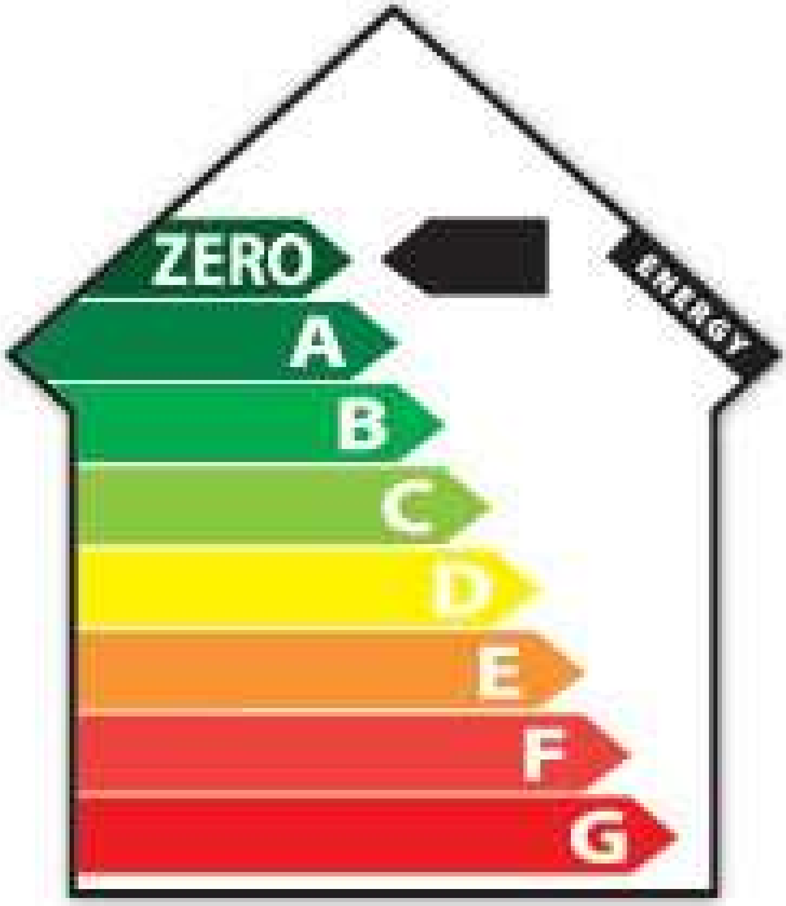


ENEN9103

D E A P Project

Contents

1.0 Introduction and Aim

1.1 Aim of the Project

This project sets out to use the DEAP software to model a strategy for the given Exemplar House that complies with the NZEB target net primary energy of 30kWh/m2/yr.

The DEAP software will be used to test various strategies and specifications before identifying an optimal solution and accurately modelling it to achieve the target.

Items to be considered include:

- fabric specifications (other than those already defined in the exemplar house)
- ventilation type
- systems to be incorporated for water and space heating and their controls
- renewable energy systems

EU guidance, Irish Building Regulations and other relevant standards and publications will be used and referenced to aid in compiling the strategy.

The DEAP tool will be assessed and critiqued as an aid to achieving the future low energy targets.

2.0 Executive Summary

All new dwellings that are granted planning permission after April 1st 2019 must meet the NZEB target of 30kWhr/m2/yr.

In order to ensure this target is met, strategies for low energy design must be used from early design stage. The DEAP tool is an essential part of this process and as shown in this report it can be used during the design stage to test strategies and come up with an optimum .

This study has used DEAP to model an exemplar house and examine the steps required to go from achieving the current Part L specification to achieving the nZEB standard of 30kwH/m2/year.

In order to achieve this, both passive and active measures were incorporated. Once the heat loss through the fabric is reduced by way of superinsulation, reduction of ventilation losses and reduction of losses at fabric junctions, the heating demand becomes very low. This demand can be met in a number of ways but a simple (and cost effective) solution is adequate as there is little point in introducing expensive and complicated systems to satisfy such a low heat demand.

Whilst these measures reduced the heating demand, it is noted that the hot water demand remains high. This demand is calculated by DEAP based on area and this house is an a-typical three bedroom house at 170m2. The demand can’t be reduced but can be met by the use of renewable systems which the tool will offset against energy load.

This process has highlighted that the DEAP tool has some limitations. The high hot water demand may not be accurate in all cases and can result in a too high energy penalty. There is no functionaility that highlights the over use of powerful systems. To use an analogy: it would not make economic sense to cut a 5m2 area of lawn with a commercial ride on lawnmower.

In conclusion, when used with appropriate sytsems and renewables, the Passive House standard is still the gold standard when it comes to achieving nZEB.

3.0 Methodology

The following methodology will be undertaken:

1. Enter exemplar house geometry into DEAP software

2. With reference to Irish and EU standards and Regulations, compile and enter the following into the DEAP software:

- a heating and hot water system
- fabric specification
- ventilation system
- renewable energy contribution

3. Alter and amend the various inputs to achieve the target 30kWh/m2/yr

4. Present results and analyse findings

5. Produce a schematic of the services and renewables

6. Compile all supporting data to be included in Appendices, annotate where necessary.

4.0 Preliminary Analysis

The geometry of the project house for input into DEAP software is set out in the table below:

Table 1: Exemplar House geometry	
Item	
Ground Floor	91.02m^2
First Floor	80.49 m^2
Living	29 m^2
Glazed windows and doors - North	6.3 m^2
Glazed windows and doors - West	9.28 m^2
Glazed windows and doors - South	18.2 m^2
Glazed windows and doors - East	11.36 m^2
Solid windows and doors	0 m^2
Height ground floor	2.54m
Height first floor	2.842m

4.1 Baseline Specification

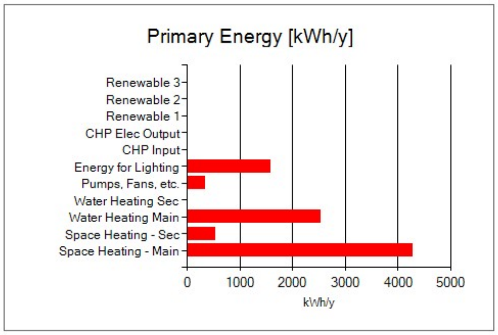
The baseline specification chosen is the current Part L Compliant specification, amended where necessary for specifics of the project house (denoted by *)

The input and results are set out below:

Table 2: Baseline Specification DEAP inputs

Element	Detail
Walls	0.13
Roof	0.11
Floor	0.14
Glazing (doors and windows)	Double glazed U=1.3 W/m2K, solar transmittance = 0.63
Shading, orientation	*N/S and E/W glazing, average overshading
Sheltered sides	*1
Thermal bridging	0.05 x total exposed surface area
Internal heat capacity category	Medium
Ventilation system	Natural with intermittent fans
Air Permeability	0.25 ac/h (5m3/hr.m2)@50pa
Chimneys	None
Open flues	None
Extract fans	*4
Draught lobby	1
Primary heating fuel	Mains gas
Heating system	Boiler and radiators and energy efficient pump in house
Boiler	Mains gas condensing, seasonal efficiency 91.3, room sealed, fanned flue
Heating controls	Time and temperature zone control
Hot water system	Solar water heating system: *Evac tube aperture area = 8.0m2 (note this has been increased to take account of house size), n0=0.6, a1=3.0w/m2k, facing south 45 degrees unshaded twin coil cylinder 330 litre with 100mm insulation remainder demand space heating boiler separate time control cylinder temp controlled by thermostat
Primary water heating losses	Insulated primary pipework between boiler and cylinder
Secondary space heating	Gas fire, closed front fan assisted, balanced flue- 80% efficiency
Low energy lighting	100%
Results	
Primary Energy	**54.33**

4.2 Analysis of results of baseline specification



It is clear from the chart above that reducing the space heating is the first aspect to investigate. This can be done in a number of ways; reducing the requirement for space heating, increasing the efficiency of the heating system, changing the type of heating system, perhaps incorporating renewables, or a combination of all of these approaches.

Passive Measures:

CEPHEUS or Cost Efficient Passive Houses as European Standard has tested the viability of the Passive House concept across multiple building projects in Europe. The report found that passive measures were a cost efficient way of improving the specification as they rely on 'optimising those components of a building which are necessary in any case'.

Following this principle, the specification can be improved for the following elements:

- Windows, walls, roof and floor u values can be improved, the house can be 'Superinsulated'
- Air tightness
- Thermal bridging at junctions

It is noted that the other passive design criteria used by both CEPHEUS and the German Passiv Haus cannot be changed but should be looked at during the early design stage of projects. These include orientation, compact building form, shelter from wind and thermal mass.

Active Measures:

In addition to the passive measures to improve the overall performance of the Exemplar House, it will be necessary to improve the systems required to heat water and space.

Heat source: The move from reliance on fossil fuels to renewable sources of heat is a key strategy underpinning the need to reduce global warming. Under the 2009 Renewable Energy Directive, Ireland has a target to deliver 12% of final heat demand from renewable energy sources by 2020. Heat pumps source their energy from air, water or the ground. They rely on a small amount of electricity in their operation but this can be offset by the use of PV array.

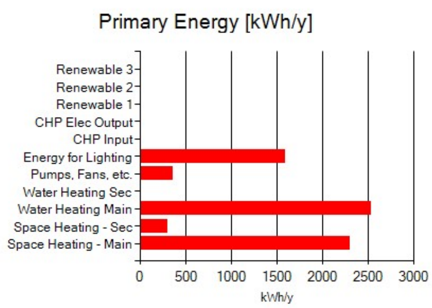
Ventilation: Now that the envelope is superinsulated, air tight and with minimal thermal bridging at junctions, control of the heat loss from ventilation becomes essential. Natural ventilation via windows provides no control so a change to mechanical ventilation with heat recovery is required.

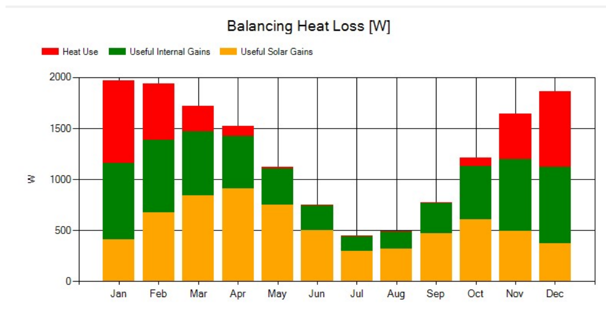
The revised specification is set out in the table below:

Table 3: Revised Specification			
Element	**Detail**	**Passive**	**Active**
Walls	0.13	0.12 150 Kooltherm KW5	
Roof	0.11	0.10 Aerofit 225+100	
Floor	0.14	0.12 140mm Kooltherm K3)	
Glazing	Double glazed U=1.3 W/m2K solar transmittance = 0.63	Triple Glazed U=0.8 Solar transmittance=0.69 Pilkington EnergiCare	
Thermal bridging	0.05 x total exposed surface area	0.02	
Ventilation system	Natural with intermittent fans		MHRV Xpellair
Air Permeability	0.25 ac/h (5m3/hr.m2)@50pa	0.05 ac/h (1m3/hr.m2)	
Chimneys	None		
Open flues	None		
Extract fans	4		
Draught lobby	0		
Heating system	Boiler and radiators and energy efficient pump in house		Air to water heat pump
Boiler	Mains gas condensing, seasonal efficiency 91.3, room sealed, fanned flue		
Heating controls	Time and temperature zone control		
Hot water system	Solar water heating system:		No SHW
Primary water heating losses	Insulated primary pipework between boiler and cylinder		
Secondary space heating	Gas fire, closed front fan assisted, balanced flue- 80% efficiency		
Low energy lighting	100%		
Other renewable			PV Array 6 x 1.2m2 180wP @45 degrees south facing

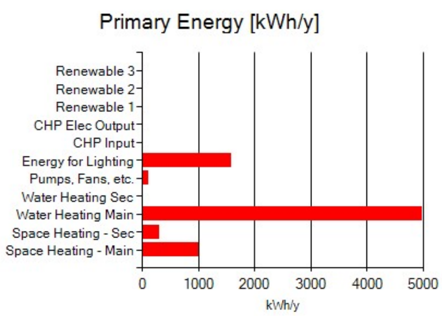
Results			
Primary Energy	54.33	**41.35**	**46.65** **46.4 (MHRV)** **32.77 (PV)**
MPEPC	0.4		
MPCPC	0.46		
RER	10.15		

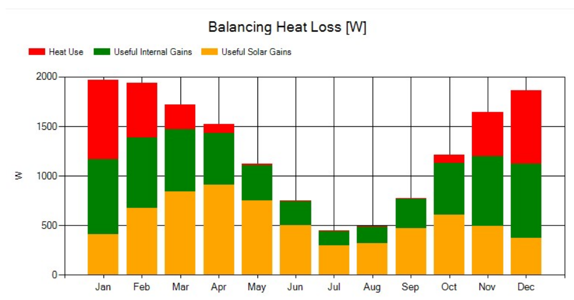
Passive results:



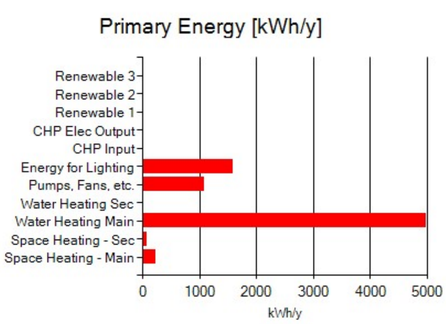


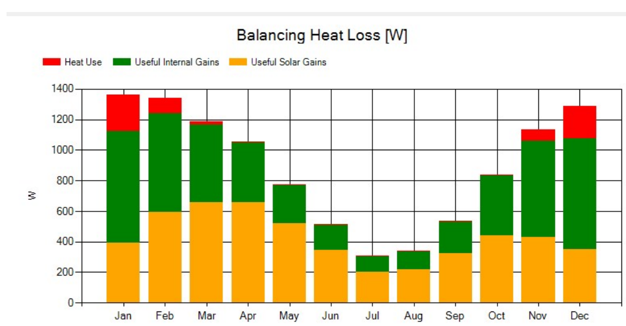
Heat pump plus no SWH:



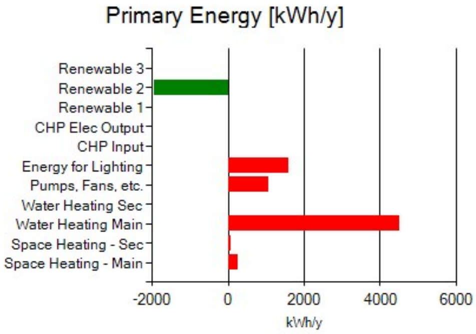


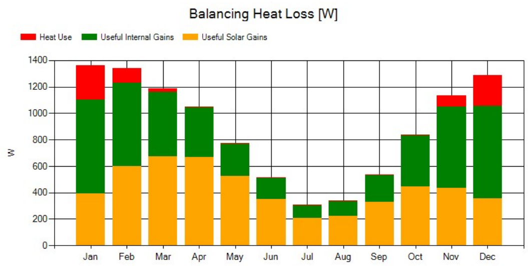
MVHR added:





PV Array added:





5.0 Optimum

The results above show that the passive measures have reduced the space heating demand. This was then further reduced with the change of system from boiler to heat pump, however the water heating load increased with this intervention. It is noted that hot water demand is area based in DEAP, and this house is a larger than average 3 bedroom house at 170m2. The addition of MHRV has again reduced the heating demand, and the PV array has offset the energy required for pumps, fans etc.

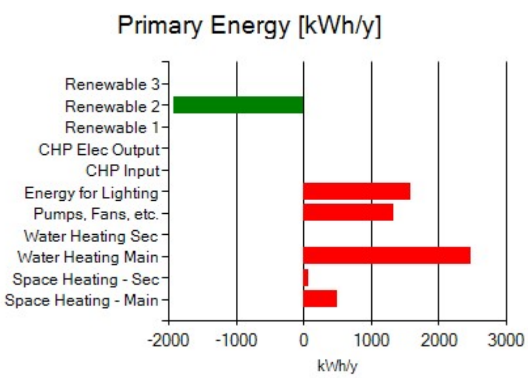
From the above data it is clear that meeting the hot water demand with renewables is key to reducing the overall primary energy demand.

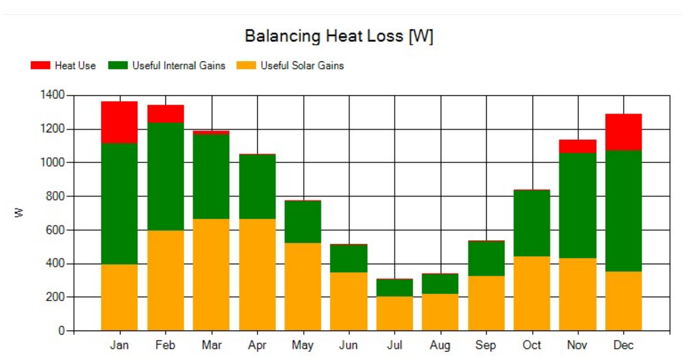
With a drastically reduced heating demand, the use of an expensive heat pump is not justified.

Summary of optimum strategy:

- Passive measures: superinsulation, super airtight, reduced thermal bridging at junctions
- Active measures: MVHR, efficient gas boiler with optimised controls
- Renewables: Solar hot water and PV array

Result: Primary Energy of 23.62kWhr/yr/m^2 and a BER of A1





Appendix A – Calculations

A 1 - Heat pump tool calculation

8. Results			
Results			
Efficiency of Main Heating System	426%	%	Enter this in DEAP: energy requirements: space heating
Efficiency Adjustment Factor - Main Heating	1.00		Enter this in DEAP: energy requirements: space heating
Efficiency of Main Hot Water System	162%	%	Enter this in DEAP: energy requirements: water heating
Efficiency Adjustment Factor - Main Hot Water	1.00		Enter this in DEAP: energy requirements: water heating
Additional Renewable Contribution from Heat Pump	800.06	kWh/year	Enter this in DEAP: energy requirements: fuel data: Renewable Energy: Energy Saved or Produced: Renewable Thermal: Part L Total contribution (kWh/yr). Note: this is only applied to Part L renewable contribution in new dwelling assessments.

A 2 – PV Calculation

6 x panels @ 1.2m^2

180wP
45 degrees
south facing

PV = 0.8 x kWP x S x ZPV

= 0.8 x 1.08 x 1 x 1072 = 926kWh/yr

A3 – MVHR Calculation

Xpellair

K + 2 wet

Rigid Duct 1.4
Insulated pipes 0.85

SFP 0.60 x 1.4 = 0.84
Eff 91% x 0.85 = 0.77

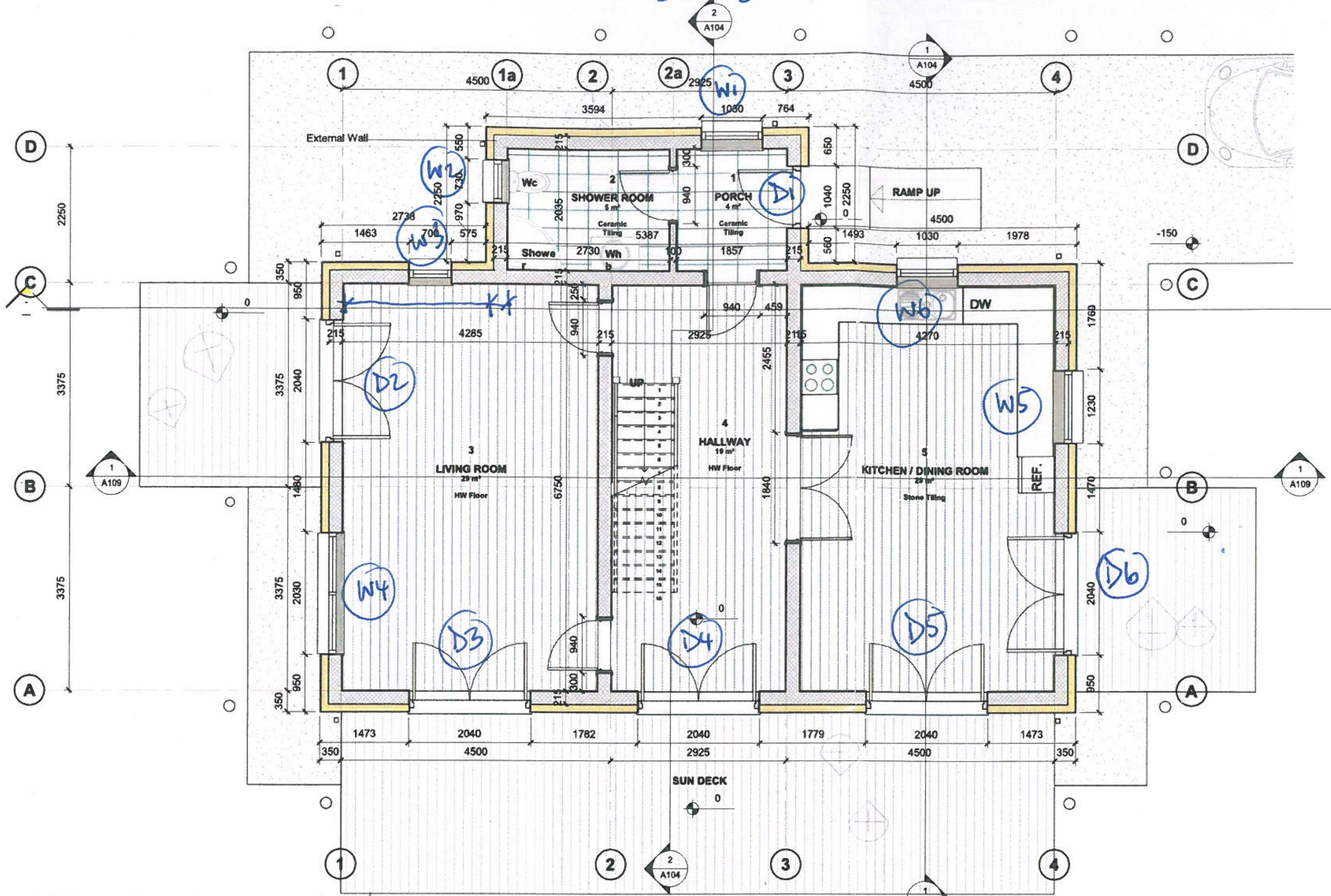
Walls: (3375x2) + 11.95 + 6750 + 4.485 + 2.035 + 4.687 + 2.035 + ~~[struck]~~ 2.738 = 41.43 x height = 222.4
– minus glazing ~~[struck]~~ – 25.29 – 19.842 = 177.76

Pitched Roof area:
6750 x 11925 = 80.49

Flat Roof area:
9.53.

Heights	
gr	2540
1st	2842

total 5.382



01_Ground Floor Plan sheet view
1 : 50

Doors L H

	No	Dims	Area
E	D1	1040 x 2250	2.34
W	D2	2040 x 2250	4.59
S	D3	2040 x 2250	4.59
S	D4	2040x 2250	4.59
S	D5	2040 x 2250	4.59
E	D6	2040 x 2250	4.59

25.29

D - North - 0
West - 4.59
South - 13.77
East - 6.93

W - North - 6.3
West - 4.686
South - 4.428
East - 4.428

All doors glazed.

Dimensions:

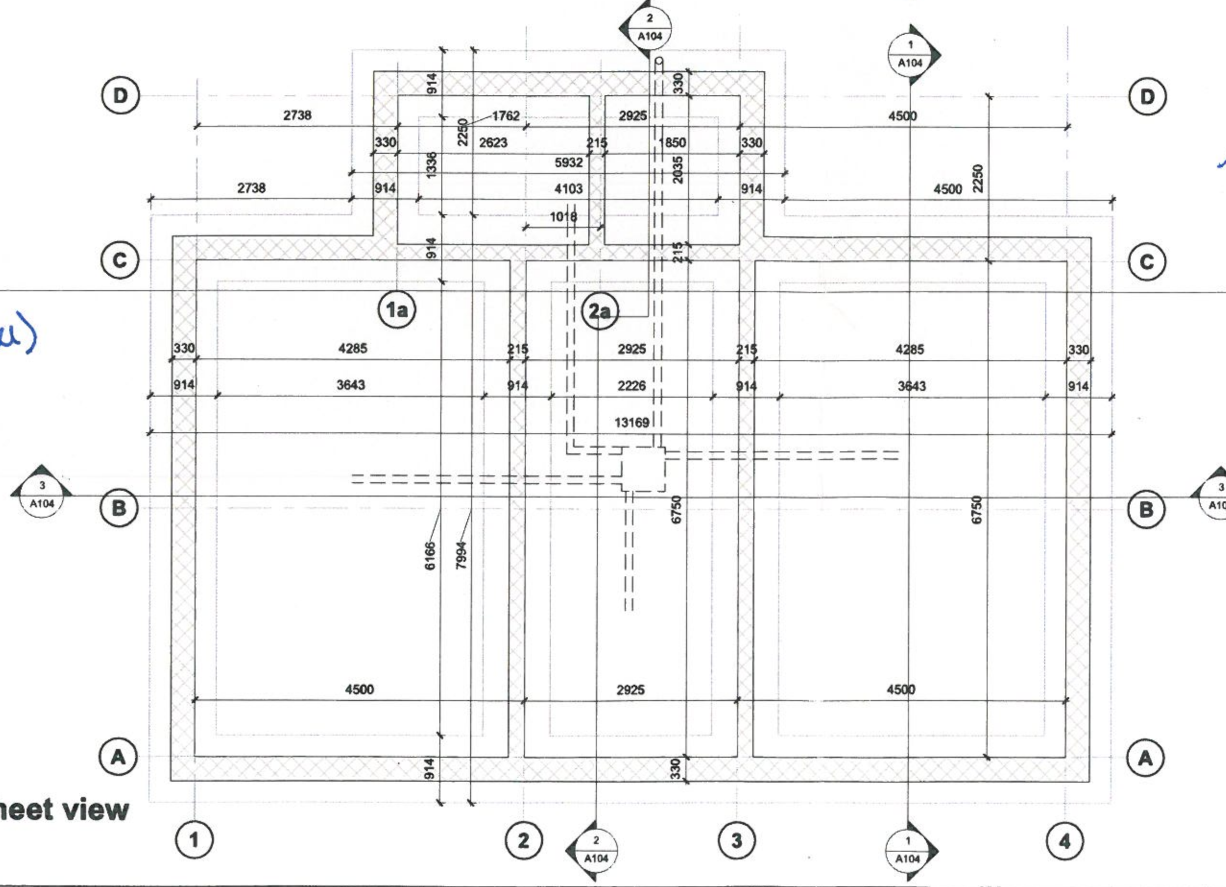
gf

3375 + 3375 = 6750
x
4500 + 2925 + 4500 = 11925
= 80.49 m²
+
2035 x 2730+100+1857
2035 x 4687 + 1 (wall)
= 9.53
= 10.53

1st

gr	= 91.02 m²
1st	= 80.49 m²

living = 29 m²



00_Foundation Plan sheet view
1 : 50

Windows: L H

N	W1	1030 x 1200	1.236
N	W2	730 x 1200	0.876
N	W3	700 x 1200	0.84
W	W4	2030 x 1200	2.436
E	W5	1230 x 1200	1.476
N	W6	1030 x 1200	1.236
N	W7	1030 x 1200	1.236
N	W8	730 x 1200	0.876
W	W9	660 x 1200	0.792
W	W10	1215 x 1200	1.458
S	W11	1230 x 1200	1.476
S	W12	1230 x 1200	1.476
S	W13	1230 x 1200	1.476
E	W14	1230 x 1200	1.476
E	W15	1230 x 1200	1.476

19.842

~~[struck]~~
45.132

PG Cert BP (EED)

Exemplar House

PLANS - FOUNDATION / GROUND FLOOR

Project number	BIM 01
Date	25-10-17
Drawn by	Niall Byrne
Checked by	Joseph Little

A102

Scale: @A1 1 : 50

Appendix B - Schematic

nZEB 30 kWh/m^2/year