WindLab™

BY INSOL

FAÇADE TESTING LABORATORY


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Introducing WindLab™

We're advancing façade engineering and testing.

Research, expertise and testing combine to improve safety, reduce risk, and drive better outcomes for future façades.

Executive summary

Welcome to WindLab™

The consequences of product failure can be fatal. This is why we have developed The Insol Façade Testing Laboratory (or WindLab™), the largest testing facility of its type to mitigate risk by providing vital data to help us answer:

Is it safe? Can we break it?

We have been operating in this specialist field since 2003. As the complexities of screening have increased, going beyond published guidelines and knowledge, there is a need for more scientific and analytical understanding.

Is it noisy?

Wind noise is difficult to predict. The acoustics of bespoke screening can be the cause of significant occupant discomfort and substantial financial cost to building owners, designers and contractors.

Our wind tunnel has an open jet, high power, short tunnel configuration. It's specifically designed to meet 1:1 scale building façade elements for structural integrity and wind noise.

Able to generate flow velocities of up to 200km/h, variable speed controls over the 1.5MW, 4 centrifugal fans allow maximum control of wind speeds which enables low-speed acoustic testing as well as high-speed structural tests.

Greg Simmons
CEO

Shane Hart
Client Relations

Daniel Forrest
Project Manager

Improving outcomes with façade design

Façade testing with Insol's WindLab™ will help meet project goals, optimise complex designs and identify and mitigate risks prior to construction.

Wind noise mitigation

- Reduced acoustic disturbances
- Identify potential for wind-induced vibrations, fatigue, or instability

WindLab™

Structural safety

- Safe structures under extreme wind conditions
- Optimise design

Serviceability

- Enhanced operability in high winds
- Quiet and functional façade systems

The Insol Wind Tunnel

- 1.5MW
- 4 x Oversized Fans
- 500m³ / second
- Capable of delivering constant wind speed close to 200km/h (56 metres per second)
- Full 1:1 scale load testing of complex façade construction details
- 3,000m² / 32,000sq ft workshop, storage and testing facility to accommodate modifications to test subject as required

To watch a video about the Wind Tunnel, please visit our YouTube channel or scan the QR code below.

youtube.com/watch?v=I9pGwYLsJ6A

AWES-QAM-2-2024

Architectural screens are increasingly bespoke, requiring custom designed extrusions, building connections or brackets.

- AS/NZS1170.2 and other literature applicable to local regions are not comprehensive enough for many installations.
- Wind loading assumptions applicable to windows and cladding are often not relevant.
- Some or most designs cannot be fully assessed using computational methods like CFD (Computational Fluid Dynamics).

The Australian Wind Engineering Society is responsible for the first comprehensive industry guidelines for full scale wind testing of building envelope components, created as a direct response to industry concerns about the rising risk of wind-induced incidents in the built environment.

The AWES-QAM-2-2024 standard was developed to provide guidance to construction professionals on conducting full-scale wind testing of building envelope components and architectural features.

Part A: Wind Tunnel Tests for Aerodynamic Shape Factors

Focuses on static samples to determine quasi-steady shape factors, covering wind tunnel setups, configurations, and data reporting.

Part B: Tests for Wind-Induced Dynamic Excitation

Addresses dynamic tests on prototypes to assess wind-induced vibrations, structural stability, and fatigue life, including specific configurations and reporting requirements.

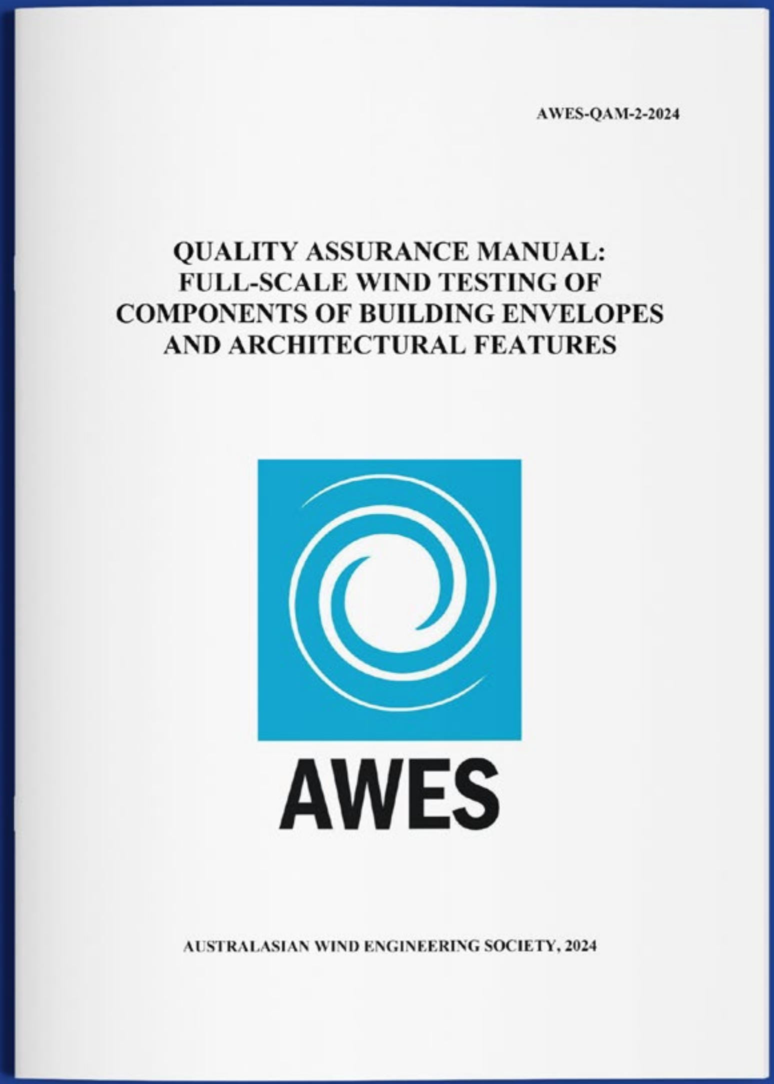
Part C: Functionality Testing of Façade Components

Covers tests for operable façade elements (e.g., windows, sunshades, ventilated systems) to ensure safe functionality under serviceability wind conditions.

Part D: Wind Tunnel Tests for Wind-Noise

Examines the potential for wind-noise generation in full-scale façade prototypes, including tonal noise identification and acoustic performance reporting.

Global Relevance: This test standard offers internationally applicable guidelines for improving design and construction practices under wind conditions. WindLab™ façade testing laboratory can meet all guidelines for wind testing of large-scale building envelope components as set out in AWES-QAM-2-2024.



The GustFlex™ System

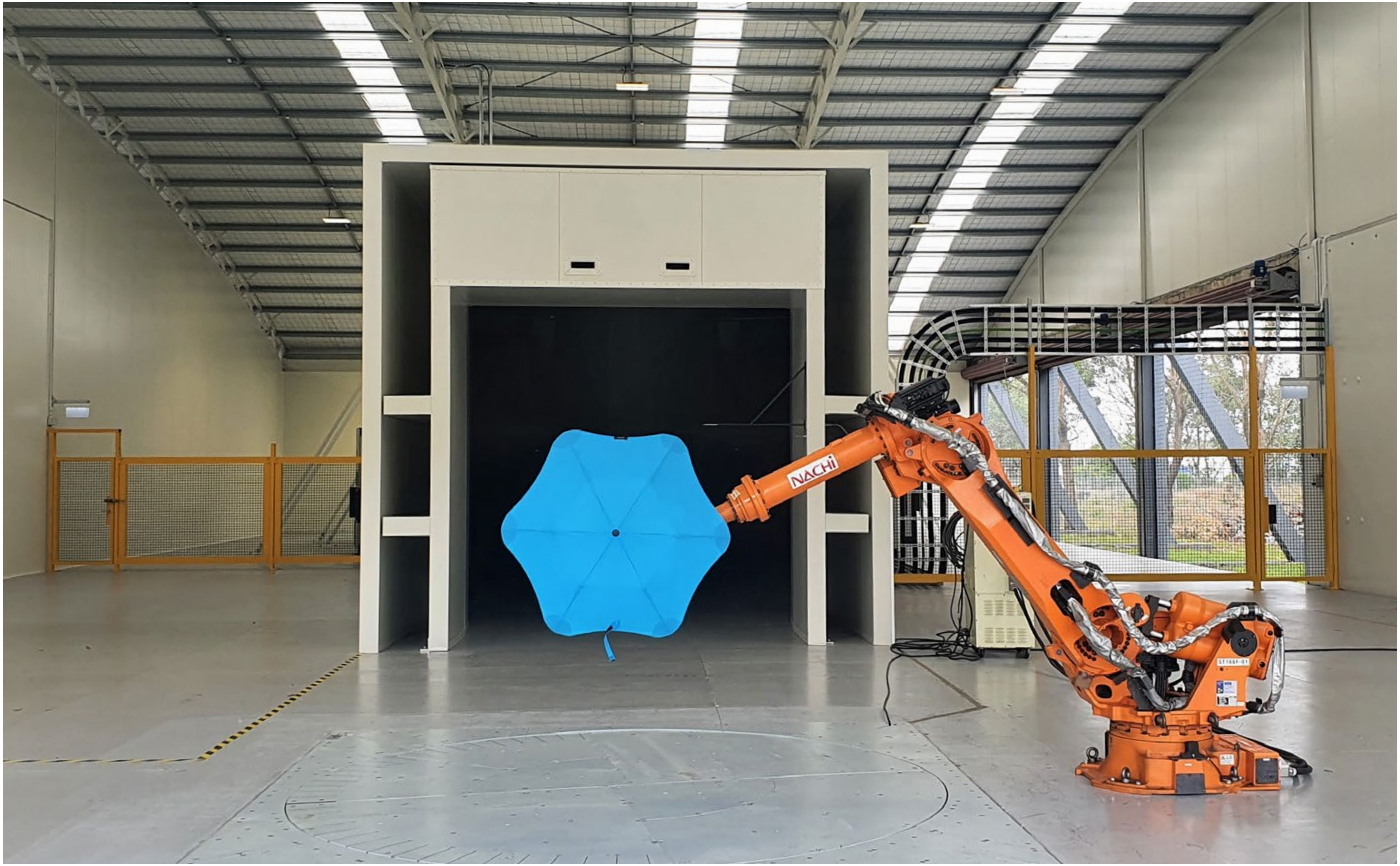
Accelerated lifecycle testing for façade elements

GustFlex was developed to mitigate the risks associated with complex façade elements exposed to testing environmental conditions, potentially leading to early failure.

Façade designs may pass initial wind testing for acoustic performance and operability only for durability issues to arise years short of the design life of the product. The complex geometries frequently encountered in porous façades can lead to complex wind interactions with vortex shedding putting undue stress and strain on certain elements. Under these conditions fasteners can loosen or work out, and materials fatigue under daily wind conditions much lower than full design wind speeds. This can lead to catastrophic failure when a design wind speed event occurs.

We know increasingly complex façade designs are often accompanied by increased risk, and with no set standards to test for façade durability, we have devised our own methodology to provide the assurances architects, engineers, and building owners need. The GustFlex testing methodology uses fins which oscillate from side-to-side, sweeping wind over the façade with a 3 second pause to simulate a wind gust. The façade is subjected to 5 gusts every minute and testing can continue for hours or days depending on the project requirements. This simulates daily exposure to wind conditions for an extended period of time and provides specific confidence levels for façade durability.

GustFlex is the only accelerated lifecycle testing of its kind currently available for façades.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CASE STUDIES

Auckland International Airport Transport Hub

Client
Auckland International Airport

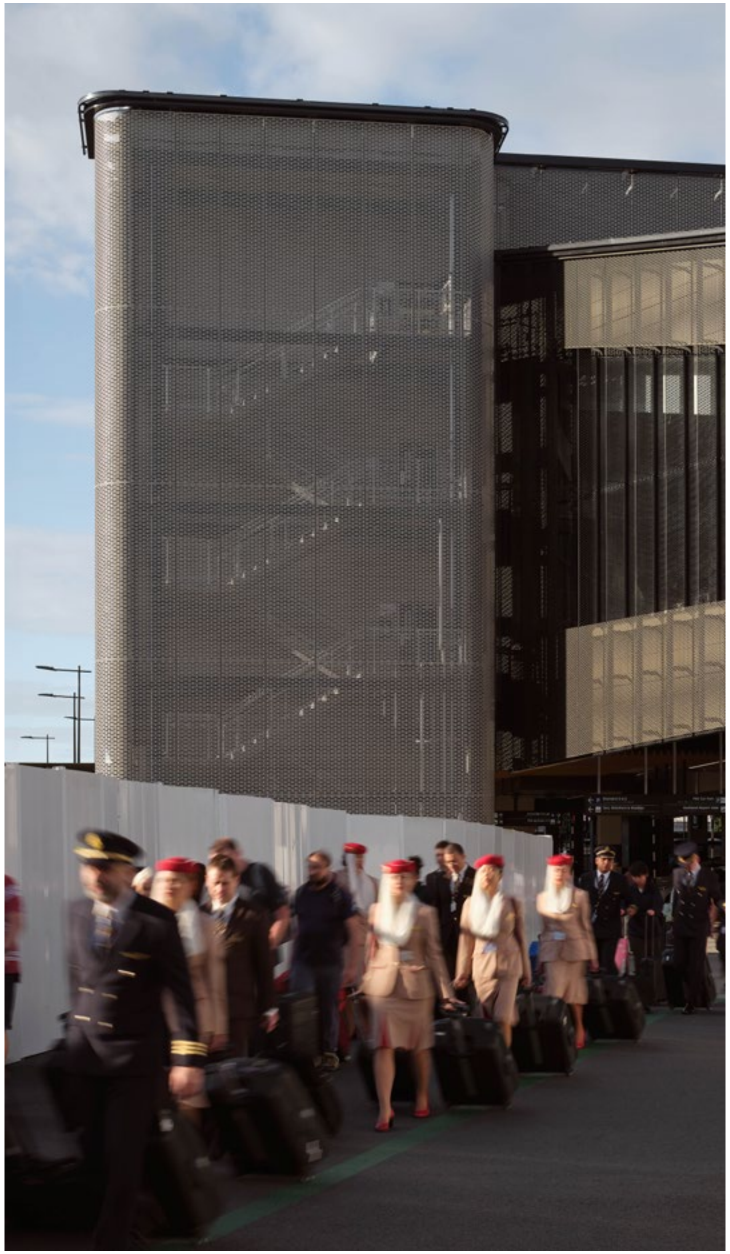
Location
Auckland, New Zealand

Architect
Peddlethorp

The situation

The Auckland International Airport Transport Hub is arguably the busiest in the country. With over 10,000 vehicle movements per day and tens of thousands of passengers walking past, any issues of noise from the perforated façade would create a significant and embarrassing problem for this gateway to the world.

Located next to the International Terminal, adjacent to gateway hotels and providing a sheltered walkway to the domestic terminal, the Transport Terminal is a high throughput facility in a high wind zone with over 8,500m² of perforated screening. The potential for wind-induced noise and vortex-induced oscillation posed a risk which could play out under the gaze (and within earshot) of enough connected travellers to pose a significant problem for the Airport, making wind-tunnel testing critical.



Testing results & recommendations

The initial perforated pattern specified performed poorly in both acoustics and deflections. By testing subsequent patterns using an iterative process, we were able to modify the pattern to a point whereby it would produce no noise while maintaining the architectural intent.

Multiple variations of the pattern were needed to reach that point, each being subjected to increasing wind speeds at different angles, the 1:1 mock-up being rotated by 15 degrees on the turntable between each test. The client was able to view the panel under full wind load and understand how it would look and perform in the eyes of concerned travellers passing by.

Conclusion

By incrementally changing the pattern we were able to preserve the original vision for the Transport Hub. No noise was generated by the adapted pattern even in wind speeds exceeding the daily average at the Airport, or at an expected (and unexpected) gust level.

Furthermore, we were able to prove the fixings would be able to hold fast against vibrations and expected wind loadings, maintaining the structural integrity of the façade.

Shelly Beach Road Apartments

Client
GN Construction

Location
Auckland, New Zealand

Architect
PB&A

The situation

Sitting atop an elevated position in St. Mary's Bay, XXXII is a boutique apartment complex with views of downtown Auckland and the Waitakere Ranges.

Occupant privacy and thermal gain is provided by 42 Azimuth Sliding Screens, each panel using 40x3mm flat bars and a 60x6mm angle perimetre. The screens are able to be manipulated into the optimal position by occupants.

As the screens are not for weather tightness or security, it was easy to foresee a situation whereby they would not be secured into position, by method of dead-man latch. The question then becomes one of which dead-man latch. There was nothing available with test reports showing the latch was robust and durable enough to cope and hold under pressure from wind gusts, requiring a bespoke latch.

With no test data available, we needed to make sure it met our demands for risk mitigation and tested it to failure.

Testing results & recommendations

A full 1:1 scale mock-up was manufactured and then placed on the turntable in front of the wind tunnel. This mock-up was rotated to simulate the varying angle of wind direction, with all angles tested at every speed increment to find the angle at which the most load was placed on the latch by the wind.

The next step was to increase the speed until the latch failed. The first tests had the latch failing when the wind tunnel was running at 15m/s (54km/h). That would be enough for significant issues to likely occur multiple times per year. Further modifications to the latch were made and the testing regime was repeated until we again reached the point of failure.

Conclusion

For sliding screens to be used in medium density apartments and/or buildings of multiple storeys, there is significant risk from wind-induced damage (noting the potential for wind noise is also a concern). The currently available latches are unable to offer the safety required and require significant modification to meet anything approaching an acceptable level.

For prudent risk mitigation, we'd recommend the use of wind tunnel testing for similar projects or speaking with us about our now tried and tested design that we know already works.

Scammonden Bridge, UK

Client
National Highways Limited

Location
West Yorkshire, UK

Engineer
Windtech

The situation

When it opened in 1970, the seven mile stretch of the M62 motorway that connects parts of the Pennines in West Yorkshire was hailed as the “most exciting section of motorway construction yet undertaken in Britain”.

Sitting 37 metres (120 ft) above the motorway is the Scammonden Bridge. At 120m (410 ft) long, it was the longest concrete arch bridge in England. The bridge had only a waist high fence on each side and, sadly, in more recent years had become well known as a place where people went to end their lives.

This led to safety improvements in 2020. As part of the £1 million upgrade plan, an inwardly curved 2.4m (8ft) high anti-climb fence was installed. However, the high winds which plagued the bridge from the moment it was opened continued to cause problems.

The infill elements of the parapet were immediately susceptible to vortex induced oscillation (VIO) and the fluctuating lift and drag forces caused structural vibrations.

The result was a deterioration of sections of the new anti-climb fence, to the point where they were deemed beyond repair in under 3 years since being commissioned.

Testing results & recommendations

A remedial solution was designed to help reduce the wind induced excitation on the fencing and barrier, however because of the issues with the initial design, the client needed to test the remedial before this was applied on site. To establish the effectiveness, a full 1:1 scale mock up was built and tested extensively using Insol wind tunnel.

This mock-up was rotated to simulate the varying angle of wind direction, and subjected to extreme wind speeds up to 49m/s for extended periods of time. Further modifications were made to the test mock up to cancel out any instances of vibration which still occurred, and a second round of testing with a final mock up proved a 100% effective result.

Conclusion

The result is a design which is 100% effective and will ensure the parapet structure meets the design life criteria requirements, along with increasing pedestrian comfort.

Kōawa Studios

Client
University of Canterbury

Location
Christchurch

Architect
Ignite Architects

The situation

Kōawa Studios is a 1,400sqm building housing advanced post-production facilities, editing suites, production offices, screening room, and a state of the art 440 sqm sound stage.

The west-facing exterior of the building features 700+ triangular panels made from perforated aluminium, creating a large visual reinterpretation of the Kōawa Studios logo, which draws its arrow-like shape from the diagonal lines of the stylised Kōawa word mark. Approximately half of these panels protrude outwards at various angles, effectively creating a series of sails with multiple opportunities to catch the wind and whistle.

Given there is zero tolerance for wind noise or outside interference of any kind, it was recommended that both a performance mock-up and visual mock-up would be advantageous, beginning with using the PMU in the Insol WindLab™ for testing.

Testing results & recommendations

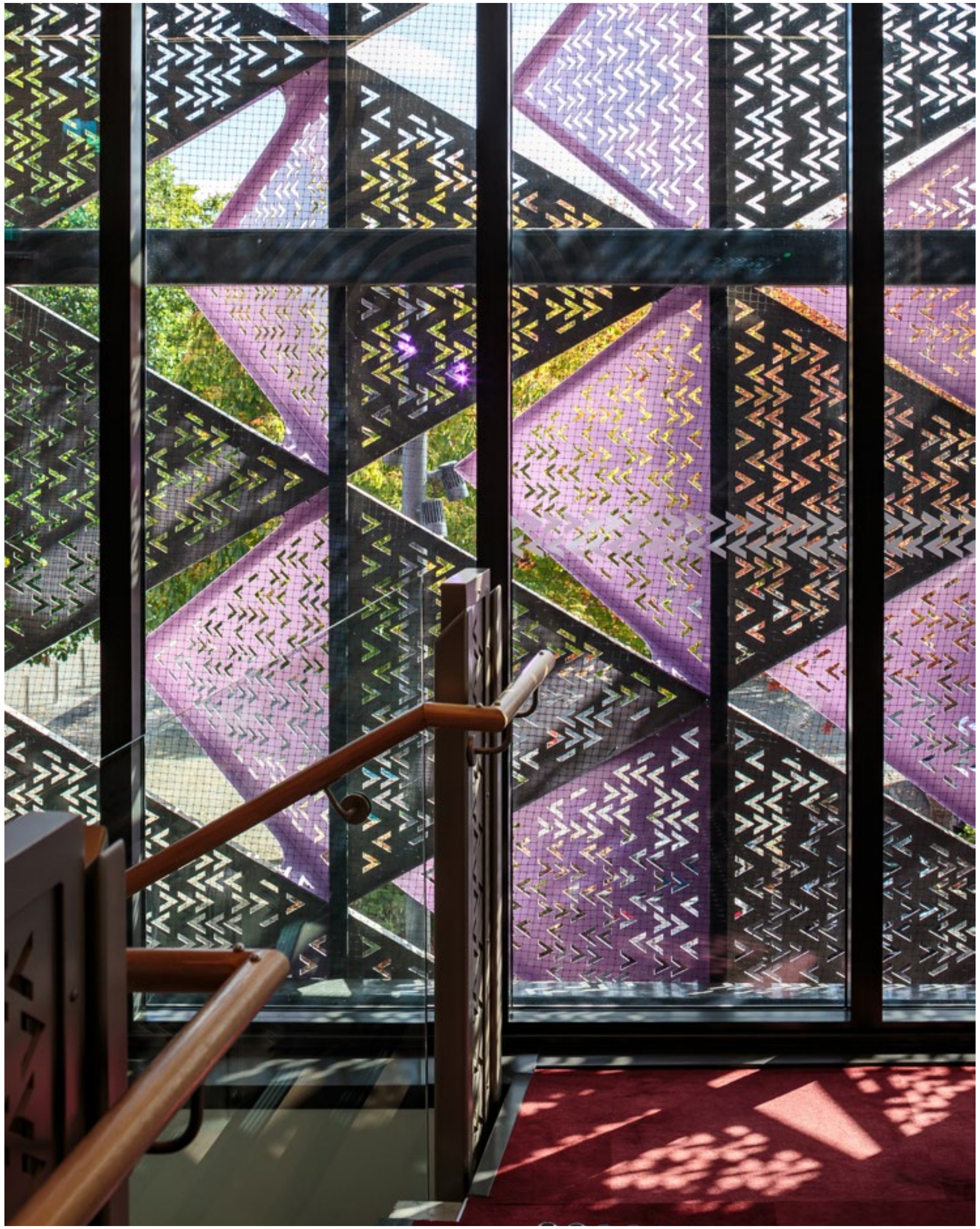
A PMU, representing a 3m wide x 4m high section with 8 triangular shaped perforated façade shapes, was rotated on the wind tunnel turntable to systematically check through to the worst case scenario for wind induced noise. Wind speeds from 10m/s up to 48m/s represented typical wind/gust speeds for the location of the studios. Acoustic measurements were then taken in the third octave, providing a more granular analysis of the acoustics and the ability to break down complex sounds by frequency components.

Testing measured for deflections as the protruding panels had the potential to vibrate excessively in high winds. Accelerometres positioned on the PMU were used to measure deflection in millimetres.

Conclusion

No acoustic or deflection issues were detected during testing, resulting in a production facility where the only dramatic sounds are intentional and scripted.


KŌAWA
KŌAWA
STUDIOS
BACKLOT




KŌAWA
STUDIOS

U.S. Consulate General Rio de Janeiro, Brazil

Client
U.S. Department of State Bureau of Overseas Building Operations

Location
Rio de Janeiro, Brazil

Architect
Richärd Kennedy Architects

Reducing Risk on the U.S. Consulate in Rio de Janeiro

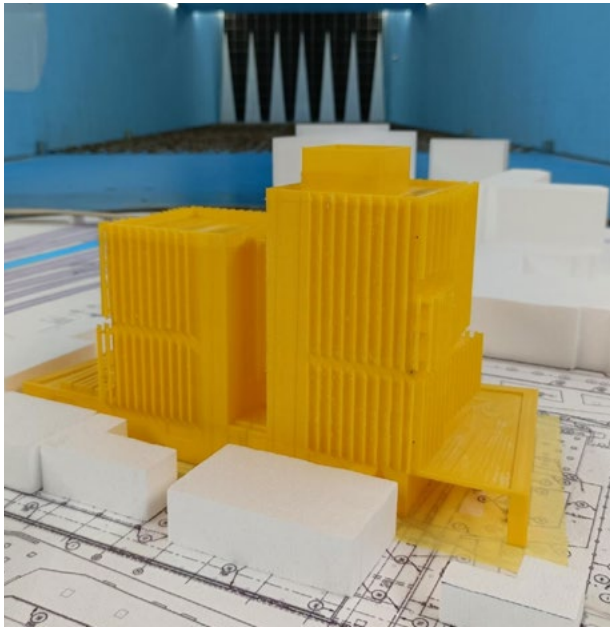
The new United States Consulate in Brazil will occupy a 3.7 acre parcel in the prime downtown area of Cidade Nova and features a complex design, extending upwards to tower over neighbouring buildings. This makes it a near-perfect example of why façades should be wind-tested:

- Complicated façade geometry
- High risk of wind noise
- High profile public building
- Low risk tolerance profile

The façade itself features repeated vertical louvres over multiple elevations, running from the ground level to the 11th floor, designed to minimise heat gain and to reduce glare in both workspaces and public places. When open, the building will welcome 1,800 daily visitors and will become a landmark viewable from across the city.

With such a high-profile and a high risk of wind-induced noise, Insol WindLab™ has been engaged to provide testing services which are currently on-going. Whilst we're not able to provide more information at present, we can say the decision to conduct testing was the correct one, with testing informing the final design.

If you have a project that meets any of the criteria detailed above (i.e. high profile public building with a low risk tolerance profile), we highly recommend wind testing. Adapting the façade prior to construction compares favourably to the cost of remediation work later.

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1:1 scale testing of complex and beautiful façades to meet the needs of architects around the world

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