Document One

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Top vented water managed cavities

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Top vented water managed cavities

1. CLIENT

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2. INTRODUCTION

The Ministry of Education has asked BRANZ if walls with top-and-bottom vented wall cavities are more able to manage water leaks than walls with bottom-only vented cavities.

3. EXECUTIVE SUMMARY

Walls with top and bottom vents will typically have more airflow behind the cladding (and so greater potential for ventilation drying) than walls vented only at the bottom. However, there is no field evidence that ventilation drying in walls without top vents is insufficient.

At least two vents are required to provide a path for airflow behind a cladding. In walls with bottom vents, the second 'vent' takes the form of an infiltration path through cracks and gaps that are normally present in the construction. Top venting is one way of more securely engineering this ventilation path.

It is required practice to 'rainscreen' vents (top and bottom) to prevent rain and vermin entry. Also, damp air from the wall cavity must not flow into another construction cavity e.g., a roof space.

4. CAVITY VENTILATION

Residential cavity wall ventilation in the Building Code

New Zealand widely adopted cavity walls after a systemic failure of buildings with 'risky' designs and direct-fixed face-sealed claddings (Department of Building and Housing 2005).

Cavity dimensions and vent areas were simply copied from existing systems and applied to a wider range of claddings, without any real understanding of how these variables influenced wall performance. These dimensions and vent areas are still common practice in the acceptable solution to the New Zealand Building Code clause E2 "External Moisture" (E2/AS1). Since then, we have developed a broader understanding of ventilation drying and its implication to cavity design. The science of ventilation drying allows alternative and possibly more effective vented cavity designs as explained below.

There are two water managed cavity and vent solutions in wide use.

- **High risk applications of sheet and weatherboard claddings** where the cavity is defined in E2/AS1. In this case, the cavity depth must be between 18 and 25 mm and vermin-proofed bottom vents must have an open area of 1000 mm^2/m of wall length. The cladding must be supported on vertical battens and the cavity must not obstruct drainage and ventilation.

- **Brick veneer walls** where cavity depths and vent areas are defined in SNZ HB 4236. Brick veneer walls require a deeper cavity (40 – 75mm to minimise mortar bridging) along with top and bottom vents, each with an open area of at least 1000 mm^2/m of wall perimeter length.

Alternative solutions with a wider range of cavity ventilation options
The science of cavity ventilation has developed to the point where we can compare alternative vent arrangements. Early research in Canada (ASHRAE PR-1091 2001 and Institute for Research in Construction 2002) laid the theoretical foundation for ventilation in wall cavities. Later work (Straube et al 1998 and 2004, Burnett et al 1995, Piñon, J et al 2004) developed an understanding of the drying potential of cavity ventilation. This was validated in NZ by BRANZ (Bassett et al 2005, 2008, 2009). The conclusions of this work are currently being developed for users as a graphical model called WALLDRY-NZ (Bassett et al 2011).

The broad conclusions that relate to vents in water managed cavities are:

Bottom only vented cavities.
Ventilation levels in wall cavities vented at the bottom only have been shown to be at least ten times higher than expected from a single vent (Bassett et al 2005). These fortuitously higher ventilation levels are due to cracks and gaps (air infiltration paths) between cavities and at the head of the cavity.

These accidental infiltration paths significantly add to the drying potential of walls with just bottom vents. It must be recognised that much of the drying performance of these walls rests on an aspect of building quality, finish and material selection. However, these cavities are widely applied in NZ and BRANZ is unaware of any systemic lack of ventilation drying. The practice of bottom-only venting is also common internationally.

Top and bottom vented cavities.
Specific vents at the top and bottom of cavities provide a ventilation path that has been engineered so that it no longer depends on build quality and material choices. Figure 1 (Bassett et al 2009a) compares the ventilation and drying performance of a

number of cavity types averaged over 14 regions in NZ and four wind exposure classes. It shows ventilation rates and the drying potential of these walls tend to be higher than walls that are bottom-only vented. There is therefore a clear advantage of top-and-bottom vented cavity construction so long as the vents can be adequately screened against rain and vermin entry. The other proviso for all wall cavities is that they should not be vented into any other construction cavity e.g., the roof cavity.

Matching cavity drying potential with cladding weathertightness
Theoretically, It might be desired to 'match' the drying potential to rain entry loads. Unfortunately, there is still considerable uncertainty about the rain entry loads that can be expected through claddings. A start has been made for some cladding types (Bassett et al 2011) but considerable more research will be needed.

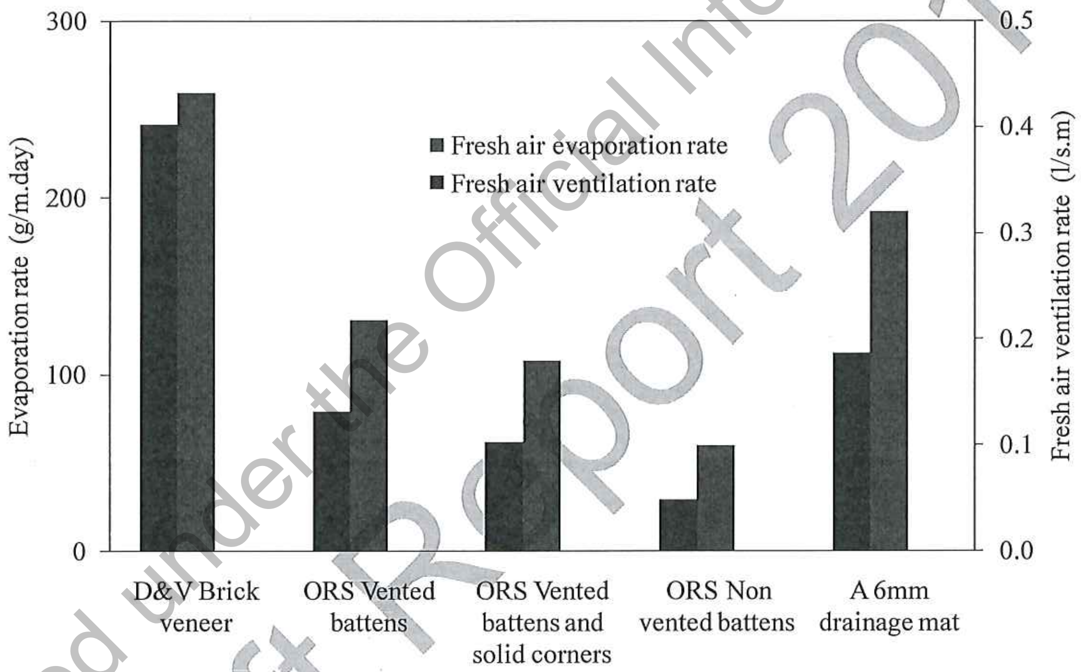

Figure 1: Fresh air ventilation and evaporation rates in five wall types averaged over region and wind exposure classification over a full year (Bassett et al 2009)

5. REFERENCES

ASHRAE RP – 1091 project. 2001. *Development of design strategies for rainscreen and sheathing membrane performance in wood frame walls.* Housing Research Centre at Pen State University, the Building Engineering Group at Waterloo University and the Building Technology Centre at Oak Ridge National Laboratory. www.ASHRAE.org.

Bassett, M.R and McNeil, S. 2005. *Drained and vented cavity walls – Measured ventilation rates.* Proceedings of the IRHACE Annual Conference, Nelson.

Bassett, M.R. and McNeil, S. 2009. *Ventilation rates measured in the wall cavities of high moisture risk buildings.* Journal of Building Physics Vol. 32 No 4 April 2009, Montreal.

Bassett, M.R. & McNeil, S. 2008. *Drying from framing in water managed walls.* 4th International Building Physics Conference, Istanbul, Turkey.

Bassett, M.R, McNeil, S. And Overton. G. 2009a. Ventilation and evaporation rates in wall cavities in New Zealand. Proc 12th Canadian conference on Building Science and Technology. Montreal.

Bassett, M.R., McNeil, S, and Overton, G. 2011. WALLDRY-NZ: An educational tool for rain loads and ventilation drying in cavity walls. Submitted to 5th International Building Physics Conference, Japan.

Davidovic, D., Srebric, J. & Burnett, E.F.P. 2005. Modelling convective drying of ventilated wall chambers in building enclosures. *International Journal of Thermal Sciences* 45: 180-189.

Department of Building and Housing. 2005. *Approved Document E2/AS1 External Moisture.* Wellington, New Zealand.

Institute for Research in Construction. 2002 *MEWS*: Beaulieu, P.; Bomberg, M.T.; Cornick, S.M.; Dalgliesh, W.A.; Desmarais, G.; Djebbar, R.; Kumaran, M.K.; Lacasse, M.A.; Lackey, J.C.; Maref, W.; Mukhopadhyaya, P.; Nofal, M.; Normandin, N.; Nicholls, M.; O'Connor, T.; Quirt, J.D.; Rousseau, M.Z.; Said, M.N.; Swinton, M.C.; Tariku, F.; van Reenen, D. Final Report from Task 8 of MEWS Project (T8-03) - *Hygrothermal Response of Exterior Wall Systems to Climate Loading: Methodology and Interpretation of Results for Stucco, EIFS, Masonry and Siding-Clad Wood-Frame Walls*, Research Report, Institute for Research in Construction, National Research Council Canada, 118, pp. 1 v. November 01, 2002 (RR-118).

New Zealand Standard SNZ HB 4236 2002 Masonry veneer wall cladding.

Piñon, J., Davidovic, D., Burnett, E. & Srebric, J. 2004. *Characterization of ventilation airflow in screen-type wall systems.* Volume 1 of Report #5 of the ASHRAE 1091 project. www.ASHRAE.org.

Straube, J. & Burnett, E. 1998. Drainage, ventilation drying, and enclosure performance. *Proceedings Thermal Performance of the Exterior Envelopes of Buildings VII.* pp.189-197. Clearwater Beach, Florida, USA.

Straube J, Van Straaten, A. & Burnett, E. 2004. *Field studies of ventilation drying.* Thermal 9 Conference, Clearwater Beach, Florida. USA. (ASHRAE 1091 Project).

Burnett, E. and Straube, J. (1995). *Vents, ventilation drying, and pressure moderation.* Canada Mortgage and Housing Corporation, Ottawa.