

CUNDALL

16/12/2015

Reflectivity Study

1012212 The Ribbon, 31 Wheat Road



Prepared for:

Grocon Group

By Cundall
Level 1, 48 Alfred Street
Milsons Point, NSW 2061
Ph (02) 8424 7000
Fax (02) 8424 7099

Please contact: Hannah Morton

Author:	Natalie Cahill	
Checked by:	Hannah Morton	
Approved by:	Hannah Morton	
Revision	Description	Date
A	Issue for DA	10/12/2015
B	Revised DA issue	16/12/2015
<p>This report has been prepared in accordance with the terms and conditions of appointment. Cundall Johnston & Partners Pty Ltd trading as Cundall (ABN 16 104 924 370) cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.</p>		
<p>The success and realisation of the proposed initiatives will be dependent upon the commitment of the design team, the development of the initiatives through the life of the design and also the implementation into the operation of the building. Without this undertaking the proposed targets may not be achieved.</p>		

Contents

- 1 Introduction 4**
- 1.1 Limitations 4
- 2 Methodology 5**
- 3 Results 7**
- 3.1 Observation Point 1 7
- 3.2 Observation Point 2 9
- 3.3 Observation Point 3 11
- 3.4 Observation Point 4 13
- 3.5 Observation Point 5 15
- 3.6 Observation Point 6 16
- 3.7 Observation Point 7 19
- 3.8 Observation Point 8 21
- 4 Conclusions 23**

Executive Summary

This report has been prepared for the development application of The Ribbon, 31 Wheat Road, in Darling Harbour, Sydney, to review facade sun light reflectivity issues with respect to nearby roads and pedestrian routes.

The maximum recommended specular reflectivity requirement for each facade is detailed in the table below:

Facade orientation	Maximum Visible Light Reflectivity
North Elevation	8%*
South Elevation	15%
West Elevation	8%
East Elevation	15%

Table 1 – Recommended surface reflectivity * 15% with some vertical elements as required

Subject to the facade material selection, satisfying the reflectivity values stated above, any potential glare reflected from the building should be reduced according to the requirements of the City of Sydney and the Sydney Harbour Foreshore Authority.

1 Introduction

This report has been prepared for the development application of The Ribbon, 31 Wheat Road, in Darling Harbour, Sydney, to review facade sun light reflectivity issues with respect to nearby roads and pedestrian routes.

The proposed development comprises a retail and Hotel facilities podium and a 18 storey high hotel and serviced apartments tower with significant amounts of glazing facing north over the harbour, south over Darling Walk and a cladding ribbon running east to west.

Reflective materials used on the exterior of buildings can sometimes result in discomfort glare for pedestrians and temporarily disabling glare for drivers. The objective in the City of Sydney Development Control Plan is to reduce the reflection of sunlight from buildings to surrounding areas and recommends the following:

- a) New buildings and facades should not result in glare that causes discomfort or threatens safety of pedestrians or drivers.
- b) Visible light reflectivity from building materials used on the facades of new buildings should not exceed 20%.
- c) A Reflectivity Report that analyses the potential glare from the proposed new development on pedestrians or motorists may be required.

1.1 Limitations

Whilst Cundall have endeavoured to ensure the information used is accurate, we do not accept any liability for results as we have relied on third party information and methodologies.

Glare is a complex issue to predict and model accurately as it depends on the position of the sun at any particular moment in a year, the orientation and inclination of the reflective surface, the position of the receptor (observation point) and their susceptibility to glare. For example, drivers subject to glare in their direct line of sight creates a bigger risk than a pedestrian who can avoid looking directly at the building.

This report is based on the stated methodology in order to assess the potential reflectivity issues at selected observation points which have been assumed to represent the likely worst case locations. However, further analysis would be necessary to evaluate potential reflectivity issues at every possible observation point. We have used the methodology developed by David Hassall, a Building Science Consultant to the Faculty of Architecture at the University of New South Wales, and any limitations associated with this approach also apply to this study.

2 Methodology

Observation points for both drivers and pedestrians have been selected in order to assess the potential glare issues. Points 1 to 4, as shown below, relate to view points from cars and the travel direction is indicated by the arrows. Pedestrian observation points represented by Points 5 to 8 were also chosen on the elevated footpath, stairs, the Darling Harbour concourse and Darling Quarter Kids' Playground.

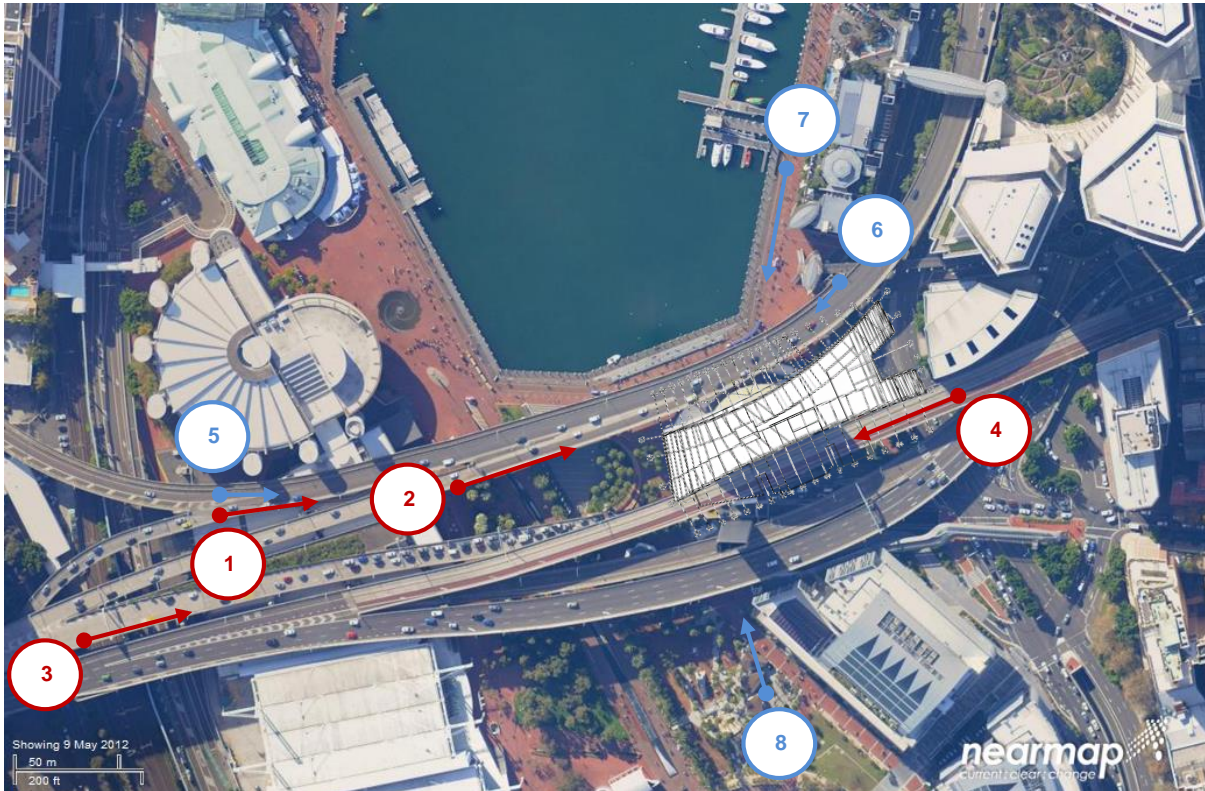
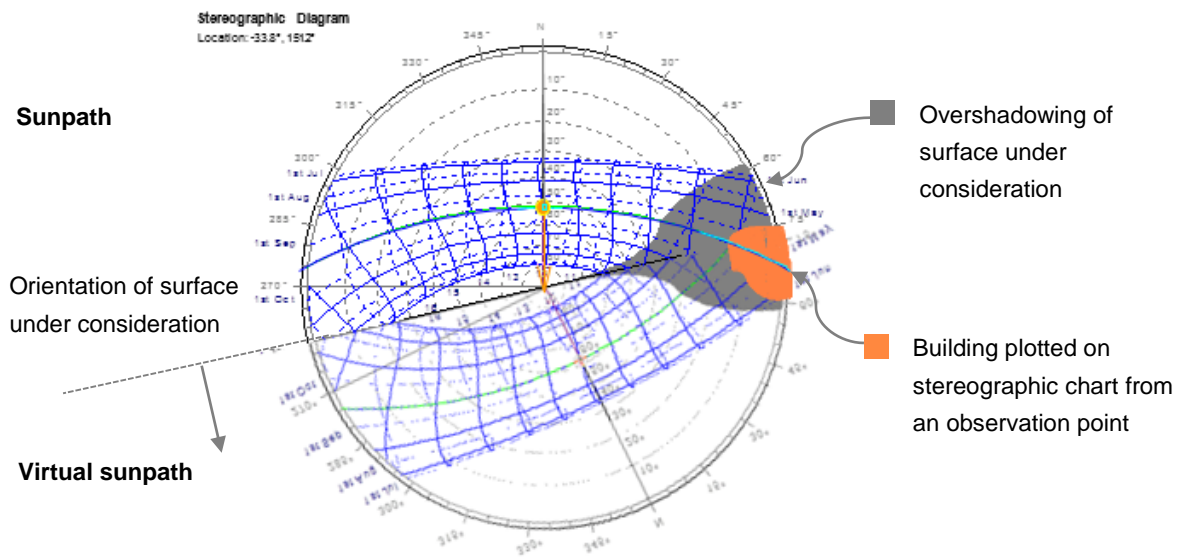


Figure 1 – Aerial photograph showing proposed building and critical view paths

Glare is assessed using the methodology in David Hassall's publication *Reflectivity: Dealing with Rogue Solar Reflections* (1991). This methodology defines the process as follows; views from the selected observation points are plotted on a glare protractor, to determine recommended reflectivity to limit reflections to 500cd/m^2 and critical facades are then assessed on a sunpath diagram to determine if and when the sun will be reflected.

The methodology uses the concept of a virtual sun which is the reflection of the real sun in a highly reflective surface of infinite size at the same aspect and inclination as the surface being considered. This is done by reflecting the sun path in front of the surface to determine the virtual sun path. Because the surface being considered is not infinite, the surface is also plotted on a stereographic chart from the observation point. If the virtual sun path and the plotted surface coincide then a solar reflection could be seen from that observation point.



For the purposes of this study the hotel tower is the main focus of the reflectivity analysis as the retail podium will be overshadowed by the elevated Western Distributor, although reflectivity targets for the tower are also recommended for the podium.

2.1 Information used

Cundall have based this assessment on the DA documentation as listed below and preliminary reflectivity studies previously completed during concept design.

- Architectural drawings provided by Hassell for The Ribbon Hotel and Residences, revision H, 17 November 2015
- Reflectivity: Dealing with Rogue Solar Reflections (David Hassell, UNSW, 1991)

3 Results

3.1 Observation Point 1

View travelling east along the Pymont Street entry onto the Western Distributor.



Figure 2 – Observation Point 1

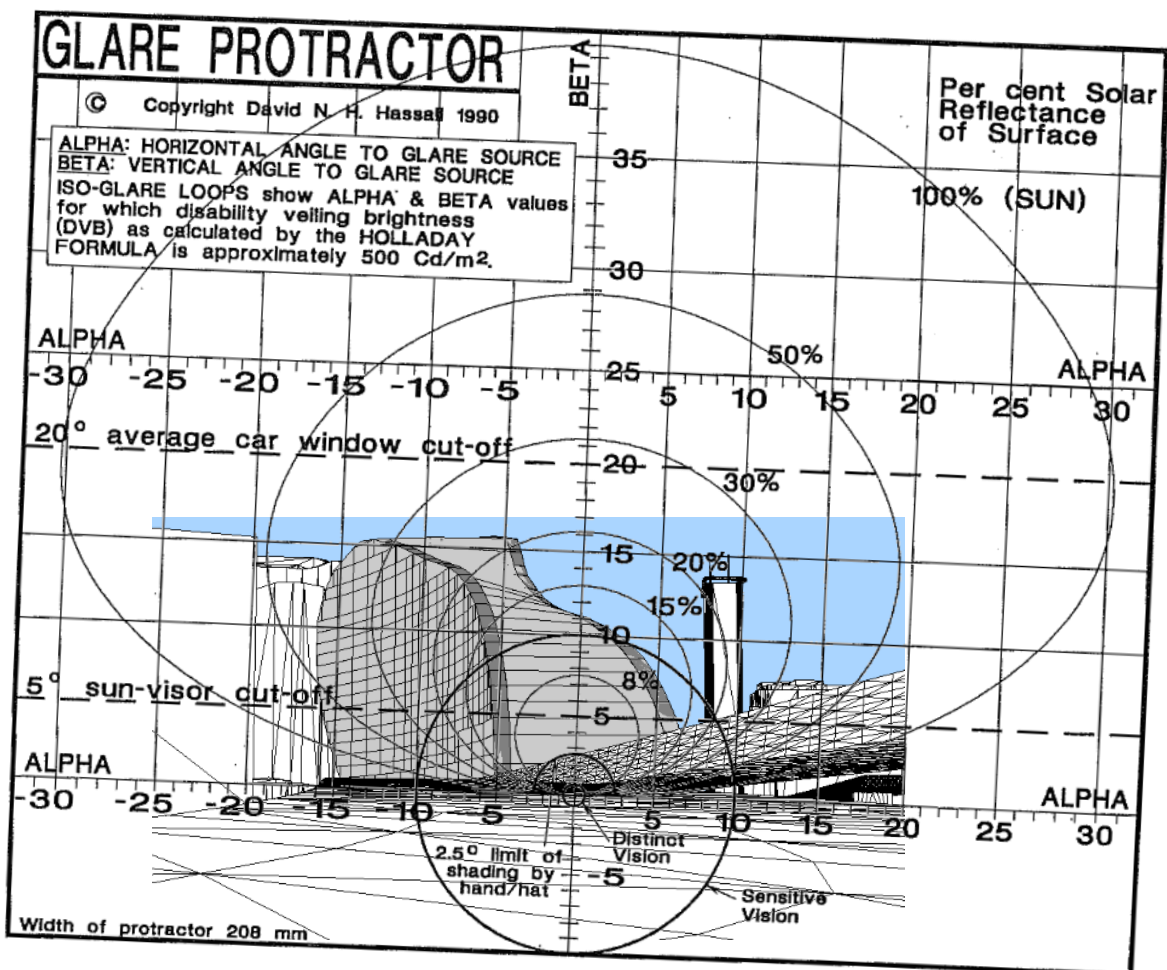


Figure 3 – Observation Point 1 Glare Protractor

3.1.1 North Aspect Glazing

There is a possible reflection in the early morning in winter towards this point however it is likely that the facade at the western end of the curve will be shaded by the shape of the building at that time.

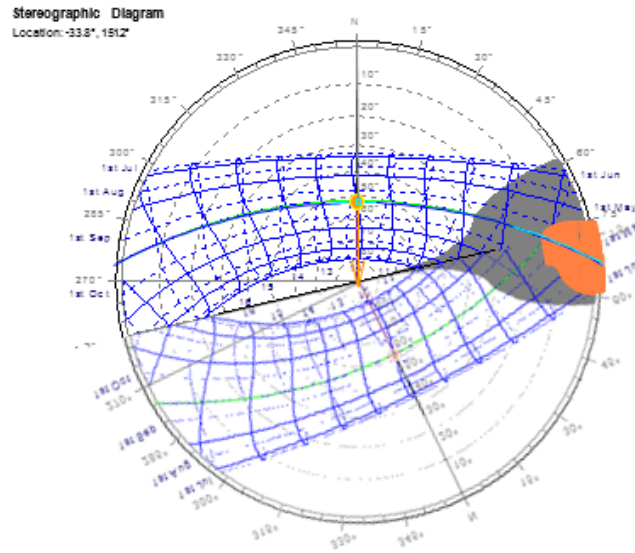


Figure 4 – OP1 North Glazing Sunpath Diagram

3.1.2 West Aspect Ribbon

In the late afternoon in summer, from 5pm EST, the sun reflects off the building towards this observation point. Late afternoon sun may reflect off the building towards cars travelling eastwards on the western distributor. The section of the building known as 'The Ribbon' should be made of diffuse material or 8% maximum specular reflectance for cladding/glazing to reduce the impact of glare on drivers.

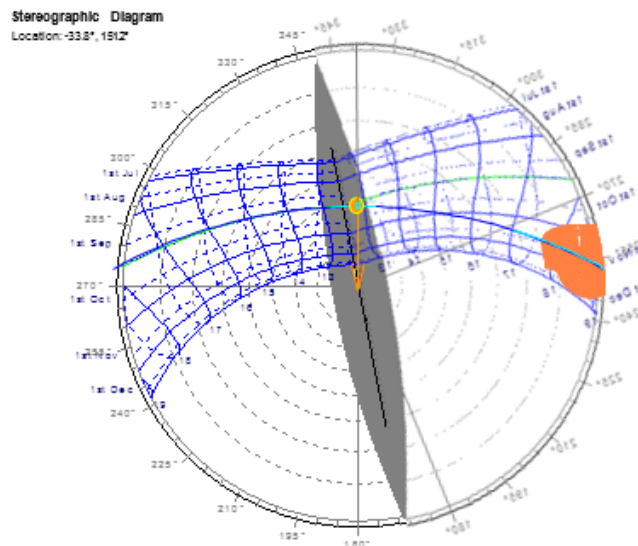


Figure 5 –OP1 West Ribbon Sunpath Diagram

3.2 Observation Point 2

View travelling east along the Western Distributor.

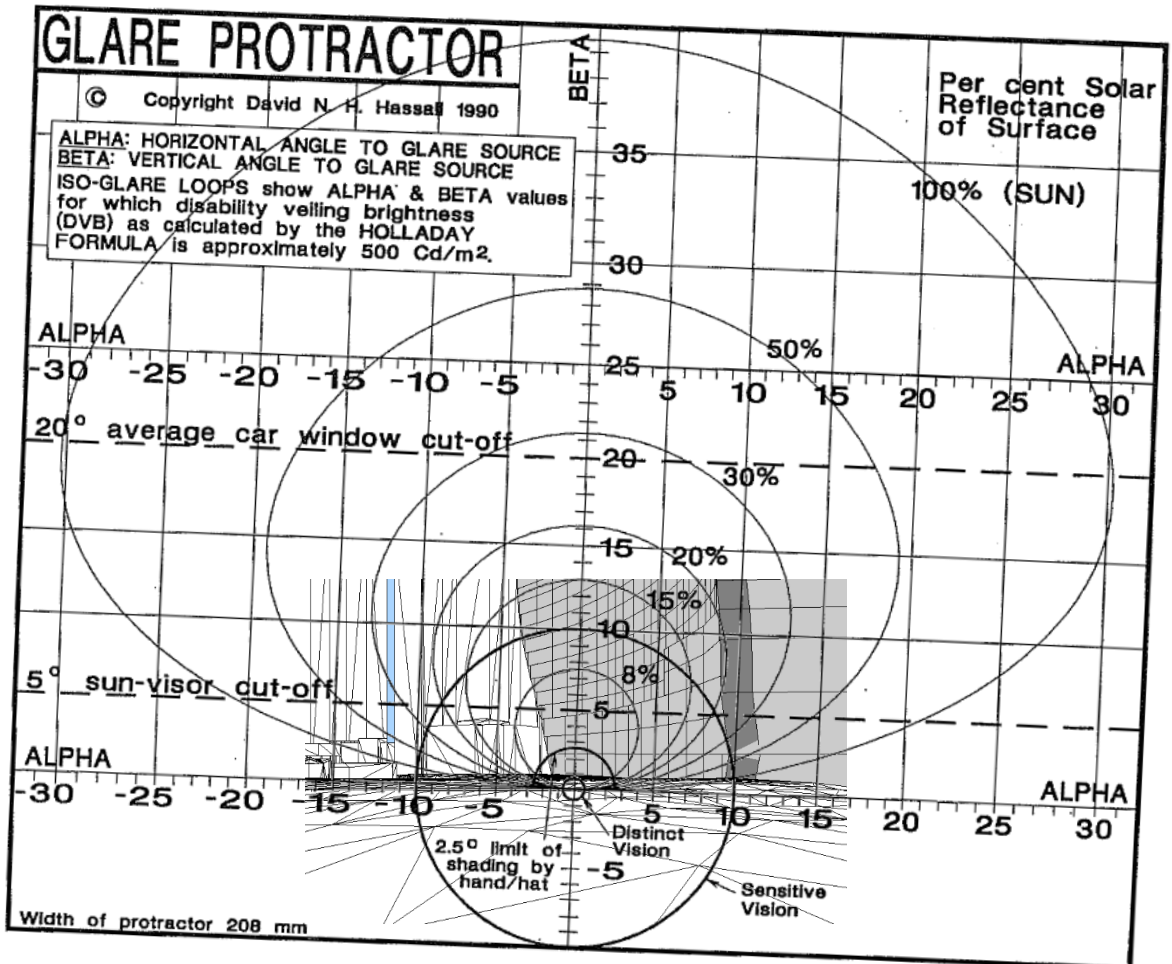


Figure 6 – Observation Point 2 Glare Protractor

3.2.1 North Aspect Glazing

Similar to observation point 1, there is a possible reflection in the early morning in winter towards this point however it is likely that the facade at the western end of the curve will be shaded by the shape of the building at that time.

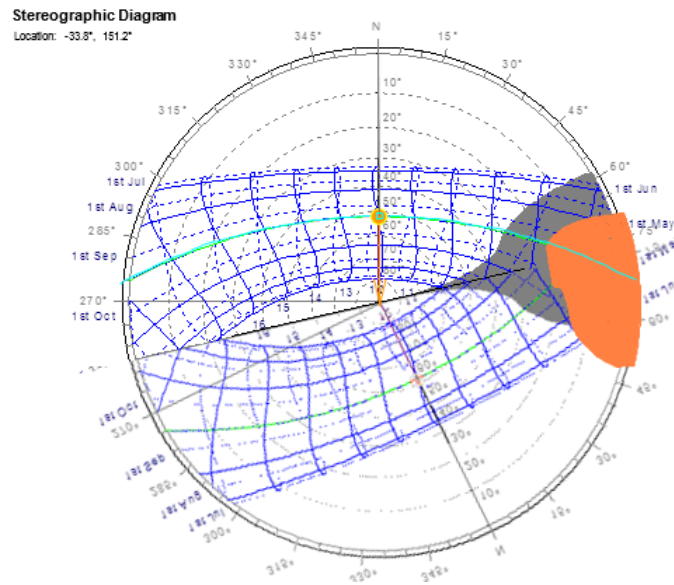


Figure 7 – OP2 North Glazing Sunpath Diagram

3.2.2 West Aspect Ribbon

Also similar to observation point 1, late afternoon summer sun, reflects off the building towards this observation point from 5pm EST towards cars travelling eastwards on the western distributor. The section of the building known as 'The Ribbon' should have 8% maximum specular reflectance to reduce the impact of glare on drivers.

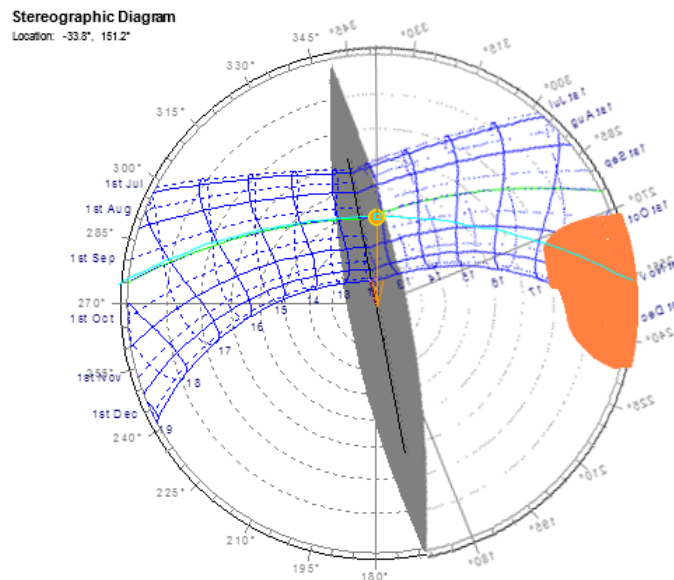


Figure 8 – OP2 West Ribbon Sunpath Diagram

3.3 Observation Point 3

View travelling east along the Western Distributor ramp down to Cross City Tunnel.

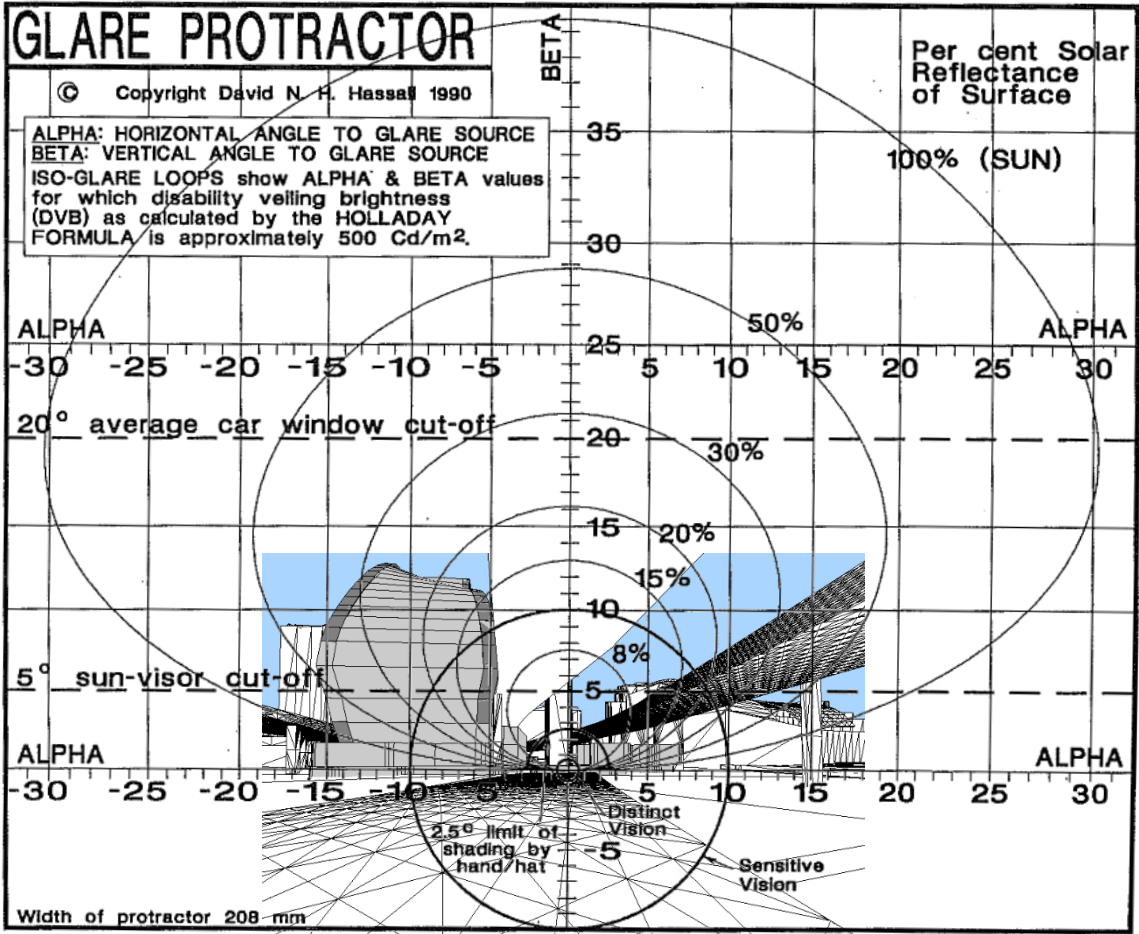


Figure 9 – Observation Point 3 Glare Protractor

3.3.1 West Aspect Ribbon

In the late afternoon in midseason, from 4pm EST, the sun reflects off the building towards this observation point. The section of the building known as 'The Ribbon' should be made of diffuse material or 8% maximum specular reflectance for cladding/glazing to reduce the impact of glare on drivers.

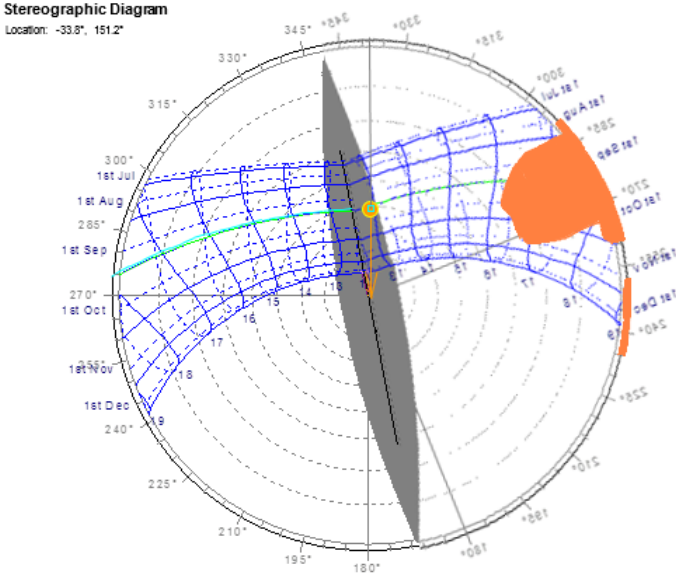


Figure 10 – OP3 West Ribbon Sunpath Diagram

3.4 Observation Point 4

View travelling west along the Western Distributor.

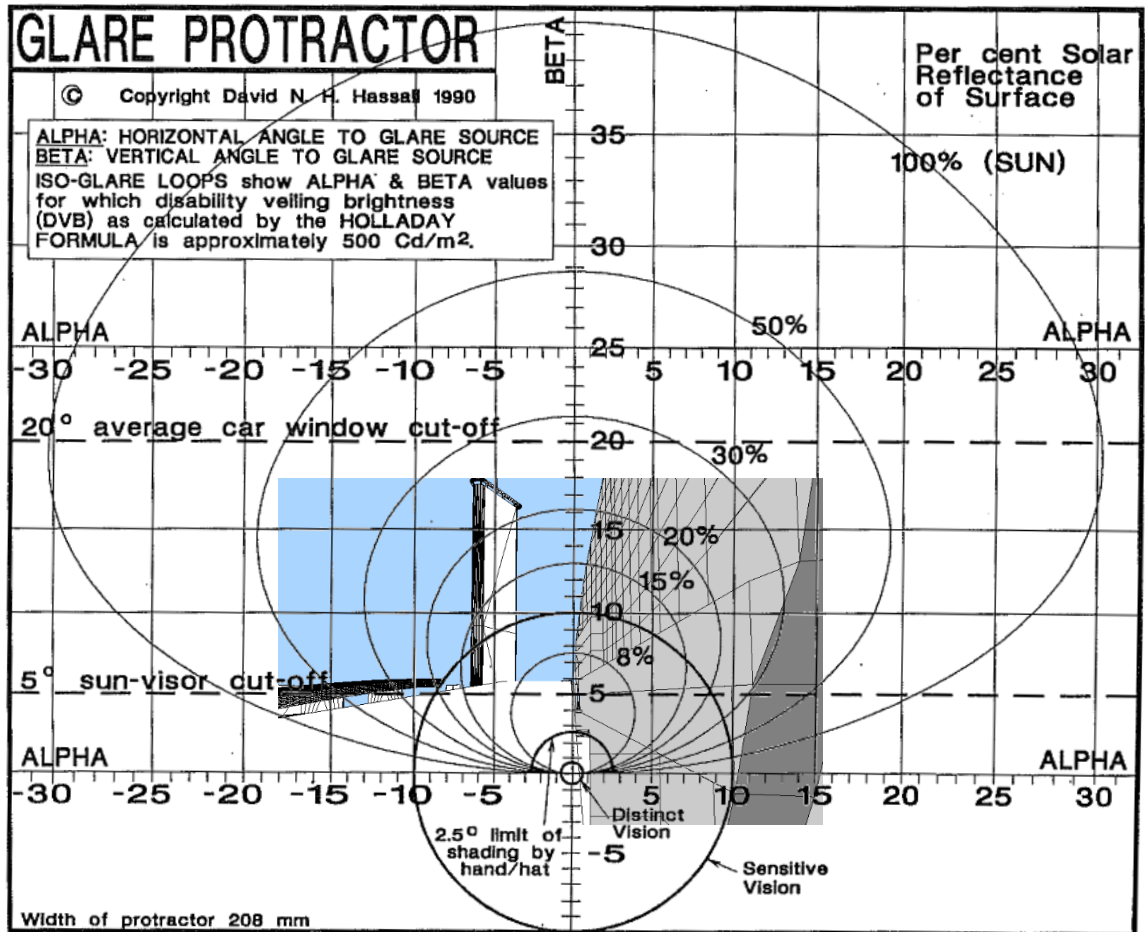


Figure 11 – Observation Point 4 Glare Protractor

3.4.1 South Aspect

For cars travelling west along the Western Distributor on late summer afternoons the sun will be reflected at a shallow angle towards this point. This should be no surprise as the actual sun will be low in the sky at the same time and likely to be in the field of vision. It is recommended that the maximum reflectivity of the glazing on the southern elevation is 15% to reduce the impact of glare on drivers.

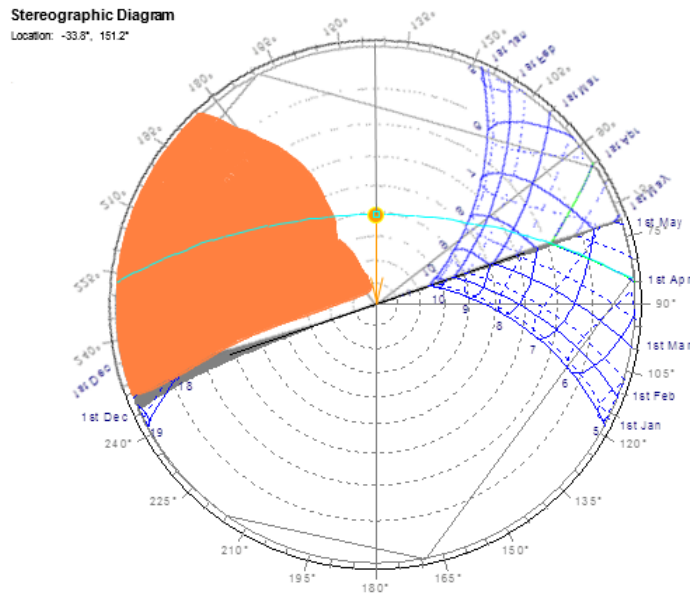


Figure 12 – OP4 South Glazing Sunpath Diagram

3.4.2 East Aspect Ribbon

For cars travelling west along the Western Distributor the building, sun may reflect off the ribbon during the mornings, when this elevation is not shaded by the buildings in Darling Park. It is therefore recommended that the ribbon's specular reflectivity be restricted to 15% to reduce the impact of glare on drivers.

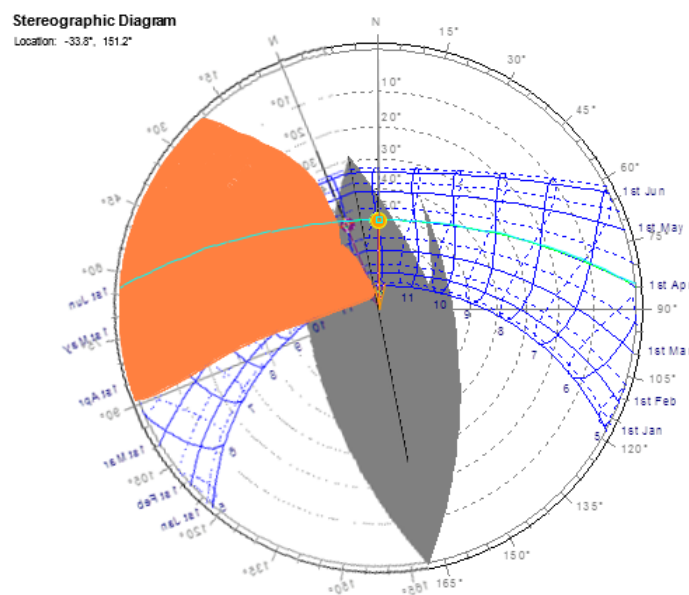


Figure 13 – OP4 East Ribbon Sunpath Diagram

3.5 Observation Point 5

Pedestrian view travelling east along the elevated walkway.



This point is expected to be similar to Observation Point 1.

3.5.1 North Aspect Glazing

No instances of glare are expected from the northern glazing at this observation point.

3.5.2 West Aspect Ribbon

In the late afternoon in summer, from 5pm EST, the sun reflects off the building towards this observation point. Late afternoon sun may reflect off the building towards pedestrians travelling eastwards on the elevated walkway. The section of the building known as 'The Ribbon' should be made of diffuse material or 15% maximum specular reflectance for cladding/glazing to reduce the impact of glare on pedestrians.

3.6 Observation Point 6

Pedestrian view travelling west along the elevated walkway.



Figure 14 – Observation Point 6

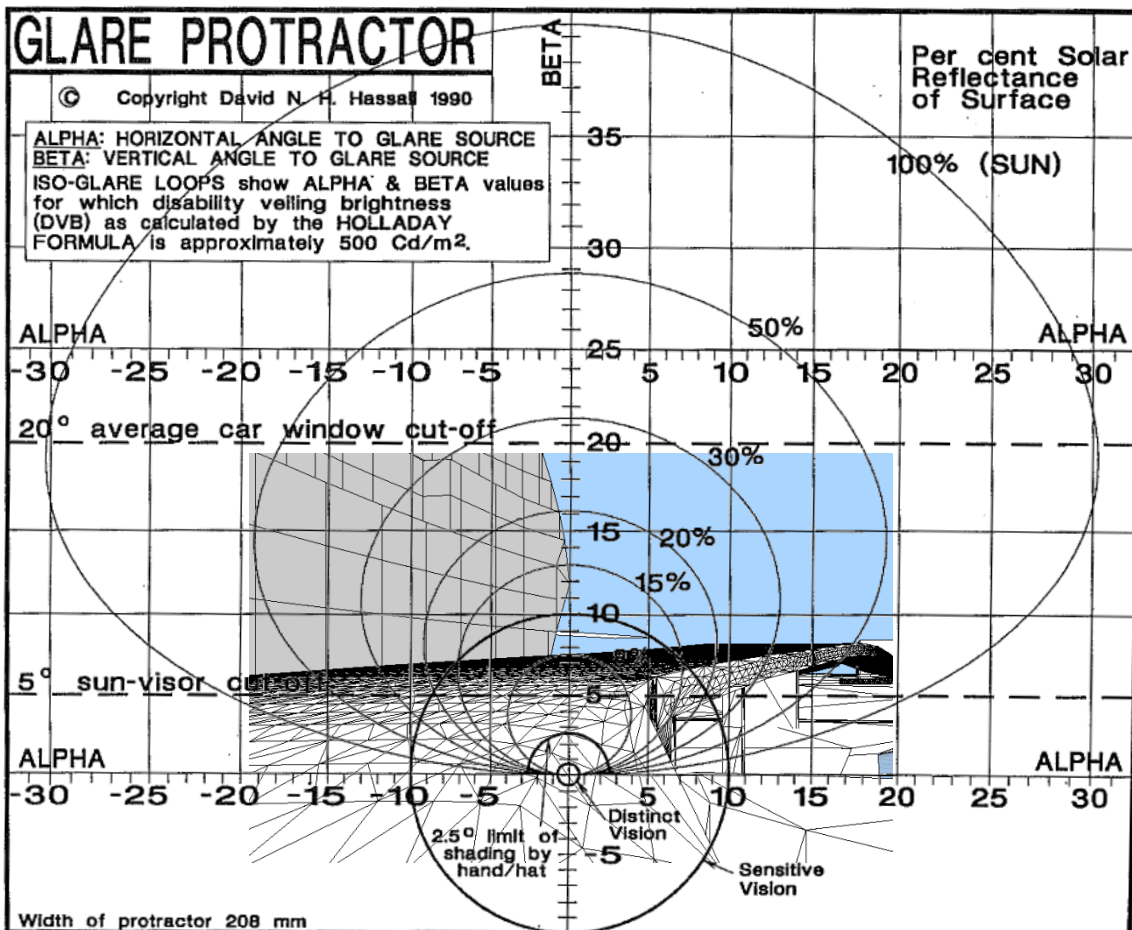


Figure 15 – Observation Point 6 Glare Protractor

3.6.1 North Aspect Glazing

Afternoon sun will reflect off the northern elevation. While the reflection from the north elevation could be shaded by a hand or hat it is recommended that the maximum reflectivity of the glazing on the northern elevation is 8% to reduce the impact of glare on pedestrians. If double glazing is selected and the reflectivity is less than 15%, then some vertical shading elements could be used to mitigate the glare for pedestrians on the elevated walkway, as shown on the elevation below in yellow. The popout window boxes should provide some additional shading and break up the surface.

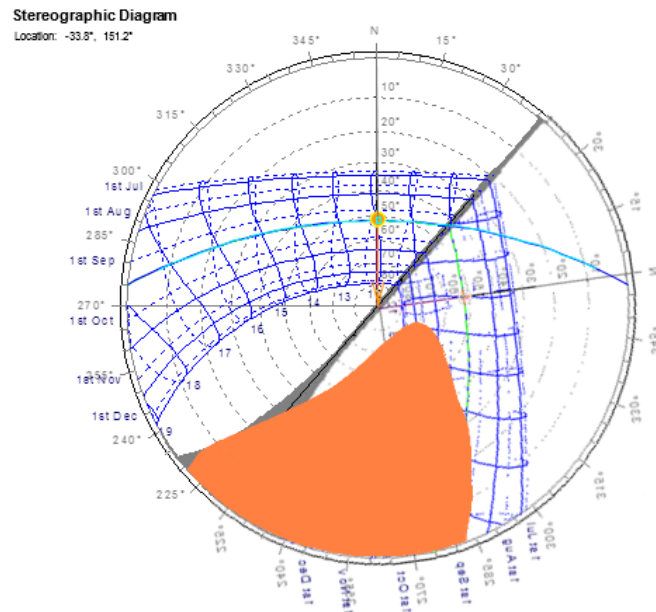


Figure 16 – OP6 North Glazing Sunpath Diagram (eastern end of curve)

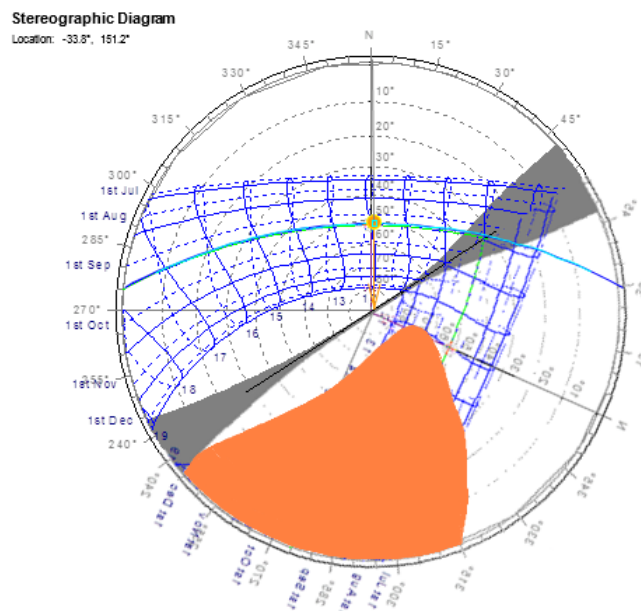


Figure 17 – OP6 North Glazing Sunpath Diagram (middle of curve)

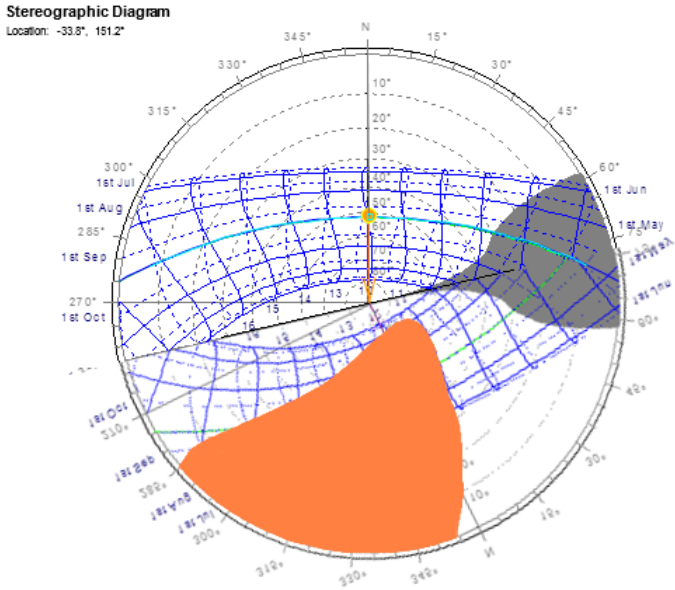


Figure 18 – OP6 North Glazing Sunpath Diagram (western end of curve)

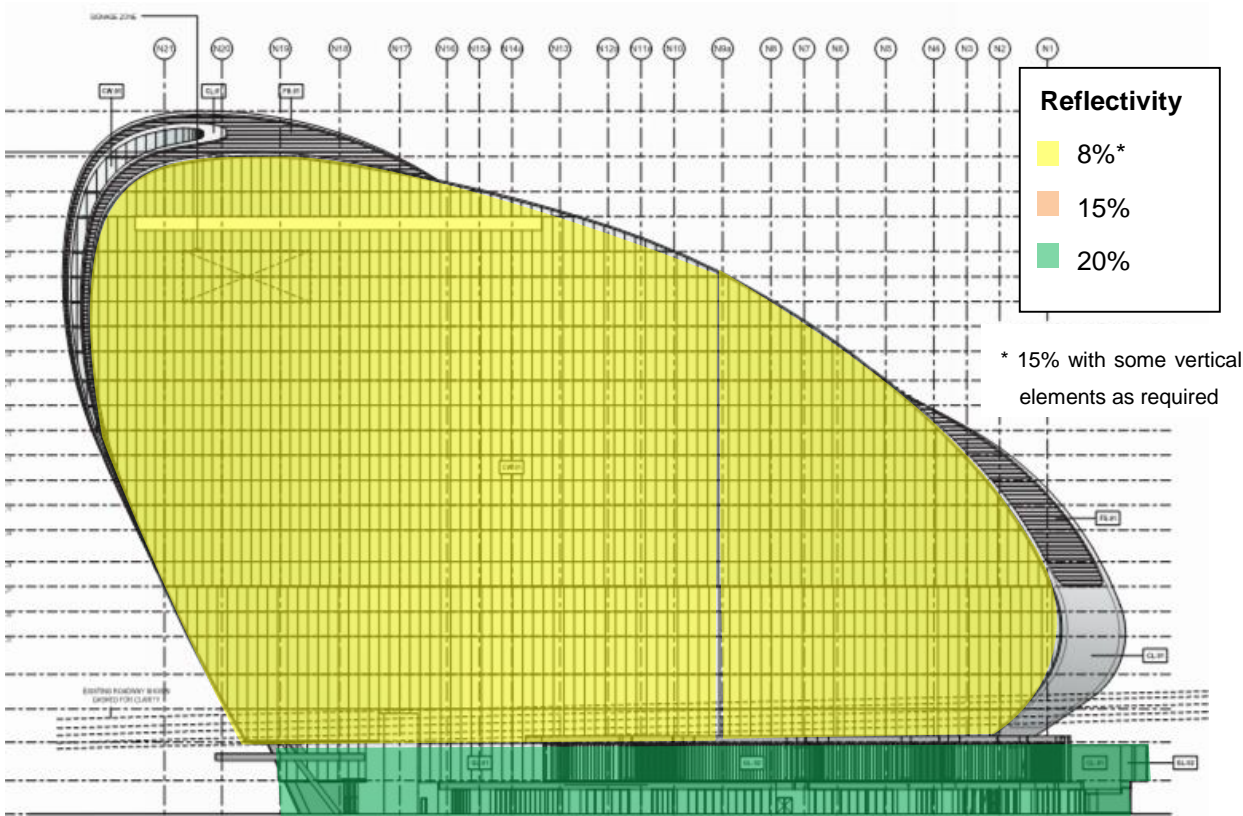


Figure 19 – North Glazing Reflectivity

3.7 Observation Point 7

Pedestrian view travelling south along Darling Harbour concourse.



Figure 20 – Observation Point 7

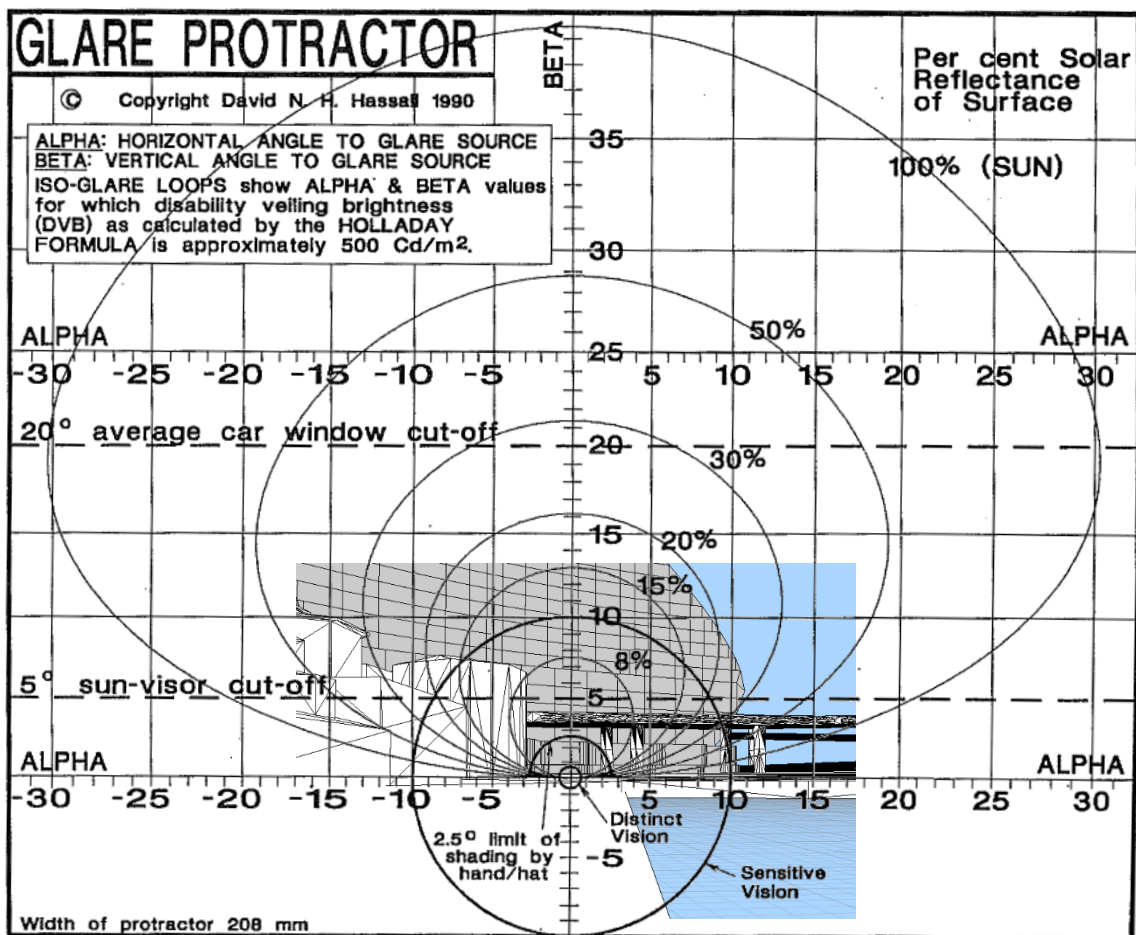


Figure 21 – Observation Point 7 Glare Protractor

3.7.1 North Aspect Glazing

Afternoon sun could reflect off the northern elevation (middle to eastern end) towards pedestrians travelling south along the concourse. While the reflection from this elevation could be shaded by a hand or hat, it is recommended that the maximum reflectivity of the glazing on the northern elevation is 8% to reduce the impact of glare on pedestrians.

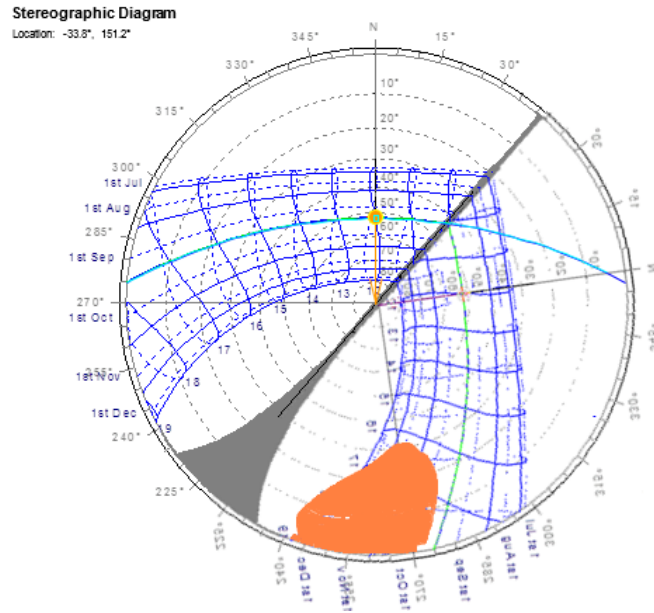


Figure 22 – OP7 North Glazing Sunpath Diagram (eastern end of curve)

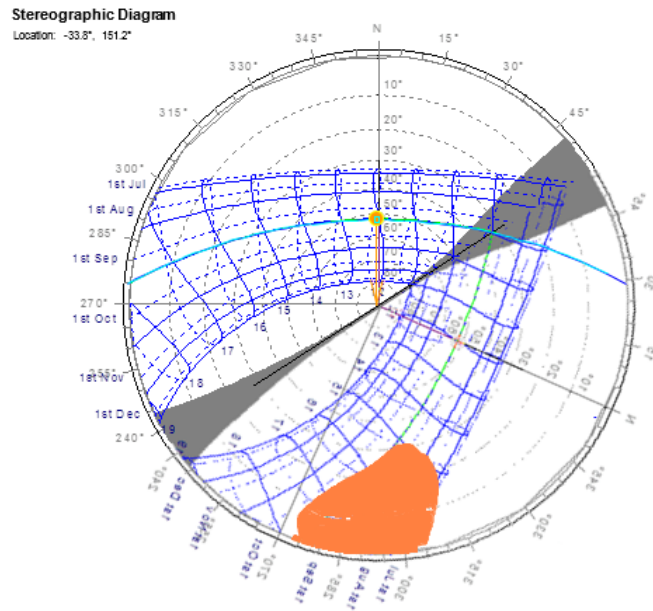


Figure 23 – OP7 North Glazing Sunpath Diagram (middle of curve)

3.8 Observation Point 8

Pedestrian view north from Darling Quarter Kids' Playground.

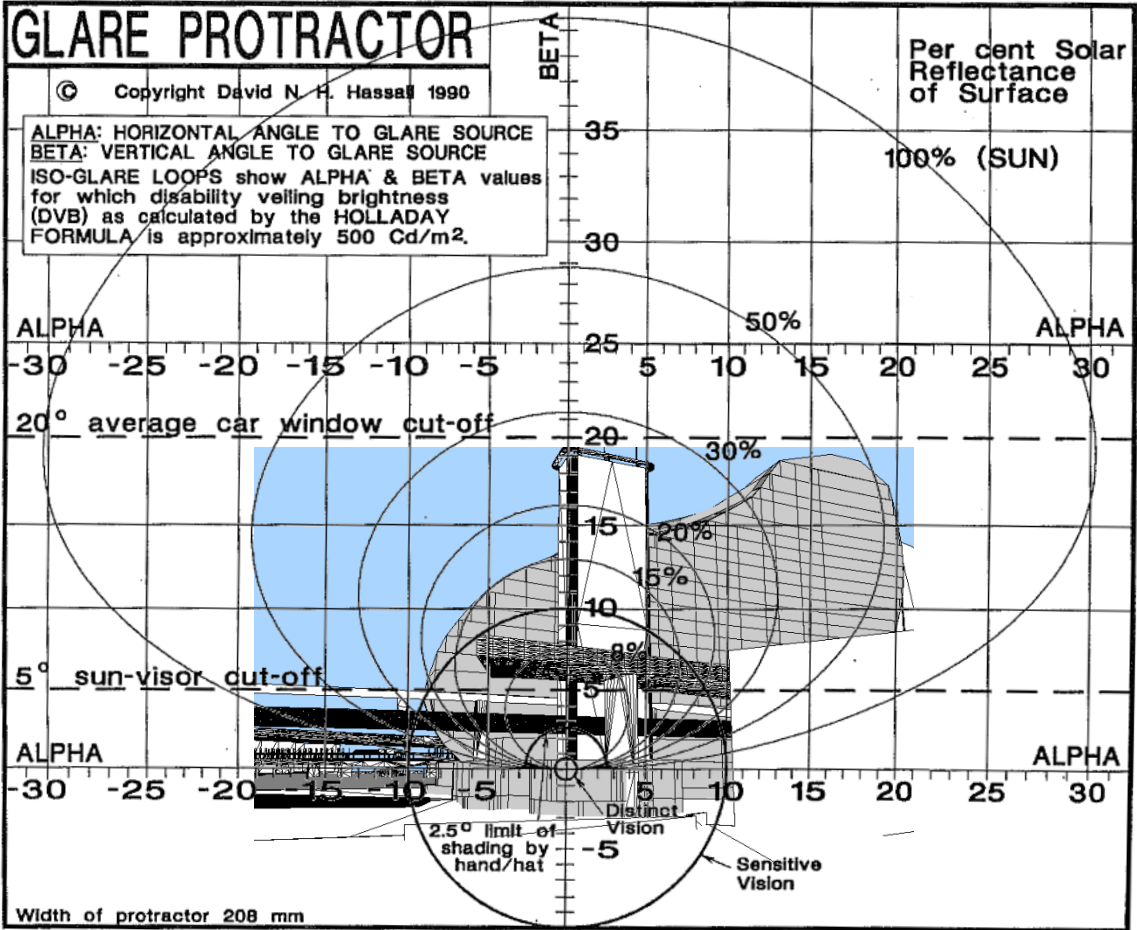
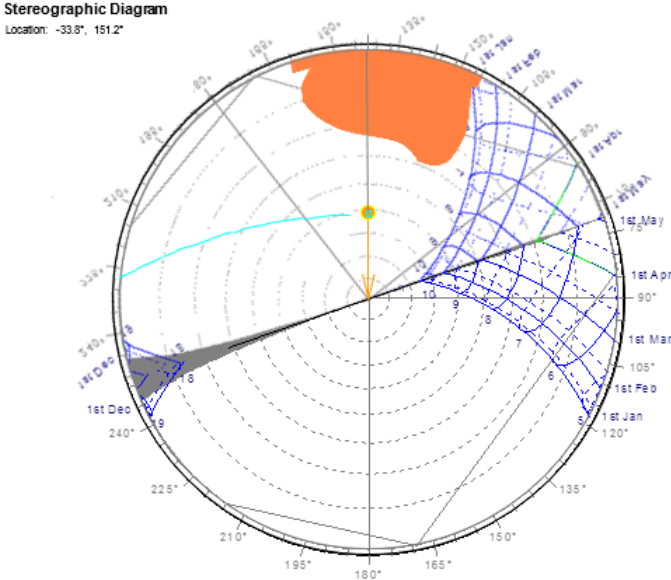


Figure 24 – Observation Point 8 Glare Protractor

3.8.1 South Aspect

No instances of glare are expected from the southern glazing at this observation point.



4 Conclusions

This assessment has considered potential glare issues at 8 observation points around the building to develop façade reflectivity criteria in accordance with the City of Sydney’s DCP.

On most buildings, glazing and any other specular cladding materials should typically have a maximum visible light reflectivity of 20%. However, based on the findings of this assessment, to reduce the impact of glare on drivers and pedestrians near the building it is recommended that the specular reflectivity should not exceed the values stated in the table below for all façade elements in each orientation.

Facade orientation	Maximum Visible Light Reflectivity
North Elevation	8%*
South Elevation	15%
West Elevation	8%
East Elevation	15%

Table 2 – Recommended surface reflectivity * 15% with some vertical elements as required

The northern glazed elevation should have a maximum reflectance of 8%. If double-glazing is selected and the reflectivity is less than 15%, then some vertical shading elements could be used to mitigate the glare for pedestrians on the elevated walkway. The southern glazed elevation should have a maximum reflectance of 15%. For the ribbon a maximum reflectance of 8% is recommended to reduce the risk of disability veiling glare for drivers travelling along the Western Distributor from the east and from the west and discomfort glare for pedestrians on the elevated walkway and looking up from the Darling Harbour concourse.