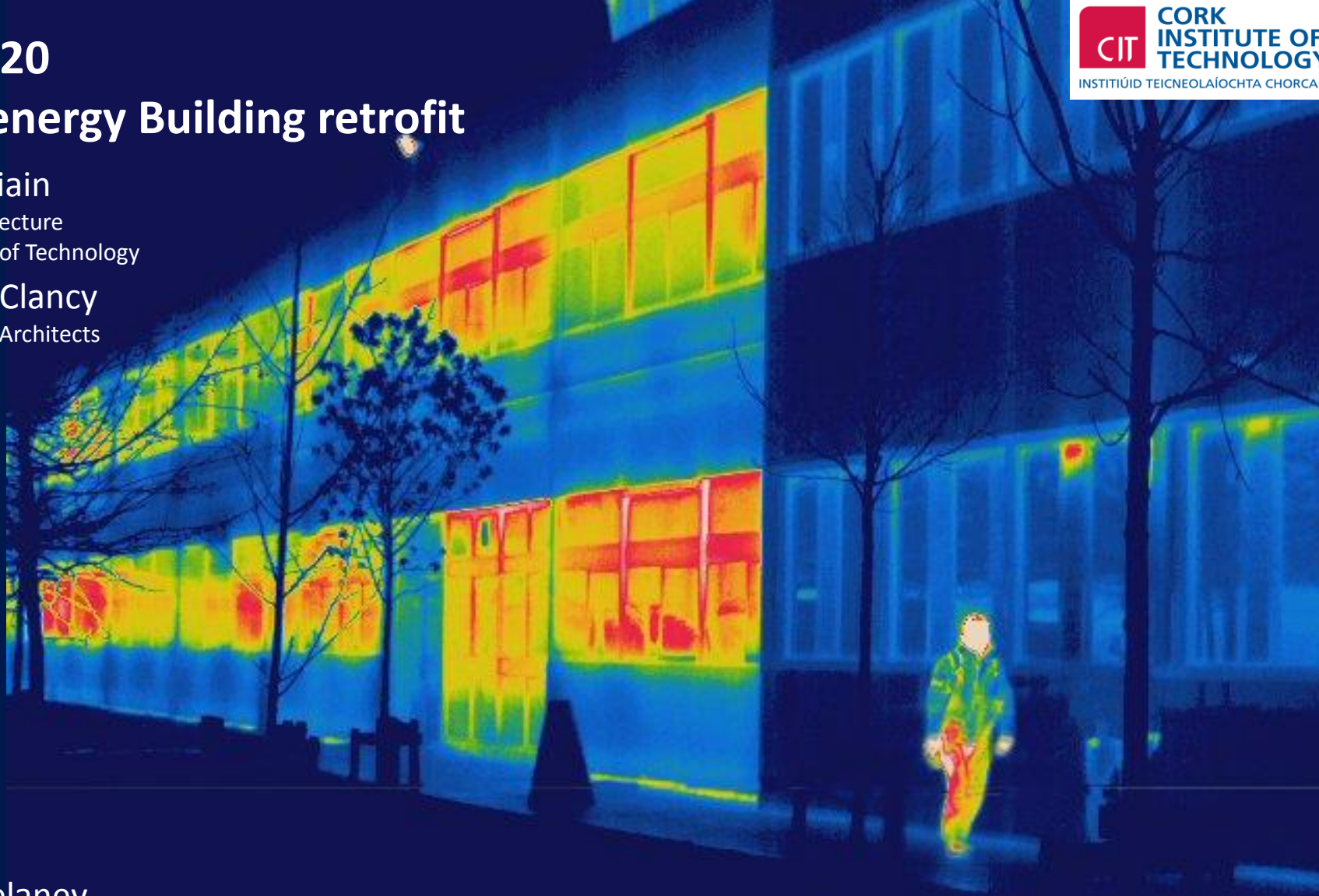
Zero2020
A low energy Building retrofit

Marc O Riain
Dept of Architecture
Cork Institute of Technology

Turlough Clancy
Henry J Lyons Architects



Fergus Delaney
Dept of Process, Energy, Transport Eng
School of Mechanical and Process Engineering

Paul O Sullivan
Dept of Process, Energy, Transport Eng
School of Mechanical and Process Engineering

http://www.zero2020energy.com

What is the zero2020?

The Regional Technical Colleges (RTC)

Design concept based on M&M building Birmingham

Designed by Scotts & Arup as a system build that could be rolled out

Precast contrete frame
Pre cast concrete elevation and roof panels
Blockwork infill
All to a strict 7.2m grid

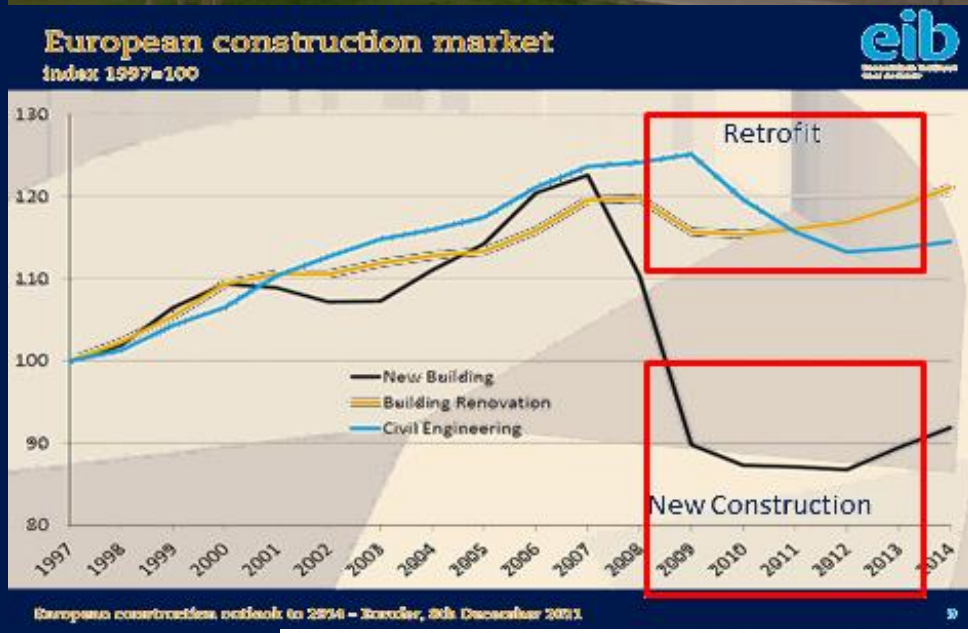
11 RTC's constructed around Ireland between 1970 & 1977Designed for a 20 year life

Coady Arup report in Feb 2011 for redevelopment.

Existing redevelopments at Leterkenny, Carlow, Waterford and Dundalk.

•A low energy retrofit targeting Net Zero energy building (site) performance over 3 stages.

•It's a pilot for a full building retrofit.



Existing Condition

Brief:

- A phased, modular, scalable, flexible, Durable
- Original structure
  poor thermal envelope performance
- poor thermal comfort conditions.

Envelope

- 100mm block leaf
- precast concrete aggregate panel
- well-ventilated cavity
- no insulation
- aluminium window frame
- 6mm single glazing

Roof

- 150mm two way waffle slab & beam
- 25mm thermally drifting Styrofoam and 25mm locally failing asphalt

Existing

No Temperature Control

Un-insulated fabric UA
2.4 W/m2K

High Air Permeability
14.77 $m^3/h/m^2$

Space Heat Demand
99 kWh/m2a

Poor Ventilation Control

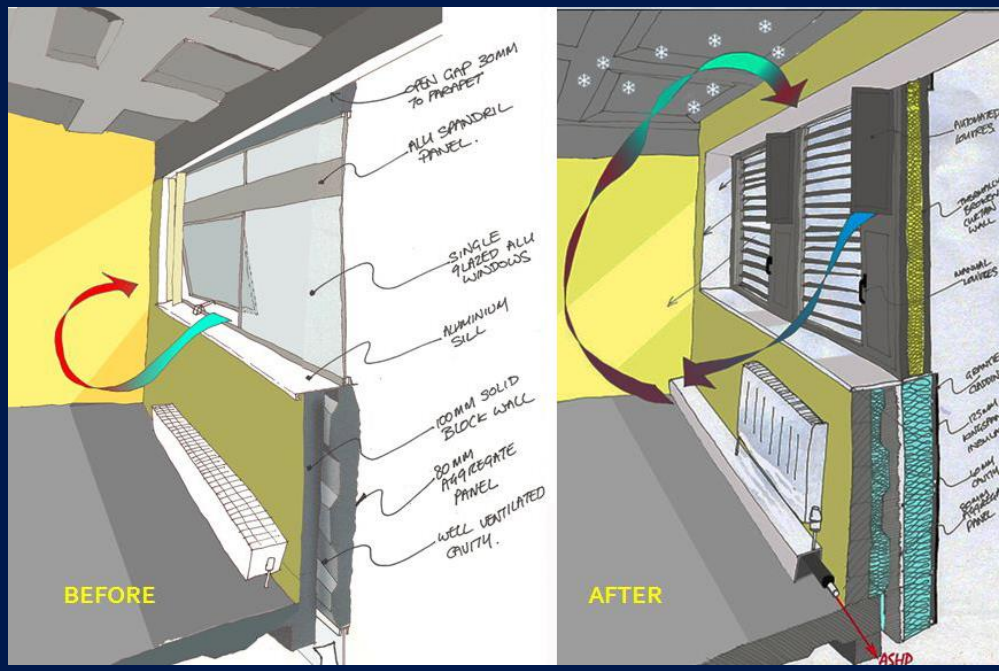
Summer Overheating

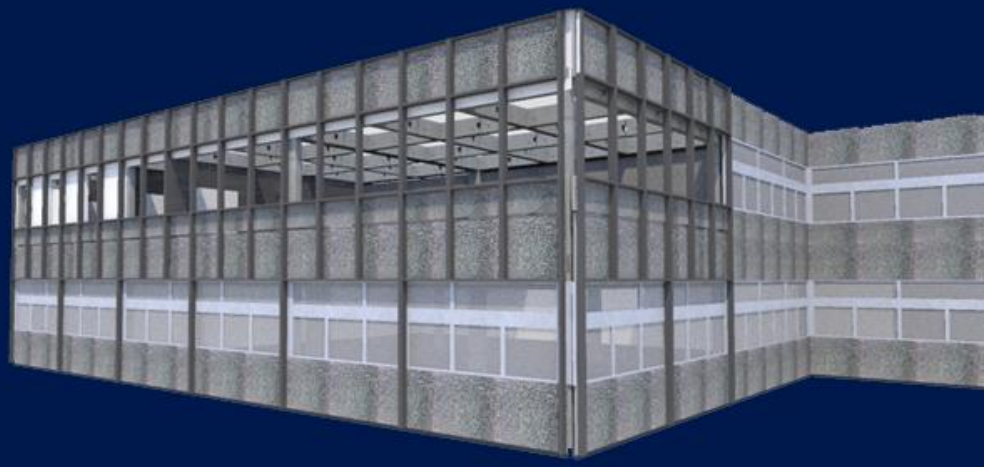
No Energy Monitoring

Recessed T5 manual

Design Solution/Research Team

- Overcladding solution
- locally developed products
- thermal bridging mitigation,
- vastly improved air tightness
- natural ventilation
- Scalable
- Modular
- no structural change
- Maximised material retention
- External granite aggregate panel
- reduced hygroscopic transfer
- highly ventilated cavity
- reduced summer heat transfer
- Interstitial shading



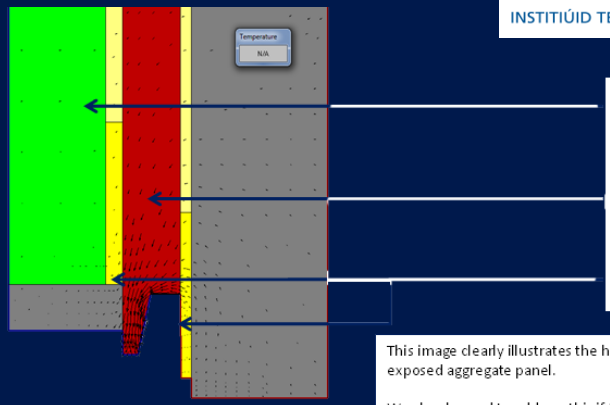


Design Team Appointment

- Initiall ARUP-Engineering
- Later Henry J Lyons-Architecture

Research Simulation

- IES dynamic simulation modelling (ARUP 2011).
- Therm 5-thermal performance
- Heat-transfer analysis helped iterate
- Lowered thermal bridging
- Lowered condensation risk
- Indigenous Product Solutions
- Kingspan, AMS & Wesco
- Turnkey solution
- scalable solution



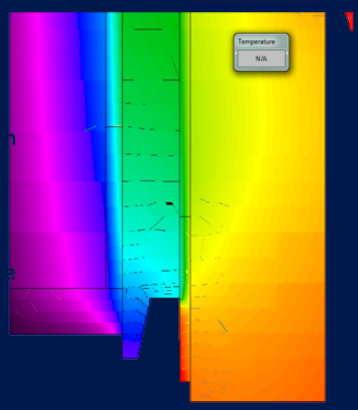
This image clearly illustrates the heat movement through the exposed aggregate panel.

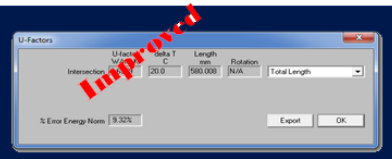
We clearly need to address this if the research project is to be achieved.

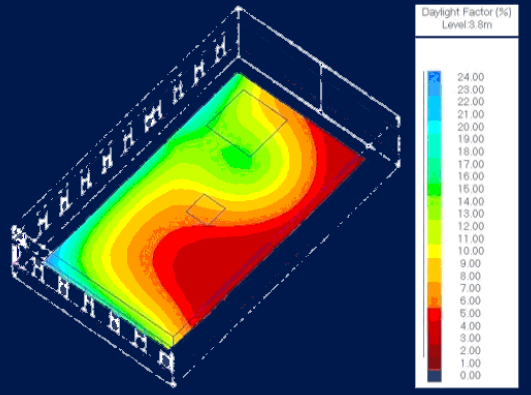
By taking 2 simple steps, a further 30% improvement in U value performance for this junction can be delivered.

1. Replace Rockwool with EPS insulation sandwiched between the new Kingspan panel and the aggregate panel.

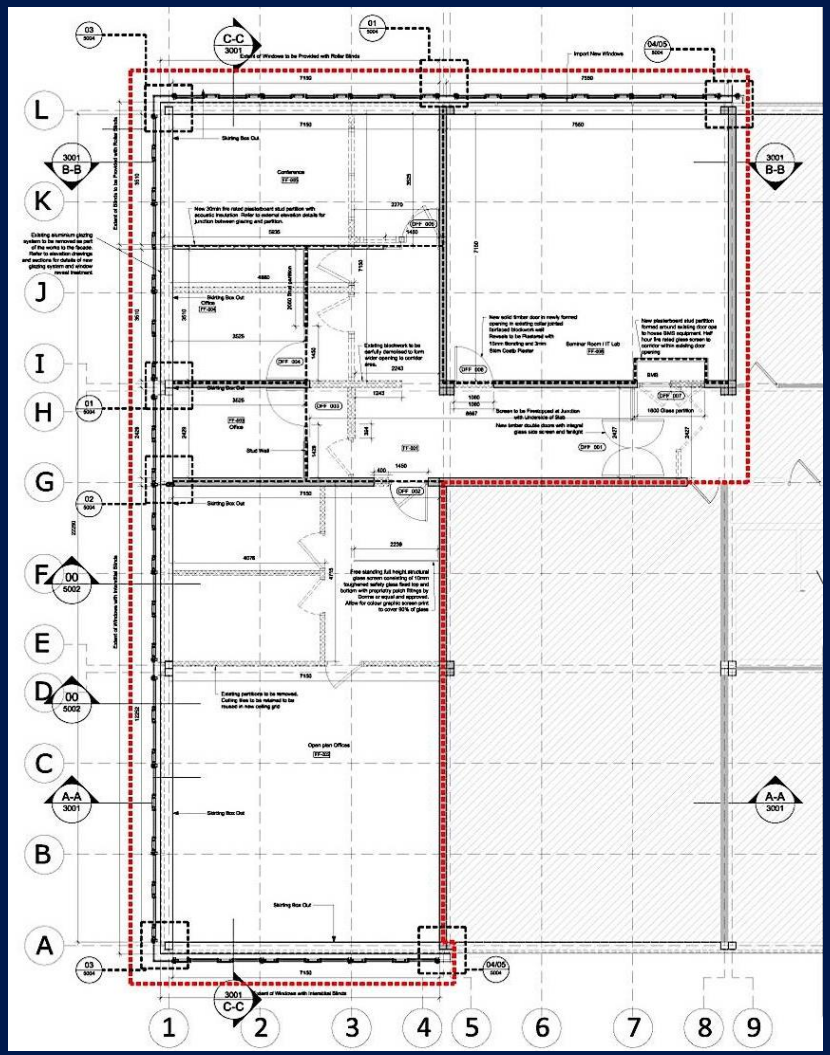
2. Phenolic injection foam into the interior cavity which would also help with air sealing. It has minimal shrinkage and non VOC.

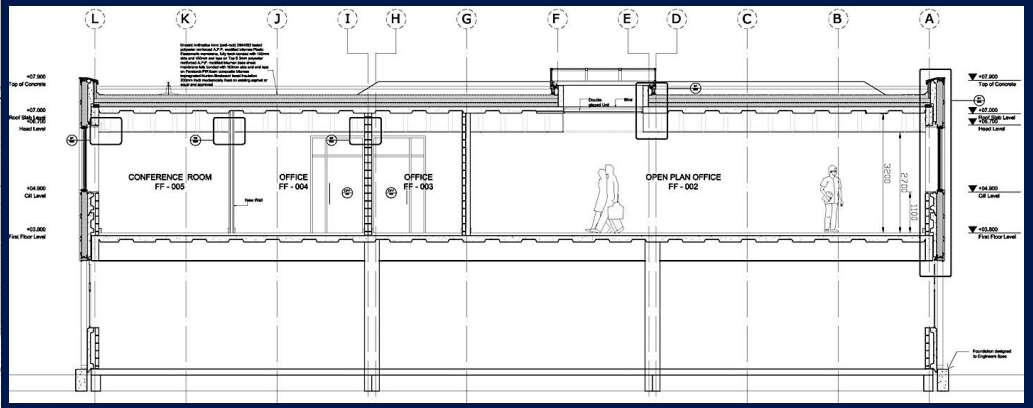


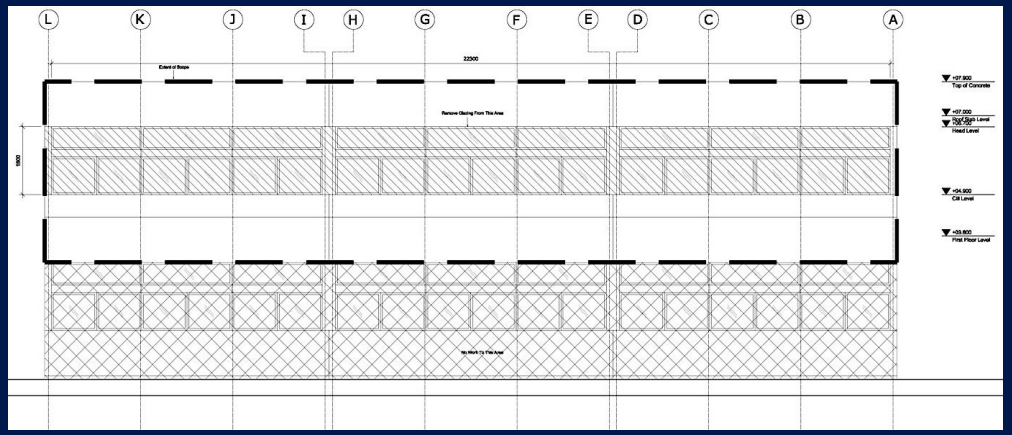




Project Area







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Henry J Lyons
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Principal elements

Roof Options

- Restricted by limitations of project extent
- Inverted roof system
- Cladding System

Wall Options

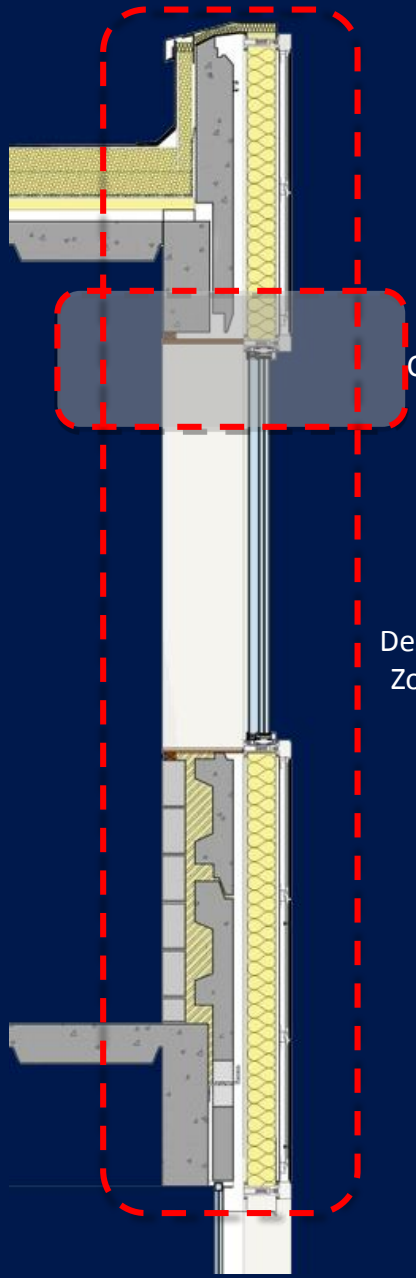
- Leave existing panels in place – quality?
- Insulated render system
- Insulated Cladding Panels
- Rainscreen System

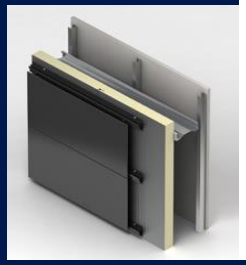
Glazing Options

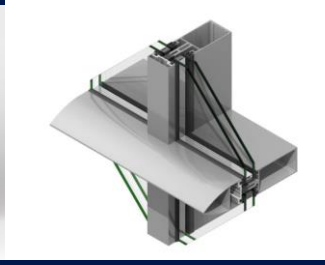
- uPVC
- Thermally Broken Aluminium
- Alu Clad

Design Considerations

- Junctions between three elemnets
- Airtightness
- Ventilation Strategy
- Cooling Strategy
- Glare
- Solar Gain







- Patented Thermal Break
- Profile design 'in house'
- On site testing rig
- On site aluminium extrusion line
- On site powdercoating
- On site fabrication
- Certified u-values
- Range of finishes including
- Zinc
- Cassette Panel
- Corten
- Timber
- Ceramic Granite
- CWCT tested
- "Dry System"
- Certified U-values

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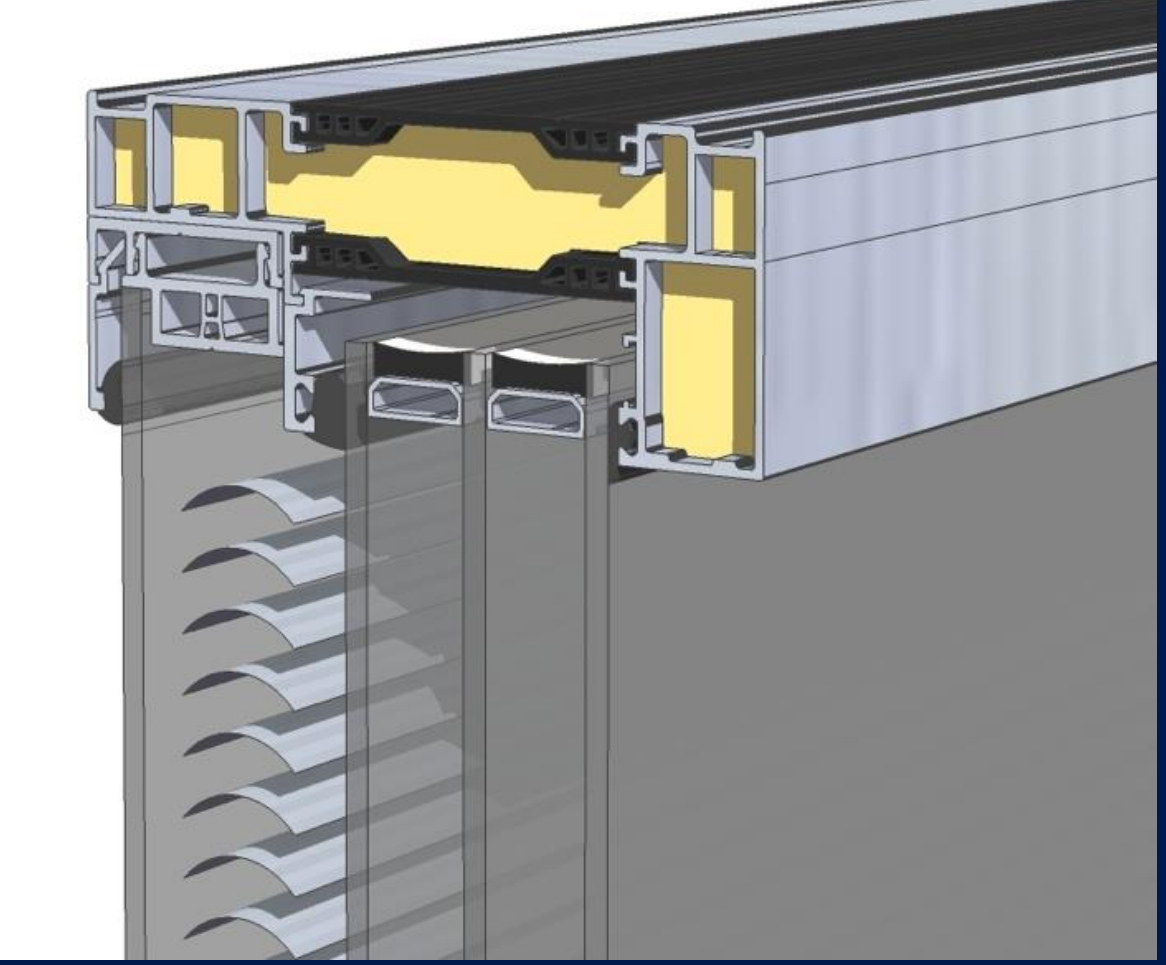
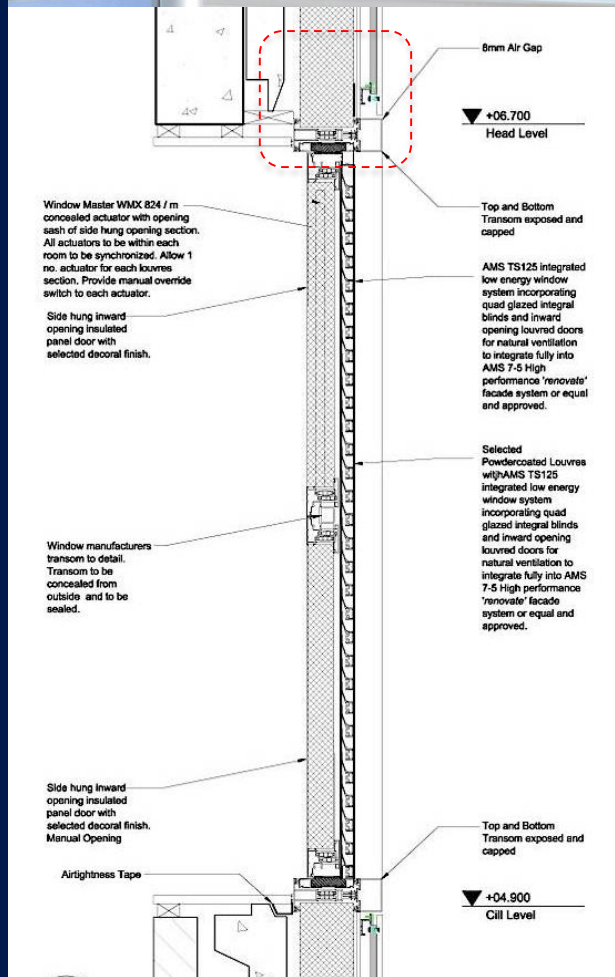
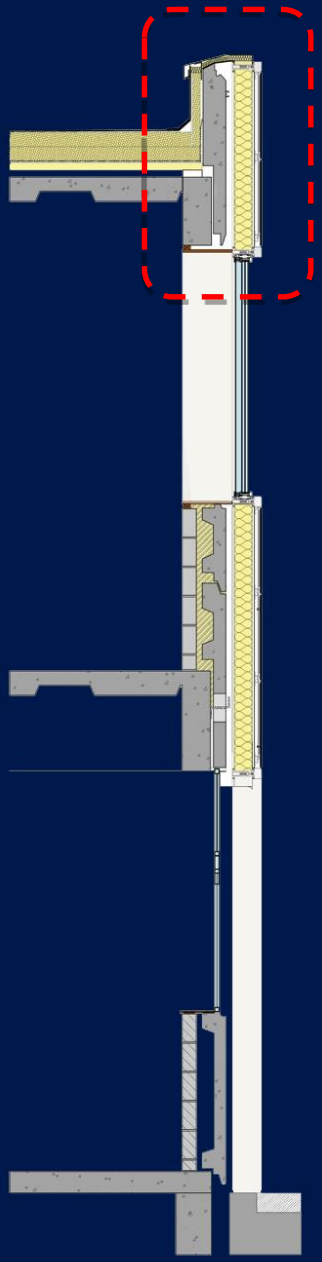


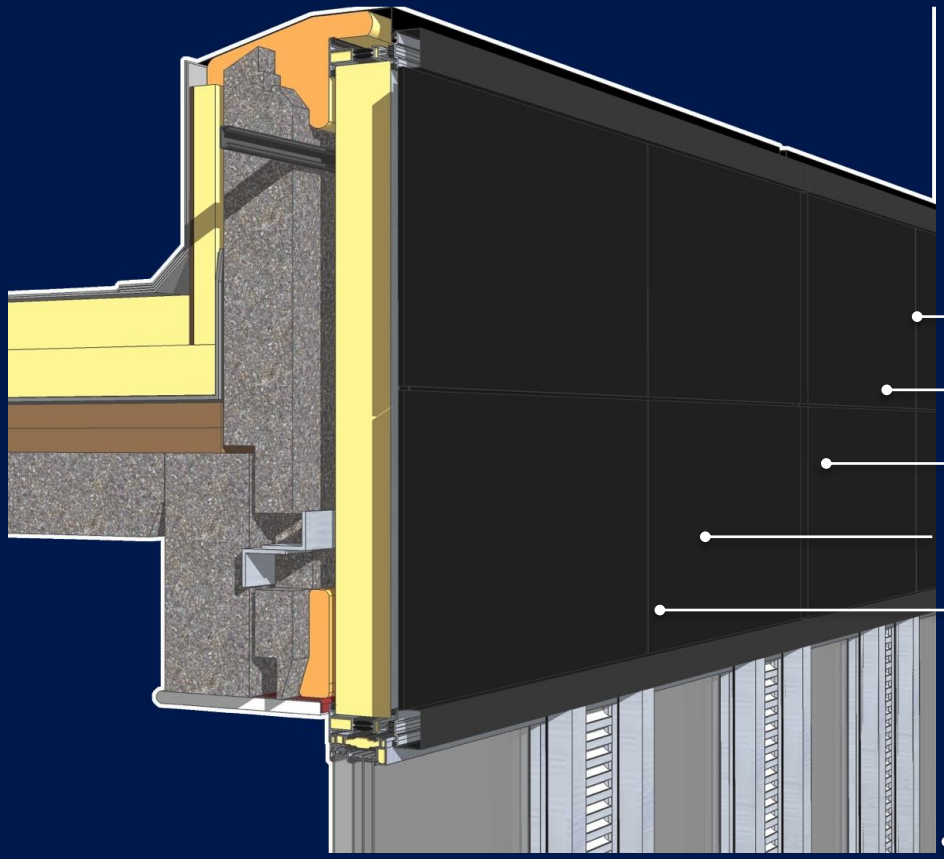


- Aluminium foam filled thermally broken curtain wall system
- 48mm triple glazed krypton filled sealed unit
- 24mm interstitial blinds behind 4th (removable) pane of 4mm clear float glass with thumb turn open/close operation
- Certified U-Value of
- High and Low inward opening vents (soild – insulated)

- Top opening vent has concealed motorised actuator linked to BMS
- Manual override button for motorised vents
- Fixed louvres to exterior

- All aluminium profiles designed & extruded in Cork – 14 no profiles
- Foam filling of aluminium by Munster Joinery





12mm Ceramic Granite Panel

130mm Insulated Carrier Panel

Carrier Rail

25mm Residual Cavity

Existing Concrete Panel

Carrier Rail

Cover Cap

48mm Sealed Triple Glazed Unit

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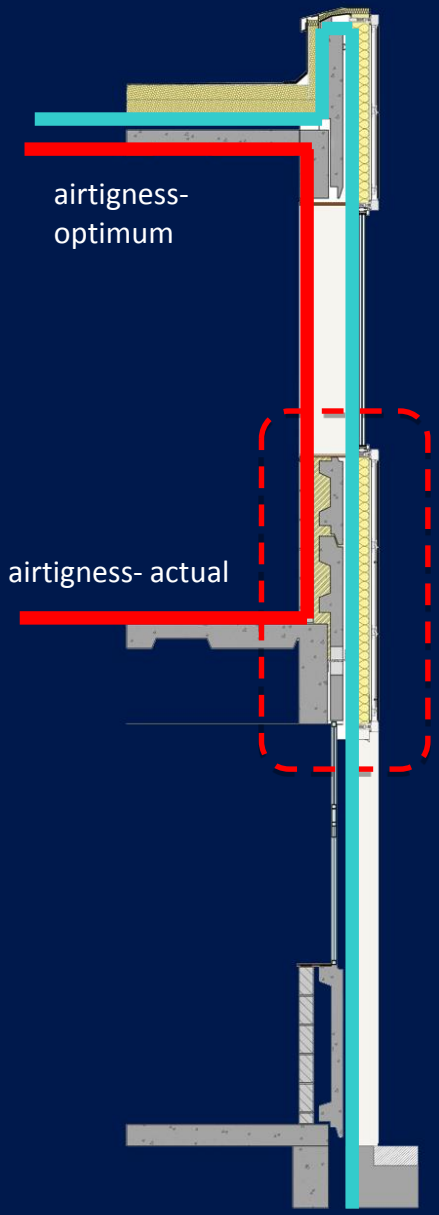

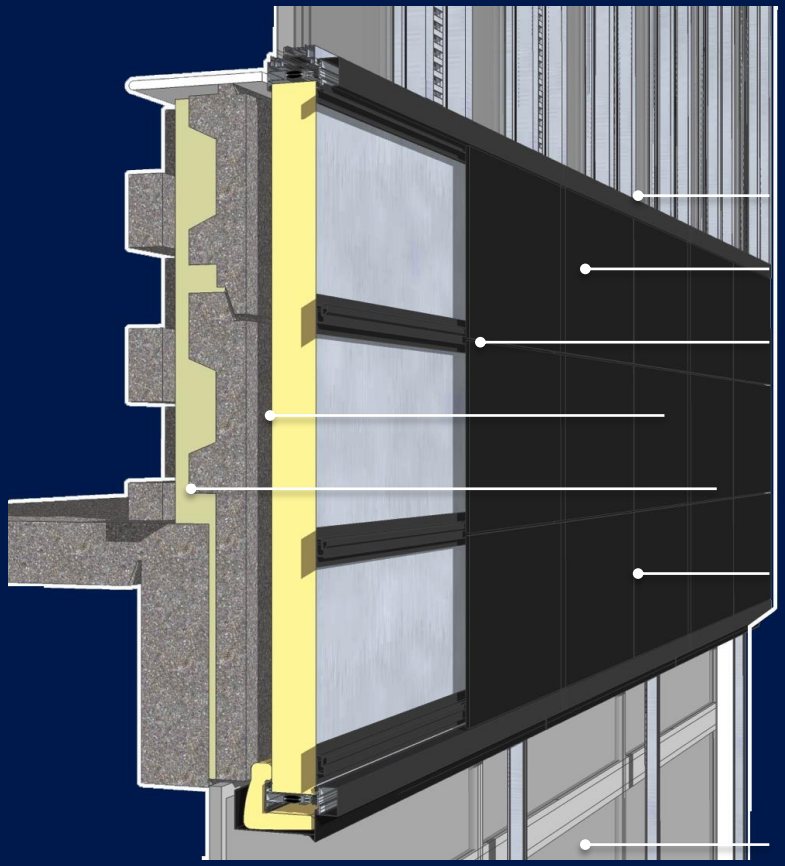

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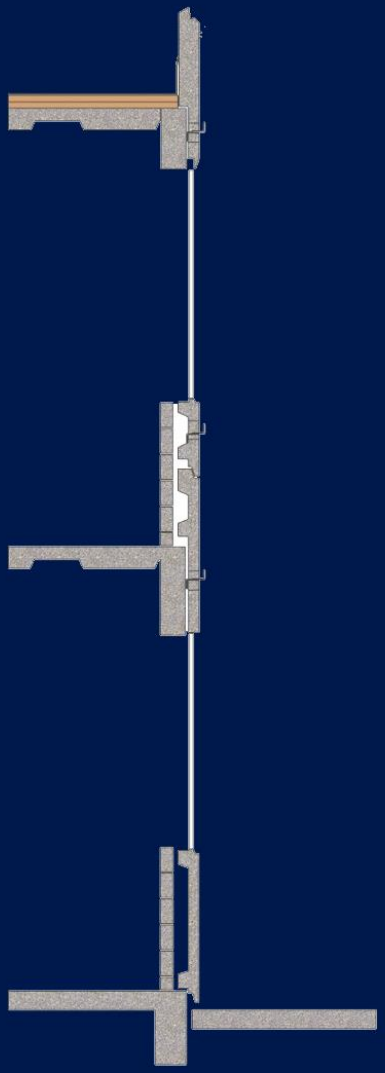

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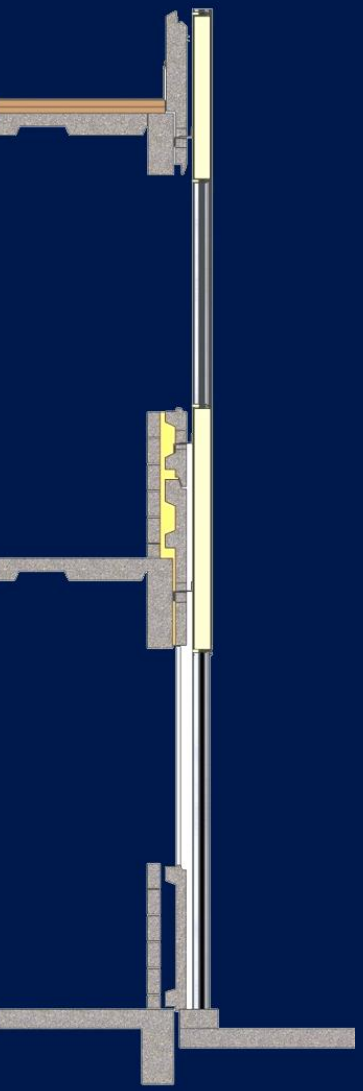

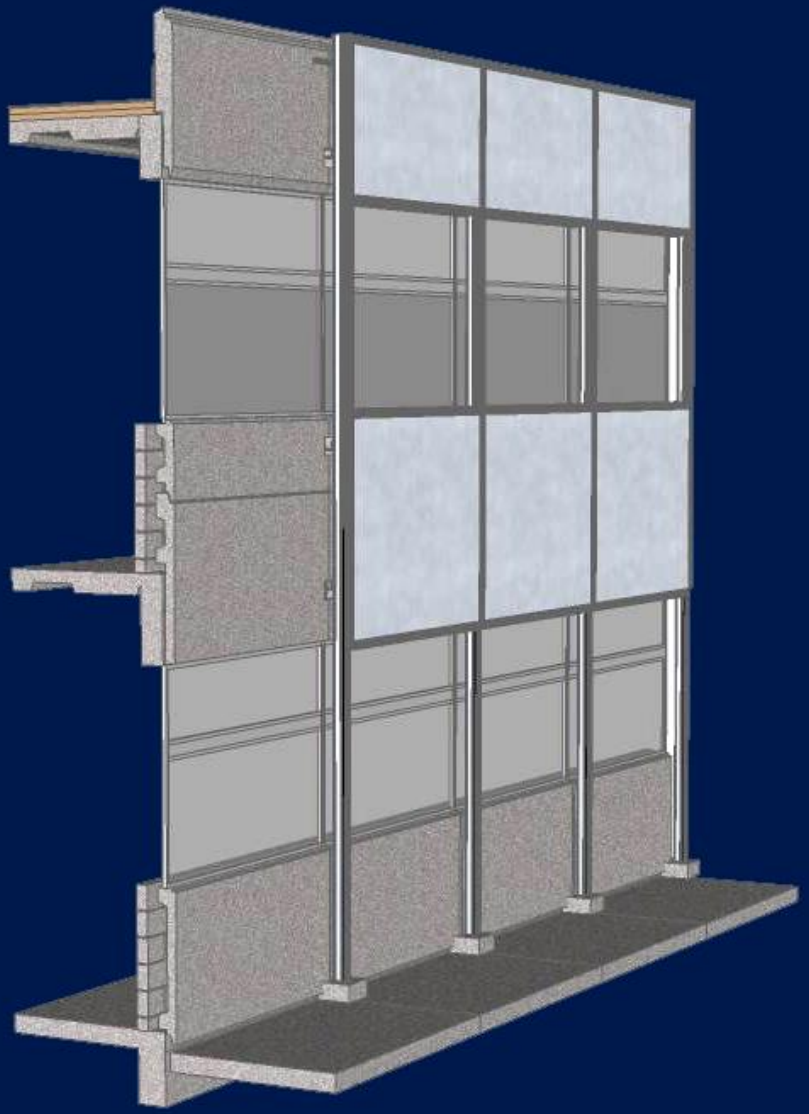

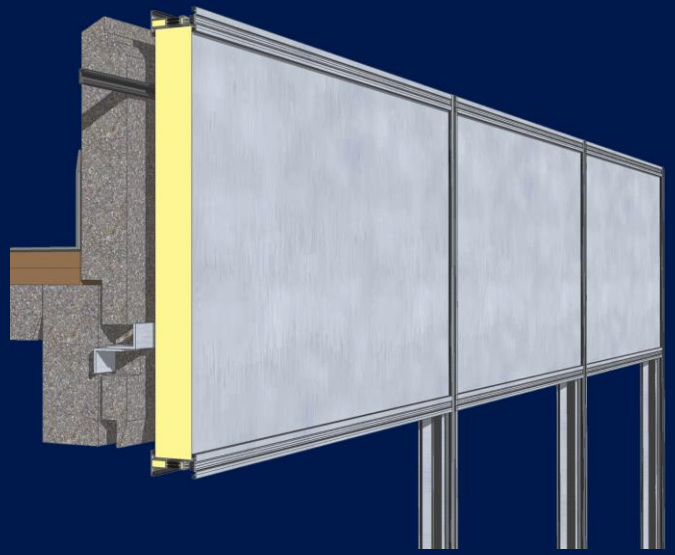

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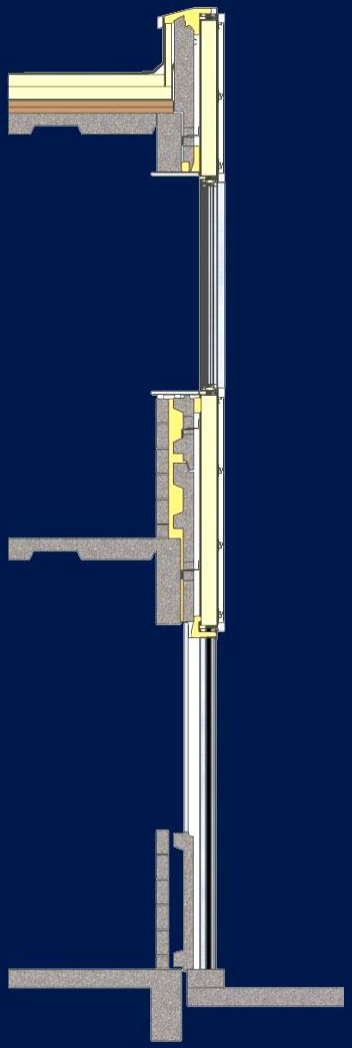

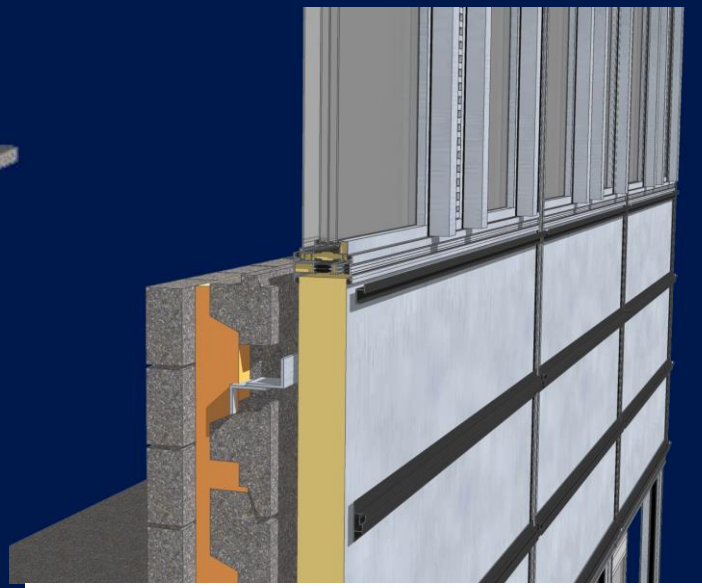

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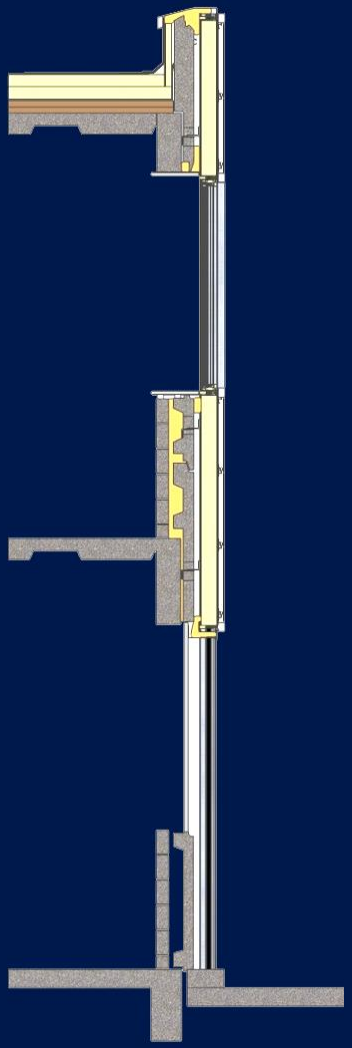

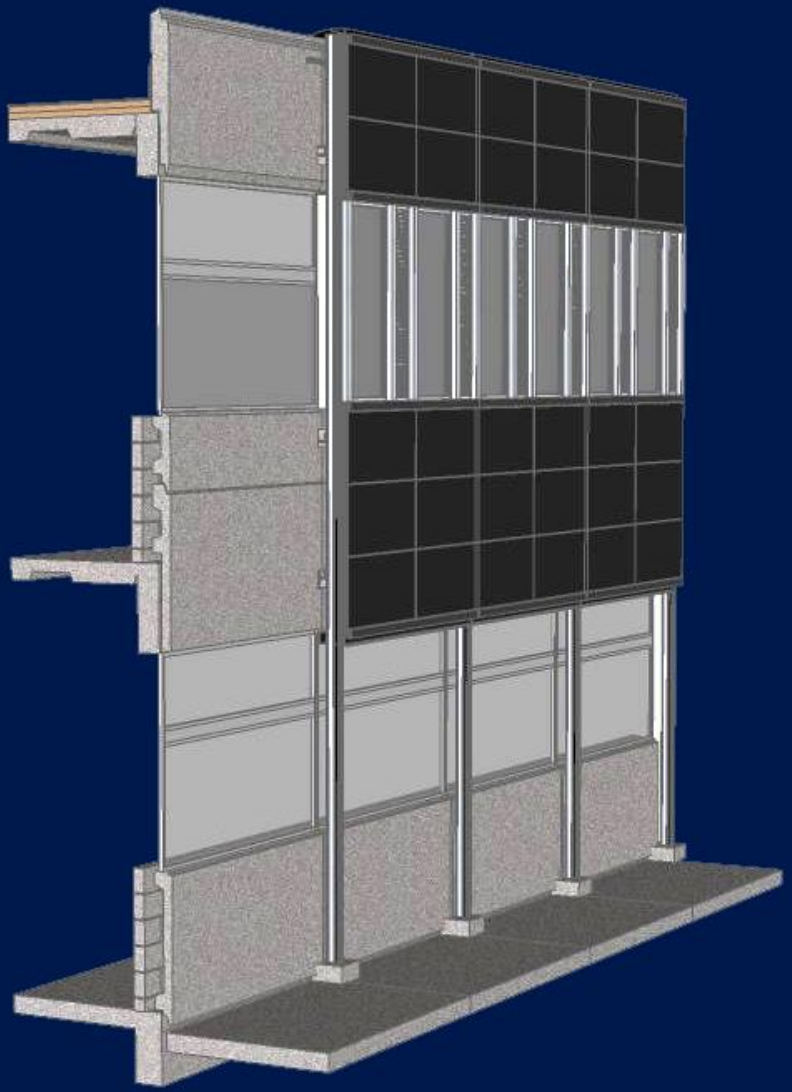

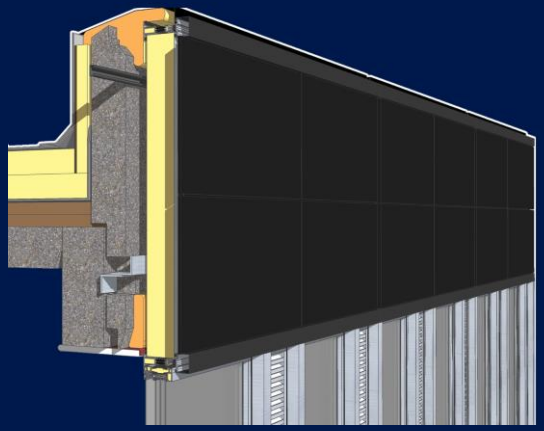

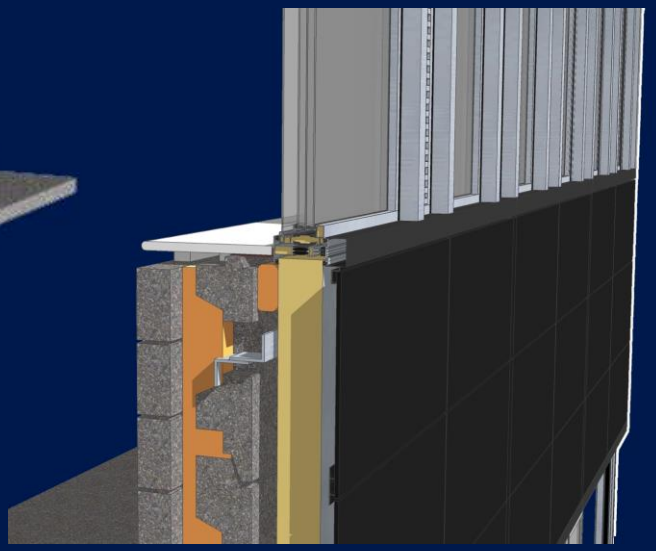

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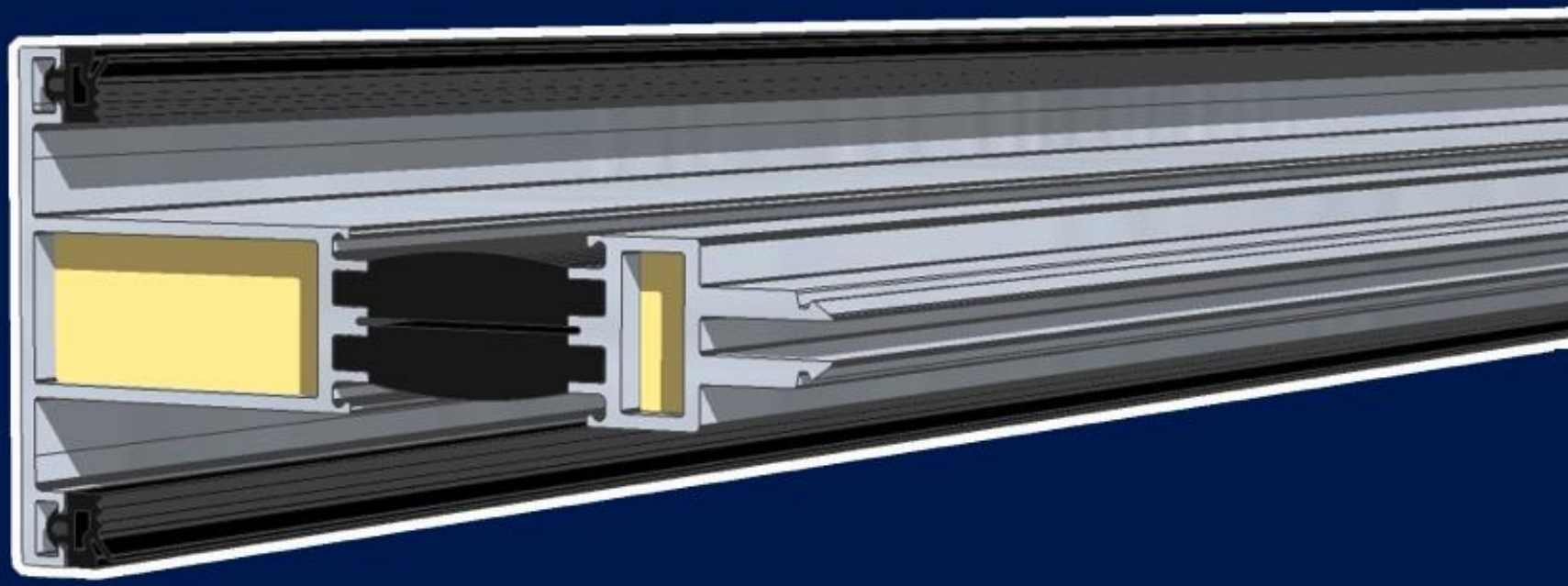

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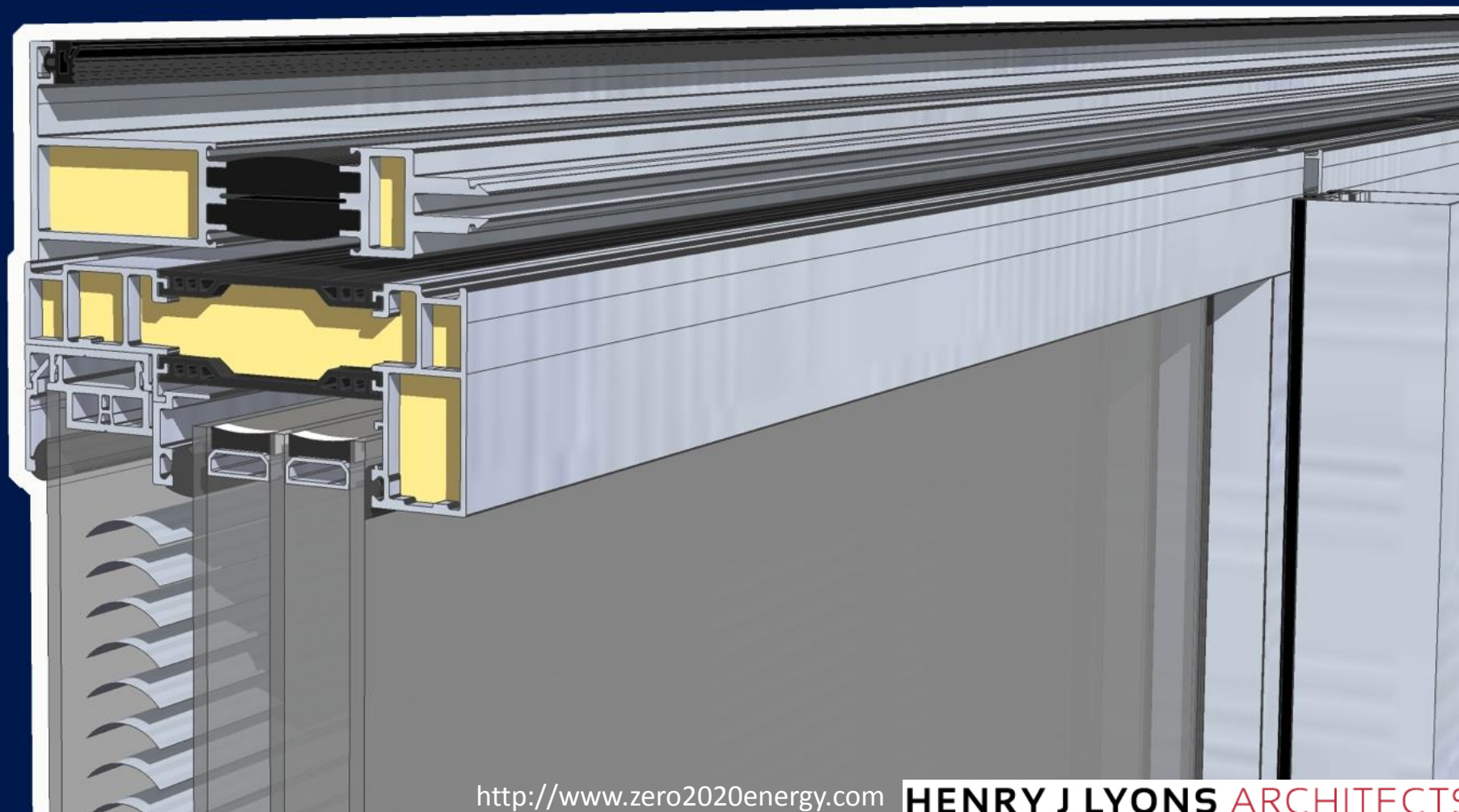

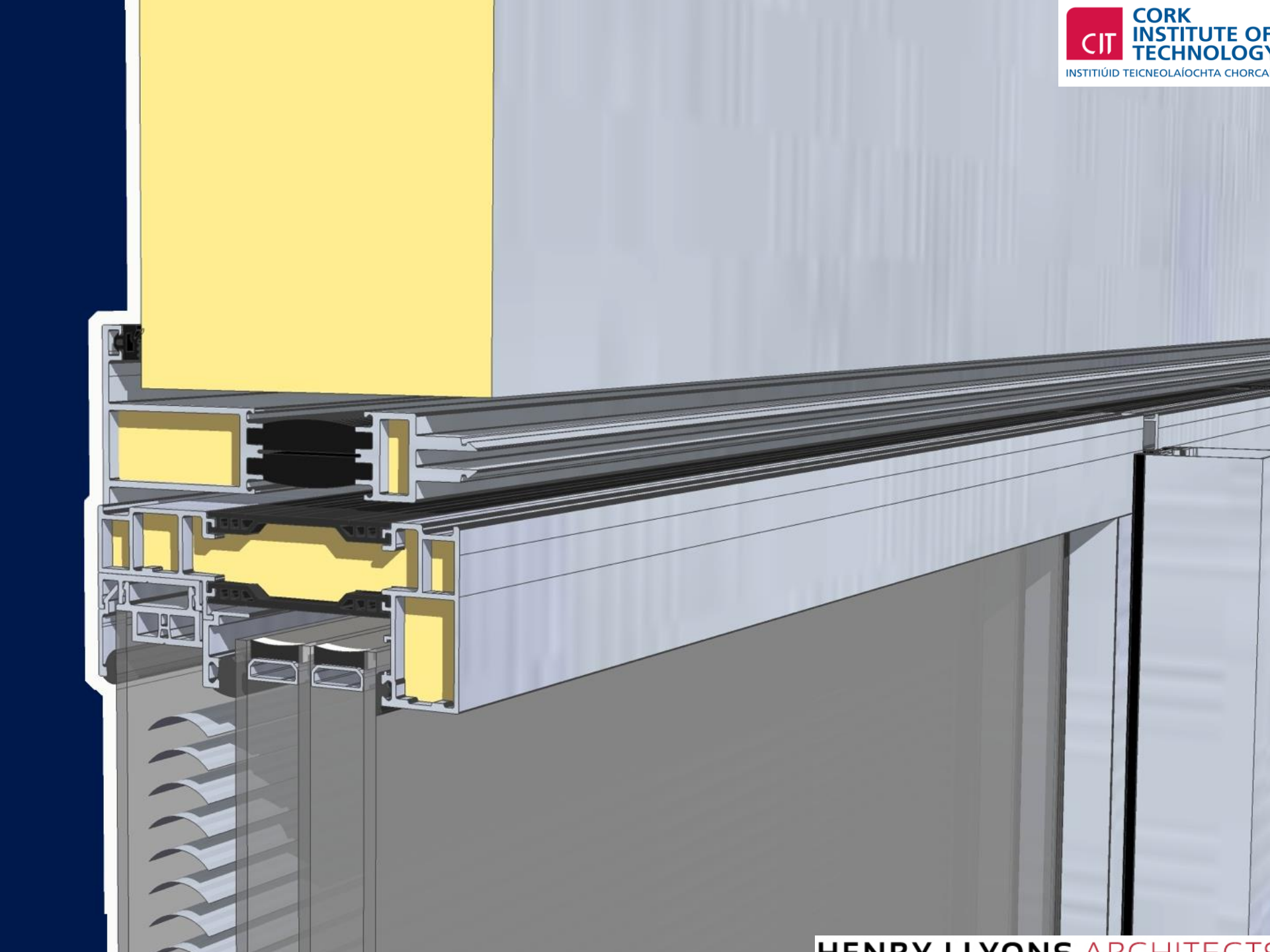
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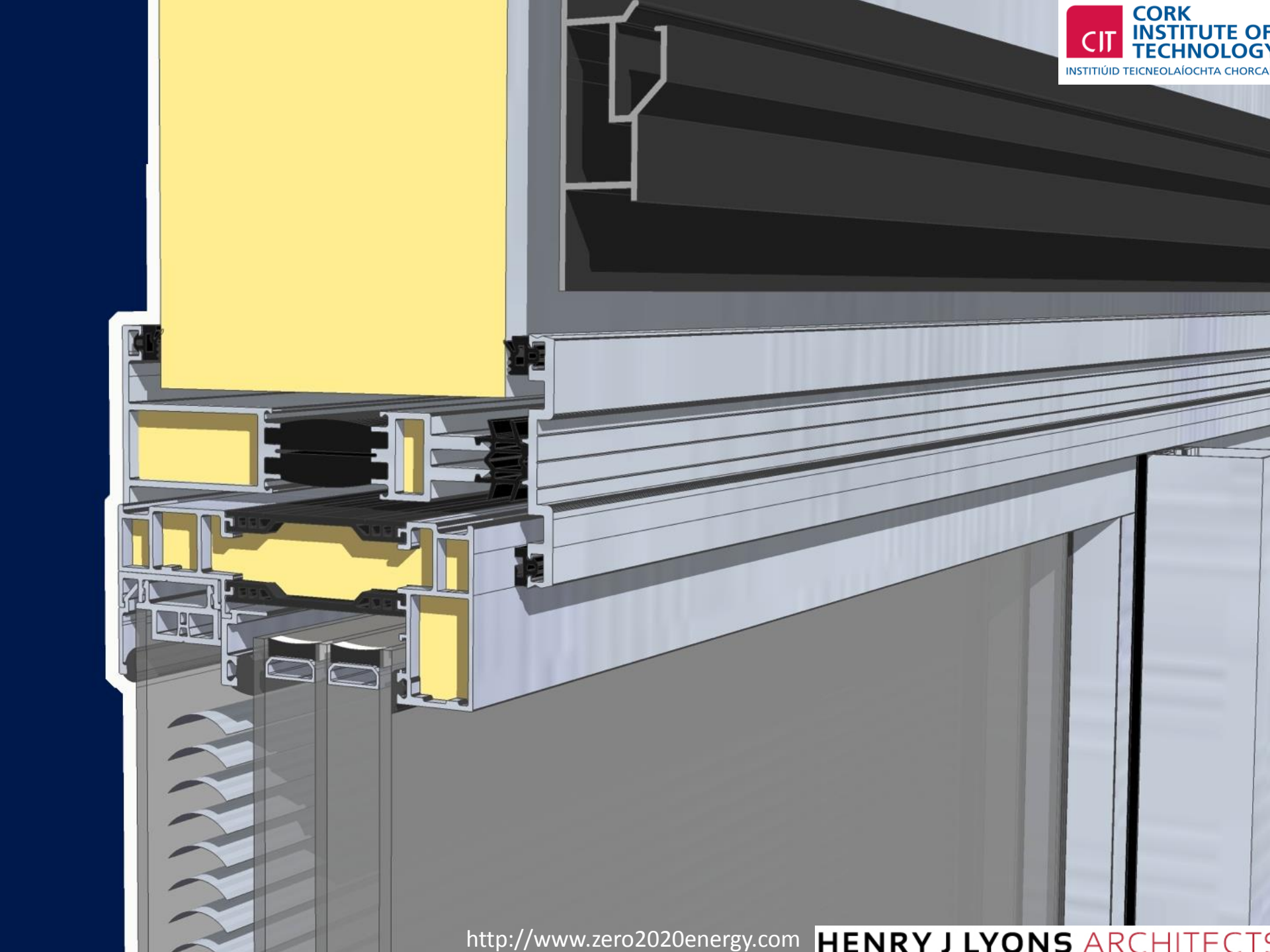
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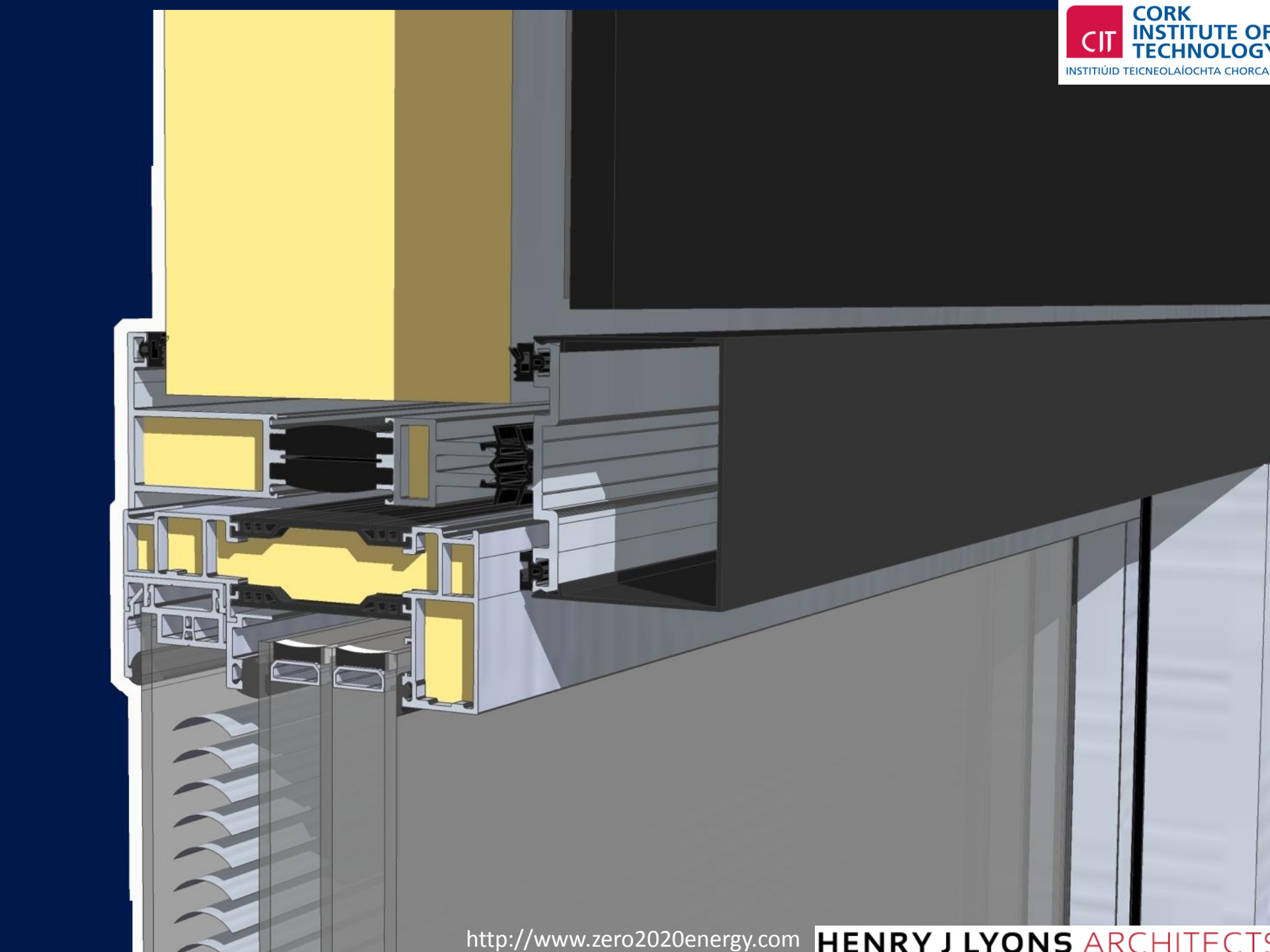
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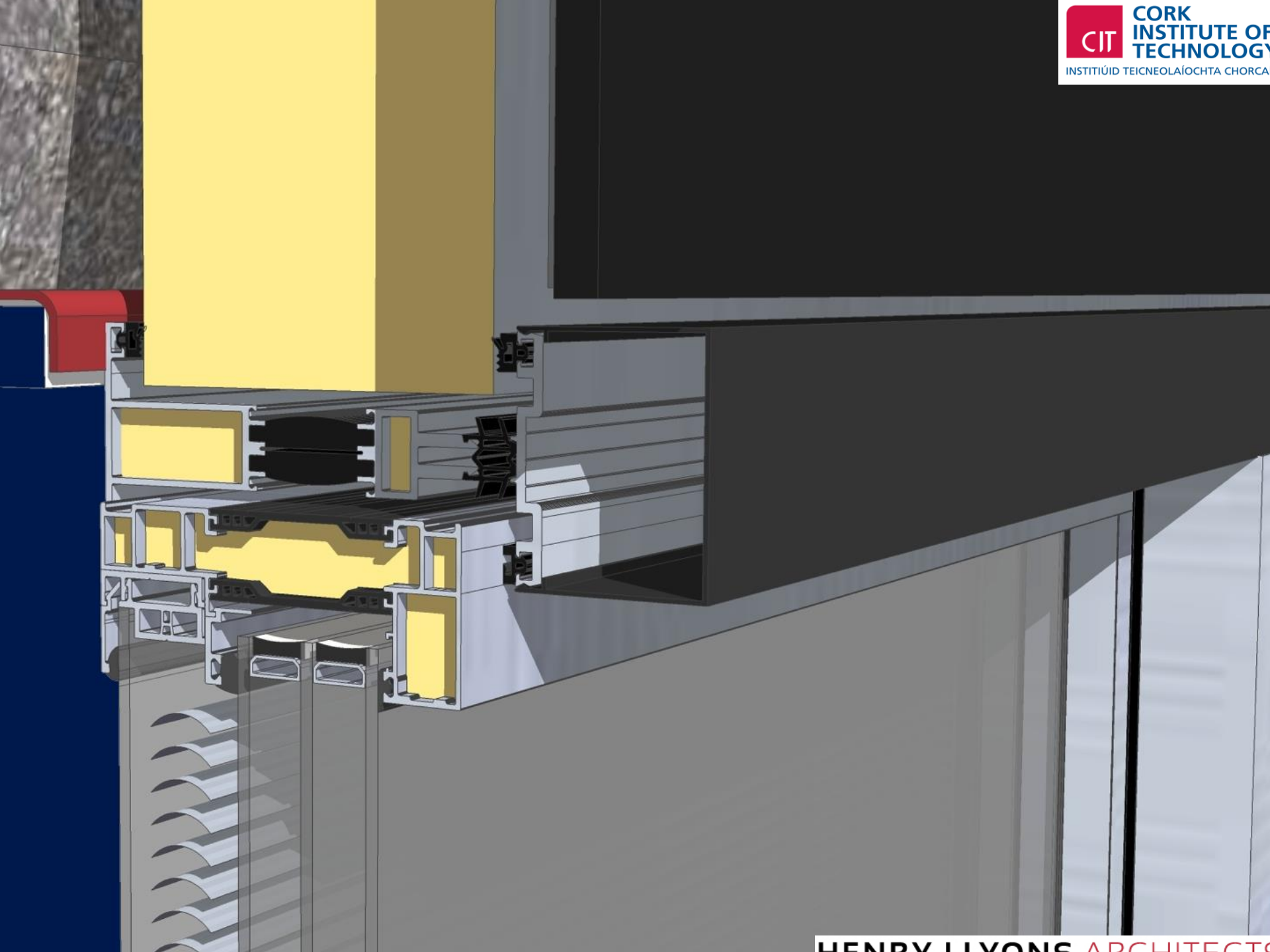
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Did it work?

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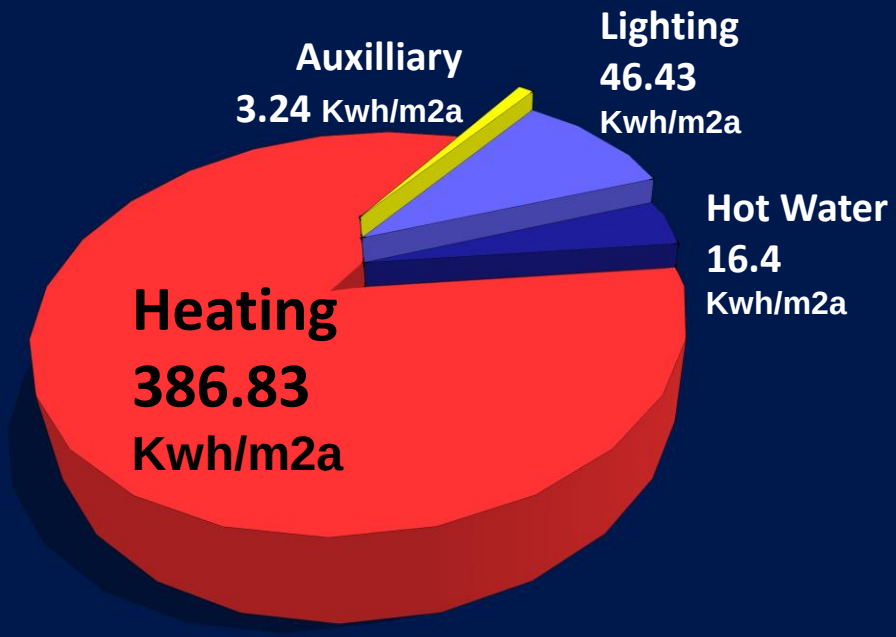
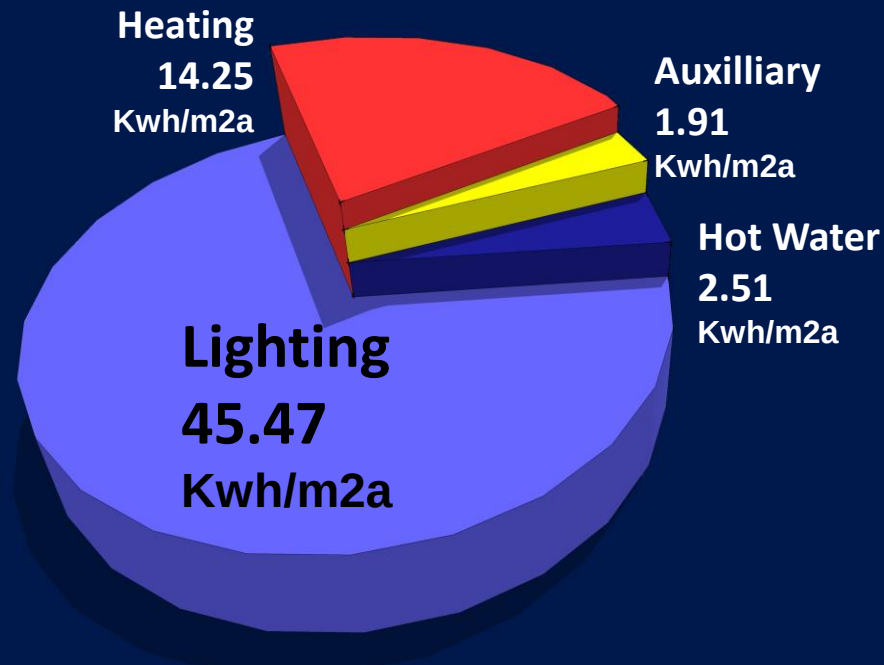
Building Energy Rating Assessment Results

All figures above are delivered energy
A3 is based on phase 1 of zero2020 project
A1 very difficult to achieve without electrical renewable energy / high efficiency lighting
Phase 3 of this project covers renewable energy supply systems to meet net zero site energy





1974 Asset Rating – D2*

** Assuming 1974 building could be maintained at 20°C*

Zero2020 Asset Rating – A3

Paul O'Sullivan and graphics by Marc O Riain

Energy Performance – 1974 B Block

Gas Based Annual Thermal Energy Consumption

99 kWh/m²/yr delivered energy

Why is existing building perceived as performing well?

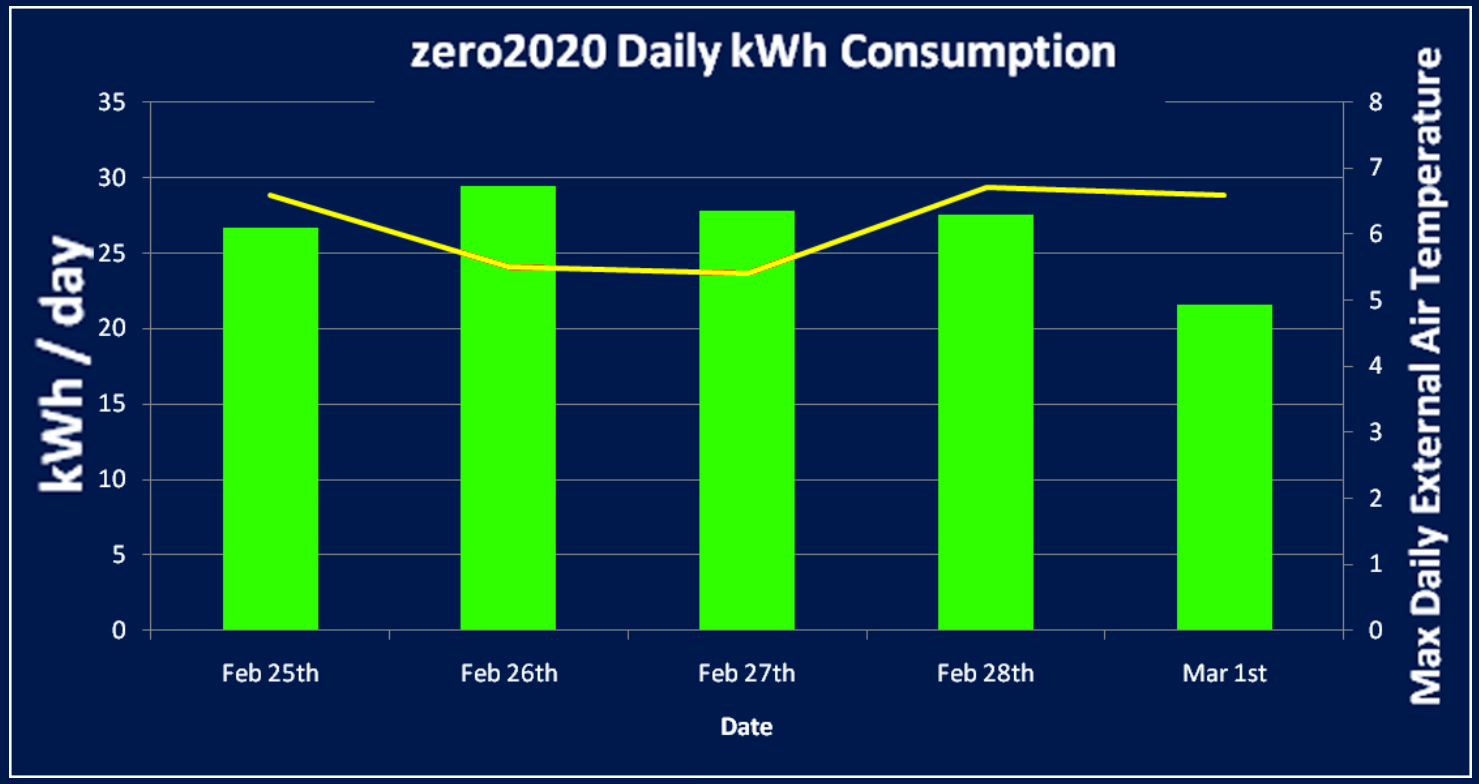
- Conventional radiator system with no individual space temperature control
- Common return water setpoint control (>29,000m²)
- Time scheduled even during occupied hours (currently not demand controlled)
- Average Hours of Operation - 6 h/d 5 d/w
- Existing building never above 21°C based on A262L

Energy Performance – zero2020 retrofit

Electrical Based Thermal Energy Consumption

133 kWh
(over 250sqm)

for working week
25th feb – Mar 1st
0.53 kWh/m²



€10 heating 1 week

(Note this is 1 week of data – annualised values not yet available)

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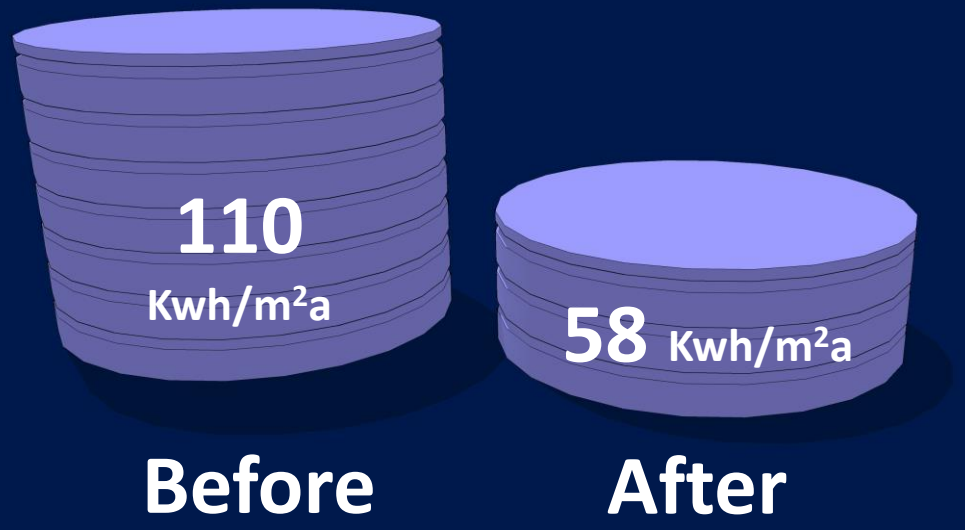
Performance

Calculated Thermal Energy Use
(kWh/m²/yr) delivered energy

Actual Electrical Energy Use
(kWh/m²/yr) metered values



* 1974 heating system cannot maintain the building at 20°C

Data Paul O'Sullivan/Graphic by Marc O Riain

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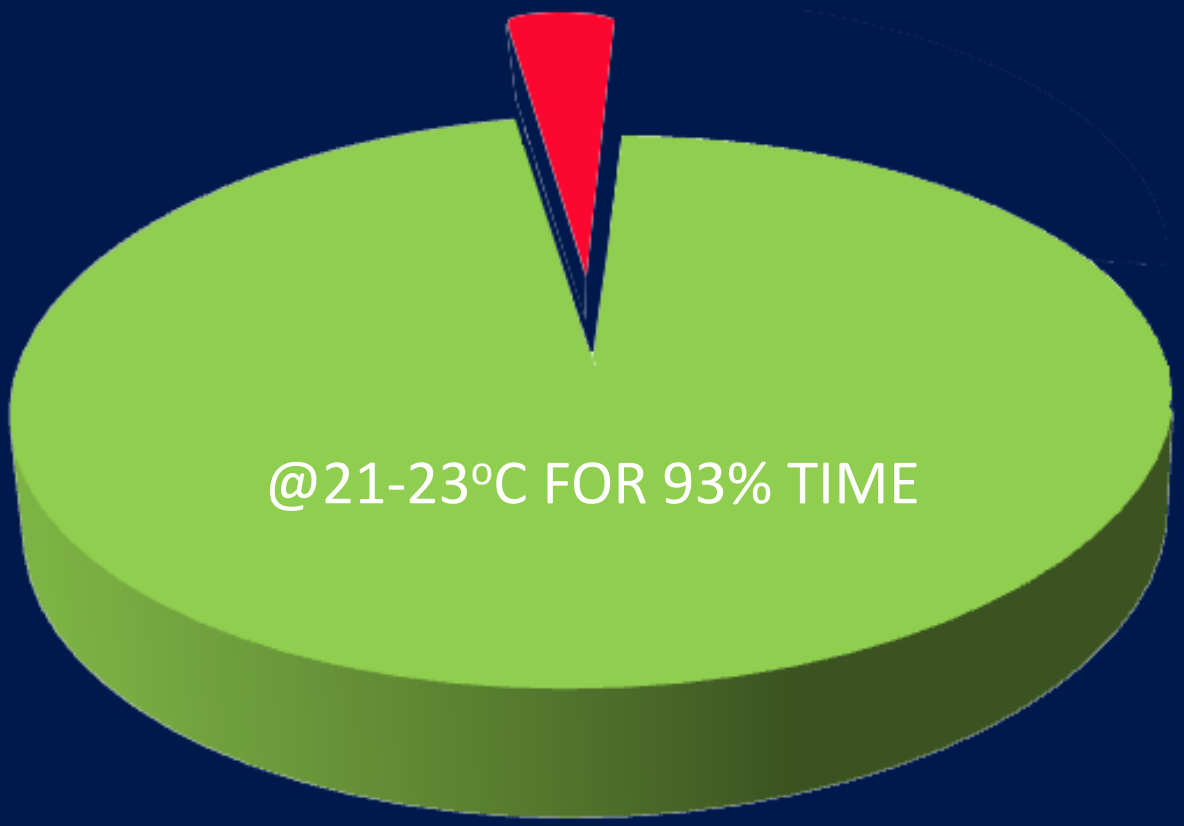
Thermal environmental performance

(Figures are base on occupancy from 9am to 6 pm, Monday to Saturday)

70% of the time the temperature is within 21-23°C

90% of the time the temperature is between 20 -23°C

3% of the time the temperature is above 23°C. This occurred between 3rd and 6th September and never exceed 25°C.

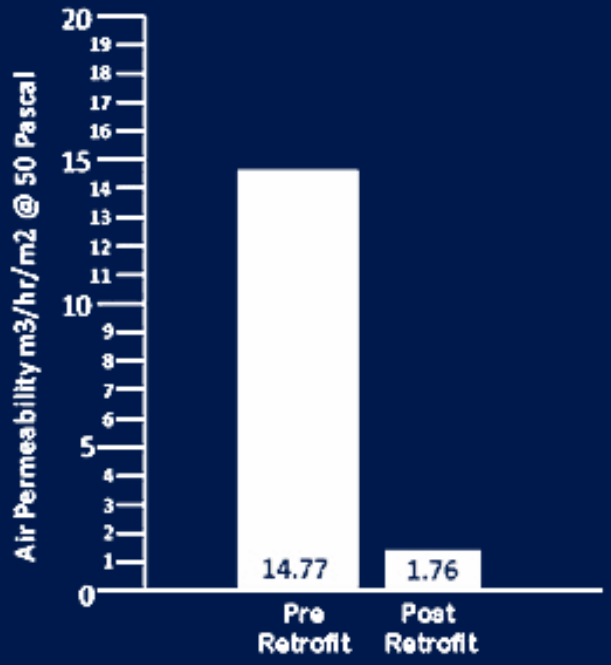


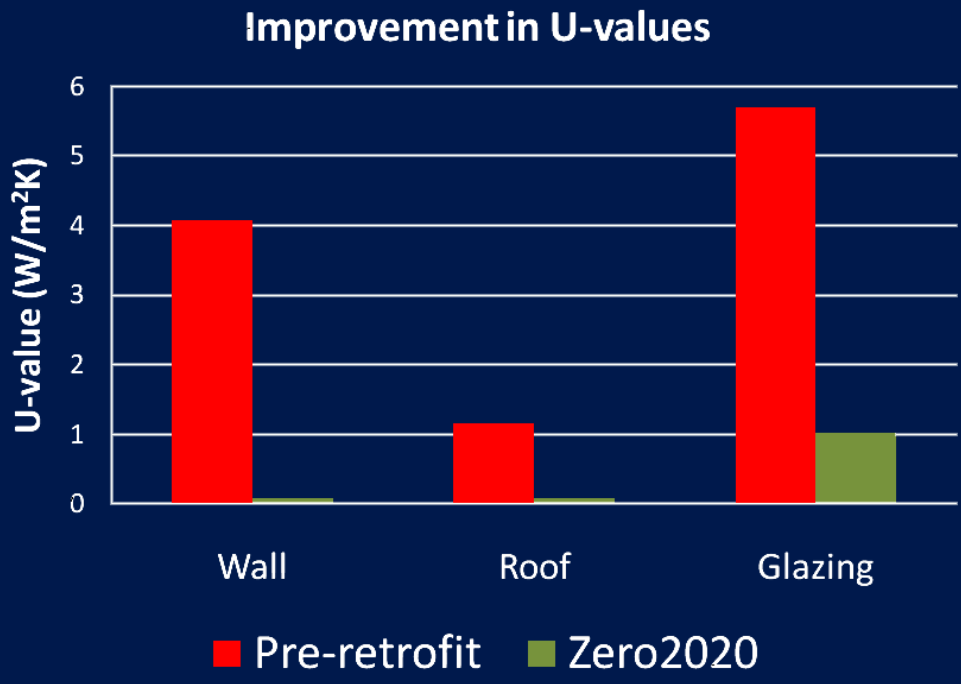
Building element performance

Substantial reduction in steady state thermal transmittance:

Wall reduced by a factor of 45
Roof reduced by a factor of 12.5
Windows reduced by a factor of 5.5

Element	U-value (W/m²K) Pre-retrofit	Zero2020
Wall	4.079	0.09
Roof	1.156	0.092
Glazing	5.7	1.03





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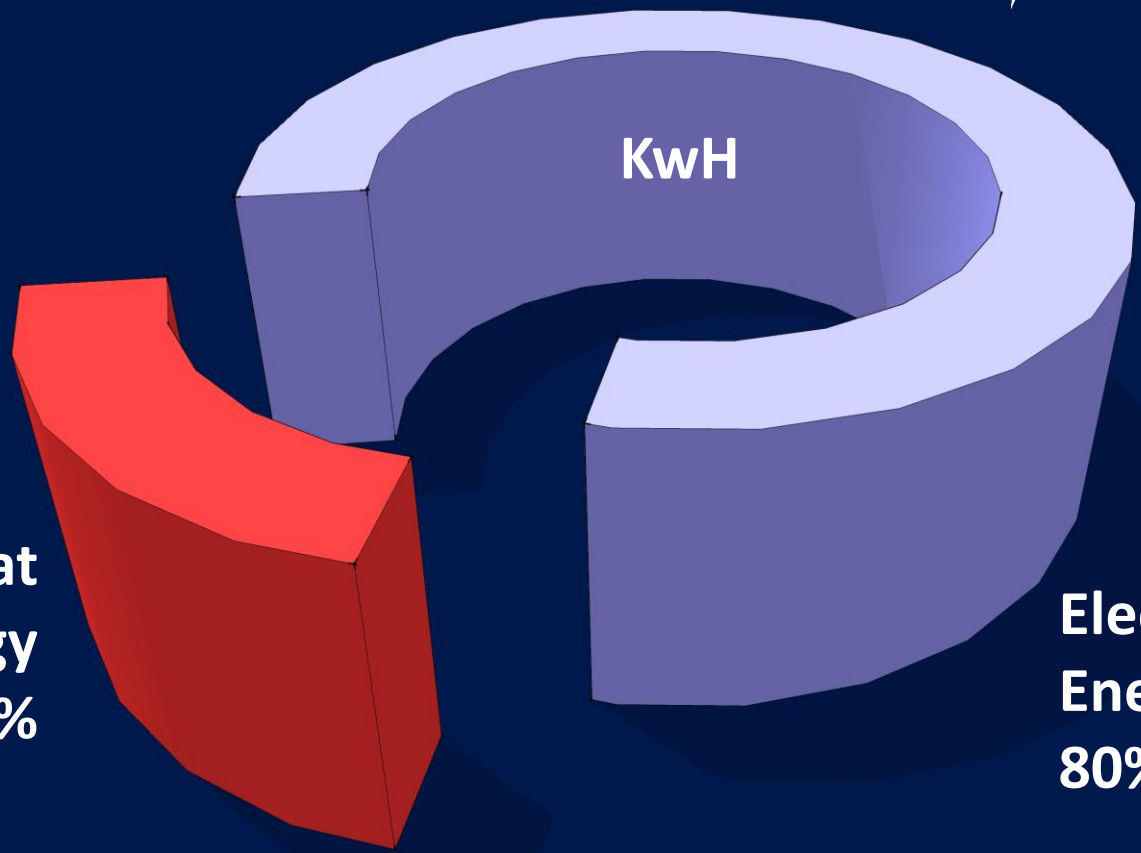
Lessons Learned

The energy balance post retrofit is 80% electrical and 20% heating. More electrical energy savings need to be targeted outside of Part L.

Electrical energy is larger post retrofit



Slide: Marc O Riain (2013) Data by Paul O Sullivan
http://www.zero2020energy.com

Lessons Learned

Temperature fluctuations are highly moderated by thermal mass.

There is more scope in plug loads for savings. Watch out for Vampire loads

Thermal bridging detailing is more important than you think

Inter disciplinary communication can lead to poor performance decisions

Air tightness is critical to energy performance

Post Occupancy Evaluation is critical to continued professional development

More information on:
www.**zero2020energy.ie**