16th Australasian Wind Engineering Society Workshop
Brisbane, Australia
18-19 July, 2013

Windstorms in Victoria and Southern NSW – March 21, 2013

J.D. Holmes[1]

[1]JDH Consulting
Mentone, Victoria 3194

Abstract

This paper gives a short summary of the thunderstorm related wind damage that occurred in north-eastern Victoria and southern New South Wales on 21st March 2013. The damaging events included a confirmed tornado north of Lake Mulwala, NSW, and separate smaller events – most probably downbursts at Bundalong, Rutherglen and Euroa, all in Victoria.

Introduction

Severe winds impacted on Victoria and southern New South Wales on Thursday 21st March 2013, with significant damage produced by a well-publicised tornado in the Lake Mulwala region of NSW on the evening of that day. Other smaller severe damaging wind events occurred at isolated locations in north-east Victoria on the same evening. Melbourne also experienced strong northerly winds with some damage reported.

Although a detailed analysis or damage survey was not possible, this paper summarizes media reports and some 'on-the spot' checks by the author in the days following.

Synoptic situation and warnings

The isobaric chart for south-eastern Australia for 9a.m onThursday Match 21st 2013 (Figure 1) indicated strong northerly winds, followed by an approaching cold front and a low-pressure system, but was otherwise relatively benign with little indication of severe storms to come.

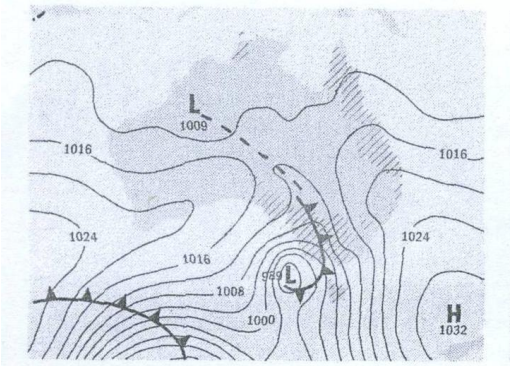

Figure 1. Isobaric chart for 9a.m., 21-3-2013

A 'Weatherzone' report issued at 3.30 pm on that day reported as follows:

" Rain, storms and gales lash Victoria
Ben McBurney, Thursday March 21, 2013 - 15:31 EDT

Thunderstorms, rain and damaging winds have lashed Victoria today, with more to come over the next few hours as a deep low and trough sweep across the state.

The most noticeable feature has been the wild winds, with many places seeing gusts in excess of 90km/h, strong enough to bring down trees and powerlines. The highest wind gusts have been seen about the ranges, with Mount Buller reaching 115km/h and Mount William 104km/h. However, damaging winds have also battered many low-lying parts of the state, including Melbourne.

The city has seen northerly winds average 40-60km/h since early this morning, with gusts reaching 90-100km/h during the morning and afternoon. Fawkner Beacon on the north side of the Bay reached 109km/h just before 3pm, its strongest wind gust since 2008.

Fast-moving thunderstorms are also sweeping over central parts of the state, including Melbourne. Further damaging winds are possible in any thunderstorms, as well as the risk for large hailstones."

By 5.45 pm, the Bureau of Meteorology announced:

"Severe thunderstorms are no longer affecting the Melbourne Area. The immediate threat of severe thunderstorms has passed, but the situation will continue to be monitored and further warnings will be issued if necessary.
A more general severe thunderstorm warning remains current for the North Central, North East, West and South Gippsland and parts of the Central, East Gippsland and Northern Country districts."

In fact, a number of severe local windstorm events occurred in north-east Victoria, and across the border into southern New South Wales, in the evening of 21/3/13.

The Lake Mulwala area

Most of the media coverage focussed on the severe damage that occurred at the Denison County Caravan Park on the north shore of Lake Mulwala. However, there were two other sites near the shores of the lake that also experienced significant damage: the Sun Country Holiday Village on the edge of the Lake Mulwala (NSW) township, and the small township of Bundalong at the eastern end of lake on the Victorian side, (Figure 2). To illustrate the localised nature of the damage, there was apparently no wind damage to buildings in the main part of the lake Mulwala township itself, or in the main town of Yarrawonga (Victoria). However, significant hail was reported in the latter.

Figure 2. Damage sites near Lake Mulwala (NSW-Vic border) (the red ellipse indicates the road from which a close-up video of the tornado was obtained)

A video of a tornado travelling east was made from a car on the Mulwala-Barooga Road (indicated by the red ellipse in Figure 2), and made available on 'You-Tube'. This was almost certainly the same event produced the extreme damage at the two caravan parks.

Figures 3 and 4 show images from the Denison County Park apparently taken the day after the event. These figures indicate damage reminiscent of tropical cyclones and probably wind gust speeds of 55+ m/s.

Figure 3. Aerial view of damage to the Denison County caravan park, Mulwala

Figure 4. Close up view of damage to the Denison County Caravan Park

Figures 5 to 9 show damage at the Sun Country Holiday Village taken some two weeks after the event. There is a mixture of caravans, attached annexes, separate cabin units, and boat storage units on this site. The worst damage appeared to occur at the north-west corner of the site, from which reportedly complete caravans were blown towards the north.

There were a large number of boat storage sheds on that site (Figure 6) with large roller doors, which, as expected, were not able to resist the wind pressure when on a windward wall. On the other hand some recently-constructed residential units seem to suffer no damage (Figure 7).

Some idea of the of the minimum level of wind speeds that occurred at this site can be obtained from a bus shelter that apparently was lifted by the wind and travelled several metres (Figure 8), and a substantial steel light pole (approximately 5 metres long, with a square hollow section cross-section 75mm square and steel thickness of about 2 mm) that was completely buckled at the base (Figure 9).

Figure 5. Roof damage – Sun Country Holiday Village, Mulwala

Figure 6. Boat storage sheds – Sun Country Holiday Village, Mulwala

Figure 7. Undamaged holiday units – Sun Country Holiday Village, Mulwala

The minimum gust wind speed required to lift the bus shelter, resisted only by the gravitational force, can be estimated by:

$$V_{min} = \sqrt{\frac{2mg}{\rho A C_L}} \qquad (1)$$

Taking m = 350Kg, A = 3.6 × 1.2 = 4.3 m^2, and C_L = 1.5, gives $V_{min} \cong$ 30m/s. This calculation, of course, assumes no structural resistance to the uplift force, so the actual wind speed at the time of failure could have been considerably in excess of 30 m/s. However, it should be noted that this structure was probably 200-300m from the centre of the tornado path

The average wind speed required to fail the light pole shown in Figure 9 (a) and (b), can be estimated approximately assuming the section is made from steel with 350 MPa yield stress:

$$V_{fail} = \sqrt{\frac{2M_{all}}{\rho\left[\frac{bL^2C_d}{2} + LAC_D\right]}} \qquad (2)$$

where M_{all} is the allowable moment for the section – estimated as 4.7 kN.m. The length, L, is 5 metres, b = 0.075m, C_d is 2.0 for

the square cross section pole, C_D is about 1.0 for the light, and A $\cong 0.03$ m^2. Then Eq. (2) gives $V_{fail} \approx 62$ m/s.

This may be a not unrealistic value, given that part of the site was close to the centre of the tornado path.

There was also apparently substantial damage to power transmission lines in the area. However, these had been repaired before the inspections by the author.

The damage in the township of Bundalong at the south-east end of Lake Mulwala was less severe, and more localised, than that at the two caravan parks reported above. Two houses had significant roof damage, and three or four others only suffered superficial damage. Given the distance (about 15 km) from the tornado damage reported above, and the localized nature of the Bundalong event – it was most probably a local downburst and independent of the tornado.

Figure 8. Bus shelter – adjacent to Sun Country Holiday Village, Mulwala

(a)

(b)

Figure 9. Buckled light pole – Sun Country Holiday Village, Mulwala

Rutherglen and Euroa

Other isolated severe winds occurred at Rutherglen - centre of a wine-producing region further up the River Murray from Lake Mulwala - and near Euroa, Victoria about 100 kilometres to the south east (Figure 10).

The damage in Rutherglen (Figure 11) was restricted to older buildings at the eastern end of the town, and to some winery buildings further east. There was no damage in the town of Euroa itself, but a service station on the Hume Freeway sustained some damage, although relatively superficial. (Figures 12 and 13). It is likely that these two events were local downbursts unrelated to the Mulwala tornado, except they were created on the same frontal system (Figure 1).

Figure 10. Damage sites in north-east Victoria

Figure 11. Roof damage – Rutherglen, Victoria

Figure 12. Soffit and canopy damage – Shell service station, Euroa, Victoria

Conclusions

A brief survey of the wind damage that occurred in southern New South Wales and north-eastern Victoria on 21st March 2013 has been given. The damage in Mulwala, NSW, was clearly caused by a tornado that crossed to the north of Lake Mulwala and was filmed by several people. Wind speeds probably exceeded 60 m/s in the core of the tornado, and it was indeed fortunate that it did not cross the more heavily populated part of Mulwala, or the larger centre of Yarrawonga across the border in Victoria. The wind speeds most probably greatly exceeded design levels (V_{500}) for Region A in this event; however, consideration of tornados is excluded from structural design by Clause 1.1 of AS/NZS 1170.2 (Standards Australia, 2011).

Weaker and more localised events occurred on the same day at Bundalong, Rutherglen and Euroa, Victoria. It is likely they were three separate severe downdrafts, with gust wind speeds of 30-35 m/s and significantly below design levels.

Fortunately no fatalities occurred during these events which occurred a week before the Easter holiday period, but a number of persons sustained injuries.

Figure 13. Panel damage – Shell service station, Euroa, Victoria

Acknowledgments

Some of the information in this paper was derived from media web sites which are duly acknowledged, as is the assistance of Jacqui Sonter of the Sun Country Holiday Village, Mulwala, NSW. The assistance of Leo Noicos (URS, Adelaide) in estimating the failure moment for the light pole is also gratefully acknowledged.

Reference

Standards Australia, Structural design actions. Part 2: Wind actions, Australian/New Zealand Standard AS/NZS 1170.2:2011.