Airtightness Strategy

Lancaster West, Morland House - London

Lancaster West Neighbourhood team W11

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1. Airtightness Introduction

1.1 Airtightness in general

Airtightness is a vital part of any low energy building. Draughts from leaky buildings can account for over 50% of its heat losses. This is not only a waste of energy, but it also greatly reduces comfort. On this project a high level of permanent airtightness is vital to its success. Ventilation is still needed but this is handled using a mechanical ventilation heat recovery (MVHR) unit that takes fresh air and heats it by transferring approximately 90% of the outgoing heat rather than wasting it. The ventilation rate of the MVHR is calculated to ensure the correct amount of air is supplied.

"Build Tight – Ventilate Right"

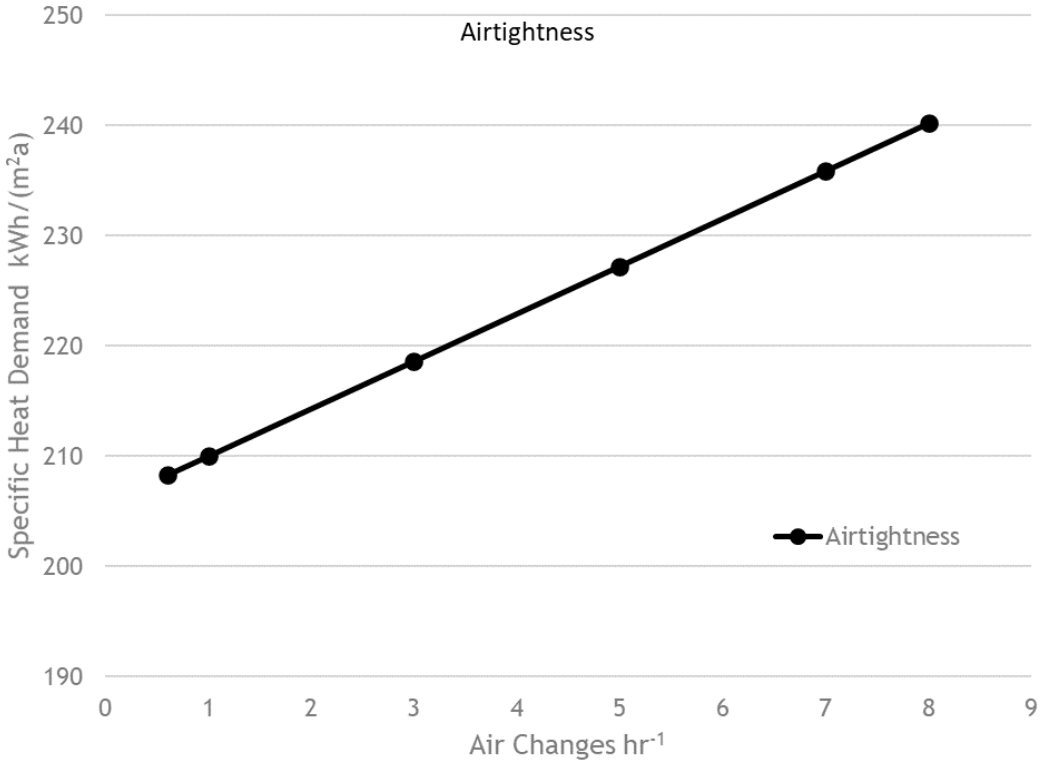
It is vital that the building is sealed, with special care, at all places where potential gaps may occur. A continuous airtight barrier should be formed surrounding the inside of the building. This can take many forms as long as the materials are airtight, these include concrete, glass, plaster, membranes and some timber products, such as 18mm OSB class 3. The junctions between the materials are obvious weak points where movement and shrinkage cracks are possible. These can be sealed in different ways, however we would recommend the use of specialist tapes that are long lasting and stretchable to cope with future movement.

The use of such tapes is becoming standard on the continent and there are two main suppliers, Pro Clima (German) and Siga (Swiss).

1.2 The Importance of Airtightness

On Morland House we are aiming for an airtightness of just 1.0 air changes per hour (ACH) at 50 Pascal, to achieve EnerPHit by Component standard. Our current assumptions is that the existing building has an air change rate of 8.0ACH. This assumption is based on similar case studies, practical experience and an assessment of the building materials, components, type, and age. An air change rate of 8ACH can be comparable to a hole of approximately 170mm diameter on a 3-bedroom house. This will not be just one hole, if it were it would be easy to spot, but it is probably a series of cracks, therefore more difficult to identify and address. Any warm air that escapes through these holes is lost from the house, while any cold air coming in cools the house causing uncomfortable draughts.

As you can see from the below graph, by improving the airtightness from 8.0ACH, to 1.0ACH, our proposed airtightness, the Specific Heat demand can be reduced by approximately 30 kWh/m^{2}Ka, 12.6%, therefore reducing heating costs significantly.



1.3 The benefits of Airtightness

In the previous paragraphs we focused on the advantages of airtightness from an energy performance perspective. There are however further benefits that can be experienced where a good level of airtightness is achieved. The benefits of ensuring airtightness mean:

- No Draughts
- Reduced Energy Use and Reduced Fuel Costs
- Reduced CO_2 Emissions
- No Building Damage
- Meets Building Regulations
- Improved Sound Insulation
- Improved Fire Protection

However, in airtight buildings, people often wonder if being too airtight is unhealthy and whether indoor air will become stuffy and unbreathable. The opposite is actually true as we recommend installing an MVHR. With this system the fresh air is taken from high level outside where the air is cleaner and then delivered in the building at a calculated rate. This ensures consistent air quality levels, rather than depending on leaky fabric and wind direction, which can instead result in stale pockets around the building.

If the MVHR is turned off or it breaks down, it is still possible to open the windows, and even if you do not it is still safe, and would take several days at full occupancy with highly active people to become unhealthy, and prior to this people would feel the building becoming stuffy.

1.4 Vapour Control

In the United Kingdom, with increased insulation standards in modern buildings, the average internal temperature has risen over the last 10 years by approximately 3.5°C. This temperature rise means that air in habitable space retain more moisture than ever before. Therefore, the vapour control layer has a critical role.

In this building we have suggested the use of 100mm of mineral wool internal wall insulation. Internal wall insulation, especially where this is thicker than 50mm, can be critical and special care needs to be taken to avoid moisture transmission through the insulation and risk of interstitial condensation and mould generation behind the insulation. in this project it is recommended to install a vapour control barrier which retains the vapour.

1.5 Airtightness in Existing buildings

We have assumed that Morland House has an air change rate of 8 air changes per hour. Heat loss through infiltration in the existing building accounts for 12% of losses. This building is probably better than many due to the solid brick walls and concrete. Areas where particular care is needed are junctions between different materials or components such as plastered walls and concrete floor, areas of services penetration, windows, defects in construction and insulation installation.

In the following sections we have outlined a series of strategies for each building element, to make sure infiltration will be reduced to 8% and the building will achieve the level of airtightness recommended of 1.0 air changes per hour.

2. The Step by Step Approach

In this section we outline the steps to be taken to avoid mistakes and make sure the airtightness strategy is carried out effectively. Please note that these are highly recommended, however where not relevant, some might be omitted.

1. Determine the airtightness target – this might be a Building regulation or an energy or environmental standard requirement. Our Options report can help set this target, along with other measures.

2. Define the Air Barrier Strategy – this summarises the building fabric choices to be pursued to achieve the above target. Please see section 3 for a detailed strategy for your building.

3. Prepare air barrier drawings - these should show the air barrier in plans, sections and relevant details. The drawings should also provide notes identifying the material or product which forms the air barrier in each location. This should be developed by the project architect with the support of an air leak specialist or an environmental consultant. Section 3 shows relevant details for your building.

4. Simple detailing is encouraged to ensure that airtightness tapes can be easily fitted and function efficiently at difficult junctions. Ensuring there is space for the tapes to be fitted, and room for hands to fit them, this can make a significant improvement to the results.

5. Detail airtightness requirements into the project specifications – these should outline the following:
   - the air leakage target and the air barrier strategy;
   - the requirements for various work packages to incorporate particular items that contribute to the airtightness;
   - details of the project requirements for air barrier drawings, air leakage design checking, site air leakage audits and preliminary and acceptance air leakage testing;
   - requirements for Airtightness Champions and other management strategies to ensure that workmanship is satisfactory, sealing works are verified and that the airtightness target is achieved;
   - roles and responsibilities for works, particularly if remedial works and further testing are required.

6. Air Leakage Design Review – this should be carried out to check all details relevant to the air barrier, such as sections through external facades.

   Air Leakage Design Workshop – the above review should be discussed and agreed by the design team and the airtightness specialist, and robust and cost-effective solutions are developed as necessary for the issues raised in the design review report. Some of the techniques and materials used are not currently commonplace in the UK. The providers of airtightness tapes can provide airtightness workshop in the office or on site, to train all trades and craftsmen in the application of airtightness tapes, and this should be encouraged. Training is often provided to the mangers, but it is as equally important if not more important to train those doing it, and for them to understand why it is important.

7. Airtightness Champions Program – it is recommended to have this role in place to ensure effectiveness of installation. It is also important that site inductions are given to all operatives working on site so that they all understand the need for airtightness, where the barrier is and how it functions. It is vital that all trades are inducted and aware, as anyone can inadvertently make a

hole in the airtightness layer – particularly when they are unaware of the requirement and where the layer is.

8. Air Barrier Delivery – this is to ensure that materials used are ordered correctly and on time and used appropriately by competent people. A no blame culture is also encouraged when a hole is made in the air barrier by mistake. All accidental penetrations of the air barrier must be brought to the attention of the supervisor so it can be taped up and put right. A hole which is left could be difficult to find later.

9. Site Leakage Audits – walk-around site air leakage audits are recommended throughout the project, typically by the Airtightness Champion or the Airtightness Specialist, to determine actual and potential air leakage weaknesses and determine any additional works that need to be carried out.

10. Preliminary Air Leakage Testing – carrying out the final acceptance airtightness test only is risky, particularly for buildings with onerous airtightness requirements, therefore carrying out preliminary testing would be beneficial and would provide security of satisfactory results at the end. This can be partial and whole-building testing.
    - Partial testing is localised checking on specific elements or components of the building carried out by experienced testers, supervised by an Airtightness Specialist.
    - Whole-building testing to be undertaken on the whole building.

11. Acceptance Air Leakage Testing – for the acceptance air leakage test the building should be essentially complete, the only permissible temporary sealing is to exclude the ventilation systems so as to provide a true evaluation of the building fabric. Testing shall be carried out by a recognised specialist contractor in accordance with the applicable standards (ATTMA TSL1 (2016) for dwellings). The airtightness testing contractor should issue an Air Leakage Certificate once testing is complete and the building has met the required standard. This would normally be incorporated in a full report detailing the test methodology, measurements recorded and the results, as well as any temporary sealing undertaken.

12. Post Completion Air Leakage Review – this is a lesson learned review of what worked and what did not with regard to the design and implementation of airtightness on the project.

3. Airtightness Strategy and Construction Details

This section defines the Air Barrier Strategy. This is a summary of the building fabric choices which should be implemented to achieve the airtightness target. Major areas where air leakages can be identified in Morland House are

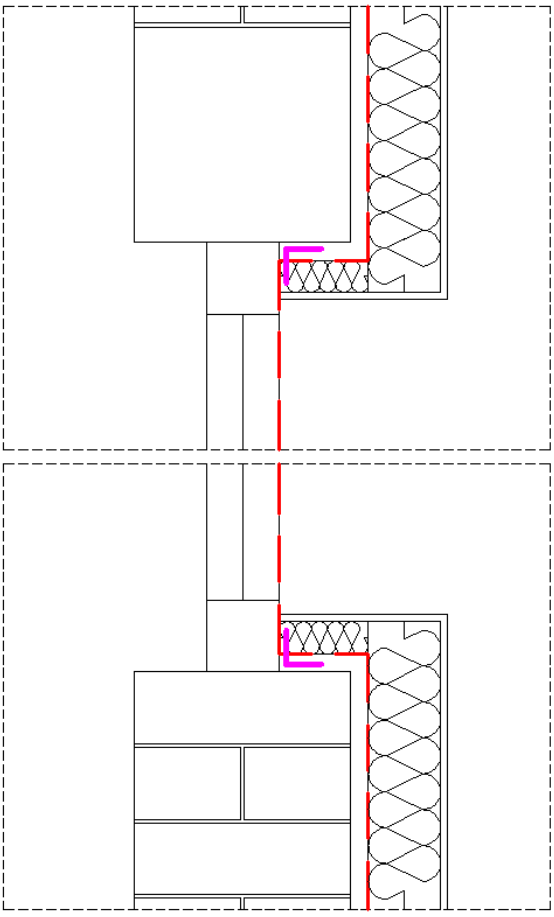
- Wall/Windows and Doors junction
- Floors/External wall junction
- Eaves and Roof
- Services and Cables penetration

A simple and useful principle is the adoption of a single layer, with junctions between materials as necessary, as the air barrier throughout the building. As well as the airtightness layer, on the warm side of the bulk of the insulation, there should also be a wind-tight layer on the outside of the insulation to prevent wind-washing that takes heat out of the insulation and cools the building down.

Materials and connections need to be clearly defined, moreover, when selecting materials, consideration of their durability is needed, for instance, silicone gets rigid with age and cracks and so is not considered airtight.

3.1 Wall/Windows junction

Windows and frames are considered to be airtight, and so is a masonry wall with plaster. The challenge comes at the point where these connect. It is therefore paramount for these elements to be fitted correctly. Windows and doors must be robustly sealed to the air barrier at the head, jambs, and threshold. Here all corners need to be fitted with airtight tape. The building will have internal insulation, and this will partially cover the frame for effective insulation. The reveal of the windows will be sealed with airtight tape.



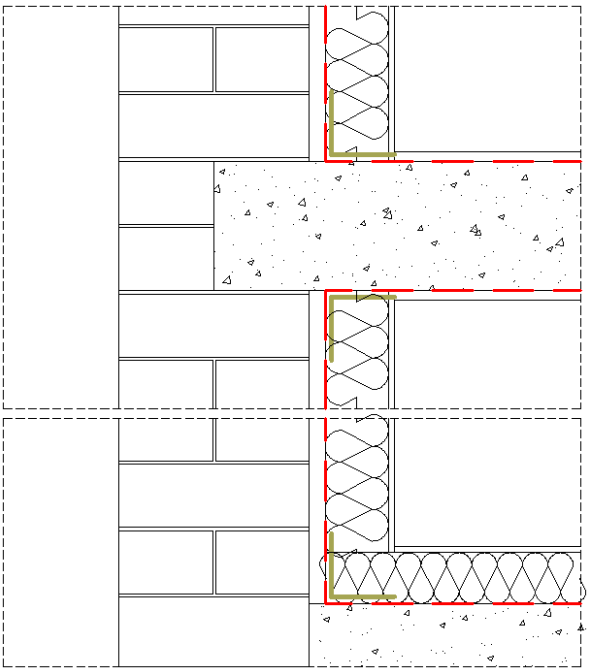
Red Line – Denotes position of continuous airtightness barrier, in this case wet plaster and the window.
Pink Line – Denotes **Pro CLima CONTEGFA FC** or **SIGA Fentrim 20.** If sealing the window frame to the plaster on the inside. **Use Fentrim 2** with render on the outside.

Windows and doors should be sealed to the plaster using **Pro Clima CONTEGA SL** or **SIGA Fentrim 20** vapour resistant sealing tapes for use with wet plaster and installed in accordance with manufacturer's guidance. The tapes can the fixed to the windows prior to installation and then fixed to the block work using the release tapes. The tapes must be long lasting and allow for movement since we expect the building to move over time. It is also important that the corner from the frame to the wall are sharp and do not bulge, partly to ensure no gaps at any wrinkles in the tapes, but also to ensure when plastering these are not cut by the plasters trowel either intentionally or unintentionally. The Siga pre folded tapes make this partially easier to apply.

Door thresholds are also a common weak point, with level access requirements often making delivering effective airtightness more difficult. External doors can benefit from the installation of draught excluders. Thermal bridging can also occur in this location, and it is recommended that a detail is developed to show how this is to work.

3.2 Floors and external wall junction

Masonry, if covered by plaster, and concrete construction can achieve excellent levels of airtightness due to the inherent properties of concrete and plaster. All that is required here is to connect these airtight layers together to create a continuous and effective airtight layer. Moreover, since cracks might occur with time, it is advisable to seal the corners with airtight tape. In this building we proposed the use of wet plaster, which delivers airtightness on the walls. This needs to reach the floor level to avoid an exposed strip behind skirting, which is not normal practice, so this must be clearly specified. Tapes are then required to join wall to floor and floor to ceiling.



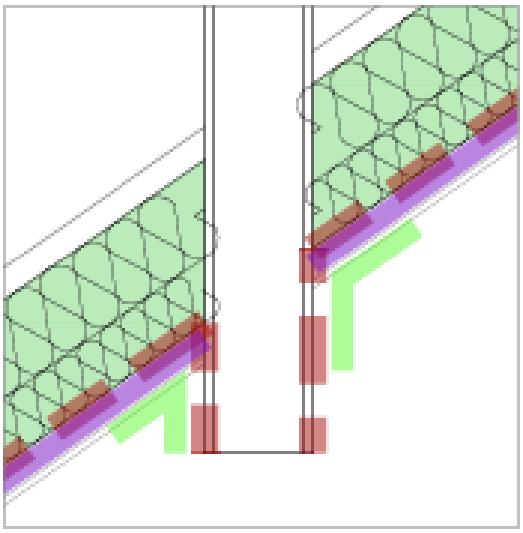
Red Line – Denotes position of continuous airtightness barrier. This is formed by the screed and wet plastered walls

Beige Line – Denotes **Pro CLima SA-S** using **ORCON F** adhesive or **SIGA RISSAN** using **DOCKSKIN** adhesive for sealing sandy, fibrous substrates (screed).

Alternatively paint on airtightness membranes such as Blowerproof can be used.

Please note all images are only examples and are not in scale.

3.3 Service Penetrations



Red Line – Denotes position of continuous airtightness barrier.

Purple Line – Denotes airtight vapour control layer.

Green Line – Denotes **SIGA RISSAN** / **Pro climea Tescon No 1** to form cicular airtight seal made up in layers. Or **Roflex /Kaflex** airtightness grommet.

Please note images only constitutes an example.

Different services, including electrical, mechanical and hydraulic services generally penetrate buildings through the external envelope. These can cause major air leakages and, therefore, all service penetrations, into/out of the external envelope of the building are to be sealed when pursuing a good level of airtightness in buildings. We suggest service penetrations use a **ROFLEX/ KAFLEX** airtightness grommet made from EPDM to form an airtight seal around the penetration.

On concrete or screed these are sealed to the floor slab with **ORCON F multi-purpose** flexible joint adhesive (use **TESCON PRIMER RP** prior to gluing back to concrete floor) or sealed to **INTELLO PLUS with TESCON No 1** flexible multi-purpose tape. It should also be noted that all incoming and outgoing services are to be insulated, to reduce condensation risk. There are a range of sizes to suit all applications and have high levels of temperature resistance.

Alternativley, you can use **SIGA RISSAN or pro clima TESCON No. 1** tape to form a cicular airtight seal made up in layers.

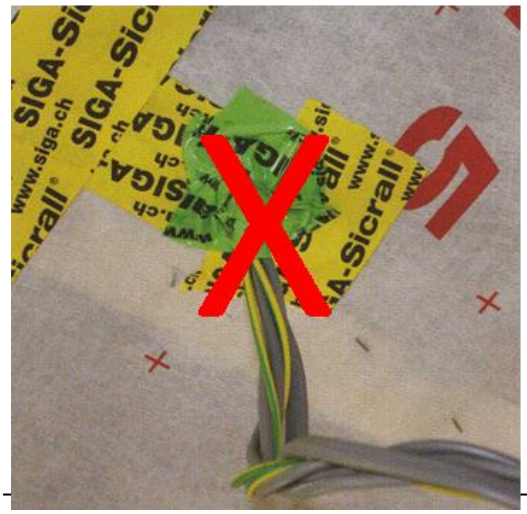
3.4 Cables and Electricals

Passing electrical cables through the airtightness barrier should be avoided and reduced to a minimum, most service runs should run within the building and inside of the air barrier. As we have 100mm of insulation on the inside of the block work this area can be used for service runs, leaving the parge coat which is the air barrier in this case unharmed. Any un-intentional damage to the parge coat should be repaired with plaster or tapes.

If it is essential cables run through the plaster barrier then these should be sealed using grommets or individually taped. Cables or pipes should not be bundled together as this leaves gaps between that cannot be filled.

PRO Clima Kaflex Cable Grommet enables a better airtight seal for electrical cables that penetrate the airtight seal. Kalflex grommets are manufactured from EPDM which is flexible to form a cicular airtight seal made up in layers. Some **Kalflex** cable grommets feature an integrated adhesive with a release paper for ease of application.

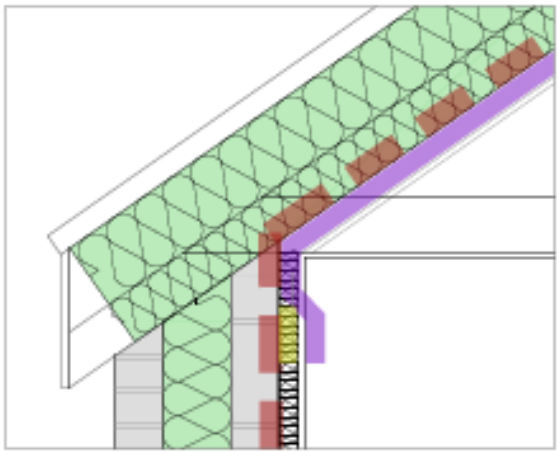
Another option is to tape each cable thoroughly with **SIGA RISSAN or pro clima TESCON No. 1**



Do not wrap clumps of wires and cables in airtightness tapes as this leaves air gaps between and therfore air leakage.

Wireless door bells should be fitted as standard to avoid airtightness barrier penetrations.

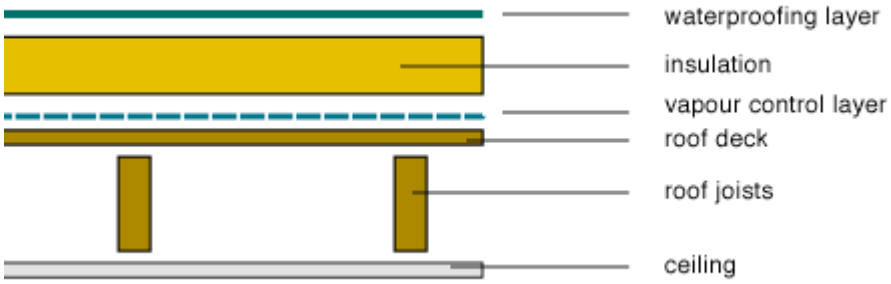
3.5 Roof and Eaves



Red Line – Denotes position of coninuous air tightness barrier. Use **Covrum 30/30** or **TESCON PROFIL** to seal in corners and around purlins or OSB board.

Purple Line – denotes **Pro CLima CONTEGFA FC** or **SIGA MAJPELL 5**

Yellow Line – Denotes **SIGA Primur Rol** or **Pro-Clima ORCON LINE** airtight sealing adhesive



In this building for the flat roof we suggest a warm roof, where all the insulation is located above the structural deck, this avoids the potential risk of condensation within the joist zone. This also allows the easy introduction of the airtightness membrane under the insulation, but on the outside of the roof structure making it possible to do the work without entering the flats.

The sloping sides to the roof and the dormer cheeks are however slightly different and less vulnerable, so it may be possible to include some insulation between the joists as well as outside, and a dew point or wufi calculation is need. It may also be possible to install the air tightness membrane on the outside of the structure but inside of most of the insulation, which is much easier, however again this needs to be carefully checked.

If the airtightness membranes need to pass around or through the structure this should be carefully considered in advance, and membranes introduced at strategic times. Alternatively, it is possible to

tape around joists and purlins individually as shown below. Again, care should be taken to ensure no gaps and that the corners are tight.

Corners formed around Purlins or Joists are airtightly sealed with **Covrum 30/30 or TESCON Profil**