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Building Science

Adventures In Building Science

www.buildingscience.com

What is a Building?

A Building is an Environmental Separator

- Control heat flow
- Control airflow
- Control water vapor flow
- Control rain
- Control ground water
- Control light and solar radiation
- Control noise and vibrations
- Control contaminants, environmental hazards and odors
- Control insects, rodents and vermin
- Control fire
- Provide strength and rigidity
- Be durable
- Be aesthetically pleasing
- Be economical

Order of Magnitude

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1 to 10

10 to 100

100 to 1000

1000 to 10000

First Order Effects, Second Order Effects.....

Arrhenius Equation

For Every 10 Degree K Rise
Reaction Rate Doubles

$$k = Ae^{-E_a/(RT)}$$

Damage Functions

Water

Heat

Ultra-violet Radiation

The Three Biggest Problems In Buildings Are Water, Water and Water...

80 Percent of all Construction Problems are Related to Water

Thermodynamics

Zeroth Law – Equal Systems

First Law - Conservation of Energy

Second Law - Entropy

Third Law – Absolute Zero

2nd Law of Thermodynamics

In an isolated system, a process can occur only if it increases the total entropy of the system

Rudolf Clausius

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

Moisture Flow Is From Warm To Cold
Moisture Flow Is From More To Less

Moisture Flow Is From Warm To Cold
Moisture Flow Is From More To Less

Thermal Gradient – Thermal Diffusion
Concentration Gradient – Molecular Diffusion

Moisture Flow Is From Warm To Cold
Moisture Flow Is From More To Less

Thermal Gradient – Thermal Diffusion
Concentration Gradient – Molecular Diffusion

Vapor Diffusion

Thermodynamic Potential



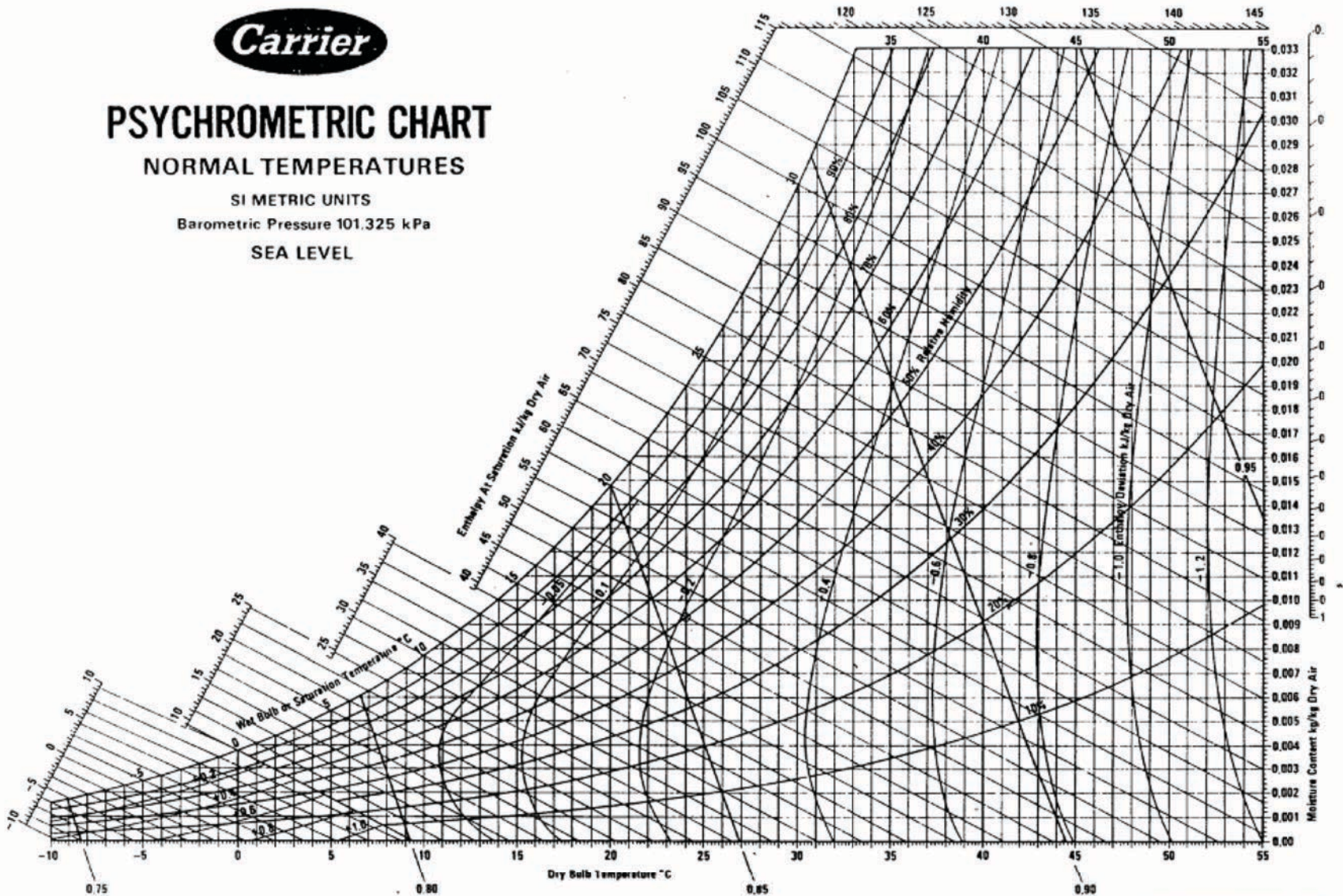
PSYCHROMETRIC CHART

NORMAL TEMPERATURES

SI METRIC UNITS

Barometric Pressure 101.325 kPa

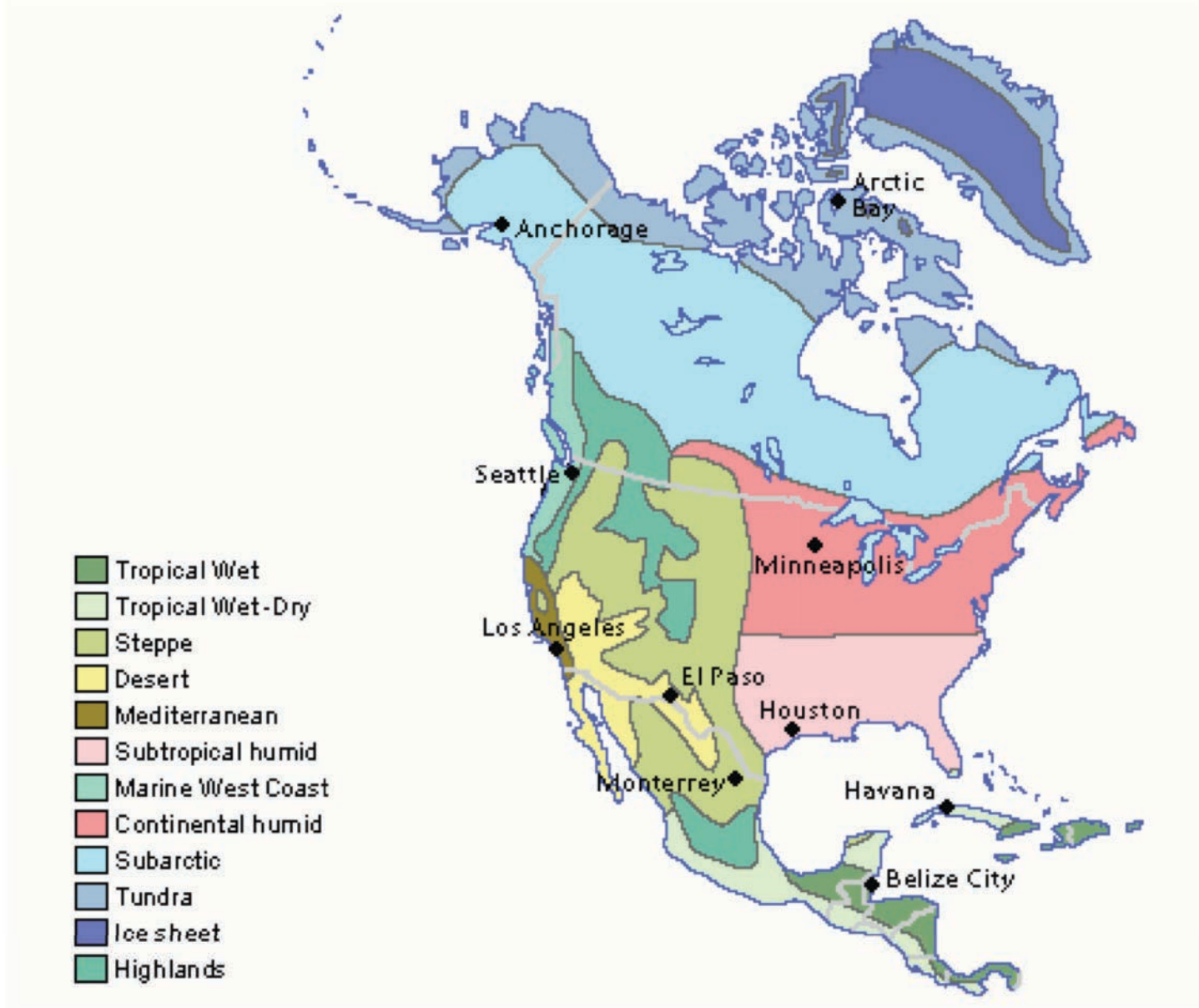
SEA LEVEL



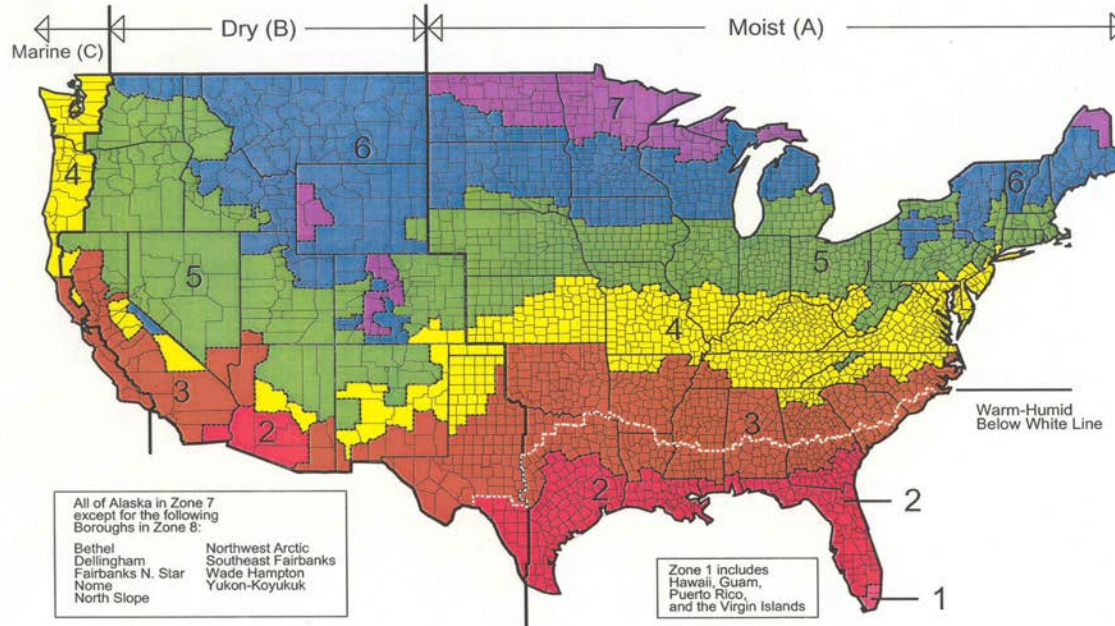
Below 0°C Properties and Enthalpy Deviation Lines Are For Ice

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Map of DOE's Proposed Climate Zones



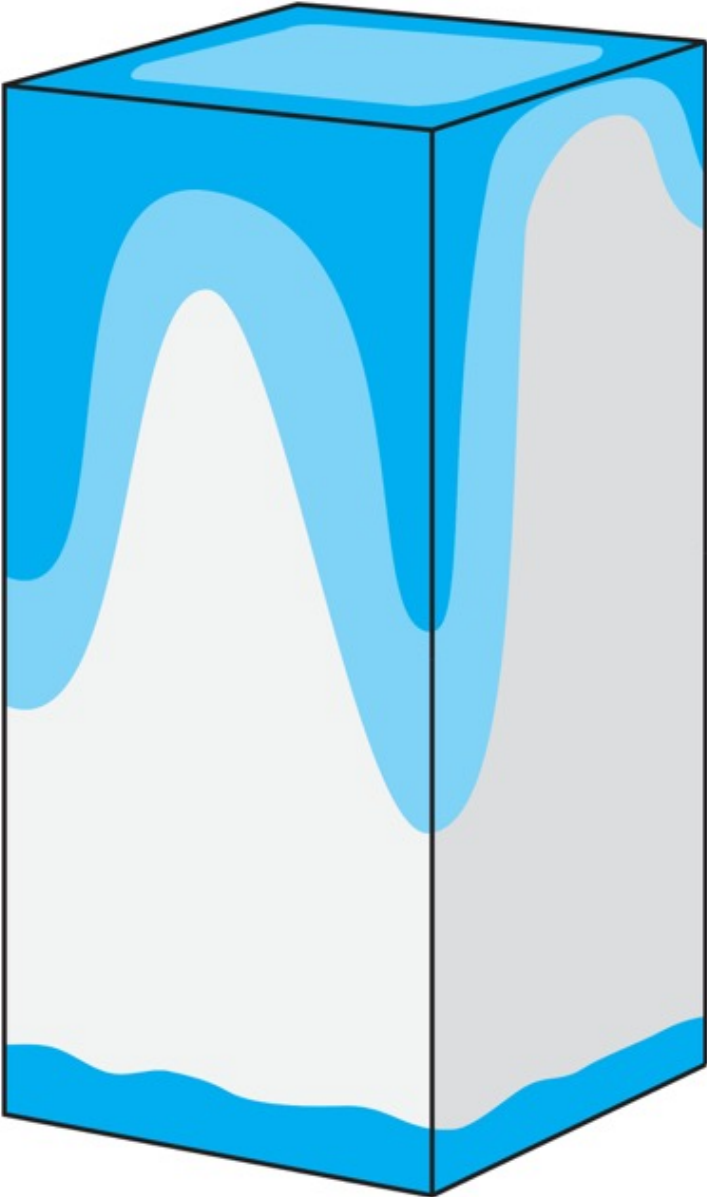
March 24, 2003

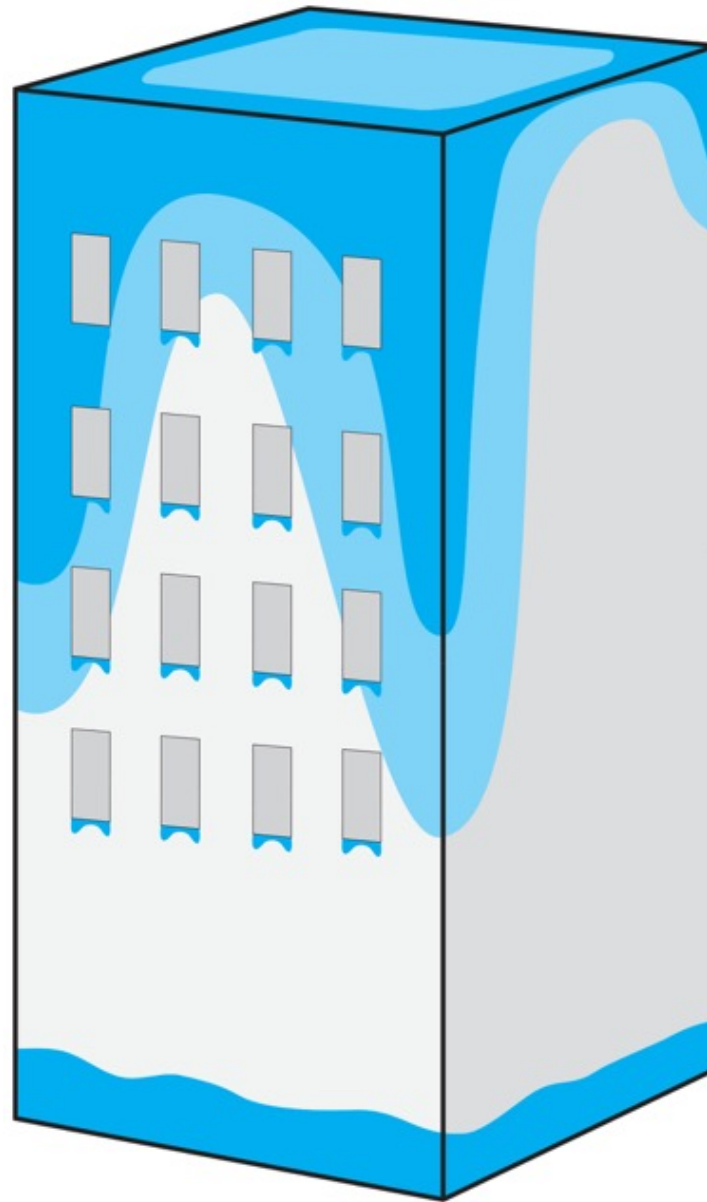


Exposure

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





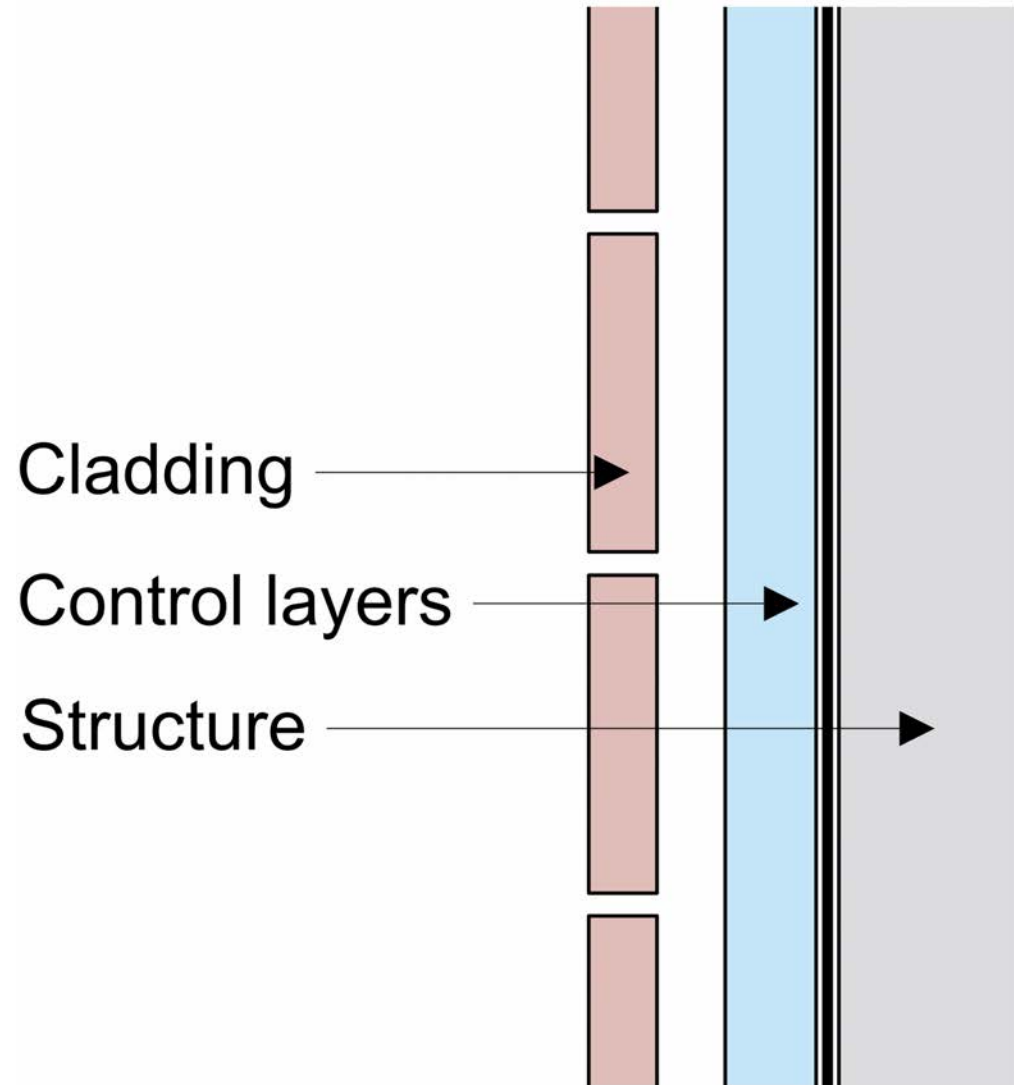


Water Control Layer

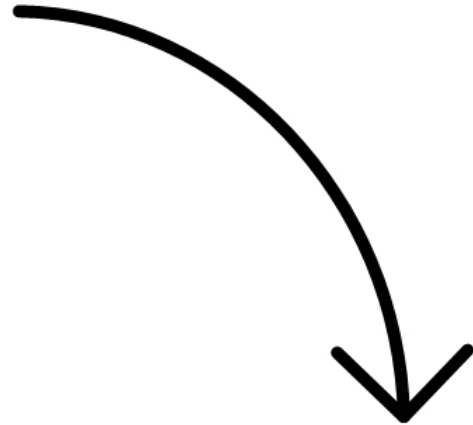
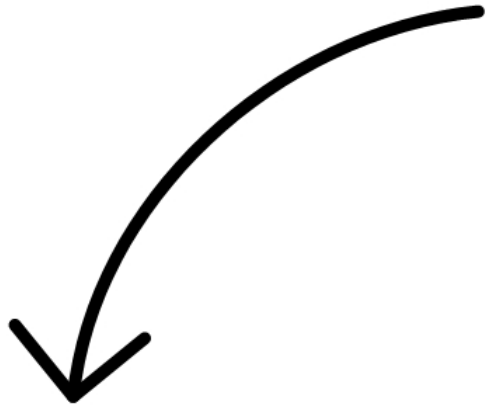
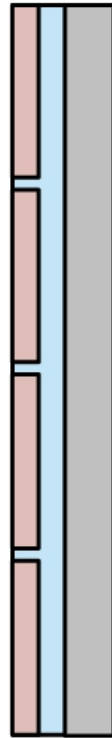
Air Control Layer

Vapor Control Layer

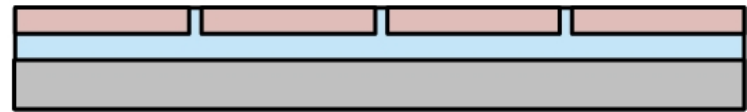
Thermal Control Layer



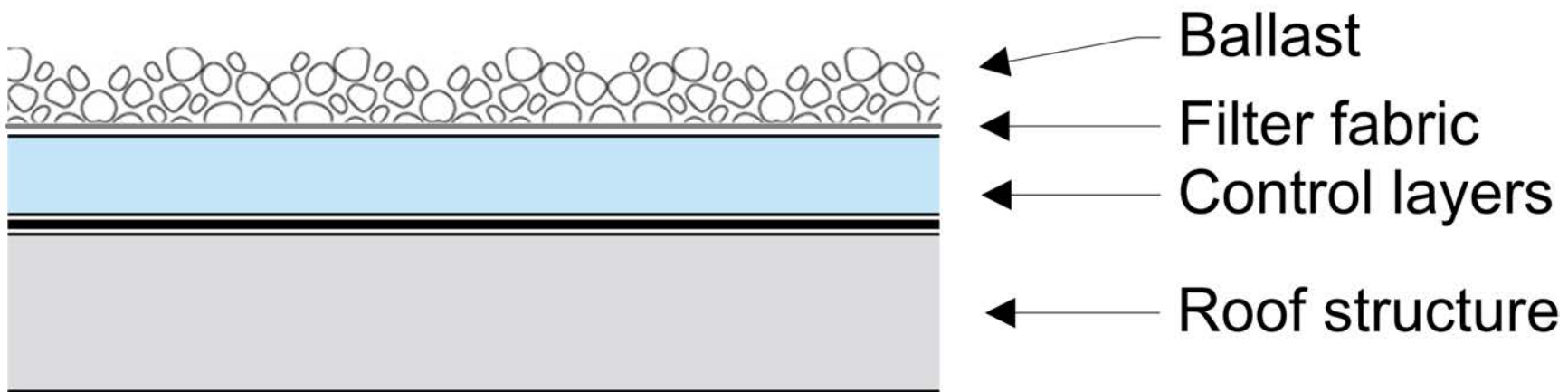
Wall

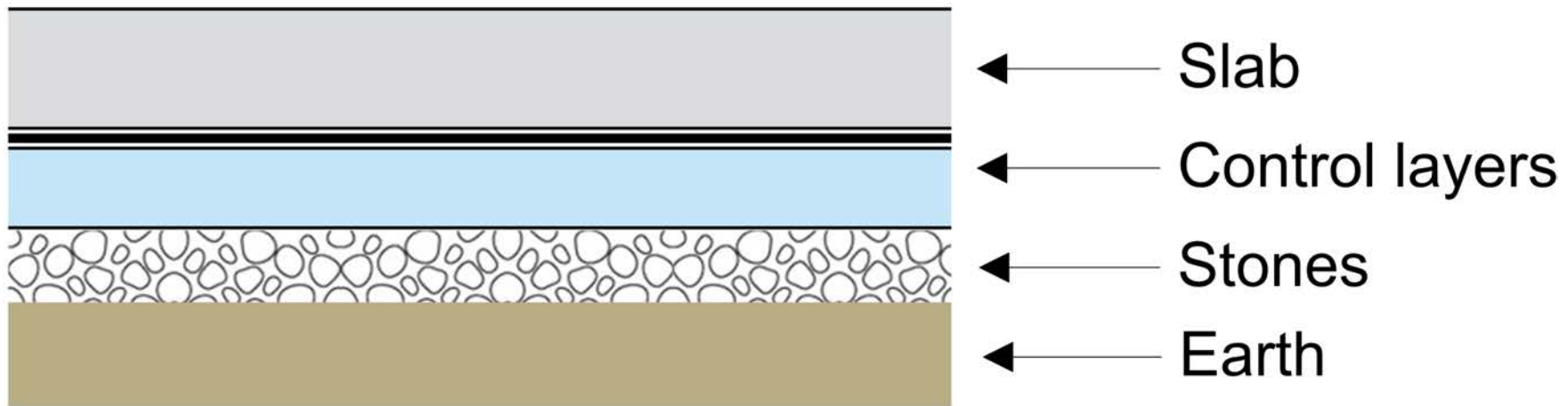


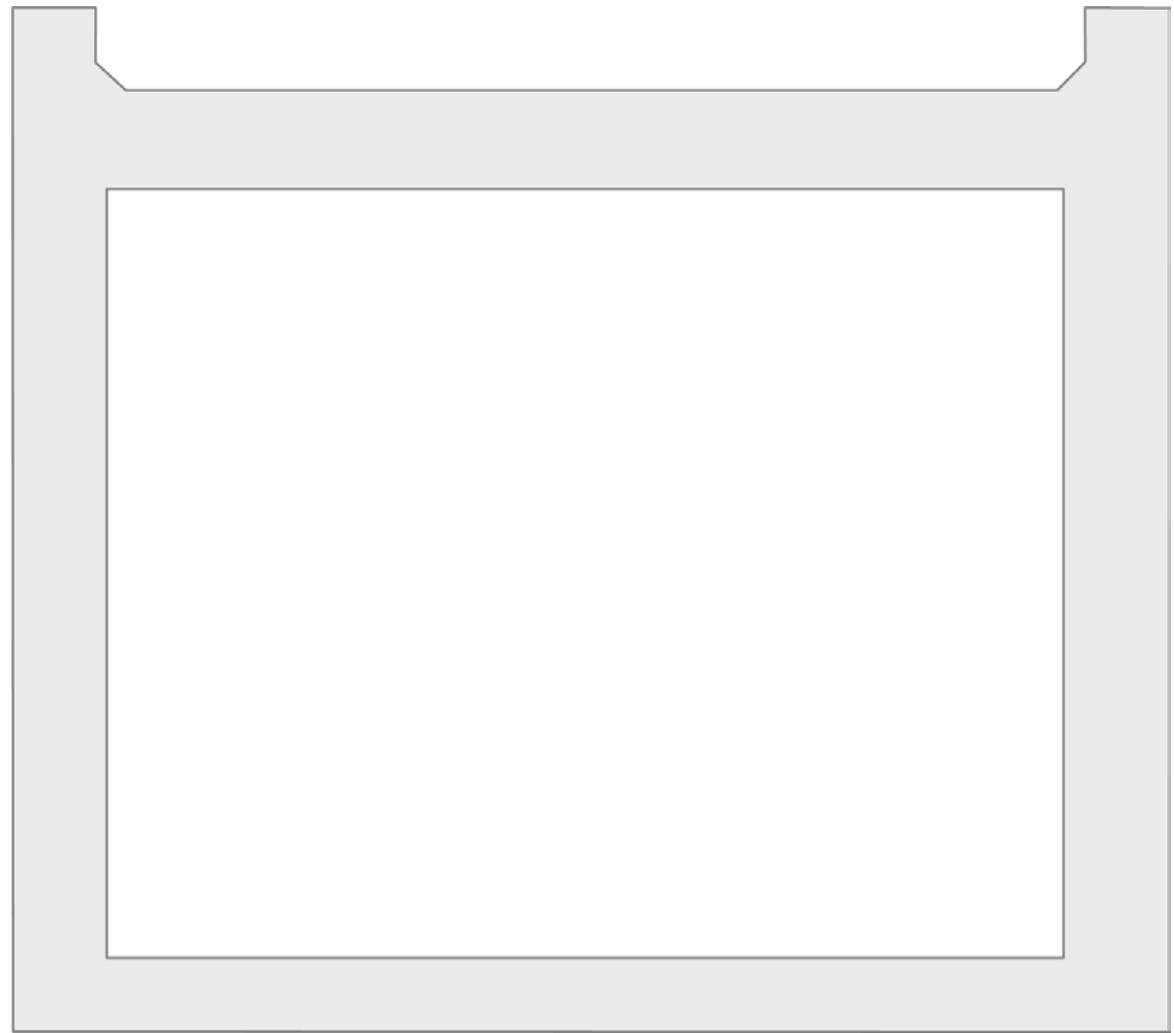
Slab



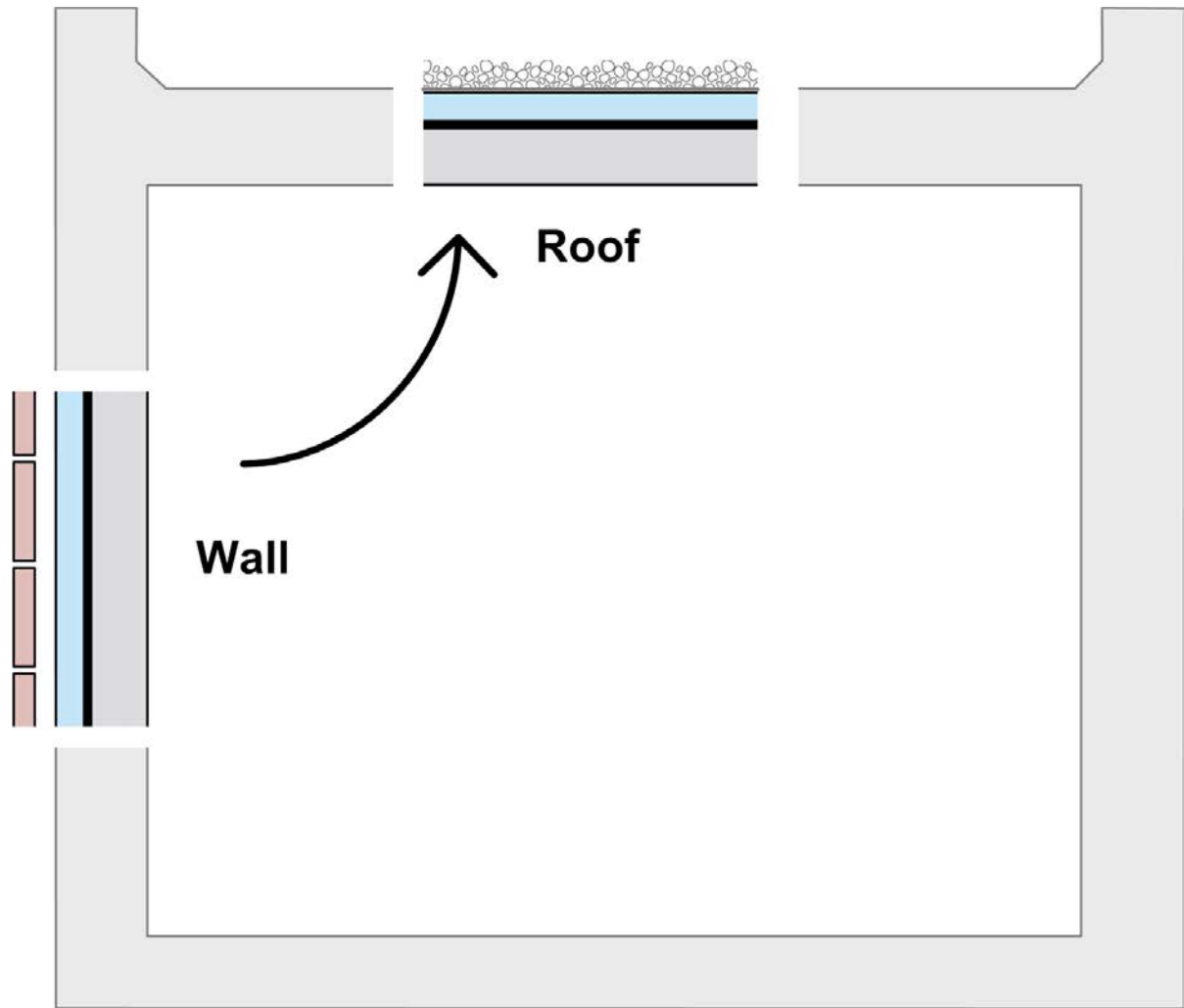
Roof

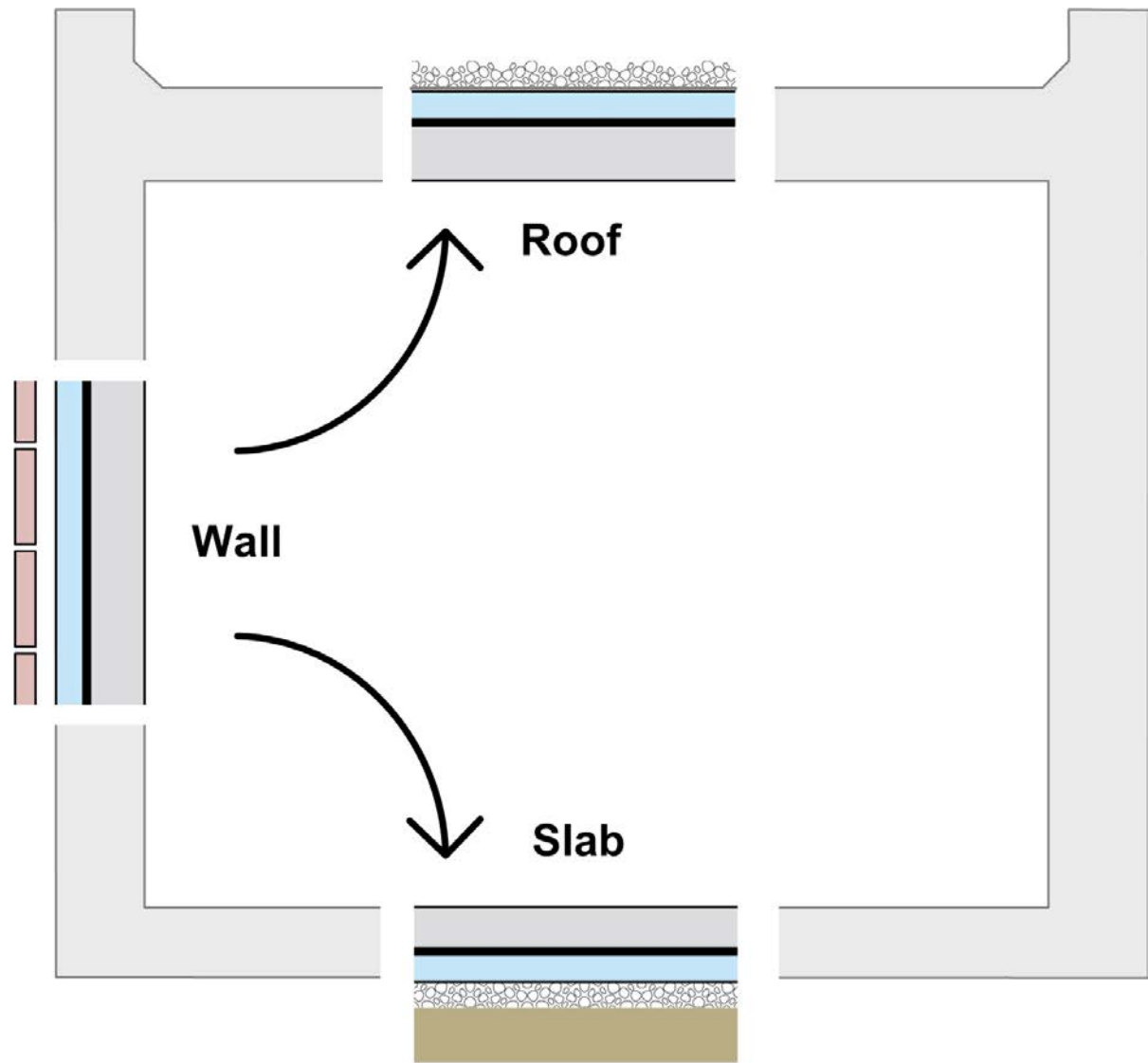


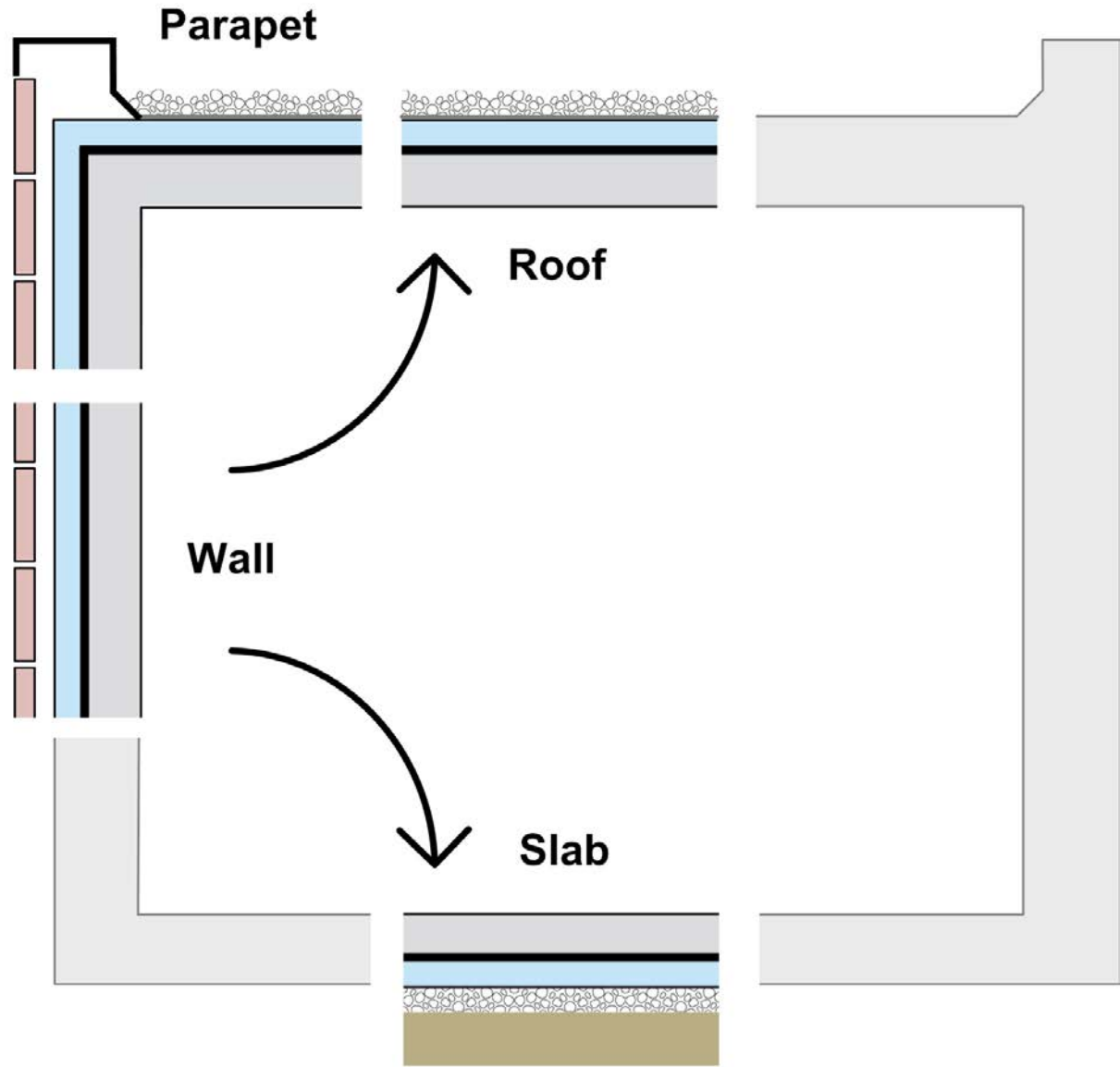


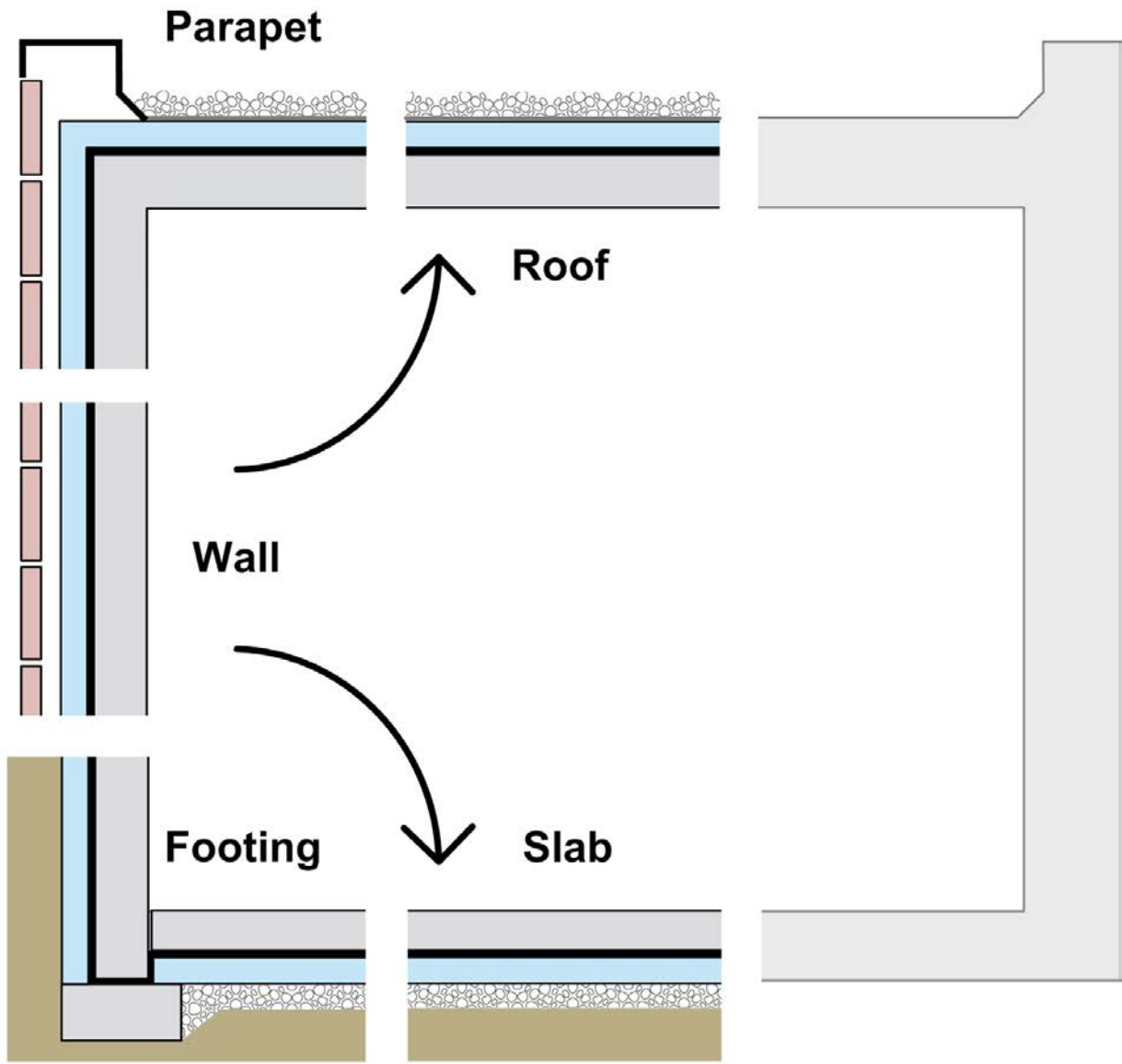


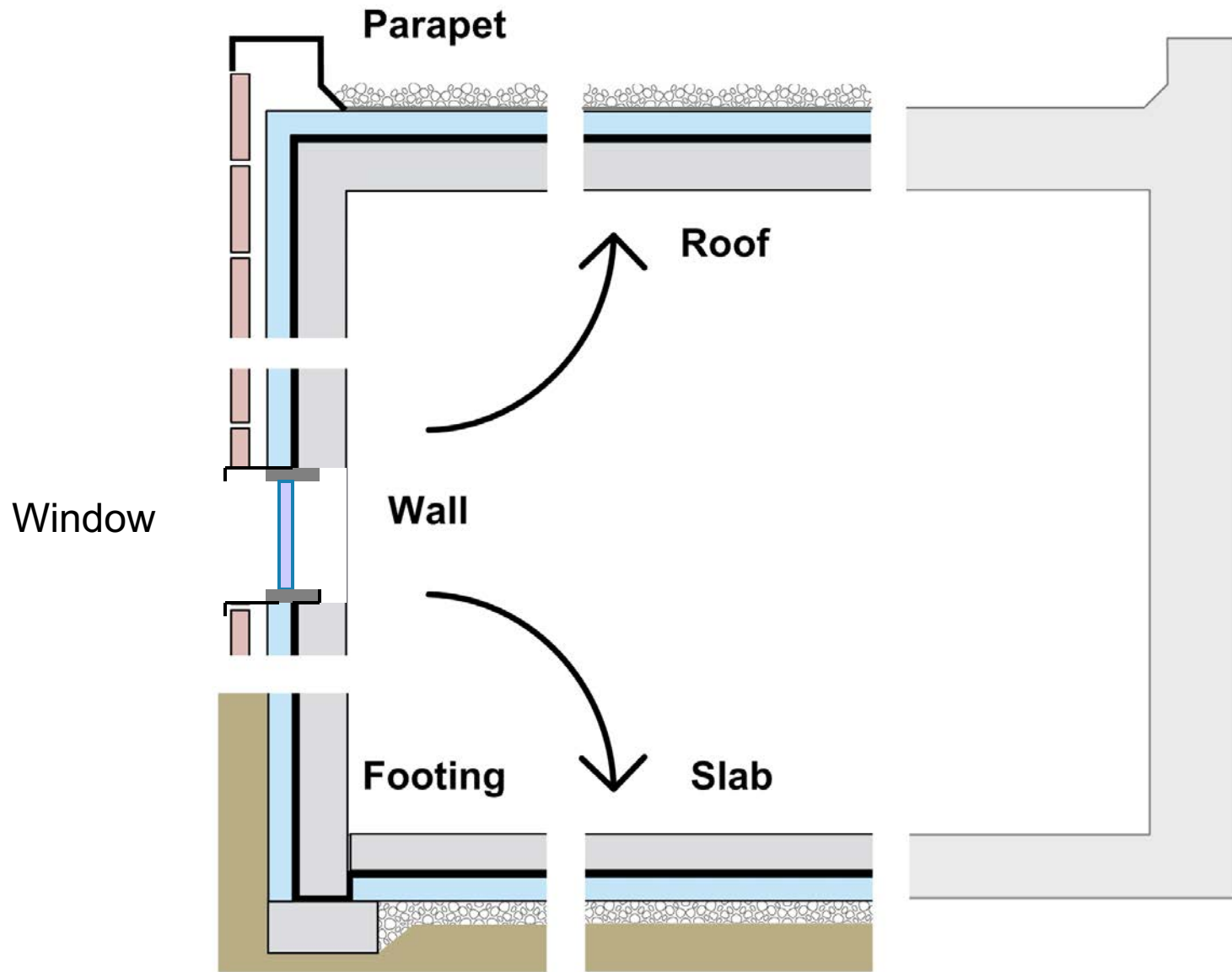


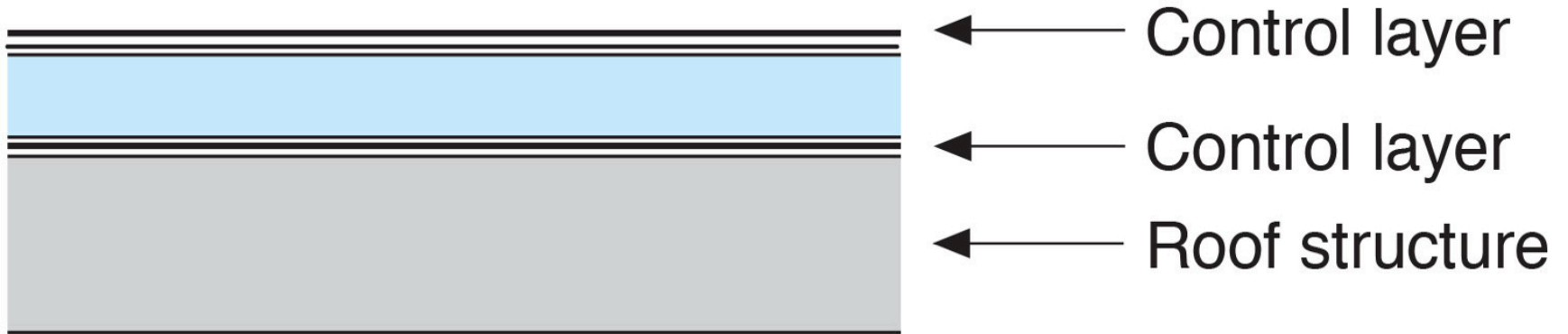


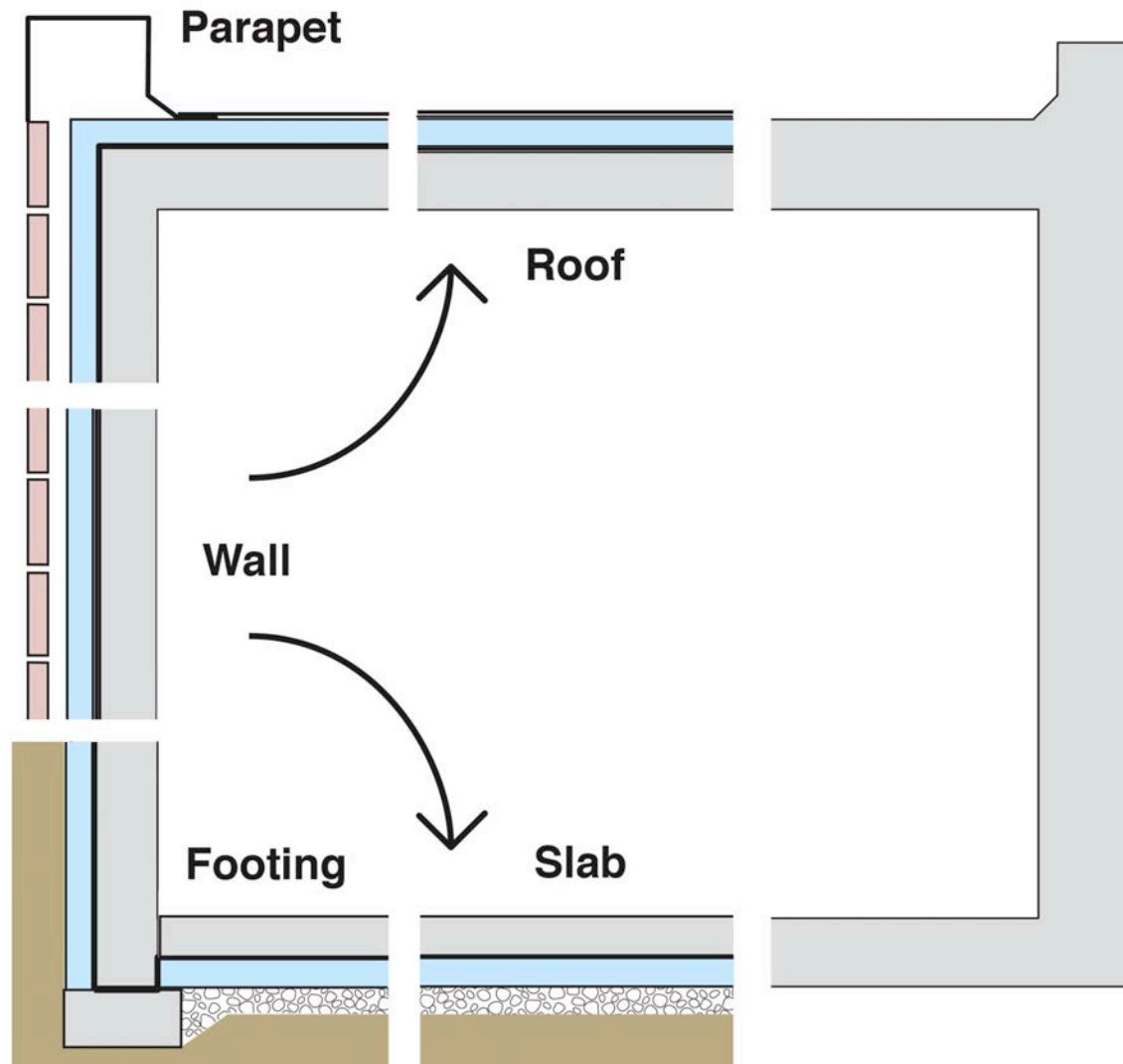


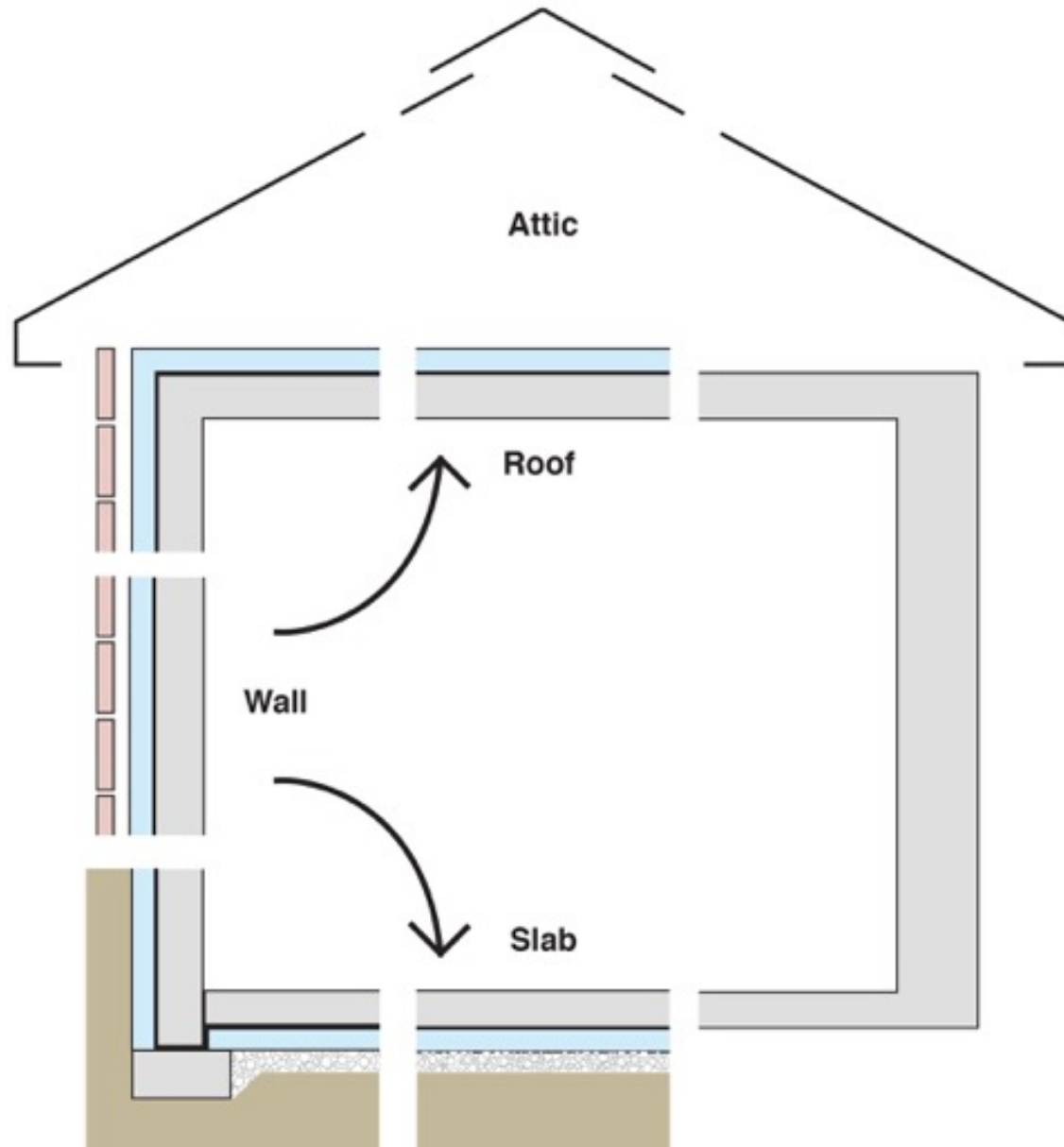


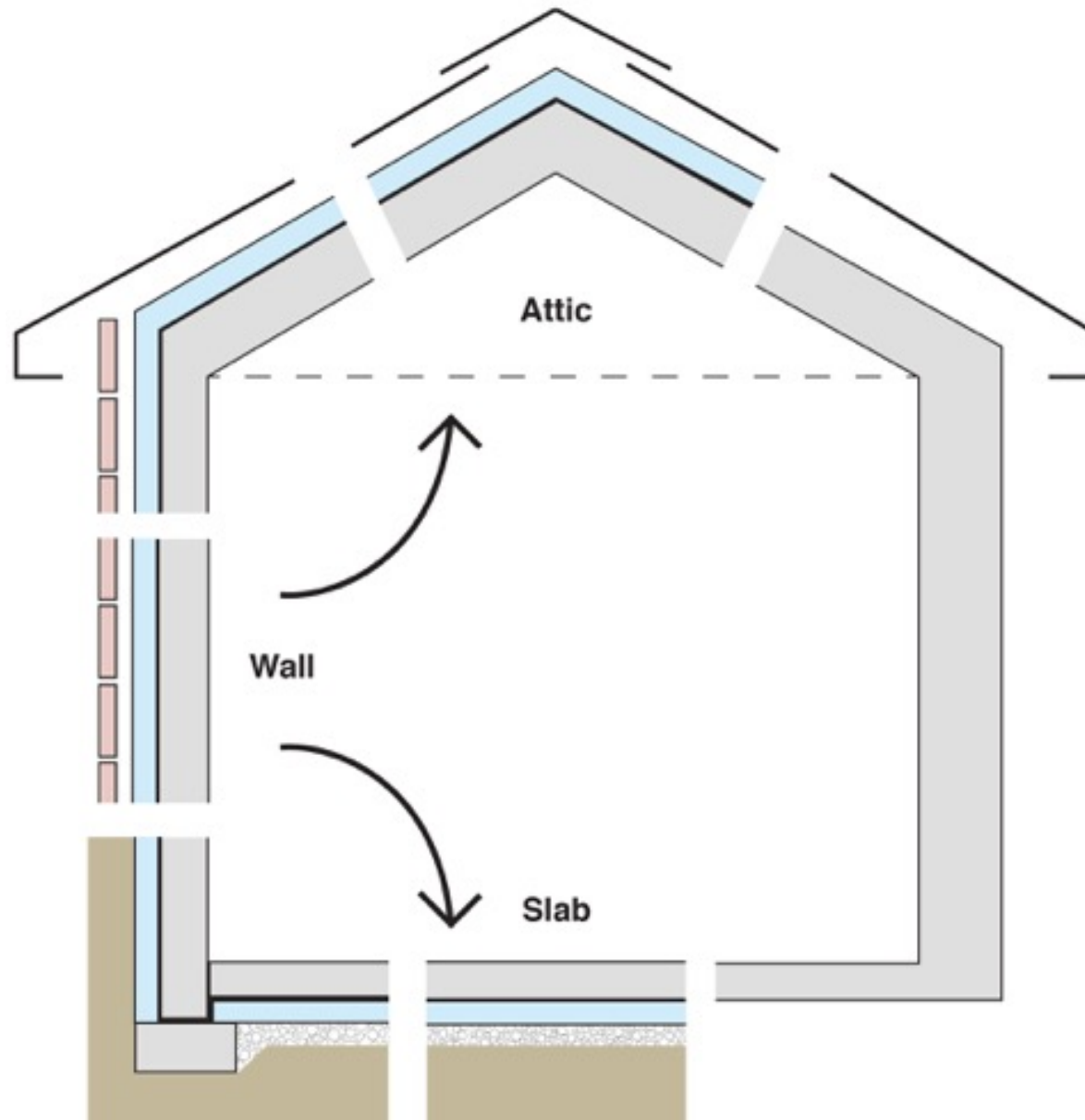


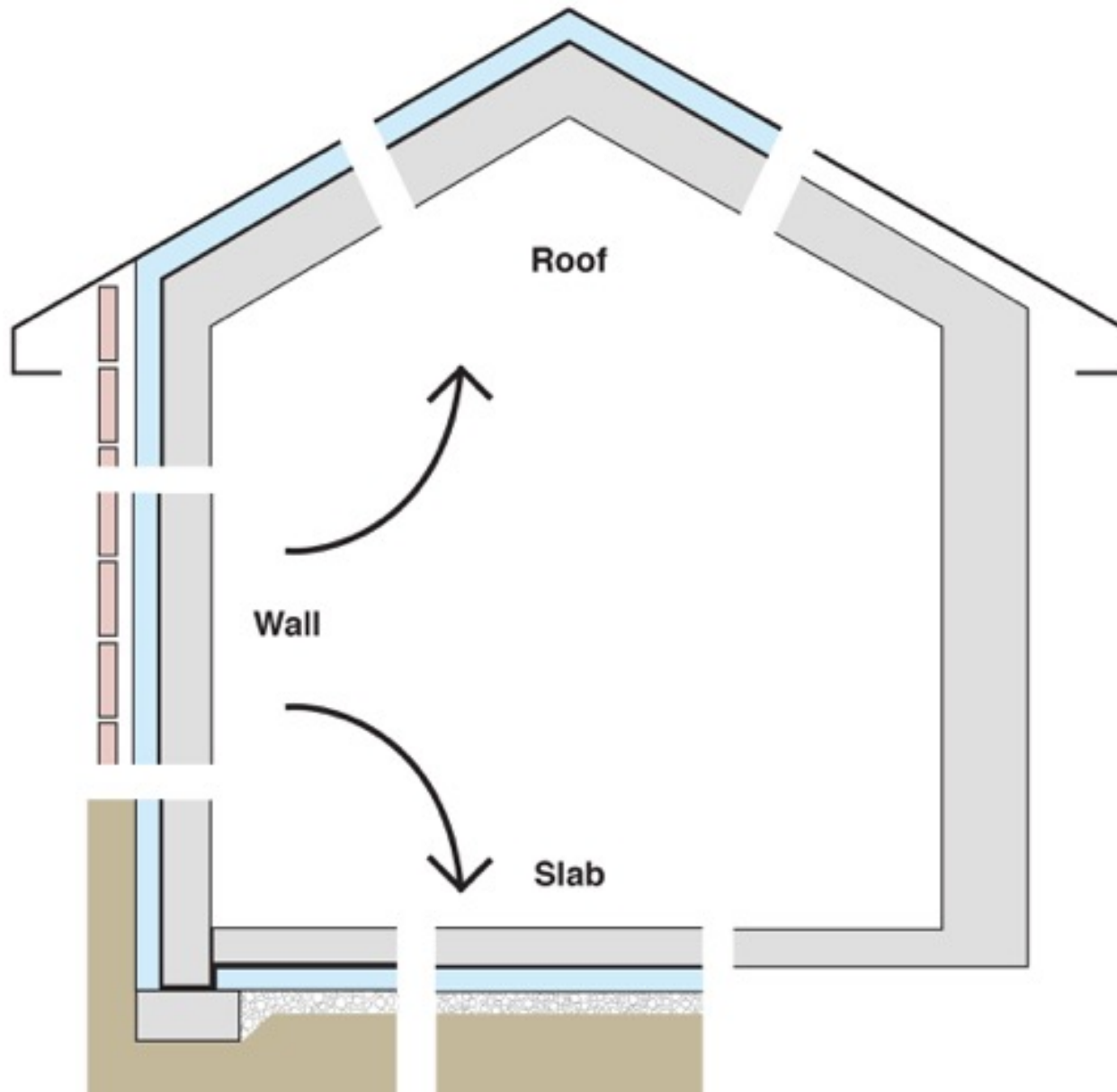


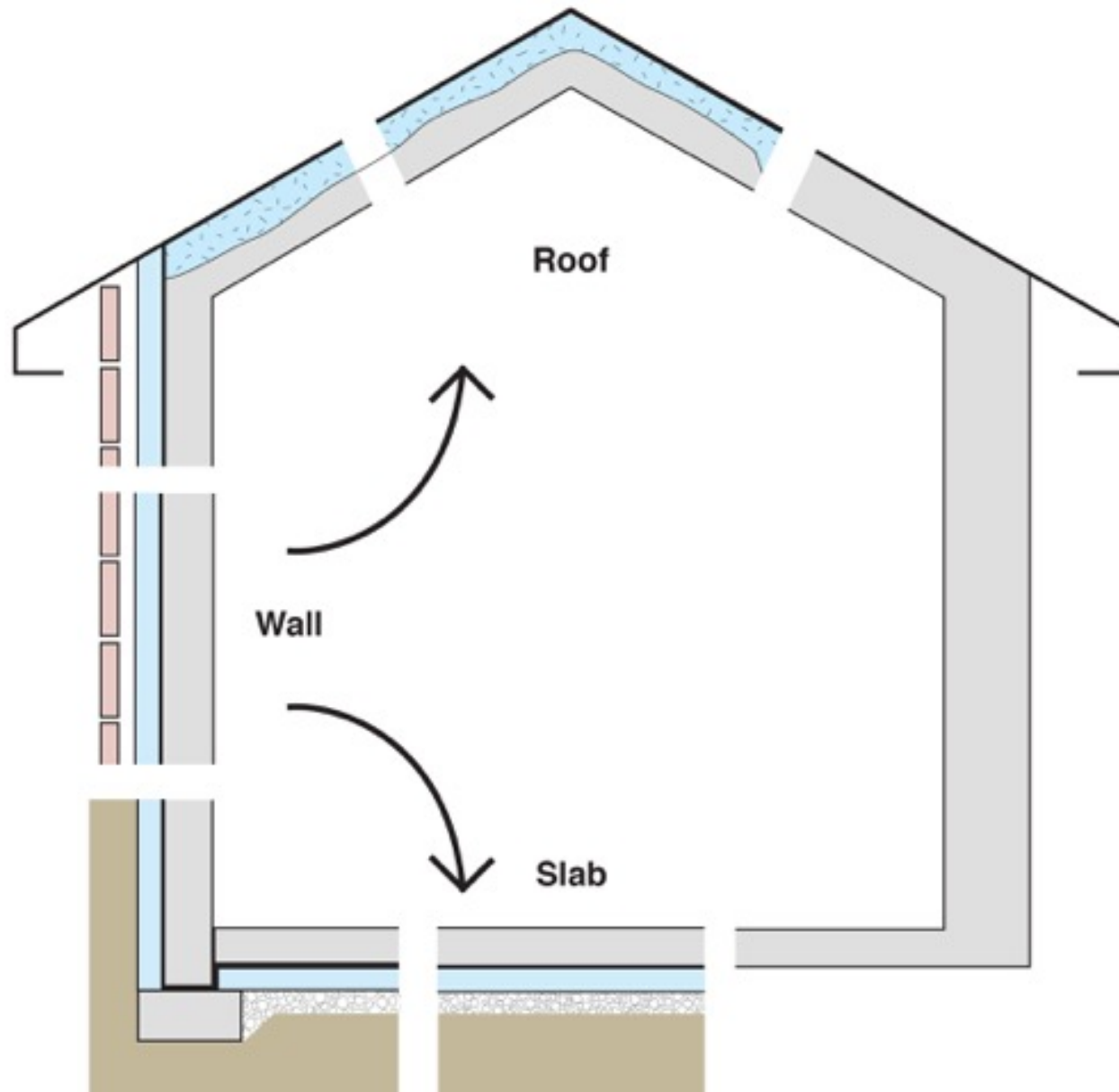




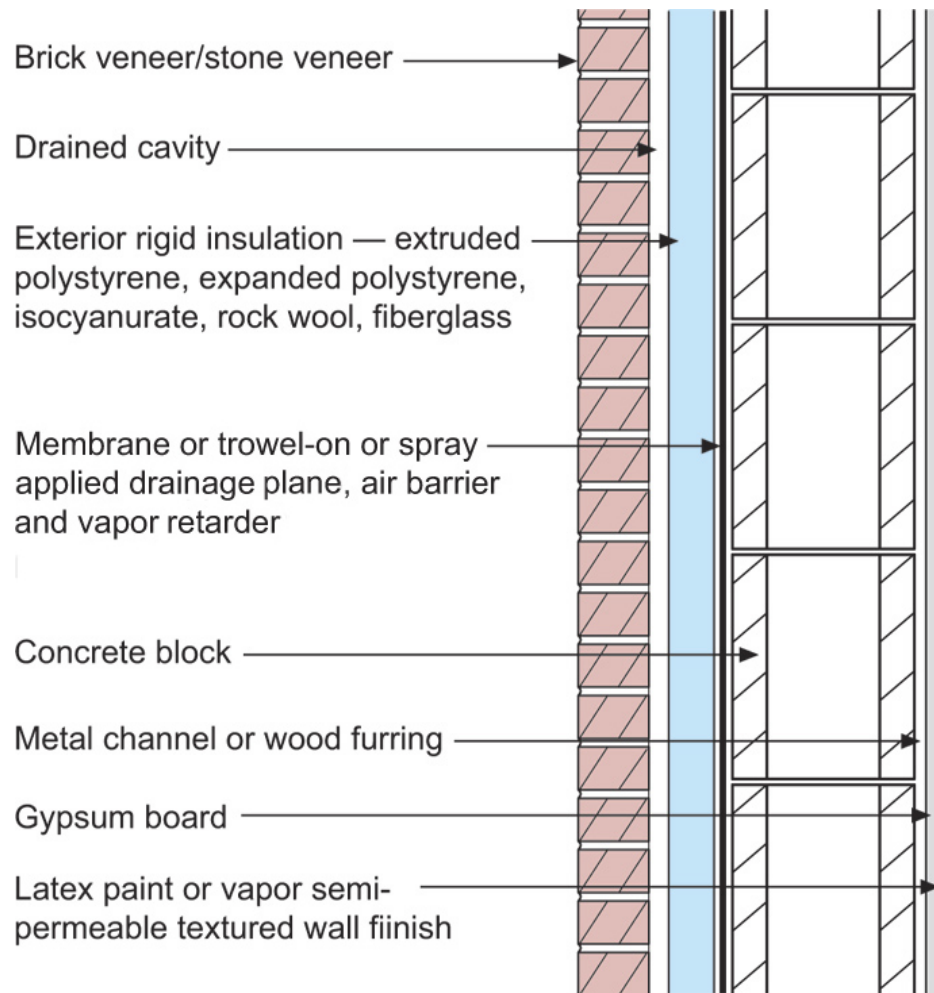




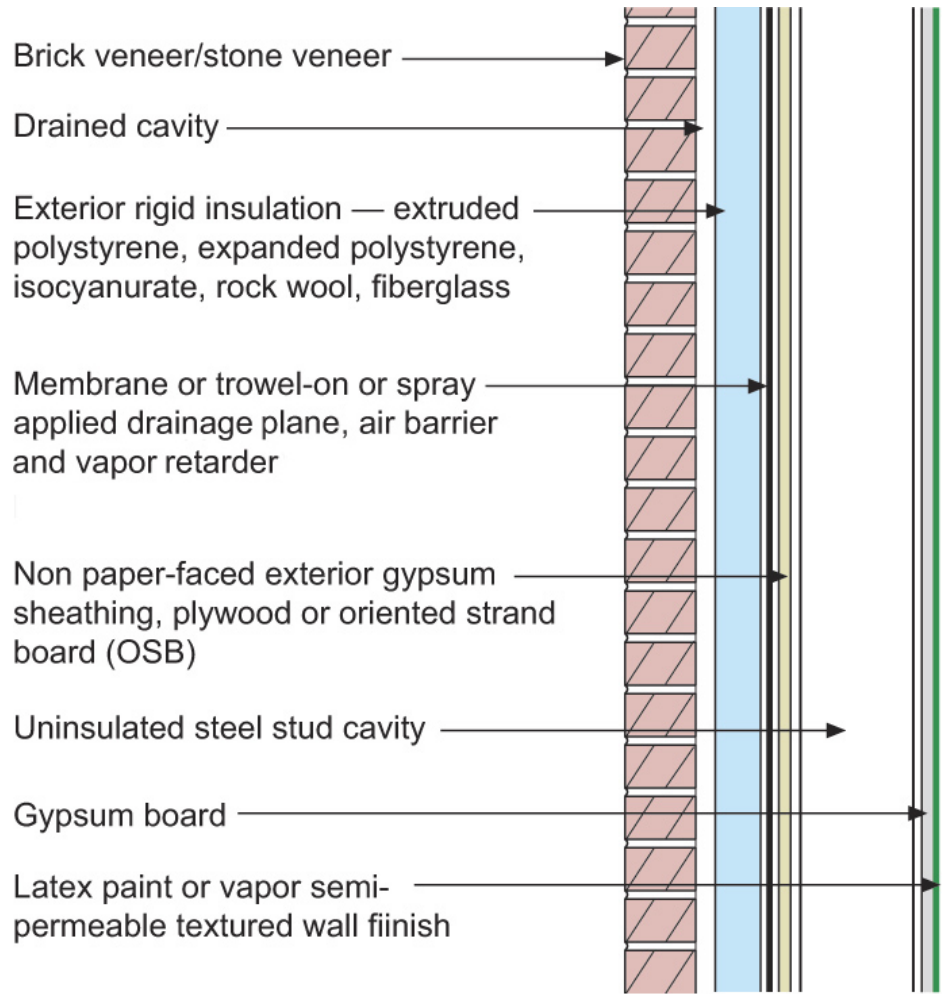


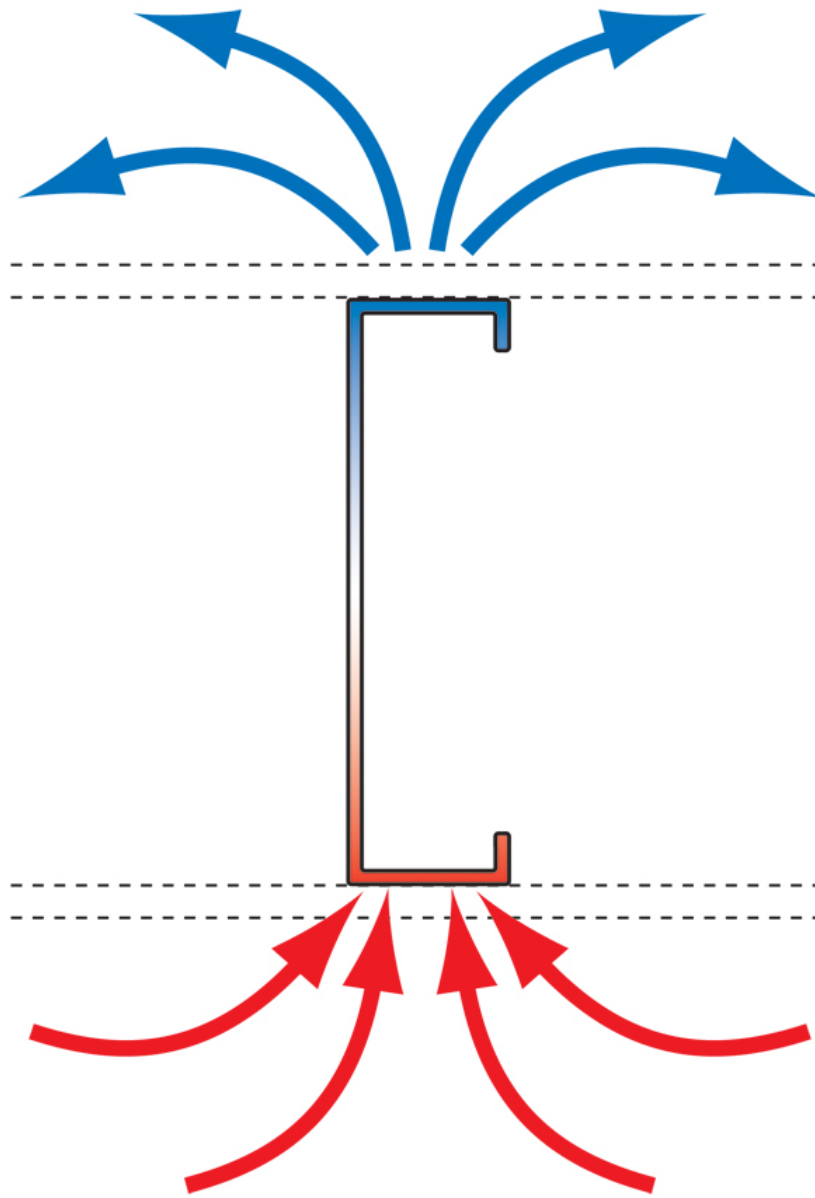


Configurations of the Perfect Wall

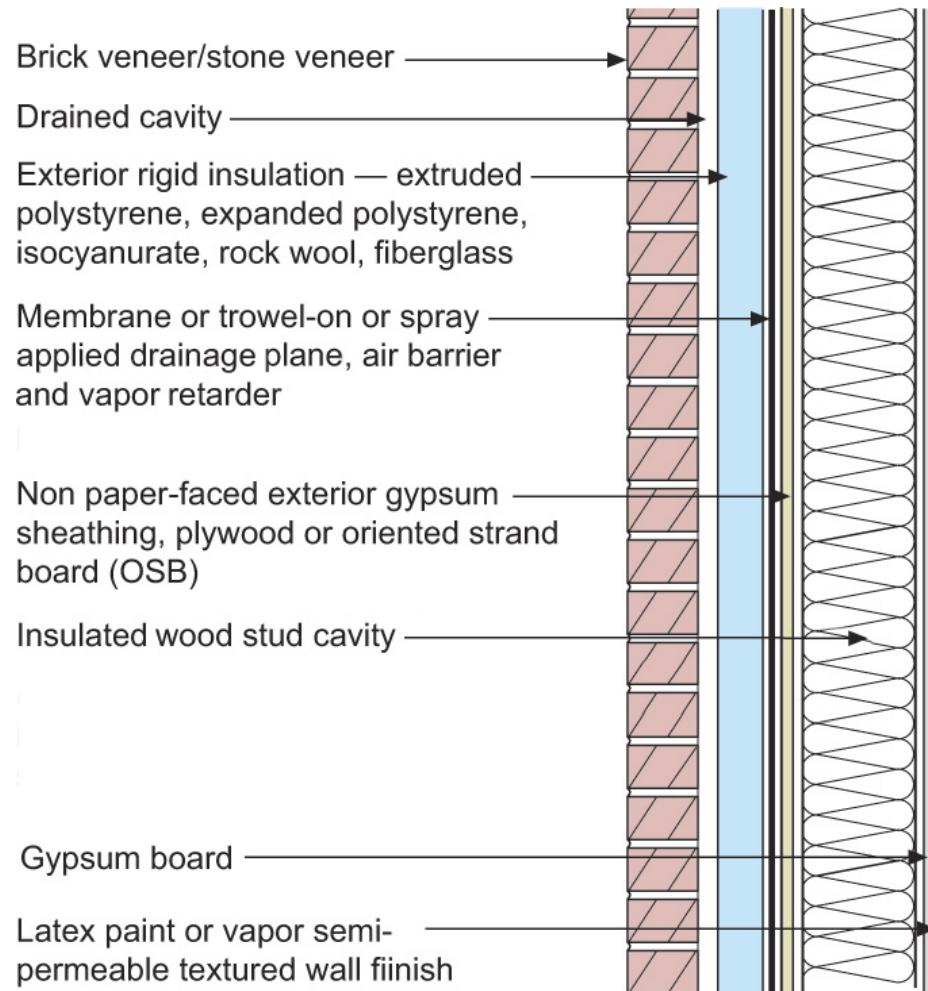


Vapor Profile

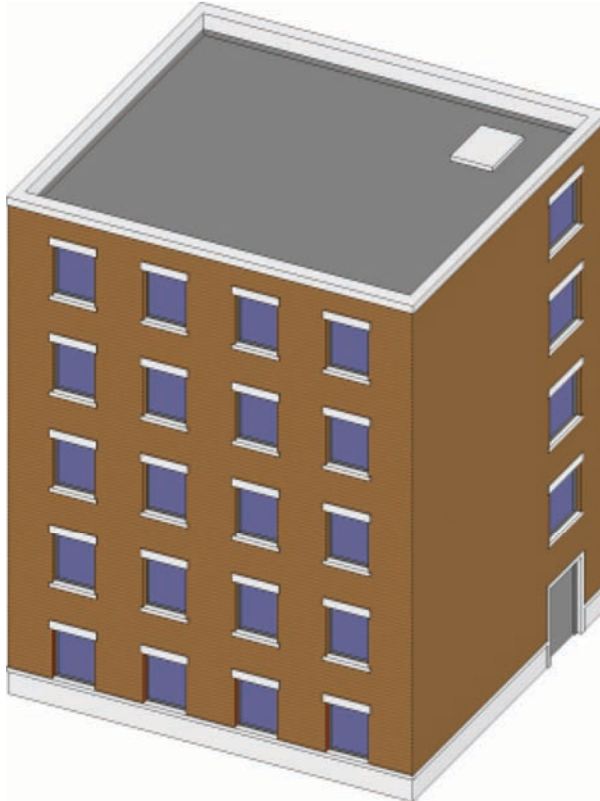




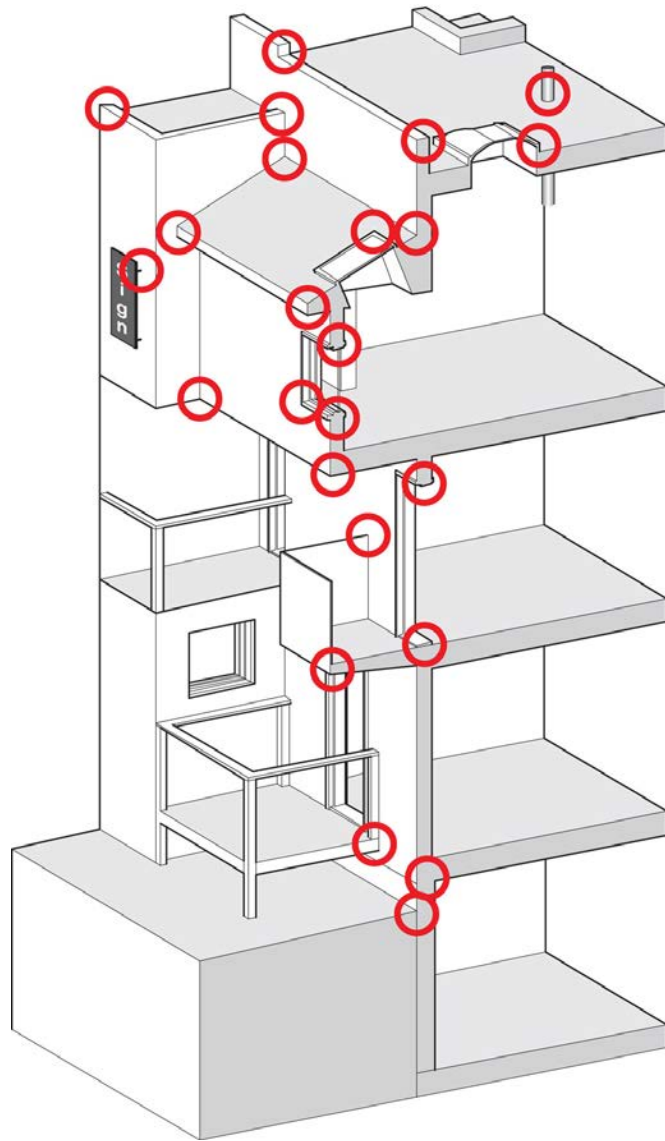


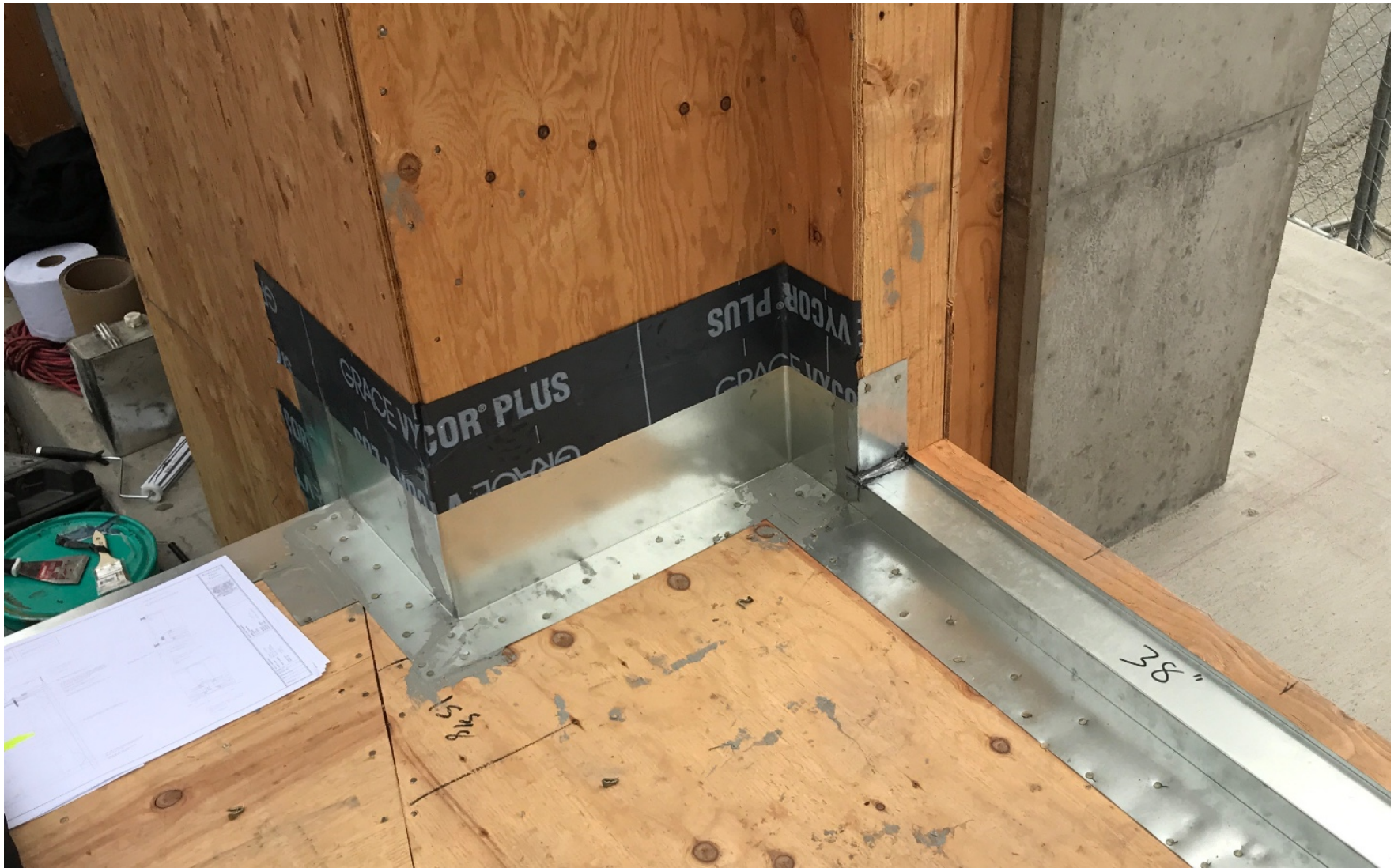


Commercial Enclosure: Simple Layers



- Structure
- Rain/Air/Vapor
- Insulation
- Finish



























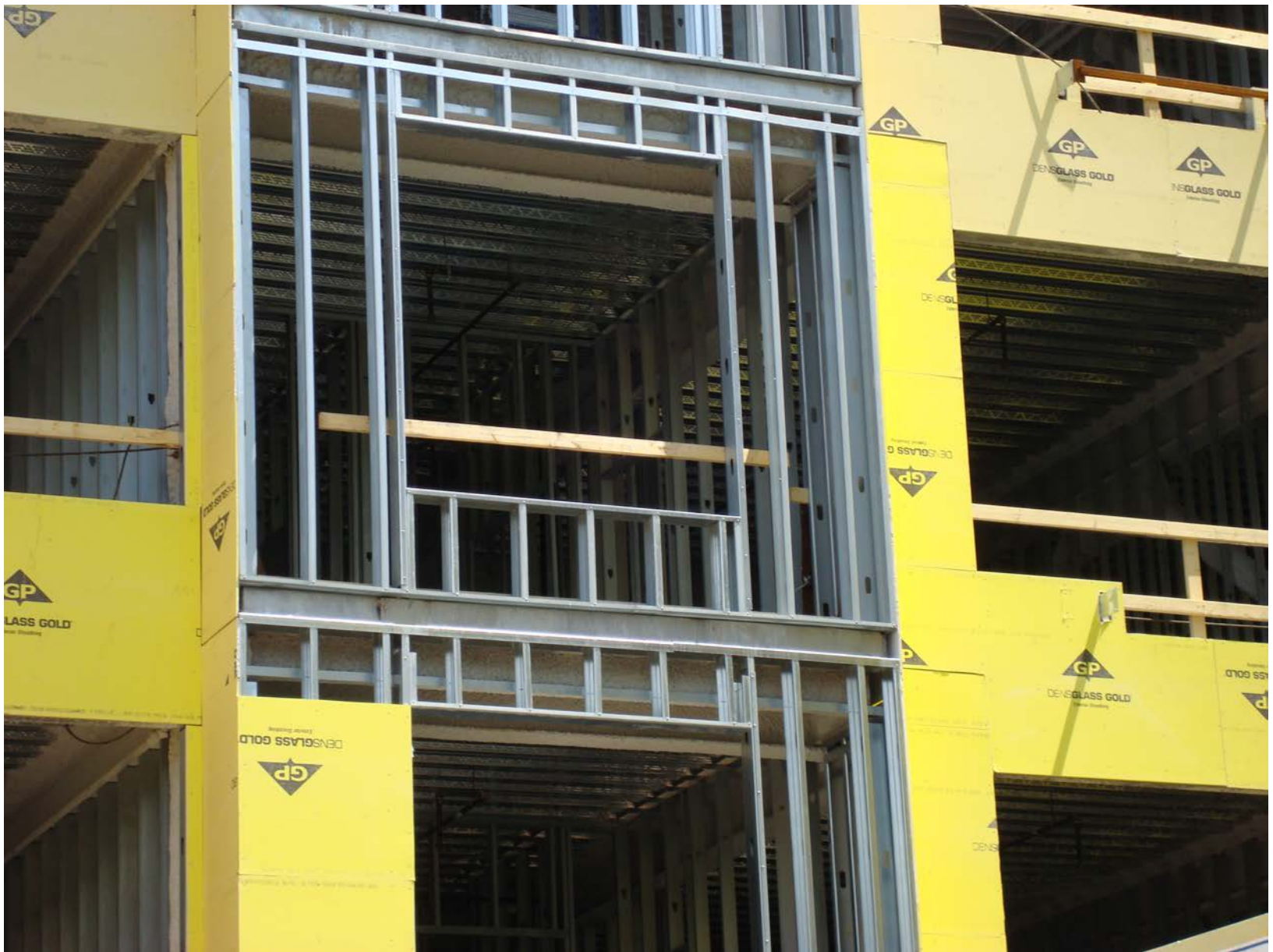






























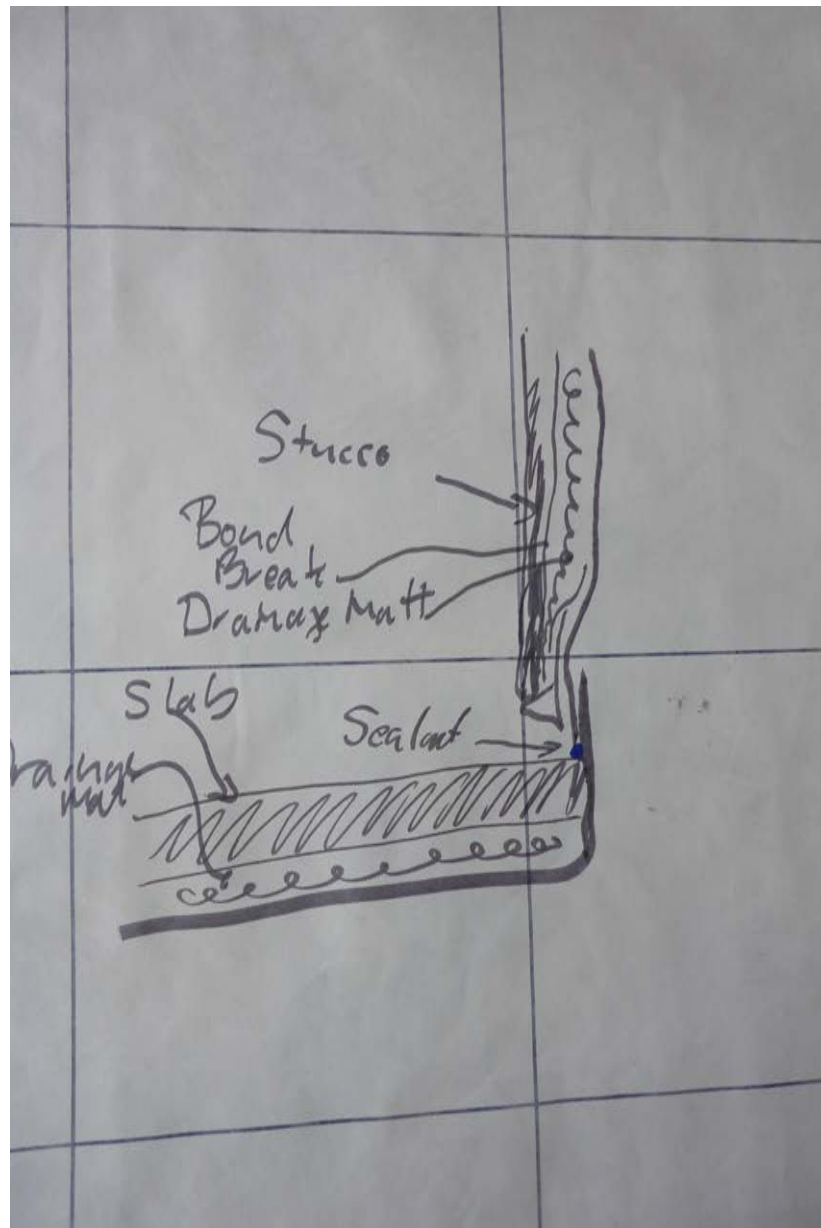






















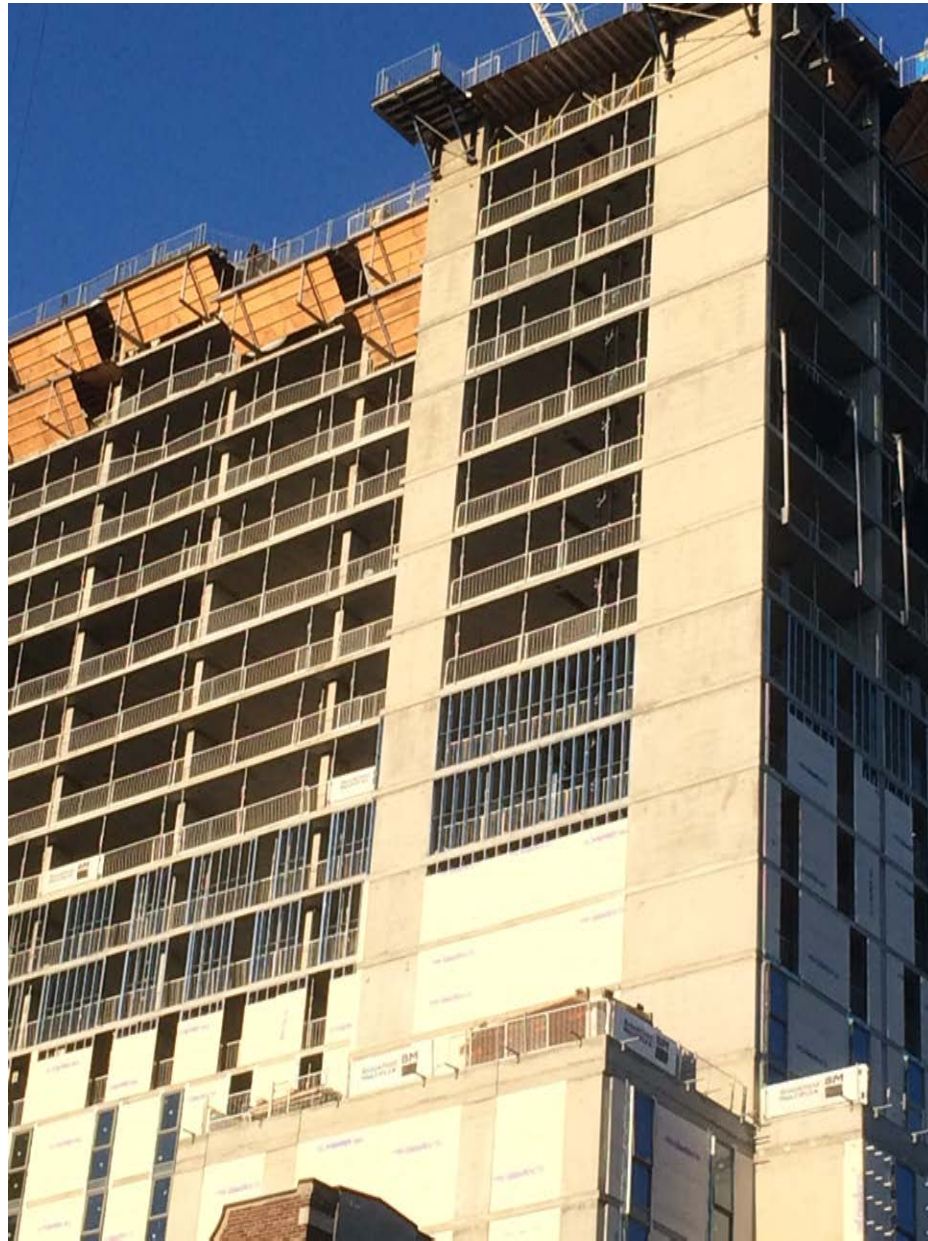
















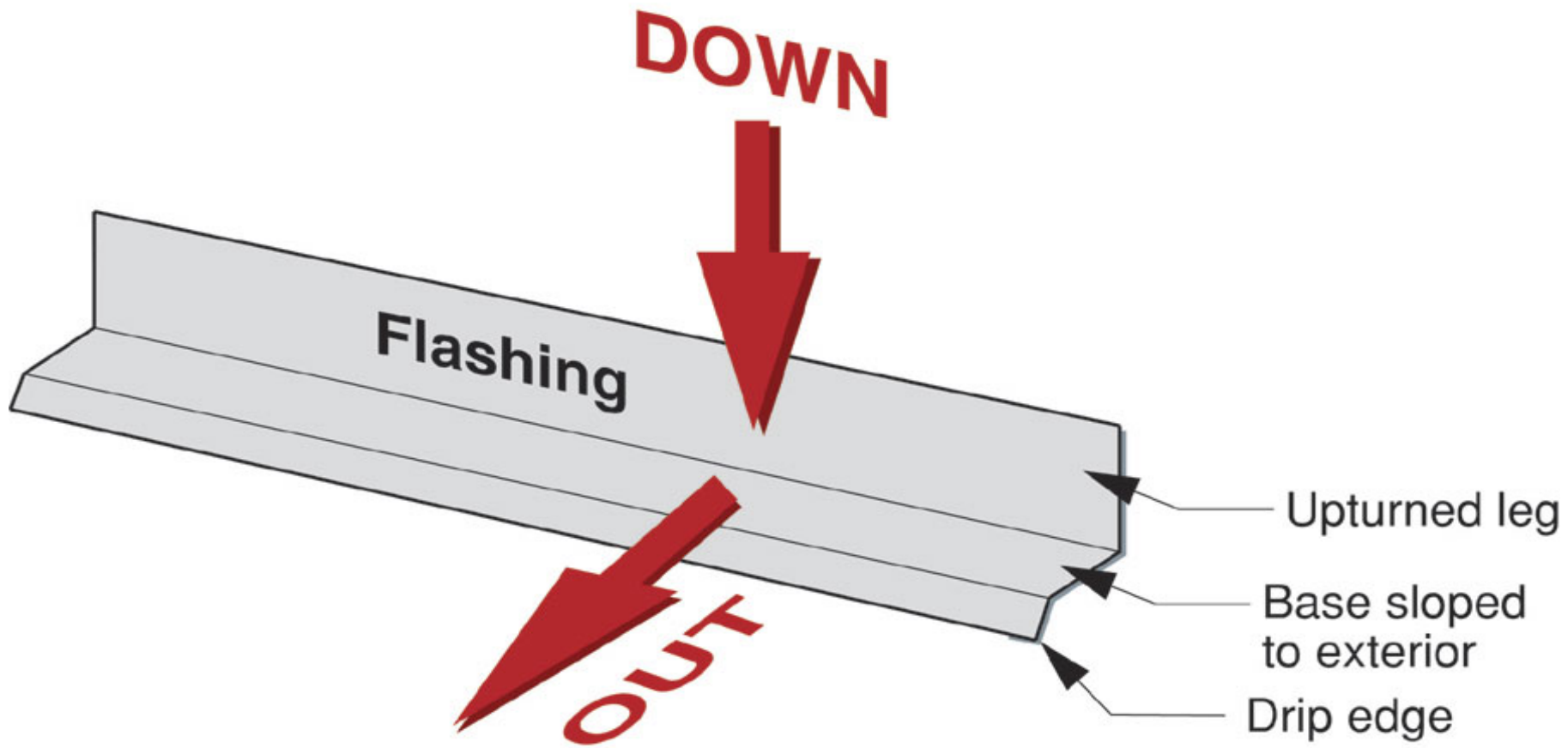


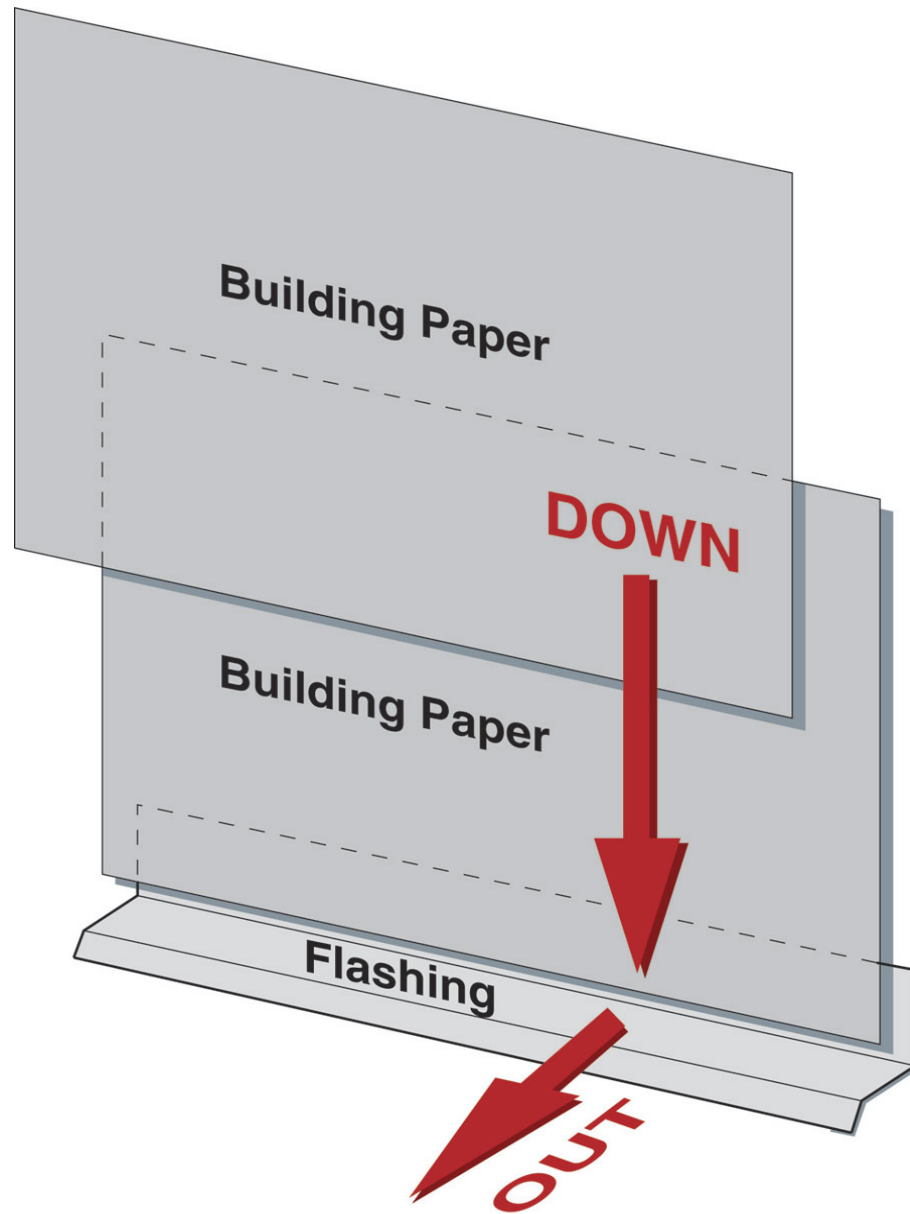


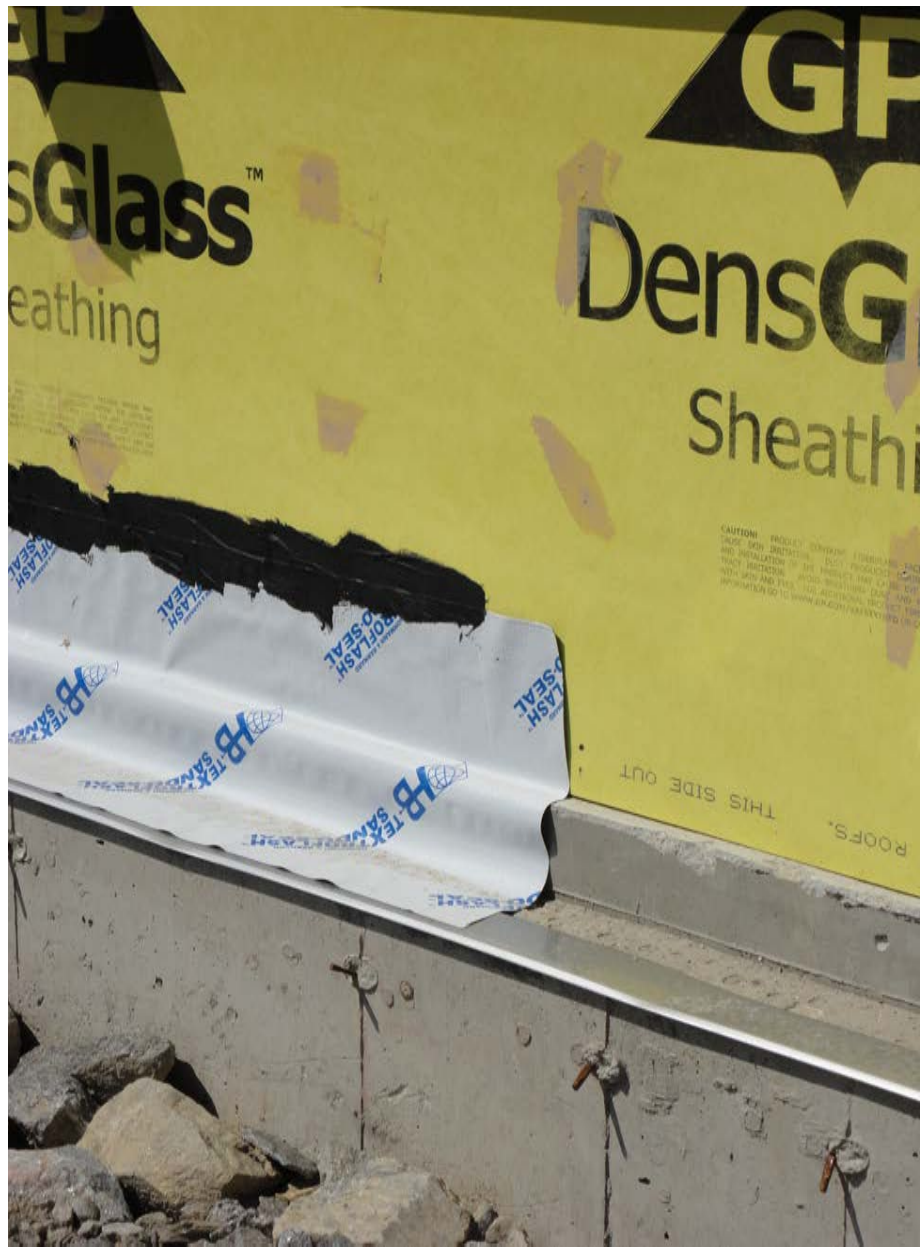




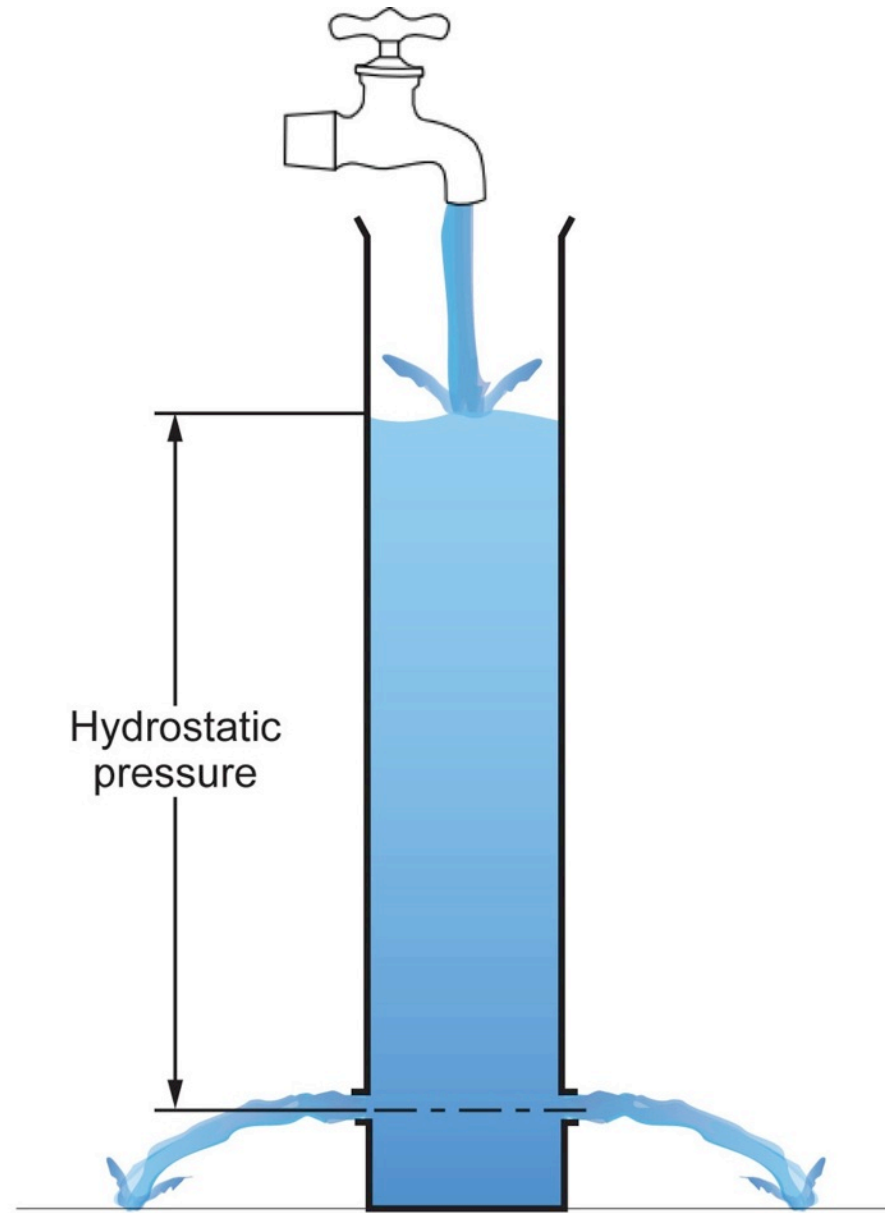
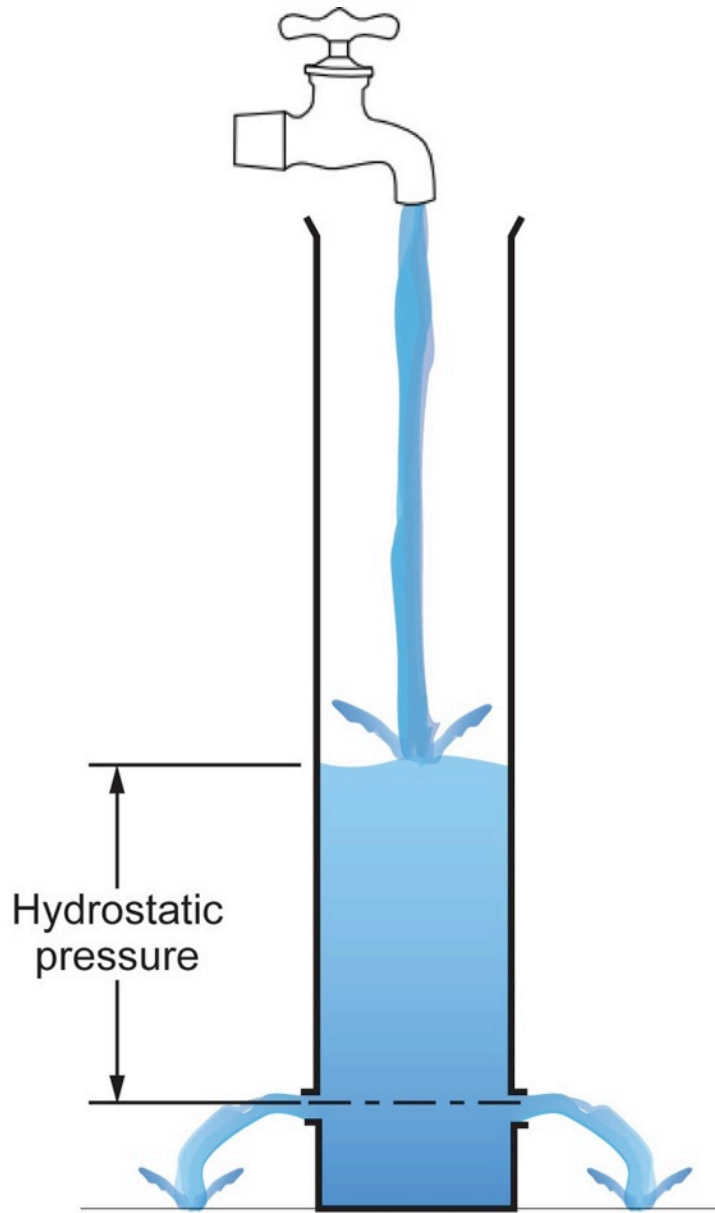




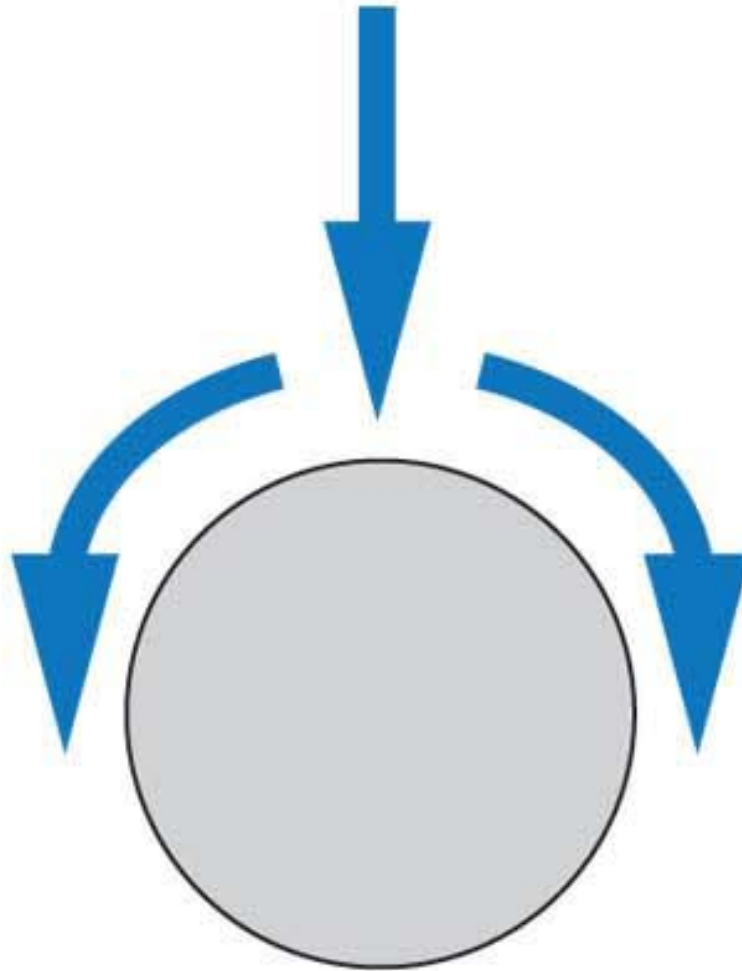


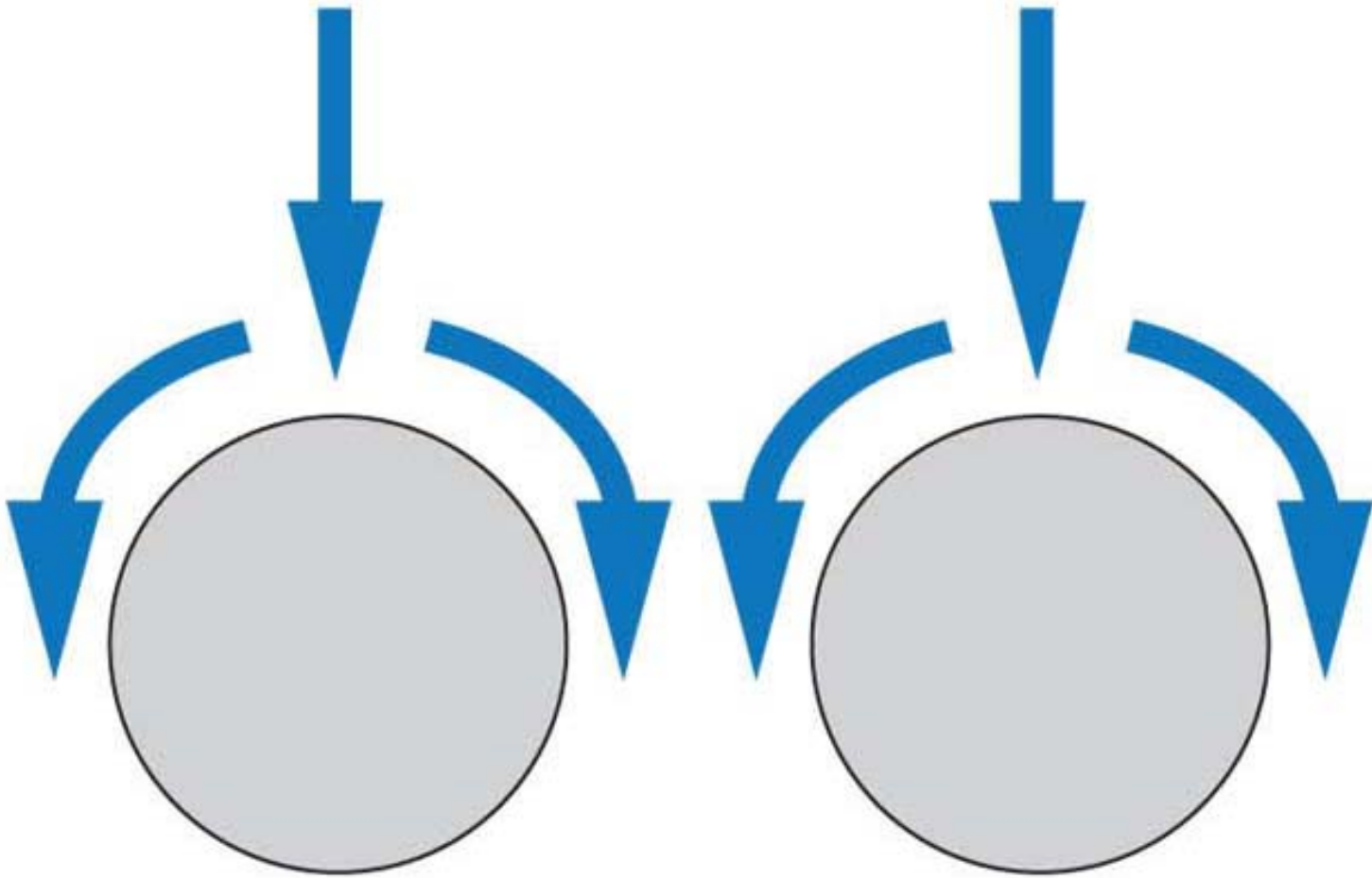


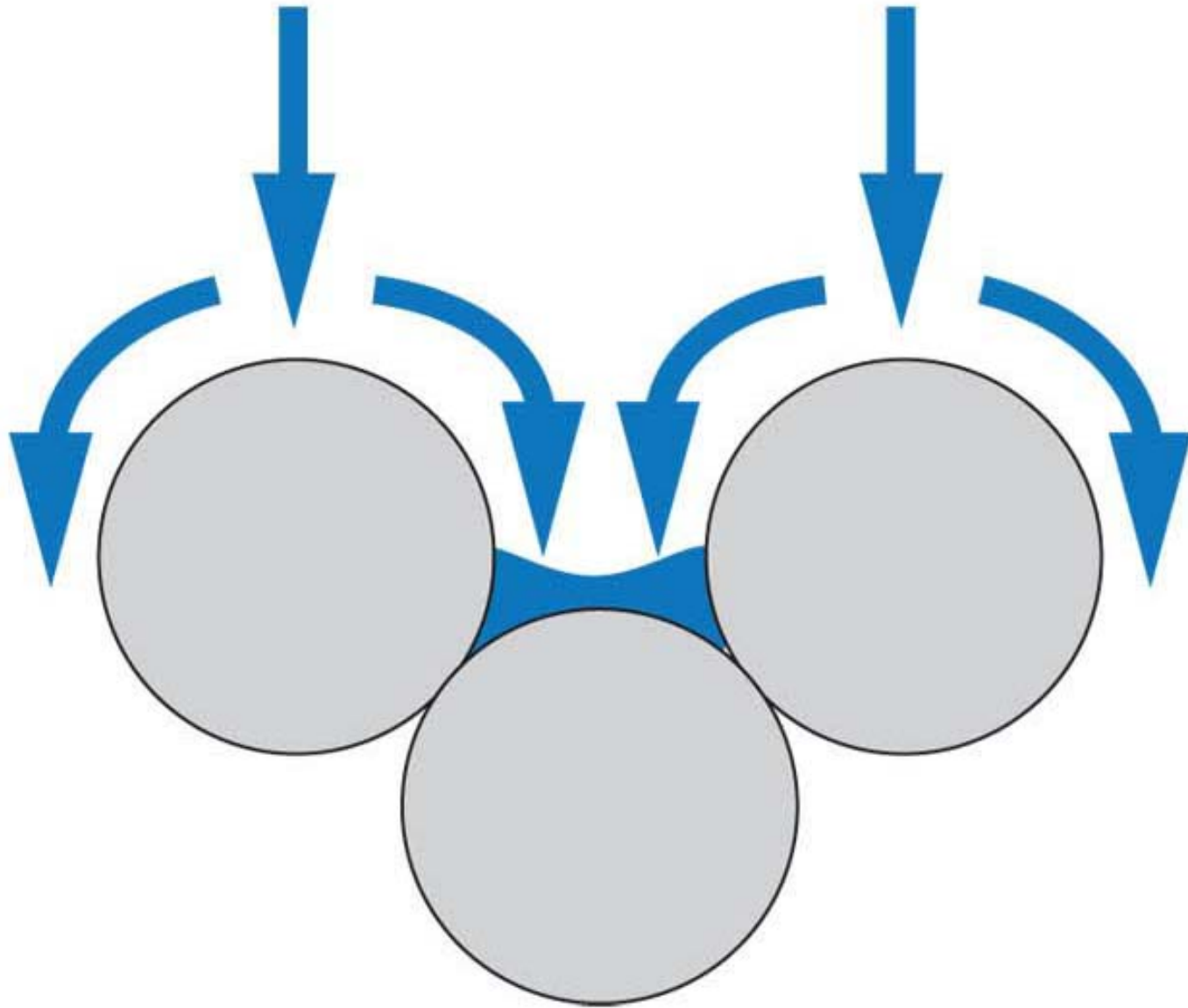




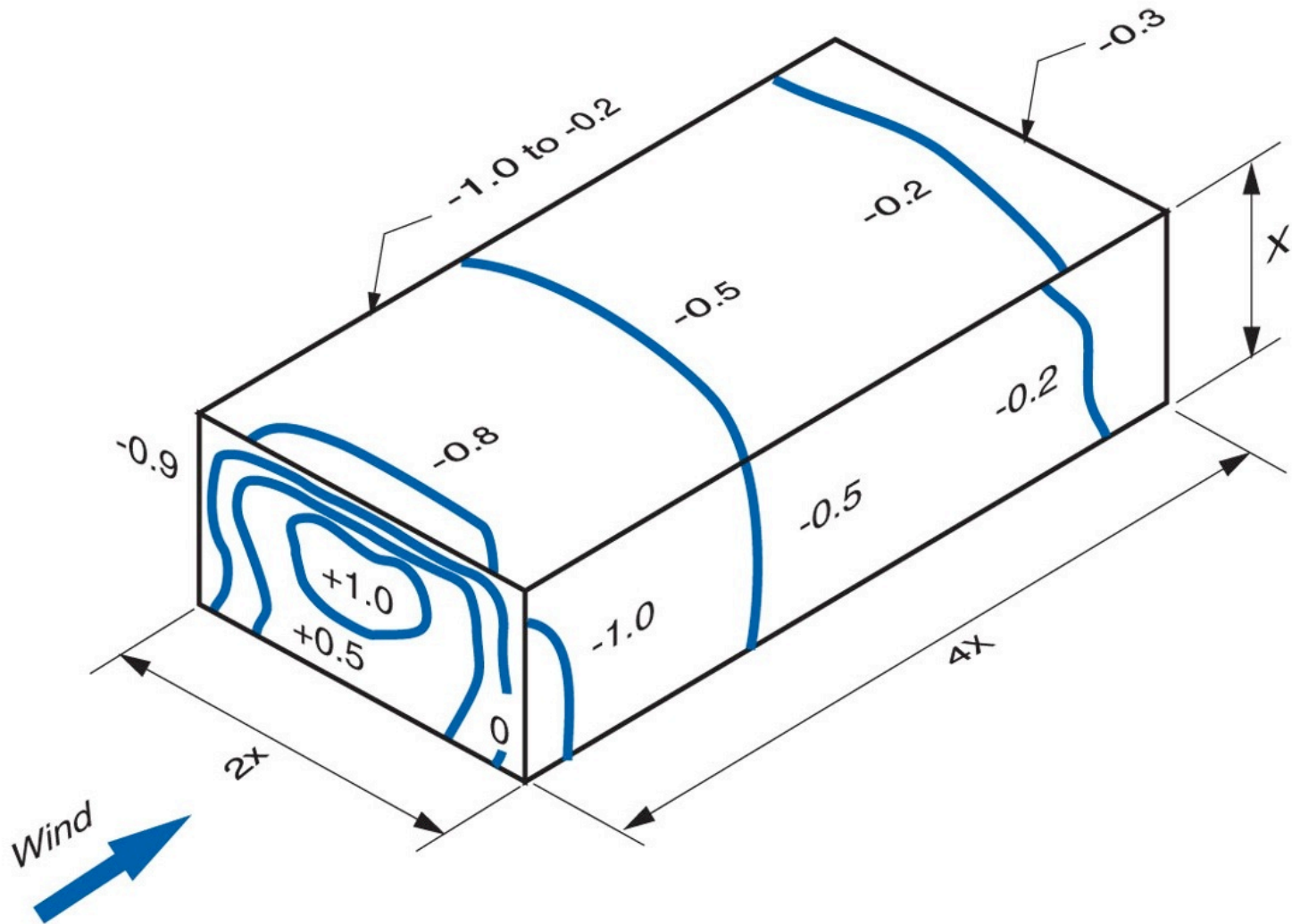








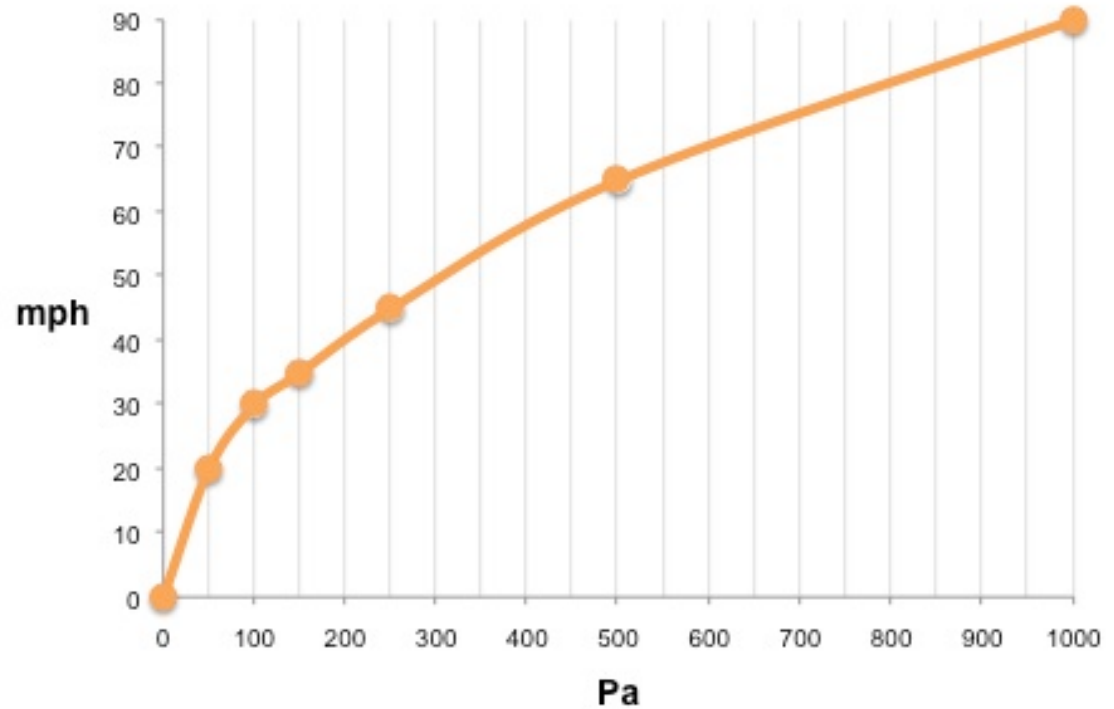




Pascals mph

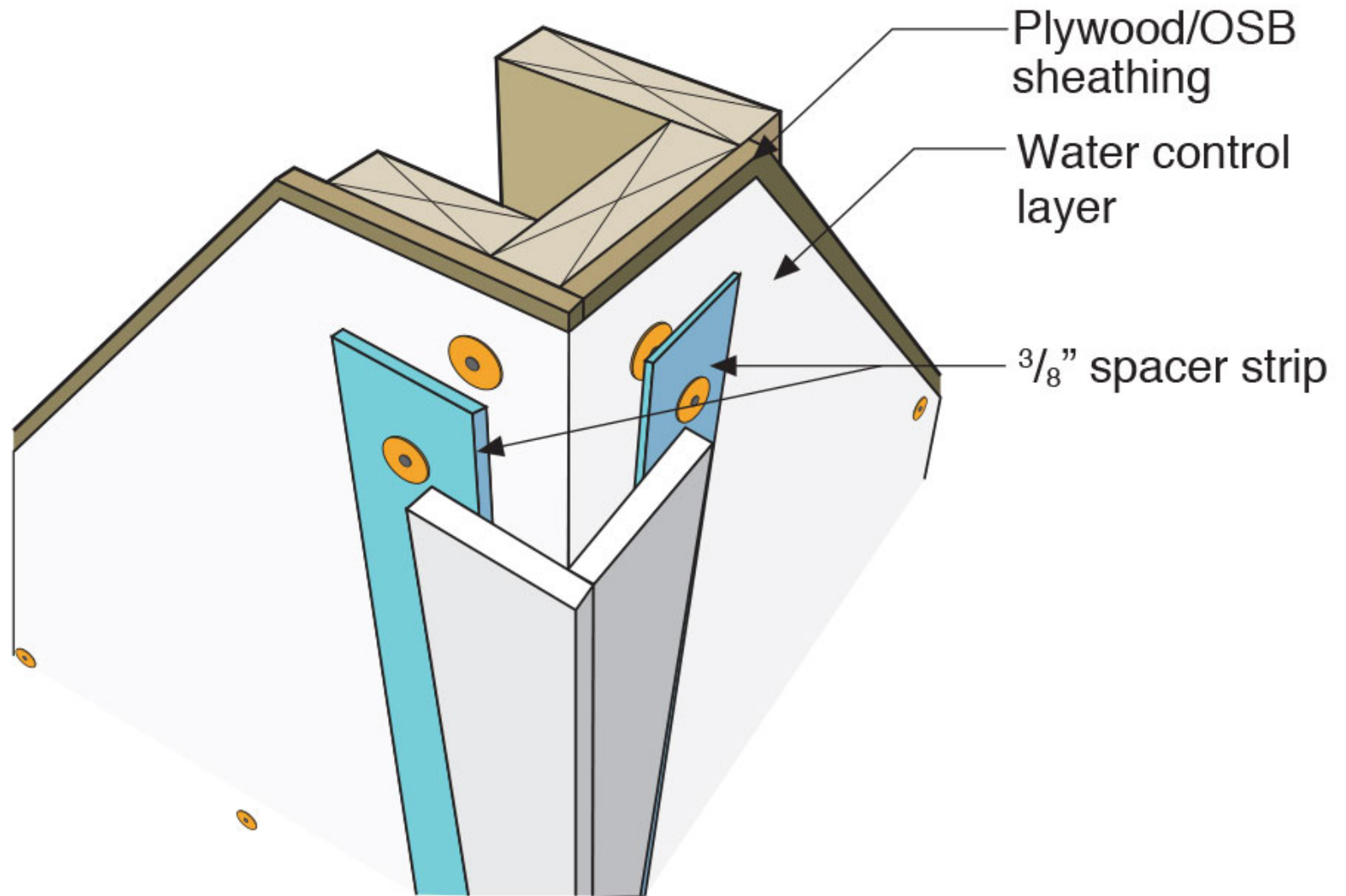
50 Pa =	20 mph
100 Pa =	30 mph
150 Pa =	35 mph
250 Pa =	45 mph
500 Pa =	65 mph
1,000 Pa =	90 mph

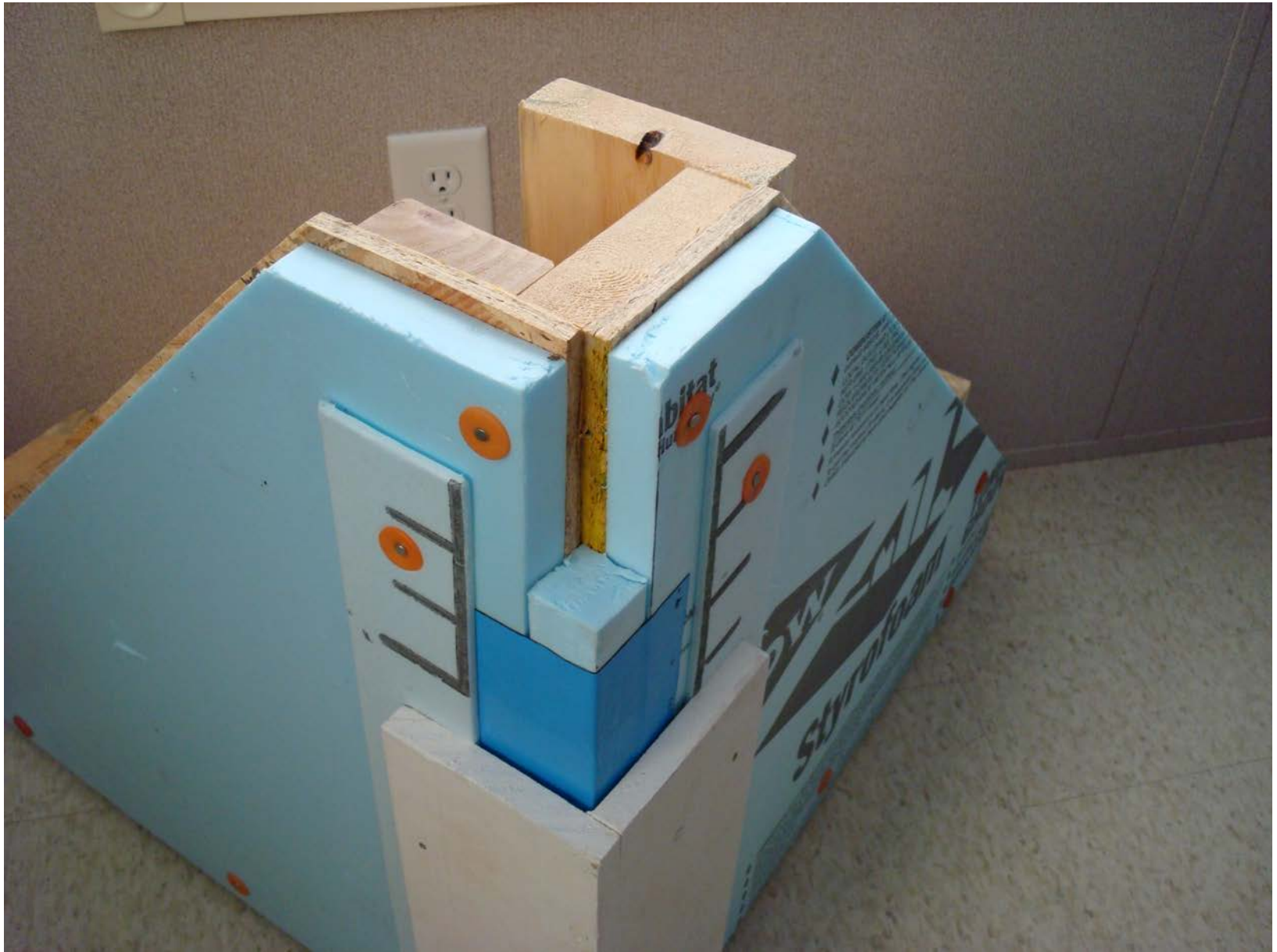
Wind Speed (mph) vs. Stagnation Pressure (Pa)



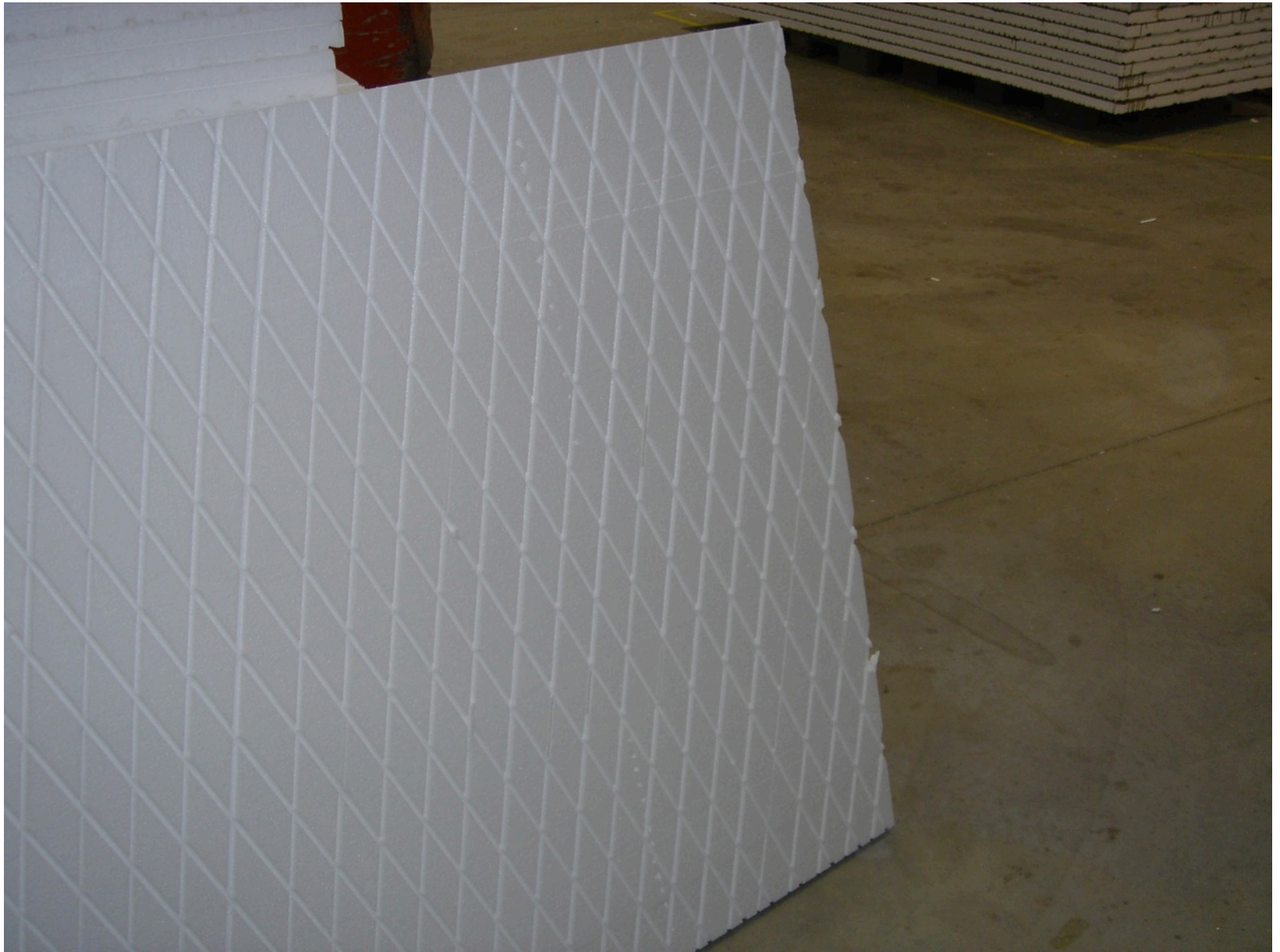




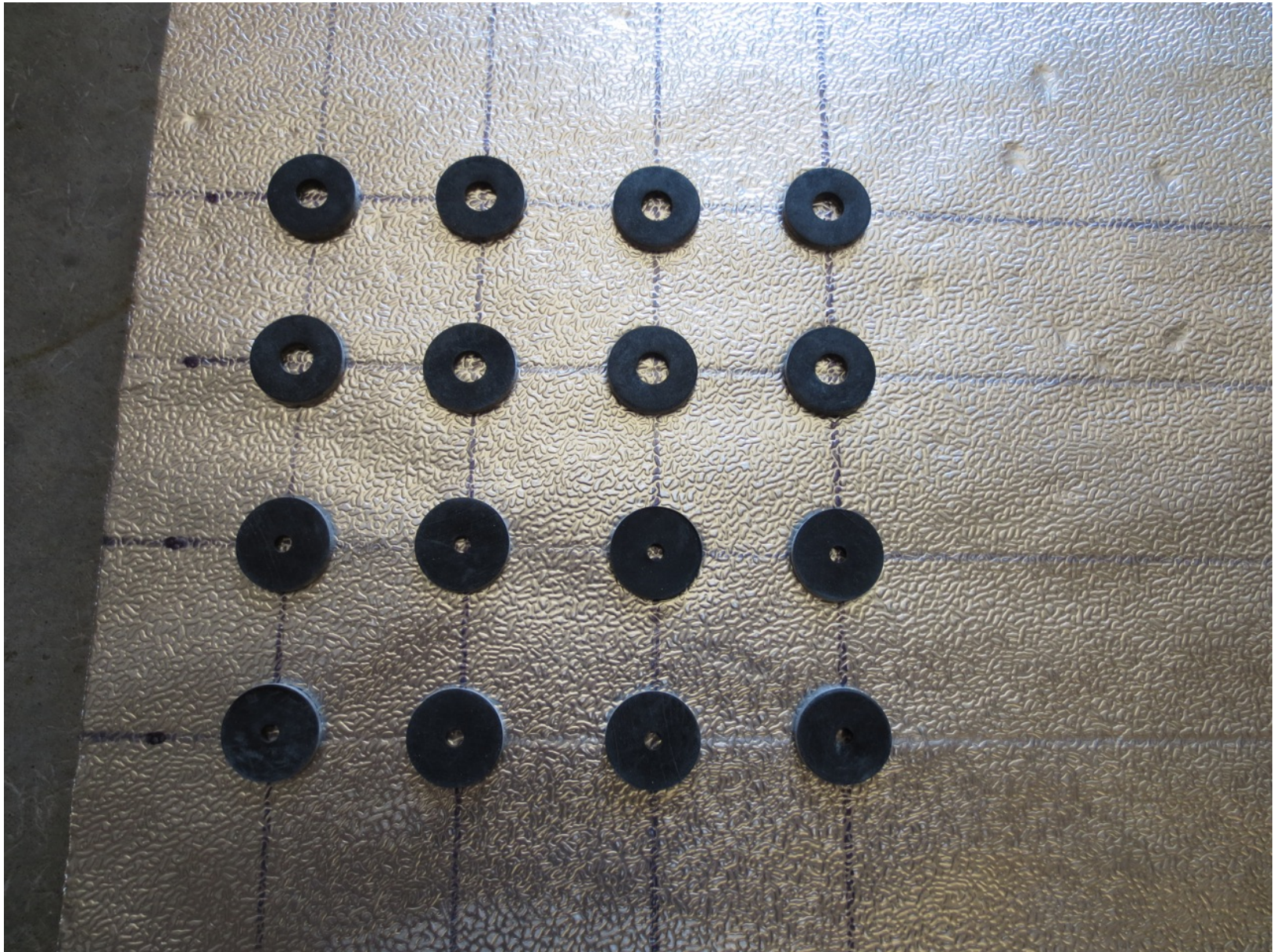




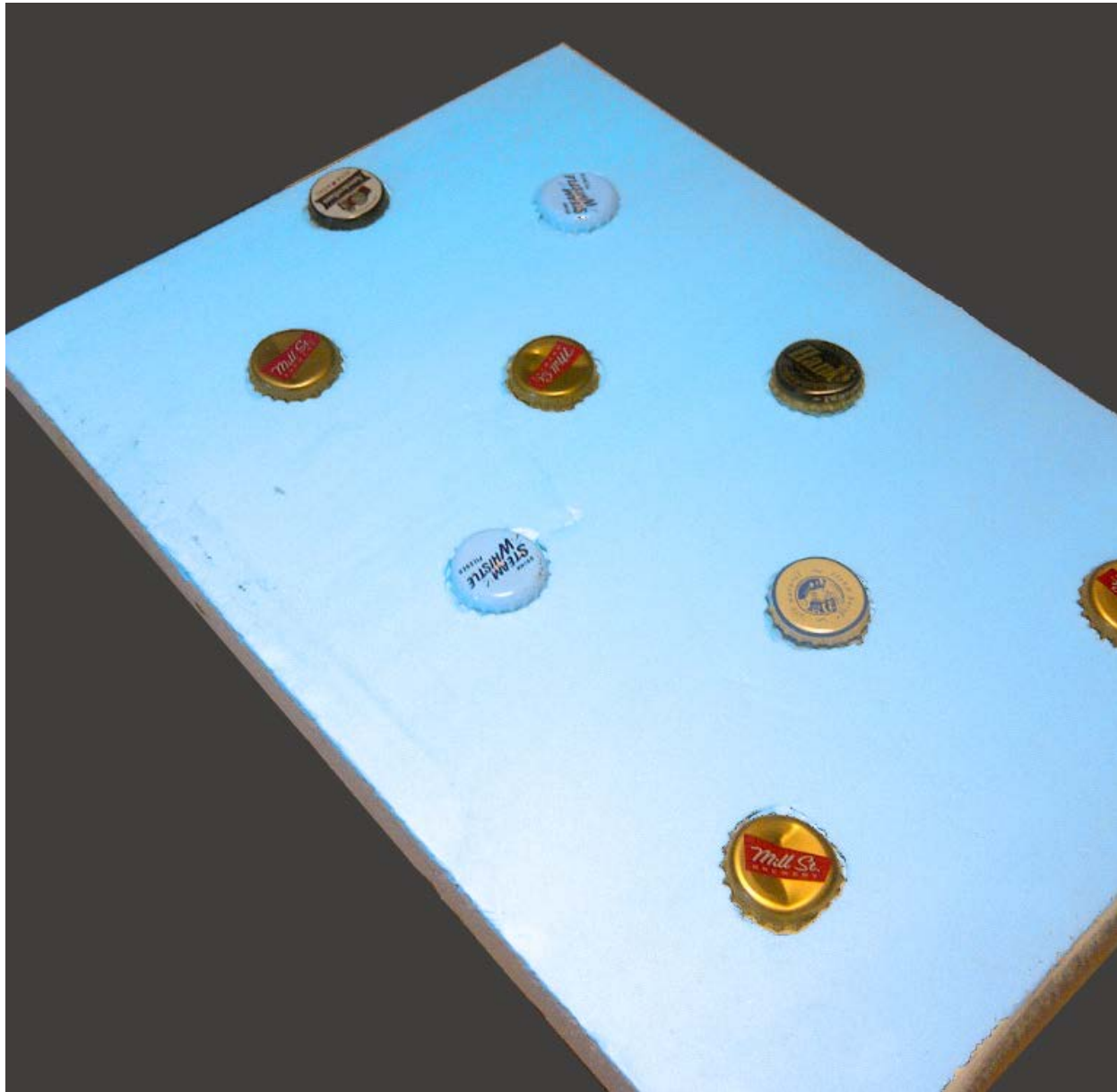




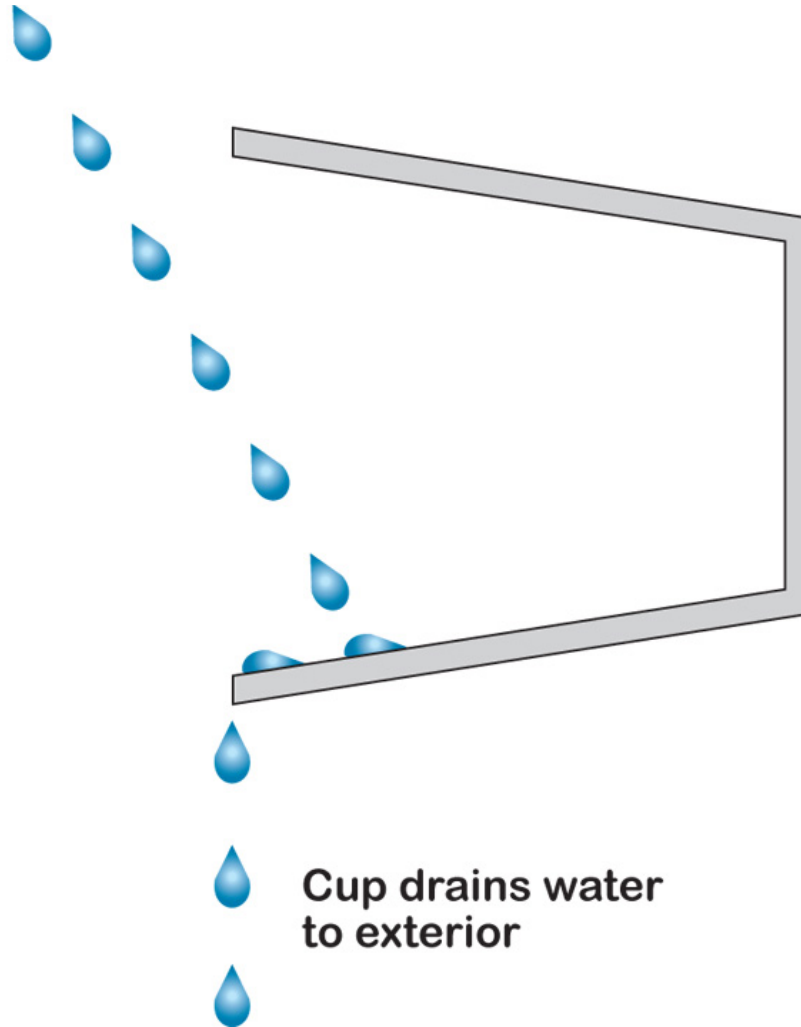
Rain Screen



Beer Screen?



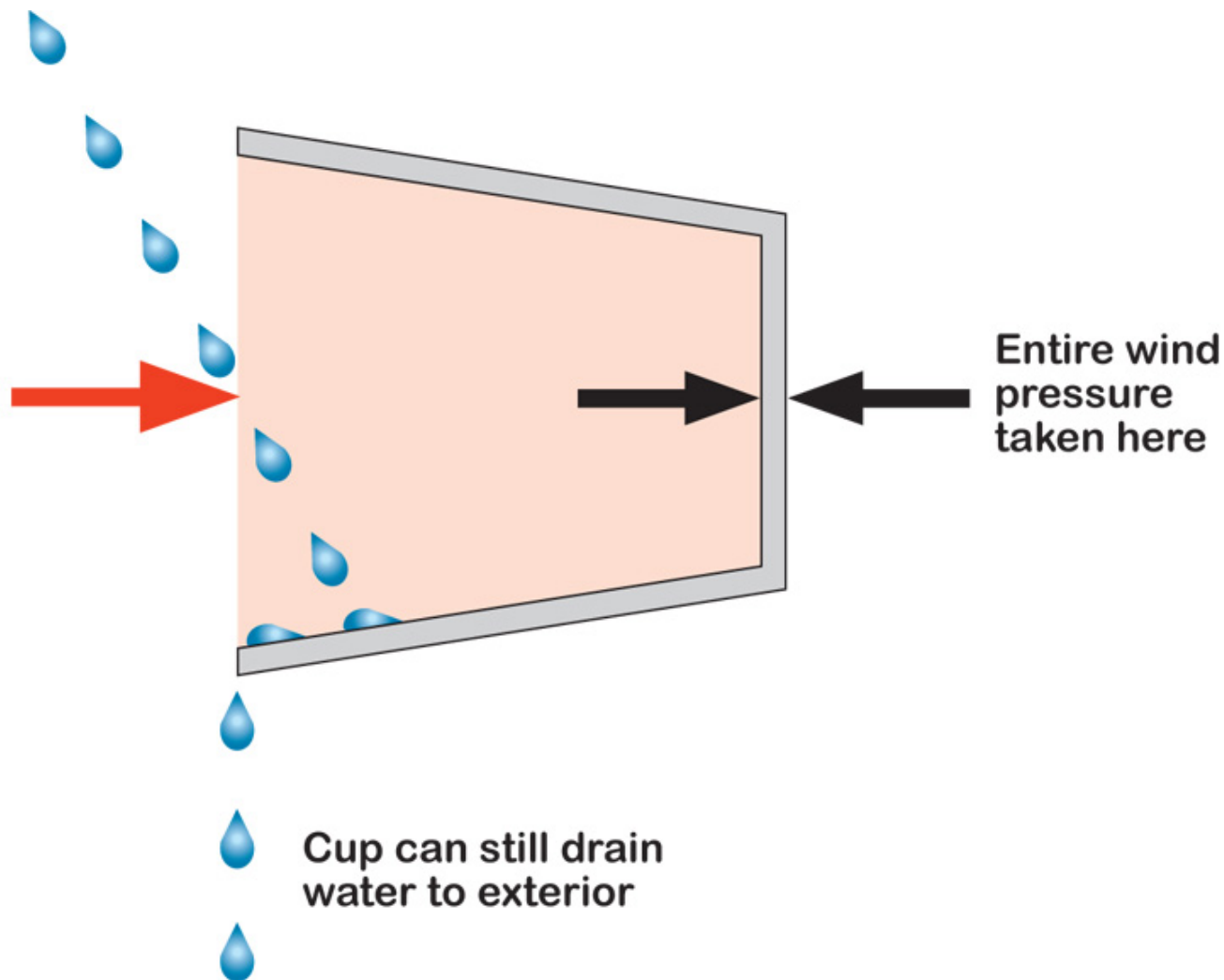
Rain enters cup
due to momentum
("kinetic energy")



Cup drains water
to exterior

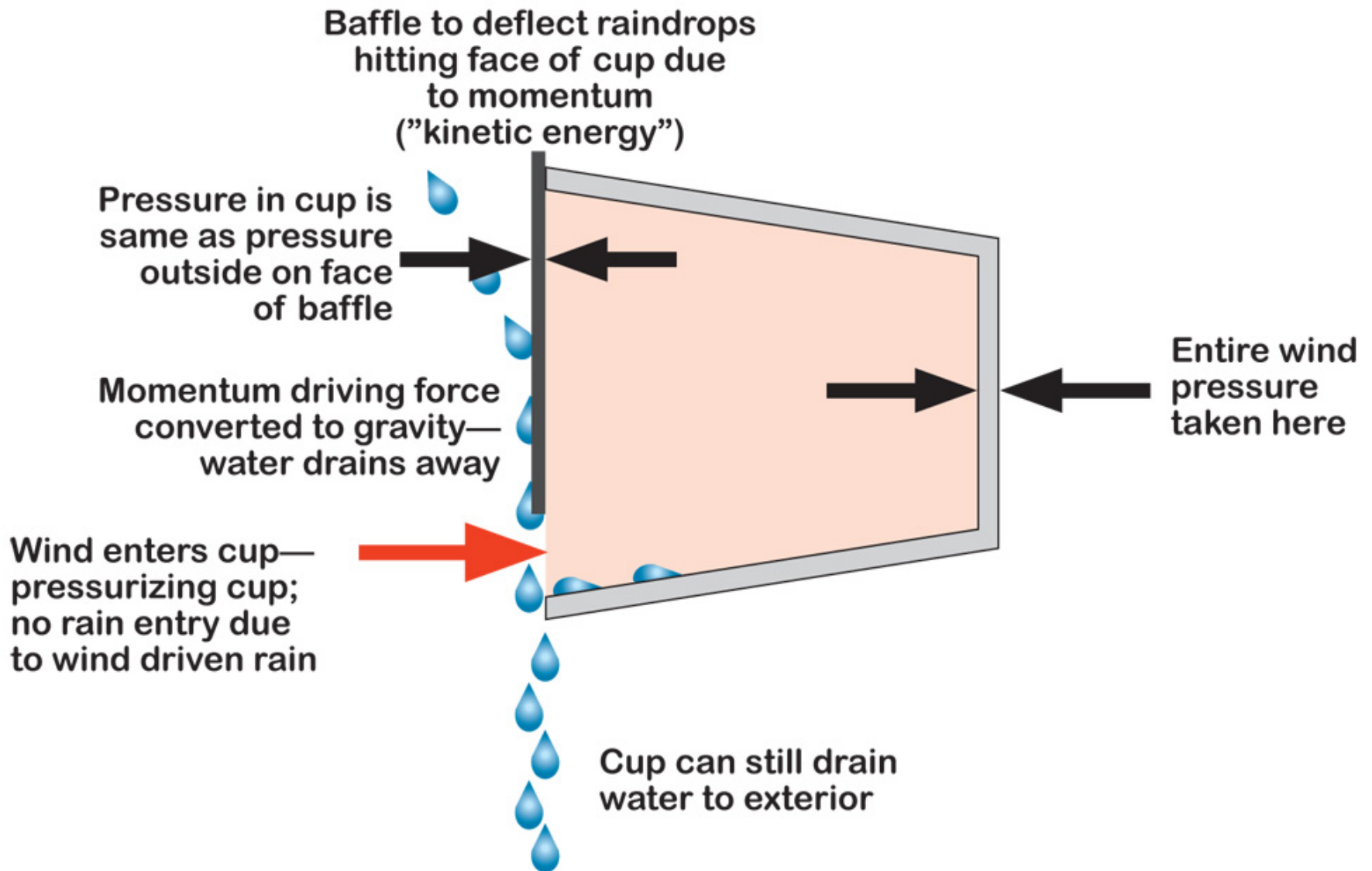
Rain enters cup due to momentum ("kinetic energy")

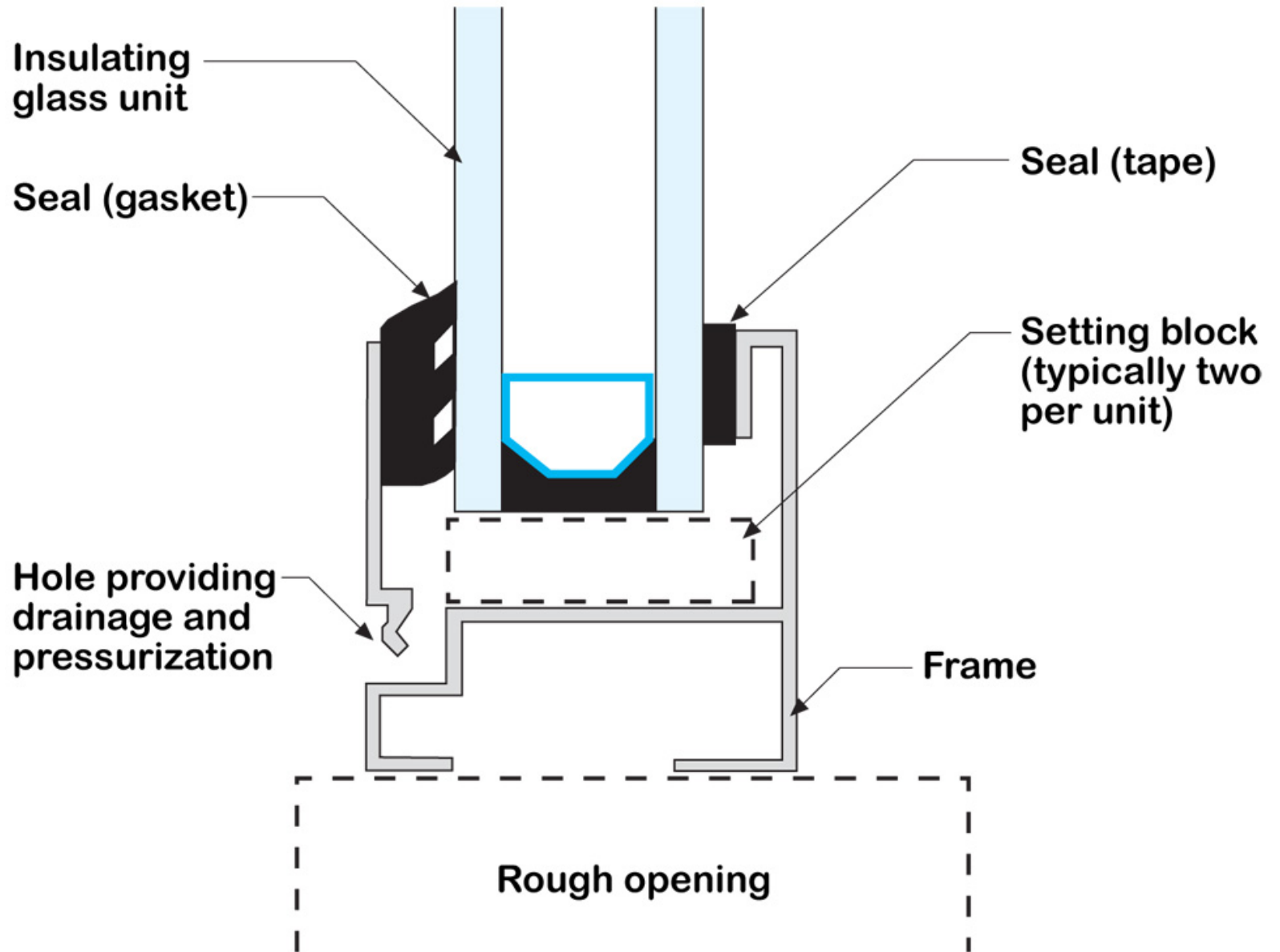
Wind enters cup—pressurizing cup; no rain entry due to wind driven rain

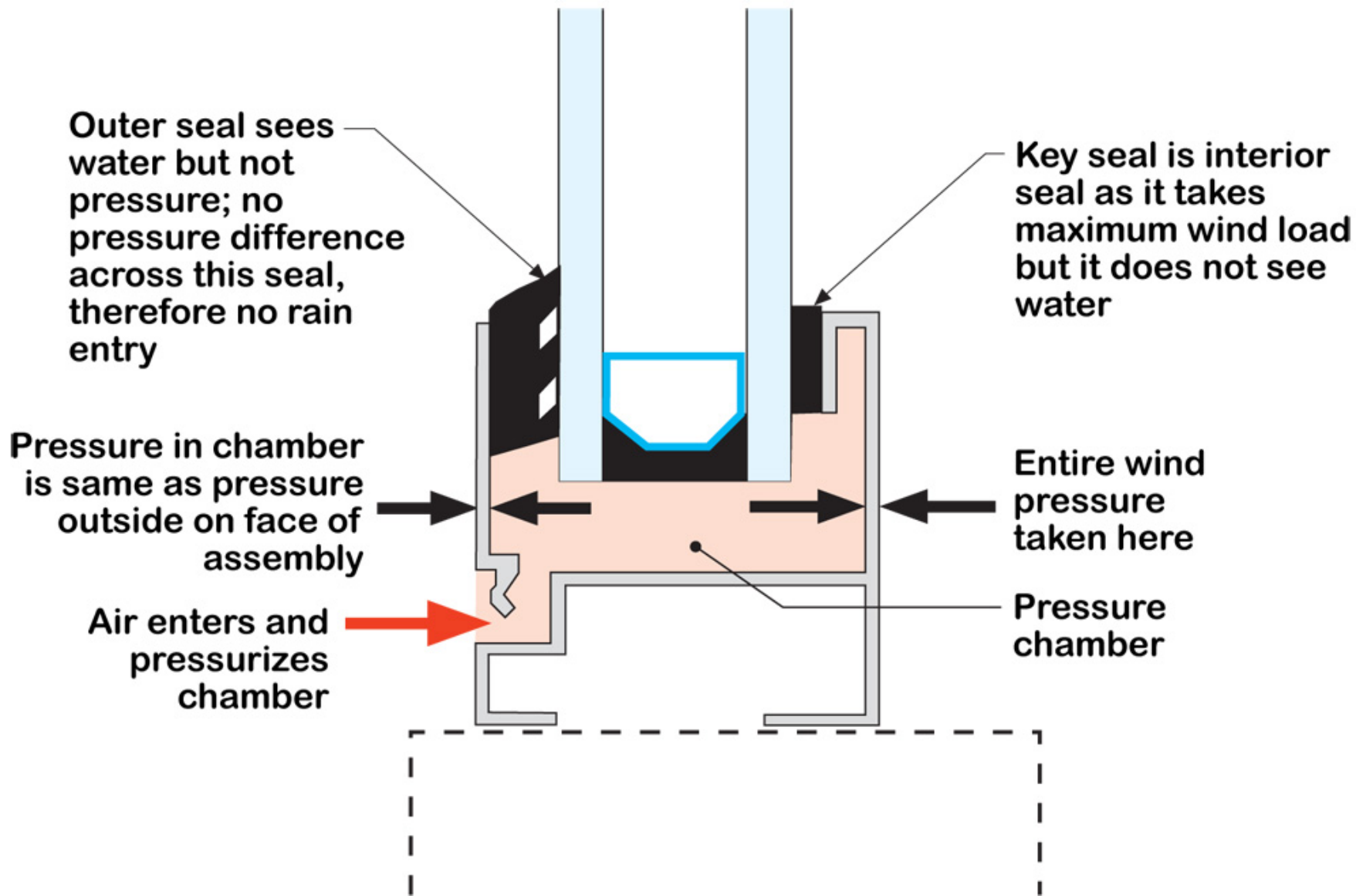


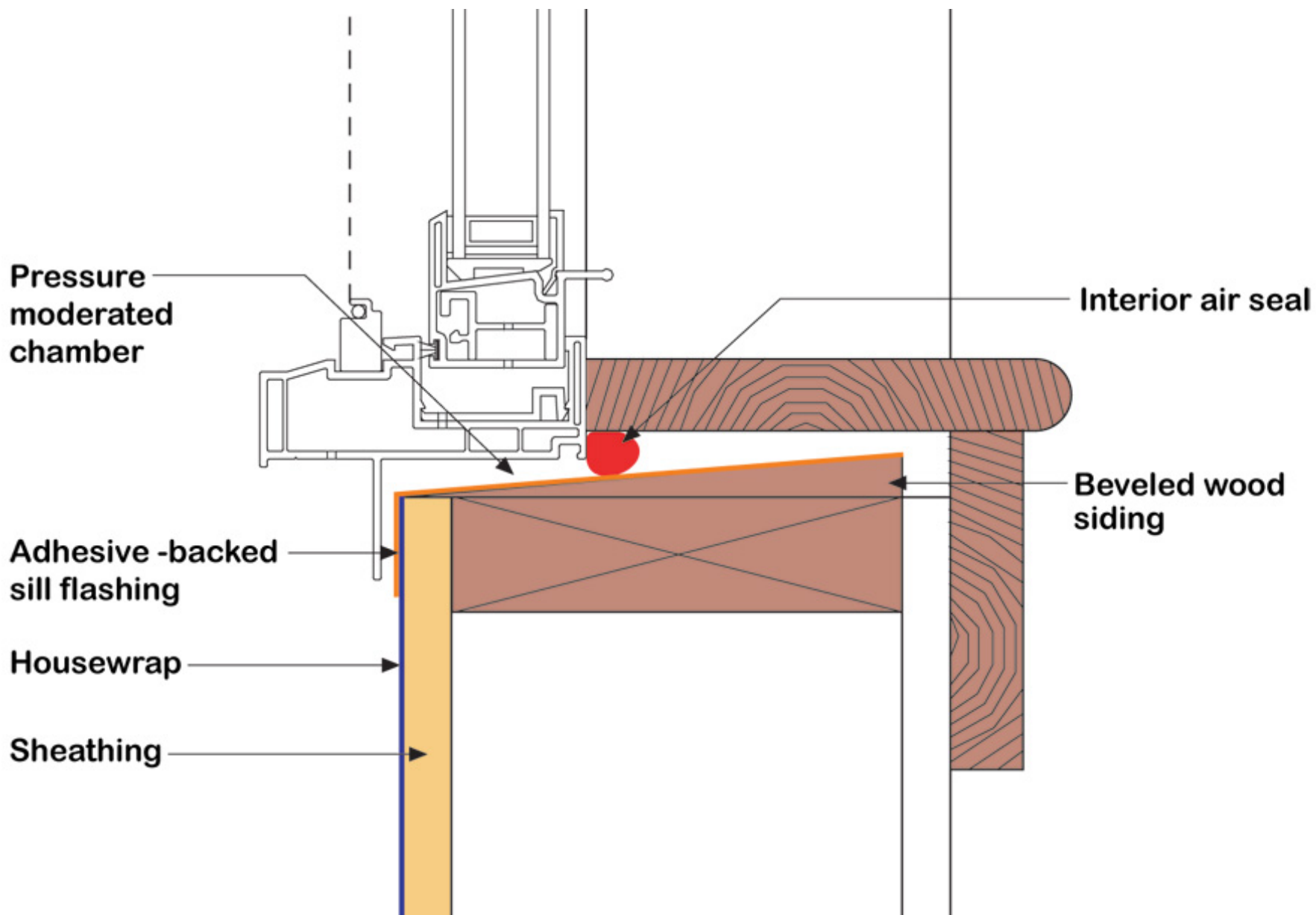
Cup can still drain water to exterior

Entire wind pressure taken here









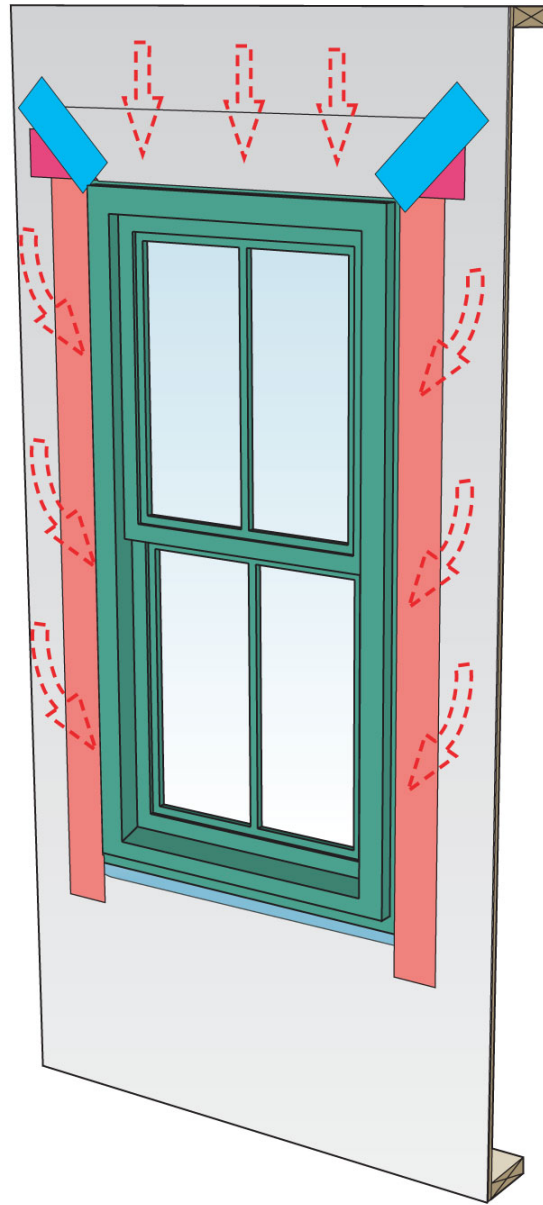


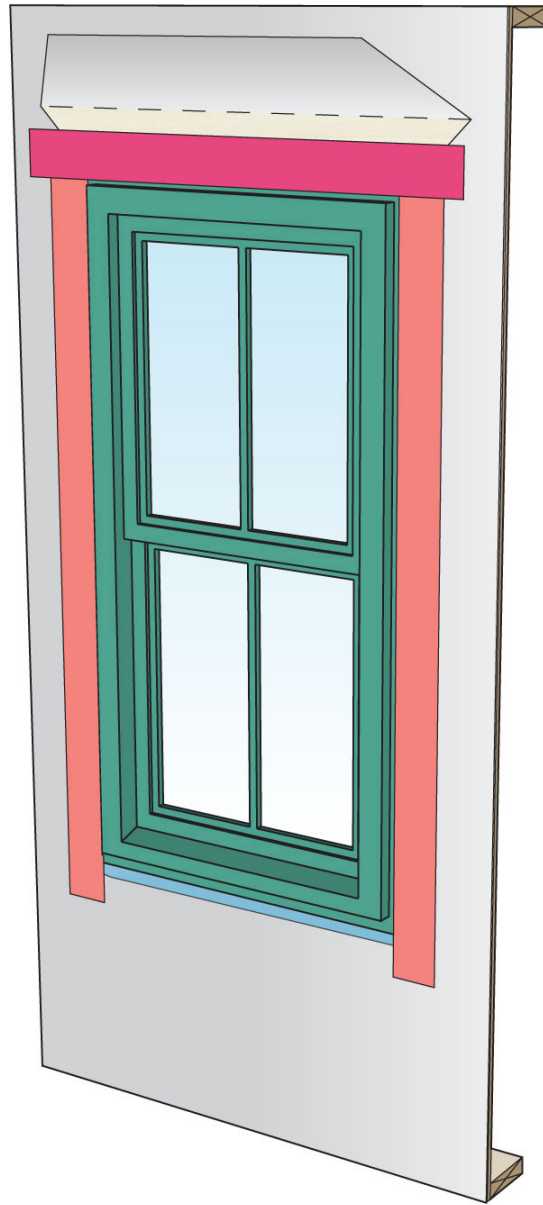




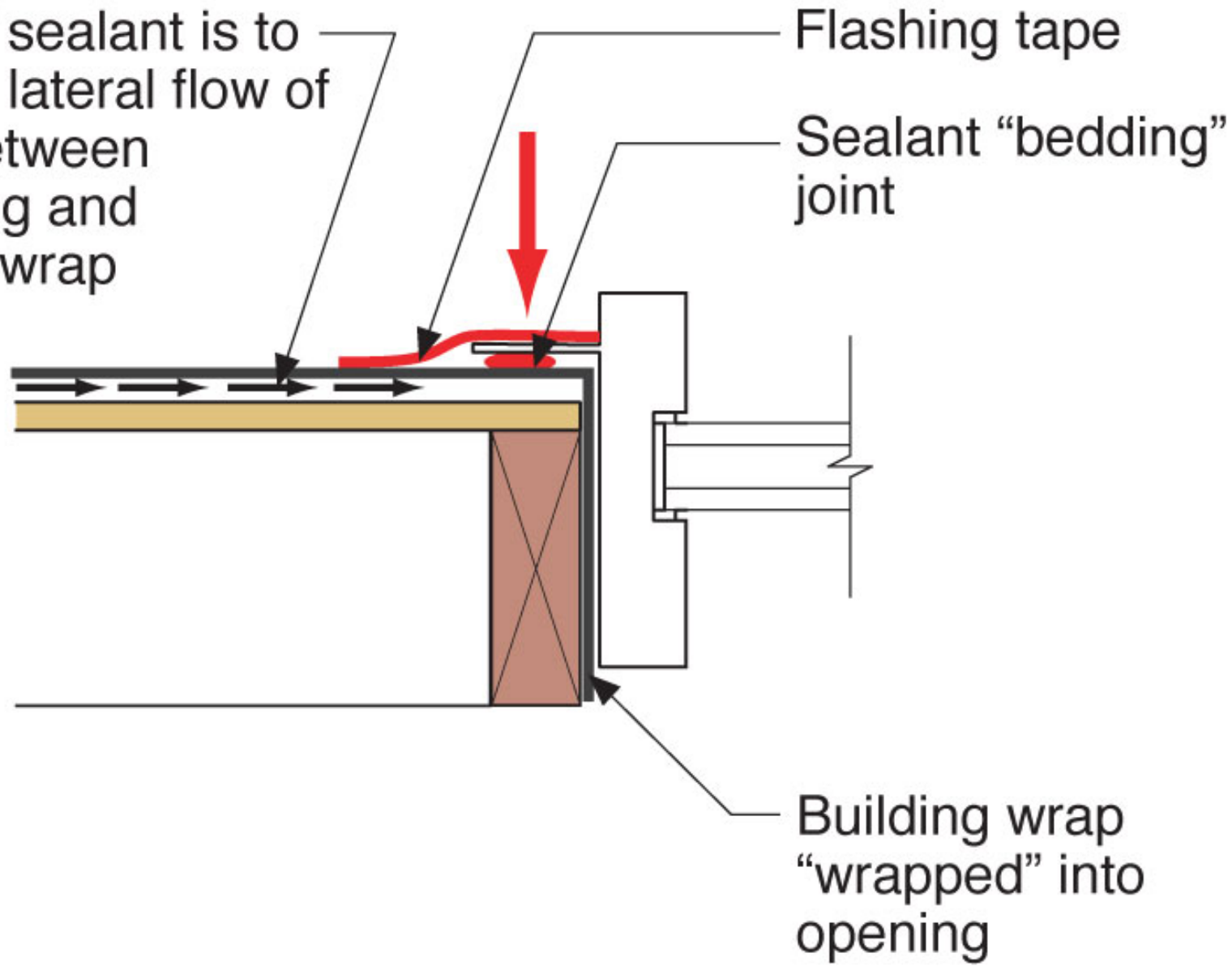


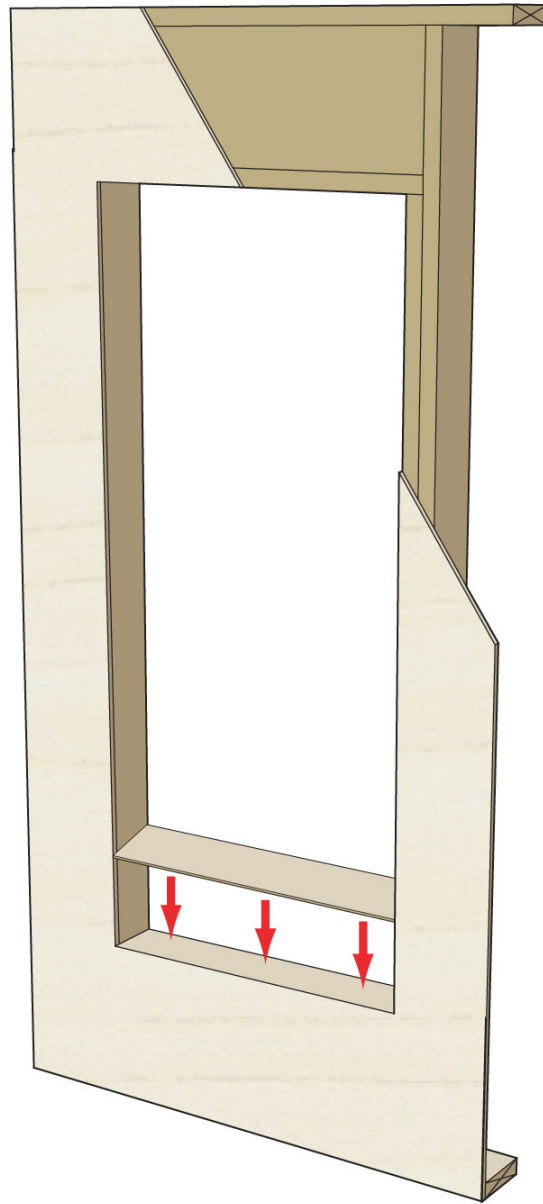


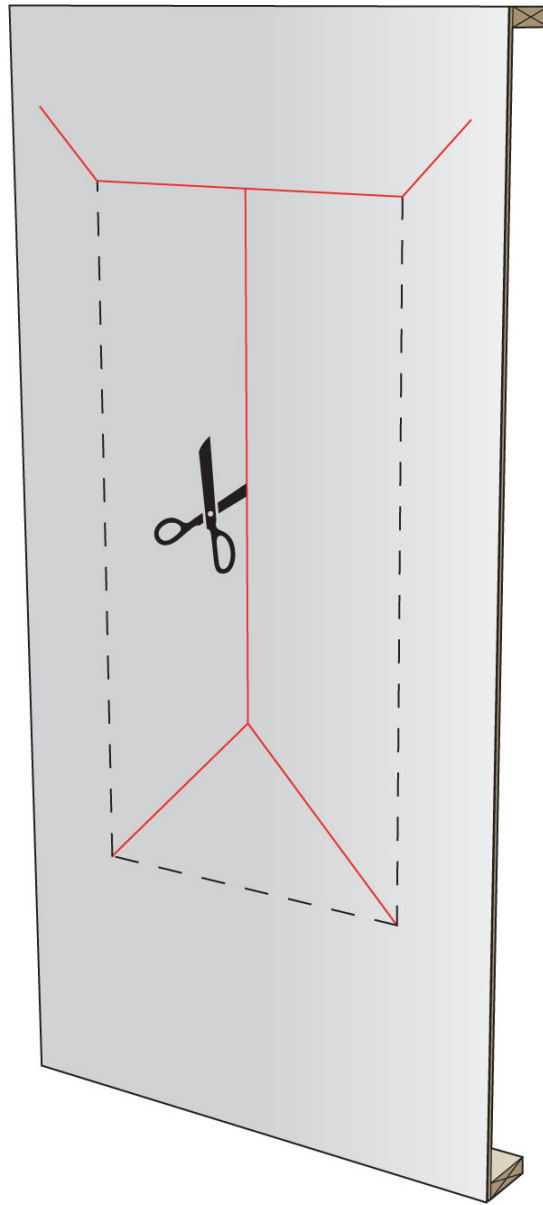


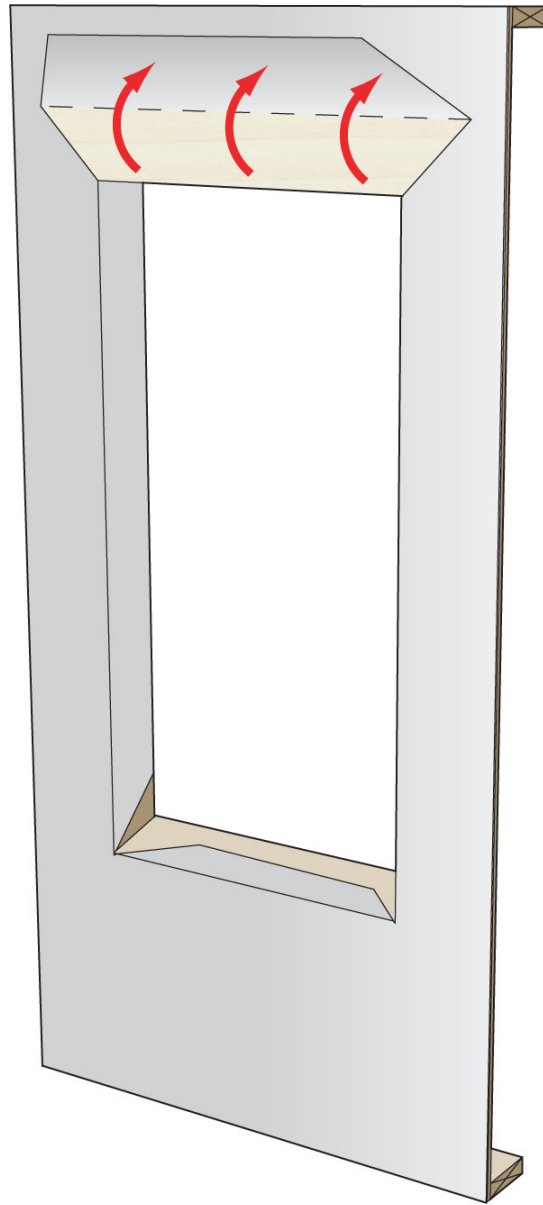


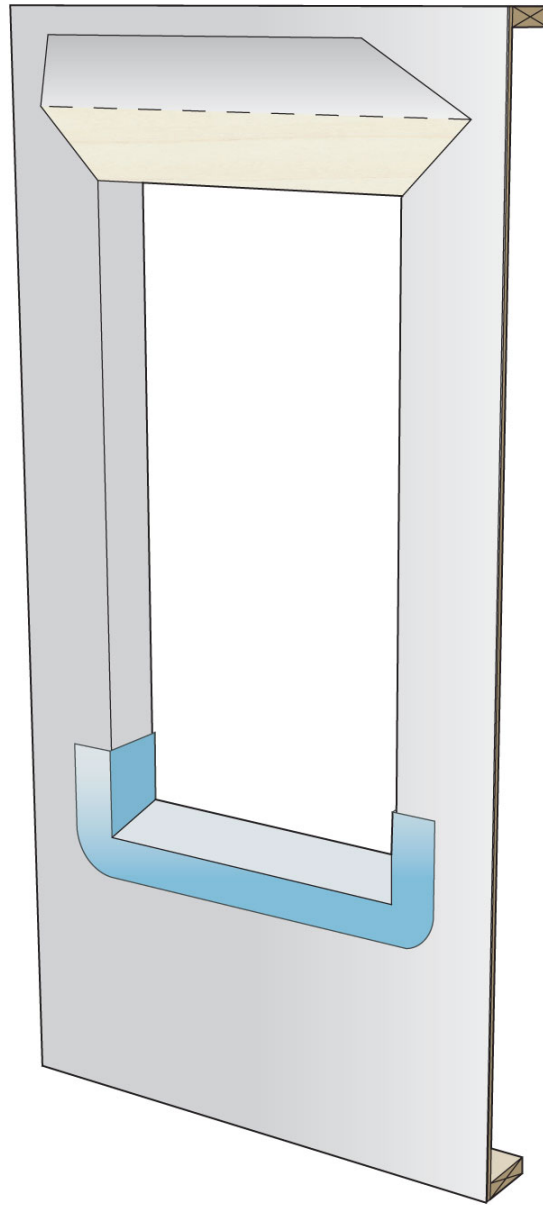
Intent of sealant is to limit this lateral flow of water between sheathing and building wrap

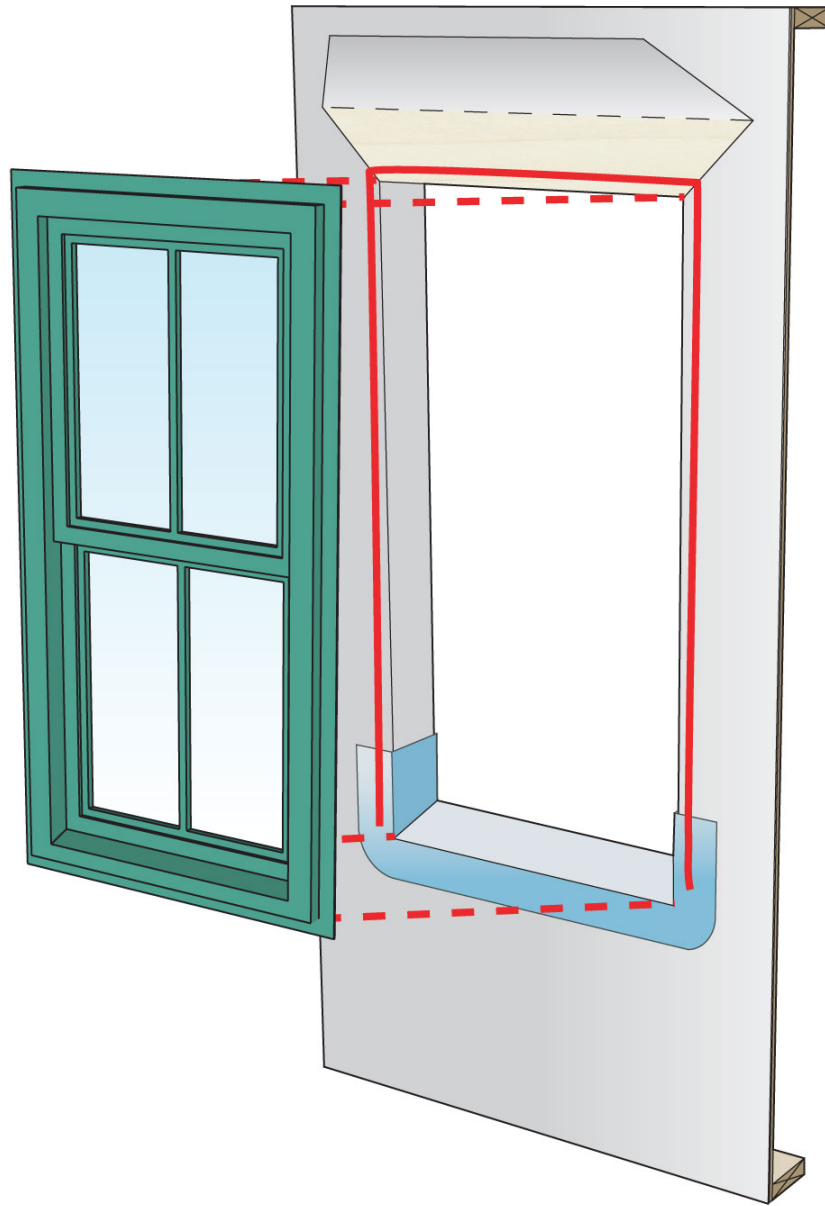


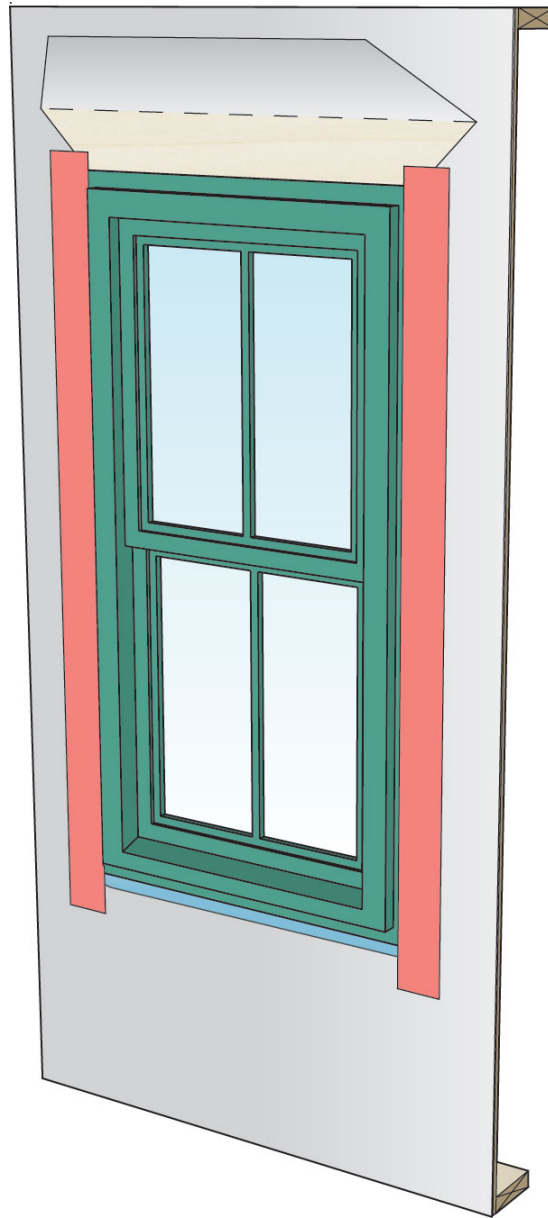


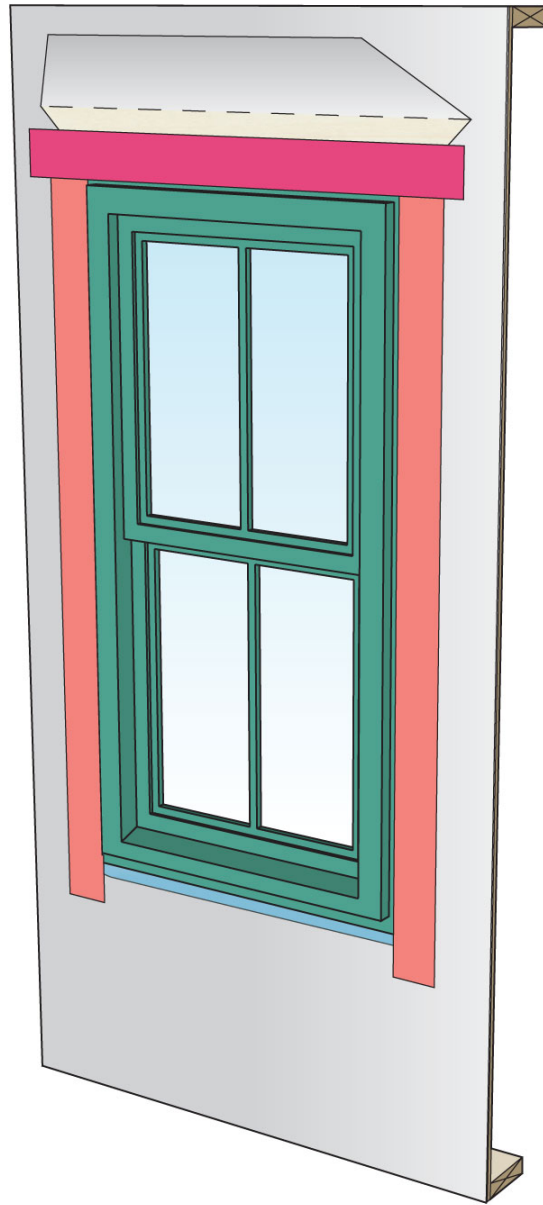


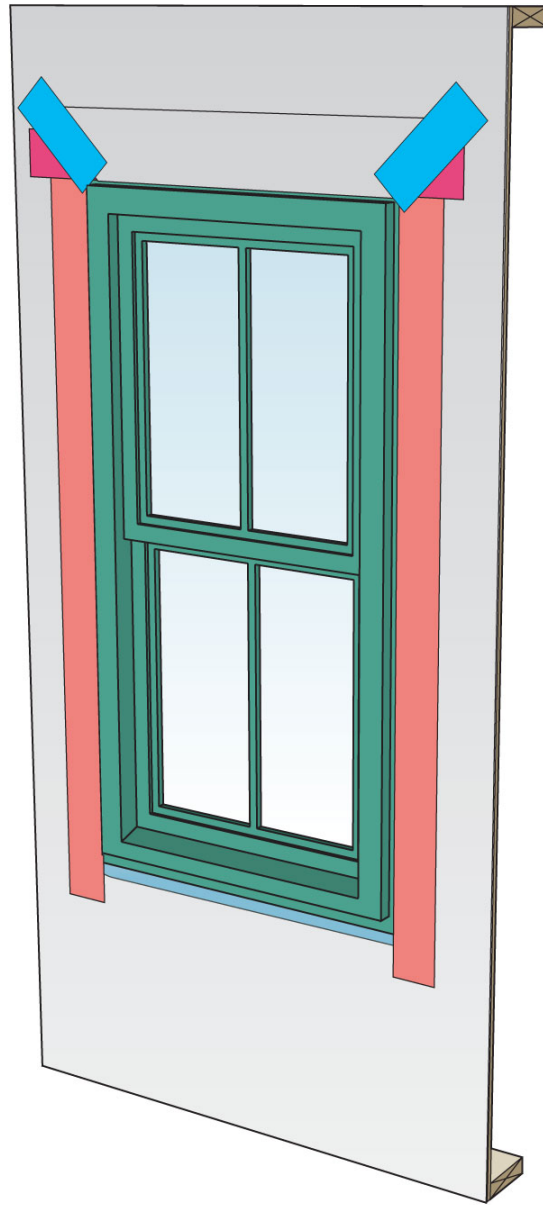


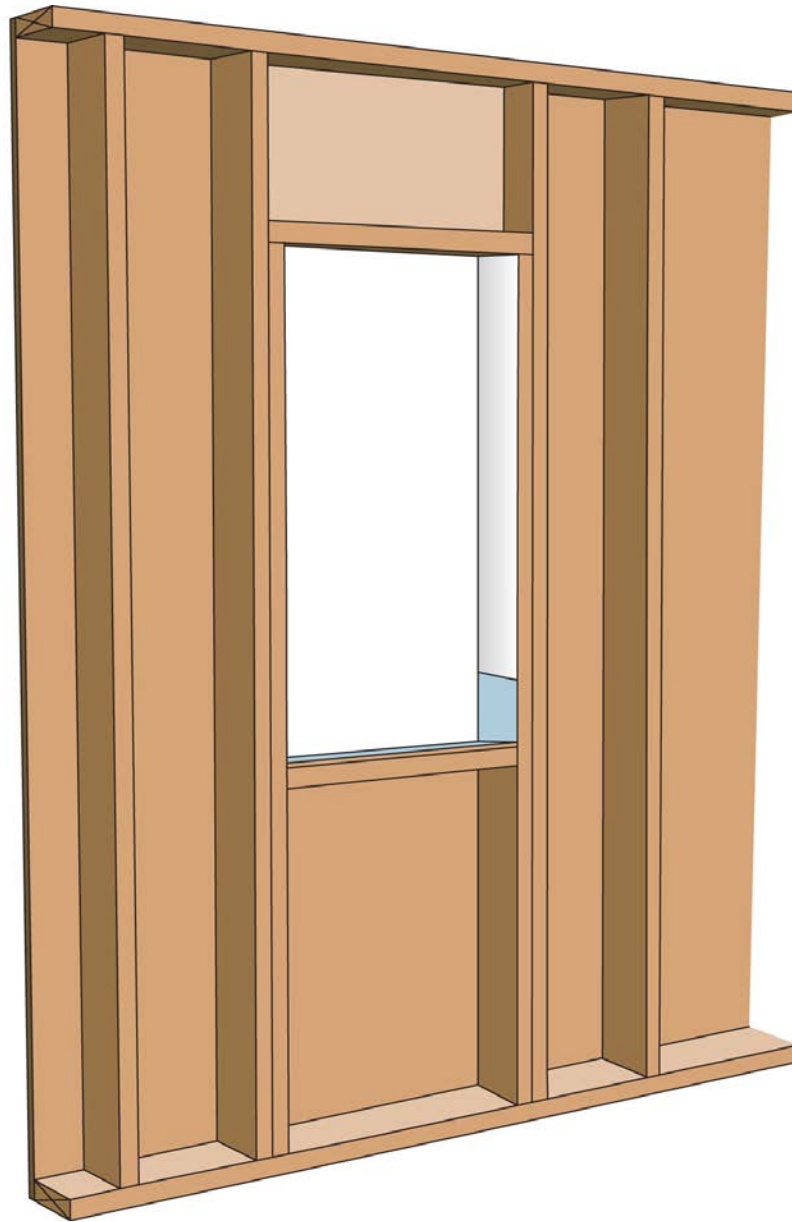








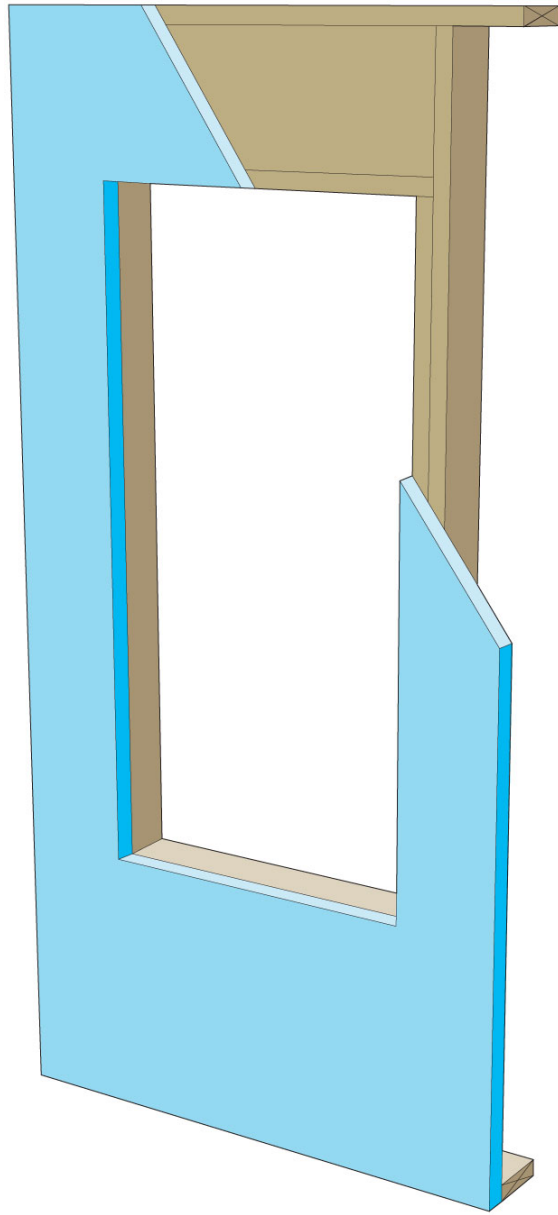


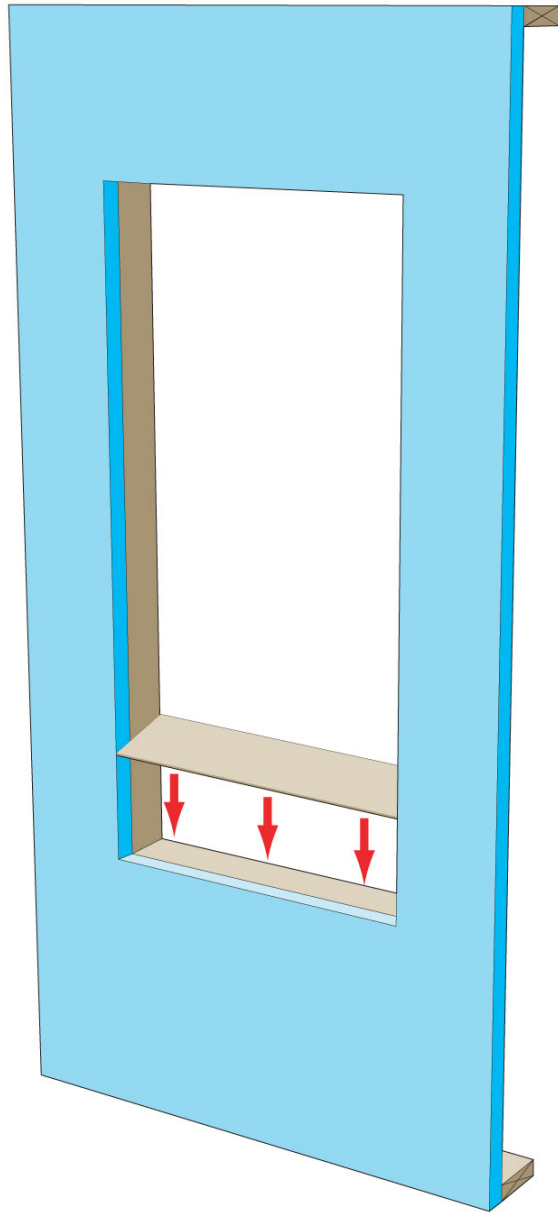


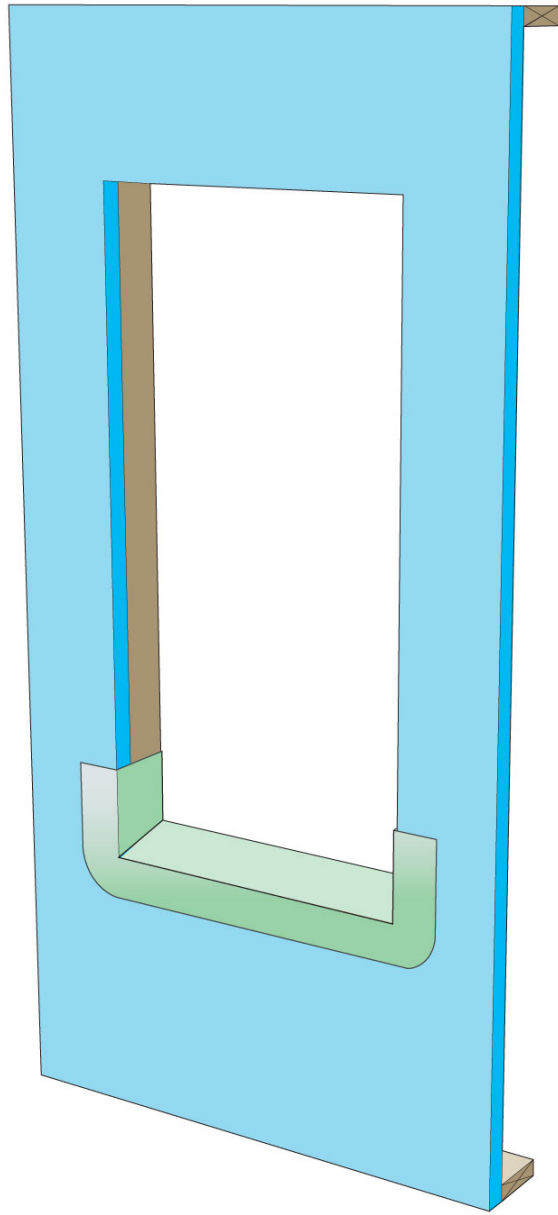


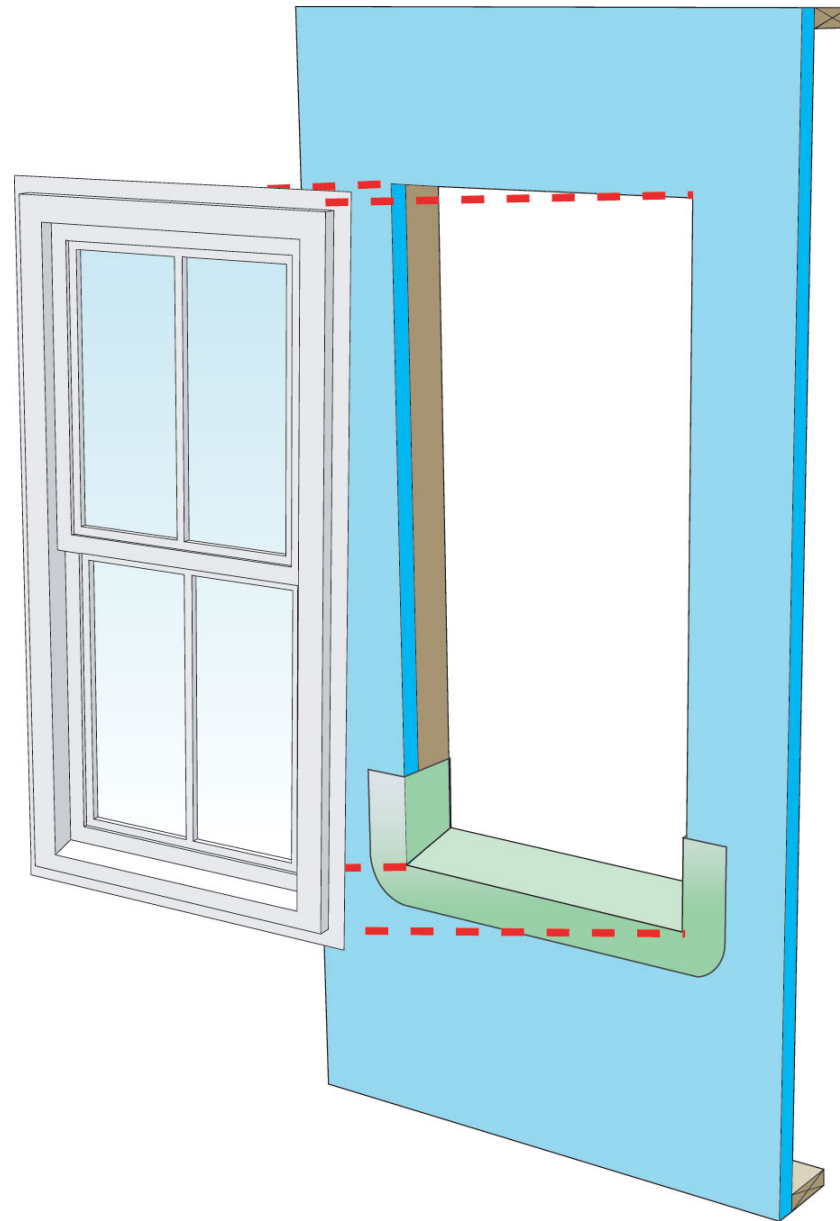


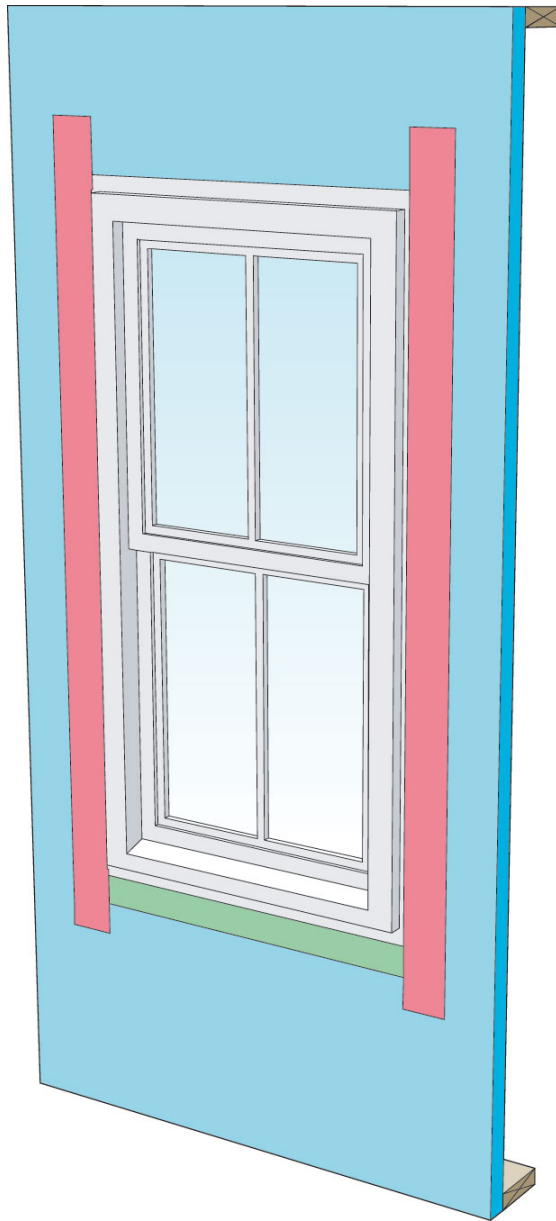


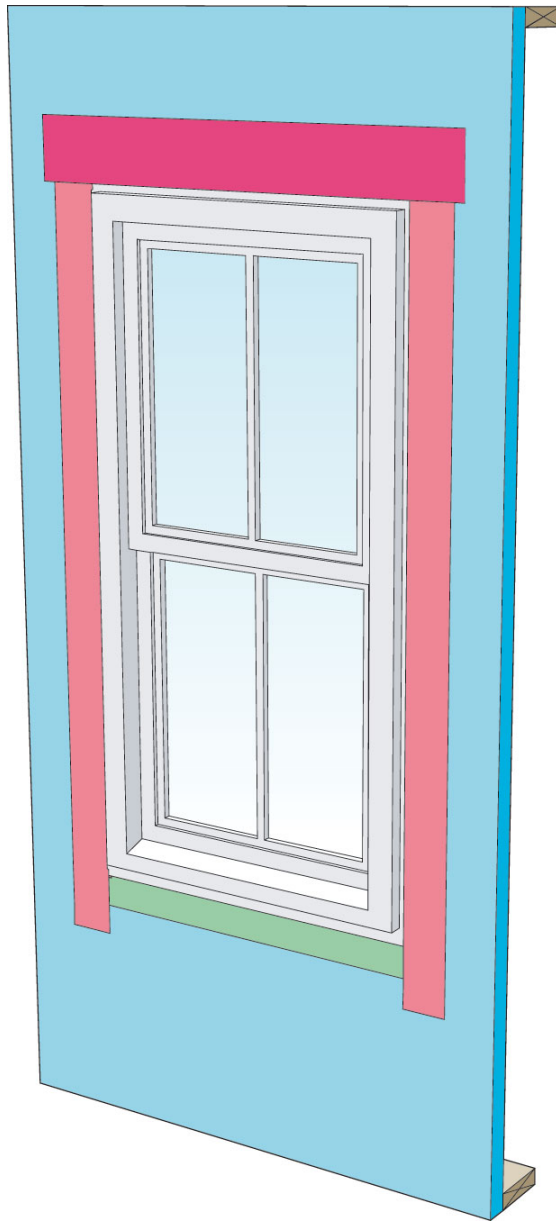


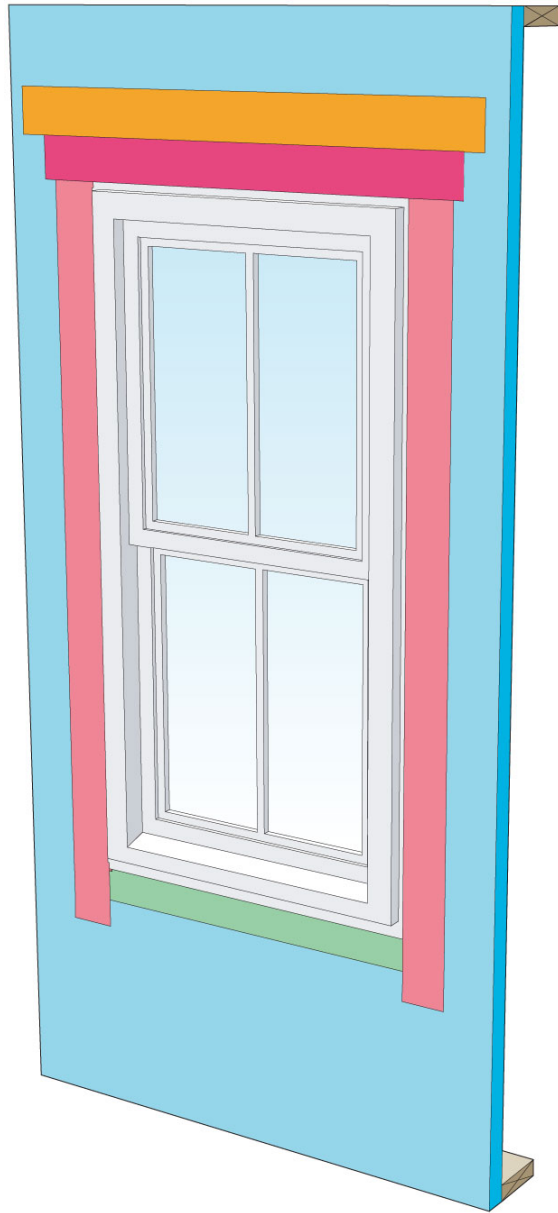


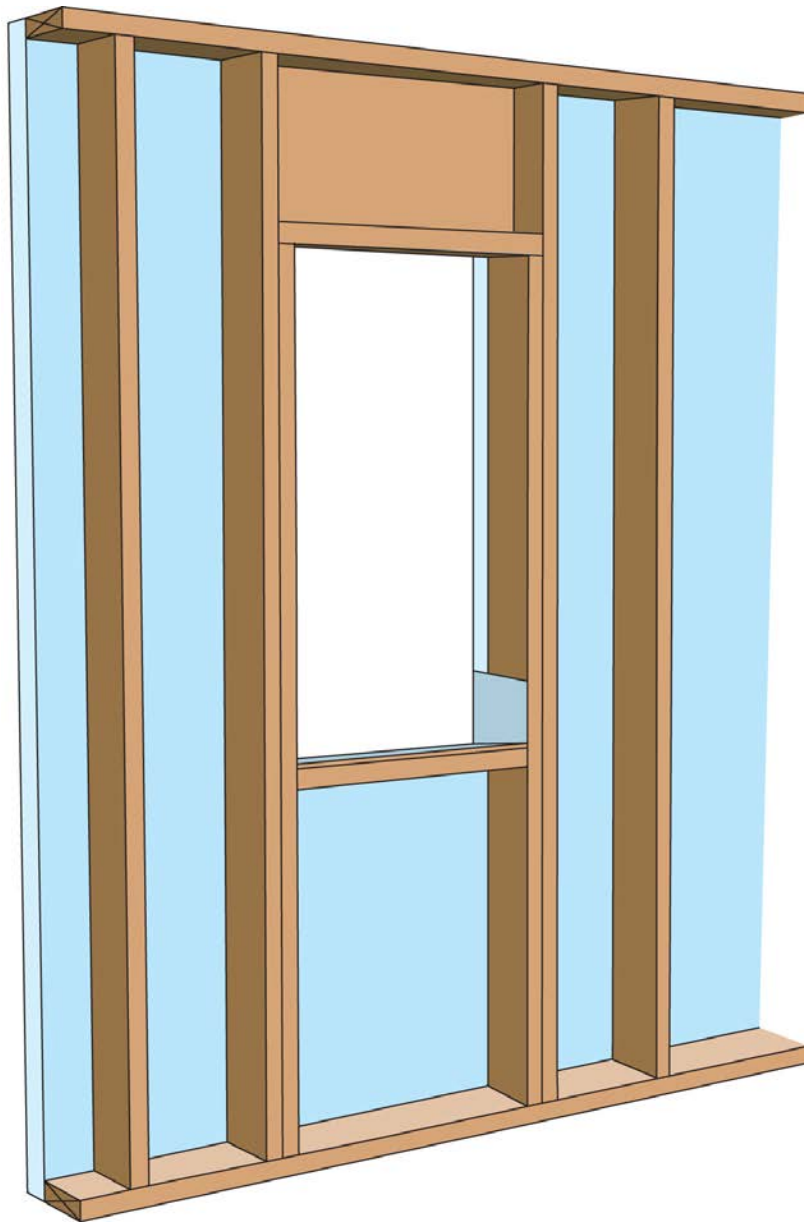




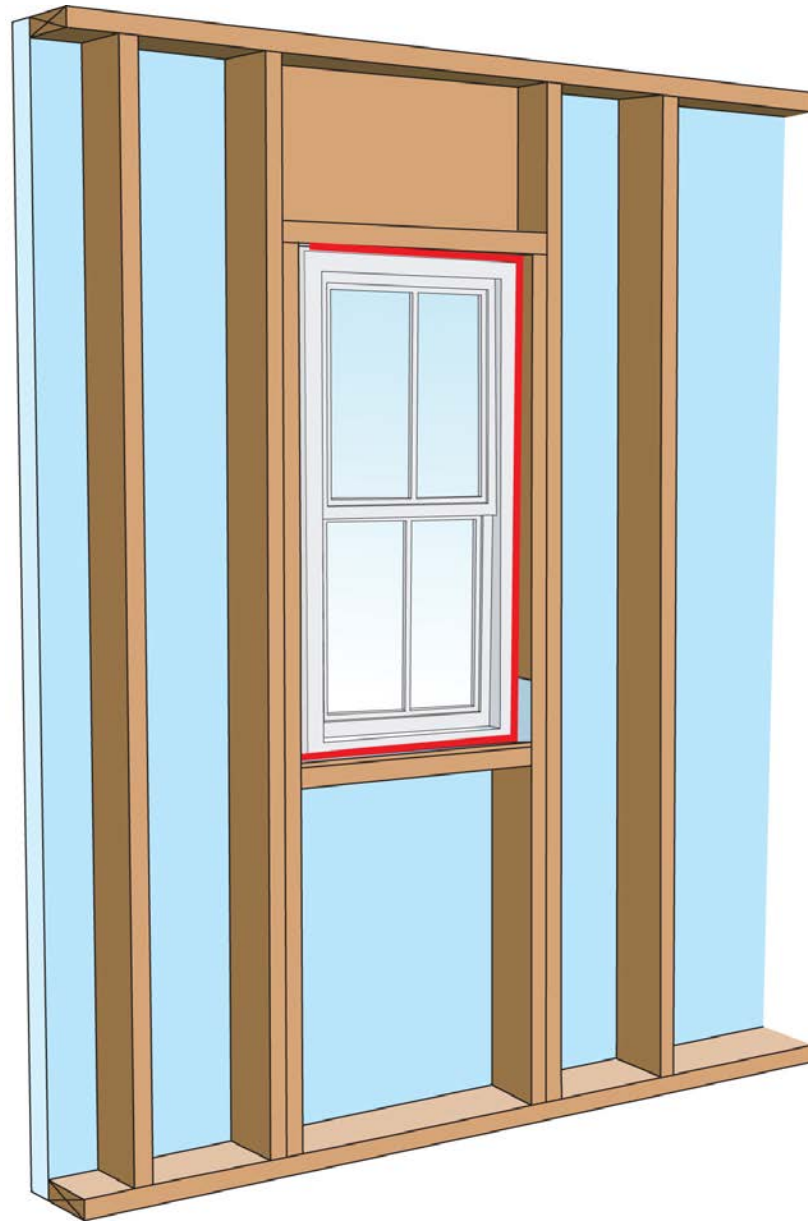






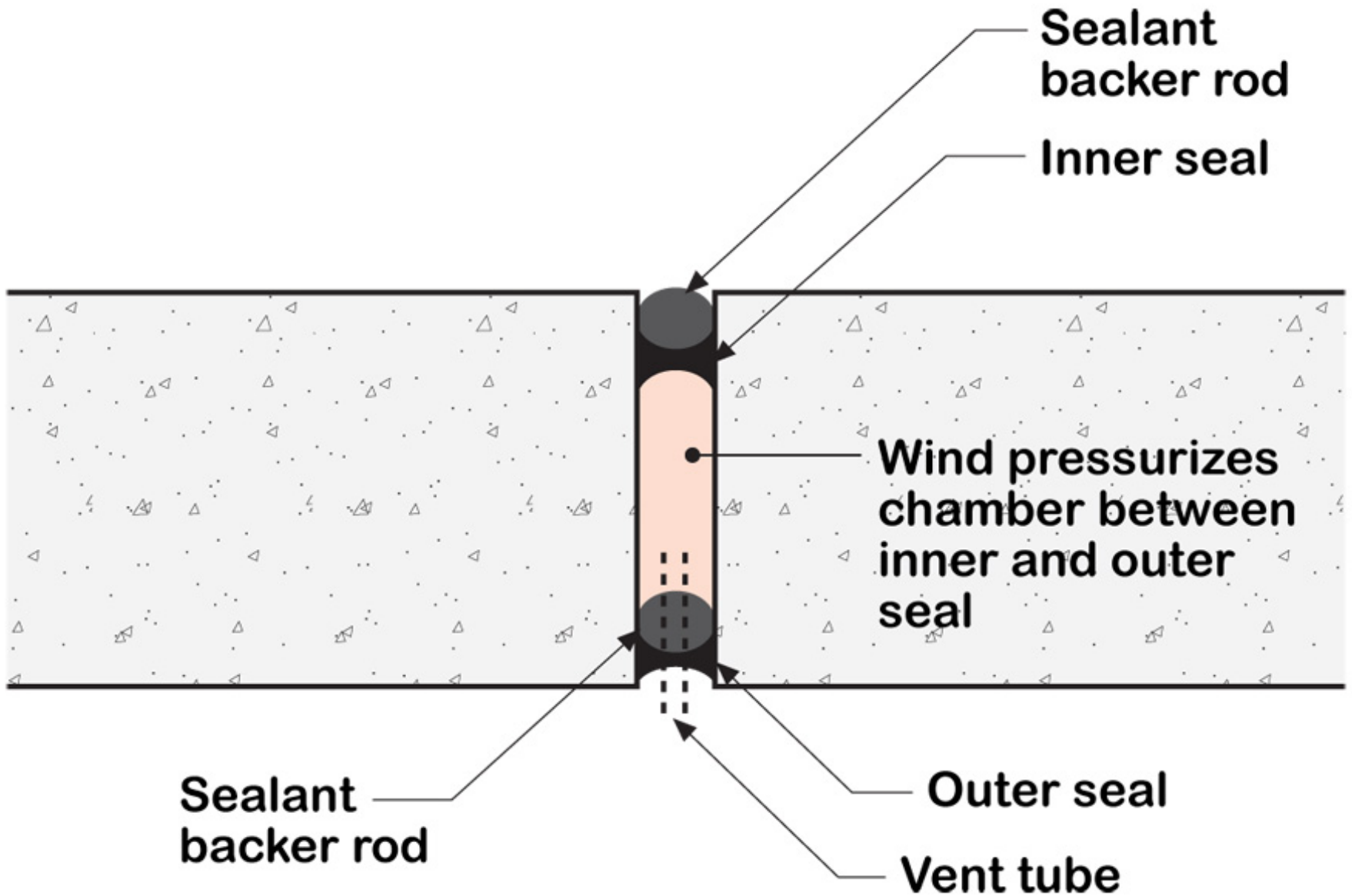


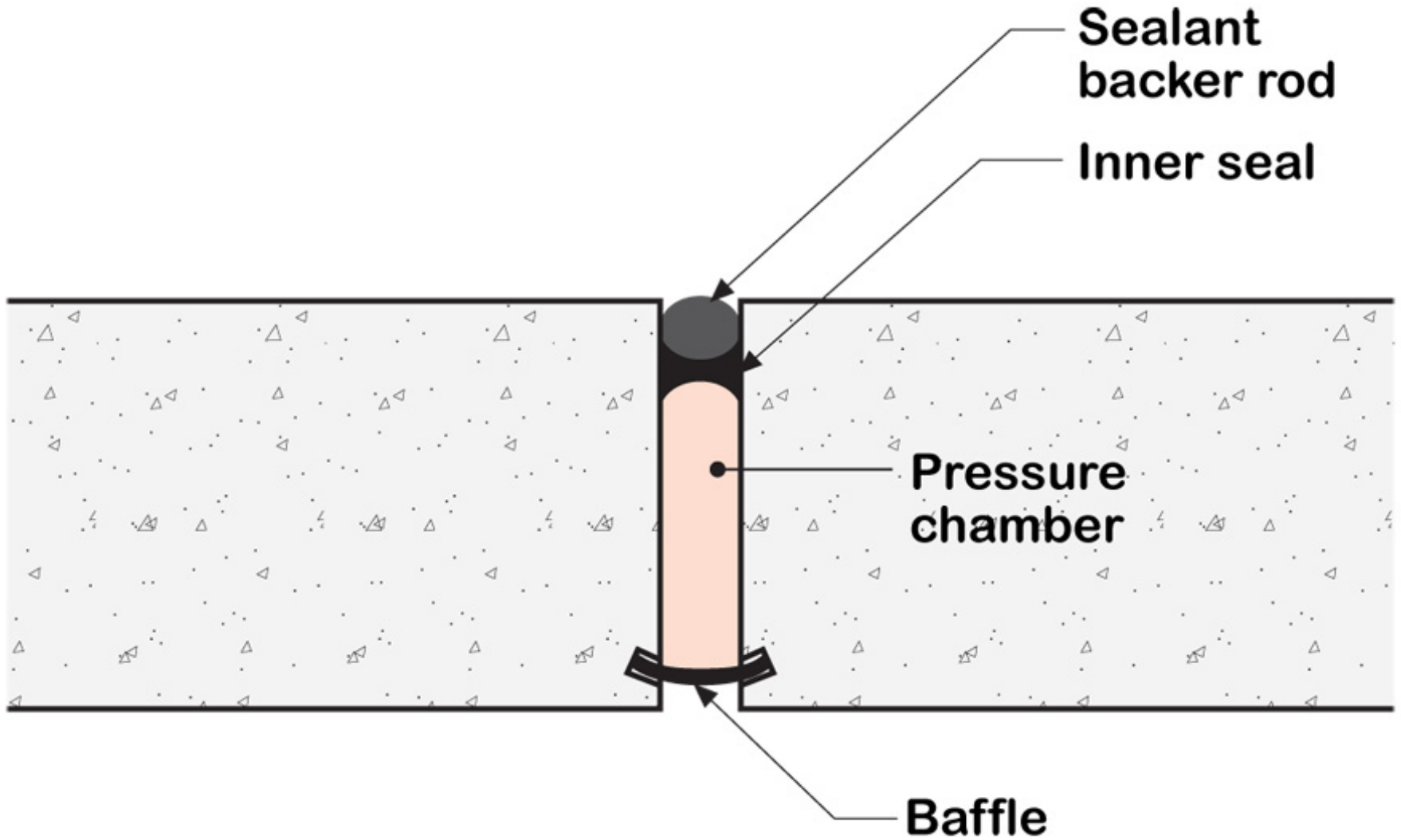


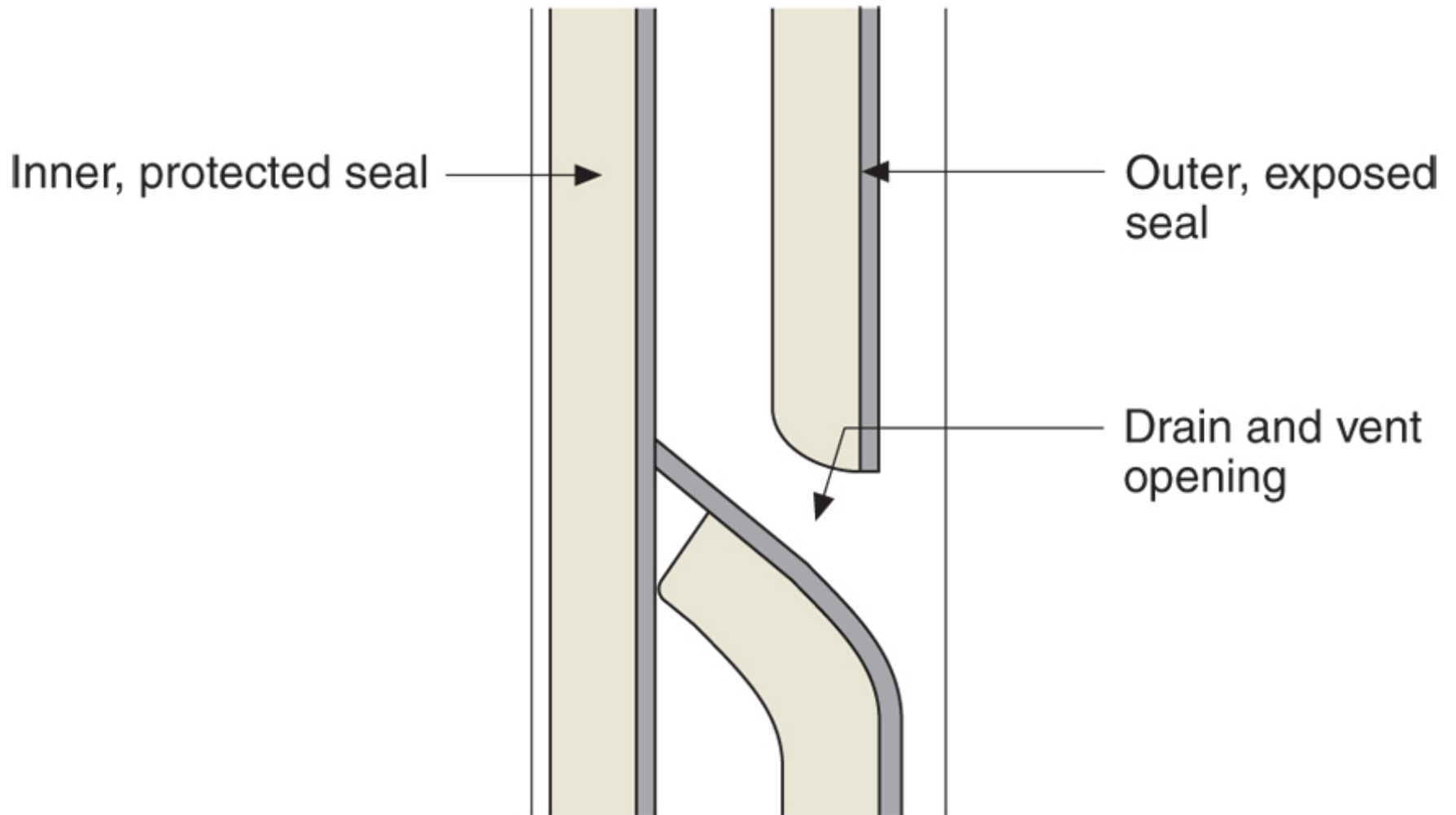


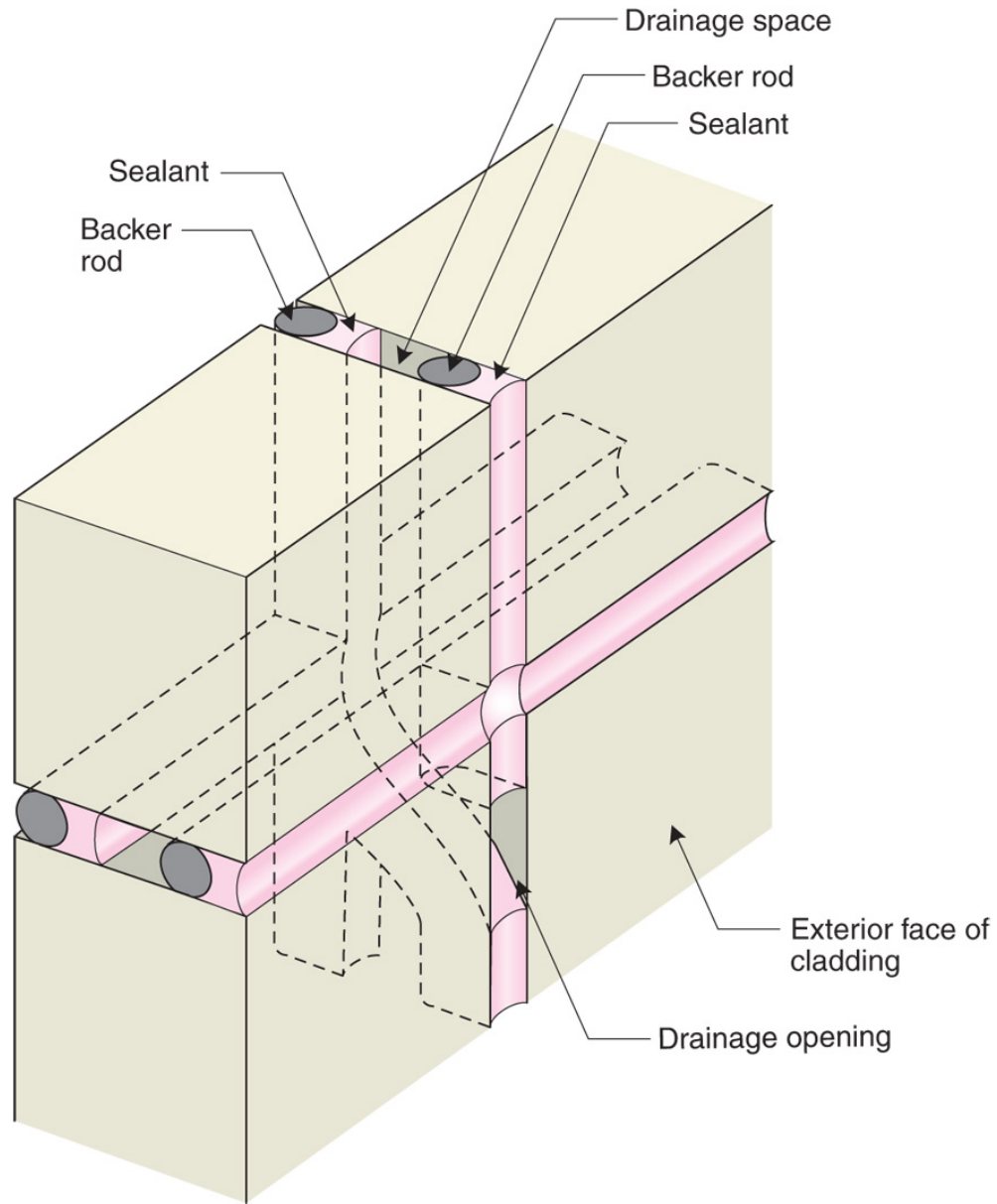




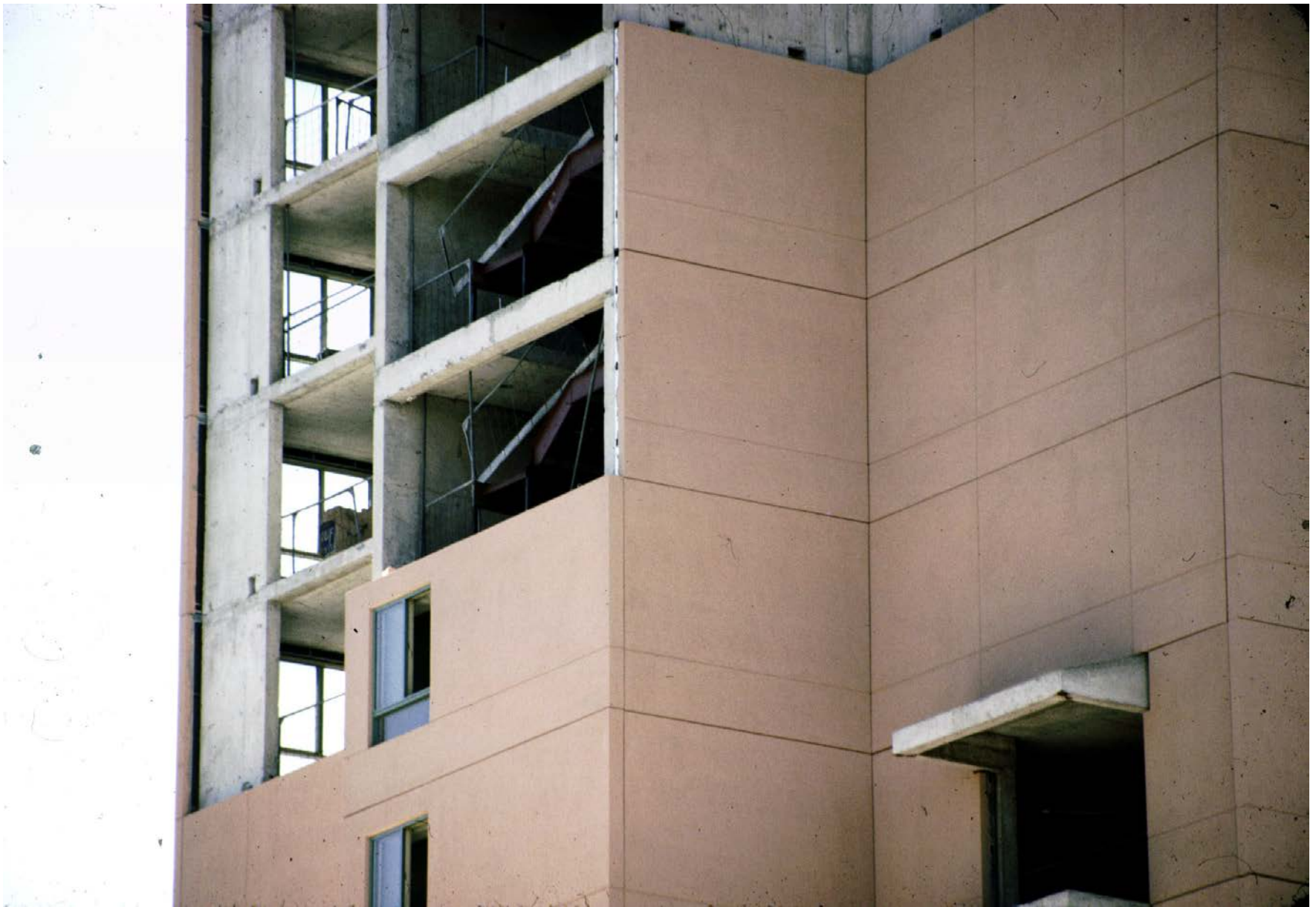














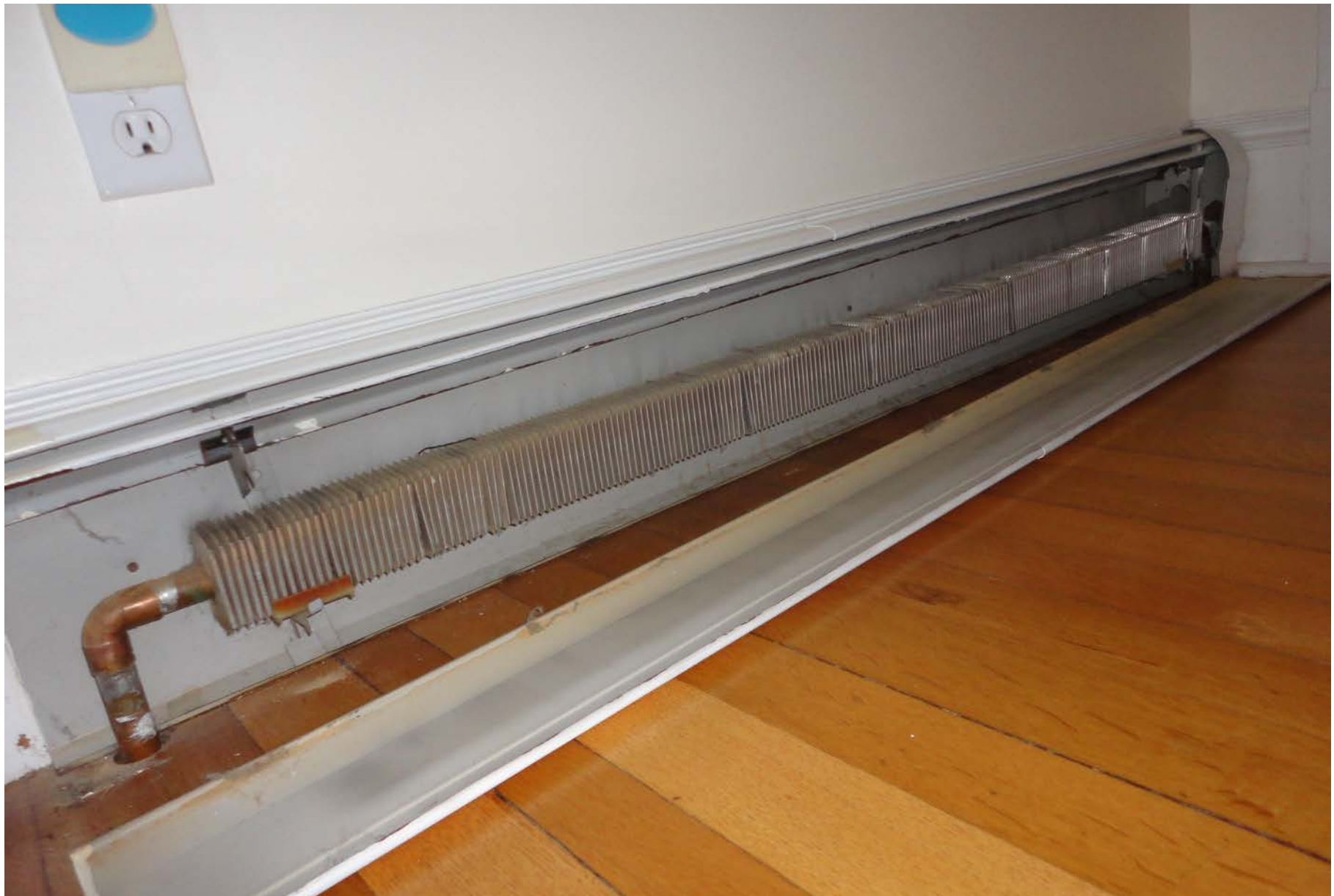


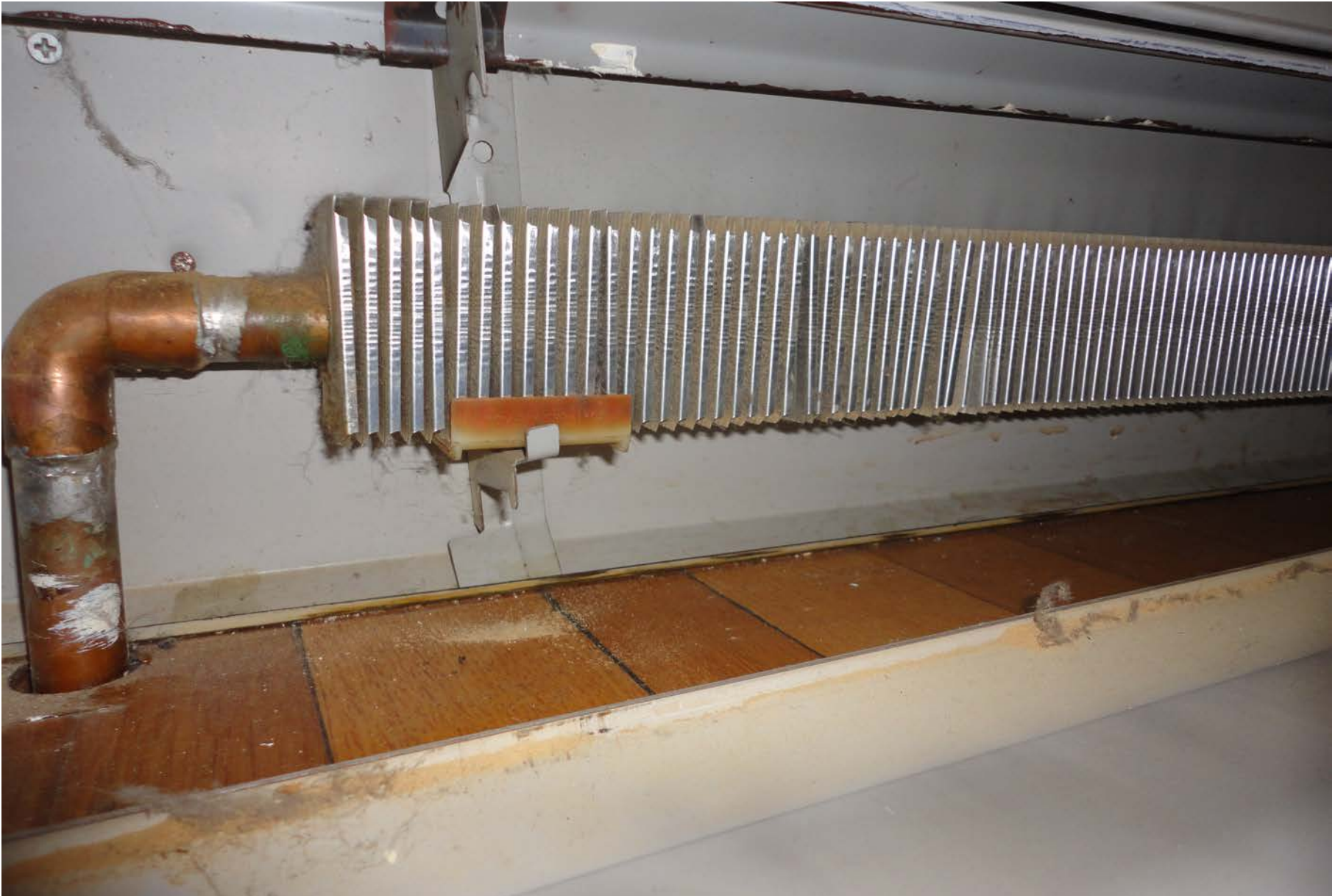
Life is Tough Enough As it Is...

Life is Tough Enough As it Is...
It's Harder When You Are Stupid

Don't Do Stupid Things

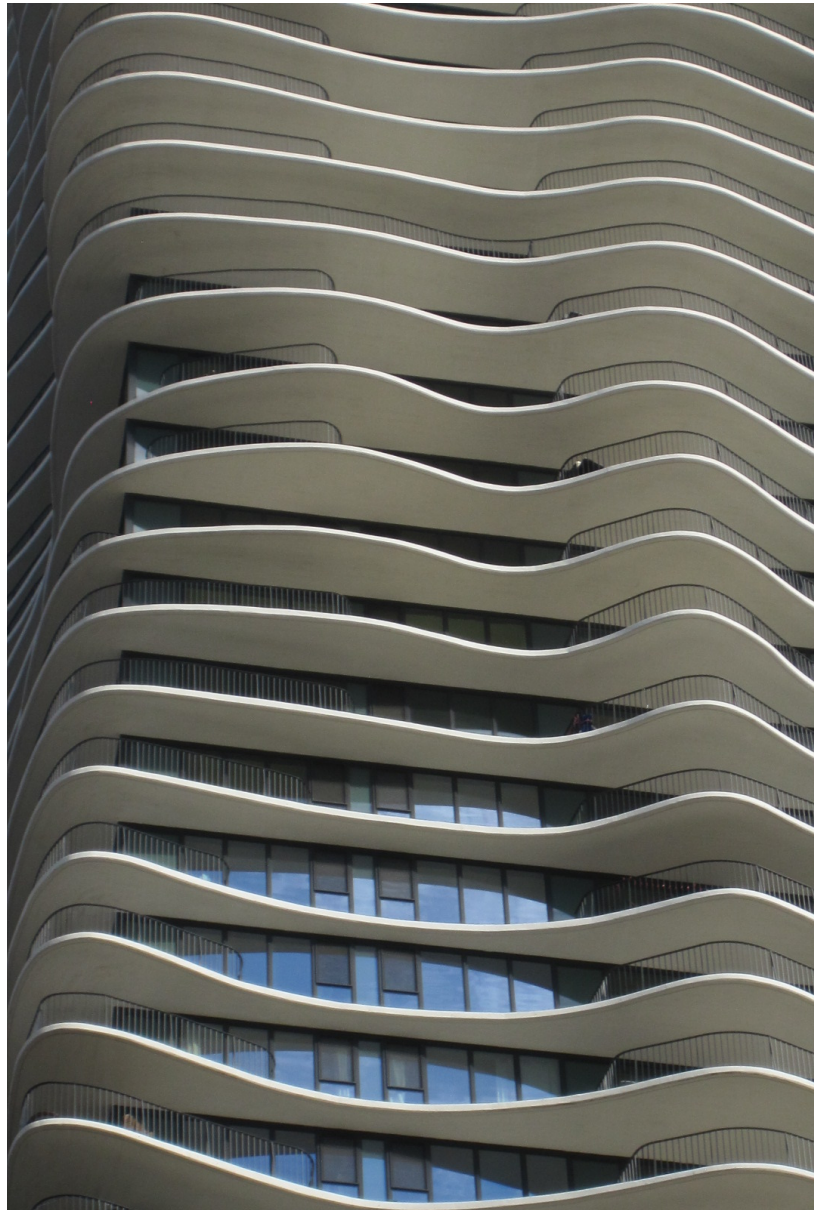


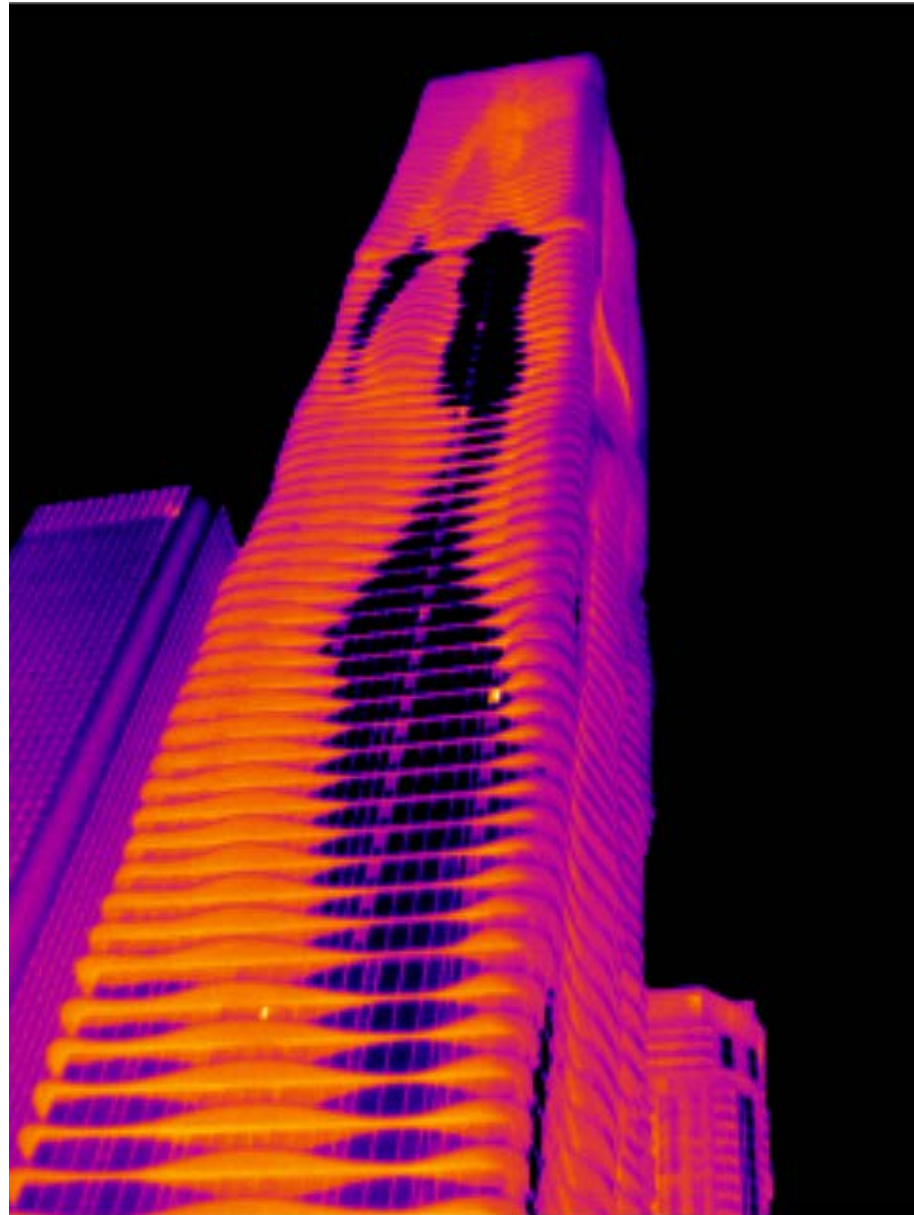


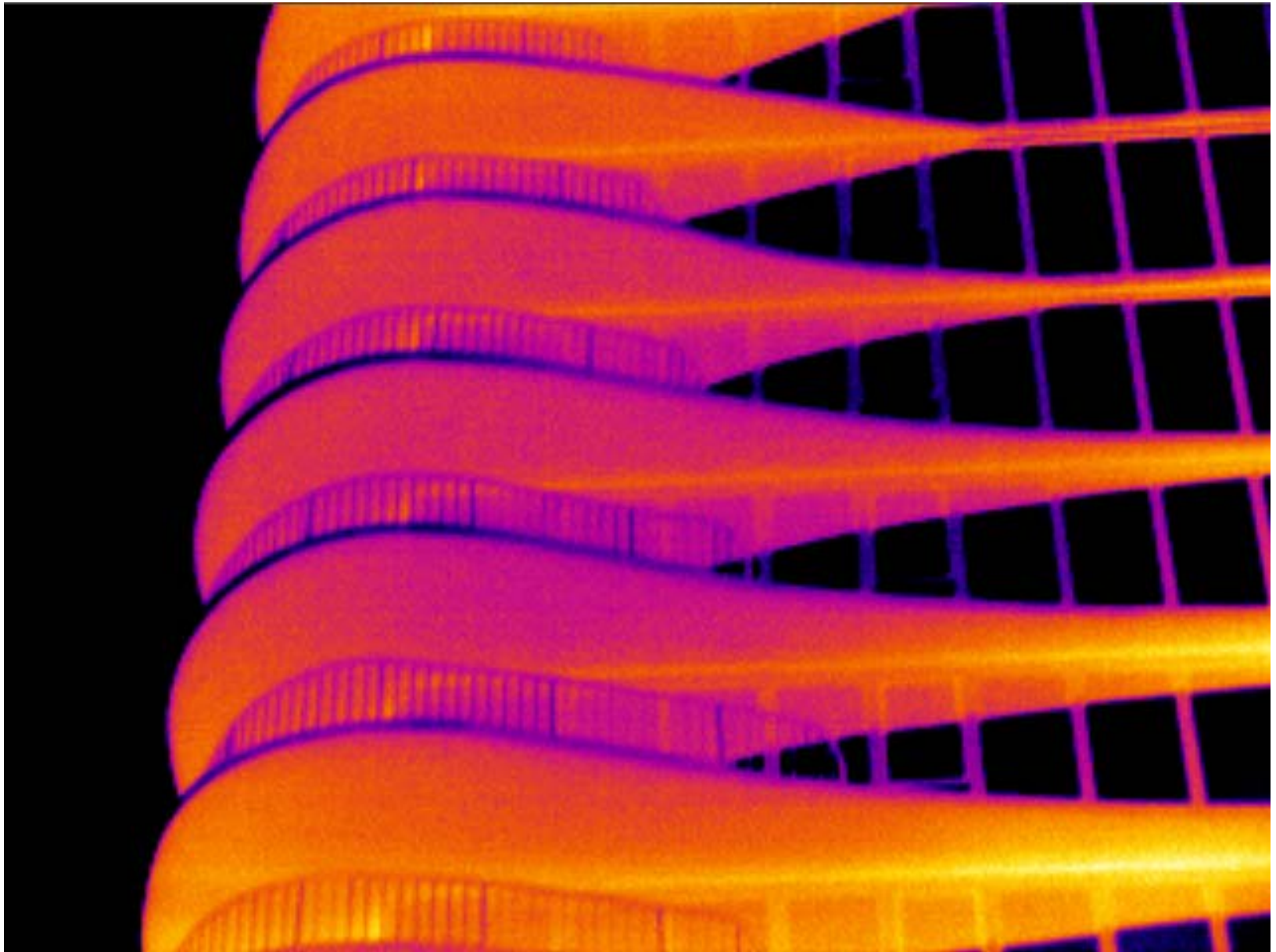


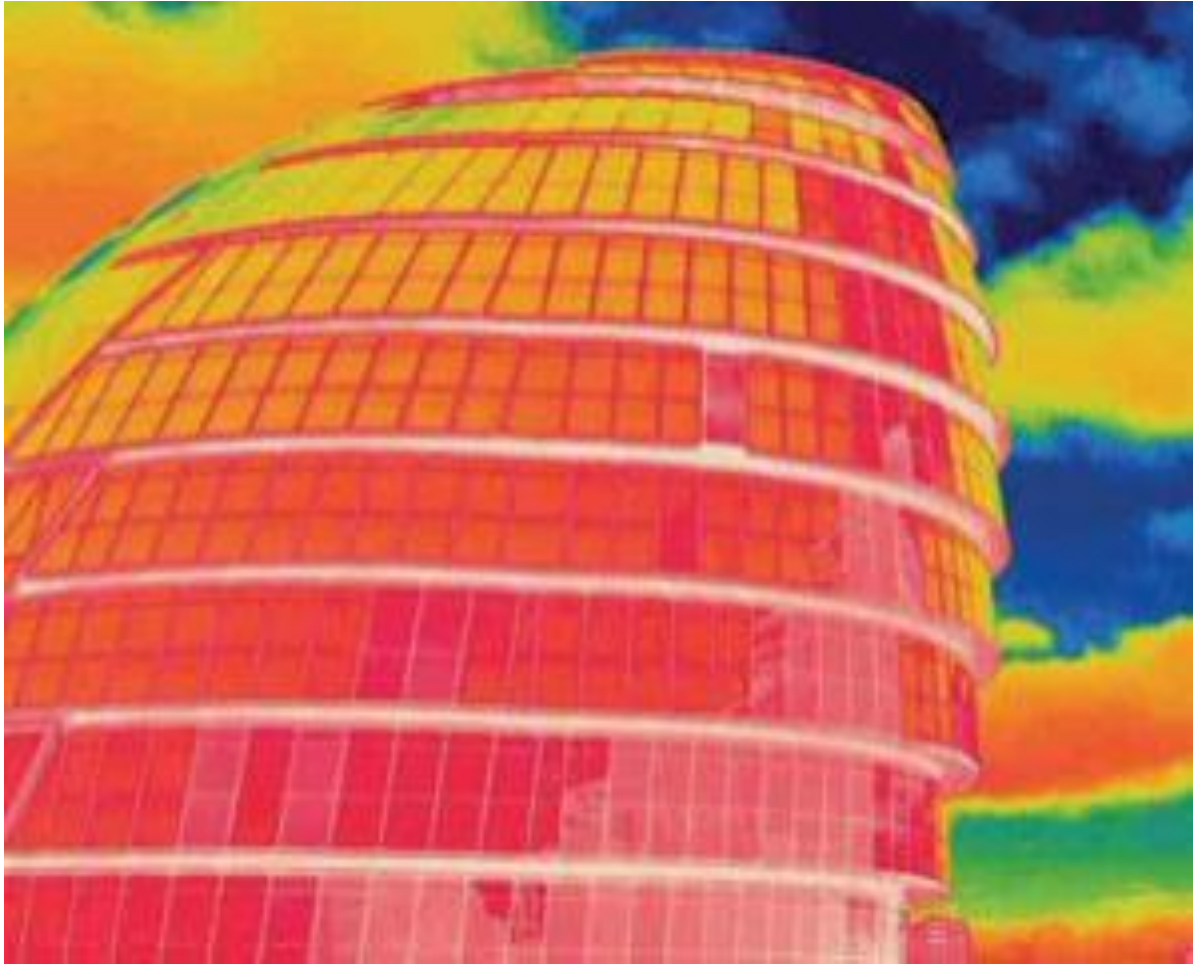






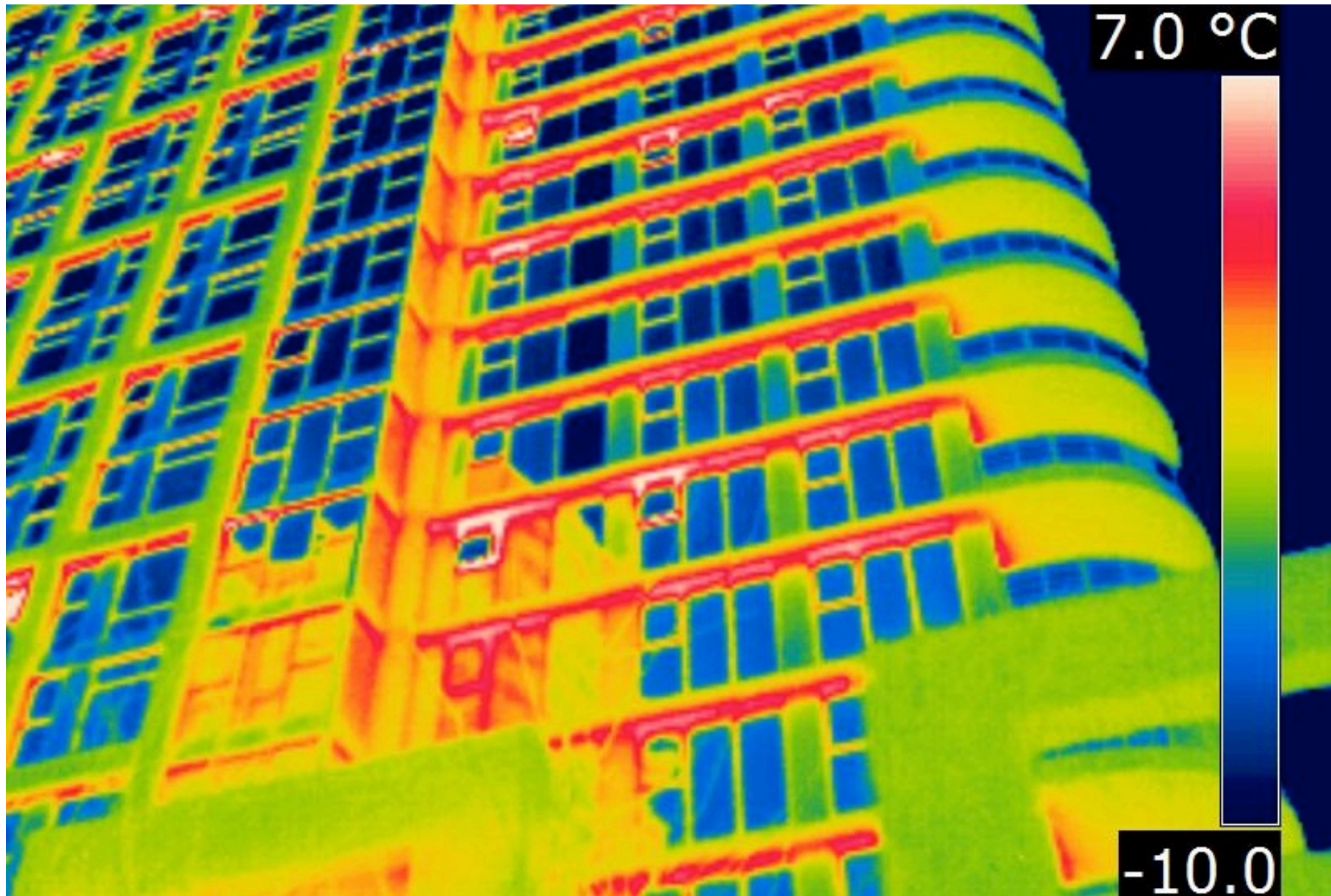


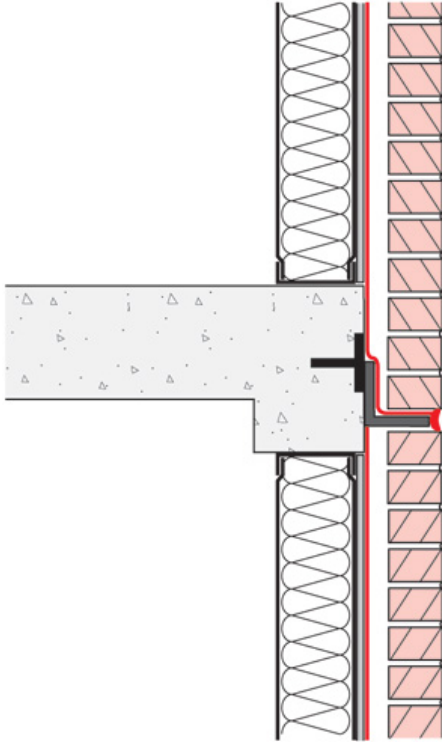




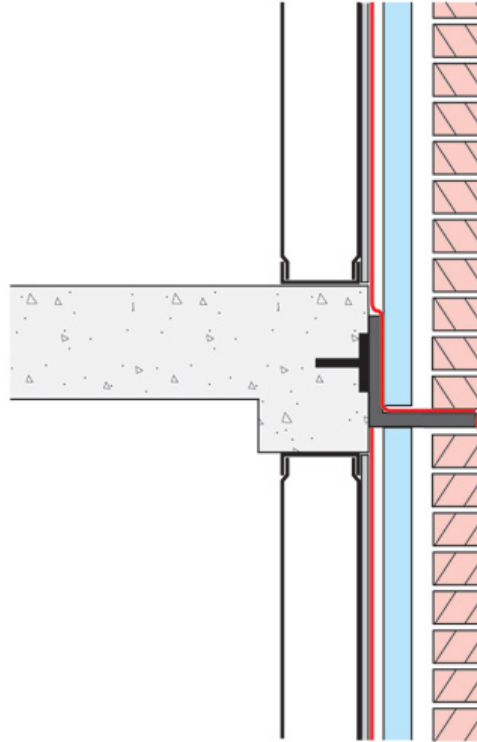




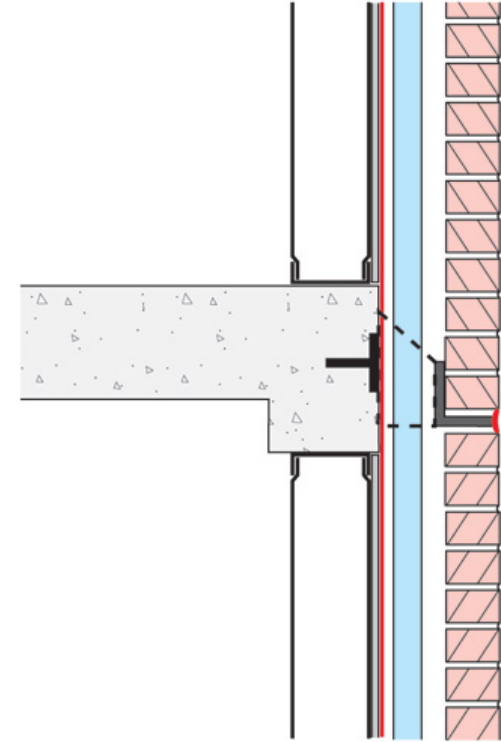




“The Ugly”



“The Bad”



“The Good”









WEDGE SHIMS INSERTED BEHIND/FRONT OF ANGLE TO ENSURE DIRECT BEARING ON BRACKET AND PROVIDE LEVEL (IF NECESSARY)

