

Scepticism about Passivhaus

- Airtightness
- Overheating

Underlying question:

“Does the Passivhaus Standard deliver long term performance in other cultures and climates?”



Scepticism about Passivhaus

- Airtightness
- Overheating

Underlying question:

“Does the Passivhaus Standard deliver long term performance in other cultures and climates?”

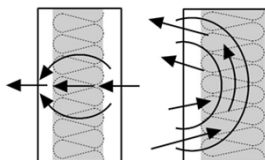


Thermal Bypass

Closed loop



Open loop



Performance Parameters

Table 1
Air leakage criteria taken from Janssens [2007] after Uvsløkk and Di Lenardo

Application	Air Leakage (m ³ /(m ² h) (75 Pa)	Air Permeance (m ³ /(m ² s Pa)	Air Leakage (m ³ /(m ² h) (50 Pa)
Air barrier material	< 0.07	< 0.3 x 10 ⁻⁶ (a)	< 0.054 ^(b)
Air barrier system (inc. joints)	<0.72	<2.7 x 10 ⁻⁶ (a)	< 0.486 ^(b)
Wind barrier (inc. joints)	<3.75 ^(a) Uvsløkk = 5% of measured U-value 0.28W/m ² K	<14.0 x 10 ⁻⁶	< 2.52 ^(b)

(a) Janssens extrapolation assuming a linear flow pressure relation
(b) Siddall extrapolation assuming a linear flow pressure relation



Design Considerations



Airtightness Hierarchy:

- Design (plans and sections)
- Sequencing and tolerances
- Details
- Product selection and Specification
- Ownership by follow on trades
- Testing



ATTIC: Airtightness and Thermal Integrity Champion

- Design and spec reviews
- Site inductions, Tool Box Talks/Briefing trades
- Identify conditions for success
- Day-to-day oversight
- Construction Quality meetings
- Arrange pre-tests
- Arrange tests & inform arch./PH Designer
- Remediation
- Stock management

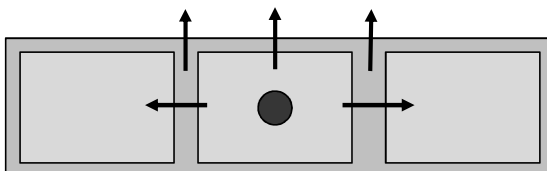


Airtightness Specialist:

- UKAS accreditation
- Experience – low leakage / Passivhaus
- Examples of previous reports
- Calculation of the n50/q50
- Temporary sealing checklist
- Smoke pencils, thermographic survey(?)
- Remediation report and drawing mark ups
- Test report



Year Zero – ATTMA



Year Zero – Passivhaus

LEAP the lively engaged architectural practice | apexair | apexacoustics | gentoo group | GBC

Year Zero – Leeds Beckett Uni

Dwelling	Date	Depressurisation only	Pressurisation only	Mean Air Permeability	Pre / post coheating test
		m ³ .h ⁻¹ .m ⁻² @ 50Pa	m ³ .h ⁻¹ .m ⁻² @ 50Pa	m ³ .h ⁻¹ .m ⁻² @ 50Pa	
Dwelling 1	08/11/11	0.83	0.94	0.89	Pre
	21/12/11	0.86	0.91	0.89	Post
Dwelling 2	09/11/11	1.30	1.33	1.31	Pre
	22/12/11	1.30	1.33	1.31	Post

Figure 1: Tested to ATTMA Technical Standard L1 (ATTMA, 2010) [Johnston et al, 2012]

Dwelling	Date	Depressurisation only	Pressurisation only	Mean Air Permeability	Pre / post coheating test
		m ³ .h ⁻¹ .m ⁻² @ 50Pa	m ³ .h ⁻¹ .m ⁻² @ 50Pa	m ³ .h ⁻¹ .m ⁻² @ 50Pa	
Dwelling 1	08/11/11	0.43	0.46	0.44	Pre
	21/12/11	0.62	0.54	0.58	Post
Dwelling 2	09/11/11	0.66	0.62	0.64	Pre
	22/12/11	0.59	0.67	0.63	Post

Figure 2: Pressure Equalisation Tests [Johnston et al, 2012]

LEAP the lively engaged architectural practice | apexair | apexacoustics | gentoo group | GBC

Year Zero – Third Party

Dwelling	Date	Depressurisation only	Pressurisation only	Mean Air Permeability	Comment
		h ¹ @ 50Pa	h ¹ @ 50Pa	h ¹ @ 50Pa	
Dwelling 1	27/10/11	0.40	0.58	0.49	Practical completion
Dwelling 2	27/10/11	0.43	0.56	0.50	Practical completion

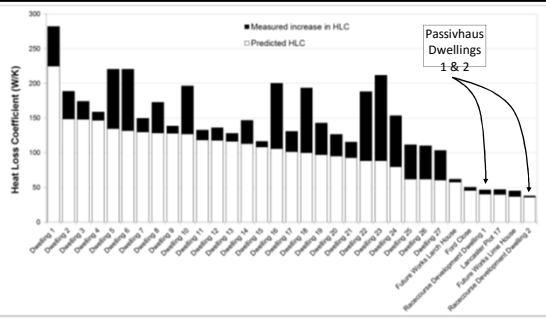
Figure 3: External Contractor test to the Passivhaus Standard [Johnston et al, 2012]

Dwelling	Date	Depressurisation only	Pressurisation only	Mean Air Permeability	Comment
		m ³ .h ⁻¹ .m ⁻² @ 50Pa	m ³ .h ⁻¹ .m ⁻² @ 50Pa	m ³ .h ⁻¹ .m ⁻² @ 50Pa	
Dwelling 1	27/10/11	0.43	0.55	0.49	Practical completion
Dwelling 2	27/10/11	0.39	0.55	0.49	Practical completion

Figure 4: Suspect pressure equalisation test results by external contractor [Johnston et al, 2012]

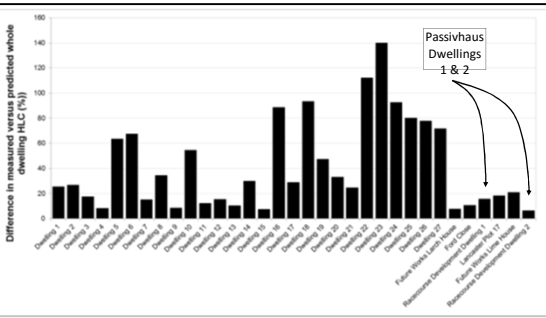
LEAP the lively engaged architectural practice | apexair | apexacoustics | gentoo group | GBC

Building Performance Evaluation



LEAP the lively engaged architectural practice | apexair | apexacoustics | The Building Fabric Thermal Performance of Passivhaus Dwellings: Do What It Says on the Tin? David Johnston and Mark Siddall, Sustainability

Building Performance Evaluation



LEAP the lively engaged architectural practice | apexair | apexacoustics | The Building Fabric Thermal Performance of Passivhaus Dwellings: Do What It Says on the Tin? David Johnston and Mark Siddall, Sustainability

2-3 Years On

Dwelling	Date	Depressurisation only	Pressurisation only	Mean Air Permeability	Pre / during / post in-use monitoring
		m ³ .h ⁻¹ .m ⁻² @ 50Pa	m ³ .h ⁻¹ .m ⁻² @ 50Pa		
Dwelling 7	22/07/14	1.45	1.28	1.36	Post
Dwelling 7	10/02/14	1.01	1.15	1.08	During
Dwelling 7	09/04/13	0.99	1.02	1.01	Pre

Figure 5: Tested to ATTMA Technical Standard L1 (ATTMA, 2010) [Johnston et al., 2014a]

LEAP the lively engaged architectural practice | apexair | apexacoustics | gentoo | The Building Fabric Thermal Performance of Passivhaus Dwellings: Do What It Says on the Tin? David Johnston and Mark Siddall, Sustainability

5 Years On



5 Years On



5 Years On



5 Years On

LEAP the lively engineered architectural practice apexair apexacoustics gentoo group good spaces

5 Years On

Dwelling	Date	Depressurisation	Pressurisation	Mean Air Permeability
		m ³ .h ⁻¹ .m ⁻² @ 50Pa	m ³ .h ⁻¹ .m ⁻² @ 50Pa	m ³ .h ⁻¹ .m ⁻² @ 50Pa
Dwelling 7 (terraced)	11/12/15	0.79	0.91	0.85
Dwelling 7 (terraced)	05/01/16	0.84	0.82	0.83
Dwelling 9 (terraced)	10/12/15	1.13	1.23	1.18
Dwelling 3 (terraced)	06/01/16	1.24	1.34	1.29

Figure 4: Results of air leakage tests by Apex Acoustics

LEAP the lively engineered architectural practice apexair apexacoustics gentoo group good spaces

5 Years On

Party Wall Leakage
Low = 76.1 m³
High = 110.5 m³

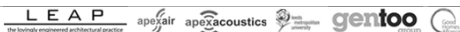
$q_{50} = Q - \text{party wall} / A$

LEAP the lively engineered architectural practice apexair apexacoustics gentoo group good spaces

5 Years On - Normalisation

Dwelling / mean result from +ve and -ve pressure tests	Date	Low Party Wall Air Leakage	High Party Wall Air Leakage	Co-pressurised tests, 2011
		$m^3 \cdot h^{-1} \cdot m^{-2}$ @ 50Pa	$m^3 \cdot h^{-1} \cdot m^{-2}$ @ 50Pa	$m^3 \cdot h^{-1} \cdot m^{-2}$ @ 50Pa
Dwelling 7 (terraced)	11/12/15	0.54	0.40	
Dwelling 7 (terraced)	05/01/16	0.52	0.38	0.41
Dwelling 9 (terraced)	10/12/15	0.56	0.28	0.51
Dwelling 3 (terraced)	06/01/16	0.67	0.39	0.44

Figure 5: Theoretical external envelope only air leakage compared with original tests [Outhwaite, 2011]



5 Years On - Detached (non-Passivhaus)

Dwelling	Date	Depressurisation only	Pressurisation only	Mean Air Permeability	Comments
		$m^3 \cdot h^{-1} \cdot m^{-2}$ @ 50Pa	$m^3 \cdot h^{-1} \cdot m^{-2}$ @ 50Pa	$m^3 \cdot h^{-1} \cdot m^{-2}$ @ 50Pa	
Dwelling 19	10/02/16	0.48	0.46	0.47	Occupied
Dwelling 19	12/08/11	0.31	0.47	0.39	Completion
Dwelling 19	14/04/11	0.35	0.28	0.32	Pre-services

Results of air leakage tests by Apex Acoustics compared with original tests [Outhwaite, 2011]

Dwelling	Date	Depressurisation only	Pressurisation only	Mean Air Permeability	Comments
		h^{-1} @ 50Pa	h^{-1} @ 50Pa	h^{-1} @ 50Pa	
Dwelling 19	10/02/16	0.50	0.48	0.49	Occupied
Dwelling 19	12/08/11	0.27	0.41	0.34	Completion
Dwelling 19	14/04/11	0.35	0.27	0.31	Pre-services

Results of air leakage tests by Apex Acoustics compared with original tests [Outhwaite, 2011]



Conclusion....

Lessons:

- 1) Airtightness and thermal integrity is a team sport
- 2) Preparation, preparation, preparation
- 3) All details need to be addressed
- 4) Tool box talks
- 5) ATTIC – vital
- 6) Site inspections
- 7) Incentives



...thank you for your time.



Mark Siddals:
E: mark.siddals@respl.it
T: 07795 031 700

Photo M.S