

Passivhaus EnerPHit Retrofitting at Scale

Wilmcote House

Southsea, Portsmouth

John Pratley: sustainableBYdesign

Wally Shave: Keepmoat



Wilmcote House Overview

- Pre-retrofit: description & problems
- Client Aspiration: deep retrofit, why enerPHit?
- Tender Contract: design & spec:
- Building Contract: design & build to EnerPHit
- Contractor + Subcontractor Design Development: air-testing, thermal modelling, ventilation, sequencing
- Retained Electric Heating
- EnerPHit compliance?
- On-site progress

Wilmcote House Existing

- 3 x 11-storey blocks connected by open balconies with lift access
- Bison Reema pre-cast concrete panel construction
- Built 1968
- 100 3-bed maisonettes + 7 1-bed flats – all social housing, no leaseholders
- Owned and managed by Portsmouth City Council
- Electric hot water and space heating (Gas supply removed due to panel construction)
- Security problems open deck, balcony arrangement



Wilmcote House Condition

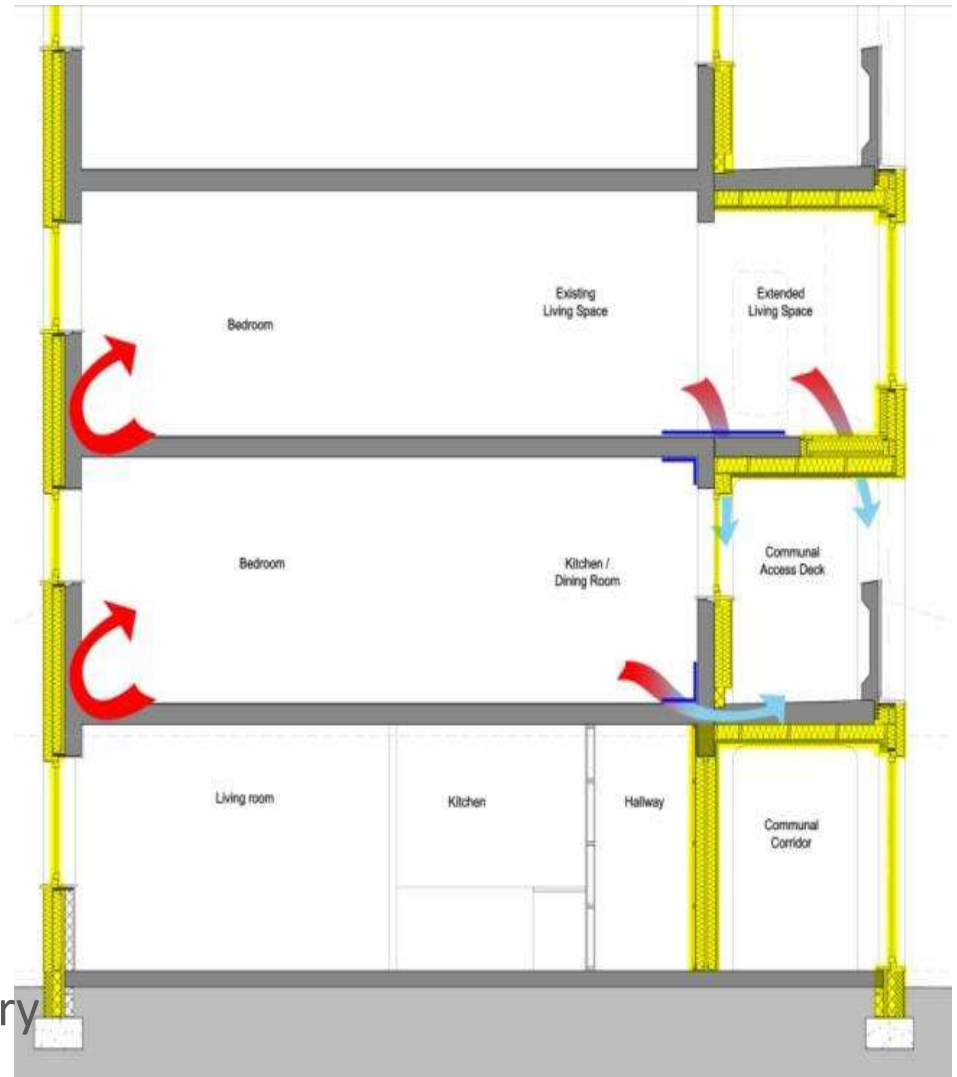
- Cold and damp internal living conditions created by 1960's design & construction
- Exacerbated by all-electric heating costs – creating fuel poverty
- Maintenance costs driven by condensation & water ingress
- Concrete repairs to existing panels if left exposed to weather
- Security problems open deck, balcony arrangement – difficult to re-decorate
- Area housing office re-location from ground floor
- Demolition not an option



condition

The Deep Retrofit Strategy

- Fabric First, super-insulated thermal and weather-proofing over-cladding concept
- Improved Air-tightness
- Efficient mechanical ventilation with heat recovery (MVHR)
- Integrated EnerPHit approach incorporating thermal performance, air-tightness & ventilation
- Enclosed secure balconies and walkways
- Retained, reduced electric heating
- Promote the benefits (extra space, very low bills, comfort)



Addressing concerns one-by-one

- Can't afford to heat
- No control over temperature
- Mould in wardrobes/poor health
- Drying clothes a problem
- Falling objects/child safety
- No hot water when needed
- No security
- Unloved visual appearance



- EnerPHit fabric reduces space heating demand by 80-90%
- EnerPHit stabilises temperature
- Heat recovery ventilation and warm surfaces
- Flexible balcony/sunspace design
- Enclosed walkways
- Add showers and well-insulated HW system
- Controlled access to enclosed walkways (shared private space)
- "Like living in a new building"

Overall Retrofit Proposals

- External wall insulation and new pitched roof supported on 'exo-skeleton' steel frame
- Parge-coat airtight barrier to road-side elevations , ply-supported membrane to garden-side
- Triple-glazed windows and doors
- Efficient mechanical ventilation with heat recovery (MVHR)
- Enclosed secure balconies and walkways
- Retained, reduced electric heating with new hot water cylinders & showers

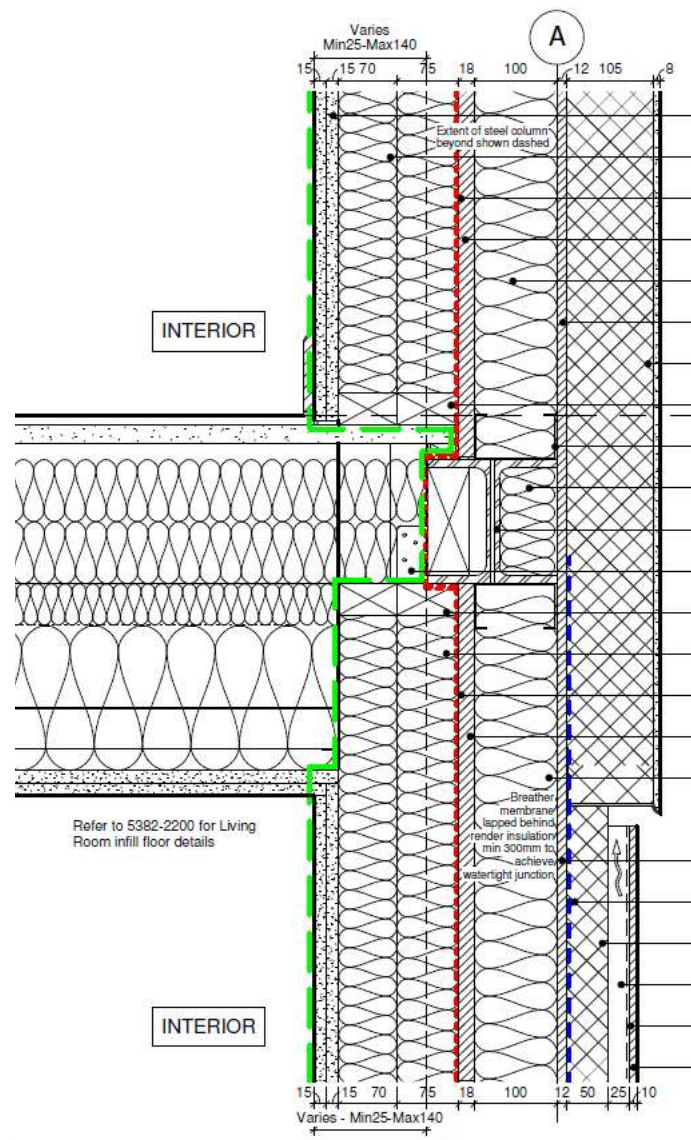


Tender design (by ECD architects & Carter Clack engineers)

Contractor Design Portion

- Outside the green line, but...
- All new and modified structural works
- External building fabric
- Air barrier implementation & Air testing
- MVHR installation
- EnerPHit compliance

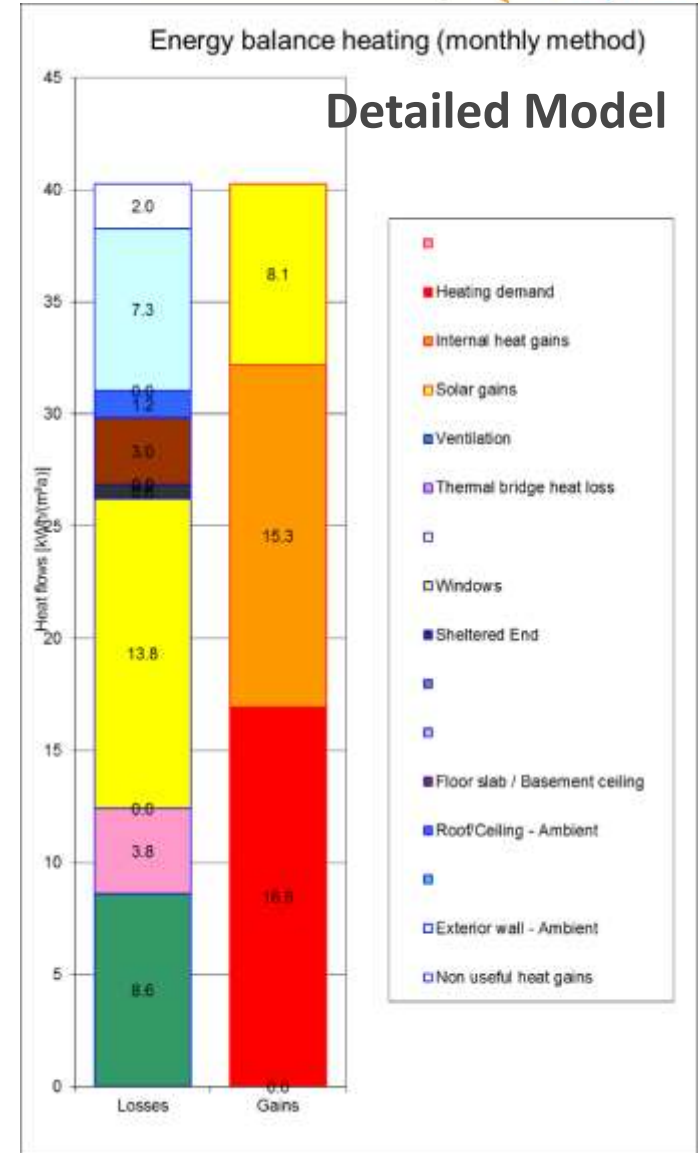
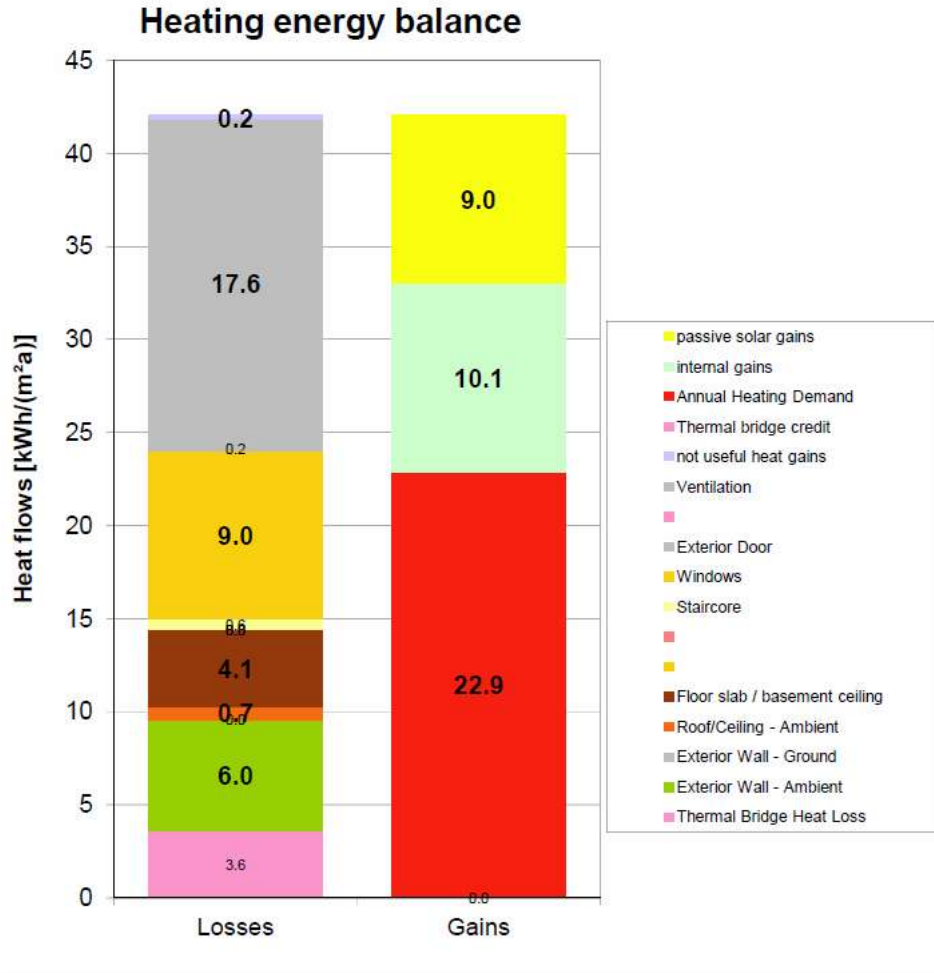
- SbyD: lead designer
- Encraft: PH consult
- Curtins: structural engineer
- Greenwood: MVHR design & install



Contractor Design

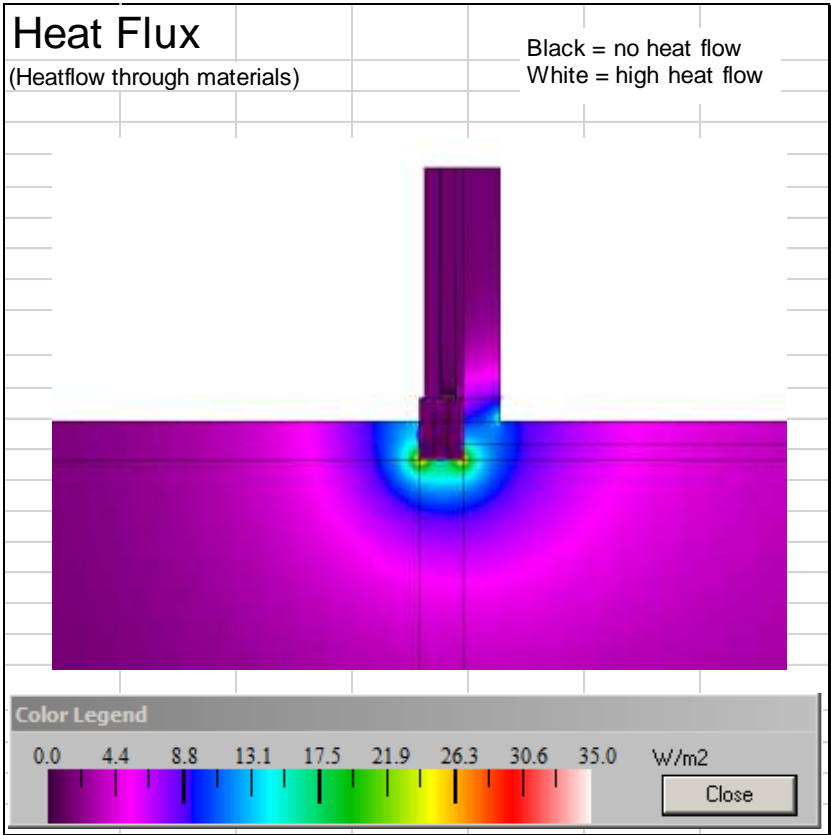
Testing the Design in PHPP

Simplified Model (pre-tender)



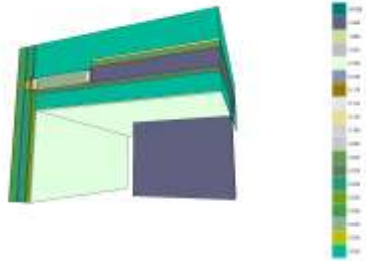


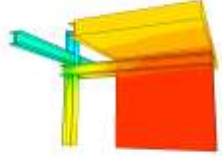
Contract Design Evaluation

Thermal Bridge Modelling



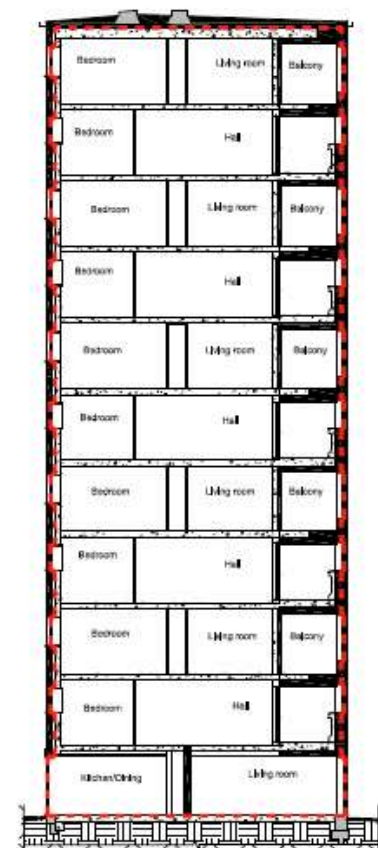
psi External **-0.57 W/mK**

Detail Ref	Two tie back beams at eaves level – infill timber roof over balcony	Modelled U_{wall}	Modelled $U_{main\ roof}$	ξ -value
		M4	0.138 W/m ² K	0.060 W/m ² K

	
Full model showing all materials	Model showing only steel and concrete
	
Full model showing boundary conditions	Model showing heat flow

EnerPHit Fabric Specification

Building assembly overview	Average U-Value [W/(m ² K)]
Windows (as installed)	0.928
Exterior walls	0.139
Roof	0.127
Floor slab	2.447
Sheltered End	0.337
Thermal bridges - Overview	Y-Value [W/(mK)]
Thermal bridges Ambient	0.029
Perimeter thermal bridges	-0.348
Average therm. envelope	0.555



① Typical Block Cross Section - Air-tightness strategy
1:100

The Primary Energy Challenge

“In individual cases where a very high primary energy demand is necessary, this limit value can be exceeded after agreement with the Passive House Institute. For this, evidence of efficient use of electrical energy is necessary, with the exception of existing electricity uses for which an improvement of the electrical efficiency by means of upgrading or renewal would prove uneconomical over the lifecycle.”

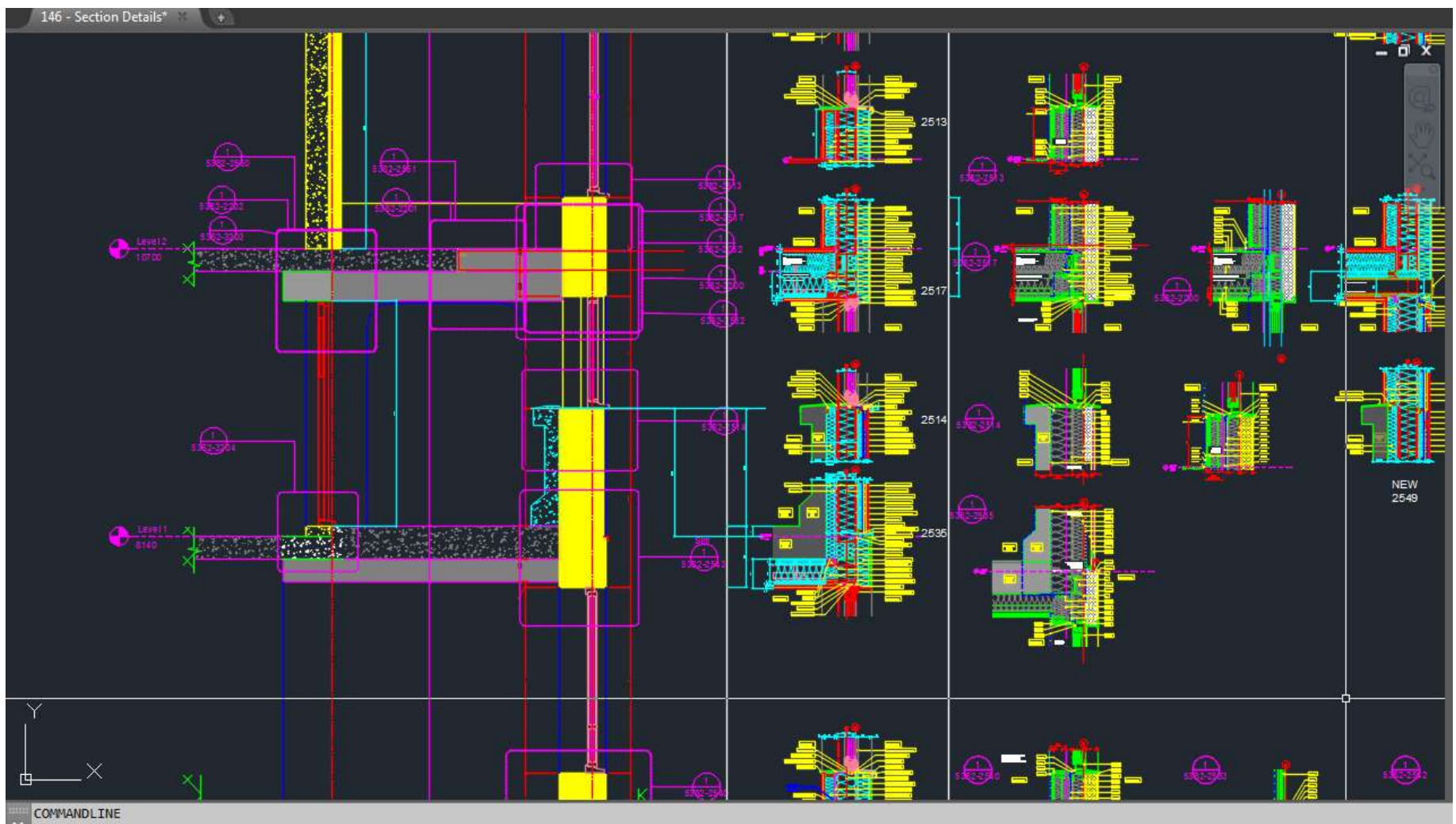
Specific building demands with reference to the treated floor area			
	Treated floor area	3119.6 m ²	
Space heating	Heating demand	19 kWh/(m ² a)	Requirements: 25 kWh/(m ² a) Fulfilled? yes
	Heating load	12 W/m ²	- Fulfilled? -
Space cooling	Overall specif. space cooling demand	kWh/(m ² a)	- Fulfilled? -
	Cooling load	W/m ²	- Fulfilled? -
	Frequency of overheating (> 25 °C)	0.1 %	- Fulfilled? -
Primary energy	Heating, cooling, dehumidification, DHW, auxiliary electricity, lighting, electrical appliances	179 kWh/(m ² a)	125 kWh/(m ² a) Fulfilled? no
	DHW, space heating and auxiliary electricity	126 kWh/(m ² a)	- Fulfilled? -
	Specific primary energy reduction through solar electricity	kWh/(m ² a)	- Fulfilled? -
Airtightness	Pressurization test result n ₅₀	1.0 1/h	1 1/h Fulfilled? yes

* empty field: data missing; '-': no requirement

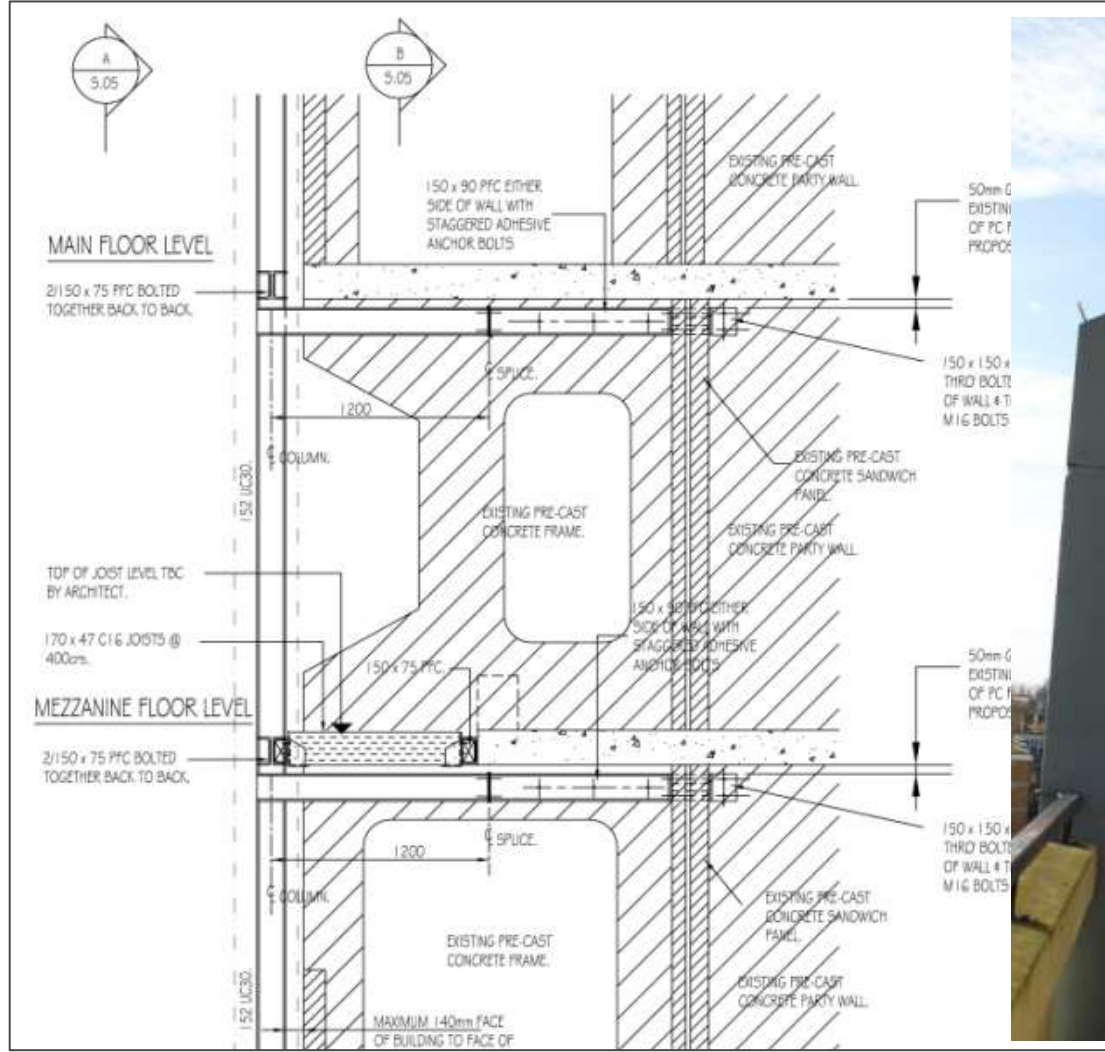
EnerPHit building retrofit (according to heating demand)?	no
---	-----------

We 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 application.	Name:	Helen	PHPP Version 8.5
	Surname:	Brown	Issued on:
	Company:	Encraft	21/08/2014
			Signature:
			DRAFT as Contract Design

BIM or CAD transfer?



How Do You Overclad This?

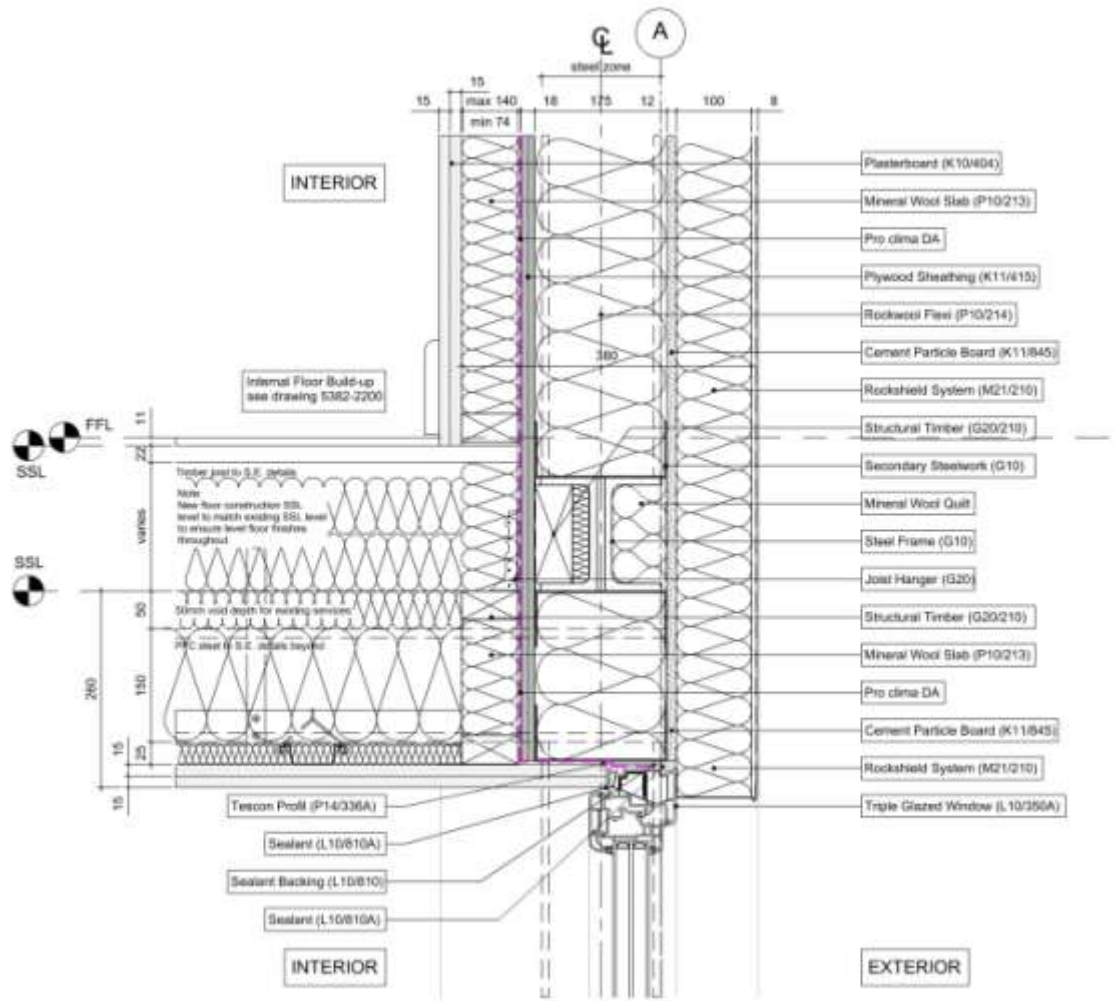


Over-cladding Strategies



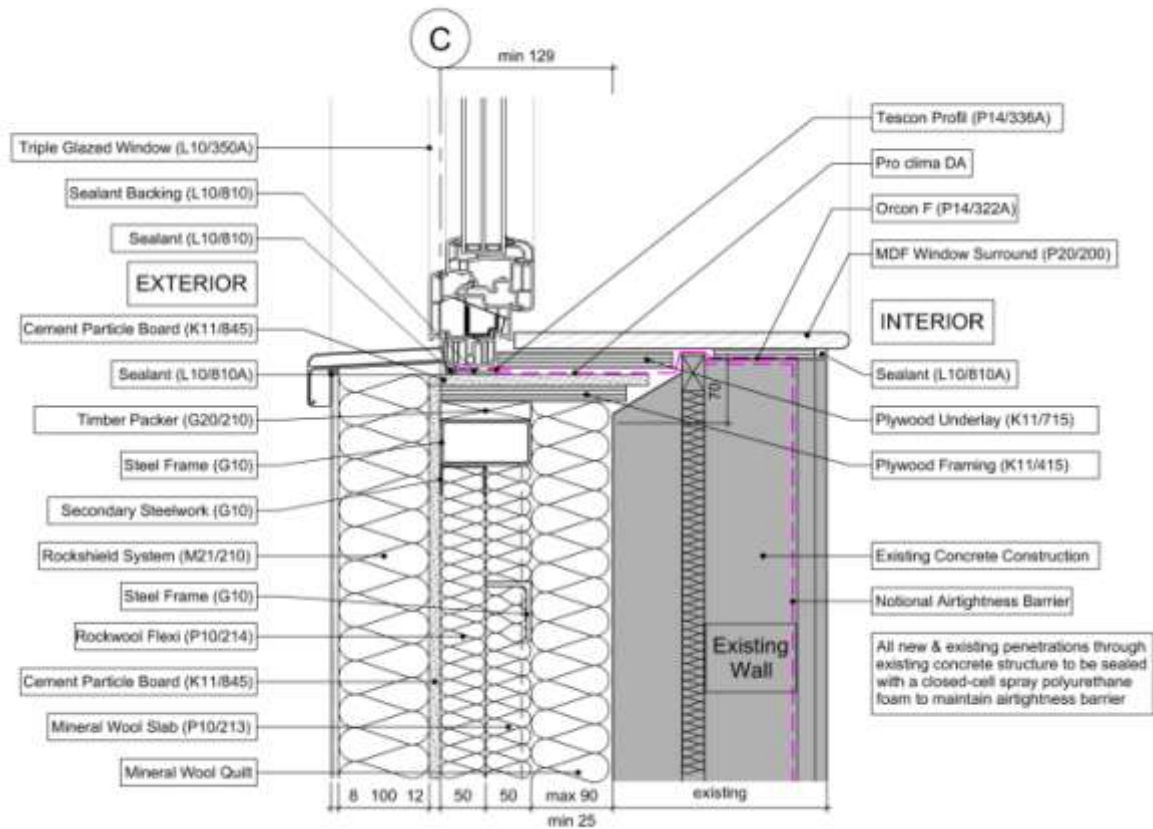
How Do You Overclad This?

- Review construction sequencing
- Increase tolerance zone to existing building
- Straighten up air-tightness membrane
- Over-size secondary steel to simplify construction
- Additional air-tightness tape for testing volumes
- Insulation within steel channels
- Review construction sequencing!



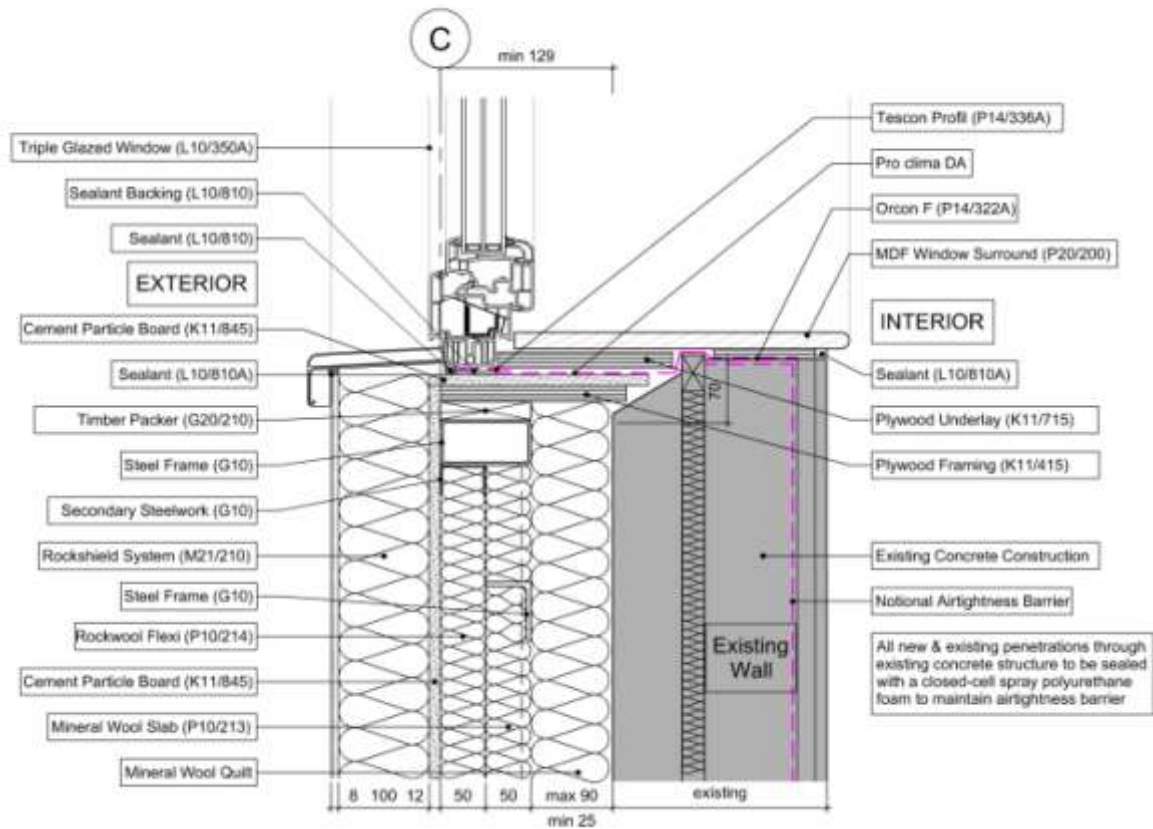
How Do You Overclad This?

- Review construction sequencing
- Increase tolerance zone to existing building openings
- Simplify air-tightness taping at window installation
- Utilise existing concrete air tightness – no need for parge coat
- Wrap weather-proof board around reveal to protect insulation
- Review construction sequencing!



How Do You Overclad This?

- Review construction sequencing
- Increase tolerance zone to existing building openings
- Simplify air-tightness taping at window installation
- Utilise existing concrete air tightness – no need for parge coat
- Wrap weather-proof board around reveal to protect insulation
- Review construction sequencing!



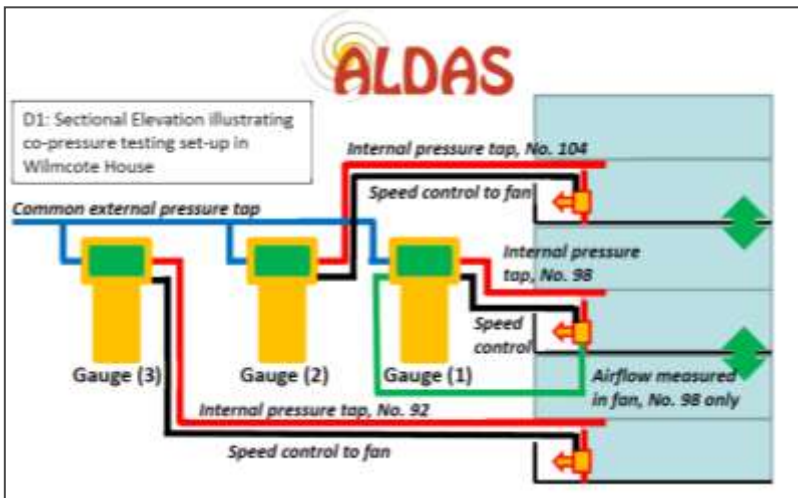
Passivhaus Contractor Team Up-Skill

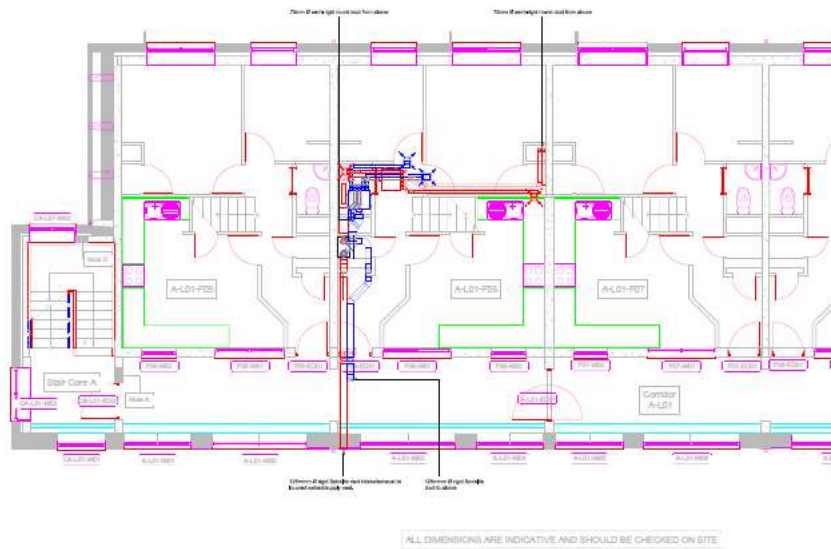
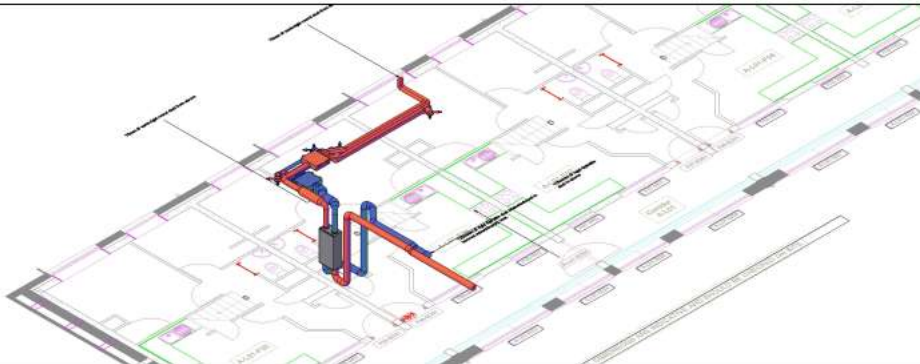
- EnerPHit Risk register
- Design stage assessment
- Project management checklists
- Desktop buildability reviews
- Buildability workshops
- Quality assurance champion training
- Tool box talks to provide basic training for site trades
- Change management sign off
- Intermittent site inspections and site inspection reports
- Contractors declaration proforma



Contractor Team

Further Air Testing





ALL DIMENSIONS ARE INDICATIVE AND SHOULD BE CHECKED ON SITE

Heat Recovery Legend

The system is designed to operate continuously to provide ventilation rates in line with the requirements of Part F 2013 - System 4 Continuous Supply and Extract Ventilation with Heat Recovery. The unit specific installation instructions and recovery Guide are supplied with each unit and this product must be installed in line with the manufacturer's instructions and Compliance Code (Greenwood, 2013). The Homeowner Guide must be followed with the unit.

- Notes**
- The ductwork unit must be installed using one of the duct configurations below and in accordance with your ventilation design.
 - Both configurations are not suitable for use where the roof void is suitable to accommodate the specified duct. Clear paths through the roof void for the duct to be installed are also required.
- 200mm x 100mm duct - [Minimum ceiling void depth required below.](#)
 - 150mm x 100mm duct - [Minimum ceiling void depth required below.](#)
 - 200mm x 100mm duct - [Minimum ceiling void depth required below.](#)
 - 100mm x 100mm duct - [Minimum ceiling void depth required below.](#)

Ducting of the unit is required where it passes through unheated areas and voids (e.g. loft spaces) with the exception of solid floors or a minimal height of thermal insulation of 250mm (10") to reduce the possibility of condensation forming. Where a duct passes above roof level the section above the roof should be insulated to a minimum 100mm (4") but better not less.

The MERV unit should be installed in a condensable duct, which should be connected to the nearest waste water network. Where units are sited in a position that makes the connection of piping to a full, independent condensate pump may be necessary as part of the installation.

Vertical ducting will require a condensate trap in order to prevent back flow of any moisture into the product (these items are to be purchased by the client).

The performance of the ventilation system relies on efficient air distribution and it is vital that duct installation is not left until the last moment when the only means of expediting obligations is to install ductwork where it has not been specified.

For continuous running ventilation systems an assessment involving outdoor air control with carbon dioxide is advised to decrease the air at the source of pollution, preventing a build up of pressure from forming within the ducting.

It is recommended a site visit consideration should be paid to the effective equivalent area of the terminals chosen that this does not adversely affect the fan performance. Please refer to the product installation instructions for further details.

Important notes

- The stopping materials have not been specified. For advice on appropriate stopping products in the other voids please refer to the following (this document is 2005 Approved Document Part 6 Volume 1, Building Regs (2005) para 6.14 any other relevant sections). We suggest a minimum distance of 300mm from the nearest edge.

Notes: These installations must be earthed. All wiring must conform with BS7671, IEC Wiring Regulations. The installation must be carried out by a qualified electrician in accordance with prevailing regulations.

Please refer to the product installation instructions for further information.

Room name	Area	Clear height	Room vol.	Volume flow per room			Air chng. rate
	A	h	A x h	V _{air}	V _{rec}	V _{mix}	per room n
	m ²	m	m ³	m ³ /h	m ³ /h	m ³ /h	
Kitchen	13	2.50	33			47	1.42
Hall/Stairs 1	9	2.50	23			31	1.38
WC	1	2.50	3			22	7.30
Bed 3	6	2.50	15	18			1.23
Bed 2	11	2.50	28	20			0.72
Hall/Stairs 2	6	2.50	14			28	1.99
Bed 1	14	2.50	35	30			0.86
Living	25	2.50	63	30			0.47
Balcony	4	2.50	9			3	0.32
Bathroom	5	2.50	12		29		2.50

THESE DRAWINGS ARE FOR INDICATIVE PURPOSES ONLY

Our quotation is specifically based on the indicative design layout provided. For installations where deviations occur, additional materials may be required.

Greenwood Air Management cannot accept liability for the cost of extra parts required to complete an installation unless in the unlikely event, an error during the quotation process has occurred. Additionally, where changes to our indicative design proposals occur they must be validated to check whether they pose a major risk to performance with the original system design.


To return terms, we require as filled drawings and a brief explanation to support the request for a credit.

Greenwood Air Management cannot accept returns unless in the unlikely event, an error during the quotation process has occurred where design layout differs from materials list.

COPYRIGHT 2012 GREENWOOD AIR MANAGEMENT Ltd.
This drawing and design are the property of Greenwood Air management and must not be copied or submitted to a third party or used in any way prejudicial to their interest.

Keepmoat

Wilmcote House	
QUOTE 5798	SCALE 1:50
DRAWN RK	DWG No 001e
PAPER SIZE A1L	DATE 04.11.2014



GREENWOOD AIR MANAGEMENT LTD, BROOKSIDE INDUSTRIAL ESTATE, RUSTINGTON, WEST SUSSEX, BN16 5LF, TELEPHONE: 01903 771021, FAX: 01903 762394

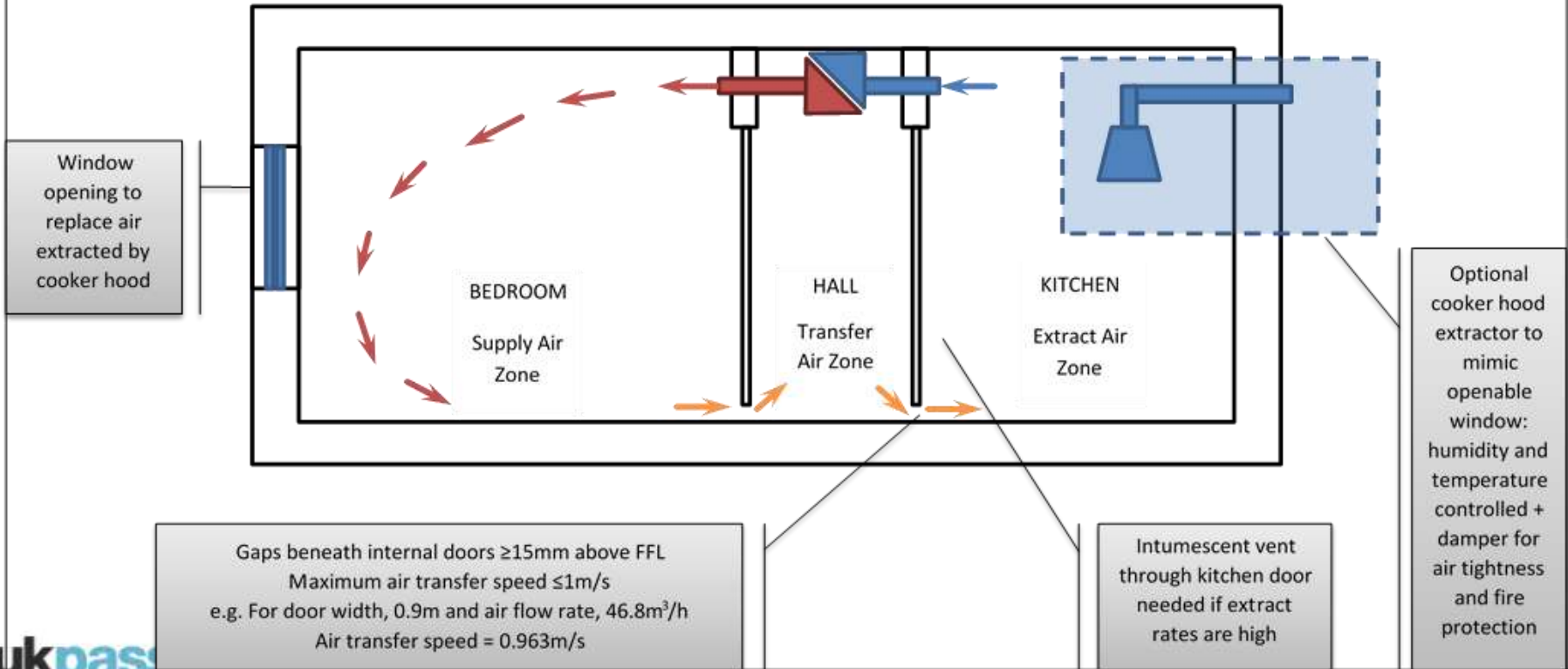
Ventilation strategy

Ventilation Requirements from Part F: Internal rooms with no openable window should be provided with the minimum extract rates, either by intermittent or continuous extract. It will take longer to purge when using the continuous extract option.

	Intermittent	Continuous
Kitchen	60l/s = 216m ³ /h	13l/s = 46.8m ³ /h
WC	6l/s = 21.6m ³ /h	

Ventilation Guidelines in PHPP: Target continuous extract rates are the high rates i.e. to be delivered on the "boost" setting. Normal ventilation rates to be ~30% lower such that the average whole building ventilation rate works out to be around 0.3ach. There is a risk of dry air if the ventilation rates are too high.

	Continuous (High)
Kitchen	60m ³ /h
Bathroom	40m ³ /h
WC/Utility	20m ³ /h



BUILDING THE 'EXO-SKELETON'

- Light gauge steel substructure between primary frame
- Insulate behind, between and over
- Air tightness has to cross ties on courtyard facade



PASSIVHAUS WINDOW INSTALL



Exterior, awaiting final external insulation and render



Interior, with air tight membrane awaiting dry lining

LIVING ROOM EXTENSIONS

Temporary wall
separates work zone



LIVING ROOM EXTENSIONS

Upstand structures
crushed in-situ and
removed



LIVING ROOM EXTENSIONS

New floors extended to facade



LIVING ROOM EXTENSIONS



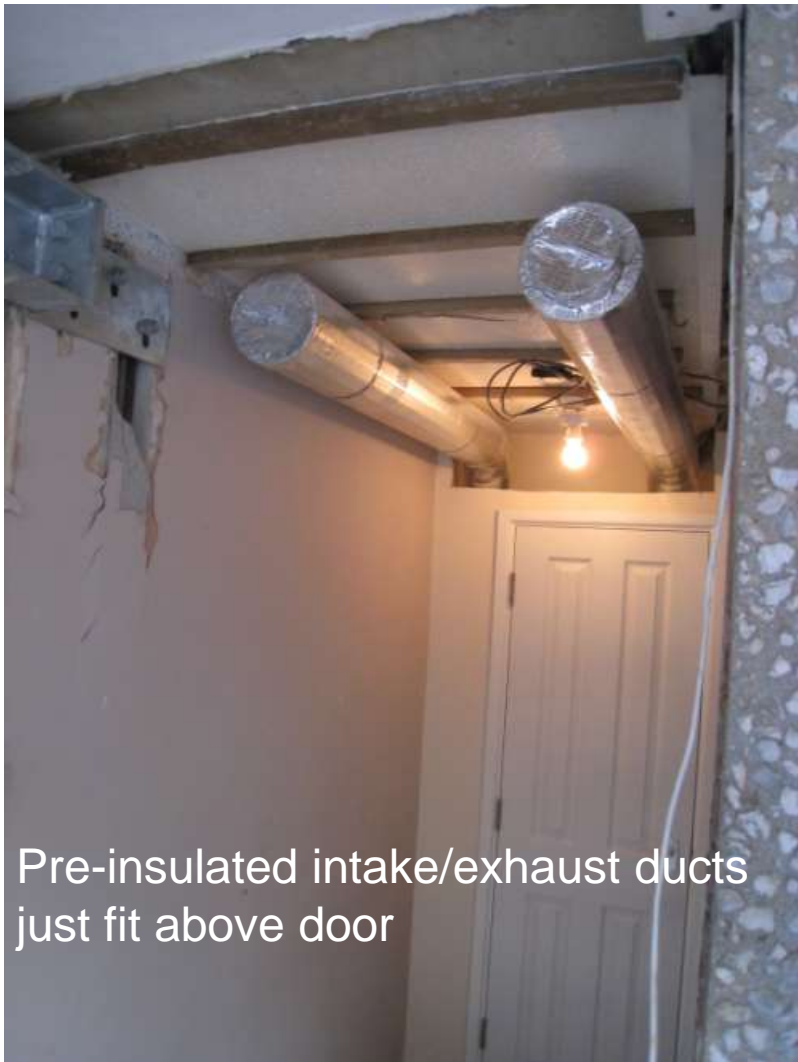
**External framing
added**

BOOSTED EXTRACT REQUIREMENT

- Extract triggered by boost ventilation
- Dampers locked during normal operation
- Some loss of excess heat from cooking
- Air tightness achievable if seals between duplex risers (where redundant ducts removed) are made effective.



MVHR INSTALLATIONS



Pre-insulated intake/exhaust ducts just fit above door



Ceiling mounted ducts and plenums



Heat exchanger in cupboard

Where are we now?

