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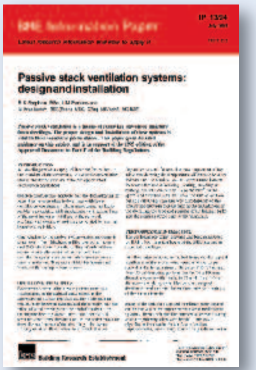
INTELLIGENT NATURAL VENTILATION

A LOW ENERGY STRATEGY

Human production of greenhouse gases, primarily CO_2, is changing the world's climate. 50% of CO_2 emissions in the UK derive from energy consumption in buildings. Heating and cooling can account for more than 50% of this energy requirement. A well controlled and energy efficient ventilation system for dwellings is therefore a prerequisite for low energy consumption and a substantial reduction in CO_2 emissions.

Glidevale *i*PSV® - intelligent passive stack ventilation - is one of the most sustainable and environmentally friendly domestic ventilation strategies available. It provides numerous 'green' benefits compared with mechanical ventilation heat recovery (MVHR) or other mechanical systems. The *i*PSV system was first launched in 1984 and many tens of thousands of systems have been sold since under Passivent, a sister company of Glidevale.

BRE IP 13/94 PASSIVE STACK VENTILATION SYSTEMS. DESIGN AND INSTALLATION



This authoritative document was first published in 1994 to support Part F of Building Regulations 1995 and was the culmination of extensive research work going back to the 1980s.

During the heating season, and under normal UK weather conditions, the ducts will allow warm moist air from the 'wet' rooms of the dwelling to be vented directly outside. The airflow rate in each duct will depend on several factors, the most important at low wind speeds being the temperature difference between indoors and the outside. As the temperature indoors increases, because of cooking, heating, washing or bathing, the airflow rate will also increase. Wind speed and direction also influence the rate of air flow but in a relatively complex way that depends on the interaction between factors such as the airtightness of the dwelling and the position of the duct outlet terminals.

The document also refers to ‘controlled psv systems’. It states: “For the purposes of energy conservation, controlled psv systems should be provided so that they can be closed when the moisture has been removed. This may be achieved by means of manual and/or automatic sensors or controllers.” It goes on to state: “Any alternative design solutions should be shown, for example by experimental or field data, to perform in an equivalent manner to systems described in this guide.”

This was the first recognition that intelligent passive stack ventilation had energy saving benefits over standard systems and over the years since, as buildings have become more airtight and insulation levels have also improved, *i*PSV has become more important than ever.

The document was ground breaking and is still widely referenced including in current Building Regulations, particularly for installation advice, and so retains a significant relevance.

BUILDING REGULATIONS RECOGNITION SINCE 1995

Efficient and effective ventilation is mandatory under current building regulations for modern airtight dwellings and to meet the increasingly important need for energy conservation.

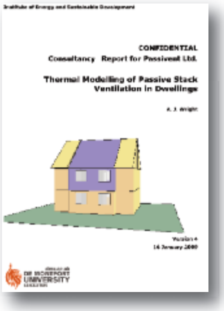
Glidevale’s *i*PSV solution allows the most up-to-date ventilation requirements to be met with ease.

True values of PSV performance, particularly with intelligent control, are now recognised and substantiated by the latest versions of the authoritative documents:

- Approved Document F1 for ventilation for England and Wales.
- Technical Handbook Domestic Section 3 for Scotland.
- Technical Booklet K for Northern Ireland.
- Technical Guidance Document Part F for Republic of Ireland.
- BRE IP 13/94 Passive stack ventilation systems design and installation.
- The latest SAP 2012 software for assessing energy performance.
- BBA certification for Glidevale *i*PSV is a recognised ‘Alternative Approach’ to building regulations compliance in England, Wales, Scotland and Northern Ireland.

BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE 95/3273

INDEPENDENT RESEARCH / VENTILATION PERFORMANCE OF *i*PSV SYSTEMS



In 2010 the Institute of Energy and Sustainable Development at De Montfort University conducted two thermally modelled studies in to the performance of the *i*PSV system within a modern mid terrace property using IES VE software.

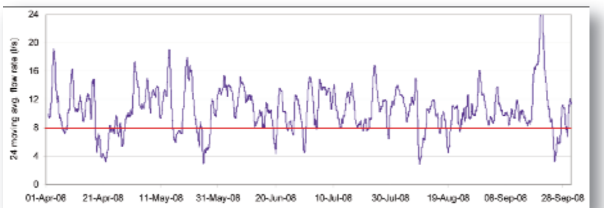
ApacheSim was used for thermal simulation and Macroflow for air flow. This was to address two regularly raised concerns regarding the use of passive stack ventilation as a strategy for ventilation in properties:

1. **Will passive stack ventilation perform adequately in 'unfavourable conditions' of the summer when the temperature differential is at its lowest?**
2. **Will passive stack ventilation work with increasingly airtight properties?**
3. **Will a passive stack deliver the minimum high rate of flow for continuous extraction systems as set out in Approved Document Part F?**

In summer months

When external temperatures are higher, the passive stack effect is reduced but Glidevale *i*PSV has been shown to work effectively even in these conditions. The IESD study, conducted between 1st April and 30th September using weather data from Manchester test reference year 2008, showed that the 24hr average ventilation rate from an upstairs bathroom to a ridge mounted terminal was 12.1 litres per second with a building designed airtightness of 3m³/hr/m². It further showed that during the same period, the ventilation rate only fell below 8 litres per second for around 18% of the time. This is understandable and is due to the intelligent passive stack inlets and extracts reducing in ventilation area, so slowing down the extract rate when not required, thereby saving energy.

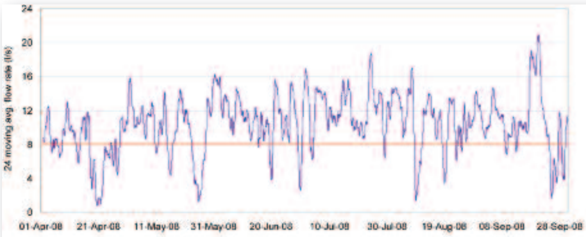
This was based on Glidevale humidity-sensitive wall and/or window inlets in the habitable rooms as stated in BBA certificate 96/3273, the windows in the dry rooms being opened intermittently (as would be likely some of the time in summer months), and the bathroom door being closed three times a day during periods of high humidity gain but otherwise being open.



Graph of 24hr average stack flow from *i*PSV bathroom - in summer months

With airtight buildings

The building airtightness was set at 0m³/hr/m² which is not currently a regularly achieved level for most properties, and the simulations re-run. This showed that whilst the ventilation rate had reduced as would be expected, it was still at a 24hr average of 11.30 litres per second albeit that the ventilation rate fell below 8 litres per second for around 24.7% of the time.



Graph of 24hr average stack flow from *i*PSV bathroom - with airtight buildings

The claim that passive stack would be inadequate in very airtight buildings is not shown to be the case by thermal / flow modelling. This modelling undertaken could be regarded as a worst case scenario as it was only for a summer period when flows due to buoyancy effects / temperature differentials may be reduced compared to wintertime.

Minimum high flow rates for continuous extract systems

Approved Document F sets a minimum high flow rate of 8 litres/second for bathrooms, utility rooms and sanitary accommodation in continuous extraction systems. It also sets a rate of 13 litres per second for kitchens.

The modelling undertaken by De Montfort University shows a 24hr average flow rate of circa 11.0 litres per second for bathrooms on the first floor of a dwelling. The stack height in this instance was 3.0m in height.

It is common knowledge that the longer the stack, the more efficient the flow rate. Based on the table below for a kitchen stack of circa 5m the flow rate will be in the region of a 24hr average of 14-16 litres per second in continuous extraction systems.

	Flow rate in litres/sec				
	Temperature difference (°C)				
Stack height	25°C	20°C	15°C	10°C	5°C
5 metre	21	19	16	14	10
4 metre	19	17	15	12	9
3 metre	16	15	13	11	8
2 metre	13	12	11	9	6
1 metre	10	9	8	6	4

The above table is based on straight duct runs and 125mm diameter ducting. The use of swept elbows up to 45 degrees are permitted but will reduce the ventilation effectiveness.

ENERGY CONSUMPTION AND CARBON PRODUCTION

The second study undertaken was to compare the likely energy consumption and carbon production resulting from that energy consumption in domestic dwellings fitted with a range of ventilation schemes to control moisture resulting from cooking, washing and other domestic activities.

This was to address a concern regarding the use of passive stack ventilation as a strategy for ventilation in properties:

1. **Why do standard PSV systems perform less well when assessed in SAP when compared to MVHR and most other systems that use fan energy?**

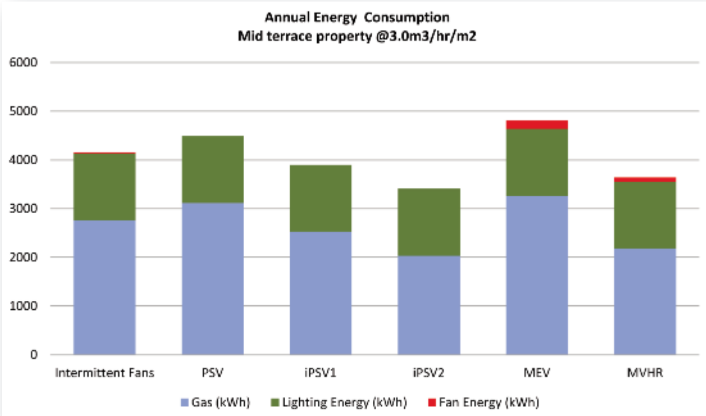
The ventilation systems investigated were:

- Intermittent fans
- Standard passive stack ventilation (PSV)
- Intelligent passive stack ventilation with standard air inlets (*i*PSV1)
- Intelligent passive stack ventilation with humidity sensitive air inlets (*i*PSV2)
- Whole-house mechanical extract system (MEV)
- Mechanical ventilation heat recovery (MVHR)

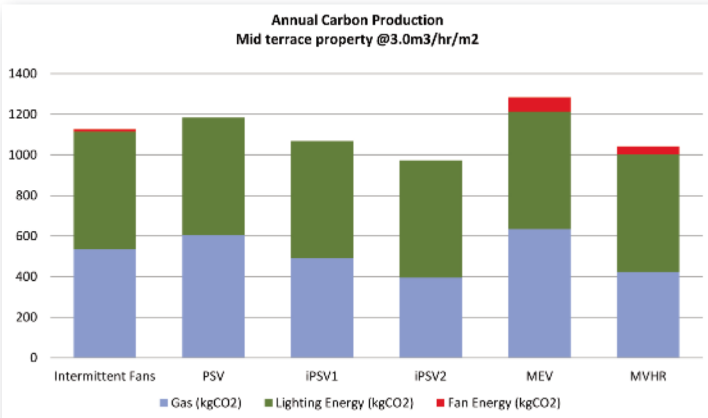
The study did indeed agree with SAP that the standard PSV system was not as energy efficient as it might first appear. It can be clearly seen from the above of the benefit of *i*PSV when compared to standard PSV in terms of the additional energy required to heat the building in winter due to the permanently open air extracts.

Whilst some users will opt for standard air inlets when using *i*PSV, the further advantage of using humidity-sensitive air inlets (*i*PSV2) can also be seen achieving a lower overall energy consumption and carbon production when compared to MVHR. This is recognised in the Scottish Regulations in Technical Handbook 3 which specifically requires any passive stack ventilation system to have "ceiling mounted automatic humidity sensitive extract grilles that will operate when the relative humidity is between 50 and 65%."

The comparative annual energy consumption were as follows split down by gas used for heating, fan energy where used and lighting energy:



The associated carbon production levels were as follows:



LONG-TERM COST BENEFITS OF *i*PSV

Glidevale *i*PSV provides significant savings in equipment replacement costs over the life of the system. A passive stack ventilation system will last the planned life of a dwelling (source: Energy Saving Trust and BBA). This is because there are no electrical components requiring maintenance and replacement. With all other ventilation systems, electrical fans are used, which have finite motor lives and will require periodic replacement. Replacements cost money. They also require energy to manufacture, so there is an additional carbon emission factor.

Installed and cumulative costs

The initial cost of an *i*PSV system is dramatically lower than other continuous ventilation strategies and comparable in cost to intermittent extract fans.

The table below shows the cumulative costs associated with each ventilation strategy over a 30 year lifespan including both replacement and maintenance costs. *i*PSV offers the most cost-effective ventilation solution.

The table has been broken down into initial costs, replacement costs and ongoing maintenance costs. In regard to maintenance costs, extract fans have a zero value as they are required to be changed every five years and it is anticipated that no maintenance would be carried out on them during this time. The costs for *i*PSV is for cleaning of the extract units in the 'wet' rooms.

Cumulative costs over 30 years life

All cost figures are in £ at current prices

	*i*PSV	MVHR	Extract fans	MEV
Initial costs				
Parts	300	1500	90	625
Background vents	100	0	140	40
Installation	245	500	270	400
Total initial costs	£645	£2000	£500	£1065
Replacement costs				
Fan motor life	n/a	10 years	5 years	5 years
Replacements required	0	3 no	6 no	6 no
Replacement unit cost	0	1000	90	250
Installation cost	0	225	270	200
Total replacement costs	0	£3675	£2160	£2700
Maintenance costs				
Service cost	50	150	0	100
Number of services	6	30 no	0	30 no
Total maintenance costs	£300	£4500	0	£3000
Cumulative cost over 30 years	**£945**	**£10,175**	**£2660**	**£6765**

Other white papers from Glidevale include:

BS 5250:2011 Control of condensation in buildings

Roof ventilators & terminals: fire performance

Important information on the use of internally installed roof underlay lap ventilators

Other products:

Glidevale markets a range of other products including:

Ground floor gas and damp protection barriers.

Cavity trays and preformed DPCs.

Universal in-line tile & slate ventilator range.

In-line tile, slate & ridge tile ventilators.

G Range tile & slate ventilators.

Versa-Tile G5 ventilator / terminal.

Abutment ventilation systems.

Eaves & low level ventilation systems.

Loft access traps / ladder.

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