DAYLIGHT ILLUMINATION STUDY

42 NORTH STEYNE, MANLY

WG580-01F02(REV0)- DL REPORT

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EXECUTIVE SUMMARY

This report presents the results of a detailed assessment of the amount of natural daylight illumination available within the residential apartments of the proposed development located at 42 North Steyne, Manly. The analysis has been undertaken based on the latest available architectural drawings prepared by Squillace. The study takes into account any overshadowing effects caused by neighbouring buildings, overhead protruding balcony slabs and blade walls, etc, which may affect the amount of natural light able to enter the development. Light from the various lightwells of the development have been accounted for in the assessment.

The results of the study indicate that adequate natural light will be achieved within the development with the incorporation of a high-reflectance façade for the lightwells, which requires the following:

- A 1m spandrel of high-reflectance glass (with a light reflectance value of up to 50%) to be used on Levels 2 and 3 for the façade facing into each lightwell. Note that the light transmittance value of such highly-reflective glass will be quite poor though, and for this assessment it has been assumed that no light will enter the development through the spandrel.

- Glass with a light reflectance value of approximately 10% and a light transmittance value of approximately 90% is assumed for areas of the lightwell above the spandrel on Levels 1, 2 and 3.

- The abovementioned high-reflectance glass (with a light reflectance value of up to 50%) is also to be used on the entire aspect of the lightwell on Levels 1, 2 and 3 for aspects of the lightwell that are not windows (eg: the northern aspect of the central lightwell adjacent to the fire stairs).

CONTENTS

1 THE NATURE OF DAYLIGHT

A daylight illumination study is quite different to that of a direct solar access study. A direct solar access study, which is often a requirement for a development application in NSW as part of the Apartment Design Guide (ADG) requirements, typically only assesses the number of hours of direct sunlight either to the glass-line of the living room window, or sometimes within the living room itself, but it will not provide any information on the quality of light available within the room or any indication on whether the amount of natural light available within a room is adequate for the intended use. A daylight illumination study is able to determine if the amount of available natural light is sufficient for the intended use of a room within a development.

1.1 The Uniform Standard Sky

Daylight (or natural light) can be classified in two ways; light from the sky, and light from the sun. In a daylight illumination study it is usual to only consider light from the luminous sky since the sun may not be available when needed through being either in the wrong part of the sky or obscured by clouds. An overcast sky is usually assumed as being the "worst case" for the supply of natural light (even though an overcast sky can be more luminous than a blue sky in some situations). If a room receives enough natural light with an overcast sky, then extra light received when the sun is shining is considered a bonus.

The Uniform Standard Sky is considered to be a fully overcast sky that has the same illuminance in every direction. Although the amount of illuminance will vary throughout the day, the value that is exceeded for 75% of the time is used for this assessment. Note also that the amount of illuminance available from the sky will vary throughout the year, with the most being available in summer and the least in winter.

The amount of daylight illumination available from the unobstructed Uniform Standard Sky model for the Sydney region is 17,500Lux. This value is representative of the Equinox (March 21) between 9am and 3pm, and is derived from the procedure detailed by Nassau (1975) and is in agreement with measurements made for the Sydney region. Note that the total amount of daylight illumination available from the unobstructed Uniform Standard Sky model for the Equinox (March 21) is representative of an average value for the whole year.

1.2 Light Required for Various Tasks

The human eye is very adaptive and can see even in moonlight (which gives illumination of only about 0.2Lux on a clear night). The response of the human eye to light is approximately logarithmic. For example, if 100 Lux is required and 90Lux is available (a drop of 10%) then the ratio of log90/log100 = 98%. That is, with a light reduction of 10%, a person's visual efficiency has only dropped by about 2%. A summary of adequate lighting levels for various activities are summarised in Table 1.

Table 1: Adequate Lighting Levels for Various Activities

Activity/Area	Illumination (Lux)	Reference
Minimum required for the safe movement of people	20	AS/NZS1680.0:2009
Corridors, passageways	40	AS/NZS1680.2.1:2008
Bedrooms, general	50	Boer & Fischer (1978)
Stairways	80	AS/NZS1680.2.1:2008
Bathrooms, general	100	Boer & Fischer (1978)
Living rooms, general	100	Boer & Fischer (1978)
Continuously occupied interior space, with occasional reading of printed documents	160	AS/NZS1680.1:2006
Entrances, foyers, food consumption areas	160	AS/NZS1680.2.1:2008
Bedrooms, bed head	200	Boer & Fischer (1978)
Information desks	320	AS/NZS1680.2.1:2008
Bathrooms, shaving and make-up	500	Boer & Fischer (1978)
Living rooms, reading and sewing	500	Boer & Fischer (1978)

2 METHODOLOGY

2.1 Governing Equation

The amount of daylight illuminance available at a specific point within a room is calculated as shown by the following equation:

$$E_v = (DF)E_{v,SUS} \quad 2.1$$

where DF is the Daylight Factor, which is the percentage of light available within a room when compared to what is available from the sky. For example, if the amount of daylight within a room in Sydney is 200 Lux, then compared to the total sky value $E_{v,SUS}$ of 17,500Lux for Sydney on March 21 between 9am and 3pm (as specified in Section 1.1 of this report), the Daylight Factor DF for the room would be 1.1%.

The Daylight Factor comprises of several other factors, as shown by the following equation:

$$DF = (SC + ERC + IRC) \times (GF \times FF) \quad 2.2$$

where:

E_v is the illuminance on a plane at a representative height for the room, expressed in Lux. For a living room or bedroom, the reference plane is set at 0.5m (ie: approximately the height of a coffee table, bed, etc). For a study room or kitchen space, the reference plane is set at 0.8m (ie: approximately the height of a desk, benchtops, etc). Note that the reference plane is also sometimes referred to as the "working plane" in these types of assessments.

$E_{v,SUS}$ is the illuminance of the total unobstructed sky (see Section 1.1).

DF is the Daylight Factor, expressed as a percentage of $E_{v,SUS}$.

SC is the Sky Component, and represents the amount of unobstructed illuminance from the sky. This can be calculated using the BRE Daylight Factor Protractor (attached in Appendix A), or from the Standard Sun Chart for Sydney (attached in Appendix B).

ERC is the External Reflected Component, and represents the amount of illuminance reflected from any obstructions. This is calculated using the BRE Daylight Factor Protractor (attached in Appendix A).

IRC is the Internal Reflected Component, and represents the amount of illuminance reflected from the internal surfaces of the room. Note that this factor is typically negligible.

GF is the Glazing Factor, which takes into account the transmissibility of the window. For this assessment, this factor has been set at 90% (which is a typical value used to represent clear glass).

FF is the Framing Factor, and accounts for a portion of the overall window area being occupied by the window frame. For this assessment, this factor has been set at 90% (which is a typical value used for the windows of a residential apartment building).

The Sky Component and the External Reflected Component are calculated using the BRE Daylight Factor Protractor (attached in Appendix A). The amount of reflectance from the external surface of an obstruction

(required for the determination of ERC) is dependent on the type of façade material. In this study, for glazed surfaces, a reflectance of 20% is used, whereas a value of 10% is used for concrete, brickwork, etc. However, in this study the reflectance of the façade within the various lightwells of the development range from 30% to 50% (further details of the lightwell façade is provided in Section 3 of this report). Note also that further adjustments are made to the calculation to account for the vertical tunnel effect of light available from lightwells, since the height of the lightwell affects how much light is available from it.

2.2 General Calculation Procedure

For this study, the amount of daylight illuminance available at specific study point locations is calculated. The height of the study point is selected to be representative of a "working plane" for that type of room, as described in Section 2.1 of this report. The calculation method for determining the amount of daylight illuminance at each study point location is been described in the 1968 "BRS Daylight Protractors" publication by the Building Research Station Department of the Environment, although the general method is also described in various other publications, and involves the following procedure:

- Determine the available illuminance received from the unobstructed sky.
- Generate scaled plan and elevation drawings of the subject rooms to be assessed, and include any obstructions to the light entering the room from the window(s). Obstructions could be neighbouring buildings, eaves, protruding overhead balcony slabs, blade walls, fins, etc.
- Identify the study point location within each selected room.
- Use the BRE Daylight Factor Protractor to determine the Daylight Factor at each study point.
- Determine the total daylight illuminance within the room by combining the final Daylight Factor with the total amount of illumination available from the unobstructed sky.
- Compare the result with relevant criteria.

2.3 Study Point Locations and Assessment Criteria

In this assessment, the amount of daylight illumination available to the following room types within the development are determined:

- Living rooms
- Bedrooms
- Study rooms
- Kitchen spaces

The criteria adopted in this study for the determination of adequate daylight illumination levels for these room types is summarised below. These criteria are generally adopted from those listed in Table 1, with the exception

of the kitchen spaces (which are not specifically listed in Table 1). For the kitchen spaces, the BS8206-2:2008 standard (a British Standards Institution publication for "Lighting for Buildings") suggests that the light available to kitchen spaces be approximately 50% higher than to the living room, and hence that has been adopted as the criterion for the kitchen spaces in this assessment.

- Living rooms: 100Lux
- Bedrooms: 50Lux
- Study rooms: 100Lux
- Kitchen spaces: 150Lux

The locations of the study points examined in this study are presented in the following figures, in the form of marked-up plans. Note that study points have only been selected for Levels 1, 2 and 3 of this development for the determination of daylight illumination. There are no residential apartments on the Ground level of this development, and ample daylight illumination will be available to the rooms of the penthouse apartment on Level 4 since those rooms are generally located closer to the main windows and do not rely on light from lightwells as a primary light source, as is the case for some of the rooms on Levels 1, 2 and 3.

Figure 1a: Layout of Study Points - Level 1 Plan

Figure 1b: Layout of Study Points - Level 2 Plan

Figure 1c: Layout of Study Points - Level 3 Plan

3 RESULTS AND DISCUSSION

The results of the assessment are summarised in the table below for each study point selected for detailed analysis, and are presented as the average amount of daylight illumination at each study point location for the Equinox (March 21) between 9am and 3pm.

The results for the study points which are reliant on light from the various lightwells have been calculated based on the assumption that a high-reflectance façade will be utilised within this lightwells. This requires that:

- A 1m spandrel of high-reflectance glass (with a light reflectance value of up to 50%) to be used on Levels 2 and 3 for the façade facing into each lightwell. Note that the light transmittance value of such highly-reflective glass will be quite poor though, and for this assessment it has been assumed that no light will enter the development through the spandrel.

- Glass with a light reflectance value of approximately 10% and a light transmittance value of approximately 90% is assumed for areas of the lightwell above the spandrel on Levels 1, 2 and 3.

- The abovementioned high-reflectance glass (with a light reflectance value of up to 50%) is also to be used on the entire aspect of the lightwell on Levels 1, 2 and 3 for aspects of the lightwell that are not windows (eg: the northern aspect of the central lightwell adjacent to the fire stairs).

With the incorporation of the high-reflectance façade for the lightwells, the results of the study indicate that adequate natural light will be achieved at each study point location located on Levels 1, 2 and 3 within the development. Furthermore, as described in Section 2.3 of this report, ample daylight illumination will be available to the rooms of the penthouse apartment on Level 4 since those rooms are generally located closer to the main windows and do not rely on light from lightwells as a primary light source, as is the case for some of the rooms on Levels 1, 2 and 3.

Table 2: Average Daylight Illuminance for Each Room of the Development (for Levels 1 to 3) (Equinox (March 21), from 9am to 3pm)

Study Point	Unit Number	Room Type	Average Daylight Illumination (Lux)	Criterion (Lux)
U101L	Unit 101	Living	209	100
U101K	Unit 101	Kitchen	153	150
U101S	Unit 101	Study	234	100
U101B1	Unit 101	Bedroom 1	180	50
U101B2	Unit 101	Bedroom 2	84	50
U101B3	Unit 101	Bedroom 3	253	50
U102L	Unit 102	Living	150	100
U102K	Unit 102	Kitchen	160	150
U102S	Unit 102	Study	113	100
U102B1	Unit 102	Bedroom 1	250	50

Study Point	Unit Number	Room Type	Average Daylight Illumination (Lux)	Criterion (Lux)
U102B2	Unit 102	Bedroom 2	322	50
U102B3	Unit 102	Bedroom 3	189	50
U201L	Unit 201	Living	209	100
U201K	Unit 201	Kitchen	189	150
U201S	Unit 201	Study	270	100
U201B1	Unit 201	Bedroom 1	180	50
U201B2	Unit 201	Bedroom 2	84	50
U201B3	Unit 201	Bedroom 3	320	50
U202L	Unit 202	Living	150	100
U202K	Unit 202	Kitchen	198	150
U202S	Unit 202	Study	141	100
U202B1	Unit 202	Bedroom 1	250	50
U202B2	Unit 202	Bedroom 2	411	50
U202B3	Unit 202	Bedroom 3	263	50
U301L	Unit 301	Living	209	100
U301K	Unit 301	Kitchen	226	150
U301S	Unit 301	Study	306	100
U301B1	Unit 301	Bedroom 1	180	50
U301B2	Unit 301	Bedroom 2	84	50
U301B3	Unit 301	Bedroom 3	388	50
U302L	Unit 302	Living	150	100
U302K	Unit 302	Kitchen	235	150
U302S	Unit 302	Study	169	100
U302B1	Unit 302	Bedroom 1	250	50
U302B2	Unit 302	Bedroom 2	500	50
U302B3	Unit 302	Bedroom 3	338	50

4 REFERENCES

Baker et al, "Daylighting in Architecture: A European Reference Book", James & James, London, 1993.

British Standards Institution, BS8206-2:2008, "Lighting for Buildings".

"BRS Daylight Protractors", Building Research Station Department of the Environment, 1968.

Burberry, P., 1979, "Mitchell's Building Series: Environment & Services", B.T.Batsford, London.

"Daylighting for Buildings", EBS Note on the Science of Building No.56.

"Daytime Lighting of Buildings", IES Technical Report No.4.

Design Data (Section 4-17, Conversion Factors), AIRAH.

"Environmental Science Handbook for Architects and Builders", Szokolay, 1980.

Hayman, S., 1996, "The Daylight Climate of Sydney", Thesis (Ph. D.), University of Sydney.

Hopkinson, R.G., Petherbridge, P., and Longmore, J., 1963, "Daylighting", Heinemann, London.

"Interior Lighting", Boer & Fischer, 1978.

Moon, P., 1961, "The Scientific Basis of Illuminating Engineering", Dover, New York.

Nassau, P.F., 1975, "Daylight Calculations" in IES Lighting Review, February 1975.

"NSW Model Code: A model of performance-based multi-unit housing codes", June 1997, Department of Urban Affairs and Planning.

Pears, A., June 1998, "Strategic Study of Household Energy and Greenhouse Issues", Australian Greenhouse Office, p61.

Standards Australia, AS/NZS1680.1:2006, "Interior and workplace lighting - General principles and recommendations".

Standards Australia, AS/NZS1680.2.1:2008, "Interior and workplace lighting - Specific applications - Circulation spaces and other general areas".

State Environmental Planning Policy No. 65 (SEPP65), 2015, "Apartment Design Guide", NSW Department of Planning and Environment.

Sydney Solar Tables, CSIRO.

"The Design of Buildings for Daylighting", EBS Bulletin No.7.

Turner, D.P., (editor), 1977, "The Window Glass Design Guide", Architectural Press London.

APPENDIX A BRE DAYLIGHT FACTOR PROTRACTOR

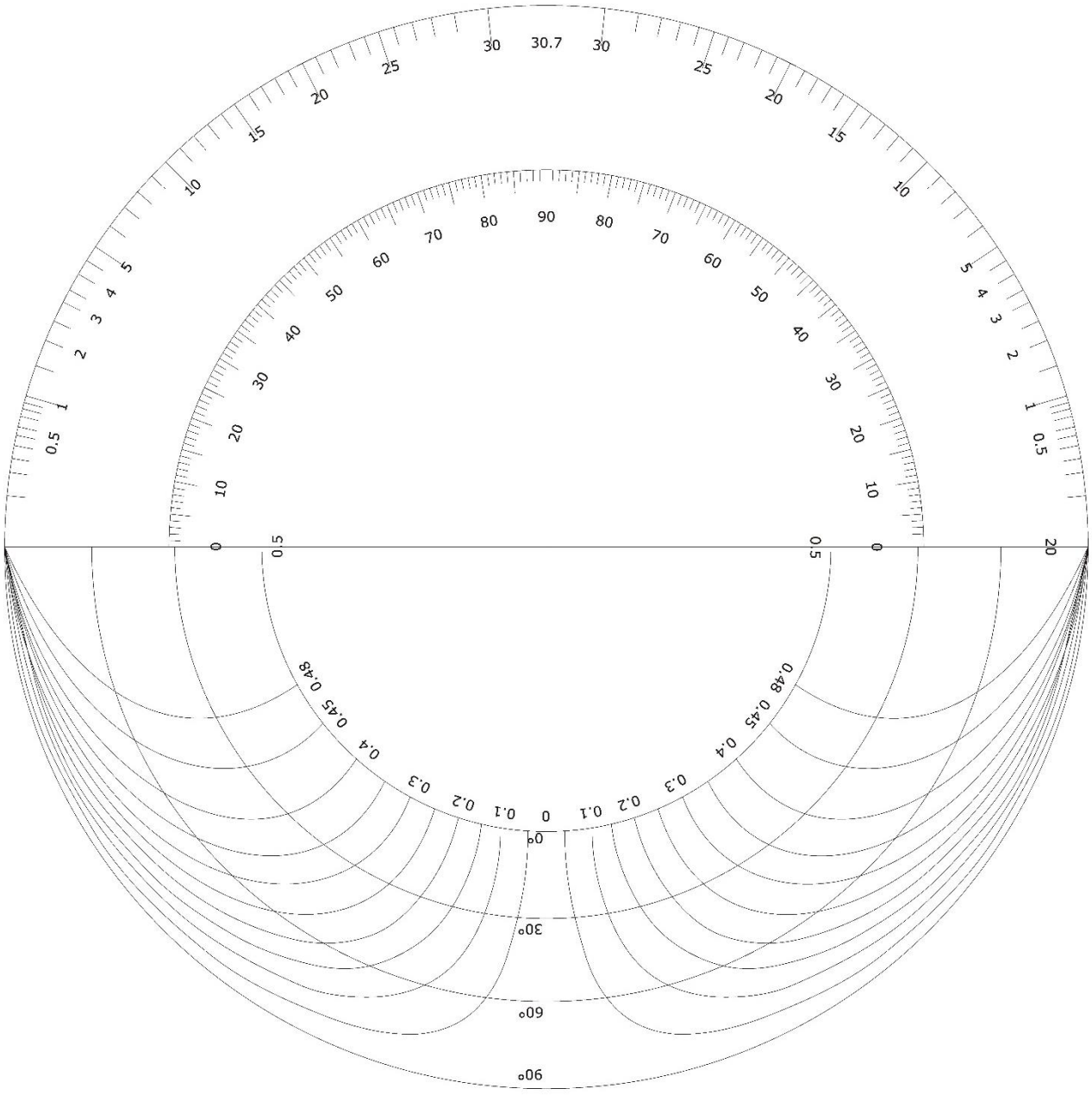

Figure A.1: BRE Daylight Factor Protractor (Protractor Number 2 - for Vertical Glazing)