BUILDING F23, UNIVERSITY OF SYDNEY

SOLAR LIGHT REFLECTIVITY ANALYSIS

WC596-04F03(REV1)- SR REPORT (F23)

APRIL 7, 2016

Prepared for:

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DOCUMENT CONTROL

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February 26, 2016	Update of previous report (report reference WC596-02F02(rev0), dated July 28 2015) for the latest design scheme.	0	DK	TR	AB
April 7, 2016	Finalised drawings.	1	DK	TR	AB

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EXECUTIVE SUMMARY

This report presents the results of a detailed study for the effect of potential solar glare from the proposed development known as Building F23, located within the University of Sydney. The analysis has been undertaken based on the architectural drawings prepared by the project architect Grimshaw, received April 7, 2016.

This study identifies any possible adverse reflected solar glare conditions affecting motorists and pedestrians within the local surrounding area, and to occupants of neighbouring buildings. If necessary, recommendations are made to mitigate any potentially adverse effects. This study assesses compliance with the controls for solar glare from the City of Sydney Development Control Plan 2012.

A site survey has been undertaken to obtain photographs of the critical sightlines of motorists on surrounding streets. These photographs are calibrated and are able to be overlaid with a glare meter, which allows us to determine the extent, if any, of potential solar glare reflections from the subject development. It should be noted that there will be a new road adjacent to the development, and a sketch of the viewpoint of drivers on this road has been created for this assessment.

The results of the study indicate that, to avoid any adverse glare to motorists and pedestrians on the surrounding streets, occupants of neighbouring buildings, and to comply with the abovementioned planning control requirements, the following is recommended:

- All glazing used on the eastern aspect of the development, on Levels 3 and above, should have a maximum normal specular reflectance of visible light of 11%.
- All other glazing used on the external façade of the development should have a maximum normal specular reflectance of visible light of 20%.

It should be noted that the most reflective surface on the façade of a building is the glazing. Reflected solar glare from concrete, brickwork, timber, etc, is negligible (ie: less than 1% normal specular reflectance) and hence will not cause any adverse solar glare effects. Note also that, for any painted or powder-coated metallic surfaces on the exterior façade of the development, the maximum normal specular reflectance of visible light for those types of surfaces is in the range of 1% to 5%, which is well within the abovementioned limit.

With the incorporation of this recommendation, the results of this study indicate that the subject development will not cause adverse solar glare to pedestrians and motorists in the surrounding area, or to occupants of neighbouring buildings, and will comply with the planning controls regarding reflectivity for the City of Sydney Development Control Plan 2012.

CONTENTS

1 METHODOLOGY

This study assesses compliance with the controls for solar glare from the City of Sydney Development Control Plan 2012.

The reflectivity analysis of the subject development has been carried out using the technique published by Hassall (1991). The limiting veiling luminance of 500 cd/m^2 for the comfort of motorists, as suggested in Hassall (1991), has been adopted as a basis of assessing the glare impact from the subject development. In meeting this criterion for vehicle motorists, conditions will also be satisfactory for pedestrians.

The various critical glazed aspects were determined for the development and are shown in Figure 1. Solar charts for each of these critical glazed aspects are presented in Appendix B, and these are used to derive the check zones which are shown in Figure 2. The check zones highlight the areas that are potentially affected by solar reflections from each critical glazed aspect. It should be noted that the check zones shown in Figure 2 do not take into account the effect of overshadowing by neighbouring buildings or the shielding effect of any existing trees or other obstructions. These effects are examined in the detailed analysis described in Section 2 of this report.

Study point locations are selected within the check zone areas where motorists are facing the general direction of the subject development. These are shown in Figure 2. For each of the study point locations, photographs have been taken from the viewpoint of motorists using a calibrated camera. Views from the study point locations are presented in Appendix A of this report. A scaled glare protractor has been superimposed over each photograph. It should be noted that there will be a new road adjacent to the development, and a sketch of the viewpoint of drivers on this road has been created for this assessment.

The glare protractor is used to assess the amount of glare likely to be caused and to provide a direct comparison with the criterion of 500 cd/m^2. Alternatively, the glare protractor can be used to determine the maximum acceptable reflectivity index of the façade material of the development for the glare to be within the criterion of 500 cd/m^2.

If it is found that a section of the subject development will be within the zone of sensitive vision of a motorist at a selected study point location (the central area of the glare protractor), the glare protractor is used to determine what the maximum normal specular reflectance of visible light should be for the glazing or any other reflective material used on that section of the façade of the development to ensure that solar glare will not cause discomfort or threaten the safety of motorists or pedestrians, and hence to allow the subject development to comply with the relevant planning control requirements.

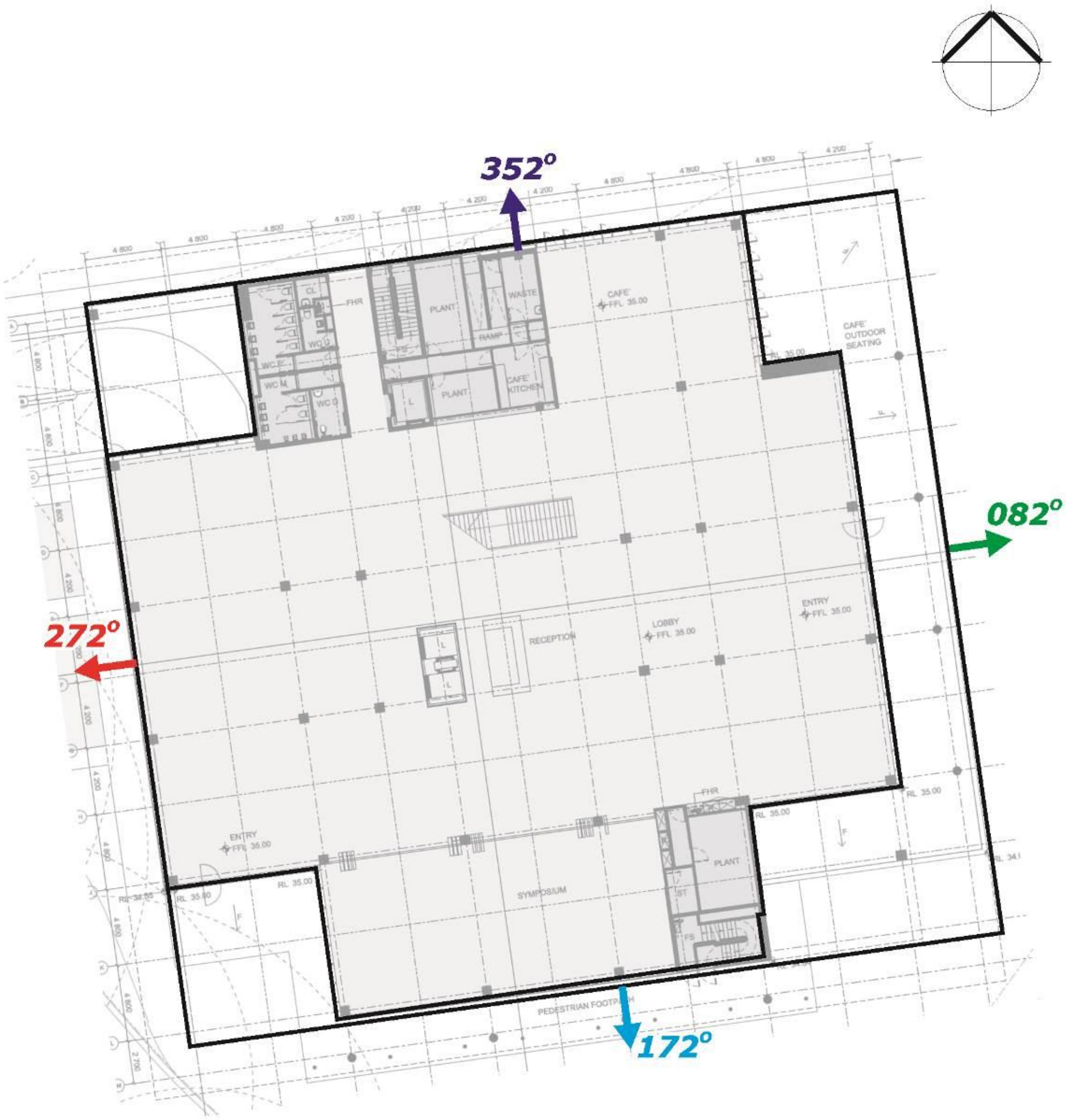

Figure 1: Critical Glazed Aspects of the Development

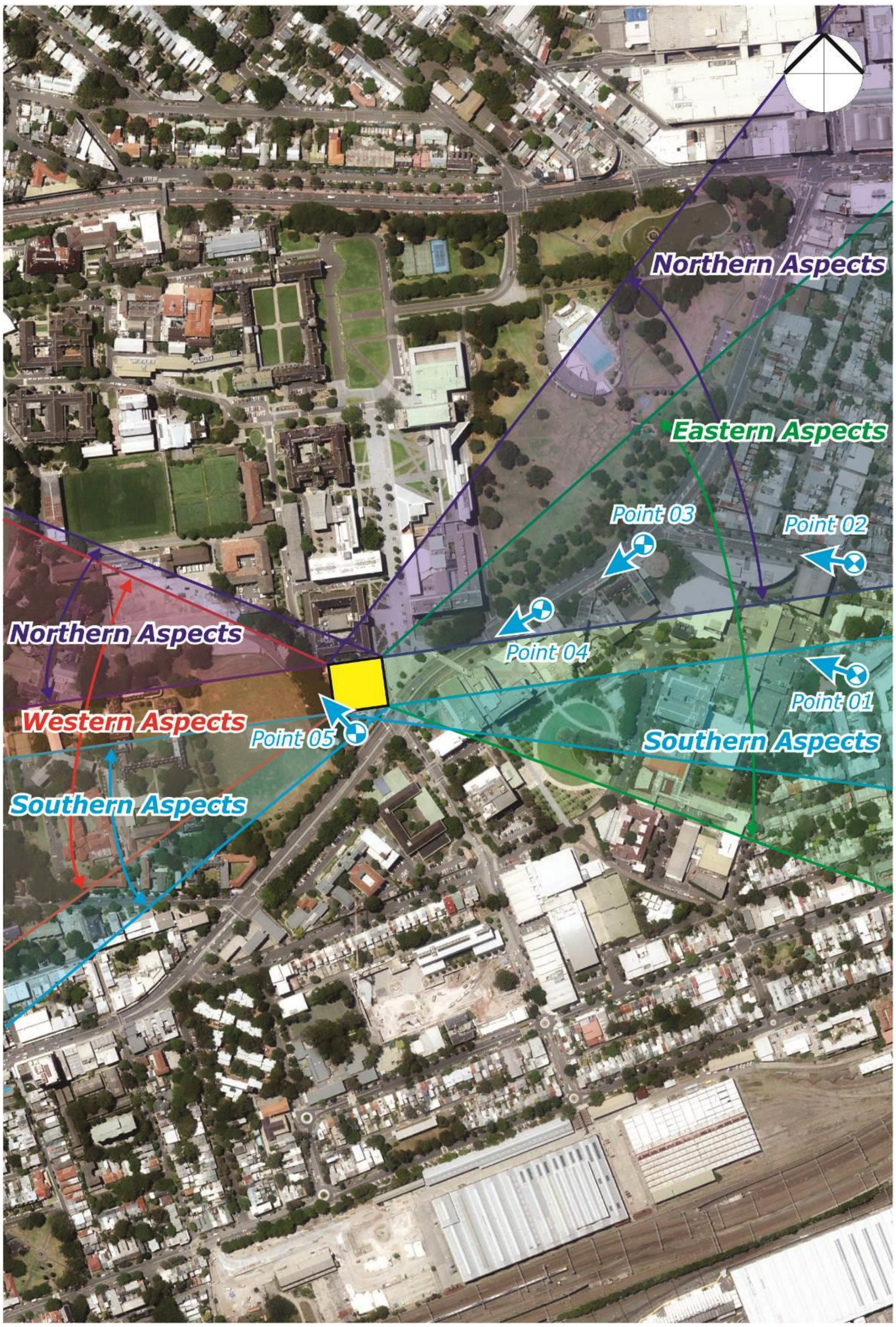

Figure 2: Check Zones and Study Point Locations of the Development (the check zones are the areas where glare could potentially be observed)

2 ANALYSIS

2.1 Impact onto Motorists and Pedestrians

From the study of the check zones shown in Figure 2, a total 5 street level locations have been identified for detailed analysis. A summary of the location of each study point, and the aspects of the subject development could potentially reflect solar glare to each study point location, is shown in Table 1 below. Note that, as mentioned in Section 1, the check zones shown in Figure 2 do not take into account the effect of overshadowing by neighbouring buildings or the shielding effect of any existing trees or other obstructions. These effects are examined in the detailed analysis described in the following sub-sections.

Table 1: Aspects of the Proposed Development that could reflect Solar Glare to each Study Point

Study Point	Location and Viewpoint	Aspect(s) of the Development
1	Ivy Street, heading west	Southern and eastern aspects.
2	Cleveland Street, heading west.	Northern and eastern aspects.
3	City Road, heading south-west.	Northern and eastern aspects.
4	City Road, heading south-west.	Northern and eastern aspects.
5	Fisher Road, heading north-west.	Southern aspect.

2.1.1 Drivers heading west along Ivy Street

Point 1 is located along Ivy Street, to the east of the development site. This point represents the critical sightline of drivers heading west along Ivy Street at this location. A site survey of this point has been undertaken, and a photograph showing the viewpoint of drivers at this location was obtained using a calibrated camera. The photograph has been scaled to enable the glare meter to be overlaid onto this image, as shown in Figure A1 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoints at Point 1 indicates that the subject development is not visible and is not within the zone of sensitive vision of motorists. Hence, there will be no adverse solar glare observed by motorists or pedestrians heading west along Ivy Street.

2.1.2 Drivers heading west along Cleveland Street

Point 2 is located along Cleveland Street, to the east of the development site. This point represents the critical sightline of drivers heading west along Cleveland Street at this location. A site survey of this point has been undertaken, and a photograph showing the viewpoint of drivers at this location was obtained using a calibrated camera. The photograph has been scaled to enable the glare meter to be overlaid onto this image, as shown in Figure A2 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoints at Point 2 indicates that the subject development is not visible and is not within the zone of sensitive vision of motorists. Hence, there will be no adverse solar glare observed by motorists or pedestrians heading west along Cleveland Street.

2.1.3 Drivers heading south-west along City Road

Points 3 and 4 are located along City Road, to the east of the development site. These points represent the critical sightlines of drivers heading south-west along City Road at these locations. A site survey of these points has been undertaken, and photographs showing the viewpoints of drivers at these locations were obtained using a calibrated camera. Each photograph has been scaled to enable the glare meter to be overlaid onto these images, as shown in Figures A3 and A4 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Points 3 and 4 indicates that the proposed development is visible and is within the zone of sensitive vision of motorists. The analysis indicates that glazing on the eastern aspect being recessed, the visible portion of the façade will be overshadowed by the lattice screen of the proposed development at the times of day when glare could potentially be observed by motorists or pedestrians heading south-west along City Road. Furthermore, the northern aspect of the development is not visible at Point 3 and 4. Nonetheless, the results of the study indicate that to avoid adverse glare for motorists or pedestrians heading south-west along City Road, it is recommended that the selected glazing used on the eastern aspect of the development on Levels 3 and above, should have a maximum normal specular reflectance of visible light of 11%.

2.1.4 Drivers heading north-west along Fisher Road

Point 5 is located along Fisher Road, to the south of the development site. This point represents the critical sightlines of drivers heading north-west along Fisher Road. Since this portion of Fisher Road is yet to be constructed, a figure has been manually created showing the viewpoint of drivers at this location. The figure has been scaled to enable the glare meter to be overlaid onto this image, as shown in Figure A5 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 5 indicates that the subject development is visible but not within the zone of sensitive vision of motorists or pedestrians. Hence, there will be no adverse solar glare observed by motorists or pedestrians heading north-west along Fisher Road from the façade of the subject development.

2.2 Occupants of Neighbouring Buildings

Our past experience involving more than 250 projects, and also research by Rofail and Dowdle (2004), tends to indicate that Buildings which cause a nuisance to occupants of neighbouring buildings are those that have a normal specular reflectivity of visible light greater than 20%. This seems to justify the suggested limit of 20% reflectivity by many local government authorities and state planning bodies.

Hence a general recommendation is made that all glazing and other reflective materials used on the façade of the subject development have a maximum normal specular reflectivity of visible light of 20% to avoid adverse solar glare to occupants of neighbouring buildings.

2.3 Typical Normal Specular Reflectivity from Building Surfaces

It should be noted that the most reflective surface on the façade of a building is the glazing. Reflected solar glare from concrete, brickwork, timber, etc, is negligible (ie: less than 1% normal specular reflectance) and hence will not cause any adverse solar glare effects. The following sub-sections provide some general reflectance values of more reflective materials used on building facades.

2.3.1 Glazed Surfaces

A glazing supplier will be able to provide information on the maximum normal specular reflectance of visible light of different types of glazing. Some typical reflectivity values of different types of glazing are listed as follows:

- Clear float glass – typically 5% to 8%
- Low-e solar control glazing – typically 8% to 12%
- Other types of compliant performance glazing – up to 20%

2.3.2 Painted and/or Powder-Coated Metallic Surfaces

In the event that some portions of the external façade of the development feature power-coated or painted metallic surfaces, it is not expected that adverse glare will be observed from those surfaces since the maximum normal specular reflectance of visible light of these types of façade materials range from 1% to 5%. This is well within the maximum limits specified in previous sections of this report.

3 CONCLUSION

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With the incorporation of this recommendation, the results of this study indicate that the subject development will not cause adverse solar glare to pedestrians and motorists in the surrounding area, or to occupants of neighbouring buildings, and will comply with the planning controls regarding reflectivity for the City of Sydney Development Control Plan 2012.

REFERENCES

City of Sydney Council, "City of Sydney Development Control Plan 2012".

Hassall, D.N., "Reflectivity, Dealing with Rogue Solar Reflections", (published by author), 1991.

Phillips, R.O., "Sunshine and Shade in Australasia", Sixth Edition, CSIRO Publishing, 1992.

Rofail, A.W., and Dowdle, B., "Reflectivity Impact on Occupants of Neighbouring Properties", International Conf. on Building Envelope Systems & Technologies, Sydney, 2004.

APPENDIX A - GLARE OVERLAYS FOR THE CRITICAL SIGHT-LINES

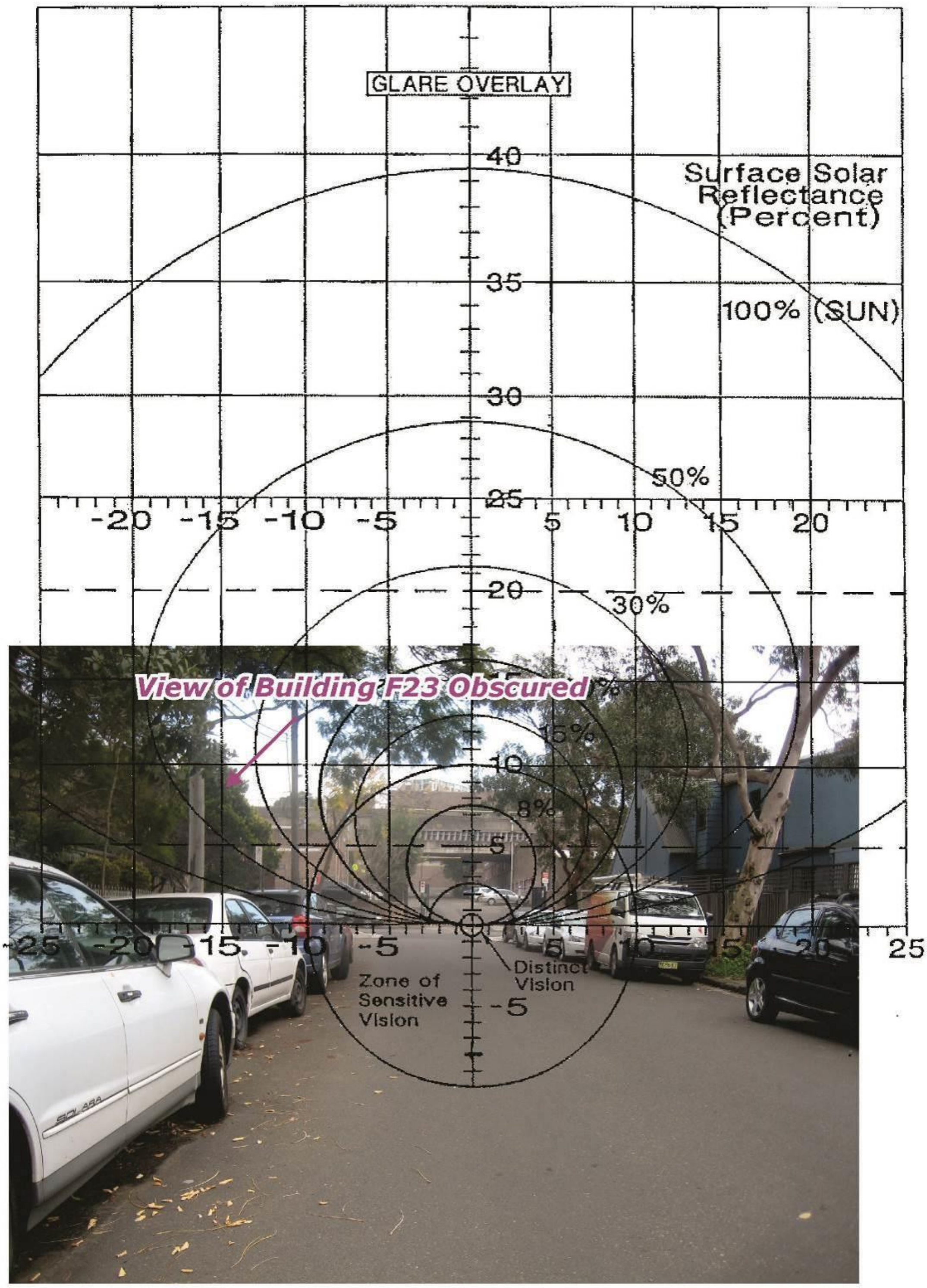

Figure A1: Glare Overlay for Point 1

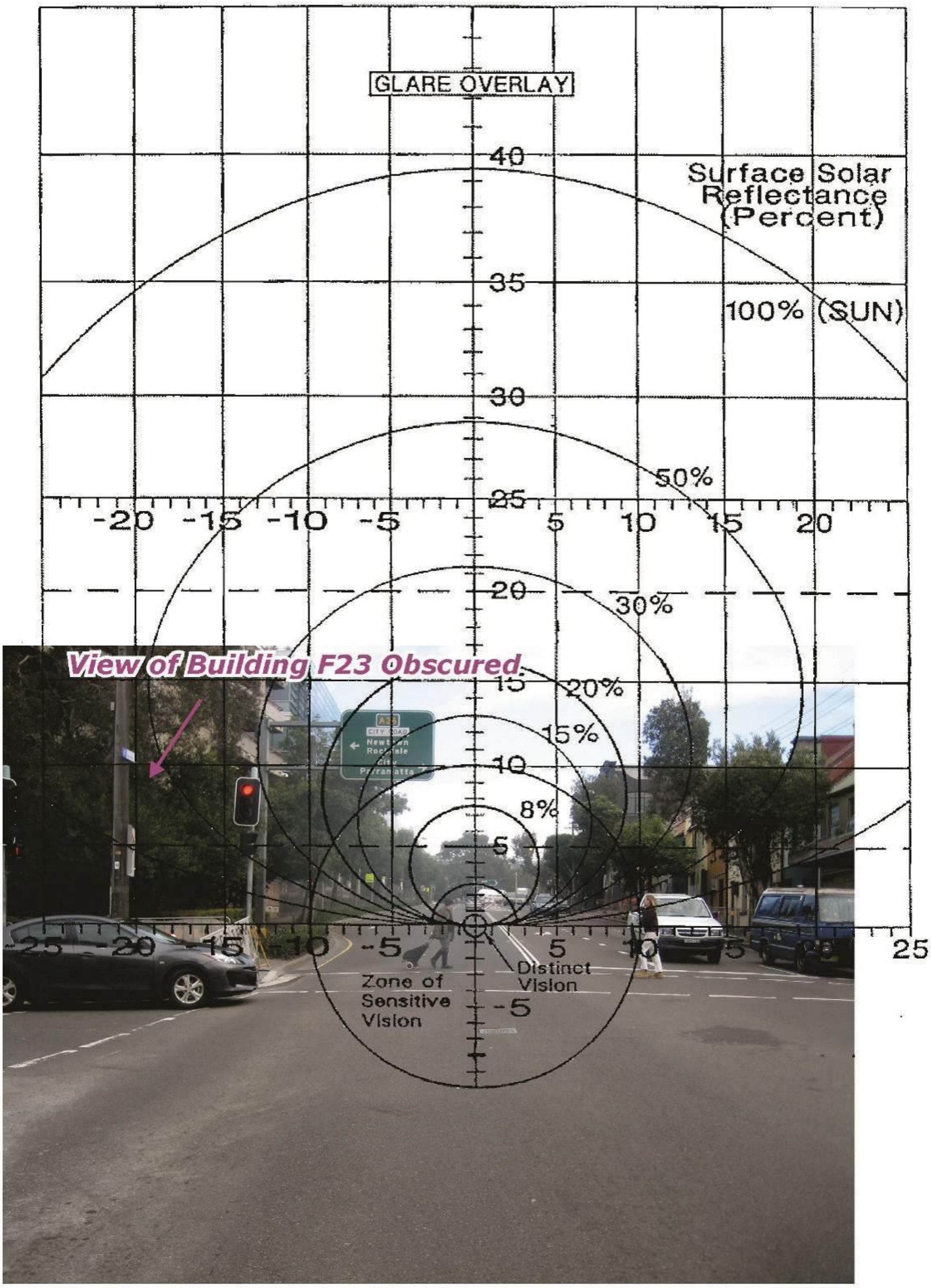

Figure A2: Glare Overlay for Point 2

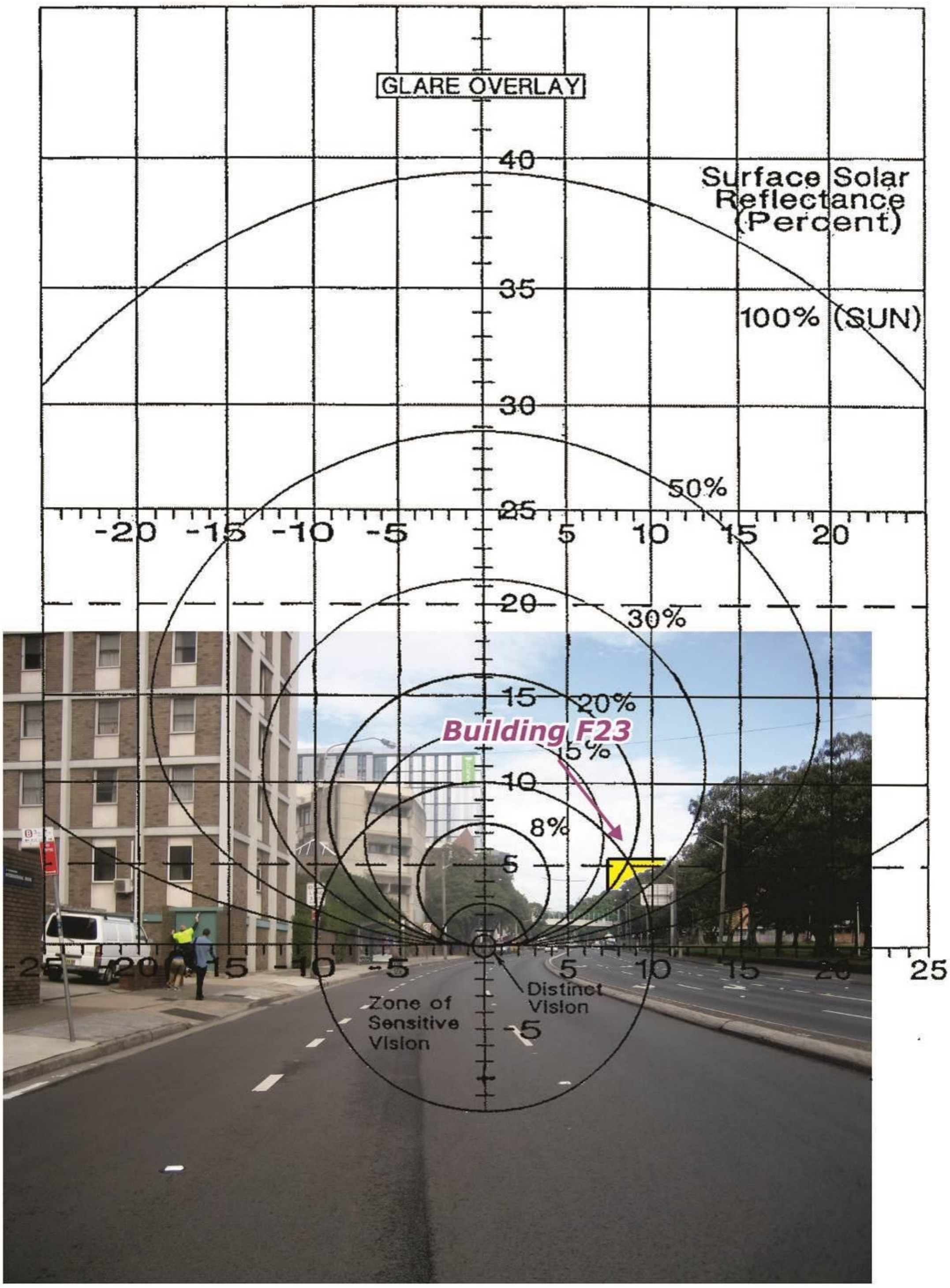

Figure A3: Glare Overlay for Point 3

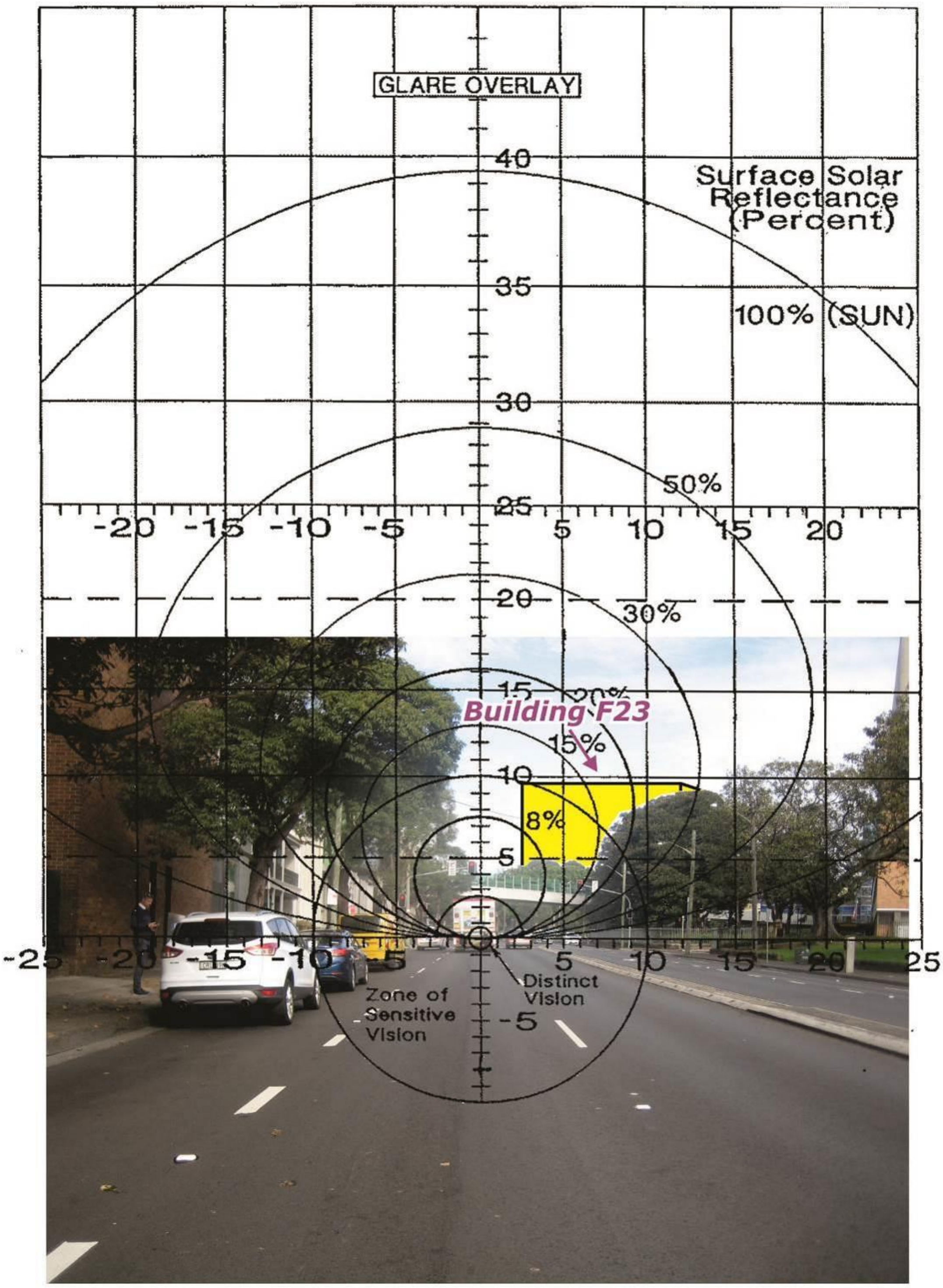

Figure A4: Glare Overlay for Point 4

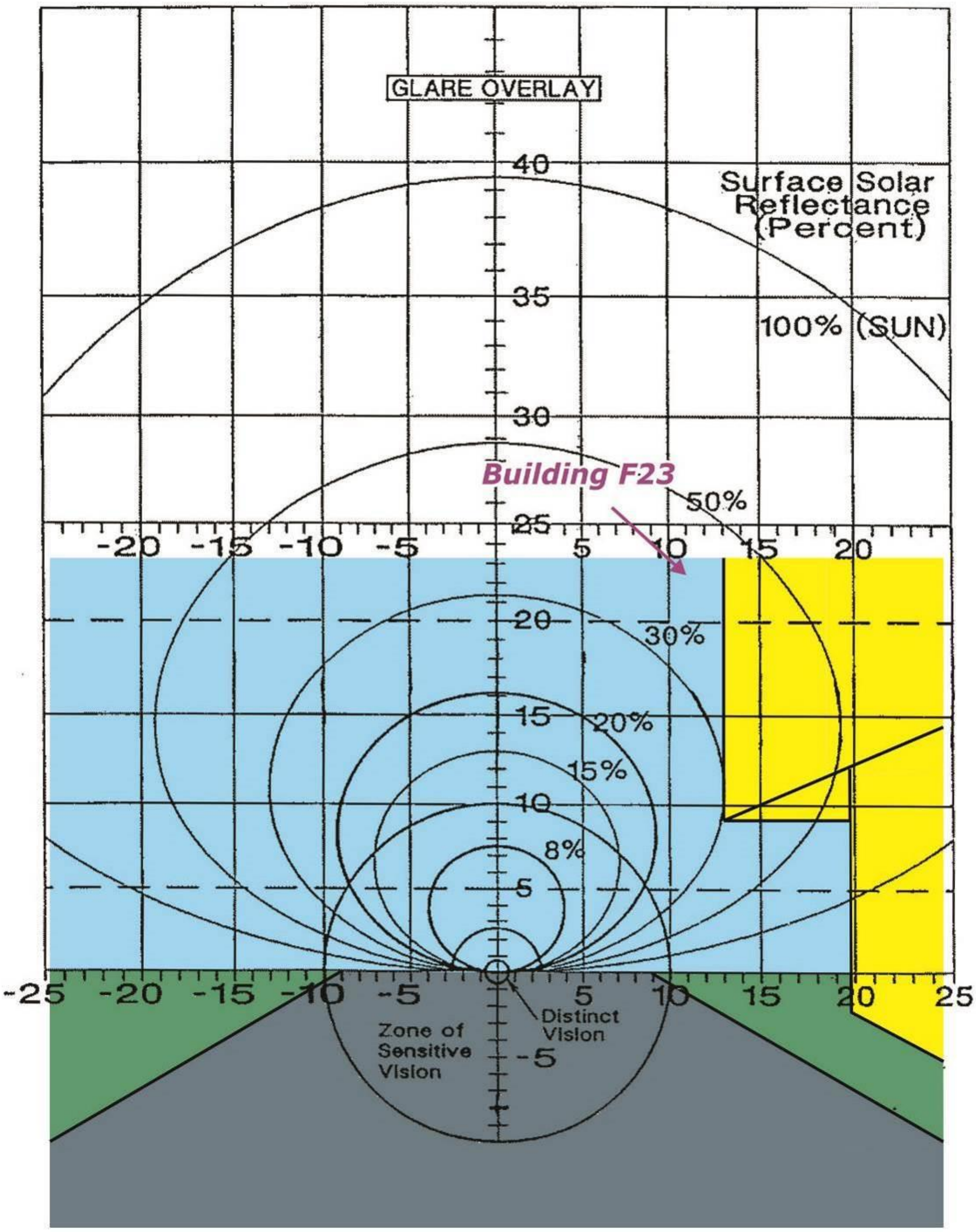

Figure A5: Glare Overlay for Point 5

APPENDIX B - SOLAR CHARTS FOR THE VARIOUS CRITICAL ASPECTS

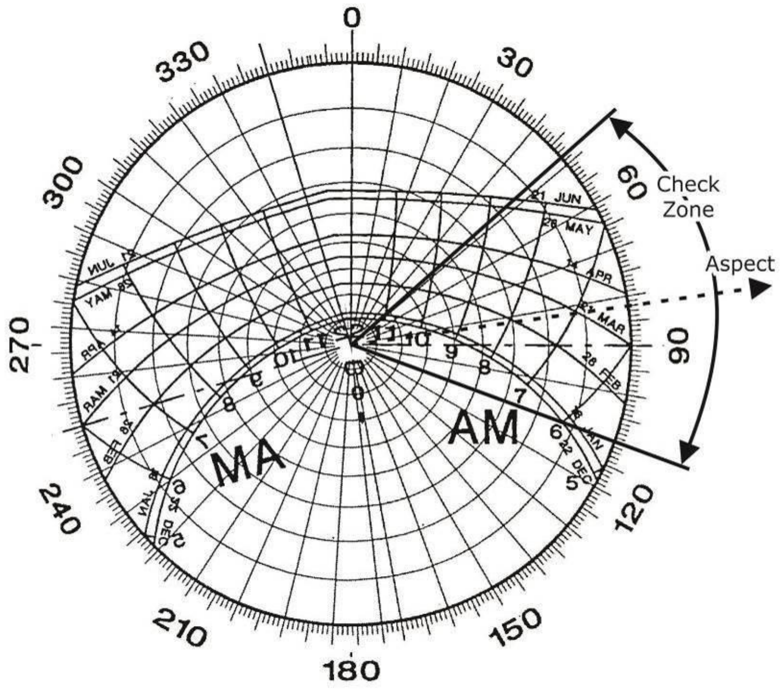

Figure B1: Sun Chart for Aspect 082°

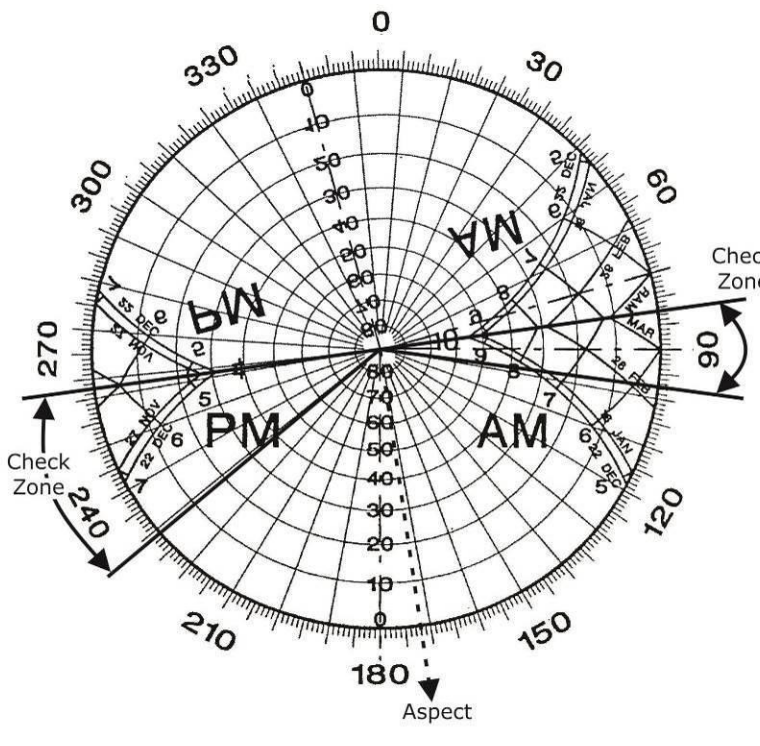

Figure B2: Sun Chart for Aspect 172°

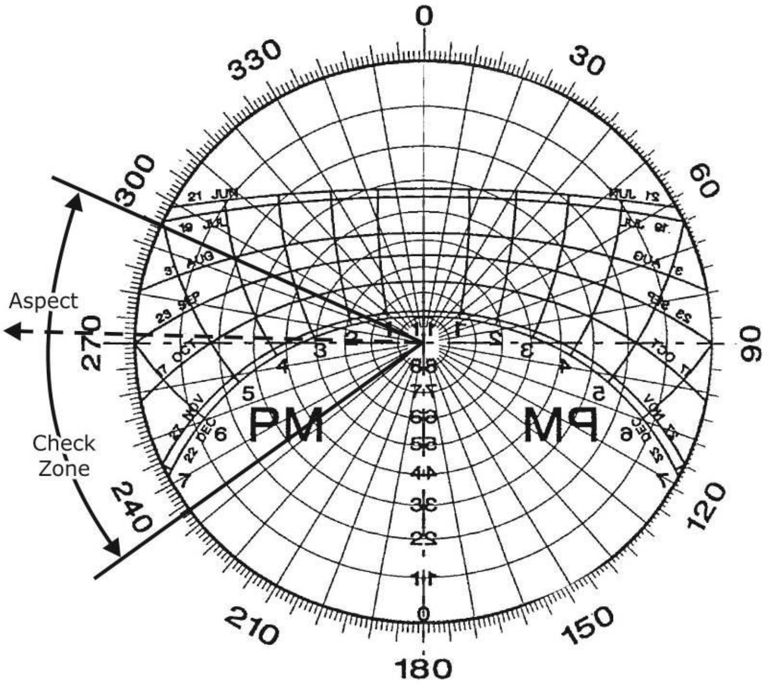

Figure B3: Sun Chart for Aspect 272°

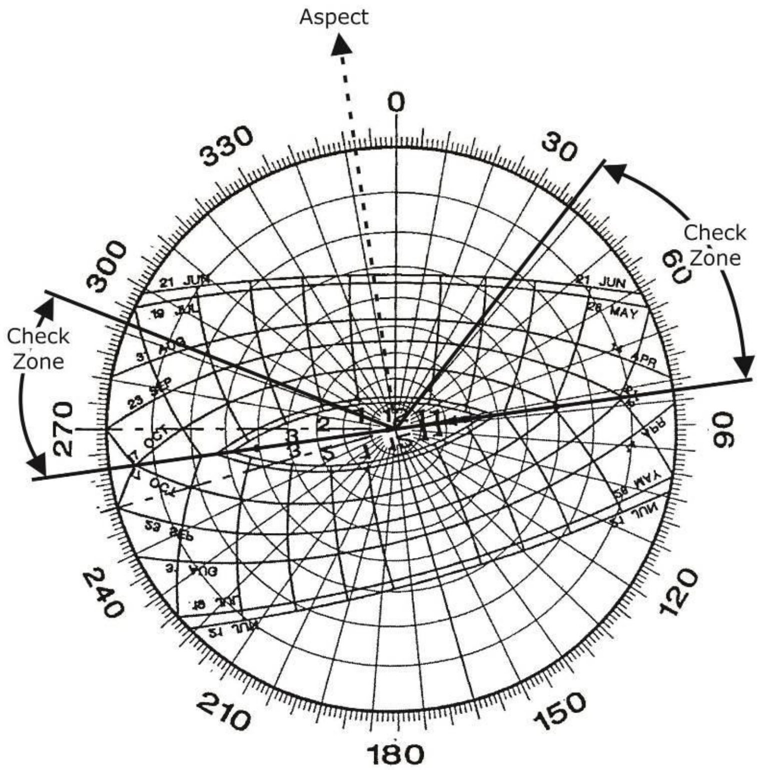

Figure B4: Sun Chart for Aspect 352°

APPENDIX C - STANDARD SUN CHART FOR THE SYDNEY REGION

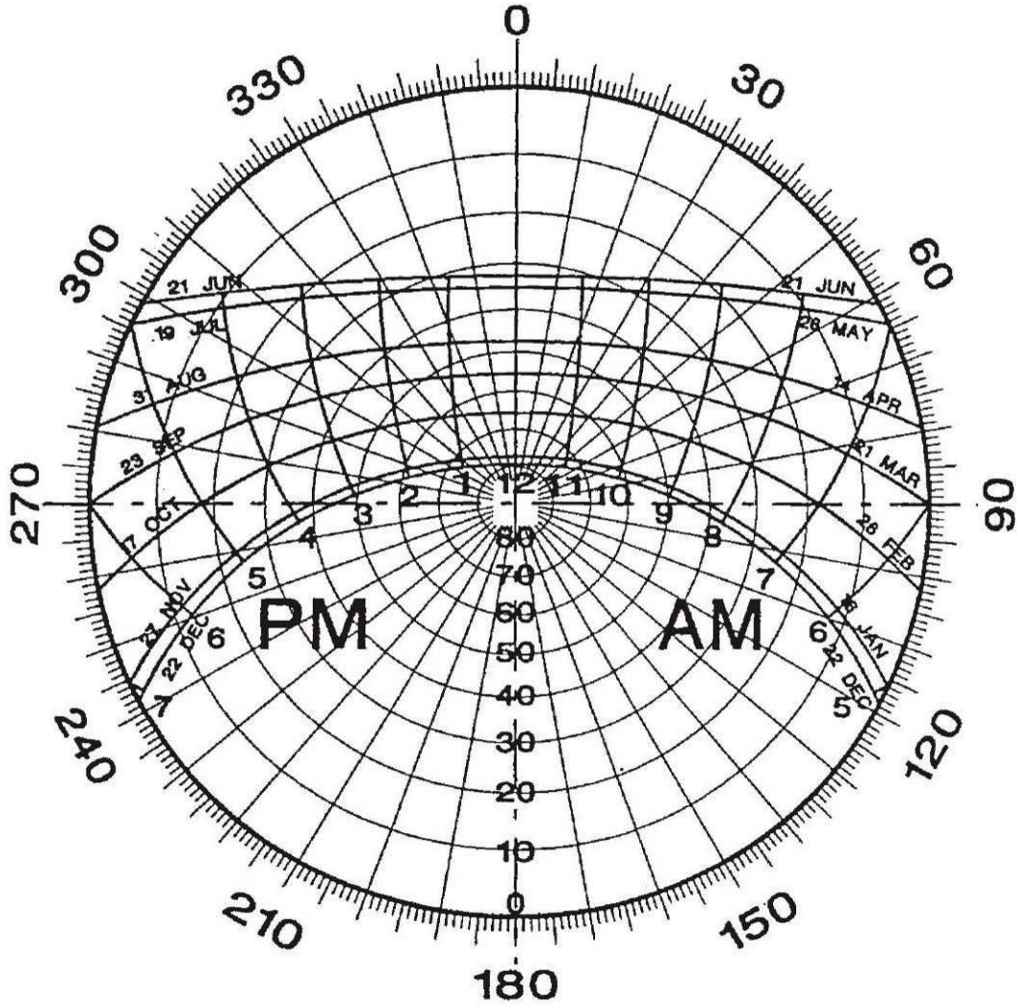

Figure C1: Standard Sun Chart for the Sydney Region