

Passivhaus Designer Re-certification – Peter Ranken (Renewal of Passivhaus Designer Certificate issued on 25 July 2012, expiring on 31 August 2017)

Gales Place, Three Bridges, Crawley UK

Revision A 21 February 2019





Block 1 – three terraced houses



Block 3 – six apartments



Block 2 – four terraced houses

Gales Place is an affordable certified Passivhaus housing development by Crawley Borough Council that provides the following accommodation:

						U-va	lues		
Total 7 houses and 6 flats in three blocks:	Treated Floor Area	Annual Heating Demand	Primary Energy Renewable	Heat Recovery	Wall	Roof	Ground Floor	Window	Air Tightness Result
		kWh/m².a	kWh/m².a	Efficiency	W/m²K	W/m²K	W/m²K	W/m²K	ach
 Three house terrace – 3 no. 2 bed houses 	225.9m ²	14.6	60	87.4%	0.101 0.098	0.068	0.122	0.95	0.583 0.623 0.606
 Four house terrace – 2 no. 2 bed houses, 2 no. 3 bed houses 	330.2m ²	14.2	60	88.9%	0.119 0.114	0.068	0.122	0.93	0.599 0.631 0.647 0.567
 Block of flats – 3 no. 1 bed, 3 no. 2 bed 	255.6m ²	14.3	6.8	88.6%	0.138 0.145	0.068	0.122	0.93	0.646

All three blocks are listed on the Passivhaus Database held by the International Passive House Association. These listings can be viewed from:

https://passivhausprojekte.de/index.php#k Crawley

The PH database references are as follows:

Block 1 – three house terrace: ID 5406

Block 2 – four house terrace: ID 5414

Block 3 – block with six apartments: ID 5415

2. Abstract of Building Project

Gales Place is a social housing development in Crawley, West Sussex with thirteen dwellings in three separate blocks, all of which pass the Passivhaus standard. Seven of the dwellings are 2 or 3 bedroom houses, with one terrace of three houses and another of four houses. The third block comprises six 1 or 2 bedroom flats. The project provides high quality and low energy rented social housing for Crawley Borough Council.

All three blocks are built using cavity walls with a thin joint aircrete blockwork inner leaf with brickwork or rendered blockwork external facings, and each block has different thicknesses of wall insulation to reflect the different form factor of each block.

The ground floors of the houses comprise insulated concrete rafts and the flats have an insulated beam and block suspended ground floor. All roofs are timber with horizontal insulation at top floor ceiling level.

Each dwelling is serviced individually using the following:

- Ventilation: a single Paul Novus 300 heat recovery ventilation unit per dwelling
- Heating: electric towel rails and panel radiators
- Hot water: provided by solar thermal panels serving a hot water storage cylinder fitted with an electric immersion heater.

3. Elevation View of the Buildings

3.1 Block 1 (Plots A, B and C)



Block 1 (three houses) – elevation facing west



Elevation facing south, solar thermal panels not visible





Elevation facing north



Block 2 – terrace of four houses – front elevation facing north



Block 2 – elevation facing south – note solar thermal panels on roof

3.3 Block 3 (Plots H, J, K, L, M and N)



View of Block 3 from south west – note MVHR terminals on side wall and solar panels on roof



View of Block 3 from south

4. Exemplary Photos from Inside the Buildings



Living room in one bedroom flat in Block 3.



Main bedroom in house in Block 1

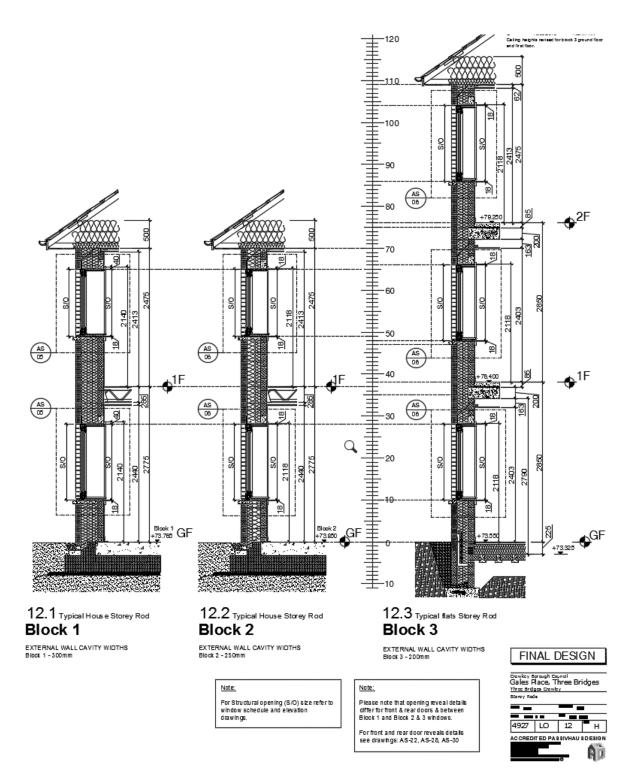


Kitchen in house of Block 1 (similar to those in Block 2)



Living room of house in Block 1, decorations by resident.

5. Sectional View of The Buildings



Part sections of each block – note differences in cavity wall insulation thickness and ground floor construction.

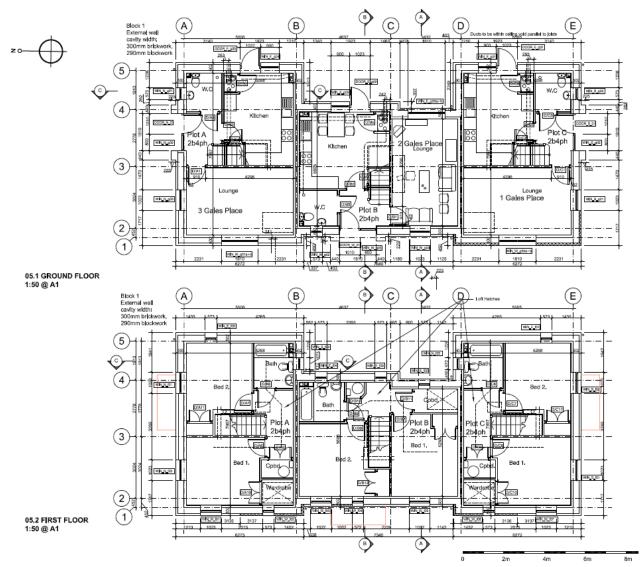
6. Floor Plans

6.1 Houses (Blocks 1 and 2)

The plans of the houses are based on a core double fronted two bedroom layout, one room deep and where possible standard stair, bathroom and kitchen elements. For Block 1 the end houses are rotated 90 degrees relative to the central house to provide entrances in each front elevation. For Block 2 the end houses include an additional bedroom to create 2no. three bedroom houses.

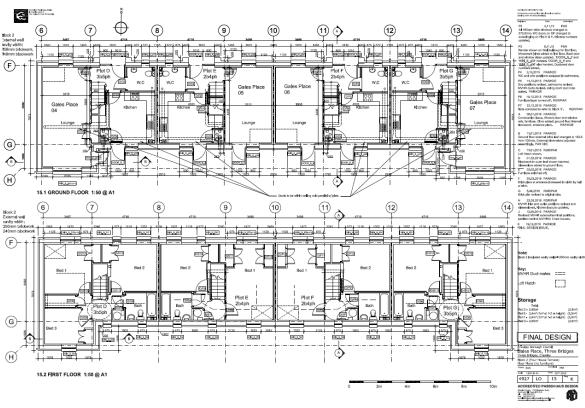
The single room depth of the core house layout allows cross ventilation through many living rooms and section ventilation via the stairs to upstairs landing windows.

Kitchens, bathrooms and ground floor shower/wc rooms (houses only) were designed to minimise pipe lengths between hot water storage and points of use of hot water.



Plans

Block 1 three house terrace floor plans

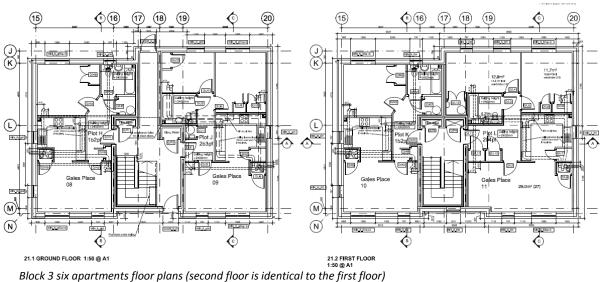


Block 2 four house terrace floor plans

6.2 Flats (Block 3)

Block 3 comprises 3no two bedroom flats and 3no 1 bedroom flats over three floors. Common kitchen and bathroom elements are included in each flat type.

Plans



6.3 The floor layouts of these dwellings have proved popular with the client and similar layouts have been used on three other sites, one of which (Dobbins Place) has also been built for Passivhaus certification.

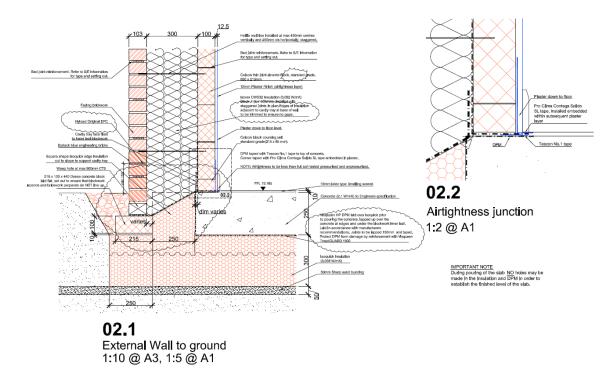
7. Construction of Floor Slab

7.1 Houses.

The houses are all two storey and the structural loadings of the main walls are low enough to allow for an insulated slab ground floor. This is a proprietary system by Isoquick, and allows a thermal bridge free junction between the ground floor slab and external walls.



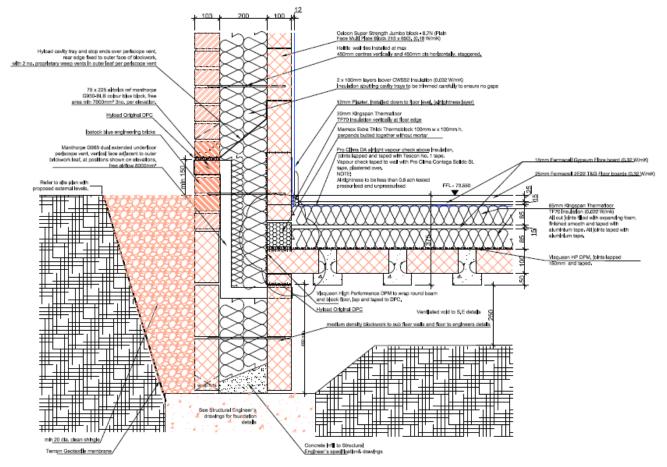
Block 2 insulated raft foundation before and after concrete was poured



Extract from detail drawing 4927 AS 02A for floor wall junction to the houses Block 1 (Block 2 similar)

7.2 Flats.

The structural loadings of the blockwork walls in the three storey block of flats are too great for an insulated slab construction and an insulated beam and block suspended floor is used. To mitigate the thermal bridge between the inner leaf of blockwork and the suspended floor load bearing insulation (by Marmox) is used. The resulting small thermal bridge has been calculated using Therm and included in PHPP.



Extract from detail drawing 4927 AS 01A for floor wall junction for the flats Block 3

8. Construction of the Exterior Walls

Following planning approval the project was tendered to potential contractors for construction using a design and build contract and the choice of an aircrete masonry construction was made by the successful contractor during the tender stage in conjunction with APD. This is a variant of conventional UK domestic masonry construction with a facing brick (or rendered block) outer leaf, full fill cavity insulation and an aerated blockwork inner leaf. The aircrete blocks used for the inner leaf have the following advantages over conventional medium dense block:

- Formed from recycled power station ash and cured, there is a large air content and improved lambda value:
 - Aircrete blocks 0.15 W/mK
 - Medium dense blockwork 0.79 W/mK
- Larger unit size reduces the length of thermal bridges formed by the mortar joints,
- Reduced bed joint mortar thickness (2mm vs 10mm) further reduces the area of thermal bridges formed by the mortar joints
- The reduced weights of the units (along with larger unit sizes and thinner bed joints) can give reduced construction times.

Each block has a different form factor (ratio of heat loss surface area to treated floor area), and whilst the same wall construction is used for all three blocks, the thickness of cavity wall insulation varies:

Block 1 (three houses) – cavity wall insulation thickness 300mm Block 2 (four houses) – cavity wall insulation thickness 250mm Block 3 (six flats, three storey) – cavity wall insulation thickness 200mm

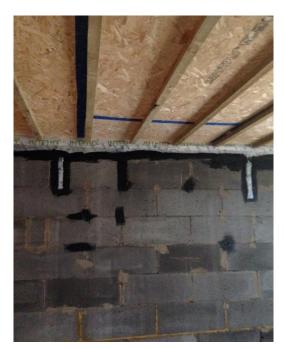
Air leakage through the blockwork is prevented by site applied plaster. Plasterboard dry-lining is not used. In addition the contractor used liquid applied airtightness (Blowerproof) to additionally seal some areas of blockwork prior to plastering.



Cavity wall insulation – no gaps



Airtightness – Blowerproof to joints, sockets and windows before plaster applied



Typical external wall and top floor ceiling showing construction prior to plastering:

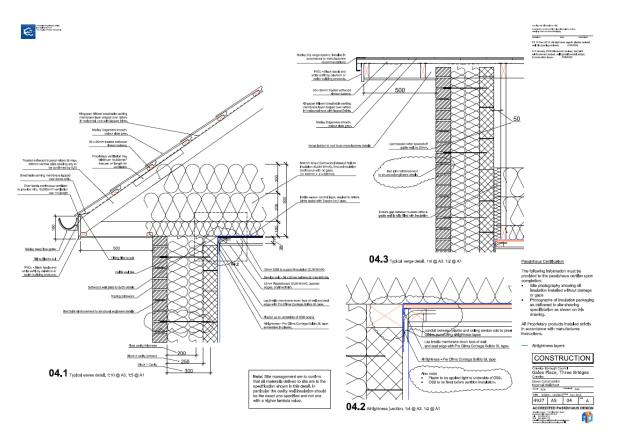
- Intello air tight membrane behind OSB ceiling
- Joints in OSB taped
- Intello membrane taped to wall, and painted with Blowerproof
- Intello membrane over lateral restraint straps, taped to wall and painted with Blowerproof
- Large format aircrete blocks with thin joints

9. Construction of the roof/ ceiling of the top floor

Conventional UK roof construction is used with trussed rafters, a ventilated roof void below roof tiles and horizontal insulation at ceiling level. The ceiling construction below the trussed rafters is as follows:

- Intello air tightness and vapour control membrane stapled and taped to underside of the rafters with taped air tight joints and at edges with external walls.
- OSB board to support 500mm mineral/glass wool insulation
- Battened service void
- Plasterboard and skim finish, lapping with plastered internal blockwork.

This construction can provide a relatively thermal bridge free junction with the external wall and is economical to construction. There were some issues on site with hard to detect damage/ vandalism to the Intello layer and for the subsequent Passivhaus project with the same contractor a rigid air tight board with taped joints was used to replace the Intello and OSB.



Detail drawing 4927 AS 04A for roof eaves (all blocks) including ceiling construction and airtightness.



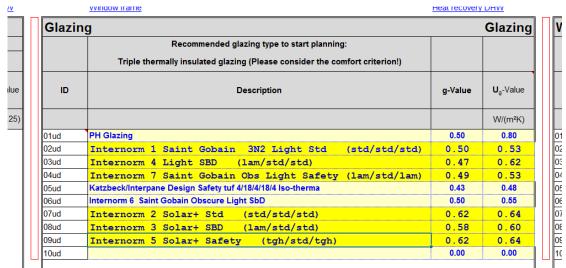
Top floor ceiling installation showing Intello membrane, taped joints, OSB board and taped joints, battens for service void for cables etc.

10. Windows and the Installation of the Window

The windows and external doors were Internorm KF410 aluminium clad PVC-u, and are all triple glazed, with tilt and turn operation. The windows were installed within the insulation zone of the external walls within a plywood former, taped to the blockwork and plaster airtightness layer.

The thermal properties of the frames and glazing are as follows:

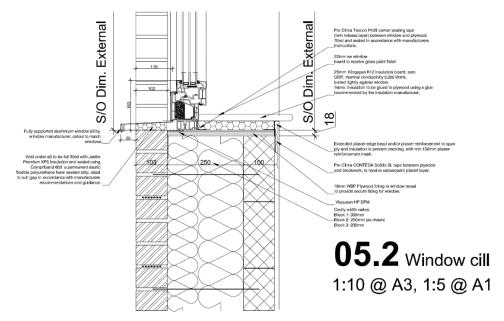
- U value of frame U_f 0.96 W/m²K
- Glazing spacer Psi value 0.033 W/mK
- U value of glass Ug these vary dependent on the type of glass used an extract of the data included in PHPP for Block 1 in strong yellow is below (the same glass types were also used for the other blocks)



• G value of glazing – these also vary, and are also shown below

Extract of Block 1 PHPP showing glazing Ug and g values used on all blocks (in strong yellow)

Manufacturer's information confirming this data is included in the appendices.



Extract from detail drawing 4927 AS 05A for window installation for all blocks

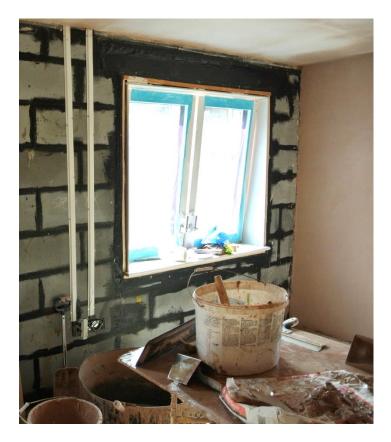


Photo of window installation showing plywood former. Note wet plaster airtightness layer to internal compartment wall between houses and additional Blowerproof airtightness paint applied to blockwork joints and adjacent to the window.

11. Airtight Building Envelope

Measures to reduce air leakage include:

- Walls wet plaster finish to blockwork, with additional liquid airtight paint (Blowerproof) applied where necessary to blockwork before plastering.
- Ground floor in houses in-situ concrete slab
- Ground floor in flats airtightness membrane within layers of Fermacell board
- Roof Intello membrane with taped joints fixed to underside of trussed rafters, edges taped to wall plaster
- Junctions taped with airtight tape as shown on details, tape being ProClima Tescon No. 2 or Contega Solido SL or equivalent.

The air test results for each house and the block of flats follow.

Certificate of Test

Page 1 of 2

Title: Air tightness test of Block 3, Gales Place, Crawley in accordance with The Passivhaus Standard (generally in accordance with BS EN 13829:2001 [method B])

Certificate of Test Number: 25239

Customer's name & address Westridge Construction Limited Ruskin House Junction Road Bodiam East Sussex TN32 5UP

Our Ref: N950/TR0088 VTC Job No.: 3UL6 Your Ref: Block 3 Issue date: 10th January 2016 Date sample(s) received: N/A Sample(s) received from: N/A Sample No.: B6014

Tested by:see adjacent text..... S.Maddison (position: Engineer)

Authorised by: S. Collins (position: Principal Engineer) VINCI Technology Centre UK Limited 01525 859000 info@technology-centre.co.uk

www.technology-centre.co.uk

Stanbridge Road, Leighton Buzzard, Bedfordshire, LU7 4QH Registered Office, Watford, England. Registered No.05640885





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TECHNOLOGY CENTRE

Certificate of Test Number: 25239

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1. BUILDING DETAILS

All combustion appliances were turned off and flues sealed. All mechanical ventilation systems were turned off and sealed at grilles. All internal doors were open during the test. Sufficient internal openings were provided to ensure pressure equalisation throughout the dwelling. All drainage traps were filled or sealed over. All external doors and windows were closed. All natural ventilation openings were temporarily sealed. Carpets were partly fitted. The single blower door fan was connected to the building via the front entrance door. The entire block was tested.

2. RESULTS

Estimated construction date	2016	
Date and time of test	5 Jan 17	12.30
Building volume	1014 n	n ³ (calculated by Warm Low Energy Building Practice)
Measured air changes per hour	0.646	
Target air changes per hour	0.649	
Building volume Measured air changes per hour	1014 n 0.646	

These calculations comply with ATTMA Technical Standard Appendix A

Plot No.	Block 3	1	Target ach		0.649		FAIL	
Job No. Test date	B6014 5 Jan 17		Measured ac Measured pe		0.65 #DIV/0!	m ³ /(h.m ²)	FAIL	
Time of test	12.30		Air flow expo		0.739		ok	
Tested by	S.Maddison		Correlation of	coefficient, r ²	1.000		ok	
Fan/Manometer No.	CLR 698		Air flow coef		0.010			
Calibration due	18 Feb 17			coefficient, CL	0.010	8.1		
Thermo/Barom No. Calibration due	MTL 017 5 Jul 17		Air leakage r Equivalent le		0.18	m ³ .s ⁻¹		
Calibration due	5 Jul 17		Equivalent le	akayo alba	0.00	10		
Pressurisation Test	At start	At end	m.s ⁻¹		nu (internel)	650 202		
Wind speed Barometric pressure	0.8 1023	1 1023	mbar		pv (internal) pv (external)	650.393 343.464		
Internal temperature	11.3	10.4	°C		sity (internal)	1.252	kg/m ³	
External temperature	1.6	1.6	°C	air dens	ity (external)	1.295	kg/m ³	
Zero flow +ve average	0.0 -1.0	0.0 -1.1	pascals pascals					
Zero flow -ve average Overall Zero flow average		-1.1	pascals	Minneapolis	Retrotec	Retrotec	Retrotec	
				door	219	218	269	1
	pressure	flow		blower	open	open	open	G54
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2	75.1	857		857				
3	70.2	819	1	819				
4	65.3	778		778				
5	60.1 55.3	735 689		689				
7	50.2	641	1	641				
8	45.0	593		593				-
9 10	40.0 35.0	543 492		543 492				
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	4.2662	-1.4464		0.05				
	4.1949 4.1133	-1.4977 -1.5546		0.00				
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	3.8297 3.7148	-1.7692 -1.8573				Building pressur	e (Pa)	
	3.5849	-1.9560				- 2.8		
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Version 2 - Dec 2013 TechnologyCentre2008\Tem	plates\Reports					C	ENTE	RE

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-0.6 flow (m ³ .hour ⁻¹) 889 850 808 789 727	pascals	door blower (m ³ .hour ⁻¹) 889 850	219 open	218 open		
flow (m ³ .hour ⁻¹) 889 850 808 789 727		door blower (m ³ .hour ⁻¹) 889 850	219 open	218 open		
(m ³ .hour ⁻¹) 889 850 808 789 727	3	blower (m ³ .hour ⁻¹) 889 850	open	open		
(m ³ .hour ⁻¹) 889 850 808 789 727	3	(m ³ .hour ⁻¹) 889 850		Contraction of the second	open	G54
889 850 808 789 727	3	889 850	(1-a)		(Pa)	(m ³ .s ⁻¹)
850 808 789 727) 3 7	850		(1-a)	(Fa)	(11.5)
808 789 727	3					
789 727)					
727		789				
		727				
		683				
636	3	636				
587		587				
538		538				
486	5	486				
219 GF 467.1291 287.5859 144.6206	10.562 46.584		218 offset	269 GF	269 offset	G54 G
980.169	39.272		-371.786	991.4565	-189.398	0.942
	low (m ³ .s ⁻¹)					
0.25						
0.24		0.3			1	1
0.23						
0.23						
0.21		0.25			P	
0.20					90	
0.18		0.2				
0.17				2		
0.15		3/S)		1		
0.14	•	E 0.15				
		Air flow (m ^{3/} s)		0		
log flow		Air				
-1.3667	7	0.1			+	
-1.4116						
-1.4623						1
-1.4861		0.05		-	+	
-1.5679						
-1.6303						
-1.7016		0			+ +	
-1.7818		0	20	40	60 80	100
				Building pressur	re (Pa)	
-1.8690	6					
-1.8690	Date:	10/1/1	7			
-1.8690		10/1/17				
-1.8690	Date:		TE			~0
-1.8690	Date:			C	ENTA	E
	5	V Y	V X Ialla	Date: 10/1/17	Date: 10/1/17 TECHNI	V. V. Inlla

Certificate of Test

Page 1 of 2

Title:

Air tightness test of Plot A, Gales Place, Crawley in accordance with The Passivhaus Standard (generally in accordance with BS EN 13829:2001 [method B])

Certificate of Test Number: 25240

Customer's name & address Westridge Construction Limited Ruskin House Junction Road Bodiam East Sussex TN32 5UP

Our Ref: N950/TR0088 VTC Job No.: 3UL6 Your Ref: Plot A Issue date: 10th January 2017 Date sample(s) received: N/A Sample(s) received from: N/A Sample No.: B6014

Tested by:see adjacent text.

(position: Engineer) Authorised by:

S. Collins (position: Principal Engineer) VINCI Technology Centre UK Limited 01525 859000 info@technology-centre.co.uk www.technology-centre.co.uk

Stanbridge Road, Leighton Buzzard, Bedfordshire, LU7 4QH Registered Office, Watford, England. Registered No.05640885



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TECHNOLOGY CENTRE

Certificate of Test Number: 25240

1. BUILDING DETAILS

All combustion appliances were turned off and flues sealed. All mechanical ventilation systems were turned off and sealed at grilles. All internal doors were open during the test. Sufficient internal openings were provided to ensure pressure equalisation throughout the dwelling. All drainage traps were filled or sealed over. All external doors and windows were closed. All natural ventilation openings were temporarily sealed. Carpets were partly fitted. The single blower door fan was connected to the building via the front door. The entire dwelling was tested.

2. RESULTS

Estimated construction date	2016	
Date and time of test	5 Jan 17	13.25
Building volume	187 r	n ³ (calculated by Warm Low Energy Building Practice)
Measured air changes per hour	0.583	
Target air changes per hour	0.649	

These calculations comply with ATTMA Technical Standard Appendix A

Customer	Westridge		Envelope ar			m ²		
Project	Gales Place		Building volu		186.7	m°		
Plot No.	Α		Target ach		0.649			
Job No.	B6014		Measured a	ch	0.59		PASS	
Test date	5 Jan 17		Measured p	And in case of the local division of the loc	#DIV/0!	$m^{3}/(h.m^{2})$		
Time of test	13.25		Air flow exp		0.700		ok	
	Shaun Maddi	ison	and the second sec	coefficient, r ²	0.997		ok	
Tested by		15011					UK	
Fan/Manometer No.	CLR 698		Air flow coel		0.002			
Calibration due	18 Feb 17			coefficient, CL	0.002			
Thermo/Barom No.	MTL 017		Air leakage			m ³ .s ⁻¹		
Calibration due	5 Jul 17		Equivalent l	eakage area	0.01	m ²		
Pressurisation Test	At start	At end						
Wind speed	0.7	0.9	m.s ⁻¹		pv (internal)	650.393		
Barometric pressure	1023	1023	mbar		pv (external)	354.699		
Internal temperature	11.3	10.4	°C		sity (internal)		kg/m ³	
External temperature	2.0	2.1	°C		ity (external)		kg/m ³	
Zero flow +ve average	0.1	0.0	pascals					
Zero flow -ve average	0.0	-0.3	pascals					
Overall Zero flow avera		-0.3	pascals	Minneapolis	Retrotec	Retrotec	Retrotec	
	• •			door	219	218	269	
	pressure	flow		blower	open	open	open	G54
	(Pa)	(m ³ .hour ⁻¹)		(m ³ .hour ⁻¹)	(Pa)	(Pa)	(Pa)	(m ³ .s ⁻¹)
1	65.3	126		126		, , ,		
2		120		120				
3	55.0	114		114				
4		106		106				
5		99		99				
6		91		91				
7		83		83				
8		77		77 65				
9 10		65 55		55				
	A ring	219 GF 467.1291	10.562	!	218 offset	269 GF	269 offset	G54 GF
	B ring	467.1291 287.5859	10.562 46.584		218 offset	269 GF	269 offset	G54 GF
		467.1291	10.562 46.584 -105.663		218 offset	269 GF 991.4565		
	B ring C8 ring open	467.1291 287.5859 144.6206 980.169	10.562 46.584 -105.663 39.272					
corrected p	B ring C8 ring open	467.1291 287.5859 144.6206 980.169 corrected fi	10.562 46.584 -105.663 39.272					
corrected p	B ring C8 ring open ressure (Pa) 65.4	467.1291 287.5859 144.6206 980.169 corrected fl 0.04	10.562 46.584 -105.663 39.272	1041.283				
corrected p	B ring C8 ring open ressure (Pa) 65.4 60.3	467.1291 287.5859 144.6206 980.169 corrected fi 0.04 0.03	10.562 46.584 -105.663 39.272					
corrected p	B ring C8 ring open ressure (Pa) 65.4 60.3 55.1	467.1291 287.5859 144.6206 980.169 corrected fi 0.04 0.03 0.03	10.562 46.584 -105.663 39.272	0.04				
corrected p	B ring C8 ring open ressure (Pa) 65.4 60.3	467.1291 287.5859 144.6206 980.169 corrected fi 0.04 0.03	10.562 46.584 -105.663 39.272	1041.283				
corrected p	B ring C8 ring open ressure (Pa) 65.4 60.3 55.1 50.3	467.1291 287.5859 144.6206 980.169 corrected ff 0.04 0.03 0.03 0.03	10.562 46.584 -105.663 39.272	0.04				
corrected p	B ring C8 ring open eressure (Pa) 65.4 60.3 55.1 50.3 45.2 40.4 35.5	467.1291 287.5855 144.6206 980.169 corrected fi 0.04 0.03 0.03 0.03 0.03 0.03 0.03 0.03	10.562 46.584 -105.663 39.272	0.04				
corrected p	B ring C8 ring open (65.4 60.3 55.1 50.3 45.2 40.4 35.5 30.3	467.1291 287.5855 144.6206 980.169 corrected fi 0.04 0.03 0.03 0.03 0.03 0.03 0.03 0.03	10.562 46.584 -105.663 39.272	0.04				
corrected p	B ring C8 ring open ressure (Pa) 65.4 60.3 55.1 50.3 45.2 40.4 35.5 30.3 25.1	467.1291 287.5855 144.6206 980.165 corrected ff 0.04 0.03 0.03 0.03 0.03 0.03 0.03 0.03	10.562 46.584 -105.663 39.272	0.04				
corrected p	B ring C8 ring open (65.4 60.3 55.1 50.3 45.2 40.4 35.5 30.3	467.1291 287.5855 144.6206 980.169 corrected fi 0.04 0.03 0.03 0.03 0.03 0.03 0.03 0.03	10.562 46.584 -105.663 39.272	0.04				
corrected p	B ring C8 ring open ressure (Pa) 65.4 60.3 55.1 50.3 45.2 40.4 35.5 30.3 25.1	467.1291 287.5855 144.6206 980.165 corrected ff 0.04 0.03 0.03 0.03 0.03 0.03 0.03 0.03	10.562 46.584 -105.663 39.272	0.04				
	B ring C8 ring open 65.4 60.3 55.1 50.3 45.2 40.4 35.5 30.3 25.1 20.2	467.1291 287.5855 144.6206 980.165 corrected f 0.04 0.03 0.03 0.03 0.03 0.03 0.03 0.03	10.562 46.584 -105.663 39.272	0.04				
	B ring C8 ring open ressure (Pa) 65.4 60.3 55.1 50.3 45.2 40.4 35.5 30.3 25.1 20.2 log pressure	467.1291 287.5855 144.6206 980.169 corrected ff 0.04 0.03 0.03 0.03 0.03 0.03 0.02 0.02 0.02	10.562 46.584 -105.663 39.272	0.04				
	B ring C8 ring open ressure (Pa) 65.4 60.3 55.1 50.3 45.2 40.4 35.5 30.3 25.1 20.2 log pressure 4.1805	467.1291 287.5855 144.6206 960.169 corrected ff 0.04 0.03 0.03 0.03 0.03 0.02 0.02 0.02 0.02	10.562 46.584 -105.663 39.272	0.04 0.035 0.03 0.025 (g) 0.02 (g) 0.02 (g) 0.02				
	B ring C8 ring open ressure (Pa) 65.4 60.3 55.1 50.3 45.2 40.4 35.5 30.3 25.1 20.2 log pressure 4.1805 4.0993	467.1291 287.5855 144.6206 980.165 corrected fi 0.04 0.03 0.03 0.03 0.03 0.02 0.02 0.02 0.02	10.562 46.584 -105.663 39.272 low (m ³ .s ⁻¹)	0.04				
	B ring C8 ring open ressure (Pa) 65.4 60.3 55.1 50.3 45.2 40.4 35.5 30.3 25.1 20.2 log pressure 4.1805 4.0993 4.0091	467.1291 287.5855 144.6206 980.165 corrected f 0.04 0.03 0.03 0.03 0.03 0.03 0.02 0.02 0.02	10.562 46.584 -105.663 39.272 low (m ³ .s ⁻¹)	0.04 0.035 0.03 0.025 0.02 0.015 0.01				
	B ring C8 ring open ressure (Pa) 65.4 60.3 55.1 50.3 45.2 40.4 35.5 30.3 25.1 20.2 log pressure 4.1805 4.0993	467.1291 287.5855 144.6206 980.165 corrected fi 0.04 0.03 0.03 0.03 0.03 0.02 0.02 0.02 0.02	10.562 46.584 -105.663 39.272 low (m ³ .s ⁻¹)	0.04 0.035 0.03 0.025 (g) 0.02 (g) 0.02 (g) 0.02				
	B ring C8 ring open ressure (Pa) 65.4 60.3 55.1 50.3 45.2 40.4 35.5 30.3 25.1 20.2 log pressure 4.1805 4.0093 4.0091 3.9180	467.1291 287.5855 144.6206 980.169 corrected ff 0.04 0.03 0.03 0.03 0.03 0.02 0.02 0.02 0.02	10.562 46.584 -105.663 39.272 low (m ³ .s ⁻¹)	0.04 0.035 0.03 0.025 0.025 0.015 0.01 0.005				
	B ring C8 ring open ressure (Pa) 65.4 60.3 55.1 50.3 45.2 40.4 35.5 30.3 25.1 20.2 log pressure 4.1805 4.0993 4.0091 3.9180 3.8111 3.6988 3.5695	467.1291 287.5855 144.6206 980.165 corrected f 0.04 0.03 0.03 0.03 0.03 0.03 0.03 0.02 0.02	10.562 46.584 -105.663 39.272 low (m ³ .s ⁻¹)	0.04 0.035 0.03 0.025 (g) 0.02 0.015 0.01 0.005	-371.786	991.4565	-189.398	0.9426
	B ring C8 ring open ressure (Pa) 65.4 60.3 55.1 50.3 45.2 40.4 35.5 30.3 25.1 20.2 log pressure 4.1805 4.0993 4.0091 3.9180 3.8111 3.6988 3.6695 3.4111	467.1291 287.5855 144.6206 980.169 corrected ff 0.04 0.03 0.03 0.03 0.03 0.03 0.02 0.02 0.02	10.562 46.584 -105.663 39.272 low (m ³ .s ⁻¹)	0.04 0.035 0.03 0.025 0.025 0.015 0.01 0.005	-371.786	991.4565	-189.398	
	B ring C8 ring open ressure (Pa) 65.4 60.3 55.1 50.3 45.2 40.4 35.5 30.3 25.1 20.2 log pressure 4.1805 4.0993 3.9180 3.8111 3.6988 3.5695 3.4111 3.2229	467.1291 287.5855 144.6206 980.165 corrected f 0.04 0.03 0.02 0.02 0.02 0.02 0.02 0.02 0.02	10.562 46.584 -105.663 39.272 (ow (m ³ .s ⁻¹)	0.04 0.035 0.03 0.025 (g) 0.02 0.015 0.01 0.005	-371.786	991.4565	-189.398	0.9426
	B ring C8 ring open ressure (Pa) 65.4 60.3 55.1 50.3 45.2 40.4 35.5 30.3 25.1 20.2 log pressure 4.1805 4.0993 4.0091 3.9180 3.8111 3.6988 3.6695 3.4111	467.1291 287.5855 144.6206 980.169 corrected ff 0.04 0.03 0.03 0.03 0.03 0.03 0.02 0.02 0.02	10.562 46.584 -105.663 39.272 (ow (m ³ .s ⁻¹)	0.04 0.035 0.03 0.025 (g) 0.02 0.015 0.01 0.005	-371.786	991.4565	-189.398	0.9426
	B ring C8 ring open ressure (Pa) 65.4 60.3 55.1 50.3 45.2 40.4 35.5 30.3 25.1 20.2 log pressure 4.1805 4.0993 3.9180 3.8111 3.6988 3.5695 3.4111 3.2229	467.1291 287.5855 144.6206 980.165 corrected f 0.04 0.03 0.02 0.02 0.02 0.02 0.02 0.02 0.02	10.562 46.584 -105.663 39.272 (ow (m ³ .s ⁻¹)	0.04 0.035 0.03 0.025 (g) 0.02 0.015 0.01 0.005	-371.786	991.4565	-189.398	0.9426
	B ring C8 ring open ressure (Pa) 65.4 60.3 55.1 50.3 45.2 40.4 35.5 30.3 25.1 20.2 log pressure 4.1805 4.0993 3.9180 3.8111 3.6988 3.5695 3.4111 3.2229	467.1291 287.5855 144.6206 980.165 corrected f 0.04 0.03 0.02 0.02 0.02 0.02 0.02 0.02 0.02	10.562 46.584 -105.663 39.272 (ow (m ³ .s ⁻¹)	0.04 0.035 0.03 0.025 (g) 0.02 0.015 0.01 0.005	-371.786	991.4565	-189.398	0.9426
Calculated by:	B ring C8 ring open ressure (Pa) 65.4 60.3 55.1 50.3 45.2 40.4 35.5 30.3 25.1 20.2 log pressure 4.1805 4.0993 3.9180 3.8111 3.6988 3.5695 3.4111 3.2229	467.1291 287.5855 144.6206 980.165 corrected f 0.04 0.03 0.02 0.02 0.02 0.02 0.02 0.02 0.02	10.562 46.584 -105.663 39.272 low (m ³ .s ⁻¹)	0.04 0.035 0.03 0.025 (g) 0.02 0.015 0.01 0.005	-371.786	991.4565	-189.398	0.9426
	B ring C8 ring open ressure (Pa) 65.4 60.3 55.1 50.3 45.2 40.4 35.5 30.3 25.1 20.2 log pressure 4.1805 4.0993 3.9180 3.8111 3.6988 3.5695 3.4111 3.2229	467.1291 287.5855 144.6206 980.165 corrected f 0.04 0.03 0.02 0.02 0.02 0.02 0.02 0.02 0.02	10.562 46.584 -105.663 39.272 (ow (m ³ .s ⁻¹)	0.04 0.035 0.03 0.025 (g) 0.02 0.015 0.01 0.005	-371.786	991.4565	-189.398	0.9426
Calculated by: Checked by:	B ring C8 ring open ressure (Pa) 65.4 60.3 55.1 50.3 45.2 40.4 35.5 30.3 25.1 20.2 log pressure 4.1805 4.0993 3.9180 3.8111 3.6988 3.5695 3.4111 3.2229	467.1291 287.5855 144.6206 980.165 corrected f 0.04 0.03 0.02 0.02 0.02 0.02 0.02 0.02 0.02	10.562 46.584 -105.663 39.272 low (m ³ .s ⁻¹)	0.04 0.035 0.03 0.025 (g) 0.02 0.015 0.01 0.005	-371.786	991.4565	-189.398	0.9426
Calculated by:	B ring C8 ring open ressure (Pa) 65.4 60.3 55.1 50.3 45.2 40.4 35.5 30.3 25.1 20.2 log pressure 4.1805 4.0993 3.9180 3.8111 3.6988 3.5695 3.4111 3.2229	467.1291 287.5855 144.6206 980.165 corrected f 0.04 0.03 0.02 0.02 0.02 0.02 0.02 0.02 0.02	10.562 46.584 -105.663 39.272 low (m ³ .s ⁻¹)	0.04 0.035 0.03 0.025 (g) 0.02 0.015 0.01 0.005	-371.786	991.4565	-189.398	0.9426

	Westridge		Envelope an			m ²		
Project	Gales Place		Building volu		186.7	m°		
Plot No.	A		Target ach		0.649			
Job No.	B6014		Measured a	ANN DANSON COMPANY	0.57	3.00 2	PASS	
Test date	5 Jan 17		Measured p	1999 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 -		m³/(h.m²)		
Time of test	13.25		Air flow expo		0.725		ok	
Tested by	Shaun Madd	ison		coefficient, r ²	1.000		ok	
Fan/Manometer No.	CLR 698		Air flow coef		0.002			
Calibration due	18 Feb 17			coefficient, CL		3 -1		
Thermo/Barom No.	MTL 017		Air leakage	1	0.03			
Calibration due	5 Jul 17		Equivalent le	eakage area	0.01	m*		
Depressurisation Test	At start	At end						
Wind speed	1	1.2	m.s ⁻¹		pv (internal)	616.598		
Barometric pressure	1023	1023	mbar		pv (external)	357.239	100 million (1996)	
Internal temperature	10.3	9.8	°C		sity (internal)		kg/m ³	
External temperature	2.1	2.2	°C	air dens	ity (external)	1.293	kg/m ³	
Zero flow +ve average Zero flow -ve average	0.0 -0.5	0.0 -0.6	pascals pascals					
Overall Zero flow avera		-0.6	pascals	Minneapolis	Retrotec	Retrotec	Retrotec	1
				door	219	218	269	
	pressure	flow		blower	open	open	open	G54
	(Pa)	(m ³ .hour ⁻¹)		(m ³ .hour ⁻¹)	(Pa)	(Pa)	(Pa)	(m ³ .s ⁻¹)
1		125		125				
3		111		111				
4	50.3	104		104				
5		97		97				
6 7	40.1	88		88				
8		72		72				-
9		64		64				
10	20.3	54	4	54				
	A ring		10.562	2				
corrected p	B ring C8 ring open oressure (Pa) 65.7 60.9	467.1291 287.5859 144.6206 980.169 corrected f 0.04 0.03	9 46.584 6 -105.663 9 39.272 Flow (m ³ .s ⁻¹)	4 3	-371.786	991.4565	-189.398	0.942
corrected p	B ring C8 ring open oressure (Pa) 65.7 60.9 55.8	287.5859 144.6206 980.169 corrected f	9 46.584 5 -105.663 9 39.272 7 low (m³.s⁻¹) 4	1041.283	-371.786	991.4565	-189.398	0.942
corrected p	B ring C8 ring open oressure (Pa) 65.7 60.9 55.8 50.9	287.5859 144.6206 980.169 corrected f 0.04 0.03 0.03 0.03	9 46.584 5 -105.663 9 39.272 Row (m ³ .s ⁻¹) 4 3 3	1041.283	-371.786	991.4565	-189.398	0.942
corrected p	B ring C8 ring open oressure (Pa) 65.7 60.9 55.8 50.9 45.9	287.5859 144.6206 980.169 corrected f 0.04 0.03 0.03 0.03 0.03	9 46.584 5 -105.663 9 39.272 Row (m ³ .s ⁻¹) 4 3 3 3	1041.283	-371.786	991.4565	-189.398	0.942
corrected p	B ring C8 ring open bressure (Pa) 65.7 60.9 55.8 55.8 50.9 45.9 40.7	287.5859 144.6206 980.169 corrected f 0.04 0.03 0.03 0.03 0.03 0.03	9 46.584 6 -105.663 9 39.272 1000 (m ³ .s ⁻¹) 4 3 3 3 3	0.04	-371.786	991.4565	-189.398	0.942
corrected p	B ring C8 ring open oressure (Pa) 65.7 60.9 55.8 50.9 45.9 40.7 35.8 30.6	287.5855 144.6206 980.165 corrected f 0.04 0.03 0.03 0.03 0.03 0.03 0.03 0.03	 46.584 -105.663 39.272 100w (m³.s⁻¹) 4 3 3 3 3 3 3 3 2 2 	1041.283	-371.786	991.4565	-189.398	0.942
corrected p	B ring C8 ring open bressure (Pa) 65.7 60.9 55.8 50.9 45.9 40.7 35.8 30.6 25.7	287.5855 144.6206 980.165 corrected f 0.04 0.03 0.03 0.03 0.03 0.03 0.03 0.03	 46.584 -105.663 39.272 Now (m³.s⁻¹) 4 3 3 3 2 2 	1041.283	-371.786	991.4565	-189.398	0.942
corrected p	B ring C8 ring open oressure (Pa) 65.7 60.9 55.8 50.9 45.9 40.7 35.8 30.6	287.5855 144.6206 980.165 corrected f 0.04 0.03 0.03 0.03 0.03 0.03 0.03 0.03	 46.584 -105.663 39.272 Now (m³.s⁻¹) 4 3 3 3 2 2 	1041.283	-371.786	991.4565	-189.398	0.94;
	B ring C8 ring open 65.7 60.9 55.8 55.8 55.9 45.9 40.7 35.8 30.6 25.7 20.9	287.5855 144.6206 980.165 corrected f 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.	 46.584 -105.663 39.272 Now (m³.s⁻¹) 4 3 3 3 2 2 	1041.283	-371.786	991.4565	-189.398	0.942
	B ring C8 ring open oressure (Pa) 65.7 60.9 55.8 50.9 45.9 40.7 35.8 30.6 25.7 20.9 log pressure	287.5855 144.6206 980.165 corrected f 0.00 0.03 0.03 0.03 0.03 0.03 0.03 0.0	 46.584 -105.663 39.272 Now (m³.s⁻¹) 3 3 3 3 2 2 	1041.283	-371.786	991.4565	-189.398	0.942
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	B ring C8 ring open oressure (Pa) 65.7 60.9 55.8 50.9 45.9 40.7 35.8 30.6 25.7 20.9 log pressure 4.1843 4.1084 4.0209 3.9289	287.5855 144.6206 980.165 corrected f 0.00 0.03 0.03 0.03 0.03 0.03 0.03 0.0	 46.584 -105.663 39.272 Now (m³.s⁻¹) 3 3 3 2 2 1 8 9 0 	0.04 0.035 0.03 0.025 (5) 0.02 (5) 0.02	-371.786	991.4565	-189.398	0.942
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Certificate of Test

Page 1 of 2

Title: Air tightness test of Plot B, Gales Place, Crawley in accordance with The Passivhaus Standard (generally in accordance with BS EN 13829:2001 [method B])

Certificate of Test Number: 25241

Customer's name & address Westridge Construction Limited Ruskin House Junction Road Bodiam East Sussex TN32 5UP

Our Ref: N950/TR0088 VTC Job No.: 3UL6 Your Ref: Plot B Issue date: 10th January 2017 Date sample(s) received: N/A Sample(s) received from: N/A Sample No.: B6014

Tested by:see adjacent text.

Authorised by:

(position: Engineer)

Moria

S. Collins (position: Principal Engineer)

VINCI Technology Centre UK Limited 01525 859000 info@technology-centre.co.uk www.technology-centre.co.uk

Stanbridge Road, Leighton Buzzard, Bedfordshire, LU7 4QH Registered Office, Watford, England. Registered No.05640885



TECHNOLOGY

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TECHNOLOGY CENTRE

Certificate of Test Number: 25241

Page 2 of 2

1. BUILDING DETAILS

All combustion appliances were turned off and flues sealed. All mechanical ventilation systems were turned off **and** sealed at grilles. All internal doors were open during the test. Sufficient internal openings were provided to ensure pressure equalisation throughout the dwelling. All drainage traps were filled or sealed over. All external doors and windows were closed. All natural ventilation openings were temporarily sealed. Carpets were partly fitted. The single blower door fan was connected to the building via the front door. The entire dwelling was tested.

2. RESULTS

Estimated construction date	2016	
Date and time of test	5 Jan 17	13.25
Building volume	189	m ³ (calculated by Warm Low Energy Building Practice)
Measured air changes per hour	0.623	
Target air changes per hour	0.649	

These calculations comply with ATTMA Technical Standard Appendix A

Plot No. B Target ach 0.649 Job No. B6014 Measured ach 0.63 PASS Test date 5 Jan 17 Measured permeability #DIV/0! m³/(h,m²) Time of test 13.25 Air flow exponent, n 0.692 ok Tested by Shaun Maddison Correlation coefficient, r² 0.999 ok Fan/Manometer No. CLR 698 Air flow coefficient, C _L 0.002 0.03 m³.s¹ Calibration due 18 Feb 17 Air leakage coefficient, C _L 0.002 0.01 m² Pressurisation Test At start At end Ms² 0.01 m² 0.02 633 Barometric pressure 1023 1023 mbar pv (internal) 692.633 Barometric pressure 1023 1023 mbar pv (external) 366.257 Internal temperature 12.4 11.2 °C air density (external) 1.291 kg/m³ Zero flow +ve average 0.0 pascals popen open (Pa) 1 650.1 <td< th=""><th></th><th>Westridge</th><th></th><th>Envelope are</th><th></th><th></th><th></th><th>m²</th><th></th><th></th></td<>		Westridge		Envelope are				m ²		
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$\begin{array}{c c c c c c c c c c c c c c c c c c c $		B ring	467.1291 287.5859	10.562 46.584		F	218 offset	269 GF	269 offset	G54
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		· · · · · · · · · · · · · · · · · · ·				33	-371.786	991.4565	-189.398	0.94
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	corrected pr	essure (Pa)	corrected fl	ow (m ³ .s ⁻¹)						
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$										
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$					0.045	1				
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$										
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$					0.04 -	-			P	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$									1	1
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$					0.035 -				1	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$					0.00	1			1	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$						1		1		
4.1813 -3.2270 4.1051 -3.2791 4.0209 -3.3421 3.9230 -3.4181 3.8188 -3.4909 3.7025 -3.6657 3.4226 -3.7723 3.2367 -3.8776 3.0229 -4.0272 Calculated by: Date: D////4					(spans					
4.1813 -3.2270 4.1051 -3.2791 4.0209 -3.3421 3.9230 -3.4181 3.8188 -3.4909 3.7025 -3.6657 3.4226 -3.7723 3.2367 -3.8776 3.0229 -4.0272 Calculated by: Date: D////4		20.6	0.02		E0.025			¢		
4.1813 -3.2270 4.1051 -3.2271 4.1051 -3.2791 4.0209 -3.3421 3.9230 -3.4181 3.8188 -3.4909 3.7025 -3.6657 3.4226 -3.7723 3.2367 -3.8776 3.0229 -4.0272 Calculated by: Date: D////4	5 m.	00 0500000	log flow		Air flo	1				
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3.9230 -3.4181 3.8188 -3.4909 3.7025 -3.5693 3.5766 -3.6657 3.4226 -3.7723 3.2367 -3.8776 3.0229 -4.0272 Calculated by: Date: D/1/17					0.01	-				
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3.4226 -3.7723 3.2367 -3.8776 3.0229 -4.0272 Calculated by: Date: 0/1/1/4						1				
3.2367 -3.8776 3.0229 -4.0272 Calculated by: Date: 10/1/14						0	20	40	60	80
3.0229 -4.0272 Calculated by: Date: 10/1/17							1	Building pressur	re (Pa)	
AN										
AN			1		11					
Checked by: Date: Date: Date:	Calculated by:	-	2	Date:	10/1/	17				
	Checked by:	AAG	Sund	Date:	10/1/1	7_				
Version 2 - Dec 2013							TE	CHN		v C

Project	Westridge		Envelope an	ea		m²		
Fillect	Gales Place		Building volu	me	188.9	m ³		
Plot No.	в		Target ach		0.649			
Job No.	B6014		Measured ad	:h	0.61		PASS	
Test date	5 Jan 17		Measured pe	ermeability	#DIV/0!	m ³ /(h.m ²)		
Time of test	14.20		Air flow expo		0.688		ok	
Tested by	Shaun Maddi	son	Correlation of		0.999		ok	
Fan/Manometer No.	CLR 698	o o n	Air flow coef		0.002		100 C	
Calibration due	18 Feb 17			coefficient, CL				
				5		m ³ .s ⁻¹		
Thermo/Barom No.	MLT 017		Air leakage I					
Calibration due	5 Jul 17		Equivalent le	akage area	0.01	m*		
Depressurisation Test	At start	At end						
Wind speed	1.1	1.4	m.s ⁻¹		pv (internal)	654.730		
Barometric pressure	1023	1023	mbar		pv (external)	368.870		
Internal temperature	11.2	10.7	°C	air dens	sity (internal)	1.251	kg/m ³	
External temperature	2.6	2.6	°C	air dens	ity (external)	1.291	kg/m ³	
Zero flow +ve average	0.0	0.0	pascals					
Zero flow -ve average	-0.6	-0.9	pascals					
Overall Zero flow average	-0.6	-0.9	pascals	Minneapolis	Retrotec	Retrotec	Retrotec	
		61 e · · · ·	1	door	219	218	269	054
	pressure	flow		blower	open	open	open	G54
	(Pa)	(m ³ .hour ⁻¹)		(m ³ .hour ⁻¹)	(Pa)	(Pa)	(Pa)	(m ³ .s ⁻¹)
1	65.1 60.3	136 129		136 129				
23		129		129				
4		111		120				
5		104		104				
6		96		96				
7		88	5	88				
8		79		79				
9	James and international statements	71		71				
10	20.3	62	2	62				
	A ring B ring C8 ring open	467.1291 287.5859 144.6206	46.584					
corrected p		980.169			-371.786	991.4565	-189.398	0.9420
corrected p	ressure (Pa) 65.9		low (m ³ .s ⁻¹)		-371.786	991.4565	-189.398	0.9420
corrected p	ressure (Pa)	corrected f	low (m ³ .s ⁻¹)		-371.786	991.4565	-189.398	0.9420
corrected p	ressure (Pa) 65.9	corrected fi 0.04	low (m³.s⁻¹)	1041.283	-371.786	991.4565	-189.398	0.9420
corrected p	ressure (Pa) 65.9 61.1 55.8 50.9	corrected fi 0.04 0.03 0.03 0.03	low (m ³ .s ⁻¹)	1041.283	-371.786	991.4565	-189.398	0.9420
corrected p	ressure (Pa) 65.9 61.1 55.8 50.9 46.1	corrected fi 0.04 0.03 0.03 0.03 0.03	low (m ³ .s ⁻¹)	0.045	-371.786	991.4565	-189.398	0.9420
corrected p	ressure (Pa) 65.9 61.1 55.8 50.9 46.1 41.0	corrected fl 0.04 0.03 0.03 0.03 0.03 0.03	low (m ³ .s ⁻¹)	0.045	-371.786	991.4565	-189.398	0.9420
corrected p	ressure (Pa) 65.9 61.1 55.8 50.9 46.1 41.0 36.0	corrected fl 0.04 0.03 0.03 0.03 0.03 0.03 0.03	low (m ³ .s ⁻¹)	0.045	-371.786	991.4565	-189.398	0.9420
corrected p	ressure (Pa) 65.9 61.1 55.8 50.9 46.1 41.0 36.0 30.8	corrected fi 0.04 0.03 0.03 0.03 0.03 0.03 0.03 0.03	low (m ³ .s ⁻¹)	0.045	-371.786	991.4565	-189.398	0.9420
corrected p	ressure (Pa) 65.9 61.1 55.8 50.9 46.1 41.0 36.0 30.8 25.9	corrected fi 0.04 0.03 0.03 0.03 0.03 0.03 0.03 0.02 0.02	low (m ³ .s ⁻¹)	0.045	-371.786	991.4565	-189.398	0.9420
corrected p	ressure (Pa) 65.9 61.1 55.8 50.9 46.1 41.0 36.0 30.8	corrected fi 0.04 0.03 0.03 0.03 0.03 0.03 0.03 0.03	low (m ³ .s ⁻¹)	0.045	-371.786	991.4565	-189.398	0.9426
	ressure (Pa) 65.9 61.1 55.8 50.9 46.1 41.0 36.0 30.8 25.9 21.1	corrected fi 0.04 0.03 0.03 0.03 0.03 0.03 0.02 0.02 0.02	low (m ³ .s ⁻¹)		-371.786	991.4565	-189.398	0.9420
	ressure (Pa) 65.9 61.1 55.8 50.9 46.1 41.0 36.0 30.8 25.9	corrected fi 0.04 0.03 0.03 0.03 0.03 0.03 0.02 0.02 0.02	low (m ³ .s ⁻¹)	0.045 0.04 0.035 0.03 0.03 0.03 0.03 0.03 0.03	-371.786	991.4565	-189.398	
	ressure (Pa) 65.9 61.1 55.8 50.9 46.1 41.0 36.0 30.8 25.9 21.1 log pressure 4.1874	corrected fl 0.04 0.03 0.03 0.03 0.03 0.02 0.02 0.02 0.02	low (m ³ .s ⁻¹)		-371.786	991.4565	-189.398	
	rressure (Pa) 65.9 61.1 55.8 50.9 46.1 41.0 36.0 30.8 25.9 21.1 log pressure 4.1874 4.117	corrected fi 0.04 0.04 0.03 0.03 0.03 0.03 0.02 0.02 0.02 0.02	low (m ³ .s ⁻¹)	0.045 0.04 0.035 0.03 (<u>§0.025</u> 0.03 <u>0.03</u> 0.03	-371.786	991.4565	-189.398	
	ressure (Pa) (65.9 61.1 55.8 50.9 46.1 41.0 36.0 30.8 25.9 21.1 log pressure 4.1874 4.1177 4.0209	corrected fi 0.04 0.04 0.03 0.03 0.03 0.03 0.02 0.02 0.02 0.02	low (m ³ .s ⁻¹)	0.045 0.04 0.035 0.03 0.03 0.03 0.03 0.03 0.03	-371.786	991.4565	-189.398	
	ressure (Pa) 65.9 61.1 55.8 50.9 46.1 41.0 36.0 30.8 25.9 21.1 log pressure 4.1874 4.1877 4.0209 3.9289	corrected fl 0.04 0.03 0.03 0.03 0.03 0.02 0.02 0.02 0.02	low (m ³ .s ⁻¹)	0.045 0.04 0.035 0.03 0.03 0.03 0.02 0.015 0.01	-371.786	991.4565	-189.398	
	ressure (Pa) 65.9 61.1 55.8 50.9 46.1 41.0 36.0 30.8 25.9 21.1 log pressure 4.1874 4.1117 4.0209 3.32289 3.8289	corrected fl 0.04 0.03 0.03 0.03 0.03 0.02 0.02 0.02 0.02	low (m ³ .s ⁻¹)	0.045 0.04 0.035 0.03 (<u>§0.025</u> 0.03 <u>§0.025</u> 0.015	-371.786	991.4565	-189.398	
	ressure (Pa) 65.9 61.1 55.8 60.9 46.1 41.0 36.0 30.8 25.9 21.1 log pressure 4.1874 4.1177 4.0209 3.9289 3.8297 3.7124	corrected fi 0.04 0.04 0.03 0.03 0.03 0.03 0.02 0.02 0.02 0.02	low (m ³ .s ⁻¹)	0.045 0.04 0.035 0.03 0.03 0.03 0.03 0.03 0.03 0.0				
	ressure (Pa) 65.9 61.1 55.8 50.9 46.1 41.0 36.0 30.8 25.9 21.1 log pressure 4.1874 4.1177 4.0209 3.9289 3.8297 3.7124 3.5821	corrected fi 0.04 0.04 0.03 0.03 0.03 0.03 0.02 0.02 0.02 0.02	low (m ³ .s ⁻¹)	0.045 0.04 0.035 0.03 0.03 0.03 0.03 0.03 0.03 0.0	-371.786	991.4565	-189.398	0.9426
	ressure (Pa) 65.9 61.1 55.8 60.9 46.1 41.0 36.0 30.8 25.9 21.1 log pressure 4.1874 4.1177 4.0209 3.9289 3.8297 3.7124	corrected fi 0.04 0.04 0.03 0.03 0.03 0.03 0.02 0.02 0.02 0.02	low (m ³ .s ⁻¹)	0.045 0.04 0.035 0.03 0.03 0.03 0.03 0.03 0.03 0.0	20		60	
	ressure (Pa) 65.9 61.1 55.8 60.9 46.1 41.0 36.0 30.8 25.9 21.1 log pressure 4.1874 4.1874 4.1874 4.1874 4.1874 4.1874 3.2829 3.2223 3.7124 3.5821 3.4259 3.2523 3.0469	corrected fl 0.04 0.03 0.03 0.03 0.03 0.02 0.02 0.02 0.02	low (m ³ .s ⁻¹)	0.045 0.04 0.035 0.03 0.03 0.03 0.03 0.03 0.03 0.0	20	40	60	
	ressure (Pa) 65.9 61.1 55.8 50.9 46.1 41.0 36.0 30.8 25.9 21.1 log pressure 4.1874 4.1117 4.0209 3.8289 3.8297 3.7124 3.8221 3.4259 3.2523	corrected fl 0.04 0.03 0.03 0.03 0.02 0.02 0.02 0.02 0.02	low (m ³ .s ⁻¹)	0.045 0.04 0.035 0.03 0.03 0.03 0.03 0.03 0.03 0.0	20	40	60	
	ressure (Pa) 65.9 61.1 55.8 60.9 46.1 41.0 36.0 30.8 25.9 21.1 log pressure 4.1874 4.1874 4.1874 4.1874 4.1874 4.1874 3.2829 3.2223 3.7124 3.5821 3.4259 3.2523 3.0469	corrected fl 0.04 0.03 0.03 0.03 0.02 0.02 0.02 0.02 0.02	low (m ³ .s ⁻¹)	0.045 0.04 0.035 0.03 0.03 0.03 0.03 0.03 0.03 0.0	20	40	60	
	ressure (Pa) 65.9 61.1 55.8 60.9 46.1 41.0 36.0 30.8 25.9 21.1 log pressure 4.1874 4.1874 4.1874 4.1874 4.1874 4.1874 3.2829 3.2223 3.7124 3.5821 3.4259 3.2523 3.0469	corrected fl 0.04 0.03 0.03 0.03 0.02 0.02 0.02 0.02 0.02	low (m ³ .s ⁻¹)	0.045 0.04 0.035 0.03 0.03 0.03 0.03 0.03 0.03 0.0	20	40	60	
	ressure (Pa) 65.9 61.1 55.8 60.9 46.1 41.0 36.0 30.8 25.9 21.1 log pressure 4.1874 4.1874 4.1874 4.1874 4.1874 4.1874 3.2829 3.2223 3.7124 3.5821 3.4259 3.2523 3.0469	corrected fl 0.04 0.03 0.03 0.03 0.02 0.02 0.02 0.02 0.02	low (m ³ .s ⁻¹)	0.045 0.04 0.035 0.03 0.03 0.03 0.03 0.03 0.03 0.0	20	40	60	
Calculated by:	ressure (Pa) 65.9 61.1 55.8 60.9 46.1 41.0 36.0 30.8 25.9 21.1 log pressure 4.1874 4.1874 4.1874 4.1874 4.1874 4.1874 3.2829 3.2223 3.7124 3.5821 3.4259 3.2523 3.0469	corrected fl 0.04 0.03 0.03 0.03 0.02 0.02 0.02 0.02 0.02	low (m ³ .s ⁻¹)	0.045 0.04 0.035 0.03 0.03 0.03 0.03 0.03 0.03 0.0	20	40 Building pressu	60	80

PROPERTY OF

Certificate of Test

Page 1 of 2

Title:

Air tightness test of Plot C, Gales Place, Crawley in accordance with The Passivhaus Standard (generally in accordance with BS EN 13829:2001 [method B])

Certificate of Test Number: 25242

Customer's name & address Westridge Construction Limited Ruskin House Junction Road Bodiam East Sussex TN32 5UP

Our Ref: N950/TR0088 VTC Job No.: 3UL6 Your Ref: Plot C Issue date: 9th January 2017 Date sample(s) received: N/A Sample(s) received from: N/A Sample No.: B6014

Tested by:see adjacent text. Shaun Maddison (position: Engineer) axour

Authorised by:

S. Collins (position: Principal Engineer)

VINCI Technology Centre UK Limited 01525 859000 info@technology-centre.co.uk www.technology-centre.co.uk

Stanbridge Road, Leighton Buzzard, Bedfordshire, LU7 4QH Registered Office, Watford, England. Registered No.05640885



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TECHNOLOGY CENTRE

Certificate of Test Number: 25242

1. BUILDING DETAILS

All combustion appliances were turned off and flues sealed. All mechanical ventilation systems were turned off and sealed at grilles. All internal doors were open during the test. Sufficient internal openings were provided to ensure pressure equalisation throughout the dwelling. All drainage traps were filled or sealed over. All external doors and windows were closed. All natural ventilation openings were temporarily sealed. Carpets were partly fitted. The single blower door fan was connected to the building via the front door. The entire dwelling was tested.

2. RESULTS

Estimated construction date	2016	
Date and time of test	5 Jan 17	15.05
Building volume	187 n	n ³ (calculated by Warm Low Energy Building Practice)
Measured air changes per hour	0.606	
Target air changes per hour	0.649	

These calculations comply with ATTMA Technical Standard Appendix A

-	Gales Place		Envelope are Building volu		186.7	m ² m ³		
	5		Target ach		0.649			
	36014		Measured ac		0.61		PASS	
	5 Jan 17		Measured pe	and the second se	#DIV/0!	m ³ /(h.m ²)		
	15.05		Air flow expo	Control of the Control of Control	0.747		ok	
	Shaun Maddis	son	Correlation c		0.999		ok	
-	CLR 698		Air flow coeff		0.002			
	18 Feb 17		Air leakage o	oefficient, CL	0.002			
	VITL 017		Air leakage r		0.03	m ³ .s ⁻¹		
	5 Jul 17		Equivalent le		0.01			
Pressurisation Test	At start	At end						
Wind speed	0.8	0.9	m.s ⁻¹		pv (internal)			
Barometric pressure	1023	1023	mbar		pv (external)			
Internal temperature External temperature	10.4	9.7 2.7	°C ℃		sity (internal) ity (external)		3 kg/m ³) kg/m ³	
Zero flow +ve average	. 0.0	0.0	pascals	all uells	ity (external)	1.290	/ Ng/III	
Zero flow -ve average	-0.4	-0.4	pascals					
Overall Zero flow average	-0.4	-0.4	pascals	Minneapolis	Retrotec	Retrotec	Retrotec	
	1	61 e	1	door	219	218	269	054
	pressure (Re)	flow (m ³ hour ⁻¹)		blower (m ³ hour ⁻¹)	open (Pa)	open (Pa)	open (Re)	G54
1	(Pa) 65.2	(m ³ .hour ⁻¹) 135		(m ³ .hour ⁻¹) 135	(Pa)	(Pa)	(Pa)	(m ³ .s ⁻¹)
2	60.0	128		128				
3	55.1	119	9	119				
4	50.1	110		110				
5	45.3 40.0	102		102 93			-	
7	35.2	93		84				
8	30.4	76		76				
9	25.3	67		67				
10	20.1	57	1	57				
corrected pre	B ring C8 ring open essure (Pa) o	287.5859 144.6206 980.169	-105.663 39.272	1041.283	-371.786	991.4565	5 -189.398	0.9426
	65.6 60.4 55.5 50.5 45.7 40.4	0.04 0.04 0.03 0.03 0.03	4 4 3 3 3	0.045				
	60.4 55.5 50.5	0.04 0.04 0.03 0.03	4 4 3 3 3 3					
	60.4 55.5 50.5 45.7 40.4 35.6 30.8	0.04 0.03 0.03 0.03 0.03 0.03 0.03 0.02	4 4 3 3 3 3 2 2	0.04				
	60.4 55.5 50.5 45.7 40.4 35.6 30.8 25.7	0.04 0.03 0.03 0.03 0.03 0.03 0.03 0.03	4 4 3 3 3 3 3 2 2 2 2	0.04				
	60.4 55.5 50.5 45.7 40.4 35.6 30.8	0.04 0.03 0.03 0.03 0.03 0.03 0.03 0.02	4 4 3 3 3 3 3 2 2 2 2	0.04				
	60.4 55.5 50.5 45.7 40.4 35.6 30.8 25.7 20.5	0.04 0.03 0.03 0.03 0.03 0.03 0.03 0.03	4 4 3 3 3 3 3 2 2 2 2	0.04				
	60.4 55.5 50.5 45.7 40.4 35.6 30.8 25.7 20.5	0.04 0.03 0.03 0.03 0.03 0.03 0.03 0.03	4 4 3 3 3 3 2 2 2 2 2	0.04 0.035 0.03 (s) 0.025 (s) 0.02 14 0.02				
	60.4 55.5 50.5 45.7 40.4 35.6 30.8 25.7 20.5	0.04 0.03 0.03 0.03 0.03 0.02 0.02 0.02 0.02	4 4 3 3 3 3 2 2 2 2 2 2 2	0.04				
	60.4 55.5 50.5 45.7 40.4 35.6 30.8 25.7 20.5	0.04 0.03 0.03 0.03 0.03 0.03 0.03 0.03	4 4 3 3 3 3 2 2 2 2 2 2 2 2 2 5	0.04 0.035 0.03 (s) 0.025 (s) 0.02 14 0.02	6			
	60.4 55.5 50.5 45.7 40.4 35.6 30.8 25.7 20.5 bg pressure 4.1836 4.1010 4.0164 3.9220	0.04 0.04 0.03 0.03 0.03 0.03 0.03 0.03	4 4 3 3 3 3 2 2 2 2 2 2 2 2 2 2 2 2 2 2	0.04 0.035 0.03 (sc)0.025 0.02 0.015 0.01				
	60.4 55.5 50.5 45.7 40.4 35.6 30.8 25.7 20.5 9g pressure 4.1836 4.1010 4.0164 3.9220 3.8221	0.04 0.05 0.05 0.05 0.05 0.05 0.05 0.05	4 4 3 3 3 2 2 2 2 2 2 2 2 5 4 4 0 5 5	0.04 0.035 0.03 (%)0.025 0.025 0.025 VU VU 0.015				
	60.4 55.5 50.5 45.7 40.4 35.6 30.8 25.7 20.5 90 pressure 4.1836 4.1010 4.0164 3.9220 3.8221 3.6988	0.0- 0.04 0.05 0.05 0.05 0.05 0.05 0.05 0.05	4 4 3 3 3 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	0.04 0.035 0.03 (50,025 0.02 0.015 0.01 0.01 0.005				
	60.4 55.5 50.5 45.7 40.4 35.6 30.8 25.7 20.5 9g pressure 4.1836 4.1010 4.0164 3.9220 3.8221	0.04 0.05 0.05 0.05 0.05 0.05 0.05 0.05	4 4 3 3 3 3 2 2 2 2 2 2 2 2 2 5 5 4 0 0 5 9 9 7 8	0.04 0.035 0.03 0.03 0.02 0.02 0.015 0.01 0.005	20	40	60	
	60.4 55.5 50.5 45.7 40.4 35.6 30.8 25.7 20.5 9g pressure 4.1836 4.1010 4.0164 3.9220 3.8221 3.6988 3.5723 3.4275 3.2465	0.0- 0.04 0.05 0.05 0.05 0.05 0.05 0.05 0.05	4 4 3 3 3 2 2 2 2 2 2 2 2 2 2 2 5 4 4 0 5 5 9 9 7 8 8 8	0.04 0.035 0.03 (50,025 0.02 0.015 0.01 0.01 0.005	20	40 Building press		80
	60.4 55.5 50.5 45.7 40.4 35.6 30.8 25.7 20.5 9 pressure 4.1836 4.1010 4.0164 3.9220 3.8221 3.8221 3.6988 3.5723 3.4275	0.04 0.05 0.05 0.05 0.05 0.05 0.05 0.05	4 4 3 3 3 2 2 2 2 2 2 2 2 2 2 2 5 4 4 0 5 5 9 9 7 8 8 8	0.04 0.035 0.03 (50,025 0.02 0.015 0.01 0.01 0.005	20			80
	60.4 55.5 50.5 45.7 40.4 35.6 30.8 25.7 20.5 9g pressure 4.1836 4.1010 4.0164 3.9220 3.8221 3.6988 3.5723 3.4275 3.2465	0.0- 0.04 0.05 0.05 0.05 0.05 0.05 0.05 0.05	4 4 3 3 3 2 2 2 2 2 2 2 2 2 2 2 5 4 4 0 5 5 9 9 7 8 8 8	0.04 0.035 0.03 (50,025 0.02 0.015 0.01 0.01 0.005	20			eo
	60.4 55.5 50.5 45.7 40.4 35.6 30.8 25.7 20.5 9g pressure 4.1836 4.1010 4.0164 3.9220 3.8221 3.6988 3.5723 3.4275 3.2465	0.0- 0.04 0.05 0.05 0.05 0.05 0.05 0.05 0.05	4 4 3 3 3 3 2 2 2 2 2 2 2 2 2 2 2 2 2 2	0.04 0.035 0.03 (50,025 0.02 0.015 0.01 0.01 0.005	20			
	60.4 55.5 50.5 45.7 40.4 35.6 30.8 25.7 20.5 9g pressure 4.1836 4.1010 4.0164 3.9220 3.8221 3.6988 3.5723 3.4275 3.2465	0.0- 0.04 0.05 0.05 0.05 0.05 0.05 0.05 0.05	4 4 3 3 3 2 2 2 2 2 2 2 2 2 2 2 5 4 4 0 5 5 9 9 7 8 8 8	0.04 0.035 0.03 (50,025 0.02 0.015 0.01 0.01 0.005	20			
Ic Calculated by:	60.4 55.5 50.5 45.7 40.4 35.6 30.8 25.7 20.5 9g pressure 4.1836 4.1010 4.0164 3.9220 3.8221 3.6988 3.5723 3.4275 3.2465	0.0- 0.04 0.05 0.05 0.05 0.05 0.05 0.05 0.05	4 4 3 3 3 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	0.04 0.035 0.03 (50,025 0.02 0.015 0.01 0.01 0.005	20			80
la	60.4 55.5 50.5 45.7 40.4 35.6 30.8 25.7 20.5 9g pressure 4.1836 4.1010 4.0164 3.9220 3.8221 3.6988 3.5723 3.4275 3.2465	0.0- 0.04 0.05 0.05 0.05 0.05 0.05 0.05 0.05	4 4 3 3 3 3 2 2 2 2 2 2 2 2 2 2 2 2 2 2	0.04 0.035 0.03 (50,025 0.02 0.015 0.01 0.01 0.005	20			EQ

Project	Westridge Gales Place		Envelope area m ² Building volume 188.9 m ³ Target ach 0.649					
Job No.	C 86014	1	Target ach Measured ac		0.60		PASS	
	B6014		Measured ac Measured pe	No. of Concession, Name of Concession, Name of Street, or other	#DIV/0! r		100	
Test date	5 Jan 17		Air flow expo		#DIV/01 F		ok	
Time of test	15.20 Shows Model		Concernance and the second second					
	Shaun Maddi	son	Correlation c		1.000	0	ok	
	CLR 698		Air flow coeff		0.002			
Calibration due	18 Feb 17			coefficient, CL	0.002	3 .1		
Thermo/Barom No.	MTL 017		Air leakage r		0.03 r			
Calibration due	5 Jul 17		Equivalent le	akage area	0.01 r	m²		
Depressurisation Test	At start	At end				500 000		
Wind speed	1.2	1	m.s ⁻¹		pv (internal)	586.329		
Barometric pressure	1023 9.5	1023	mbar °C		pv (external)	370.183 1.259	calm ³	
Internal temperature	9.5	9.1 2.6	°C		sity (internal)	1.299		
External temperature Zero flow +ve average	0.0	0.0	pascals	all dens	ity (external)	1.290	kg/m	
Zero flow -ve average	-0.8	-1.1	pascals					
Overall Zero flow average		-1.1	pascals	Minneapolis	Retrotec	Retrotec	Retrotec	
				door	219	218	269	
	pressure	flow		blower	open	open	open	G54
	(Pa)	(m ³ .hour ⁻¹)		(m ³ .hour ⁻¹)	(Pa)	(Pa)	(Pa)	(m ³ .s ⁻¹)
1	65.1	133		133				
2		126		126 119				
3		119		119				
4 5		103		103				
6		95		95				
7		87		87				
8		78		78				
9 10		69 58		69 58				
	A ring B ring C8 ring open	219 GF 467.1291 287.5859 144.6206 980.169	10.562 46.584 -105.663		218 offset -371.786	269 GF 991.4565	269 offset -189.398	G54 GF 0.9426
corrected p	ressure (Pa)	corrected fl	ow (m ³ .s ⁻¹)					
	66.1	0.04						
	61.3	0.04		0.045				
	56.3	0.03						
	51.2	0.03		0.04			0	
	46.0	0.03		0.035			1º	
	41.1 36.3	0.03		0.035			ø	
	31.1	0.02		0.03			/	
	26.2	0.02				1		
	21.0	0.02		£0.025				
) MC		1		
				- 0.00		1		
		Contractory of the local sectory of the local secto		1 2 0.02	1	0	1	
	log pressure	log flow		(\$),0.025	5	0		
	4.1904	-3.2737		€ 0.02 ₹ 0.015	5			
	4.1904 4.1150	-3.2737 -3.3278	3		5			
	4.1904	-3.2737	3	0.015	5			
	4.1904 4.1150 4.0298	-3.2737 -3.3278 -3.3849	3 9 5	0.015	5			
	4.1904 4.1150 4.0298 3.9348 3.8276 3.7148	-3.2737 -3.3278 -3.3849 -3.4545 -3.5293 -3.6102	3 5 3 2	0.015	5			
	4.1904 4.1150 4.0298 3.9348 3.8276 3.7148 3.5904	-3.2737 -3.3278 -3.3849 -3.4545 -3.5293 -3.6102 -3.6982	3 5 3 2 2	0.015	20	40	60	80
	4.1904 4.1150 4.0298 3.9348 3.8276 3.7148 3.5904 3.4356 3.2638	-3.2737 -3.3278 -3.3849 -3.4545 -3.5293 -3.6102 -3.6982 -3.6982 -3.8074 -3.9300	3 5 5 2 2 2 4 0	0.015	20	40 Building pressure	60 (Pa)	80
	4.1904 4.1150 4.0298 3.9348 3.8276 3.7148 3.5904 3.4356	-3.2737 -3.3278 -3.3849 -3.4545 -3.5293 -3.6102 -3.6982 -3.8074	3 5 5 2 2 2 4 0	0.015				80
Calculated by:	4.1904 4.1150 4.0298 3.9348 3.8276 3.7148 3.5904 3.4356 3.2638	-3.2737 -3.3278 -3.3849 -3.4545 -3.5293 -3.6102 -3.6982 -3.6982 -3.8074 -3.9300	3 5 5 2 2 2 4 0	0.015				80
	4.1904 4.1150 4.0298 3.9348 3.8276 3.7148 3.5904 3.4356 3.2638	-3.2737 -3.3278 -3.3849 -3.4545 -3.5293 -3.6102 -3.6982 -3.6982 -3.8074 -3.9300	8 5 5 2 2 2 4 5 5	0.015				80

Certificate of Test

Page 1 of 2

Title: Air tightness test of Plot D, Gales Place, Crawley in accordance with The Passivhaus Standard (generally in accordance with BS EN 13829:2001 [method B])

Certificate of Test Number: 25243

Customer's name & address Westridge Construction Limited Ruskin House Junction Road Bodiam East Sussex TN32 5UP

Our Ref: N950/TR0088 VTC Job No.: 3UL6 Your Ref: Plot D Issue date: 10th January 2017 Date sample(s) received: N/A Sample(s) received from: N/A Sample No.: B6014

Tested by:see adjacent text.....

(position: Engineer) Authorised by:

S. Collins (position: Principal Engineer)

VINCI Technology Centre UK Limited 01525 859000 info@technology-centre.co.uk www.technology-centre.co.uk

Stanbridge Road, Leighton Buzzard, Bedfordshire, LU7 4QH Registered Office, Watford, England. Registered No.05640885

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TECHNOLOGY CENTRE

Certificate of Test Number: 25243

1. BUILDING DETAILS

All combustion appliances were turned off and flues sealed. All mechanical ventilation systems were turned off and sealed at grilles. All internal doors were open during the test. Sufficient internal openings were provided to ensure pressure equalisation throughout the dwelling. All drainage traps were filled or sealed over. All external doors and windows were closed. All natural ventilation openings were temporarily sealed. Carpets were partly fitted. The single blower door fan was connected to the building via the front door. The entire dwelling was tested.

2. RESULTS

Estimated construction date	2016	
Date and time of test	6 Jan 17	11.30
Building volume	226	m ³ (calculated by Warm Low Energy Building Practice)
Measured air changes per hour	0.599	
Target air changes per hour	0.649	

These calculations comply with ATTMA Technical Standard Appendix A

	Westridge		Envelope are			m ²		
Project	Gales Place		Building volu		226.3	m°		
Plot No.	D		Target ach		0.649			
Job No.	B6104		Measured ac	h	0.61		PASS	
Test date	6 Jan 17		Measured pe	ermeability	#DIV/0!	m ³ /(h.m ²)		
Time of test	11.30		Air flow expo	inent, n	0.730		ok	
Tested by	Shaun Madd	lison	Correlation of	oefficient, r2	1.000		ok	
Fan/Manometer No.	CLR 698		Air flow coef	ficient, C _{env}	0.002			
Calibration due	18 Feb 17		Air leakage o	coefficient, CL	0.002			
Thermo/Barom No.	MTL 017		Air leakage r	ate, Q ₅₀	0.04	m ³ .s ⁻¹		
	5 Jul 17		Equivalent le		0.01			
		100 10						
Pressurisation Test Wind speed	At start 0	At end 0	m.s ⁻¹		pv (internal)	608.395		
Barometric pressure	1024	1024	mbar		pv (internal) pv (external)	327.793		
Internal temperature	10.1	9.6	°C		sity (internal)		kg/m ³	
External temperature	0.9	1.0	°C		ity (external)	1.300		
Zero flow +ve average	0.0	0.0	pascals		ity (external)	1.000	Ng/III	
Zero flow -ve average	-1.8	-0.9	pascals					
Overall Zero flow average		-0.9	pascals	Minneapolis	Retrotec	Retrotec	Retrotec	
				door	219	218	269	
	pressure	flow		blower	open	open	open	G54
	(Pa)	(m ³ .hour ⁻¹)		(m ³ .hour ⁻¹)	(Pa)	(Pa)	(Pa)	(m ³ .s ⁻¹
1	60.0	152		152				
2	55.2	144		144				
3	50.2	136		136				
4 5	45.2	126		126				
5	40.0 35.1	115 104		115 104				
7	30.3	94		94				
8	25.3	83		83				
9	20.1	71		71				
10	15.2	59	j	59				
	C8 ring open ressure (Pa) 61.4 56.6 51.6 46.6 41.4 36.5 31.7 26.7 21.5 16.6	0.04 0.04 0.04 0.03 0.03 0.03 0.02 0.02	39.272		-371.786	991.4565	-189.398	0.94
	4.1166 4.0351 3.9426 3.8405 3.7221 3.5959 3.4547 3.2828 3.0657 2.8064	-3.1318 -3.1859 -3.2430 -3.3194 -3.4108 -3.5113 -3.6124 -3.7369 -3.8930	9 1 3 3 4 9 0	0.015	20	40 Building pressur	60 re (Pa)	80
Calculated by: Checked by:	Anco	end	Date:	10/17				

Customer	Westridge		Envelope are			m ²		
Project	Gales Place		Building volu		226.3	m*		
Plot No.	D		Target ach		0.649			
Job No.	B6104		Measured ad	and the second se	0.59	310 2.	PASS	
Test date	6 Jan 17		Measured pe			m ³ /(h.m ²)		
Time of test	15.20		Air flow expo		0.743		ok	
Tested by	Shaun Maddi	son	Correlation of		1.000		ok	
Fan/Manometer No.	CLR 698		Air flow coef		0.002			
Calibration due	18 Feb 17			coefficient, CL				
Thermo/Barom No.	MTL 017		Air leakage r	ate, Q ₅₀		m ³ .s ⁻¹		
Calibration due	5 Jul 17		Equivalent le	eakage area	0.01	m ²		
Depressurisation Test	At start	At end						
Wind speed	0	0	m.s ⁻¹		pv (internal)	592.276	1	
Barometric pressure	1024	1024	mbar		pv (external)	331.352	1	
Internal temperature	9.6	9.3	°C	air den	sity (internal)		kg/m ³	
External temperature	1.0	1.2	°C	air dens	sity (external)	1.299	kg/m ³	
Zero flow +ve average	0.0	0.0	pascals					
Zero flow -ve average	-1.1 (-1.1	-1.0 -1.0	pascals	Minneapolis	Retrotec	Retrotec	Retrotec	
Overall Zero flow avera	ų -1.1	-1.0	pascals	door	219	218	269	
	pressure	flow	1	blower	open	open	open	G54
		(m ³ .hour ⁻¹)		(m ³ .hour ⁻¹)	(Pa)	(Pa)	(Pa)	(m3.51
1		147		147	/	v -1	(/	1.1.1
2	55.2	139		139				
3		130		130				
4		121		121				
5		111		111				
7		90		90				
8		79	-	79				
9	20.0	67		67				
10	15.1	55		55				
	A ring B ring C8 ring open	467.1291 287.5859 144.6206 980.169	46.584 -105.663		218 offset -371.786			
corrected p	B ring C8 ring open 61.4 56.3 51.1 46.3 41.2 36.2 31.4 26.3 21.1	287.5859 144.6206 980.169 corrected ff 0.04 0.04 0.03 0.03 0.03 0.03 0.03 0.03	46.584 -105.663 39.272 (low (m ³ .s ⁻¹)	0.05 0.045 0.045 0.045				0.94
corrected p	B ring C8 ring open 61.4 56.3 51.1 46.3 41.2 36.2 31.4 26.3	287.5859 144.6206 980.169 corrected fl 0.04 0.04 0.03 0.03 0.03 0.03 0.03	46.584 -105.663 39.272 (low (m ³ .s ⁻¹)	0.05 0.045 0.045 0.045			5 -189.398	
corrected p	B ring C8 ring open oressure (Pa) 61.4 56.3 51.1 46.3 41.2 36.2 31.4 26.3 21.1 16.2	287.5859 144.6206 980.169 corrected fl 0.04 0.04 0.03 0.03 0.03 0.03 0.02 0.02 0.02	46.584 -105.663 39.272 (low (m ³ .s ⁻¹)	0.05 0.04 0.035 0.04 0.035 0.04 0.035			5 -189.398	
corrected p	B ring C8 ring open oressure (Pa) 61.4 56.3 51.1 46.3 41.2 36.2 31.4 26.3 21.1 16.2 log pressure	287.5859 144.6206 980.169 corrected ff 0.04 0.04 0.03 0.03 0.03 0.03 0.02 0.02 0.02	46.584 -105.663 39.272 low (m ³ .s ⁻¹)	0.05 0.045 0.045 0.045			5 -189.398	
corrected p	B ring C8 ring open oressure (Pa) (61.4 56.3 51.1 46.3 41.2 36.2 31.4 26.3 21.1 16.2 log pressure 4.1166	287.5859 144.6206 980.169 corrected ff 0.04 0.04 0.03 0.03 0.03 0.02 0.02 0.02 0.02	46.584 -105.663 39.272 low (m ³ .s ⁻¹)	0.05 0.04 0.035 0.04 0.035 0.04 0.035			5 -189.398	
corrected p	B ring C8 ring open oressure (Pa) 61.4 56.3 51.1 46.3 41.2 36.2 31.4 26.3 21.1 16.2 log pressure	287.5859 144.6206 980.169 corrected ff 0.04 0.04 0.03 0.03 0.03 0.03 0.02 0.02 0.02	46.584 -105.663 39.272 low (m ³ .s ⁻¹)	0.05 0.04 0.035 0.04 0.035 0.025 0.025 0.025 0.015			5 -189.398	
corrected p	B ring C8 ring open oressure (Pa) 61.4 56.3 51.1 46.3 41.2 36.2 31.4 26.3 21.1 16.2 log pressure 4.1166 4.0298 3.9328 3.8341	287.5859 144.6206 980.169 corrected fi 0.04 0.04 0.03 0.03 0.03 0.03 0.02 0.02 0.02 0.02	46.584 -105.663 39.272 low (m ³ .s ⁻¹)	0.05 0.045 0.045 0.04 0.035 0.035 0.025 0.015 0.01			5 -189.398	
corrected p	B ring C8 ring open oressure (Pa) 61.4 56.3 51.1 46.3 41.2 36.2 31.4 26.3 21.1 16.2 log pressure 4.1166 4.0298 3.9328 3.8341 3.7172	287.5859 144.6206 980.169 corrected ff 0.04 0.04 0.03 0.03 0.03 0.03 0.02 0.02 0.02 0.02	46.584 -105.663 39.272 low (m ³ .s ⁻¹)	0.05 0.04 0.035 0.04 0.035 0.025 0.025 0.025 0.015			5 -189.398	
corrected p	B ring C8 ring open oressure (Pa) (61.4 56.3 51.1 46.3 41.2 36.2 31.4 26.3 21.1 16.2 log pressure 4.1166 4.0298 3.9328 3.8341 3.7172 3.5882	287.5859 144.6206 980.169 2007ected ff 0.04 0.04 0.03 0.03 0.03 0.03 0.03 0.03	46.584 -105.663 39.272 low (m³.s⁻¹)	0.05 0.045 0.045 0.045 0.04 0.035 0.025 0.025 0.015 0.01 0.005			5 -189.398	
corrected p	B ring C8 ring open oressure (Pa) (61.4 56.3 51.1 46.3 3.41.2 36.2 31.4 26.3 21.1 16.2 log pressure 4.1166 4.0298 3.9328 3.8341 3.7172 3.5882 3.4452	287.5859 144.6206 980.169 2007ected ff 0.04 0.04 0.04 0.03 0.03 0.03 0.03 0.02 0.02 0.02 0.02	46.584 -105.663 39.272 low (m ³ .s ⁻¹) - - - - - - - - - - - - - - - - - - -	0.05 0.045 0.045 0.04 0.035 0.035 0.025 0.015 0.01			5 -189.398	0.94
corrected p	B ring C8 ring open oressure (Pa) (61.4 56.3 51.1 46.3 41.2 36.2 31.4 26.3 21.1 16.2 log pressure 4.1166 4.0298 3.9328 3.8341 3.7172 3.5882 3.4452 3.2677	287.5859 144.6206 980.169 corrected fi 0.04 0.04 0.03 0.03 0.03 0.03 0.02 0.02 0.02 0.02	46.584 -105.663 39.272 low (m ³ .s ⁻¹)	1041.283	-371.786	991.4566	5 -189.398	0.94
corrected p	B ring C8 ring open oressure (Pa) (61.4 56.3 51.1 46.3 3.41.2 36.2 31.4 26.3 21.1 16.2 log pressure 4.1166 4.0298 3.9328 3.8341 3.7172 3.5882 3.4452	287.5859 144.6206 980.169 2007ected ff 0.04 0.04 0.04 0.03 0.03 0.03 0.03 0.02 0.02 0.02 0.02	46.584 -105.663 39.272 low (m ³ .s ⁻¹)	1041.283	-371.786	991.4566	5 -189.398	
corrected p	B ring C8 ring open oressure (Pa) 61.4 56.3 51.1 46.3 41.2 36.2 31.4 26.3 21.1 16.2 log pressure 4.1166 4.0298 3.9328 3.8341 3.7172 3.5882 3.4452 3.2457 3.0469	287.5859 144.6206 980.169 corrected fi 0.04 0.04 0.03 0.03 0.03 0.03 0.03 0.02 0.02 0.02	46.584 -105.663 39.272 low (m ³ .s ⁻¹)	1041.283	-371.786	991.4566	5 -189.398	0.94
corrected p	B ring C8 ring open oressure (Pa) 61.4 56.3 51.1 46.3 41.2 36.2 31.4 26.3 21.1 16.2 log pressure 4.1166 4.0298 3.9328 3.8341 3.7172 3.5882 3.4452 3.2457 3.0469	287.5859 144.6206 980.169 corrected fi 0.04 0.04 0.03 0.03 0.03 0.03 0.03 0.02 0.02 0.02	46.584 -105.663 39.272 low (m ³ .s ⁻¹)	1041.283	-371.786	991.4566	5 -189.398	0.94
	B ring C8 ring open oressure (Pa) 61.4 56.3 51.1 46.3 41.2 36.2 31.4 26.3 21.1 16.2 log pressure 4.1166 4.0298 3.9328 3.8341 3.7172 3.5882 3.4452 3.2457 3.0469	287.5859 144.6206 980.169 corrected fi 0.04 0.04 0.03 0.03 0.03 0.03 0.03 0.02 0.02 0.02	46.584 -105.663 39.272 low (m ³ .s ⁻¹)	1041.283	-371.786	991.4566	5 -189.398	0.94
Calculated by: Checked by:	B ring C8 ring open oressure (Pa) 61.4 56.3 51.1 46.3 41.2 36.2 31.4 26.3 21.1 16.2 log pressure 4.1166 4.0298 3.9328 3.8341 3.7172 3.5882 3.4452 3.2457 3.0469	287.5859 144.6206 980.169 corrected fi 0.04 0.04 0.03 0.03 0.03 0.03 0.03 0.02 0.02 0.02	46.584 -105.663 39.272 -100 (m ³ .s ⁻¹)	1041.283	-371.786	991.4565	5 -189.398	0.94
Calculated by:	B ring C8 ring open oressure (Pa) 61.4 56.3 51.1 46.3 41.2 36.2 31.4 26.3 21.1 16.2 log pressure 4.1166 4.0298 3.9328 3.8341 3.7172 3.5882 3.4452 3.2677 3.0469 2.7819	287.5859 144.6206 980.169 corrected fi 0.04 0.04 0.03 0.03 0.03 0.03 0.03 0.02 0.02 0.02	46.584 -105.663 39.272 -100 (m ³ .s ⁻¹)	1041.283	-371.786	991.4565	5 -189.398	0.94

Certificate of Test

Page 1 of 2

Title: Air tightness test of Plot E, Gales Place, Crawley in accordance with The Passivhaus Standard (generally in accordance with BS EN 13829:2001 [method B])

Certificate of Test Number: 25244

Customer's name & address Westridge Construction Limited Ruskin House Junction Road Bodiam East Sussex TN32 5UP

Our Ref: N950/TR0088 VTC Job No.: 3UL6 Your Ref: Plot E Issue date: 10th January 2017 Date sample(s) received: N/A Sample(s) received from: N/A Sample No.: B6014

Tested by: see adjacent text.

Shaun Maddison (position: Engineer)

Authorised by:

(position: Principal Engineer)

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TECHNOLOGY CENTRE Certificate of Test Number: 25244

Page 2 of 2

1. BUILDING DETAILS

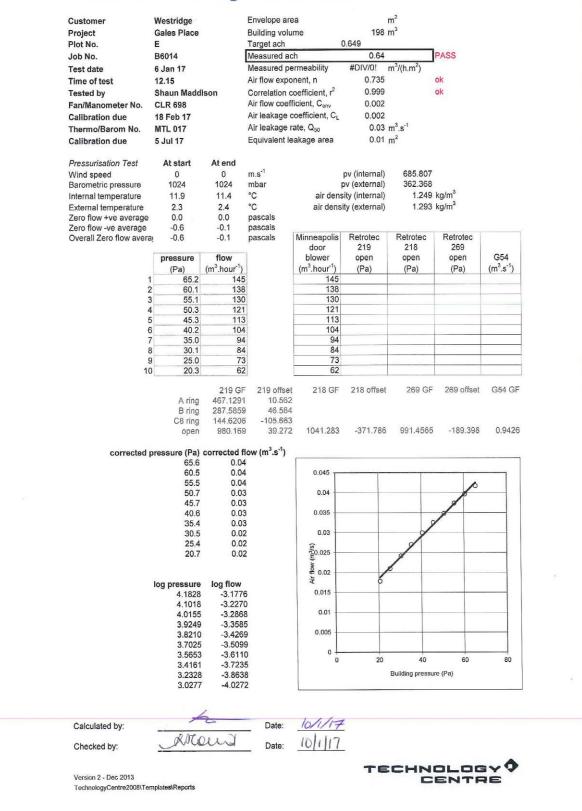
All combustion appliances were turned off and flues sealed. All mechanical ventilation systems were turned off and sealed at grilles. All internal doors were open during the test. Sufficient internal openings were provided to ensure pressure equalisation throughout the dwelling. All drainage traps were filled or sealed over. All external doors and windows were closed. All natural ventilation openings were temporarily sealed. Carpets were partly fitted. The single blower door fan was connected to the building via the front door. The entire dwelling was tested.

2. RESULTS

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Estimated construction date	2016	
Date and time of test	6 Jan 17	12.15
Building volume	198	m ³ (calculated by Warm Low Energy Building Practice)
Measured air changes per hour	0.631	
Target air changes per hour	0.649	

These calculations comply with ATTMA Technical Standard Appendix A



Project Plot No.	Gales Place		Building volu	me	198 r	nĭ		
Plot No.	-							
	E		Target ach	and the second se	0.649			
Job No.	B6014		Measured ac	h	0.63		PASS	
Test date	6 Jan 17		Measured pe			n ³ /(h.m ²)		
Time of test	15.20		Air flow expo	nent, n	0.705		ok	
Tested by	Shaun Madd	ison	Correlation c	oefficient, r ²	1.000		ok	
Fan/Manometer No.	CLR 698		Air flow coeff	icient, C _{env}	0.002			
Calibration due	18 Feb 17		Air leakage o	oefficient, C	0.002			
Thermo/Barom No.	MTL 017		Air leakage r		0.03 r	m ³ s ⁻¹		
Calibration due	5 Jul 17		Equivalent le		0.00 r			
D								
Depressurisation Test Wind speed	At start 0	At end 0	m.s ⁻¹		pv (internal)	663.480		
Barometric pressure	1024	1024	mbar		pv (internal)	367.562		
Internal temperature	11.3	11.0	°C		sity (internal)		kg/m ³	
External temperature	2.5	2.6	°Č		sity (external)		kg/m ³	
Zero flow +ve average		0.0	pascals		ity (external)	1.202	Ng/III	
Zero flow -ve average	-0.1	-0.9	pascals					
Overall Zero flow avera	aj -0.1	-0.9	pascals	Minneapolis	Retrotec	Retrotec	Retrotec	
	P			door	219	218	269	
	pressure	flow		blower	open	open	open	G54
	(Pa)	(m ³ .hour ⁻¹)		(m ³ .hour ⁻¹)	(Pa)	(Pa)	(Pa)	(m ³ .s ⁻¹
1		143		143				
2		136		136				
	3 <u>55.1</u> 4 <u>50.2</u>	128 120		128 120				
5		111		111				
6		102		102				
-		94		94				
8	30.2	85		85				
	9 25.0	74		74				
10	20.1	63	d	63				
	A ring B ring C8 ring open	467.1291 287.5859 144.6206 980.169	46.584 -105.663 39.272	1041.283	-371.786	991.4565	-189.398	0.942
corrected (pressure (Pa)							
	65.5	0.04						
	60.6 55.6	0.04		0.045				
	50.7	0.04		0.04			P	
	45.5	0.03		0.07			P	
	40.8	0.03		0.035			1	
	35.6	0.03				9		
	30.7	0.02		0.03		1		
	25.5	0.02		(s		1		
	20.6	0.02		(\$/E0.025		1		
				MOL 0.02	1	5		
	logrpressure	log flow		Air Air	6			
	4.1821	-3.1940)	0.015				
	4.1043	-3.2442						
	4.0182	-3.3048	3	0.01				
	3.9259	-3.3694						
	3.8177	-3.4473		0.005				
	3.7087	-3.5319		0				
	3.5723	-3.6130		0	20	40	60	80
	3.4243	-3.7142			1	Building pressu	re (Pa)	
	3.0253							
	1							
		4		1.11				
Calculated by:	- A 07	0 M	Date:	10/1/17	-			
Checked by:	Ma	und	_ Date:	10/1/17	-			
					TE		oLog	144
Version 2 - Dec 2013							ENTR	

Certificate of Test

Page 1 of 2

Title:

 Air tightness test of Plot F, Gales Place, Crawley in accordance with The Passivhaus Standard (generally in accordance with BS EN 13829:2001 [method B])

Certificate of Test Number: 25245

Customer's name & address Westridge Construction Limited Ruskin House Junction Road Bodiam East Sussex TN32 5UP

Our Ref: N950/TR0088 VTC Job No.: 3UL6 Your Ref: Plot F Issue date: 10th January 2017 Date sample(s) received: N/A Sample(s) received from: N/A Sample No.: B6014

Tested by:see adjacent text. Shaun Maddison (position: Engineer)

S. Collins (position: Principal Engineer) VINCI Technology Centre UK Limited 01525 859000 info@technology-centre.co.uk

Authorised by: ...

info@technology-centre.co.uk www.technology-centre.co.uk Stanbridge Road, Leighton Buzzard, Bedfordshire, LU7 4QH

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TECHNOLOGY CENTRE

Certificate of Test Number: 25245

Page 2 of 2

1. BUILDING DETAILS

All combustion appliances were turned off and flues sealed. All mechanical ventilation systems were turned off and sealed at grilles. All internal doors were open during the test. Sufficient internal openings were provided to ensure pressure equalisation throughout the dwelling. All drainage traps were filled or sealed over. All external doors and windows were closed. All natural ventilation openings were temporarily sealed. Carpets were partly fitted. The single blower door fan was connected to the building via the front door. The entire dwelling was tested.

2. RESULTS

Estimated construction date	2016	
Date and time of test	6 Jan 17	10.00
Building volume	198	m ³ (calculated by Warm Low Energy Building Practice)
Measured air changes per hour	0.647	
Target air changes per hour	0.649	

These calculations comply with ATTMA Technical Standard Appendix A

Project	Westridge Gales Place		Envelope are Building volu		198 i	m ² m ³		
	Gales Place		-		0.649	n		
Plot No.			Target ach		0.65		FAIL	
Job No.	B6014		Measured ac Measured pe		the second s	m ³ /(h.m ²)	I ALL	
Test date	6 Jan 17		Air flow expo		0.751	n /(n.m.)	ok	
Time of test	10.00				1.000		ok	
Tested by	Shaun Maddi	son	Correlation of				OK	
Fan/Manometer No.	CLR 698		Air flow coef		0.002			
Calibration due	18 Feb 17		the second second	coefficient, CL	0.002	3 .1		
Thermo/Barom No.	MTL 017		Air leakage r		0.04			
Calibration due	5 Jul 17		Equivalent le	eakage area	0.01	m²		
Pressurisation Test	At start	At end						
Wind speed	0	0	m.s ⁻¹		pv (internal)	596.270		
Barometric pressure	1025	1025	mbar	- CONTENT-CONTE	pv (external)	308.257		
Internal temperature	9.8	9.3	°C		sity (internal)		kg/m ³	
External temperature	0.1	0.1	°C	air dens	ity (external)	1.305	kg/m ³	
Zero flow +ve average	0.0	0.0	pascals					
Zero flow -ve average	-0.1	-0.2	pascals	Minnesselie	Detrotes	Detretes	Detrotes	· · · · · · · · · · · · · · · · · · ·
Overall Zero flow average	-0.1	-0.2	pascals	Minneapolis door	Retrotec 219	Retrotec 218	Retrotec 269	
	pressure	flow	1	blower	open	open	open	G54
		(m ³ .hour ⁻¹)		(m ³ .hour ⁻¹)	(Pa)	(Pa)	(Pa)	(m ³ .s ⁻¹
1	a comparison of a sufficient of the Contract of the second se	(11 .11001)		149	(i a)	(i a)	(i ci)	(11.3
2		140		141				
3		133		133				
4		124		124				
5	45.2	114		114				
6	40.1	104		104				
7		95		95				
8		85		85				
9 10	and the second second	74 62		74 62				
		219 GF	*	218 GF	218 offset	269 GF	269 offset	G54 0
	B ring C8 ring open	287.5859 144.6206 980.169	-105.663	l	-371.786	991.4565	-189.398	0.942
corrected p	ressure (Pa)	corrected fl	ow (m ³ .s ⁻¹)					
	65.2 60.3	0.04		0.05				
	55.2	0.04		0.05				
	50.4	0.04		0.045				
	00.1	0.0.						
	45.4	0.03					~	
	45.4 40.3	0.03		0.04				
	40.3 35.5	0.03 0.03		0.04				
	40.3 35.5 30.5	0.03 0.03 0.02		0.04				
	40.3 35.5 30.5 25.4	0.03 0.03 0.02 0.02		0.04				
	40.3 35.5 30.5	0.03 0.03 0.02		0.04		1		
	40.3 35.5 30.5 25.4	0.03 0.03 0.02 0.02		0.04				
	40.3 35.5 30.5 25.4 20.3	0.03 0.03 0.02 0.02 0.02		0.04		/		
	40.3 35.5 30.5 25.4 20.3	0.03 0.03 0.02 0.02		0.04 0.035 (0.03 (0.03 (0.025) (0.025) (0.02		/		
	40.3 35.5 30.5 25.4 20.3	0.03 0.03 0.02 0.02 0.02 0.02		0.04				
	40.3 35.5 30.5 25.4 20.3 log pressure 4.1767	0.03 0.02 0.02 0.02 0.02 log flow -3.1497		0.04 0.035 (0.03 (0.03 (0.025) (0.025) (0.02	6			
	40.3 35.5 30.5 25.4 20.3 log pressure 4.1767 4.0985 4.0101 3.9190	0.03 0.02 0.02 0.02 log flow -3.1497 -3.2048 -3.2633 -3.3333	3	0.04 0.035 0.03 0.025 0.025 0.015 0.01	8			
	40.3 35.5 30.5 25.4 20.3 log pressure 4.1767 4.0985 4.0101 3.9190 3.8144	0.03 0.02 0.02 0.02 0.02 0.02 0.02 0.02		0.04 0.035 (€ 0.03 E0.025 E0.025 E0.022 0.015	6			
	40.3 35.5 30.5 25.4 20.3 log pressure 4.1767 4.0985 4.0101 3.9190 3.8144 3.6951	0.03 0.02 0.02 0.02 0.02 0.02 0.02 0.02		0.04 0.035 (0.03 (0.03 (0.025) (0.025) (0.015) 0.015 0.005	8			
	40.3 35.5 30.5 25.4 20.3 log pressure 4.1767 4.0985 4.0101 3.9190 3.8144 3.6951 3.5681	0.03 0.02 0.02 0.02 0.02 0.02 0.02 0.02	7 9 3 3 4 2 2	0.04 0.035 0.03 0.025 0.025 0.015 0.01	20	40	60	
	40.3 35.5 30.5 25.4 20.3 log pressure 4.1767 4.0985 4.0101 3.9190 3.8144 3.6951 3.5681 3.4161	0.03 0.02 0.02 0.02 0.02 0.02 0.02 0.02	7	0.04 0.035 (m 0.03 분) 0.025 분 전 0.02 0.015 0.01 0.005	20			
	40.3 35.5 30.5 25.4 20.3 log pressure 4.1767 4.0985 4.0101 3.9190 3.8144 3.6951 3.5681	0.03 0.02 0.02 0.02 0.02 0.02 0.02 0.02	7	0.04 0.035 (m 0.03 분) 0.025 분 전 0.02 0.015 0.01 0.005	20	40 Building pressu		
	40.3 35.5 30.5 25.4 20.3 log pressure 4.1767 4.0985 4.0101 3.9190 3.8144 3.6951 3.5681 3.4161 3.4161	0.03 0.02 0.02 0.02 0.02 0.02 0.02 0.02		0.04 0.035 (m 0.03 분) 0.025 분 전 0.02 0.015 0.01 0.005	20			
Calculated by:	40.3 35.5 30.5 25.4 20.3 log pressure 4.1767 4.0985 4.0101 3.9190 3.8144 3.6951 3.5681 3.4161 3.4161	0.03 0.02 0.02 0.02 0.02 0.02 0.02 0.02	7	0.04 0.035 (m 0.03 분) 0.025 분 전 0.02 0.015 0.01 0.005	20			80
	40.3 35.5 30.5 25.4 20.3 log pressure 4.1767 4.0985 4.0101 3.9190 3.8144 3.6951 3.5681 3.4161 3.4161	0.03 0.02 0.02 0.02 0.02 0.02 0.02 0.02		0.04 0.035 (m 0.03 분) 0.025 분 전 0.02 0.015 0.01 0.005	20			80

	Westridge		Envelope an			n ²		
	Gales Place		Building volu		198 r	ກັ		
	F		Target ach		0.649		1	
Job No.	B6014		Measured a		0.64		PASS	
Test date	6 Jan 17		Measured pe			m ³ /(h.m ²)		
Time of test	10.15		Air flow expo	nent, n	0.764		ok	
Tested by	Shaun Maddis	son	Correlation of	coefficient, r ²	0.999		ok	
	CLR 698		Air flow coef		0.002			
	18 Feb 17			coefficient, CL	0.002			
	MTL 017		Air leakage		0.04	m ³ s ⁻¹		
	5 Jul 17		Equivalent le		0.01			
Calibration due	5 501 17		Equivalent	anago area	0.01			
Depressurisation Test	At start	At end						
Wind speed	0	0	m.s ⁻¹		pv (internal)	578.482		
Barometric pressure	1025	1025	mbar		pv (external)	311.628		
Internal temperature	9.3	8.9	°C		sity (internal)		kg/m ³	
External temperature	0.2	0.3	°C	air dens	ity (external)	1.305	kg/m ³	
Zero flow +ve average	0.0	0.0	pascals					
Zero flow -ve average Overall Zero flow average	-0.1 -0.1	-0.5 -0.5	pascals pascals	Minneapolis	Retrotec	Retrotec	Retrotec	
Overall Zero now average	-0.1	-0.5	pascals	door	219	218	269	
1	pressure	flow	1	blower	open	open	open	G54
		(m ³ .hour ⁻¹)		(m ³ .hour ⁻¹)	(Pa)	(Pa)	(Pa)	(m ³ .s ⁻¹)
1	65.3	149		149	/	()	(/	(
2	60.1	140)	140				
3	55.1	131		131				
4	50.2	123		123				
5	45.2	114		114				
6 7	40.0	105		105 94				
8	35.1 30.3	83		83				
9	25.1	73		73				
10	20.2	61		61				
	B ring C8 ring open	287.5859 144.6206 980.169	-105.663		-371.786	991.4565	-189.398	0.942
e e sur e te et e et e et e et e et e et e et	Pacouro (Da)							
corrected p			low (m ³ .s ⁻¹)					
corrected p	65.6	0.04	4	0.05				
corrected p	65.6 60.4	0.04	1 1	0.05				
corrected p	65.6	0.04	4 4 4	0.05				
corrected p	65.6 60.4 55.4	0.04 0.04 0.04	4 4 4 4	0.045				
corrected p	65.6 60.4 55.4 50.5 45.5 40.3	0.04 0.04 0.04 0.03 0.03	4 4 4 3 3					
corrected p	65.6 60.4 55.4 50.5 45.5 40.3 35.4	0.04 0.04 0.04 0.02 0.03 0.03	4 4 4 3 3 3	0.045			ß	
corrected p	65.6 60.4 55.4 50.5 45.5 40.3 35.4 30.6	0.04 0.04 0.04 0.03 0.03 0.03 0.03	4 4 3 3 3 2	0.045				
corrected p	65.6 60.4 55.4 50.5 45.5 40.3 35.4 30.6 25.4	0.04 0.04 0.02 0.03 0.03 0.03 0.03 0.03	4 4 4 3 3 3 2 2	0.045			ſ	
corrected p	65.6 60.4 55.4 50.5 45.5 40.3 35.4 30.6	0.04 0.04 0.04 0.03 0.03 0.03 0.03	4 4 4 3 3 3 2 2	0.045			p	
corrected p	65.6 60.4 55.4 50.5 45.5 40.3 35.4 30.6 25.4	0.04 0.04 0.02 0.03 0.03 0.03 0.03 0.03	4 4 4 3 3 3 2 2	0.045 0.04 0.035 (% 0.03 (% 0.03) 0.025				
	65.6 60.4 55.4 50.5 45.5 40.3 35.4 30.6 25.4	0.04 0.04 0.02 0.03 0.03 0.03 0.03 0.03	4 4 4 3 3 3 2 2	0.045				
	65.6 60.4 55.4 50.5 45.5 40.3 35.4 30.6 25.4 20.5 log pressure 4.1836	0.04 0.04 0.02 0.03 0.03 0.03 0.02 0.02 0.02 0.02	4 4 3 3 3 2 2 2 2	0.045 0.04 0.035 (% 0.03 (% 0.03 0.025		/		
	65.6 60.4 55.4 50.5 45.5 40.3 35.4 30.6 25.4 20.5 00 pressure 4.1836 4.1010	0.04 0.04 0.02 0.03 0.03 0.03 0.03 0.03 0.03 0.03	4 4 3 3 3 2 2 2 2 9 2	0.045 0.04 0.035 (% 0.03 (% 0.03) 0.025				
	65.6 60.4 55.4 50.5 45.5 40.3 35.4 30.6 25.4 20.5 20.5 00 pressure 4.1836 4.1010 4.0146	0.04 0.04 0.04 0.03 0.03 0.03 0.03 0.03	4 4 3 3 3 2 2 2 2 9 2 2 6	0.045 0.04 0.035 (% 0.03 (% 0.03 0.025				
	65.6 60.4 55.4 50.5 45.5 40.3 35.4 30.6 25.4 20.5 kg pressure 4.1836 4.1010 4.0146 3.9220	0.04 0.04 0.04 0.05 0.03 0.03 0.03 0.03 0.03 0.03 0.03	4 4 4 3 3 2 2 2 9 9 2 6 6 7	0.045 0.04 0.035 (fr 0.03 0.025 0.025 0.015 0.01				
	65.6 60.4 55.4 50.5 40.3 35.4 30.6 25.4 20.5 00 pressure 4.1836 4.1010 4.0146 3.9220 3.8177	0.04 0.04 0.04 0.05 0.03 0.03 0.03 0.03 0.03 0.03 0.03	4 4 4 3 3 3 2 2 2 9 2 6 6 7 7 6	0.045 0.04 0.035 (e) 0.03 (e) 0.03 0.025 0.025 0.02 0.015				
	65.6 60.4 55.4 50.5 45.5 40.3 35.4 30.6 25.4 20.5 kg pressure 4.1836 4.1010 4.0146 3.9220	0.04 0.04 0.04 0.05 0.03 0.03 0.03 0.03 0.03 0.03 0.03	4 4 4 3 3 3 2 2 2 2 2 9 2 2 6 6 7 7 6 9 9	0.045 0.04 0.035 (fr 0.03 0.025 0.025 0.015 0.015 0.01 0.005				
	65.6 60.4 55.4 50.5 40.3 35.4 30.6 25.4 20.5 00 pressure 4.1836 4.1010 4.0146 3.9220 3.8177 3.6964	0.04 0.04 0.04 0.03 0.03 0.03 0.03 0.03	4 4 4 3 3 3 2 2 2 2 2 2 5 6 6 9 9 6 6 9 9 6	0.045 0.04 0.035 0.035 0.025 0.025 0.02 0.015 0.01 0.005	20	40	60	
	65.6 60.4 55.4 50.5 45.5 40.3 35.4 30.6 25.4 20.5 40.3 35.4 20.5 4.1836 4.1010 4.0146 3.9220 3.8177 3.6964 3.5667 3.4210 3.2347	0.04 0.04 0.04 0.05 0.03 0.03 0.03 0.03 0.03 0.03 0.03	4 4 4 3 3 3 2 2 2 9 2 2 6 6 7 6 6 9 9 6 0 0 4	0.045 0.04 0.035 (fr 0.03 0.025 0.025 0.015 0.015 0.01 0.005		40 Building pressu		
	65.6 60.4 55.4 50.5 45.5 40.3 35.4 20.5 25.4 20.5 00 pressure 4.1836 4.1010 4.0146 3.9220 3.8177 3.6964 3.5667 3.4210	0.04 0.04 0.04 0.05 0.03 0.03 0.03 0.03 0.03 0.03 0.03	4 4 4 3 3 3 2 2 2 9 2 2 6 6 7 6 6 9 9 6 0 0 4	0.045 0.04 0.035 (fr 0.03 0.025 0.025 0.015 0.015 0.01 0.005				 80
	65.6 60.4 55.4 50.5 45.5 40.3 35.4 30.6 25.4 20.5 40.3 35.4 20.5 4.1836 4.1010 4.0146 3.9220 3.8177 3.6964 3.5667 3.4210 3.2347	0.04 0.04 0.04 0.05 0.03 0.03 0.03 0.03 0.03 0.03 0.03	4 4 4 3 3 3 2 2 2 9 2 2 6 6 7 6 6 9 9 6 0 0 4	0.045 0.04 0.035 (fr 0.03 0.025 0.025 0.015 0.015 0.01 0.005				80
	65.6 60.4 55.4 50.5 45.5 40.3 35.4 30.6 25.4 20.5 40.3 35.4 20.5 4.1836 4.1010 4.0146 3.9220 3.8177 3.6964 3.5667 3.4210 3.2347	0.04 0.04 0.04 0.05 0.03 0.03 0.03 0.03 0.03 0.03 0.03	4 4 4 3 3 3 2 2 2 9 2 2 6 6 7 6 6 9 9 6 0 0 4	0.045 0.04 0.035 (fr 0.03 0.025 0.025 0.015 0.015 0.01 0.005				
Calculated by:	65.6 60.4 55.4 50.5 45.5 40.3 35.4 30.6 25.4 20.5 40.3 35.4 20.5 4.1836 4.1010 4.0146 3.9220 3.8177 3.6964 3.5667 3.4210 3.2347	0.04 0.04 0.04 0.05 0.03 0.03 0.03 0.03 0.03 0.03 0.03	4 4 4 3 3 3 2 2 2 2 9 2 2 6 6 7 6 6 9 9 6 0 0 4 4 0 0 Date:	0.045 0.04 0.035 (fr 0.03 0.025 0.025 0.015 0.015 0.01 0.005				80
	65.6 60.4 55.4 50.5 45.5 40.3 35.4 30.6 25.4 20.5 40.3 35.4 20.5 4.1836 4.1010 4.0146 3.9220 3.8177 3.6964 3.5667 3.4210 3.2347	0.04 0.04 0.04 0.05 0.03 0.03 0.03 0.03 0.03 0.03 0.03	4 4 4 3 3 3 2 2 2 9 2 2 6 6 7 6 6 9 9 6 0 0 4 0	0.045 0.04 0.035 (fr 0.03 0.025 0.025 0.015 0.015 0.01 0.005				
Calculated by:	65.6 60.4 55.4 50.5 45.5 40.3 35.4 30.6 25.4 20.5 40.3 35.4 20.5 4.1836 4.1010 4.0146 3.9220 3.8177 3.6964 3.5667 3.4210 3.2347	0.04 0.04 0.04 0.05 0.03 0.03 0.03 0.03 0.03 0.03 0.03	4 4 4 3 3 3 2 2 2 2 9 2 2 6 6 7 6 6 9 9 6 0 0 4 4 0 0 Date:	0.045 0.04 0.035 (fr 0.03 0.025 0.025 0.015 0.015 0.01 0.005	-		ure (Pa)	80

Certificate of Test

Page 1 of 2

Title: Air tightness test of Plot G, Gales Place, Crawley in accordance with The Passivhaus Standard (generally in accordance with BS EN 13829:2001 [method B])

Certificate of Test Number: 25246

Customer's name & address Westridge Construction Limited Ruskin House Junction Road Bodiam East Sussex TN32 5UP

Our Ref: N950/TR0088 VTC Job No.: 3UL6 Your Ref: Plot G Issue date: 10th January 2017 Date sample(s) received: N/A Sample(s) received from: N/A Sample No.: B6014

Tested by:see adjacent text.

Authorised by:

accus

S. Collins (position: Principal Engineer) VINCI Technology Centre UK Limited 01525 859000 info@technology-centre.co.uk www.technology-centre.co.uk

Stanbridge Road, Leighton Buzzard, Bedfordshire, LU7 4QH Registered Office, Watford, England. Registered No.05640885



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TECHNOLOGY CENTRE

Certificate of Test Number: 25246

1. BUILDING DETAILS

All combustion appliances were turned off and flues sealed. All mechanical ventilation systems were turned off and sealed at grilles. All internal doors were open during the test. Sufficient internal openings were provided to ensure pressure equalisation throughout the dwelling. All drainage traps were filled or sealed over. All external doors and windows were closed. All natural ventilation openings were temporarily sealed. Carpets were partly fitted. The single blower door fan was connected to the building via the front door. The entire dwelling was tested.

2. RESULTS

Estimated construction date	2016	
Date and time of test	6 Jan 17	8.45
Building volume	226 n	³ (calculated by Warm Low Energy Building Practice)
Measured air changes per hour	0.567	
Target air changes per hour	0.649	

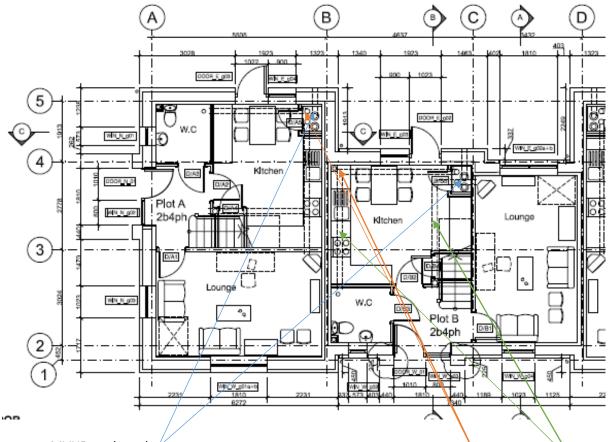
These calculations comply with ATTMA Technical Standard Appendix A

Destant	Westridge					m ²		
Project	Gales Place		Building volu		226.3 r	m'		
Plot No.	G		Target ach		0.649	_	PASS	
Job No.	B6014		Measured a		0.57	3 101 2	PASS	
Test date	6 Jan 17		Measured p			m ³ /(h.m ²)		
Time of test	8.45		Air flow expo		0.689		ok	
Tested by	Shaun Madd	ison		coefficient, r ²	0.997		ok	
Fan/Manometer No.	CLR 698		Air flow coet		0.002			
Calibration due	18 Feb 17		Air leakage	coefficient, CL				
Thermo/Barom No.	MTL 017		Air leakage	rate, Q ₅₀	0.04	m ³ .s ⁻¹		
Calibration due	5 Jul 17		Equivalent k	eakage area	0.01	m ²		
Pressurisation Test	At start	At end						
Wind speed	0	0	m.s ⁻¹		pv (internal)	564.972	2	
Barometric pressure	1025	1025	mbar		pv (external)	294.022	2	
Internal temperature	9.1	8.4	°C	air den	sity (internal)		kg/m ³	
External temperature	-0.6	-0.5	°C	air dens	sity (external)	1.308	3 kg/m ³	
Zero flow +ve average	0.0	0.0	pascals					
Zero flow -ve average	-0.2	-0.3	pascals	Minnenstie	Detector	Detreter	Detrotes	
Overall Zero flow avera	ų -0.2	-0.3	pascals	Minneapolis door	Retrotec 219	Retrotec 218	Retrotec 269	
	pressure	flow	1	blower	open	open	open	G54
	(Pa)	(m ³ .hour ⁻¹)		(m ³ .hour ⁻¹)	(Pa)	(Pa)	(Pa)	(m ³ .s ⁻¹
1	harris and a stand a stand a stand as st	14		145	(1 4)	(1 4)	(1 4)	(11.5
2		139		139				
3		132		132				
4	50.1	12	5	125				
5		117		117				
6		108		108				
7		99		99				
8		80		88				
10		6		65			-	
corrected p	C8 ring open pressure (Pa) 65.4	0.04	9 39.272 flow (m ³ .s ⁻¹) 4	1041.283	-371.786	991.4565	5 -189.398	0.94
corrected p	open 65.4 65.5 55.3 50.4 45.4 40.6 35.5 30.3 25.5	980.163 corrected 1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.	6 -105.663 9 39.272 flow (m ³ .s ⁻¹) 4 4 4 3 3 3 3 2	0.05 0.04 0.04 0.035	-371.786	991.4565	5 -189.398	0.94
corrected p	open 65.4 60.5 55.3 50.4 45.4 45.4 40.6 35.5 30.3	980.163 corrected 1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.	6 -105.663 9 39.272 flow (m ³ .s ⁻¹) 4 4 4 3 3 3 3 2	0.05 0.04 0.04 0.035	-371.786	991.4565		0.94
corrected p	open 65.4 60.5 55.3 50.4 45.4 40.6 35.5 30.3 25.5 20.4	980.163 corrected 1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.	6 -105.663 9 39.272 flow (m ³ .s ⁻¹) 4 4 4 3 3 3 3 2	0.05 0.04 0.04 0.035		991,4565		0.94
corrected p	open 50 50 50 50 50 50 50 50 40 45 40 60 55 50 40 45 40 60 55 50 40 50 40 50 40 50 40 50 40 50 50 40 50 40 50 50 40 50 50 50 40 50 50 50 50 50 50 50 50 50 5	980.16: corrected f 0.0: 0.0: 0.0: 0.0: 0.0: 0.0: 0.0: 0.0	5 -105.663 9 39.272 flow (m ³ .s ⁻¹) 4 4 4 4 3 3 3 3 3 2 2	0.05 0.041.283 0.045 0.045 0.044 0.035 0.025 0.025	-371.786	991,4565		0.94
corrected p	open 65.4 60.5 55.3 50.4 45.4 40.6 35.5 30.3 25.5 20.4	980.16: corrected f 0.0. 0.	6 -105.663 9 39.272 flow (m ³ .s ⁻¹) 4 4 4 4 3 3 3 3 2 2	0.05 0.04 0.04 0.035		991,4565		0.94
corrected p	open 65.4 60.5 55.3 50.4 45.4 40.6 35.5 30.3 25.5 20.4 log pressure 4.1798	980.16: corrected f 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.	6 -105.663 9 39.272 flow (m ³ .s ⁻¹) 4 4 4 4 3 3 3 3 2 2 2	0.05 0.041.283 0.045 0.045 0.044 0.035 0.025 0.025		991,4565		0.94
corrected p	open 65.4 60.5 55.3 50.4 45.4 40.6 35.5 30.3 25.5 20.4 log pressure 4.1798 4.0119 3.9190	980.16: corrected i 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.	6 -105.663 9 39.272 flow (m ³ .s ⁻¹) 4 4 4 4 3 3 3 3 3 3 2 2 2 4 7 3 8	3 2 1041.283 0.05 0.04 0.035 0.04 0.035 0.04 0.035 0.02 0.01 0.01		991.4565		0.94
corrected p	open 65.4 60.5 55.3 50.4 45.4 45.4 40.6 35.5 30.3 25.5 20.4 log pressure 4.1798 4.1018 4.0119 3.9190 3.8144	980.16: corrected f 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.	6 -105.663 9 39.272 flow (m ³ .s ⁻¹) 4 4 4 3 3 3 3 3 2 2 2	3 1041.283 0.05 0.045 0.04 0.035 0.03 0.03 0.025 0.015		991.4565		0.94
corrected p	open 65.4 60.5 55.3 50.4 45.4 40.6 35.5 30.3 25.5 20.4 log pressure 4.1798 4.1018 4.0119 3.9190 3.8144 3.7025	980.16: corrected f 0.0. 0.3. 271 -3.325 -3.325 -3.3472 -3.3472	6 -105.663 9 39.272 flow (m ³ .s ⁻¹) 4 4 4 4 3 3 3 3 3 2 2 2 4 7 3 8 0 0	3 2 1041.283 0.05 0.04 0.035 0.04 0.035 0.04 0.035 0.02 0.01 0.01		991.4565		0.94
corrected p	open 65.4 60.5 55.3 50.4 45.4 40.6 35.5 20.4 log pressure 4.1798 4.1018 4.0119 3.9190 3.8144 3.7025 3.5681	980.163 corrected f 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.	6 -105.663 9 39.272 flow (m ³ .s ⁻¹) 4 4 4 3 3 3 3 2 2 2 4 4 7 3 8 0 0 0 0	32 1041.283 0.05 0.045 0.04 0.035 0.03 0.03 0.03 0.03 0.03 0.02 0.01 0.01 0.005		991.4565		0.94
corrected p	open 65.4 60.5 55.3 50.4 45.4 40.6 35.5 30.3 25.5 20.4 log pressure 4.1798 4.1018 4.0119 3.9190 3.8144 3.7025	980.163 corrected i 0.0- 0.0- 0.0- 0.0- 0.0- 0.0- 0.0- 0.0	6 -105.663 9 39.272 flow (m ³ .s ⁻¹) 4 4 4 4 3 3 3 3 3 3 2 2 2 4 7 3 8 0 0 0 0 8	3 1041.283 0.05 0.04 0.04 0.035 0.04 0.035 0.04 0.035 0.025 0.01 0.01 0.005 0.01 0.05 0.01 0.05 0.01 0.05 0.05 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.05 0.04 0.05 0.5 0.	20		6	
corrected p	open 65.4 60.5 55.3 50.4 45.4 40.6 35.5 30.3 25.5 20.4 10g pressure 4.1798 4.0119 3.9190 3.8144 3.7025 3.5681 3.4095	980.163 corrected f 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.	6 -105.663 9 39.272 flow (m ³ .s ⁻¹) 4 4 4 3 3 3 3 3 2 2 2 4 7 3 8 8 0 0 0 0 8 8 3 3	3 1041.283 0.05 0.04 0.04 0.035 0.04 0.035 0.04 0.035 0.025 0.01 0.01 0.005 0.01 0.05 0.01 0.05 0.01 0.05 0.05 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.05 0.04 0.05 0.5 0.	20	40	6	
corrected p	open 65.4 60.5 55.3 50.4 45.4 40.6 35.5 30.3 25.5 20.4 log pressure 4.1798 4.1018 4.0119 3.9190 3.8144 3.7025 3.5681 3.4095 3.2367	980.163 corrected f 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.	6 -105.663 9 39.272 flow (m ³ .s ⁻¹) 4 4 4 3 3 3 3 3 2 2 2 4 7 3 8 8 0 0 0 0 8 8 3 3	3 1041.283 0.05 0.04 0.04 0.035 0.04 0.035 0.04 0.035 0.025 0.01 0.01 0.005 0.01 0.05 0.01 0.05 0.01 0.05 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.5 0.	20	40	6	
corrected p	open 65.4 60.5 55.3 50.4 45.4 40.6 35.5 30.3 25.5 20.4 log pressure 4.1798 4.1018 4.0119 3.9190 3.8144 3.7025 3.5681 3.4095 3.2367	980.163 corrected f 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.	6 -105.663 9 39.272 flow (m ³ .s ⁻¹) 4 4 4 3 3 3 3 3 2 2 2 4 7 3 8 8 0 0 0 0 8 8 3 3	3 1041.283 0.05 0.04 0.04 0.035 0.04 0.035 0.04 0.035 0.025 0.01 0.01 0.005 0.01 0.05 0.01 0.05 0.01 0.05 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.5 0.	20	40	6	
	open 65.4 60.5 55.3 50.4 45.4 40.6 35.5 30.3 25.5 20.4 log pressure 4.1798 4.1018 4.0119 3.9190 3.8144 3.7025 3.5681 3.4095 3.2367	980.163 corrected f 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.	6 -105.663 9 39.272 flow (m ³ .s ⁻¹) 4 4 4 3 3 3 3 3 2 2 4 7 3 8 8 0 0 0 0 8 8 8	3 1041.283 0.05 0.04 0.04 0.035 0.04 0.035 0.04 0.035 0.025 0.01 0.01 0.005 0.01 0.05 0.01 0.05 0.01 0.05 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.5 0.	20	40	6	
Calculated by:	open 65.4 60.5 55.3 50.4 45.4 40.6 35.5 30.3 25.5 20.4 log pressure 4.1798 4.1018 4.0119 3.9190 3.8144 3.7025 3.5681 3.4095 3.2367	980.163 corrected f 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.	6 -105.663 9 39.272 flow (m ³ .s ⁻¹) 4 4 4 4 3 3 3 3 2 2 4 4 7 3 8 0 0 0 0 0 8 8 8 8 2 2 2 2 2 2 2 2 2 2	3 1041.283 0.05 0.04 0.04 0.035 0.04 0.035 0.04 0.035 0.025 0.01 0.01 0.005 0.01 0.05 0.01 0.05 0.01 0.05 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.5 0.	20		6	80

Project	Westridge		Envelope are			m ²		
	Gales Place		Building volu		226.3	m		
Plot No.	G		Target ach		0.649			
Job No.	B6014		Measured ad	h	0.56		PASS	
Test date	6 Jan 17		Measured pe	ermeability	#DIV/0!	m ³ /(h.m ²)		
Time of test	9.00		Air flow expo	nent, n	0.729		ok	
Tested by	Shaun Maddi	ison	Correlation of	$ext{ oefficient } r^2$	1.000		ok	
Fan/Manometer No.	CLR 698	Joon	Air flow coef		0.002		-	
Calibration due	18 Feb 17			coefficient, CL				
Thermo/Barom No.	MTL 017		Air leakage r			m ³ .s ⁻¹		
Calibration due	5 Jul 17		Equivalent le	akage area	0.01	m²		
Depressurisation Test	At start	At end						
Wind speed	0	0	m.s ⁻¹		pv (internal)	538.783		
Barometric pressure	1025	1025	mbar		pv (external)	296.173		
Internal temperature	8.3	7.8	°C	air dens	sity (internal)	1.267	kg/m ³	
External temperature	-0.5	-0.4	°C	air dens	ity (external)	1.308	kg/m ³	
Zero flow +ve average	0.0	0.0	pascals				U U	
Zero flow -ve average	-0.6	-0.6	pascals					
Overall Zero flow average	-0.6	-0.6	pascals	Minneapolis	Retrotec	Retrotec	Retrotec	
				door	219	218	269	
	pressure	flow		blower	open	open	open	G54
	(Pa)	(m ³ .hour ⁻¹)		(m ³ .hour ⁻¹)	(Pa)	(Pa)	(Pa)	(m ³ .s
1	65.2	147		147	1	v -1	()	
2	60.0	140		140				
3	55.3	132		132				
4	50.2	124	-	124				
5	45.0	113		113				
6	40.1	104		104				
7	35.1	95		95				
8	30.3	85		85				
9	25.1	75	i.	75				
10	20.2	64	•	64				
	A ring B ring C8 ring open	467.1291 287.5859 144.6206 980.169	46.584 -105.663	1041.283	-371.786	991.4565	-189.398	0.9
corrected p	ressure (Pa)							
	65.8	0.04						
	60.6	0.04		0.05				
	55.9	0.04		0.045				
	50.8	0.04		0.045			~	
	50.8 45.6	0.04	5	0.045			p	
	50.8 45.6 40.7	0.04 0.03 0.03		0.04			P	
	50.8 45.6 40.7 35.7	0.04 0.03 0.03 0.03					P	
	50.8 45.6 40.7 35.7 30.9	0.04 0.03 0.03 0.03 0.02		0.04				
	50.8 45.6 40.7 35.7 30.9 25.7	0.04 0.03 0.03 0.02 0.02 0.02		0.04			P	
	50.8 45.6 40.7 35.7 30.9	0.04 0.03 0.03 0.03 0.02		0.04		/		
	50.8 45.6 40.7 35.7 30.9 25.7	0.04 0.03 0.03 0.02 0.02 0.02		0.04		/		
	50.8 45.6 40.7 35.7 30.9 25.7 20.8	0.04 0.03 0.03 0.02 0.02 0.02		0.04				
1	50.8 45.6 40.7 35.7 30.9 25.7 20.8	0.04 0.03 0.03 0.02 0.02 0.02 0.02		0.04 0.035 (s) MO.025 MO.025				
,	50.8 45.6 40.7 35.7 30.9 25.7 20.8	0.04 0.03 0.03 0.02 0.02 0.02 0.02 log flow -3.1667		0.04				
1	50.8 45.6 40.7 35.7 30.9 25.7 20.8 log pressure 4.1866	0.04 0.03 0.03 0.02 0.02 0.02 0.02 0.02 log flow -3.1667 -3.2155		0.04 0.035 (%,0.03 (%,0.025 0.025 U_V 0.02 0.015				
1	50.8 45.6 40.7 35.7 20.8 log pressure 4.1866 4.1043	0.04 0.03 0.03 0.02 0.02 0.02 0.02 log flow -3.1667 -3.2155 -3.2743	7	0.04 0.035 (s) MO.025 MO.025	6			
1	50.8 45.6 40.7 35.7 30.9 25.7 20.8 log pressure 4.1866 4.1043 4.0236	0.04 0.03 0.03 0.02 0.02 0.02 0.02 log flow -3.1667 -3.2155 -3.2743 -3.3368		0.04 0.035 (%,0.03 (%,0.025 0.025 U_V 0.02 0.015				
1	50.8 45.6 40.7 35.7 20.8 log pressure 4.1866 4.1043 4.0236 3.9279	0.04 0.03 0.03 0.02 0.02 0.02 0.02 log flow -3.1667 -3.2155 -3.2743	7	0.04 0.035 (s, 0.03 0.025 0.025 0.015 0.01 0.005				
,	50.8 45.6 40.7 35.7 20.8 log pressure 4.1866 4.1043 4.0236 3.9279 3.8199	0.04 0.03 0.03 0.02 0.02 0.02 10g flow -3.1667 -3.2155 -3.2743 -3.3366 -3.2743		0.04 0.035 (% 0.03 20.025 0.02 0.015 0.01 0.01 0.005				
Ţ	50.8 45.6 40.7 30.9 25.7 20.8 log pressure 4.1866 4.1043 4.0236 3.9279 3.8199 3.7062	0.04 0.03 0.03 0.02 0.02 0.02 0.02 0.02 0.02		0.04 0.035 (s, 0.03 0.025 0.025 0.015 0.01 0.005	20	40	60	
1	50.8 45.6 40.7 35.7 20.8 log pressure 4.1866 4.1043 4.0236 3.9279 3.8199 3.7062 3.5752	0.04 0.03 0.03 0.02 0.02 0.02 0.02 0.02 0.02	- - - - - - - - - - - - - - - - - - -	0.04 0.035 (% 0.03 20.025 0.02 0.015 0.01 0.01 0.005		40 Building pressu	60	
Ţ	50.8 45.6 40.7 35.7 30.9 25.7 20.8 log pressure 4.1866 4.1043 4.0236 3.9279 3.8199 3.7062 3.5752 3.4308	0.04 0.03 0.03 0.02 0.02 0.02 0.02 0.02 0.02	7	0.04 0.035 (% 0.03 20.025 0.02 0.015 0.01 0.01 0.005			60	8
	50.8 45.6 40.7 35.7 20.8 log pressure 4.1866 4.1043 4.0236 3.9279 3.8199 3.7062 3.5752 3.4308 3.2465	0.04 0.03 0.03 0.02 0.02 0.02 0.02 0.02 0.02		0.04 0.035 (% 0.03 20.025 0.02 0.015 0.01 0.01 0.005			60	8
Calculated by:	50.8 45.6 40.7 35.7 20.8 log pressure 4.1866 4.1043 4.0236 3.9279 3.8199 3.7062 3.5752 3.4308 3.2465 3.0350	0.04 0.03 0.03 0.02 0.02 0.02 0.02 0.02 0.02	Date:	0.04 0.035 (0) 0.03 0.025 0.025 0.015 0.01 0.005 0 0			60	8
	50.8 45.6 40.7 35.7 20.8 log pressure 4.1866 4.1043 4.0236 3.9279 3.8199 3.7062 3.5752 3.4308 3.2465 3.0350	0.04 0.03 0.03 0.02 0.02 0.02 0.02 0.02 0.02	Date:	0.04 0.035 (% 0.03 20.025 0.02 0.015 0.01 0.01 0.005			60	8
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12. Layout of the Ventilation System Ducting

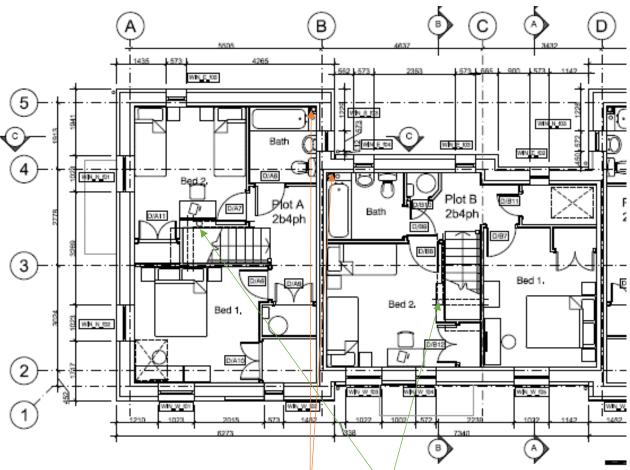
Concept duct layouts were prepared by Peter Ranken and included in the general arrangement plans. Detailed installation layouts were prepared by suppliers and installers Built Environment Technology. Copies of the installation drawings are included in the appendices.



- MVHR cupboards
- Supply Ducts above kitchen units/ above ceiling to vertical duct in partition on first floor
- Extract Ducts above ceiling/ adjacent to svps to bathrooms on first floor

Extract of tender ground floor drawing showing the positions of MVHR units and ductwork.

The MVHR units are installed in cupboards in each kitchen adjacent to external walls. This allows for easy access by residents to controls and for the replacement and/or cleaning of filters. The MVHR cupboards face the rear gardens of the houses or side elevations of the flats and therefore clean sources of fresh intake air. The same installation was used for each dwelling.



- Vertical extract duct adjacent bathroom svp
- Vertical supply duct in wider partition to serve bedrooms

Extract from tender drawing of first floor of Block 1 houses showing positions of MVHR ductwork

Tempered supply air is provided to habitable spaces (living rooms, bedrooms) and air is extracted from bathrooms, wcs and kitchens. Circulation spaces in each dwelling are used for air transfer and enlarged gaps at the bottom of doors allow air movement when doors are closed.

13. Ventilation Unit

Individual Paul Novus 300 MVHR units were used in each dwelling, installed against external walls with insulated inlet and discharge ducts, these ducts being insulated with 50mm of Armaflex vapour resistant insulation. Inlet and discharge duct lengths are kept to a reasonable minimum to minimise heat loss and to maintain separation of air flow externally.

Technical data for the Paul Novus 300 unit is included in the appendices, and this information includes the following data from the Passivhaus Institut certificate for this unit:

- Effective heat recovery of 93%
- Electrical efficiency Pel of 0.24 Wh/m³



Typical installation of heat recovery ventilation unit.

The installed efficiency was calculated by Passivhaus Certifier WARM Low Energy Practice as follows;

- Three House Terrace 87.4%
- Four House Terrace 88.9%
- Block of Flats 88.6%

14. Heat Supply

After sunlight, appliances and people, each dwelling is electrically heated with panel heaters in living rooms and electric towel rails in bathrooms.

The equipment specified is as follows:

Electric towel rails, in bathroom and ground floor WC:

Dimplex TDTR 350W colour white, 843mm (h) x 602mm (w), with air temperature thermostatic control and connected to separate timer controlled circuit and individual on/off switches.

Electric panel heater, in living rooms:

Dimplex EPX 500 panel heater 450mm (h) x 450mm (w), with thermostatic control, connected to separate timer controlled circuit and individual switch.

Timer control for heating circuit to include:

- 30 minute boost button
- 24h / day control
- Weekend / weekday control



Living room in Block A showing electric panel heater in living room

Hot water is provided by Viridian solar thermal panels and cylinders with immersion heater back up.



Solar thermal panels during construction – Block 2



Solar hw cylinder – Block 1 – pipes to be insulated

350W output

500W output

15. Short Documentation of PHPP (Verification Sheets)

Copies of the PHPP verification sheets for each block, as issued by WARM Low Energy Practice, are below:

rassive r	iouse	Verification						
No. of Concession, Name				Building:	1-3 Gales Pl	ace ·		
				Street:	Gales Place	Three Bridges		
				Postcode/City:	RH10 1QG	Crawley		
			1	Province/Country:	West Susse	×	GB-United Kingdon	n/ Britain
				Building type:	Residential	Тегтасе	-	
				Climate data set:	GB0003a-Lo	ndon Gatwick		
				Climate zone:	3: Cool-tem	perate	Altitude of location:	74 m
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Postcode/City:		Buckhurst Hill		Postcode/City:		PLYMOUTH		
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No. or occupants.	5.6		Specific ca	pacity [Wh/K per m ² TFA]:	132	M	echanical cooling:	_
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values of the building. T Task:	ne PHPP calcu	lations are attached to this ve First name			Sumame			Signa
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PHPP, Verification

PHPP Gales Place Block 1 MR1 2017 01 31 final.xlsx

Block 1 PHPP Verification page

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	Architecture: Street Postcode/City. Province/County: Energy consultancy: Street Postcode/City. Province/County: Year of construction: No. of decupants: No. of decupants: No. of decupants: Specific building char Space heating Free Airtightness Primary Energy Renewable (PER)	Architecture: Accredited I Street: Warwick Ho Postoode/Dip: Idd 5LQ Province/Country Essex Energy consultancy: Accredited I Street: Warwick Ho Postoode/Dip: Idd 5LQ Province/Country Essex Year of construction: 2016 No. of dwelling units No. of occupants: 7.6 Specific building characteristics w Space heating Prequency of ow Airtightness Pressuriz Primary Energy Renewable (PER) Gener I confirm that the values given herein values of the building. The PHPP cat Task:	Province/Country: Essex UK Energy consultancy: Accredited Passivhaus Design Street: Warwick House, 116 Patnerston Road Postcode/City: 09 SLQ Povince/Country: Essax Vear of construction: 2016 No. of dwelling units: 3 No. of occupants: 7.6 Specific building characteristics with reference to the treated floor Space heating Heating demand kWh/(m²a) Heating load Wim² Frequency of overheating (> 25 °C) % Airtightness Pressurization test result n ₅₀ 1/h Primary Energy Generation of renewable (hER) Renewable (PER) Generation of renewable with/(m²a) I confirm that the values given herein have been determined following to task.	Architecture: Accredited Passivhaus Design Street: Warwick House, 116 Palmerston Road Postcode/City: 495 L.0 Buckhurst Hill Province/Country: Energy consultancy: Cocredited Passivhaus Design Street: Warwick House, 116 Palmerston Road Postcode/City: 495 L.0 Buckhurst Hill Province/Country: Energy consultancy: Cocredited Passivhaus Design Street: Warwick House, 116 Palmerston Road Postcode/City: G5 L.0 Buckhurst Hill Province/Country: Street: Varwick House, 116 Palmerston Road Postcode/City: G5 L.0 Buckhurst Hill Province/Country: Specific building characteristics with reference to the treated floor area No. of occupants: 7.6 Specific building characteristics with reference to the treated floor area Treated floor area m ² 14.2 Heating load W/m ² 14.2 Heating load W/m ² 10 Frequency of overheating (> 25 °C) % 2 Artightness Pressurization test result ngo 1h 0.6 Primary Energy Renewable (PER)	Building: Street: Postcode/City: Province/Country: Building: Building:	Building: 4-7 Gales Place. Street: Gales Place. Postcode/CDP: Platode/CDP: Postcode/CDP: Platode/CDP: Climate data set: GB0033-LC Street: Warwick House, 116 Palmerston Road Postcode/Clip: Climate data set: Street: Warwick House, 116 Palmerston Road Postcode/Clip: Climate data set: Street: Warwick House, 116 Palmerston Road Postcode/Clip: Climate data set: Street: Warwick House, 116 Palmerston Road Postcode/Clip: Climate data set: Street: Warwick House, 116 Palmerston Road No: of occupants: 7.6 Street: Marinala P Postcode/Clip: Climate data set: No: of occupant	Building: 4-7 Gales Place. Street: Gales Place. Postcode/Chry. RH10 1GG Crawley Province/Country. West Sussex Building type: Residential Terrace Climate zone 3: Cool-Cemperate Climate zone 3: Cool-Cemperate GeloceMerzet Architecture: Accredited Passiwhaus Design Street: Warwick House, 118 Paineerston Road Postcode/Chry. Energy consultancy: Accredited Passiwhaus Design Street: Street: Varwick House, 118 Paineerston Road Postcode/Chry. Cimate zone 3: Cool-Cemperate Province/Country: Essex Warth Cool-Climp: Cimate zone 3: Cool-Contry: Vest of construction: 3 No. of occupants: 7.6 Specific capacity (WhXp er m ¹ TFA): 132 Metaing demand KWh/(m ² h) 14.2 Specific building characteristics with reference to the treated floor area m ² 330.2 Specific building characteristics with reference to the treated floor area m ² 10 Frequency of overheating (> 25 °C) % 2 10 Artightness Pressurization test result	Building: 47 Cales Place Street: Cales Place. Three Bridges. Postcode/City: Vest Sussex Clined back.tic: Place. Three Bridges. Postcode/City: Vest Sussex Clined back.tic: Place.Three Bridges. Postcode/City: Vest Sussex Clined back.tic: Place.Three Bridges. Architecture: Accredited Passivhaus Design Street: Warvick House, 115 Palmerston Road Postcode/City: Vest Sussex Postcode/City: Vest Note: Province/Country: Essext: Warvick House, 115 Palmerston Road Postcode/City: Province/Country: Essext: Province/Country: Essext: Warvick House, 115 Palmerston Road Postcode/City: Province/Country: Essext: Province/Country: Essext: Warvick House, 115 Palmerston Road Postcode/City: Province/Country: Essext: Warvick House, 115 Palmerston Road Postcode/City: Province/Country: Essext: Vesto doce/City:

PHPP Gales Place Block 2 MR1 2017 01 31 final.xlsx

Block 2 PHPP verification page

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PHPP, Verification

PHPP Gales Place Block 3 Flats MR1 2017 01 31 Final.xlsx

Block 3 verification page

16. Building Costs

Whilst Crawley Borough Council owned part of the building site, parts of the site were owned by West Sussex College and a land transfer had to be negotiated between these parties. The cost of this was not known to the design team.

17. Construction Costs

Tender base date. The project was tendered in 2015. *Build period*. This was 56 weeks, completing in February 2017. *Cost details*. Costed quantities are not available, but contractor Westridge have confirmed that the build cost was based on £2234/m2 (Gross internal floor area not Treated floor area).

They have also confirmed the following:

- Were there any elements of the project that were difficult to price? If yes, why? No
- Would you complete the project again at the same price (not taking into account of TPI)? Yes plus increase costs

18. Year of Construction

Construction started in November 2015 and completed in February 2017. The contractor was Westridge Construction, and Gales Place was their first Passivhaus project. On the recommendation of the architect and Passivhaus designer Westridge ensured that the site manager, contracts manager and one director received Passivhaus Tradespersons training.

19. Design and Architect.

Accredited Passivhaus Design (a part of architects The Tooley & Foster Partnership) designed the buildings on behalf of Crawley Borough Council (Crawley Homes), achieved planning consent from Crawley Borough Council and prepared construction drawings for contractor Westridge. The team was led by Peter Ranken, an architect with extensive experience of social housing masterplanning and design, and he also holds an MSc in Environmental Design and Engineering from University College London. At the time of design he was a Certified Passivhaus Designer.

Within a site with complex pedestrian and vehicle access routes, the blocks were laid out to provide safe external areas for residents and others visiting nearby shops, community centre and school. Each block includes south facing roofs for solar hot water, double windows in principal rooms and an energy efficient envelope as well as attractive spaces to live in.

Like most construction projects the construction of Gales Place provided lessons for future Passivhaus projects. The same design team (Peter Ranken of Accredited Passivhaus Design/ Tooley & Foster) were appointed to design Dobbins Place, the second Passivhaus development for Crawley Borough Council and subsequently Westridge were appointed as contractors for this project working with the same contract manager and site agents as Gales Place. The following detailed design and construction changes were made to Dobbins Place following the experience of building Gales Place:

- Airtight OSB to the window surrounds and the top floor ceilings to assist airtightness. The rigid board at top floor ceiling level shows damage more readily than an Intello membrane and is easier to repair.
- MVHR systems with semi-rigid duct installed via manifolds to improve sound insulation and to ease commissioning (one duct per terminal).
- Metal web floor joists in the houses for the following reasons:
 - Semi-rigid ventilation ductwork can be included in the floor depth to avoid dropped ceiling/ additional boxing in the kitchens
 - Floors can span front to back and thereby omitting load bearing partitions and foundations under them
- Aluminium clad timber windows with narrower sections than PVCu to improve solar gain, and to reduce mullion thicknesses.
- Order load bearing insulation (Marmox) well in time to minimise delays.

20. Information about the building services design

Detailed building services design was carried out by:

- Built Environment Technology Ltd (Ventilation systems) and
- JWS Maintenance Kent Ltd (Electrical services)
- White Associates (Mechanical services)

The building services strategy was determined by Peter Ranken in accordance with Passivhaus principles to include the following:

- Efficient ventilation with heat recovery, with high performance units, located and installed to maintain efficient operation with minimal lengths of ducts containing air at external temperatures.
- Separate heating system using direct electric heaters in bathrooms (towel rails) and living rooms (panel heaters)
- Solar hot water, installed on south facing roofs at optimum roof pitches with back up electric immersion heaters.

The building services concept was intended to provide simple systems to install, operate and maintain and was agreed with Crawley Homes (building managers) in advance of tender and construction.

Concept pipe routes and lengths were determined by the architect Peter Ranken and entered into PHPP.

21. Information about the Planner Of The Building Physics

PHPP energy and comfort analysis of each block was carried out by architect and Passivhaus designer Peter Ranken. This also included thermal bridge analysis using Therm software.

22. Information about the Structural Designer

The structural engineer was Graham Waller of the Eastbourne office of Stephen Wilson Partnership Ltd.

23. User's Experiences

In June 2018 Peter Ranken visited Gales Place to interview a number of residents to understand their experience of their homes after more than one year of occupation. The notes of this visit are attached as an appendix.

24. Appendices

Appendices

- 1. iPHA database pages for projects 5406, 5414, 5415
- 2. Floor and roof plans
- 3. Typical construction details
- 4. Window manufacturers information
- 5. MVHR installers drawings
- 6. MVHR unit technical information Paul Novus 300
- 7. Final PHPP files for each block
- 8. Thermal bridge reports
- 9. Notes of Post Occupancy visit held on 20 June 2018
- 10. Confirmation of Peter Ranken's RIBA membership
- 11. List of specified items included in PHPP
- 12. Building Passivhaus Certification