School of Architecture, Building and Civil Engineering

The effect of refurbishment and trickle vents on airtightness

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Context

- UK homes are being refurbished with double glazing to reduce wintertime heating demand.
- This refurbishment can cause a reduction in infiltration and have a detrimental effect on indoor air quality.
- Trickle vents are provided to improve indoor air quality.

Aims of the research

1. Quantify effect of refurbishment on air tightness.
2. Quantify effect of trickle vent opening on air tightness.
3. Comment on the repeatability of the blower door test method.

Methods

- Experiments conducted in a single test house.
- 167 blower door tests were carried out (table 1).
- Different trickle vent opening configurations were compared.
- Indoor/outdoor temperature was measured on site. Wind speed and direction measured at University weather station <1km from test house.

Table 1: Pre- and post-retrofit blower door testing phases.

Pre- or Post-Retrofit	Trickle Vent Status	No. of Tests
Pre[1]	No vents installed	1
Post	All closed and sealed with tape	10
Post	All closed	34
Post	One or more trickle vents open	118
Post	All closed (testing other openings)	4

Test House

- Built in 1930s with cavity wall construction.
- Semi-detached, adjoining another house.
- Refurbished in summer 2016 with double-glazed windows and doors, trickle vents and loft insulation.

Test house pre-refurbishment (left), post-refurbishment (right), and blower door equipment used (Model 3 Minneapolis Blower Door).

Trickle vent closed (left) and open (right).

Table 2: Trickle vent location and sizing.

Room	Number of vents	Trickle vent equivalent area (mm^2)	Trickle vent geometric free area (mm^2)
Living room	4	5000	6400
Dining room	3	5000	6400
Kitchen	2	2500	3200
Bathroom	2	2500	3200
Rear bedroom	4	5000	6400
Front bedroom	4	5000	6400
TOTAL	19	25000	32000

Effect of refurbishment on air tightness

- Refurbishment reduced mean air leakage (q50) by 6.1$m^3/h/m^2$ (29%) with all windows and trickle vents closed.
- Post-refurbishment q50 of 14.7$m^3/h/m^2$ is in excess of current regulations for new builds (10$m^3/h/m^2$).

Table 3: Pre- and post-retrofit air tightness results.

Pre-refurbishment			Post-refurbishment		
q50 ($m^3/h/m^2$)	n50 (ACH_{50}) (1/h)	ACH (1/h)	q50 ($m^3/h/m^2$)	n50 (ACH_{50}) (1/h)	ACH (1/h)
20.8	21.5	1.1	14.7	15.3	0.8

Impact of trickle vent opening

- Linear relationship between q50 and trickle vent opening area.
- Opening trickle vents to building regulation stipulated levels increased q50 by 1.8$m^3/h/m^2$ (12.2%) to 16.5$m^3/h/m^2$.

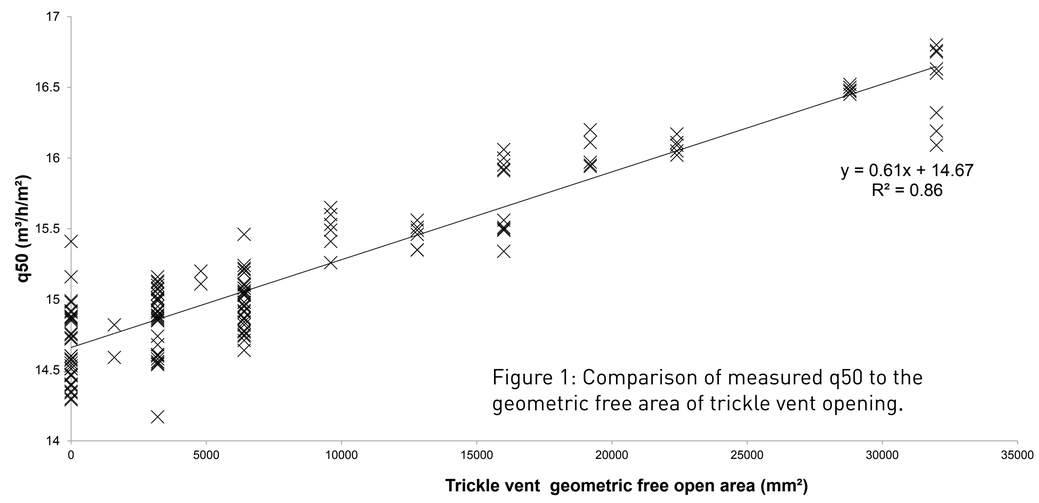

Figure 1: Comparison of measured q50 to the geometric free area of trickle vent opening.

Repeatability of blower door test method

- 34 blower door tests over 13 separate days with all windows and trickle vents closed used for analysis.
- Maximum wind speed recorded during testing was 6.8m/s. Wind speed and direction did not influence measured q50.
- Indoor/outdoor ΔT did not influence measured q50.

Table 4: Mean, standard deviation and standard error of 34 blower door tests.

Mean q50	Standard deviation	Standard error
14.7$m^3/h/m$	0.2$m^3/h/m$	0.07$m^3/h/m$

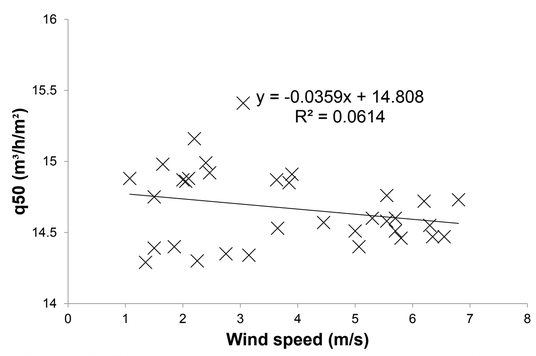

Figure 2: Comparison of measured wind speed to measured q50.

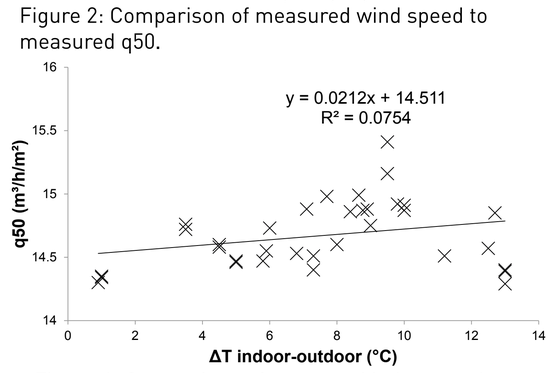

Figure 4: Comparison of measured indoor-outdoor temperature against measured q50.

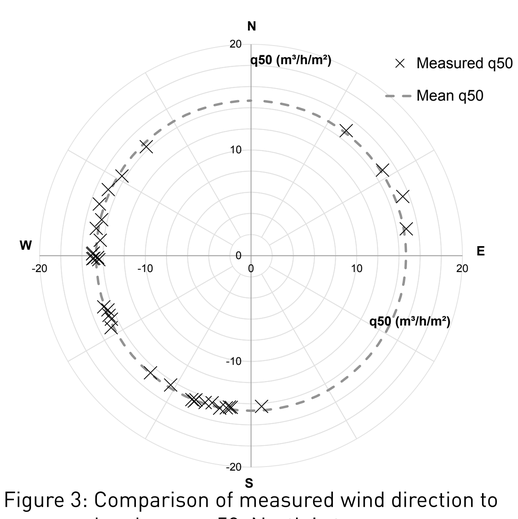

Figure 3: Comparison of measured wind direction to measured and mean q50. North is top.

Summary and conclusions

1. Refurbishment reduced mean air leakage (q50) by 6.1$m^3/h/m^2$ (29%). Refurbishing older homes is unlikely to have negative implications for indoor air quality.
2. Trickle vents, when fully opened provided additional ventilation of 1.8$m^3/h/m^2$ at 50Pa or 0.1 ACH at atmospheric pressure.
3. The blower door test is repeatable under a variety of wind conditions and indoor-outdoor temperature differences.

REFERENCES

1. Beizaee, A., Allinson, D., Lomas, K. J., Foda, E., & Loveday, D. L. (2015). Measuring the potential of zonal space heating controls to reduce energy use in UK homes: The case of un-furbished 1930s dwellings. *Energy and Buildings*. 92, 29-44.

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