APEC-WW Economy Report: Australia 2009

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ABSTRACT: This paper is submitted as an economy report which covers the progress with Australian wind code/standards AS/NZS1170.2, wind hazard data and wind engineering projects or events occurred in Australia in the past two years. Cyclone Hamish was estimated to reach a maximum gust wind speed of 82m/s. Computer simulation has predicted an increase of more than 10% in design wind speed for some areas if climate change induces increase in intensity and frequency of Tropical Cyclones. Five new wind tunnels were constructed during the last two years and Wind Engineering subjects are taught in two of the universities in Australia at present.

KEYWORDS: Australia, AS/NZS1170.2, wind hazard data, projects.

1 PROGRESS WITH AS/NZS1170.2

Many of the currently-proposed changes to AS/NZS1170.2 were reported at the APEC-WW 2007 meeting in Shanghai.

These are summarized briefly below. For fuller details and comments the reader is referred to the 2007 Economy Report for Australia,

- Torsion provisions

Eccentricity in the along-wind loads of 0.3 times the building width to be specified for buildings greater than 50 metres in height.

- Dominant openings

Roller doors and other types of door are to be treated as dominant openings for internal pressure assessment, 'unless they are capable of resisting the applied wind pressures and debris'.

Missile impact resistance for cyclonic areas to be restricted to facades up to 25 metres on any building

- Action combination factor

A complete re-draft of Section 5.4.3 of the Standard has been prepared. This allows a factor of 0.9 when two surfaces contribute to a load effect, and 0.8 when three or more surfaces contribute.

- Local pressure factors

Increased local pressure factors, K_ℓ , for small areas on windward walls of high-rise buildings (later extended to all buildings) to 1.5, and of 3.0 for the corners of roofs have been specified. The requirement for local pressure factors of 3.0 on side walls of taller building will be restricted by the building aspect ratio being greater than 1.0, rather than by the building height being greater than 25m as at present.

In addition, other changes for the next edition of AS/NZS1170.2 have been proposed as follows:

- Debris impact test

It is proposed to specify the debris impact loading test for dominant openings separately in a new Clause, and the debris speed has been linked to the regional wind speed. The horizontal impact speed for the 4 Kg timber will be specified as 40% of the regional wind speed.

- Regional wind speeds

Regional wind speeds V_1, V_{250}, V_{2500}, V_{5000} *and* V_{10000} *will be added for serviceability design requirements, for design of public storm shelters in Queensland, and for compatibility with AS/NZS1170.0 (General principles),*

- Internal walls and partitions

Addition of a new clause requiring consideration of wind loads on internal walls and partitions. Further numerical advice will be given in the Commentary to AS/NZS1170.2.

- Dominant openings on leeward walls, side walls and roofs

Correction of factors applied to external pressure coefficients for dominant openings on leeward walls, side walls and roof, to more correctly reflect the relationship between internal and external pressures when multiple openings occur.

- Structural damping

It is proposed to remove the current table giving values for structural damping ratios for structures with dynamic response to wind from AS/NZS1170.2, and insert a new section in the Commentary to AS/NZS1170.2 giving advice on possible values as a function of height of building and amplitude of vibration. It is believed that AS/NZS1170.2, as a Standard specifically on wind actions, should not require structural designers to use specific values of structural properties such as natural frequency or damping. Information is available from many other sources for these parameters.

- Curved roofs

A note to the table of shape factors for curved roofs will be added to cover the case of building height to rise greater than 2 – cases that are currently excluded.

- Cantilevered grandstand roofs

The load distribution specified for cantilevered roofs and canopies, covering mainly smaller roofs of grandstands of sporting grounds, will be revised to reflect recent research at the University of Queensland.

- Television antennas

Drag coefficients for sections of UHF television antennas Types 1 and 3 will be revised following recent commercially-sponsored studies in the large wind tunnel at Monash University. It is recommended that the value of drag force coefficients for the Type 2 antenna be removed from the Standard, since this type has not been used in Australia or New Zealand for many years.

- Pentagonal sections

Drag coefficients for pentagonal sections will be added to the table of drag coefficients for sharp-edged prisms.

Unfortunately progress towards publication of the next edition of AS/NZS1170.2 has been retarded by a number of factors, including resignation of key personnel at Standards Australia, and financial problems linked to the global financial crisis. It appears likely now that the revised document will be available for public review at the end of 2009 – possibly running into 2010, and be published at the middle of 2010.

2 WIND HAZARD DATA

Based on the Australian Bureau of Meteorology data, the most severe tropical cyclone occurred during 2008-2009 was Cyclone Hamish, which moved down the northeast coast of Australia on 7 March 2009. The storm was formed on 4 March off the Queensland coast (400km north of Cairns) and intensified as it moved southeast, keeping about 250 to 300km offshore. The maximum wind gust was estimated to reach 295 km/hr (81.94 m/s). It finally weakened and meandered back north off the Sandy Cape (300km north of Brisbane), without landfall, on 11 March. The overall wind hazard data for tropical cyclones during the last two years can be summarized as follows (note wind speeds are estimated from satellite images – not measured values):

Duration		Tropical Cyclone	Category	intensity (km/hr)	V10min (m/s)	mbar	Total fatalities	Total damage (2008 US$)
13-Nov-07	19-Nov-07	Guba	3	140	38.89	970		
13-Nov-07	15-Nov-07	Lee-Ariel	2	95	26.39	984		
28-Dec-07	2-Jan-08	Melanie	2	110	30.56	962		
3-Jan-08	6-Jan-08	Helen	2	90	25.00	975		
10-Feb-08	20-Feb-08	Nicholas	3	150	41.67	948		
27-Feb-08	7-Mar-08	Ophelia	2	100	27.78	985		
25-Mar-08	29-Mar-08	Pancho	4	175	48.61	934		
18-Apr-08	25-Apr-08	Rosie	2	95	26.39	988		
23-Apr-08	25-Apr-08	Durga	2	95	26.39	984	170	86.0 million
18-Nov-08	22-Nov-08	Anika	2	95	26.39	984		
17-Dec-08	28-Dec-08	Billy	4	175	48.61	948		
8-Jan-09	12-Jan-09	Charlotte	1	85	23.61	987		
22-Jan-09	27-Jan-09	Dominic	2	95	26.39	980		
30-Jan-09	4-Feb-09	Ellie	1	80	22.22	989		
2-Feb-09	10-Feb-09	Freddy	2	95	26.39	983		
1-Mar-09	5-Mar-09	Gabrielle	-	55	15.28	998		
4-Mar-09	11-Mar-09	Hamish	5	215	59.72	925		
12-Mar-09	27-Mar-09	Ilsa	4	165	45.83	958		
23-Mar-09	24-Mar-09	Jasper	2	100	27.78	980		
25-Apr-09	28-Apr-09	Kirrily	1	75	20.83	998	5	103.3 million

The corresponding cyclone tracks are given below:

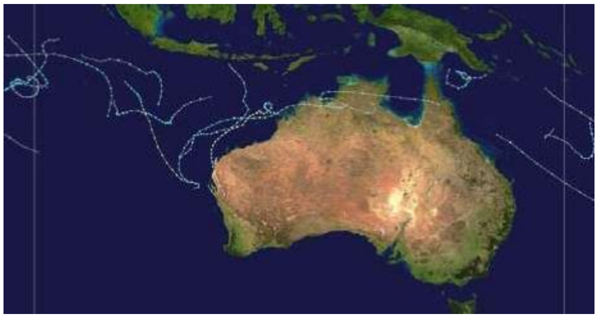


Fig. 1 2007-2008 Season Summary Map

Fig. 2 2008-2009 Season Summary Map

Geoscience Australia has also assessed severe wind hazards using Monte Carlo Simulation [1] and produced a Tropical Cyclone Risk Model [2], which generated synthetic cyclone tracks as shown in Figure 3 and the 0.2% annual exceedence probability wind speeds as shown in Figure 4. This statistical software will be made publicly available under the terms of the Disaster Mitigation Australia Package in the near future. Geoscience Australia is hosting the 14th Australasian Wind Engineering Society Workshop in Thredbo, Canberra, in June 2010.

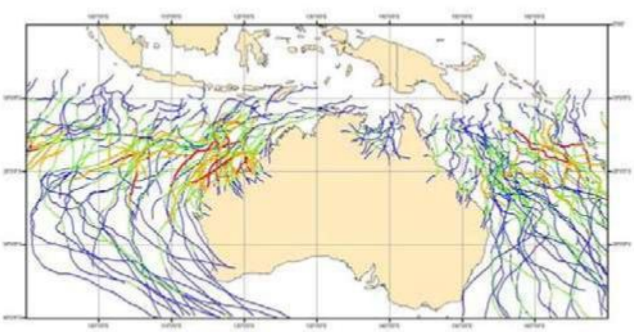


Fig. 3 Synthetic cyclone tracks (10years, 179 events)

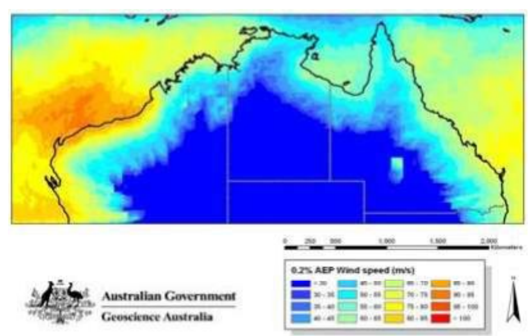


Fig. 4 Simulated wind speeds (5000years)

Preliminary work using General Circulation Models [3] has shown the impacts of climate change on tropical cyclone hazard and risk assessments. More recent study [4] on the sensitivity of extreme wind gusts hazard to buildings in Australia to climate change has also been presented. The effects of increasing intensity and frequency, possibly due to climate change, on the 500years return period gust wind speeds are extracted and shown in Figures 5 and 6.

Fig. 5 under current climate conditions

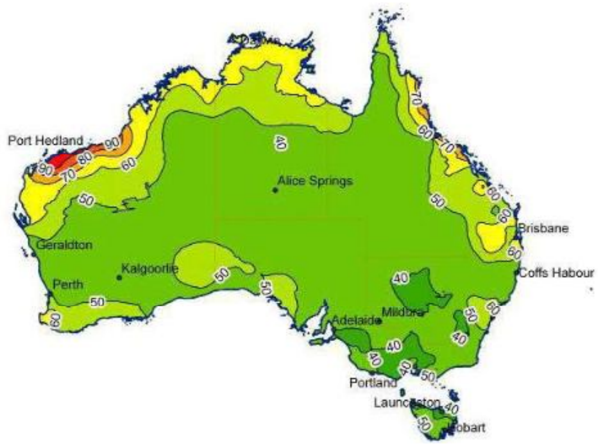


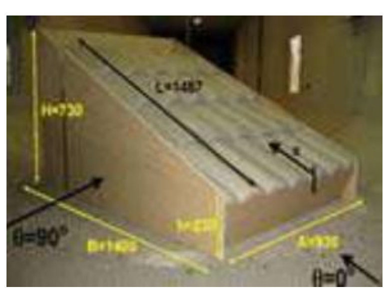
Fig. 6 intensity +20% & frequency +50%

A report was prepared in 2008 by JDH Consulting for the Australian Building Codes Board, reviewing possible impacts of predicted climate changes on design wind speeds in cyclonic regions in Australia [5]. This study indicated that in the Australian Region, the total number of cyclones has diminished in recent times. This can be related to the preponderance of El Nino events affected Australia's climate during the last few decades. However, there is evidence that the number of the more severe events has increased. Simulations of future climate, with projected increases in CO_2 concentrations, indicates further increases in the more severe tropical cyclones and a southerly drift in the genesis region on the Queensland coast. This indicates a greater risk of a severe cyclone affecting Brisbane and South-east Queensland than was assumed in the past.

3 WIND ENGINEERING PROJECTS

There are a number of wind engineering research projects coordinated by Dr John Ginger in the Cyclone Testing Station at James Cook University, Queensland, three of which were reported at 13th AWES Workshop in Hobart, December 2008. Peter Kim [6] related building internal pressures in a non-dimensional format with varying sizes of dominant openings and volumes. Dr Rolando Castillo [7] studied wind pressures on a permeable tile roof for various wind directions and batten spacing. David Henderson [8] is finishing his PhD work on the simulation of cyclonic wind loads on roof cladding.

(a) by Peter Kim



(b) by Dr Rolando Castillo

(c) by David Henderson

Fig. 7 Research projects carried out at James Cook University

Apart from wind loading on buildings and structures, other research projects of Wind Engineering topics being conducted in wind tunnels and full-scale at the University of Adelaide include Aero-acoustics of wind turbine blades and Wind Energy Production.

(a) Led by Dr Con Doolan (b) Led by Dr Maziar Arjomandi

Fig. 8 Research projects being conducted at the University of Adelaide

Wind engineering subjects are offered as part of engineering degree programs in the following two Australian universities:

1. University of Technology, Sydney – co-ordinated by Professor Bijan Samali (alternate years)
2. University of Adelaide – co-ordinated by Professor John Cheung (one semester per year)

There are a number of new wind tunnels completed in the last two years in Australia for commercial projects, which include CPP Consultants, Windtech Consultants, MEL Consultants, a small 3.5m by 1m wind tunnel at the University of Adelaide, and an automotive testing facility owned by Ford Australia and the University of Melbourne. The concept design for the large wind tunnel at the University of Adelaide by Associate Professor Richard Kelso has been completed and construction at its Thebarton campus site is scheduled to commence next year. Another new large wind tunnel is also proposed in the University of Sydney and Dr Steve Cochard has recently joined the University for the Project.

(a) CPP Sydney (b) Windtech (c) MEL (d) Adelaide (e) Ford-Melbourne

Fig. 8 New wind tunnels constructed during the last two years in Australia

4 REFERENCES

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