



ENERGY STAR Multifamily High-Rise (MFHR)



Why 'Green'

Why do MF Builders need to Differentiate their Properties





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Apartments.com National Survey Reveals More Than 95 Percent of Renters Are Making a Move in 2010

Moves Motivated by Better Bargains, Nicer Apartments and Safe Neighborhoods

CHICAGO, Jan. 19 /PRNewswire/ – Many renters across the country are ringing in the New Year with a new apartment. According to a national survey conducted by Apartments.com—securing more than 1,500 renter responses—more than 95 percent of renters said they are planning a move in 2010. Striking while their 2010 moving resolutions are hot, many renters are also moving earlier this year, searching for better deals and nicer apartments in great neighborhoods.

What Renters Want?



APARTMENTS.COM NATIONAL SURVEY REVEALS RENTERS ARE GOING “GREEN” IN THEIR APARTMENTS

Nearly Seventy-Five Percent of Renters Recycle and Conserve Energy; Twenty-Five Percent Willing to Pay More Rent for Green Living

CHICAGO (April 15, 2009) – More than 60 percent of renters said they search for apartments that offer environmentally-friendly amenities and 25 percent are willing to pay more rent to live at an apartment community that considers the environment in their day-to-day community operations.

Source: Apartments.com

Green Premium



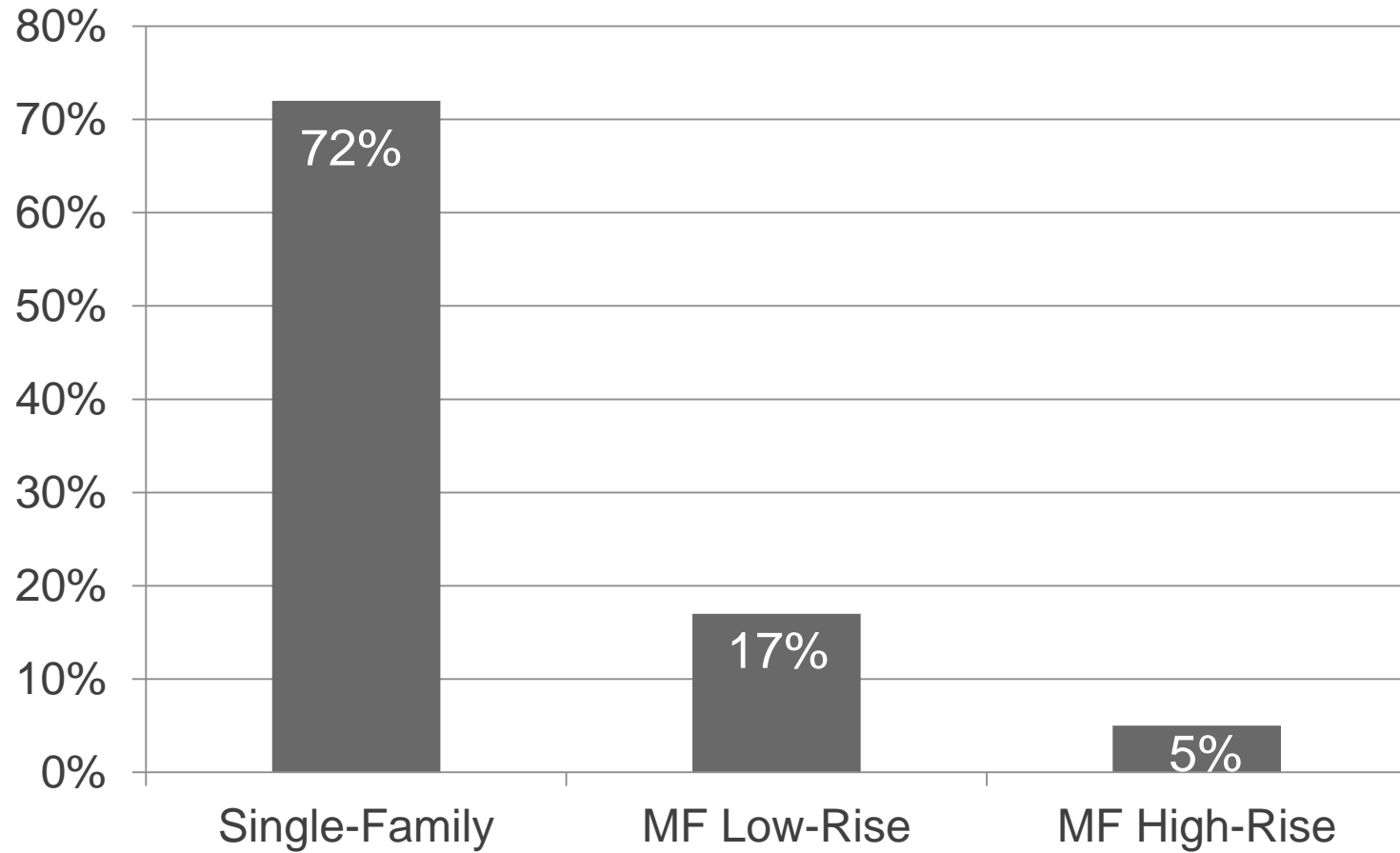
- A survey of 1,000 apartment seekers by Rent.com finds that 86 percent of the U.S. rental pool would prefer to live in a green apartment, and a full 42 percent would pay a \$100 rent premium to do so.

Source: MultifamilyExecutive.com, June 2010



The Market

Multifamily Market



Source: DOE Buildings Data Book 2009



Multifamily Market

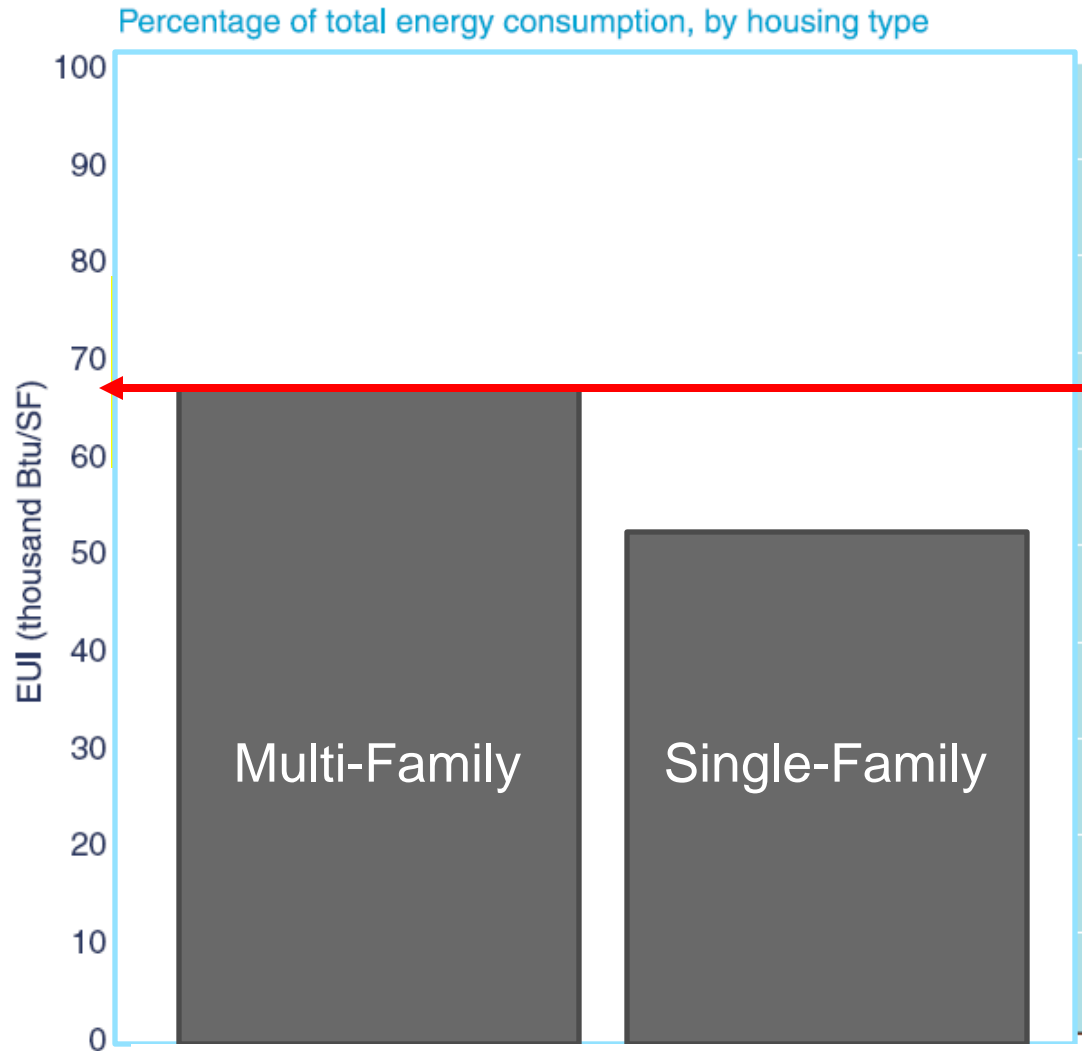


Demand for higher-density homes is expected to hit new highs by 2015 due to an influx of:

- 78 million downsizing baby boomers
- 78 million college graduates
- 9 million immigrants

Source: U.S. Census Bureau

Multifamily Consumption

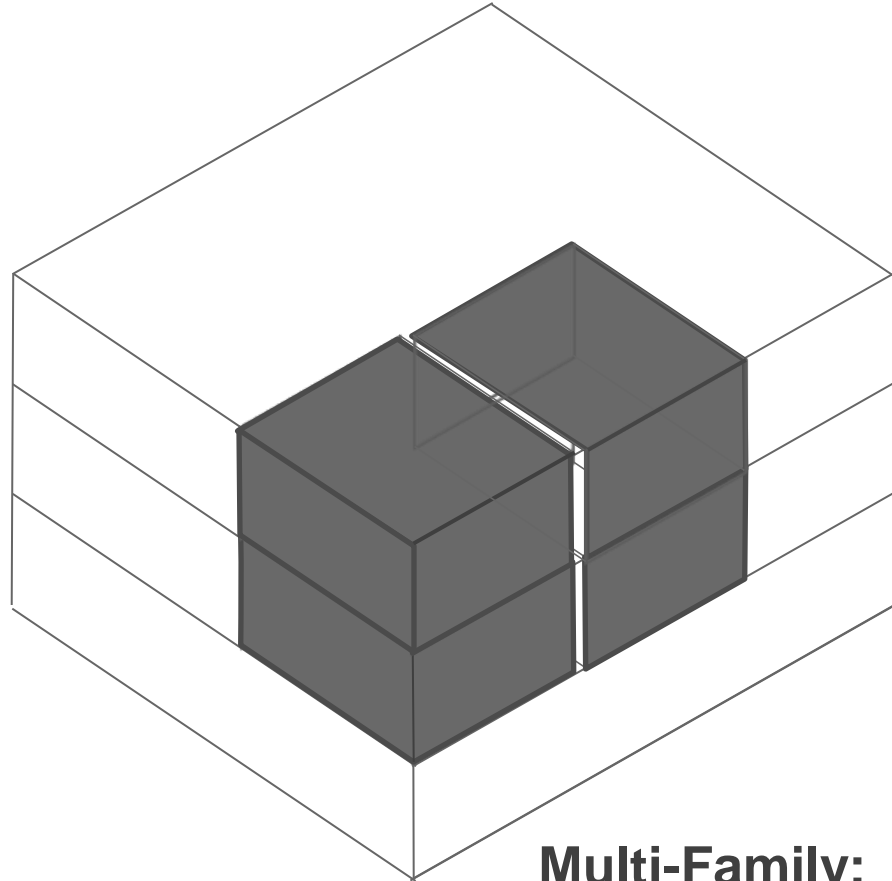
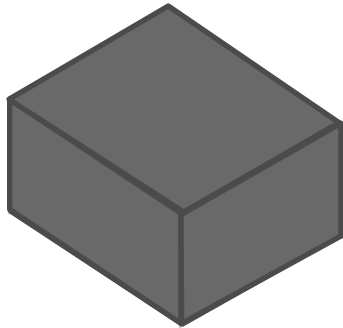


EUI is 27% higher for MF housing

Why Multifamily Consumption is Disturbing



Single-Family:
All surfaces exposed
to unconditioned
spaces



Multi-Family:
One or few surfaces
exposed to unconditioned
spaces



The Value Proposition

EPA Objectives for ENERGY STAR MFHR Program



- Cost effective
- Represent real reductions in energy consumption
- Provide value to MFHR stakeholders
- Offer a process that consistent, replicable, and addresses the barriers to energy efficiency in this building sector

MultiFamily High-Rise vs. Other Residential Buildings



MFHR

- Development time (2 - 5 years)
- ENERGY STAR products not always available
- Multiple HVAC configurations (central and in-unit)
- Currently no national 3rd party verification organization
- Multiple verification visits needed
- Modeling is technical and requires special expertise
- Building science is well understood but implementation challenges remain

MFLR and Single Family

- Development time (3 -12 Months)
- ENERGY STAR products for residential applications
- Basic system with ENERGY STAR HVAC available
- RESNET provided national oversight for verification
- Typically two verification visits
- Modeling easily learned and cost effective
- Building science well understood and easily implemented

Value Propositions



Occupants

- Improved indoor air quality
- Improved comfort
- Lower Utility Bills (if not included in rent or not owned)



Building Eligibility

Building Eligibility



- New construction or substantially rehabilitated multifamily buildings
 - 4 or more stories **AND** not eligible for ENERGY STAR New Homes Program
 - Residential space must comprise over 50% of the conditioned square footage.
 - Residential space must be separately metered from commercial space.



Participant Roles and Expectations

Role and Expectations of Developer

Role

- Work with Energy Consultant(s)
- Sign off on Program documentation (Architect/Engineer Rep.)
- Benchmark building in Portfolio Manager

Expectations

- Provide access to EPA for QA inspections
- Costs of implementing the program requirements
 - Energy modeling
 - Energy conservation measures
 - General contractor and design team time
 - Subcontractor training
 - Testing and Verification

Role of Energy Consultant(s)

- Work with project design team
- Model Baseline and Proposed building **OR** follow Prescriptive Path requirements
- Conduct plan review to ensure final design meets reqts. and necessary details are included in bid specifications
- Perform on-site inspections during construction to ensure measures are installed as specified
- Perform final inspection performance testing
- Submit required documentation to Program Administrator/EPA



Earning the ENERGY STAR

ASHRAE Standard 90.1-2007 and Appendix G



ASHRAE 90.1-2007

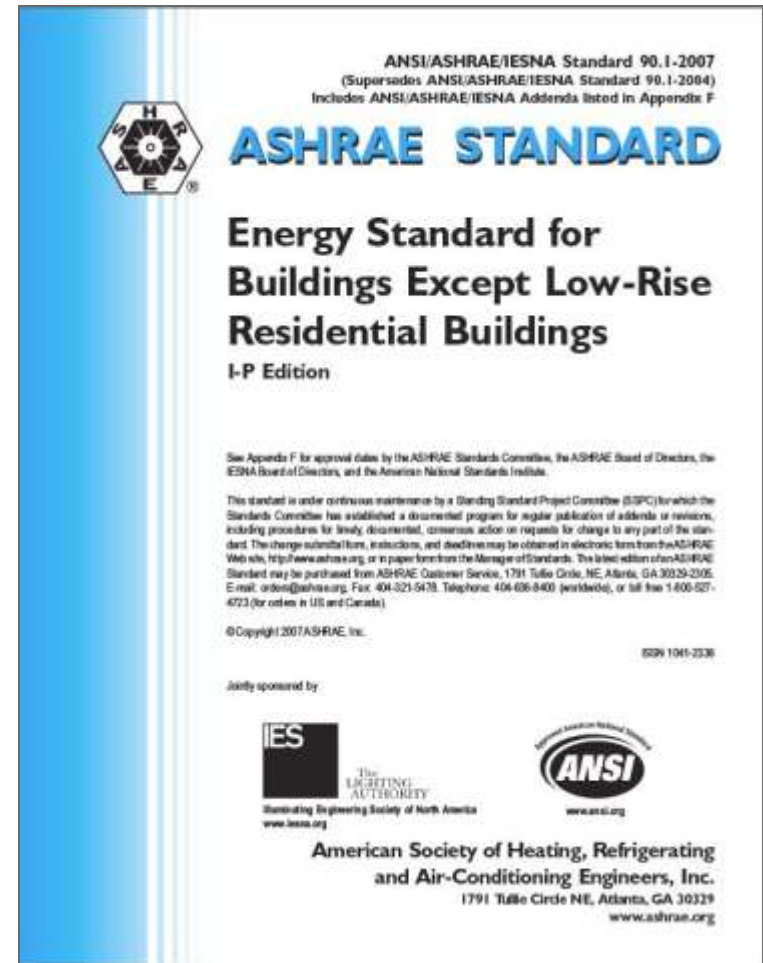
- Minimum requirements for the energy-efficient design of high-rise multifamily buildings

Appendix G

- Protocols for generating an energy performance rating for buildings that exceed the requirements of ASHRAE 90.1-2007

Program Standard

- LEED Mid-Rise
- Enterprise Green Communities

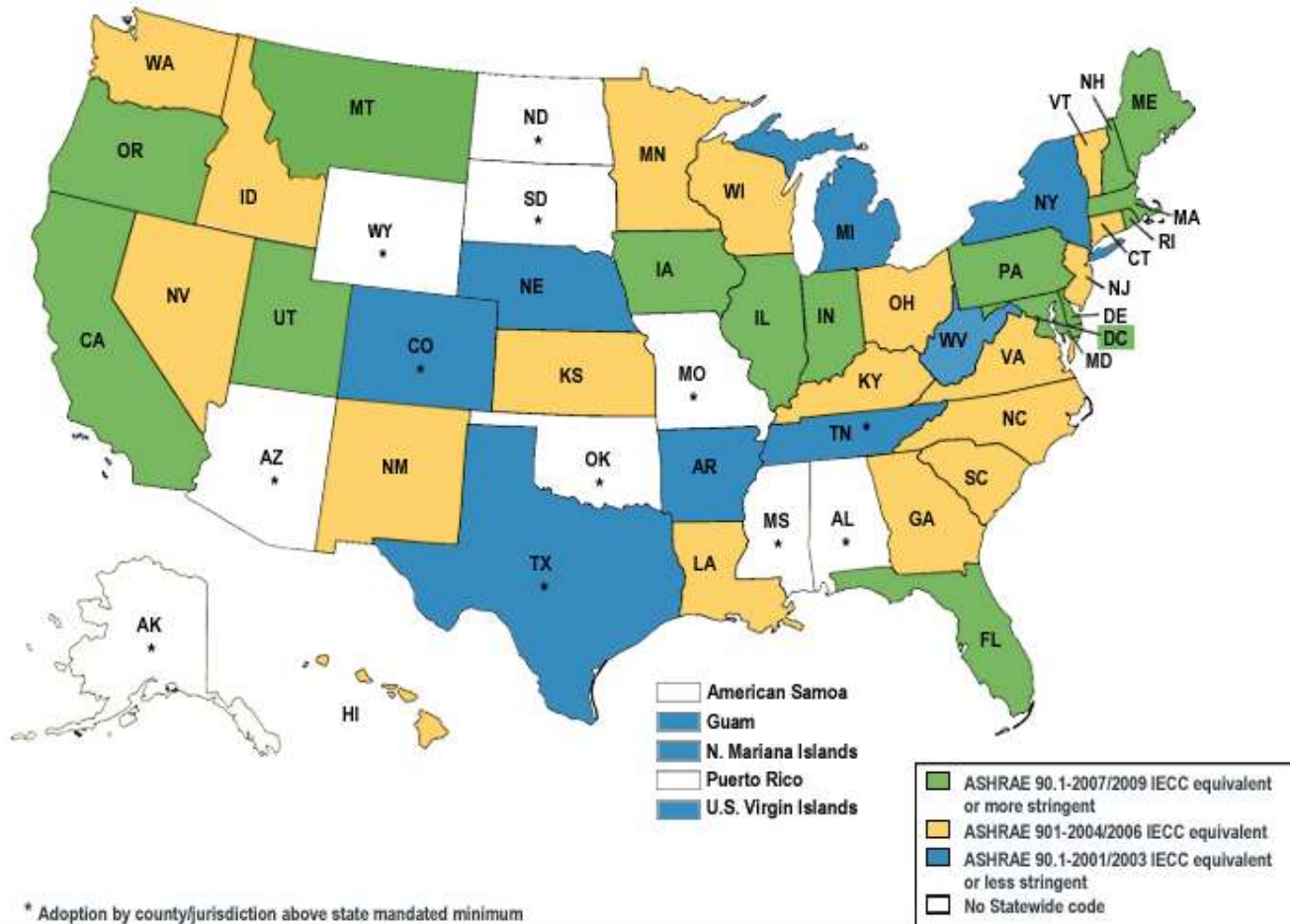


Status of Commercial Energy Codes



Status of Commercial Energy Codes

As of July 20, 2010



Two Paths to ENERGY STAR

- Performance Path
 - Meet Prerequisites
 - Conduct Energy Modeling
[$\geq 15\%$ ASHRAE 90.1, Appendix G]
 - Build according to Design
 - 3rd Party Testing and Verification
- Prescriptive Path
 - Meet Prerequisites
 - Build according to Prescriptive Requirements
 - 3rd Party Testing and Verification

Meeting the Prerequisites

- ENERGY STAR qualified products, where applicable
- ENERGY STAR qualified lighting in 80% of light fixtures
- Occupancy sensors for lighting in most common spaces
- Right-sized heating and cooling equipment
- Double-pane, low-e windows
- Low-flow faucets & showerheads (<2.0gpm) and toilets (<1.3gpf)
- Total duct leakage for in-unit systems ≤ 6 CFM25 per 100ft² of conditioned floor area (≤ 8 CFM25 per 100ft² for units <1200ft²)
- Continuous air barrier between conditioned/unconditioned spaces
- Air-sealing to achieve infiltration <0.30 CFM50/ft² of enclosure
- Ventilation per ASHRAE 62-2007 (apts. and common areas)

*Not all Prerequisites have been listed here; see website for full list

Prescriptive vs. Performance



| MEASURE | PRESCRIPTIVE | PERFORMANCE (Baseline ASHRAE 90.1-2007) |
|----------------------------------|---|---|
| Appliances | ENERGY STAR Qualified | ENERGY STAR Qualified |
| Heating | CZ 1-3: 80% AFUE CZ 4-5: ENERGY STAR CZ 6-8: 93% AFUE | CZ 1-3: 80 %AFUE CZ 4-8: ENERGY STAR |
| Cooling | CZ 1-2: SEER 16 CZ 3-5: ENERGY STAR CZ 6-8: SEER 13 | CZ 1-3: ENERGY STAR CZ 4-8: SEER 13 |
| Heating and Cooling Distribution | Total duct leakage <6 CFM25/100 ft ² | Total duct leakage <6 CFM25/100 ft ² |
| Envelope | Climate Specific Requirements that meet or Exceed AHSRAE 189.1-2009 Maximum Allowable Glazing Area: 30% Window to Wall Ratio | Local code for insulation Double-pane, low-e windows |
| Ventilation and Infiltration | Compartmentalized units with ASHRAE 62-2007 ventilation (can't exceed ASHRAE by more than 50%) | Compartmentalized units with ASHRAE 62-2007 ventilation |
| Domestic Hot Water | High Efficiency (Same as ENERGY STAR Homes) Lower Flow Faucets and Showerheads | No DHW efficiency requirements Low Flow Fixtures and Toilets |
| Lighting | ENERGY STAR qualified lighting in 80% of fixtures and Occupancy Sensors in Halls and Stairs Maximum lighting power allowance | ENERGY STAR qualified lighting in 80% of fixtures |

Testing and Verification Protocols

- Mandatory requirements for the inspection, testing and verification of components related to the building's energy performance.
- The intent of the protocols is to verify that
 - the construction documents & final building include all Prerequisites.
 - measures used to achieve the Performance levels predicted by the model have been installed and perform as modeled.
 - all measures specified by the Prescriptive Path have been installed.

ENERGY STAR[®]
MULTIFAMILY HIGH RISE PROGRAM

Testing and Verification Protocols
Version 1.0
January 2011



Verification: Energy Consultant

Interim Solution:

- State Licensed Engineer or Architect required
- Documentation must be submitted to developer

Final Solution:

- National oversight organization (e.g., COMNET)
- Certified Multi-Family High-Rise Raters

Highly Recommended: Benchmarking



- Identify billing errors
- Assess effectiveness of current operations, policies, and practices
- Assist in the planning process: set goals, targets, timelines, prioritize capital improvements
- Contribute to more responsible management
- Be more responsive to building occupants

 **STATEMENT OF ENERGY PERFORMANCE**
Sherri's Multifamily Housing Community

Building ID: 1706659
For 12-month Period Ending: May 31, 2009¹
Date SEP becomes ineligible: N/A

Date SEP Generated: June 24, 2009

| | | |
|--|------------------------------|---|
| Facility Sherri's Multifamily Housing Community 100 Man Street Annapolis, MD 21403 | Facility Owner N/A | Primary Contact for this Facility N/A |
|--|------------------------------|---|

Year Built: 1995
Gross Floor Area (ft²): 250,000

Energy Performance Rating² (1-100): N/A

Site Energy Use Summary³

| | |
|---------------------------------|------------|
| Electricity (kBtu) | 39,606,496 |
| Natural Gas (kBtu) ⁴ | 0 |
| Total Energy (kBtu) | 39,606,496 |

Energy Intensity⁴

| | |
|-----------------------------------|-----|
| Site (kBtu/ft ² /yr) | 158 |
| Source (kBtu/ft ² /yr) | 529 |

Emissions (based on site energy use)

| | |
|---|-------|
| Greenhouse Gas Emissions (MTCO ₂ e/year) | 6,032 |
|---|-------|

Electric Distribution Utility
Baltimore Gas & Electric Co

National Average Comparison

| | |
|---|---------------------|
| National Average Site EUI | |
| National Average Source EUI | |
| % Difference from National Average Source EUI | |
| Building Type | Multifamily Housing |

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.



The Pilot

Program Pilot (2005 – 2010)



Pilot Analysis



ENERGY STAR MRHR Pilot Metrics

| | | | |
|---|-----------|---|---------|
| Total # Units | 753 (12) | Incremental Cost Per Unit | \$4,600 |
| Total Square Footage | 884,460 | Average % of Development Cost | 1.8 |
| Total Estimated Energy Saved (MMBtu/yr) | 21,100 | Annual Estimated Savings Per Unit (MMBtu/unit) | 28 |
| Total Estimated Electricity Saved (kWh/yr) | 1,333,500 | Annual Estimated Savings Per Unit (\$/unit) | \$500 |
| Total Estimated Natural Gas (Therms) | 136,650 | Energy Use Intensity (kBtu/SF) | 38 |
| Total Estimated GHG Avoided (MTCE) | 415 | GHG Avoided per Unit | 0.55 |

20% Performance Target = \$3.10 Incremental Cost per ft²

20% Performance Target = 1.7% of Development Cost

20% Performance Target = \$4000 Incremental Cost per Unit

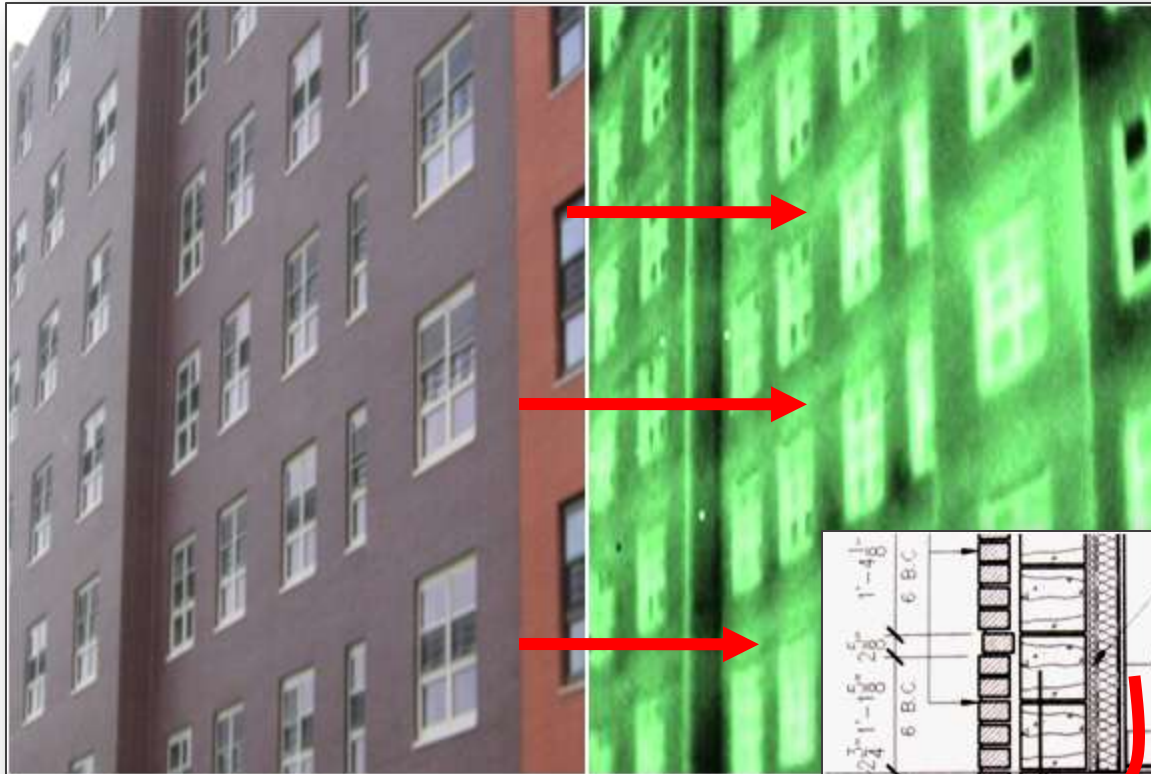


Future Issue

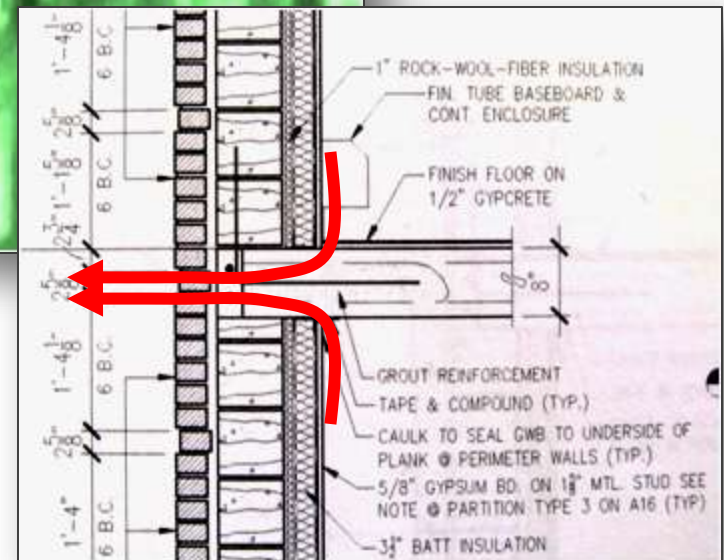
Real Wall R-Values

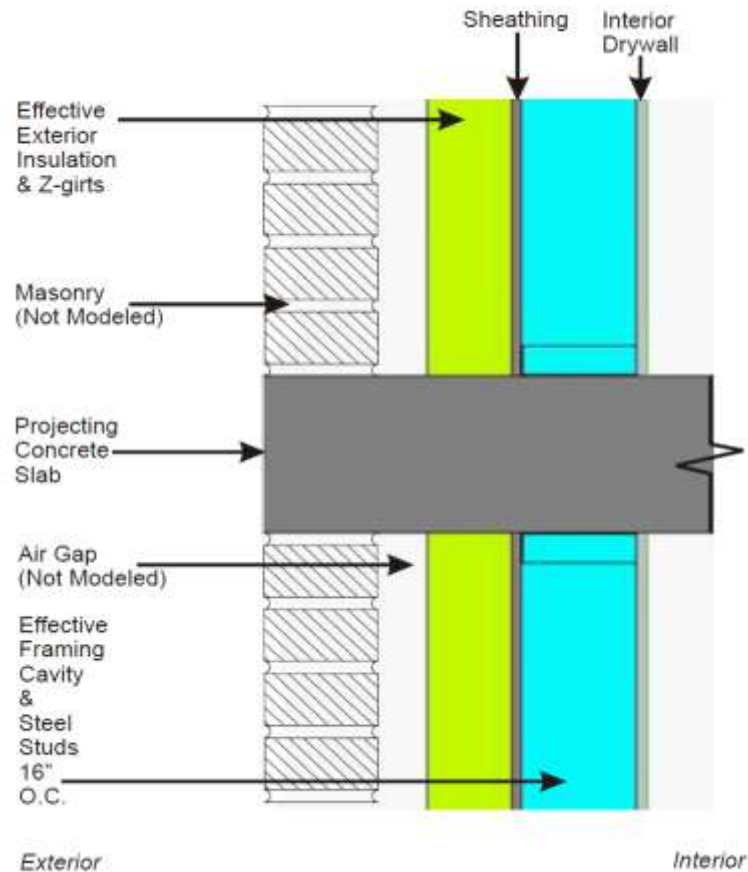
“Should continuous insulation be a requirement for both prescriptive and performance paths?”

Thermal Bridging at Slab Edges



Uninsulated slab edges





From *Real R-Value of Exterior Insulated Wall Assemblies*

Mark Lawton, P.Eng., Patrick Roppel, P.Eng., David Fookes, P.Eng., Anik Teasdale St Hilaire, PhD., and Daniel Schoonhoven. *Journal of Building Enclosure Design*. Summer/Fall 2008.

Table 3: Summary of Effective Thermal Resistances for Walls and Slab Regions (Exterior Insulation Only, No Insulation in Frame Cavity) (Based on a 2.65m Slab-to-Slab Height)

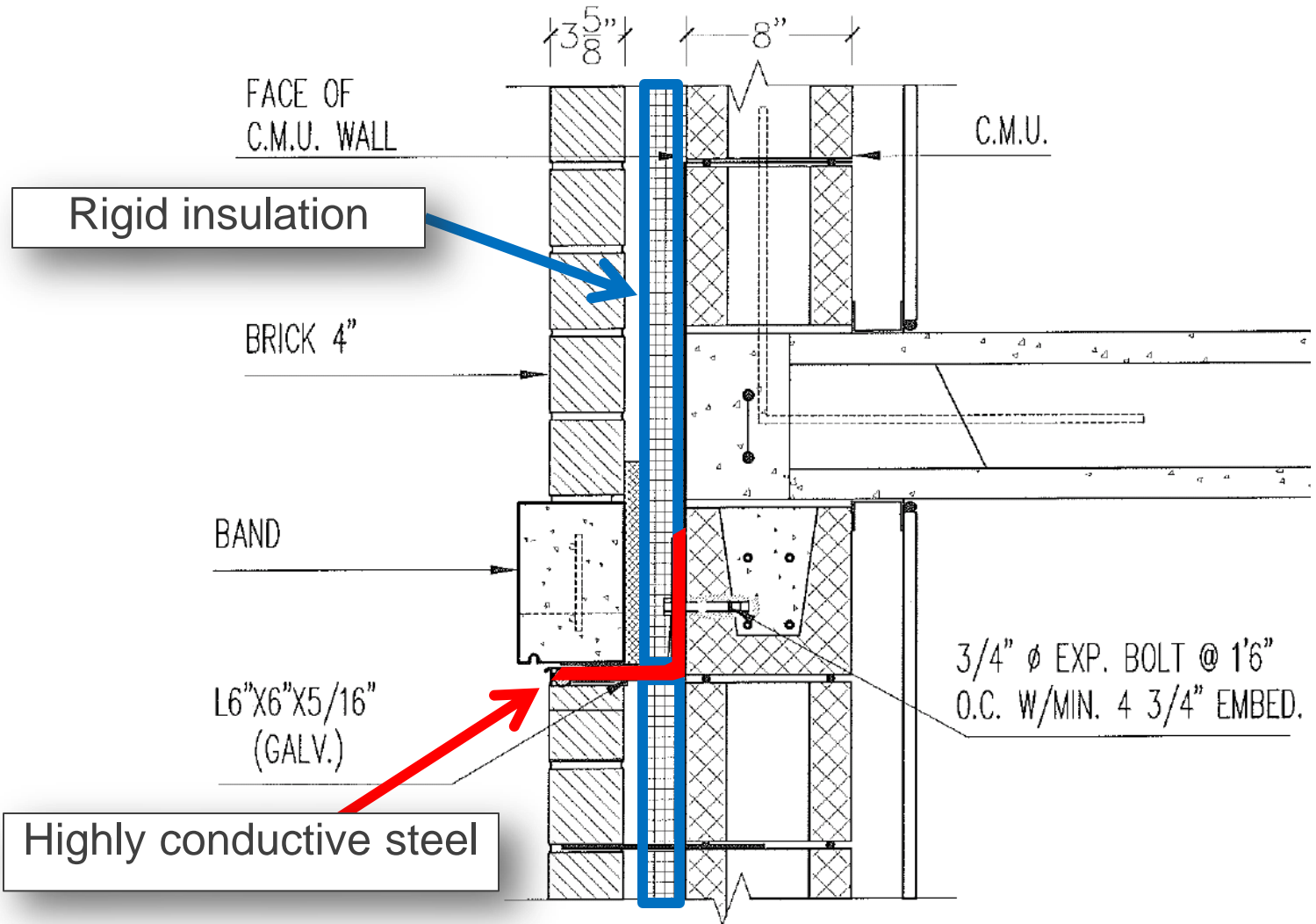
| Type of Thermal Bridging at Slab | Nominal Wall R-Value | Insulation Thickness (Inches) | | | Effective Wall R-Value for Various Cladding Attachments (hr·ft ² ·°F/Btu) | | | |
|----------------------------------|----------------------|-------------------------------|------------|------------|--|------------|--------------------|-----------------------|
| | | Mineral Wool | EXPS | Spray foam | Vert. Girts | Hor. Girts | Vert. & Hor. Girts | 2" x 1/16" Brick Ties |
| Exposed Concrete Slab or Balcony | 33.1 | 7.0 | 5.9 | 4.9 | 7.8 | 9.9 | 11.1 | 12.1 |
| | 27.9 | 6.0 | 5.0 | 4.2 | 7.4 | 9.4 | 10.5 | 11.2 |
| | 24.7 | 5.0 | 4.2 | 3.5 | 6.9 | 8.7 | 9.4 | 10.2 |
| | 20.5 | 4.0 | 3.4 | 2.8 | 6.3 | 7.9 | 8.5 | 9.2 |
| | 16.3 | 3.0 | 2.5 | 2.1 | 5.7 | 7 | 7.6 | 7.8 |
| | 12.1 | 2.0 | 1.7 | 1.4 | 5.1 | 6 | 6.4 | 6.4 |
| | 7.9 | 1.0 | 0.8 | 0.7 | 4.2 | 4.7 | | 4.8 |
| | 5.8 | 0.5 | 0.4 | 0.4 | | | | |
| | 3.7 | 0.0 | 0.0 | 0.0 | | | | |

R-16.3

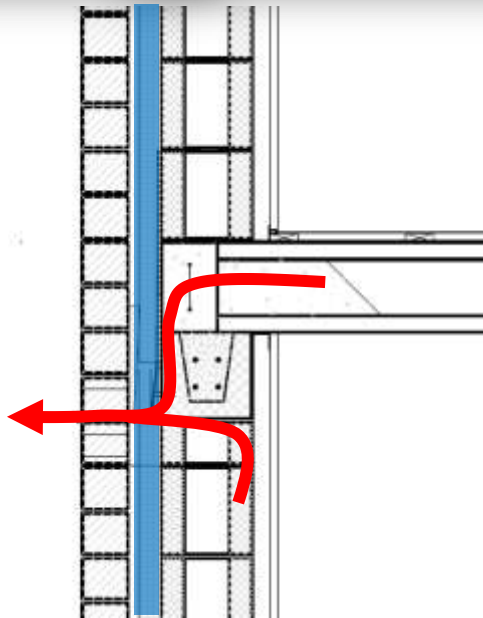
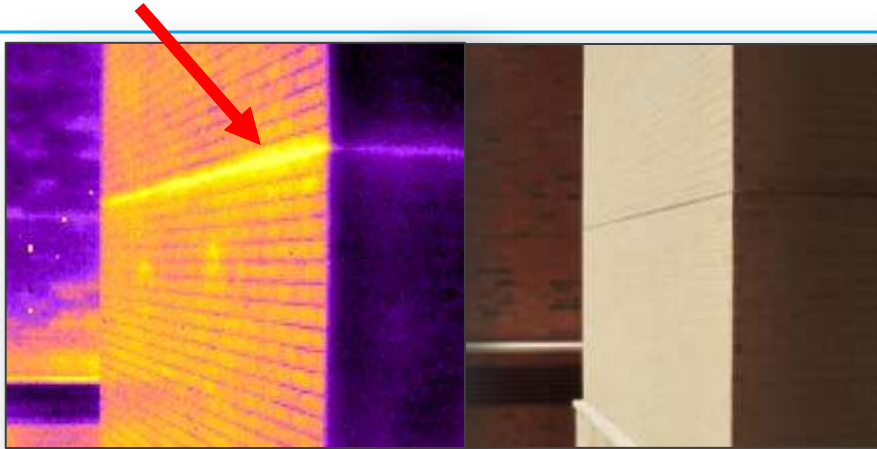
Real R-value of nominal R-16.3 wall with uninsulated slabs = R-7.8

- Mark Lawton, P.Eng., Patrick Roppel, P.Eng., David Fookes, P.Eng., Anik Teasdale St Hilaire, PhD., and Daniel Schoonhoven. Real R-Value of Exterior Insulated Wall Assemblies. *Journal of Building Enclosure Design*. Summer/Fall 2008.

“Continuous” Insulation

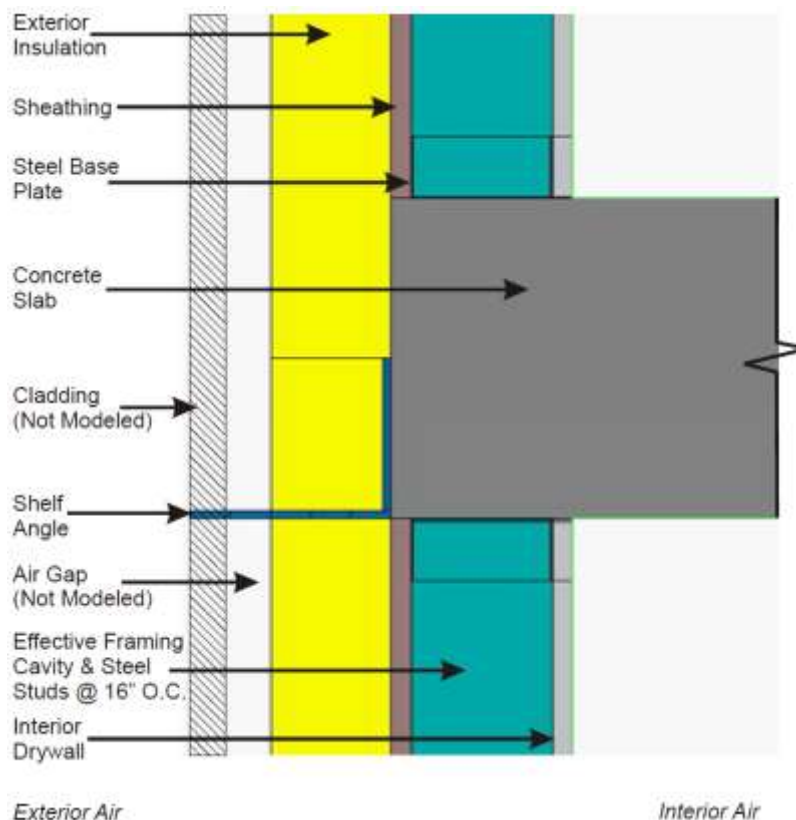


Thermal Bridging at Shelf Angles



Left photos taken on a 35°F day with clear skies and no precipitation. Right photos taken on a 45°F day with cloudy skies and light rain.

Thermal Bridging at Slab Edges



- Mark Lawton, P.Eng., Patrick Roppel, P.Eng., David Fookes, P.Eng., Anik Teasdale St Hilaire, PhD., and Daniel Schoonhoven. Real R-Value of Exterior Insulated Wall Assemblies. *Journal of Building Enclosure Design*. Summer/Fall 2008.

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|---------------------------------------|----------------------|-------------------------------|------------|------------|--|------------|--------------------|-----------------------|
| | | Mineral Wool | EXPS | Spray foam | Vert. Girts | Hor. Girts | Vert. & Hor. Girts | 2" x 1/16" Brick Ties |
| 1/4" thick shelf angle bolted to slab | 33.1 | 7.0 | 5.9 | 4.9 | | | | 13.8 |
| | 28.9 | 6.0 | 5.0 | 4.2 | | | | 12.8 |
| | 24.7 | 5.0 | 4.2 | 3.5 | | | | 11.5 |
| | 20.5 | 4.0 | 3.4 | 2.8 | | | | 10.1 |
| | 16.3 | 3.0 | 2.5 | 2.1 | | | | 8.7 |
| | 12.1 | 2.0 | 1.7 | 1.4 | | | | 7.1 |
| | 7.9 | 1.0 | 0.8 | 0.7 | | | | 5.1 |
| | 5.8 | 0.5 | 0.4 | 0.4 | | | | 4.1 |
| | 3.7 | 0.0 | 0.0 | 0.0 | | | | 2.6 |

R-16.3

Real R-value of nominal R-16.3 wall with insulation over shelf angles = R-8.7

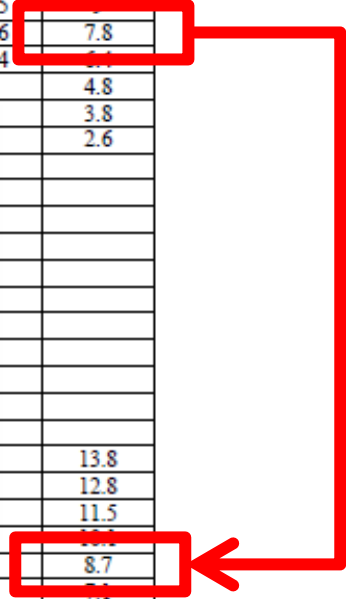
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| | | Mineral Wool | EXPS | Spray foam | Vert. Girts | Hor. Girts | Vert. & Hor. Girts | 2" x 1/16" Brick Ties |
| Cast Concrete Slab or Balcony | 33.1 | 7.0 | 5.9 | 4.9 | 7.8 | 9.9 | 11.1 | 12.1 |
| | 28.9 | 6.0 | 5.0 | 4.2 | 7.4 | 9.4 | 10.3 | 11.2 |
| | 24.7 | 5.0 | 4.2 | 3.5 | 6.9 | 8.7 | 9.4 | 10.2 |
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| | 12.1 | 2.0 | 1.7 | 1.4 | | | | 2.6 |
| | 7.9 | 1.0 | 0.8 | 0.7 | | | | |
| | 5.8 | 0.5 | 0.4 | 0.4 | | | | |
| | 3.7 | 0.0 | 0.0 | 0.0 | | | | |
| Shelf Angle fastened to 3" x 1/4" steel brackets spaced at 24" o.c. | 33.1 | 7.0 | 5.9 | 4.9 | | | | 13.8 |
| | 28.9 | 6.0 | 5.0 | 4.2 | | | | 12.8 |
| | 24.7 | 5.0 | 4.2 | 3.5 | | | | 11.5 |
| | 20.5 | 4.0 | 3.4 | 2.8 | | | | 10.1 |
| | 16.3 | 3.0 | 2.5 | 2.1 | | | | 8.7 |
| | 12.1 | 2.0 | 1.7 | 1.4 | | | | 7.2 |
| | 7.9 | 1.0 | 0.8 | 0.7 | | | | 5.1 |
| | 5.8 | 0.5 | 0.4 | 0.4 | | | | 4 |
| 3.7 | 0.0 | 0.0 | 0.0 | | | | 2.6 | |

Going from R-0 at slab region to R-15 continuous with shelf angles nets a whole-wall R-value improvement from R-7.8 to R-8.7

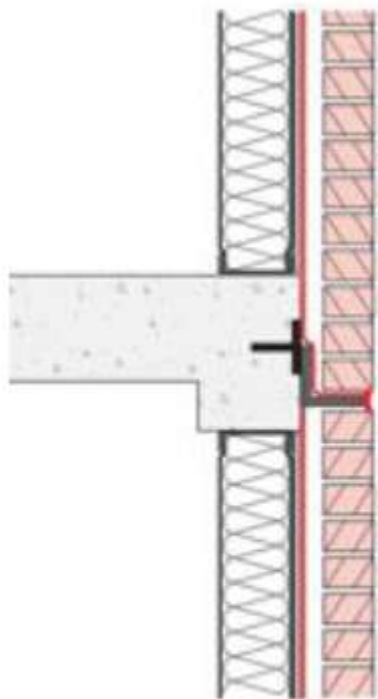


Structural Considerations

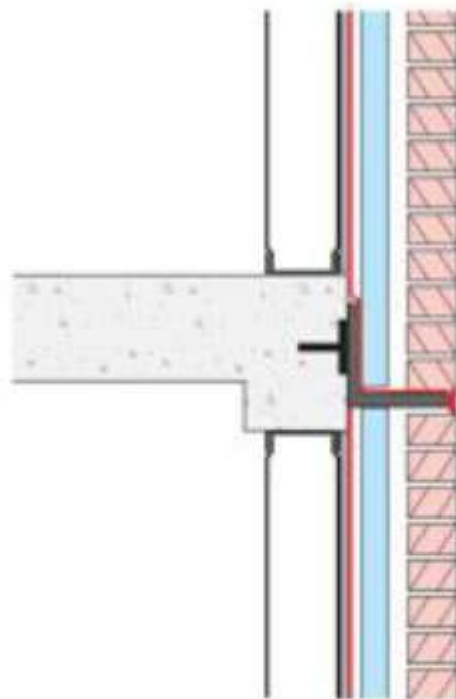


- Loose lintels limited to 4 ft – too small for most multifamily windows
- Non-bearing walls must have shelf angles
- Expansion gaps must be properly accounted for if shelf angles are not used

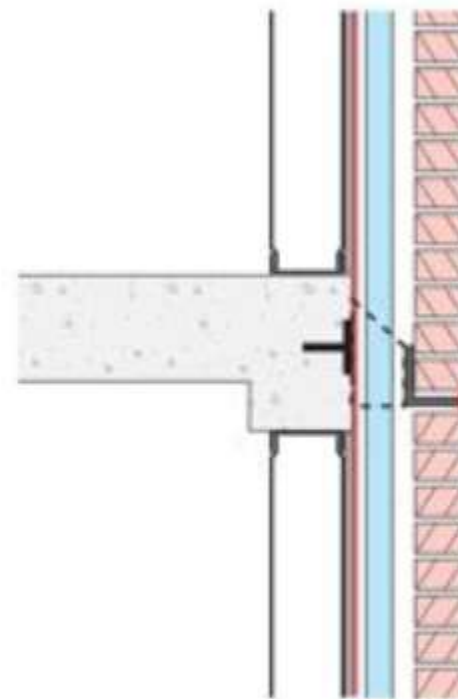
Thermal Bridging Solutions



"The Ugly"



"The Bad"



"The Good"

Intermediate supports

More Information



- The ENERGY STAR MFHR documents will be available at www.energystar.gov in late February

Questions?



New Construction

Ted Leopkey
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Existing Buildings

Alyssa Quarforth
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