AECB
the sustainable building association

2011 Annual Conference

Retrofit: Moving in and Moving on

16-17 September 2011
Jubilee Campus, University of Nottingham

Organised by:
AECB
the sustainable building association

In association with:
The University of Nottingham
Department of Architecture and Built Environment

Totnes Passivhaus

‘Lessons learned from a Certified Passivhaus retrofit’

AECB 2011 Annual Conference

“Retrofit: Moving in and Moving on”

16 September 2011, University of Nottingham, Jubilee Campus

Adam Dadeby and Janet Cotterell
Passivhaus Homes Ltd.

Agenda

- Background to Totnes Passivhaus project
- Choice of building
- Building stats
- Building timeline
- Site plan and elevations
- Form Factor
- Choice of architect and builder
- Planning
- Airtightness
- Windows + external wall insulation
- External wall to floor detail – weakest point
- Extension
- Ventilation/MVHR
- Conclusions
- Questions

Background to ‘Totnes Passivhaus’

- Private home
- Limited choice of plots/properties
- Our brief
  - Ultra low energy use
  - Invest now to save
  - Minimise technology
- Personal journey:

  “peak oil moment” → CAT AEES → CEPH PH designer course

Strong modernist style of estate…

Lessons: choice of building

Criteria	Ideal	Met by our house?
Minimise planning constraints	Not listed building	Yes
	Not in a conservation/ architecturally sensitive area	Yes and no
No/limited shading	Unshaded solar gain façades	Partly
Feasible to insulate the floor	Available ceiling height or suspended floor	
Feasible to insulate external walls	Solid walls, rendered finish, large roof overhang (unless it is being replaced)	Partly
Build quality	Original structure built to a decent standard (hidden quality)	No!!
Form factor	Efficient (low ratio of TFA to external envelope area)	No*

* Until it was extended

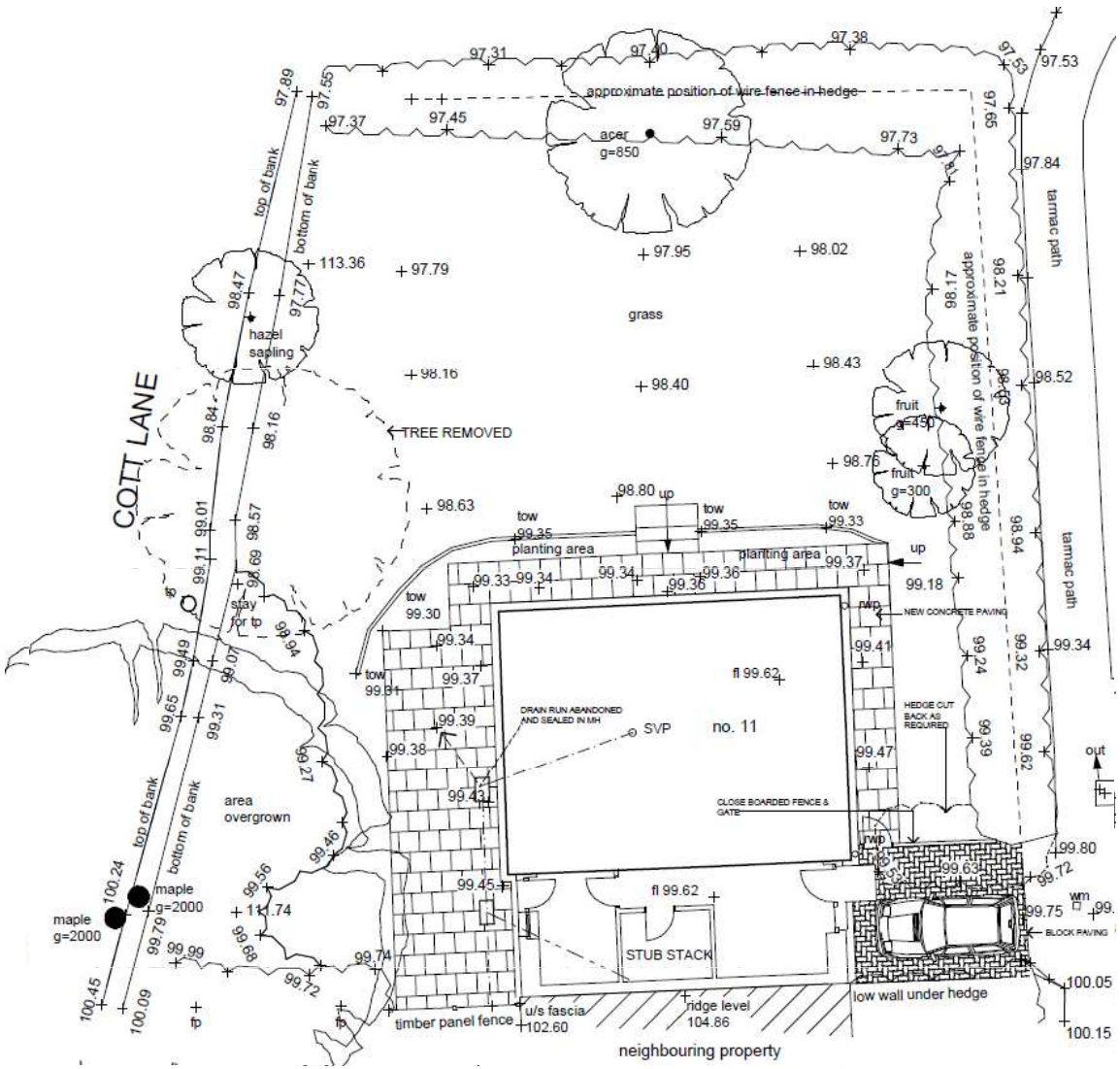
Building stats

- Original structure built 1971, typical construction: dense concrete block cavity walls, concrete slab, concrete tiles
- Project doubled building size to **TFA 162m², SAP 185m²**
- Mixture of two building styles ‘masonry’ and ‘timber’
- Windows, triple glazed and “2 + 1” windows (with integral blinds) **Internorm Varion/Varion 4**
- MVHR **Paul Novus 300, 0.24Wh/m³, 93% HR efficiency**
- Solar thermal **9.4m² drainback system, west facing**
- Solar PV **3.99kWp, transformerless inverter**
- Thermal DHW store **500 litres**
- Air tightness certificate **0.2 ach@±50Pa**
- Space heating at circa **14 kWh/m² per annum**

Lessons: building timeline

April 2009 – May 2009	Project initiation/definition, pre-planning enquiries
May – June 2009	Architect selection
September 2009	Property purchase
October 2009 – April 2010	Detailed design and PHPP modelling
February 2010	Contractor selection
April 2010	Submission of planning application
July 2010	Re-design following change of heart by planners
26 October 2010	Planning permission granted
8 November 2010	Construction commences
5 April 2011	First air-tightness test: result 0.4 ach
21 July 2011	Certification air-tightness test: result 0.2 ach
19 August 2011	Move back into house
August – September 2011	Passivhaus Certification underway

Lessons: site plan



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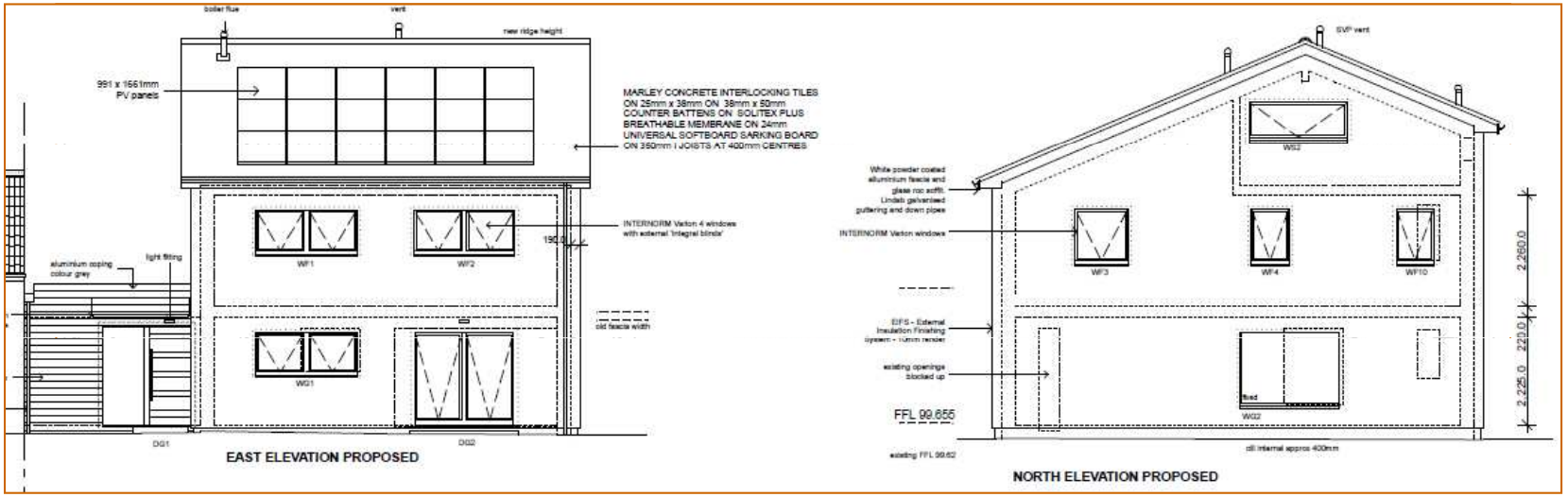
Lessons: elevations



Lessons: form factor

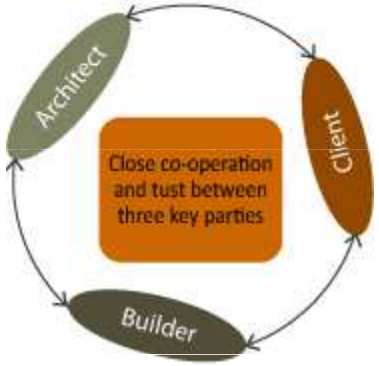
- Form factor is the ratio of external thermal envelope to treated floor area

Form factor	Typical type of dwelling this might represent	Wall/roof/floor – approximate range of U-values needed to reach below 15 kWh/m2.a in the UK
< 2	Apartment block or terrace (row houses)	0.15W/m²k
2 to 3	Semi-detached or compact detached two or three storey property	0.10 to 0.15 W/m²k **Totnes PH = 2.6**
3 to 4	Less compact detached house or bungalow	0.10 W/m²k
> 4	Very spread out bungalow	0.05 to 0.10 W/m²k

* Credit: Warm Low Energy Building Practice

Lessons: choice of architect and builder

- Key project decision for client
- Passivhaus project an unlearning experience for architect
- Trust, co-operation and *Common Purpose* essential
- Involve contractor or contractor candidates early
- In-house, multidisciplinary contractor team
- Minimise subcontracting
- Contractor culture change to:
  - Escape from the blame game
  - Unlearn old habits
  - Understand the what and why of Passivhaus
- Contractor briefing/training



"Education consists mainly in what we have unlearned." *Mark Twain, 1898*

"Common Purpose is a shared intention to achieve a shared goal, where collective aims are advanced by the individual purpose, and individual aims are advanced by the collective purpose." *David Fleming, 2010, from Lean Logic*

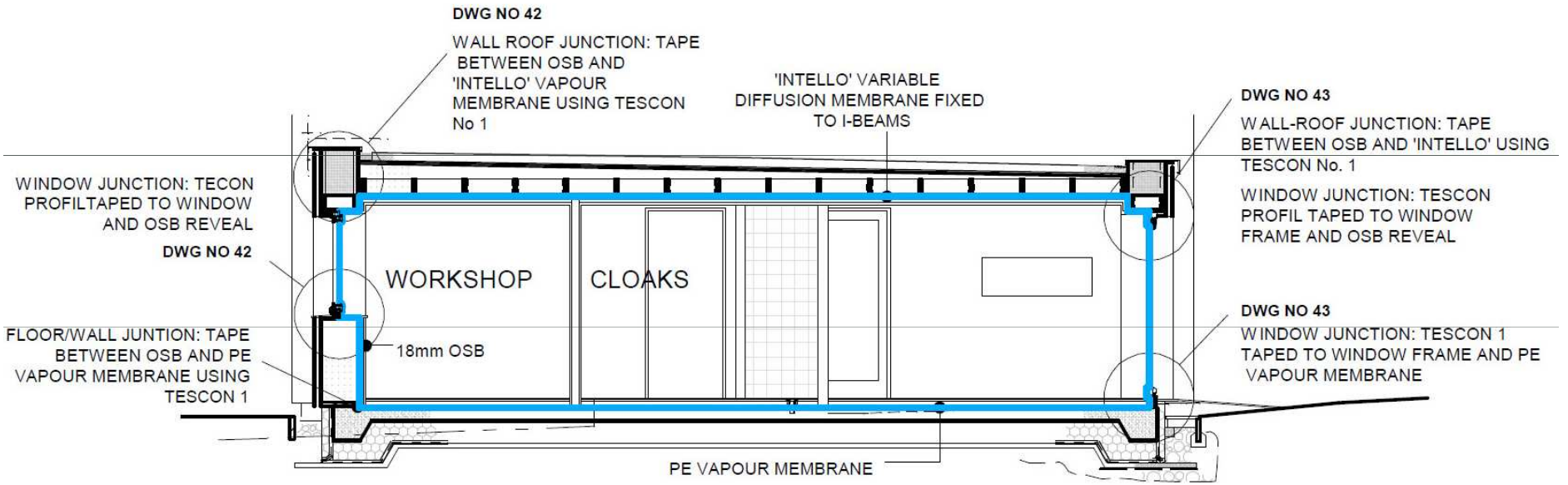
Lessons: planning

- More design work undertaken at risk (before PP granted) – particularly on a first PH project, particularly if it is retrofit.
- Self-censoring during design process – do we exclude options because we want to avoid confronting the planners
- Planning adds more costs than Passivhaus?
- All the benefits of ultra low energy building set out in planning application, but…
- In practice this seems to have very little traction in promoting the application

Lessons: airtightness layer

Understanding in a comprehensive way…

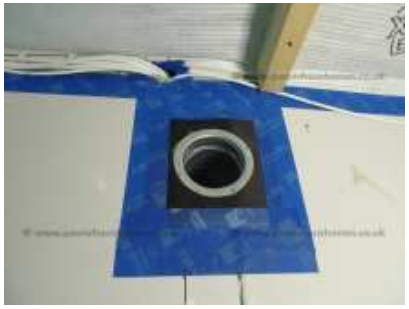
Using minimal materials/products!!



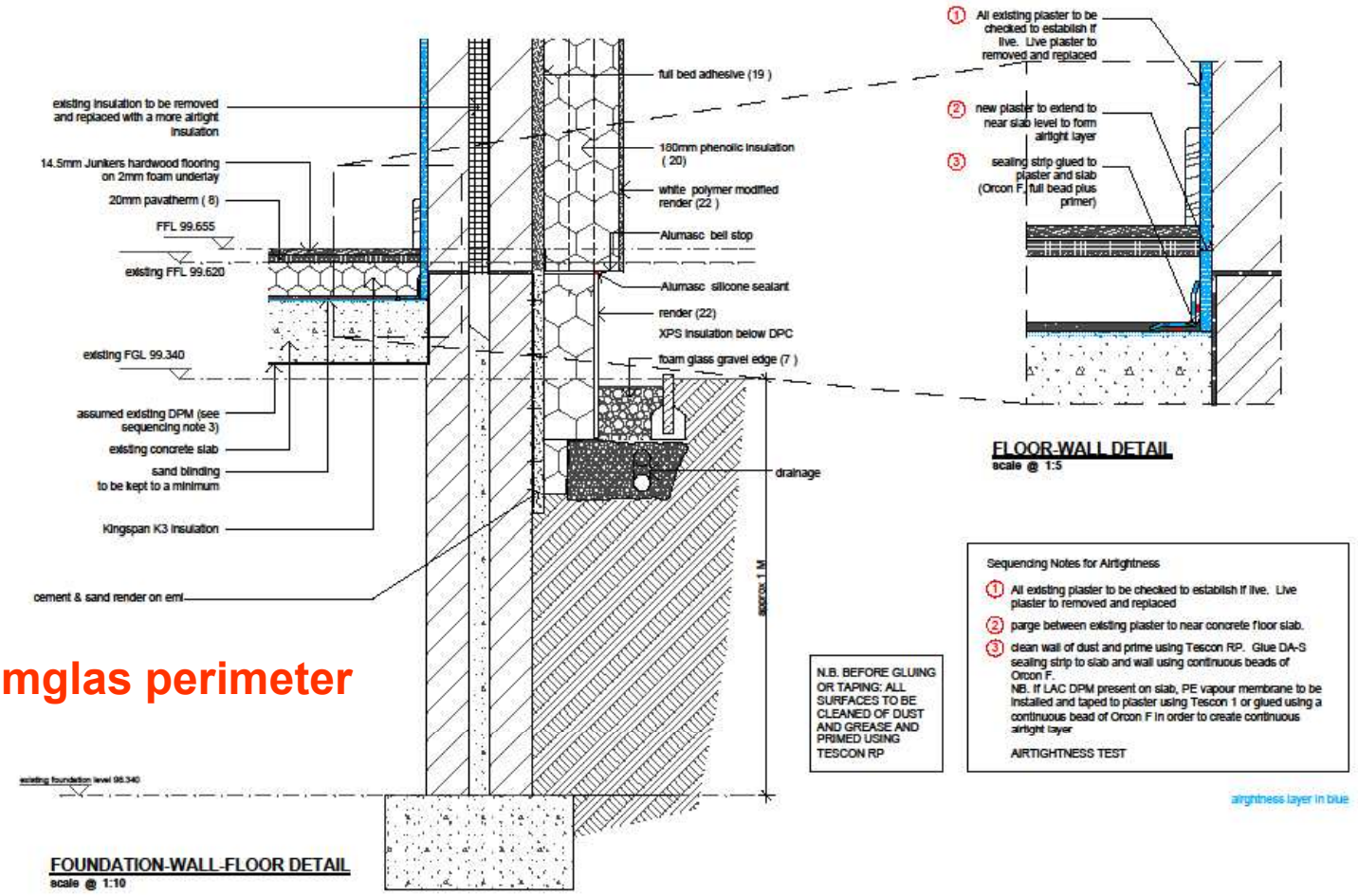
SECTION D-D

Control over site workers…

Lessons: airtightness layer



Floor to Wall Detail Existing

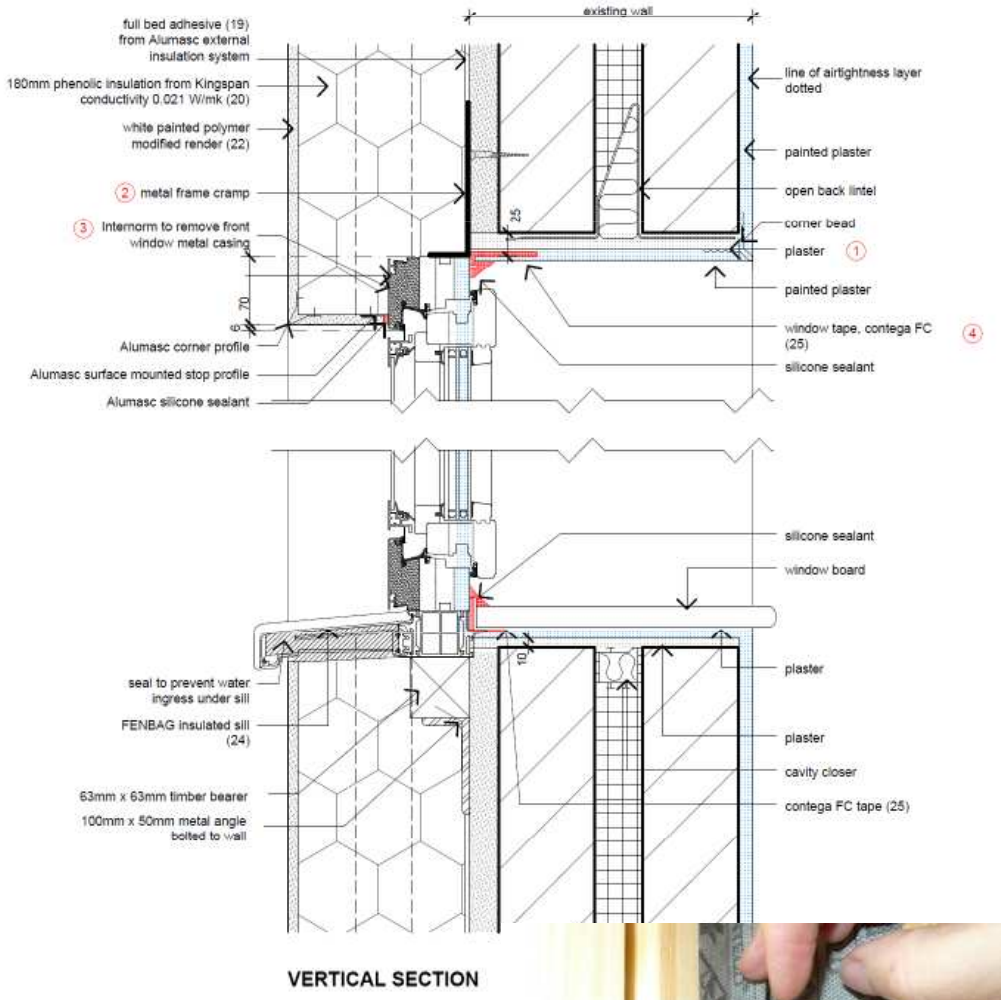


Foamglas perimeter

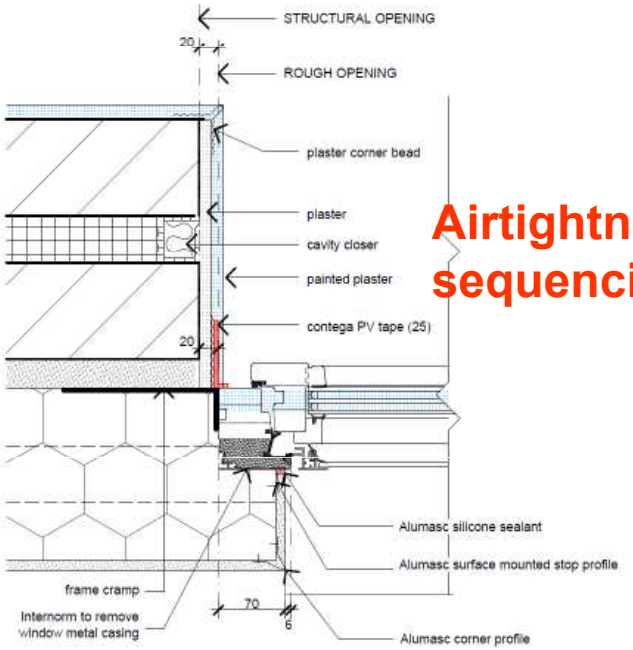
11 Hunters Moon, Dartin -Wall-Floor

Cotterell Thomas & Thomas L ale: 1:10 & 1:5 @ A3

Lessons: Window Retrofit Detail



VERTICAL SECTION



HORIZONTAL SECTION

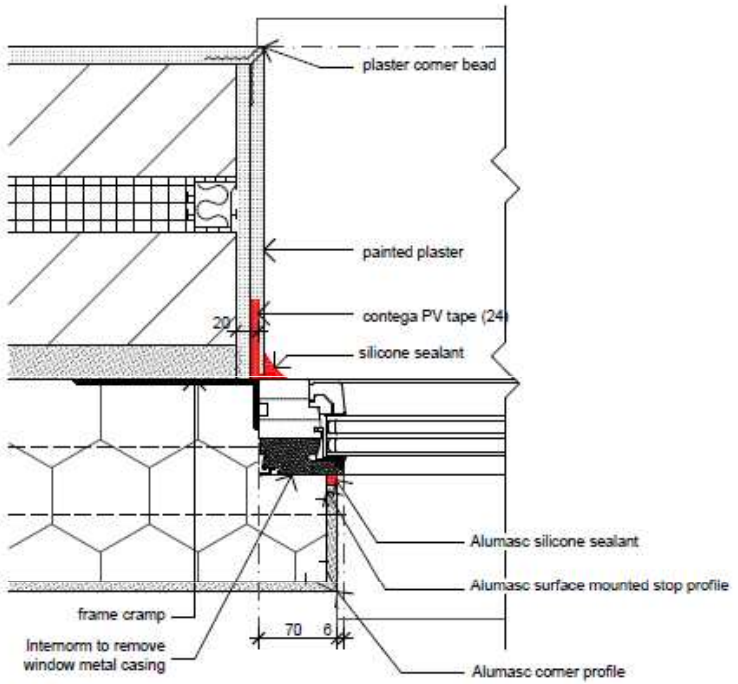
Airtightness sequencing

Sequencing Notes for Airtightness (layer indicated by dashed line)

1. plaster reveal in preparation for window installation
2. fix metal frame cramp to the outside of the existing wall
3. Install window.
4. Stick tape to the inside of the window frame as per manufacturers instructions.
   Embed the tape into a coat of plaster to create continuous airtight layer between plaster and window.

Position in wall
Wrapping of frame

Lessons: windows + external insulation



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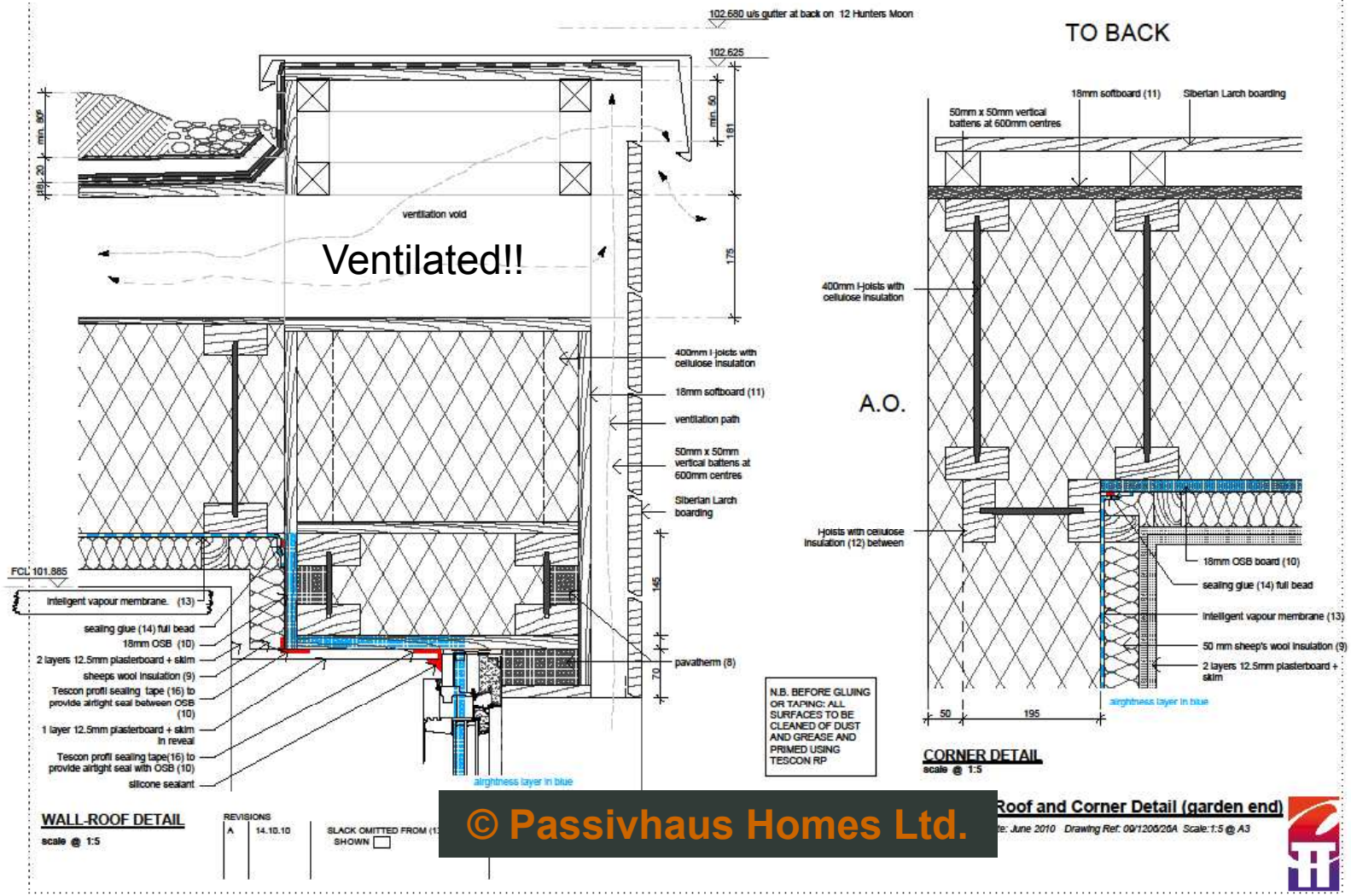
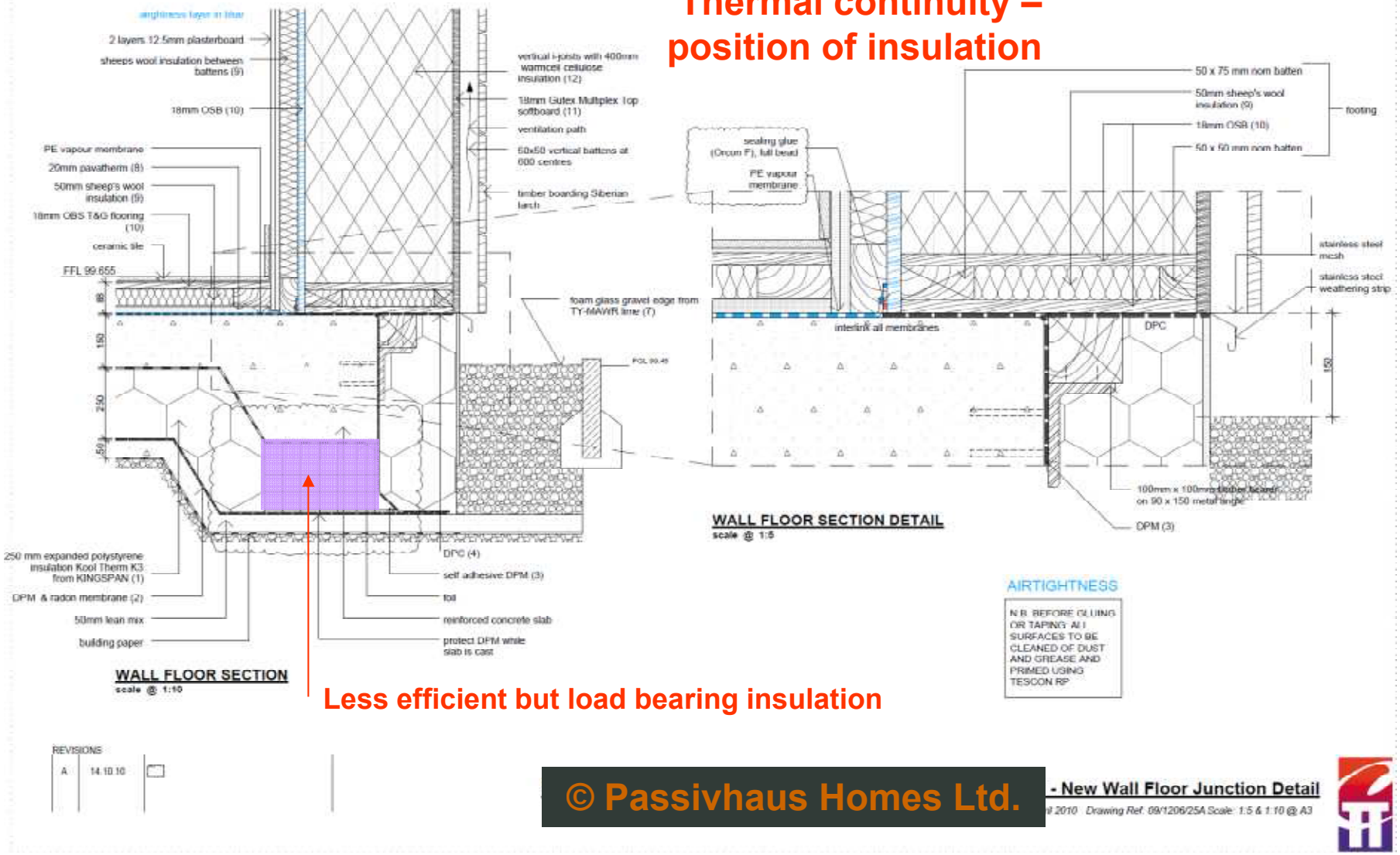
Lessons: Extension



Lessons: New Building – wall to floor

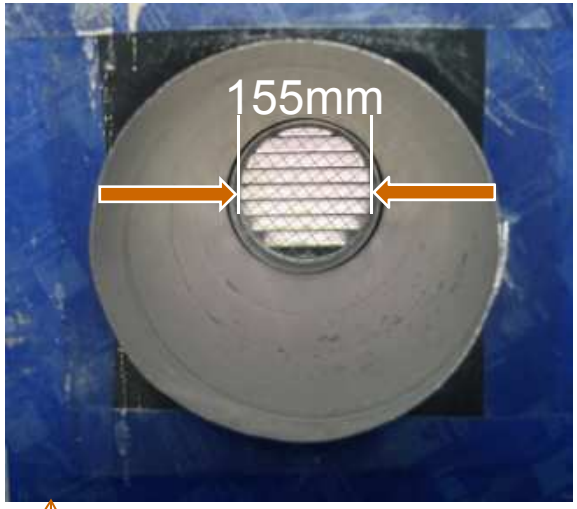



Continuous


Alternating
Foamglas structural ‘pads’ under slab

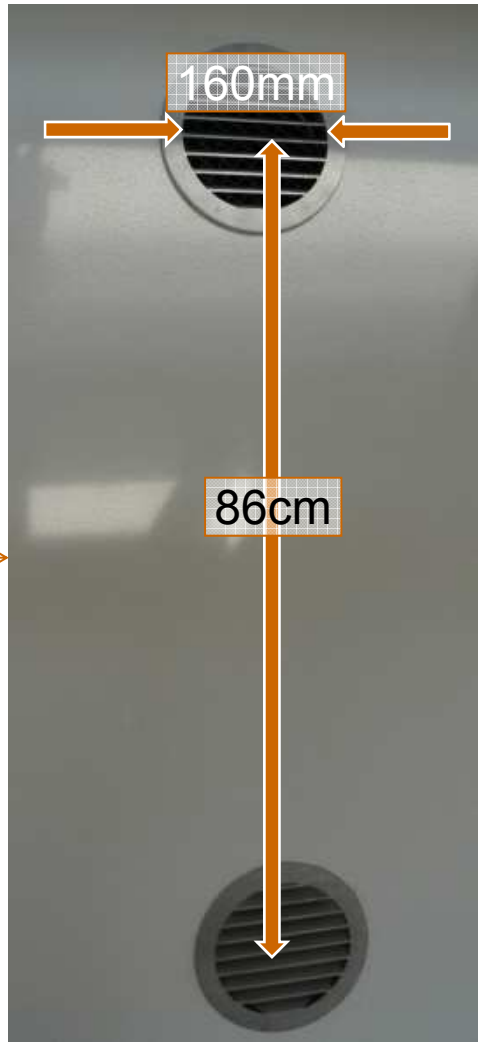
MVHR

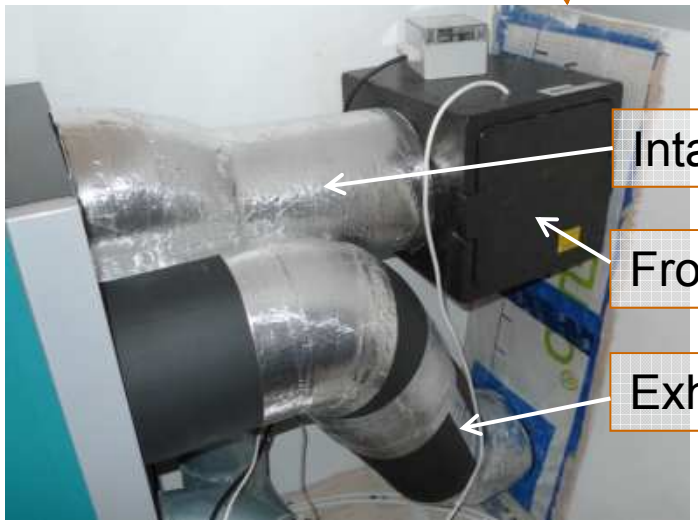
"What's wrong with these pictures?"



Interior views

Exterior views





Conclusions

1. Work hard to avoid the planners determining your agenda or options.
2. Get the form factor right and your task becomes easier
3. Is the building really worth saving? Don't let sentiment or "belief" in retrofit determine choice. Critically assess risks & costs (VAT), financially and energetically – there are many variables (obviously).
4. Need to make sure contractor team understands ALL key concepts, specifically: airtightness, thermal bridging, ventilation principles - EDUCATION.
5. Consider resilience of systems and choices, not only efficiency – sometimes the two pull against each other.
6. Don't rely on the most high-spec windows, insulation etc: it narrows down options, increasing risks and costs – keep something 'in the bag'.
7. MVHR ductwork – link layout planning to more detailed room planning, e.g. cupboards, kitchen units
8. Natural materials were easier, nicer and quicker to work with!
9. Take into account complexity of MVHR commissioning when choosing a unit
10. Think about sub-contractors and how they will be managed…
11. Small is much easier – is there a way to chunk multi-building projects (feasible to adapt RAD approach used in IT projects?)

Any questions?










www.passivhaushomes.co.uk

Passivhaus renovation

- New EnerPHit standard for renovations:
- Still very challenging but more flexible standard for renovations and retrofits
- Key differences to full Passivhaus standard:
  - 25kWh/m².a space heating demand*
  - 0.6 ach target or 1.0 ach limit, if 0.6 can be shown (to the Certifiers) to be unachievable practicably

* Other criteria have to be met if 25 kWh/m².a can be demonstrated to be impractical