DrillVent – Design study on timber frame cavity ventilation

Foreword

It is clear from study and research into timber frame cavity ventilation, that the drainage and ventilation of the cavity of timber framed structures is of paramount importance when it comes to ensuring the longevity of the primary structural element of the building: i.e. the timber frame itself. As the ventilation of timber framed cavity walls is of such importance, it would be reasonable to expect that the reasonability for providing correct cavity ventilation and installing cavity ventilators should be stand-alone task and not left to chance or an item on a snag-list.

Research and lessons learnt has identified the need for the drainage and ventilation of the cavity space, however there is very little information about the likely ventilation and airflow requirement in the cavities wall of real buildings. There are many examples of costly structural and cosmetic defects and failure contributable to the lack of drained and ventilated cavity as well as the devastating effects dry rot can do to timber once it takes hold. (See: Leaky Condo syndrome) "*The investigation concluded that rain screen wall assemblies, i.e. a ventilated and drained cavity between the stud walls and external cladding, offered the most robust resistance to fungal decay…*"

Regulations and guidance identifies that the drainage and ventilation of the cavity is vital to ensure a long life and that this important element should not be ignored. Although regulation may differ slightly from area to area, it is clear that vents should be installed inorder to provide the necessary drainage and ventilation to the cavity.

It is known that ventilation is primarily driven by a combination of wind pressure and thermal buoyancy. The provision of vent openings at the top and bottom of the wall will generally allow the most ventilation by these mechanisms. Unfortunately, there is no finite guidance with respect to the volume of ventilation required to ensure the longevity of the timber structure and associated components. Our desk study set out to identify what comparisons could be drawn between current regulation, the use of standard commercially available perpvents for cavity ventilation and the performance of a DrillVent. This would identify the best spacing of the DrillVent's in order to achieve compliance with current regulations from area to area.

Desk Study

Design Study 1. *"The cavity shall be ventilated by means of open perpend joints at the top and bottom of the wall. There shall be at least one open perpend joint for every 1.2 m length of wall."*

Open Perp

- An open perpvent/weep is considered to be equal to 650mm^2. (10 X 65 x 90)
  Research, conducted by Straub,J.F and Burnett,E.F.P. identified the likely air flow thru this uninterrupted opening would be to the order of 0.62L/second or 2.16M^3/Hr at a 1Pa pressure difference. Using a typical building elevation, where by the cavity volume would be equal to 3.4M^3, in order to achieve a ventilated cavity, 9 high level and 9 low level open perpvents are installed at 1200mm intervals. The cavity, in this instance would experience a ventilation rate of 11.4 air changes per hour (Ach) **Refer: Drawing example 1A.**

Cavity volume = 3.4M^3, (a)	(b) x (c) = 33.88 M^3/Hr@1Pa (d)
Open perpend = 2.16M^3/Hr@1Pa (b)	
Vents installed = 18 (c)	(d) / (a) = 11.4 Ach /Hr@1Pa

The cavity has been drained and ventilated in compliance with the above regulation. It is noted that this is an ideal instance where each of the 18 open perpvents are perfectly formed and free from blockages, however unlikely this may be.

Weepvent

- Using a traditional proprietary ventilators, where by the average free area is a nominal 240mm^2 and the flow rate is expected to be in the order of 0.20M^3/Hr. 52 number weepvents would be required to be installed in order to comply with the same regulations on the same typical building elevation example. **Refer: Drawing example 1B.**

Cavity volume = 3.4M^3, (a)	(b) x (c) = 10.30 M^3/Hr@1Pa (d)
Perpend Weep = 0.20M^3/Hr@1Pa (b)	
Vents installed = 52 (c)	(d) / (a) = 3.06 Ach /Hr@1Pa

It is assumed in this instance, however unlikely this may be, that each of the 52 weepvents that have been installed are free from defects, deformation or blockages.

DrillVent

- Again, using the same typical building elevation example, 28 number DrillVent's were installed at centre's of 750mm. Each DrillVent, as tested by BRE (Building Research Establishment) would achieve an air flow rate of 1.40M^3/Hr at a comparable air pressure difference of 1Pa. In this instance, the cavity would experience a ventilation rate of 11.5Ach. **Refer: Drawing example 1C**

Cavity volume = 3.4M^3, (a)	(b) x (c) = 39.20 M^3/Hr@1Pa (d)
DrillVent Ave. = 1.40M^3/Hr@1Pa (b)	
Vents installed = 28 (c)	(d) / (a) = 11.5 Ach /Hr@1Pa

It is noted that once the hole is cored thru the outer leaf of block work or brickwork and with the DrillVent inserted, the primary objective of providing cavity ventilation has been achieved. Once installed, DrillVent's flow rate will remain comparable with the "as tested" air flow rate. There is little chance that the DrillVent can become blocked from dropping mortar spoil from within the cavity as they are installed upon completion of the external leaf of the cavity wall.

Design Study 2. *"Open perpends to ventilate and drain cavity, spaced at max 1.5 m centres".*

Open Perp

- Open perpvents are installed as per design study 1. In this instance, 14 number open vents are installed at high and low levels and at centres no greater than 1500mm. The cavity will experience a ventilation rate of 8.9 Ach. **Refer: Drawing example 2A**

Cavity volume = 3.4M^3, (a)	(b) x (c) = 30.24 M^3/Hr@1Pa (d)
Open perpend = 2.16M^3/Hr@1Pa (b)	
Vents installed = 14 (c)	(d) / (a) = 8.9 Ach /Hr@1Pa

Weepvent

- 38 number proprietary ventilators, with a nominal free area of 240mm^2 are installed at centres of 550mm in order to comply with the regulation. In this instance, the combined airflow would be expected to be in the order of 7.6 M^3/Hr@1Pa and the cavity would experience a ventilation rate of 2.26 Ach. **Refer: Drawing example 2B**

Cavity volume = 3.4M^3, (a)	(b) x (c) = 7.6 M^3/Hr@1Pa (d)
Perpend Weep = 0.20M^3/Hr@1Pa (b)	
Vents installed = 38 (c)	(d) / (a) = 2.26 Ach /Hr@1Pa

DrillVent

- 22 number DrillVent's are installed at centres of 1000mm. In this instance, the combined airflow would be expected to be in the order of 30.8 M^3/Hr@1Pa and the cavity would experience a ventilation rate of 9.05 Ach. **Refer: Drawing example 2C**

Cavity volume = 3.4M^3, (a)	(b) x (c) = 30.8 M^3/Hr@1Pa (d)
DrillVent Ave. = 1.40M^3/Hr@1Pa (b)	
Vents installed = 22 (c)	(d) / (a) = 9.05 Ach /Hr@1Pa

Design Study 3. "*Cavities should be vented to the outside air by installing ventilators with at least 300^2 mm free opening area at 1.2 m maximum centres"* In this instance, vents are installed at both high and low level in order to avail of the benefit from the stack effect. It is accepted that the cavity would be considered, in this instance as slightly ventilated as described in *BS EN ISO 6946*. "*A slightly ventilated air layer is one in which there is provision for limited air flow through it from the external environment by openings within the following ranges: > 500 mm^2 but < 1 500 mm^2 per m length for vertical air layers"*

Open Perp

- 10 number open perpvents are installed at centres of 2400mm. It is noted that this spacing is excessive, particularly for cavity drainage and unlikely to be specified. However this comparison is used in order to maintain consistency with design study 1 and 2 where by 300mm^2 is divided into 1200mm and multiplied by 650mm^2, the free opening size of open perpvent. It is accepted that the answerer requires the vents to be installed at 2600centres but in order to fit a row of 5 vents at high and low level, 2400mm is used. In this instance, the combined air flow rate thru 10 vents would be expected to be in the order of 21.6 M^3/Hr and the 3.4 M^3 cavity would experience a ventilation rate of 6.88 Ach. **Refer: Drawing example 3A**

Cavity volume = 3.4M^3, (a)	(b) x (c) = 21.6 M^3/Hr@1Pa (d)
Open perpend = 2.16M^3/Hr@1Pa (b)	
Vents installed = 10 (c)	(d) / (a) = 6.88 Ach /Hr@1Pa

Weepvent

- 22 number proprietary ventilators, with a nominal free area of 240mm^2 are installed at centres of 960mm in order to comply with the regulation. In this instance, the combined airflow would be expected to be in the order of 4.4 M^3/Hr@1Pa and the cavity would experience a ventilation rate of 1.29 Ach. **Refer: Drawing example 3B**

Cavity volume = 3.4M^3, (a)	(b) x (c) = 4.4 M^3/Hr@1Pa (d)
Perpend Weep = 0.20M^3/Hr@1Pa (b)	
Vents installed = 22 (c)	(d) / (a) = 1.29 Ach /Hr@1Pa

DrillVent

- 18 number DrillVent's are installed at centres of 1200mm. In this instance, the combined airflow would be expected to be in the order of 25.2 M^3/Hr@1Pa and the cavity would experience a ventilation rate of 7.4 Ach. **Refer: Drawing example 3C**

Cavity volume = 3.4M^3, (a)	(b) x (c) = 25.2 M^3/Hr@1Pa (d)
DrillVent Ave. = 1.40M^3/Hr@1Pa (b)	
Vents installed = 18 (c)	(d) / (a) = 7.4 Ach /Hr@1Pa

The following averages are calculated from the results of design study 1, 2 and 3.

An average of 14 open perpvent achieves an average ventilation rate of 9.06 Ach.
An average of 38 proprietary ventilators achieves an average ventilation rate of 2.2 Ach
An average of 22 DrillVent's achieves an average ventilation rate of 9.32 Ach

Conclusion

Although regulations from area to area appear to differ slightly, the ventilation effect on the cavity on a timber frame structure, as demonstrated, will vary even more so with a range of cavity ventilation rates from 6.88 to 11.4 Ach. The average ventilation rate of 9.06 Ach appears to be consistent with the general understanding that a ventilated cavity will experience a ventilation rate of between 5 and 10 air changes per hour.

The effective ventilation properties of the perpend weep vent example used in this desk study, appears to be more dramatic with consistent underperformance across the 3 design studies. This desk study highlights serious concerns with the use of weepvent ventilators for the ventilation of timber frame cavities. It is acknowledged that the weepvent example used in this design study is a generalised example, based on a weepvent with a nominal 240mm^2 of measured free space with anticipated airflow of 0.20 M^3/Hr@1Pa.

There are a considerable number of commercially available weep ventilators been used for the ventilation of timber frame cavity walls. It is fair to assume that some ventilators will fair better than the example used here, and others that will not. Weep ventilators that conform to EN 13141-1:2004 will clearly identify the flow rates of the vent and moreover the effective ventilation properties.

DrillVent has been tested to conform with EN 13141-1:2004. **Refer: BRE Appendix A**
The effective ventilation properties of the DrillVent, considerably outperforms that of a traditional weepvent and compares closest with that of an open perpvent. **Refer: Graph Appendix B**
Moreover, as Drillvent is installed following the completion of the outer leaf of the cavity wall, the effective ventilation properties remain consistent with the "as-tested" results.

To coin a phrase, "Not all vents are equal, some are more equal than others". This rings true when you read the definition of **Free Area**. The physical size of the ventilator has little to do with its ventilation ability. The more complex/restrictive the design, the more turbulent the airflow. As weepvents are installed in association with wet trades e.g brick/block layers, render and dry-dash application, there is an increased risk of the weepvents becoming damaged and blocked. This can have an even more dramatic effect on the already reduced performance of the weepvent.

DrillVent's uncomplicated, back to basics design is clearly the way ahead for the ventilation of timber framed cavity walls. Cavity ventilation can be provided exactly where it is needed and not reliant on the position of the perp's. The ability to retrospectively install DrillVent's with ease and speed, will undoubtedly avert the onset of dry rot owing to poorly drained and ventilation cavity.