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By email
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John Rancic
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Our ref 313025

Dear John,

2-10 Valentine Avenue, Parramatta

Building Slenderness

The proposed tower at 2-10 Valentine Avenue, Parramatta, is very slender in the east-west direction, with an overall height-to-width ratio of approximately 14:1. Slender residential towers of this scale are uncommon, and controlling occupant comfort under wind loading requires careful management of lateral stiffness and dynamic response.

Arup, in collaboration with the project architects Furtado Sullivan + Buchan, have developed a structural system that maximises the full width of the building to achieve optimal lateral stiffness. Even with this approach, the tower requires additional measures, including high-strength concrete, embedded steel sections, ground anchors, and supplementary damping systems, to meet serviceability and wind comfort requirements.

A modest increase in the tower's width would substantially improve structural performance. For example, increasing the width by approximately 3m would double the lateral stiffness and reduce foundation tension forces by around 22%, while also reducing wind-induced accelerations and overall structural material requirements.

In summary, widening the tower provides a more conventional structural solution, improves occupant comfort, reduces material use, and mitigates risks associated with the building's dynamic response to wind, while the tower remains slender.

Structural Design Considerations and Detailed Measures

The tower's slenderness (approx. 14:1) and plan aspect ratio (approx. 4:1) present challenges for lateral stiffness and dynamic response under wind. To address these, the structural system has been designed to maximise geometrical stiffness, effectively using the full width of the building as a lever arm for lateral resistance. This is analogous to providing outriggers on a skiff, using poles when skiing, or tapering buildings to widen the base where possible.

Based on our preliminary structural finite element analysis in ETABS, utilising the maximum available building width, additional measures will be required including:

- **Stiffness Driven Sizing:** A structural system sized for stiffness (or serviceability), significantly exceeding the structural requirements needed for the ultimate strength condition. In simple terms, this means that we need to provide significantly more material in the structural system to control building movement than is needed to resist the loads. The result is reduced functional amenity, increased material use, increased embodied carbon, and increased transport carbon and road impacts;
- **High Strength Concrete:** The use of very high-stiffness concrete of grades 100-120MPa;
- **Embedded High Stiffness Steel**: The additional use of high-stiffness embedded steel sections in the concrete shear walls and engaged columns to further increase the structural stiffness over and above that needed for strength;
- **Ground Anchors/ Tension Piles:** Significant ground anchors/tension piles to resist the net tensions from wind loading; &
- **Supplementary Damping Systems:** Supplementary damping systems including visco-elastic dampers, tuned, or active mass dampers integrated into the structural design and space to mitigate accelerations under wind loading to acceptable levels.

Impact of Increasing Building Width

With reference to Figure 1 below, the most effective method to provide better control and a more conventional structural solution for the building would be to make the building wider in the east-west direction.

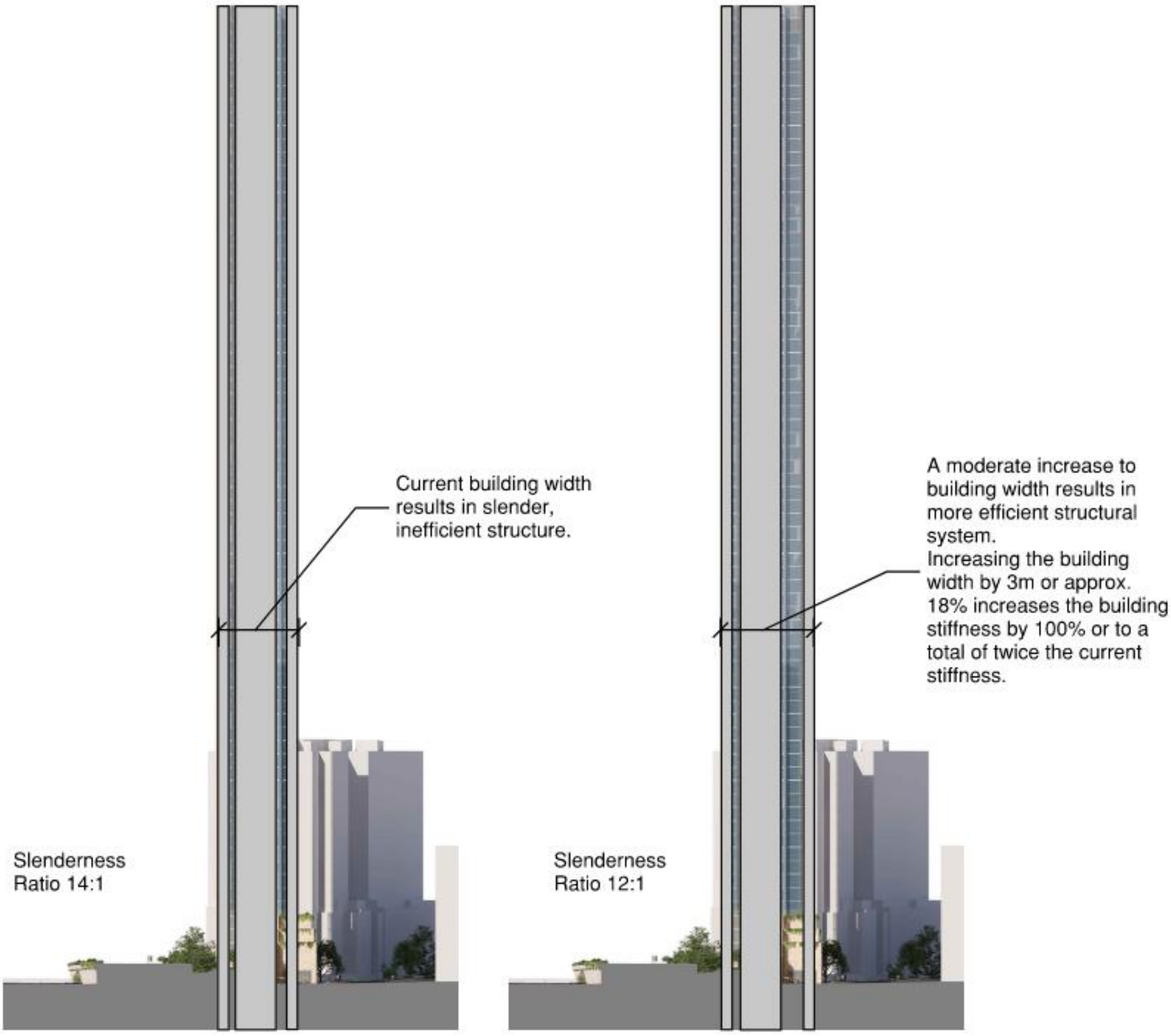

Figure 1 - Elevation showing proposed increase in building width

This widening of the tower has two significant and fundamental impacts:

1. **Enhanced Stiffness and reduced foundation tensions:** With the structural system using the full width of the building this increases structural footprint or breadth at the base and a wider lateral system. For example, increasing the building width by 3m or approximately 18% in the east-west direction increases the building stiffness by 100% or to a total of twice the current stiffness if the current structural sizes were retained, and reduces the significant tension forces at

foundation level that will be required to anchor the tower in ultimate wind conditions by approximately 22%;

2. **Reduced wind loading and dynamic response.** The wind loading on the building and response to wind is reduced two-fold:
    - The additional geometric stiffness noted in Item 1 above further reduces the wind loads (wind response) under the primary wind gusts – otherwise known as the dynamic component of wind response – which reduces accelerations and overall wind loading; &
    - The additional width reduces the aspect ratio of the building.

The notes in Item 2 have been confirmed independently by our wind engineer, Windtech, who is currently engaged to undertake wind tunnel testing for the building.

Conclusion

The proposed tower is very slender. A modest increase to the building's width would significantly increase its structural performance and although the tower would still be slender (12:1), it will reduce the quantum of material use and reduce risks associated with adverse response to building accelerations under wind.

Please do not hesitate to contact the undesigned, and we would be happy to discuss the above in person at any time.

Yours sincerely,

Andrew Johnson
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