NAVIGATING
HIGH PERFORMANCE WALL SYSTEMS

USING INSULATED COMPOSITE PANELS AND INTEGRATED WINDOWS

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Key Learning Objectives

- Identify key wall performance issues from a consultant's experience
- Recognize how Insulated Composite Panels can address some of the key wall performance issues
- Review new code requirements and the impact on wall system design
- Review thermal performance of panels and windows
- Demonstrate how value engineering can impact the wall performance
- Review steps that will aid in achieving a quality installation

Terminology

- ICP: Insulated Composite Panels with a foam core, gage metal skins and integrated joinery
- IMP: Insulated Metal Panels is a term used by the Metal Construction Association for ICP.
- ICBP: Insulated Composite Backup Panels are ICPs used as a backup system behind other various claddings
- MCWS: Multiple Component Wall System where different materials are used to create the critical performance barriers

Common Pitfalls

Not understanding the concepts of moisture movement and control, and barrier selection and design

- Rainwater control
- Water in air/ air transport
- Water in air/ vapor diffusion
- Water entrapment or water management

– by Vince Cammalleri, Simpson Gumpertz & Heger (SGH)
& Keith Boyer

Entrapped moisture

Framing Damage

Entrapped moisture

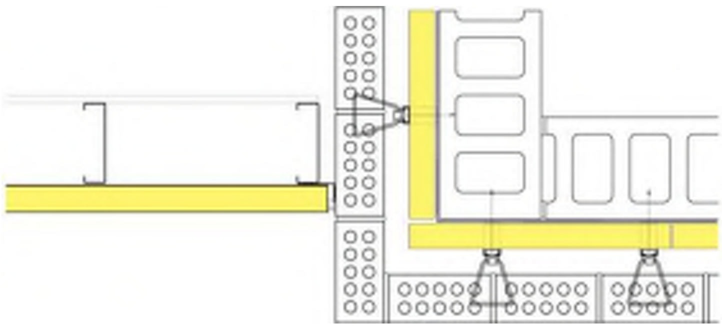
Window Perimeter Leaks

Poor material selection

- Will weather barrier remain adhered to the substrate?
- Will tapes stay adhered?
- Compatibility of tapes or WRBs and sealants
- UV exposure effects on WRBs
- Insulation efficiency
  - Thermal shorts
  - Condensation and energy loss
  - Thermal continuity
- Fire performance of wall assembly
  - With foam plastics
  - With asphalt based barriers

Poor detailing

- Erectable
- Discontinuous air barriers
  - Material joinery
  - One wall type to another
  - Air barrier breaks > energy loss and moisture movement via air transport and water entrapment



Insufficient redundancy of barriers

- Need methods to avoid moisture buildup / entrapment
- Need methods to assure air tightness

– By Vince Cammalleri, SGH

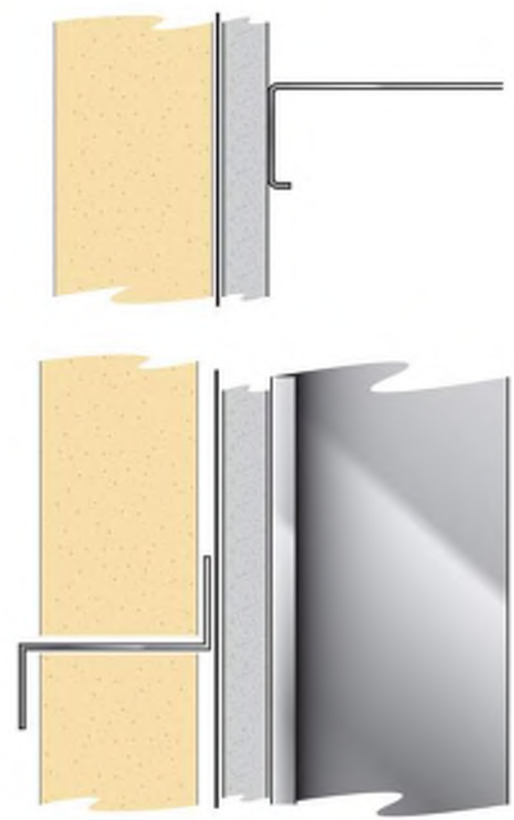
Poor installation / QA procedures / Monitoring

Need steps to assure quality installation

– By Vince Cammalleri, SGH

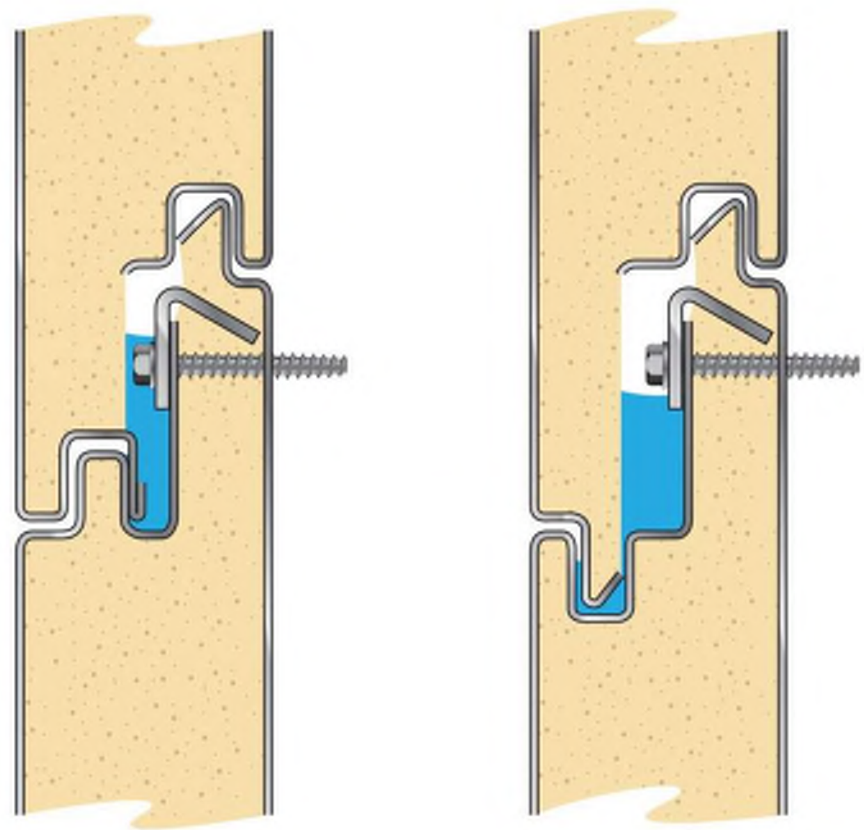
What happens when…

- ...board stock foam has gaps at joints or Z's penetrating joints?
- …combustible weather wraps are used in an architectural wall assembly?



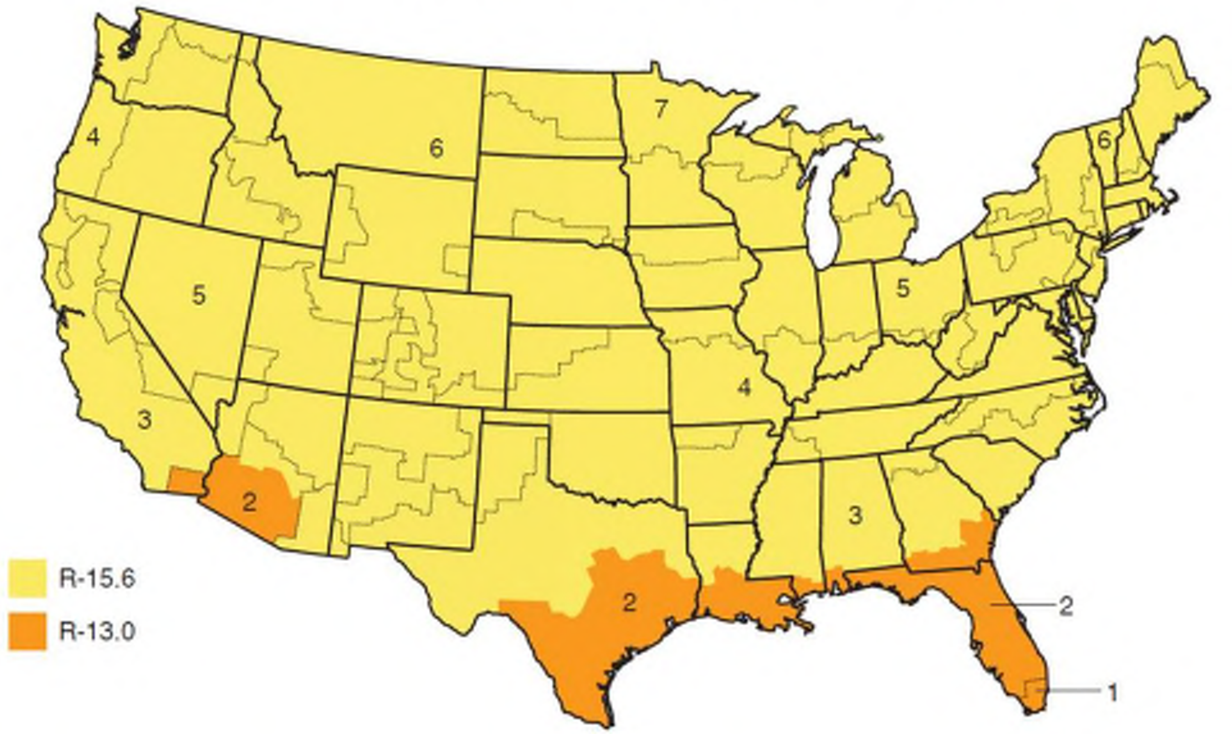
What happens when…

…moisture is entrapped within an insulated composite side joint?



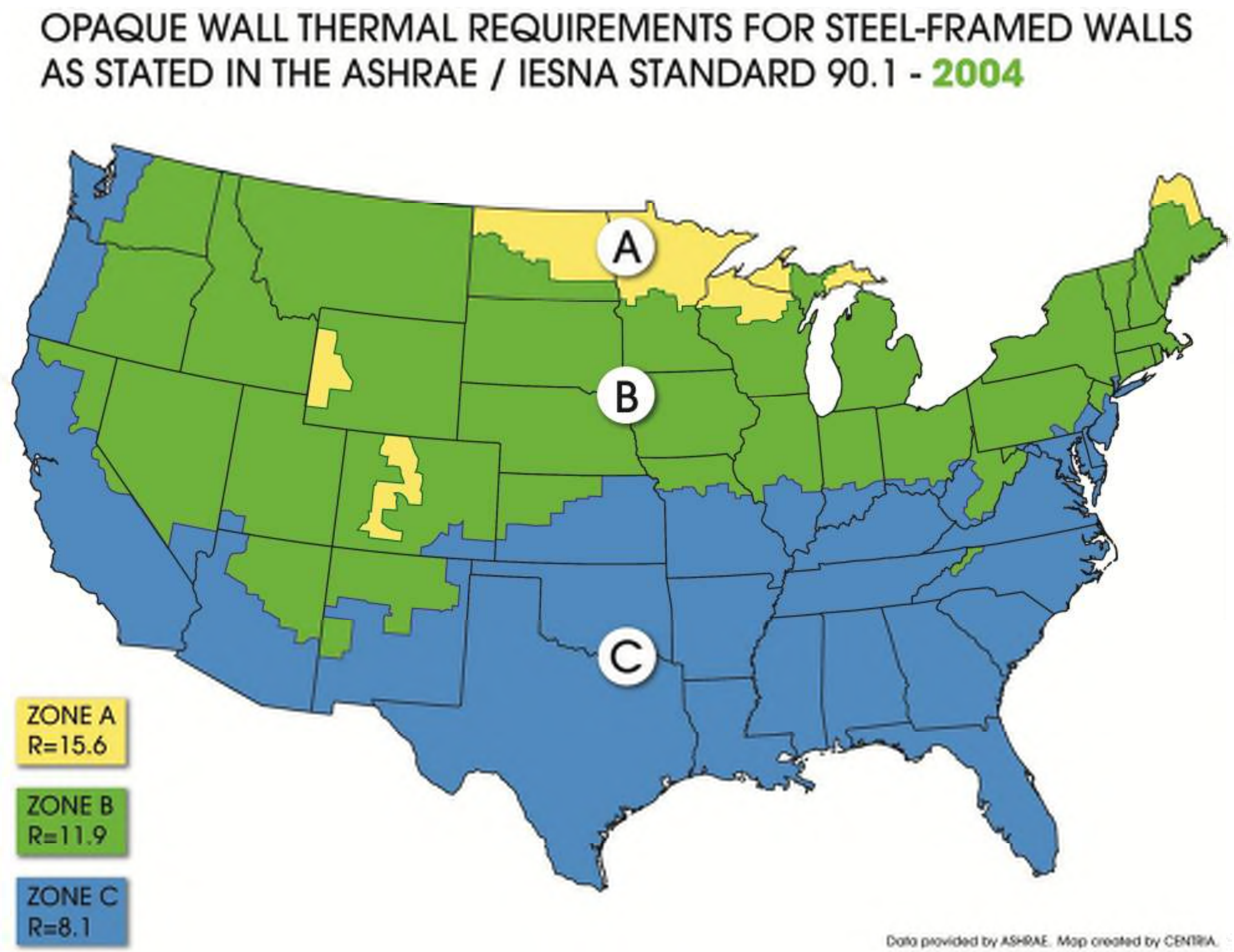
IECC 2015 / Panel R-values

Minimum R-Values* - Opaque Thermal Envelope for Steel Framed Walls



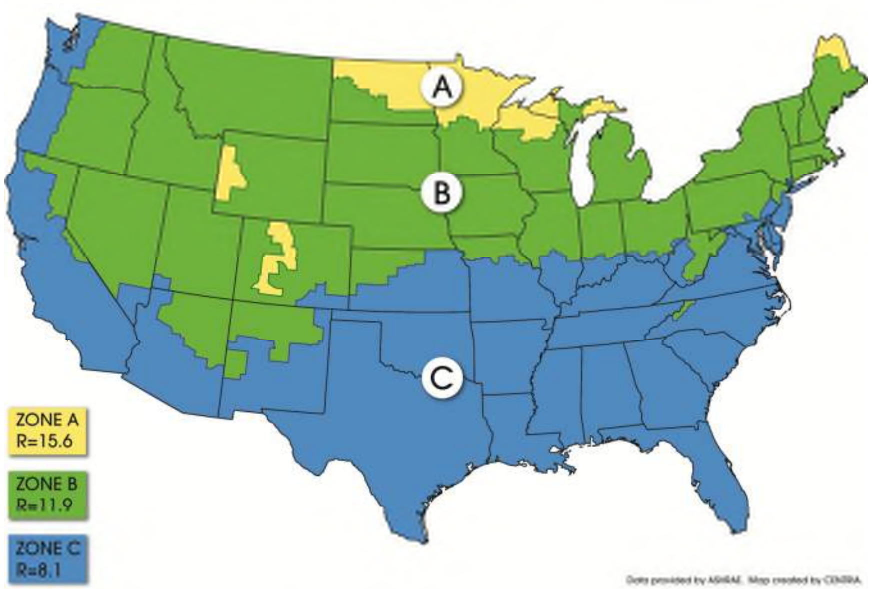
*Minimum R-Values = 1/(Assembly Maximum U-Values)

Code mandated R-Values for opaque wall areas

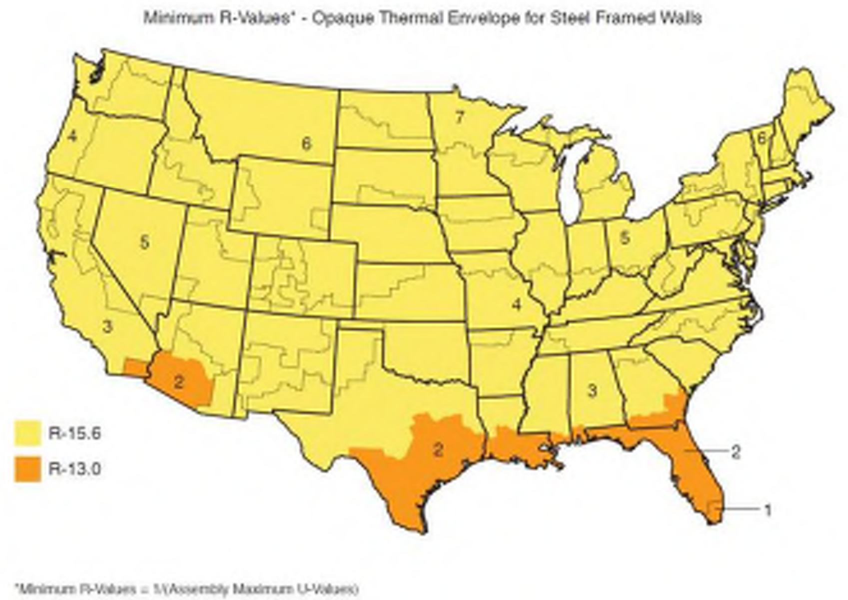


Code mandated R-Values for opaque wall areas

OPAQUE WALL THERMAL REQUIREMENTS FOR STEEL-FRAMED WALLS
AS STATED IN THE ASHRAE / IESNA STANDARD 90.1 - **2004**

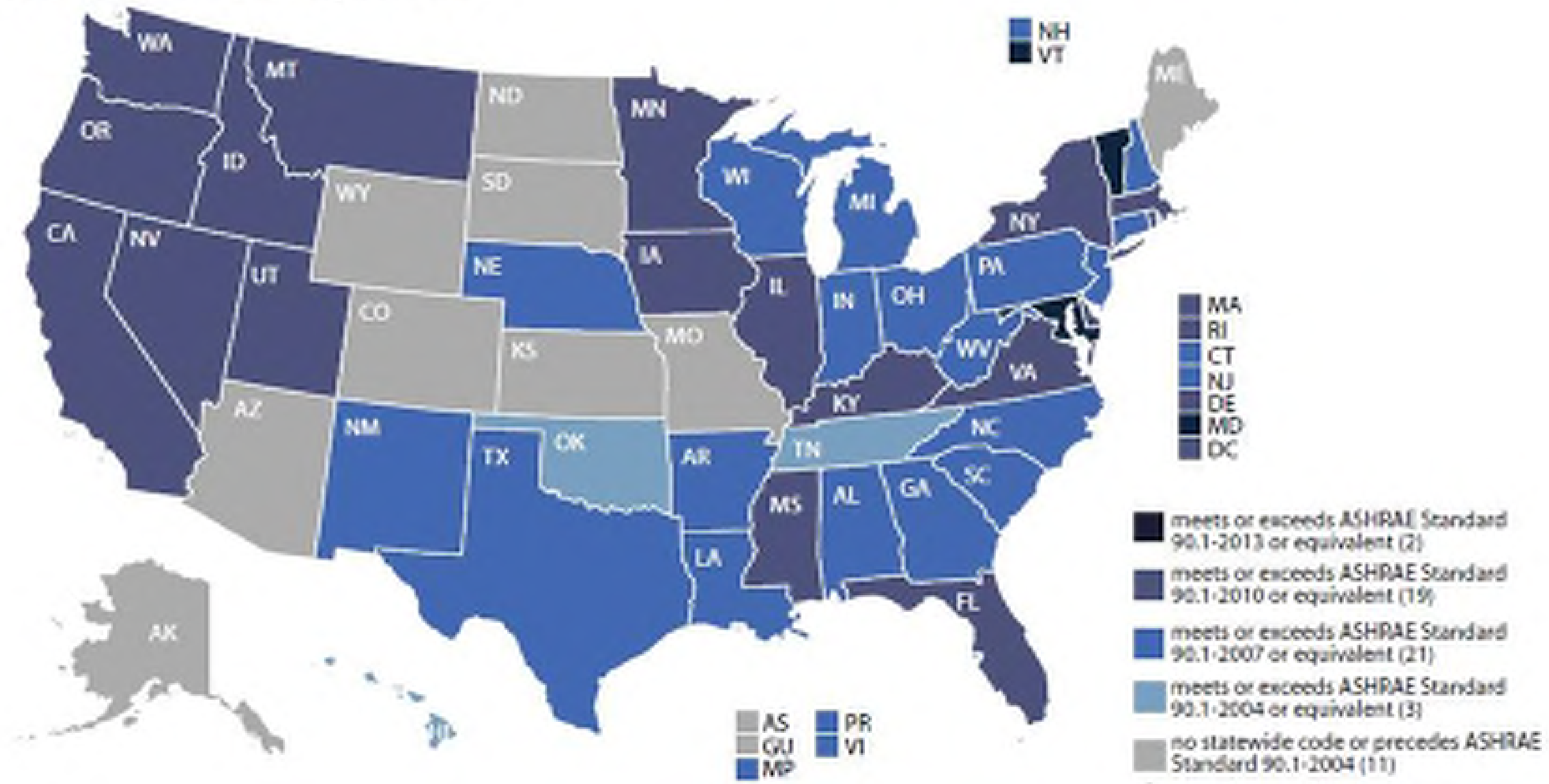


OPAQUE WALL THERMAL REQUIREMENTS FOR STEEL FRAMED WALLS
2015 IBC / IECC



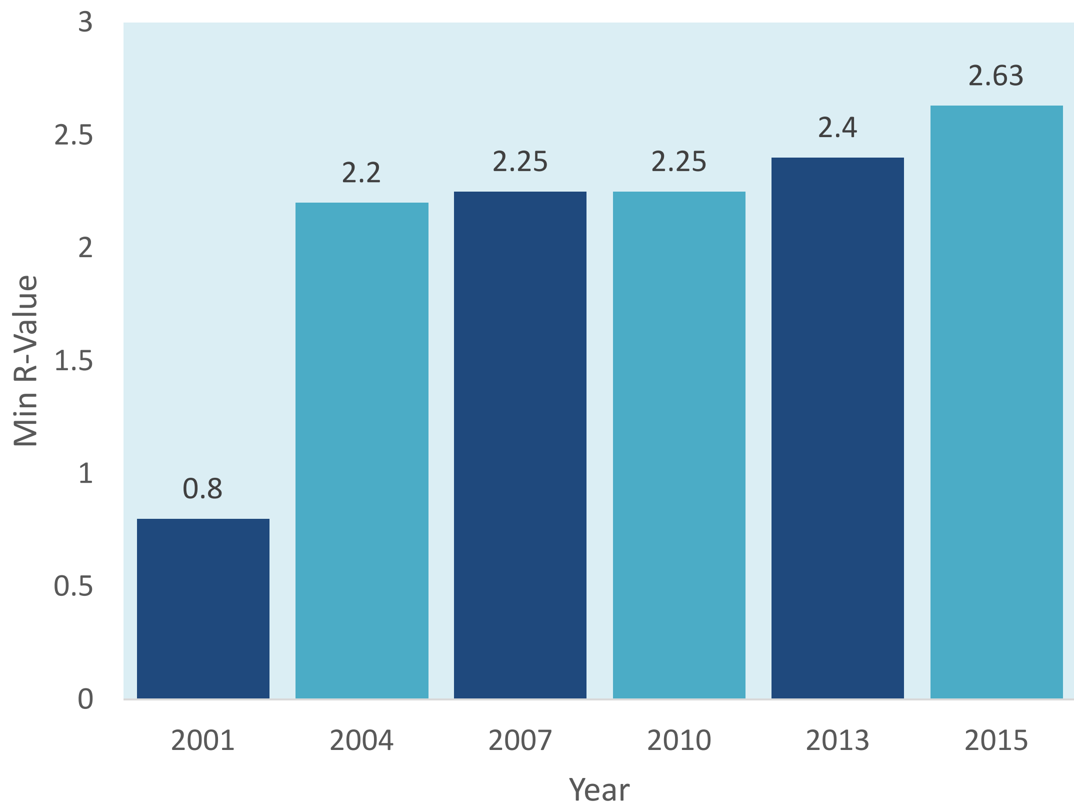
Commercial State Energy Code Status

AS OF JULY 1, 2015



ASHRAE 90.1 climate zone 5 Fixed Fenestration

- Code mandated minimum R-values



Whole wall analysis

- Windows and opaque wall areas
- Cold climate performance / conductive heat loss / flow
- Use ASHRAE U_0 concept for parallel heat flow
  - Does not consider solar heat gain, radiation or the effects of air leakage

Parallel heat flow whole wall thermal efficiency

- Similar analysis to parallel resistors
- ASHRAE Fundamentals, U_0 concept

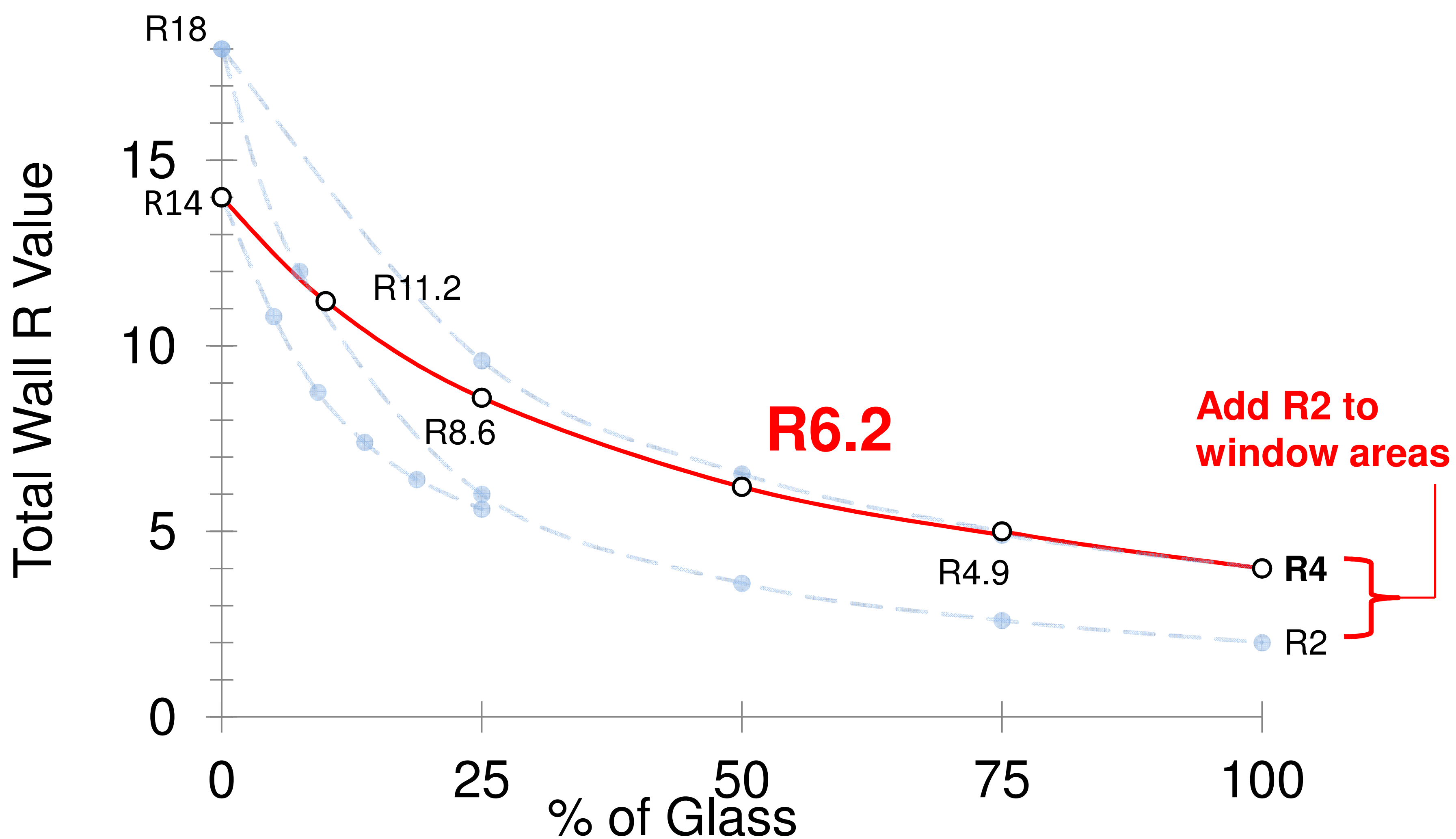
$$U_0 = \frac{U_{wall}\,A_{wall} + U_{window}\,A_{window}}{A_0}$$

$$R = 1/U$$

Overall wall R-value with varying window area

- Know 100% opaque area > R-14
- Know 100% window area > R-2
- With 50% window area, what is the whole wall R-value ?

Windows vs. opaque areas



Summary – Windows vs. opaque areas

Windows have significant impact on the whole building performance…

To improve the whole wall performance

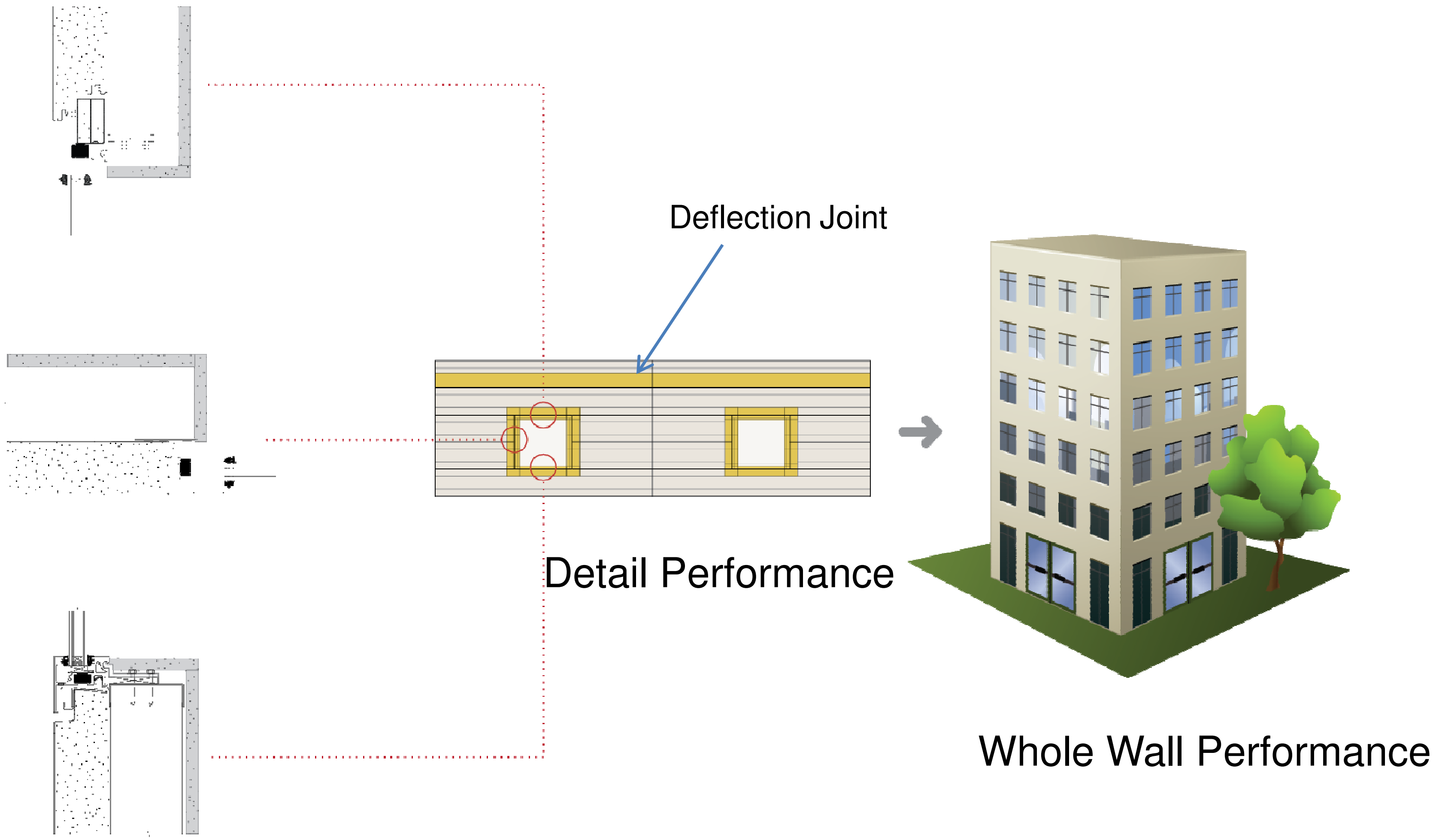
- Use high efficiency windows
- Use fewer windows

Thermal Modeling and Whole Wall Performance

- Thermal efficiency of the window and opaque products is only part of the solution.

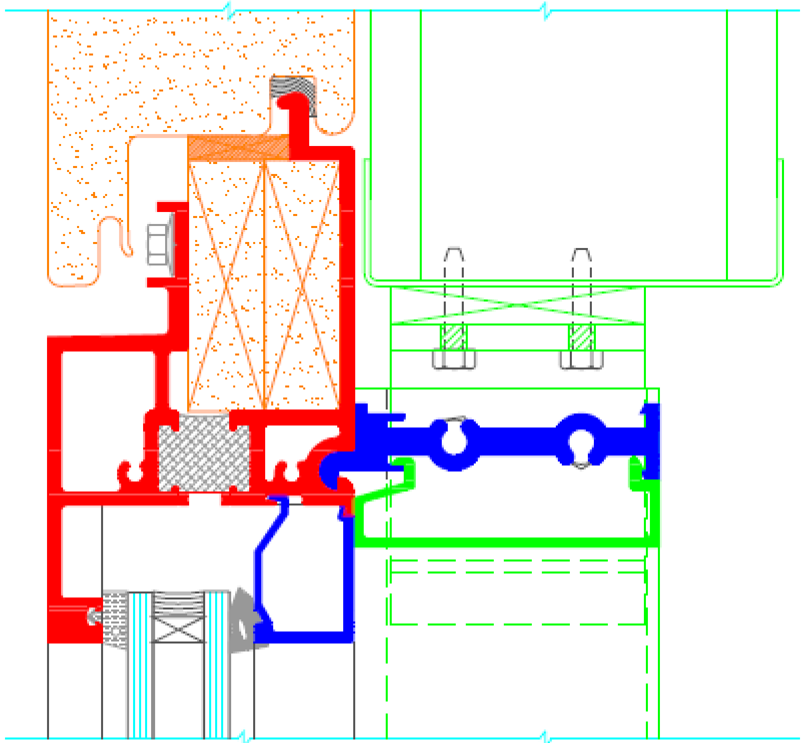
- Let’s look at the impact of the **interface details**…

What can we learn from thermal modeling?



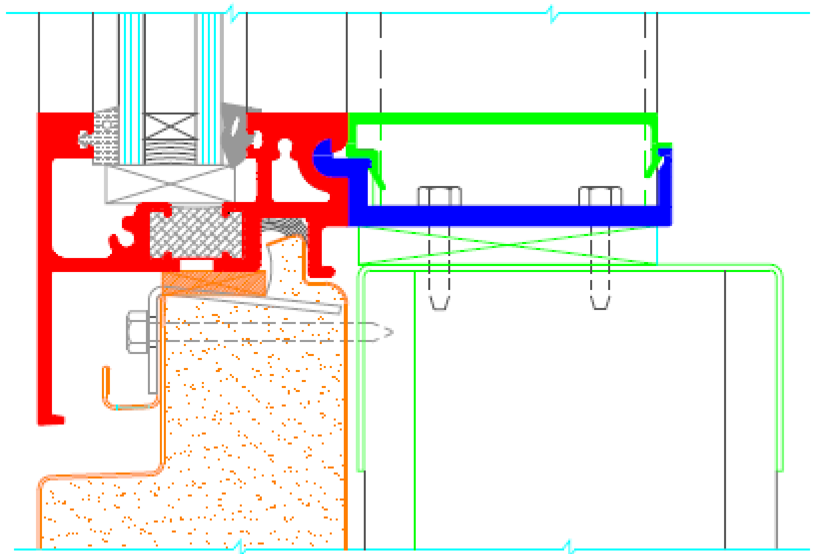
Integrated window head and ICP

46% ICP

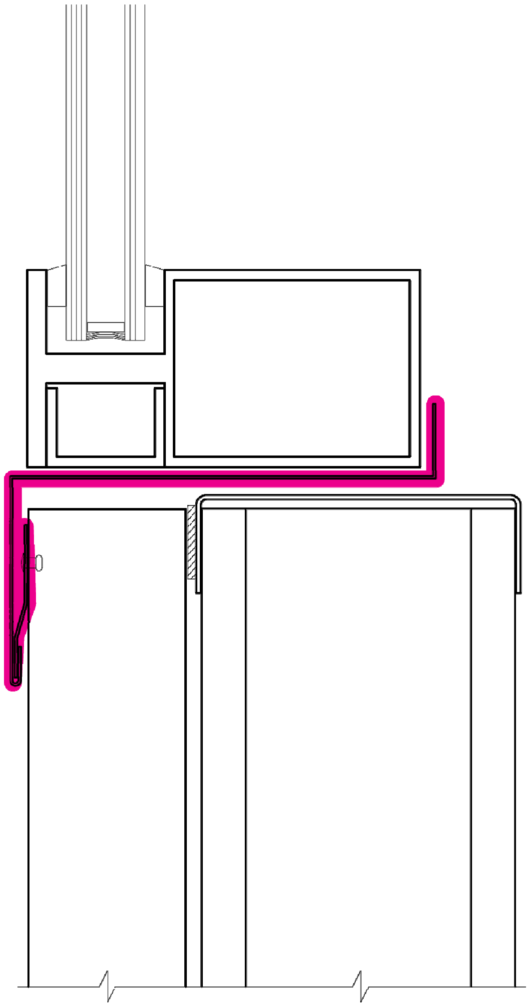


Integrated window sill and ICP

64% ICP



Non-integrated window with flash detail



Integrated windows vs. non-integrated

50%

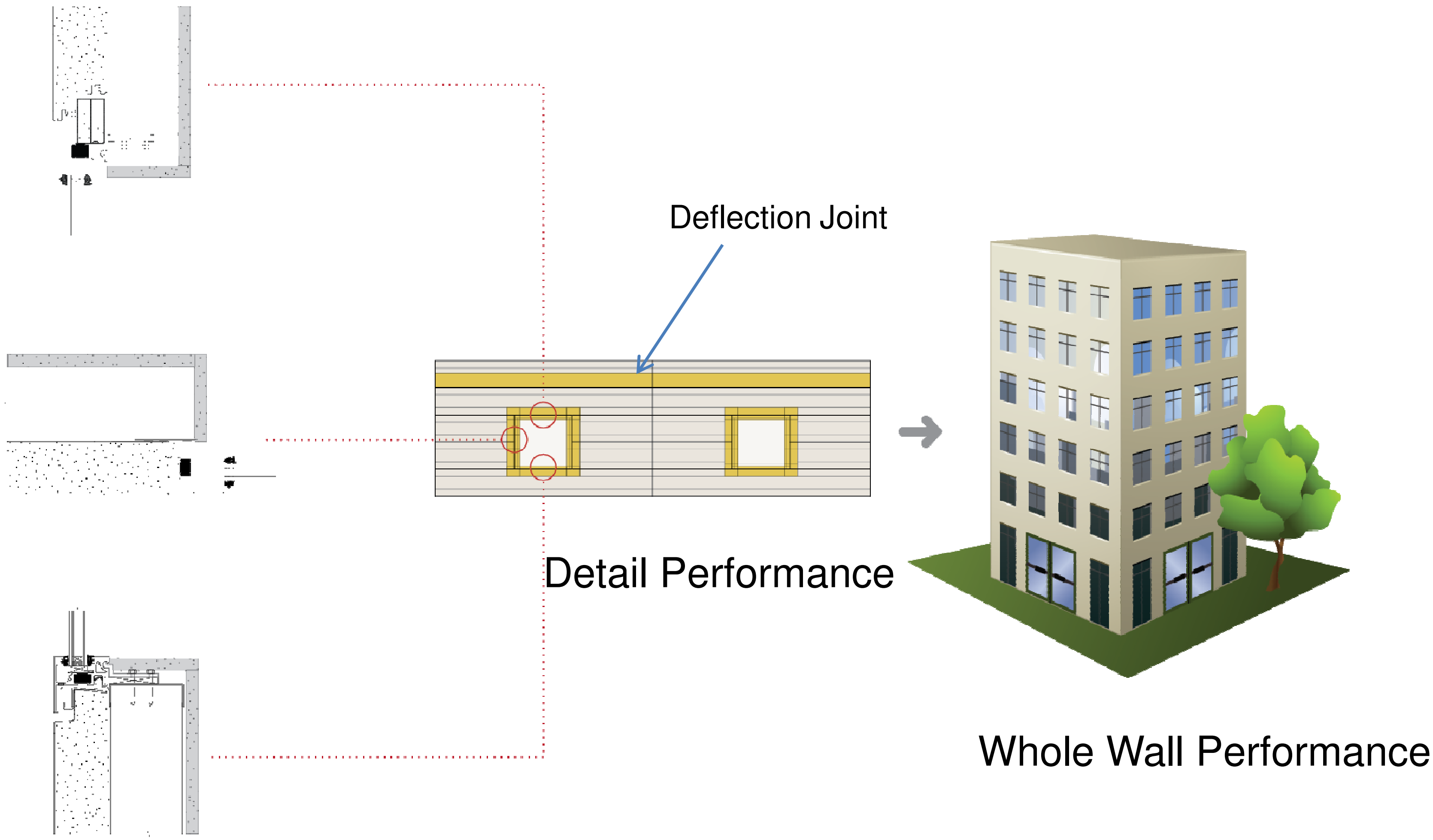
NON-INTEGRATED

INTEGRATED

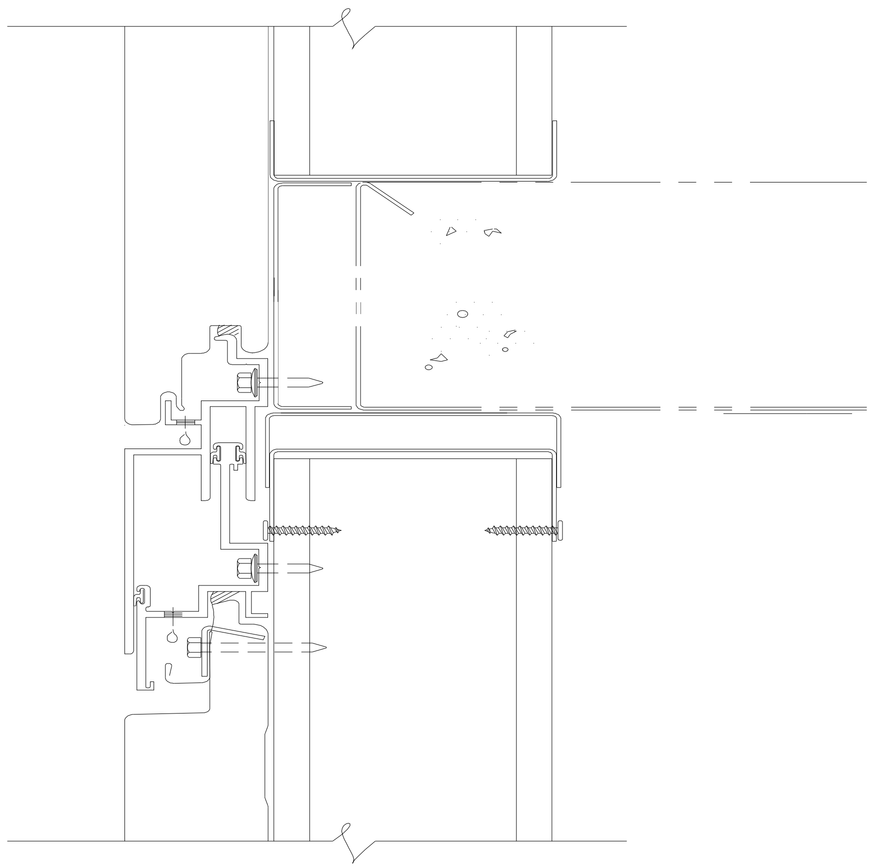
Thermal modeling

- Check for interior surface temperatures to avoid condensation

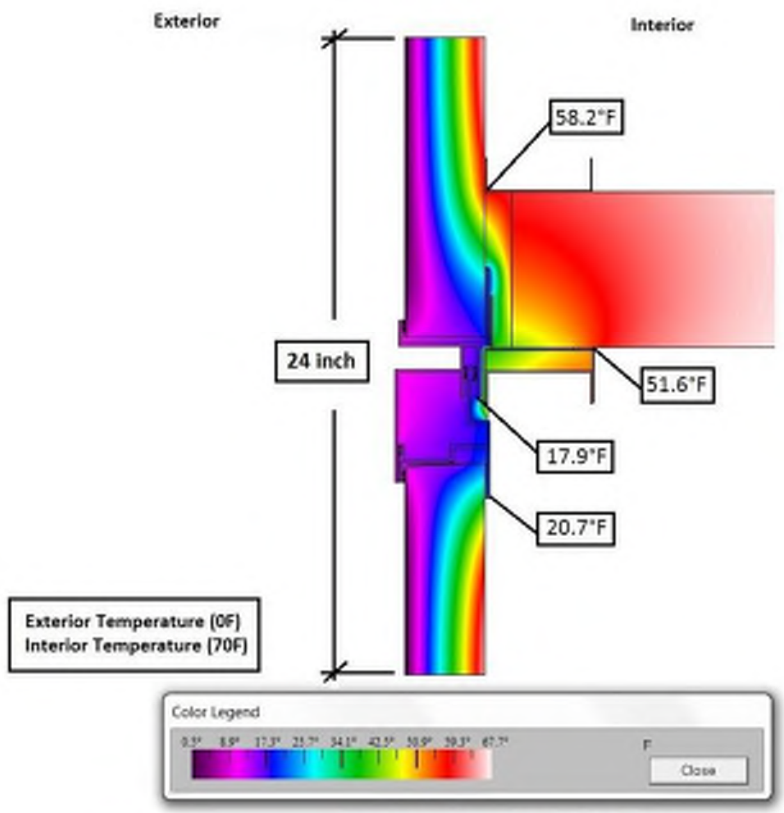
What can we learn from thermal modeling?



Un-insulated Deflection Joint

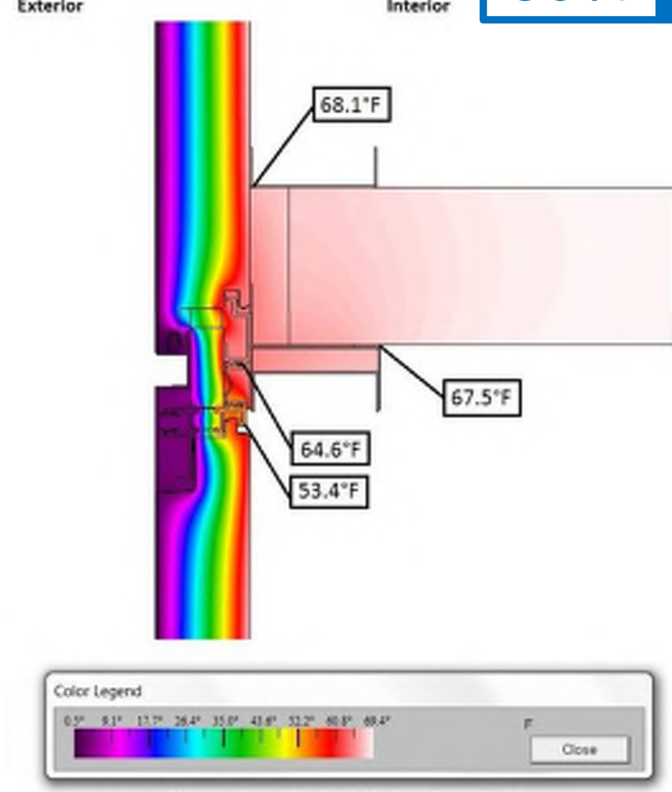


Deflection joint



Standard Industry Deflection Joint

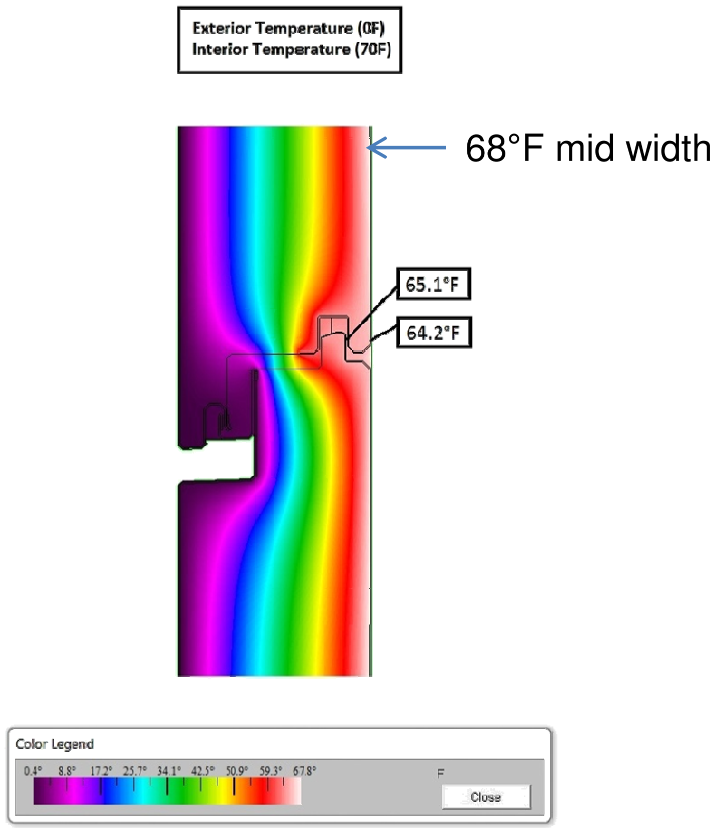
80% ICP

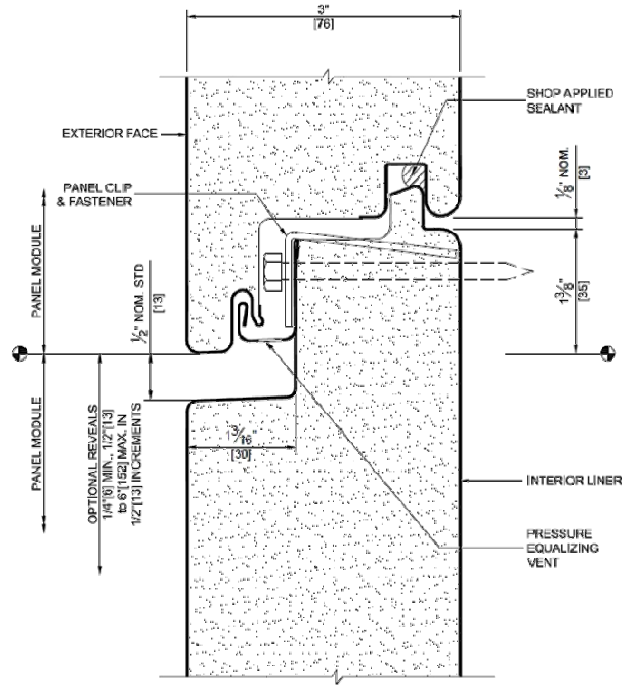


Thermally Enhanced Deflection Joint

High thermal efficiency side joint

ICP

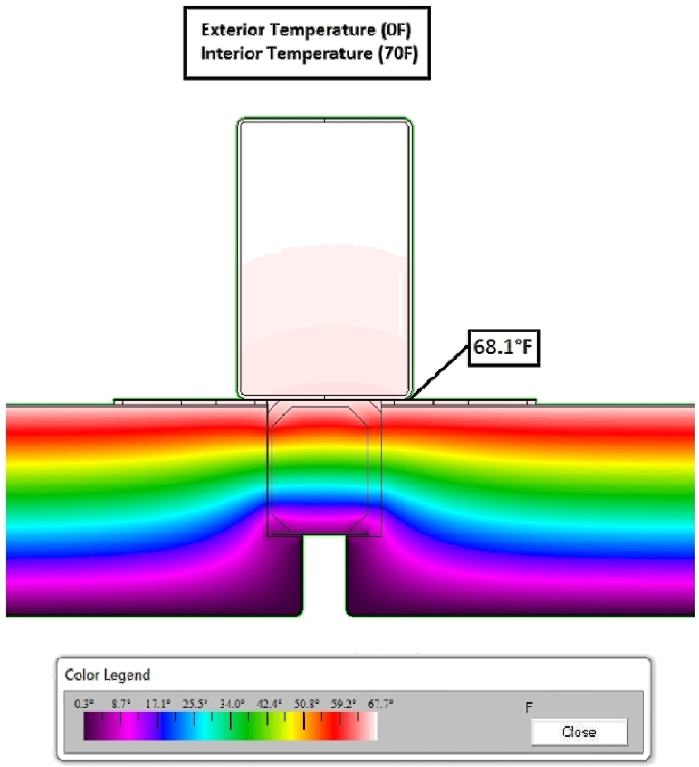


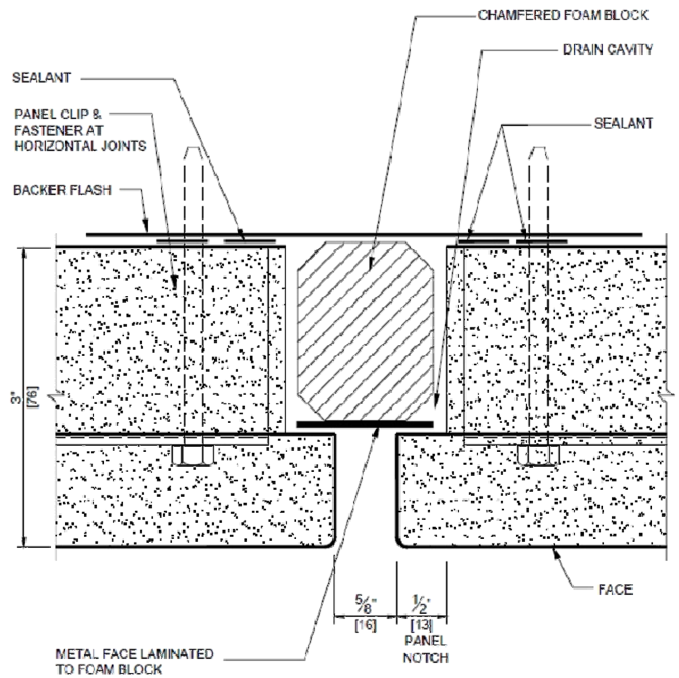


Horizontal Joint

High efficiency vertical joint

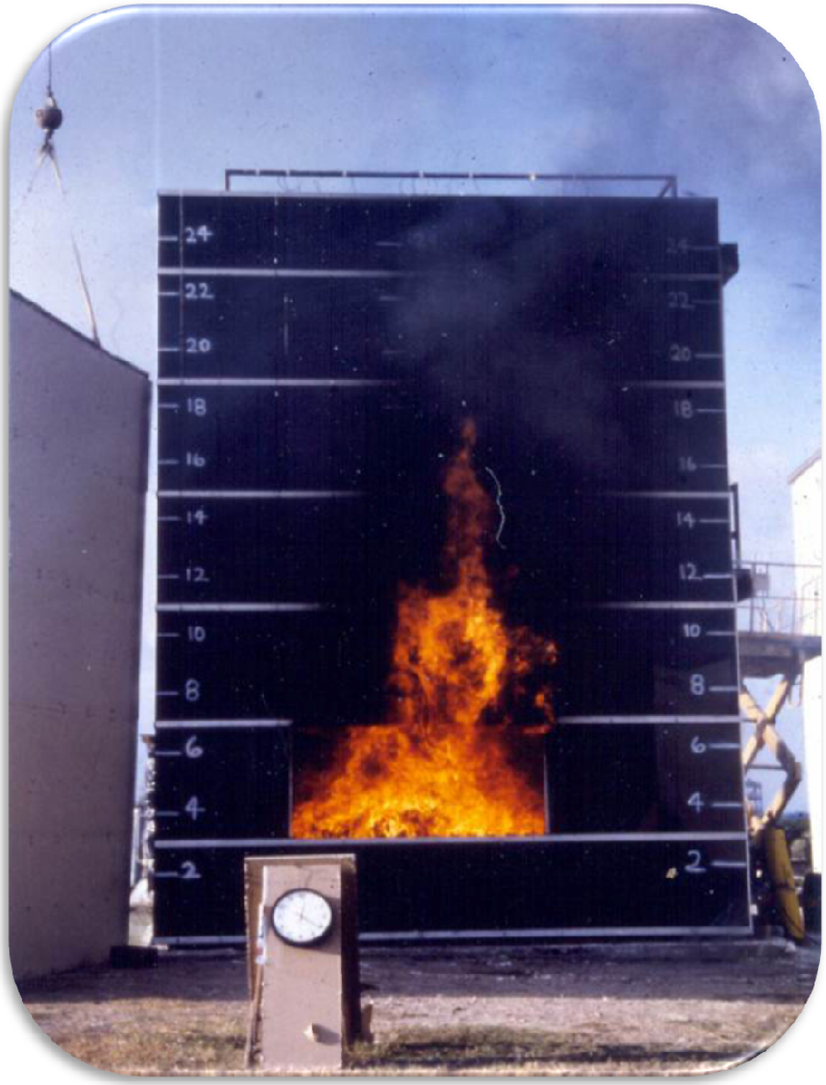
ICP





Vertical IMV Joint

UBC 17-6 / UBC 26-4 Test
In Progress



NFPA 285 – Side view

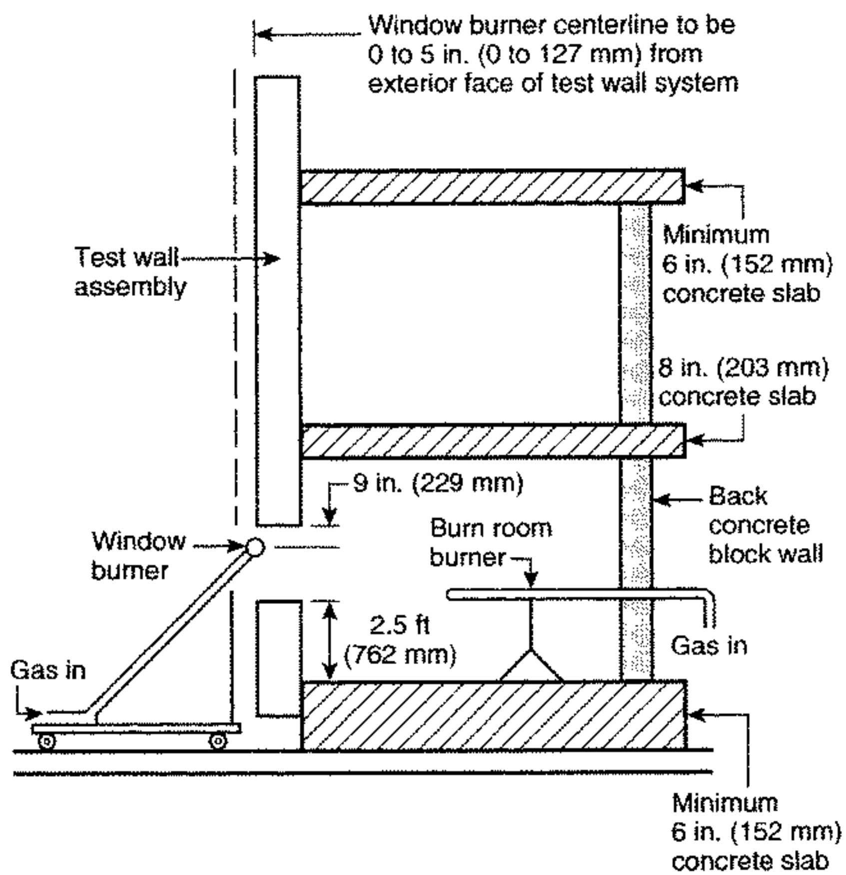


FIGURE A.4.4.8 Side View of Burner Placement in First-Story Test Room (not to scale).

NFPA 285 – Vertical limits

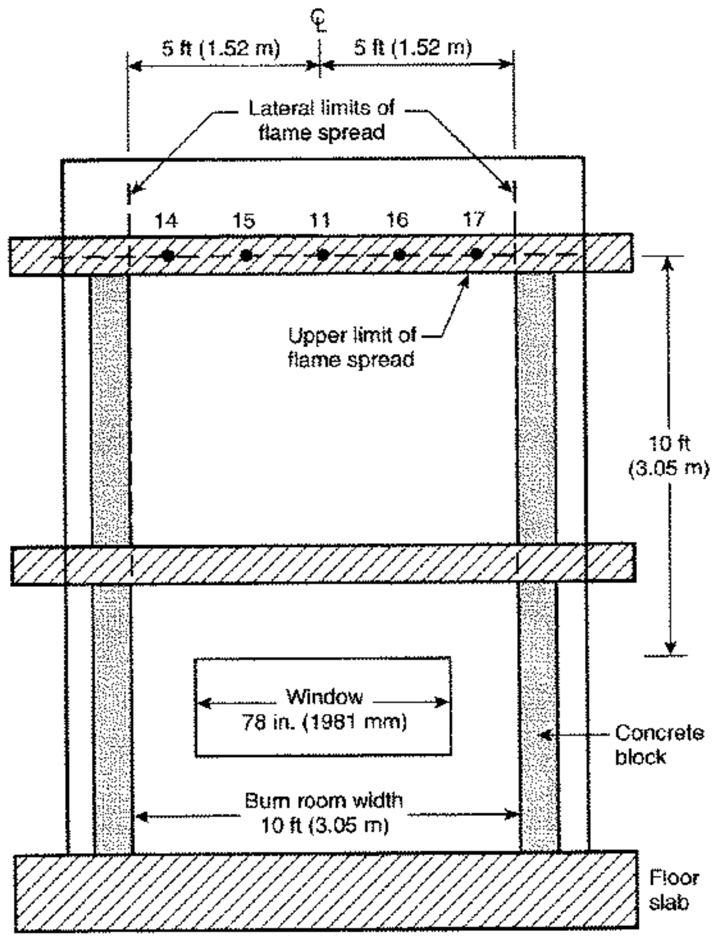


FIGURE 10.2.1.2 Limits of Flame Propagation (not to scale).

- NFPA 285 Test In Progress
  - Test duration: 30 minutes
  - Test cost : $20,000 - $25,000
- Beitel-Spiewak paper
- Engineering judgments
- Work with suppliers/ review tested options

BID & CONTRACT STAGE

Bid challenge

- End with what you designed and specified…

  …Especially the aesthetics and performance items

Case 1 Deflection joints influence on performance

- Job designed with through tubes with no moving joints in the panel field
  - Movement taken at tube connection to slab edge
- To cut costs the GC wants to use studs inset from the slab edge
  - Creates a moving joints in the wall plane
  - One joint per floor around the whole building

Infill

Framing

Case 1 Deflection joints influence on performance

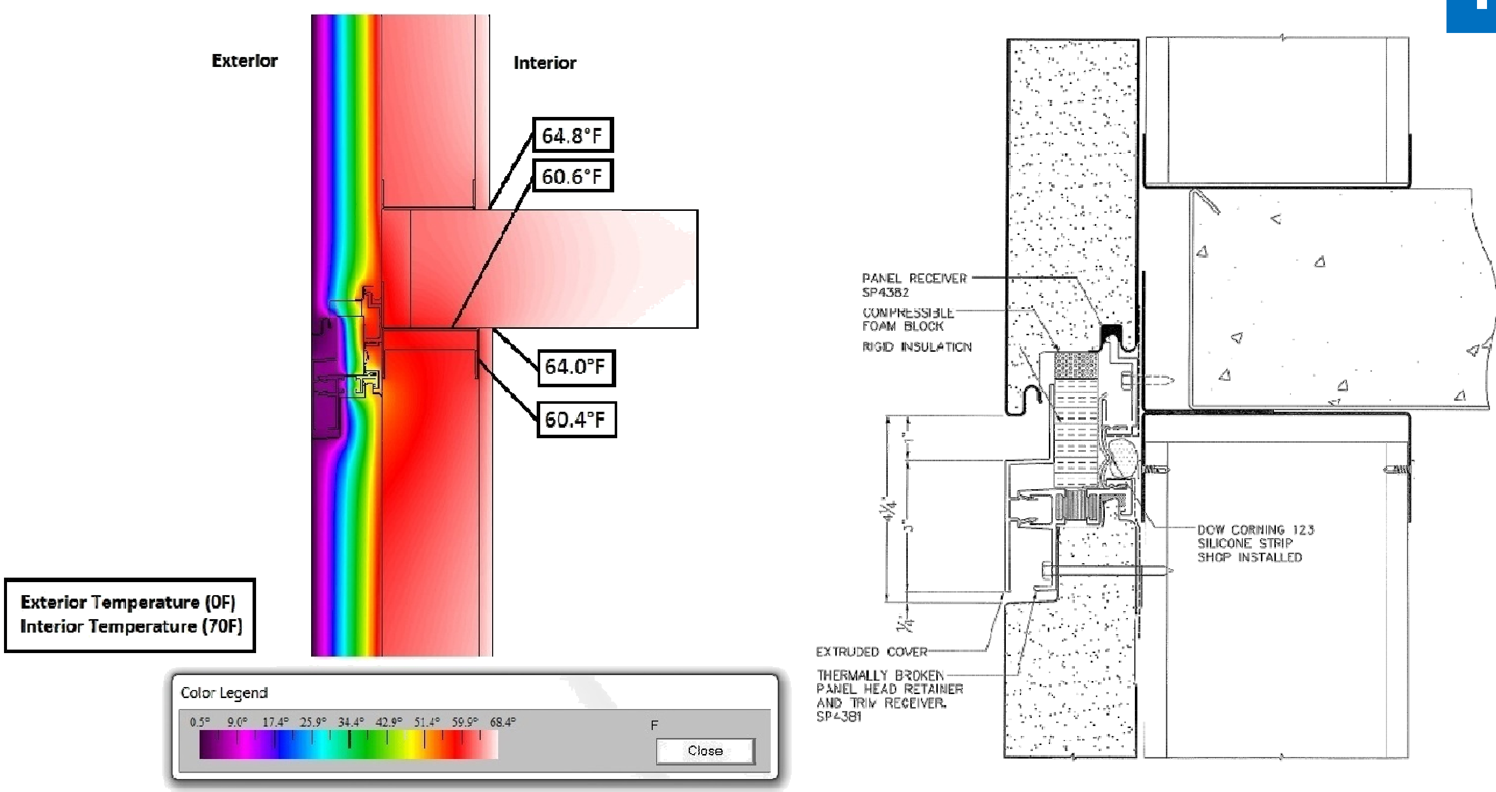
With deflection joints at every floor…

The Challenge

- How to make weather tight (air and water)
- How to handle the movement range
- How to make thermally efficient

Case 1 Deflection joints influence on performance

ICP



Thermally Improved Deflection Joint

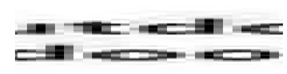
Case 1 Deflection joints influence on performance

- Impact on the whole wall thermal efficiency
  - Compare to through tube without movement joints
  - With insulated joint / 30% more heat loss
  - With un-insulated joint / 100% more heat loss

  - When making comparisons…Consider the energy costs, material, schedule impact, and labor to create the more complex deflection joints

Case 2 Integrated vs. non-integrated windows

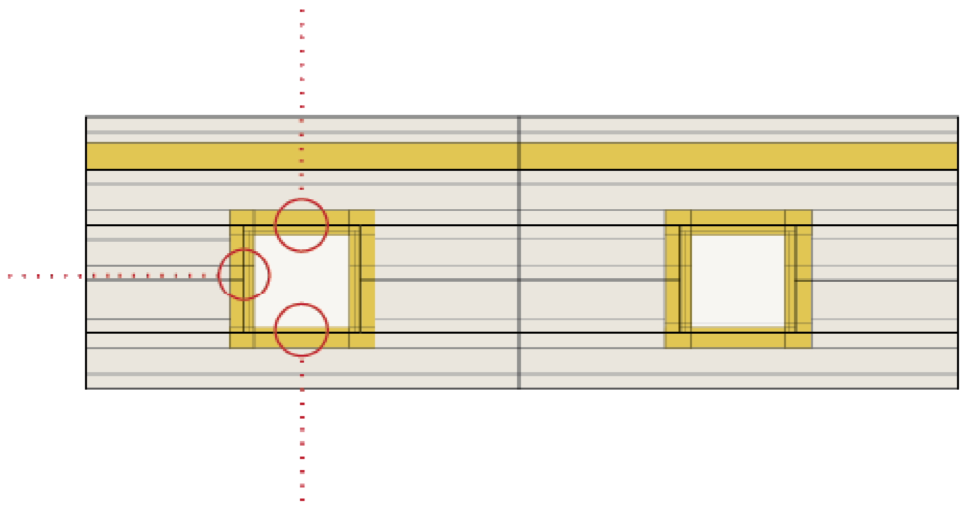
- The job had an ICP & integrated windows specified
- The GC wants to use a non-integrated window
  - To install this in the panel area, perimeter trim is needed



NON-INTEGRATED INTEGRATED

Case 2 Integrated vs. non-integrated windows

- The result of using a non-integrated window can reduce the thermal performance by about 50% at the head, sill and jamb details



Case 2 Integrated vs. non-integrated windows

- The effect on the whole wall thermal performance is also in the 40 to 60% area depending on the window to panel ratio.

Case 2 Integrated vs. non-integrated windows

- In a winter climate zone the temperature of the interior window extrusions can now be 10 degrees colder and may be a condensation issue.

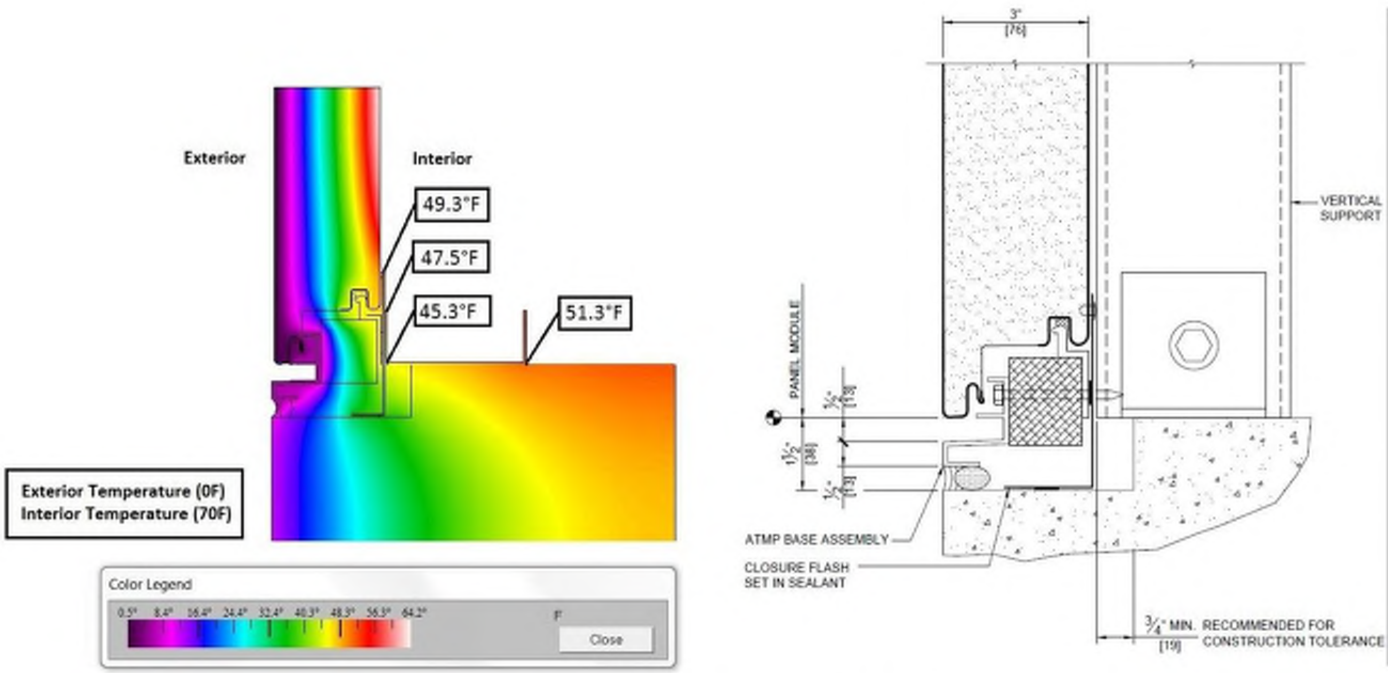
Case 3 Use of thermally improved panel extrusions

- The project specifies thermally improved panel trim and transition extrusions

- To cut costs it is desired to use non-thermally improved details.

Panel base

48% ICP



Thermally Improved Base Detail

Case 3 Use of thermally improved panel extrusions

- The percent reduction in heat loss for the thermally improved base, deflection and stack details is 48%, 80% and 66% compared to the non thermally improved details.
- The impact on the whole wall can be significant and is dependent on the panel layout.
- The temperatures on the interior at the details can be 20 to 30 degrees cooler for a 0 degree exterior air temperature raising concern for condensation in cold climates.

Summary – Value engineering

- Use thermal modeling to understand the effects of any changes to details and to the whole wall performance.
- If possible, perform whole building energy analysis to evaluate the impact that the building enclosure may have on the building energy usage.
- Consider material, labor, schedule and energy savings when evaluating design changes…
- For the most efficient details
  - Eliminate moving joints
  - Use integrated windows
  - Use thermally improved panel details

INSTALLATION STAGE

Construction stage

- Support coordination
- Training
- Field hose test
- Field mockup

Support Coordination

*Through tubes are in
panel and window contract
*Studs by others
Minimum gage
Alignment
Low profile fasteners at stud
to track connections

Training

At corporate facilities

On site

Field Mockup

Check installation methods

Test assembly

Establish expected quality

Field Hose Test

Check at various stages

Check each crew

Field Hose Test

Field Hose Test

SUMMARY

Learn from the consultants

- Understand moisture movement and management
- Make good material and design decisions
- Monitor and control installation

Consider using ICPs to establish the 4 barriers

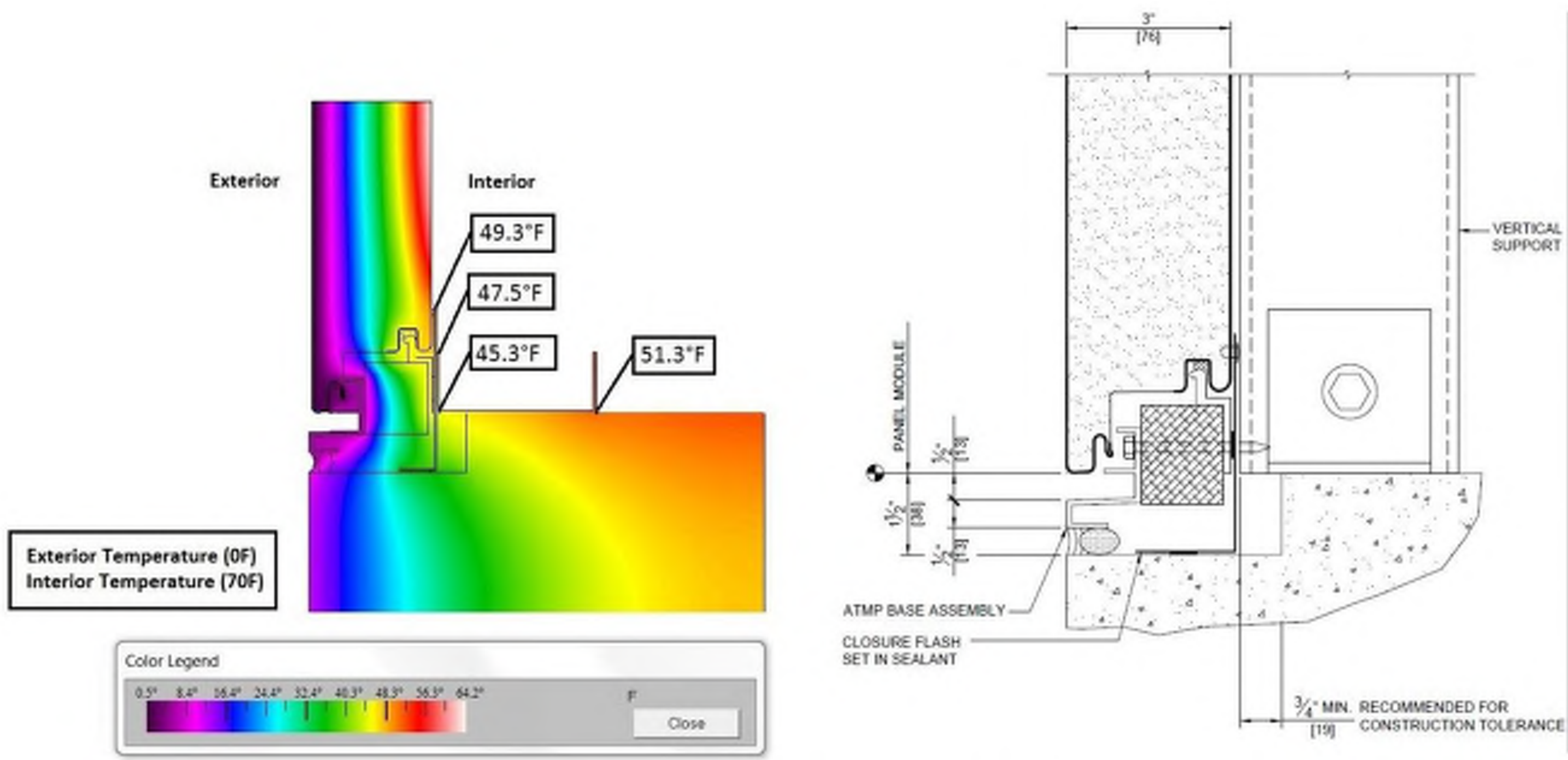
- As a finished product
- As a backup system to other claddings
- As a method to establish a consistent barrier system from one cladding type to another
- As a system that works in any climate

Select an efficient ICP

- Check side joints for potential water traps
- Check the thermal model of the panel side joint
- Where possible use redundant air and water seals

- Use efficient windows and scrutinize the interface details
- Check thermal models for interior temperatures and heat loss

Use thermally improved ICP details



Thermally Improved Base Detail

Know the code / foam plastics

- Consult the experts for wall assemblies with foam plastics
- Use materials that have been tested in NFPA 285
- Require submittal of pertinent NFPA 285 tests

Watch Value Engineering and its impact on performance

- Use thermal modeling to verify decisions
- Consider all the factors: material, labor, schedule differences, and building operating costs

Support System Coordination

- Assure that the support systems work with the chosen cladding
  - Alignment
  - Gage
  - Spacing
  - Inter-story Deflection
- Tubes in a through tube system part of the window system and contract

Use proper field measures in training and testing

- Train the installers
- Implement testing protocols
  - Test early in the construction stage (not after completion)

ICP or ICBP with Integrated Windows

- …properly designed, contracted and installed …
  offers high performance air and water tightness, and thermally efficiency for the entire wall system.