









aspen aerogels®

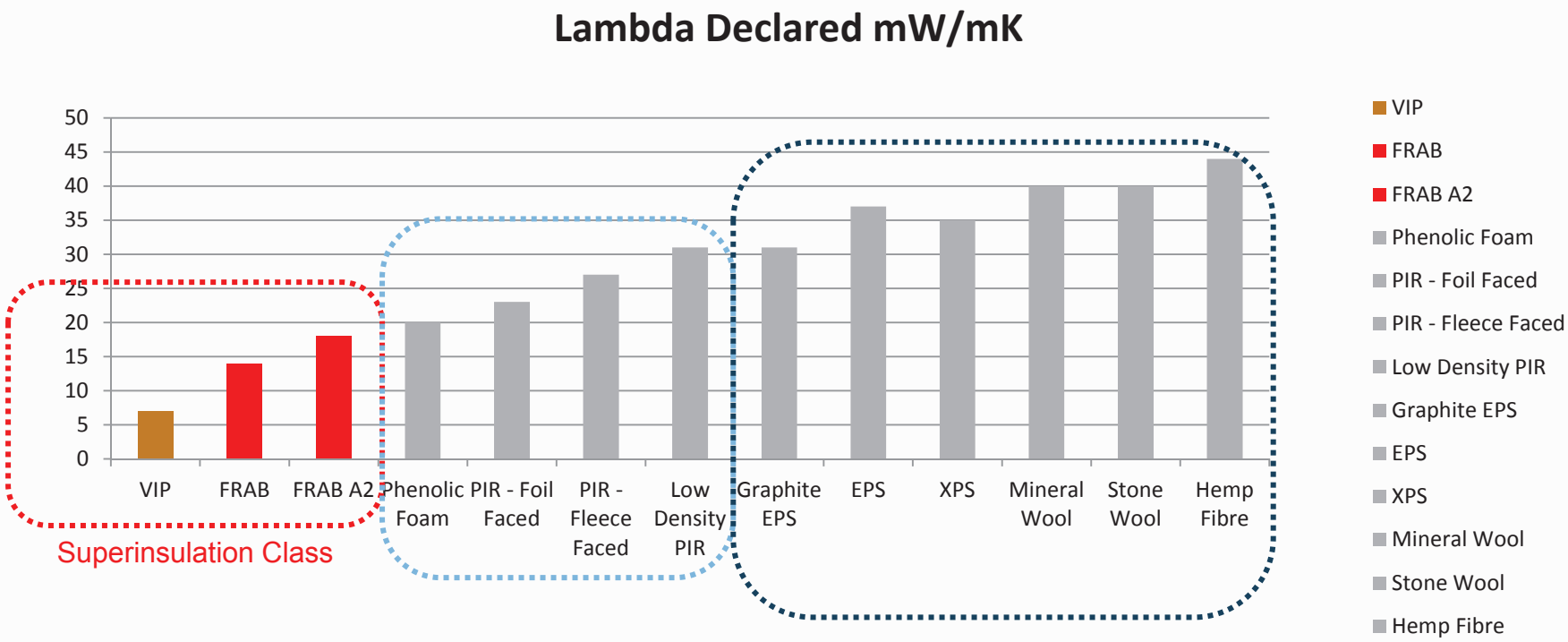
Fibre Reinforced Aerogel Blanket

Introduction & Applications

Annex 65 Superinsulating Materials

What is a “superinsulating” material?

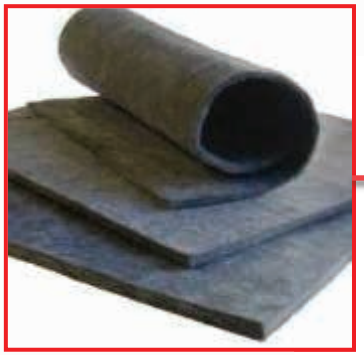
- In practice – a vacuum insulation panel or an aerogel containing product or assembly.
- Aspen Aerogels fall into 2nd category – we manufacture fibre reinforced aerogel blankets (FRABs)



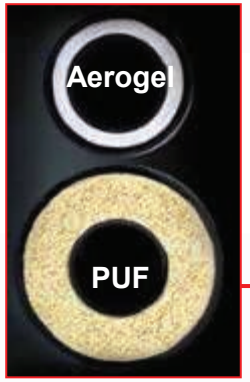
Aspen Aerogels

Aerogels invented

Aerogels for spacesuits



Aspen makes fiber-reinforced aerogels



Aerogels offshore

Construction Applications

1930s | 1993 | 1995 | 1997 | 1999 | 2001 | 2003 | 2005 | 2007

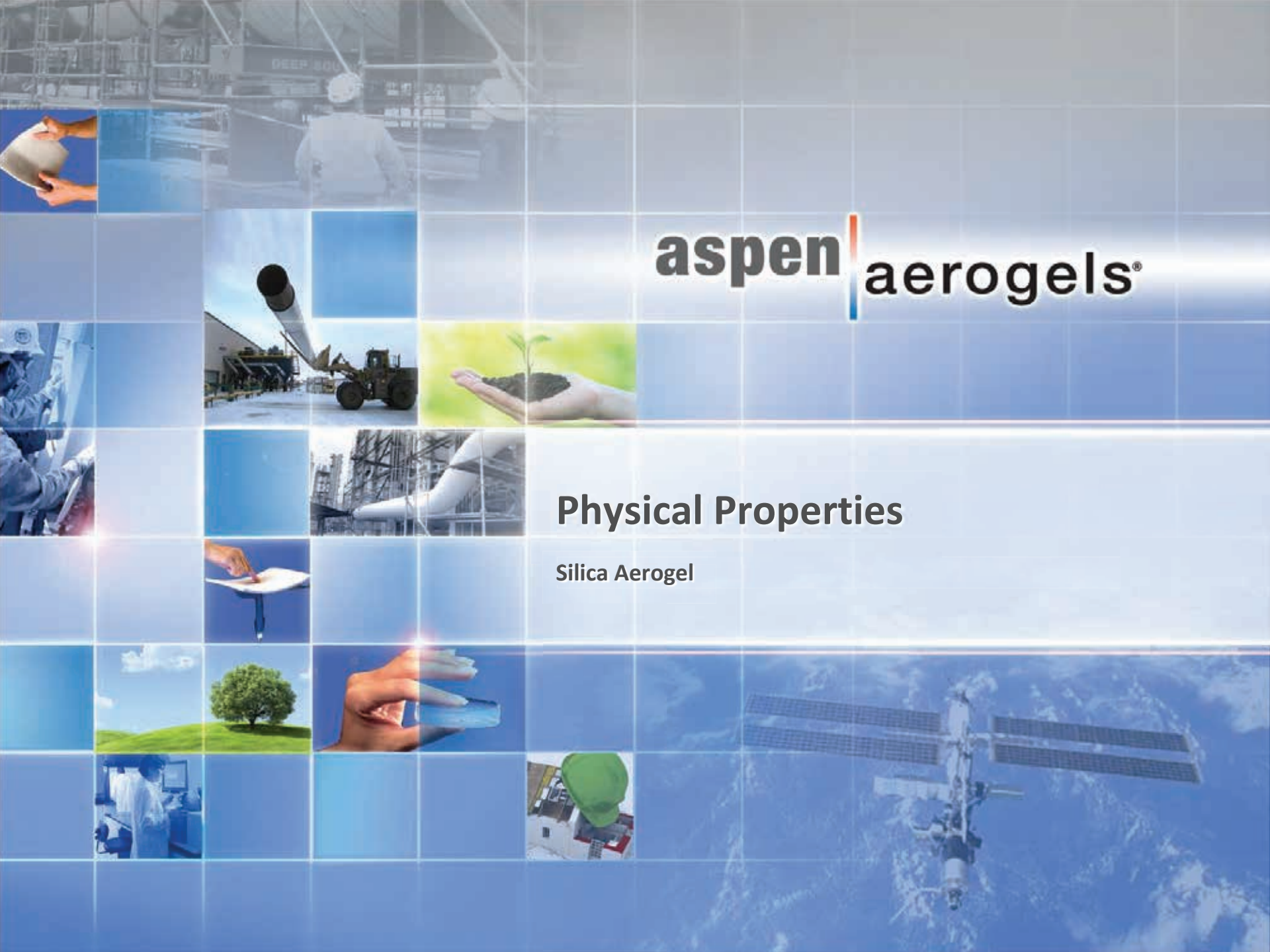
Aspen Aerogels born

Plant 1 opens

10 MM sqft capacity

Plant 2 opens

100 MM sqft capacity



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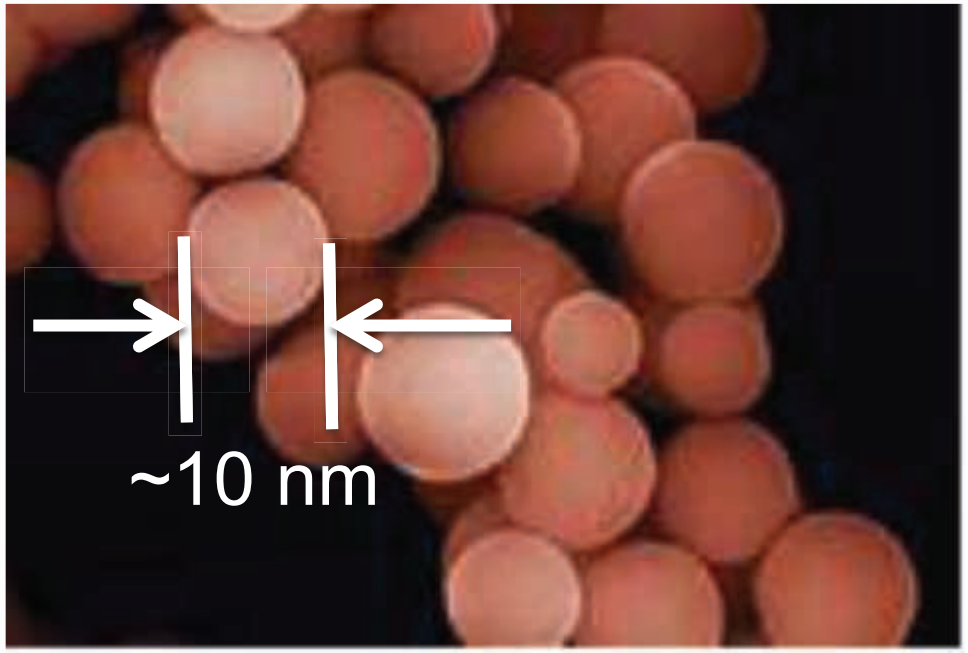
Physical Properties

Silica Aerogel

Silica Aerogel

- Silica Aerogel contains 95 - 97% air
- Not vacuum based, do not require blowing agents
- Air is trapped within the nanometer scale cells
- Very convoluted silica matrix
- Extremely Hydrophobic by design



Aspen Aerogels – "Mission Critical" applications

-200° C to +200° C

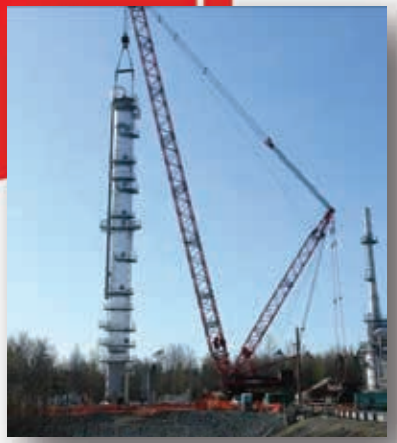
- Cryogenic
- LNG
- Petrochemical
- Industrial

-100° C to +200° C

- Building & Construction
- Clothing
- Appliances
- Services

+650° C

- Industrial
- Hot Process
- Fire Protection
- District heating
- Appliances
- Transport



Aspen Aerogels – FRAB in Extreme Environments

Aerogel blanket insulation used in shuttle *cryogenic* systems: launch tower, vehicle umbilicals, inside the shuttle.

ISS: Glacier Operations

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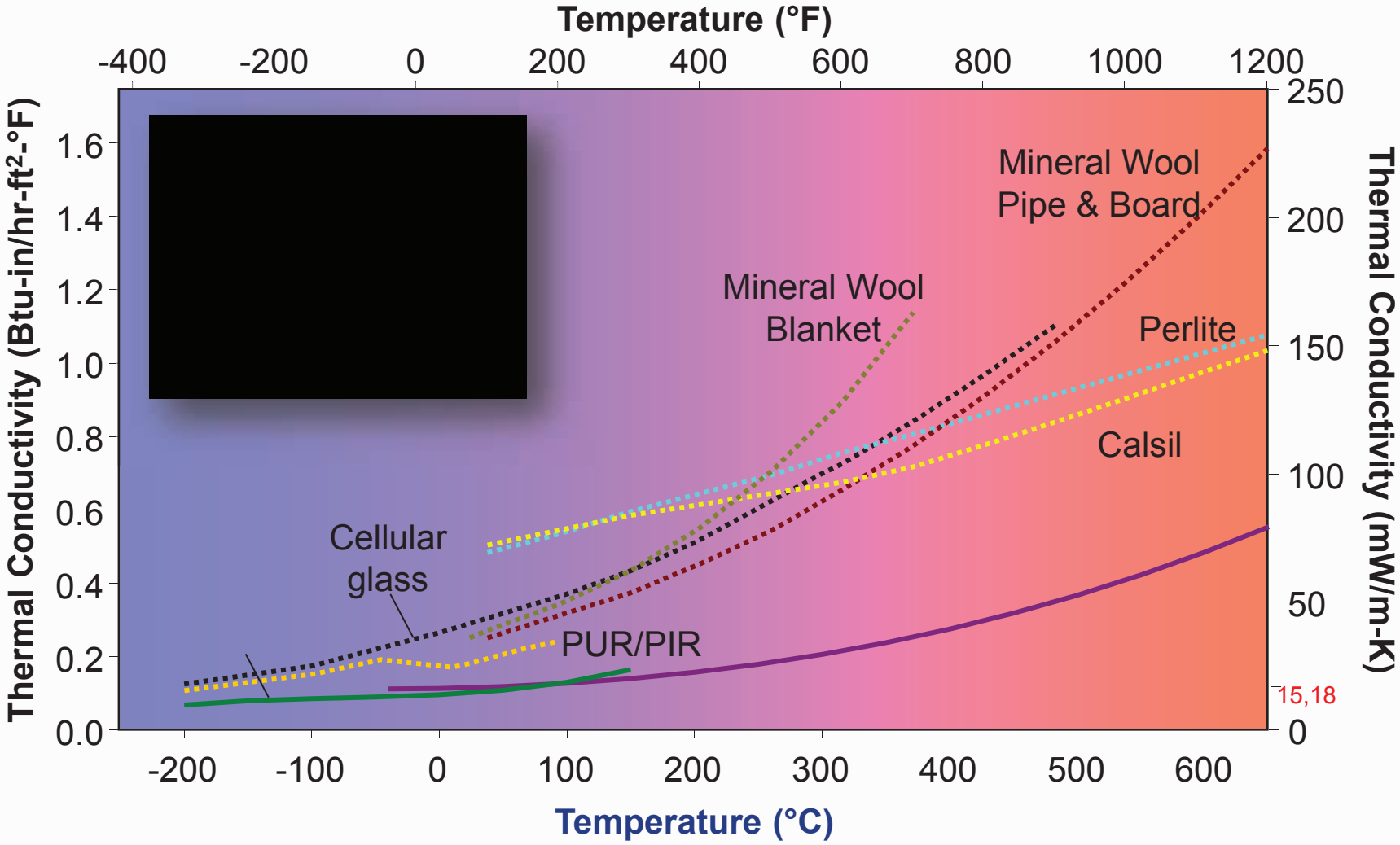
Thermal Conductivity Comparison

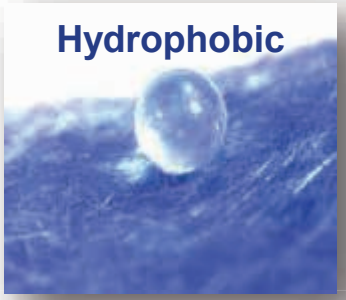


Unique Property set

- Lambda 15mW/mK to 18mW/mK
- 2, 5mm & 10mm blanket thicknesses
- Excellent Vapour permeability (μ = 5), Extremely Hydrophobic

– withstand hydrostatic Head test to 80cm

- Euro Fire class C or A2
- Will not promote mould growth, first class indoor air quality test result
- Good impact sound absorption, up to 20% light transmission
- Data set available for hygro-thermal simulation software
- European Technical Approval – 11_0471



Start with the basics - Spaceloft

Property	Spaceloft Classic	Spaceloft A2
5mm Thickness	Yes	No
10mm Thickness	Yes	Yes
Euro Fire Class	C-s1,d0	A2-s1, d0
Thermal Conductivity	0.014 W/mK	0.018 W/mK
Specific Heat Capacity @ 40◦ C	1000 J/kg.K	1000 J/kg.K
Bulk Density	150 kgs / m^3	150 kgs / m^3
Color	White Grey	White
		Unit
Porosity	91.6	%
Water Vapour Diffusion Resistance μ (23-0/50)	4.7	-
Water Vapour Diffusion Resistance μ (23-50/93)	4.8	-
Water Absorption Coefficient (4h)	0.025	$kg/m^2\sqrt{h}$
Water Absorption Coefficient (24h)	0.01	$kg/m^2\sqrt{h}$

Add Hygrothermal Properties

Measurement results
Standard properties

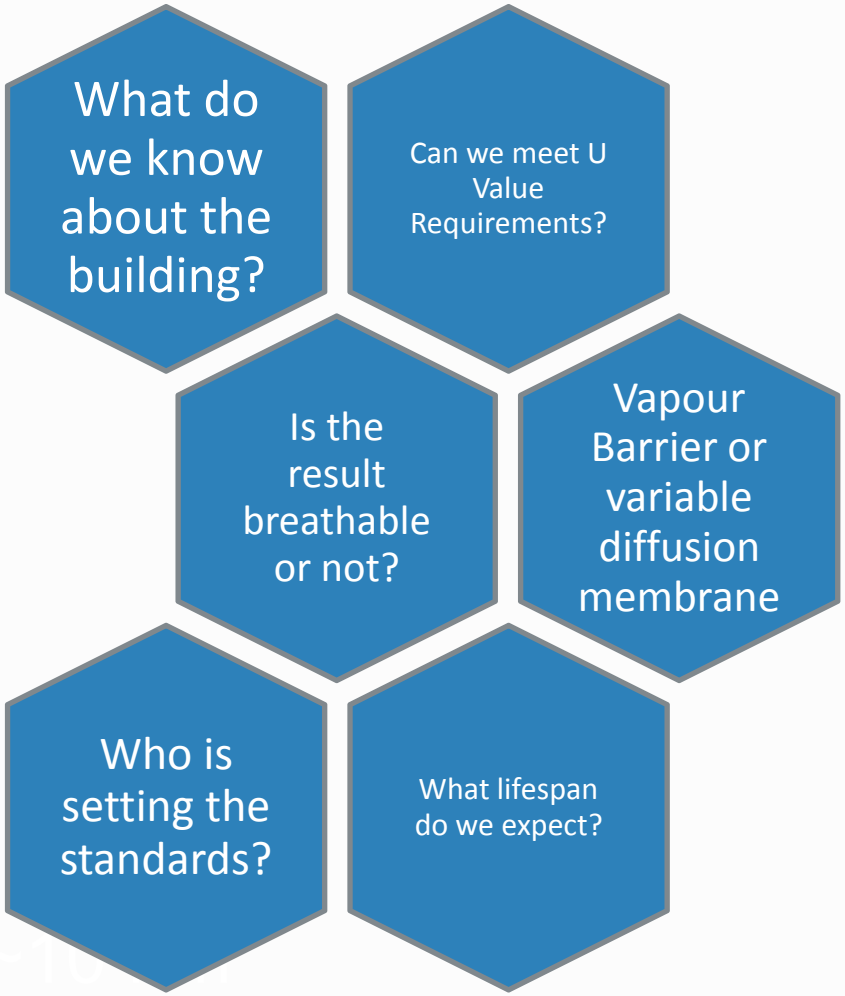
Property	Unit	
Bulk density	kg/m³	146
True density	kg/m³	1778,5
Porosity	[%]	91,6
Water vapour diffusion resistance factor μ (23-0/50)	-	4,7
Water vapour diffusion resistance factor μ (23-50/93)	-	4,8
Water absorption coefficient (4h)	kg/m²√h	0,025
Water absorption coefficient (24h)	kg/m²√h	0,01

Measurement results
Sorption moisture content

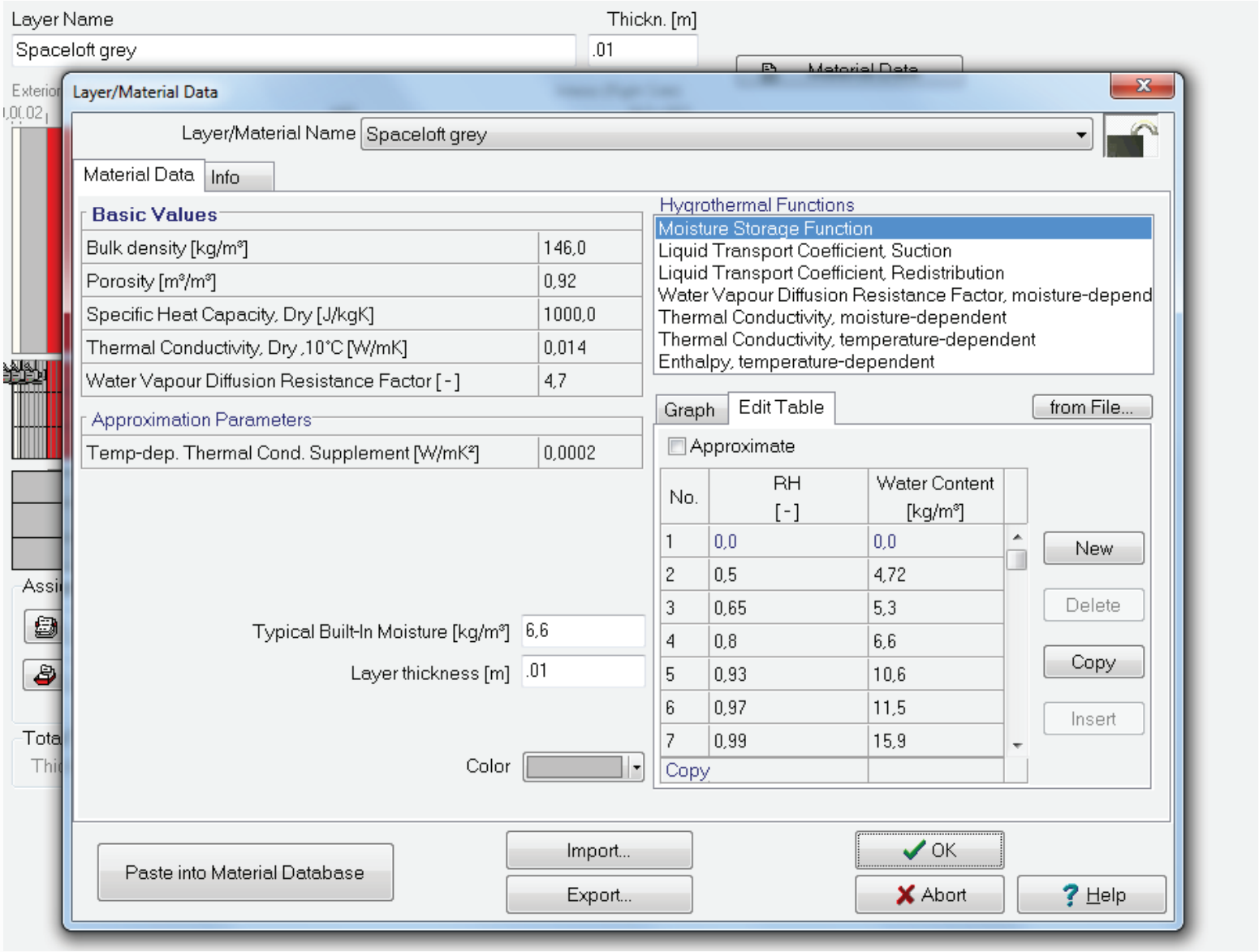
Relative humidity	Moisture content
	[kg/m³]
0	0
50	4,72
65	5,3
80	6,6
93	10,6
97	11,5
99	15,9
99,5	19,3
99,9	29,6
99,95	35,3
99,99	51,9
100	213

Risk Assessment Based Selection

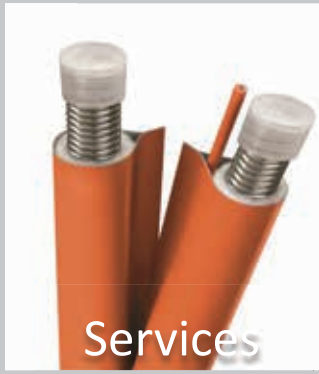
- Do the project stakeholders understand the impact of the proposed upgrades?
- Do they want to know!
- Is the proposed upgrade solution fit for purpose?
- Is it achievable with the conditions on site?
- Does it address the risk of damage to (a) the building and (b) health of human users?
- Will a simulation / analysis help?
- How reliable is the other material information?

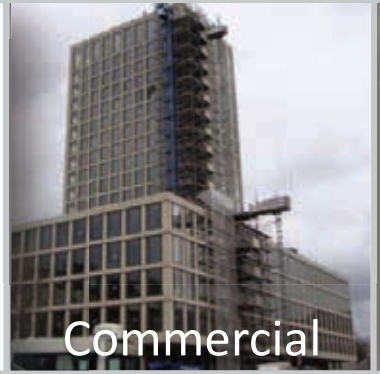


Result = WUFI Material File (xml)



FRAB in Construction – where?

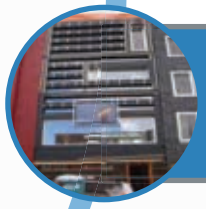




FRAB in Construction – why?

Preserve living space in small properties

Maximise Gross Internal Area for investors



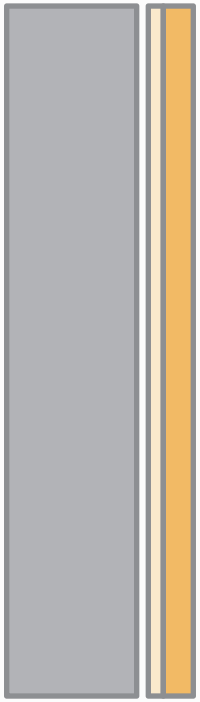
Realise unrivalled U value improvements

Complete building envelope solutions

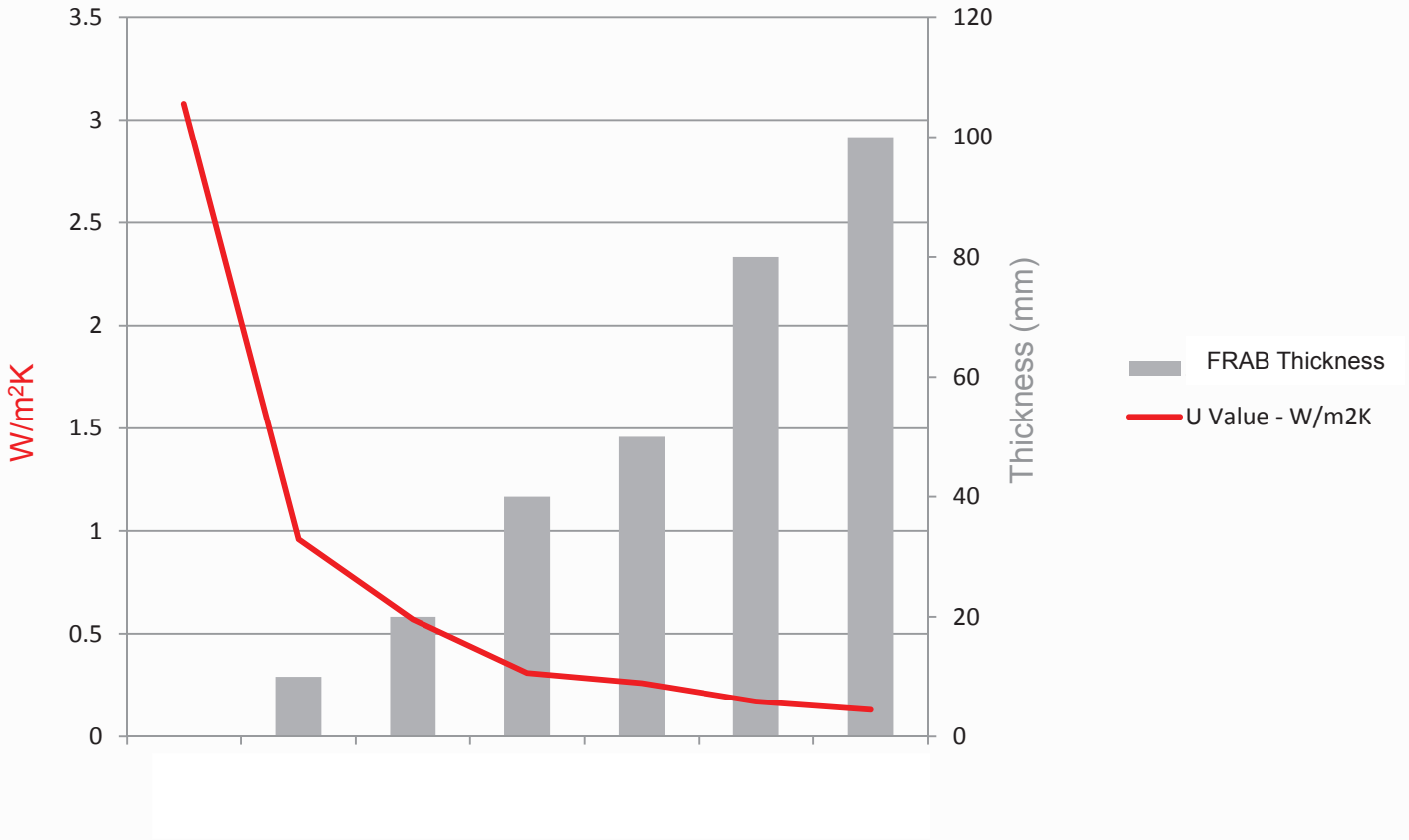
Incremental Improvement

- Solid wall – mass concrete construction

10mm FRAB + 9.5mm plasterboard)



220 mm Concrete



Internal Wall Insulation

- Project — Stone Cottage Renovation
- Location — England
- Bldg. Type — Traditional Stone
- Application — Internal insulation, 40mm
- Benefit — U value from 2,1 to 0,3 in 40mm
- Achieves code

Internal Wall Insulation

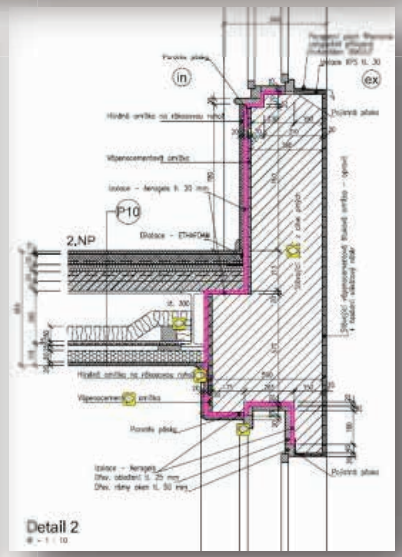
- Project — Renovation
- Location — Italy
- Bldg. Type — House
- Application — Internal Wall
- Benefit — Energy Saving, Space Saving

Internal Wall Insulation - Heritage

- Project — Renovation
- Location — Watford, UK
- Bldg. Type — Commercial Demonstrator
- Application — Internal Wall – 80mm,10mm
- Benefit — Passive House performance, heritage, breathable, thermal bridge treatments
- Achieves code

Internal Wall Insulation - Heritage

- Project — Renovation
- Location — Podebrady, Czech Rep.
- Bldg. Type — Commercial, Dwelling
- Application — Internal Wall – 20mm,10mm
- Benefit — Heritage protected, breathable, thermal bridge treatments, challenging environment



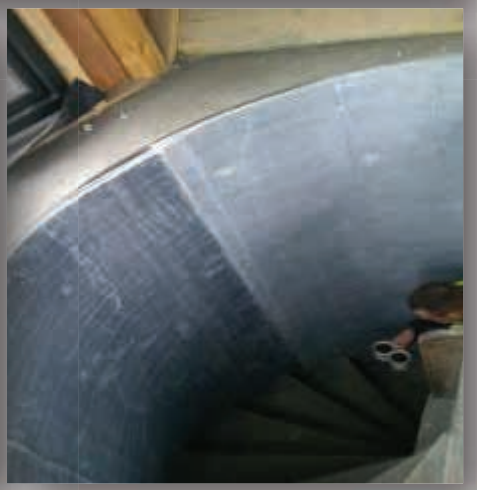
NEW

WUFI®

assessment available

Internal Wall Insulation - Heritage

- Project: Renovation
- Location: Glasgow, Scotland
- Bldg. Type: Single Family Dwelling
- Application: Internal Wall – 30mm
- Benefit: Space saving in concrete stairwell, preserves means of escape
- Achieves code



Internal Wall Insulation with Lime Plaster

- Project — Renovation
- Location — London, UK
- Bldg. Type — Heritage protected Brick House
- Application — Internal Wall Insulation with historic plaster finish
- Benefit — Energy saving, space saving vapour open wall construction

West Facade showing gauge test tubes at the Ground Floor and Second Floor level

Internal Wall Insulation - Dublin

- Project — Decouple thermal mass
- Location — Dublin, Ireland
- Bldg. Type — Multi Family Dwelling
- Application — Internal Wall, Reveals, Floors, returns, wardrobe liner – 10mm
- Benefit — Deliver comfort, eliminate condensation, reduce energy costs in recently built apartment scheme Restore occupants confidence & reduce vacancy levels.

Internal Wall Insulation - Dublin

- Site visit detected several problems
- Interviewed home owners
- Design a FRAB based solution for walls, floors, heat bridges – including some surprise ones
- Balance comfort, energy performance and impact on living space
- Solution accepted – average 2% loss of floor area
- Stakeholders extremely pleased with result
- On-going project

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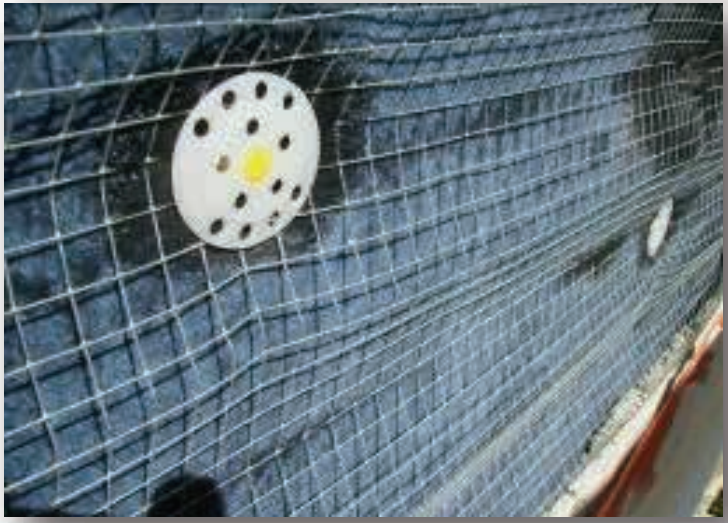
External Insulation

Applications
Case Studies
Installation Tips

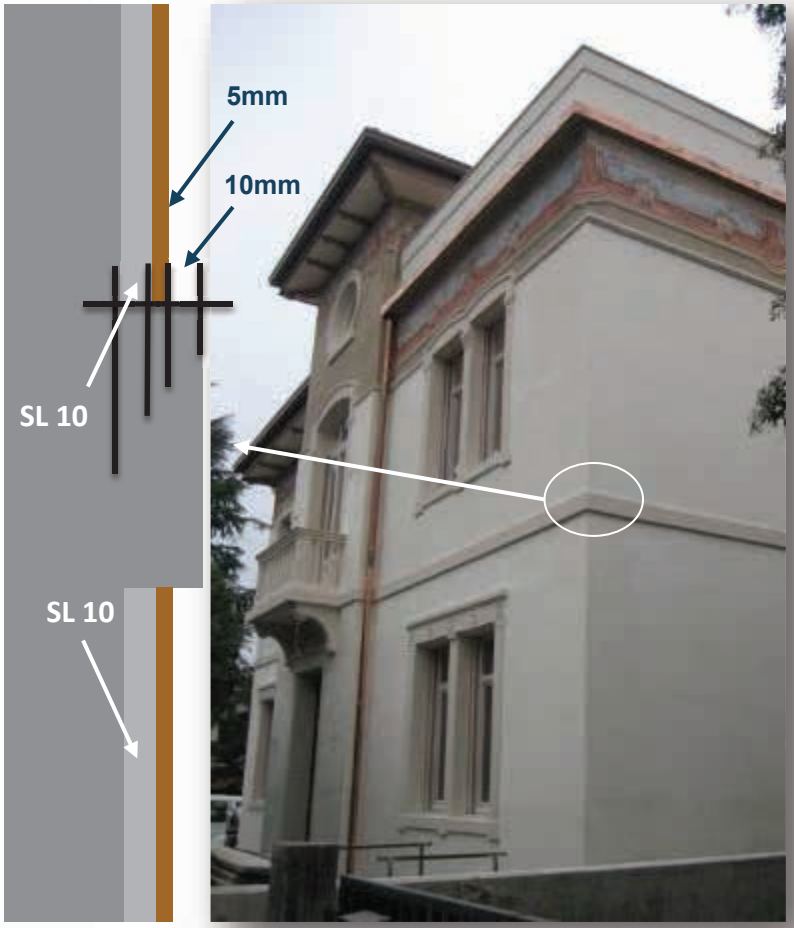
External Wall Insulation - Heritage

- Project — Renovation
- Location — Switzerland
- Bldg. Type — Private Dwelling
- Application — External Wall 20mm,10mm
- Benefit — Heritage protected, breathable thermal bridge treatments



External Wall Insulation - Heritage

- Project — Renovation
- Location — Venice, Italy
- Bldg. Type — Private Dwelling
- Application — External Wall – 10mm
- Benefit — Heritage protected, breathable thermal bridge treatments approx 50% heat loss reduction



External Wall Insulation

- Project — Renovation
- Location — Switzerland
- Bldg. Type — Commercial, solid concrete
- Application — External Wall – 10mm
- Benefit — Space saving, thermal bridge treatments, continuous façade lines

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Floor, Balcony, Terrace Insulation

Applications
Case Studies

Floor & Balcony Insulation

- Thin section facilitates non-disruptive upgrades
- Suitable for domestic compressive loadings
- Compatible with most floor finishes, under-floor heating systems
- Fast Installation in roll or pre-fabricated board format
- Thin section maintains safety levels and reduces water ingress risk on balconies

Terrace Insulation

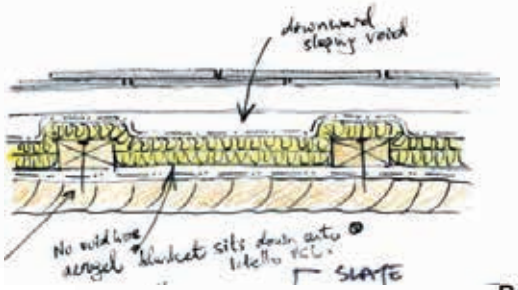
Roof Insulation

Dormer
Pitched
Flat

Pitched Roof Insulation - Heritage

- Project — Renovation
- Location — Dublin, Ireland
- Bldg. Type — Government, historic stone
- Application — 20mm Pitched roof insulation
- Benefit — Energy saving, space saving vapour open to allow roof elements to breathe

Figure 1 – inside view of existing roof



NEW

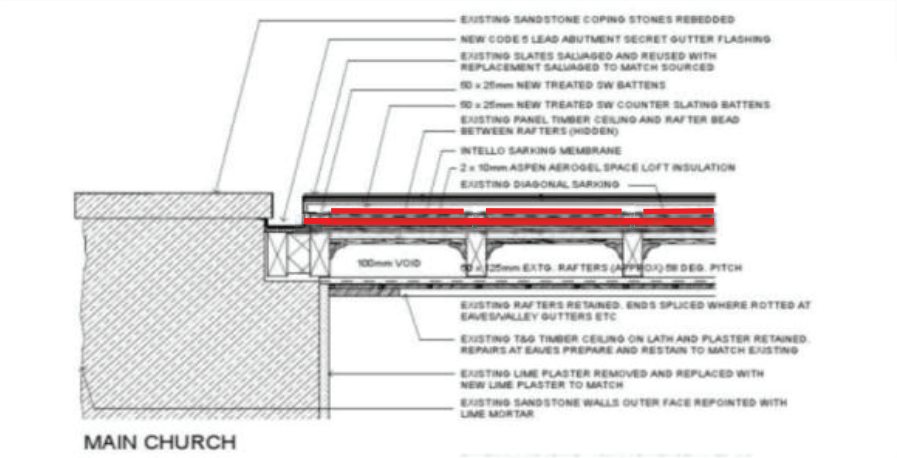
WUFI® assessment available

Request for analysis

Client wishes to assess performance of Aspen Aerogel as roof insulation in warm-roof buildup between a timber ceiling deck and battens of a vaulted Victorian courthouse building in the south suburbs of Dublin. Roof buildup to be absolutely minimised. Building to be intensely used by small number of people with a lot of electronics.

Pitched Roof Insulation - Heritage

- Project — Renovation
- Location — Belfast, Northern Ireland
- Bldg. Type — Historic stone church
- Application — 20mm Pitched roof insulation
- Benefit — Energy saving, space saving vapour open to allow roof elements to breathe



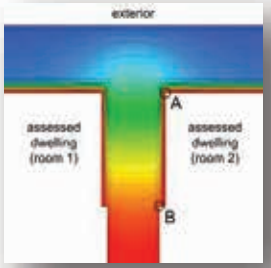
MAIN CHURCH

Pitched Roof Insulation - Heritage


aspen aerogels®
Heat Bridge Treatments & OEM

Thermal Bridging Applications

- Internal or External
- Straight or curved sections
- Pre-cut or fabricate onsite
- Adhesive and / or mechanical fix
- Window & Door reveals
- Dormer & Roof Windows
- Partition Wall Returns
- Door & Window Components
- Service pipe & duct work

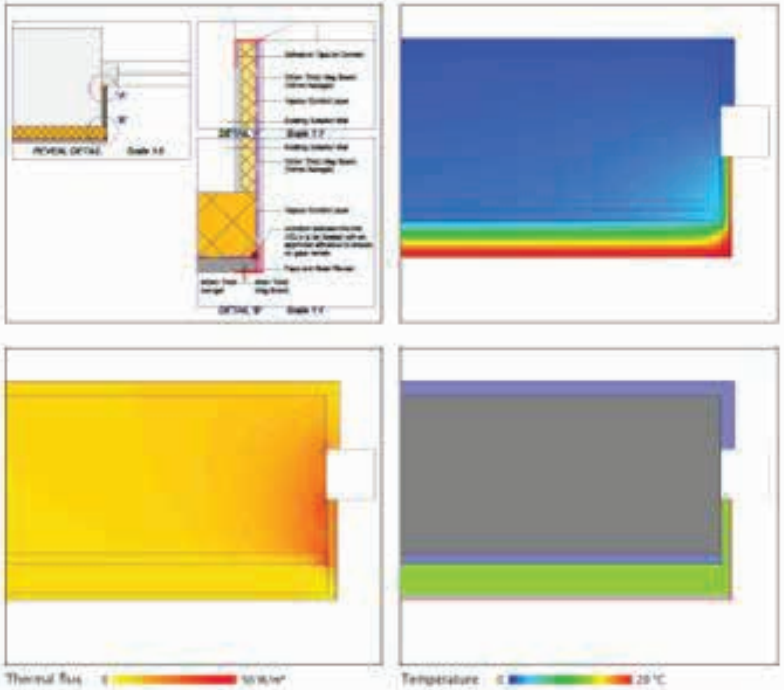


Heat Bridge Insulation - Reveals

- Thin reveals do not interfere with window function
- Maintain temperature factors above condensation limits

Description

9mm thick magnesium silicate board on 40mm aerogel insulation on existing wall (retain lime or cement internal plaster but strip off any gypsum). 16mm thick board on reveal (10mm aerogel insulation between 3mm magnesium silicate boards)

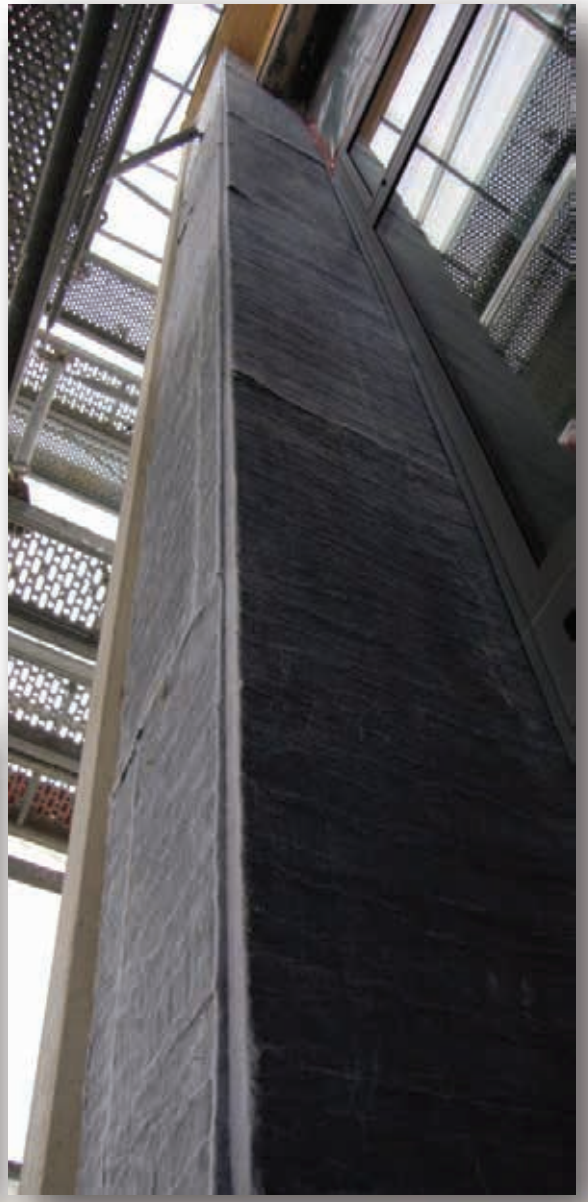


Linear thermal transmittance		Temperature factor
Ψ = 0.081 W/mK (reveal)	Ψ = 0.086 W/mK (frame)	f_{Rsi} = 0.875

This detail has been assessed in accordance with the procedure in BRE IP 1/06 "Assessing the effects of thermal bridging at junctions and around openings" and the guidance in BRE report BR 497 "Conventions for calculating linear thermal transmittance and temperature factors" in accordance with Appendix D of Technical Guidance Document L (2007) of the Irish Building Regulations. The calculations have been carried out analysing a 2D numerical model through conduction heat-transfer analysis based on the finite-element method performing to the standard indicated by IS EN ISO 10211.

Perimeter Insulation

- Project — New Build
- Location — Basel, Switzerland
- Bldg. Type — Commercial
- Application — 30mm concrete column insulation
- Benefit — lower ψ values, space saving solution



Thermal Bridging Insulation

- Project — Renovation
- Location — Norwich
- Bldg. Type — Family Dwelling
- Application — 10mm & 20mm heat bridge at Finlock guttering
- Benefit — Energy saving, condensation control, external solution

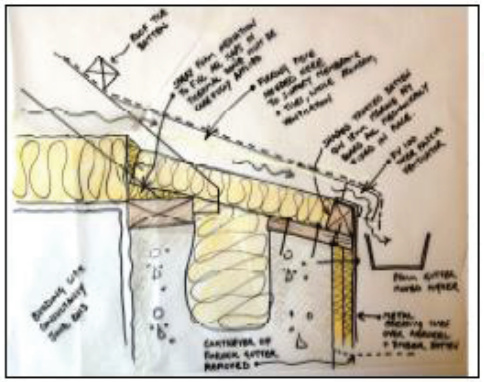
Thermal Bridge Assessment of Junction

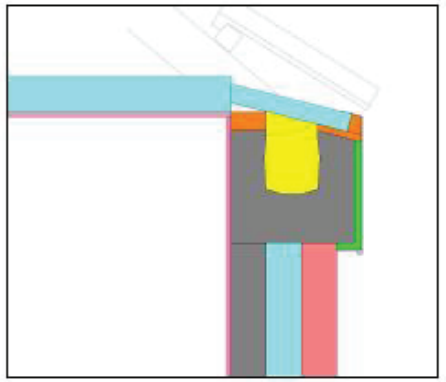
EAVES JUNCTION: full-fill cavity, 20mm Spaceloft + batten

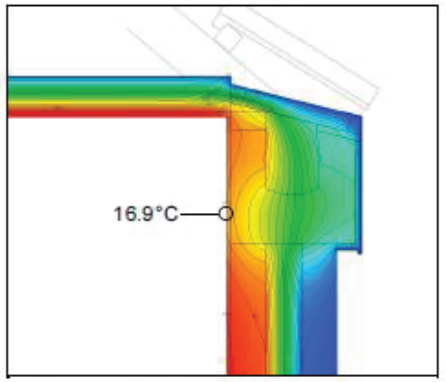
Description

Roof eaves detail at junction of a fully filled cavity wall and roof insulated at ceiling level with rigid PIR.

Existing Finlock gutter filled with mineral wool, capped with a 50mm sheet of PIR insulation, and cladded on the outside with 20mm Spaceloft insulation fitted into powder coated aluminium flashing.







Linear thermal transmittance

Ψ = 0.344 W/mK	internal (SAP)	Ψ = 0.250 W/mK	external (PHPP)

Temperature factor

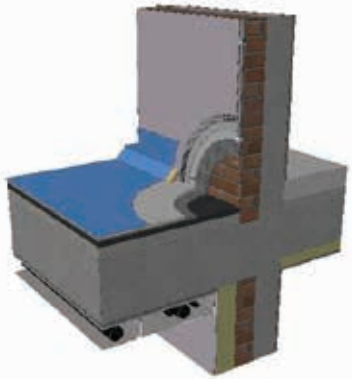
f_{Rsi} = 0.845

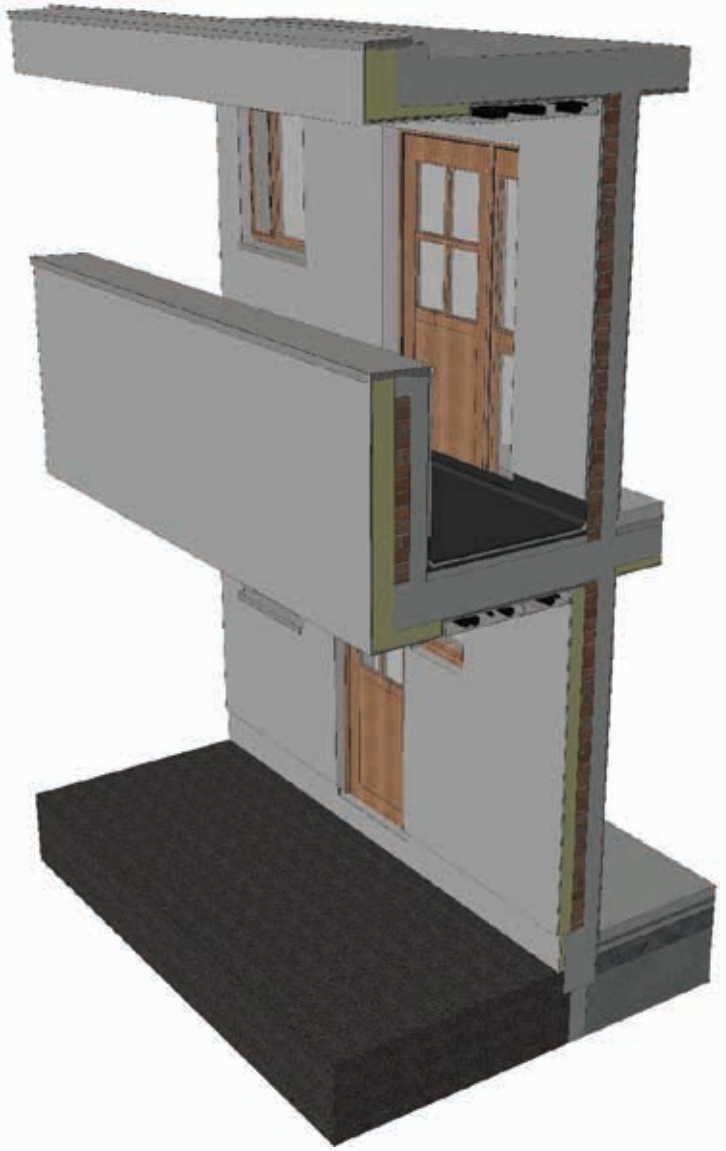
Apartment Thermal Bridge

- Project — Renovation
- Location — Switzerland
- Bldg. Type — Apartment Block
- Application — 10mm thermal bridge treatment
- Benefit — lower ψ values, space saving solution

Apartment Thermal Bridges

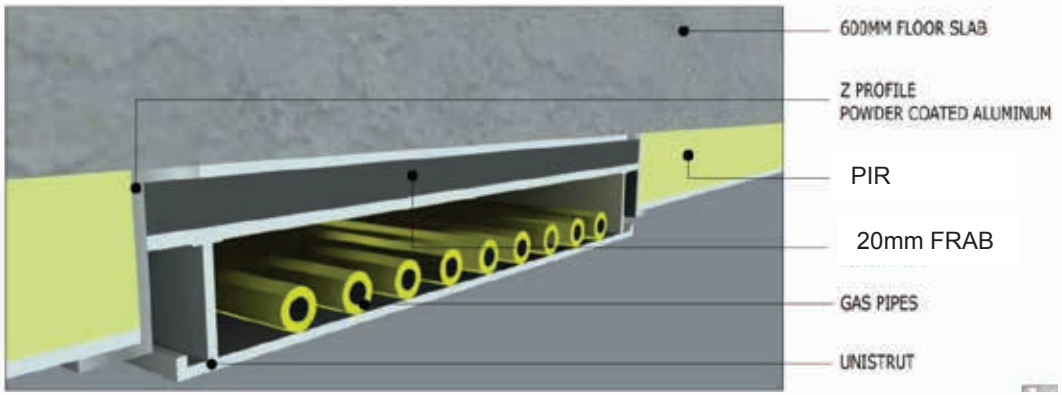
- Project — Renovation
- Location — Ireland
- Bldg. Type — Apartment Block
- Application — 10mm thermal bridge treatment
- Benefit — lower ψ values, space saving solution

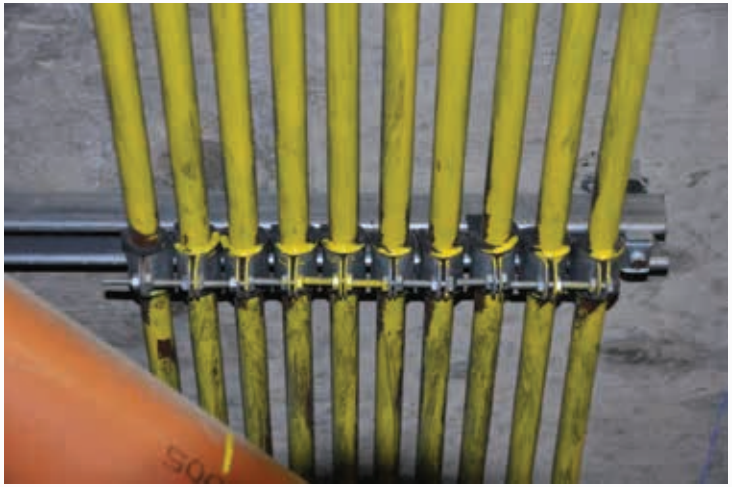




Apartment Thermal Bridges

- Project — Renovation
- Location — Ireland
- Bldg. Type — Apartment Block
- Application — 10mm, 20mm thermal bridge treatment
- Benefit — lower ψ values, space saving solution





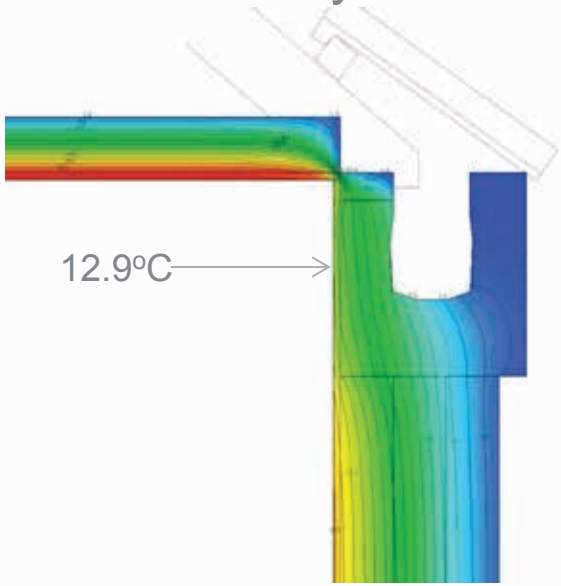
EWI Thermal Bridge

- Project — Renovation
- Location — Hillingdon, London
- Bldg. Type — Semi Detached
- Application — 10mm thermal bridge treatment for soil pipes, RWP, satellite dishes, waste pipes on EWI
- Benefit — continuity of insulation layer, faster install, less prone to cracking

FRAB in EWI risk reduction

Finlock Guttering Thermal Bridge

Full Fill Cavity – Existing

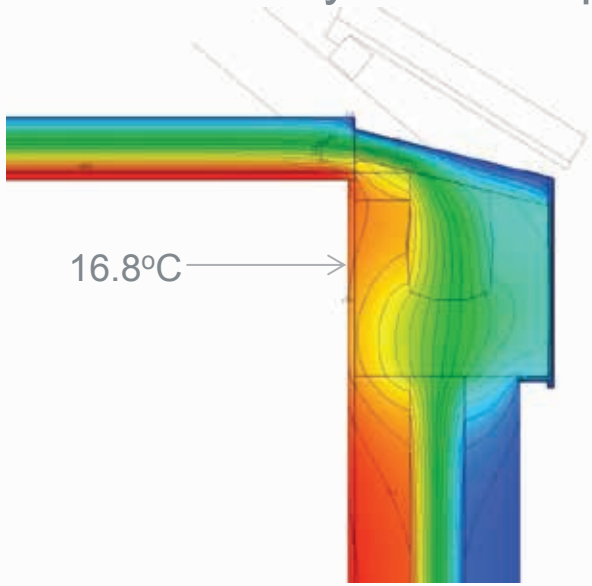


Linear Thermal Transmittance

Ψ = 0.998 W/mK

FRsi = 0.645

Full Fill Cavity – With Spaceloft



Linear Thermal Transmittance

Ψ = 0.361 W/mK

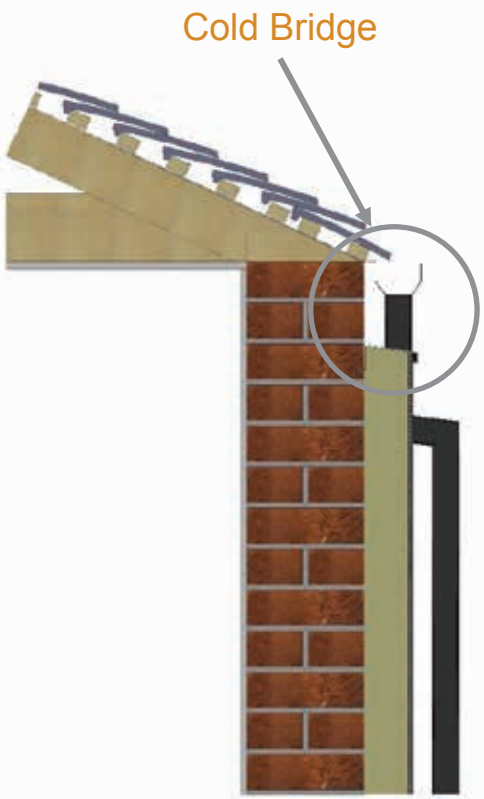
FRsi = 0.840

0 — 20ºC

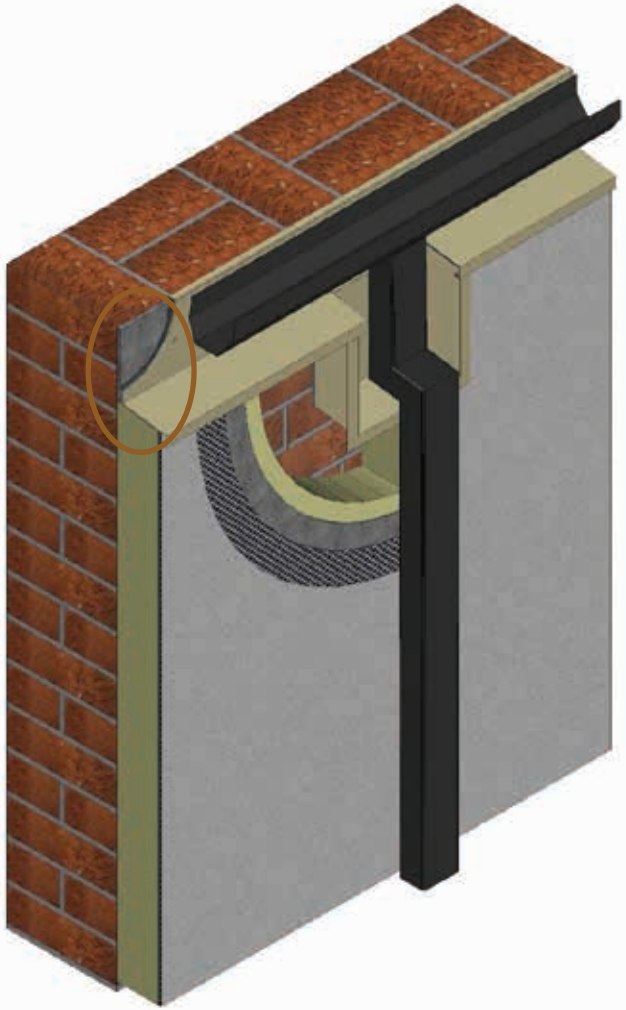
By introducing a Spaceloft layer the linear thermal transmittance is reduced by over **60%** and the internal surface temperature is increased by 3.9ºC eliminating the risk of condensation creating a healthy indoor environment. The temperature factor is now above 0.75

Thermal Bridge at soffit

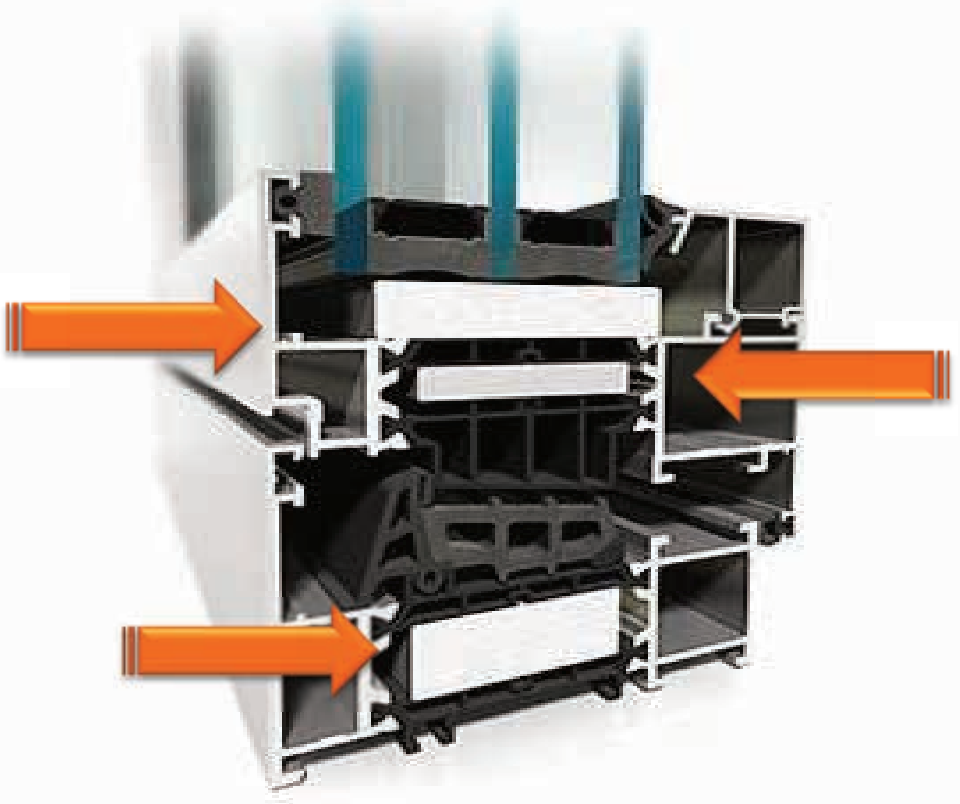
Without Insulated Soffit



With Insulated Soffit



Thermal Breaks in High Performance Windows



Achieve class leading U_W values as low as 0.5 W/m²K

Industry leading Pipe Insulation Applications

- Hot & cold water
- Solar Thermal
- 5 & 10mm Spaceloft variants
- Class leading passive frost protection
- Increases the effectiveness & running costs of trace heating systems

Summary

Save Space	• Preserve Living Space • Maximise property income for investors
Facilitate Innovation & Preserve Heritage	• Technology leaders – lowest practical TC • Competitive net cost of use – reduced labour & disruption
Easy to Use	• Compatible with existing trades & processing techniques • Pan Euro complementary / Drop in solution
Certified	• Established competency • ETA & local certifications in place – trust with decision makers
Safe	• Good Fire performance • Clean environmental profile

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