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Kingdown School New PE Building

Internal Daylight Analysis

Sustainability Services

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Executive Summary

This Internal Daylight Analysis has been undertaken by Cooper Homewood Ltd (CHL) to advise on the daylight conditions of the Proposed Development and its performance in achieving good daylighting requirements.

The daylight simulation is based on FlucsDL software through the use of IES VE 2023. FlucsDL uses the point by point plus radiosity method to calculate the Average Daylight Factor (ADF) within all occupied spaces within the Proposed Development. Simulation results have been included in the Appendices.

Assessment has been undertaken in Three parts in line with the BS EN 17037 requirements, which are:

- Daylighting (ADF)
- View Out
- Sunlight (APSH)

The results of the analysis demonstrate that the BS EN 17037 Day Lighting for buildings requirements for Average daylight factor, View Out and Sunlight (APSH) criteria have been met.

The results of the internal daylight analysis demonstrate that all assessed rooms exceed the recommendations set out by industry guidance. All main occupied spaces within the Proposed Development will receive adequate internal daylight levels, which can in turn support the health, wellbeing, and productivity of the building occupant, while reducing the energy consumption associated with lighting and visual comfort.

1.0 Introduction

This Internal Daylight Analysis has been undertaken by Cooper Homewood Ltd (CHL) for the Proposed Development at Kingdown School on behalf of Acorn Education Trust Ltd to advise on the Proposed Development's performance in achieving the daylighting criteria.

This report and the 3D model are based on information and drawings provided by Footprint Architects.

1.1 Proposed Development

Kingdown School is located in Warminster and comprises the refurbishment and extension of an existing school site.

This Development forms a new standalone PE building, including, activity studios, general teaching classrooms and associated changing and welfare facilities.



Figure 1 - Indicative Site Render

2.0 Background

Daylighting is an important consideration in building design, which has a strong influence on the health, wellbeing and productivity of the building occupants. The human visual system is extremely well adapted to daylight and the benefits to human health are well documented.

In addition, daylight performance also considerably impacts the energy consumption of a building. The use of daylight in buildings can significantly reduce artificial lighting energy consumption and therefore the associated greenhouse gas emissions.

Uniformity is another parameter to evaluate the daylight level within a space. It represents the ratio between the minimum illuminance (or minimum daylight factor) on the working plane and the average illuminance (or average daylight factor) on the same working plane. A higher uniformity ratio indicates that daylight level is distributed more evenly on the working plane of a space.

2.1 Assessment Criteria

Average daylight factor

Traditionally, daylight has been evaluated quantitatively, using the Average Daylight Factor (ADF). The daylight factor is defined as a ratio that represents the amount of illumination available indoors relative to the illumination present outdoors at the same time under an overcast sky.

ADF is normally expressed as a percentage of the illuminance available to an unobstructed point outdoors, under an overcast sky of known luminance and luminance distribution. This is the most detailed of the daylight calculations and considers the physical nature of the rooms and windows, including; window transmittance, window size, room size, angle of external obstruction and room surface reflectivity.

Although there are various recommendations for typical Average Daylight Factor values, an average value between 2% and 5% is considered satisfactory. The BRE guide recommends an ADF of 5% or more if there is no supplementary electric lighting, or 2% or more if supplementary electric lighting is provided. However, interiors with very high ADFs (over 6%) sometimes have problems with summertime overheating or excessive heat loss in winter due to increased glazing levels.

View out

95% of the floor area in 95% of spaces for each relevant building area provide an adequate view out. To provide adequate view out, all areas within the main habitable spaces are to be within 8m of a wall which has a window or permanent opening ≥ 20% of the surrounding wall area and in addition for multi-residential buildings all positions within relevant areas are to be within 5m of a wall which has a window or permanent opening providing an adequate view out.

Sunlight - Annual Probable Sunlight Hours (APSH)

The APSH test calculates the percentage of statistically probable hours of sunlight received by each window in both the summer (March 21st through to September 21st) and the winter months (September 21st to March 21st).

In the northern hemisphere, windows are only considered in this analysis where they face within 90° of due south, and are therefore most likely to receive daylight. Where a window is within 90°

of due south, the guidance proposes it should receive at least 25% of the total Annual Probable Sunlight Hours (APSH) in summer months and at least 5% of APSH in the winter months.

An adverse impact on sunlight will be experienced if the total number of sunlight hours falls below these recommendations of 25% for summer and 5% for winter. A good APSH score means the occupiers will receive good access to direct sunlight within the room.

Glare Control

A glare control assessment can be undertaken to determine the areas of the building that are at risk of glare, including a demonstration of the building areas not at risk. This can be achieved through a survey or modelling of the relationship between sunlight and the building. Design studies can be used to demonstrate that glare cannot reach the eyes of building occupants, or the computer screens they are using, during occupied hours.

Where compliant shading measures such as blinds/overhangs are specified for all relevant building areas regardless of the risk of glare, a glare control assessment will not be necessary. The glare control strategy should demonstrate building design measures are specified for all relevant building areas.

Methodology

This study is based on guidelines set out in the BRE 'Site Layout Planning for Daylight and Sunlight, A Guide to Good Practice', the British Standard of practice for daylight (BS 8206-2) and Daylight in buildings (BS EN 17037) . The assessment has been conducted using FlucsDL Day lighting analyses software through the IES VE software.

The 3D model created is based on the latest architectural drawings provided by Footprint Architects Ltd. A perspective view of the model can be seen below in Figure 2 with additional models in Appendix B.

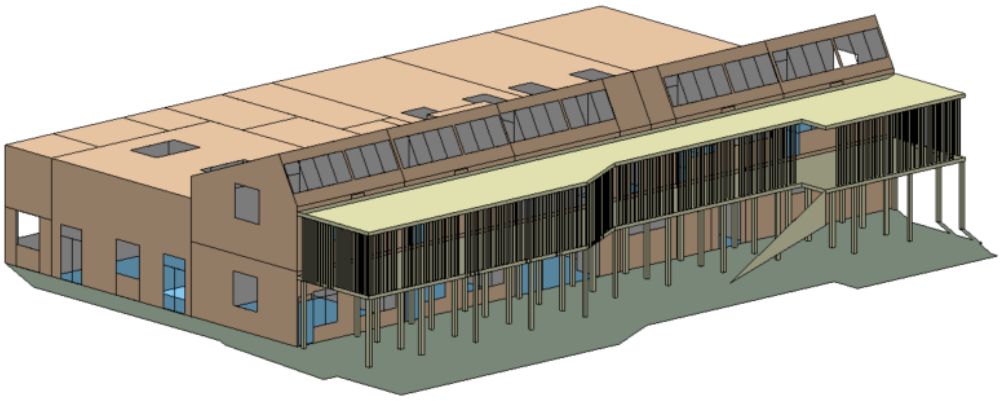


Figure 2: Perspective View of the Daylight Model from North

This analysis has included all habitable spaces in order to assess the performance of the Proposed Development. The tested spaces are listed in Table 1.

This analysis has included all occupied spaces in order to assess the performance of the Proposed Development. The tested spaces are listed in Table 1, and floor layouts can be found in Appendix A.

Space Name	Floor Area (m^2)
1.08 – Fitness Suite	85
1.06a - Activity Studio	90
1.06b - Activity Studio	90
1.02 – Health and Wellbeing Studio	117
1.03b – Group	22
1.04a – Office	10
1.05 - Group	18
1.04b – Office	11
1.19 – PE Classroom	56
1.21 – PE Classroom	56
1.22 - PE Classroom	56
1.23 - PE Classroom	56
1.24 - PE Classroom	56
1.25 - PE Classroom	56

Table 1 – Summary of Assessed Spaces

Key settings of the simulation include:

- working plane at 0.70 m above the floor,
- grid size of 0.25 m,
- 0.5 m margin from walls and obstructions, and
- under a standard CIE overcast sky.

Table 2 below shows the reflectance of the internal surfaces that have been used in the model. Changes to these figures would change the overall results. However, they are based on colours likely to be applicable to each surface.

	Material	Reflectance
Walls	Off white	0.80
Floor	Light grey	0.50
Ceiling	White ceiling board	0.90
Glazing	Light transmittance 40% Frame width 70mm	

Table 2 - Reflectance of internal surfaces

3.0 Results & Conclusion

3.1 Daylighting

Internal daylighting assessment has been carried out for the relevant occupied space in the commercial building. The results of the daylight analysis are summarised in Table 3 below.

Space Name	Daylighting	
	ADF	
	Room ADF (%)	Pass / Fail
1.08 – Fitness Suite	5.1	Pass
1.06a - Activity Studio	4.3	Pass
1.06b - Activity Studio	4.2	Pass
1.02 – Health and Wellbeing Studio	5.7	Pass
1.03b – Group	2.9	Pass
1.04a – Office	5.9	Pass
1.05 - Group	5.8	Pass
1.04b – Office	12	Pass
1.19 – PE Classroom	2.2	Pass
1.21 – PE Classroom	3.7	Pass
1.22 - PE Classroom	7.9	Pass
1.23 - PE Classroom	6.5	Pass
1.24 - PE Classroom	6.6	Pass
1.25 - PE Classroom	7.9	Pass

Table 3 –Assessment Summary for Daylighting Criteria

The above results confirm that the assessed spaces exceed the 2% minimum requirement for the recommended levels of Average Daylight Factor (ADF) and therefore a good level of natural daylight can be expected within the assessed spaces. A floor plan with detailed distribution of daylight factor is included for the assessed spaces. These have been included in Appendix B.

3.2 View Out

The occupied spaces within the Proposed Development are provided with window openings of greater than 20% of the surrounding wall area, accordingly, based on the corresponding room depths and percentage window required based on Table 1 of BS82061 (Lighting for Buildings). The results of the View out criteria are summarised in Table 4 below.

Space Name	View Out					
	Room Depth	Total Wall Area	Adequate View Out			
			Opening Area	Window to Wall Ratio	% Window /Wall Requirement	Compliance
1.08 – Fitness Suite	11.80	102.00	34.20	33.5	25	Pass
1.06a - Activity Studio	11.80	32.80	20.30	61.9	25	Pass
1.06b - Activity Studio	11.80	32.80	20.30	61.9	25	Pass
1.02 – Health and Wellbeing Studio	10.47	46.00	27.10	58.9	25	Pass
1.03b – Group	6.00	6.40	5.30	82.8	20	Pass
1.04a – Office	3.50	3.30	5.30	160.6	20	Pass
1.05 - Group	3.50	9.10	5.30	58.2	20	Pass
1.04b – Office	3.50	9.60	10.90	113.5	20	Pass
1.19 – PE Classroom	8.00	20.20	10.10	50.0	20	Pass
1.21 – PE Classroom	8.00	49.00	13.40	27.3	20	Pass
1.22 - PE Classroom	8.00	45.00	23.22	51.6	20	Pass
1.23 - PE Classroom	8.00	9.50	19.88	209.3	20	Pass
1.24 - PE Classroom	8.00	32.60	20.44	62.7	20	Pass
1.25 - PE Classroom	8.00	67.32	23.22	34.5	20	Pass

Table 4 - Assessment Summary for View Out Criteria

With the proposed window design all occupied spaces in the building pass to provide an adequate view out of a landscape or adjacent building at seated eye level.

3.3 Sunlight – Annual Probable Sunlight Hours (APSH)

The amount of direct sunlight accessible to windows within the Proposed Development has been assessed against the APSH criteria on the façades facing south, to achieve a required value of at least 25% of the total APSH in summer months and at least 5% of total APSH in the winter months (Sept 21 – March 21).

Room Type.	Window No.	Summer APSH	Winter APSH	Annual APSH
1.08 Fitness Suite	1	55.86	39.04	58.65
	2	24.66	12.33	
	3	24.66	12.33	
	4	24.66	12.33	
	5	24.66	12.33	
	6	24.66	12.33	
	7	24.66	12.33	
	8	41.1	36.3	
	9	41.1	36.3	
	10	41.1	36.3	
	11	41.1	36.3	
	12	41.1	36.3	
1.06b Activity Studio	1	56.06	39.04	80.35
	2	41.1	36.3	
	3	41.1	36.3	
	4	41.1	36.3	
	5	41.1	36.3	
	6	41.1	36.3	
1.06a Activity Studio	1	56.06	39.04	80.35
	2	41.1	36.3	
	3	41.1	36.3	
	4	41.1	36.3	
	5	41.1	36.3	
	6	41.1	36.3	
1.03b – Group	1	77.40	41.10	36.3
1.04a – Office	1	77.4	41.10	36.3
1.05 - Group	1	77.4	41.10	36.3
1.04b – Office	1	63.1	36.30	26.71
	2	77.4	41.10	

Table 5 – Annual Probable Sunlight Hours (APSH) analysis results of Assessed Spaces

All windows oriented within 90 degrees of due south have been assessed for Annual Probable Sunlight Hours (APSH). The scheme performs very well in terms of APSH value, both for the entire year and during the winter months.

All the assessed spaces will receive sufficient levels of sunlight annually, during summer and winter months. This results in a pass against the 25% summer and 5% winter criteria.

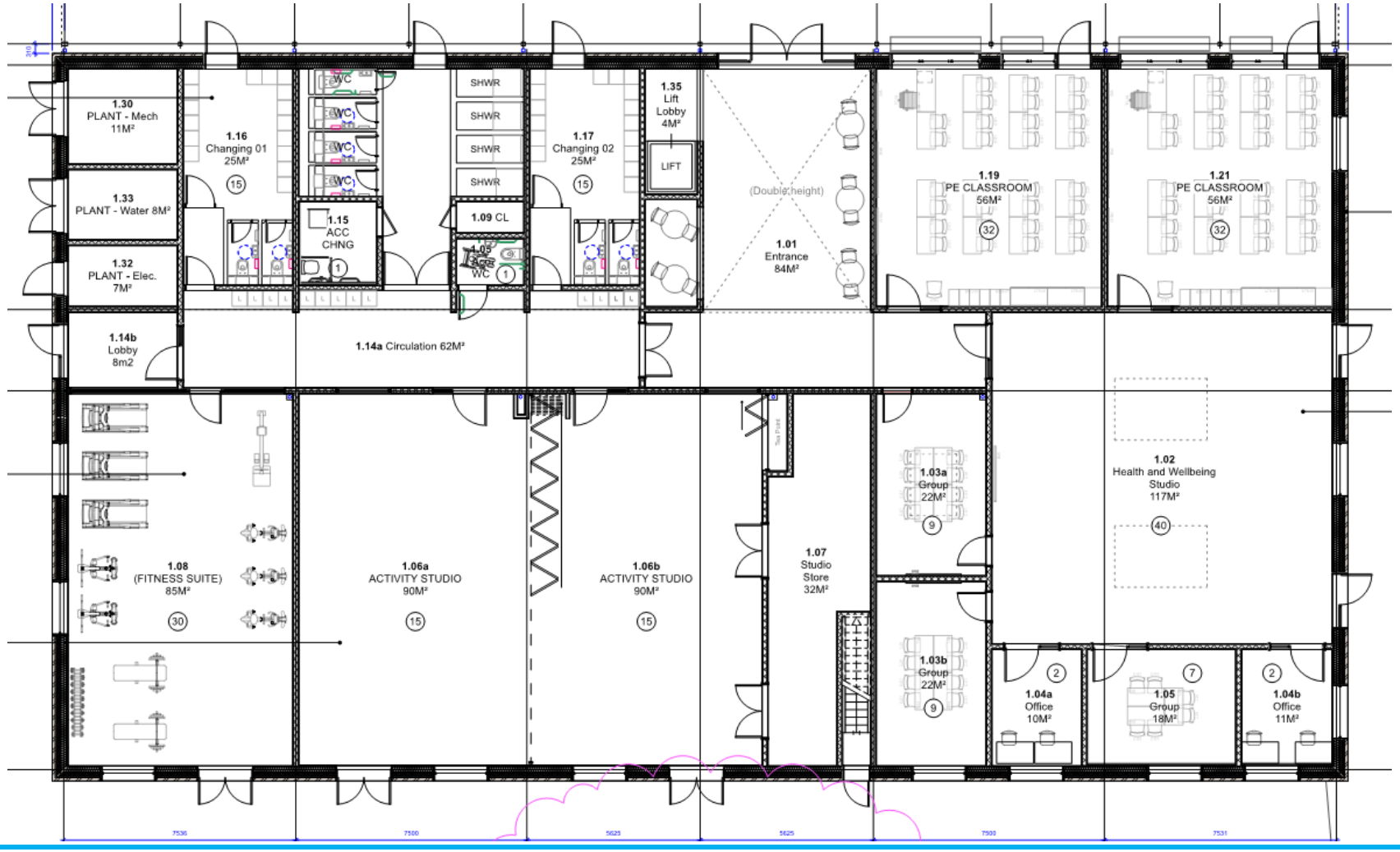
3.4 Glare Control

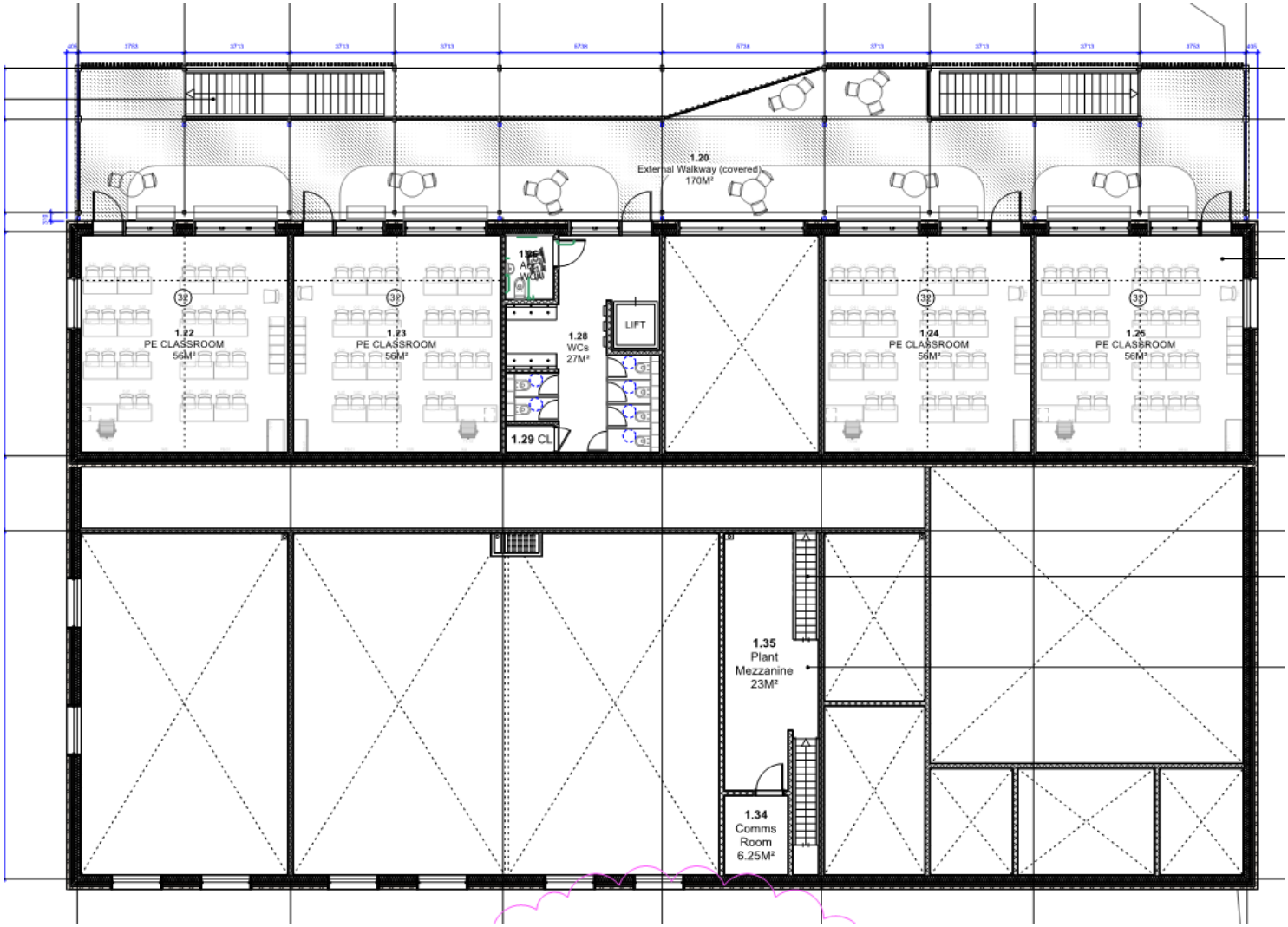
The use of internal blinds can be specified for the classroom and office space to limit the potential glare. It is recommended that all relevant building areas within the proposed development will be provided with occupant-controlled shading devices such as blinds to avoid any risk of glare.

3.5 Conclusion

The results of the internal daylight analysis demonstrate that all assessed rooms exceed the recommendations set out by industry guidance. All main occupied spaces within the Proposed Development will receive adequate internal daylight levels, which can in turn support the health, wellbeing, and productivity of the building occupant, whilst reducing the energy consumption associated with artificial lighting. Images from the daylighting analysis from the IES software are shown in the figure below in appendix B. Each image shows the assessed spaces for each evaluated area.

Appendix A – Floor Plans




1.20
External Walkway (covered)
170M²
1.22
PE CLASSROOM
56M²
1.23
PE CLASSROOM
56M²
1.28
WCs
27M²
LIFT
1.29 CL
1.24
PE CLASSROOM
56M²
1.25
PE CLASSROOM
56M²
1.35
Plant
Mezzanine
23M²
1.34
Comms
Room
6.25M²

Appendix B – Daylight Factor Distribution

