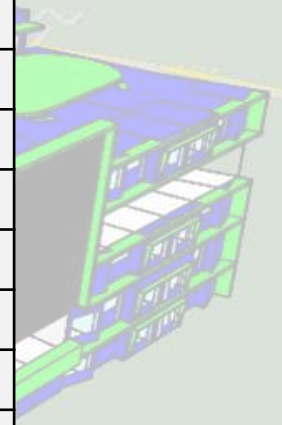
# Westmead Catholic Community (WCC) K-6 Building

## Solar & Daylight Access Analyses: Outdoor Play Areas

21st August 2020
Rev. 0

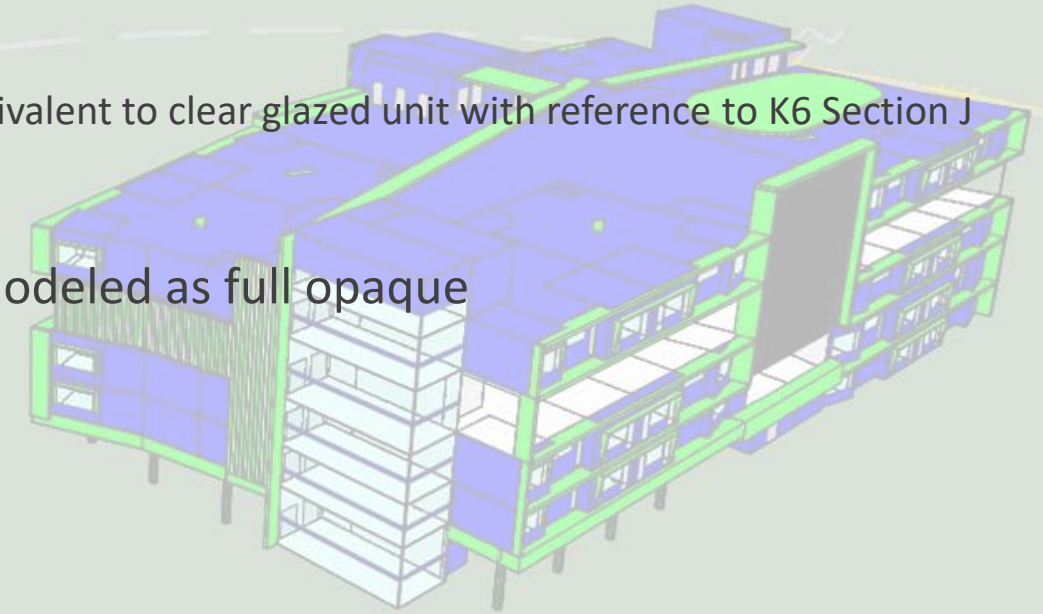
# Model Reference: Drawings

| Project Reference No. | Drawing No. | Rev. | Title |
|---|---|---|---|
| 19122 | K6-DA-100 | A | Ground Floor Plan |
| 19122 | K6-DA-101 | A | Floor Plan – Level 01 |
| 19122 | K6-DA-102 | A | Floor Plan – Level 02 |
| 19122 | K6-DA-103 | A | Floor Plan – Level 03 |
| 19122 | K6-DA-104 | A | Floor Plan – Level 04 |
| 19122 | K6-DA-105 | A | Floor Plan – Level 05 |
| 19122 | K6-DA-106 | A | Roof Plan |
| 19122 | K6-DA-200 | A | Sections – Sheet 1 |
| 19122 | K6-DA-201 | A | Sections – Sheet 2 |
| 19122 | K6-DA-300 | A | Elevations |
| 19122 | K6-DA-301 | A | Elevations |
| 19122 | K6-DA-500 | A | Perspective Views – Sheet 1 |
| 19122 | K6-DA-501 | A | Perspective Views – Sheet 2 |
| 19122 | K6-DA-503 | A | Perspective Views – Sheet 3 |

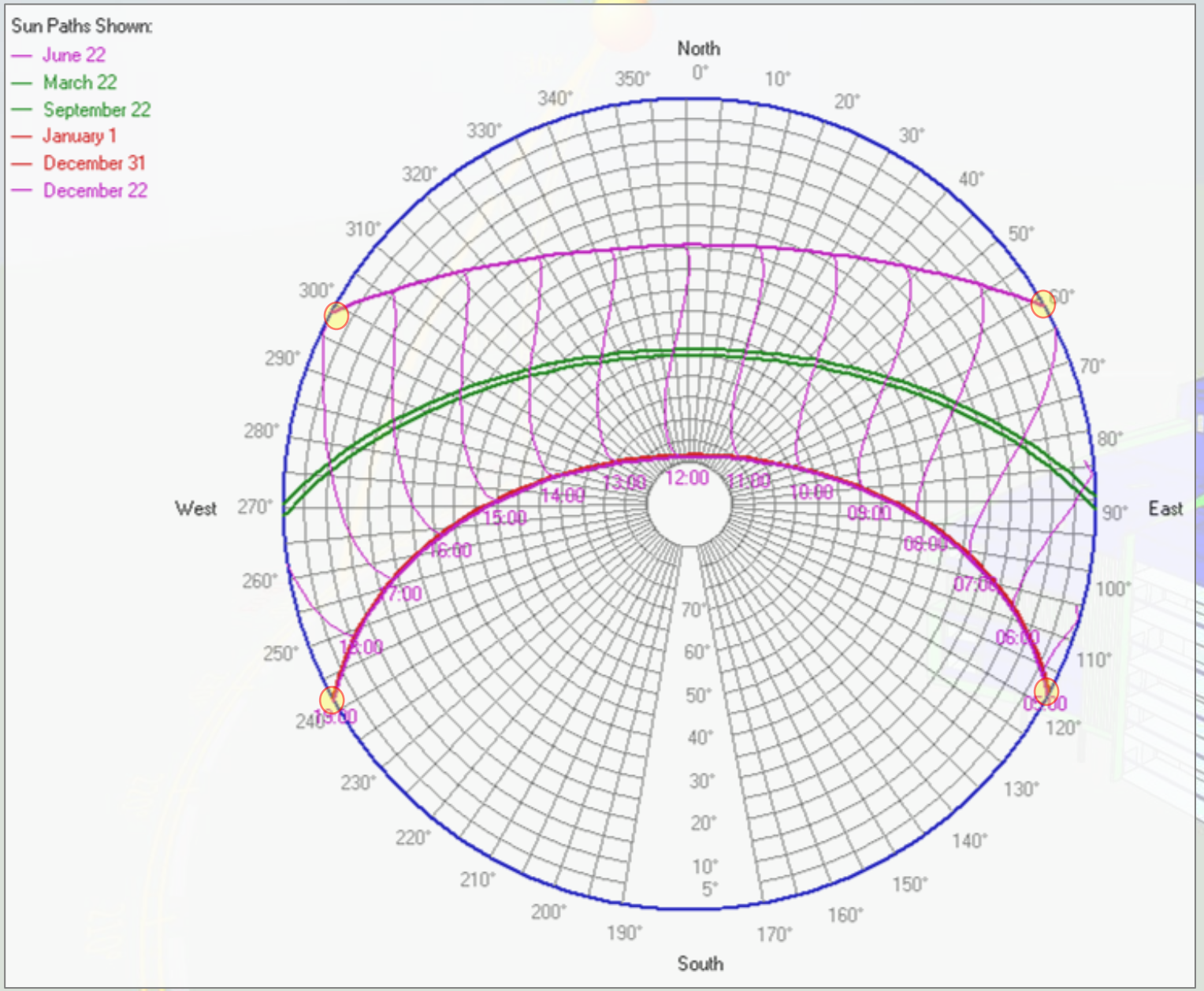


# Model Reference: Material Reflectance & Visible Light Transmittance (VLT)

- Wall: 0.7 (equivalent to white paint)
- Ceiling: 0.8 (equivalent to white paint)
- Floor: 0.3 (equivalent to light-coloured carpet)
- Glazing (including louvred windows): VLT = 0.6 (equivalent to clear glazed unit with reference to K6 Section J report, U-value: 5.8, SHGC: 0.57)
- Fibre cement vertical panels (Level 01, 02 & 04): Modeled as full opaque
- Sky Model: Perez (direct + diffuse illuminance)



# Model Reference: Sydney Sun Path Stereographic Diagram




*Key Note(s):*

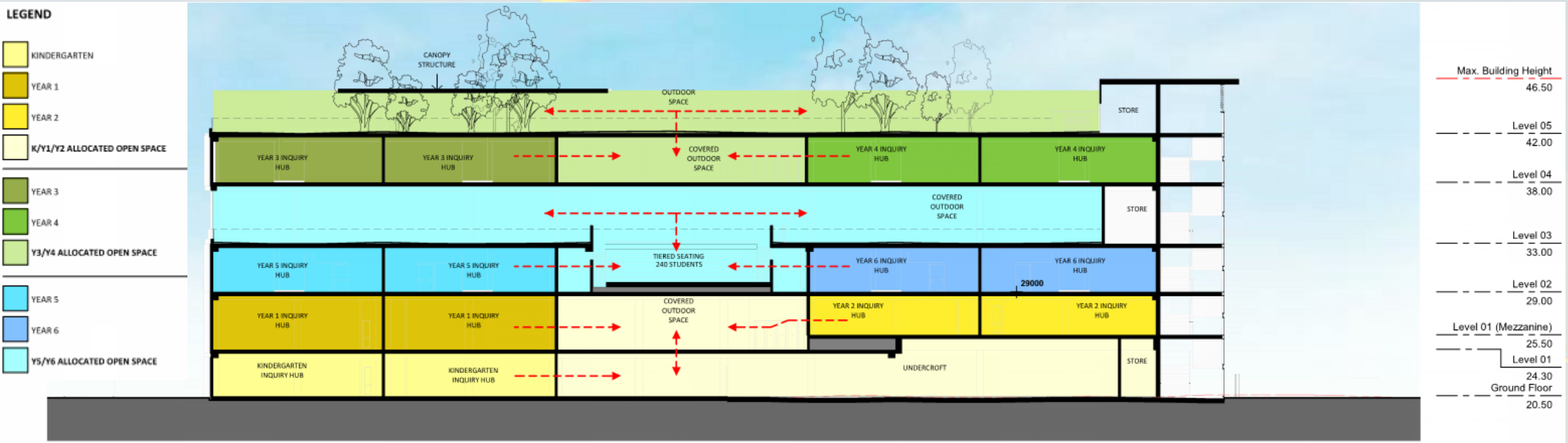
- *The Sydney sun path indicate that the sun rise and set hours range from 7:00am to 17:00pm for Winter Solstice and 5:00am to 19:00pm for Summer Solstice;*

- *Hence, hourly solar access analysis in line with typical operation hours of 6:00am to 18:00pm will be based on 7:00am to 17:00pm for Winter Solstice (i.e. 21st June) and 6:00am to 18:00pm for Summer Solstice (i.e. 21st Dec);*

- *Dynamic daylight analyses shall be based on typical operation hours of 6:00am to 18:00pm.*

# K6 Building Allocation of Open Space & EFSG* Illumination (Lux) Requirement

*(Ref: Architectural Drawing no. K6-DA-906, Issue A)*




1 **NORTH SOUTH SECTION**

1 : 200

*<u>*NSW Department of Education's Educational Facilities Standards and Guidelines (EFSG), Illumination (Lux) Requirements*</u>

- *Covered Outdoor Play Area (i.e. Ground, Level 01, Level 02, Level 03 & Level 04): NA*
- *Outdoor Play Area (i.e. Level 05): NA*

*<u>Key Note(s)</u>: There is no specific EFSG lux level requirements for outdoor play area*

# K6 Building Outdoor Play Area Illuminance (Lux) Reference Benchmark

*Given that the National Construction Code (NCC) on natural lighting and AS1680.2 is intended only for interior rather than outdoor open space, a separate benchmark is established. The project has been benchmarked against relevant Council lighting policies as the parameters of the NCC are not applicable to the K6 covered play space. The below Councils lighting policy and AS1158.3 have been adopted noting that the City of Parramatta public domain policy does not have an applicable category for the K6 covered play space.*

*Ref: City of Ryde Open Space Lighting Policy*

Opn Space Lighting Policy

| Open Space Use | Recommended Lighting | Light type | Luminance Level |
|---|---|---|---|
| **Playgrounds** | • Light selected locations in accordance with the Children's Play Implementation Plan. | Open Space pole top luminaire | 50 lux |

*Ref: City of Sydney Public Domain Design Code for Sydney Lights*

| | Street Type | | Lighting Type* | Recommended Lighting Level** |
|---|---|---|---|---|
| | **City Centre Park**  | Usually experience high pedestrian activity over a longer span of hours. Pathway networks usually provide direct connections to city streets. Park may include activity areas that accommodate night time use. | City Standard Pedestrian Pole Top Lighting Range | Major Pathways: P1-P2<br>Minor Pathways: P3<br>Path Edges[1]: P5<br>Activity Area: P8 |

*Ref: AS1158.3.1:2005 Lighting for Roads & Public Spaces*

AS/NZS 1158.3.1:2005 18

**TABLE 2.6**

**VALUES OF LIGHT TECHNICAL PARAMETERS AND PERMISSIBLE LUMINAIRE TYPES FOR ROADS IN LOCAL AREAS AND FOR PATHWAYS**

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| | Lighting subcategory | Light technical parameters: Average horizontal illuminance[a,b] ($\bar{E}_h$) lux | Point horizontal illuminance[a,b] ($E_{Ph}$) lux | Illuminance (horizontal) uniformity[c] Cat. P ($U_{E2}$) | Point vertical illuminance[a,b] ($E_{Pv}$) lux | Permissible luminaire type (see Table 2.10) |
| | P1 | 7 | 2 | 10 | 2 | Type 4 where part of a road reserve or Types 2, 3, 4 or 6 elsewhere |
| | P2 | 3.5 | 0.7 | 10 | 0.7 | |
| A1 | P3[e] | 1.75 | 0.3 | 10 | 0.3[d] | |
| | P4[e] | 0.85 | 0.14 | 10 | N/A | |
| | P5[e] | 0.5 | 0.07 | 10 | N/A | |

19 AS/NZS 1158.3.1:2005

**TABLE 2.7**

**VALUES OF LIGHT TECHNICAL PARAMETERS AND PERMISSIBLE LUMINAIRE TYPES FOR PUBLIC ACTIVITY AREAS (EXCLUDING CAR PARKS)**

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| Lighting subcategory | Light technical parameters: Average horizontal illuminance[a,b] ($\bar{E}_h$) lux | Point horizontal illuminance[a,b] ($E_{Ph}$) lux | Illuminance (horizontal) uniformity[c] Cat. P ($U_{E2}$) | Point vertical illuminance[a,b] ($E_{Pv}$) lux | Permissible luminaire type (see Table 2.10) |
| P6 | 21 | 7 | 10 | 7 | Types 2, 3, 4, 5 or 6 |
| P7 | 14 | 4 | 10 | 4 | |
| P8 | 7 | 2 | 10 | 2 | |

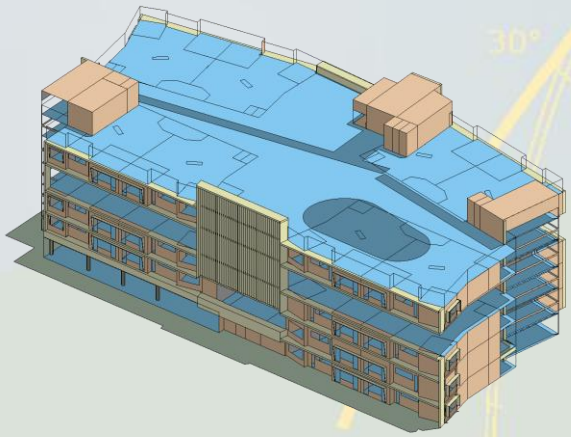
a) These values are maintained.
b) Compliance is achieved by being greater than or equal to the applicable table value.
c) Compliance is achieved by being less than or equal to the applicable value.

*Key Note(s):*

*K6 Targeted Illuminance (lux) Range with reference to respective Councils and Australian Standards recommendations for equivalent outdoor space:*

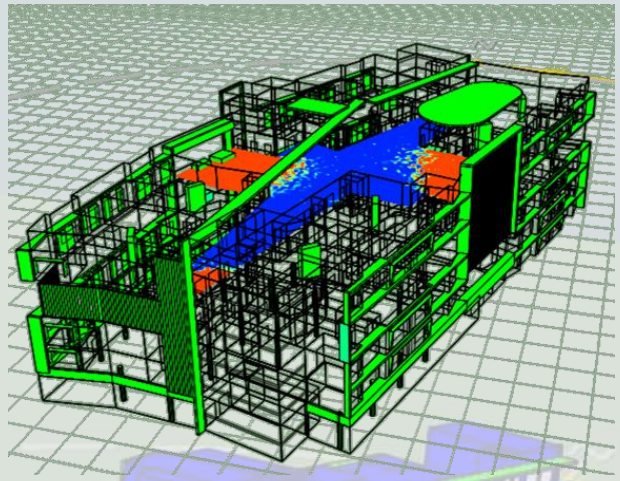
- *Desirable lux: 50 lux (also equivalent to the specific lux requirement indicated in AS2560.2.3-2007 for sports field recreational level, amateur and semi-professional level ball and physical training)*
- *Mid-range lux: 21 lux (highest level of illuminance for public activity areas as indicated in AS1158.3.1:2005, Table 2.7. For comparison, the recommended illuminance level for outdoor hockey physical training is 30 lux)*
- *Min. lux: 7 lux (lowest level of illuminance for public activity areas as indicated in AS1158.3.1:2005, Table 2.7)*

# K6 Solar Access and Daylight Access Design Aim



*Key Note(s):*

- *Winter Solstice: Allow minimum 3 hours of direct sunlight, contributing light and warmth to occupants at the outdoor play area*
- *Summer Solstice: Provide sufficient shading from direct sunlight exposure, creating a shaded outdoor environment for improved occupants comfort at the outdoor play area*



*Key Note(s):*

- *Achieve at least 50 lux to most of the primary outdoor play area at Ground, Level 03 and Level 05*
- *Achieve at least 21 lux to most of the passive/ secondary outdoor play area at Level 01, Level 02 and Level 04*

# Hourly Solar Access during Winter Solstice

(7:00 AM –17:00 PM)

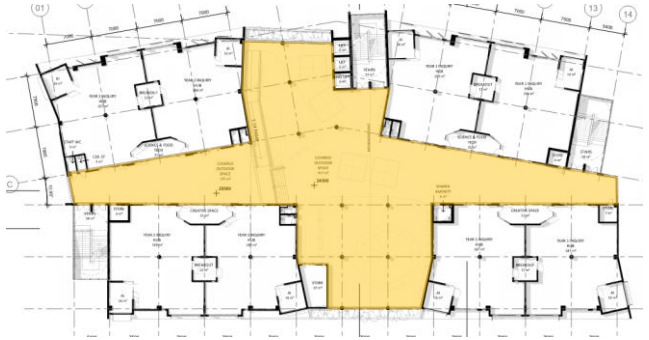
# Summary: Winter Solar Access Analyses

*Key Note(s):*

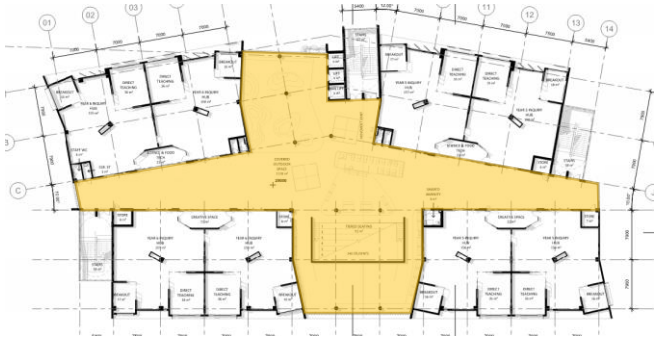
- Overall, the outdoor play areas at Ground, Level 1 to 5 respectively received ≥ 3 hours of direct sunlight at some point of the day during Winter Solstice, with extent of coverage at exceeding ≥ 1m$^2$ of its floor area [2]. Refer subsequent slides for analyses results.
- The outdoor play space for respective floor levels that is deemed to have received at least 3 hours of direct sunlight is marked-up in orange shade below.

Ground Level

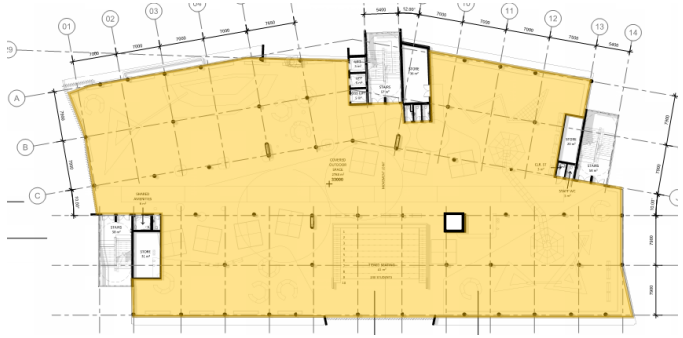
Level 01



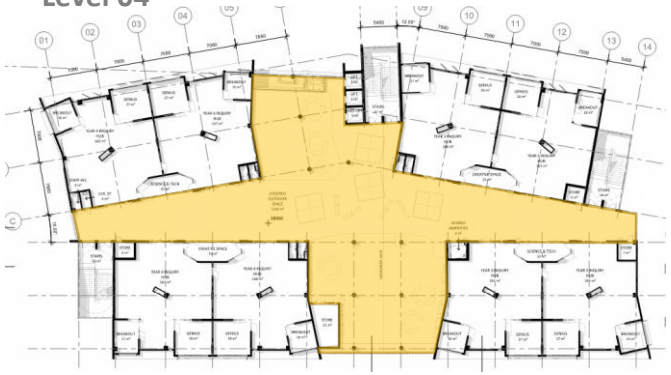
Level 02



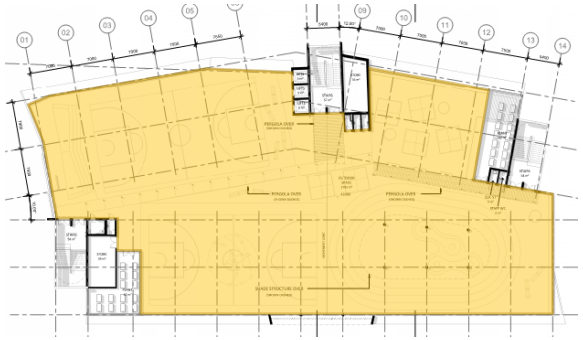
Level 03



Level 04



Level 05



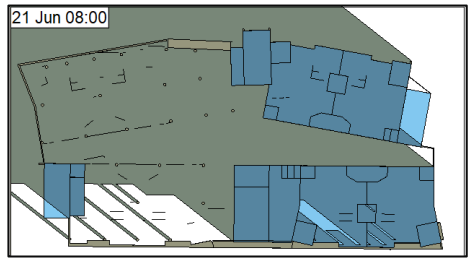
*Note:*

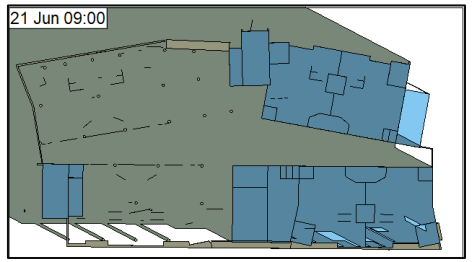
1) *All solar access analyses result on plans in subsequent slides are representative of the actual simulation model built based on the DA architectural set. Hence, internal wall outlines can be seen at each floor level as it reflect the internal wall outlines of the floor beneath it (i.e. not visually representative of the actual space outline as indicated in DA architectural drawing for each floor level)*

2) *Hourly direct sunlight is measured 1m above floor level at minimum of 1m$^2$ (Reference: Given that there is no other applicable guide for educational facilities, reference has been made to the solar access assessment methodology outlined in Technical Note for Solar access requirements in State Environmental Planning Policy (SEPP) 65 – Design Quality of Residential Apartment Development and the Apartment Design Guide)*

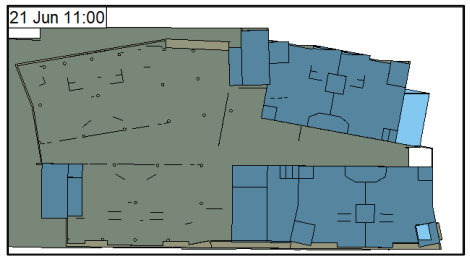
# Ground Level: Solar Access (Winter Solstice, 21st June)

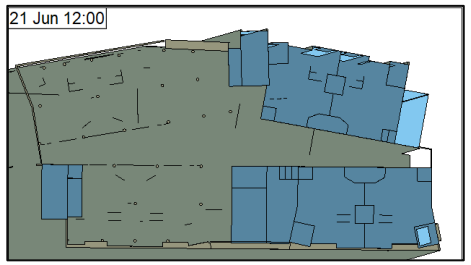
Key Plan – Outdoor Play Area space:

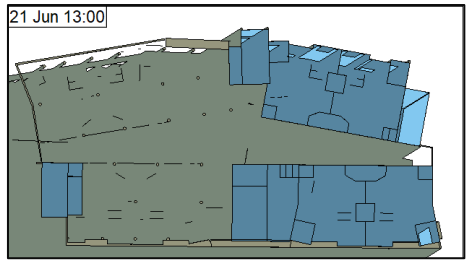



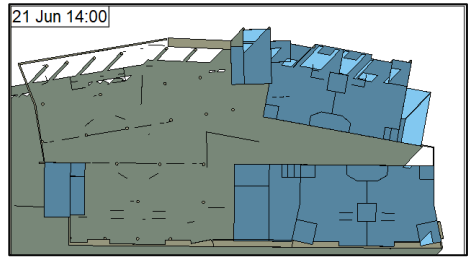



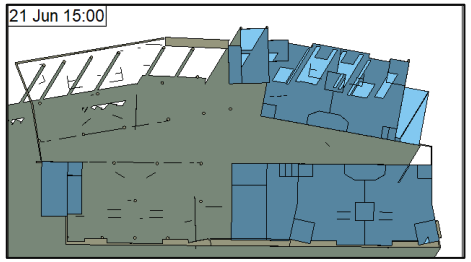


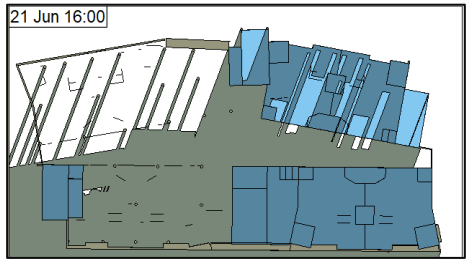


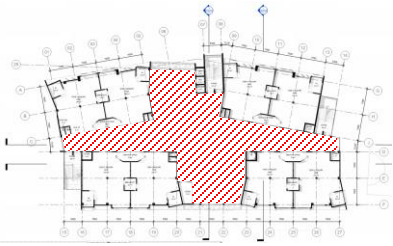


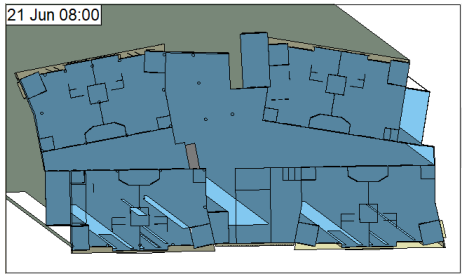
***Key Note(s):***

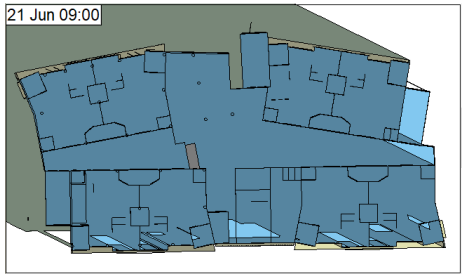
Based on the above solar access analyses, the outdoor play area space received at least 3 hours of direct sunlight during Winter Solstice, as shown in slivers and patches of light.

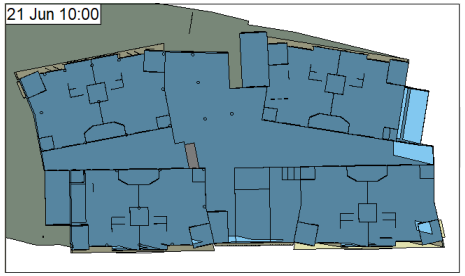
# Level 01: Solar Access (Winter Solstice, 21st June)

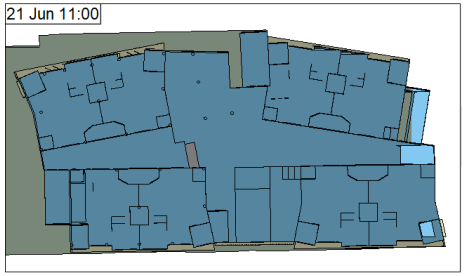
Key Plan – Outdoor Play Area space:

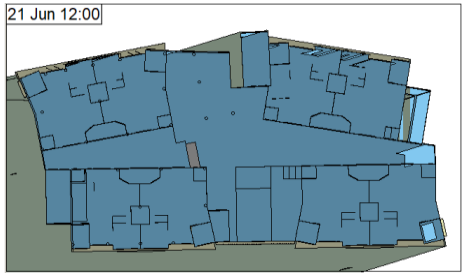


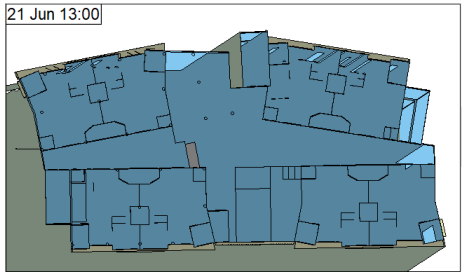



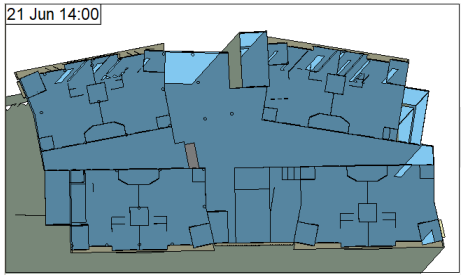



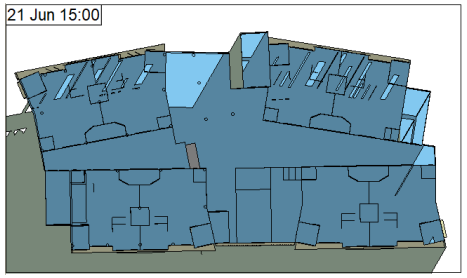



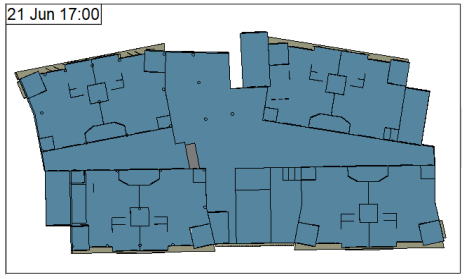





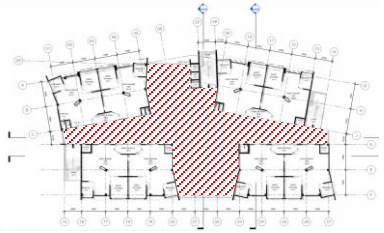


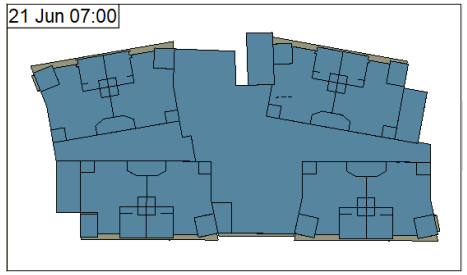

***Key Note(s):***

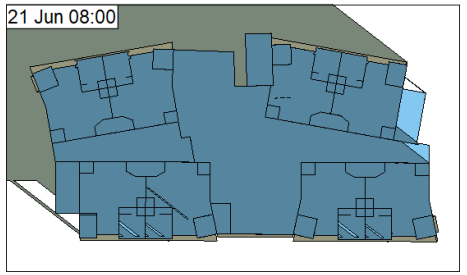
Based on the above solar access analyses, the outdoor play area space received at least 3 hours of direct sunlight during Winter Solstice, as shown in slivers and patches of light.

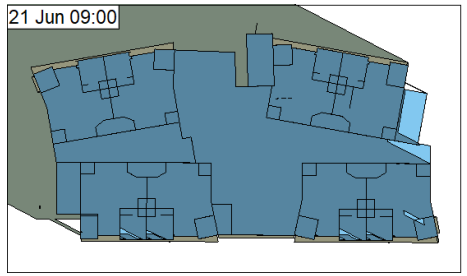
# Level 02: Solar Access (Winter Solstice, 21st June)

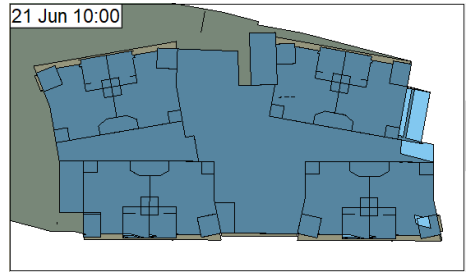
Key Plan – Outdoor Play Area space:

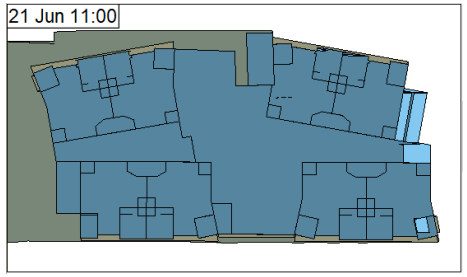


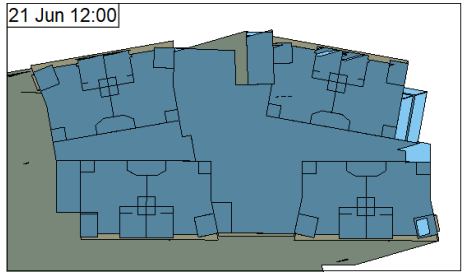


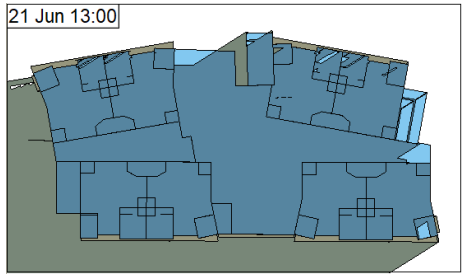



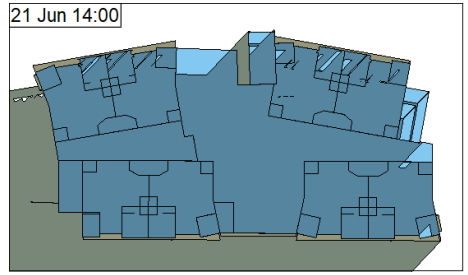



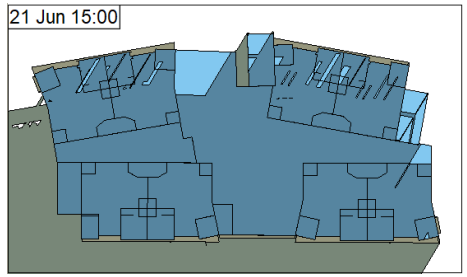



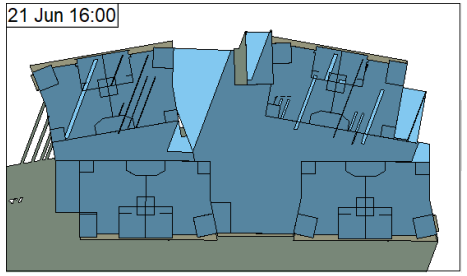



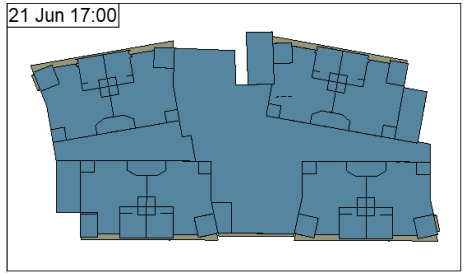



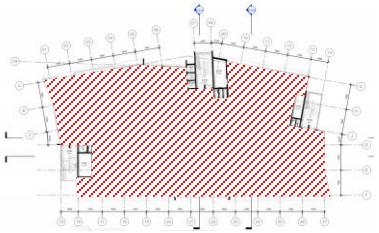



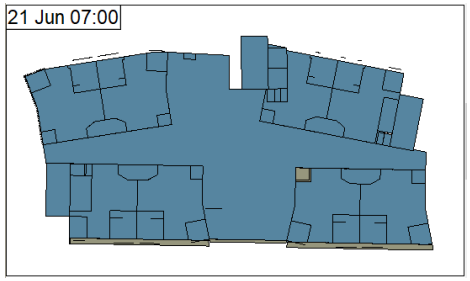

***Key Note(s):***

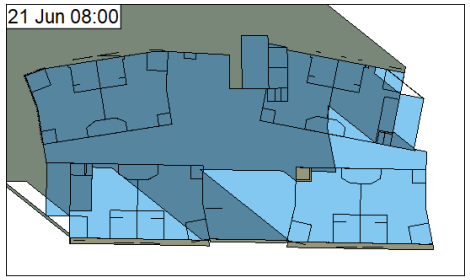
Based on the above solar access analyses, the outdoor play area space received at least 3 hours of direct sunlight during Winter Solstice, as shown in slivers and patches of light.

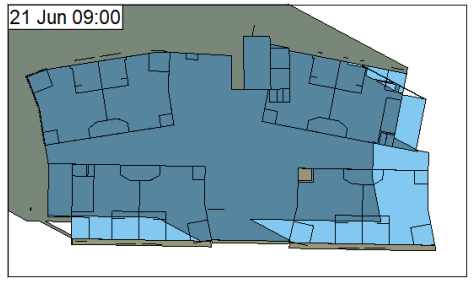
# Level 03: Solar Access (Winter Solstice, 21st June)

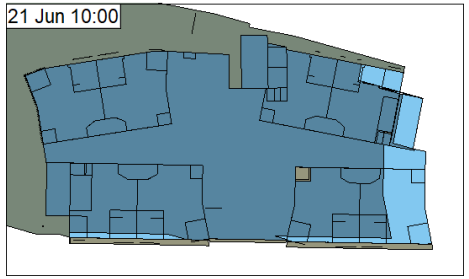
Key Plan – Outdoor Play Area space:

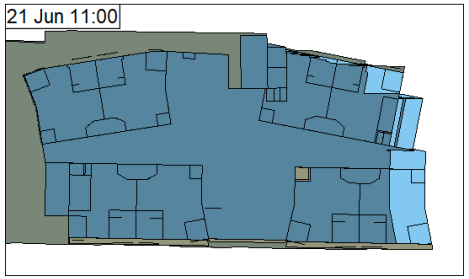


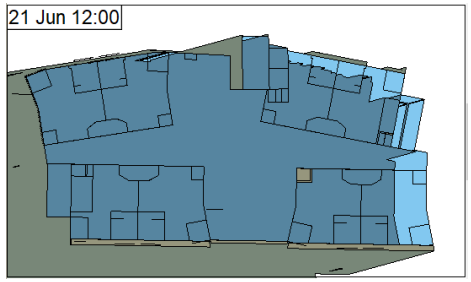


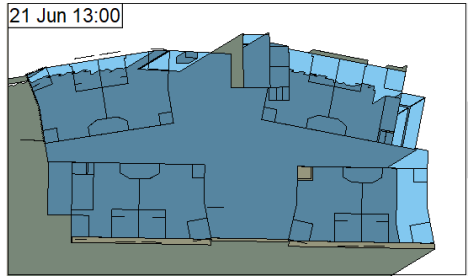



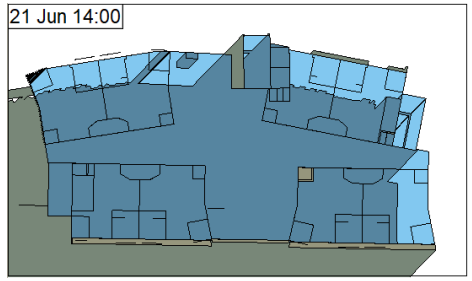



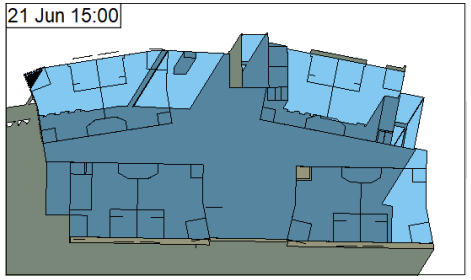



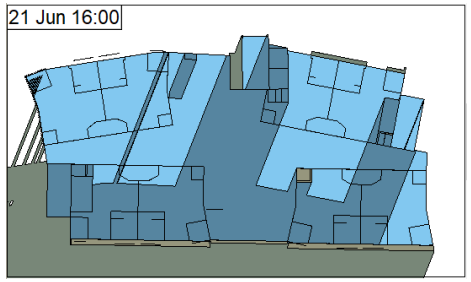



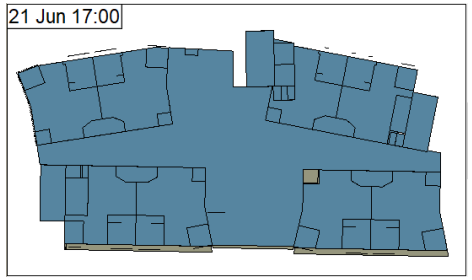



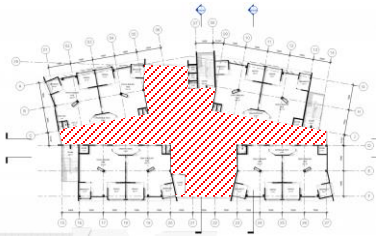



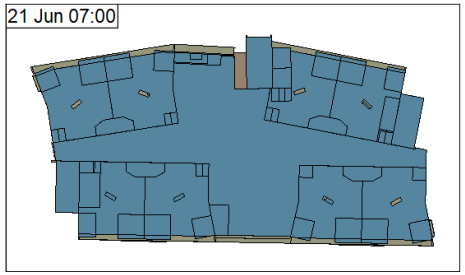

***Key Note(s):***

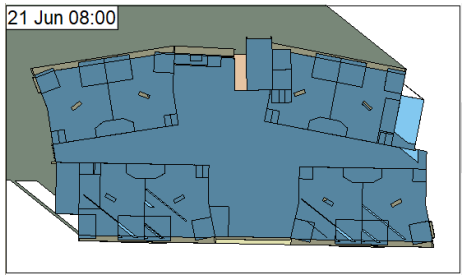
Based on the above solar access analyses, the outdoor play area space received at least 3 hours of direct sunlight during Winter Solstice, as shown in slivers and patches of light.

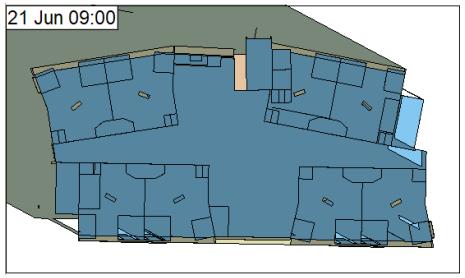
# Level 04: Solar Access (Winter Solstice, 21st June)

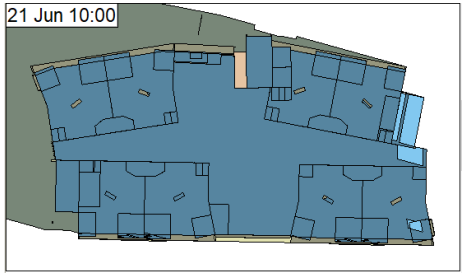
Key Plan – Outdoor Play Area space:

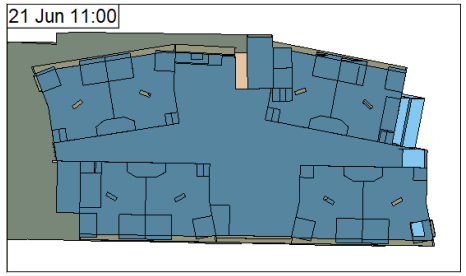


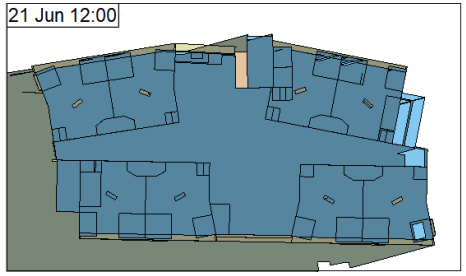


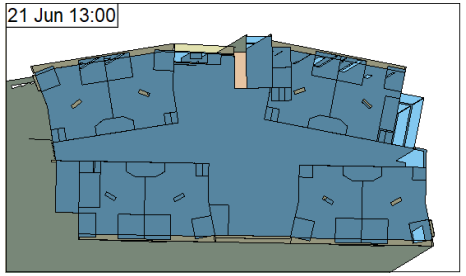



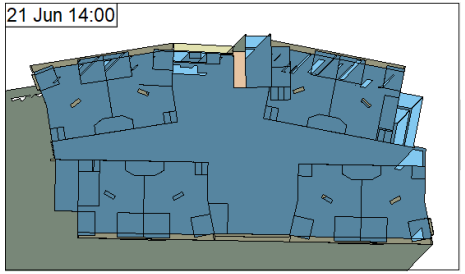



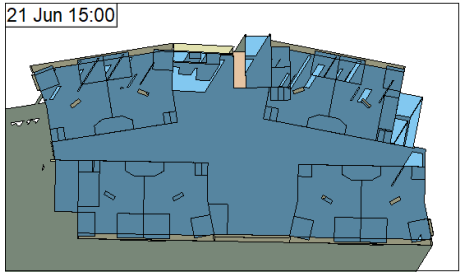



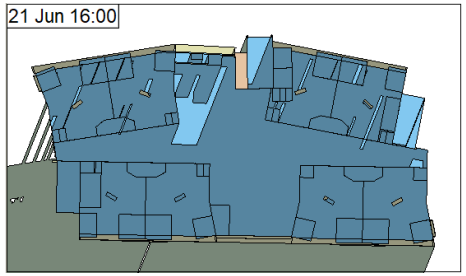



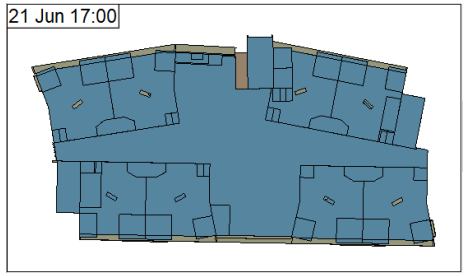



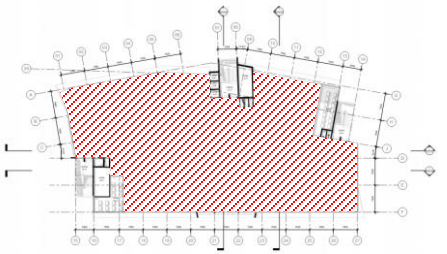



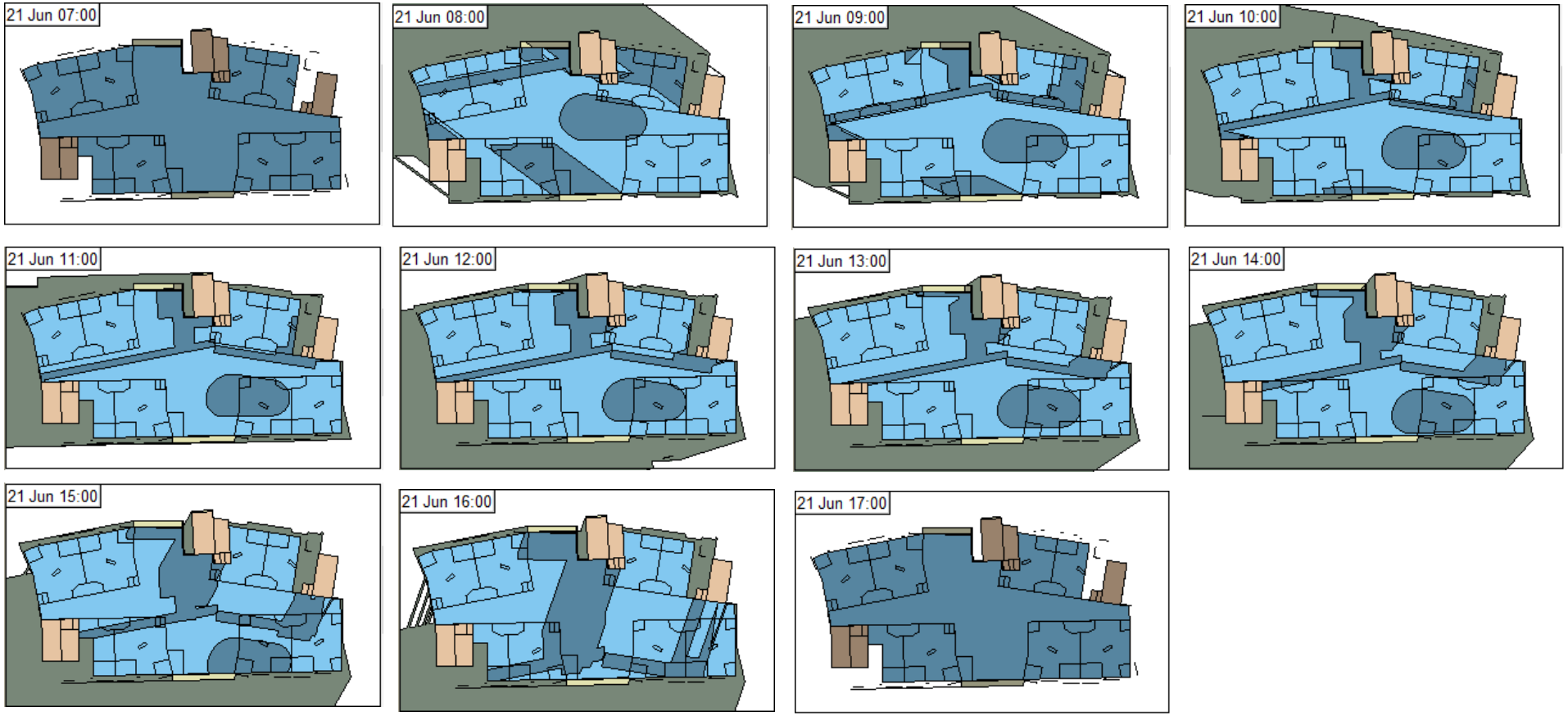

***Key Note(s):***

Based on the above solar access analyses, the outdoor play area space received at least 3 hours of direct sunlight during Winter Solstice, as shown in slivers and patches of light.

# Level 05: Solar Access (Winter Solstice, 21st June)

Key Plan – Outdoor Play Area space:



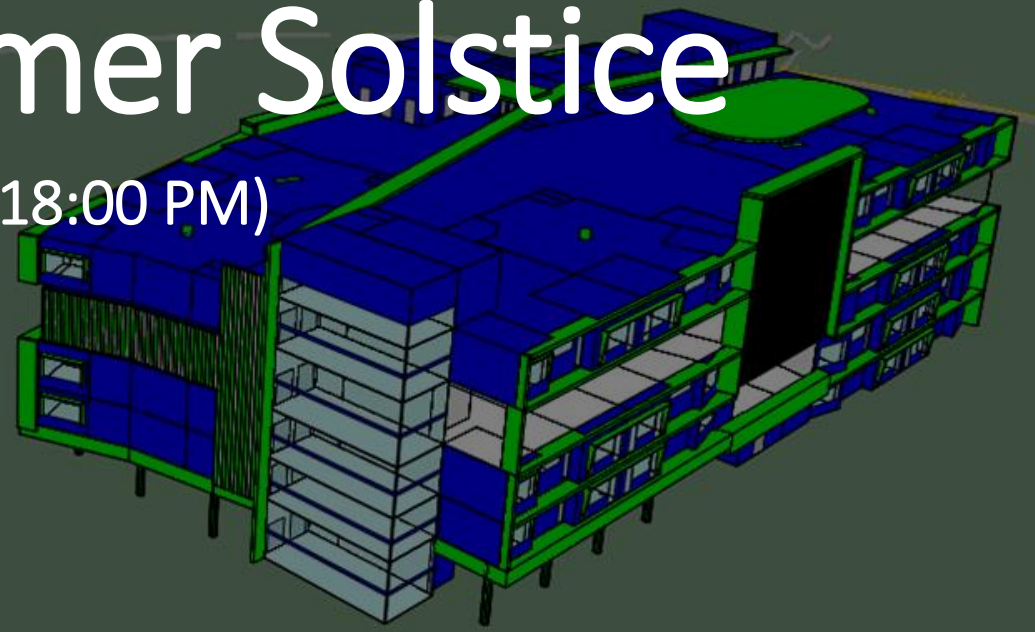



***Key Note(s):***

Based on the above solar access analyses, the outdoor play area space received at least 3 hours of direct sunlight during Winter Solstice, as shown in slivers and patches of light.

# Hourly Solar Shading during Summer Solstice

(6:00 AM –18:00 PM)



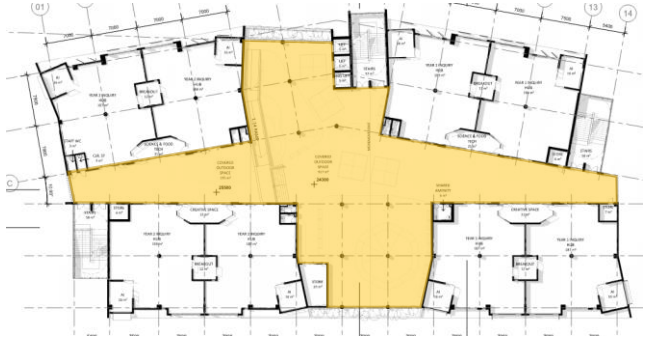
# Summary: Summer Solar Shading Analyses

*Key Note(s):*

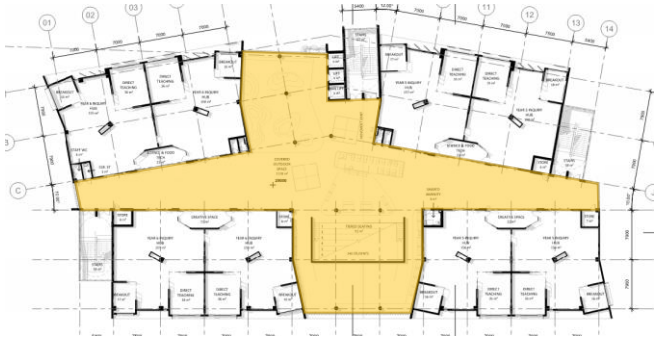
- Overall, the outdoor play areas at Ground and Level 1 to 4 respectively received shading from direct solar access at some point of the day during Summer Solstice, with extent of coverage ranging from at least 55% to 100% of its floor area [2]. Refer subsequent slides for analyses results.
- While most part at Level 05 is unshaded, some part of the Level 05 outdoor play area remain shaded throughout the Summer Solstice[2].
- The outdoor play space for respective floor levels that is deemed to have received reasonable amount of shading is marked-up in orange shade below.

Ground Level

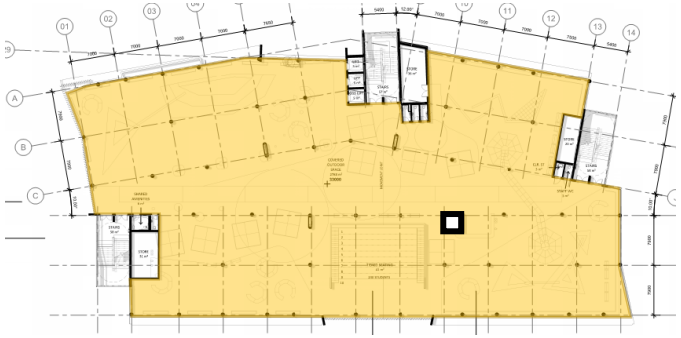
Level 01



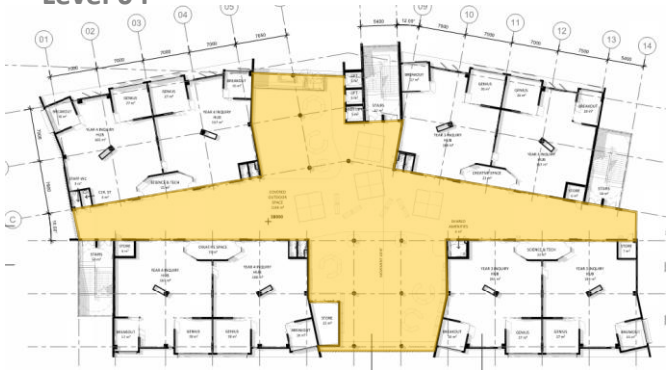
Level 02



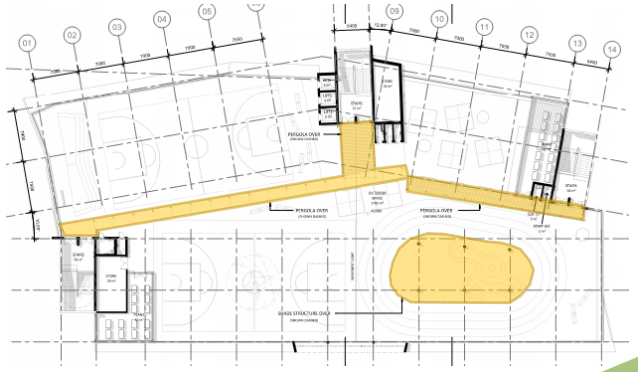
Level 03



Level 04



Level 05



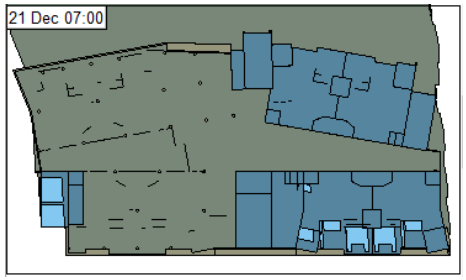
*Note:*

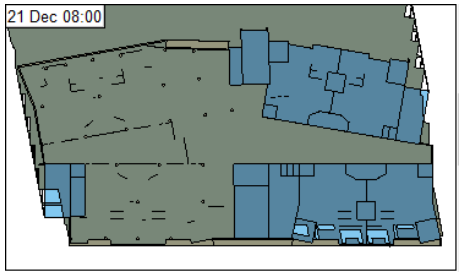
1) *All solar access analyses result on plans in subsequent slides are representative of the actual simulation model built based on the DA architectural set. Hence, internal wall outlines can be seen at each floor level as it reflect the internal wall outlines of the floor beneath it (i.e. not visually representative of the actual space outline as indicated in DA architectural drawing for each floor level)*

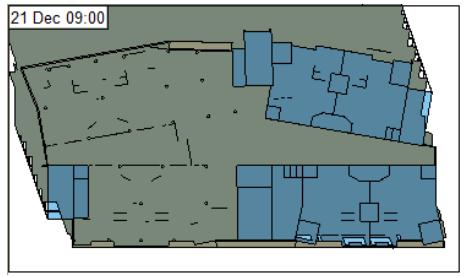
2) *Hourly direct sunlight shading is measured 1m above floor level (in line with Reference: Technical Note for Solar access requirements in State Environmental Planning Policy (SEPP) 65 – Design Quality of Residential Apartment Development and the Apartment Design Guide solar access assessment methodology given that there is no other applicable guide for educational facilities)*

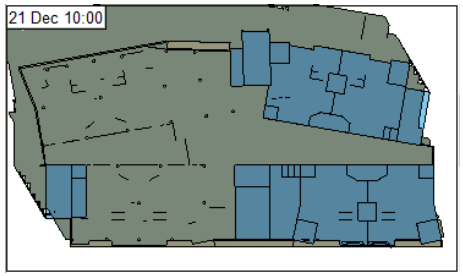
# Ground Level: Solar Shading (Summer Solstice, 21st Dec)

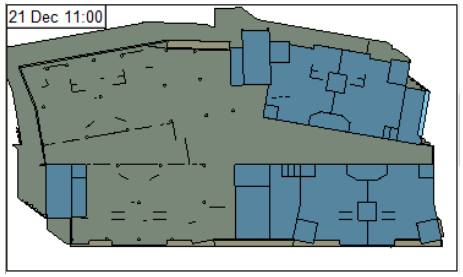
Key Plan – Outdoor Play Area space:

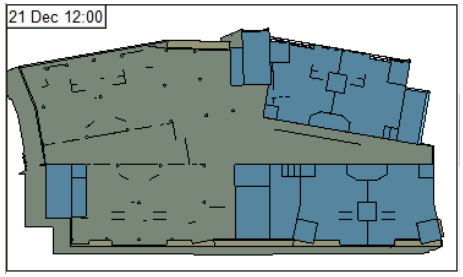



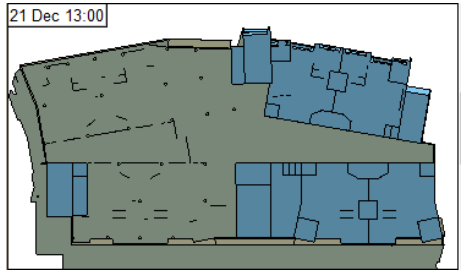



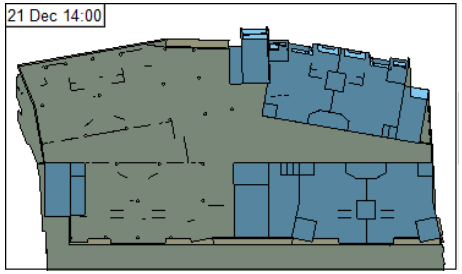



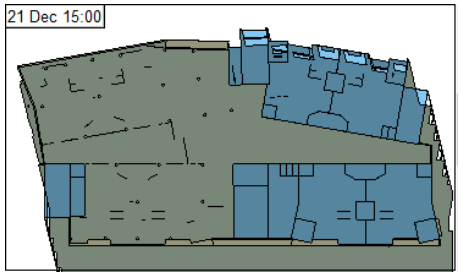



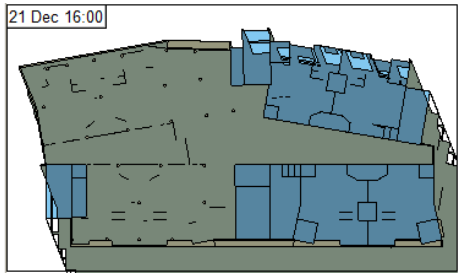



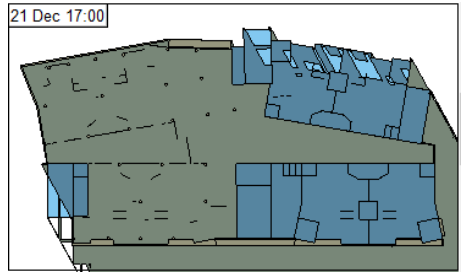



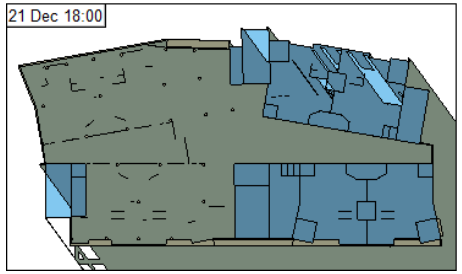



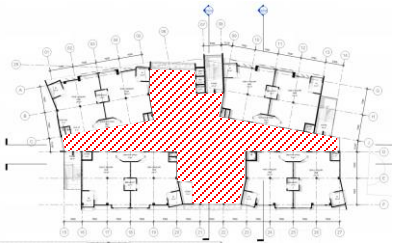




***Key Note(s):***

Based on the above solar shading analyses, the outdoor play area space is fully shaded from direct sunlight during Summer Solstice, as indicated in darker tone of grey colour overlay.

# Level 01: Solar Shading (Summer Solstice, 21st Dec)

Key Plan – Outdoor Play Area space:

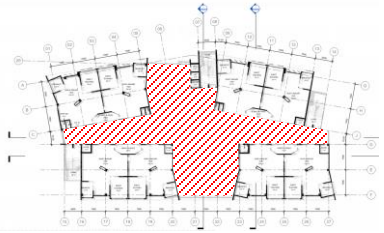


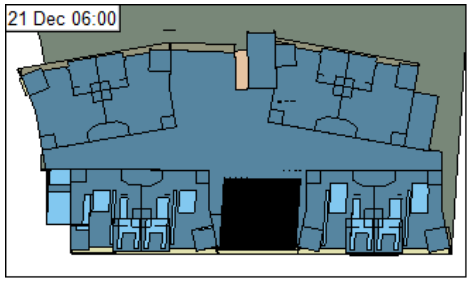

*Key Note(s):*

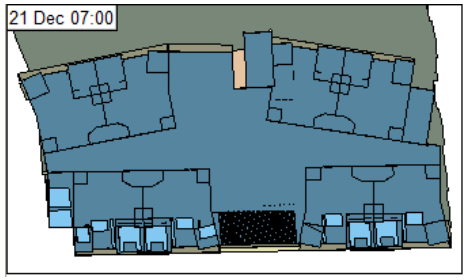
Based on the above solar shading analyses, the outdoor play area space is mostly shaded from direct sunlight during Summer Solstice, as indicated in darker tone of grey colour overlay.

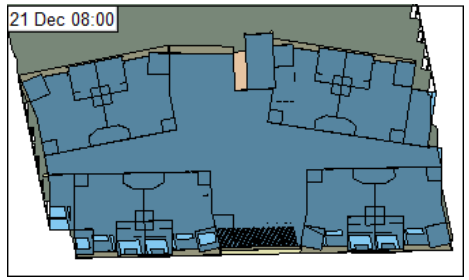
# Level 02: Solar Shading (Summer Solstice, 21st Dec)

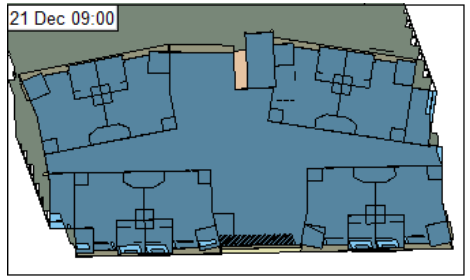
Key Plan – Outdoor Play Area space:

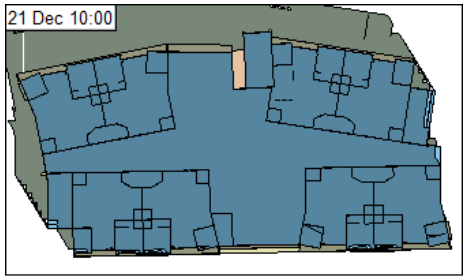


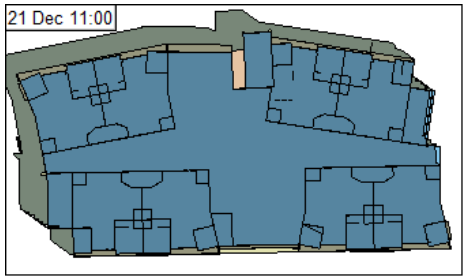


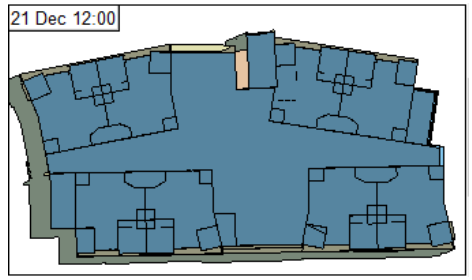



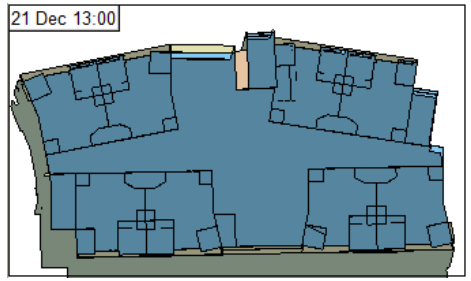



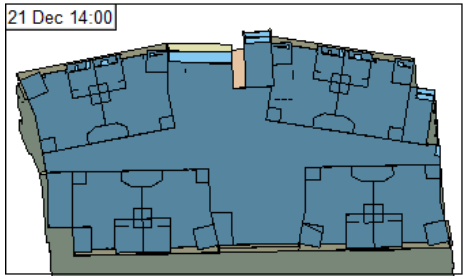



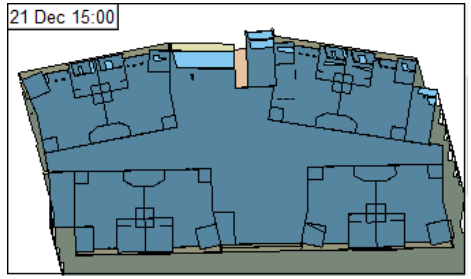



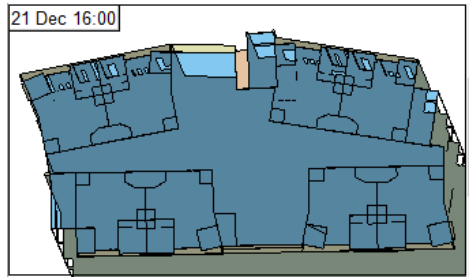



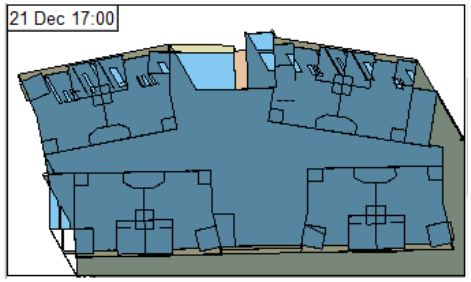



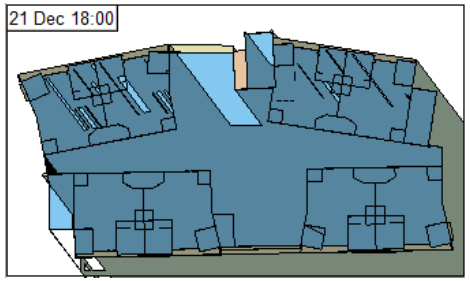



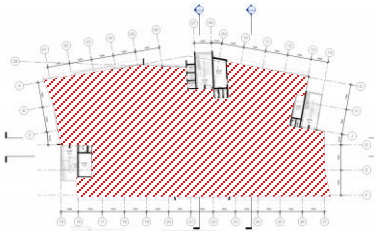



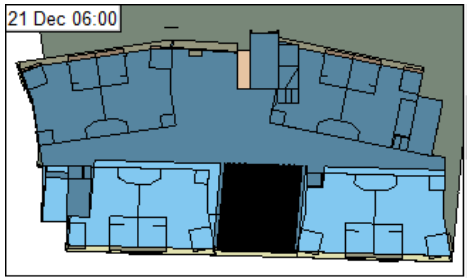

***Key Note(s):***

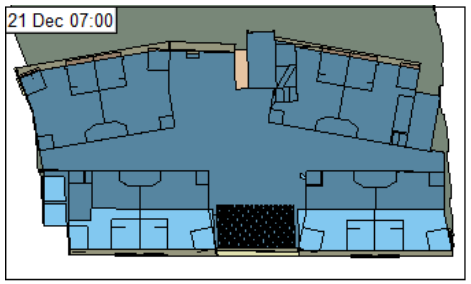
Based on the above solar shading analyses, the outdoor play area space is mostly shaded from direct sunlight during Summer Solstice, as indicated in darker tone of grey colour overlay.

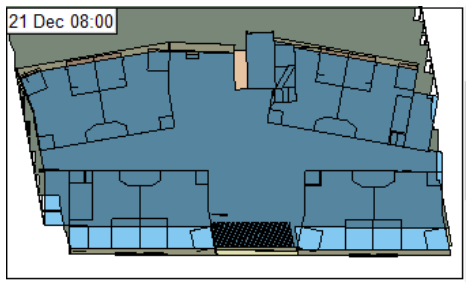
# Level 03: Solar Shading (Summer Solstice, 21st Dec)

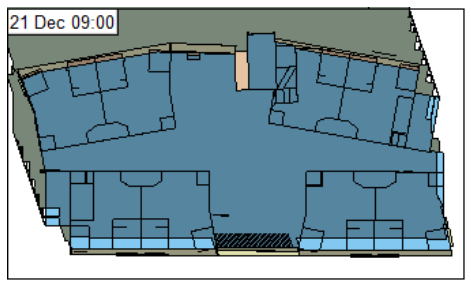
Key Plan – Outdoor Play Area space:

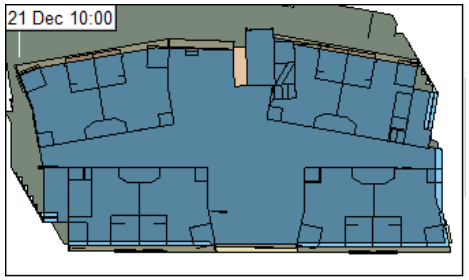


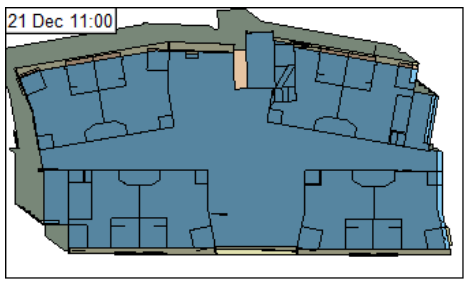


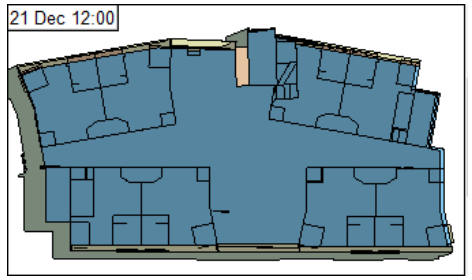



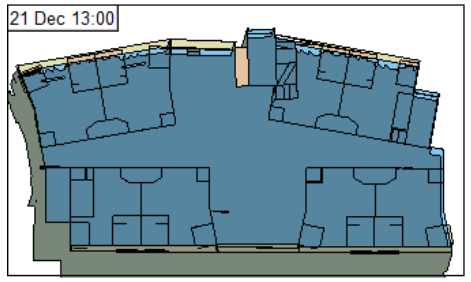



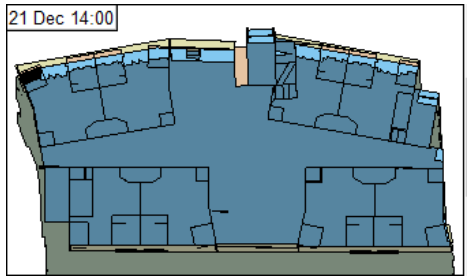



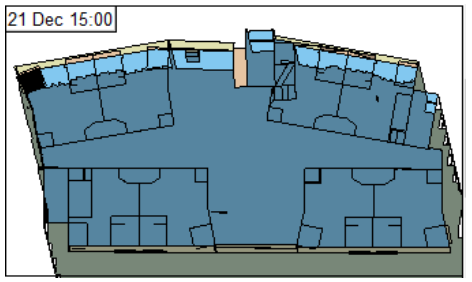



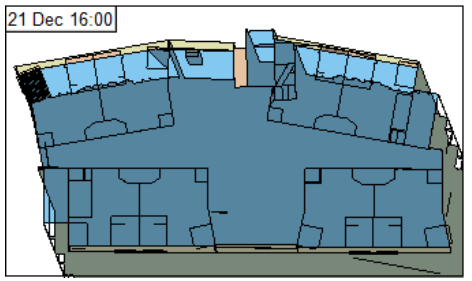



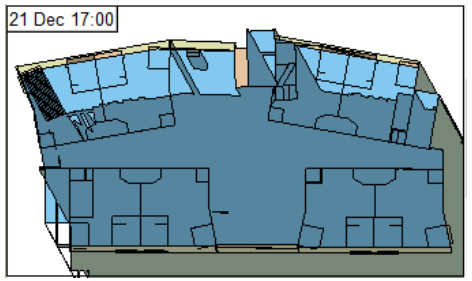



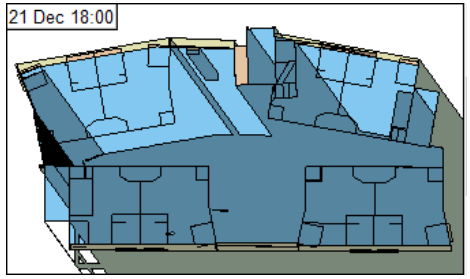



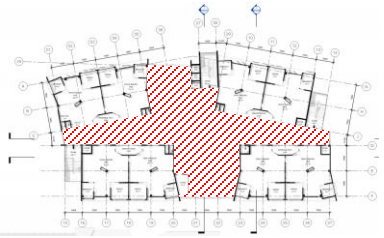



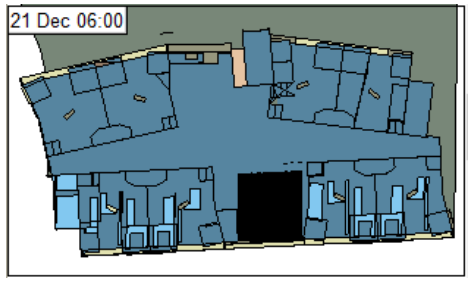

***Key Note(s):***

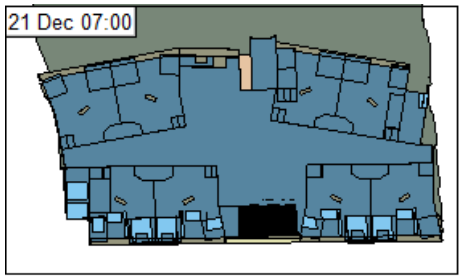
Based on the above solar shading analyses, the outdoor play area space is mostly shaded from direct sunlight during Summer Solstice, as indicated in darker tone of grey colour overlay.

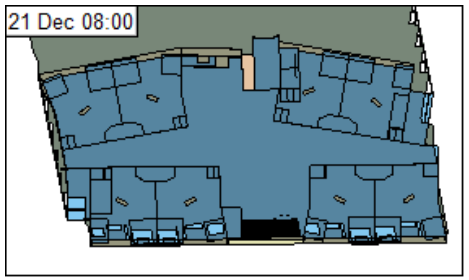
# Level 04: Solar Shading (Summer Solstice, 21st Dec)

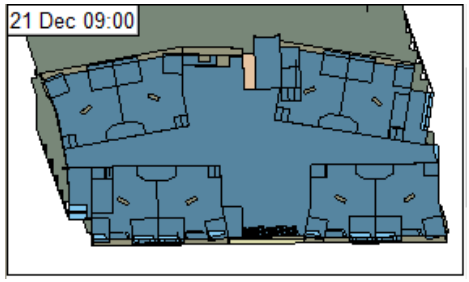
Key Plan – Outdoor Play Area space:

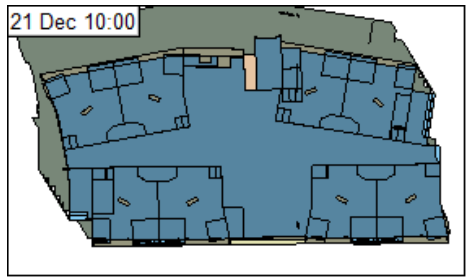


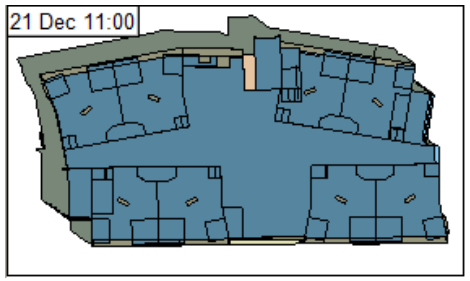


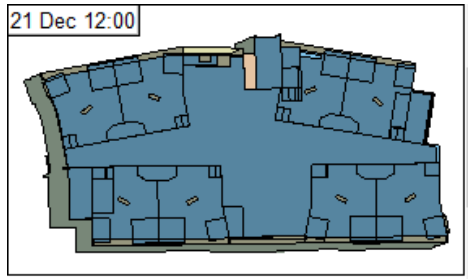



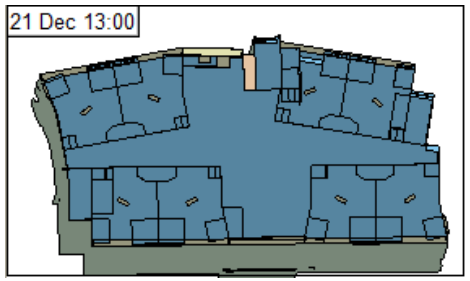



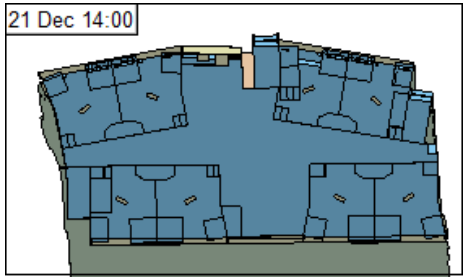



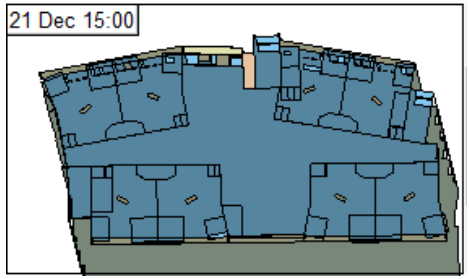



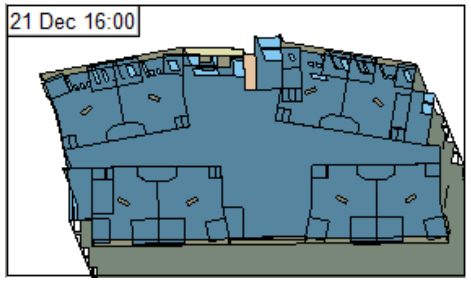



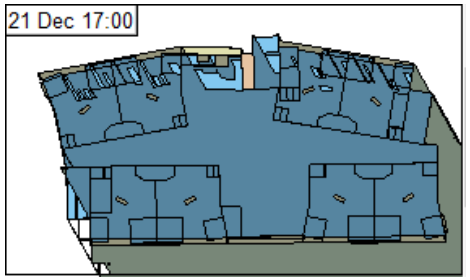



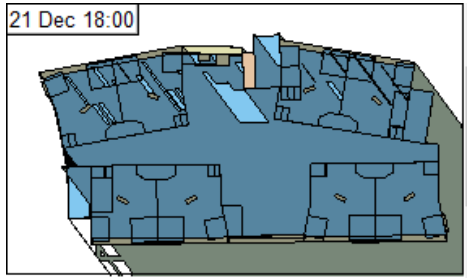



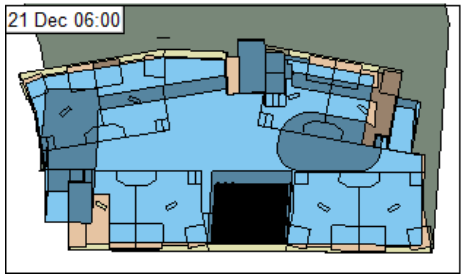



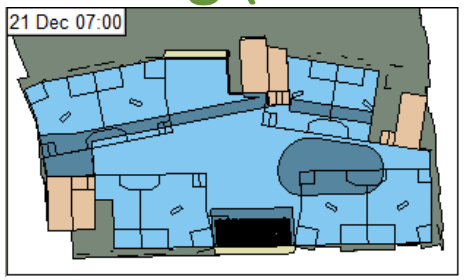



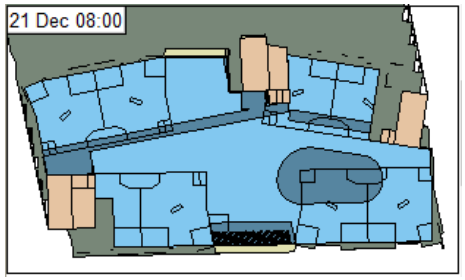

*Key Note(s):*

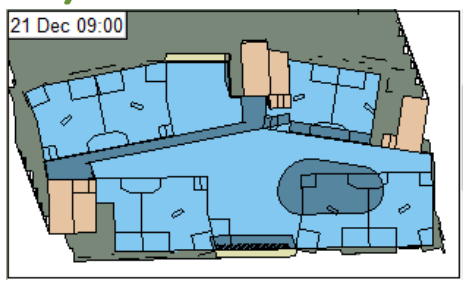
Based on the above solar shading analyses, the outdoor play area space is mostly shaded from direct sunlight during Summer Solstice, as indicated in darker tone of grey colour overlay.

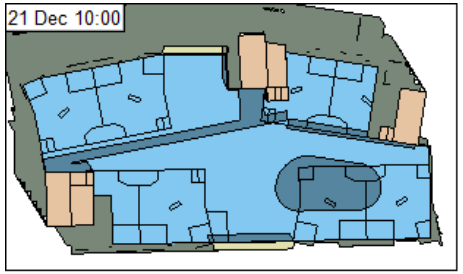
# Level 05: Solar Shading (Summer Solstice, 21st Dec)

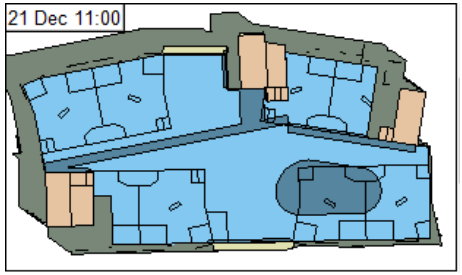


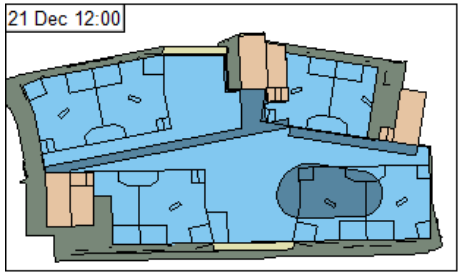



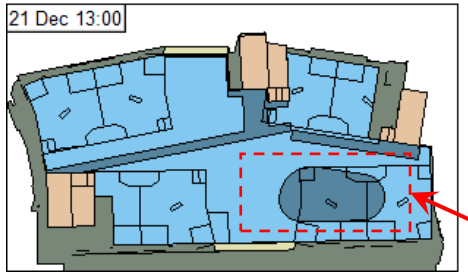



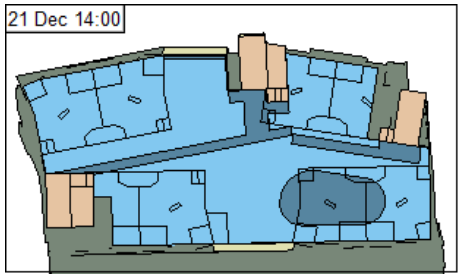



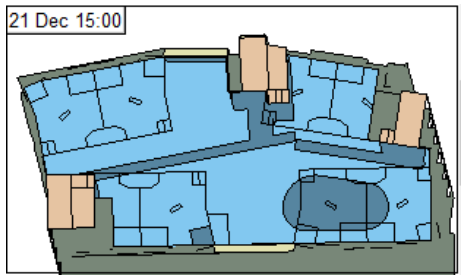



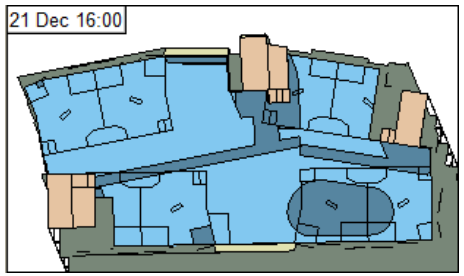



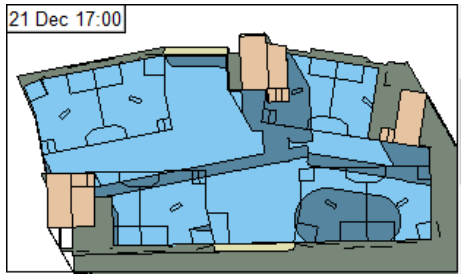



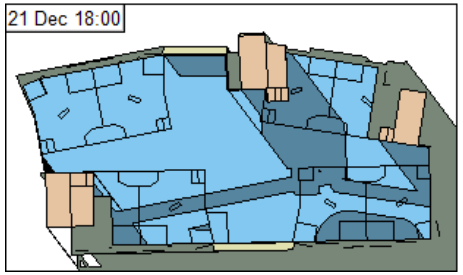



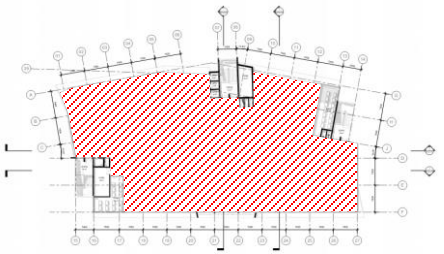



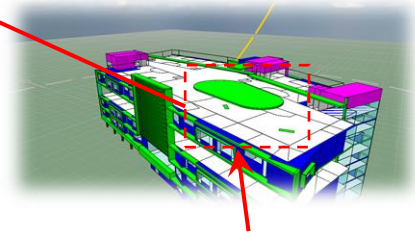




Key Plan – Outdoor Play Area space:



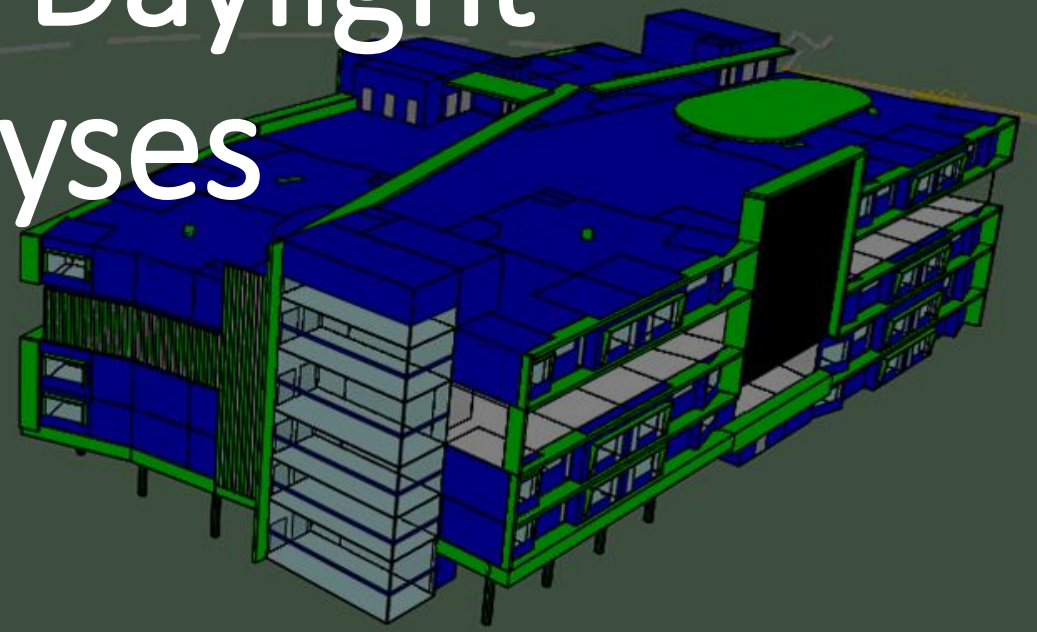


*Shading structure provided at Level 05 outdoor area provide some shading throughout the summer solstice*

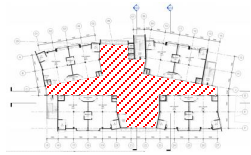
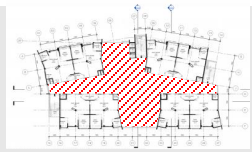
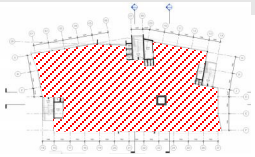
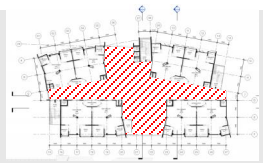
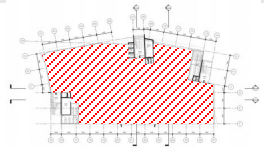
***Key Note(s):***

Based on the above solar shading analyses, the outdoor play area space is mostly unshaded from direct sunlight during Summer Solstice. However, part of the outdoor play area still remains shaded by shading structure as indicated in darker tone of grey colour overlay.

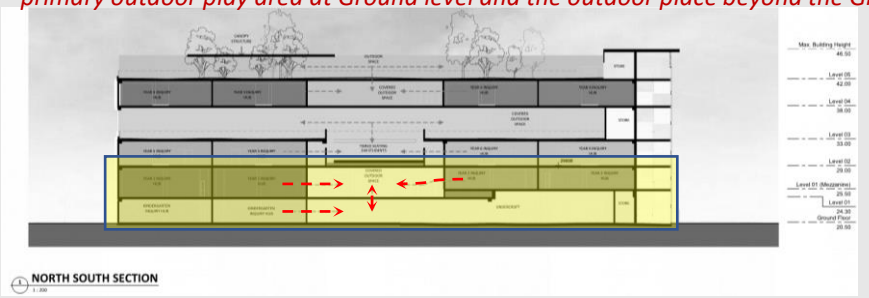
# Dynamic Daylight Analyses



# Summary: Daylight Access Analyses

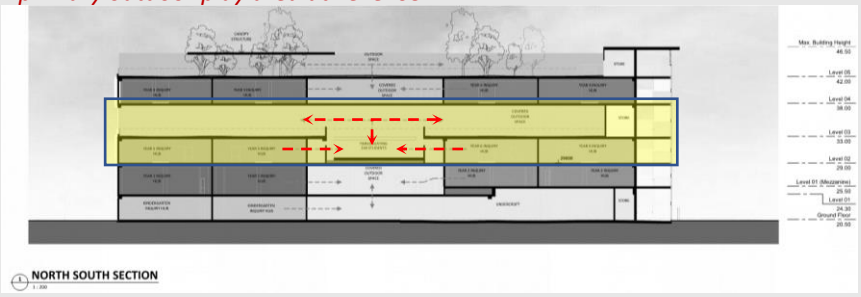
| Level/ Key Plan of Outdoor Play Area Space | Annual Average ≥ 21 Lux | Annual Average > 50 Lux | Area Weighted Average of Allocated Outdoor Play Areas that achieves Annual Average > 50 Lux *(refer page 5 architectural drawing for intended occupants' flow)* |
|---|---|---|---|
| Ground  | 86% | 79% | |
| 01  | 76% | 60% | |
| 02  | 57% | 39% | |
| 03  | 99% | 99% | |
| 04  | 83% | 64% | |
| 05  | 100% | 100% | |

*Ground and Level 01 outdoor play areas integrated to allow bi-directional occupants' flow towards the primary outdoor play area at Ground level and the outdoor place beyond the Ground building outline.*



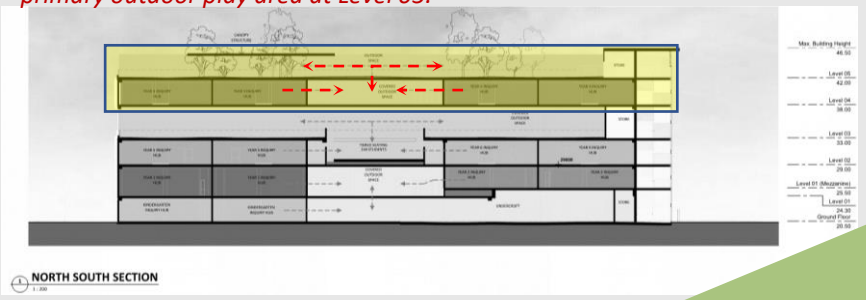

72%

*Level 02 and Level 03 outdoor play areas integrated to allow bi-directional occupants' flow towards the primary outdoor play area at Level 03.*




82%

*Level 04 and Level 05 outdoor play areas integrated to allow bi-directional occupants' flow towards the primary outdoor play area at Level 05.*




89%

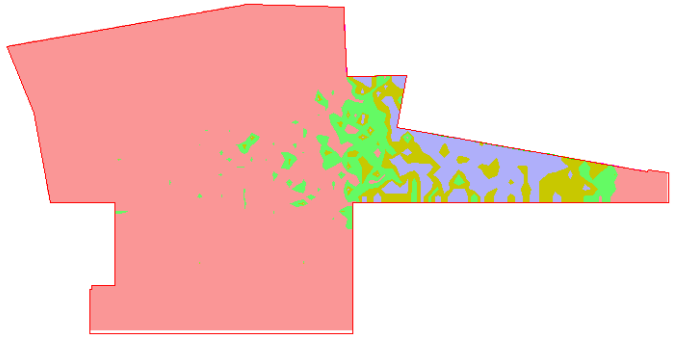
# Daylight Access Analyses: Ground & Level 01

Key Plan – Ground and Level 01 Outdoor Play Area space:

**Ground Level**

**Average Lux for Perez Sky Occupancy**
**Period = 6:00-18:00**

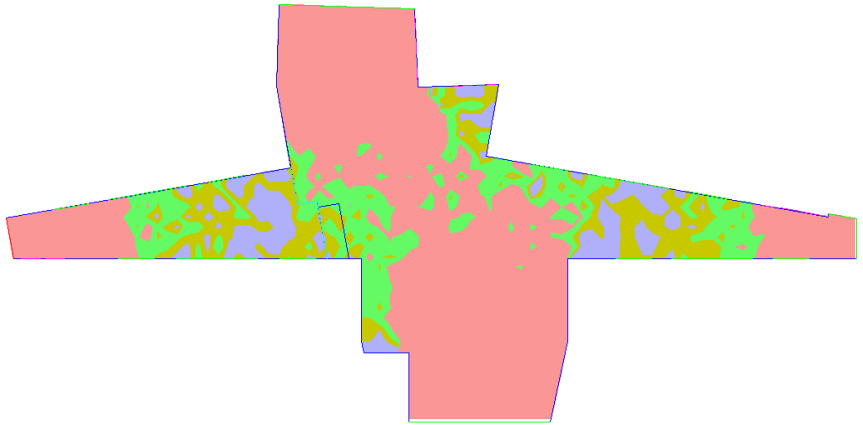
| Lux | |
|---|---|
| > 50 | 78.9 % |
| 21 - 50 | 7.1 % |
| 7 - 21 | 6.1 % |
| < 7 | 7.9 % |



**Level 01**

**Average Lux for Perez Sky Occupancy**
**Period = 6:00-18:00**

| Lux | |
|---|---|
| > 50 | 60.5 % |
| 21 - 50 | 15.9 % |
| 7 - 21 | 12.7 % |
| < 7 | 10.8 % |

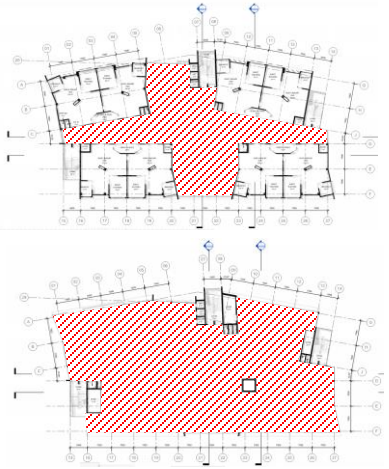


*Key Note(s):*

- ***Ground Level**: Approx. **79%** of the outdoor play area achieves annual average of > 50 lux during its indicative operational hours (6:00am – 18:00pm) throughout the year, with an estimated total of **86%** ≥ 21 lux;*
- ***Level 01:** Approx. **60%** of the outdoor play area achieves annual average of > 50 lux during its indicative operational hours (6:00am – 18:00pm) throughout the year, with an estimated total of **76%** ≥ 21 lux;*
- ***Area Weighted Average (Ground + Level 01): 72%** of the outdoor play area achieves annual average of > 50 lux during its indicative operational hours (6:00am – 18:00pm) throughout the year.*

# Daylight Access Analyses: Level 02 & Level 03

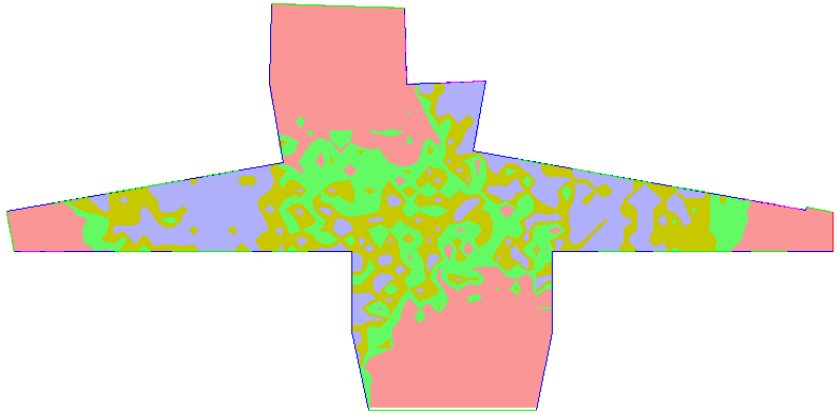
Key Plan – Level 02 and Level 03 Outdoor Play Area space:



**Level 02**

**Average Lux for Perez Sky Occupancy**
**Period = 6:00-18:00**

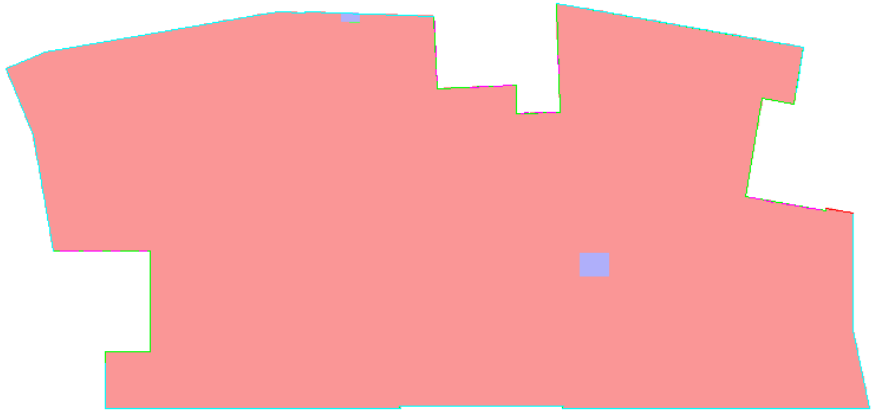
| Lux | |
|---|---|
| > 50 | 39.6 % |
| 21 - 50 | 17.5 % |
| 7 - 21 | 20.2 % |
| < 7 | 22.6 % |



**Level 03**

**Average Lux for Perez Sky Occupancy**
**Period = 6:00-18:00**

| Lux | |
|---|---|
| > 50 | 99.5 % |
| 21 - 50 | 0.0 % |
| 7 - 21 | 0.0 % |
| < 7 | 0.5 % |

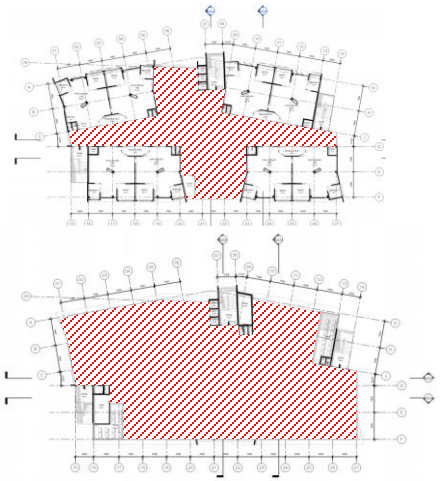


*Key Note(s):*

- ***Level 02**: Approx. **39%** of the outdoor play area achieves annual average of > 50 lux during its indicative operational hours (6:00am – 18:00pm) throughout the year, with an estimated total of **57%** ≥ 21 lux;*
- ***Level 03:** Approx. **99%** of the outdoor play area achieves annual average of > 50 lux during its indicative operational hours (6:00am – 18:00pm) throughout the year, with an estimated total of **99%** ≥ 21 lux;*
- ***Area Weighted Average (Level 02 + Level 03):** **82%** of the outdoor play area achieves annual average of > 50 lux during its indicative operational hours (6:00am – 18:00pm) throughout the year.*

# Daylight Access Analyses: Level 04 & Level 05

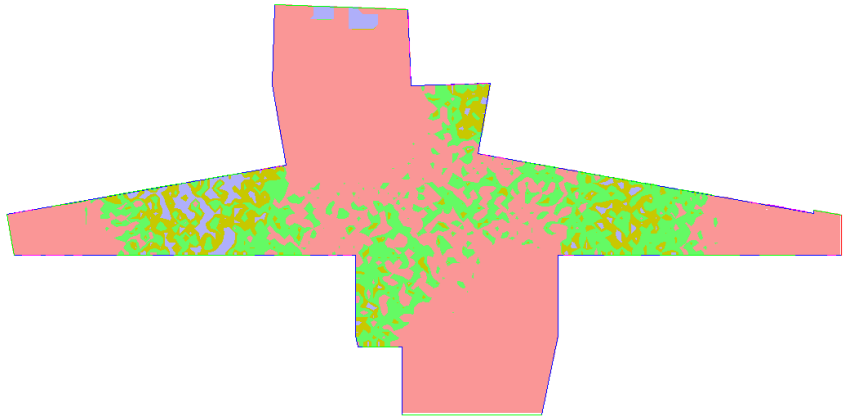
Key Plan – Level 04 and Level 05 Outdoor Play Area space:



**Level 04**

**Average Lux for Perez Sky Occupancy**
**Period = 6:00-18:00**

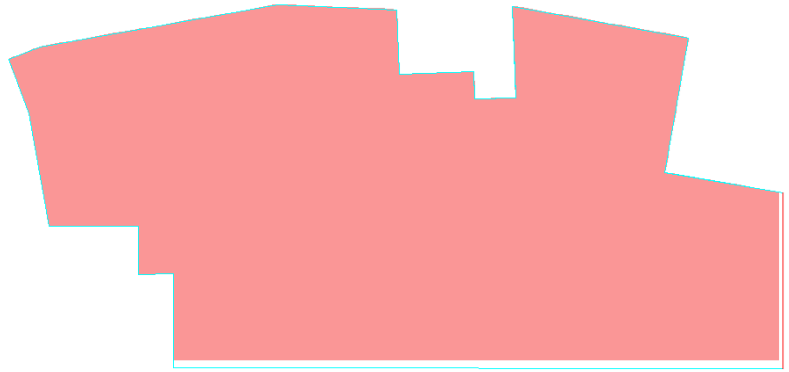
| Lux | |
|---|---|
| > 50 | 63.7 % |
| 21 - 50 | 19.2 % |
| 7 - 21 | 9.6 % |
| < 7 | 7.5 % |



**Level 05**

**Average Lux for Perez Sky Occupancy**
**Period = 6:00-18:00**

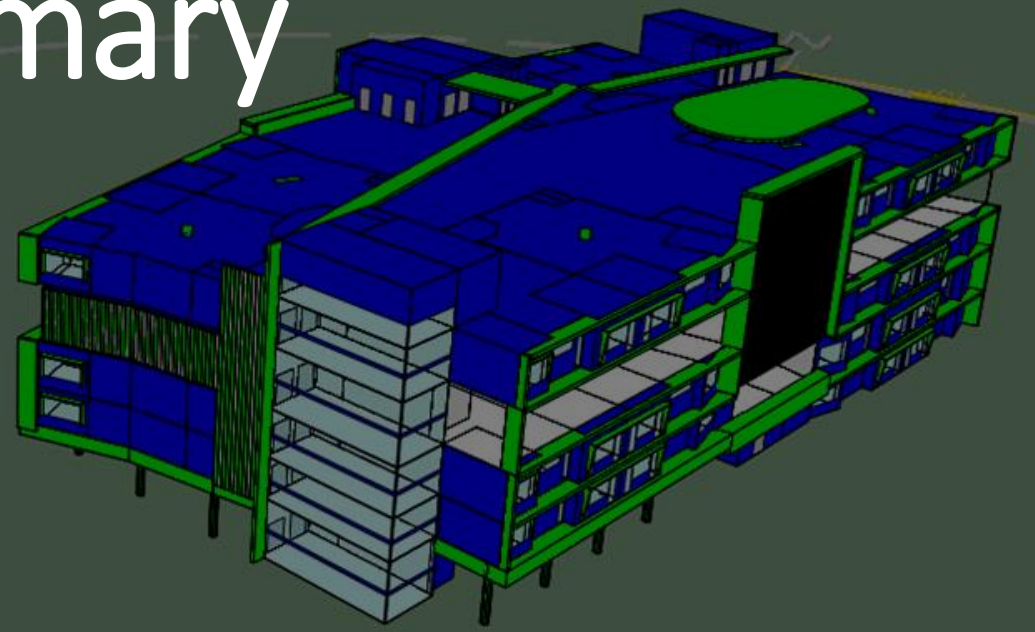
| Lux | |
|---|---|
| > 50 | 100.0 % |
| 21 - 50 | 0.0 % |
| 7 - 21 | 0.0 % |
| < 7 | 0.0 % |



*Key Note(s):*

- ***Level 04**: Approx. **64%** of the outdoor play area achieves annual average of > 50 lux during its indicative operational hours (6:00am – 18:00pm) throughout the year, with an estimated total of **83%** ≥ 21 lux;*
- ***Level 05:** Approx. **100%** of the outdoor play area achieves annual average of > 50 lux during its indicative operational hours (6:00am – 18:00pm) throughout the year, with an estimated total of **100%** ≥ 21 lux;*
- ***Area Weighted Average (Level 04 + Level 05):** **89%** of the outdoor play area achieves annual average of > 50 lux during its indicative operational hours (6:00am – 18:00pm) throughout the year.*

# Summary



# Summary

- **Winter Solar Access**: Each of the outdoor play area at Ground level, Level 1 to 5 received ≥ 3 hours of direct solar access during the Winter Solstice. This will provide some light and warmth to the space during the cold winter months.

- **Summer Solar Shading**: All outdoor play area space at Ground and Level 1 to 4 are generally well-shaded from direct solar access during the Summer Solstice, with good extent coverage approximately ranging from at least 55% to 100% of its floor area. The high extent of shade environment provided at Ground to Level 4 not only improves occupants' comfort but also promotes better thermal adaptability (e.g. occupants' movement from non-shaded area to shaded area) as required. While most of Level 05 are unshaded, some part of the Level 05 outdoor play area remain shaded throughout the Summer Solstice.

- **Daylight Access**: Area weighted average ranging from 72% - 89% of the outdoor play areas achieves annual average > 50 lux during its indicative operational hours (6:00am – 18:00pm) throughout the year. Overall, the analyses shows that at least 80% of the average outdoor play areas daylighting are sufficient for the level of activities equivalent to those at public playground. In addition, it is also worth noting that artificial lighting will be used to complement the natural lighting as required. Such integration will not only ensure that visual comfort can be met at all time but also promote energy efficiency, striking a balance between the both.

- **Additional open space**: Beyond the K-6 building footprint, additional open space (refer green area in the image to the right) at Ground level is also available to the K-6 building occupants.

*Additional open space (in green) extending beyond the K-6 building footprint at Ground level that are also available to K-6 occupants*

# Thank You