Barnes CONSTRUCTION

PASSIVHAUS

A Contractor's Perspective

DOVEHOUSE COURT, GIRTON, CAMBRIDGE

ABOUT US

- Established in 1978 as a local family-owned building contractor
- Work in all sectors Healthcare, Leisure, Education, Commercial and Residential
- Bidding for Passivhaus projects but managing business risk
- Key pillars of our business based on:
  - **Sustainability** – long term strategy for everything we do
  - **Collaboration**- basing our business approach on excellent teams
  - **Innovation**- looking to improve our process and approach through innovative thinking
- Over 75% of our work is repeat-business or negotiated

Girton TownCharity

- The first mention of GTC is in The Victoria County History which can be traced back to a bequest in 1521 by William Collyn
- Land sold in 2003 for development raising significant funds and enabled exciting changes for the charity
- Consists of 7 Trustees
- Portfolio of 28 alms-houses
- GTC run several charitable schemes for the residents of Girton

PROJECT BRIEF

- Procurement route – Single stage design and build
- Demolish existing GTC office (bungalow) and develop the site of the 6 former bungalows
- Create 15 passivhaus alms-houses and new office facility – Scheme wasn't compliant at tender stage
- 3 separate blocks
- Mix of bungalows and 2 storey buildings approx. 55m2 /180sqft per unit
- Details external works communal garden, car parking and relocation of existing sub-station.
- Value Circa £5m

Mole

conisbee

NORTHMORES

HOARE LEA

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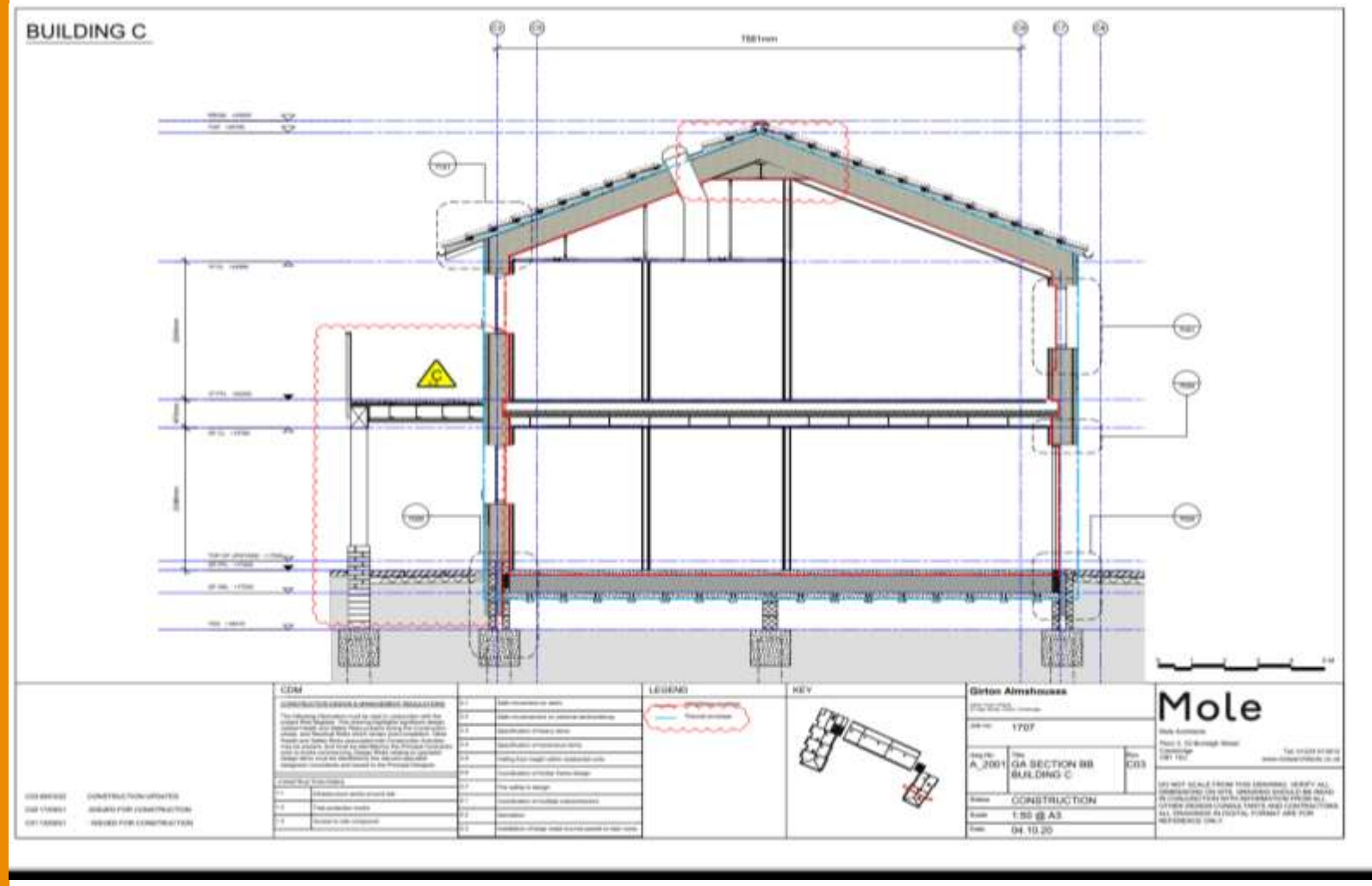
CONSTRUCTION METHODOLOGY

- CFA piles with ring beam foundations
- Block and beam floor
- Traditional timber frame
- Floor and roof panel cassettes
- Passivhaus certified windows and doors
- Clay roof tiles
- External steel frame staircase
- Hybrid solution of metal and timber glulam external walkways
- Lightweight stud partitions
- Mix of flat and vaulted ceilings
- 300mm of floor insulations with 75mm screed
- External render on 75mm wood fiber Insulation
- Insulation pumped into timber frame



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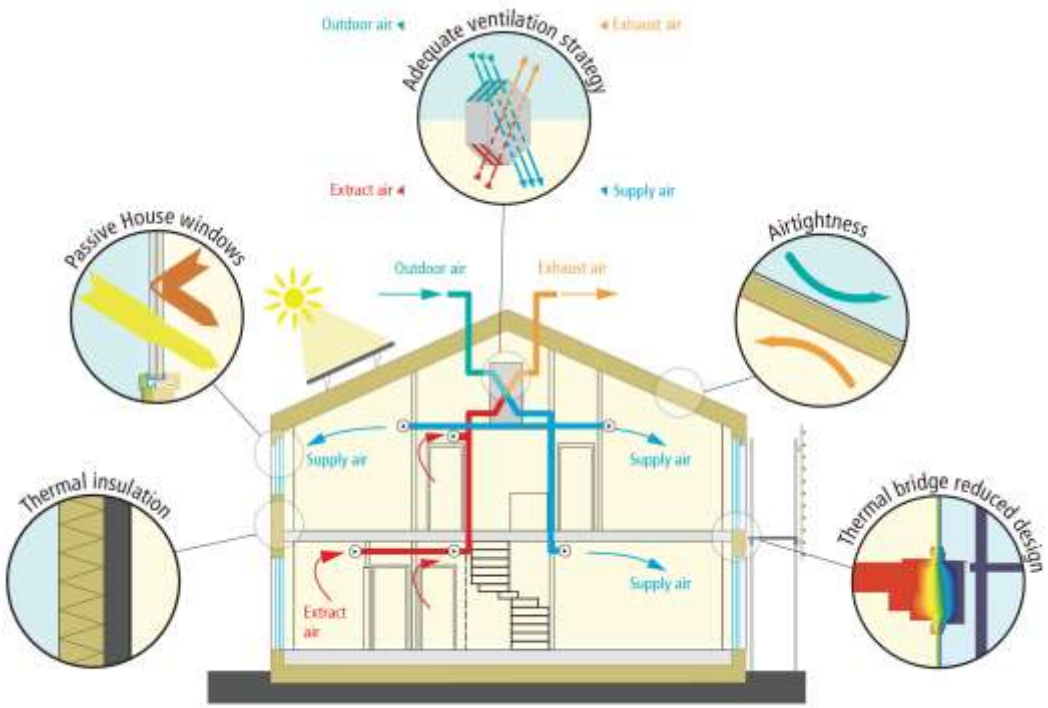
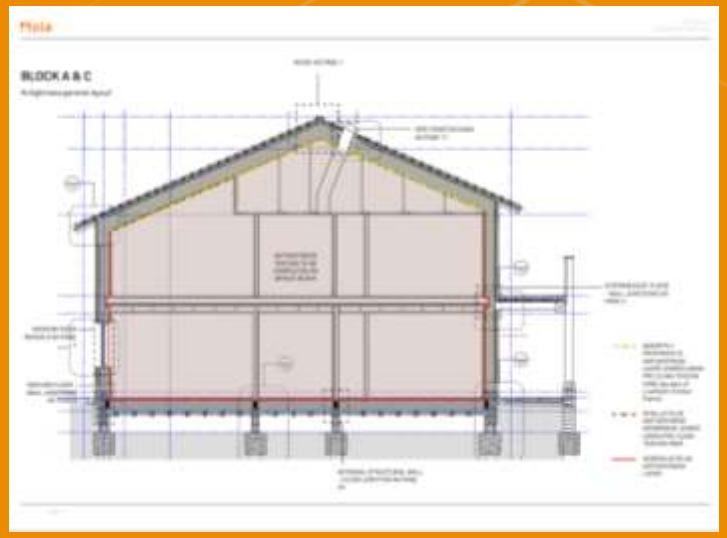
PRE-CONSTRUCTION CRITICAL ACTIVITIES

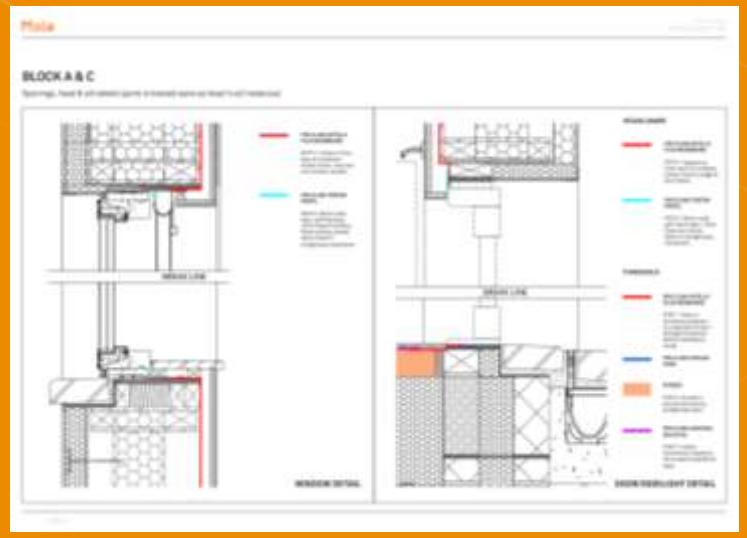
- Development of key stakeholders' management plan
- Understanding Passivhaus principles
- What is a Passive House Planning Package (PHPP model) and how is this effected, material selection, cold bridging etc
- Early appointment of MEP contractor to feed into the model Solar Thermal change to ASHP for compliance
- Timber fraction consideration before completion of design
- Air testing requirements and decisions on how to test in blocks
- Training required for the team and business “Certified Passive House Tradesperson” Engaging with passivhaus certifiers
- Appointing a Passivhaus Champion



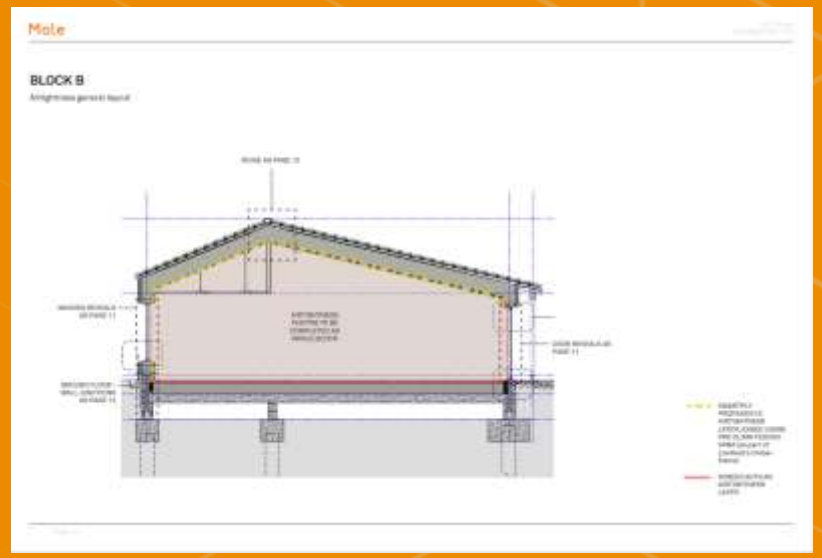
AIR TIGHTNESS STRATEGY

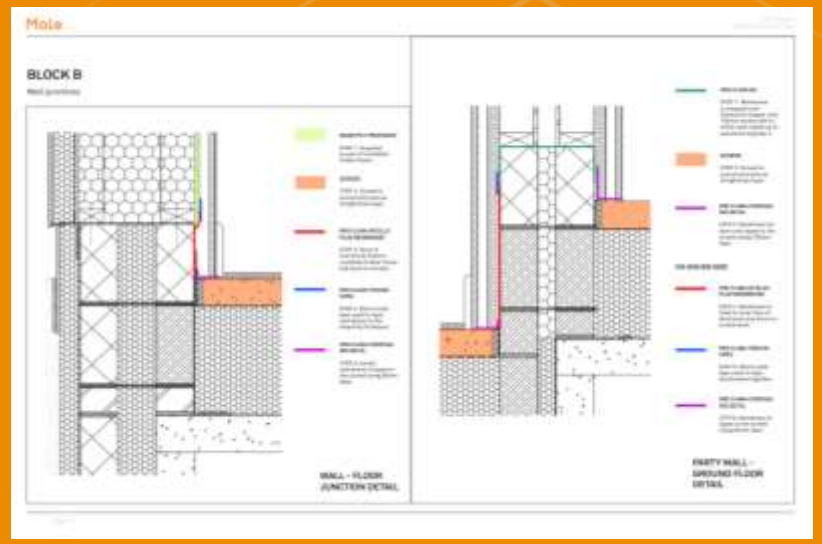
- Design teams responsibly to produce an air tightness strategy for construction the document we received was very good.
- Two different strategies to meet fire regulations during construction for spread of flame, STA 16 steps to fire safety, close proximity of neighbouring properties
- Bungalows pro-passive board to walls
- Two storey elements membranes Pro Clima Intello
- Airtight lines/ locations





THE BUNGALOWS





- Different strategy for the bungalows
- Horizontal and vertical steps (floor levels, wall and roof lines)
- Liquid screed with airtight line taped at wall junction, tapes can become damaged easily.

PRODUCTS USED

Mole

BLOCK B

Products used

Line type on standard details	Product name & Spec code	Product image	Description	Installation
	Pro Clima Intello Plus P10/312		Intelligent hydrosafe airtight vapour control membrane to be used in the opening reveals and between the SmartPly ProPassiv and screed.	
	Pro Clima DA P10/311		Robust airtight internal vapour control membrane and air barrier with excellent weather resistant properties. To be used between blockwork and timber frame.	
	Pro Clima Tescon Profil P10/313B		Airtight adhesive tape for use on corners and junctions. The tape has a split backing of 12mm (attached to the window frame) and 48mm (attached to the membrane).	

Mole

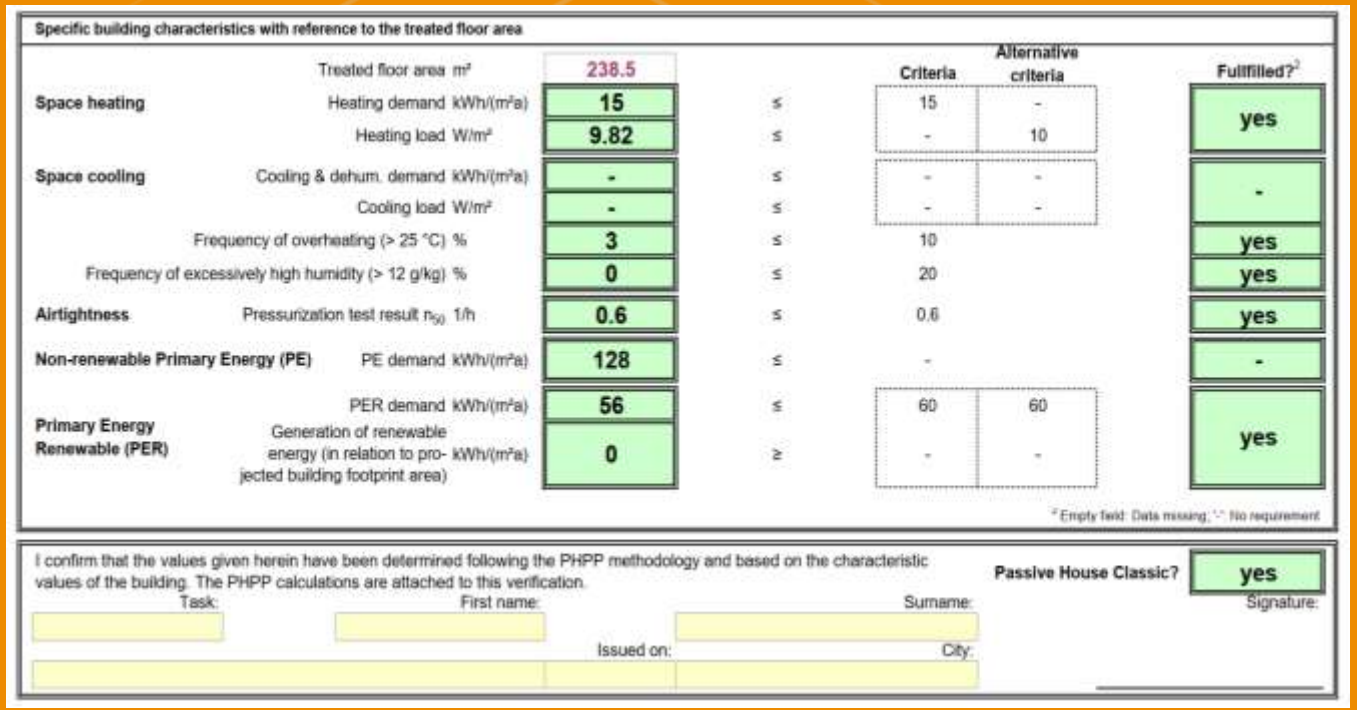
BLOCK B

Products used (continued)

	Pro Clima Tescon Vana P10/313C		Multi-purpose airtight adhesive tape used for membrane joins, as well as for joins in the SmartPly Propassiv between panels.	
	Pro Clima Contego Solido SL P10/313A		Airtight tape for masonry to membrane connections, door and window sealing tape. Used between the screed and Pro Clima Intello Plus and to tape the Intello Plus to blockwork.	
	Pro Clima Tescon Sprimer as P10/316		Spray primer to be used on all surfaces before tapes are applied	

EVIDENCING AND FEEDING INTO PHPP MODEL

- The PHPP model is the most important tool in successfully achieving Passivhaus certification – Fact !
- Designated individual by the architect to manage the model, approx. approx. 580hrs of architect teams time attributed to working specifically on the PHPP or certification process from stage 4 onwards
- Bungalows particularly difficult to certify due to the external surface area Vs apartments (upgraded insulation with additional south glazing)
- SAP calcs not required as the PHPP model is far more complex. However, PHPP can't be used to produce EPC
- PHPP model can affect structural solutions
- Actual timber fractions used feed in very late in the process



Specific building characteristics with reference to the treated floor area

					Criteria	Alternative criteria	Fulfilled?[2]
	Treated floor area	m²	238.5				
Space heating	Heating demand	kWh/(m²a)	15	≤	15	-	yes
	Heating load	W/m²	9.82	≤	-	10	
Space cooling	Cooling & dehum. demand	kWh/(m²a)	-	≤	-	-	-
	Cooling load	W/m²	-	≤	-	-	
	Frequency of overheating (> 25 °C)	%	3	≤	10		yes
	Frequency of excessively high humidity (> 12 g/kg)	%	0	≤	20		yes
Airtightness	Pressurization test result n_{50}	1/h	0.6	≤	0.6		yes
Non-renewable Primary Energy (PE)	PE demand	kWh/(m²a)	128	≤	-		-
Primary Energy Renewable (PER)	PER demand	kWh/(m²a)	56	≤	60	60	yes
	Generation of renewable energy (in relation to projected building footprint area)	kWh/(m²a)	0	≥	-	-	

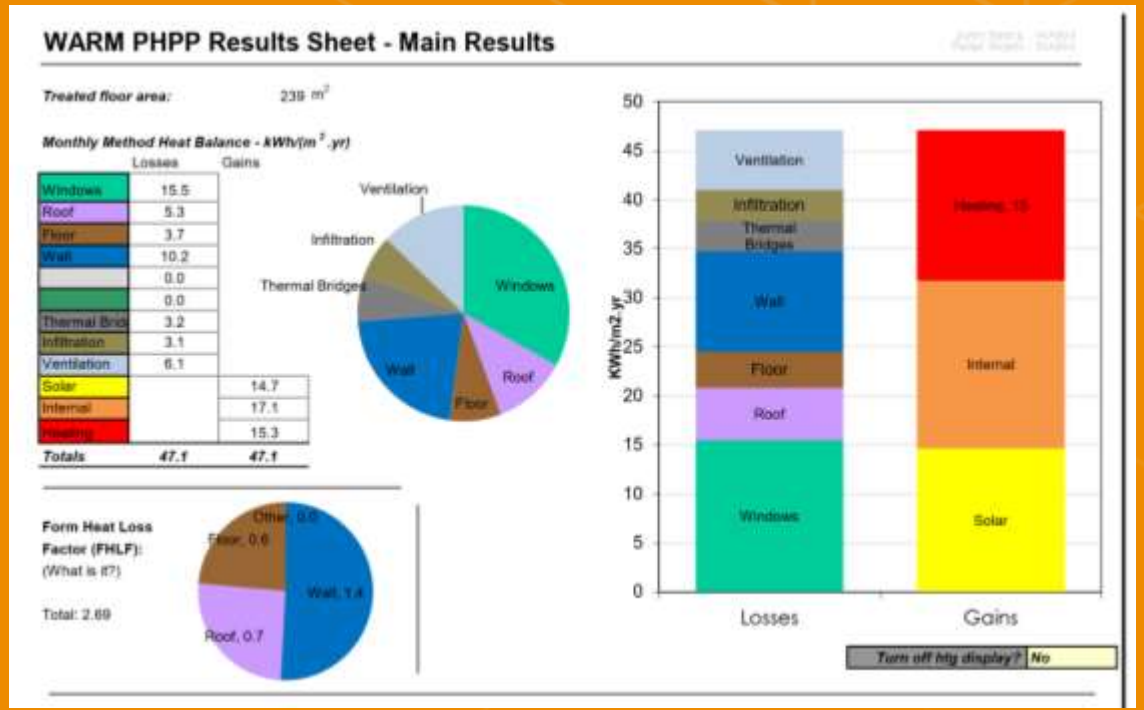
[2] Empty field: Data missing; "-": No requirement

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:

Issued on: City:



WARM PHPP Results Sheet - Main Results

Treated floor area: 239 m²

Monthly Method Heat Balance - kWh/(m².yr)

	Losses	Gains
Windows	15.5	
Roof	5.3	
Floor	3.7	
Wall	10.2	
	0.0	
	0.0	
Thermal Brid	3.2	
Infiltration	3.1	
Ventilation	6.1	
Solar		14.7
Internal		17.1
Heating		15.3
Totals	47.1	47.1

Form Heat Loss Factor (FHLF): (What is it?)

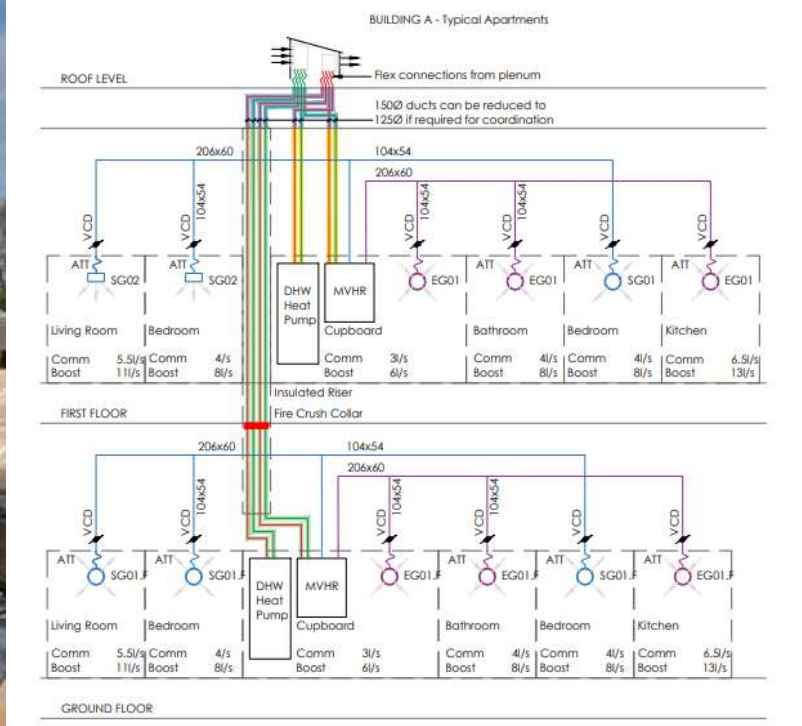
Total: 2.69

Turn off big display? No

CONSTRUCTION PHASE –
WHAT WE DISCOVERED...

DETAILING

- Step details at sub-structure, facade and roof lines caused real difficulties
- Membrane Vs Pro-passive board robust detailing
- Insulation operation cutting through airtight and fire line
- Managing cold bridging, access for duct work and actual space available
- Vent strategy through chimney's
- Fire rated ground floor ceiling
- Passivhaus certified windows and doors
- External service risers
- Damage to airtight lines and repairs required



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HOW IS THIS MANAGED

- Role of the Passivhaus Champion
- Penetration logs
- Record keeping
- Uploading information to portal
- If there's no evidence, it didn't happen !!

190

Assignee Lowfield Timber Frame

Block A 1st floor - warmcell penetration

2.01 - Insulation performance

Assigned To Birch Screeding

150mm Jablite Floor Insulation

Snag 2 - FN01 Study

Assigned To LTF

Hole in membrane, needs taping

Snag 3 - FN 01 Study

Assigned To LTF

Incorrect detail, intello plus membrane should finish flush with screed and the Contega taped from screed to intello membrane

AIR TIGHTNESS PERFORMANCE

- Opted for a 2-test strategy, pre fit out and on completion
- Not every detail drawn and change of airtight line caused a real problem with party walls
- Airtight manual not updated during construction – ridge beam issue linked to cold bridging
- Pass test result of 0.6 air changes per hour or less required
- First test results…
- Difficulties and challenges… and our process of elimination
- Failed tests and remedials
- Use of an anemometer
- Difference in performance of membrane Vs Pro-passive board
- Advise building performance will tighten up post-plaster, render, mastic etc
- Relatively poor sub-contractor buy-in to passivhaus requirements despite discussions

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Test Results — Pass

Target:	<= 1.00	$m^3.h^{-1}.m^{-2}$@50Pa
Air Flow Coefficient (C_{env}):	49.000	$m^3.h^{-1}.Pa^n$
Air Leakage at 50 Pa (Q_{50}):	0.146	$m^3.h^{-1}$
Air Flow Exponent (n):	0.60	
Coefficient of Determination (r^2):	0.984	

Air Permeability: **0.59** $m^3.h^{-1}.m^{-2}$@50Pa

This is to certify that the above name building has been tested by a registered provider in accordance with ATTMA TSL1, TSL2 or TSL3, subject to the above statements regarding temporary sealing and deviations from these test standards.

This certificate is a short form report. If a full compliant report is required please contact the company that issued the certificate. Enquiries about this certificate should be made to: Scheme Manager, ATTMA, Unit 3, Tannery Road, Loudwater, Buckinghamshire, HP13 7EQ or visit www.bcta.group/attma/

9SNB-SI64-5633

M&E INSTALLATION

- Combined approach for M&E with passivhaus experience
- Co-ordination of services within a small structure especially from the chimneys, duct sizing once lagged.
- Builders work detailing required upfront to ensure safe passage of services without hindering architectural features, ceiling heights etc
- MVHR by Zehnder/Comfo air supply and extract 25lps
- ASHP Dimplex Edel 200 UK hot water pump and cylinders
- Collating evidence for PHPP model
- Allowing for excessive insulation grouping together for lagging
- Noise break out should be expected and acoustic cupboard doors considered units exceed 25db allowance
- MVHR and ASHP will leak air during air testing
- ASHP used to get the scheme compliant

Passivhaus Trust
The UK Passive House Organisation

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LATE CHANGES

Passivhaus certifiers change in approach to the Office…

- The office was outside of the passivhaus assessment as it had its own thermal envelope .
- Part of the assessment was due to occupancy levels being different to that of a residential property
- Originally design for conventional bathroom extract
- Unfortunately, WARM changed their advice given at the start of the project, suggesting it's not possible to leave this element out of the assessment
- Air test result…
- WARM accepted that we can't make changes to the fabric at this late stage and asked us 'to do the best we can in the spirit of Passivhaus'.
- Installation of Passivhaus certified MVHR system
- Considerable delays and buildability issues

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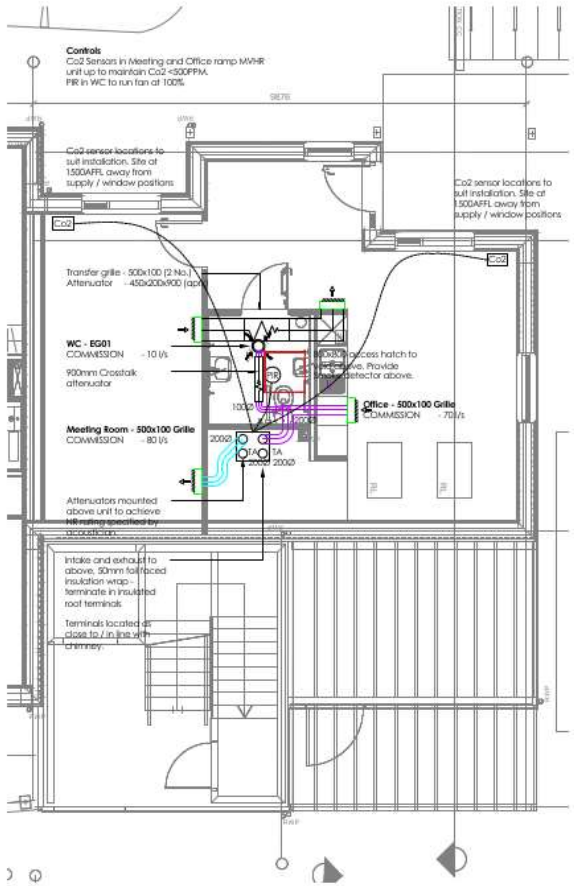
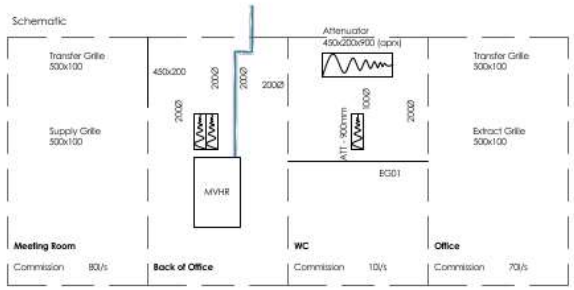
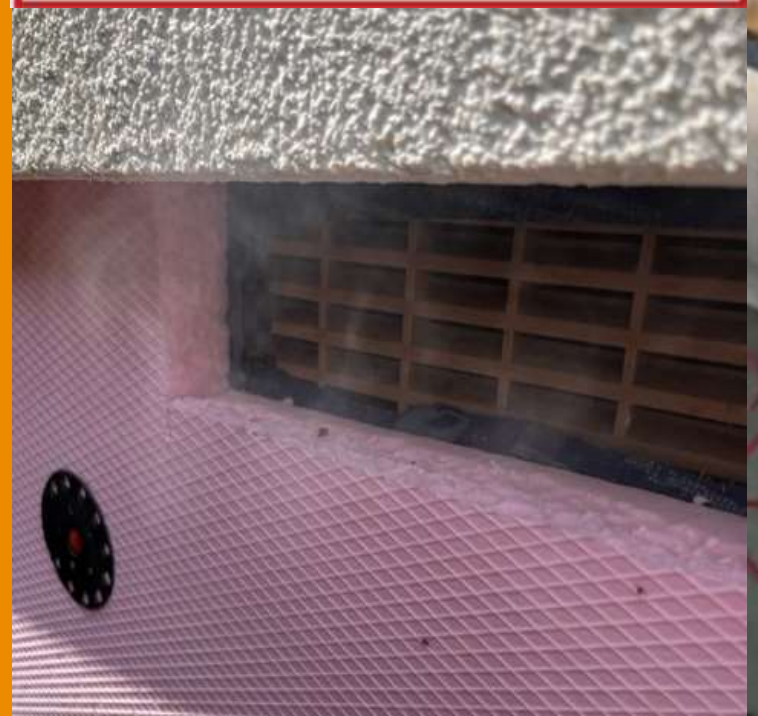




LESSONS LEARNT

- Certified timber frame suppliers are limited and very expensive, cost increase led to our tendering contractor pulling out of the project leaving us with a significant cost increase
- Carryout our own air testing (in house) and air test between individual trades if programme allows
- Airtight membrane ballooning pro-passive board preferred option
- Passivhaus certified products aren't airtight (windows)
- What happens when the floor screed cracks?
- Space required on site for additional thickness of insulation/materials
- Every lap in tape will leak air
- The weather can affect the ability of tapes
- Try and avoid/design out step junctions
- Thermal bridging issues with walkways resulting full redesign and considerable costs



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LIVING IN AND OWNING A PASSIVHAUS BUILDING

Resident – “The areas are spacious, light and airy, following the recent hot weather internally the building has remined cool”

Resident – “I was concerned hearing that all services run off electric supplies, but the usage is so minimal my costs are considerably cheaper than my previous property”

Ann Bonnett, Chair of GTC said: “This is a major milestone for us, we are delighted to have now taken ownership of Dovehouse Court and after many years, seen our plans to futureproof housing in our Village come to fruition. I’d like to thank all the contractors who worked on the site for doing such a splendid job over the last 15 months as well as my fellow Trustees

OTHER FORMS OF PASSIVHAUS WE HAVE BEEN INVOLVED IN

SELWYN COLLEGE NEW COURT

- Supposedly designed to ENerPHit Passivhaus standards
- Major concerns raised during tender process due to lack of detailing
- Non passivhaus certified products specified
- No cold bridge assessment
- Products specified without actual knowledge of product limitations such as wood fibre, lime render etc
- Our knowledge on passivhaus construction saved this project from disaster

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THANK YOU FOR LISTENING