

Joseph Lstiburek, Ph.D., P.Eng, ASHRAE Fellow

# Building Science

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Adventures In Building Science

[www.buildingscience.com](http://www.buildingscience.com)

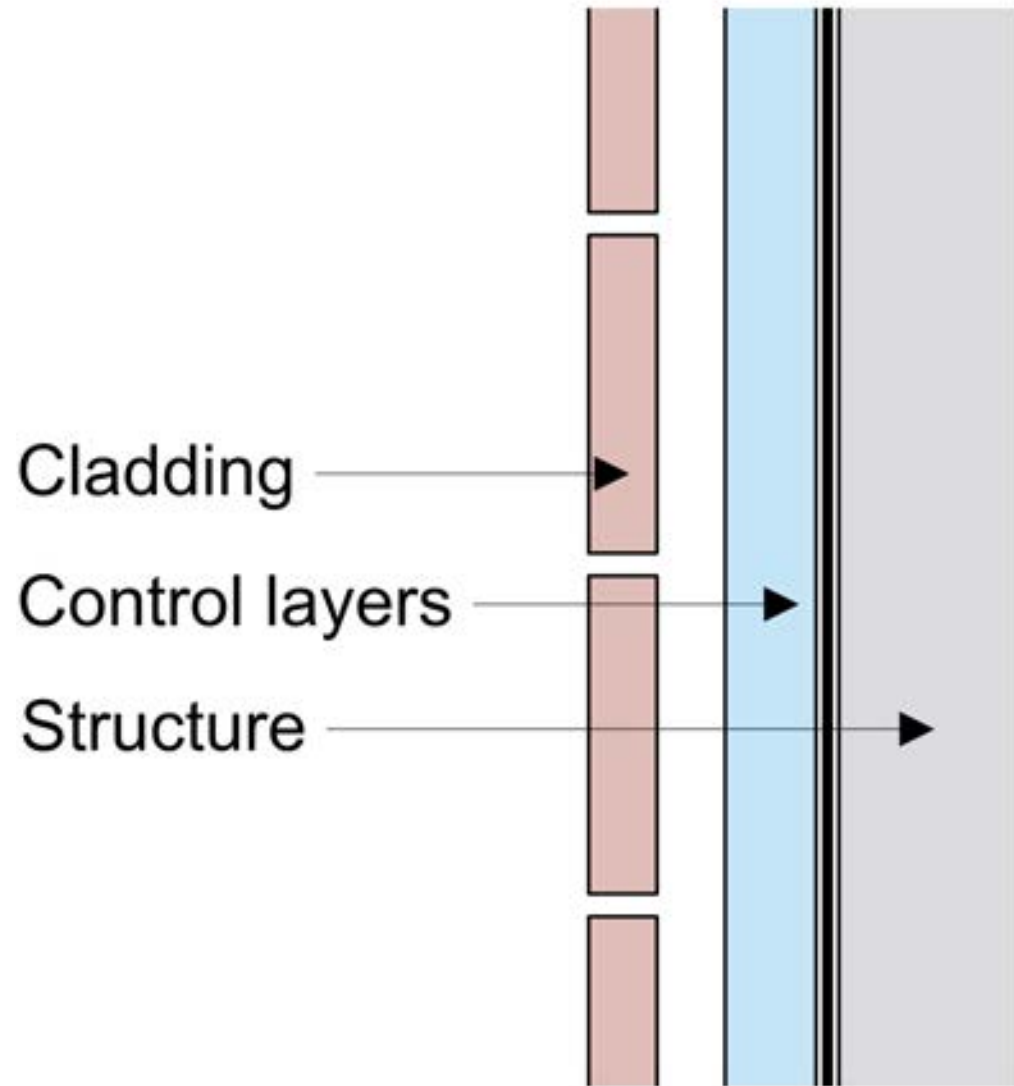
# The Perfect Wall

Water Control Layer

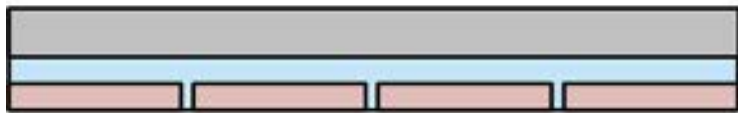
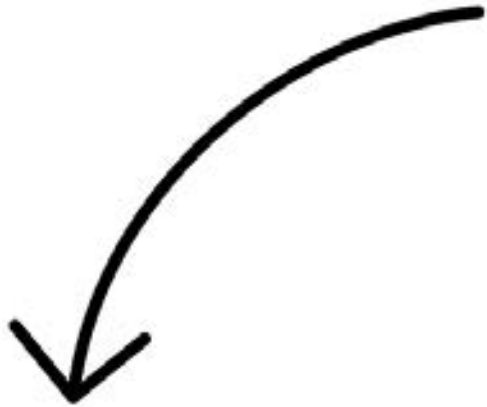
Air Control Layer

Vapor Control Layer

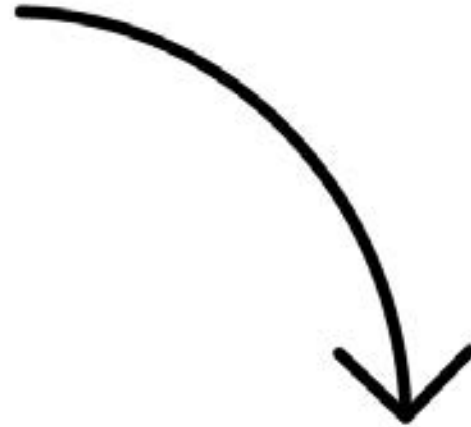
Thermal Control Layer



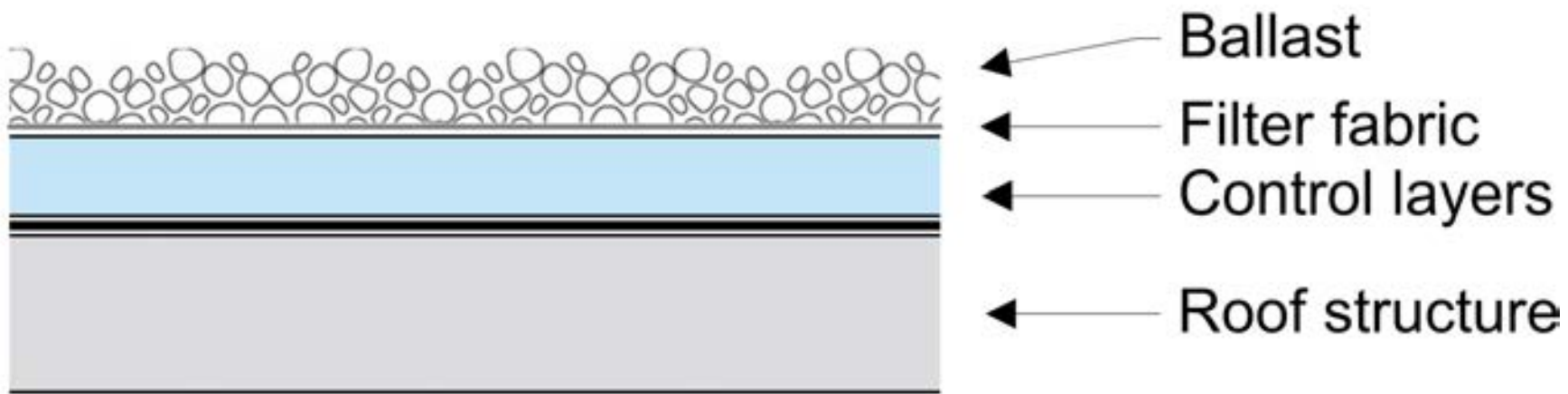
# Wall

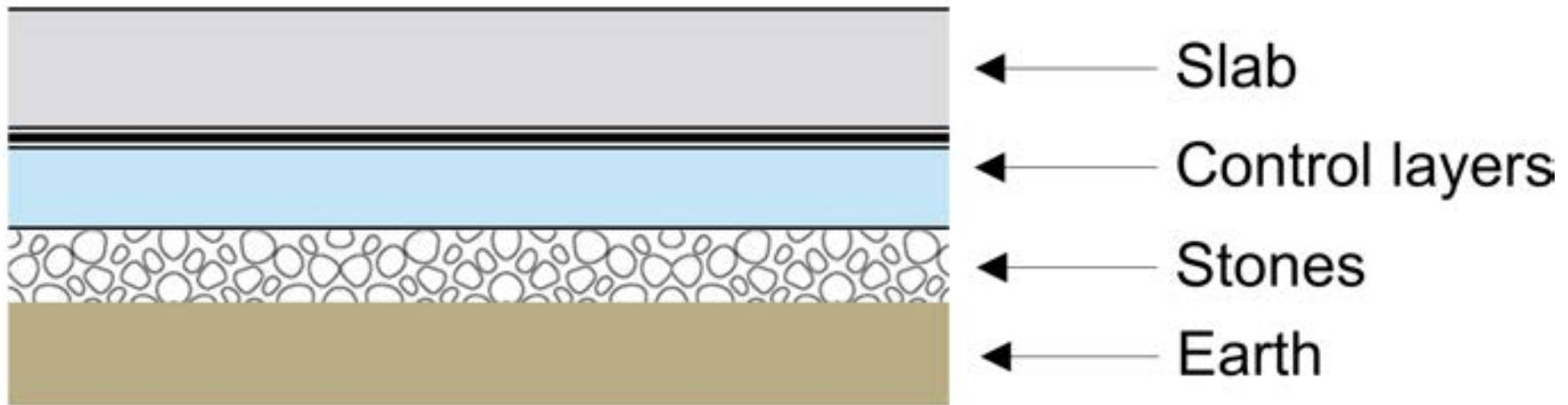


# Slab



# Roof



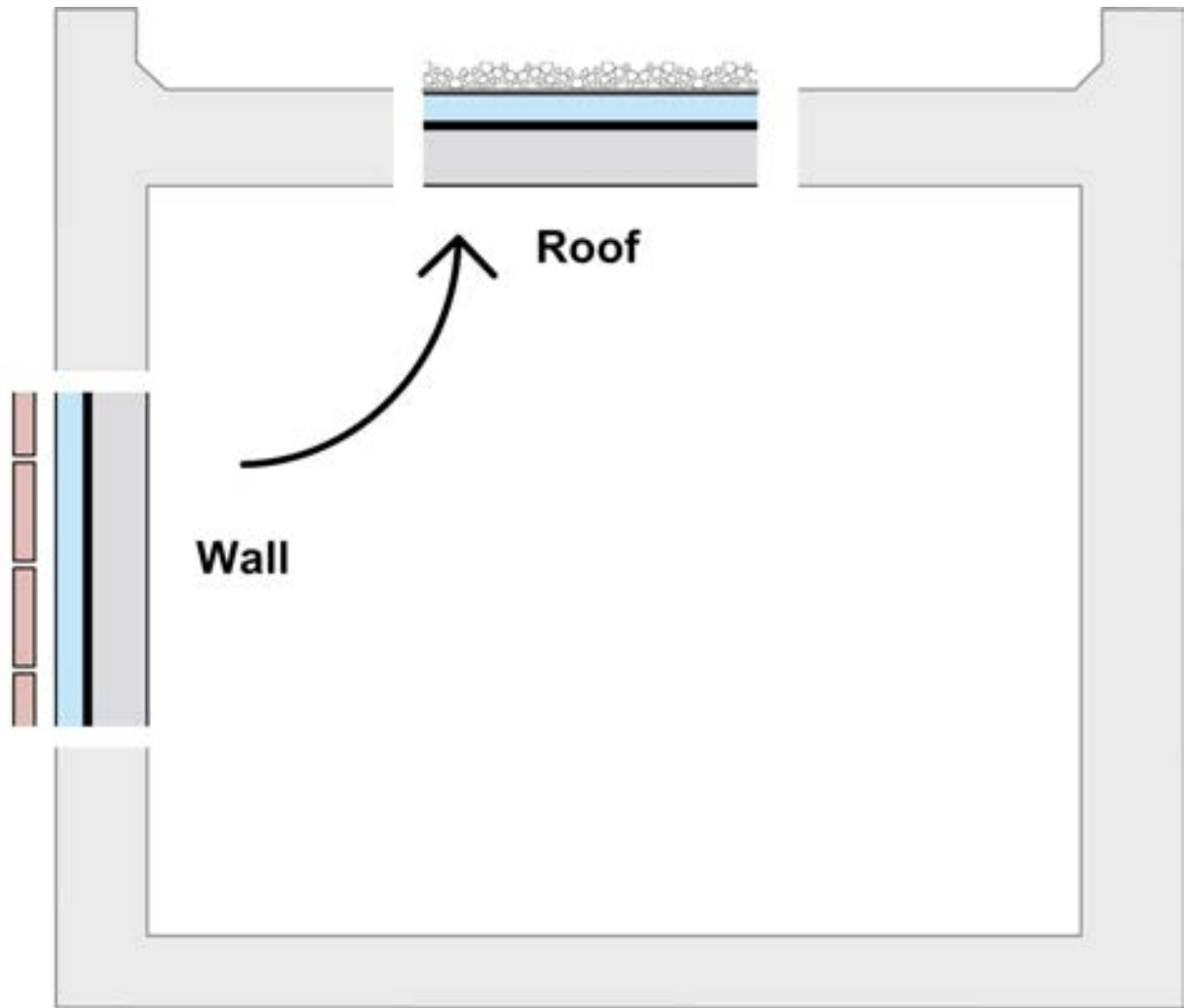


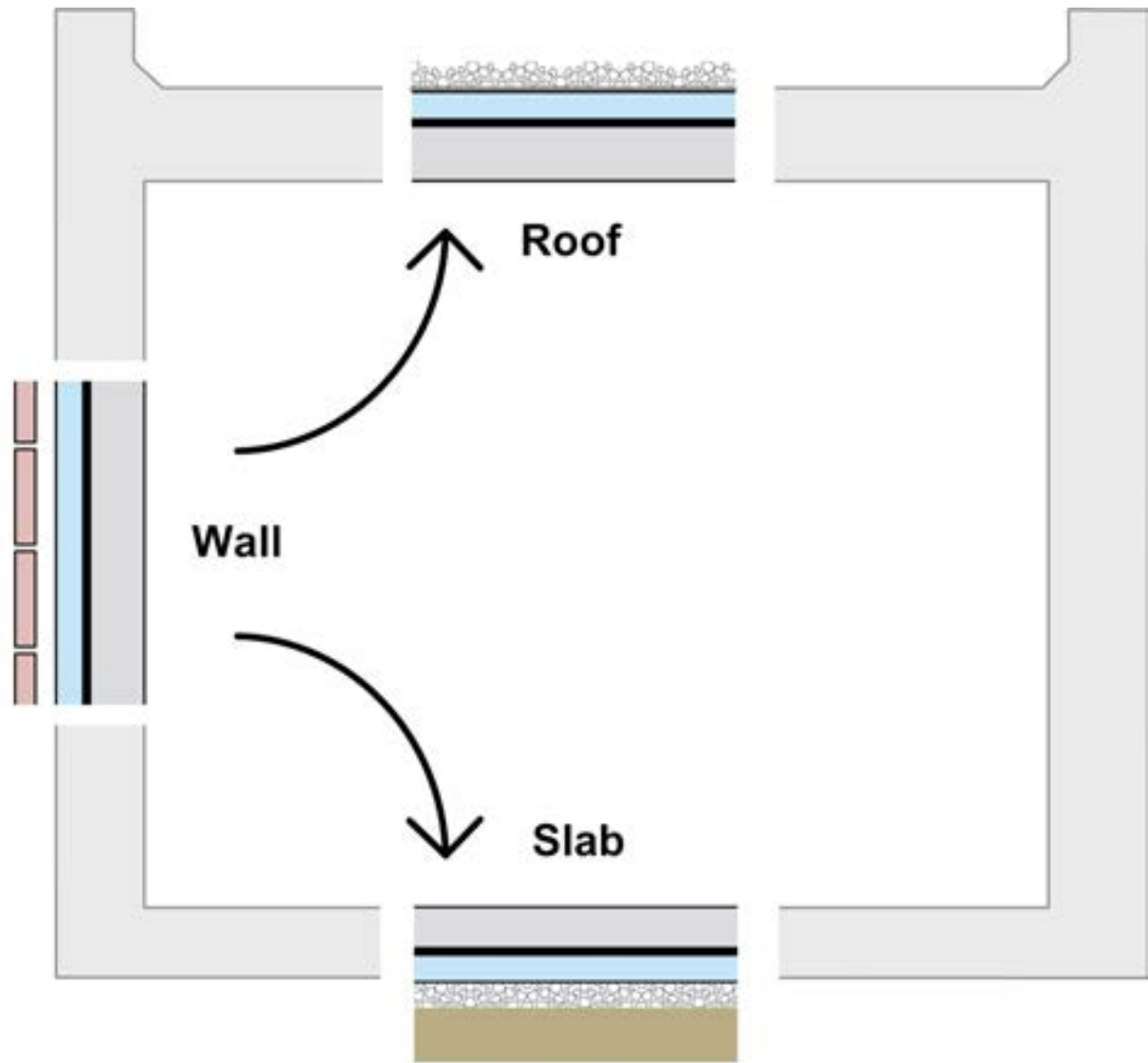
# The Perfect Building

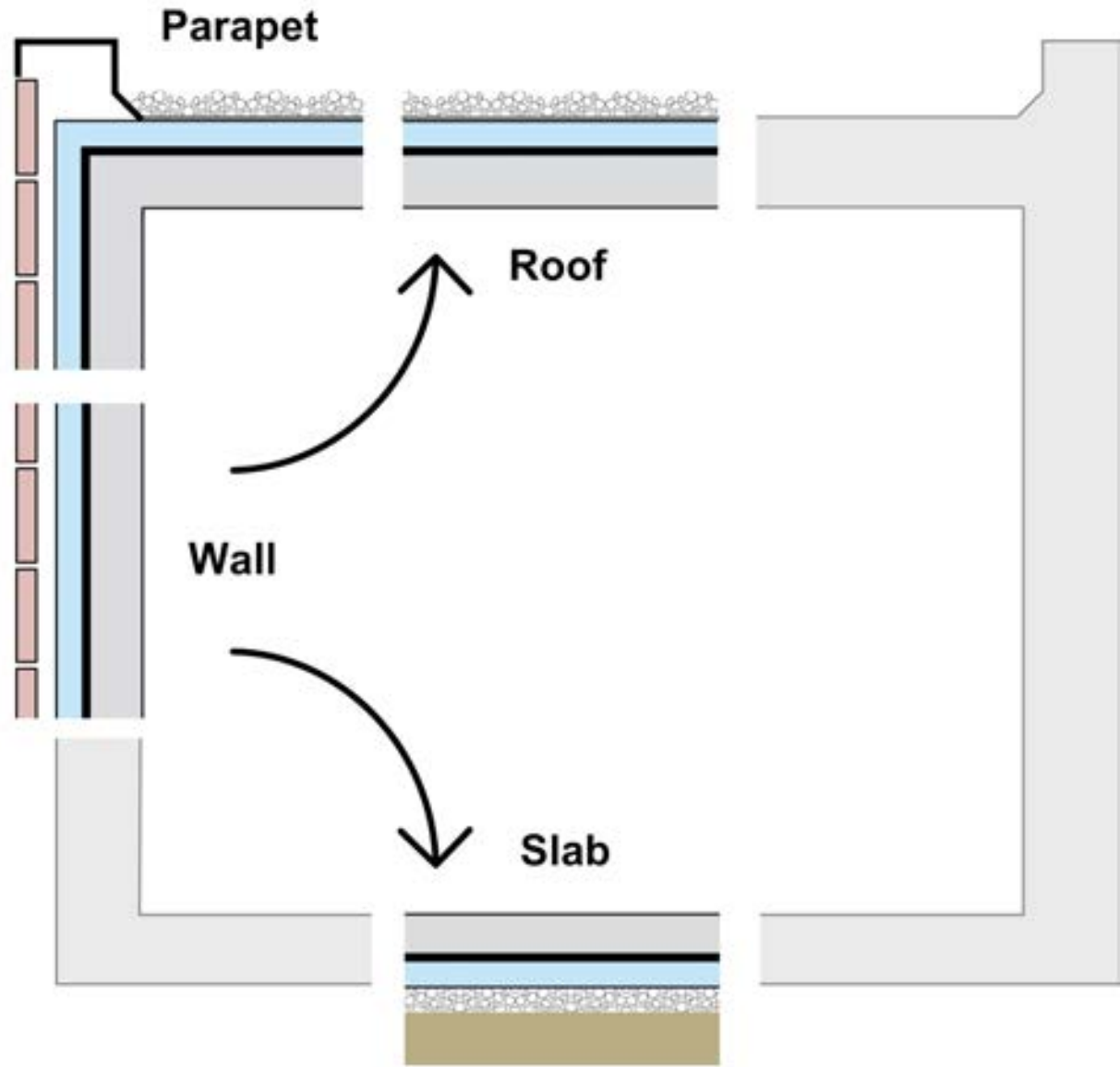


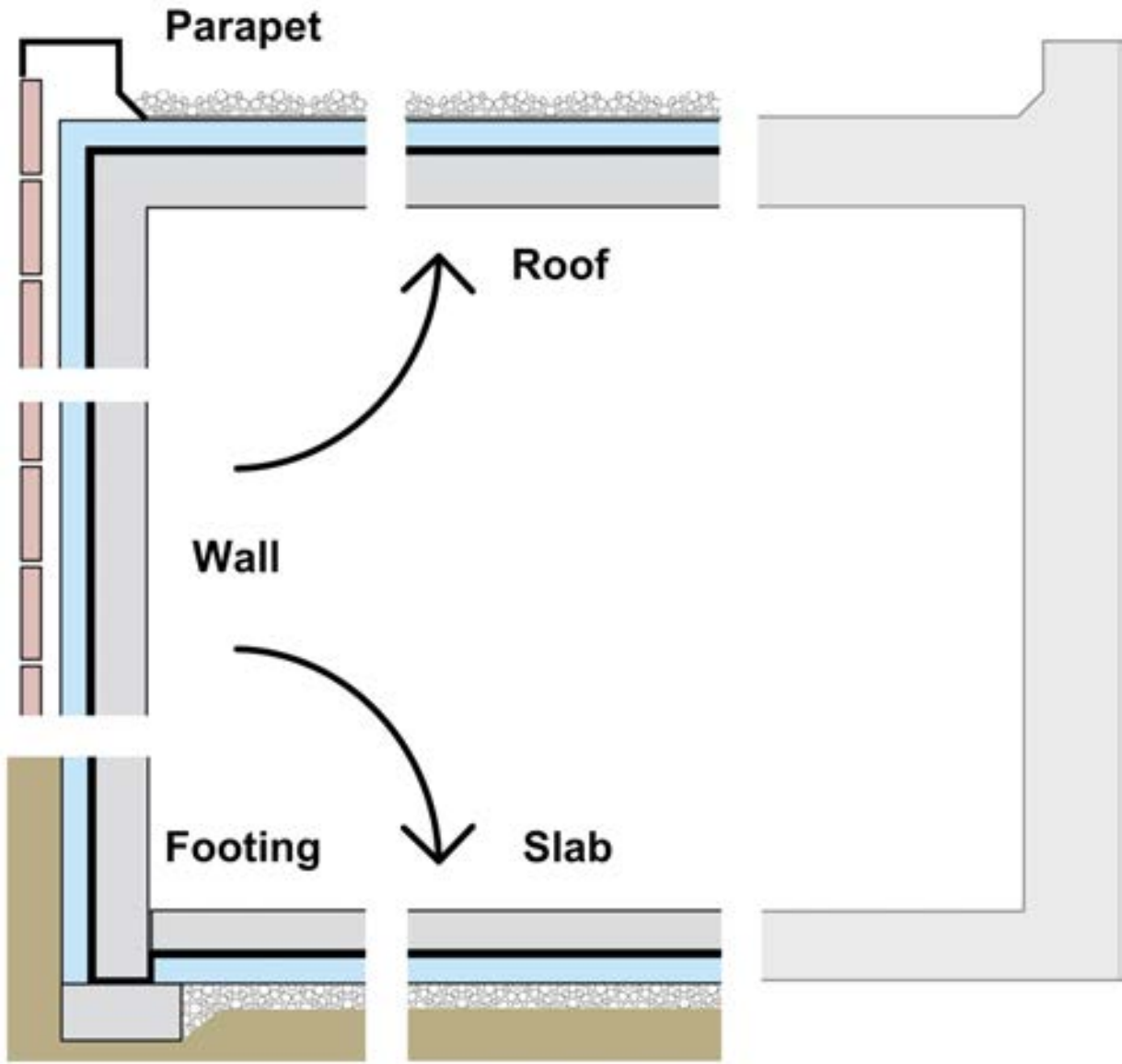


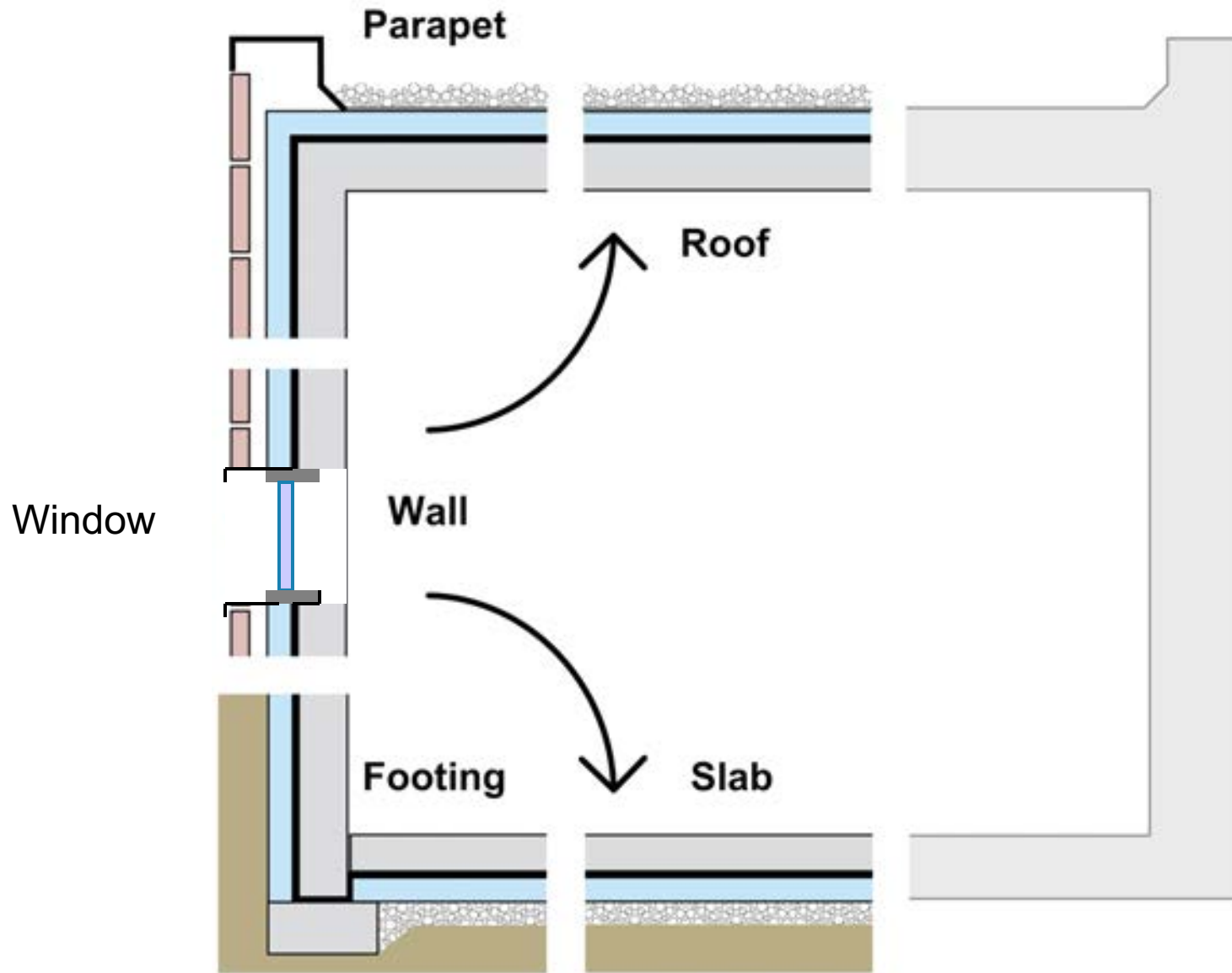






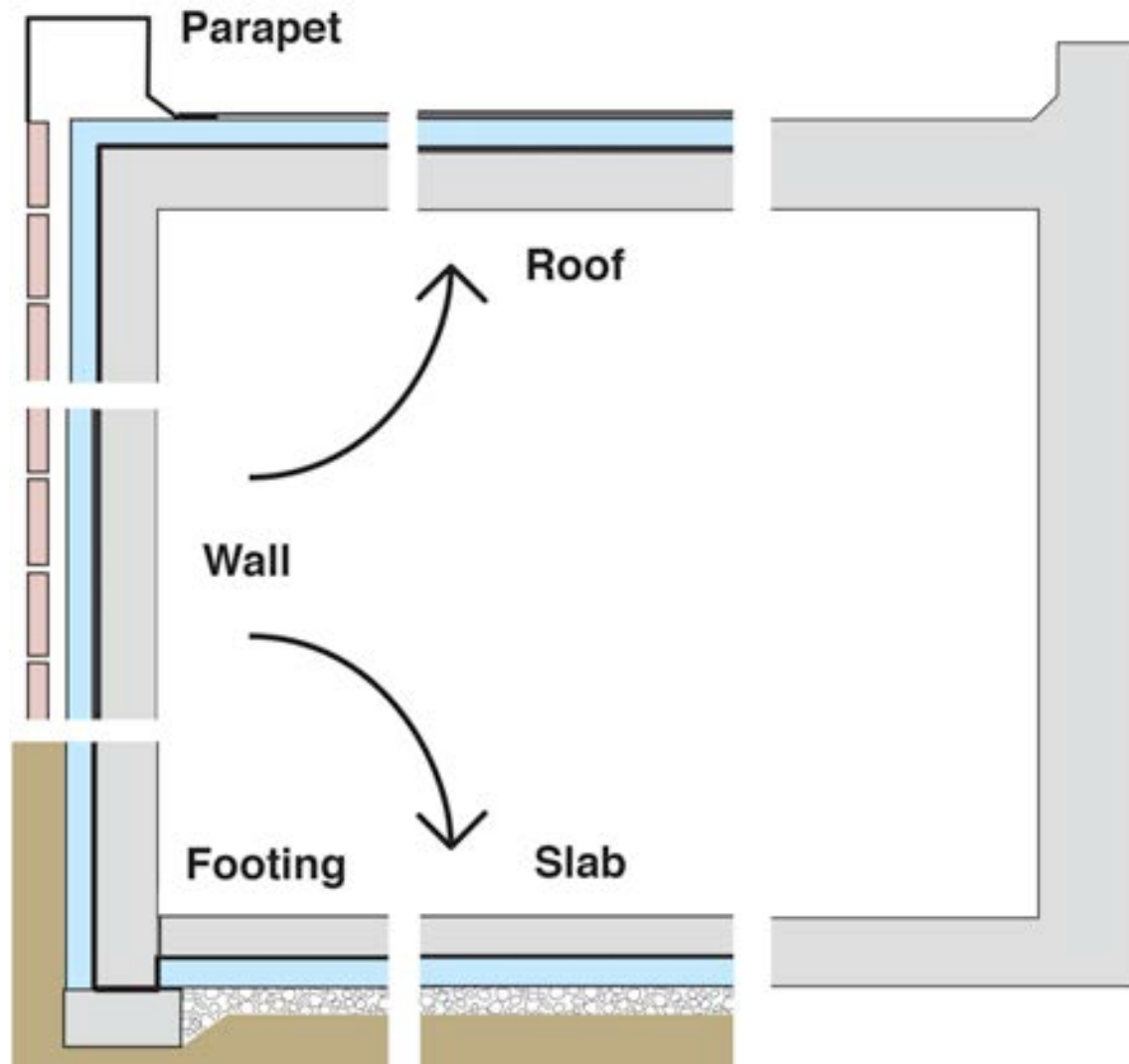


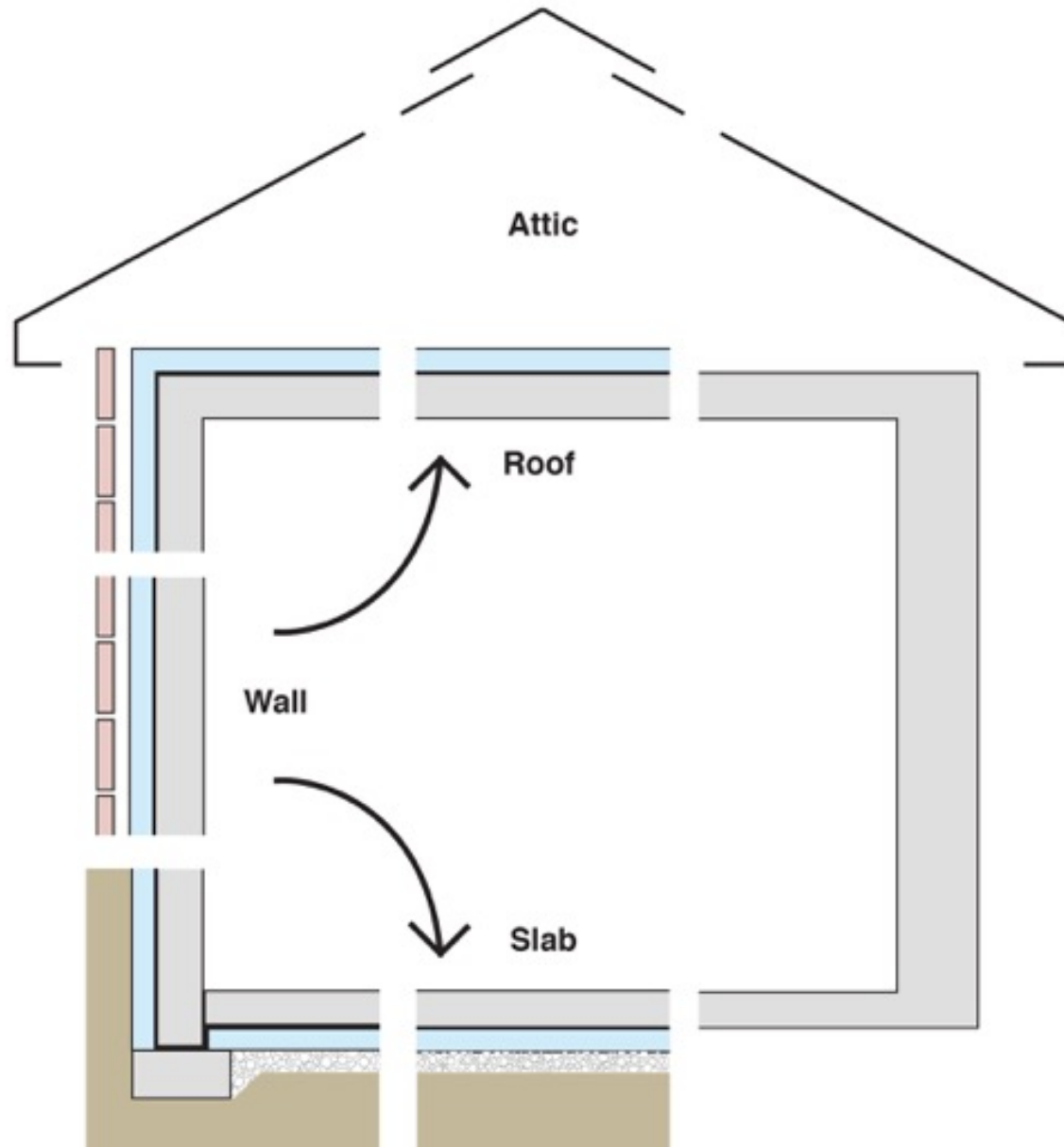


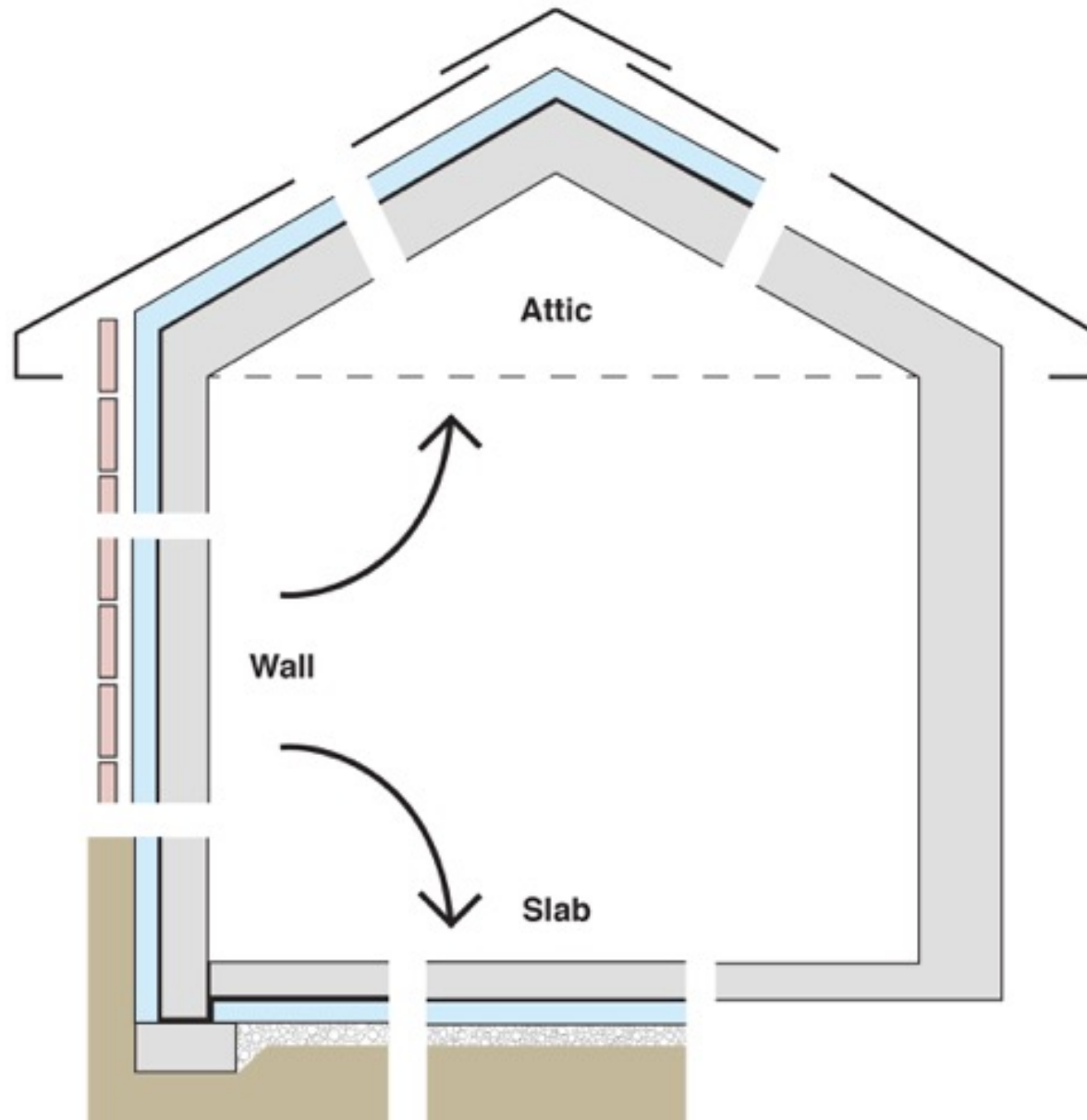


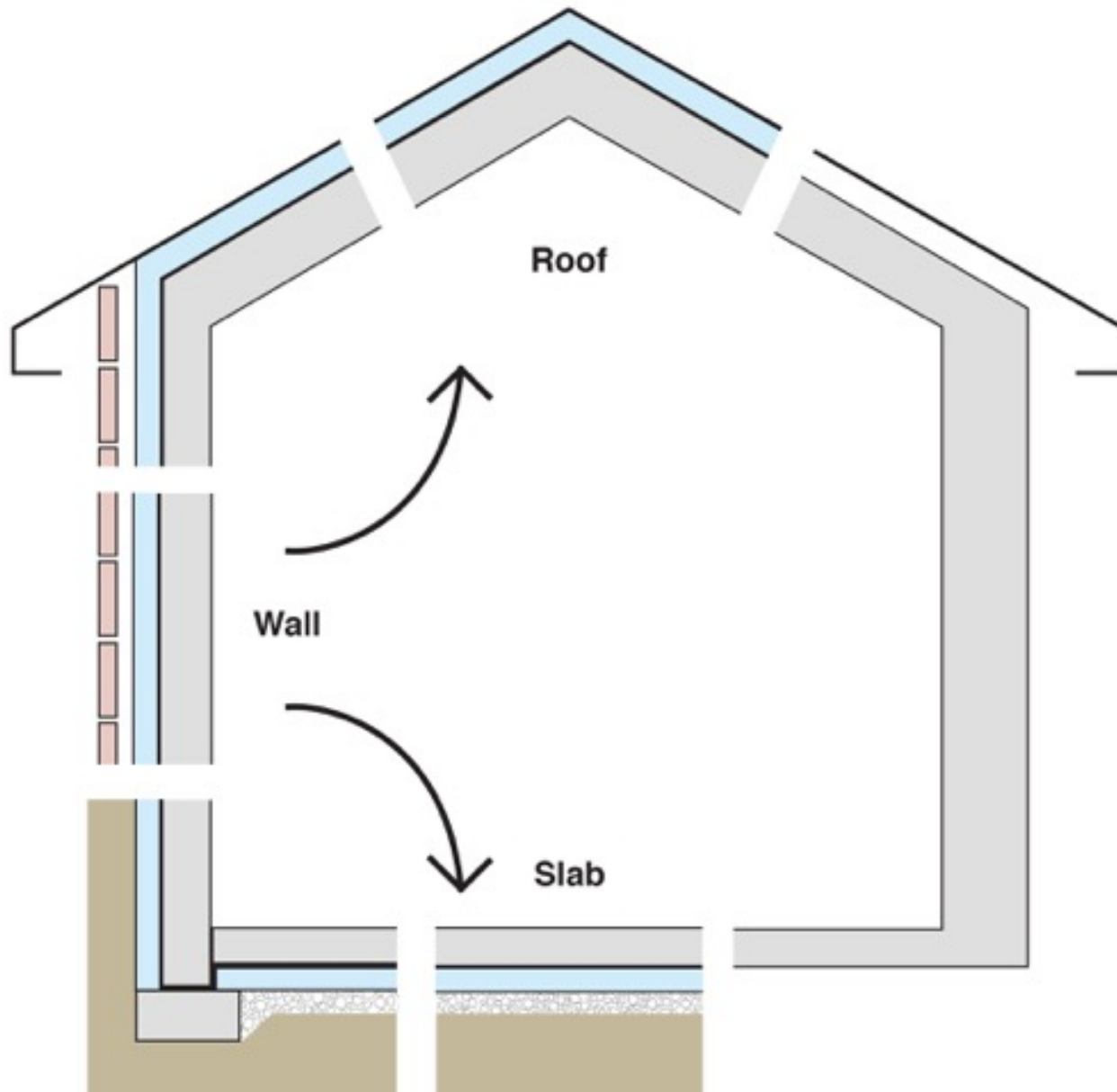


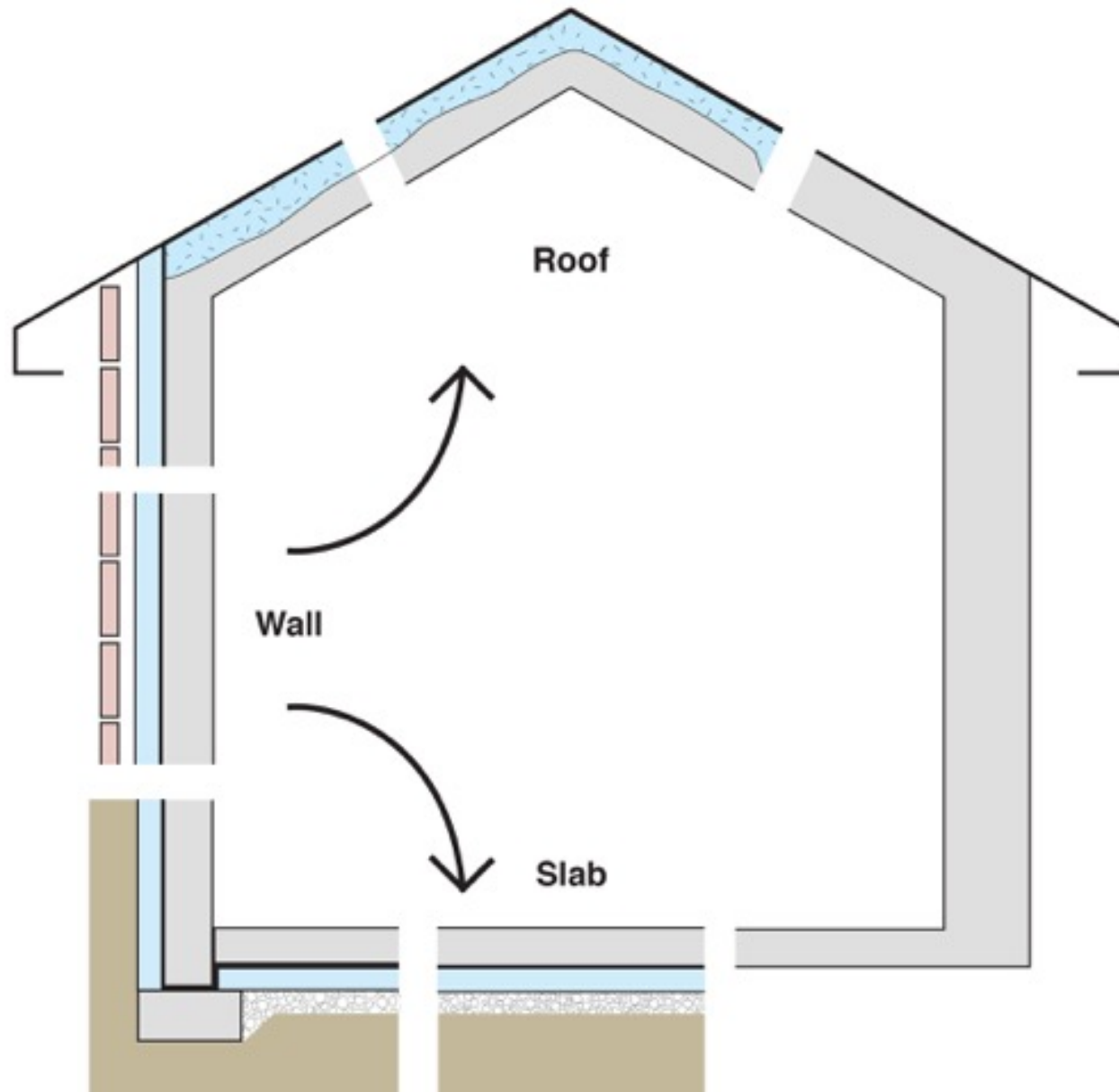




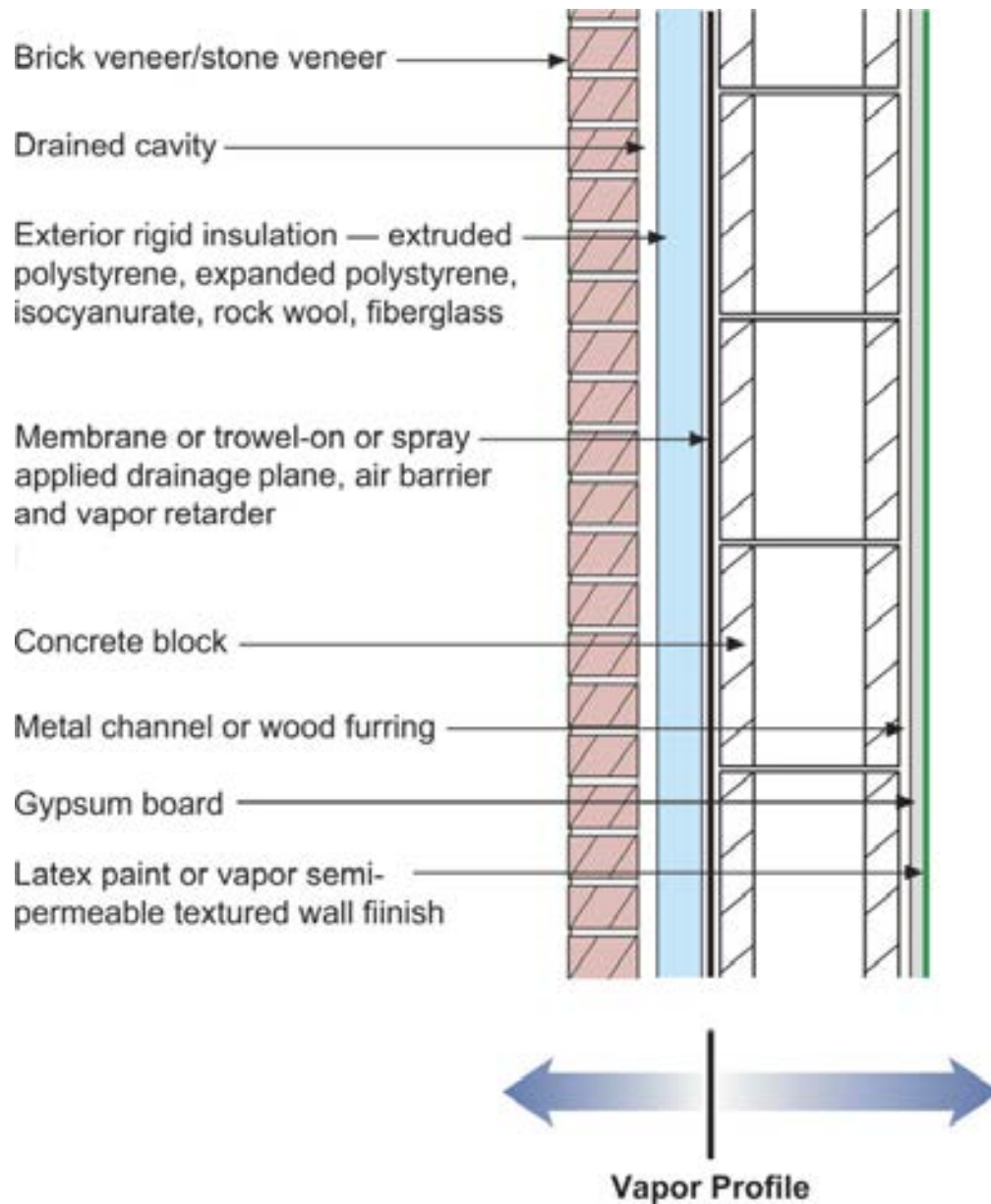


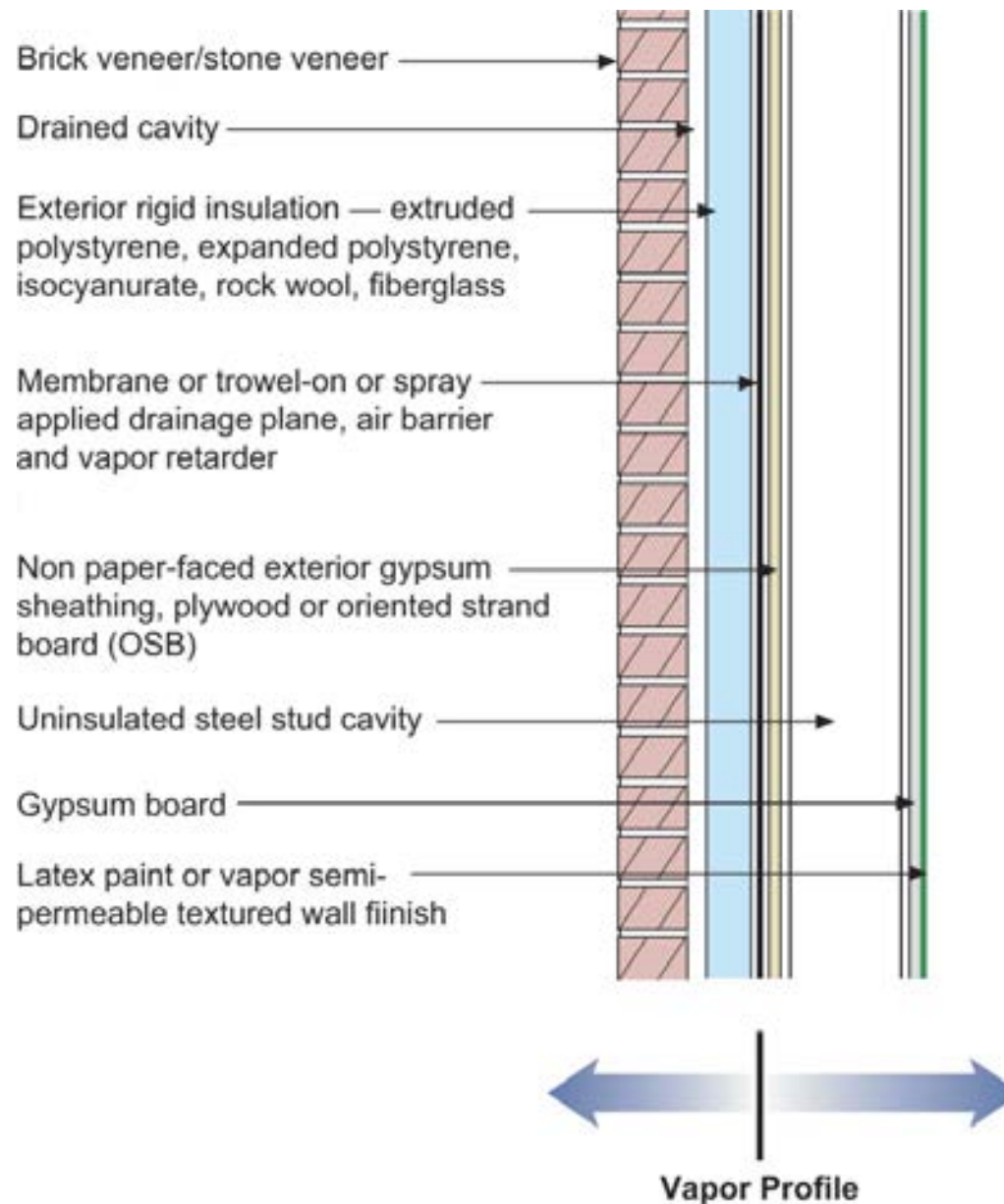




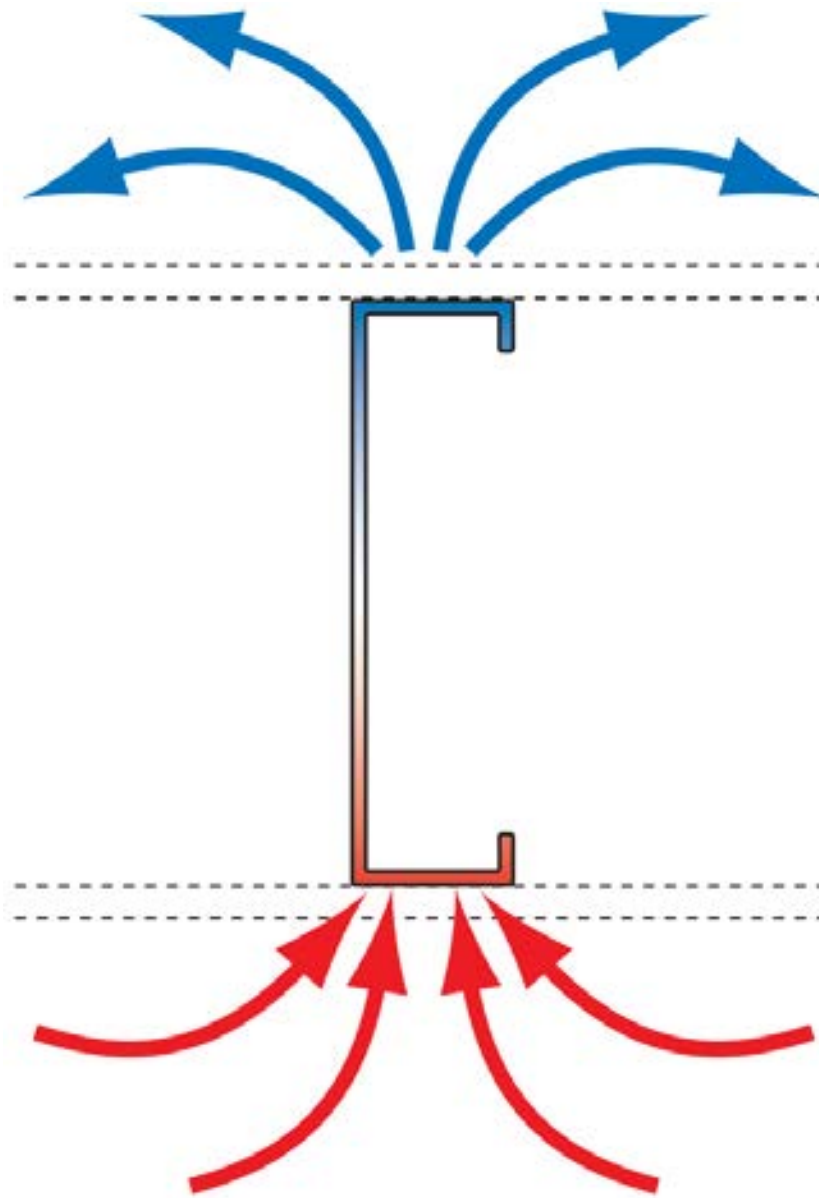


# Configurations of the Perfect Wall

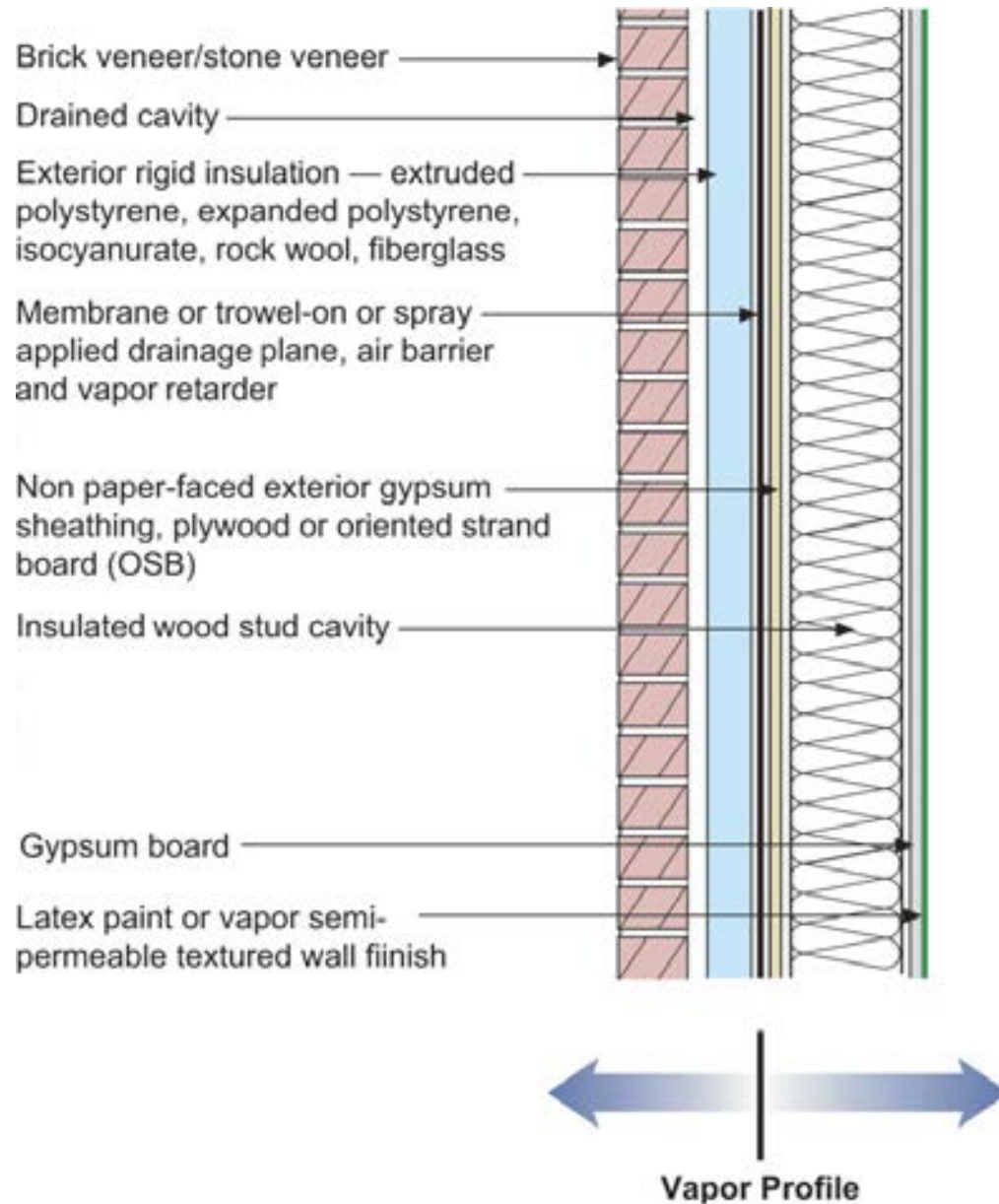


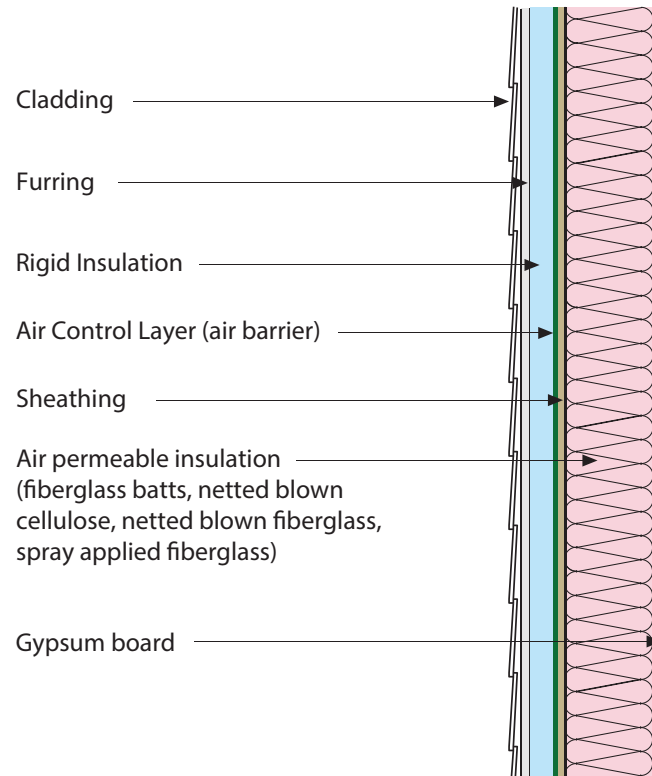


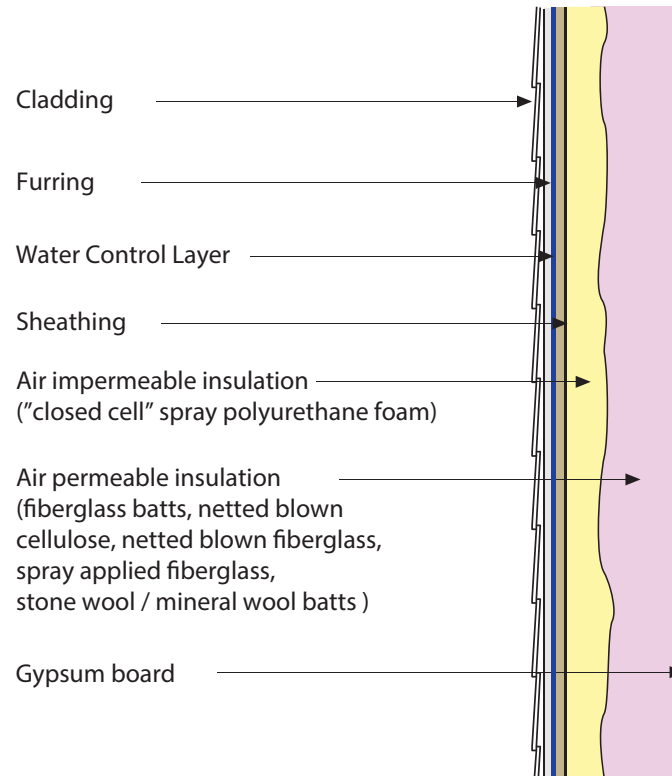


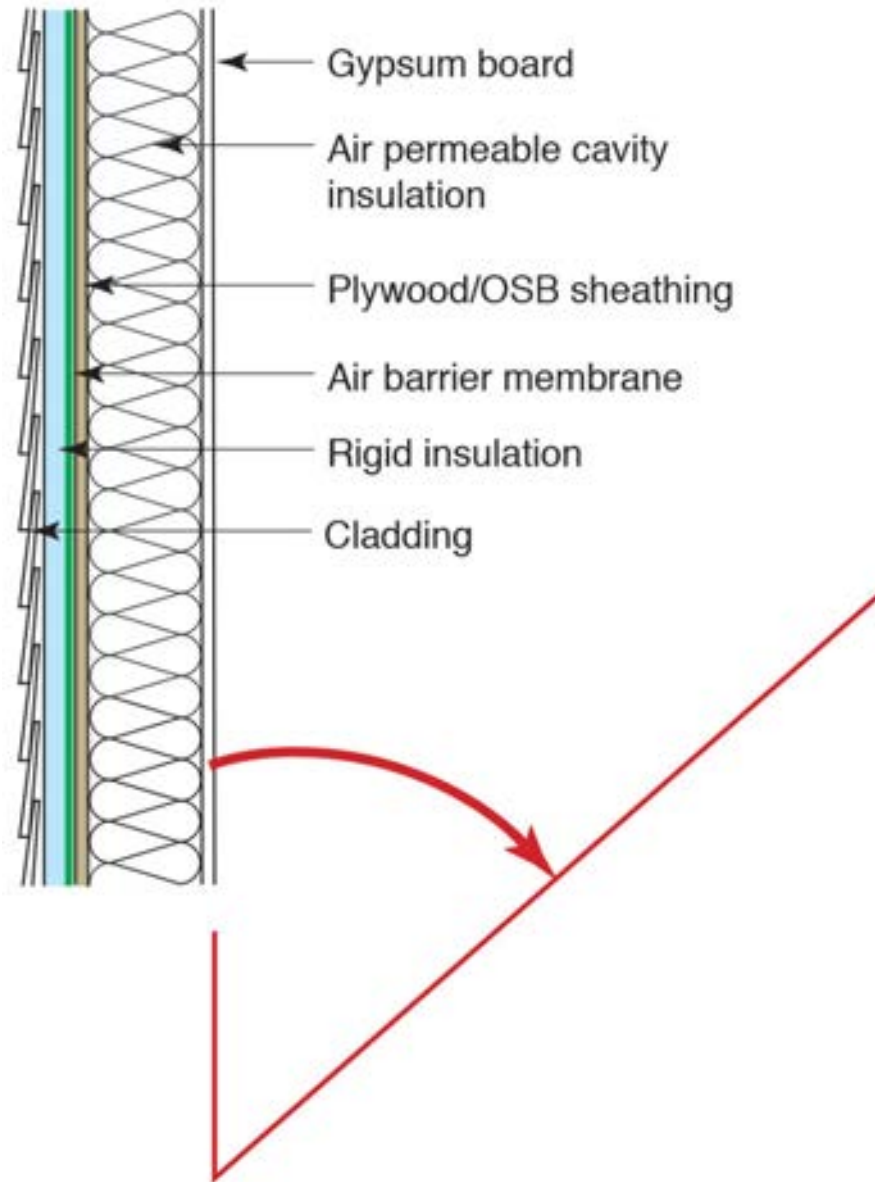


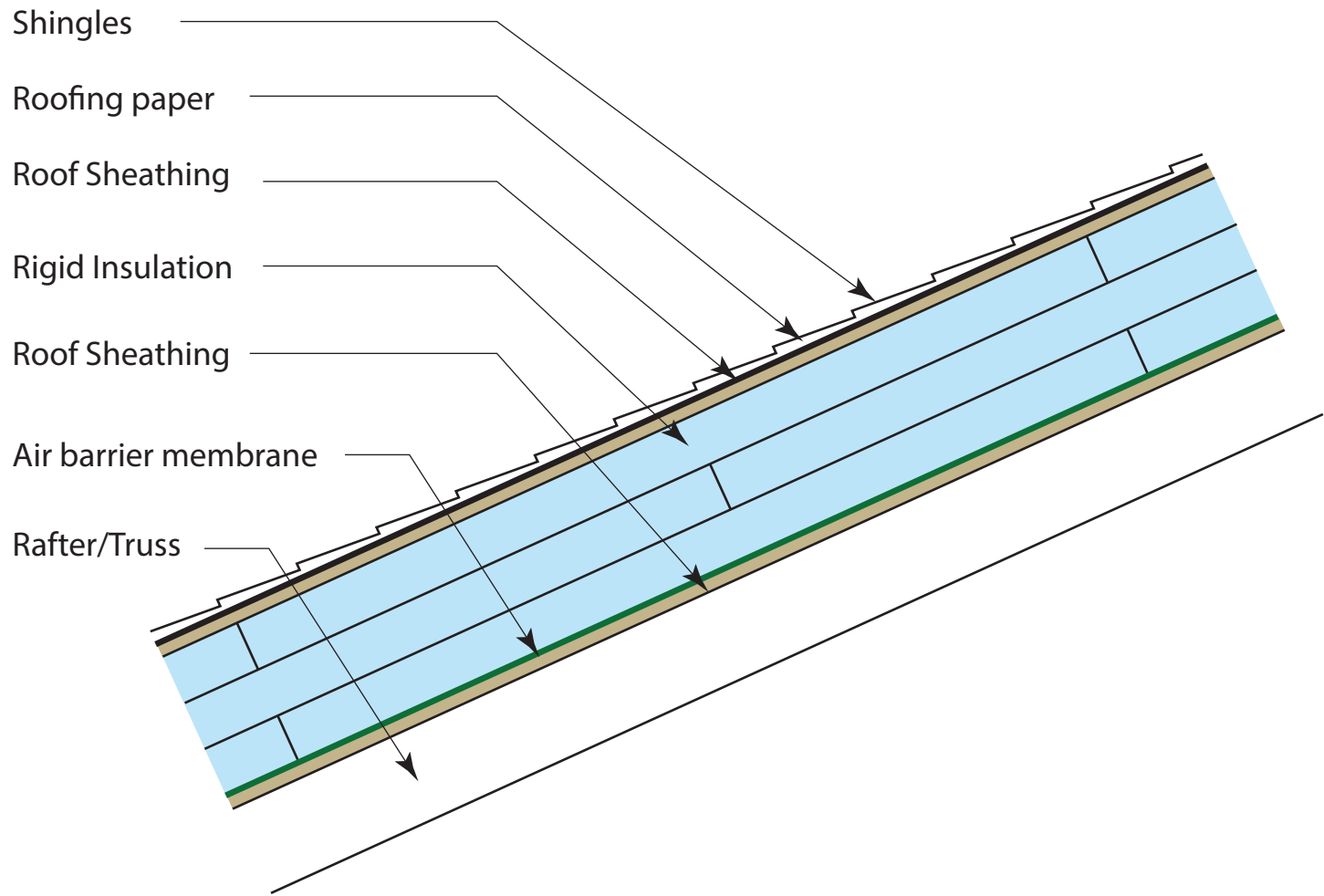


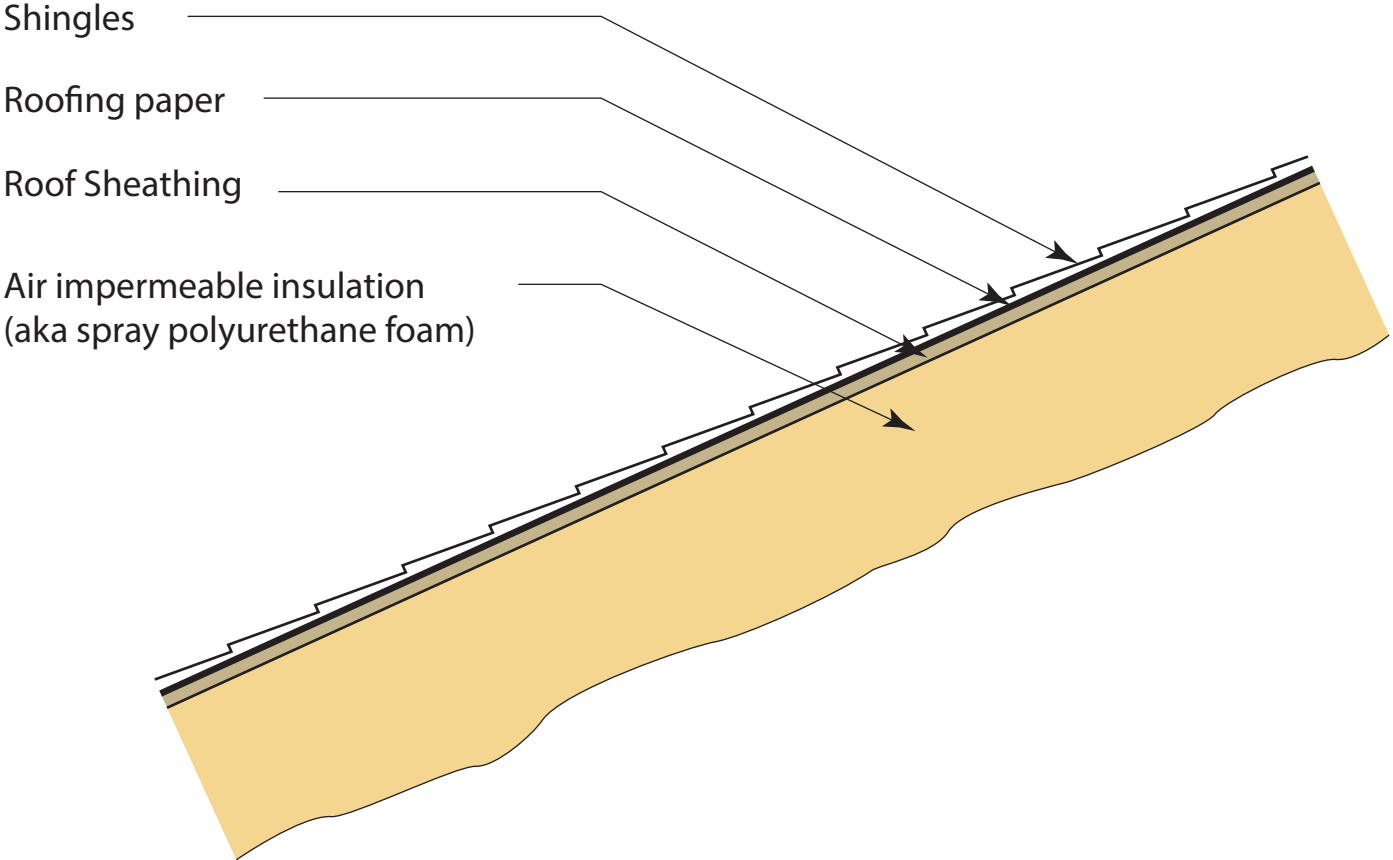




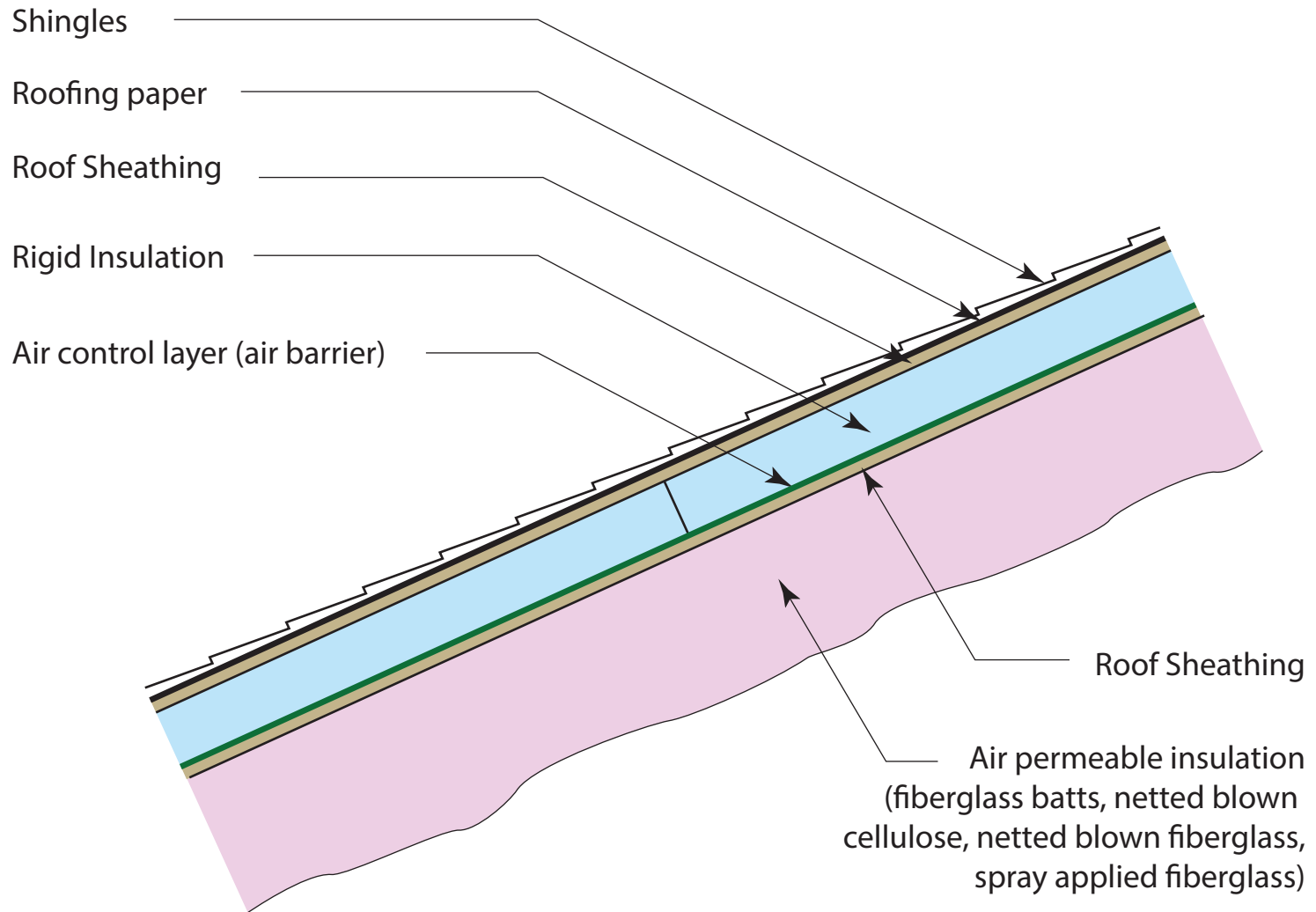










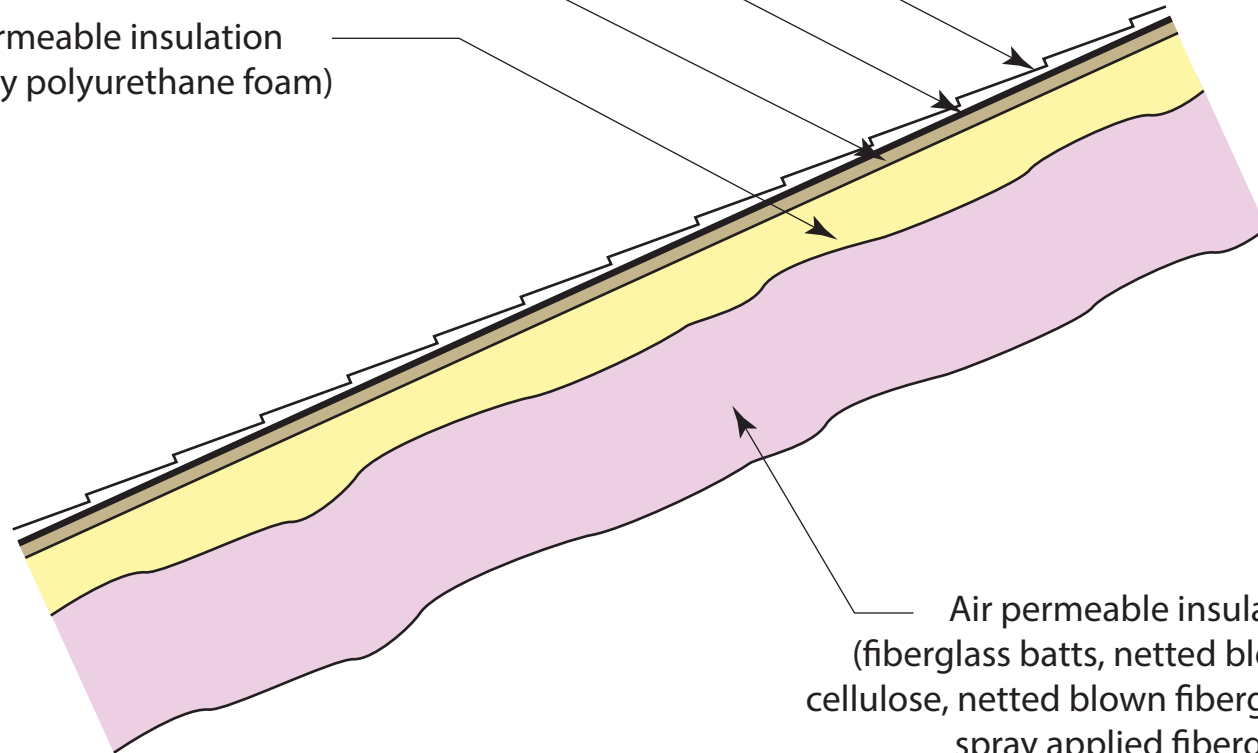


Shingles

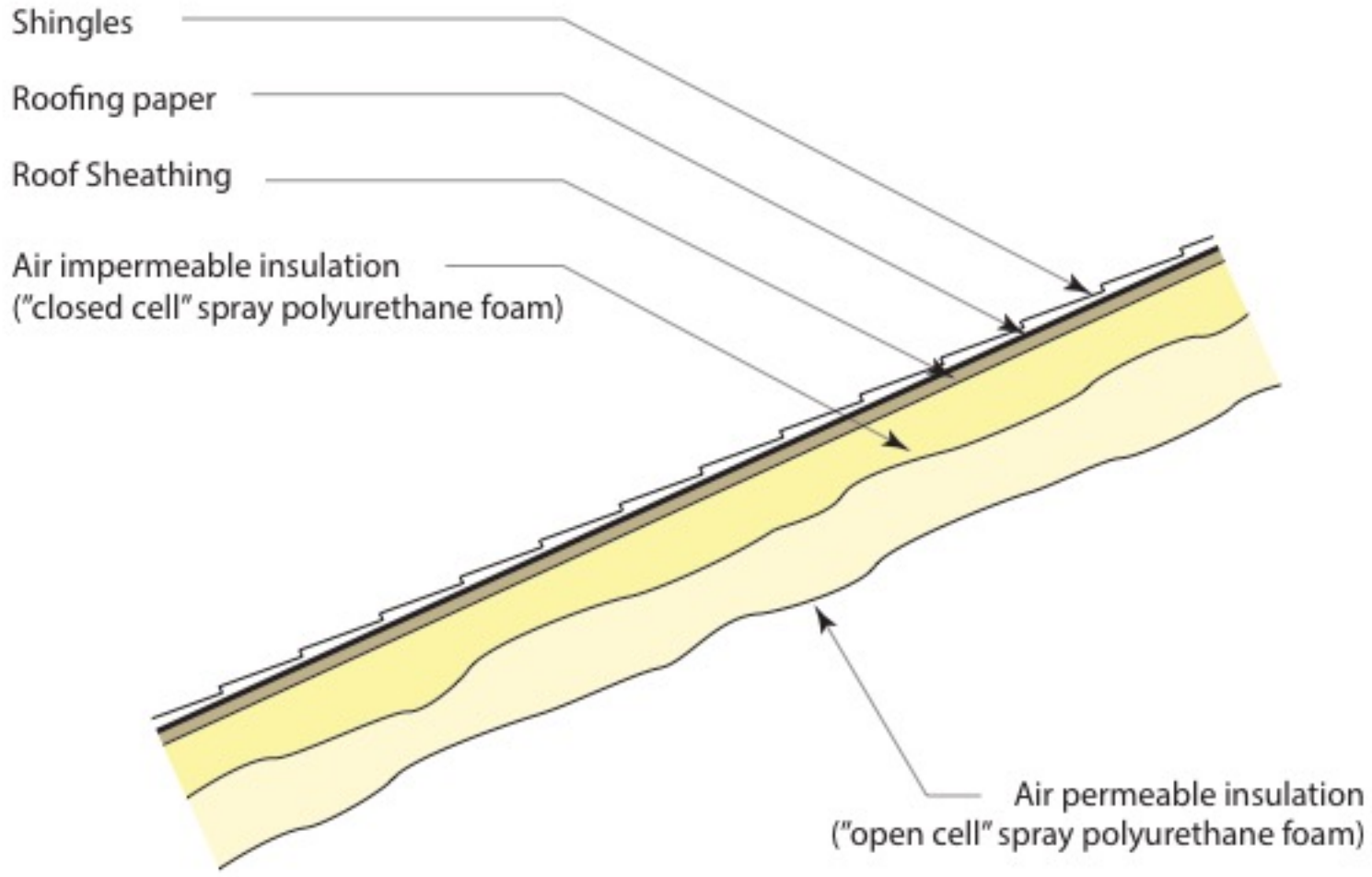
Roofing paper

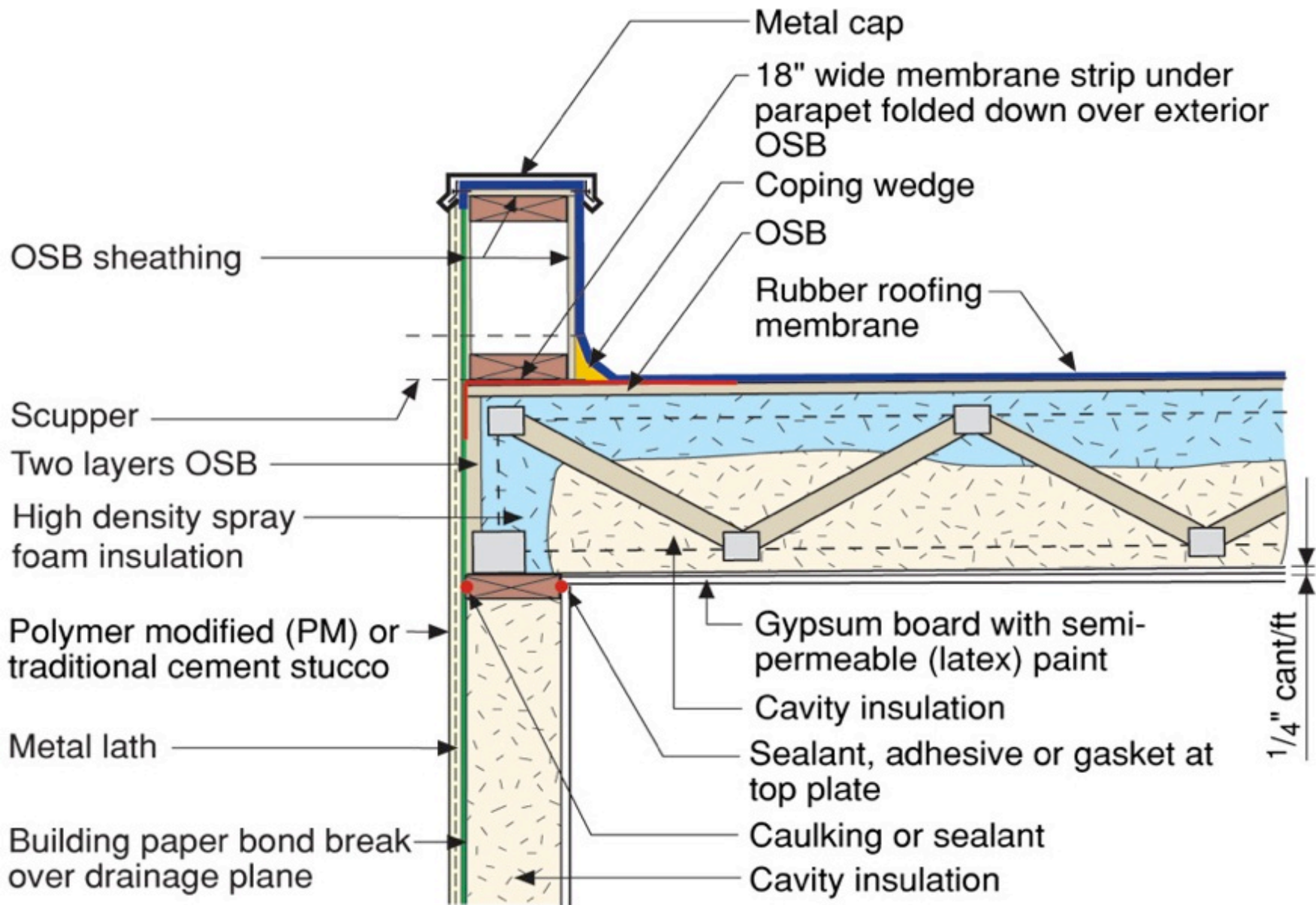
Roof Sheathing

Air impermeable insulation  
(aka spray polyurethane foam)



Air permeable insulation  
(fiberglass batts, netted blown  
cellulose, netted blown fiberglass,  
spray applied fiberglass)







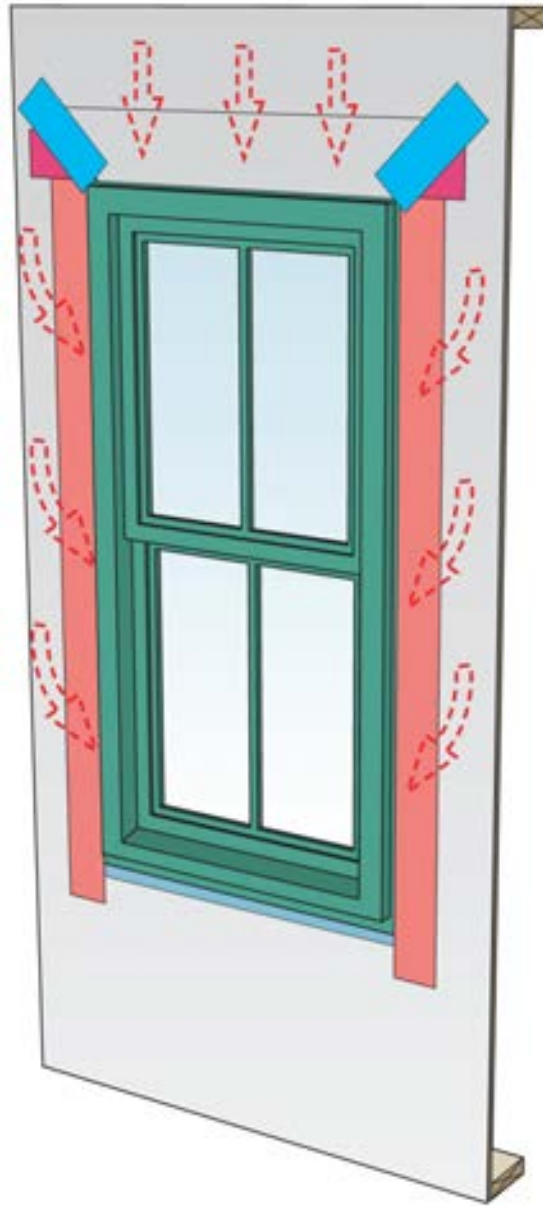


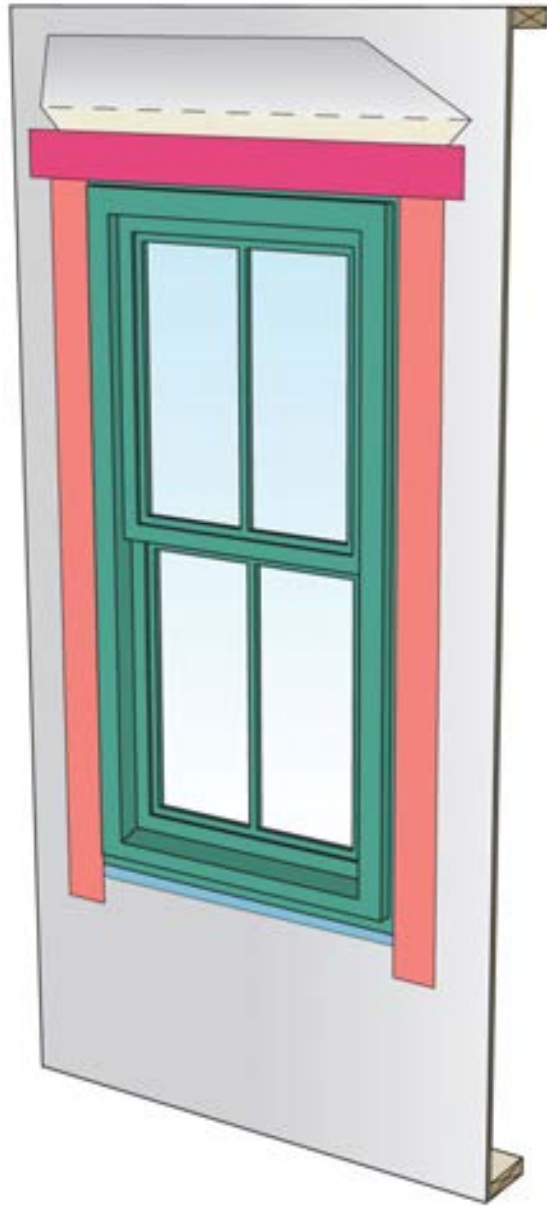




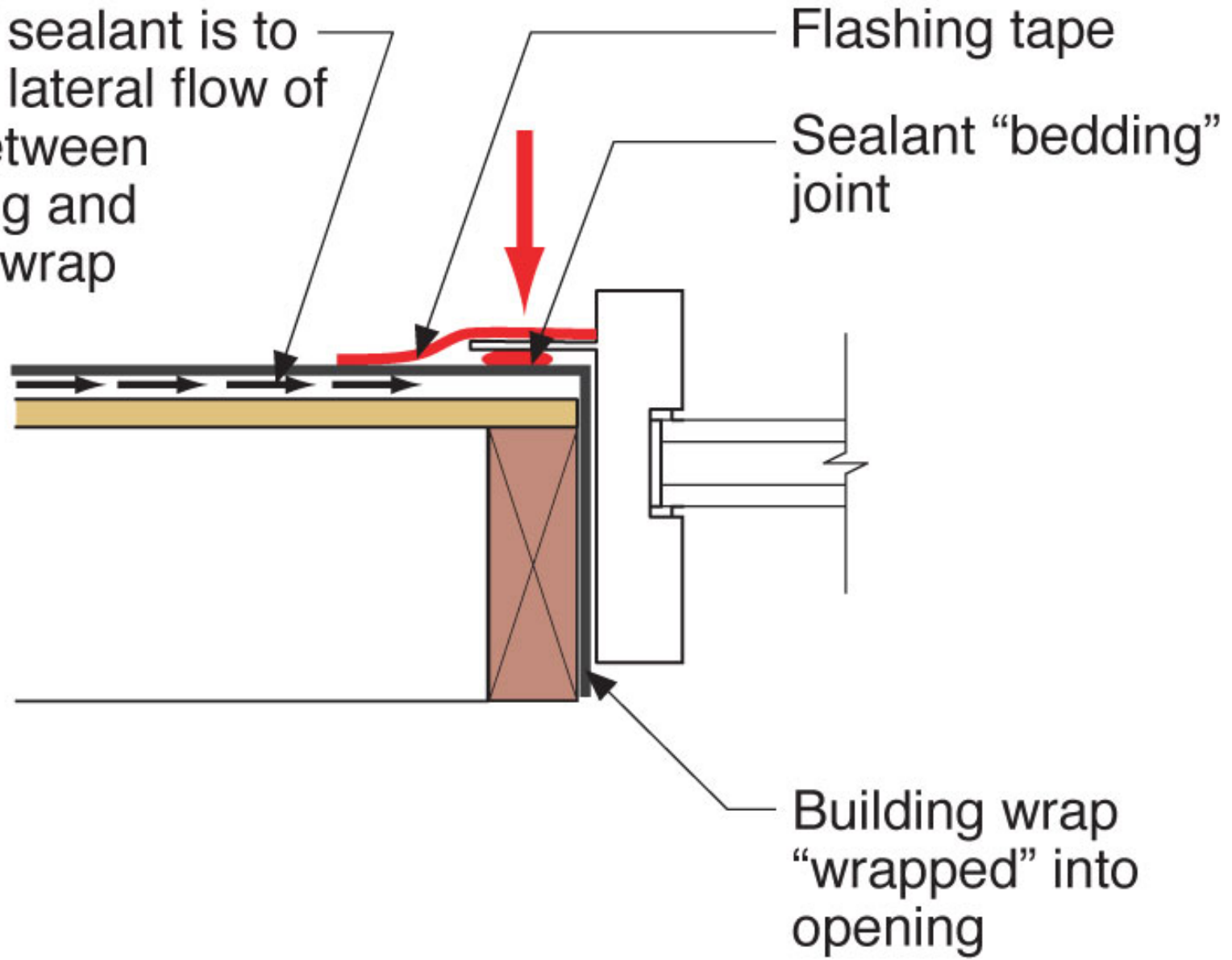


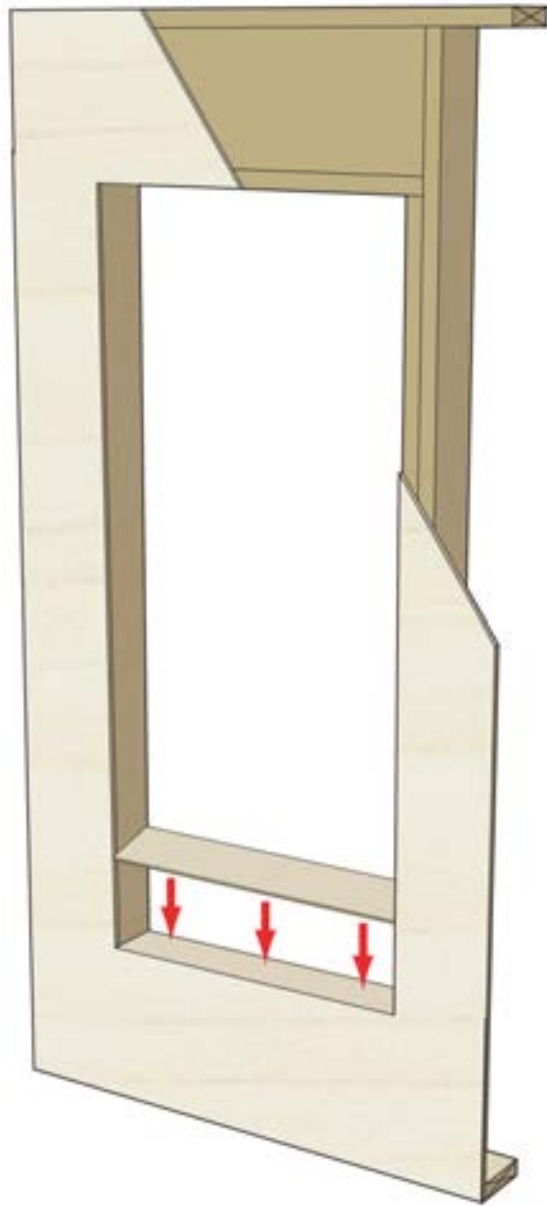


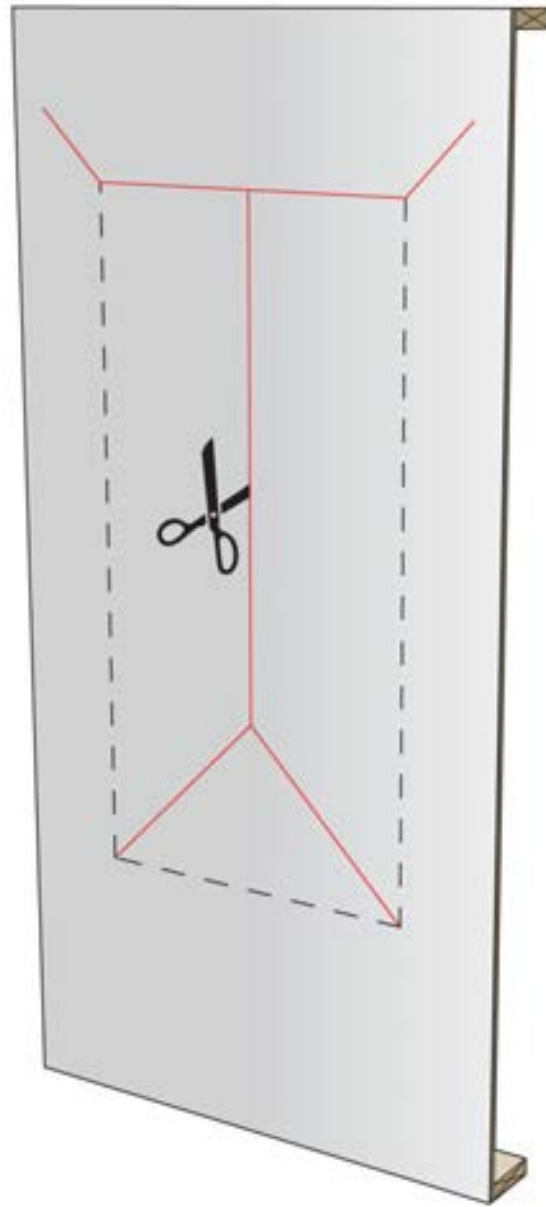


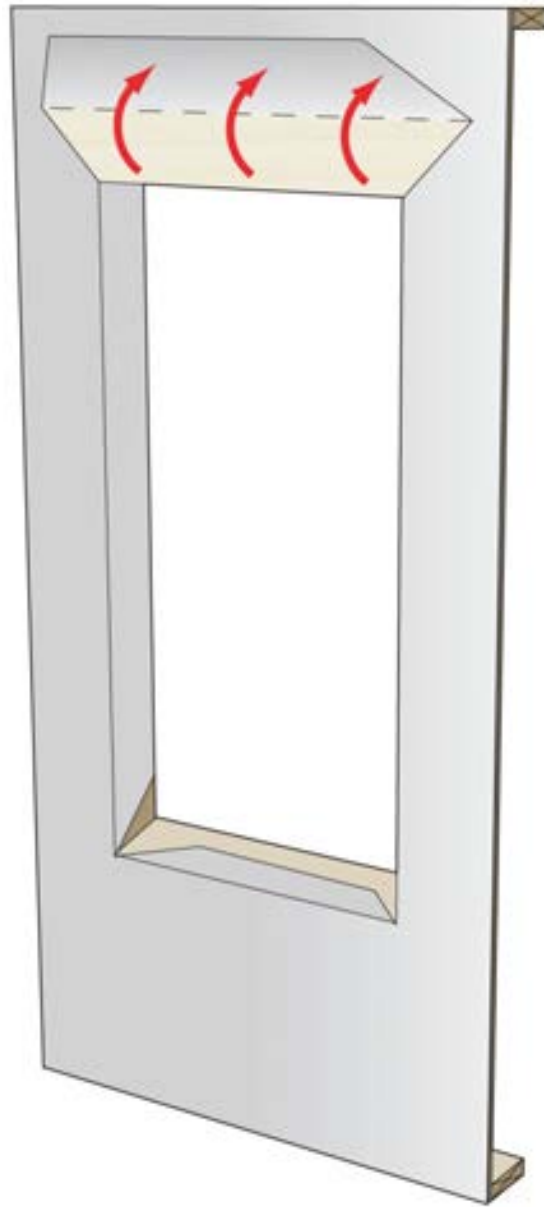


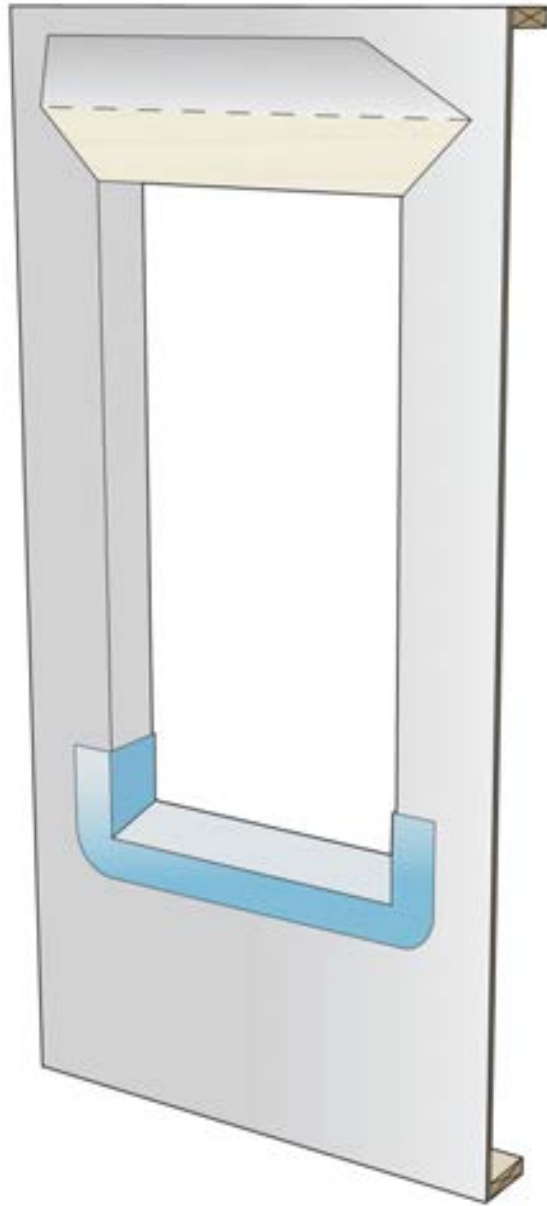
Intent of sealant is to limit this lateral flow of water between sheathing and building wrap



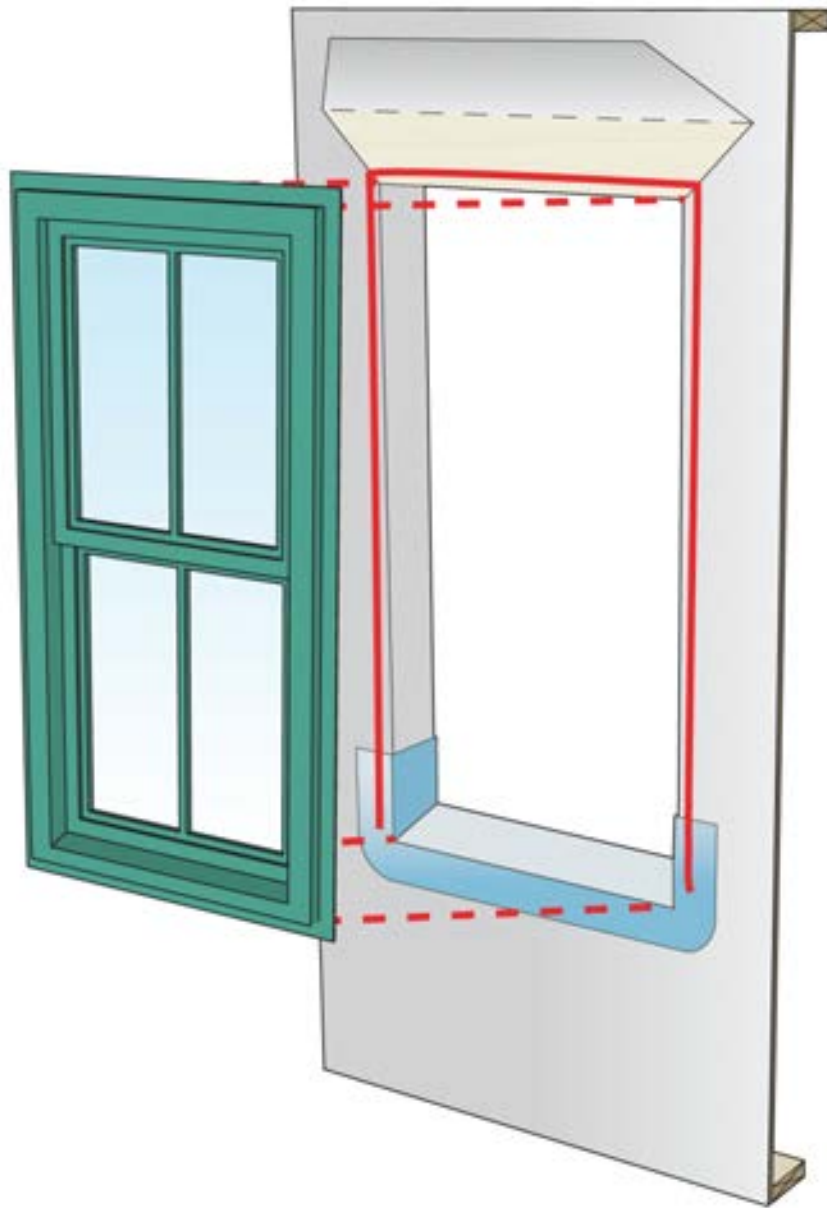


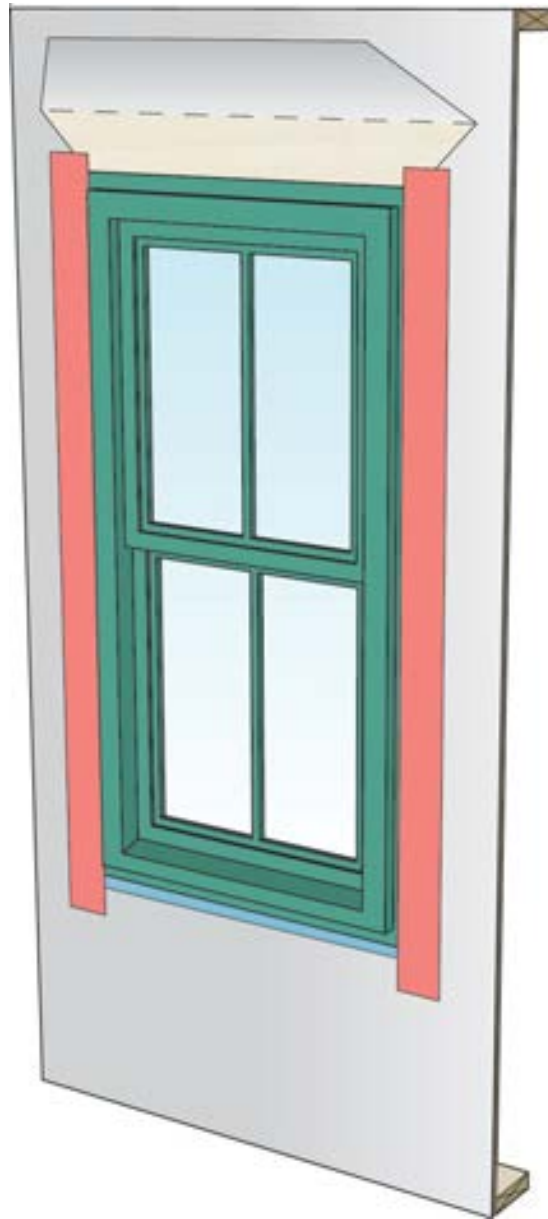


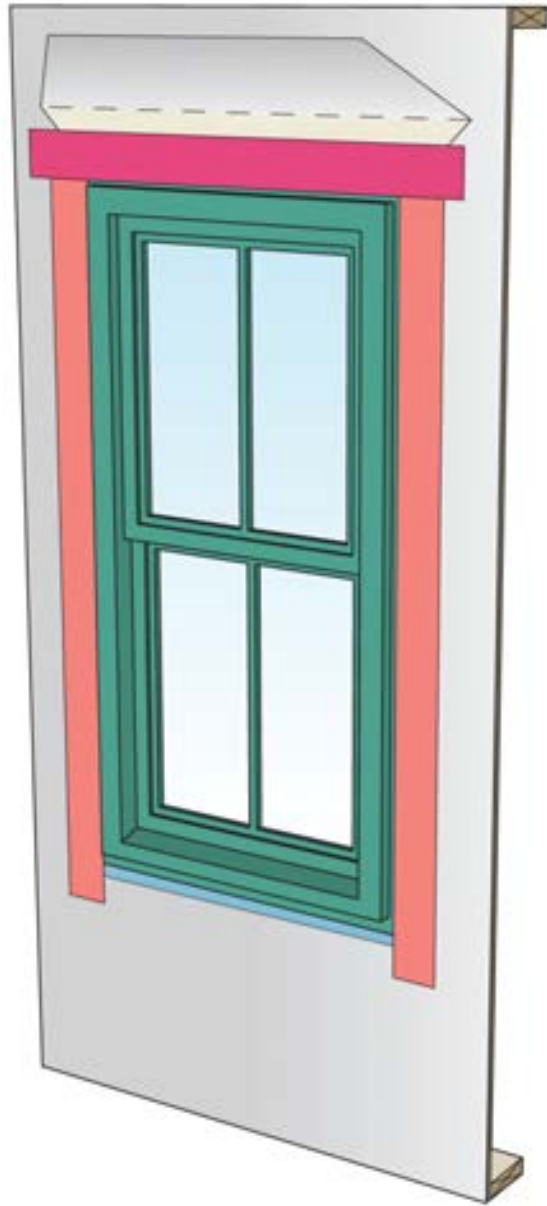


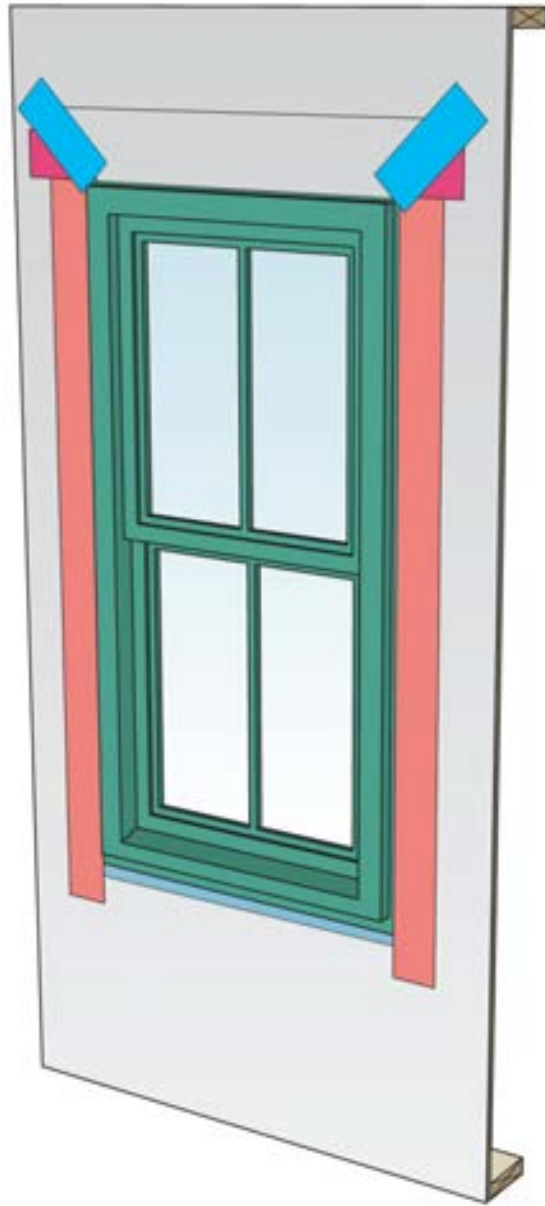


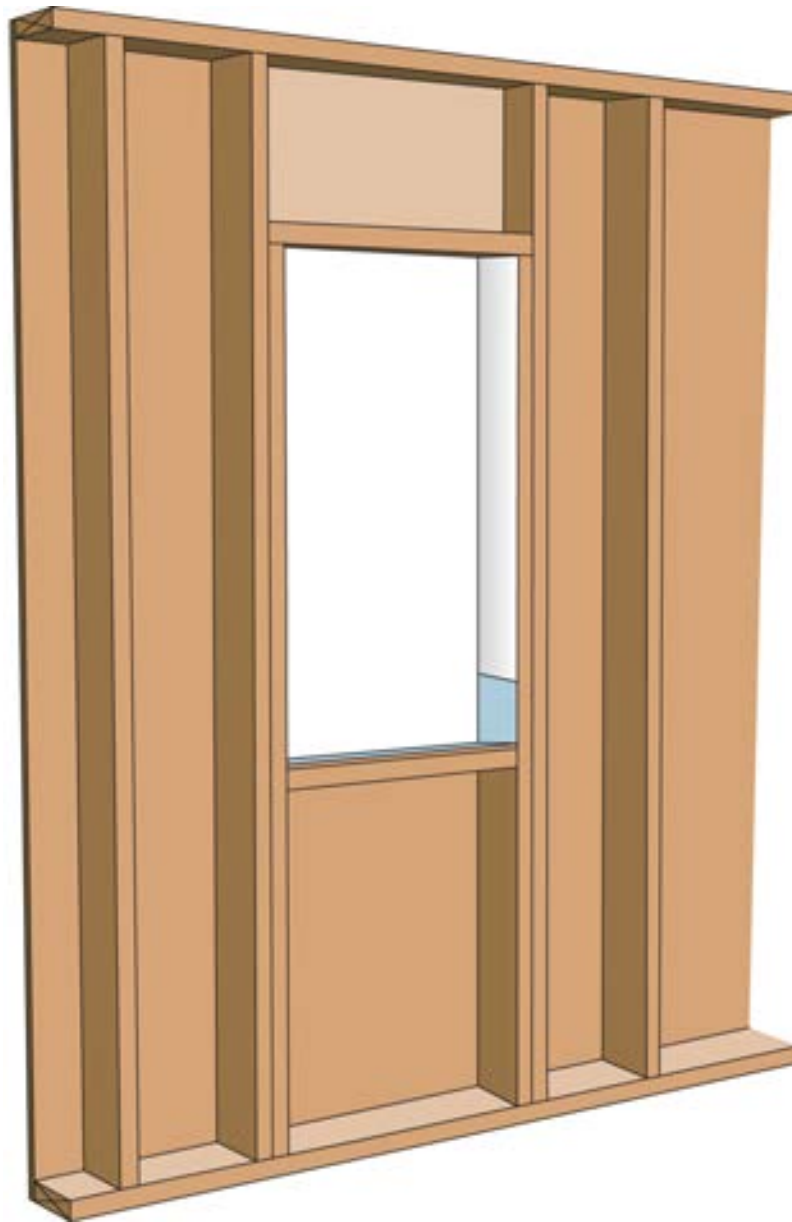




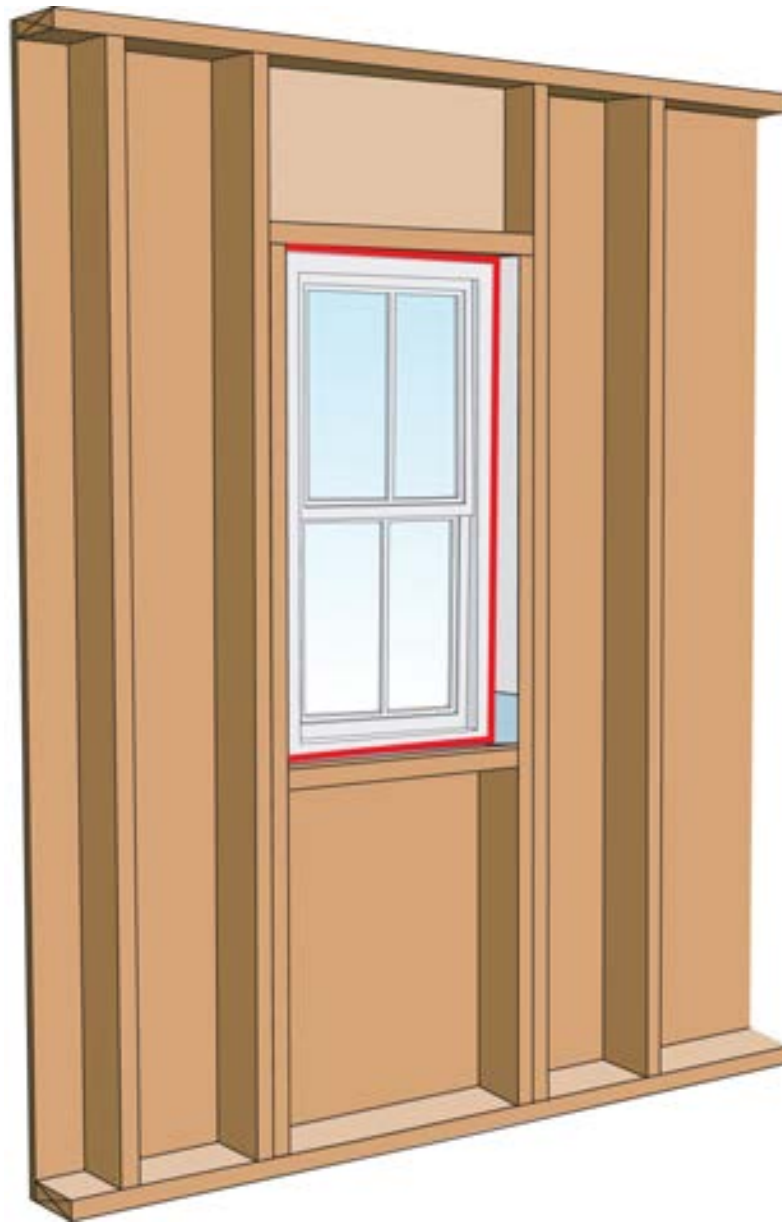






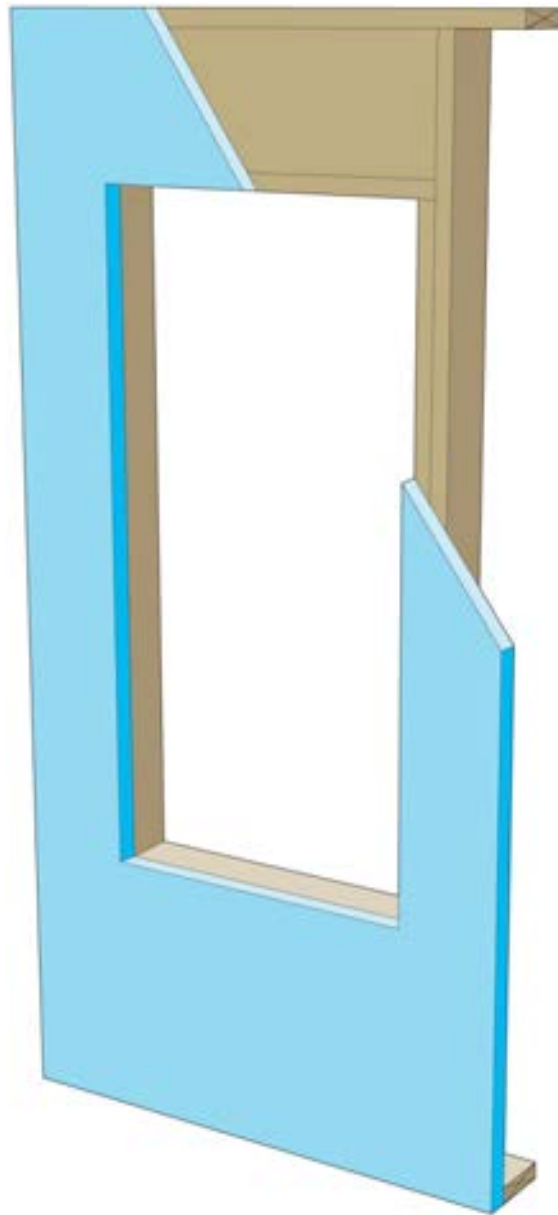


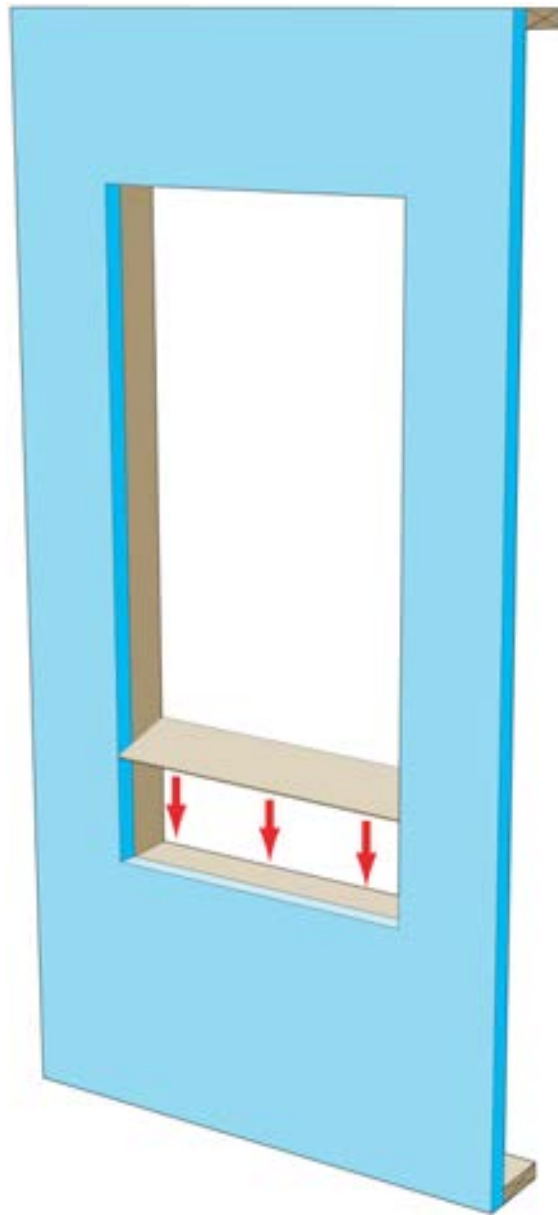


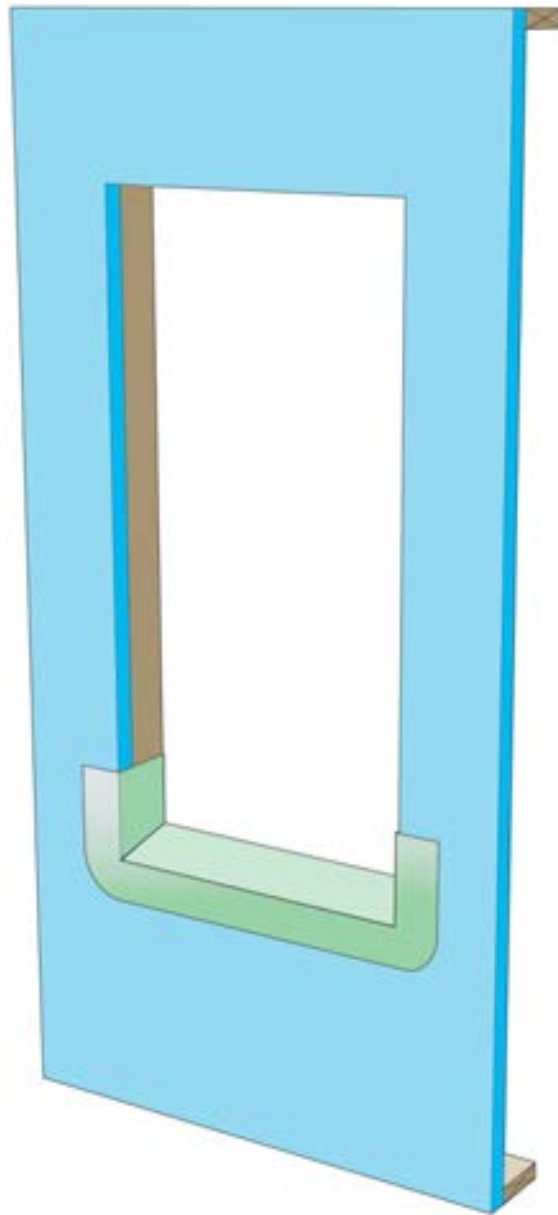


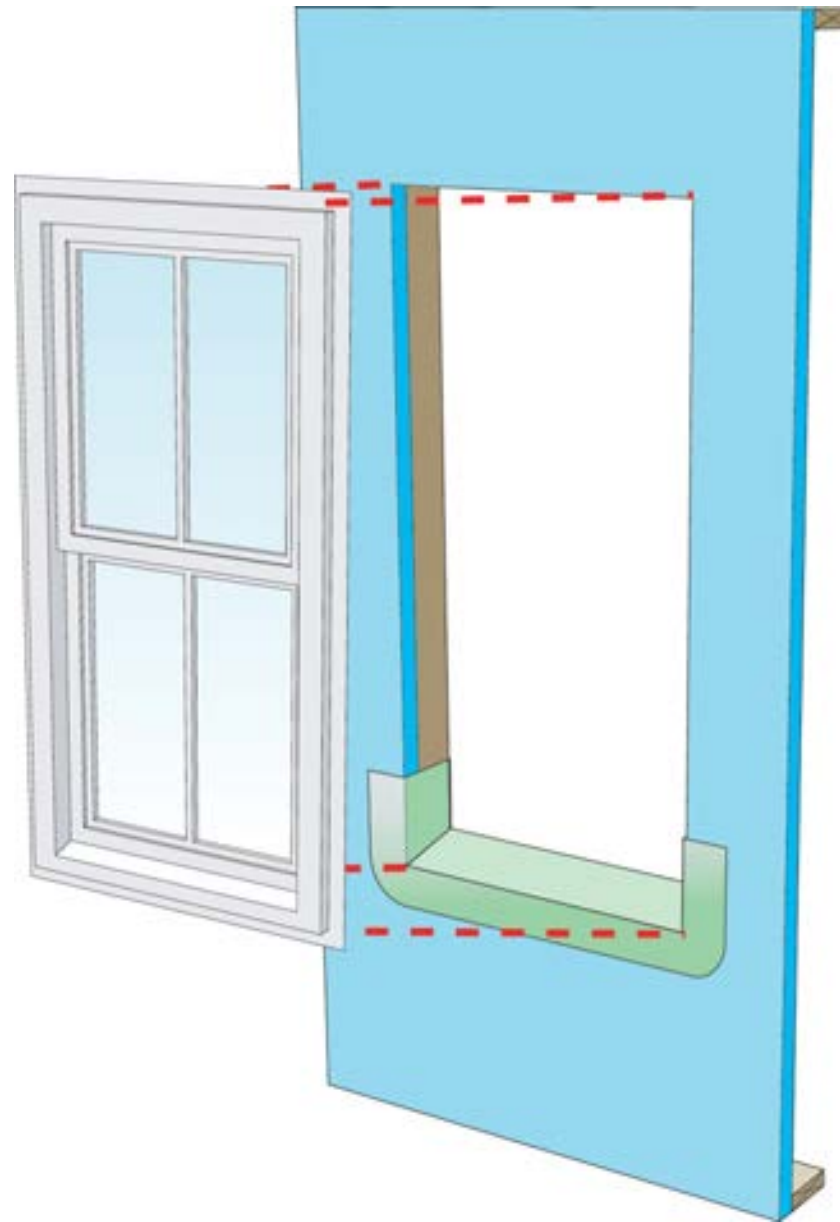








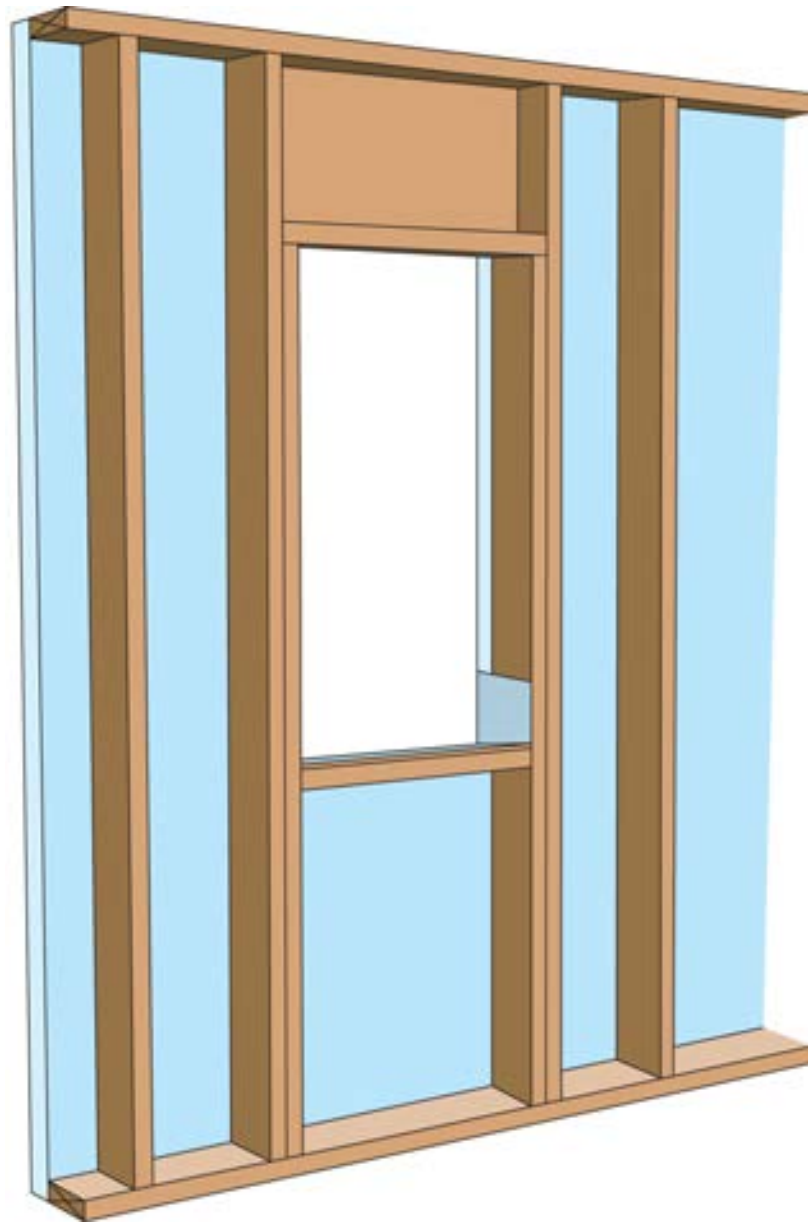




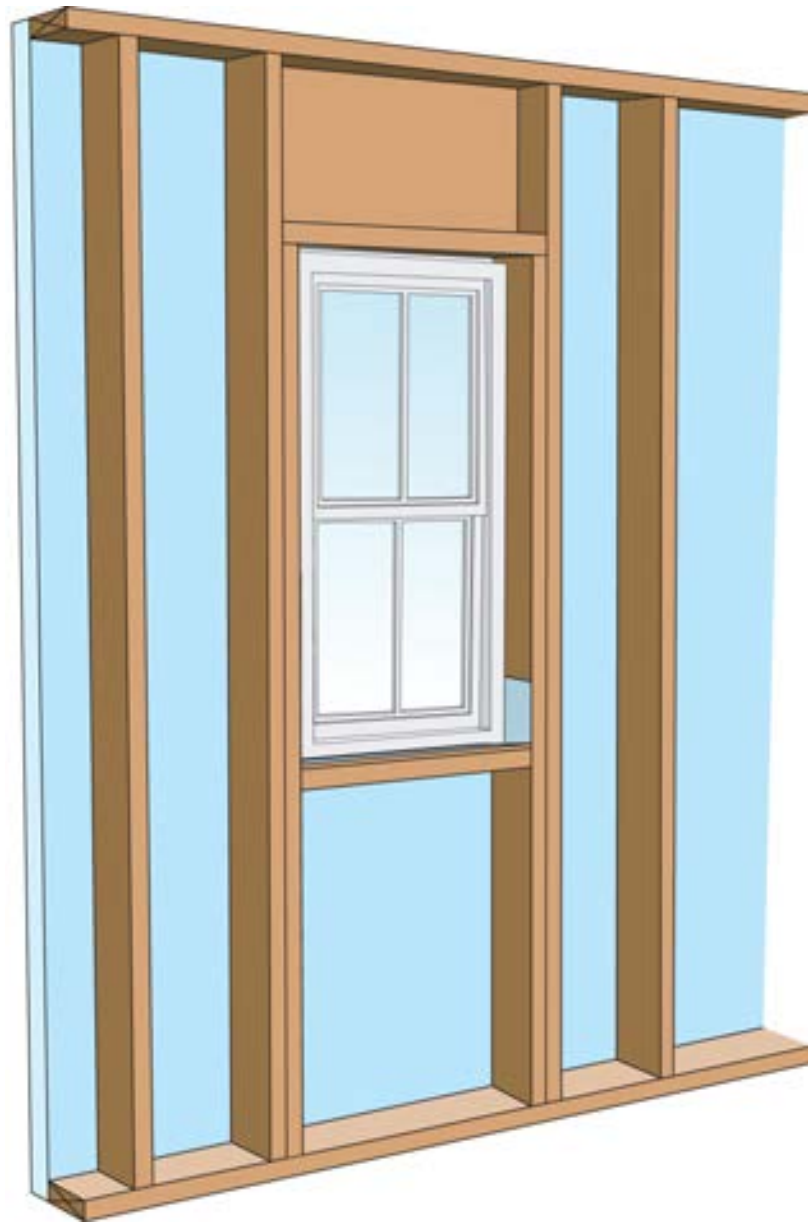


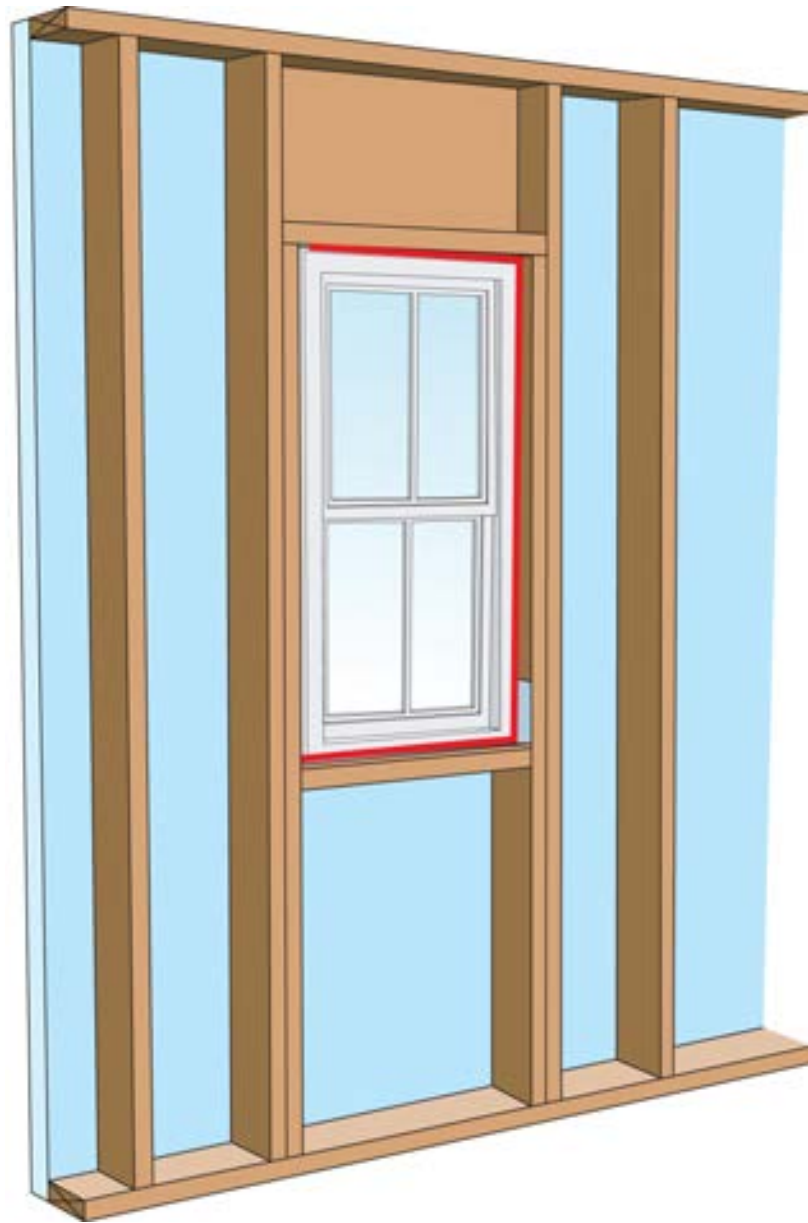


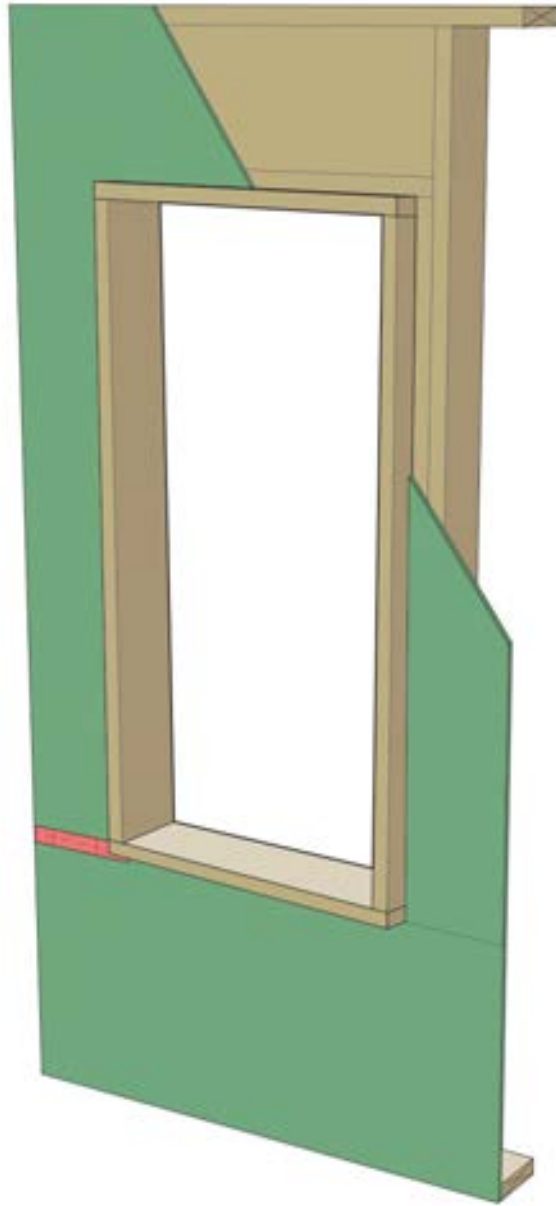


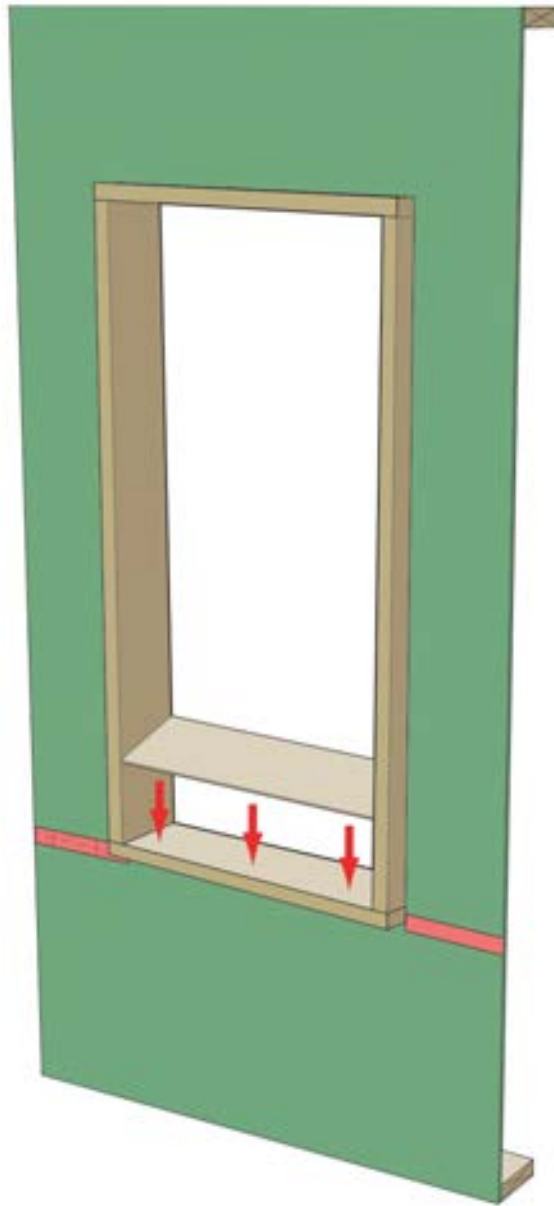


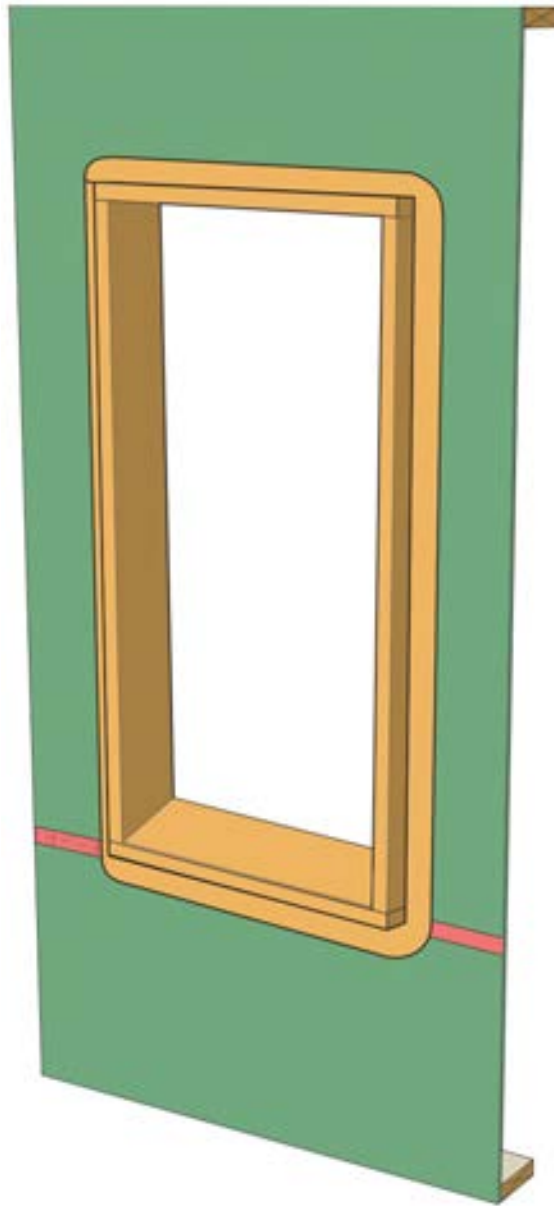


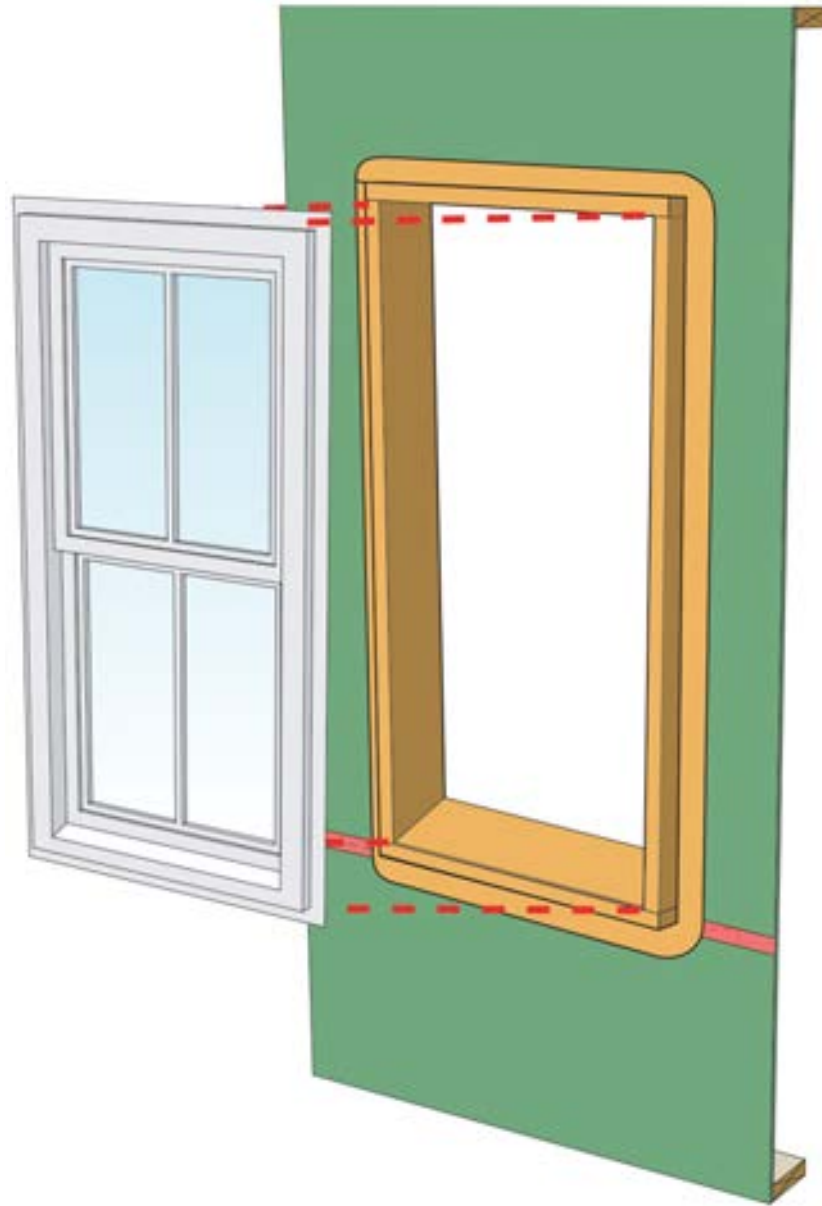














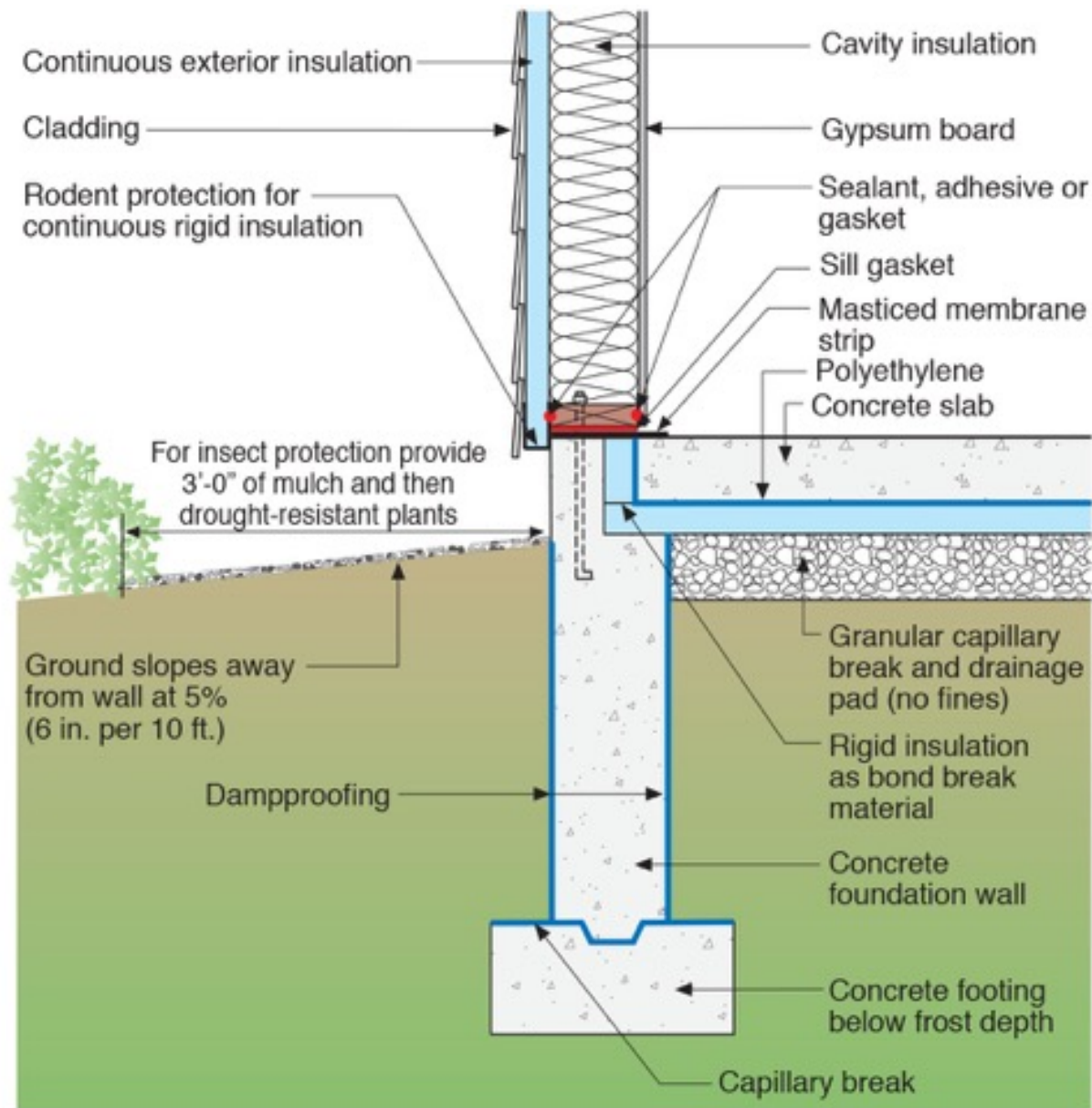


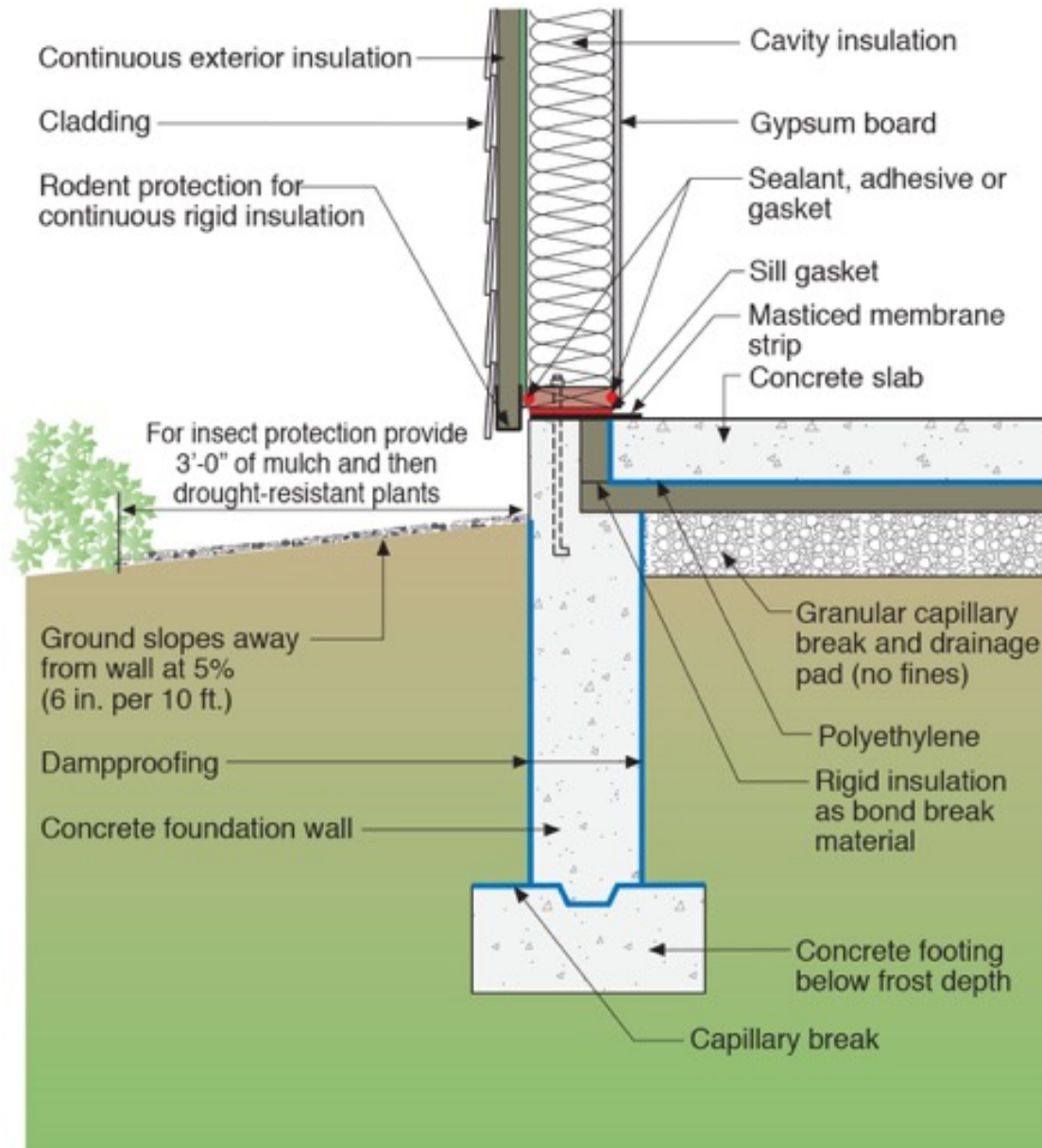


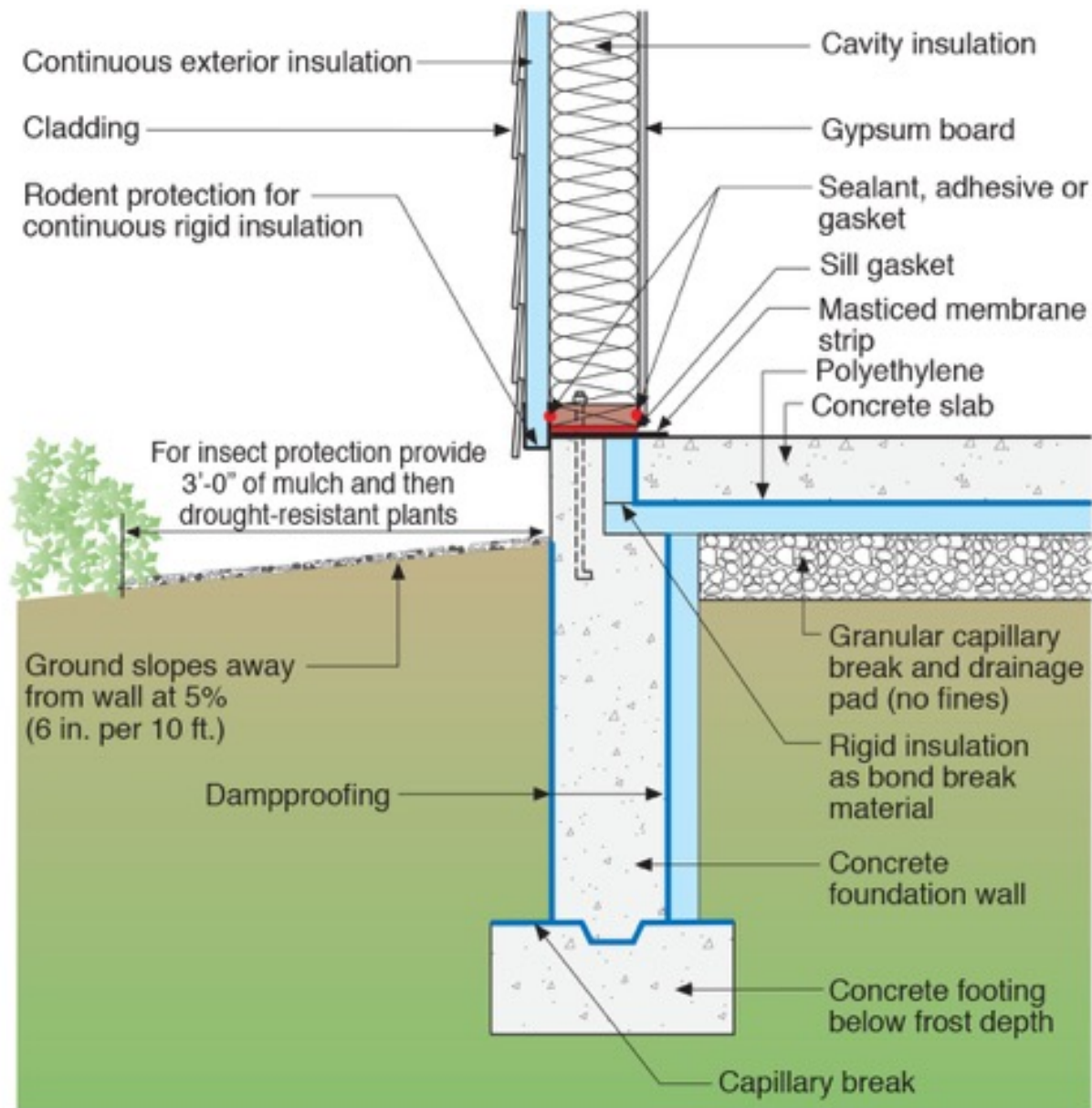


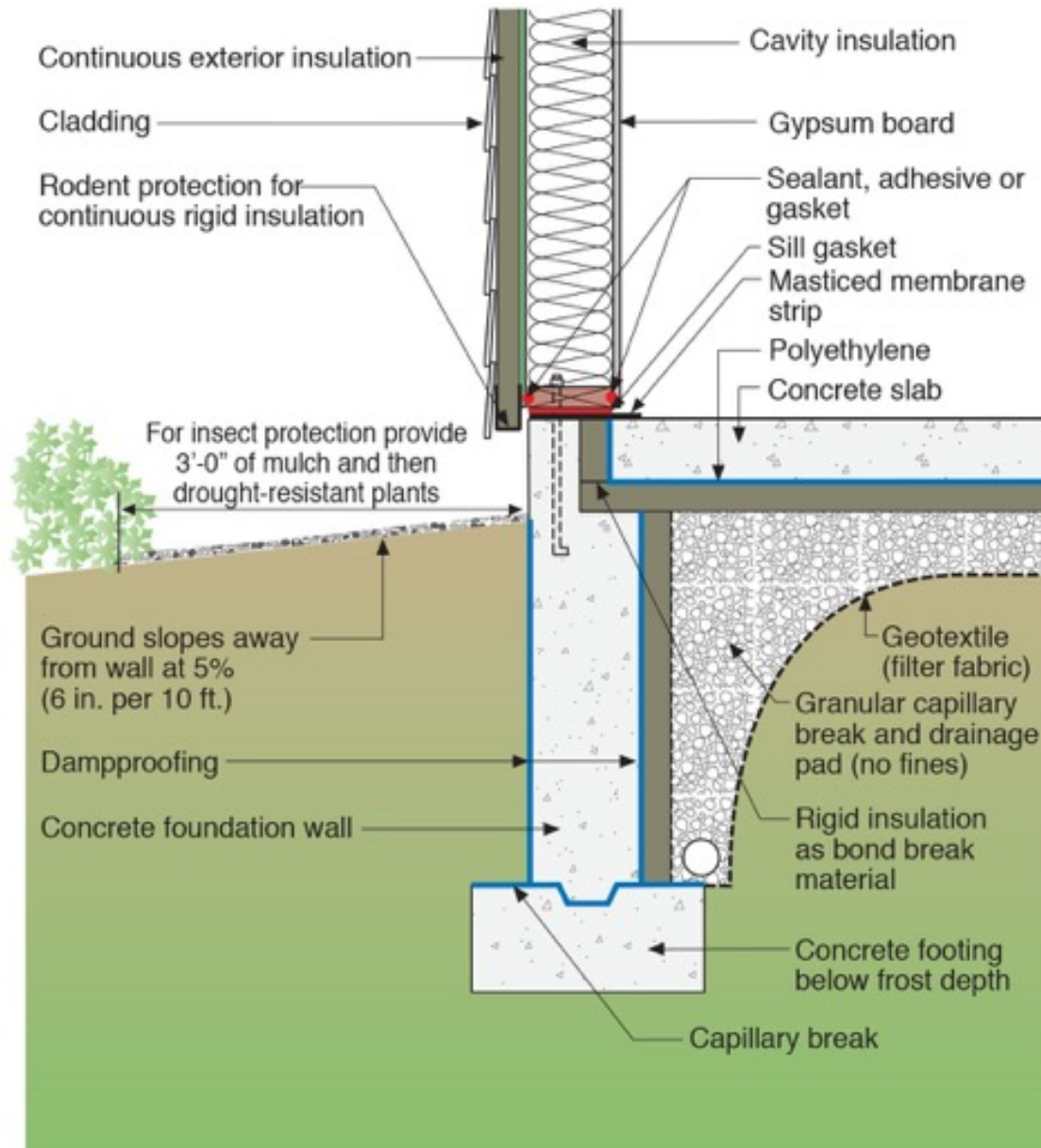


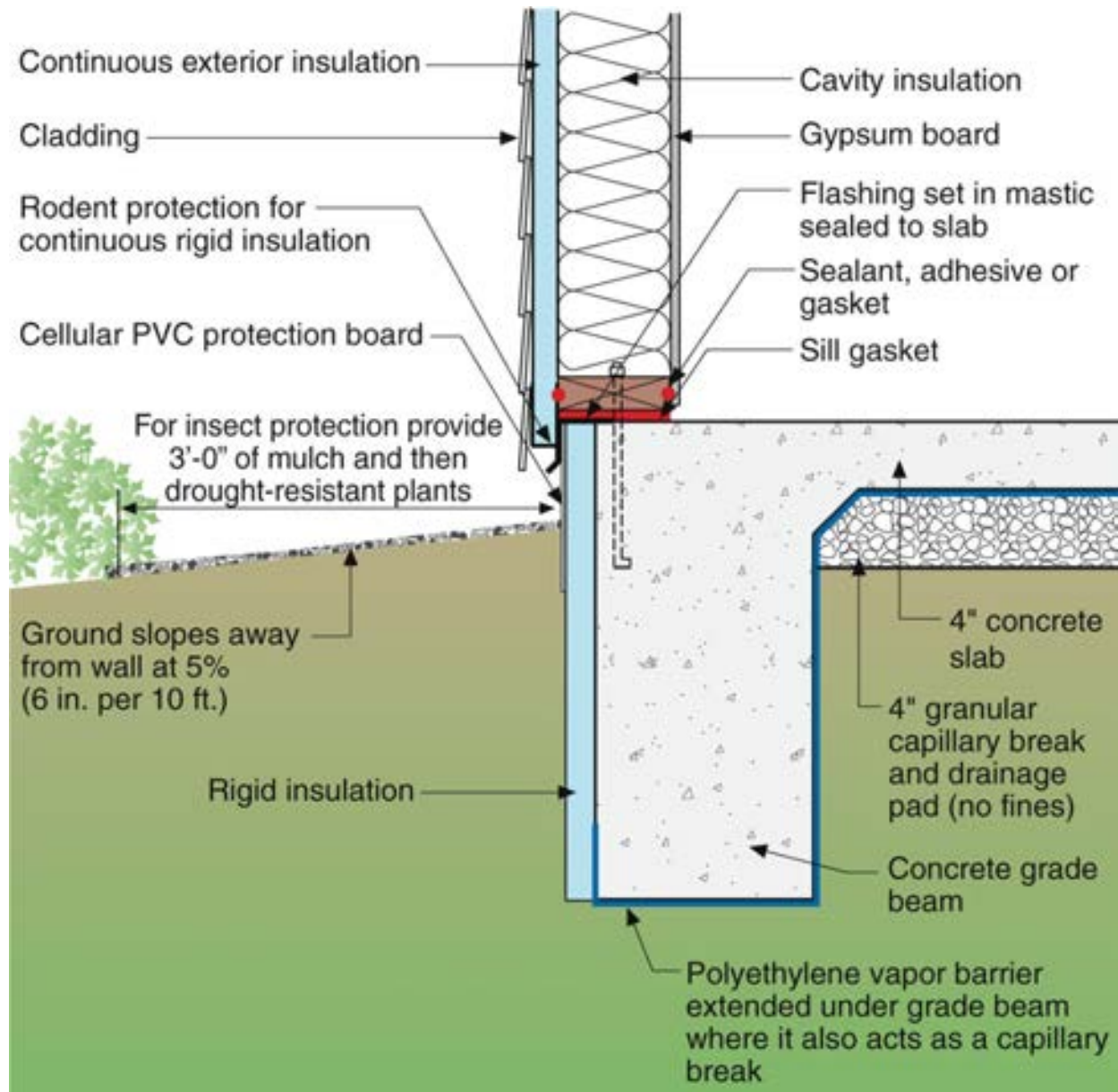




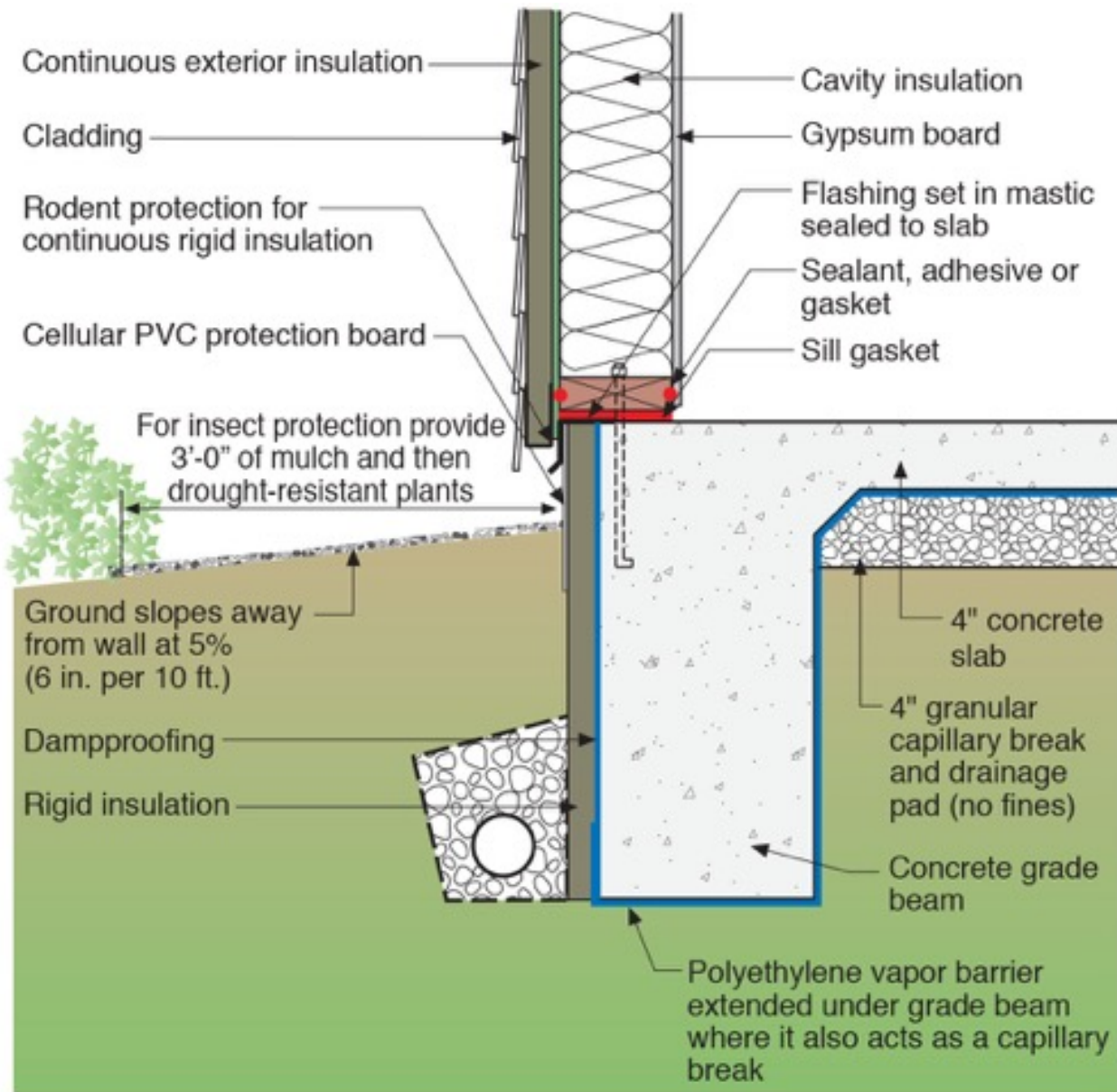


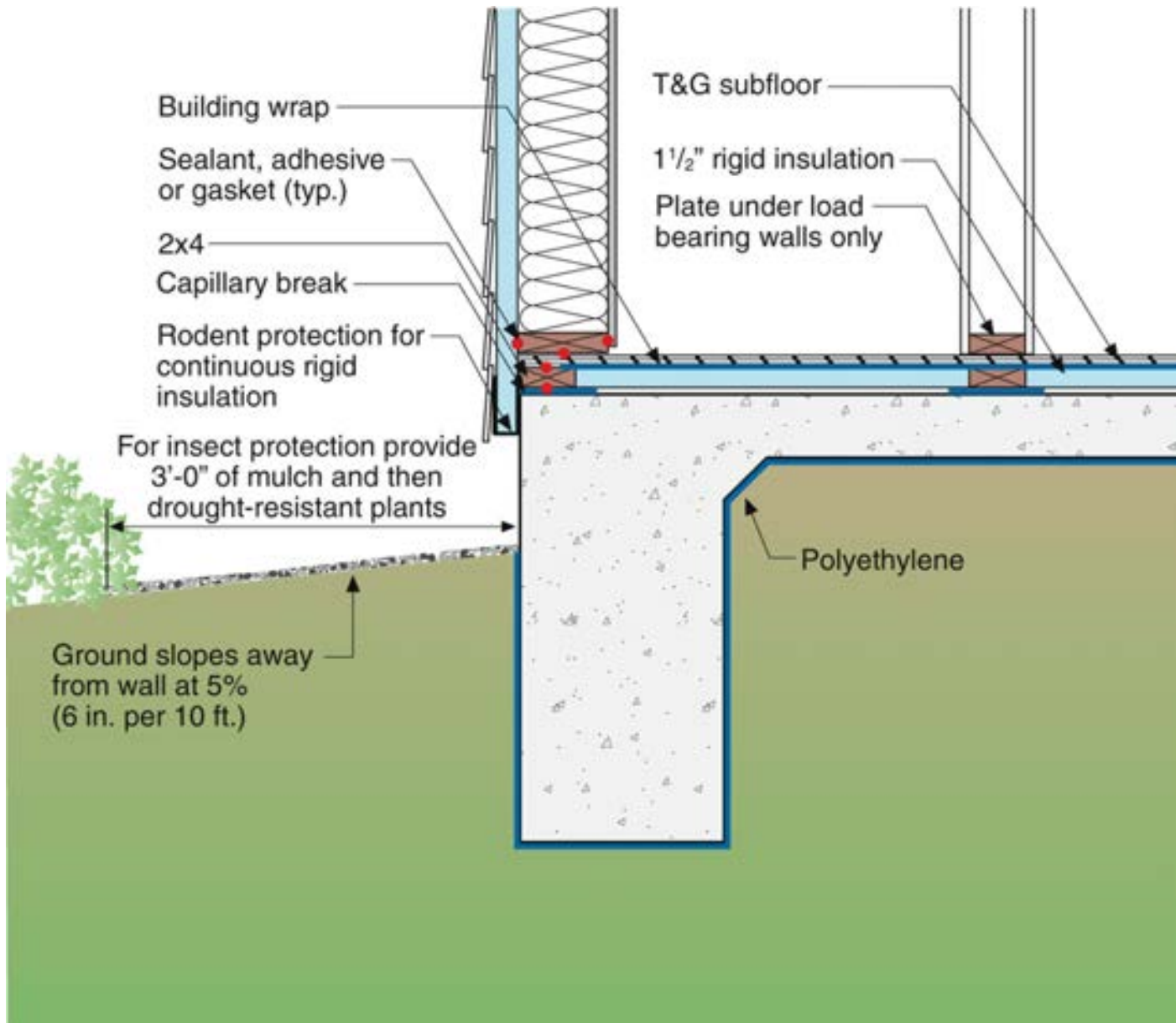


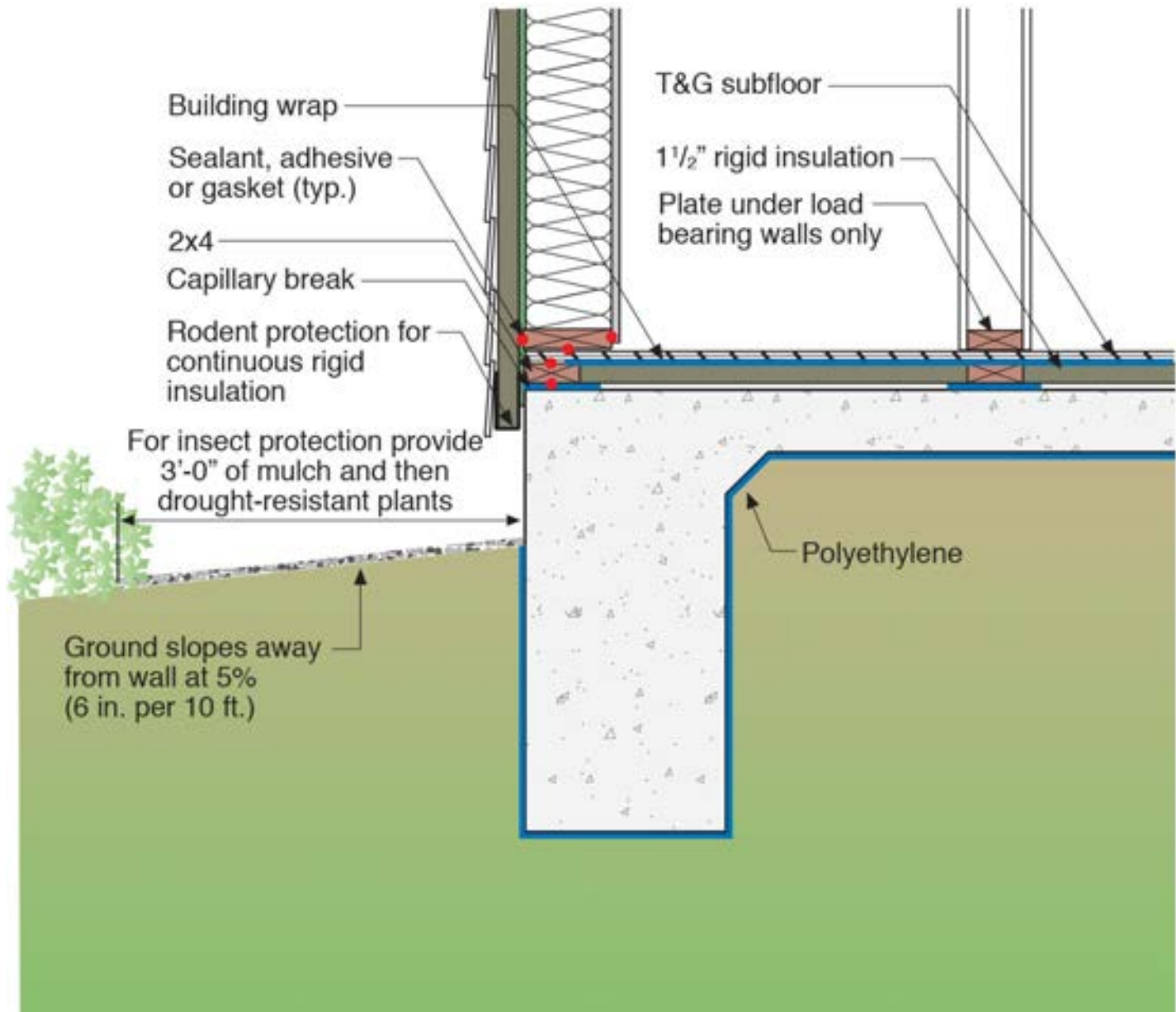


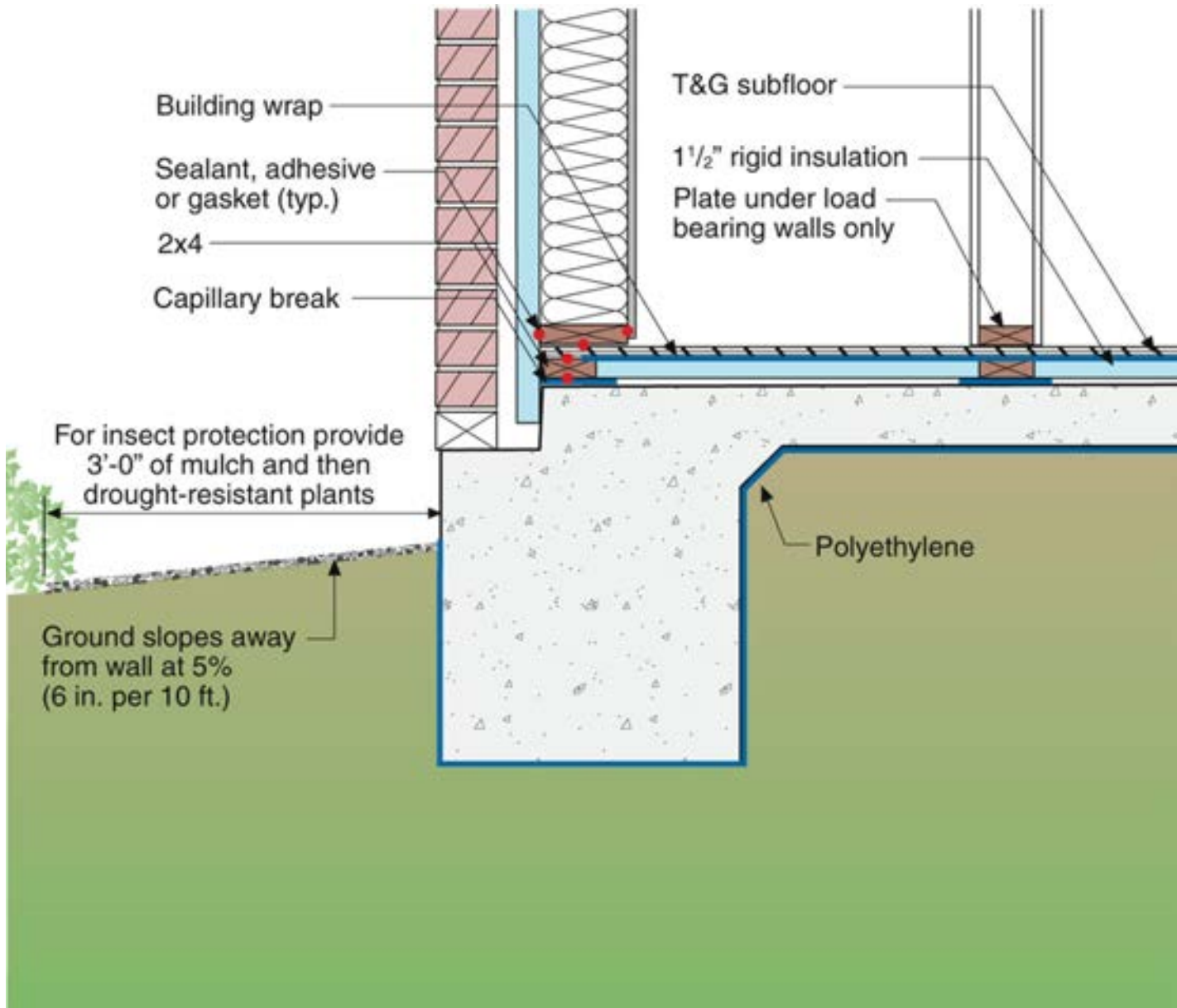


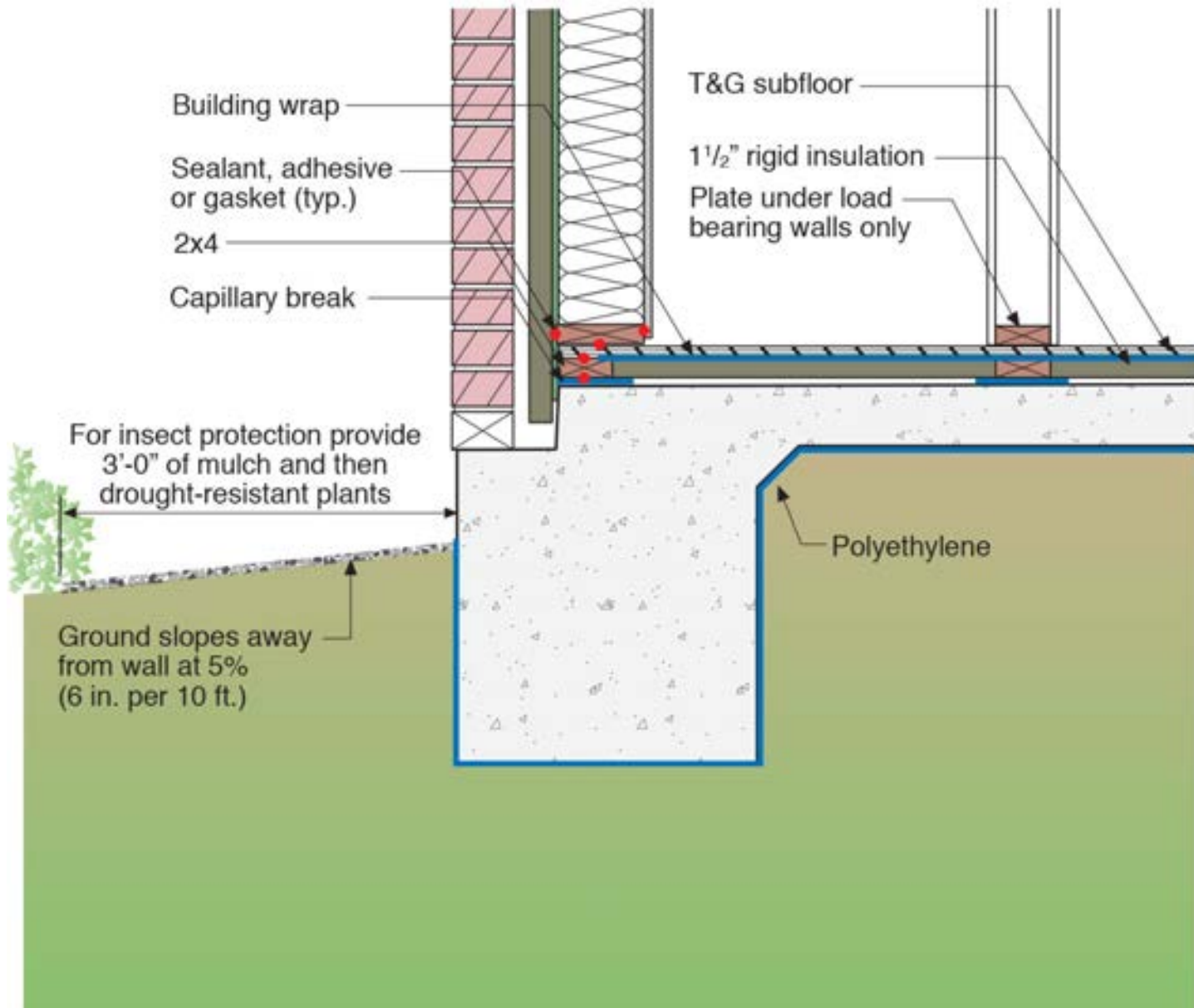


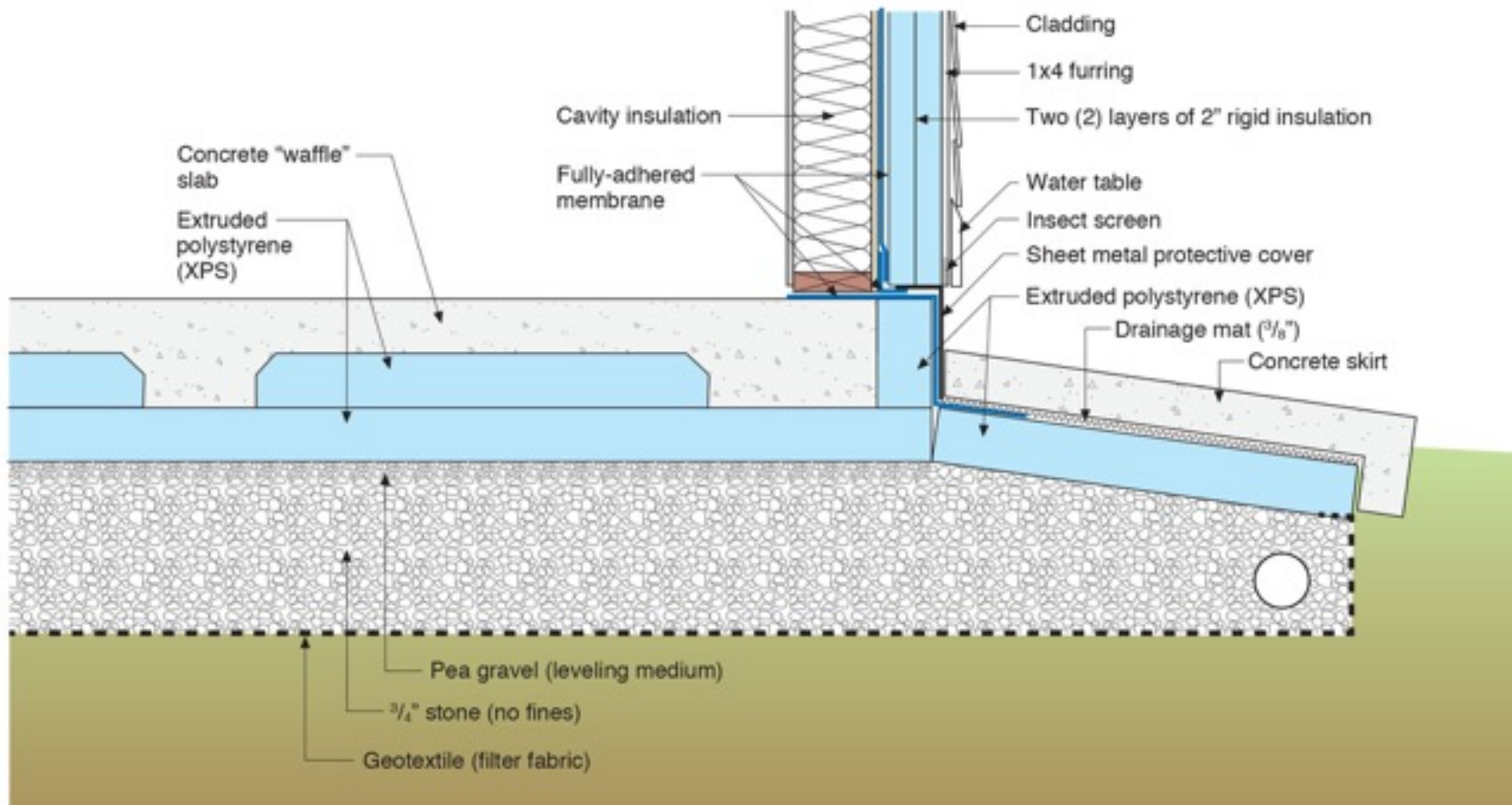


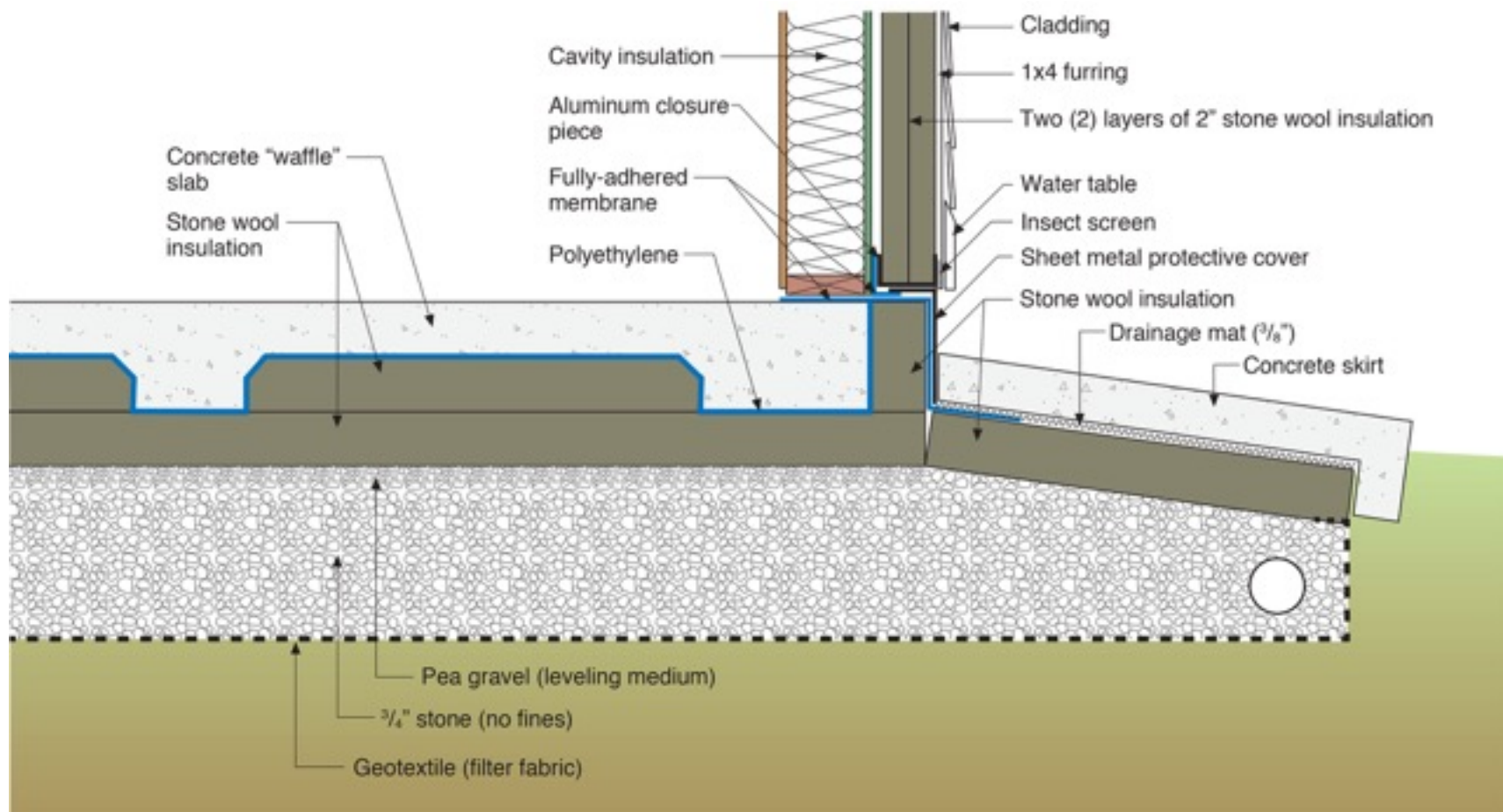


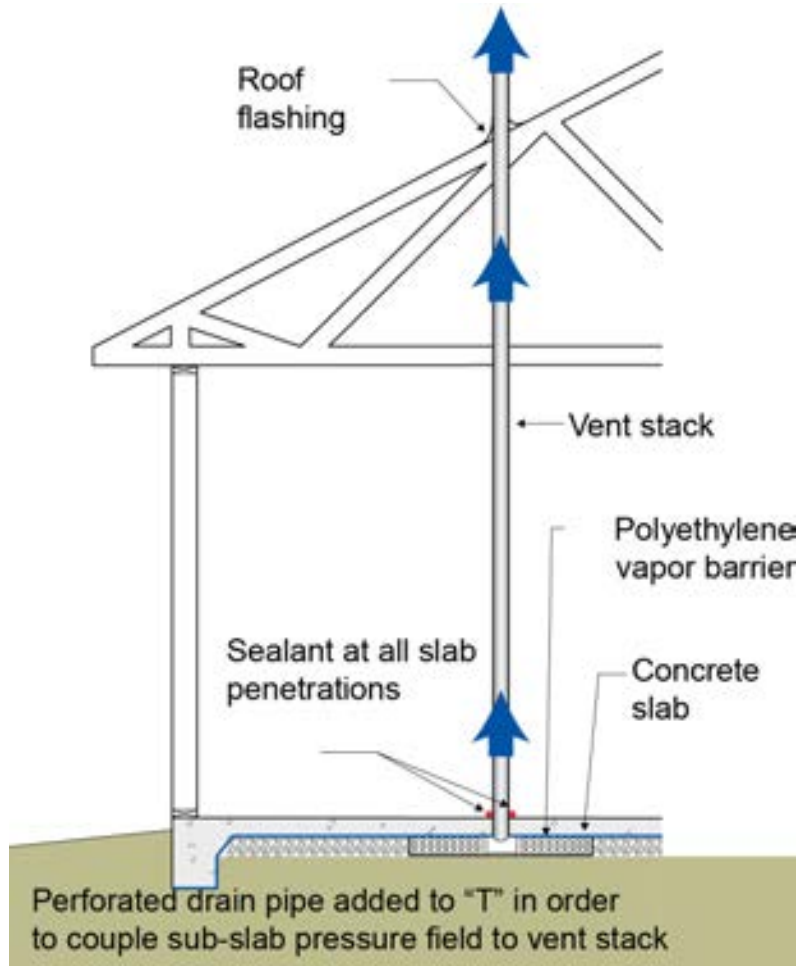






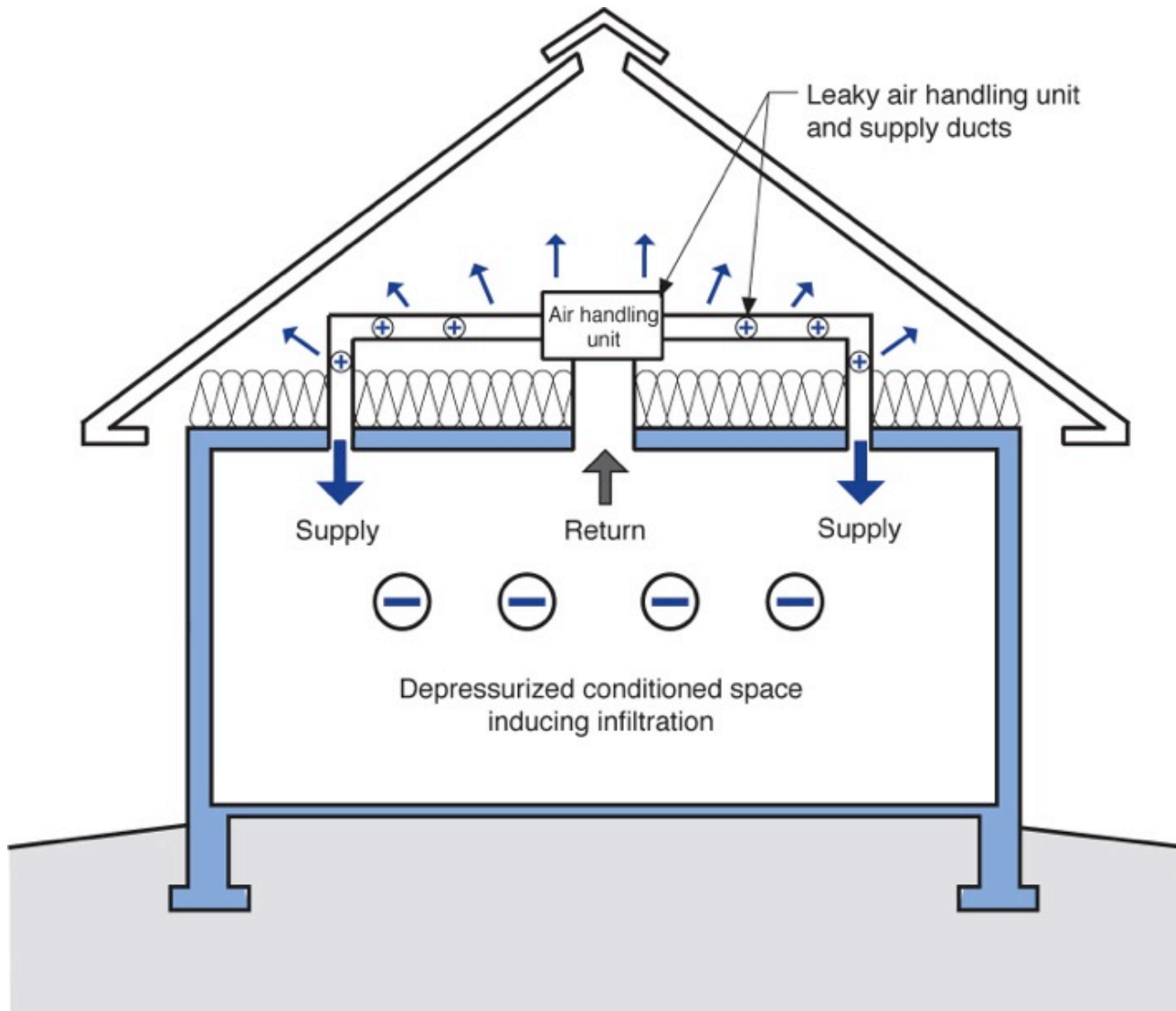


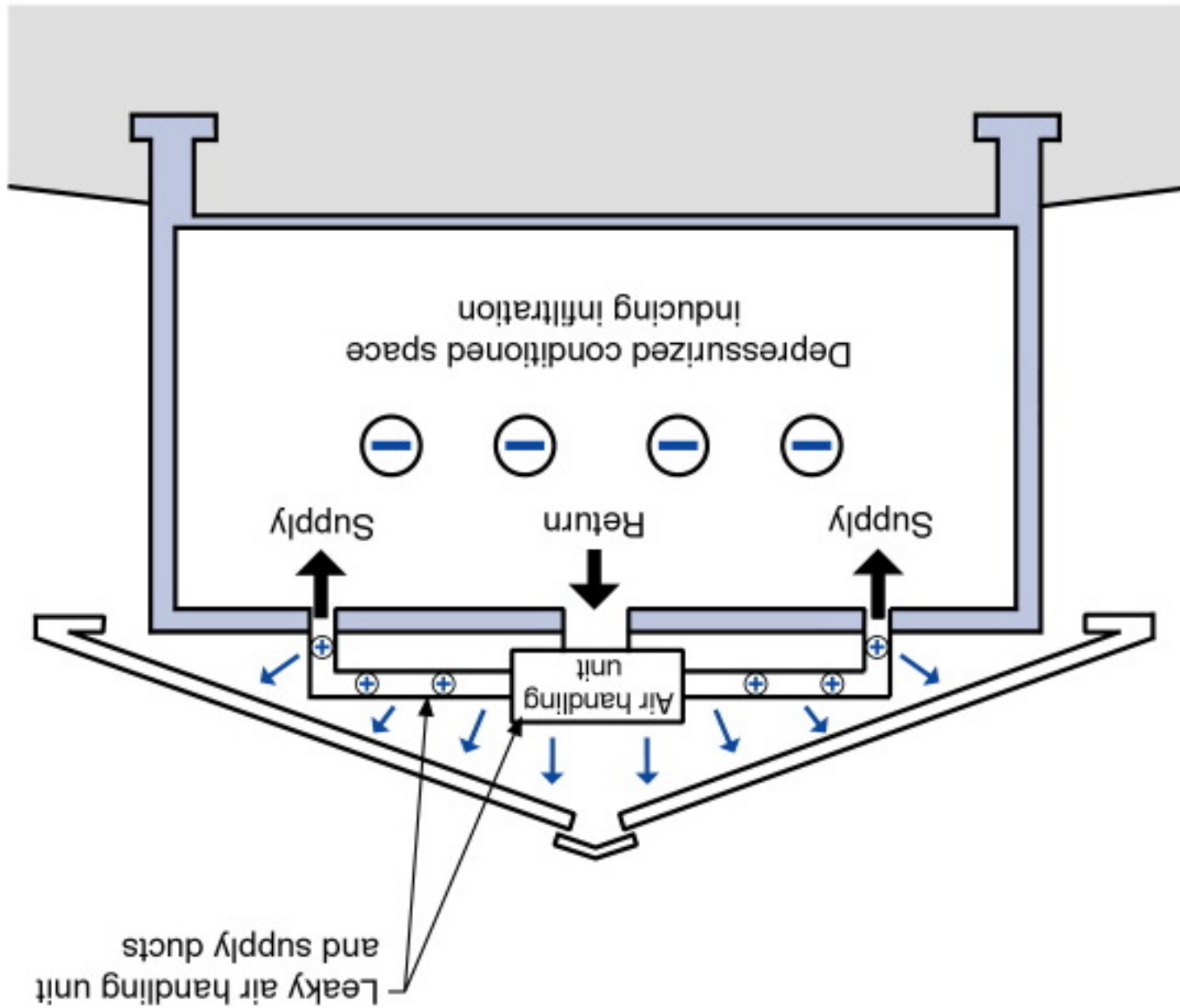


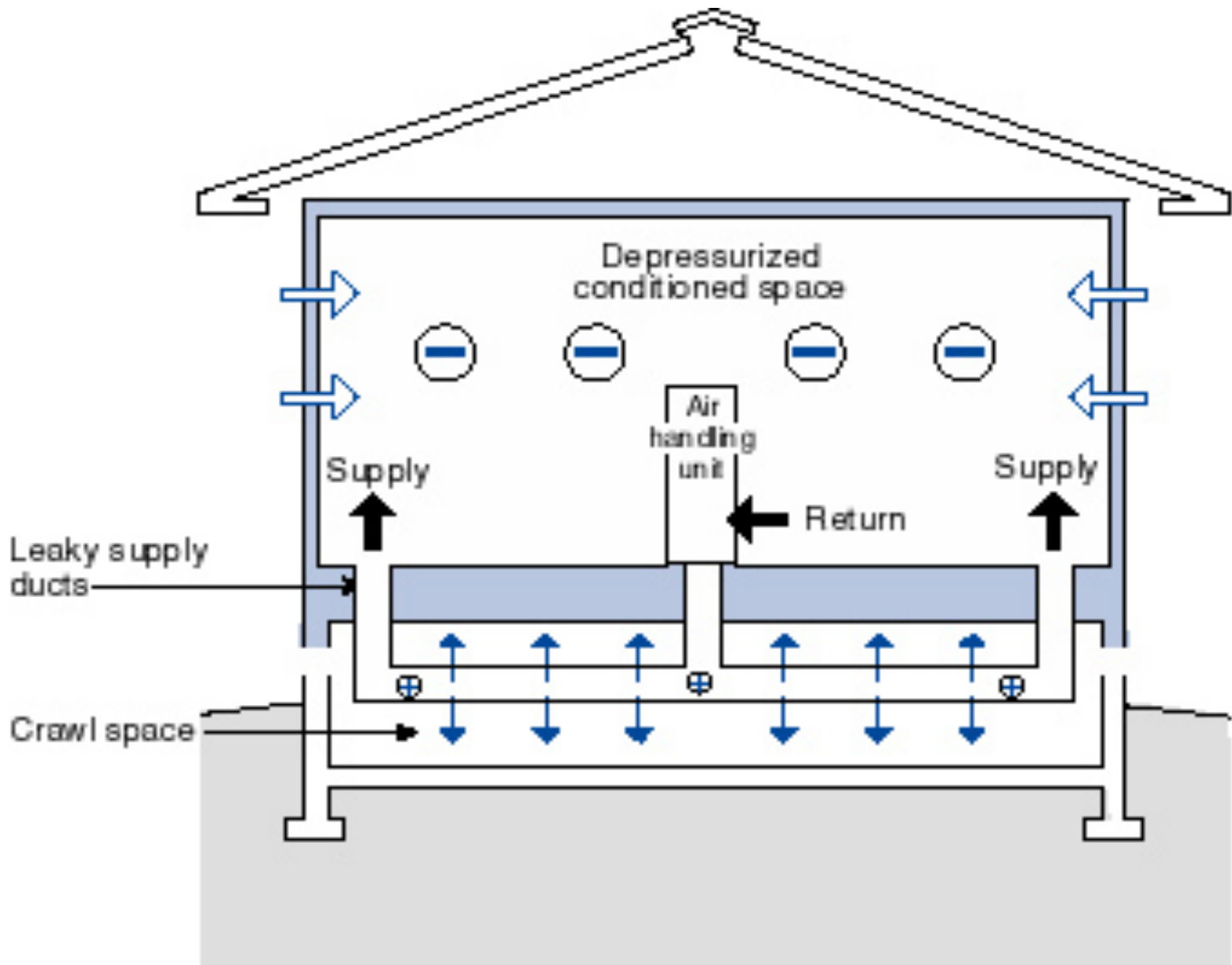




# Crawl Spaces







# Crawl Spaces Need to be Completely “Inside” or Completely “Outside”





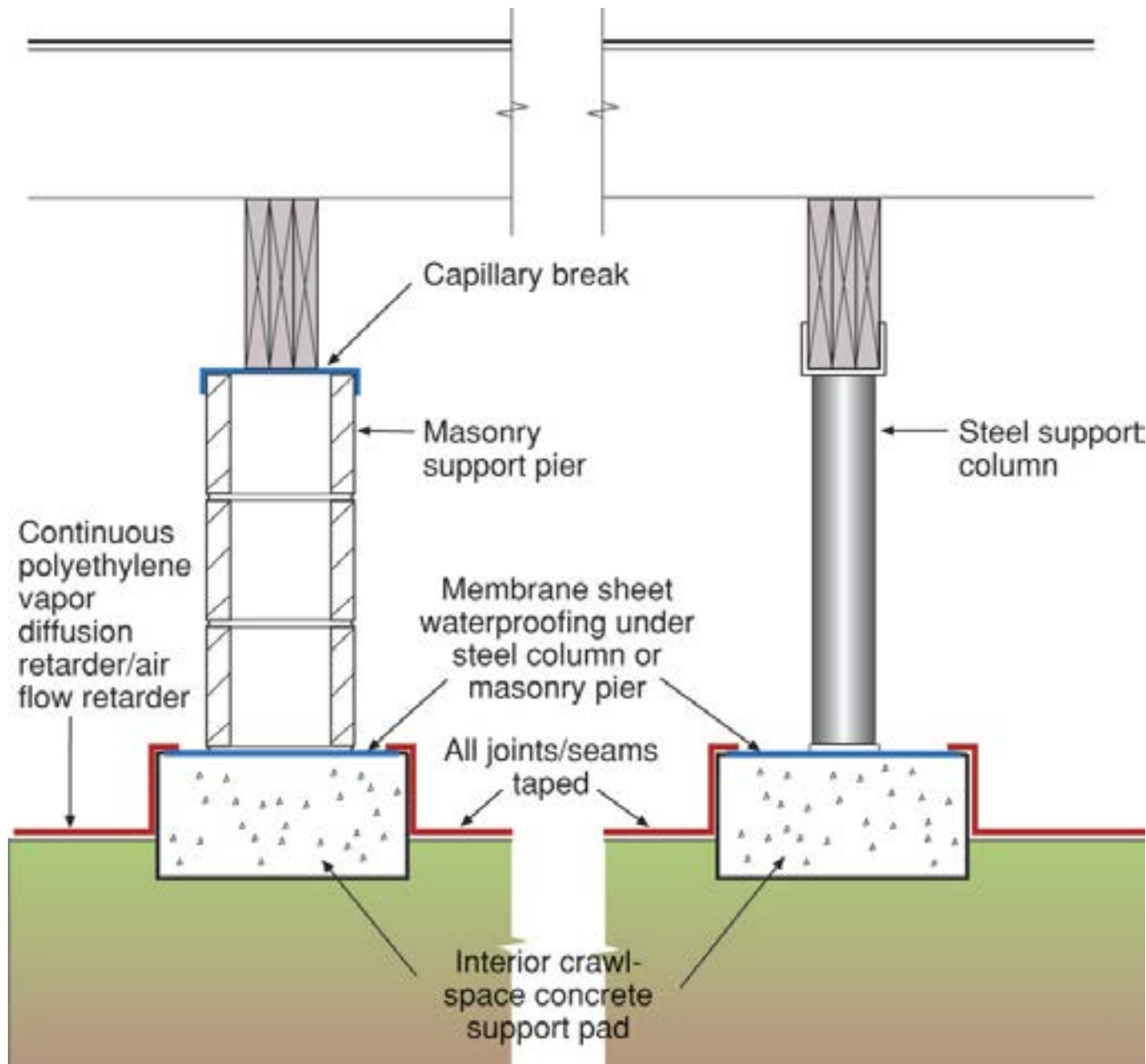












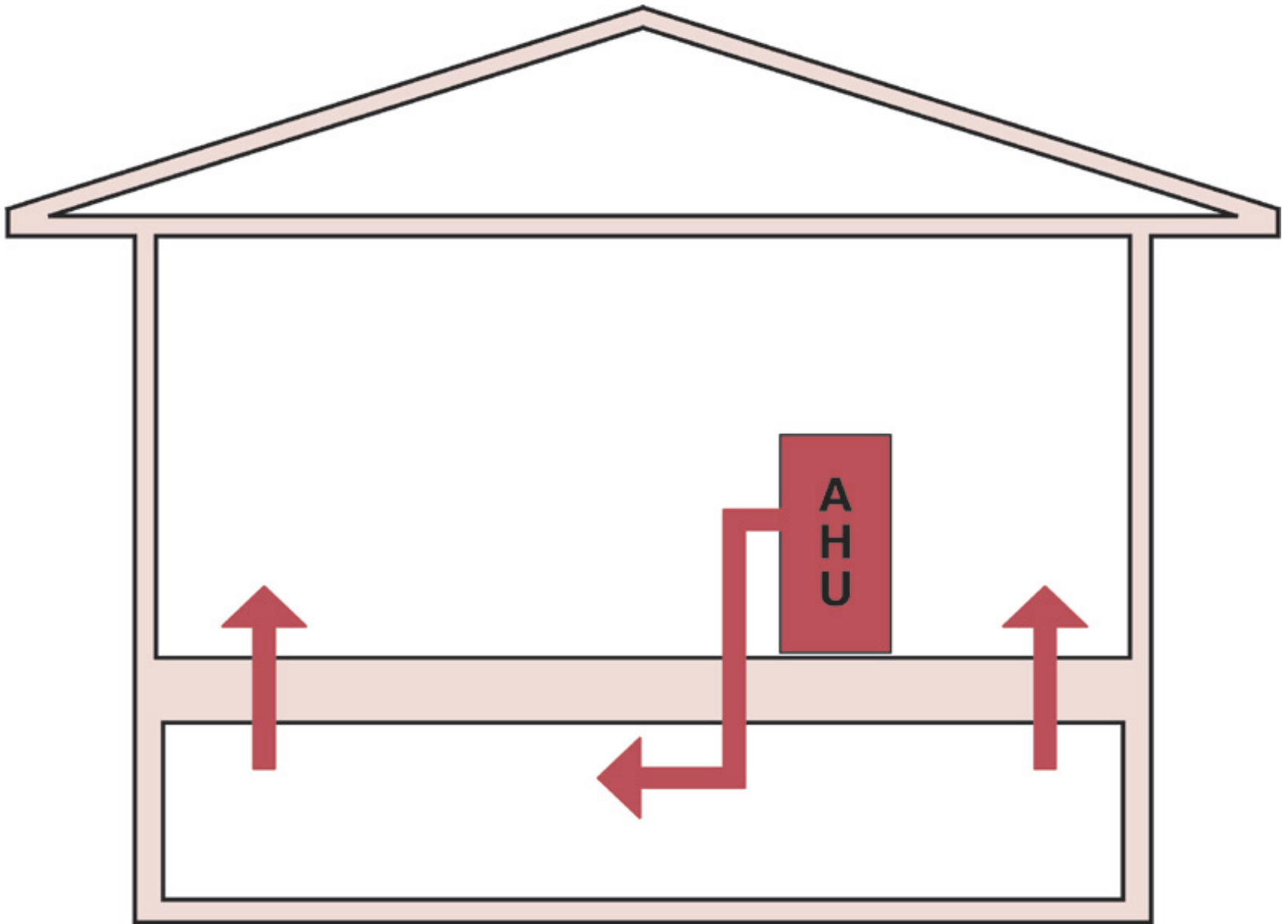
Conditioned Crawlspace Not Unvented  
Crawlspace

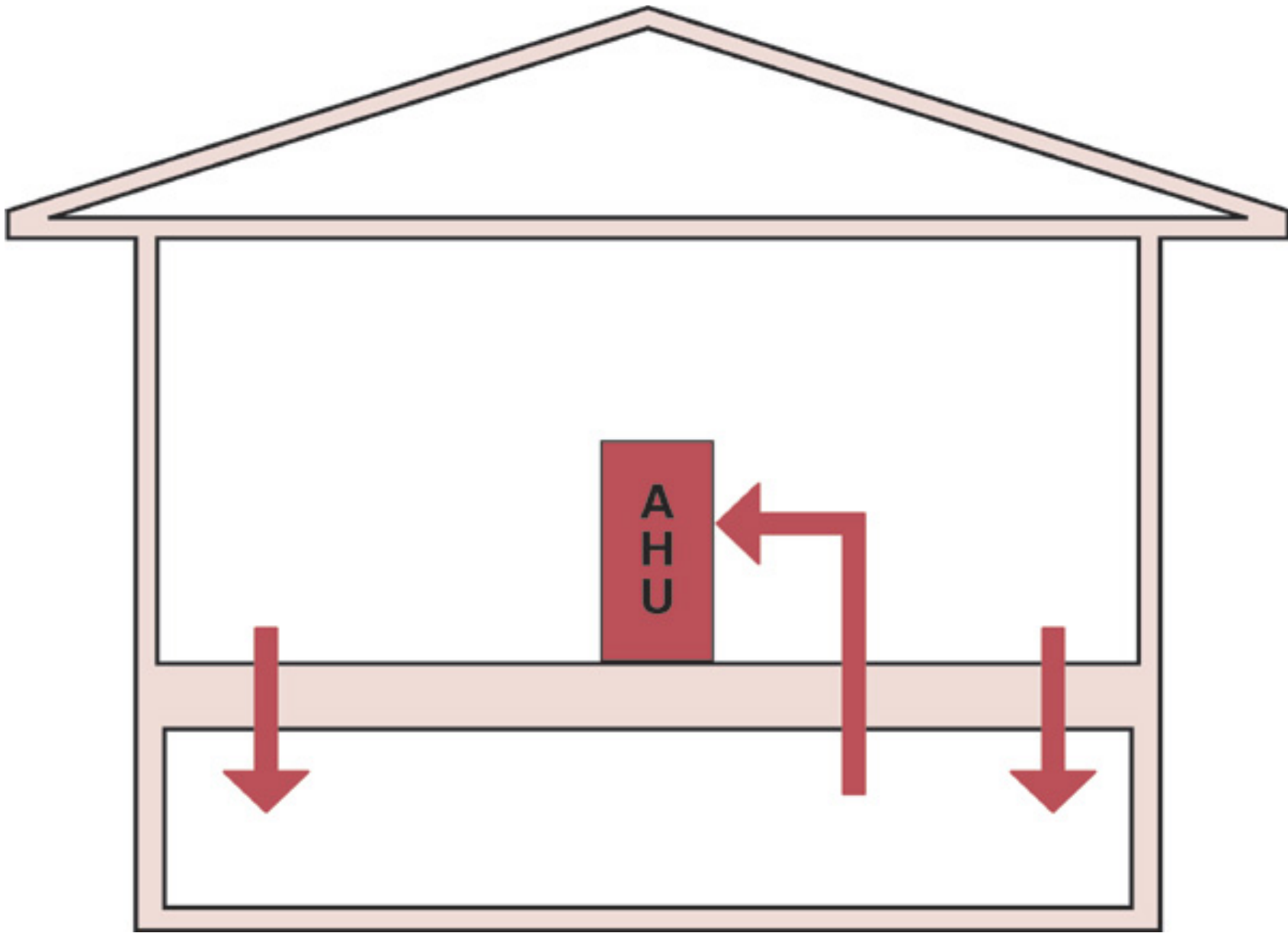
Need Supply Air

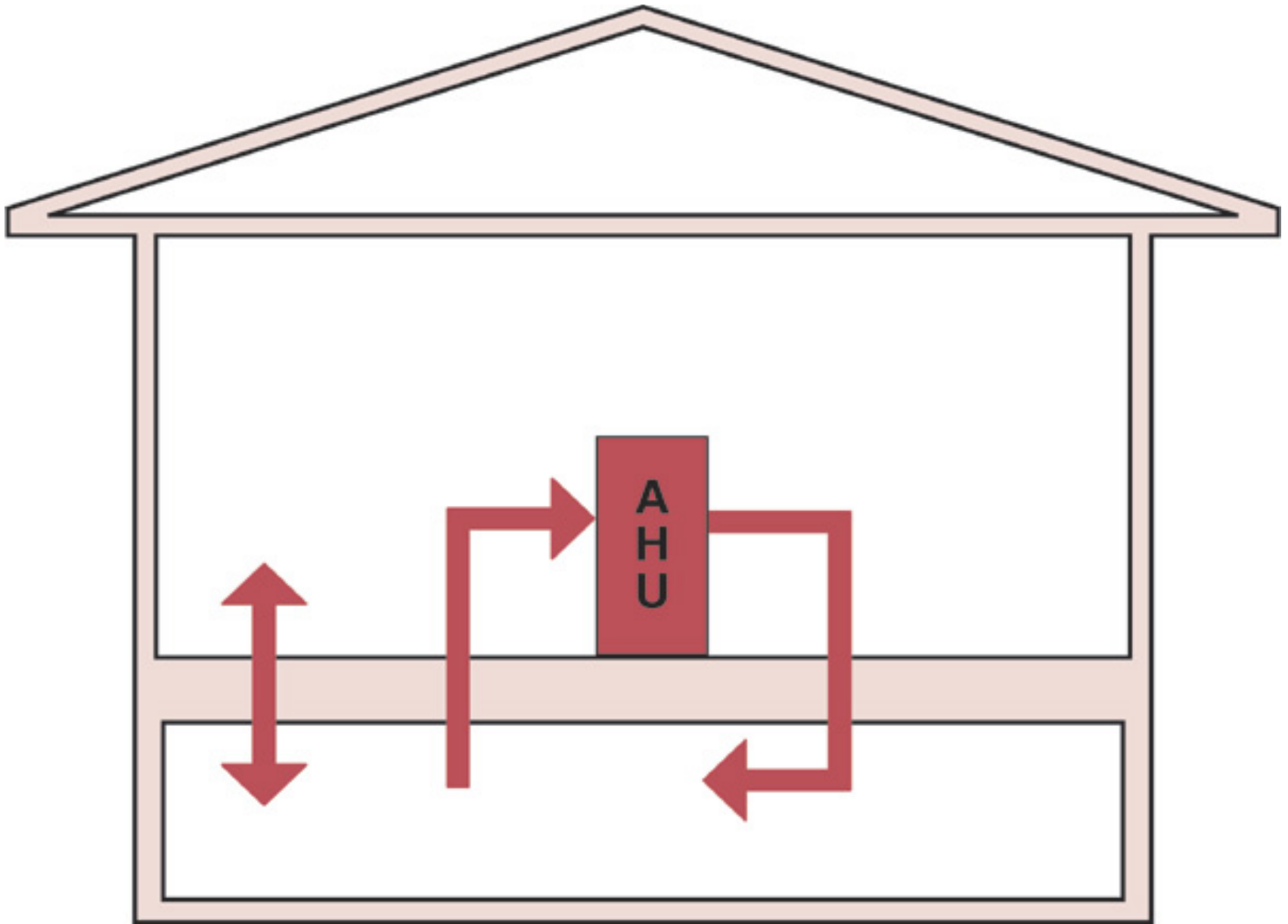
50 cfm/1000 ft<sup>2</sup> of Crawlspace Area

Or

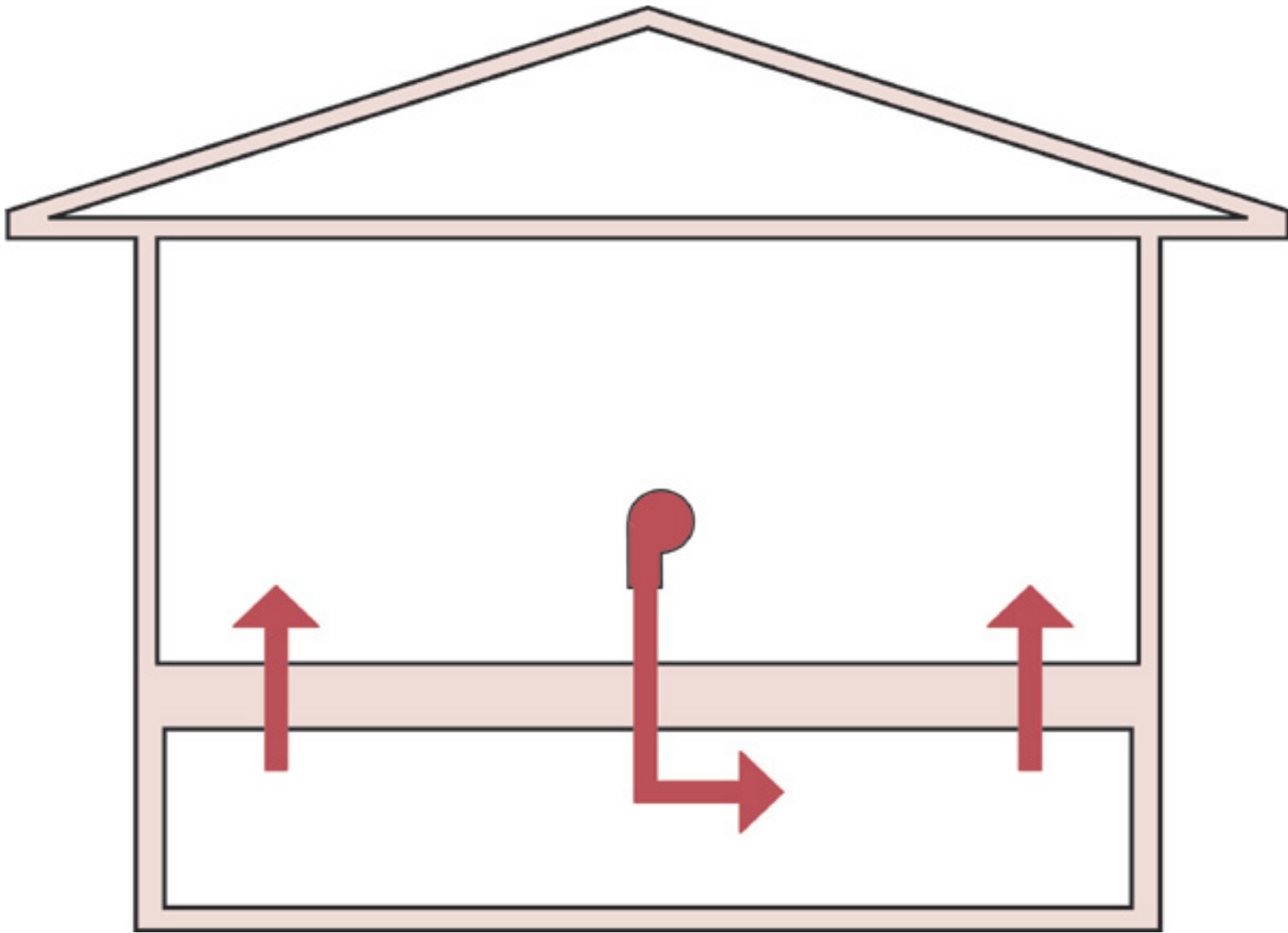
Dehumidification

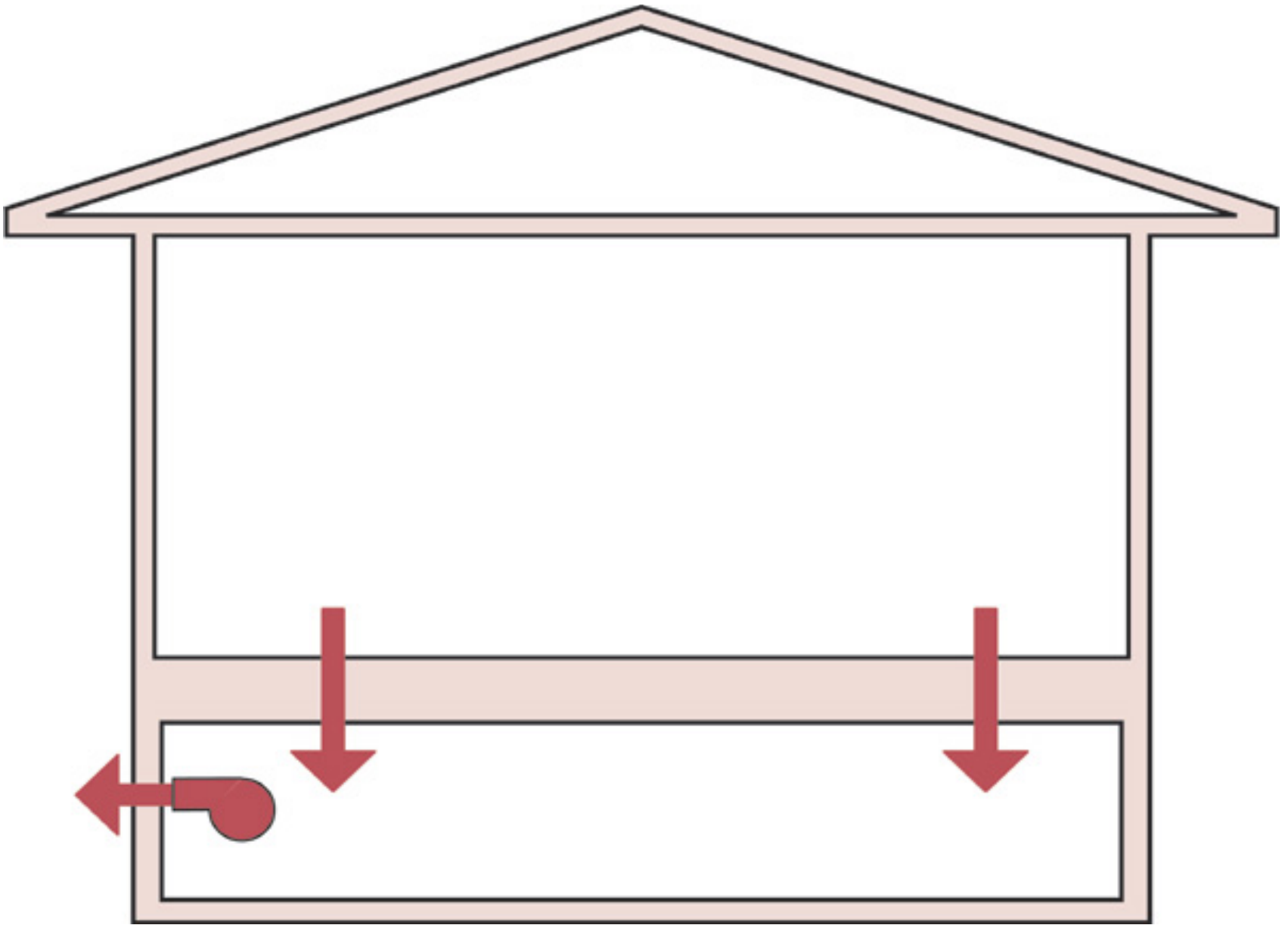


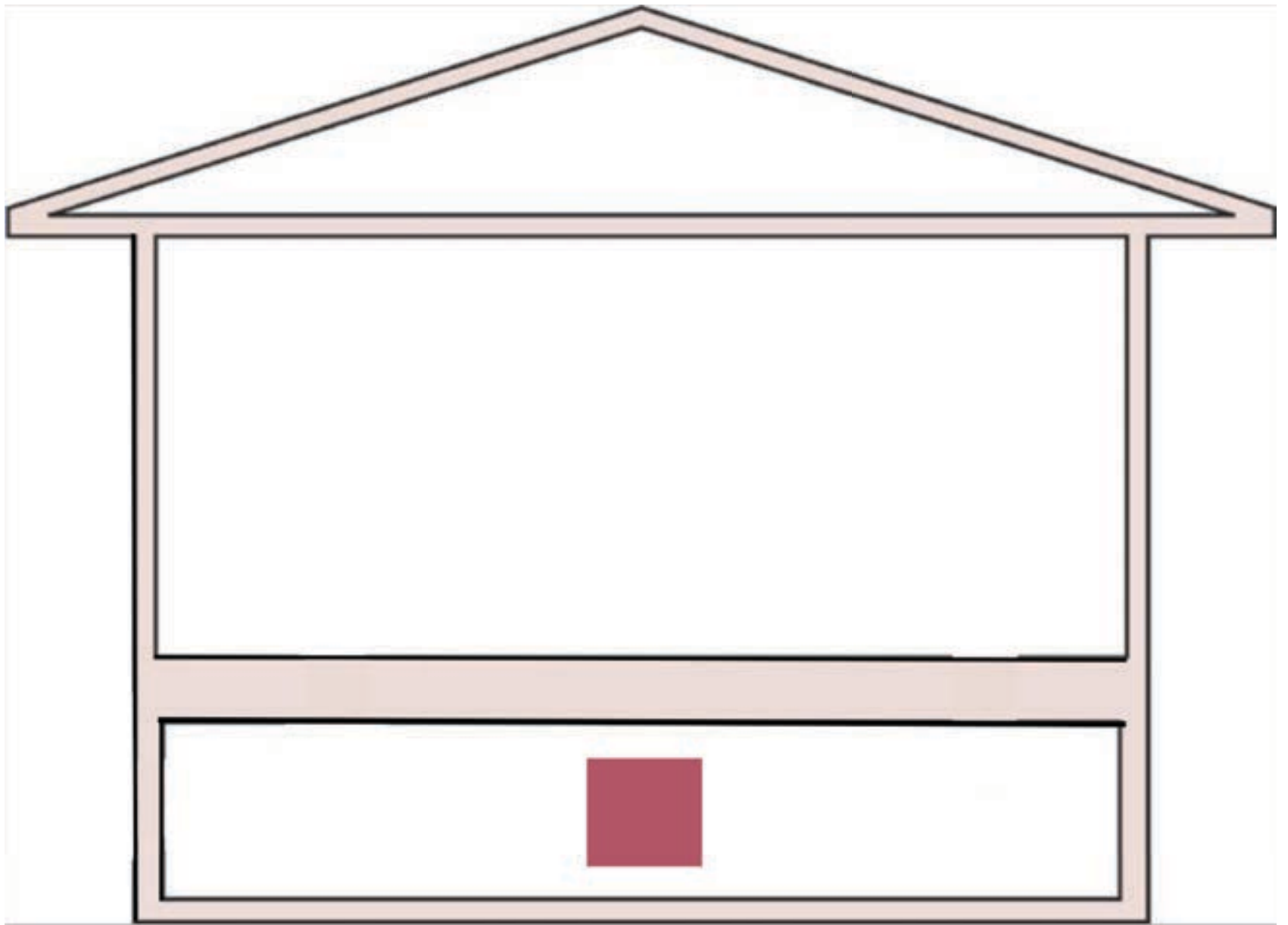


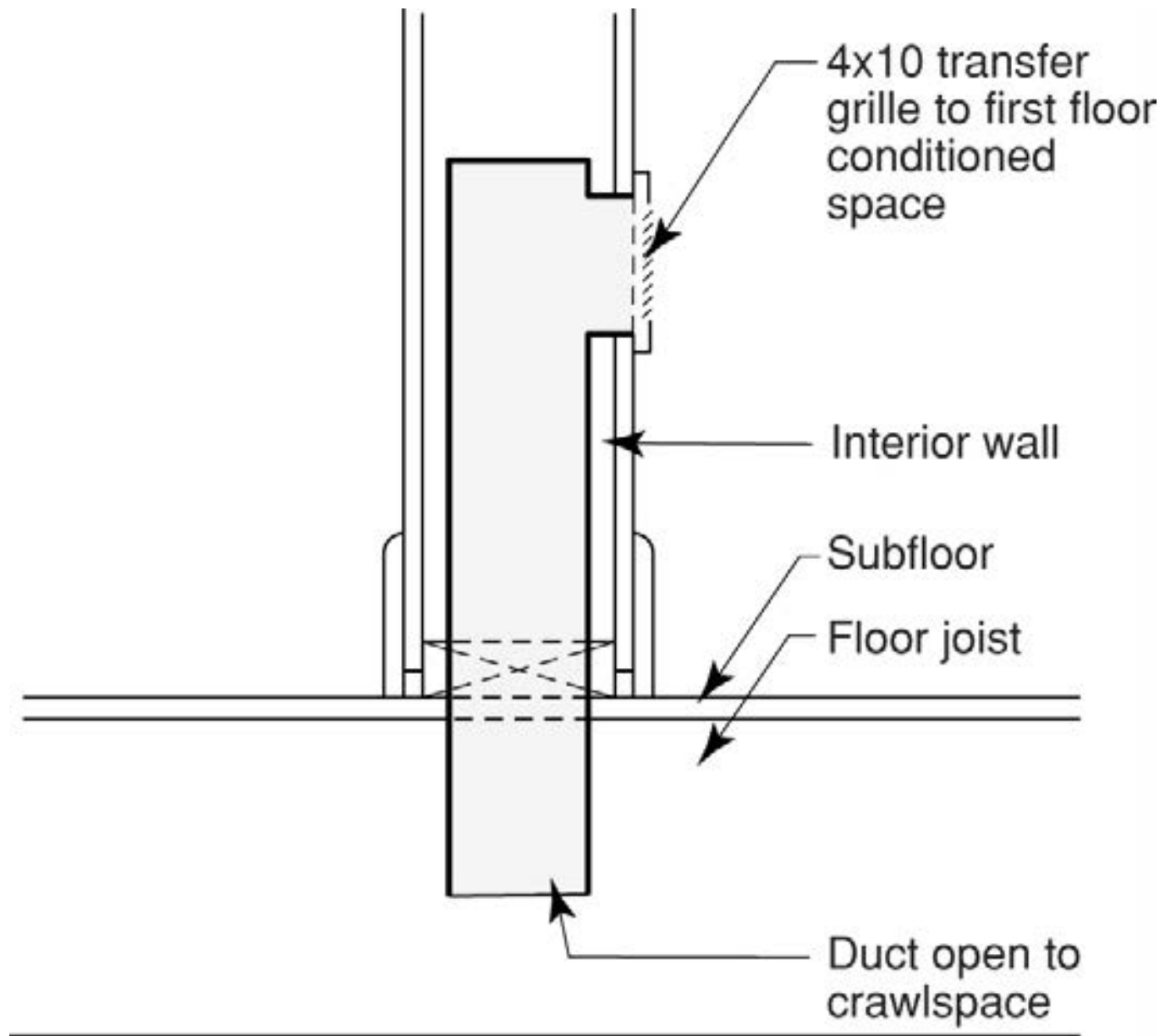




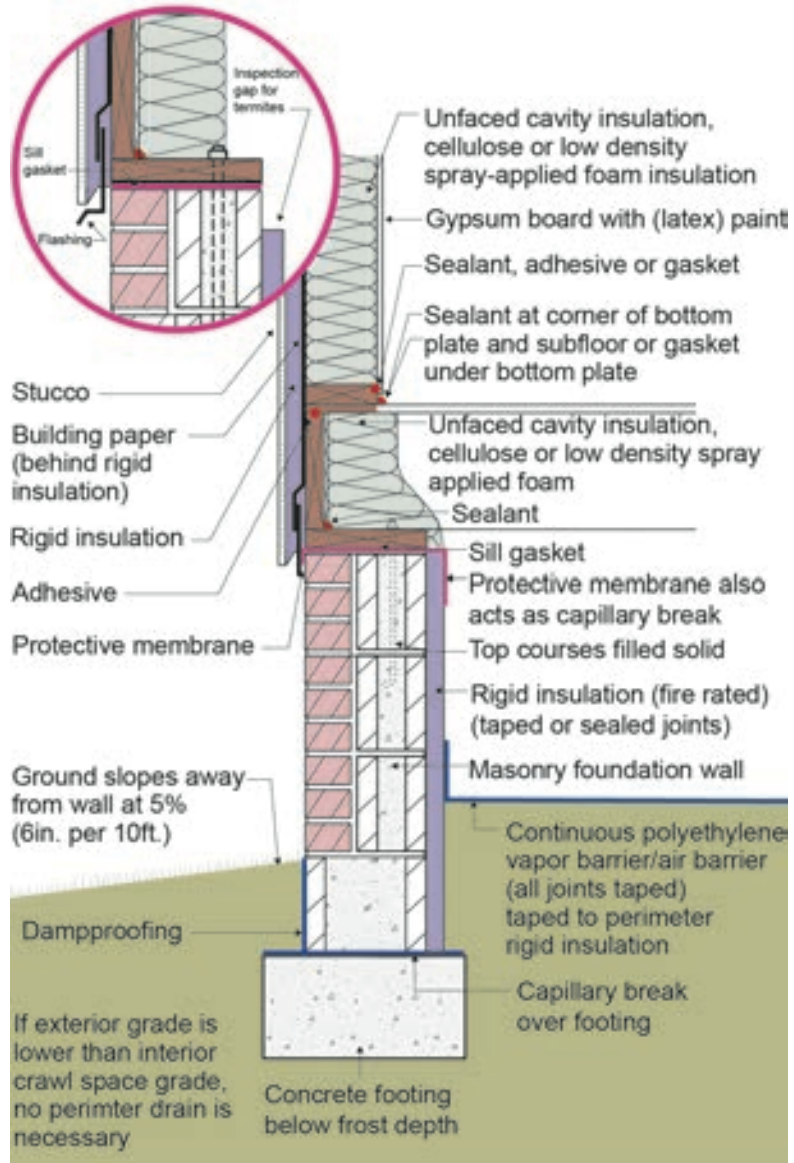


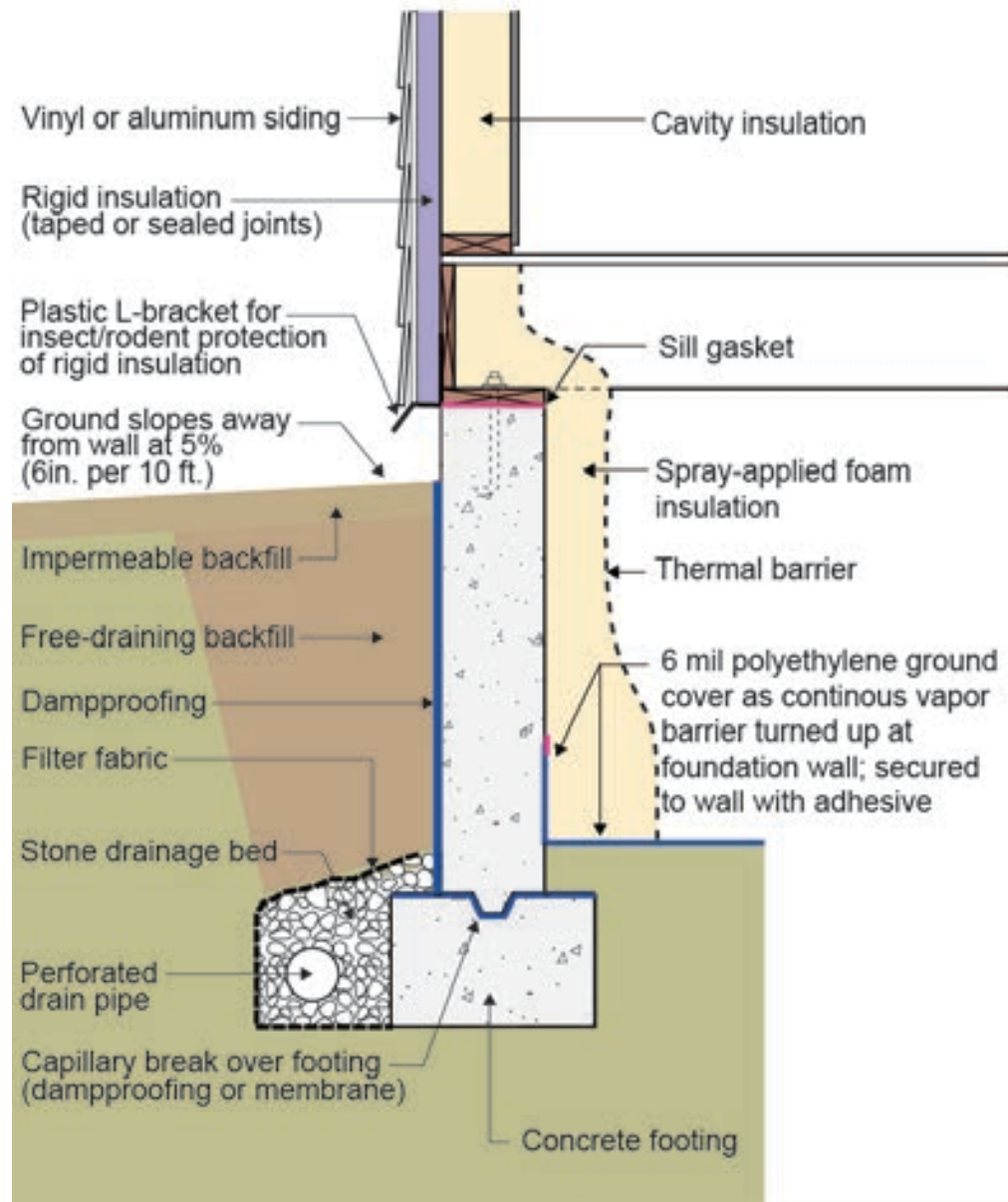


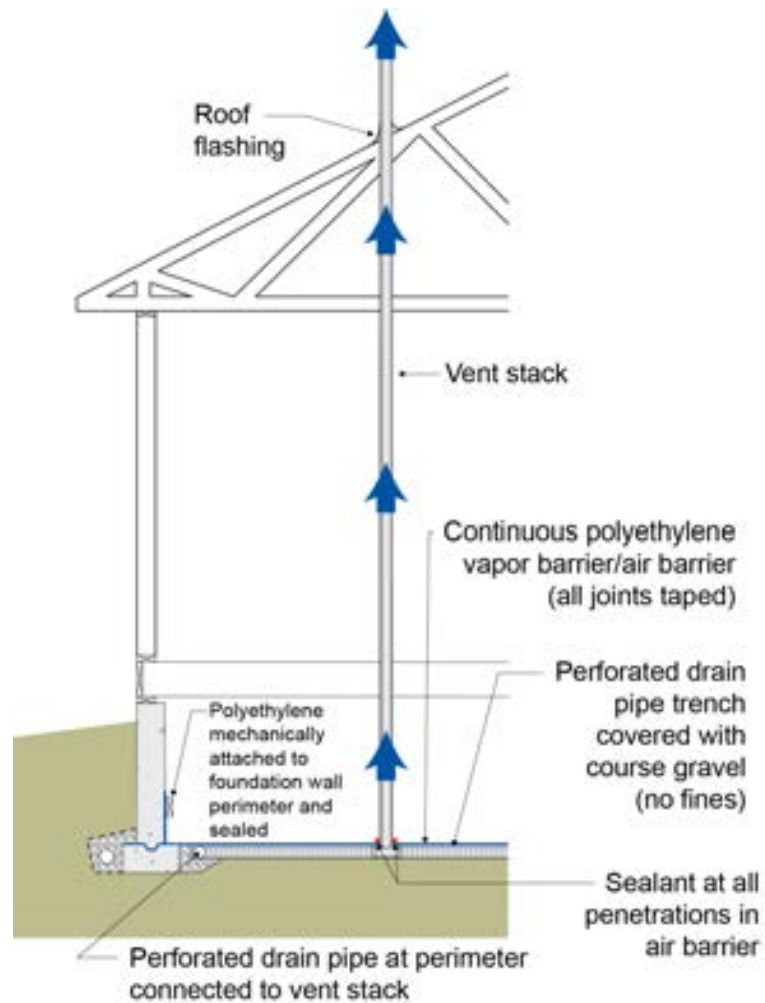


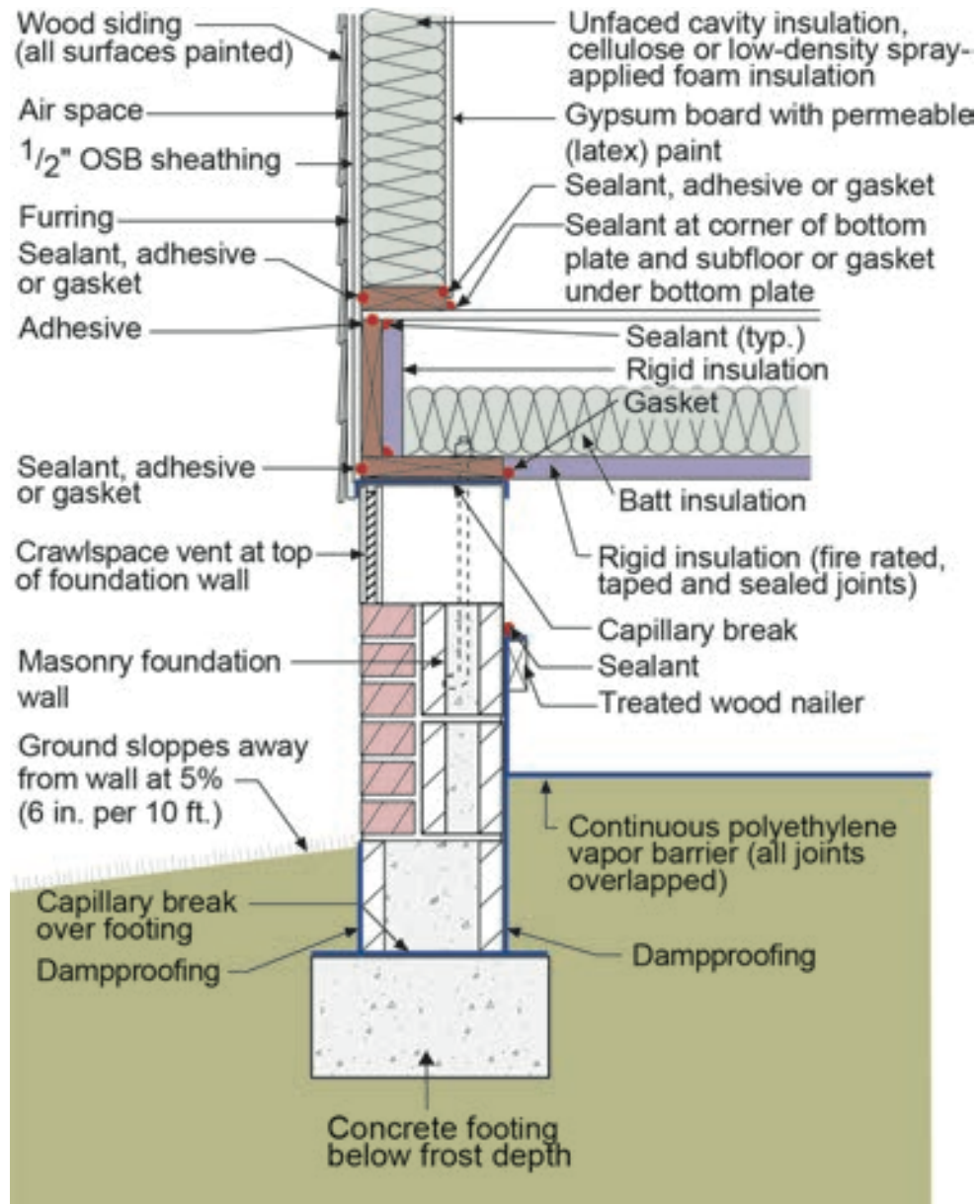


### Alternative Detail

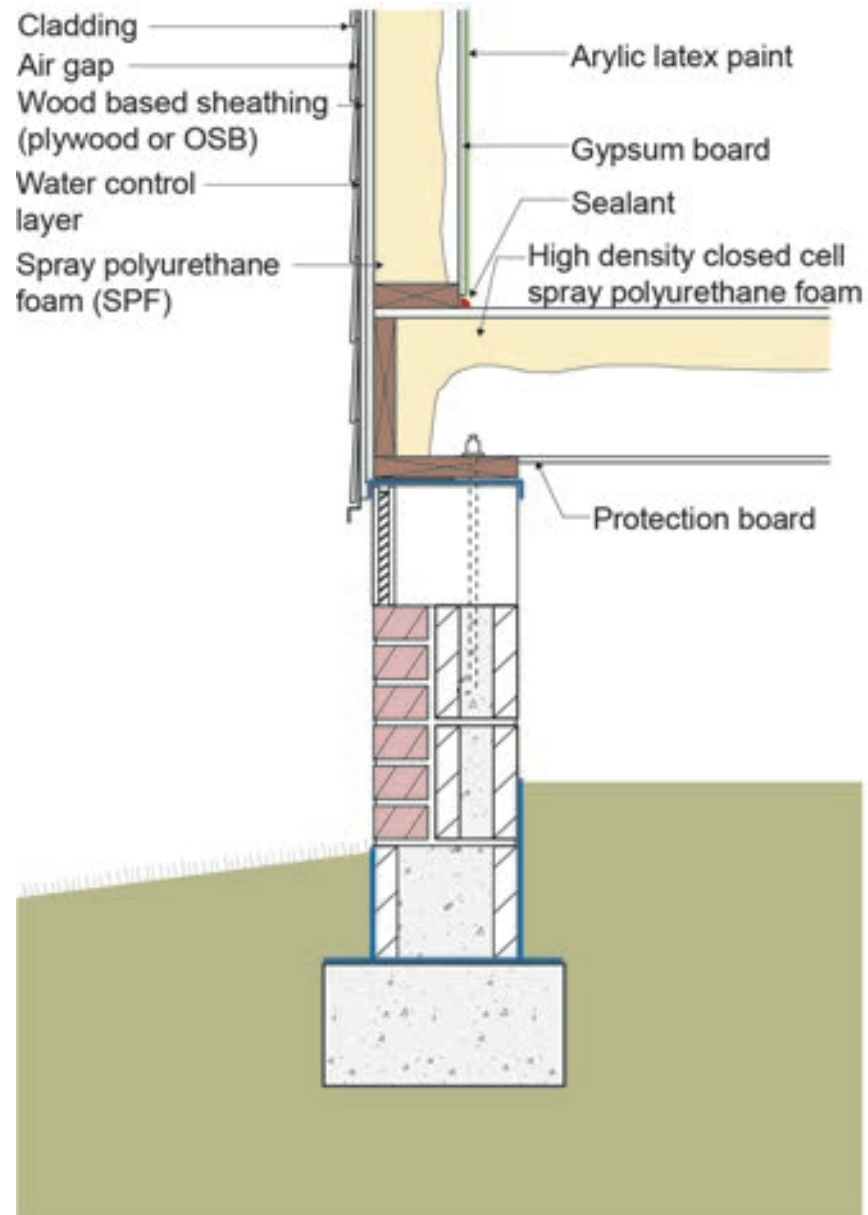


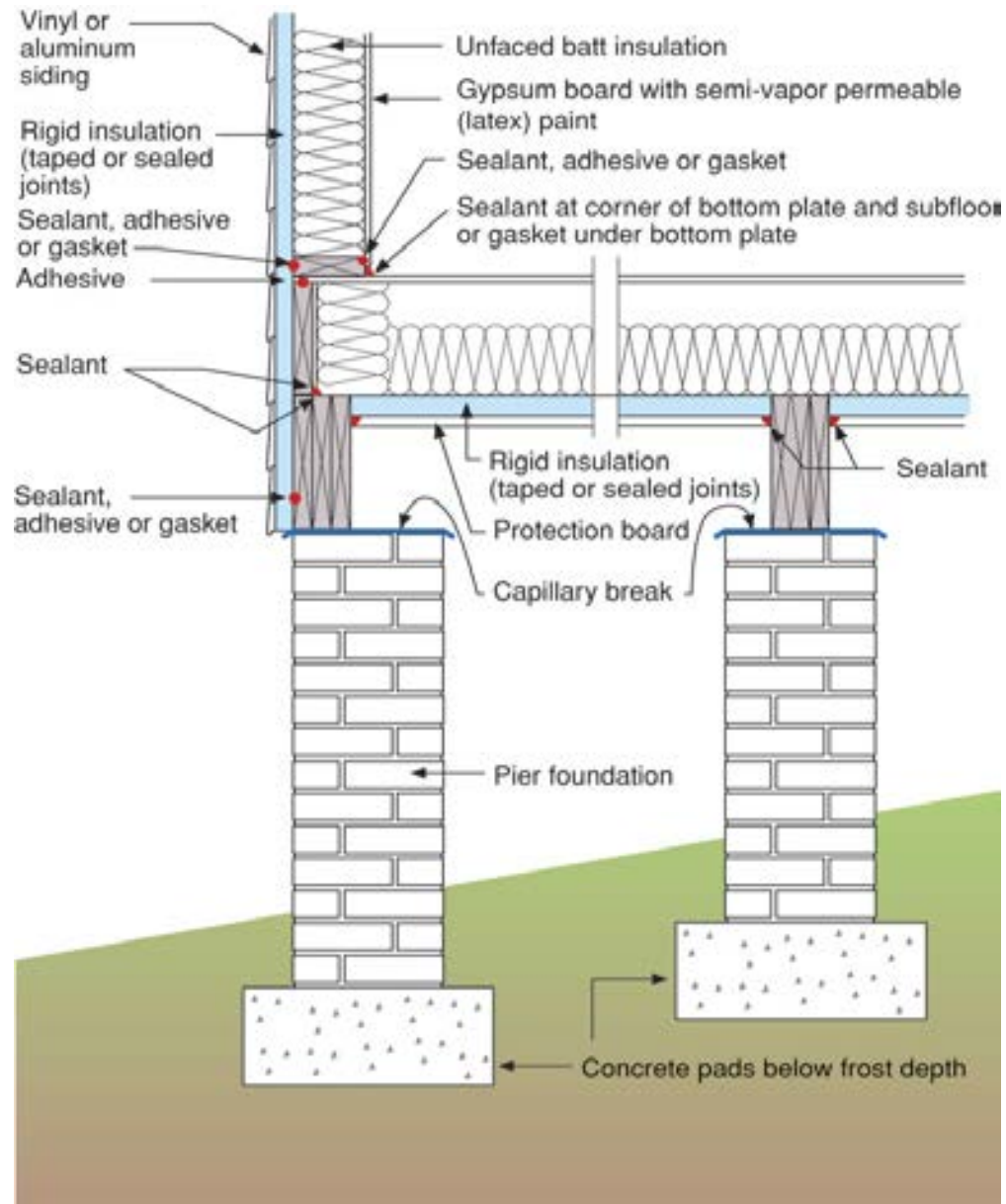


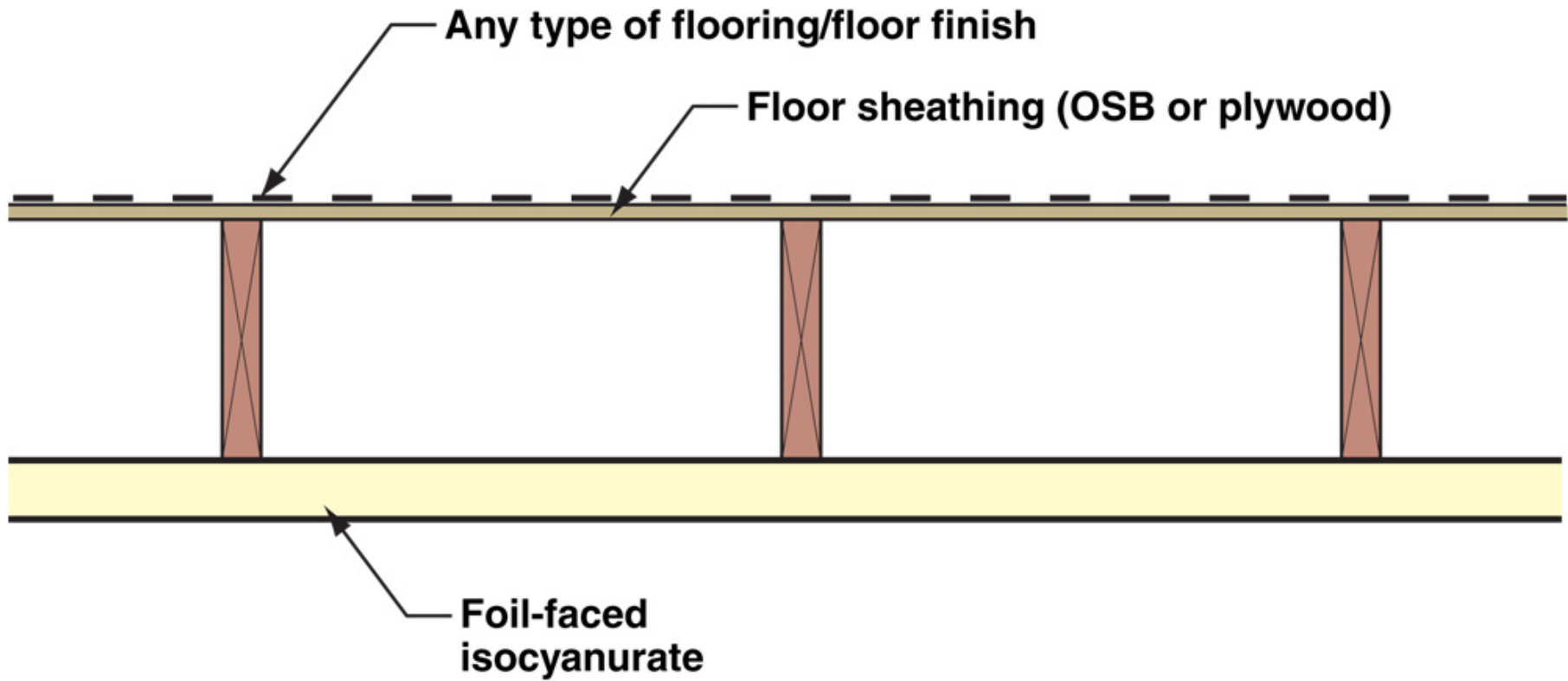


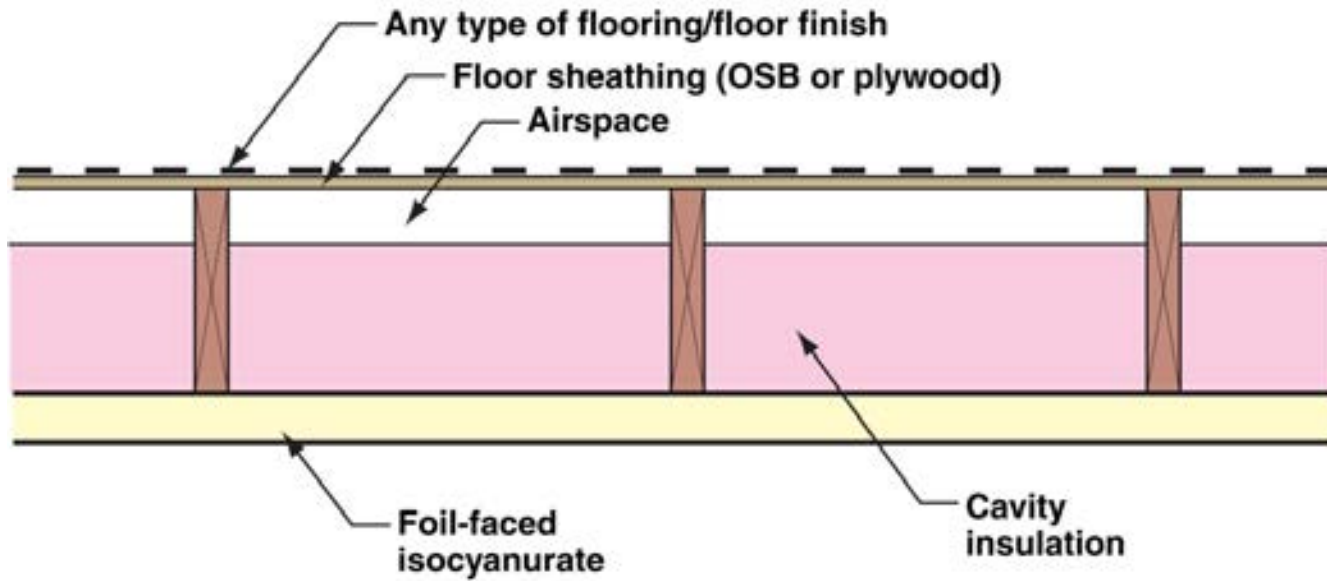


















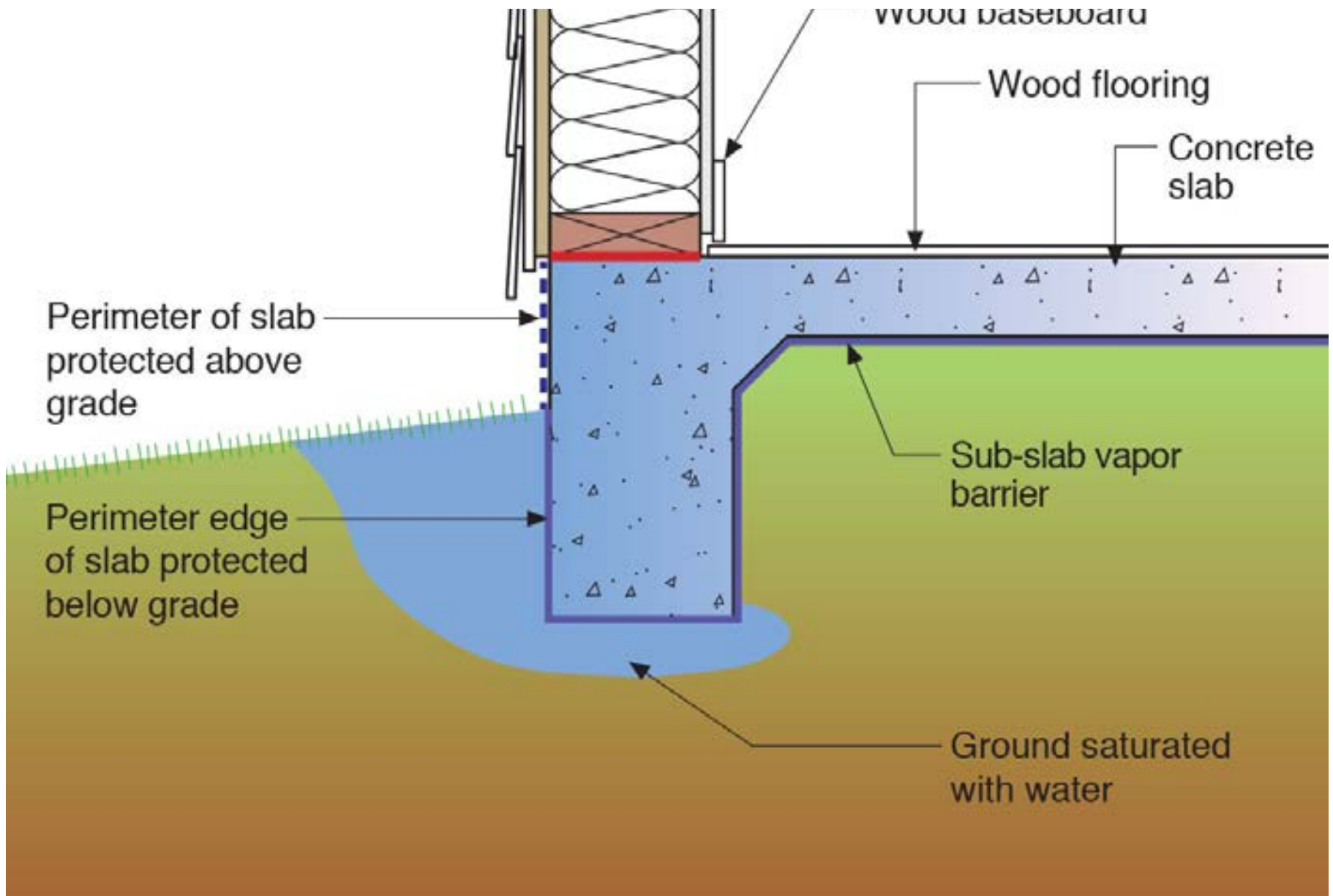


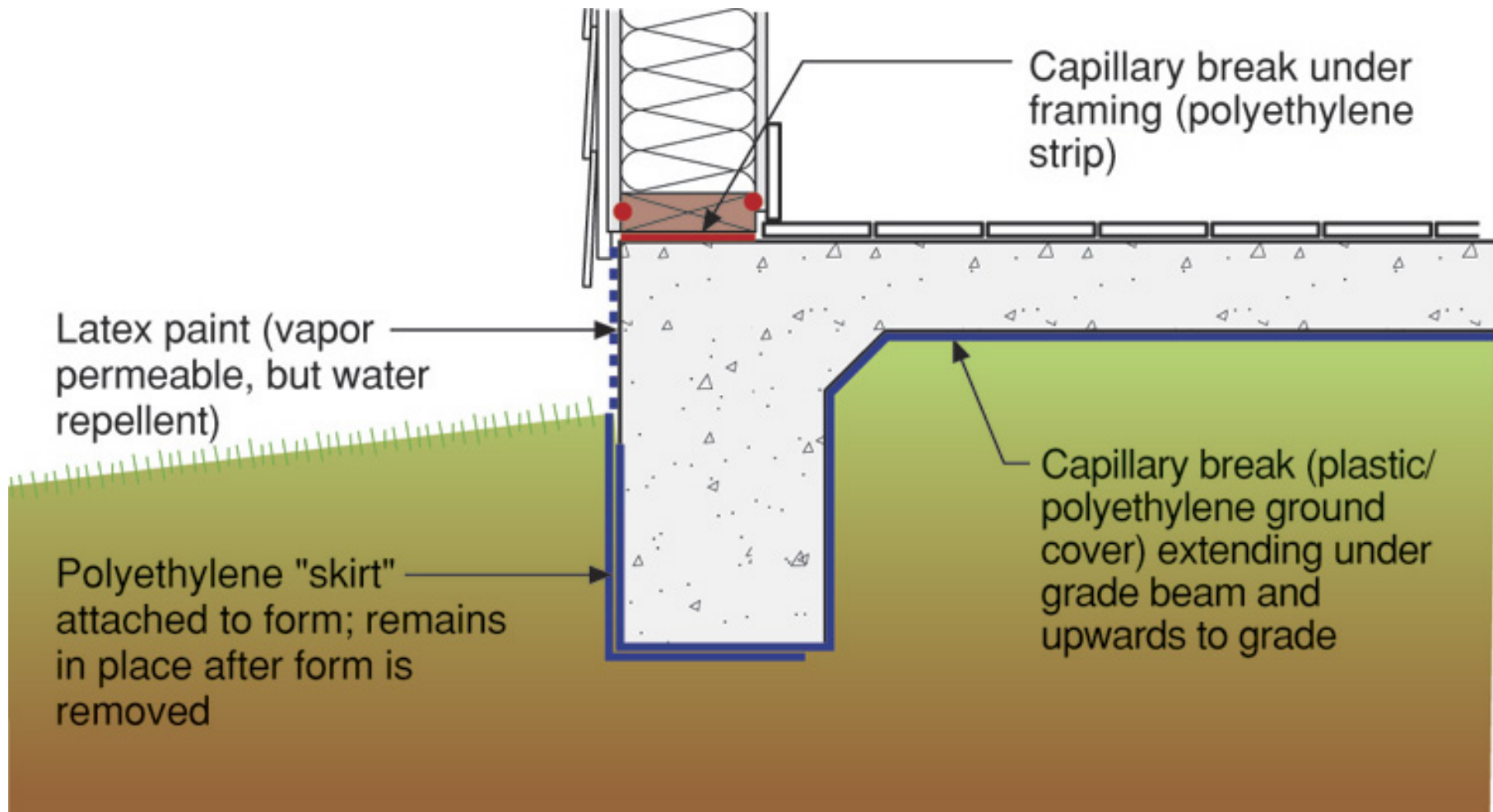
















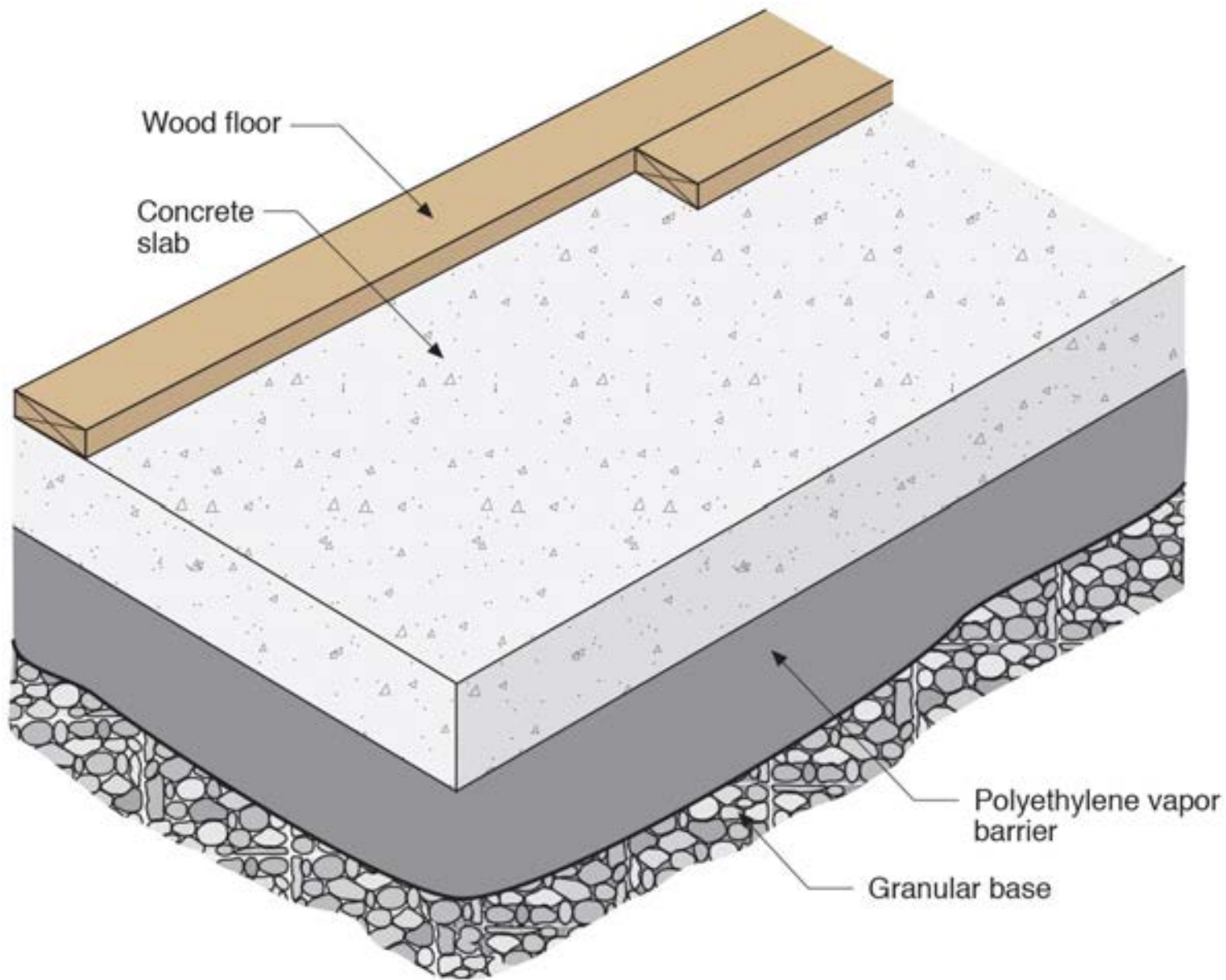


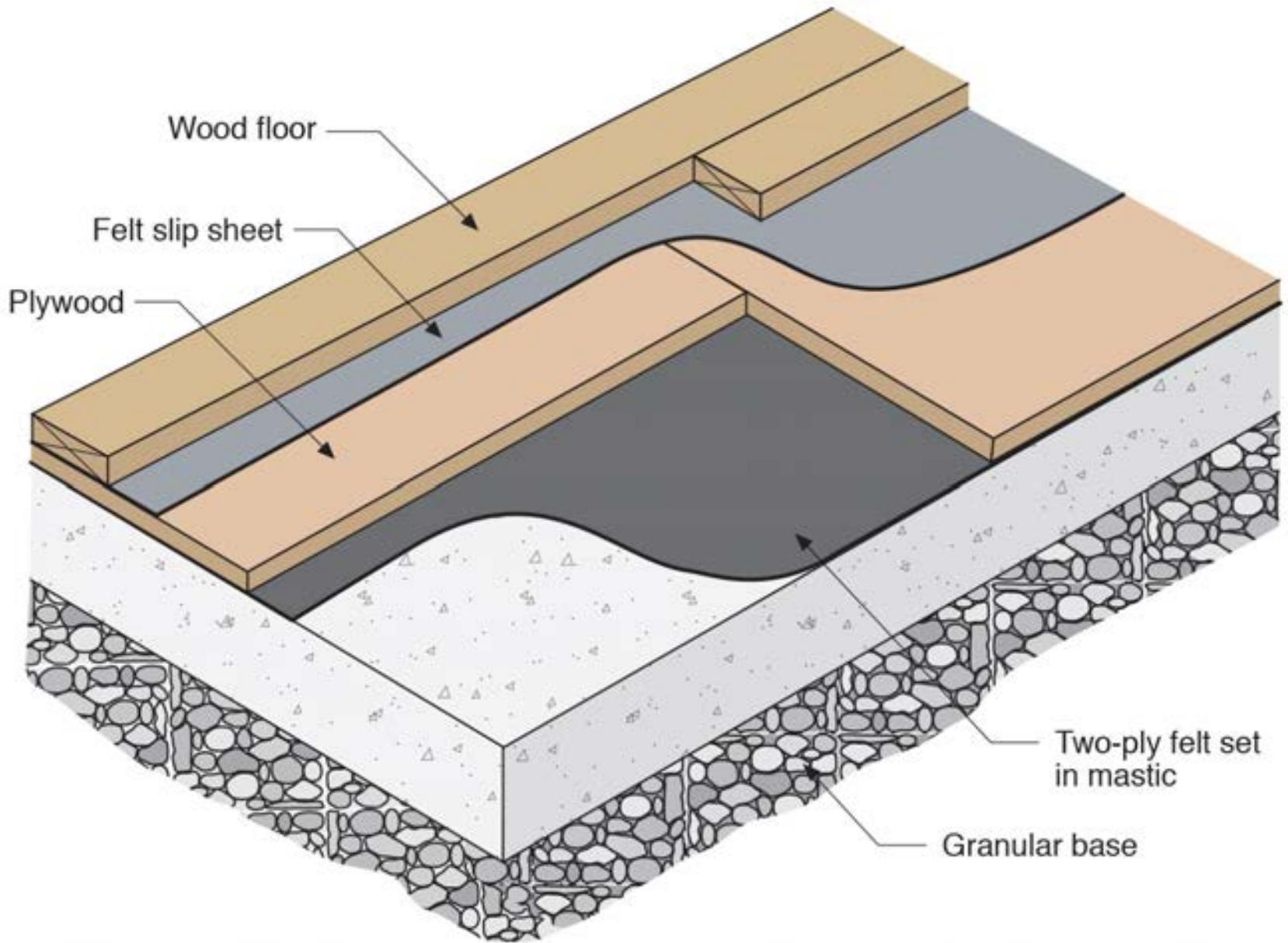




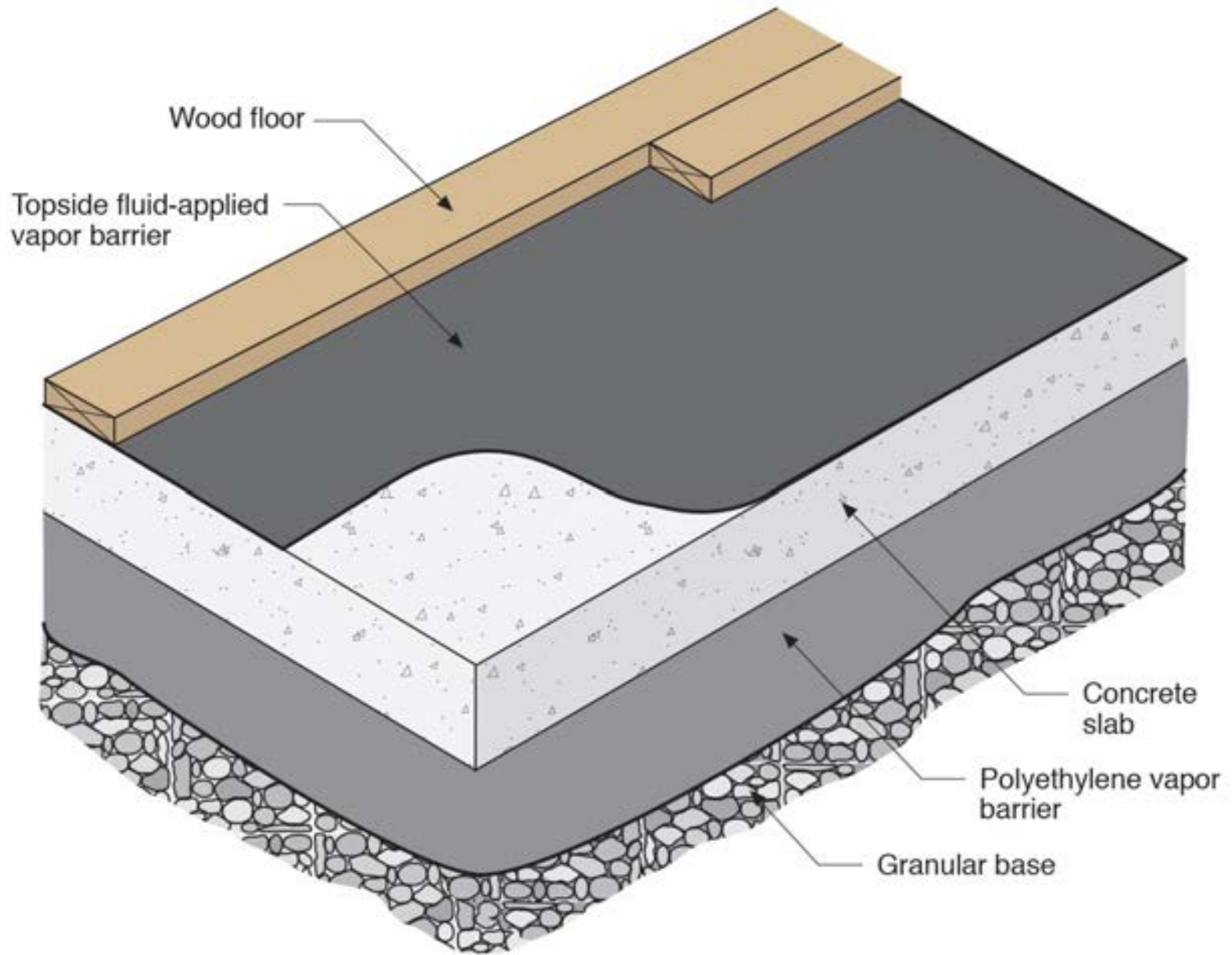








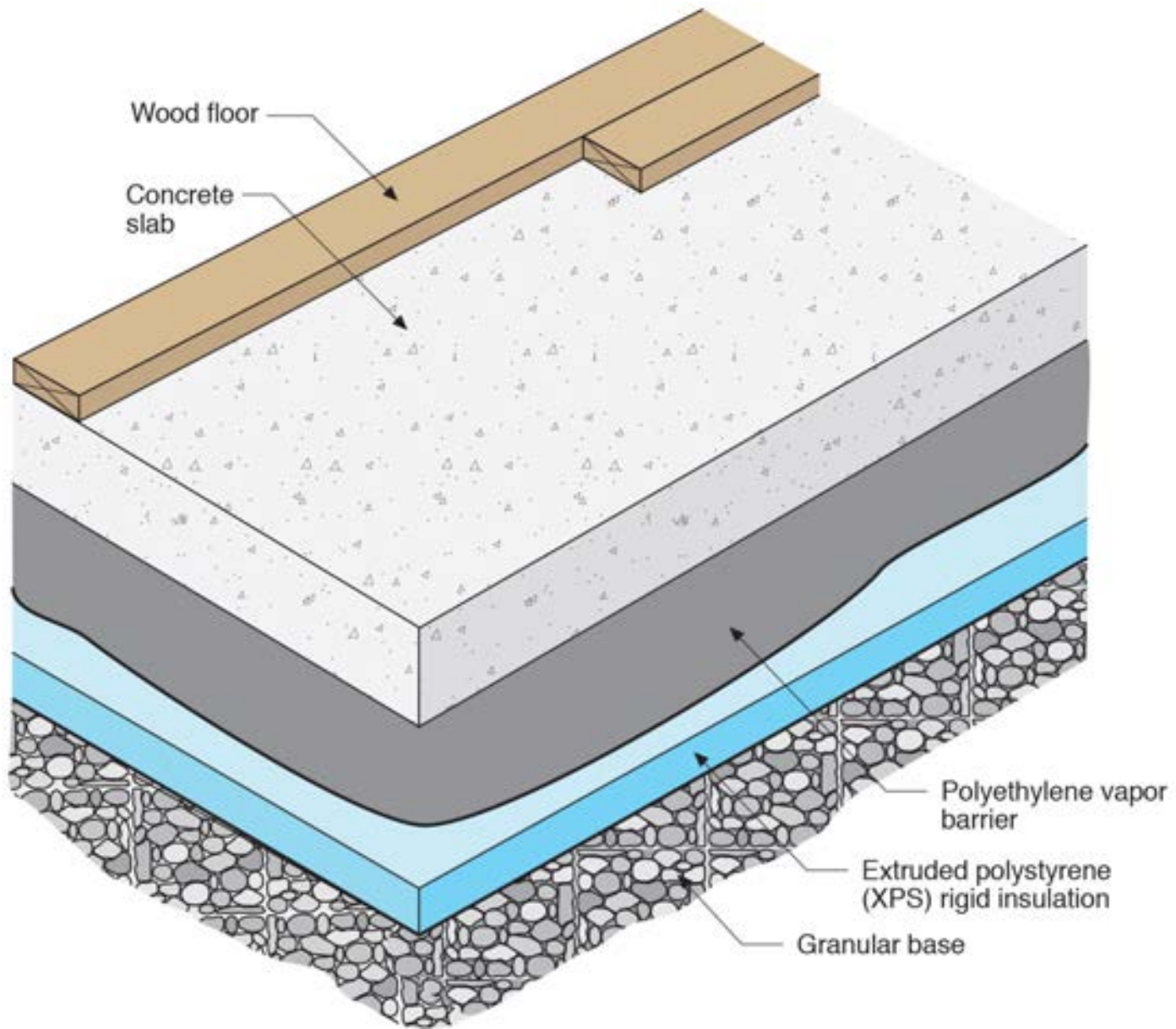


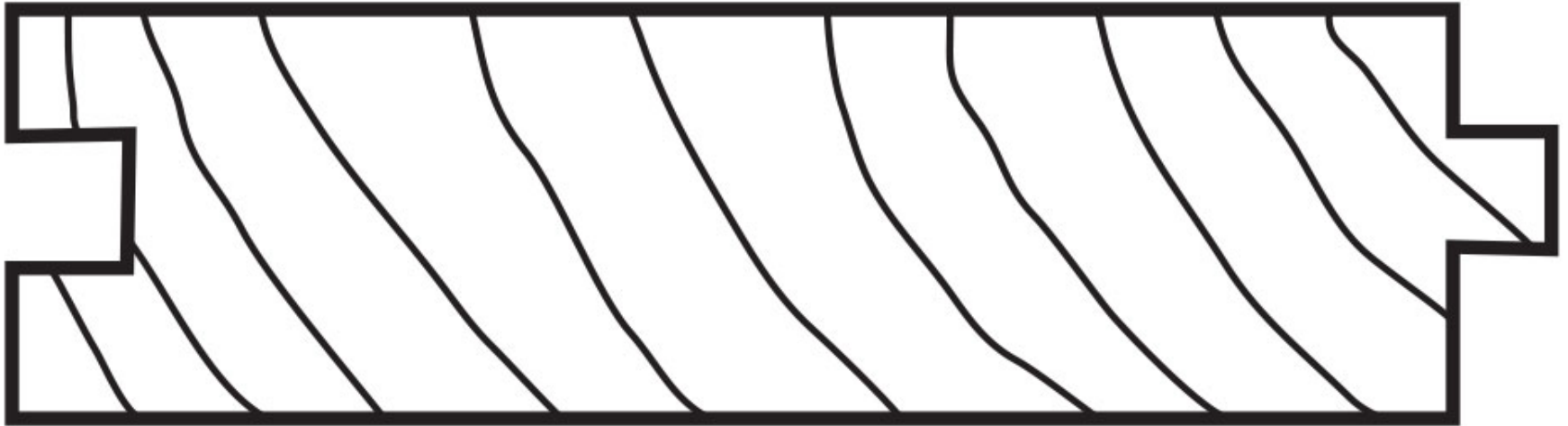








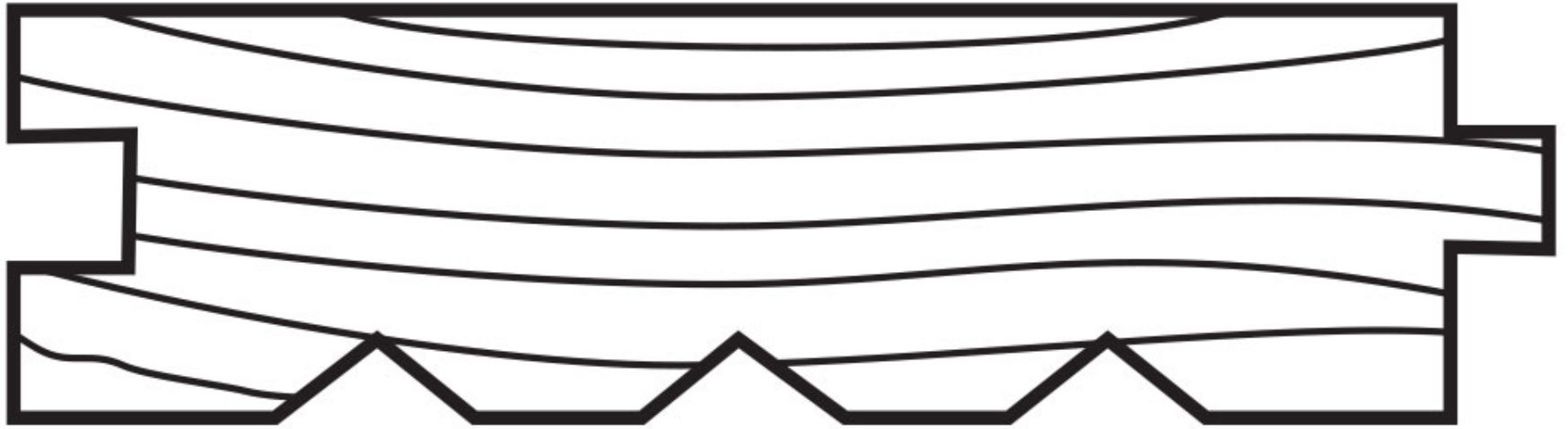




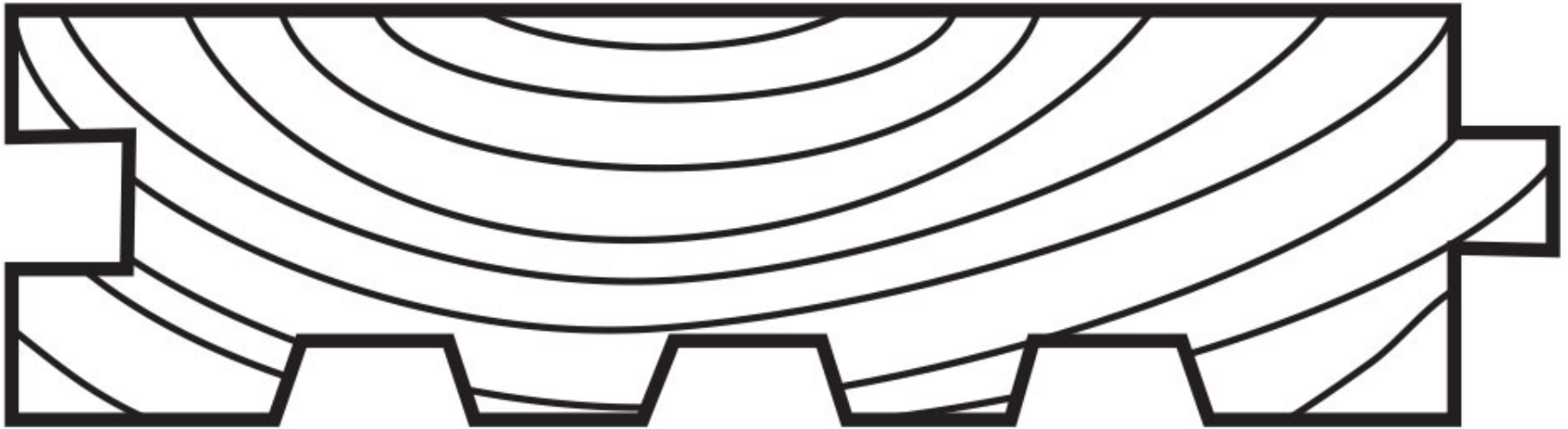
# Plain



# Hollow Back

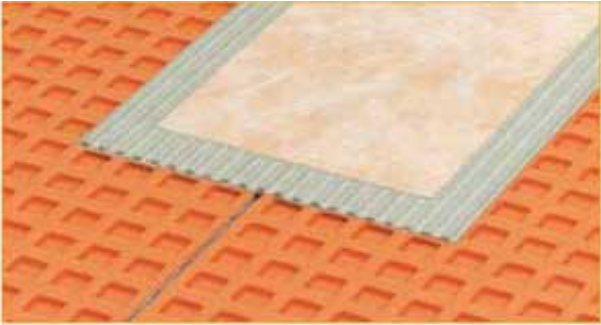


# Scratch Back



# Hollow or Scratch Back









# Mechanical Systems

# Mechanical Systems

## Cooling System To Make It Cold

# Mechanical Systems

Cooling System To Make It Cold

Dehumidification System To Make It Dry

# Mechanical Systems

Cooling System To Make It Cold

Dehumidification System To Make It Dry

Heating System To Make It Warm

## Mechanical Systems

Cooling System To Make It Cold

Dehumidification System To Make It Dry

Heating System To Make It Warm

Energy Recovery System To Keep It Cold  
and Dry and Warm and Comfortable

## Mechanical Systems

Cooling System To Make It Cold

Dehumidification System To Make It Dry

Heating System To Make It Warm

Energy Recovery System To Keep It Cold  
and Dry and Warm and Comfortable

Distribution System To Make It Uniform

## Mechanical Systems

Cooling System To Make It Cold

Dehumidification System To Make It Dry

Heating System To Make It Warm

Energy Recovery System To Keep It Cold  
and Dry and Warm and Comfortable

Distribution System To Make It Uniform

Range Hoods Are A Special Kind of Hell



Don't Try to Combine Them.....

