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TECHNICAL NOTE No.6
Simulated Wind Load Testing of Garage Doors and Other Large Access Doors
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1 INTRODUCTION

The Cyclone Testing Station (CTS) is an independent authority on the effects of high wind and related damage to low-rise building systems in Australia, South East Asia and the Pacific.

The CTS provides a service to the building industry for testing the effects of wind forces on buildings and building components.

The CTS has the equipment and technical expertise to test garage doors and other large access doors or components to comply with relevant standards and building regulations.

2 TESTING GARAGE DOORS AND OTHER LARGE ACCESS DOORS

Doors used in the external building envelope should be able to resist the design wind pressure for their intended location and building type. The principal requirements are contained in the National Construction Code. The NCC in turn references Australian/New Zealand Standard 4505:2012, which includes the detailed requirements for Garage doors and other large access doors.

Door manufacturers typically supply a range of door sizes and usually produce load-span design tables for their product range supported by test results. Depending upon the intended locations and building types, the following tests may need to be considered for each door model, in accordance with *AS/NZS 4505:2012*:

1. Simulated Static Strength Wind Load Testing – non-cyclonic regions
2. Simulated Cyclic Strength Wind Load Testing – cyclonic regions
3. Windborne Debris Impact Testing – this is an optional test for cyclonic regions focusing on life safety; normally conducted in cases where building specification calls for it, such as cyclone shelter or other habitable spaces.

3 SIMULATED WIND LOAD TESTING REQUIREMENTS

3.1 Span Range for Testing

The Standard *AS/NZS 4505:2012* requires that the widest door is tested as a minimum, however this limits the pressure that can be assigned to doors of other widths. A more thorough approach is to test doors across the range of widths, thus allowing interpolation and calculation of the full capacity of the various doors widths. Where interpolation is used, at least the largest and smallest doors in the range must be tested, together with one other in between.

Another advantage of more comprehensive testing is the Standard includes rules that allow a reduction in the variability that is assigned to the test results if repeat tests are performed. These rules are similar to those in most other Standards.

On completion of testing, the results can be used to prepare design wind strength load tables for the span range tested. Importantly, extrapolation to spans greater that those tested is not permitted, but limited extrapolation for doors of lesser width is possible.

A design wind pressure for a specific door width can be assigned to a similar door of lesser width if the narrower door is similar in all respects except width, and the assigned design wind pressure for the narrower door is no greater than the design wind pressure for the wider door actually tested.

In cases of commonly used, standard door widths, testing the discrete door widths used in practice may reduce the number of tests required and avoid the need for subsequent development of load-span tables.

3.2 Full-Width and Sub-Assembly Testing

The CTS has the facilities to test full-width doors. *AS/NZS 4505:2012* allows this testing to be done on "slices" of doors that are greater than 1.5m in height. It is not usually necessary to provide complete doors for wind load testing (although complete doors are used for classification testing in accordance with *AS/NZS 4505:2012*).

CTS can also test sub-assemblies and under specific circumstances, *AS/NZS 4505:2012* allows these tests to be used to minimise the need for repeat full scale testing where there has been only a simple change, such as a change in the substrate that the system is fixed to.

For doors with large spans (nominally larger than 6,000 mm) that are to be used in cyclonic areas, a slightly different testing program is normally used. This alternative approach is consistent with the options in *AS/NZS 4505:2012*. A static test to failure will be conducted to evaluate the critical elements. From this, the critical sub-assemblies can be evaluated using the cyclic test procedure, to simplify the testing process.

A similar approach can also be adopted when various combinations of materials are used in practice, to avoid the need to re-test multiple complete door assemblies.

3.3 Design Pressures

In some cases, clients request evaluation against a specific design wind pressure. If no such pressure has been identified, it is necessary to conduct one or more static tests and use the results to develop the remainder of the test program, including any target pressures.

The testing process includes an allowance for material variability. The allowance or factor is dependent upon the number of repeat tests undertaken. The options are quantified in *AS/NZS 4505:2012* and many other Standards. Essentially, the greater the number of tests the lower the material variability factor and thereby the higher resultant design pressure.

4 AIRBOX AND TEST SET UP

The CTS is fully equipped to conduct simulated wind load testing on continuous curtain roller doors using the airbox and related ancillary testing facilities.

4.1 Airbox Testing Facility and Test Setup

The airbox test rig is an open top pressure chamber. The air box internal clearance dimensions are 2.05m wide with an adjustable length of up to 10 m. Centrifugal fans introduce air pressure inside the airbox and simulate the combined effect of suction pressure on the external surface, and positive internal pressure on an internal surface on the test sample. Cyclic loading is achieved by opening and closing pressure dump valves.

In the case of roller doors, the door guides for the test sample are fixed to supporting members (nominally 100 × 150 × 10 mm steel angle) and bolted to the airbox frame becoming part of the top horizontal surface.

The test door (and its guides) can be tested using two orientations for simulated wind pressure loading, as follows:

1. **Inwards**: The test door is installed with the outside (external) surface facing inside the airbox – so that increasing air pressure can be applied to the external face of the test door, simulating net inwards pressure on a door in situ.

2. **Outwards**: The test door is installed with the inside (internal) surface facing inside the airbox - so that increasing air pressure can be applied to the internal surface of the test door, simulating net outwards pressure on a door in situ.

4.2 Test Specimen

Test specimens should be representative of normal production, and due to limitations in the test facility must not exceed a span of 6,000 mm. The specimen support configurations will be modelled as accurately as possible to simulate conditions used in practice.

Larger specimens can be accommodated in certain circumstances, and can be discussed in advance with CTS staff.

5 AIRBAG TESTING

The CTS also has capability to perform garage door tests in an alternative test rig using airbags (generally required for sectional or panel doors). The airbags are placed between the door (and components such as braces or mullions) and the bed of the test rig and inflated. The load is measured on the test rig and converted to an equivalent pressure.

Cyclic loading can also be performed on this system, by applying a cyclic load to the reaction frame and platens that support the air bags.

6 SIMULATED WIND LOAD TESTING OF GARAGE DOOR OR OTHER LARGE ACCESS DOOR SYSTEMS

6.1 General

The ability of a garage door or large access door to resist wind pressures in non-cyclonic and cyclonic regions is best determined by testing.

A complete test system consists of door curtain, panels or slats, wind clips or wind locking mechanism components, hinges, connectors and guides. The tests covered in this note do not include the supporting structure that the door guides are attached to, but the test is useful to give an indication of the forces that might be transferred from the guides. *AS/NZS 4505:2012* includes a requirement to evaluate these forces in some way. The client should advise if these forces or any deflections are to be specifically measured as part of the test program.

6.2 Static Strength Testing – Non Cyclonic Regions

The CTS performs static strength testing in accordance with Clause *7.3 "Ultimate wind pressure test"* of *AS/NZS 4505:2012*. This standard sets out a test method for determining the resistance of a door to wind pressure for non-cyclonic regions. Static strength test results can be used to determine strength design wind capacities.

The test pressure is determined as the highest applied pressure, which was achieved and held for one minute, without the door failing the test. The test pressure is then divided by an appropriate factor to allow for variability of structural units ($K_{t,min}$) as defined in Table A2 of the standard to obtain the Strength Limit State Design Wind Load capacity. If a number of identical tests are carried out, then the lowest maximum test pressure is used, along with the appropriate value of Kt,min, to calculate the design pressure..

6.3 Static Strength Testing – Cyclonic Regions

For doors to be used in cyclonic areas, cyclic testing is required. Static Strength Testing is used to determine the target test pressure required for cyclic testing.

The CTS performs cyclic strength testing for garage doors and other large access doors in accordance with Clause *7.3 "Ultimate wind pressure test"* of *AS/NZS 4505:2012*. This standard sets out a test method for determining the resistance of garage doors and other large access doors to wind pressures in cyclonic regions.

A fatigue loading sequence will be conducted in accordance with Table A1 of *AS/NZS 4505:2012.* The fatigue loading sequence is presented in **Table 1** below where P_t is the test pressure.

***Table 1**: AS/NZS 4505 Fatigue Loading Sequence*

Range	Number of cycles
0 to 0.40 P_t	800
0 to 0.50 P_t	200
0 to 0.65 P_t	20
0 to 1.0 P_t	1

The client can nominate up to two ranges to pause and hold at for one minute during the final loading cycle, to increase the likelihood of achieving a cyclic result in the event that the test specimen does not reach the 1.0 P_t test pressure. The resulting test pressure in this situation will be that which was achieved and held for one minute prior to failure as long as all of the previous loading sequences have been successfully sustained.

The test pressure is then divided by an appropriate factor to allow for variability of structural units ($k_{t,min}$) as defined in Table A2 of the standard to obtain the Strength Limit State Design Wind Load capacity.

6.4 Strength Testing Acceptance Criteria

The test specimen can be considered to have passed, if all of the following criteria have been satisfied:

- There is no dislodgement of door components.
- There is no damage to any of the connections between the frame and the supporting structure, or between the door and the guide that would allow the door to become unlocked or open.
- There is no damage to any component, locking device, fastener or supporting stay which would allow the door to become unlocked or open.

As the test method is for an ultimate limit state design strength criteria, the test specimen can show signs of distortion and permanent deformation and be non-serviceable, and still be considered a successful outcome.

7 WINDBORNE DEBRIS IMPACT TESTING

7.1 General

Testing for resistance to windborne debris is optional and is not necessary to comply with *AS/NZS 4505:2012*. However, where a wind-borne debris impact rating is claimed or required in the design, it must be determined by testing. Where the specified range includes a variety of sizes, at least the largest and smallest sizes in the range shall be tested. The timber test member, used to test windborne debris resistance, is specified in *AS/NZS 1170.2*.

7.2 Typical Testing Requirements

Garage doors and other large access doors shall be tested as an assembly, consisting of the door curtain, panels or slats, wind clips or wind locking mechanism components, hinges, connectors and guides. In order to obtain a debris resistance rating the following criteria must be satisfied:

a) The door shall arrest the progress of the timber test member and there shall be no opening in the test sample large enough for the cross-section of the timber test member to pass through, and

b) The door and its guides shall remain attached to their supports. Any local damage shall not allow the specified timber test member to pass through. While the sample does not have to be re-tested, the door shall be in a condition likely to still be able to resist the wind-pressure for the relevant region (it may be severely deformed and be non-operational)

Multiple impact tests are conducted at different locations:

1. Centre of test specimen (mid-span)
2. Centre of supported edge within 300 mm of edge
3. In a corner of the test specimen
4. Where other materials (e.g. windows) are used, in the centre of feature (if present)

8 NATA ACCREDITED TEST REPORTS

After completion of testing, the CTS will issue a commercial-in-confidence test report describing the test methods and results and if requested, recommended design capacities for the configurations tested.

9 REFERENCES

- *AS/NZS 4505:2012* – Garage Doors and other large access doors
- *AS/NZS 1170.2:2011* –Structural Design Actions, Part 2: Wind Actions