CONSTRUCTION BLUEPRINT

Module 4

Building Fabric 1: Air Permeability

Energy Efficiency for Construction

24 partners

12 countries

Date of Event

*Author/ **Institute***

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Building Fabric 1 | Summary

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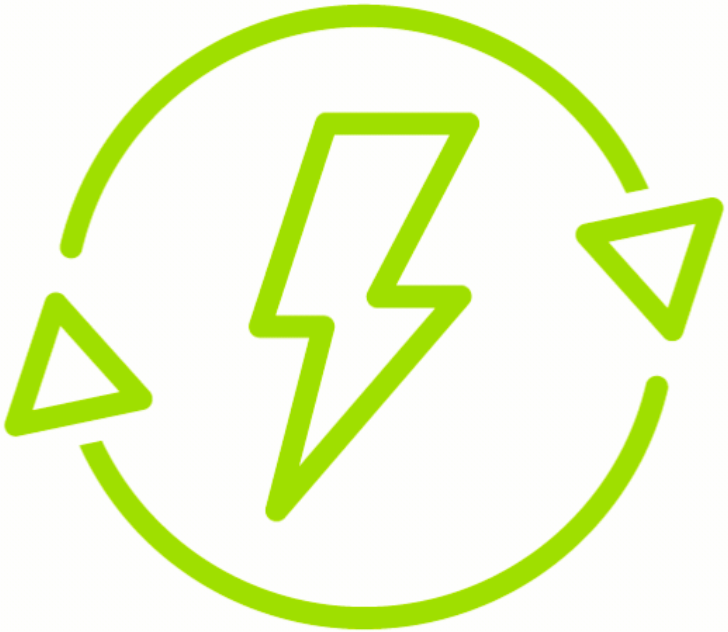
To equip the learner with the relevant knowledge and skills required to understand the importance of airtightness and wind-tightness and how to implement measures to alleviate heat loss.



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Building Fabric 1 | Objectives

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1. Define the term **air permeability** and describe how the air permeability of a building has an influence on heat losses.
2. List common **leakage points** in both masonry and timber frame construction types.
3. Outline the multiplicity of **benefits** that airtightness brings to dwellings
4. Identify the **airtight layer**, its constituent parts and its routing on building assemblies and junctions
5. Outline how **airtightness** can be achieved for **different construction forms**, floor, walls and roof and the detail for difficult junctions (separating floors, wall to roof, wall to floor, reveals) and for service penetrations.
6. Identify and outline the different kinds of **air tightness products** (tapes, membranes, paint and plaster) that can be used to create long-term airtightness on rough concrete, plaster, wood or membranes.
7. Understand the benefits and demonstrate the creation of a **service cavity** on the warm side of walls and attic ceilings to avoid the need for services to penetrate the vapour control layer.
8. Understand the importance of an **airtightness strategy** and the roles of each team member.
9. List and outline the consequences of using materials not **fit-for-purpose** in relation to creating airtightness in dwellings over time, (such as low-quality tapes and silicone sealants which tend to delaminate after a period of some months or year).

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Building Fabric 1 | Content

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Topic 1 – Air Tightness in Buildings

Topic 2 – Air Tightness Strategy and Materials

Topic 3 – Air Permeability Test

On the following slides you will see this icon:

Click and play to find out more

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1. Air Tightness in Buildings

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Air Leakage

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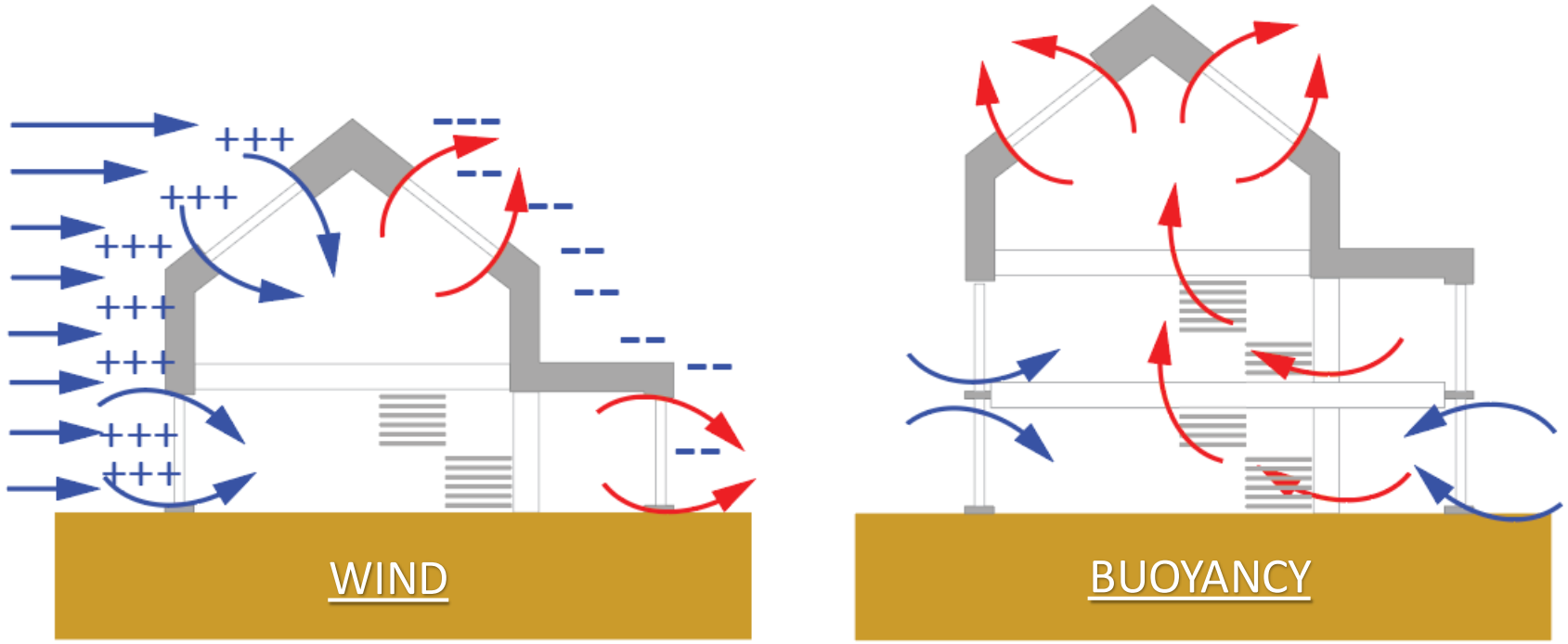
Definition of Air Leakage

The **Uncontrolled** flow of air through **Gaps**, **Cracks** and **Holes** in the fabric of the Building



Infiltration and Exfiltration

Image Source: Passive House Institute

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Location of the Airtightness ‘Layer’

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Airtightness:
One continuous airtight layer on the warm (interior) side
The RED LINE

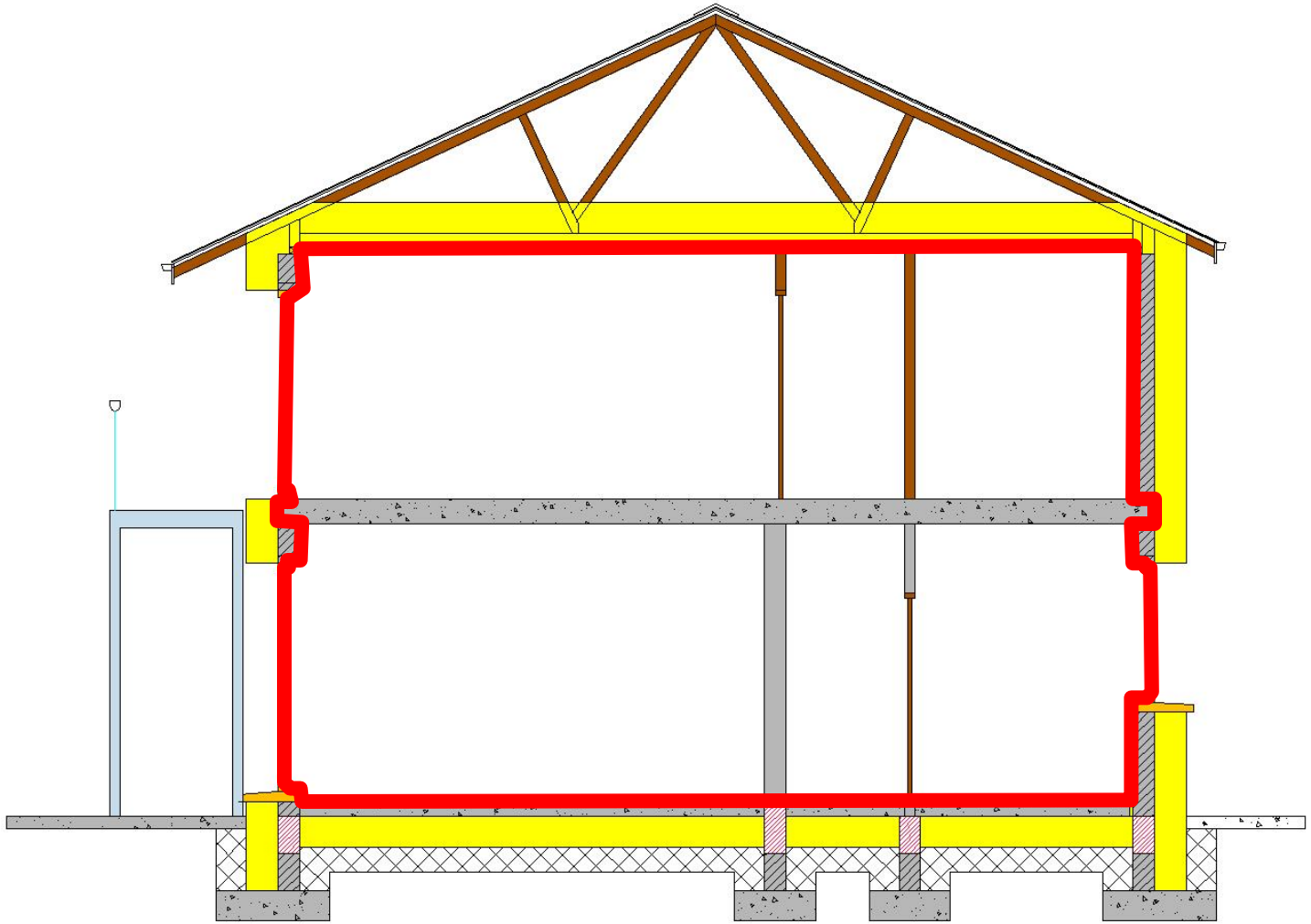

Image Source: MosArt

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Benefits of Airtightness

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- Eliminate drafts
- Improve comfort
- Reduce heat losses
- Reduce heating bills
- Reduce risk of interstitial condensation
- Improved sound proofing
- Increase efficiency of ventilation system

Image Source: MosArt

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Benefits of Windtightness

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- Breathable but wind-tight layer located on the wall exterior
- Improved performance of the insulation layer (the heat is not blown away by the wind)
- Reduced heat losses and energy bills
- Improved comfort
- Especially important with ‘loose’ insulation such as cellulose or mineral wool

Image Source: Partel

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Vapour Open Windtightness: Overlap & Tape Joints

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Image Source: Partel

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Vapour Open Windtightness: Overlap & Tape Joints

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Windtight Layer - Very Important on Dormer Roof

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- Prevents cold wind blowing through insulation
- Note how all joints are taped – vapour open tape!

Image Source: MosArt

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Roof Windtightness – Only Used with Warm Roofs

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Where should we put the Airtightness layer?

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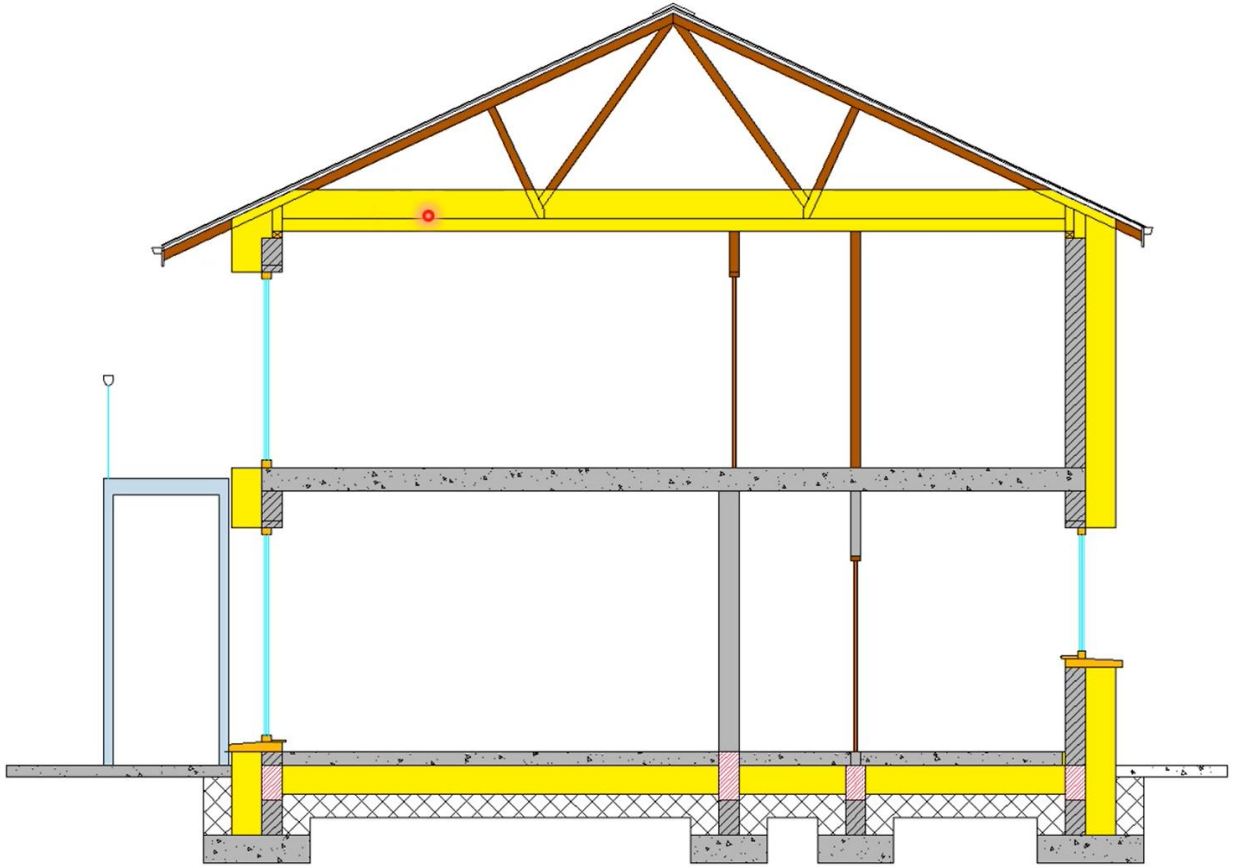

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Location of the Airtightness ‘Layer’

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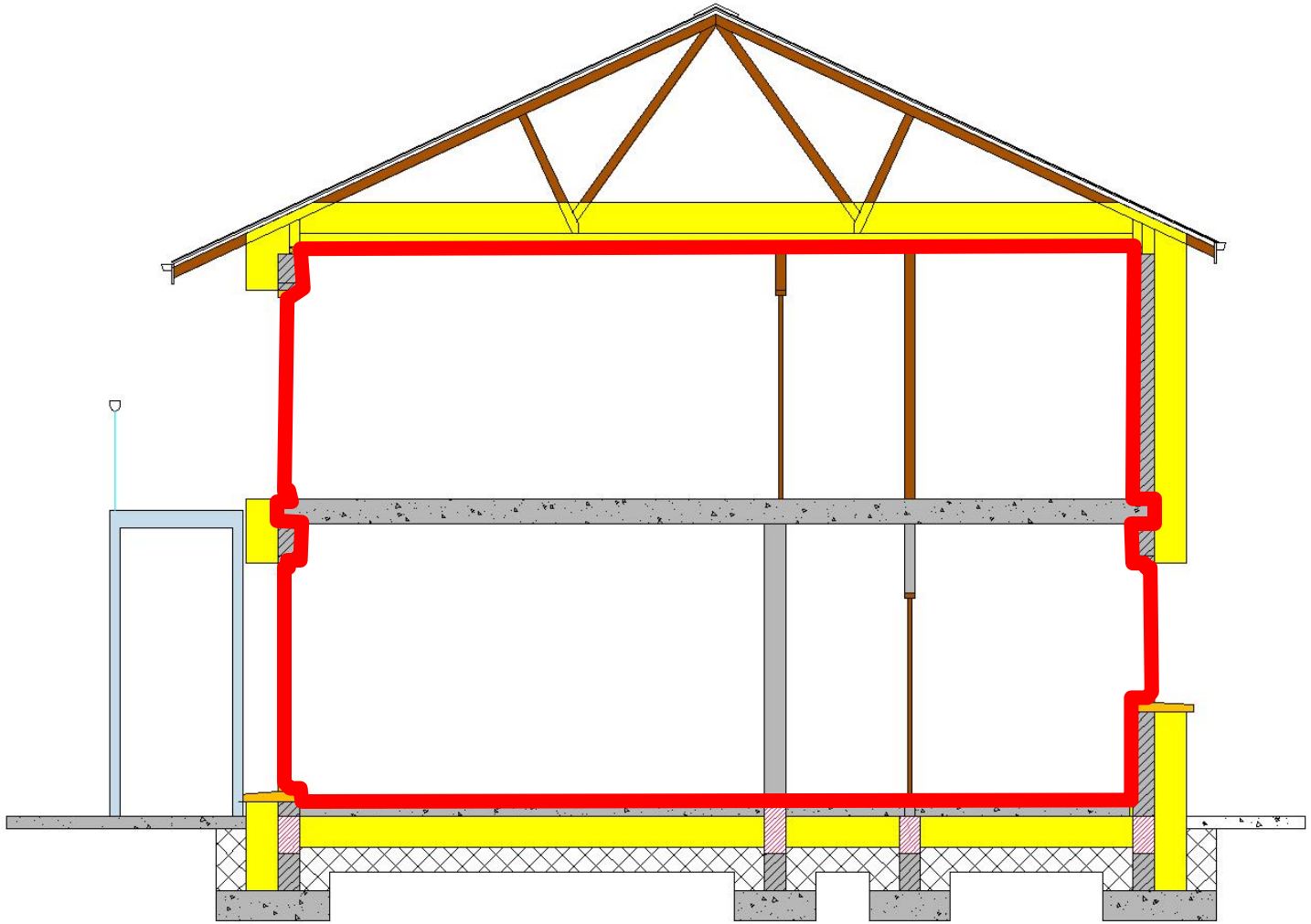
Airtightness:
One continuous airtight layer on the warm (interior) side
The RED LINE



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Evolution of Airtightness Standards in Ireland

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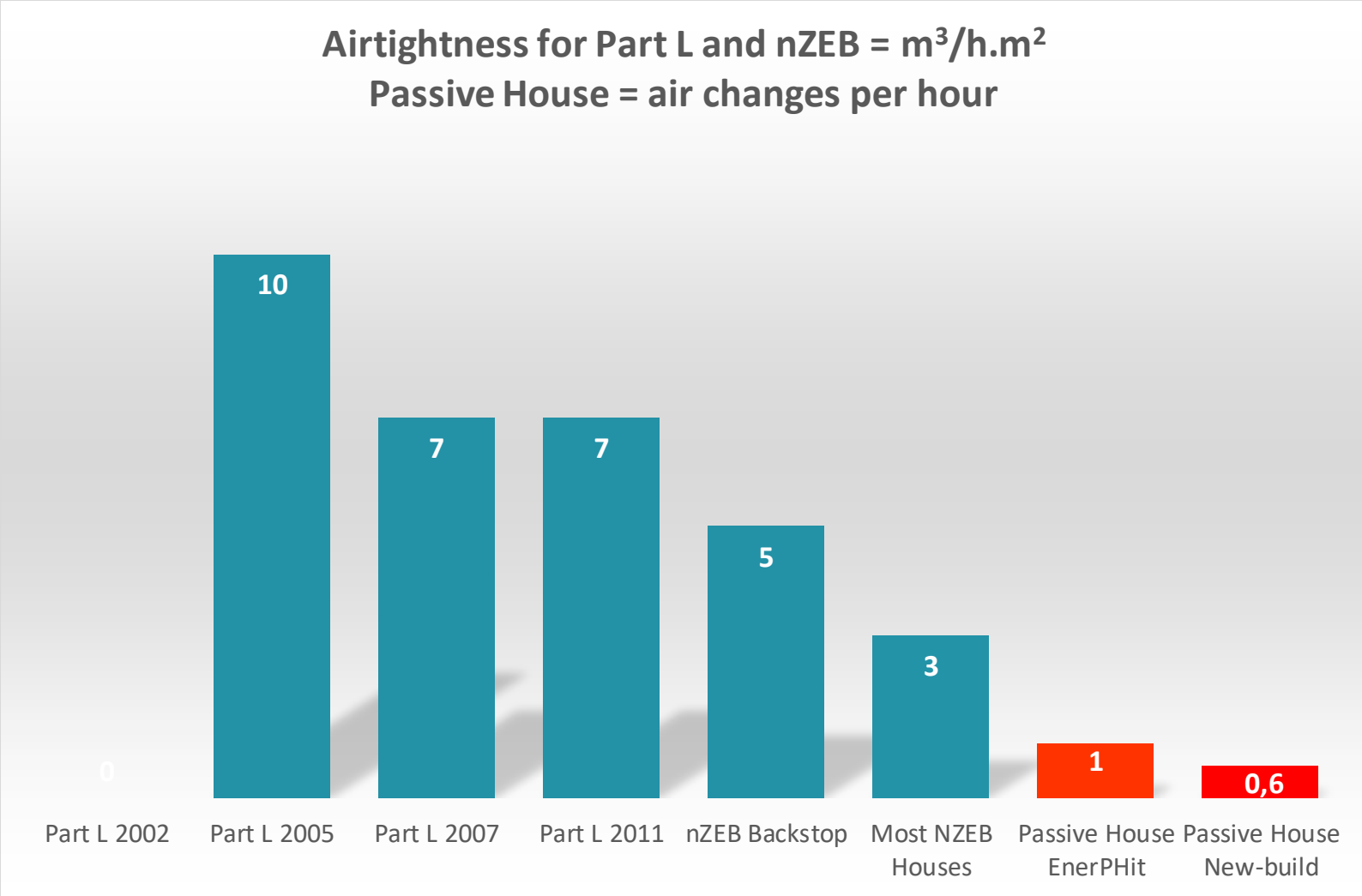

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Air Permeability Scale

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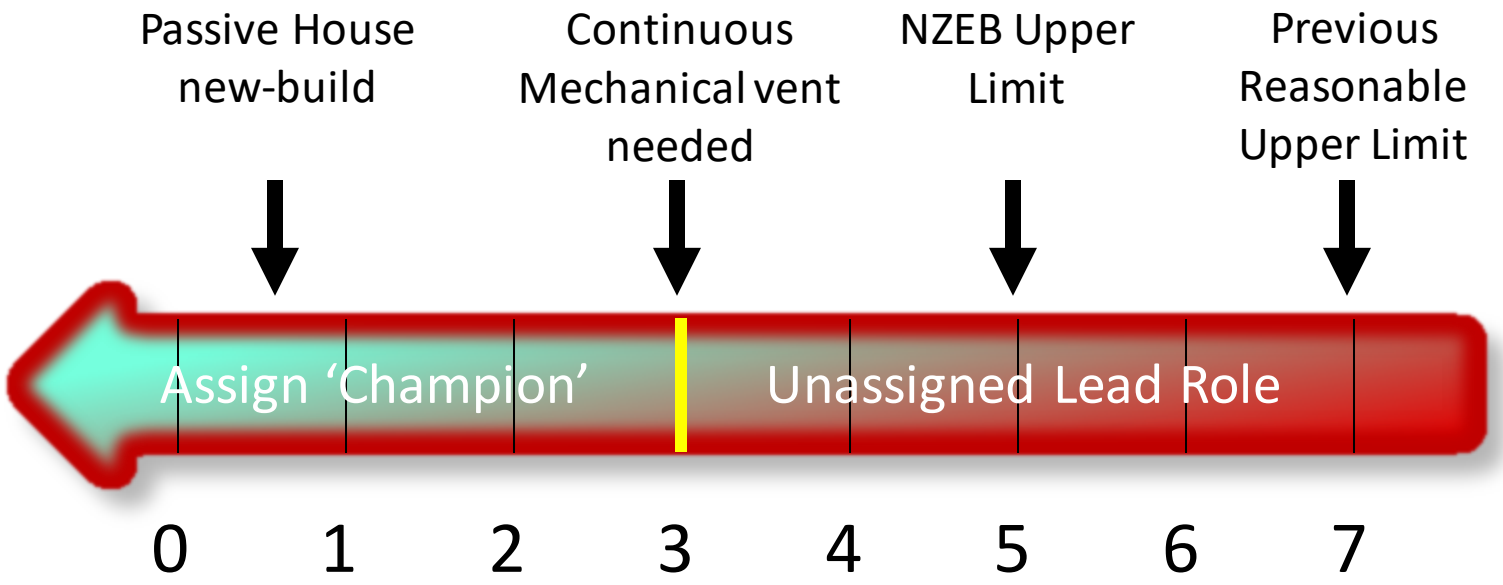

Air permeability q_E50 result: $m^3/hr.m^2$

Image Source: MosArt

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Air Permeability and Energy Performance

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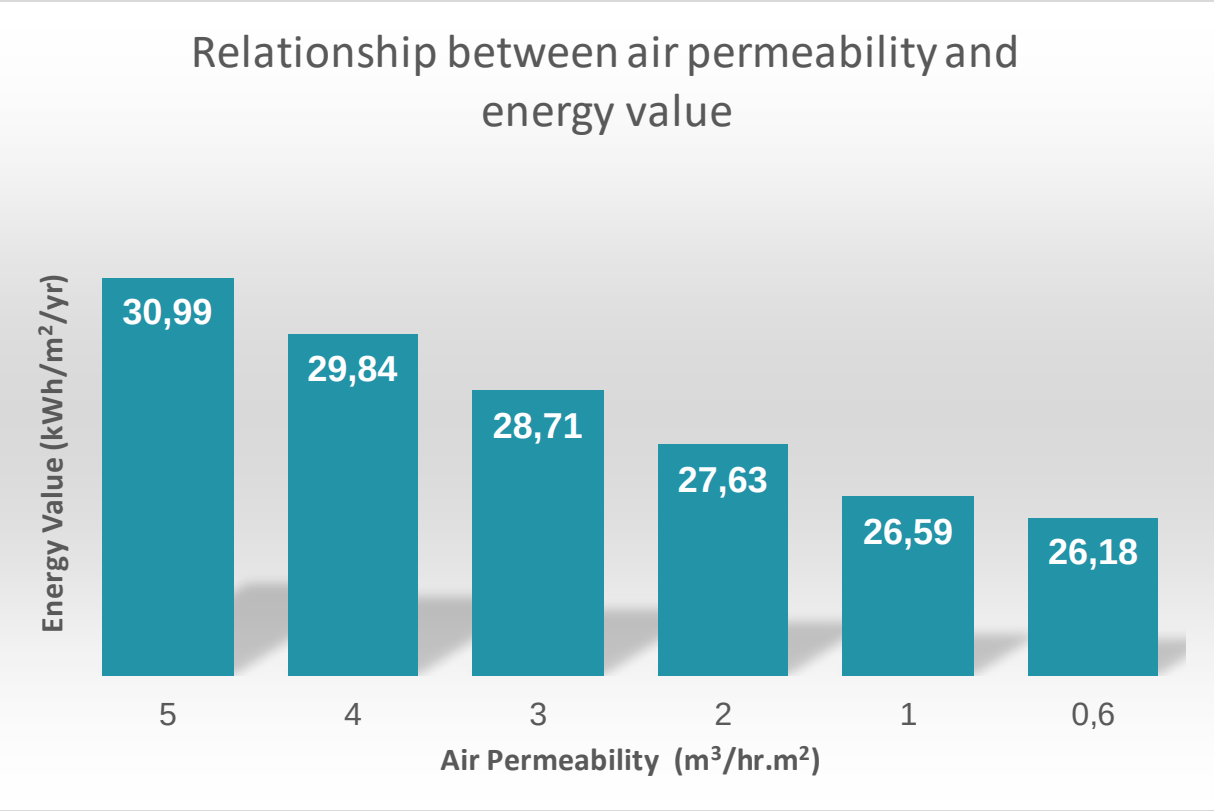

- These figures are based on an NZEB dwelling modelled in DEAP.
- The only change made to the dwelling is the air permeability number – everything else remained the exact same.
- The more airtight the building becomes, the more energy efficient it is.

Image Source: MosArt

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Communicate Importance of Airtightness

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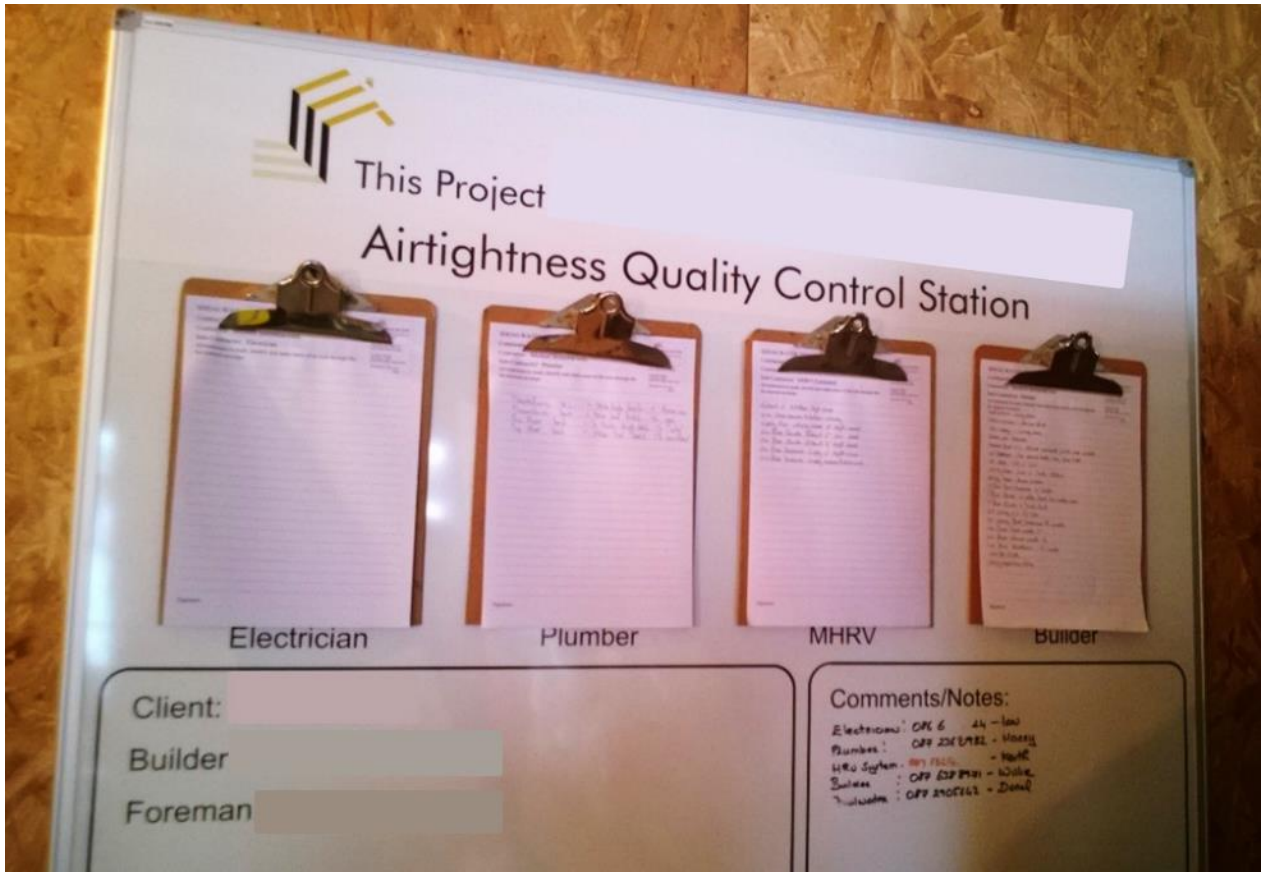

Be Innovative and record all penetrations by different trades - to be signed off by project airtightness 'champion'. This needs teamwork and understand how the air tightness strategy works.

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Get in the Right Frame of Mind for Airtightness

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- When it comes to airtightness, attitude is everything. Get into the submarine mindset!

- You wouldn't use cheap materials in a submarine, so you shouldn't do so in a house either.

- Just like in a submarine, if one of the team bursts a hole, the entire project will suffer.

Image Source: Purchased by MosArt (iStock-1181149790)

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Identification of Airtightness Layer: Wall to Floor Junction

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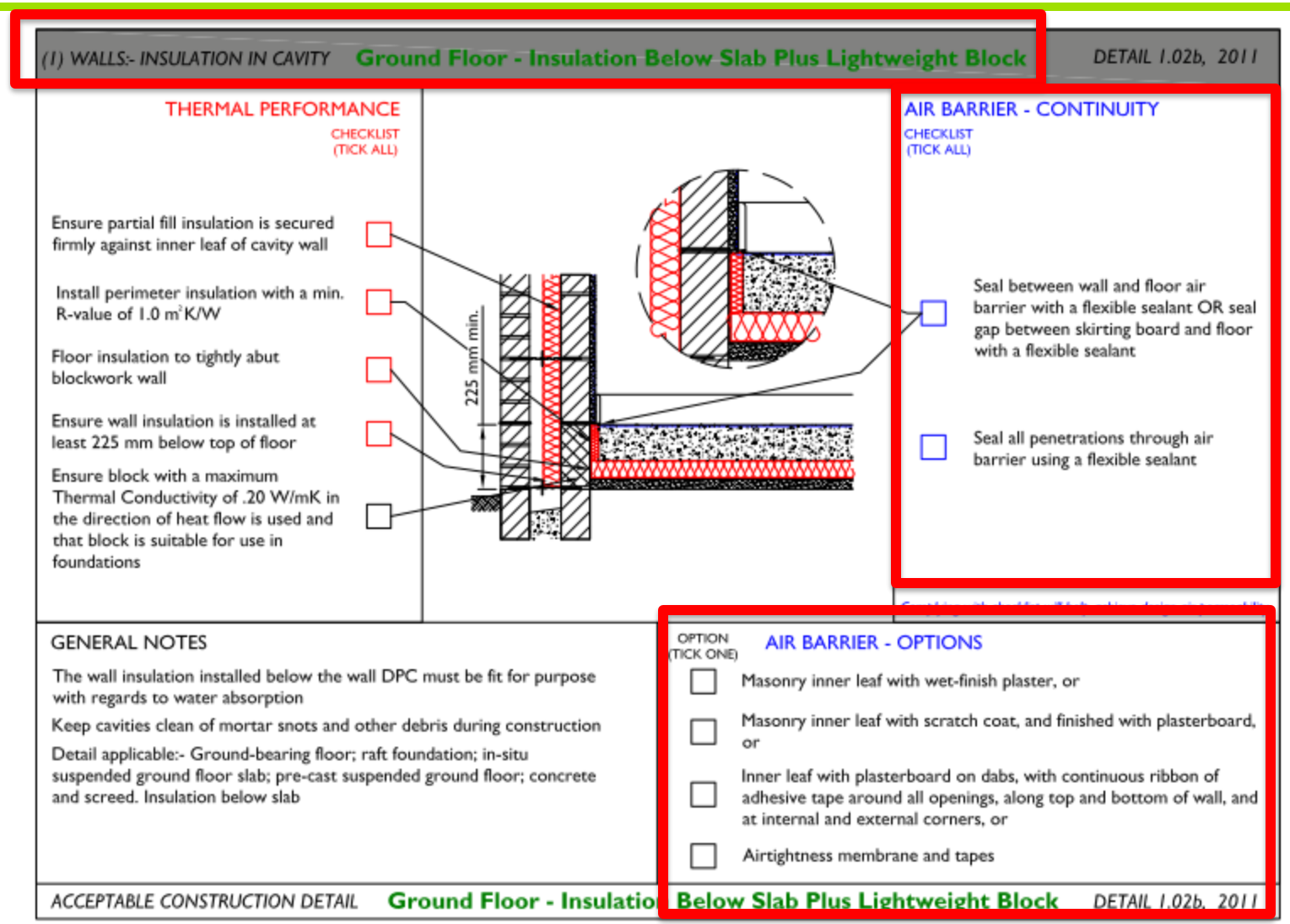

- Construction Type: insulated cavity, insulation below floor
- Air barrier location (shown in blue)

- Air barrier continuity checklist
- Air barrier options

Image Source: Department of Housing, Planning and Local Government

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Identification of Airtightness Layer: Eaves

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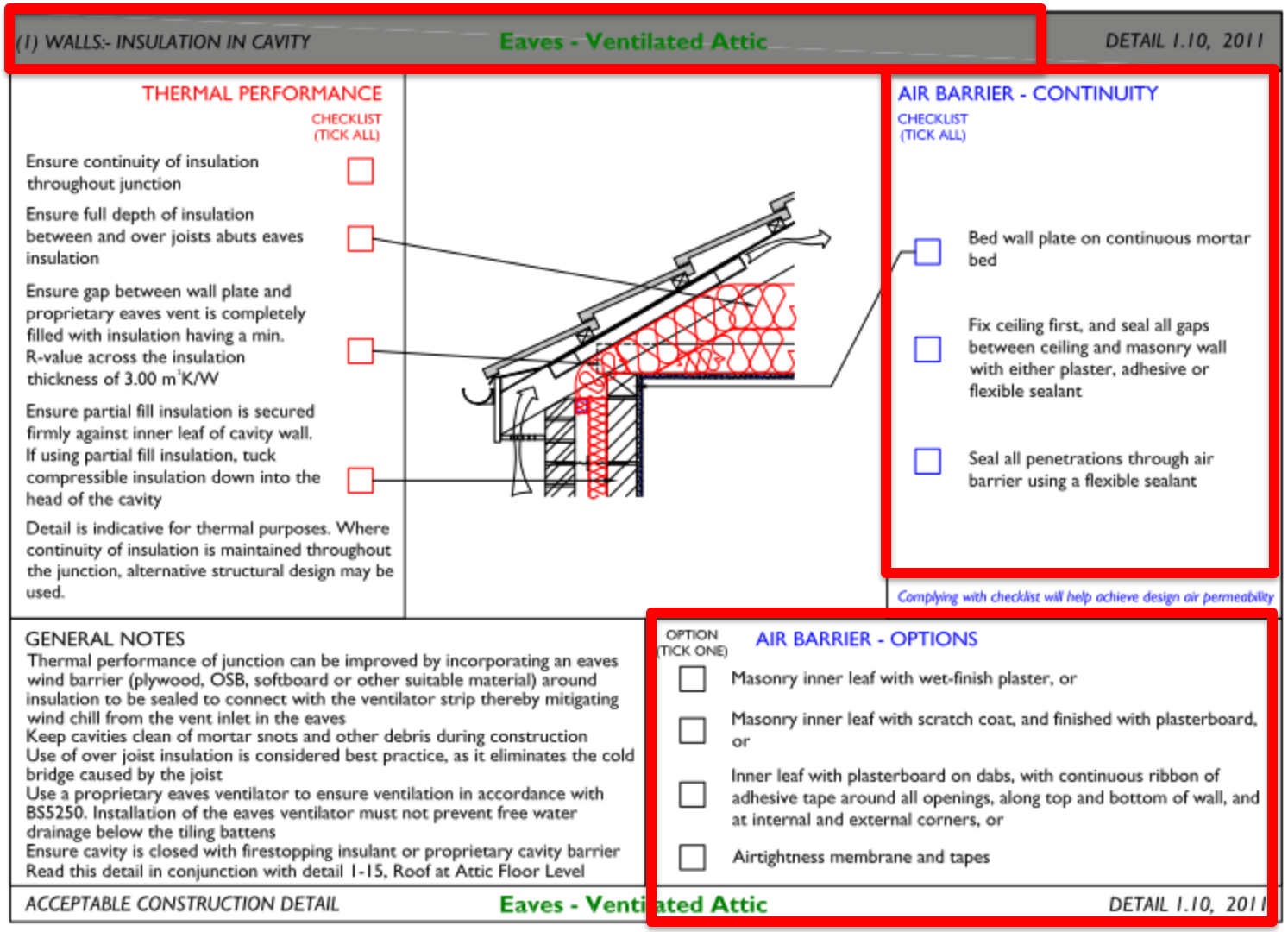

- Construction Type: insulated cavity, eaves, ventilated attic
- Air barrier location (shown in blue)
- Air barrier continuity checklist
- Air barrier options

Image Source: Department of Housing, Planning and Local Government

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2. Air Tightness Strategy and Materials

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Non – Airtight Materials

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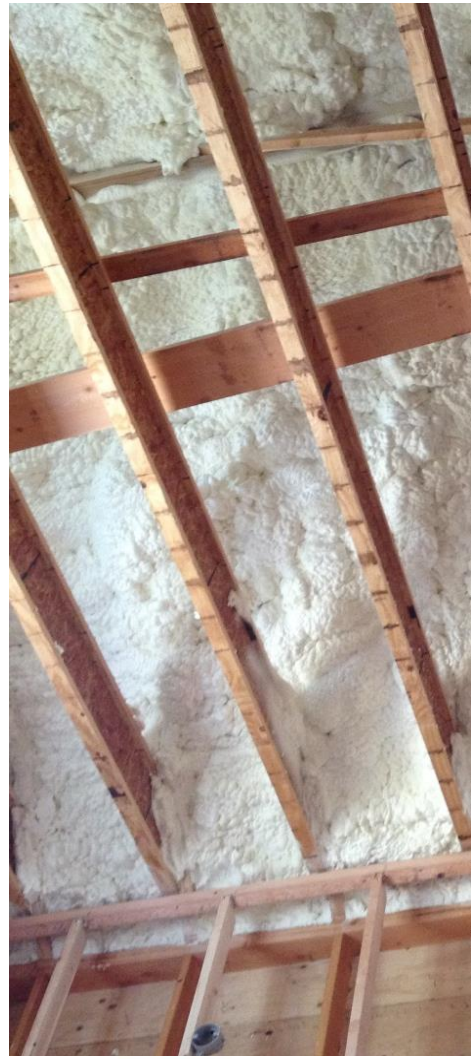

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Ducktape
Does not have
longevity

Image source: Purchased by MosArt (istock-172289824)

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Reliably Airtight Materials

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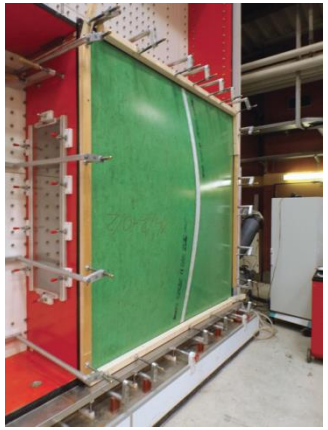
Plastered brick or blockwork

Specialist tapes and membranes



Certified airtightness boards

Concrete poured on site

Specialist liquid applied membranes

Image Source: Lower left - Medite SmartPly / Bottom right - Partel / Others - MosArt

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Multiple Material Airtight Layers

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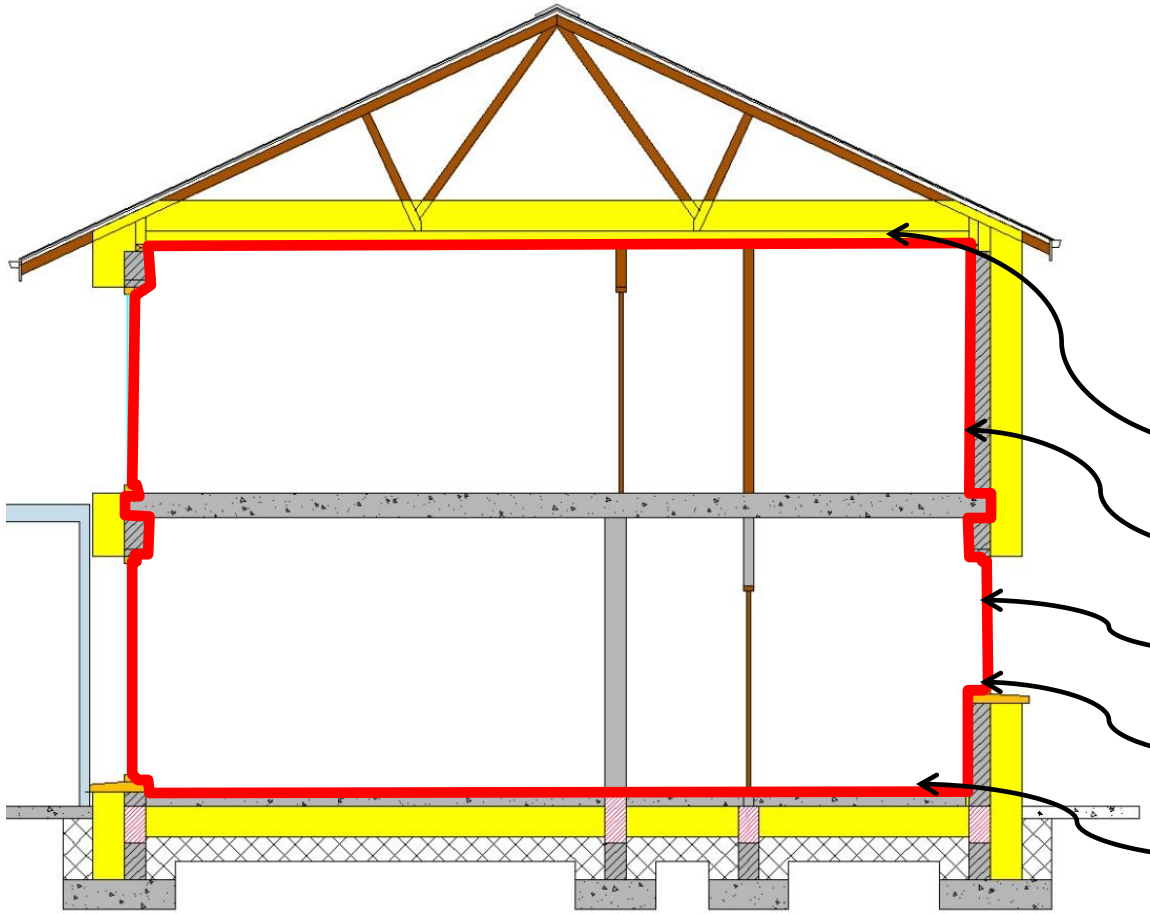

In almost every project, there are lots of different materials used to create one continuous airtight layer.

In this example of a building the following materials were used:

- **Airtight membranes**
- **Sand and cement plaster**
- **Window units**
- **Airtight tapes at junctions and overlaps**
- **Poured concrete floor**

Image Source: MosArt

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Not all OSB Boards are Airtight

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"We started finding increasing evidence of OSB3 failure in the timber frame extension of this house"

On-site 'balloon' tests

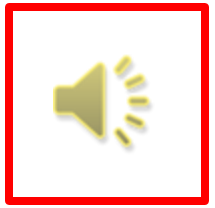

Image Source: Greenbuild

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Airtightness Strategies - Masonry Projects

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- Quick and easy to apply
- Can achieve excellent levels of airtightness
- Offers a solution to problematic air tightness junctions
- M1 emissions certification of building materials

Image Source: Blowerproof

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Airtightness Strategies - Masonry Projects

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Image Source: Blowerproof

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Airtightness Strategies - Masonry Projects

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Image Source: Partel

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Sealing Connections in Masonry Projects

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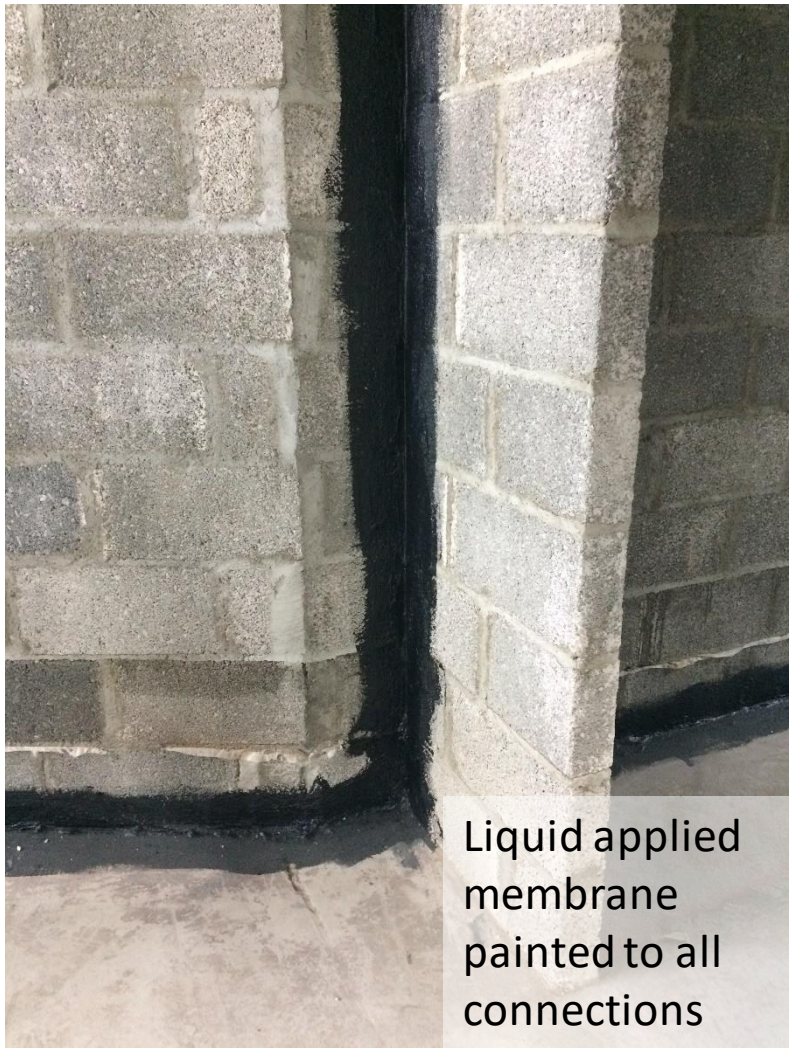
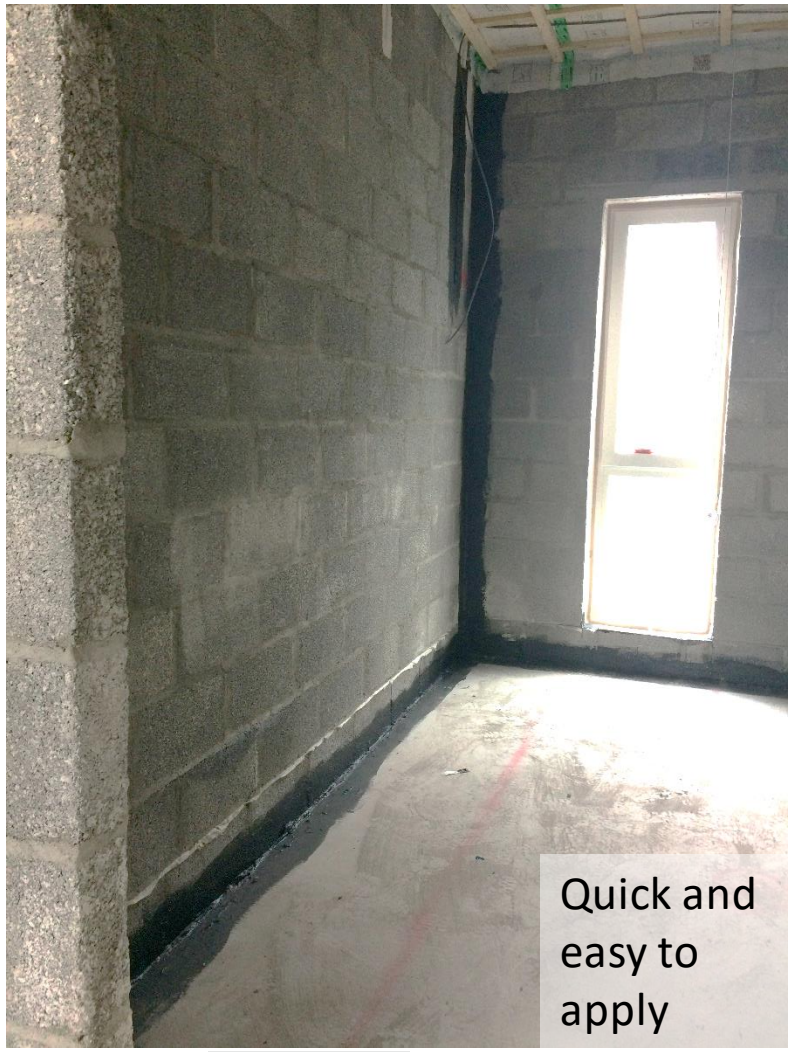


Liquid applied membrane painted to all connections



Quick and easy to apply

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Airtightness in Insulated Concrete Form (ICF) Construction

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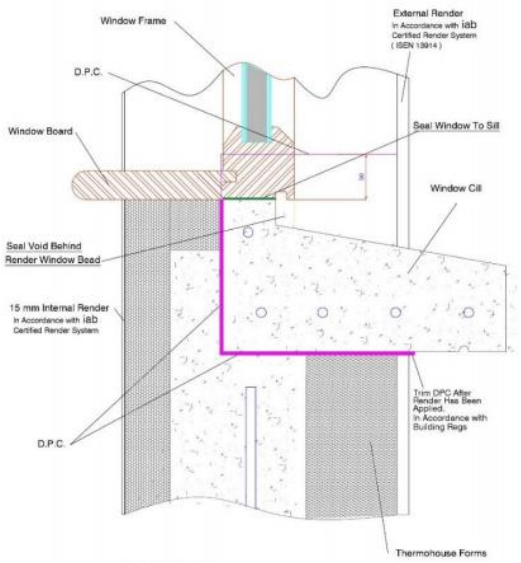
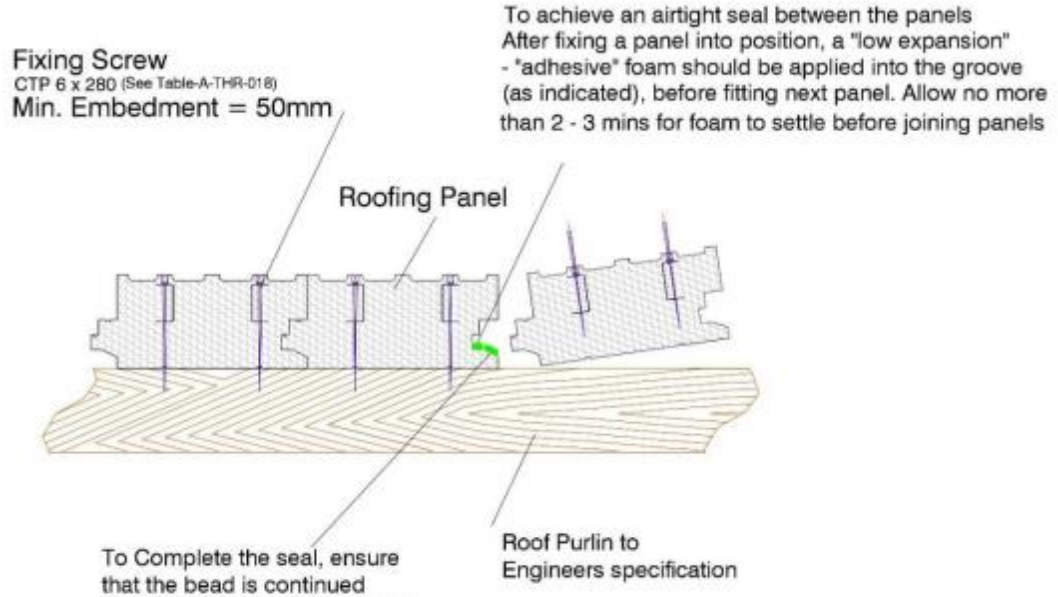
Thermo Wall with Window





Thermo Roof

Energy Efficiency for Construction:
Building Fabric 1

Image Source: Thermohouse

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Specialty Airtightness and Vapour Control Membranes

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Fixing Airtight Membranes to Timber Frame

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Image Sources: WWETB and SIGA

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Airtight Tape Technical Details

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Tape size: 60mm x 30m Roll

Key Technical Data

Can be used	Externally, Internally
Construction type	Cross Laminated Timber (CLT), Lightweight construction, Metal frame, Prefabricated (off-site manufactured) timber frame, Timber frame
Durability	Airtight for 100 years (Kassel University independent testing)
For use on	Ceilings, Roofs, Suspended timber floors, Walls (timber frame), Walls with closed timber cladding (no gaps)
Permanently sticks to	Aluminium, Aluminium / foil membranes, Chipboard, Hard plastics, MDF, Metal, OSB, PE, PA, PP, PET and foil membranes, Painted timber, Plywood, Pro Clima membranes, Smooth planed timber
Primer required for sticking to	Dust producing surfaces, Gypsum plaster, Lime plaster, Rough/uneven surfaces, Smooth cement (plaster or render), Smooth concrete, Surfaces that may come-away or delaminate, Wood fibre rigid insulation boards
Release strip width	60mm
Release strip/paper	Silicone coated paper
Roll Length	30 m
Roll Width	60 mm
Warranty	10 years (when correctly installed with Pro Clima system products only), 6 years (when correctly installed with non-Pro Clima products)
sd-value	0.4 m

Image Source: Ecological Building Systems

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CONSTRUCTION BLUEPRINT

Avoid Reducing Warranties by Mixing Products

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Two different brands of airtightness products were used on this project – this will reduce the warranty provided and should thus be avoided
This may also create problems if the membranes do not perform in the same way as each other

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Avoid Reducing Warranties by Mixing Products

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It is best to stick with airtightness products from the same brand to guarantee warranty

Image Source: Partel

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Use of caulks in airtight connections

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- Use of caulks is very common in construction
- When using caulks to create airtight connections or seal leakage points, careful consideration must be given to the type of caulk used
- Where caulks are used, the airtight layer is only as durable as the caulk holding it together!

Images Source: Ecological Building Systems

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Sealing Membranes to Floors and Ceilings

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- Vapour control layer and airtight layer is achieved using a membrane
- All joints and connections are taped
- Connection to floor and ceiling for this project used specialist airtightness sealant
- Complete airtight system in place

Image Source: MosArt

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Caulk Failure!

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Image Source: Purchased by MosArt (Adobe Stock-299286352)

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Appropriate caulks for airtight connections

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- Standard building caulks are not designed to be durable enough to last the life time of the building
- They will likely dry out, shrink or crack after the first couple of years
- Quality caulks will be tested to an established standard, such as DIN 4108-11 - *'Thermal insulation and energy economy in buildings - Part 11: Minimum requirements to the* ***durability of bond strength*** *with adhesive tapes and adhesive masses for the* ***establishment of airtight layers'***

DIN 4108-11 is not the only standard for airtight caulks, but it is one of the most common

Images Source: Right - Partel / Left - Ecological Building Systems

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Appropriate caulks for airtight connections

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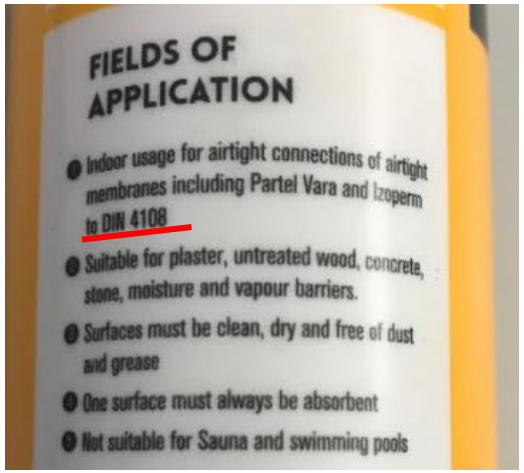
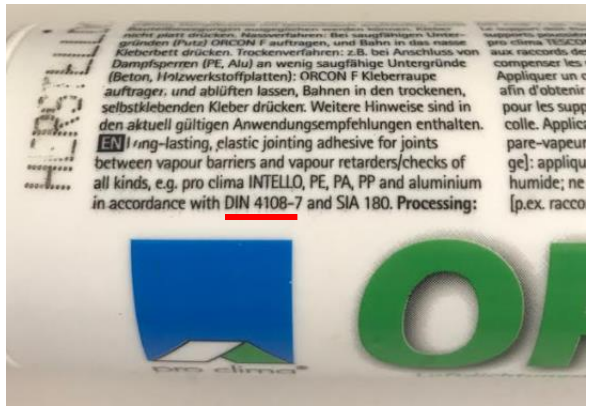


Partel's 'airtight caulk'

Fields of Application

Indoor usage for airtight connections of airtight membranes including Partel Vara Plus and Izoperm Plus to DIN 4108.

Suitable for plaster, untreated wood, concrete, stone, moisture and vapour barriers. Surfaces must be clean, dry and free of dust and grease. One surface must always be absorbent. Not suitable for Sauna and swimming pools.



Ecological Building Systems 'airtight caulk'

Advantages

- ✔ Very high adhesion and quick drying. No pressure lath is required on load-bearing substrates
- ✔ Very elastic, permanently flexible
- ✔ Penetrates deep into the substrate
- ✔ Can also be stored in the event of frost
- ✔ Construction in adherence with standards: for airtight bonding in accordance with DIN 4108-7, SIA 180 and RT 2012
- ✔ Excellent values in the hazardous substance test, has been tested according to the ISO 16000 evaluation scheme

You will find this sort of information on the suppliers website, on the tube of caulk or by asking your supplier

Images Source: MosArt

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Inappropriate caulks for airtight connections

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SPECIFICATION	
Brand	Anonymous
CE Standard (Tested to EN...)	EN 11600, F12-5E.
Colour	White
Label Info 4: Supplementary Label Info	May produce an allergic reaction. Safety data sheet available on request.
Label Info 5: Hazardous Chemical Content	Contains 4,5-dichloro-2-octyl-2H-isothiazol-3-one
Manufacturer Guarantee	1 Year Guarantee
Max Heat Resistant Temperature	150 °C
Pack Size	1
Parent Colour	White
Pieces in Pack/Case	1
Product Type	Sanitary Silicone
Resistant Type	Waterproof & Water-Repellent
Sealant/Adhesive Container Type	Cartridge
Suitable Application	For Use on Baths, Showers, Basins & Sanitaryware
Volume	310 ml
Water Resistant	Water-Resistant Once Fully Cured

EN 11600 – 'Building construction. Jointing products. Classification and requirements for sealants'

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Use of Caulk Rolls for Easy Application

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While airtight caulks can be an excellent solution, they have two main disadvantages:

- An even application can be difficult
- They need time to dry

These disadvantages have been addressed with the creation of caulk rolls. It is easy to apply an even thickness and there is no drying time.

Adhesive performance is the same as liquid caulk.

Images Source: Left - Partel / Right - SIGA

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Why use caulk in airtight connections?

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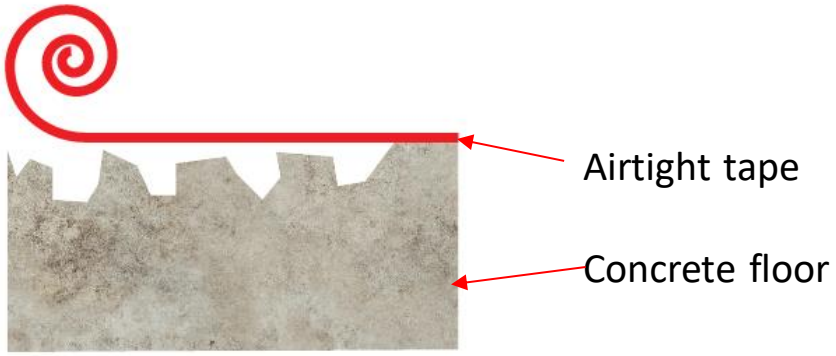
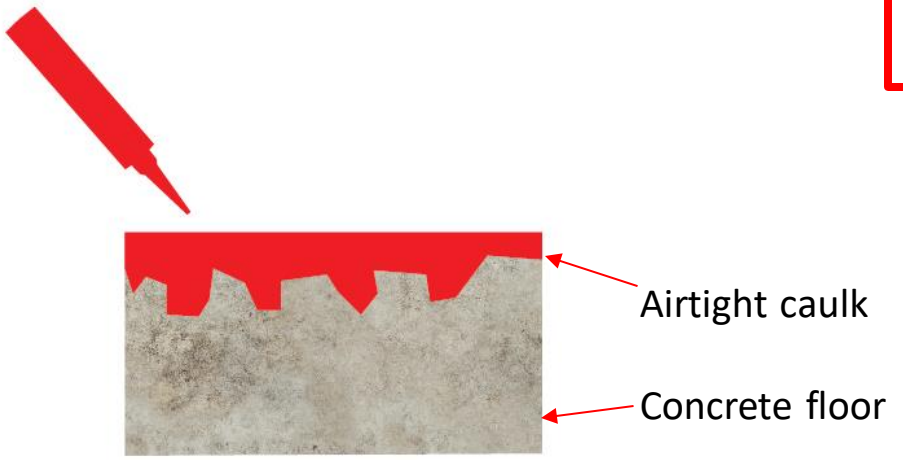
- When using an airtight tape, it is important that there is a large surface contact between the tape and the material it is being applied to.
- This is not a problem when sticking to smooth surfaces, such as steel, timber or plastic but can be difficult when taping to a rough surface, such as concrete.
- Caulks can penetrate the pores in the concrete, creating an excellent bond on a molecular level.



Note the limited contact between concrete and tape



Note the large contact between concrete and caulk

Image Source: MosArt

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Sealing Membranes to Floors and Ceilings

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Connections to concrete floors can be a particularly difficult connection

In this project, the connection to the concrete floor had failed shortly after installation

There are a number of reasons for this:

- Use of inappropriate products for rough surface
- Dirty surface
- Might require the use of a primer

Do it right the first time to avoid wasting time and money, and compromising on quality!

Image Source: MosArt

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Sealing the Wall to Floor Junction

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Connecting Different Surface Types

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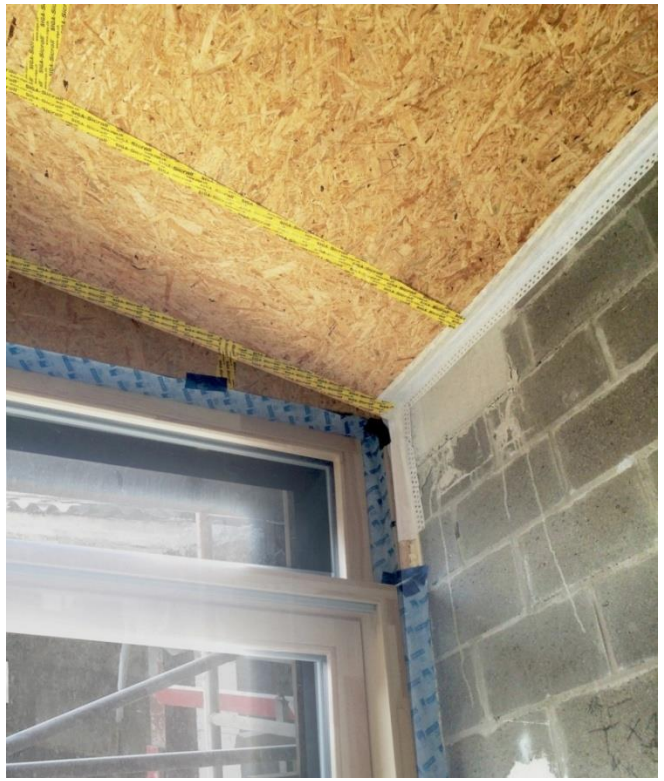

- In this case, a complex junction of wood window, OSB ceiling and masonry wall needs careful planning and material selection
- Use the right tape for the right job

- Tape to masonry has perforations to facilitate
- good key to plaster
- Some imperfections on this junction: can you see them?

Image Source: MosArt

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Airtightness Strategies - Masonry Projects

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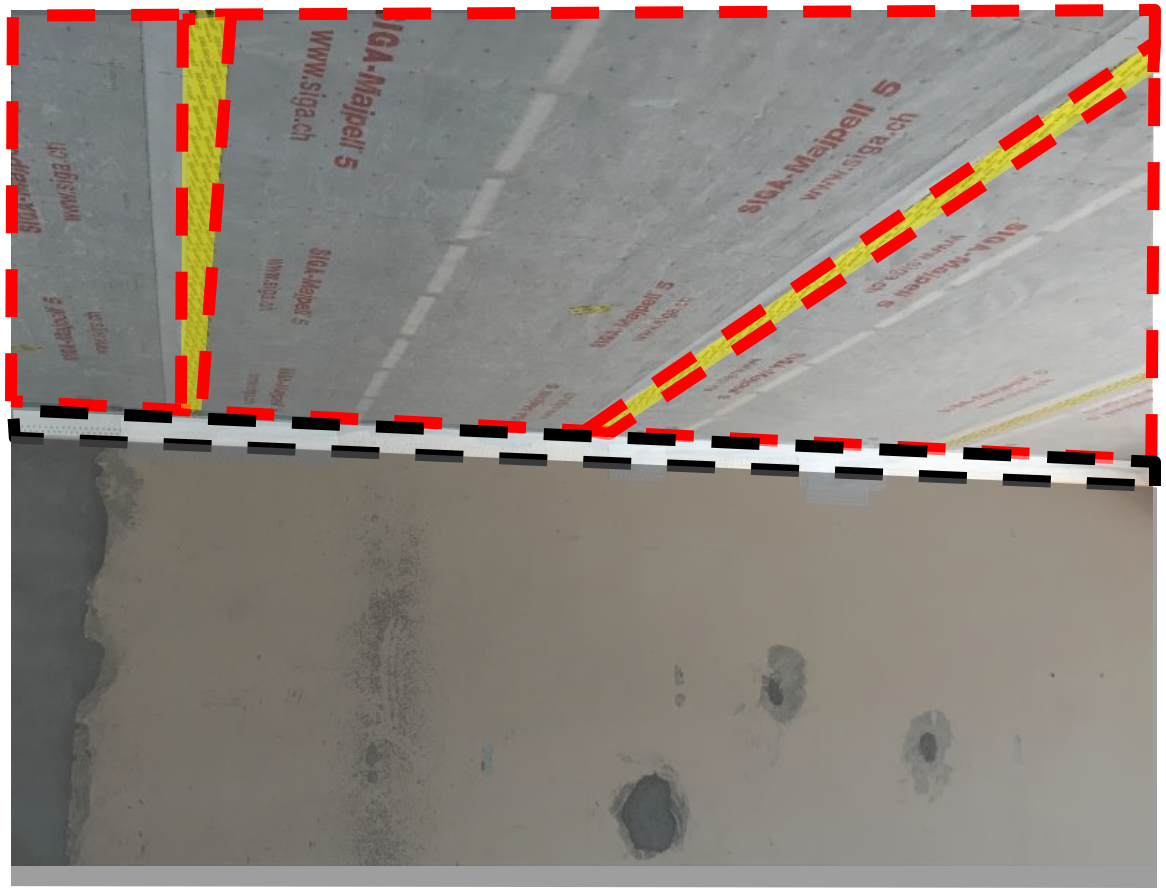

Step 1 – Install airtight membranes on the ceiling using staples or double sided tape.

Step 2 – Seal the overlap between membranes (100mm of an overlap is required between membranes, and an airtight tape must be used).

Step 3 – Use a plasterable tape to connect the membrane to the masonry wall.

Step 4 – Plaster the wall, covering the plasterable tape (or use liquid applied membrane).

Image Source: MosArt

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Repair Tears As You Go

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Membranes will get nicked and torn – often by the plasterers trowel – make sure to repair with patches of airtight tape

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Maintaining Continuity of the Airtight Layer

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- Can you see a problem with this image in relation to airtightness?
- In this retrofit project, all of the internal walls on the first floor were erected before the airtight membrane was installed
- This makes it impossible to connect the membranes on the ceilings of each room

Sequencing is key when it comes to airtightness!

Image Source: MosArt

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Maintaining Continuity of the Airtight Layer

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How could this be avoided?

1) The walls could be plastered and airtight membranes installed before erecting internal walls

2) The areas that will be separated by internal walls could be covered with a strip of airtight material before the walls are erected.

Image Source: MosArt

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Maintaining Continuity of the Airtight Layer

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When it comes to continuity of the airtight barrier between rooms, **sequencing** is key.

Image Source: bldgtyp

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Continuity of Airtightness Below the Attic is Essential

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Note how internal masonry walls stop short of the airtightness layer enabling easy connection of all spaces

Image Source: MosArt

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Airtightness Strip – Can You Spot any Damage

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Membranes can get damaged when dragging over sharp or rough edges – be sure to repaid as you go.

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One Small Room – 8 Different Airtightness Connections

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5. Service penetration sealed

6. Roof straps sealed with plasterable tape. Watch-out for thermal bridging issues

7. Electrical chase sealed

8. All external masonry walls to be plastered

1. Membrane applied to ceiling joints, taped and service cavity installed

2. Ceiling membrane overlaps with walls, to be sealed with plasterable tape (not yet in place)

3. Window taped to reveal

4. Liquid applied membrane to multiple junctions

Image Source: MosArt

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Seal all Elements

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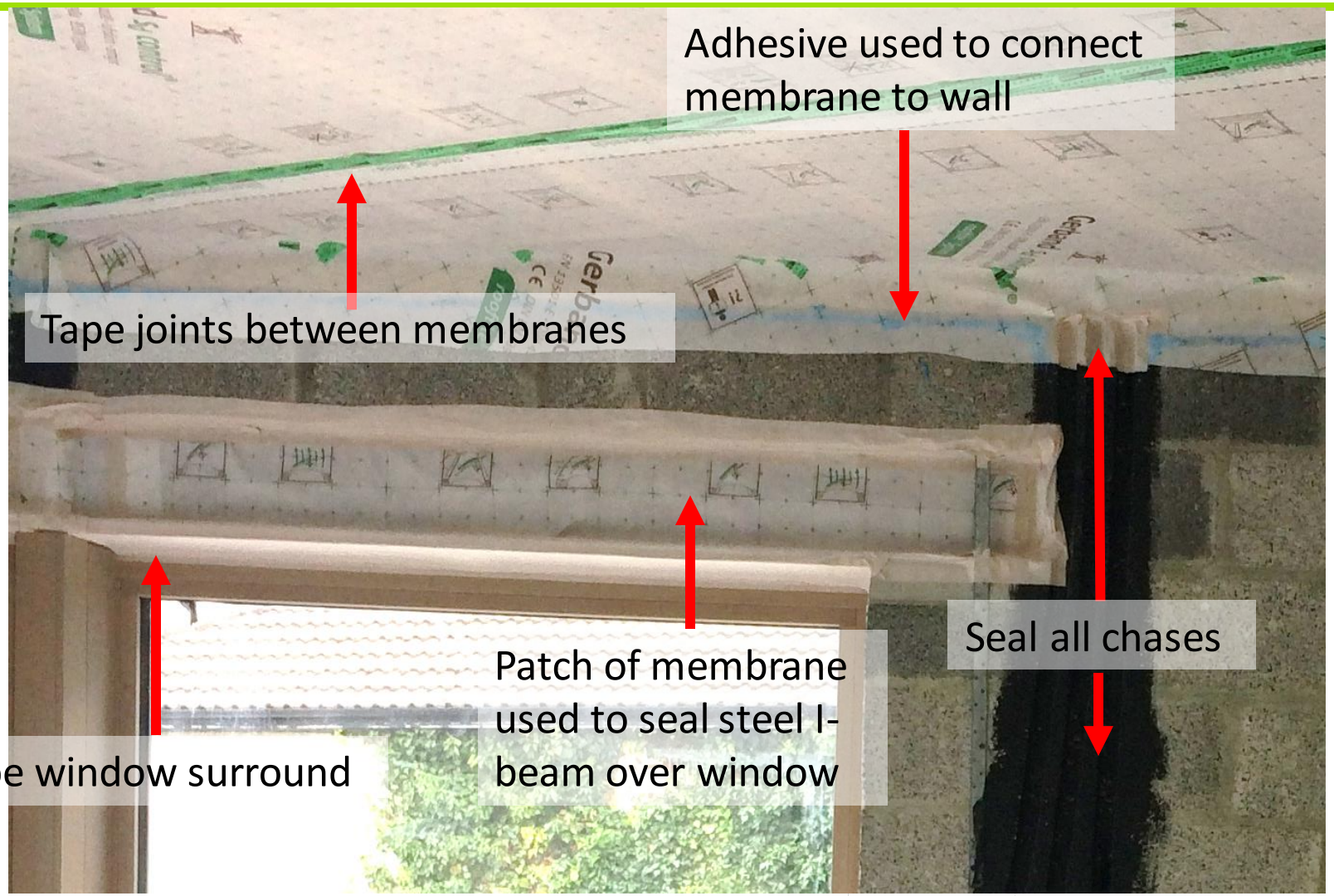

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Seal All Connections

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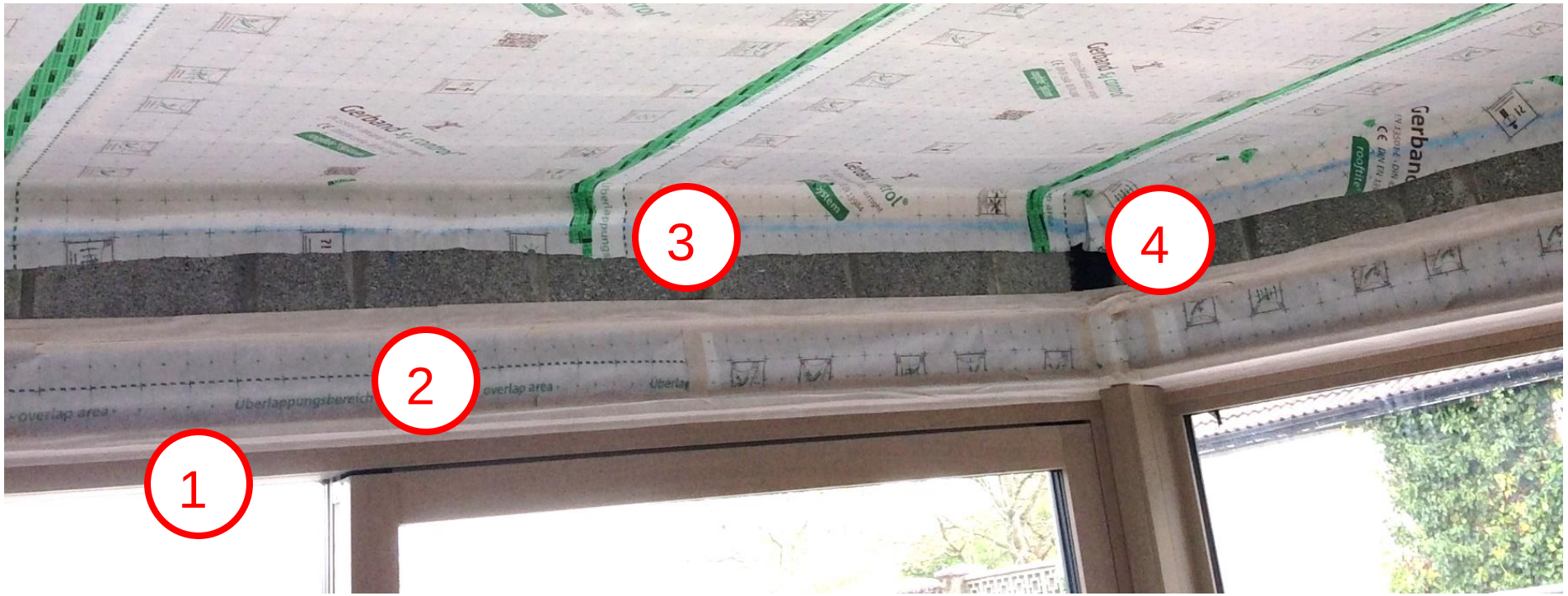

1. Window to steel beam
2. Steel beam to block wall
3. Block wall to ceiling membrane
4. Wall to wall junction

Image Source: MosArt

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Maintaining Continuity of the Airtight Layer – Concrete Floor

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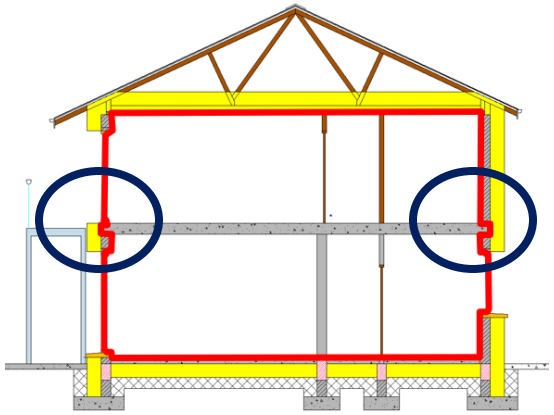

How do we maintain continuity between ground floor and first floor?

Airtight Multi-story Masonry:

- This example is a new built masonry cavity wall construction
- On completion of ground floor walls, airtight membrane draped over top of wall onto floor above
- Later taped to upper-story wall and integrated into plaster layer
- This detail requires forethought, as it must be included before the floor slab is installed

Image Source: MosArt

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Dealing with Changes in Floor level

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Membrane was pre-wrapped around concrete floor slab at higher level to maintain airtightness

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Continuity of the Airtight Layer – Timber Floor

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- The majority of intermediate floors in Ireland are made of timber joists which are built into the internal leaf.
- Maintaining the airtight layer in such a case requires taping each joist individually, on both ends. This is possible in new builds but can also be achieved in retrofits, as shown above.

Image Source: Foursevenfive.com

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Step 1: Plaster Strip of Blockwork to Correct Dimensions

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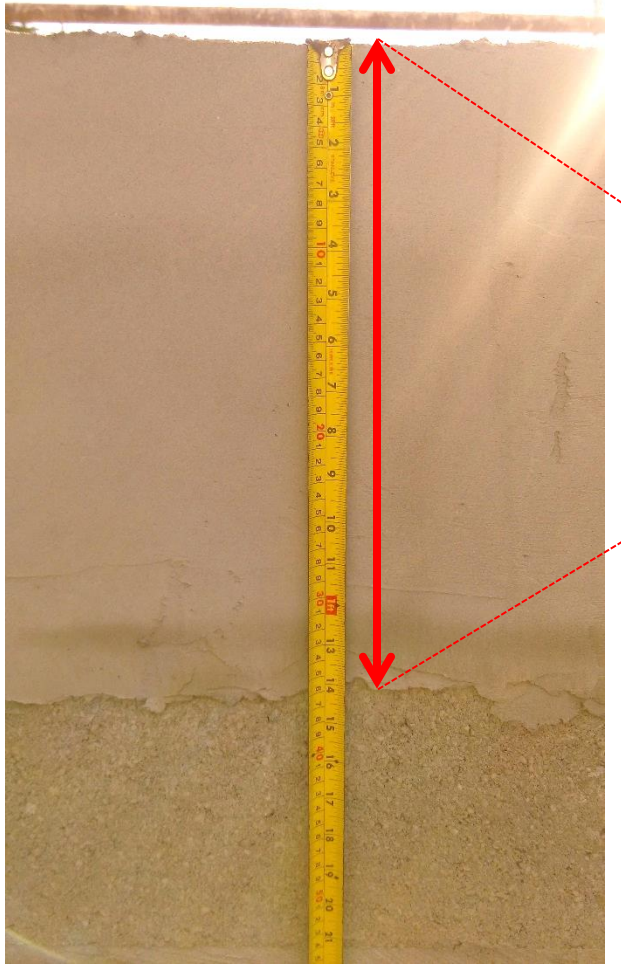

Image Source: WWETB-MosArt

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Step 2: Mechanically Fix Hangers – Seal with Caulk

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Step 3: Space Hangers to Structural Requirements

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Step 4: Insert Joists

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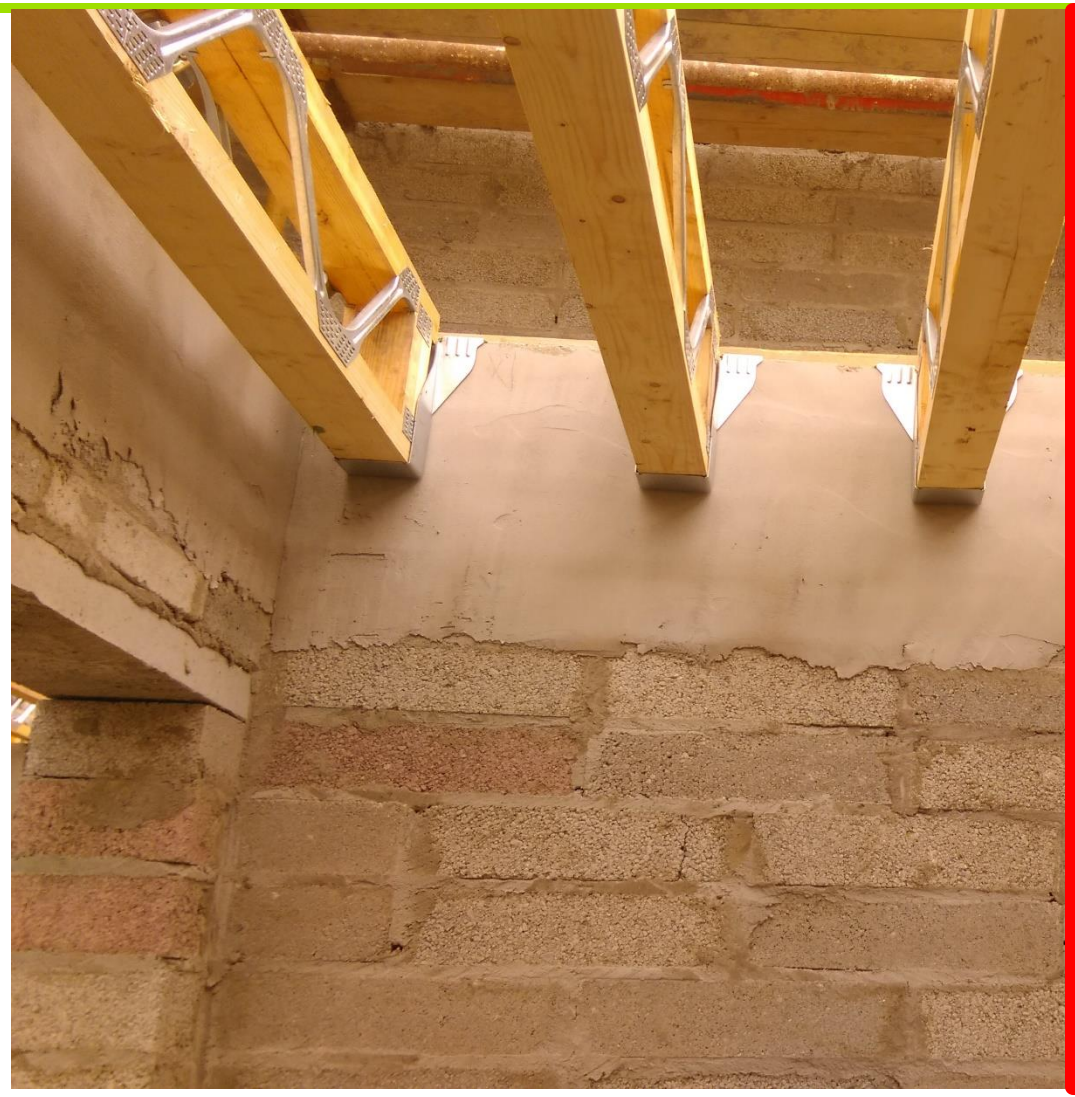

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Step 5: Build Next Floor Up (where needed)

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Strip of Airtight Membrane Used at First Floor

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Everything OK Here?

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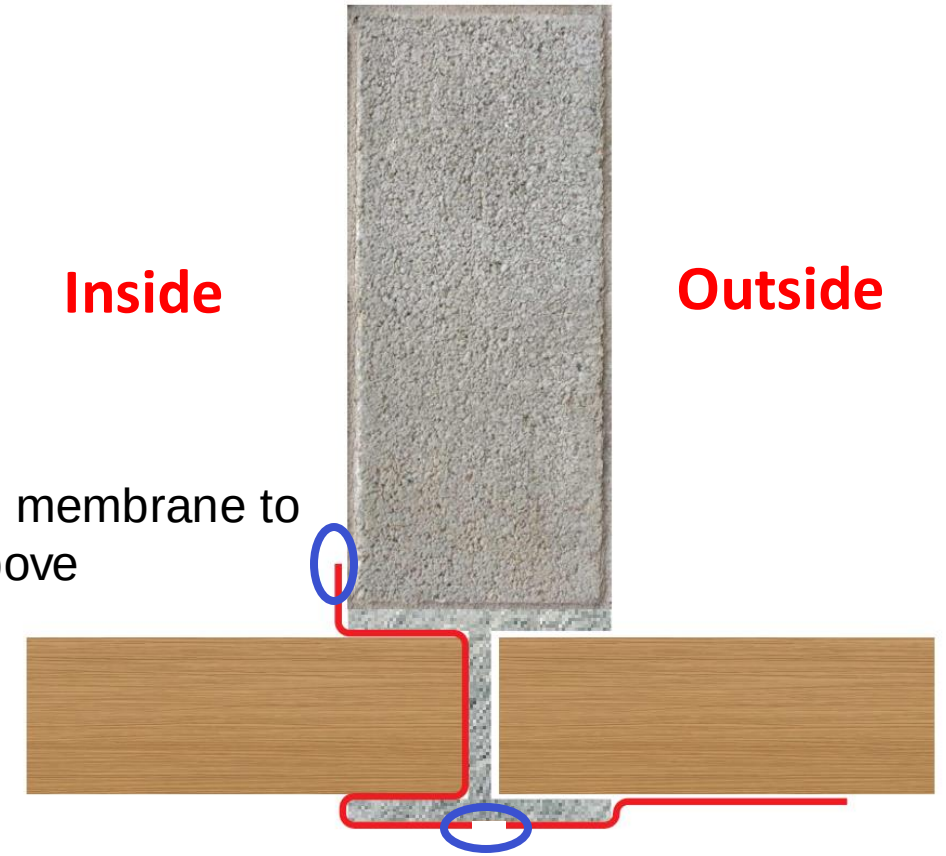

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Sealing Joists Inserted into Steel Beam

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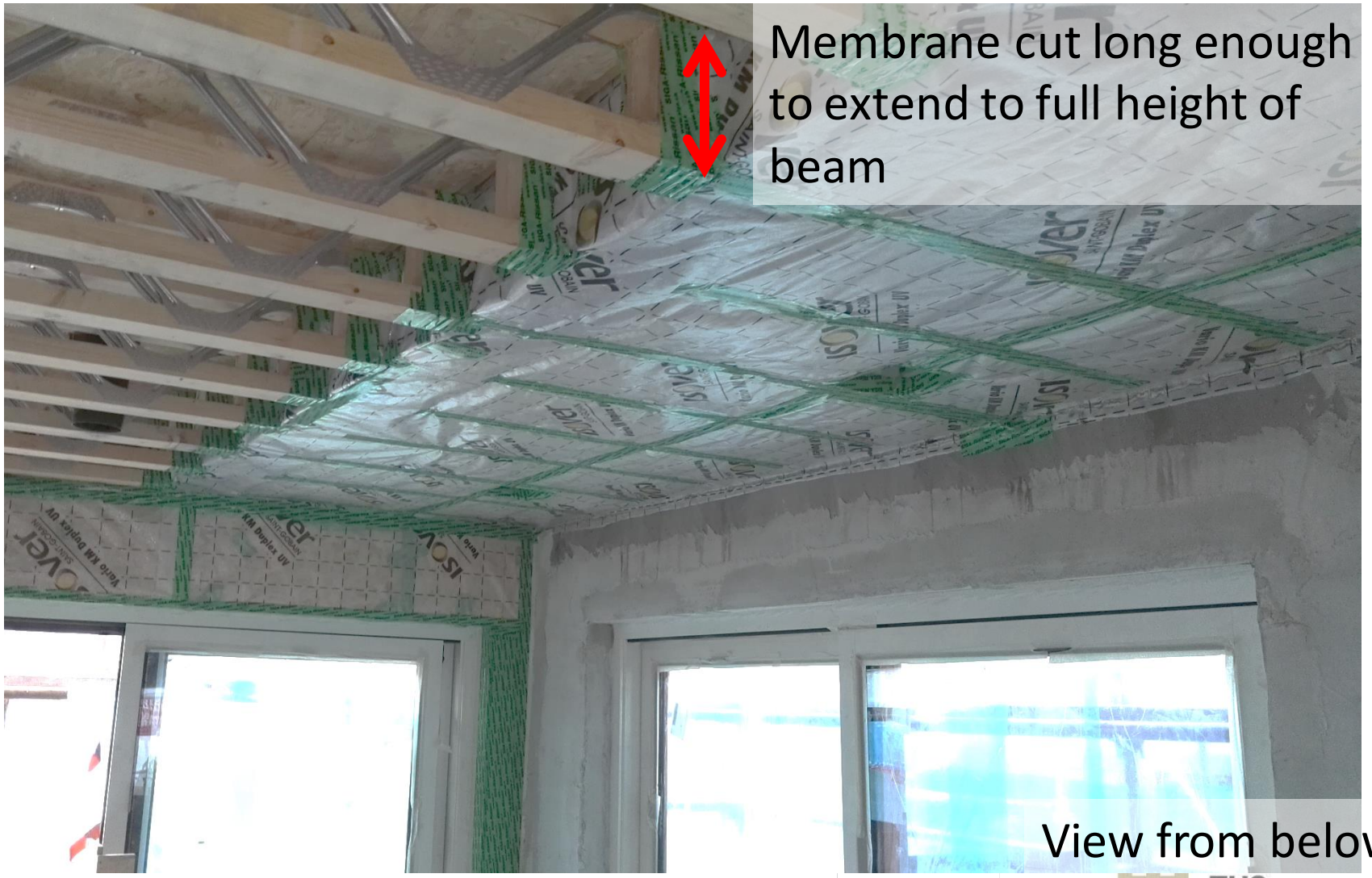

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The Impact of First Fix on Air Permeability

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Once continuity of airtightness has been maintained, first fix becomes the biggest risk to airtightness.

Quality assurance is key to success!

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Use of a Service Cavity to Reduce Service Penetrations

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- The site on the left is a scheme of 65 NZEB homes, which have utilised a service cavity to achieve an excellent level of airtightness.
- Use of a 'service cavity' on the interior of the airtight membrane protects the membrane from the homeowner, and reduces service penetrations.
- A service cavity is a great idea when aiming for a good air permeability number.
- Service cavities can be insulated to improve the u-value of the wall.
- Socket boxes can also be installed without damaging the airtight layer.

Can you spot any issue with using vertical battens in the service cavity instead of horizontal ones?

Think thermal bridging!

Image Source: MosArt

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Use of a Service Cavity – Not Just for Timber Frame

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Insulated the Air-Sealed Hatch for Future Services

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- Consider providing means by which future services can be brought into the dwelling without compromising the airtightness layer
- Using a rubber / neoprene patch enables easy and reliable sealing of penetrations
- Probably best located in utility room through which future services might be routed
- Thinking ahead!

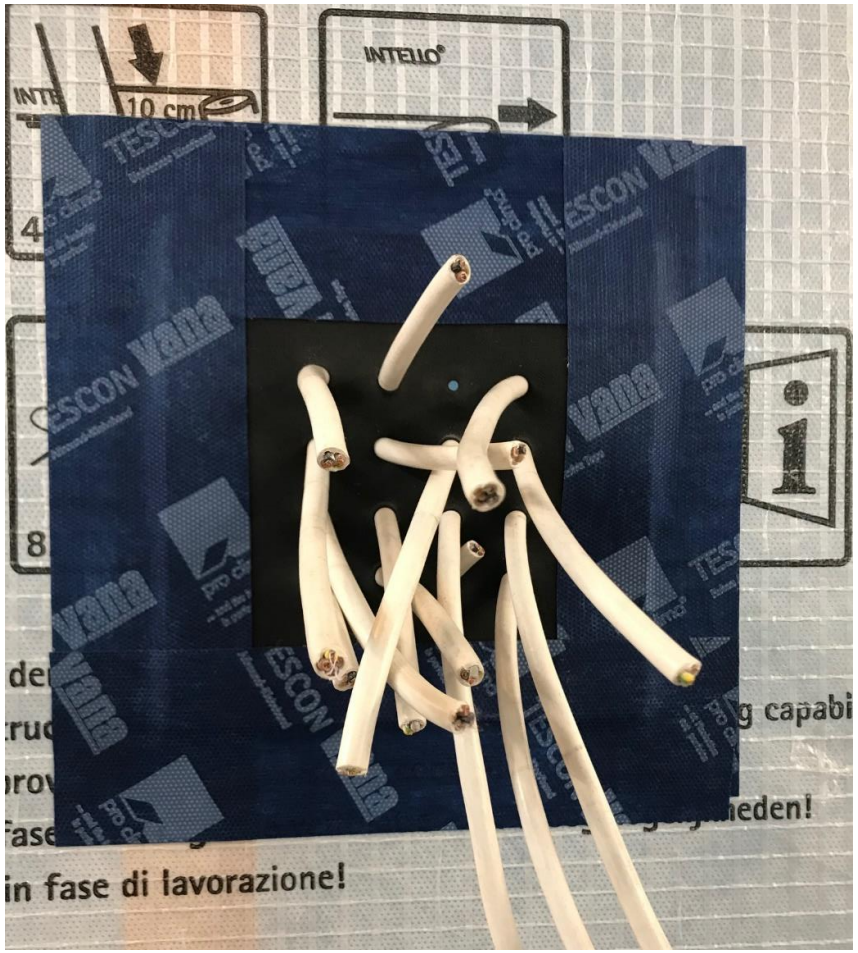

Image Source: Passive House Institute

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Risks Associated with Poor Workmanship

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- Might not meet the required air-permeability target
- Might not be able to certify the project
- Increased discomfort for occupants (drafts)
- Risk of moisture build up in external envelope
- Reduced effectiveness of the ventilation system
- Increased noise pollution from exterior

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Air Permeability Test

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Fan to Identify Early Leaks – A Good Investment

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- The airtightness test ‘rehearsal fan’ is typically inserted into a window or door
- They cost approximately €800 + VAT – the cost of three airtightness tests
- They pay for themselves very quickly

Image Source: WWETB - MosArt

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Official Blower Door Test

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- Must be completed by an Accredited Tester
- Measured at 50 Pascal
- Might need multiple tests if first result is poor
- Every NZEB dwelling must be tested
- (no default air permeability numbers any more)

Image Source: WWETB-MosArt

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Envelope Checks: Blower Door Test

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Negative Pressure Test

Positive Pressure Test

Blower Door Targets

EN9972 recommends testing in both directions:

- Recommended to carry out 10 **positive and negative** airtightness tests
  - you can evaluate the **sealing provided by the window and door gaskets** when they are inward opening a better airtightness result is expected for a positive pressure test where the sash gasket is 'pressed-against' the frame
- Official result is the **average of all tests positive and negative**

Source: BIMzeED

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Air permeability & Adverse Impacts of Open Chimneys

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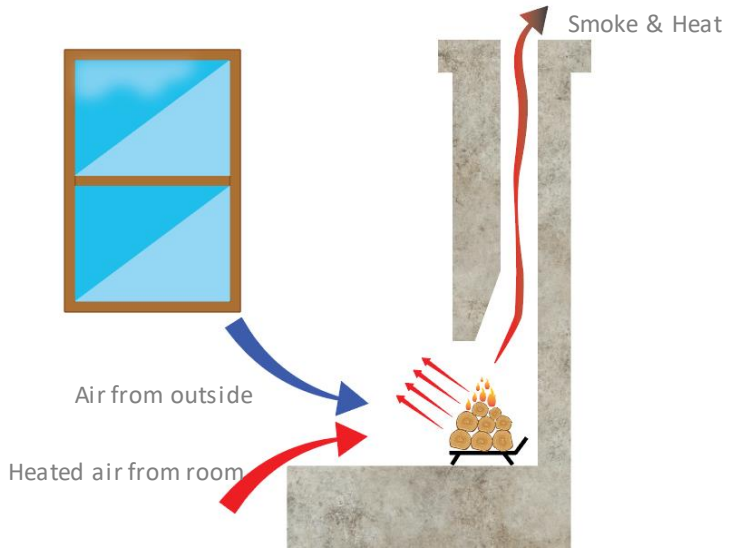
Chimneys for an open fire are a **route for heat loss**.
It is a **large hole in the building**



>200mm Ø = Chimney
<200mm Ø = Flue

EAP MANUAL - Table 2.1 Ventilation Rates	
Item	**Ventilation rate m^3/hour**
Chimney	40
Open flue	20
Intermittent extract fan	10
Passive vent	10
Flueless gas fire	40

Image Source: Left – Justairtight / Right – MosArt

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Carry on Working During the Airtightness Test

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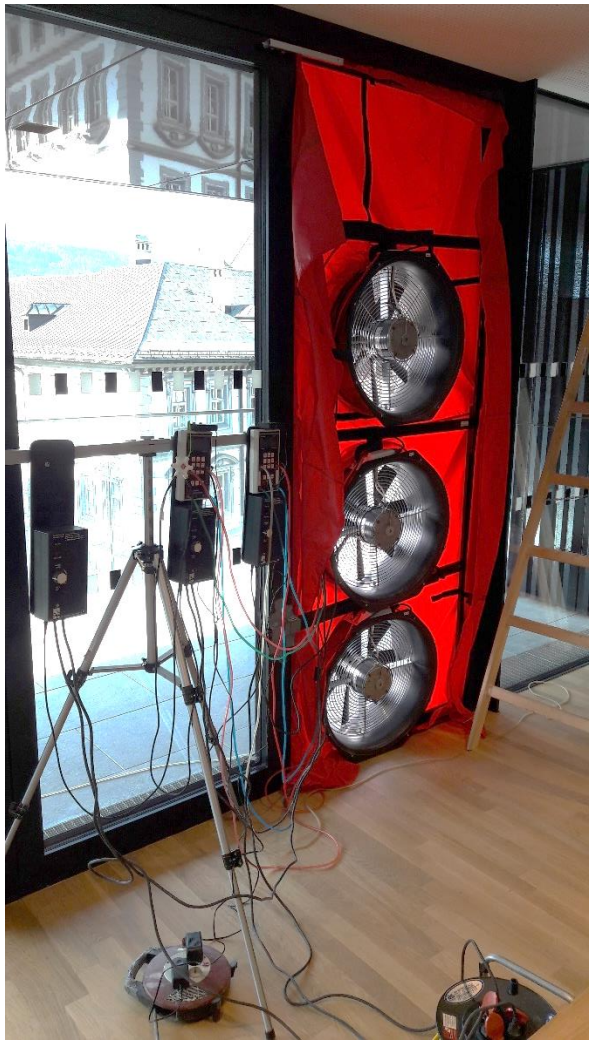

As long as no one is entering or leaving the building, most construction work can continue whilst the airtightness test is being carried out

Image Source: WWETB

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Envelope Checks: Airtightness

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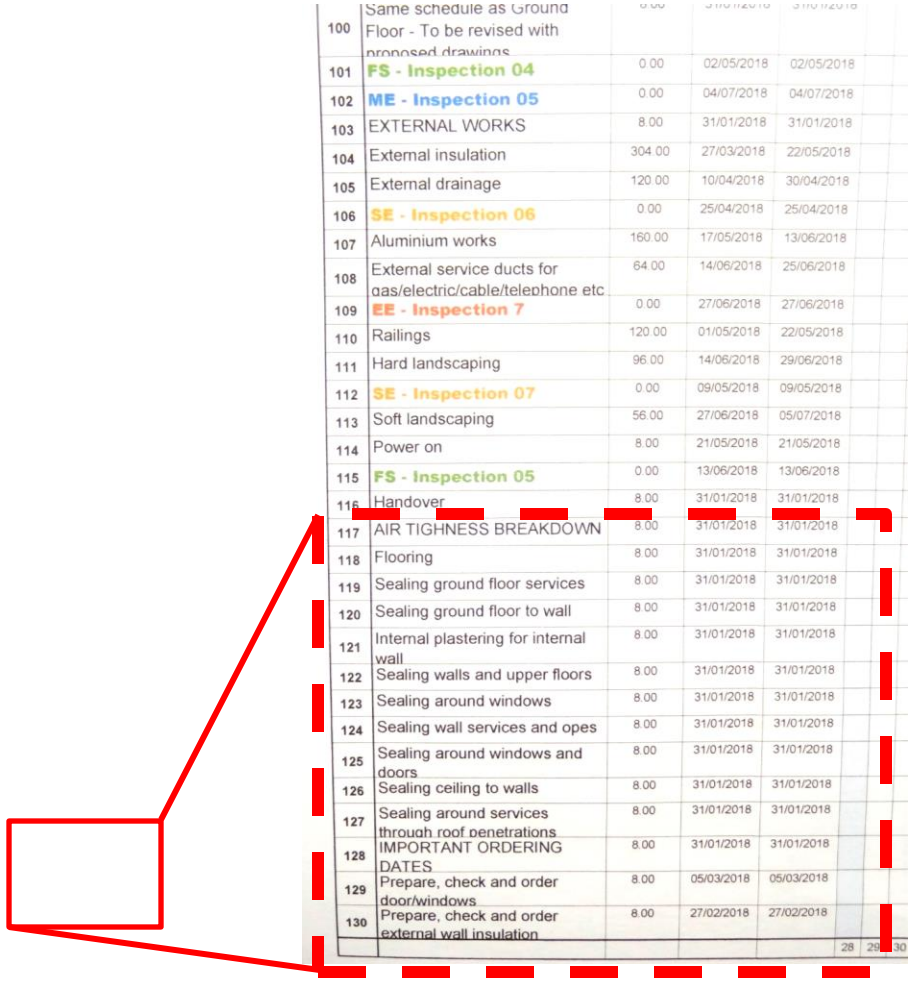
Checklist

- On your first project(s), it is recommended to **do several intermediate tests** to determine how the building is performing
- If you leave the test to the very end, you will probably not have **access to the sources of any leaks**
- Build testing into the **construction project – allow for this in the tender documents**

Typically, on a house project the contractor should allow for 3 pressure tests:

1. Building sealed, including electrical first fix in place.
2. Mechanical ventilation system & all services penetrating external fabric of building have been fully installed.
3. Practical completion



100	Same schedule as Ground Floor - To be revised with proposed drawings			
101	FS - Inspection 04	0.00	02/05/2018	02/05/2018
102	ME - Inspection 05	0.00	04/07/2018	04/07/2018
103	EXTERNAL WORKS	8.00	31/01/2018	31/01/2018
104	External insulation	304.00	27/03/2018	22/05/2018
105	External drainage	120.00	10/04/2018	30/04/2018
106	SE - Inspection 06	0.00	25/04/2018	25/04/2018
107	Aluminium works	160.00	17/05/2018	13/06/2018
108	External service ducts for gas/electric/cable/telephone etc	64.00	14/06/2018	25/06/2018
109	EE - Inspection 7	0.00	27/06/2018	27/06/2018
110	Railings	120.00	01/05/2018	22/05/2018
111	Hard landscaping	96.00	14/06/2018	29/06/2018
112	SE - Inspection 07	0.00	09/05/2018	09/05/2018
113	Soft landscaping	56.00	27/06/2018	05/07/2018
114	Power on	8.00	21/05/2018	21/05/2018
115	FS - Inspection 05	0.00	13/06/2018	13/06/2018
116	Handover	8.00	31/01/2018	31/01/2018
117	AIR TIGHNESS BREAKDOWN	8.00	31/01/2018	31/01/2018
118	Flooring	8.00	31/01/2018	31/01/2018
119	Sealing ground floor services	8.00	31/01/2018	31/01/2018
120	Sealing ground floor to wall	8.00	31/01/2018	31/01/2018
121	Internal plastering for internal wall	8.00	31/01/2018	31/01/2018
122	Sealing walls and upper floors	8.00	31/01/2018	31/01/2018
123	Sealing around windows	8.00	31/01/2018	31/01/2018
124	Sealing wall services and opes	8.00	31/01/2018	31/01/2018
125	Sealing around windows and doors	8.00	31/01/2018	31/01/2018
126	Sealing ceiling to walls	8.00	31/01/2018	31/01/2018
127	Sealing around services through roof penetrations	8.00	31/01/2018	31/01/2018
128	IMPORTANT ORDERING DATES	8.00	31/01/2018	31/01/2018
129	Prepare, check and order door/windows	8.00	05/03/2018	05/03/2018
130	Prepare, check and order external wall insulation	8.00	27/02/2018	27/02/2018

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Source - MosArt:

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Envelope Checks - Airtightness

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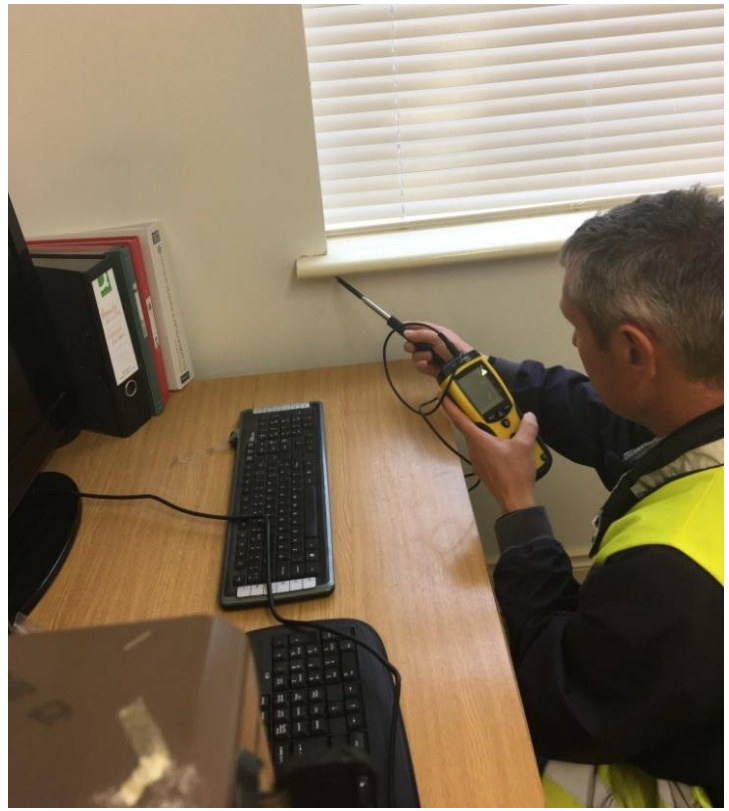
Leak Detection - Anemometer

- Cannot find unexpected leaks?
- Severity of leaks to be gauged
- Will prove a leak if others doubt its presence



Source: B. Milovanović- BIMzeED

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Envelope Checks - Airtightness

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Leak Detection - Smoke

- There are 3 main types of smoke used:
  - **mini-smoke** – smoke puffers and pencils that are useful for determining draughts at specific locations
  - **small smoke gun** – handheld smoke guns are useful for especially around windows and to determine air movement paths in discrete areas of the building
  - **mega smoke** – such as disco generators. These are handy for particularly larger, perhaps single skinned buildings, to determine leakage locations from outside.

Source: B. Milovanović- BIMzeED

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Airtightness – Visualising the Leaks

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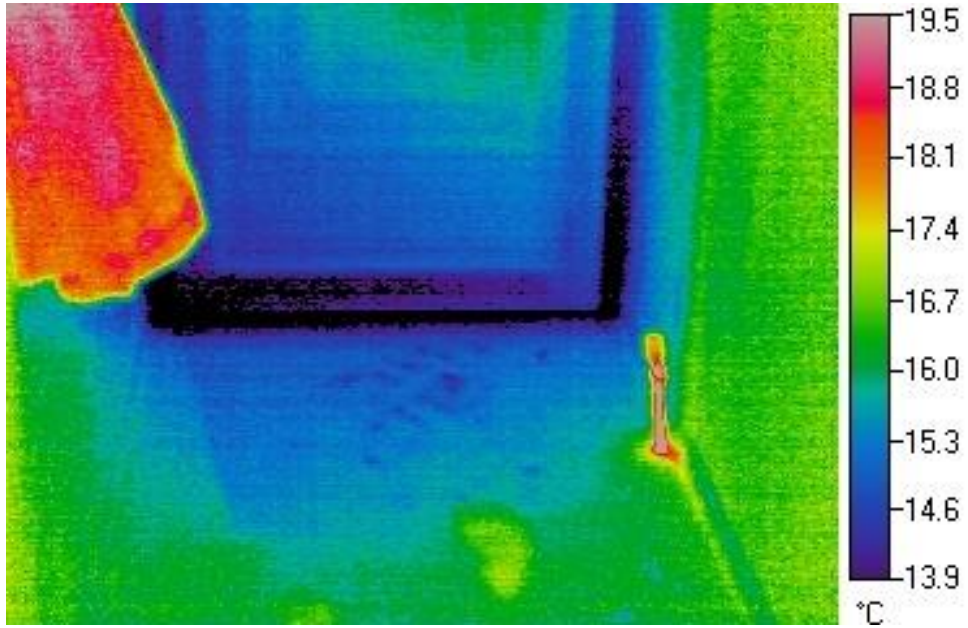
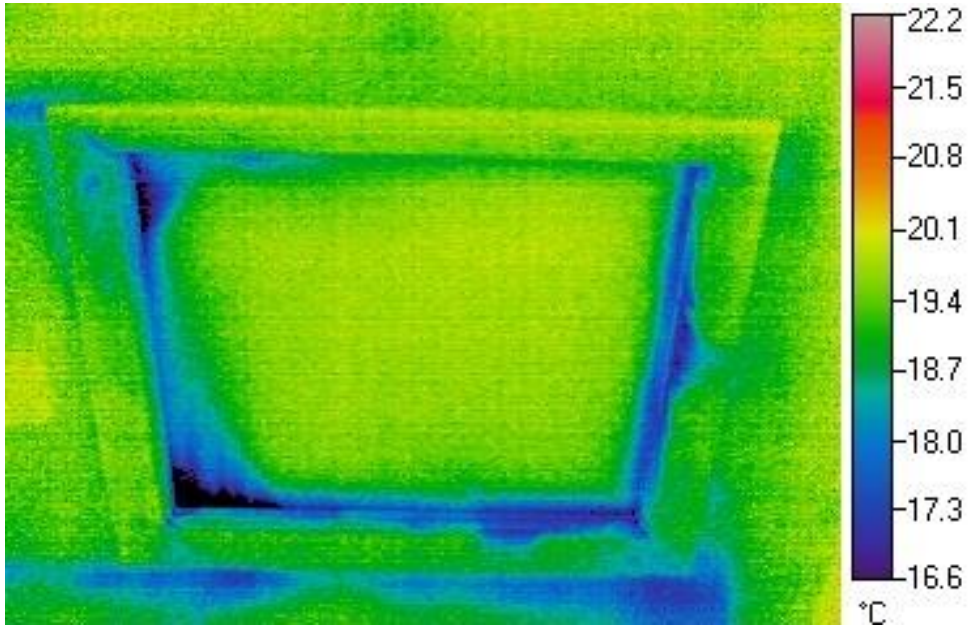
With an infrared (thermographic) camera, leaks can be visualized before and during the measurement



Cold air leakage through an external door



Cold air leakage through a poorly sealed attic hatch

Image Source: Flir

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“Build Tight – Ventilate Right”

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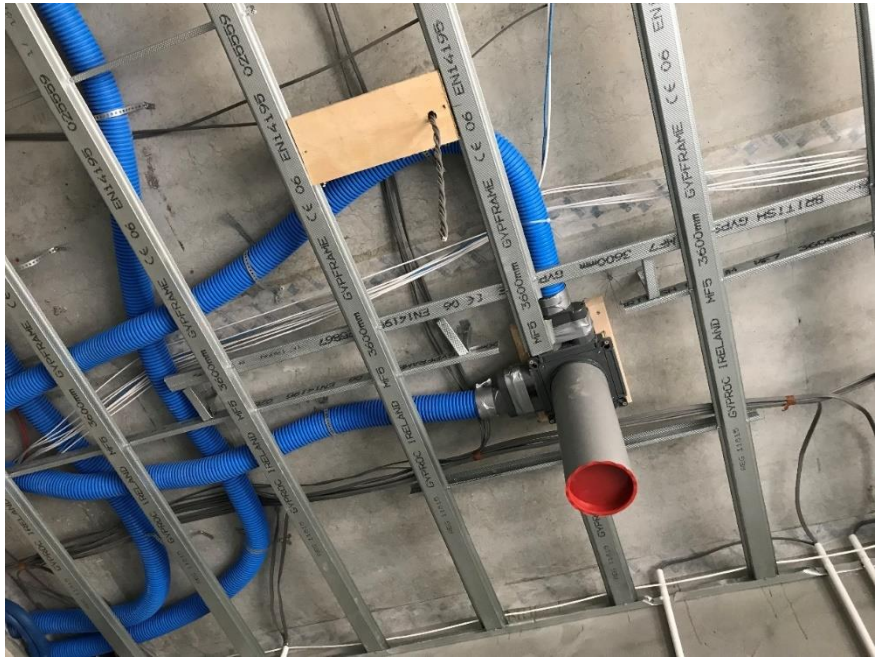

It is essential to provide high indoor air quality

Where good levels of airtightness are being delivered (< 3.0 m^3/hour.m^2 @ 50 Pascal), it is important to provide some kind of mechanical ventilation (ideally with heat recovery)

Image Source: MosArt

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NZEB Compliance Using DEAP

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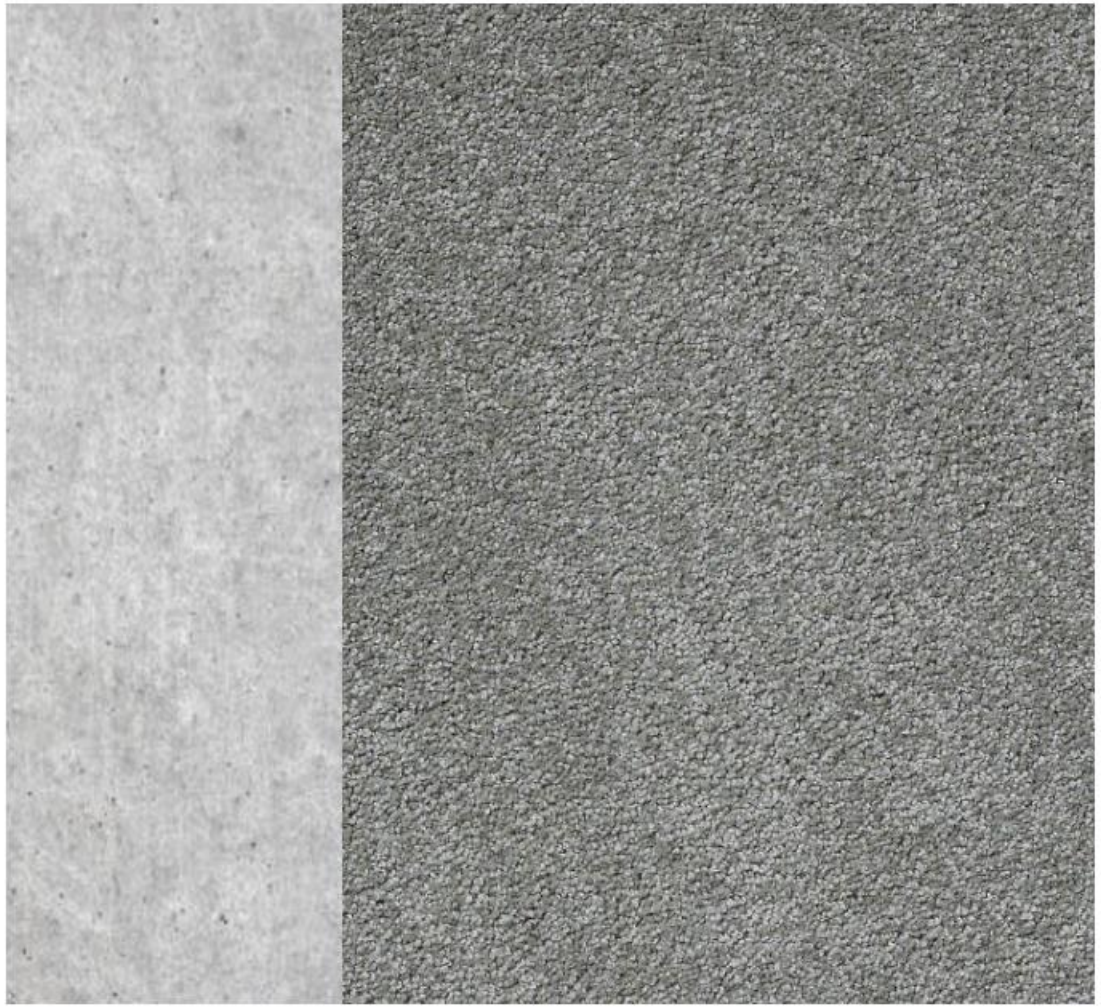

Air Permeability 5.0 $m^3/m^2/hr$

Thermal Bridging 0.15 W/m^2K

U-Value 0.08 W/m^2K

Insulation thickness 360mm

Image Source: MosArt

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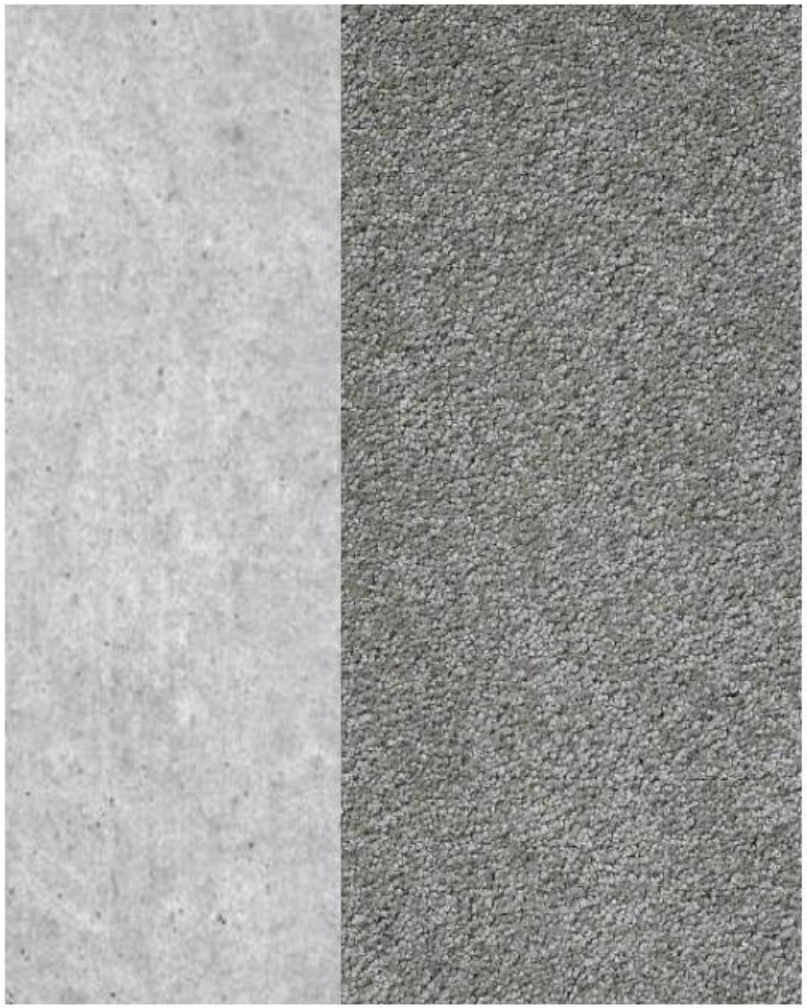

Air Permeability 3.0 $m^3/m^2/hr$

Thermal Bridging 0.08 W/m^2K

U-Value 0.13 W/m^2K

Insulation thickness 220mm

Image Source: MosArt

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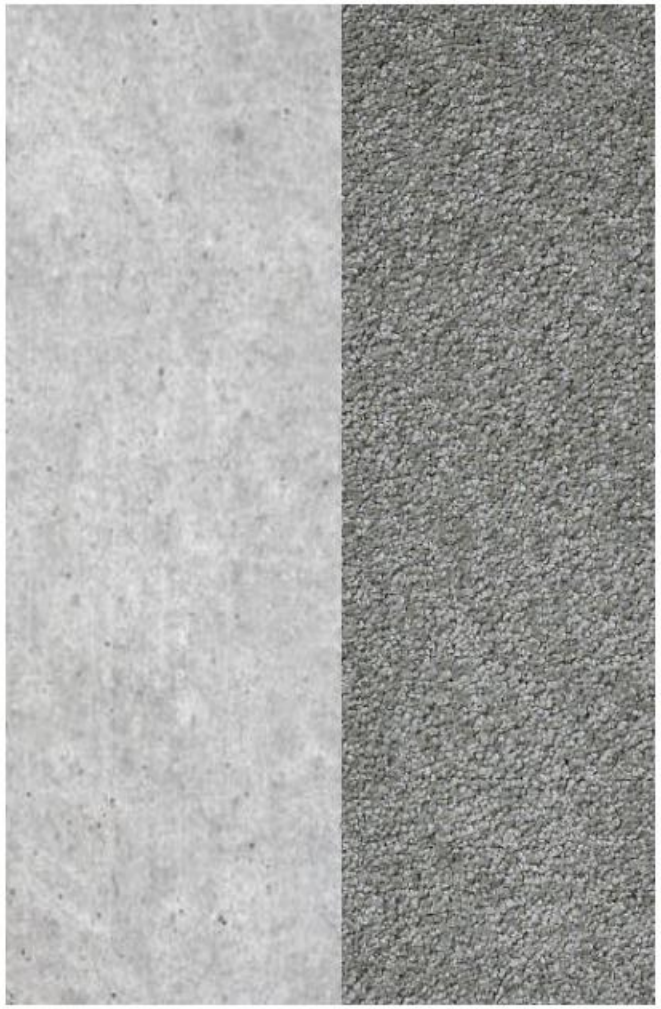

Air Permeability 0.6 $m^3/m^2/hr$

Thermal Bridging 0.04 W/m^2K

U-Value 0.18 W/m^2K

Insulation thickness 150mm

Image Source: MosArt

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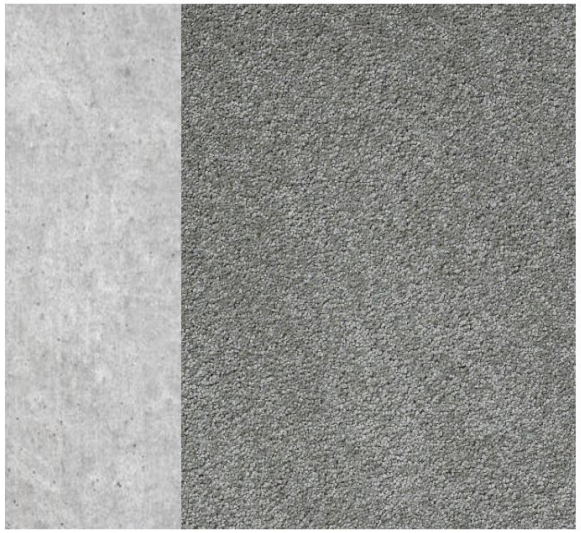
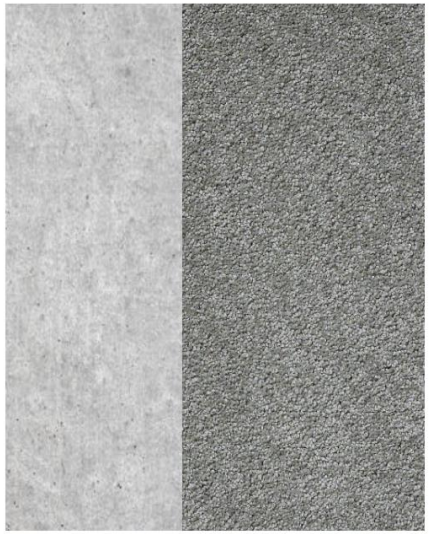
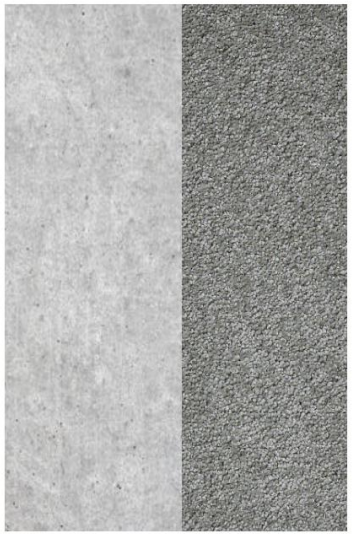


Air Permeability 5.0 $m^3/m^2/hr$
Thermal Bridging 0.15 W/m^2K
U-Value 0.08 W/m^2K
Insulation thickness 360mm



Air Permeability 3.0 $m^3/m^2/hr$
Thermal Bridging 0.08 W/m^2K
U-Value 0.13 W/m^2K
Insulation thickness 220mm



Air Permeability 0.6 $m^3/m^2/hr$
Thermal Bridging 0.04 W/m^2K
U-Value 0.18 W/m^2K
Insulation thickness 150mm

Each DEAP input has an impact on the overall energy performance. If one input has a poor performance, other inputs must perform very well to ensure overall targets (EPC, CPC, RER) are achieved.

Image Source: MosArt

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Assessment

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Module 4

Building Fabric 1: Air Permeability

Energy Efficiency for Construction

24 partners

12 countries

Date of Event

*Author/ **Institute***

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Building Fabric 1 | Summary

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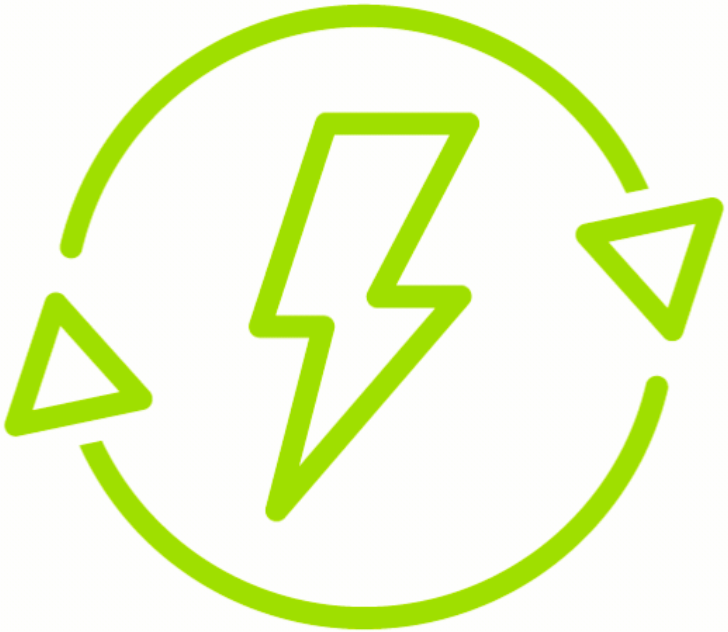
To equip the learner with the relevant knowledge and skills required to understand the importance of airtightness and wind-tightness and how to implement measures to alleviate heat loss.



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Air Tightness Strategy

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Importance of Airtightness Strategy - Traditional

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As previously mentioned:
Be Innovative and record all penetrations by different trades

Choose an Airtightness champion who will sign off air tightness for the project.

Teamwork and understanding how the air tightness strategy works is important

This can be completed using a board in the main office

Image Source: MosArt-Michael Bennett contractors

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Importance of Airtightness Strategy - Digital

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Or

- Use a **Mobile App** to allow each team member to record airtightness installations.
- Apps can also be used to take photographs to record before and after installation.
- Take photos of penetrations which need to be corrected
- Support the transfer of information into a central location
- Up to date information

Lets look at the **Mobile Field App Trello** -

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Trello Field App Download – Phone & Laptop

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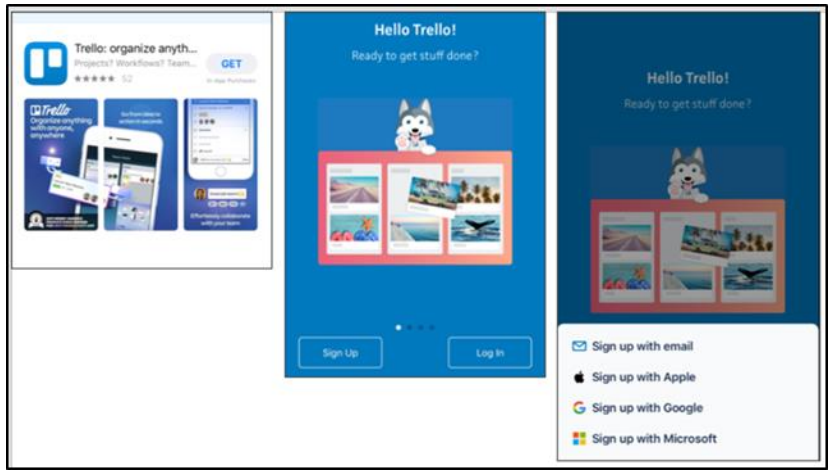
You can download a free **Trello App on the phone**.

Step 1: Download the Trello application from the app store

Step 2: Create a Trello account by clicking ‘Sign Up’.

Step 3: Create an account using ‘Sign up with email



Download a free **Trello App on your laptop** or tablet using the link:

https://trello.com/en/platforms

Install

Step 1: Download the App,

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Mobile Field App – Trello

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Tutorial lessons related to Trello have been developed using the free tool

Set Up

Step 1: Download Trello

Step 2: Create a Trello board to help track progress in your specific field (in your trade for a project).

Step 3: Apply the use of the app to a scenario and include lists, cards, checklists and explore the menu options. You should also include images and due dates to several of your cards.

Learn more

Helpful guides to using Trello https://trello.com/guide
Demo in the use of Trello https://www.youtube.com/watch?v=xky48zyL9iA

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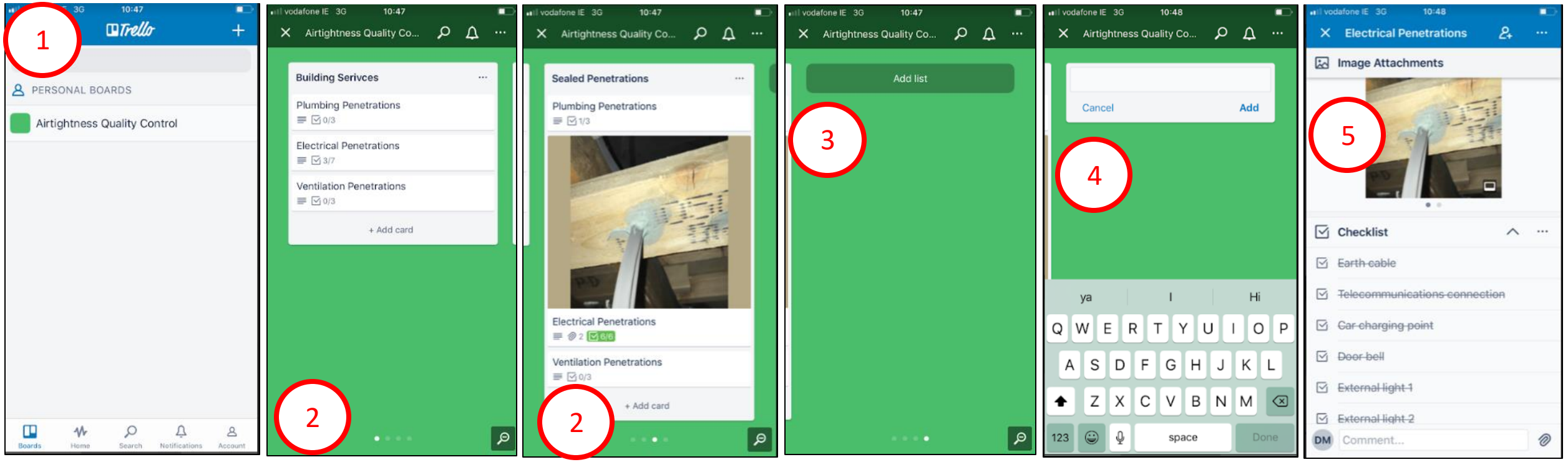

1. Upon opening the app, you will be asked what board you want to select
2. Once you open a board, you can navigate lists by swiping left and right
3. To add a new list, click on ‘Add list’.
4. Name your list an press ‘Add’ to place it on the Trello board.
5. Images, checklists and due dates can be added to each card by simply clicking on them.

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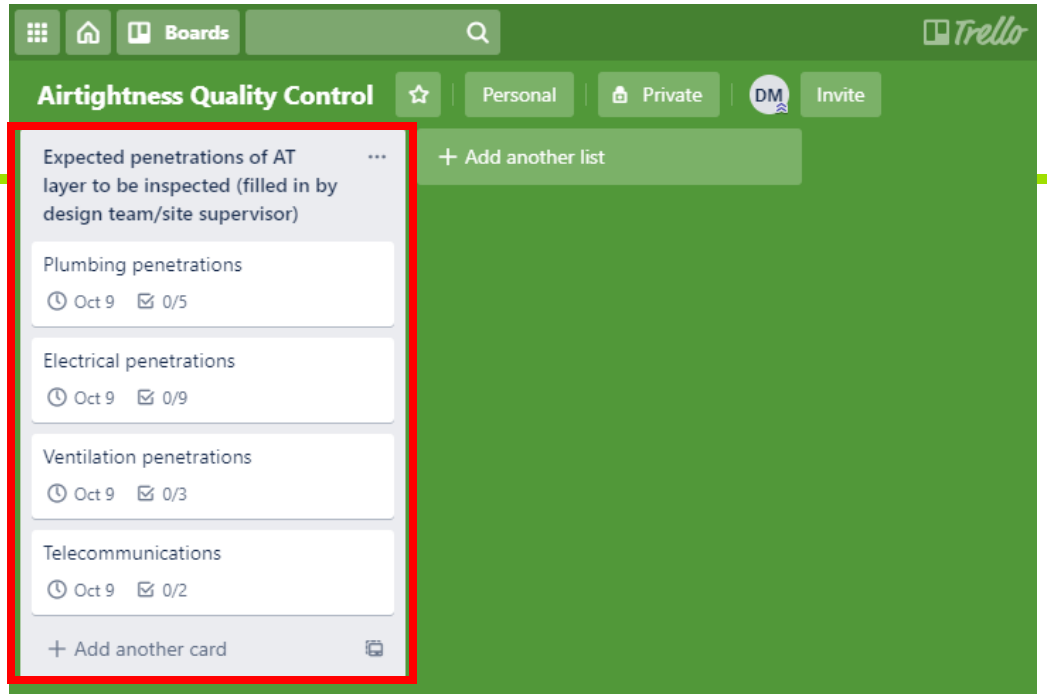

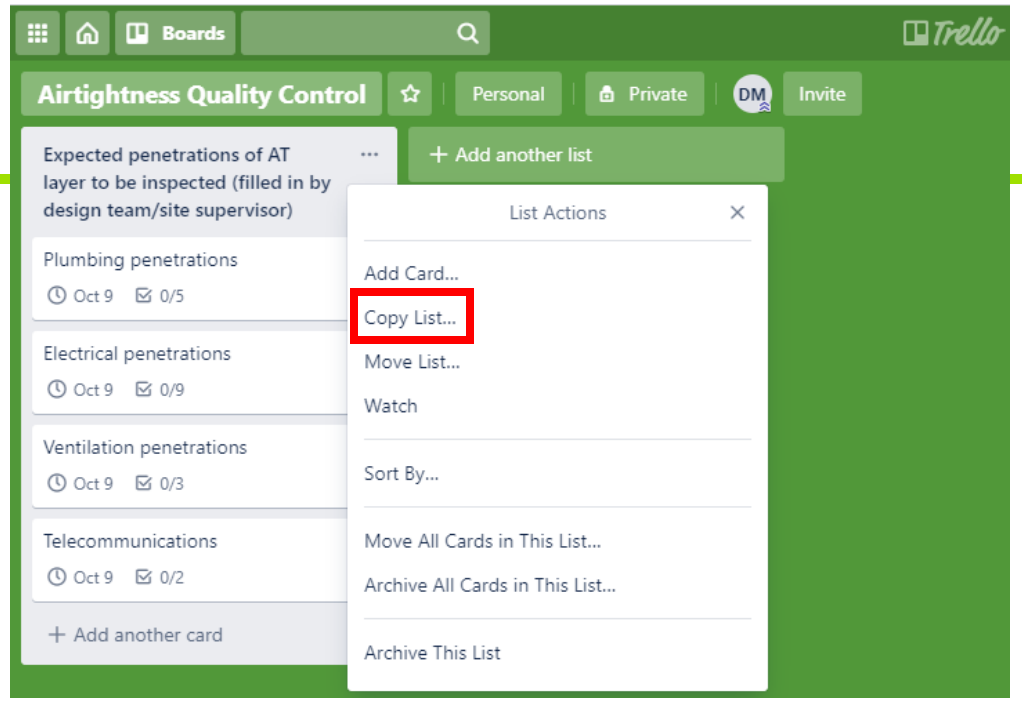

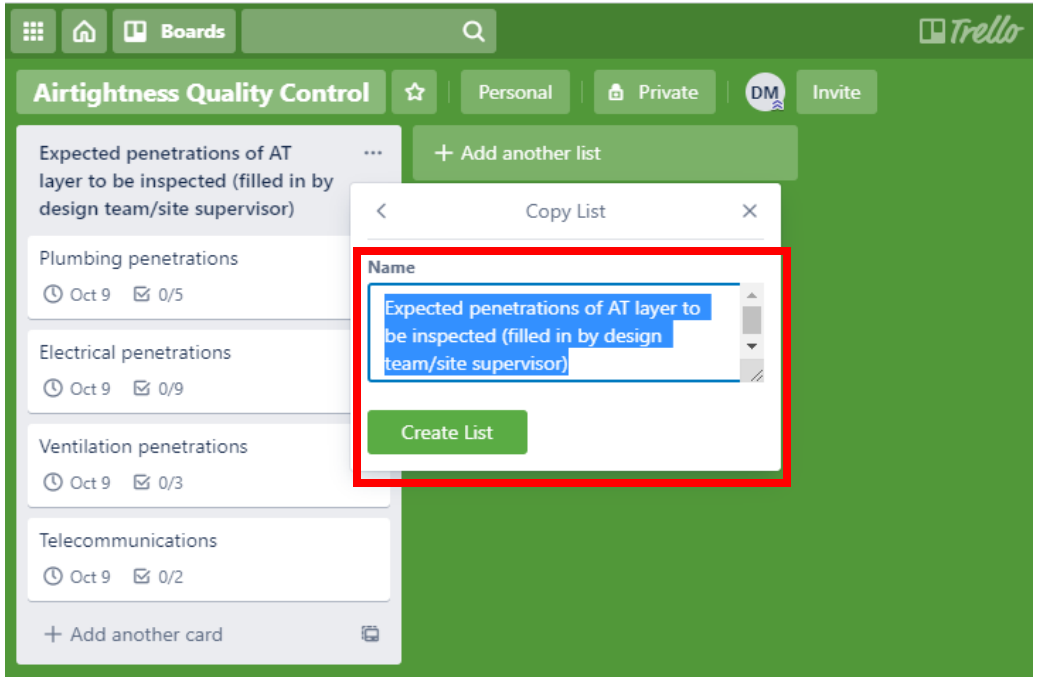

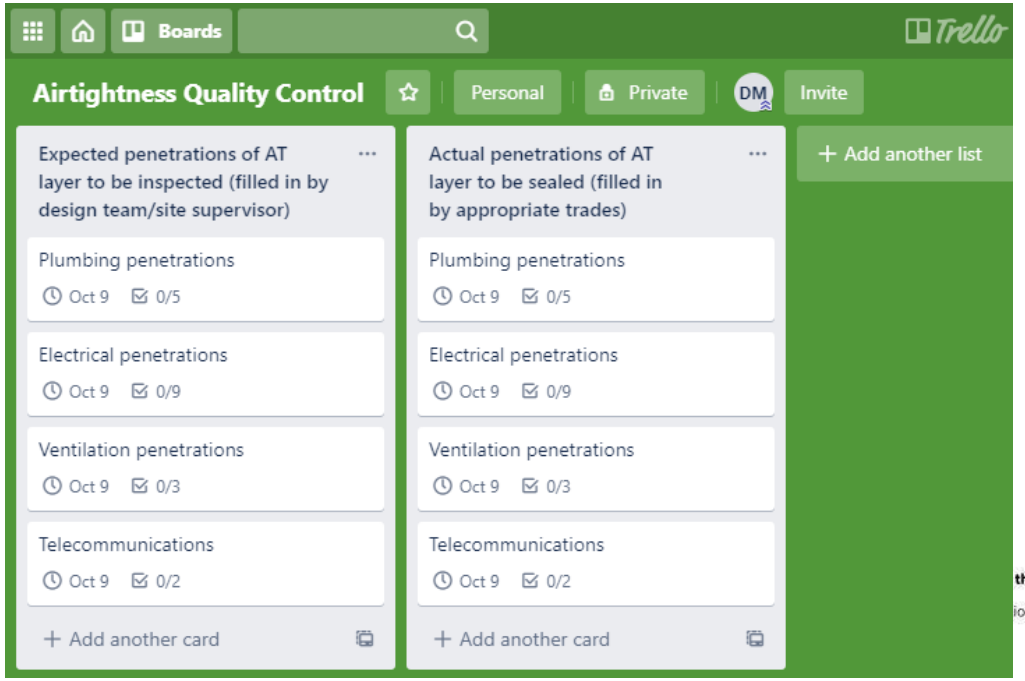

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Board

Lists

Cards

Checklists

Menu

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Boards

Trello

DM

Airtightness Quality Control

Personal

Private

DM

Invite

Butler (8 Tips)

Building Serivces

Plumbing Penetrations

0/3

Electrical Penetrations

3/7

Ventilation Penetrations

0/3

Add another card

Unsealed Penetrations

Plumbing Penetrations

3/3

Electrical Penetrations

7/7

Ventilation Penetrations

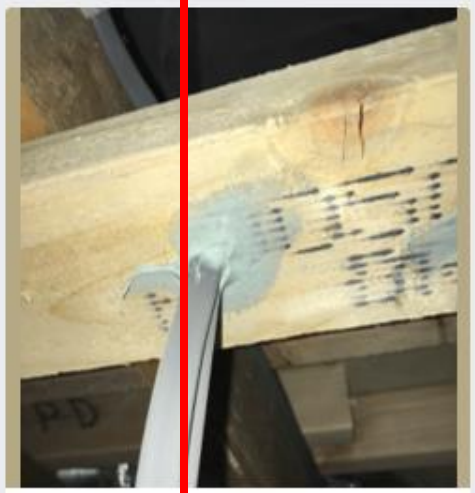
0/3

Add another card

Sealed Penetrations

Plumbing Penetrations

1/3



Electrical Penetrations

2

6/6

Ventilation Penetrations

0/3

Add another card

Add another list

Menu

About This Board

Add a description to your board

Change Background

Search Cards

Stickers

More

Butler

Automate cards and more...

Power-Ups

Calendar, Google Drive and more...

1 Add Power-Up...

Activity

DM **Dara McGowan** marked Cold water feed incomplete on Plumbing Penetrations

Aug 5 at 8:27 PM

How to use Trello for Airtightness Quality Control

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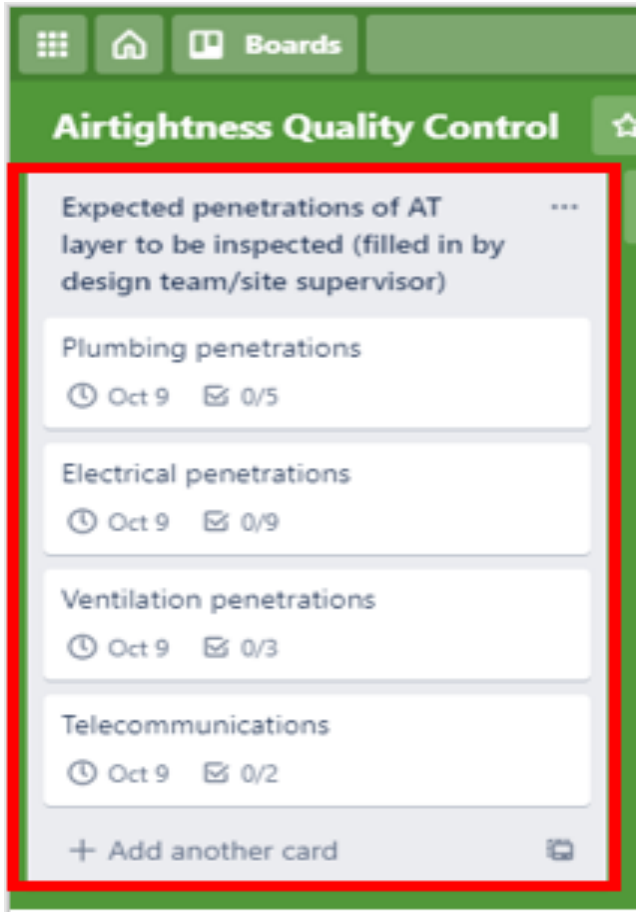

Activity 2:
See example of a template that could be used to improve airtightness quality control on site:

Expected penetrations of AT layer to be inspected (filled in by design team/site supervisor):

This list contains cards for each service that will likely need to penetrate the airtight layer. Within each card there is a checklist of common penetrations required to provide the service.

This list can be altered to include/exclude penetrations as required.

This list is the 'to do' list.

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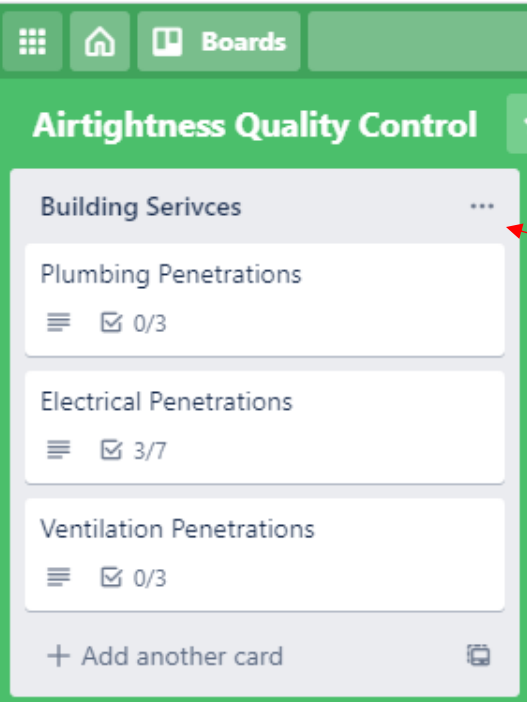

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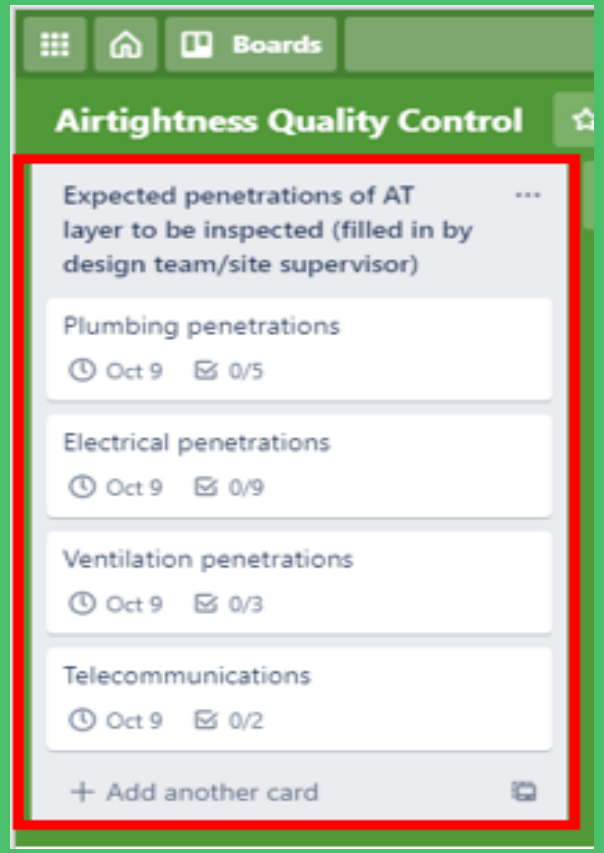

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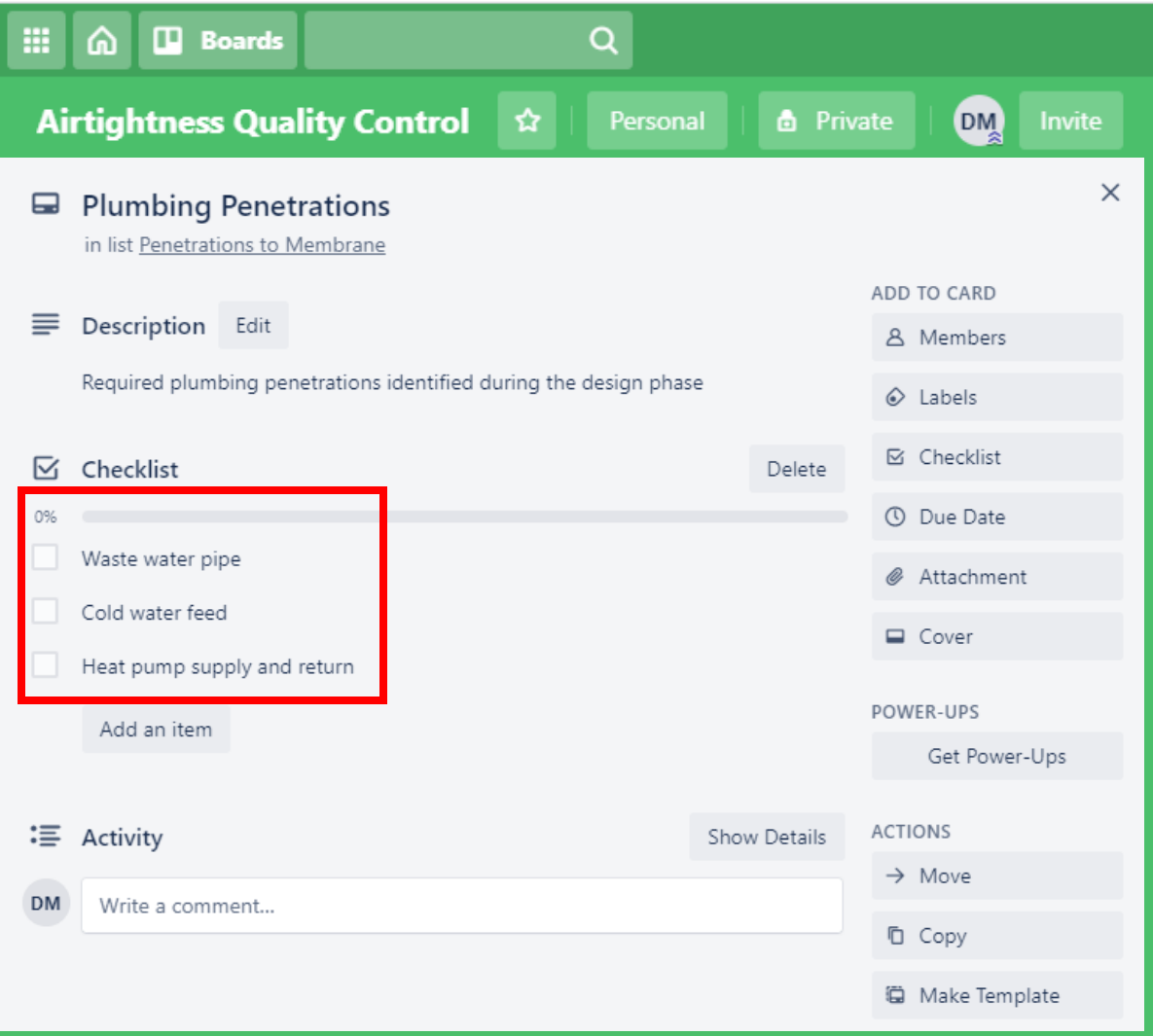

Site supervisor/contractor should list all plumbing/electrical/ventilation/other services required for the project.

This will require collaboration with appropriate contractors.

This list can be used for every project once initially set up, and can be added to, for each project.

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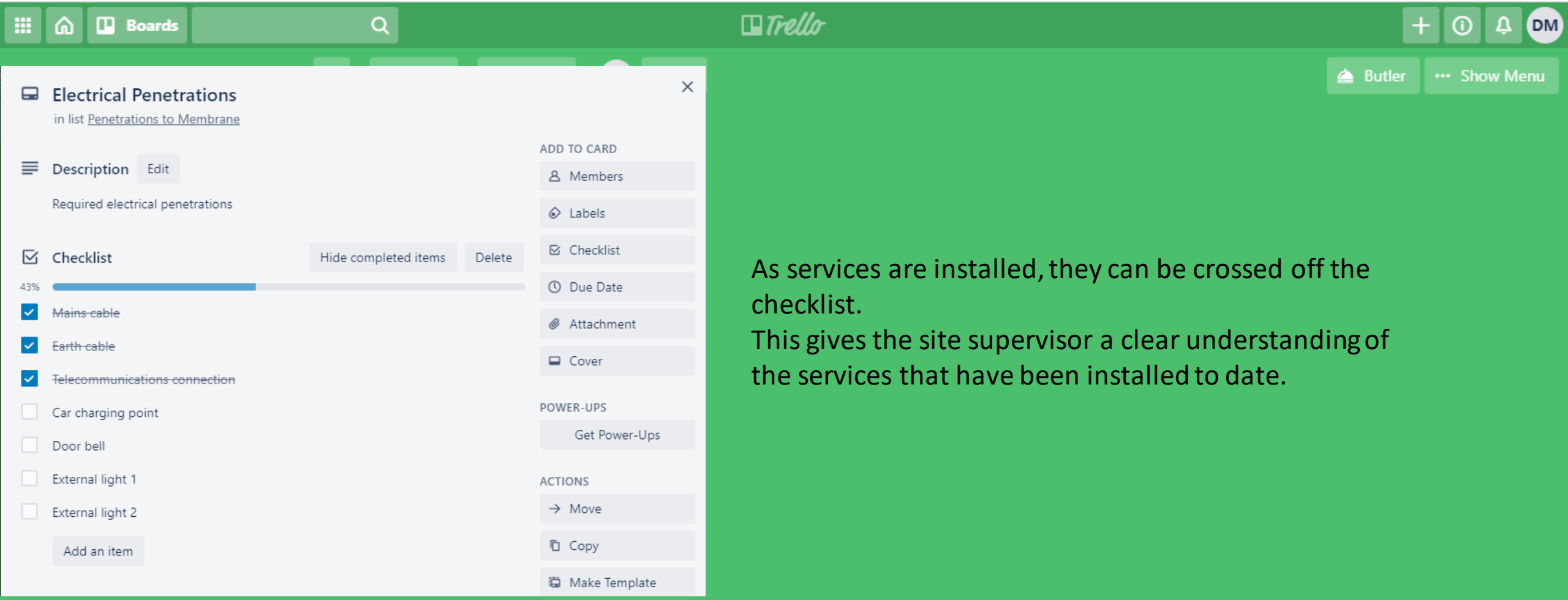

As services are installed, they can be crossed off the checklist.
This gives the site supervisor a clear understanding of the services that have been installed to date.

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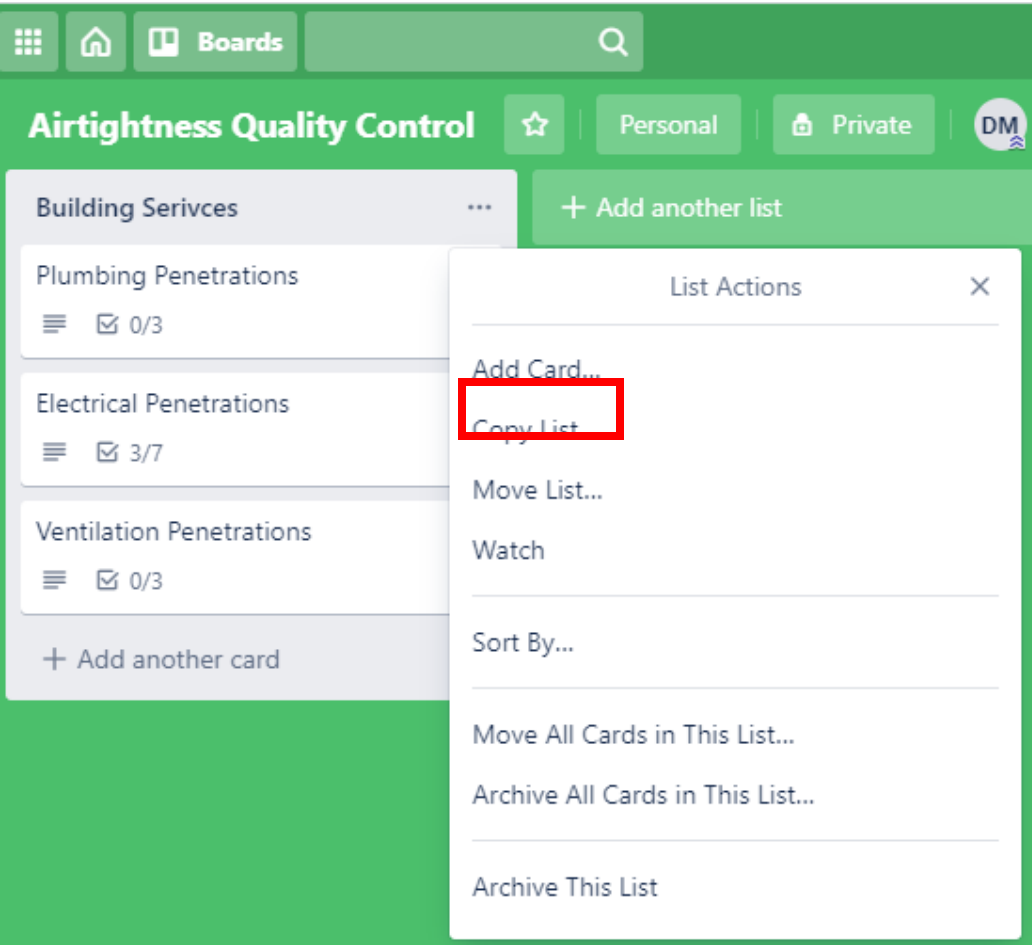

Once the site supervisor has complied the list of building services specific to the project, they should use the 'Copy List' function

Copy list: The 'copy list' function can be used to duplicate the initial list. This ensures that cards and checklists are the same across all lists on the board, ensuring no penetrations are missed. This also saves time duplicating lists manually.

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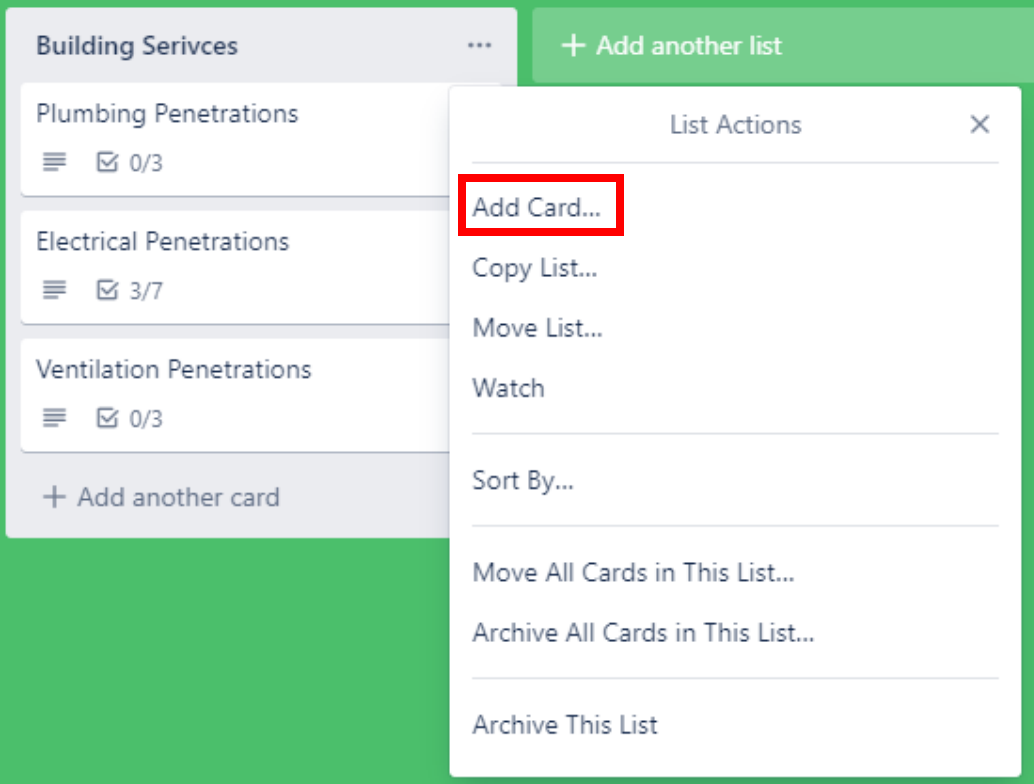
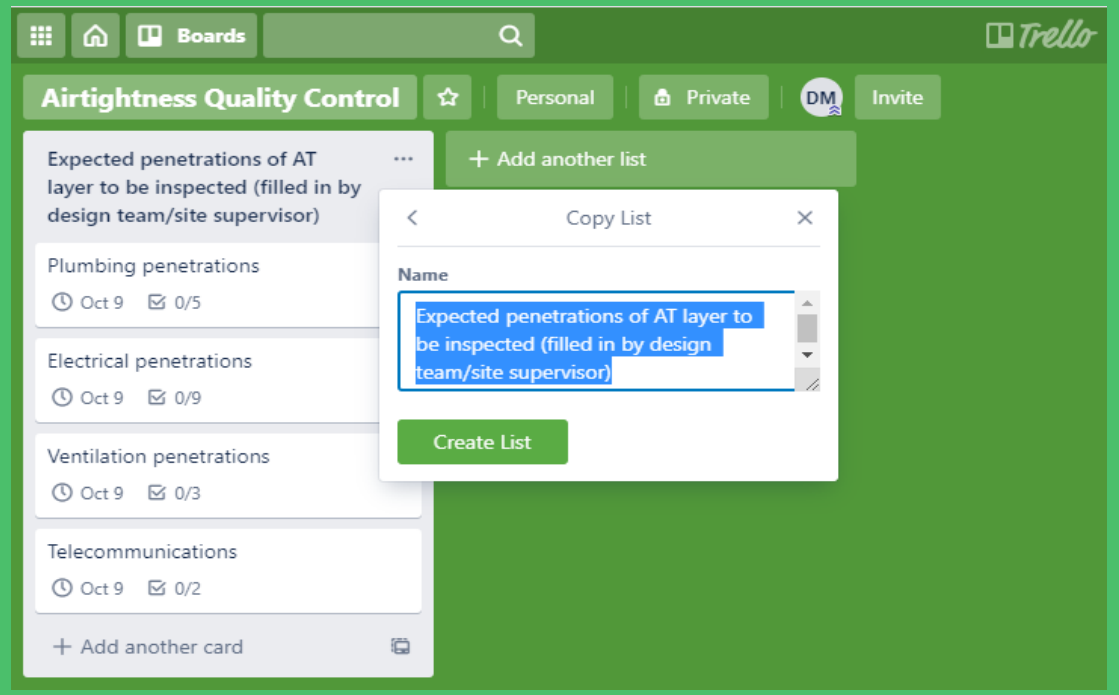
Naming new list: Once you copy the initial list, it is important to rename it. It is a good idea to indicate who the list is for in the name (tradespeople, site management, quality control team)





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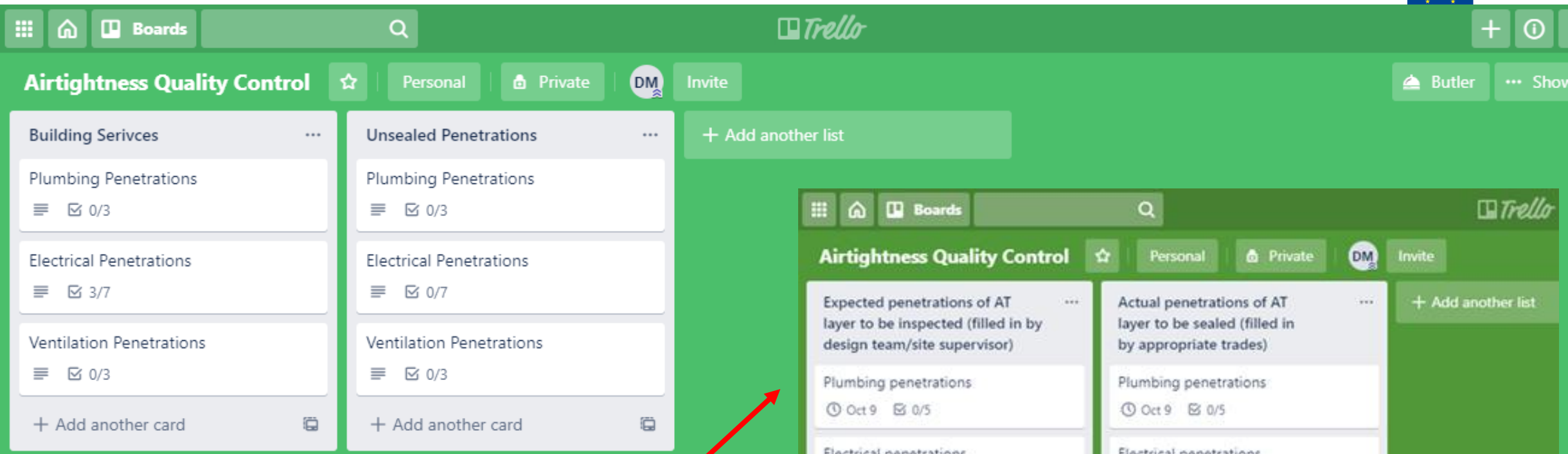

Create list: Once you create the new list it will appear on the Trello board. This list is the 'doing list'.

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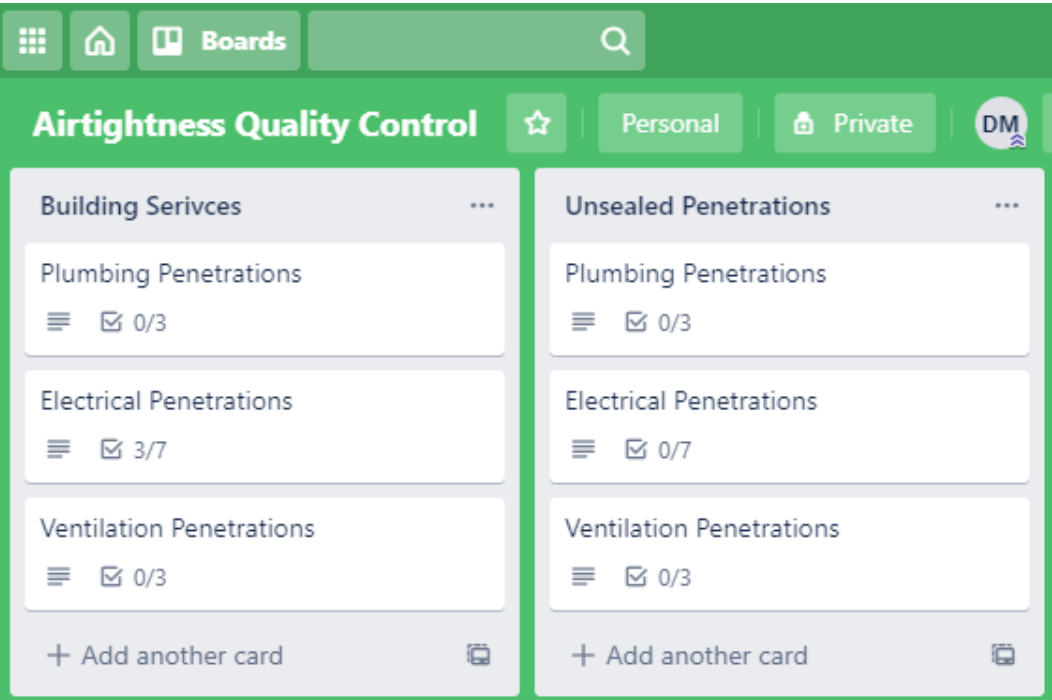

At this stage, services that do not penetrate the airtight layer can be removed from the list.
This may include the cold water feed to the attic for example (assuming the airtightness layer is at ceiling level).

The 'Unsealed Penetrations' list can be used as a checklist for the airtightness champion.
ensures no penetrations are left unsealed.
The checklist function can be used by airtightness champions to cross off penetrations as they seal them up.

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Boards | Trello | DM

Airtightness Quality Control | Personal | Private | DM | Invite | Butler | Show Menu

Building Serivces	Unsealed Penetrations
Plumbing Penetrations 0/3	Plumbing Penetrations 0/3
Electrical Penetrations 3/7	Electrical Penetrations 0/7
Ventilation Penetrations 0/3	Ventilation Penetrations 0/3
+ Add another card	+ Add another card

+ Add another list

Repeat ‘copy list’: By copying the list again you can create a third list. This list will be the ‘done’ list, meaning penetrations have been sealed. Images of completed work should be included in this list for quality control purposes.

Boards | Trello

Airtightness Quality Control | Personal | Private | DM | Invite

Expected penetrations of AT layer to be inspected (filled in by design team/site supervisor)	Actual penetrations of AT layer to be sealed (filled in by appropriate trades)	Sealed penetrations (filled in by airtightness champion)
Plumbing penetrations Oct 9 0/5	Plumbing penetrations Oct 9 0/5	Plumbing penetrations Oct 9 0/5
Electrical penetrations Oct 9 0/9	Electrical penetrations Oct 9 0/9	Electrical penetrations Oct 9 0/9
Ventilation penetrations Oct 9 0/3	Ventilation penetrations Oct 9 0/3	Ventilation penetrations Oct 9 0/3
Telecommunications Oct 9 0/2	Telecommunications Oct 9 0/2	Telecommunications Oct 9 0/2
+ Add another card	+ Add another card	+ Add another card

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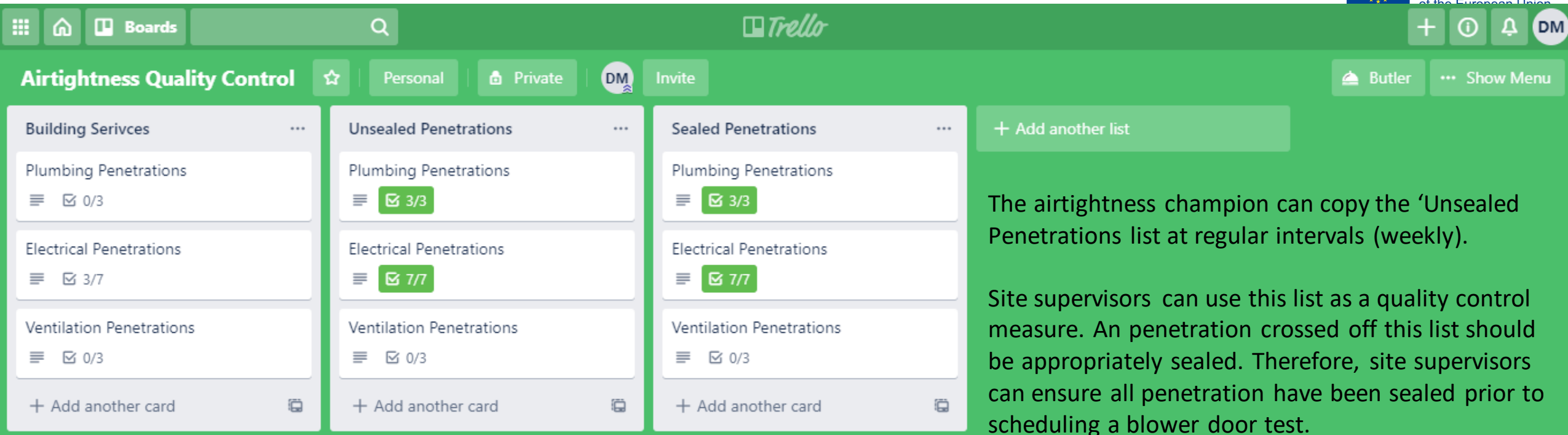

The airtightness champion can copy the 'Unsealed Penetrations list at regular intervals (weekly).

Site supervisors can use this list as a quality control measure. An penetration crossed off this list should be appropriately sealed. Therefore, site supervisors can ensure all penetration have been sealed prior to scheduling a blower door test.

Site supervisors can also select any penetration that has been crossed off this list to carry out a spot check.

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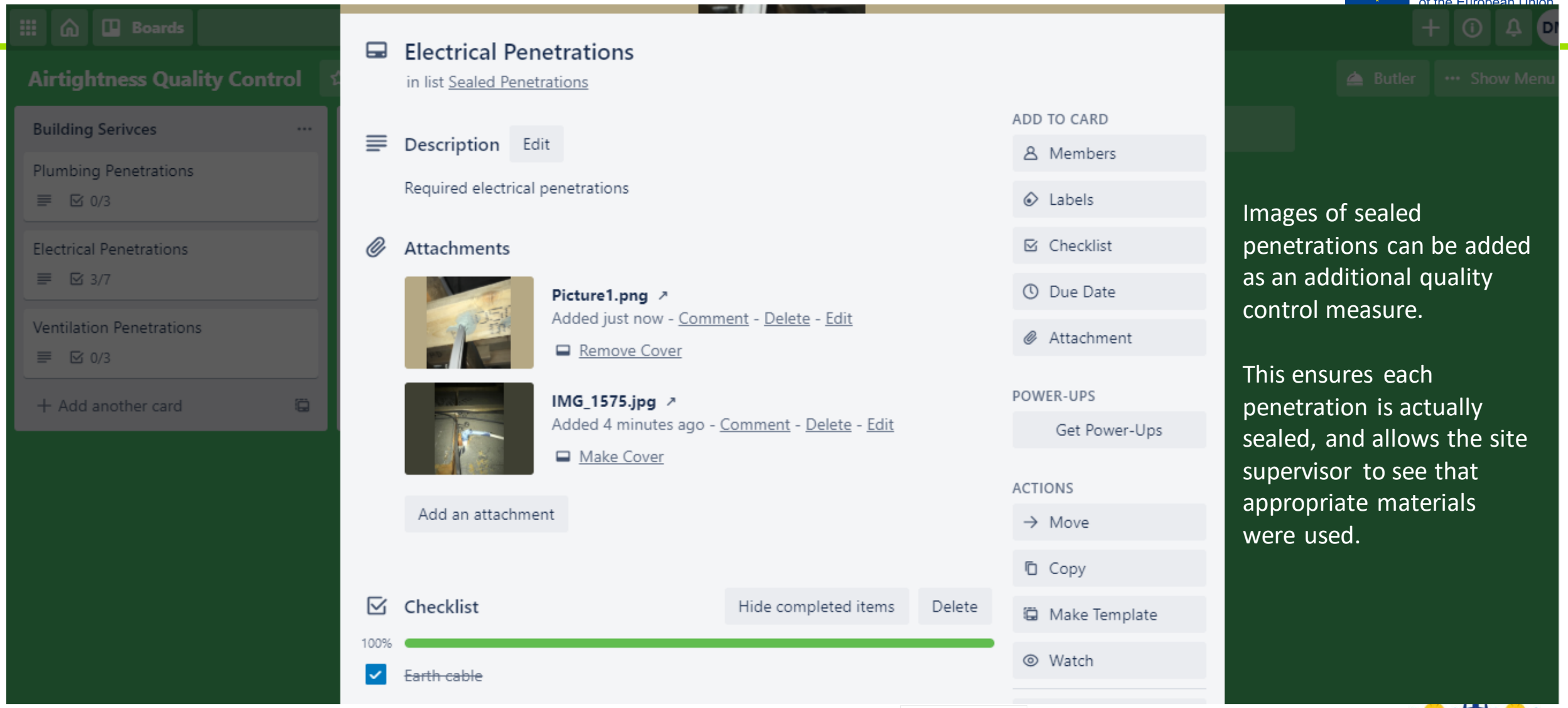

Images of sealed penetrations can be added as an additional quality control measure.

This ensures each penetration is actually sealed, and allows the site supervisor to see that appropriate materials were used.

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Boards

Trello

DM

Airtightness Quality Control

Personal | Private | DM | Invite | Butler | Show Menu

Building Serivces

- Plumbing Penetrations — 0/3
- Electrical Penetrations — 3/7
- Ventilation Penetrations — 0/3

+ Add another card

Unsealed Penetrations

- Plumbing Penetrations — 3/3
- Electrical Penetrations — 7/7
- Ventilation Penetrations — 0/3

+ Add another card

Sealed Penetrations

- Plumbing Penetrations — 3/3
- 
  Electrical Penetrations — 2 — 6/6
- Ventilation Penetrations

+ Add another card

+ Add another list

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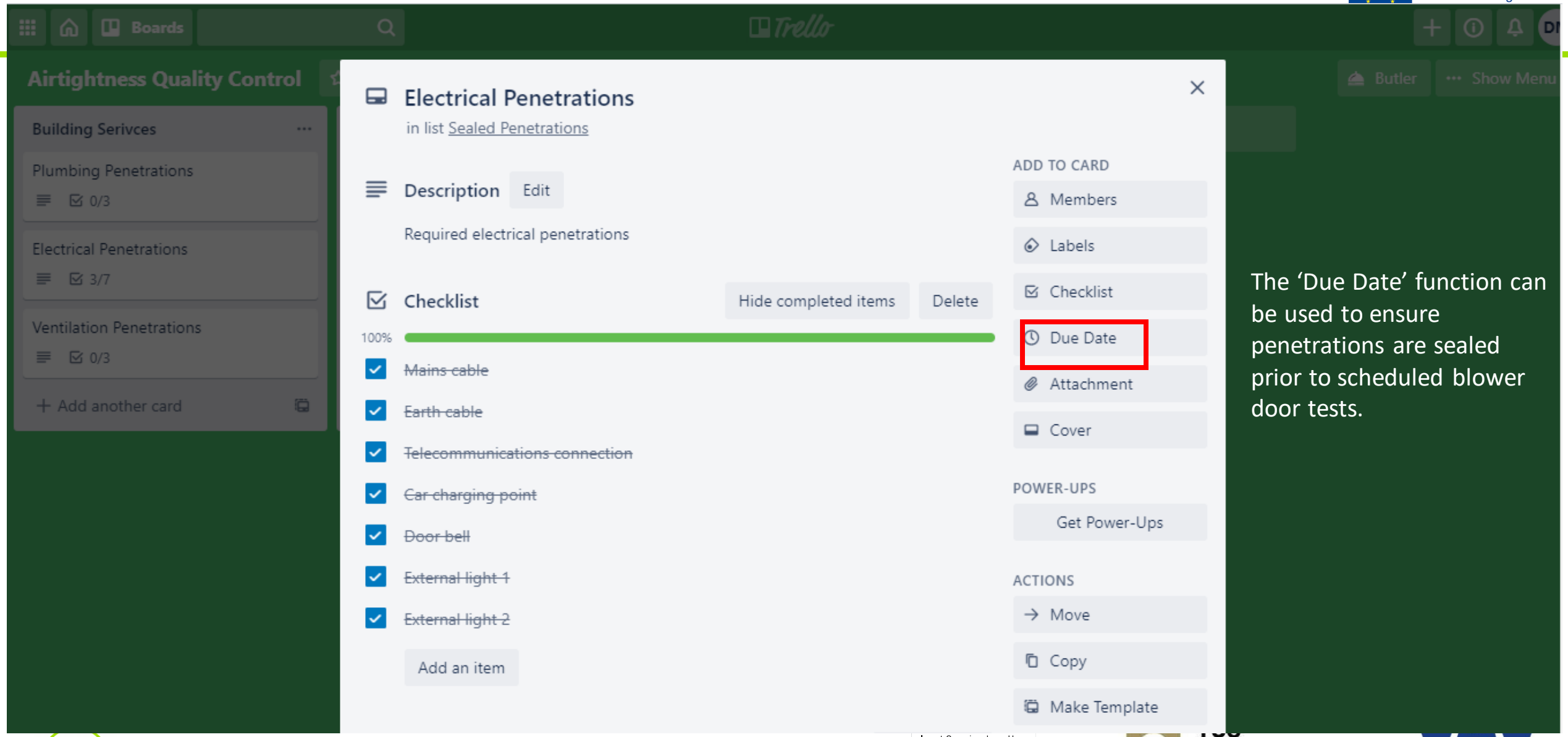

The ‘Due Date’ function can be used to ensure penetrations are sealed prior to scheduled blower door tests.

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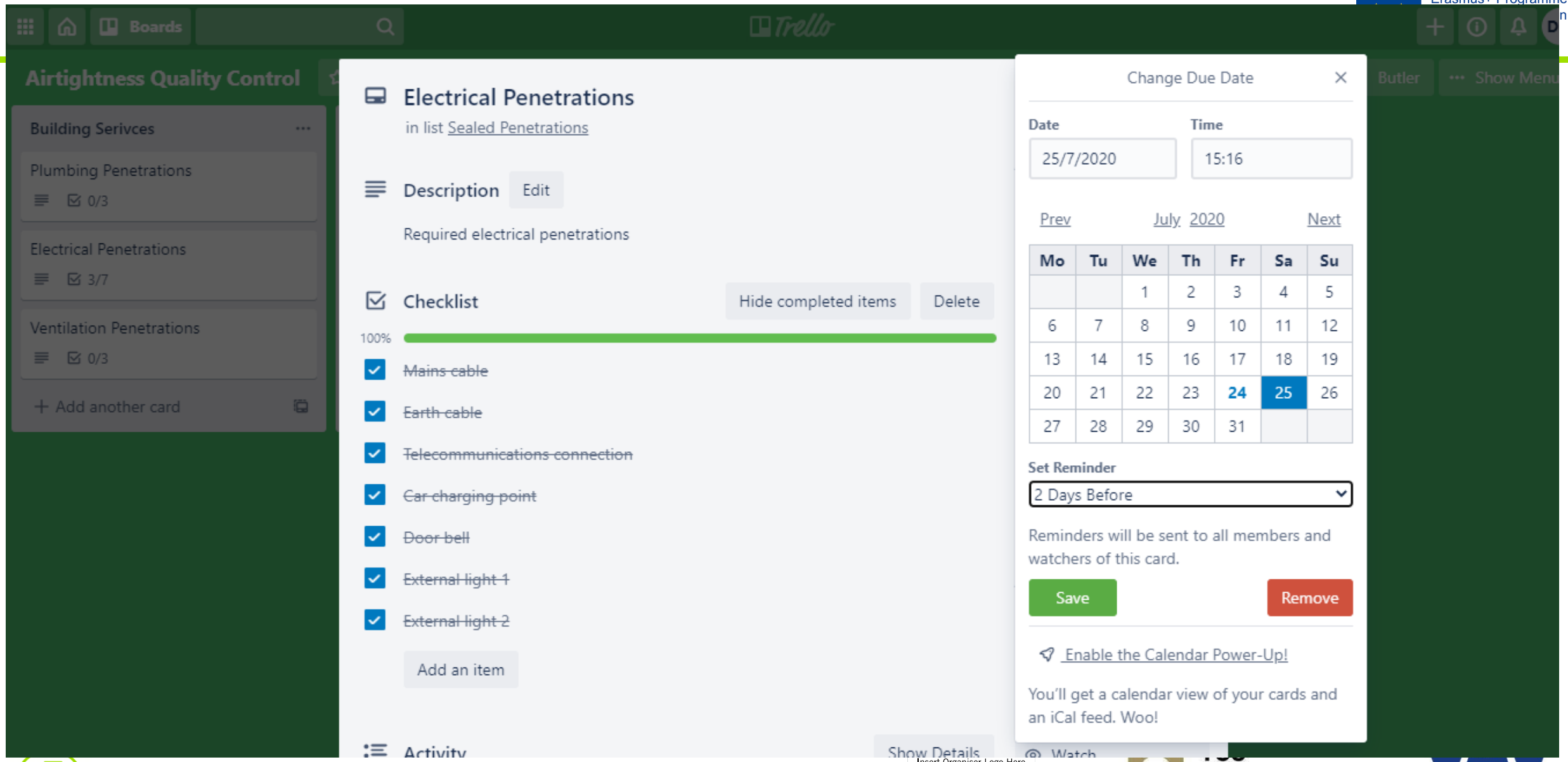

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Assessment

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Use the Mobile App Trello to set out a simple air tightness test.

Carry out the steps in this tutorial

Save the results for next class

Discuss all results in a group

Present the group findings

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Thank You

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