Project Documentation
Gebäude-Dokumentation

1 Abstract / Zusammenfassung

Gorslas Primary School, Carmarthenshire, Wales

1.1 Data of building / Gebäudedaten

Year of construction/ Baujahr	2022	**Space heating / Heizwärmebedarf**	**14 kWh/(m²a)**
U-value external wall/ U-Wert Außenwand	0.10-0.013 W/(m²K)		
U-value ground floor/ U-Wert Kellerdecke	0.157 W/(m²K)	**Primary Energy Renewable (PER) / Erneuerbare Primärenergie (PER)**	75 kWh/(m²a)
U-value roof/ U-Wert Dach	0.12 W/(m²K)	**Generation of renewable energy / Erzeugung erneuerb. Energie**	0 kWh/(m²a)
U-value window/ U-Wert Fenster	1.09 W/(m²K)	**Non-renewable Primary Energy (PE) / Nicht erneuerbare Primärenergie (PE)**	133 kWh/(m²a)
Heat recovery/ Wärmerückgewinnung	84 %	Pressure test n_{50} / Drucktest n_{50}	0.18 h-1
Special features/ Besonderheiten			

1.2 Brief Description ...

Gorslas Passive House Primary School

Gorslas Primary School is a new two storey school at Gorslas, Carmarthenshire for 240 pupils aged 4 to 11 years old including integral provision for an Early Years facility. The new building is situated on an alternative site to the existing school behind the village park. Some of the external areas will be used by the local community outside of school hours. The new building has been designed and constructed to the Passivhaus Classic Standard. The project involved the associated infrastructure, external works, drainage and further site undertakings. Improvement works to existing external areas were undertaken where affected by the project.

1.2 Kurzbeschreibung der Bauaufgabe

Passivhaus Darmstadt Kranichstein

1.3 Responsible project participants / Verantwortliche Projektbeteiligte

Architect/ Entwurfsverfasser	Acanthus Holden Architects www.acanthus-holden.co.uk
Implementation planning/ Ausführungsplanung	Acanthus Holden Architects www.acanthus-holden.co.uk
Building systems/ Haustechnik	SO Modular www.somodular.co.uk
Structural engineering/ Baustatik	Roger Casey Associates www.rca-eng.co.uk/
Building physics/ Bauphysik	Piers Sadler www.delta-q.co.uk
Passive House project planning/ Passivhaus-Projektierung	Piers Sadler www.delta-q.co.uk
Construction management/ Bauleitung	Lloyd and Gravell Limited www.lloydandgravell.co.uk

Certifying body/ Zertifizierungsstelle	Warm Low Energy Building Practice www.peterwarm.co.uk
Certification ID/ Zertifizierungs ID	7849

Author of project documentation / Verfasser der Gebäude-Dokumentation	Piers Sadler www.delta-q.co.uk
Date, Signature/. Datum, Unterschrift	

2 Building Views

The south facing side is shown on the cover page.

Gorslas Primary School, View from north (east end)t

Gorslas Primary School, View from northwest

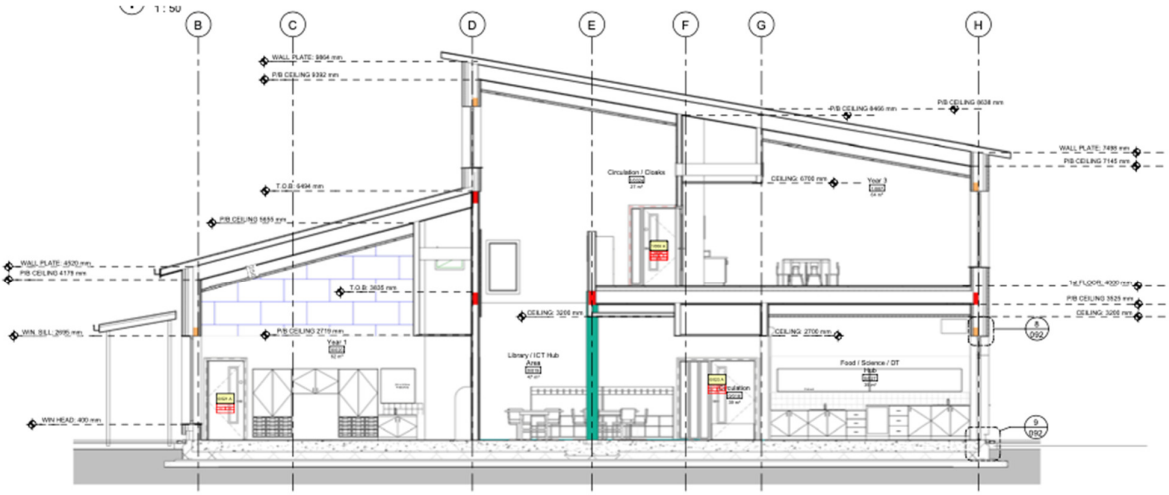
Gorslas Primary School, View from west

Gorslas Primary School, View from east

Interior view of the hall

Interior view: typical classroom

3 Sectional drawing of Gorslas Primary School



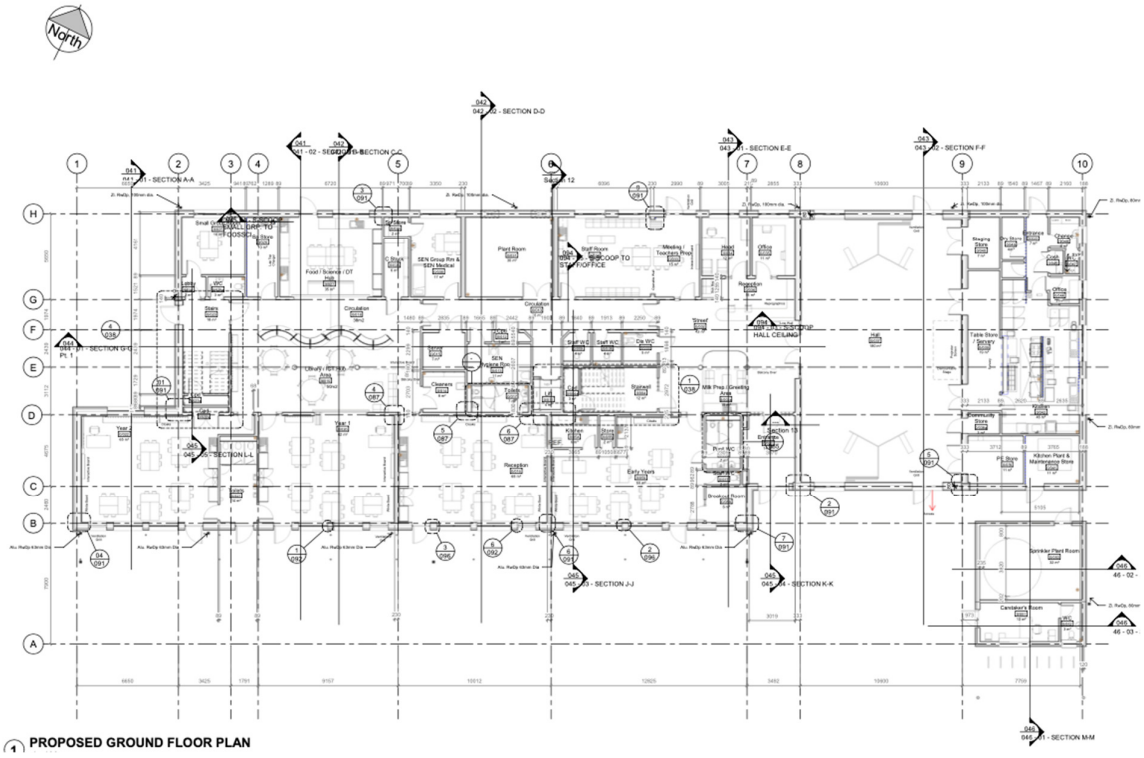
2 SECTION B - B
1 : 50

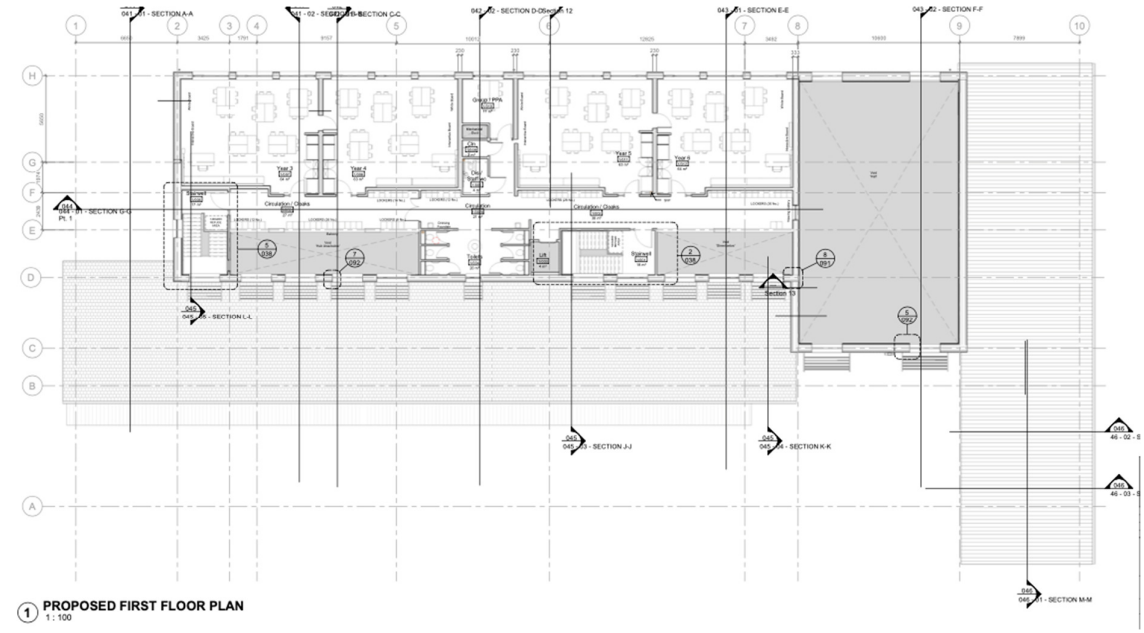
The line of the section B-B is shown on the floor plan below.

The thermal envelope with excellent uninterrupted insulation follows the section around the building, with below slab insulation, larsen truss style timber frame walls and insulated roof cassettes.

The nursery and early years classrooms are in a single storey on the south side; staff, administration and meeting rooms are generally on the north side ground floor; and the first floor north side accommodates years 3-6 classrooms. Clerestory windows allow light to enter the central corridor on the first floor and via full height open areas to the ground floor reception and corridors.

4 Floor plans of Gorslas Primary School





The nursery and early years classrooms are on a single storey on the south side. The hall is a double height space, with single storey kitchen adjacent tot he school on the east side.

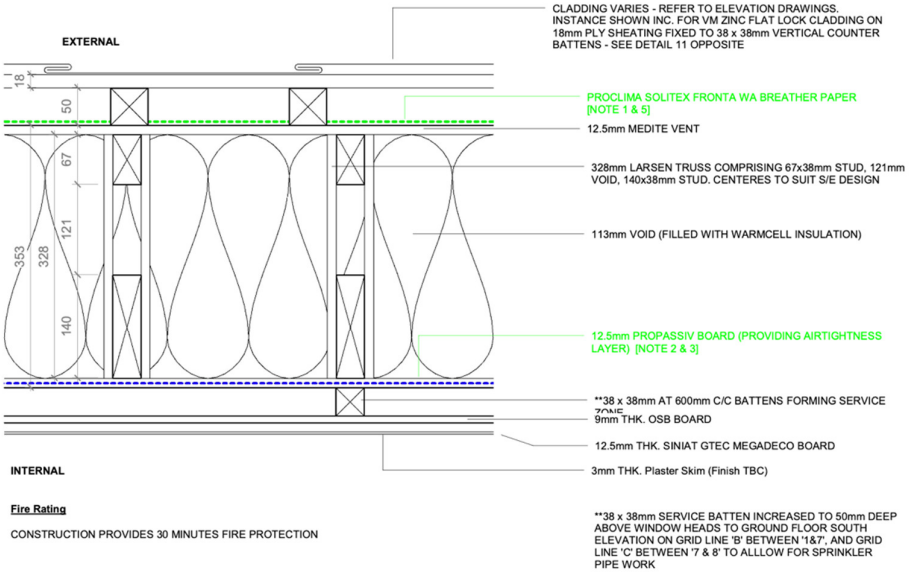
5 Thermal envelope

5.1 Construction build-ups & U-values

The ground floor is constructed of 200mm EPS insulation with 300mm reinforced concrete slab cast on top. The calculated U-value is 0.13 W/m^{2}K.

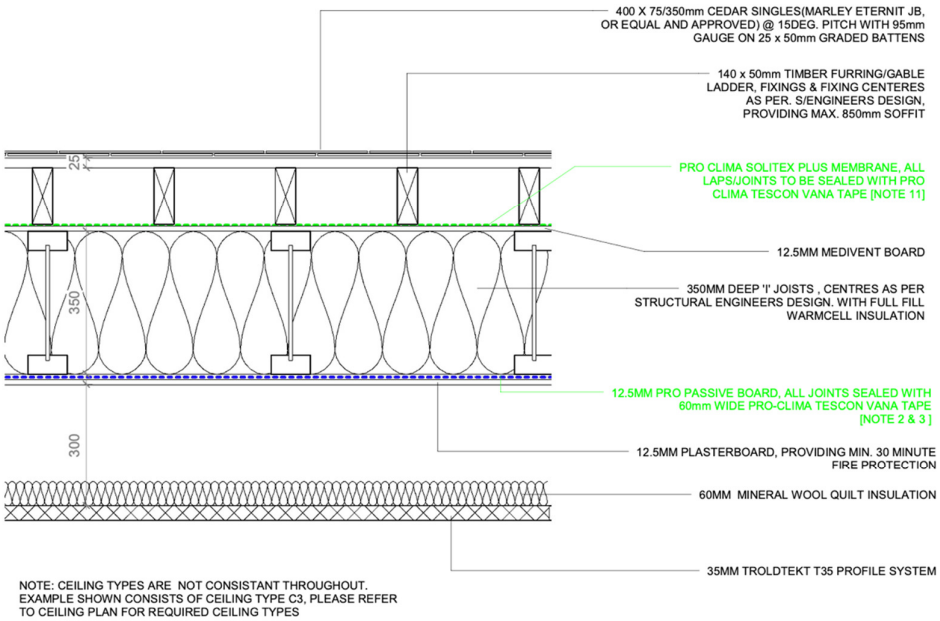
There are several types of external wall, with the main construction illustrated below. The U-value is 0.13 W/m^{2}K. The walls of the main hall are slightly thicker to accommodate glulam posts and steels in the structural zone and have U-values of 0.10-0.11 W/m^{2}K

.



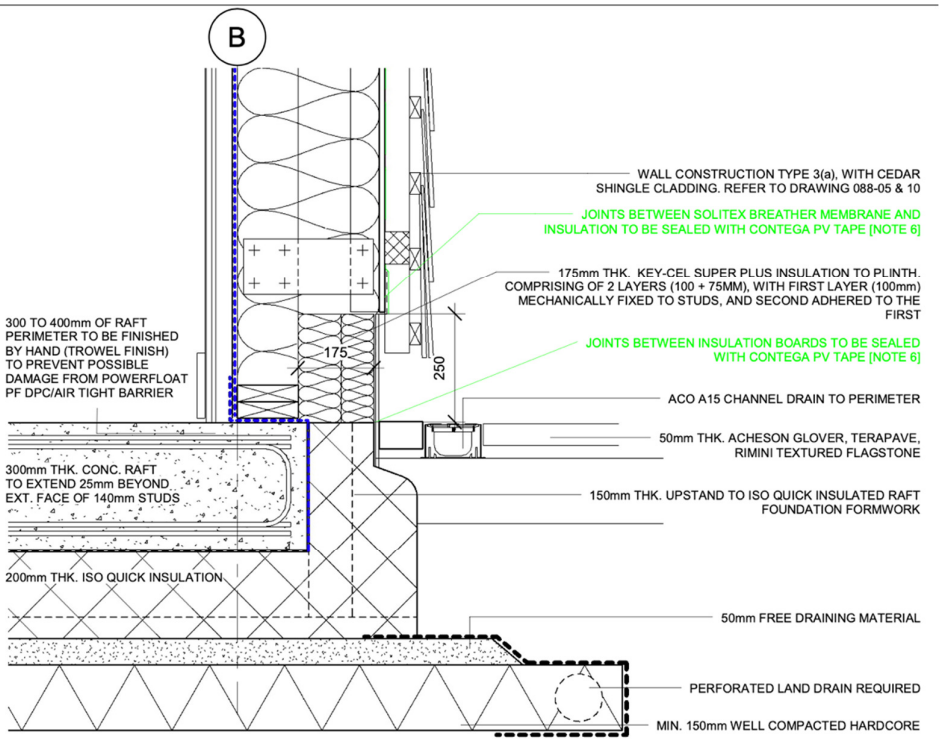
05 EXT. WALL TYPE 3(a) - REST OF SCHOOL
1 : 5

The typical roof build-up is shown below, with 350mm timber i-beams insulated with pumped cellulose insulation and U-value 0.12 W/m²K.



7 **CEDAR SHINGLE ROOF CONST.**
1 : 10

5.2 Construction details



9 **089 - 09 - DPC/PERIMETER DETAIL**
1 : 10

The ground floor is insulated below slab foundation using Isoquick EPS insulation. The slab is cast into the insulation with the timber frame wall sitting on the edge of and overhanging the slab.

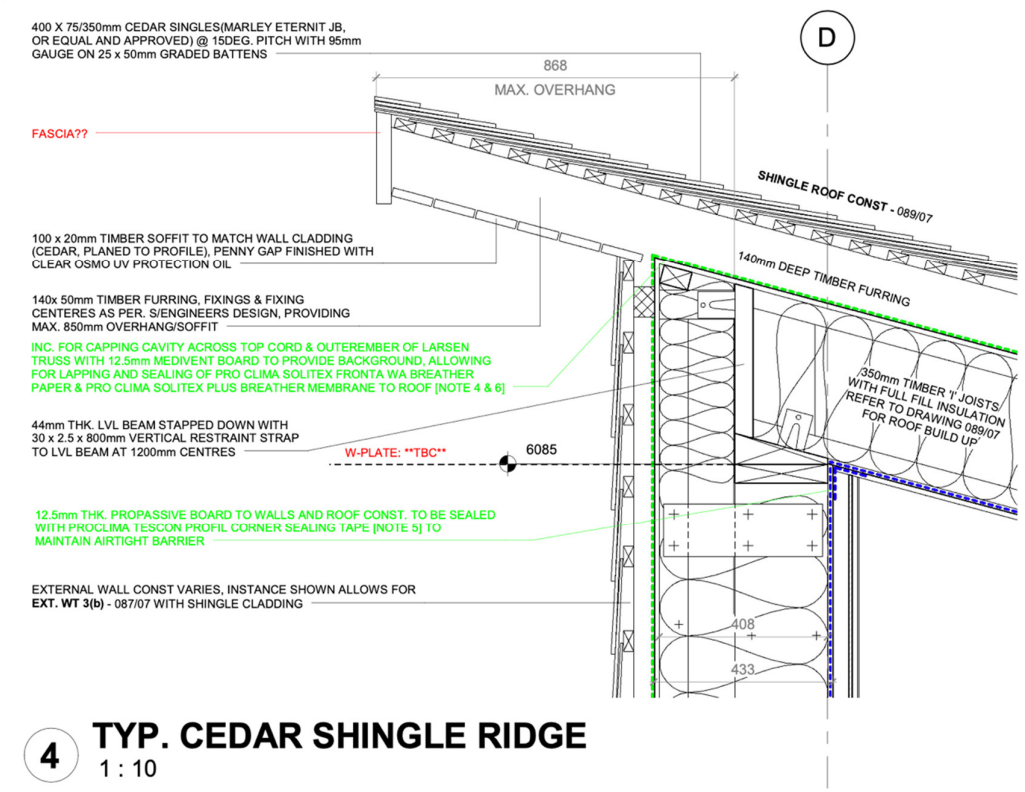
The external walls are constructed of a larsen truss system timber frame wall. The walls were constructed in panels in the SO Modular factory and brought to site where they were clad and insulated.

The picture on the left above, shows the pale EPS of the Isoquik system at the bottom with the timber frame over-sailing the EPS insulation and the black EPS insulation friction fitted into the space after the frame is installed. This arrangement provides a continuous thermal bridge free wrap at this junction.

The larsen truss uses an inner load bearing stud which sits on the concrete slab foundation and then supports the insulation and the cladding with a series of plywood gussets as shown in the photo on the right above. The structural zone of the timber frame walls aligns with the inner stud, so that the inner timber fraction is high, but the timber fraction aligned with the gussets is very low.

The image on the left below shows a steel column (red) within the main structural zone of the external wall, with the larsen truss and outer stud of the timber frame.

Roof cassettes constructed in the factory rest on the inner stud of the external wall with timber furring oversailing the roof to create an overhang. The photo below shows the roof cassette opened up to reveal Warmcel insulation made from recycled newspaper filling the voids.



5.3 Windows and Doors

Triple glazed aluminium windows by Al UK were used for the project. The design involved numerous frame sections, including fixed and opening lights and a variety of mullion and transom couplings. All were modelled to calculate the frame U-value fort he particular section. Frame U-values were typically around 1.5 W/m2K and as high as 2 W/m²K for door couplings.

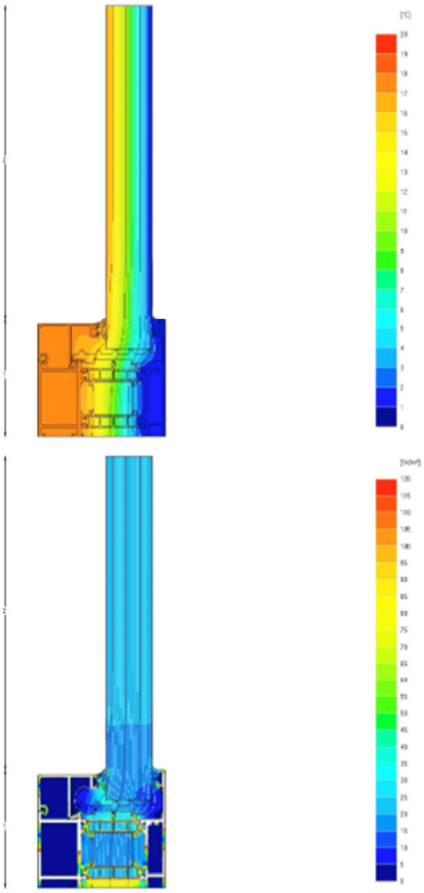
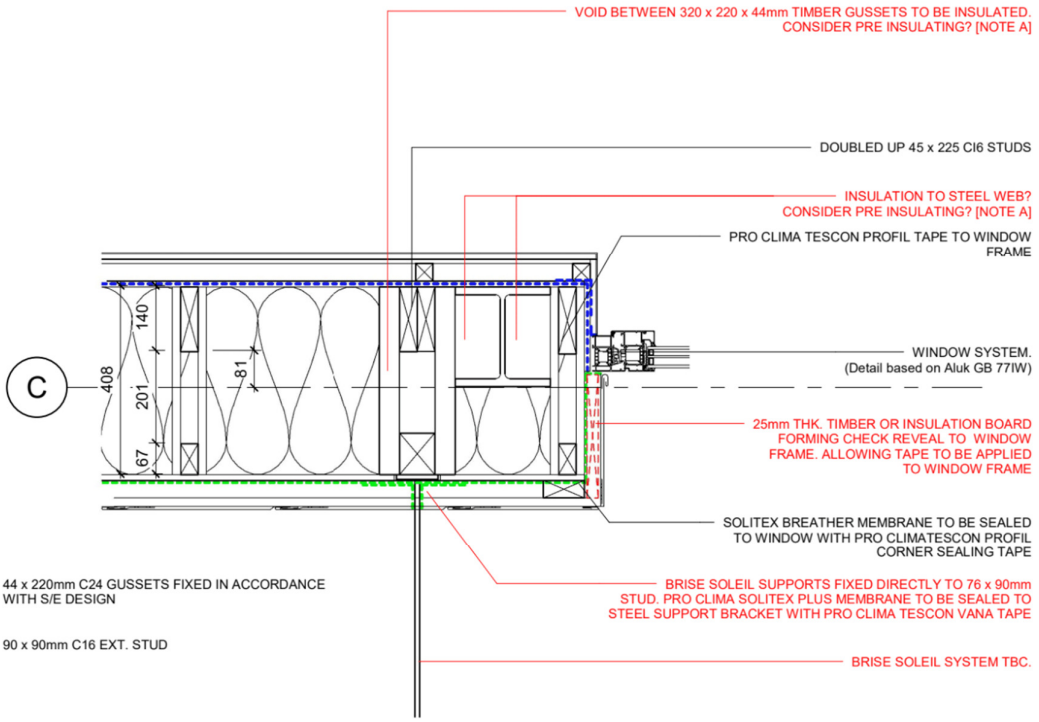


Fig. 17 Trend of temperatures and of the heat fluxes within node K2010

Thermal transmittance of node K2010 $U_f = 1,5$ W/m²K

The glazing U-value (g) was 0.63 W/m2K and the glazing g-value was 0.47.

Typical installed window U-values ranged from 1005-1.2 W/m²K. A typical installation detail is shown below.



5 WINDOW REVEAL/BRISE SOLEIL FIXING TO HALL
1 : 10

The picture shows the structural opening before the window was installed.

6 Airtightness and Pressure Test

The airtightness layer runs on the inside oft he thermal envelope and includes the concrete floor slab, airtight board (green in photos) on the inside oft he external walls and on the underside oft he roof and Proclima tapes and membranes to connect airtight boards, the different thermal envelope elements through building junctions and to widows and doors.

Careful planning was required to achieve continuity of this layer. The photos below show:

- the green airtight board taped at junctions on the inside of the hall walls and roof, with careful taping round the glulam beams which support the roof and penetrate the airtight layer
- membrane wrapped around the floor cassette to achieve continuity between ground floor and first floor airtightness
- wrapping the ends of glulam beams in the hall roof
- complex detailing of airtightness between the hall wall and adjacent classroom roof.
- the air tester undertaking the test


www.proclima.com

An initial air test was carried out when the timber frame was complete and after the windows were installed achieving a result of 0.15 air changes per hour (ACH) @ 50 Pa. The final air test on completion achieved 0.18 ACH @ 50 pa. This is an exceptionally good result for a building of this size and complexity.

7 Ventilation

A cascade ventilation system was used with air supplied to classrooms and other occupied spaces and transferring to corridors through fire and acoustic air transfer grilles; the air is then extracted from toilets and the hall. The ventilation rate is fixed through the school day.

The main ventilation unit is a Passivhaus Certified Swegon Gold RX35 located in the main plantroom (see photo below). A second Swegon Gold unit, this time a smaller RX12 ventilates the kitchen and a third small ventilation unit ventilates the kitchen food store, offices and toilets. The intake and exhaust ducts run for short distances to the exterior wall and are insulated to prevent heat loss. The duct insulation is wrapped with a vapour impermeable foil wrap which is sealed to the airtightness layer of the building to prevent condensation.

8 Heating

The heating is via a single condensing LPG boiler located in the plant room, which supplies heat to radiators in all spaces.

9 Domestic Hot Water

Domestic hot water is supplied by a combination of distributed direct electric water heaters around the school and a centralised gas calorifier with a 1600 l cyclinder for the kitchen. The distributed electric hot water enbables deadleg pipe lengths to be minimised. The kitchen hot water system has a secondary circulation loop which, combined with the cylinder ensures that high flows can be quickly delivered to taps. In this case, best practice thermally broken pipe hangers have not been used.

9.1 PHPP Calculations

The calculations were undertaken using PHPP 9.6. An extract from the certifier's Verification page and the heat balance from the heating tab of the PHPP are shown below.

Passive House Verification

Building:	Gorslas Primary School				
Street:	Church Road				
Postcode/City:	SA14 7NF	Gorslas			
Province/Country:	Carmarthenshire	GB-United Kingdom/ Britain			
Building type:	School				
Climate data set:	ud--01-GB0023a-Swansea				
Climate zone:	3: Cool-temperate	Altitude of location:	169 m		
Home owner / Client:	Carmarthenshire County Council				
Street:	County Hall, Castle Hill				
Postcode/City:	SA31 1JP	Carmarthen			
Province/Country:	Carmarthernshire	GB-United Kingdom/ Britain			
Architecture:	Acanthus Holden Architects		**Mechanical engineer:**	Bullock Consulting	
Street:	Watermans Lane, The Green		Street:	Bridge Innovation Centre, Pembrokeshire Science and Techr	
Postcode/City:	SA71 4NU	Pembroke	Postcode/City:	SA72 6UN	Pembroke Dock
Province/Country:	Pembrokeshire	GB-United Kingdom/ Britain	Province/Country:	Pembrokeshire	GB-United Kingdom/ Britain
Energy consultancy:	Delta Q Consulting Ltd		**Certification:**	WARM: Low Energy Building Practice	
Street:	Studio 2, St Andrews Road,		Street:	3 Admirals Hard	
Postcode/City:	BS6 5EH	Montpelier	Postcode/City:	PL1 3RJ	Plymouth
Province/Country:	Bristol	GB-United Kingdom/ Britain	Province/Country:	Devon	GB-United Kingdom/ Britain
Year of construction:	2022		Interior temperature winter [°C]:	19.4	Interior temp. summer [°C]: 25.0
No. of dwelling units:	1		Internal heat gains (IHG) heating case [W/m²]:	3.2	IHG cooling case [W/m²]: 3.2
No. of occupants:	270.0		Specific capacity [Wh/K per m² TFA]:	72	Mechanical cooling:

Specific building characteristics with reference to the treated floor area

					Criteria	Alternative criteria	Fullfilled?[2]
	Treated floor area	m²	1355.3				
Space heating	Heating demand	kWh/(m²a)	14	≤	15	-	yes
	Heating load	W/m²	10	≤	-	10	
Space cooling	Cooling & dehum. demand	kWh/(m²a)	-	≤	-	-	-
	Cooling load	W/m²	-	≤	-	-	
	Frequency of overheating (> 25 °C)	%	0	≤	10		yes
	Frequency of excessively high humidity (> 12 g/kg)	%	0	≤	20		yes
Airtightness	Pressurization test result n_{50}	1/h	0.2	≤	0.6		yes
Moisture protection							
	Smallest temperature factor $f_{Rsi=0.25\ m²K/W}$	-	-	≥	0.70		-
Thermal Comfort	All requirements fulfilled?	-			yes		yes
	U-value	W/(m²K)		≤	1.23		
	U-value	W/(m²K)		≤	1.47		
	U-value	W/(m²K)		≤	1.60		
	U-value	W/(m²K)		≤	0.67		
Non-renewable Primary Energy (PE)	PE demand	kWh/(m²a)	133	≤	135		yes
Primary Energy Renewable (PER)	PER demand	kWh/(m²a)	75	≤	-	-	-
	Generation of renewable energy (in relation to pro-jected building footprint area)	kWh/(m²a)	0	≥	-	-	

[2] Empty field: Data missing; '-': No requirement

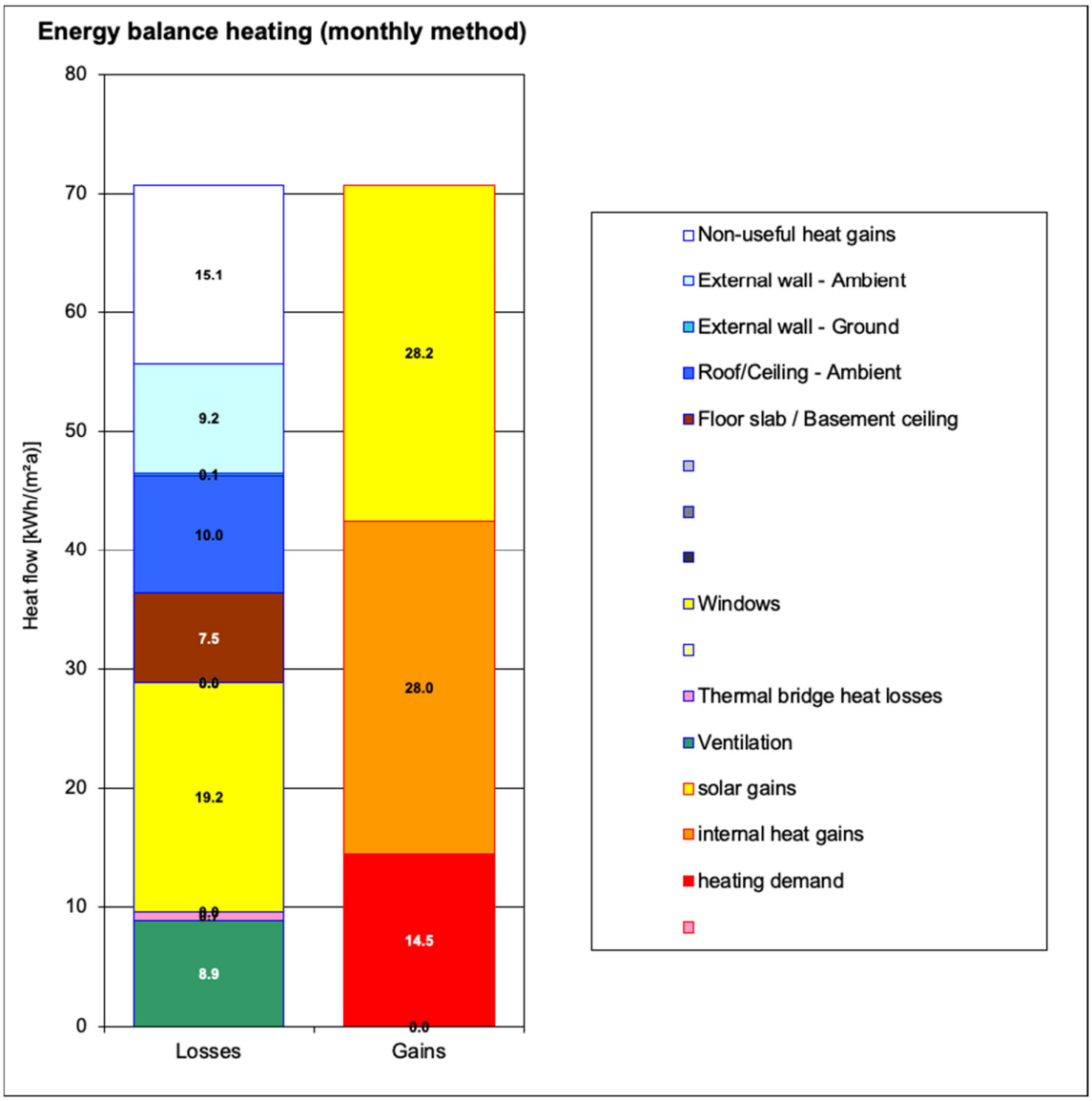
I confirm that the values given herein have been determined following the PHPP methodology and based on the characteristic values of the building. The PHPP calculations are attached to this verification.

Passive House Classic? yes

Task:	First name:	Surname:	Signature:
2-Certifier	Sally	Godber	

Certificate ID	Issued on:	City:
41886-41899_WARM_PH_20240205_SG	28/11/23	Plymouth

In the UK schools usually have large windows to achieve high levels of daylighting; this results in the windows being the largest element of the heat balance in terms of losses and gains (shown in yellow in the graph below).


Energy balance heating (monthly method)
Heat flow [kWh/(m²a)]
80
70
60
50
40
30
20
10
0
15.1
9.2
0.1
10.0
7.5
0.0
19.2
0.9
8.9
28.2
28.0
14.5
0.0
Losses
Gains
Non-useful heat gains
External wall - Ambient
External wall - Ground
Roof/Ceiling - Ambient
Floor slab / Basement ceiling
Windows
Thermal bridge heat losses
Ventilation
solar gains
internal heat gains
heating demand