Homebush Bay Bridge | Environmental Assessment

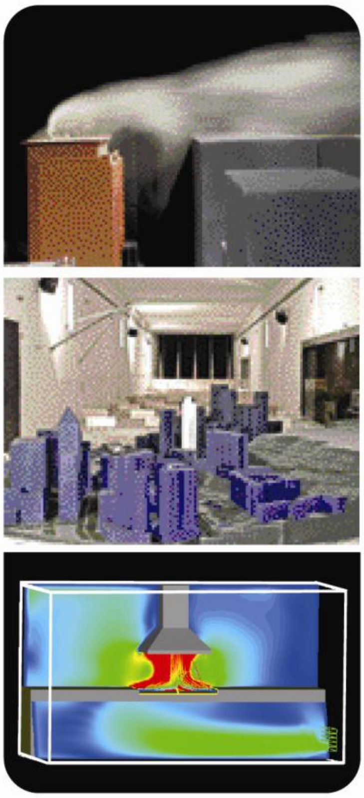
APPENDIX M

Wind assessment report

CERMAK
PETERKA
PETERSEN

WIND ENGINEERING AND AIR QUALITY CONSULTANTS

FINAL REPORT



Wind Assessment for:

HOMEBUSH BAY BRIDGE

Sydney, Australia

Fairmead Business Pty. Ltd.
c\- Arup Pty. Ltd.
Level 10, 201 Kent Street
Sydney, NSW 2000
Australia

July 2011

CPP Project: 5930

CPP
Unit 2, 500 Princes Highway
St. Peters, NSW 2044, Australia
info-syd@cppwind.com
www.cppwind.com

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

Introduction

Cermak Peterka Petersen Pty. Ltd. has been engaged by Fairmead Business Pty. Ltd. to provide an opinion based assessment of the pedestrian level local wind environment on and around the proposed Homebush Bay Bridge.

The proposed pedestrian, public transport, and cyclist bridge crosses Homebush Bay, linking Wentworth Point and Rhodes in Sydney, Figure 1. The proposed form of the bridge is shown in Figure 2 and Figure 3 with the pedestrian lane to the north of the bridge and the deck rising to a maximum height of 9.2 m above the high water sea level. From a wind engineering perspective, topography surrounding the site is essentially flat in the near vicinity of the site, rising slightly to the east along the Rhodes peninsula.

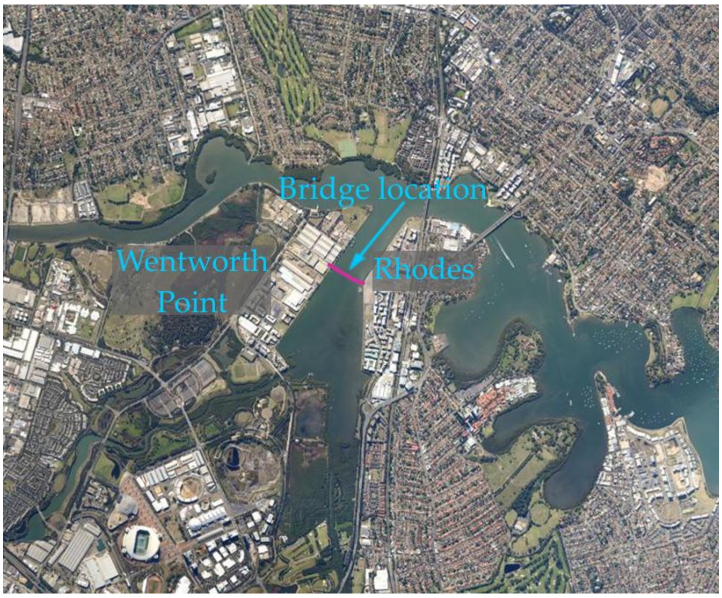


Figure 1: Location of the proposed development (Near Map, 2011)

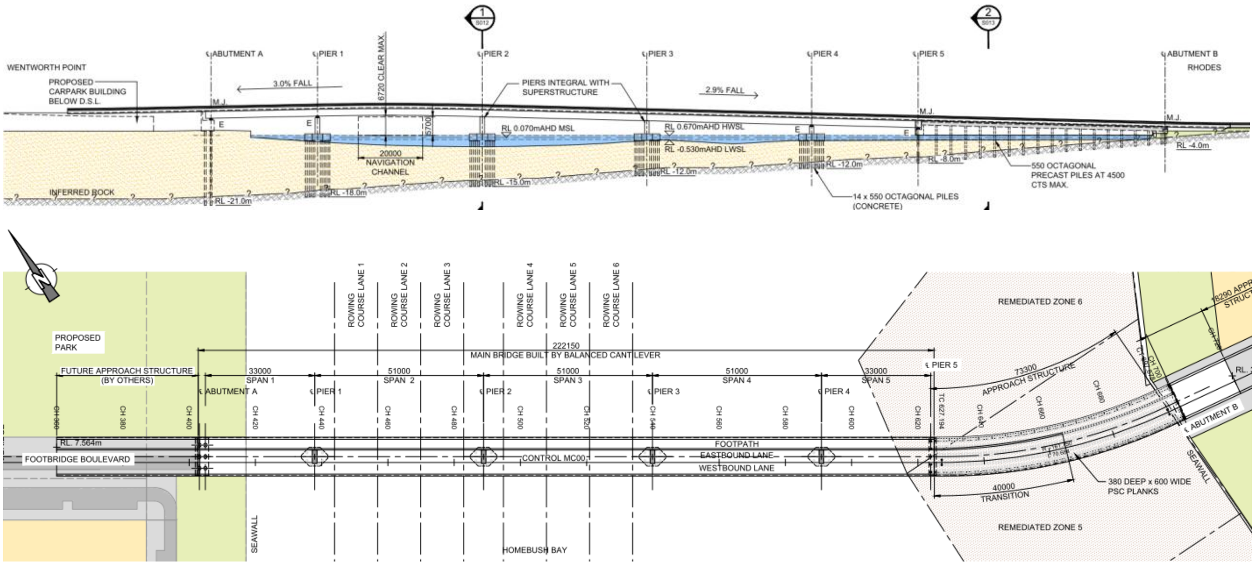


Figure 2: Plan and elevation of the proposed Homebush Bay bridge

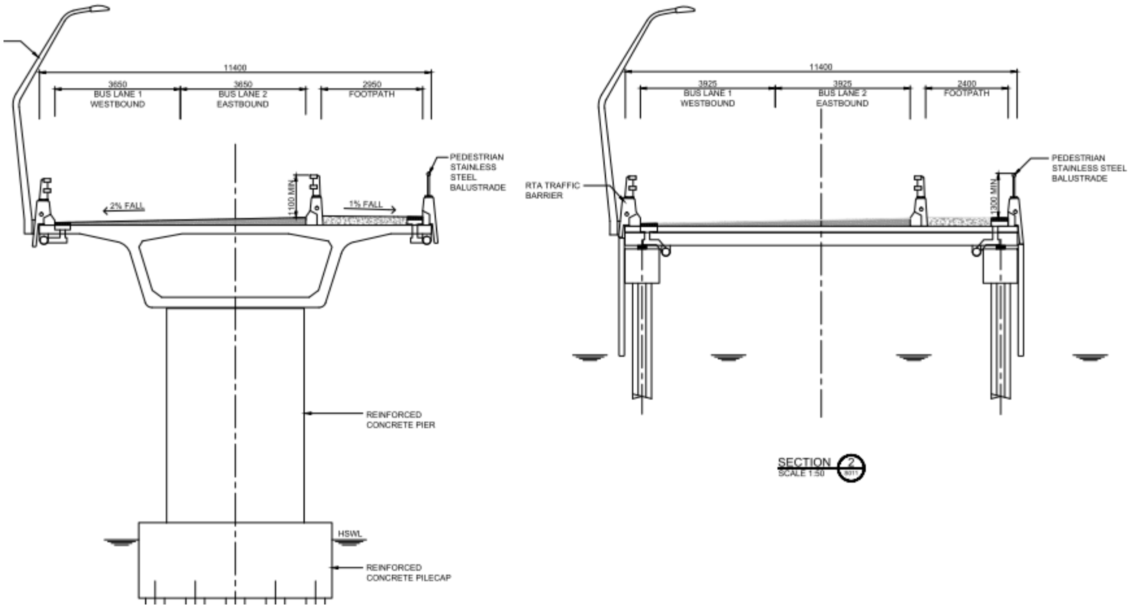


Figure 3: Sections through the Homebush Bay bridge

Sydney Wind Climate

The proposed development lies approximately 15 km to the north-west of the Sydney Airport Bureau of Meteorology anemometer, and 14 km to the north-east of the Bankstown Airport Bureau of Meteorology anemometer. The wind roses for the airports are shown in Figure 4, and are considered to be representative of prevailing winds at the site. The Bankstown anemometer is more shielded by surrounding suburbia hence the lower wind speeds. The Bureau of Meteorology anemometer at Homebush Bay is known to be directionally influenced by surrounding buildings hence the readings are unreliable for pedestrian level wind comfort analysis. It is evident that the prevailing winds in coastal Sydney come from the north-east, south, and west.

Winds from the north-east tend to be summer sea breezes and bring welcome relief on summer days, but dissipate with distance from the coast and are mild at Homebush Bay and almost non-existent at Bankstown.

Winds from the south tend to be cold and tend to be associated with frontal systems that can last several days and occur throughout the year.

Winds from the west are the strongest of the year and are associated with large weather patterns and thunderstorm activity. These winds occur throughout the year and can be cold or warm depending on the inland conditions.

The prevailing wind directions associated with rain are from the south and west quadrants.

This wind assessment is focused on these prevailing wind directions.

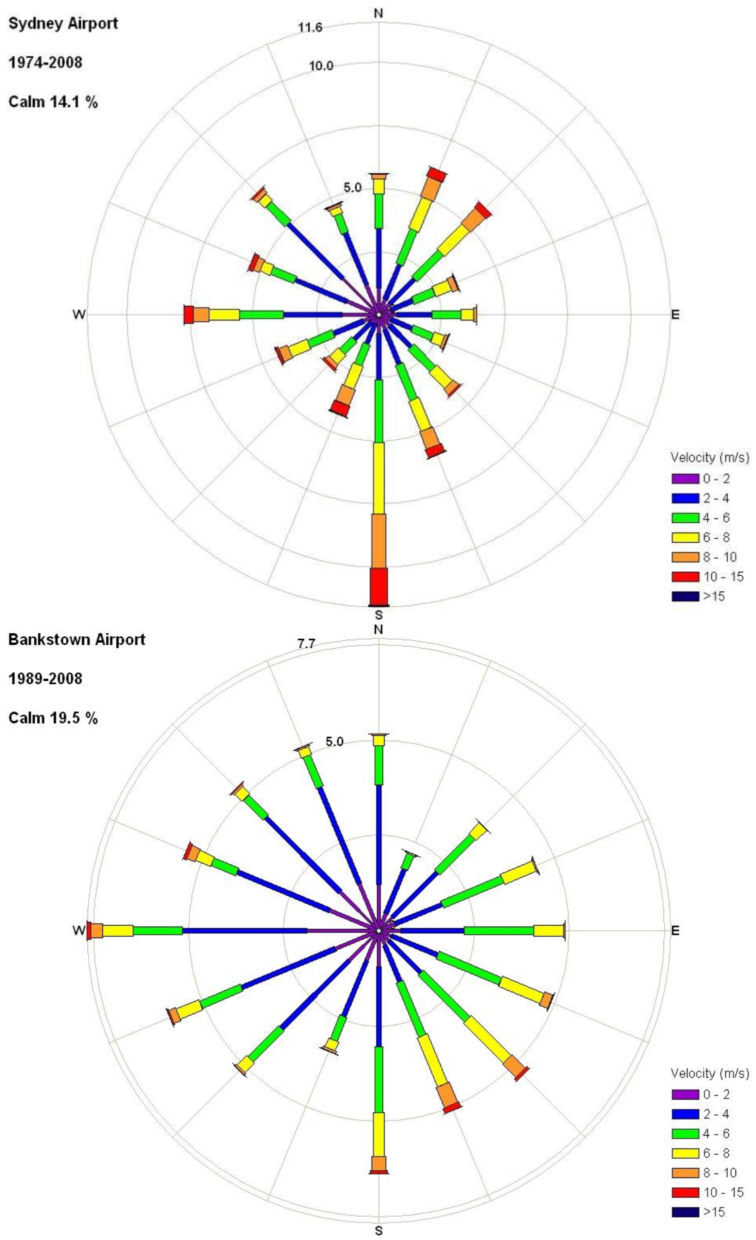


Figure 4: Wind rose for Sydney and Bankstown Airports

Environmental Wind Speed Criteria

It is generally accepted that wind speed and the rate of change of wind velocity are the primary parameters that should be used in the assessment of how wind affects pedestrians. Local wind effects can be assessed with respect to a number of environmental wind speed criteria established by various researchers. Despite the apparent differences in numerical values and assumptions made in their development, it has been found that when these are compared on a probabilistic basis, there is remarkably good agreement.

Auburn Council or City of Canada Bay Council do not have any specific wind criteria in their Development Control Plans. The City of Sydney, Central Sydney Development Control Plan 1996 (DCP) specifies the once per annum maximum gust around proposed building developments should not exceed 16 m/s. This wind assessment criterion is based on the work of Melbourne (1978) and relates the acceptability for use as a main public accessway during daylight hours to a once per annum 3 s gust wind speed. These criteria yield no direct information on the mean wind climate or the percent of year that serviceability winds occur, which are generally of most use to town planners and architects.

As well as the once per annum maximum gust wind speed, this study is based upon the criteria of Lawson (1990), which are described in Table 1 for both pedestrian comfort and distress. The benefits of these criteria over many in the field are that they use both a mean and gust equivalent mean (GEM) wind speed to assess the suitability of specific locations. The criteria based on the mean wind speeds define when the steady component of the wind causes discomfort, whereas the GEM wind speeds define when the wind gusts cause discomfort.

Comfort (maximum wind speed exceeded 5% of the time)	
<2 m/s	Outdoor dining
2 - 4 m/s	Pedestrian sitting (considered to be of long duration)
4 - 6 m/s	Pedestrian standing (or sitting for a short time or exposure)
6 - 8 m/s	Pedestrian walking
8 - 10 m/s	Business walking (objective walking from A to B or for cycling)
> 10 m/s	Uncomfortable
Distress (max. wind speed exceeded 0.022% of the time, twice per annum)	
<15 m/s	General access area
15 - 20 m/s	Acceptable only where able bodied people would be expected; no frail people or cyclists expected
>20 m/s	Unacceptable

The wind speed is either a mean wind speed or a gust equivalent mean (GEM) wind speed. The GEM wind speed is equal to the 3 s gust wind speed divided by 1.85.

Table 1: Pedestrian comfort criteria for various activities

Environmental Wind Assessment

Wind flow around a bridge does not significantly change the wind flow pattern, or create localised high wind speeds unless there are significant solid barriers. The current design has a solid 1.3 m high balustrade on the north edge, and open 1.3 m high balustrades on the south edge and between the cyclist and pedestrian lanes. The raised central section of the bridge has a relatively streamlined edge. The below-deck sections of the low, end sections bridge are enclosed with precast panels.

For all wind directions, the wind conditions on the bridge will be similar to those on land away from buildings, which locally accelerate the flow causing large changes in wind speed over a relatively short distance. The streamlined nature of the bridge deck and the porous nature of the southern balustrade will limit the amount of interference of the structure on the flow pattern. The open wind environment will generate relatively constant windy locations with a turbulence level that doesn't change rapidly with distance, which is important for cyclists. The windiest locations on the bridge will tend to be on the approaches near the building corners.

The solid balustrade to the north of the bridge will offer better protection for pedestrians as it creates a calmer, but more turbulent environment.

Conclusions

Cermak Peterka Petersen Pty. Ltd. has provided an opinion based assessment of the impact on the local wind environment of the proposed Homebush Bay bridge. Wind conditions on the bridge are expected to be suitable for winds from all directions for all pedestrian traffic.

References

Lawson, T.V., (1990), The Determination of the wind environment of a building complex before construction, *Department of Aerospace Engineering, University of Bristol*, Report Number TVL 9025.

Melbourne, W.H., (1978), Criteria for environmental wind conditions, *J. Industrial Aerodynamics*, **3**, 241-249.