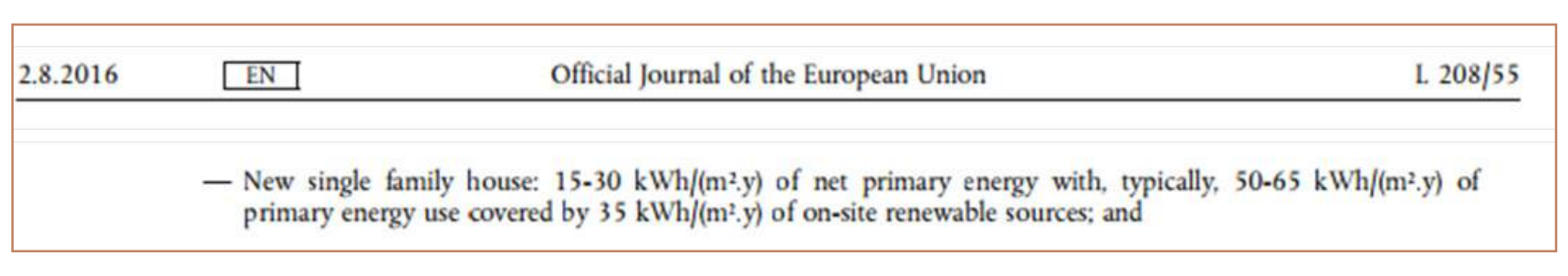
DT774 - 2017 Railway Cottage Olivia Golden

INTRODUCTION

The project involves the refurbishment of the 40sqm stone railway cottage, demolition of existing extension and building a new 109 sqm single storey, courtyard extension to rear. The house is semi detached and forms part of a terrace running parallel to the dart line.

The aim is to achieve compliance with EU Recommendation 2016/ 1218 using the nZEB skills accumulated. The EU Recommendation looks for a net primary energy below 30 KWh/m2/yr and also puts a cap on renewable energy use at 35 kWh/m2/yr. This goes above and beyond the current building regulations however the European Energy Performance of Buildings Directive Recast (EPBD) requires all new buildings to be Nearly Zero Energy Buildings (NZEB) by 31st December 2020.



2.8.2016 EN Official Journal of the European Union L 208/55

— New single family house: 15-30 kWh/(m².y) of net primary energy with, typically, 50-65 kWh/(m².y) of primary energy use covered by 35 kWh/(m².y) of on-site renewable sources; and

DEAP ANALYSIS

The Dwelling Energy Assessment Procedure (DEAP) is the Irish official procedure for calculating and assessing the energy performance of dwellings. Two cases of been reviewed for the extension and retrofit of Railway Cottage.
The baseline case meets current Technical Guidance Document, Part L - Conservation of Duel and Energy-Dwellings (2017). The second DEAP case looks at an epitomised study that meets the EU recommendations and is referred to as the nZEB house.

KEY DIFFERENCES BETWEEN PART L VERSION AND nZEB VERSION

- MEASURE 1 - SIZE OF LIVING AREA - In the Part L house the living room is 40 sqm with the living area and study area in the same space. In the Euro House the living area and study area are divided so that the living area is reduced to 22 sqm therefore decreasing the volume of space to be heated.

- MEASURE 2 - VENTILATION - The nZEB House design has a Mechanical Ventilation with Heat Recovery system (MVHR) which reduces the amount of heat lost through ventilation. The Part L house uses natural ventilation.

- MEASURE 3 - WINDOWS - The nZEB house uses triple glazing (Rational Aura - 0.79 W/m2K) and has no roof lights. The Part L compliant house has double glazing (Rational Domus - 1.32 W/,2K) and has 2 velux roof lights.

- MEASURE 4 - BUILDING FABRIC - The nZEB house has super insulated fabric achieving 0.1 W/m2K in the new walls and roof. In the Part L compliant version the fabric U-values have been relaxed to 0.16 in new wall and in retro fit to existing cavity wall. The roof has been relaxed to 0.16 W/m2K and 1.4 W/m2k in the retrofit of existing roof.

- MEASURE 5 - THERMAL BRIDGE Y-FACTOR - The nZEB house has aims to achieve a Y-Factor of 0.04 W/m2K. This is relaxed to 0.08 W/mK for the Part L compliant house. 0.08 W/m2k is accepted where all details conform with the ACD's (Acceptable Construction Details, Part L).

- MEASURE 6 - RENEWABLE ENERGY - Solar Photo voltaic Panels have been installed in both options however half the amount is installed in the Part L compliant house when compared to the nZEB house. This is partly to reduce cost and partly because there is a lower electrical demand with the omission of MVHR.

	Delivered Energy Total - kWh/yr	Delivered Energy per m2 - kWh/m2/yr	Primary Energy Total - kWh/yr	Primary Energy per m2 - kWh/m2/yr	CO2 Emissions- kg/yr	CO2 Emissions per m2- kg/m2/yr	BER Rating	kWh/m2/yr	EPC	CPC
Baseline - TGD Part L Compliant	9551	64.1	10616	71.25	1828	12.27	A3	71	0.399	0.325
Optimum - nZEB - Euro House	4440	29.8	4480	30.07	757	5.08	A2	30	0.173	0.138

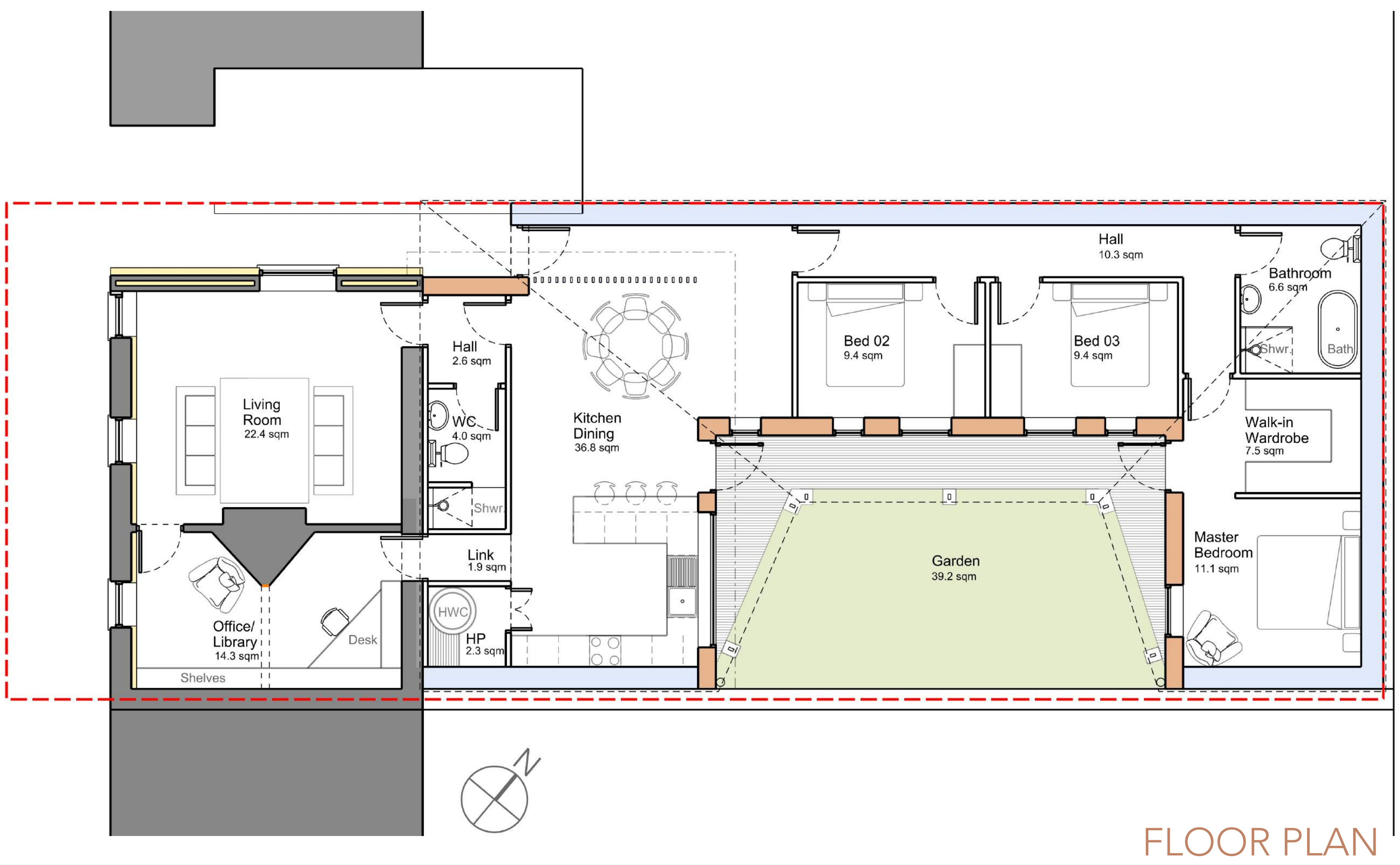
	Delivered Energy Total - kWh/yr	Delivered Energy per m2 - kWh/m2/yr	Primary Energy Total - kWh/yr	Primary Energy per m2 - kWh/m2/yr	CO2 Emissions- kg/yr	CO2 Emissions per m2- kg/m2/yr	BER Rating	kWh/m2/yr	EPC	CPC
Measure 1 - Living Room Area	9178	61.6	10195	68.42	1758	11.8	A3	68	0.393	0.321
Measure 2 - Ventilation	7584	50.9	8736	58.63	1544	10.36	A3	59	0.328	0.275
Measure 3 - Windows	9491	63.7	10579	71	1822	12.23	A3	71	0.397	0.324
Measure 4 - Fabric	8687	58.3	9663	64.85	1669	11.2	A3	65	0.363	0.297
Measure 5 - Y-Factor	8478	56.9	9424	63.25	1630	10.94	A3	63	0.354	0.29
Measures 4+5 Combined	7599	51	8471	56.85	1471	9.87	A3	57	0.318	0.262
Measure 6 - PV	8815	59.2	8997	60.38	1478	9.92	A3	60	0.338	0.263

COST ANALYSIS

The existing structure had limitations in the change of fabric and the new structure also had limitations as the shape and scale meant there were a lot of exposed walls to contend with. This meant that the fabric and systems had to be of a very high level to even meet compliance with Technical Guidance Document, Part L. The last 41.18 kWh/m2/yr to get from an A3 of 71 kWh/m2/yr to an A2 of 30 kWh/m2/yr was the most difficult phase due to the limitations of the options left. The upgrades chosen bridge the gap between the Part L version and the nZEB version at an estimated cost of approximately €15,087.00. While some items are more easily justified than others the real value comes in the combination of all the measures in terms of elevating the building from Part L to nZEB.

Measure 01 2.83 kWh/m2/yr — €275.50
Measure 02 12.62 kWh/m2/yr — €4505.00
Measure 03 0.25 kWh/m2/yr — -€340.00
Measure 04 6.4 kWh/m2/yr — €6,646.50
Measure 05 8.0 kWh/m2/yr
Measure 06 10.87 kWh/m2/yr — €4,000.00

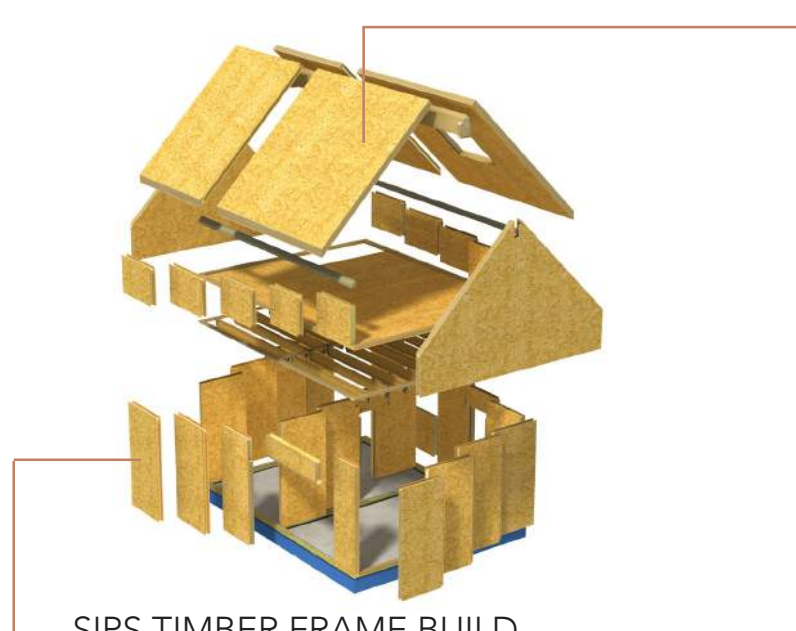
Total Delivered Energy Savings 41.18 kWh/m2/yr — €15,087.00



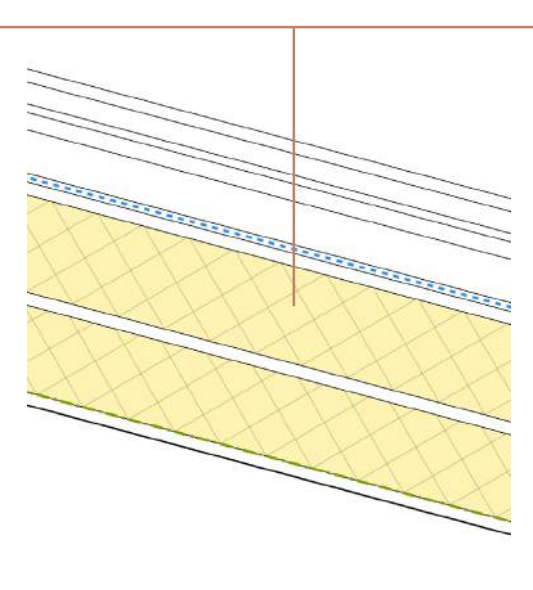
FLOOR PLAN

BUILDING FABRIC & HYGROTHERMAL ANALYSIS

NEW BUILD - The New Build is to be constructed using Structural Insulated Panels (SIPs), a timber frame solution that provides insulation and structure in a panel system that is manufactured off site and is put together on site. The selected system is TEK Building System from Kingspan and both the walls and roofs are to be made of 142mm panels. To achieve the greater U-values required and reduce thermal bridging, both the roof and walls are also lined with an additional layer of insulation. The floor slab is a concrete slab insulated below to allow for some thermal storage of sunlight.



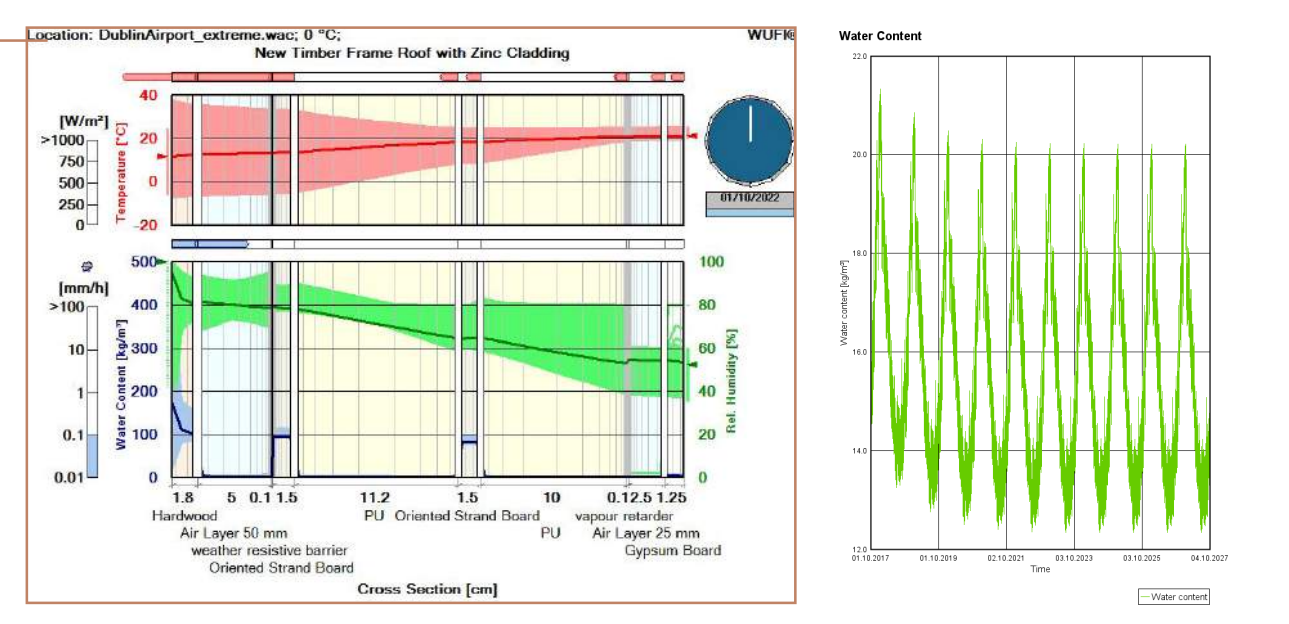
SIPS TIMBER FRAME BUILD



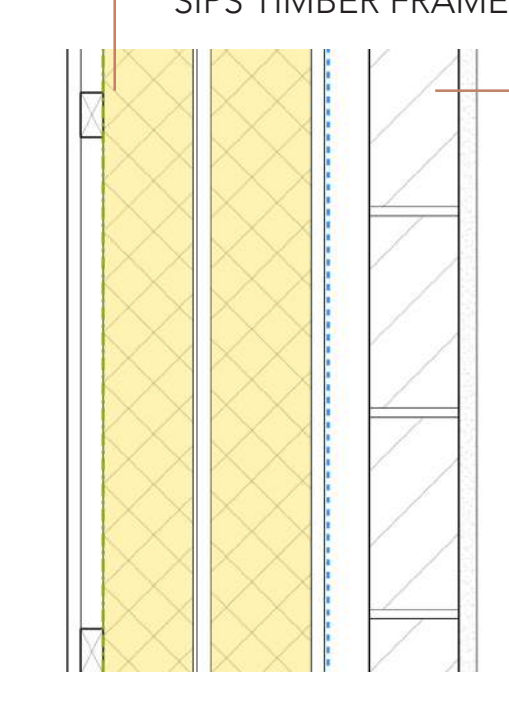
ROOF BUILD UP TO EXTENSION (AT 15 DEGREES)

12.5 mm Gyproc Wallboard with Skim Finish
Intelo Airtight Layer
100mm Rigid PIR Insulation (0.022 W/mK) (0.020 W/mK)
142 Kingspan TEK Frame
(15mm OSB+ 112mm PUR Insulation (0.023 W.mK) + 15mm OSB)
Kingspan Nilvent Weatherproof Layer
50mm Timber Battens/ Ventilated Air Layer
18mm Class 3 OSB Board
VM Standing Seam ZINC

U-VALUE 0.10 kWh/m2/yr



WUFI PRO HYGROTHERMAL ANALYSIS - NEW ROOF



NEW WALL BUILD-UP TO EXTENSION

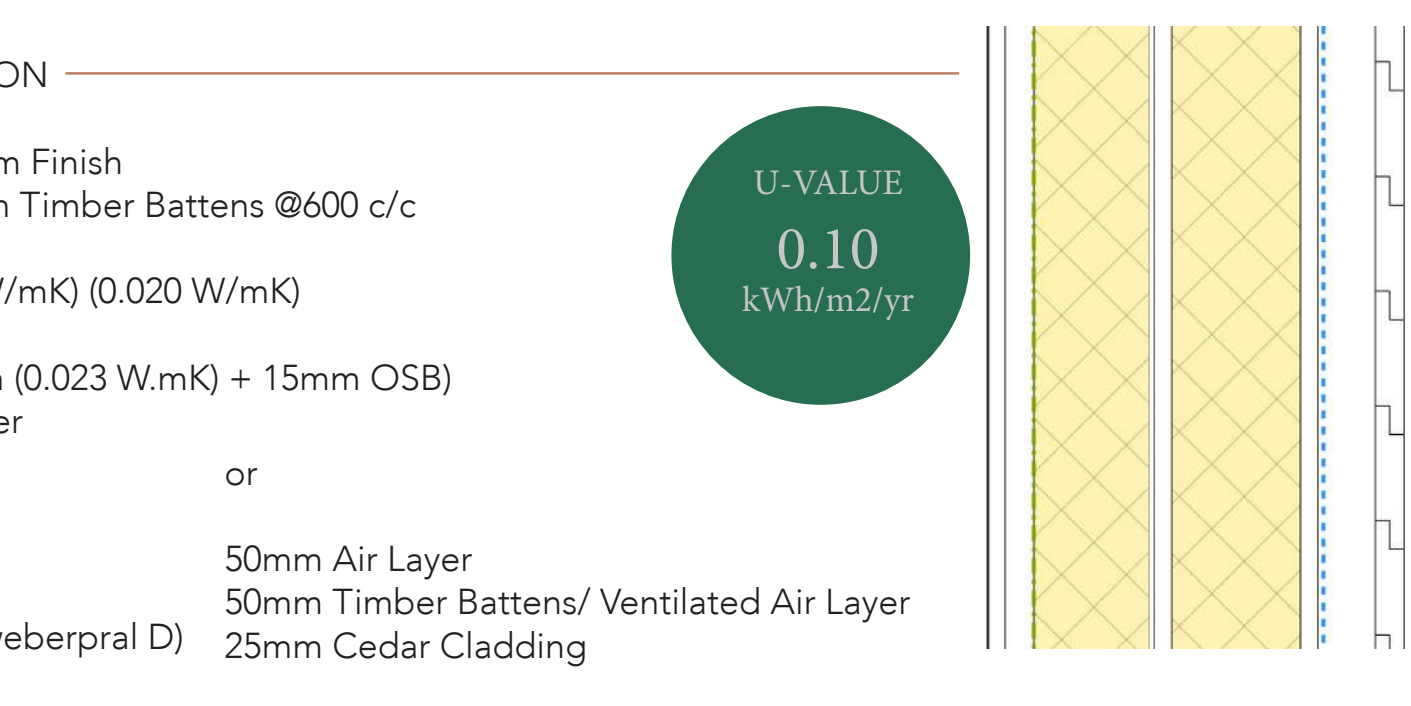
12.5 mm Gyproc Wallboard with Skim Finish
25mm Service Cavity/ 50mm x 25mm Timber Battens @600 c/c
Intelo Airtight Layer
100mm Rigid PIR Insulation (0.022 W/mK) (0.020 W/mK)
142 Kingspan TEK Frame
(15mm OSB+ 112mm PUR Insulation (0.023 W.mK) + 15mm OSB)
Kingspan Nilvent Weatherproof Layer
with

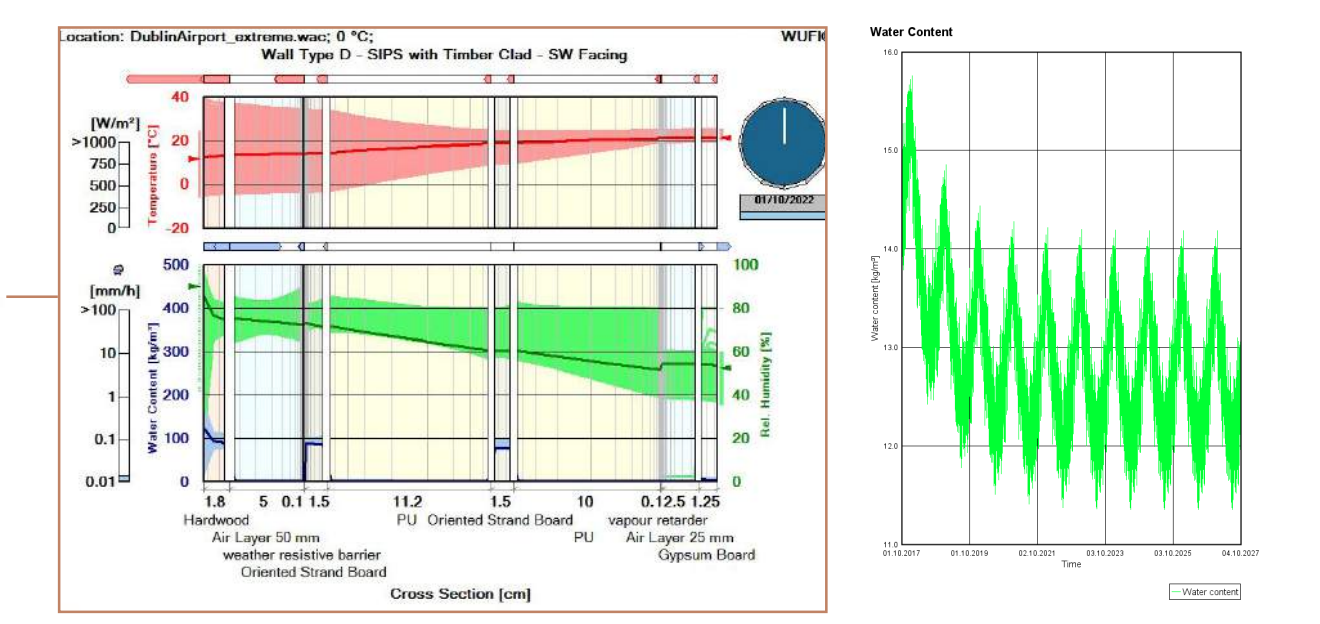
50mm Air Cavity
100mm Block
20mm External Render (monocoat weberpral D)

or

50mm Air Layer
50mm Timber Battens/ Ventilated Air Layer
25mm Cedar Cladding

U-VALUE 0.10 kWh/m2/yr





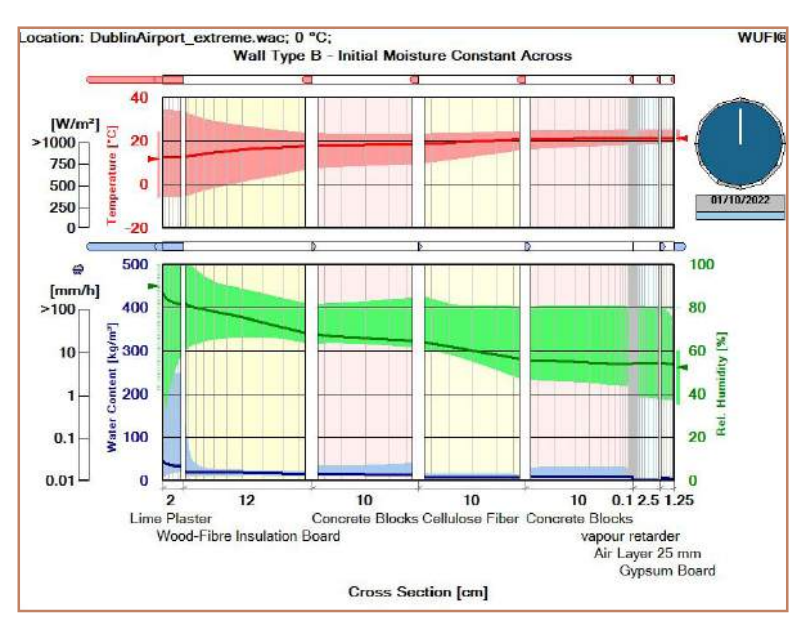
WUFI PRO HYGROTHERMAL ANALYSIS - NEW WALL

EXISTING BUILDING RETROFIT - The existing railway cottage is complex as is has been altered over the years. The front wall is the original stone wall and it is vital to keep this in it's current appearance as it adds to the character and integrity of the street scape. The house was extended by the width of the front door and so the gable wall is a block work cavity wall. The original roof has also been altered so that the hip roof comes down on the new gable wall. The roof is a straight forward retrofit with mineral wool insulation used at attic level. The front wall is a minimum intervention with mineral wool insulation used internally. The cavity wall can reach better U-values than the front wall and in the this case we fill the cavity with cellulose insulation and use wood fibre insulation externally.

RETROFIT TO EXISTING STONE WALL TO FRONT OF HOUSE

Gyproc Wallboard (0.019W/mK)
Vario Membrane and Tapes
80mm Isover Glasswool Insulation (0.032 W/mK)
Optima Metal Studs and Fixings Rail to Top and Bottom
50mm Cavity
430mm Existing Stone Wall

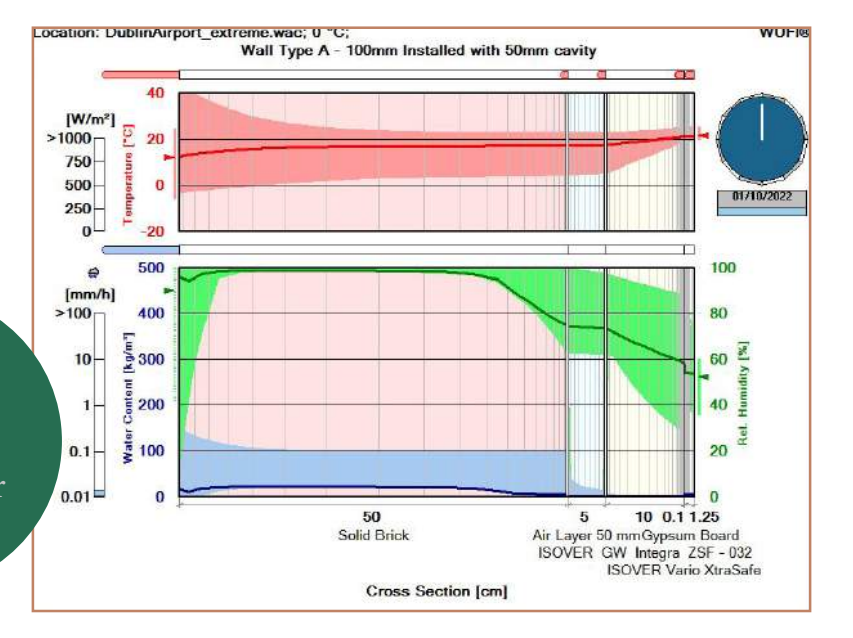
U-VALUE 0.32 kWh/m2/yr

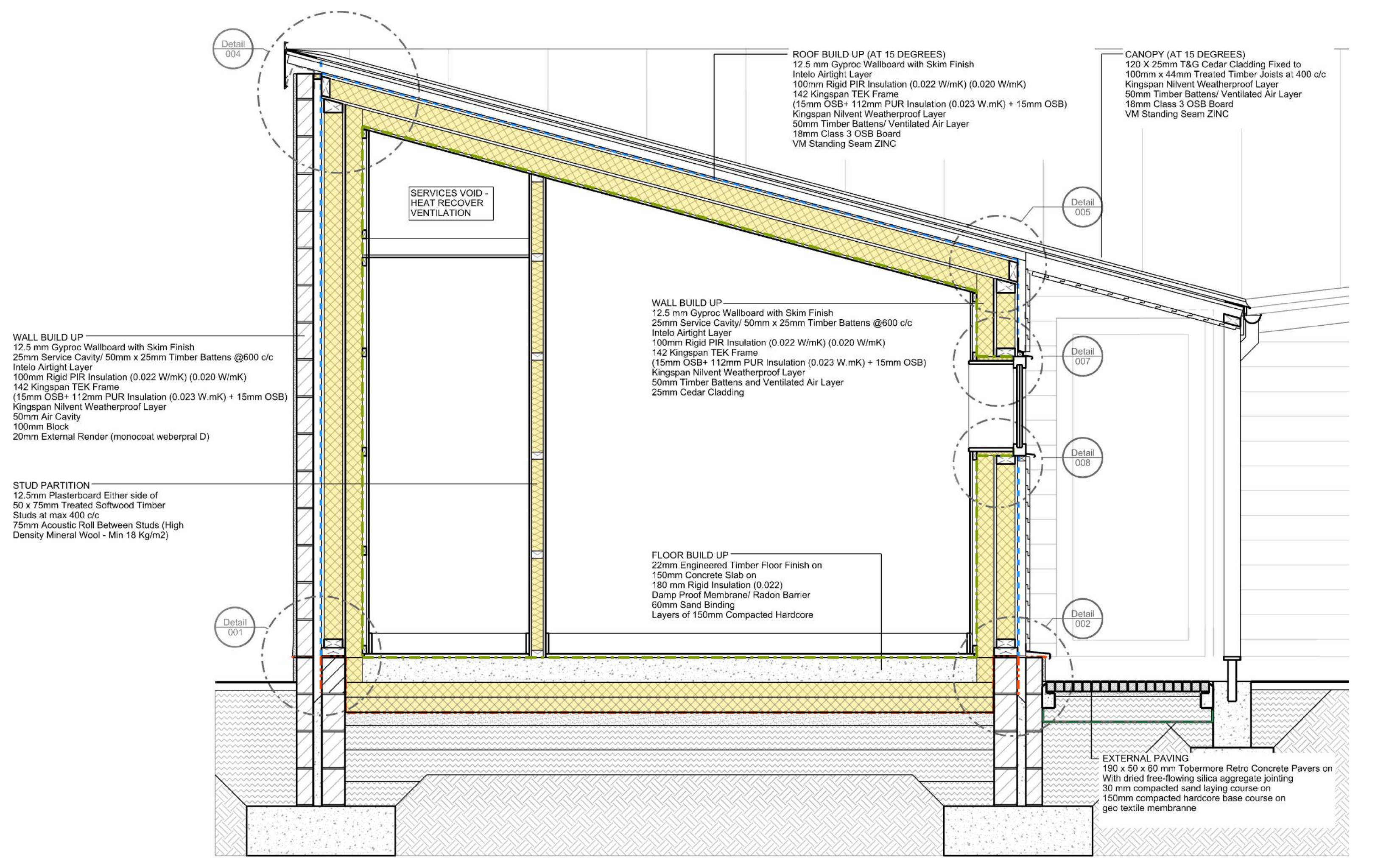


RETROFIT TO CAVITY WALL (EXISTING GABLE)

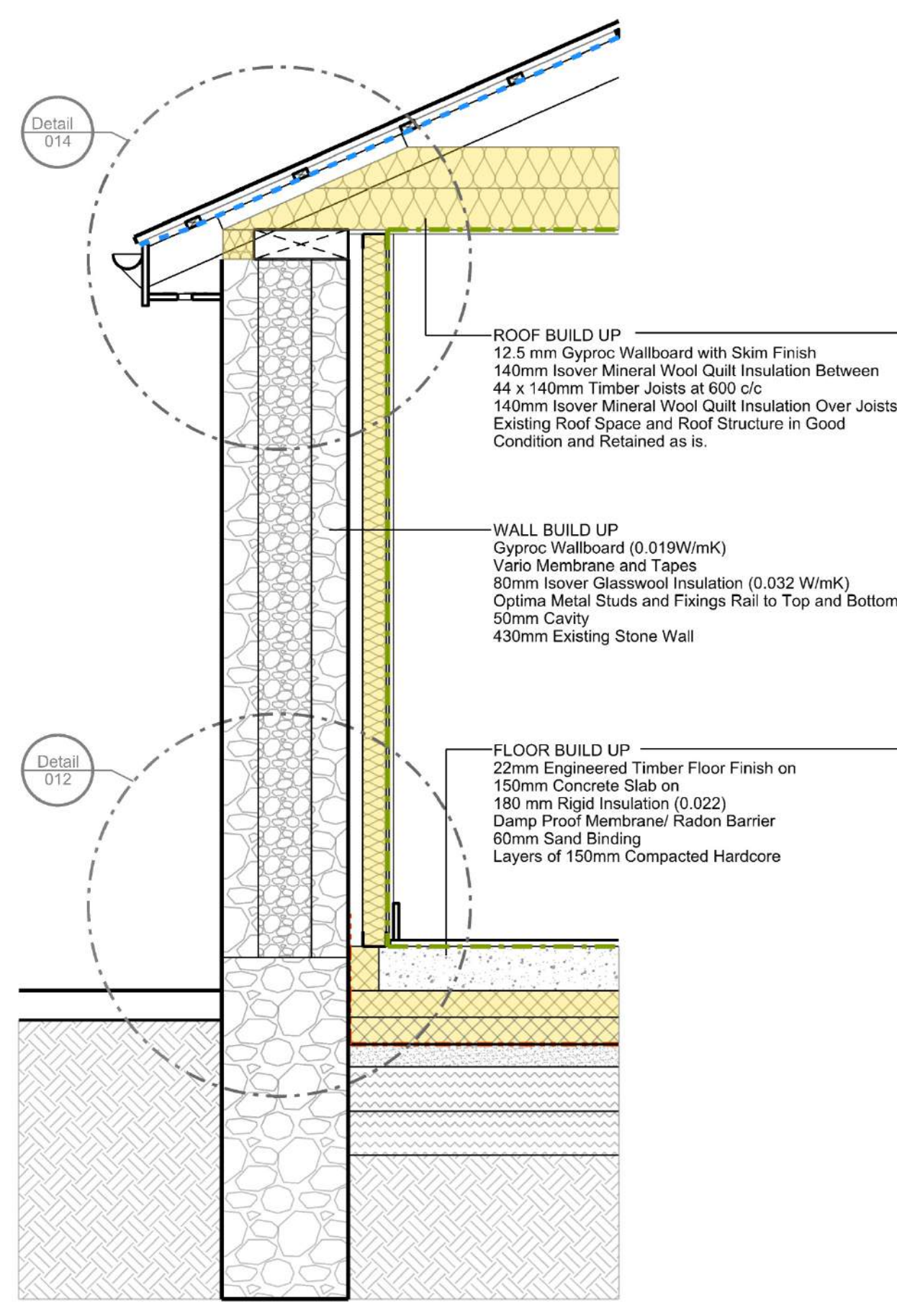
12.5 mm Gyproc Wallboard with Skim Finish
25mm Services Cavity (softwood Timber Battens at 600 c/c
Vario Airtight Membrane
100mm Concrete Block Inner Leaf
100mm Cellulose Fill to Existing Cavity (0.037 W/mK)
100mm Concrete Block Inner Leaf
120mm External Wood Fibre Insulation (0.038 W/mK)
20mm External Render (monocoat weberpral D)

U-VALUE 0.1 kWh/m2/yr

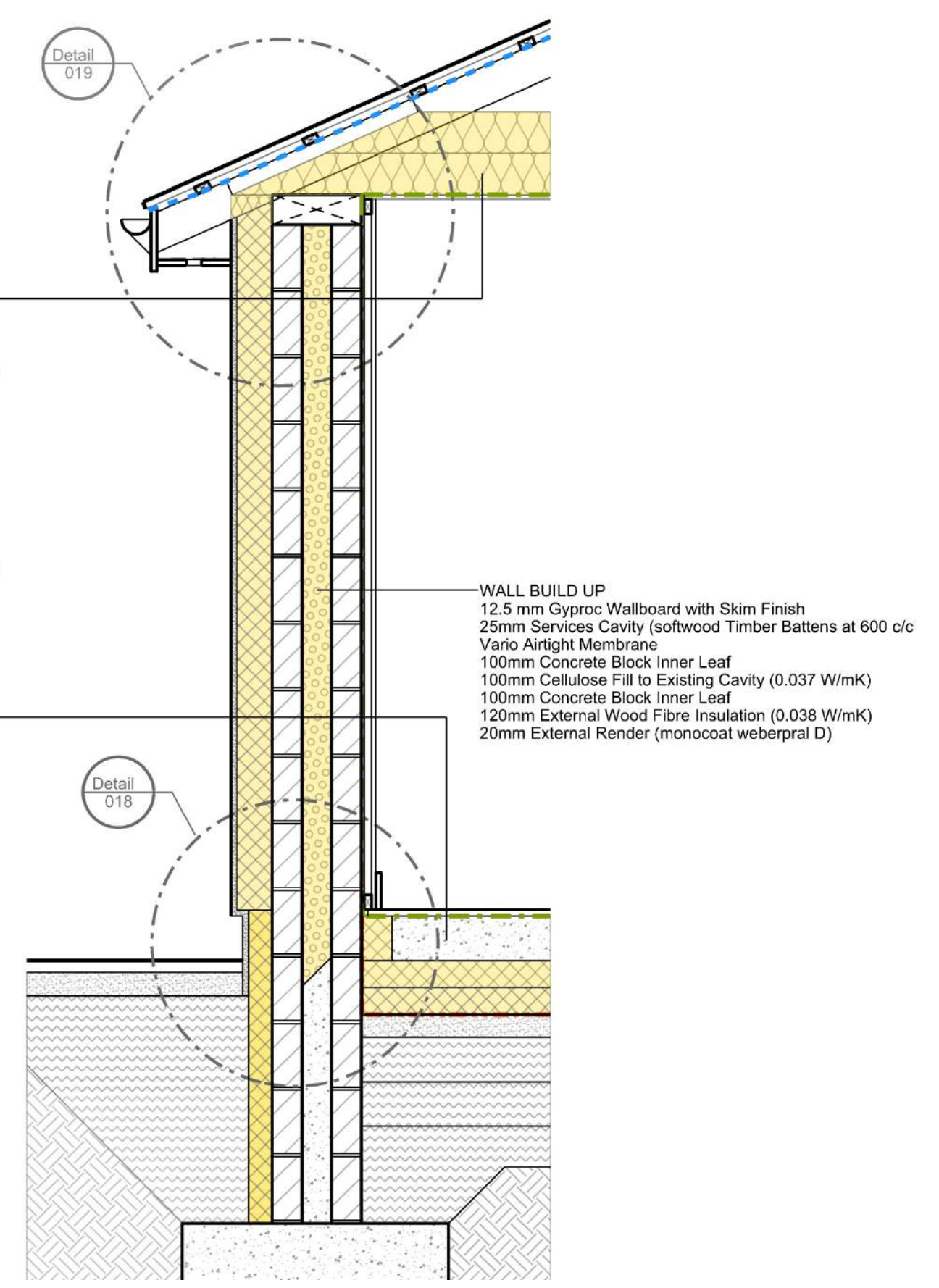




SECTION THROUGH NEW BUILD EXTENSION

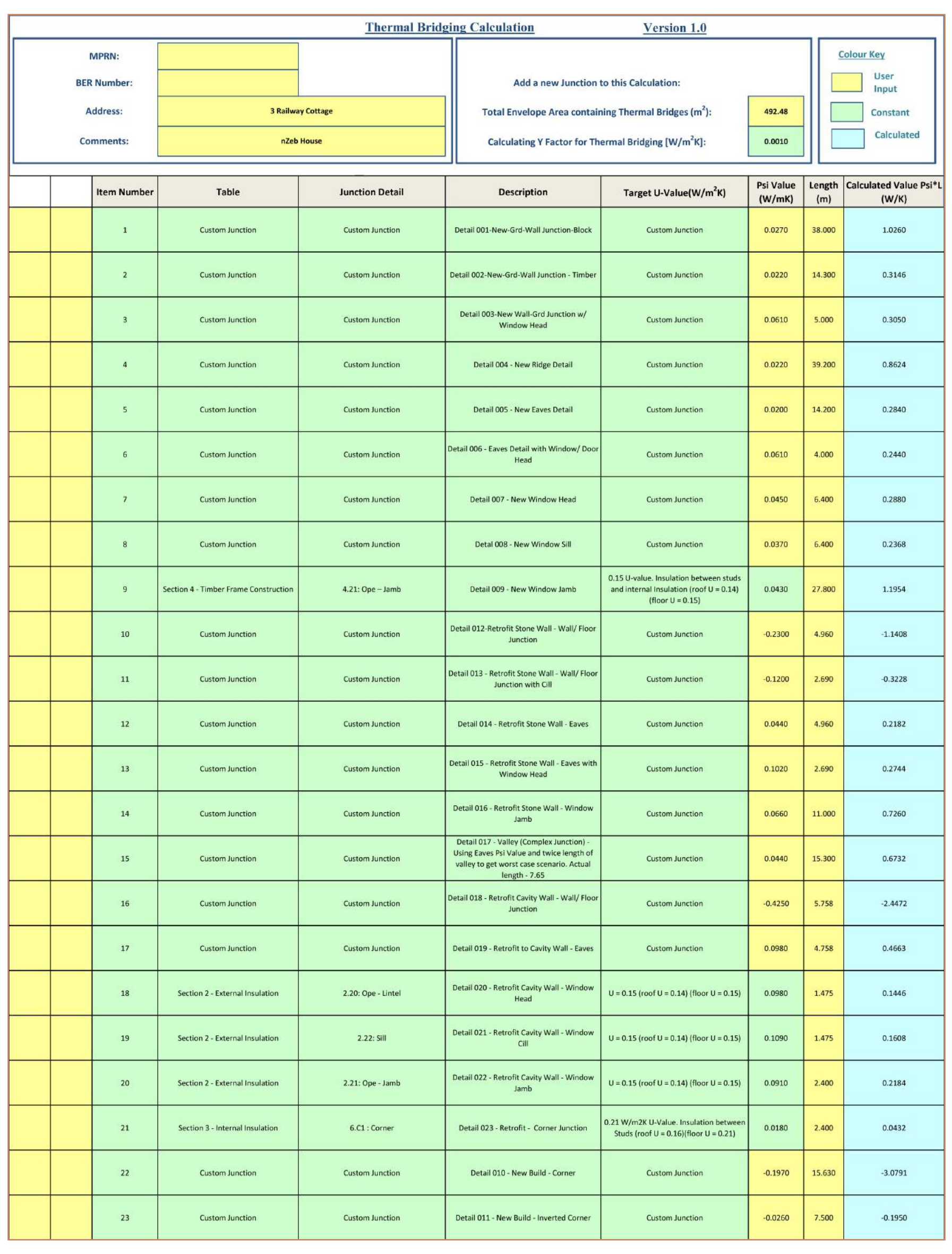


SECTION THROUGH RETROFIT OF STONE WALL



SECTION THROUGH CAVITY WALL

SECTIONS



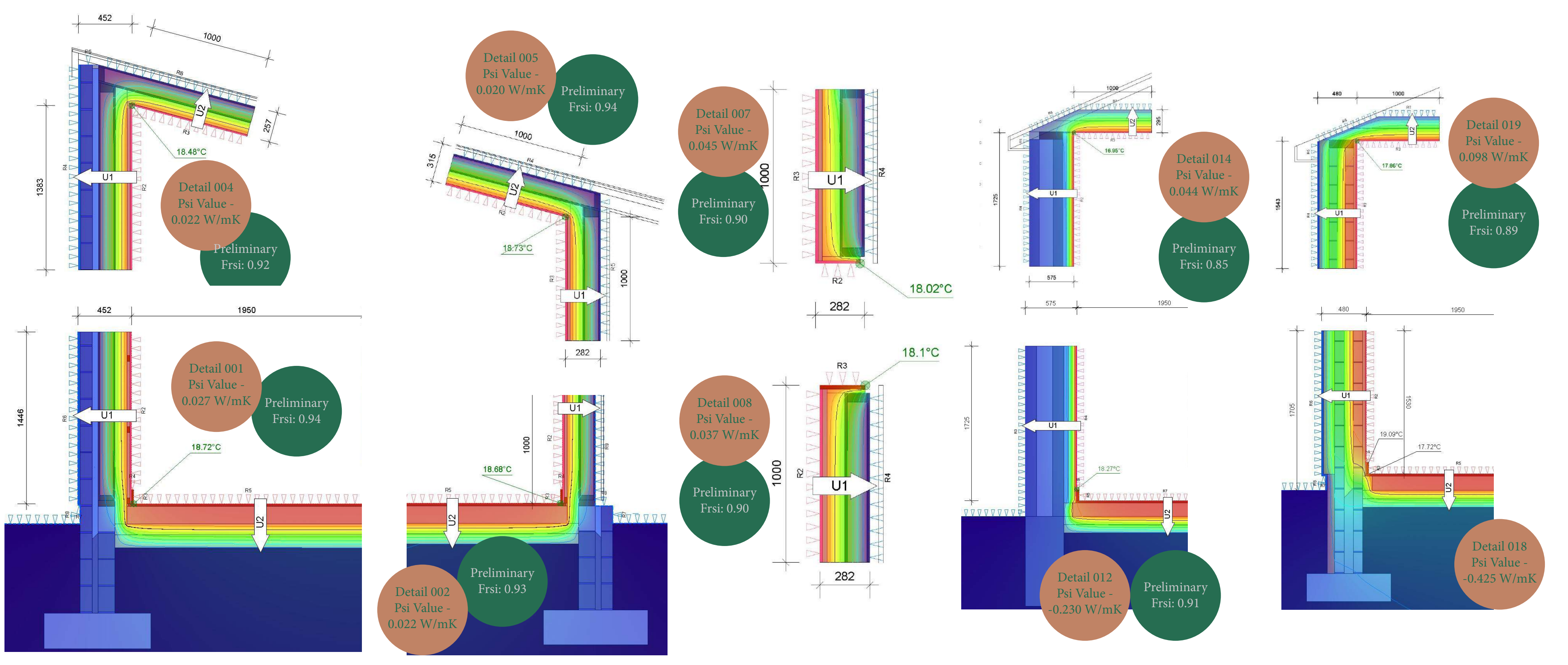
THERMAL BRIDGE CALCULATIONS

Psi Therm Software was used to look at 24 Junctions in Total. This was for two purposes.

The first was to establish the overall Y-Factor to be inserted in DEAP. The overall Y-Factor was calculated at 0.001 W/m2/K which is very good and far exceeded my expectations. In the end I maintained 0.04 W/m2/K in the DEAP calulations as it was more than sufficient and allows for a certain amount of error on site.

The second item reviewed in Psi-Therm was to get a Preliminary fRsi calulcation. These would need to be verified by a Certified Thermal Brisge Modeler. For dwellings, the value of fRsi should be greater than or equal to 0.75 so as to avoid the risk of mould growth and surface condensation and to comply with building regulations. No junctions measured fell below the 0.75 threshold and there was no internal surface temperature measured below the 15 degrees Celsius which is the temperature target associated with causing surface mould growth.

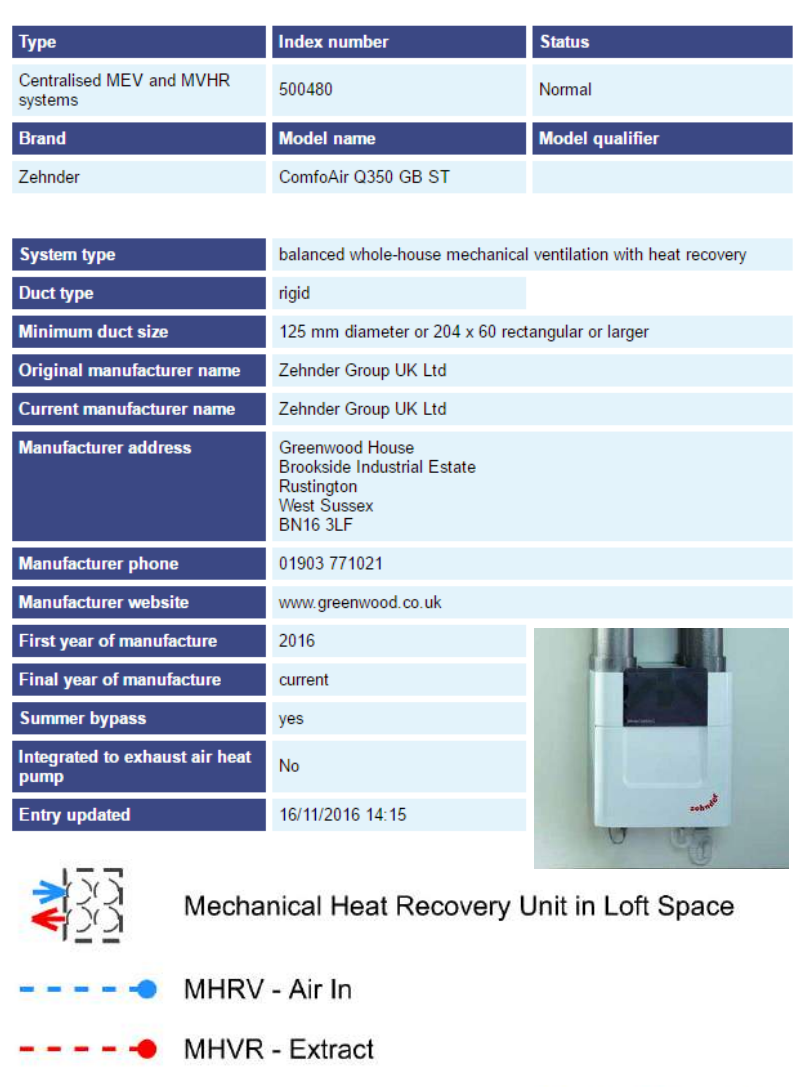
Outlined here are a selection of the models that coalate with the selected sections above.



ENERGY SYSTEMS AND RENEWABLES

01 - SOLAR HOT WATER PANELS
20 x Kingspan HP400 Evacuated Tube System

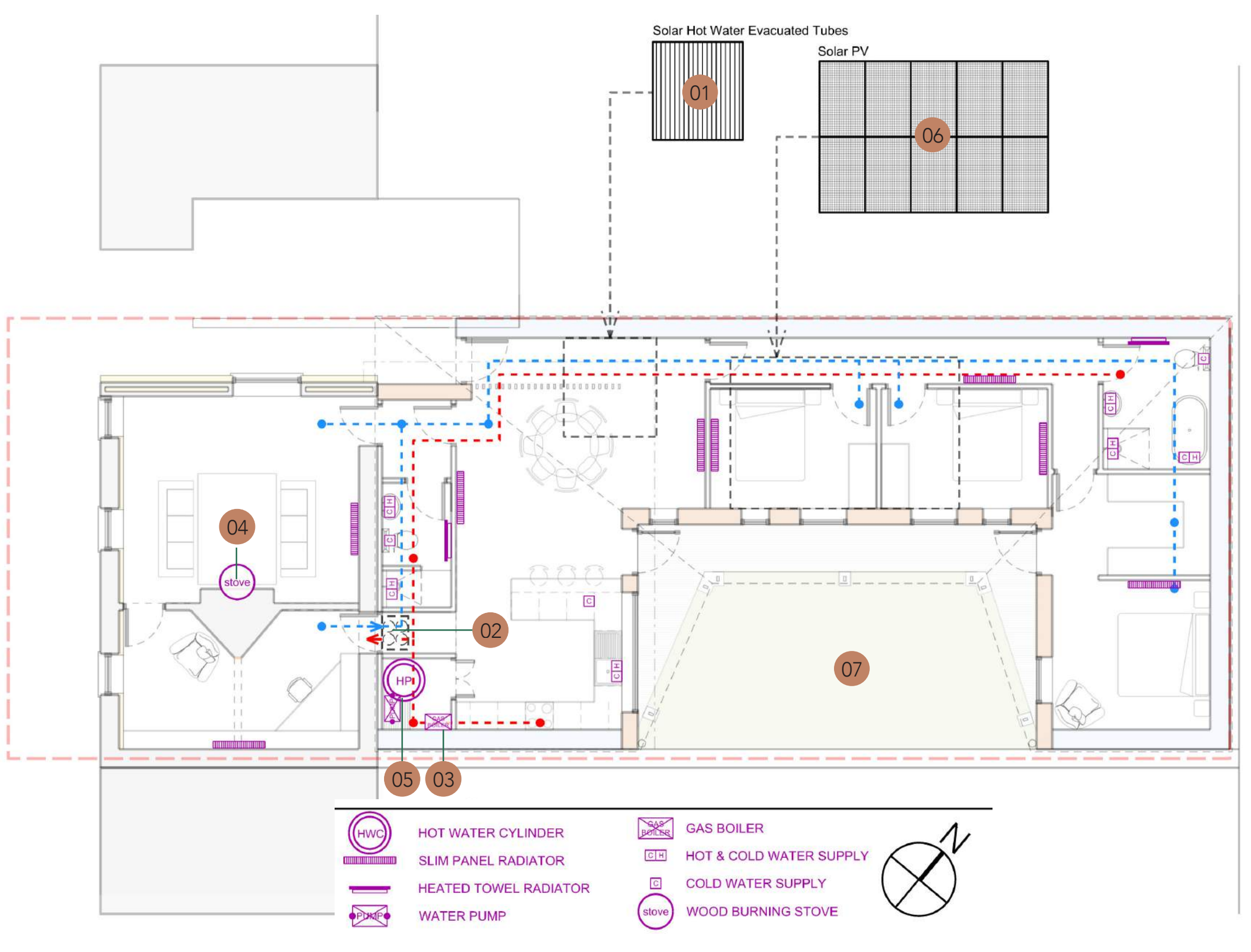
02 - MHRV (Mechanical Heat Recovery Ventilation)
Zehender ComfoAir Q350



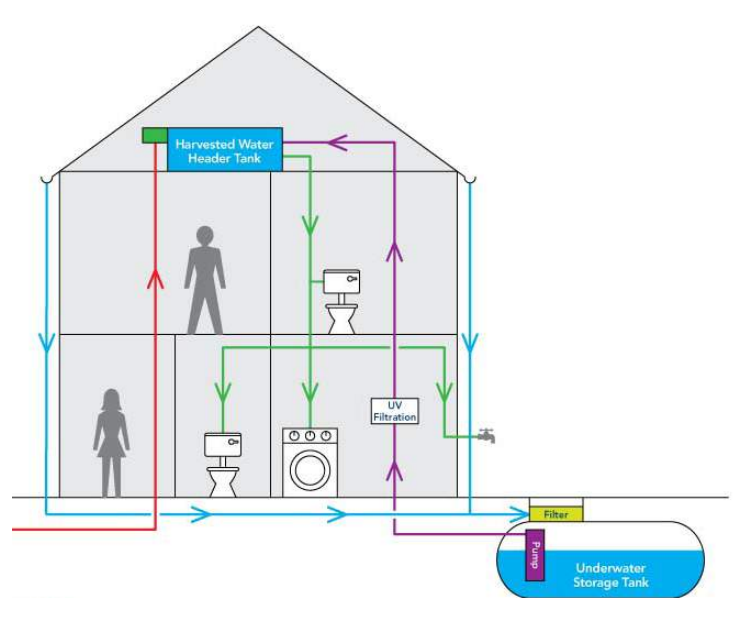
Type	Index number	Status
Centralised MEV and MVHR systems	500480	Normal
Brand	**Model name**	**Model qualifier**
Zehnder	ComfoAir Q350 GB ST	

System type	balanced whole-house mechanical ventilation with heat recovery
Duct type	rigid
Minimum duct size	125 mm diameter or 204 x 60 rectangular or larger
Original manufacturer name	Zehnder Group UK Ltd
Current manufacturer name	Zehnder Group UK Ltd
Manufacturer address	Greenwood House Brookside Industrial Estate Rustington West Sussex BN16 3LF
Manufacturer phone	01903 771021
Manufacturer website	www.greenwood.co.uk
First year of manufacture	2016
Final year of manufacture	current
Summer bypass	yes
Integrated to exhaust air heat pump	No
Entry updated	16/11/2016 14:15

Mechanical Heat Recovery Unit in Loft Space
MHRV - Air In
MHVR - Extract

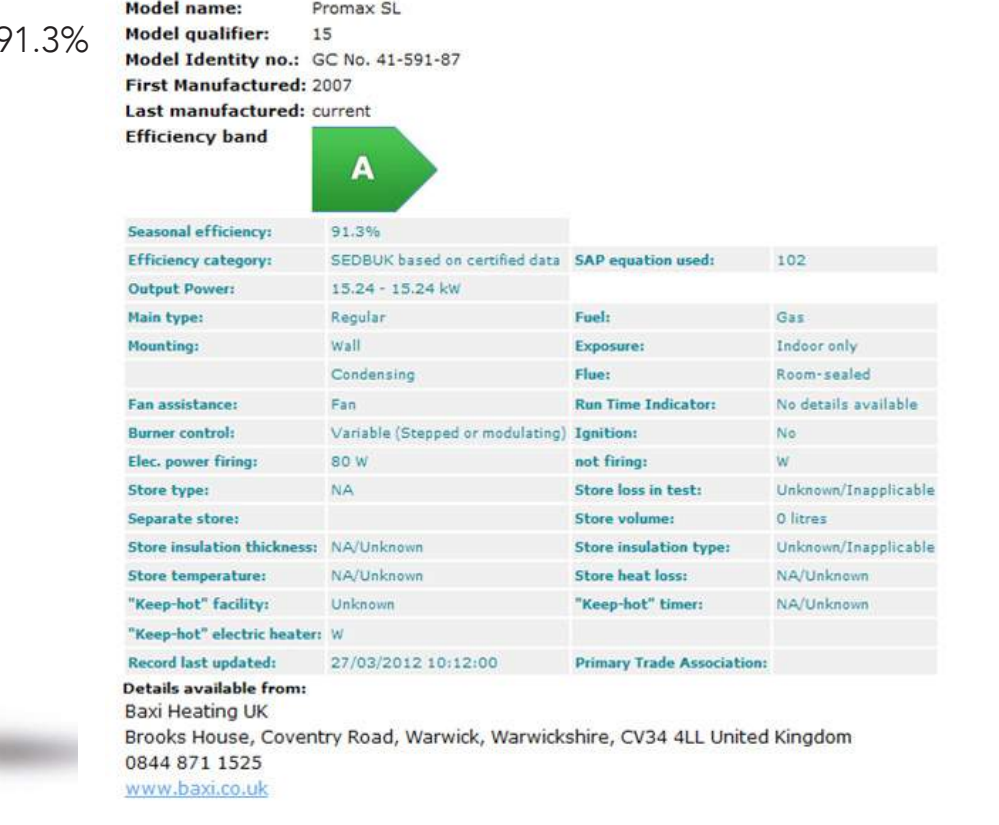


07 - RAINWATER HARVESTING



06 - SOLAR PV
- Dimplex Solar PV DXPV230/230/2/5
- 10 Modules Total Providing 1480 kWh/y of Electricity. Surface Area - 16.8 m2.

03 - PRIMARY SPACE HEATING - GAS BOILER
Baxi Potterton Promax SL (91.3% efficiency)

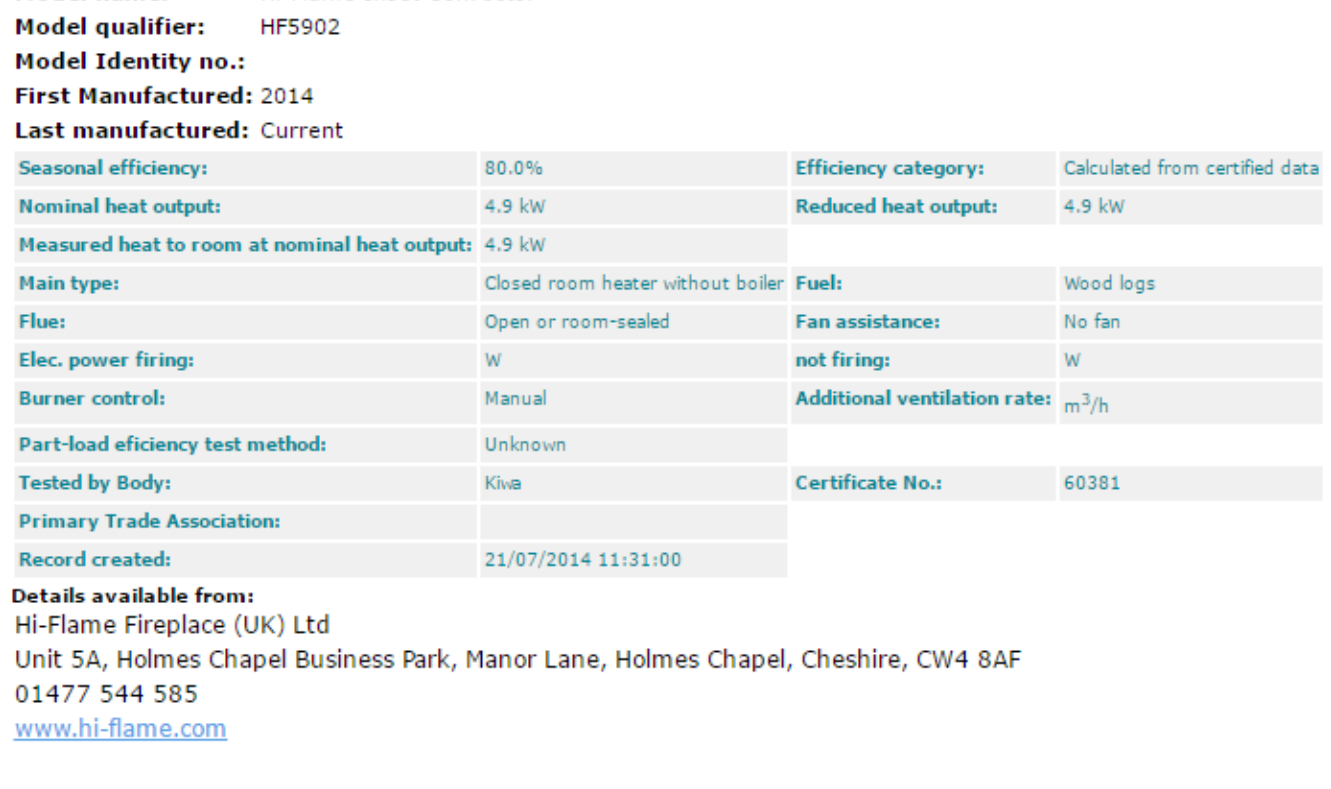


Manufacturer: Baxi Heating
Trade name: Potterton
Model name: Promax SL
Model qualifier: 15
Model Identity no.: GC No. 41-591-87
First Manufactured: 2007
Last manufactured: current
Efficiency band A

Seasonal efficiency:	91.3%		
Efficiency category:	SEDBUK based on certified data	SAP equation used:	102
Output Power:	15.24 - 15.24 kW		
Main type:	Regular	Fuel:	Gas
Mounting:	Wall	Exposure:	Indoor only
	Condensing	Flue:	Room-sealed
Fan assistance:	Fan	Run Time Indicator:	No details available
Burner control:	Variable (Stepped or modulating)	Ignition:	No
Elec. power firing:	80 W	not firing:	W
Store type:	NA	Store loss in test:	Unknown/Inapplicable
Separate store:		Store volume:	0 litres
Store insulation thickness:	NA/Unknown	Store insulation type:	Unknown/Inapplicable
Store temperature:	NA/Unknown	Store heat loss:	NA/Unknown
"Keep-hot" facility:	Unknown	"Keep-hot" timer:	NA/Unknown
"Keep-hot" electric heater:	W		
Record last updated:	27/03/2012 10:12:00	Primary Trade Association:	

Details available from:
Baxi Heating UK
Brooks House, Coventry Road, Warwick, Warwickshire, CV34 4LL United Kingdom
0844 871 1525
www.baxi.co.uk

04 - SECONDARY HEATING - WOOD BURNING STOVE
Hi-Flame Inset Stove
80% efficiency

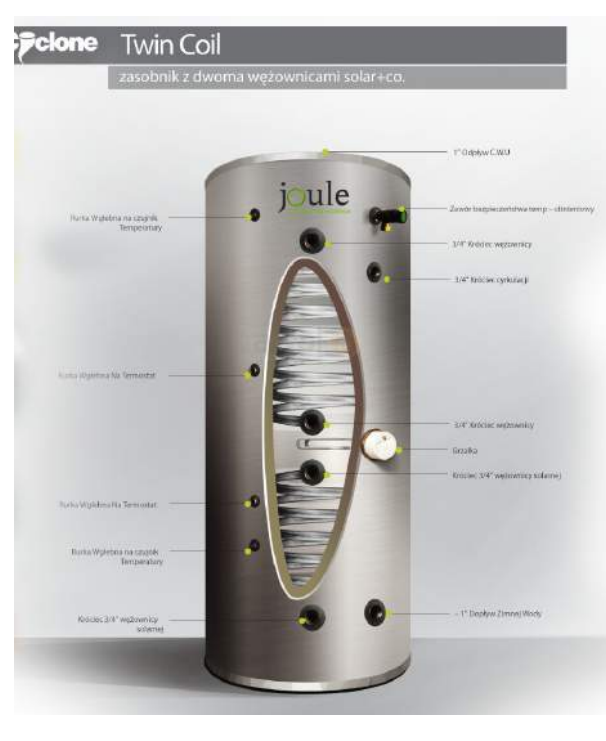


Manufacturer: Hi-Flame Fireplace (UK) Limited
Trade name: Hi-Flame
Model name: Hi-Flame Inset Convector
Model qualifier: HF5902
Model Identity no.:
First Manufactured: 2014
Last manufactured: Current

Seasonal efficiency:	80.0%	Efficiency category:	Calculated from certified data
Nominal heat output:	4.9 kW	Reduced heat output:	4.9 kW
Measured heat to room at nominal heat output:	4.9 kW		
Main type:	Closed room heater without boiler	Fuel:	Wood logs
Flue:	Open or room-sealed	Fan assistance:	No fan
Elec. power firing:	W	not firing:	W
Burner control:	Manual	Additional ventilation rate:	m^3/h
Part-load efficiency test method:	Unknown		
Tested by Body:	Kiwa	Certificate No.:	60381
Primary Trade Association:			
Record created:	21/07/2014 11:31:00		

Details available from:
Hi-Flame Fireplace (UK) Ltd
Unit 5A, Holmes Chapel Business Park, Manor Lane, Holmes Chapel, Cheshire, CW4 8AF
01477 544 585
www.hi-flame.com

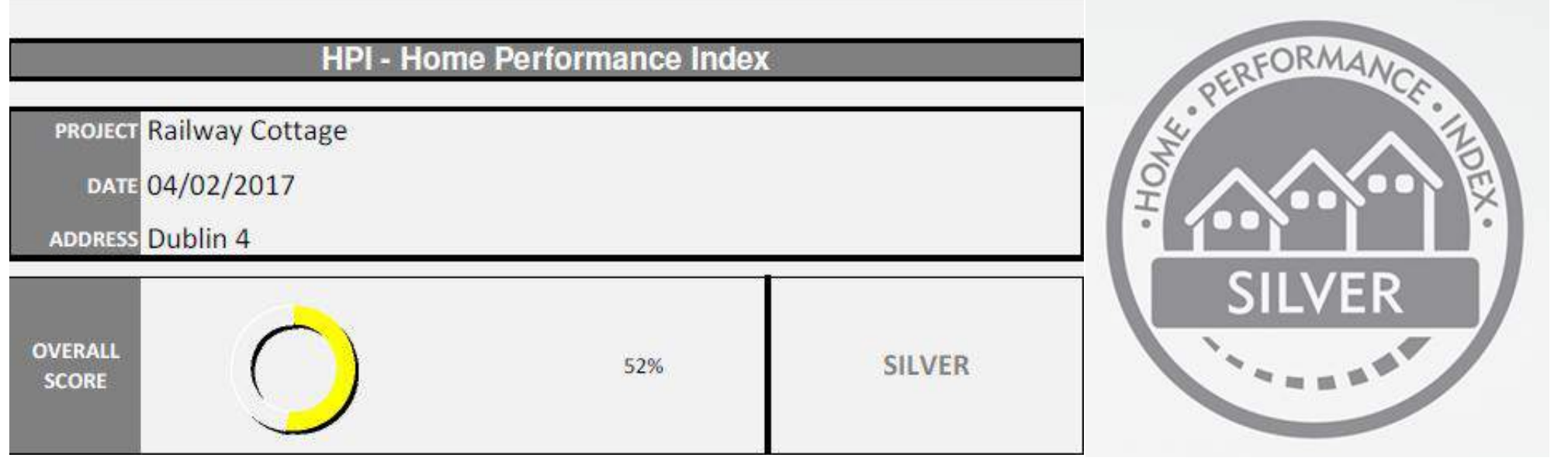
05 - HOT WATER CYLINDER
- Joules 300 Eco with 80mm Insulation
- Twin Coil with Dedicated Solar Hot Water Storage.



HPI - HOME PERFORMANCE INDEX

HPI is a Ireland's national volunatry certification system for quality and sustainable development and has facilitated by the Irish Green Building Council. The certification is calculated using five categories: Enviornment, Economic, Health and Wellbeing, Quality Assurance and Sustainnable Location.

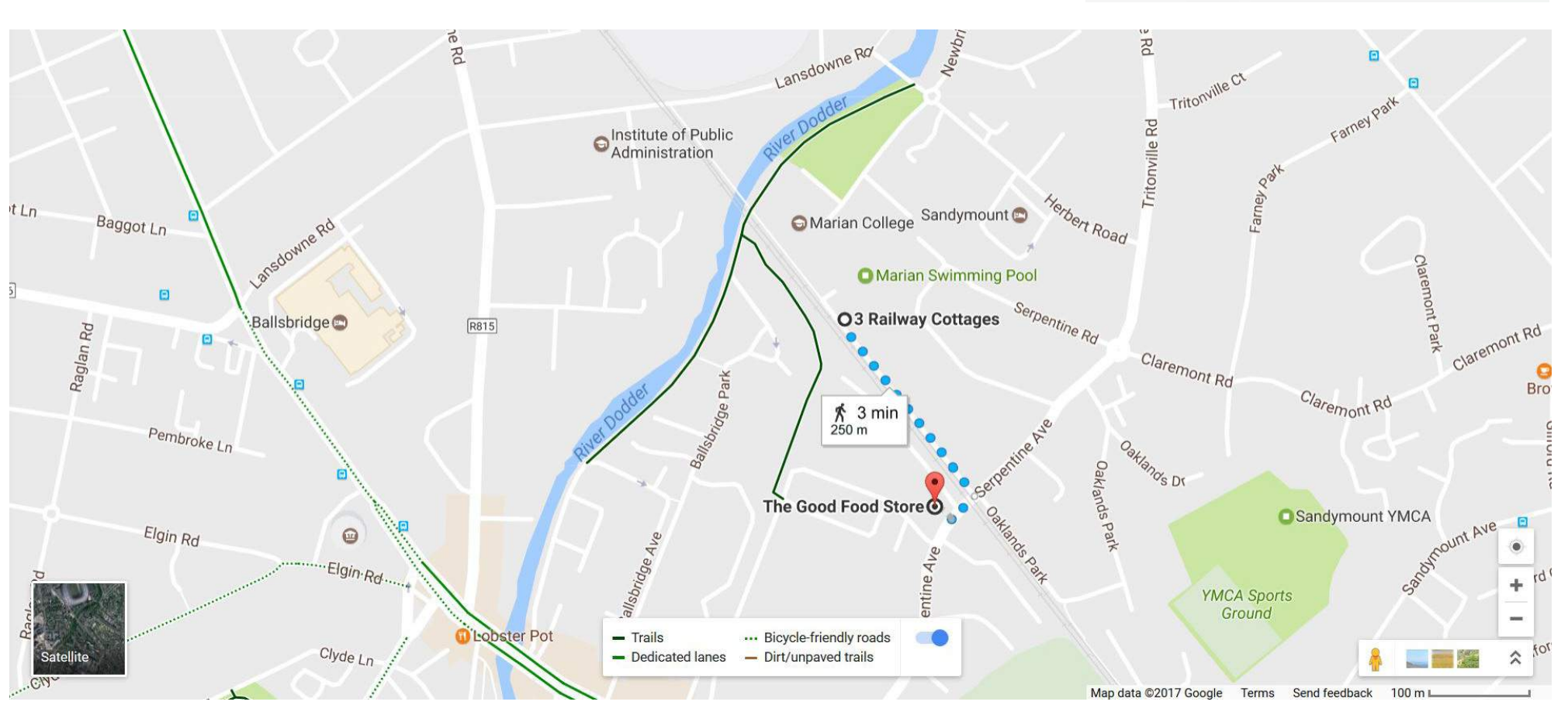
Railway Cottages scored high in terms of Sustainable Location as it is in a central Dublin location with good access to facilities and transport services. The index also highlighted the need to upskill design teams and get suitably qualified contractors to achive a high standard of sustainable building.



HPI - Home Performance Index

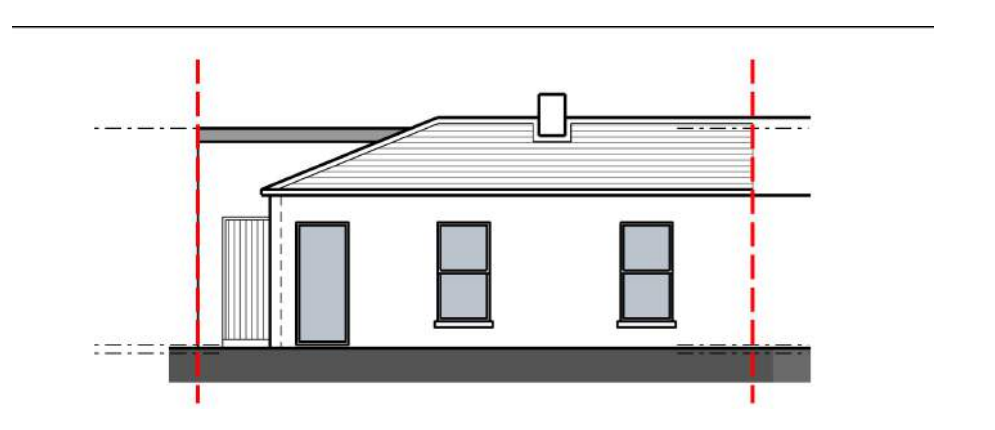
PROJECT Railway Cottage
DATE 04/02/2017
ADDRESS Dublin 4

OVERALL SCORE	52%	SILVER

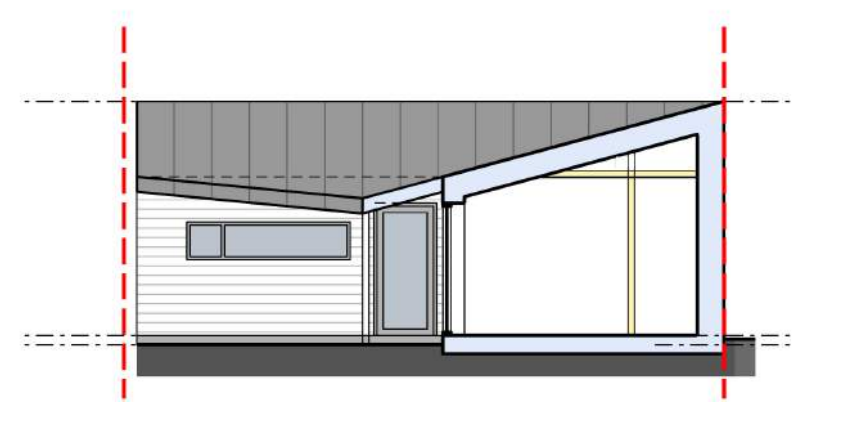


SUSTAINABLE LOCATION INPUT - DISTANCE TO SHOP

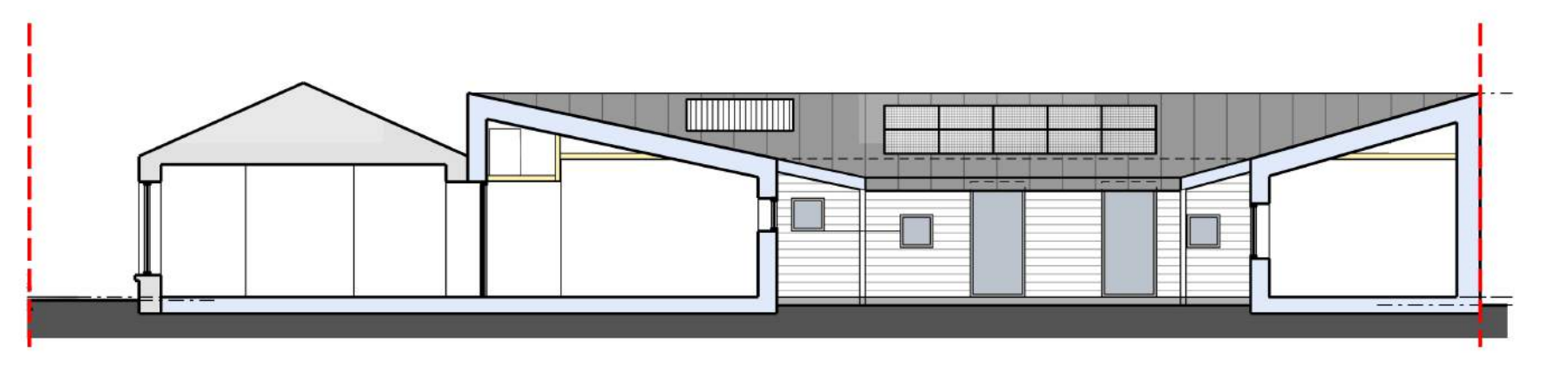
HEALTH AND WELLBEING INPUT - DAYLIGHT STUDY FOR LIVING ROOM



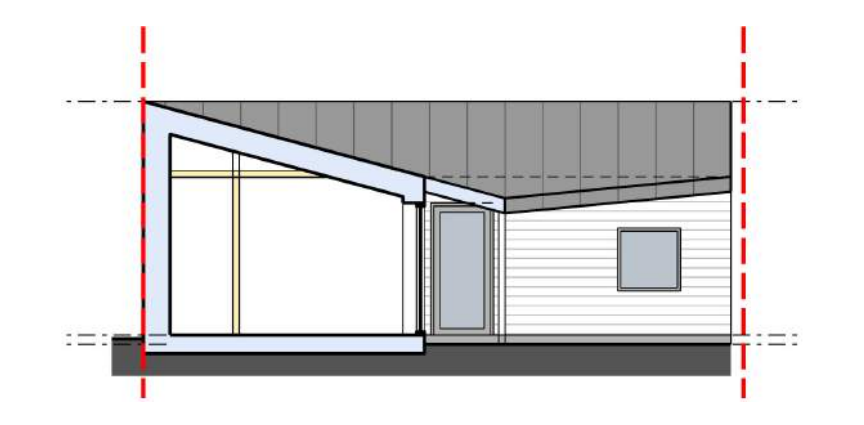
FRONT ELEVATION



SECTION C-C



SECTION A-A



SECTION D-D

Postgraduate Certificate in Digital Analysis and Energy Retrofit