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Dear Sir / Madam

Liverpool Tower
Reflectivity Study

This letter is to accompany the Development Application for the proposed commercial development at 9-19 Scott Street & 275-277 Bigge Street, Liverpool. The letter addresses the façade performance against the objectives of the Liverpool DCP 2008 Section 5.3. This section seeks to restrict the reflected glare from sunlight through the following controls:

- Visible light reflectivity of façade materials should be limited to 20%
- Subject to the extent and nature of the reflective façade, a reflectivity report may be required that analyses potential solar glare from the proposed development on pedestrians or motorists

Arup have reviewed the drawings in the DA package provided by Fender Katsalidis, and this letter reports on preliminary observations based on high-level studies and experience from similar projects. A detailed reflectivity assessment may be required in the following DD stage as potential reflectivity risks to oncoming traffic at specific locations could not be excluded at this stage.

General

Liverpool tower is situated centrally in Liverpool adjacent to the train station. The proposed building will be significantly higher than the existing surrounding context, standing at approximately 100m tall. The façade comprises full height glazing in vision and spandrel zones. The north-west and south-east corners are convex curved in plan with faceted glazing. The geometry, orientation, material and context of the proposed building have been assessed at high level to come to the following observations.

Observations

A high-level desktop study, including preliminary calculations of maximum equivalent veiling luminance for the principal building elevation orientations and the travel directions of traffic on main nearby roads (though not yet considering detailed building geometry), and based on experience from past projects, produced the observations about potential reflection issues of the Liverpool Tower façade noted below. Equivalent veiling luminance

was calculated according to the methodology in Hassall D. N. H. (1991): *Reflectivity. Dealing with Rogue Solar Reflections*, Faculty of Architecture, University of New South Wales. This source also nominates a limit of acceptability of reflections of 500Cd/m^2.

Impact on traffic

- Reflection impact on traffic and pedestrians potentially exceeding the Hassall 500Cd/m^2 equivalent veiling luminance threshold and causing glare would likely be limited to Memorial Avenue / Scott Street heading east and Newbridge Road heading north west. This can occur in the early morning for Newbridge Road and during evening hours on Memorial Avenue / Scott Street. Glare from reflections off vertical facades usually only occurs at low sun angles, when they reach viewers at angles close to their plane of vision. As the proposed building is taller than the surrounding context, reflections may well be visible for long stretches along these roads.

- Reflections from corner facets can be cast in a number of directions and may be visible from other roads at times of low sun angles. However, their intensity will be limited at distance where the single panel width of facets will appear smaller than the angular diameter of the reflected sun disk

- Solar shading devices such as vertical or horizontal louvres referenced in the DA package have the potential to reduce the impact of reflections. However, where reflections occur at close to normal angle of incidence, the shading effect of devices will be limited.

- Other nearby main traffic routes such as Bigge Street and the railway corridor are unlikely to present with reflectivity issues. Reflections cast into the directions of traffic on these routes from the main facades would originate from sun positions higher in the sky, and thus either further away from the direction of view with much reduced glare potential, or beyond typical car window cut-off.

The potential reflectivity issues on Memorial Avenue / Scott Street and Newbridge Road will be further assessed in the coming project stages. If required, they may be mitigated by employing some or all the following:

- **Selecting low reflectivity glass**: the reflectivity of the glass may be reduced below the general DCP limit of 20%. As potentially problematic reflections are expected predominantly close to normal angle of incidence, where reducing the normal angle reflectivity of glass has a close to proportional reducing effect on the intensity of reflections. Preliminary high level calculations suggest that selecting low reflectivity glass within feasible parameters for typical façade glazing products (reflectivity >8-10%) may be sufficient to limit reflection intensity to acceptable levels per the Hassall methodology.
- **Shading devices**: although not as effective as reducing the reflectivity of the glass for reflections close to normal, sunshades positioned correctly can help reduce the potential of unacceptable reflections.

Impact on pedestrians

From the perspective of pedestrians moving along roadways, the incidence of reflections from the building is generally similar to the examined road traffic locations. Glare from reflections is therefore expected in similar locations.

Furthermore, pedestrian observers are easily able to adjust their view and thus reduce the glare impact of reflections. They move at a rate significantly slower than that of a vehicle. For this reason it can be assumed that it will be safe for pedestrians to divert their vision in order to avoid glare.

Impact on other buildings

Solar reflections off the facade may reach surrounding buildings in the area. This may occur for limited time periods throughout the day, i.e. during the morning sun may be reflected off the east facades towards buildings further to the east, and afternoon sun may be reflected towards buildings further west.

In general, reflections from facades with external reflectance below 20% are much less likely to cause discomfort to occupants of surrounding buildings than facades with strongly reflective glazing. The proposed building will be targeting a glass reflectance below 20% in accordance with the Liverpool DCP, which will serve to reduce potential glare reflections that may occasionally be produced towards other buildings.

Conclusions

This initial high-level review of building and site conditions has noted the potential for reflections to exceed limits of glare acceptability under the commonly used methodology by Hassall occasionally on Memorial Avenue / Scott Street heading east and Newbridge Road heading north west, assuming the maximum allowable reflectivity of 20%.

A detailed analysis of site building and solar geometry is proposed for the next phase to confirm the impact to be expected.

Glazing will be selected to have a normal reflectivity not exceeding 20% in line with the requirements of the Liverpool DCP. Reflections potentially causing glare can likely be controlled by specification of a maximum reflectivity for the glass further lowered below 20%, and consideration of positioning external shading elements to support reduction of reflections at critical times.

Yours sincerely

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