

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

Building Science

Roofs

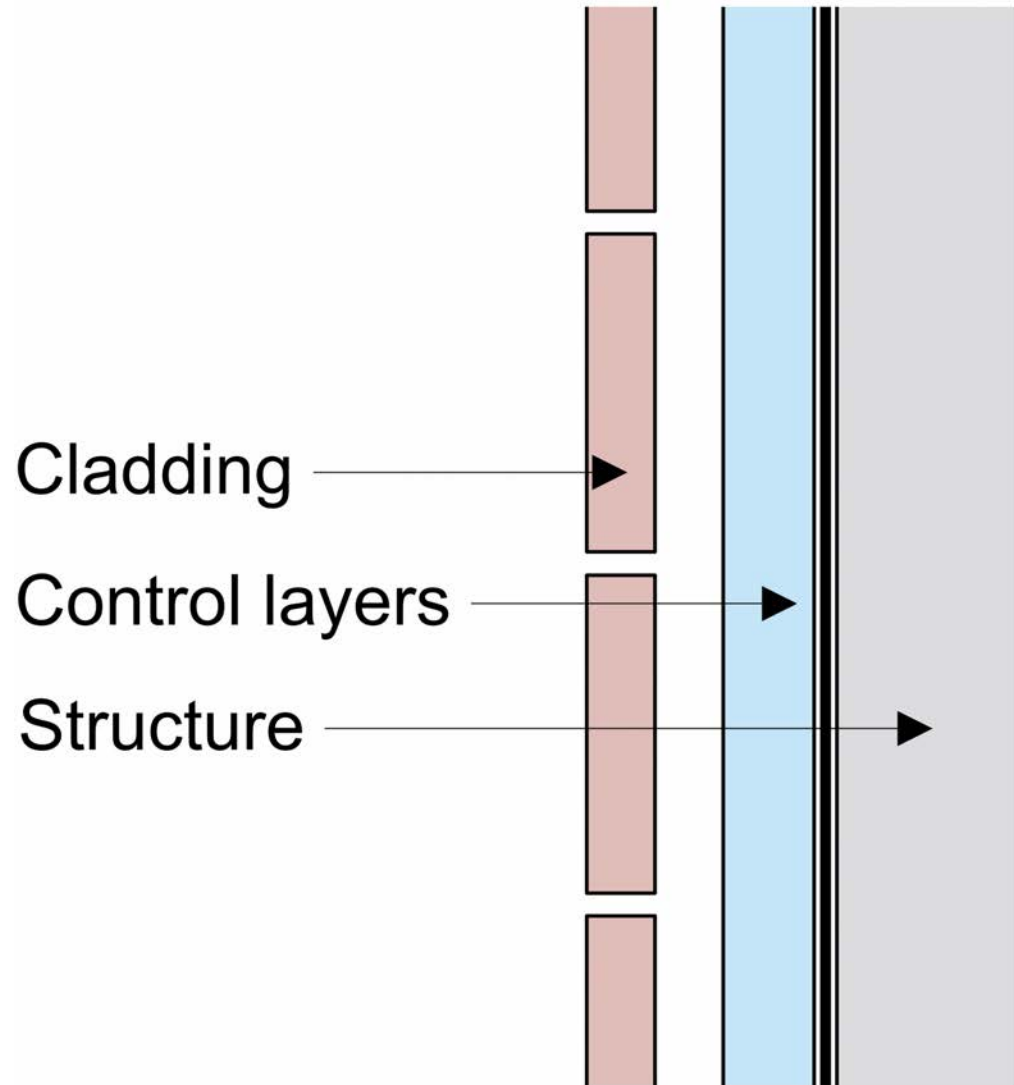
presented by www.buildingscience.com

Water Control Layer

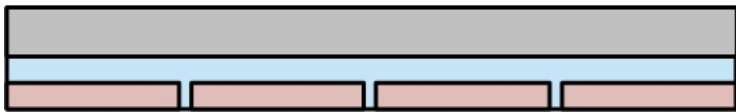
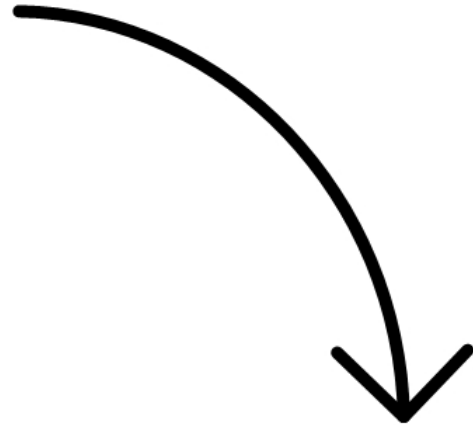
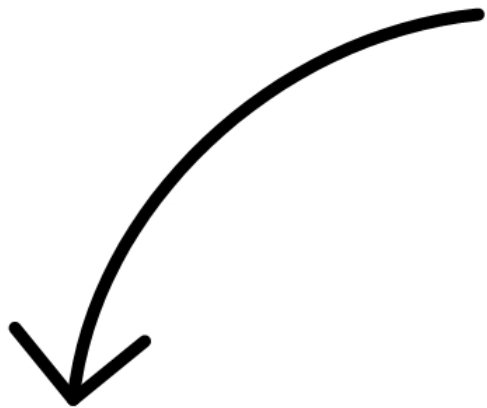
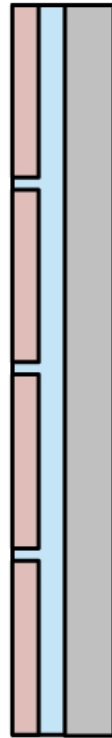
Air Control Layer

Vapor Control Layer

Thermal Control Layer



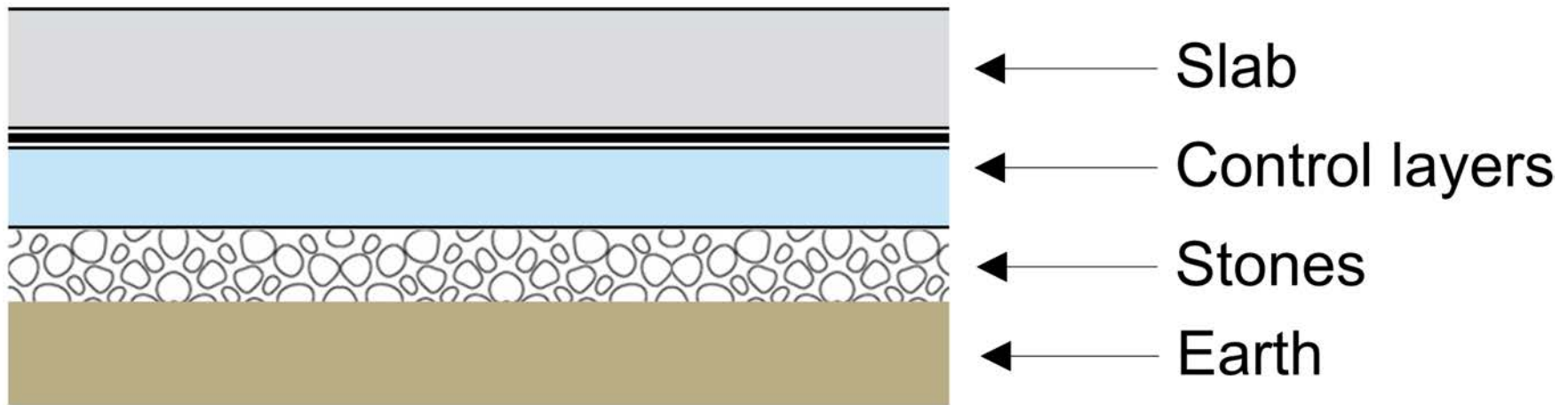
Wall

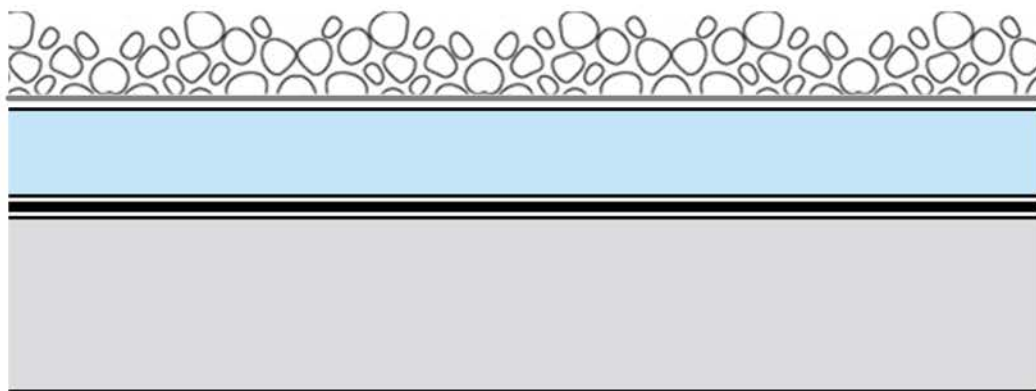


Slab

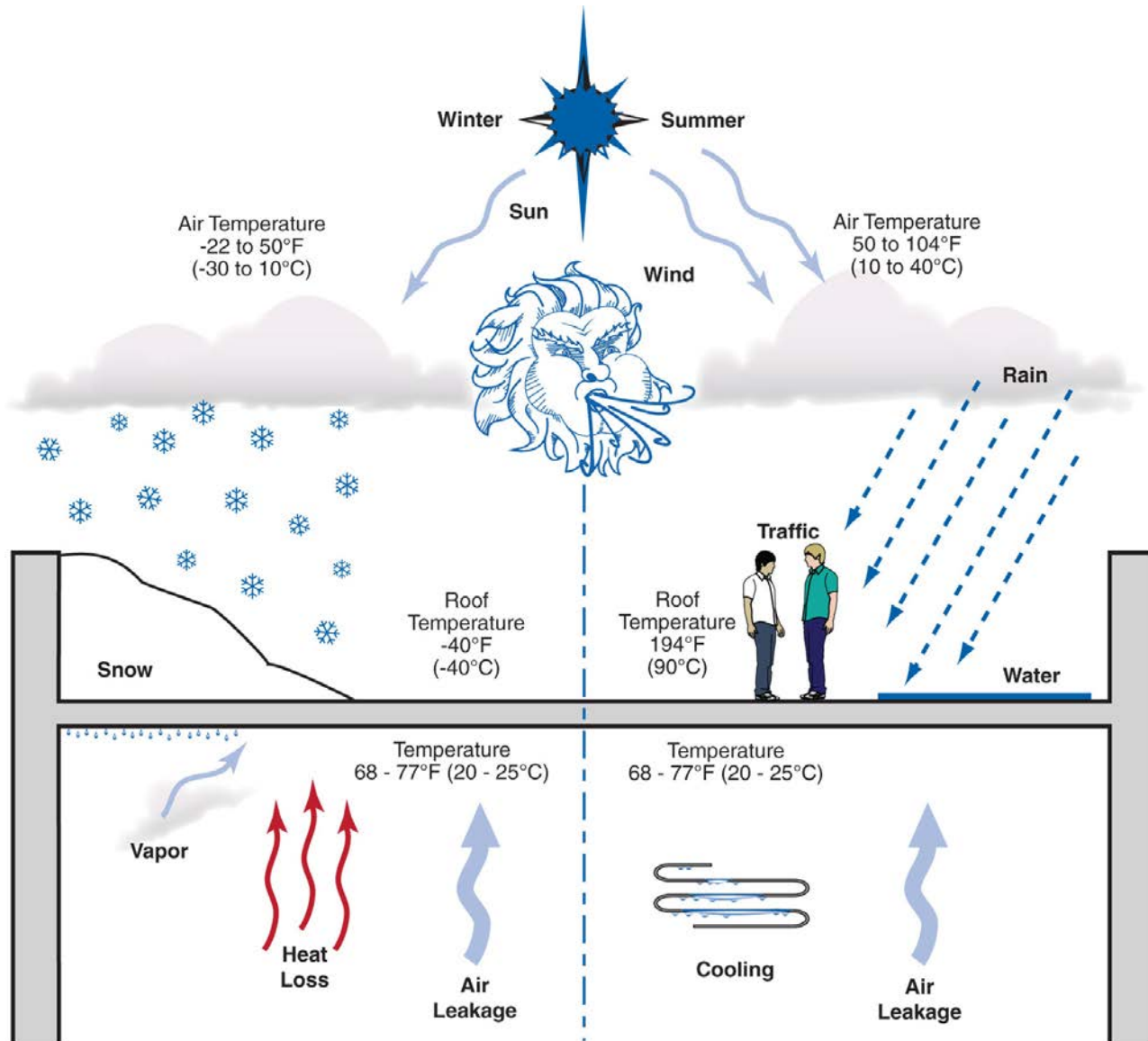


Roof

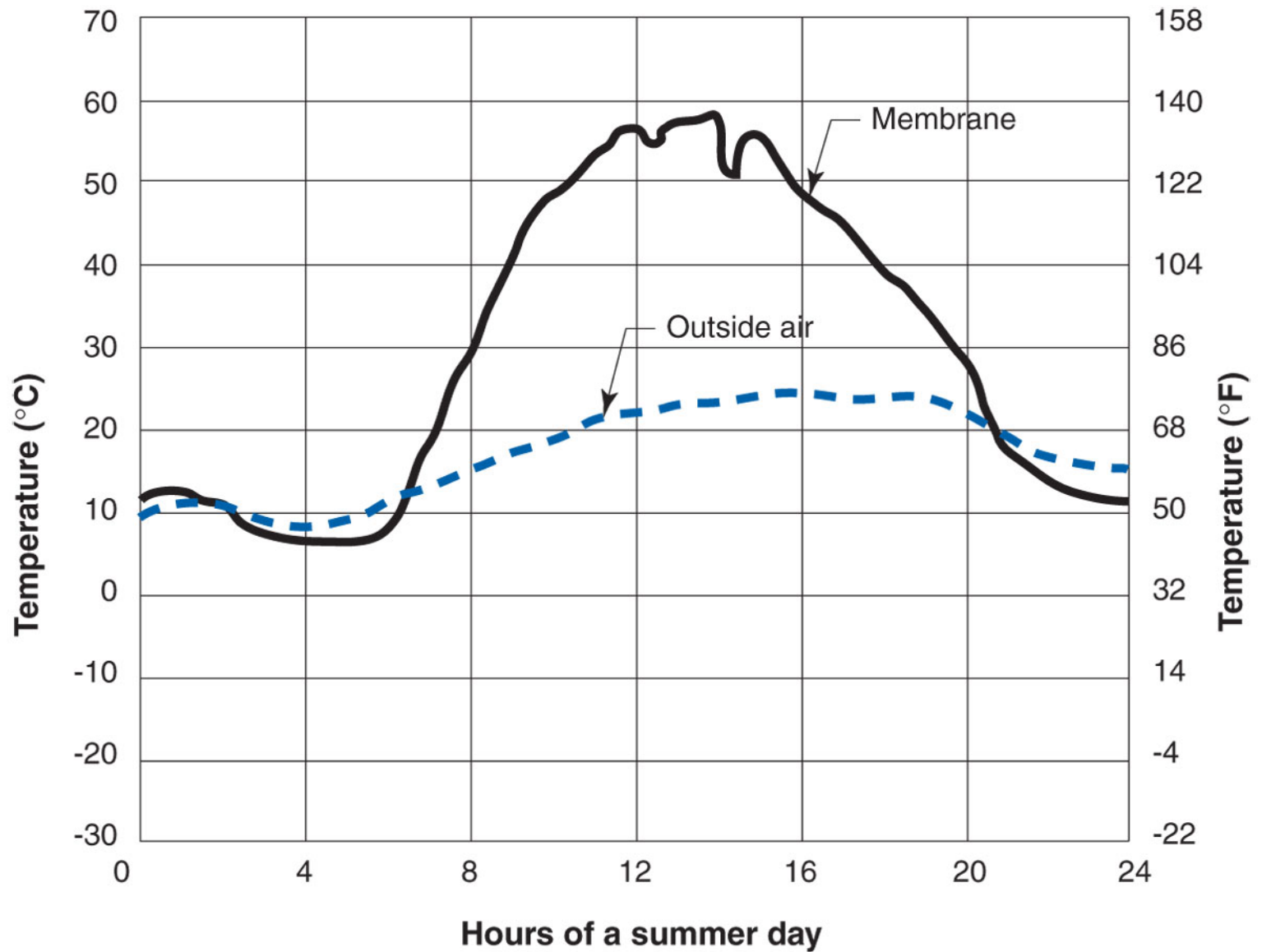




- ← Ballast
- ← Filter fabric
- ← Control layers
- ← Roof structure

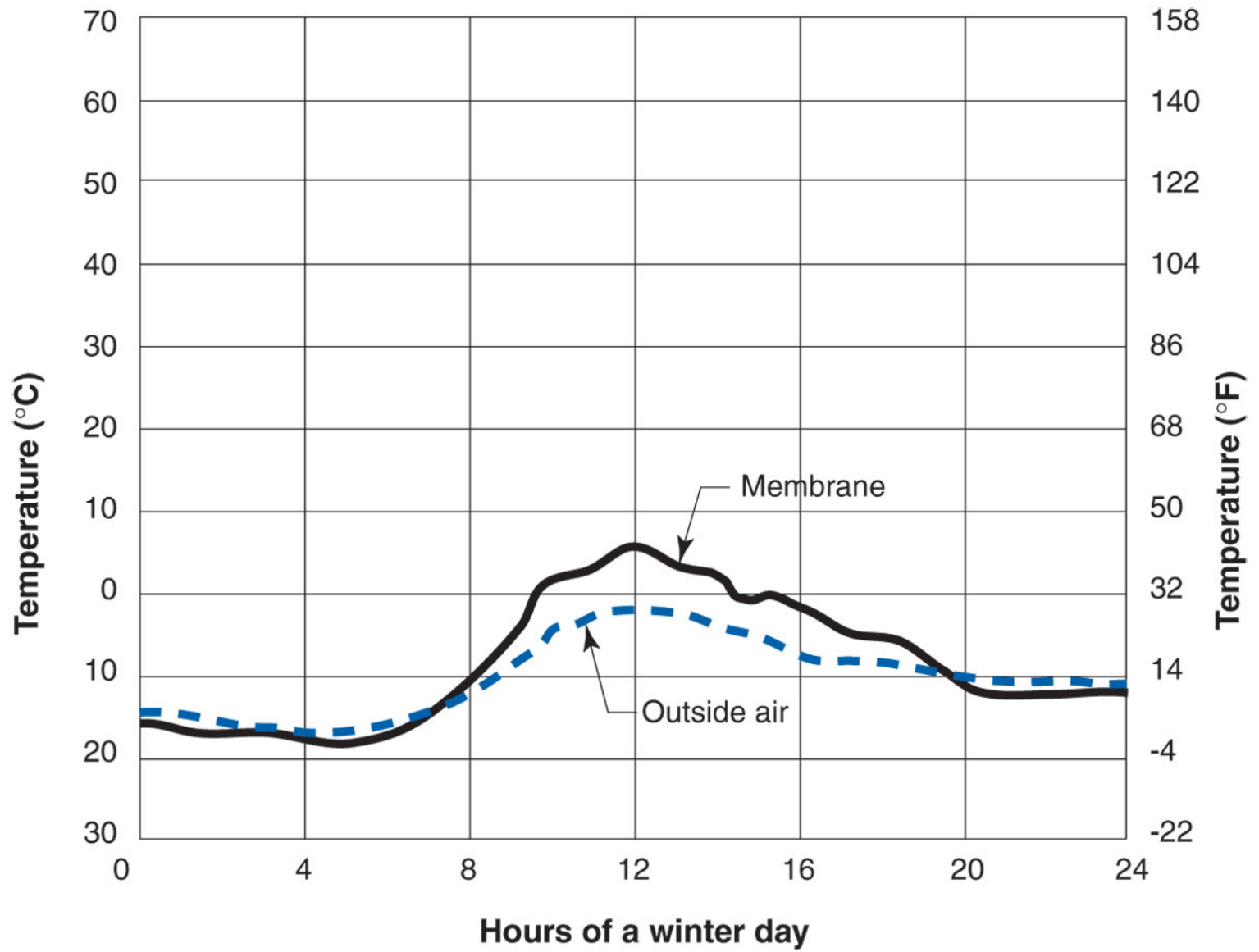


Adapted from Baker, M.; *Roofs*, 1980;
 Courtesy National Research Council of Canada

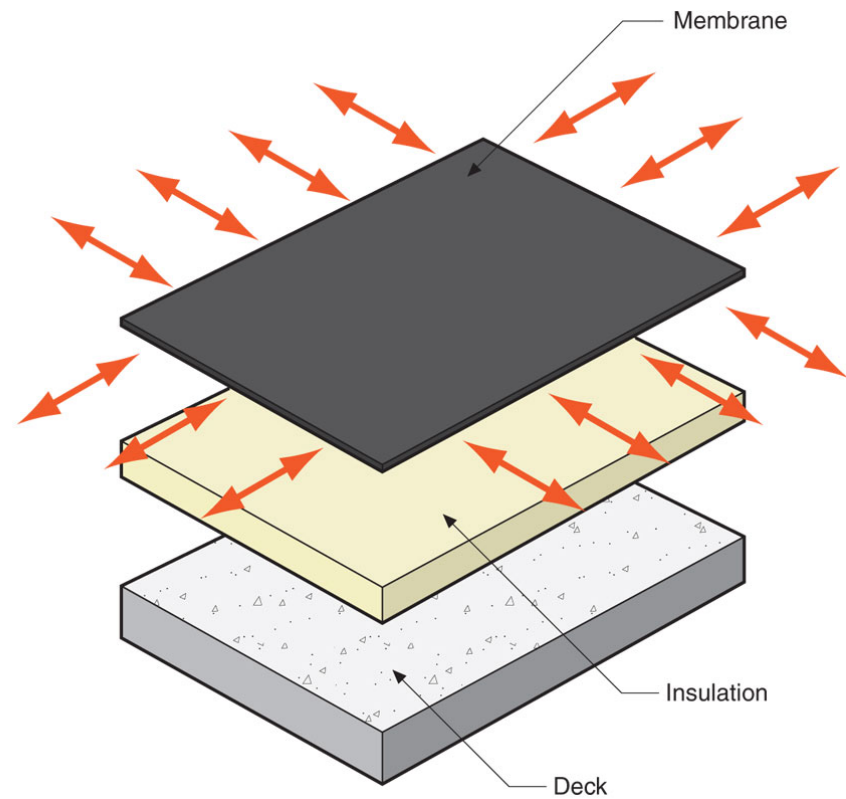
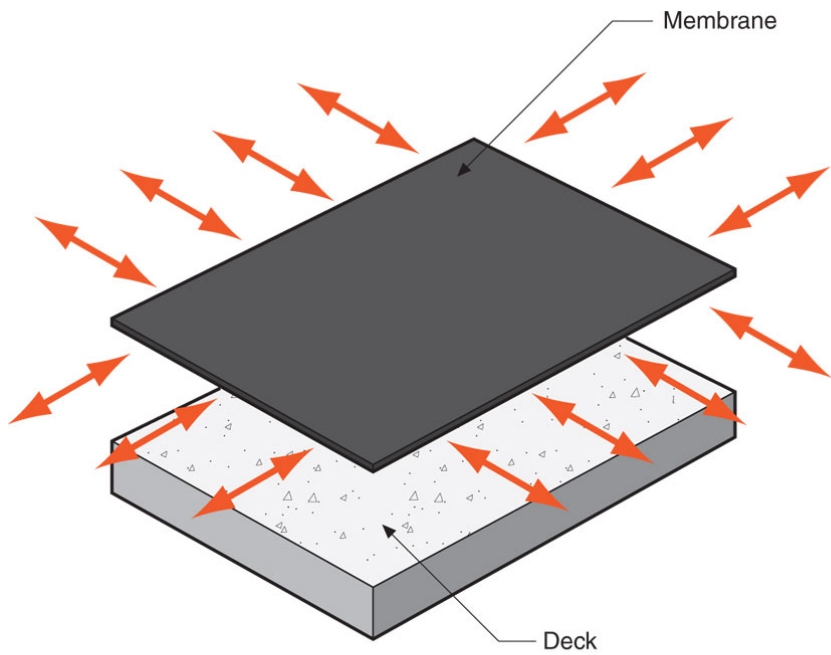


Hours of a summer day

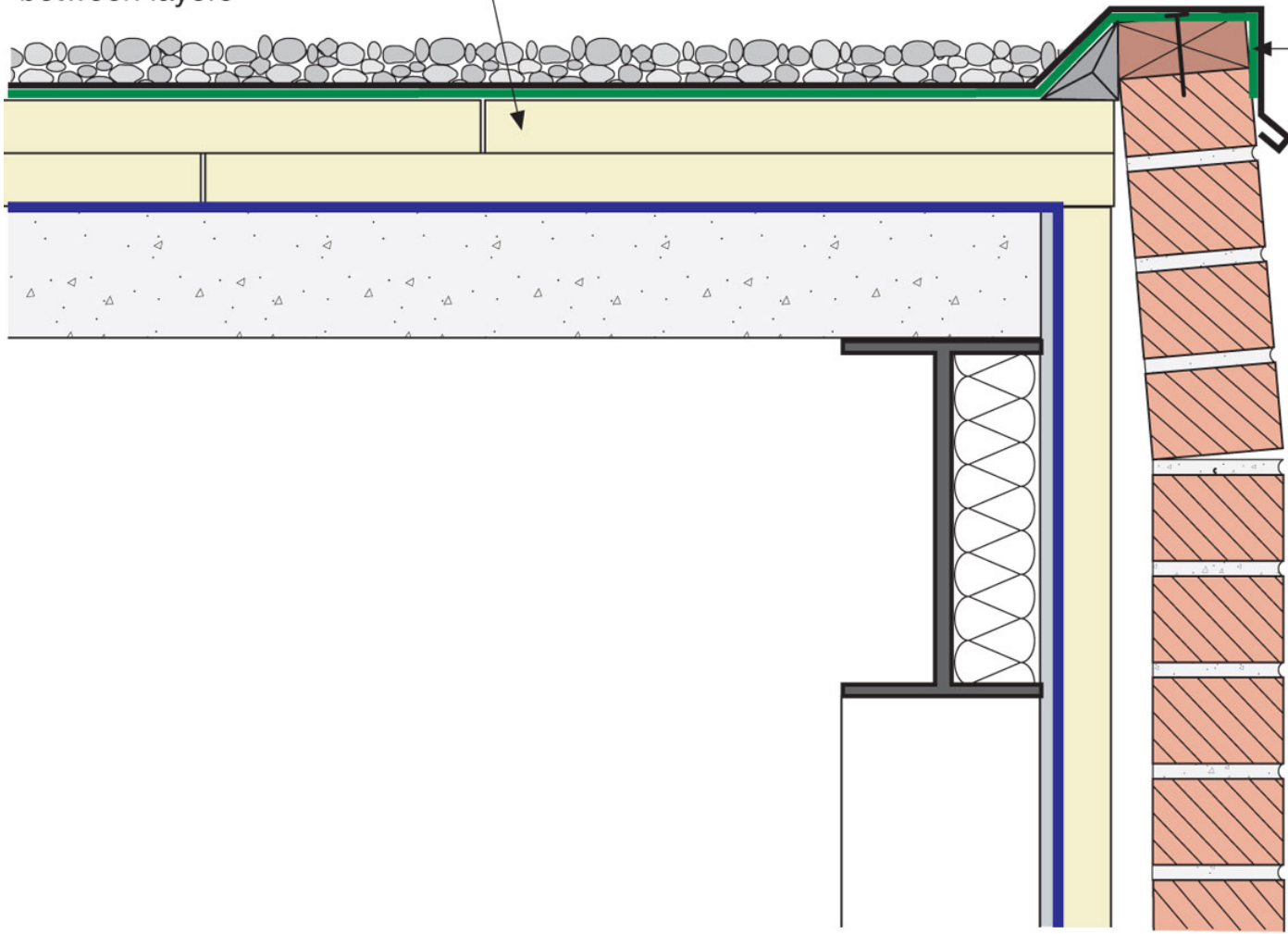
From Baker, M.; Roofs, 1980



From Baker, M.; *Roofs*, 1980

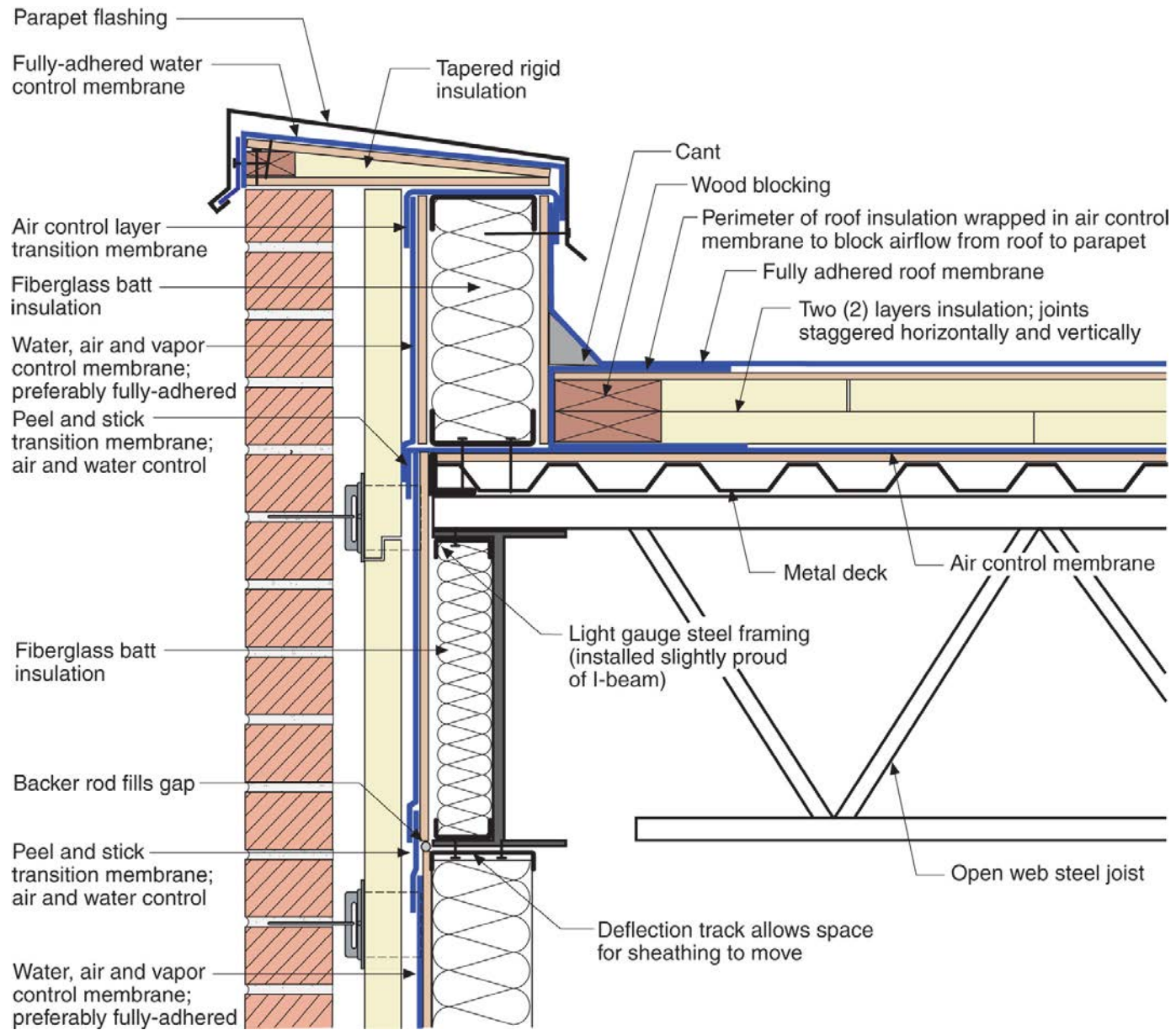


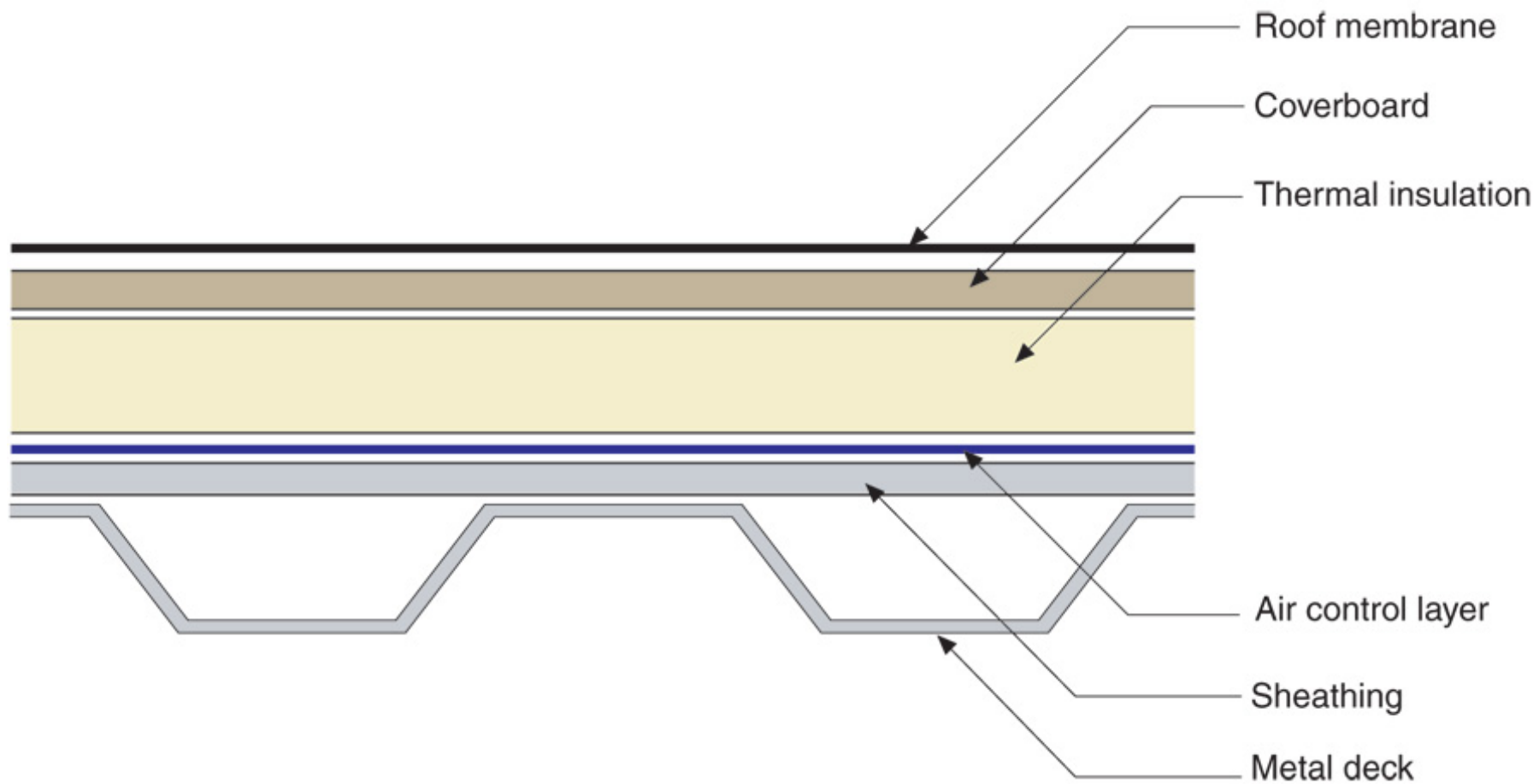
Insulation moved because of poor adhesion to deck and between layers

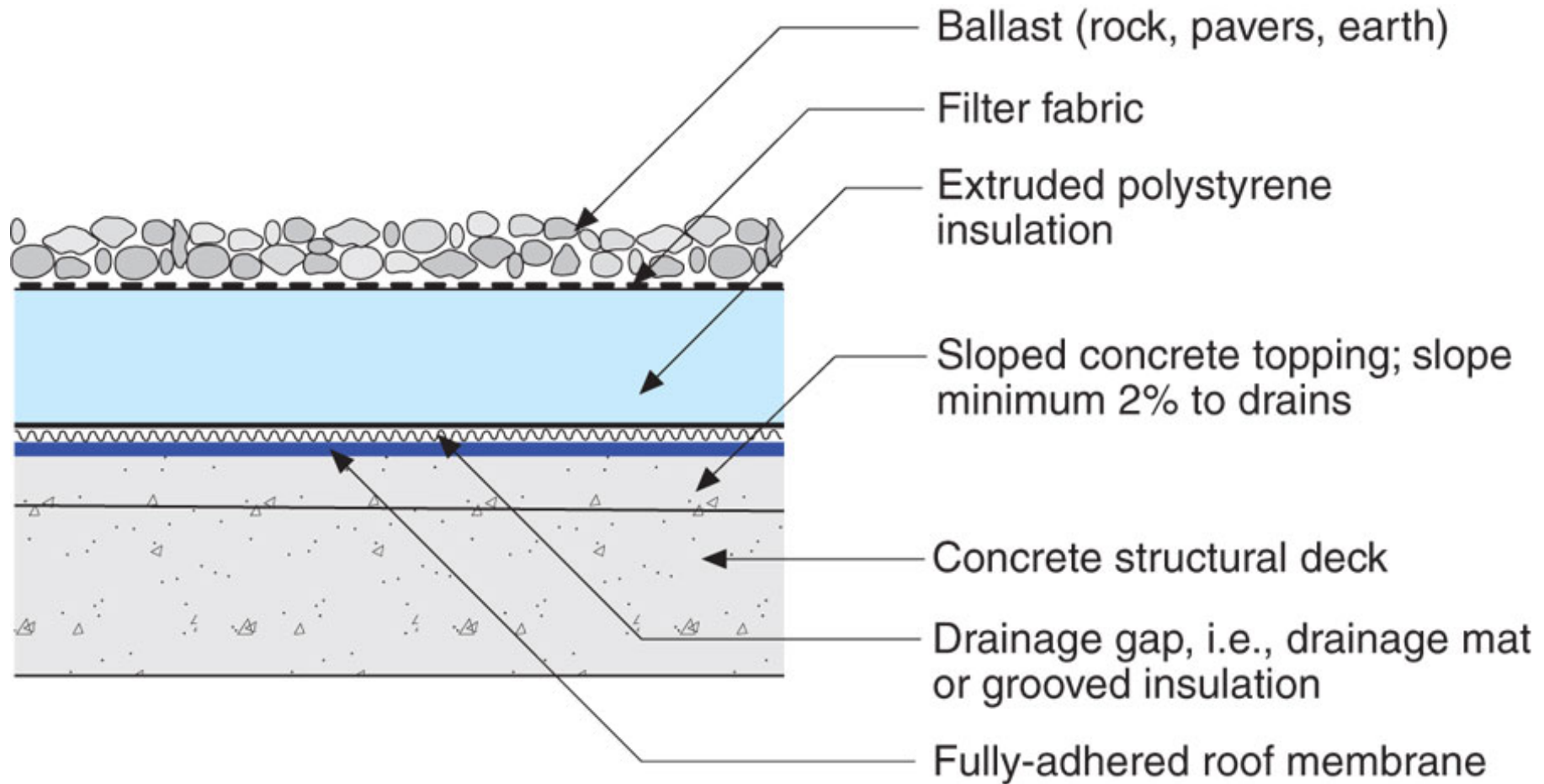


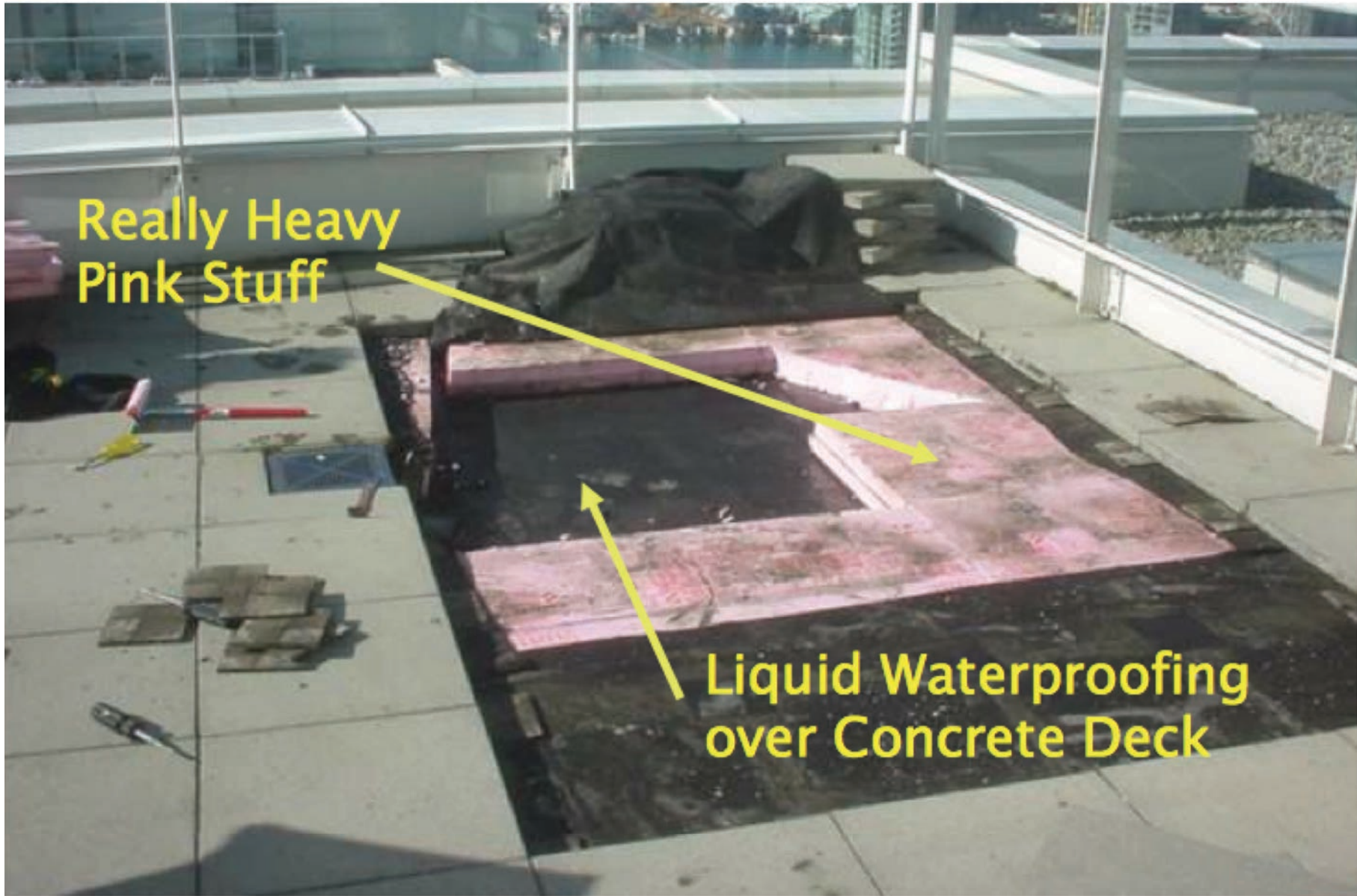
Top four courses of brick and wood blocking pulled inward by contracting membrane

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



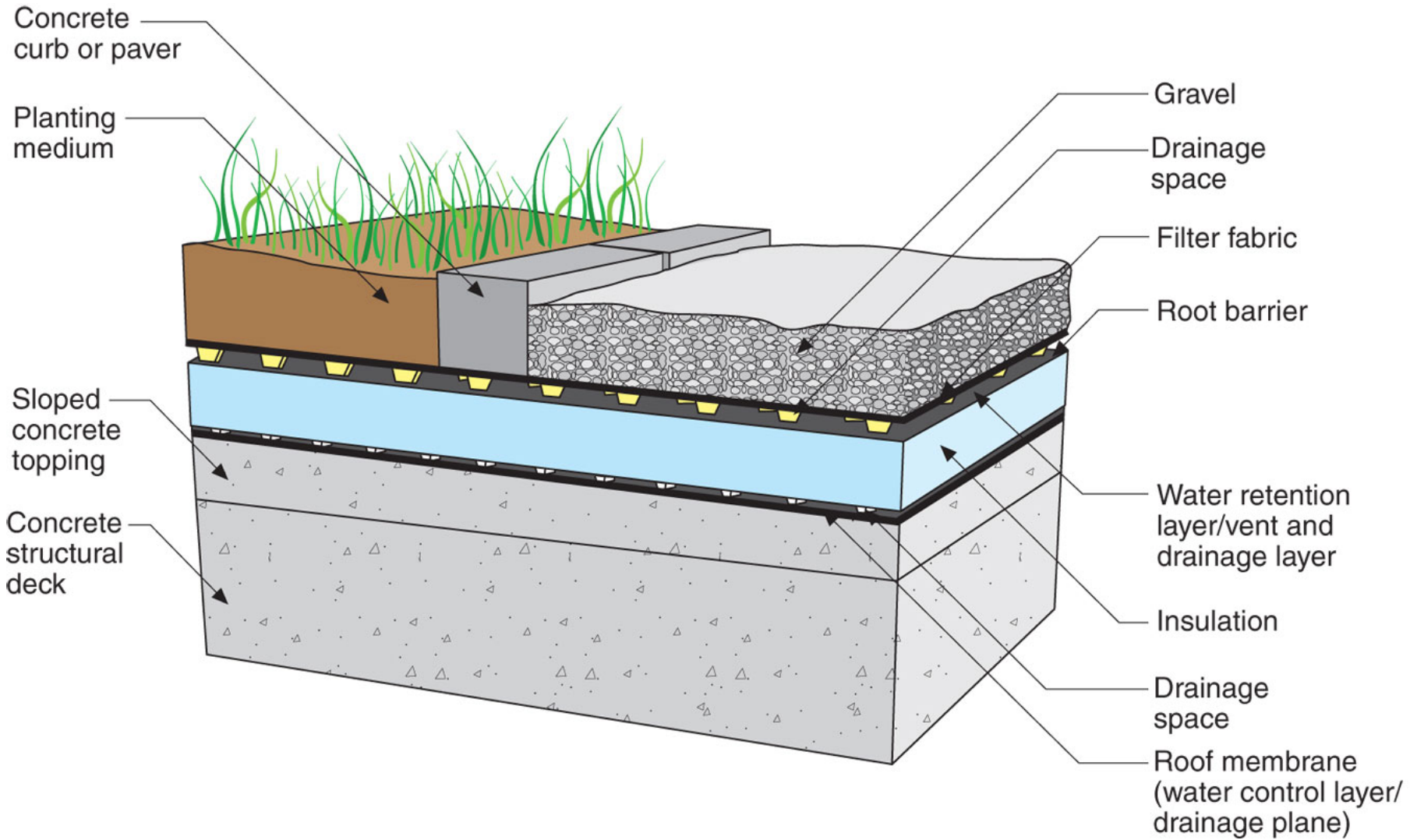






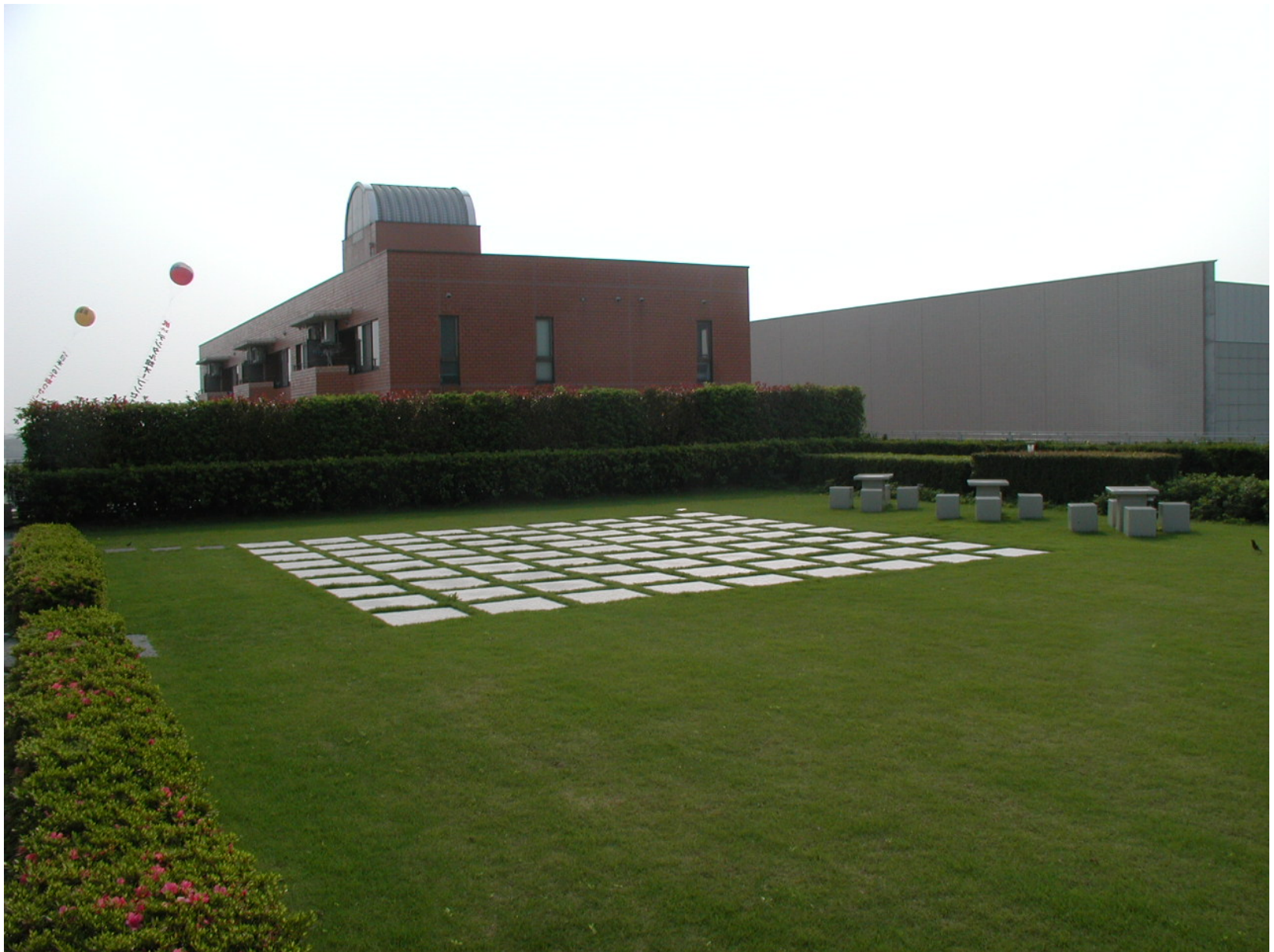
Really Heavy
Pink Stuff

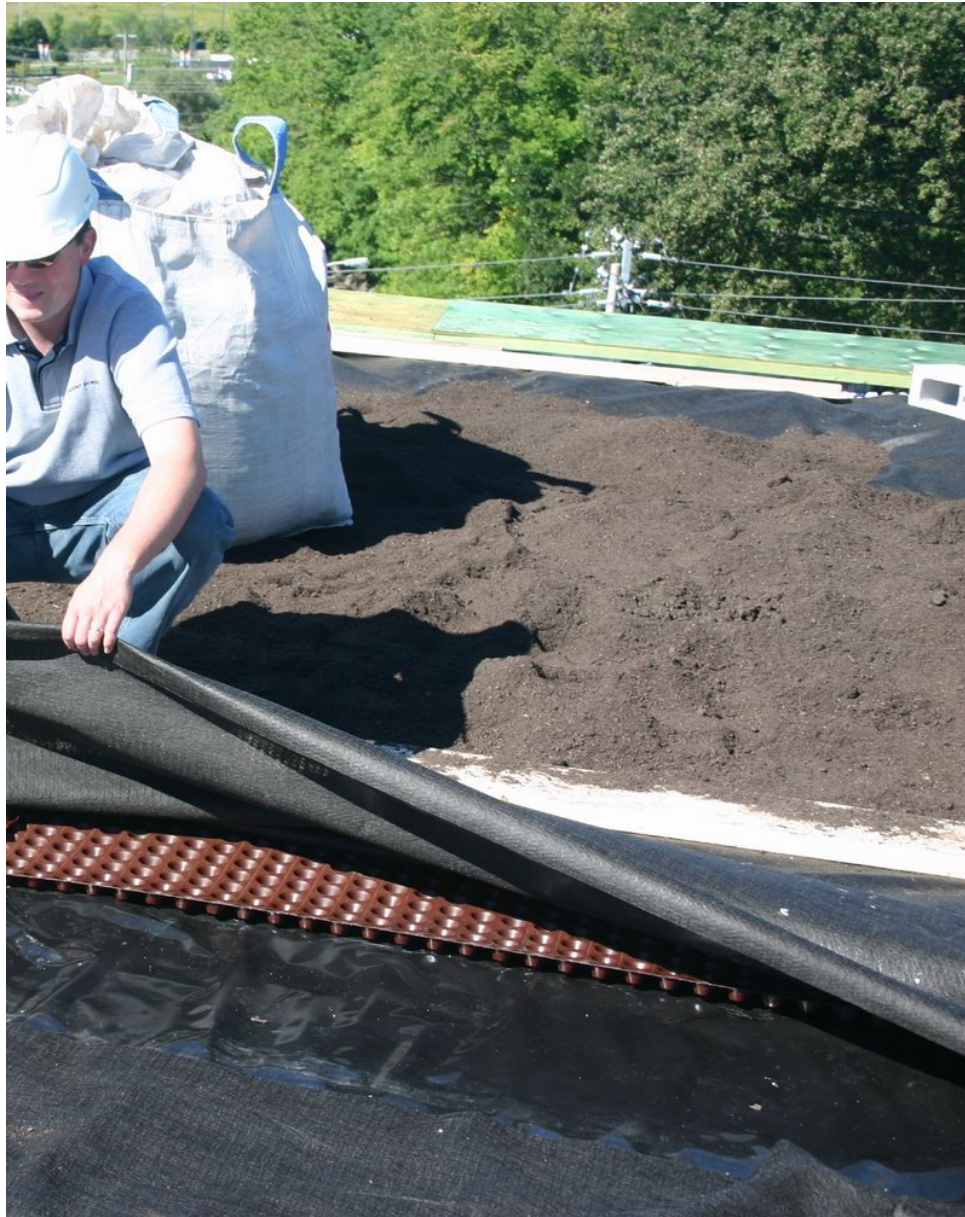
Liquid Waterproofing
over Concrete Deck

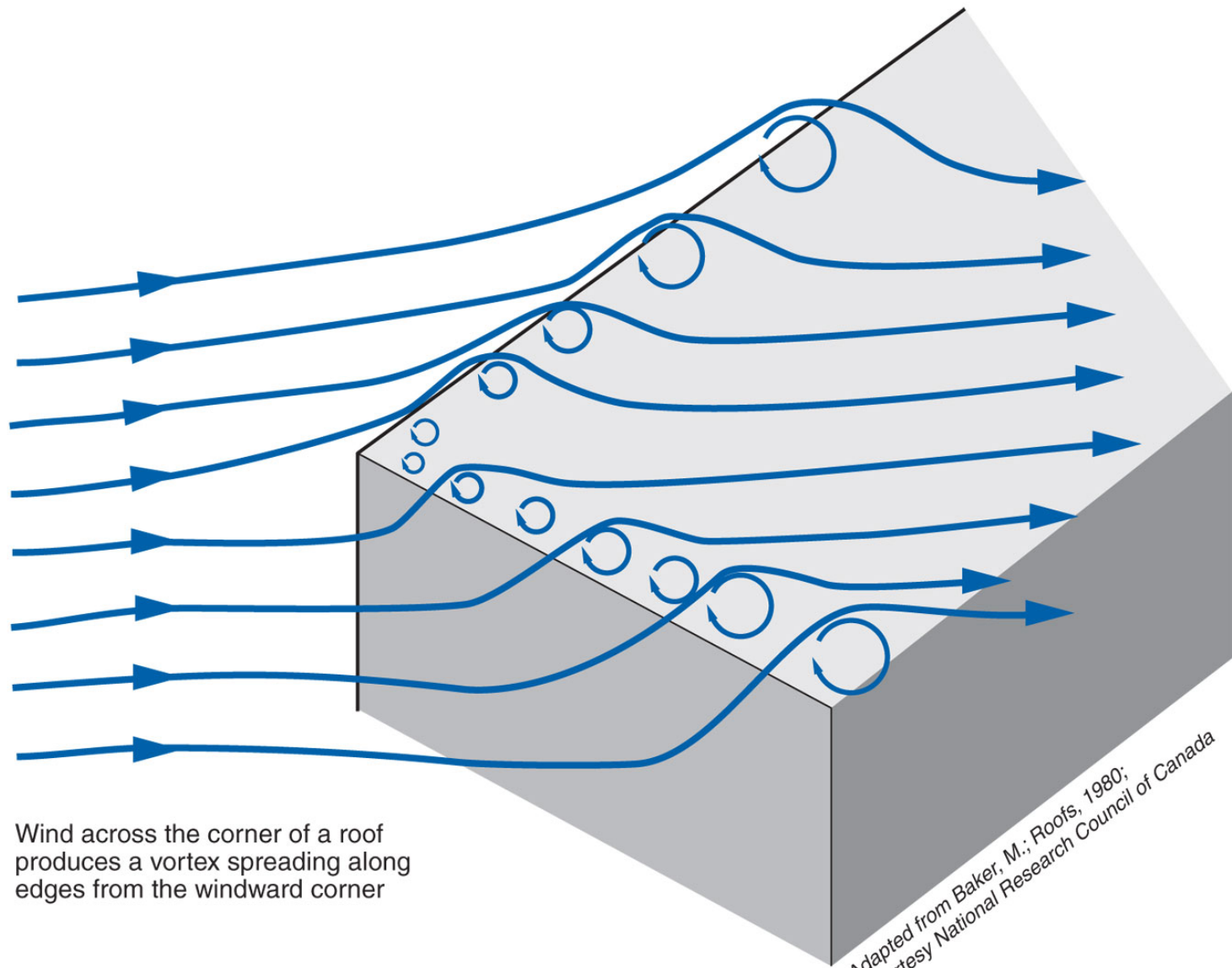






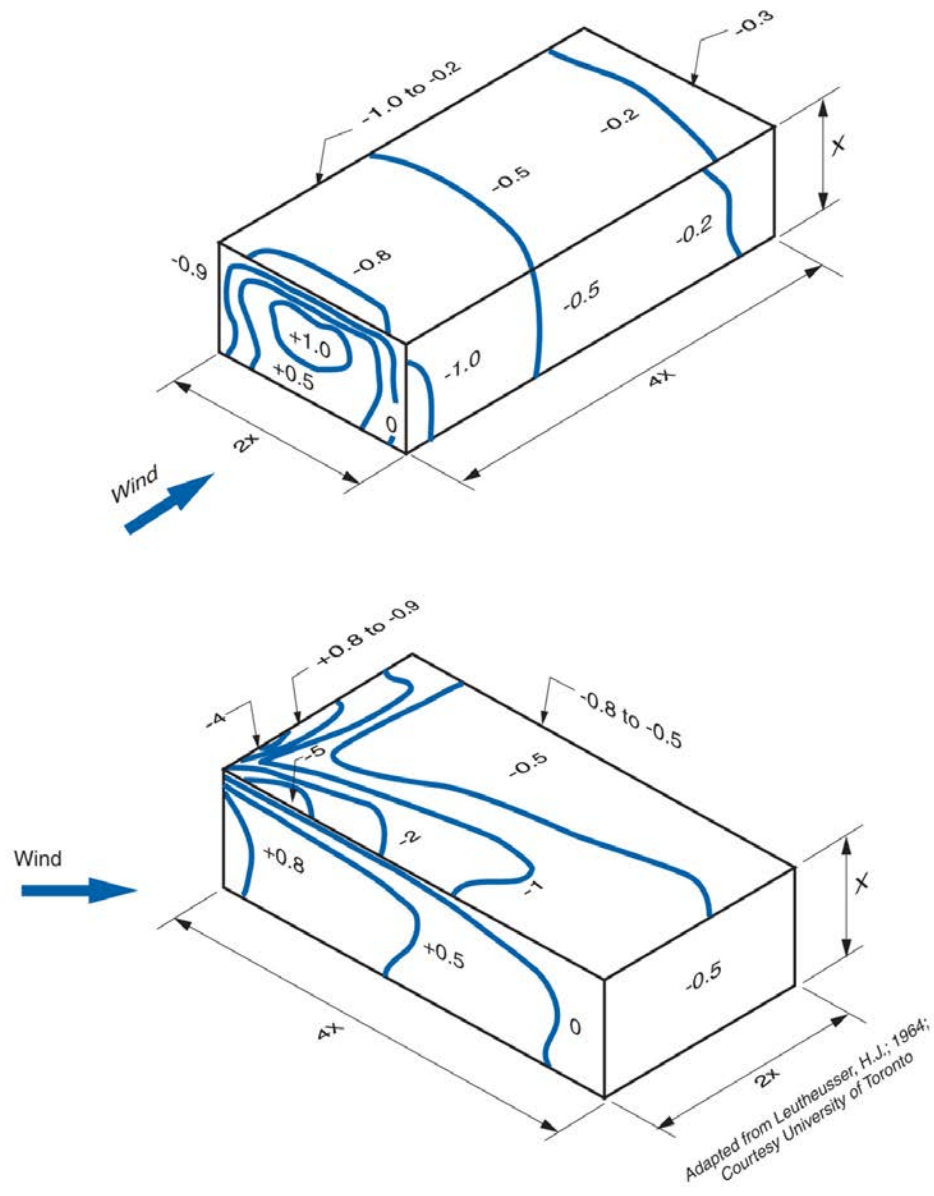


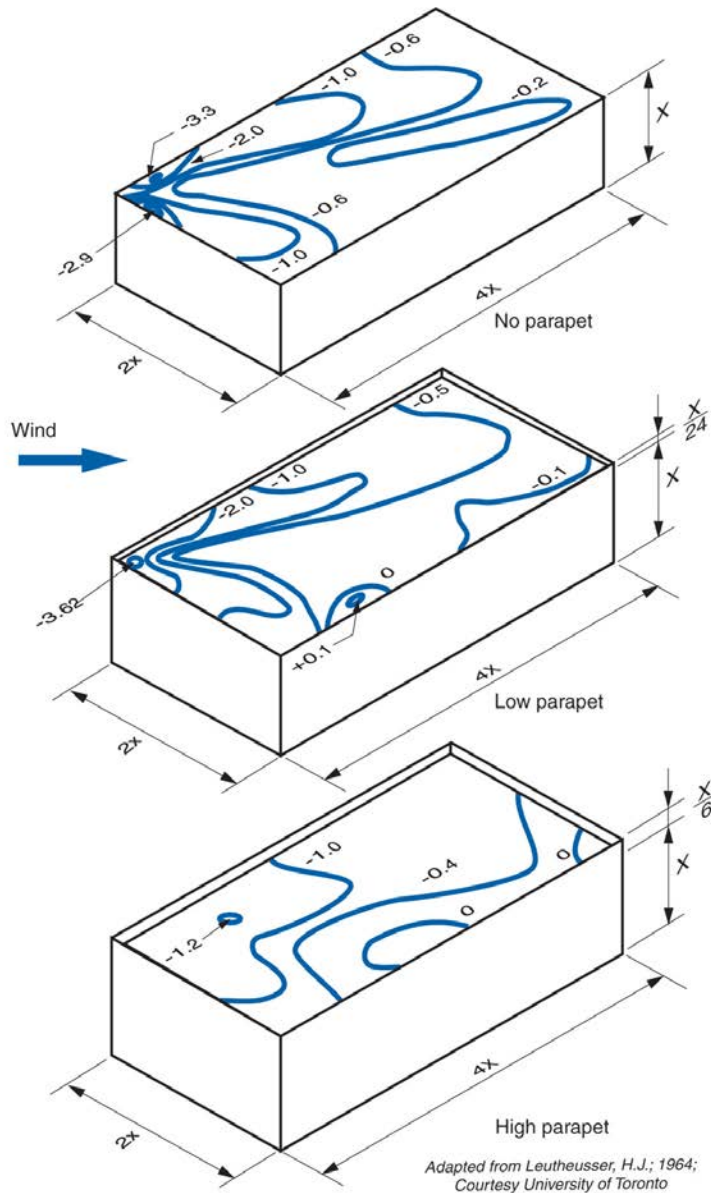


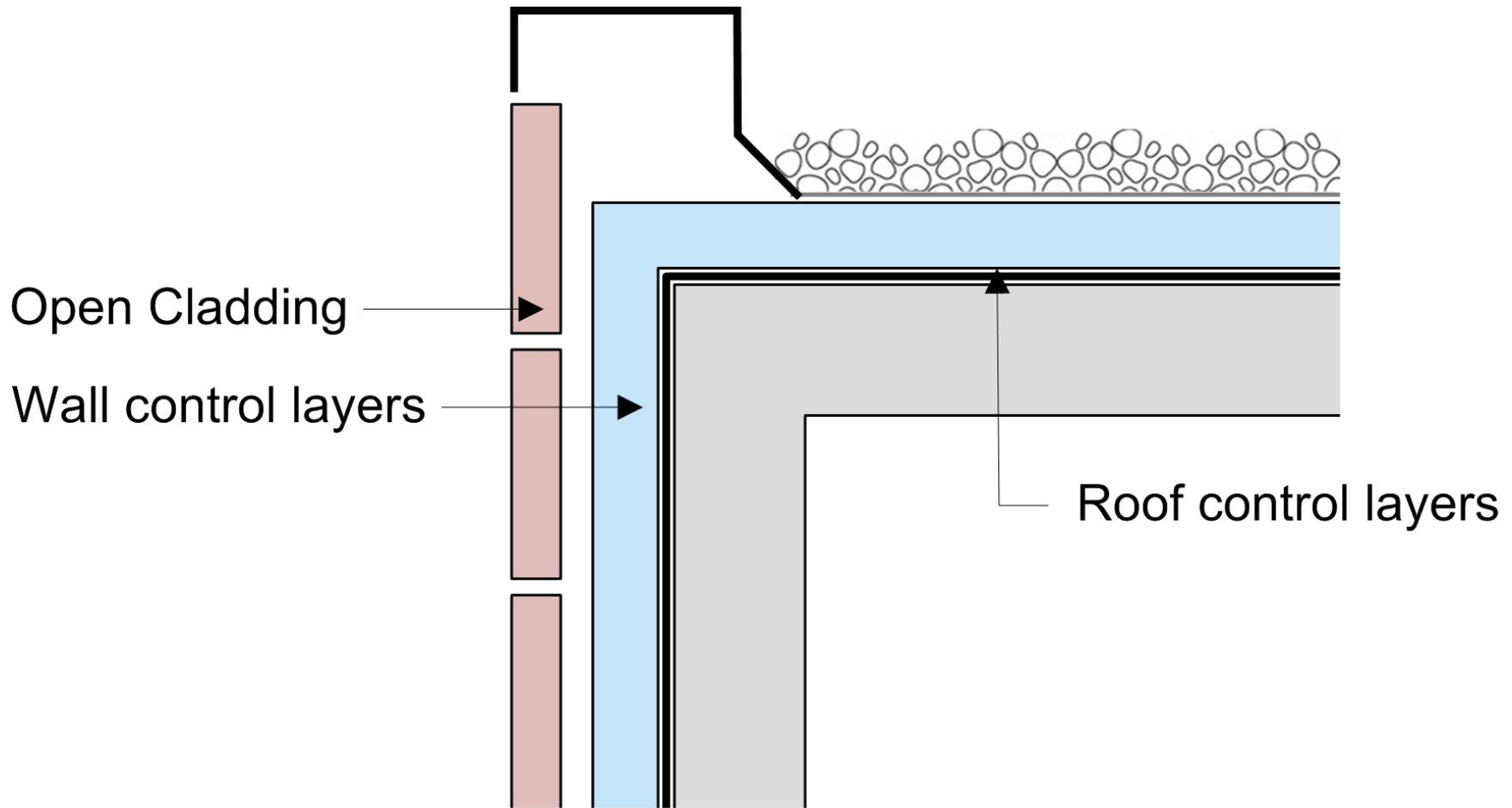


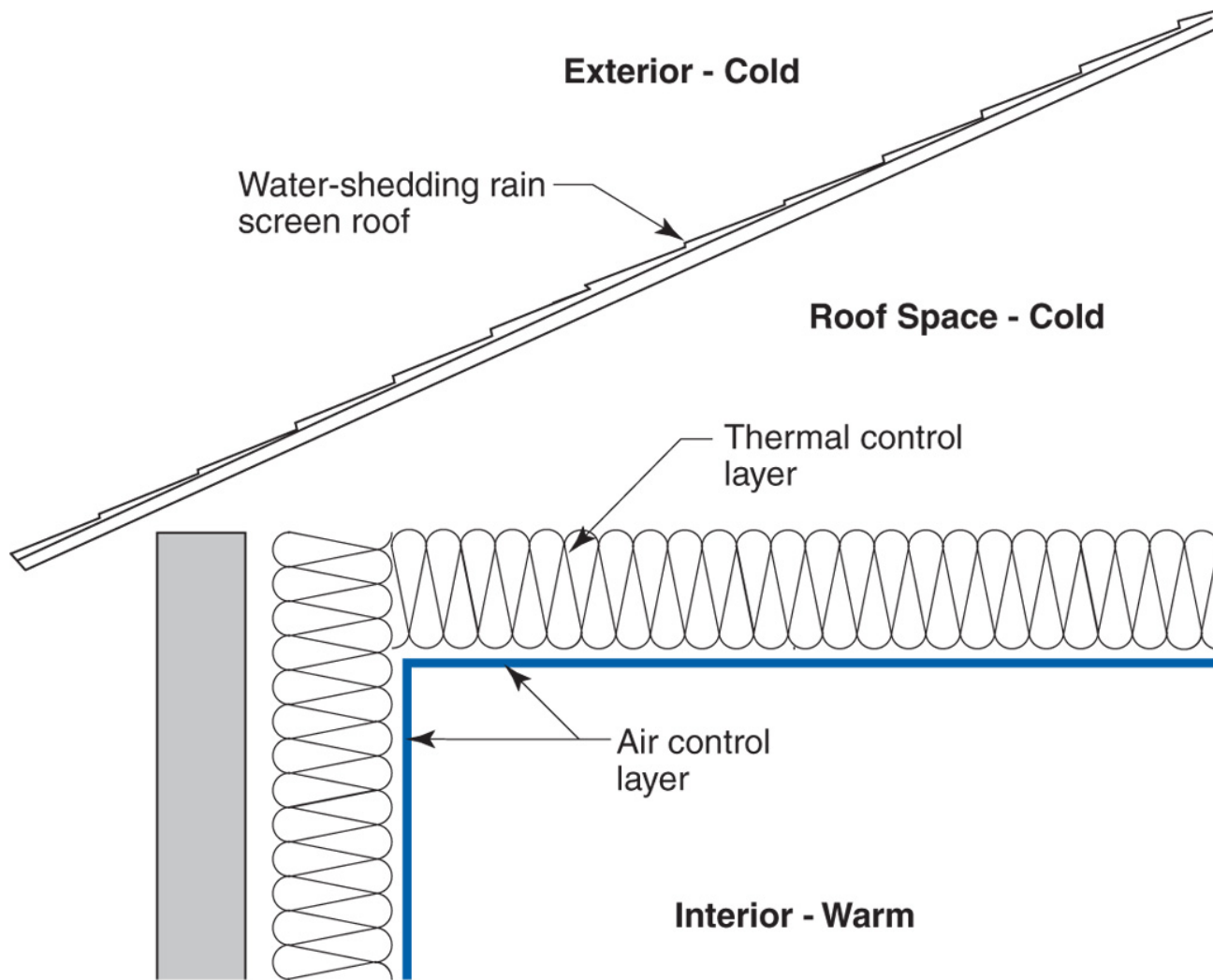
Wind across the corner of a roof produces a vortex spreading along edges from the windward corner

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

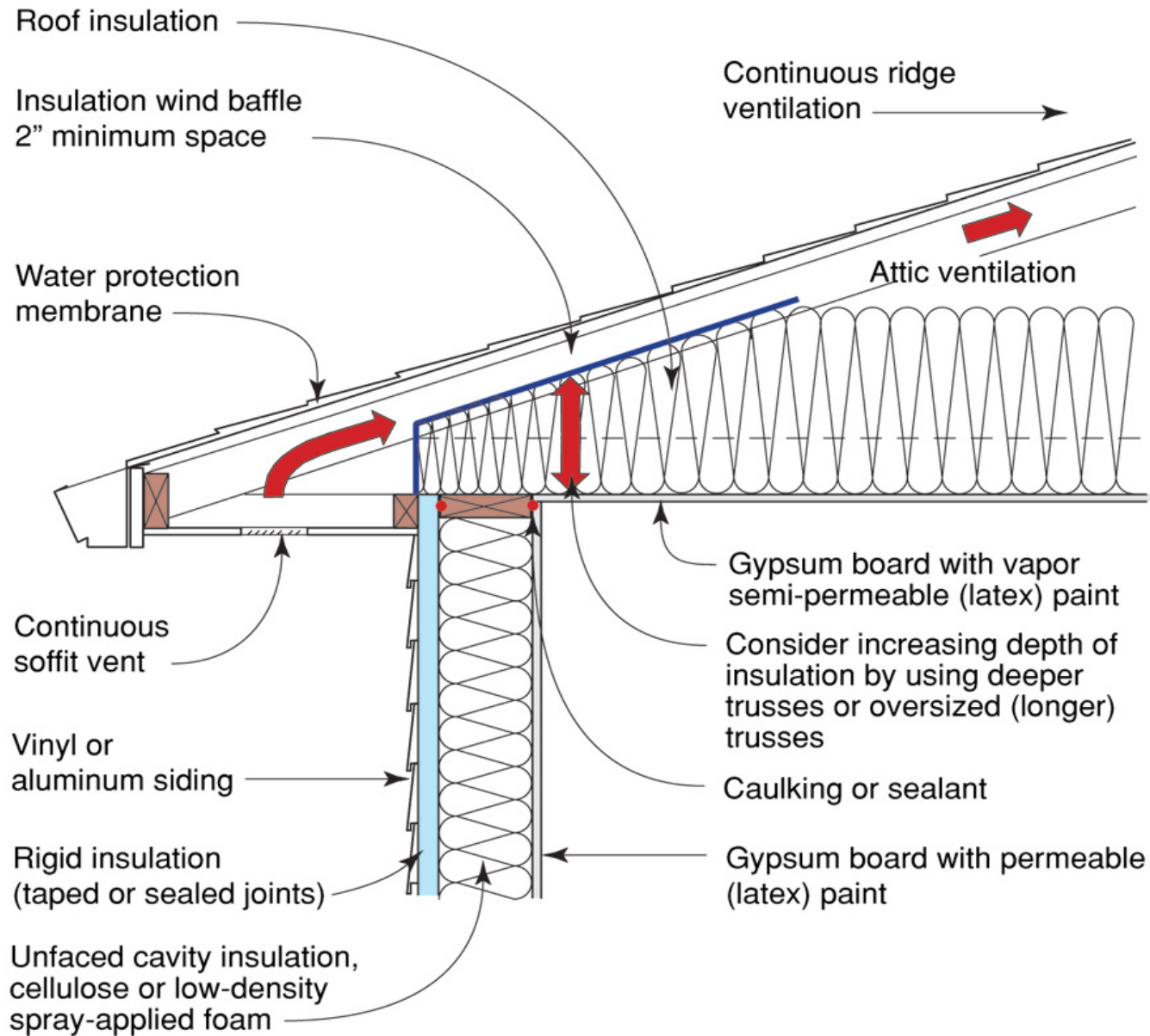




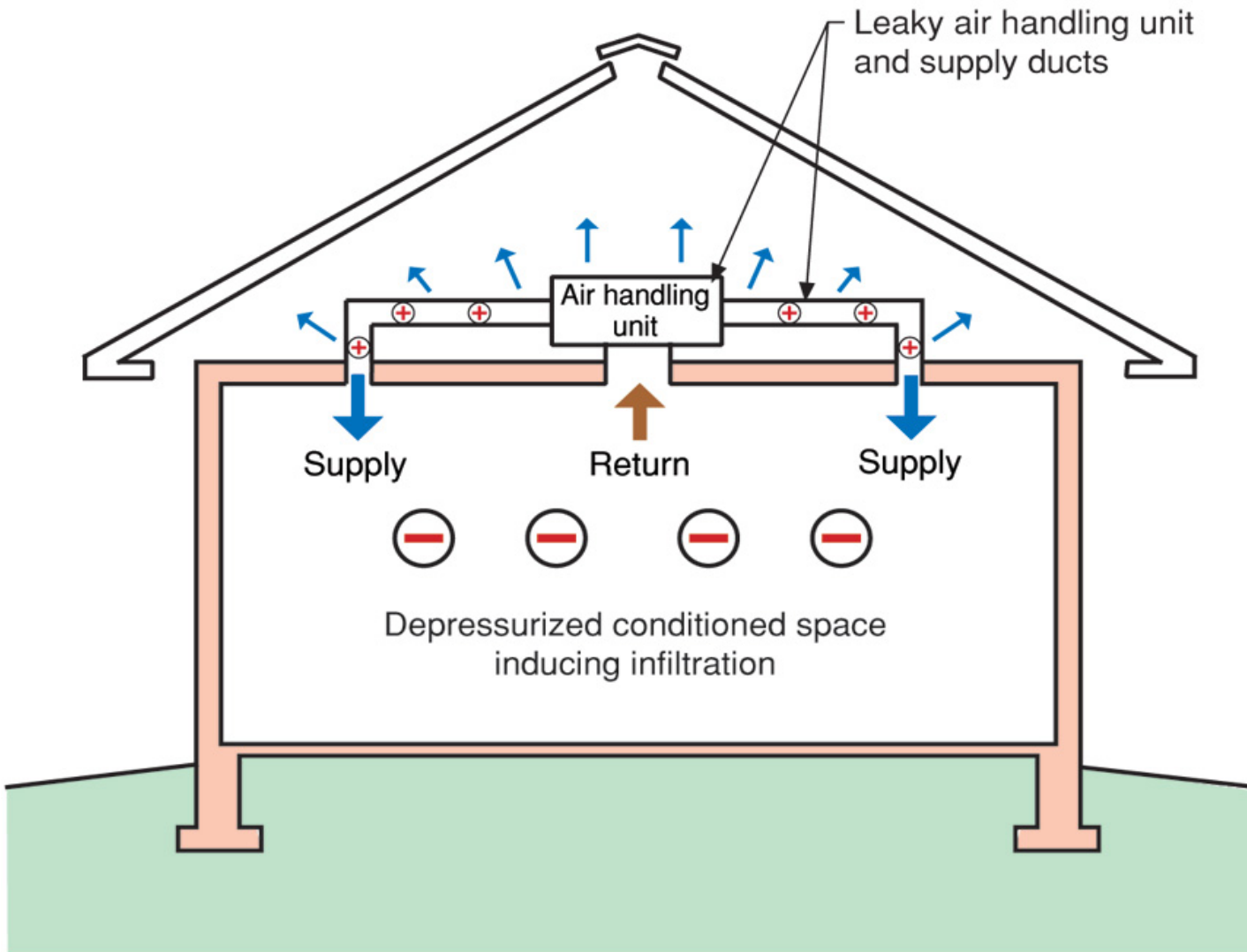




From Baker, M.; *Roofs*, 1980







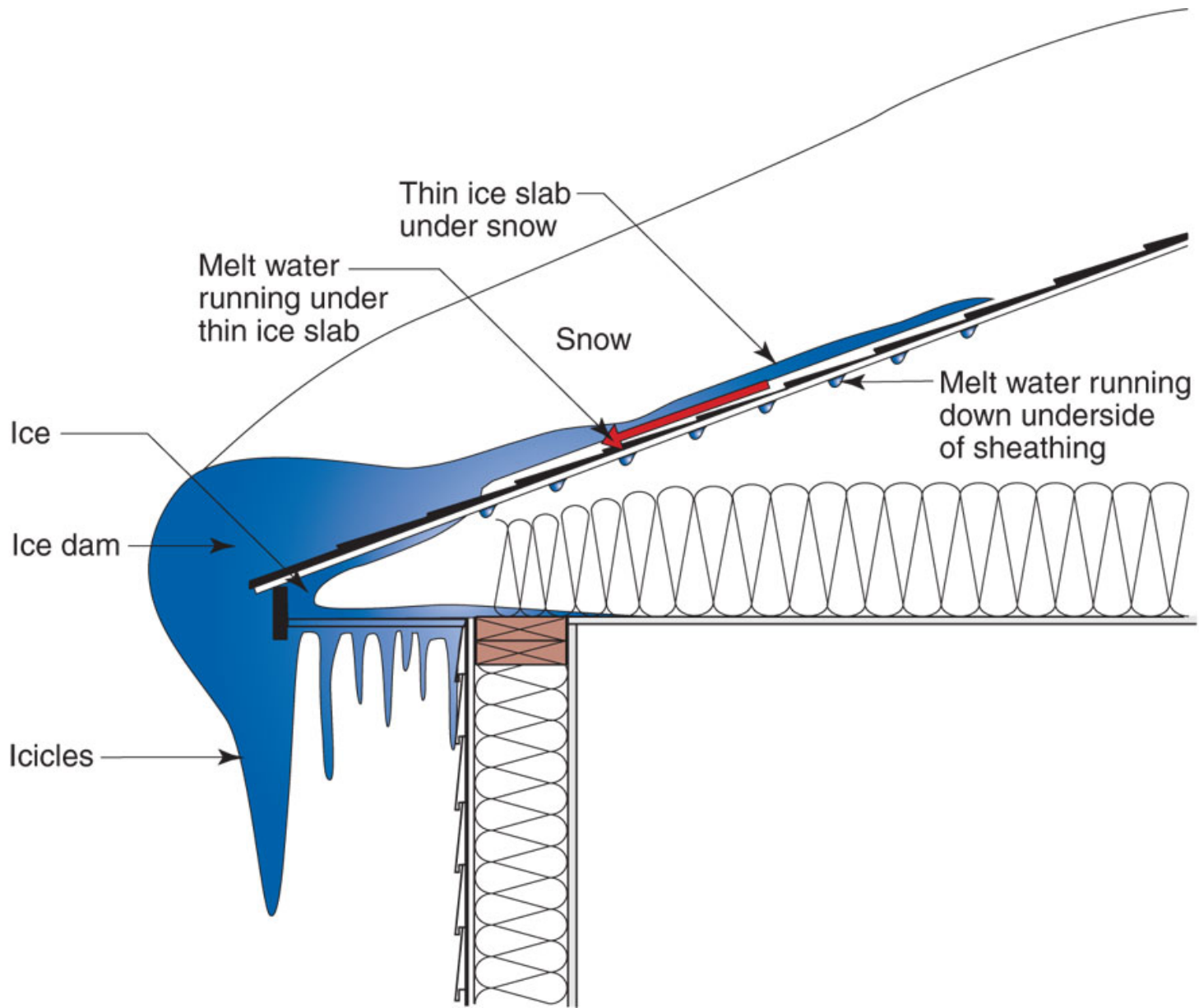
Note: Colored shading depicts the building's thermal barrier and pressure boundary. The thermal barrier and pressure boundary enclose the conditioned space.

















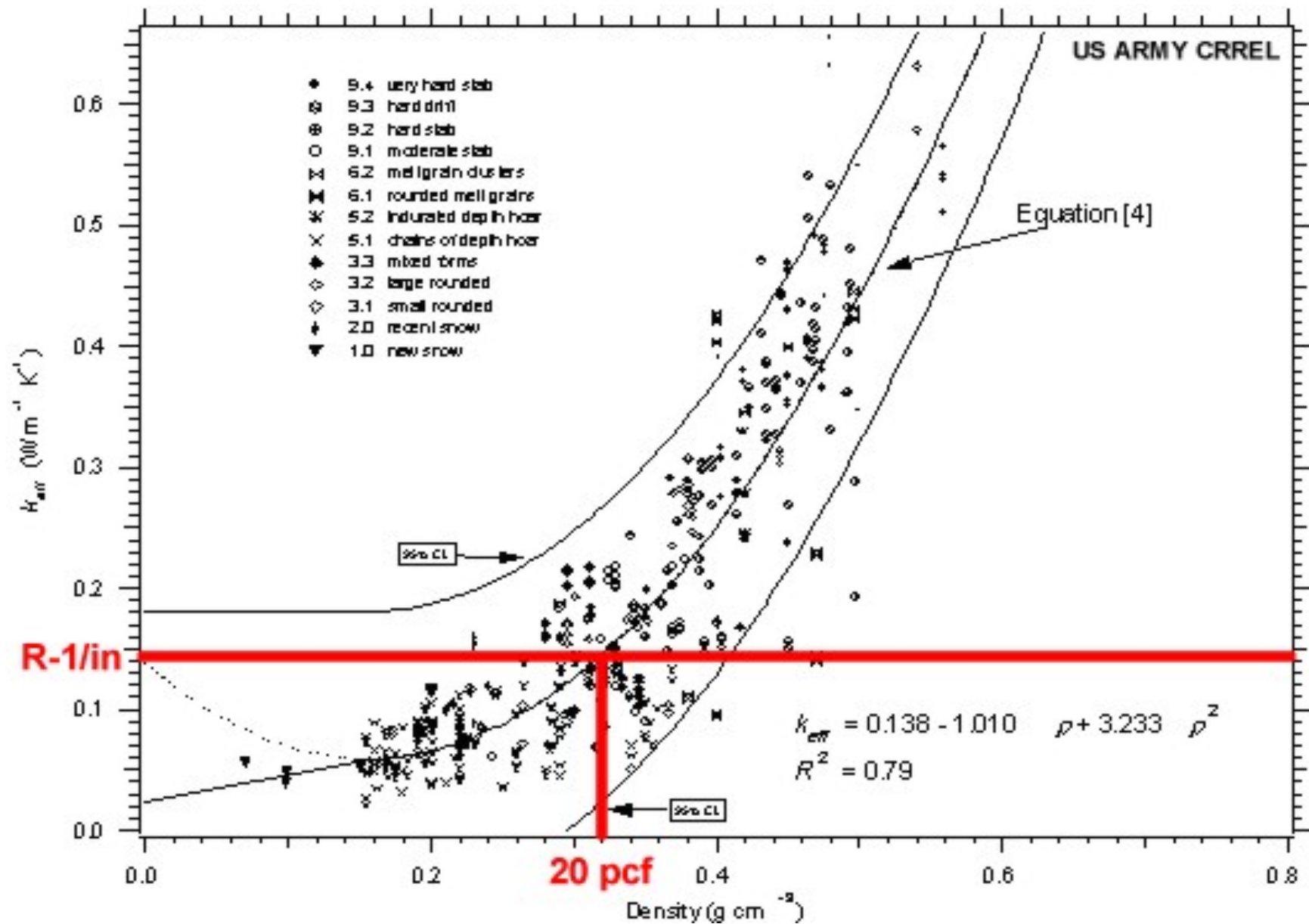






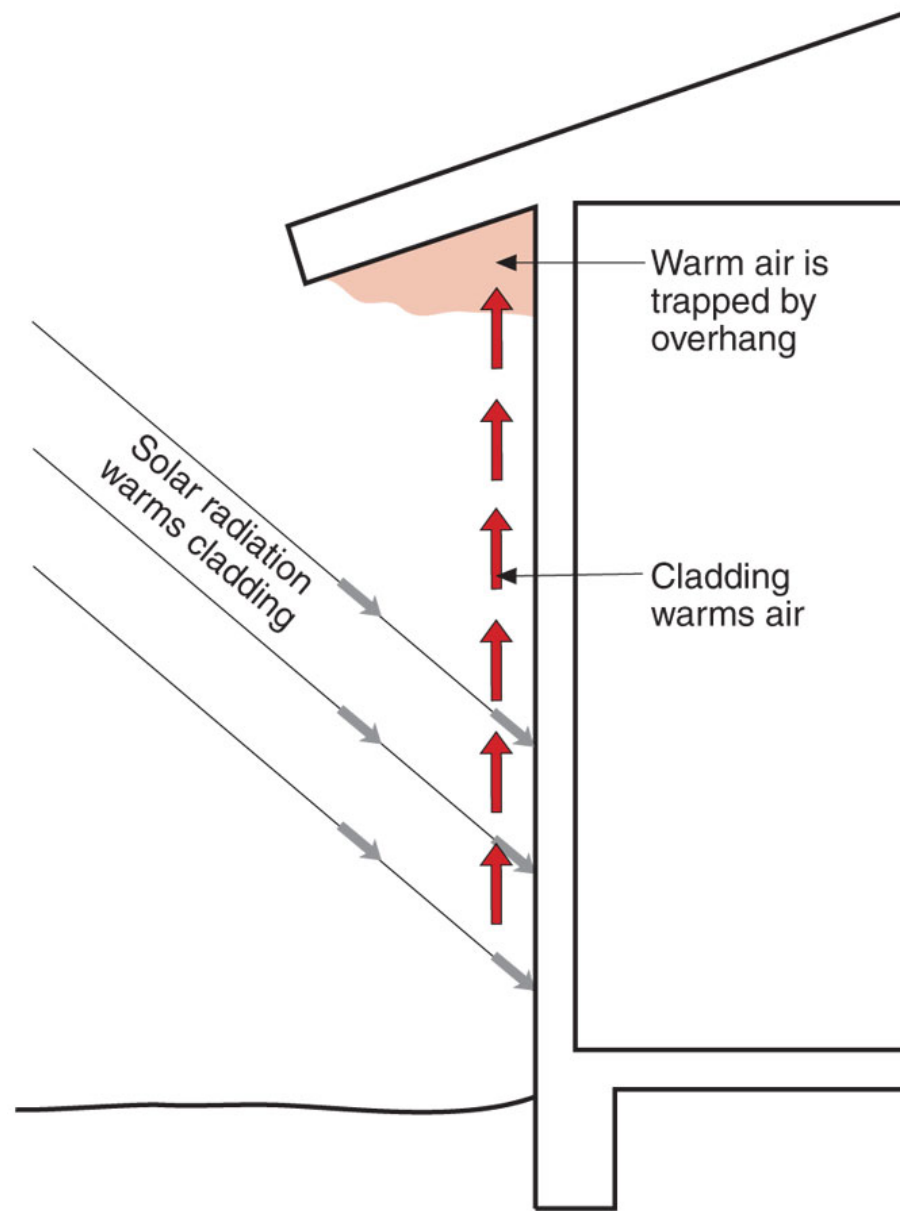










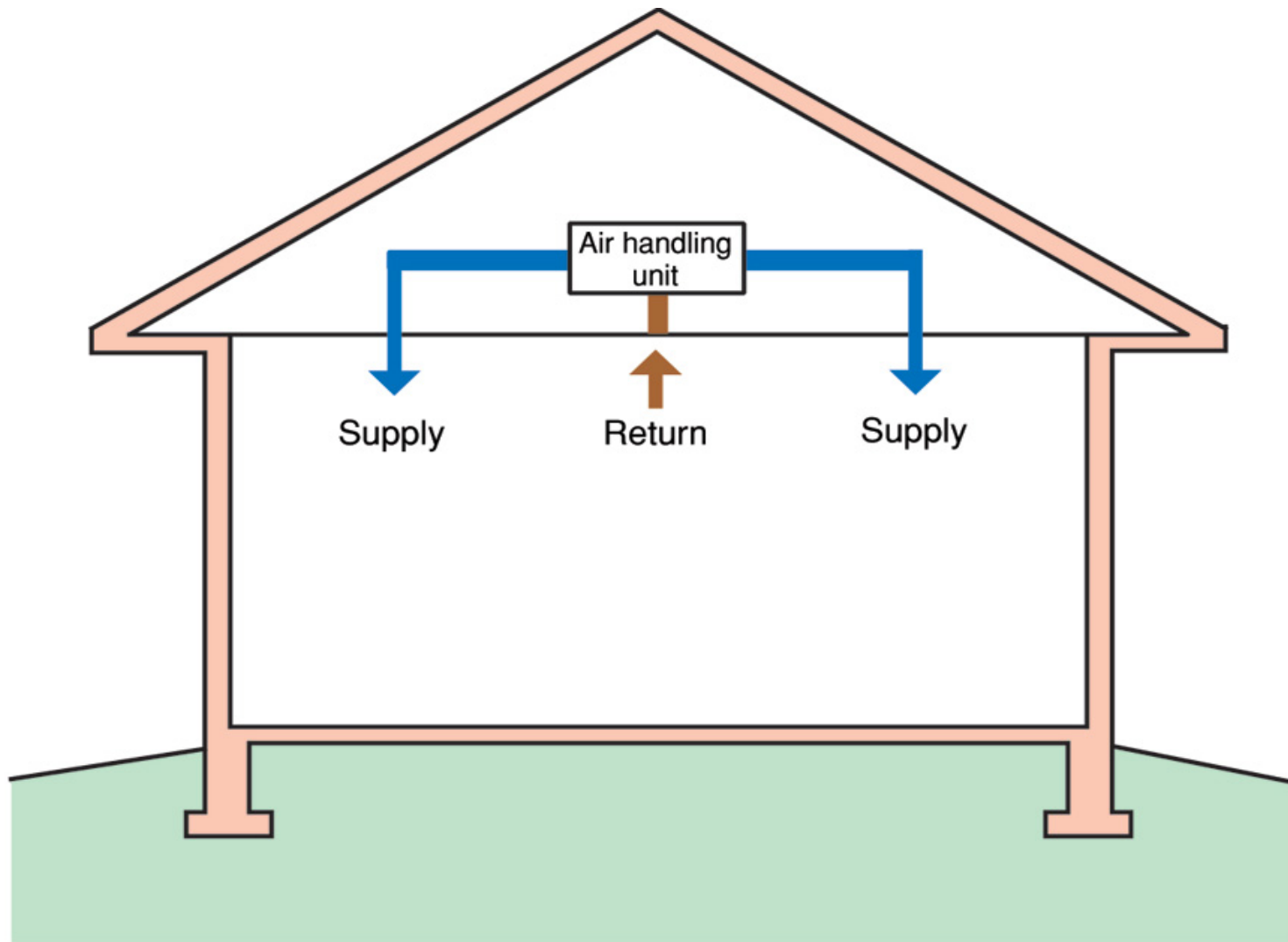




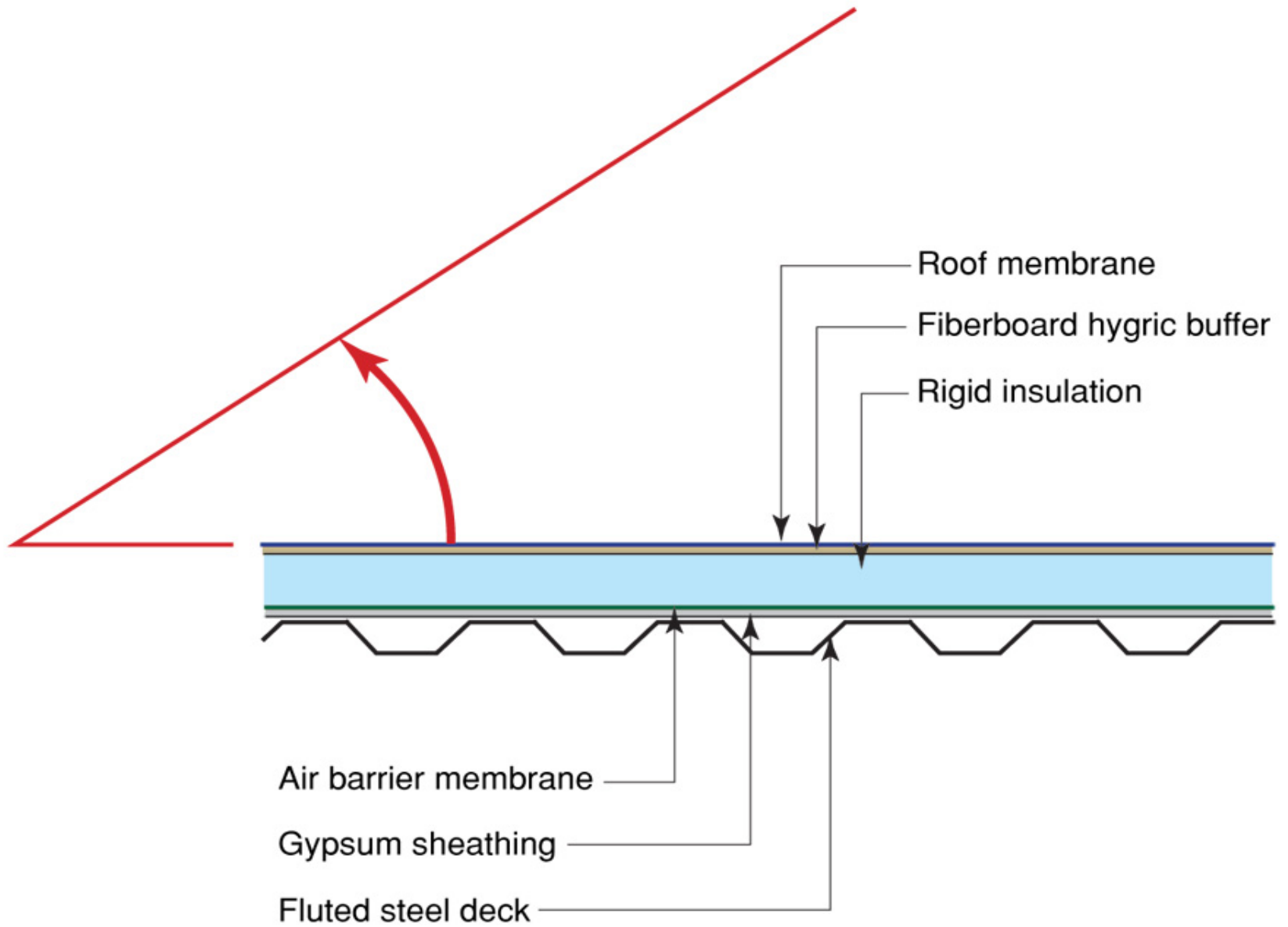


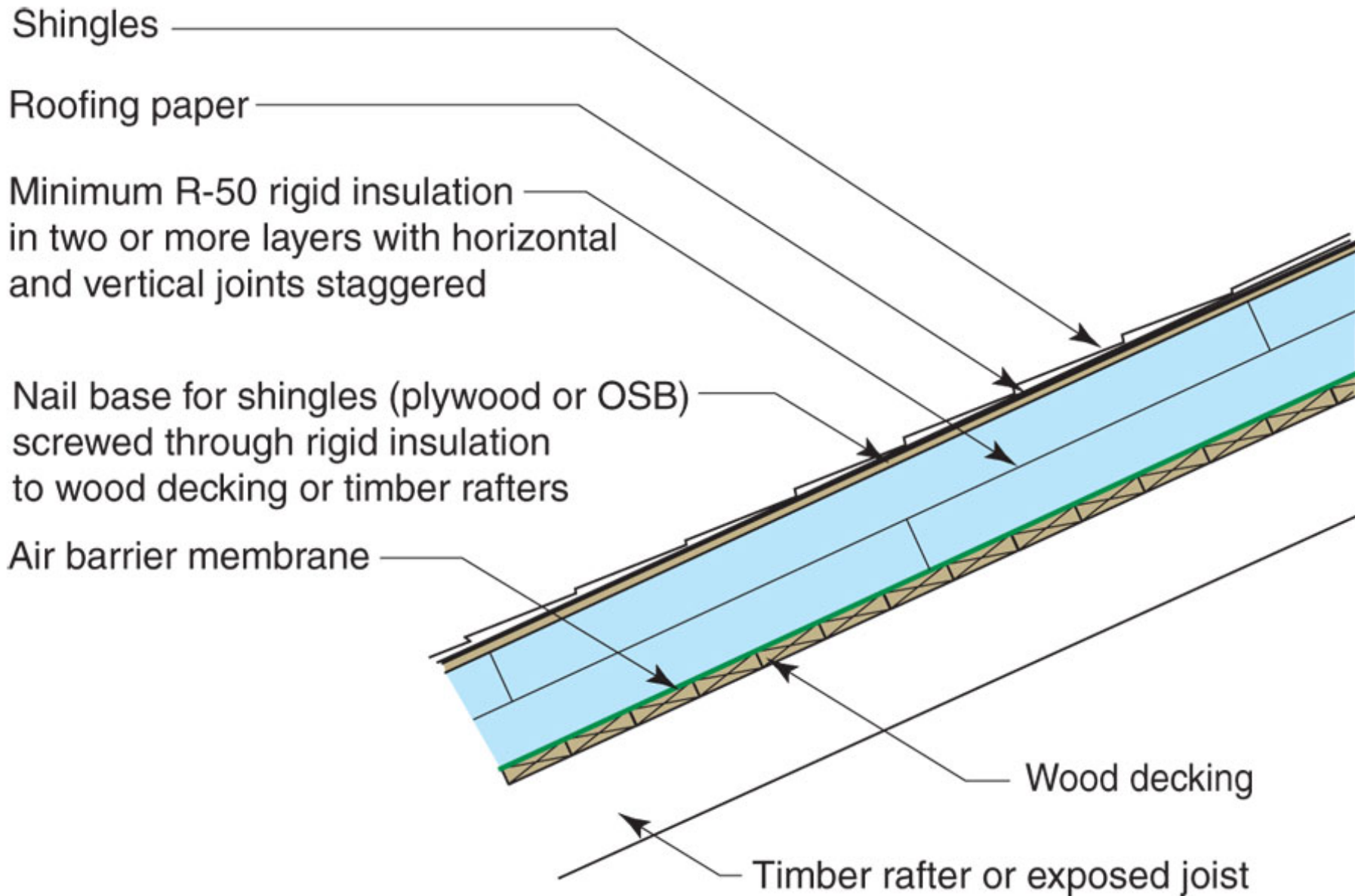


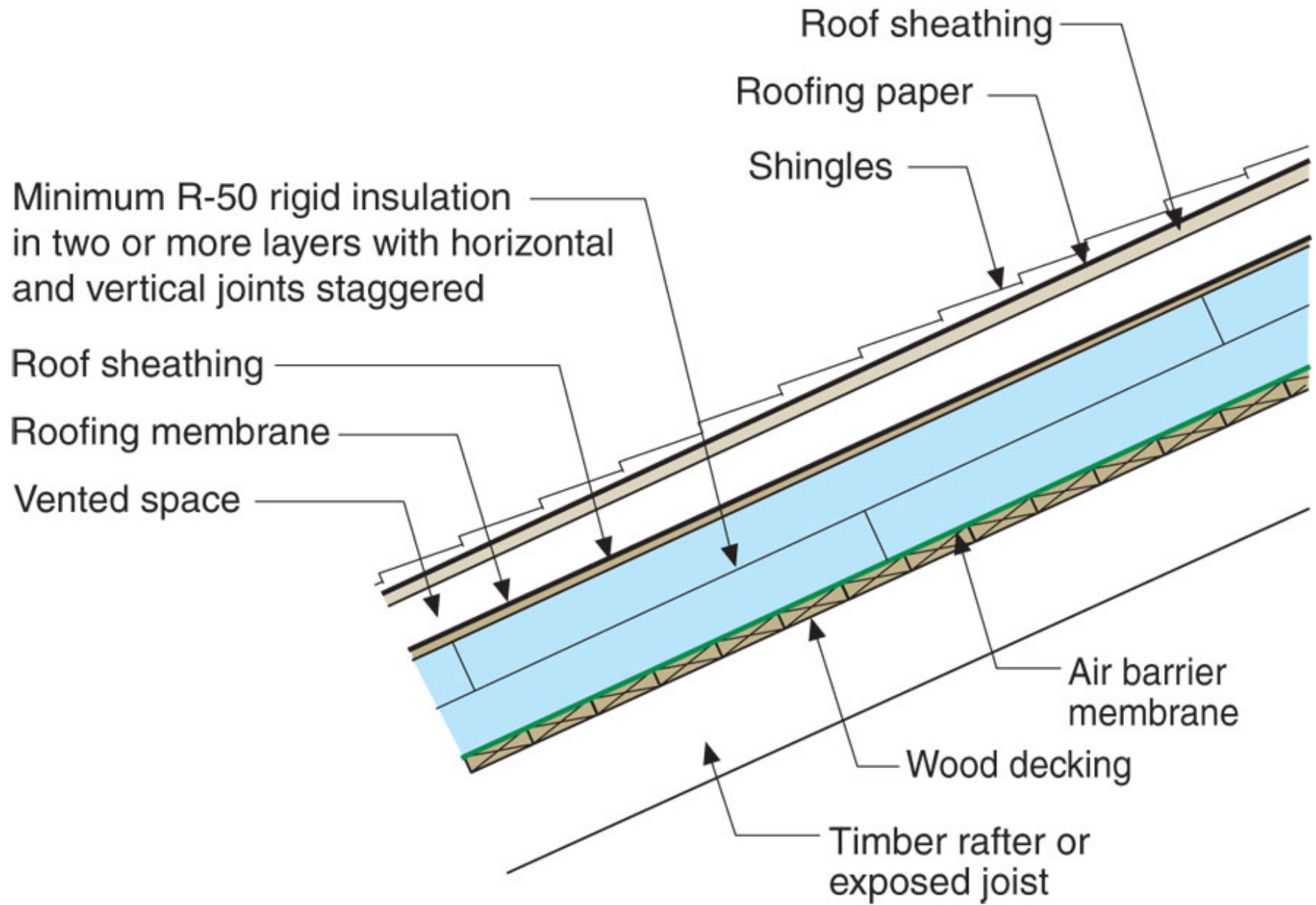


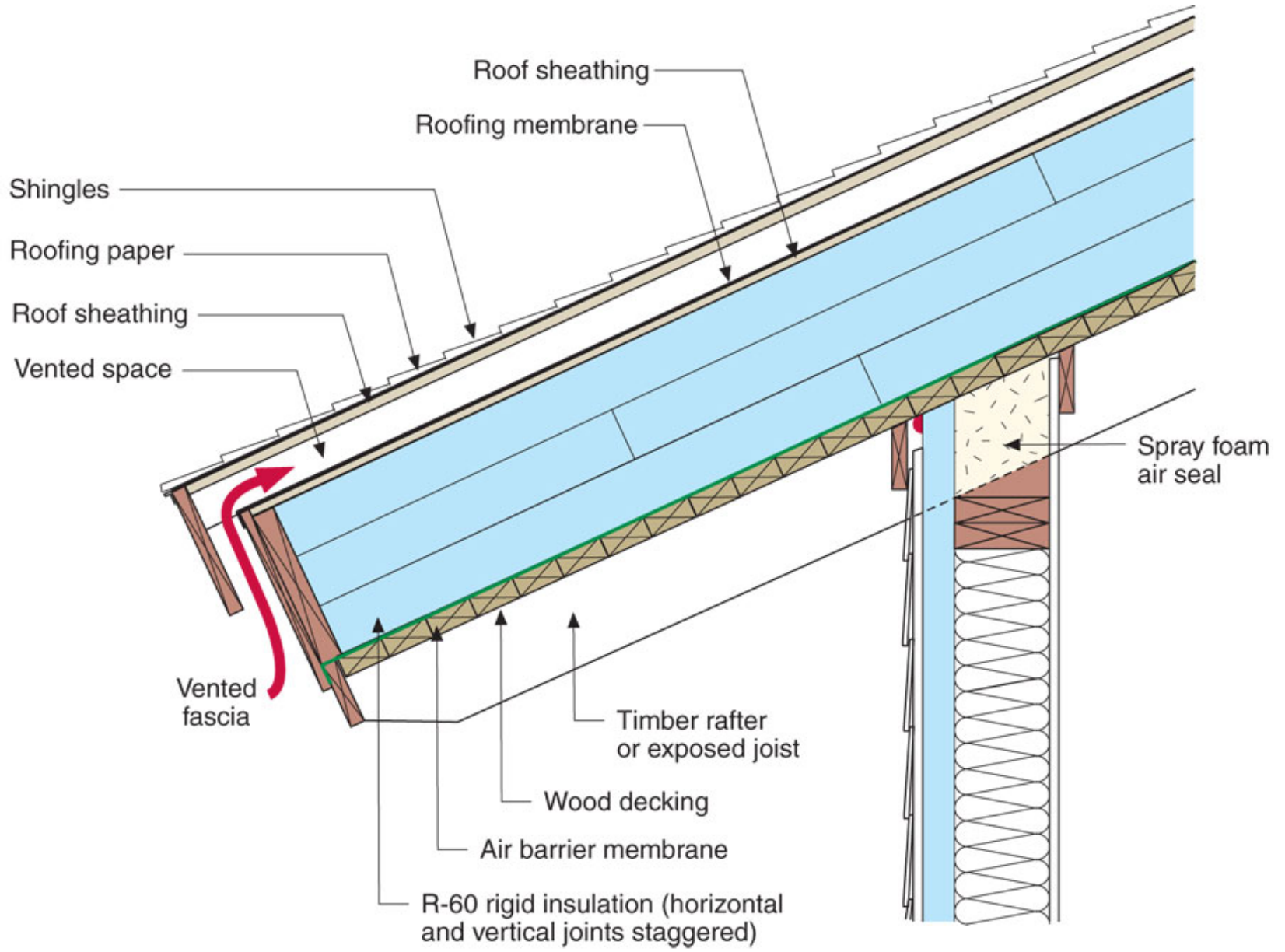


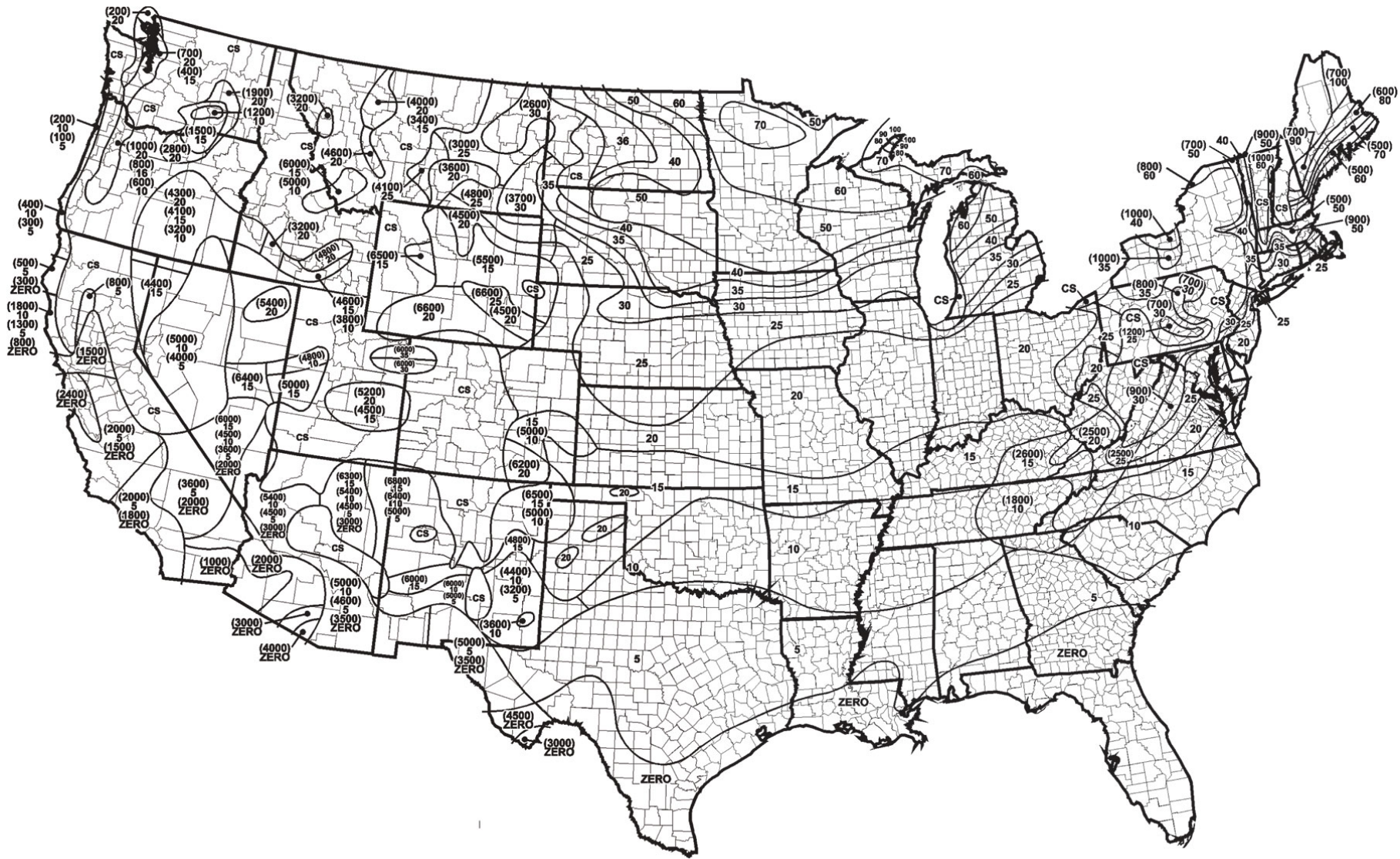
Note: Colored shading depicts the building's thermal barrier and pressure boundary. The thermal barrier and pressure boundary enclose the conditioned space.











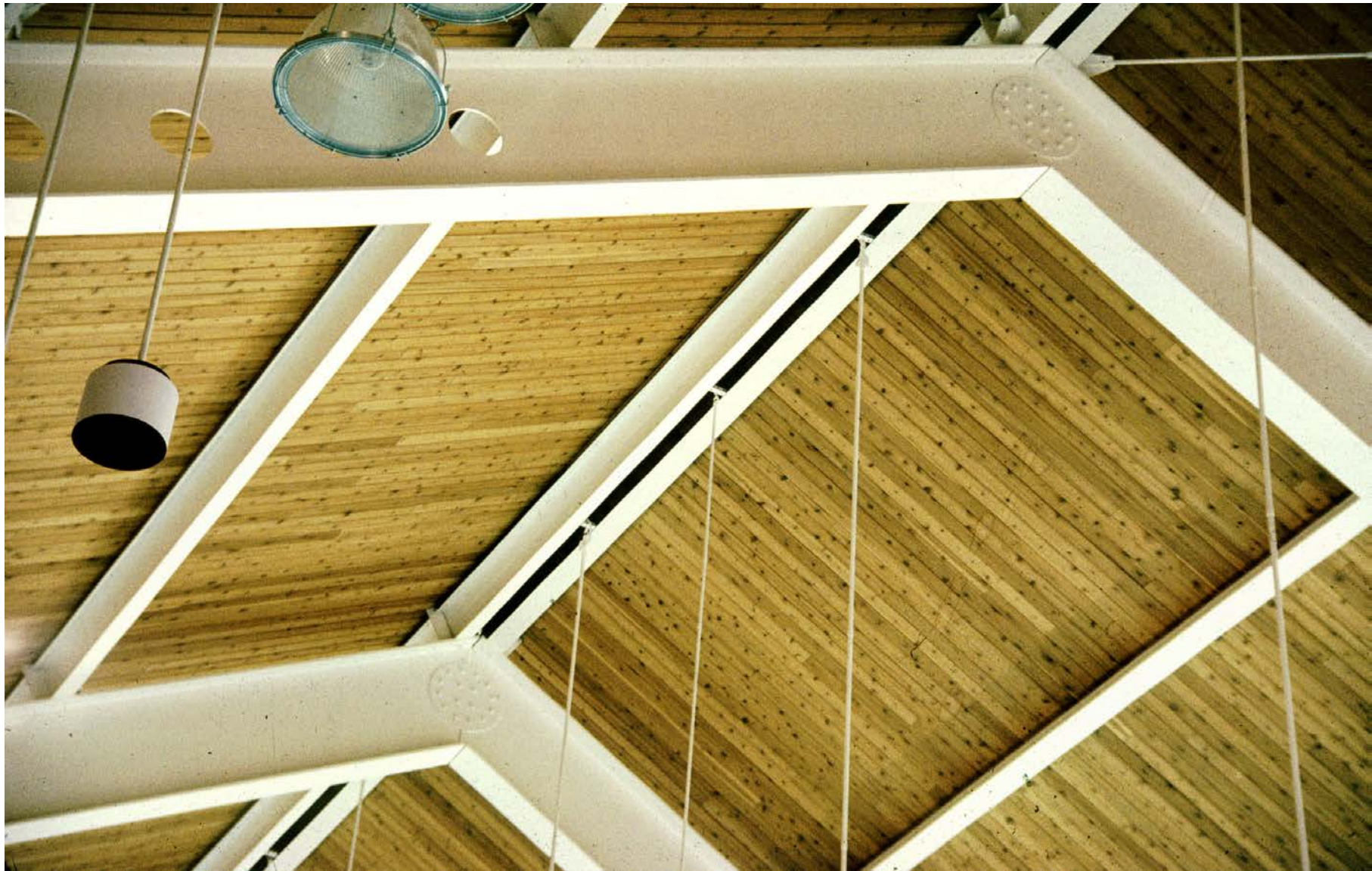






















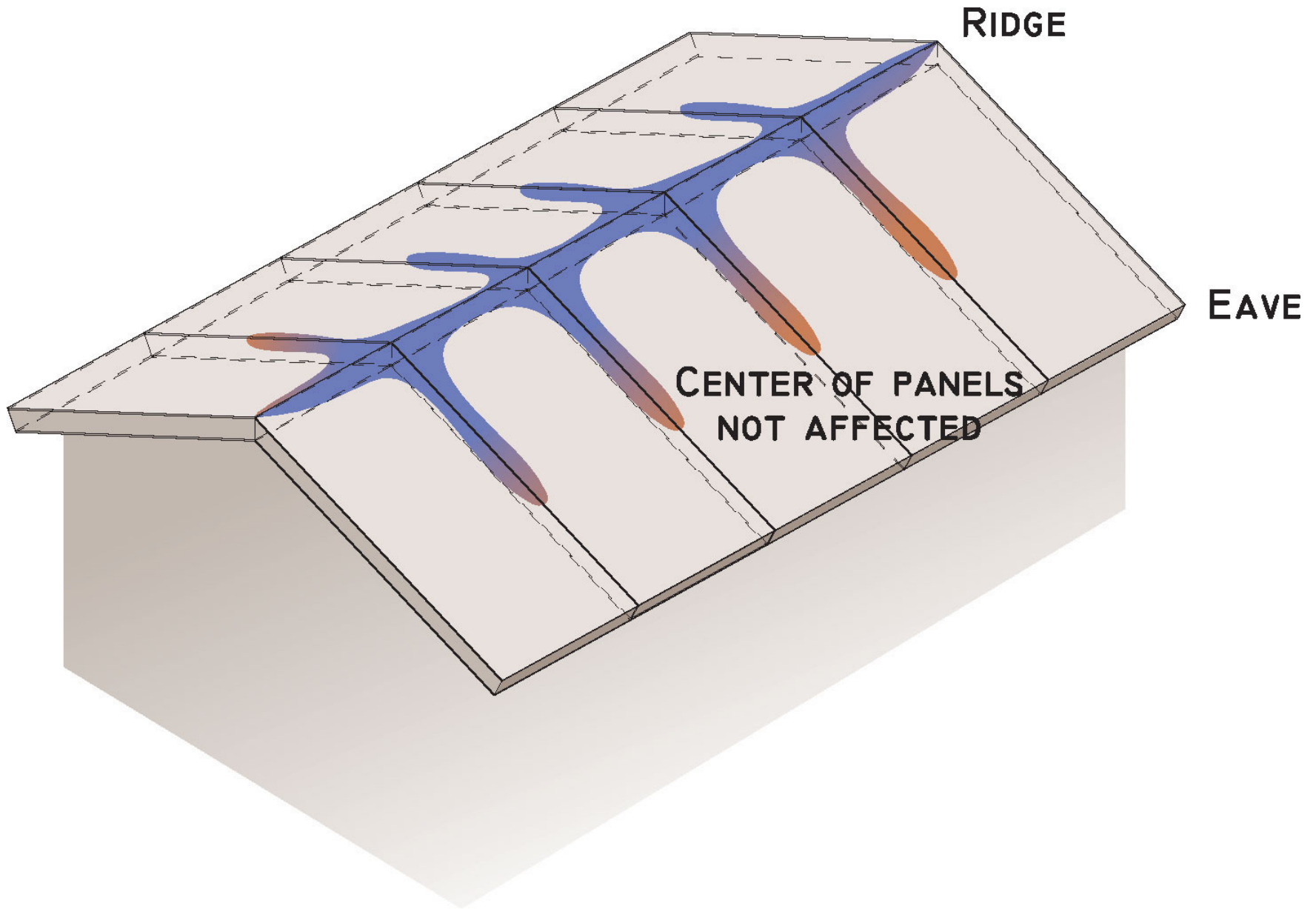




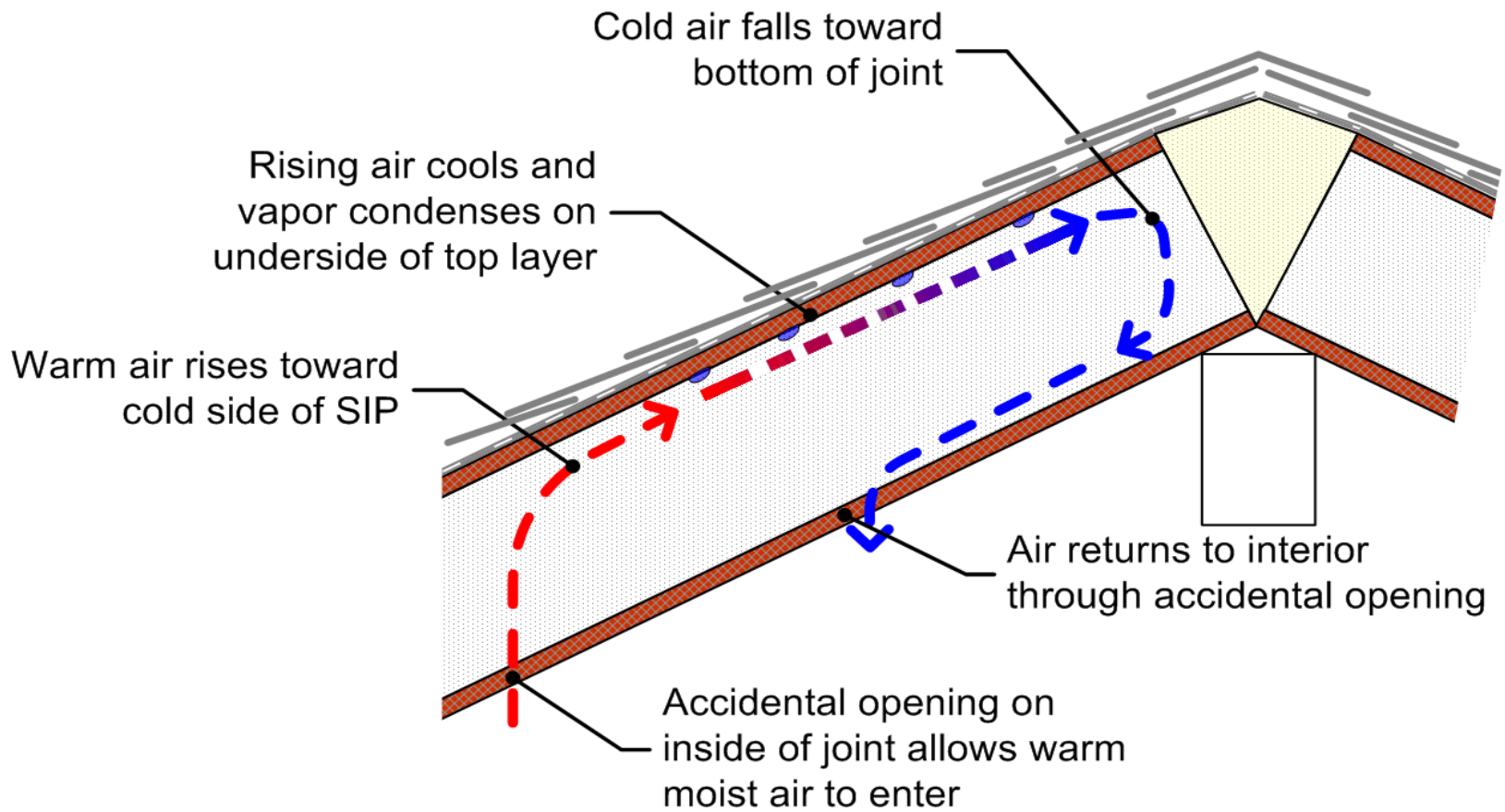


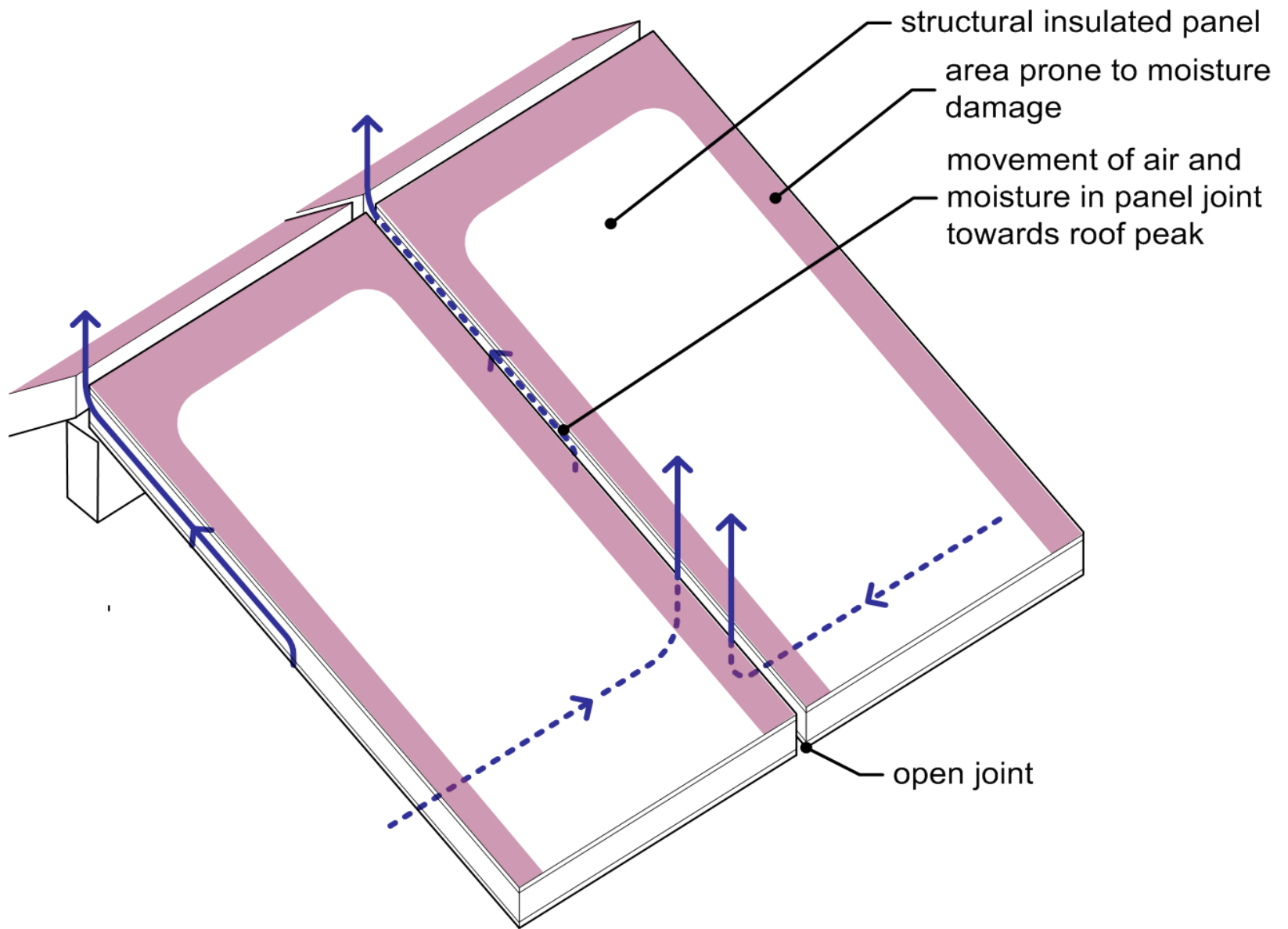


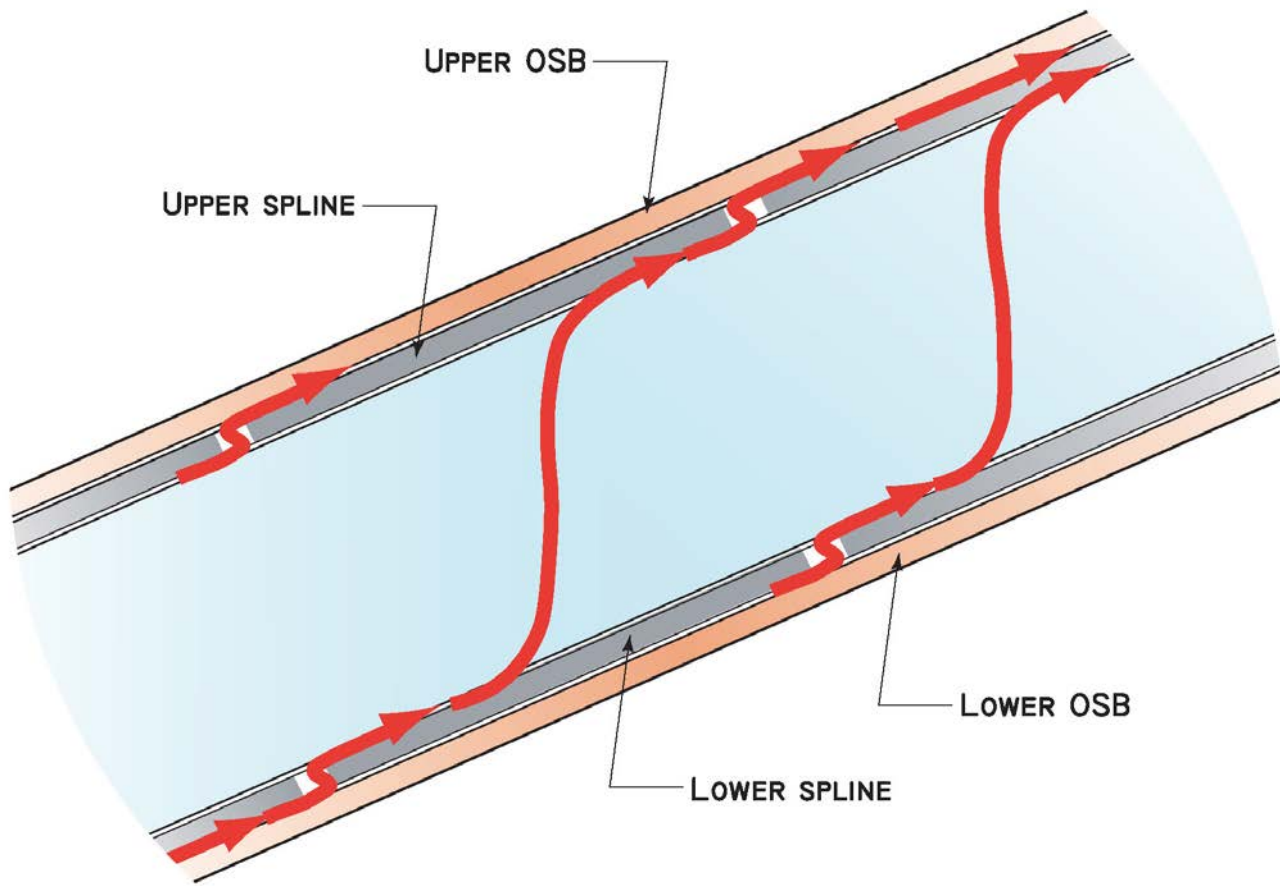




















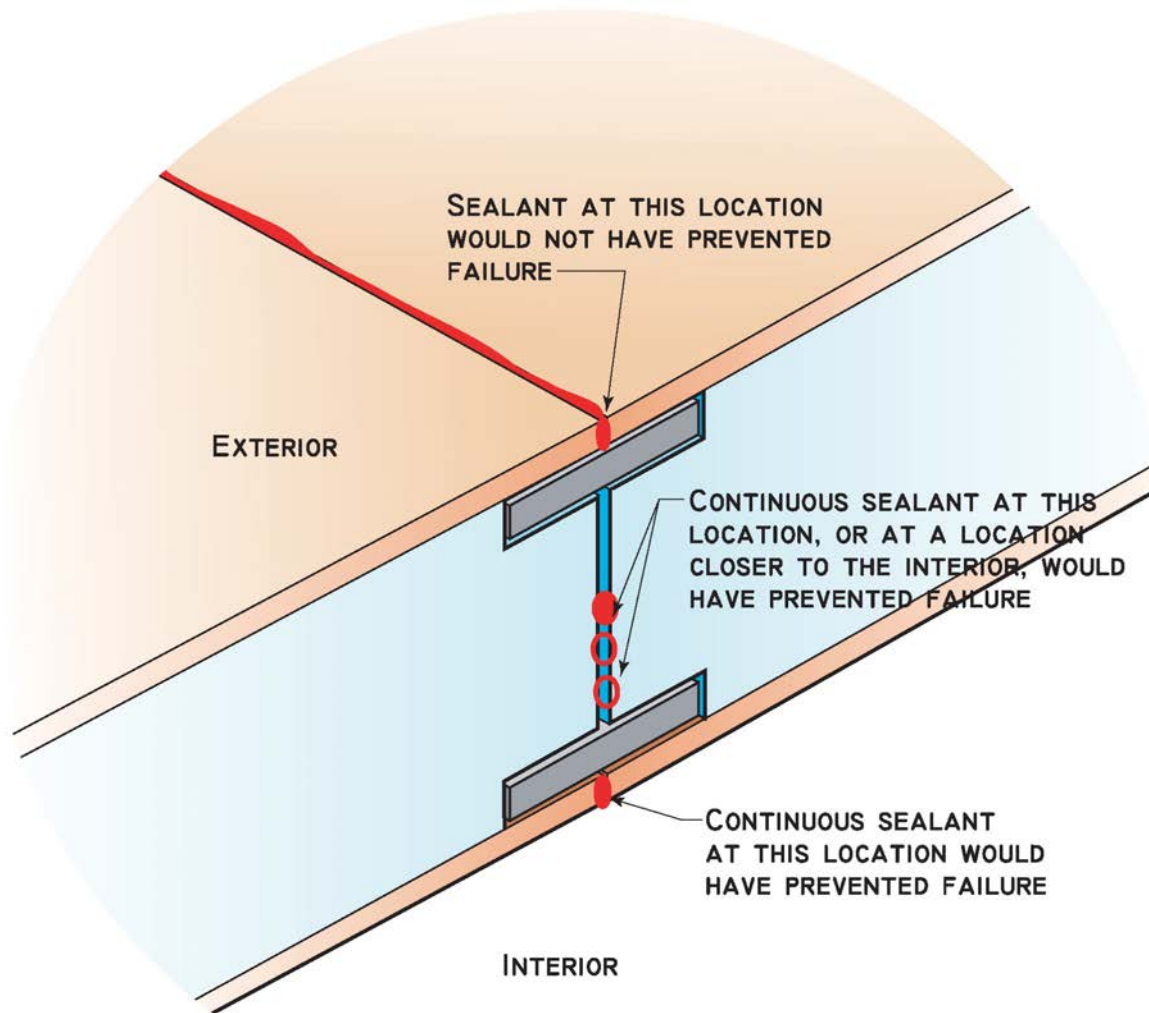


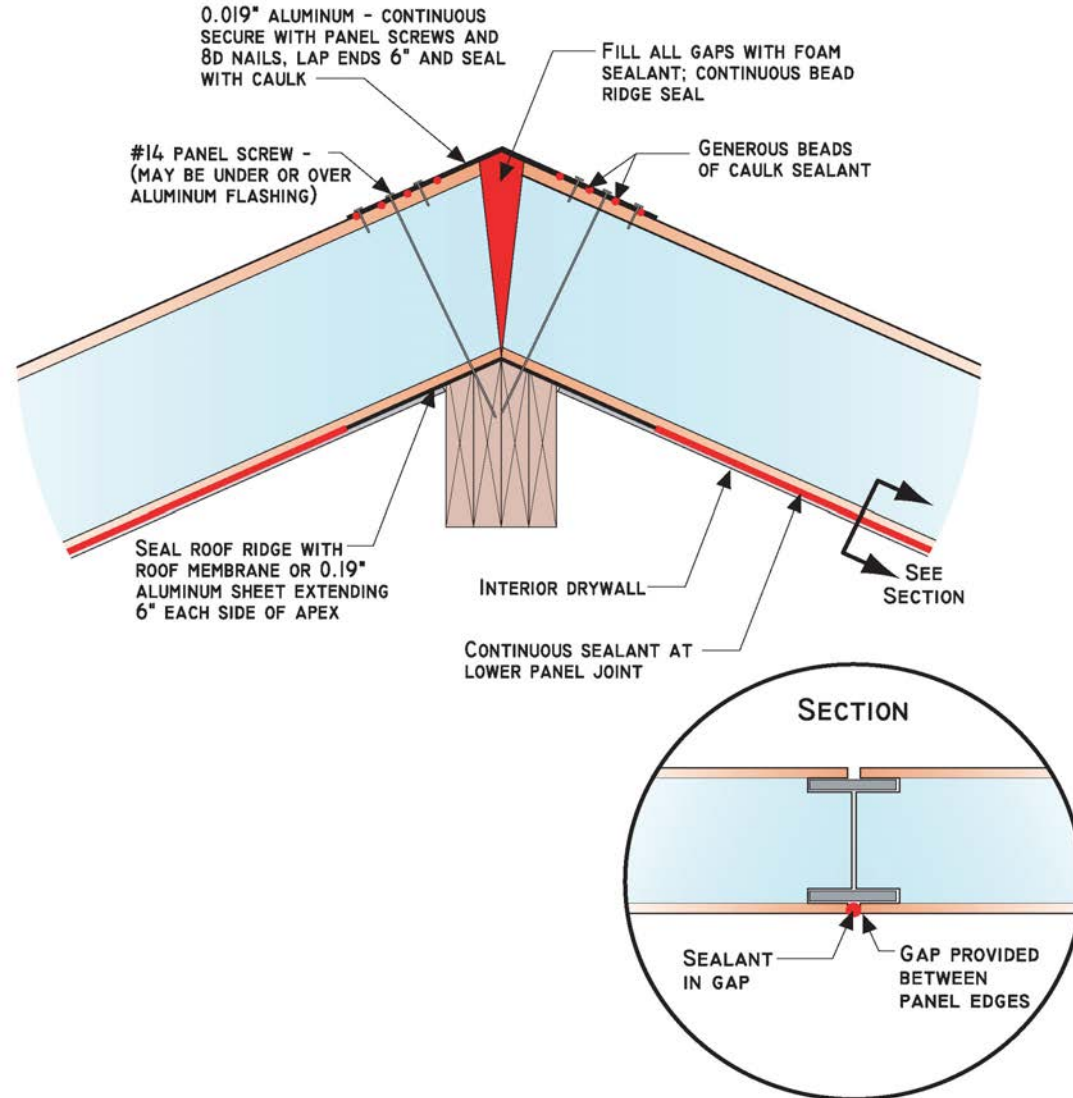














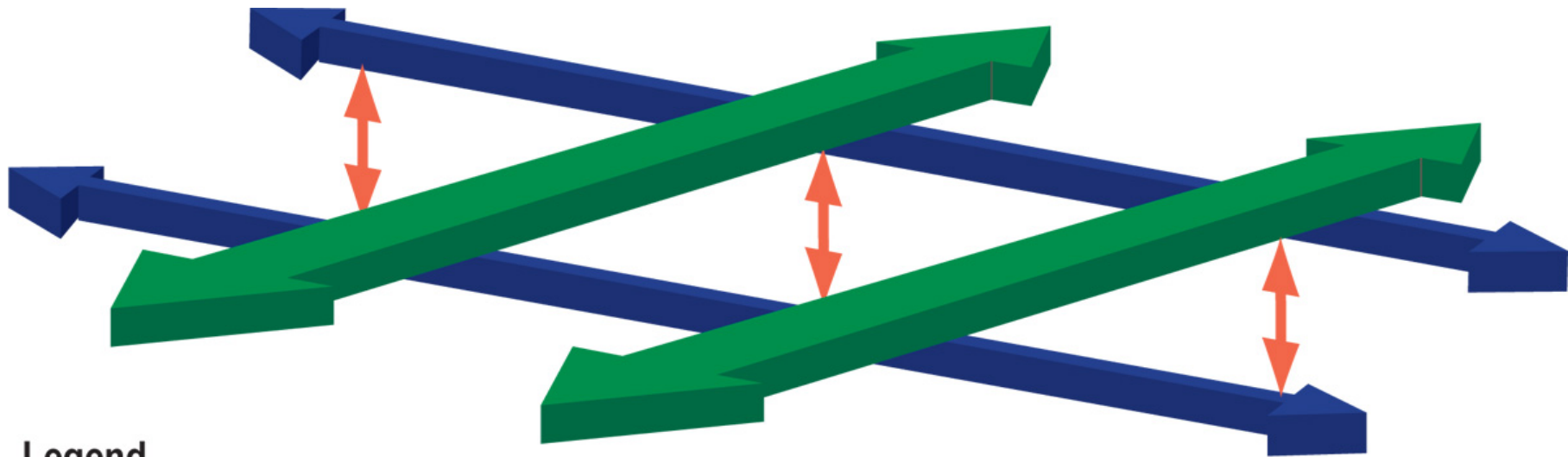









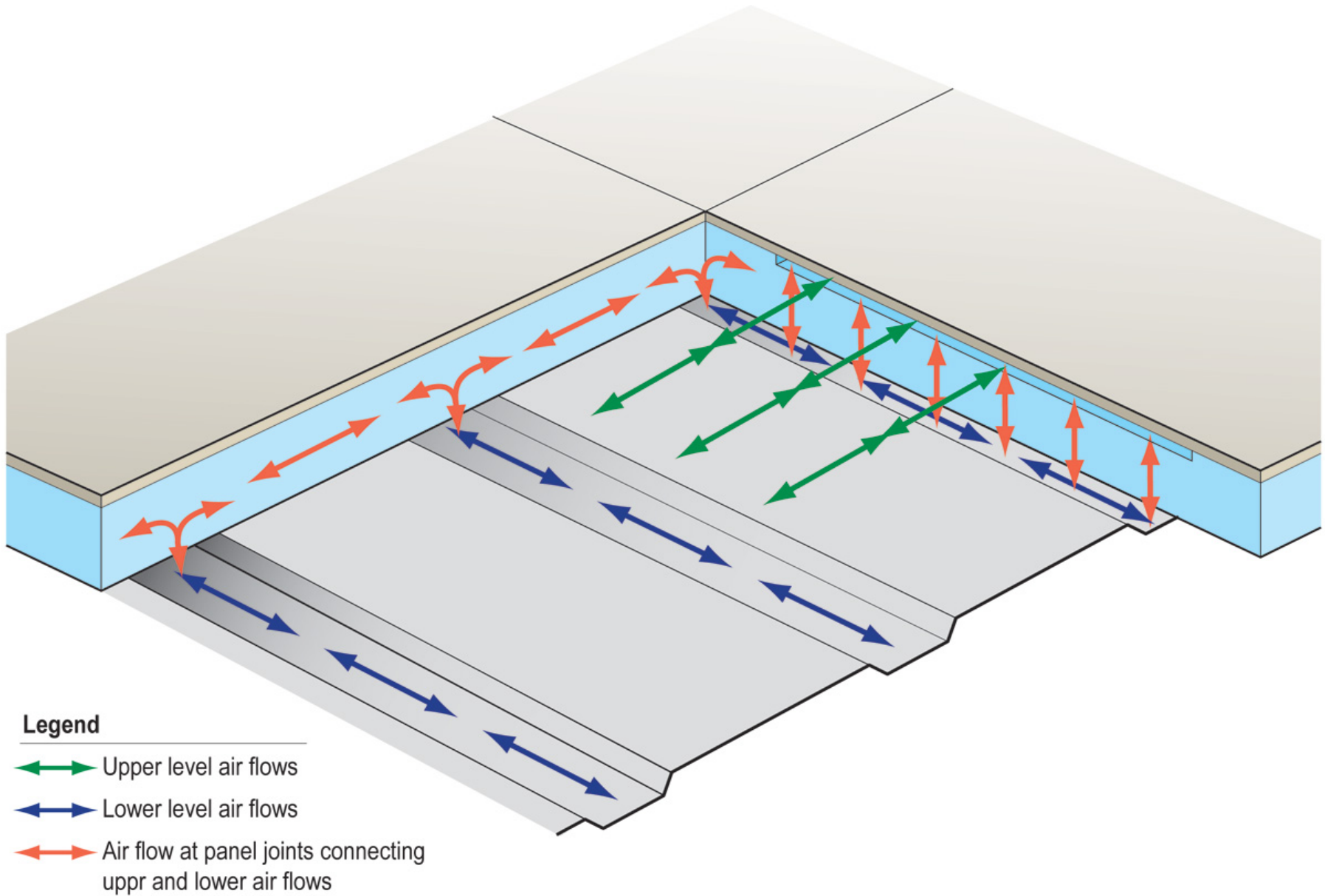


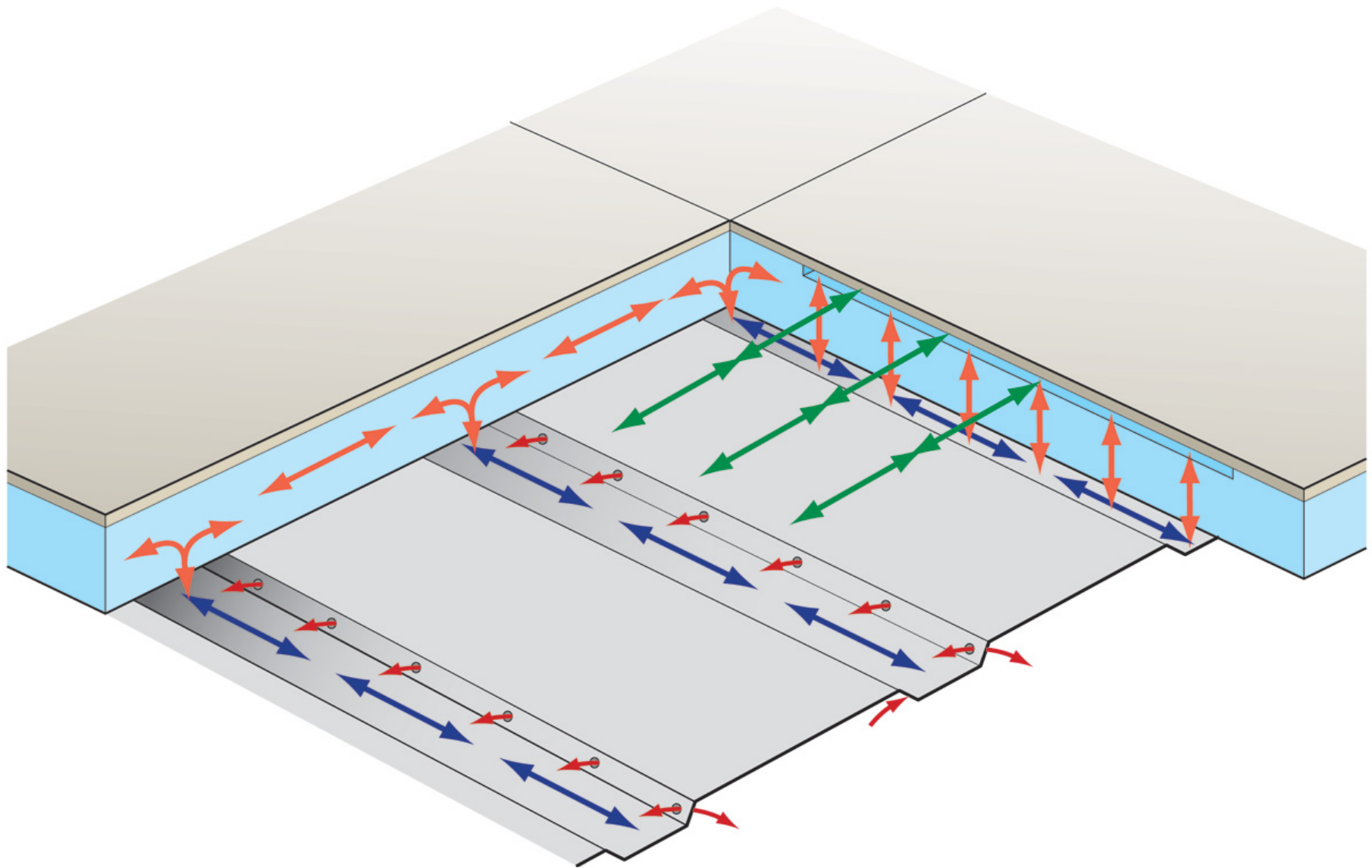




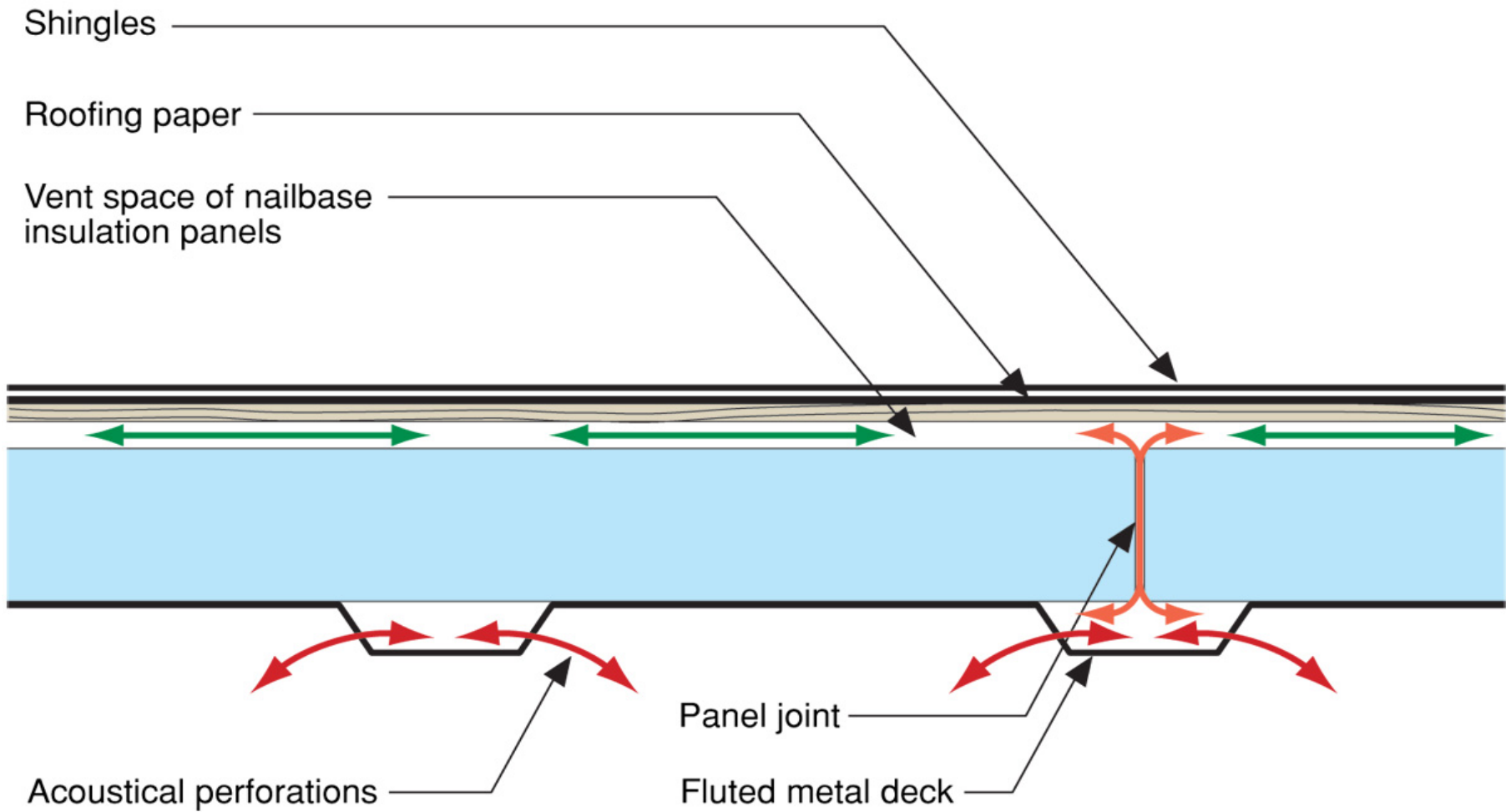
Legend

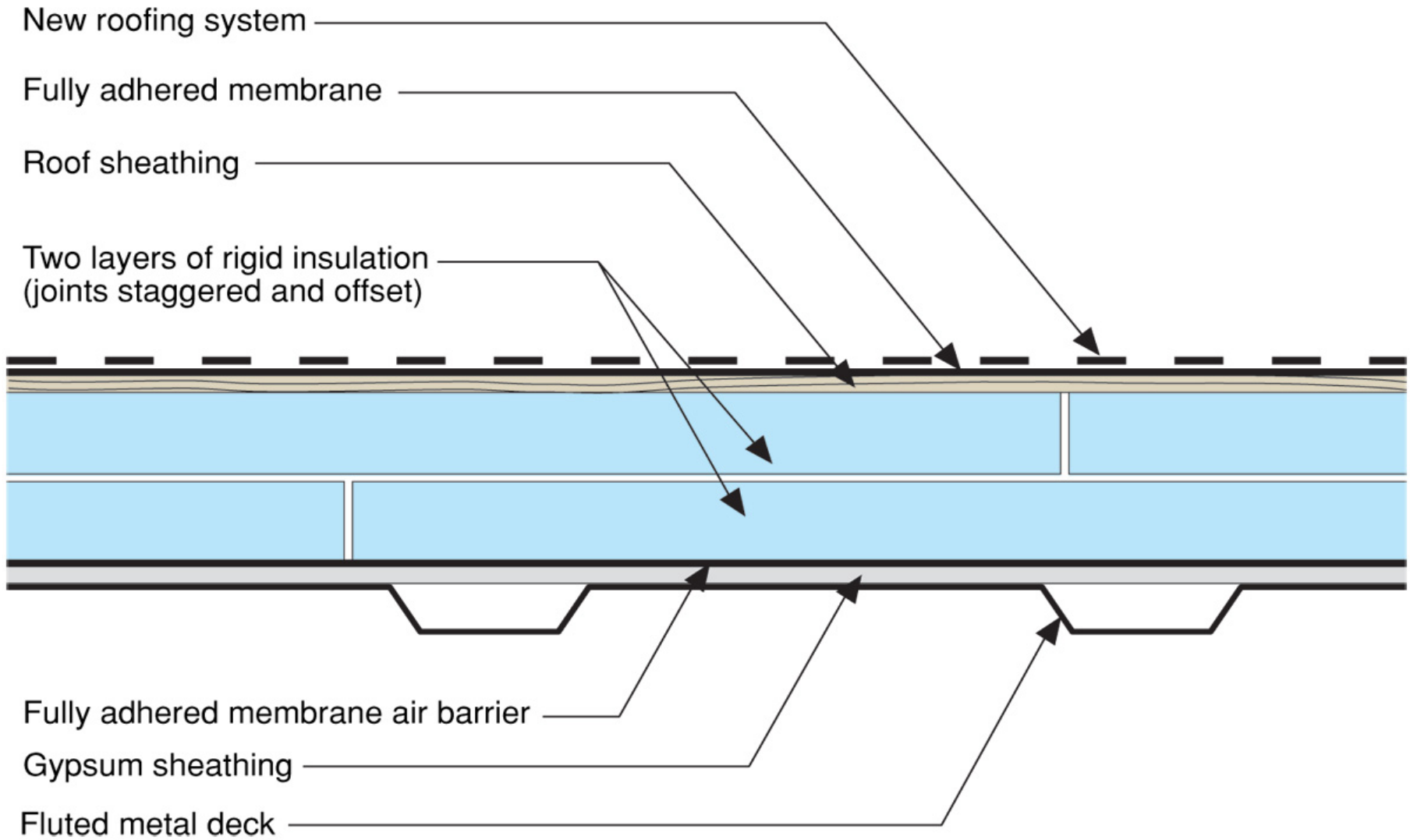
-  Upper level air flows
-  Lower level air flows
-  Air flow at panel joints

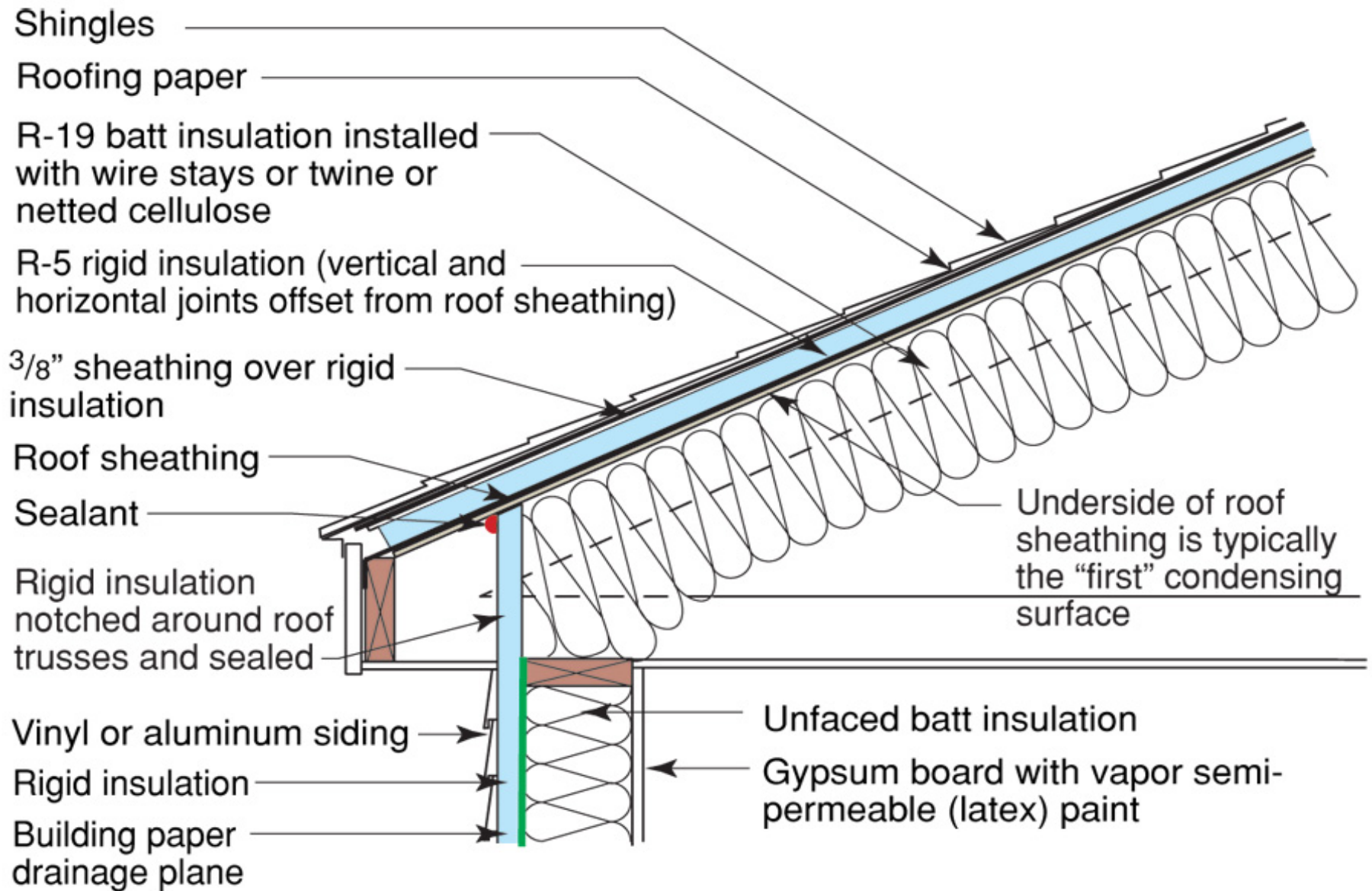


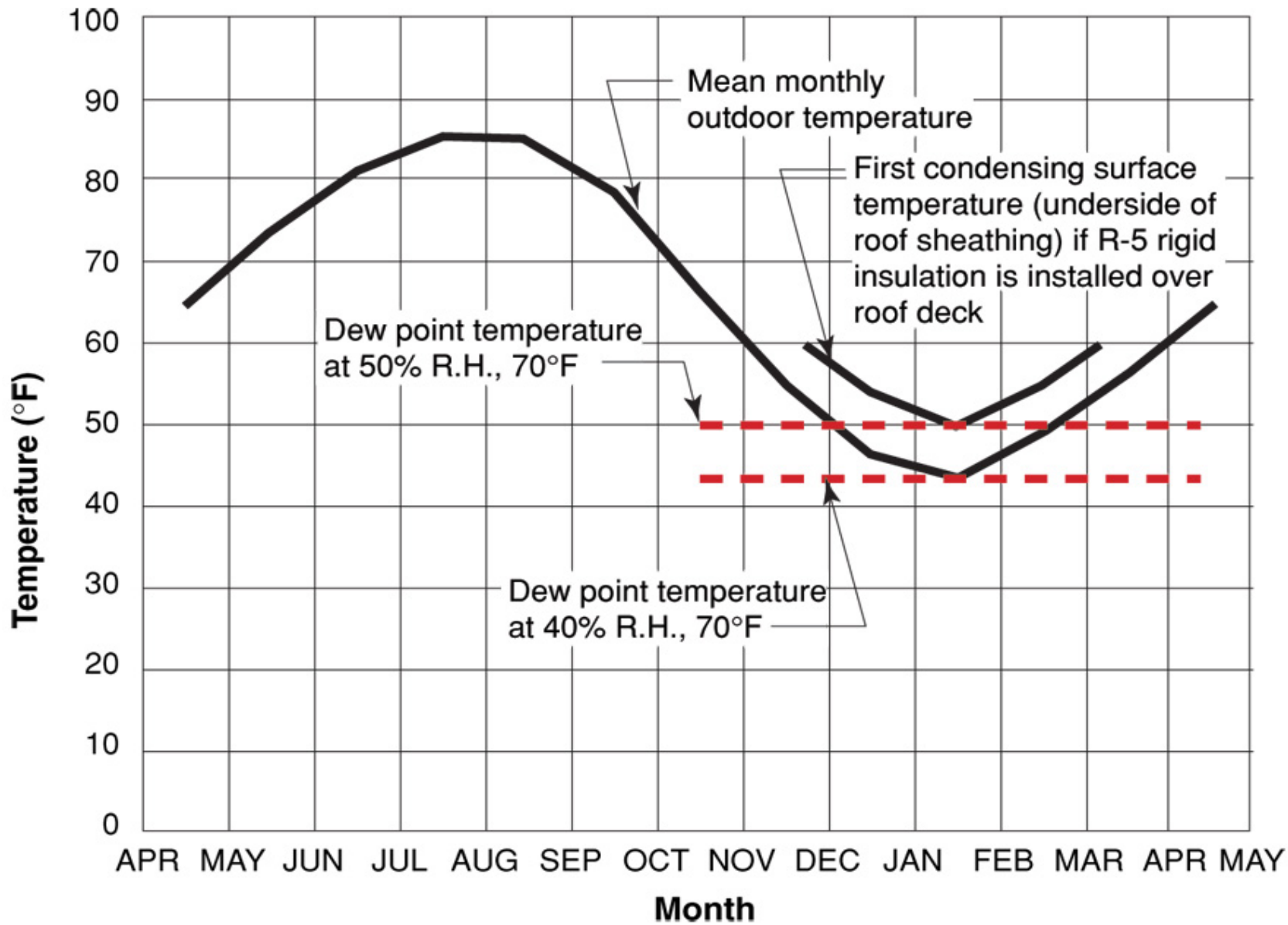


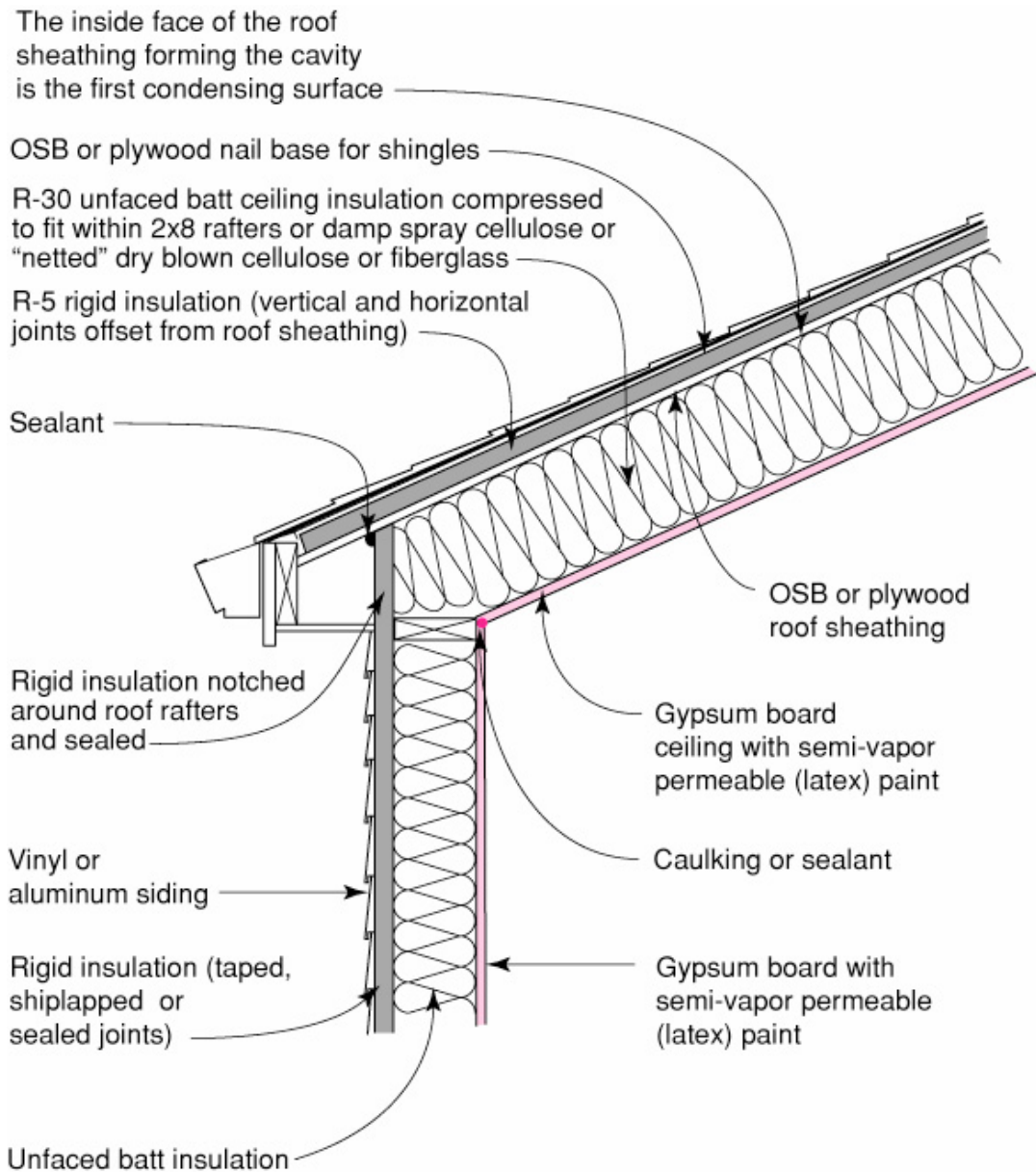


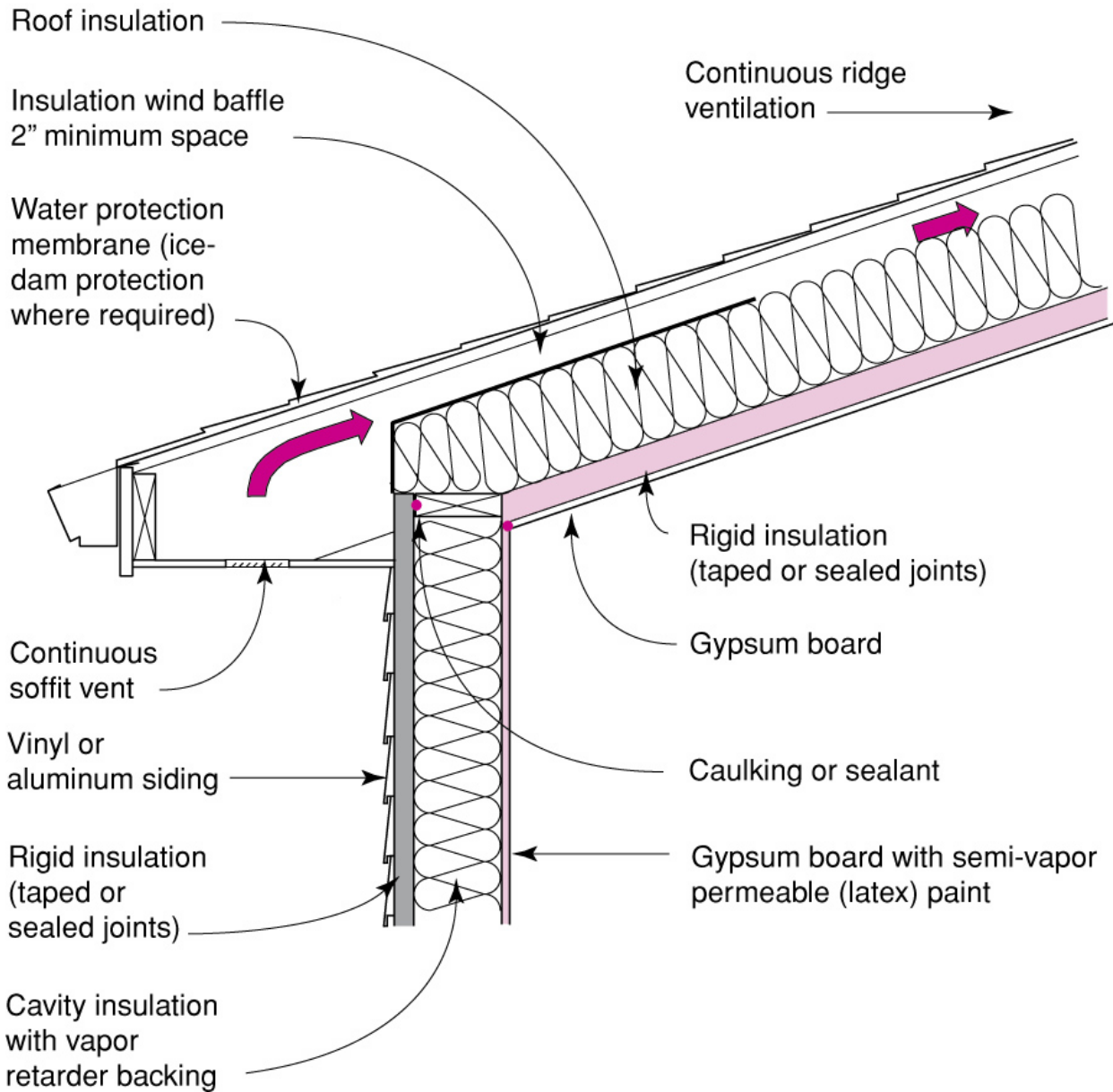


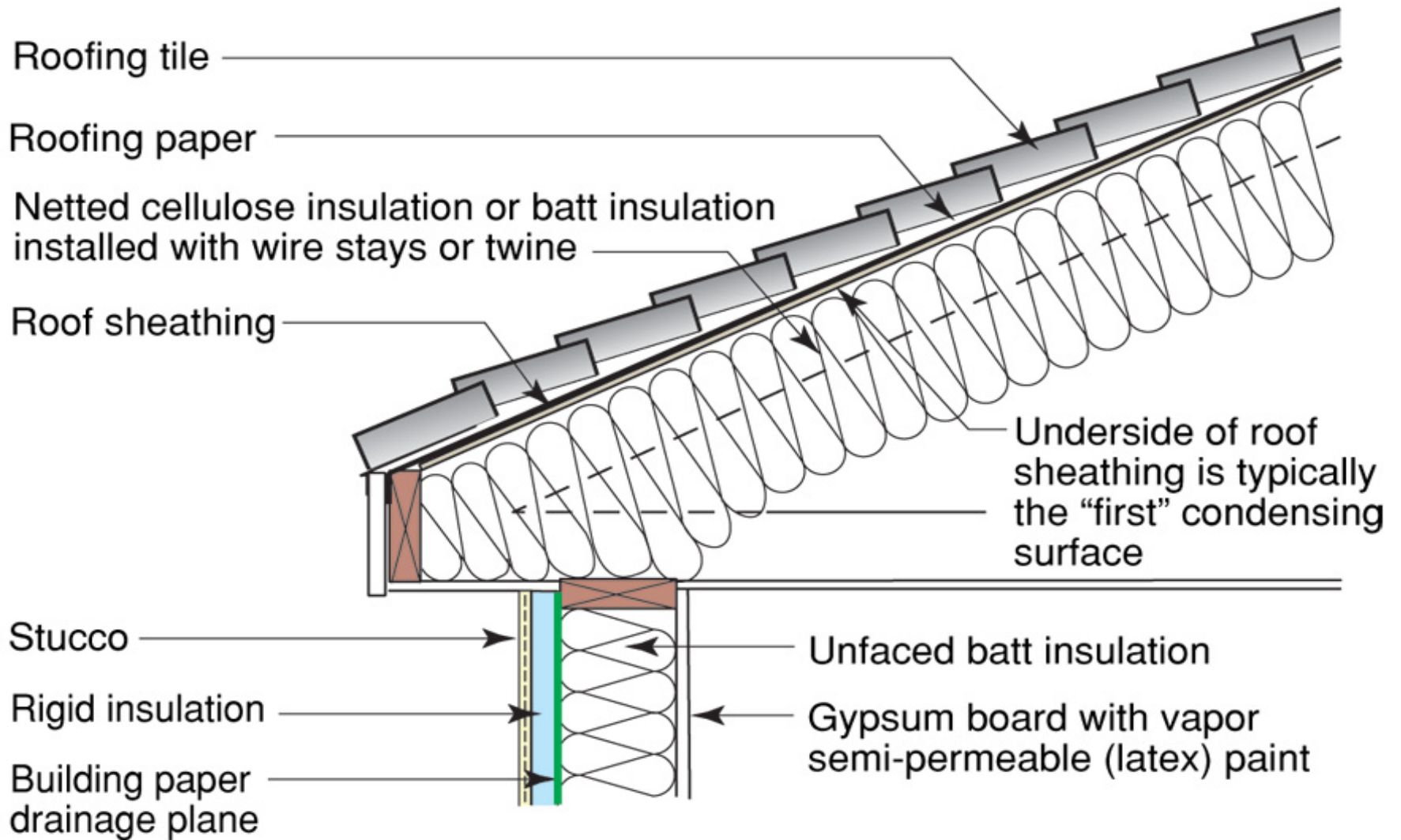








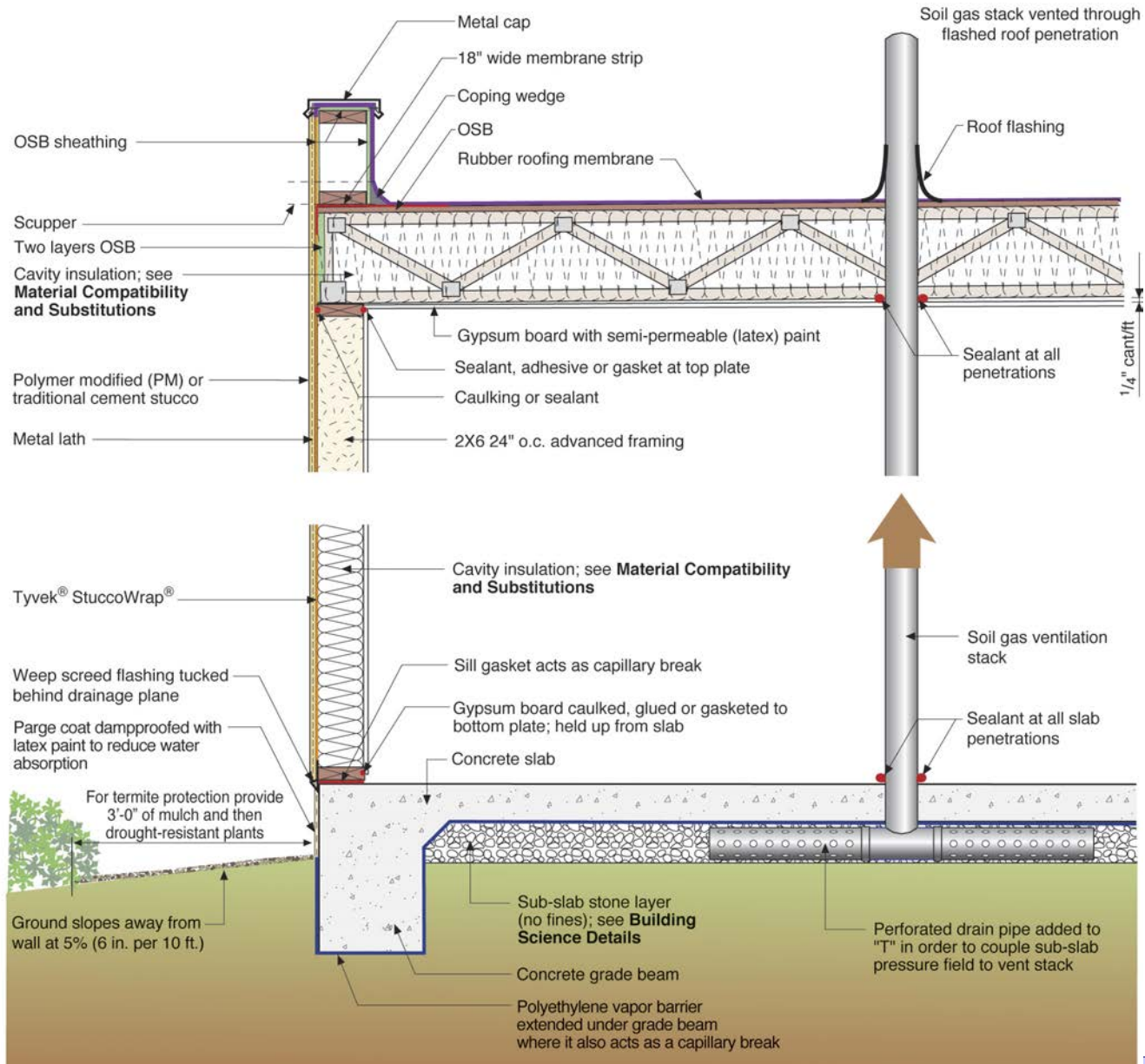


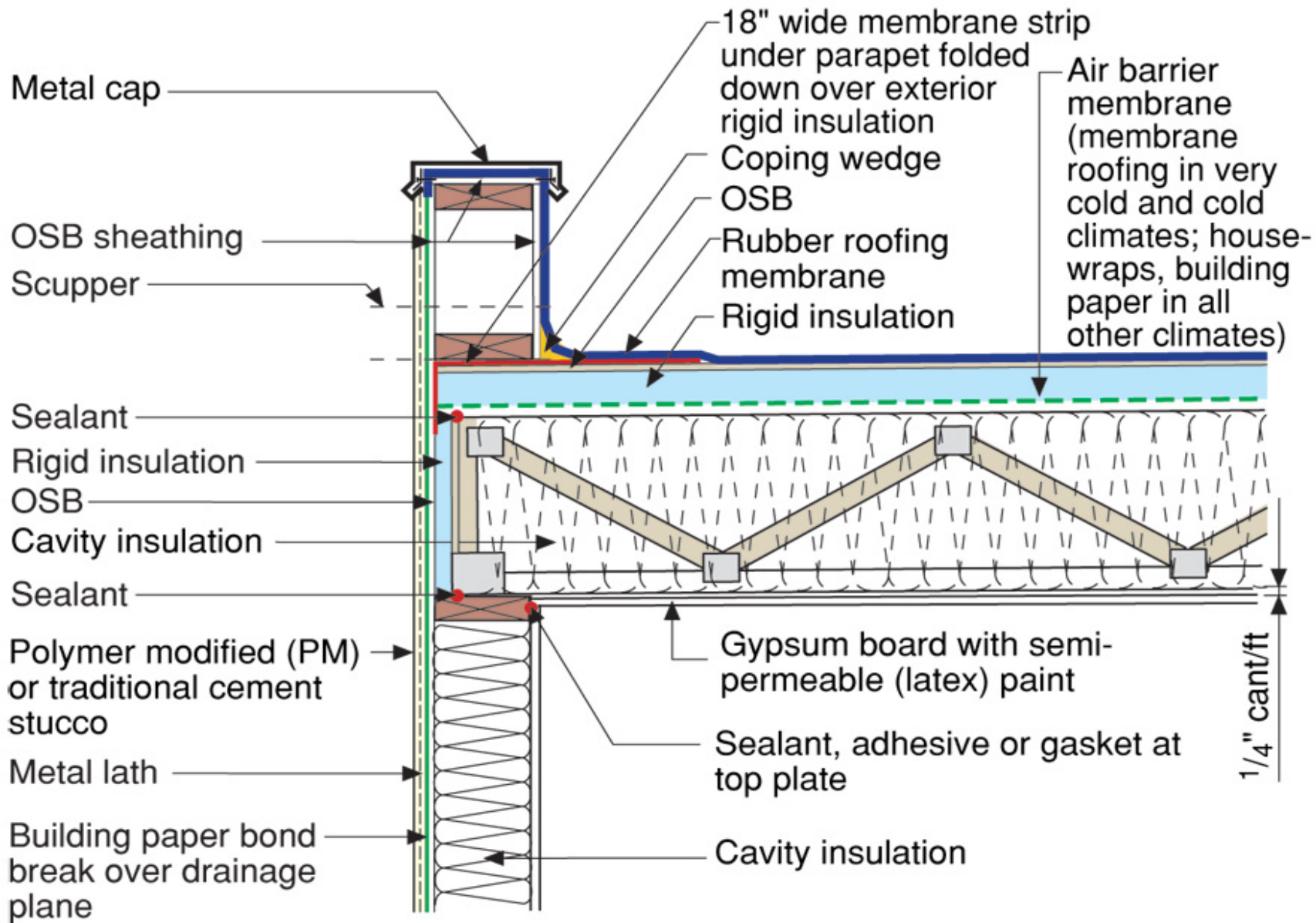


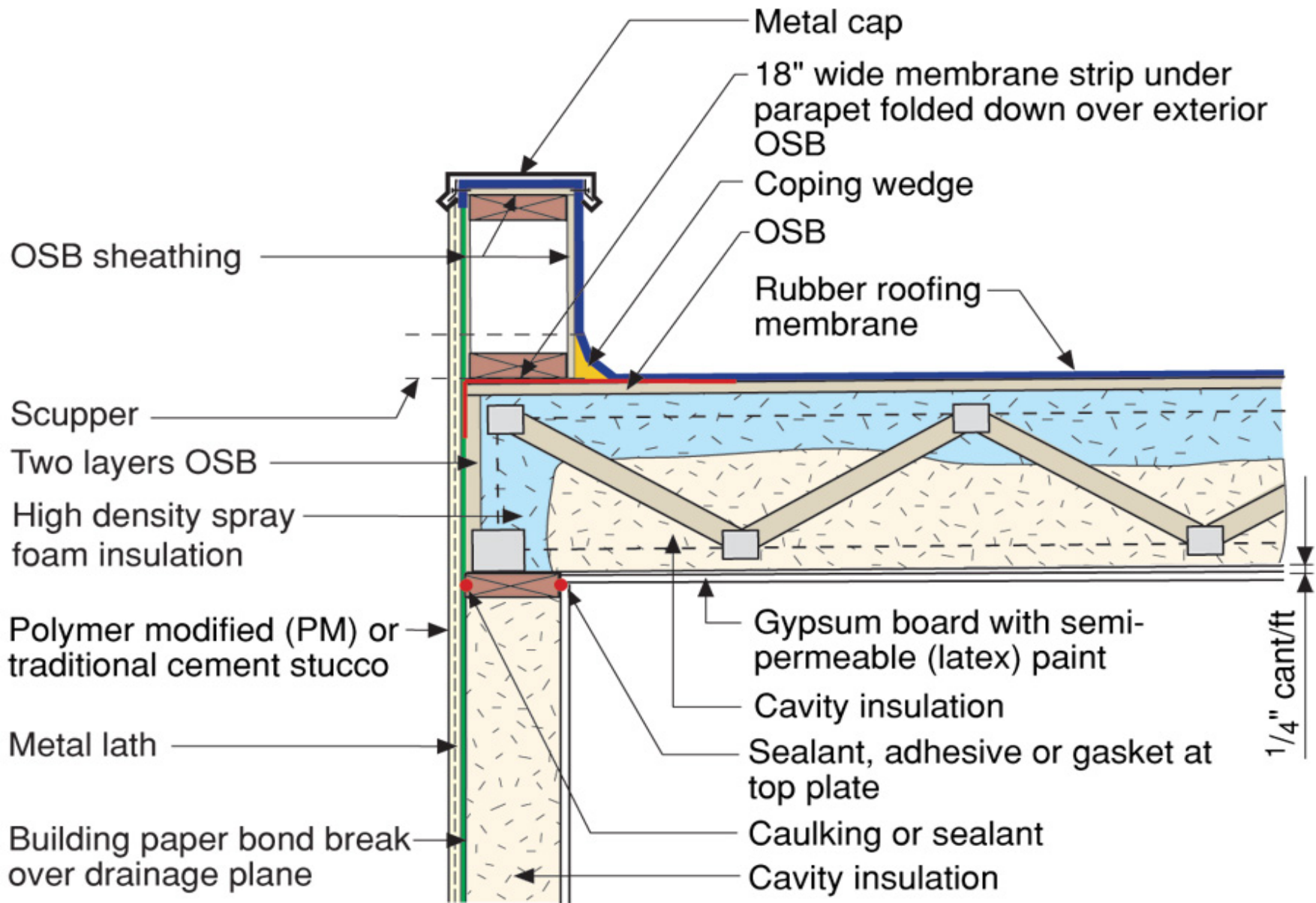




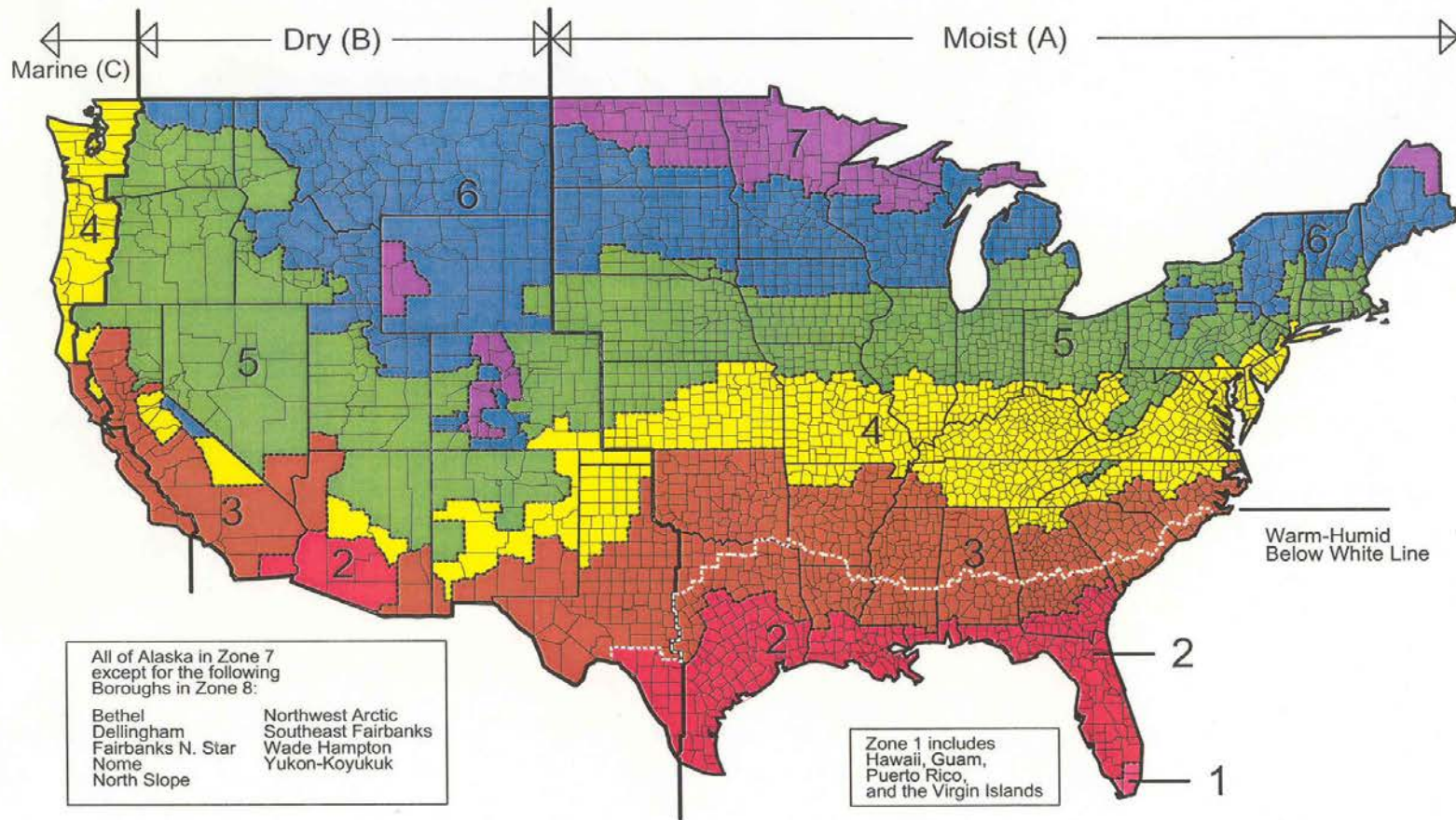








Map of DOE's Proposed Climate Zones



March 24, 2003

