JAMES COOK UNIVERSITY
AUSTRALIA

Cyclone Testing Station

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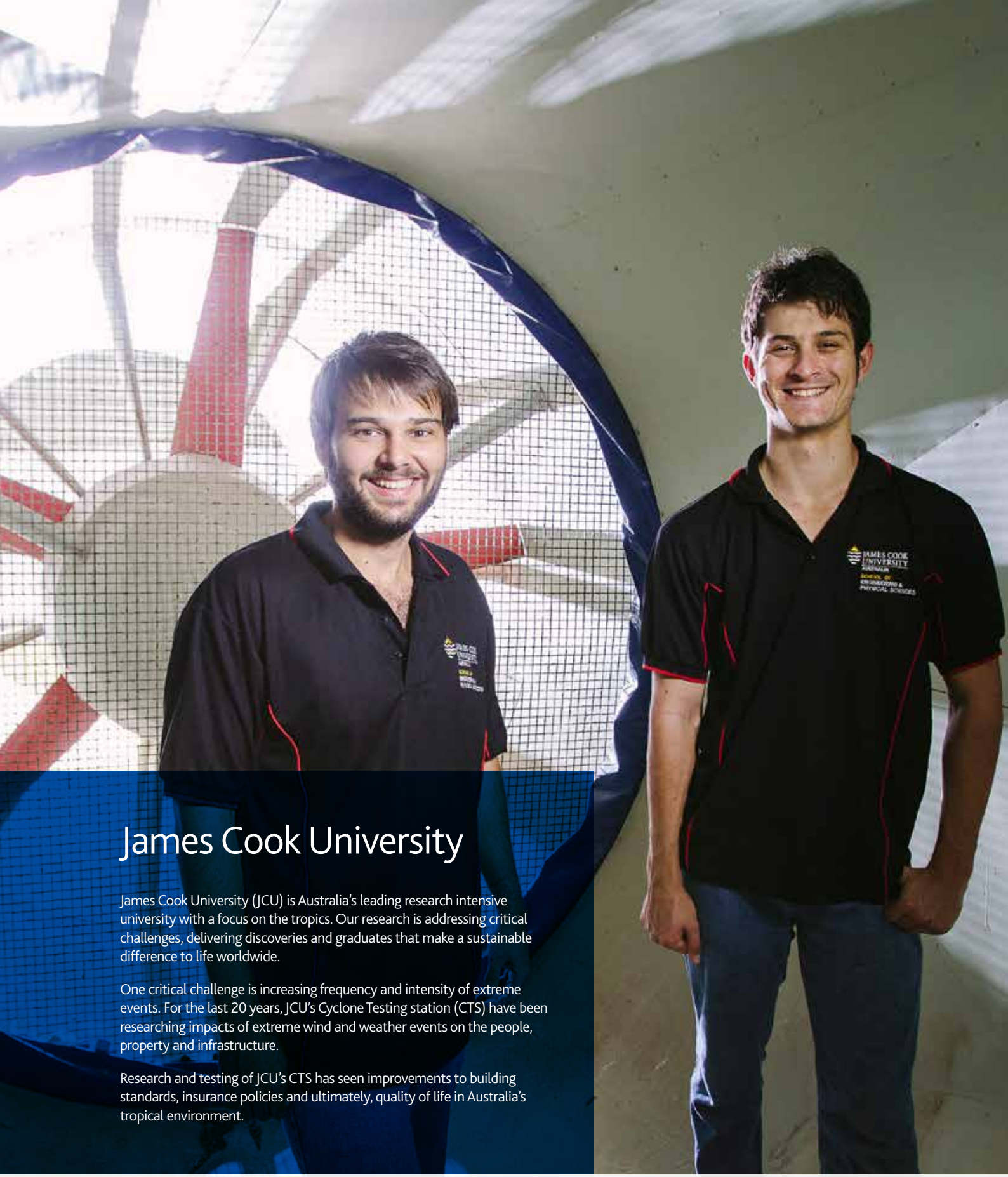

James Cook University

James Cook University (JCU) is Australia's leading research intensive university with a focus on the tropics. Our research is addressing critical challenges, delivering discoveries and graduates that make a sustainable difference to life worldwide.

One critical challenge is increasing frequency and intensity of extreme events. For the last 20 years, JCU's Cyclone Testing station (CTS) have been researching impacts of extreme wind and weather events on the people, property and infrastructure.

Research and testing of JCU's CTS has seen improvements to building standards, insurance policies and ultimately, quality of life in Australia's tropical environment.

Sponsors and benefactors

CTS thanks all of its benefactors and sponsors for their ongoing support

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Cyclone Testing Station

James Cook University's Cyclone Testing Station is the pre-eminent independent authority on the performance of buildings and structures in severe wind events.

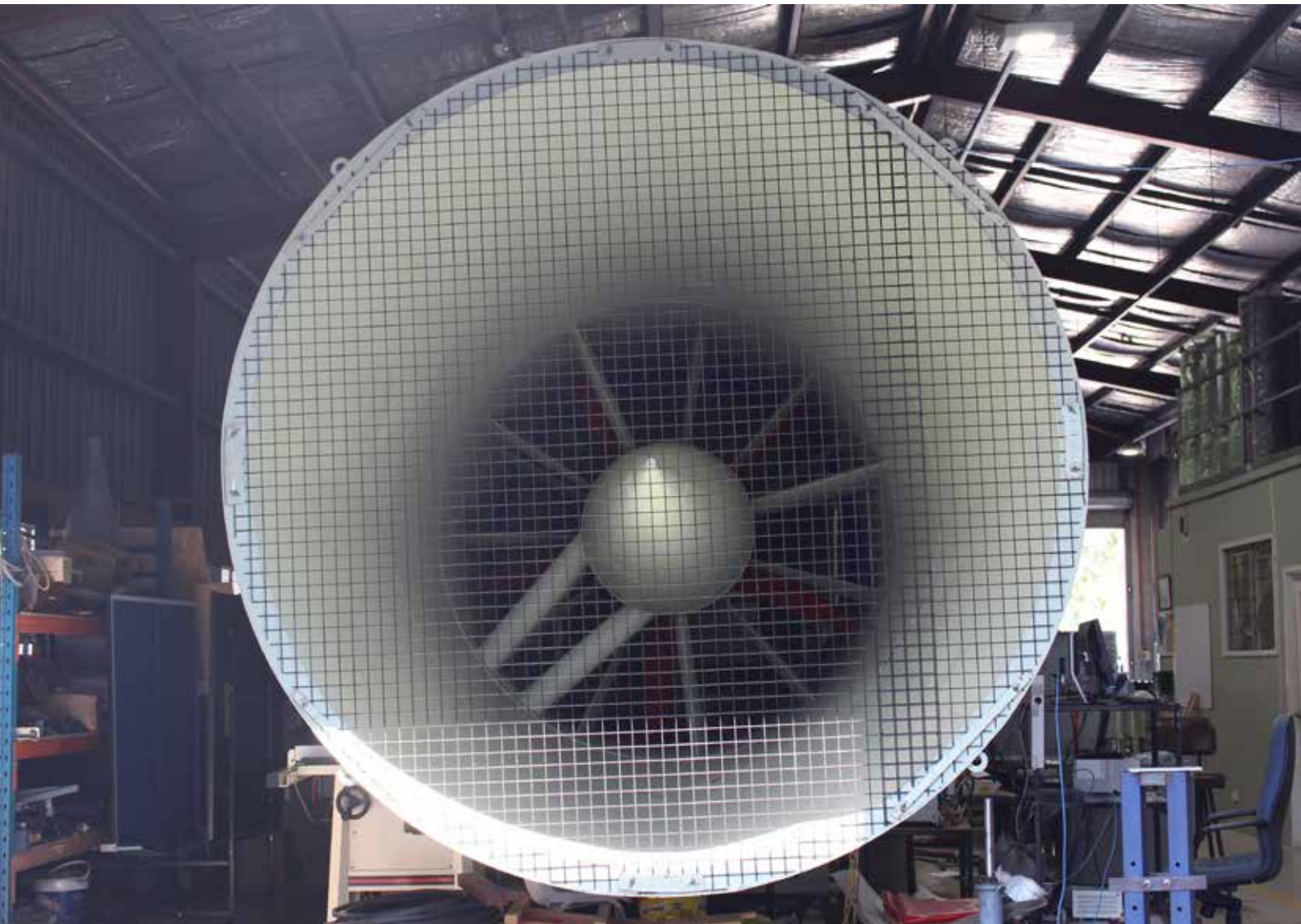
The CTS carries out research, standarised tests, damage investigations & education that generates the knowledge and data needed to inform government, industry and the wider community on building performance and fosters resilient, sustainable and affordable buildings and infrastructure.

CTS actively collaborates in the development of building regulations, standards and solutions, while developing risk mitigation and building resilience.

The CTS is a NATA (National Association of Testing Authorities, Australia) accredited testing laboratory in the field of mechanical testing and operates in accordance with ISO/IEC 17025.

The Cyclone Testing Station endeavours to:

- improve the safety of those who experience cyclones & severe wind events, and minimise their loss and suffering.
- drive technical leadership in the development of effective design & construction practices that lead to practical, durable and sustainable solutions and outcomes.
- deliver quality research & monitoring programs, testing services, technical advice and educational programs to support improved building resilience.
- build a public resource of good data on wind, buildings and infrastructure, to help guide building regulations and building practices.
- be at the forefront of risk mitigation and building resilience solutions in response to cyclones & other wind events, to recognise the CTS essential role in community safety & recovery, as well as insurance affordability



Areas of research

The Cyclone Testing Station conducts wind engineering research into the performance of houses and other buildings in response to cyclones and other severe wind events. The knowledge gained is used to improve building regulations and standards, to ensure that buildings are safe, economical and sustainable, as well as being disseminated via research papers and building industry forums. This research is directly used by industry in the development of new products and solutions.

Vulnerability of infrastructure to windstorms

The CTS works with industry groups to assess the vulnerability of infrastructure in cyclonic and non-cyclonic parts of Australia. Wind tunnel tests based on scale models and full scale wind load data, combined with observational data collected after cyclone events, are used to produce vulnerability models that estimate damage to a range of house types. The outcomes from this research are being expanded to align with the government regulations on adapting Australia's communities to changing climates.

Post disaster damage investigations

For over 30 years, the CTS has been at the forefront of damage investigations after cyclones and other severe wind events. The aim of these investigations has been to understand what building products and systems performed well, as well as identifying areas for improvement in building regulations and standards.

SWIRLnet

The Surface Weather Information Relay and Logging Network (SWIRLnet), is a network of portable anemometer towers that record and store data on wind speed, temperature, relative humidity and pressure and transmit wind speed data every 10 minutes during high wind events. These units and associated weather instrumentation are deployed ahead of a cyclone's predicted landfall to measure the cyclones' max wind speeds in northern Australia.

Working with Industry

Retrofitting strategies to reduce damage and loss for homeowners in cyclonic regions

Cyclones are a common natural disaster affecting the tropical regions of Australia. While the incidence of cyclones cannot be stopped, much can be done to mitigate the impacts on our tropical communities, and infrastructure. Since 1985, building codes in Australia have required that houses in cyclone prone areas are able to withstand higher winds; however insurers, governments and natural disaster management agencies still seek to reduce the risks and limit the compensation from these natural disasters.

Researchers at the James Cook University, Cyclone Testing Station (CTS), in partnership with a prominent Queensland insurer, Suncorp, are conducting innovative research analysing insurers' policy and claims data. This data is being used, in combination with CTS findings on damage investigations and full scale house testing, to highlight mitigation options to reduce the risk of damage from cyclones. Partners Suncorp, along with other insurers, are incorporating these learnings to actively promote mitigation/retrofitting strategies to reduce damage from cyclones as well as to reward homeowner with reductions on their insurance premium for mitigation work undertaken. The benefits are not only for older "pre-code" housing they can also improve the performance of new construction especially by reducing the damage from wind driven rain water ingress.

Other areas of research

While the CTS primarily work with buildings and infrastructure they also work across other areas and industries which can be effected by serve winds. These include:

- improving the performance of crop protection enclosures to resist wind loads
- assessment of forces on orchards and plantations as well as amelioration methods
- wind and wave impacts on coastal areas
- assessment of wind accelerating and shielding effects from surrounding landscapes
- Best practice guide for timber plantations in cyclonic areas

Testing for Industry

The CTS is the leading independent testing authority in Australia for wind effects on buildings and components. We provide services to the building industry as an authority for testing the effects of wind forces on buildings and building components and provides a comprehensive test report that can be used to further develop and accredit an industry product. Where standard test methods are not available the CTS has developed its own techniques to accurately simulate the effects of wind pressures on structural elements.

Windborne Debris Testing

The CTS has the facilities to test the impact resistance of building components. The impact resistance test is NATA accredited for impact velocities up to 15m/s. Testing to higher speeds is also available with a maximum sample size limited to 2m x 3m.

Two wind-driven debris simulators of different sizes are available to conduct simulated wind driven debris impact tests. Impact velocities of up to 40m/s (~140km/h).

Airbox Testing

The airbox is an open topped pressure chamber used to simulate wind pressure on structural elements such as roof sheeting, wall cladding, structural panels, roof vents, skylights, windows, doors and other building elements.

The airbox is available as a tool for industry to predict the likely response of products when subject to high wind pressures and for cyclic loading commercial testing.

Full Scale House Testing

One of the CTS's major advantages is the ability to test full scale housing infrastructure. This research involves the construction of full-size houses then testing them to measure their response to simulated wind forces.

By testing full-size houses rather than components the CTS can determine not only the overall strength, stiffness and resilience of the structure, but discover the weak links of the load paths, the path the applied loads take through the structure to the foundations.

Structural Testing Laboratory

A variety of tests can be conducted in the Structural and Materials Testing Laboratories, ranging from small scale tests of single connections (eg screw pull-out) to the evaluation of wall panel systems.

Universal Testing Machines

Three universal testing machines with varying capacities are available to test structural components and connections. The 10kN Instron testing machine is used for static tests only, while the 100kN Instron and the 1MN M.T.S servo-controlled testing machines can apply static as well as cyclic loads.

Structures Floor Loading Frames

The main feature of the structures laboratory is a reaction floor consisting of a 1.2m thick pre-stressed concrete slab which the testing rigs are attached to. The laboratory has an assortment of manual and servo-controlled jacks and rams ranging in capacity up to 1000 tonnes, together with associated measuring devices such as load cells and deflection gauges, and loading frames.

Airbag Test Rig

Products that cannot be wind-load tested in the airbox due to physical restrictions, can use the airbag test rig. The test load is applied to the face of the test sample by airbags compressed by a stiff loading platen connected to a hydraulic ram and load cell.

Wind Tunnel Testing

The Cyclone Testing Station operates at 2.5m x 2.0m x 22.0m long Boundary Layer Wind Tunnel to conduct research into the wind effects on building structures.

The CTS tests the spatial and temporal characteristics of wind pressures acting on various types of structures (such as canopy roofs, houses, industrial sheds and stadiums) and their response to these fluctuating pressures. Variation in internal pressure with varying envelope porosity and its interaction with the external pressure distributions are also analysed to determine the net wind loads on cladding and the primary structure. Other research areas include the use of pressure distribution for estimating the natural ventilation potential in houses, and wind flow patterns over complex topographical features which may be used to determine a site's wind energy potential. These research outcomes are incorporated into wind loading standards such as AS/NZS 1170.2 AS/NZS 4650, overseas standards and Australian building codes of practice.

The CTS offers commercial wind tunnel model testing services for:

- Cladding Pressure and Structural Loads
- Ground Level Wind Climate
- Structural Dynamics
- Building Ventilation
- Atmospheric Dispersion.

Testing Services

The testing services of the Cyclone Testing Station include, but are not limited to:

- Combined uplift and lateral loading of full scale house and light industrial building structures
- Static and cyclic wind loading of roof cladding, panels and tiles, wall cladding and panels, windows, doors, garage doors, shutters, screens and structural components such as roof battens. Applicable testing standards: AS4040.2/3, Specification B1.2 in BCA (Low-High-Low test) and AS/NZS4504.2
- Static and cyclic uplift loading of trusses/ rafters and their joints/fasteners
- Concentrated load testing of roof cladding and tiles (foot traffic requirements to testing standard AS4040.1)
- Static and cyclic racking tests of masonry, timber framed, steel framed, pre-cast concrete and panel wall assemblies. Applicable testing standard: TR440
- Static and cyclic uplift loading of masonry, timber framed, steel framed, pre-cast concrete and panel wall assemblies. Applicable testing standard: TR440
- Wind driven debris impact tests (standard missile and small spheres tests) of wall cladding and panels, windows, doors, shutters and screens. Applicable standards: Clause 5.3.2 in AS1170.2, Design Guidelines for Australian Public Cyclone Shelters (2001) and Design Guidelines for Queensland Public Cyclone Shelters (2006)
- Static and cyclic tension, withdrawal and shear loads of fasteners, joints and connections.

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Contacts

Please contact us if you wish to further discuss the services we can offer.

Email: **cts.admin@jcu.edu.au**
Phone: **07 4781 4722**

jcu.edu.au/cts

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