The impact of airtightness retrofitting on existing dwellings

Matthew Moran K00261716

What is airtightness?

Airtightness refers to the measure of air permeability of a building. This is the rate of uncontrolled air flow which leaks into & out of buildings. Air leakage is caused by two phenomenon, these are the stack effect and the building pressure differential.

Project objectives

1.To carry out a literature review of airtightness retrofitting of older existing dwellings and the technological improvement of airtightness materials.

2.To determine areas of existing dwelling envelopes that require airtightness upgrades and the factors which led to these areas of air infiltration.

3.To determine the effectiveness of each upgrade and the levels of cost and disruption caused by their retrofit.

4.To categorize and highlight effects and ancillary upgrades required with each individual aspect of an airtightness upgrade.

5.To determine the levels of upgrades and energy savings that are possible when the dwellings year and makeup are taken into consideration.

Background

Poor airtightness can lead to uncontrolled air leakage this can contribute up to one third of the heat losses in older buildings. With retrofitting increases in airtightness can lead to reductions of up to 24% in heating requirements. The typical areas of poor airtightness are at material junctions such as wall to window joints, door to wall joints, service penetrations and loft/attic hatches.

Survey

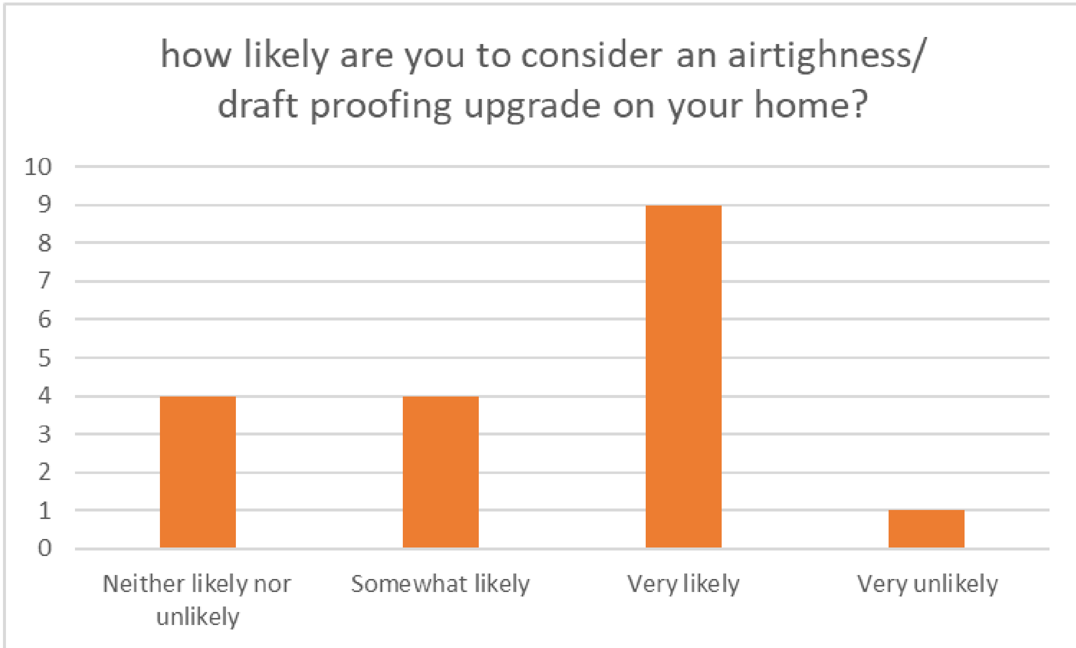
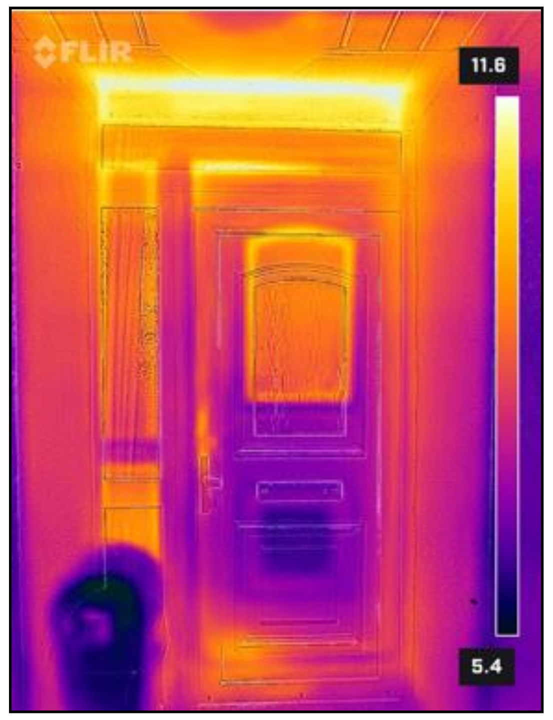


Figure 1: Q4 survey results.

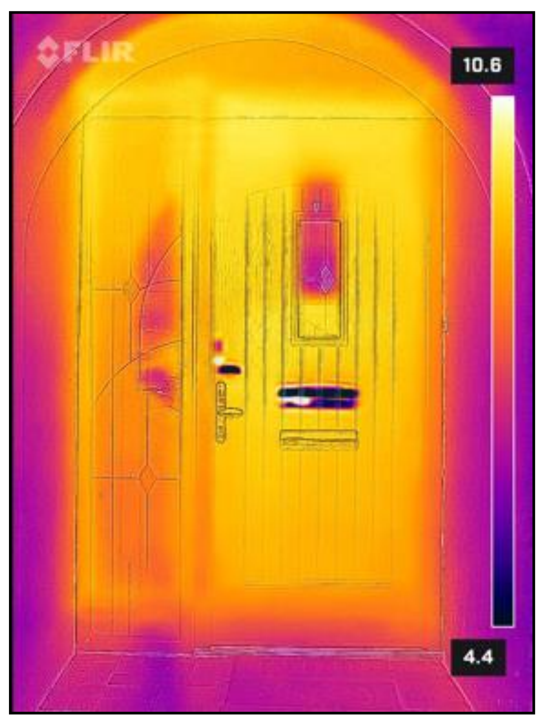
From the survey it was found that 50%(9) of respondents were very likely to consider an airtightness/ draft proofing upgrade. Which highlights the need for further research within this area.

Site survey investigation

An onsite investigative survey was created to determine the severity of air leakage pathways within existing dwellings. Two dwellings were investigated with one dwelling hill 1970 having been retrofitted with numerous airtightness solutions. While a second dwelling ash 1979 was investigated, this building had no major airtightness solutions applied. This allowed for a cross comparison between retrofitted and non retrofitted buildings. This investigation was aided through the aid of thermal imagery.



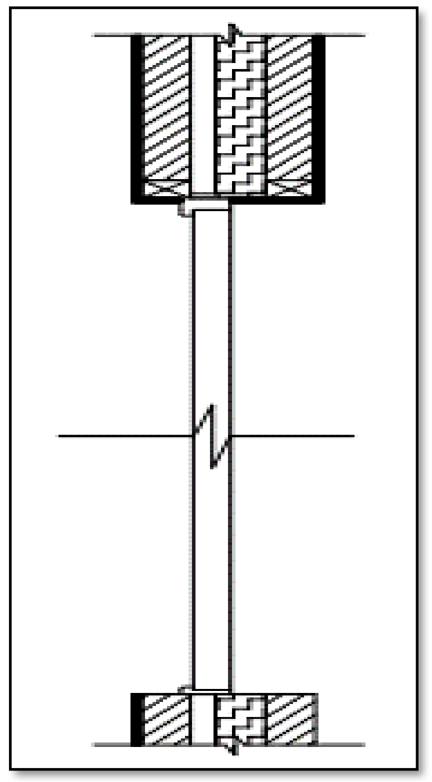
Thermal image: Hill 1970 Airtight.



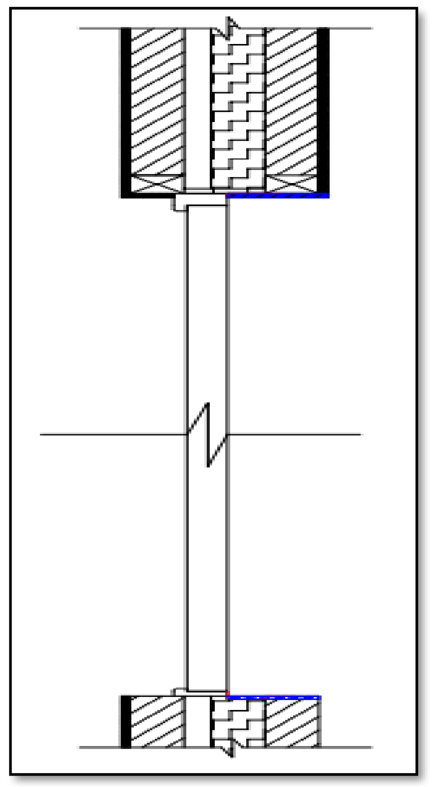
Thermal image: Ash 1979 non airtight.

Design solutions

From the knowledge gathered through the site investigation, survey and literature review a comprehensive set of solutions were developed. These changes are aimed at the technical guidance document part L. these detail a step-by-step approach to solving these air leakage pathways and increasing the airtightness of existing dwelling. Solutions were developed for 4 different areas, these are windows, doors, service penetrations and loft/attic hatches.



Before implementation of airtightness solution to door.



After implementation of airtightness solution to door.

calculations

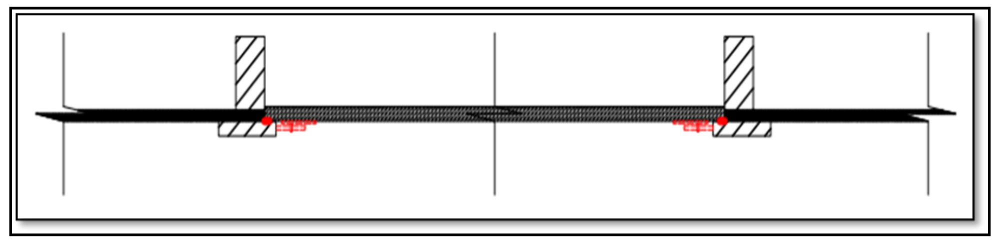
Calculations were preformed based on the ash 1979 dwelling which allowed for the calculation of air flow rates, heat losses and simple payback period for each developed solution. From this a table of payback periods was generated for different crack/opening sizes.

opening size (mm)	cost (€/year)	pay back period (years)
0	0	0
0.5	3.292394754	3.0
1	6.584789508	1.5
1.5	9.877184262	1.0
2	13.16957902	0.7
2.5	16.46197377	0.6
3	19.75436852	0.5
3.5	23.04676328	0.4
4	26.33915803	0.4
4.5	29.63155279	0.3
5	32.92394754	0.3

Figure 2: simple payback periods for taping+ replastering.

Conclusion

The impact of airtightness retrofitting within the realm of existing dwellings is a rather undocumented area particularly within the application of these airtightness solutions to dwellings. From reviewing literature areas in need of improvement were found these were then investigated further through careful inspection and measurement and using thermal imagery. With key areas of improvement found these were developed further with the implementation and construction detail of these improvements thoroughly examined. The severity of these works was also tailored to suit the requirements of dwelling occupants for a minimal disruption to their daily lives. The effects of these improvements from lack of natural airflow after retrofit and the heating energy savings achievable were also determined. The cost effectiveness and simple payback period for a variety of improvements was also determined. With tape and replastering found to have a payback period of between 36 and 1 months and attic/loft hatch airtightness improvements having a payback period of between 8.5 and 1 month.



After implementation of airtightness solution to loft/attic hatch.

References

Gillott, M.C., Loveday, D.L., White, J., Wood, C.J., Chmutina, K., and Vadodaria, K. (2016) 'Improving the airtightness in an existing UK dwelling: The challenges, the measures and their effectiveness', Building and Environment, 95, 227–239,

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