AWESW2022
21st Australasian Wind Engineering Society Workshop
2 – 3 February, 2023

The case for a new AS/NZS standard test for porous façade screens

Greg Simmons[1]
[1]*Insol LTD, 34 Onslow St, 9812 Invercargill, NZ, Greg@insolnz.co.nz*

ABSTRACT

Architectural façade screens are becoming more common and more complex. There are unique risks associated with such screens that are difficult to mitigate. Engineering can be complex and challenging, and there is no recognized performance standard.

This paper presents the case for the creation of a new performance standard to address these issues and looks at some of the benefits and challenges that would be part of creating such a standard. We conclude that the benefits of such a standard make it worth overcoming the challenges.

1. Introduction

Architectural façade screens are used primarily for sunshade, privacy, aesthetics, or weather protection. Their purpose is to either enhance a building's energy performance or to improve property desirability & value. As population increases and cities become ever more densely populated the demand for such screening is increasing.

The most common materials used are perforated sheet metal and extruded louvre profiles. However, the material options and forms created are nearly endless as architects continue to innovate and explore new materials and forms

Engineering for these screens can be challenging with pragmatism and engineering judgement required. There is currently no recognized performance test or testing standards

2. Issues with the 'Status Quo'

Wind interaction with these screens is often not well understood because they are almost always porous and often dynamic i.e., they are designed to move with sliding, bi-folding, or pivoting action.

Project specific structural designs are normally calculated based on code derived loads. However, products and components (such as hardware) incorporated into an overall design are often simply nominated as 'proprietary' and have little or no relevant engineering design or are simply overlooked due to the complexity of the design. Additionally, calculation methods, and even physical testing under AS/NZS1170.0 Appendix B or AS/NZS1664.1 Section 8, do not adequately consider serviceability over the lifetime of the product. Risks of wind generated noise, aeroelastic flutter, or fatigue are often neither known nor considered. The consequences however could be considerable. The screens are normally large enough, and high enough off the ground, that structural failure could be catastrophic; or if the façade of a building like a hotel were to generate tonal noise there would be significant financial implications for the building owners and operators.

Dynamic testing including physical 1:1 scale testing is often the only way to understand and mitigate these serviceability risks. However, unlike the window industry which has numerous test standards (such as AS/NZS 4284), there is no repeatable ‘benchmark’ standard test or industry guideline which can be used to ensure the serviceability of porous screens.

Case studies

Figures 1-3 refer to a project in Auckland where there was a failure of hardware on bi-folding screens.

The hardware manufacturer’s information stated: ‘exterior bi-fold hardware suitable for use with leaves up to 3m high by 1m wide, weighing not more than 50kg’. The engineer providing the producer statement nominated the hardware as a ‘proprietary product’ and did not check it.

Basic load testing was subsequently carried out using cement bags to simulate wind pressure. This showed that the hardware could not sustain more than 25% of the serviceability load.

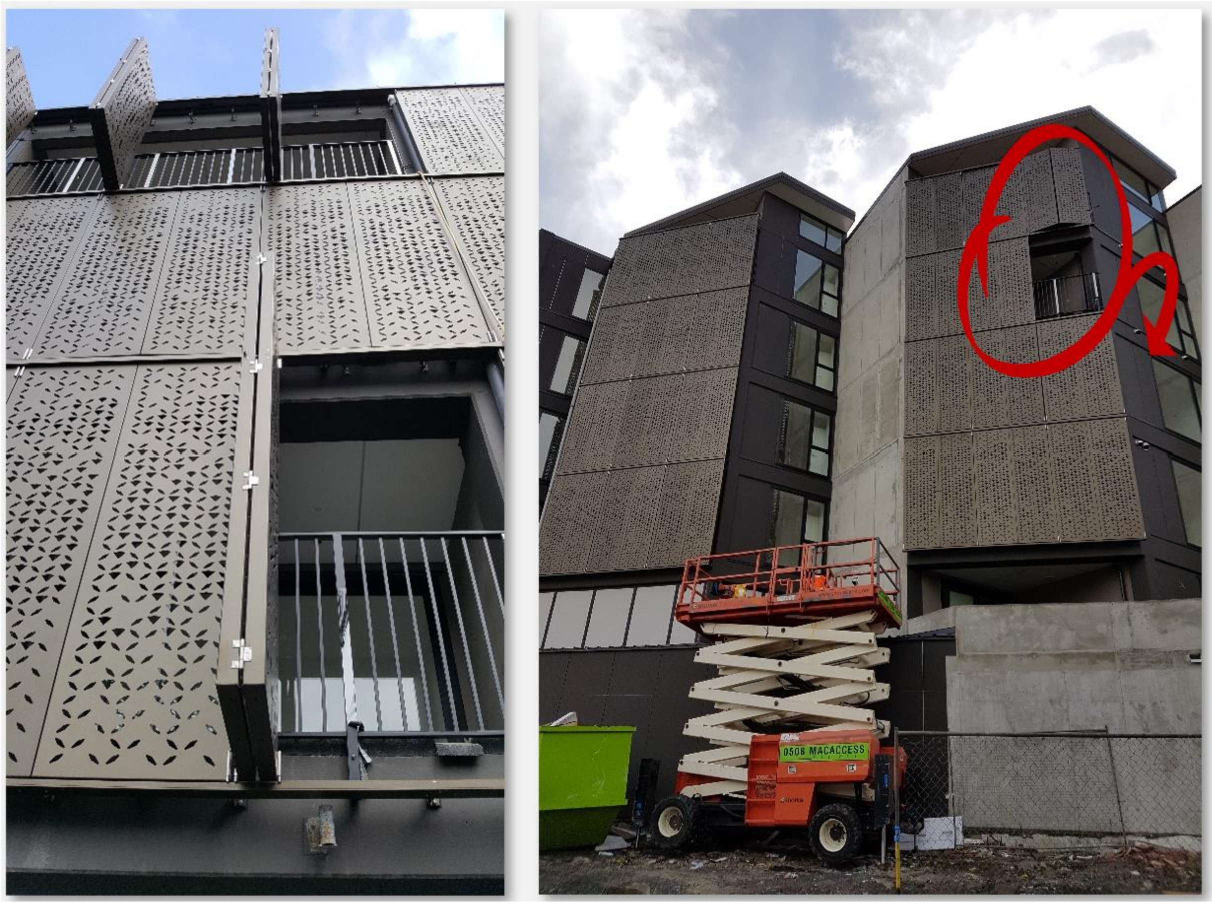

Figure 1. Bifold hardware failure

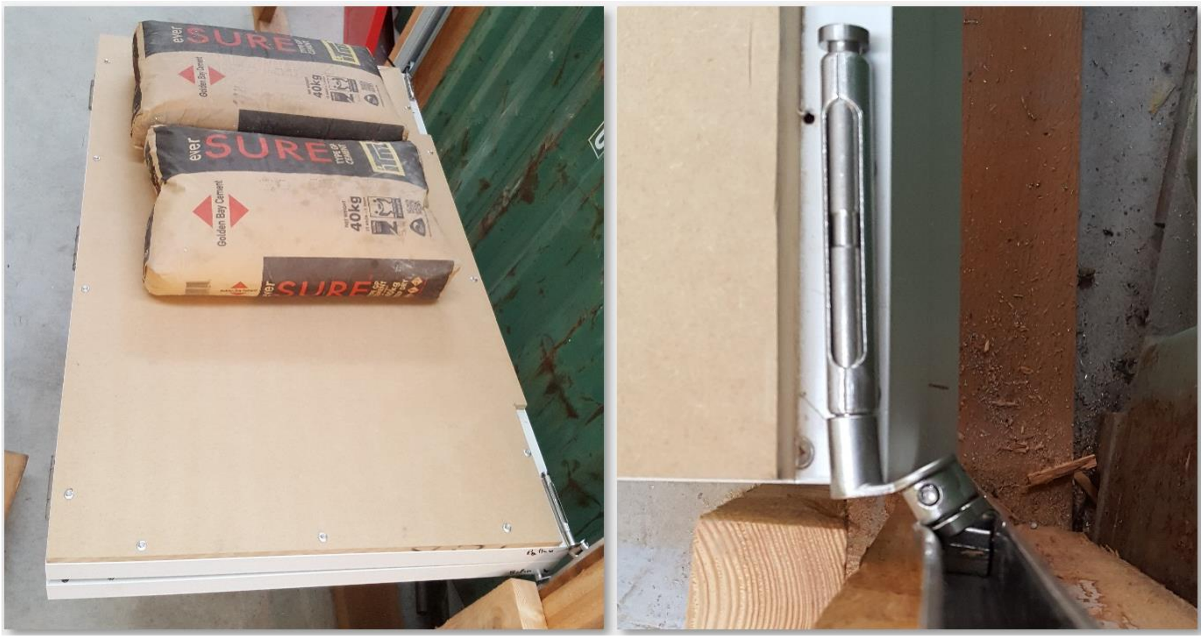

Figure 2. Bi-fold hardware load testing.

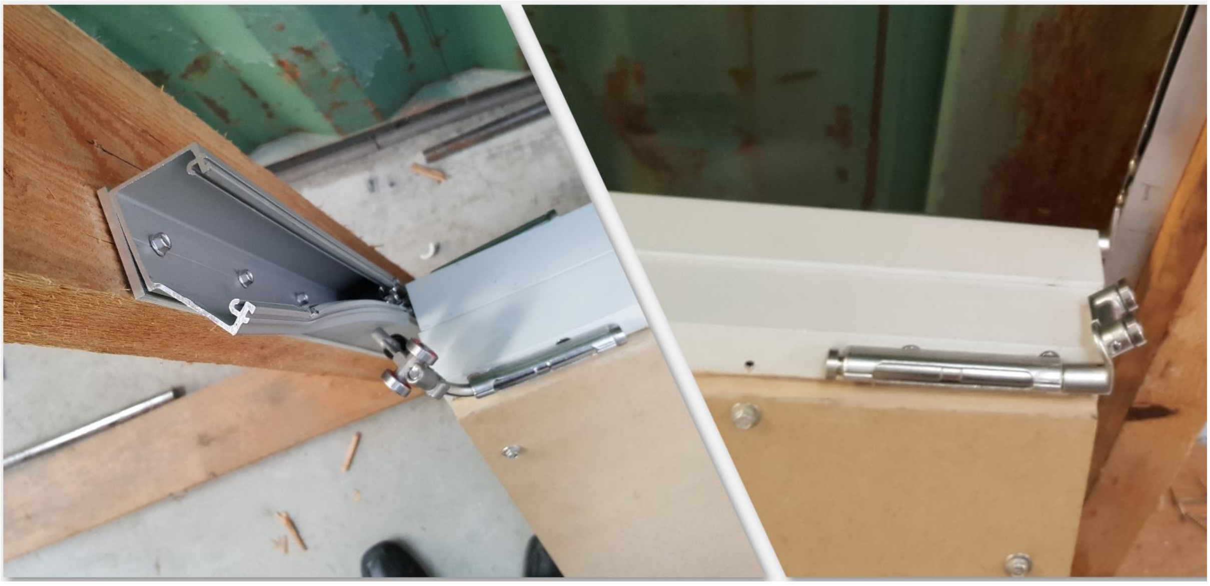

Figure 3. Bi-fold hardware failure well below serviceability loads.

Figure 4. shows the second largest multi-story car park (MSCP) in Europe at the airport in Manchester airport in the UK. The façade is covered in a grating product that whistles in the wind.

Figure 4. The second largest MSCP in Europe at Manchester Airport

3. Proposed standard and benefits

The standard envisaged should not be considered as a replacement for structural suitability checks using calculation of testing methods based on AS/NZS 1170 or AS/NZS 1664, but rather would apply specifically to porous façade screen testing as a method for checking the serviceability of screens that are considered high risk.

The standard would set out method/s of testing that would identify any issues with wind noise, vibration/flutter, and durability/serviceability of whole assemblies.

The presence of a standard leads to a shaping of the industry. This can be easily seen in the window industry where a standard such as AS/NZS 4284 can be specified as a requirement by project consultants. This leads to

- More investment in testing facilities,
- Greater knowledge for the industry (particularly at the contractor level),
- Safer buildings, and
- Ultimately better results for the built environment.

4. General considerations and challenges

The creation of such a standard would involve a lot of considerations some of which could be quite challenging.

As a minimum, a test facility would need to have a large open jet wind tunnel capable of generating wind speeds over 40m/s, a robust turn table, and the capability to measure noise and vibration.

One aspect of testing for serviceability should be to replicate turbulence. It would be helpful for the industry to be able to refer to something like a ‘1000 gust test’. However, creating turbulence at scale could be difficult and may require a specialized gust creating mechanism as part of the testing apparatus.

It would be necessary for such a standard to have two variations of test to cover the two different risks of noise and serviceability. Simple risk analysis tables should be included to ensure that testing is only specified where necessary.

Variations to the test formats should be allowed to accommodate the differences between testing for product certification (where results of one test may be used across multiple projects) and testing for product configuration that applies to one specific project.

Testing for Product certifications (where one test may be used across multiple projects) would need to be more thorough to allow for all eventualities. Whereas testing for one off project specific items may be able to be justifiably reduced based on factors such as prevailing wind data, local terrain, or localized pressure factors. Project specific test mock-ups could also be constructed to replicate the position of the element in relation to the building complete with surrounding building features. Where for product certification tests, the mock-up would need to be constructed to represent an anticipated worst-case scenario

For practical reasons it would be simpler if all tests were carried out to specified wind speeds rather than surface pressures. However, this would need to be subjected to scrutiny.

The cost of testing at this scale can be significant and this should be considered when specifying the number of data points to collect.

Due to the variable nature of the test items as well as the subjective nature of noise and deflection limits, developing a 'black and white' pass/fail or even a simple grading system for the results could be quite challenging.

5. Conclusions

The development of a new standard for testing porous and dynamic façade screens would bring significant benefit to the industry and built environment in general.

Noting there are significant challenges to developing a new standard that is effective without being too onerous for widespread adoption, we conclude that the benefits from improved building safety alone, are such that these challenges are worth overcoming.