Adapting Codes: High Performance to Resiliency

MN Chief Engineers Guild Annual Conference - 2018

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TKDA

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September is National Preparedness Month

FEMA

Be Informed.

Do you know what kind of emergencies might affect your company?

Do you know what you will do in an emergency situation?

Develop a Business Continuity Plan.

Do you know which staff, procedures and equipment are absolutely necessary to keep operating?

Do you have back-up plans for those operations?

Do you know what you will do if your building or plant is not accessible?

Do you know what you will do if your suppliers are impacted by a disaster?

Are you ready for utility disruptions?

Prepare your Emergency Plan.

Do you have an evacuation and shelter-in-place plan?

Do you have a plan to communicate with employees before, during and after an incident?

Do you have copies of building and site maps with utilities and emergency routes marked?

Are your employees trained for medical emergencies?

Practice the Emergency Plan.

Have you practiced your plan recently?

Do you practice and coordinate with other businesses in your building or industrial complex?

Have you reviewed your plans in the last 12 months?

Review Insurance Coverage.

Have you reviewed your insurance coverage recently to see if you're covered in a disaster?

Secure Your Facility and Equipment.

Have you secured all the ways people, products and supplies get into your building?

Have you conducted a room-by-room walk through to determine what can be strapped down?

Improve Cyber Security.

Do you regularly install patches to your software?

Have you installed a firewall on your computer?

Do you regularly update your antivirus software?

Promote Family and Individual Preparedness.

Do you encourage employees to have a personal emergency supply kit and a family communication plan?

If you answered "No" to any of these questions, visit ready.gov and learn how to better prepare your business.

2016 Building Industry Statement on Resilience

- ***The ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events.***

CULTIVATORS

led the effort to establish and implement the Statement with their industry peers

FOUNDERS

united to define the goals and objectives of a resilient built environment

AMPLIFIERS

joined the founding signatories in committing to the advancement of Statement goals

Potential Adverse Events

NATURAL

- Extreme Precipitation
- Storm Surge
- Extreme Temperatures
- Air Quality
- High Wind Events
- Drought
- Earthquakes
- Fire

MAN-MADE

- Cyber Terrorism
- Terrorism
- Utility Failures

First Steps: Risk Assessments for Resiliency

- Identify plausible, defensible adverse events
- Identify desired outcomes
- Identify existing assets
- Identify existing liabilities
- Develop strategies to ‘***absorb, recover and adapt***’ to adverse events.

Multiple Threats to Buildings

- Extreme Precipitation Flooding – climate change
- Extreme Temperatures – climate change
- Air Quality – Increased particulates (smoke, dust, debris)
- High Wind Events – Nor'easters, Hurricanes, Tornadoes
- Drought – climate change
- Utility Failures – The Big Blackout
- Terrorism – impact on transportation and infrastructure
- Earthquake
- Hurricane Storm Surge

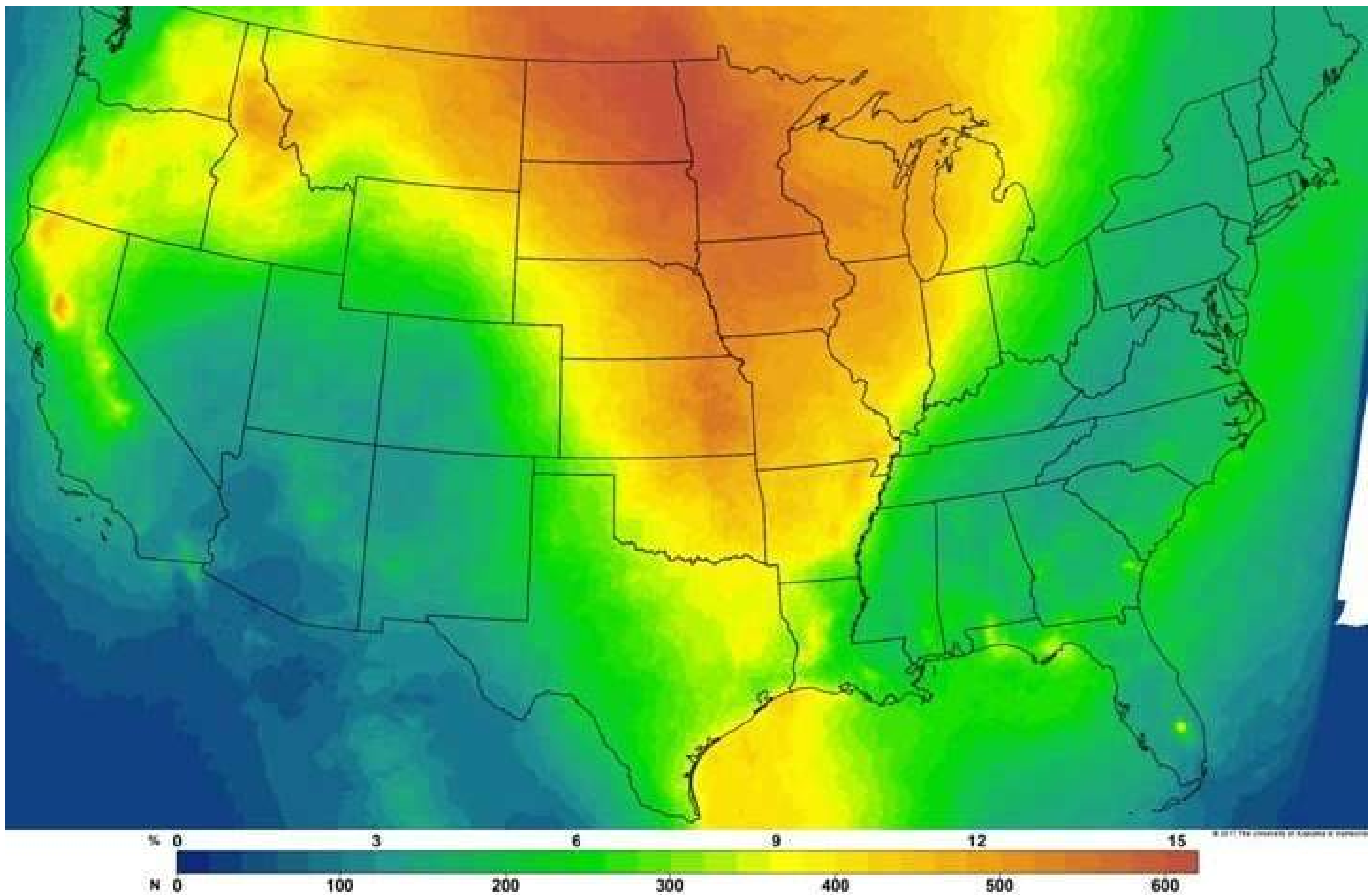
Duluth Flooding (2012)

Severe Storms: Flash Flooding and Tornadoes (2017)

Chicago Rockford International Airport, Credit to Jacob Booker.

2005-2016 Air Quality Research by University of Alabama, Huntsville

Total days covered by forest fire smoke



Consequences

- Disruption of internal life safety systems
- Flooding of critical building spaces
- Loss of utility service: power/gas/steam
- Loss of water and/or sewer service
- Reduction in accessibility
- Internal property damage
- Occupant discomfort, loss of habitable space

Risk Liabilities

TKDA's Resiliency Leadership

- **2018 UC Berkeley Climate Adaptation Roundtable:** *published in ASHRAE Journal Sept/Oct 2018*
- **2018 ASHRAE Resiliency Public Policy Document**
- **2017 ASHRAE Climate Change Public Policy Document**
- **2018 TKDA joins ULI MN Resilient Communities Council**
- **2017 TKDA joined the National Resiliency Initiative Midwest Hub** *Assessed useful MN resiliency requirements.*
- **2017 TKDA joins National Resiliency Initiative Midwest Hub:**

Assessed potential MN B3 Resiliency requirements for the State of MN

- ***2016 MN Resiliency Collaboration (TKDA in leadership)***

THE AMERICAN INSTITUTE OF ARCHITECTS: Sustainability Initiative

Understanding Resilience

Buildings and communities are subjected to destructive forces from fire, storms, earthquakes, flooding, and even intentional attack. The challenges facing the built environment are evolving with climate change, environmental degradation, and population growth. Architects have a responsibility to design a resilient environment that can more successfully adapt to natural conditions and that can more readily absorb and recover from adverse events. The AIA supports policies, programs, and practices that promote adaptable and resilient buildings and communities.

Architect have a **responsibility to design** a resilient environment that can more successfully **adapt** to natural conditions and that can more readily **absorb** and **recover** from adverse events.

Robust
Tough
Life Span
Durable
Adapt
Flexible
Absorb
Recover

1.

Hazard: poses a threat to safety

Hazards such as hurricanes, tsunamis, earthquakes, tornadoes, blizzards, drought, and wildfires are responsible for injury, death, and property damage as well as social and economic disruption. These events are no longer a one-off, once in a lifetime event; particularly when we look at the impacts of climate change.

2.

Risk: quantifies hazard threat

Risk defines the likelihood of occurrence and intensity of the hazard. Determining the level of "acceptable risk" is critical to designing for the associated level of building performance. It is important to ask: What is the projected lifespan of the building? What are the building's critical functional requirements before, during, and after a hazard strikes? And how long is it acceptable for the building to be out of service due to the impacts of a hazard?

3.

Vulnerability: personalizes risk

Vulnerability assesses the capabilities and interdependencies of individuals and communities associated with risk. A resilient building in a vulnerable community isn't truly resilient. Infrastructure, utilities, food supply and services are all necessary for adequate functionality.

Mitigation: reducing negative impact

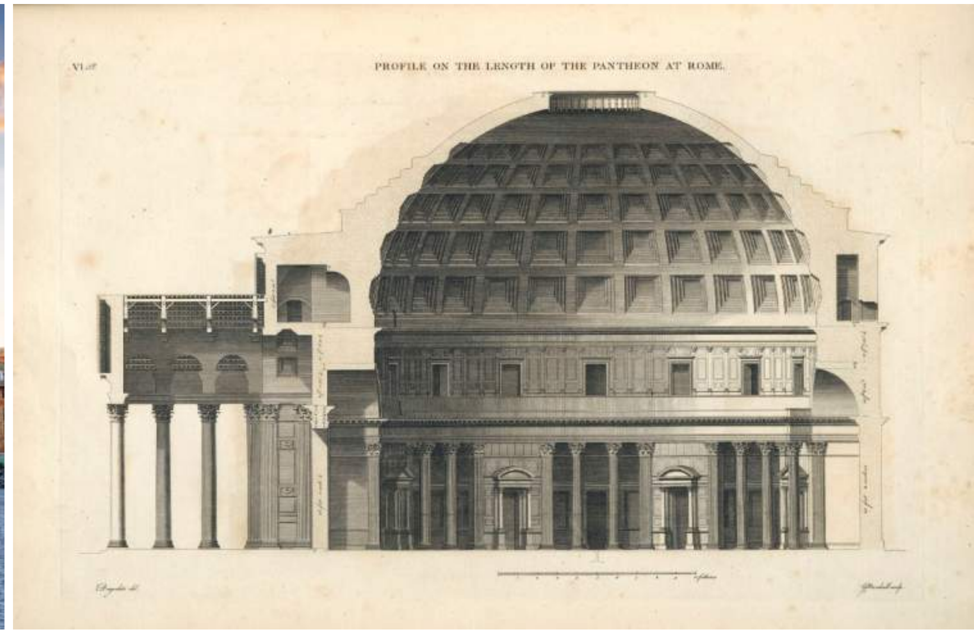
Mitigation measures are often developed in accordance with lessons learned from prior incidents. Measures may include zoning and building codes or floodplain buyouts as well as efforts to educate governments, businesses, and the public on measures they can take to reduce loss and injury. Mitigation is most successful when policies and decision-making support appropriate development, land use, site selection, and adoption of model building codes.

Resilience: inherent durability or flexibility

When working within the built environment, it's important to have foresight: incorporating changing environmental, social, and economic conditions into projects. This requires designs that are tough as well as flexible; providing the ability to not only bounce back, but forward.

Adaptation: accommodating needs throughout service life

Hazards aren't the only threat. It is critical to acknowledge the changing conditions in the physical, economic and social environment as well. Communities are ultimately successful when they are adaptable to change.

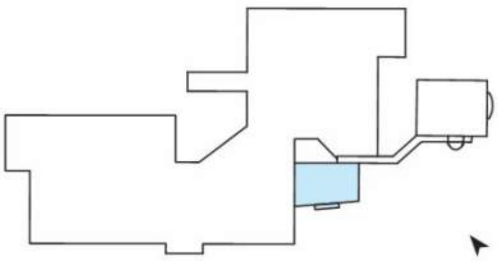


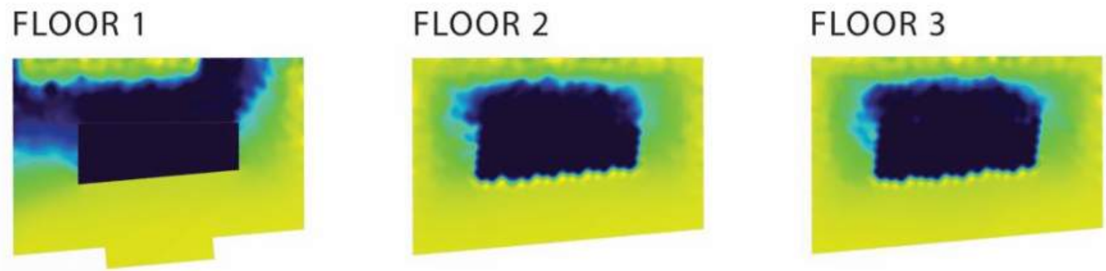
Pantheon – Rome, 126 AD

Oliver Kelly Farm, 1860’s

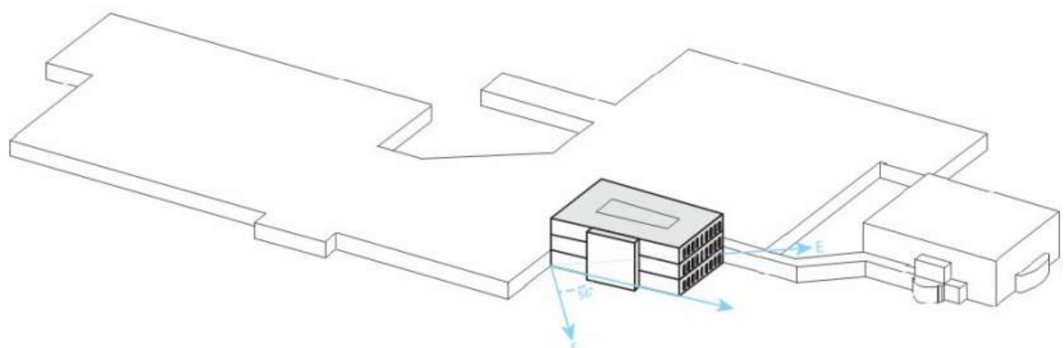
Design for Place – Reaction to Elements

MASSING C

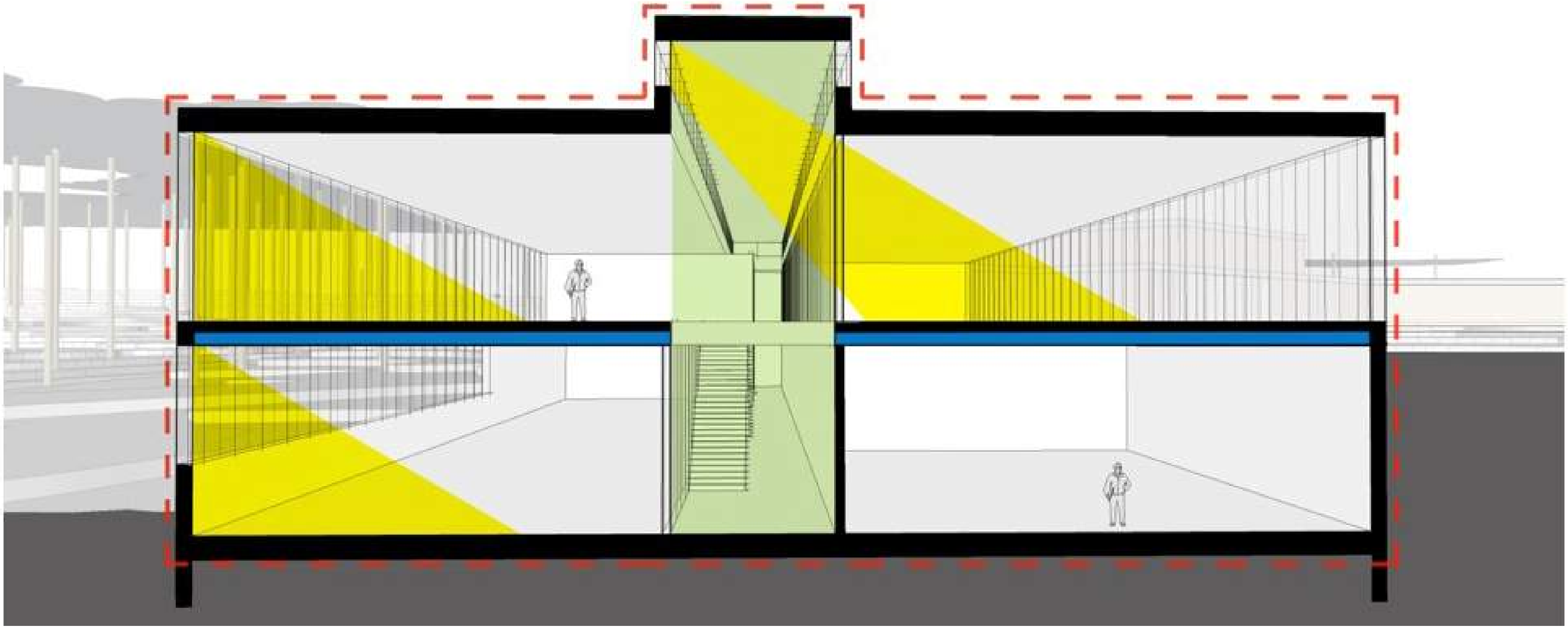




BASELINE CONCEPT	MASSING C
Annual Energy Consumption (kBTU)	1,190,400
Annual Energy Use per Gross Internal Area (kBTU/SF)	34
Annual Utility Cost ($)	58,575
Annual Space Cooling (kBTU)	325,688
Annual Space Heating (kBTU)	408,716
Annual Grid Fuel Used (kBTU)	408,716



Whole Building Energy Modeling – HVAC Reliant



Enhanced Envelope

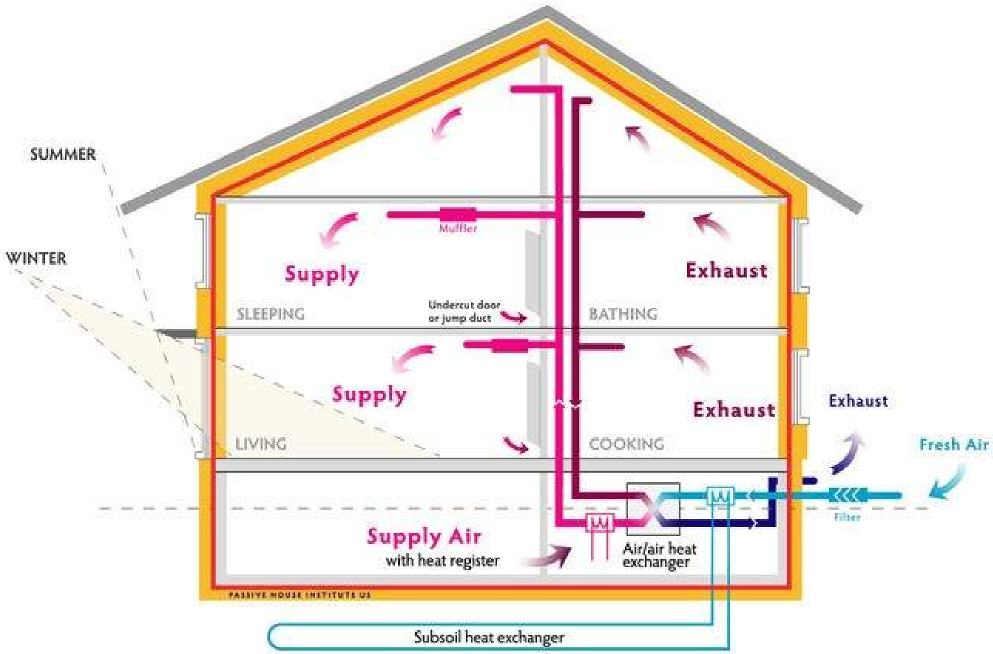
Optimal Orientation

Daylighting & Views

Natural Ventilation

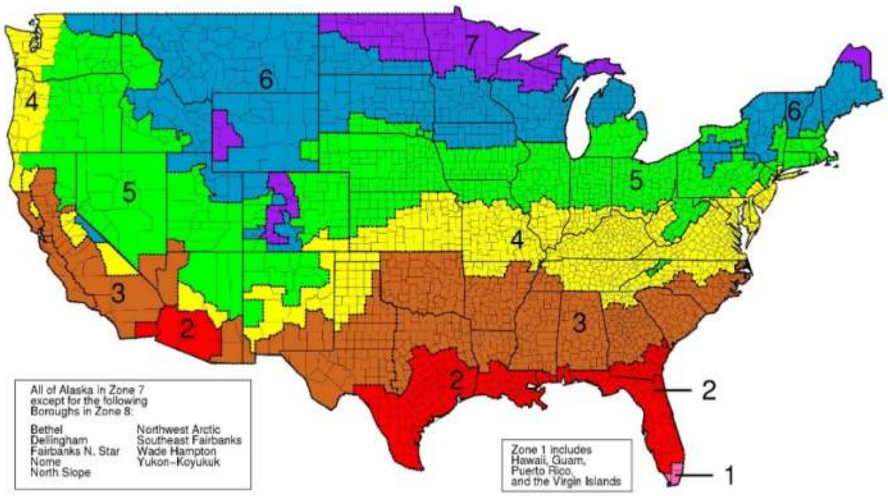
Durable Materials

Resiliency Strategies for Architectural Improvement



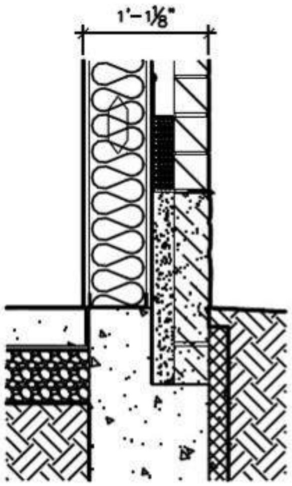
Super Insulation
Eliminate Thermal Bridging
Air-Tightness
Ventilation w/ Heat Recovery
Passive Solar Gain

Resiliency Strategies – Passive Building



* Slab = Unheated, 24" at perimeter
** 2015 MN Energy Code

Building Envelope Requirements



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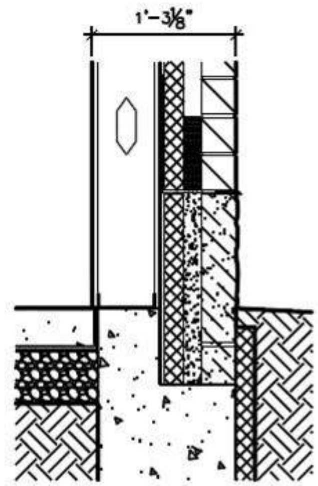

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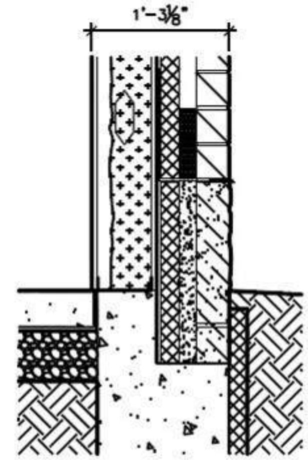

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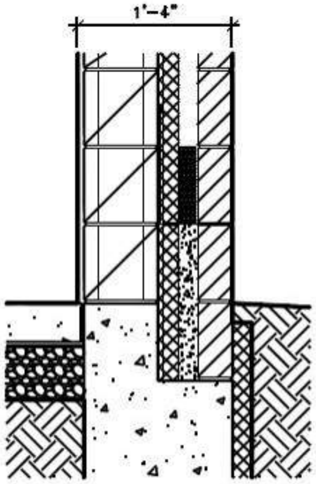
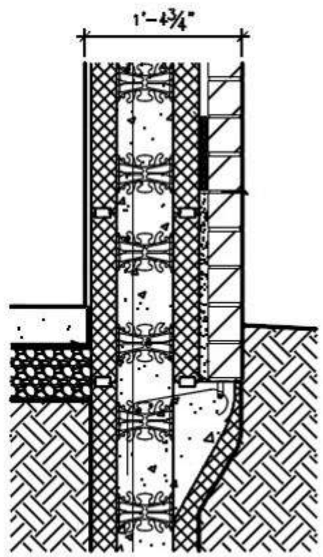
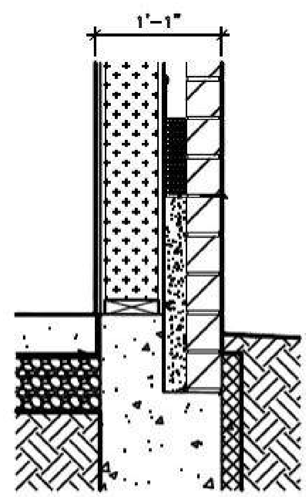


R-VALUE = 16.00

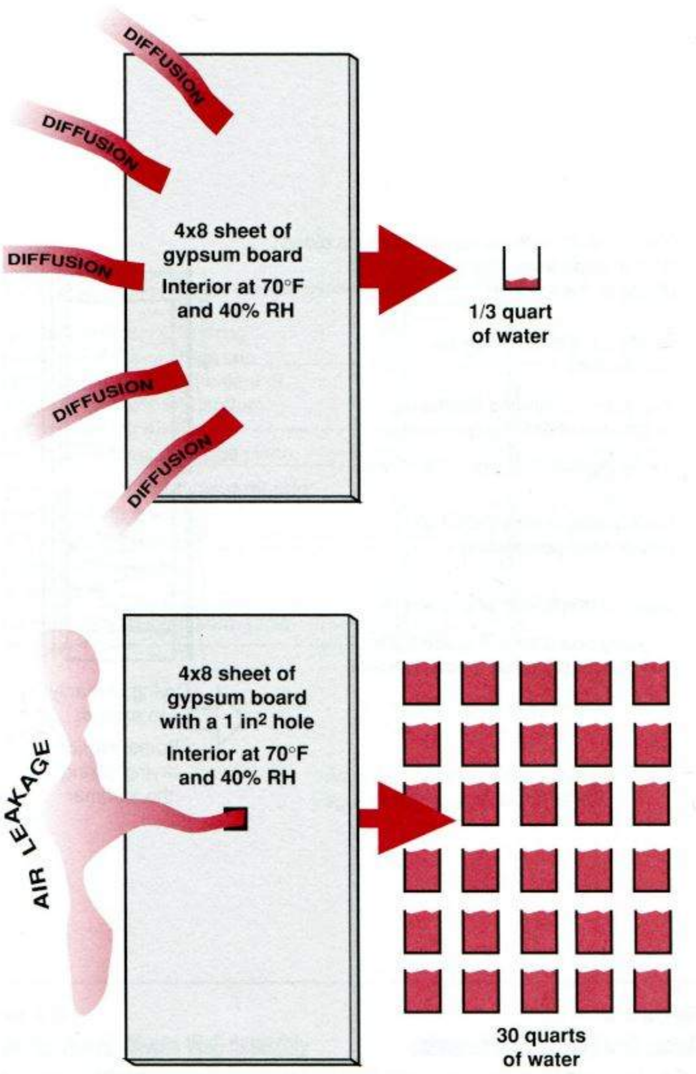


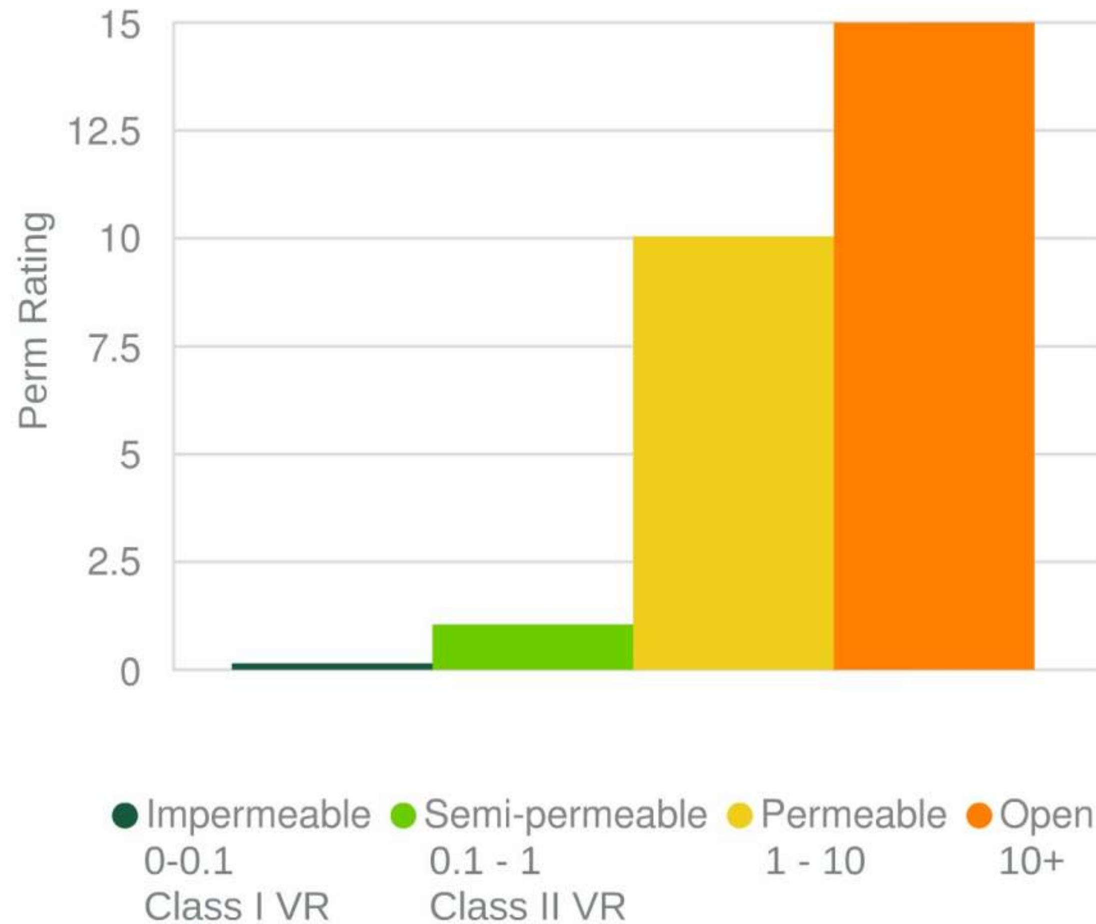
R-VALUE = 26.70



6 1/2", R-VALUE = 27.70
8 1/4", R-VALUE = 34.90

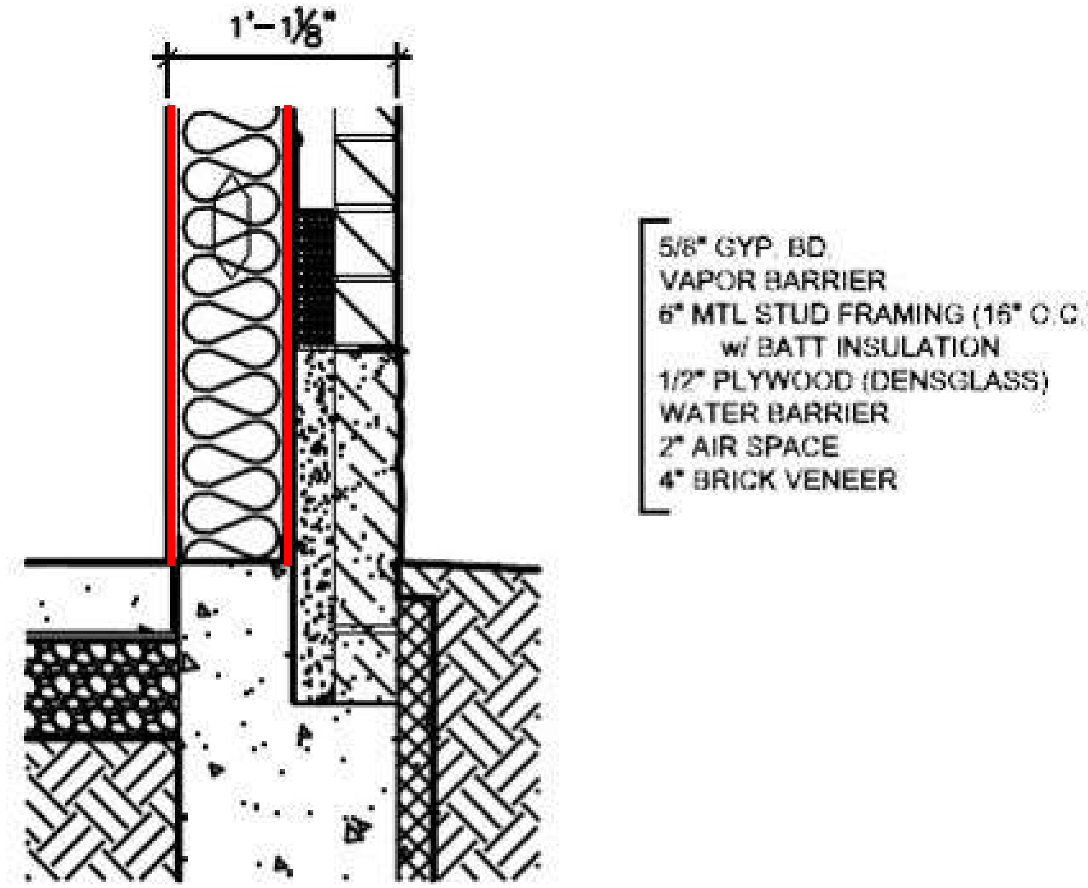
Commercial Wall Assemblies – Typical





Permeability and Air Leakage

Brick = 0.8
Concrete = 1.25
CMU = 2.4
Gypsum Board = 50
Asphalt Felt = 1
Tyvek = 48
Plywood = 0.7
EPS Insulation = 1.2
XPS Insulation = 2-5
Mineral Wool = 116
Polyethylene (10mil) = 0.03
Aluminum Foil = 0.05
Paint (2 coats) = 2-4



R-VALUE = 10.80

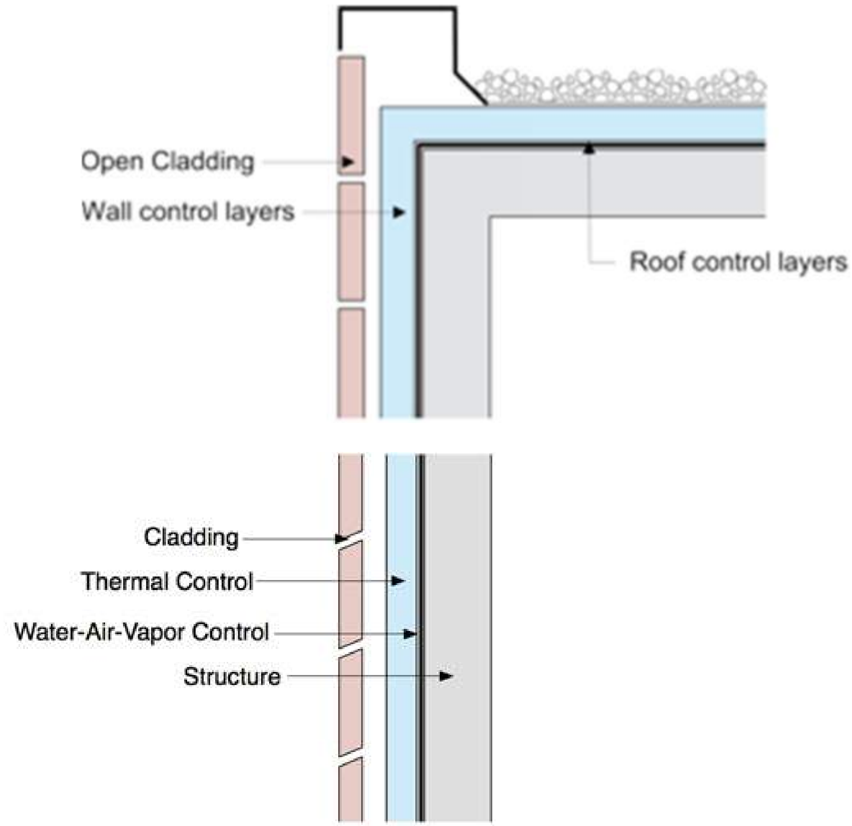
Permeability Ratings of Common Materials

The Perfect Wall

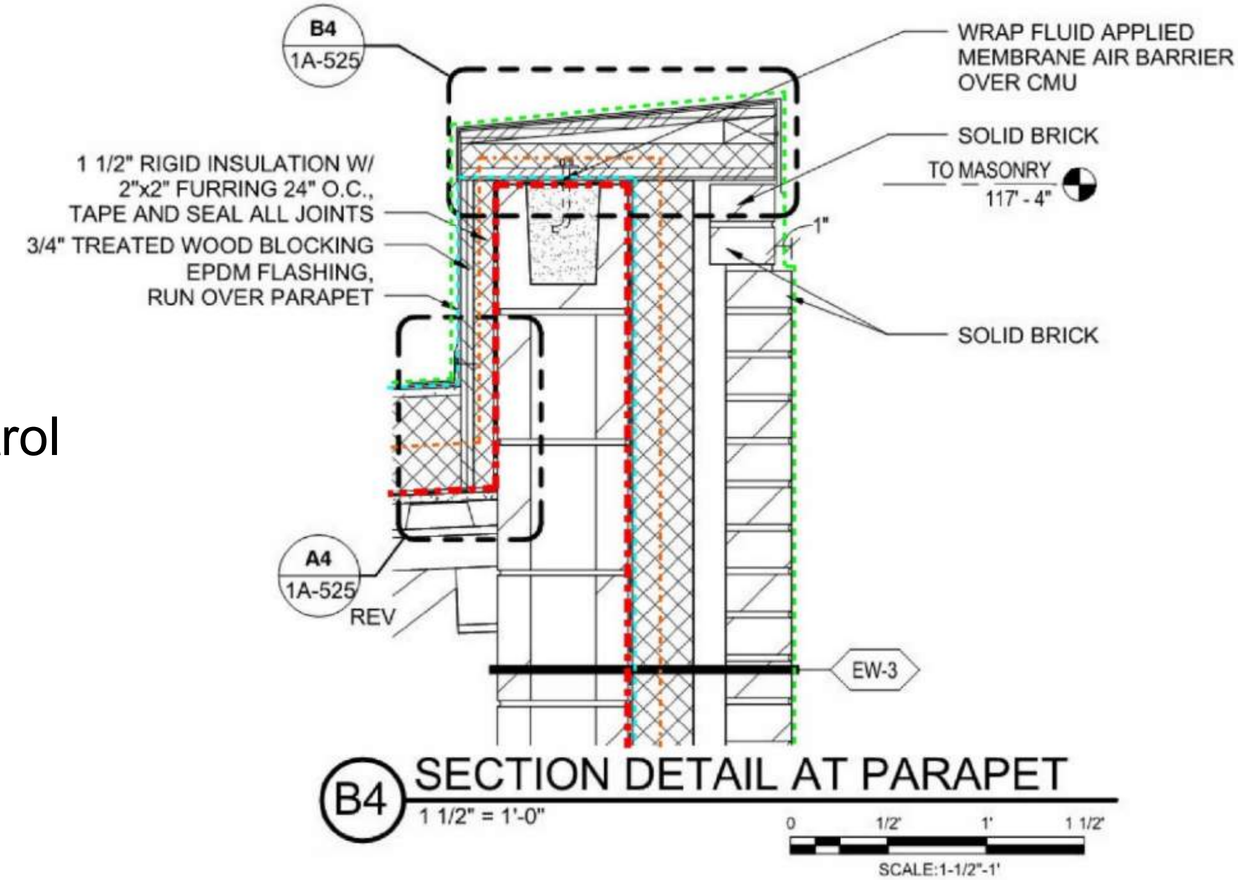
Building Science, Joseph Lstiburek

- Rain Layer
- Air Control Layer
- Vapor Control Layer
- Thermal Control Layer

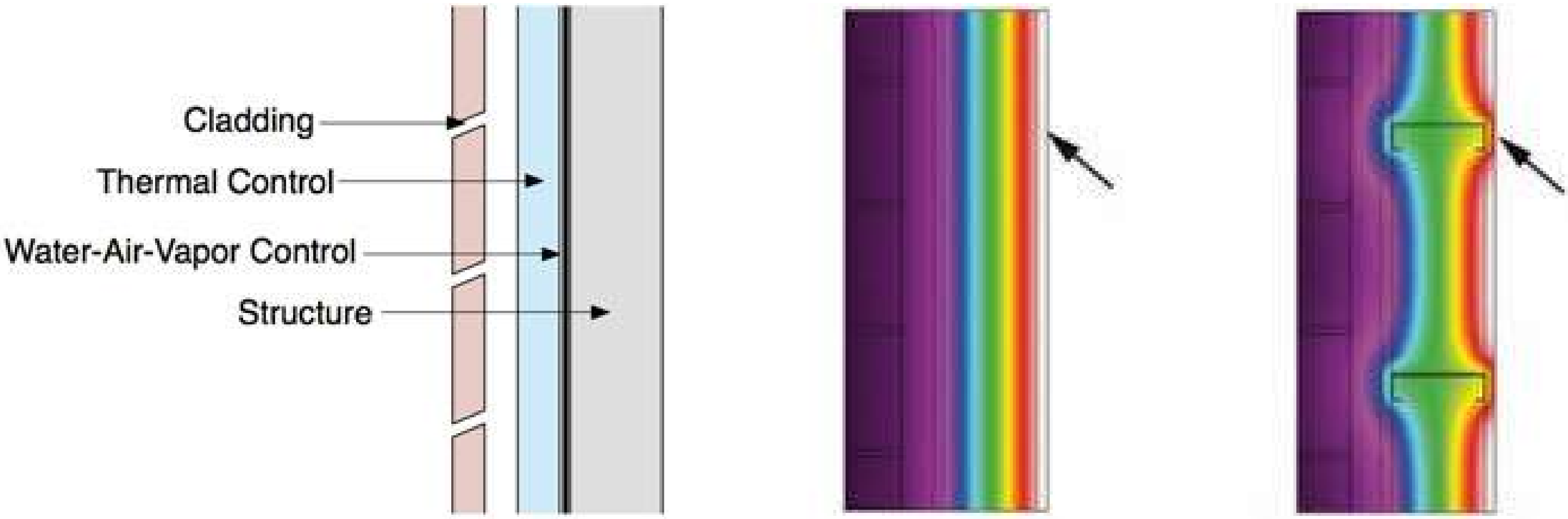
"Works everywhere in all climate zones"



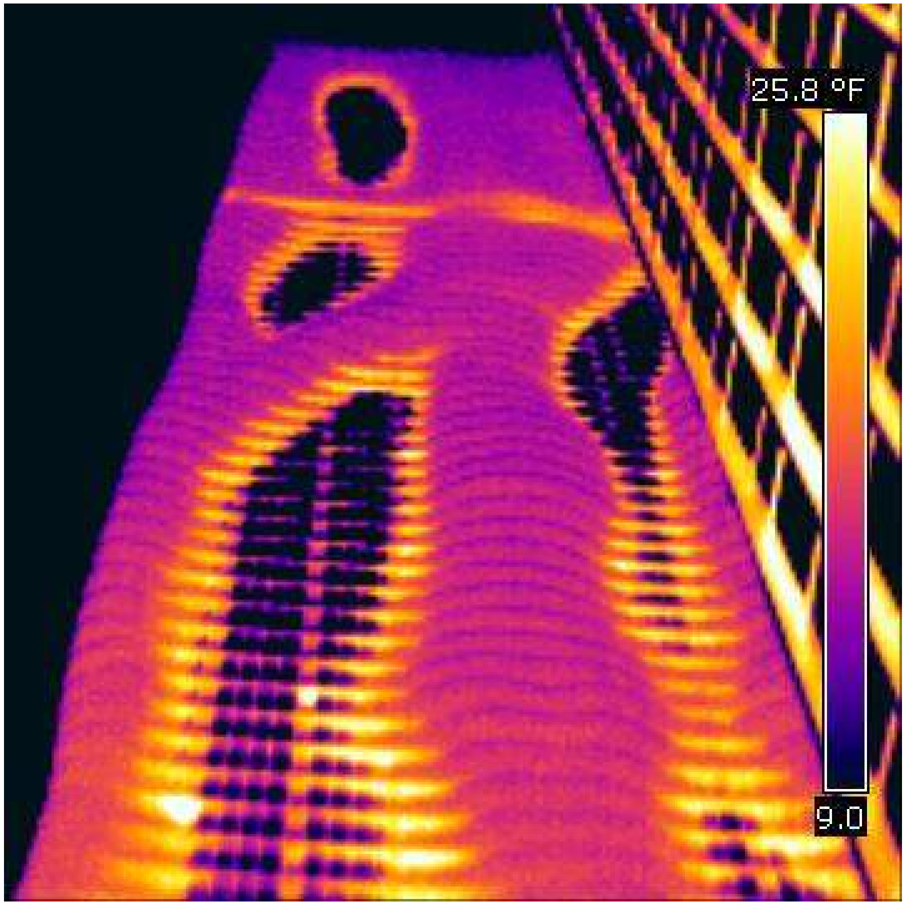
Green – Rain Layer
Blue – Waterproofing
Orange - Thermal Control
Red - Vapor Control
Red - Air Control

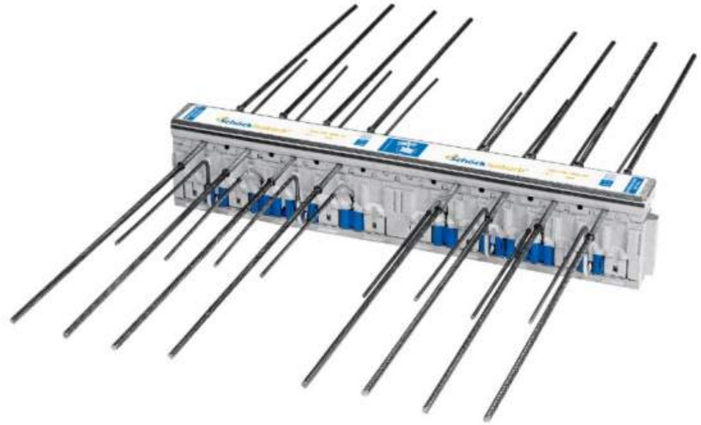


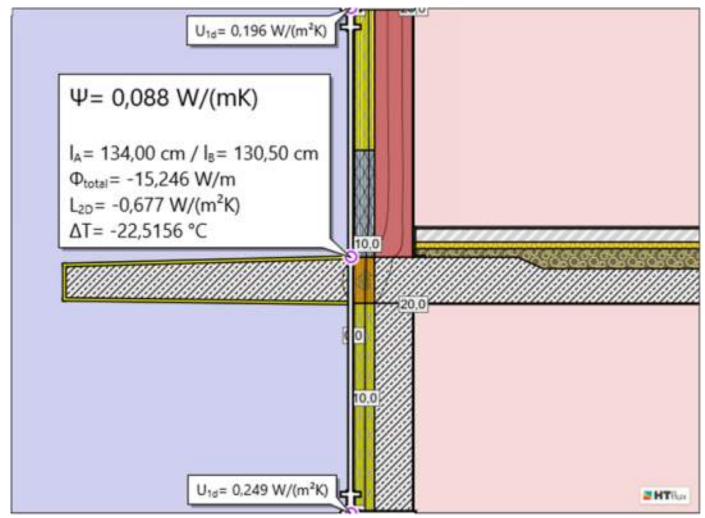
The Perfect Wall – Continuity of Layers



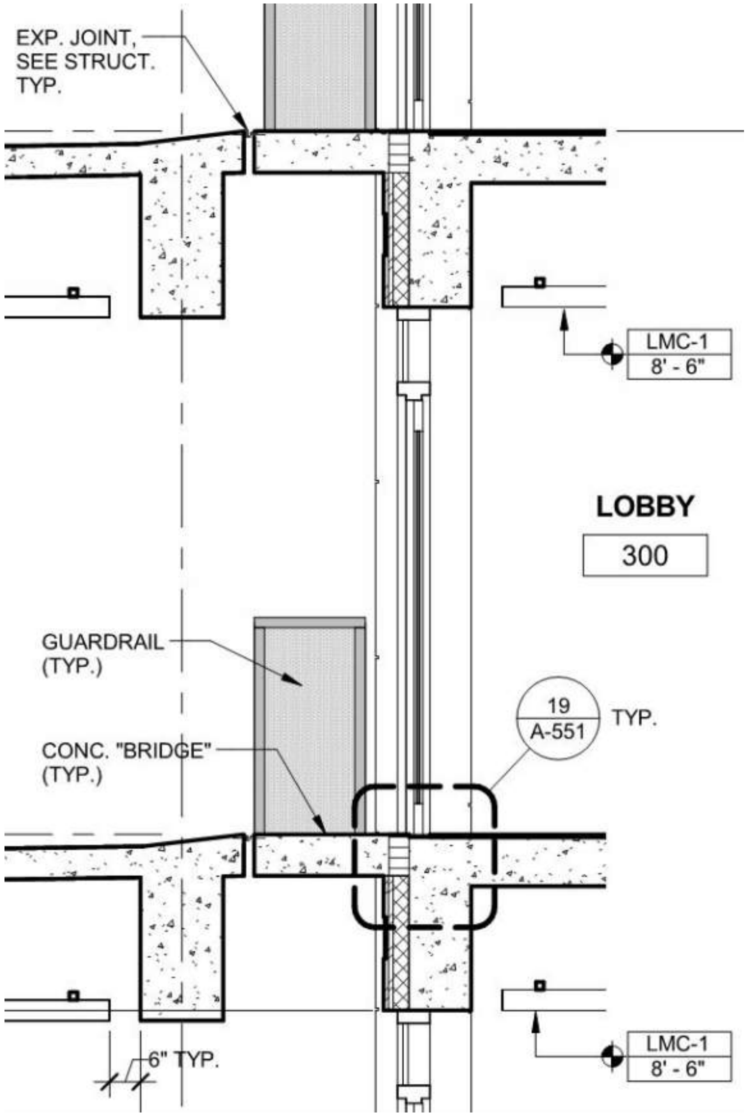
Thermal Bridging







Thermal Bridging – Slab Extension

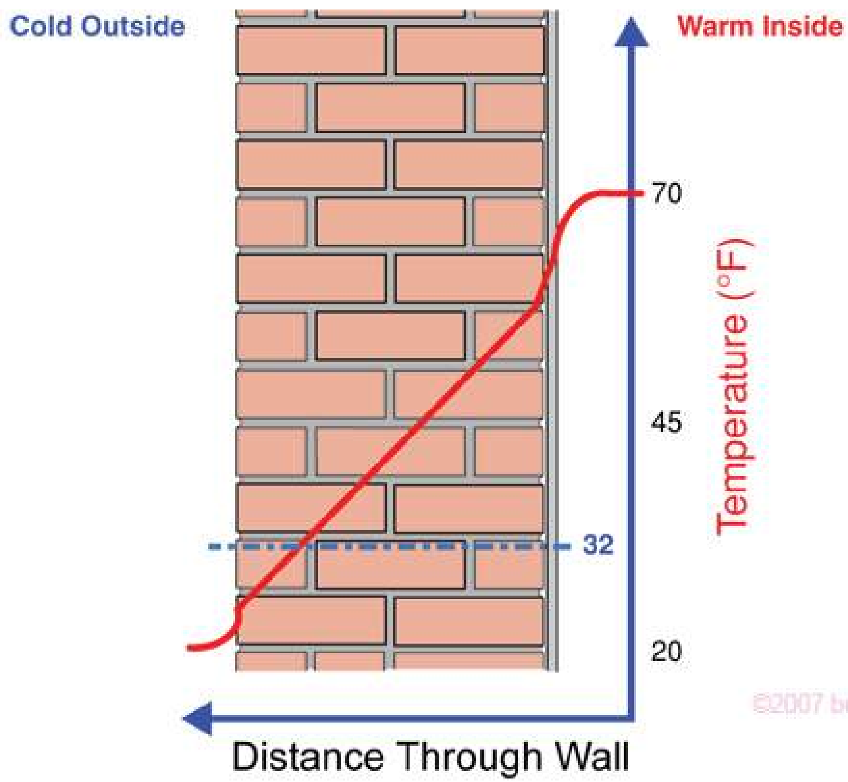


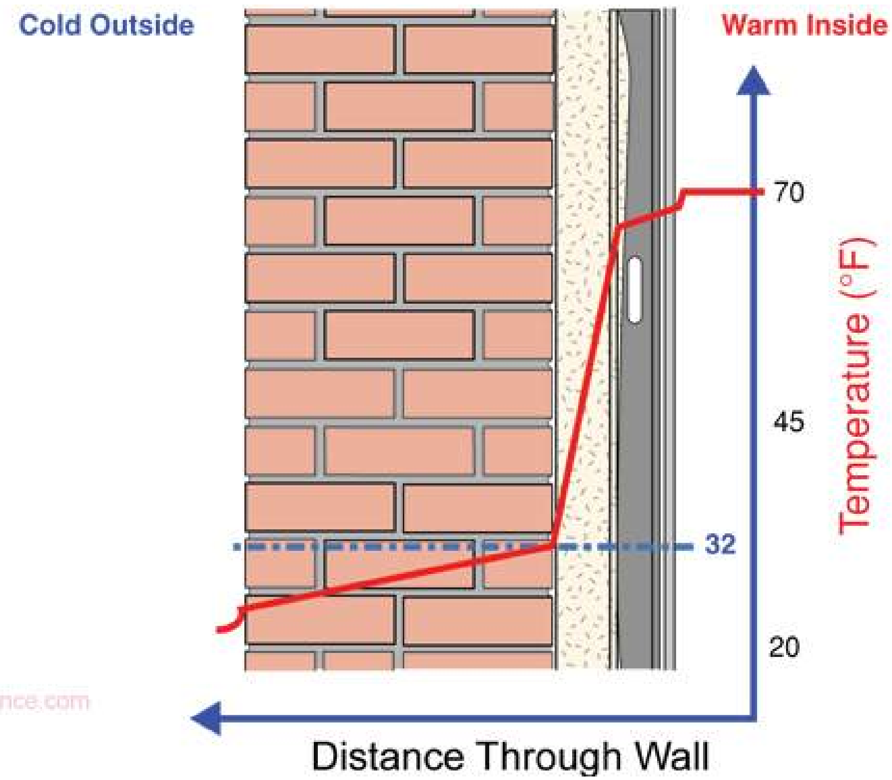
Thermal Bridging – Slab Extension Installation

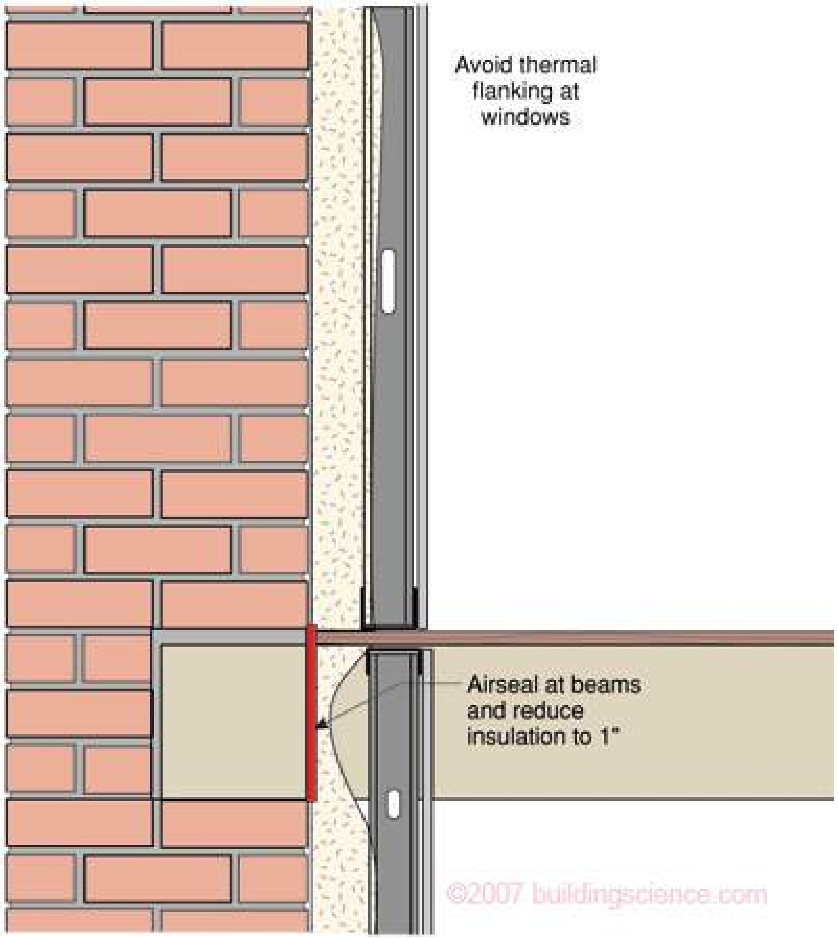
Good…*but not* Perfect

Good…*but not* Perfect





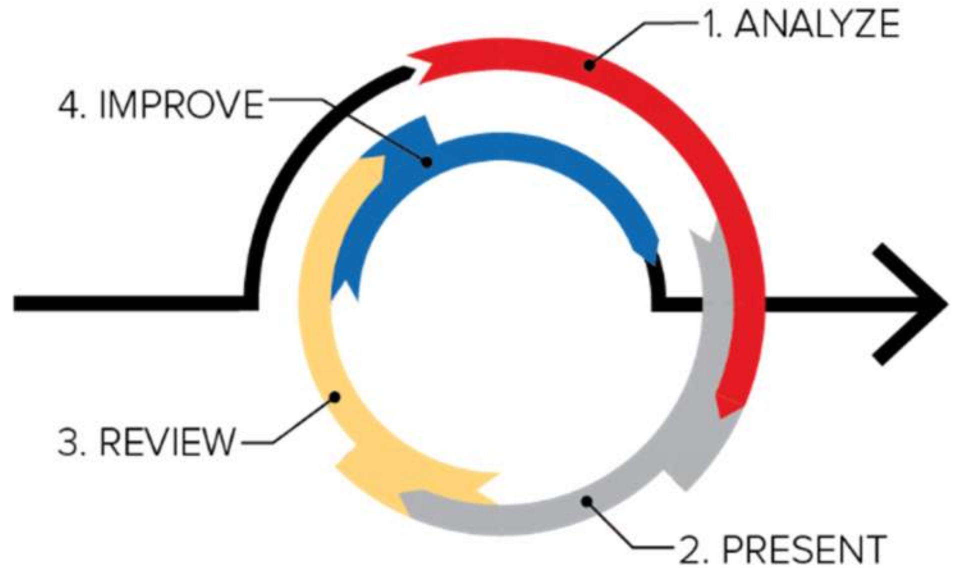
Existing Wall Assemblies



Existing Wall Assemblies – Pioneer Hall

- Set Goals Early
- Engage team
- Think creatively
- Don’t accept failure
- Continuous feedback

Lead the Way



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