

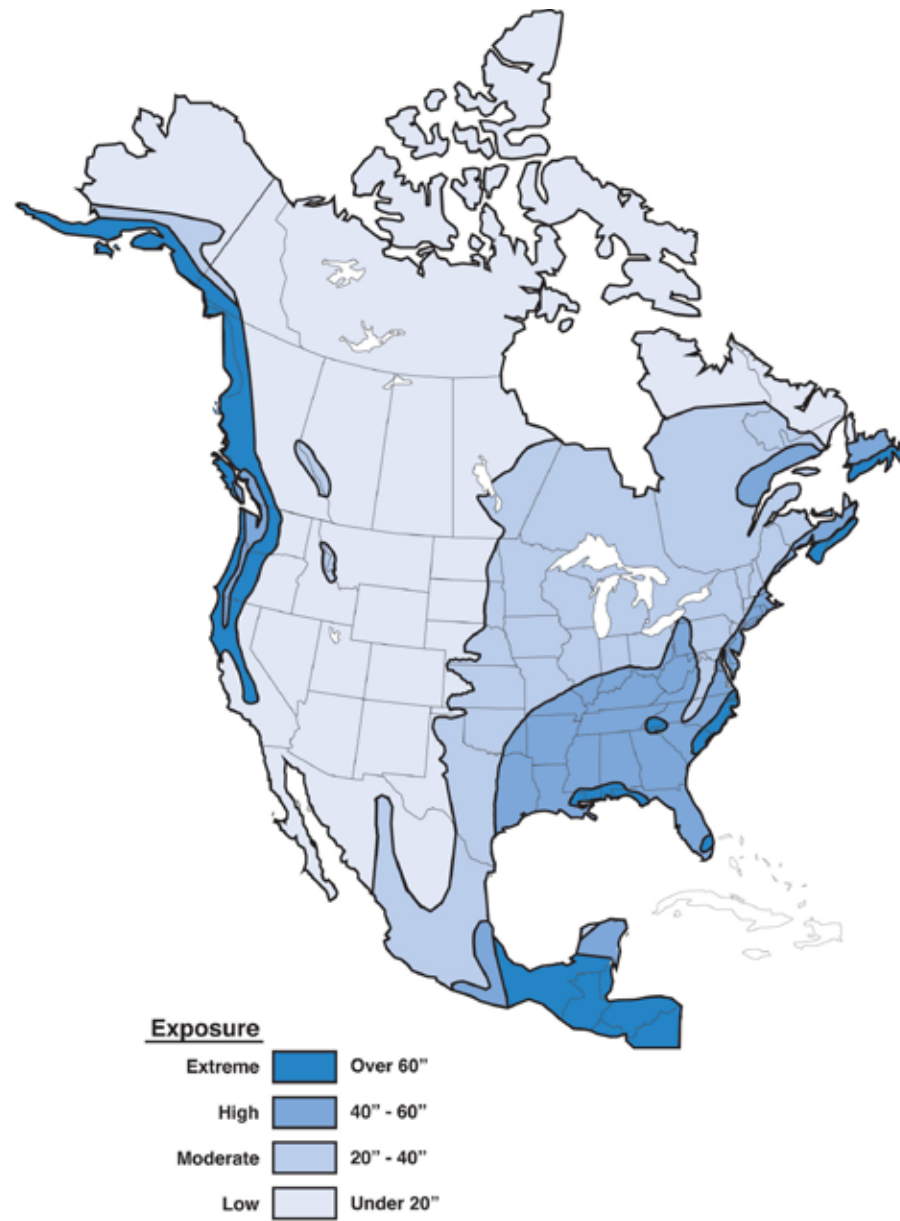
Joseph Lstiburek, Ph.D., P.Eng, ASHRAE Fellow

Building Science

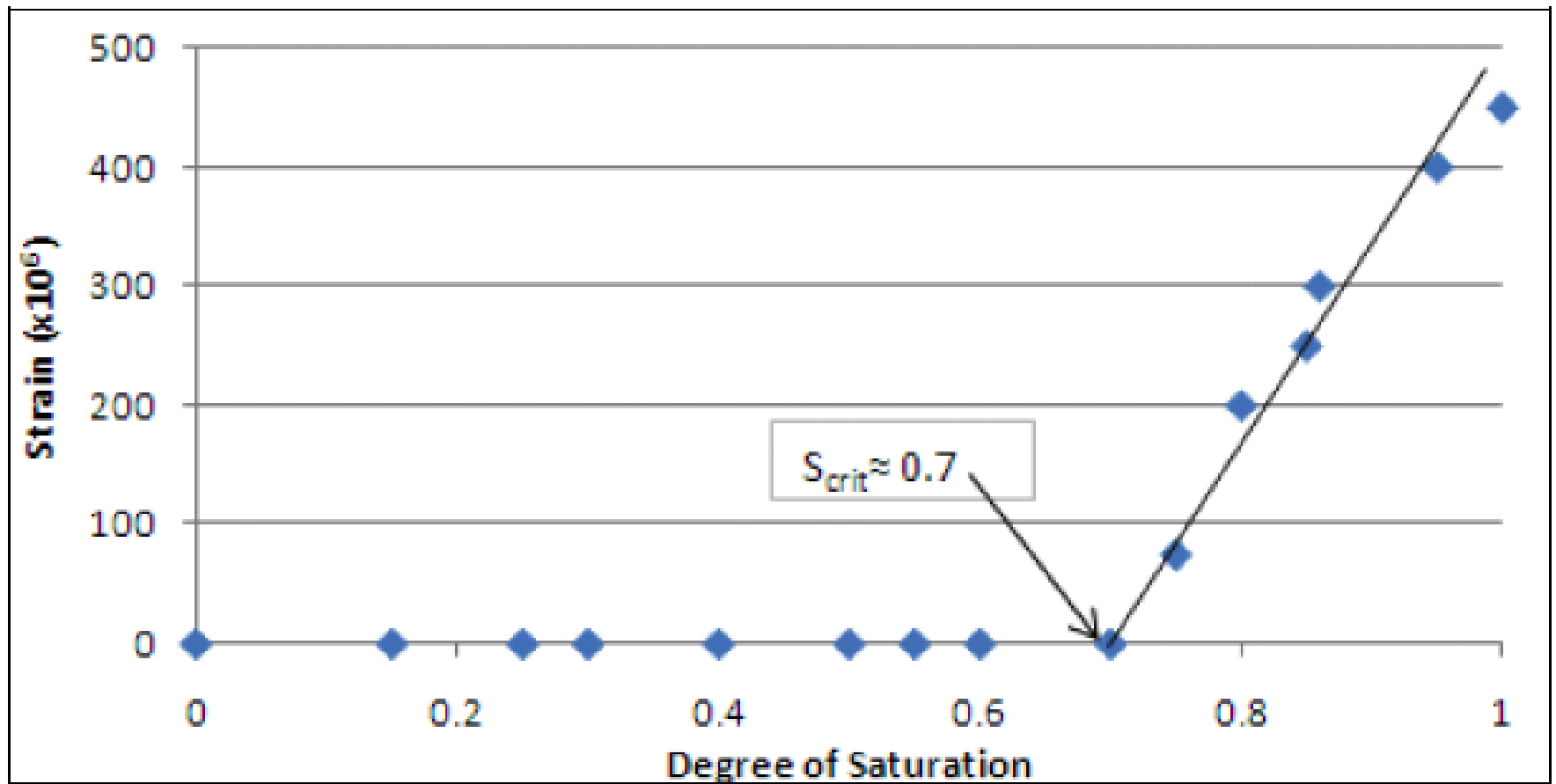
Mass Assemblies

presented by www.buildingscience.com

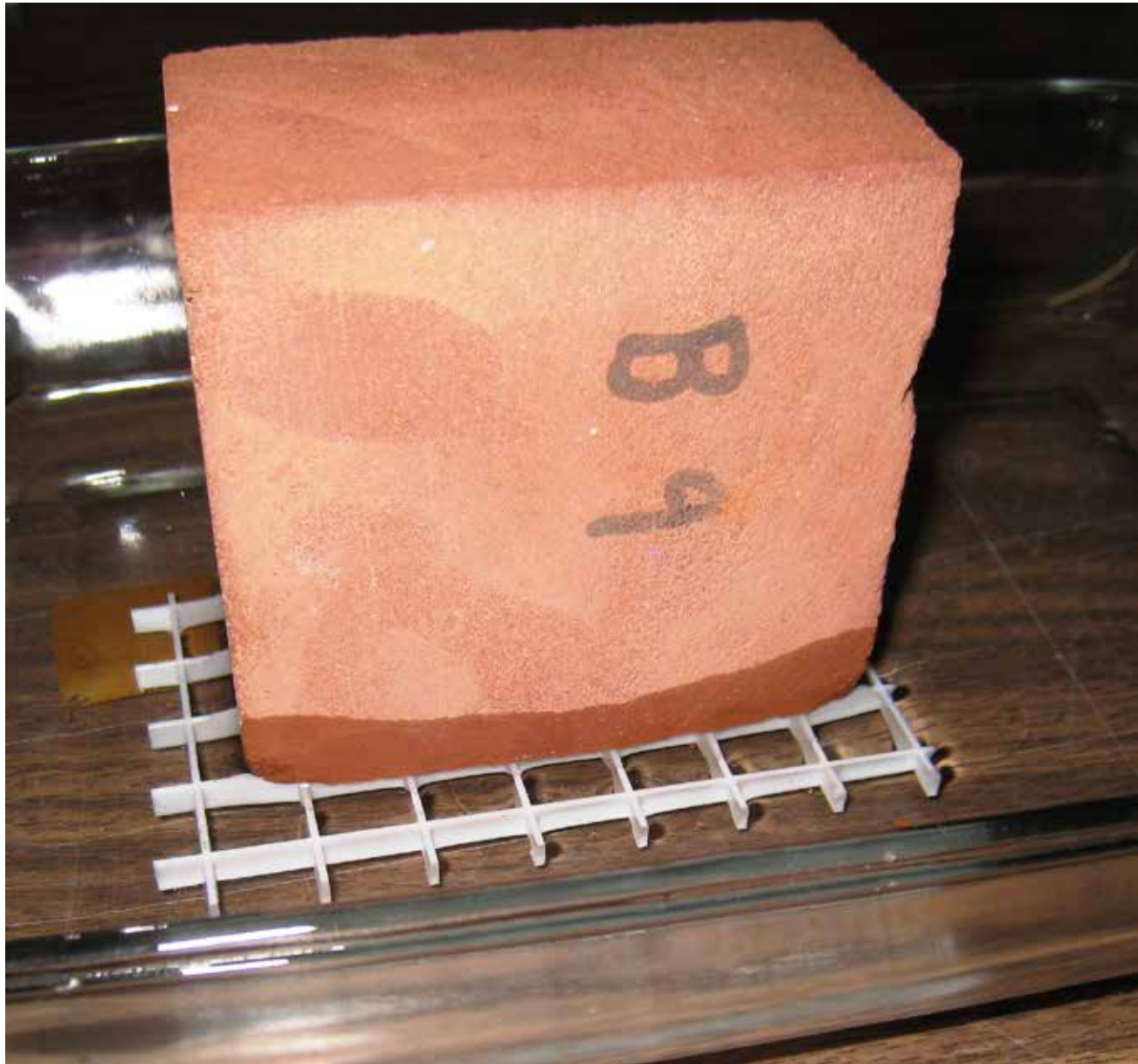


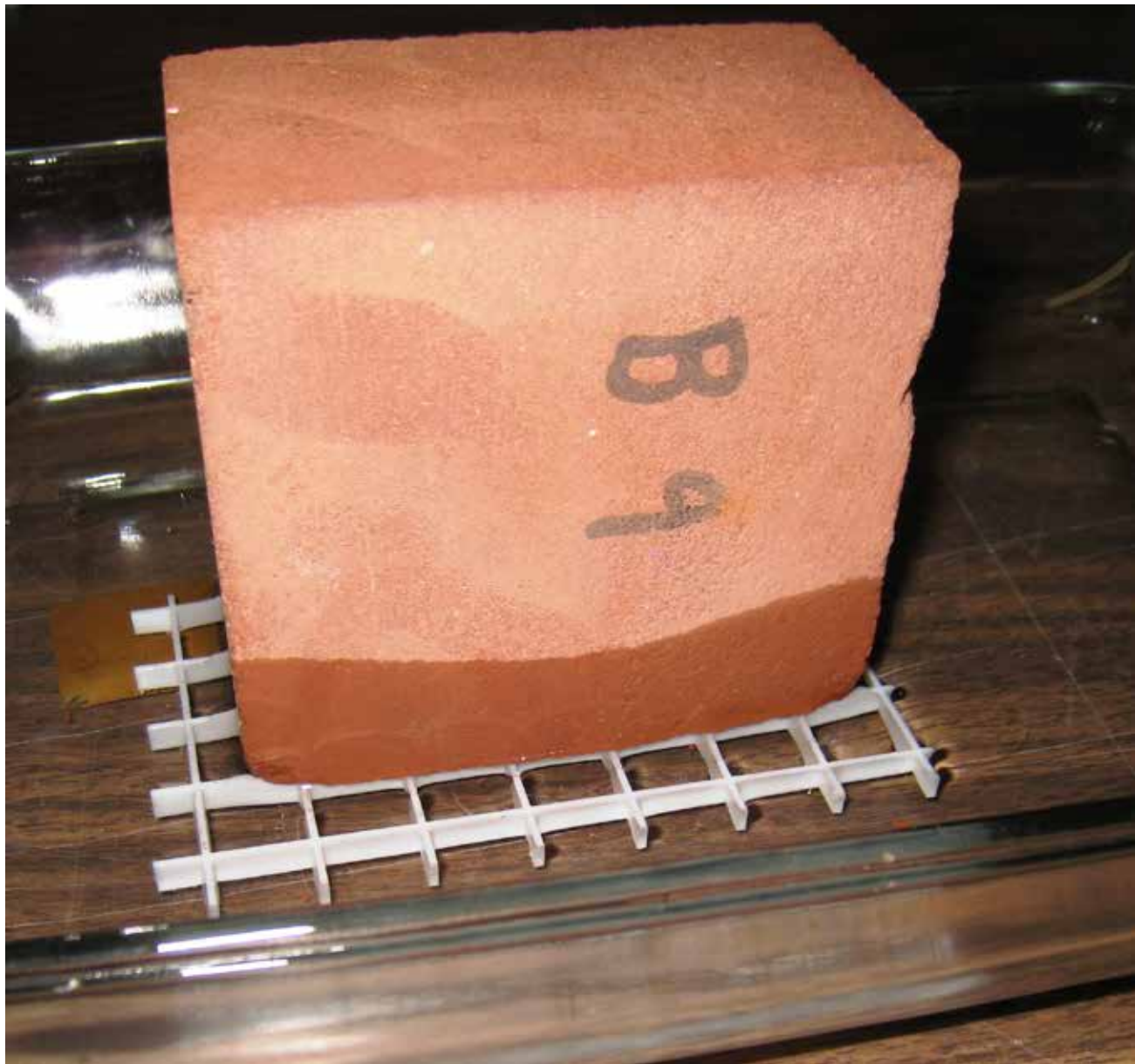


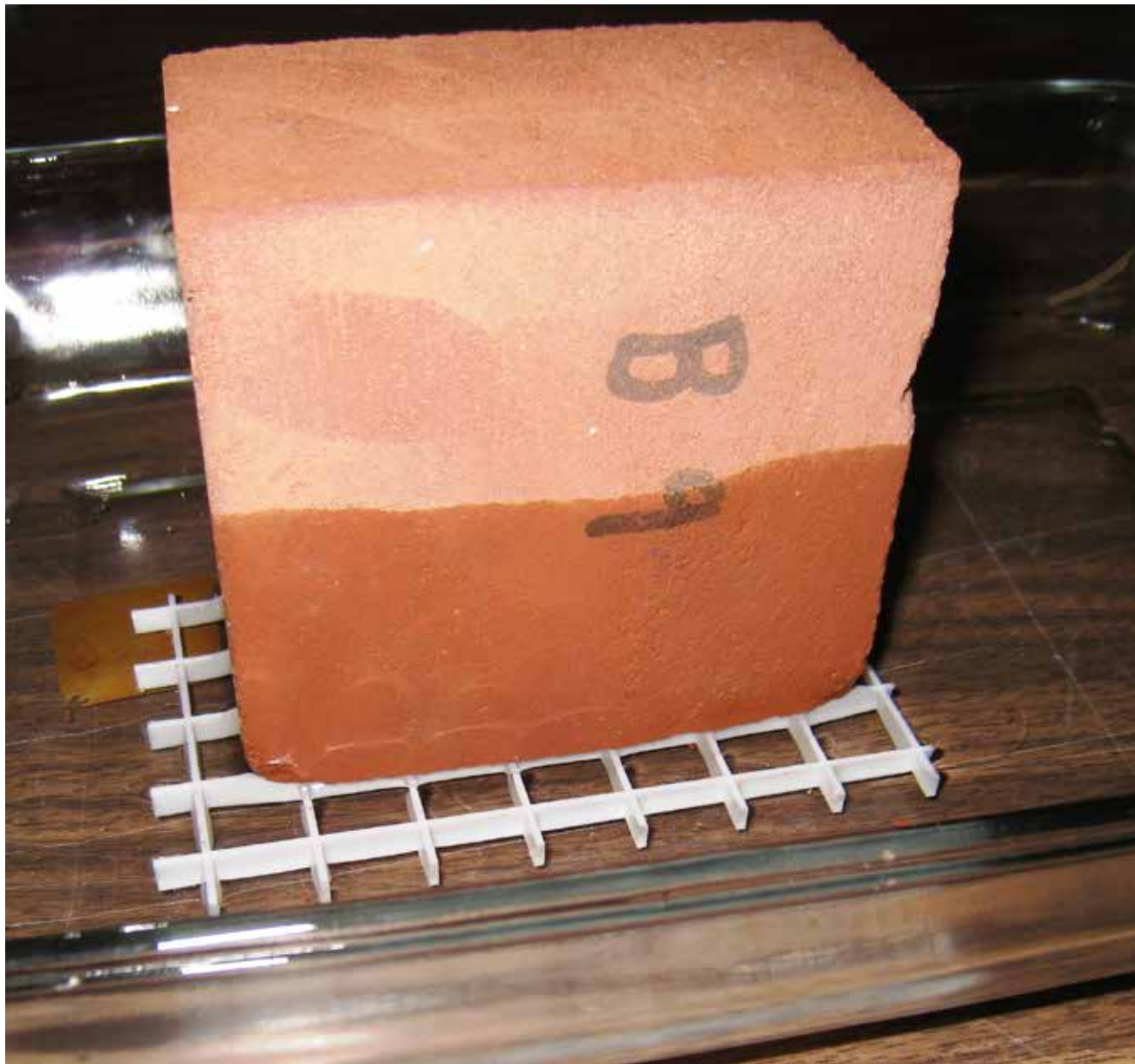


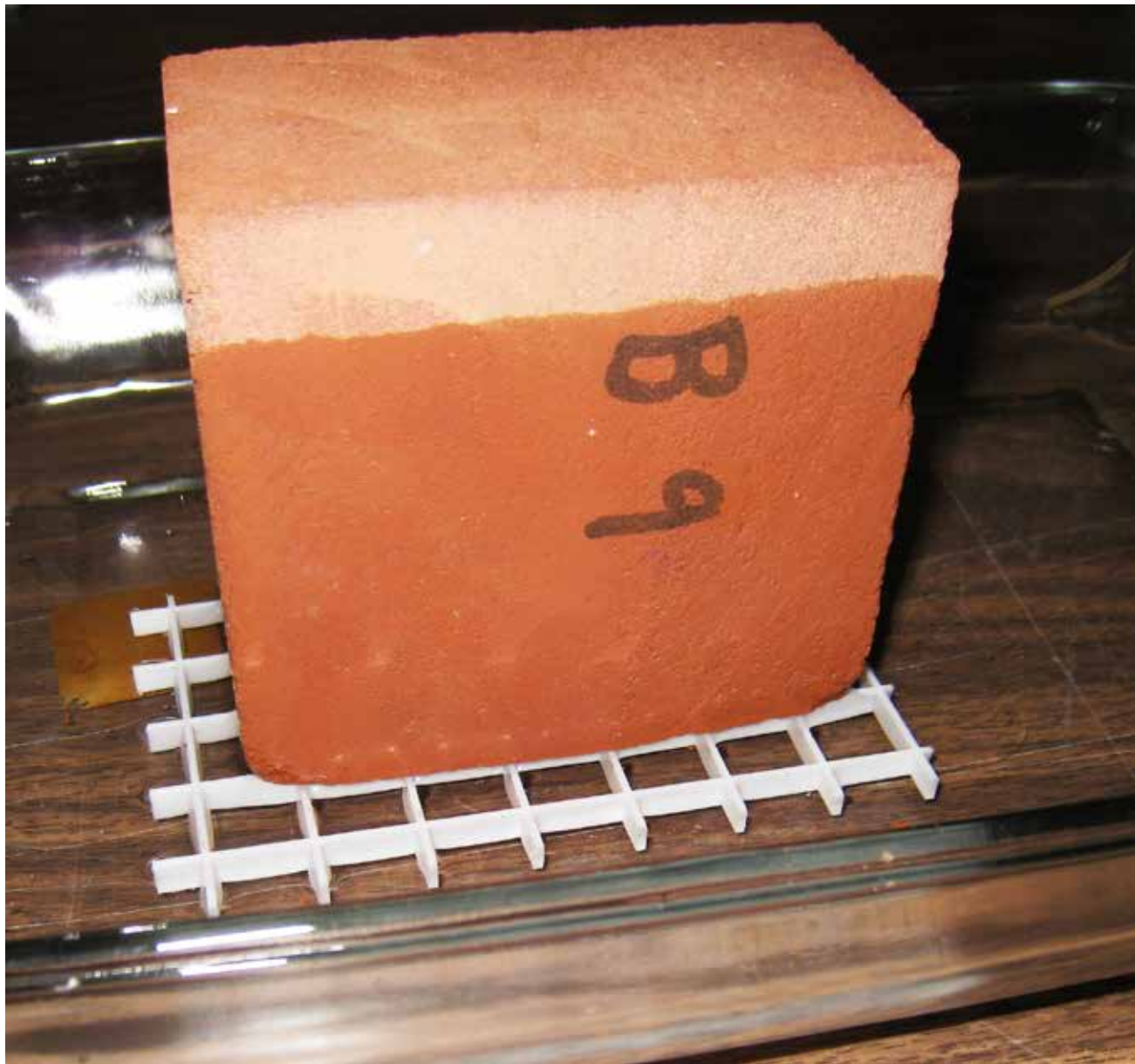






















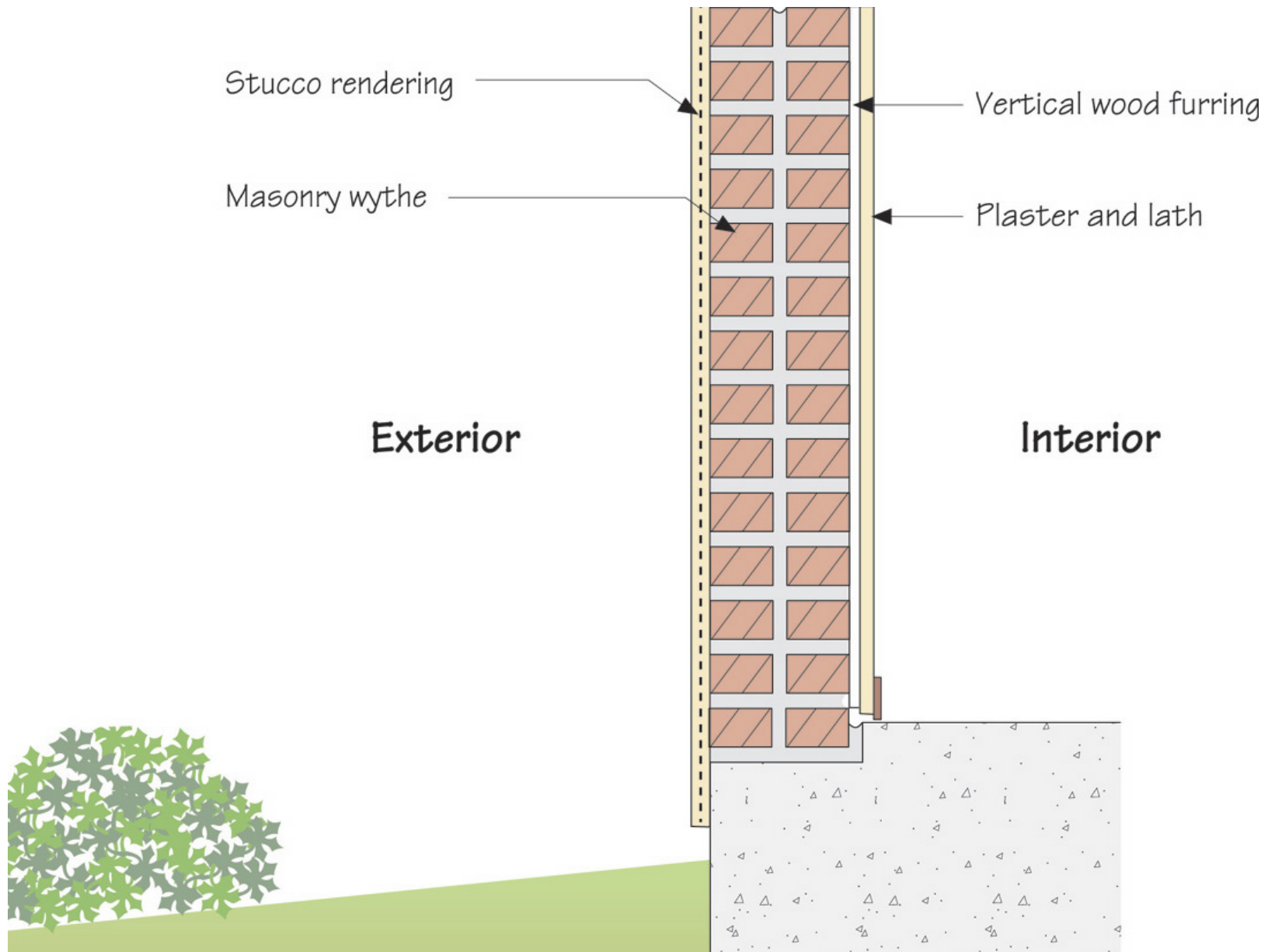


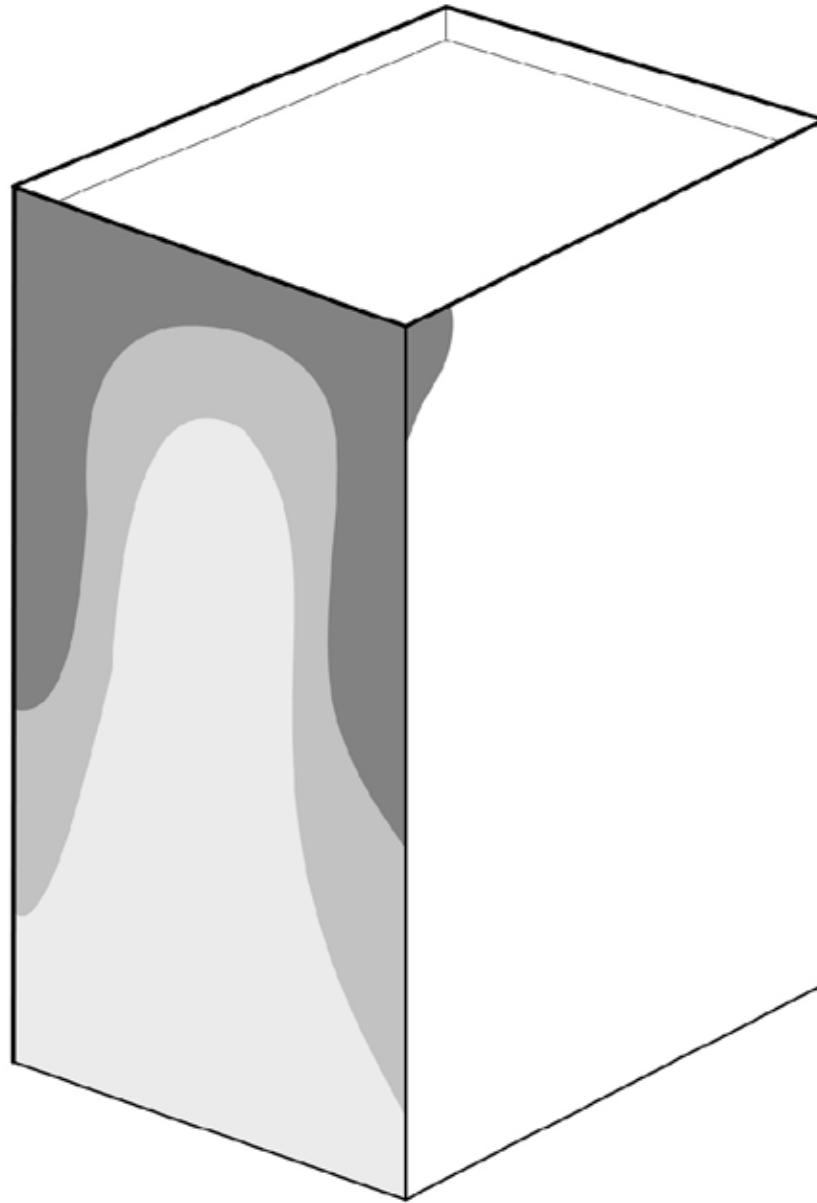






























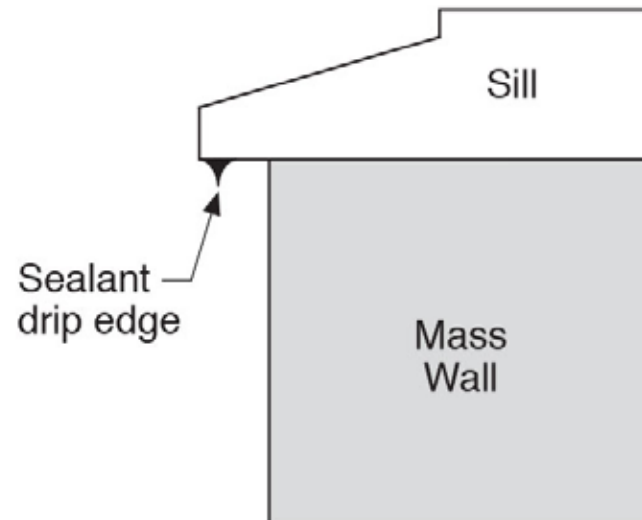
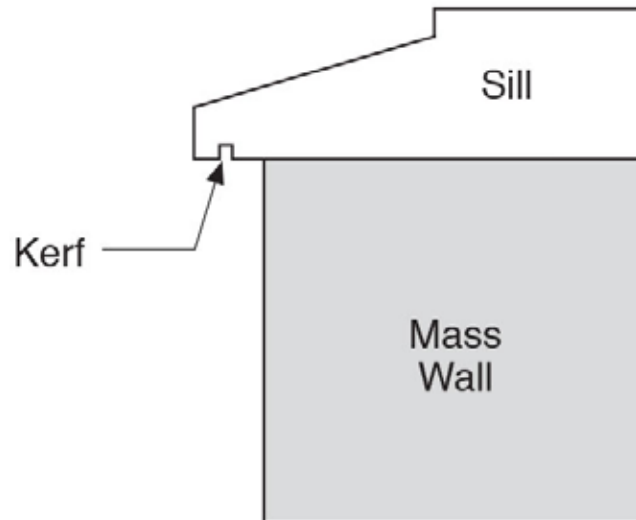


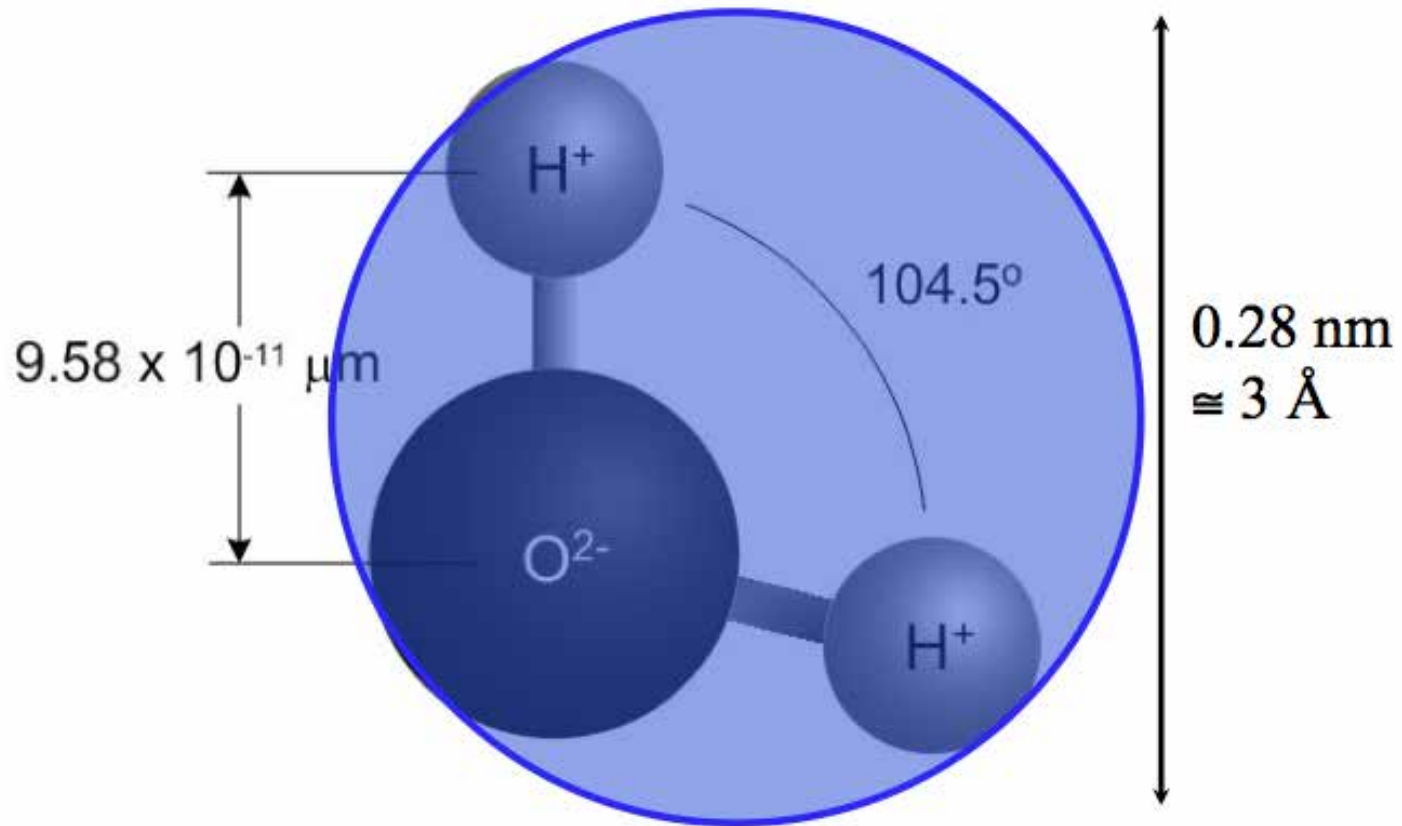


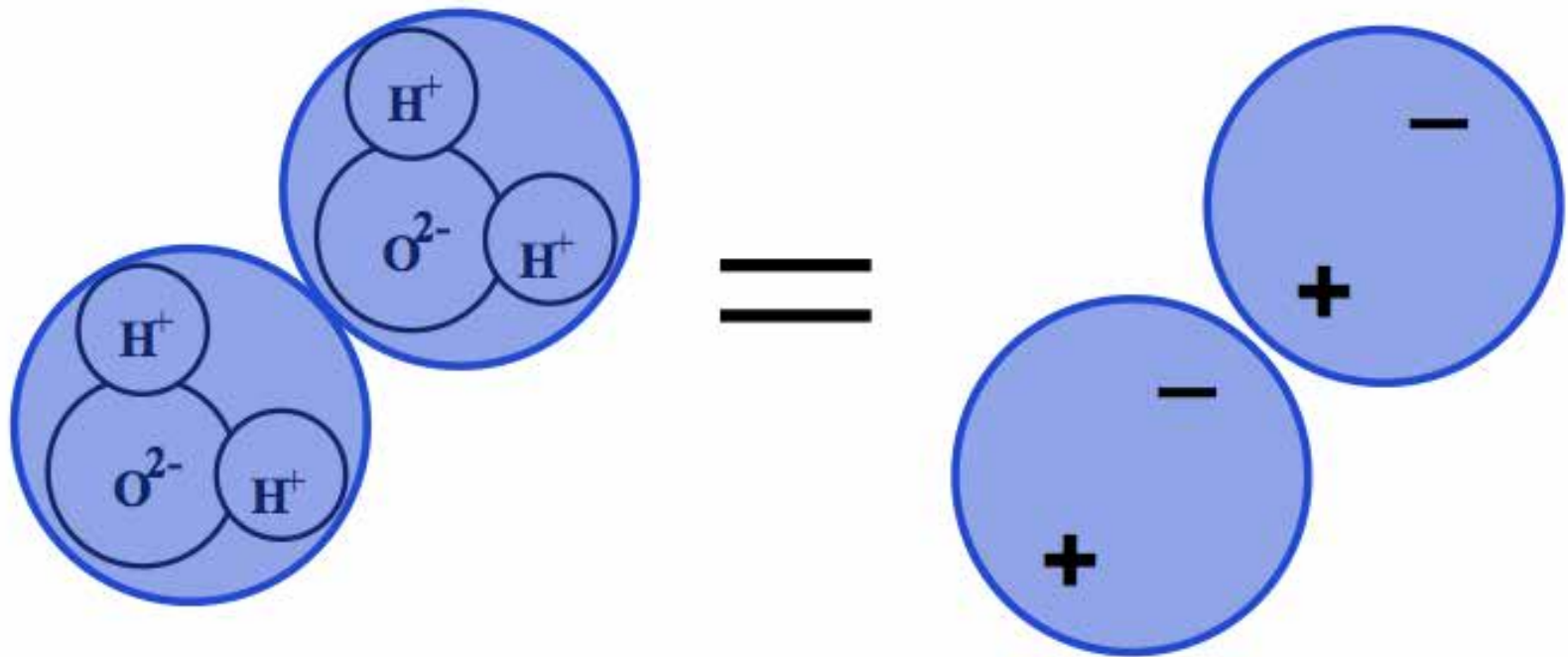


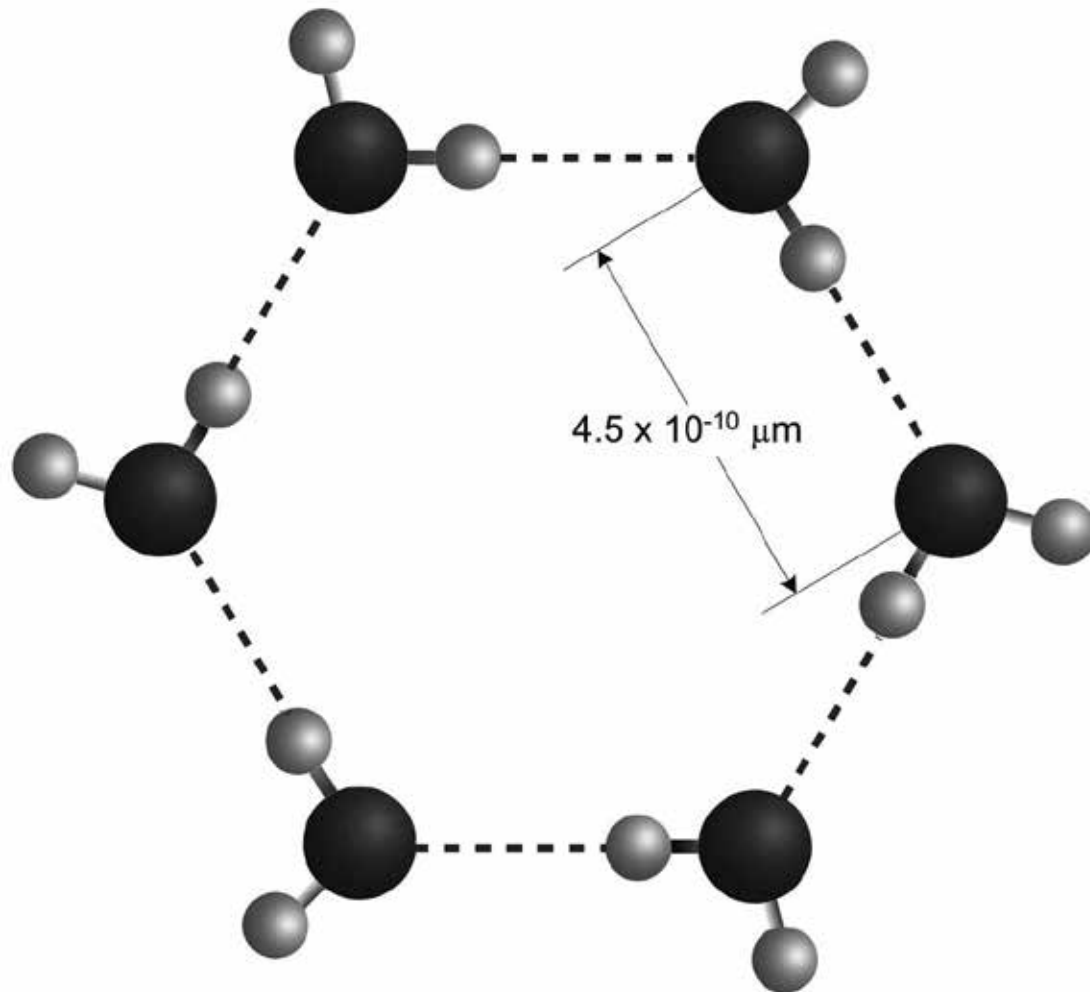












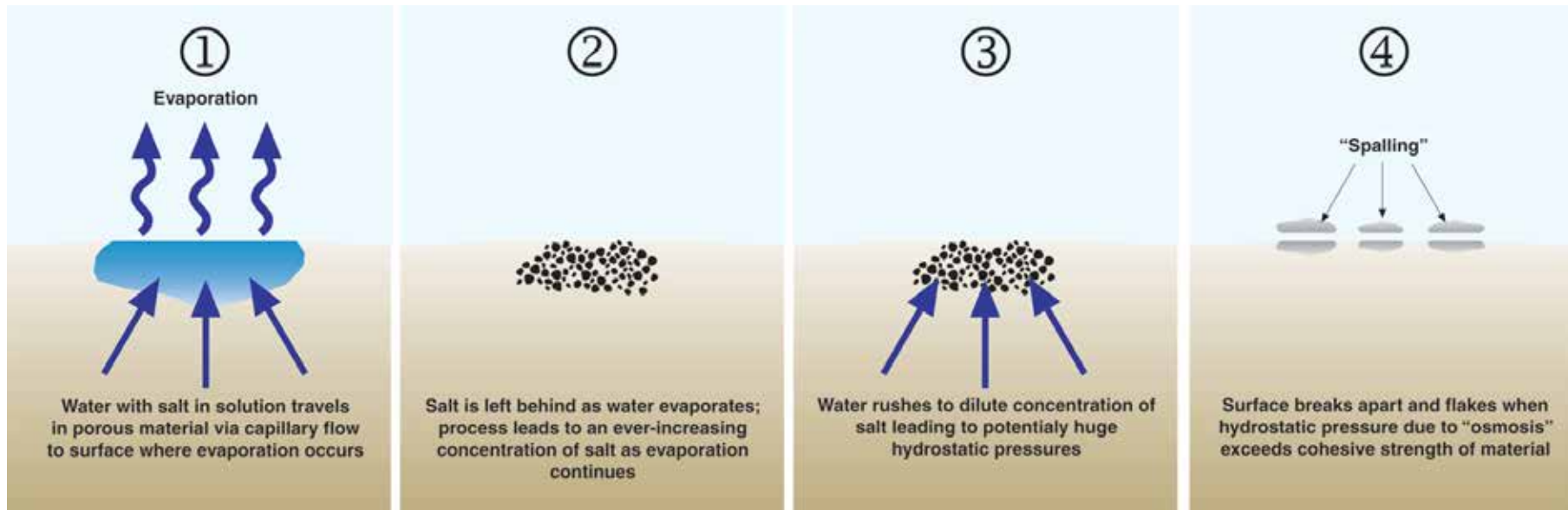
2nd Law of Thermodynamics

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

Capillarity + Salt = Osmosis

- Mineral salts carried in solution by capillary water
- When water evaporates from a surface the salts left behind form crystals in process called efflorescence
- When water evaporated beneath a surface the salts crystallize within the pore structure of the material in called sub-efflorescence
- The salt crystallization causes expansive forces that can exceed the cohesive strength of the material leading to spalling

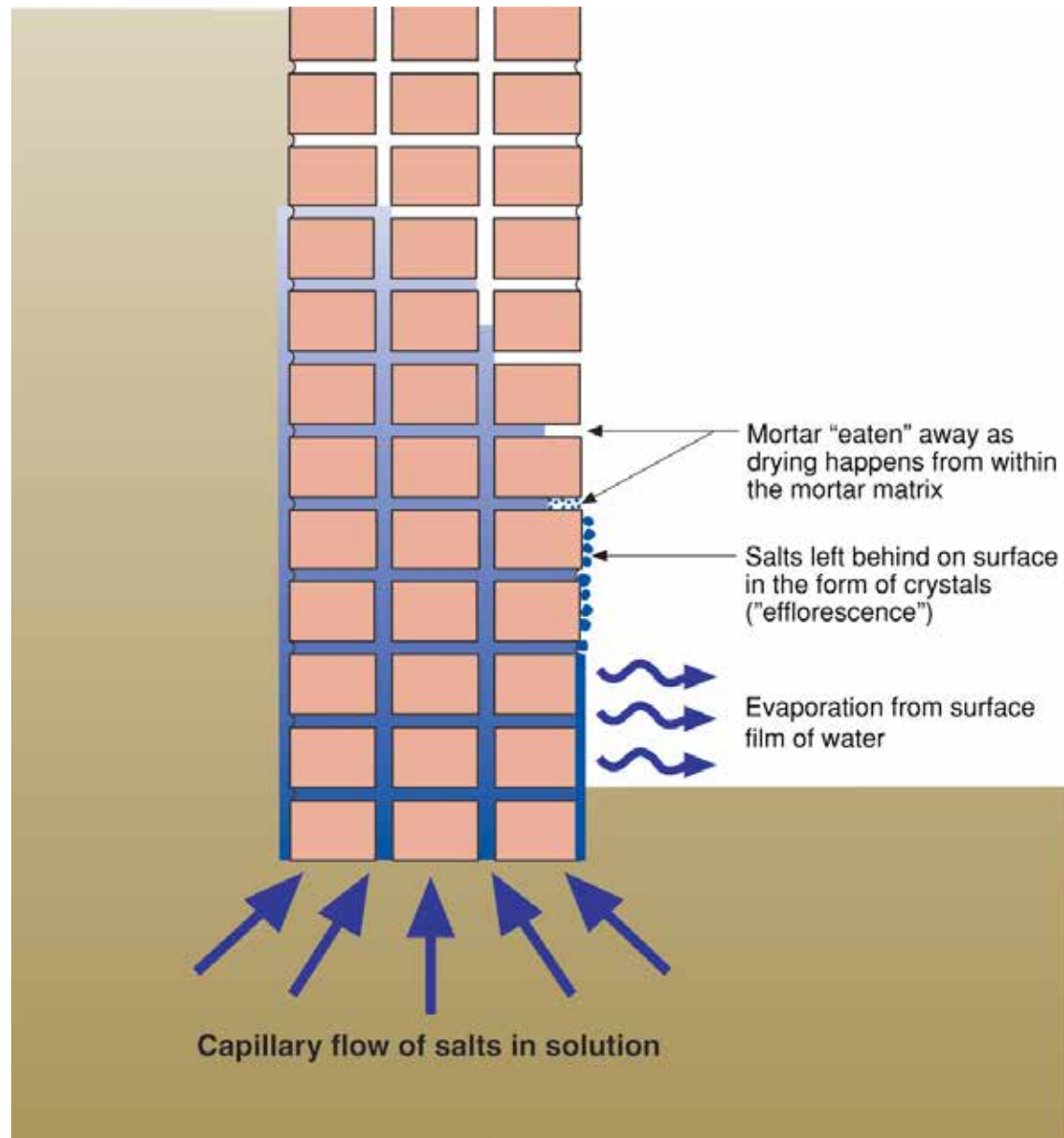


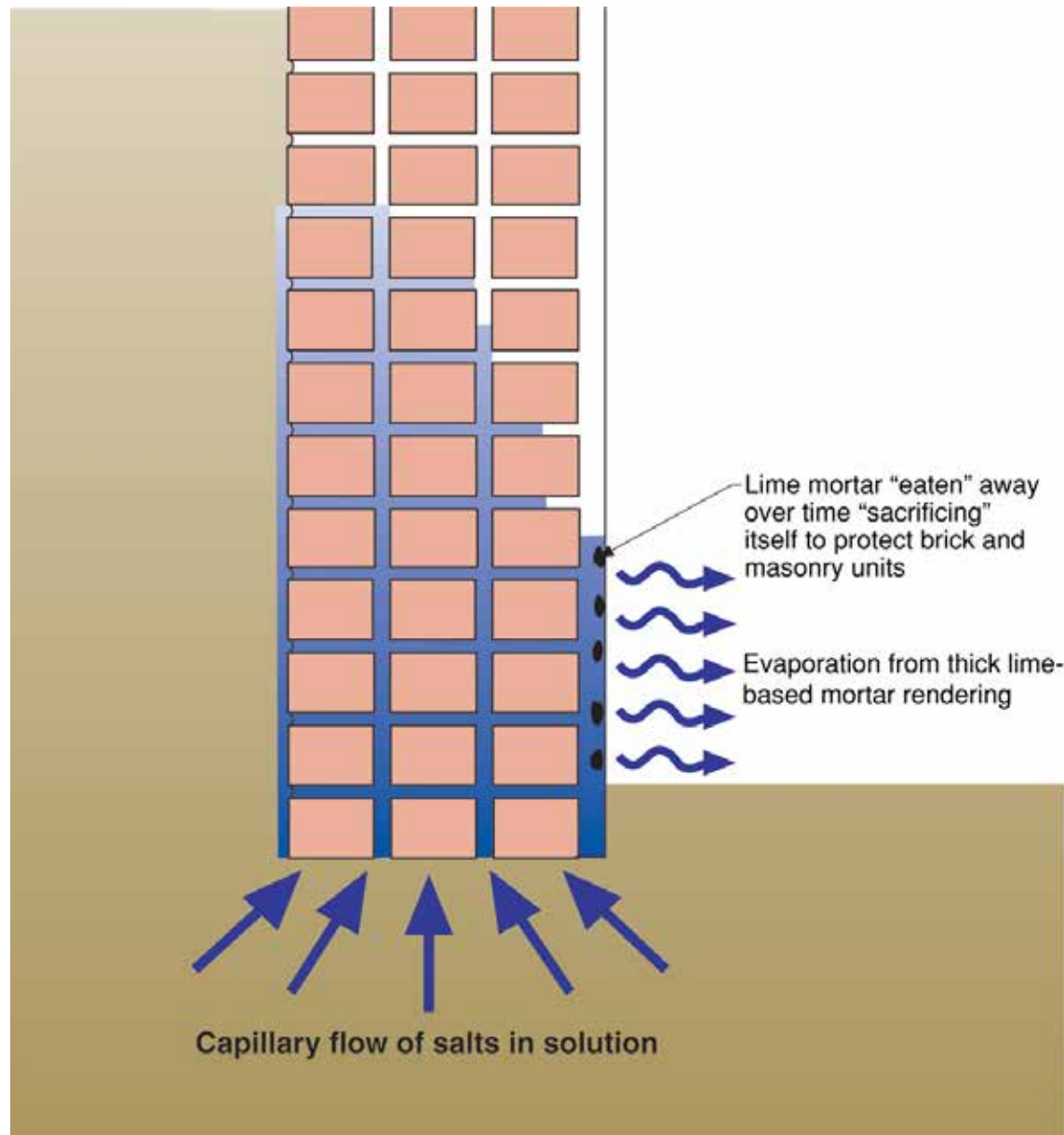
Diffusion + Capillarity + Osmosis = Problem

- Diffusion Vapor Pressure 3 to 5 psi
- Capillary Pressure 300 to 500 psi
- Osmosis Pressure 3,000 to 5,000 psi









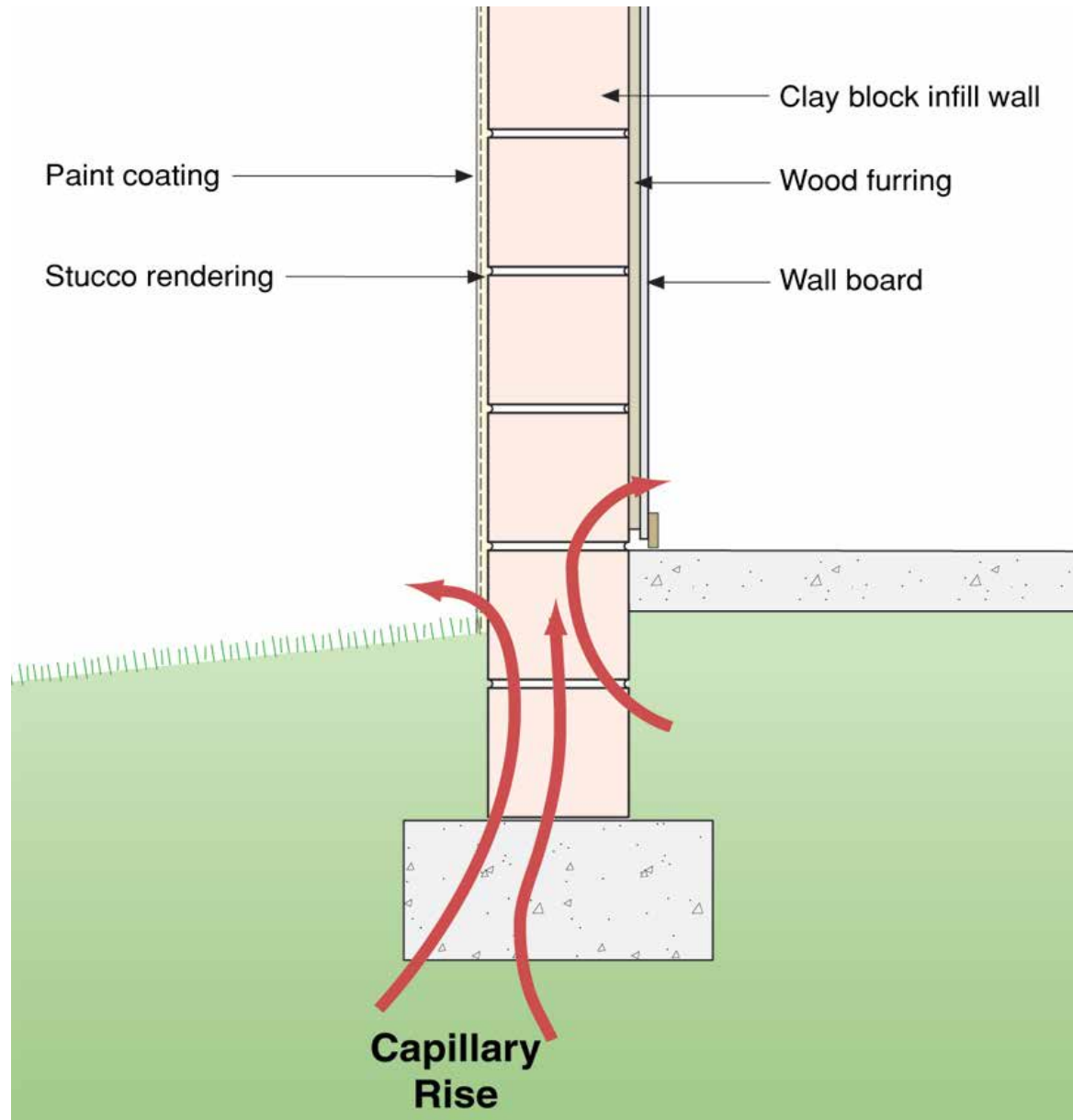


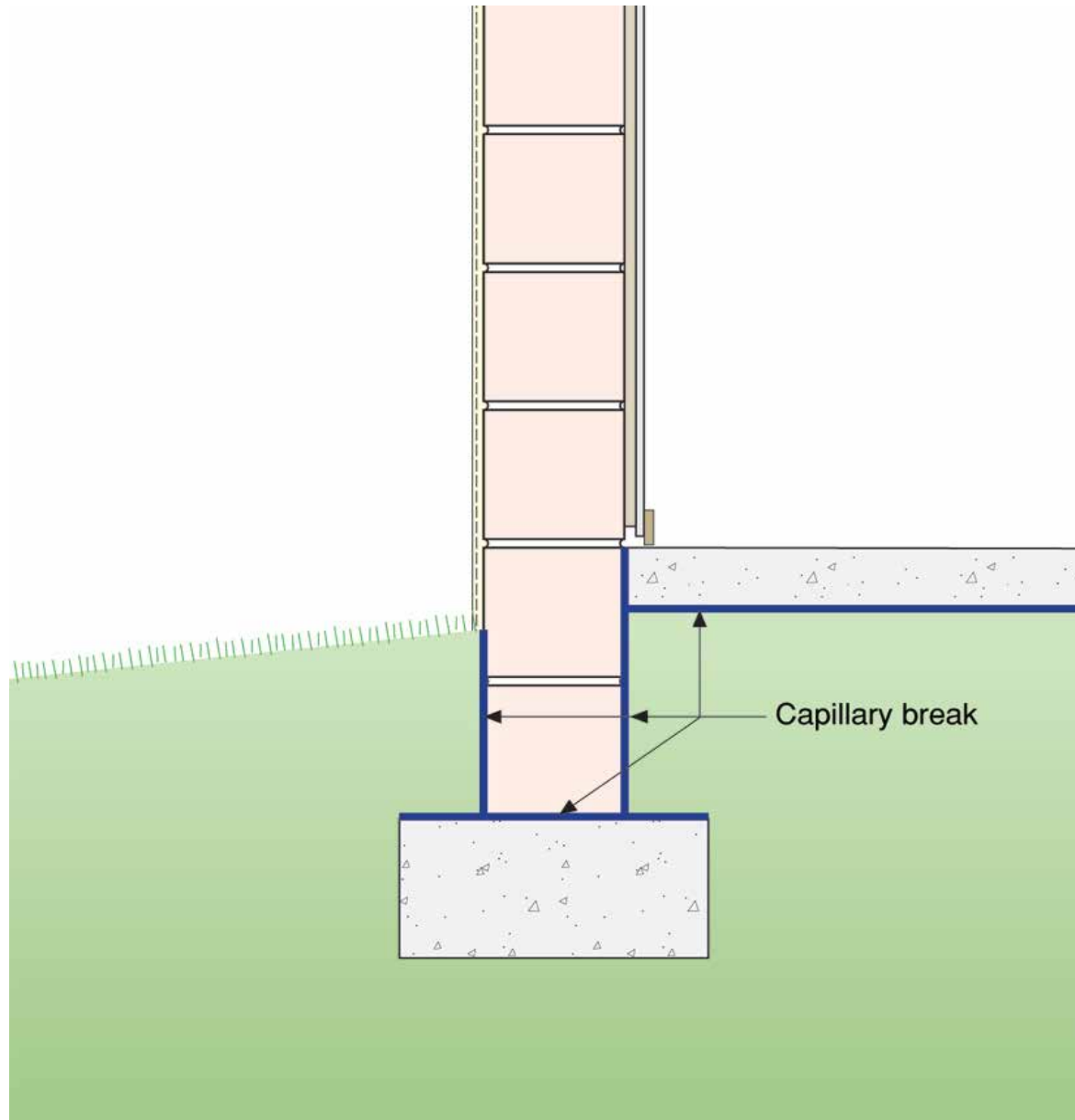


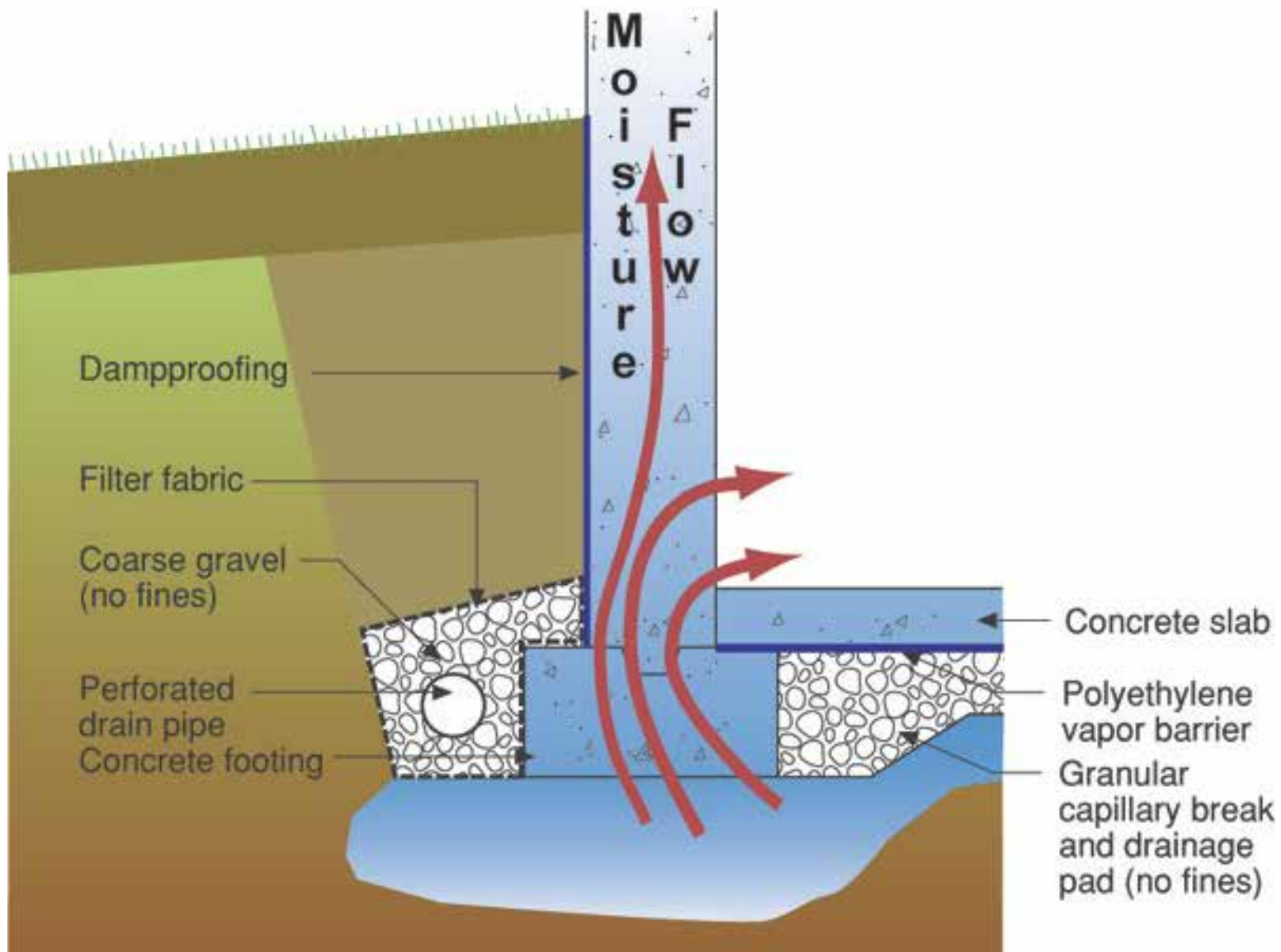


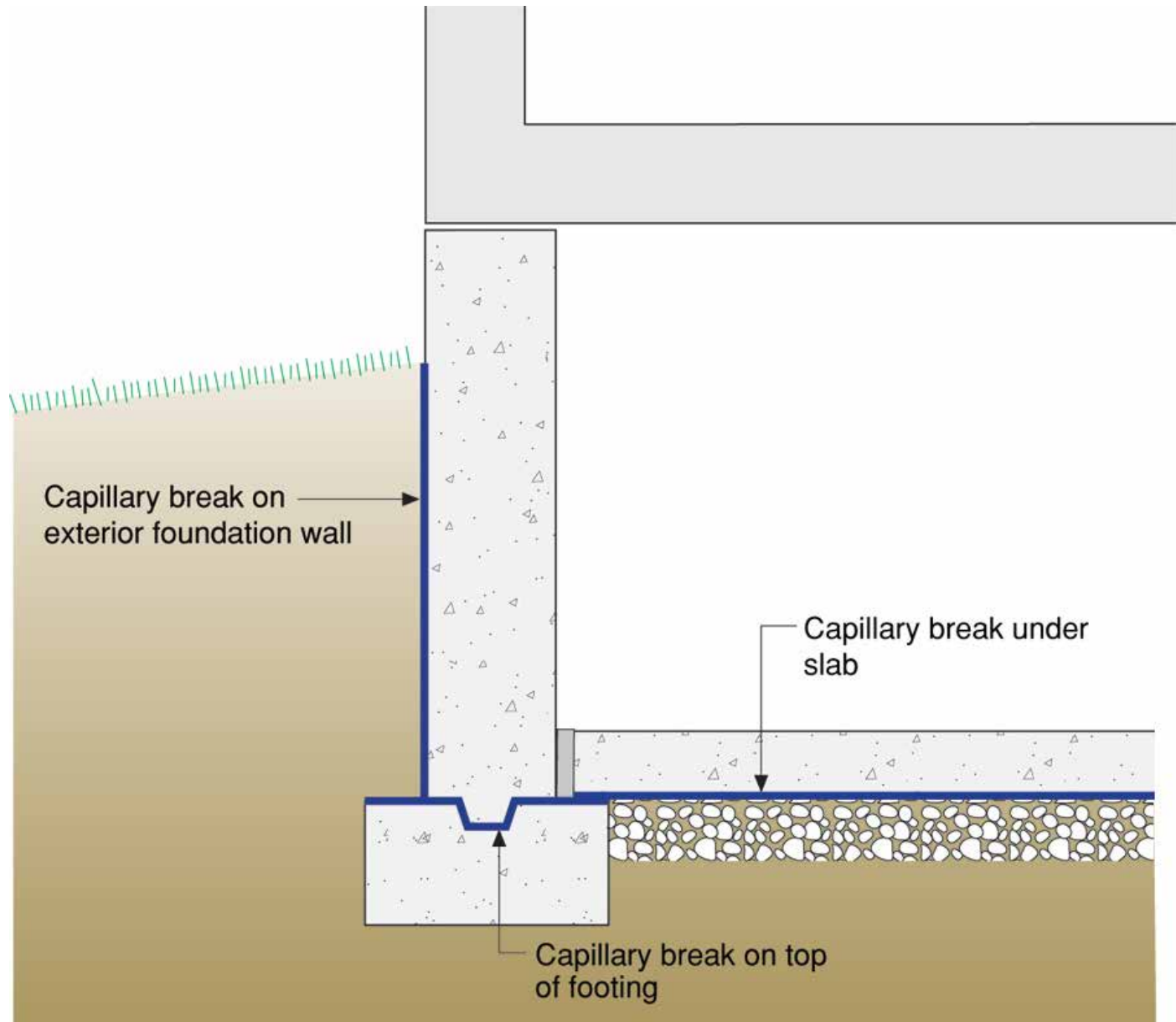
















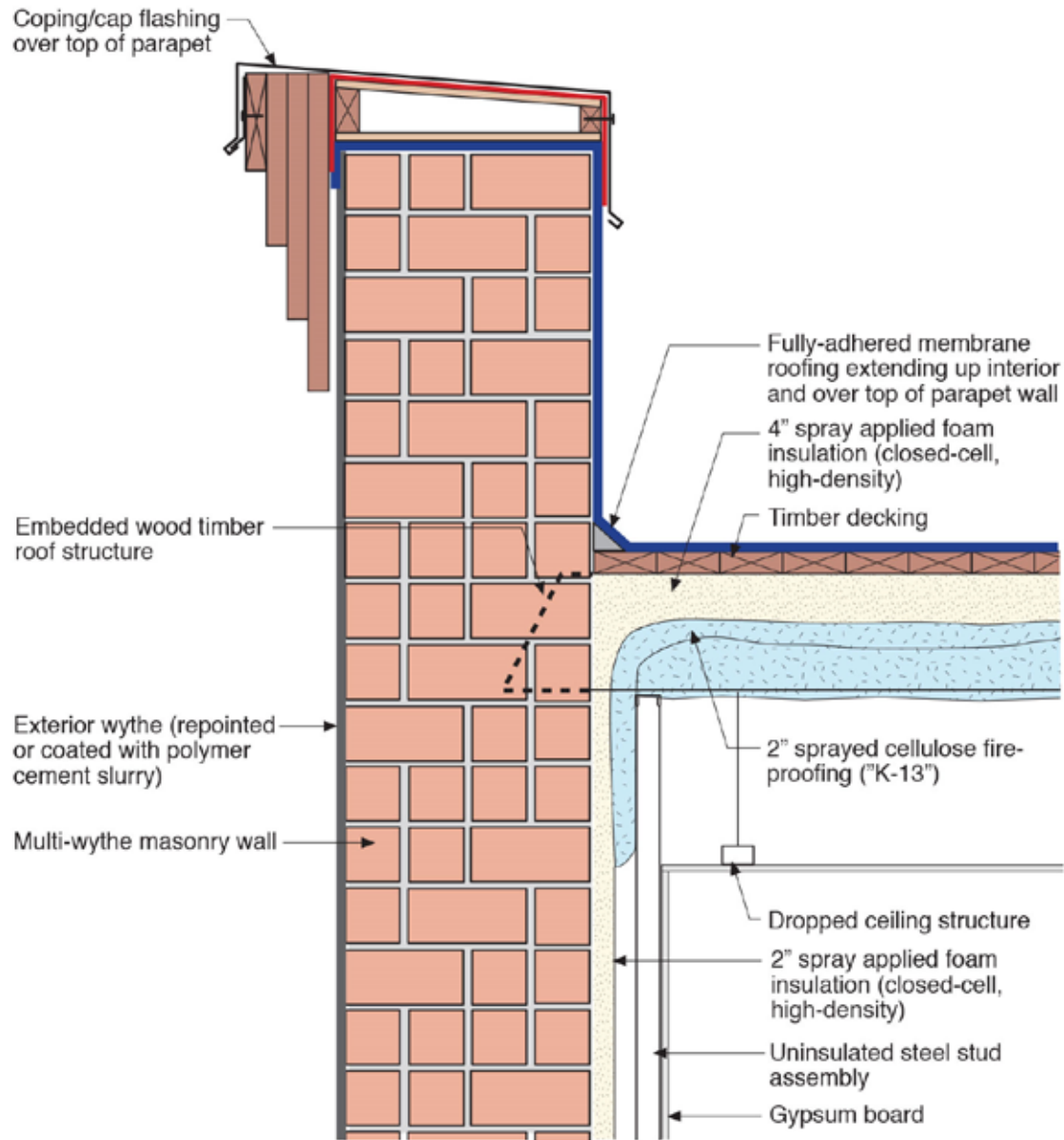






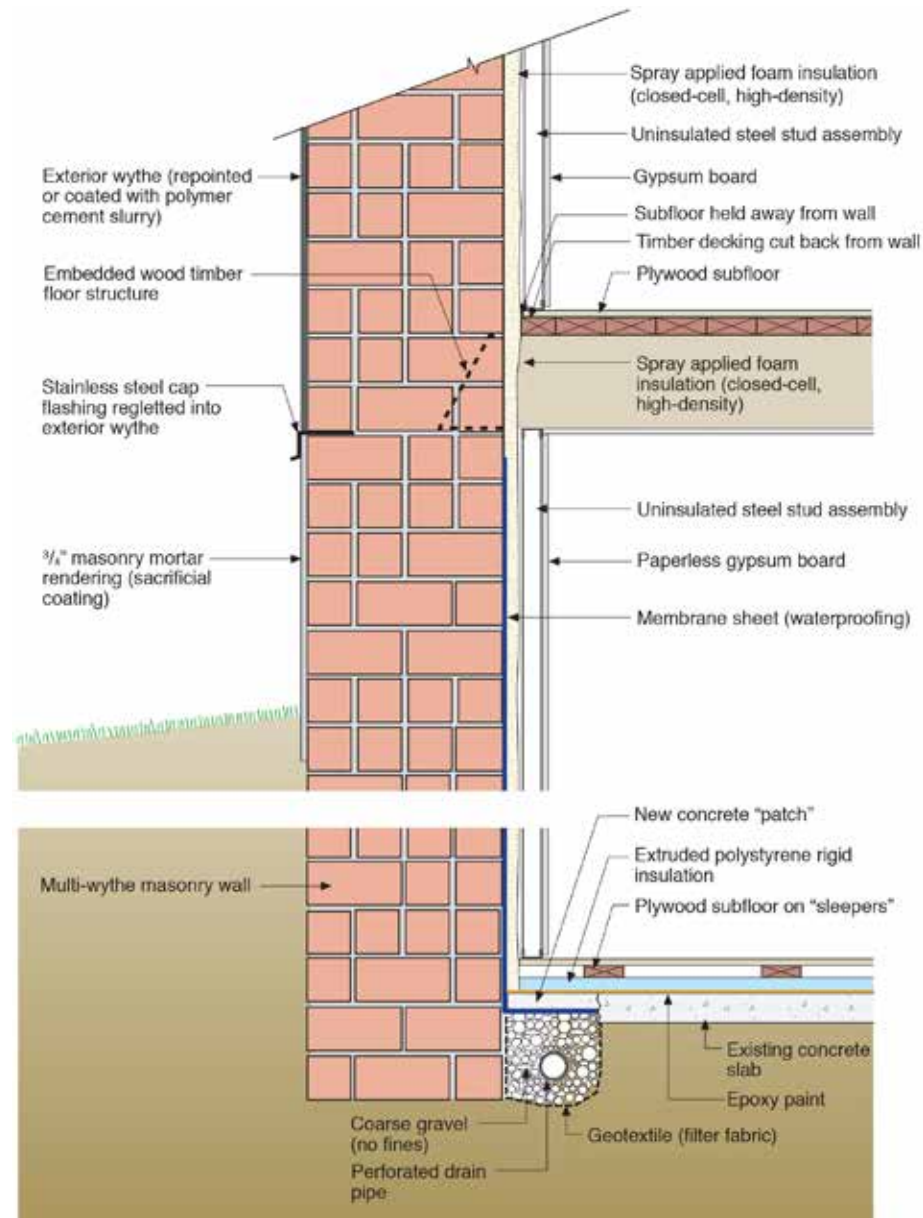


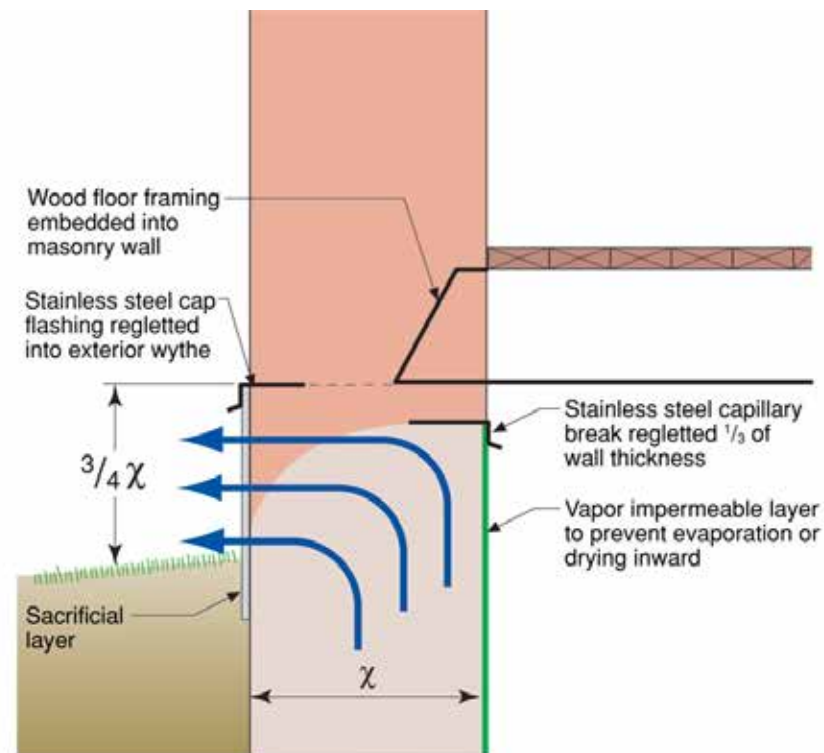
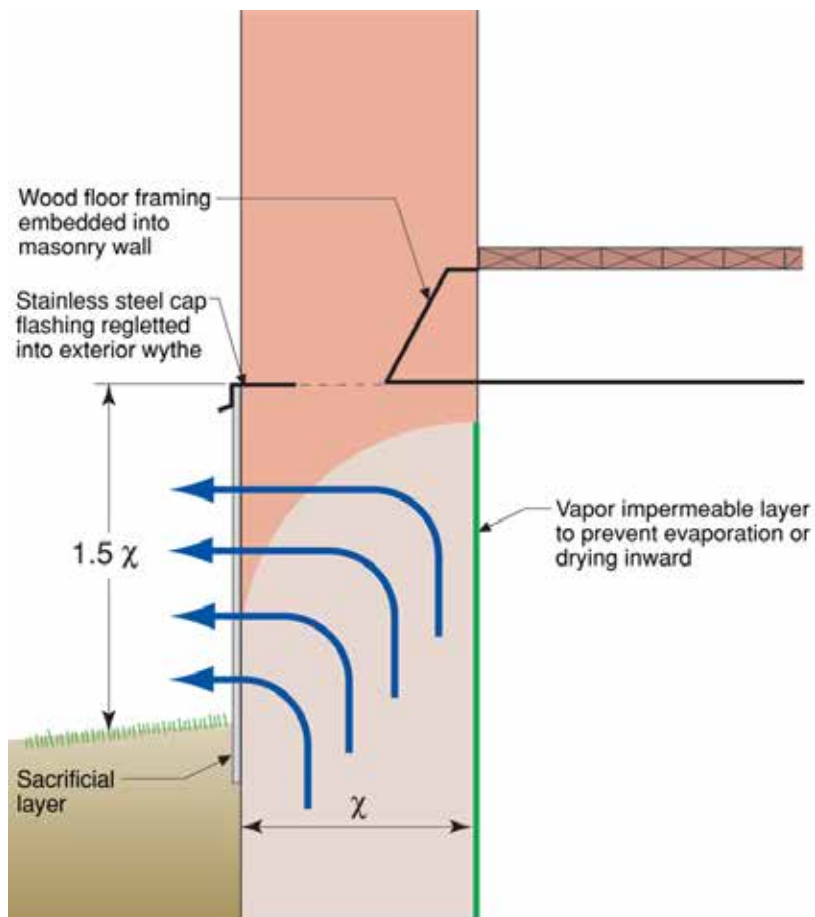


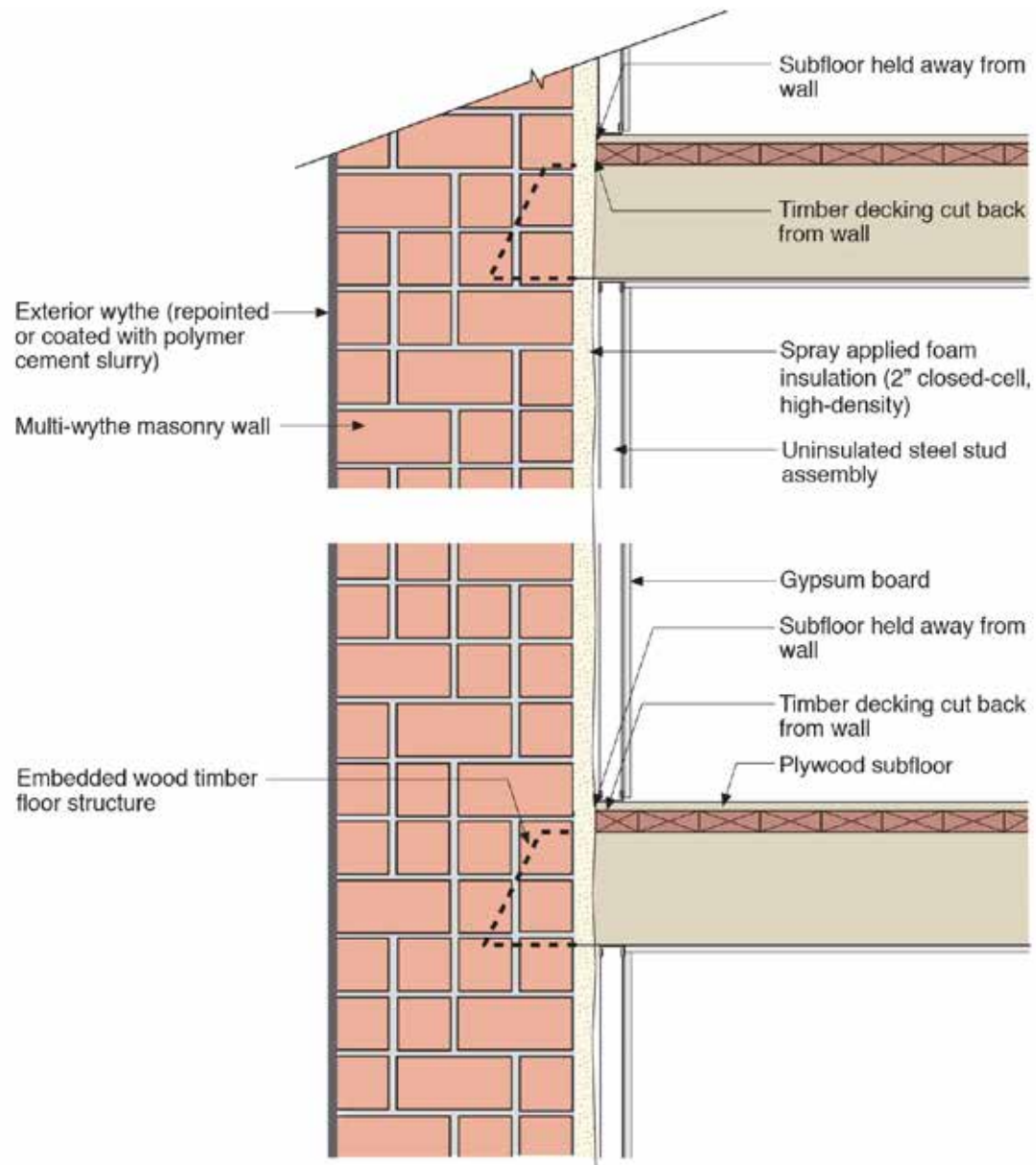


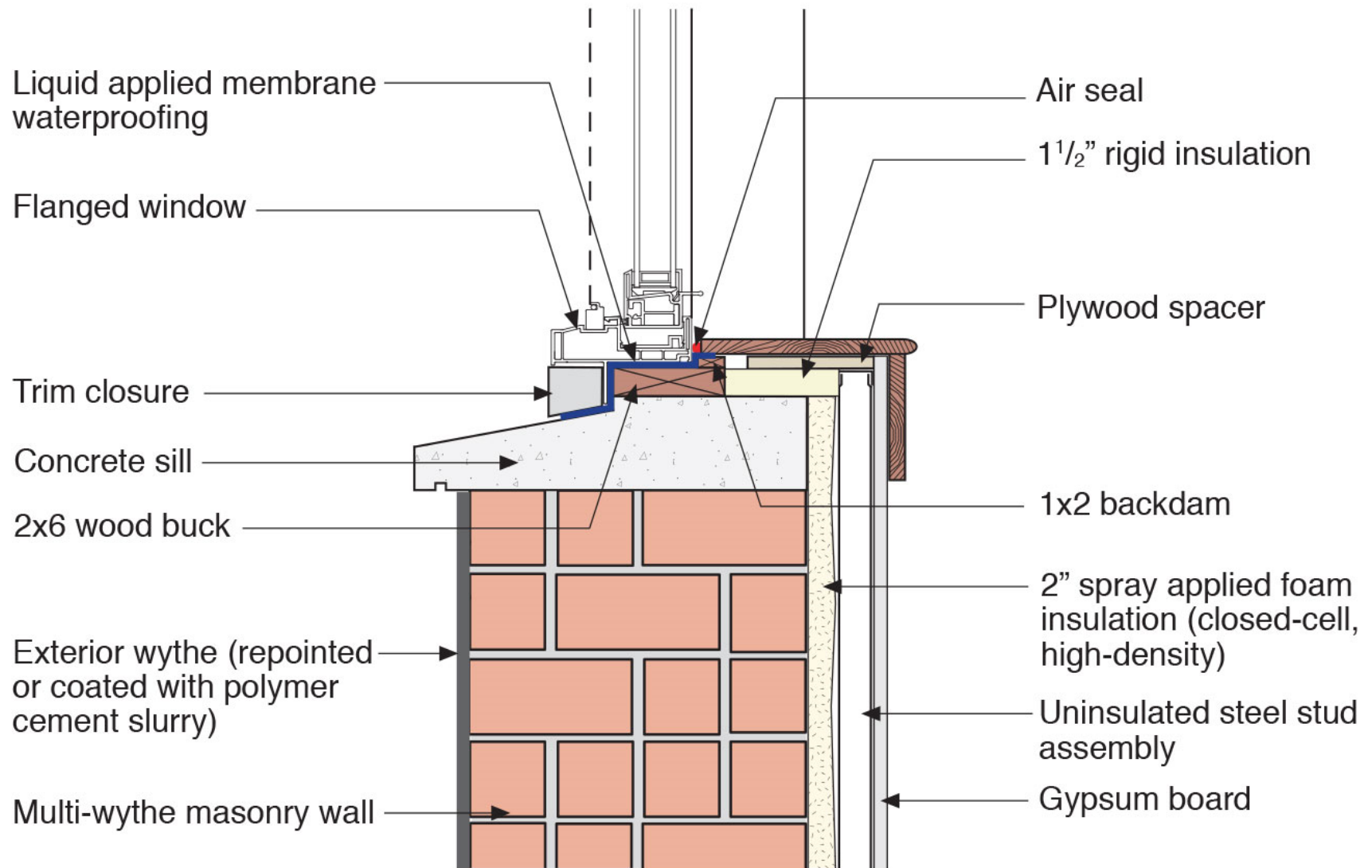


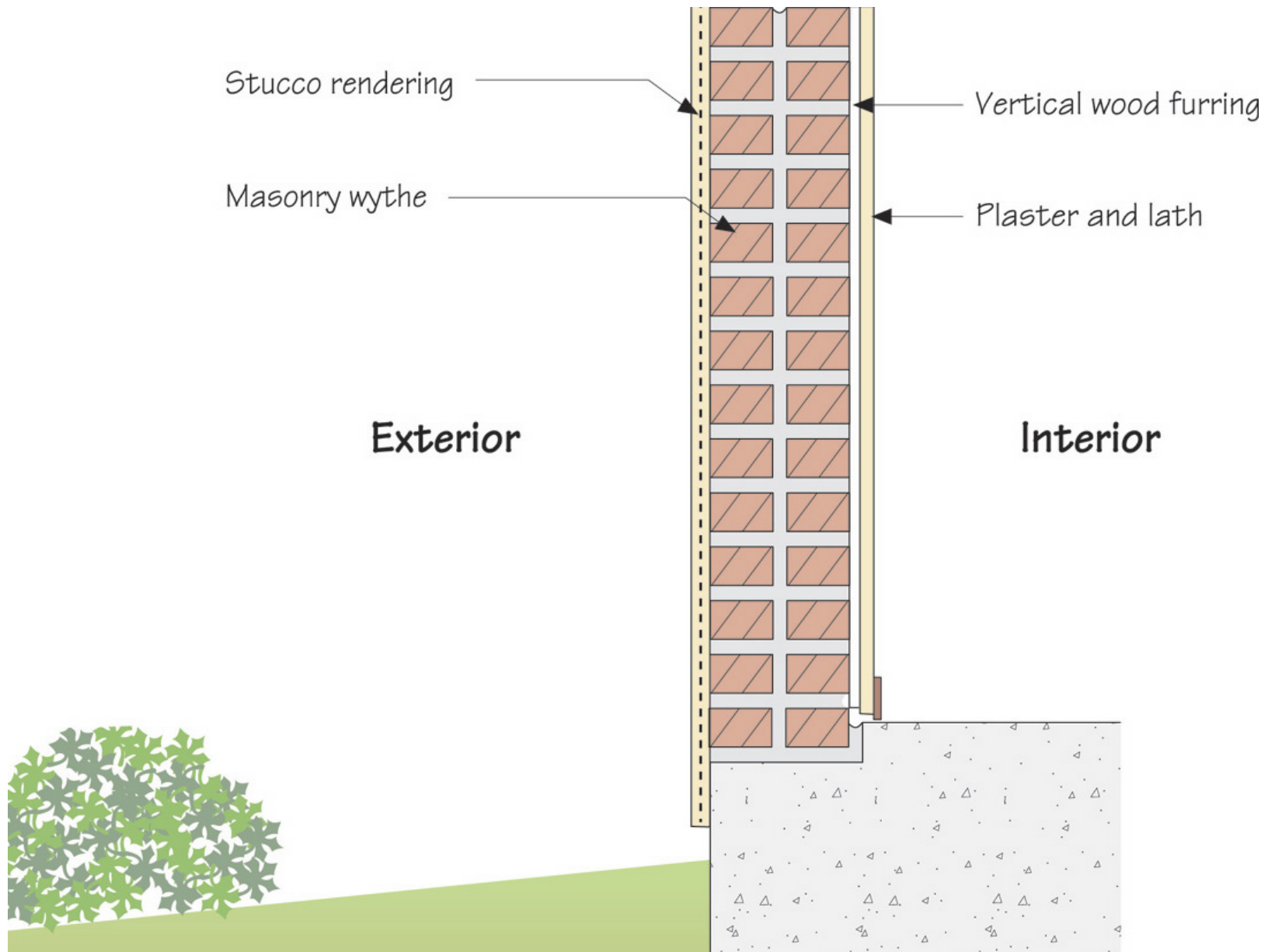






















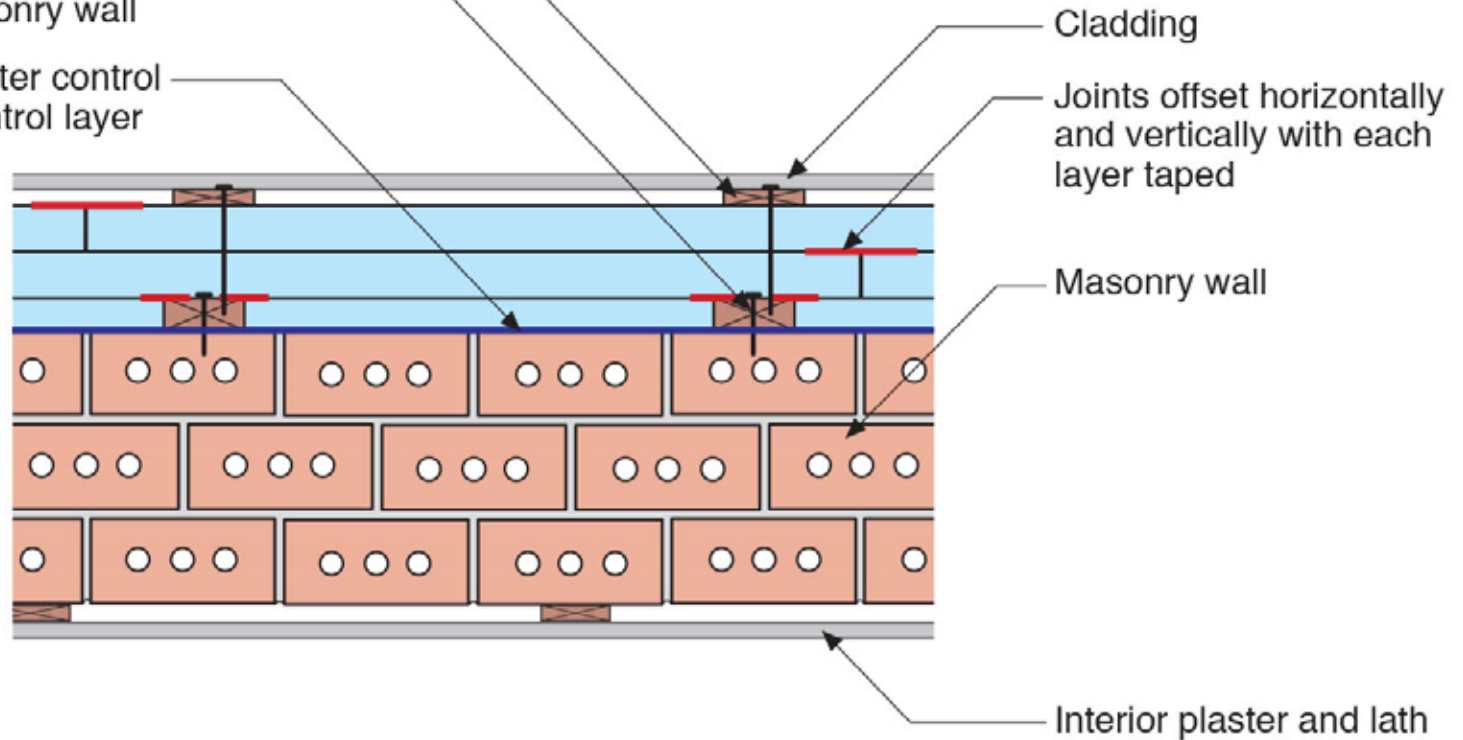




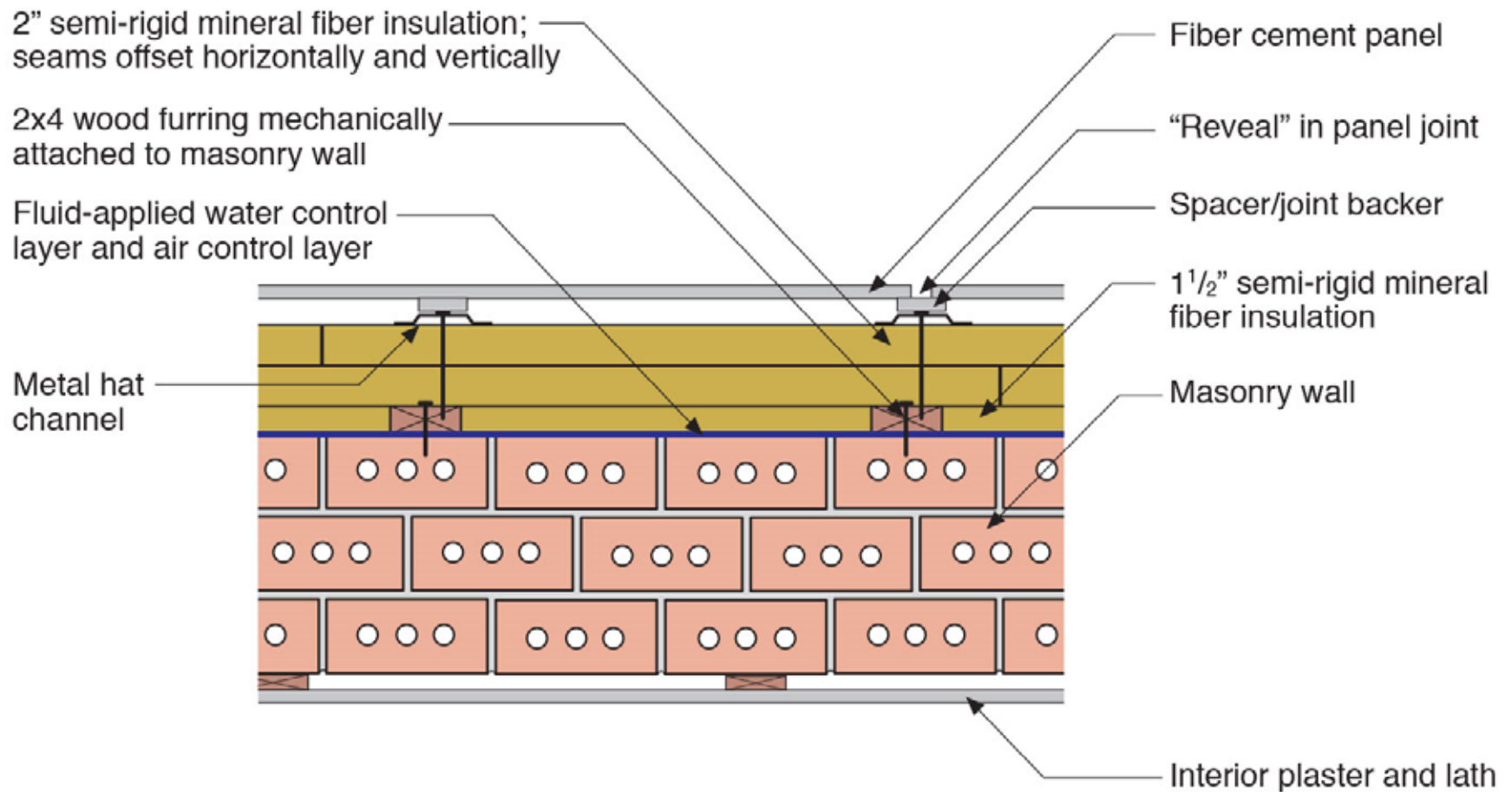
1x4 wood furring attached through rigid insulation to 2x4 wood furring

2x4 wood furring mechanically attached to masonry wall

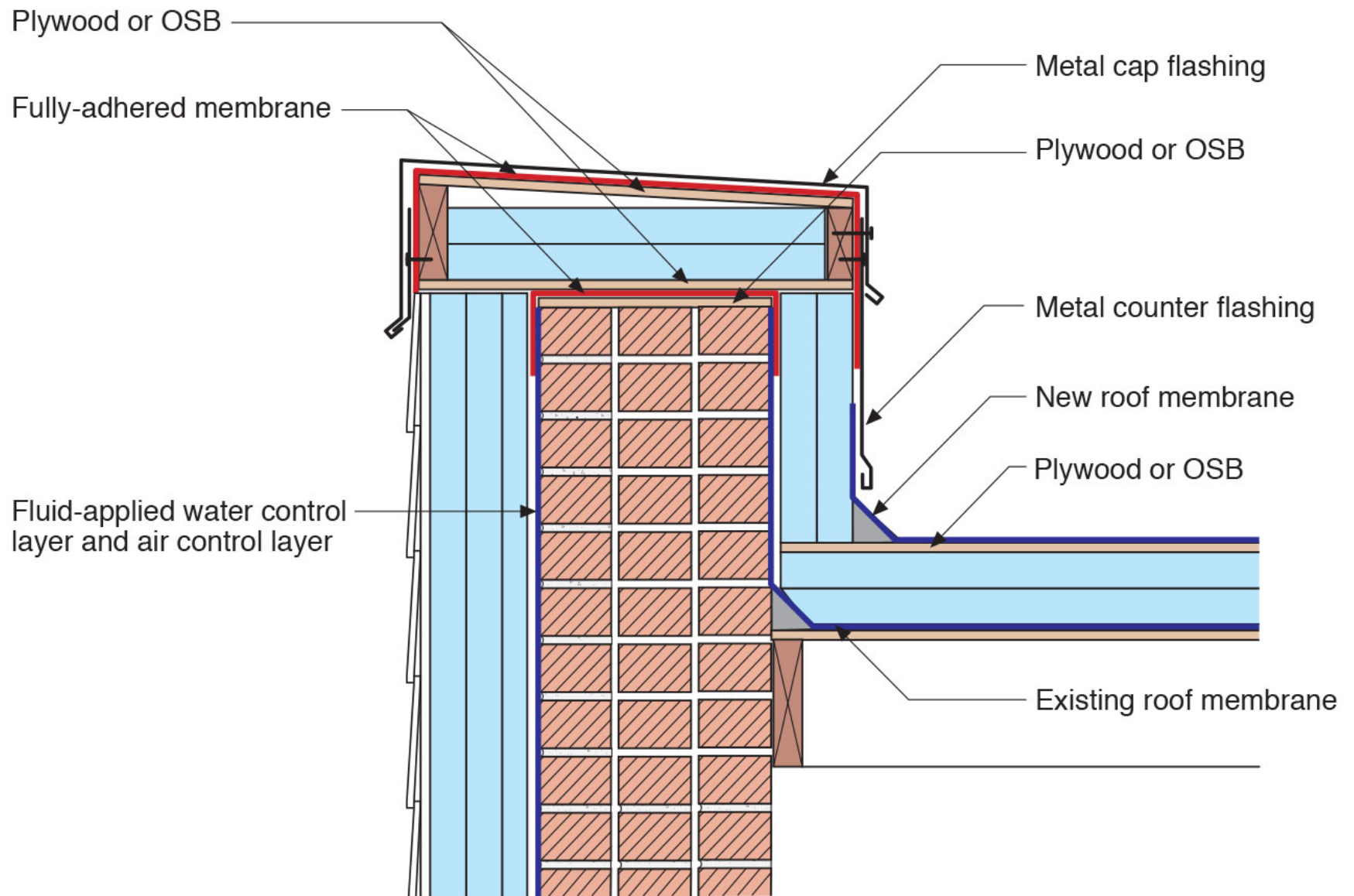
Fluid-applied water control layer and air control layer

















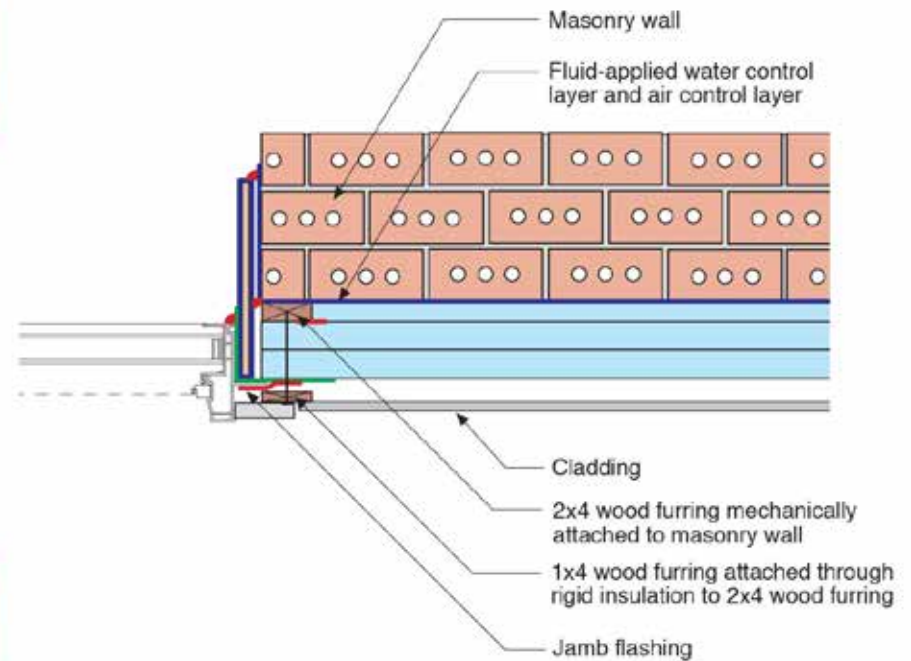
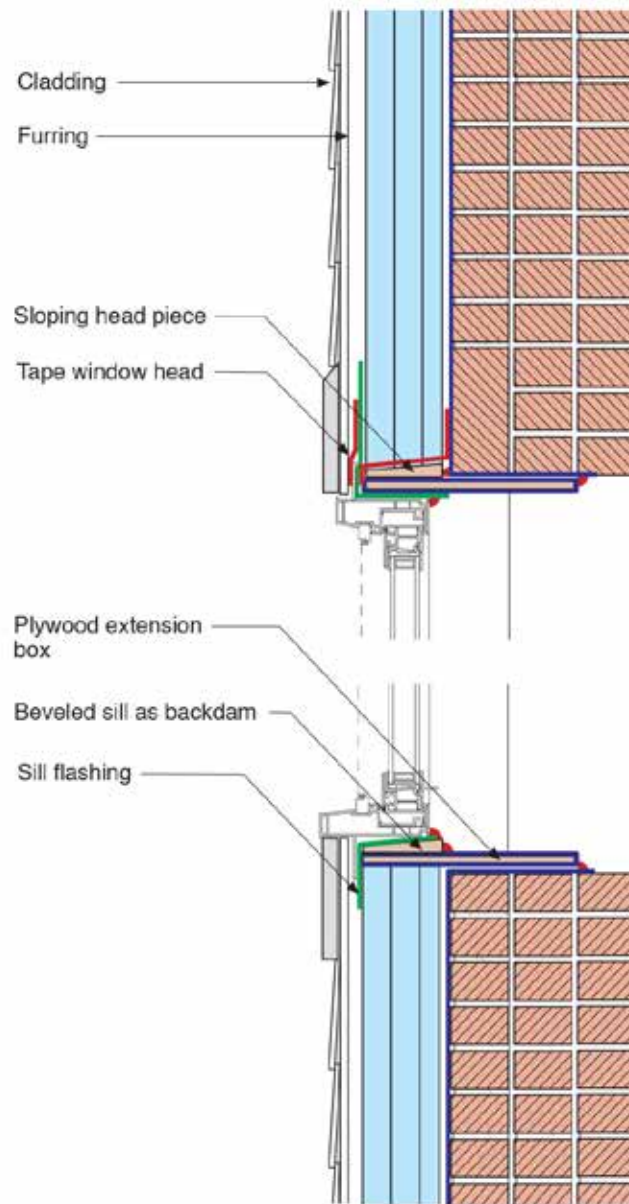


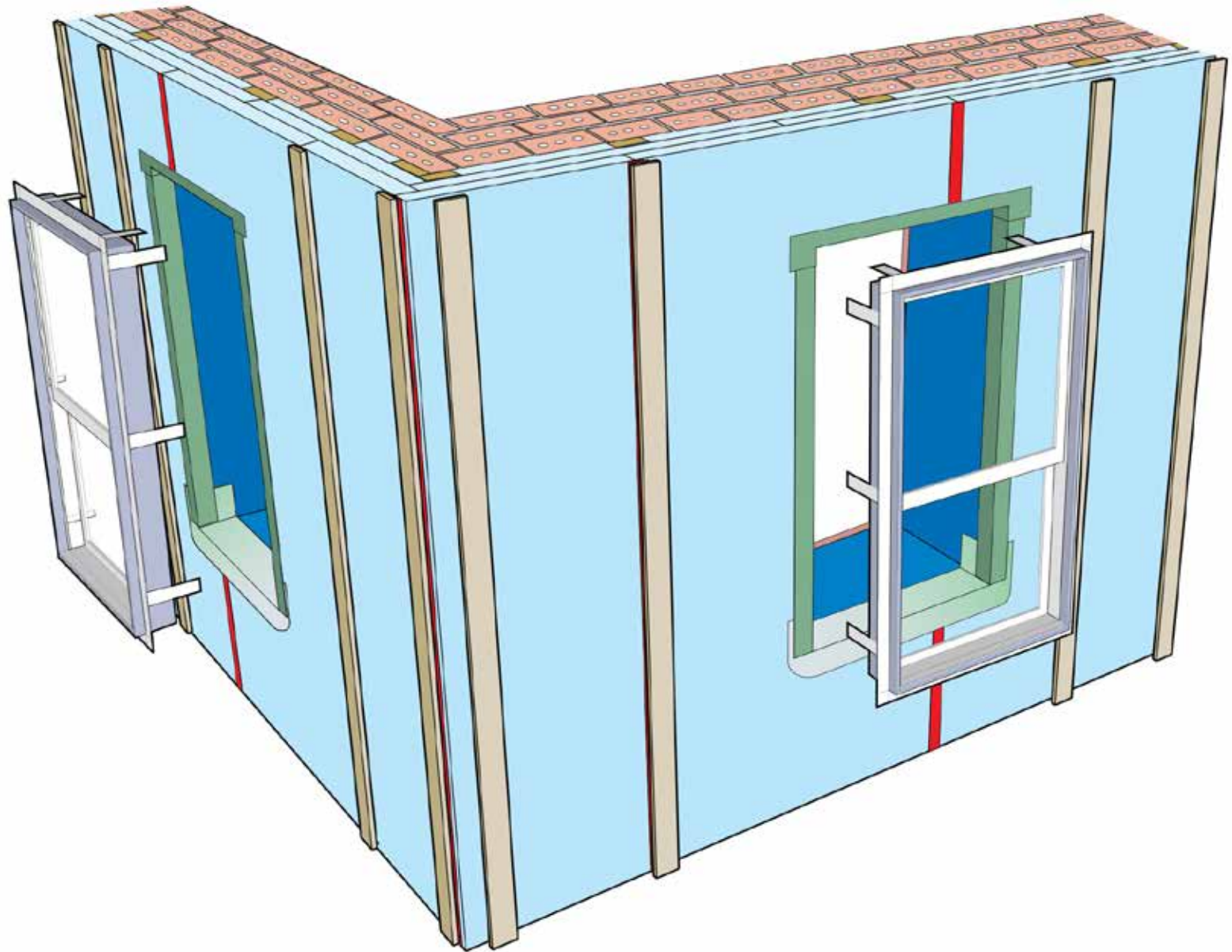














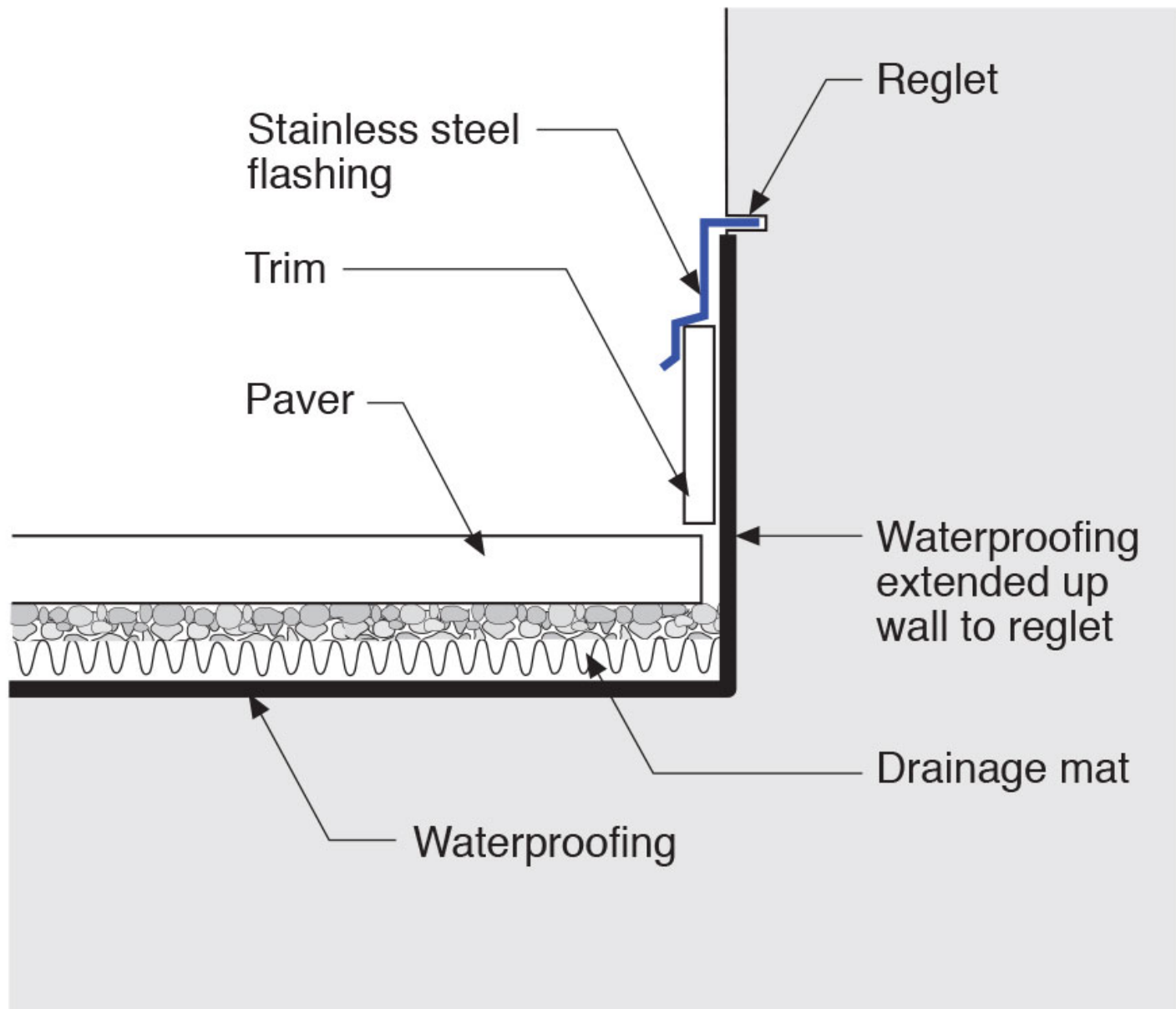






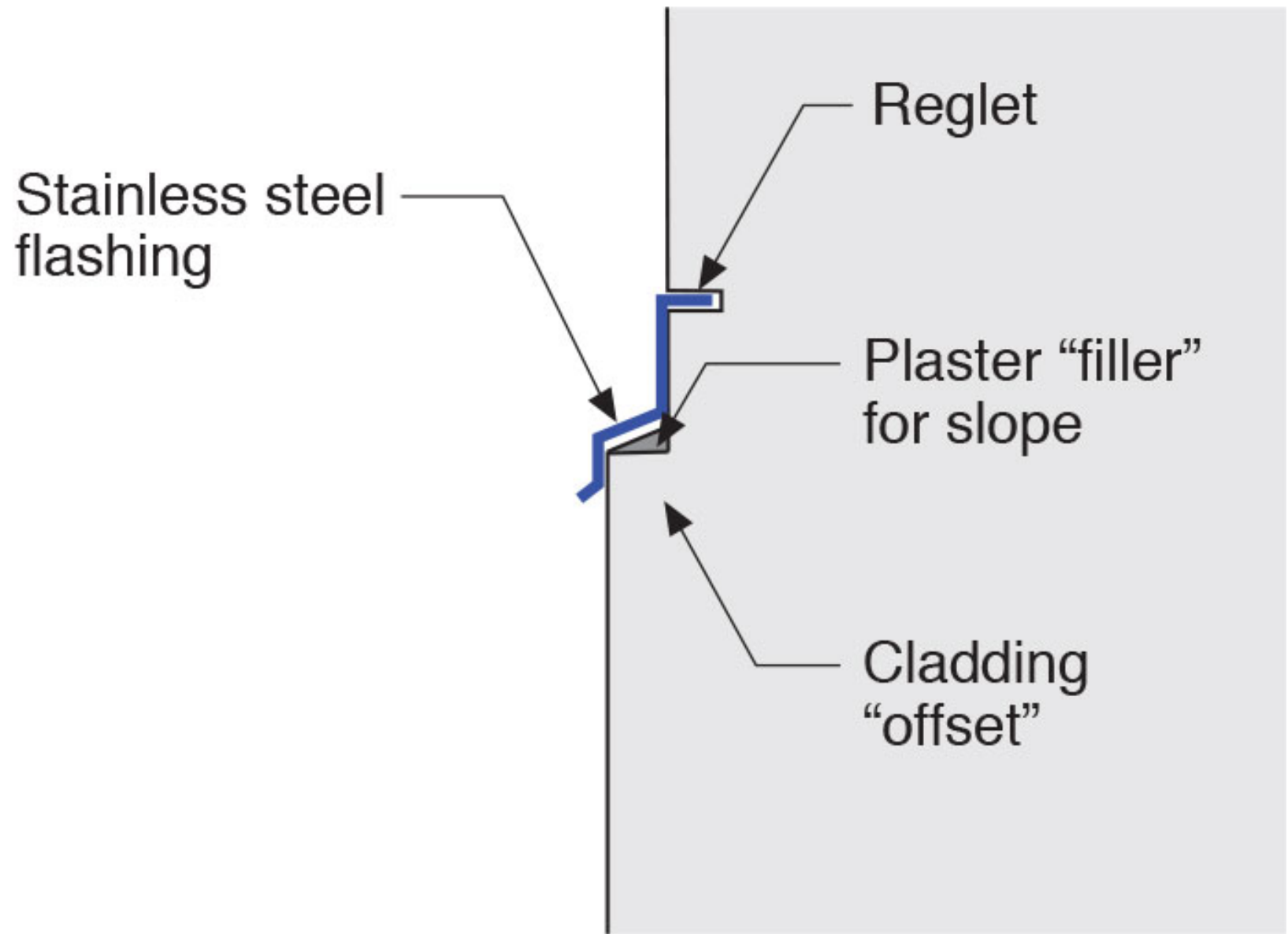




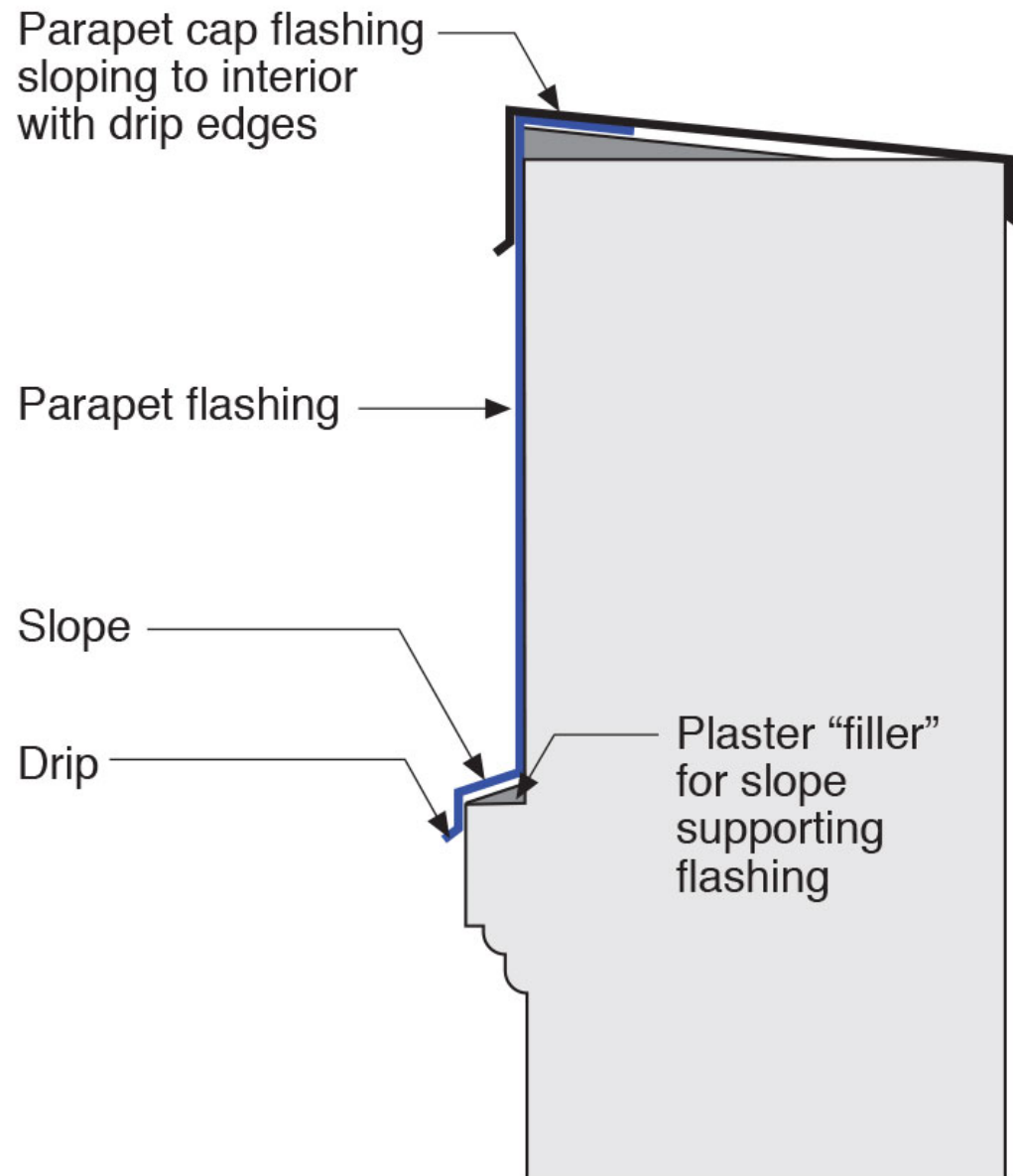












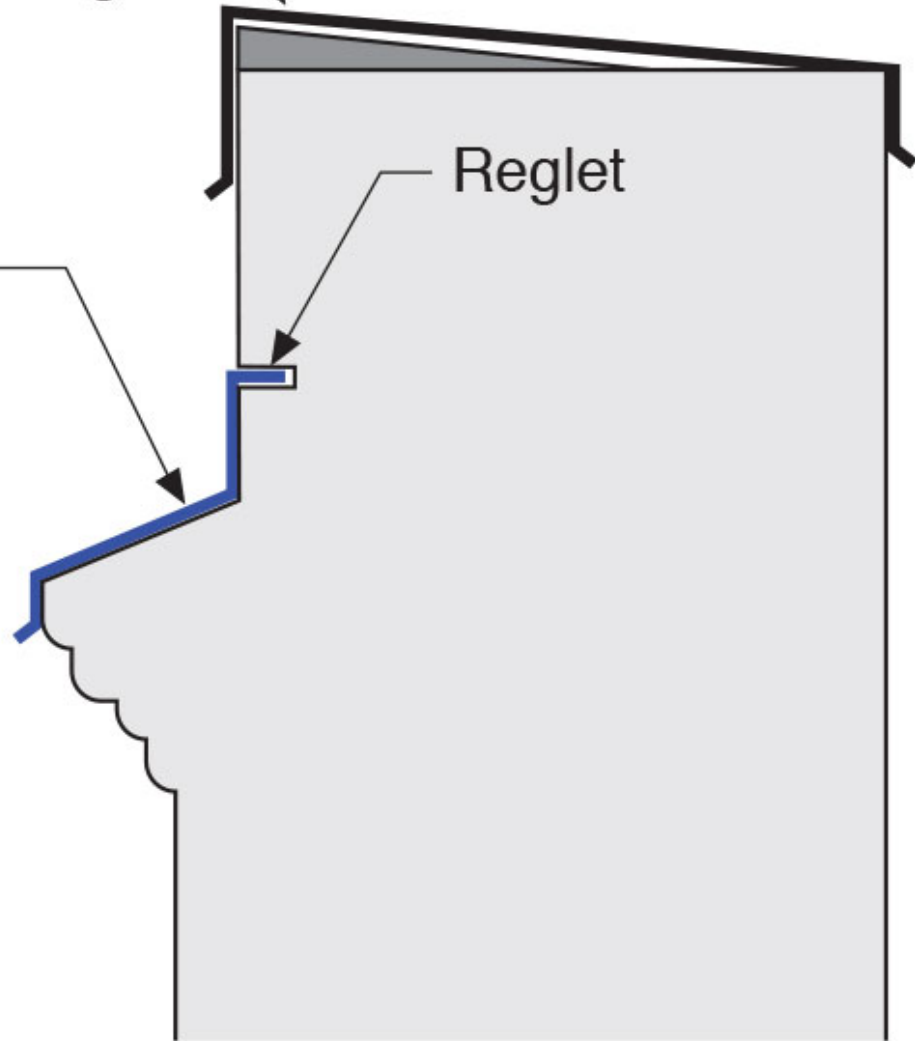




Sloping to interior cap
flashing with drip edges

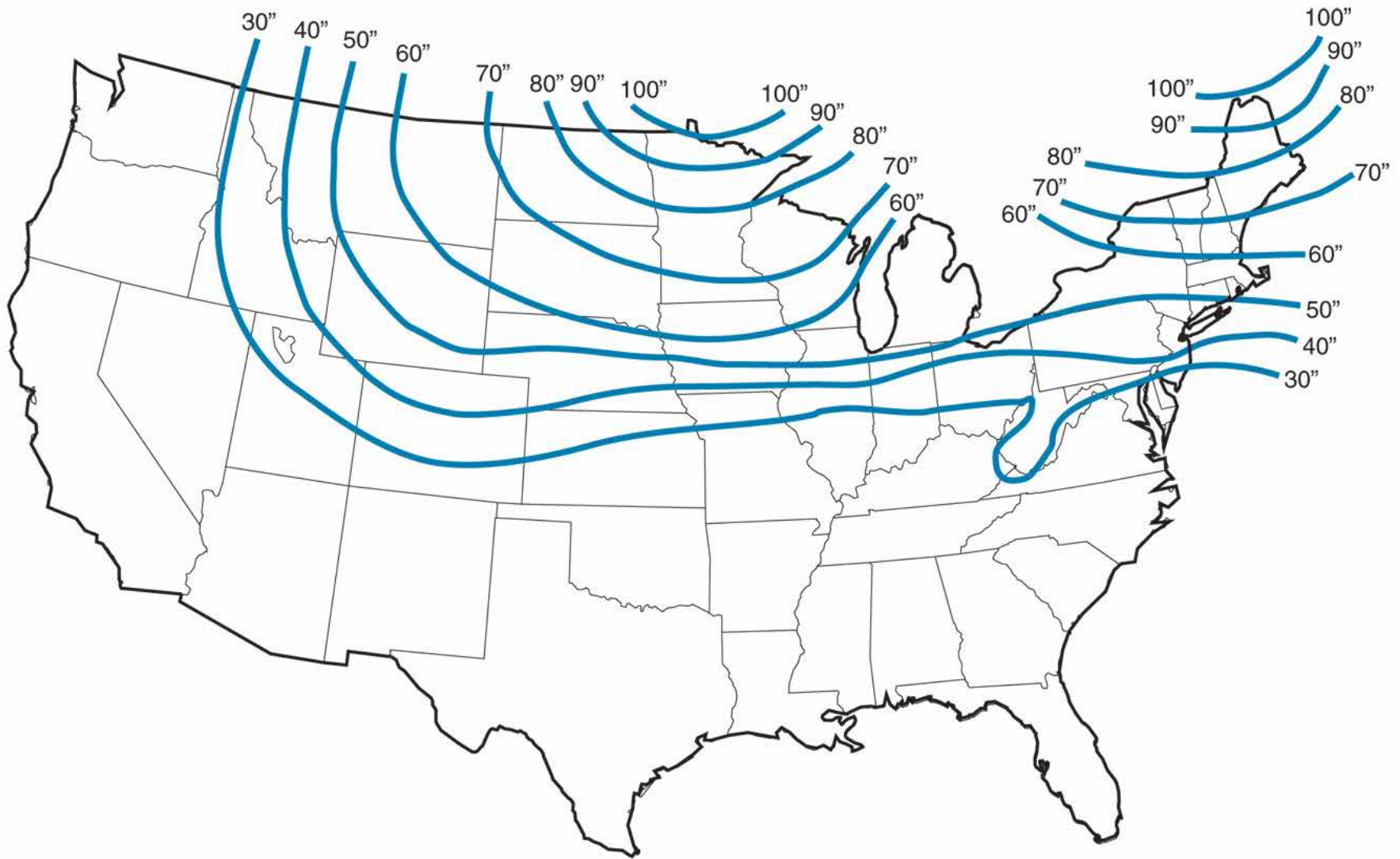
Stainless steel
flashing

Reglet









From the US Army Corps Engineers Extreme Frost Penetration
(in inches) based on state averages.

