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INSPIRING EVERYDAY SPACES

RD Masonry, Inc.
"Our Business *is* Building"

NWCMA
NORTHWEST CONCRETE MASONRY ASSOCIATION

Washington's Building Codes Get Greener:

Masonry Systems Prepared to Step Ahead

AIA Continuing Education
1.5 CEU (SD & HSW)

CONTINUING EDUCATION AIA

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Energy Code Compliance with Mass Wall Assemblies

- Thermal Mass Benefits
- Northwest Energy Codes
- Insulation Options
- Building Performance

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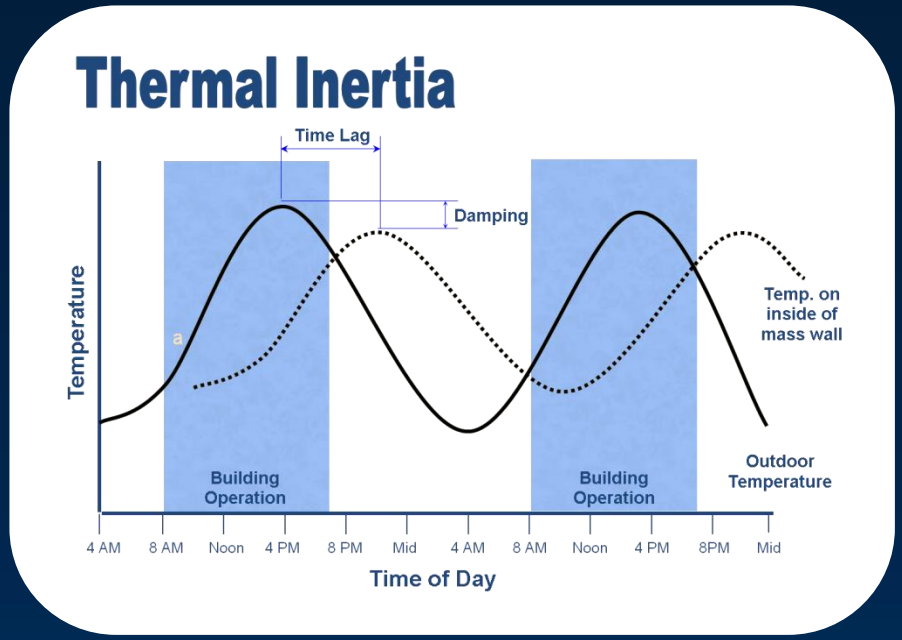

- Providing Effective Thermal Storage
- Dampening heating and cooling loads
- Shifting peak loads to off-peak hours

Mass Wall Benefits

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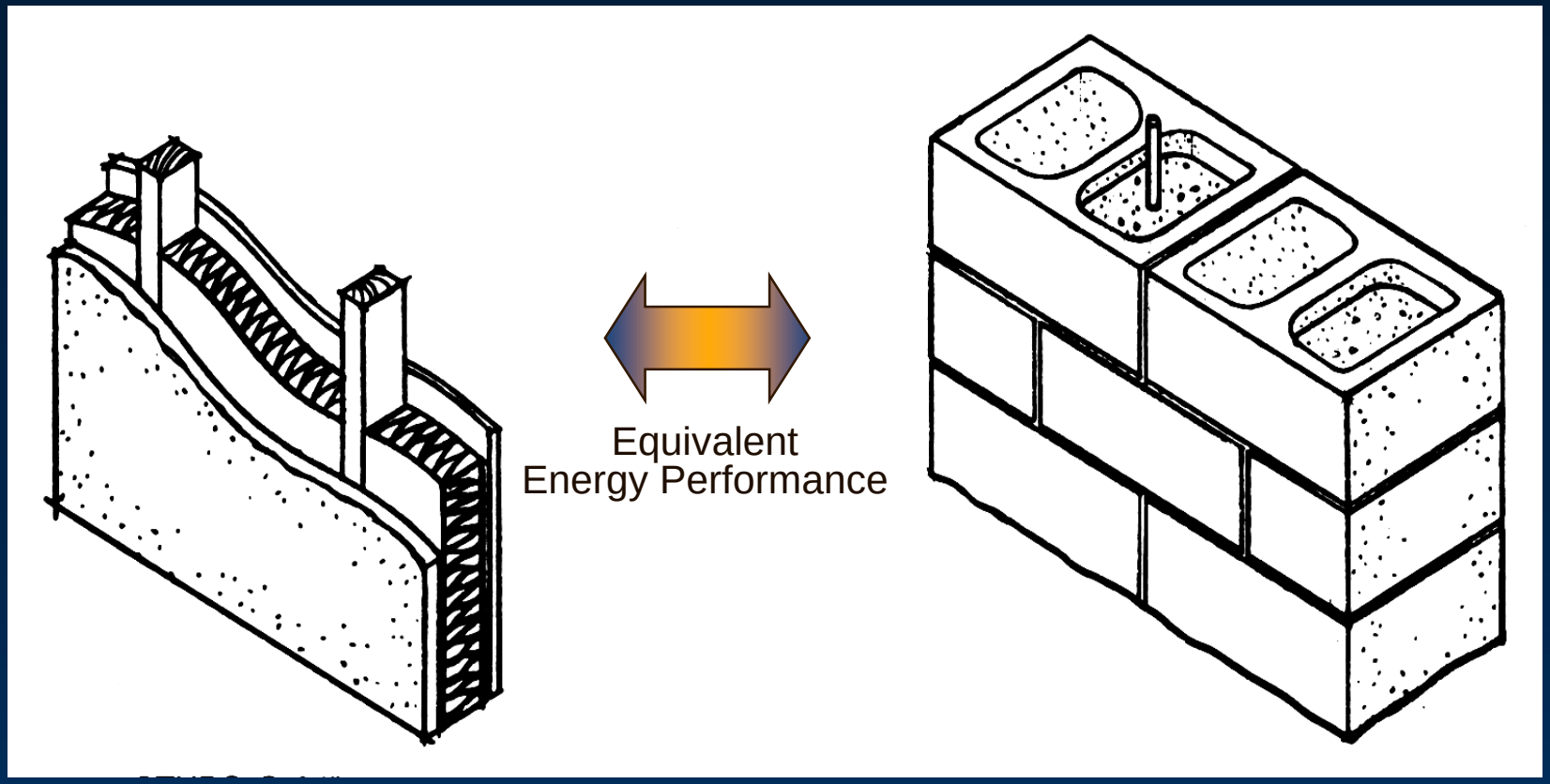

R-value not intended to predict actual energy use.

Thermal Mass Benefit

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Code Compliance Paths

- Prescriptive Path
- Component Performance
- Systems Analysis

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Wall with HC exceeding 5 - 7 Btu/ft^2 - F

HC = mass x specific heat (35 lbs/ft^2)

Wall	Partial Grout	Solid Grout
8” CMU	9.65	15.00
12” CMU	14.50	23.60
8” Brick	10.90	16.40
CMU Cavity Wall	15.00	20.35
Wall	**No Grout**	
4” brick Veneer (wood studs)	7.40	–
4” brick Veneer (metal studs)	7.20	–

Mass Wall Definition

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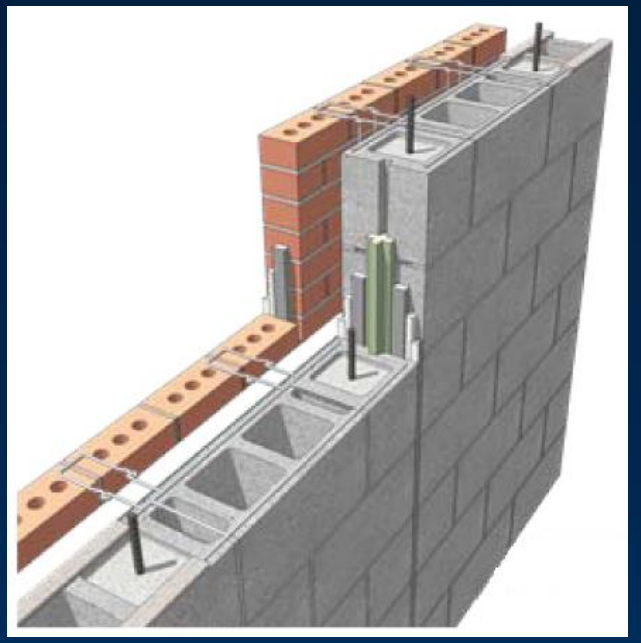

Mass Wall Systems

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Alternative Prescriptive Path Wall Requirements

- Glazing area maximum = 40%

Wall Type	Zone 1	Zone 2
CMU	U = 0.15 (avg)*	U = 0.123 (avg)

* Partially grouted wall with integral insulation complies.

OR

Wall Type	Zone 1	Zone 2
CMU	R - 5.7 continuous insulation	R – 7.6 continuous insulation

Washington Energy Code

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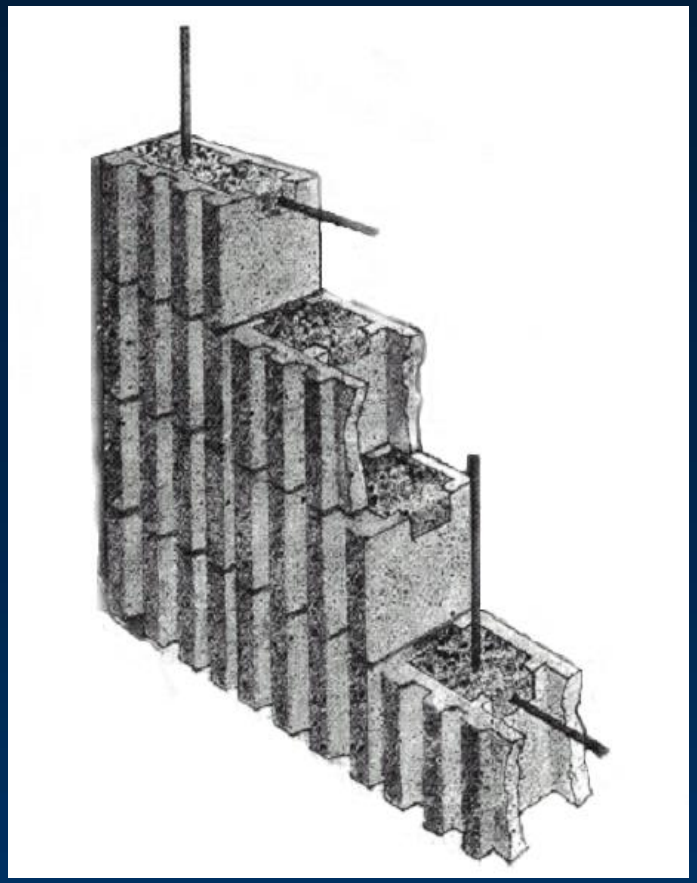

Integral insulated, partial-grouted concrete masonry walls can comply with northwest energy codes.

Code Compliance

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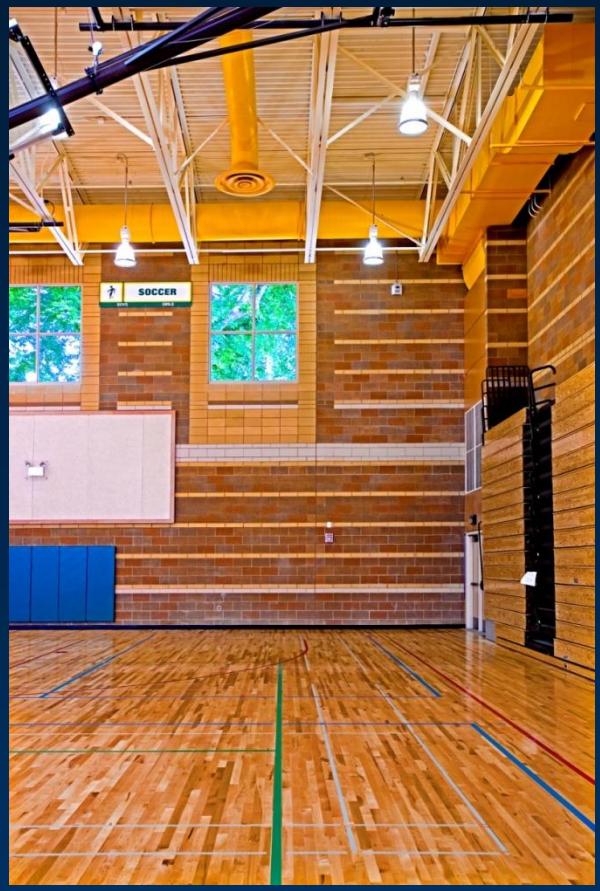

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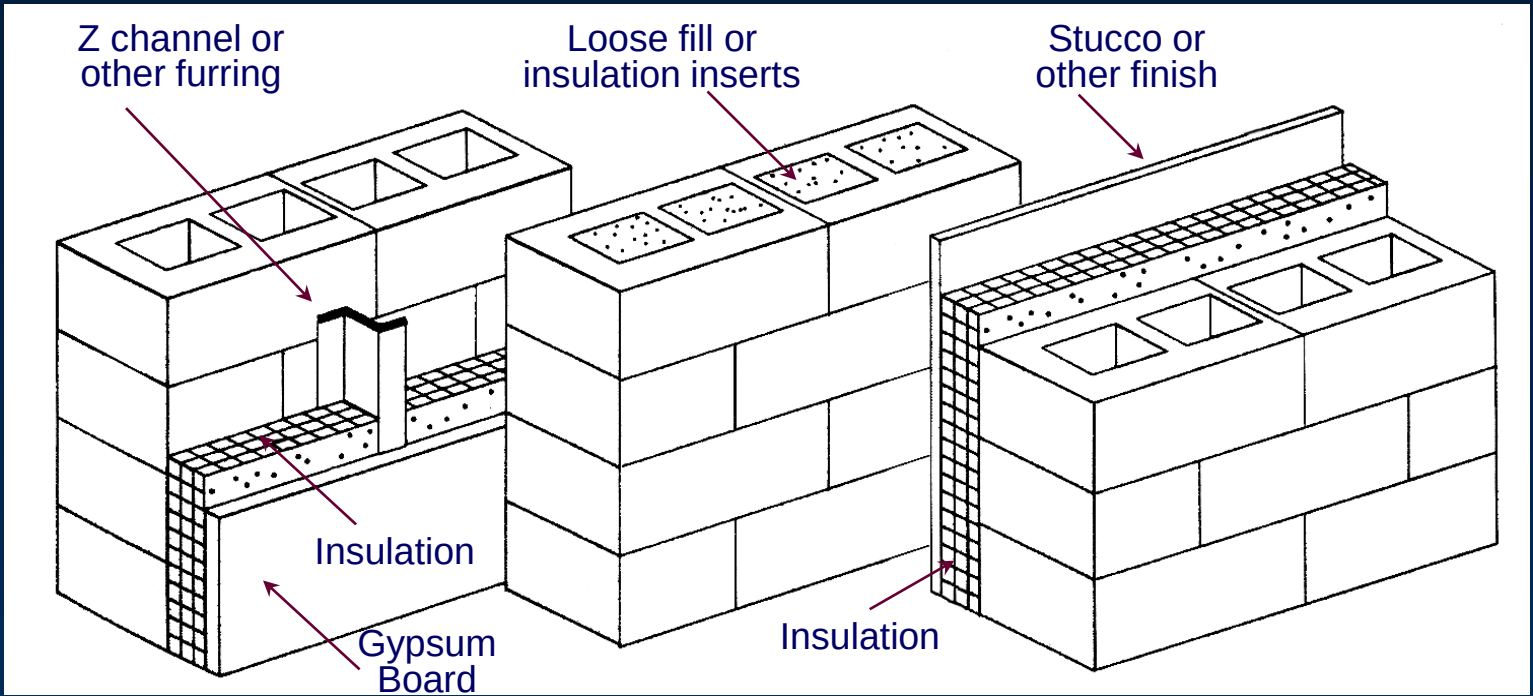

Mass Wall Insulation Options

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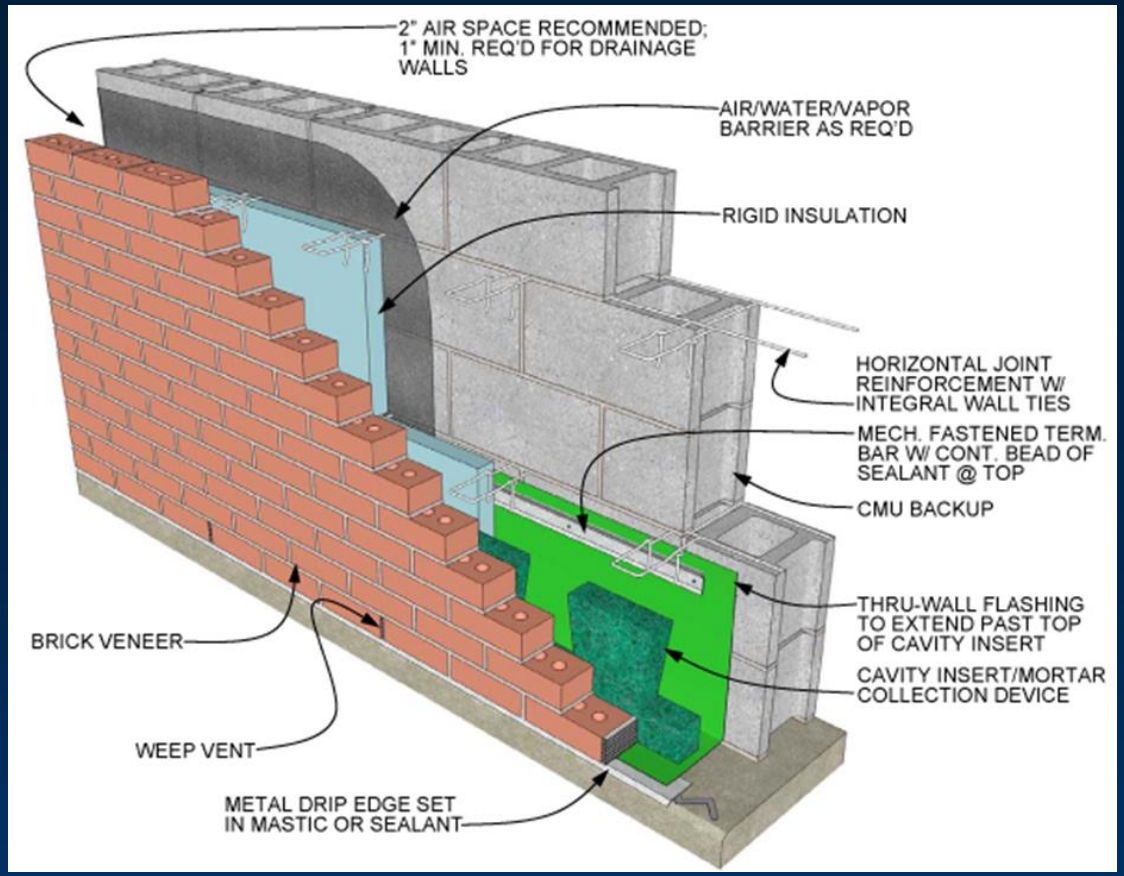

Mass Wall Insulation Options

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Factors Affecting Commercial Building Energy Performance

- Building type
  - Operation
  - Internal loads
- HVAC equipment
- Climate
- Envelope Insulation
- Thermal Mass

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- Nonresidential energy code provisions are required to be “technically feasible, commercially available, and **cost-effective** to building owners and tenants.”

Washington RCW

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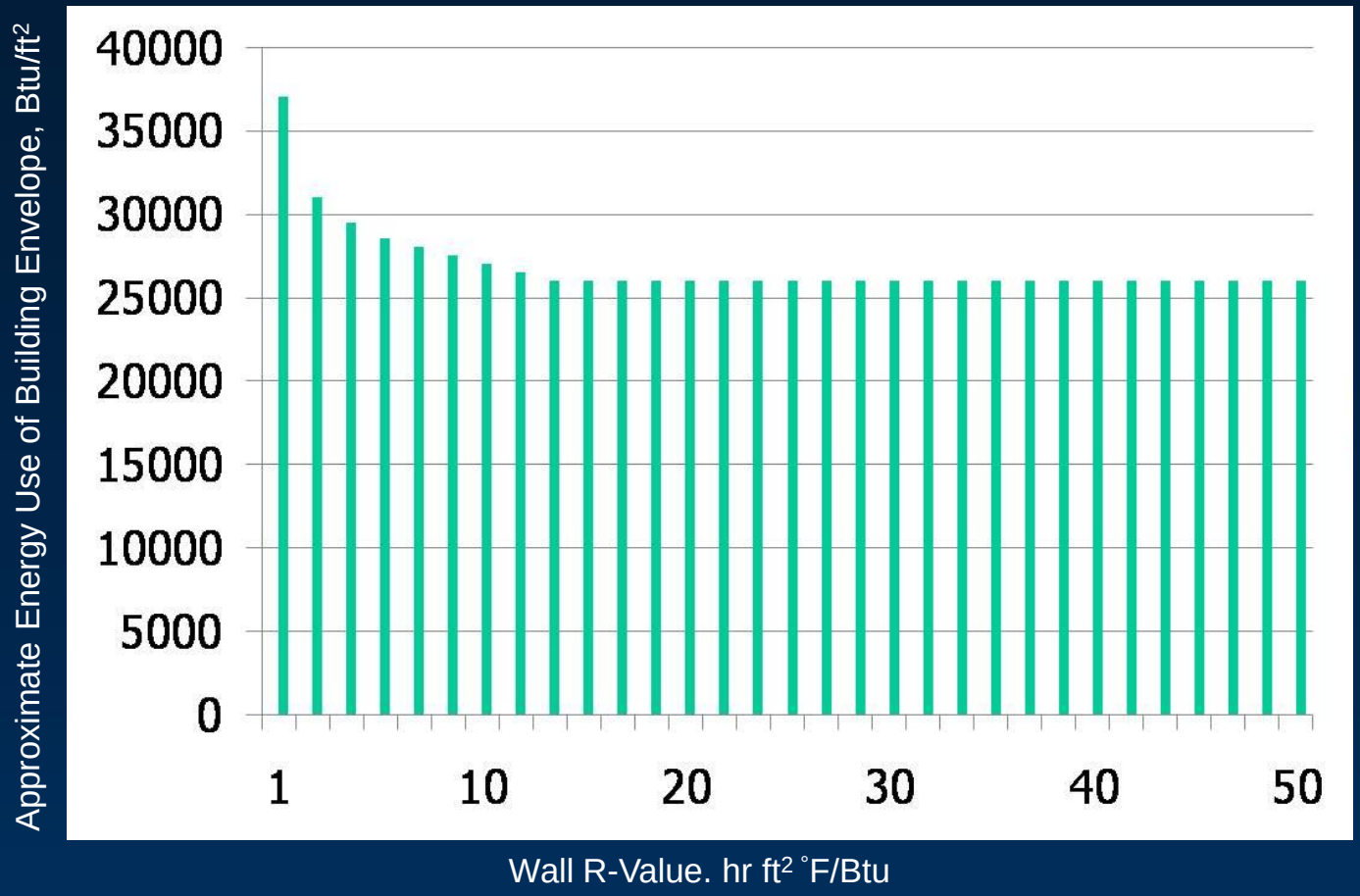

Impact of Wall R-Value

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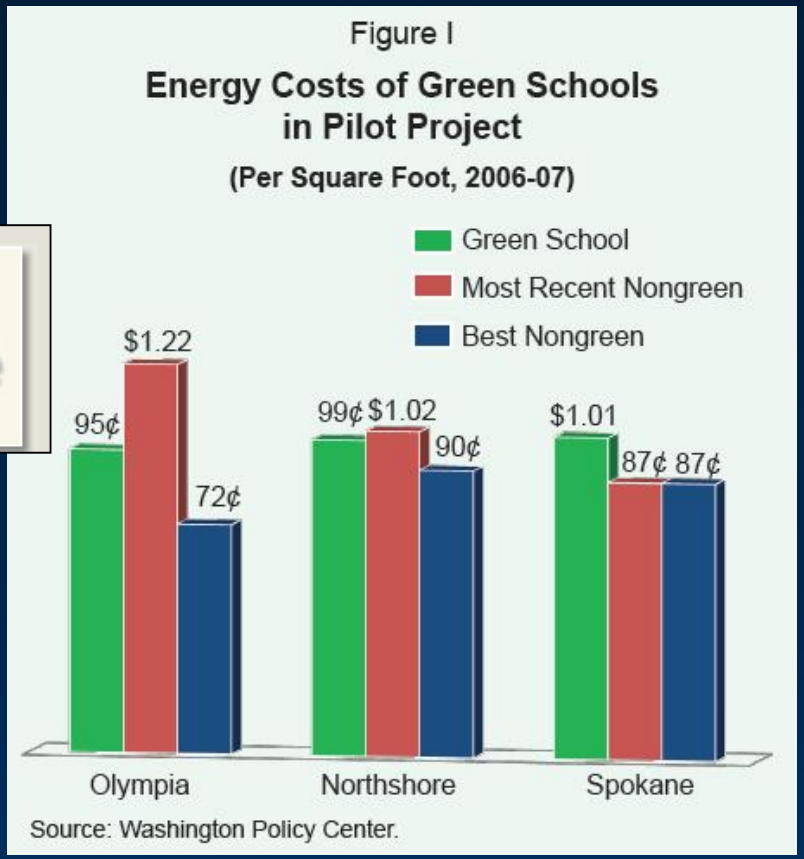
NATIONAL CENTER FOR POLICY ANALYSIS

Green Schools Don't Make the Grade



Building Performance

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State Audit Shows Most "Green" Schools Cost More and Are Less Efficient Than Average School

Exhibit 5 – Agencies Report High Performance Features Added Between 1 and 3 Percent to Building Costs

		State Agencies & Higher Education Institutions	School Districts
Number of projects		17*	14**
Total added costs		$3,507,796	$10,019,890
Net added costs after incentives and avoided costs		$2,499,726	$9,538,020
Average net added cost per square foot		$3.25	$8.52
Net added cost percent	Average	0.9%	2.6%
	Min	-1.4%	0.7%
	Max	3.8%	7.2%

*Cost reports not available for 20 of 37 projects substantially complete as of June 30, 2010.
**Total cost not available for one project still being closed out.

Exhibit 6 – Energy Use For Seven of Nine High Performance Buildings Did Not Meet Design Estimates

	Building	Annual Energy Use (000 Btu per sf)			Design Estimate Met?
		Estimate	Actual	% Difference	
State/ Higher Ed, First 12 Months	Centralia CC Science Center	78	127	+63%	No
	Everett College Graywolf Hall	33	126	+282%	No
	UW Playhouse Renovation	84	72	-14%	Yes
School Buildings, Most Recent 12 Months	Sherwood Forest ES	30	46	+53%	No
	Grove ES	22	55	+150%	No
	Gray MS	39	57	+46%	No
	Willapa Valley Jr./Sr. HS	33	12	-64%	Yes
Pilot Schools, 48 Months	Lincoln Heights ES	40	50	+25%	No
	Washington MS	26	41	+58%	No

Building Performance

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TE Inc. Energy Simulation Retail-Warehouse Bldg.

City	Wall	Energy Cost Diff.	Pay-Back Period
Seattle	Code	Baseline	
Seattle	Proposed	$978/yr (0.71%)	255 years
Portland	Code	Baseline	
Portland	Proposed (ASHRAE)	$2,025/yr (1.6%)	123 years
Spokane	Code	Baseline	
Spokane	Proposed	$17,758/yr (18.9%)	14 years

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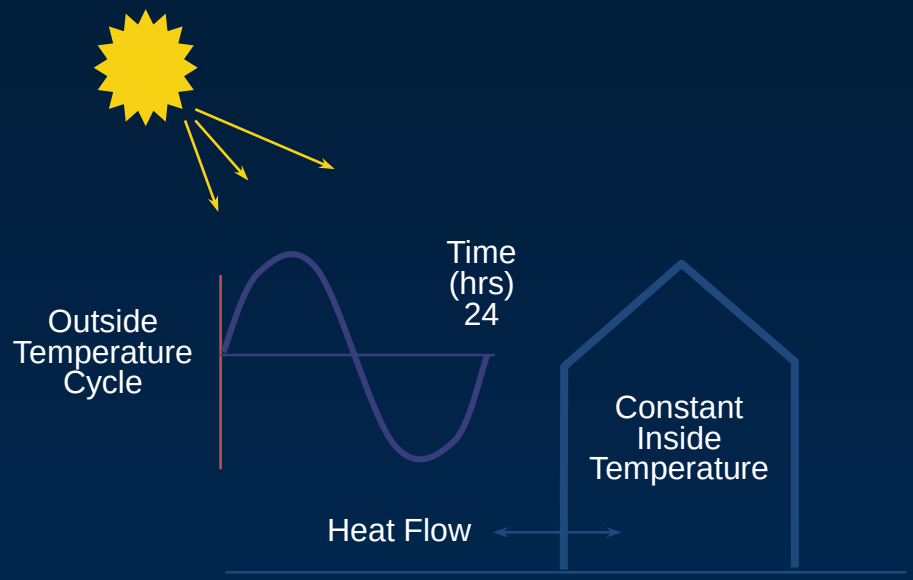
- Use comprehensive, whole-building energy analysis program with hour-by-hour simulation
- These programs can accurately model concrete masonry's thermal mass and predict the associated energy savings



Optimize Energy Performance

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ALTERNATIVE COMPLIANCE METHODS

WHY?

- ENERGY!
- 40% Energy in the US is used in operating buildings!
- 90% of the lifetime facility costs are operational costs!

Definitions

- Thermal Break
- Component Analysis
- Whole Building Analysis
- Continuous Insulation

Design Opportunity

- Thermal Transfer Mitigation
- Veneer
- New Products

Green Building Attributes

- Net Zero Energy
- Timeless Material
- Low Carbon Footprint

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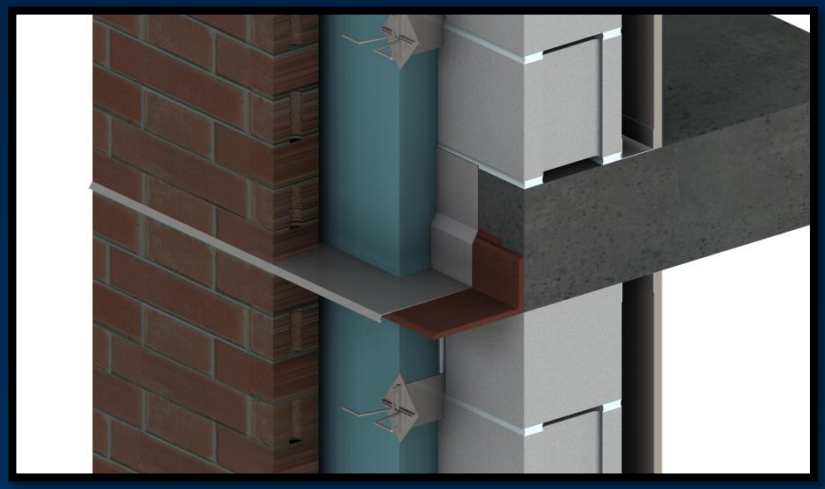
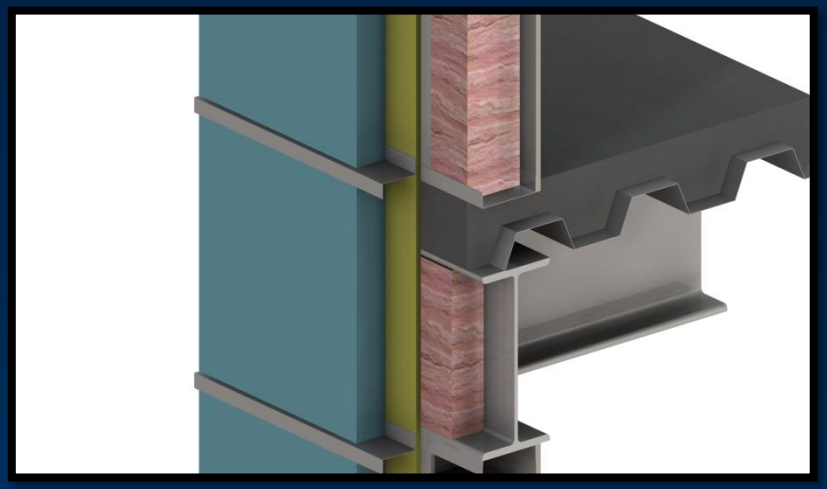
What is a Thermal Bridge?

- Highly conductive material that by-passes insulation layers
- Areas of high heat transfer
- Can greatly affect the thermal performance of assemblies





Thermal Bridging

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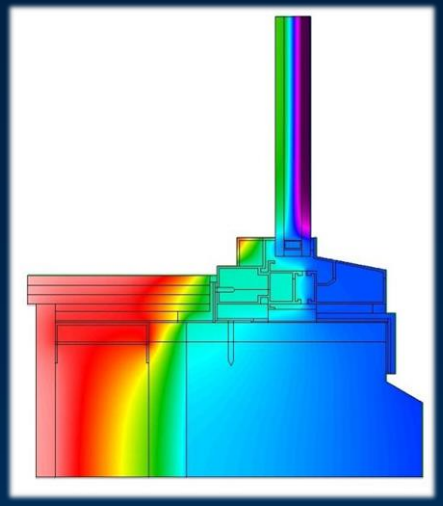
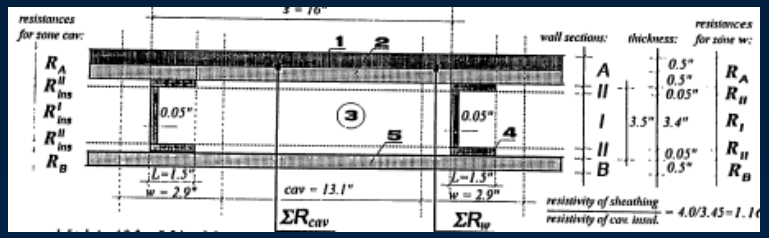
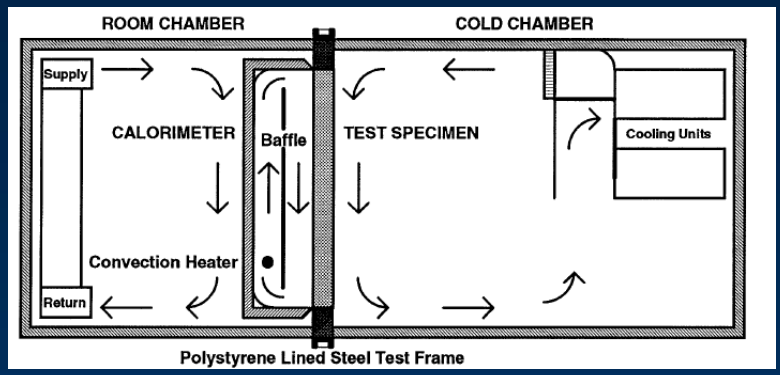
How is Thermal Bridging Typically Evaluated?



Computer Modeling



Hand Calculations



Lab Measurement

Thermal Bridging

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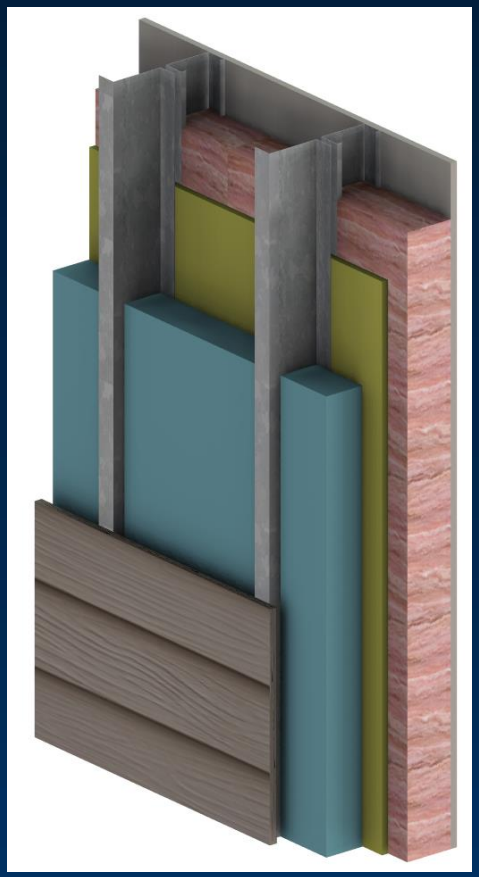

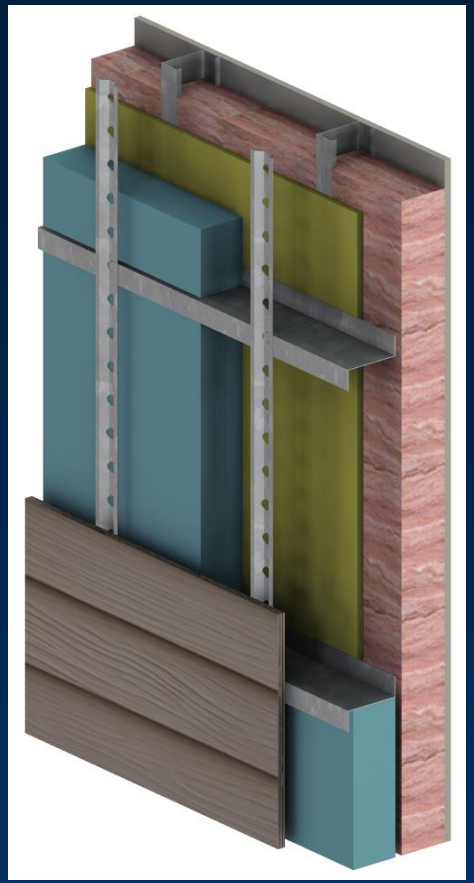

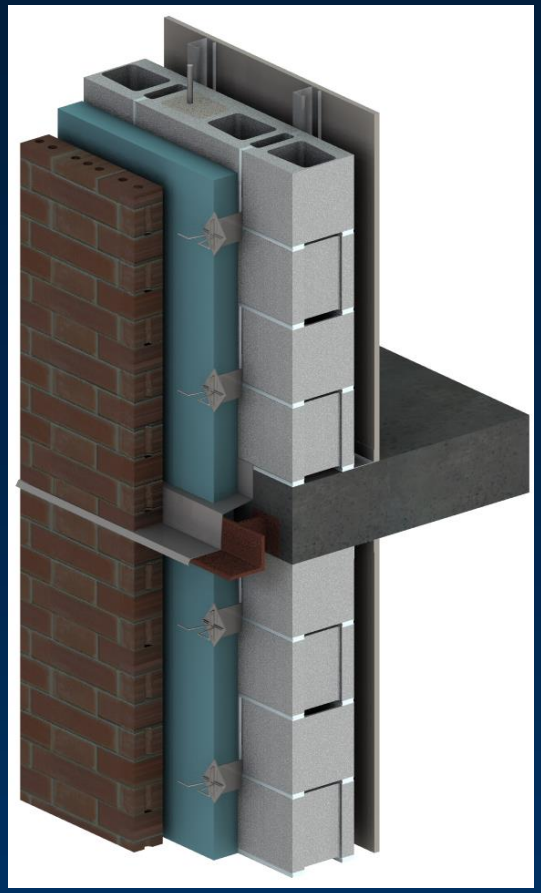

We Live in a 3D World!

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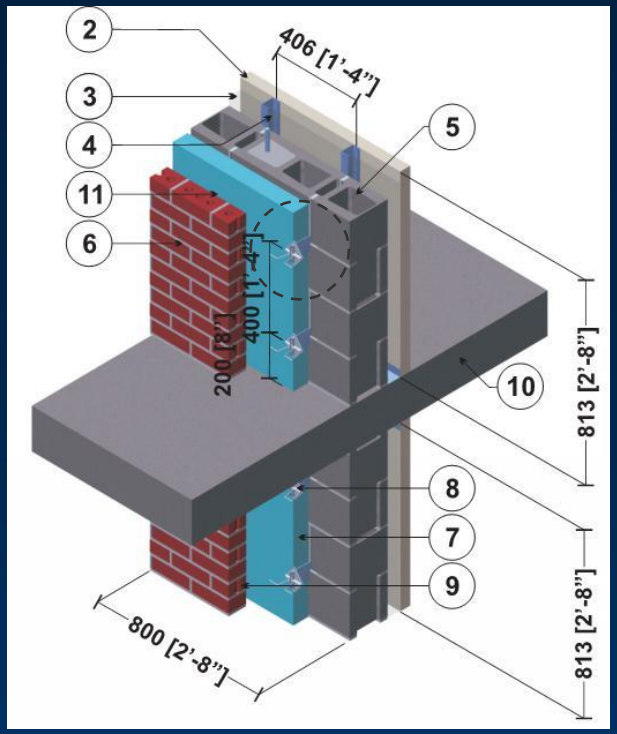
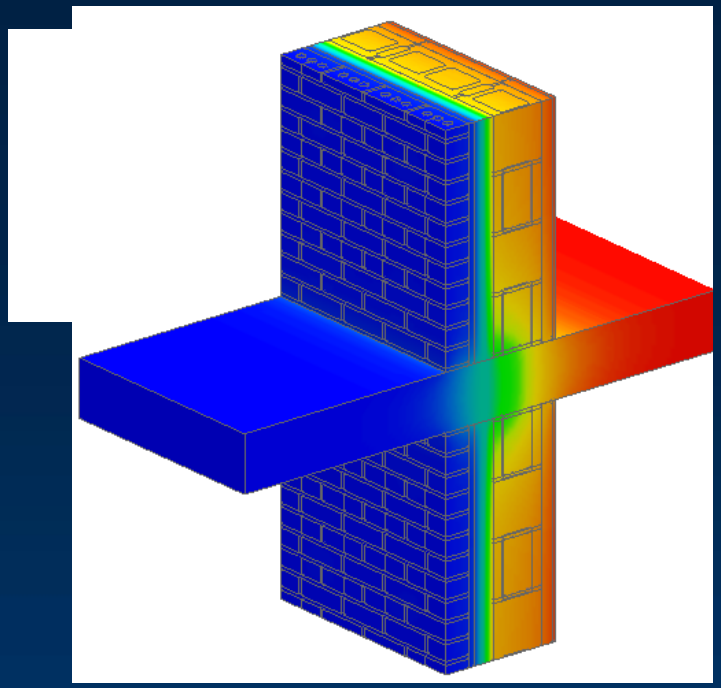
Thermal Bridging and the Area Weighted Average





Overall Heat Loss

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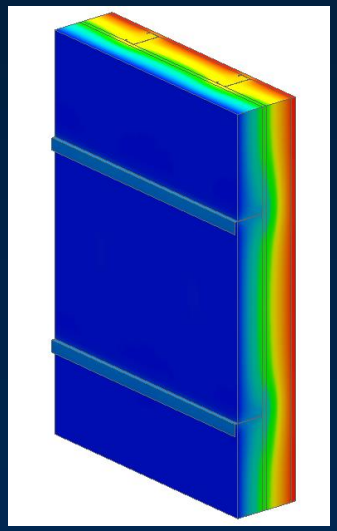
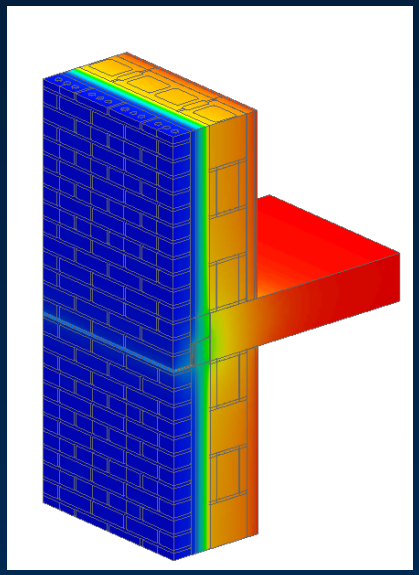
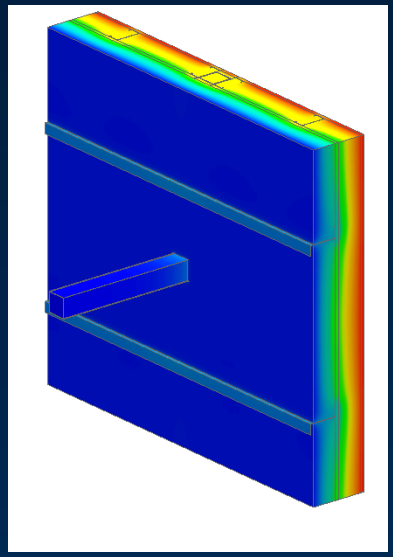
Types of Transmittances



Clear Field



Linear



Point

Overall Heat Loss

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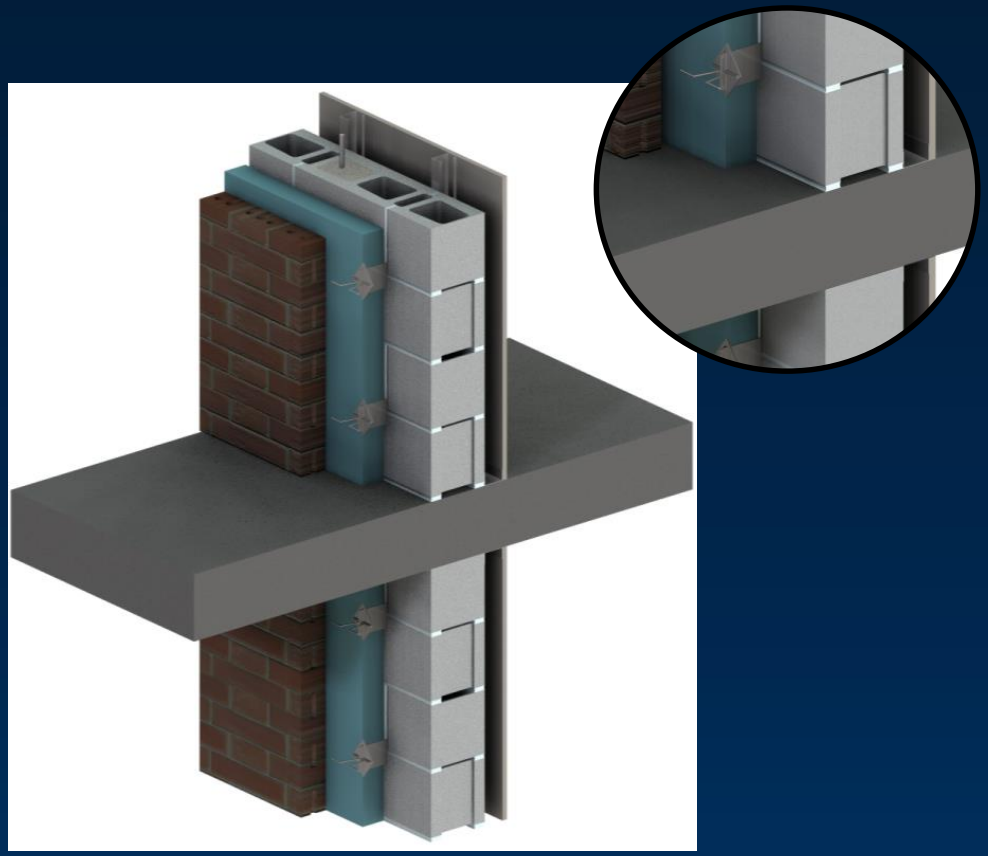

Un-Insulated Balcony Slab		
	SI (W/m·K)	**IP** (BTU/hr·ft°F)
Ψ	0.59	0.34

Slab Edges – Brick Veneer

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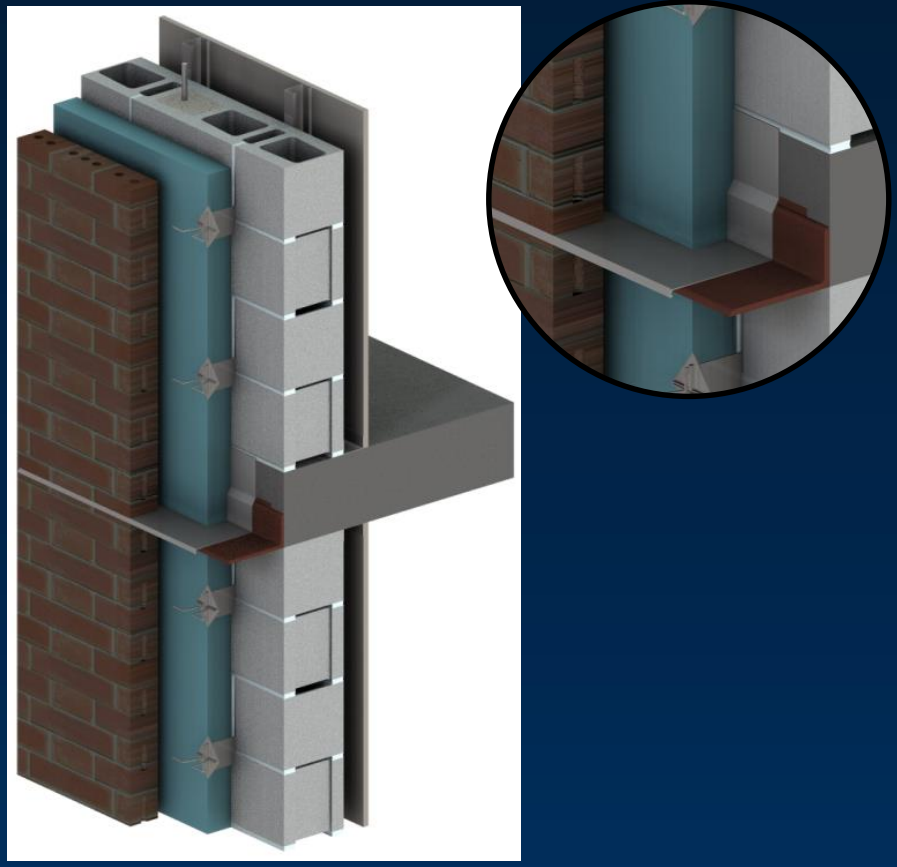

Shelf Angle		
	SI (W/m·K)	**IP** (BTU/hr·ft°F)
Ψ	0.47	0.27

Slab Edges – Brick Veneer

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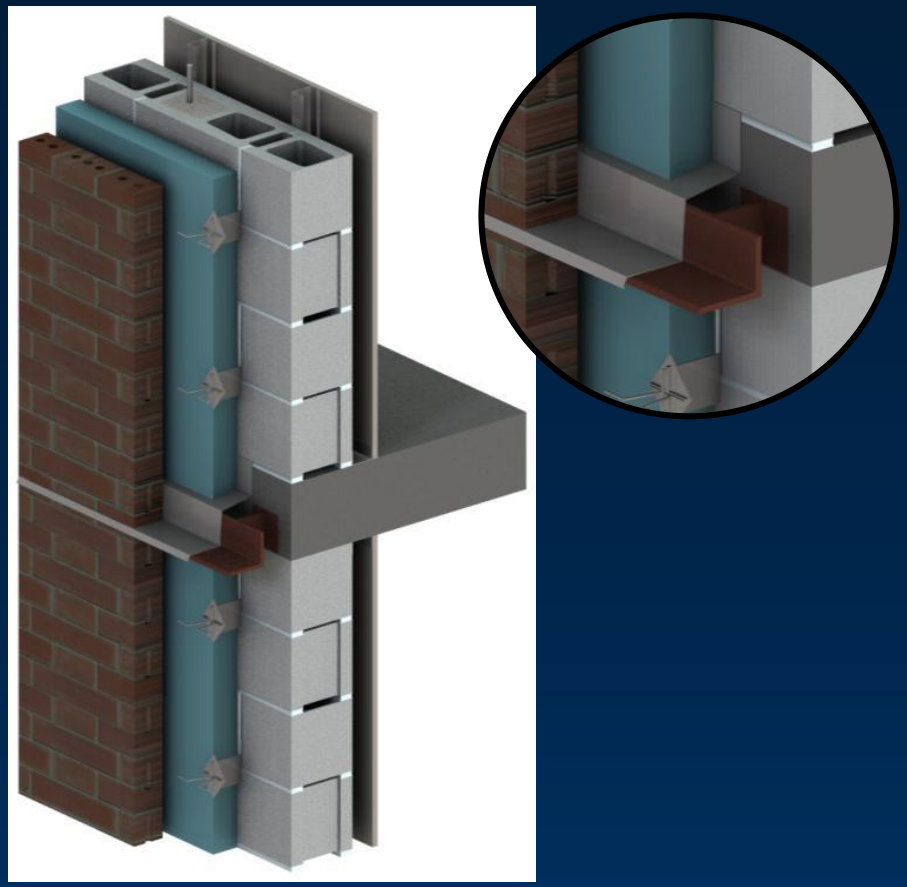

Spaced Shelf Angle		
	SI (W/m·K)	**IP** (BTU/hr·ft°F)
Ψ	0.31	0.18

Slab Edges – Brick Veneer

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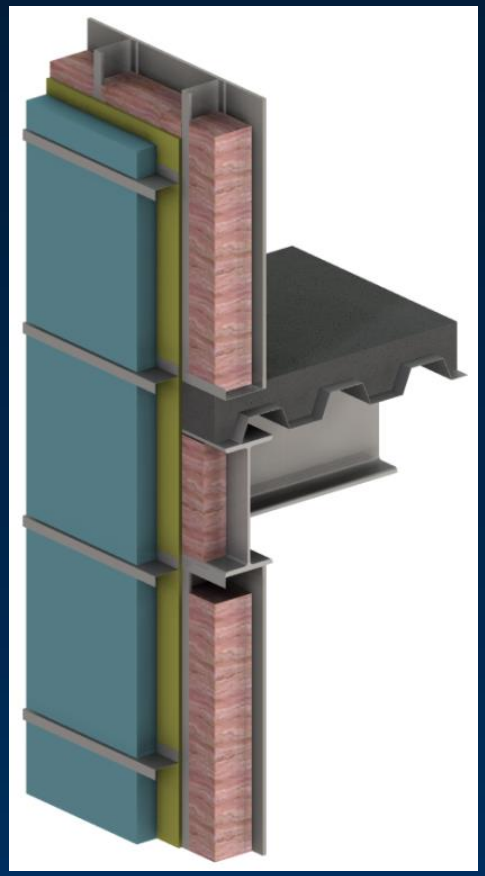

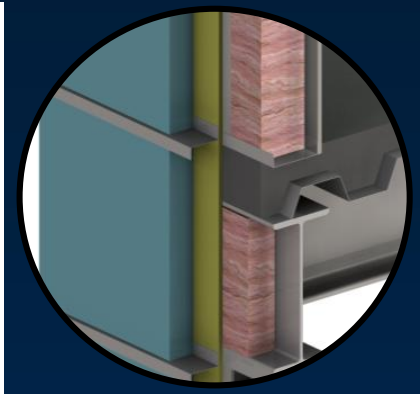

R-15 Insulated Slab Edge		
	SI (W/m·K)	**IP** (BTU/hr·ft°F)
Ψ	0.16	0.09

Slab Edges – Exterior Insulated

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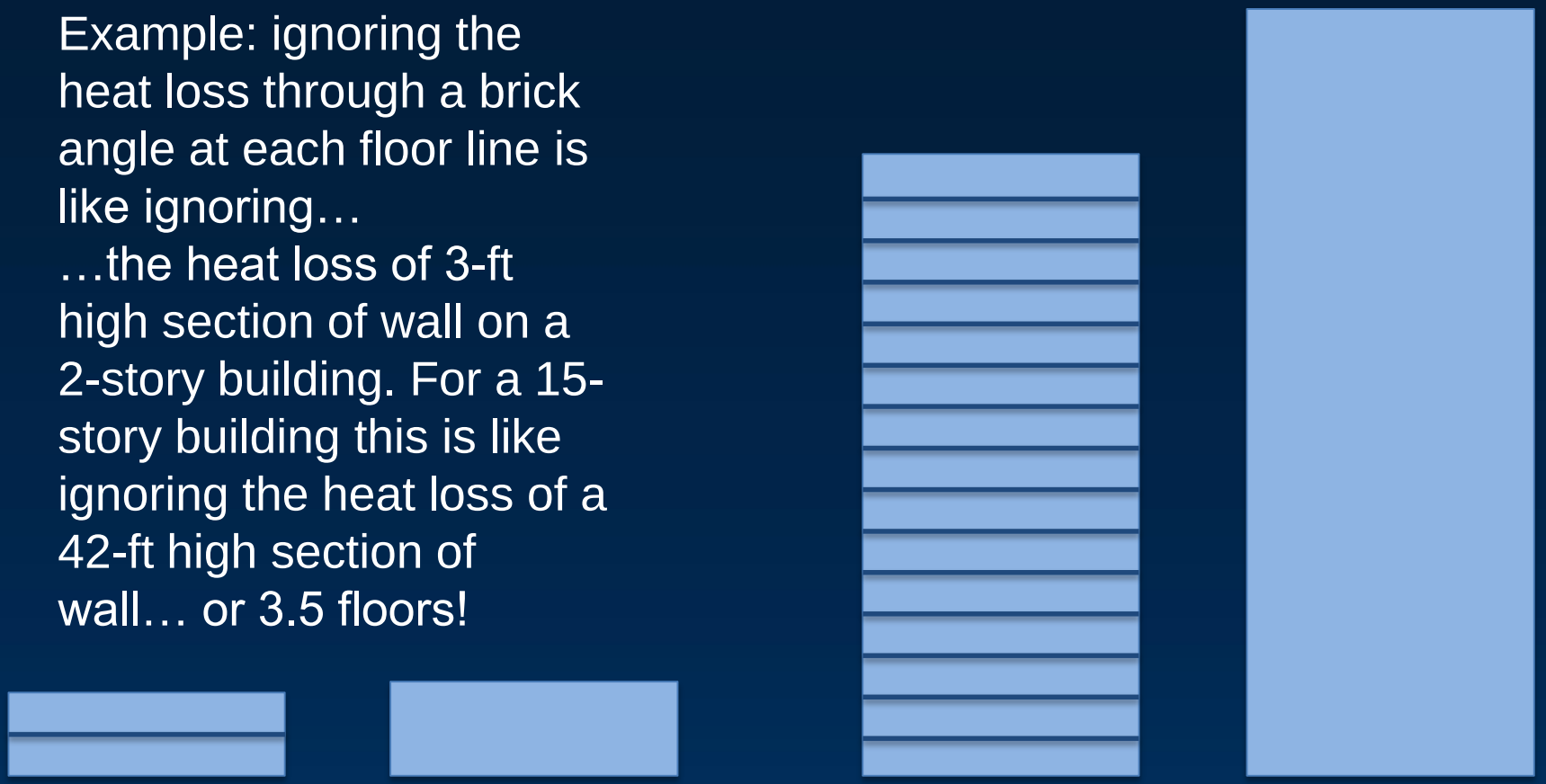
Example: ignoring the heat loss through a brick angle at each floor line is like ignoring…
…the heat loss of 3-ft high section of wall on a 2-story building. For a 15-story building this is like ignoring the heat loss of a 42-ft high section of wall… or 3.5 floors!



Linear Transmittance of 0.3 = an Additional 3-ft Strip of R-10

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Transmittance Range	Opaque Wall Total R-value (1/U-factor)
Nominal R-values	R-35
“Clear field” (ASHRAE 90.1)	R-20
“Efficient” details	R-15
“Poor” details	R-5

Wall Thermal Performance (Table 5)

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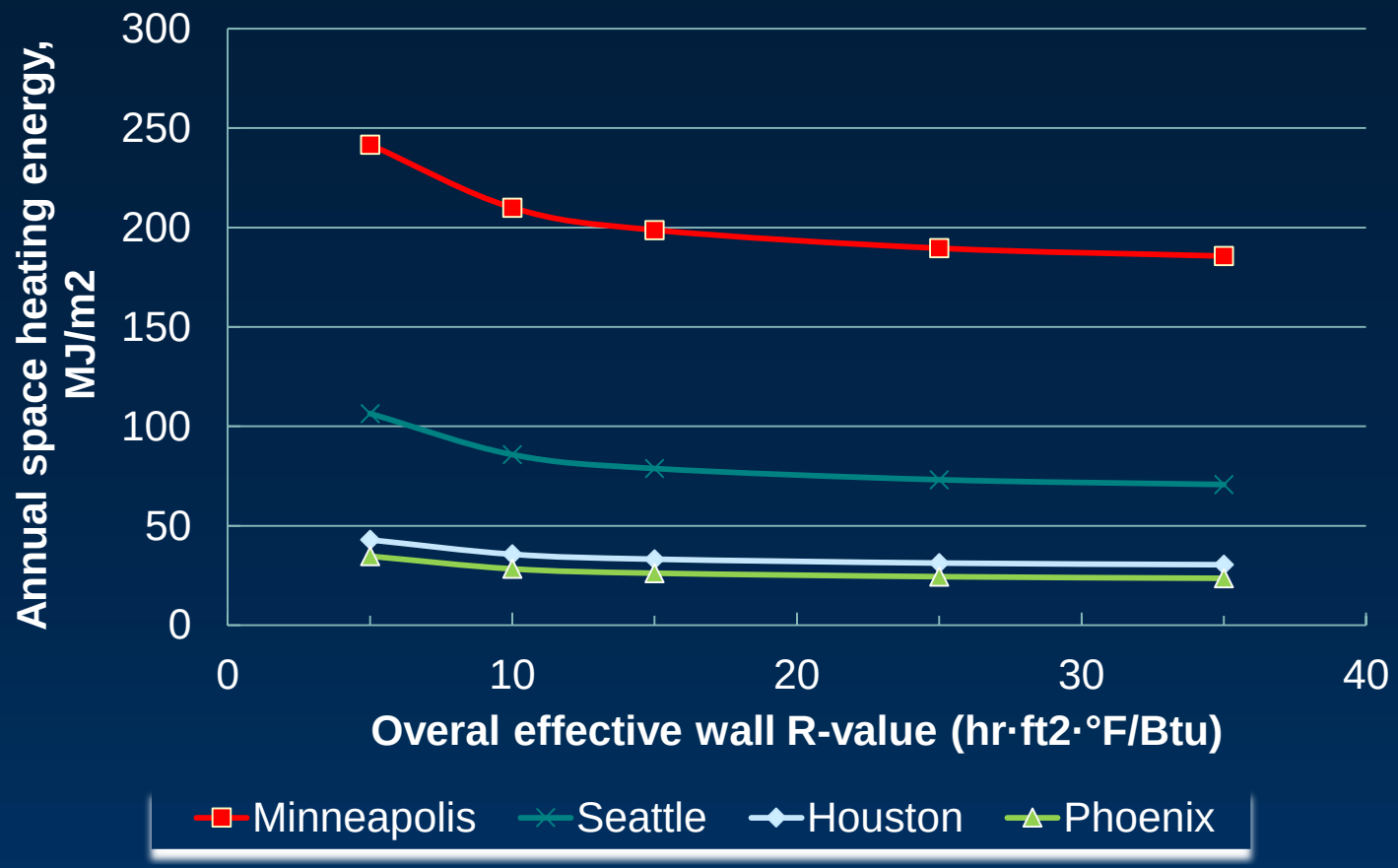

Impact of Thermal Bridging on Heating

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CONTINUOUS INSULATION (c.i.):

Insulation that is continuous across all structural members without thermal bridges other than fasteners and service openings. It is installed on the interior or exterior or is integral to any opaque surface of the building envelope.

Washington State Energy Code

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CONTINUOUS INSULATION (c.i.):

Insulation that is continuous across all structural members without thermal bridges other than fasteners (i.e. screws and nails) and service openings. It is installed on the interior or exterior or is integral to any opaque surface of the building envelope. For the purposes of this definition of continuous insulation, only screws and nails are considered fasteners. Insulation installed between metal studs, z-girts, z-channels, shelf angles, or insulation with penetrations by brick ties and offset brackets, or any other similar framing is not considered continuous insulation, regardless of whether the metal is continuous or occasionally discontinuous or has thermal break material. (See Section 1332 for determination of U-factors for assemblies that include metal other than screws and nails.)

City of Seattle Energy Code

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- Input values that account for all thermal bridging
- More accurate load analysis for sizing
- Determine cost effectiveness of insulating the building envelope through better details
- Efficient use of materials
- Change how stainable rating programs reward good design for energy efficiency and material use

Whole Building Energy Efficiency Analysis

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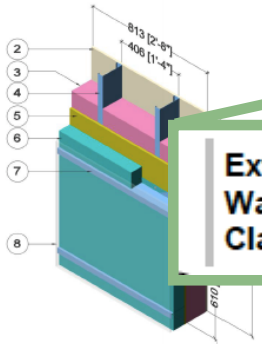
ASHRAE Data Sheets

Detail 11

Exterior and Interior Insulated 3 5/8" x 1 5/8" Steel Stud (16" o.c.) Wall Assembly with Horizontal Z-Girts (24" o.c.) Supporting Metal Cladding – Clear Wall



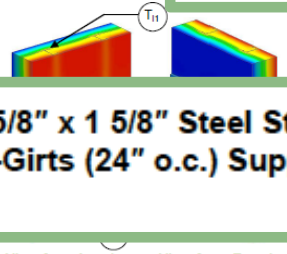
ID	Component	Thickness Inches (mm)	Conductivity Btu·in / ft²·hr·°F (W/m K)	Nominal Resistance hr·ft²·°F/Btu (m²K/W)	Density lb/ft³ (kg/m³)	Specific Heat Btu/lb·°F (J/kg K)
1	Interior Film (right side)[1]	-	-	R-0.7 (0.12 RSI)	-	-
2	Gypsum Board	1/2" (13)	1.1 (0.16)	R-0.5 (0.08 RSI)	50 (800)	0.26 (1090)
3	Fiberglass Batt Insulation in Stud Cavity	3 5/8" (92)	0.29 (0.042)	R-12 (2.1 RSI)	0.9 (14)	0.17 (710)
4	3 5/8" x 1 5/8" Steel Studs	18 gauge	430 (62)	-	489 (7830)	0.12 (500)
5	Exterior Sheathing	1/2" (13)	1.1 (0.16)	R-0.5 (0.08 RSI)	50 (800)	0.26 (1090)
6	Exterior Insulation	varies	-	R5 to R25 (0.88 to 4.4 RSI)	1.8 (28)	0.29 (1220)
7	Horizontal Z-girts w/ 1 ¼" Flange	18 gauge	430 (62)	-	489 (7830)	0.12 (500)
8	Metal cladding with ½" (13mm) vented air space is incorporated into exterior heat transfer coefficient					
9	Exterior Film (left side)[1]	-	-	R-0.7 (0.12 RSI)	-	-

[1] Value selected from table 1, p. 26.1 of 2009 ASHRAE Handbook – Fundamentals depending on surface orientation

Thermal Performance of Building Envelope Details for Mid- and High-Rise Buildings (1365-RP)

Detail 11

Exterior and Interior Insulated 3 5/8" x 1 5/8" Steel Stud (16" o.c) Wall Assembly with Horizontal Z-Girts (24" o.c.) Supporting Metal Cladding – Clear Wall



Thermal Performance Indicators

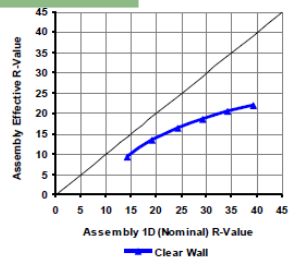
Assembly 1D (Nominal) R-Value	R_{1D}	R-14.2 (2.5 RSI) + Exterior Insulation
		"clear wall" R- and U-value
		Temperature Index 0 = exterior temp 1 = interior temp

Exterior and Interior Insulated 3 5/8" x 1 5/8" Steel Stud (16" o.c) Wall Assembly with Horizontal Z-Girts (24" o.c.) Supporting Metal Cladding – Clear Wall

View from Interior View from Exterior

Nominal (1D) vs. Assembly Performance Indicators

Exterior Insulation 1D R-Value (RSI)	R_{1D} ft² hr °F / Btu (m² K / W)	R_o ft² hr °F / Btu (m² K / W)	U_o Btu/ft² hr °F (W/m² K)
R-0 (0)	R-14.21 (2.50)	R-9.20 (1.62)	0.109 (0.62)
R-5 (0.88)	R-19.21 (3.38)	R-13.40 (2.36)	0.075 (0.42)
R-10 (1.76)	R-24.21 (4.26)	R-16.28 (2.87)	0.061 (0.35)
R-15 (2.64)	R-29.21 (5.14)	R-18.49 (3.25)	0.054 (0.31)
R-20 (3.52)	R-34.21 (6.02)	R-20.50 (3.61)	0.049 (0.28)
R-25 (4.40)	R-39.21 (6.90)	R-22.14 (3.90)	0.045 (0.26)



Temperature Indices

	R0	R5	R10	R15	R20	R25	
T_{I1}	0.060	0.211	0.277	0.319	0.359	0.384	Min T on sheathing, at girts, halfway between studs
T_{I2}	0.350	0.590	0.676	0.722	0.754	0.775	Max T on sheathing, at studs, halfway between girts

How to Access Results

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ASHRAE Reference Material available at:
http://www.morrisonhershfield.com/ashrae1365research/Pages/Insights-Publications.aspx

Thanks to Medgar Marceau from the Bellevue office of Morrison Hershfield for his contributions to this presentation.

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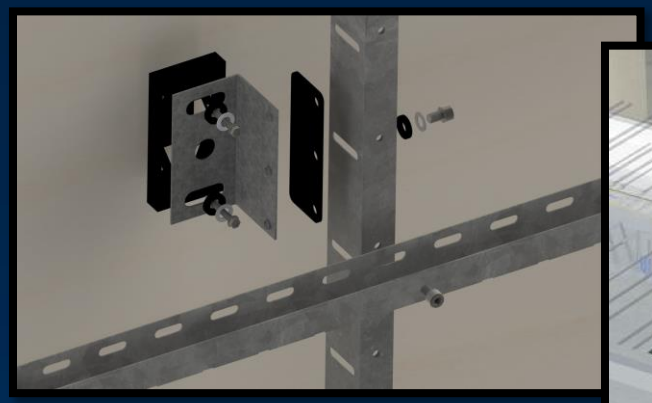
- Well suited for manufacturers for product development, performance evaluation, and marketing



Product Development

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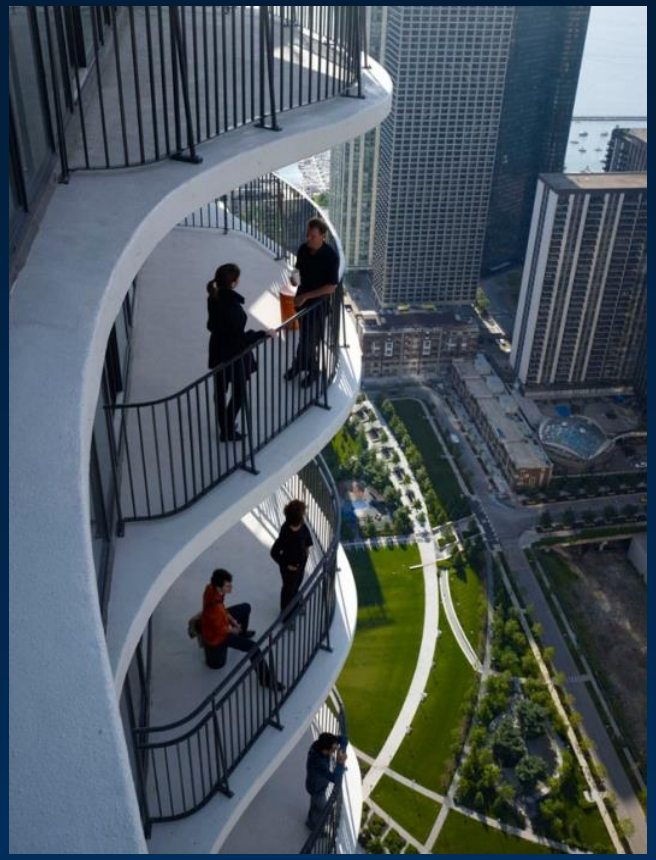

Making sure you have and use “Real” Data!

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Actual Project Examples – Valley View Middle School

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It can be beautiful too! Valley View Middle School

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MASONRY INSULATING SYSTEMS

- Three Insulation Choices for Block Walls

  (There are others, I am covering the main three that we, as mason contractors, see used in the field.)

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- Insulation Choices for Block Walls.
  - Perlite
  - Polystyrene Inserts
  - Foamed-in Insulation

- Insulation Choices for Block Walls.
  - Perlite

Masonry Insulating Systems

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- Insulation Choices for Block Walls.
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Masonry Insulating Systems

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- Insulation Choices for Block Walls.
  - Perlite
  - Polystyrene Inserts
    - Standard

Masonry Insulating Systems

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- Insulation Choices for Block Walls.
  - Perlite
  - Polystyrene Inserts
    - Standard
    - Hi-R

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- Insulation Choices for Block Walls.
  - Perlite
  - Polystyrene Inserts
  - Foamed-in Insulation

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- R-VALUE COMPARISON

Block Size		PERLITE FILLED	KORFIL & (HI-R)	FOAMED
8x8x16		5.6	5.8 & (9.8)	6.2
12x8x16		7.6	7.2 & (11.9)	8.8

R-value based on rebar 4’ o.c. R-values were taken from several sources and averaged.

Masonry Insulating Systems

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QUESTIONS?

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