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The distribution of air leakage in a dwelling - a brief review

by

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TECHNICAL NOTE

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A current problem in air infiltration research is to assess the relative importance of components of a building shell as sources of infiltrating air. The true proportions of infiltration through each component can, in theory, be found using a tracer gas to measure the ventilation rate in a building then repeating with individual components sealed. Unfortunately these measurements are prone to error and highly dependent on the weather. Hunt (1) found that sealing obvious sources of infiltration reduced the measured air change rate by an amount within the error boundaries of the original measurements. However, Gale (2) has had some success with this technique.

An alternative technique was suggested by Georgii (3) who proposed measuring the decay of carbon dioxide and an aerosol simultaneously in a room. The aerosol would give the ventilation through clefts and chinks and carbon dioxide decay would give the whole ventilation, including diffusion through walls.

Another measure of the distribution of infiltration is the ventilation rate in a loft. Gale (4) used two tracer gases to measure the proportion of air leaving a house through the loft. He found that, in an English 4-bedroomed detached house, 50—80% of the air leaving the house does so through the loft, and that in a low-energy house with a lower overall ventilation rate the proportion was from 60% to over 95%.

Given the lack of success with tracer gas measurements, researches have fallen back on pressurization methods. One method, used by Shaw (5), is to pressure test each component (window, wall, door, etc.) separately and use the results to assess the comparative leakage of each component. The other, and more generally used method is to pressurize the whole building and then to seal each component in turn and measure the new leakage. This latter method has been used by McIntyre and Newman (6), Shaw (5, 7), Tamura (8), Tietsma (9), Hunt (10) and Caffey (11). Shaw (5) used both methods and found good correlation between them. The results of all these tests are summarised in Table 1.

However, measuring the leakage of a component under a high, steady, uniform pressure will not necessarily give a good estimate of the amount of air infiltrating under small irregularly distributed and fluctuating pressure differences. Pressure tests will not therefore provide a direct indication of the magnitude of natural air infiltration through the various leakage paths. Models for calculating air infilatration rates using data from pressure tests are being developed by Grimsrud (12), Tamura (13) and Blomsterberg (14).

Nusgens and Guillaume (15) have used a combination of tracer gas and pressurization to find the proportion of air infiltrating through windows. The windows in two houses were pressure tested and the air-change-rate of the house measured with tracer gas. Wind speed and direction were recorded and these records used to calculate a wind pressure coefficient for each window and hence the air flow through each window. As the authors themselves remark, the problem is that actual wind pressures fluctuate continually and so a mean coefficient is unrepresentative of the actual situation.

Researcher	Country	Type of dwelling	No. tested	Method	Results	
Gale	Britain	4-bedroomed detached house	1	Tracer Gas	Windows and doors Flow through loft	30—45% 40—80%
		Low-energy terraced house	1	Tracer Gas	Flow through loft	60—95%
McIntyre and Newman	Britain	Semi-detached house	1	Pressurization	Windows and back door	40%
		Experimental house	1	Pressurization	Suspended floor Stackpipe casing (windows sealed)	35% 10%
Shaw	Canada	Multi-storey apartment buildings	5	Pressurization	Windows Floor-wall joint	22—71% 29—78%
		School	11	Pressurization	Air intake and exhuast Windows and doors	15—43% 4—10%
Tamura	Canada	Bungalow	4	Pressurization	Windows and doors	19—24%
		2-storey house	2	Pressurization	Windows and doors	15—23%
Hunt	U.S.A.	3rd floor apartment	1	Pressurization	Doors, windows and fireplace	12—18%
		4-bedroomed townhouse	1	Tracer Gas	—	
Tietsma and Peavy	U.S.A.	Mobile home	1	Pressurization	Wall (including window)	40%
Caffey	U.S.A.	Various designs	50	Pressurization	Soleplate Electrical wall outlet Duct system Windows	25% 20% 14% 12%
Nusgans and Guillaume	Belgium	Detached house	2	Pressurization and Tracer Gas	Windows (house one) Windows (house two)	8.9% 32.9%

Table 1: Summary of Test Results

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