EIFS – The cladding with the lowest carbon footprint…

…& *what's the deal with glass-box syndrome?*

Kevin Day

BRITISH COLUMBIA
BUILDING ENVELOPE COUNCIL

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Primary Agenda

(what you're here for, I suspect…)

- EIFS = cladding with the lowest carbon footprint…
- Benchmarking:
  - CMHC – key offerings
  - Oakridge & DOE study on claddings
  - Kesik's white paper of "EIFS Value Props"
- Good service life hinges on:
  - Critical details (design)
  - Quality control (construction)
  - Maintenance (what & when)

Ulterior Agenda

(what I'm really up to… ☺)

- Reaffirm what continuous insulation is…
- Dispel the usual misnomers…
- Solicit (or galvanize) your belief that EIFS is a high performance cladding…
- By the time we're done – maybe you'll agree that…

"EIFS is the best cladding value, in $/m²/service life"

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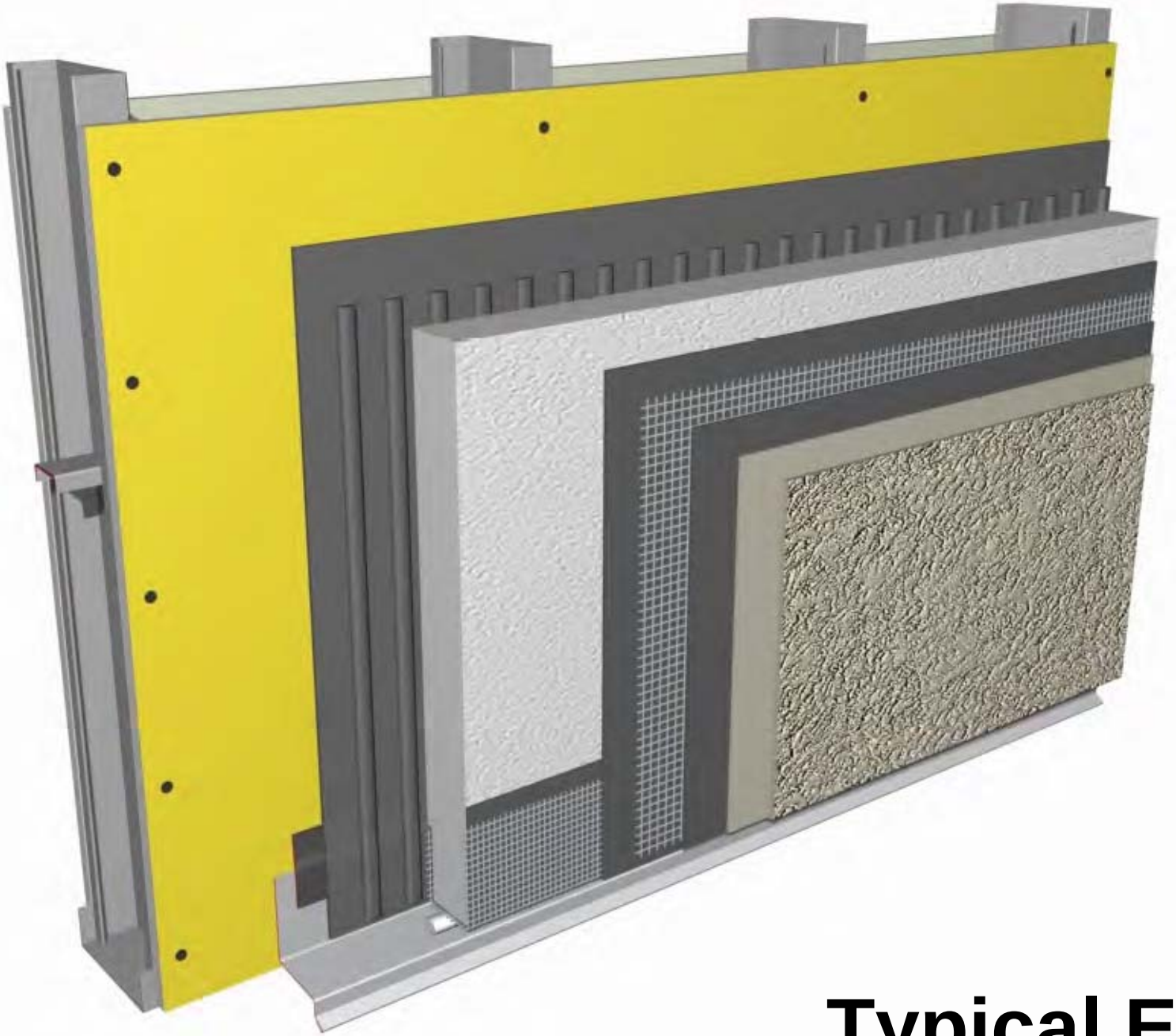
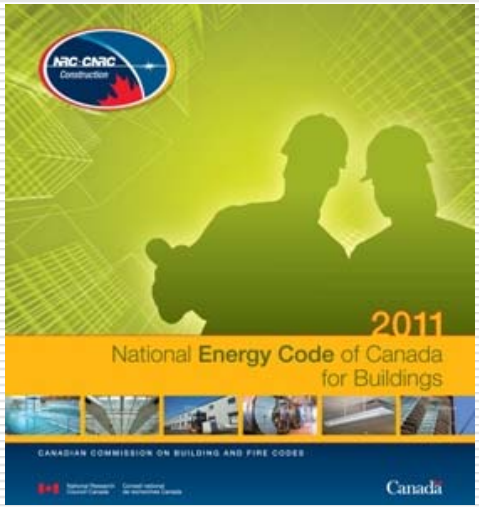


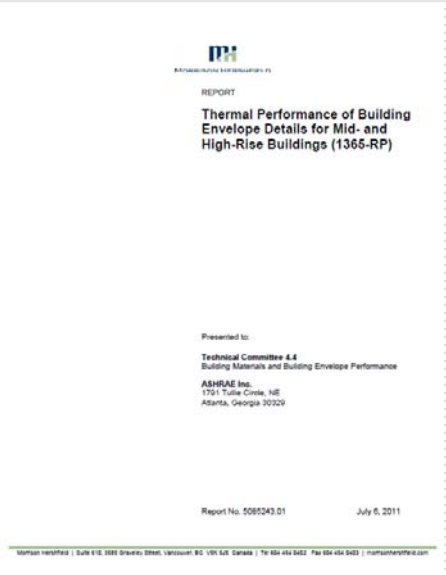
Typical EIFS

Image: ECC Practice Manual


SpringHill Suites
Marriott

Trendspotting




REPORT

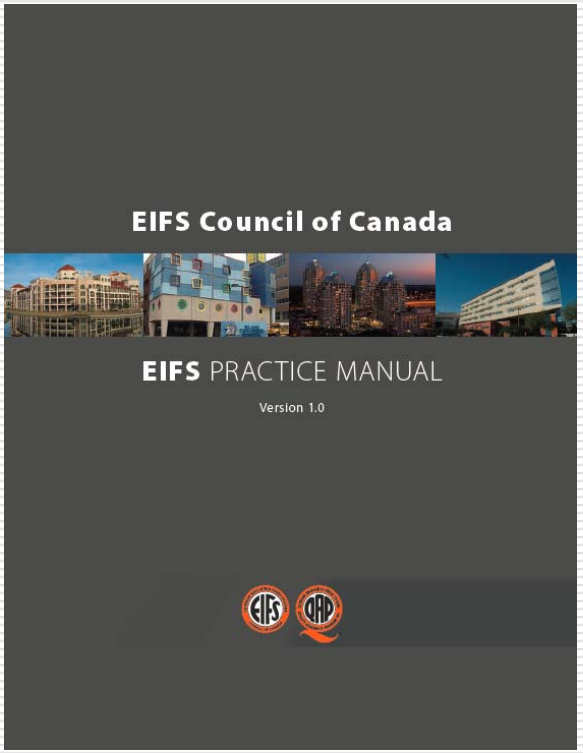
Thermal Performance of Building Envelope Details for Mid- and High-Rise Buildings (1365-RP)

Presented to:

Technical Committee 4.4
Building Materials and Building Envelope Performance

ASHRAE Inc.
1791 Tullie Circle, NE
Atlanta, Georgia 30329

Report No. 5065243.01 July 6, 2011



ENERGY STAR

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architecture 2030

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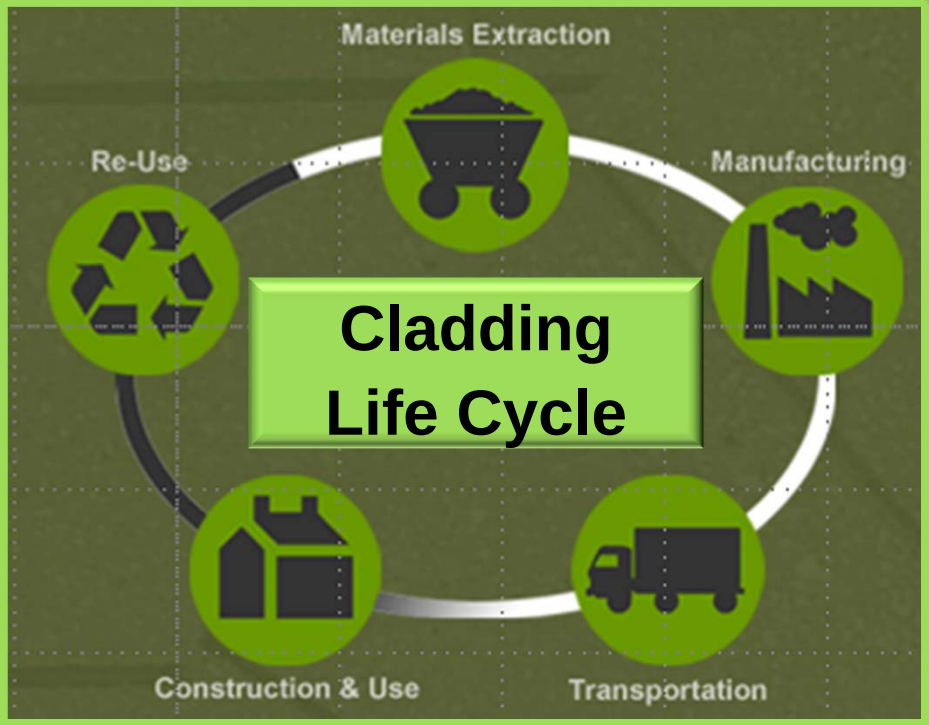
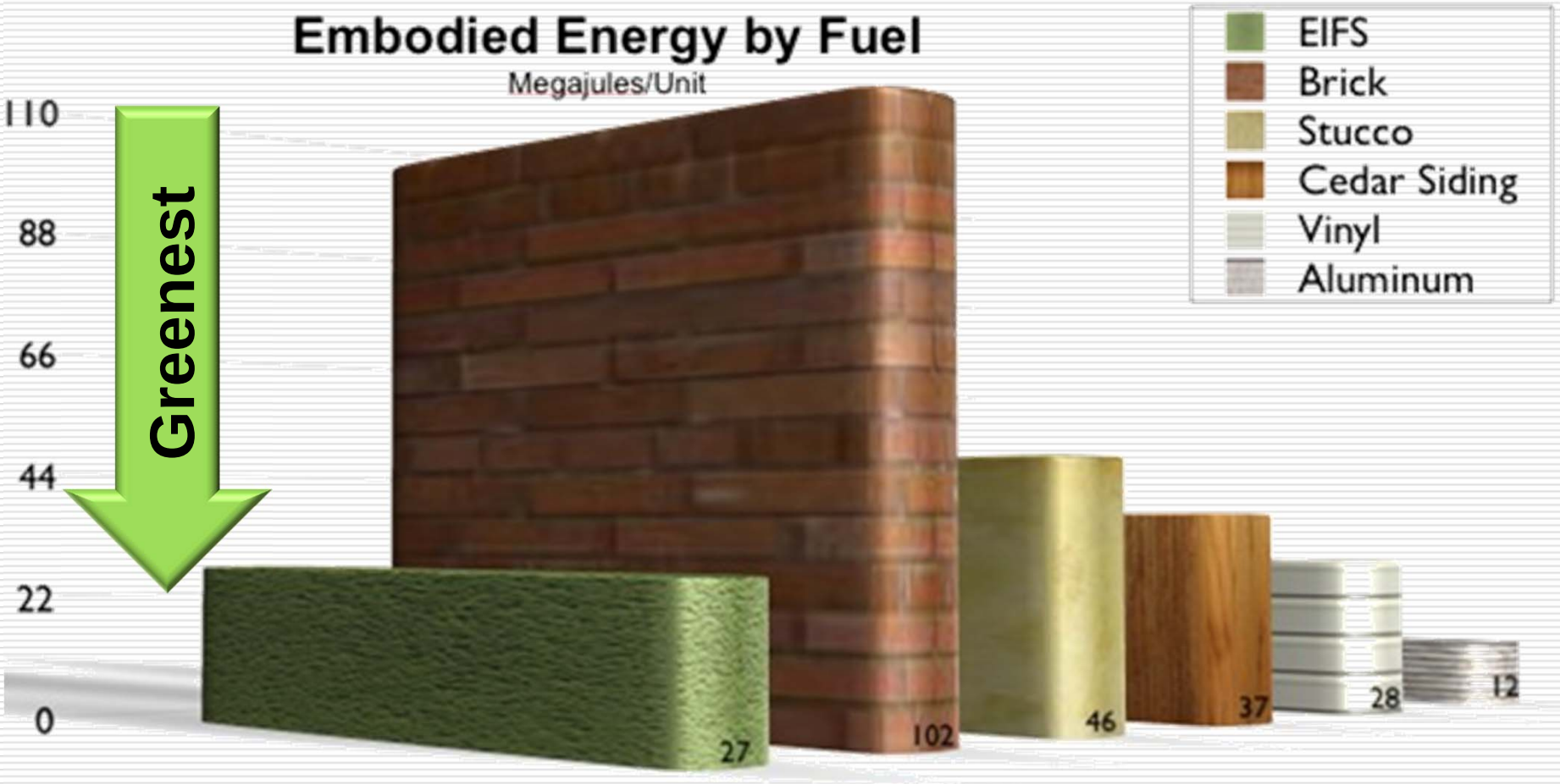
Carbon Footprint – Life Cycle

Lifecycle:

1. Material Extraction
2. Manufacturing
3. Transportation
4. Construction/Use
5. Re-use



Embodied Energy



National Institute of Standards & Technology – BEES v4.0

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Material Transportation

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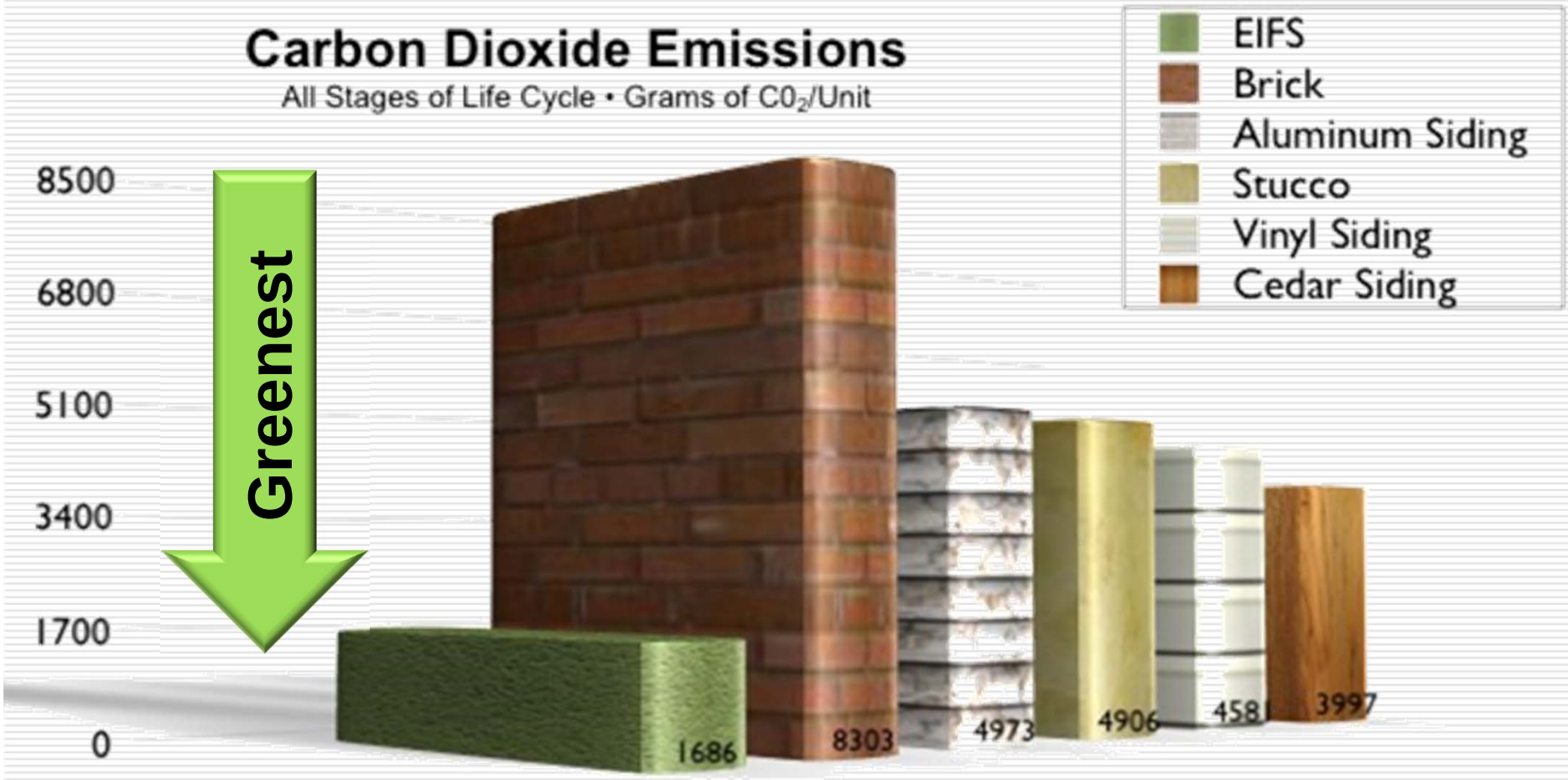
CO_2 Emissions



National Institute of Standards & Technology – BEES v4.0

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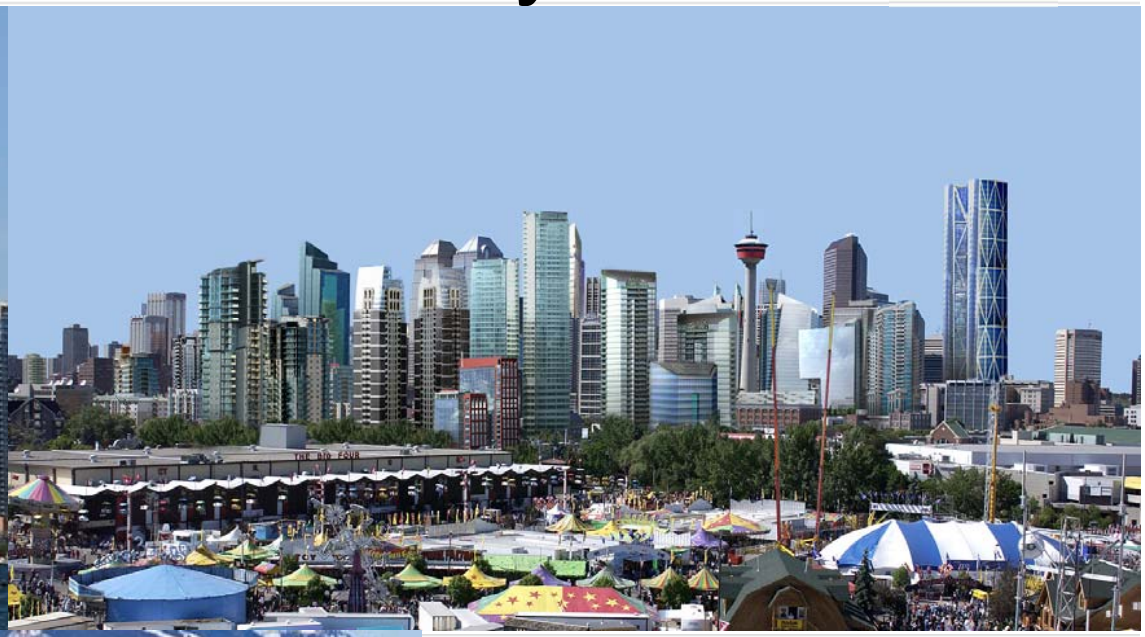
Realities of “Glass Box” Syndrome



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Actual U-values for Glass Walls

OBEC Journal Feb. 2008

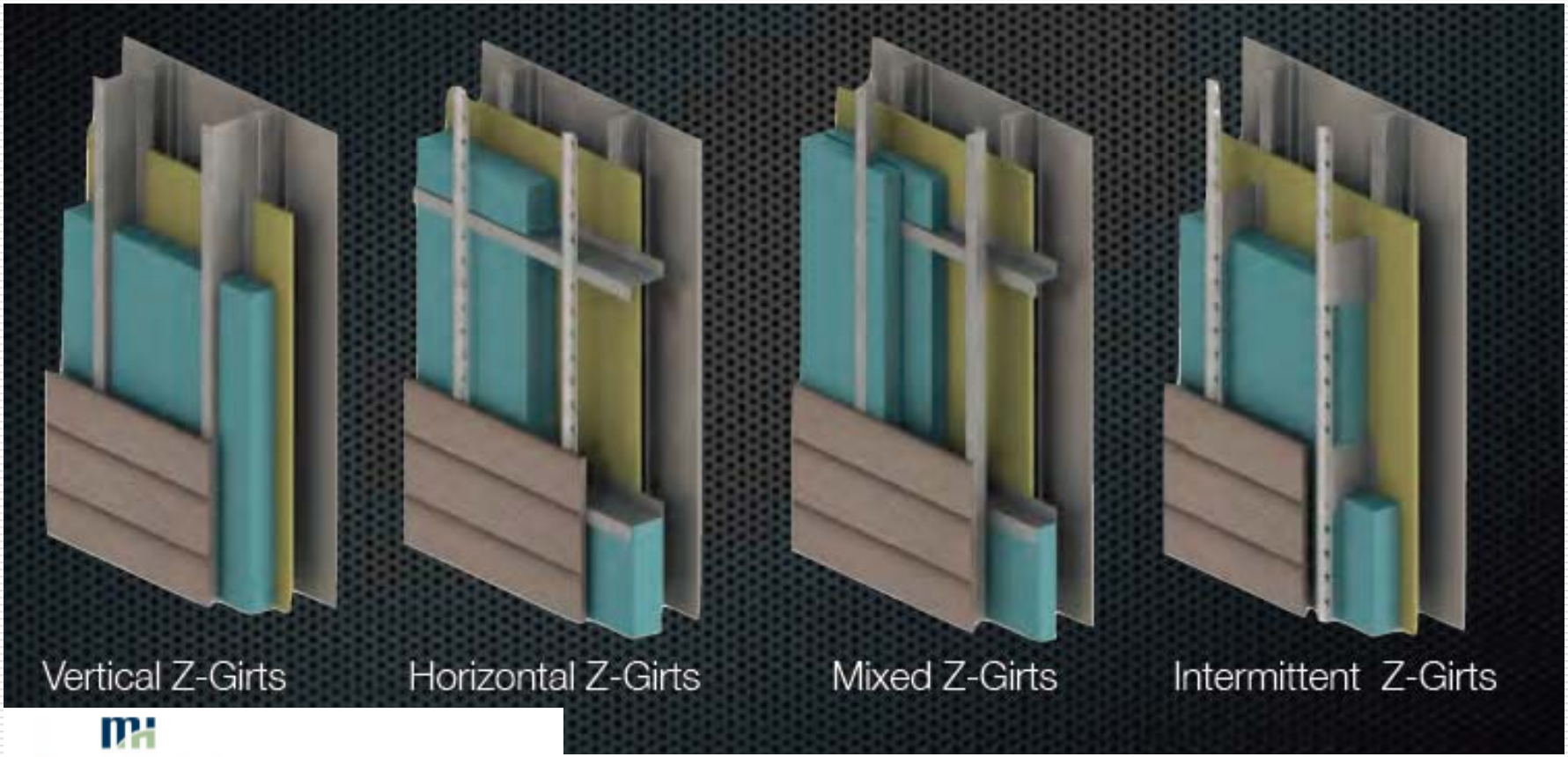
Table 1 – Determining Effective U-values (USI) for Curtain Wall

Glazing Product Type	Components: Thermal Break	Components: Centre of Glass U-Value – USI		Effective Assembly U Values[1]: Glazing Area (CSA Rated Size)[4]		Medium Glazing (1500 x 1500 mm)		Small Glazing (750 x 1500 mm)	
		U-value[2]	USI[3]	U-value	USI	U-value	USI	U-value	USI
Double Glazed Low E, argon, warm ½" spacer, 6 mm glass	3 MM EPDM	0.25	1.40	**0.37**	2.10	**0.41**	2.33	**0.49**	2.77
	9 MM PVC			0.34	1.95	0.38	2.13	0.48	2.48
Triple Glazed Low E, argon, warm ½" spacers, 6 mm glass	19 MM PVC	0.18	1.05	0.22	1.22	0.23	1.28	0.24	1.39
Spandrel Areas	Thermal Break	R-Value	RSI	R-Value	RSI	R-Value	RSI	R-Value	RSI
Spandrel Single Glazed 6 mm tempered glass, 100 mm rigid mineral fibre insulation with back-pan	3 mm EPDM	14.15	2.49	**6.75**	1.19	**4.95**	0.87	**4.26**	0.75
	9 mm PVC			7.14	1.26	5.26	0.93	4.52	0.80
				Spandrel Area		(900 x 1500 mm)		(900 x 750 mm)	

Notes:

1. *Frame™ Plus On-Line was used to generate the Effective Assembly U-Values and R-values. Other programs can be used also, such as LBNL's Window and Therm.*
2. *U-value is measured in units of* (BTU/hft²F)

Thermal Bridging



MORRISON HERSHFIELD

REPORT

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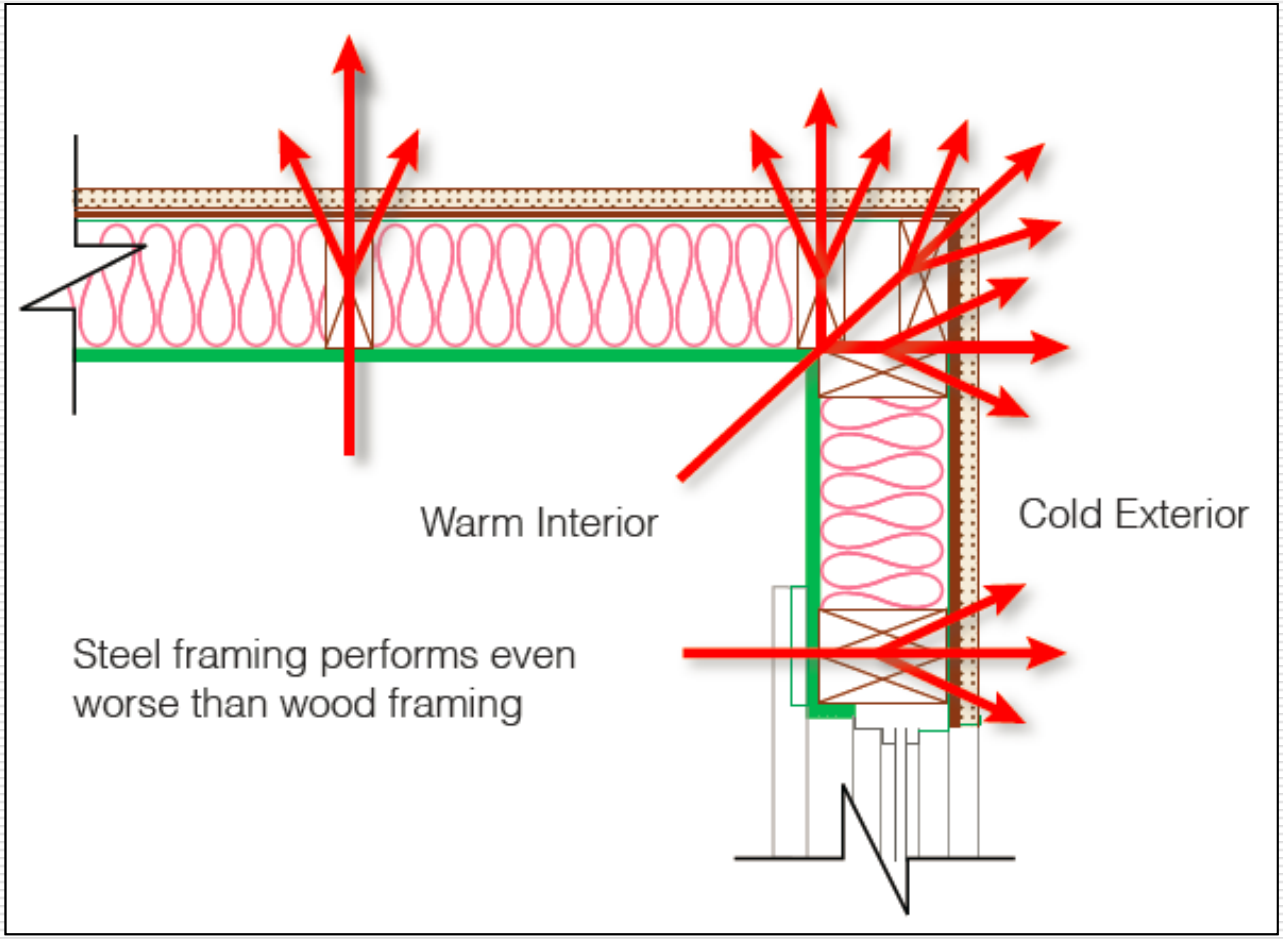
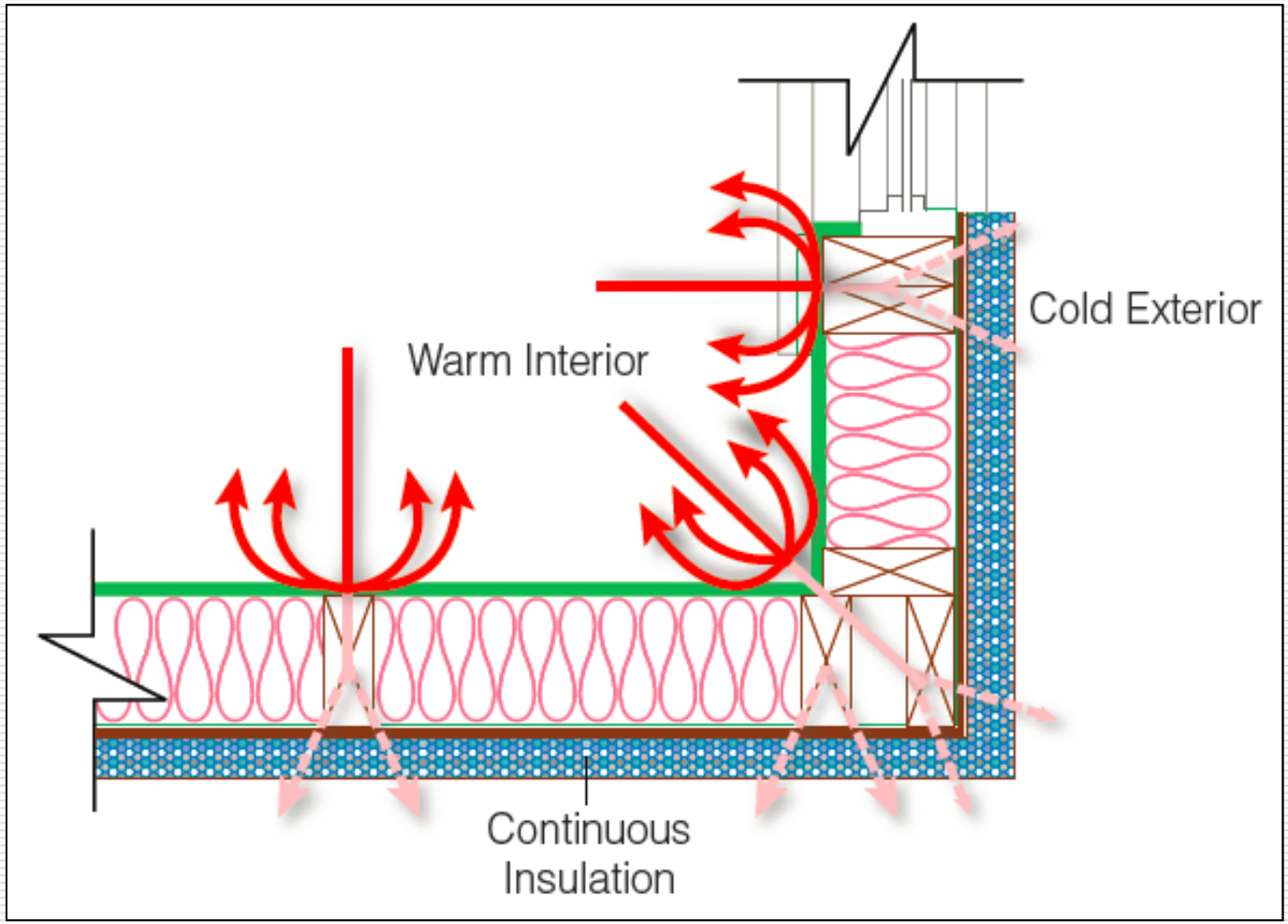
Thermal Bridging



Eliminating Thermal Bridging



EIFS – The cladding with the lowest carbon footprint…

Benchmarking…

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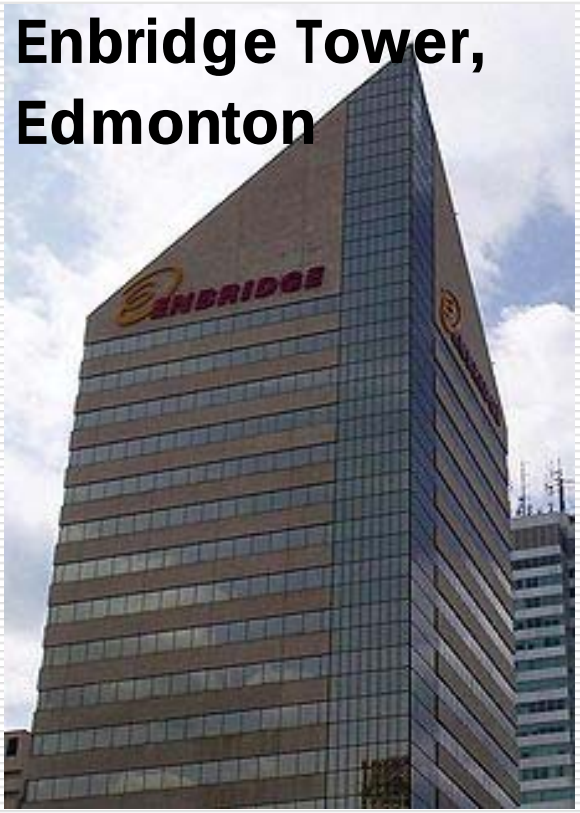
Context: 30 years of EIFS in Canada



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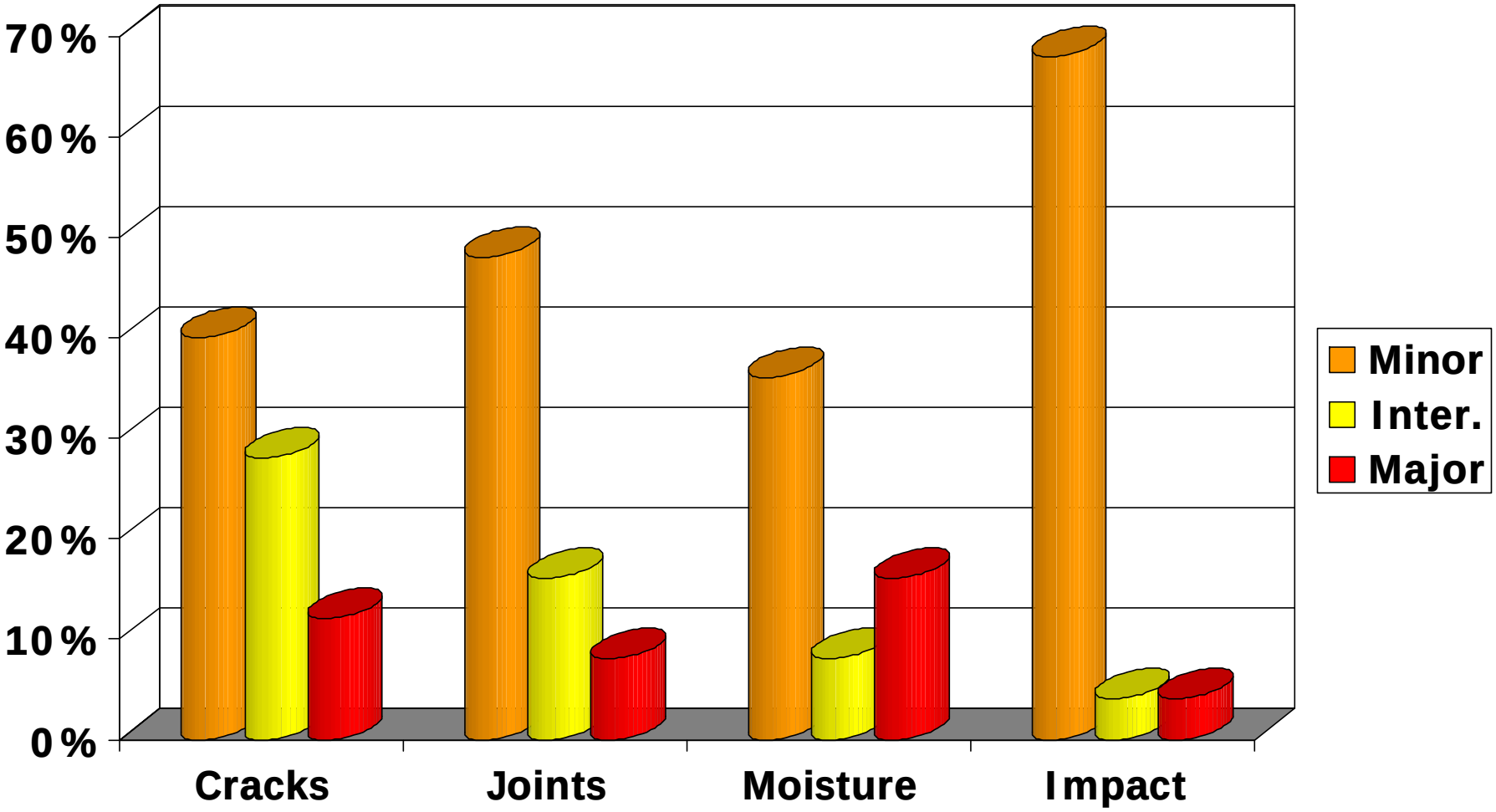
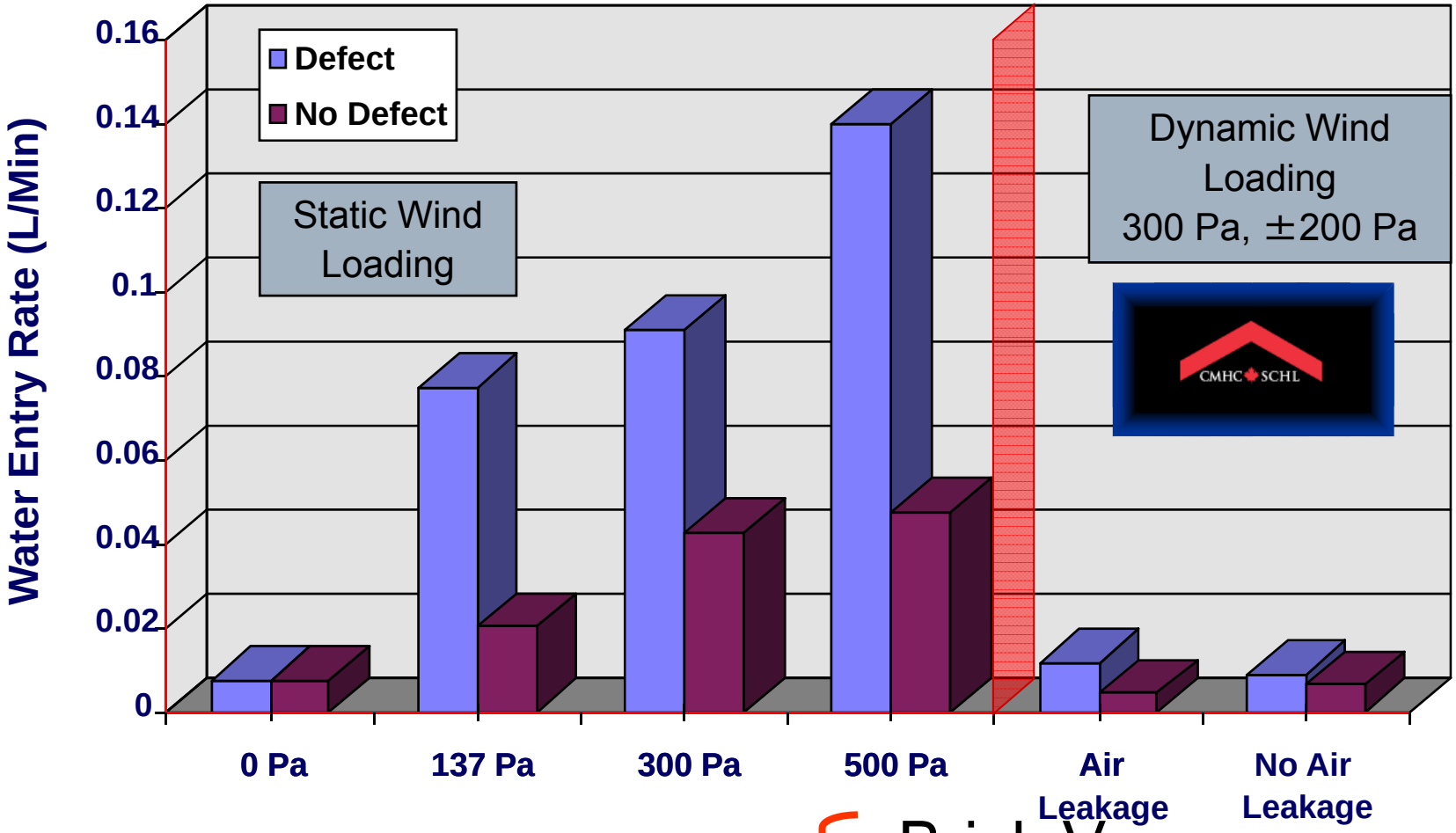
1993 CMHC Study

- Posey & Vlooswyk
- 25 buildings
- EIFS 2 – 13 years old
- Typical deficiencies included;
  - Impact damage
  - Cracking
  - Joint system failure
  - Moisture ingress

1993 CMHC Study



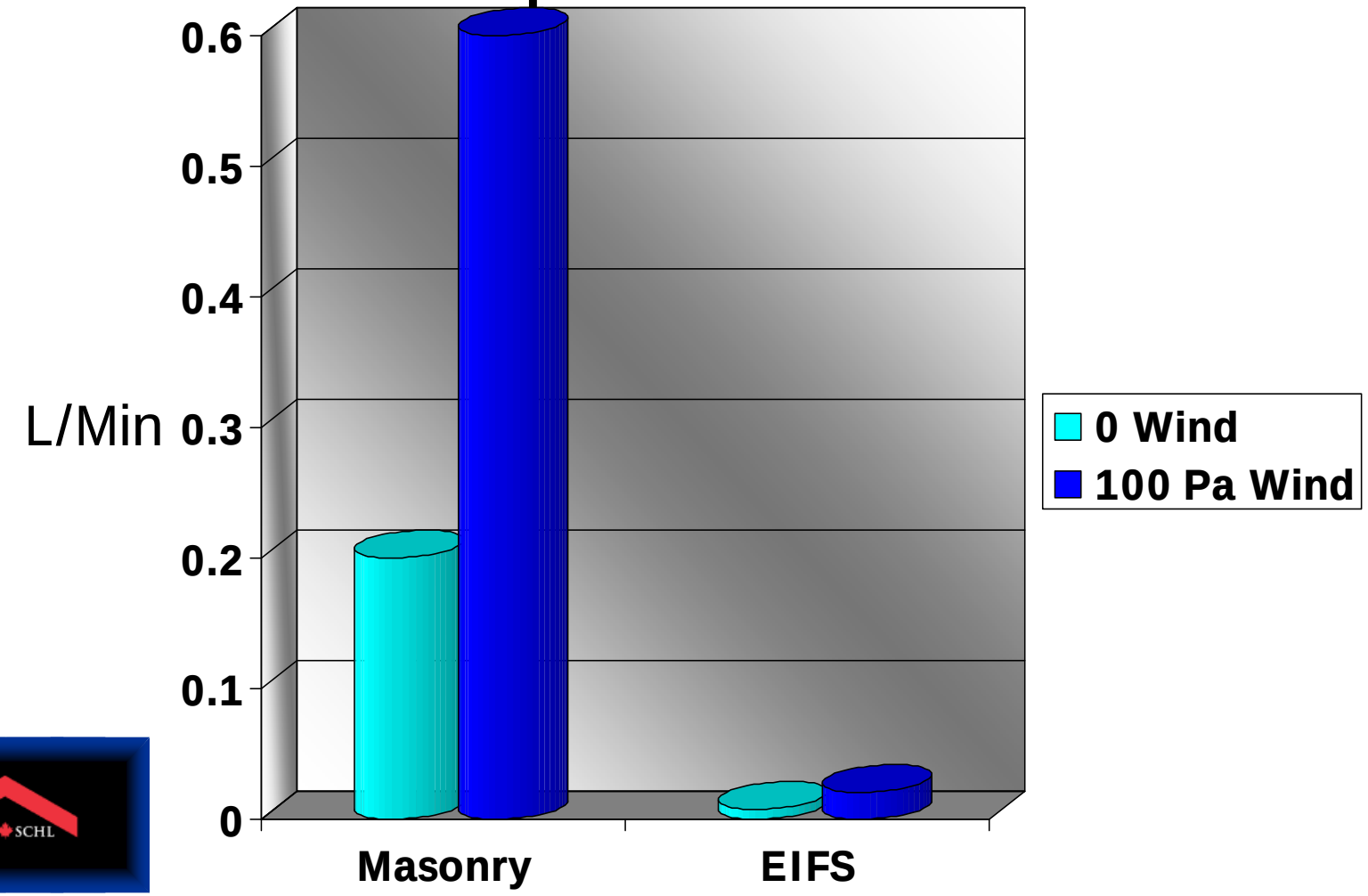
CMHC & NRC's Rainscreen Testing



0.2 L/min @ 0 Pa } Brick Veneer

0.6 L/min @ 100 Pa } 20X with no wind

Rain Load Comparison



CMHC SCHL

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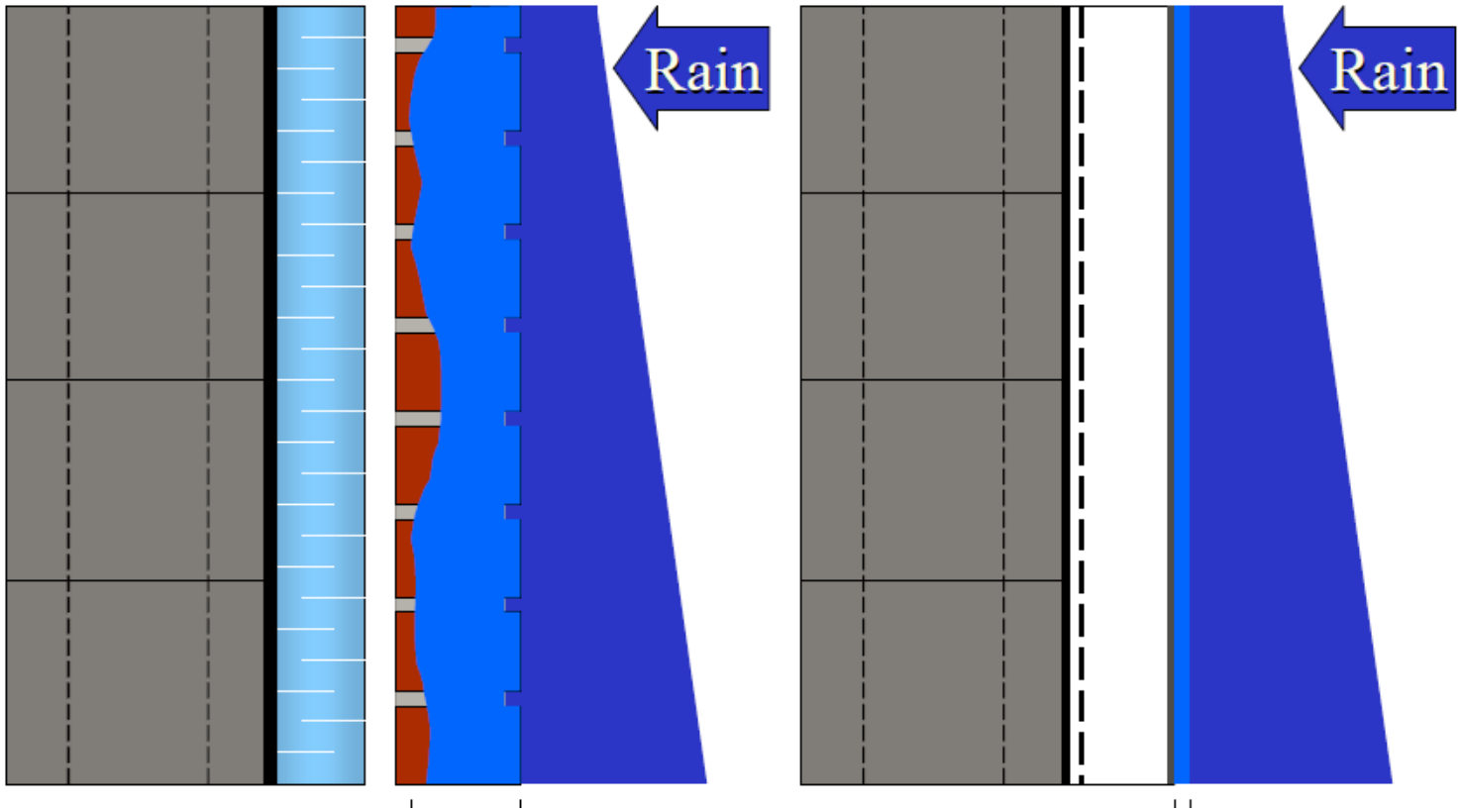
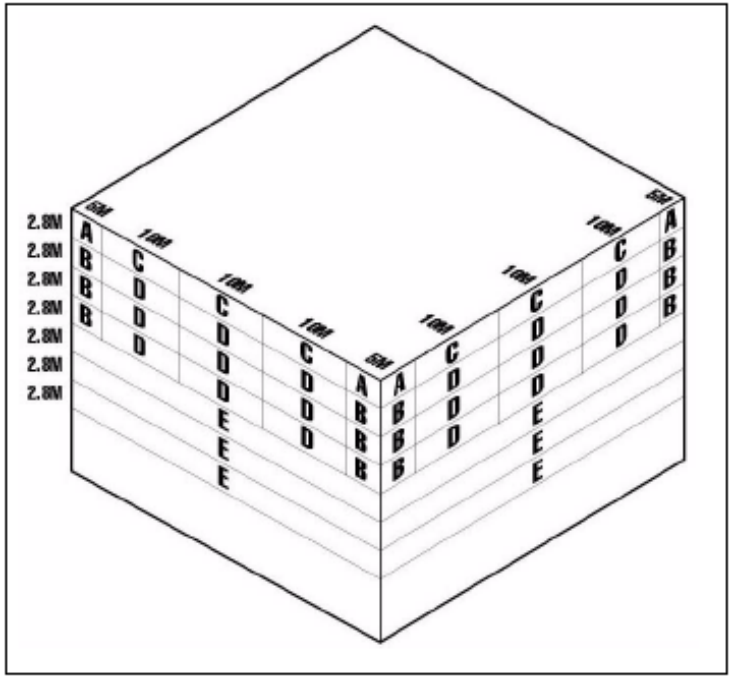
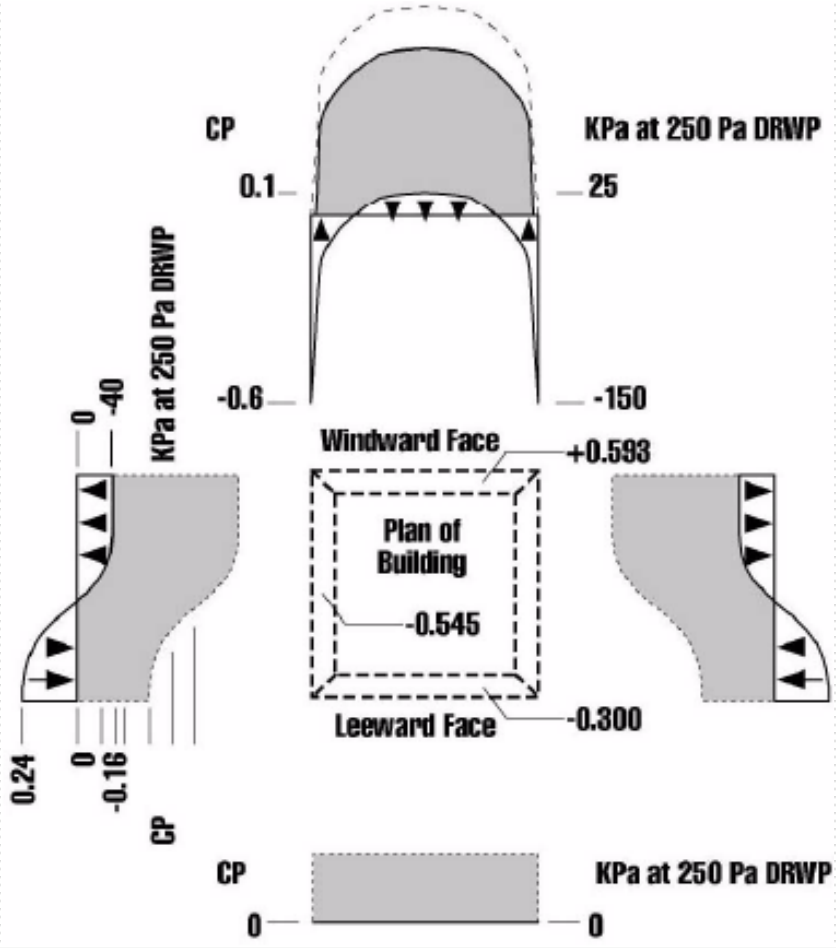
Rain Load Comparison



1999 CMHC's Rain Penetration Control Guide

RAIN PENETRATION CONTROL:
APPLYING CURRENT KNOWLEDGE





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In tandem to… 1999 CMHC's Rain Penetration Control Guide

Figure 6: Typical Building Elevation & Compartment Plan

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In tandem to… 1999 CMHC's Rain Penetration Control Guide

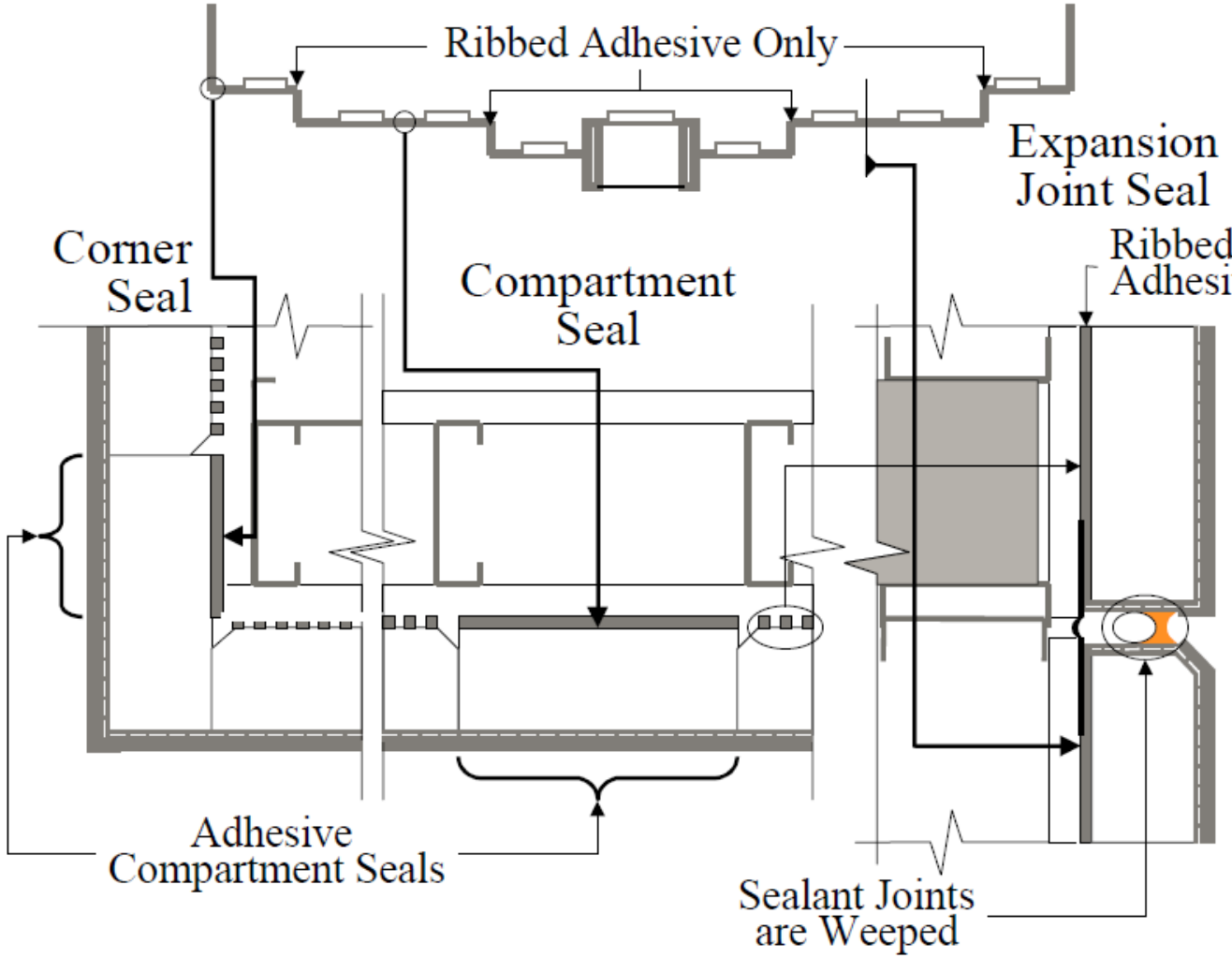
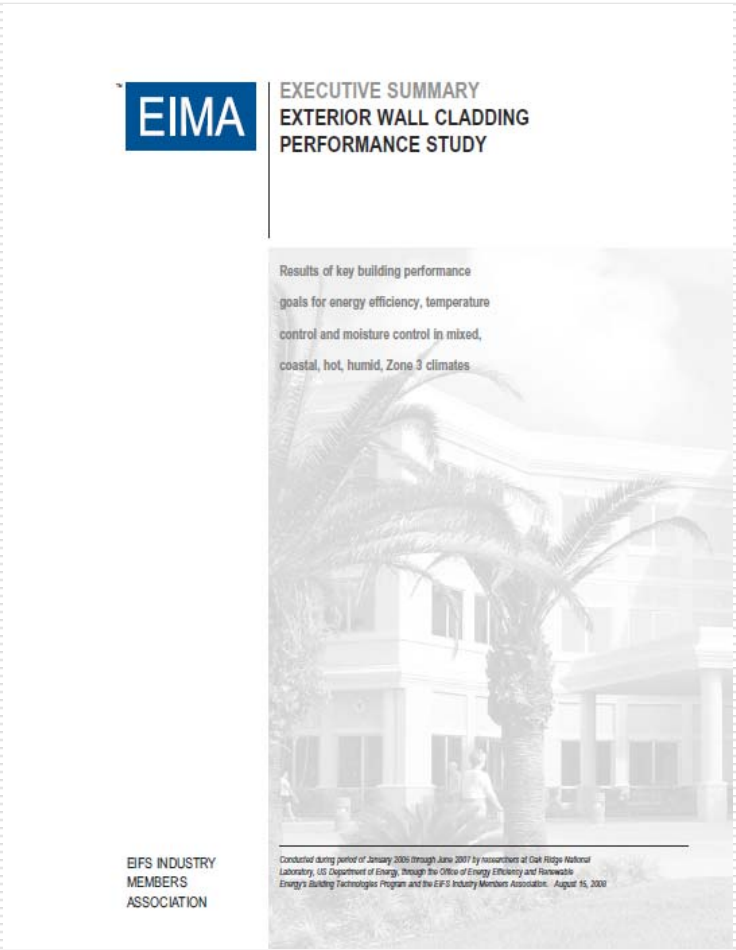


Figure 7: Compartment Details for Front Elevation (Shown in Plan View from Top)

Oak Ridge National Laboratory



Oakridge National Laboratory (ORNL) 2002

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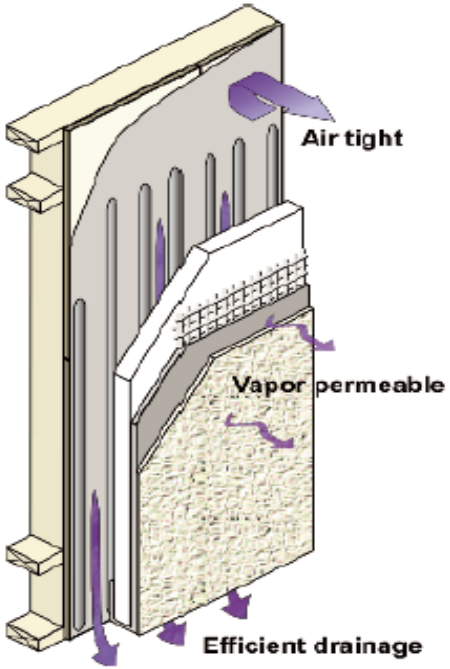
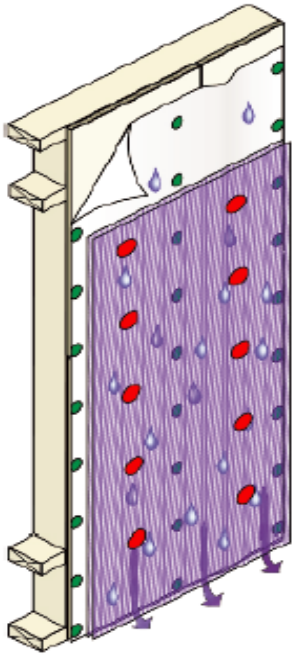
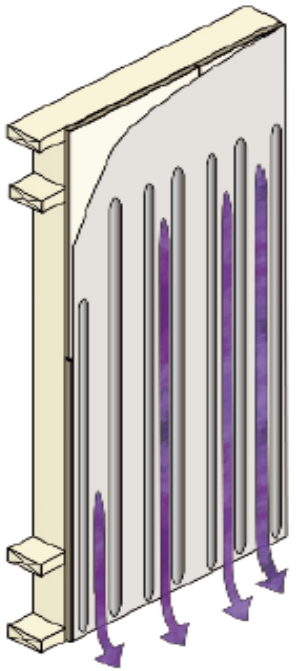
Oak Ridge National Laboratory





Drainage mats set cavity dimensions. Liquid applied water-resistive barrier coating with drainage cavity defined by vertical ribbons of adhesive.



liquid applied membranes have low surface tension.

Oakridge National Laboratory (ORNL) 2002

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Oak Ridge National Laboratory

Oakridge National Laboratory (ORNL) 2002

- Guarded hot box test to compare wall types
- **Measured the real R-Value**
- **EIFS performed 84% better than other claddings**

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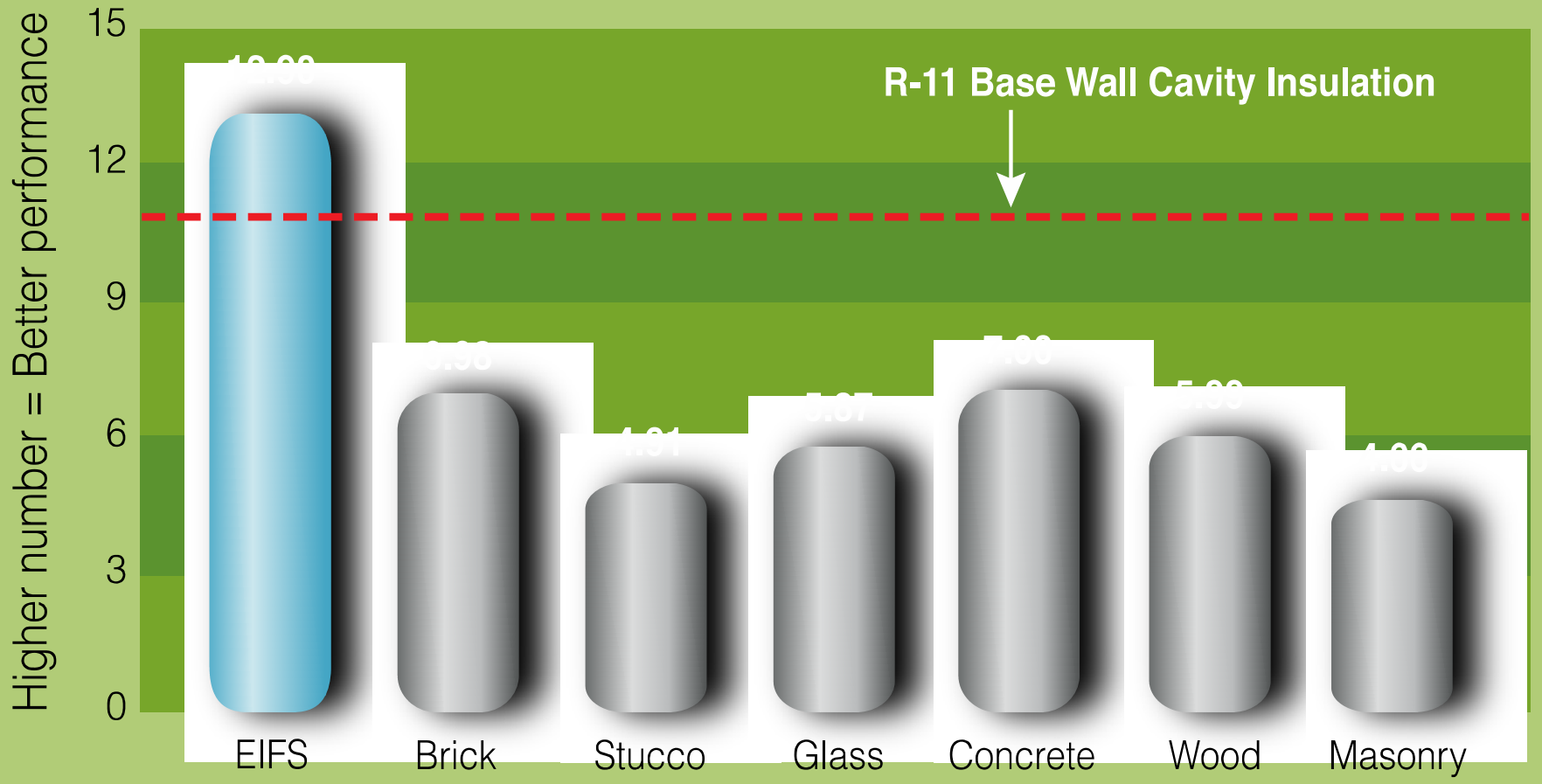
Whole R-Value Comparison



Oakridge National Laboratory (ORNL) 2002

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Why EIFS?

- By Dr. Ted Kesik – Value Propositions of:
  - EIFS
    - Effective R-value/$/$m^2$
    - $cost/$m^2$/year *or* $cost/$m^2$/life cycle
  - EIFS Quality Assurance Program

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EIFS Value proposition

PERFORMANCE REQUIREMENT	COMMENTARY	RATING		
		INFERIOR	AVERAGE	SUPERIOR
Structural Strength/Rigidity	• Lightweight, fully adhered, continuous cladding provides strong resistance to wind loads, reduces seismic and thermal loads.			●
Control of Heat Flow	• High thermal resistance with minimal thermal bridging.			●
Control of Air Flow	• Continuous air barrier behind extruded polystyrene.			●
Control of Moisture Flow	• Drainage layer and flashings enhance moisture management. • Exterior insulation reduces condensation potential.			○
Control of Solar Radiation	• UV resistant coating over continuous cladding system.			○
Control of Sound Transmission	• Airtight construction reduces airborne sound transmission. • Insufficient mass for vibration and low frequency sound.			○
Control of Fire	• Combustible cladding with low flamespread. • Fire resistance rating depends on backup wall assembly.		●	
Durability	• 30 to 50 year service life. • 10 to 15 year maintenance cycle (caulking), painting as required. • Poor impact and abrasion resistance.			○
Economy	• Low initial and maintenance costs. • Thermal efficiency contributes to low life cycle cost.			●
Environmental Impacts	• Relatively low for EIFS materials. • Energy efficiency contributes to greenhouse gas reductions.			●
Buildability (Ease of Construction)	• Winter heating and/or protection required. • Forgiving tolerances, flexible coordination and sequencing.			○
Aesthetics	• Wide range of colours and textures. • Readily combined with other facade materials.			?

● Definitely ○ Somewhat ? Subjective

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● Definitely ○ Somewhat ⓘ Subjective

Major limitations of EIFS:

1. **Impact** resistance
   - ☐ Increase base coat & reinforcing weight
2. **Application temperatures** ≥4°C
   - ☐ Control the application conditions
3. **Non-combustible** construction
   - ☐ Fire listings for use of foam plastic
   - ☐ Non-combustible insulation on lot lines

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EIFS Value Proposition

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● Definitely ○ Somewhat ⓘ Subjective

On the positive side:

1. Continuous **insulation**;
2. Reduced **air leakage** and water resistive barrier;
3. Reduced **condensation** potential;
4. Versatility and adaptability to a **wide variety of exterior wall types**; and
5. Low **carbon footprint** that is quickly offset by energy savings (reduced greenhouse gas emissions).

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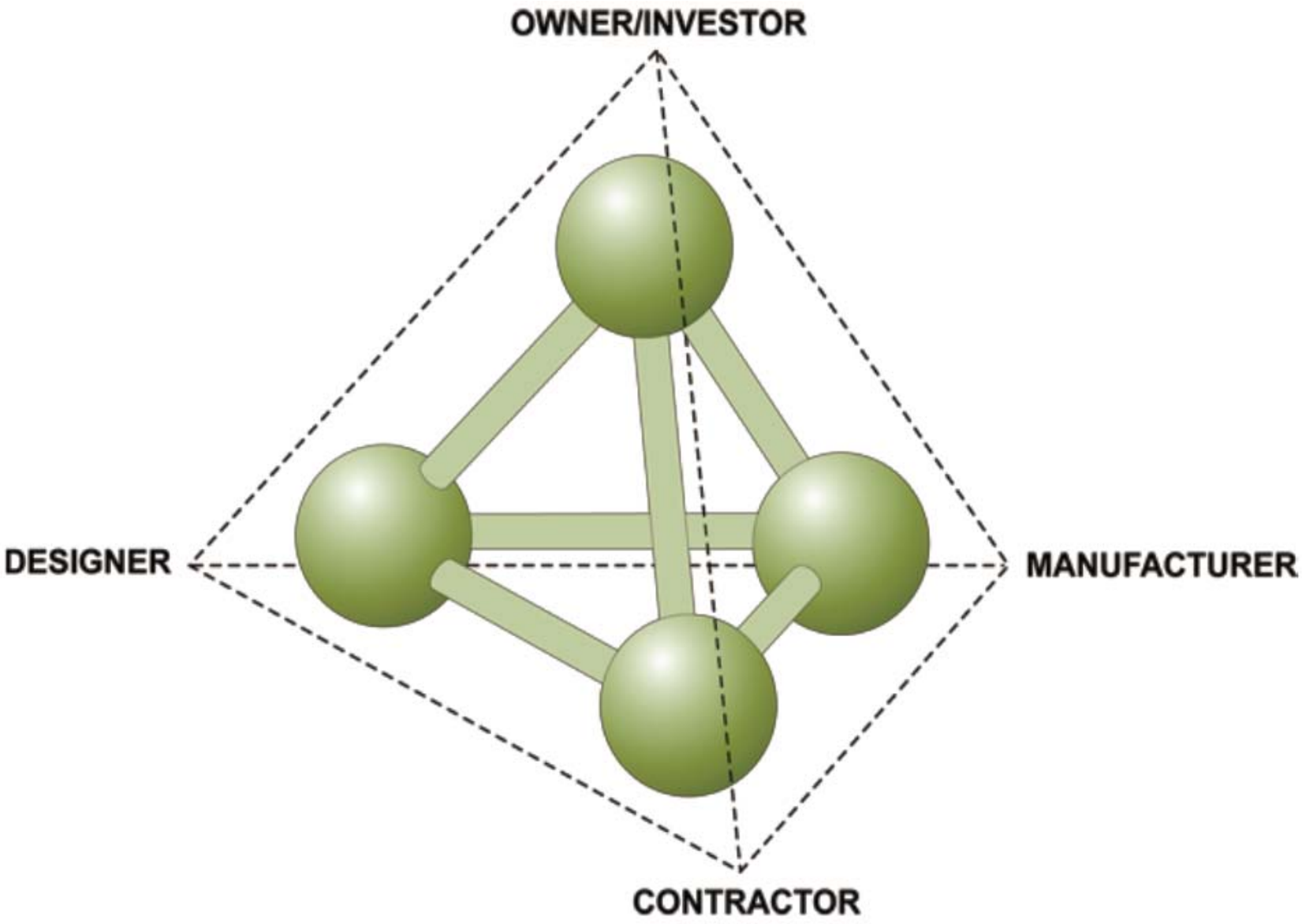
EIFS QAP Value Proposition



EIFS QAP Value proposition

KEY ELEMENT	CRITICAL MECHANISMS
Proven Performance	• Participation in the Moisture in Exterior Walls Study (MEWS) with National Research Council (NRC) • Wall performance study conducted by Oak Ridge National Laboratories in the Natural Exposure Test (NET) Facility • Research and testing program on thermal performance of EIFS drainage cavity (CCMC) (NRC)
Technology Transfer	• Development of Canadian Construction Materials Centre (CCMC) Technical Guide for EIFS • Development of National Standard Specifications for EIFS • Development of the ULC 716 family of Standards – Materials, Installation, Design • Development of EIFS Practice Manual • Ongoing Technical Bulletins
Competency	• Manufacturer Evaluation, Accreditation & Licensing • Contractor Accreditation & Licensing • Mechanic Certification & Licensing (ISO 17024) • Technical Support and Continuing Education for Designers
Accountability	• Documentation / ECC Data Base • Site Audits • Conflict Resolution • Financial Instrument • 3rd Party Warranty
Evolution	• Stakeholder Engagement and Feedback • Ongoing Research and Development

Code Compliance

- **Part 3 – Fire**
  - **Comply with fire testing – ULC-S134 and/or ULC-S101 & 114**
  - **Use mineral fibre insulation on walls limited to 10% "*unprotected openings*"**
- **Part 5 – Building Envelope**
  - **Designer's prerogative**
  - **Vancouver By-Law – PER mandated**
- **Part 9 – CCMC Approval, fire defer to Part 3**
- **Model code adopting ULC-S716 – Parts 5 & 9**

CCMC Approval

- **CCMC the current vehicle being used to validate code conformance**
- **First standardized approach to testing and evaluation**

NRC • CONSTRUCTION

Evaluation Report
CCMC 12874-R

MASTERFORMAT:	07 24 13.01
Issued:	1998-08-28
Re-evaluated:	2011-03-04
Re-evaluation due:	2013-08-28

Dryvit Outsulation® Series

Dryvit Outsulation® Series includes:
- *Outsulation® Plus, Outsulation® Plus NC*
- *Outsulation® MD, Outsulation® MD NC*
- *Outsulation® PD, Outsulation® PD NC*
- *Outsulation® PE NC*
- *Outsulation® Stratum Guard System I, and*
- *Outsulation® Stratum Guard System II*

1. Opinion

It is the opinion of the Canadian Construction Materials Centre (CCMC) that "Dryvit Outsulation® Series", when used as exterior insulation and finish system (EIFS) (wall cladding that is designed to provide thermal insulation and a weather barrier) in accordance with the conditions and limitations stated in Section 3 of this Report, complies with the National Building Code 2005:

- Clause 1.2.1.1.(1)(a), Division A, using the following acceptable solutions from Division B:
  - Sentence 3.1.5.5.(1)[1] Combustible Components for Exterior Walls
  - Clause 3.1.5.12.(3)(d) Combustible Insulation and its Protection
  - Clause 3.2.3.8.(1)(b)[2] Protection of Exterior Building Face
  - Sentence 5.6.1.1.(1) Required Protection from Precipitation
  - Clause 9.25.2.2.(1)(c) Insulation Materials
  - Sentence 9.27.1.1.(5) General (cladding)
  - Article 9.27.2.1. Minimizing and Preventing Ingress and Damage
  - Sentence 9.27.2.2.(4) Minimum Protection from Precipitation Ingress
  - Sentence 9.27.2.3.(1) First and Second Plane of Protection
  - Article 9.27.3.7. Flashing Materials
  - Article 9.27.4.2. Materials (caulking)
- Clause 1.2.1.1.(1)(b), Division A, as an alternative solution that achieves at least the minimum level of performance required by Division B in the areas defined by the objectives and functional statements attributed to the following applicable acceptable solutions:
  - Article 9.27.3.1. Elements of the Second Plane of Protection
  - Sentence 9.27.5.1.(1) Attachment (attachment of cladding)

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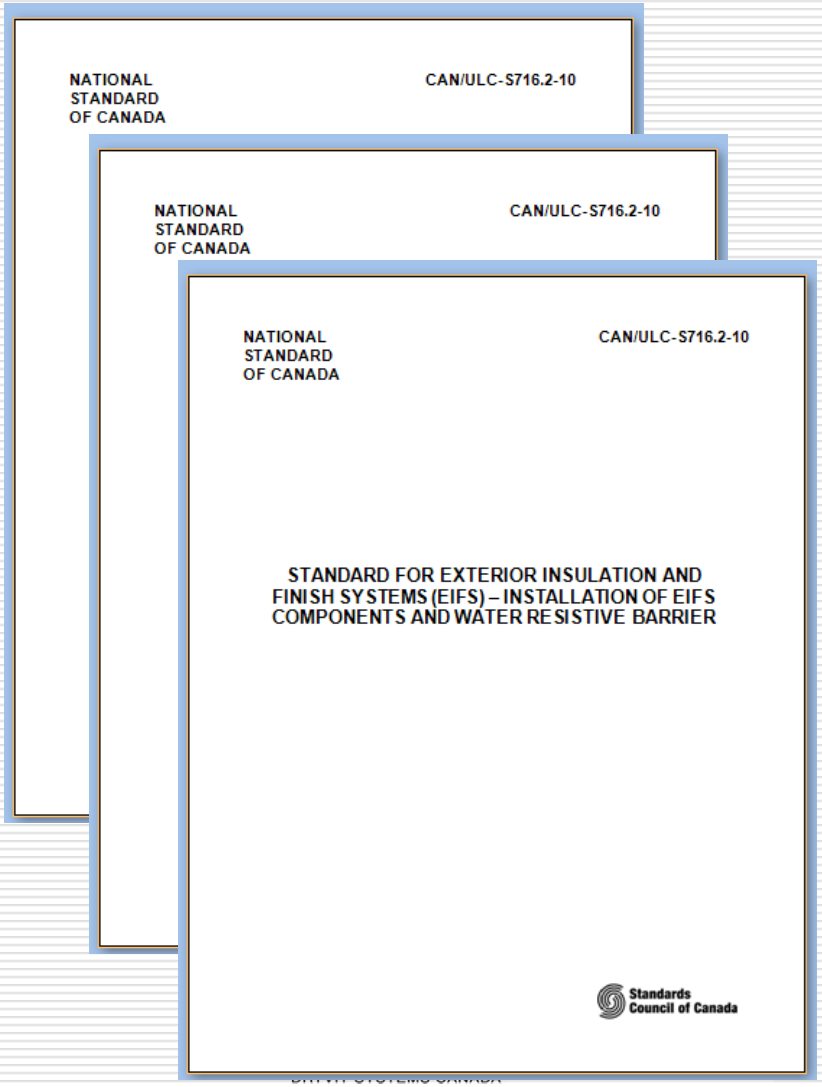
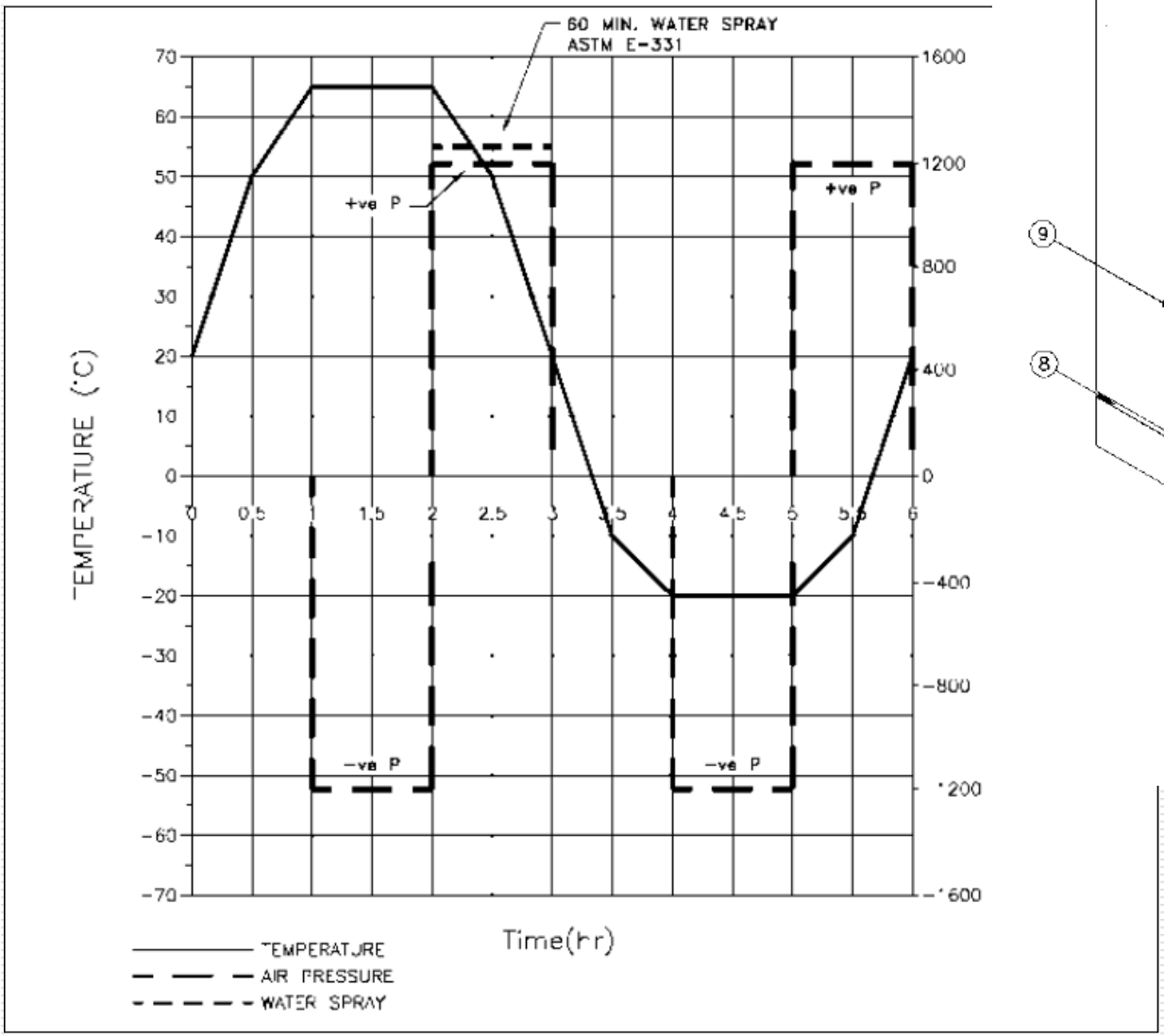
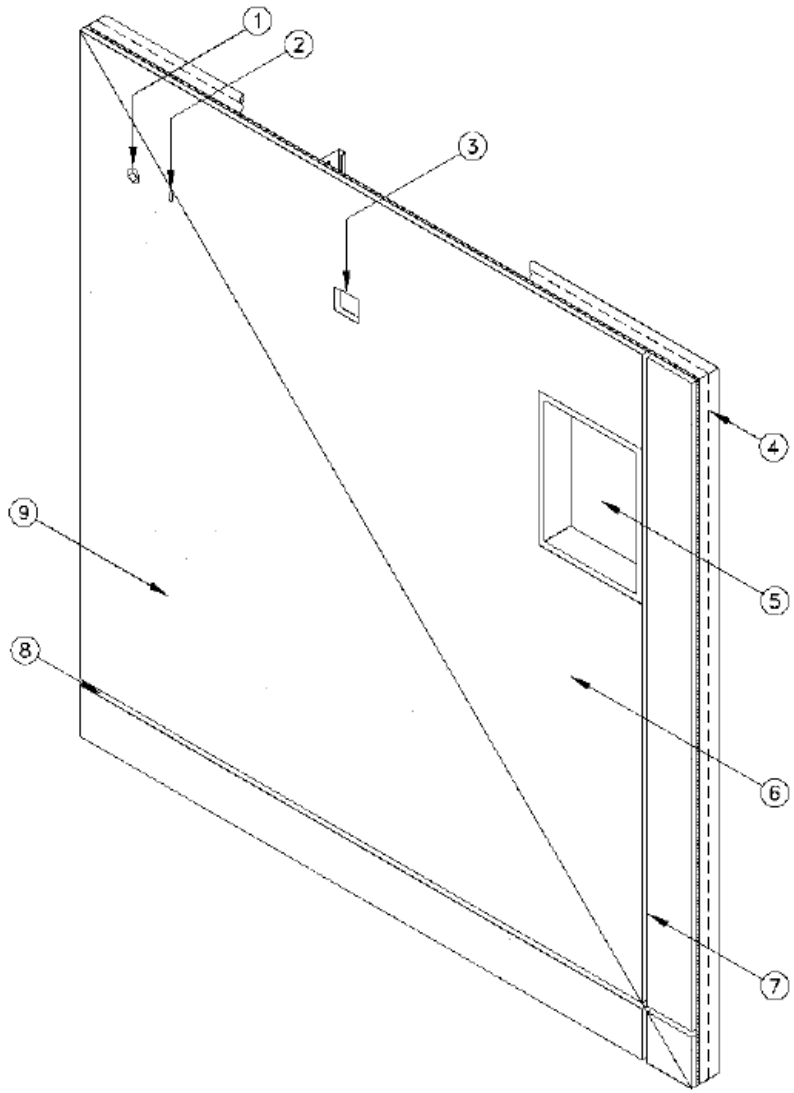
ULC-S716 Standards for EIFS

1. **ULC-S716.1 STANDARD FOR EXTERIOR INSULATION AND FINISH SYSTEMS (EIFS)**
2. **ULC-S716.2 STANDARD FOR EIFS – INSTALLATION OF EIFS COMPONENTS AND WATER RESISTIVE BARRIER**
3. **ULC-S716.3 DESIGN GUIDELINE**



Durability Testing for ULC-S716.1





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EIFS – The cladding with the lowest carbon footprint…

Designing for a predictable service life…

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Elliot Lake Oak Centre, Ontario (1994)

Prince George Law Courts, BC (1996)

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Grand Pacific ~ 2000 Addition, Victoria

Concord Pacific
Vancouver, BC
(late 1990s)

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EIFS: Designing for a predictable service life – CBSST 2001 Toronto

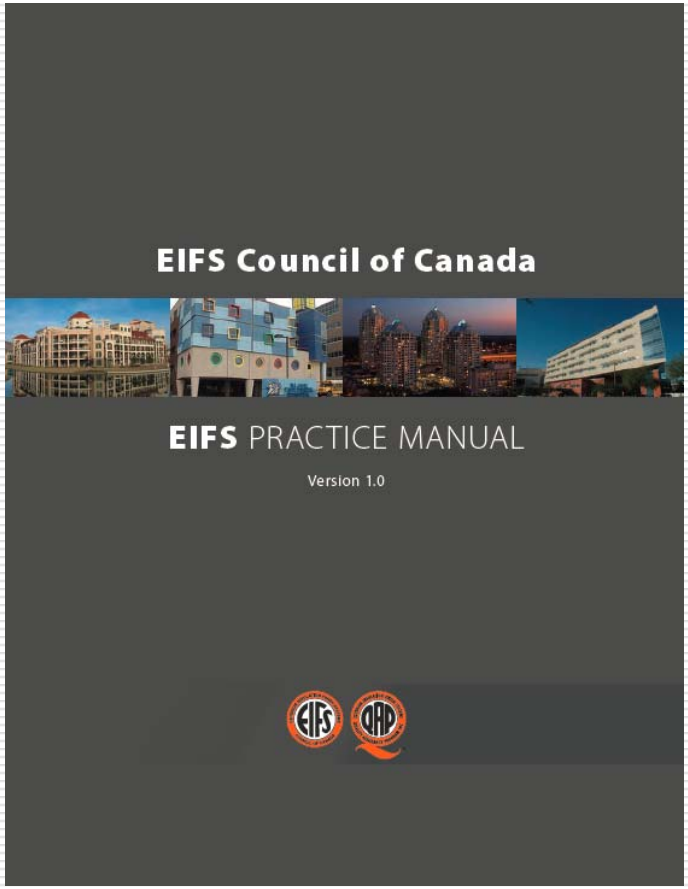
- Minimum service life of **25** – *to be expected,* ***50-100*** *years is possible*
- Moisture resistance of **substrate** – *function of durability*
- Pressure equalization - *tertiary to 1) protect moisture sensitive substrates & 2) drainage*
- **Condensation** – *risk is typically low*
- Evolution of CCMC (now ULC-S716) - *is benchmark for system performance*

Designing EIFS for a predictable service life

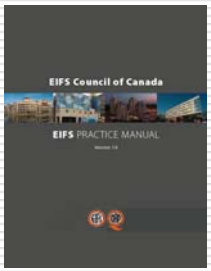
- Design **peer review** – use good resources
- Construction **quality control**
- Robust **flashings** (deflection)
- High **impact** mesh (people, woodpeckers)
- Subtle **drainage** (drain, but don't ventilate)
- Air tight **moisture control** (in cavity)
- **Mildew** resistant finishes (upgrade)
- Condition **assessment** (budget for upkeep)

Evolution of EIFS Practice Manual

- Devil is in the details…
- Download a copy at: www.eifscouncil.org
- Evolved from:
  - CMHC's EIFS Best Practice Guide, ***to***
  - ULC-S716.3, ***to***
  - **ECC's EIFS Practice Manual**



Generic Details



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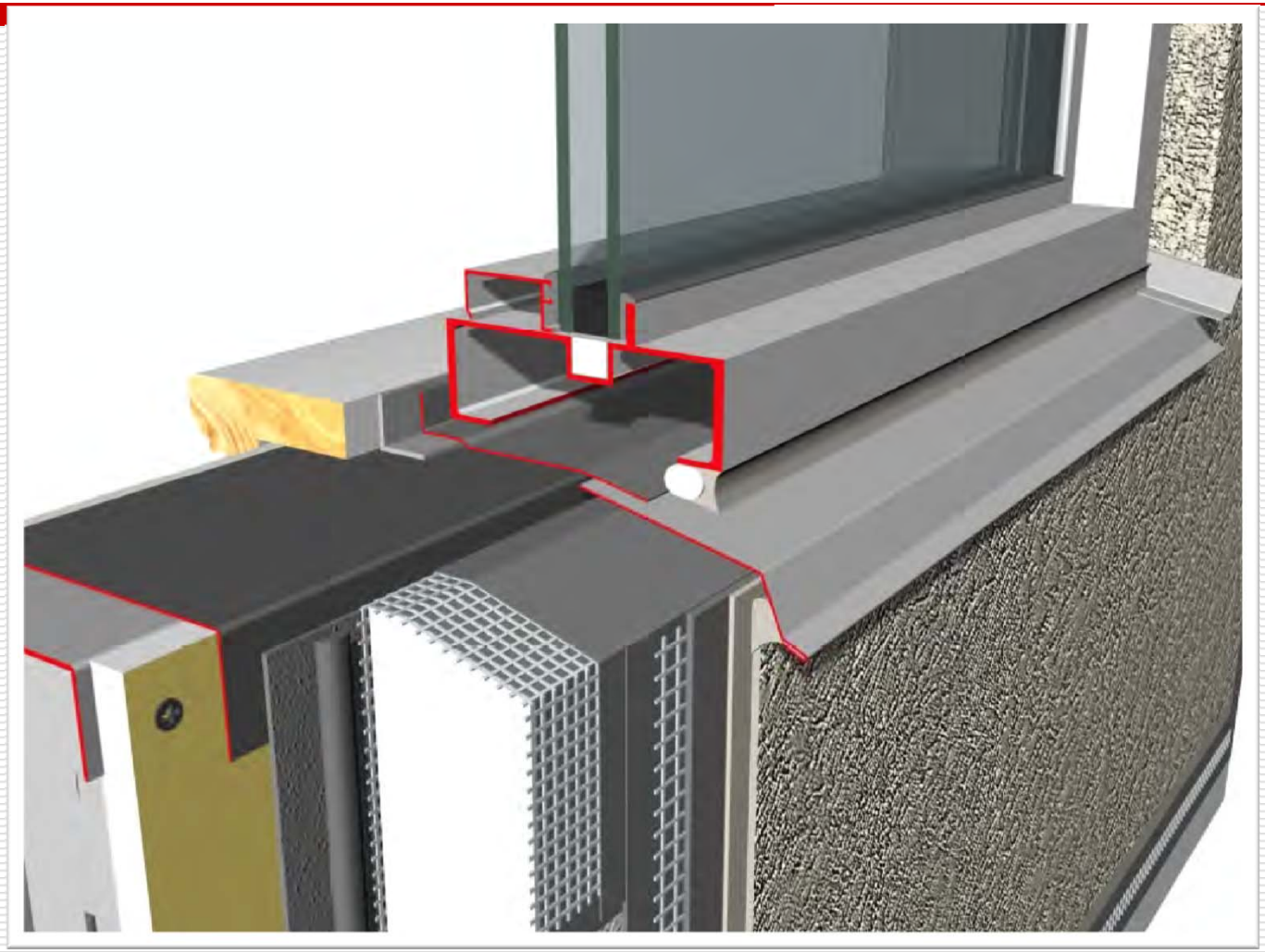
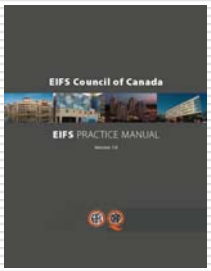
Generic Details





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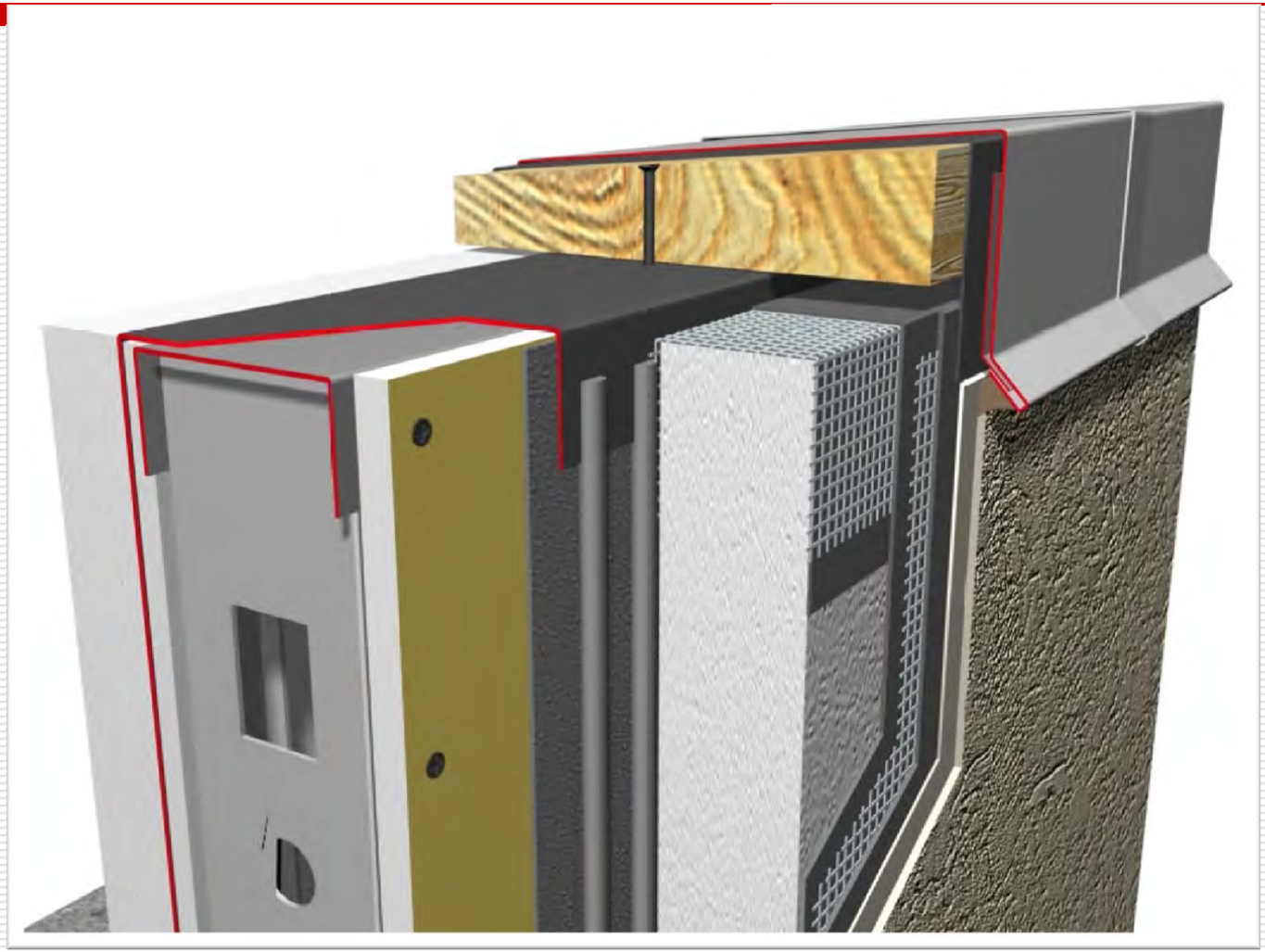
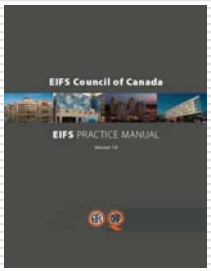
Generic Details





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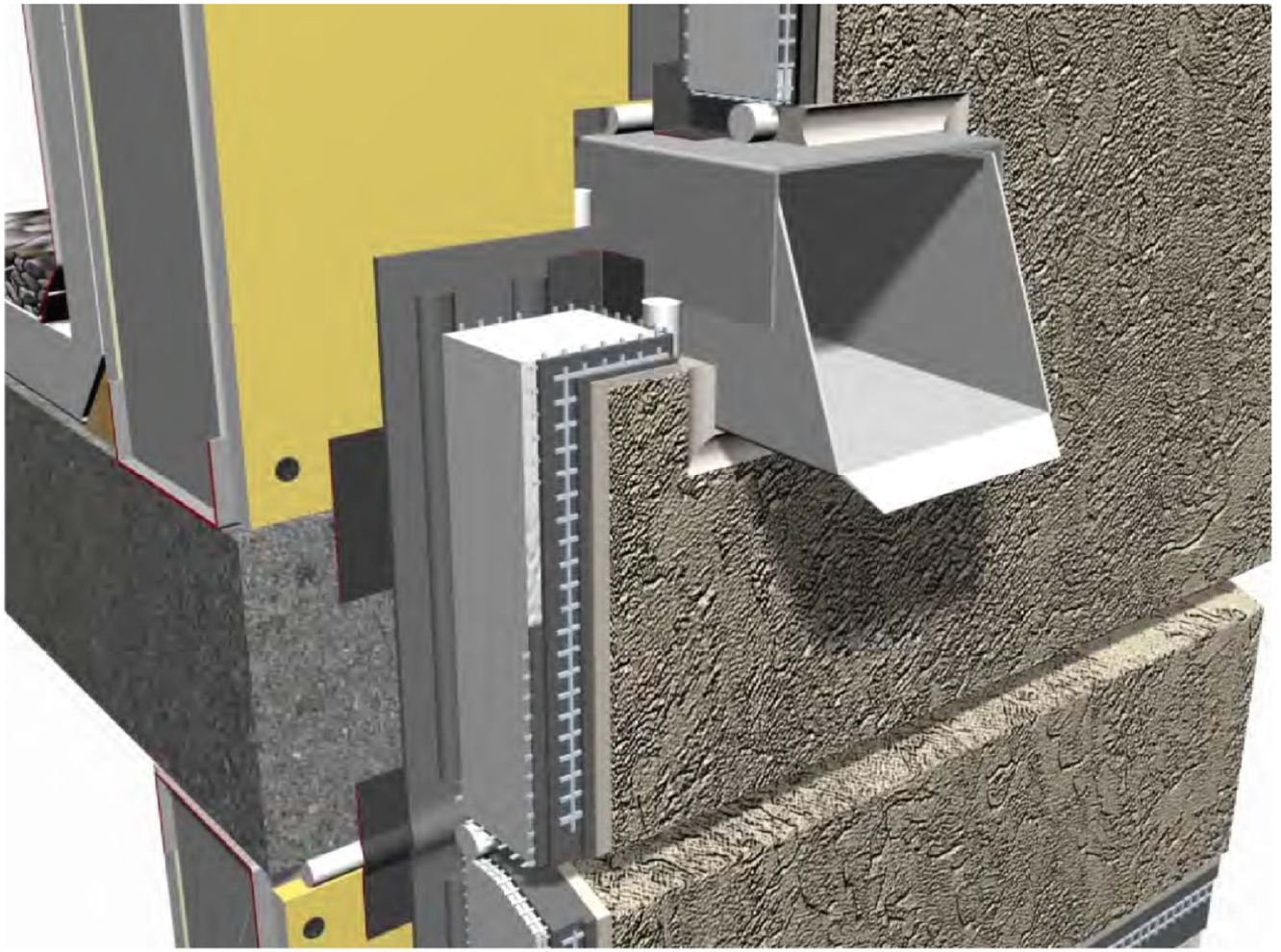
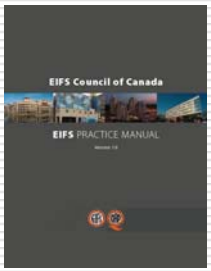
Generic Details





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EIFS – The cladding with the lowest carbon footprint…

Code requirements for (continuous) insulation…

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NRC Webinar on MNECB

Prescriptive – building envelope thermal characteristics

- Varies only with heating degree-day of building location

Prescriptive Maximum Overall U-Values (USI) Opaque Assemblies

HDD	<3000 Zone 4	3000 <4k Zone 5	4000 <5k Zone 6	5000 <6k Zone 7A	6000 <7k Zone 7B	≥7000 Zone 8
	Maximum **Overall** Thermal Transmittance (W/(m²•Kº))					
Walls	0.315	0.278	0.247	0.210	0.210	0.183
Roofs	0.227	0.183	0.183	0.162	0.162	0.142
Floors	0.227	0.183	0.183	0.162	0.162	0.142
F&D	*2.4*	*2.2*	*2.2*	*2.2*	*2.2*	*1.6*

Metric Units

USI = 1/RSI

1 RSI = 5.678 R-Value

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Prescriptive Minimum Overall R-Values Opaque Assemblies

HDD	<3000 Zone 4	3000 <4k Zone 5	4000 <5k Zone 6	5000 <6k Zone 7A	6000 <7k Zone 7B	≥7000 Zone 8
	Minimum **Overall** Thermal Transmittance ((ft²•F°)/Btu•h)					
Walls	18.0	20.4	23.0	27.0	27.0	31.0
Roofs	25.0	31.0	31.0	35.0	35.0	40.0
Floors	25.0	31.0	31.0	35.0	35.0	40.0
F&D	*2.4*	*2.6*	*2.6*	*2.6*	*2.6*	*3.5*

R-Value is an Imperial Unit

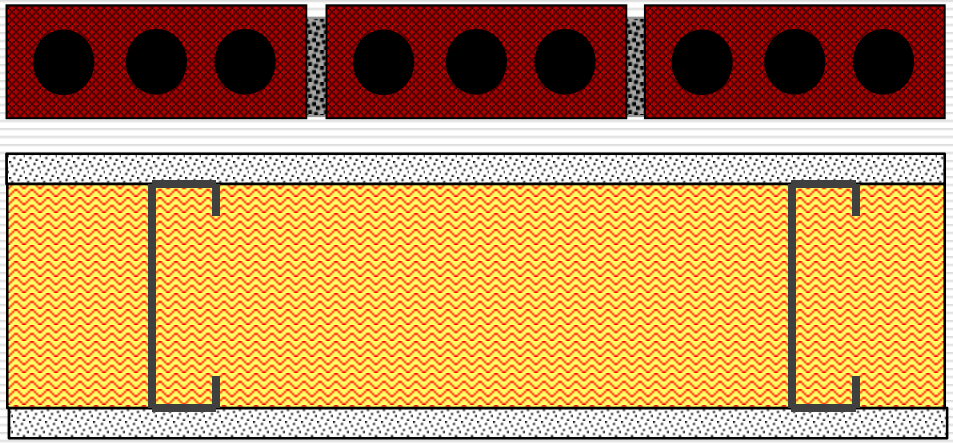
1 R-Value = 0.176 RSI

NECB Requirements:

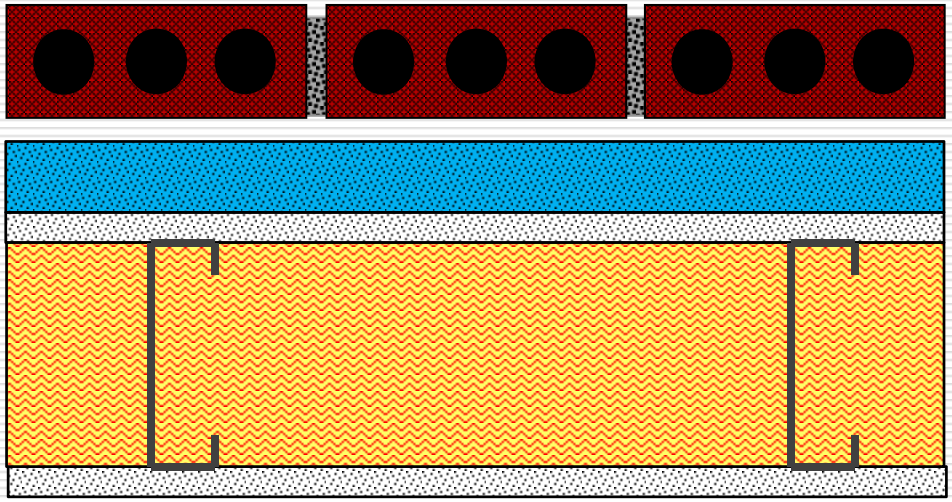
- Thermal characteristics of opaque assemblies (calculations or testing):
  - $RSI_1 = 1/(\%Framing/RSI_F + \%unframed/RSI_I)$
  - $RSI_2 = 1/(\%Framing/RSI_f + \%unframed/RSI_i)$
  - $RSI_3 = RSI_n - RSI_{f/i} + RSI_2$
  - $RSI_T = (RSI_1 + RSI_3)/2$

  Note: RSI_F & RSI_I refer to the assembly, RSI_f & RSI_i refer to only those materials.

Nominal vs. Actual R-value



- 3-5/8” stud with batt
  - Nominal R12
  - Actual ~R9 (R7 model)
  - 50-75% of nominal



- Same with 1.5” XPS
  - Nominal R19.5
  - Actual ~R12-15

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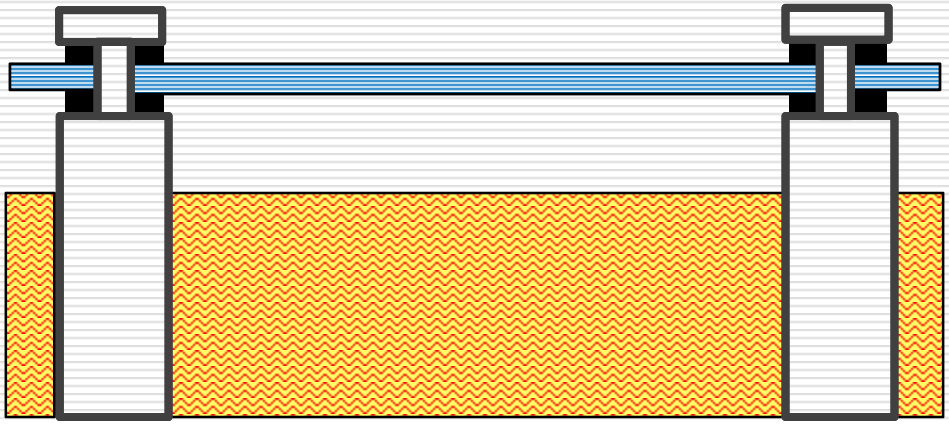
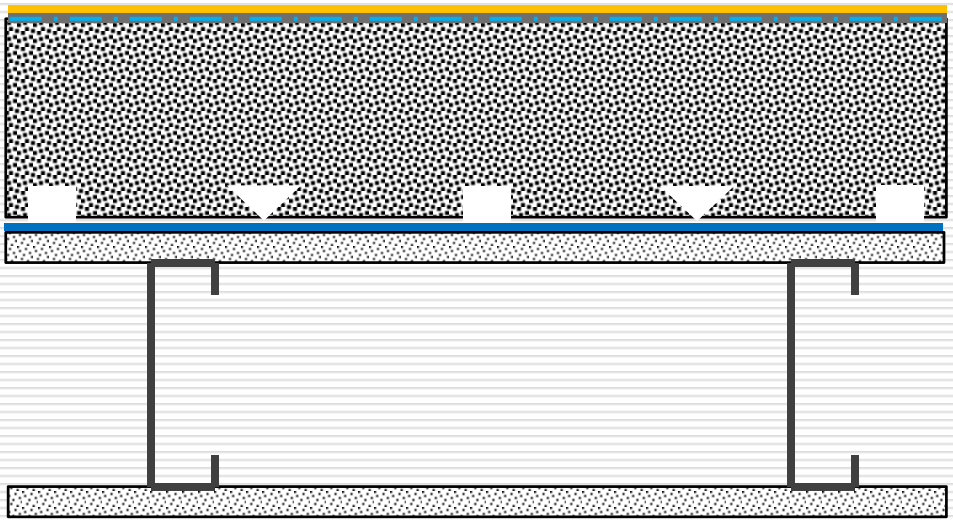
Nominal vs. Actual R-value



- 6” CW Spandrel
  - Nominal R20
  - Actual ~R2-3?



- EIFS Clad Wall
  - Nominal R22.8
  - Actual R22.1
  - At most 3% lower

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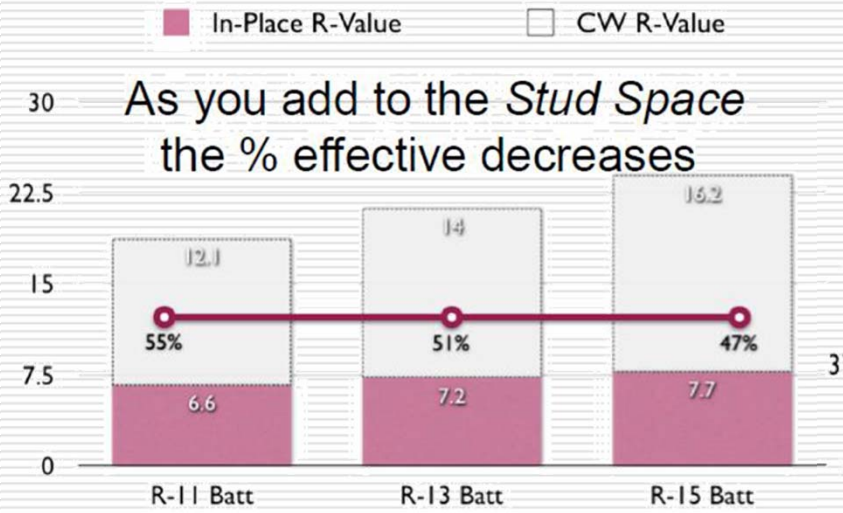
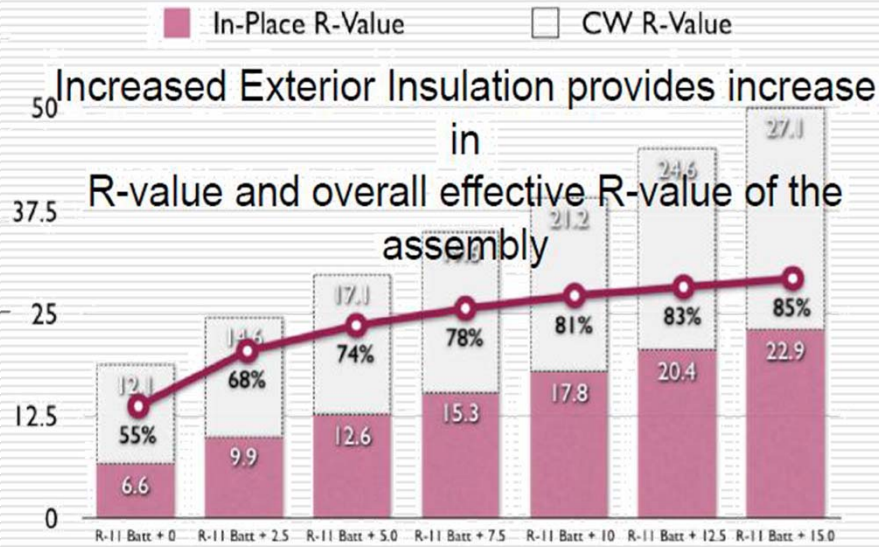
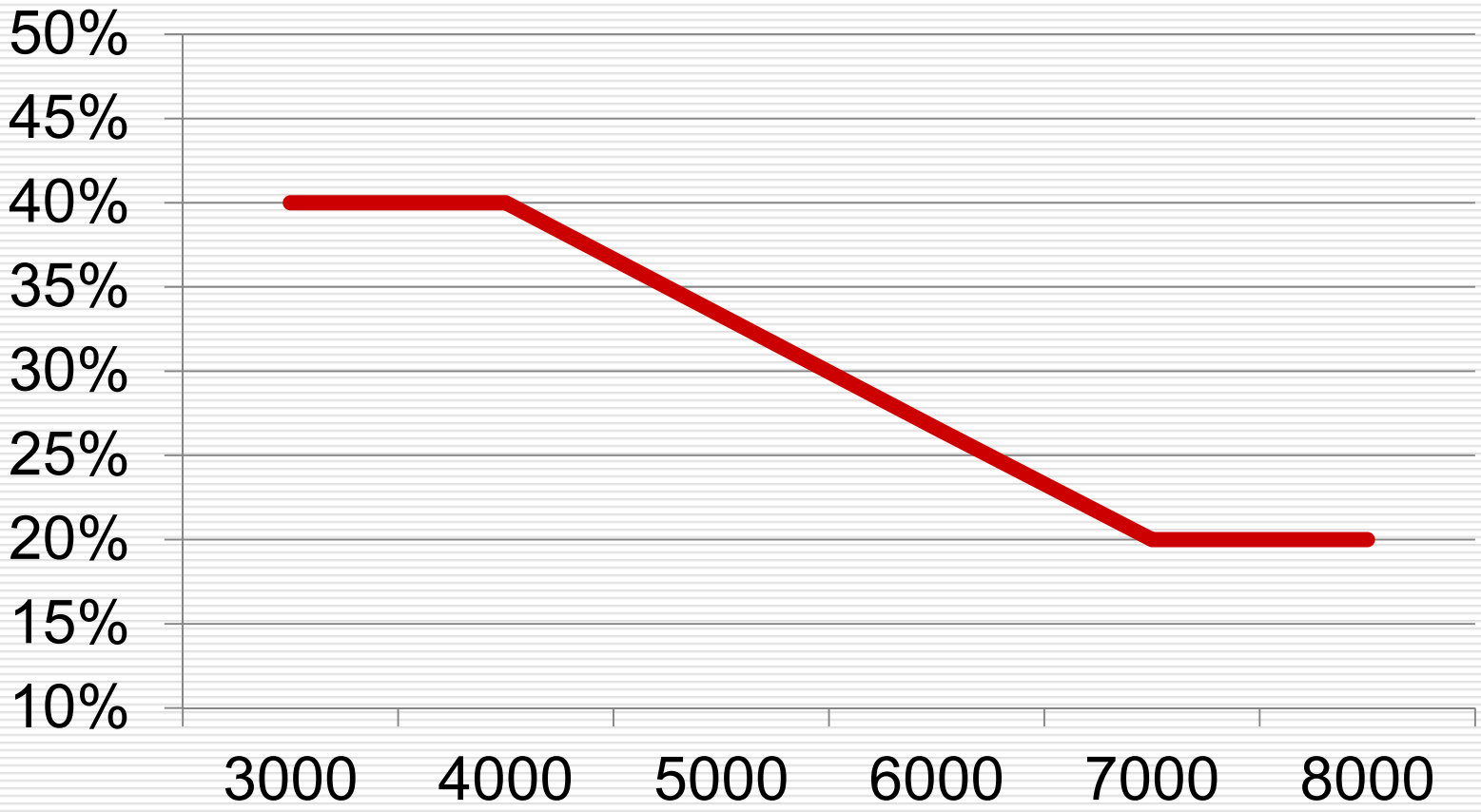
Effective R-Value





FDWR:
Fenestration/Door to Wall Ratio



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FDWR:
Fenestration/Door to Wall Ratio

<40%

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NECB Compliance Options

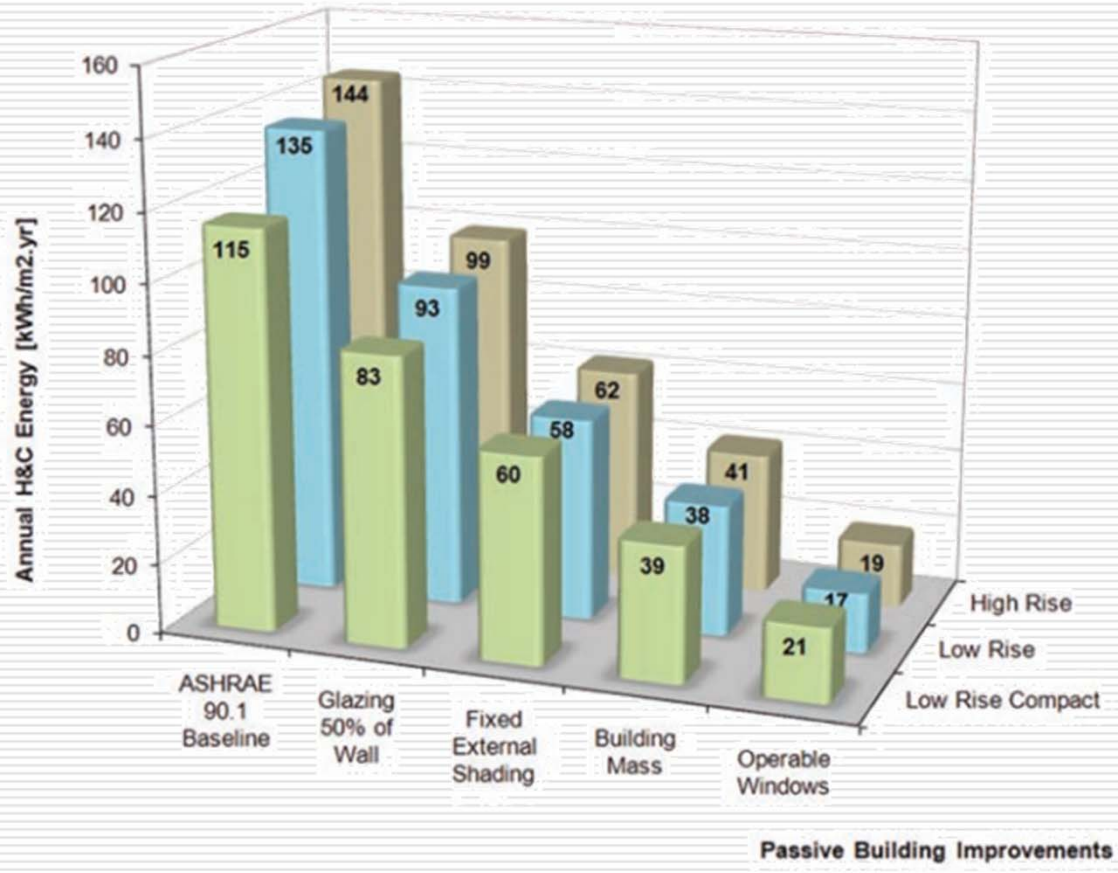
1. Prescriptive Path
   - *Follow each require as stated*
2. Simple Trade-Off Path

$$\sum_{i=1}^{n} U_{ip} A_{ip} \leq \sum_{i=1}^{n} U_{ir} A_{ir}$$

3. Detailed Trade-Off Path
   - *Energy modeling*
4. Performance Path
   - *Performance modeling*

Going further than MNECB

Figure 3: Effect of Passive Design on Energy Intensity



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Toronto Green Standard

- Tier 1 as per OBC changes
- Tier 2:
  - 35% better than MNECB
  - 10% better than OBC

ASHRAE 90.1 (USA)

- USA adoption into building code…

DRYVIT SYSTEMS, INC.

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Fax: 401-822-4510

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Distributor Communiqué

BULLETIN NO: 13-06 **DATE: 10/4/2013** **Important: Read carefully and retain for future reference**

To Our Distributors:

SUBJECT: Countdown to the Energy Code Changes

For the last two years, Dryvit has been talking about October 18, 2013. This is the day that all States are required to certify compliance with the ASHRAE Standard 90.1-2010 as their minimum commercial Energy Code. In other words – Continuous Insulation (CI) will be a requirement in nearly all climate zones – AND, as we all know, Outsulation® = CI.

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EIFS: Finish Options

Cost-Benefit Analysis
EIFS vs. WW

Cost-Benefit Analysis
EIFS vs. WW

Parameter	EIFS	WW
Nominal R-Value	~RSI 4.0 (~R23)	~ RSI 2.1 (~R12)
Actual R-Value	~RSI 3.9 (~R22)	~RSI 0.35 (~R2)
Cost cladding	$120-180/m^2	$250-450/m^2 KCD1
Cost of wall (finished)	$200-300/m^2	$300-500/m^2
Recoating	15 – 30 years	15 – 30 years
Sealants	15 – 25 years	15 – 25 years

Slide 68

KCD1 plug these into the chart
Kevin, 10/15/2013

Closing

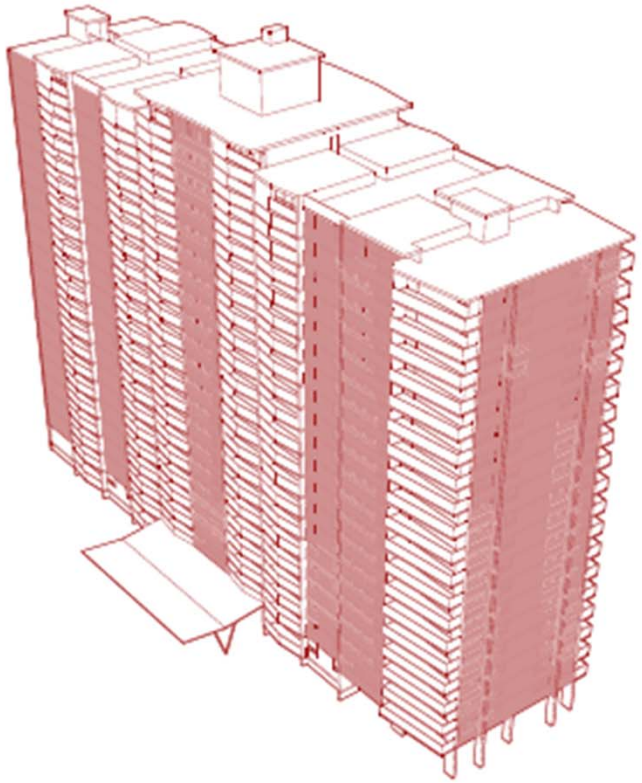
- EIFS = cladding with the **lowest carbon footprint**…
- Benchmarking: EIFS **performs**
- Value **engineering** should add **value**, not detract – use cost savings elsewhere
- Good **service life** hinges on:
  - Critical details (design)
  - Quality control (construction)
  - Maintenance (what & when)

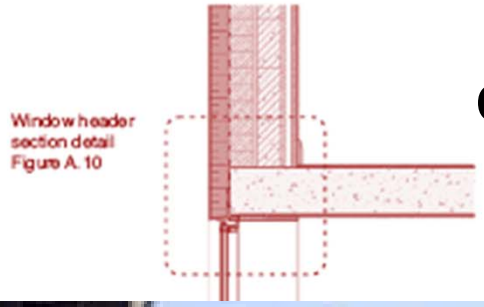
Tower Renewal Guidelines

TOWER RENEWAL GUIDELINES

EIFS Wall Overcladding and Replacement Windows

This section of details and sequence assemblies depicts the design of external insulation and finish systems (EIFS) overcladding and window replacements for plane wall elements without balconies or projections. The shaded areas on the archetype tower building represent typical locations for these types of overcladding and window replacements.





Figur
drawi

EIFS – The cladding with the lowest carbon footprint…

…& *what's the deal with glass-box syndrome?*

Kevin Day

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