



**Air Leakage
Detailing &
Awareness
Services**

Achieving Airtightness Camden & Islington Passivhaus Conference, February 2010

**Paul Jennings
ALDAS Limited**



Paul Jennings:

**Air Leakage
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- **Testing since 1987 – courtesy of Ken Livingston & the GLC!**
- **Tested, surveyed, advised on sealing in 1000's of buildings in the UK & overseas**
- **Currently**
 - **Testing Passivhaus projects such as Y Gaol & DVFP Office for John Williamson; Ranulf Road for Bere Architects; Portfield St. refurb for Andy Simmonds**
 - **Checking designs for air leakage weaknesses**
 - **Acting as Air Tightness Consultant to clients such as NHS Scotland & Exeter City Council**



Passivhaus Context

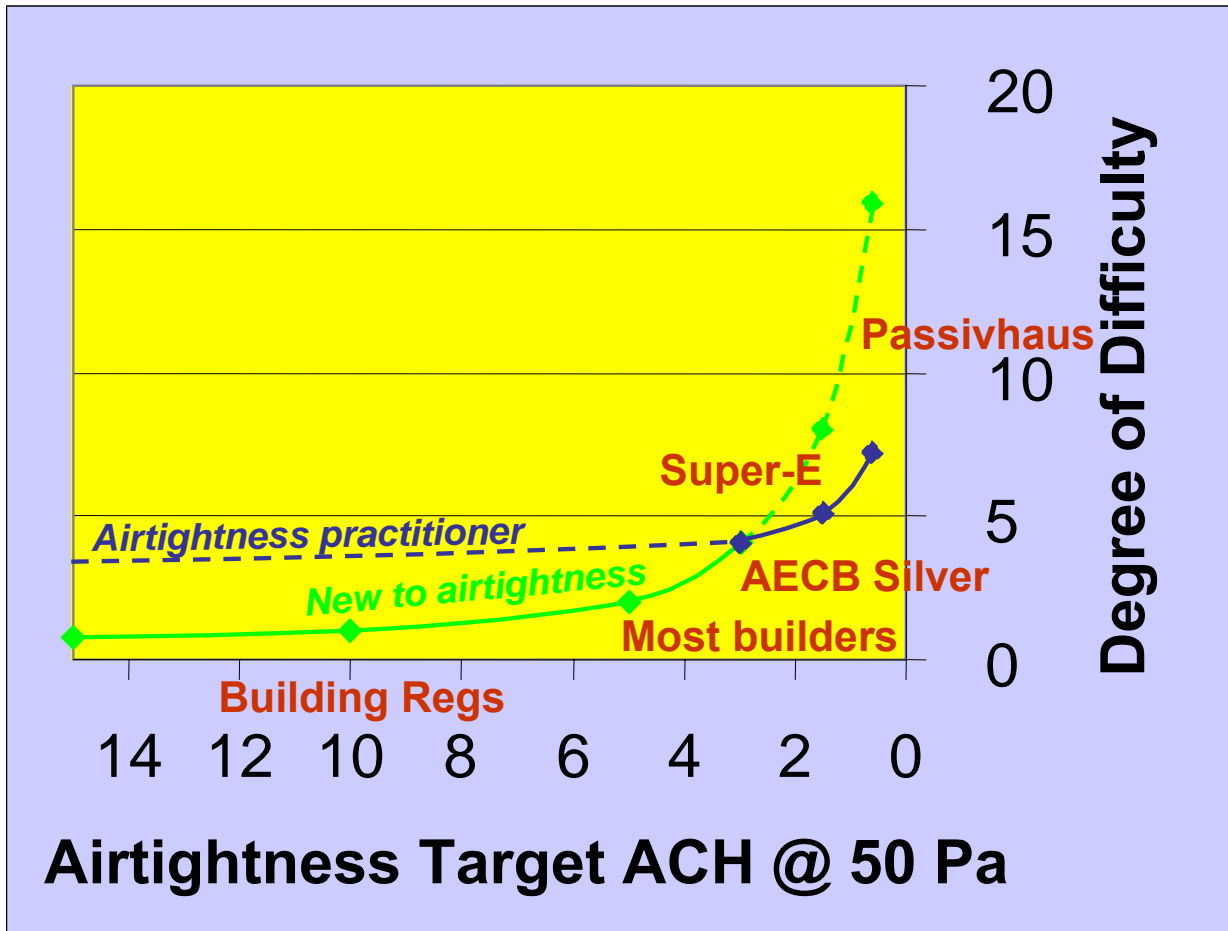
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- **Wall U-Val: from 0.35 (B Regs max) to 0.14 or less. Factor ≈ 3**
- **Airtightness: from 10 (B Regs max) to 0.6. Factor > 15**
- **A much bigger change – not achievable with standard building materials & practices**
- **For Passivhaus, a hole less than a 5p piece per 5 m² section of envelope**



How Hard is Good Air Tightness?

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Factors affecting the delivery of good airtightness:

- Size
- Complexity
- Voids
- Forethought
- Experience



12 Steps

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The successful delivery of an airtight building as a 12-step process:

- 1) Set the Target;
- 2) Define the Air Barrier Strategy;
- 3) Provide Air Barrier Drawings;
- 4) Specifications for Airtightness;
- 5) Design Review;
- 6) Design Workshop;



12 Steps – Part 2

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- 7) Airtightness Champions Program;
- 8) Air Barrier Delivery;
- 9) Air Leakage Audits;
- 10) Element/ Sample Testing;
- 11) Air Leakage Testing;
- 12) Post-Completion Review.

● **Not all steps essential for all projects, but...**



Step 1: Target - Passivhaus

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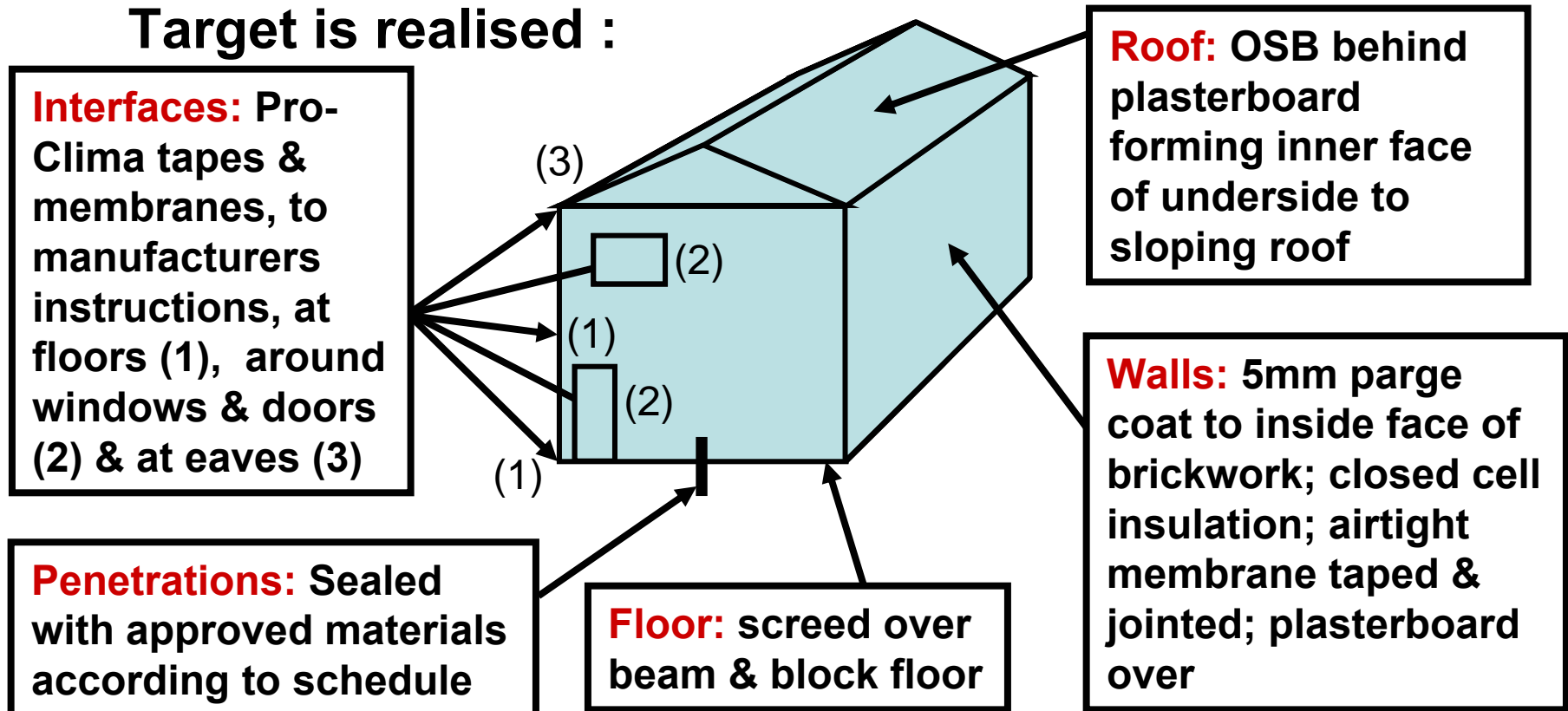
- Air Change Rate of ≤ 0.6 ACH @ 50 Pa;
- Average of Pressurisation & Depressurisation tests;
- Is NOT the same as an Air Permeability of $0.75 \text{ m}^3/\text{hr}/\text{m}^2$ @ 50 Pa;
- Selected after German Research into comfort standards showed that avoiding air movement above 0.1 m/s dropped the demand temperature by 2°C .



Step 2: Develop an Air Barrier Strategy

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- The Air Barrier Strategy is a summary of the building fabric choices by which the Air Leakage Target is realised :



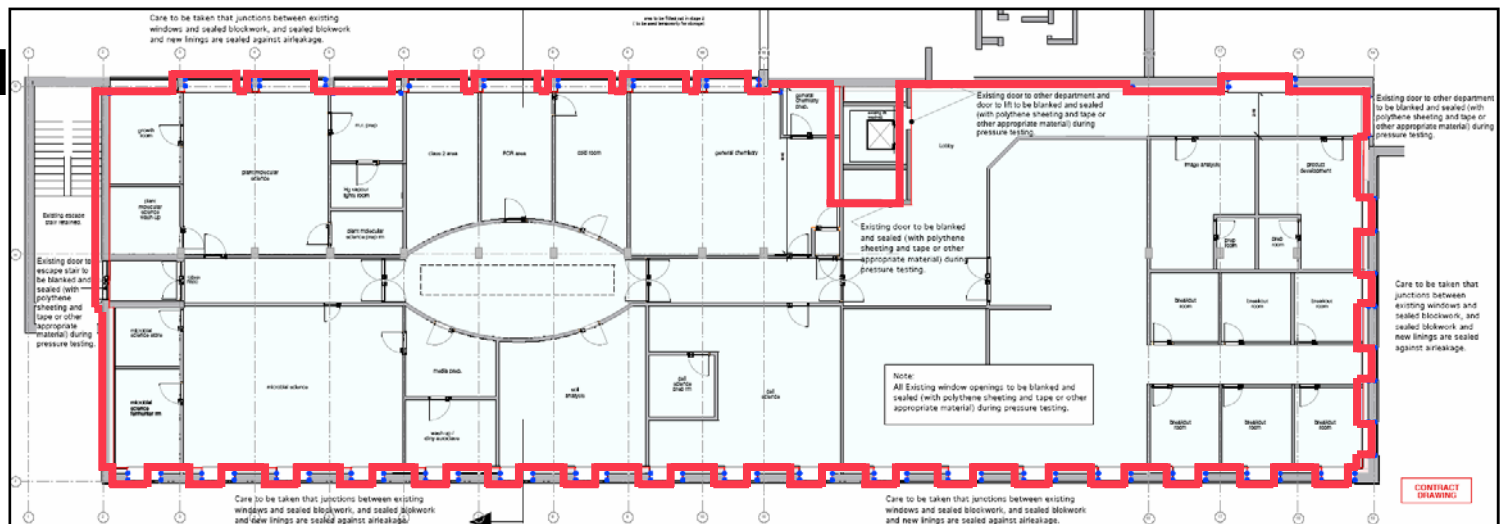
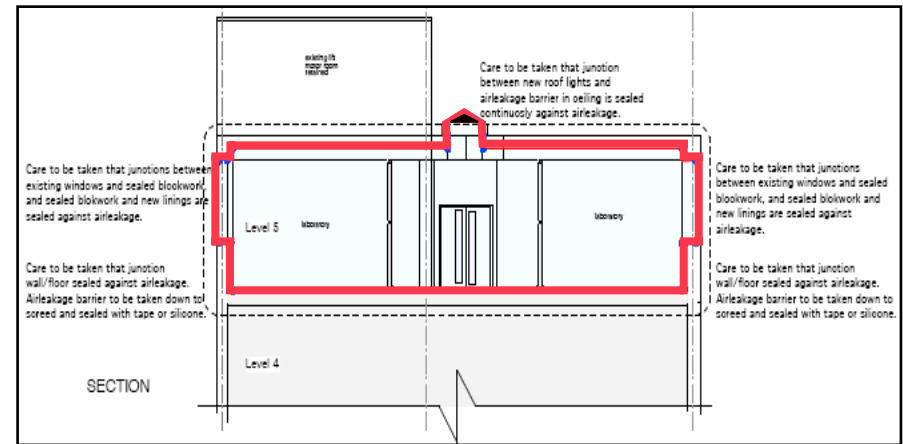


Step 3: Air Barrier Drawings

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- Detail the air barrier plane in plans, elevations & sections;
- Identify materials & means of sealing, work packages.
Abertay University, Kydd Building
– Courtesy of Gaia Architects

- Controlled document, variations must be tracked.





Step 4: Project Specifications

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- **Incorporate target, strategy & other airtightness requirements into project specifications;**
- **Detail work packages that contribute to (e.g. composite panel roof) or potentially compromise (e.g. plumbing fit-out) the airtightness target;**
- **Ensure that the airtightness process (testing, audits, supervision etc.) is fully specified**
- **Must careful check any “equal and equivalent” substitutions – often very detrimental**



Step 5: Air Leakage Design Review

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- Usually by a specialist consultant;
- Checks drawings & specifications for consistency & completeness;
- Looking for gaps between packages;
- Are there for areas where the materials forming the air barrier are undefined and/or the delivery process is unclear?
- A written report is provided, referring to particular drawings and details.



Step 6: Air Leakage Design Workshop

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- **Advisable where the specification is onerous – e.g. Passivhaus;**
- **Not normally essential when robust Air Barrier Strategy and Air Barrier Drawings are in place;**
- **Held with design team, often on site, typically when just out the ground;**
- **Essential to resolve uncertainties and produce a clear action plan.**



Step 7: Airtightness Champion

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- **The key role in ensuring the timely and efficient delivery of airtight buildings, often undertaken by a Clerk of Works;**
- **May include using an uncalibrated fan kit for leak location;**
- **Training and support essential;**
- **Must have sufficient authority to ensure that required works are correctly carried out;**
- **Works best within a full 12-step program.**



Step 8: Air Barrier Delivery

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- Carrying out the works – the construction process;
- Some of which affects the final airtightness, much doesn't – the Airtightness Champion must oversee the relevant works;
- Very important to track variations – these can quickly compromise airtightness.



Step 9: Air Leakage Audits

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- By air tightness consultants, with the Airtightness Champion;
- Normally final audit 1 – 2 weeks before Acceptance Test, to check readiness;
- 1 or 2 preliminary audits depending upon scale & complexity, target;
- Typically a written photographic report.





Step 10: Element or Sample Testing

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- **Element testing of critical elements of the building fabric may be required;**
- **Sample early testing may be undertaken – e.g. one wing of a school – to verify sealing works.**



Sample testing of a section of blockwork for leakage



Element testing of the leakage rate along a section of the wall to roof joint



Step 11: Air Permeability Testing

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- In conformance with ATTMA Technical Standard 1 (TS1);
- Normally assume a preliminary and an acceptance test, for Passivhaus budgeting for 3 tests is advisable;
- Specialist consultant to undertake the acceptance test & issue an Air Leakage Certificate.

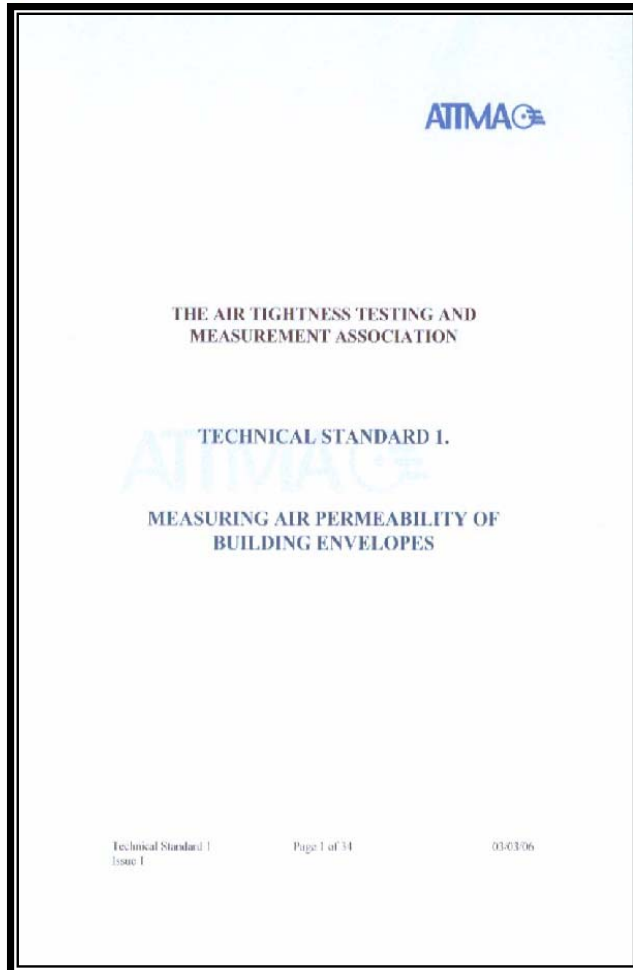


Single fan kit mounted in a doorway testing a low-energy house near Oxford



ATTMA Standard:

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**ATTMA (Air Tightness Testing & Measuring Association) Technical Standard, TS1;
Maximum existing pressure differential of 5 Pa, maximum windspeed of 6 m/sec, 13.4 mph;**

www.attma.org



Step 12: Post-Completion Review

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- **Currently only rarely done;**
- **Some discussion about repeat air permeability testing being undertaken at the end of the defects period;**
- **A massive opportunity for contractors & the design team to learn from completed jobs;**
- **Will inform and improve subsequent projects – essential as tougher targets are adopted.**



The Airtightness Champion's Role

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Simplified into 12 areas of work & responsibility:

- **1) Understand & communicate the air barrier strategy. Ensure it's adoption by all;**
- **2) Know where the Air Barrier Plane is & what forms it. Supervise or check all relevant works;**
- **3) Ensure Site Inductions emphasise Air Leakage Testing & the necessity to avoid leaks;**
- **4) Manage relevant variations, which can often compromise the Air Barrier;**



The Airtightness Champion's Role, 2

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- **5) Operate an inspection checklist for key elements, interfaces and penetrations;**
- **6) Ensure all materials which form part of the Air Barrier Plane are correctly used;**
- **7) Liaise with the air leakage consultant/ testers to organise visits for Audits & Tests, ensuring all necessary preparations are complete;**
- **8) Verify that weather conditions are satisfactory for testing;**



The Airtightness Champion's Role, 3

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- **9) Ensure that recommendations from Air Leakage Audits are acted upon;**
- **10) On major housing schemes, determine how many dwellings need to be tested;**
- **11) Ensure that envelope area & volume for the building are traceably calculated;**
- **12) Use a leakage check kit to check the effectiveness of sealing works.**



Current UK Best Practice

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- **John Williams' Y Gaol Passivhaus**
Air Permeability of 0.25 in Sept. 08
- **John Williams' DVFP New Office**
Air Permeability of 0.25 in Sept. 08
- **Andy Simmonds Passivhaus Refurb**
Final Air Permeability of 0.99, June 09
- **Gaia Architects Acharacle School** Air
Permeability of 0.27, Nov. 08
- **Bere Architects Ranulf Rd Passivhaus**
Air Change Rate of 0.36 in Feb. 2010





Refurbishment Airtightness

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- **Pre-improvement Test to establish current position, contribute to design;**
- **Preliminary test at end of first fix or earlier, verifies Air Barrier Strategy;**
- **Possible intermediate tests to check progress, combined with Site Audits;**
- **Post-Improvement Acceptance Test, with issue of Air Permeability Certificate**



Portfield St. Passivhaus Refurb – Andy Simmonds

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Preliminary test – checking seals
between sections of membrane



Acceptance test – checking seals
around new window in extension

- **Achieved 1.50 ACH @ 50 Pa on preliminary test (March 2009)**
- **0.97 on final acceptance test (June 2009)**



ALDAS Services

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- Detailed reviews of building designs, to identify actual & potential air leakage issues;
- CPD seminars and 1/2 day design workshops;
- Tailored 1- and 2-day courses, including demonstration tests;
- On-site leakage audits of buildings;
- Supporting Airtightness Champions;
- Sample testing of building sections;
- Air Leakage Testing.

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