Attachment A23

Indicative Computation
Fluid Dynamic Study
187 Thomas Street, Haymarket

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Our ref 270416
File ref -

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12 August 2020

187 Thomas Street – ground level wind conditions

Dear Mr. Jones,

Please find herein a brief report discussing the results of the indicative Computation Fluid Dynamics (CFD) study to show the benefits of potential design changes to the building on the wind conditions around the proposed development at 187 Thomas Street, Sydney. This report follows on from the meeting with the City of Sydney Council on 27 July 2020 where such a quantitative study was requested to illustrate the potential level of improvement such changes to the tower design would have on the local wind conditions prior to the design competition. Due to the relatively minor exceedances of the comfort and safety criteria measured in the wind-tunnel tests and the relative tight timeframes to conduct the analysis, it was agreed that a comparative numerical study would be appropriate to illustrate the impact of changes to the building massing on the local wind environment relative to the wind-tunnel testing.

Summary of previous results

Three configurations were previously wind-tunnel tested: existing, baseline, and proposed indicative scheme 5B. The results for the proposed indicative scheme are presented in Figure 1 showing exceedances of the safety criterion, and directional results: the contour plots show the comfort conditions with the contours at a 5% directional level, and the smaller polar plots indicate the wind directions contributing to the safety criterion. It is evident that the wind directions causing the safety exceedances are from the south and west-north-west. On the contour polar plots, wind speed measurements outside the yellow (walking) contour are the important results to mitigate.

CFD modelling

A 3d model of the site building and surrounding buildings in the near-field was prepared for the numerical study, Figure 2. Three site models were considered, Figure 3, based on the proposed potential mitigation techniques discussed in our previous report dated 12 June 2020. Configuration 5B was the proposed scheme from the previous wind-tunnel tests, Configuration 6A has an additional notch to the west, and Configuration 6B includes a more rounded south-west tower corner. All schemes have a 20:1 floor space ratio above ground with the amended geometry slightly increasing the height of the tower, but remaining inside the proposed DCP envelope. The site models did not include any awnings, which would locally improve the wind conditions.

The 3d numeric model was meshed with about 12 million cells. Each site model was modelled for the two significant incident wind directions: south and west-north-west. The

CFD analysis was conducted using a steady-state RANS simulation with an approach boundary layer profile suitable for the city environment. The volume refinement regions were introduced refining mesh to a radius of 100 m around the building to accurately capture flow features closer to the building and surrounding streets. The model was run for over 2000 iterations to allow model convergence. Monitor points on the surrounding streets and around building were implemented to ensure parameters convergence. The results show the mean wind speed and do not represent the magnitude of the gust, however the magnitude of the reduction would be expected to be similar.

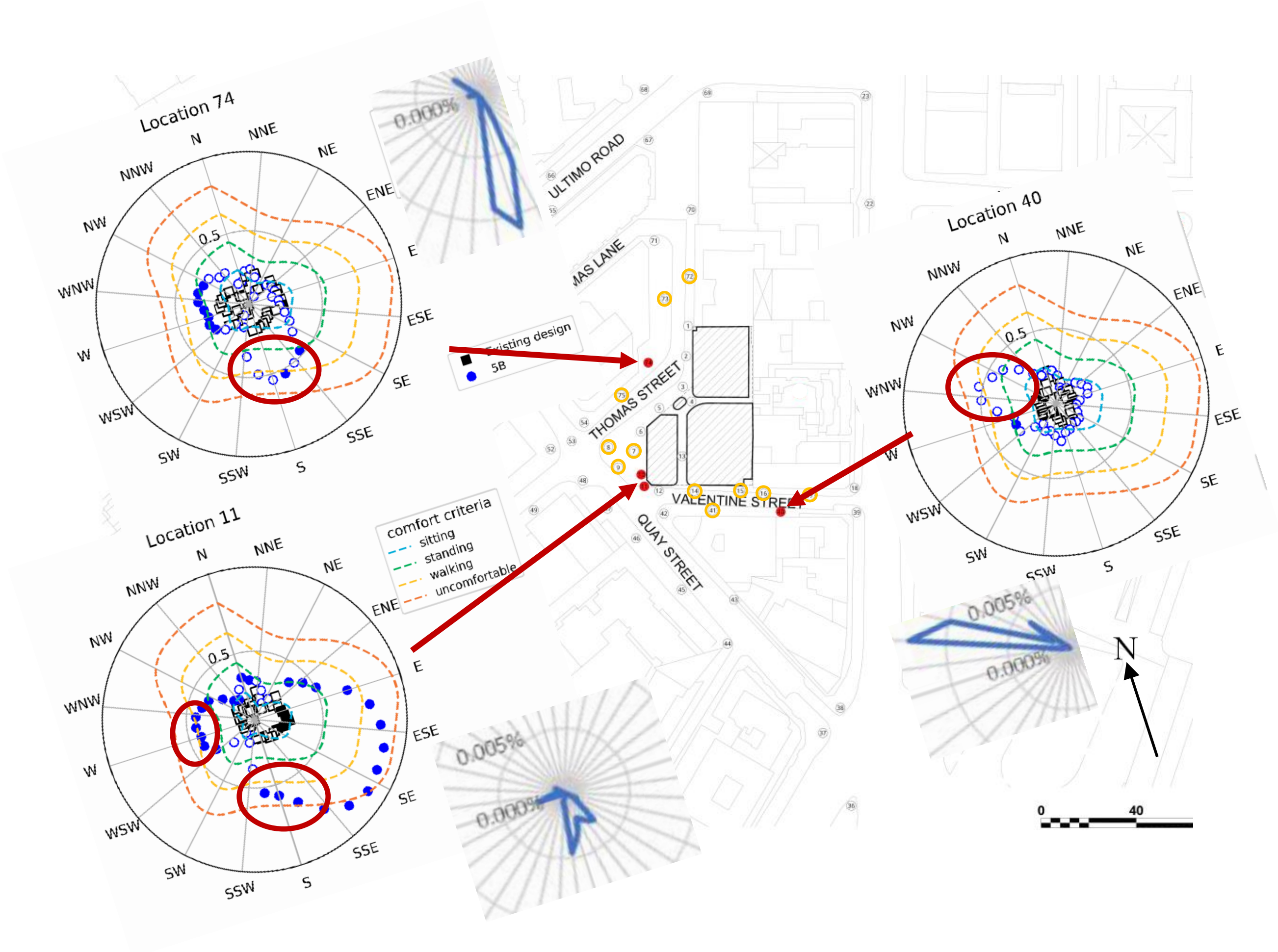

Figure 1: Proposed option 5B configuration safety wind rating and directional plots

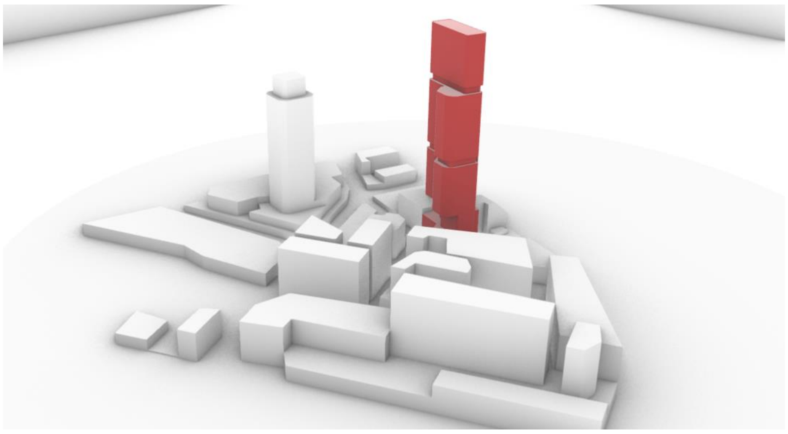

Figure 2: Extent of generic numeric model viewed from the south-west

Comparative results showing the wind speed ratio are presented in Figure 3. The wind speed ratio is the local mean wind speed at pedestrian height of 1.5 m divided by the mean wind speed at 10 m above ground level at the domain inlet. The relative wind speed ratios at the various points across the different wind directions are similar to those measured in the wind-tunnel tests, Figure 2, providing confidence in the results of the numerical modelling.

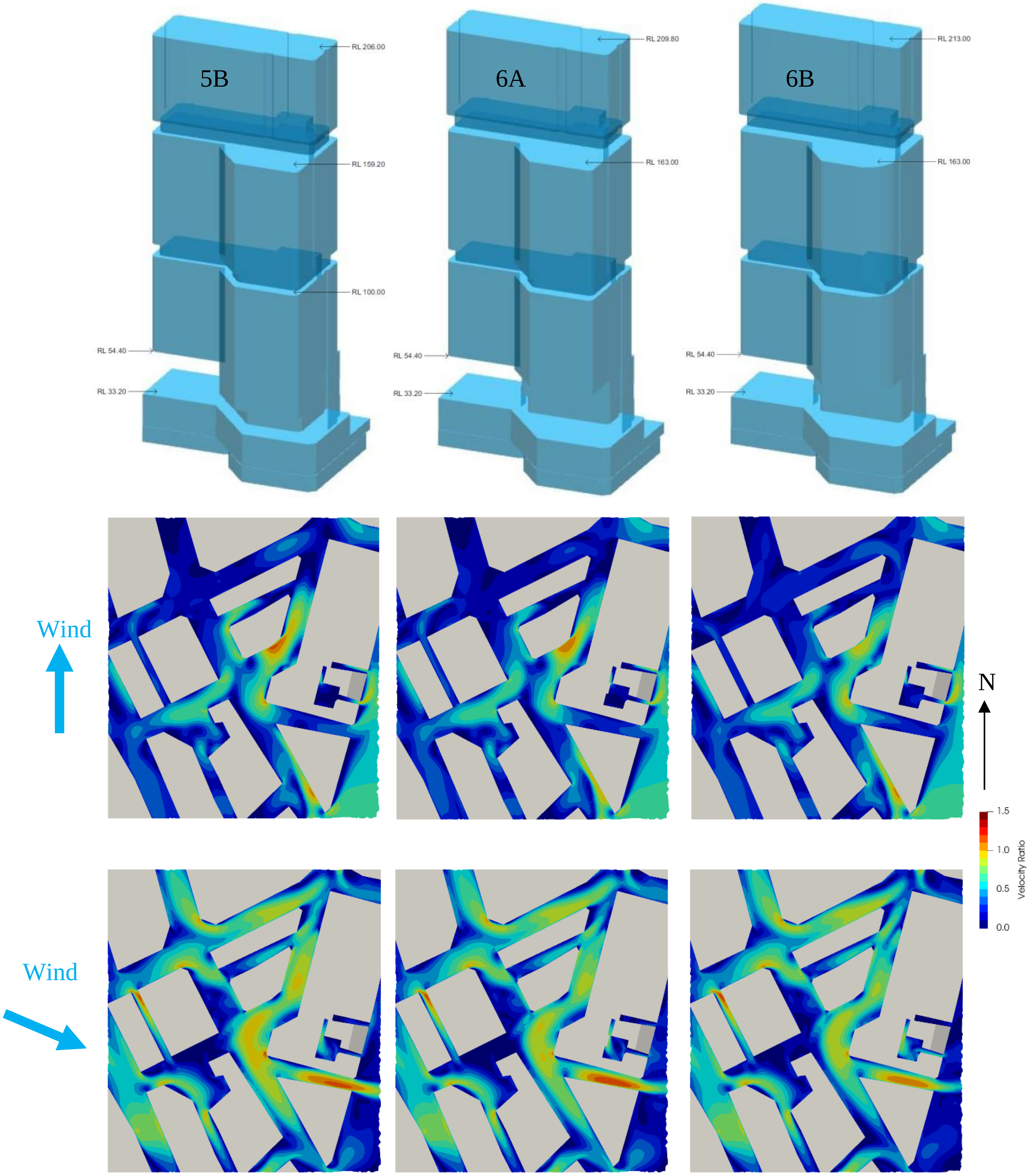

Figure 3: Tower forms viewed from the south-west, and comparative CFD results at 1.5 m above ground

For winds from the south, it is evident from Figure 3 that the inclusion of the western notch and rounded south-west tower corner, reduces the peak values along Thomas Street by about 10%, and reduces the extent of the affected area. The western notch allows a portion of the flow to be redirected to the east of the building on the east side of Thomas Street, and over the lower rise buildings to the north, Figure 4 thereby reducing the flow to the north-west along Quay Street. The curved south-west corner encourages more horizontal flow over the height of the tower reducing the amount of downwash. The wind conditions around the corner of Thomas and Valentine Streets are similar in all configurations, and would be better mitigated with local treatment such as an awning.

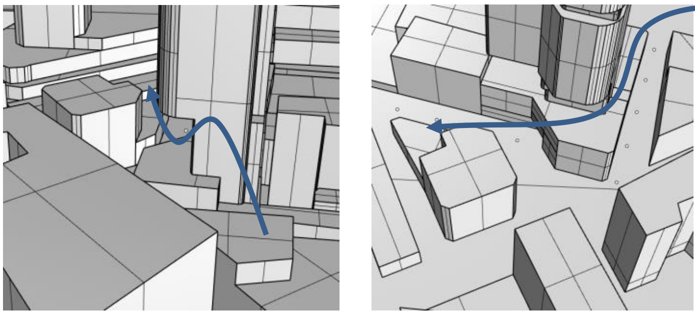

Figure 4: View from the south (L) and west (R) showing flow path

For winds from the west-north-west, the western notch shifts the peak affected zone along Valentine Street to the west further from George Street, but does not reduce the size or intensity of the wind speed. This is caused by the relative height of the notch to the buildings on the south side of Valentine Street. The inclusion of the rounded south-west corner encourages horizontal flow over the height of the tower, thereby reducing the amount of downwash improving the peak mean wind speed and the size of the affected zone along Valentine Street. This massing also improves the wind conditions along Thomas Street. In more detailed design, there would be the potential to investigate the relative height of the notch, to the roof heights on the buildings to the south of Valentine Street to further reduce the size and intensity of the wind conditions along Valentine Street.

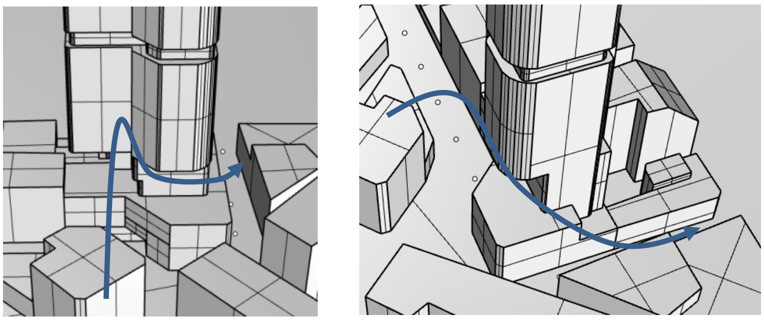

Figure 5: View from the west (L) and south-west (R) showing flow path

The directional wind tunnel test results for Configuration 5B at Locations 40 and 74 are presented in Figure 6. The CFD results for Configuration 6B were used to predict the comfort conditions at these locations. It is evident that these results lie inside the comfort walking contour for all directions, therefore the locations already meeting the walking comfort criterion would be improved.

From the wind tunnel testing on Configuration 5B, the safety criterion at Locations 40 and 74 were 25.4 and 25.7 m/s respectively, exceeding the 0.5 s gust wind speed in an hour limit of 24 m/s. As these peak values are associated with the downwash flow mechanism associated with strong mean flows, it would be expected that the safety result would decrease by a similar amount. Configuration 6B would therefore be expected to similarly meet the wind safety criterion.

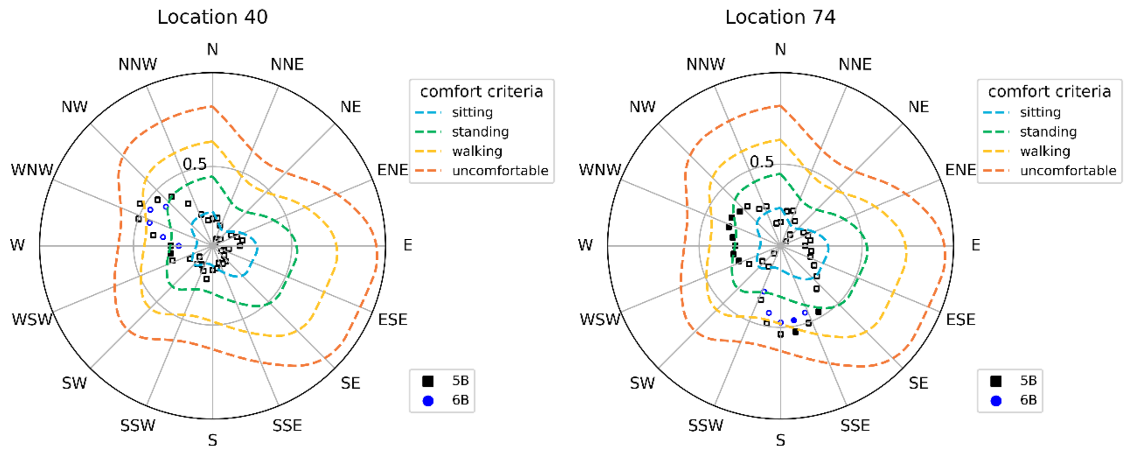

Figure 6: Directional results for Location 40 on Valentine Street, and 74 on Thomas Street

Summary

It has been shown that architectural changes to the proposed massing of the development at 187 Thomas Street reduces the maximum mean wind speeds along Valentine and Thomas Streets by over 10%, and the size of the affected zone of high wind speeds is reduced.

As wind is an important issue for this site, it is considered that a wind section should be included in the competition design brief to ensure that competitors understand the importance of the wind conditions around this isolated tower and describe potential architectural measures that could be adopted to mitigate the comfort and safety issues. Further, the inclusion of a wind expert on the technical committee for the design competition who can provide consistent information to the competitors would be recommended. The competition winning scheme would be wind-tunnel tested to ensure satisfactory wind conditions for comfort and safety are experienced around the site.

I hope this is of assistance, please do not hesitate to contact me on (02) 9320 9921, if you have any questions regarding any aspect of this report.

Yours sincerely,

Graeme Wood
Associate Principal