Cyclone Testing Station

Newsletter - December 2004 www.eng.jcu.edu.au/cts

Year of the Built Environment Award

The CTS was presented the 'Year of the Built Environment Award' in the field of Research and Investigation by the Queensland Dept of Public Works and Housing. The award recognised the Station's strong commitment and achievements in building research and investigation into improved construction techniques that help provide safer communities.

Minister for Public Works and Housing, Robert Schwarten, said the CTS's ongoing contribution to building technology and construction practice is of great value to communities in North Qld.

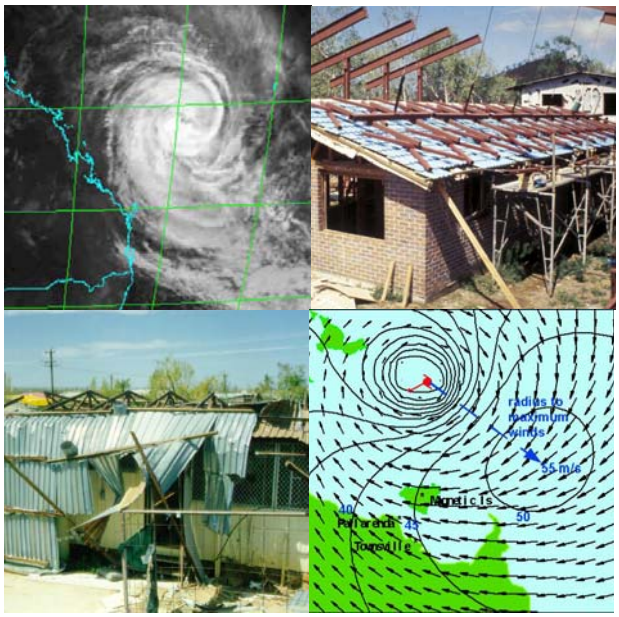
"The work of the CTS embodies all the themes of The Year of the Built Environment; healthy environments, building regional communities, excellence in building, imagining the future and design for all. For over 25 years the CTS has been committed to educating the industry and the general community, and the Station is a thoroughly deserving winner of this award," Hon Rob Schwarten MP

Mr Neville Keating, Chairman of the CTS, said the award was indicative of the important work carried out by the CTS, "It is very rewarding to have recognition for all the Station's work and achievements in research and education for the mitigation of damage to buildings from severe storms."

The CTS has broken new ground in testing full-scale structures, cladding fatigue, community vulnerability modelling, and wind-driven debris damage criteria. Many of the research findings are incorporated into Australian and international building standards and codes of practice, and the CTS is represented on several codes and standards, including 'Wind actions and wind loads for housing.'

EMA National Award

The Cyclone Testing Station along with the JCU Marine Modelling Unit has won the 2004 EMA National Safer Communities Award for our work on the 'Queensland Climate Change and Community Vulnerability to Tropical Cyclones Project'. The aim of the project was to assess the magnitude of the present and future ocean threat from tropical cyclones in Queensland, and the vulnerability of coastal communities to extreme winds.



The award was in the 'Pre-Disaster Category Combination (joint projects) Stream.' Contributors in this very large project were the Environmental Protection Agency, Department of Emergency Services, Department of Natural Resources, Bureau of Meteorology, Systems Engineering Australia, JCU Marine Modelling Unit and JCU Cyclone Testing Station. The project was in two parts (A and B) that ran simultaneously.

JCU MMU, SEA and the Bureau undertook Part A of the project which has updated and extended understanding of the threat of storm tide inundation in Queensland on a state-wide scale,

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including the effects of extreme wave conditions in selected areas, and estimates of potential enhanced Greenhouse climate impacts.
It has been a state-of-the-art assessment of the ocean hazards from tropical cyclones.

Under Part B of the project, the CTS and SEA developed an advanced numerical model of housing vulnerability under extreme winds for the Cairns, Townsville and Mackay regions. The study focused on houses and flats as they represent the shelter mainly used during cyclone events. For this reason, knowledge of housing resilience is crucial for agencies involved in disaster mitigation and response, as it serves to target disaster amelioration. The model is also capable of being extended to other regions and enhanced to incorporate probabilistic aspects such as those resulting from the Part A outcomes.

ISO 9001 compliance

The CTS is implementing quality management processes as a prelude to obtaining NATA certification. The CTS has been conducting quality testing and research for nearly three decades and has earned a well established reputation in Australia. However a formal accreditation of our testing activities will be beneficial in competing for new clients from overseas.

Wind tunnel refurbishment

Queensland Nickel Industries (QNI) has kindly provided a donation to fund the upgrading of the boundary layer wind tunnel data acquisition and measurement systems.

The wind tunnel has been used for pioneering research studies in wind loading of low-rise structures (houses, large sheds, etc). These studies provided data on low-rise structures, which have been incorporated into Australian loading standards.

Dr John Ginger inside the Wind Tunnel

Recent commercial projects conducted in the CTS Wind Tunnel have been; Townsville Bulk Sugar Storage facility, Gold Coast Convention Centre, NQEA Dry Dock facility, and investigation into anomalies of terrain affecting Bureau of Meteorology weather stations. Research projects have included Accelerated wind flow adjacent to complex topography, Natural ventilation of structures, Wind driven debris and Fluctuating loads on houses.

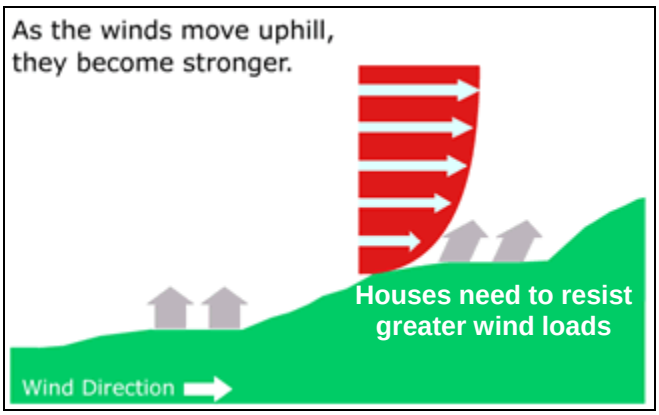
Wind flow over the earth's surface

Wind flow influenced by frictional forces near the earth's surface forms an atmospheric boundary layer, which may extend up to a height of more than 1000m. Buildings, depending on their surroundings, can have varying degrees of exposure to wind forces. For example, dwellings located in a suburban environment gain shelter from surrounding structures as opposed to houses by the sea or in open terrain. Topographical features such as hills can concentrate or divert the wind flow. Wind velocity fields around complex topographical features are frequently required for calculations in building design, site evaluation for wind energy potential, and siting or calibrating meteorological instrumentation.

Research carried out to study flow fields over simple 2D and 3D shapes have produced

topographical factors for mean and gust wind speeds, which are incorporated in loading standards. However, estimation of topographical factors for use on more complex topographical features is difficult, and often requires a wind tunnel model study.

Ground level, mean and gust wind speeds can be significantly affected by the local topography, such as cliffs, hills, ravines etc. For example, as the wind approaches a shallow hill, its speed reduces slightly as it encounters the start of the upward slope, and then increases as it flows up the crest. Maximum acceleration occurs at or near the crest, followed by a gradual reduction downstream to a value close to that well upwind of the hill.



Chris Matthews 2003, https://www.jcu.edu.au/cts

For steeper hills, flow separation can occur immediately downwind of the crest or further downstream, along with an effective 'stagnation' region on the steep upwind slope.

The boundary layer and topographic wind effects are incorporated into the wind loading standards AS/NZS1170.2 and AS4055. These wind loading standards show that design wind speeds;

- Increase with steeper topographical features.
- Increase with building height (In cyclonic regions a three storey house has approximately a 10 % increase in design wind speed compared to a similarly located single storey house).
- Decrease with surface roughness (There is a lowering of approximately 15 % for the design wind speed for a suburban sited house than a house located next to a large open area. AS4055 states the change in terrain takes a minimum of 500 m for this reduction in design wind load to take effect).

Choosing the appropriate wind modification factors is an important part of the design process.

Which way the wind blows

The Bureau of Meteorology uses Automatic Weather Stations (AWS) to record wind speeds for weather forecasting. A number of these are sited in locations affected by their surroundings (hills, buildings, trees, height, etc), which can result in the AWS anemometer giving potentially unsatisfactory forecasting information.

One such AWS anemometer is located at the top of a steep rise at Cape Moreton, near Brisbane. This AWS anemometer was thought to probably over-predict near-surface, ocean and flat land wind conditions, but the likely variability with wind speed and direction was unknown. Accordingly, the Qld Bureau commissioned the CTS to carry out a wind tunnel study to obtain the 'near ground-level wind velocity field' at the Cape Moreton AWS site and surrounding areas. This information may be used for 'calibrating' the wind flow at the AWS to that on flat land and provide more reliable wind speed data to assist forecasters.

The wind tunnel results indicated that the mean and gust wind speeds from the NW through to the SE at the elevated AWS site were more than 50 % and 30 % higher than the corresponding mean and gust wind speeds at sea level. For the ENE direction the mean and gust winds were modelled to be nearly 100 % and 50 % higher respectively!

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Wind tunnel model of the Cape Moreton AWS site

There are many other AWS throughout Australia located at sites where the wind speeds are likely to be significantly affected by local topography. Ideally, these AWS sites should be identified and audited in order to improve the value of the measurements for regional weather forecasting and to ensure that the long term records are accurate when used for establishing local design standards.

Structural engineers seminar

Dr John Ginger has been invited by the Institution of Structural Engineers and the Structural Branch of Engineers Australia, to give a lecture in Brisbane. The lecture is titled: "Wind loads for design of low-rise buildings". The presentation will summarise external and internal pressure data from a number of full scale and wind tunnel studies carried out on low-rise buildings, and compare these with data given in AS/NZS1170.2. The potentially conservative and un-conservative differences will be discussed.
6:00 pm Tuesday, 14 December 2004
Engineering House, 447 Edward Street, Brisbane

New financial supporter

Insurance Australia Group has become the latest financial supporter of the CTS. IAG joins the Queensland Government Department of Public Works, Bluescope Steel, Bluescope Lysaght, Stramit Building Products, and the Townsville City Council as a CTS Benefactor.

"IAG shares the CTS commitment to better understand the effects of severe wind on homes and commercial structures and in ensuring the community has access to the best available information on minimising losses from severe weather events."
Ms Leanne Stagnitta, National Products Manager, IAG

The Cyclone Testing Station is grateful for the ongoing support from its benefactors. This untied research funding allows the CTS to continue its work in a number of ways, including: building community awareness, standards development, fundamental research, and support in post disaster damage investigations.

CYCLONE TESTING STATION SUPPORTER

Email announcement

We are planning on distributing our Newsletters and Technical Alerts and Bulletins via our web site. This will enable us to get information out in shorter intervals and reduce our expenses. Please take the time to visit our popular web site and fill out the simple form at;

www.jcu.edu.au/cyclone-testing-station/contact-us

David, Cam, Don and John

Seasons Greetings from all of us at the Station, and all the best for the New Year.