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Rigid Sheathing and Pressure Equalisation in New Zealand

GE Overton

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Preface

This report forms part of a BRANZ study on the use of rigid sheathing which in turn forms part of the Weathertightness, Air Quality and Ventilation Engineering (WAVE) programme at BRANZ. For more information about WAVE, please visit www.branz.co.nz.

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Abstract

The use of rigid sheathing is increasing in New Zealand construction. One purported benefit of rigid sheathing is that it increases the pressure equalisation performance of the wall, thereby making the wall more weathertight.

Potential urban densification in Auckland may mean typical residential details will be used in taller buildings outside of the current scope of NZS 3604 and E2/AS1. The higher wind pressures associated with taller buildings may mean pressure equalisation determines the performance limit of residential construction details.

This study reviews some of the research on pressure-equalised wall systems and concludes that although there is theoretical support that rigid sheathing will improve pressure moderation, this improvement will only be marginal in typical New Zealand residential construction.

Since pressure differences will exist across the cladding in real situations, knowledge of joint leakage as a function of pressure and rainfall characteristics would be desirable. This could define the performance limit of residential construction details and allow decisions to be made as to whether to include rigid sheathing (from a durability perspective as opposed to a improved pressure moderation) or to change to a different style of construction, e.g. a curtain wall.

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NOMENCLATURE

A = area of opening

Q = volume flow rate

K = discharge coefficient for opening

P_o = atmospheric pressure

$\tilde{R}$ = specific gas constant

V = internal volume

T = temperature

k = stiffness

m = mass

t = time

p = pressure

γ = ratio of specific heats

ρ = density

Subscripts

$_L$= leeward

$_W$ = windward

$_a$ = ambient

$_{ab}$ = air barrier

$_c$ = cavity

$_{cl}$ = cladding

$_{co}$ = initial value in cavity

$_e$ = external

$_i$ = inside

$_o$ = original

$_v$ = vent

1. INTRODUCTION

1.1 Does Rigid Sheathing Improve Pressure Equalisation?

The New Zealand standard for timber-framed construction, NZS 3604, was updated in 2010 and now includes an extra-high wind zone (Standards New Zealand, 2010). To accommodate this, the Department of Building and Housing's compliance document for weathertightness, E2/AS1, states a rigid underlay (or rigid sheathing) must be used in the new wind zone (Department of Building and Housing, 2011).

There is also anecdotal evidence that the use of rigid sheathing is increasing. This may be partly due to the changes in E2/AS1 but also because there are several practical benefits to rigid sheathing including:

- ease of use, especially when dealing with penetrations
- increased durability from "redundancy" in the wall system
- increased robustness of the resultant cavity – less risk of insulation bulging and reducing cavity depth
- the potential to "close-in" the framing earlier
- the potential to remove the air barrier function from the internal lining

Another purported benefit of rigid sheathing is that it also increases the pressure equalisation performance of the wall, thereby making the wall more weathertight. This report reviews previous research on pressure equalisation to determine if there is evidence to support the hypothesis.

The Royal Commission on Auckland Governance suggests there will be a trend towards densification of housing (Salmon et al, 2009). Medium-rise buildings are currently outside of the scope of NZS 3604 and E2/AS1. In the absence of other design guidance, there is a possibility that construction details from E2/AS1 will be used where they are not necessarily suitable.

The higher wind pressures associated with taller buildings may mean pressure equalisation (or the lack of it) determines the limits of residential construction details. If these limits are exceeded then a different type of construction, e.g. curtain wall, may be required to meet E2 moisture requirements.

Rigid sheathing is often referred to as a "rigid air barrier" in New Zealand. This creates a degree of confusion since there is no airtightness requirement in the New Zealand Building Code. Also, overseas, where sheathing is widely used and airtightness is often a requirement, the sheathing is usually not the designated air barrier.

If rigid sheathing is run vertically and battened over the joints, it can potentially form part of an air barrier system and this is the focus of this study. Specifically how is the pressure equalisation performance affected when battened rigid sheathing is used?

1.2 Pressure Equalisation Eliminates a Means of Water Entry

A pressure-equalised wall is one where there is a cavity behind the cladding and the air pressure in the cavity is the same as it is on the outside of the cavity (Garden, 1963). This means there is no pressure difference acting across the cladding which could otherwise drive water through openings.

It is common to design both the cladding and the air barrier to resist the full wind load. A pressure-equalised wall would theoretically reduce the load on the cladding so that cladding fixtures could be optimised resulting in cost savings. This structural aspect of pressure equalisation is outside the scope of this report.

In New Zealand, walls are typically classified into two categories; those with direct-fixed claddings and those with a cavity. However, other countries often differentiate between different types of cavity. The following is adapted from Canada's National Research Council (Baskaran, 1992).

Table 1-1 Different Approaches to Water Management Adapted from Baskaran (1992)

Canadian Terminology	Description	New Zealand Terminology
Face-sealed	A wall system in which rain penetration is prevented by sealing the joints and openings, rather than eliminating the forces that drive the water inwards	Monolithic/ direct-fix (excluding weatherboards)
Cavity wall	Water migration from the building exterior to the interior is diverted by introducing a cavity between the layers. The water entering through the cladding is collected and drained at the bottom of the cavity	Cavity wall
Back-ventilated wall	In this approach, rainwater is allowed through the cladding and no attempt made to minimise the effect of wind pressure differentials. Instead, the cavity behind the cladding is drained. Moreover, circulating air from the bottom to the top of the wall helps the rapid evaporation of any rainwater deposited on the inner leaf	Cavity wall
Open rainscreen/ pressure-equalised wall	An open rainscreen wall is a system composed of two layers, separated by an air space. The air space is deliberately vented to the outside to attenuate the wind-induced pressure differential, one of the major driving forces causing the rain penetration, while keeping the inner part of the wall airtight. Thus the cavity pressure is equalised with the external air pressure through venting	Cavity wall

Using the Canadian terminology, the main difference between a cavity wall and a back-ventilated wall is the presence (or otherwise) of vents at the top of the wall. At BRANZ we have found that with typical New Zealand residential construction, there will be airflow behind the cladding even if there are no specific vents at the top of the wall and the cavity is closed off (typically with a horizontal cavity batten) (McNeil et al, 2007). Therefore there is little difference between a cavity wall and a back-ventilated wall. E2/AS1 (Department of Building and Housing, 2011) actually refers to this type of construction as a drained and vented cavity, even though there is no specific venting other than that at the bottom of the wall.

In typical New Zealand low-rise construction, there is no attempt to pressure equalise the cavity and the airflow behind the cladding provides useful ventilation drying (Bassett et al, 2009). A perfectly pressure-equalised wall is likely to have minimal airflow behind the cladding, thereby reducing the potential for ventilation drying.

1.3 Other Water Entry Mechanisms Exist

A perfectly pressure-equalised wall removes one of the driving forces that causes rain penetration – the pressure difference across the cladding. However there are other forces which can drive water into a wall system (Garden, 1963):

- gravity

- kinetic energy/momentum
- capillary and surface tension effects

Straube (1998) makes the point that if any of these mechanisms are active they decrease the relative contribution to rain control that pressure equalisation can make. In brick veneers, for example, the diffusion of water through cracks and pores in the material is largely insensitive to air pressure, so pressure equalisation is of questionable benefit.

Pressure equalisation is never perfect and should therefore be more correctly called pressure moderation. This lack of perfect pressure equalisation and the fact that other water entry mechanisms are possible means virtually all wall systems need to be able to drain water out of the cavity.

Pressure equalisation only improves performance in walls displaying:

- approximately zero water leakage under zero air pressure difference
- much higher water leakage when there is a higher air pressure difference
- limited capacity for drainage

Straube (1998) summarised this in the form of two conclusions:

- screened wall systems with a water-permeable screen should be designed with drainage and/or storage. Their performance will not be much improved by dynamic pressure moderation
- the rain penetration control of enclosure systems for which both air pressure differences are important rain penetration forces and which have little storage capacity (e.g. EIFS, metal panels, windows, vinyl siding) can potentially benefit from pressure moderation

2. MODELLING OF PRESSURE EQUALISATION

Several mathematical models have been developed to describe the pressure equalisation process. In this section, some of the models that have been developed over the years are reviewed and used to see what impact the incorporation of a rigid sheathing might have on the effectiveness of pressure equalisation.

A more comprehensive review by Suresh Kumar (2000) can be consulted for greater detail.

2.1 Steady State Performance Determined by Area Ratio

Latta (1973) proposed that under steady state conditions, i.e. a constant external pressure, the incompressible continuity equation could be used to describe the pressure drop through a wall system.

The model assumed the wall is simplified to a chamber with all cladding openings lumped together into a single sharp-edged orifice (vent area, A_v) with a similar approach on the air barrier side (leakage area, A_{ab}). See Figure 2-1.

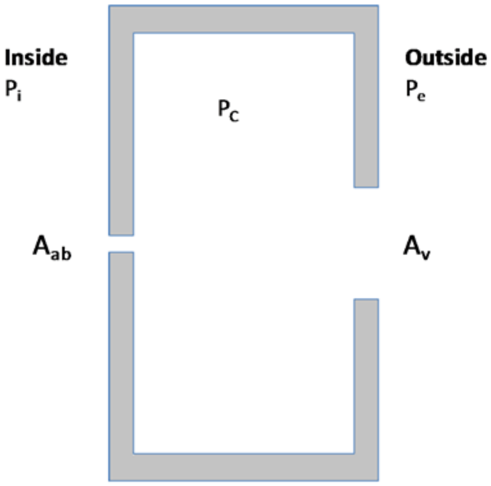

Figure 2-1 Simplified Wall Cavity

The incompressible continuity equation states that the volume flow rate of air through the vent must equal the volume flow rate leaking through the air barrier.

For flow through a sharp-edged orifice:

$$Q = KA\sqrt{\frac{2(\Delta p)}{\rho_a}} \tag{1}$$

Therefore:

$$A_v\sqrt{\Delta p_v} = A_{ab}\sqrt{\Delta p_{ab}} \tag{2}$$

And so:

$$\Delta p_{ab} = \Delta p_v\left(\frac{A_v}{A_{ab}}\right)^2 \tag{3}$$

Or:

$$p_c = \frac{A_v^2 p_e + A_{ab}^2 p_i}{A_v^2 + A_{ab}^2} \tag{4}$$

Equation 3 states that steady state pressure equalisation performance is controlled by the ratio of the venting area to the leakage area. To minimise the pressure difference across the cladding, the leakage in the air barrier should be small compared to the flow through the cladding.

The incompressible continuity equation can also be used for the case where there are more than two openings but it is usually necessary to employ an iterative approach to determine internal pressure.

Key Information

Rigid sheathing can theoretically improve *steady state* pressure moderation performance if it is more airtight than the current air barrier in New Zealand walls (typically the interior lining), thereby reducing A_{ab}.

2.2 Developing the Model – Changes in External Pressure

Equation 3 highlights the importance of a higher venting-to-leakage-area ratio. However, it does not provide information about how quickly pressure equalisation occurs.

To gain some information about the time response of wall cavities, consider the case where there is zero leakage to the inside (Holmes, 2001).

If inertia effects are neglected, i.e. ignoring the fact that the air entering the wall cavity is accelerating, we can say that the mass of air flowing into a fixed volume (the cavity) is equal to the increase in density:

$$\rho_a Q = V\left(\frac{d\rho_c}{dt}\right) \tag{5}$$

For an adiabatic process, i.e. the pressure changes are too quick for heat transfer to the surroundings, the pressure and density are related as follows:

$$\frac{p}{\rho^{\gamma}} = \text{constant}\text{, or in differential form } \frac{dp}{P} = \gamma\frac{d\rho}{\rho} \tag{6}$$

Therefore:

$$\rho_a Q = V\left(\frac{\rho_a}{\gamma P_o}\frac{dp_c}{dt}\right) \tag{7}$$

Using the equation for flow through a sharp-edged orifice and collecting all of the output (P_c) terms on one side and input (P_e) terms on the other gives:

$$\frac{\rho_a}{2}\left(\frac{V}{KA_v\gamma P_o}\right)^2\left(\frac{dp_c}{dt}\right)^2 + p_c = p_e \tag{8}$$

Equation 7 can be directly integrated to find the time, T, for the cavity pressure to equalise with a sudden increase in external pressure:

$$T = \frac{V_o\sqrt{2\rho_a}}{P_o\gamma KA_v}\sqrt{P_e - P_{co}} \tag{9}$$

This states that smaller volumes with large openings equalise quicker than large volumes with small openings.

Assume that without rigid sheathing the internal lining acts as the only air barrier (neglect the presence of insulation and building wrap). Therefore with rigid sheathing, the volume to be equalised is 20 mm deep and the airspace without sheathing is 110 mm deep (assuming 90 mm framing). Also assume that the cavity width is 600 mm, cavity height is 2400 mm and that the vent area is 1000/mm^2/m, i.e. 600 mm^2.

Using Equation 9, for a sudden increase in the external pressure of 500 Pa the wall with rigid sheathing would take 0.02 seconds to equalise, essentially instantaneous. The wall without sheathing takes 0.11 seconds to equalise. This is slower but it is unlikely to be significant in terms of water entry.

Harris (1990) further developed a model similar to Equation 8 (again assuming no inertia) to include leakage and fluctuations in the windward and leeward pressures. Equation 10 was developed for the characteristic response time (similar to a time constant) for a volume with lumped windward and leeward openings and mean pressures $\overline{p}_w$ and $\overline{p}_L$ (in the case of a wall cavity the windward side is the exterior and the leeward side is the interior of the building):

$$\tau = \frac{V A_w A_L \sqrt{2\rho_a}}{P_o \gamma K (A_w^2 + A_L^2)^{3/2}} \sqrt{\overline{p}_w - \overline{p}_L} \qquad (10)$$

Any fluctuations (superimposed onto $\overline{p}_w$ and $\overline{p}_L$) will be transmitted to the cavity if they are of a period much greater than τ. Fluctuations of the same order of magnitude as τ will be attenuated and those of smaller periods will not cause the internal pressure to respond (Holmes, 2000).

Key Information

Rigid sheathing can theoretically improve *dynamic* pressure moderation performance by reducing A_{ab} and V.

2.3 General Behaviour of the Model

Equation 8 can be solved numerically for any arbitrary input, i.e. external pressure. When investigating the behaviour of a system, it is often useful to look at the response to a sinusoidal input because all "real" signals (wind pressures in this case) can be approximated using a Fourier series of sinusoids.

When subjected to a sinusoidal external pressure the cavity pressure will also vary sinusoidally but with different amplitude and a different phase to the driving pressure.

In linear systems the amplitude ratio and phase lag will be dependent on the frequency alone. Equation 8 is non-linear and so the frequency response is also dependent on the magnitude of the external pressure.

Figure 2-2 shows some frequency responses using the parameters for New Zealand residential walls outlined in Section 2.2.

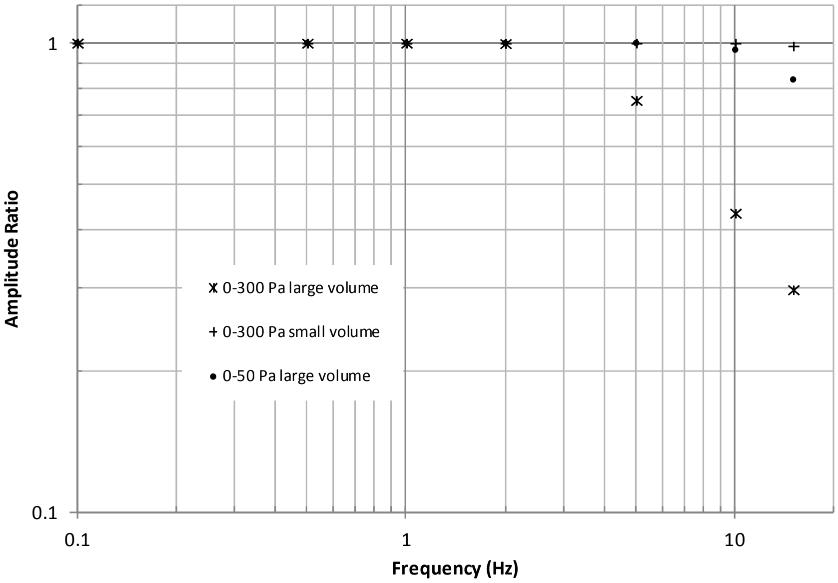

Figure 2-2 Frequency Response Using Equation 8

Without sheathing (a larger cavity volume), the amplitude ratio is still 0.9 when the frequency is 5 Hz and the amplitude of the input pressure is 300 Pa. This represents good pressure moderation performance under extreme conditions.

However, it is not enough to consider the amplitude ratio alone, the phase lag (about 5° in this case) means that the pressure *difference* across the cladding varies sinusoidally with an amplitude of about 80 Pa (Figure 2-3).

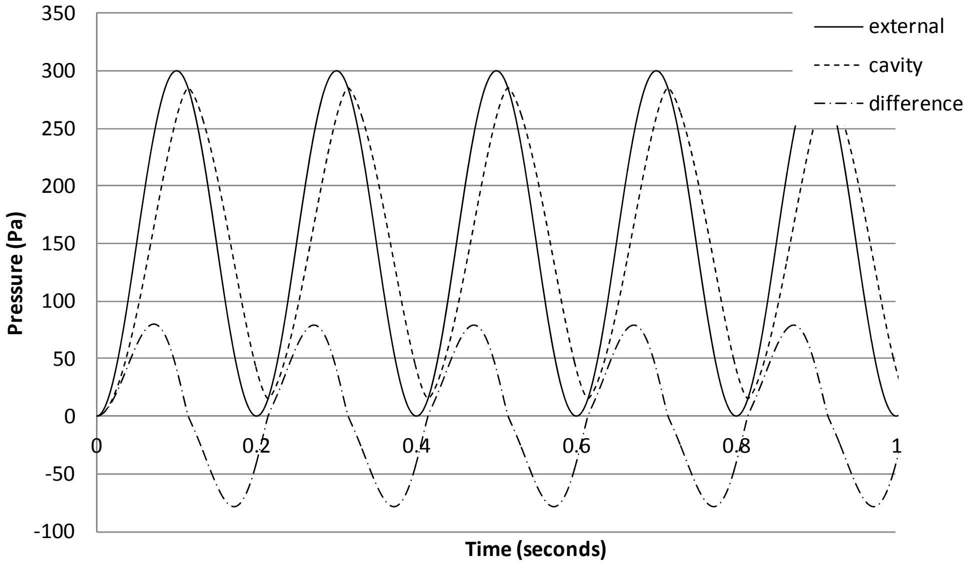

Figure 2-3 Pressure Difference Across the Cladding Using Equation 8: External Pressure = 0-300 Pa at 5 Hz, V = 0.1584 m^3

With the smaller cavity associated with rigid sheathing the pressure difference under the same loading is only about 8 Pa (see Figure 2-4).

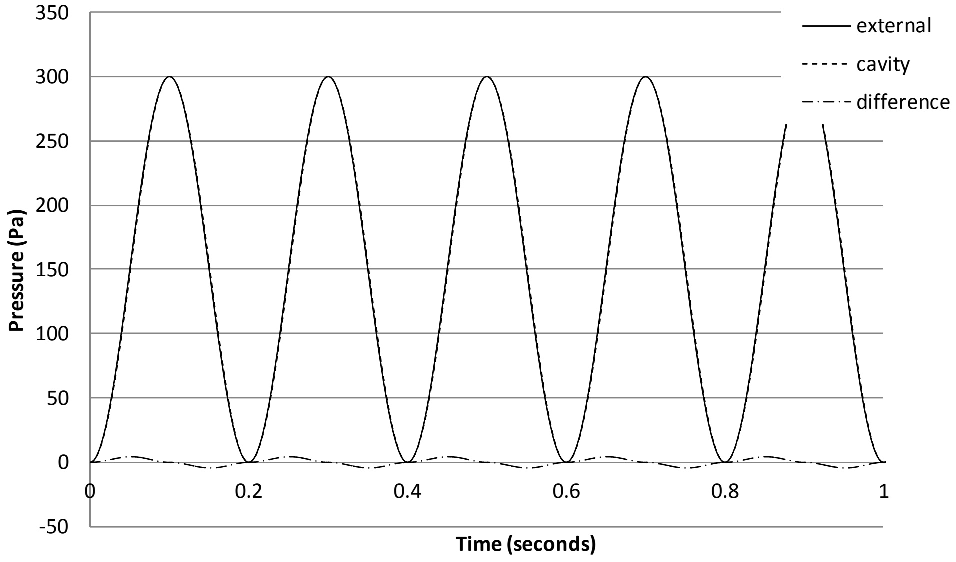

Figure 2-4 Pressure Difference Across the Cladding Using Equation 8: External Pressure = 0-300 Pa at 5 Hz, V = 0.0283 m^3

Note that this is the behaviour of an extremely simplified system, but it again highlights the benefits of having a smaller volume to equalise.

2.4 More Complex Models – Including Inertia and Stiffness

A more thorough model than Equation 8 would include the fact that the cladding and air barrier are not infinitely stiff and will deflect under pressure. It would also include inertia for the air moving through the vents and inertia of the cladding and air barrier.

In general, any flexibility of the cladding or air barrier slows down the response to changes in external pressure, i.e. changes in cavity pressure will lag further behind changes in the driving pressure.

The presence of inertia terms in the model means that the system may become resonant at certain frequencies:

- the natural frequency of the cladding
- the natural frequency of the cavity
- the natural frequency of the air barrier

Typically, the natural frequencies of these components are higher than any prevalent frequencies in the natural wind (Von Karman, 1943).

Rousseau and Quirouette (1998) developed a model based on the ideal gas law and included volume change from cladding and air barrier deflection. The model did not include inertia effects for the air, cladding or air barrier. The model was also based on the assumption that the pressure equalisation process was isothermal instead of adiabatic.

Starting with the gas equation:

$$PV = m\tilde{R}T \tag{11}$$

Assuming the air temperature is constant at 293 K then the pressure inside a wall cavity can be calculated as follows:

$$P_{cavity} = \frac{\tilde{R}T \times [original\ mass\ of\ air + mass\ of\ air\ in - mass\ of\ air\ out]}{[original\ volume\ of\ cavity + volume\ change\ from\ air\ barrier - volume\ change\ from\ cladding]} \tag{12}$$

Or:

$$P_c = \frac{84091 \times \left\lfloor \rho_a V_o + \Delta t \times K_V A_V \sqrt{2\rho(P_e - P_c)} - \Delta t \times K_{ab} A_{ab} \sqrt{2\rho(P_c - P_i)} \right\rfloor}{\left[V_o + k_{ab}(P_c - P_i) - k_{cl}(P_e - P_c)\right]} \tag{13}$$

Burgess (1995) used a similar model, but with equations for crack flow to develop a PEP (pressure-equalised percentage) for joints. Burgess’s model assumed the cavity volume was constant.

Canada’s Institute for Research in Construction (IRC) developed a computer program MPER (now unavailable) which also included inertia effects. The model was also “tuned” using factors derived from laboratory tests on full-scale wall systems to account for varying discharge coefficients.

Detailed analysis of the above models is outside the scope of this report. However, the models generally agree well with laboratory measurements where the pressure is uniform across the surface of the wall.

3. MEASURING PRESSURE EQUALISATION – IN THE LAB AND IN THE FIELD

Several studies have measured how the pressure inside a real wall cavity compares to the external wind pressure. In general, the findings show that if a wall has been designed with large vents and low leakage, the steady state performance is good (if not quite as good as the theory suggests) but the dynamic performance is far worse than theory or lab tests would suggest. Here we look at selective studies on pressure moderation measurement.

3.1 Lab Measurements

3.1.1 Steady State Pressure Differences

Killip and Cheetham (1984) compared experimental data from small-scale systems subjected to steady turbulent flow with Latta's model of steady state pressure equalisation, see Figure 3-1.

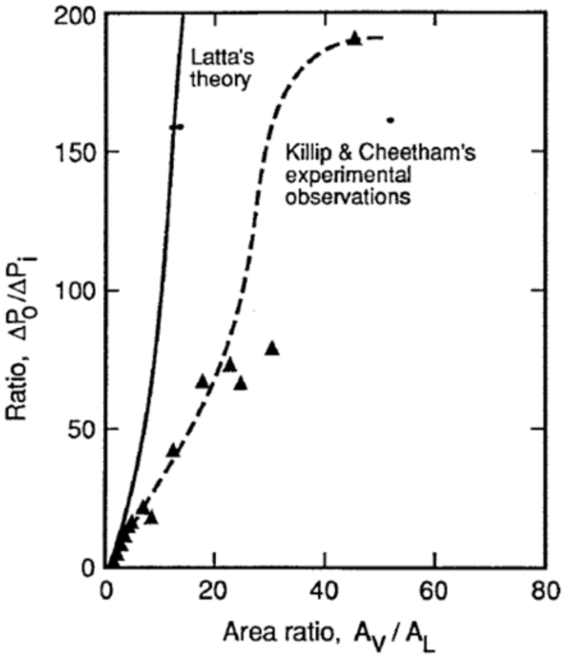

Figure 3-1 Comparison of Measurements with Steady State Theory (Baskaran, 1995)

The experimental results suggested that an even higher area ratio was required to achieve the same level of pressure equalisation as the simple steady state model predicted. It was proposed that the difference was because the opening in the air barrier was closer to a series of cracks than a single sharp-edged orifice. The result highlighted the importance of knowledge about the flow coefficients of the various openings.

3.1.2 Dynamic Pressure Differences

As mentioned in Section 2.4, the IRC performed a significant number of laboratory tests to measure the pressure equalisation performance of walls under simulated cyclic wind loading using its Dynamic Loading Facility (DLF) (Baskaran & Brown, 1991). This data was used to validate its mathematical model of pressure moderation. A typical result is shown in Figure 3-2, showing that a larger vent area (expressed as a percentage of the wall area) leads to better pressure equalisation.

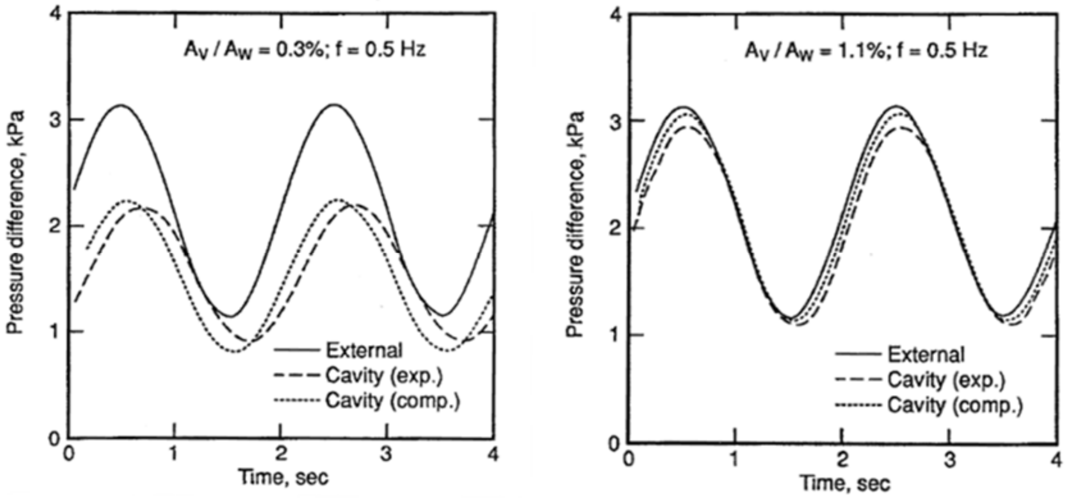

Figure 3-2 Typical Results from the IRC's Dynamic Loading Facility (Baskaran, 1995)

3.2 Field Measurements

Field measurements of pressure moderation tend to be presented in the frequency domain (as opposed to the time domain) thereby allowing comparisons between different datasets collected at different places or at different times. This approach requires the measured data to be stationary i.e., a steady mean, variance and direction. It is quite a difficult requirement to meet in a naturally variable process like the wind. Numerous measurements may be taken but only a small subset of these may meet the requirement.

The frequency domain approach also assumes that the pressure in the wall cavity follows the external pressure in a linear manner. As can be seen in Equation 8, this may not be strictly valid.

3.2.1 Place Air Canada and Lethbridge Courthouse

1n 1983-1984, the IRC measured the pressure equalisation performance of Place Air Canada (a high-rise office tower clad with precast concrete panel) in Montreal, Canada (Ganguli & Dalgliesh, 1988).

The IRC also monitored a low-rise brick veneer courthouse in Lethbridge (Canada) between 1985 and 1987 (Brown et al, 1991).

A comparison of the data from Lethbridge Courthouse and Place Air Canada is shown in Figure 3-3. Results are presented in the frequency domain to allow comparison between the two sets of data. The pressures have been normalised so that the maximum value on the vertical axis is in unity. Values for mean pressure are stated in each graph.

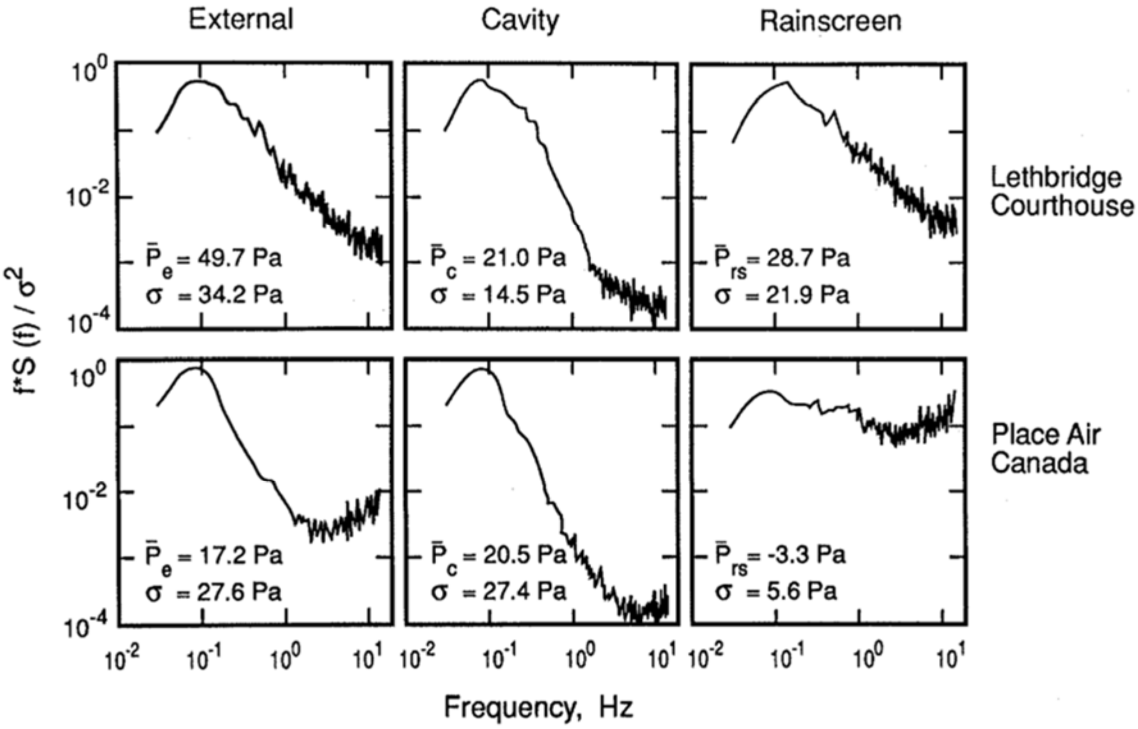

Figure 3-3 Comparison of Pressure Moderation from Canadian Field Measurements (Baskaran, 1995)

Pressure moderation at the Lethbridge courthouse was poor. Steady state pressure moderation was only about 50% with short term gusts only being moderated by as little as 10%. This poor performance was largely due to leakage through the air barrier. Using the mean pressures, we can deduce that this leakage was actually of a similar magnitude to the flow through the cladding.

Place Air Canada showed much better pressure moderation. This was due to a high venting-to-leakage ratio and a relatively small cavity volume. Over the course of the measurements at Place Air Canada the highest pressure difference across the cladding lasting several seconds or more was only about 50-60 Pa compared to an external pressure of 400-475 Pa. The maximum pressure difference across the cladding was 286 Pa but this was only sustained for a fraction of a second. These transient loads were stated as being more significant from a structural perspective as opposed to a rain penetration perspective. The explanation for these large transient pressures was the spatial variation over the surface of the cladding.

3.2.2 University of Waterloo

Straube (1998) measured the pressure moderation performance of a series of walls (brick veneer, filled-cavity brick veneer and EIFS panels) installed in an outdoor laboratory. Figure 8 shows a typical result.

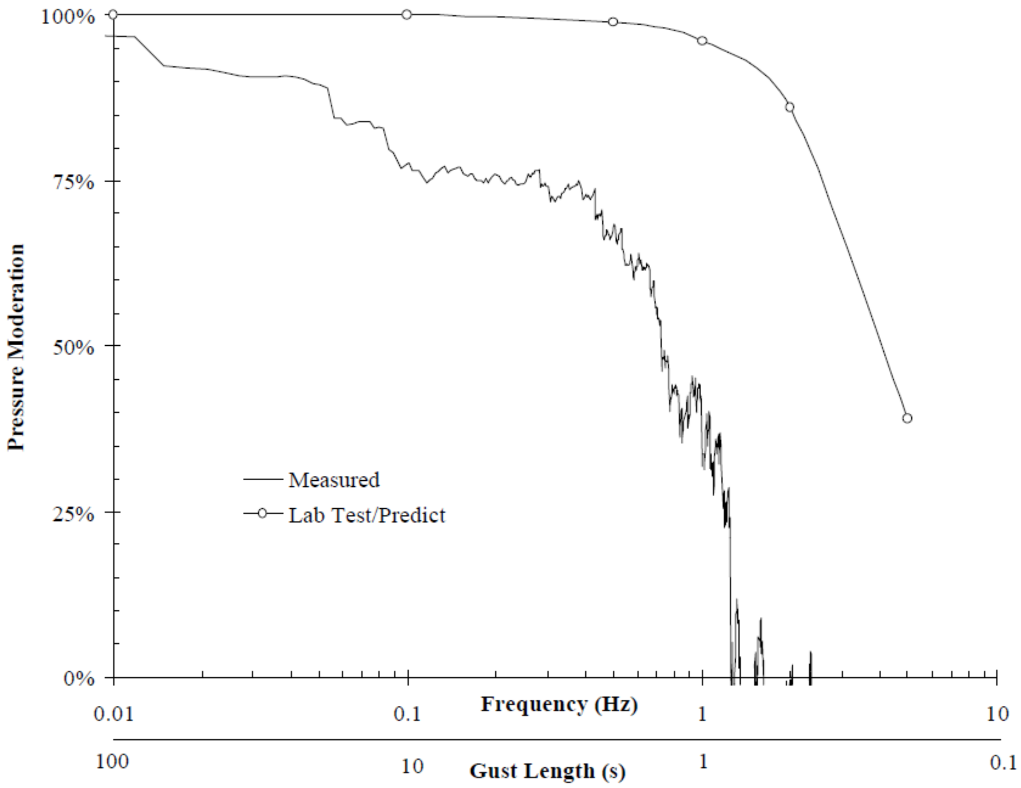

Figure 3-4 Pressure Moderation of a Brick Veneer Wall (Straube, 1998)

It was found that the pressure-moderation performance dropped off more rapidly with frequency than indoor lab tests and numerical models would suggest. The wall specimen corresponding to Figure 3-4 had a perfect air barrier and large vents but the pressure moderation for 1 second gusts was still less than 33%. The above-mentioned results were again explained as being due to the presence of pressure gradients across the wall specimen. Therefore pressure moderation is expected to be worst at upper and side edges of buildings, the same areas of cladding that receive the most driving rain (Straube and Burnett, 2005).

Key Information

Pressure moderation performance is generally not as good as theory suggests. The biggest difference between theory and practice is the dynamic performance when large pressure gradients exist across the surface of the cladding, such as the edges of buildings.

4. DISCUSSION

4.1 Implications of Models and Measurements

It is possible to develop a reasonably sophisticated model that describes pressure equalisation that is in good agreement with laboratory measurements where a spatially uniform but time-varying pressure is applied to the wall.

However, to predict the performance of "real" walls these models often require data that is difficult to obtain:

- the stiffness of the cladding and air barrier

- the “real” leakage area in the air barrier
- the “real” vent area in the cladding
- knowledge of the discharge coefficient for flow through the vents and the air barrier

In addition, even if all of the above-listed is known, the mathematical models generally cannot account for the fact that the pressure varies over the face of the cladding. In particular at the corners and edges of buildings the pressure gradients are large and these regions happen to be where most rain will strike a building.

Additionally, in terms of rain penetration there is little guidance on what is acceptable or not. Is a large pressure difference of one-second duration, for example, important in terms of rain control?

Despite these limitations it is generally known what is required to *improve* the pressure moderation performance of a wall. The following requirements can be expanded to develop general guidelines about compartment size, seal requirements etc:

- have a small volume to equalise
- maximise venting but minimise leakage
- use stiff components

Use of rigid sheathing can theoretically improve all of these things, but the research to date suggests any improvements will be small, especially in the region near the edges of buildings.

In addition to all of this is the fact that pressure differentials are just one driving force for water entry. In residential construction these other driving forces are likely to be of equal or greater importance than wind pressure.

4.2 Rigid Sheathing in Taller Buildings

Pressure equalisation will become more important when wind-driven rain becomes the dominant water-entry mechanism. This may happen if typical residential construction techniques are used for taller (>10 m) buildings because of increased wind pressures and turbulence.

The primary benefit of rigid sheathing is likely to be from increased durability rather than improved pressure moderation. The increased durability largely stems from having a more robust cavity as well as another “layer of defence”.

If the pressure difference increases to the point where the amount of water reaching the building wrap is unacceptable, then a different type of construction should be used that can manage the wind-driven rain more effectively.

For example, if executed properly, commercial curtain wall details come close to the “ideal” in terms of pressure moderation. The emphasis now becomes the pressure equalisation of joints between impervious panels, rather than pressure equalising the panels themselves. Figure 9 shows the pressure-equalised drained-joint principle for a centre-pivot window (Brown & Ballantyne, 1973). The sill member (assuming it does not extend too far into the page) will be a small, stiff volume that is well vented to the exterior, well sealed to the inside and subjected to a reasonably spatially-uniform pressure.

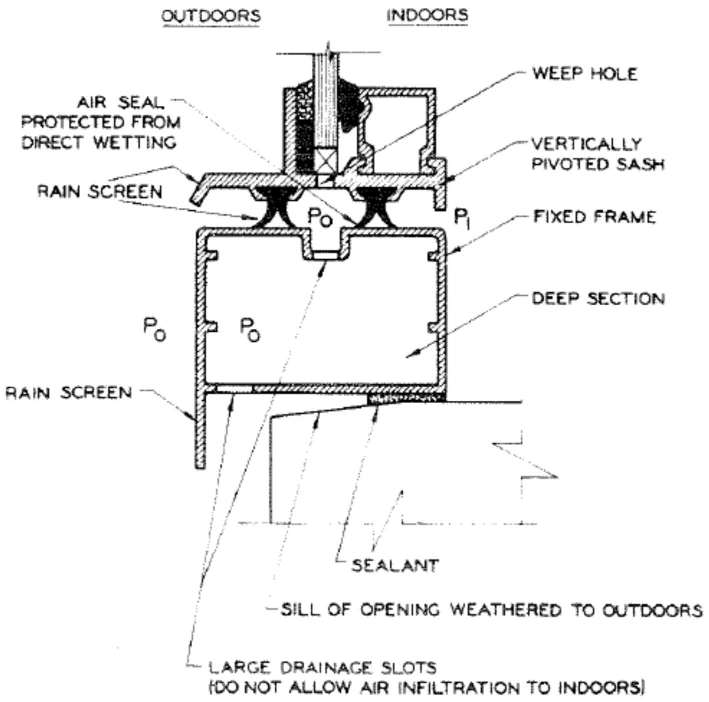

Figure 4-1 Drained-Joint Principle Applied to a Centre-Pivot Window (Brown & Ballantyne, 1973)

Commercial-style curtain walls are far removed from E2/AS1 construction. An intermediate approach is to use residential-style construction methods but with an effort to compartmentalise the wall cavity near the building edges. The Canada Mortgage and Housing Corporation presents an analytical means of determining compartment sizes but emphasises that this still relies on some “judgement calls”.[22] Compartmentalising the wall cavity would still represent a step change from current practice especially because of the requirements for tight seals between compartments.

4.3 Research Needs

We have seen that pressure differences are likely to exist across the cladding under dynamic conditions. We are also in a situation where taller buildings are on the increase and residential design solutions are potentially being used outside of their intended scope.

Therefore it is desirable to understand the limits of typical residential construction. Knowledge of how water entry varies as a function of pressure difference, rainfall characteristics and joint geometry would allow the design of joints to be underpinned by science.

Further work at BRANZ is planned to investigate the leakage characteristics of typical residential joint details in an attempt to understand these performance limits and to develop ways to improve higher-rise framed walls.

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