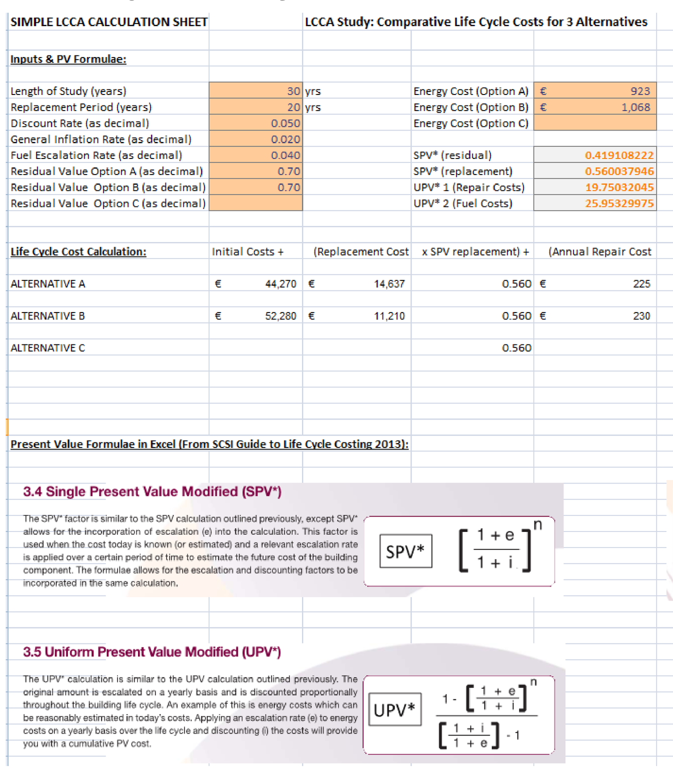
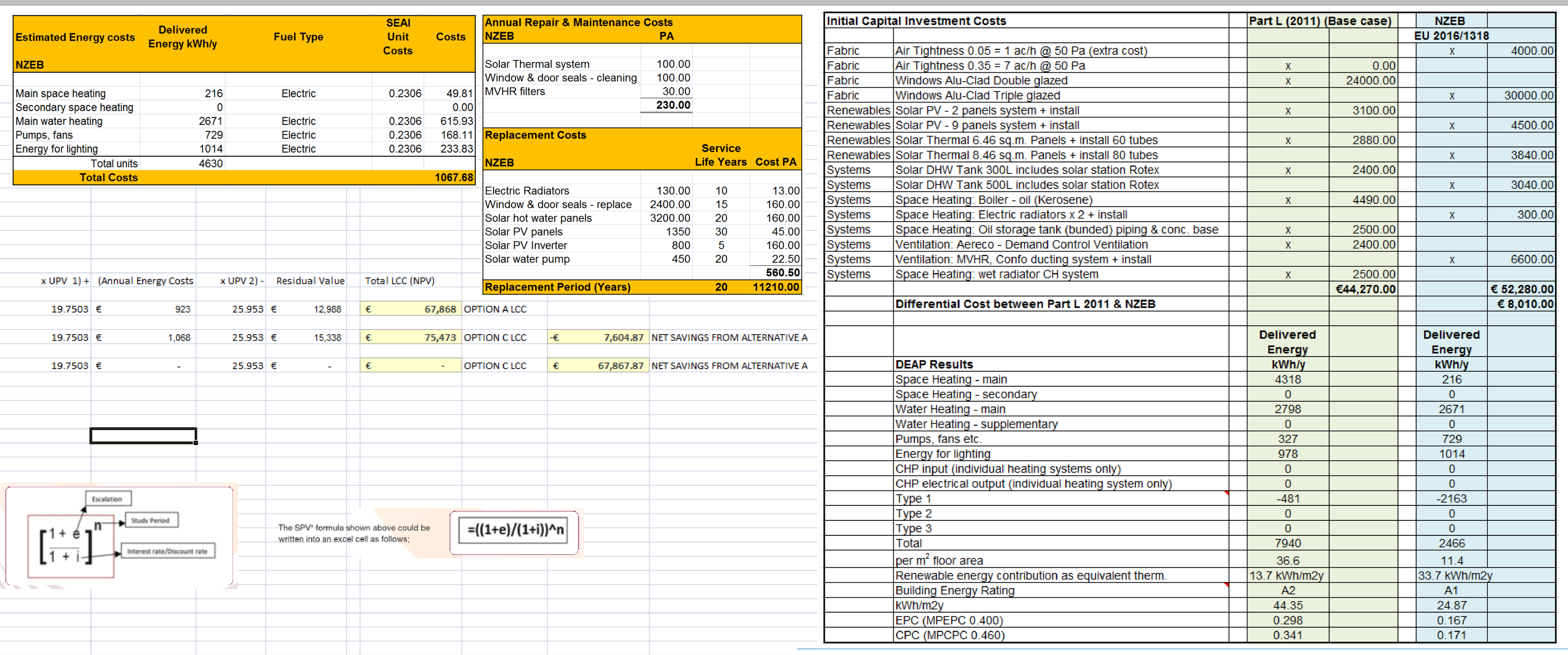
DUBLIN SCHOOL OF ARCHITECTURE
DT774 PG CERTIFICATE IN DIGITAL ANALYSIS & ENERGY RETROFIT
ARCH1280 NZEB PROJECT: RESIDENTIAL DWELLING 2017

PAUL KOPIK
D16126509

NZEB HOUSE DESIGN, KENT, UK

Cost Optimality Assessment



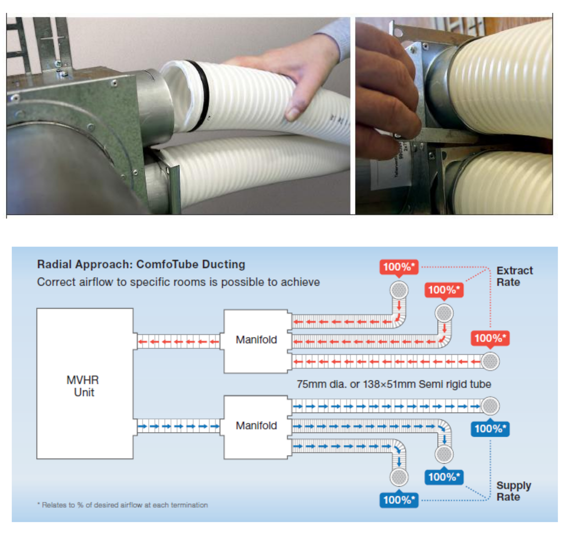


Outcome

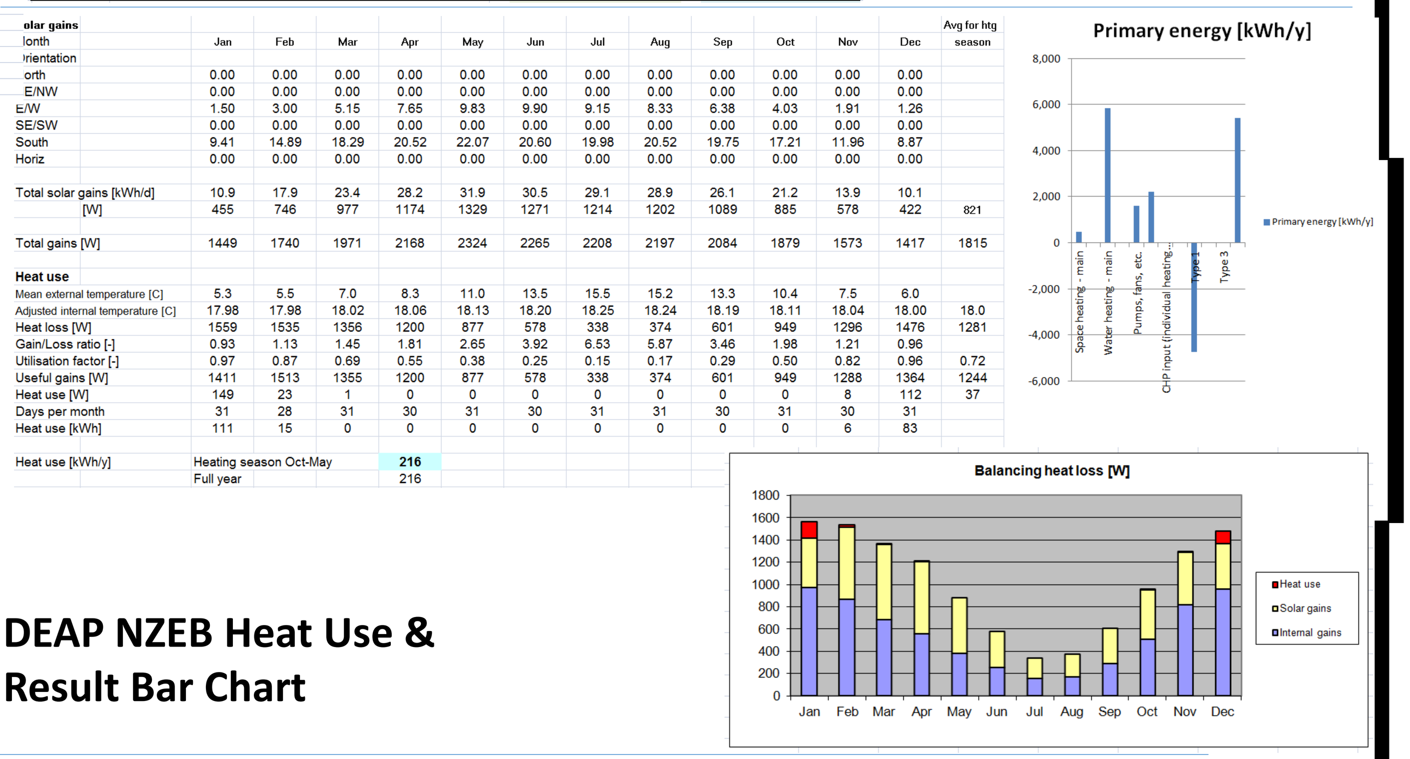
It would appear that the Part L design is overdesigned regarding energy performance and is consuming less energy than if it was designed to just meet the Part L 2011 parameters. The LTB calculations from modelling in PsiTherm also confirmed the low Y factor and resultant higher efficiency thermal envelope. The client's insistence of the use of Durisol for the walls and the same performance of the floor & roofs for both designs have resulted in good energy efficiency. The NZEB space heating requirement is almost negligible. However, it is noted that the carbon allowances are much less in the NZEB than in the part L 2011 designs. Part L CO2 emissions are 2325 kg/y versus 1166 kg/y for NZEB. Sensitivity analysis of fuel escalation has not proved significant. The NZEB house is not cost optimal although it is my preferred option regarding it's robustness against the volatility in the fossil fuel oil economy.

Ventilation Design

Ventilation design is achieved using a Paul Novus 300 MVHR system with Comfo Air semi-rigid ducting & system and to comply with TGD Part F (2009). TGD F requires 0.3 litres per second per square metre of floor area and equates to 234 m3/h.



DEAP NZEB Heat Use & Result Bar Chart



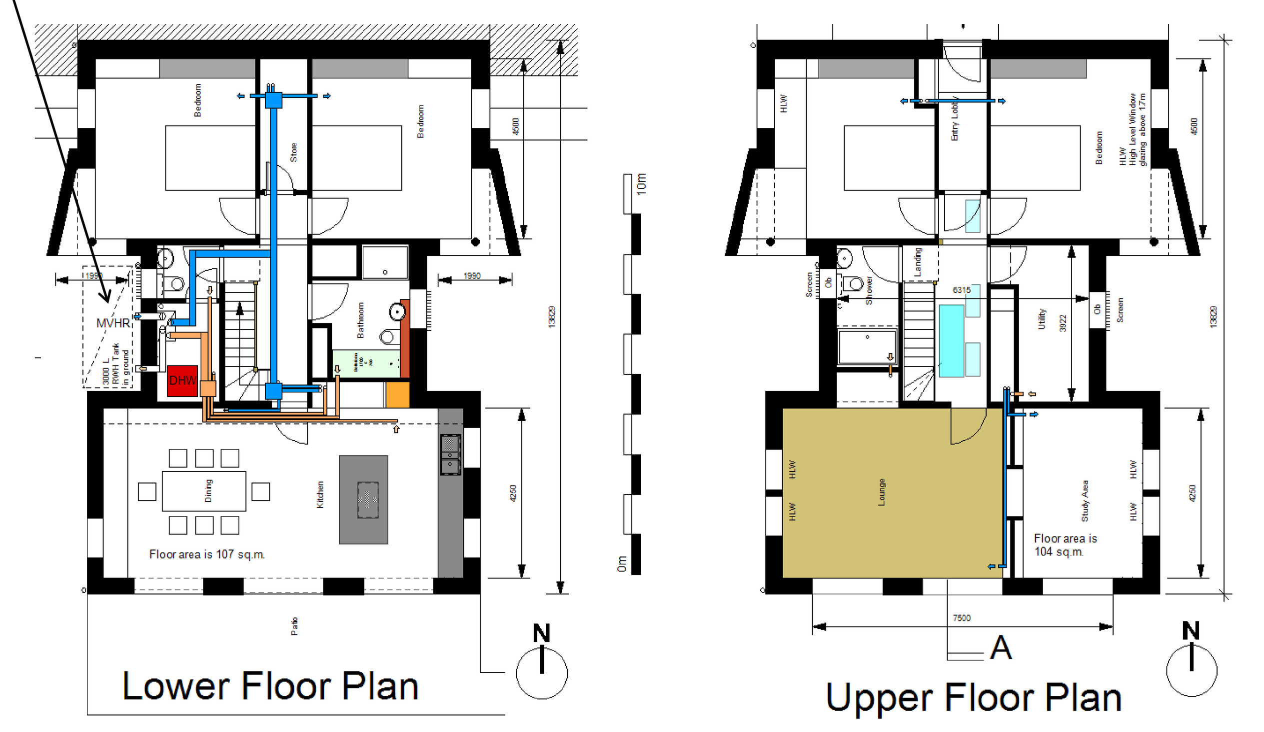
The Brief

To demonstrate compliance with Irish Building regulations at the level of design and assigned certifiers as defined under the current BCAR regulatory architecture.

Two standards of building energy performance are explored:
Full compliance with part L (2011) and compliance with EU 2016/1318

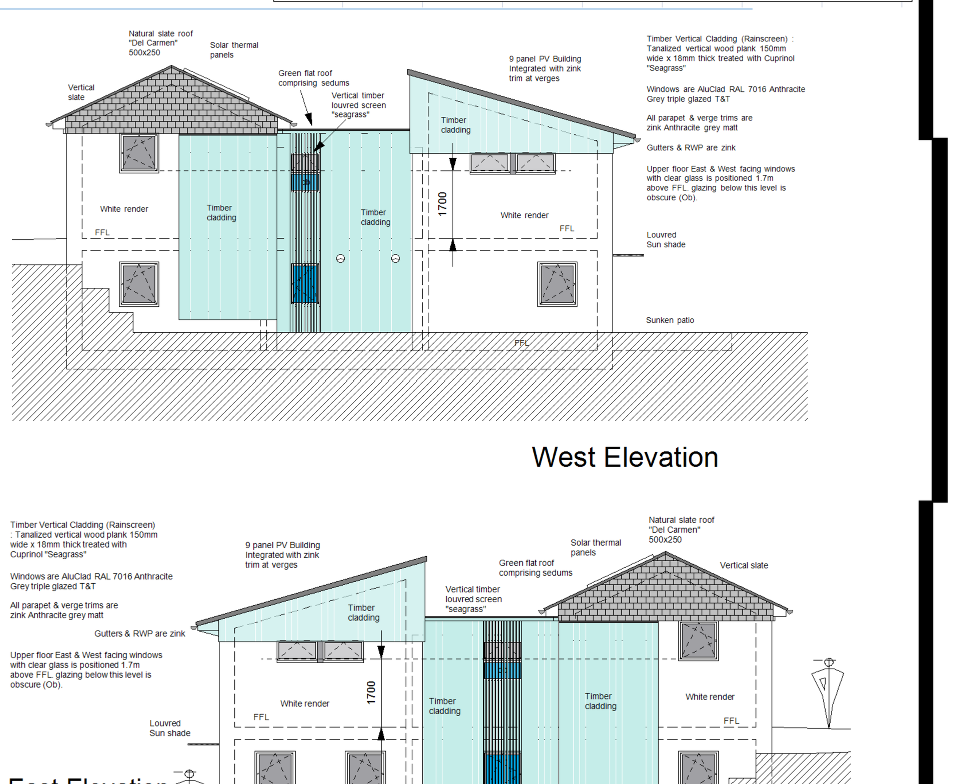
The 8 essential NZEB skills defined by DIT for the delivery of successful NZEB projects are

1. Geometry / Form-Factor Optimisation
2. Overheating
3. Condensation Risk Analysis
4. Cost Optimality Assessment
5. Thermal Bridge Calculation
6. Ventilation design
7. Air tightness Design
8. U-value & Heat Loss



Lower Floor Plan

Upper Floor Plan

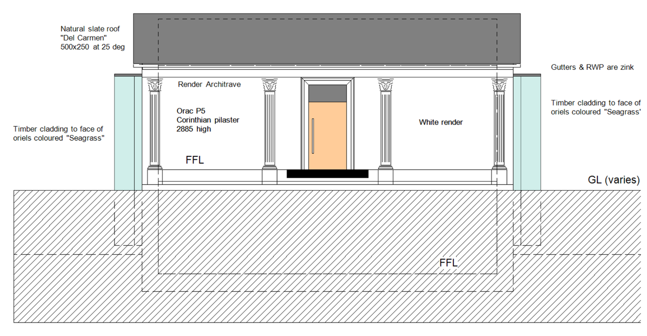


West Elevation

East Elevation

Geometry / Form Factor Optimisation

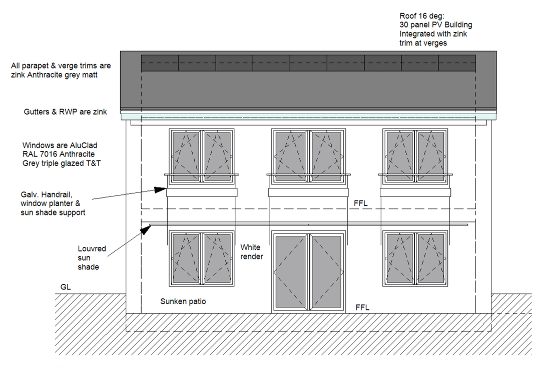
The design began as a two storey compact building approximately square on plan. The shape evolved into a form of "H" shape to enable more southern aspect walls to include southern glazing both for insulation & view to southerly seascape. The roof shape massing evolved to reduce the bold massing in the urban landscape as well as to provide south sloping surfaces for the incorporation of solar panels. The middle flat roof section is a green roof and this is to also act as a surface water attenuation sponge. All roof rainwater is directed to a 300 L tank in the ground. DEAP (NZEB) Heat Loss Parameter (HLP) = 0.57



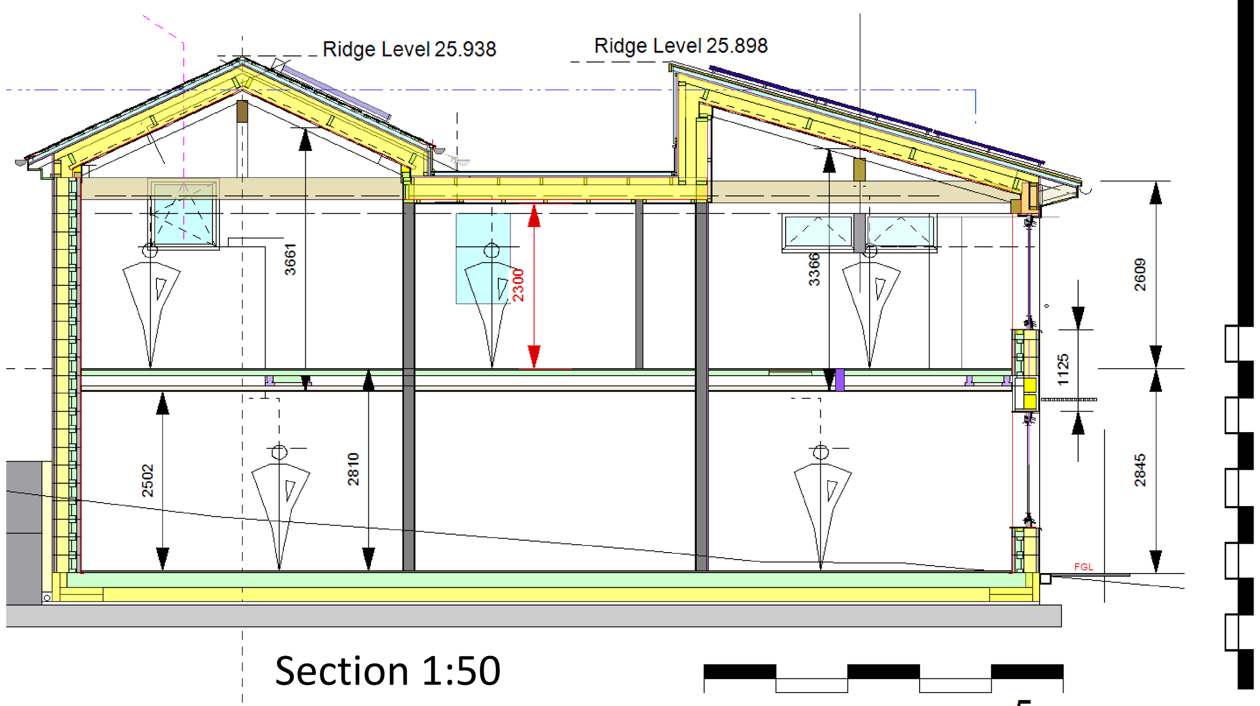
North Elevation

Overheating

There are windows to the South, East & West. The major view is South & the building uses the passive house method to gain heat from the sun. Shading is provided to the South elevation by a large eaves overhang & horizontal shading external louvers above the ground floor windows. Vertical external timber louvers are provided to the East & West elevation obscure windows (timber clad walls area). The DEAP summer sheet analysis indicates that the Threshold Internal Temperature is an acceptable 21 degrees centigrade with some window ventilation. Generally the building uses a MVHR balanced whole house ventilation system with summer bypass.

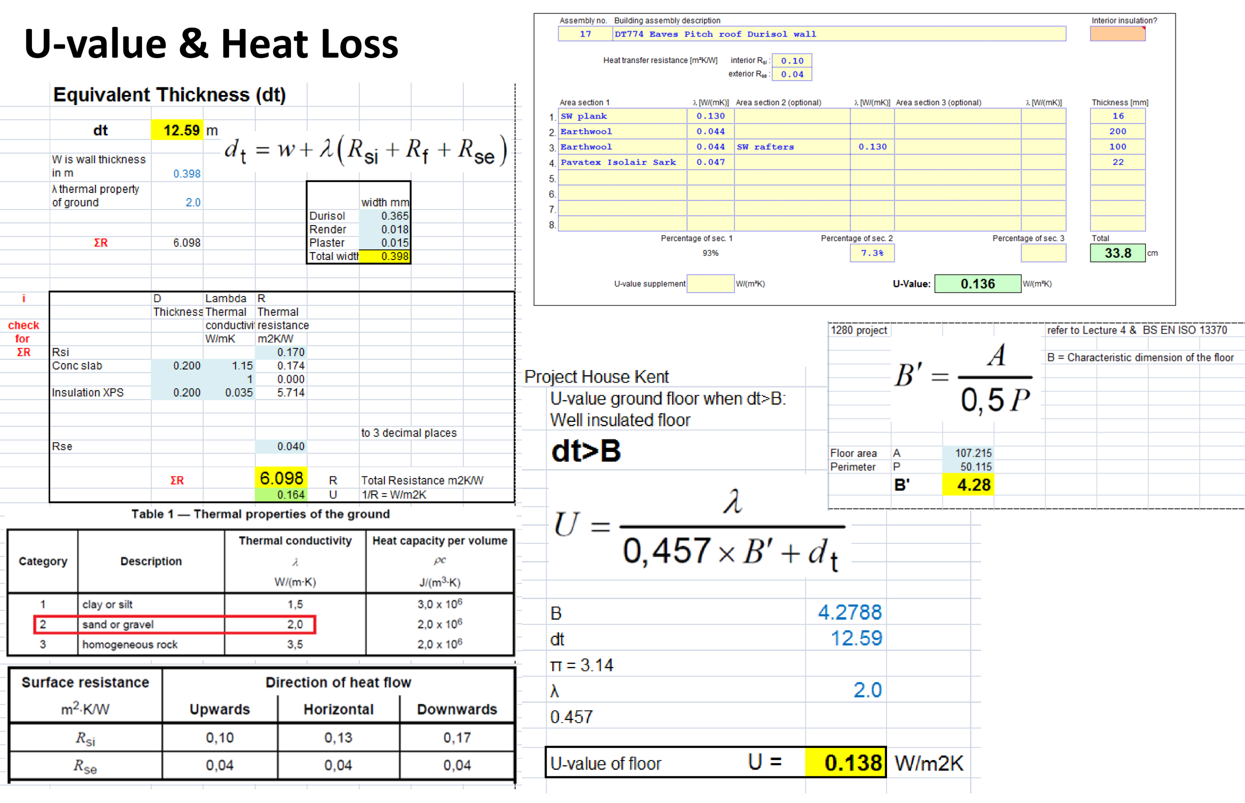


South Elevation



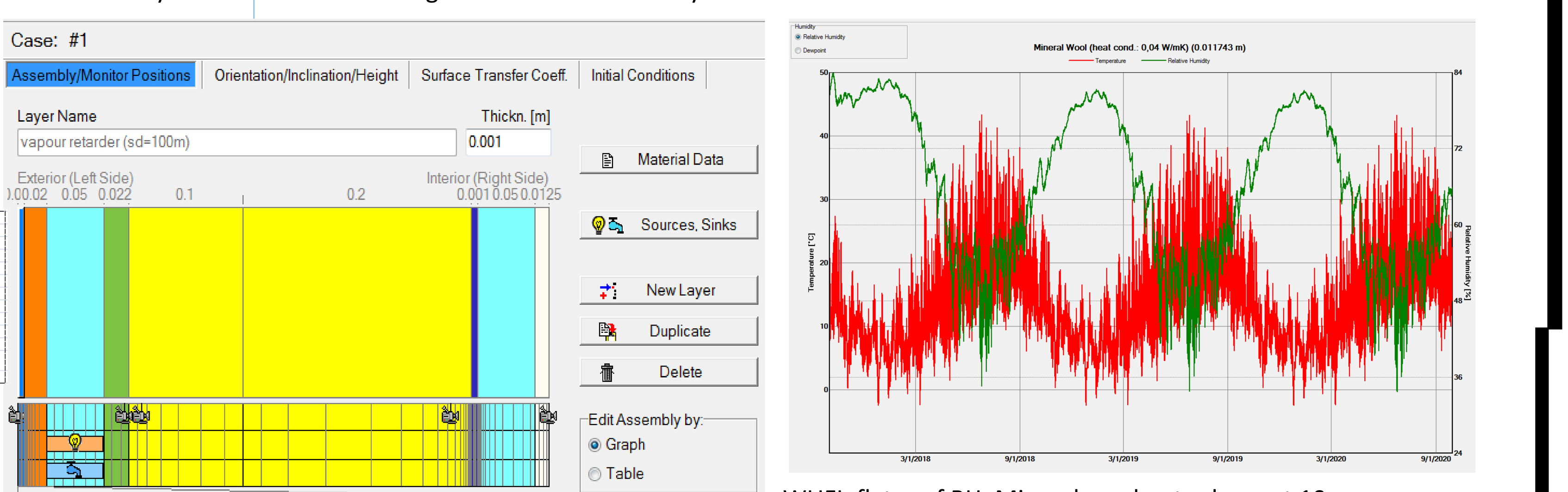
Section 1:50

U-value & Heat Loss



Condensation Risk assessment - WUFI

This risk analysis was undertaken using WUFI software to analyse the flat roof of the NZEB house.



WUFI: flat roof RH. Mineral wool outer layer at 10mm internally of the Pavatex sarking board. Refer monitor positions.
Result: The RH approaches equilibrium after one year. At equilibrium the RH fluctuates between 30% & 80% and does not cause concern. At this colder part of the insulation (more external) it is obvious that the RH increases with the drop in temperature. RH at 80% at this location does not cause concern.

Air-tightness & Wind-tightness Design

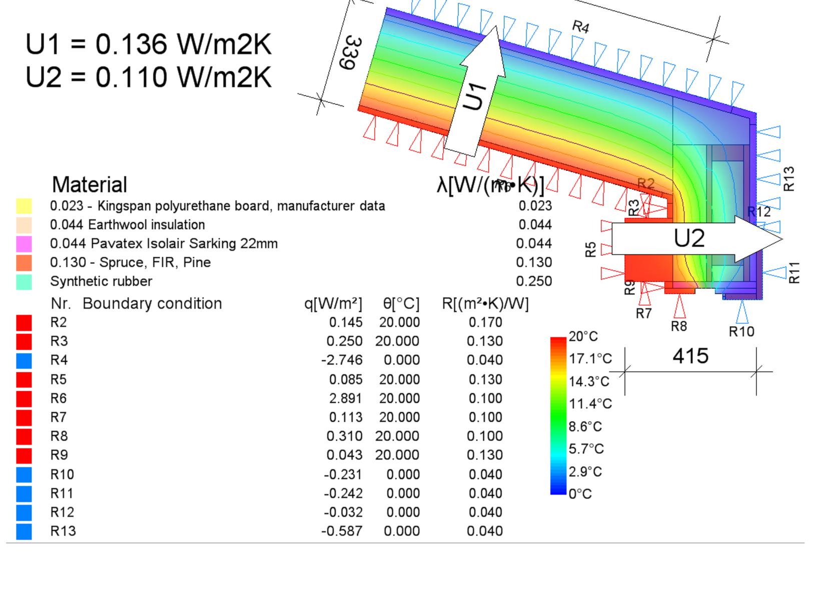
The wind-tightness is achieved by using Pavatex sarking board to manufacturers instructions. Pavatex is used externally of any timber frame components in roof or walls. Pavatex also insulates the timber and is modelled successfully in WUFI.
Durisol block external face is rendered with Parex external render system to BBA certificate.
Air-tightness internally is achieved using Intello products for ceilings, and joints. Internal finishes of external walls are 18mm gypsum wet plaster system bonded with Intello Contega SL tape at junctions and frames where necessary. All services penetrations are to be sealed with Intello products.
Electrical sockets & switches are not to be positioned on external walls.

Thermal Bridge Calculation & Condensation Risk Assessment fRsi - PsiTherm

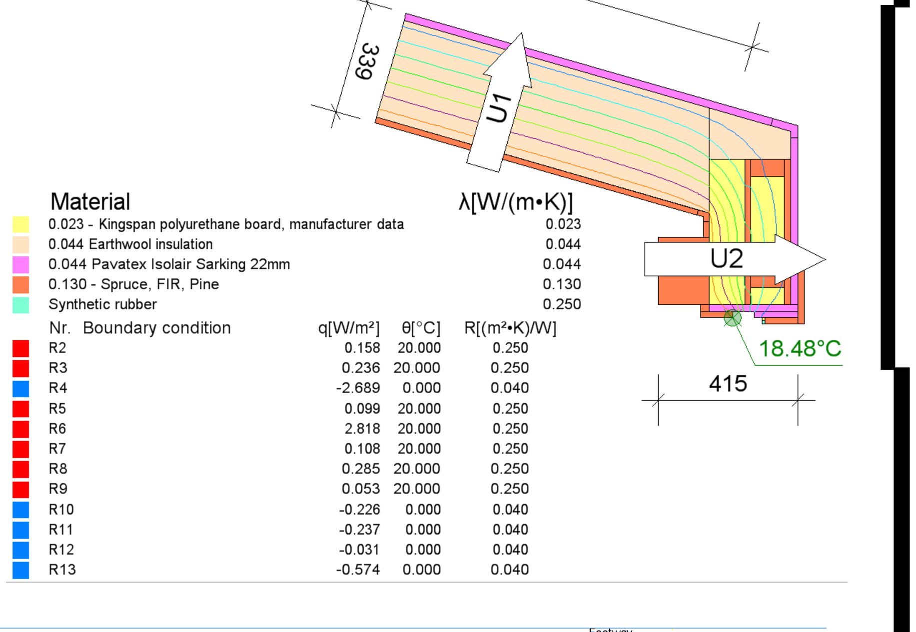
The following diagrams below indicate a Psi value & fRsi thermal models for the eaves adjacent detail.

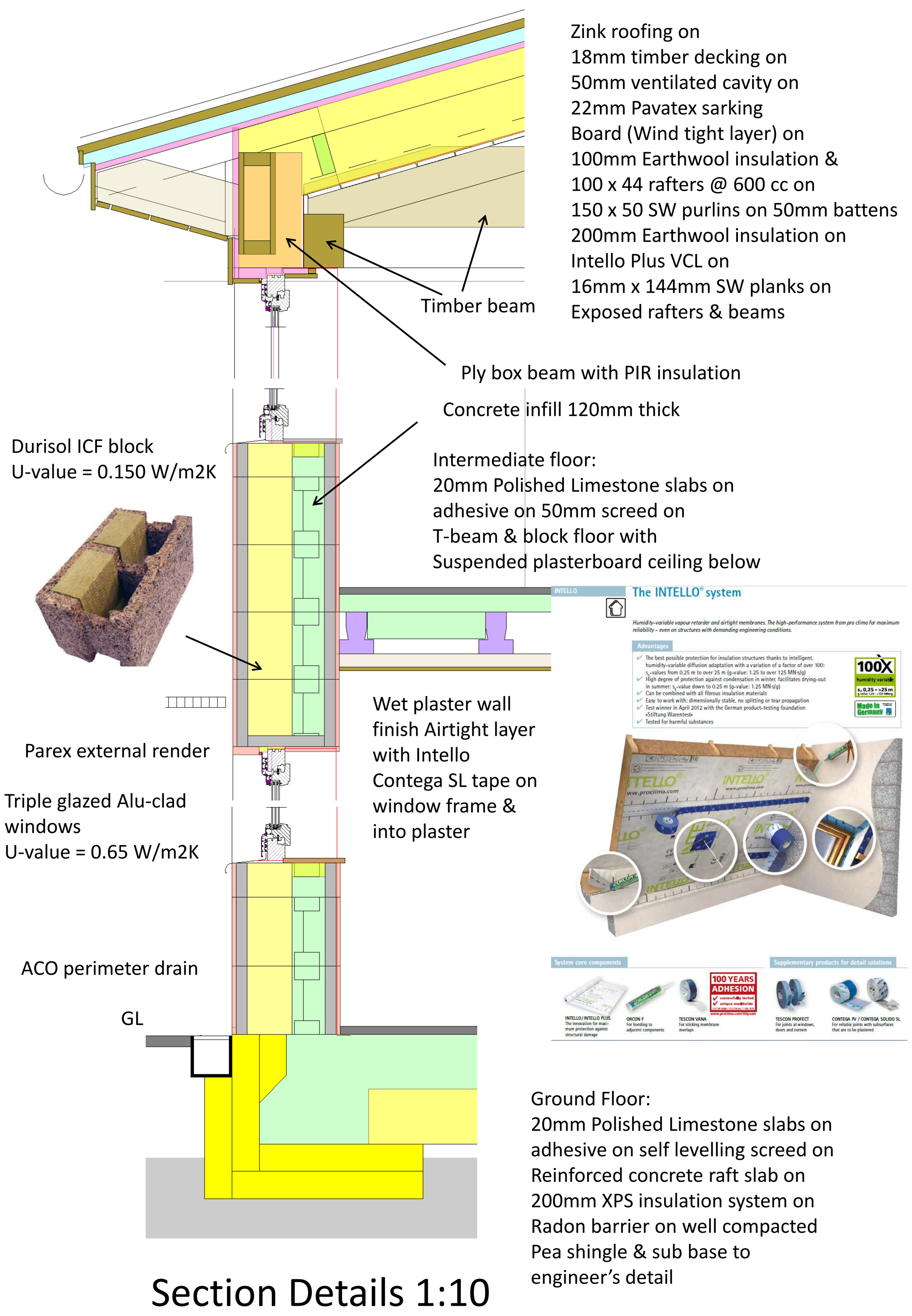
Eaves Monopitch Lintol
Psi value = 0.00789 W/mK

U1 = 0.136 W/m2K
U2 = 0.110 W/m2K



Eaves Monopitch Lintol
fRsi = 0.92 > 0.75





Zinc roofing on
18mm timber decking on
50mm ventilated cavity on
22mm Pavatex sarking
Board (Wind tight layer) on
100mm Earthwood insulation &
100 x 44 rafters @ 600 cc on
150 x 50 SW purlins on 50mm battens
200mm Earthwood insulation on
Intello Plus VCL on
16mm x 144mm SW planks on
Exposed rafters & beams

Timber beam

Ply box beam with PIR insulation

Concrete infill 120mm thick

Durisol ICF block
U-value = 0.150 W/m2K

Intermediate floor:
20mm Polished Limestone slabs on adhesive on 50mm screed on T-beam & block floor with Suspended plasterboard ceiling below

Parex external render

Wet plaster wall finish Airtight layer with Intello Contega SL tape on window frame & into plaster

Triple glazed Alu-clad windows
U-value = 0.65 W/m2K

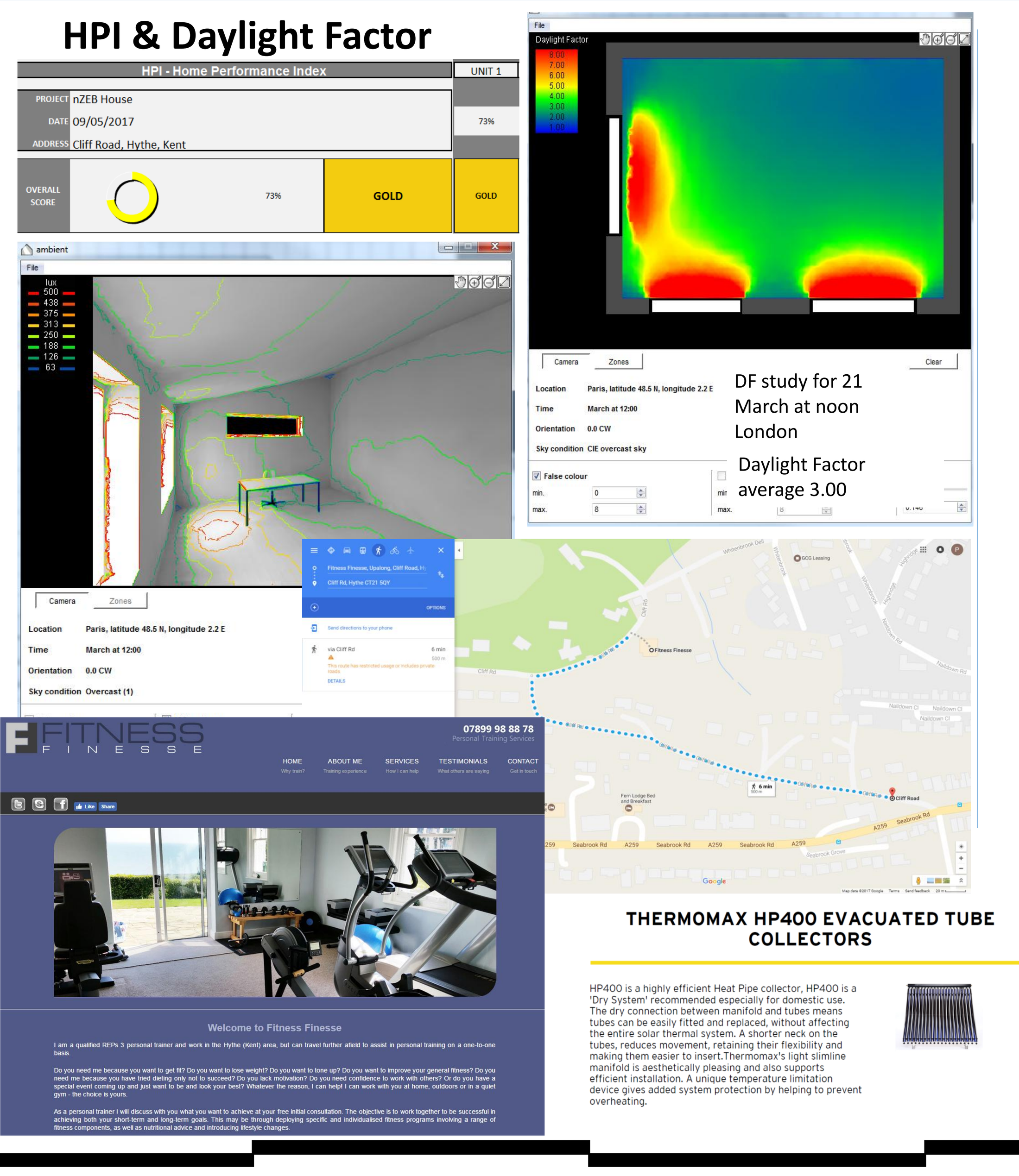
ACO perimeter drain

GL

Ground Floor:
20mm Polished Limestone slabs on adhesive on self levelling screed on Reinforced concrete raft slab on 200mm XPS insulation system on Radon barrier on well compacted Pea shingle & sub base to engineer's detail

Section Details 1:10

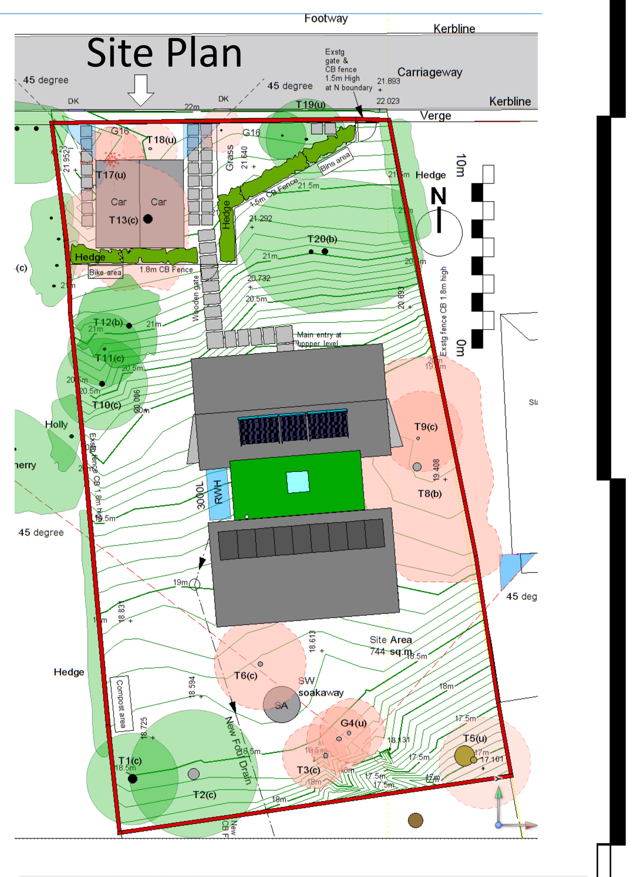
HPI & Daylight Factor

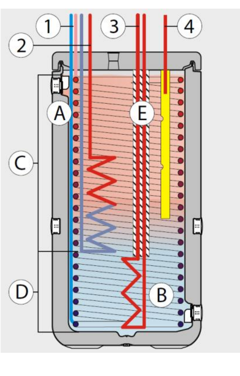


DF study for 21 March at noon London
Daylight Factor average 3.00

THERMOMAX HP400 EVACUATED TUBE COLLECTORS

Site Plan





ROTEX Sanicube Solaris SCS 538/16/0-DB

A Storage tank
B Unpressurised storage tank water
C Hot water zone
D Solar zone
E Heating support zone
1 Potable water
2 Storage tank charging
3 Heating support
4 Solaris connection