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Building Science

Adventures In Building Science

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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





Exposure

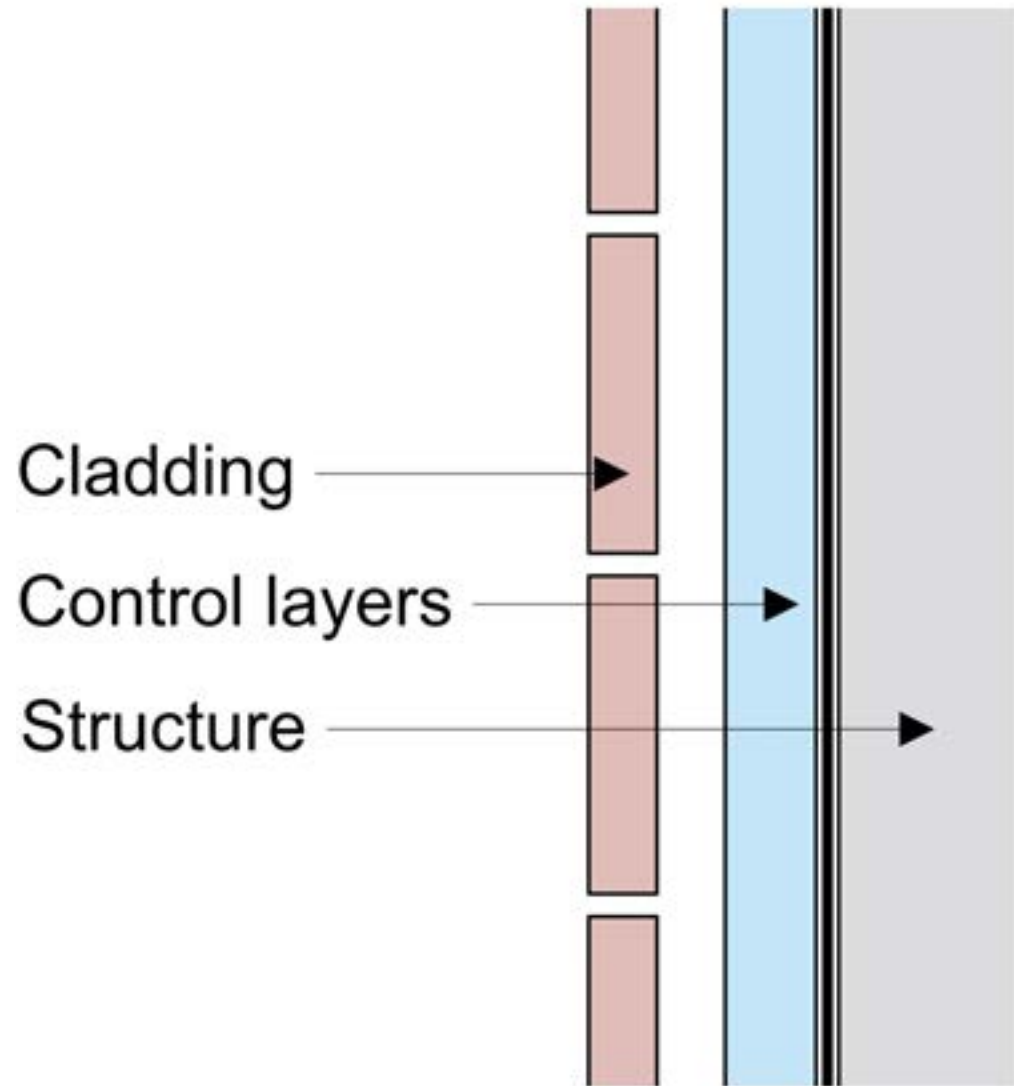
Extreme	Over 60"
High	40" - 60"
Moderate	20" - 40"
Low	Under 20"

Water Control Layer

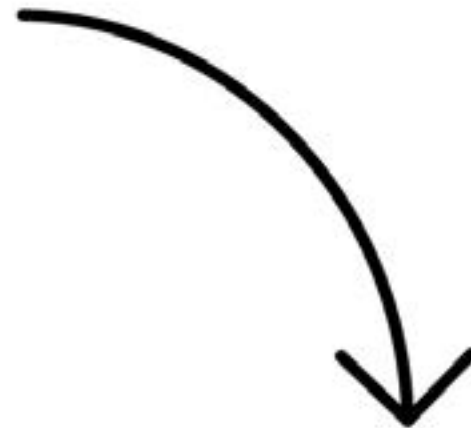
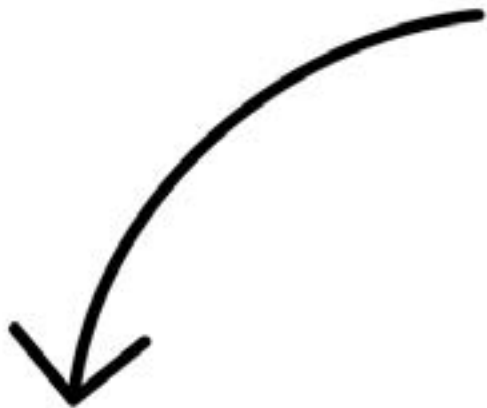
Air Control Layer

Vapor Control Layer

Thermal Control Layer



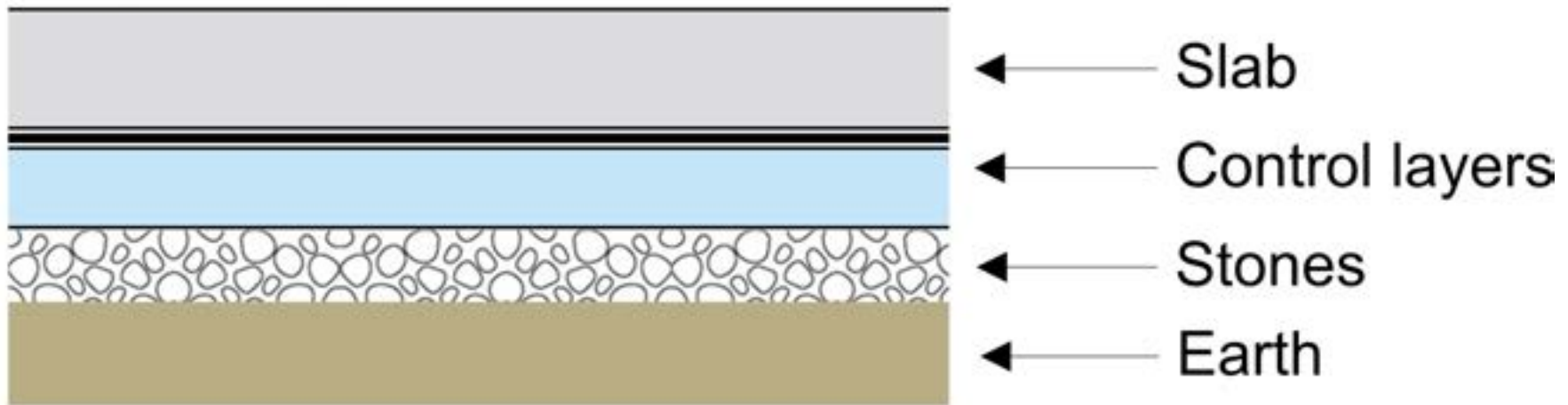
Wall

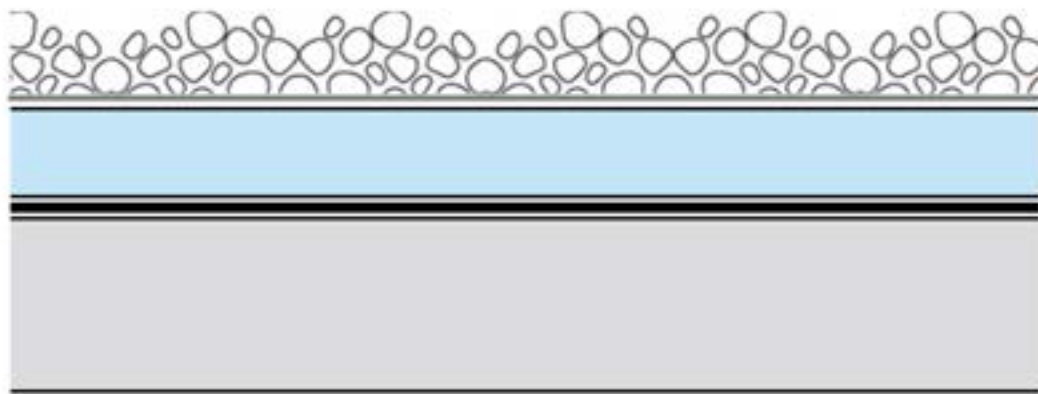


Slab



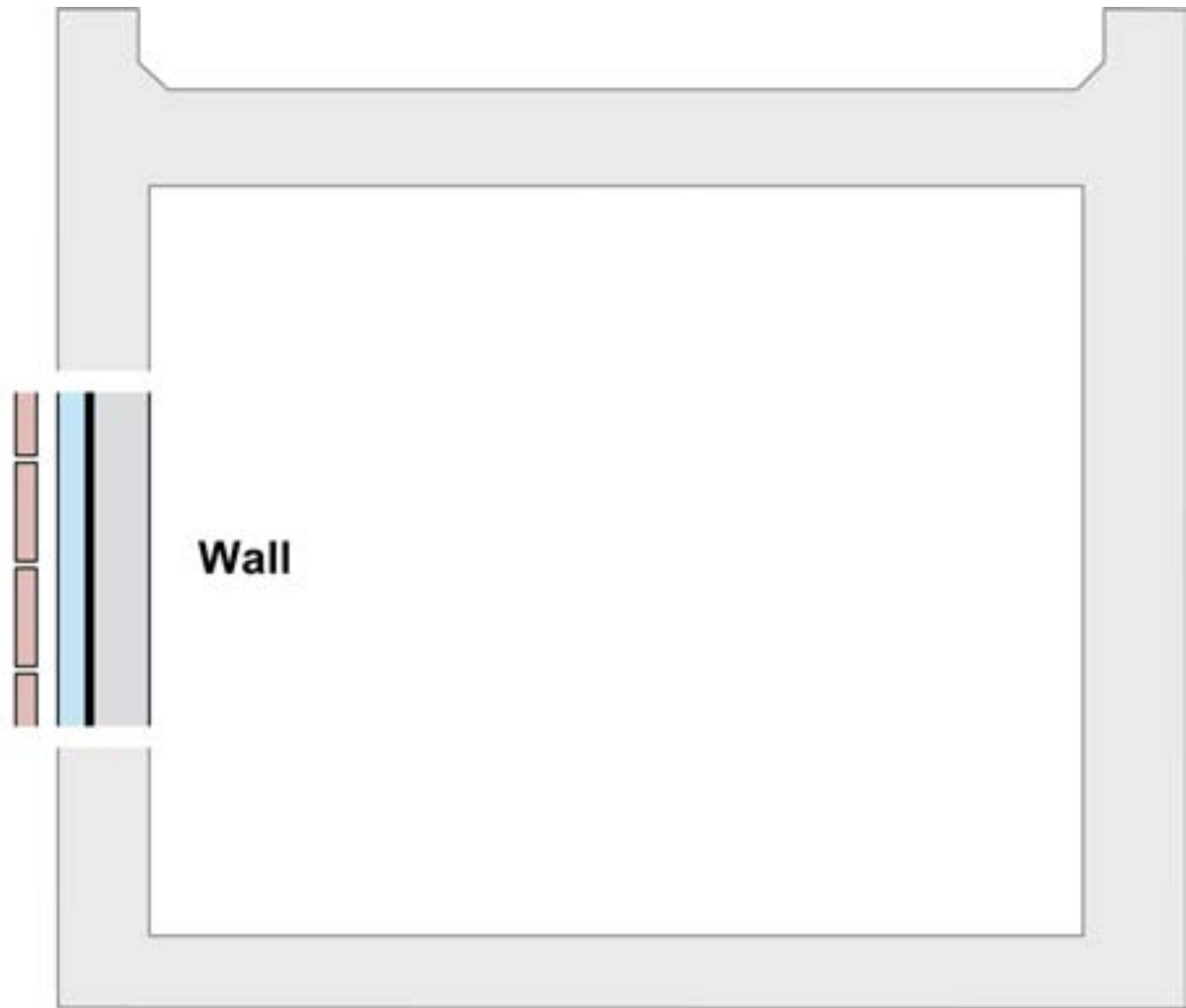
Roof

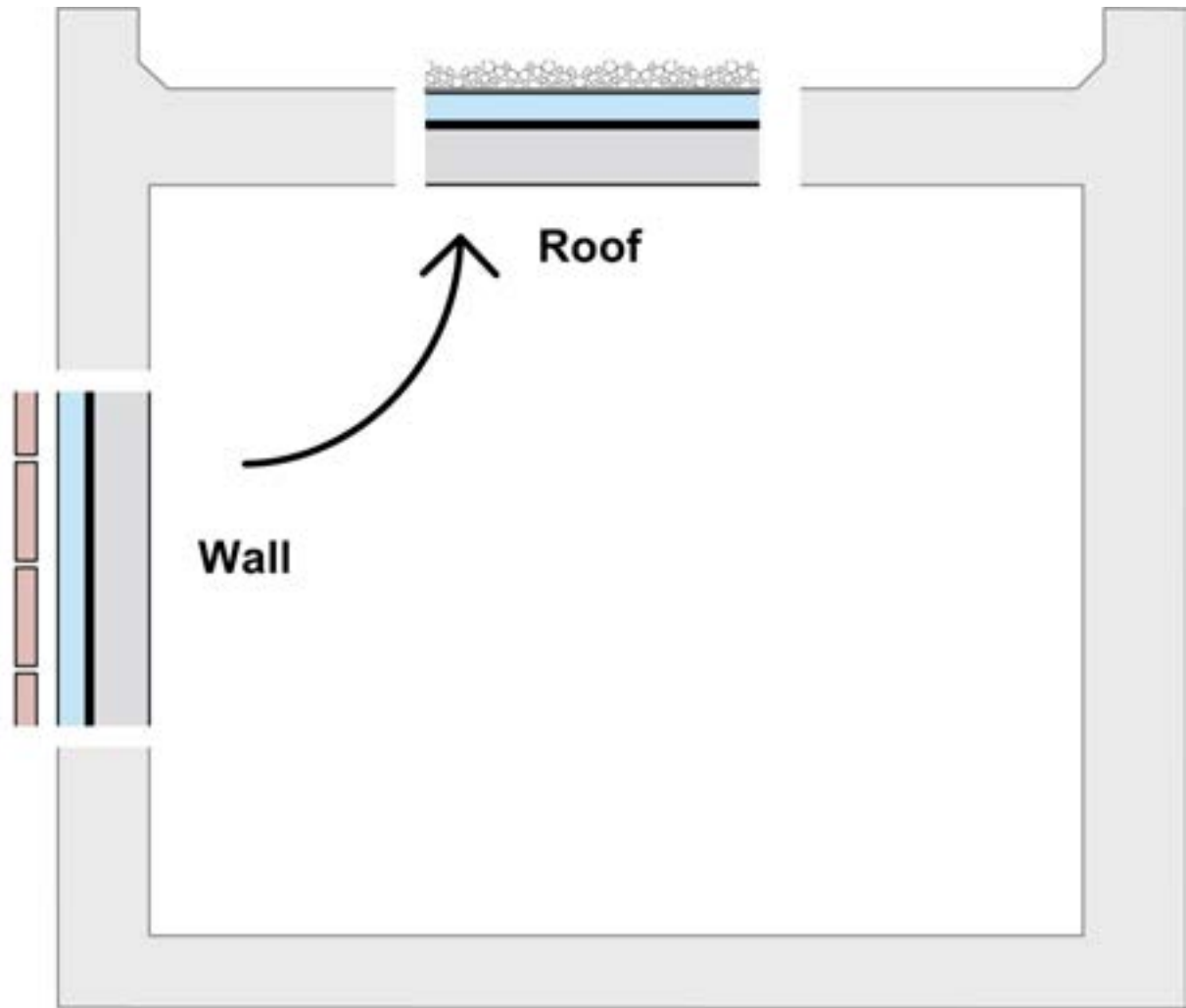


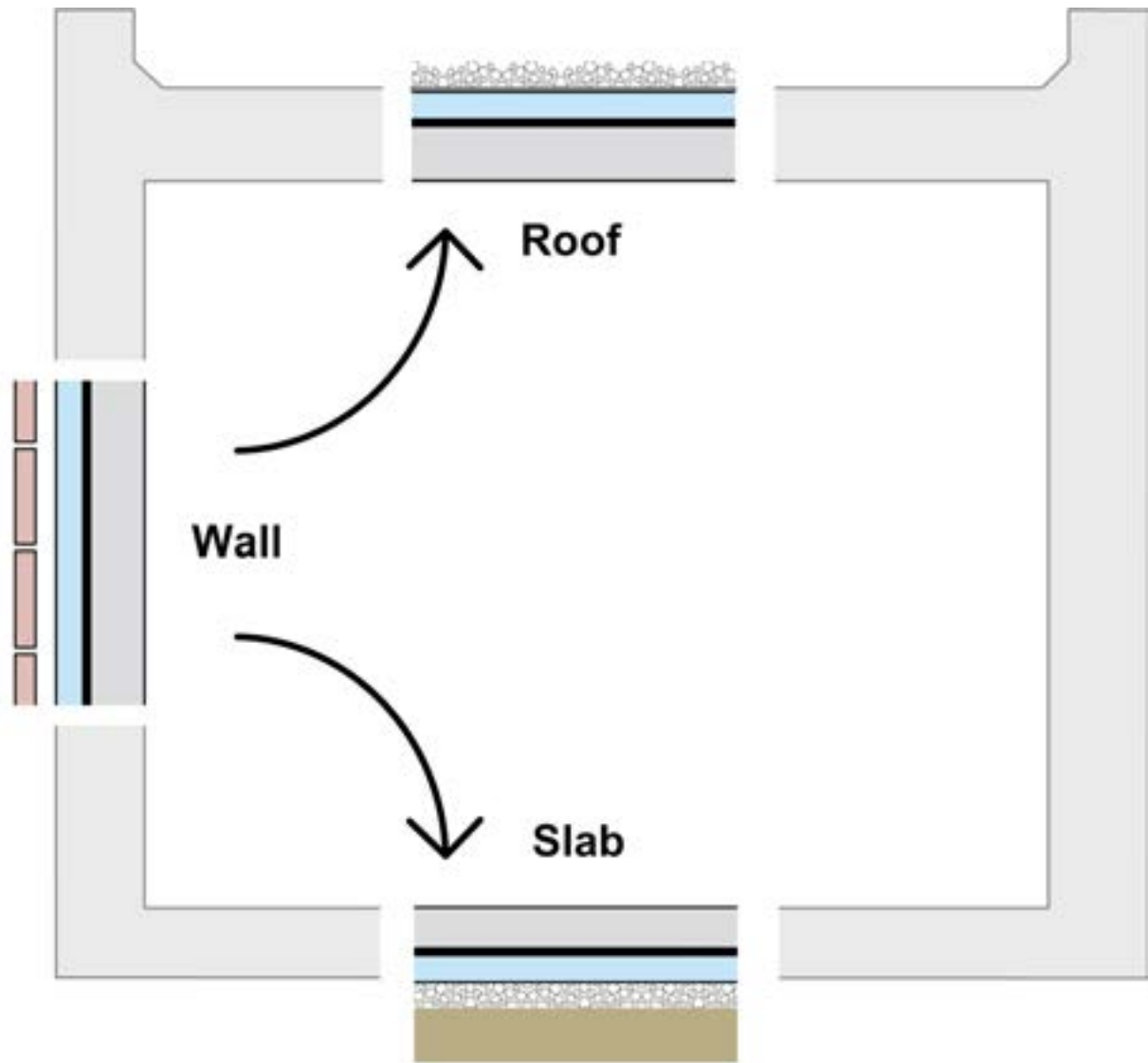


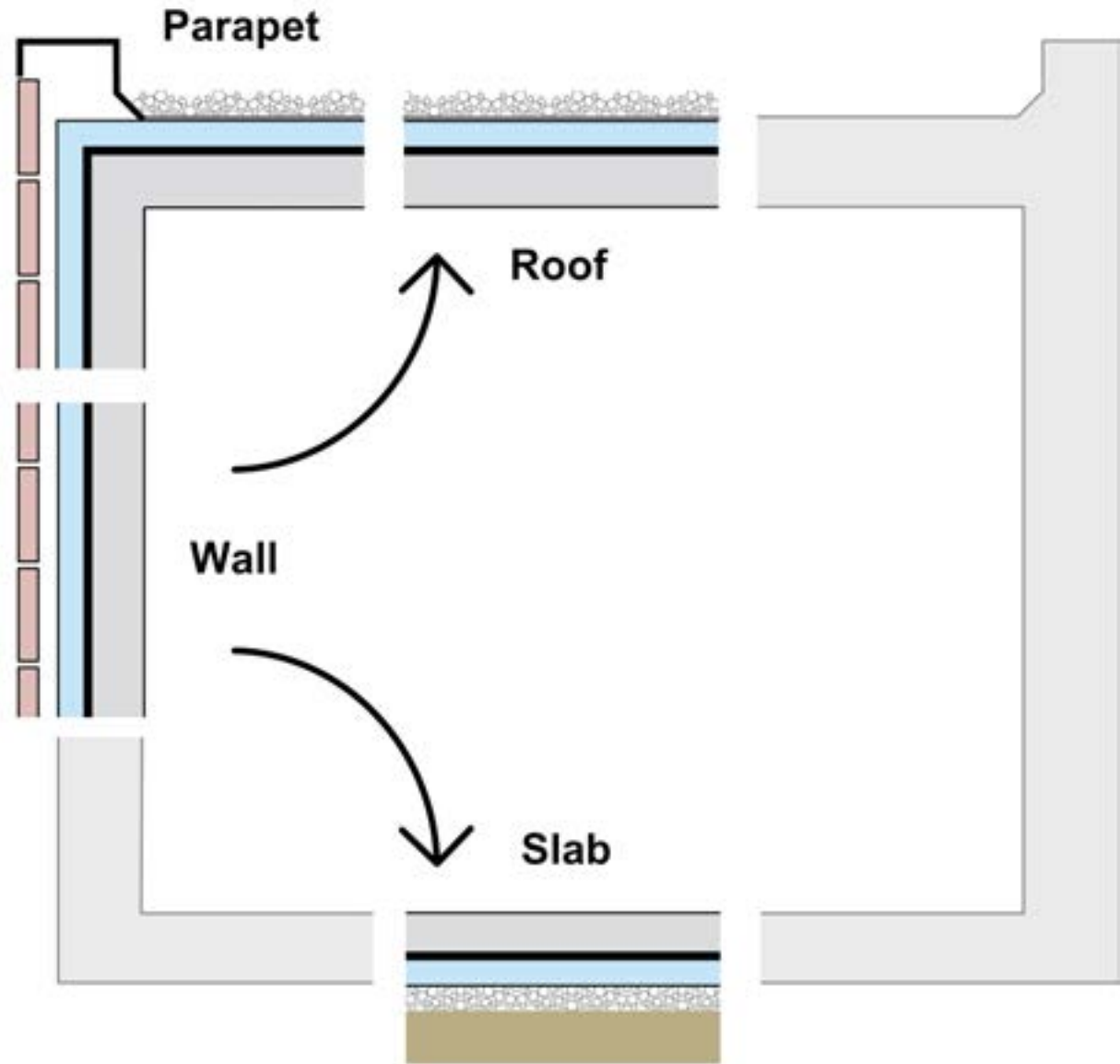
- ← Ballast
- ← Filter fabric
- ← Control layers
- ← Roof structure

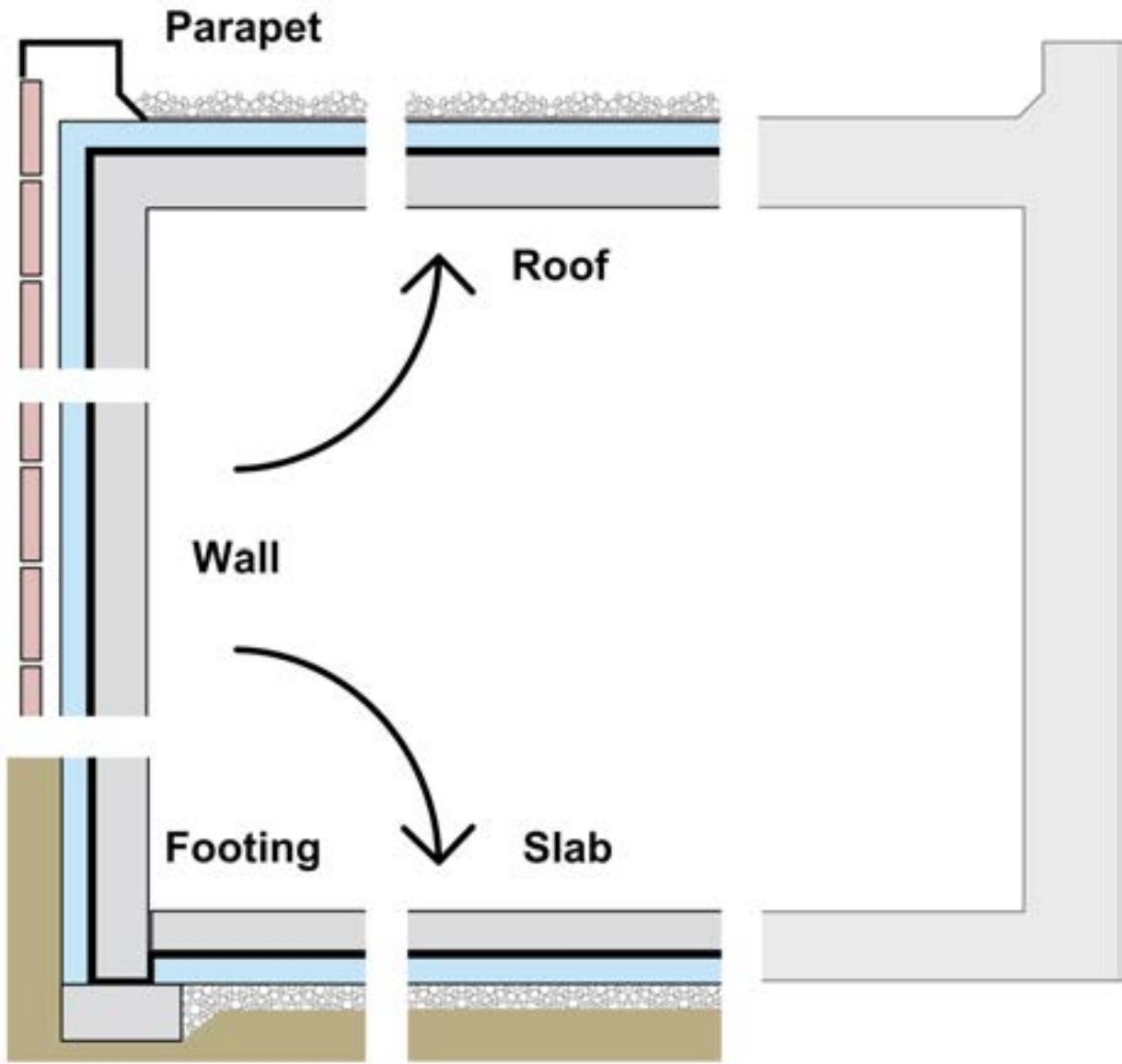




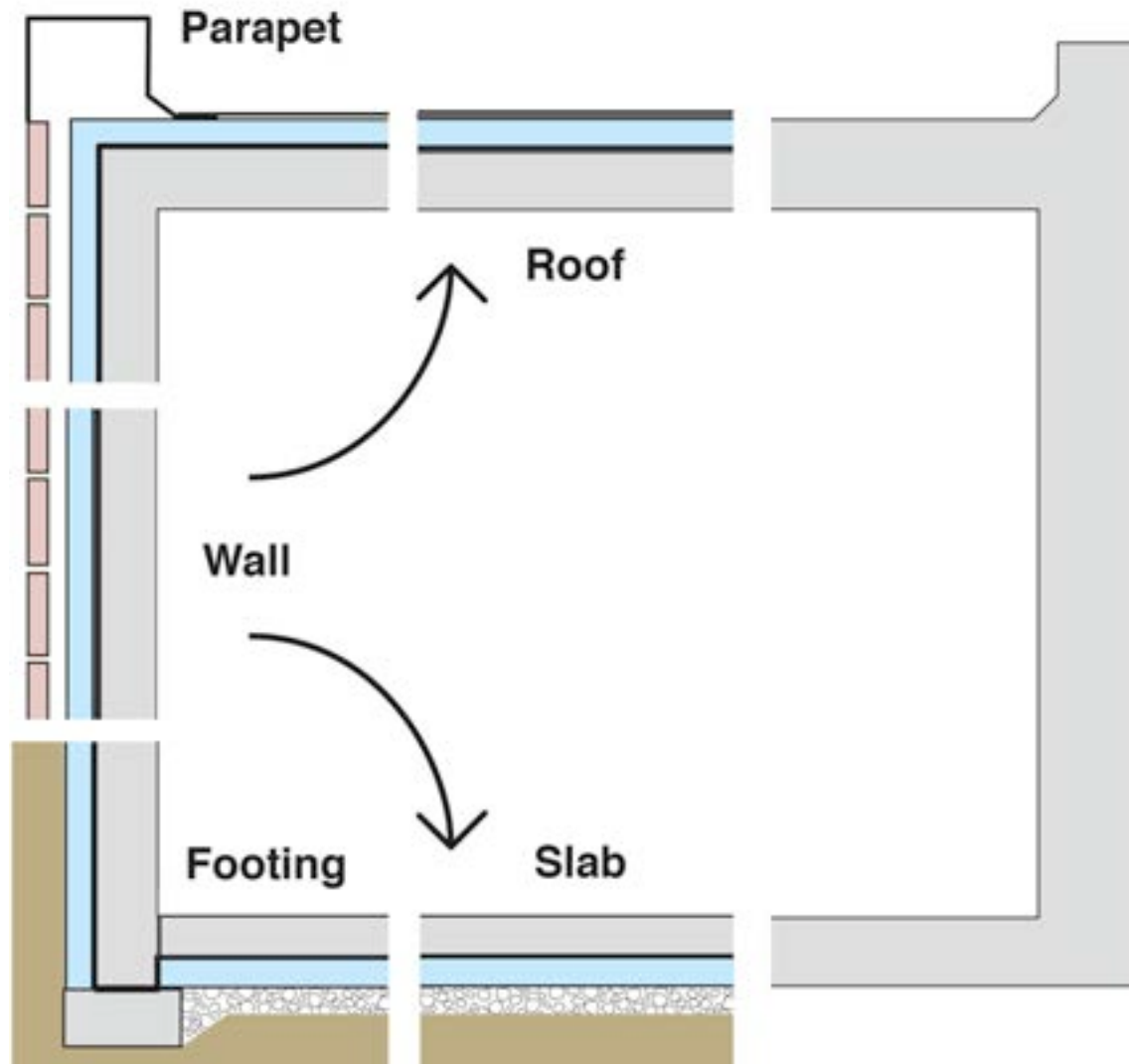


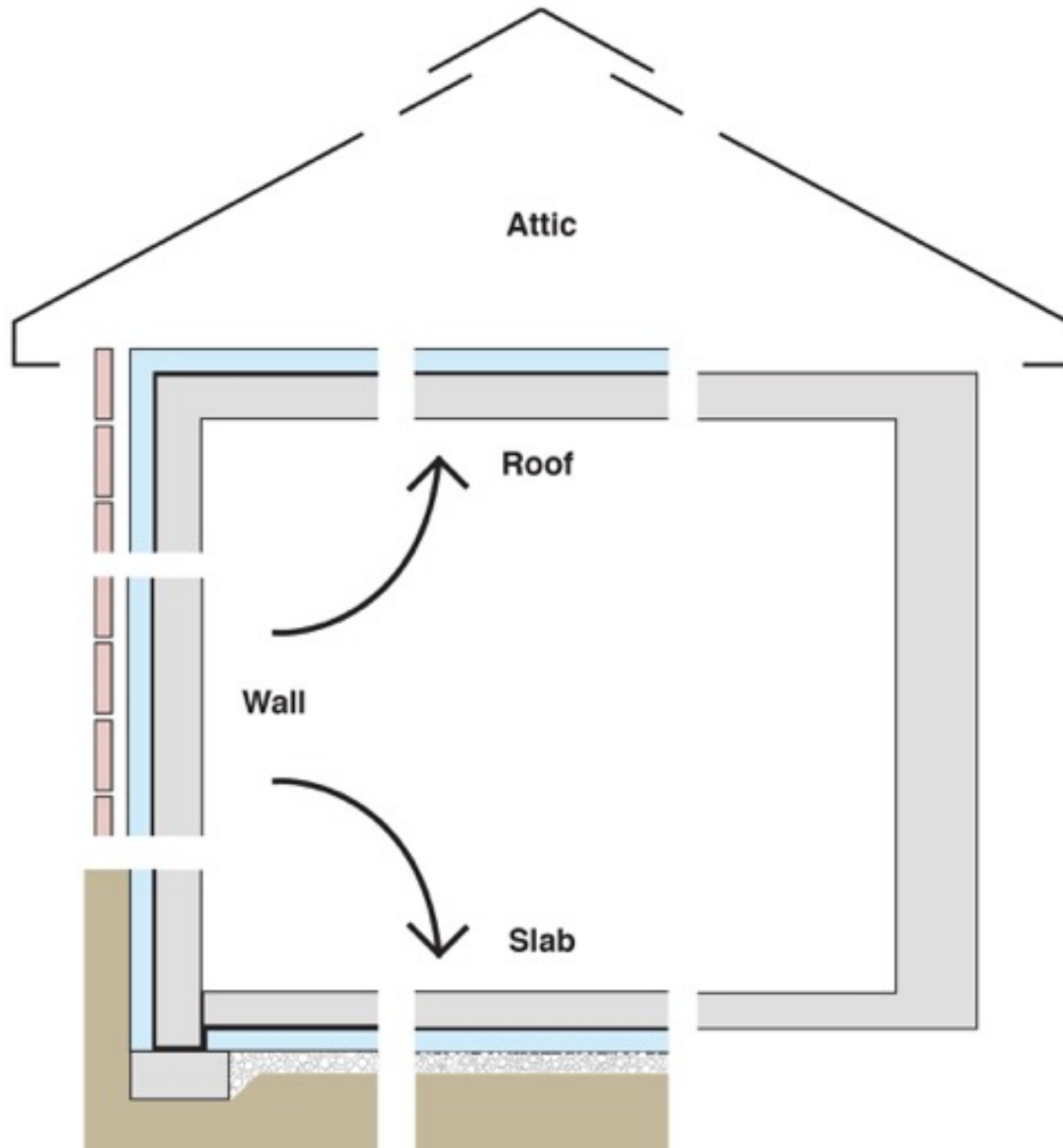


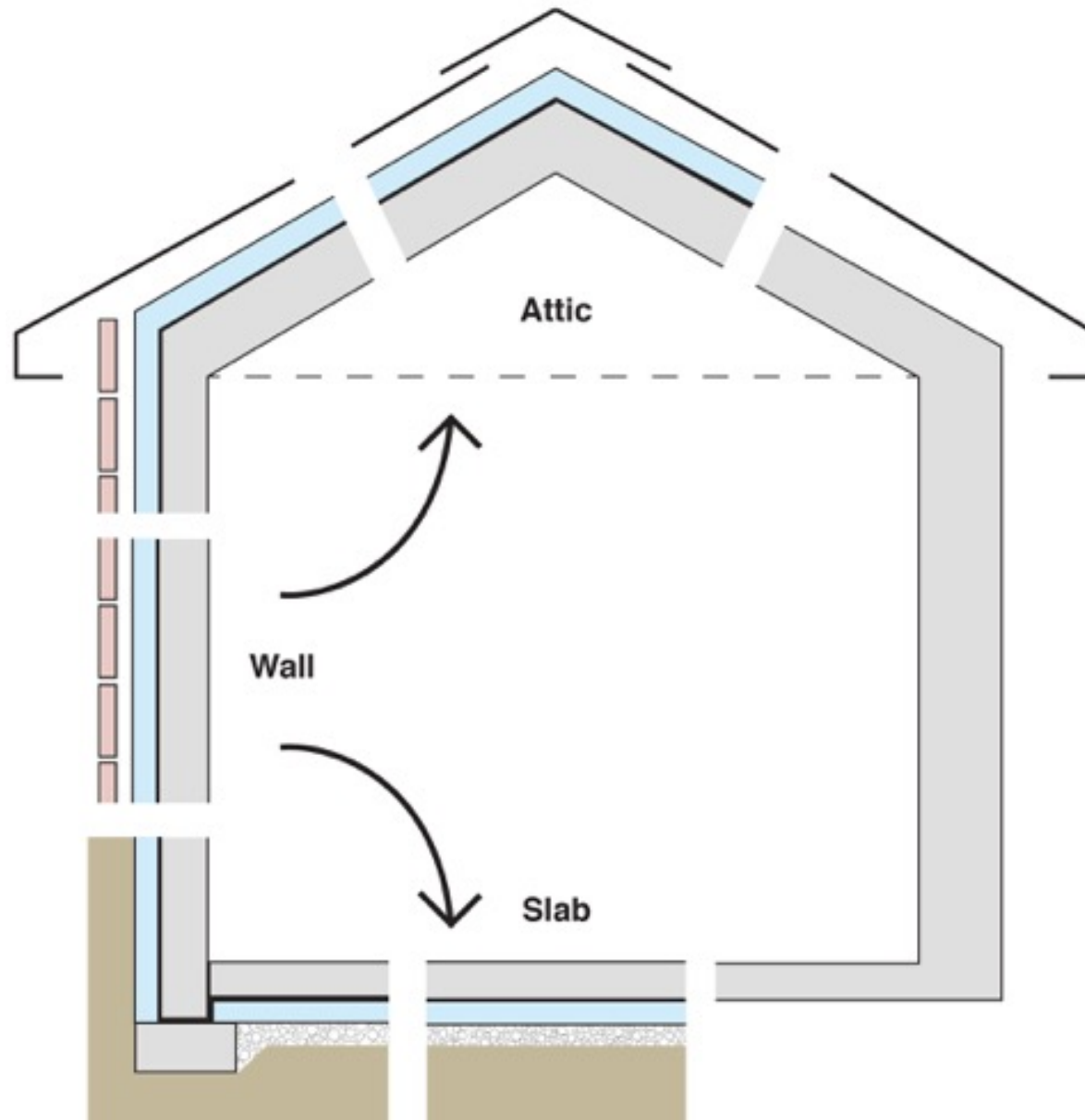


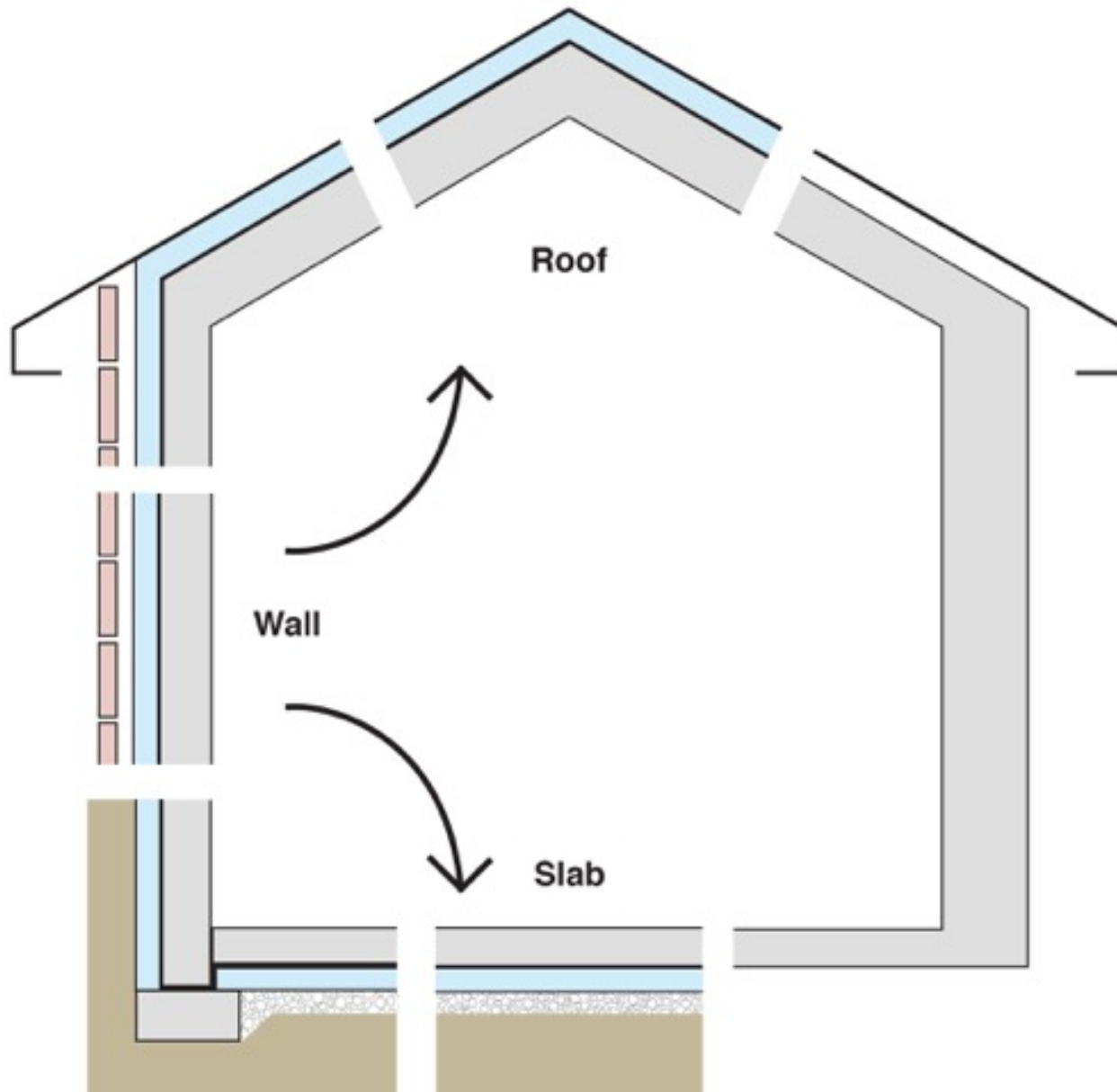


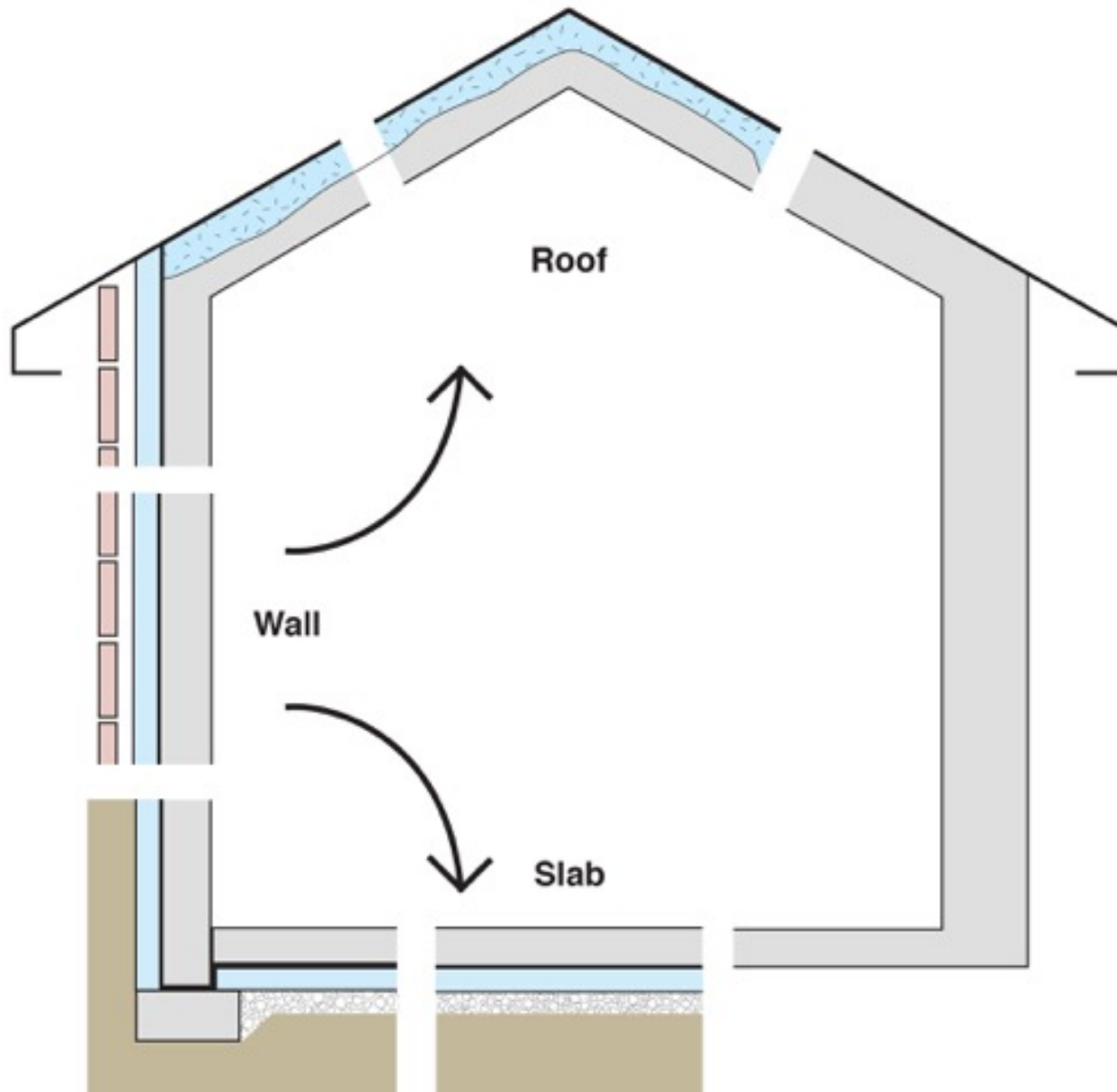


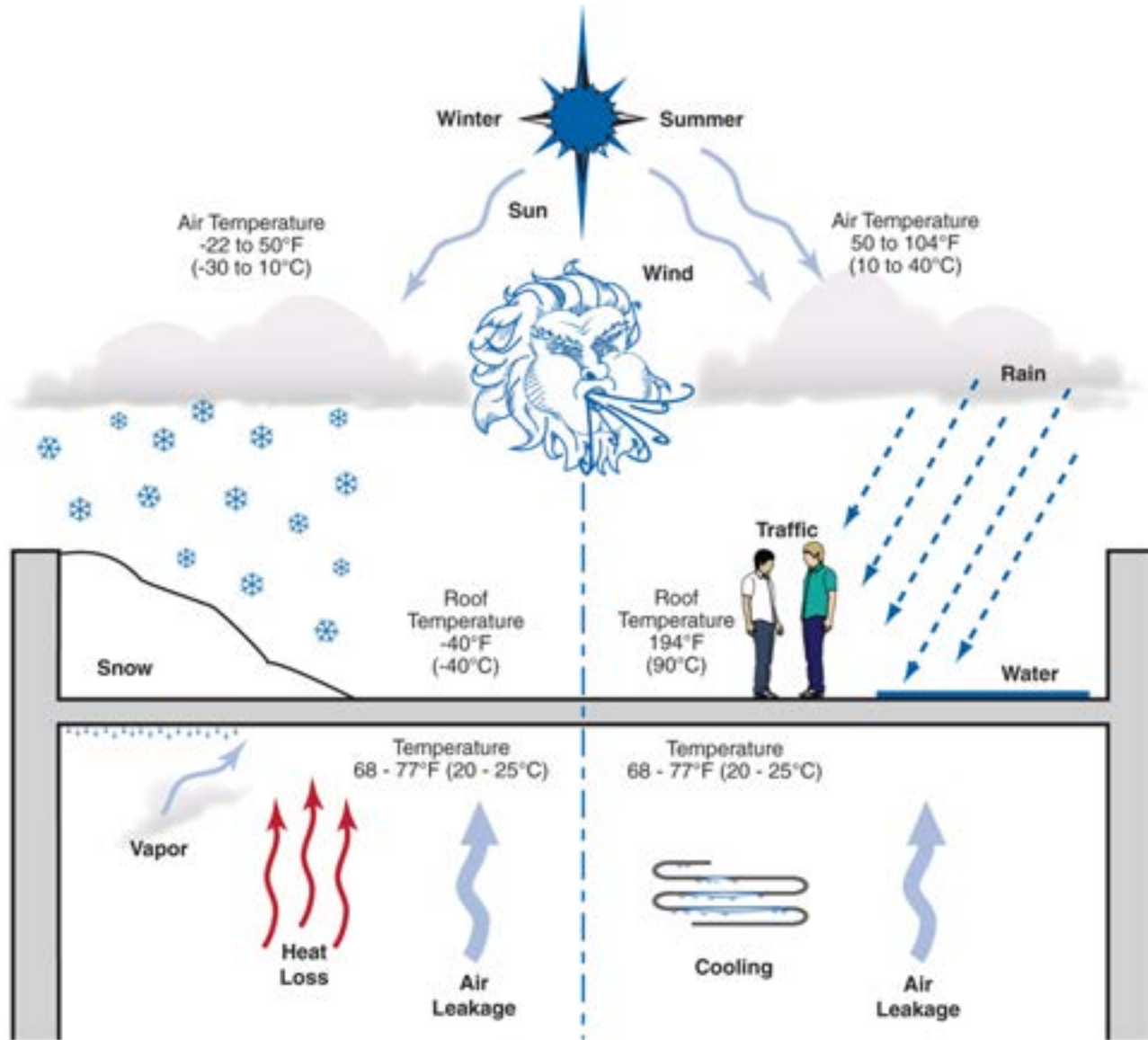




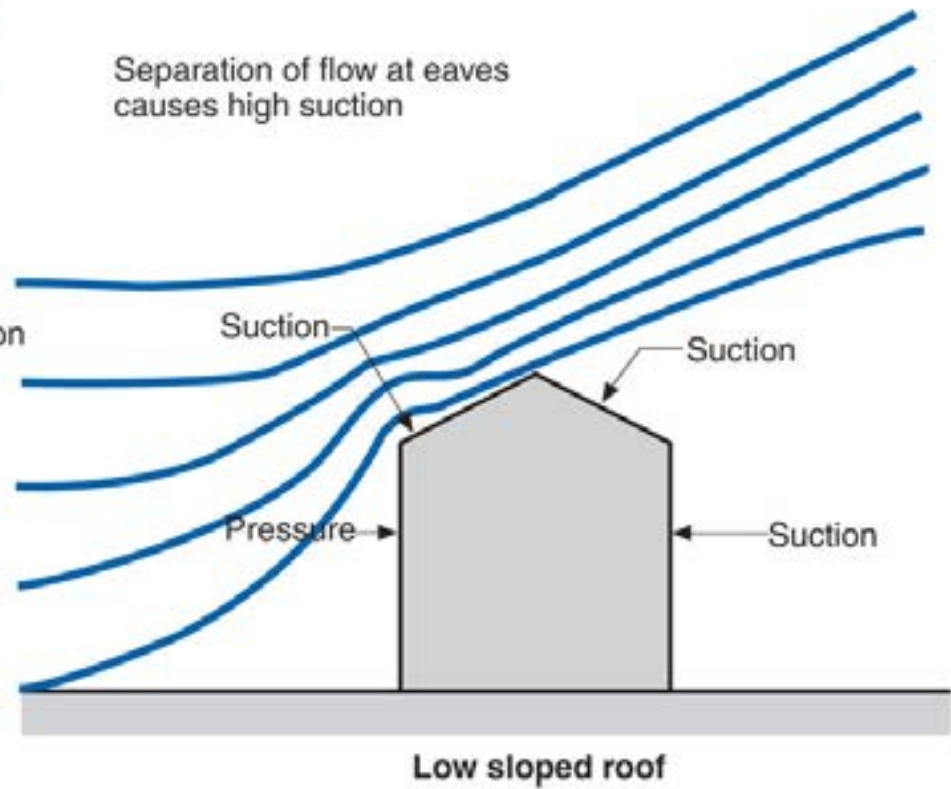
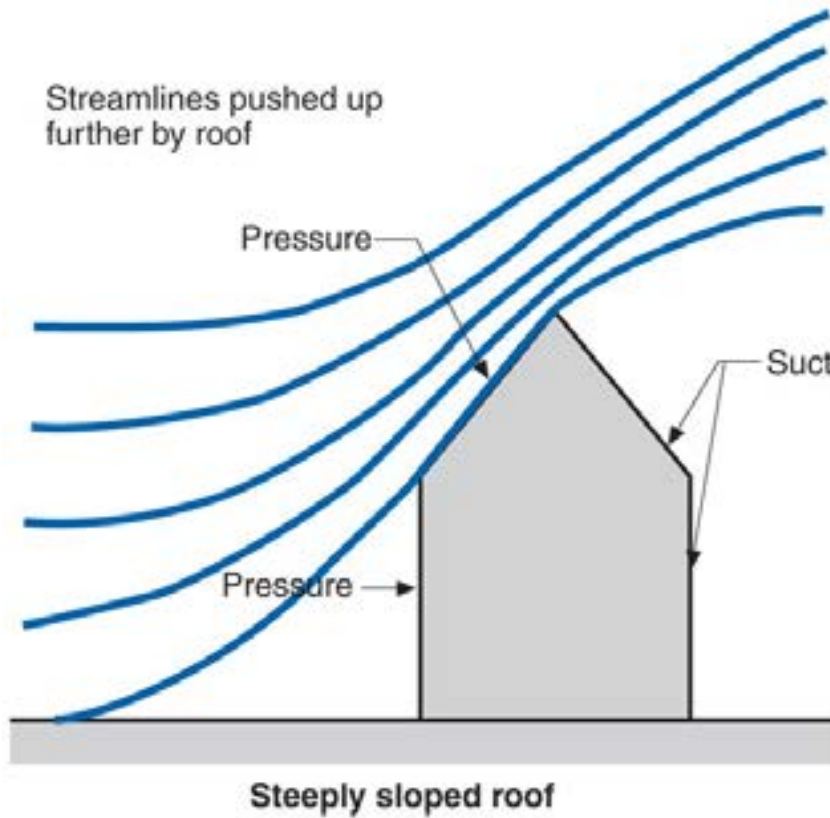


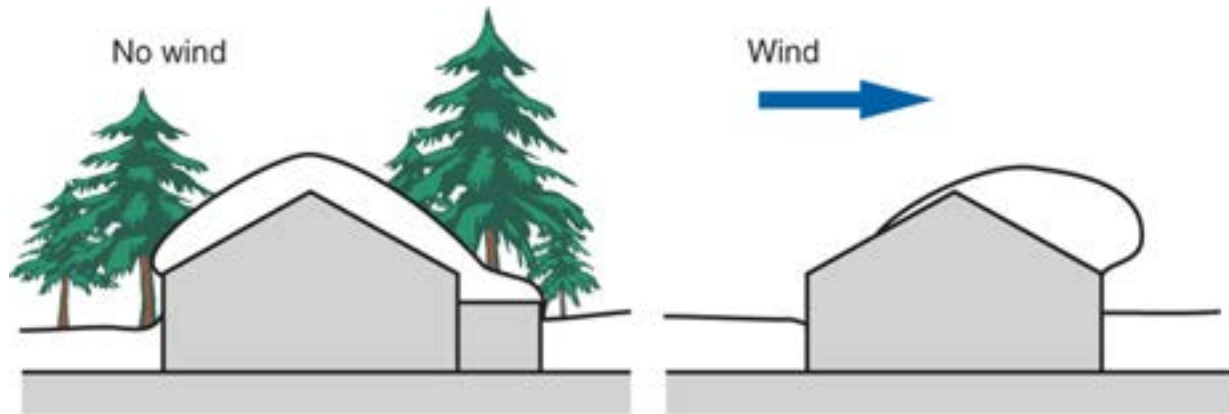






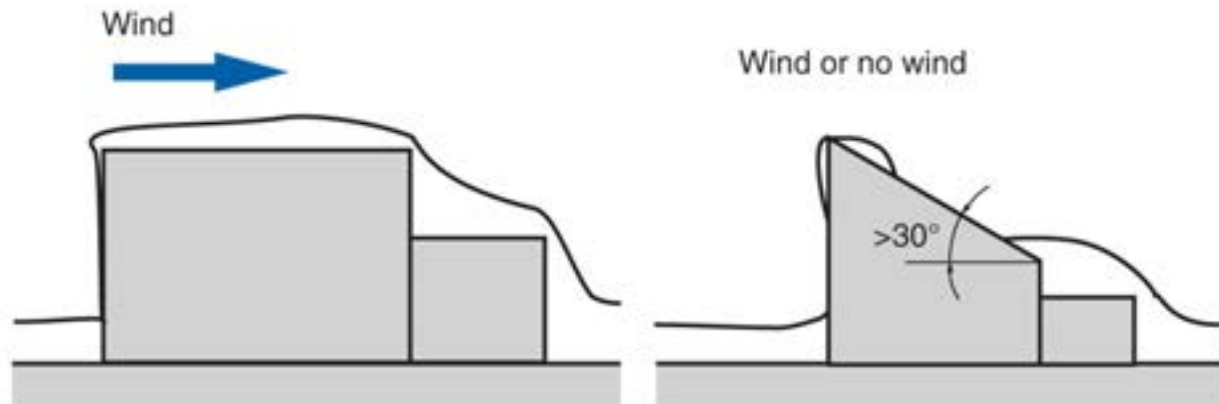
Adapted from Baker, M.: *Roofs*, 1980;
 Courtesy National Research Council of Canada





Effect of shelter

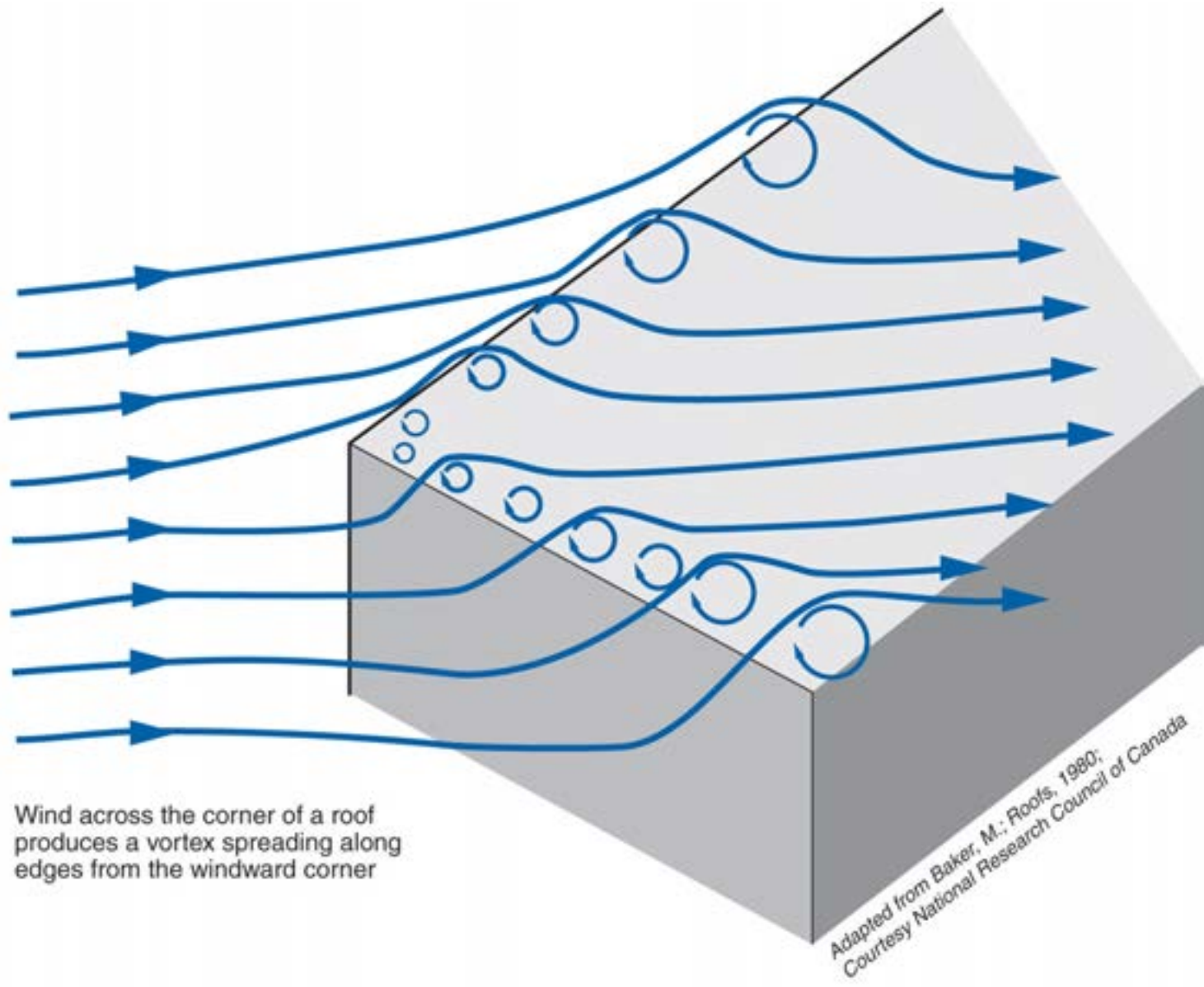
Unbalanced load



Drift on lower roof

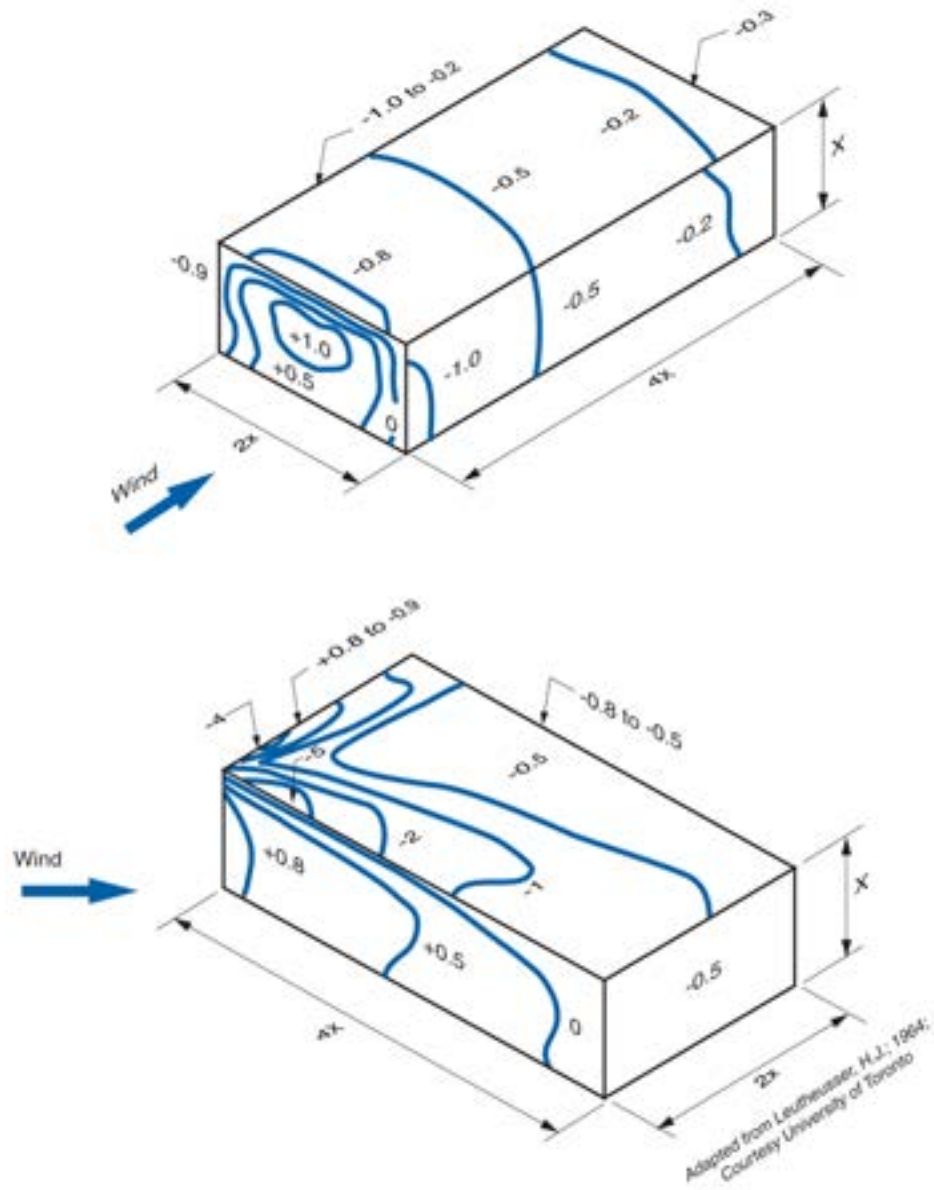
Slide off

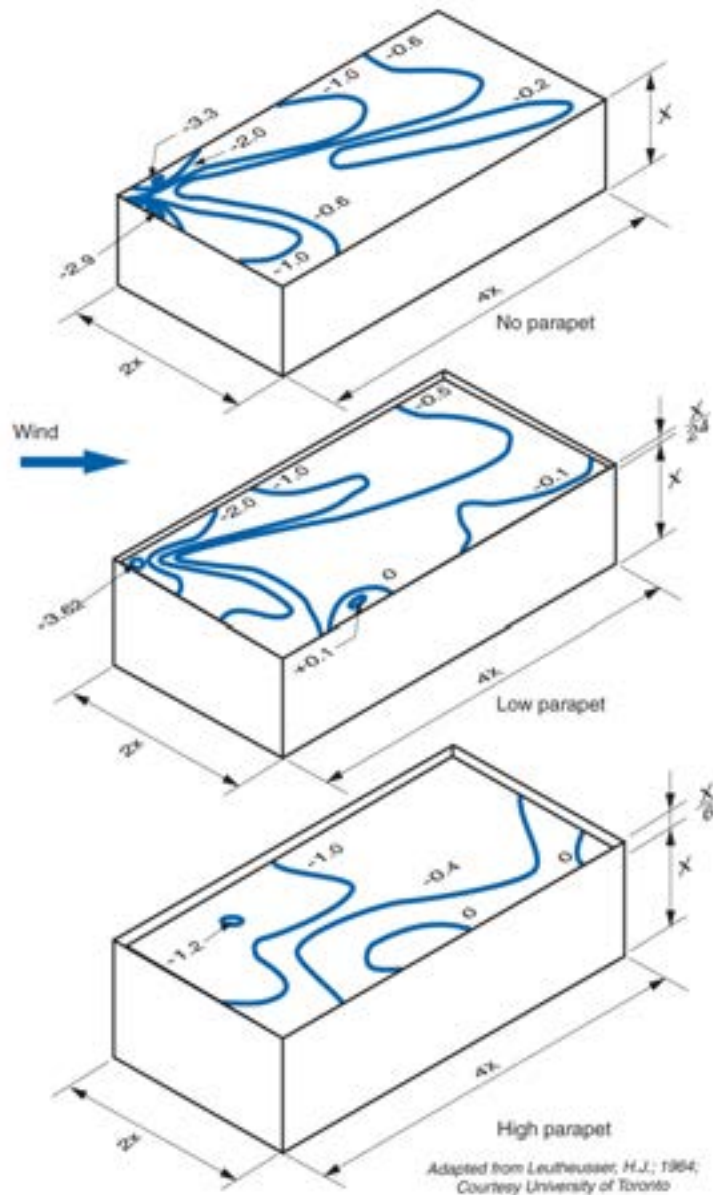
From Baker, M.; Roofs, 1980

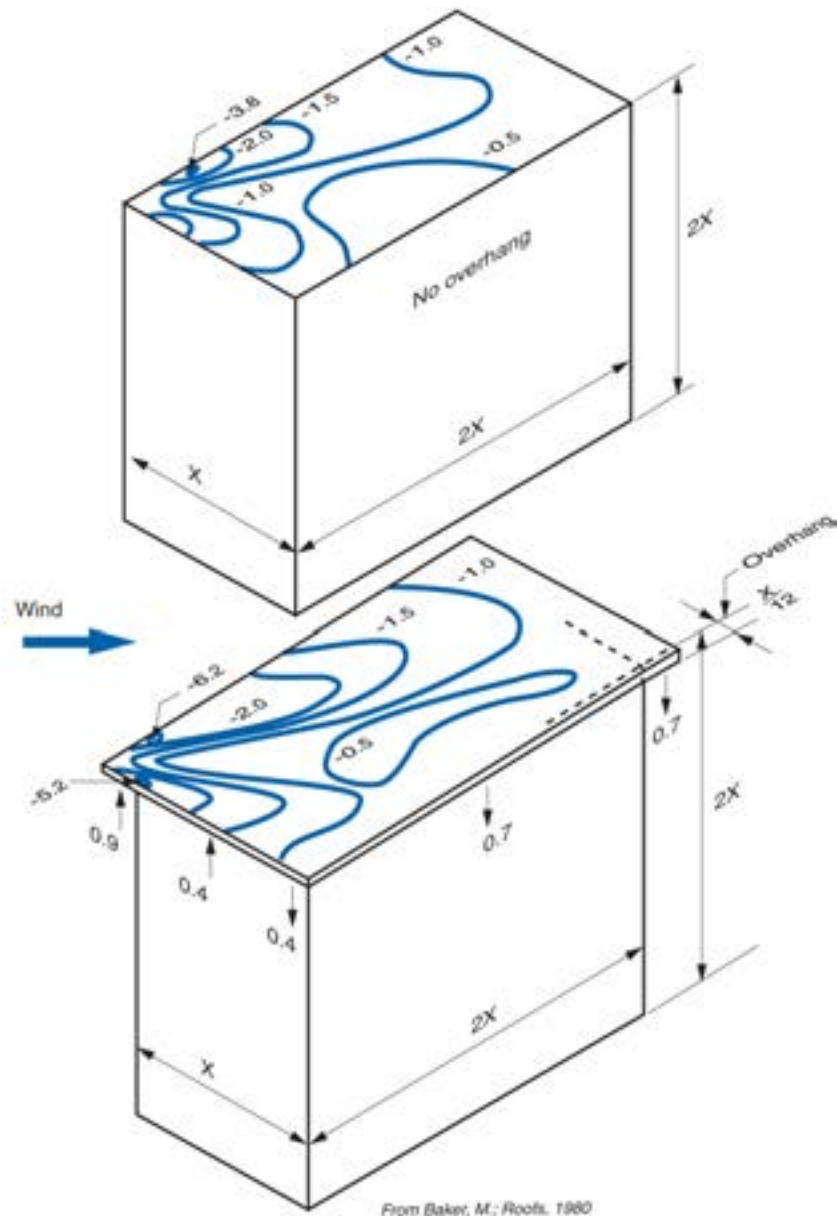


Wind across the corner of a roof produces a vortex spreading along edges from the windward corner

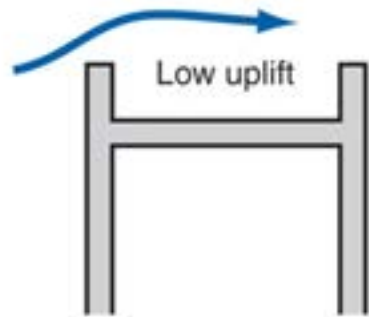
Adapted from Baker, M.: *Roofs*, 1980;
Courtesy National Research Council of Canada



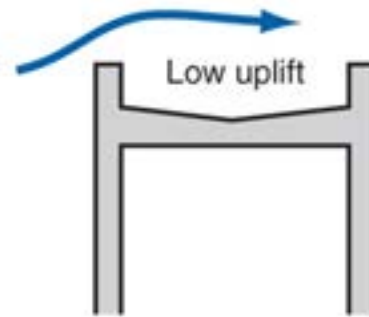




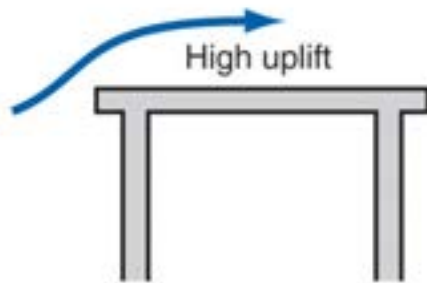
From Baker, M.; *Roofs*, 1980



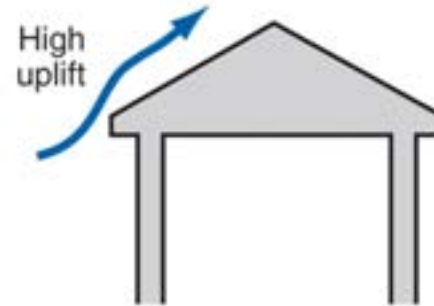
Flat roof with parapets
blow-off hazard: low
slippage hazard: low



Sloped roof with parapets
blow-off hazard: low
slippage hazard: medium

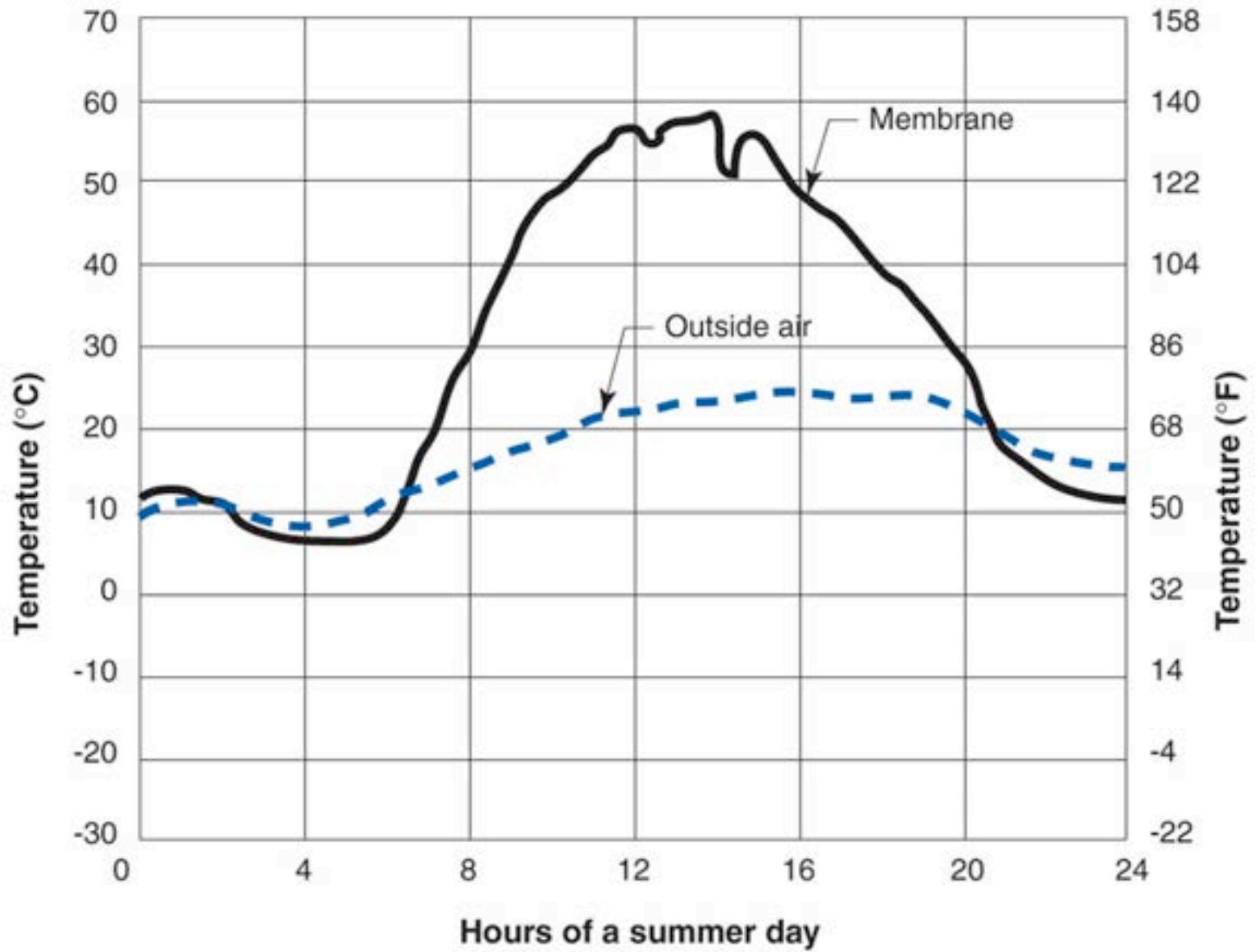


Flat roof or overhang
blow off hazard: high
slippage hazard: low

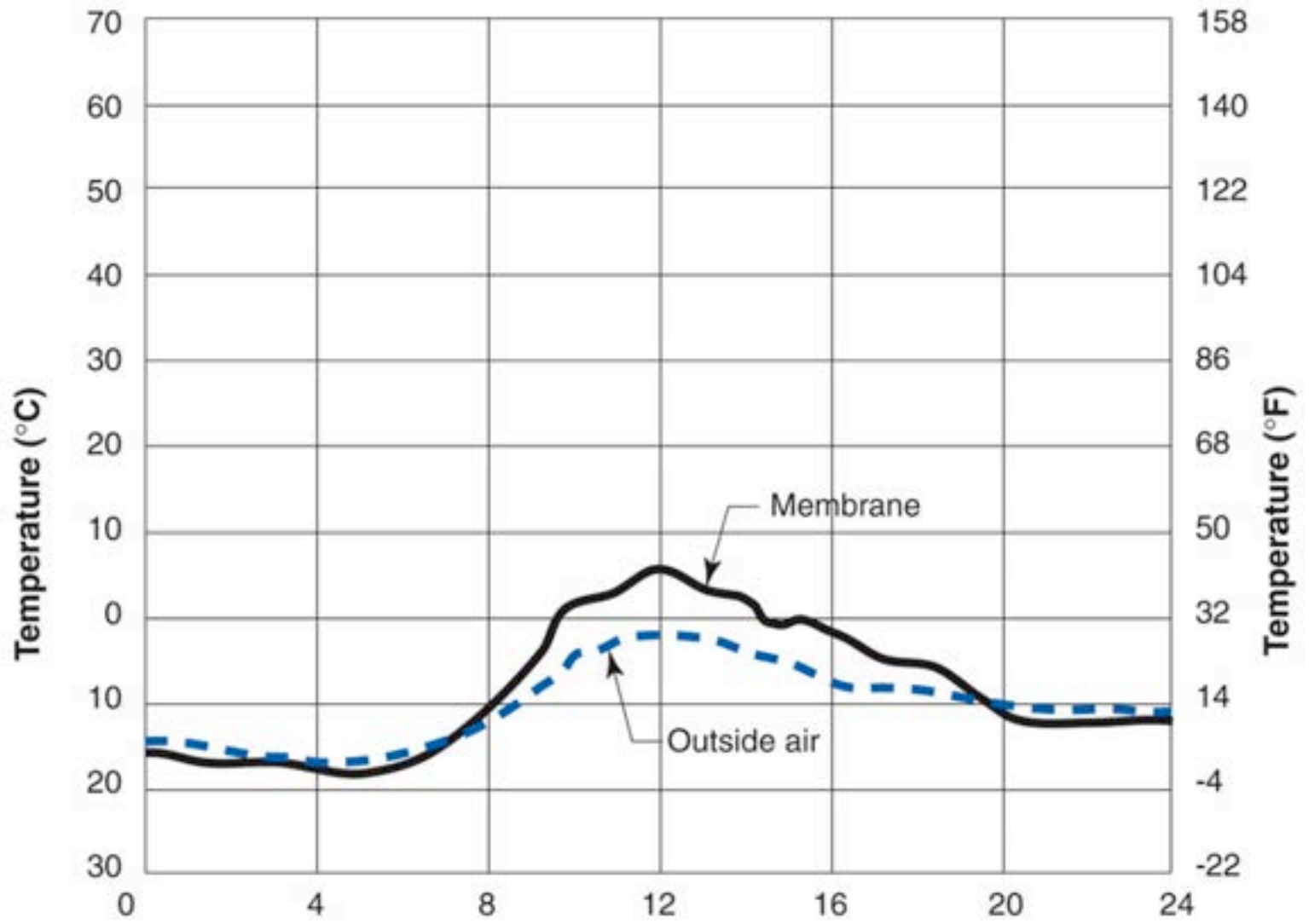


Outward sloping roof
blow-off hazard: high
slippage hazard: high

From Baker, M.; Roofs, 1980

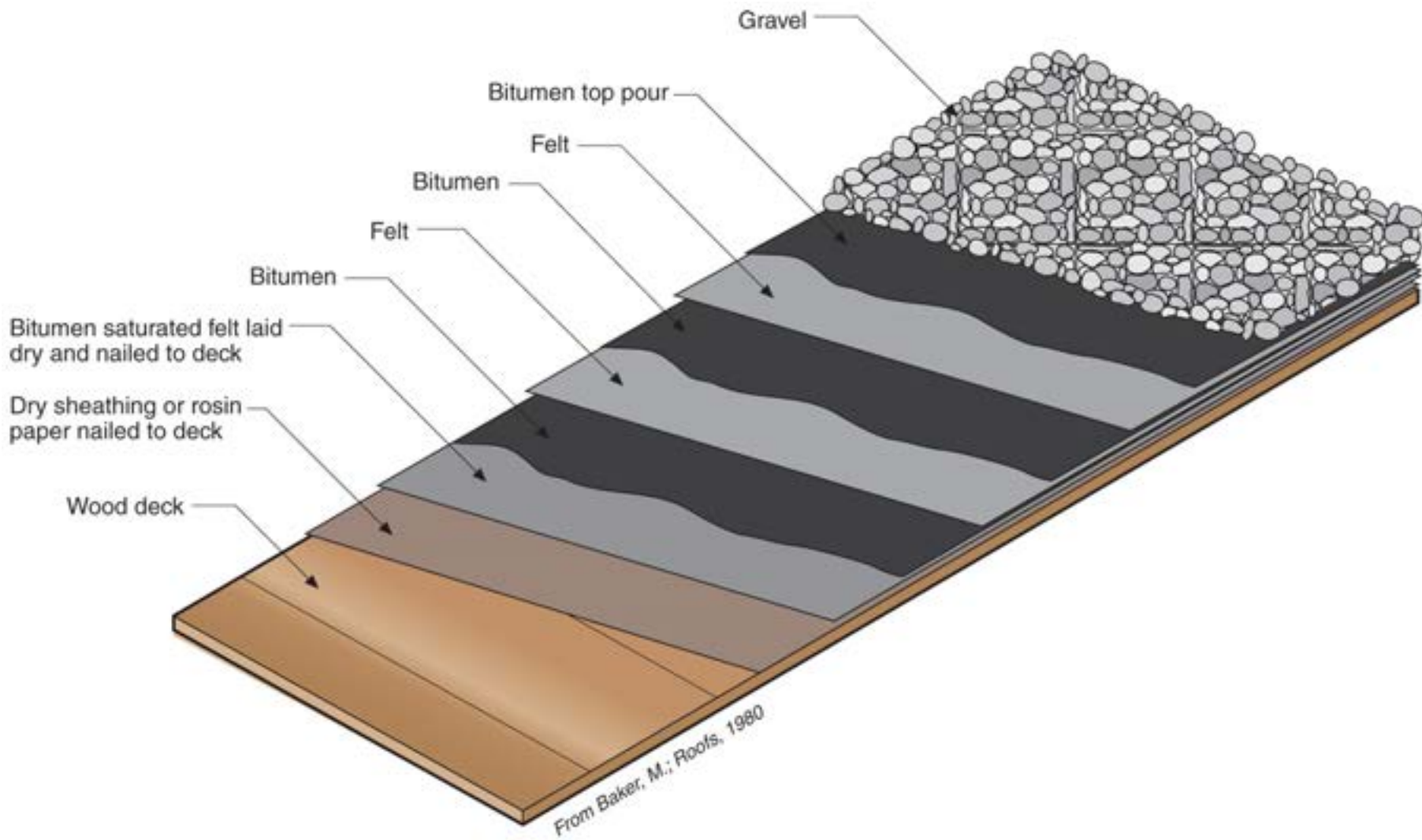


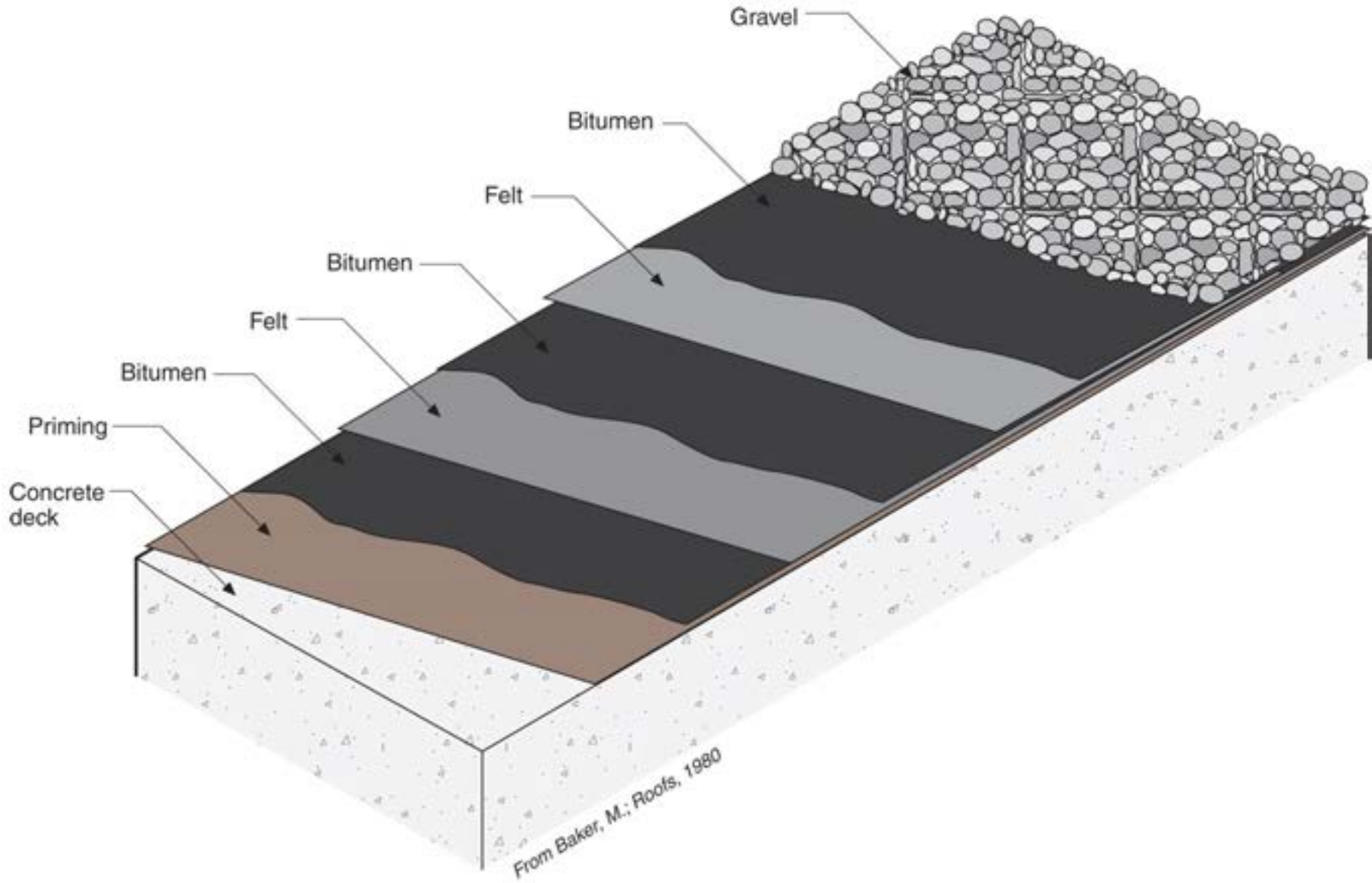
From Baker, M.; *Roofs*, 1980

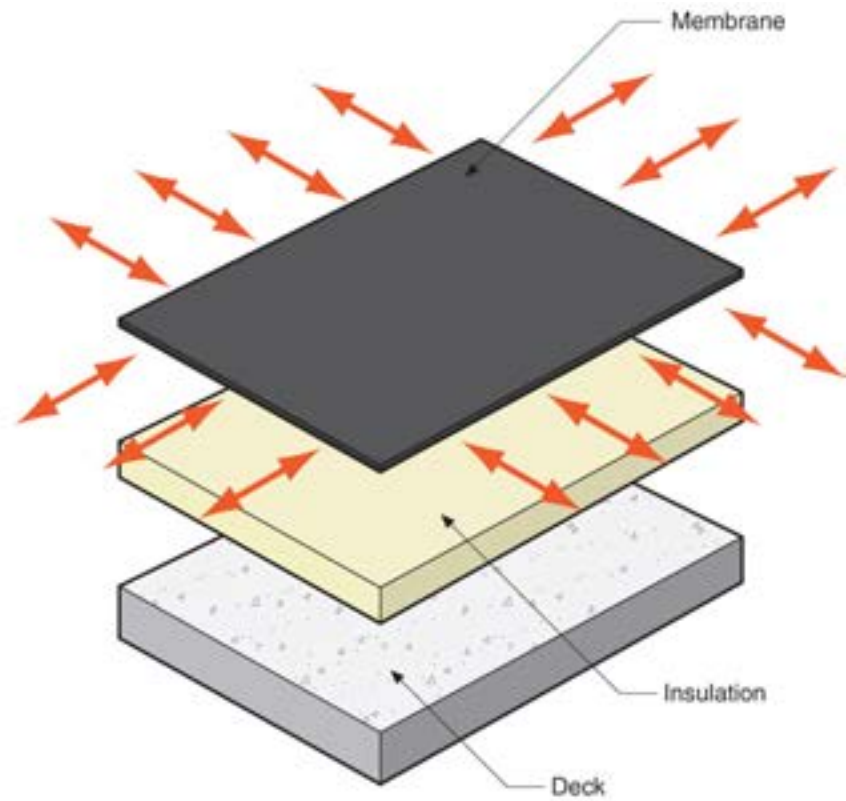
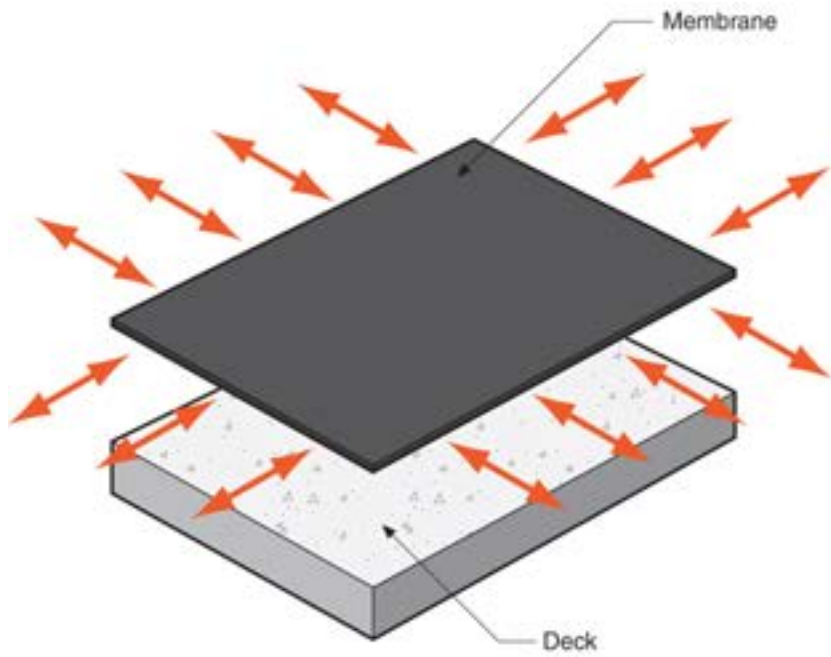


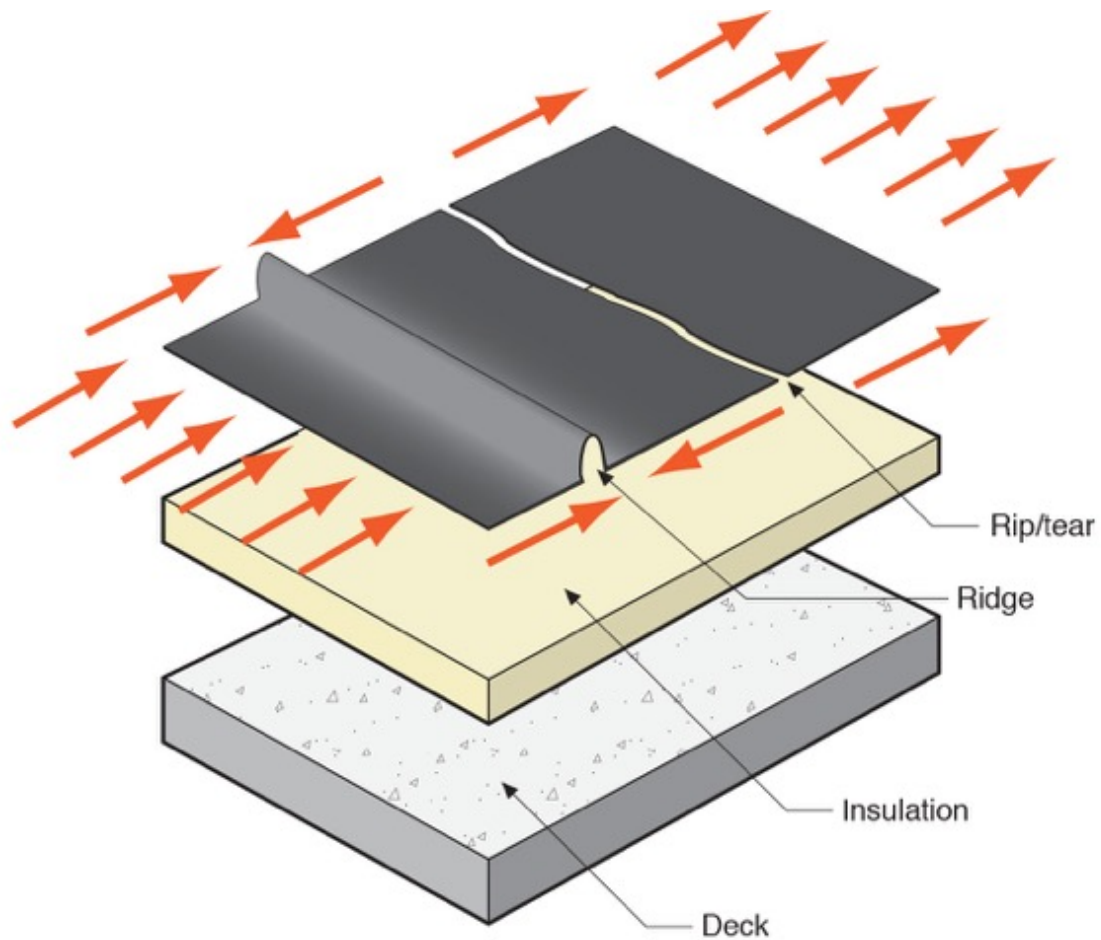
Hours of a winter day

From Baker, M.; Roofs, 1980

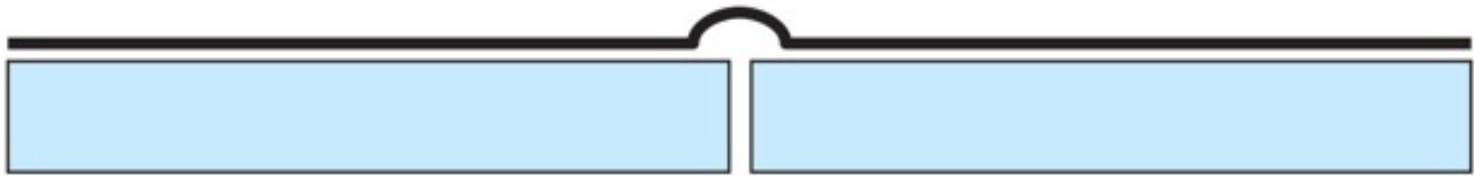
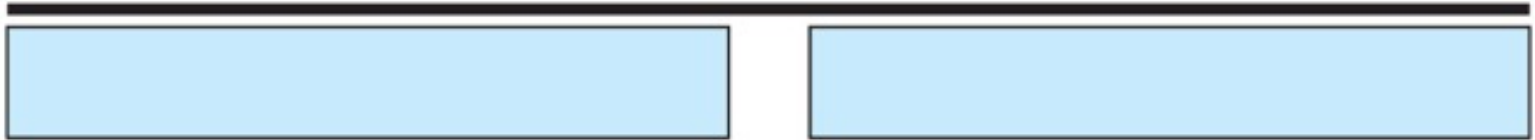




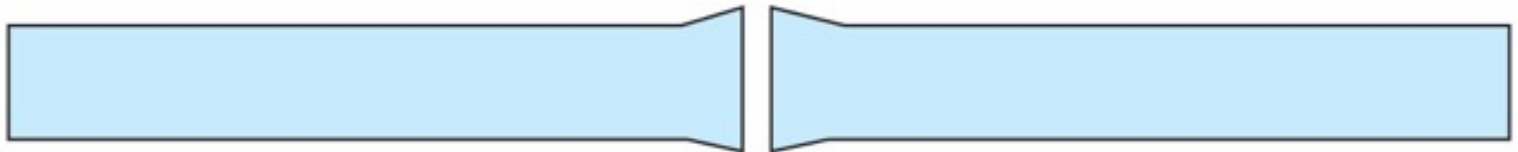
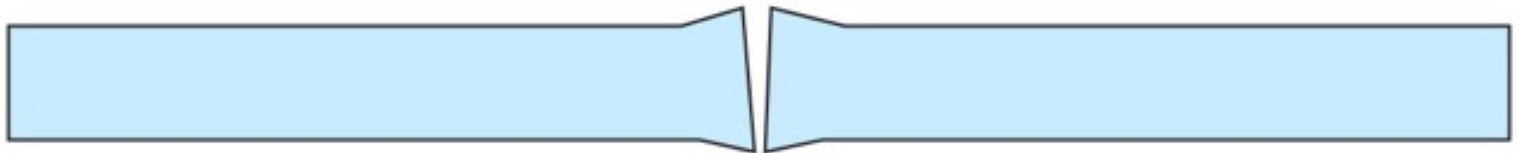


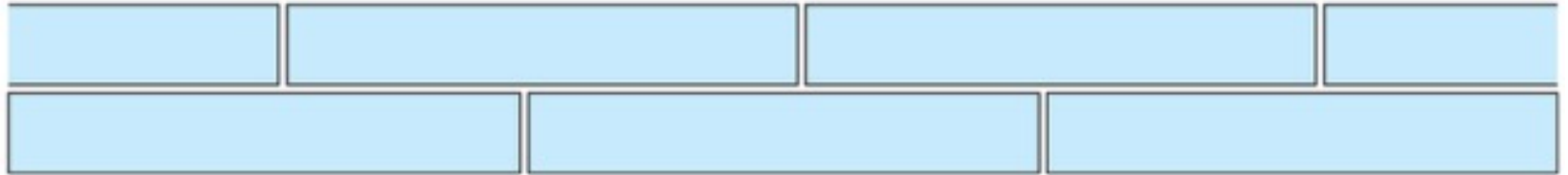






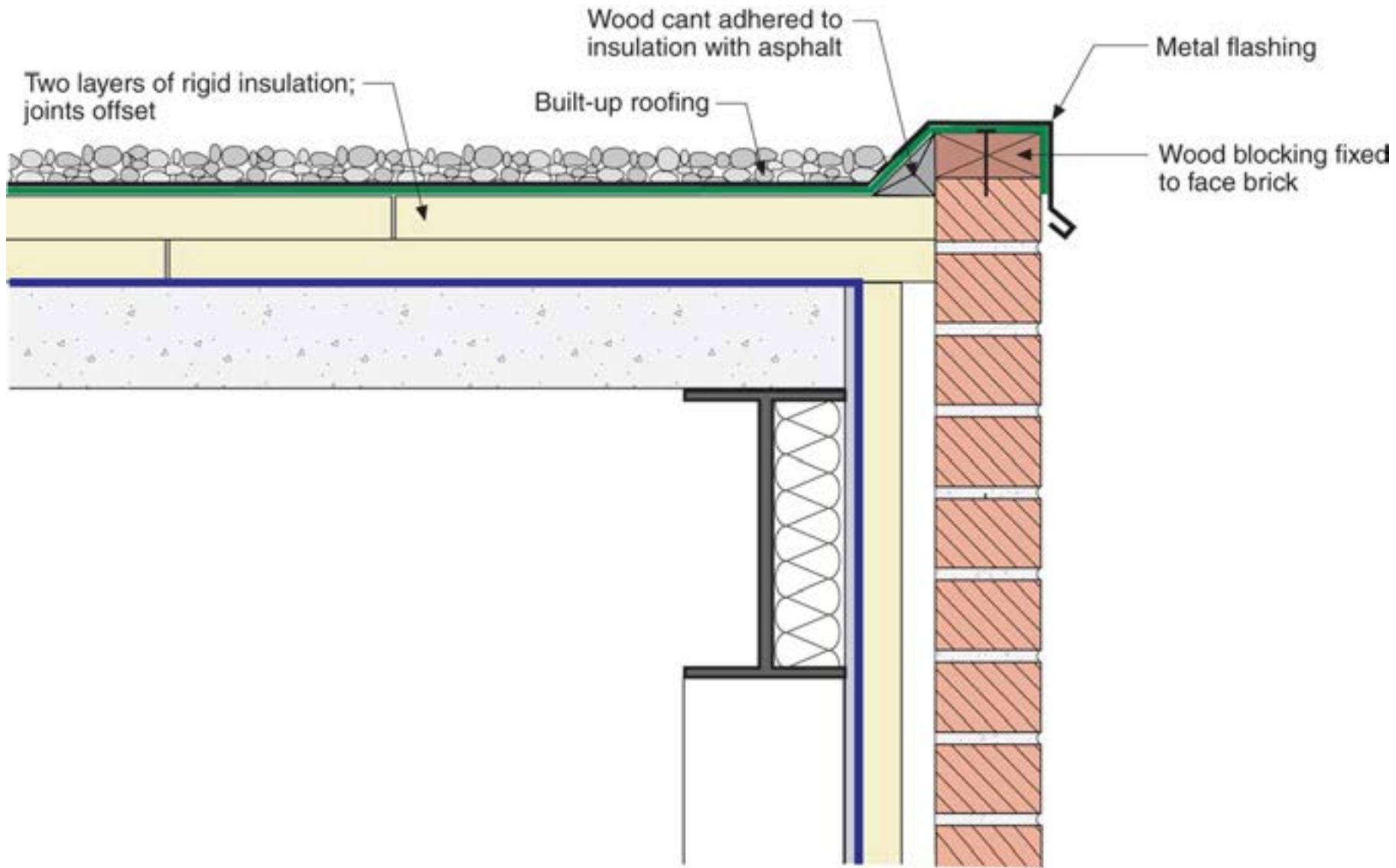






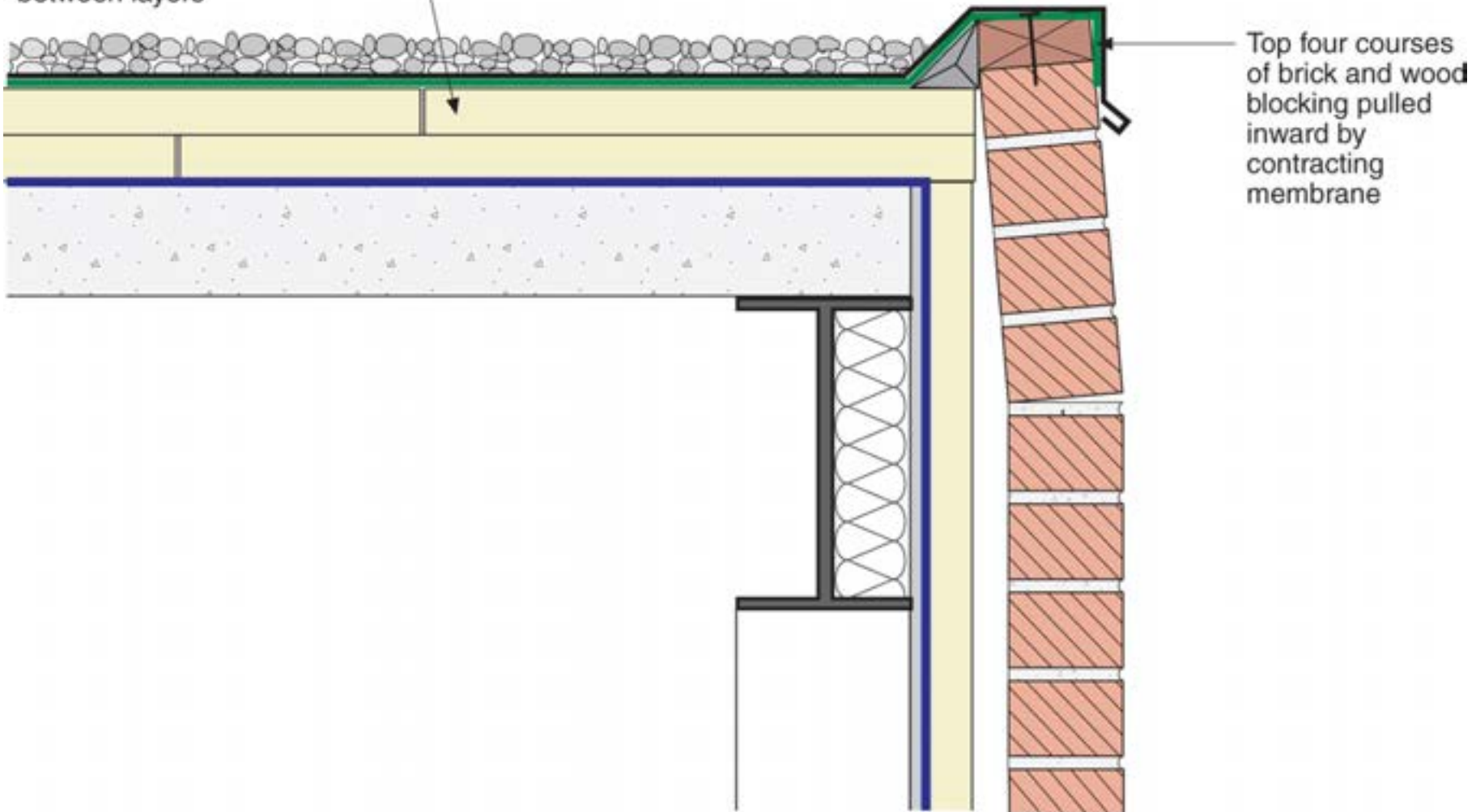




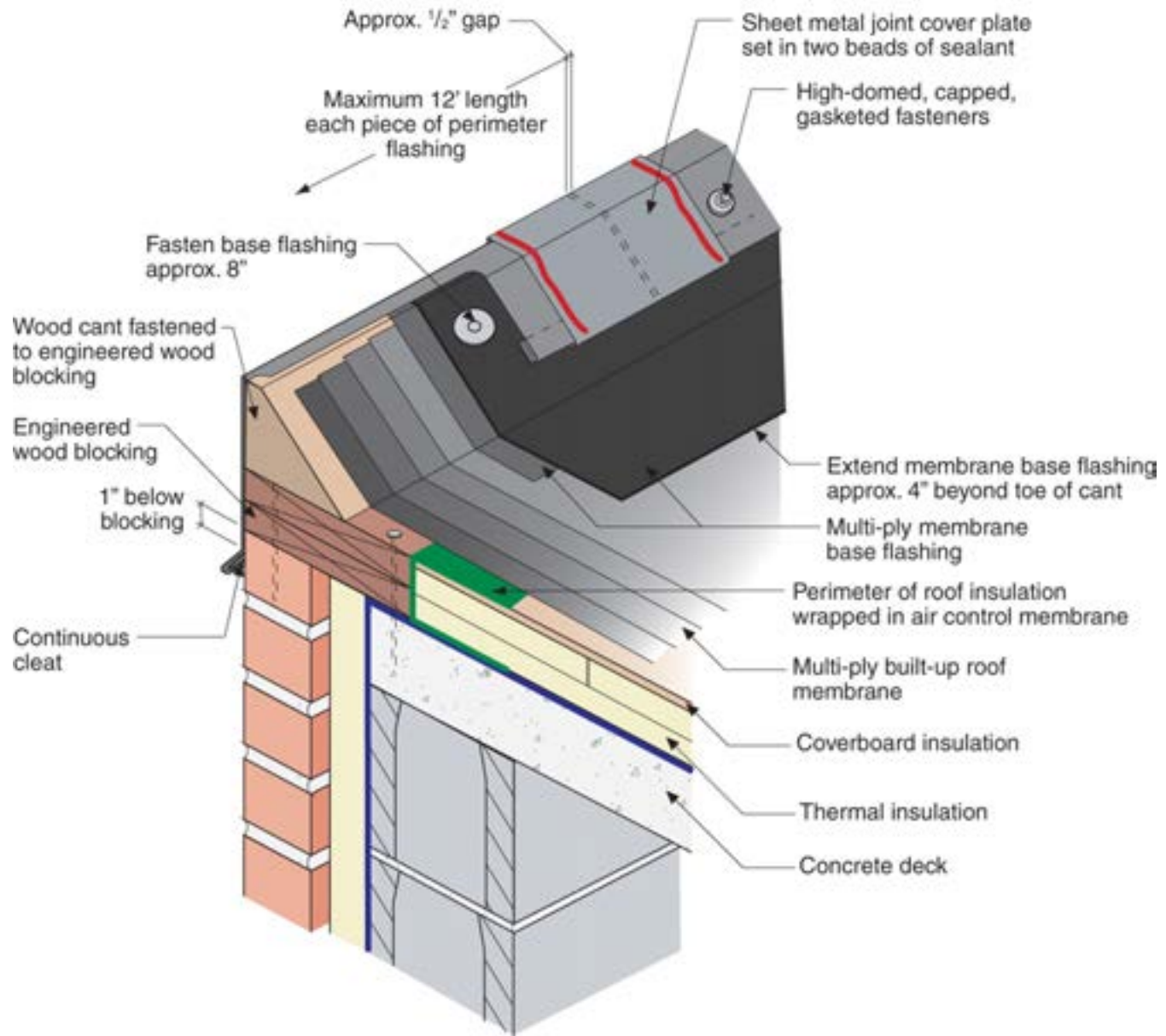


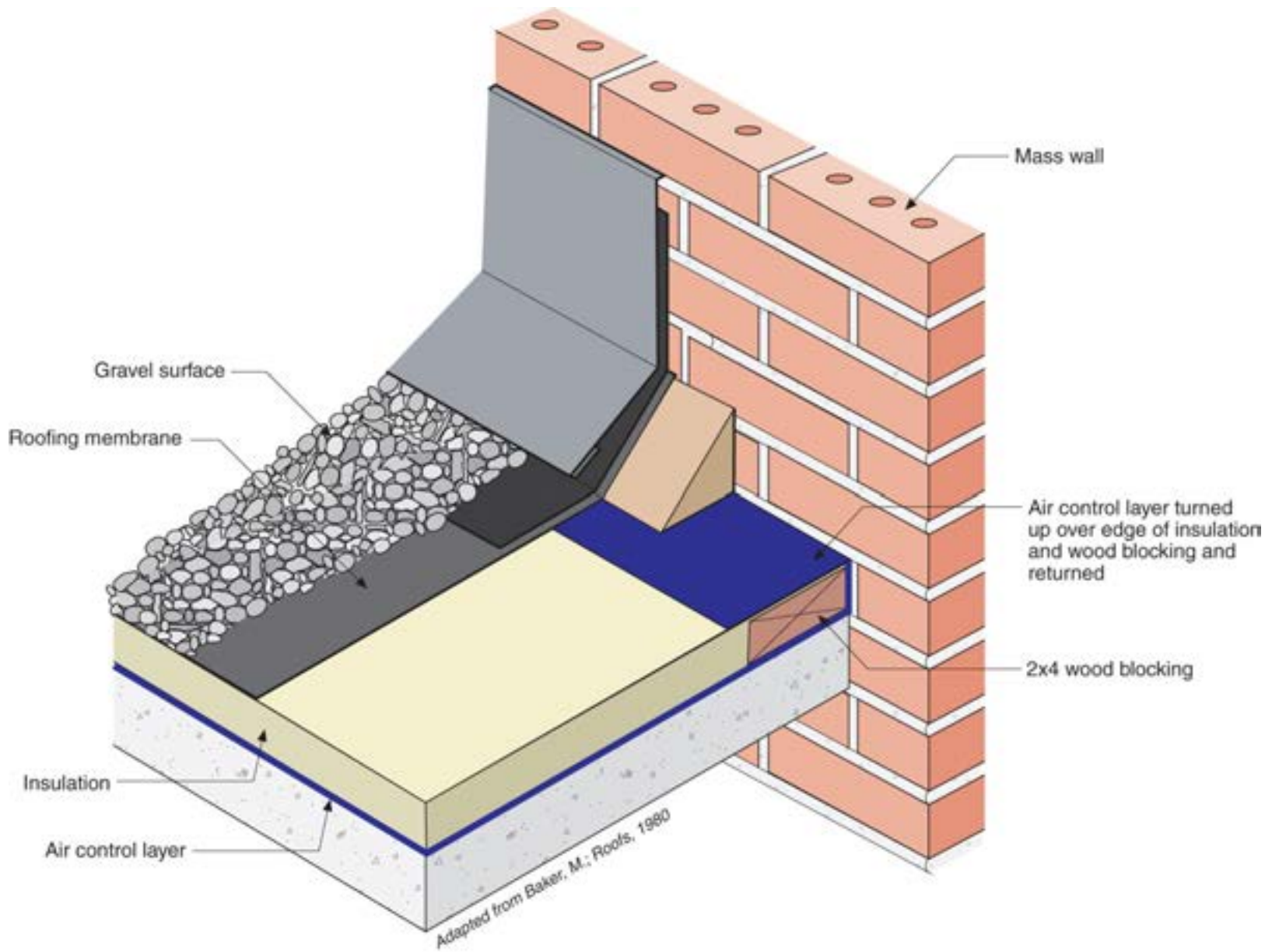
Adapted from Baker, M.; Roofs, 1980

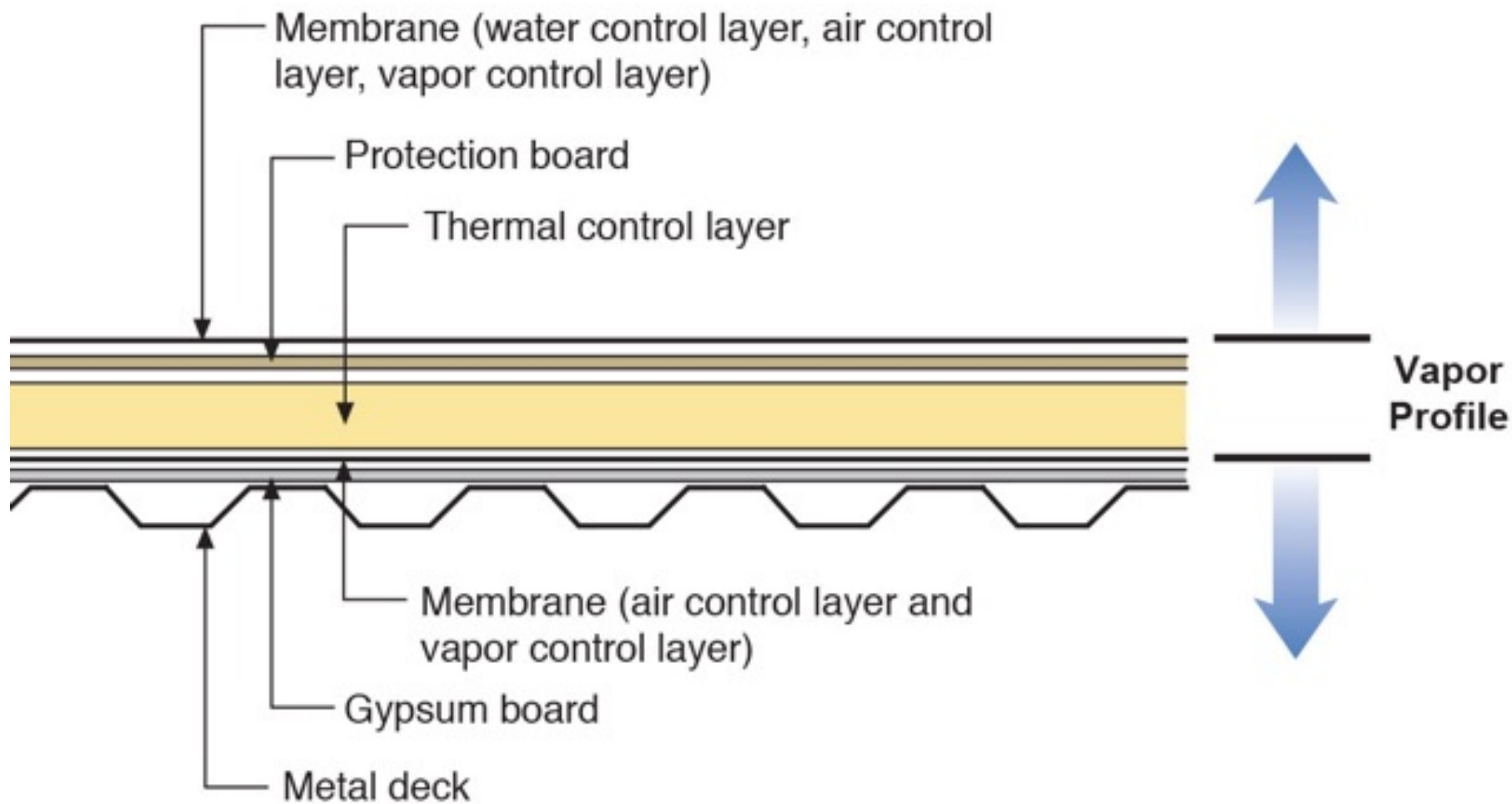
Insulation moved because of poor adhesion to deck and between layers

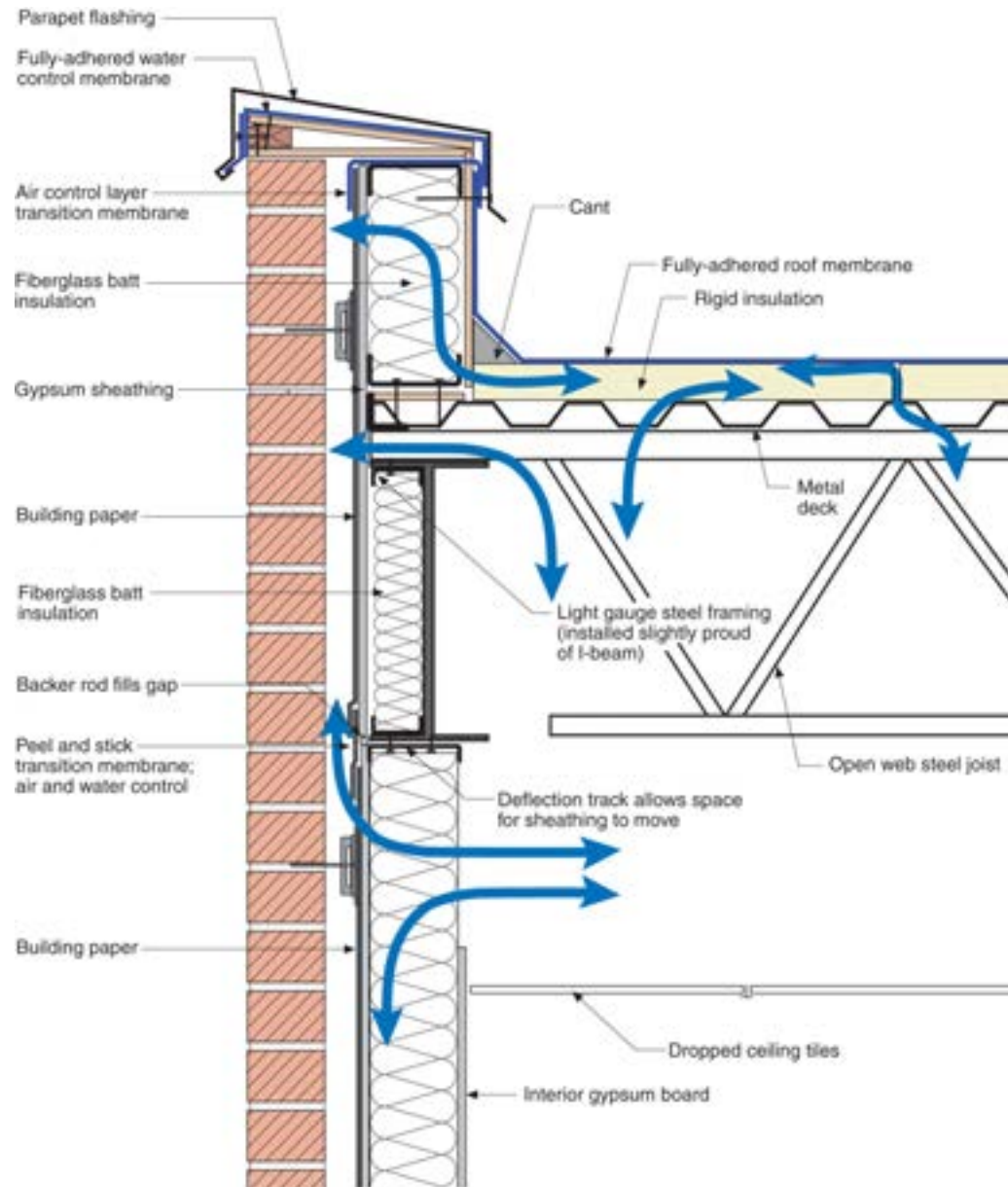


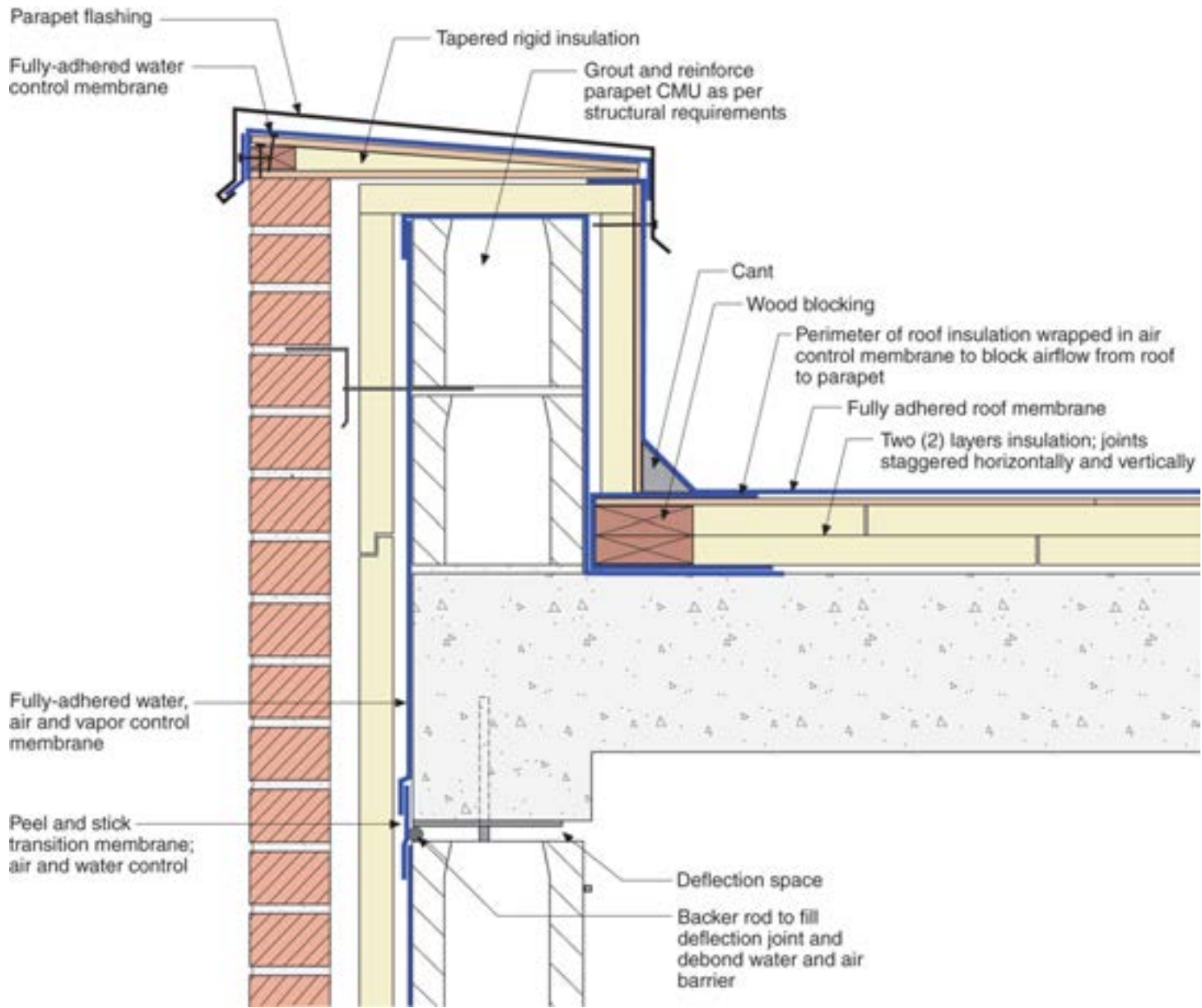
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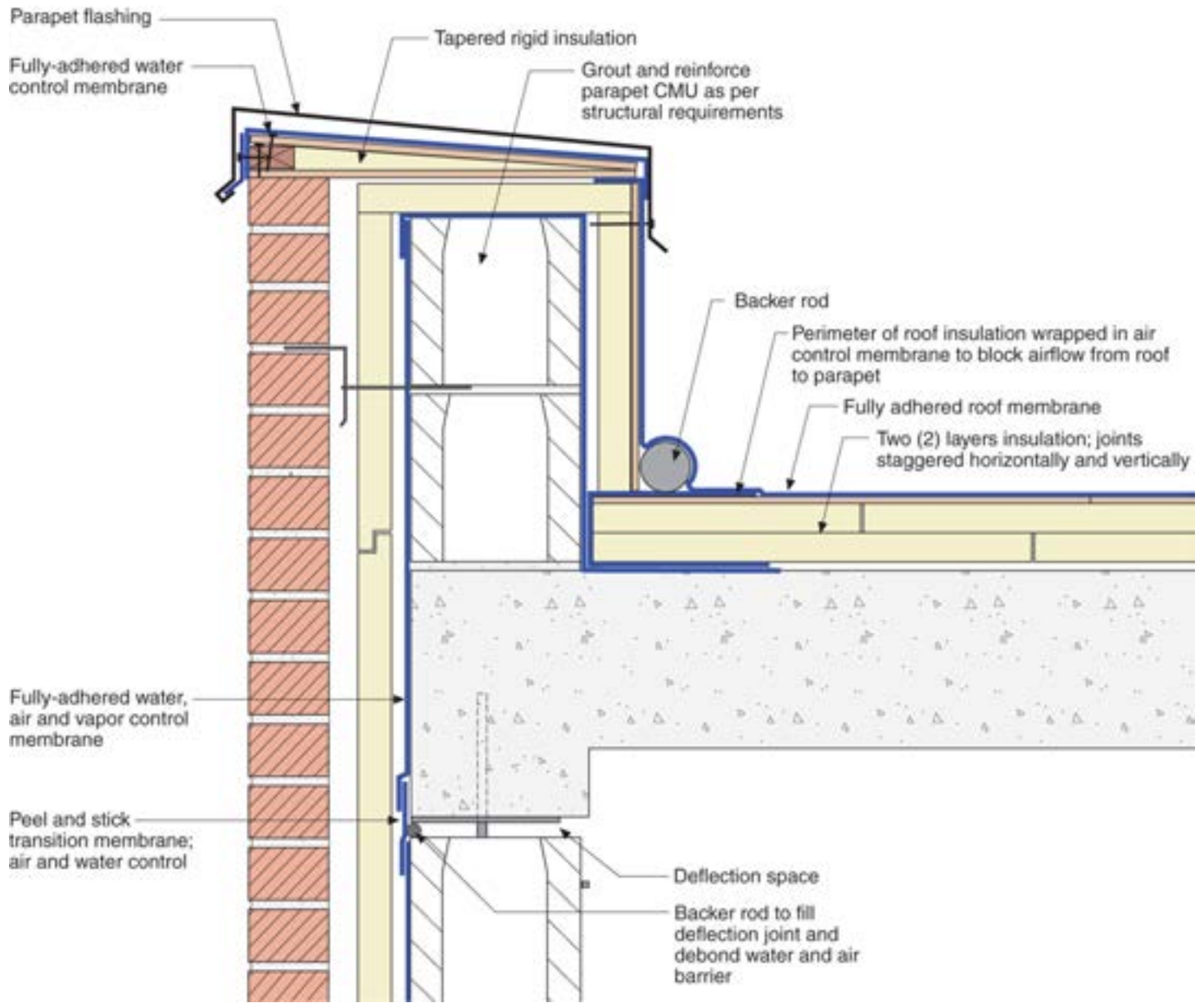


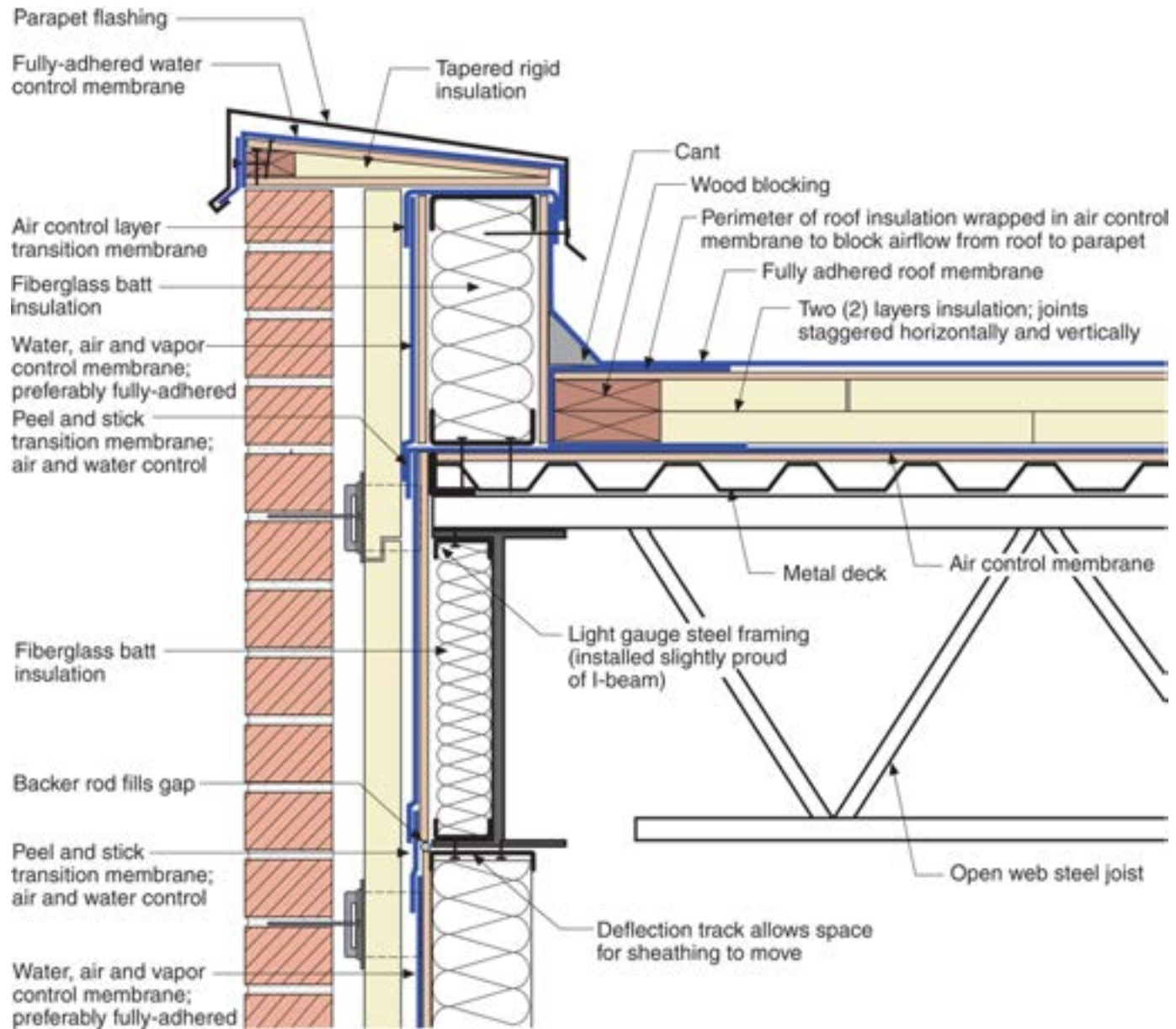


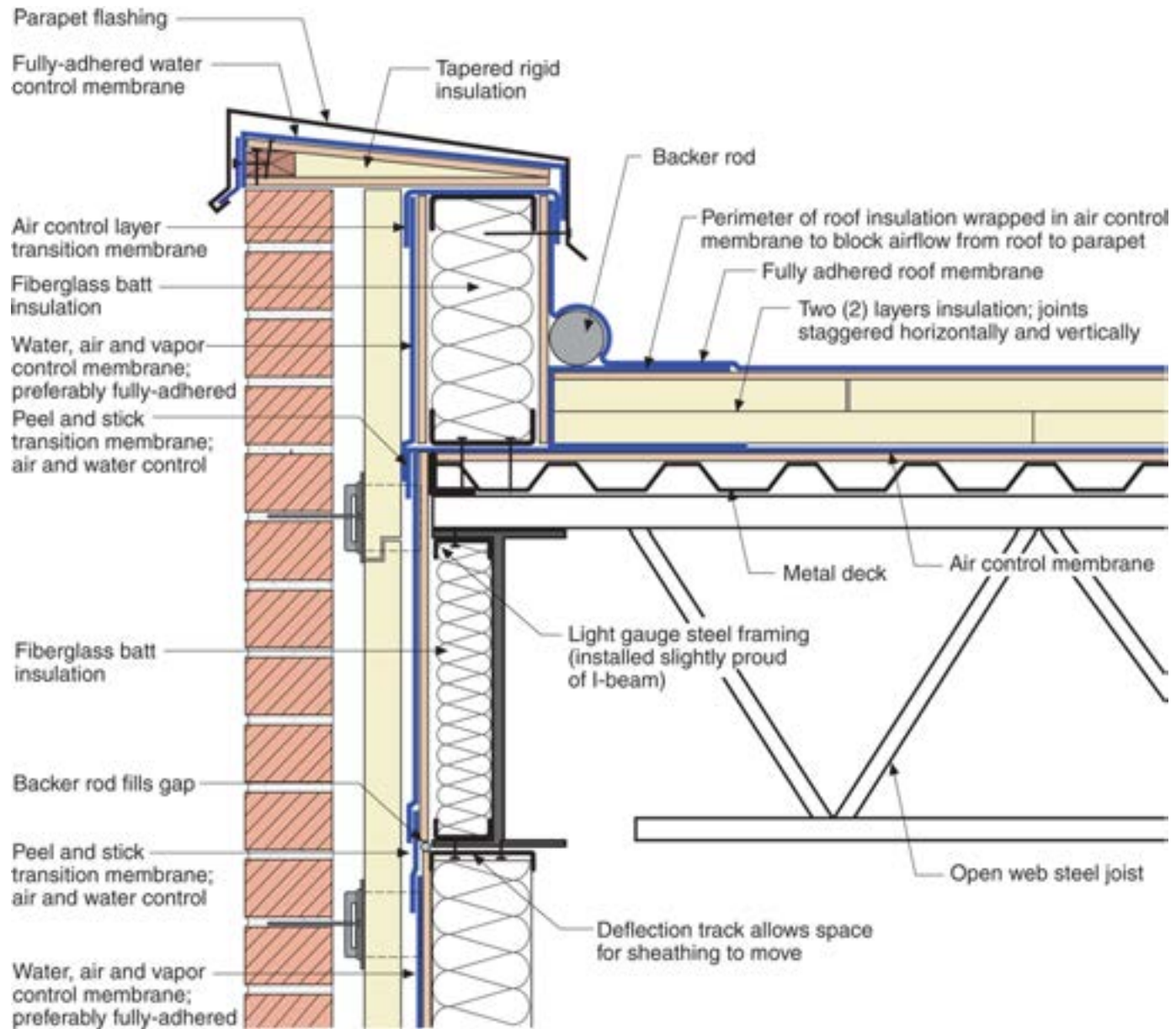


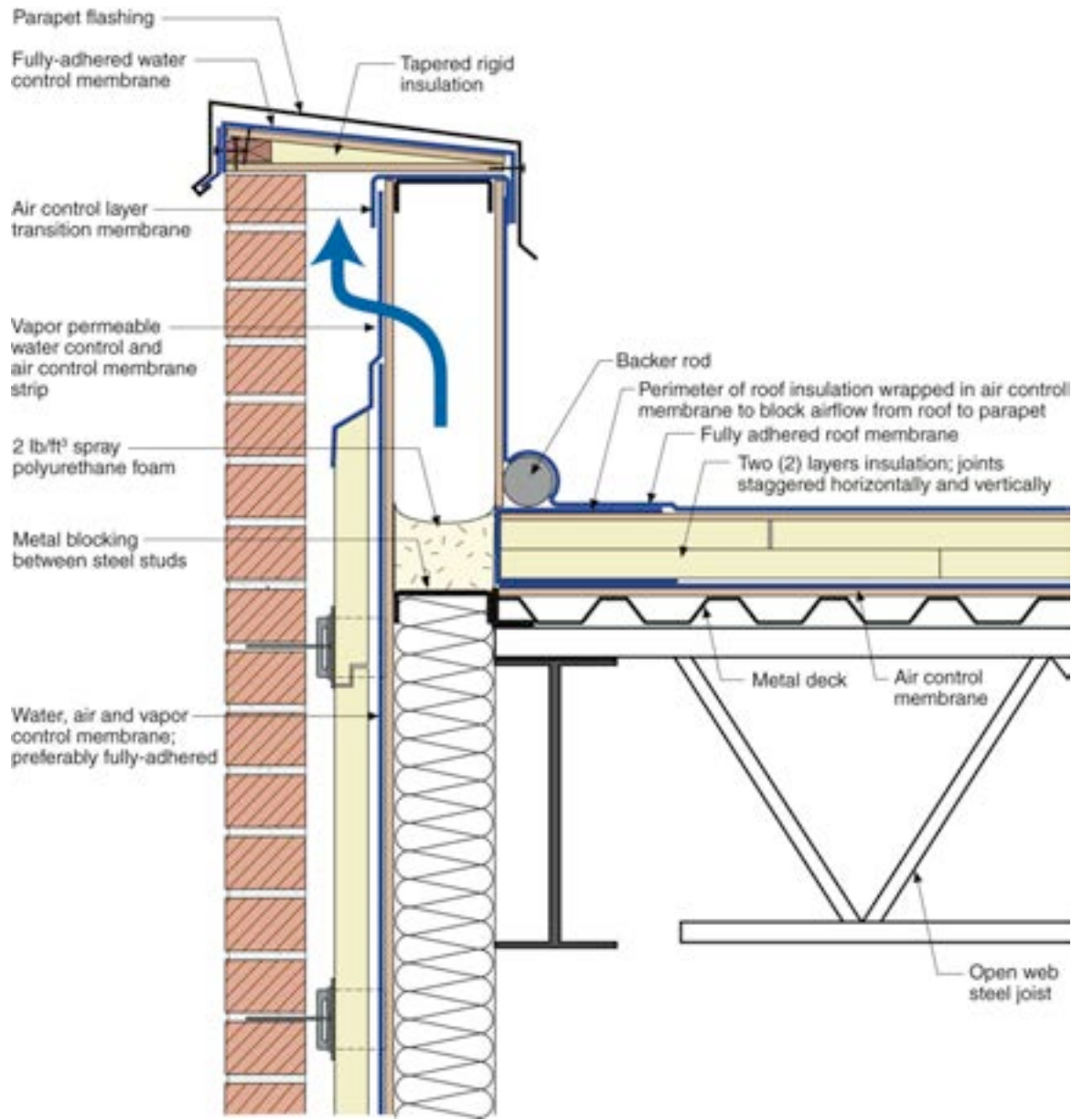


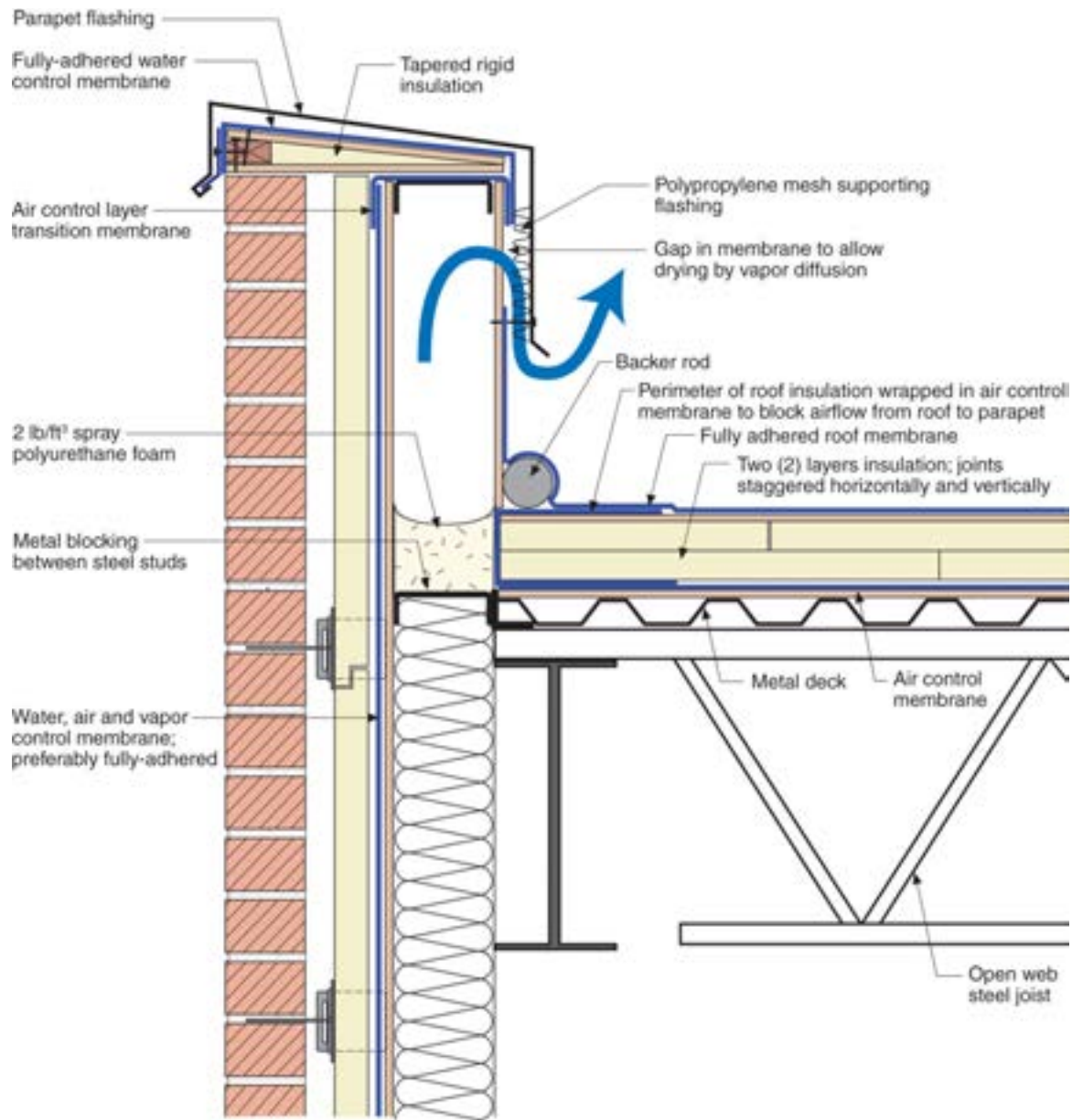


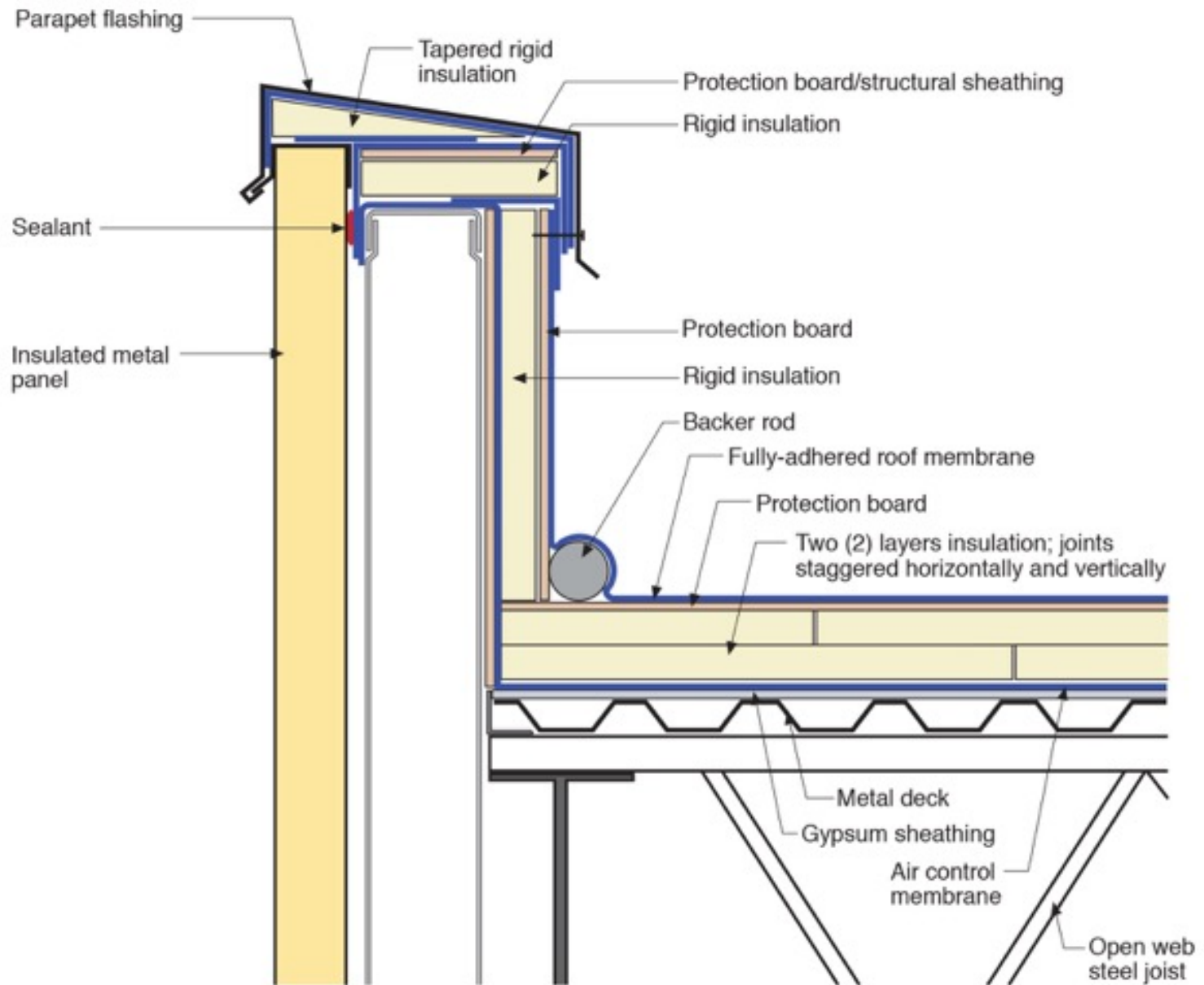


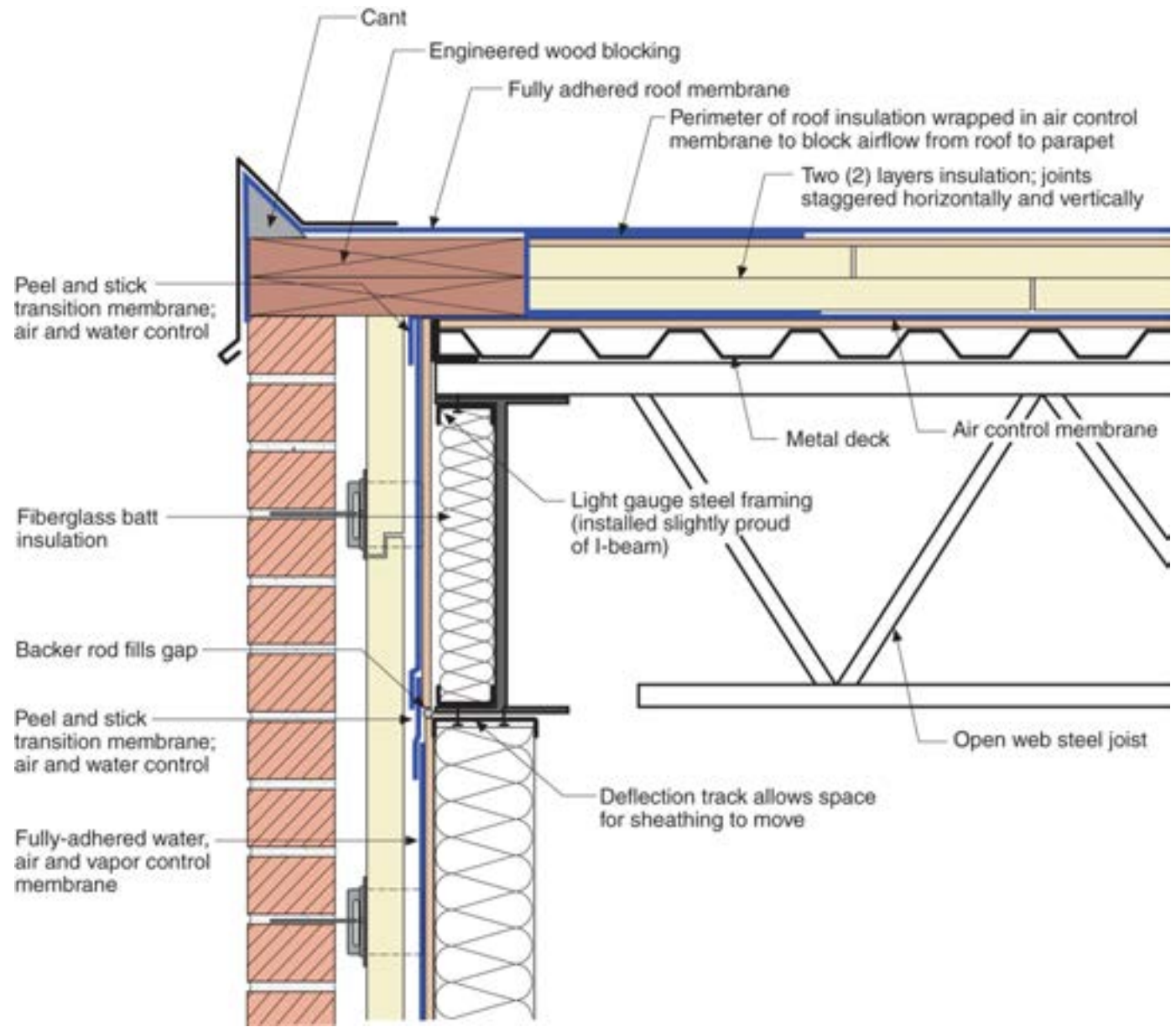


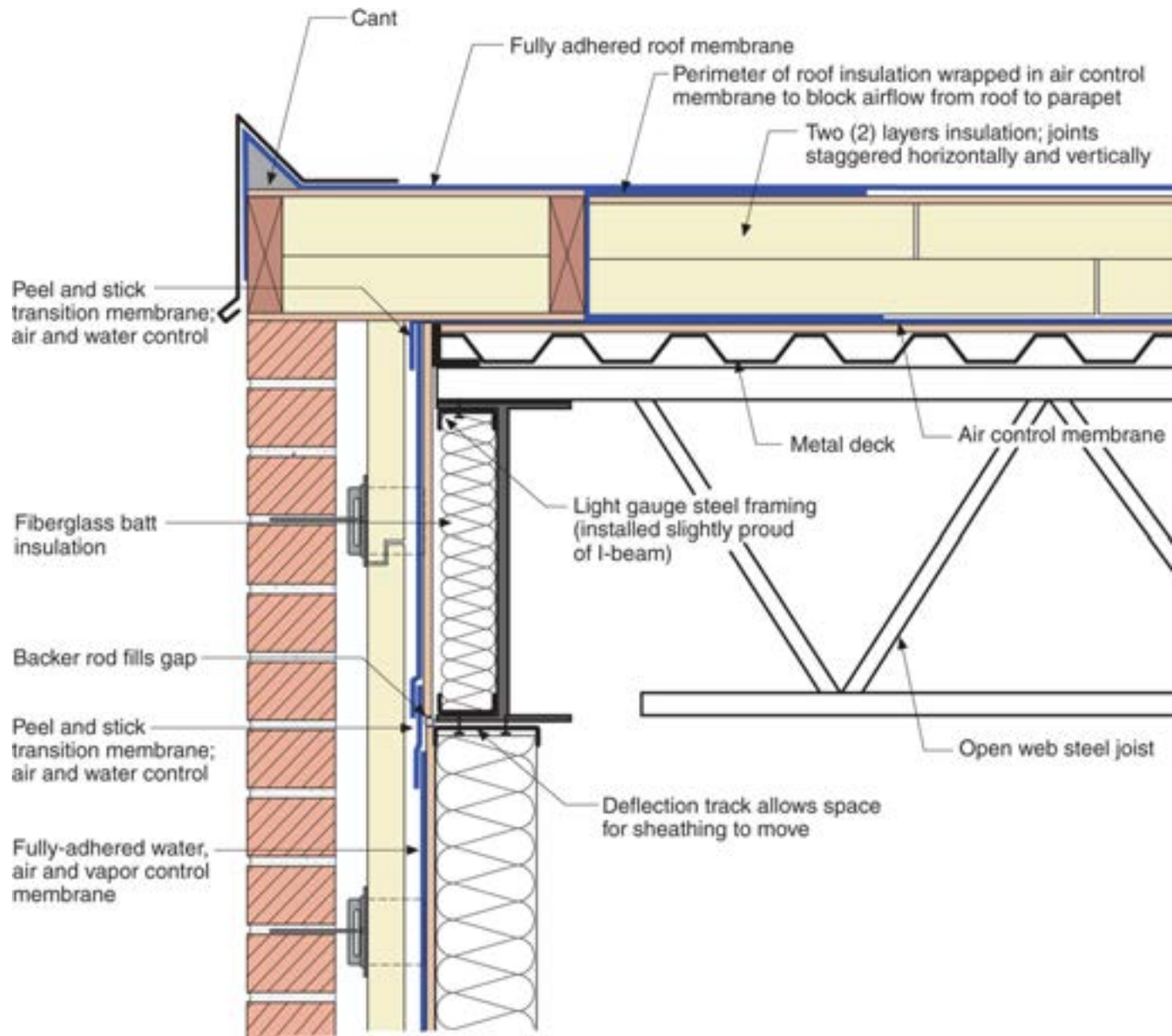


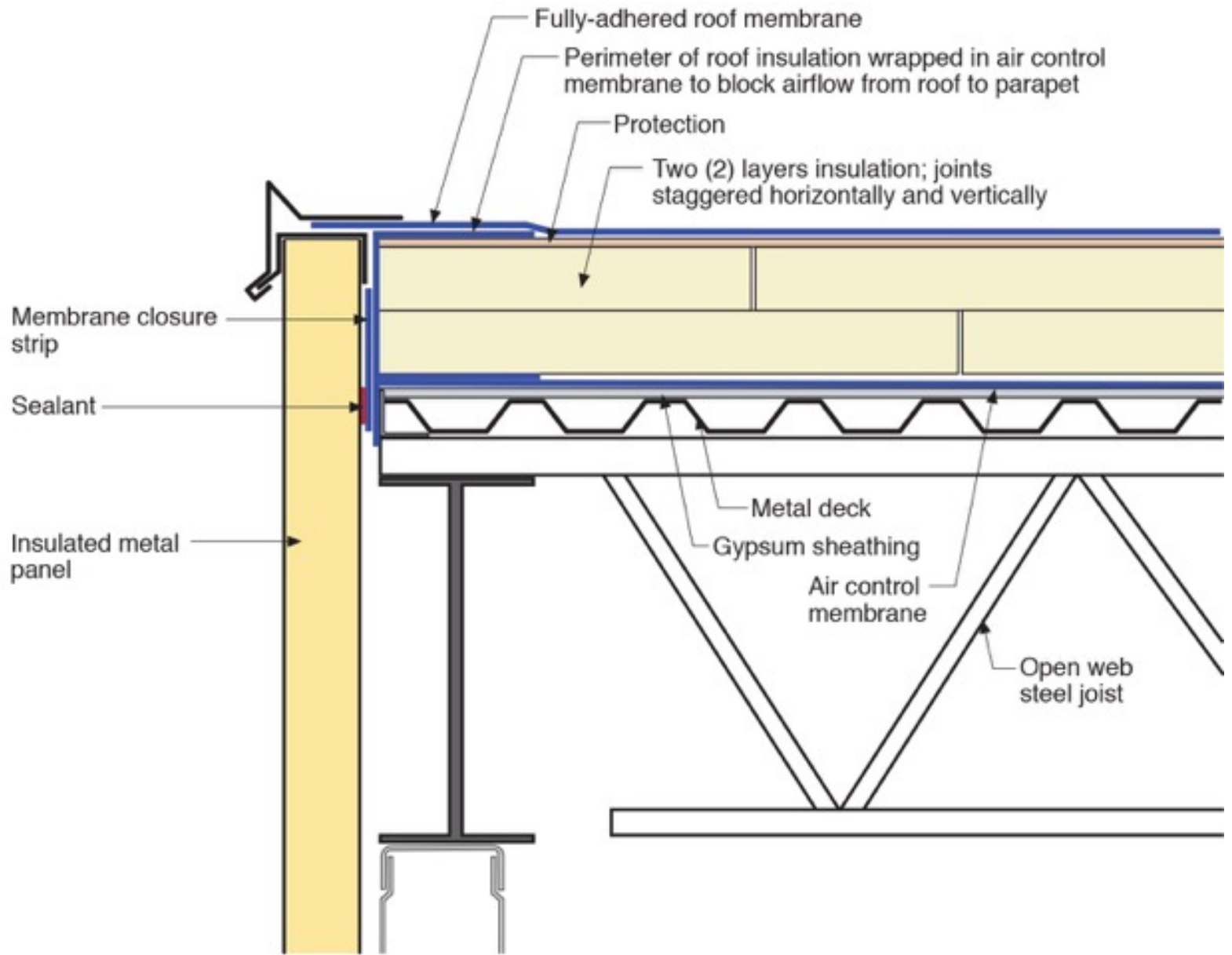












It's a Case of Black or White

It's a Case of Black or White Arrhenius

It's a Case of Black or White

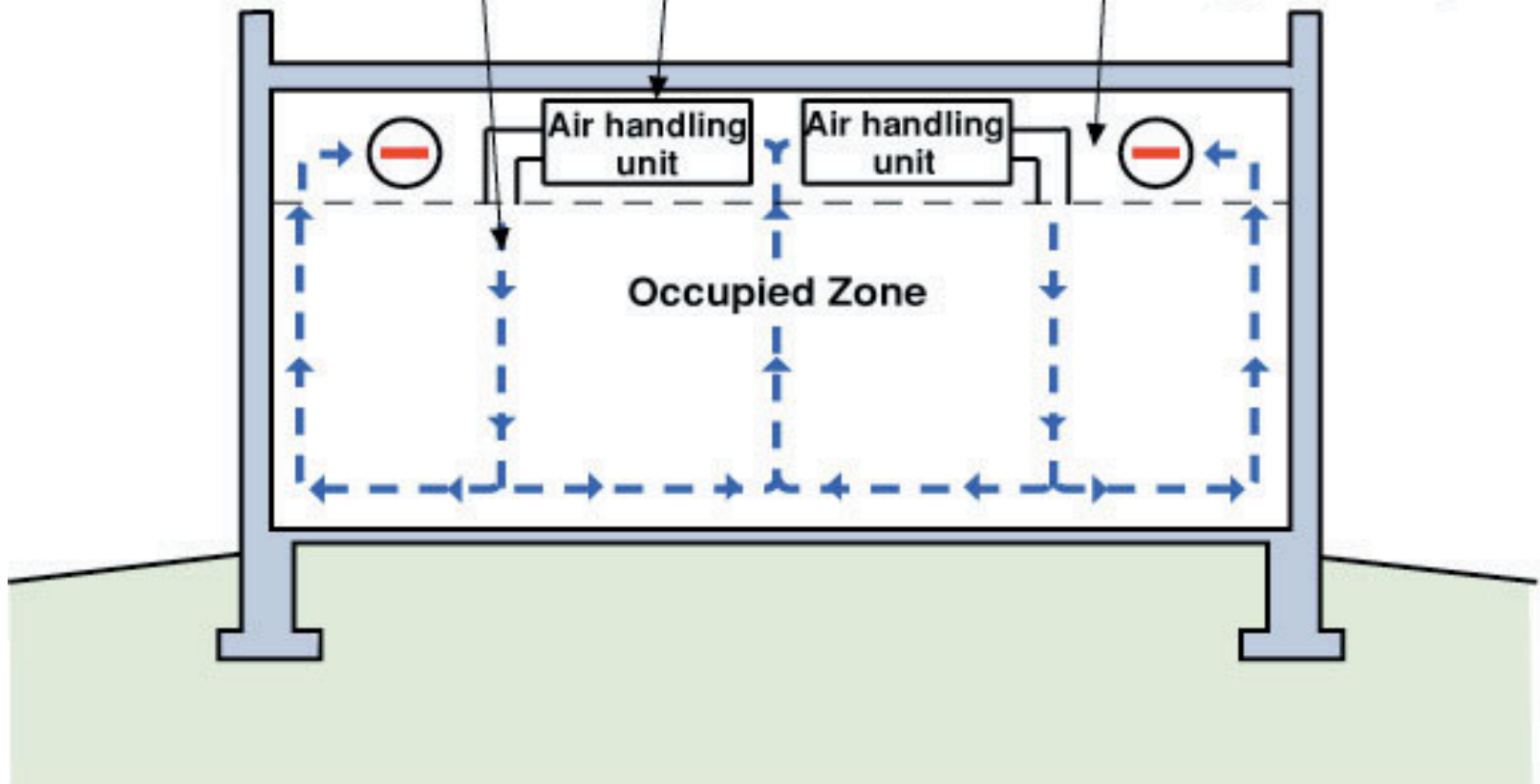
Arrhenius

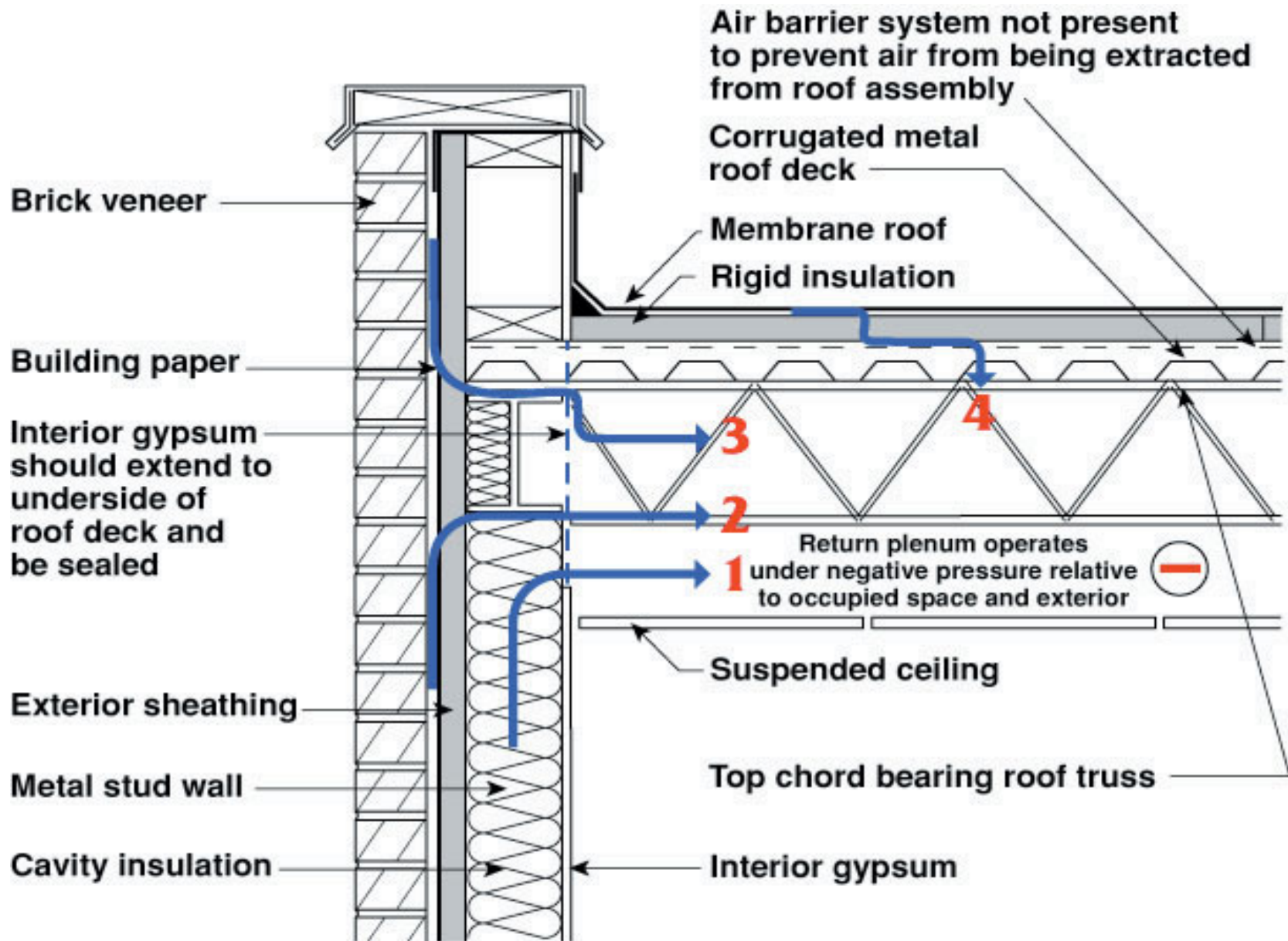
Every 10 degrees C – double the “badness”

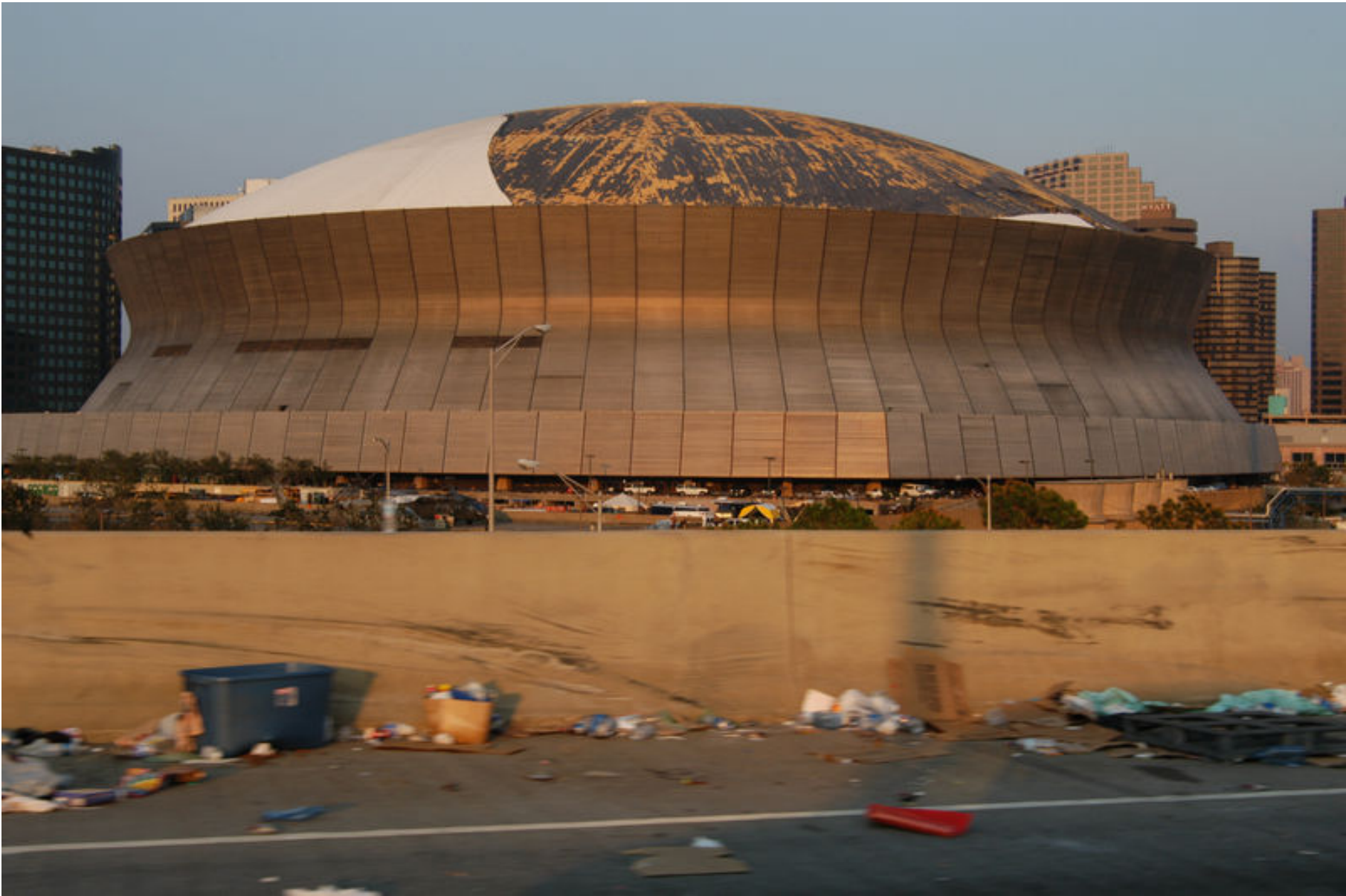
Supply air into occupied zone returns to AHU by passing through deliberately porous dropped ceiling or through return grilles installed in dropped ceiling

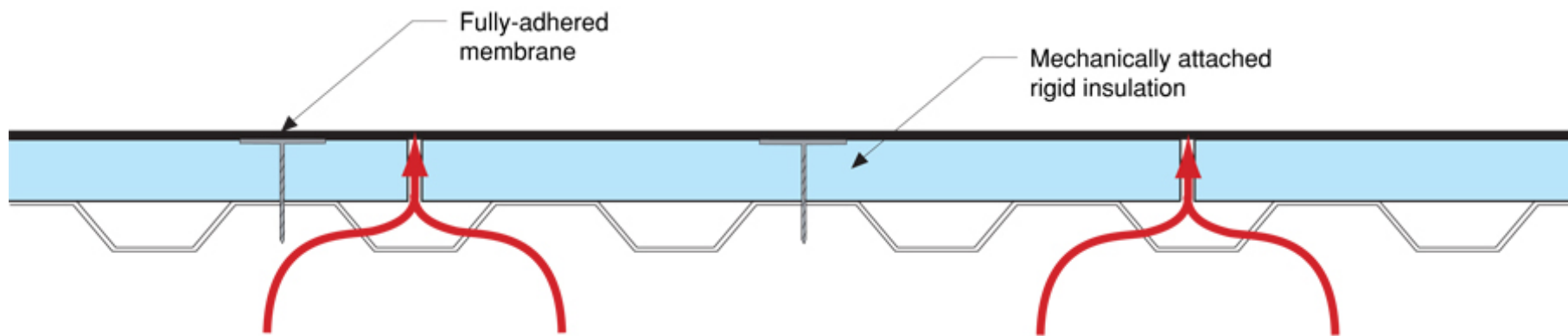
Air handling unit extracts air from dropped ceiling, conditions it and injects it into the occupied zones via supply ductwork

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

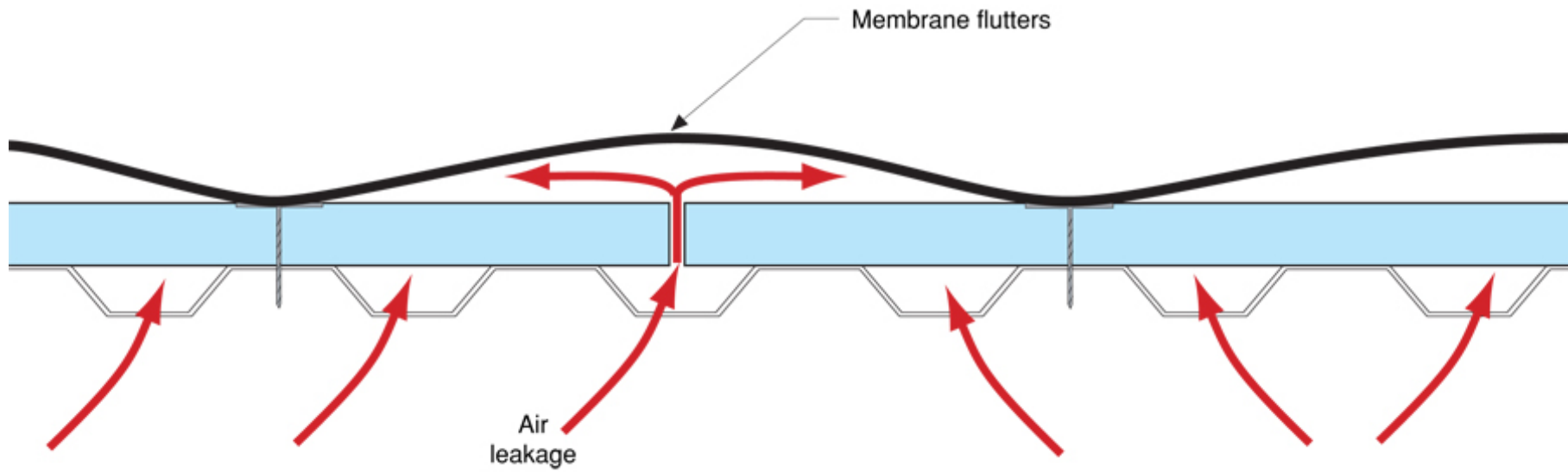










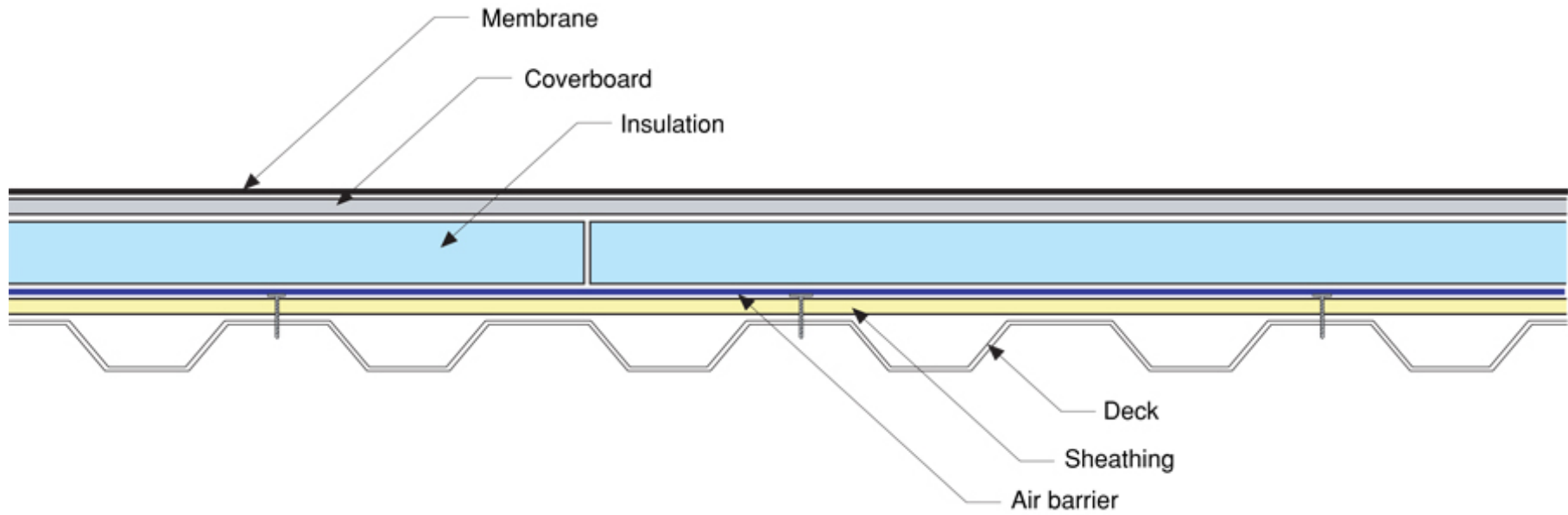




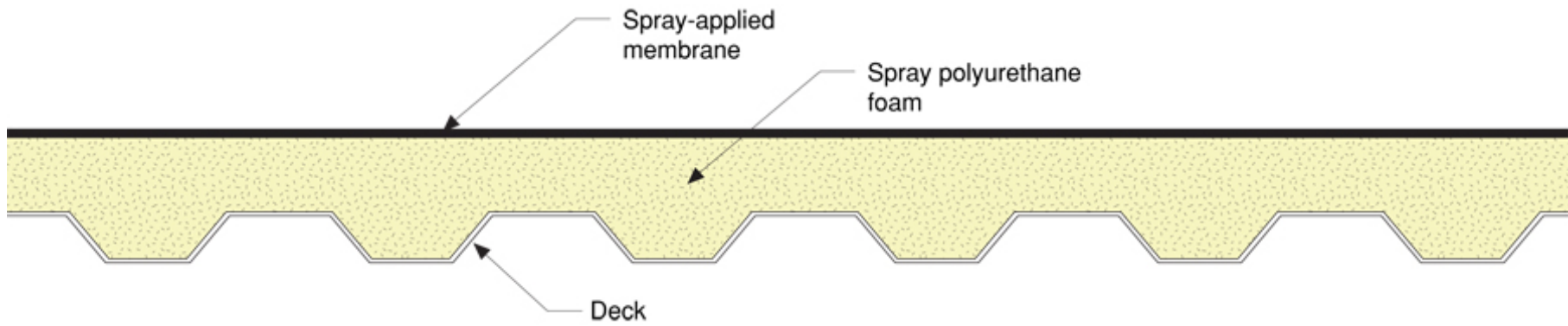




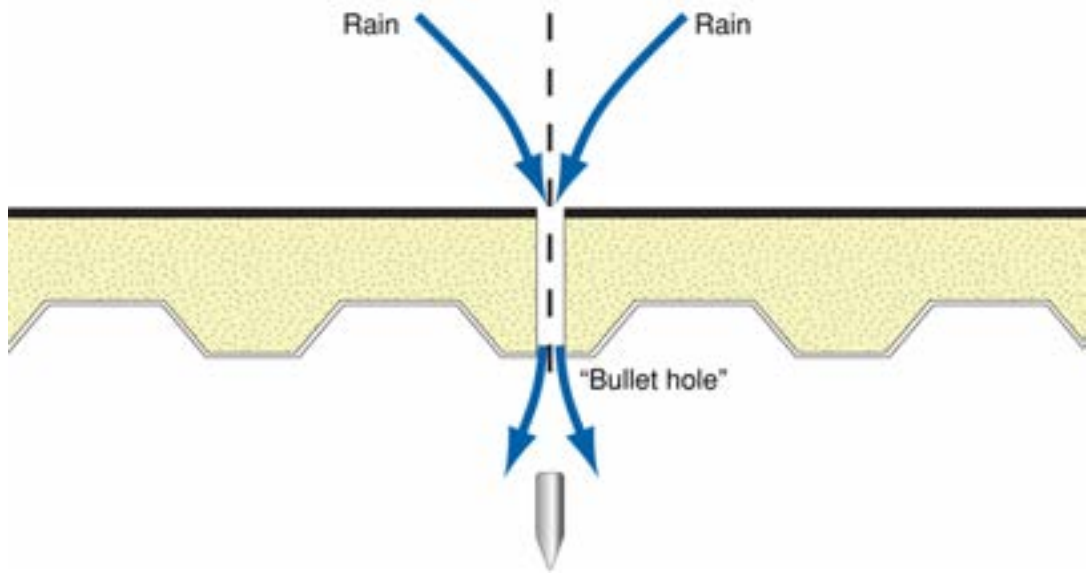
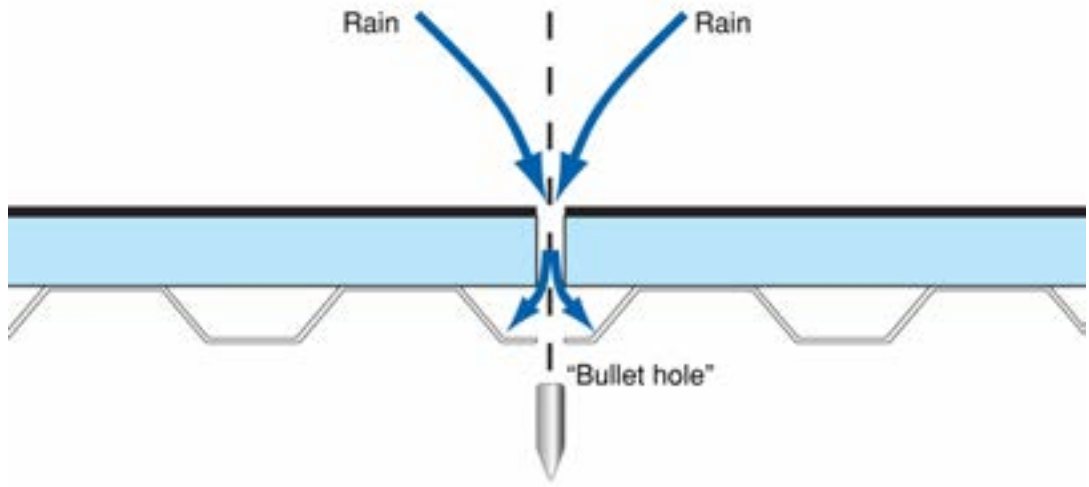








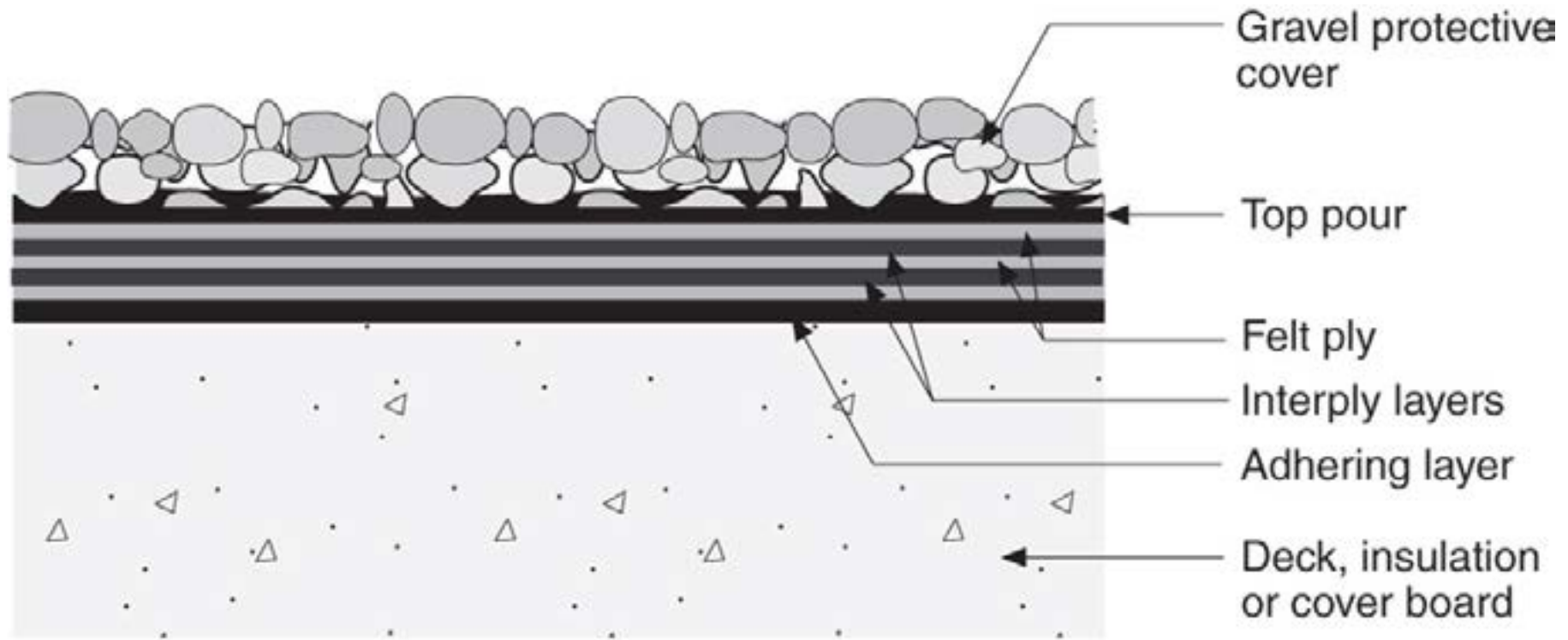




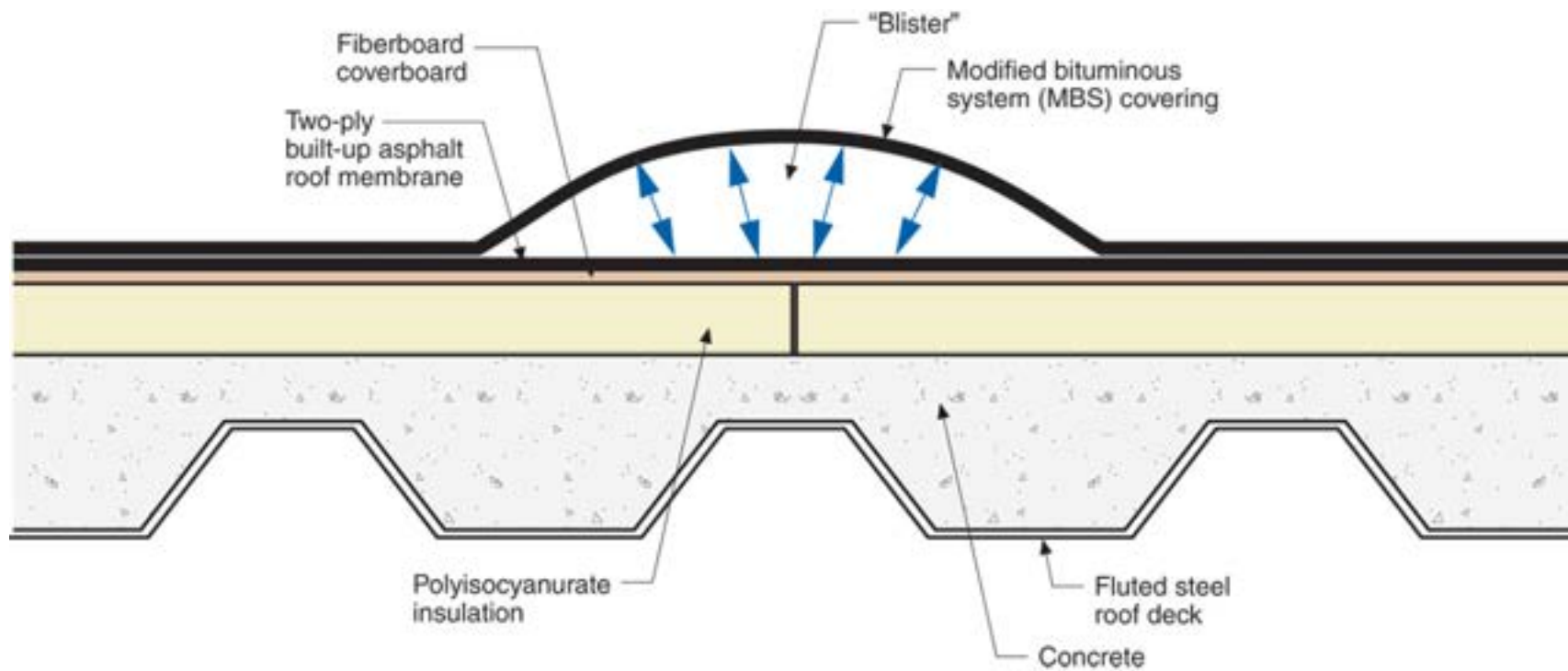


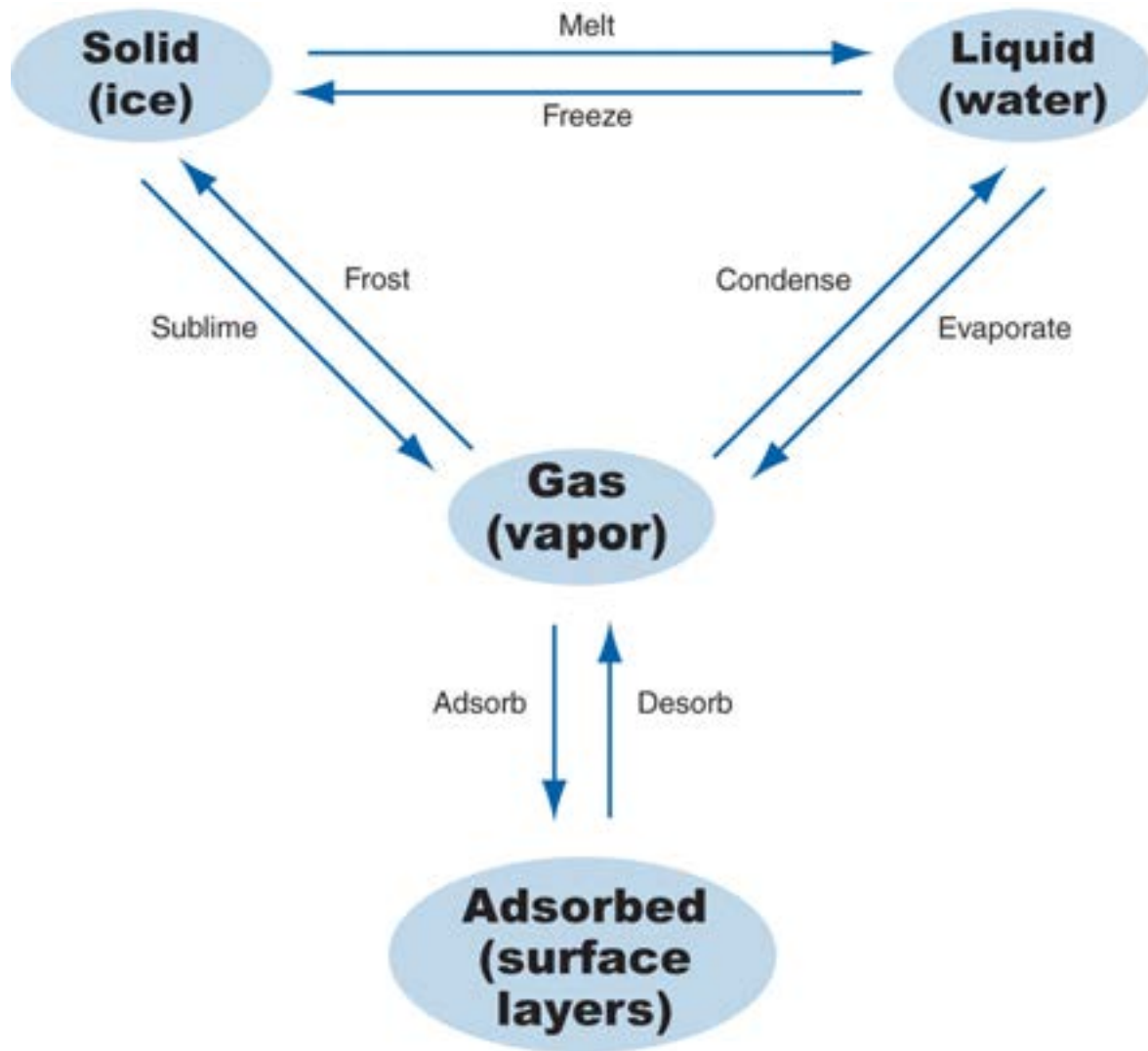






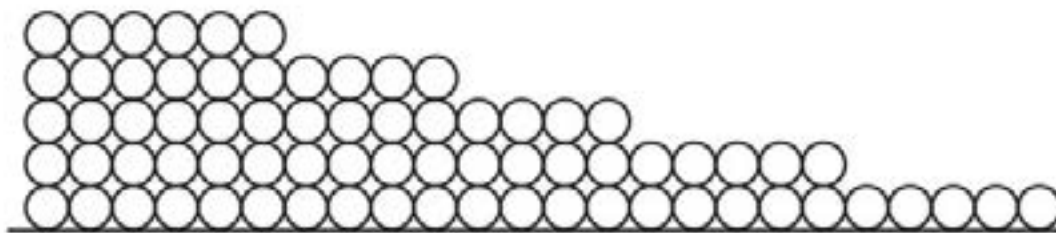
From Baker, M.; Roofs, 1980



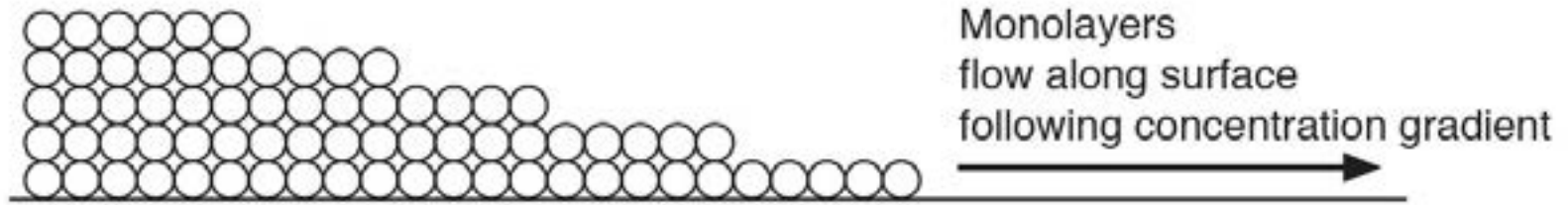


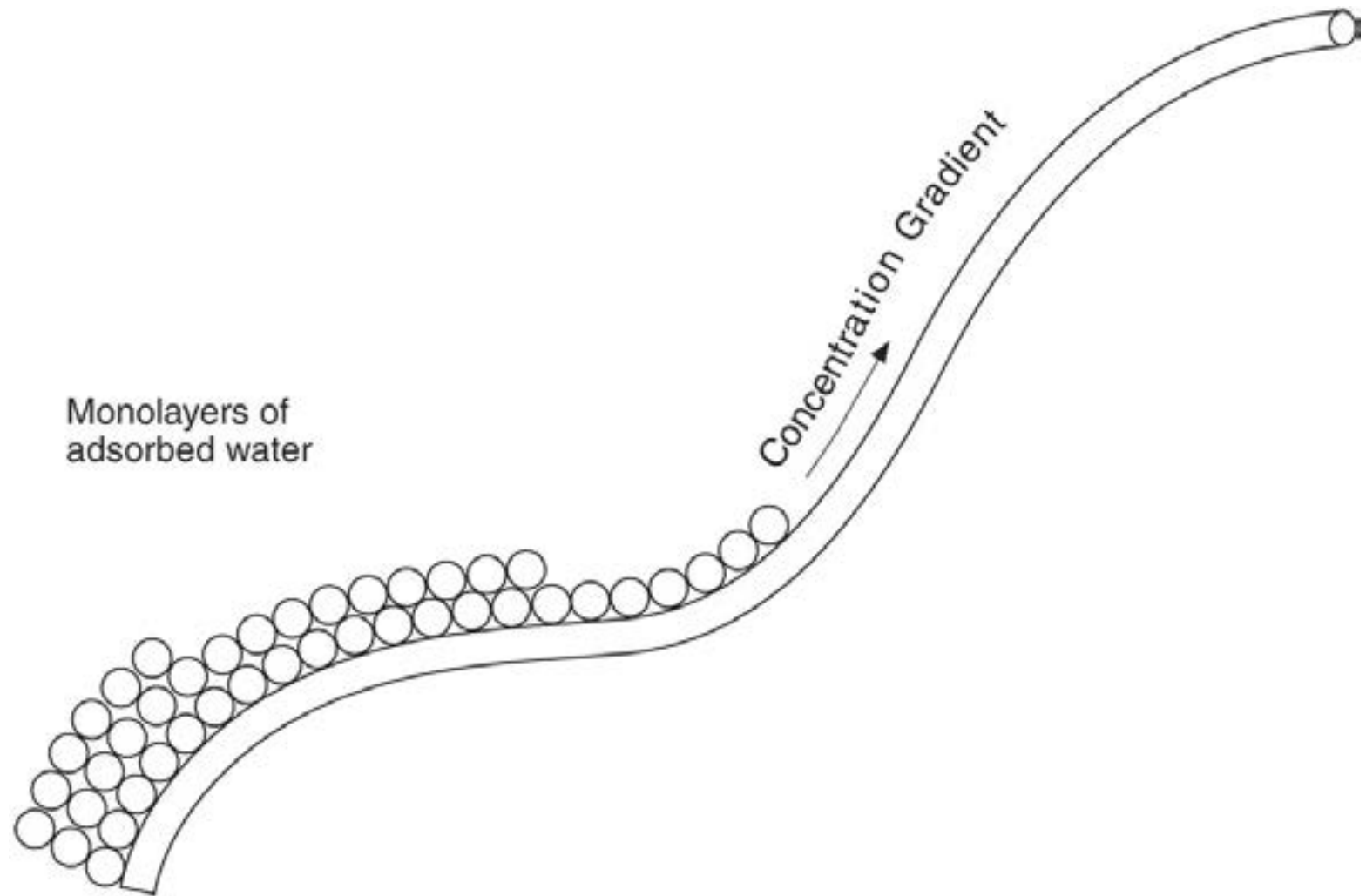
Moisture Transport in Porous Media

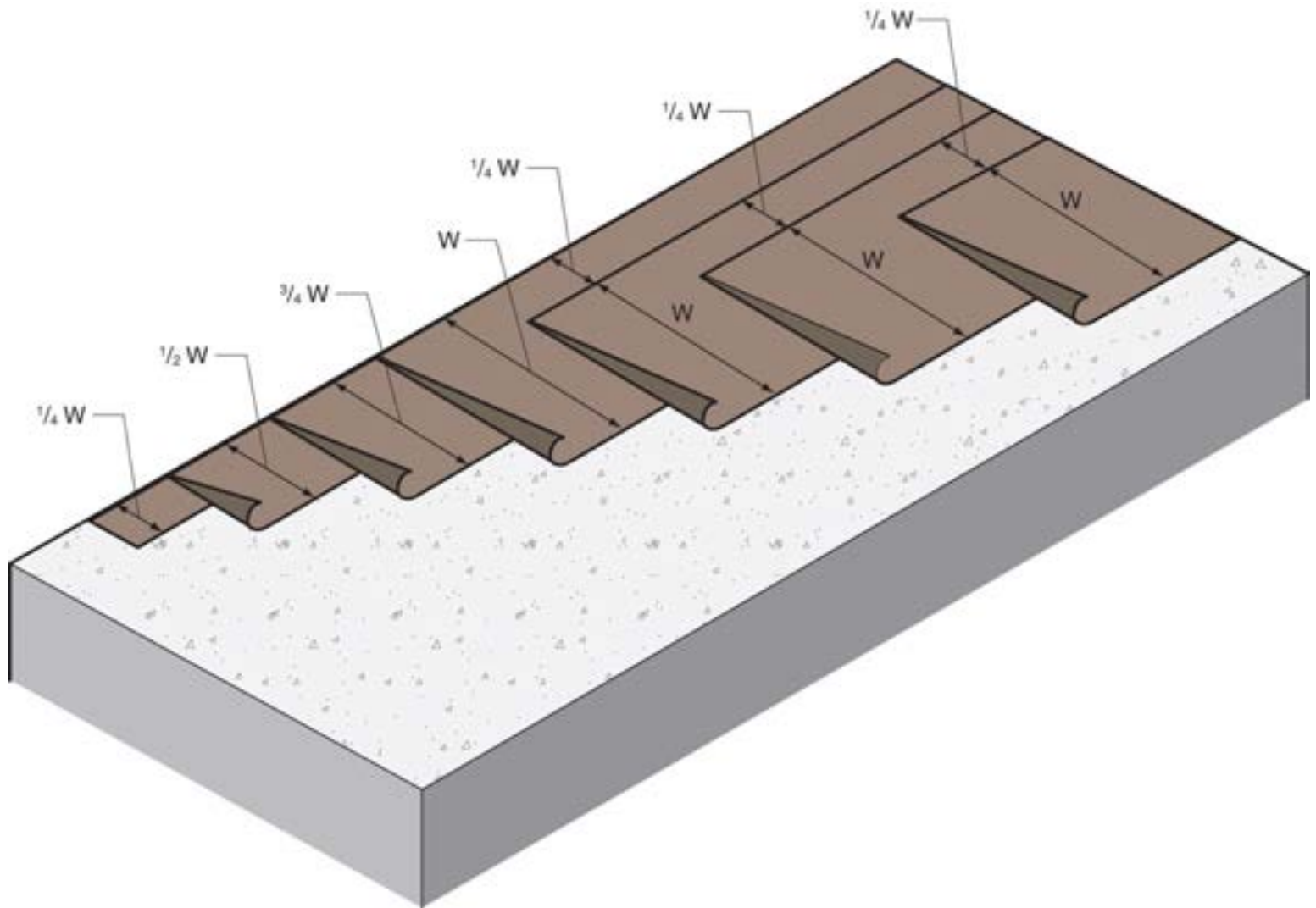
Phase	Transport Process	Driving Potential
Vapor	Diffusion	Vapor Concentration
Adsorbate	Surface Diffusion	Concentration
Liquid	Capillary Flow	Suction Pressure
	Osmosis	Solute Concentration

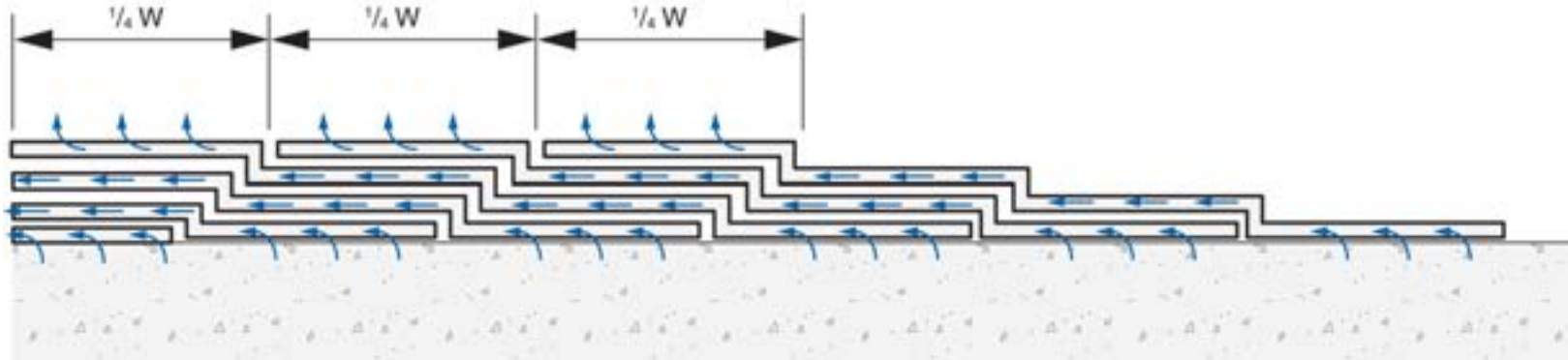


Monolayers of adsorbed water increase with increasing RH





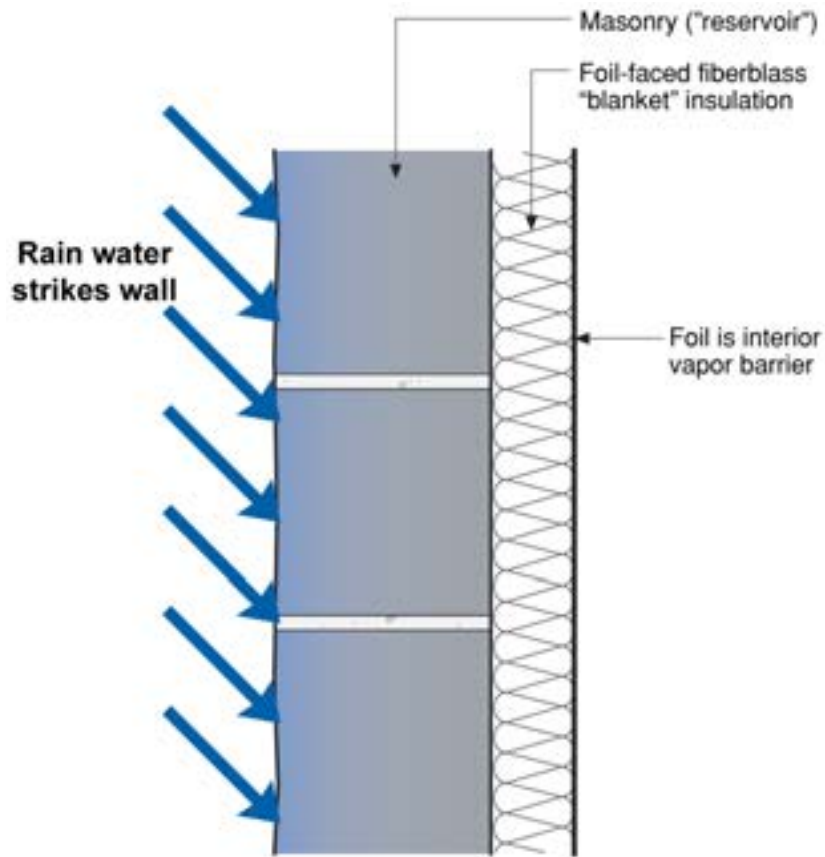






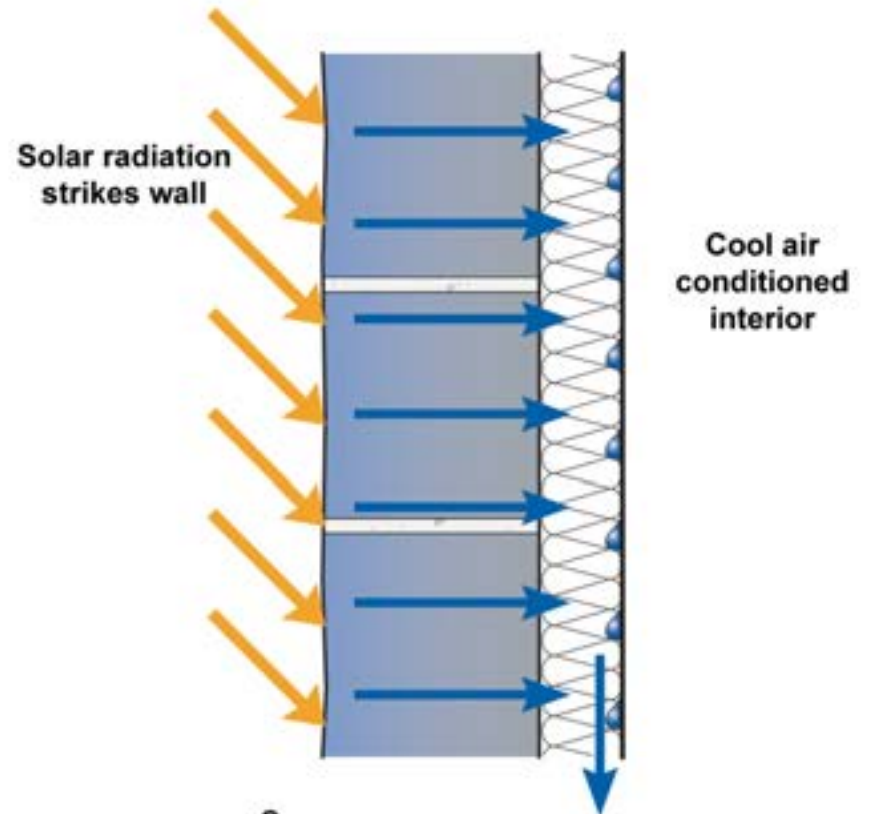






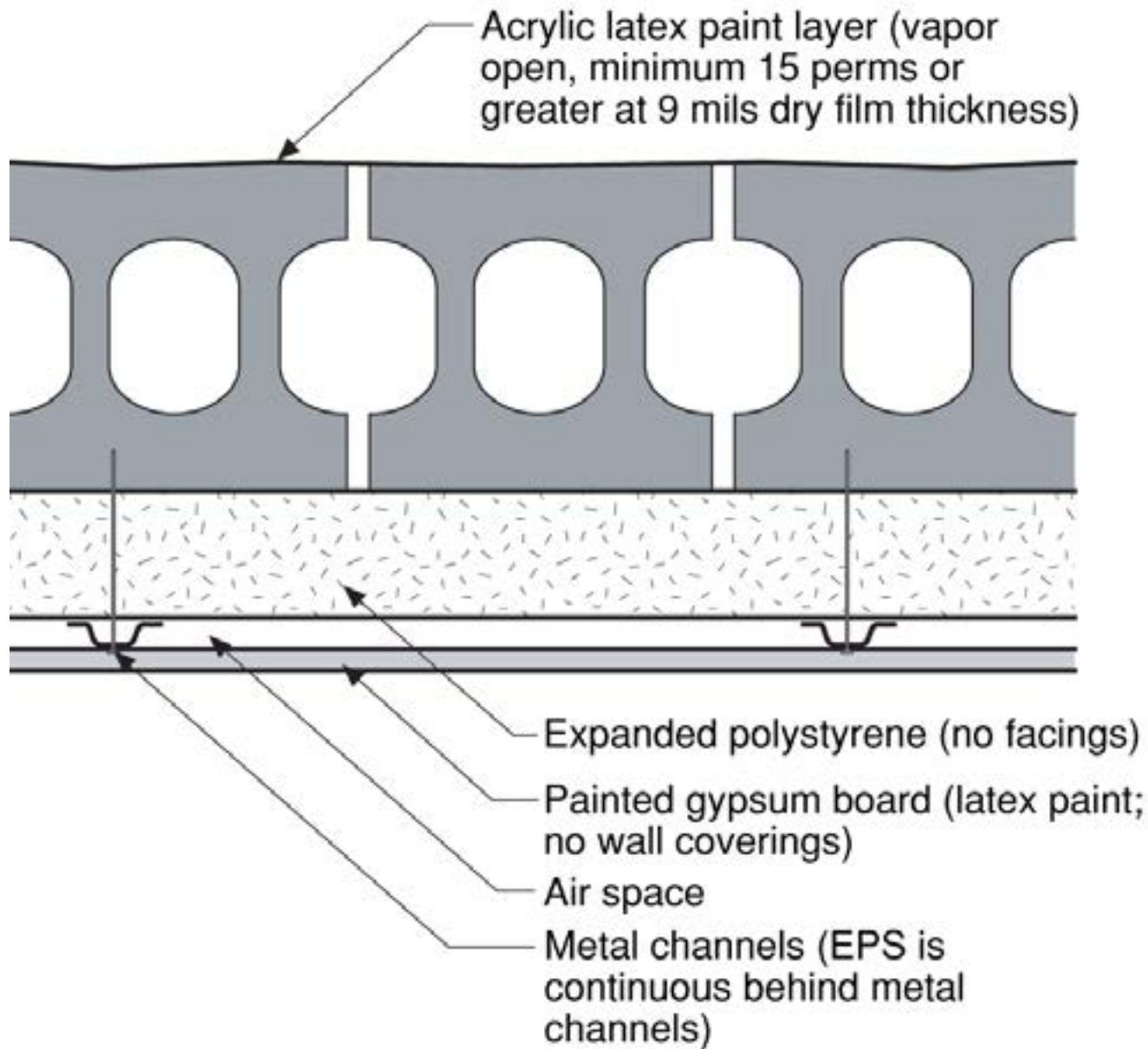
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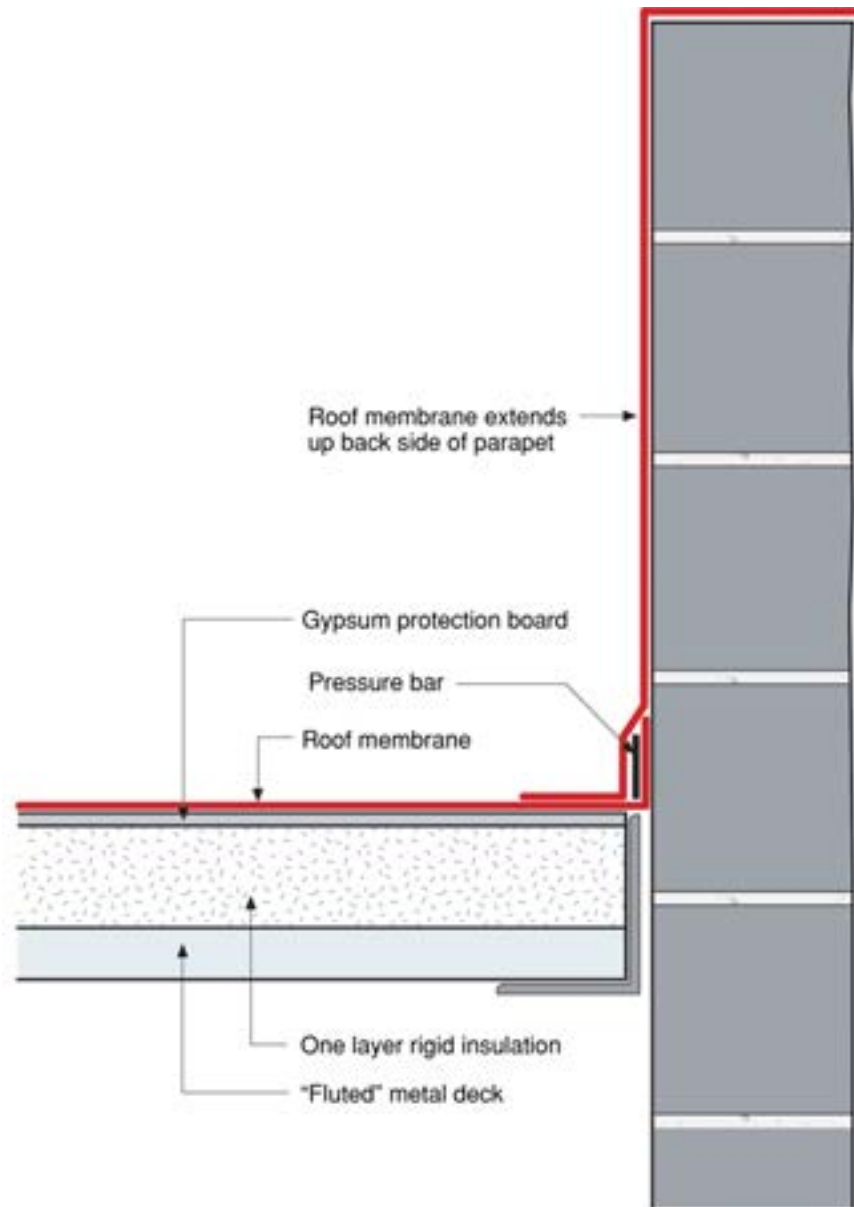
- Rain water is deposited on exterior face of masonry
- Rain water enters masonry through paint layer

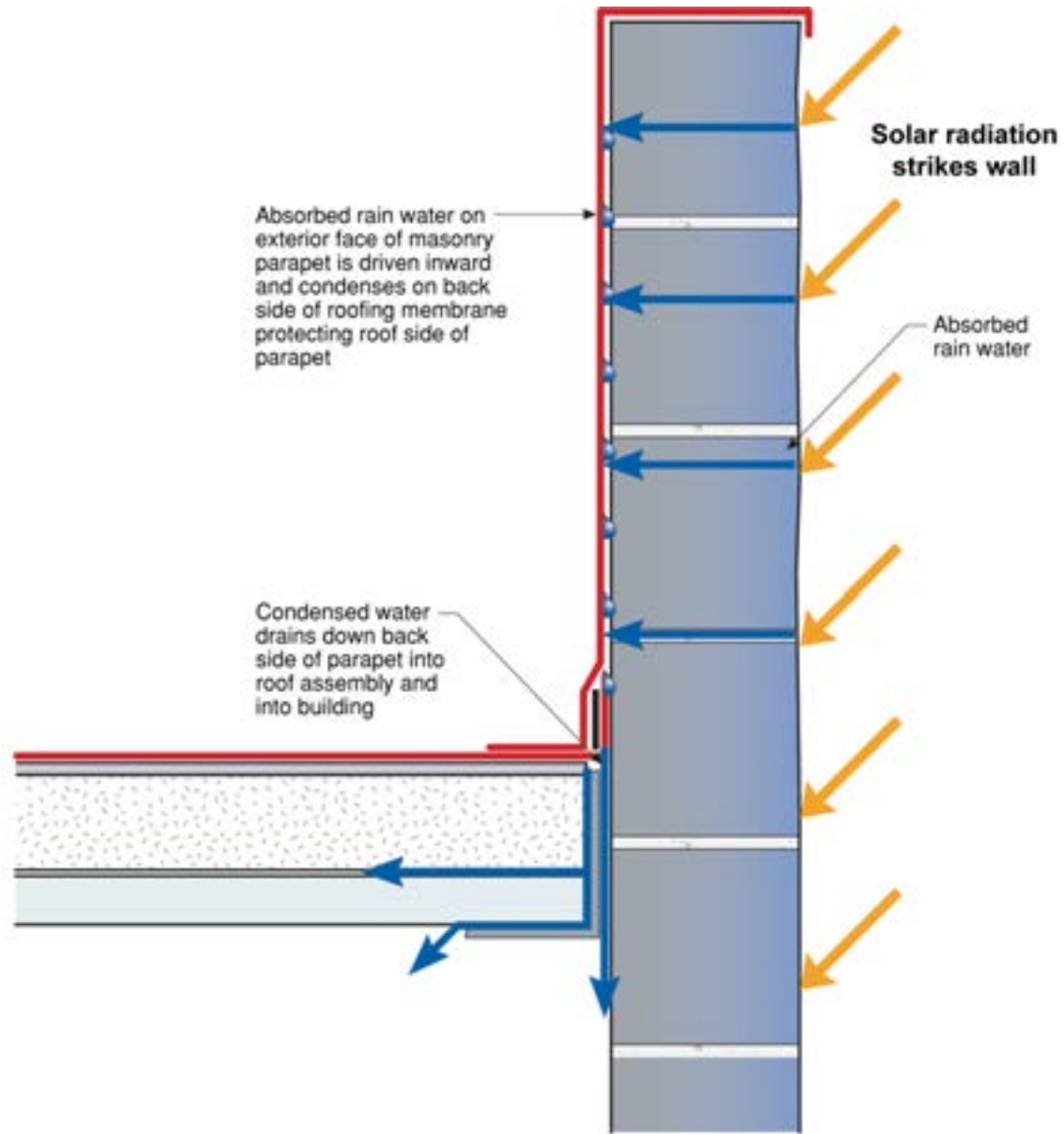


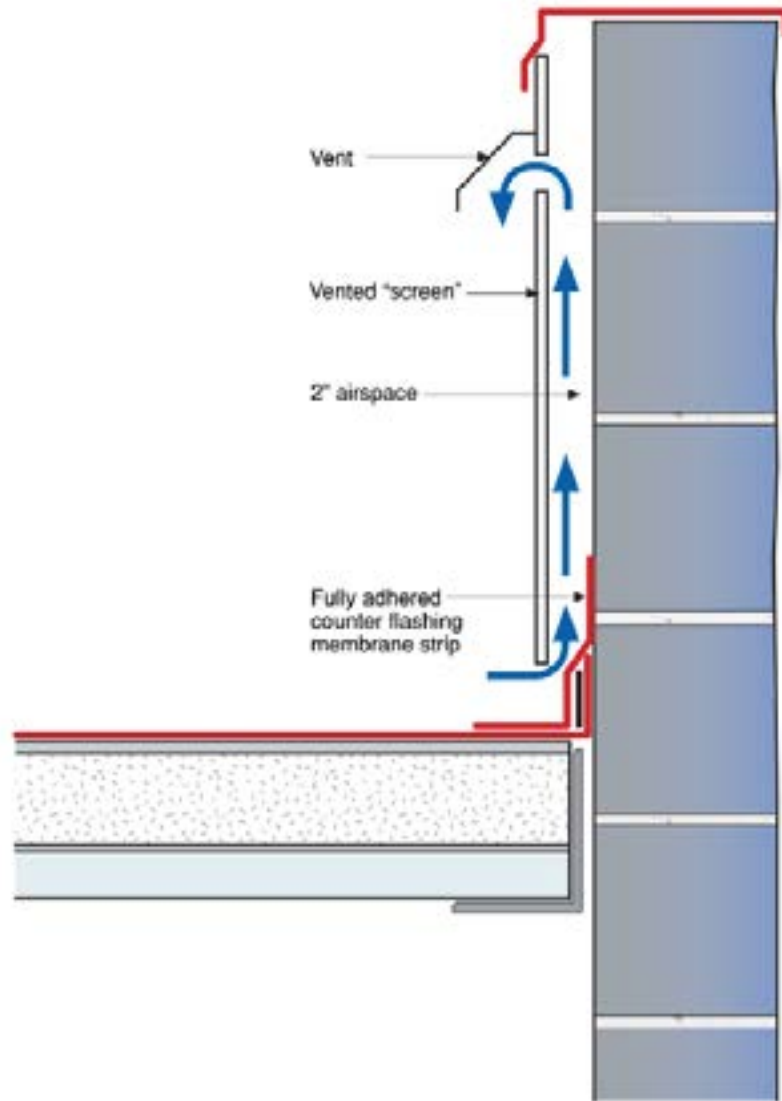
2.

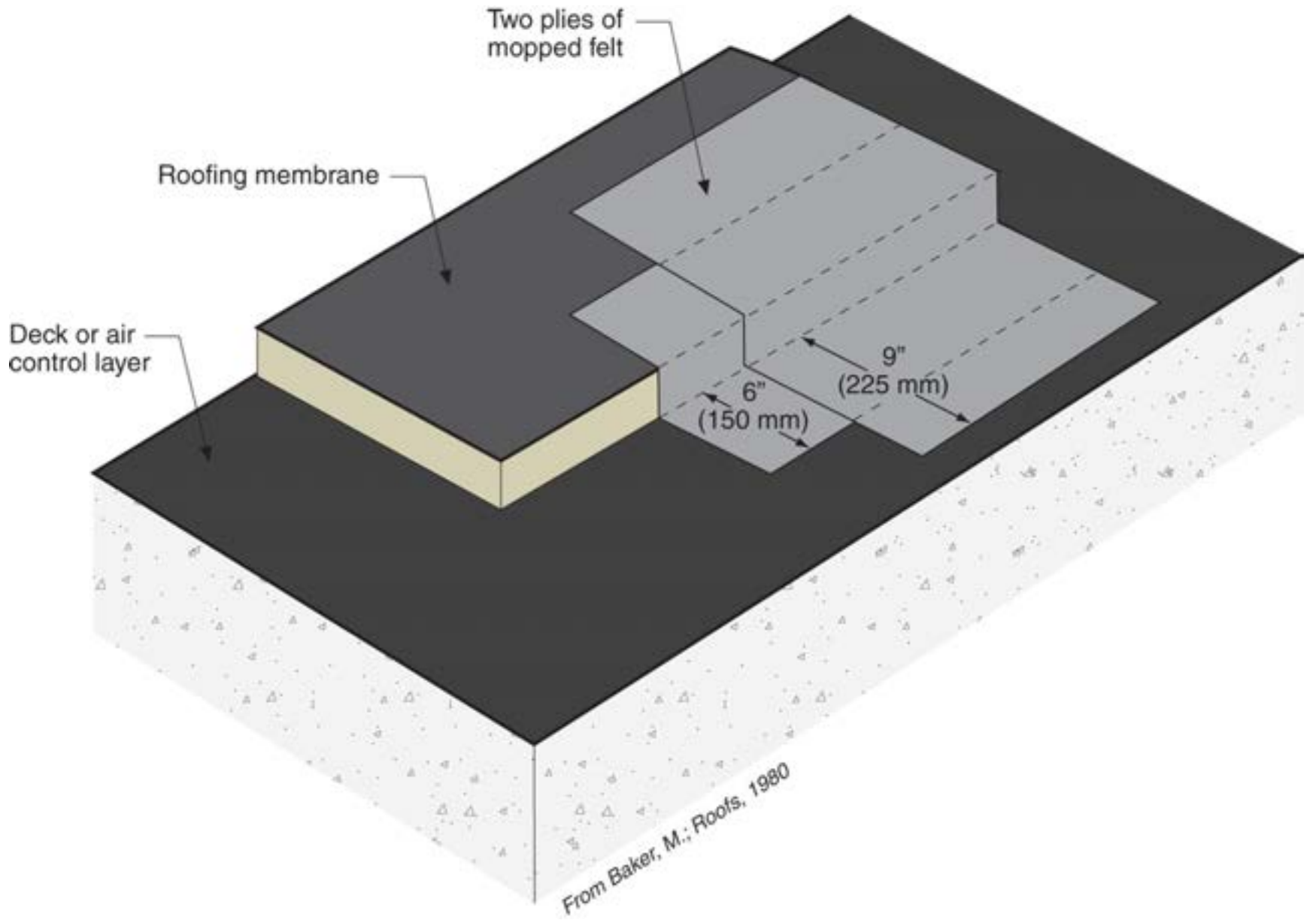
- Solar radiation heats exterior while A/C cools interior
- Moisture is driven inward, condenses on foil vapor barrier and runs down wall

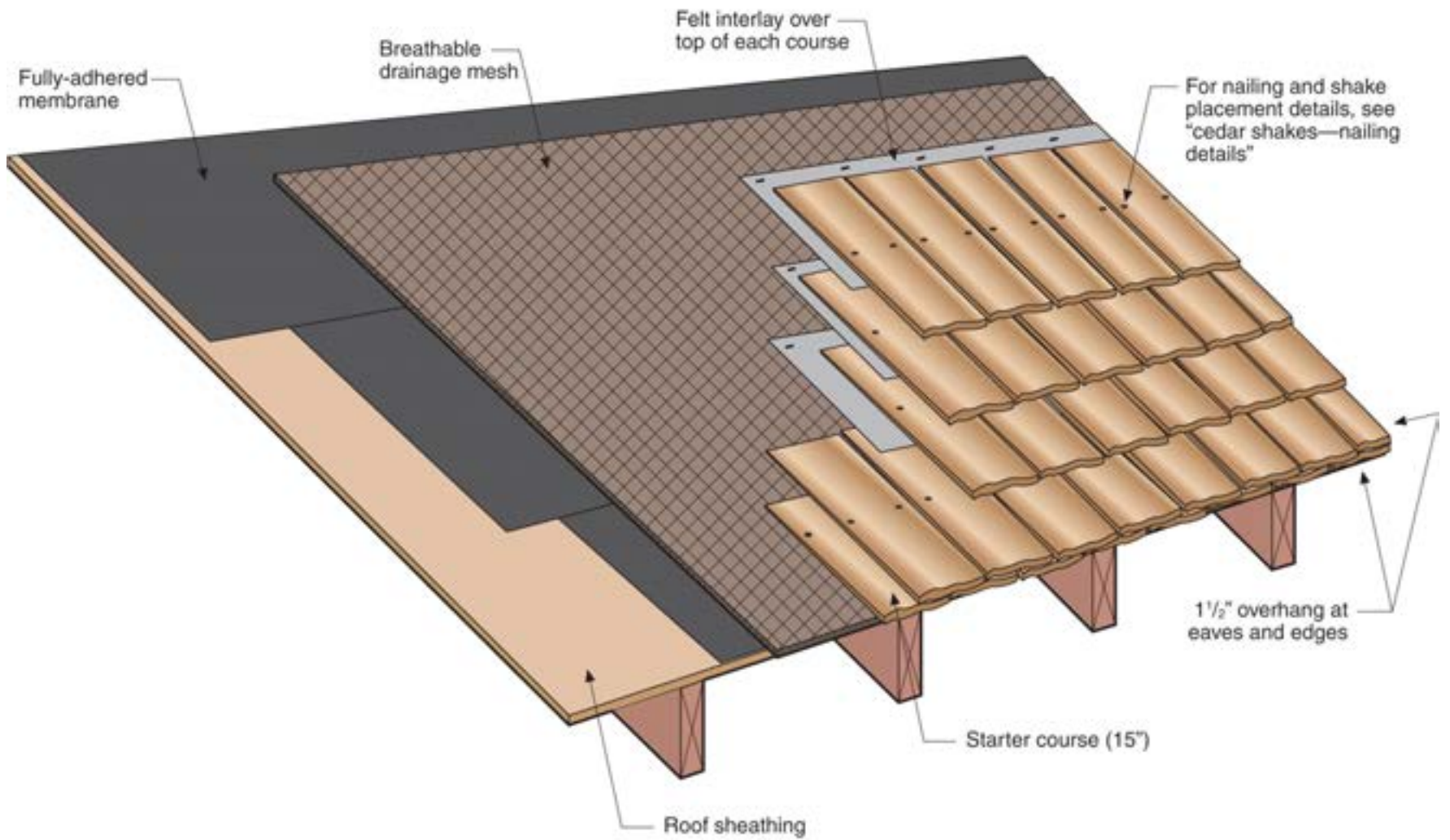


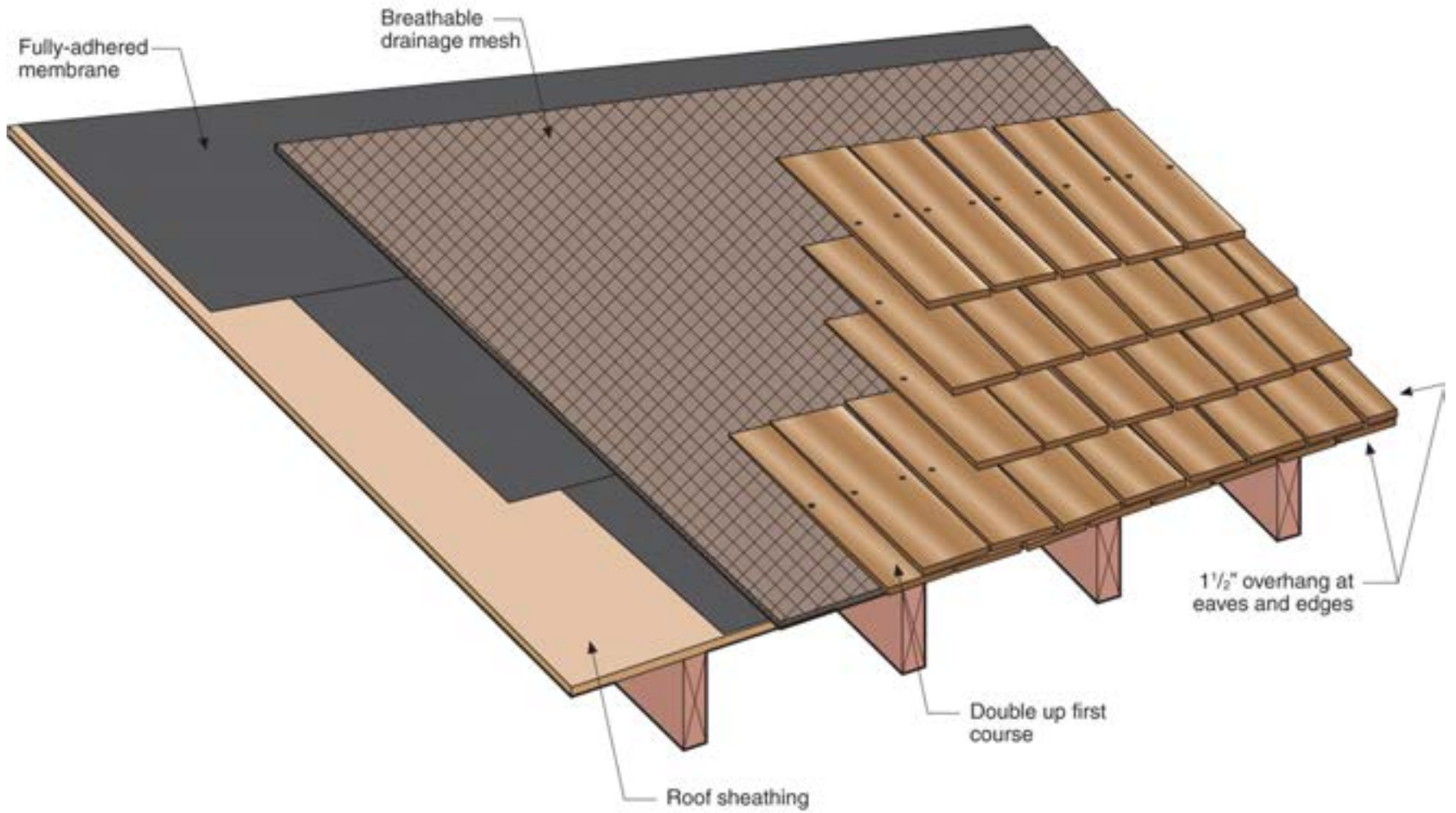


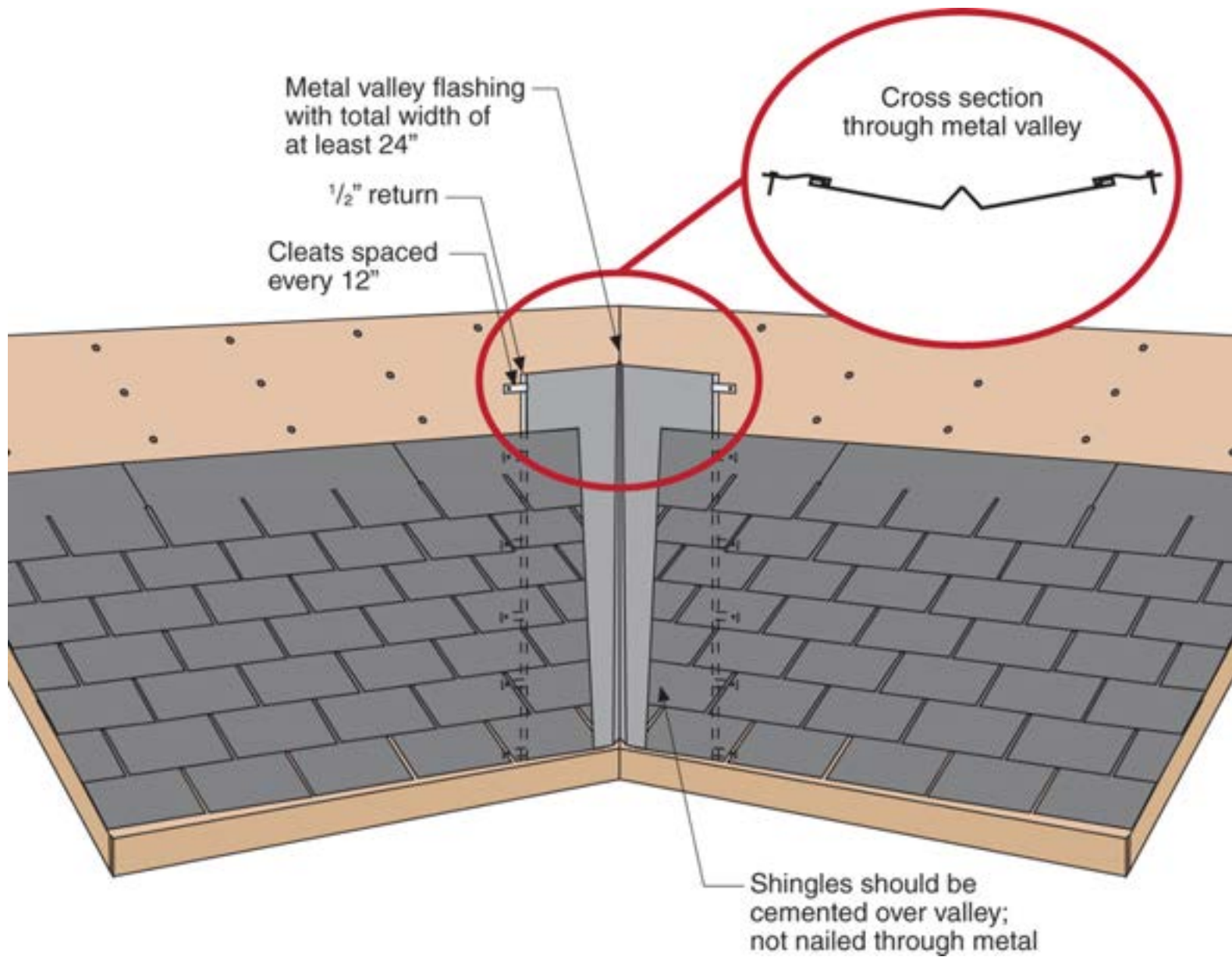


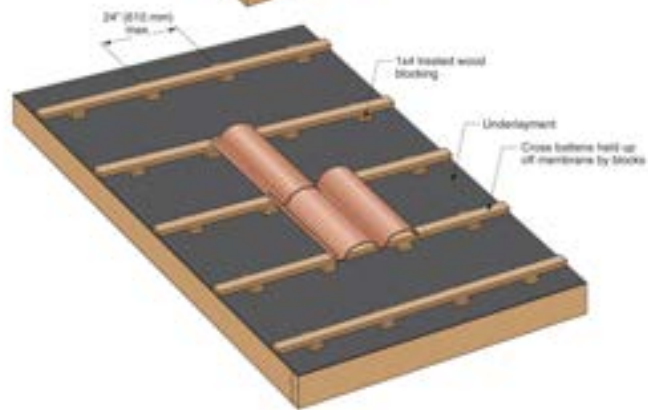
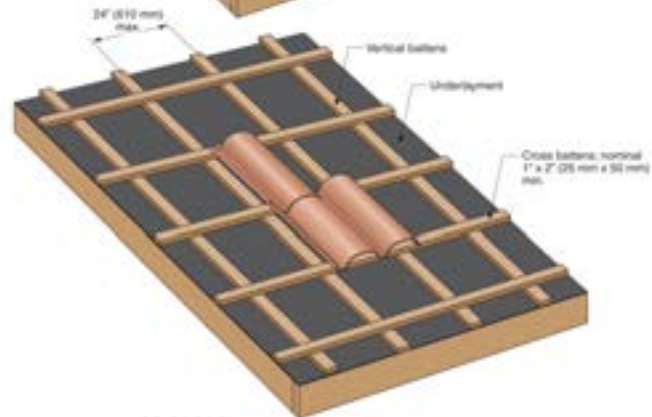
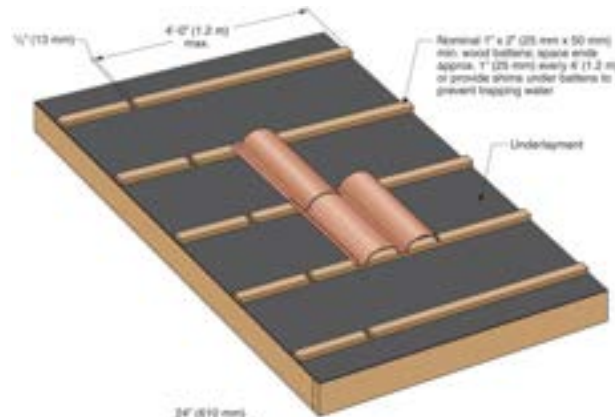








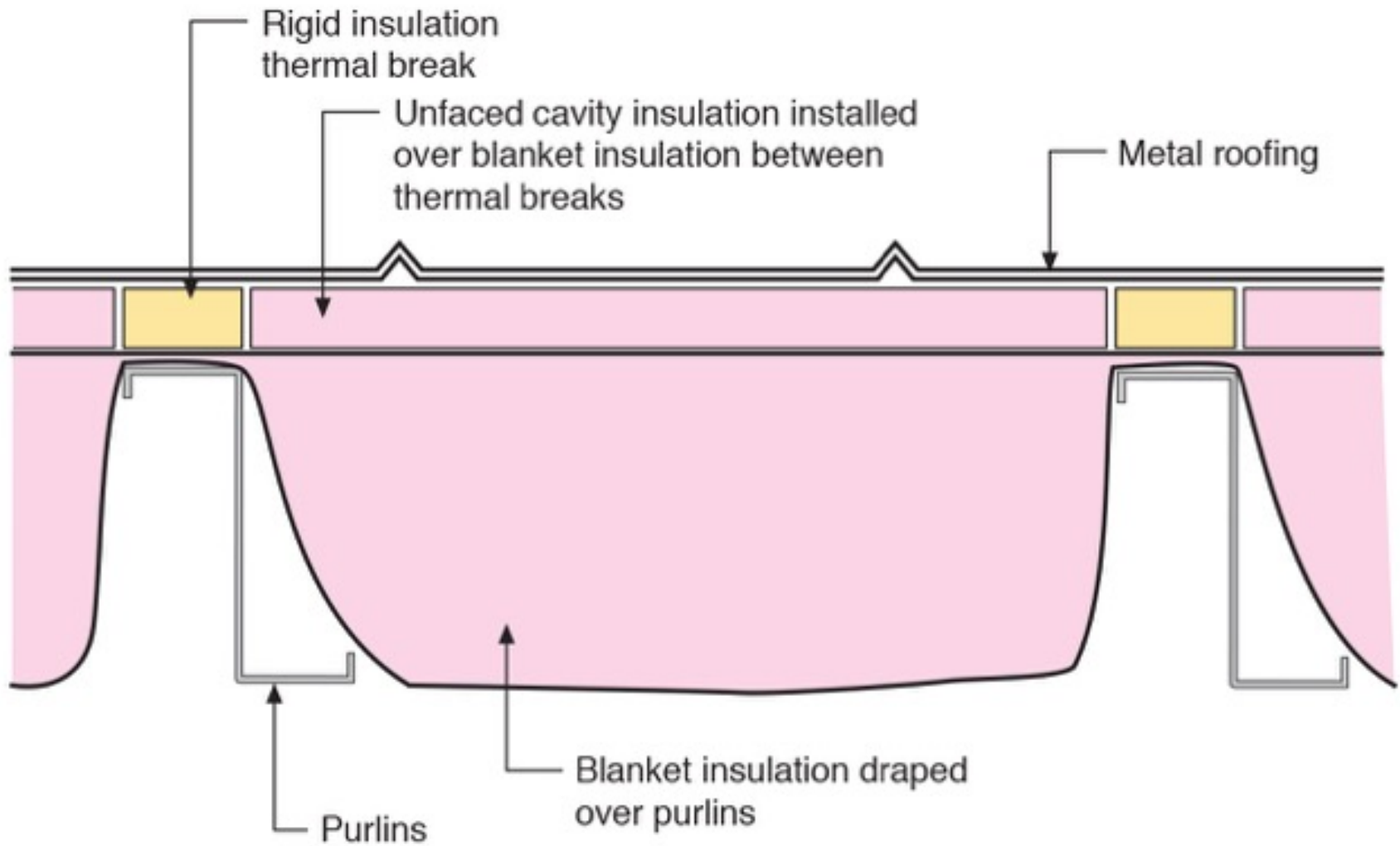












Blanket Insulation Purlin Roof System

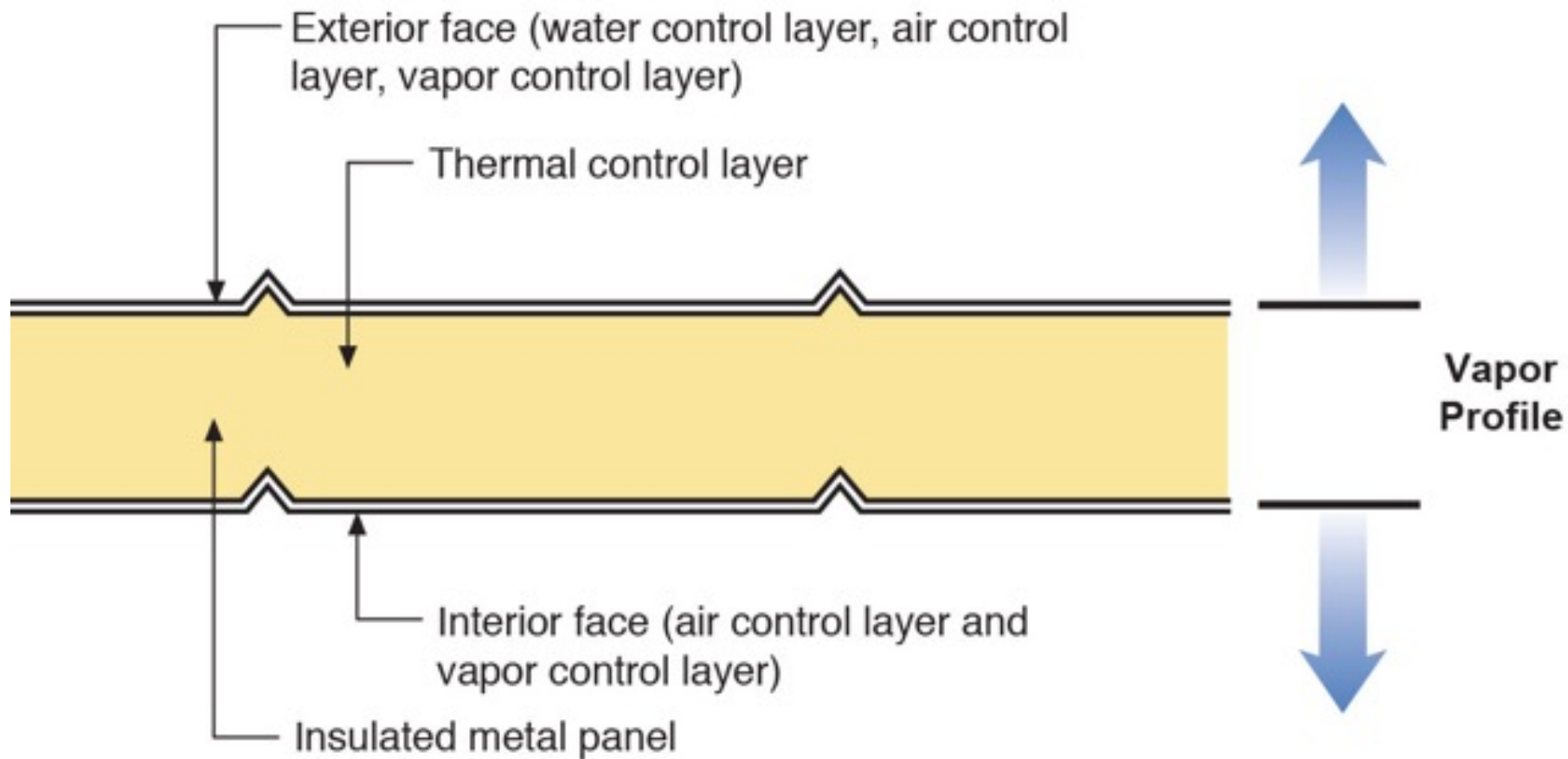


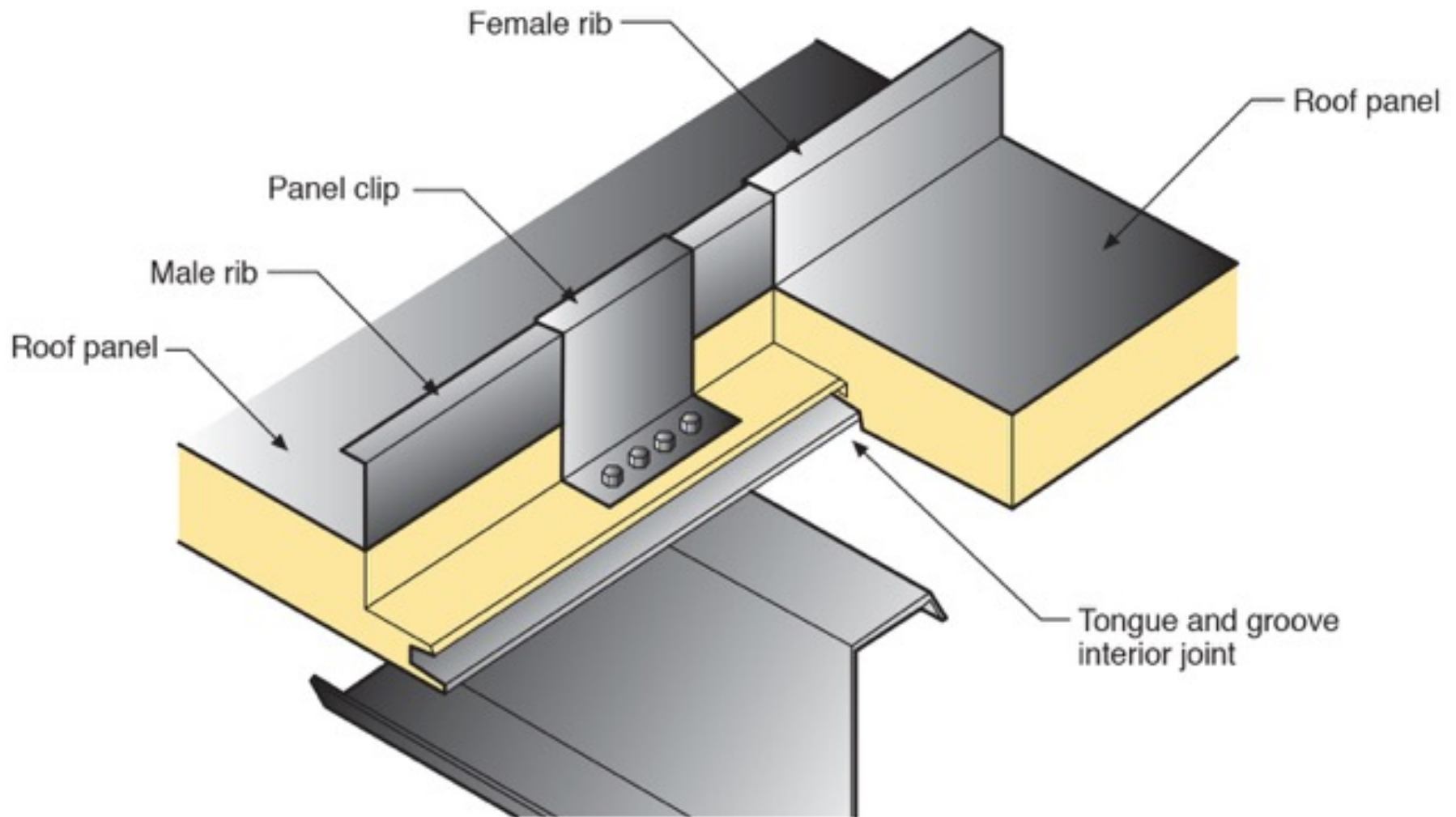




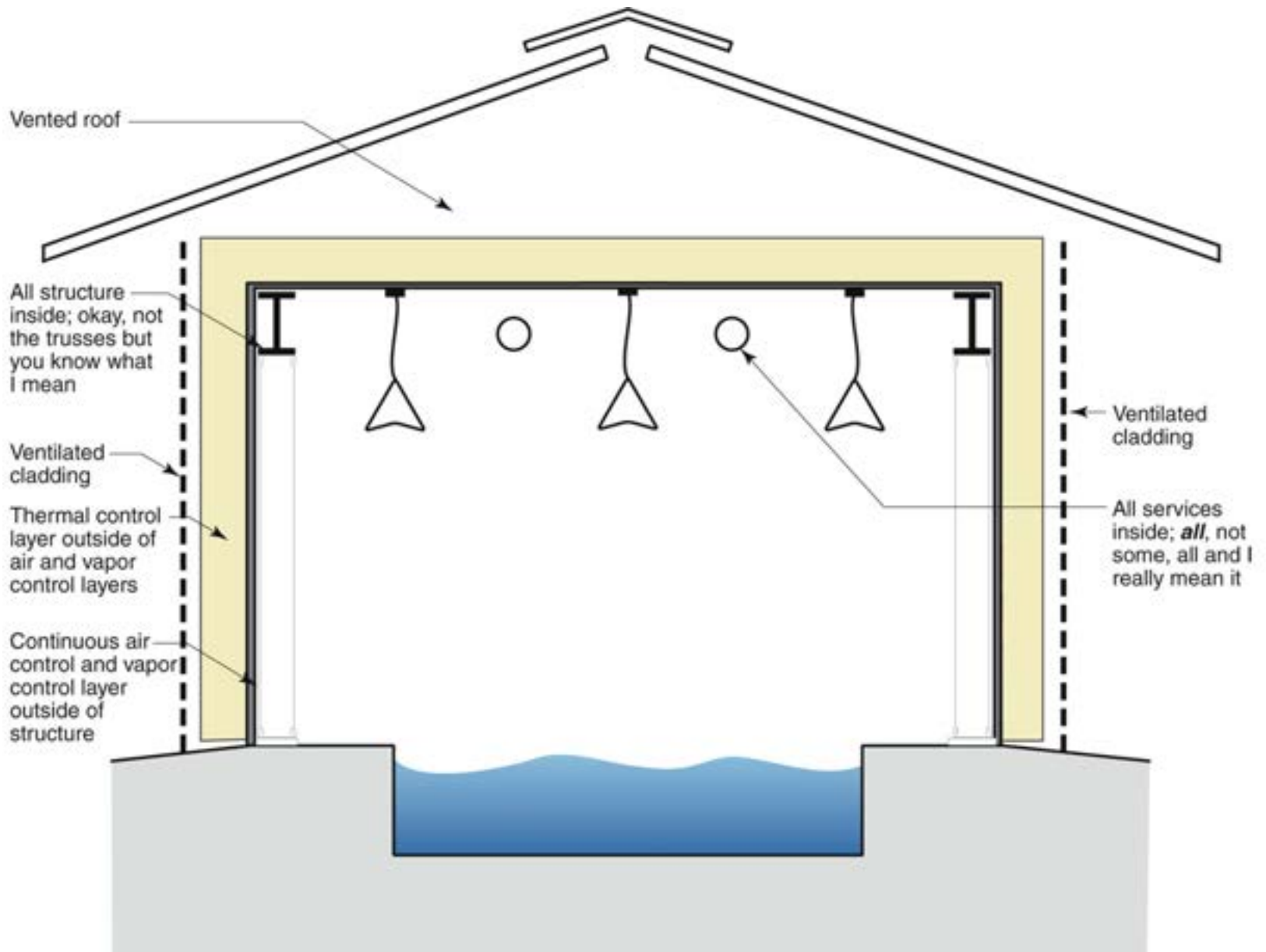


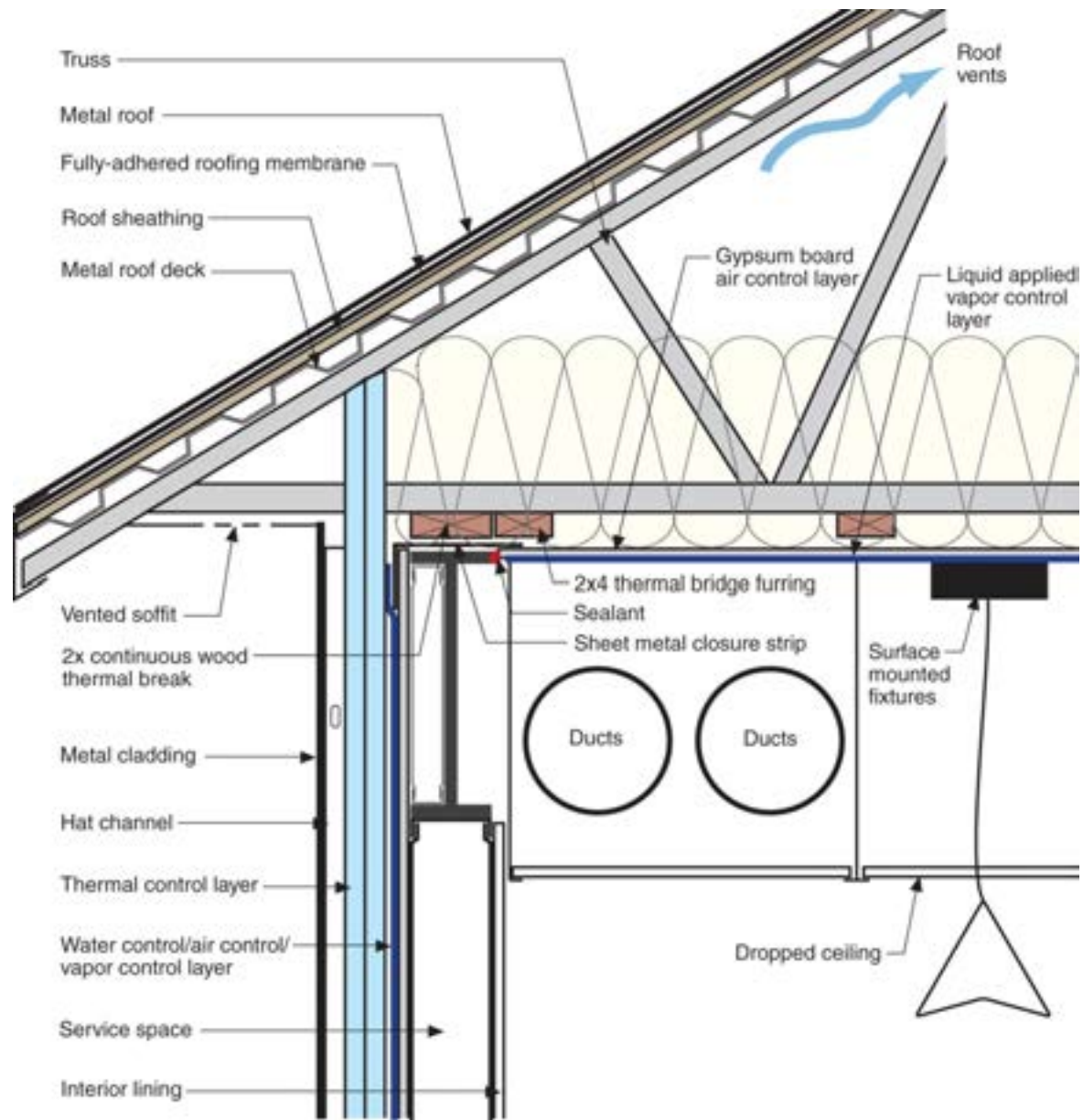


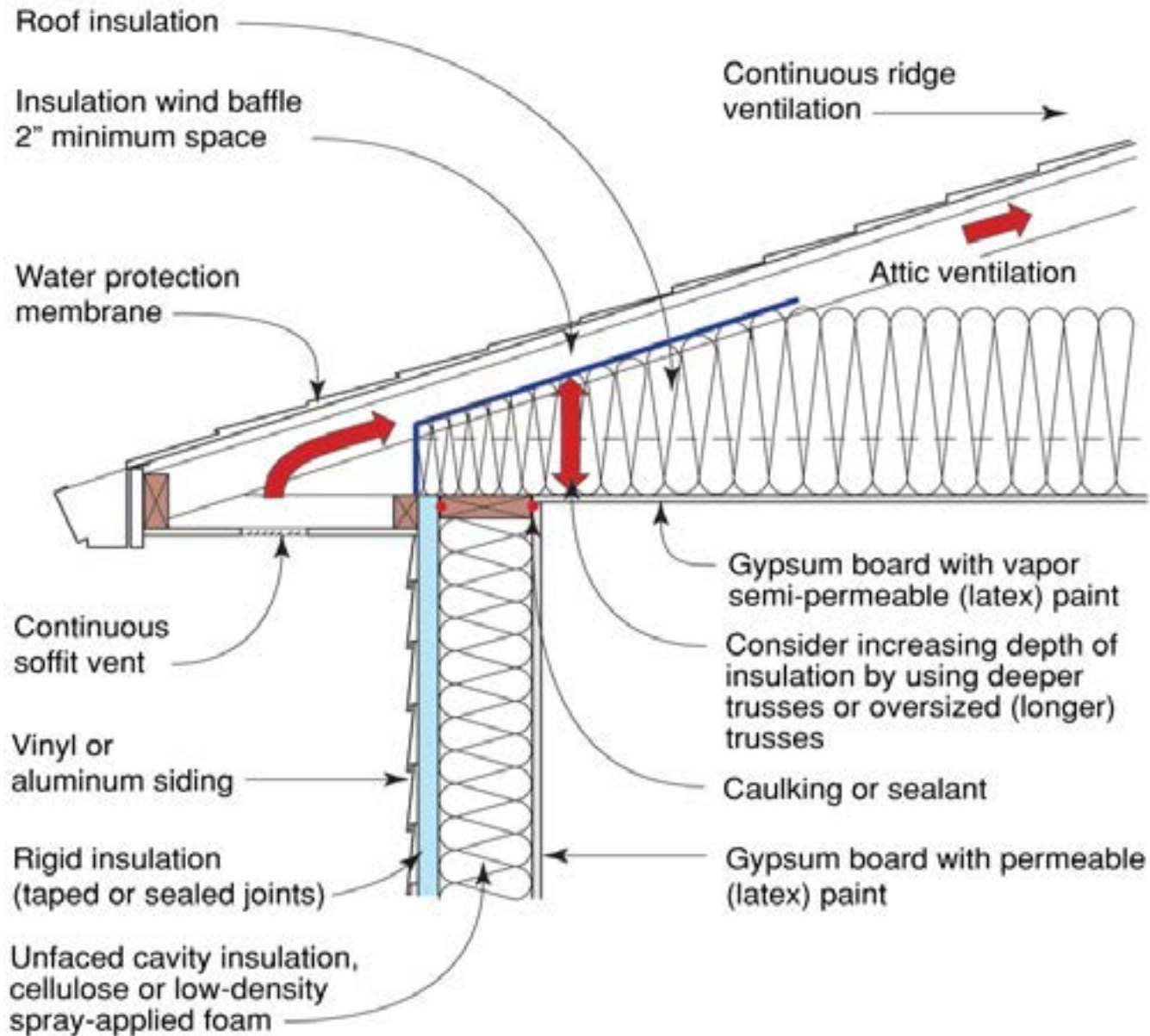




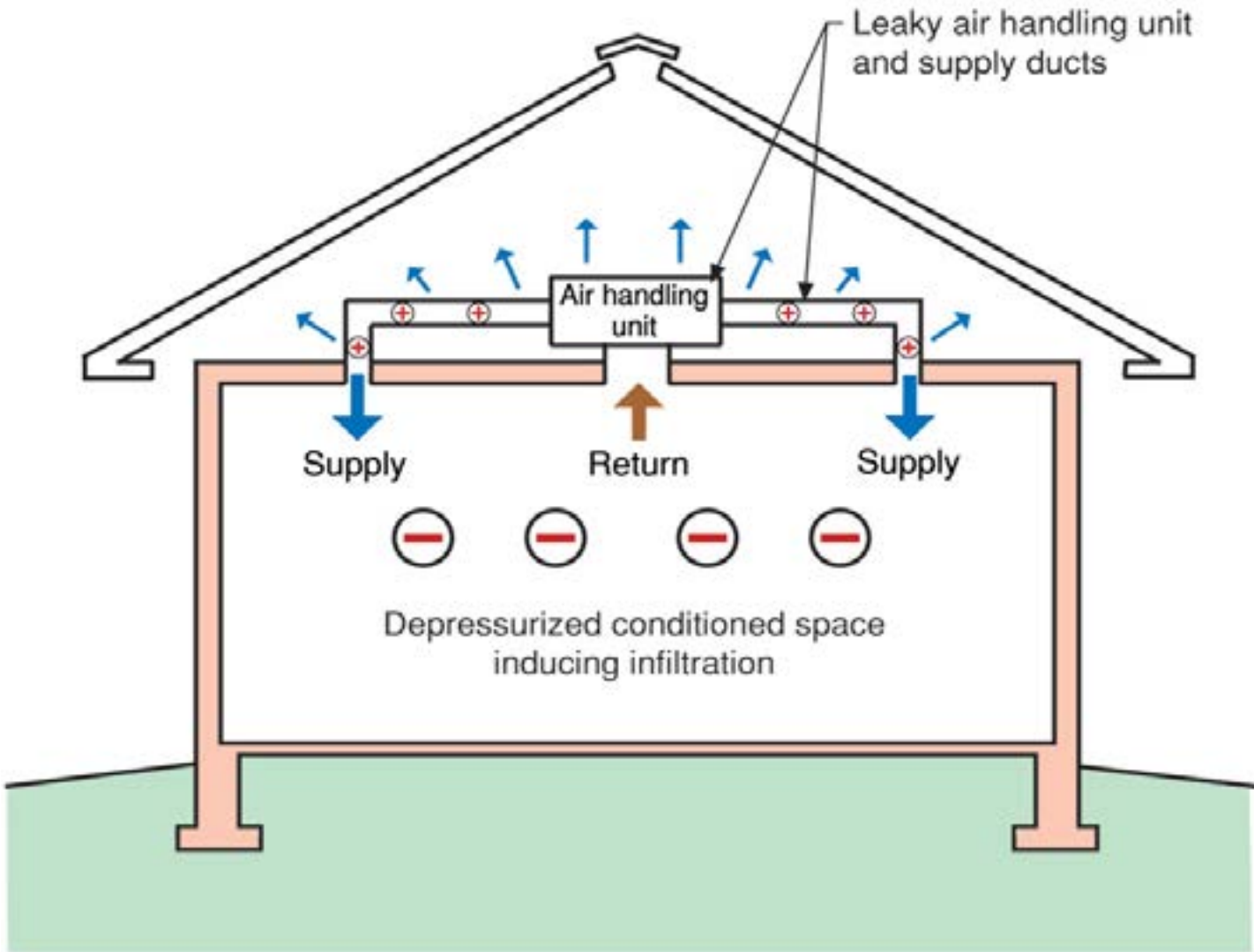






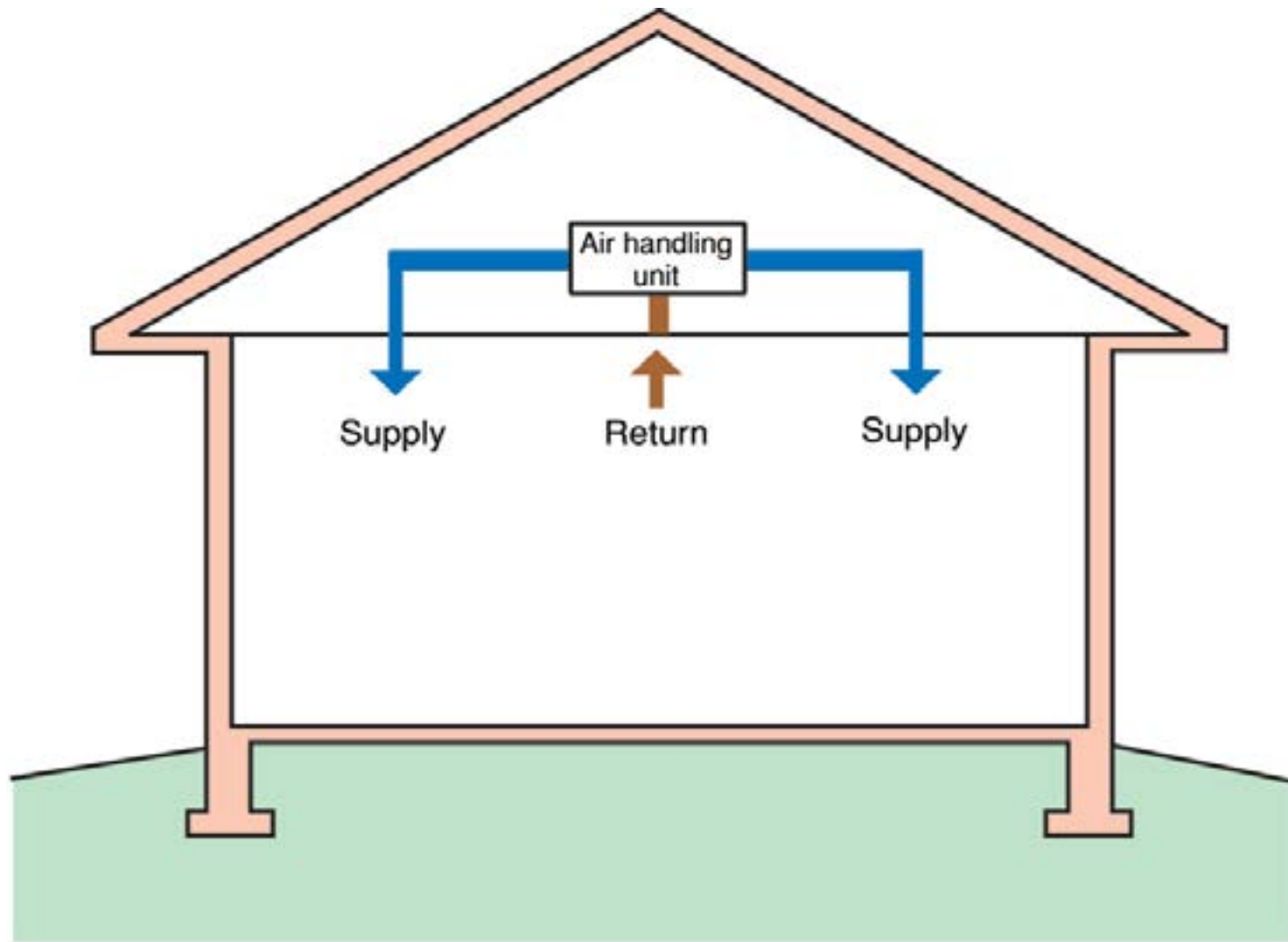






Note: Colored shading depicts the building's thermal barrier and pressure boundary. The thermal barrier and pressure boundary enclose the conditioned space.





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