NBRSARCHITECTURE50

DAYLIGHT FACTOR REVIEW

Armidale Secondary College

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PROJECT 17352

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ISSUED	REVIEW	ISSUED BY
12 April 2019	Issue A	Trevor Eveleigh

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1.0 INTRODUCTION

1.1 GENERAL

NBRS Architecture have been engaged by NSW Department of Education to develop a design for the redevelopment of the existing Armidale Secondary School campus to create the new Armidale Secondary College.

In response to additional information requested, regarding the Daylight availability to classrooms on the southern side of the proposed building, as part of the Development Approval Process, a review has been undertaken of the proposed design for the classrooms to the southern side of the central corridor in Zones 4, 5 & 6, against industry benchmarks for daylight to buildings in general and classrooms specifically.

This report is the outcome of the review undertaken.

1.2 SITE DETAILS

The site for the existing school campus is 158 – 182 Butler Street Armidale, NSW 2350

2.0 DAYLIGHT FACTOR REVIEW

2.1 THE PROPOSED DESIGN

The review is undertaken on the proposed design for the Armidale Senior College and specifically the design for Daylight within the classroom.

The proposed building is a two storey classroom building with the main classrooms located on southern side of the central corridor and breakout rooms to the northern side on both levels of the building.

The main classrooms are generally 8.7m deep and 7.1m wide and have two windows to the outside which are 1.2m high and approximately 3.3m wide each.

The sill of the windows is 1.2m above the floor level.

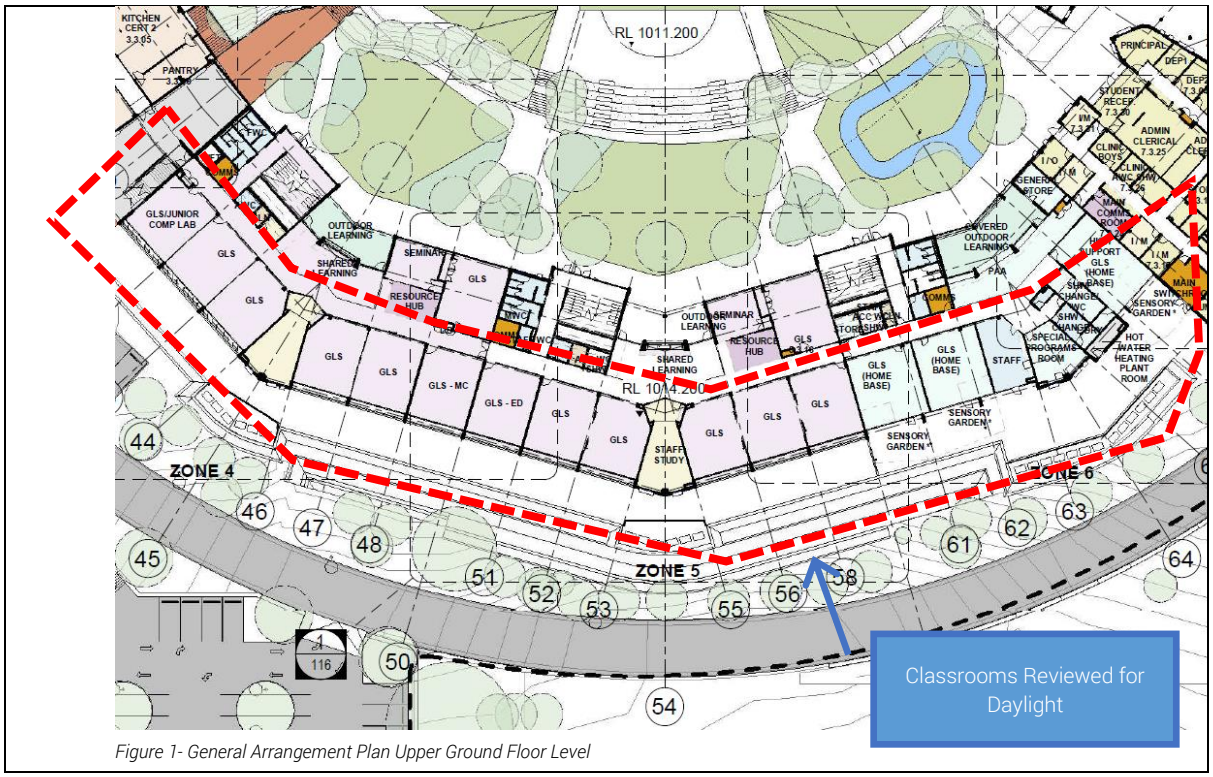

Figure 1- General Arrangement Plan Upper Ground Floor Level

2.2 DESIGN CRITERIA

With respect to room daylight to classrooms, there are a number of Design Criteria that should be considered, they have been set out in the following sections, starting with the mandatory requirements of the Building Code of Australia and then additional design principles of the Education Facilities Standards and Guidelines and other industry benchmarks of Green Building Council of Australia Green Star Assessment.

2.2.1 NCC/BCA REQUIREMENTS

The Building Code of Australia sets the minimum requirements for natural lighting to be provided to classrooms of a School (Class 9b)
The Building Code of Australia (NCC/BCA) part F4.1 requires a general classroom to have a natural daylight via a window with a total area of at least 10% of the floor area.

Within the proposed design the classrooms of concern are the southern classrooms in zone 4, 5 & 6 on the upper ground level that face the proposed retaining wall.
The following table sets out the classrooms, their area and the window area. The figures show that for all the classrooms the window area exceeds the required 10% of the floor area.

			Window Dimensions				
Room No.		Area	Height	Width	Area	Required Window area	Compliant
4.3.14	GENERAL LEARNING UNIT - HS401	60.25	1.2	6.7	8.04	6.03	Yes
4.3.12	GENERAL LEARNING UNIT - HS401	60.25	1.2	6.7	8.04	6.03	Yes
4.3.10	GENERAL LEARNING UNIT - HS401	61.12	1.2	6.7	8.04	6.1	Yes
4.3.06	GENERAL LEARNING UNIT - HS401	61.12	1.2	6.7	8.04	6.1	Yes
4.3.04	GENERAL LEARNING UNIT - HS401	60.25	1.2	6.7	8.04	6.03	Yes
4.3.02	GENERAL LEARNING UNIT - HS401	60.25	1.2	6.7	8.04	6.03	Yes
5.3.14	GENERAL LEARNING UNIT - HS401	60.25	1.2	6.7	8.04	6.03	Yes
5.3.12	GENERAL LEARNING UNIT - HS401	60.25	1.2	6.7	8.04	6.03	Yes
5.3.10	GENERAL LEARNING UNIT - HS401	61.12	1.2	6.7	8.04	6.1	Yes
5.3.06	GENERAL LEARNING UNIT - HS401	61.12	1.2	6.7	8.04	6.1	Yes
5.3.04	GENERAL LEARNING UNIT - HS401	60.25	1.2	6.7	8.04	6.03	Yes
5.3.02	GENERAL LEARNING UNIT - HS401	60.25	1.2	6.7	8.04	6.03	Yes
6.3.16	GENERAL LEARNING UNIT - HS401	69.43	2.4	7.2	17.28	6.95	Yes
6.3.15	GENERAL LEARNING UNIT - HS401	68.56	2.4	7.3	17.52	6.86	Yes
6.3.02	GENERAL LEARNING UNIT - HS401	70.66	2.4	6.7	16.08	7.07	Yes
6.3.11	Special Programs	43.75	1.2	6	8.04	4.38	Yes

2.2.2 EFSG DESIGN RECOMMENDATIONS

The Educational Facilities Standards and Guidelines includes DG12, which requires maximizing natural daylight.

DG12 Light - Natural

Maximise Natural Daylight in all habitable spaces, to reduce energy usage, improve the indoor amenity and create a pleasant environment.

This is an aspirational criteria as there is not a specific benchmark that is to be achieved.

2.2.3 GREEN STAR BENCHMARK

The Green Building Council of Australia's Green Star assessment gives guidelines for recommended daylight levels for within the Daylight Hand Calculation Guide (Version .04) which sets a number of criteria as follows:

- Daylight Factor

The benchmark of a minimum daylight factor of 2% for Education and Public Buildings is mentioned within the introduction. This is usually undertaken based on daylight simulation modeling which has not been undertaken on the proposed project.

Daylight factors for each room can be calculated based on the following formula, with the window area measured above the desk height plane of 700mm above the floor.

$$\text{Daylight Factor \%} = \frac{45 \times \text{The window area} \times \text{Visual Light transmittance of the Window.}}{\text{Total Room Surface area} \times \text{surface reflectance}}$$

The Guide also sets out a quick calculation guide that includes the following factors to show that sufficient daylight is provided :

- Not Overshadowed

Windows not being overshadowed as indicated in the figure below. Setting the angle of overshadowing at 25% from the centre of the window.

2.1 Overshadowing Requirements

Projects where external shading does not impinge on the direct 25 degree line from the mid-height (centre) of the window are deemed to not be overshadowed. External shading includes: buildings, cliffs, and any other solid structure. External shading does not include trees. Please refer to Figure 1 below for further guidance.

Figure 1: Angle of obstruction for external shading.

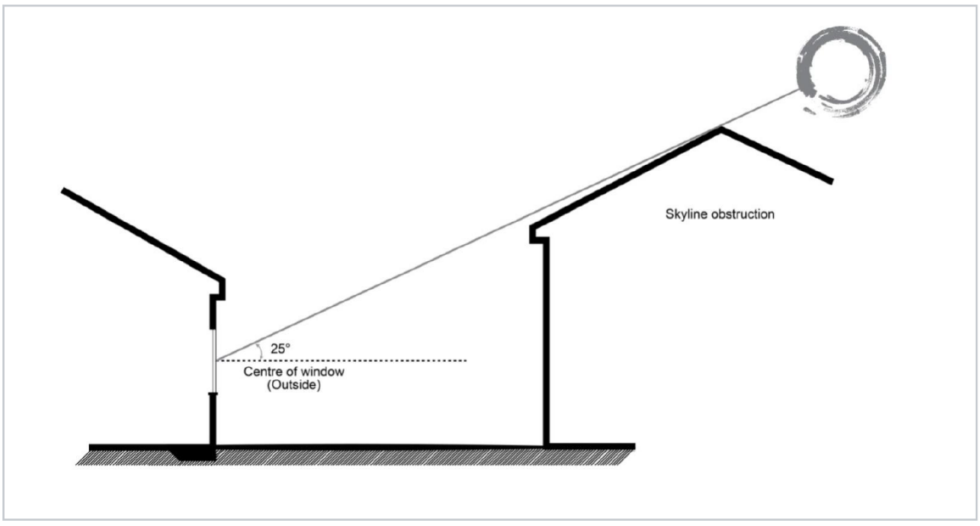

Figure 2- Daylight Obstruction criteria from Green Star

- Visual Light Transmittance

Window Glazing is to have a Visual Light Transmittance of at least 40%

- Calculating Zone of Compliance

Area of compliance to be minimum 40% of usable area for 1 Green Star point or 60% for 2 Green Star Points.

Assessment of this criteria is set out in the following sections.

3.0 THE PROPOSED DESIGN

Assessment of the proposed design classrooms included:

3.1 DAYLIGHT FACTOR ASSESSMENT

Daylight factors were calculated for each of the General Classrooms located on the southern side of the central corridor, using the following criteria.

- Classroom depth(length), Classroom width, Ceiling Height,
- Window Area and sill height,
- Window glazing details and visual light transmittance of the double glazing.
- Daylight measured at the end of the room furthest from the window.

The table below shows the daylight factor for the typical classroom.
The Table on the following page shows the rooms that were assessed and the daylight factors achieved, which across all the classrooms was more than 2% at the furthest point

Table 1

Daylight Factor						
Room	**area**	length	width	height		eave
		8.7	7.05	2.7	m	height above fl
						3
Window	**area**	length	height	sill height		offset
	8.04	6.7	1.2	1.2	m	0.9
Position to be measured		should be the worst location in room			**Reflectance**	
	distance from window		8.7		Walls	0.7
	offset from centre of window		3		Floors	0.3
	Height above floor		0.7		Ceiling	0.8
Window Type	4- 6.38mm CP Nuetral in Sliding Window		Window TVL factor		**Daylight Factor**	
Maintenance factor		0.9	0.47		**2.25%**	

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Table 2- Window Assessment

		Window Dimensions				Room Dimensions			Desk /sill Plane	Zone of Compliance					
Room No.		**Sill**	**Head**	**Height**	**Width**	**Depth**	**Width**	**Area**	**0.7m above Fl**	**h**	**Zone(m)**	**Zone(m2)**	**Zone (%)**	**Daylight factor at extreme end of room**	
4.3.14	GENERAL LEARNING UNIT - HS401	1.2	2.4	1.2	6.7	8.7	6.925	60.25	1.2	1.2	2.4	16.08	27%	2.24%	
4.3.12	GENERAL LEARNING UNIT - HS401	1.2	2.4	1.2	6.7	8.7	6.925	60.25	1.2	1.2	2.4	16.08	27%	2.24%	
4.3.10	GENERAL LEARNING UNIT - HS401	1.2	2.4	1.2	6.7	8.7	7.025	61.12	1.2	1.2	2.4	16.08	26%	2.24%	
4.3.06	GENERAL LEARNING UNIT - HS401	1.2	2.4	1.2	6.7	8.7	7.025	61.12	1.2	1.2	2.4	16.08	26%	2.24%	
4.3.04	GENERAL LEARNING UNIT - HS401	1.2	2.4	1.2	6.7	8.7	6.925	60.25	1.2	1.2	2.4	16.08	27%	2.24%	
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														2.24%	Average
5.3.14	GENERAL LEARNING UNIT - HS401	1.2	2.4	1.2	6.7	8.7	6.925	60.25	1.2	1.2	2.4	16.08	27%	2.24%	
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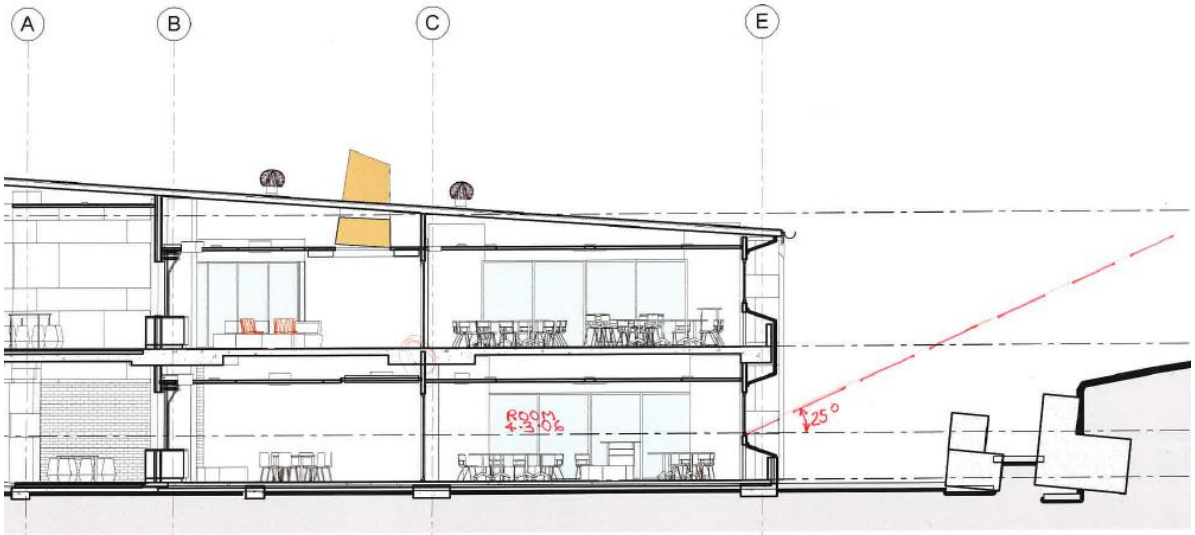
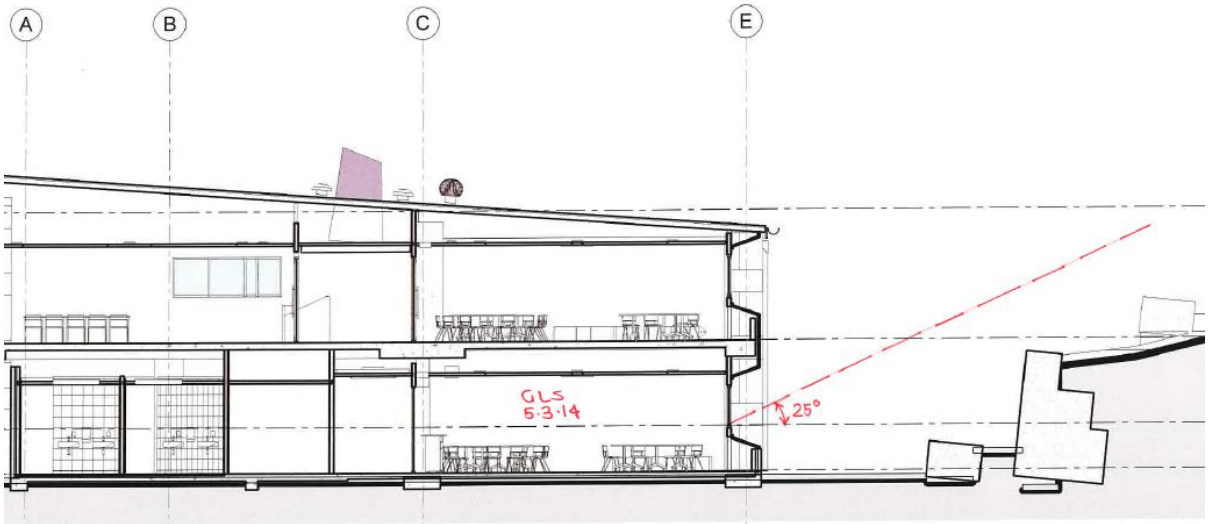
5.3.10	GENERAL LEARNING UNIT - HS401	1.2	2.4	1.2	6.7	8.7	7.025	61.12	1.2	1.2	2.4	16.08	26%	2.24%	
5.3.06	GENERAL LEARNING UNIT - HS401	1.2	2.4	1.2	6.7	8.7	7.025	61.12	1.2	1.2	2.4	16.08	26%	2.24%	
5.3.04	GENERAL LEARNING UNIT - HS401	1.2	2.4	1.2	6.7	8.7	6.925	60.25	1.2	1.2	2.4	16.08	27%	2.24%	
5.3.02	GENERAL LEARNING UNIT - HS401	1.2	2.4	1.2	6.7	8.7	6.925	60.25	1.2	1.2	2.4	16.08	27%	2.24%	
														2.24%	Average
6.3.16	GENERAL LEARNING UNIT - HS401	0	2.4	2.4	7.2	8.7	7.98	69.43	0.7	1.7	3.4	24.48	35%	4.90%	
6.3.15	GENERAL LEARNING UNIT - HS401	0	2.4	2.4	7.3	8.7	7.88	68.56	0.7	1.7	3.4	24.82	36%	4.90%	
6.3.02	GENERAL LEARNING UNIT - HS401	0	2.4	2.4	6.7	10.92	6.471	70.66	0.7	1.7	3.4	22.78	32%	3.60%	
6.3.11	Special Programs	1.2	2.4	1.2	6	6.34	6.9	43.75	1.2	1.2	2.4	14.4	33%	2.72%	
														4.03%	Average
							Total	978.85				279.44	29%	**2.69%**	**Average of all**

3.2 OVERSHADOWING

The requirement is that the windows are not overshadowed by adjacent structures.
The following sections through the buildings in a number of locations show that based on an angle of 25 Degrees elevation from the horizontal line of the base of the window none of the windows are overshadowed.

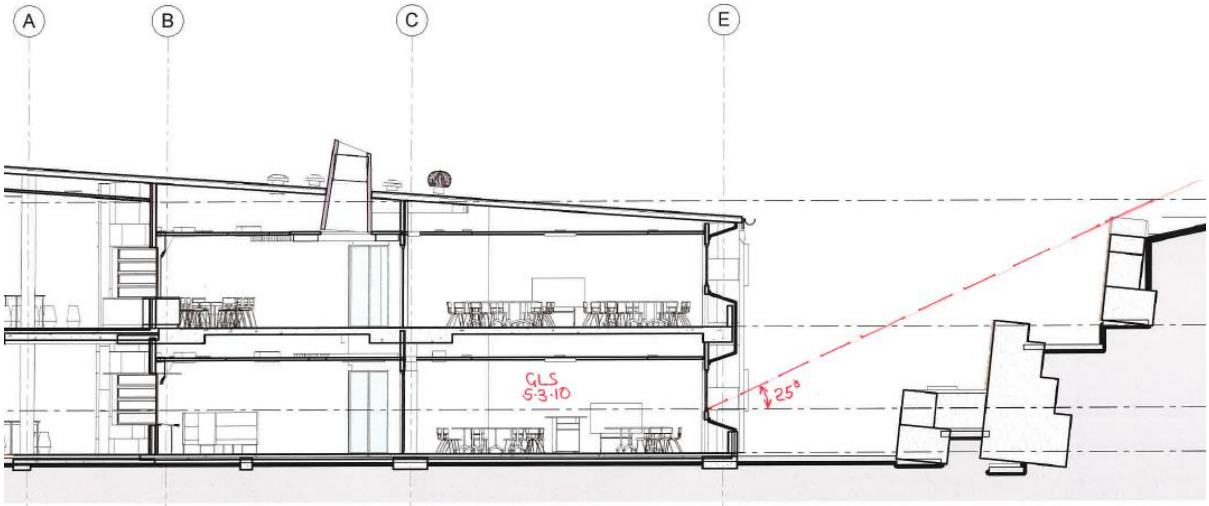


1:100 @ A3 - BETWEEN GRID 46 AND 47

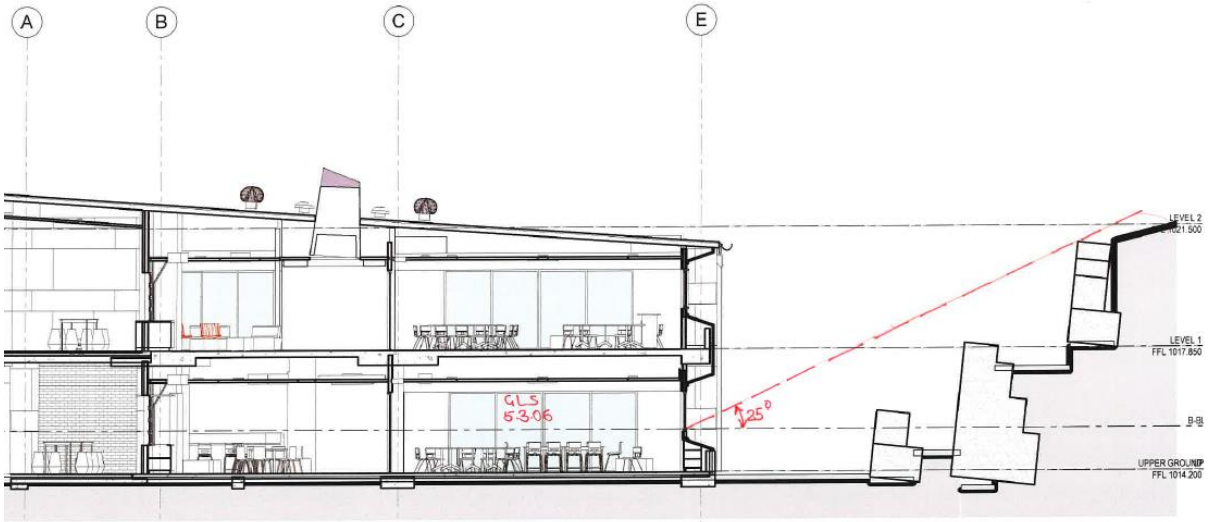


1:100 @ A3 - BETWEEN GRID 50 AND 51

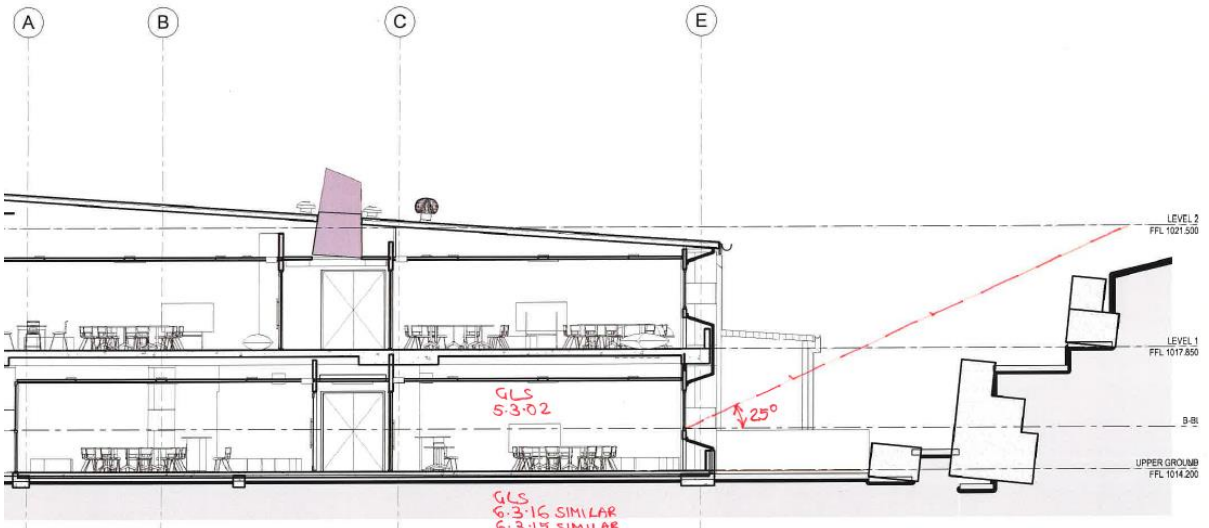
ESD DAYLIGHT FACTOR REVIEW



1:100 @ A3 - BETWEEN GRID 52 AND 53



1:100 @ A3 - BETWEEN GRID 55 AND 56



1:100 @ A3 - BETWEEN GRID 58 AND 60

3.3 VISUAL LIGHT TRANSMITTANCE

The requirement is that selected window glazing is to have a Visual Light Transmittance of at least 40%.

Within the proposed design based on 6.38mm comfort plus clear glazing the Visible light transmittance value is 0.47 or 47% which is more than the benchmark of 40%. Therefore the glazing meets this criteria.

3.4 THE ZONE OF COMPLIANCE

As a simplified method of determining if sufficient daylight is provided in a space, a rule of thumb is often used is that of a zone with strong daylight will be the area that is within a distance of twice the height of the window

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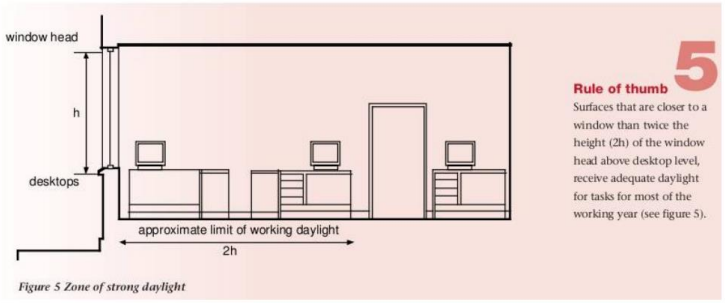

Figure 5 Zone of strong daylight

. This is also used in the Green Star Assessment criteria where'

- 1 point is achieved where 40% of nominated area is within the compliant zone and
- 2 points are achieved where 60% of the nominated area is within the compliant zone.

A calculation of the compliant zones of the classrooms, as set out within the Table 21, indicates that only 29% of the floor area of a general classrooms are within the compliant zone.

4.0 CONCLUSION

The following is a summary of the daylight criterial for the to southern classrooms in Zone 4, 5 & 6

	BCA	EFSG		Green Star		
Criteria	Natural Daylight via window of min. 10% of floor area	DG12 – Maximise daylight	Daylight Factor min 2%	Windows not overshadowed	Visual light transmittance of glazing min 0.4 (40%)	Compliant Zone area (2*H) Min. 40%
	Mandatory	Aspirational	Desirable	Desirable	Desirable	Desirable
Current design Typical Classroom	Windows area 12.8%	Not a specific benchmark	Generally min 2.24%	Retaining wall does not overshadow	Glazing VLT 0.47 (47%)	29% of classroom area
	Complies		Achieved	Achieved	Achieved	Not Achieved

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