# NEWSLETTER – SUMMER 2010

## Thoughts from the Chairman

The Cyclone Testing Station has had a busy year and has made some great progress on important issues that should lead to safer and more resilient buildings - especially important as we enter the summer cyclone season.

This issue includes articles on windows and roller doors. These have been shown to warrant attention in previous high wind damage investigations in both cyclonic and non-cyclonic areas. Community education programs are also discussed.

Several of the articles in this newsletter also highlight the progress that is being made in the development of new cyclic test methods and the benefits that can be derived from these.

I would like to welcome new and returning staff to the Cyclone Testing Station. The articles included here highlight the wide range of projects and locations that the CTS team is active in. This makes the roles both interesting and challenging. The projects also remind us that although our name might be the Cyclone Testing Station, our activities are by no means limited to cyclonic areas.

Finally I take this opportunity as we near year's end to wish all staff, colleagues and CTS supporters all the best for the festive season and a safe and bright start to 2011.

*Doug Meecham BE MESc RPEQ*
*Chairman, CTS Management Committee*

## Roller Doors and Sectional Doors

In January 2010 the Cyclone Testing Station wrote to Standards Australia to highlight an apparent inconsistency in design and test pressures for domestic garage doors. There are three different Standards that could be used to derive such pressures, AS/NZS 1170.2, AS 4055 and AS/NZS 4505. Unfortunately they do not give the same answers.

Standards Australia forwarded CTS's letter to the members of the relevant committees and sought their comment. Our understanding is that there was unanimous agreement that there is a problem and that this should be rectified.

Standards Australia has now begun a project to amend AS/NZS 4505. CTS put forward a revision aimed at aligning the Standard with both AS 4055 and AS/NZS 1170.2, so that AS/NZS 4505 could apply to all doors, not just those used in residential applications.

This is still work in progress. Until any such change occurs, manufacturers and suppliers of doors are encouraged to design and test using pressures derived from AS/NZS 1170.2.

Specifiers and certifiers should seek information to show that doors comply with the same pressures that apply to other cladding elements. This is a requirement of the BCA, to ensure that the entire building can resist a high wind event. For further information see CTS Information Bulletin No 4. Testing enquiries can be directed to cts.testing@jcu.edu.au or call Ulrich Frye on 07 47816091.

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## CTS Presentations in Darwin - "Keeping it together in a Cyclone"

With support from the Governments of NT, QLD and WA, the Station is undertaking a research and community education program to improve the resilience of housing and engineered buildings to severe wind events. As part of this program, the NT Government's *Department of Lands and Planning*, organized Station staff, Lex Somerville and Cam Leitch to fly to Darwin to give a presentation to building certifiers, builders and designers. Graeme Stark, who was in Darwin for CTS business, also attended the presentations that were held on three consecutive nights in August/September.

The hour-long presentations focussed on the importance of connections in the load path for houses. Topics covered included roof cladding, battens, window and door fixings, roller doors and durability and maintenance issues. The audience on each of the three nights comprised a mix of building certifiers, builders, engineers, manufacturers and designers. Afterwards, many took the opportunity to ask questions and discuss the topics covered.


*Cover Slide from the Presentation*

Fabio Finocchiaro, the Senior Director, Building Advisory Services from the NT Government's *Department of Lands and Planning* was very happy with the response and educational value of the presentations.

## Windows

The Cyclone Testing Station had identified concerns over poor window fixing practices that had crept into the industry in recent years. These issues have been discussed at length with the Australian Window Association. Our staff also participated in seminars run by the Building Services Authority (BSA) during 2010 to speak about window fixing.

The CTS is pleased to advise that AWA has taken the initiative to develop a window fixing guide aimed at addressing the issues identified. This can be sourced from the AWA web site

Designers, fixers and certifiers are encouraged to ensure that this document or other relevant industry literature is followed to ensure that window fixing is adequate. Previous problems from field surveys and damage investigations had included a lack of packing, under-sized nails and inadequate numbers of nails. Even though the window itself may have been fit for purpose, the entire unit could be easily dislodged in a wind event, as seen in the photo below from the Brisbane storms in November 2008.

*Photograph from CTS Technical Report No 55, showing window blown in as a unit as a result of poor fixing detail.*

## Solar Panels

One of the most significant changes to the building envelope on houses and other similar structures in recent years has been the widespread adoption of photo-voltaic (PV) solar panels for power generation. The rapid uptake has been supported by a range of government incentives.

The CTS is strongly supportive of any initiative to protect our environment, providing that adequate measures are in place to ensure that products are fit for purpose.

Amongst the range of measures that are necessary to ensure that PV solar systems are safe and resilient, the CTS is concerned that two issues have not been adequately addressed.

Firstly, there are no wind pressure coefficients for solar panels within Australian Standards or building regulations. Without that information, specifiers, designers, installers, builders, certifiers and regulators cannot be confident that systems will resist any imposed wind loading. Unlike solar hot water systems, PV panels usually cover a large percentage of the roof to maximize power generation. This means that wind pressure coefficients may also be influenced by local pressure factors near roof edges.

Secondly, PV panels are expensive and can be exposed to other loading effects such as hail and impact from wind-borne debris. The CTS recommends that some minimum standard is established to ensure that the panels themselves have a reasonable level of impact resistance to limit the need for widespread replacement.

The CTS is keen to work with other interested parties to ensure that pressure coefficients are established for PV panels. This may require a wind tunnel study. Impact resistance levels for solar panels also need to be established.

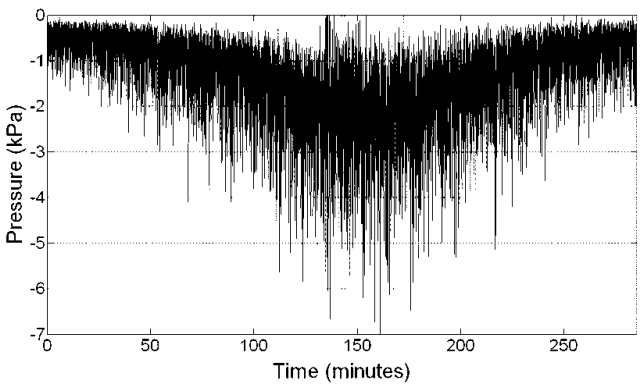
In the meantime, certifiers are encouraged to check documentation to show that wind pressure estimates appear to be reasonable, including consideration of local pressure factors where panels may be installed close to roof edges.

For further information, contact Cam Leitch at Campbell.Leitch@jcu.edu.au or on 07 4784754.

## The Next Generation of Cyclonic Wind Simulation

Historically, most testing and research of cladding subjected to wind loads has used forms of sinusoidal or on-off load cycles to represent the highly fluctuating nature of the wind pressure on the building envelope.

The Cyclone Testing Station has been applying dynamic wind pressure traces to cladding systems using the more recently developed Pressure Loading Actuator (PLA), an advanced multi-port valve and fan developed by the University of Western Ontario in Canada for their full scale house testing project. A pressure trace taken from full scale measurements or scaled from wind tunnel studies can be replicated by the PLA. As part of the research for David Henderson's PhD thesis, pressure traces representing cyclonic winds of up to five hours duration were applied to cladding specimens. The rapid and large fluctuating pressures can be seen in the figure.




*Typical pressure trace*

It may be an obvious statement, but the sight and sound of the cladding under load was quite different to that of standard loading trials based on earlier test methods. With no repetitive cadence to the loading, the intermittent large peaks in the applied wind trace were all the more dramatic with the cladding creasing and popping, then suddenly flexing back to pulse randomly to the smaller applied pressure fluctuations for a few seconds or minutes until the next large peak that would increase the buckle (or crack).

Amongst the many outcomes from this research, it has been demonstrated that the highly fluctuating loads applied to the cladding from the wind pressures are transmitted to the screw and therefore apply load cycles into the supporting structure such as top hat battens and purlins. This reinforces the need to have all components of the building envelope capable of withstanding dynamic fatigue loading.

This is one of the reasons that test methods for cladding systems in cyclonic areas state that the cyclic test must include (as a minimum) the cladding, its fasteners and its immediate supporting members.

## Testing the Wind Measuring Anemometers

The Dines anemometer, consisting of a pressure-tube and float system, was the main instrument for recording wind gusts used by the Australian Bureau of Meteorology for more than fifty years. The Dines records are a valuable resource used for the derivation of design wind speeds for our structural standards as well as climate change assessment and other applications.

With the phase out of the Dines to the cup-anemometer based Automatic Weather Stations (AWS) in the 1990s, there have been queries about the response of the Dines system to wind gusts, and whether the peak gust wind speeds are comparable to those recorded by the cup anemometers currently in use or whether some form of correction should be applied to the pre-1990 data. For example, the CTS (in Technical Report No 48 available at www.jcu.edu.au/cts) noted a 15% difference in the peak gusts recorded by the two anemometer types situated no more than 20 metres apart during Cyclone Vance at Learmonth, WA in 1999.

With the support and assistance from the Bureau of Meteorology and as part of the Department of Climate Change project: 'Extreme wind speed baseline climate investigation', we were granted access to two Dines units. One of the units is sited at the Townsville airport.

Using the Pressure Loading Actuator (PLA) that simulates cyclonic wind pressures, we were able to apply realistic wind pressure fluctuations to the Dines units and monitor their response. The PLA was mounted onto the tray of a utility and parked adjacent to the Dines on the airfield, as shown in the photograph. A portable 3-phase generator was parked nearby.

*On-site testing at Townsville Airport*

The testing involved applying steadily increasing pressures and sinusoidal

pressure cycles at different frequencies and amplitudes and of course realistic wind pressure traces. The testing showed that the Dines units accurately represent the mean wind speeds but can deviate on the peak gusts of short duration.

The CTS with our fellow project stakeholders are using the experimental data to assess potential changes in the current and historical wind data extreme values. Initial findings are reported in two papers presented at the recent AWES workshop: "Response of Dines Anemometer to simulated winds" by Henderson, Morrison, Ginger and Miller, and "Comparison of peak velocities recorded by Dines, cup and sonic anemometers" by Holmes and Henderson.

## Full Scale House Testing

Readers familiar with the history of the Cyclone Testing Station would know that it has been involved in the field of full scale testing of houses for many years, having tested nine different house designs over those years.

David Henderson is currently in Canada at the University of Western Ontario, building on the CTS full scale house testing research and collaborating with Dr Greg Kopp on the "Three Little Pigs" full scale house testing project. The current testing is on a timber framed hip roof of a two storey house.

Pressure loading actuators (PLA's) are able to replicate fluctuating wind pressures and apply them to the surface of the building envelope. Full scale testing of a gable roof at this facility has revealed that there is a form of load sharing spanning over successive trusses with progressive failure of the truss to top plate connections. This leads to a global roof failure mode at higher wind speeds than would be expected based on capacities of an individual truss to top plate connection. The instrumentation includes dozens of load cells mounted into the wall structure to capture the load dynamics of how the varying wind loads are felt across the house. Through the use of an array of 60 PLAs, spatially and temporally varying wind loads are being applied to the hip roof.

The full scale test program is to investigate the load transfer relationship of jack to girder trusses by measuring the reactions within the level of the wall frame; progressive failure of truss connection systems; and overall failure modes of the structure. During the program it is envisaged that elements of the house construction are to be altered, repaired or retrofitted and the same loading traces then re-applied, thus leading to improvements in safety and/or construction costs.

*Full Scale House Testing at University of Western Ontario*

## Workshops and Conferences

CTS staff, John Ginger and Chana Jayasinghe attended the Southern Hemisphere Extreme Winds Workshop on 4 August 2010, followed by the 14th AWES Workshop (www.awes.org) on 5 & 6 August, hosted by GeoScience Australia at their premises in Canberra. The following papers were presented there;

Jayasinghe and Ginger, *Probabilistic model of wind load on roof of low rise houses,*

Henderson, Morrison, Ginger. and Miller, *Response of Dines Anemometer to simulated winds,*

Ginger, Leitch, Kim, Jayasinghe and Henderson, *Vulnerability of metal-clad, hot-rolled sheds subjected to wind loads*.

Wehner, Sandland, Holmes, Kim, Jayasinghe and Edwards, *Development of software tool for quantitative assessment of the* v*ulnerability of Australian residential building stock to severe wind.*

The Extreme Winds Workshop focussed the wind climate in the southern hemisphere especially the recent storms that caused damage in places like Brazil, Uruguay, Argentina and Melbourne. A whole session was dedicated to discussing the intricacies of the Dines Anemometer on which the wind load standard is based. This was followed by two days listening to talks on wind engineering with a heavy emphasis on building vulnerability. A highlight was the quality of presentations by student members. The keynotes on the UWO Wind Dome by Horia Hangan and Regulatory aspects by Lam Pham were of particular interest to the CTS. The show during the Workshop Dinner at the Australian War Memorial made the workshop a memorable event.

On the return journey Chana Jayasinghe and John Ginger attended the Australasian Structural Engineering Conference, in Sydney, 8 to 12 August. The papers presented there were;

Jayasinghe and Ginger, *The vulnerability of housing components to wind loads,*

Henderson and Ginger, *Fluctuating wind loads for cladding design,*

Mackenzie, Watson, Somerville and Stark, *The importance of durability in building performance*.

The Conference Dinner was again the highlight!

John Ginger attended and presented papers at the Wind Risk Disaster Reduction Workshop (WRDRR) (run by APEC) as Australia's representative from 21-25 October in Korea.

An International Group for Wind-Related Disaster Risk Reduction (IG-WRDRR) was formally launched at the UN/ISDR Global Platform for Disaster Risk Reduction held in Geneva, Switzerland, June 16-19, 2009.

This IG-WRDRR is responsible for establishing linkages and coordinating various communities to serve as inter-agency coordinators with a charter to work with international organizations and to embolden their activities that help to serve as a bridge between policy makers and agencies responsible for actually carrying out the DRR at the local community level. The IG-WRDRR enables collaboration between academic associations related to various types of natural hazards and collaboration between academic associations and international/local organizations working on DRR.

Following the launch of IG-WRDRR, it has been decided to establish a Working Group on WRDRR inside IAWE (IAWE-WG). This IAWE-WG will support and lead the IG-WRDRR activities and will establish an IAWE Network for quick-response post-disaster investigation. Through the activities of the IAWE-WG, the IAWE will be able to contribute to wind hazard mitigation more significantly and effectively within the framework of the IG-WRDRR. The mission of the WG is even more significant in light of cyclones/typhoons that strike Southeast Asian countries.

## Cyclone Sunday Emergency Expo 14 Nov 2010, Townsville

Community awareness has always been a vision of CTS since its establishment in 1977. CTS has shared knowledge gathered through its extensive research studies and post cyclone damage investigations, with the local communities by being actively involved in various seminars, conferences and awareness programs.

This year, CTS along with other organisations including Emergency Management Queensland, Queensland Police Service and Bureau of Meteorology participated in the 'Cyclone Sunday Emergency Expo' awareness event held on 14th November at the Strand Park in Townsville. The event was organised by Townsville Local Disaster Management Group in conjunction with Townsville City Council, to assist the local community in their preparations for the coming cyclone season.

Volunteers from the CTS displayed posters, handed out brochures and interacted with the local community. The aim was to create awareness about the main causes of cyclone damage to houses and preventive measures that can be taken to reduce the risk of cyclone damage, as well as discussing the role that maintenance can play in improving housing performance.

*Cyclone Testing Station staff speak with visitors at the Expo*

## Staff News

Since our last newsletter there have been some changes in engineering and technical staff at the Cyclone Testing Station.

Ulrich Frye has now taken on a new role of Senior Engineer that includes primary responsibility for CTS Testing Services. New and existing customers seeking assistance with testing can contact Ulrich on 07 47816091 or via e-mail at cts.testing@jcu.edu.au.

Bipin Sumant has joined CTS in the position of Engineer, working closely with Ulrich and the rest of the team. Don Braddick has also returned to CTS as our Senior Technical Officer after a period working in Western Australia. Dennis Smith has also joined the team as our Technical Officer and is working with Don.

We welcome all these staff members to their roles. It is great to have them on board as we continue to strive towards better building practices.

We would also like to take this opportunity to congratulate David Henderson on completing his PhD. David is currently in Canada working on a collaborative research project between University of Western Ontario and the Cyclone Testing Station. He is due back in Australia in February 2011.

## CTS Web Site

This newsletter, along with previous newsletters, is available from our web site at:
http://www.jcu.edu.au/cts

If you are aware of others who may wish to receive future newsletters, or if you wish to stop receiving future newsletters via email, simply contact us at cts.admin@jcu.edu.au and include the words SUBSCRIBE or UNSUBSCRIBE, as appropriate.

A wide range of other CTS publications is also available on the CTS web site. Some important recent publications include:

CTS Technical Report No 56, "*Investigation of Housing and Sheds in Proserpine, Midge Point and Airlie Beach Following Tropical Cyclone Ului*" by D. Henderson, C. Leitch, U. Frye, J. Ginger, P. Kim and N. Jayasinghe.

CTS Information Bulletin No 4, "*Wind Resistance of Overhead Roller and Sectional Doors*" by George Walker and Graeme Stark.

The Cyclone Testing Station wishes to thank all of our Benefactors and Sponsors for their continued support.