

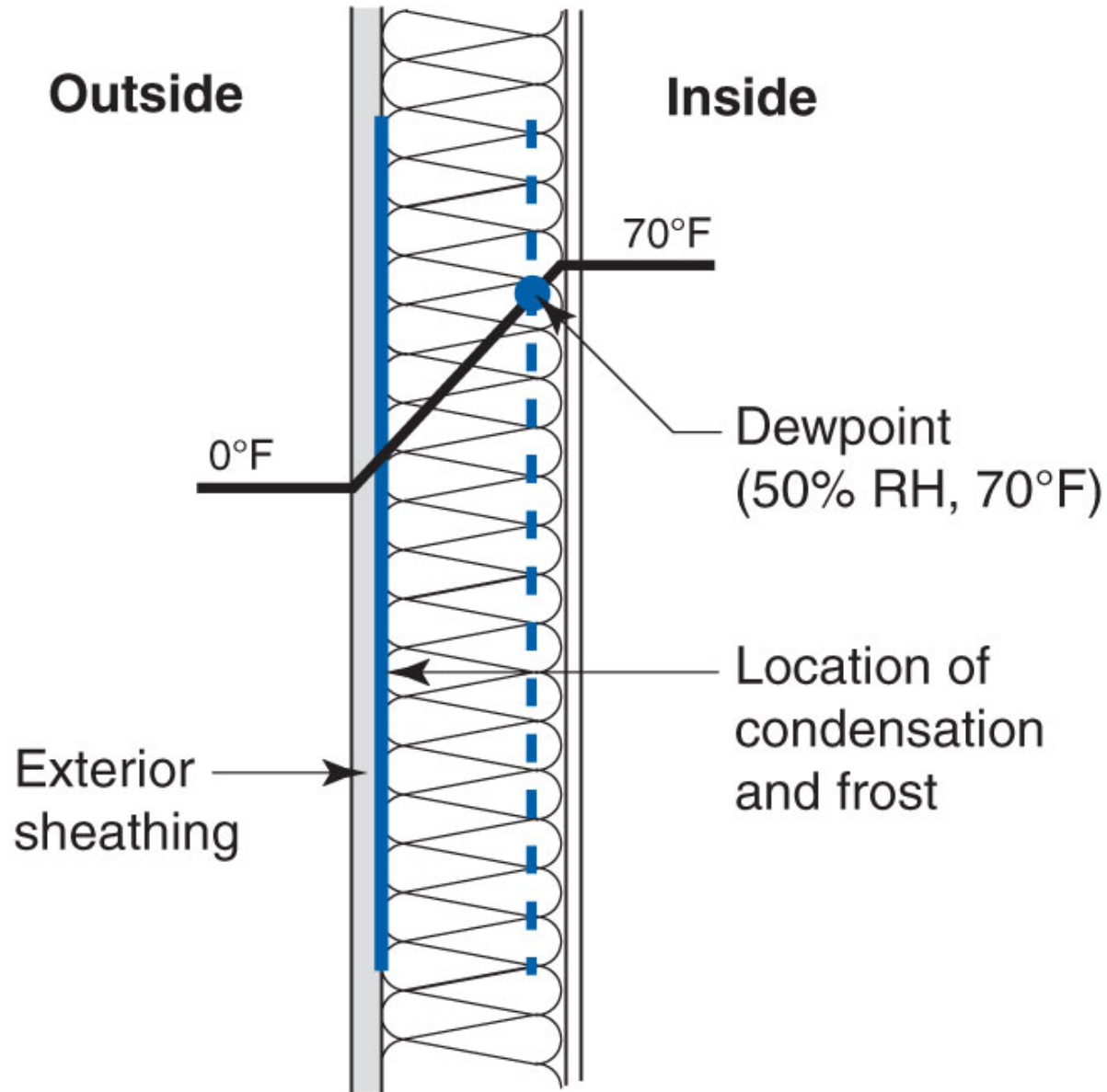
Joseph Lstiburek, Ph.D., P.Eng, ASHRAE Fellow

Building Science

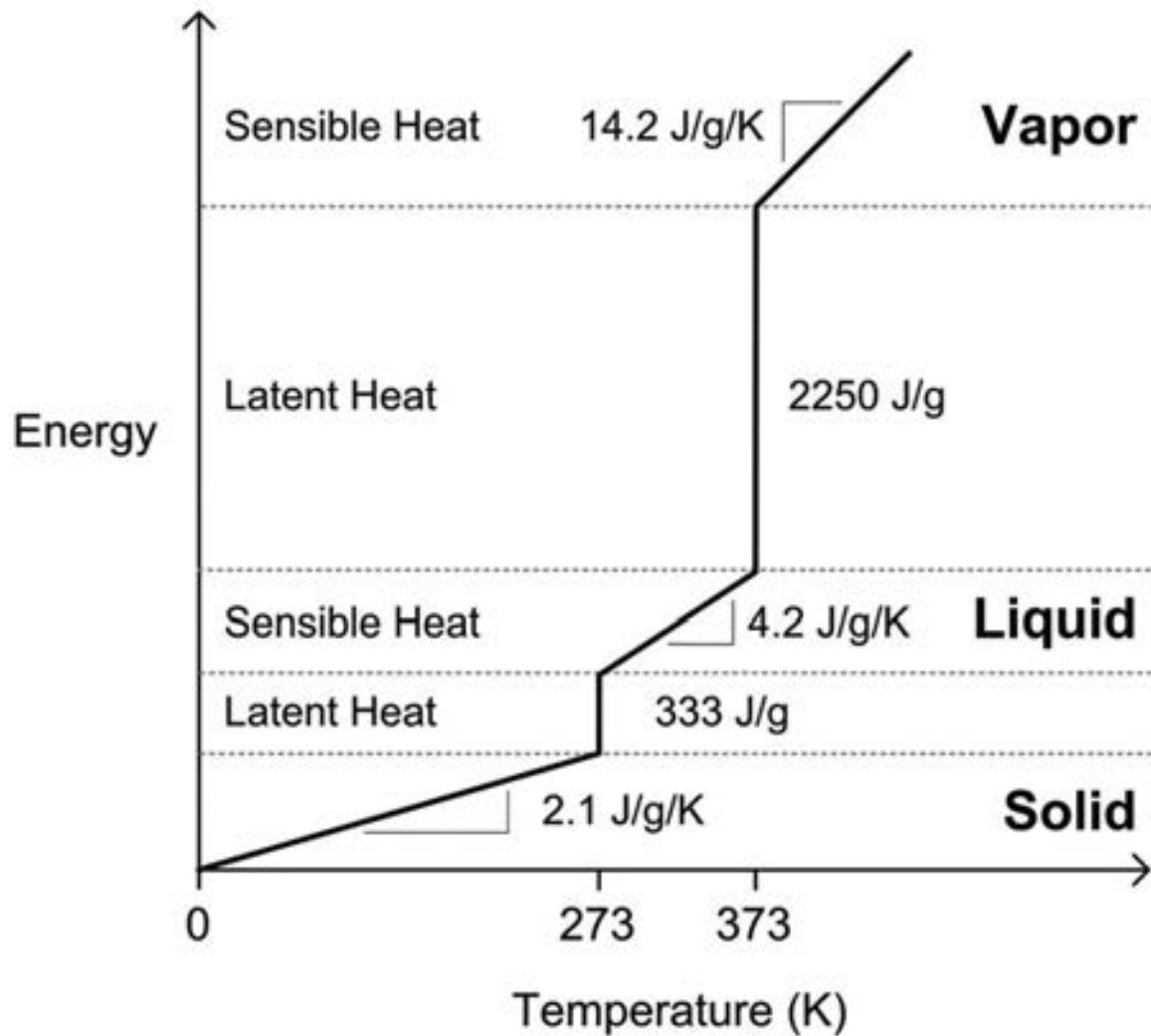
Adventures In Building Science

www.buildingscience.com

Condensing Surfaces

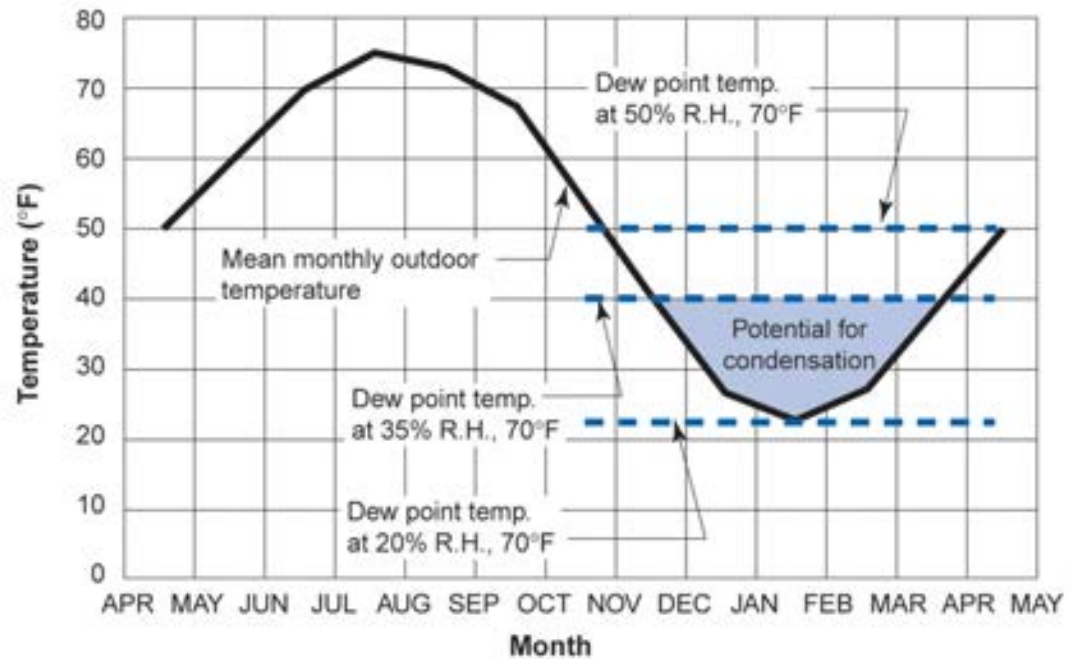
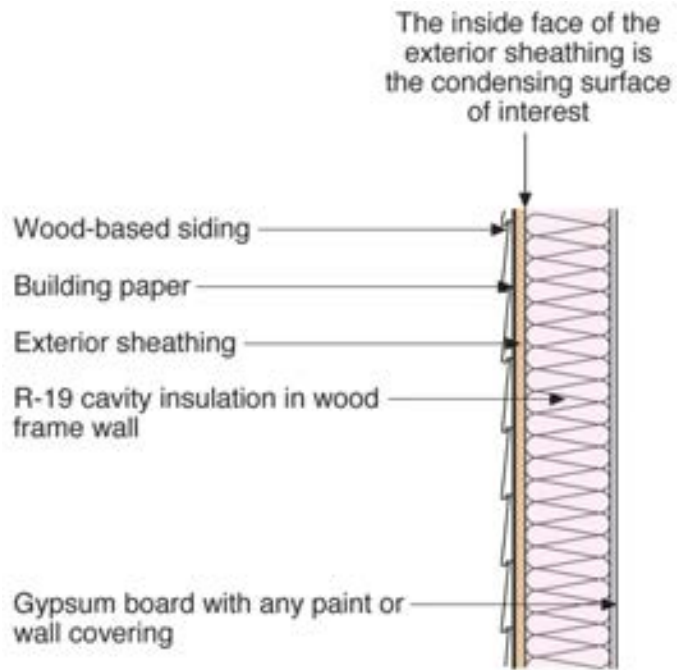


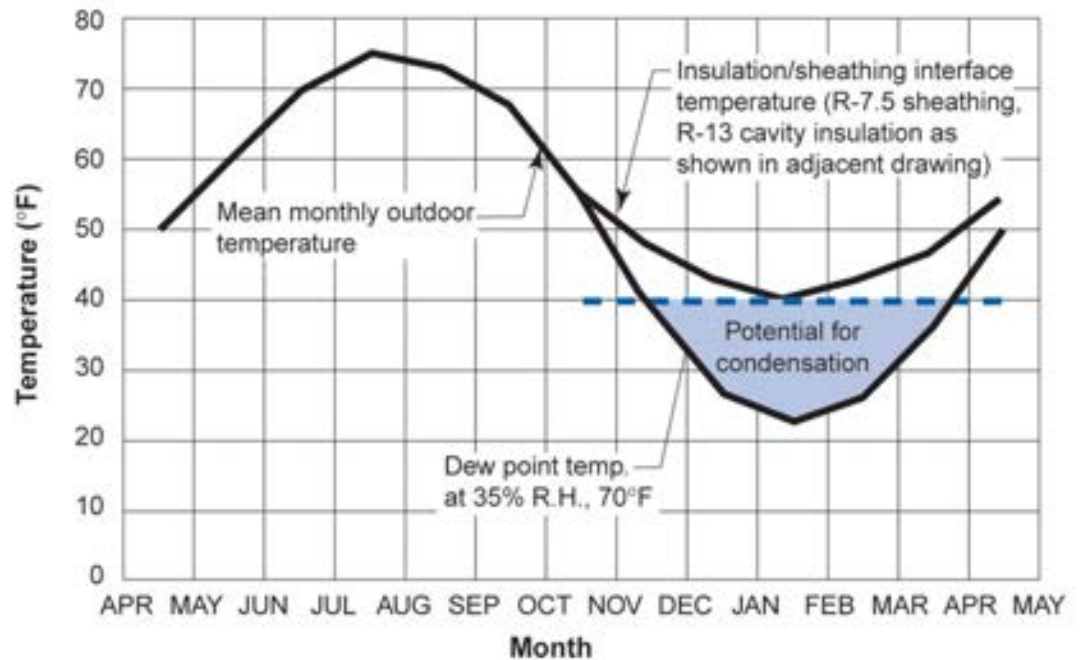
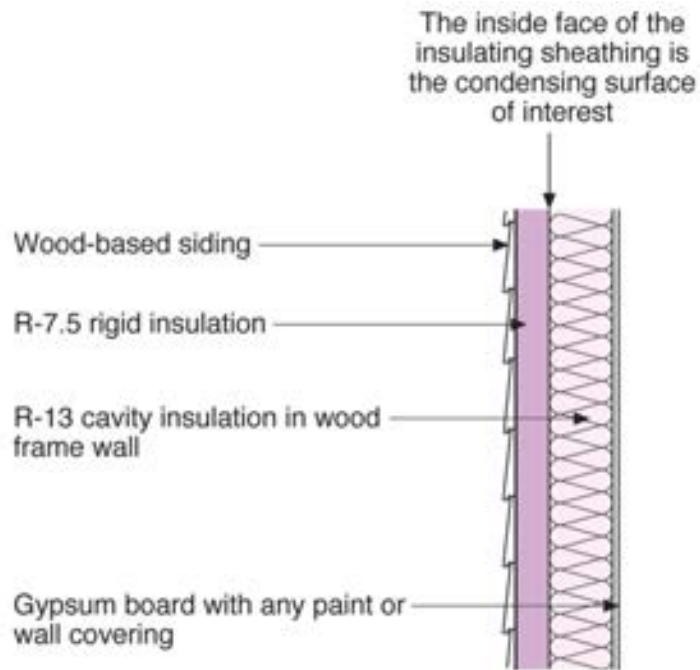




Simple linearized energy-temperature relation for water
 From Straube & Burnett, 2005







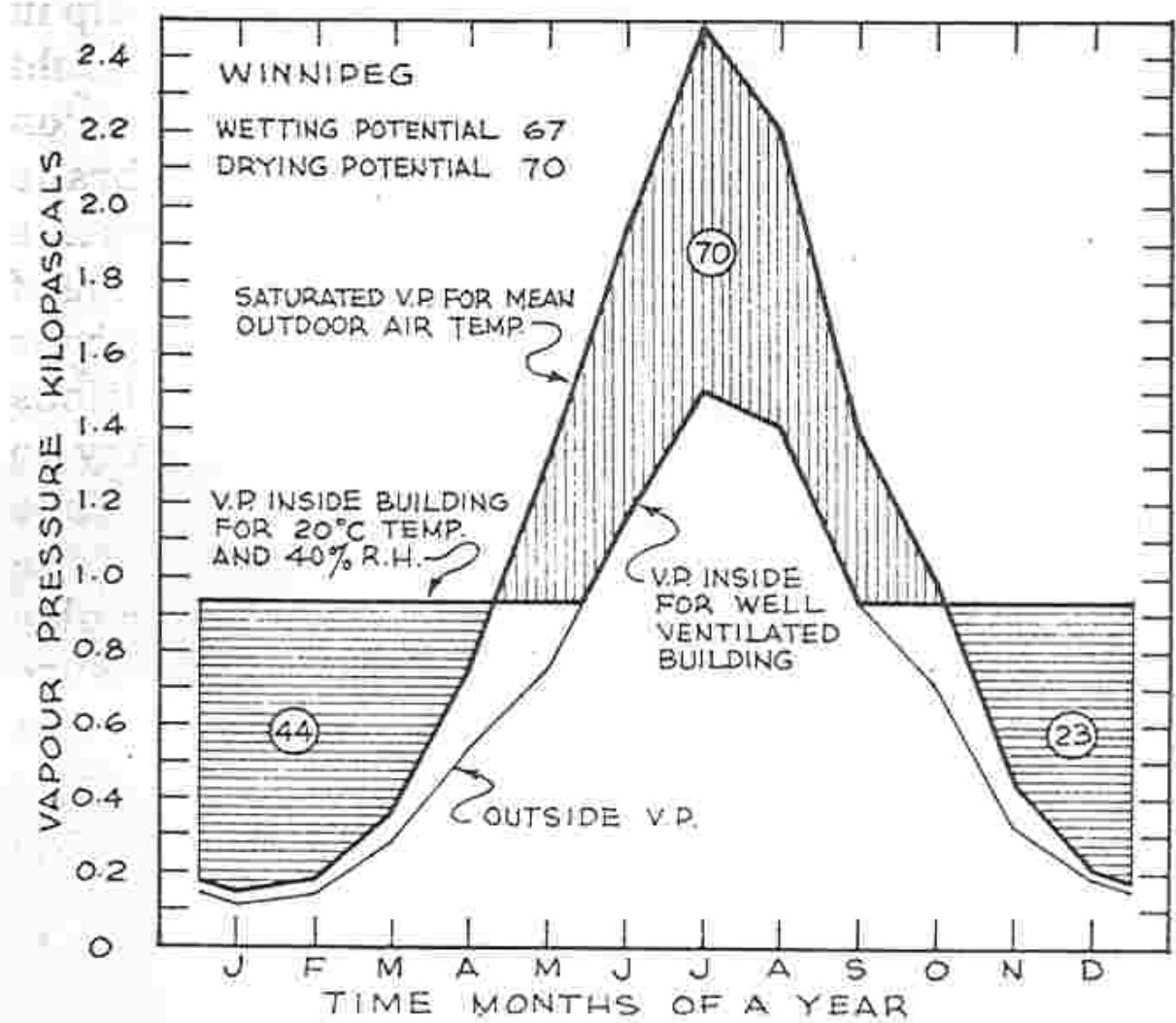
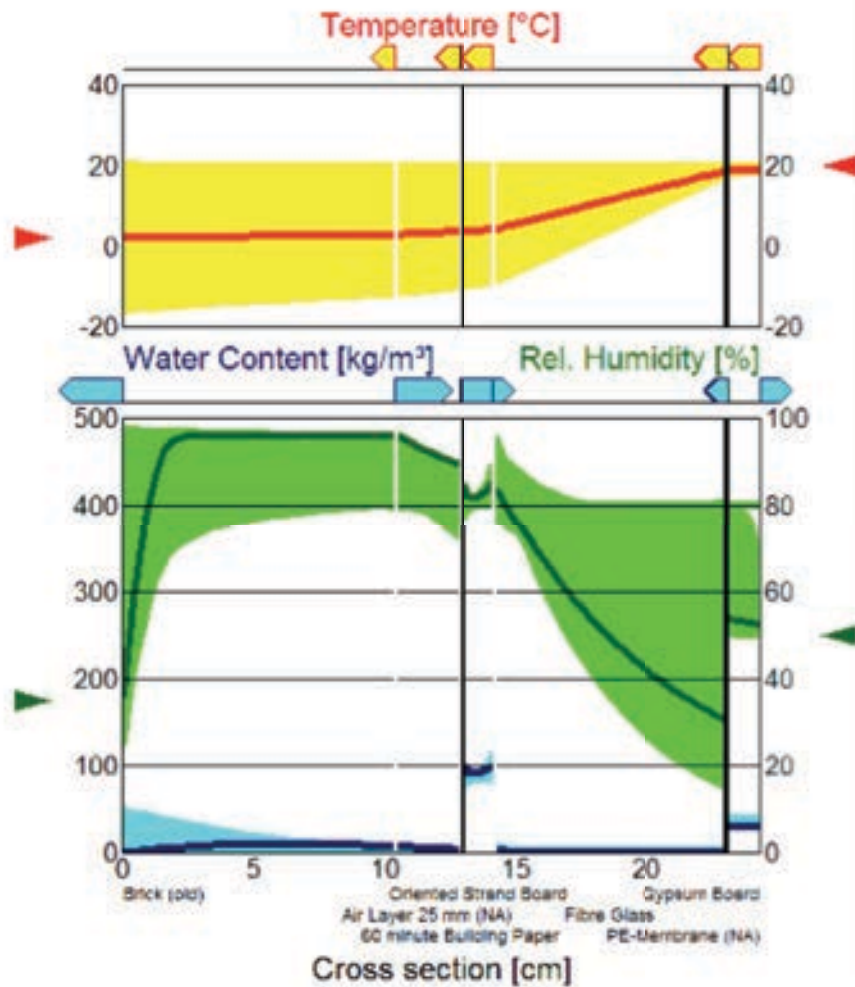


Figure 8-7. Outside vapour pressure, saturated vapour pressure and inside vapour pressure for Winnipeg.



WUFI® 3.3 Pro. IBP
Run

16 Feb
2001

WUFI software interface showing a globe icon, a date display for 16 Feb 2001, and various control buttons (min, max, reset, zoom, etc.).

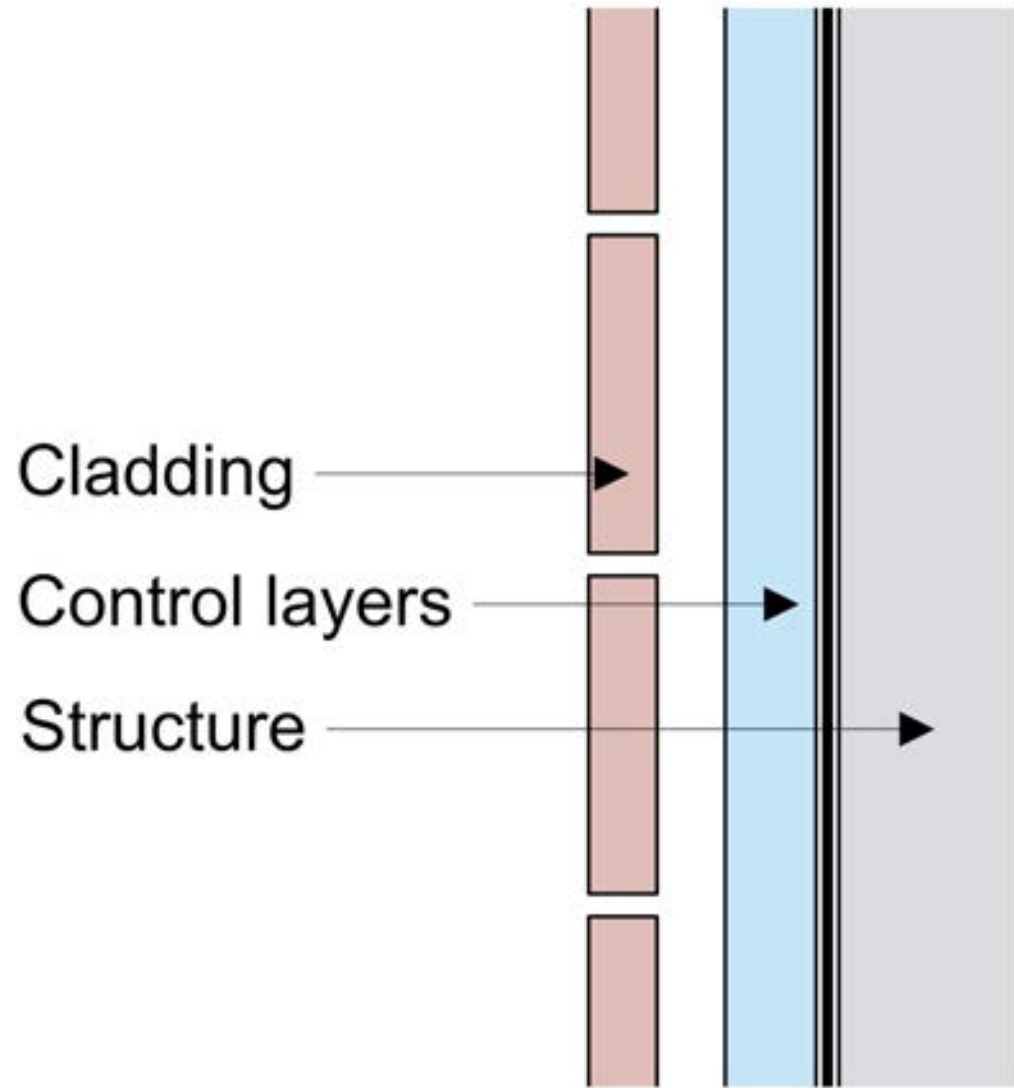
Perfect Wall

Water Control Layer

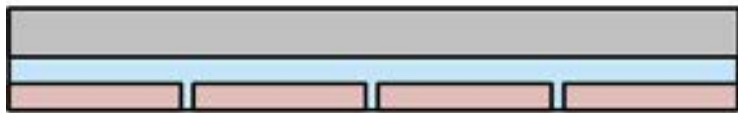
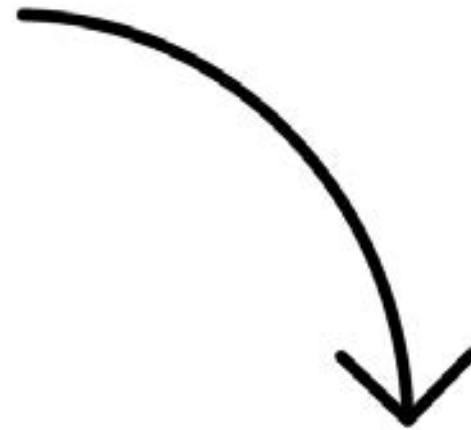
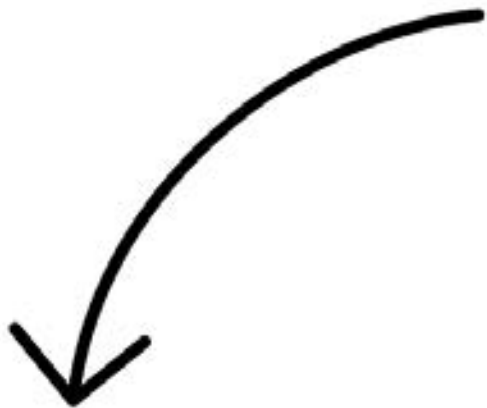
Air Control Layer

Vapor Control Layer

Thermal Control Layer



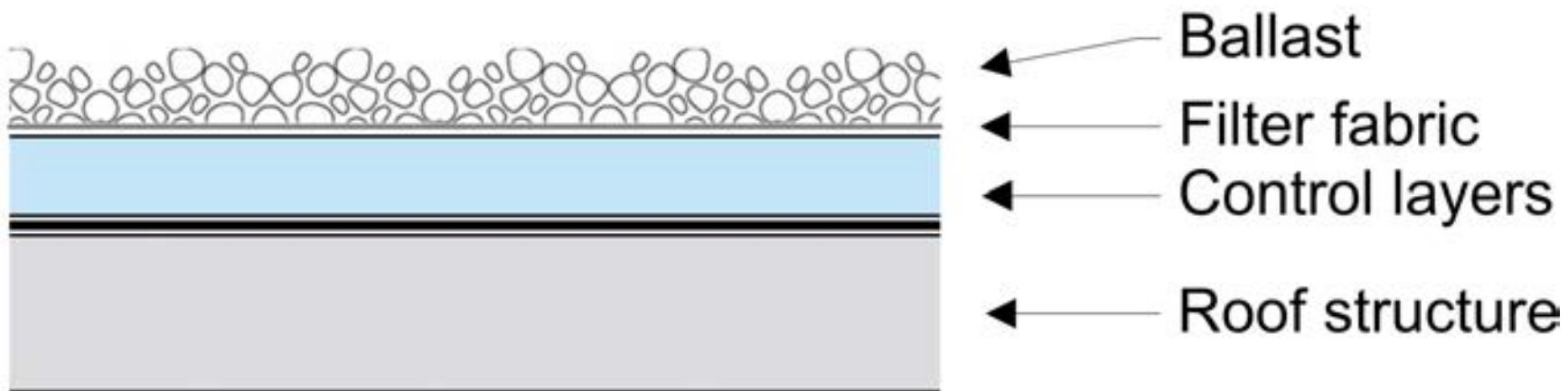
Wall

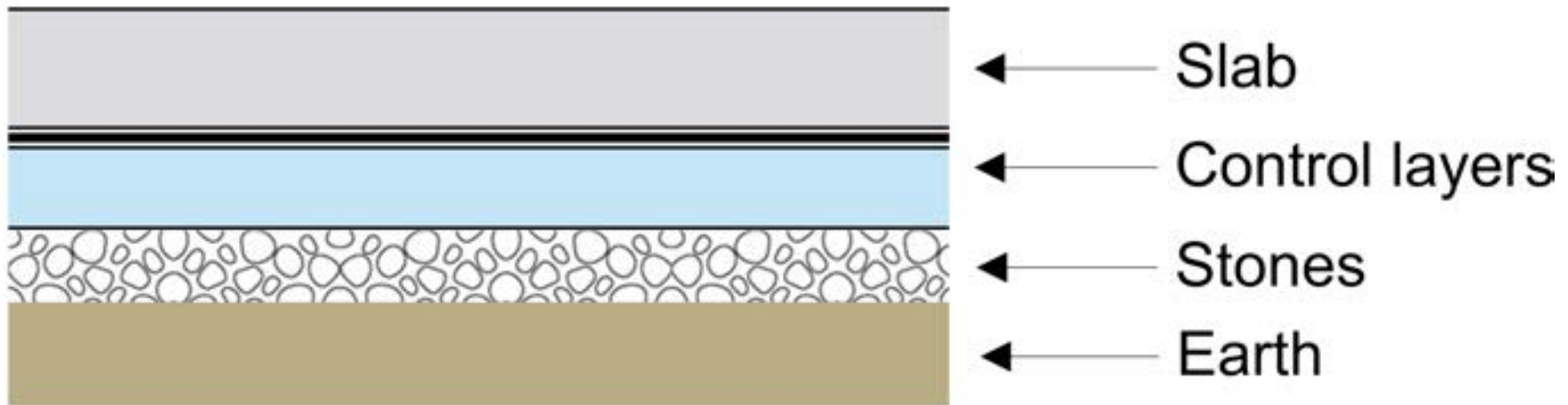


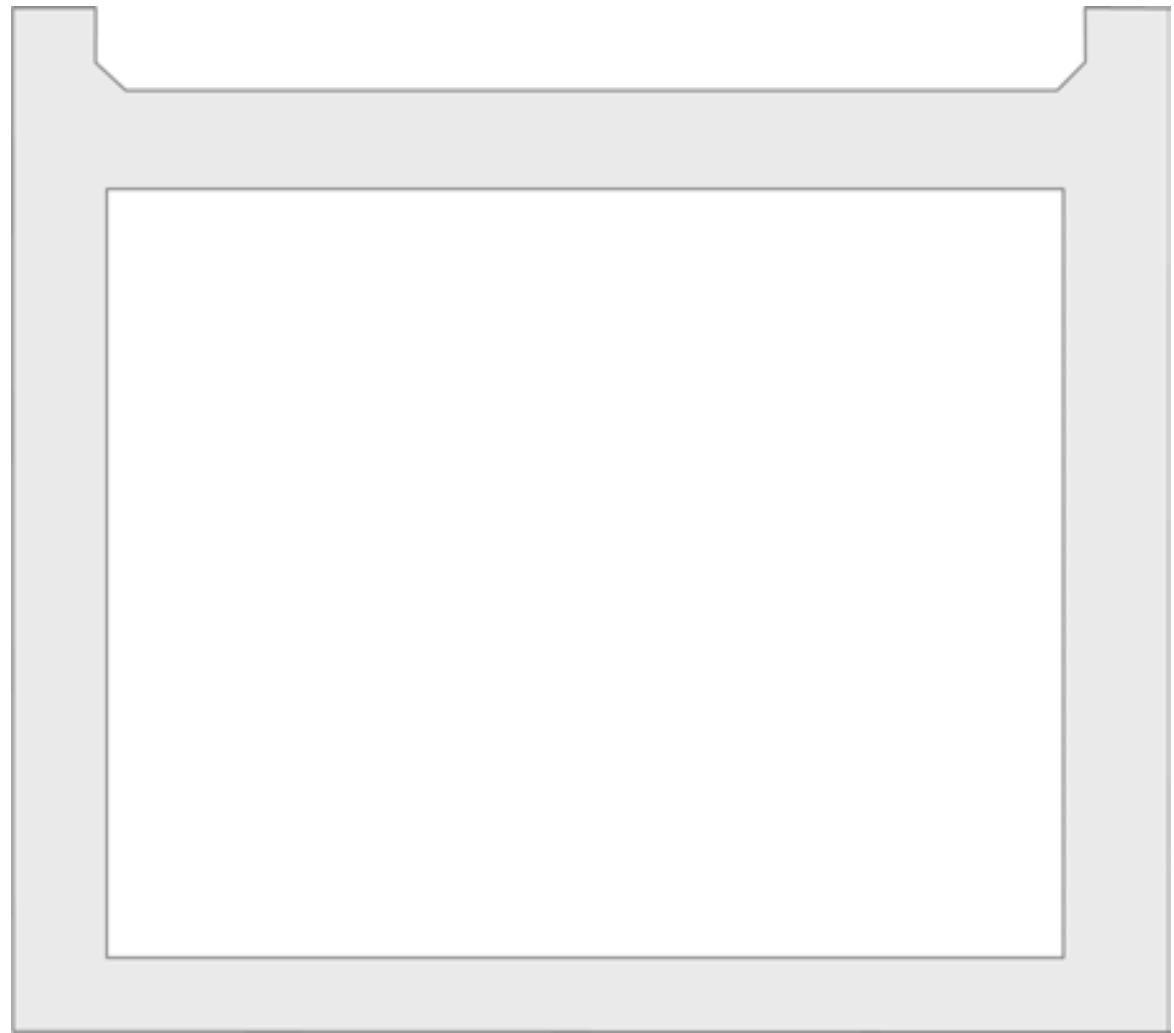
Slab



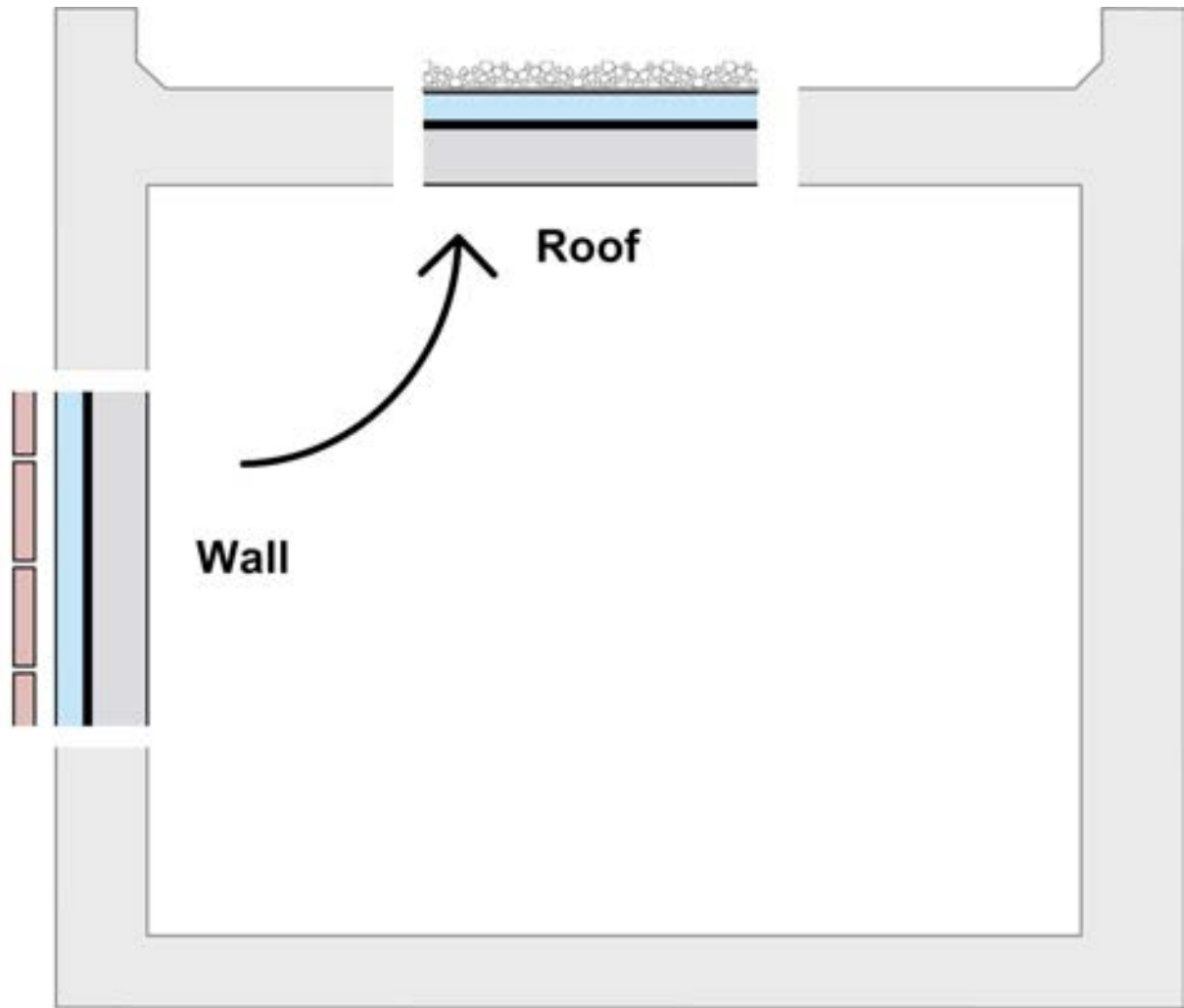
Roof

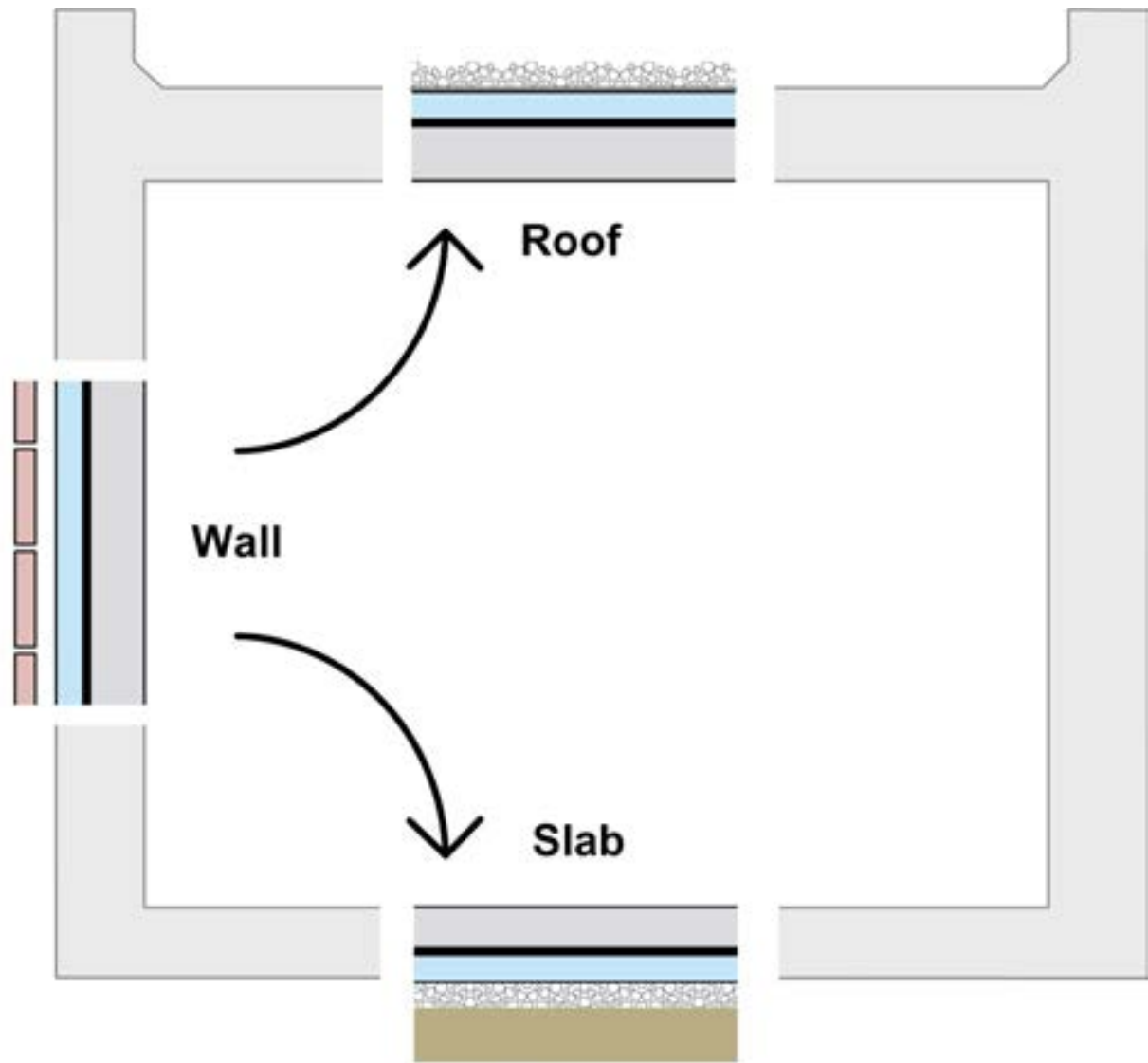


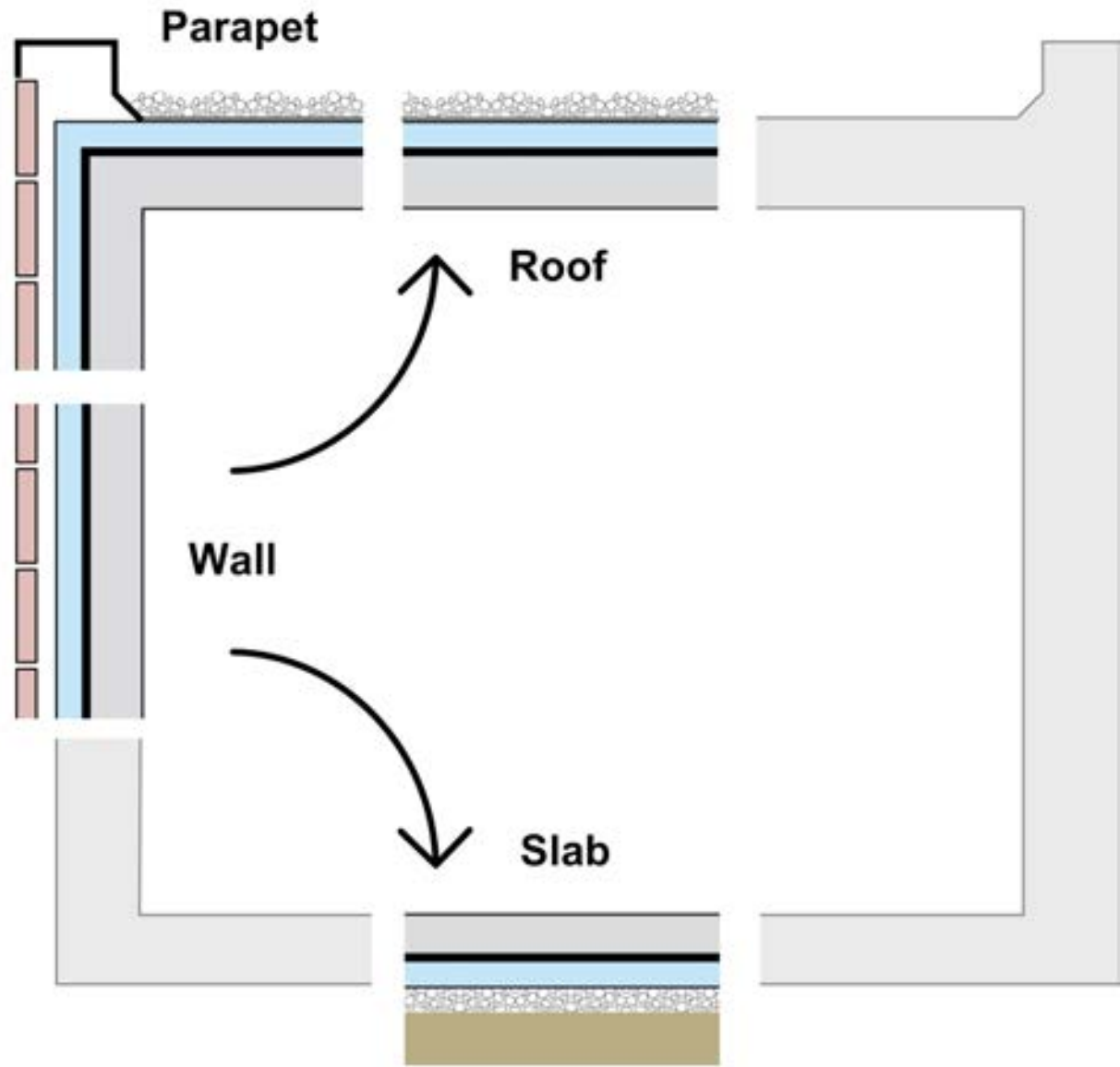


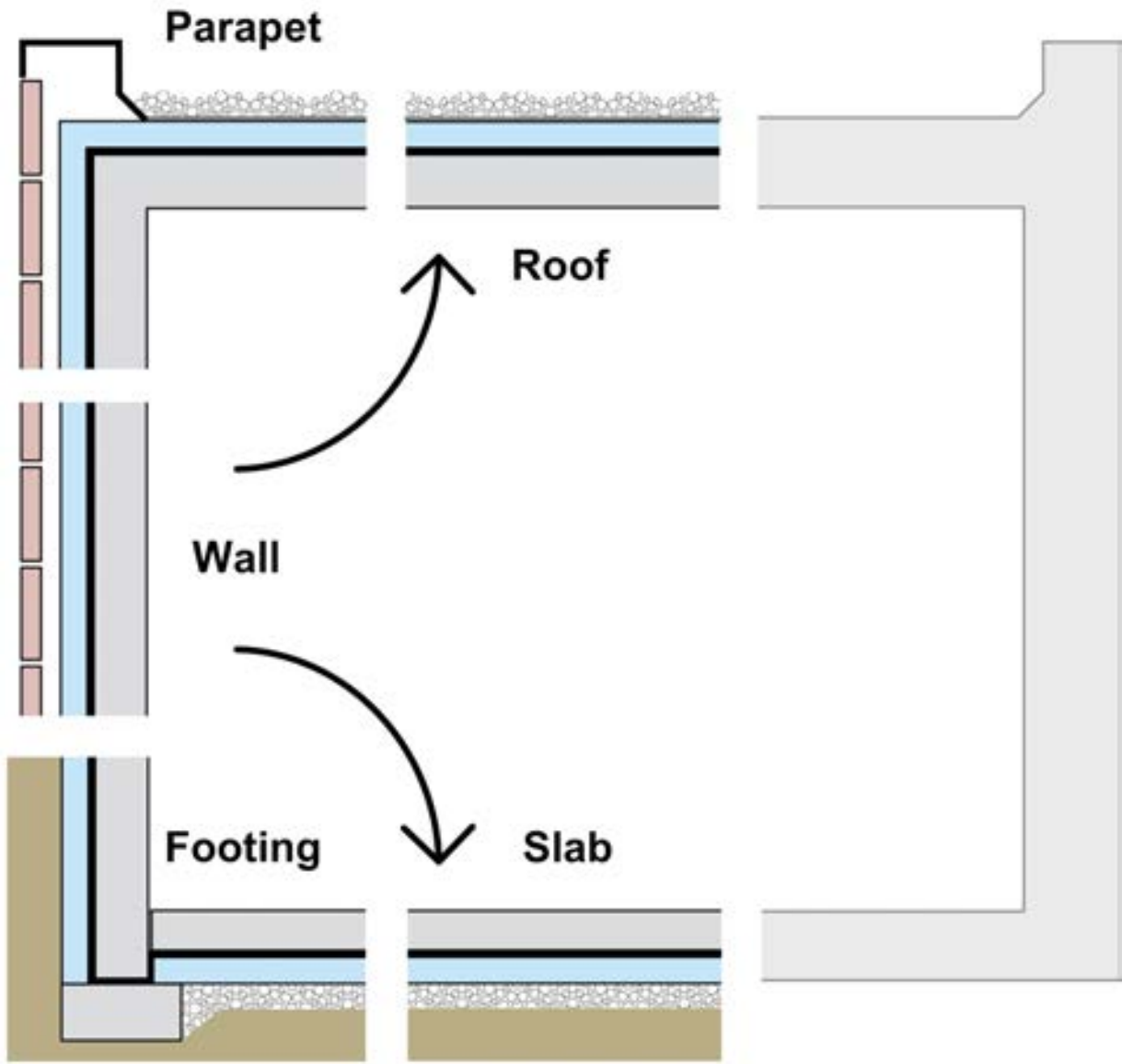


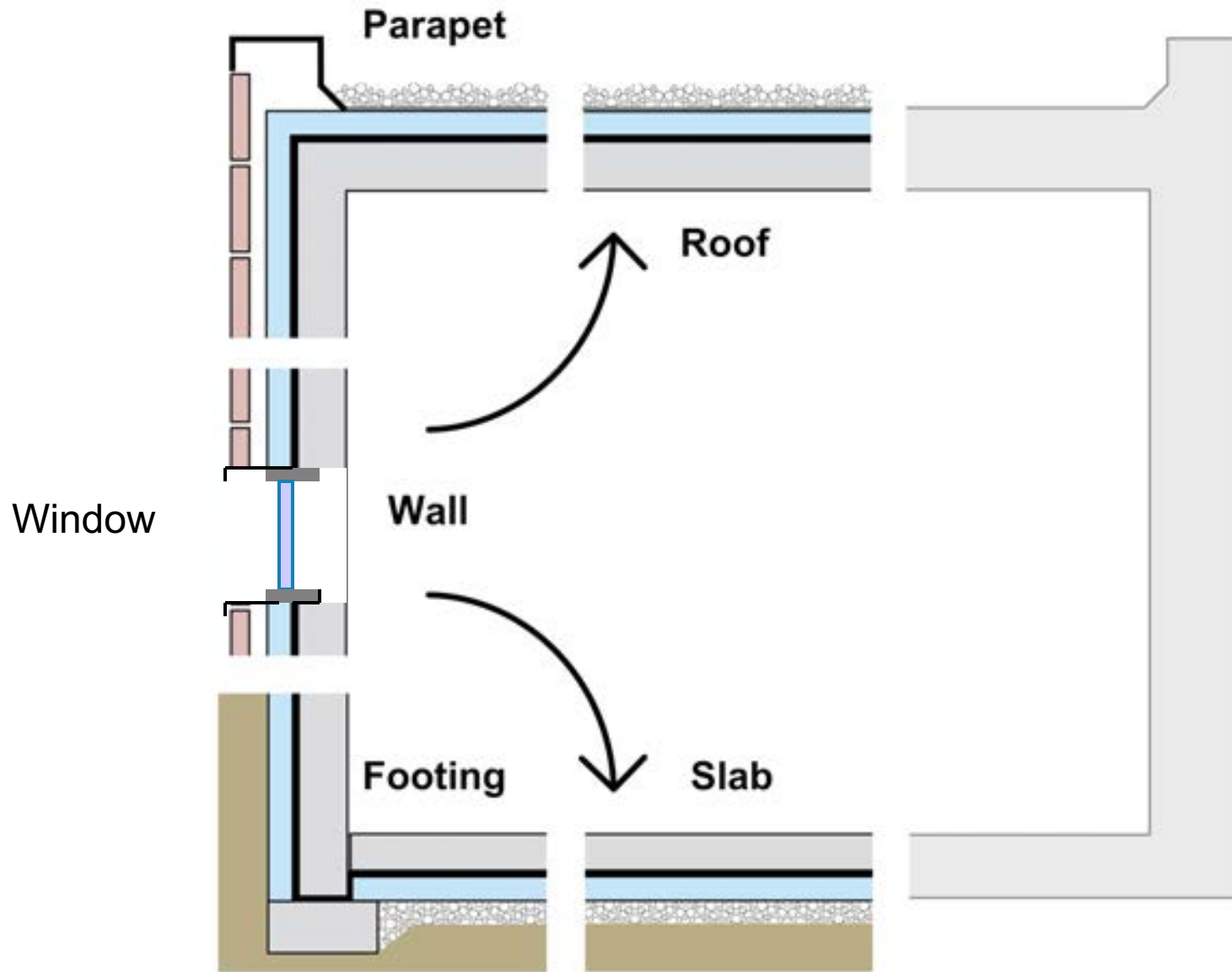




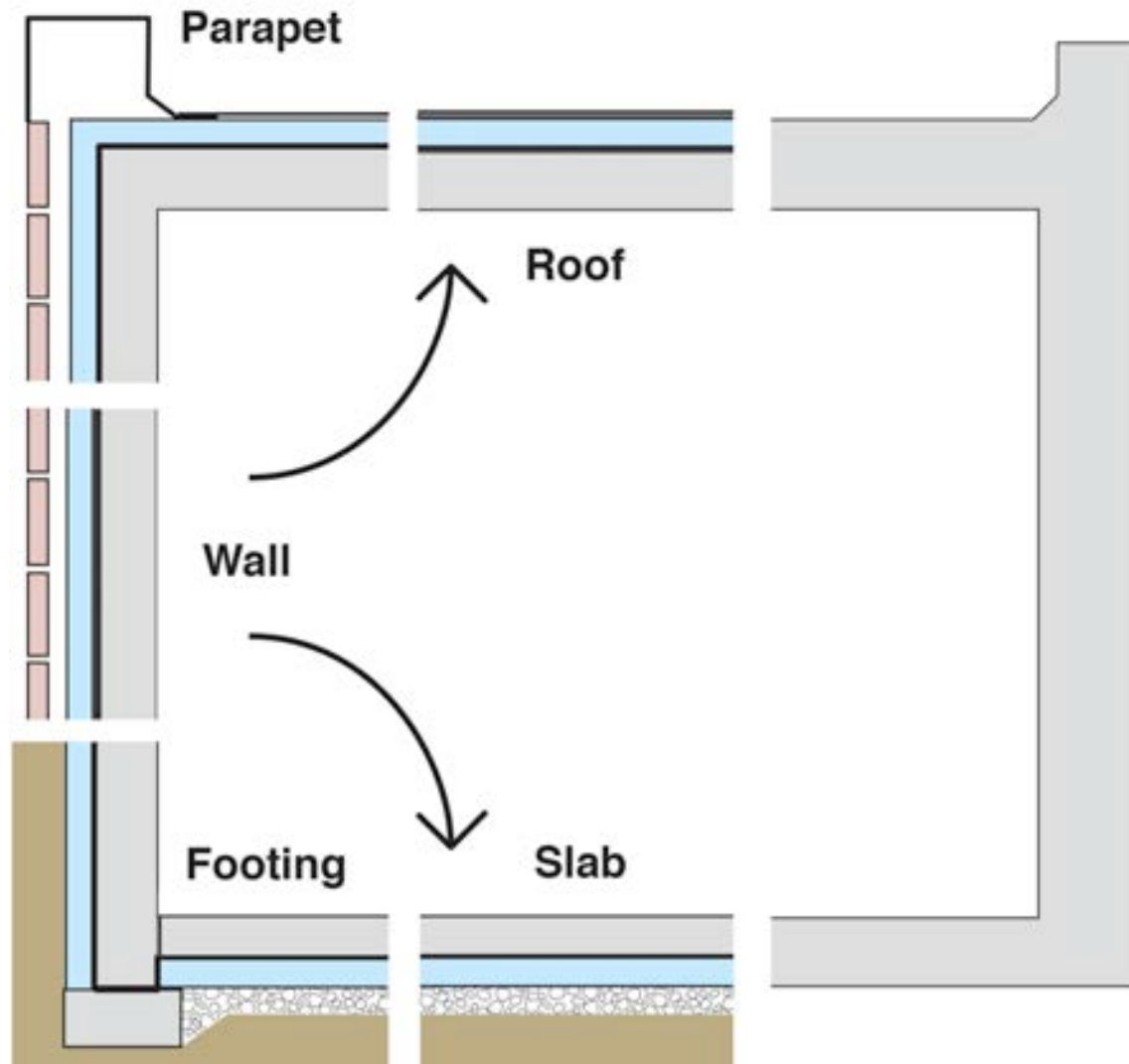


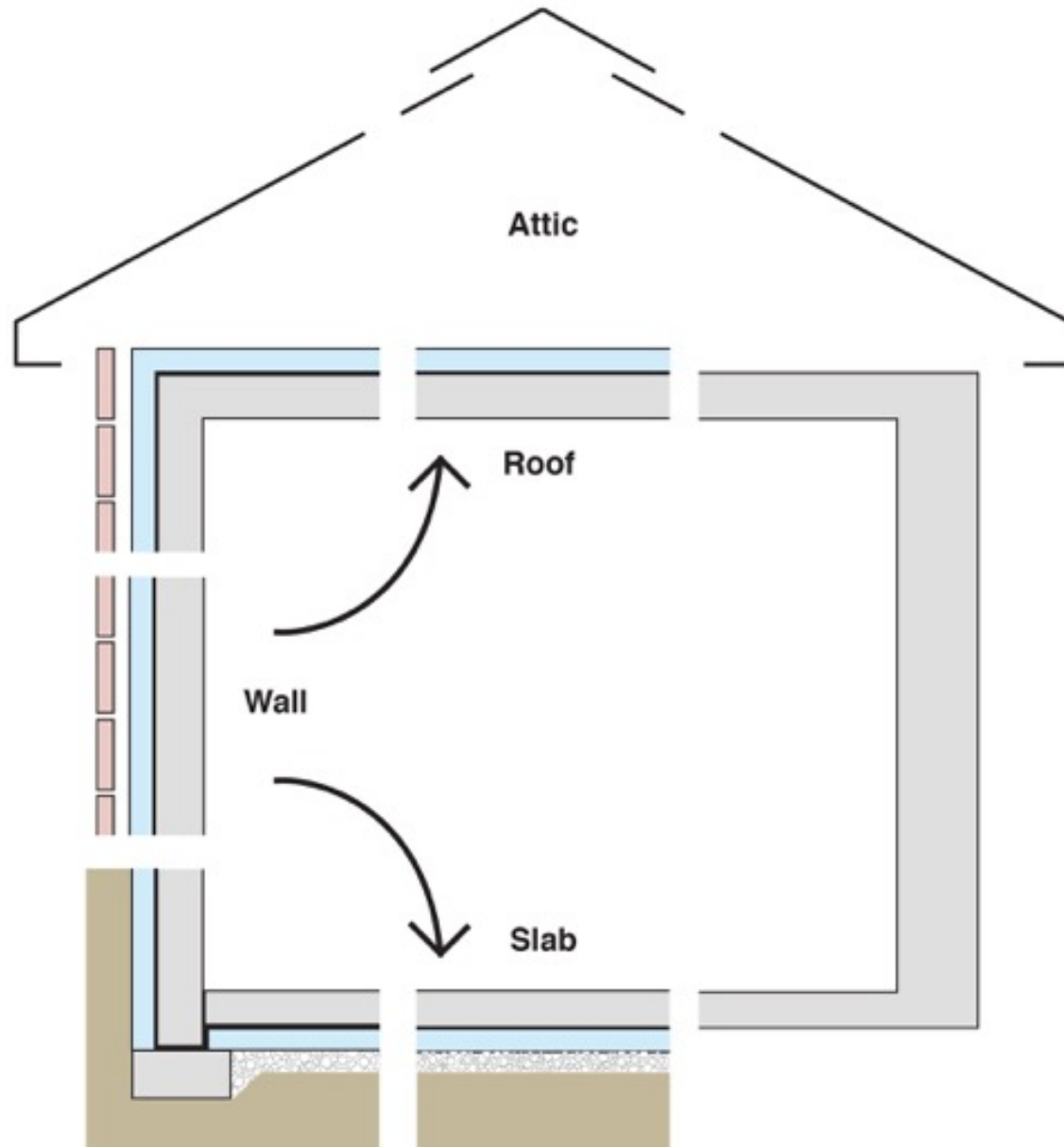


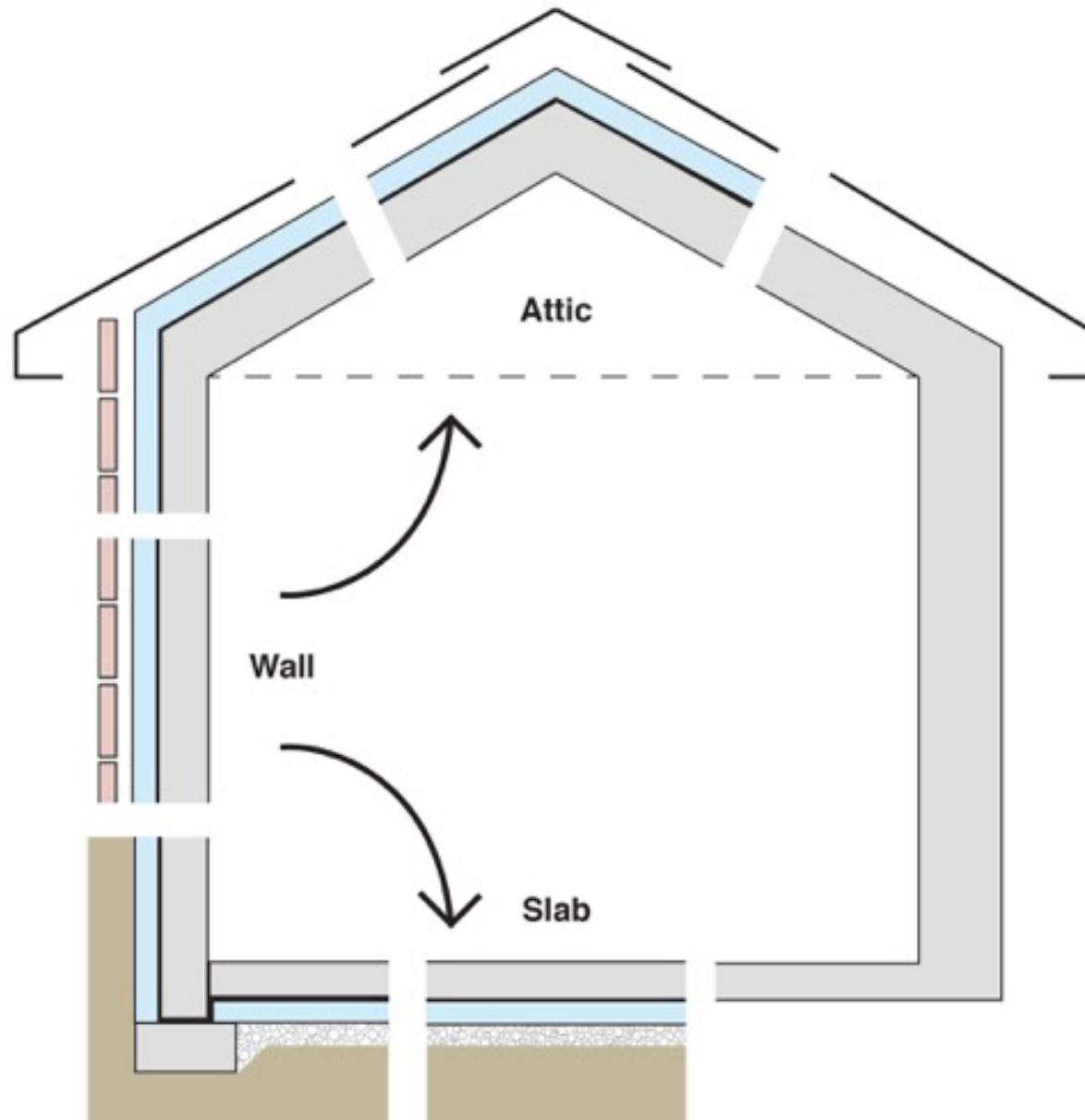


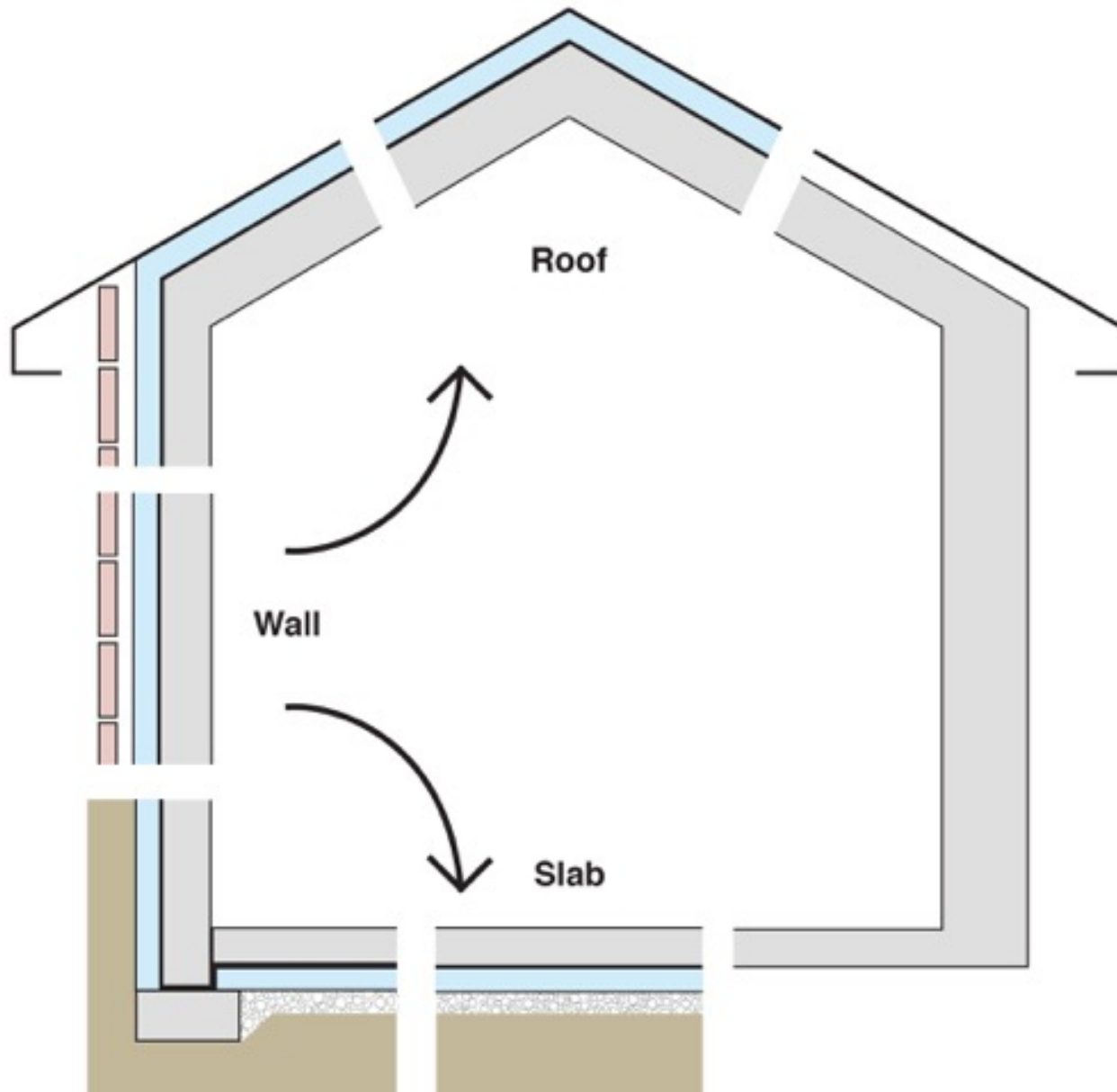


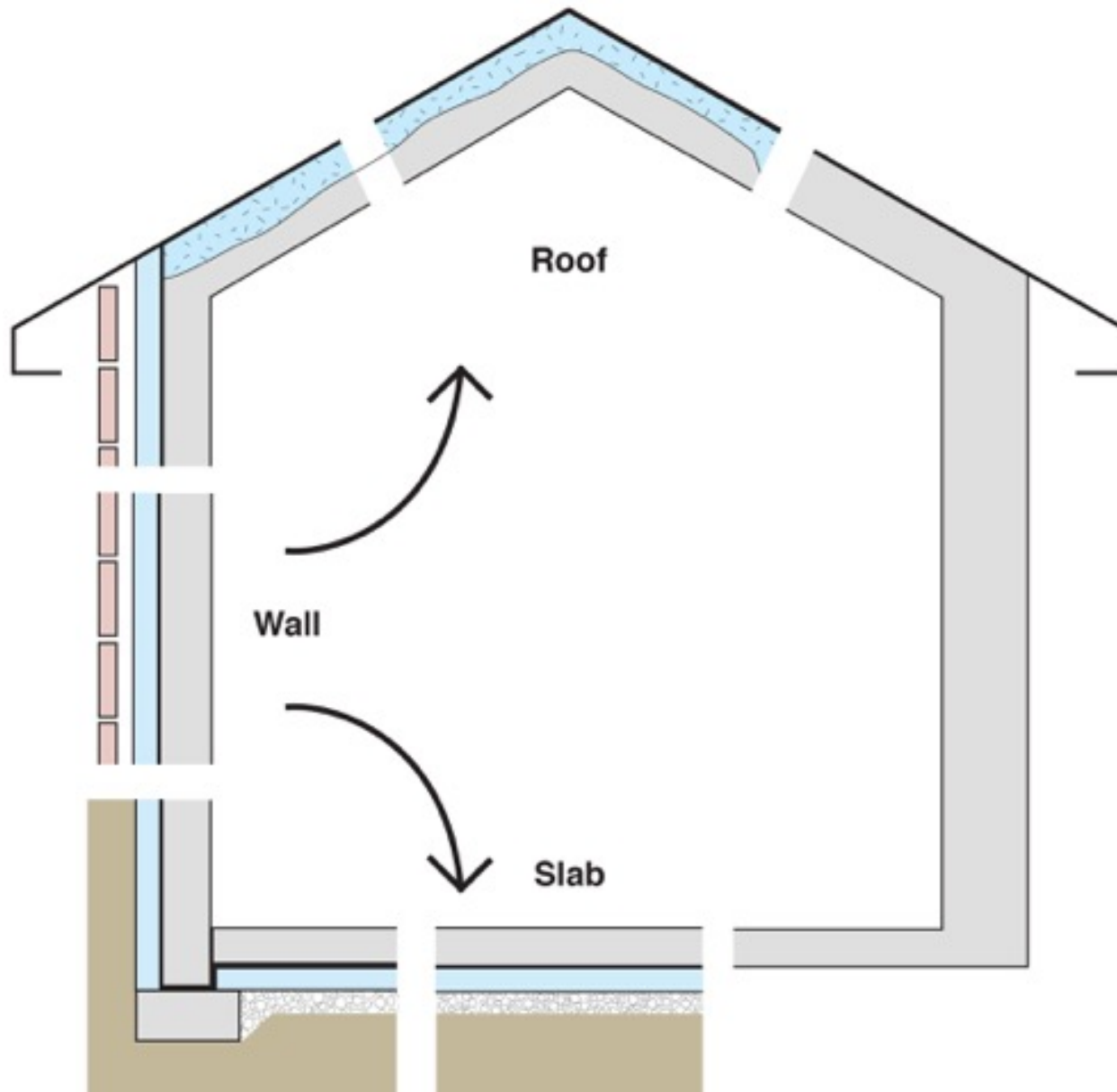










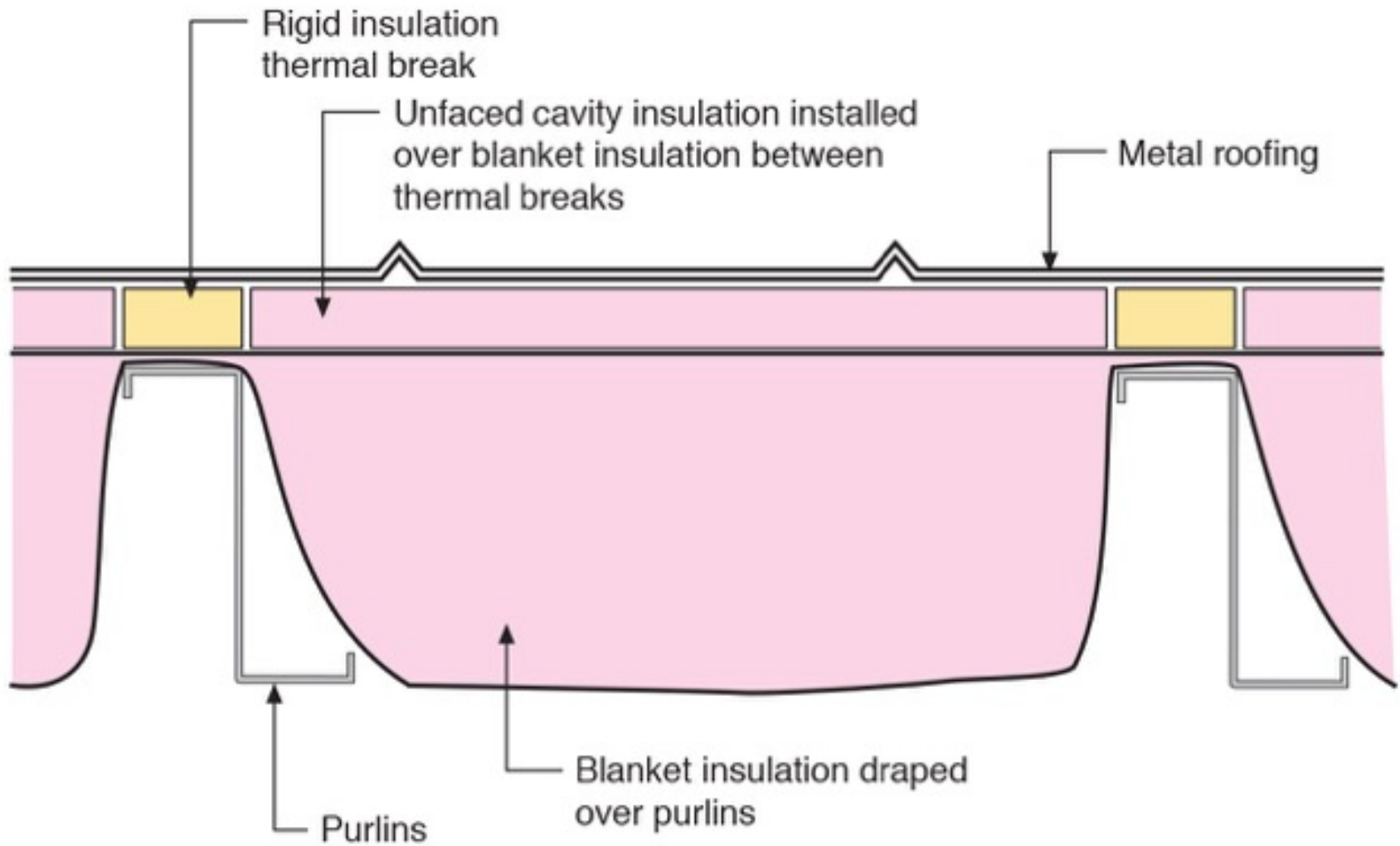


Ice Rinks









Blanket Insulation Purlin Roof System

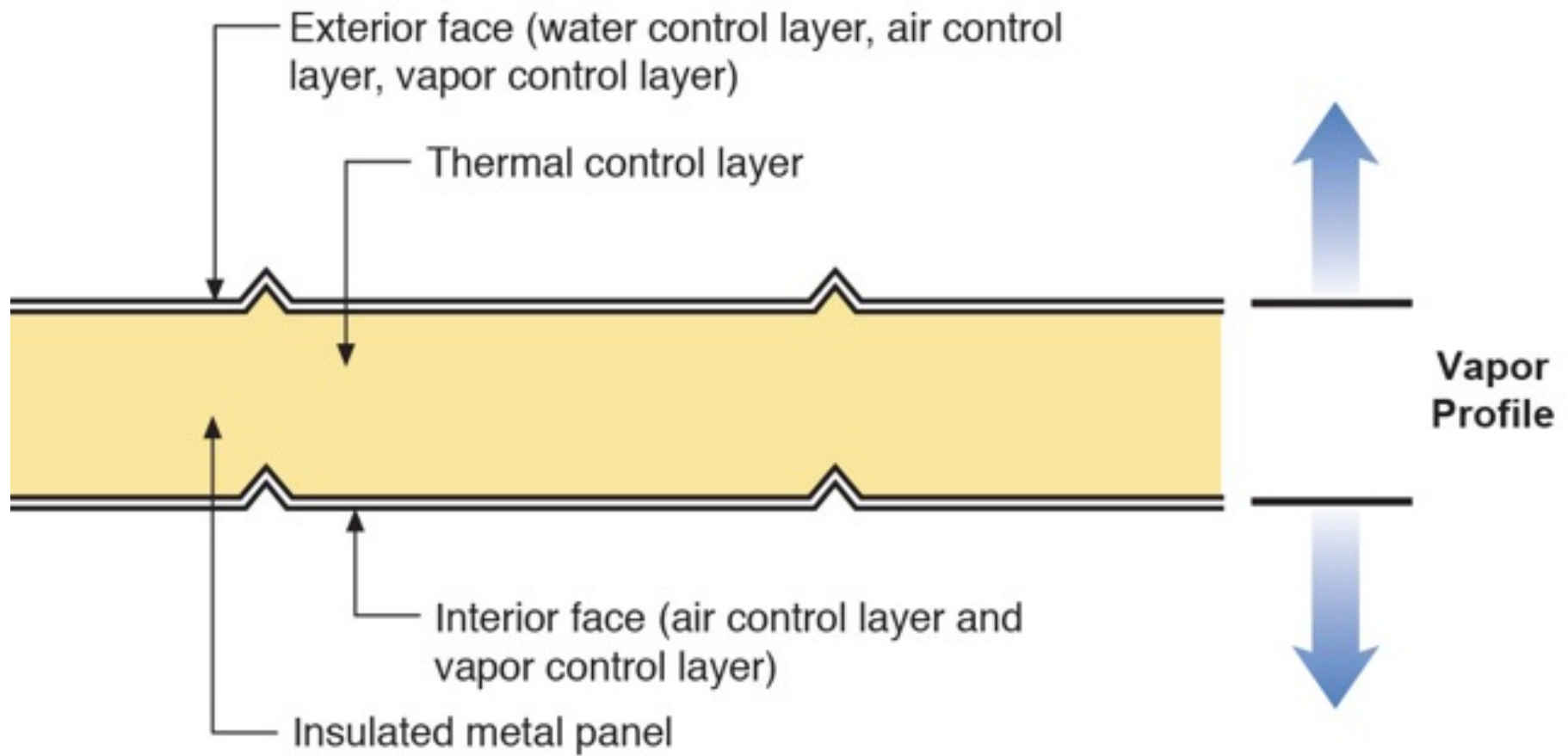


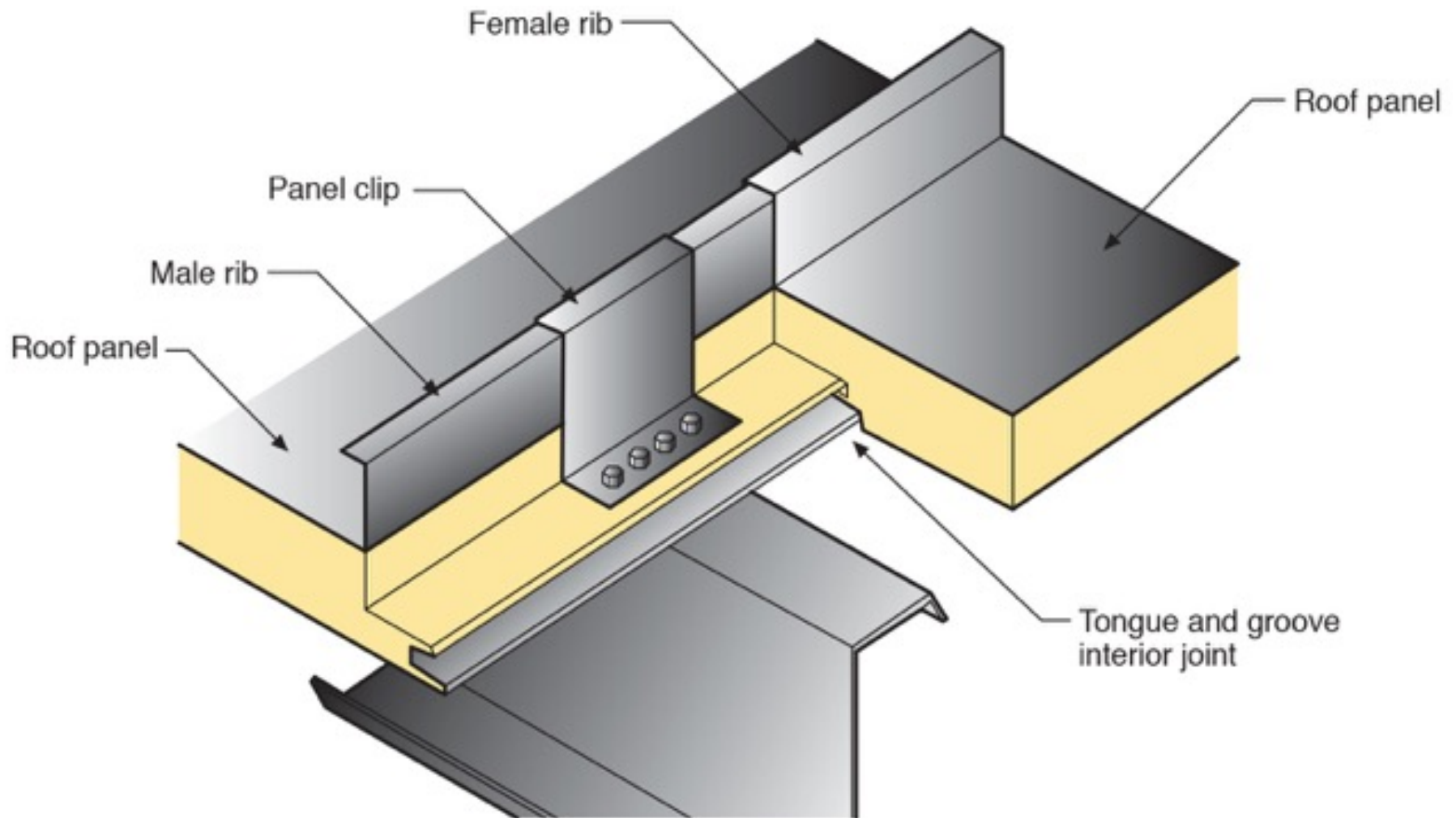


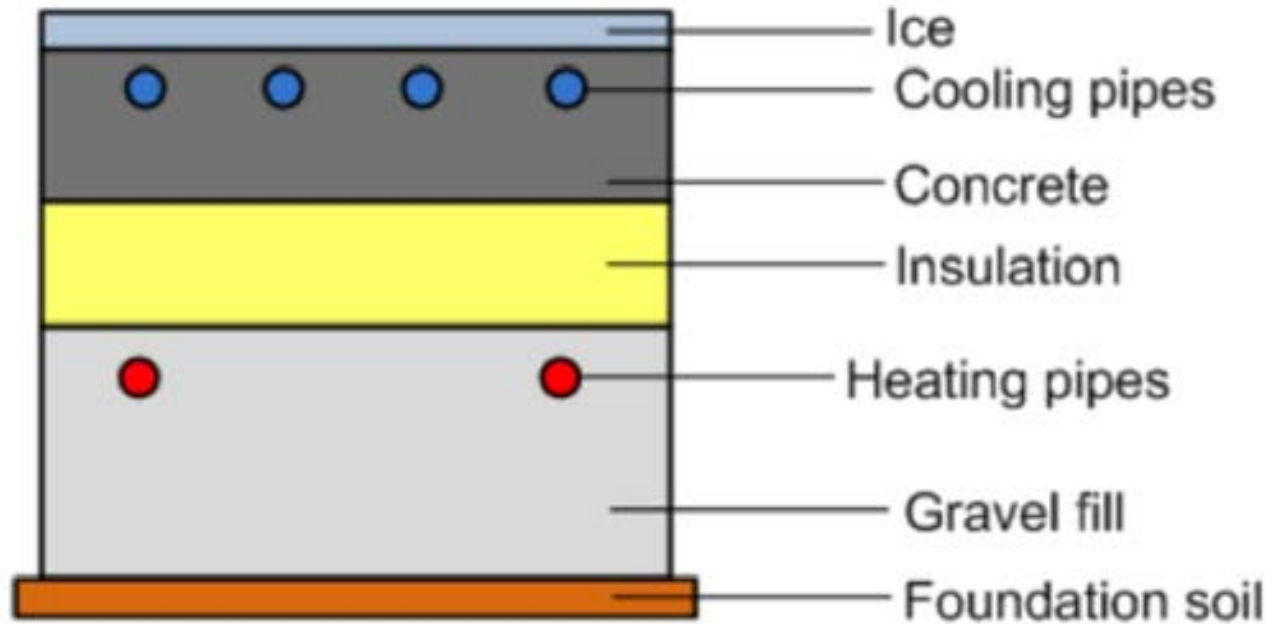


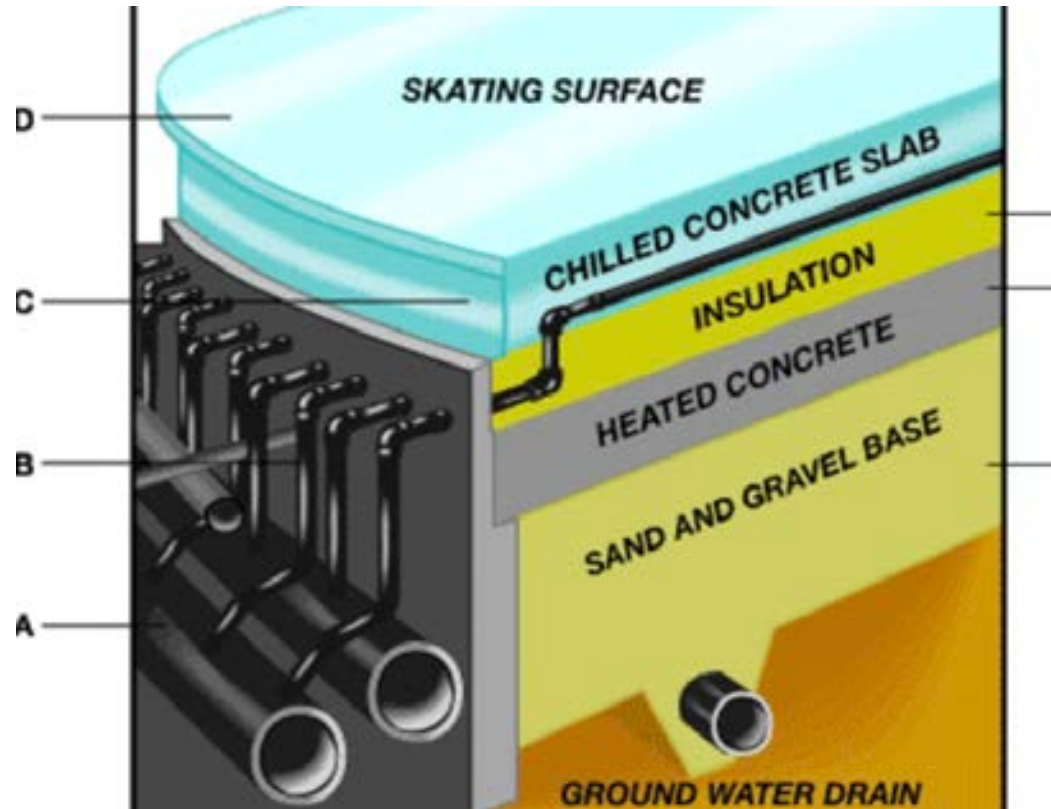


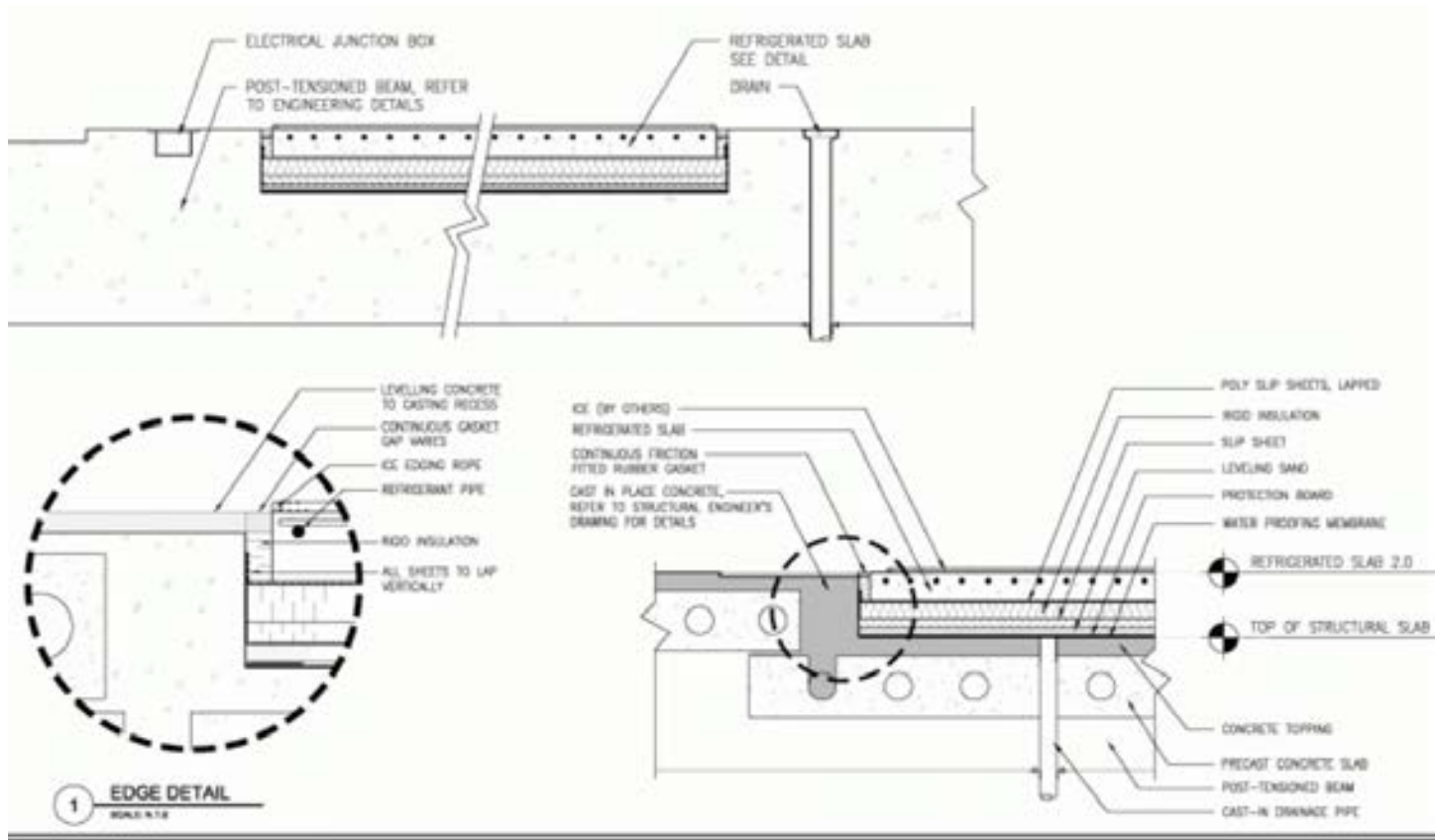








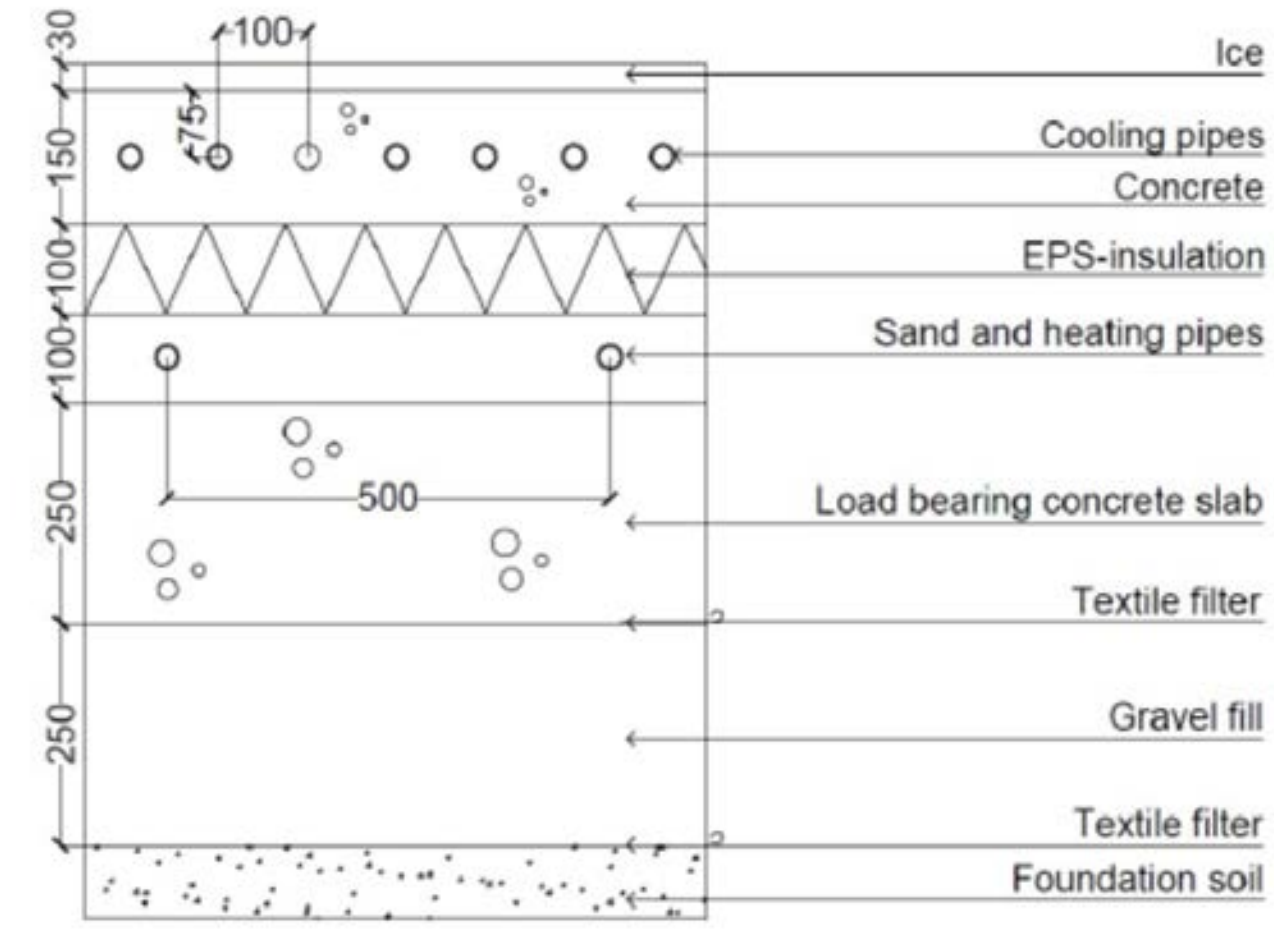




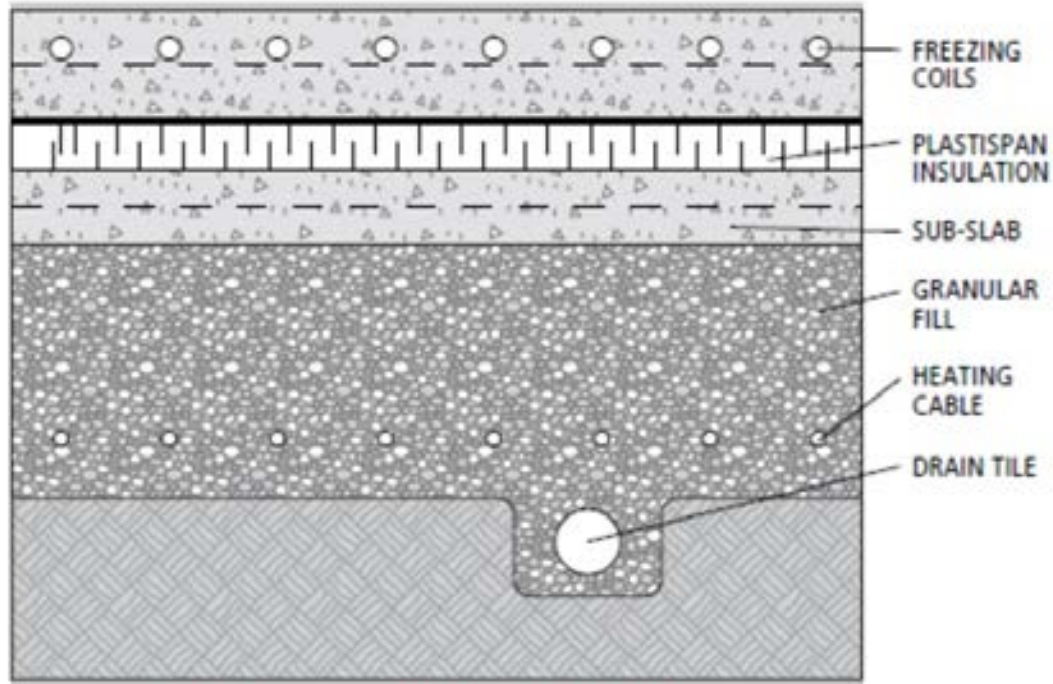
Client: City of Richmond
 Project Name: RICHMOND OLYMPIC OVAL

DATE: MAY 2008 Project No.: 4940
 DRAWN: TSC Reference No.: A109

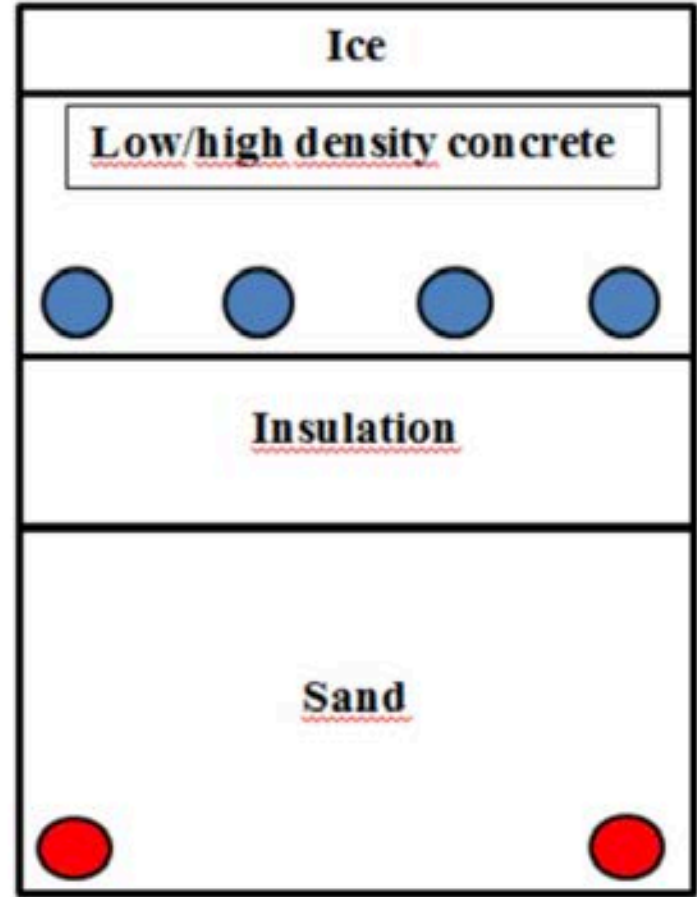
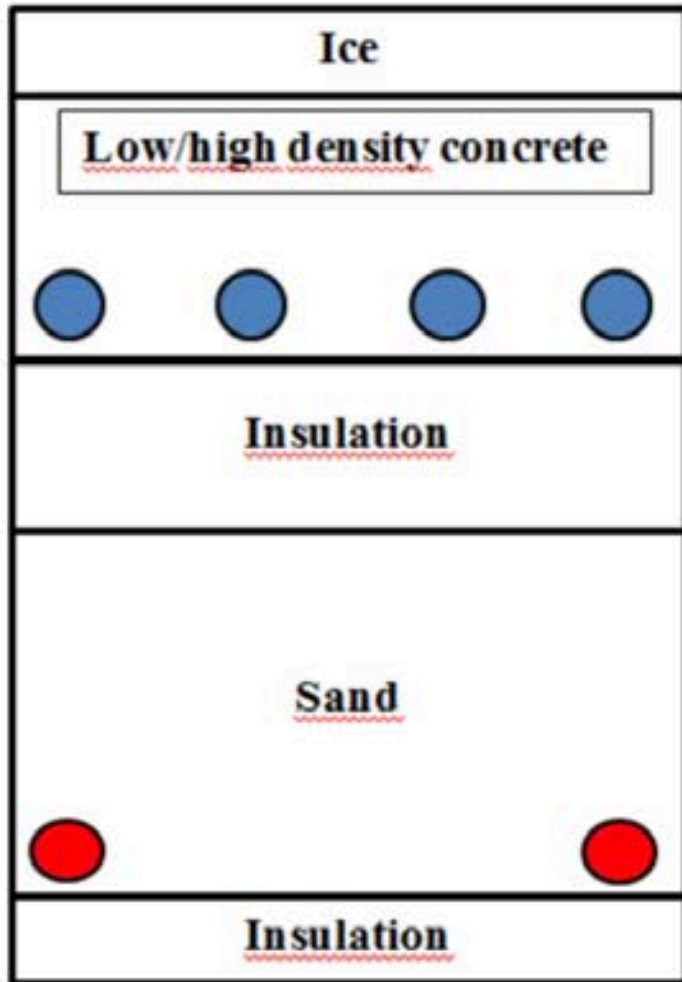
CANNON DESIGN



Continuous Operation



Multipurpose Slab with Sub Slab



Rink Floor Cross Section

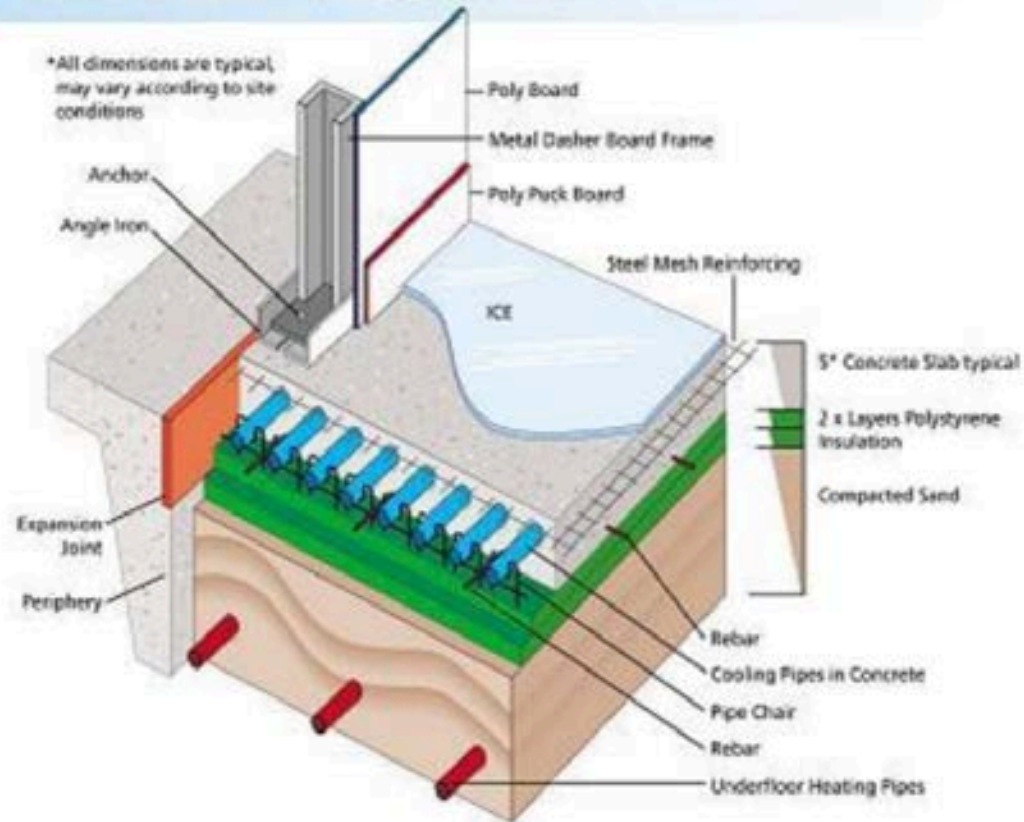
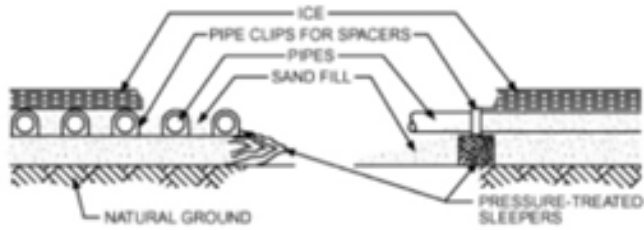
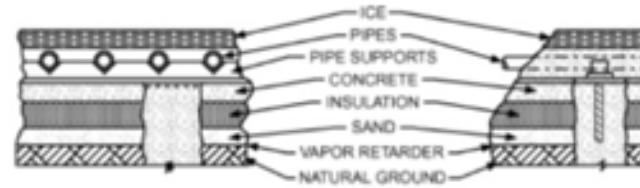


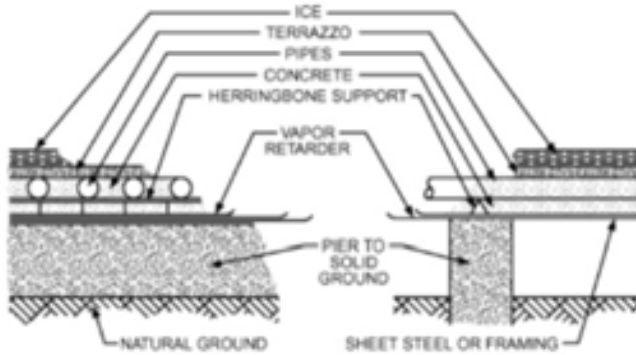
Figure 7: Typical ice pad construction (IIHF, 2010)



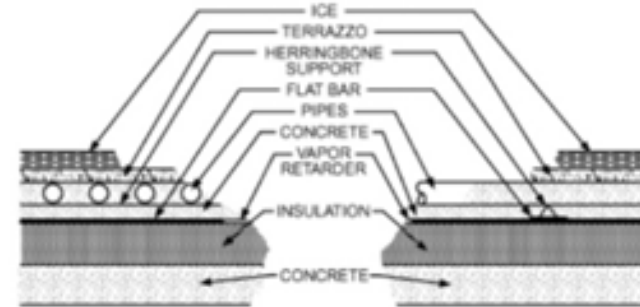
OPEN- OR SAND-FILL FLOOR WITH NO INSULATION



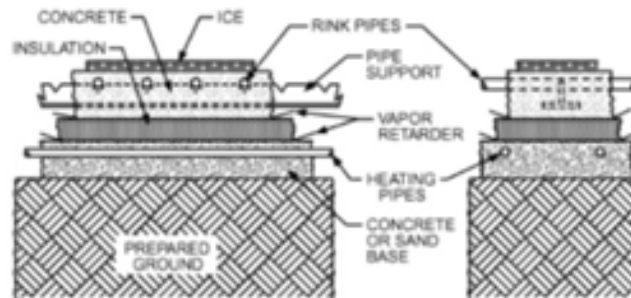
PERMANENT OR GENERAL-PURPOSE FLOOR



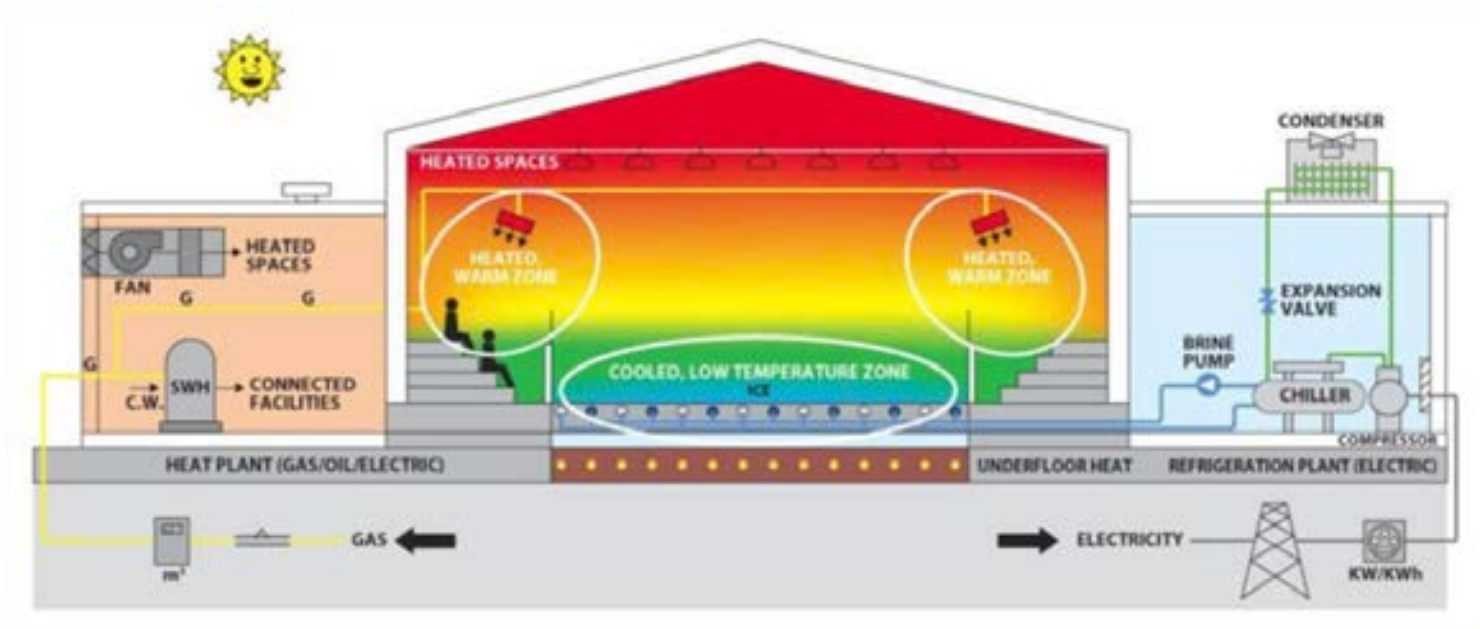
PERMANENT OR ALL-PURPOSE FLOOR



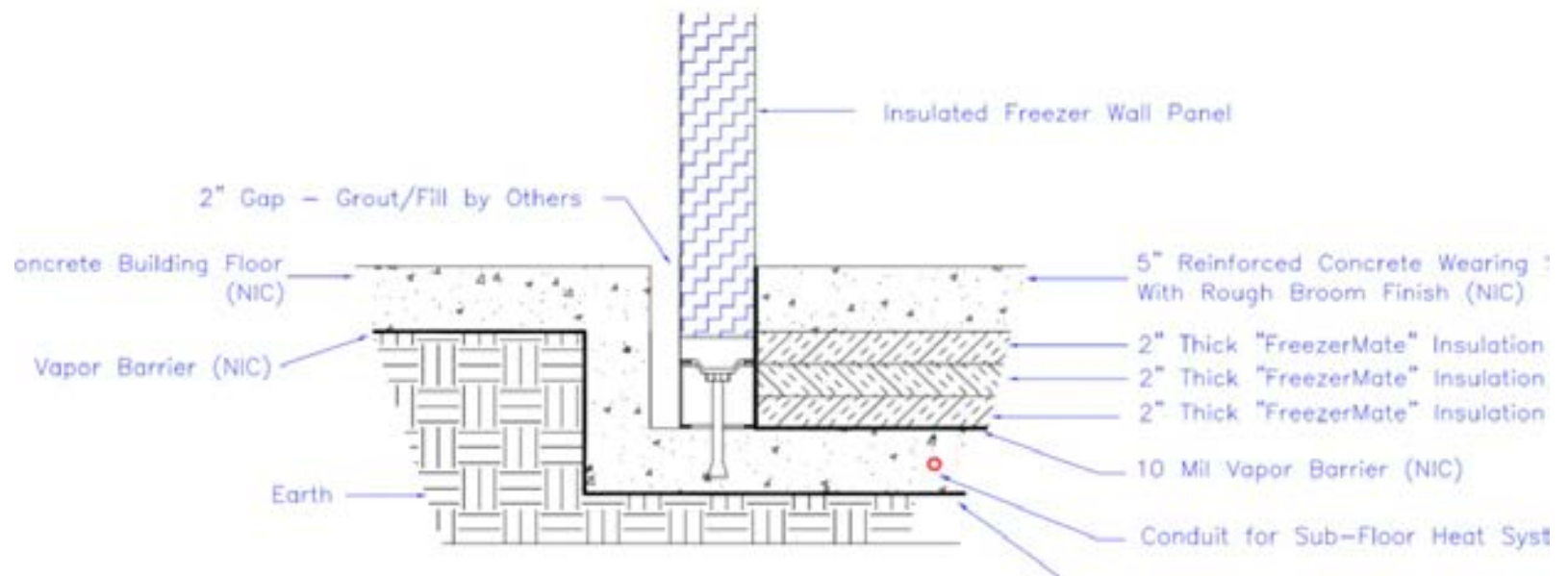
ALL-PURPOSE FLOOR

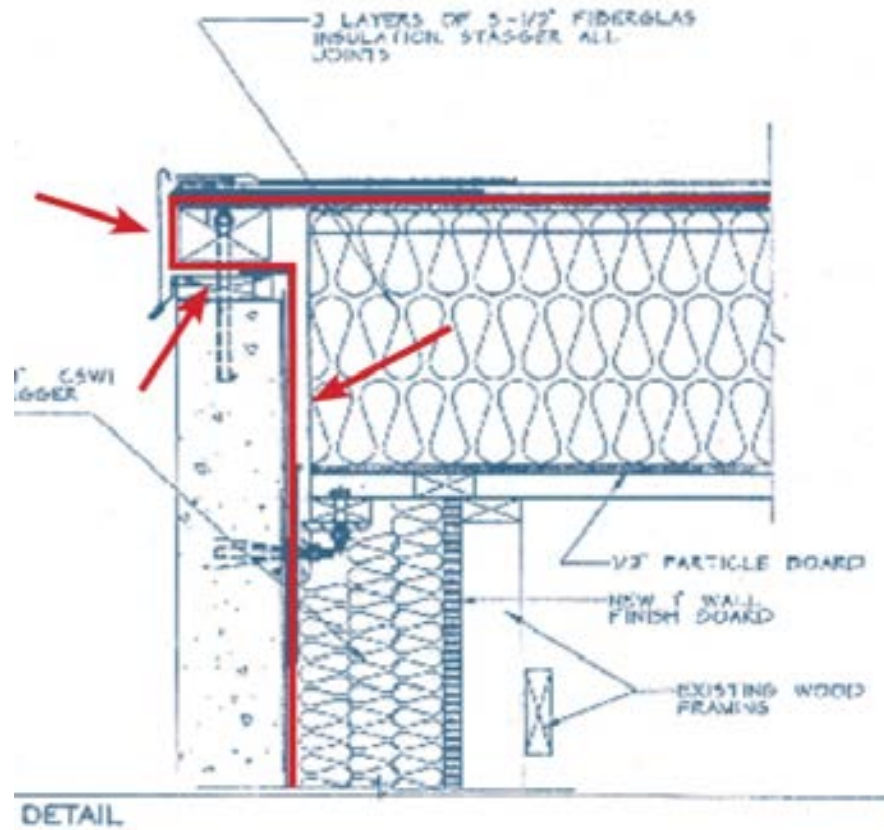


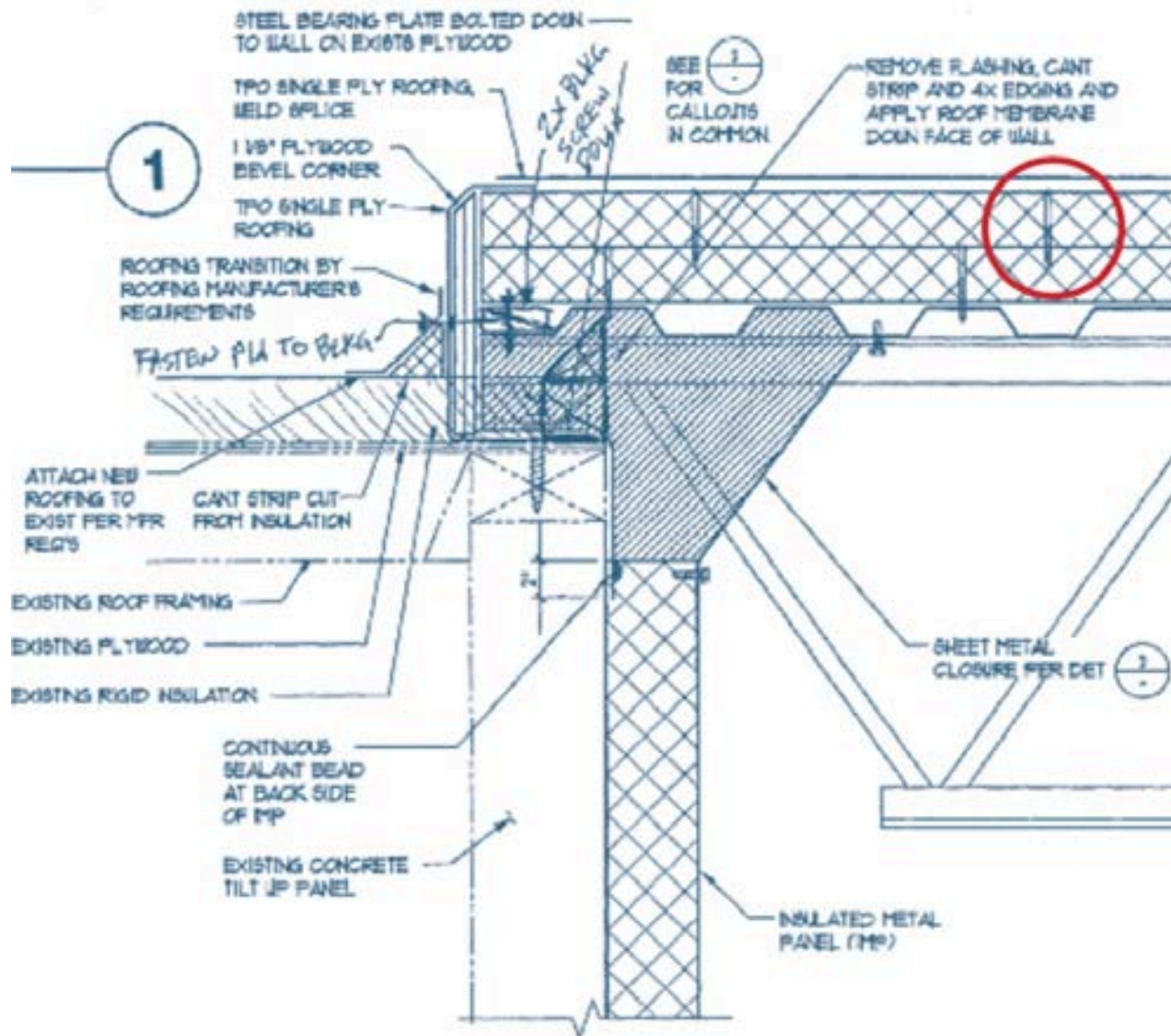
ALL-PURPOSE FLOOR WITH REHEAT



Refrigerated Buildings







Aspen Recreation Center





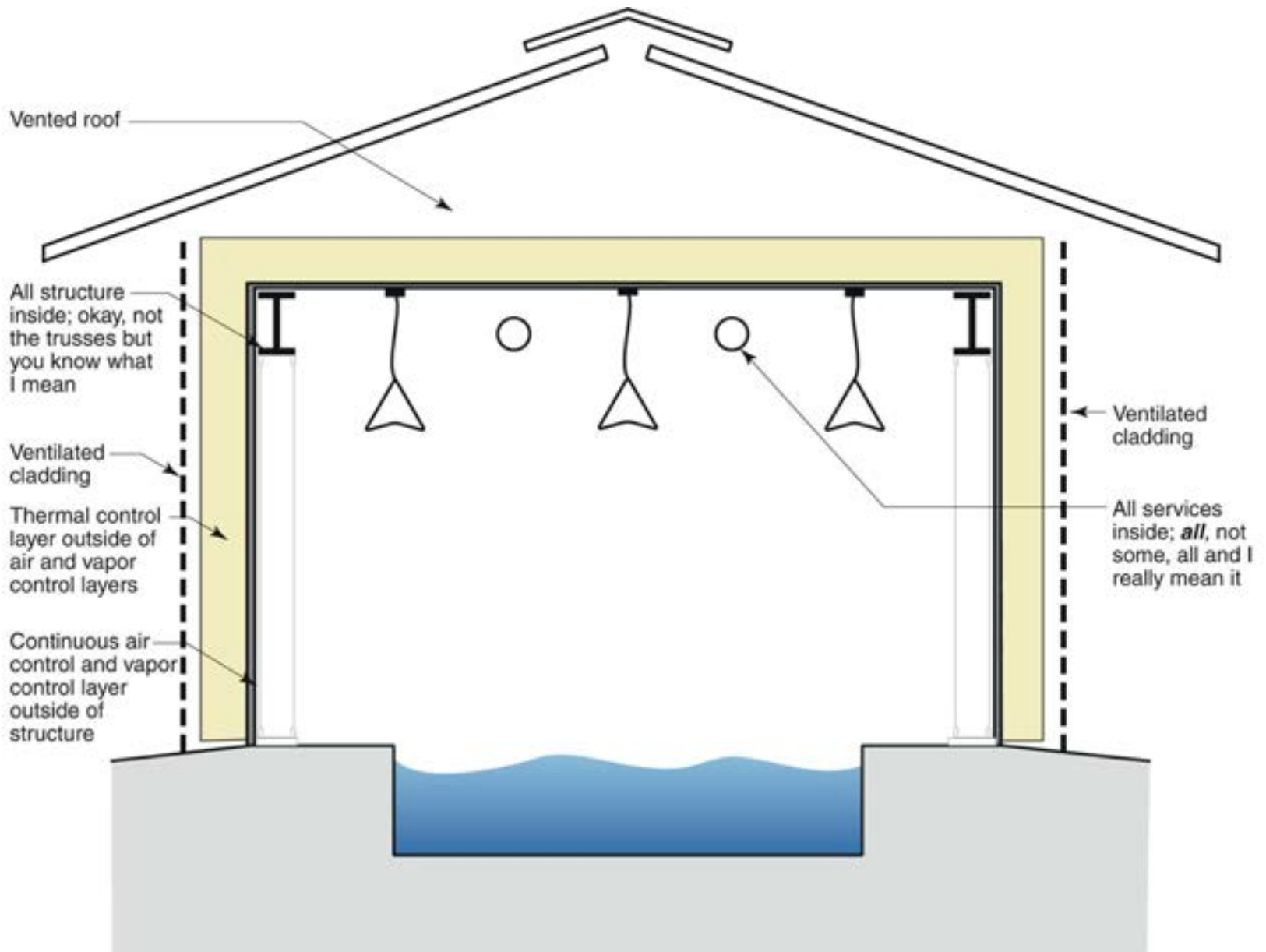


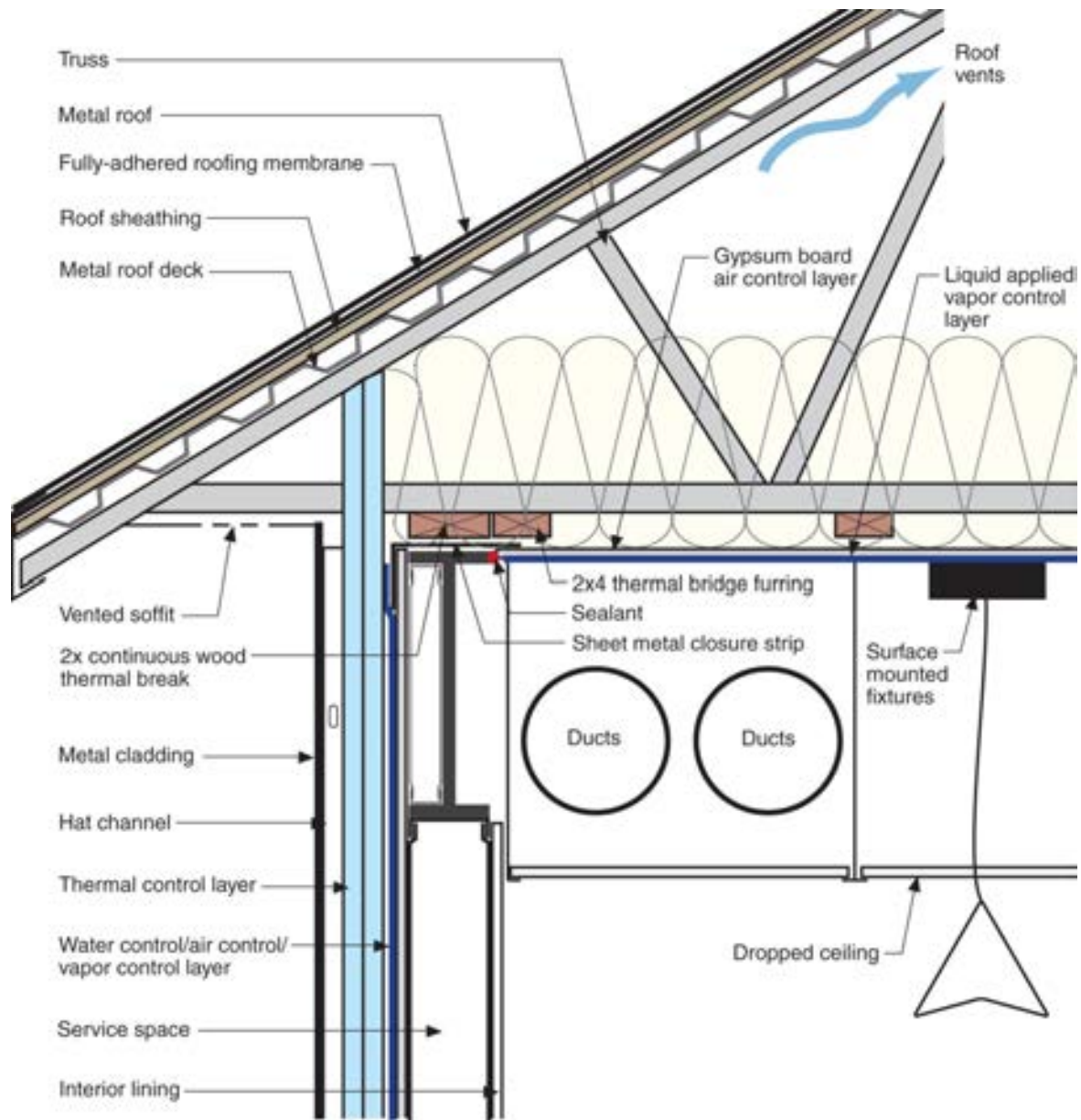




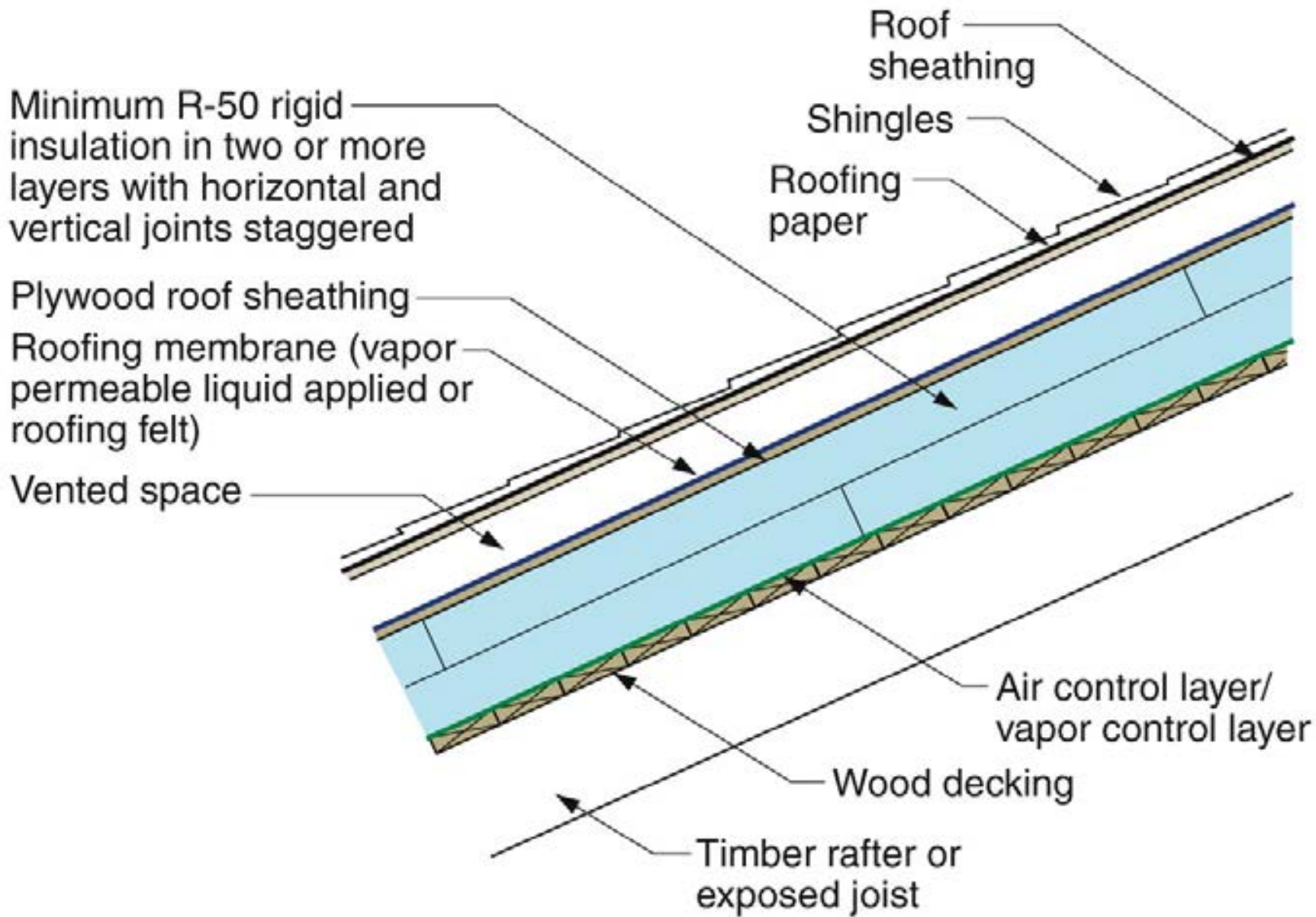


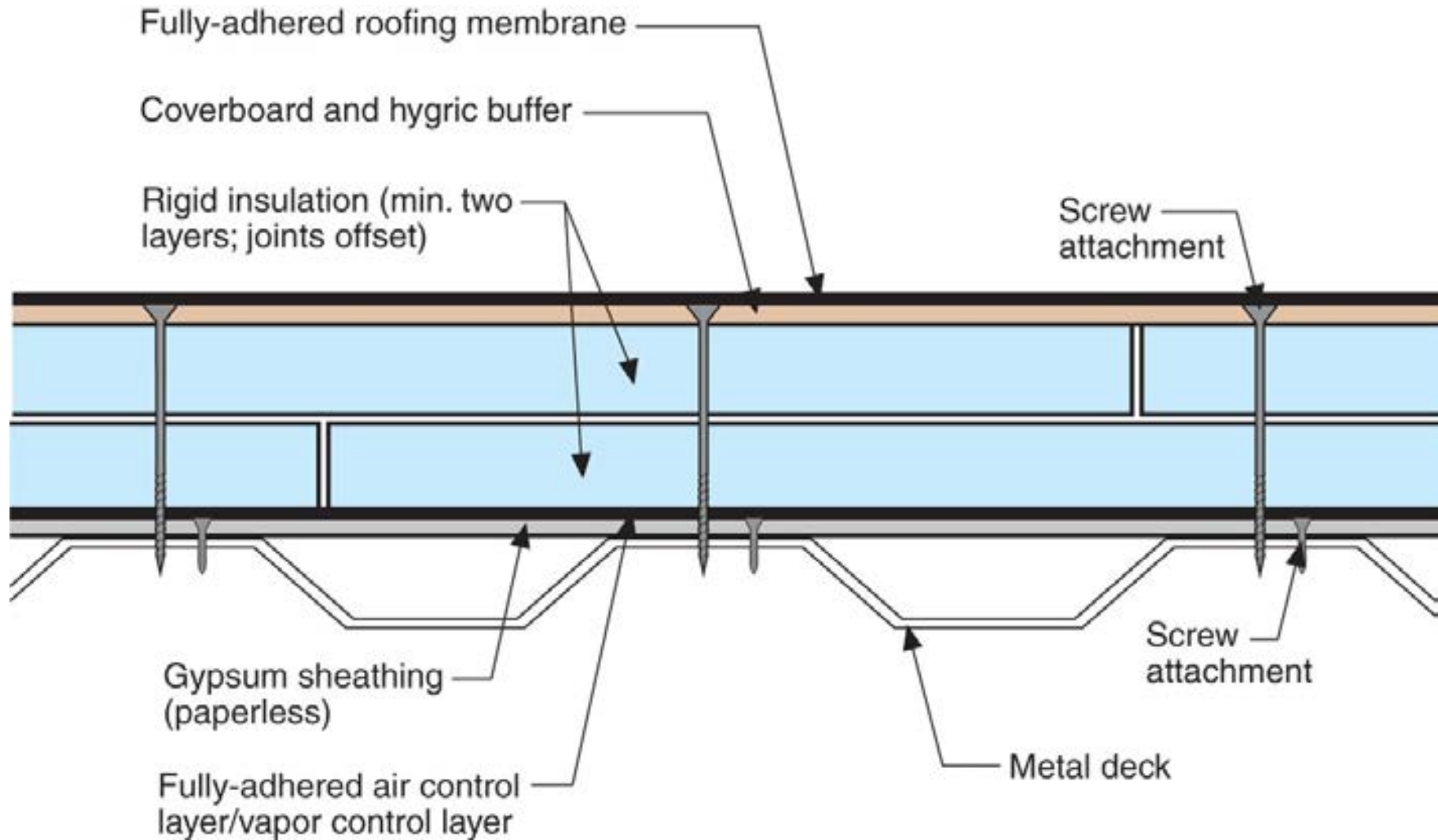
Swimming Pools

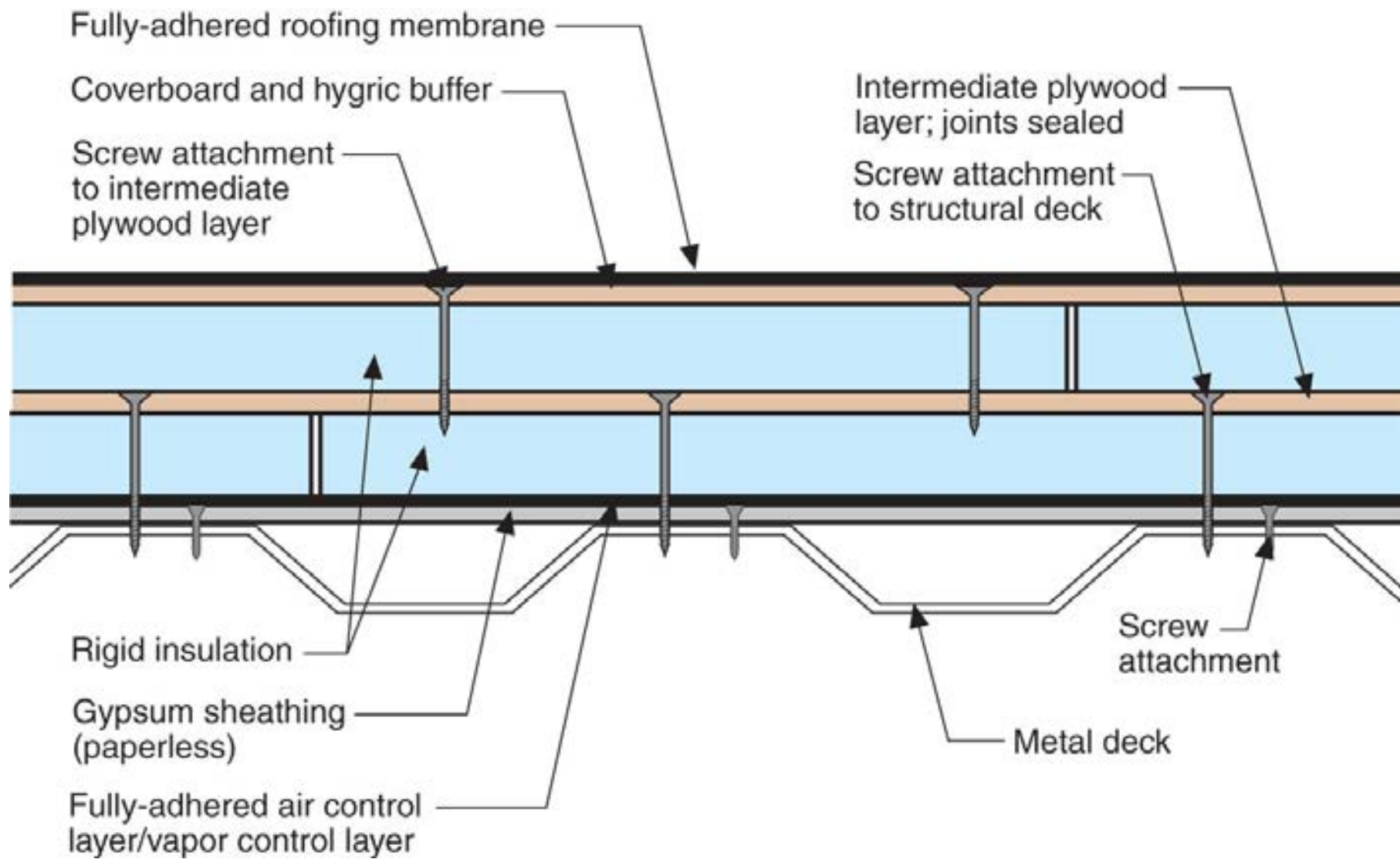


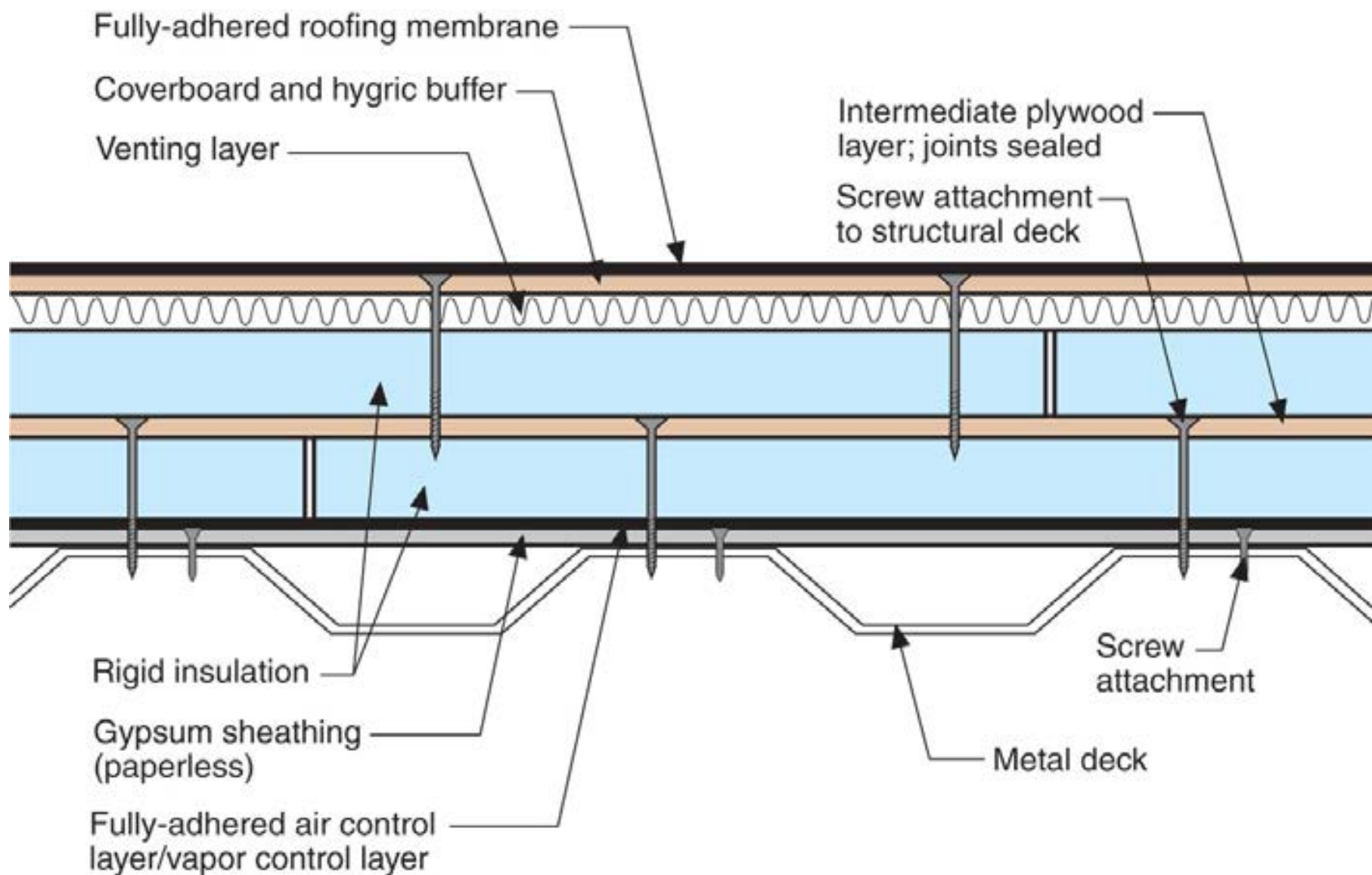




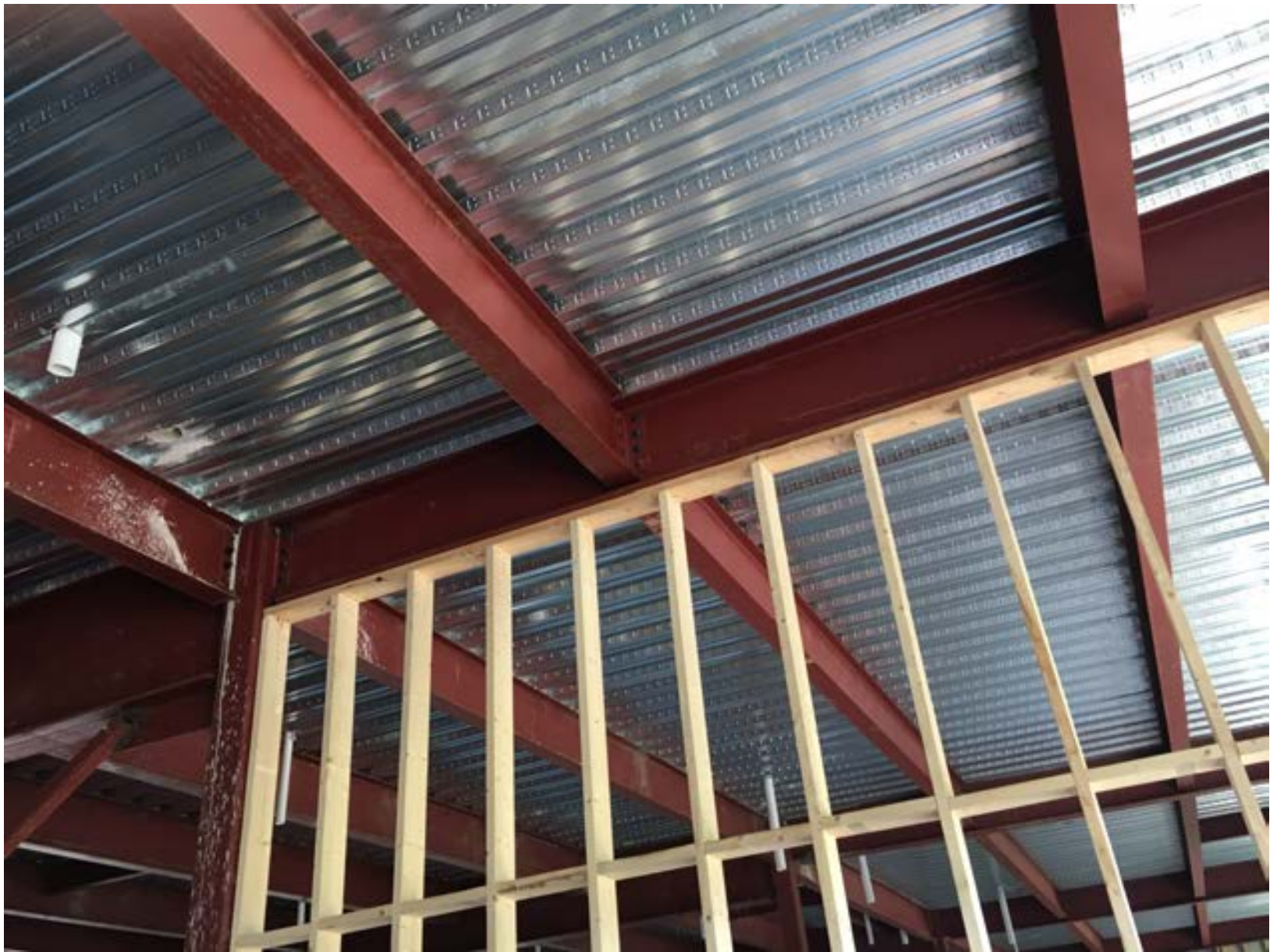












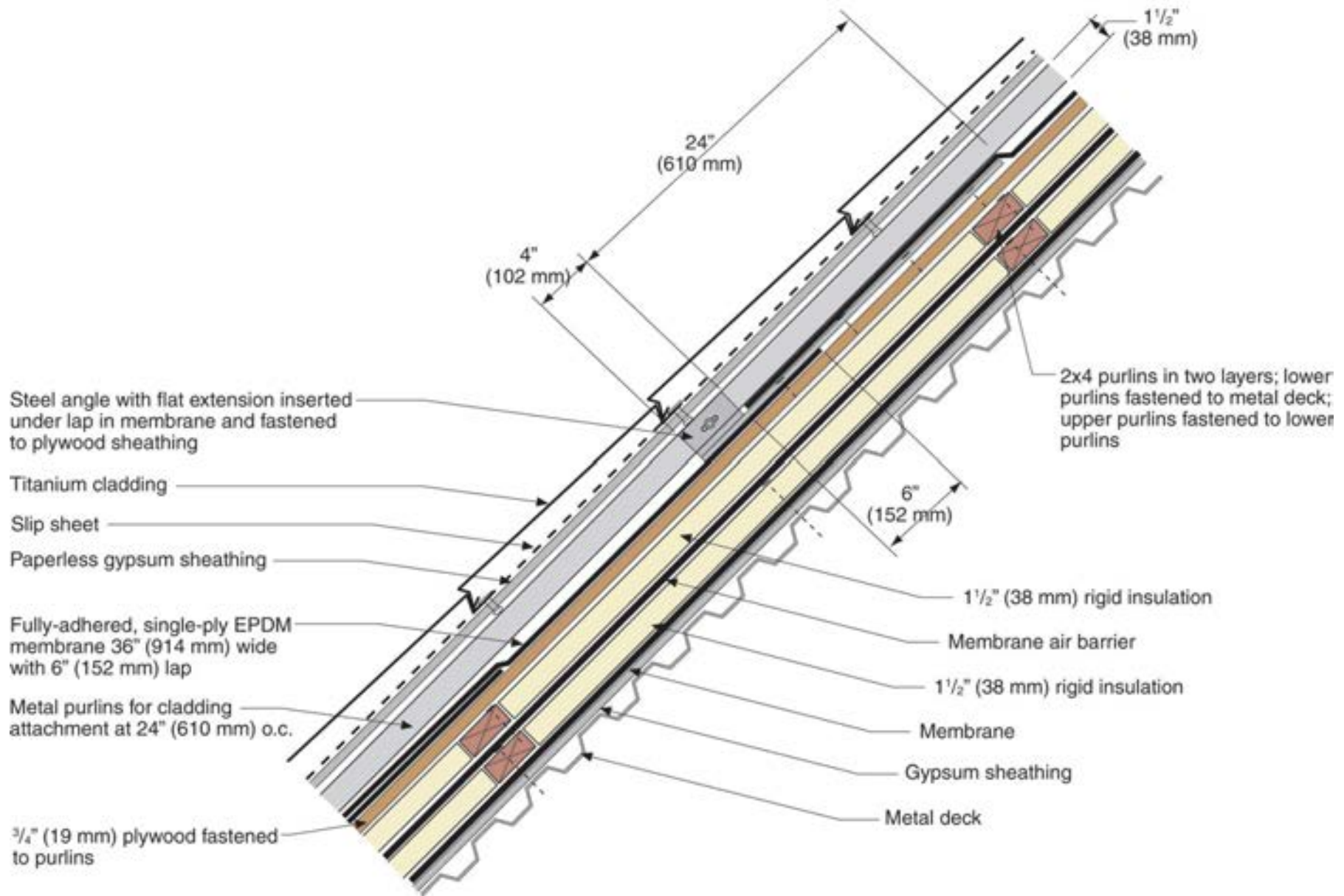


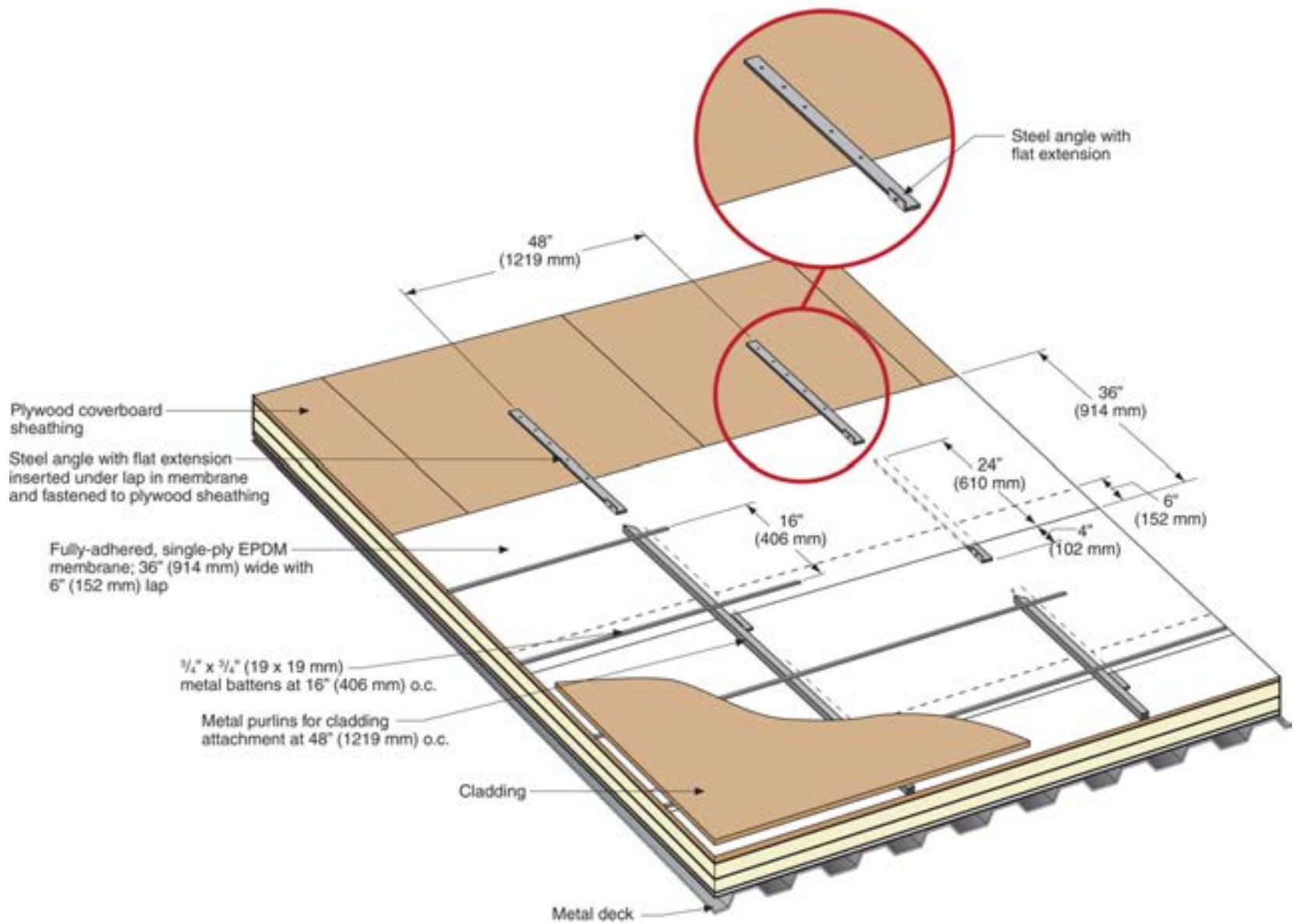
Denver Art Museum











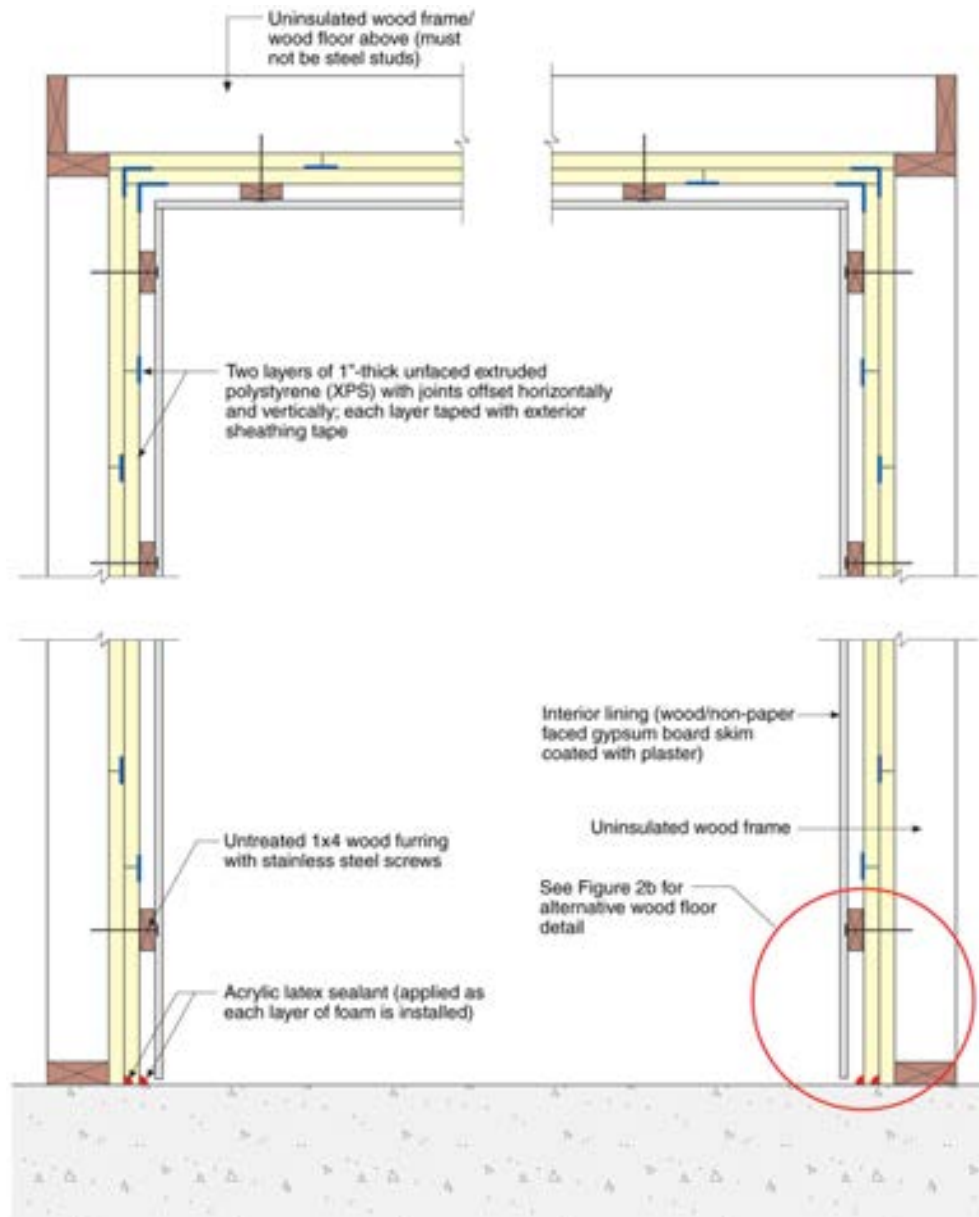
Grow Rooms – Grow Opps





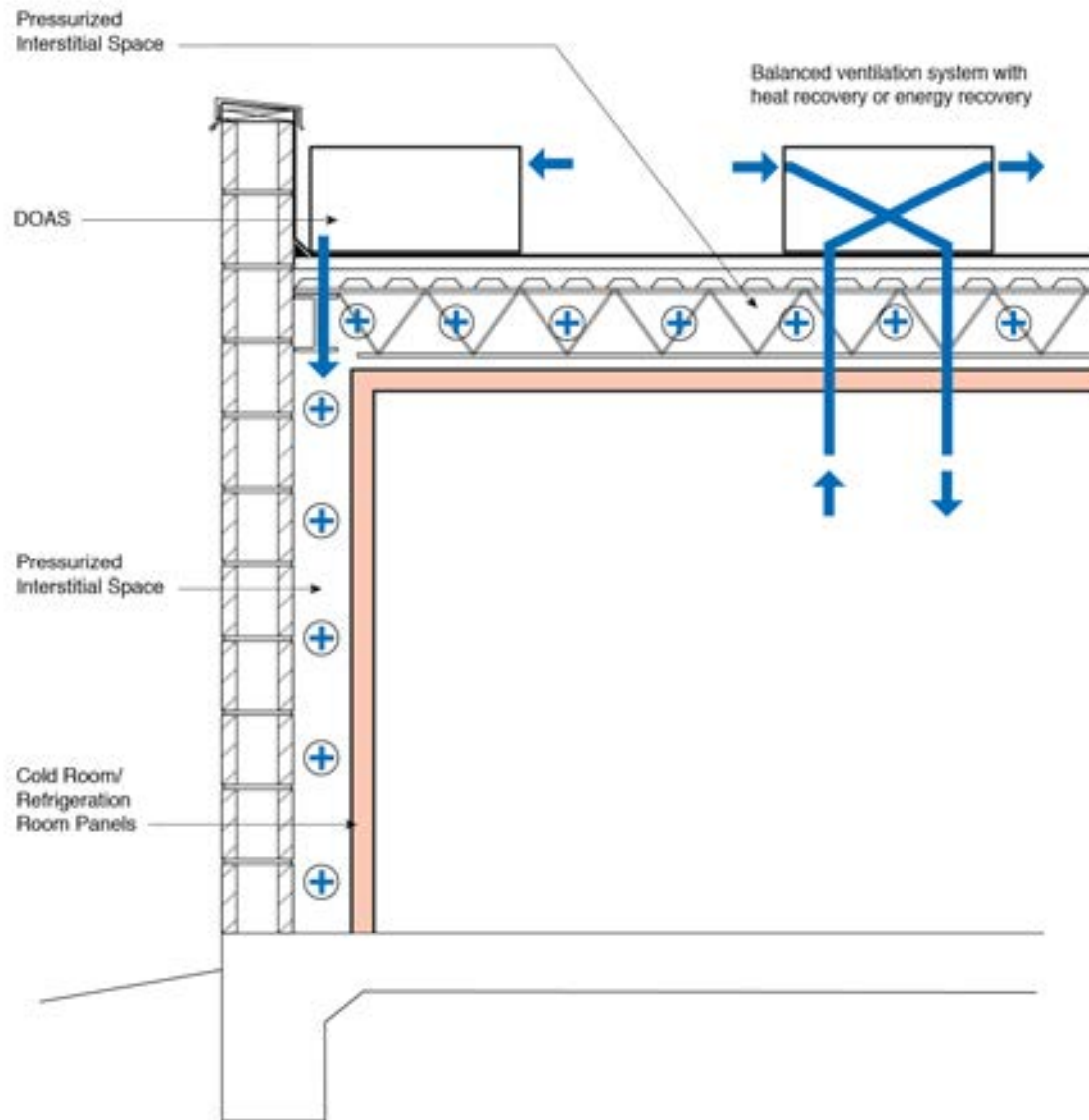












SIP's

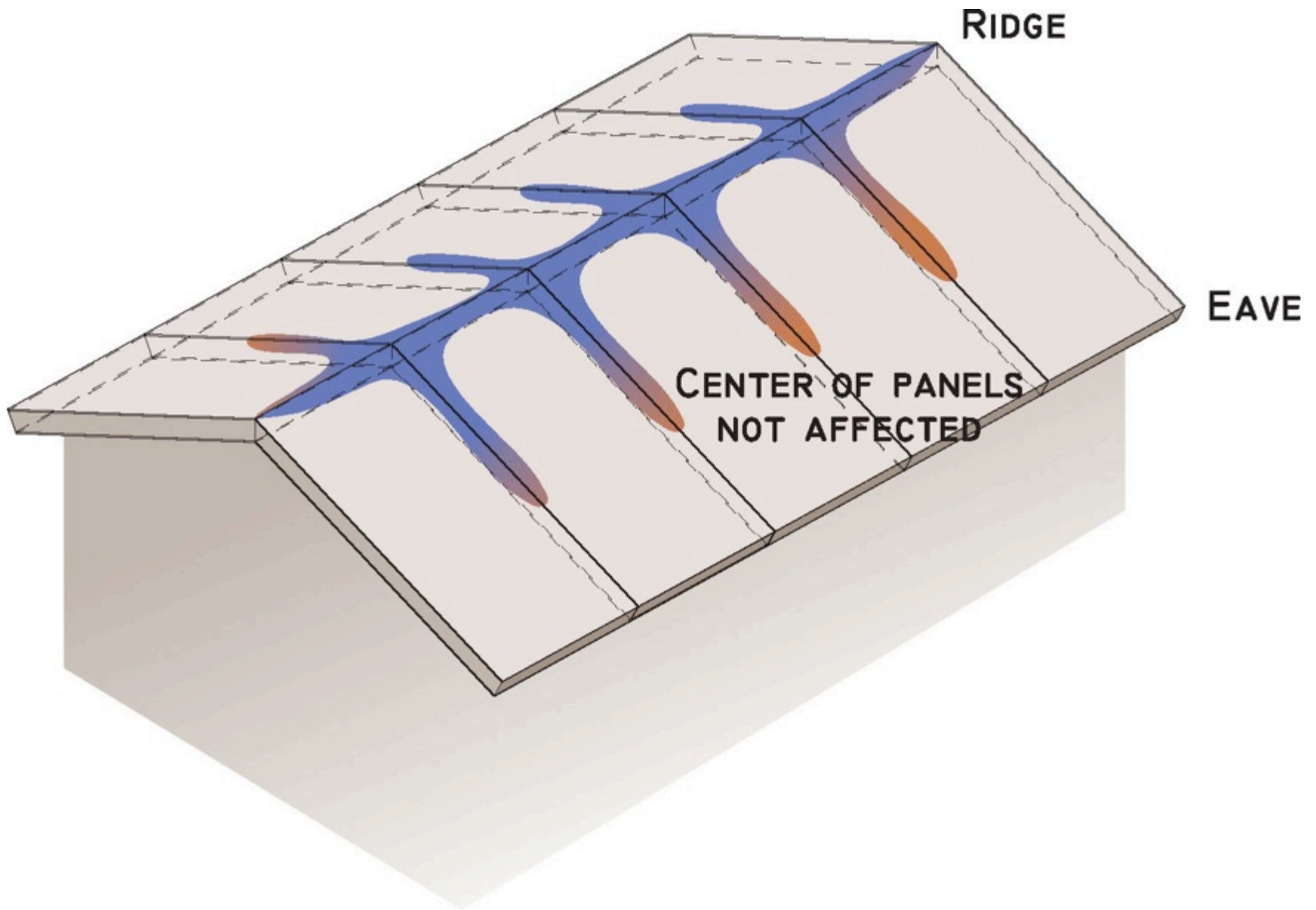






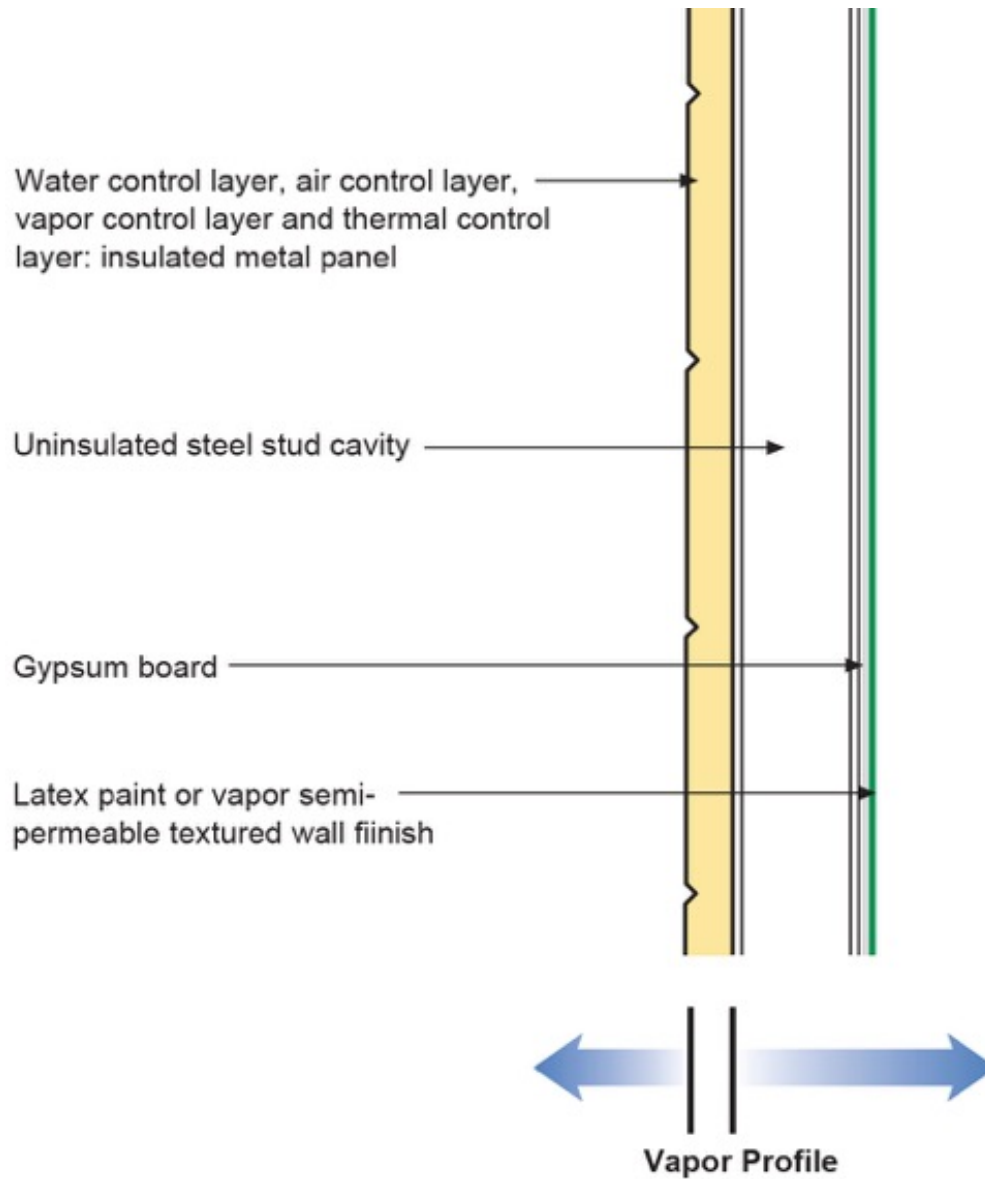


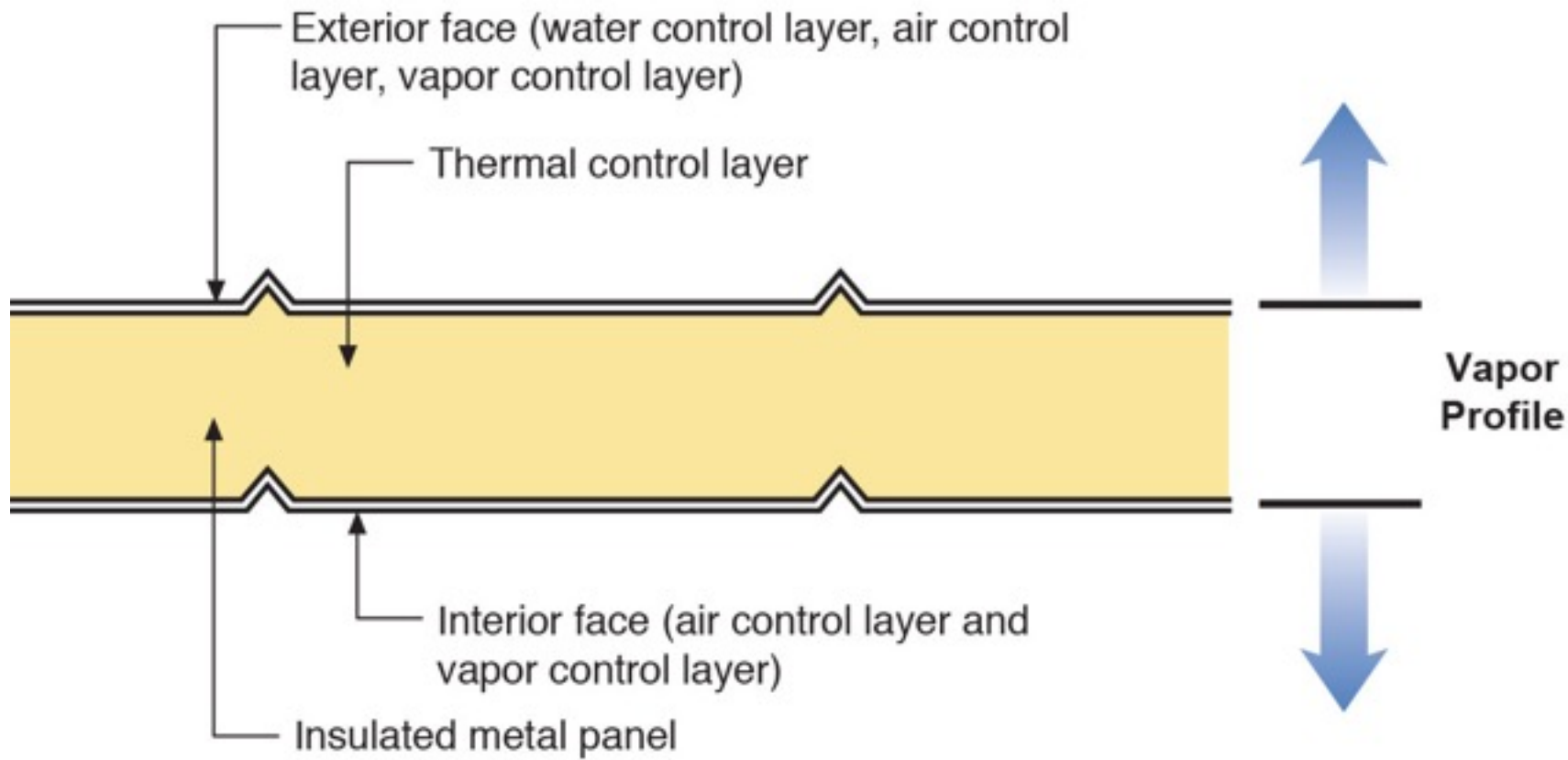


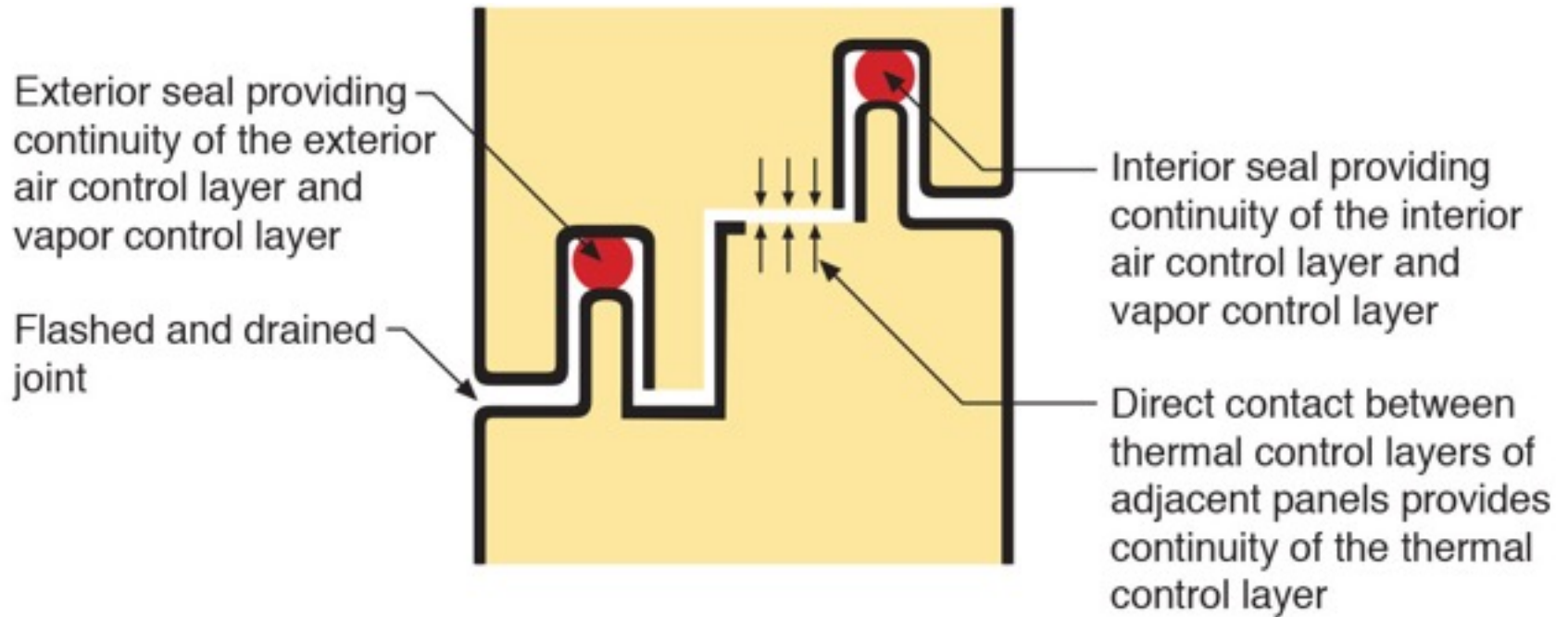


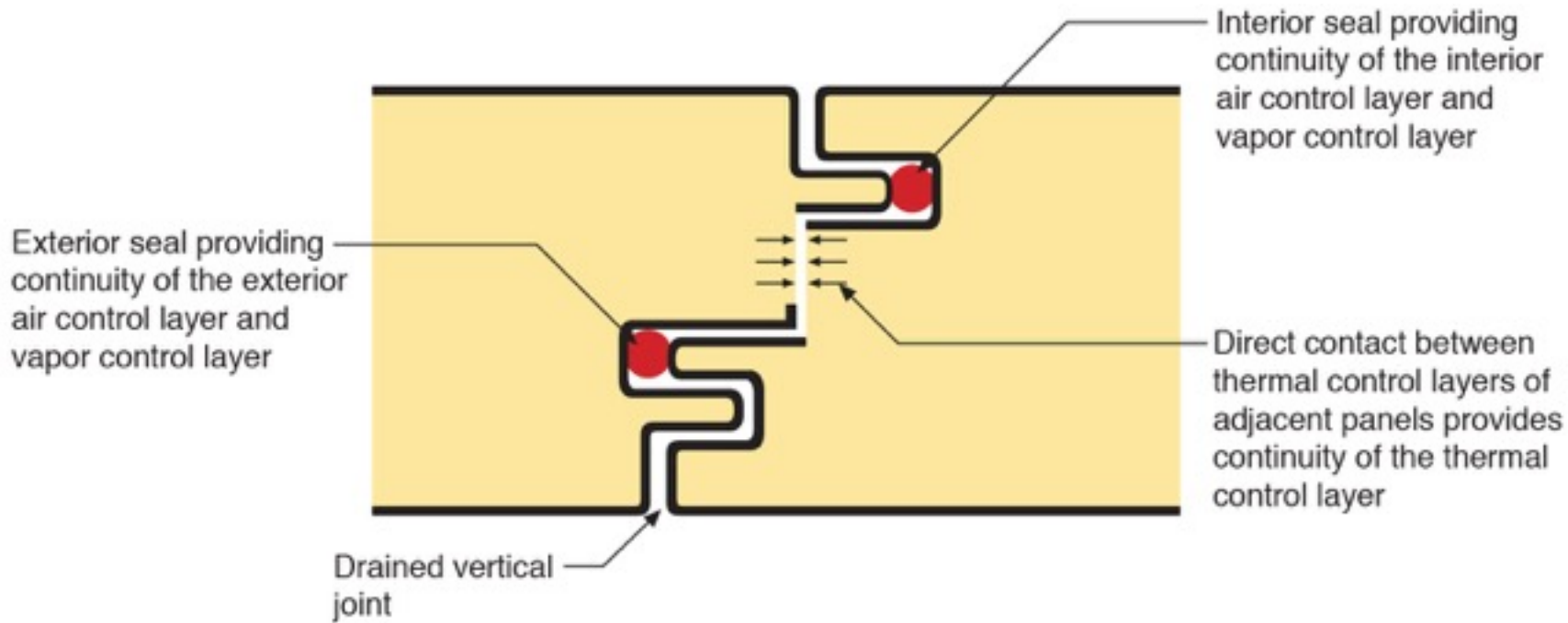


Insulated Metal Panels







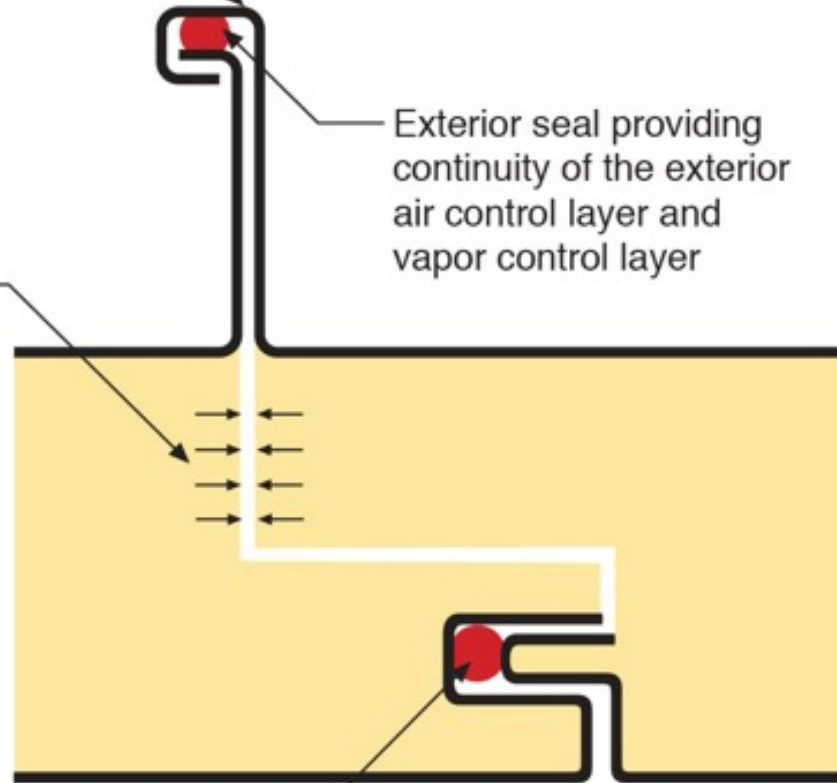


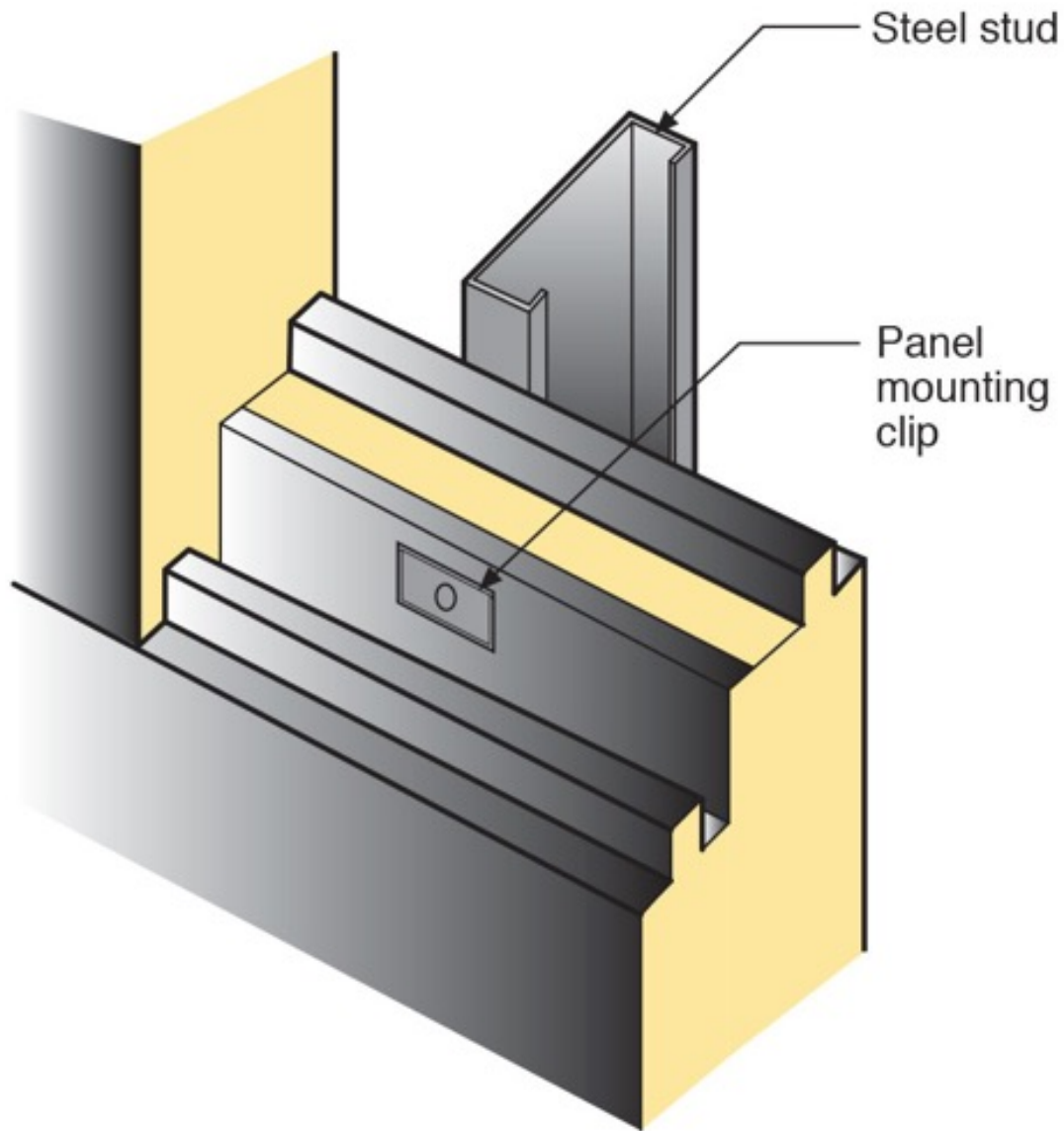
Standing seam provides continuity of the water control layer

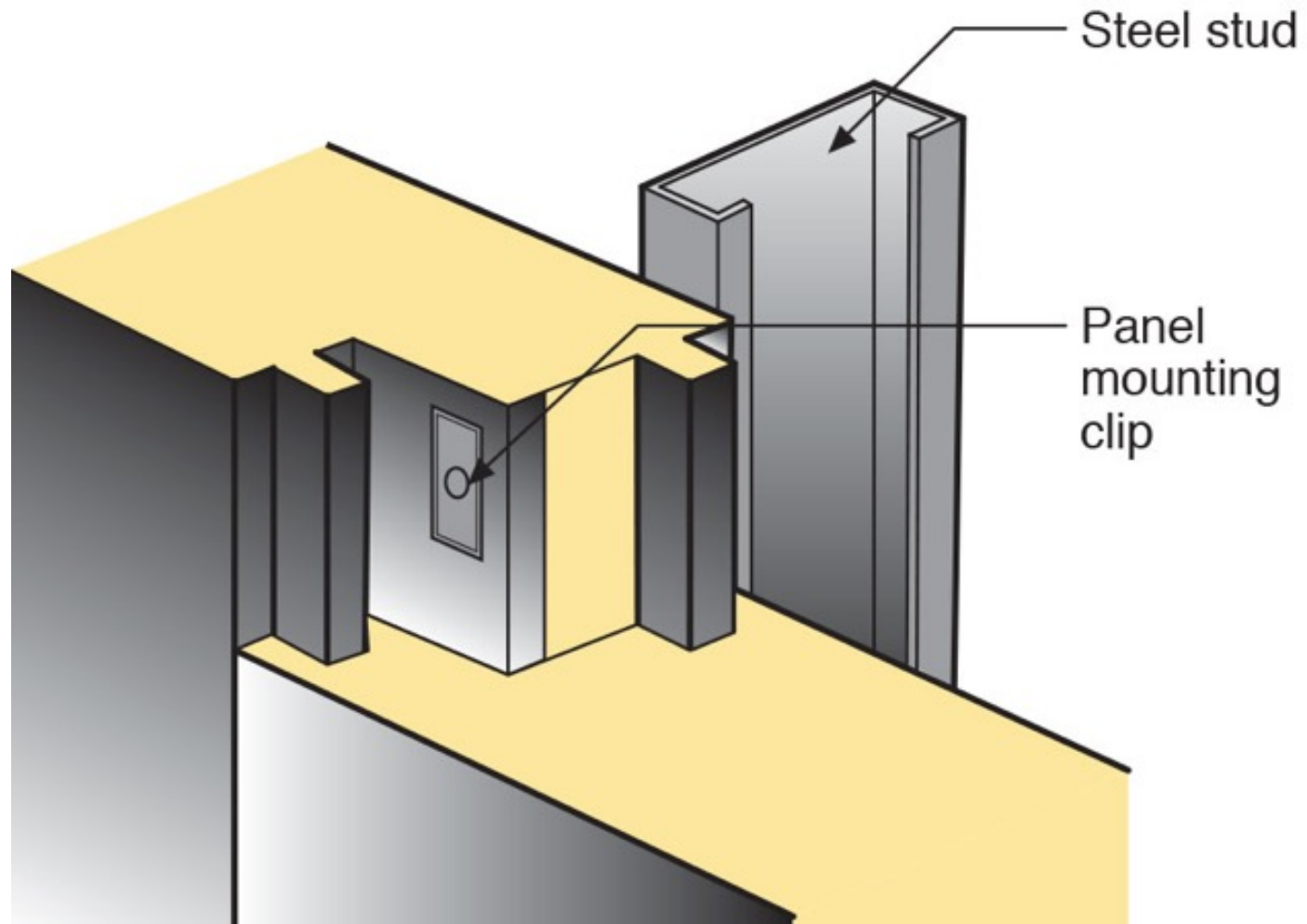
Direct contact between thermal control layers of adjacent panels provides continuity of the thermal control layer

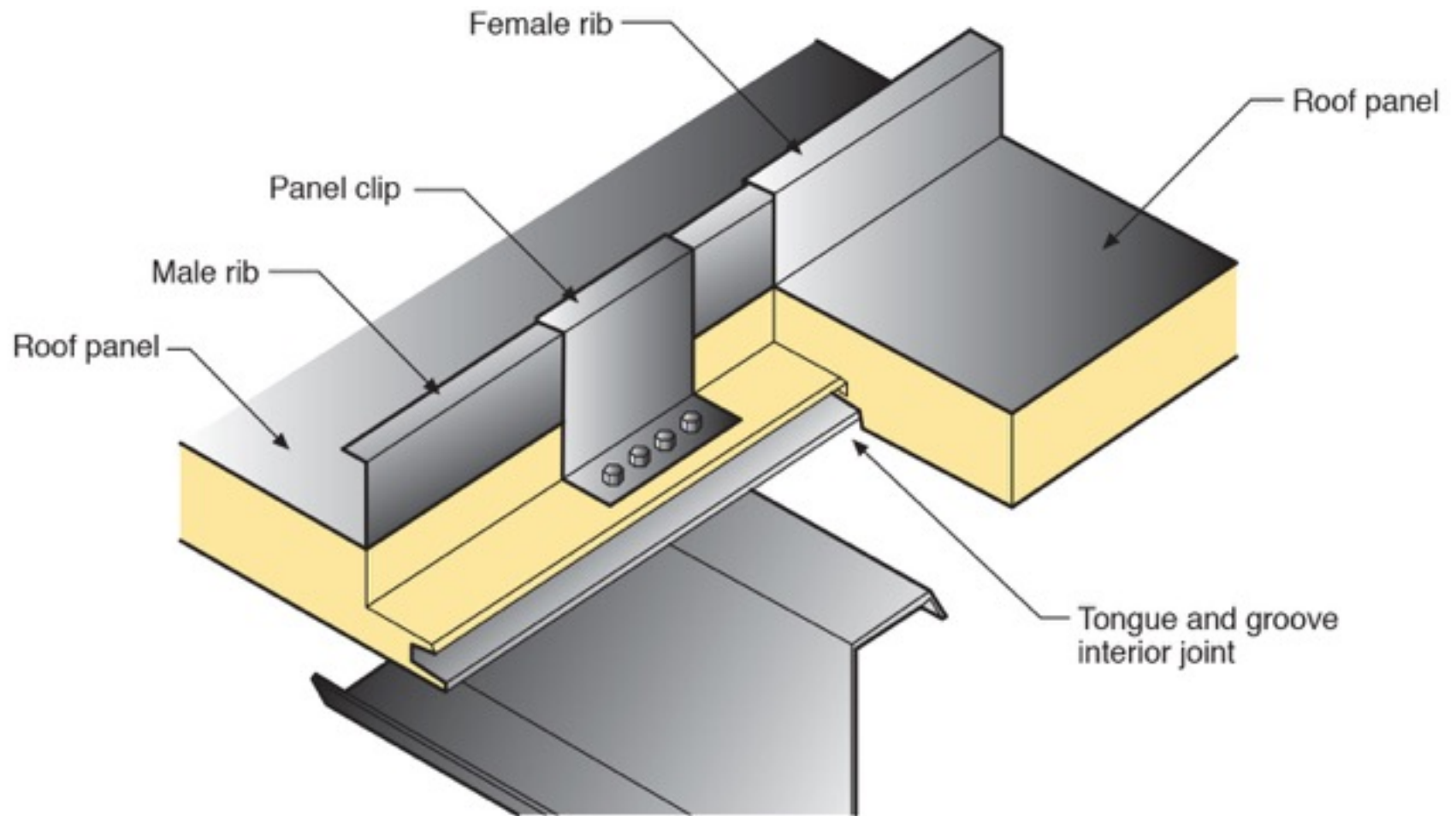
Exterior seal providing continuity of the exterior air control layer and vapor control layer

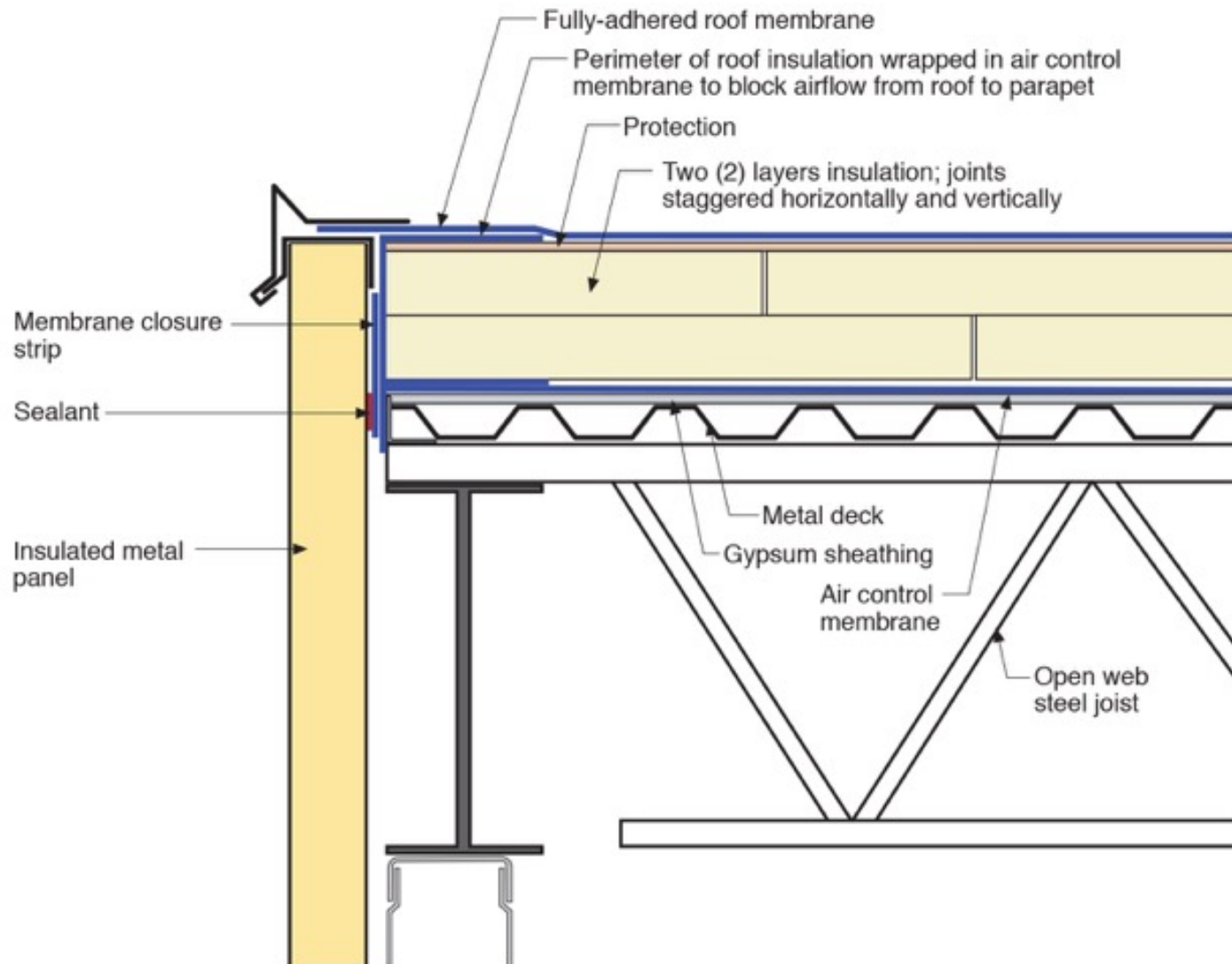
Interior seal providing continuity of the interior air control layer and vapor control layer

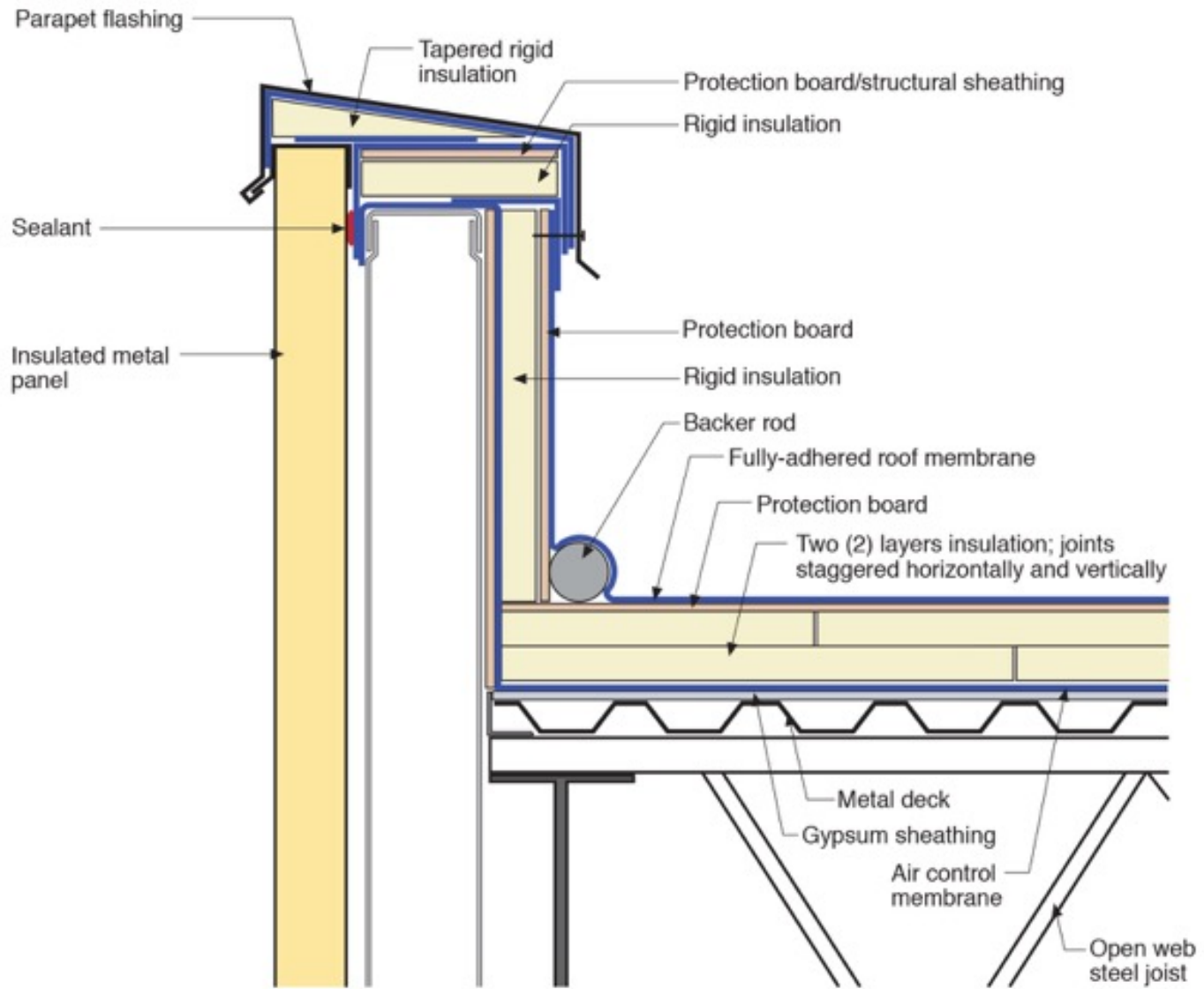


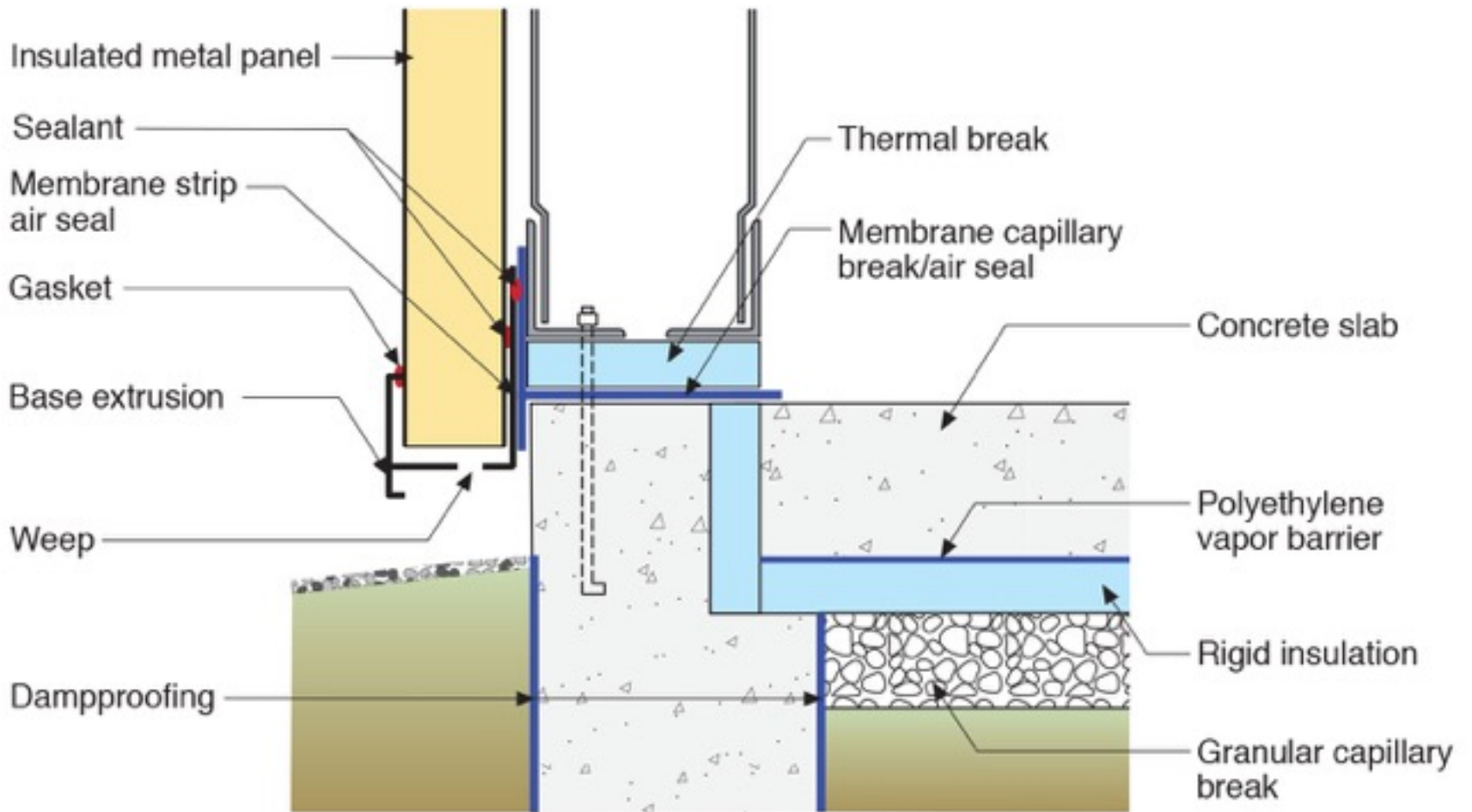


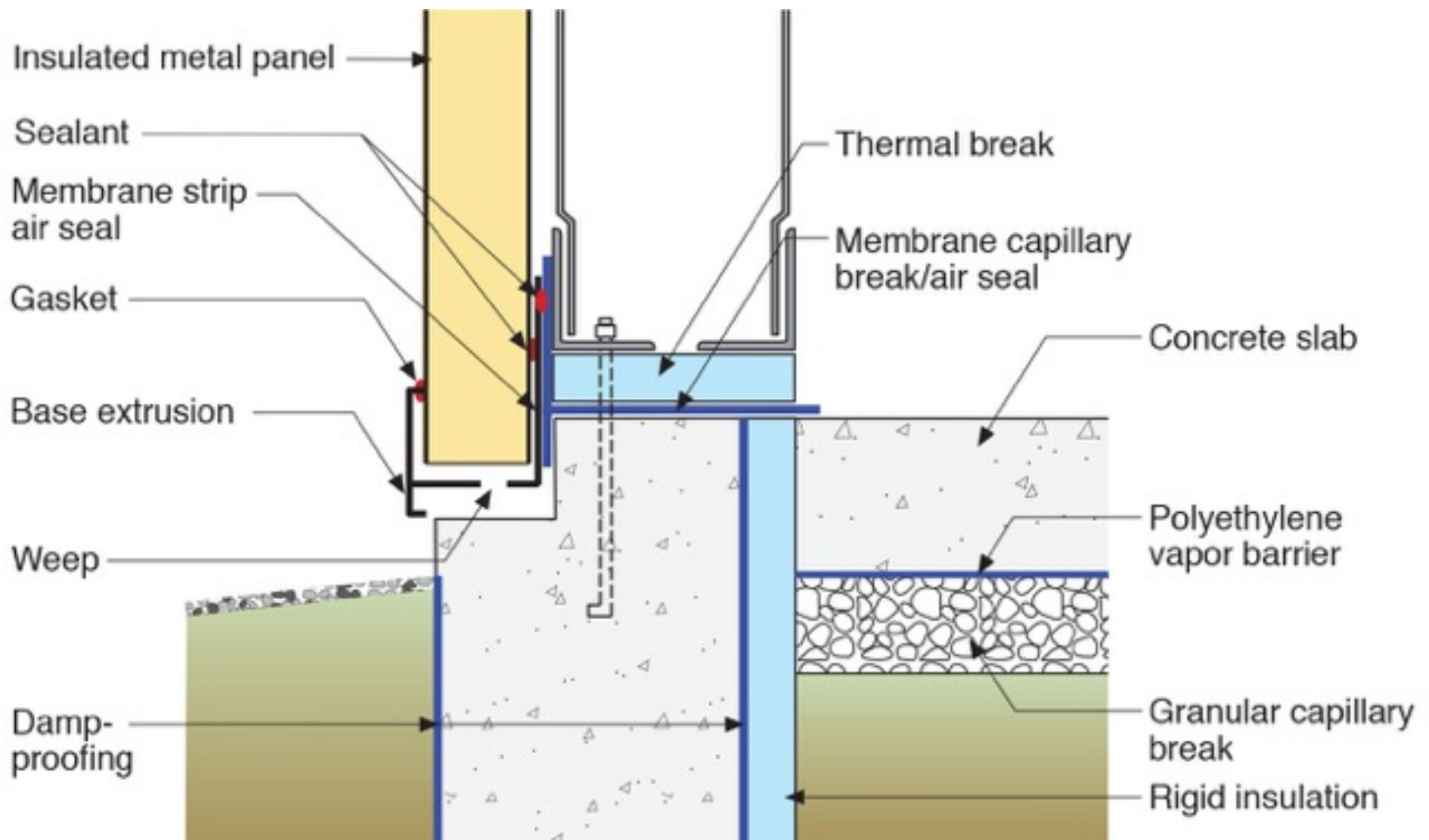


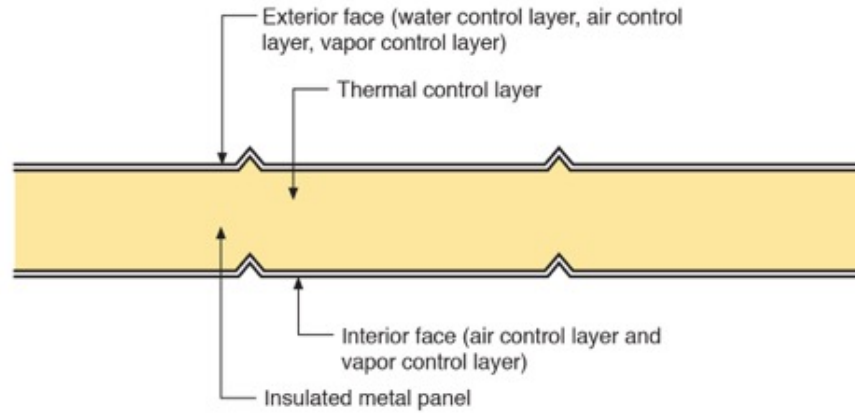




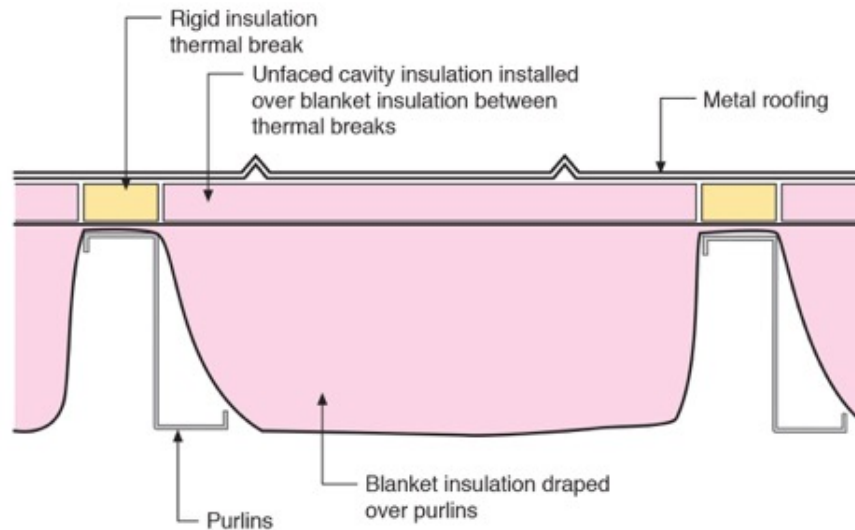








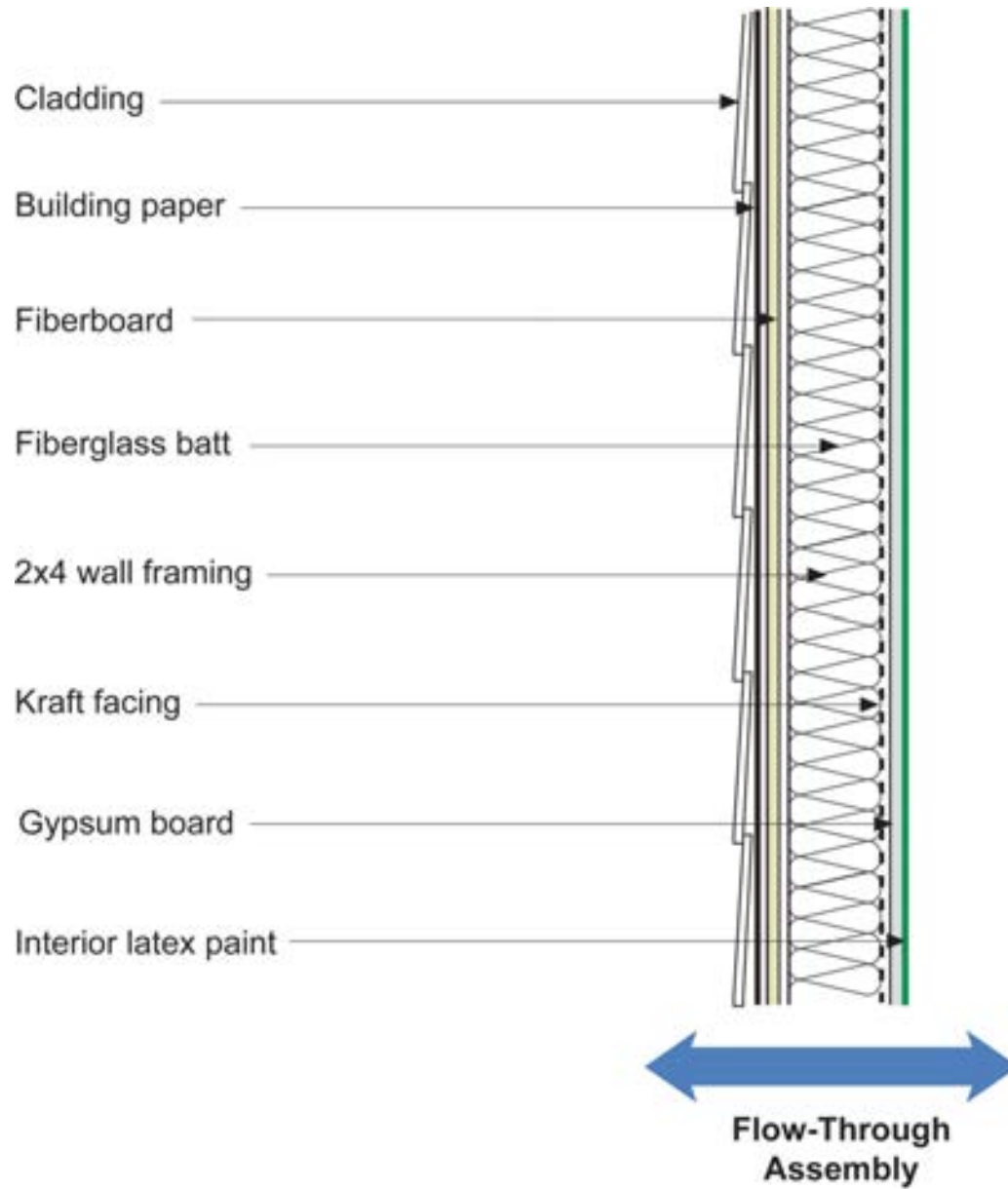
Insulated Metal Panel Roof System

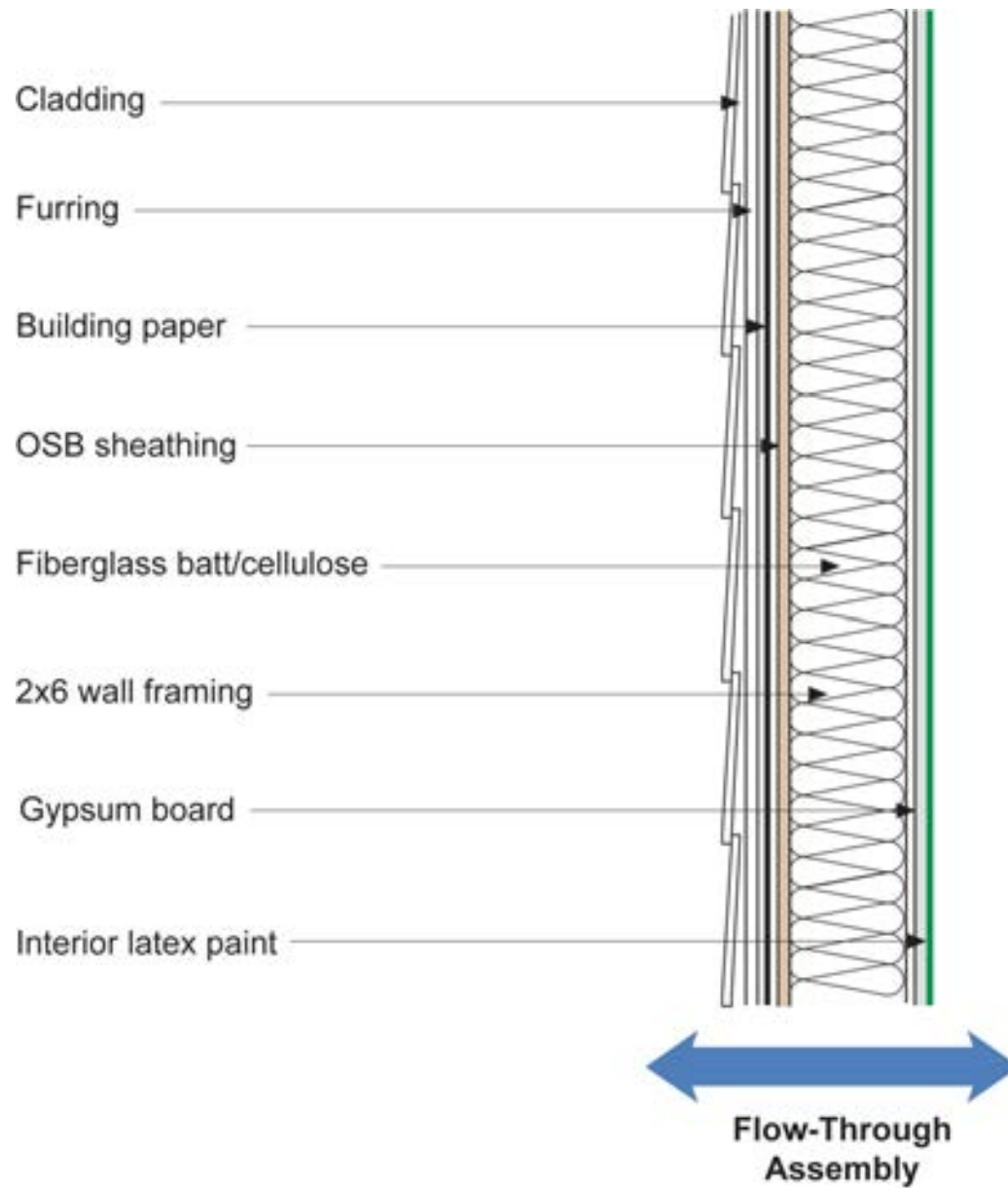


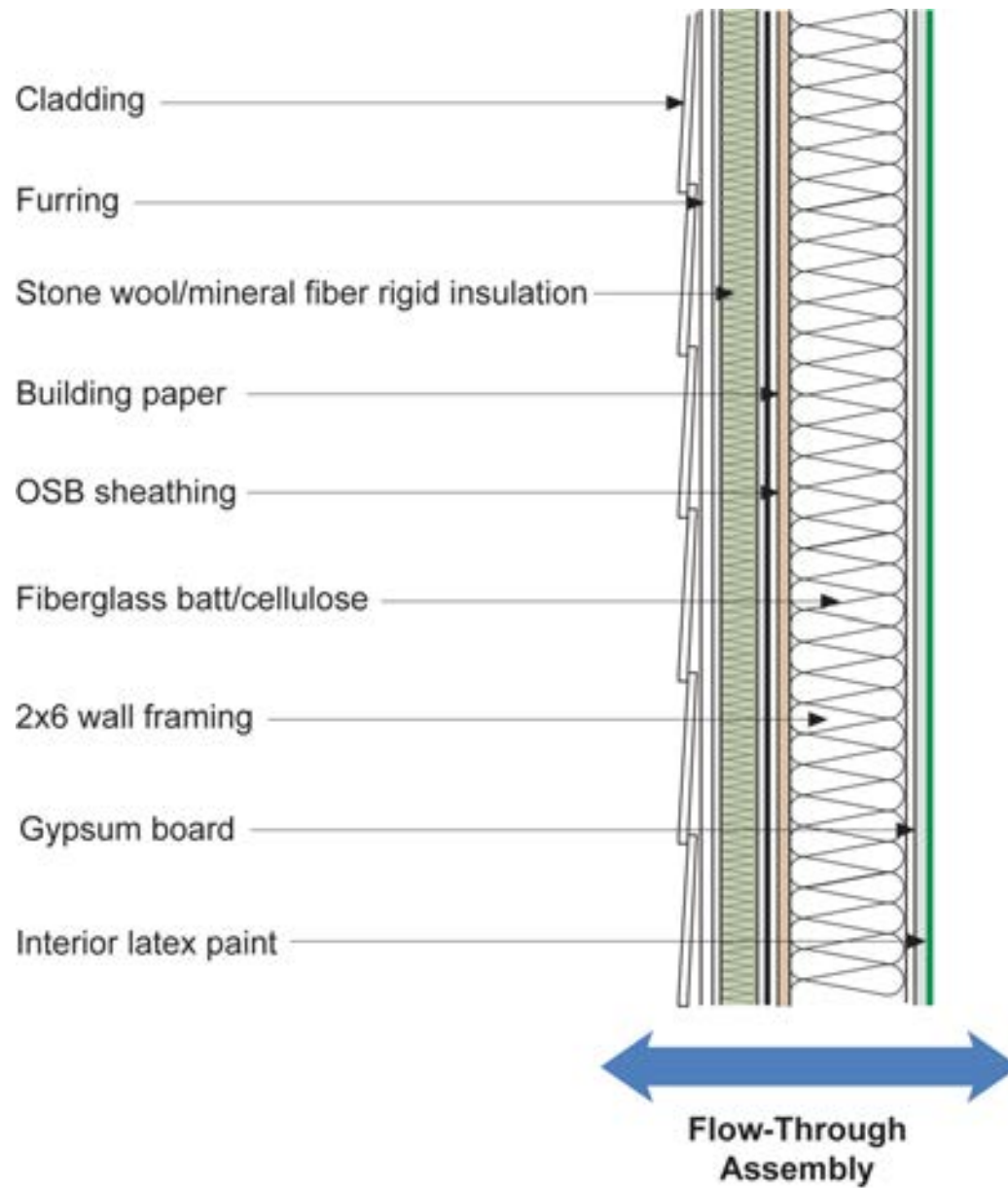
Blanket Insulation Purlin Roof System

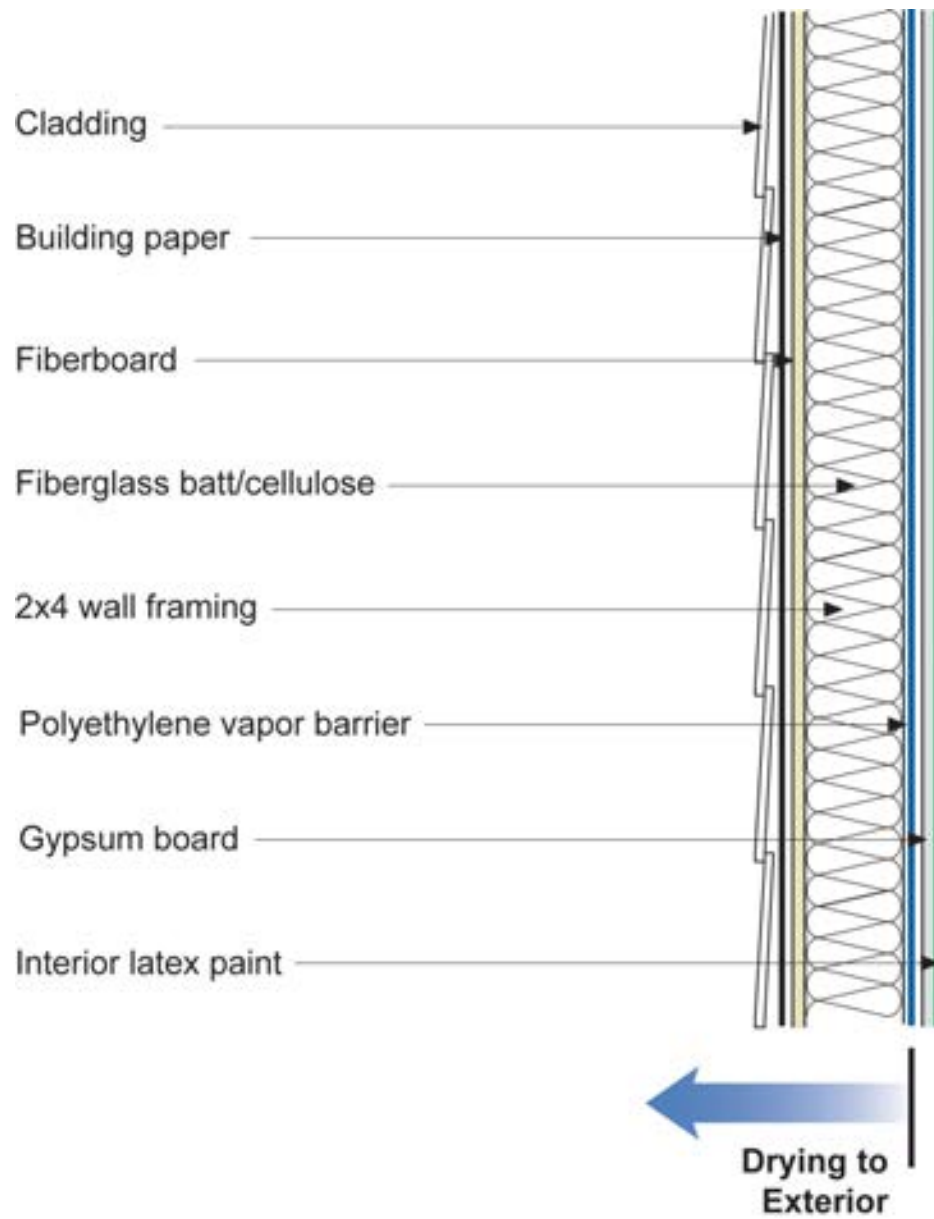


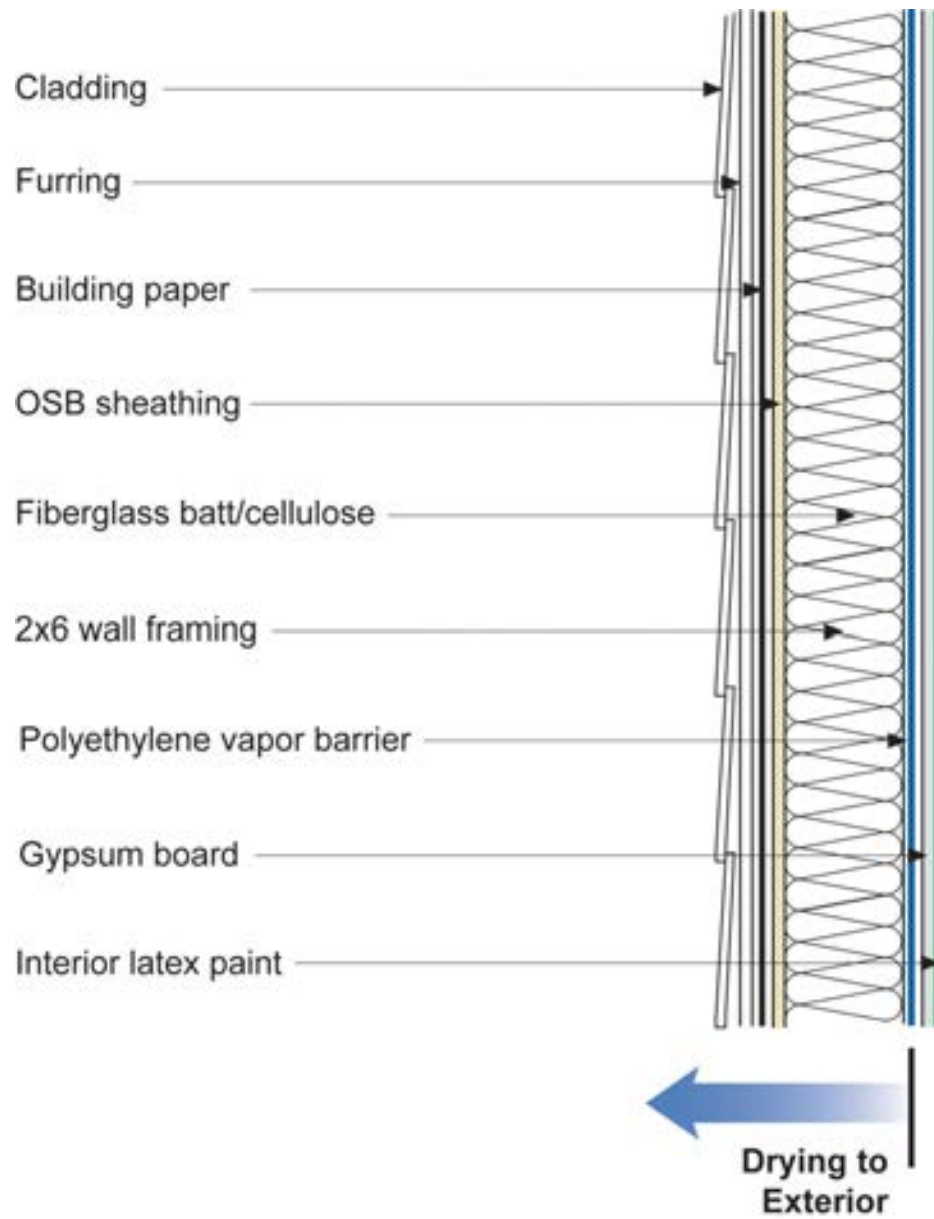
Walls

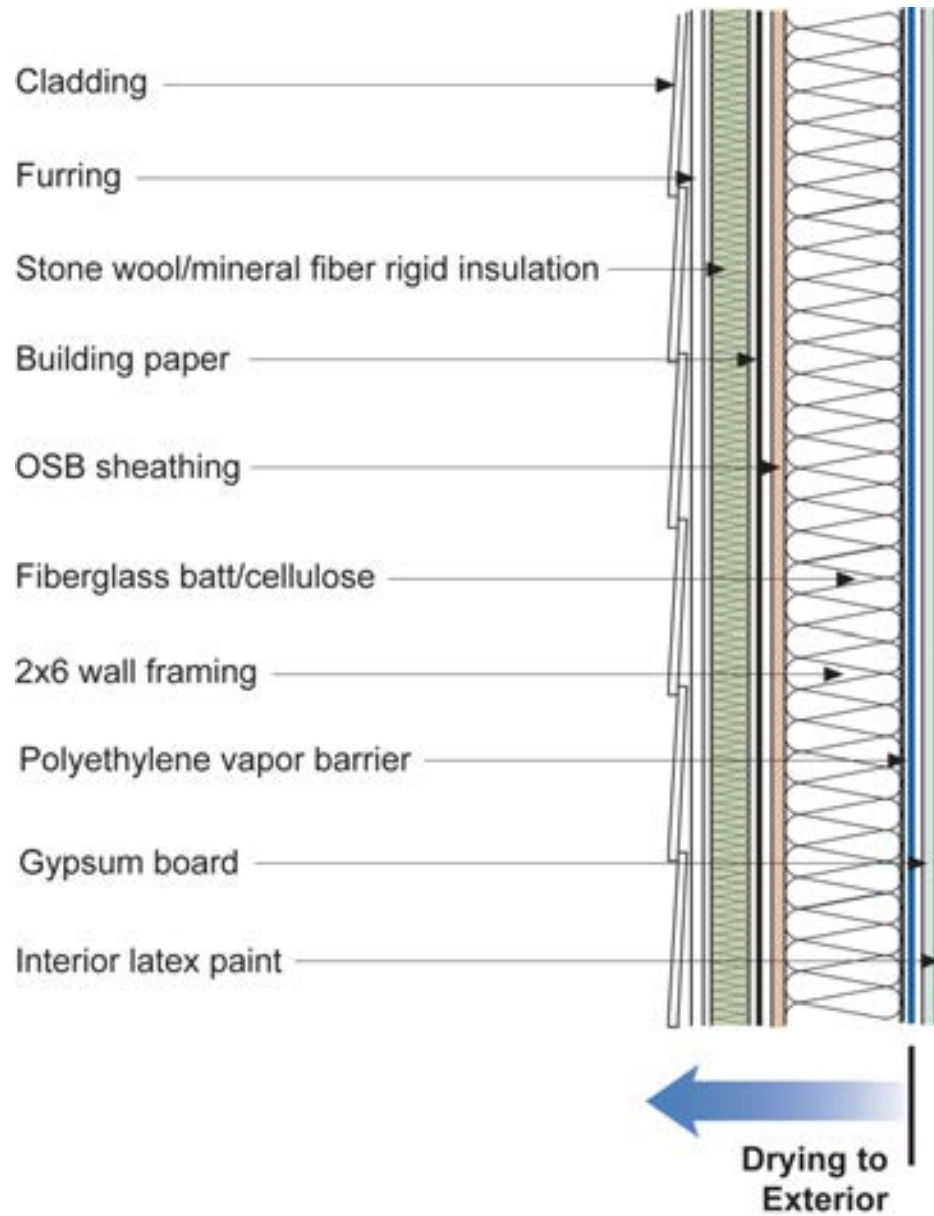


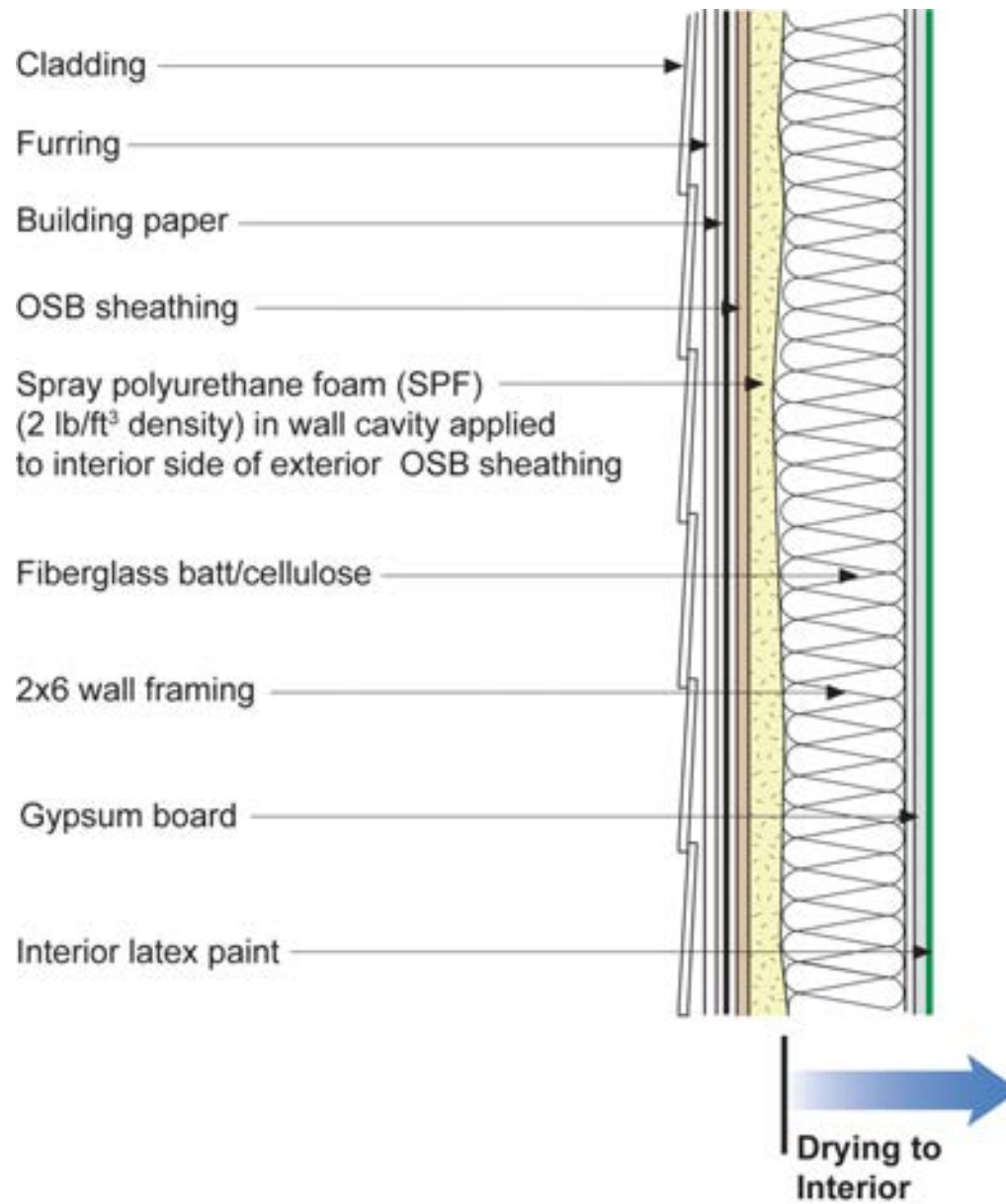


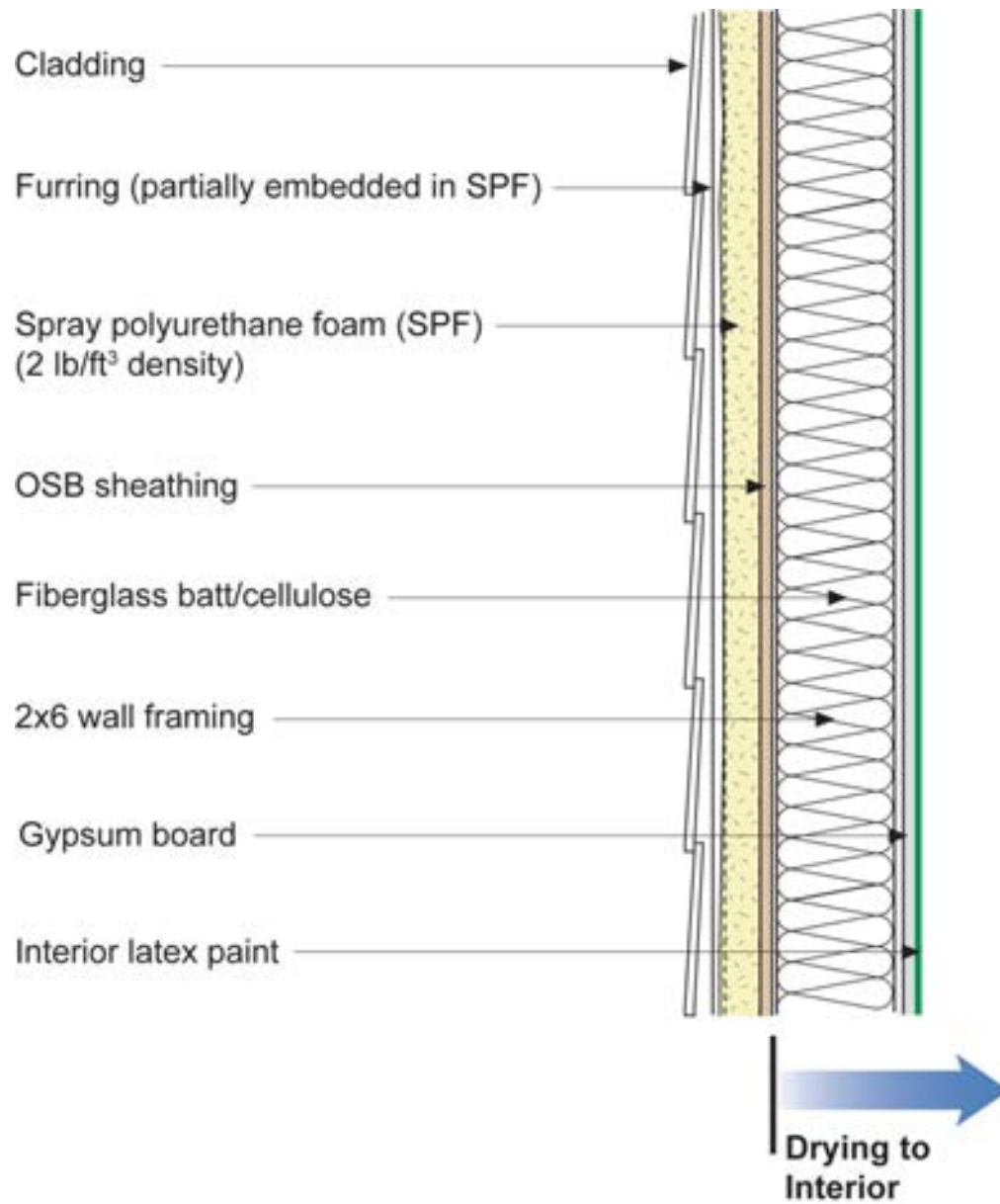












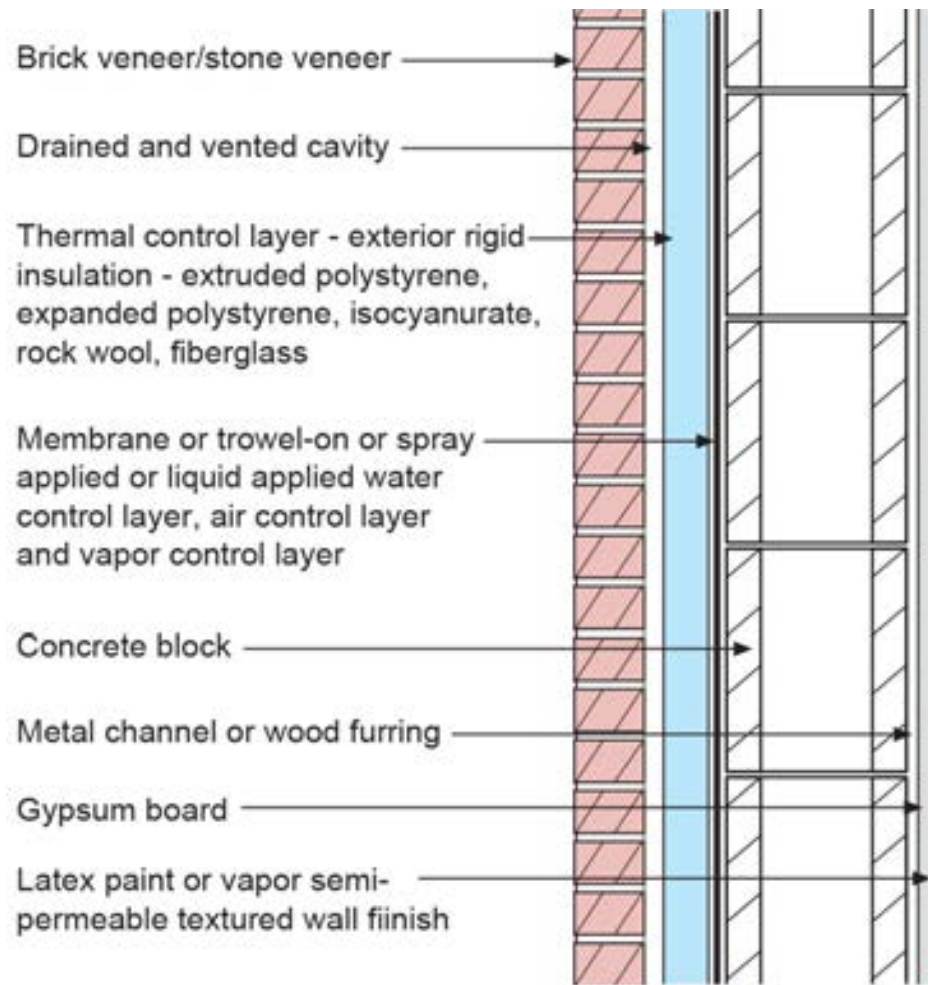


Figure 1a



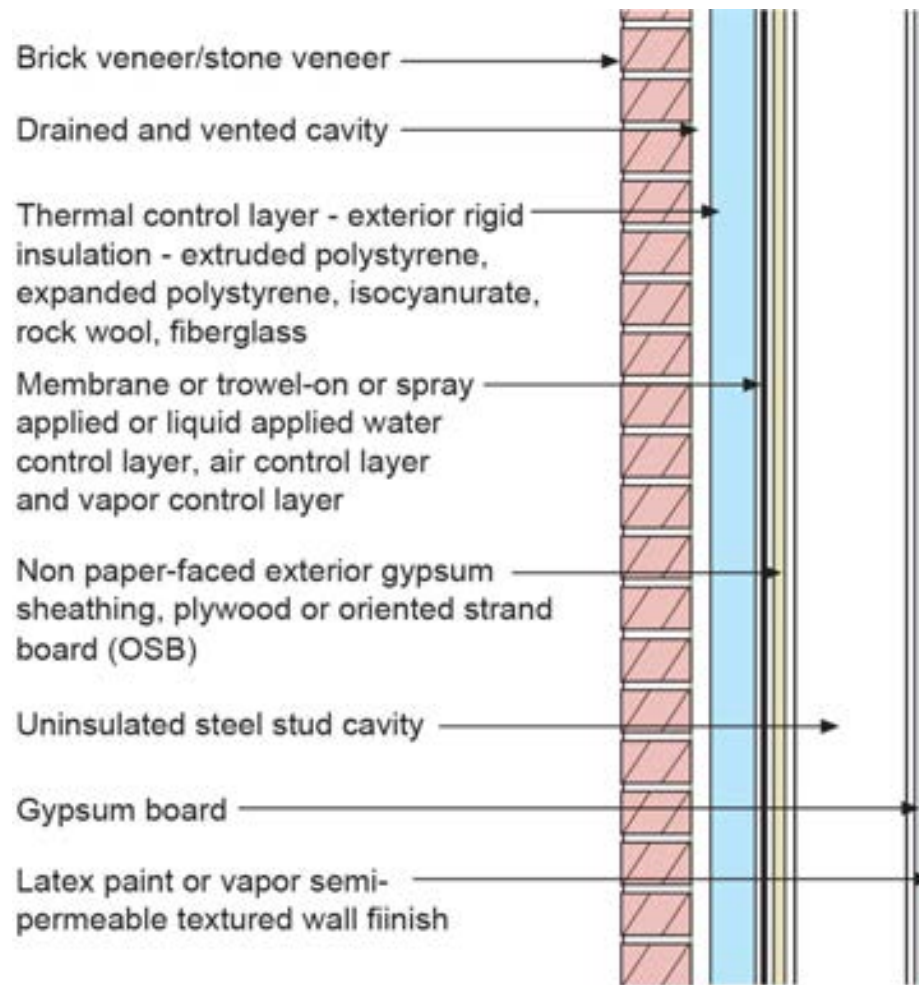


Figure 1b



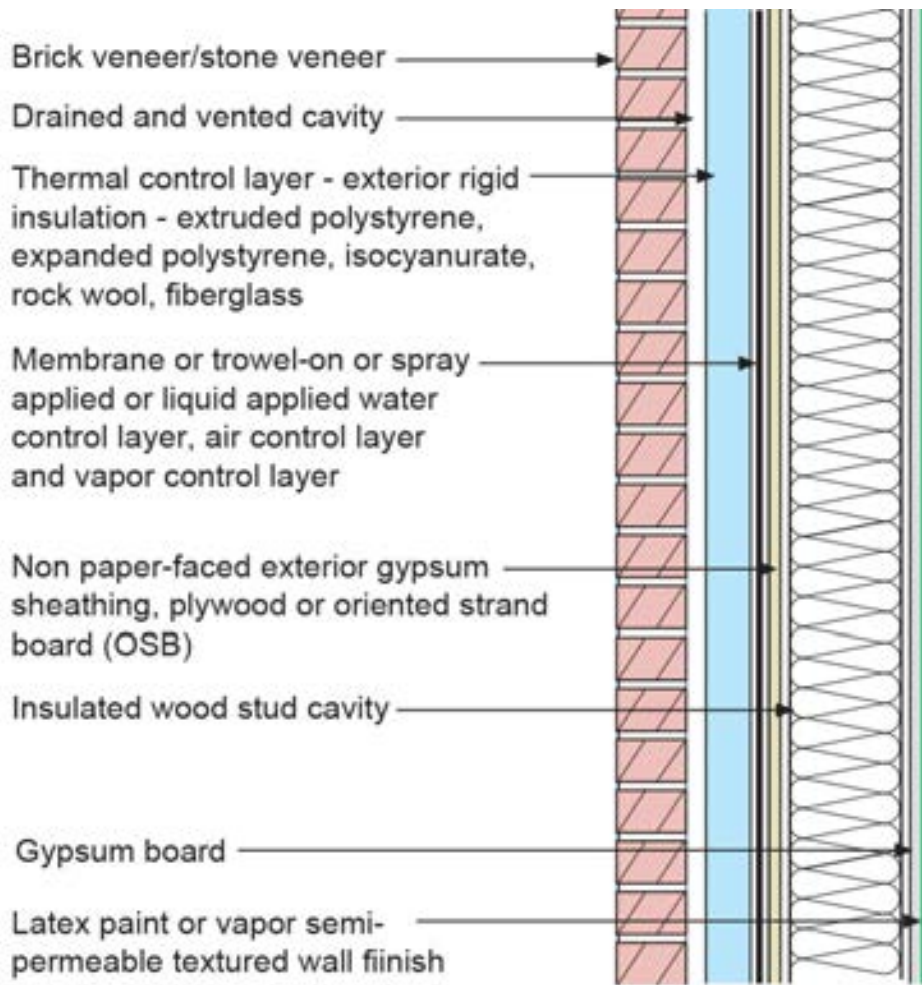


Figure 1c



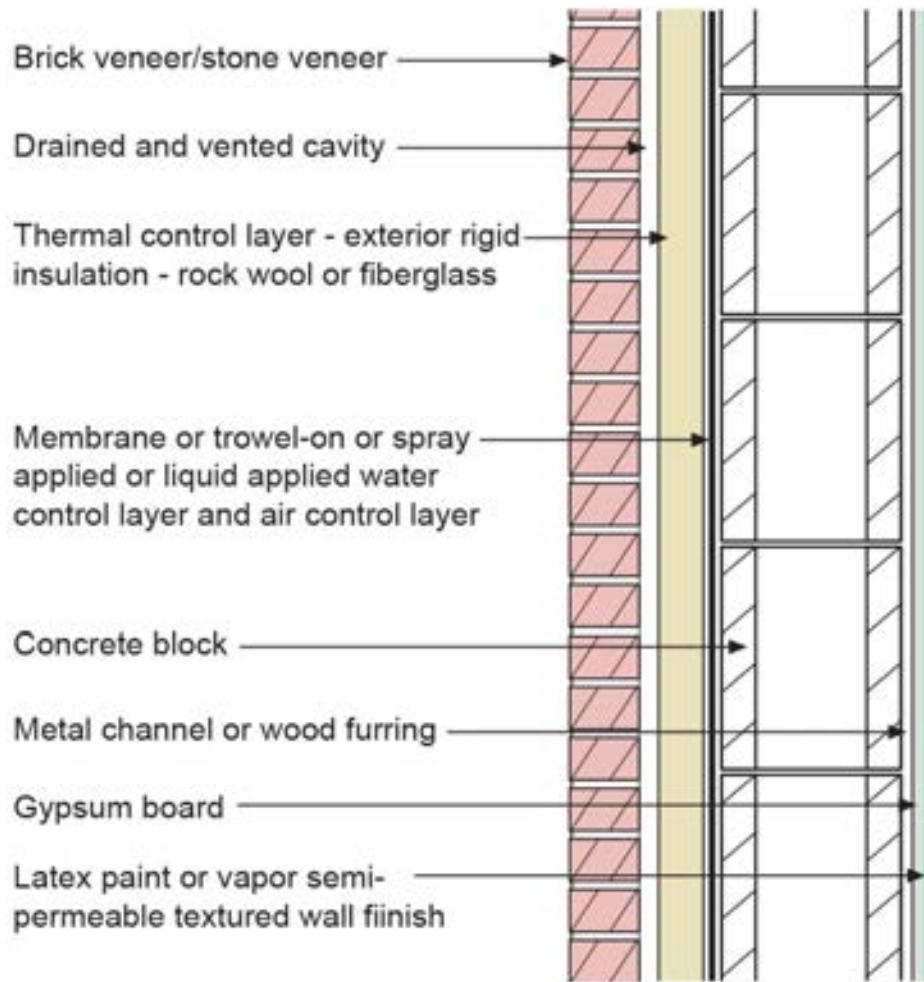


Figure 2a



Vapor Profile

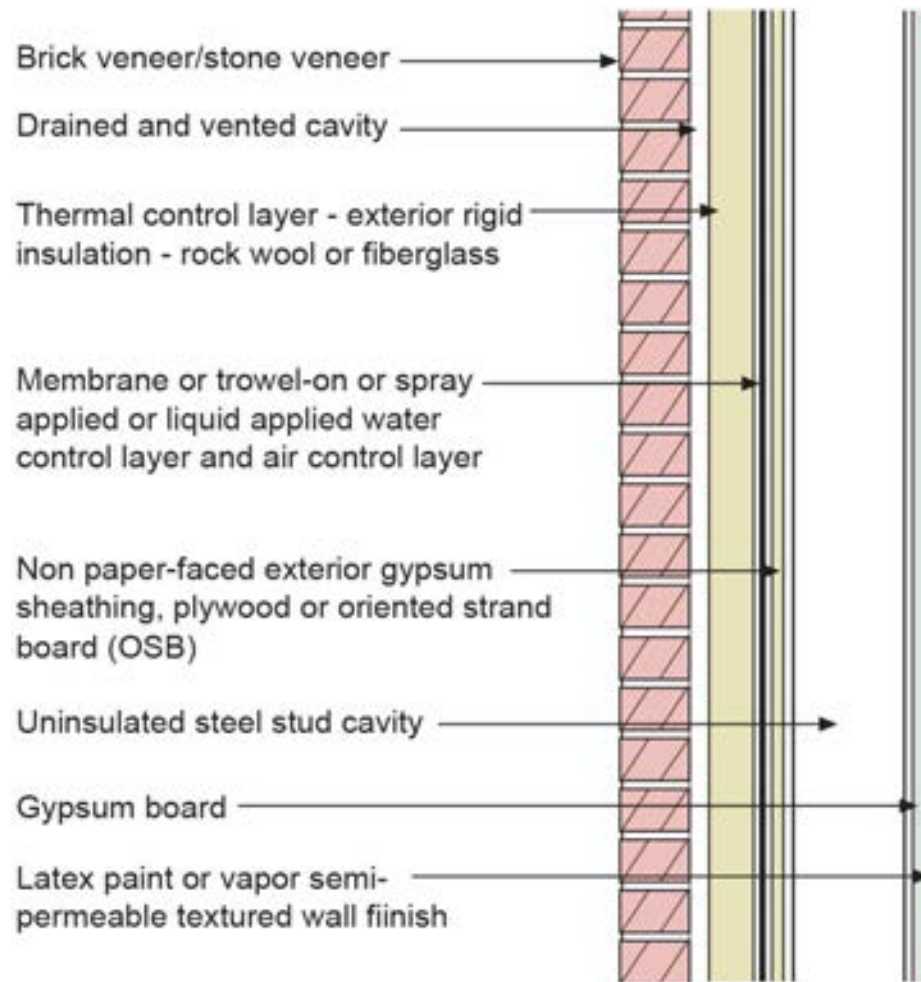


Figure 2b



Vapor Profile

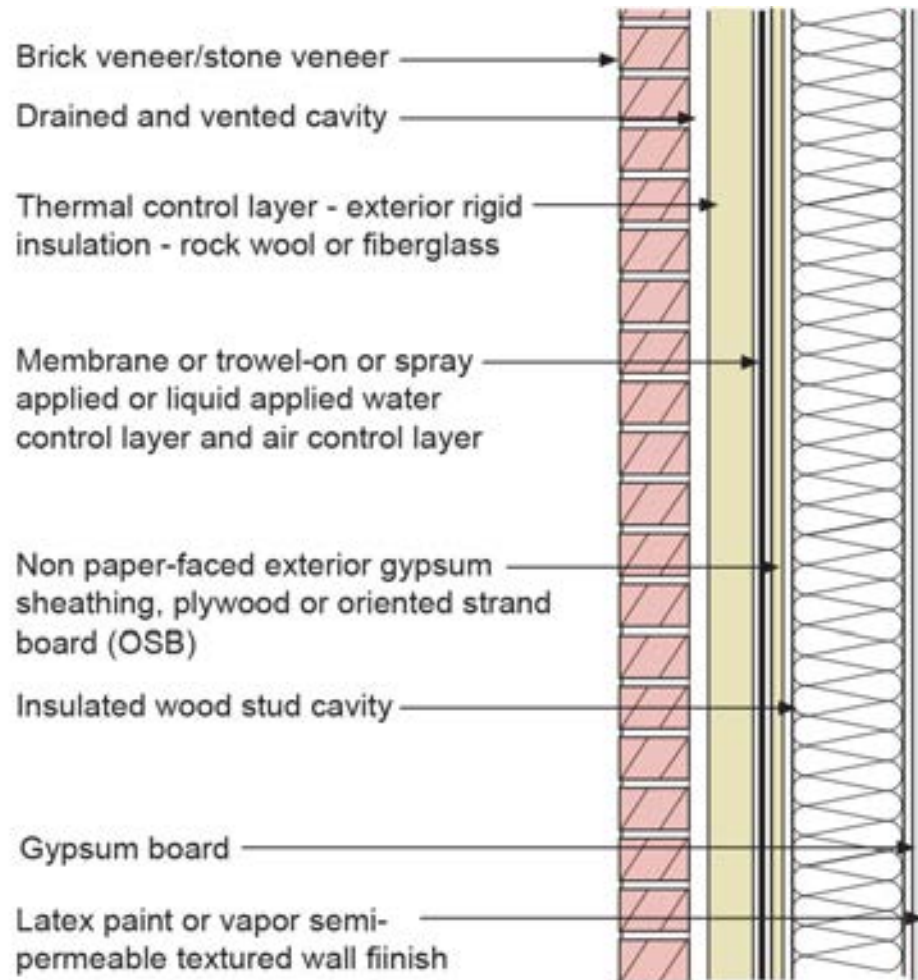
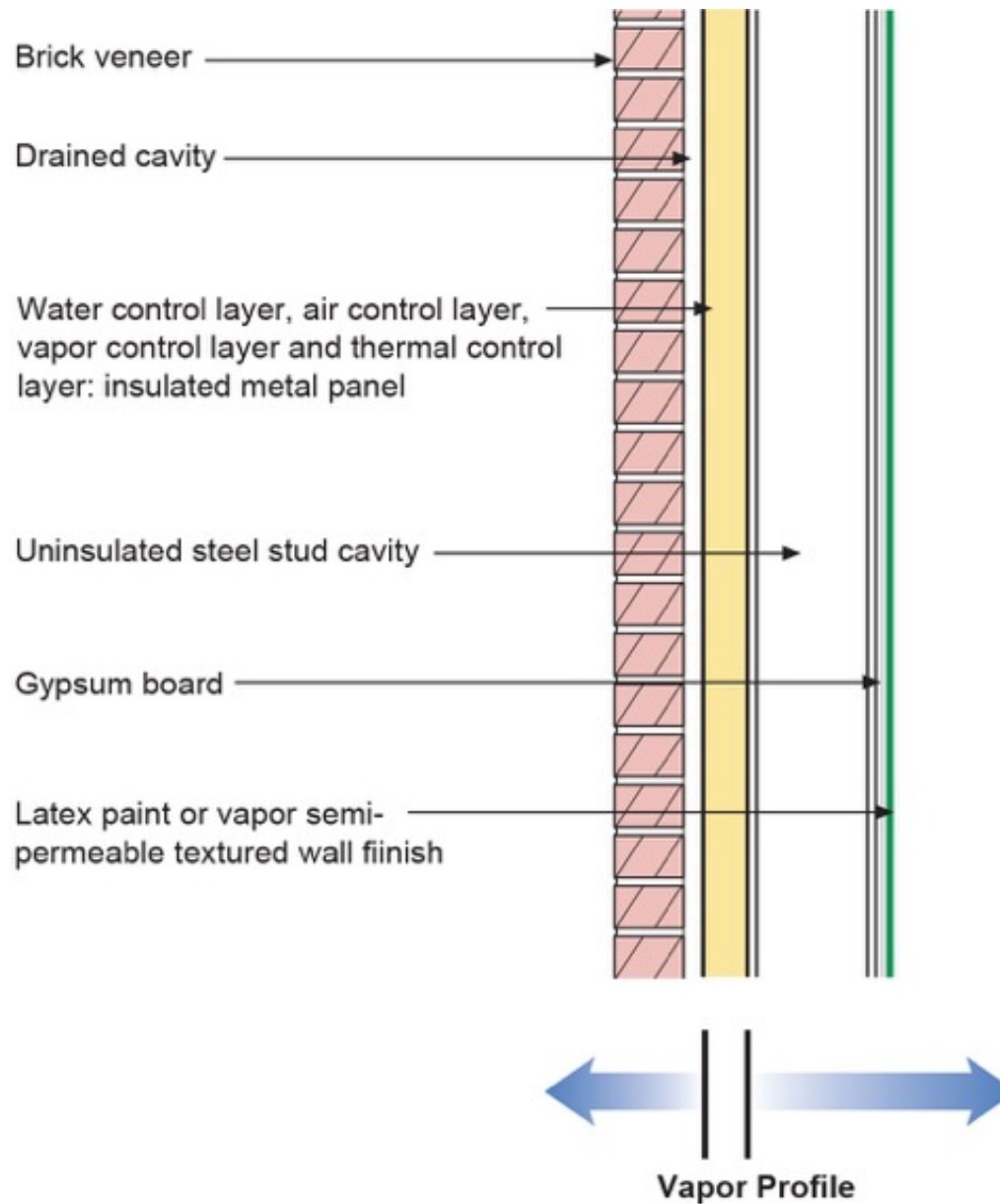
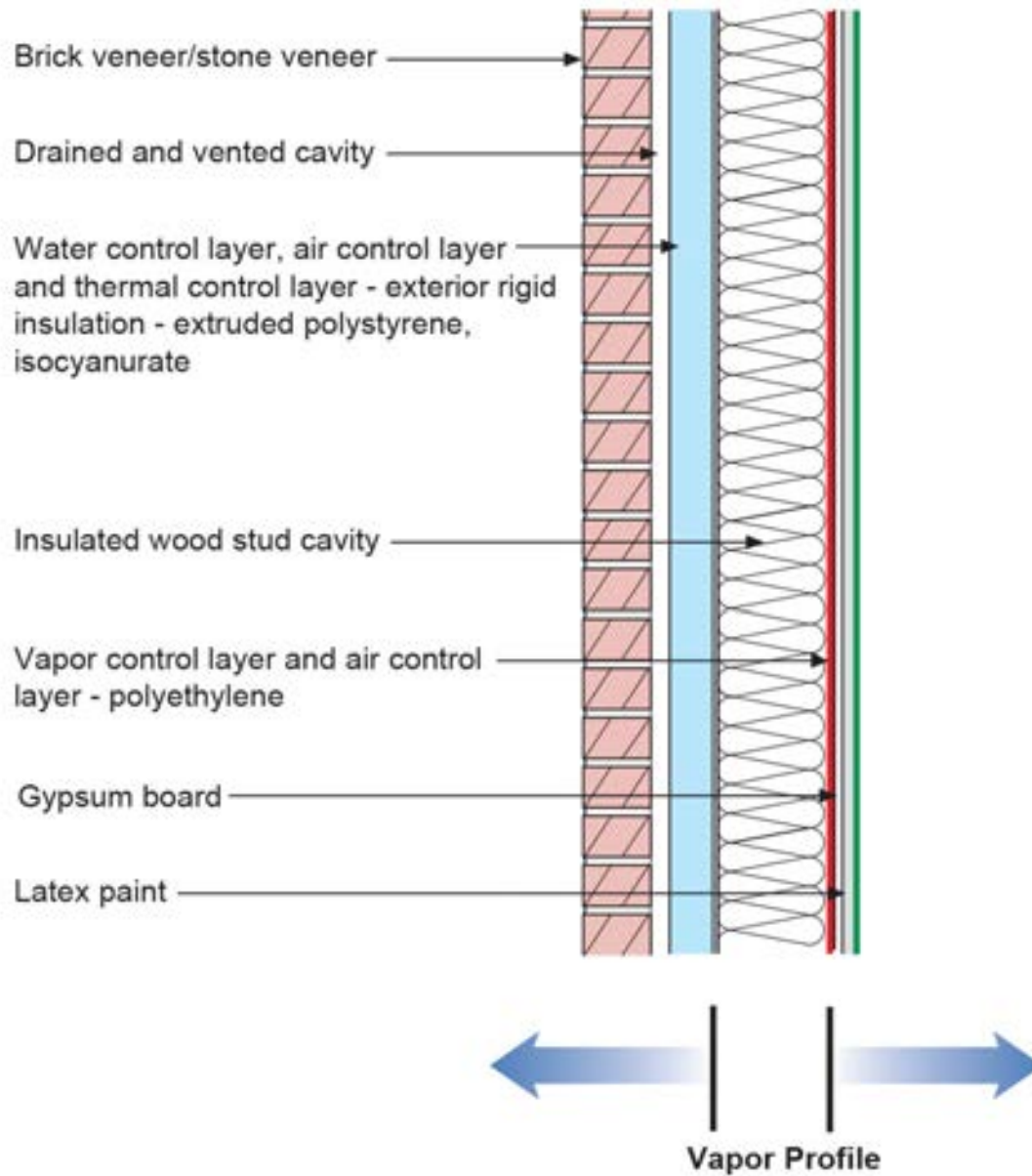


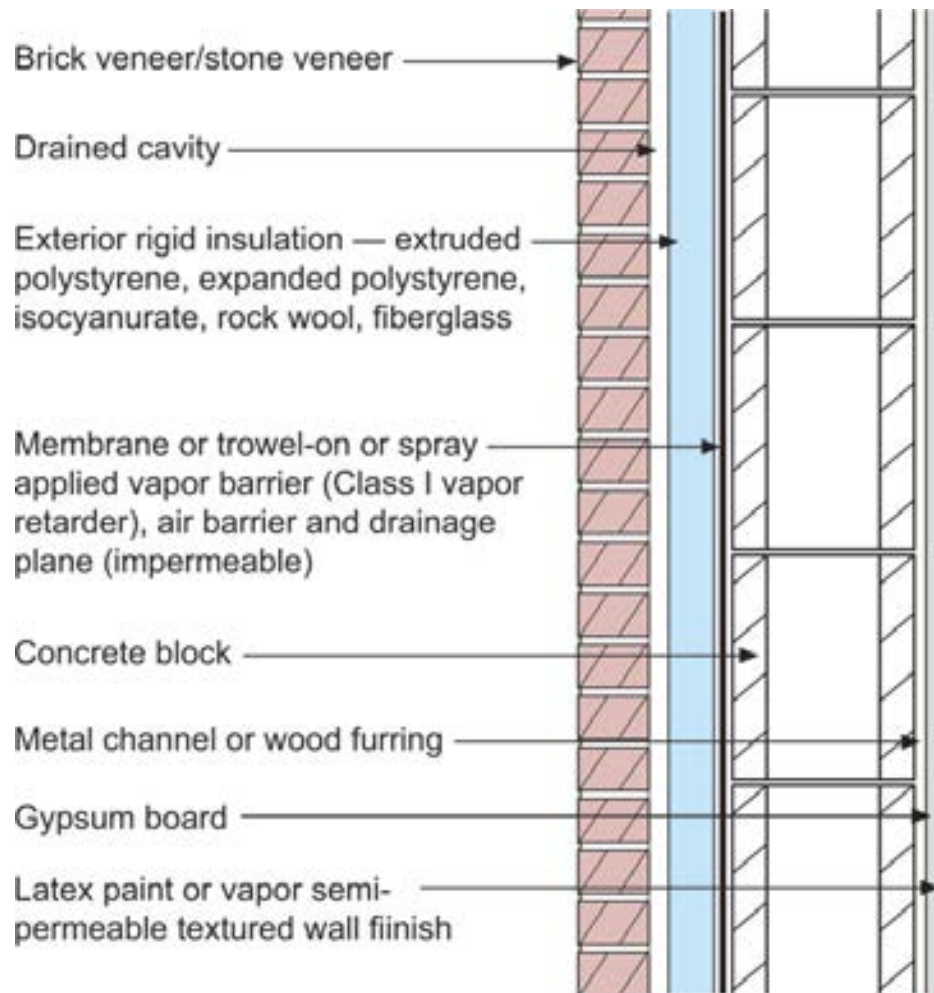
Figure 2c

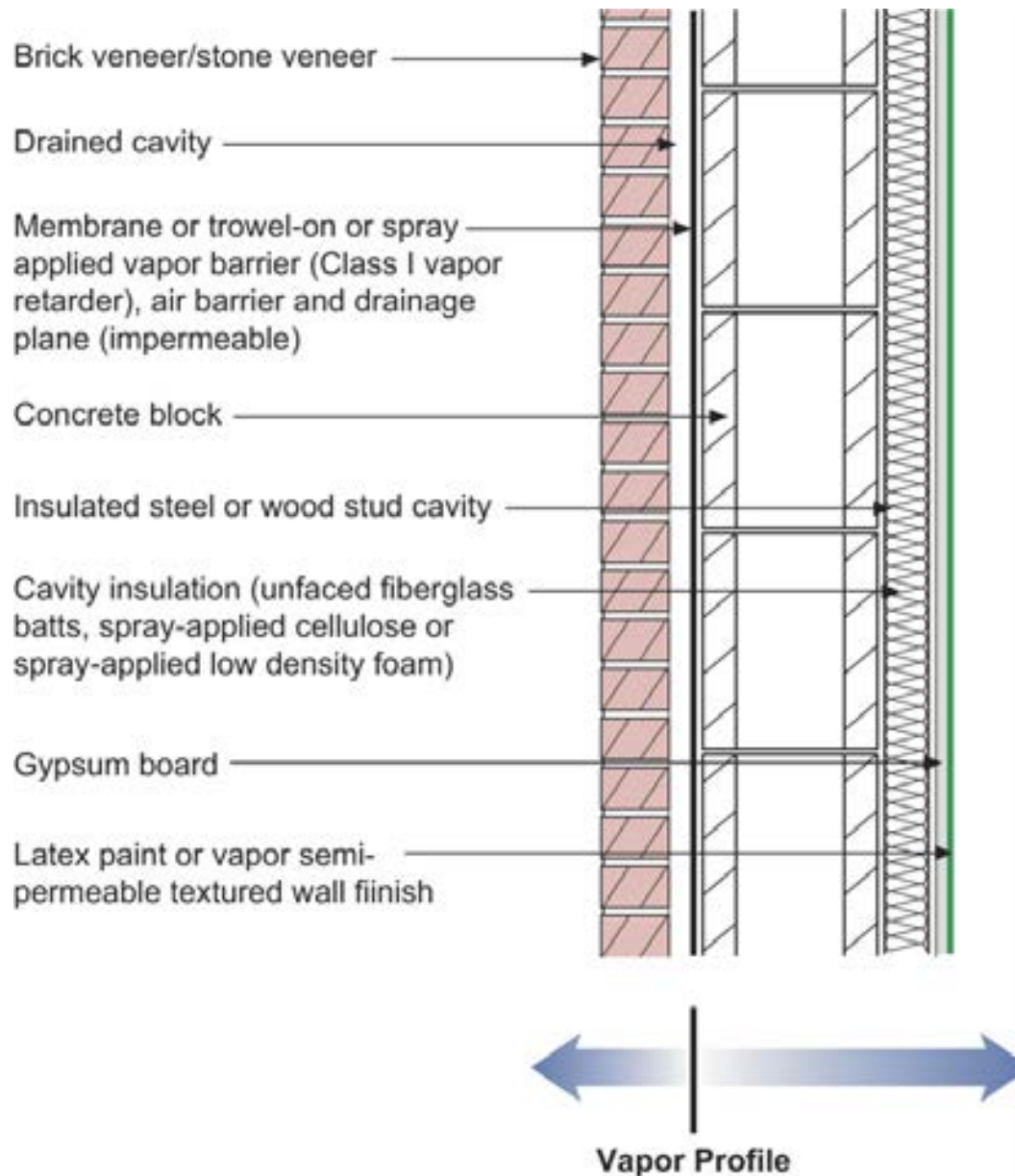


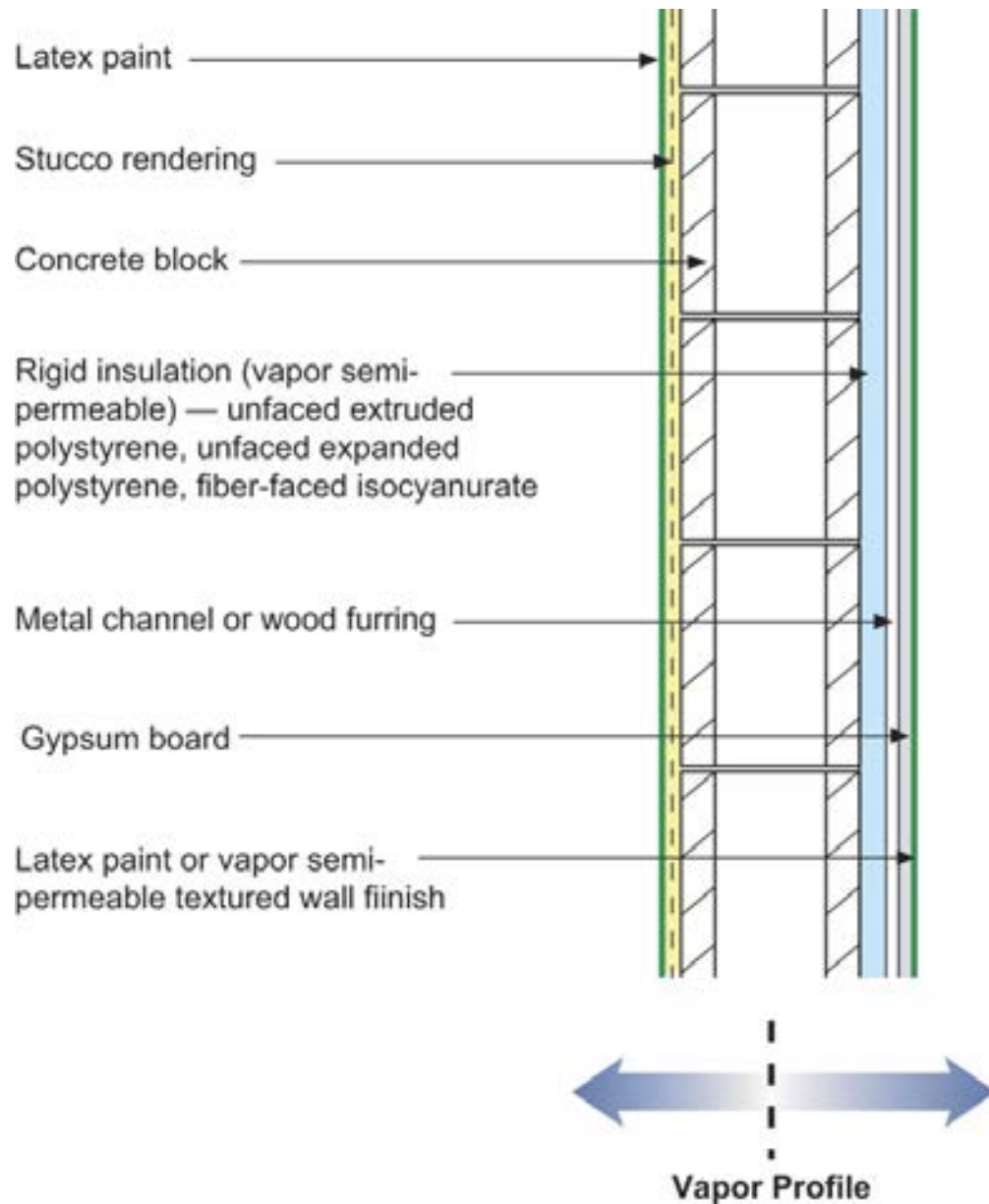
Vapor Profile

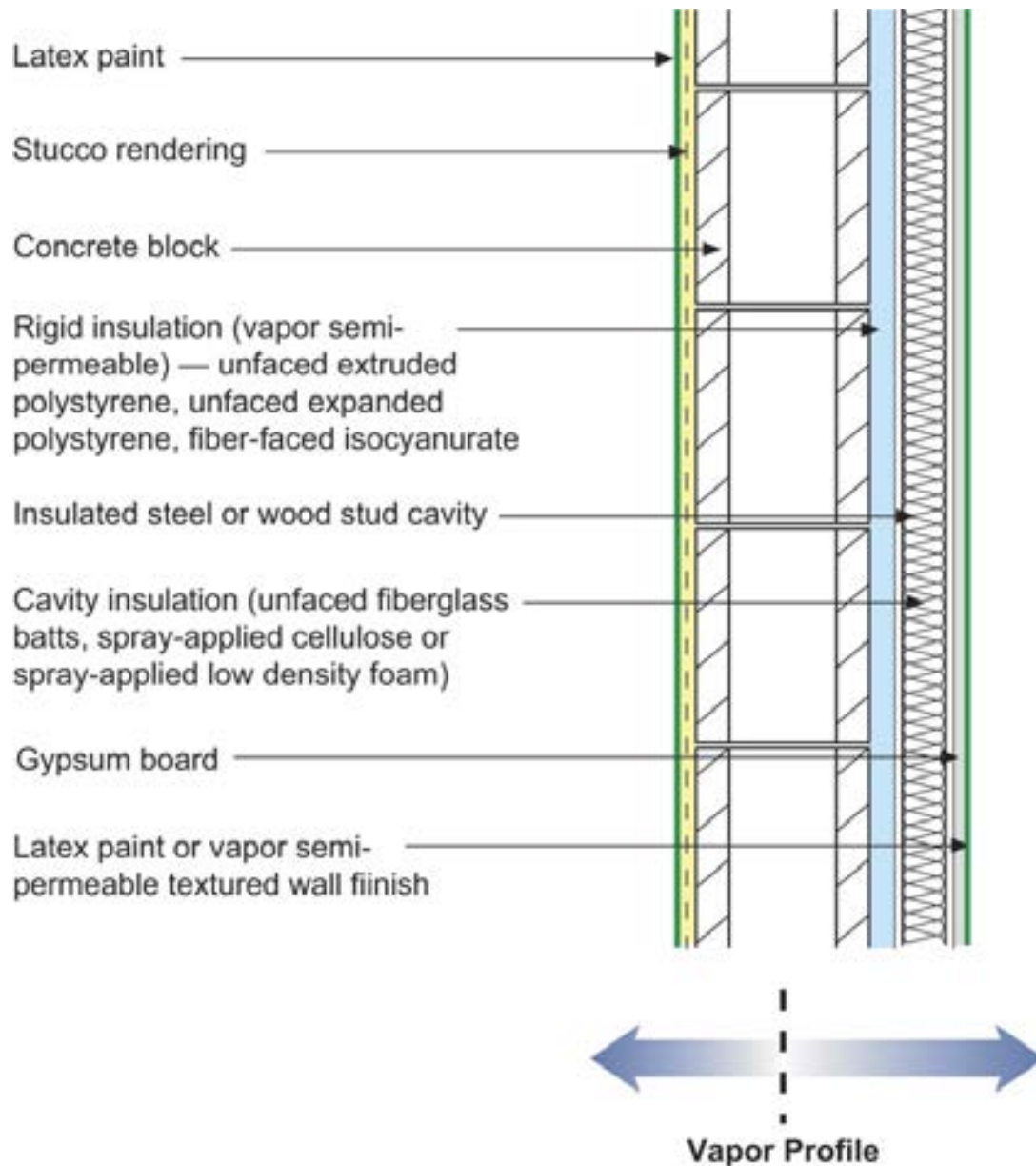


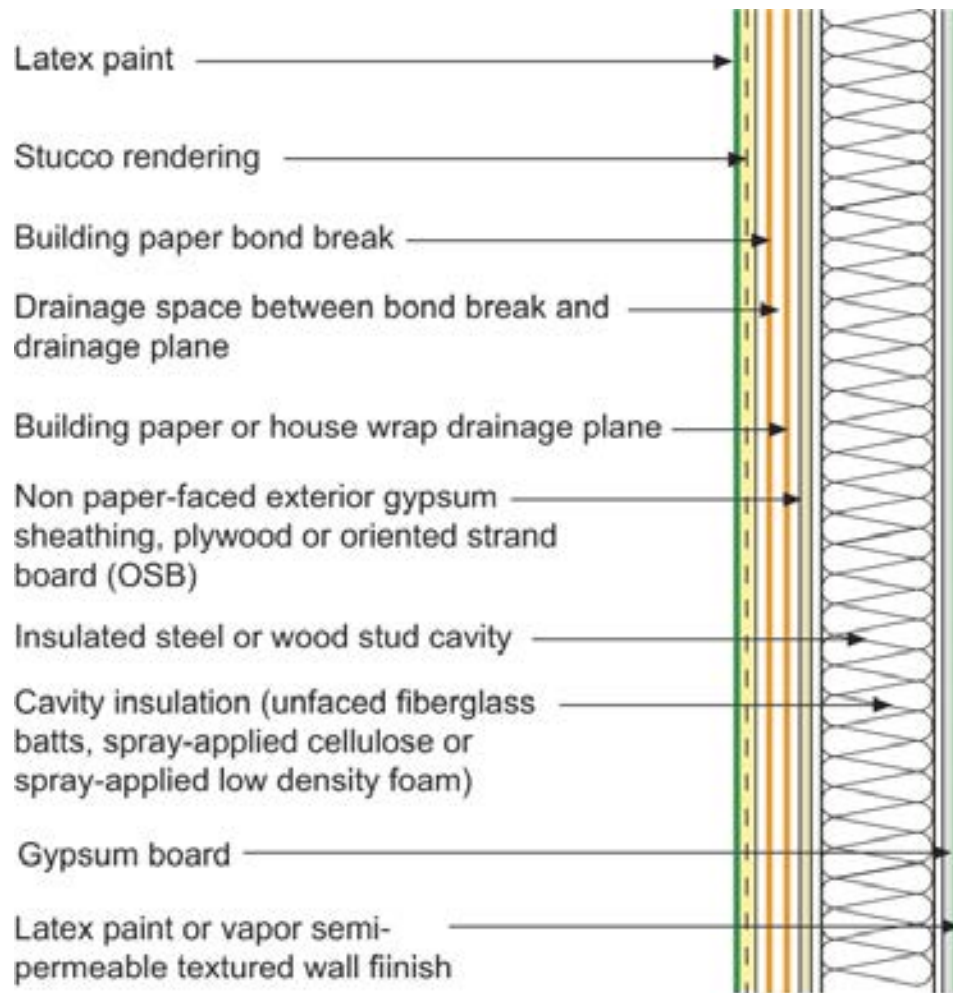




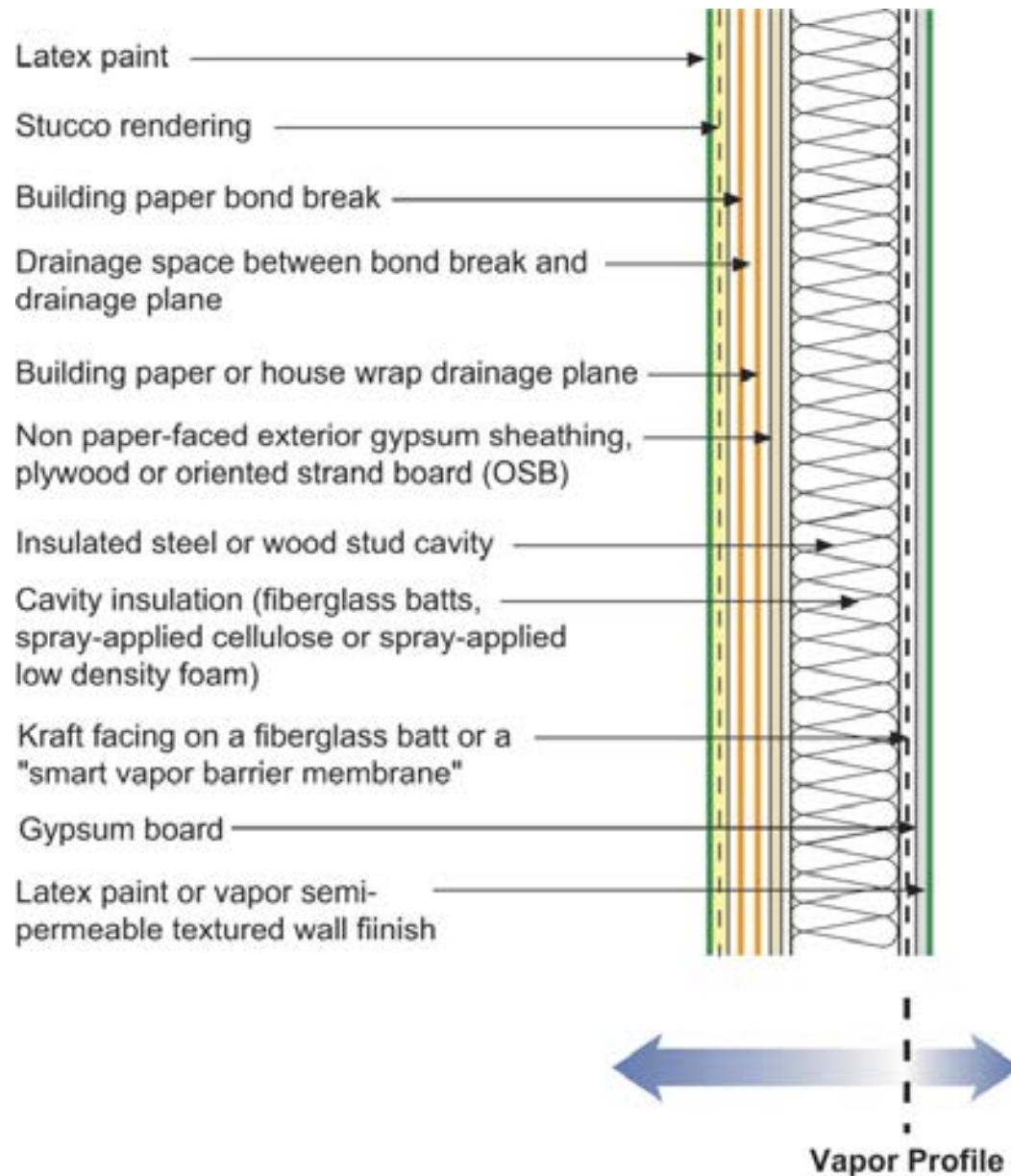


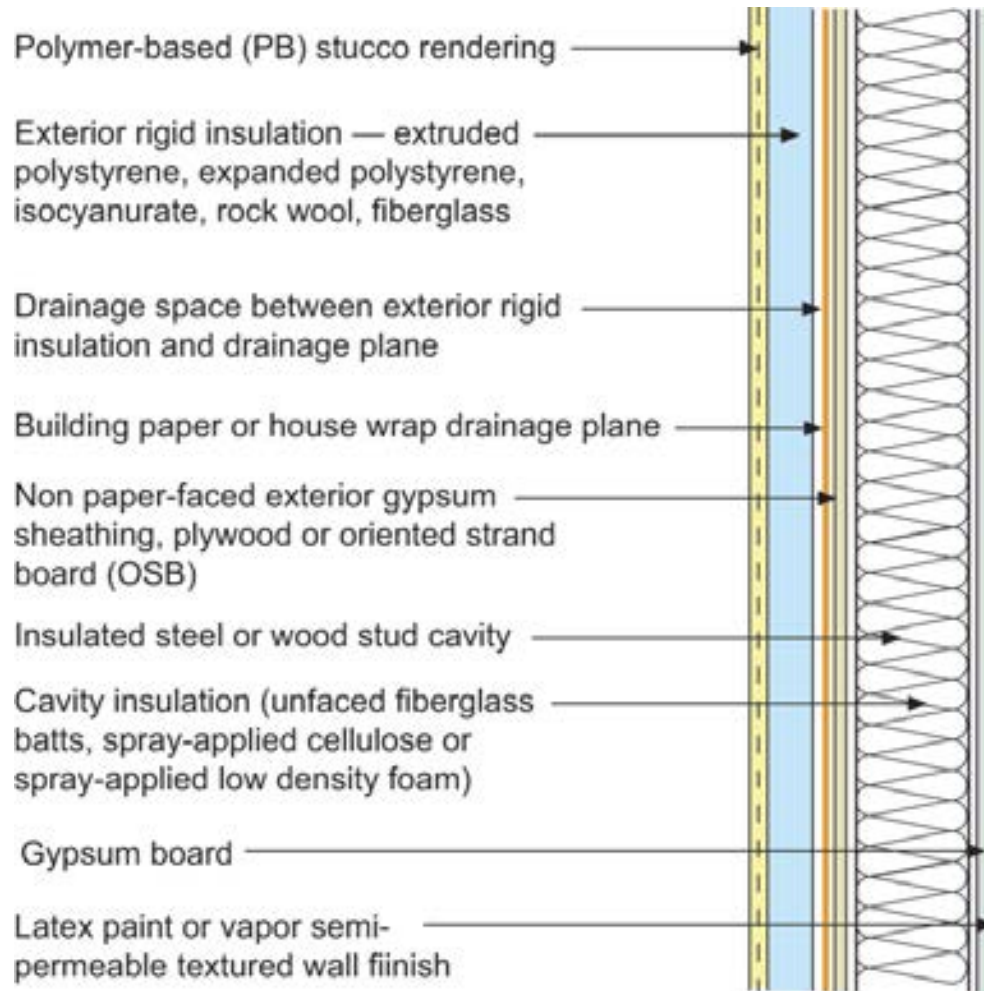




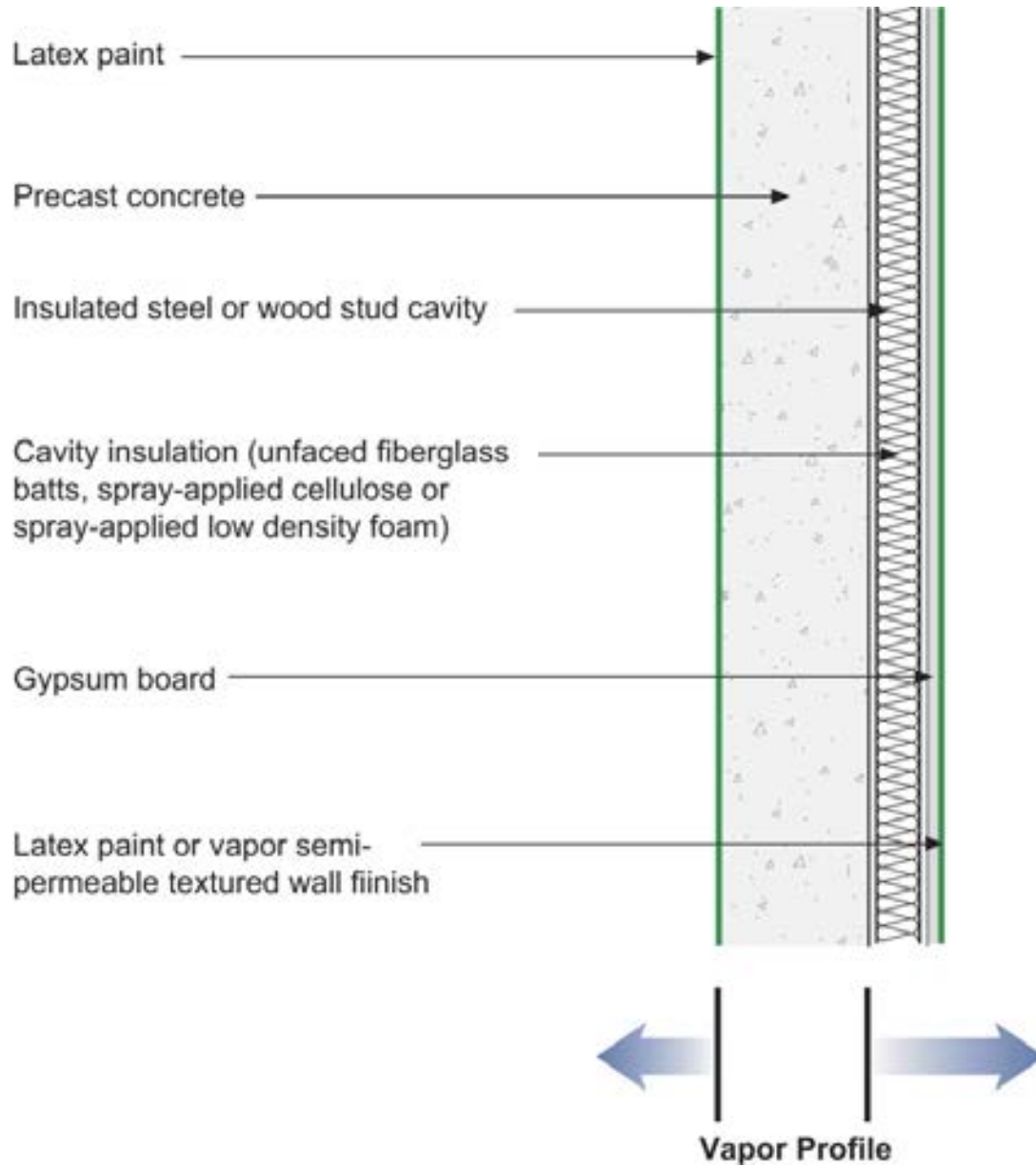


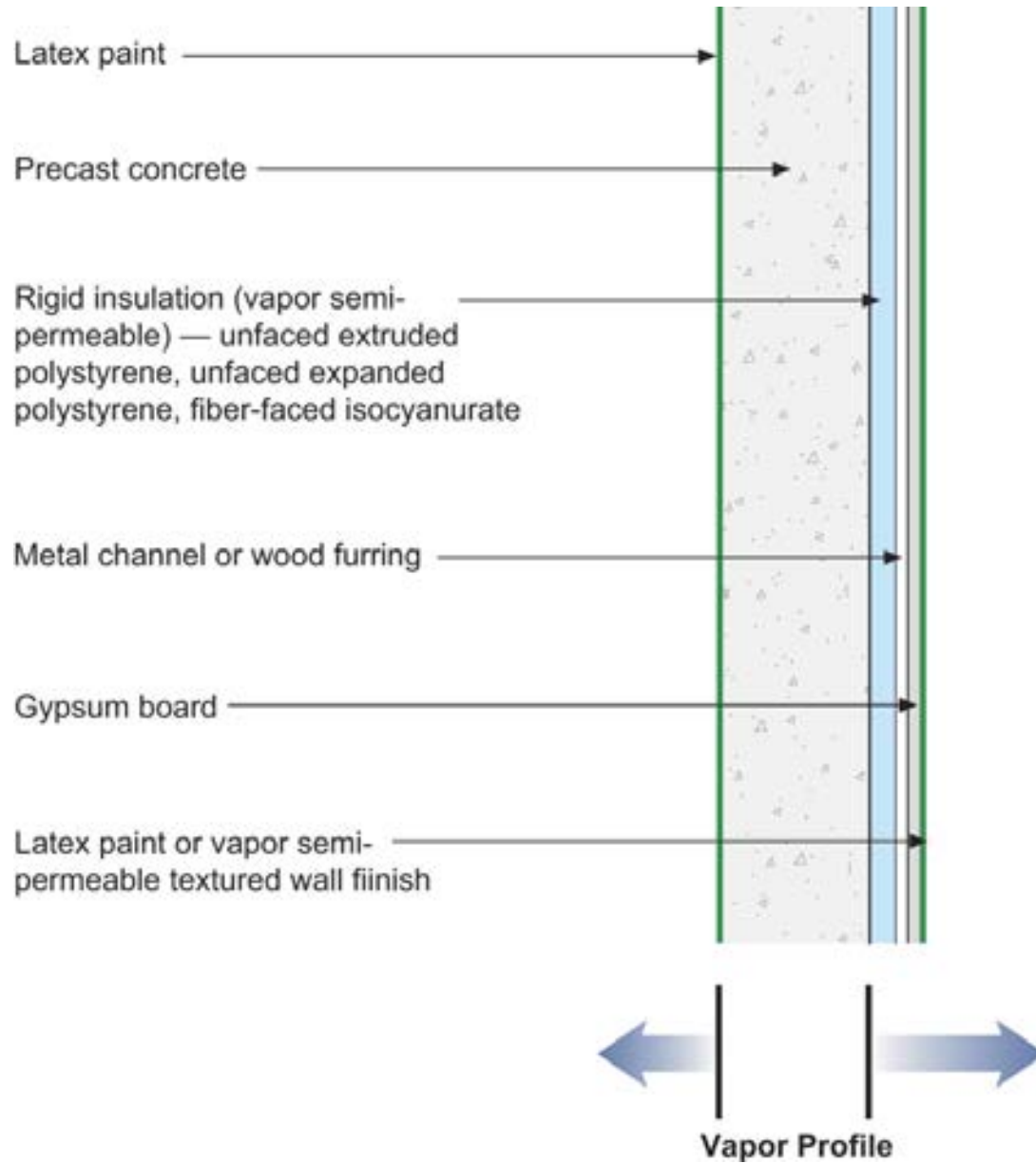
Vapor Profile

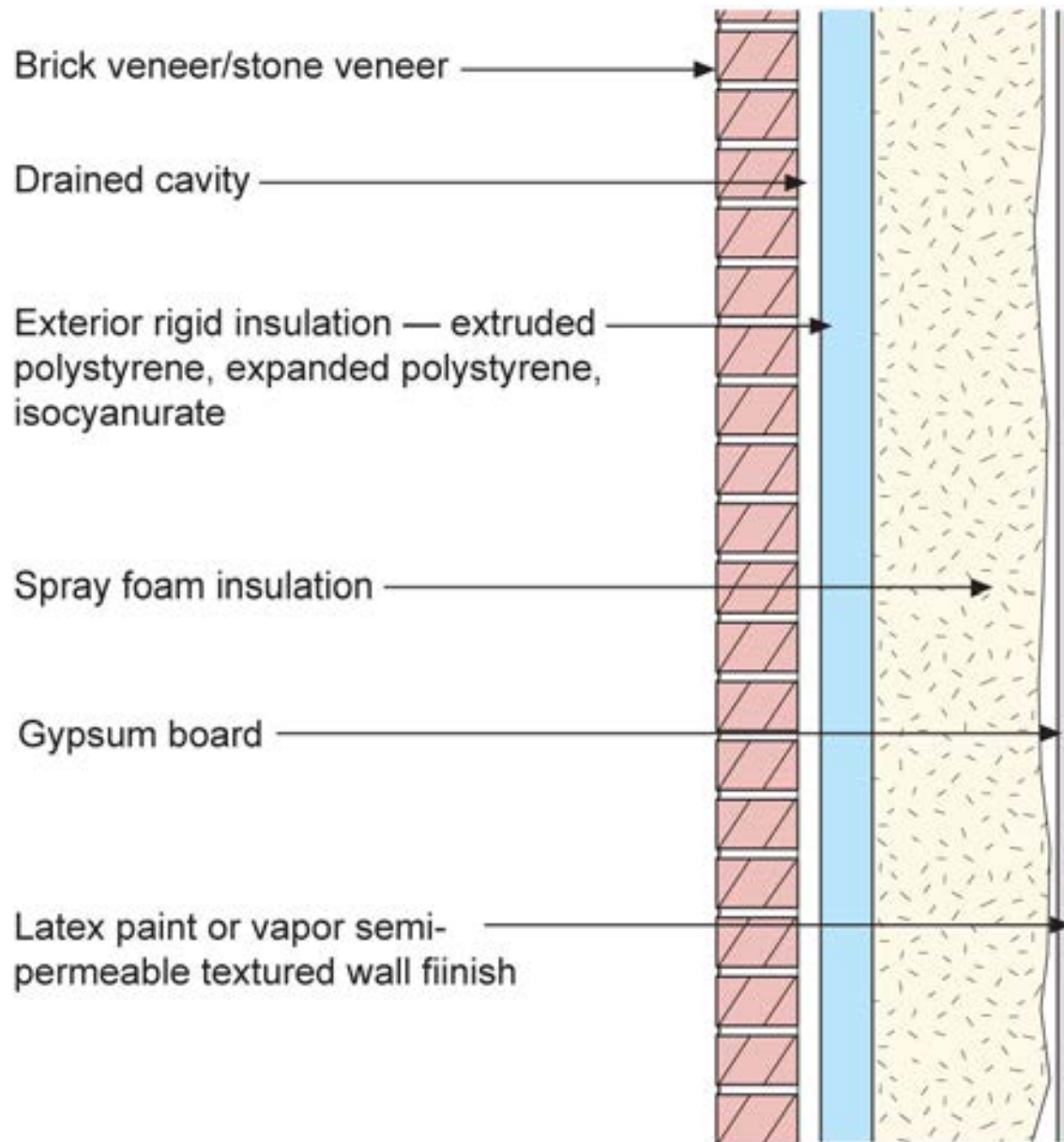


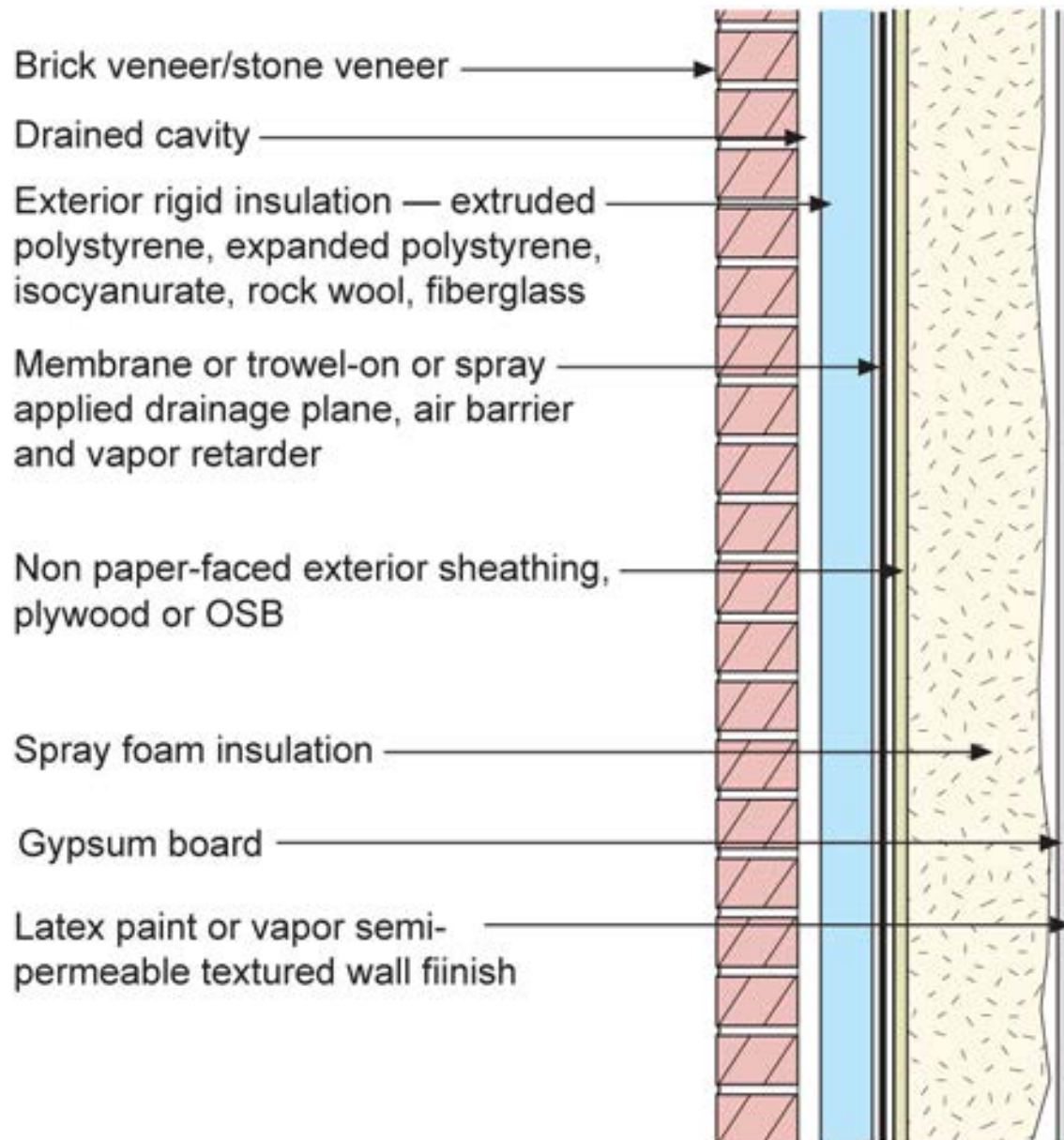


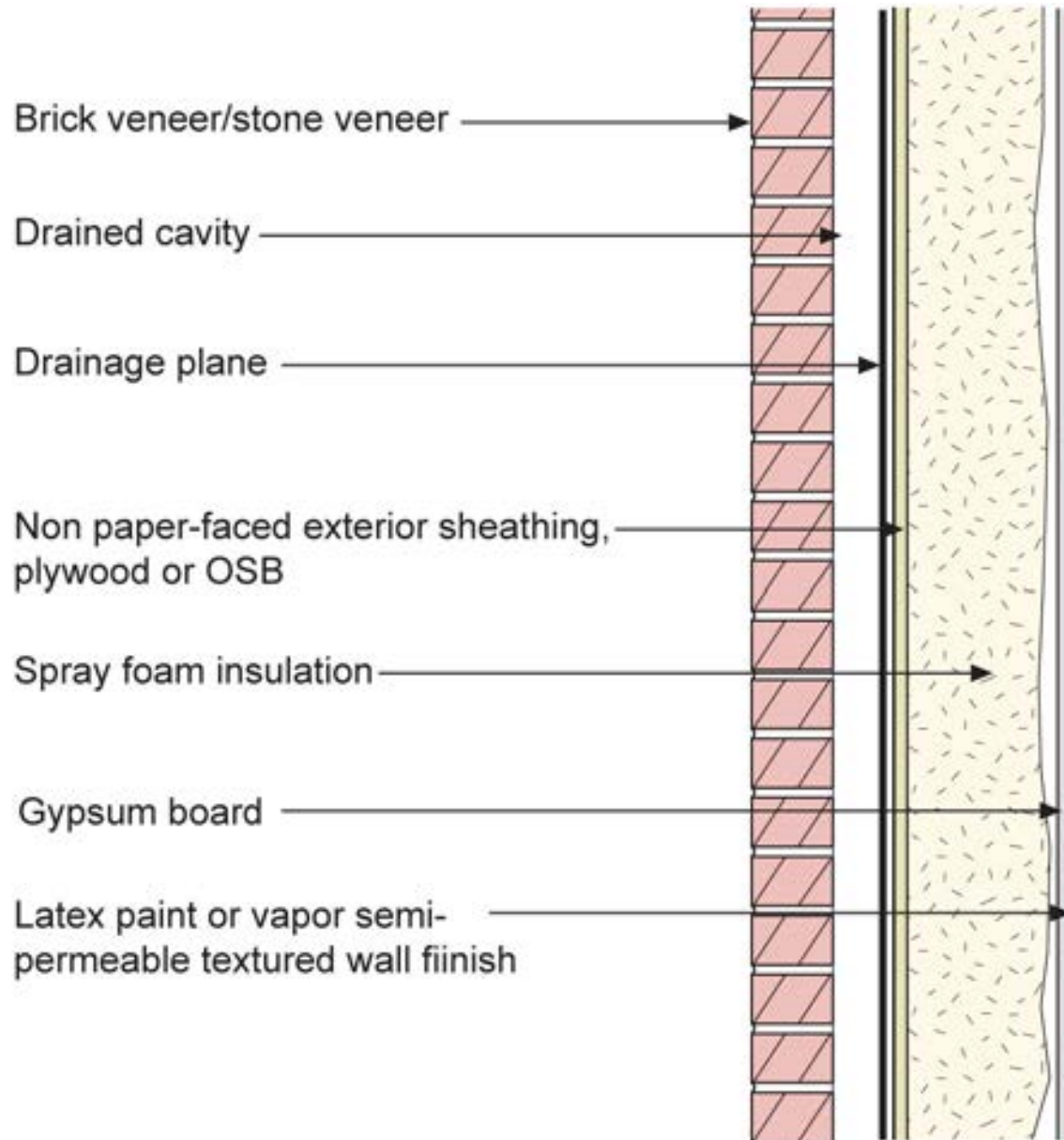
Vapor Profile

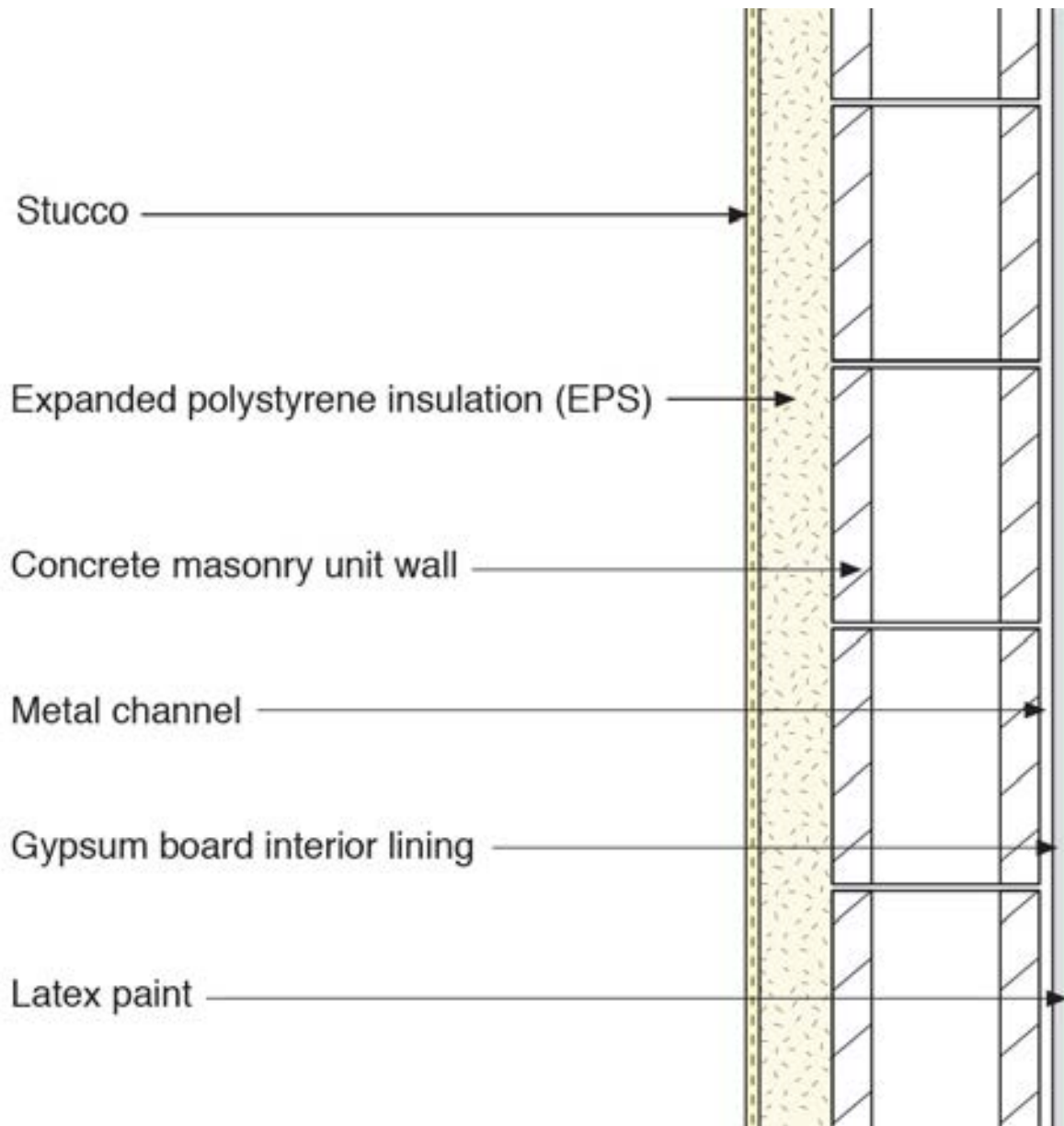


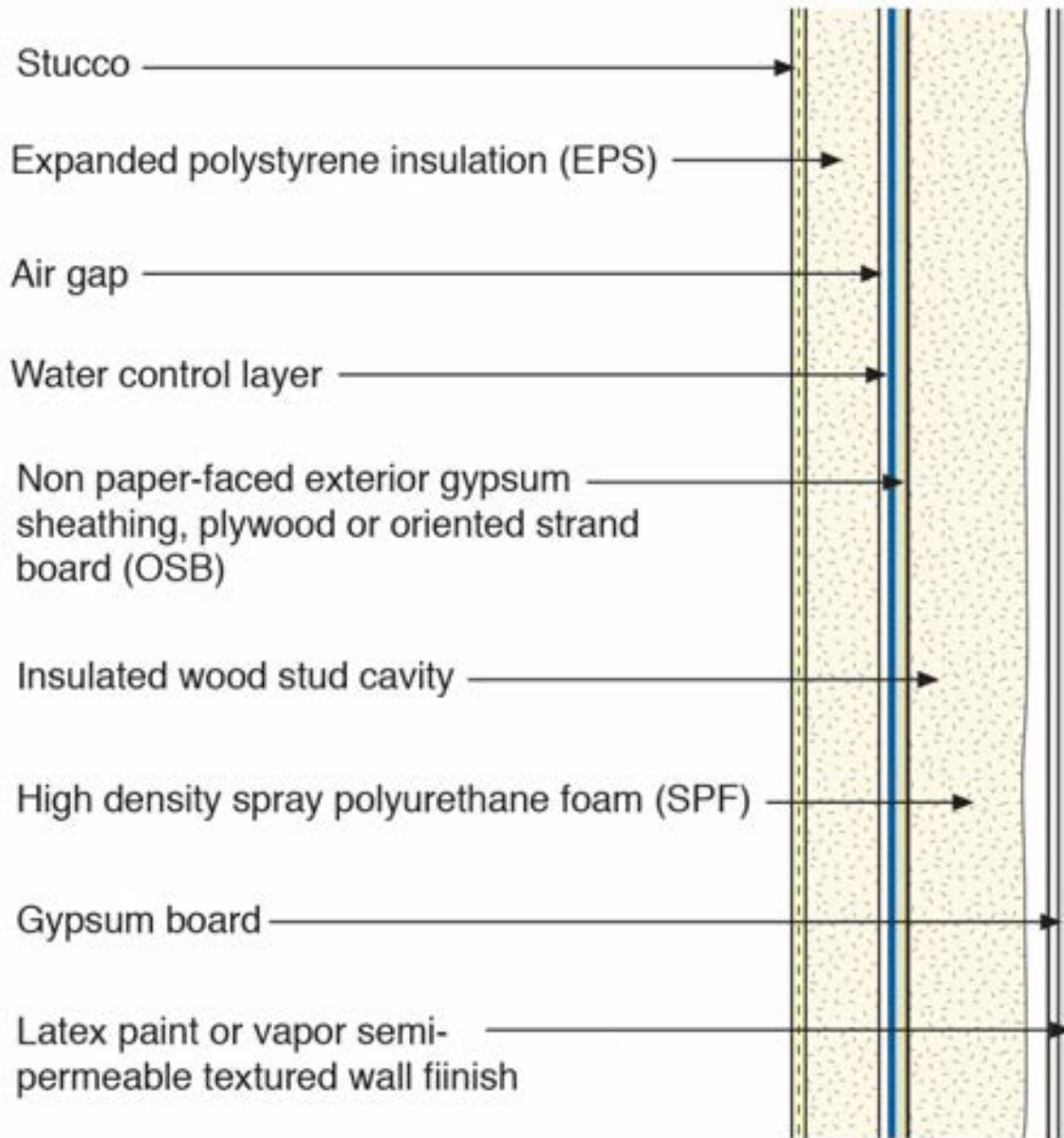


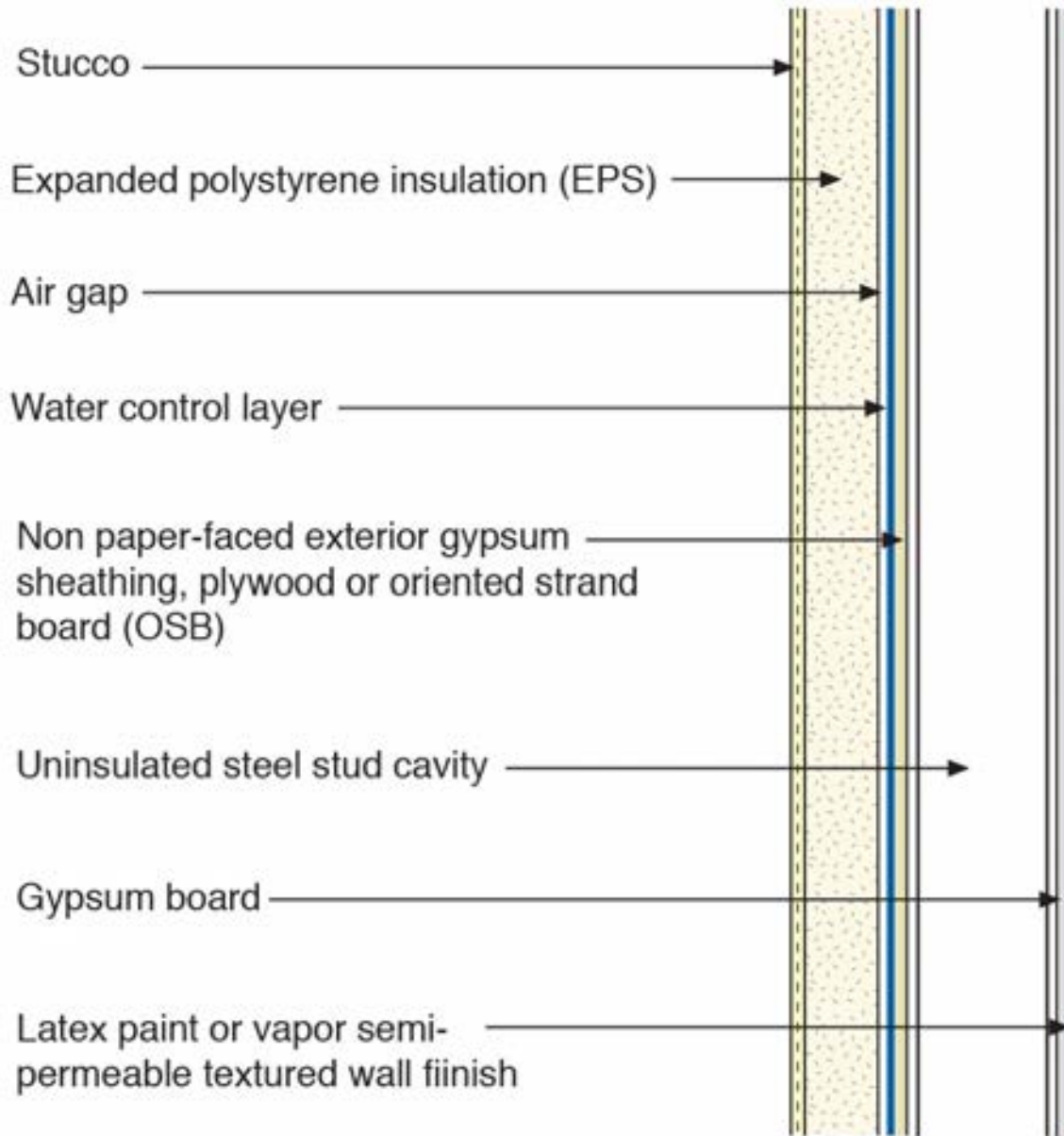


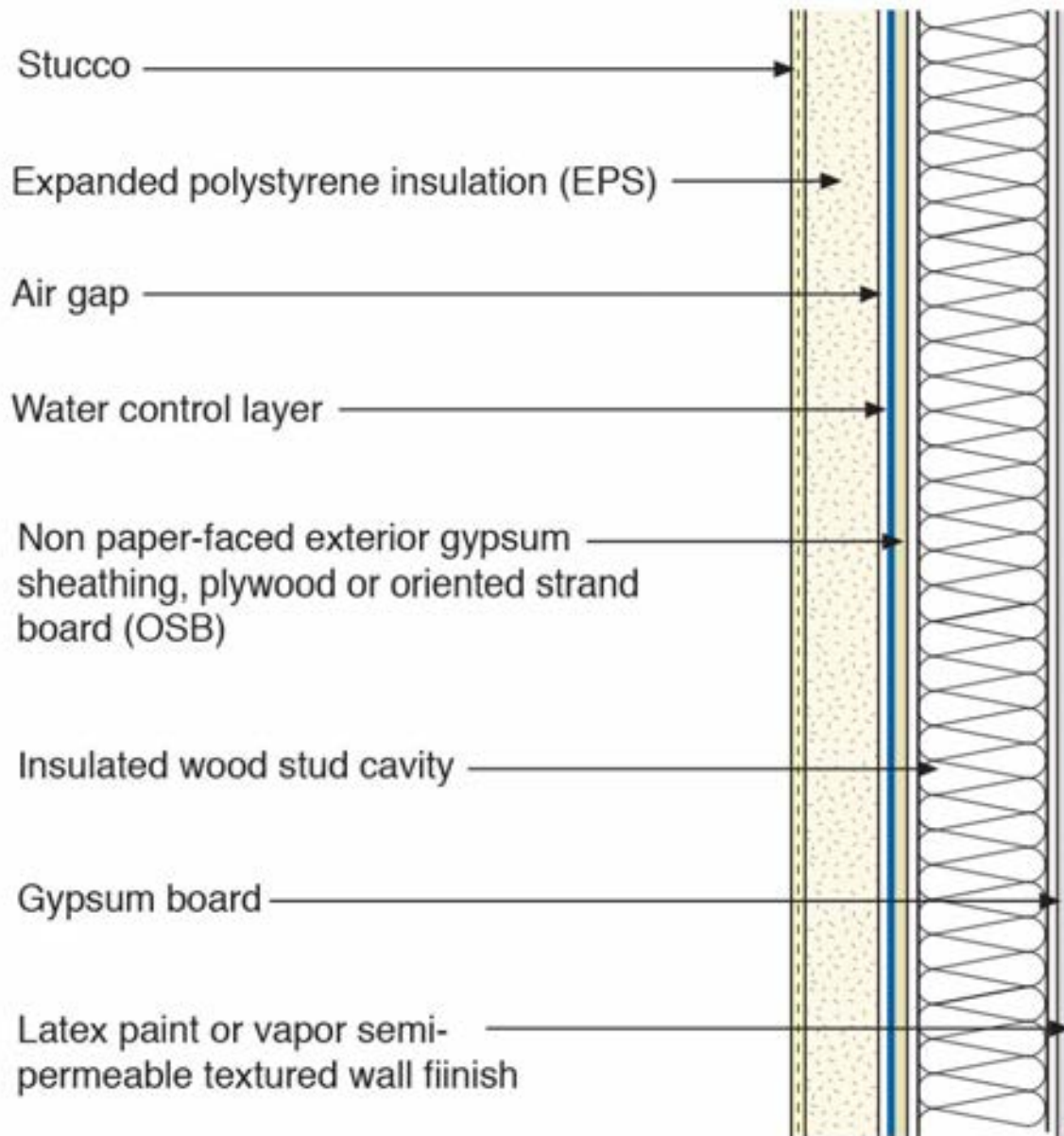


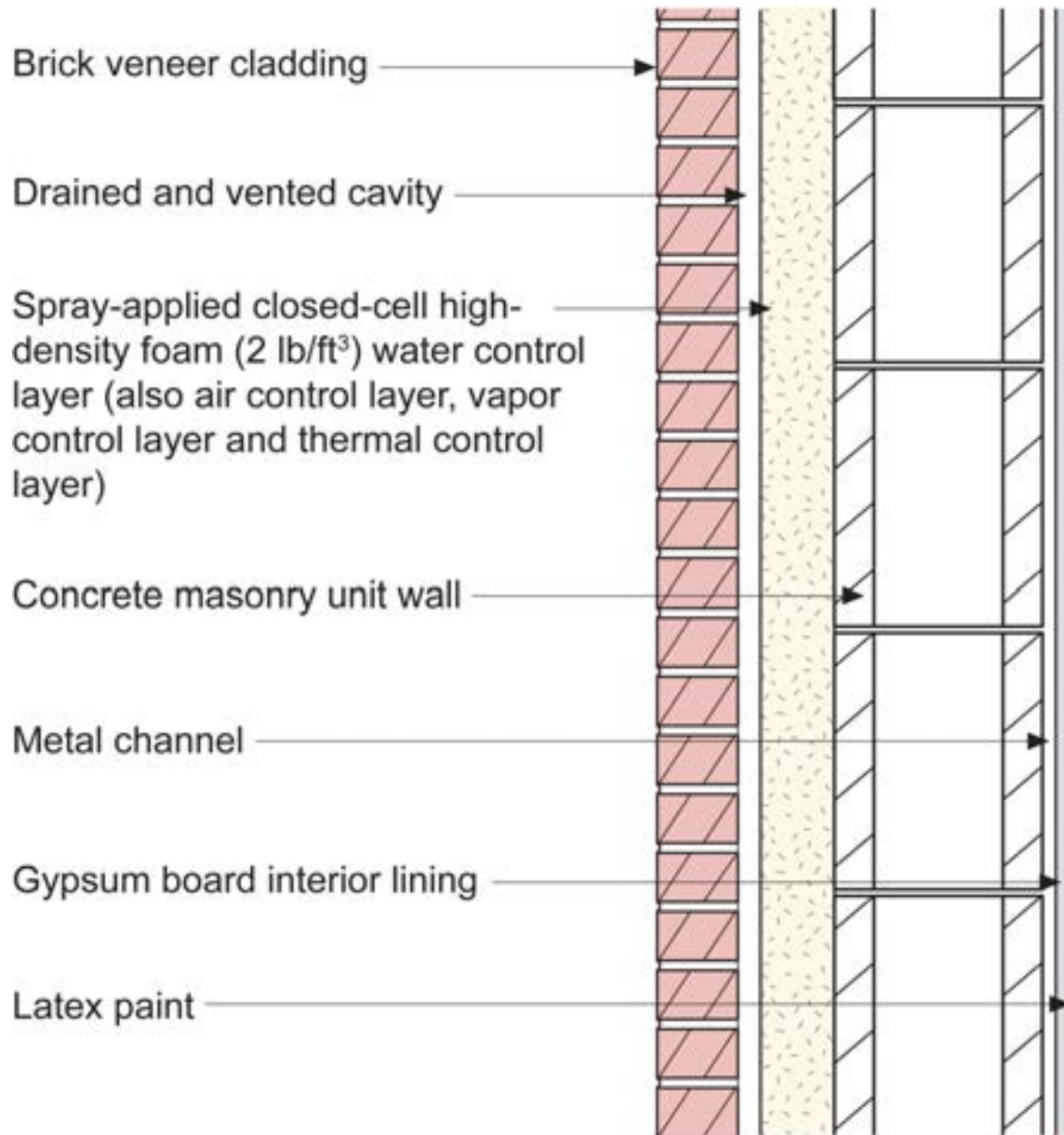


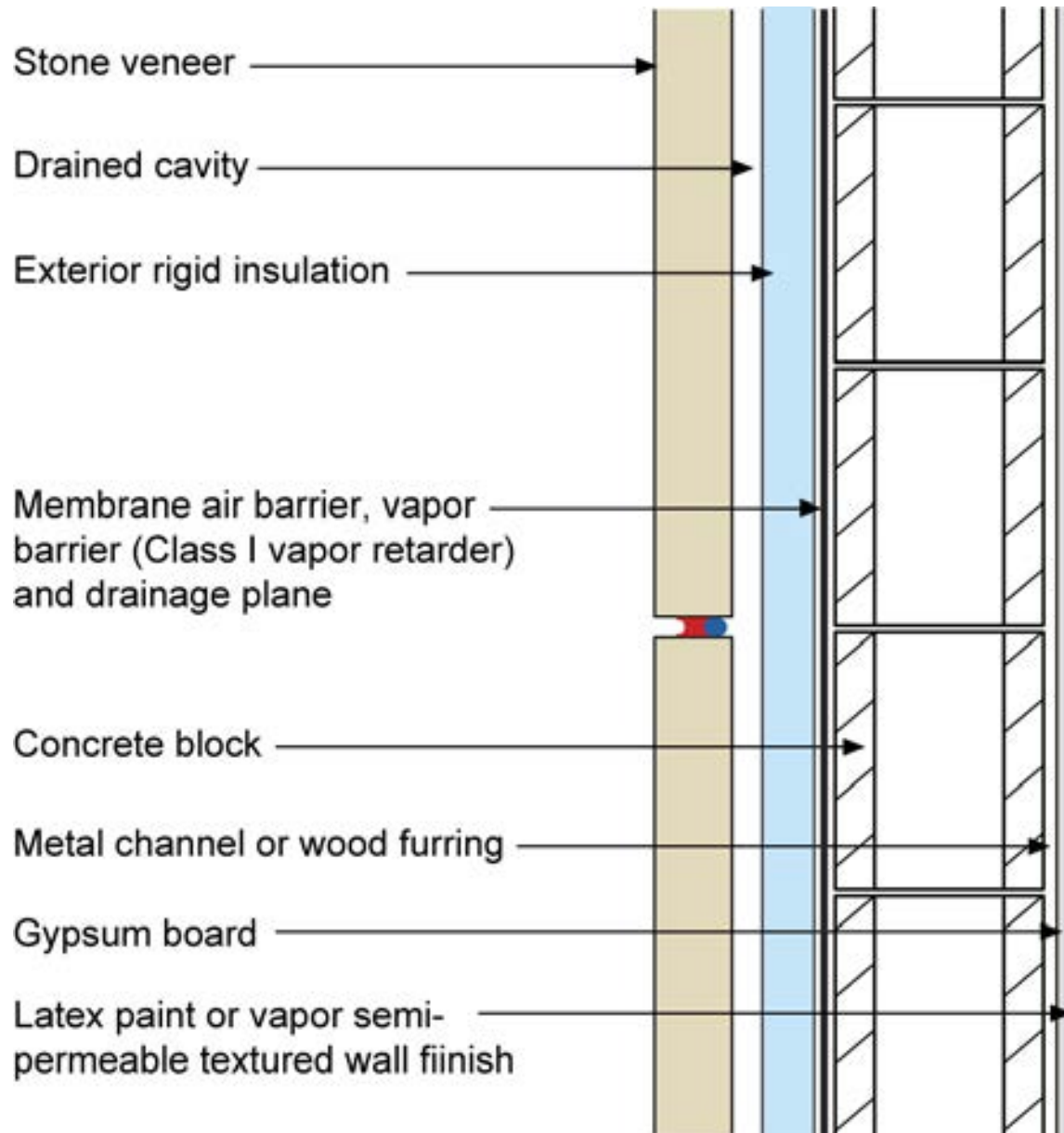


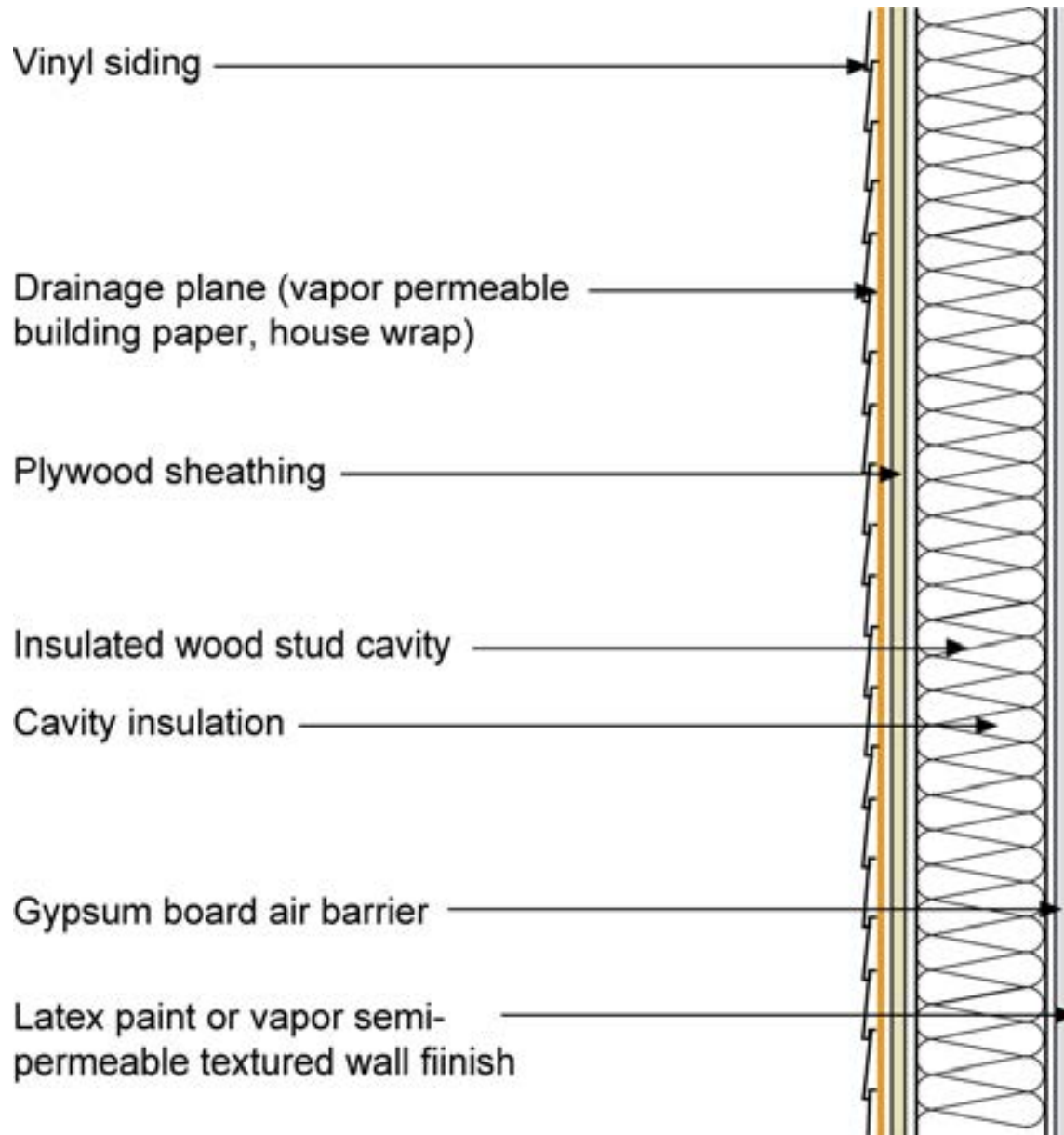


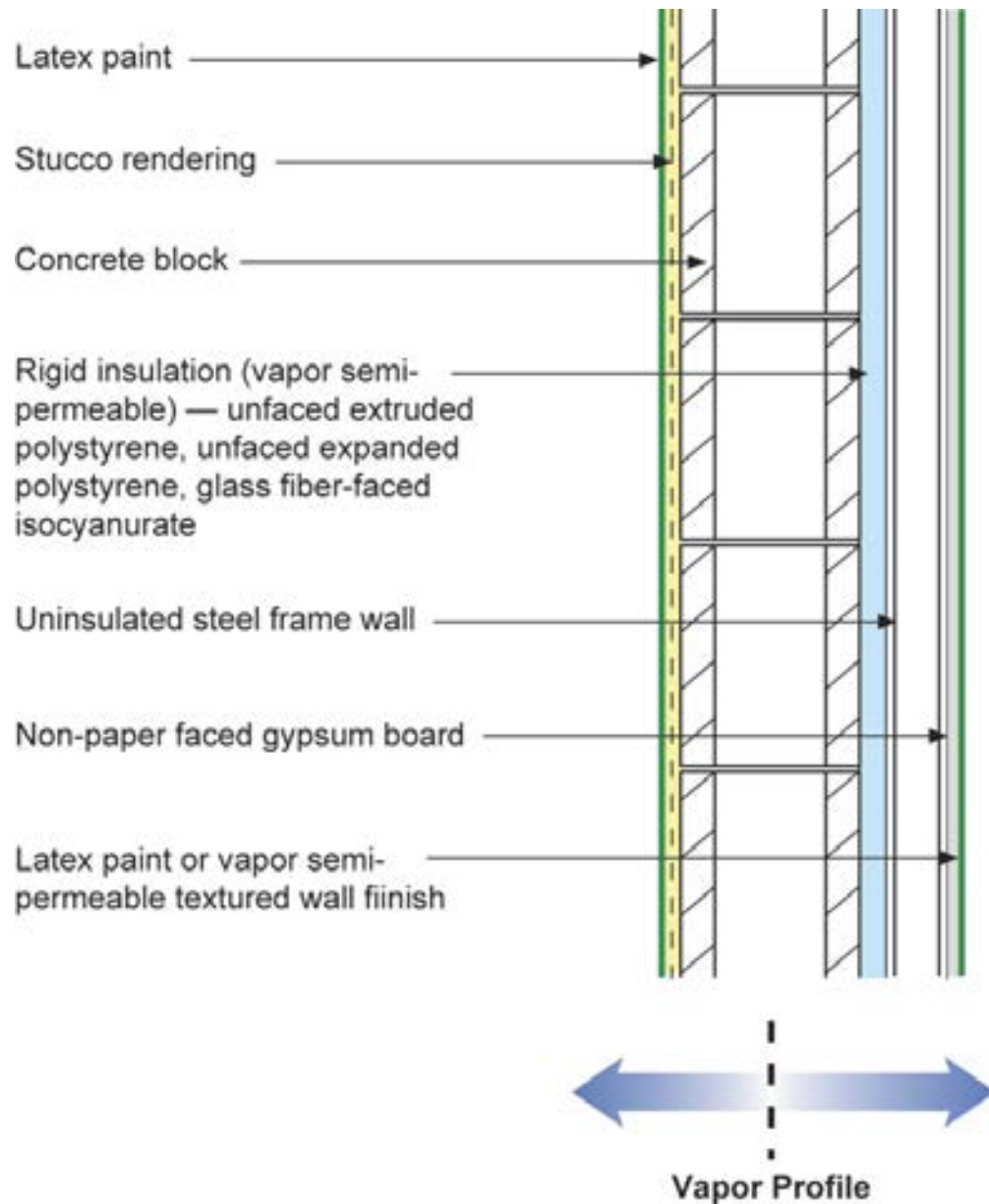


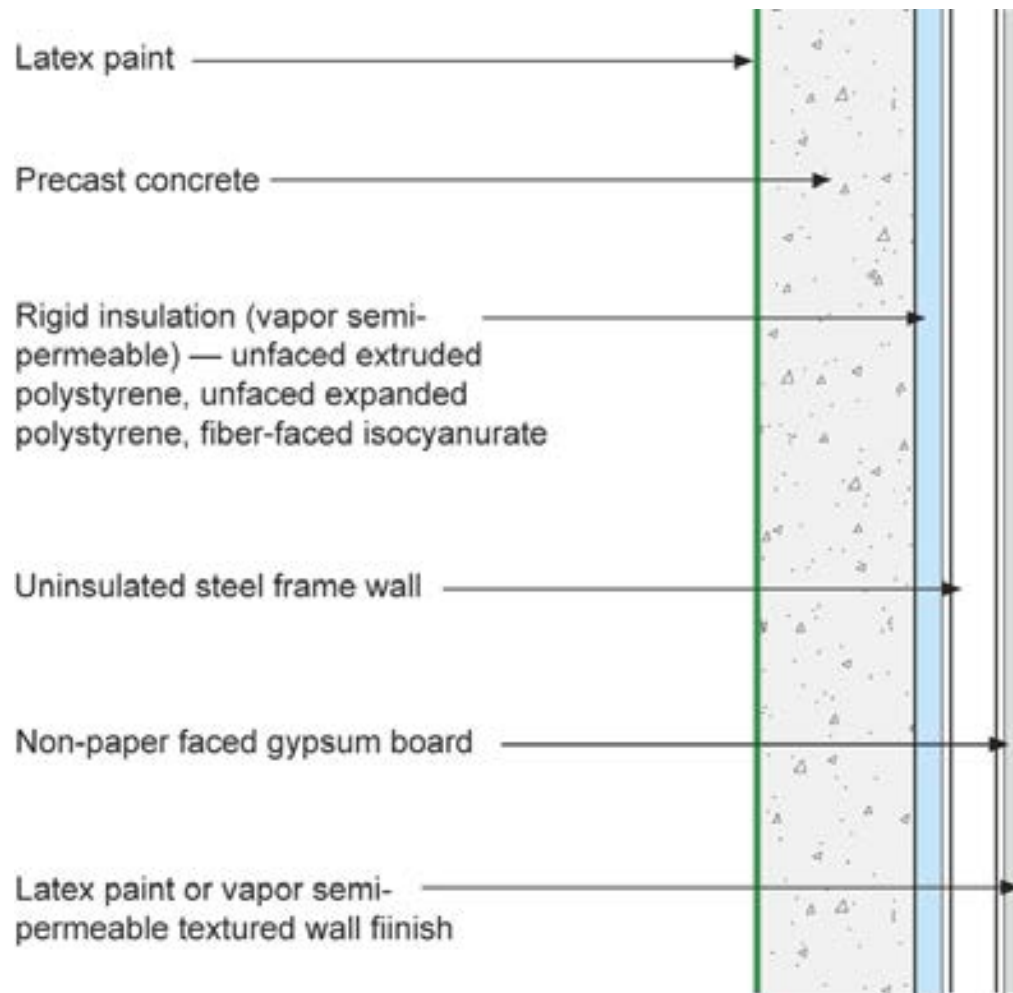




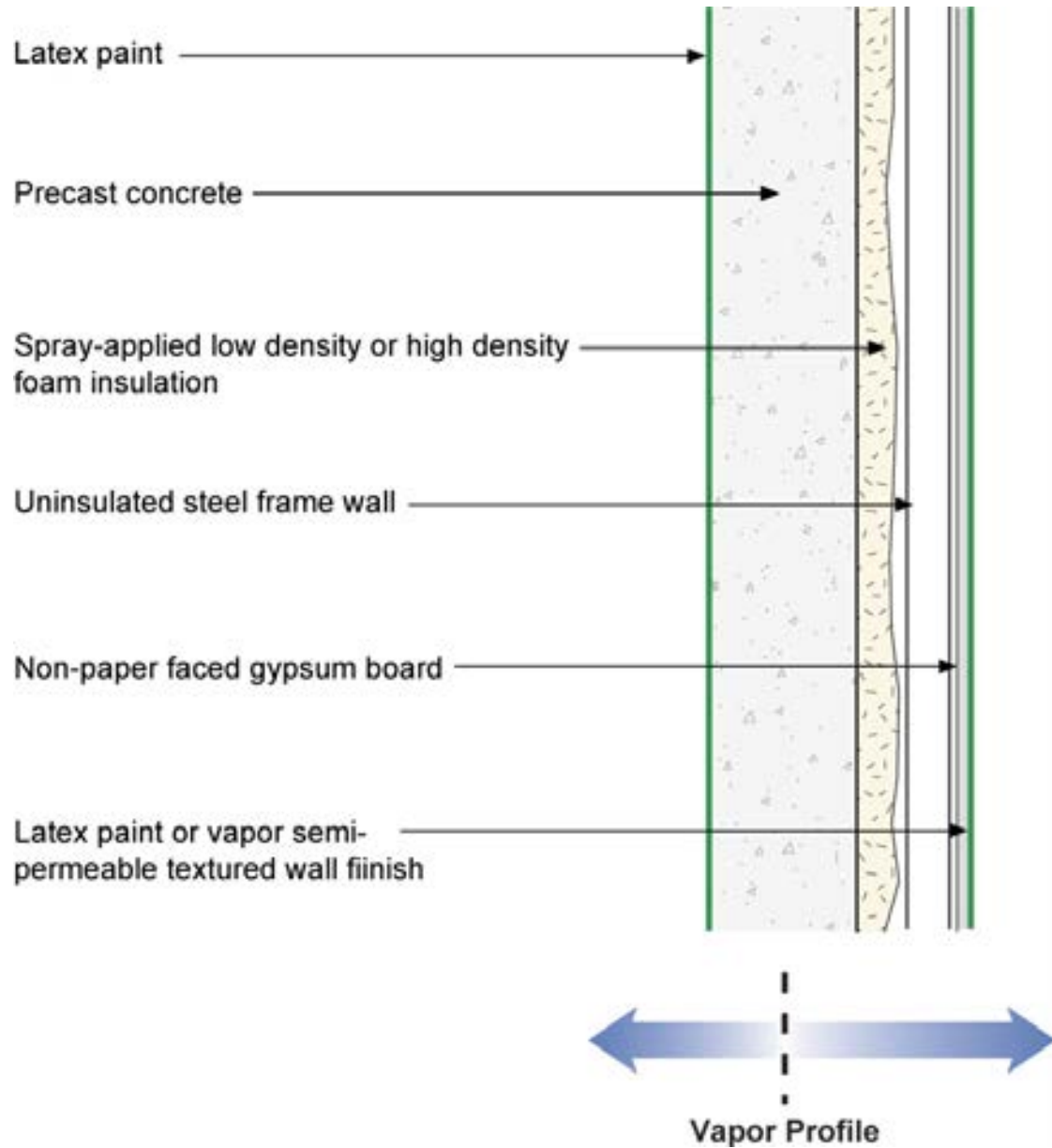


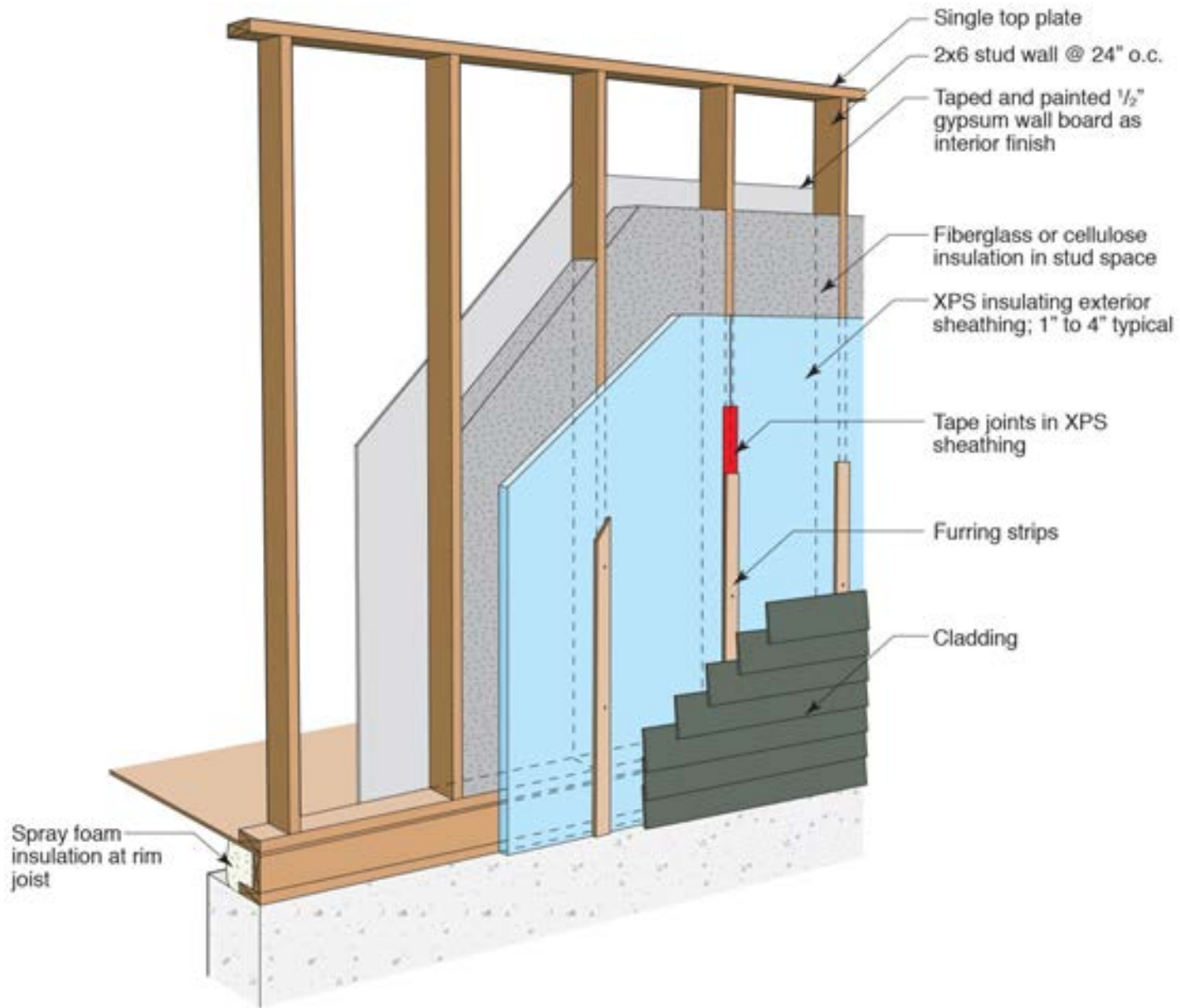


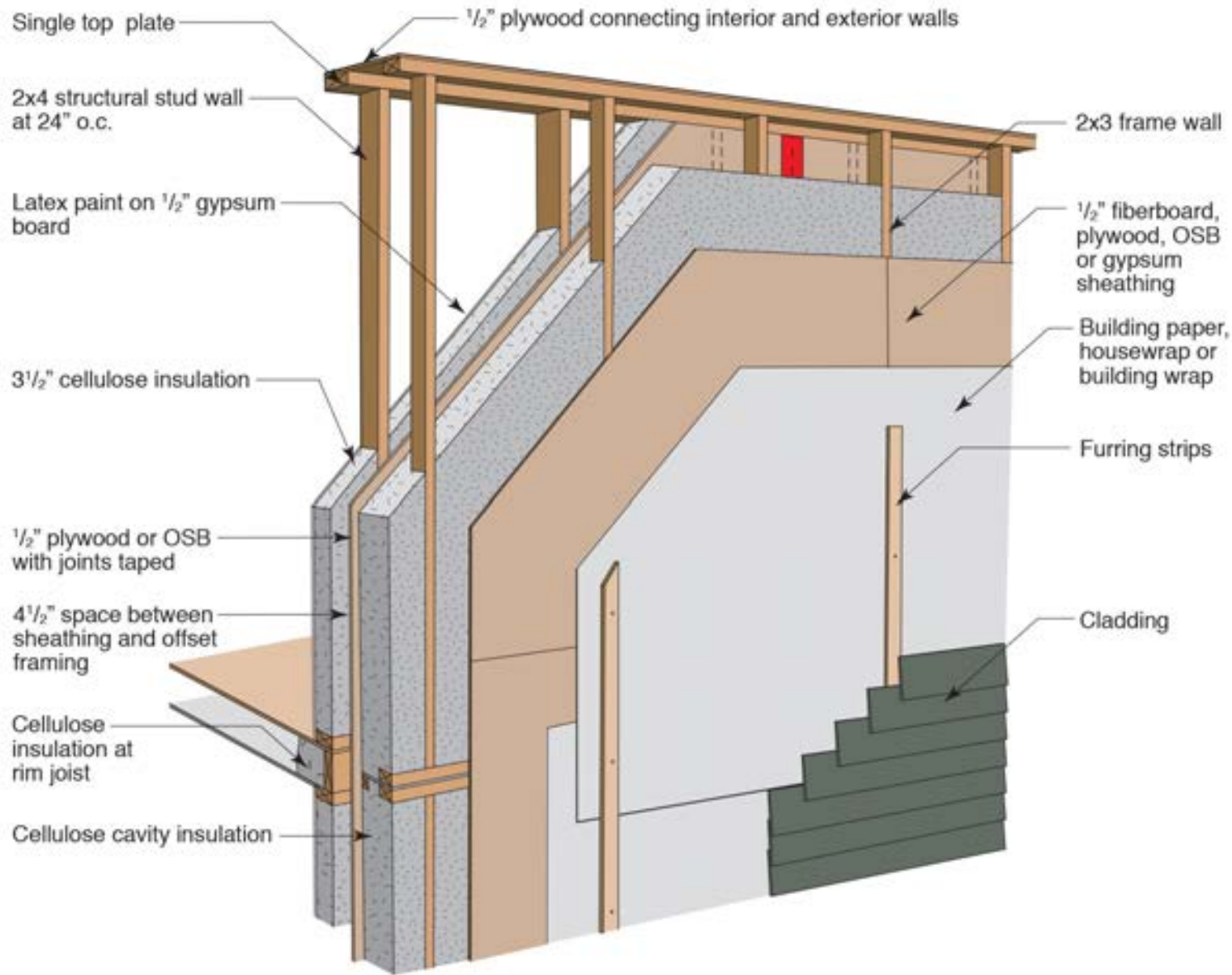


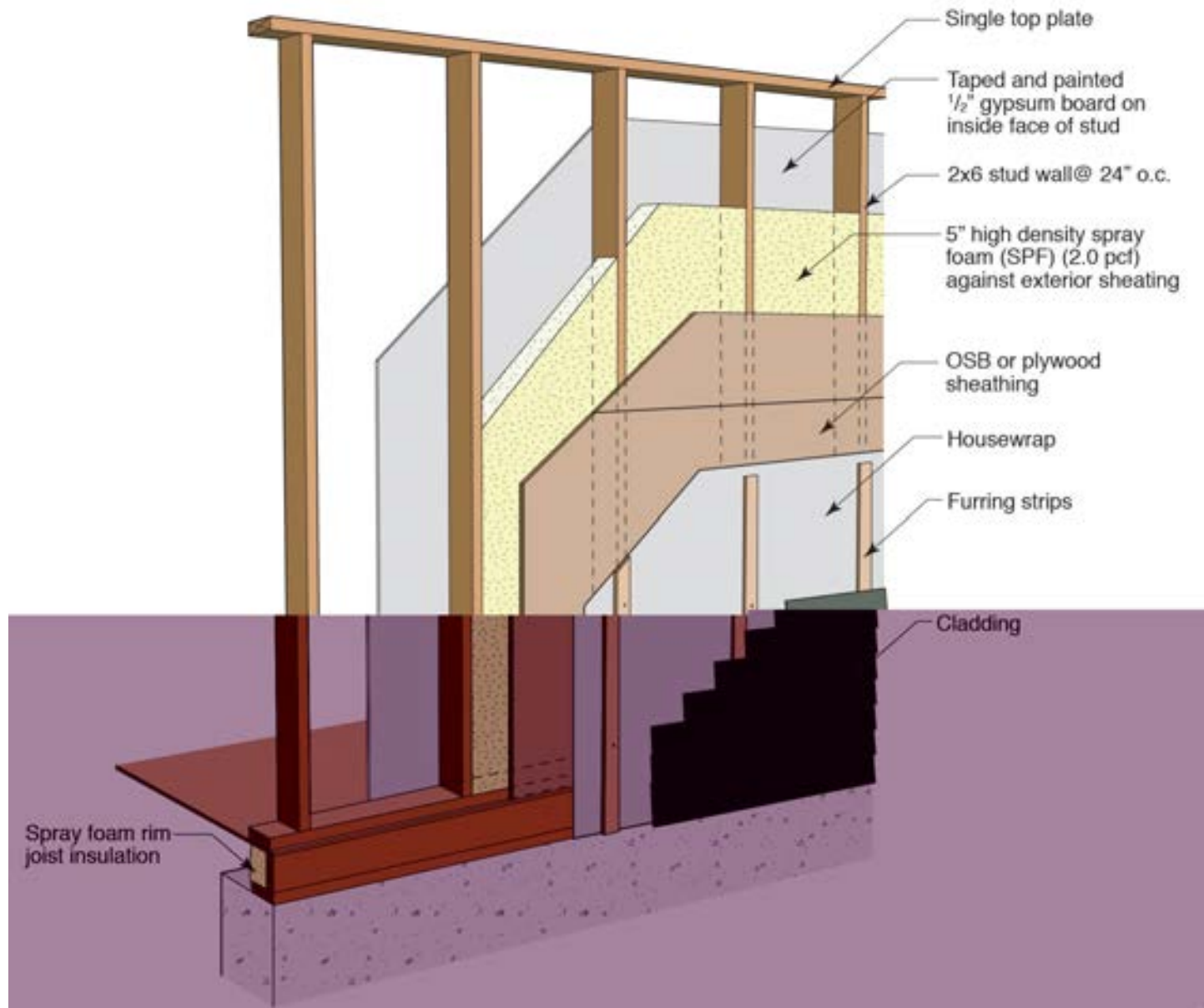


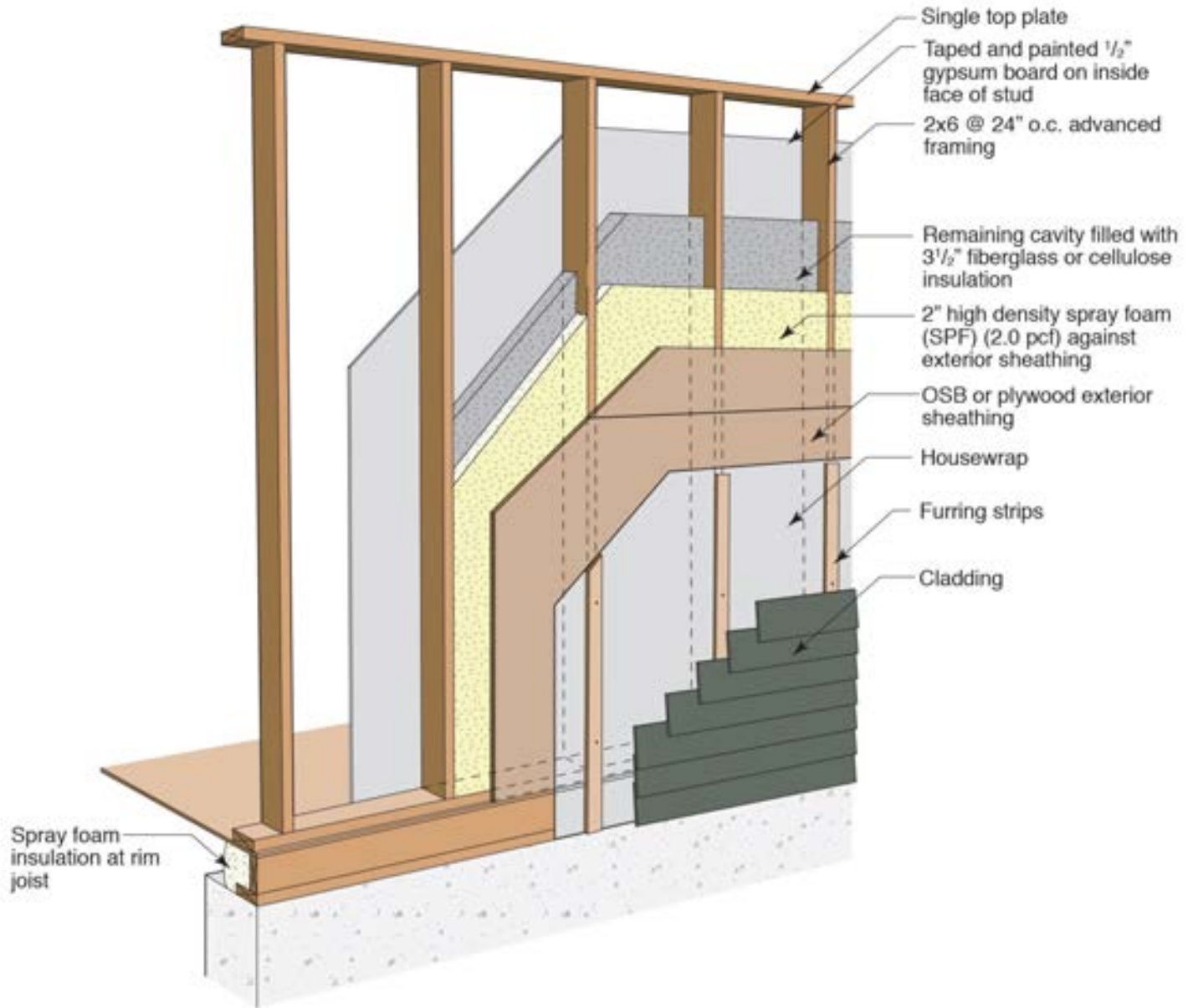
Vapor Profile

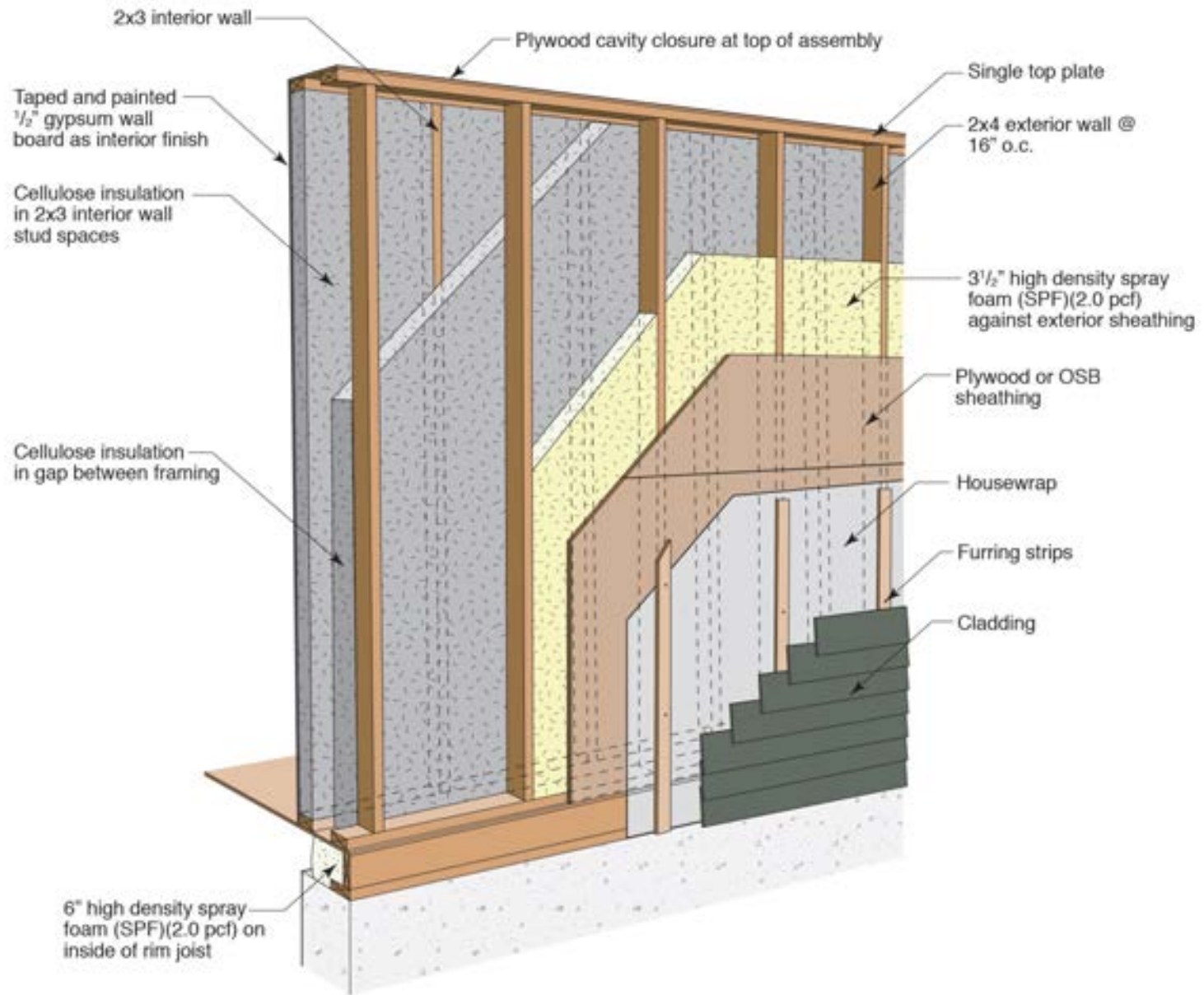


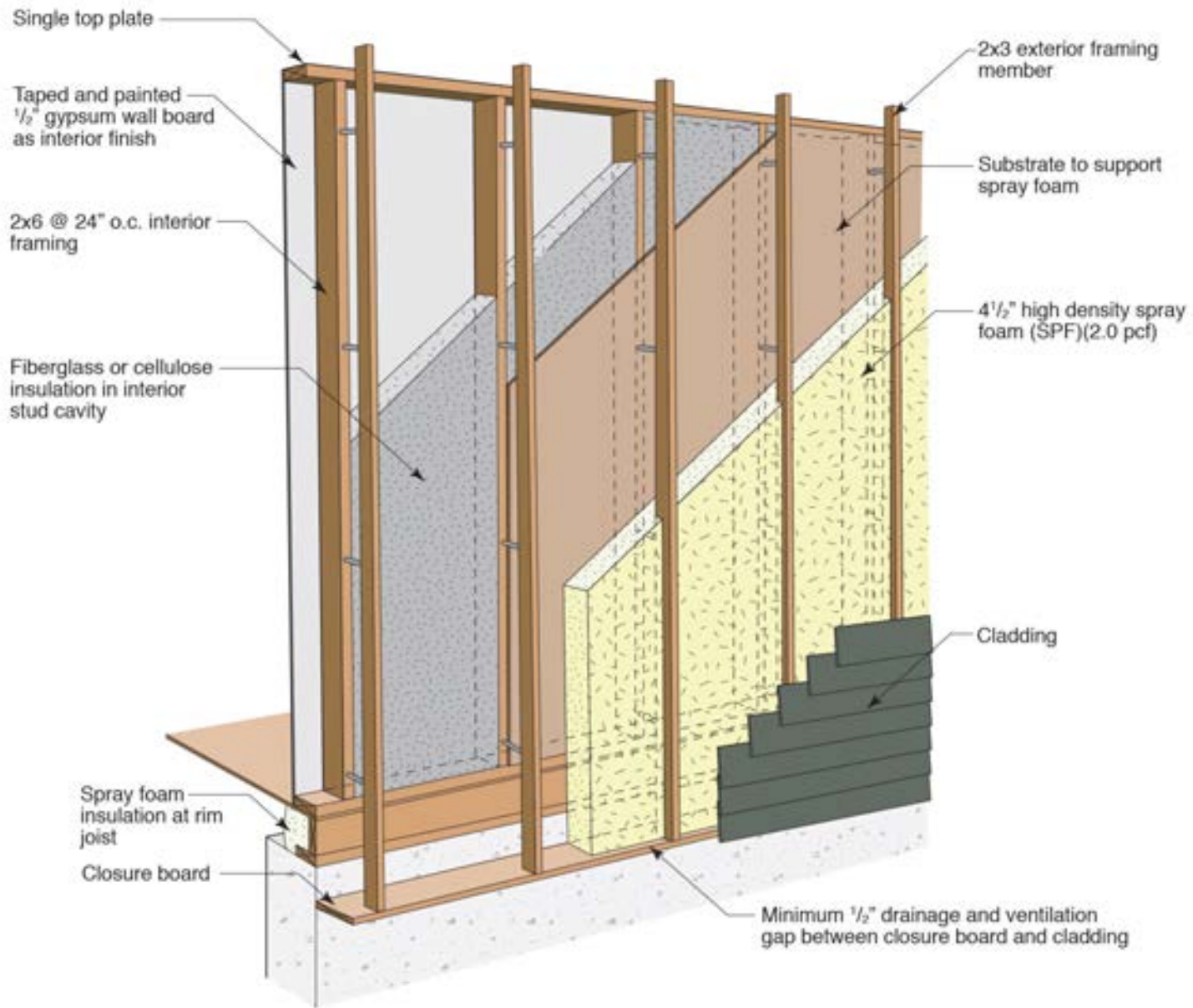


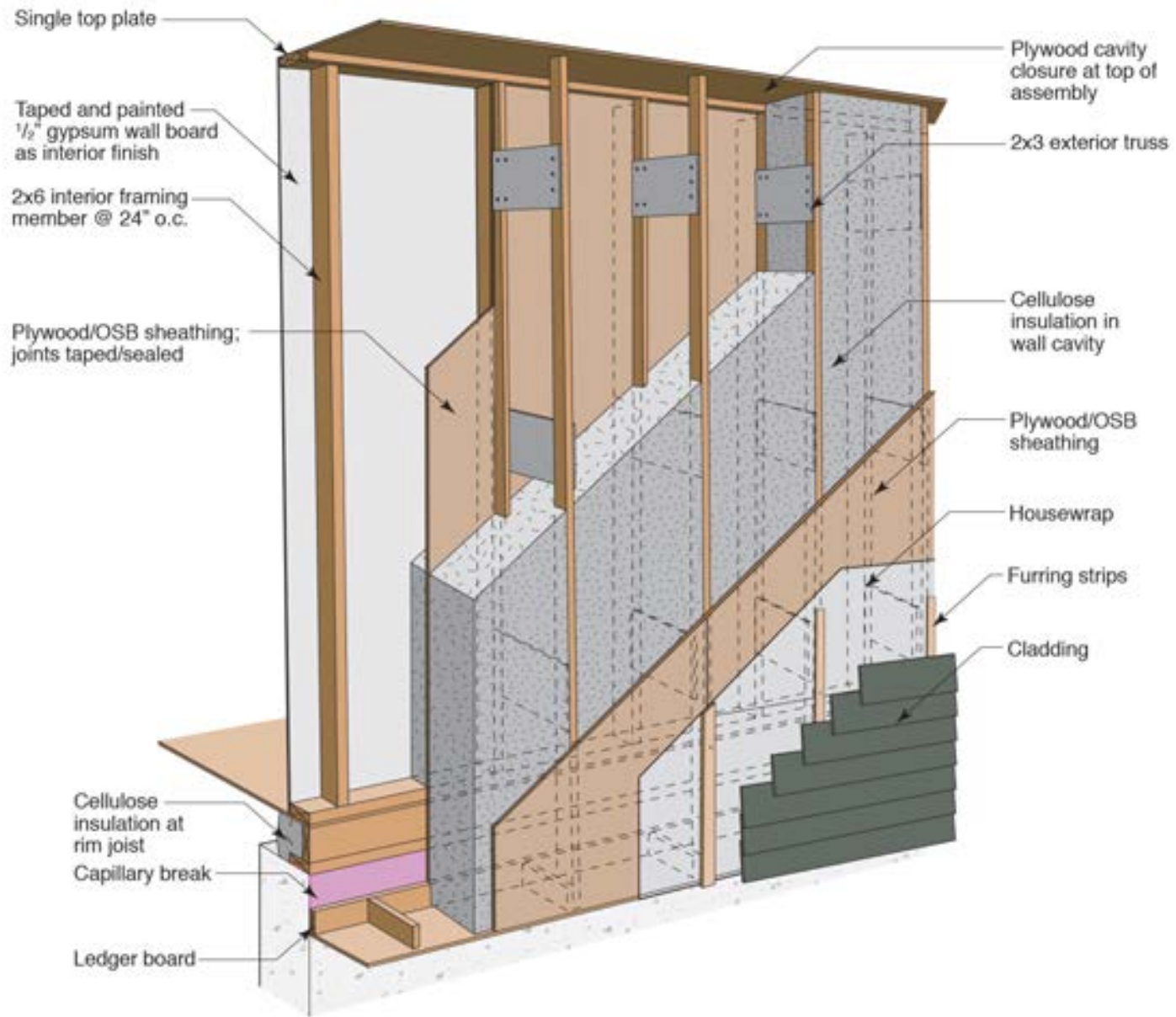


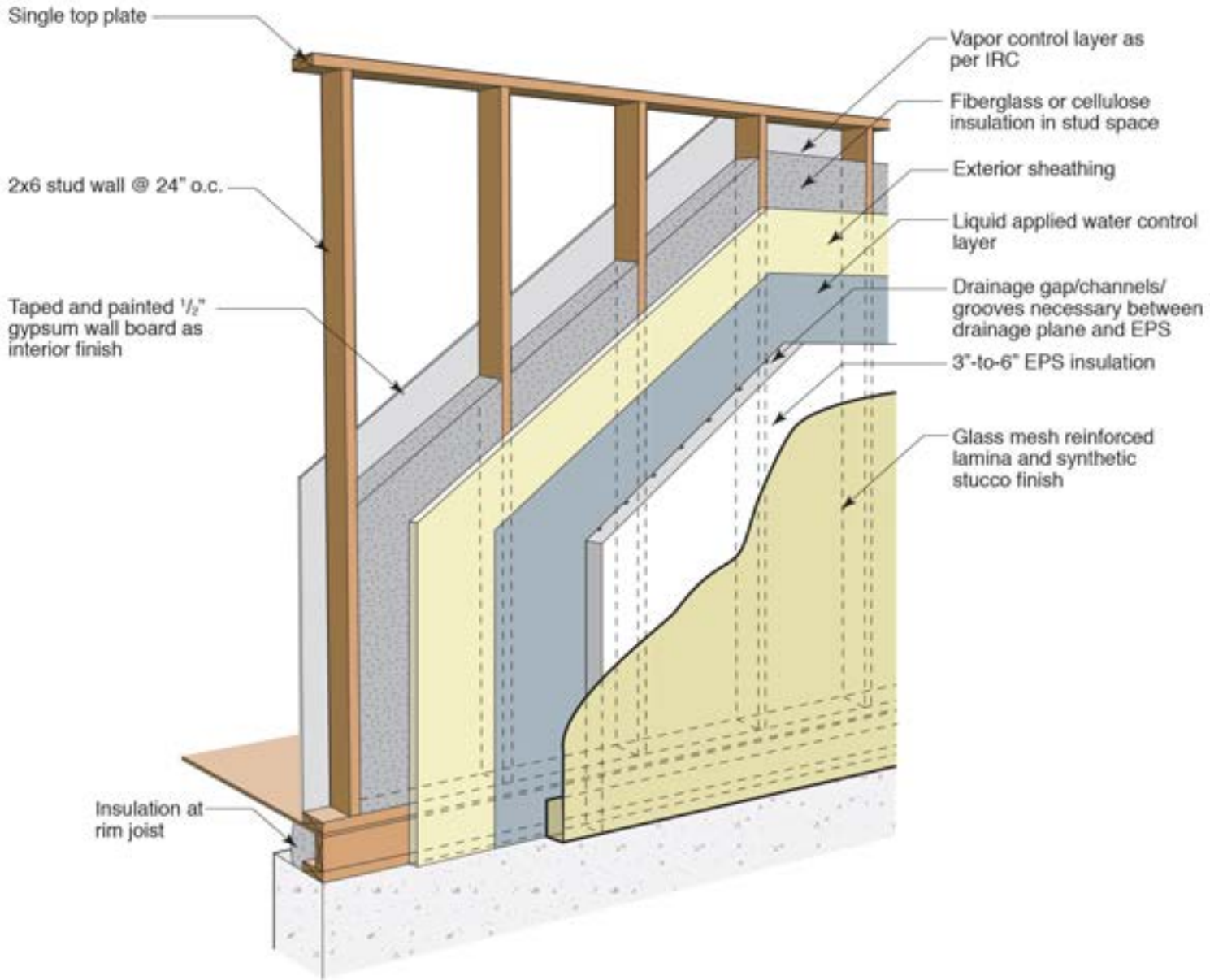


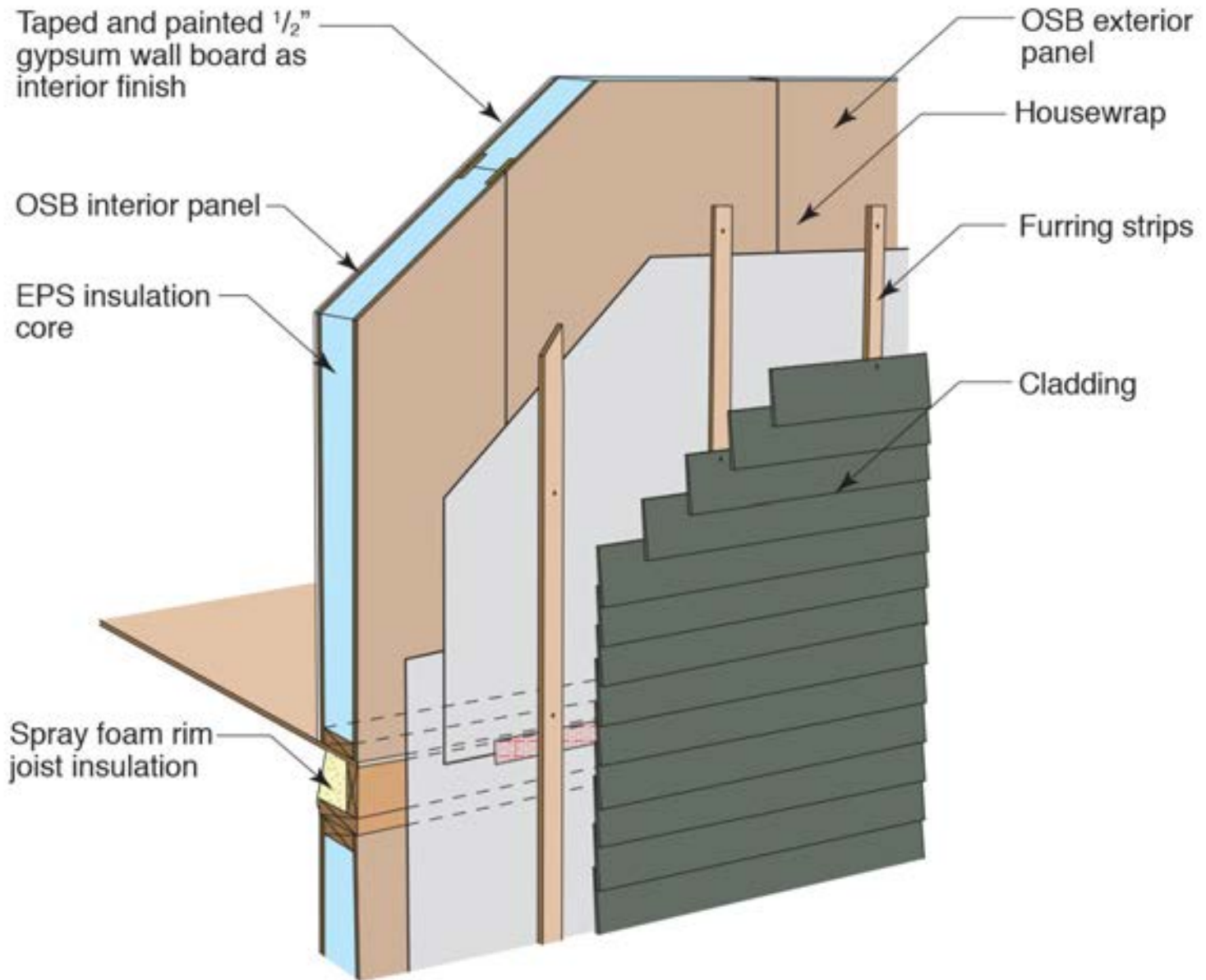


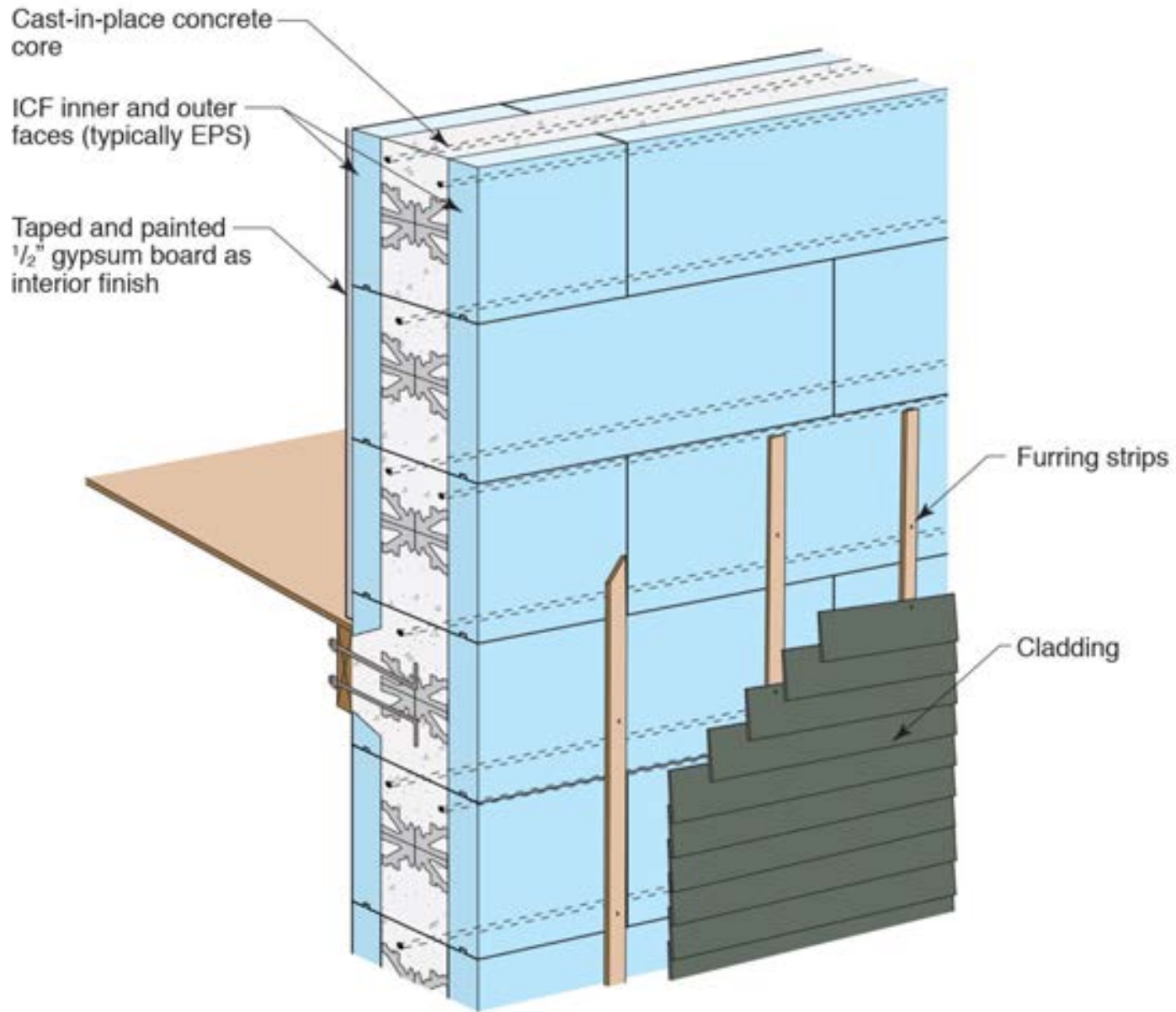








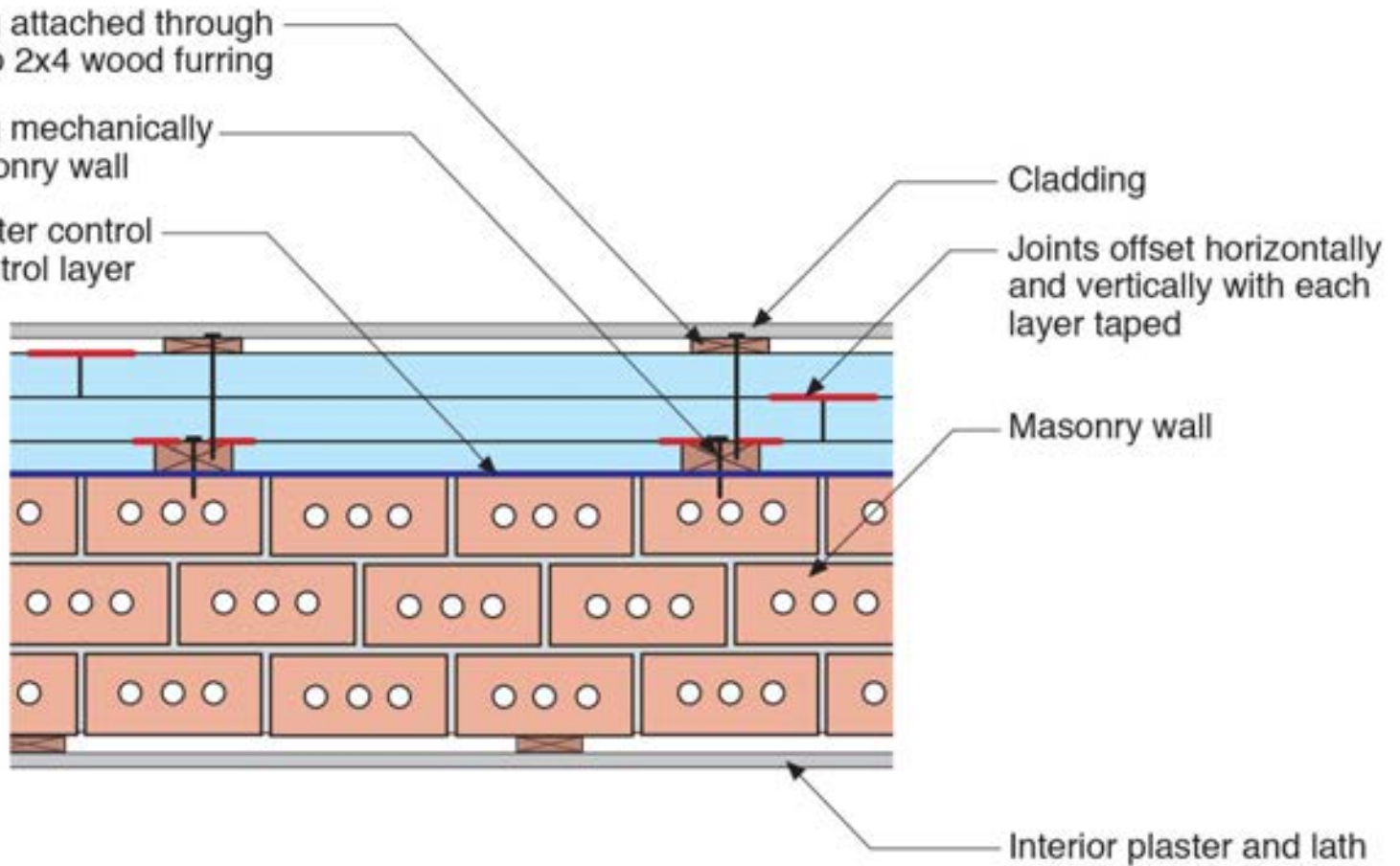




1x4 wood furring attached through rigid insulation to 2x4 wood furring

2x4 wood furring mechanically attached to masonry wall

Fluid-applied water control layer and air control layer

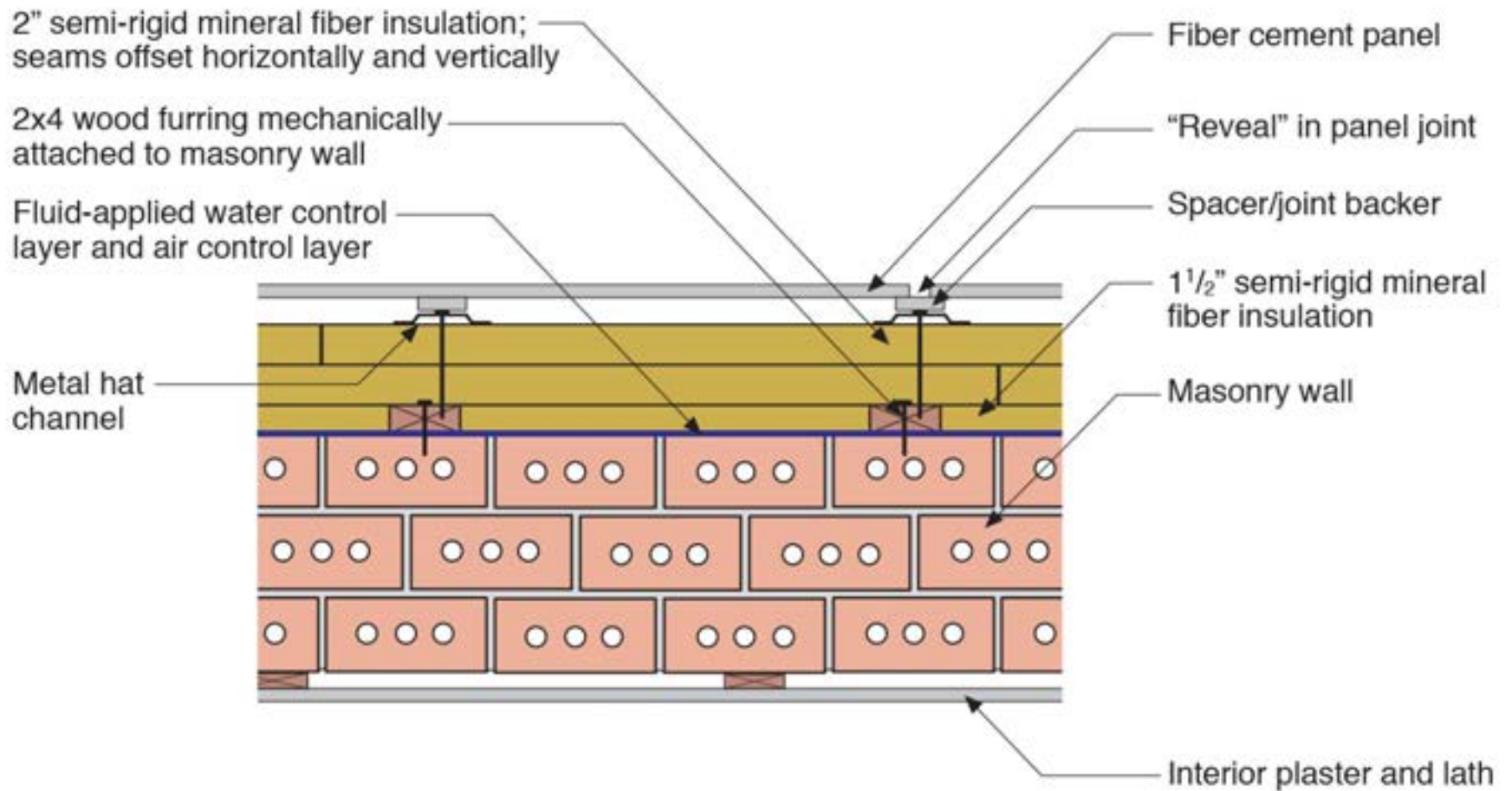


Cladding

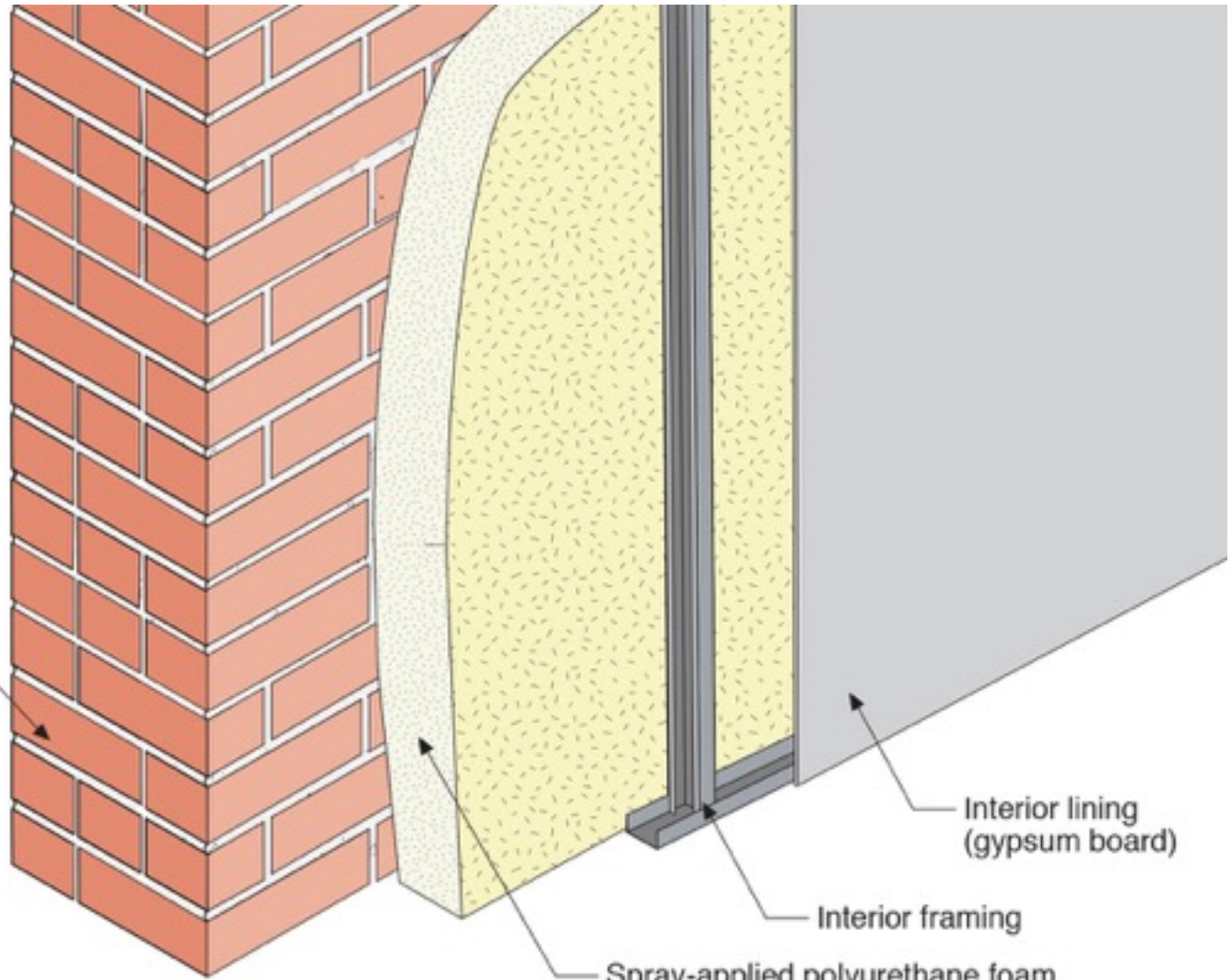
Joints offset horizontally and vertically with each layer taped

Masonry wall

Interior plaster and lath



Multi-wythe mass wall

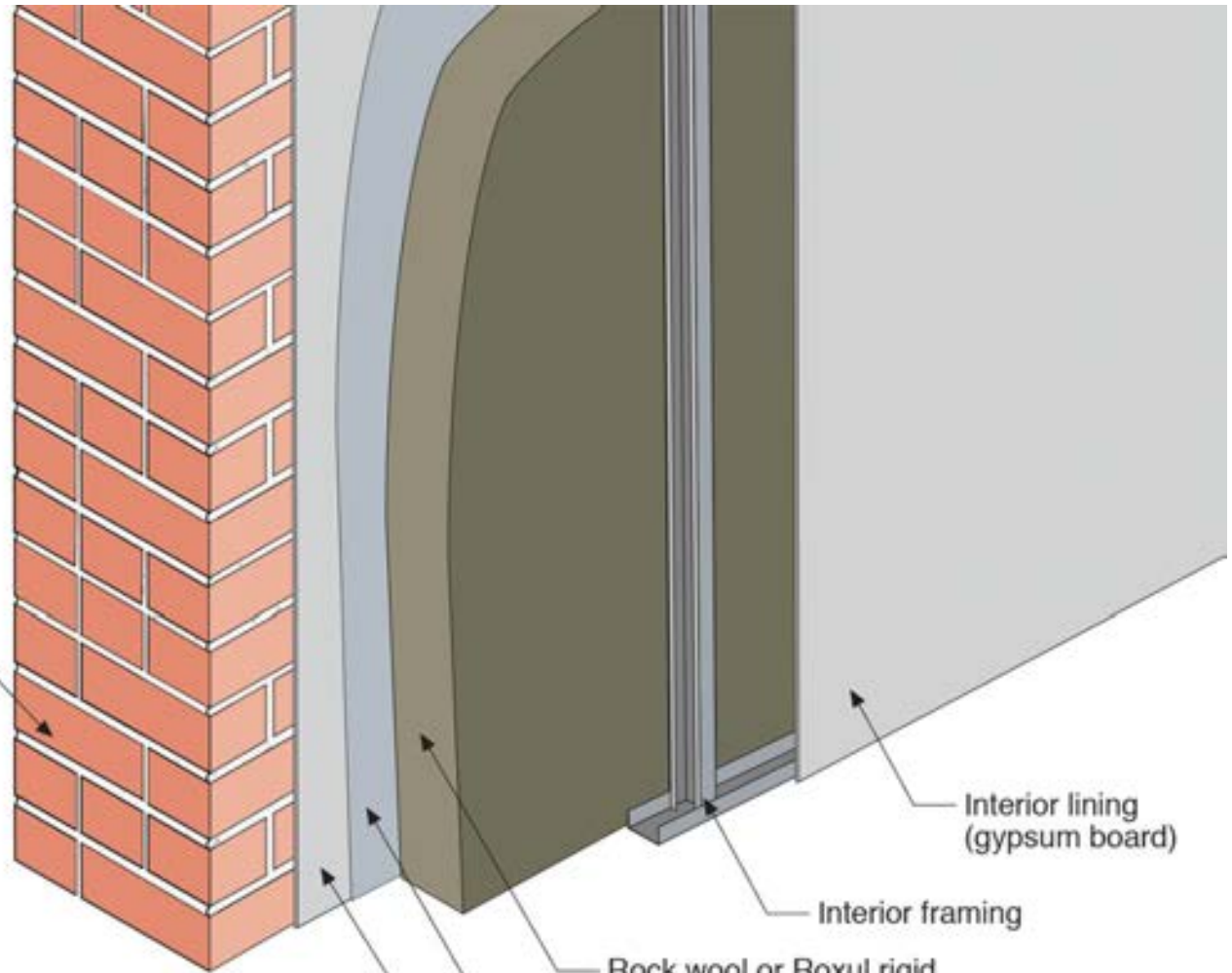


Interior lining
(gypsum board)

Interior framing

Spray-applied polyurethane foam
(2 lb/ft³ density)

Multi-wythe mass wall



Interior lining (gypsum board)

Interior framing

Rock wool or Roxul rigid mineral wool insulation

Fluid-applied water control layer (vapor semi-permeable)

Cementitious rendering

