#UKPHC18

LITTLEPITS PASSIVHAUS PLUS

with PH15 SYSTEM

Jae Cotterell

Chartered Architect & Certified Passivhaus Designer
Director of Passivhaus Homes Ltd and Passivhaus Store
Co-author of The Passivhaus Handbook (2012)

Winner Best Private House 2013 (Passivhaus Trust)
UK Finalists in Structural Timber Awards 2016 for 'Most Innovative Product' for the PH15 Timber frame system for Passivhaus Projects
Shortlisted for the Ashden Award 2018 (showcasing sustainable energy solutions)

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LITTLEPITS REPLACEMENT DWELLING IN CHILTERNS

An external aesthetic respecting the Chiltern local vernacular style while demonstrating highest sustainability levels can be achieved. Showcasing traditional, low carbon, building materials as ideal for energy efficient construction, and the benefits of a tried and tested construction system, PH15.

222m² GIA
+ Glatthaar basement

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UK TIMBER CONSTRUCTION – THE CHALLENGES

1. Layers and complexity?
2. Timber quotient (30% +)?
3. Risk of insulation gaps?
4. Risk of condensation?

A KNOWLEDGE GAP…

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LITTLEPITS PASSIVHAUS PLUS – PH15 FRAME CONSTRUCTION

1. Three layer construction + minimal tapes – **simplicity**

2. Timber to insulation ratio typical 15:85 – **maximum efficiency**

3. Vapour permeable – **moisture management**
(thicker wall but lower moisture management risk)

4. Blown-in insulation + pre-cut wood fibre infills - **accuracy**

PH15

PASSIVHAUS STORE ◊ PASSIVHAUS HOMES ◊ PHH

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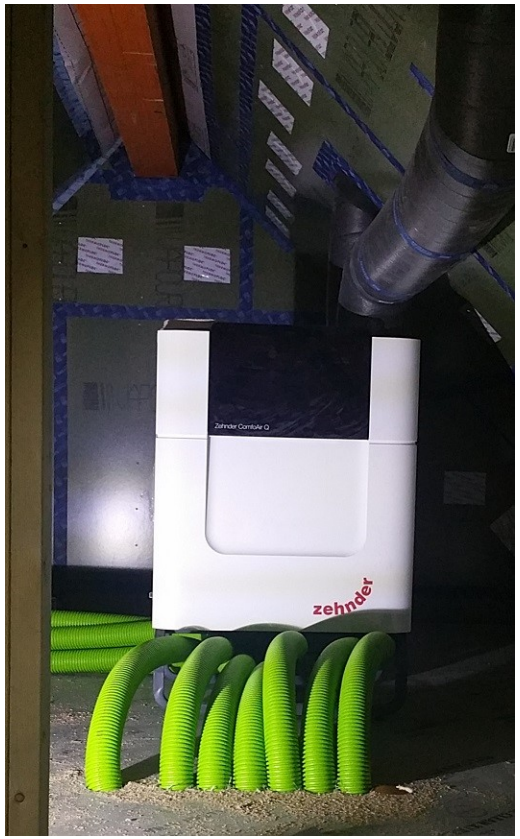
DELIVERING the THREE ESSENTIAL COMPONENTS of a PASSIVHAUS

PH15

Resolved thermal bridge details
Resolved airtightness details
Small range of tapes, no glue
Simplicity
Pre-cut to size for speed
Targeted at carpenters, for UK skill base
Supported with training
Supported with a Building Pack
Protected performance – a complete system
(2 x air tests to below 0.6ach@50Pa)
Natural materials
Recyclable at end of life, demountable
Pleasant to work with
Established partners STEICO, KATZBECK

EFFICIENT DELIVERY PROCESS

THERMAL SHELL + GLAZING + MVHR



USP is as a *complete* Passivhaus compliant solution

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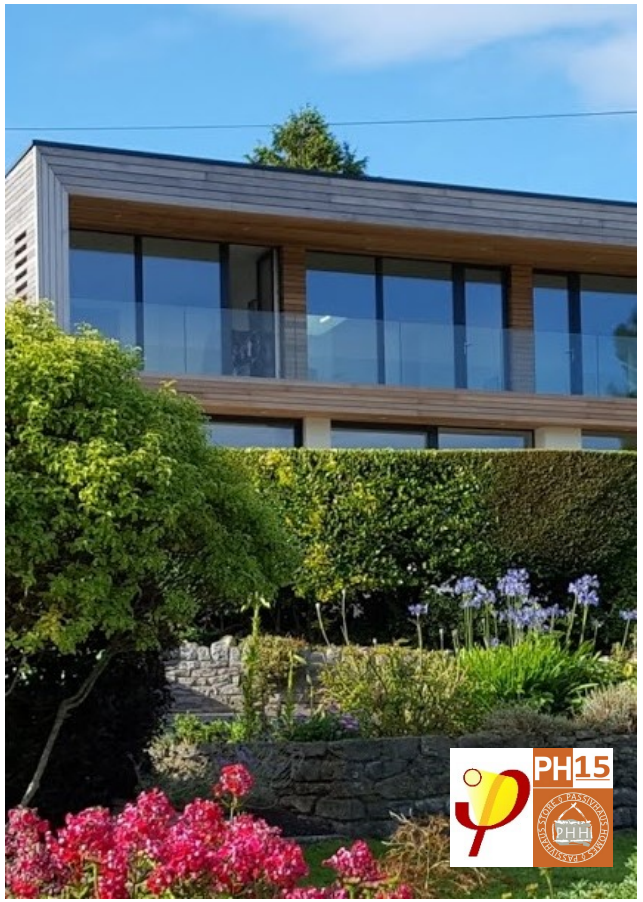


0.5ach@50Pa
Passivhaus
2014

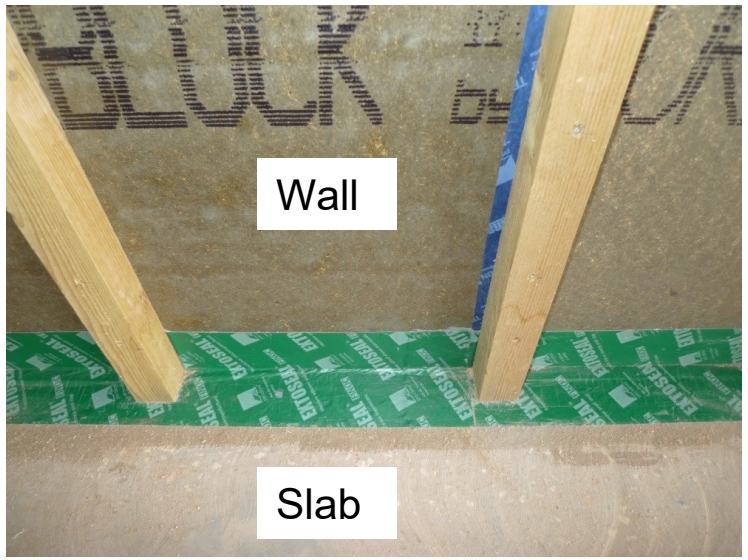
0.39ach@50Pa

0.38ach@50Pa

0.07ach@50Pa
LITTLEPITS
Passivhaus Plus

Design flexibility, ease of airtightness, all achieved at first test, only two airtight tests per project

LITTLEPITS RESOLVED thermal bridge details & SIMPLE airtightness details with PH15



Intermediate floor detail, example of an eliminated linear thermal bridge

LITTLEPITS PASSIVHAUS PLUS – OUTCOMES

1 → 2 → 3 → 4

Airtightness

- Airtight result of 0.07ach @50Pa which is exceptional & makes it one of the three lowest airtight houses in the UK.

Energy Efficiency

- Form Factor 2.4
- Fabric First principles reduce heating demand down to 11kWh/m² per annum.
- PER –renewable primary energy demand is 40 kWh/m2.a (bottled gas)
- PV 7 kW array generation of 47kWh/m2.a
- NET ZERO ENERGY

Moisture Control

- Essential when using natural timber materials. Vapour gradient to the external air maintained with use of a ventilated cavity or lime render. Cellulose insulation absorbs and releases moisture around the timber frame further modulating moisture levels within the wall/roof build up.

Overheating Risk

- Solar Gain – the use of low g-value glass on south, east and west facades. External blinds on west façade. Use of fly screens and night cooling. Careful use of PHPP and glazing specification. Overheating percentage 1%


Certificate

cocreate

Littlepits
Bowstridge Lane, Chalfont St Giles HP8 4RQ, UK

Certified Passive House
Passive House Institute

Replace bottled GAS with Air Source Heat Pump for NET ZERO CARBON…

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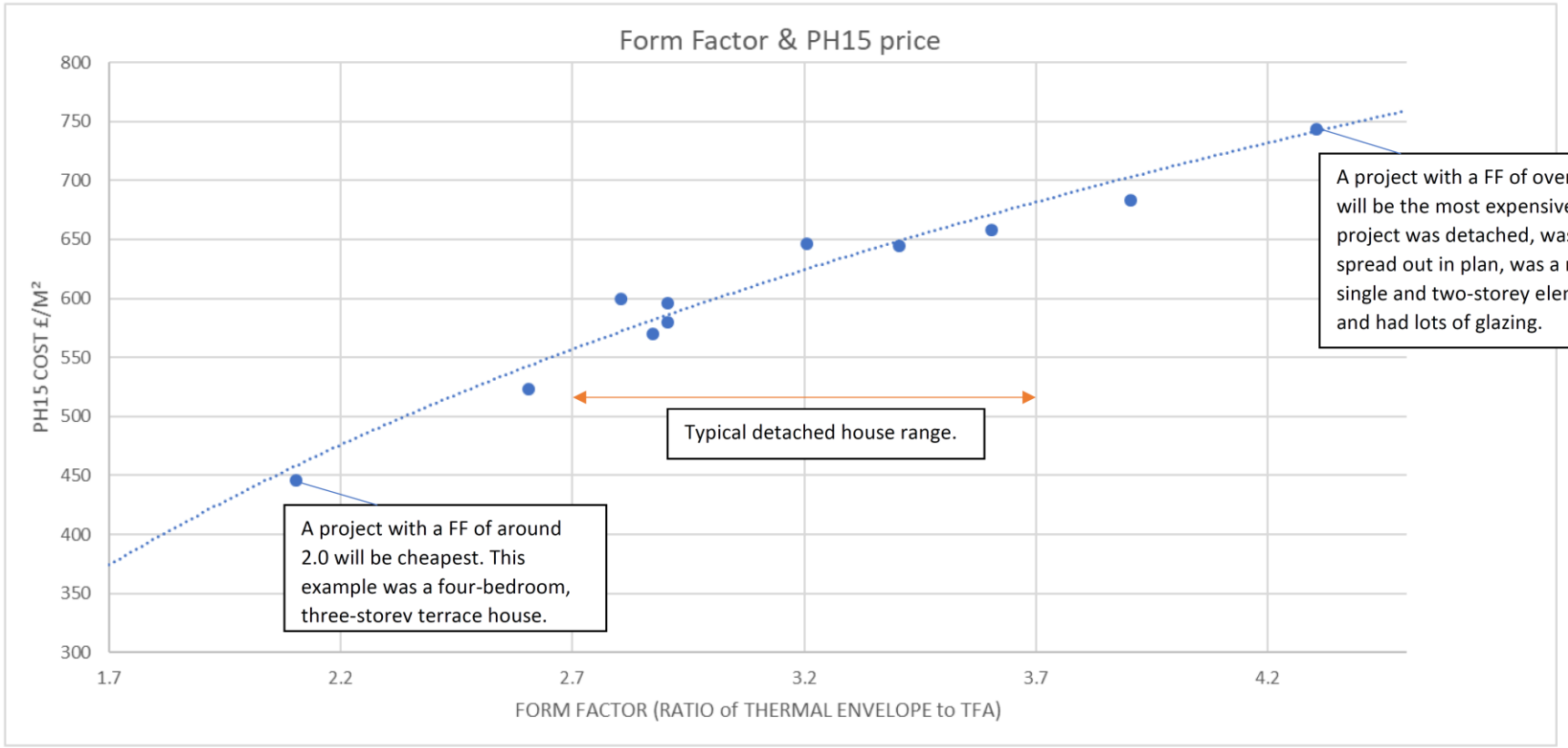


Form Factor(FF):

FF is the ratio of the thermal envelope area to the treated floor area (TFA). The thermal envelope is the area of walls/roof and floor measured to the outside face of each thermal element e.g. if you are insulating under the ground floor slab it will be measured to the under-side of the insulation. TFA is the usable floor area as calculated in the Passivhaus PHPP software. It is typically about 90% of the gross internal floor area (GIA). GIA is all internal floor area inside your external walls/roof/floor, including internal walls & stairs. It excludes any areas below 1.5m high, that are not related to staircases. Calculate the FF early, and this will give you a good guide on whether your project costs are at the cheaper or expensive ends of the spectrum. Aim to design a detached house with a FF of below 3.0, if costs are critical.

NOTE: PH15 costs are per m² of GIA (net figures)

LITTLEPITS PASSIVHAUS PLUS – **GLOBAL CO2 to ZERO**

PH15 COSTS

ENABLING COST CERTAINTY & MAXIMUM PERFORMANCE

COST for PH15 SPECIFICATION VARYING from £410/m² to over £800/m² of GIA
COST FOR LITTLEPITS **£620/m²** FLOOR AREA 222m²

Cost awareness from architects and client groups is limited.

Form factor is critical to ensure low cost, as is the glazing percentage.

PH15 can be costed off planning drawings with excellent accuracy +/- 5%.

PH15 simplifies tender process and avoids cost escalation due to unfamiliarity & time constraints.

EXAMPLE

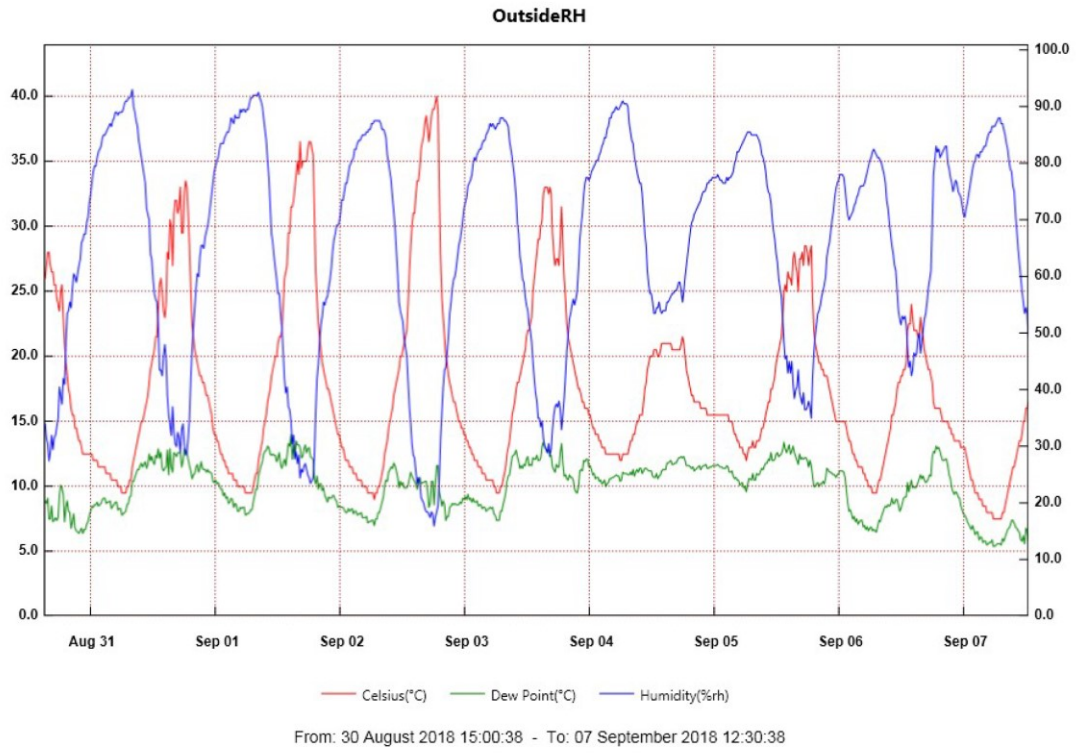
- PROJECT DESIGN FOR 140m² GIA – SUPPLY at £600/m² = £84,000.00
- PROJECT DESIGN FOR 140m² GIA – SUPPLY at £750/m² = £105,000.00
- **SAVING of £21,000.00 = 20% saving**

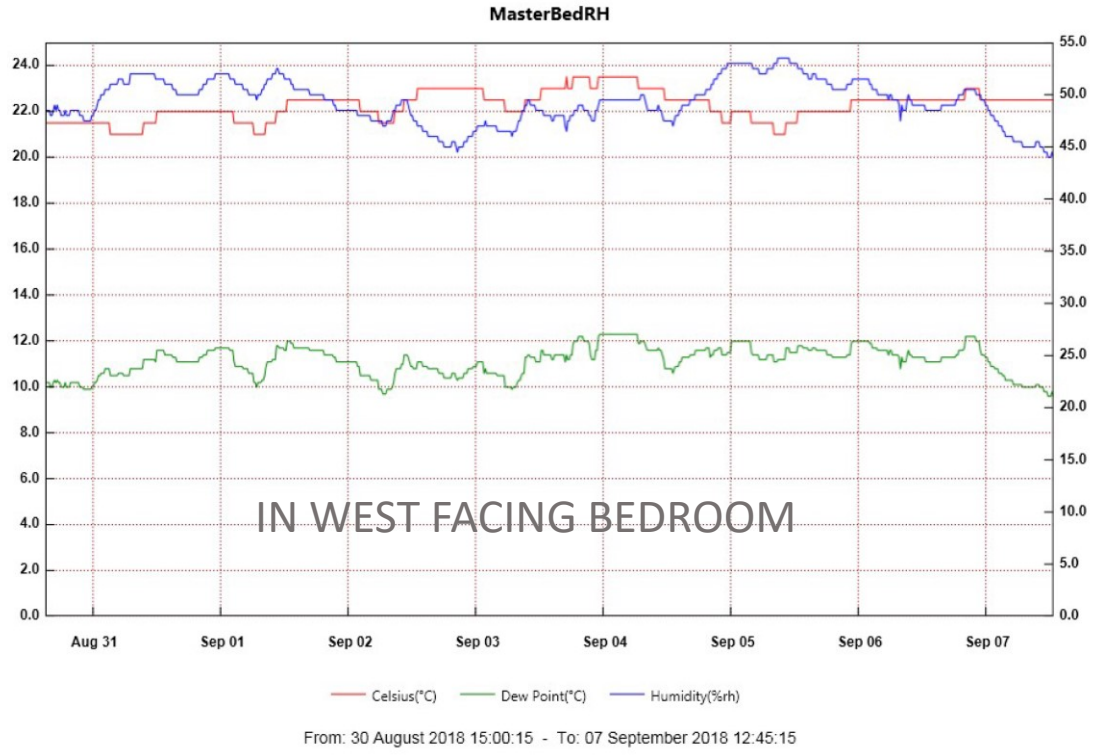
- COST OF IN-LINE PV ARRAY for LITTLEPITS £11,000.00

WITH A GOOD FORM FACTOR A HOUSE CAN EASILY JUMP FROM PASSIVHAUS TO PASSIVHAUS PLUS (NET ZERO ENERGY) WITH NO COST UPLIFT.

LITTLEPITS PASSIVHAUS PLUS – **HEALTHY BUILDINGS & OCCUPANT COMFORT CHANGING WEATHER PATTERNS**

Highest summer temperatures of 30-35 degrees, 2018.
Internal temperatures are fluctuating 21-24 degrees.





LITTLEPITS PASSIVHAUS PLUS – **HEALTHY BUILDINGS & OCCUPANT COMFORT CHANGING WEATHER PATTERNS**

Solar gain with appropriate overheating mitigation, including external green oak porch (south façade) and integral external blinds (west façade), fly screens fitted on windows used for night cooling.
Overheating percentage reduced to 1%
(Passivhaus criteria is >10%)

RH and temperature comfortable in highest summer temperatures (30-40 degrees) of 2018. RH stays within 40-60% band even with west facing bedroom, and temperatures below 25 degrees.

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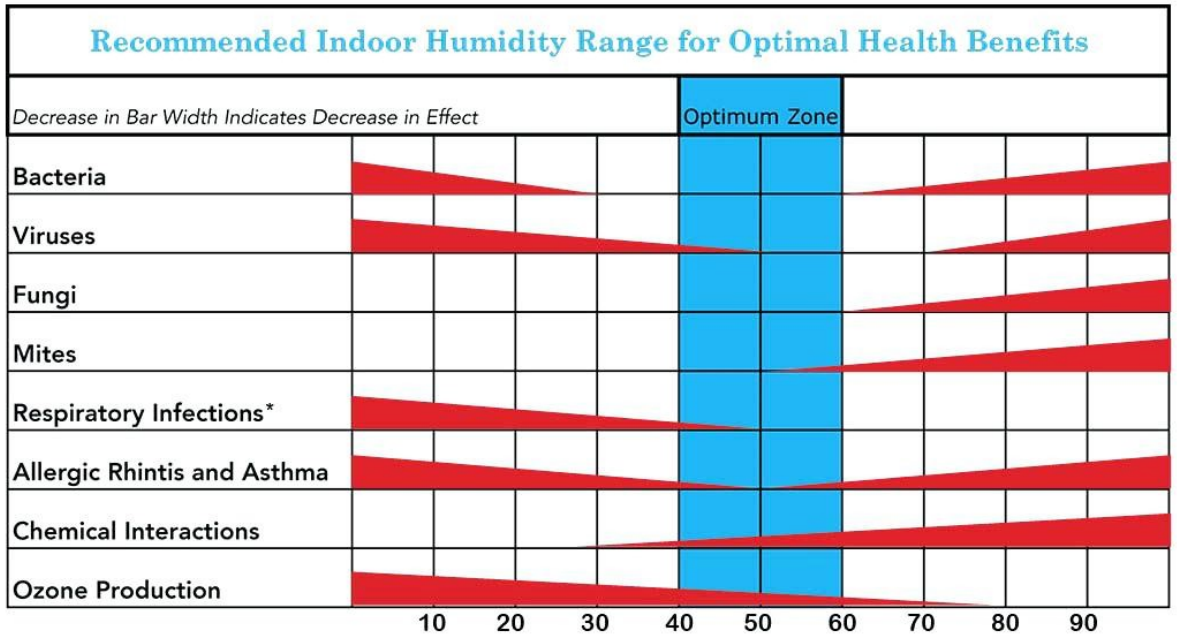
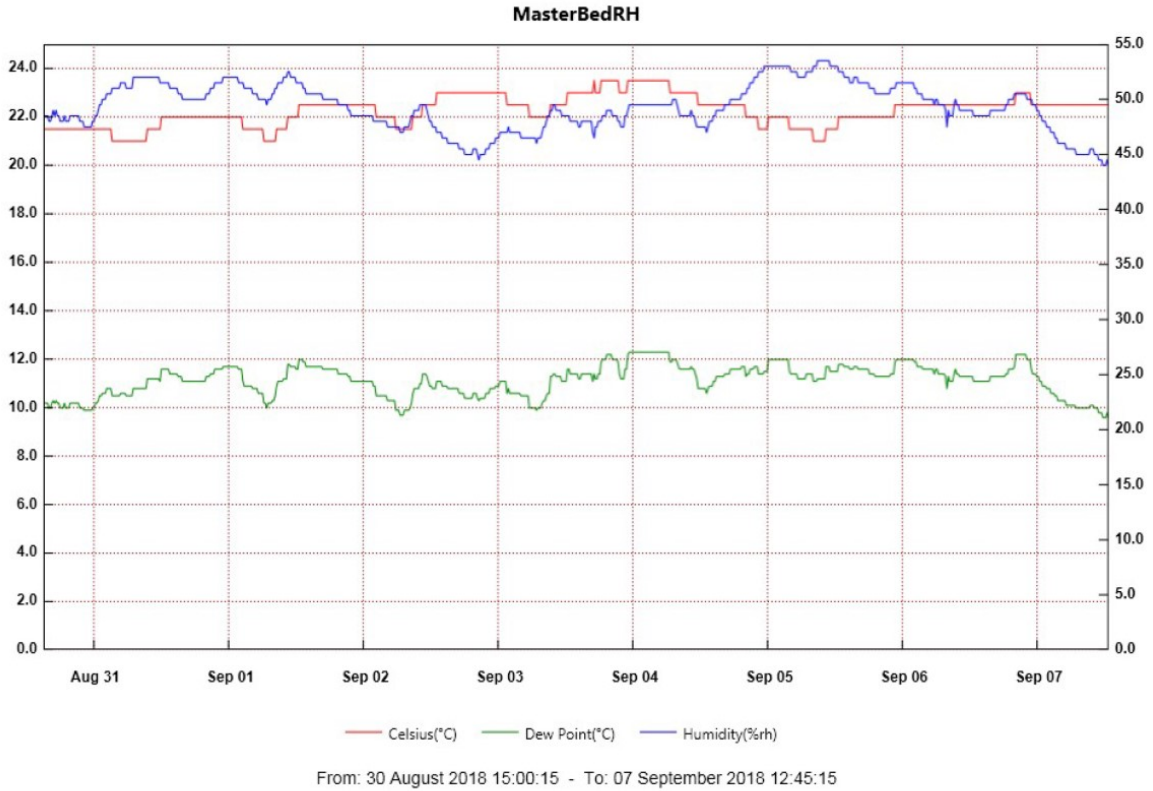
LITTLEPITS PASSIVHAUS PLUS – **HEALTHY BUILDINGS & OCCUPANT COMFORT**



Source:
Arundel, Anthony V., Elia M. Sterling, Judith H. Biggin, and Theodor D. Sterling. "Indirect Health Effects of Relative Humidity in Indoor Environments." Environmental Health Perspectives 65 (1986): 351-61. Web.

*Insufficient Data Above 50% Relative Humidity

RH levels in optimum 45-55% range



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LITTLEPITS PASSIVHAUS PLUS - CARBON

WHOLE LIFE CARBON

Embodied Carbon

Wood reduces global CO_2 during the plant's growth phase, binding and withdrawing CO_2 from the atmosphere. For each $1m^3$ of timber used, up to 1 tonne of CO_2 is captured. In the form of insulating materials and structural frames, this CO_2 remains bound in the wood fibres for the lifetime of the house – 60 to 80 years minimum.

The PH15 wall and roof construction is 85% insulating material and only 15% timber frame – an excellent timber fraction for frame construction. I-joists are small section timber with 8mm web only.

Operational Carbon

The house is certified *Passivhaus Plus* making it a **net zero energy house**. This is achieved reducing energy to a minimum, then generating on site electrical energy with a PV array (7kW).

Highly insulated fabric with natural insulations (higher decrement delay) ensures heat is retained during cold weather but also maintains cooler, comfortable conditions during the summer, avoiding electrical cooling.

RESOURCE EFFICIENCY

Sustainable sourcing

- All timber products make up the wall and roof (I-joists, wood fibre boards, airtight boards, cellulose) and are sourced sustainably from FSC or PEFC managed forests.

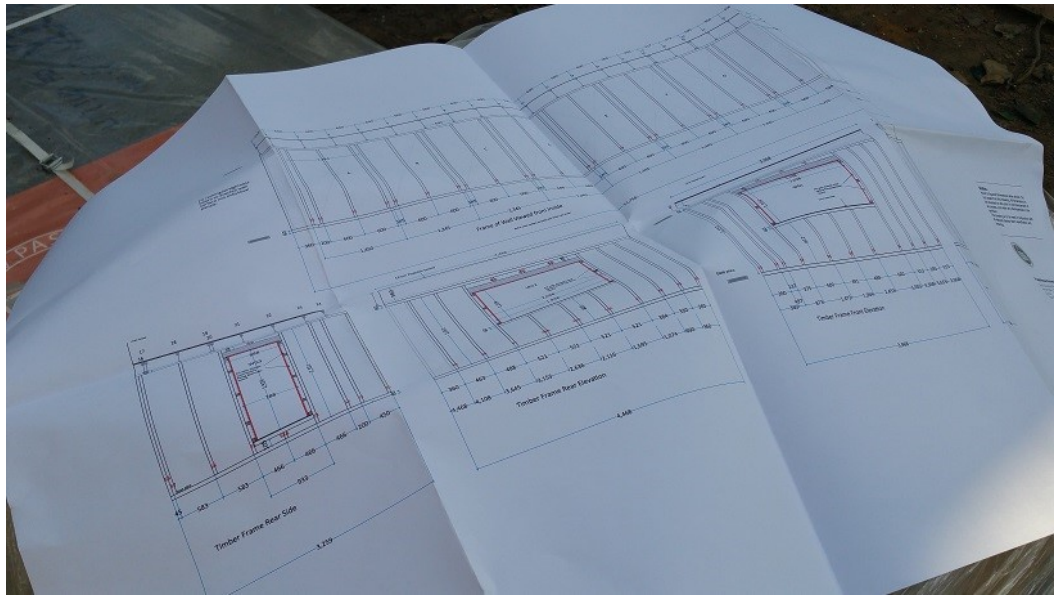
Reducing, re-using

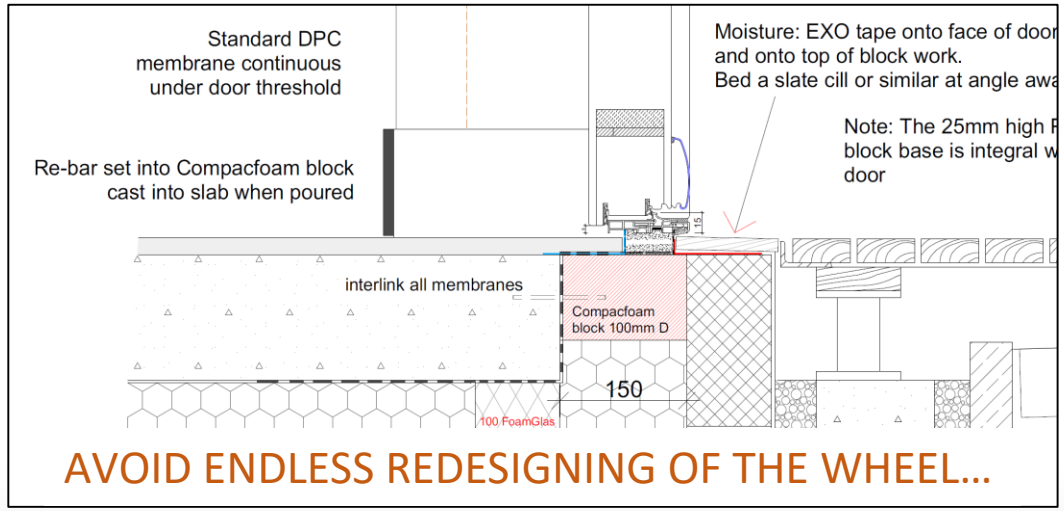
- The frame is pre-cut at the I-joist factory, and an automated cutting process ensures the pieces are cut in the most efficient manner – and that minimal waste is immediately returned into the supply chain – a zero waste process.
- The beams and lintels are pre-cut in the UK so that any timber not used (e.g. LVL's are sold in minimum quantities) can be retained and used across multiple projects.
- I-joists are optimised structurally to use minimum material and low grade timber.
- Blown-in cellulose ensures zero waste

Reusability

- Components that can be safely dismantled & recycled at the end of the life of the building.
- Due to lack of artificial additives, wall/roof (STEICO) products are easily recycled or may even be composted.

LITTLEPITS PASSIVHAUS PLUS - RESOURCES





AVOID ENDLESS REDESIGNING OF THE WHEEL…

CONSTRUCTION DETAILS

Principal Details @ 1.10

Foundation to wall/slab, walls intermediate floors, wall to roof, ridge, window/door install, level thresholds, penetrations.

Set of frame drawings.

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LITTLEPITS PASSIVHAUS PLUS – A POSITIVE EXPERIENCE

Contractor training day cover Passivhaus suitable groundworks, PH15 shell erection (airtightness etc.) and MVHR installation.

Airtight test day

MVHR commission day

Appropriate support ensures a proud contractor (Wayne!) on completion. Wayne never heard of Passivhaus before this project and he has now had a very *positive experience* of building sustainable houses.

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LITTLEPITS PASSIVHAUS PLUS COMPLETE

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LITTLEPITS PASSIVHAUS PLUS - LEARNING

INDOOR AIR QUALITY (overheating)

The most significant lesson was to see how significant *night cooling* is in controlling indoor air temperature during the summer. Night cooling is dependent on user behaviour (in this case the users are very engaged) i.e. opening/closing windows. The very hot summer emphasised the need to rigorously assess overheating (Passivhaus allowance of maximum 10% overheating percentage is far too high) and the importance of the window specification (e.g. low g-value glass) and the effectiveness of external blinds in key locations. Also fly screens proved to be an invaluable additional feature to encourage night cooling occupier behaviour.

It has led us to consider the future use of more automated ways of supplying night cooling – in particular

- Can we provide *boost MVHR ventilation for a set time linked to a temperature trigger* to provide a quick purge of the internal air.
- Can we provide *automated rooflight opening at night*, so that high level night cooling exit points are not reliant on client opening/shutting these elements.

PASSIVHAUS PLUS

With good form factor and a good construction solution getting to net zero carbon is not a big step, we are encouraging clients to think PLUS on all projects.

Passivhaus FUTURES is about embodied carbon, resource efficiency, health, & ease of delivery as well as fabric first.

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PH15

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For more information on PH15 contact PHH on 0345 257 1500

or visit our web site at www.phhomes.co.uk

PH15, contributing to a sustainable energy future and working towards Passivhaus for All.

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Available from Amazon

The Passivhaus Handbook

A practical guide to constructing and refurbishing buildings for ultra-low-energy performance

JANET COTTERELL and ADAM DADEBY

10 Passivhaus Myths

1. **A Passivhaus needs no heating.**
   No house heats itself but, due to the reduction in heat loss and making the best use of solar gain, a Passivhaus requires much less heat input than other buildings and for a shorter period of the winter.
2. **Passivhaus Buildings are all ugly and boring.**
   Passivhaus buildings come in all shapes and styles. It is true that certain forms make it easier to achieve the standard but that does not preclude other aesthetics.
3. **Passivhaus only works on a sunny site**
   Wrong. Shaded sites may be more challenging but do not mean the standard cannot be achieved. The early design work will assess and manage this.
4. **Heat recovery ventilation is noisy and complicated**
   When correctly specified, designed, installed and commissioned an MVHR system will be almost unnoticeable in operation. The controls are also no more complicated than those on a central heating system.
5. **Heat recovery ventilation costs a lot to run**
   Conventional extracts cost money to run AND throws away costly heat. A correctly installed MVHR in a Passivhaus costs much less to run than the energy it saves.
6. **You can't have a wood burner in a Passivhaus**
   Wrong. You can as long as it is externally aspirated and correctly fitted, however you may find you have to open a window to prevent the house overheating!
7. **The air is too dry in a Passivhaus**
   This can happen in very cold weather as is encountered in a lot of mainland Europe; however it is much less likely in the UK with our wetter climate. It is also a much less serious problem and easier to solve than over humid air.
8. **Passivhaus is much more expensive to build**
   Passivhaus does require more detailed design work and uses some more material in construction compared to a "building regulations compliant" house. If designed as a Passivhaus from the start however this premium is quite small. Due to tight quality assurance a Passivhaus delivers what is designed whereas "conventional" builds, due to far less control, are rarely built as designed or achieve design performance.
9. **You can't refurbish to Passivhaus standard**
   Yes you can. Our first project was just such a refurb to full Passivhaus standard. There is also now the Enerphit standard for refurbishments which allows for the greater challenges and to make the work more cost effective.
   And finally:
10. **You can't open the windows in a Passivhaus**
    RUBBISH! You can open windows any time you want to and in the summer you certainly will. The fact is you may not NEED to open them, but in the summer you can turn off the MVHR and naturally ventilate.
    The benefit is that in the winter or when you are away the MVHR will always deliver adequate fresh air and keep the internal environment fresh and comfortable.

PH15

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