Comparative Ventilation Openings Of Various Window Types

Breezway Technical Bulletin

The Window Energy Rating Scheme (WERS) has done a good job of establishing a fair, rigorous and credible system for assessing some of the energy efficiency measures of Australian window systems. These ratings facilitate accurate energy ratings of buildings and effective comparisons between various window systems.

WERS ratings list the U-value, SHGC, visible light transmittance and air infiltration of each window system, all of which are measures of a window system's performance while in the closed position. One of the primary functions of a window though is to open up to allow fresh air into a building to maintain indoor air quality and to naturally cool the building. The National Construction Code (NCC) recognises this and legislates minimum ventilation opening areas to maintain indoor air quality in habitable rooms in section 3.12.4.1 (Volume Two) and recognises the cooling benefits of larger ventilation openings in Table 3.12.2.1 (Volume Two).

A fair, rigorous and credible system of comparing the ventilation openings offered by Australian window systems is required to allow compliance with the NCC to be assessed and to allow comparison between the cooling ventilation benefits offered by various window systems.

Methodology

1. Existing methodologies.

A search for a method of determining the ventilation opening of a window system revealed the following:

a. The NCC stipulates in 3.8.5.2(a) that the ventilation opening of a window is the openable size of the window and not the overall window size. No advice is given on how to treat sashes that obstruct air flow.

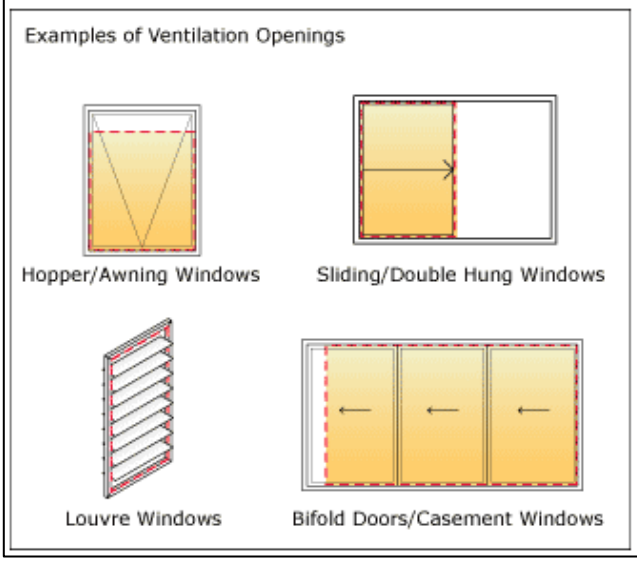
b. The BASIX website includes pictorial examples of the ventilation openings of various window types in the "Help" section, but gives no guidance is given on how to treat sashes that obstruct air flow.
(https://www.basix.nsw.gov.au/help/Thermal_comfort/Simulation_method/Cross_ventilation/Ventilation_opening.htm

What is a Ventilation opening?

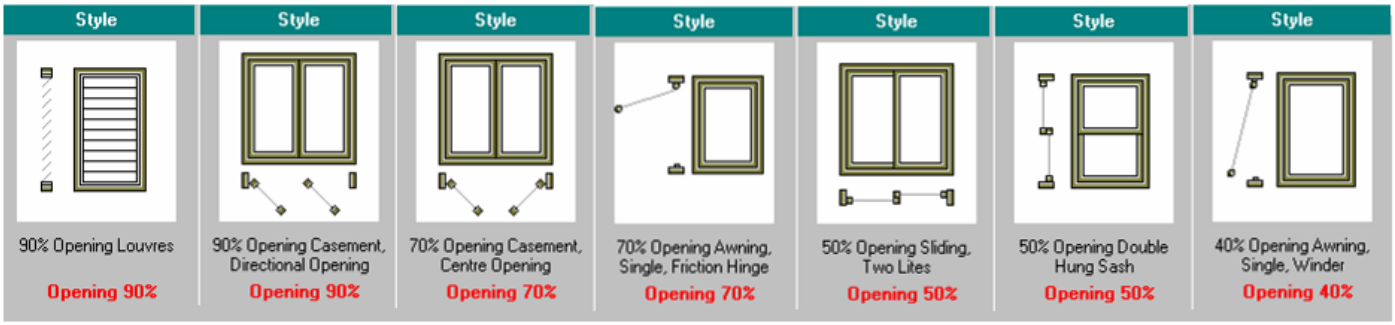
BASIX definition

Ventilation opening means an opening in the external wall, floor or roof of a building, room or area, designed to allow air movement into or out of the building, room or area by natural means, including a door (but only a door which opens onto private open space), window, or other device which can be held open.

Front doors are not considered a ventilation opening as they generally do not open onto private open space. Front doors cannot be used to comply with the cross ventilation criteria.



c. BERS Pro and other House Energy Rating Software packages make assumptions regarding the ventilation openings of various window types. No indication is given on how the ventilation openings were calculated.



2. Standardised model sizes.

WERS models window systems at the defined NFRC 100 model sizes for the window type. The resultant ratings are applied to that window system regardless of the actual size of the window. Hardware limitations cause some window types to require a mixture of fixed panes and operable sashes above certain sizes. When only considering the U-values and the SHGCs, applying the rating results at NFRC 100 model sizes to much larger actual window sizes remains fairly accurate. However, when considering ventilation, fixed panes (which clearly allow no ventilation) will significantly impact the performance of large windows.
Both the NFRC 100 model sizes and larger typical window sizes (2100h x 2400w) were used for the following calculations of the ventilation openings of various window systems.

3. Treatment of operable sashes.

The operable sashes of some window types are unaffected by wind direction. For example sliding windows, double hung windows and louvre windows.
The operable sashes of other window types may increase or decrease airflow depending on the wind direction. For example, the sashes of casement windows may either catch the wind and funnel it through the window opening, or the sashes of casement windows may shield the window opening, thereby reducing the amount of air flowing through the window.
The effect of wind direction on awning windows is difficult to predict. For example, wind blowing obliquely against an awning window may simultaneously funnel air into the window on the windward side of the sash while also sucking air out of the wind on the leeward side of the sash.
In order to remove uncertainty over the effects of wind direction, air movement directly perpendicular to the window has been assumed. It has therefore been assumed that air flow will occur through all portions of the window area that provide unimpeded views (views through glass were considered as being impeded) when viewed perpendicularly to the wall into which the window is installed.
Based on these assumptions, the operable sashes of some window types do not impede air flow when the window is opened. An example would be a sliding window where the sash sits behind the fixed pane when the window is fully open.
The operable sashes of other window types only minimally impede air flow when the window is opened. An example would be a casement window or a louvre window where the sash or louvre blades are positioned perpendicularly to the window when fully opened.
The operable sashes of awning windows with chain winders will significantly impede air flow when awning windows are opened as the sash covers a significant portion of the window area.

4. Window systems assessed.

A number of major window fabricators with national distribution were selected and assumed to be broadly representative of the Australian window systems.
Aluminium window systems were assessed in line with the dominant market share of aluminium windows in the Australian market.
Sliding Windows, Awning Windows, Double-Hung Windows and Casement Windows were all assessed as these are assumed to be the most popular window types in the Australian market.
Altair Louvre Windows in Breezway Window Systems and in Component Form were also assessed.

Information on the window systems was sourced from supplier websites and technical documentation, in some instances details were queried through the supplier websites. All assumed dimensions have been noted.

For simplicity, the operable sash pivot points were assumed to be at the very top of the head, the overall operable sash height was assumed to be equal to the overall window height and the air flow obstruction of the sill was ignored.

It is considered self-evident that window systems with fixed panes of glass do not allow any ventilation at all.

Results and conclusions.

Window Type	Ventilation Area as % of Total Window Area (Average of windows assessed, to nearest 5%)*	
	NFRC 100 Model Sizes	Common Window Sizes
Fixed Window	0%	0%
Awning Window (Chain Winder)	10%	1%
Double Hung Window	40%	20%
Sliding Window	40%	25%
Casement Window	80%	30%
Louvre Window	75%	80%**

Window type has a massive impact on the amount of ventilation that a window will provide for cooling and indoor air quality.
Replacing sliding windows with identically sized louvre or casement windows will almost double the amount of ventilation, and replacing awning windows with identically sized louvre or casement windows will increase the total ventilation by over 600%.

*See Appendix A for detailed results of ventilation area calculations.
**Larger Altair Louvre Windows can achieve up to 90% ventilation.

Window Type	Window System	NFRC 100 Model Size					Typical Window Size				
		Window Size (h x w)	Total Window Area	Window Config	Ventilation Area	Ventilation Area (% of Total Window Area)	Window Size (h x w)	Total Window Area	Window Config	Ventilation Area	Ventilation Area (% of Total Window Area)
Fixed Window	Any	1500 x 1200	1.80m²	X	0.00m²	0%	2100 x 2400	5.04m²	XXX XXX	0m²	0%
Awning Window (Dual)	Window 1	1200 x 1500	1.80m²	XO	0.05m²	3%	2100 x 2400	5.04m²	OXO XXX	0.05m²	1%
Awning Window (Single)	Window 2	600 x 1500	0.90m²	O	0.10m²	12%	2100 x 2400	5.04m²	OXO	0.03m²	1%
	Window 3	600 x 1500	0.9m²	O	0.07m²	8%	Not available at this size.				
	Window 4	600 x 1500	0.9m²	O	0.10m²	12%	2100 x 2400	5.04m²	XOX XXX	0.02m²	0%
Double Hung Window	Window 5	1500 x 1200	1.80m²	O	0.77m²	43%	2100 x 2400	5.04m²	OXO XXX	0.96m²	19%
	Window 6	1500 x 1200	1.80m²	O	0.74m²	41%	Insufficient information available.				
Sliding Window	Window 7	1200 x 1500	1.80m²	XO	0.77m²	43%	2100 x 2400	5.04m²	OXXO XXXX	1.36m²	27%
	Window 8	1200 x 1500	1.80m²	XO	0.74m²	41%	2100 x 2400	5.04m²	XOOX XXXX	1.31m²	26%
	Window 9	1200 x 1500	1.80m²	XO	0.76m²	42%	2100 x 2400	5.04m²	OXXO XXXX	1.35m²	27%
Casement Window	Window 10	1500 x 600	0.9m²	O	0.72m²	80%	2100 x 2400	5.04m²	OOO XXX	1.74m²	35%
	Window 11	1500 x 600	0.9m²	O	0.72m²	80%	Insufficient mullion information available.				
	Window 12	1500 x 600	0.9m²	O	0.70m²	78%	Not available at this size.				
	Window 13	1500 x 600	0.9m²	O	0.70m²	78%	2100 x 2400	5.04m²	OOO XXX	1.72m²	34%
Louvre Window	Altair Louvre in Easyscreen Window System	1500 x 600	0.90m²	O	0.69m²	77%	2100 x 2400	5.04m²	OOO	3.68m²	82%
	Altair Louvre in SL2 Window System	1500 x 600	0.90m²	O	0.67m²	74%	2100 x 2400	5.04m²	OOO	3.67m²	82%