AECB
the sustainable building association

2010 Annual Conference

Celebrating 21 years of the AECB

Something Old, Something New

1-2 October 2010 • WISE Building, CAT

Organised by:

AECB
the sustainable building association

In association with

Passivhaus Trust
The UK Passive House Organisation

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Designing & building a Passivhaus using standard UK building techniques

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- The Clients

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Longwood Low Energy House 1991

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Why cavity wall?

Advantages

- Familiar method for UK builders
- West Yorkshire planning requirements
- Thermal mass – acts as a heat store
- Budget restraints

Disadvantages

- Harder to get air tightness detailing correct
- Harder to test as you are going along

Passivhaus standard

Air-tightness	0.6ach @ 50Pa
Surface temp (windows)	>17degC
Summer overheating	Max 10% >25degC
Vent	~30m^3/hr.person
Heating	15kWh/m^2a
Primary Energy	120kWh/m^2a

Comfort

Comfort

Comfort

Comfort

Energy

Energy

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PHPP software considers;

- U-values for all elements, windows, doors, walls, etc
- Thermal bridges
- Shading
- Window orientation
- Ventilation
- Climate
- Domestic hot water demand
- Solar domestic hot water
- Electricity
- Boilers

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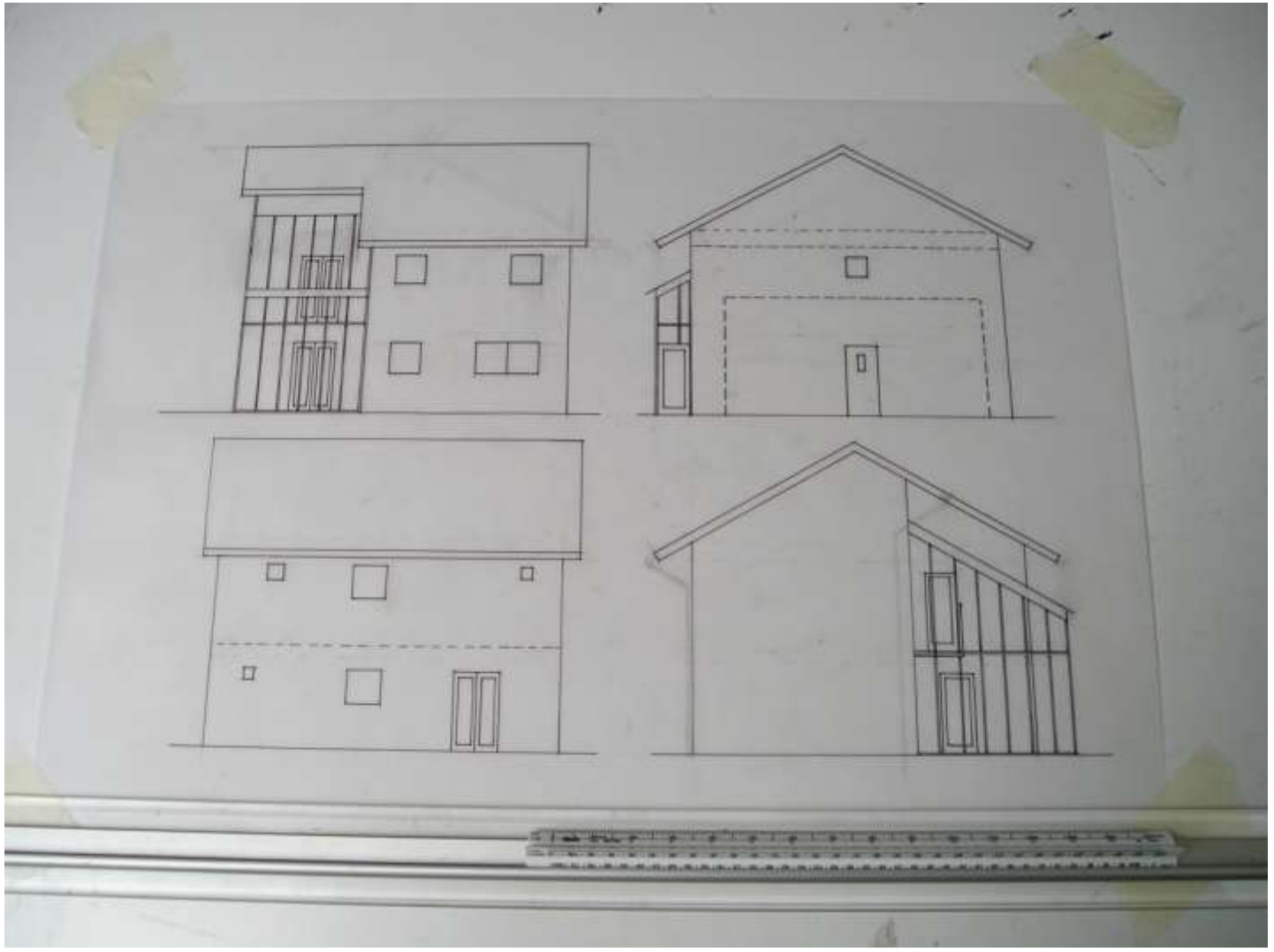
Preliminary Design 2007



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Denby Dale Passivhaus 2009

Supported by:

KNAUFINSULATION

leedsmet

Faculty of Arts & Society
School of the Built Environment

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Key features

- Detached 3 bed dwelling with integral two storey sun space
- One of first certified Passivhaus buildings in the UK
- Expected to be the first Passivhaus built using traditional cavity wall construction
- £140K budget
- Build starting May 2009

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Elevations

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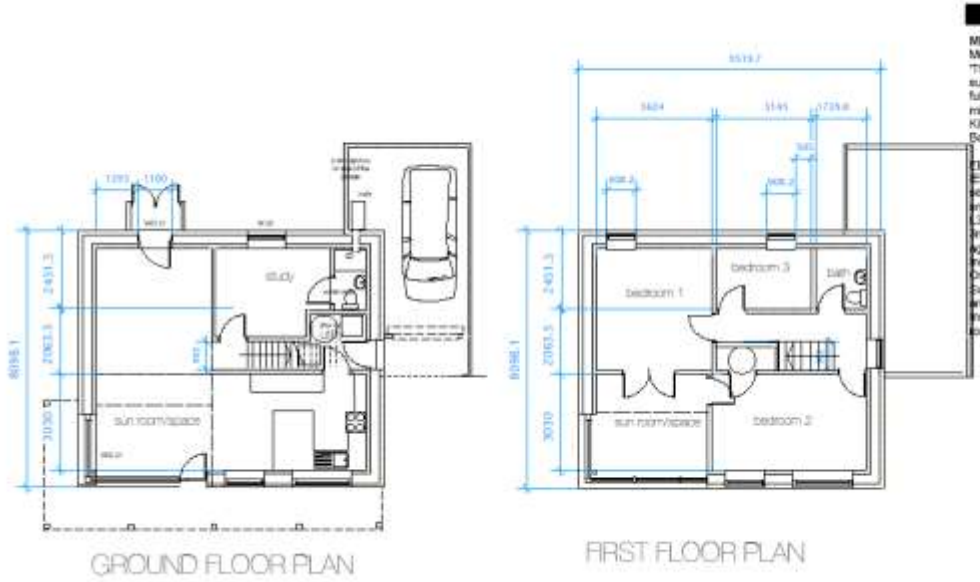
Floor plans



NOTES

MECHANICAL VENTILATION:
Mechanical Heat Recovery installation MVHR 'Thermos 200' manufactured by Paul and supplied/installed by the Green Store to provide full ventilation to all spaces and to excede the minimum Approved Documents Requirements of Kitchen 60 litres/second, Utility 30 litres/second, Bath and ensuites 15 litres/second.

ELECTRICAL INSTALLATION: To conform to IEE etc regulations. Install self contained - seperate circuit - interlinked mains operated smoke detection and alarm to BS5839 PART 1 - L3 standard, located in all circulation areas within 3m of bedroom doors, 7m from habitable rooms; agree positions on site with LA Building Inspector.
One smoke detector per storey.
Switches and sockets to be not less than 450mm and not more than 1200 above floor level.
Install energy saving light sockets at a ratio of 1 room in 3.

STAIRS: Main Staircase to be made of timber with timber treads. Dimensions to be taken on site - total height approximately 2750mm with 16 number risers @ 171mm and goings @ 300mm with maximum angle of 38 degrees. Landing to have same going as width of stairs, ie 900mm between wall and balustrade/handrail. Minimum headroom to be 2.0m above pitchline. handrail to both sides of stairs to be 900mm above pitchline. Trimmers: 2 x 50 x 150sw. Guarding/balustrading to the stairs and landing to be plywood panels or plasterboard with skim finish on 50 x70mm framing and hardwood handrails.
Balustrade at top of stairs to be 900mm above the floor. Balustrade to the landing to be 1100mm above the floor. Opening between the balustrade and the handrail to be a maximum of 85 mm spacing.

PLUMBING INSTALLATION: Install sanitary fittings as depicted on the plan. All sinks,showers,baths and basins to have re-sealing traps Provide rodding eyes at all changes of direction.Wastes to basins to be 32mm upvc. All other wastes to be 32mm, to connect into existing underground drain. Provide access to base of soil stacks and connect branches with slow radius bends. UPVC soil vent pipes to have an automatic air admittance valve in accordance with manufacturers instructions or terminate 1.0m above the the uppermost first floor windows. Rainwater down pipes and gutters to be zinc. Fit fire proof collars in pipes in floor.

HEATING INSTALLATION: Background/backup heating dhw to be provided by a Commissioning of Heating and HWS Installation; Inspection and Completion Certificates to be issued and be made available to the employer and the Building Control Authority

L002

Proposed detached dwelling
at the rear of 373 and 371 Wakefield Road
Denby Dale West Yorkshire

Clients: Geoff and Kate Turnbull
373 & 371 Wakefield Road Denby Dale West Yorkshire HD8 8RP

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Key features of Passivhaus

- Super insulation
- Minimising thermal bridging
- Stringent airtightness measures
- Minimising thermal bypass

- Mechanical ventilation heat recovery (MVHR)

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Super insulation

Target: U-value of less than 0.15 W/m2K for external envelope.

- Cavity (300mm) fibreglass batts
- Roof void (500mm) fibreglass quilt
- Under groundfloor (225mm) polyfoam insulation.

Target: combined U-value of 0.8 W/m2K for windows

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Minimising thermal bridging

Measures taken to minimise thermal bridging at junctions (eg between the ground floor and walls and at window and door openings).

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Stringent airtightness measures

Leakage target: less than 1m^3/h/m^2.

Measures include:

- Wet plaster coating to interior walls
- Floor slab carried across the top of the blockwork of the inner leaf of the wall
- Attention to airtightness detail around window and door openings and junctions between floors, walls and roofs.

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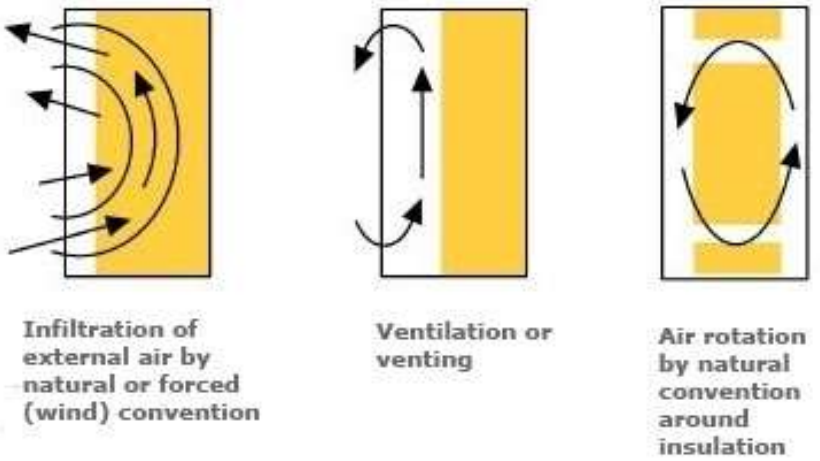
Minimising thermal bypass

Minimisation of air movement around insulation in cavity wall and roof void through windtightness detailing



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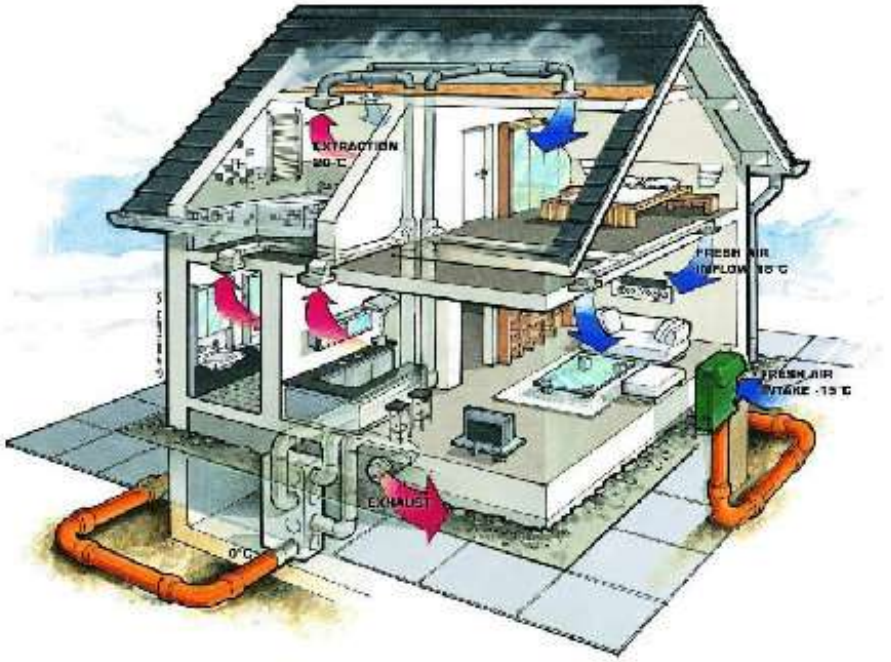
Mechanical ventilation with heat recovery (MVHR)

The PAUL Comfort Ventilation system used can transfer up to 90% of the heat from the outgoing air to the incoming air.



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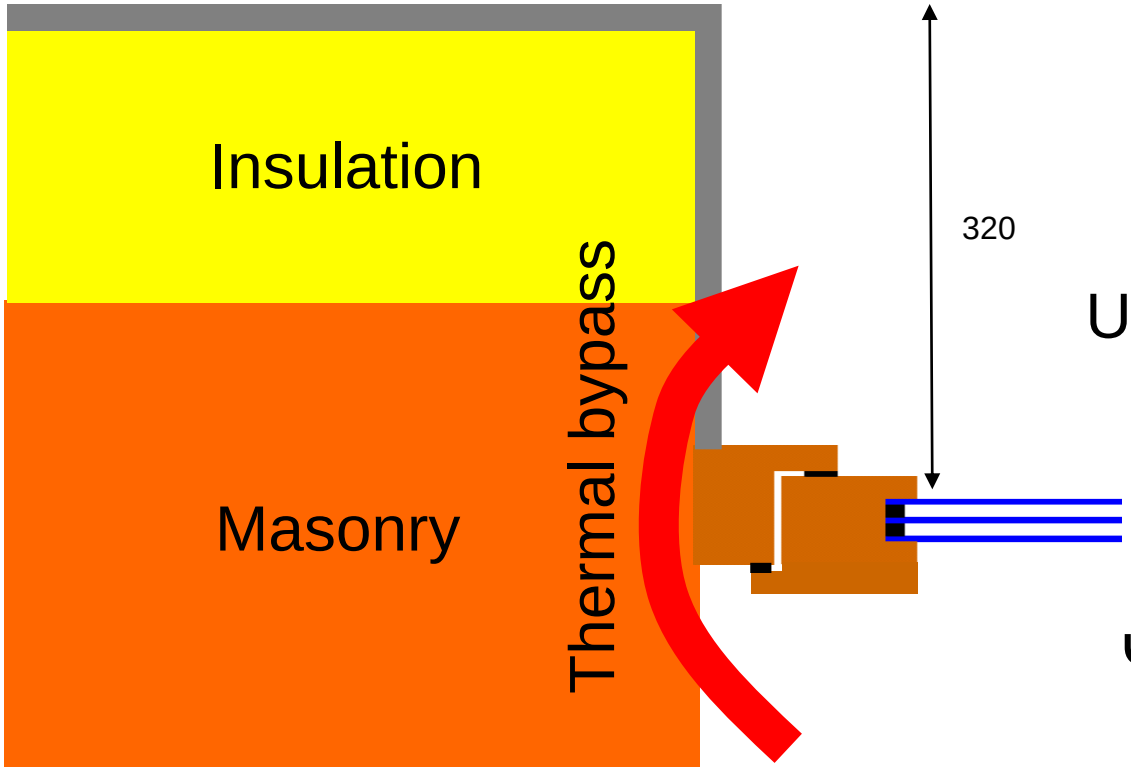
The effect of window position and insulation wrapping

Uw inst.* = 1.84 W/m²K



Uw = c. 0.8 W/m²K

Ψw = 0.26 W/mK

Schematic drawing based on an example from proceedings of the Passive House Conference 2006 for renovation of typical German construction using PH standard window. Freundorfer, Kaufmann and Krause

*1m x 1m window

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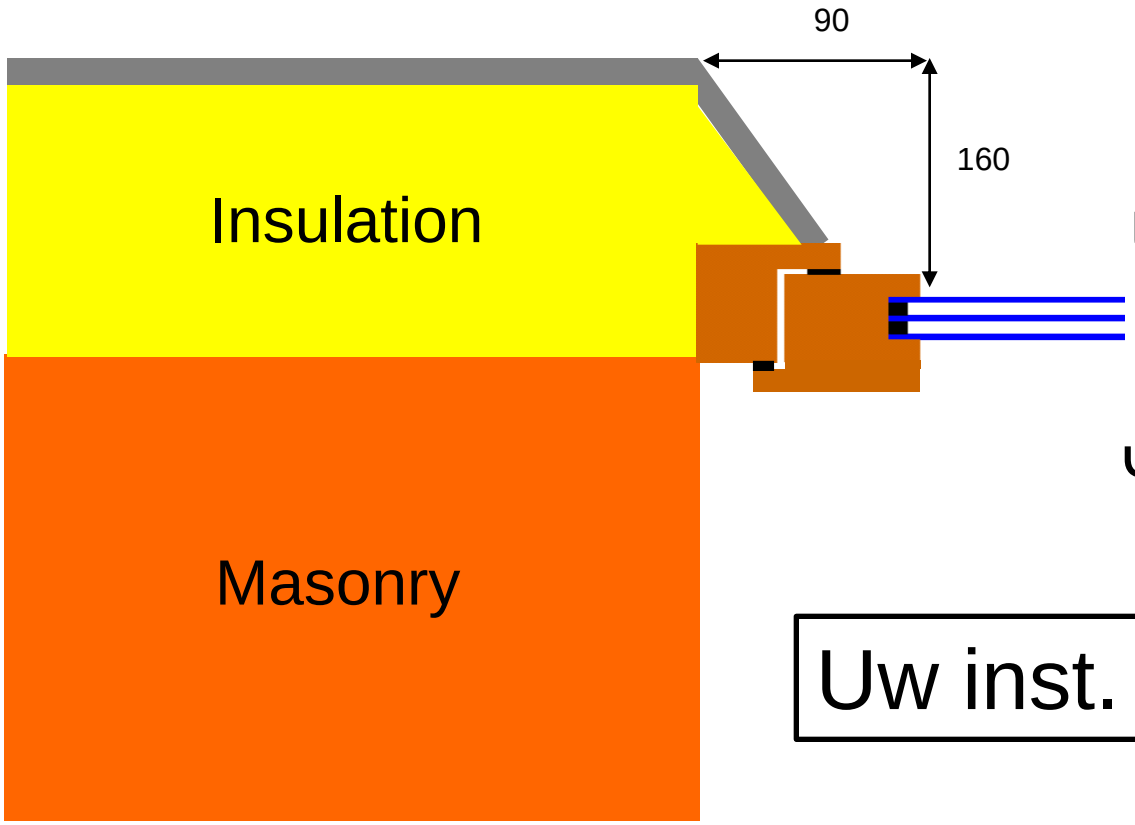
The effect of window position and insulation wrapping



U_w = 0.8 W/m²K

Ψ_w = 0.00 W/mK

U_w inst. = 0.8 W/m²K

Schematic drawing based on an example from proceedings of the Passive House Conference 2006 for renovation of typical German construction using PH standard window. Freundorfer, Kaufmann and Krause

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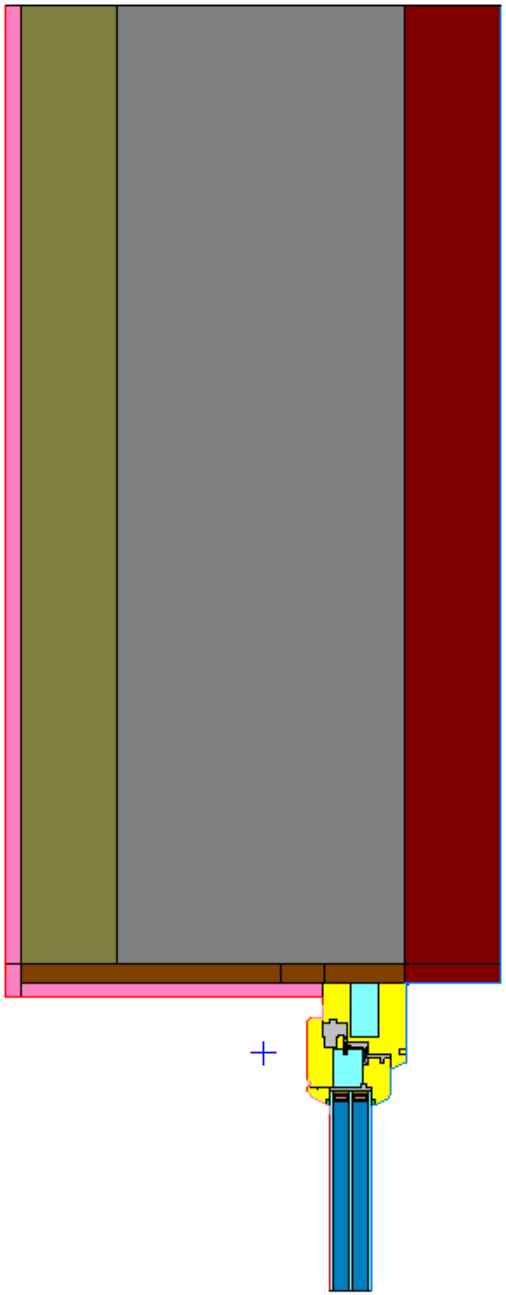
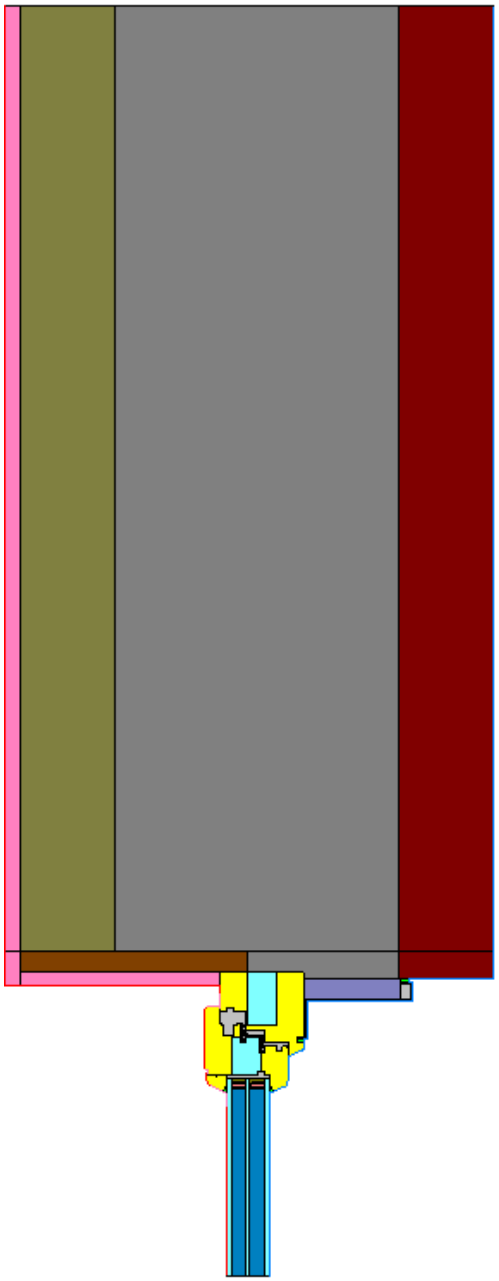
Conventional detail



Denby Dale detail



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Conventional detail

Data column	Row	Name	Ufactor nam	Length mm	U factor	L2D W/Km
S	17	L2D Uf	External	318.56	0.7921	0.2523
T	16	L2D inc glass	External	322.55	0.8090	0.2609
U	17	L2D inc Wall	Internal	1299.24	0.3130	0.4067
V	17	wall	internal	1000.00	0.1014	0.1014
W	17					
X	17					

Uframe for EN 10077-2	Window Calc.		dimension	U-value	heat flow	
			mm	W/m2K	W/mK	
L2D with insulation replacing glazing					0.2523	
Glass	from model	thickness	44	0.701		
		width	190		0.1331	
Frame	from model		127		**U Frame**	**0.939**

Psi Spacer for EN 10077-2	Window Calc		dimension	U-value	heat flow	
			mm	W/m2K	W/mK	
L2D with glazing					0.2609	
Glass	from model	width	190	0.620	0.1178	
Frame		width	127	0.939	0.1192	
					Psi Spacer	**0.024**

Psi Window Installation according to Pa:			dimension	U-value	heat flow	
			mm	W/m2K	W/mK	
L2D with wall					0.4067	
L2D without wall					0.2609	
Wall	from model		1020	0.101	0.1034	
					Psi Installation	**0.042**

Ψ inst 0.042 W/m²K

Denby Dale detail

Data column	Row	Name	Ufactor nam	Length mm	U factor	L2D W/Km
S	16	L2D Uf	External	317.00	0.7933	0.2515
T	16	L2D inc glass	External	322.55	0.8100	0.2613
U	17	L2D inc Wall	Internal	1342.55	0.2690	0.3611
V	17	wall	Internal	1000.00	0.1014	0.1014
W	17					
X	17					

Uframe for EN 10077-2	Window Calc.		dimension	U-value	heat flow	
			mm	W/m2K	W/mK	
L2D with insulation replacing glazing					0.2515	
Glass	from model	thickness	44	0.701		
		width	190		0.1331	
Frame	from model		127		**U Frame**	**0.932**

Psi Spacer for EN 10077-2	Window Calc		dimension	U-value	heat flow	
			mm	W/m2K	W/mK	
L2D with glazing					0.2613	
Glass	from model	width	190	0.620	0.1178	
Frame		width	127	0.932	0.1183	
					Psi Spacer	**0.025**

Psi Window Installation according to Pa:			dimension	U-value	heat flow	
			mm	W/m2K	W/mK	
L2D with wall					0.3611	
L2D without wall					0.2613	
Wall	from model		1020	0.1014	0.1034	
					Psi Installation	**-0.004**

Ψ inst -0.004 W/m²K

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Conventional detail

Installation				Ψ-Value	
Left 1/0	Right 1/0	Sill 1/0	Head 1/0	Ψ_{Spacer}	$\Psi_{Installation}$
				W/(mK)	W/(mK)
1.00	0.00	0.00	1.00	0.025	0.042
1.00	0.00	0.00	0.00	0.025	0.042
0.00	0.00	0.00	1.00	0.025	0.042
1.00	0.00	1.00	0.00	0.025	0.042
0.00	0.00	1.00	0.00	0.025	0.042
0.00	0.00	0.00	1.00	0.025	0.042
0.00	0.00	0.00	1.00	0.025	0.042
0.00	0.00	1.00	0.00	0.025	0.042
0.00	0.00	1.00	0.00	0.025	0.042
0.00	1.00	1.00	0.00	0.025	0.042
0.00	1.00	1.00	0.00	0.025	0.042
1.00	1.00	1.00	1.00	0.025	0.042
0.00	1.00	1.00	1.00	0.025	0.042
1.00	0.00	1.00	1.00	0.025	0.042
0.00	1.00	1.00	1.00	0.025	0.042
1.00	1.00	1.00	1.00	0.025	0.042
1.00	0.00	1.00	1.00	0.025	0.042
0.00	1.00	1.00	1.00	0.025	0.042
1.00	1.00	1.00	1.00	0.025	0.042
1.00	1.00	1.00	1.00	0.025	0.042
1.00	1.00	1.00	1.00	0.025	0.042
1.00	1.00	1.00	1.00	0.025	0.042
1.00	1.00	1.00	1.00	0.025	0.042
1.00	1.00	1.00	1.00	0.025	0.042
1.00	1.00	1.00	1.00	0.025	0.042
1.0	1.0	1.0	1.0	0.025	0.042

Denby Dale detail

Installation				Ψ-Value	
Left 1/0	Right 1/0	Sill 1/0	Head 1/0	Ψ_{Spacer}	$\Psi_{Installation}$
				W/(mK)	W/(mK)
1.00	0.00	0.00	1.00	0.025	-0.004
1.00	0.00	0.00	0.00	0.025	-0.004
0.00	0.00	0.00	1.00	0.025	-0.004
1.00	0.00	1.00	0.00	0.025	-0.004
0.00	0.00	1.00	0.00	0.025	-0.004
0.00	0.00	0.00	1.00	0.025	-0.004
0.00	0.00	0.00	1.00	0.025	-0.004
0.00	0.00	1.00	0.00	0.025	-0.004
0.00	0.00	1.00	0.00	0.025	-0.004
0.00	1.00	1.00	0.00	0.025	-0.004
0.00	1.00	1.00	0.00	0.025	-0.004
1.00	1.00	1.00	1.00	0.025	-0.004
0.00	1.00	1.00	1.00	0.025	-0.004
1.00	0.00	1.00	1.00	0.025	-0.004
0.00	1.00	1.00	1.00	0.025	-0.004
1.00	1.00	1.00	1.00	0.025	-0.004
1.00	0.00	1.00	1.00	0.025	-0.004
0.00	1.00	1.00	1.00	0.025	-0.004
1.00	1.00	1.00	1.00	0.025	-0.004
1.00	1.00	1.00	1.00	0.025	-0.004
1.00	1.00	1.00	1.00	0.025	-0.004
1.00	1.00	1.00	1.00	0.025	-0.004
1.00	1.00	1.00	1.00	0.025	-0.004
1.00	1.00	1.00	1.00	0.025	-0.004
1.00	1.00	1.00	1.00	0.025	-0.004
1.0	1.0	1.0	1.0	0.025	-0.004

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Conventional detail

Treated Floor Area:	104.4	m^2		
	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	16	kWh/(m^2a)	15 kWh/(m^2a)	No
Pressurization Test Result:	0.3	h^{-1}	0.6 h^{-1}	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	82	kWh/(m^2a)	120 kWh/(m^2a)	Yes
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	42	kWh/(m^2a)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:		kWh/(m^2a)		
Heating Load:	11	W/m^2		
Frequency of Overheating:	2	%	over 25 °C	
Specific Useful Cooling Energy Demand:		kWh/(m^2a)	15 kWh/(m^2a)	
Cooling Load:	11	W/m^2		

Denby Dale detail

Treated Floor Area:	104.4	m^2		
	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	14	kWh/(m^2a)	15 kWh/(m^2a)	Yes
Pressurization Test Result:	0.3	h^{-1}	0.6 h^{-1}	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	80	kWh/(m^2a)	120 kWh/(m^2a)	Yes
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	40	kWh/(m^2a)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:		kWh/(m^2a)		
Heating Load:	11	W/m^2		
Frequency of Overheating:	2	%	over 25 °C	
Specific Useful Cooling Energy Demand:		kWh/(m^2a)	15 kWh/(m^2a)	
Cooling Load:	11	W/m^2		

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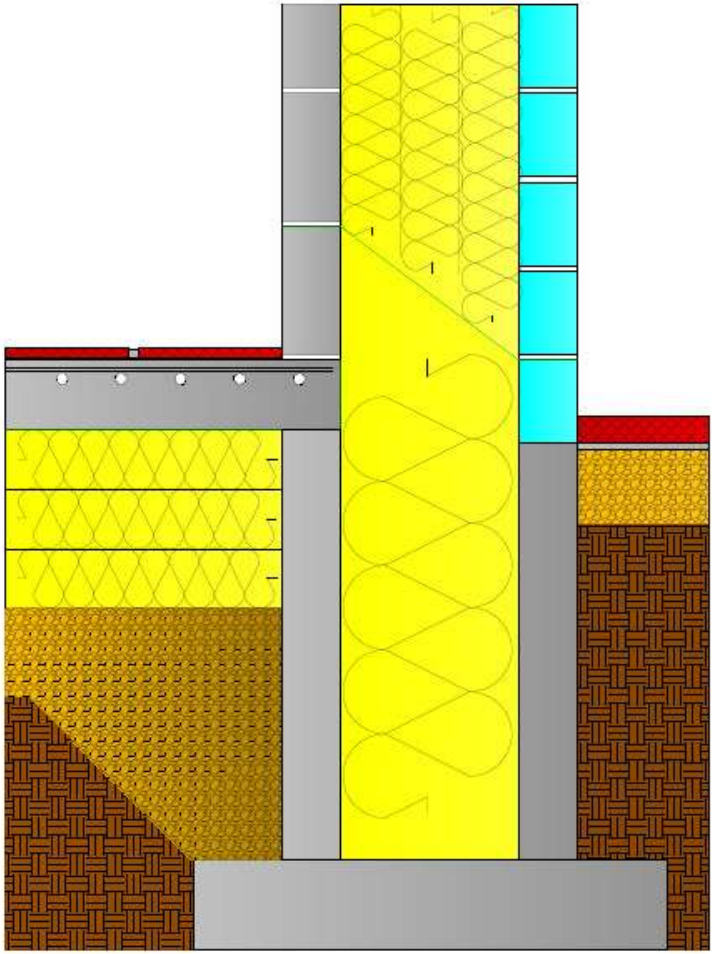
Strip Foundation and Ground Floor Slab to External Wall Junction



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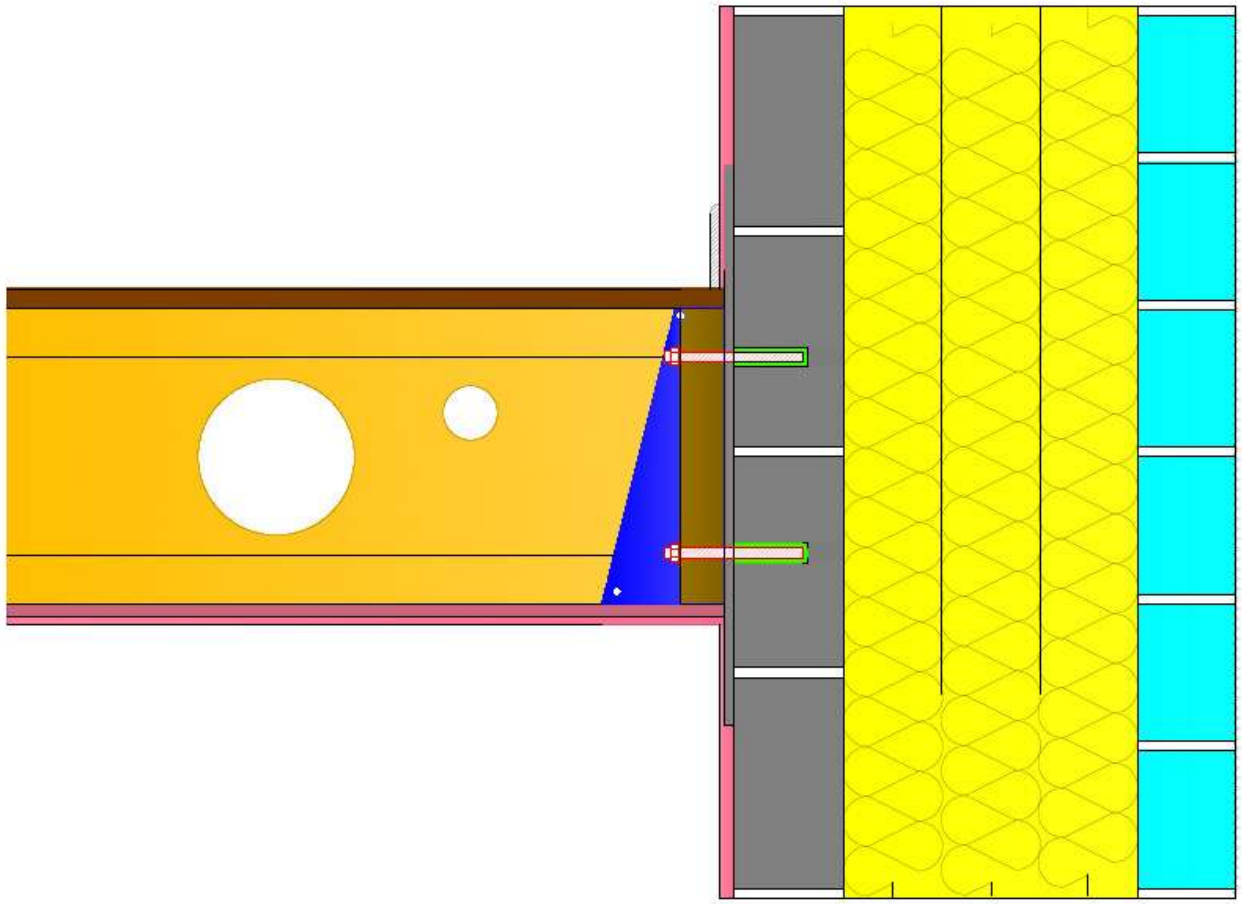
Intermediate Floor to External Wall Junction



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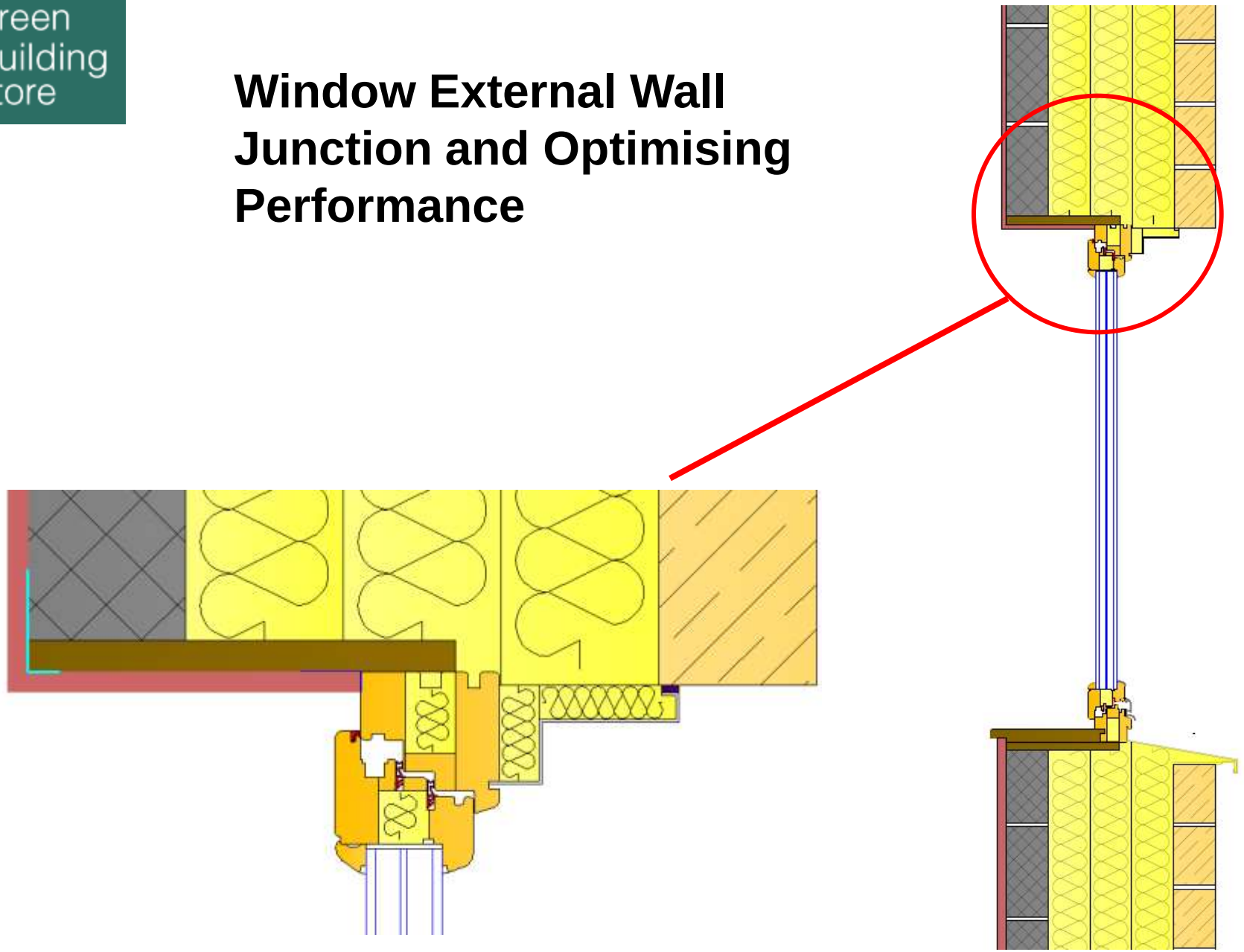
Window External Wall Junction and Optimising Performance



Installed U Value 0.75 W/m2K

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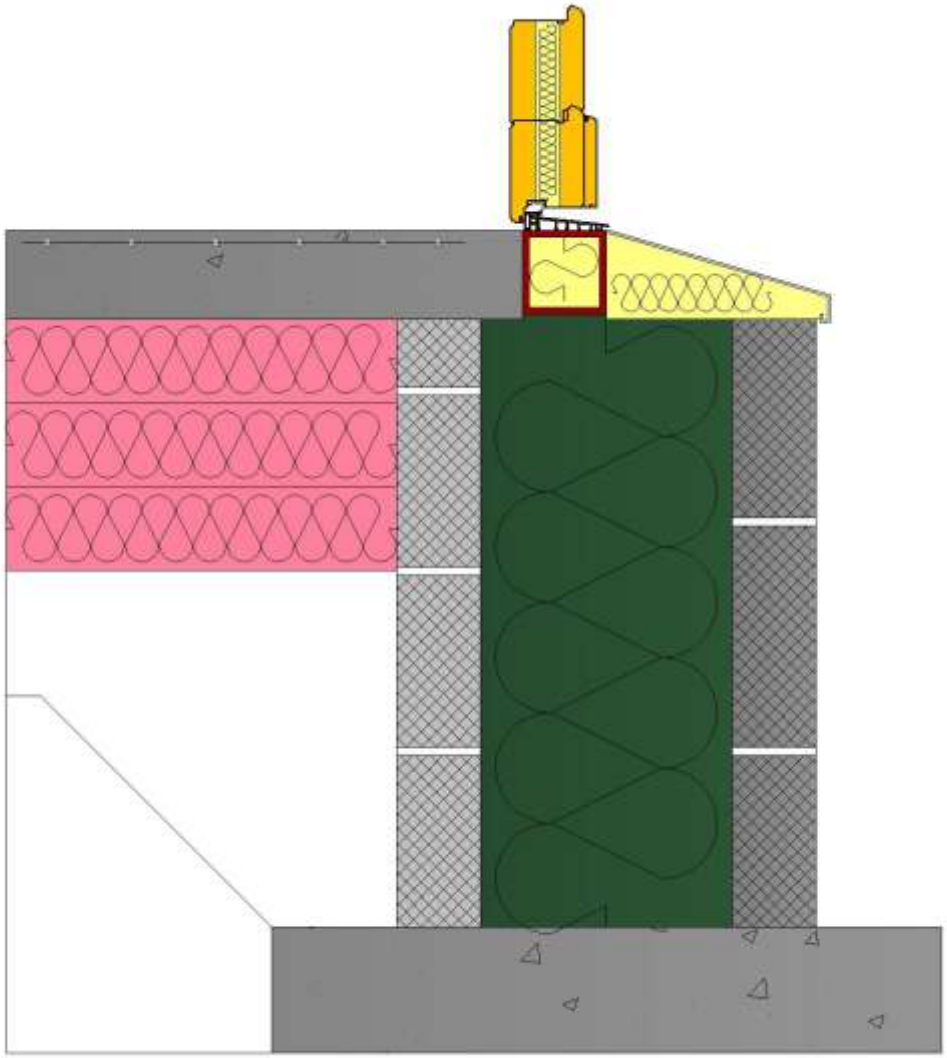
External Door Threshold Detail



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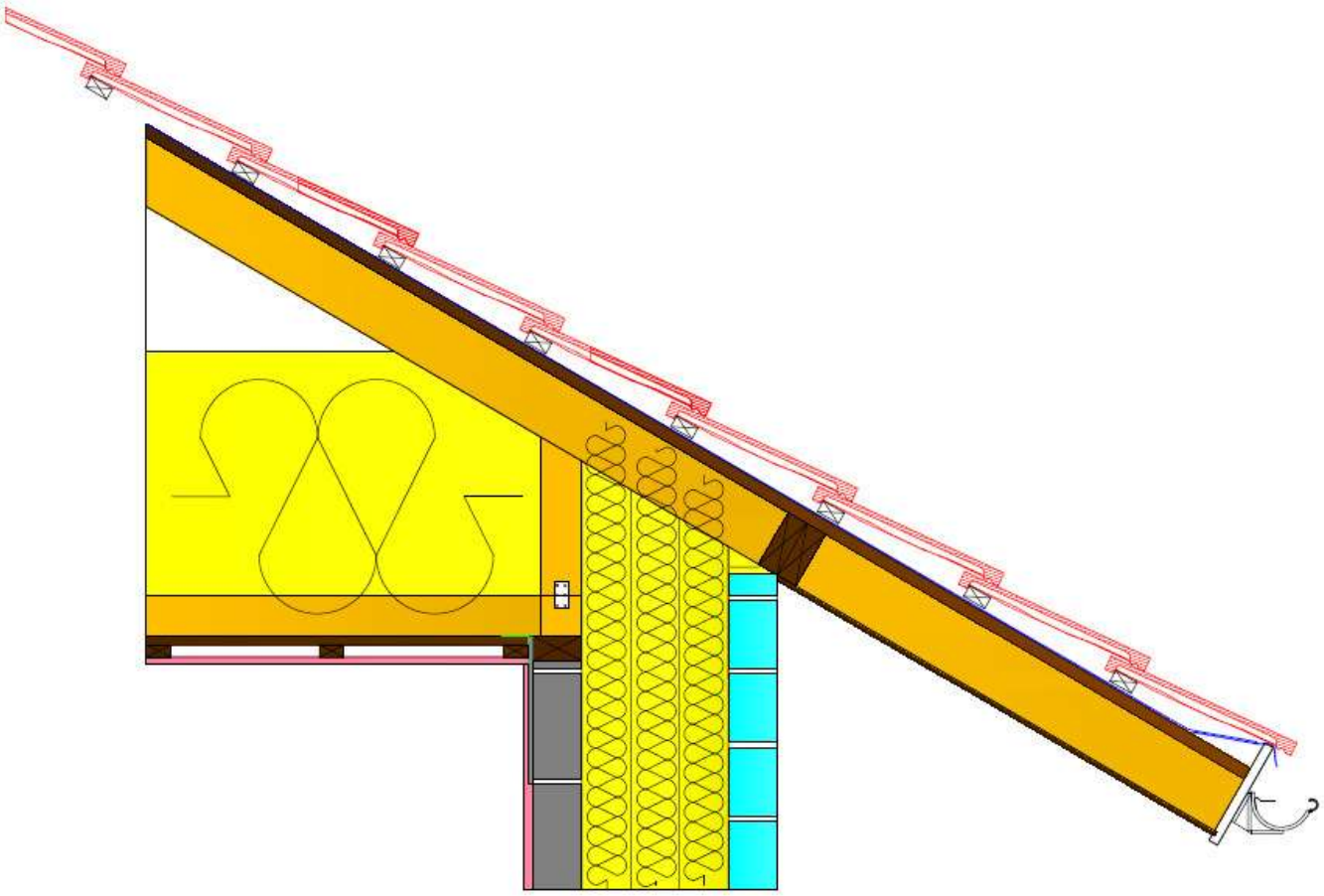
Roof External Wall Junction



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Performance Results

- 0.31m3/(hm2) @ 50Pa
- Part L requires 10m3/(hm2) @ 50Pa

- 0.33 ac/m2/hr
- Passivhaus requires 0.6ac/m2/hr

- Space heating need 13 KWh/m2/annum?
- Passivhaus requires 15KWh/m2/annum

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Certification Documents

●WARM: Low Energy Building Practice ***awarded this building the certificate:***

Quality Approved Passive House

The certification is based solely on design data proofs and specifications by the client given to the ●WARM: Low Energy Building Practice *for the purpose of certification.* ●WARM: Low Energy Building Practice *has checked and approved energy balances according to these data.*

Quality assurance of construction work was not subject of this certification. By this certification ●WARM: Low Energy Building Practice *takes no warranty for any faults in design and/or execution of the building.*

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Documentary Evidence

- Full set of drawings including shading, construction detailing, M&E layouts, etc
- Technical Specification particularly U values for all relevant components and materials
- Technical Specification for ventilation and heating including commissioning data
- Air Tightness certification
- Declaration from Construction Supervisor
- Full photographic evidence

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On site lessons

- The necessity for clear well thought through and consistent detailing
- The need for open communication channels between the design and construction sides of the ‘team’
- Imperative to share all knowledge of ‘why and how’ between all involved, from designers to site operatives
- There is no substitution for care with pride

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High quality construction?

- Traditional building process

Partner-activitiy	Fases						
	order	sketch-design	pre-design	Final design	Execution	Lead	After sale services
Builder							
Architect							
Engineering							
Constructor							

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High quality construction?

- Improved building process

Partner-activitiy	Fases						
	order	sketch-design	pre-design	Final design	Execution	Lead	After sale services
Builder	DESIGNTEAM						
Architect							
Engineering							
Constructor							

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High quality construction?

- Passive House building process

Partner-activitiy	Fases						
	order	sketch-design	pre-design	Final design	Execution	Lead	After sale services
Builder	**Buildingteam**						
Architect							
Engineering							
Constructor							

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- The Clients

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- The Builders

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- The Heating Engineers

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- The Architect

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