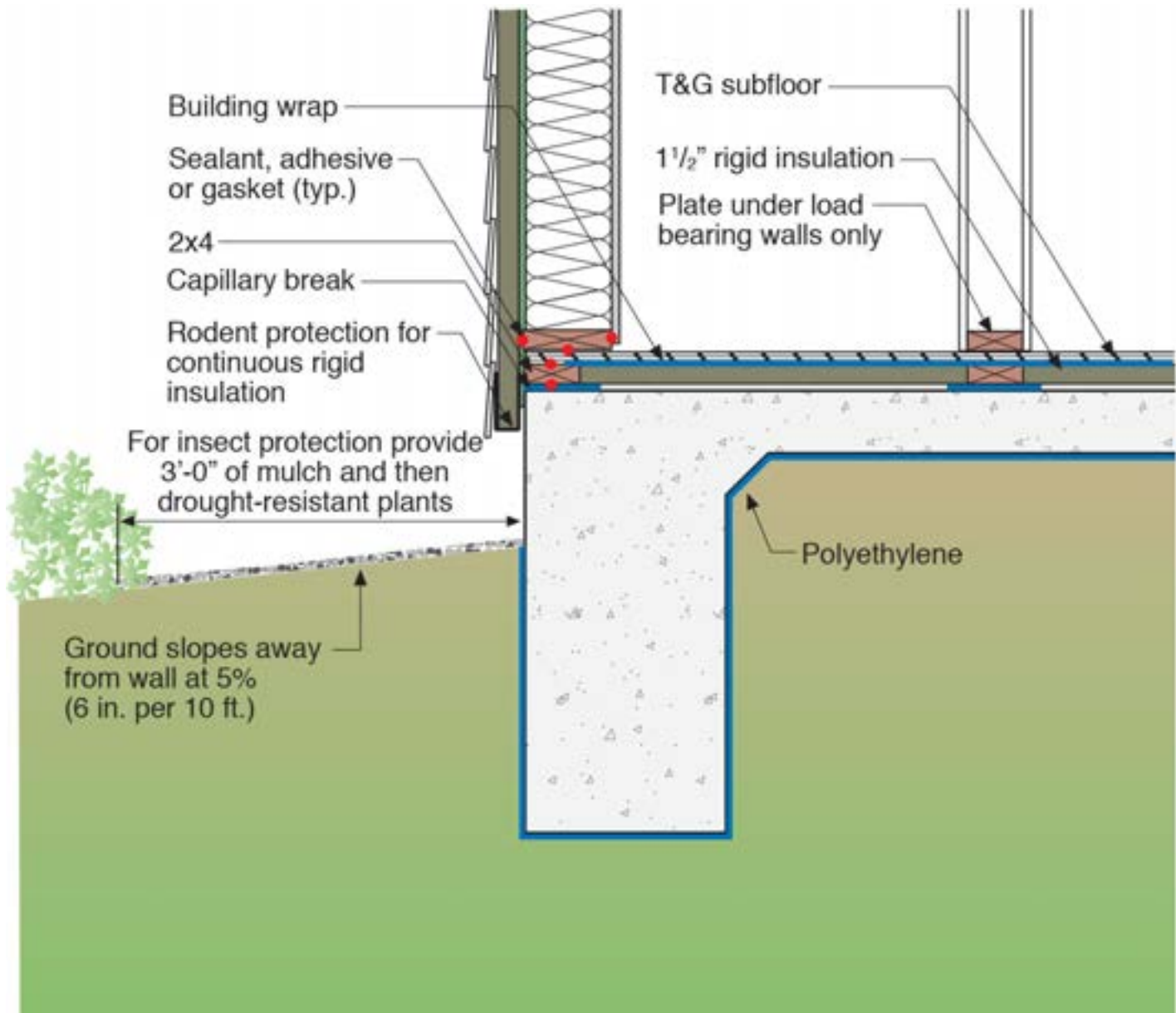


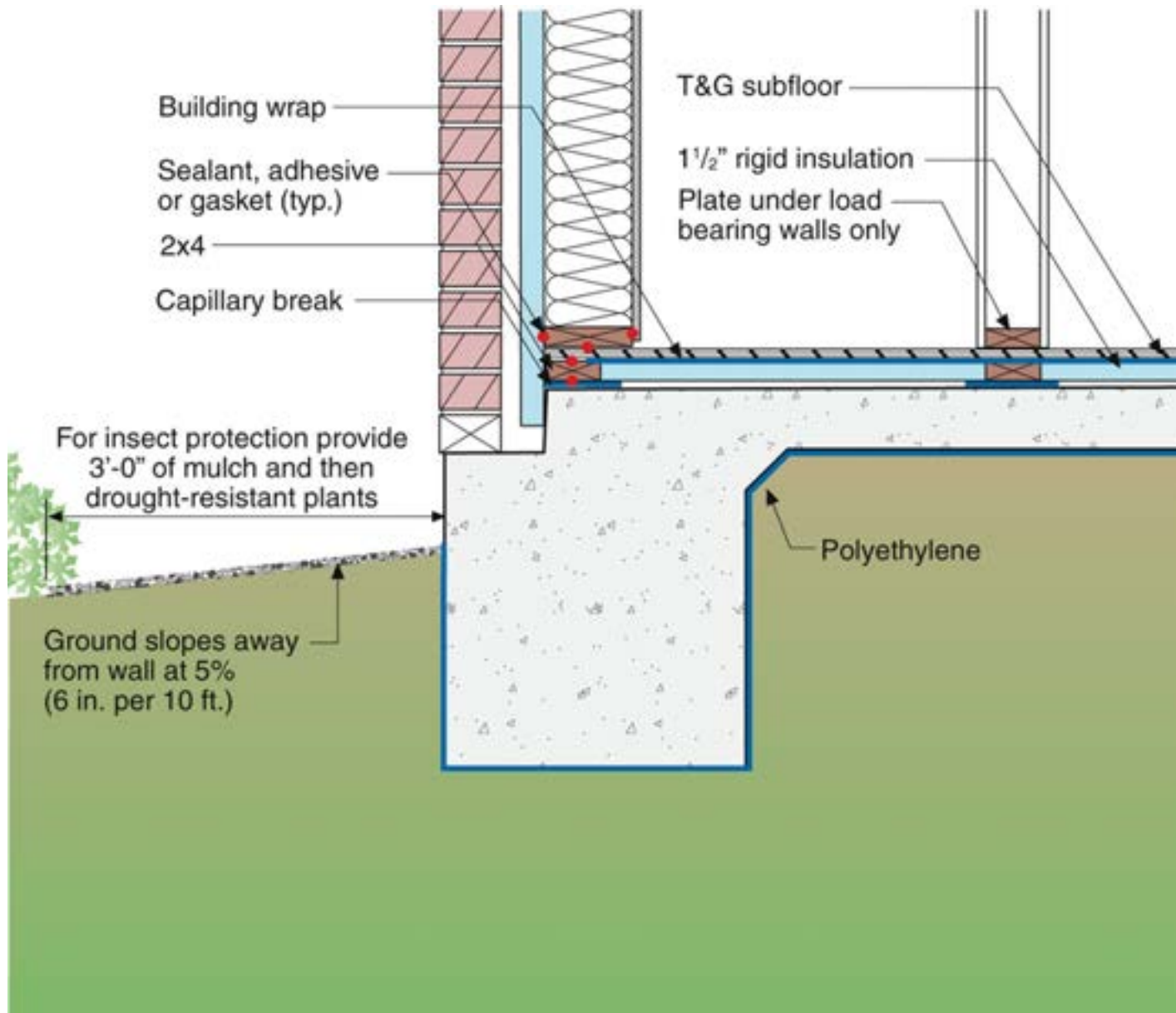


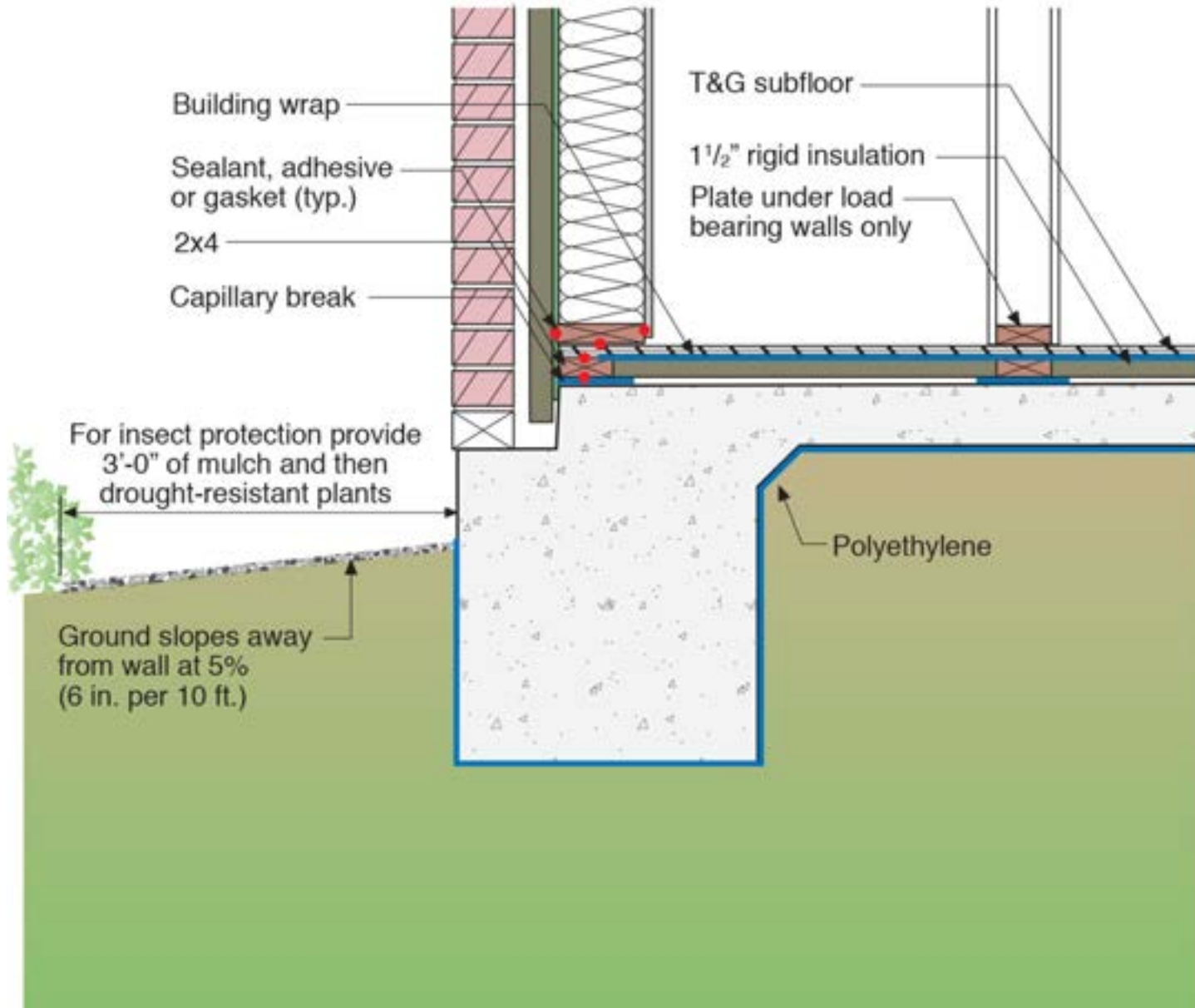


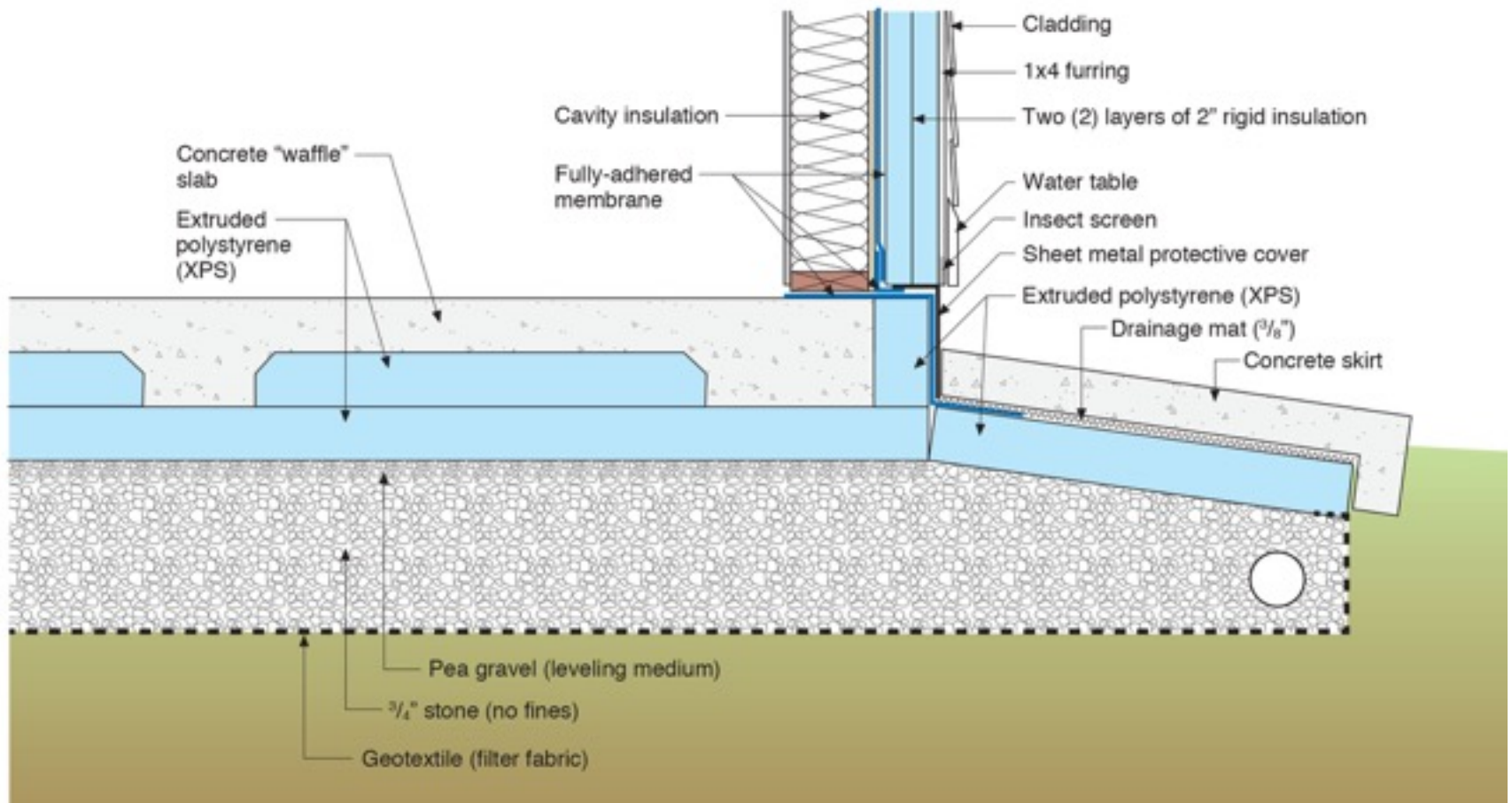


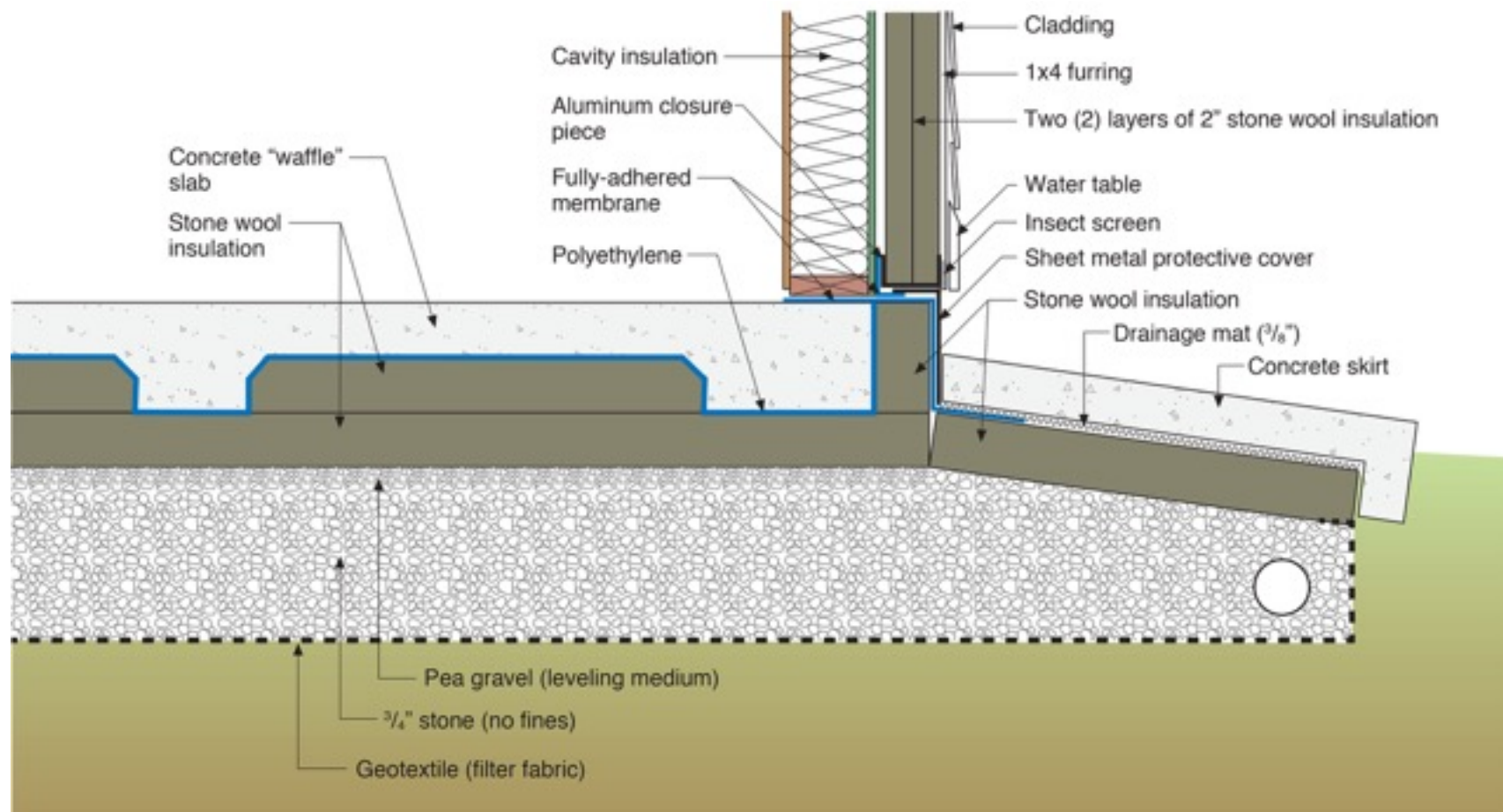










































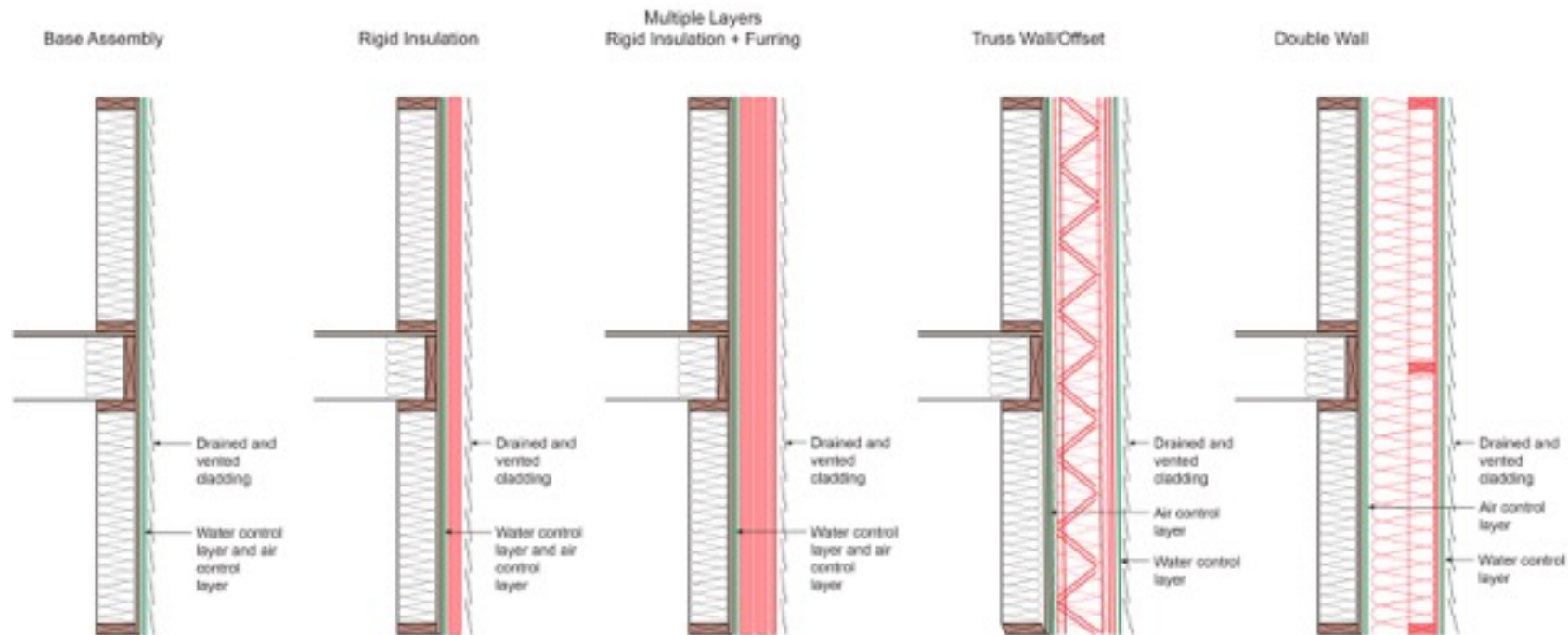
















Rockwool

1x3 furring @ 24" o.c.
#10 screws @ 16" o.c. vertically
Result: 20 psf cladding weight
with < 2/100" deflection

