

# **Attachment A12**

**Daylight Analysis  
757-763 George Street, Haymarket**

# Daylight Analysis 757-763 George Street Hotel Development, Haymarket

PREPARED FOR SAMPRIAN PTY LTD

## Revision Information

<b>Project</b>	757 - 763 George Street Hotel
<b>Title</b>	Daylight Analysis
<b>Client</b>	Samprian Pty Ltd
<b>Revision</b>	A
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## Revision Schedule

Revision	Date	Issue Name	Author	Authorised
A	28/09/20	Daylight Analysis	DM	JvD

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## Executive Summary

The proposed 757-763 George Street Hotel is a new development project, located in the Haymarket Activity Node, and situated 300 meters from Central Station. The proposal is for a 30 level hotel, with mixed commercial opportunities on the lower levels, which will also retain the existing façade.

The glazing assessment of the design was conducted using the NCC 2019 Façade Calculator to determine the performance specifications of the glazing system as shown in Table 1.

Table 1: DTS Compliant Glazing Product used within Daylight Assessment

Wall Insulation R Value (m <sup>2</sup> .K/W)	Glazing System U Value (W/m <sup>2</sup> .K)	Glazing System SHGC	Visual Light Transmission (VLT) (%)
R1.0 (North, East, West) R1.4 (South)	2.60	0.16	7%

A single type of glazing meeting the above performance specifications may be used across all facades of the proposed building. This specification satisfies 'Method 2' of the NCC 2019 Façade Calculator.

Using the glazing product in Table 1, a daylight assessment was undertaken for a standard floor of the development in order to assess the level of daylight penetration achieved across the guest suites. The Daylight Factor and lux levels were identified within each suite.

The results of the daylight analysis indicated adequate Daylight Factors in dual-aspect suites. The average Daylight Factor was below 2% to some single-aspect suites; requiring increased daylight ingress.

The addition of a 500mm upstand to the spandrel allows for a glazed product with a higher VLT of 20% to be used as part of the construction, and provide significant internal daylighting benefits to the guest suites; particularly to the single-aspect suites.

# 1 Introduction

LCI has been engaged to undertake a daylight assessment for the proposed 757-763 George Street development located at Haymarket, NSW. The Daylight Report includes the following information:

- > A summary of the NCC 2019 Façade Calculator Results to identify glazing that meets thermal and optical requirements;
- > A description of the methodology and modelling software used to calculate the Daylight Factors ;
- > Description of the Uniform Design Sky used for the daylight model;
- > Description of the building model;
- > Values of reflectance and transmittance used for each relevant material/glazing;
- > A summary of the modelling methodology used for the analysis;
- > A summary of the simulation findings.

## 1.1 Project Description

The subject site is located at the north-west corner of George Street and Valentine Street, Haymarket. The site comprises two built structures fronting George Street, the former Sutton Meat Foreast Meat Company Building on the corner site and a concrete framed building with a driveway access to the rear.

Grimshaw Architects have prepared an indicative reference scheme to support a planning proposal which facilitates the following:

- > Basement 2 – Car Parking accessible through a Car Lift, Back of House (BOH) Storage, Mechanical Plantrooms and Hydraulic Plantrooms
- > Basement 1 – BOH End of Trip (EOT) Facility, BOH Bike Storage, Bin Store along with Electrical, Mechanical, Fire and Hydraulics Plantrooms
- > Ground Floor – Hotel Entrance and Lobby areas, Retail Tenancies, Hotel Amenities, BOH Offices and the Loading Dock.
- > Level 2 Mezzanine – Hotel Amenities
- > Level 3 – Hotel Amenities, Sky Lounge and External Terrace Areas
- > Levels 5 to 8 – Guestrooms
- > Level 9 – Guestrooms and Plantroom
- > Level 10 – Guestrooms and Hotel Terrace
- > Levels 11 to 29 – Guestrooms
- > Levels 30 and 31 – Roof Plant

## 1.2 Assessing Daylight

The natural or daylight levels within a building result from a combination of building design, glazing area and the glazing specification. The purpose of this study is to determine, based on the design and architectural drawings of the hotel, the appropriate glazing performance specifications, and then to model daylight penetration through the building.

Daylight is recognised as a beneficial Indoor Environmental Quality (IEQ) of buildings which enhances occupant comfort and supports productivity. Levels of daylight can be expressed as a percentage using the Daylight Factor (DF) which is a measure of the relative proportion of internal daylight illuminance to external daylight illuminance:

$$\text{Daylight Factor} = \frac{\text{Internal Illuminance (Lux)}}{\text{External Horizontal Illuminance (Lux)}} \times 100\%$$

By calculating Daylight Factors in a space, it is possible to assess the penetration of natural light into a space. Daylight Factors are calculated by dividing the internal illuminance of a particular point within a room (i.e the amount of light falling on that point) by the unobstructed outdoor illuminance. Daylight Factors are represented as percentages, with 100% indicating an unobstructed view of the sky. A minimum 2% Daylight Factor is ideal.

The Daylight Factor is a useful method for benchmarking the effectiveness of a design, because it measures the proportion of daylight entering a building and is not climate specific.

## 2 NCC 2019 Façade Calculator Results

The NCC 2019 Façade Calculator was used to determine the minimum Deemed-to-Satisfy (DTS) thermal specification of the glazing for the hotel. The optical properties of a corresponding glass product were then used for the Daylight Analysis.

The calculation was completed for a single level of the hotel which is common to levels which accommodate guests. The floor to ceiling height for the hotel is 2.74m and the floor to floor height is 3.24m. The ceiling cavity is therefore 0.5m and it is expected that this spaces will be covered with spandrel glazing meeting an insulation value of R1.0 to North, East and West facades; R1.4 to the South facade.

Table 2: Opaque and Glazed Area to each Orientation

Façade	North	East	South	West
Glass	14.4m x 2.74m <b>39.5m<sup>2</sup></b>	17.2m x 2.74m <b>47.1m<sup>2</sup></b>	28.8m x 2.74m <b>78.9m<sup>2</sup></b>	17.2m x 2.74m <b>47.1m<sup>2</sup></b>
Wall	15.4m x 3.24m <b>49.9m<sup>2</sup></b>	3.6m x 3.24m <b>11.7m<sup>2</sup></b>	0.60m x 3.24m <b>1.9m<sup>2</sup></b>	3.6m x 3.24m <b>11.7m<sup>2</sup></b>
Spandrel*	14.4m x 0.5m <b>7.2m<sup>2</sup></b>	17.2m x 0.5m <b>8.6m<sup>2</sup></b>	28.8 x 0.5m <b>14.4m<sup>2</sup></b>	17.2m x 0.5m <b>8.6m<sup>2</sup></b>
Total Wall	49.9m <sup>2</sup> + 7.2m <sup>2</sup> <b>57.1m<sup>2</sup></b>	11.7m <sup>2</sup> + 8.6m <sup>2</sup> <b>20.3m<sup>2</sup></b>	1.9m <sup>2</sup> + 14.4m <sup>2</sup> <b>16.3m<sup>2</sup></b>	11.7m <sup>2</sup> + 8.6m <sup>2</sup> <b>20.3m<sup>2</sup></b>
Glazing to Façade Ratio	<b>41%</b>	<b>70%</b>	<b>83%</b>	<b>70%</b>

\*The spandrel will be modelled as a wall construction, having an R-value of R1.0 on North, East and West orientations. The south will have an R-value of R1.40

The DTS glass thermal performance can be calculated via two methods; Method 1 and Method 2. The glazing performance specifications for the daylight modelling were selected based on 'Method 2' as it allows for a single glass product to be specified for the proposed glazing for all façade orientations. An increased window-to-wall ratio requires a better performing glass product with a lower system U-value, SHGC and Visual Light Transmission (VLT).

The DTS glazing façade specifications (Method 2) based on the above façade proportions are shown in Table 3.

Table 3: Glazing Thermal Performance Requirements under Method 2

Glazed System U-Value (W/m <sup>2</sup> .K)	Glazed System SHGC	Corresponding VLT
2.6	0.16	7%

\*Assuming Spandrel elements have an insulation level the same as standard wall elements.



## 3 Modelling Analysis Inputs

### 3.1 Modelling Software Package for Calculation of Daylight Factors

The daylight simulation has been undertaken using an integrated version of the commercial daylighting software package. The FlucsDL module within IES Virtual Environment (2019) suite has been used to complete the analysis. FlucsDL takes a three-dimensional (3D) geometric model of the physical environment as an input to perform lighting design calculations to determine the day-lighting levels in a room. It can be used to generate Daylight Factors or lighting level values and plot it onto the working plane and visualise the plots directly within the 3D model room. It has not been used to assess the impact of reflected sunlight from surrounding buildings' facades.

### 3.2 Uniform Design Sky

The simulations for this analysis have utilised a Uniform Overcast Sky with a horizontal illuminance of 10,000 lux. The uniform overcast sky has the same distribution across the sky dome for a given day of the year and represents a sky with a constant value of luminance.

### 3.3 Building Model

A 3D computer model has been built in IES Virtual Environment and is based on the following architectural and façade drawings:

- > A03-1021 - GA PLAN - LEVEL 20 - HOTEL – TYPICAL
- > A07-1000 - GA SECTIONS (AA NORTH-SOUTH - BB EAST-WEST)

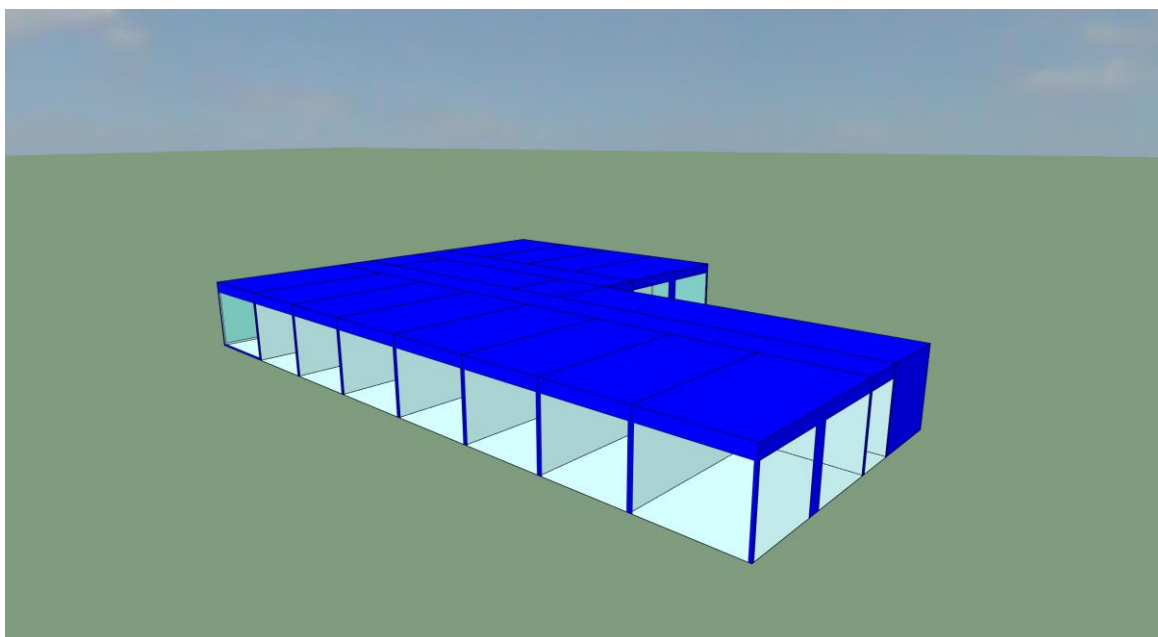


Figure 1: Typical Guest Suite in IESVE FlucsDL

## 3.4 Material Reflectance Properties

### 3.4.1 Wall, Floor and Ceiling Properties

The following surface reflectance properties were applied to the model;

Table 4: Surface Reflectance Values

Material	Surface Reflectance
Core Walls	0.50
Internal Partitions	0.50
Internal Ceiling	0.70
Internal Floor	0.20

### 3.4.2 External Glazing Properties

One glazing type will be installed throughout all vision glazing for the building, the glazing performances are reflect glass with meets the NCC 2019 Façade Calculator performance specifications from 'Method 2'.

Table 5: Thermal and Optical Properties of Proposed Glass Product used in Daylight Analysis

Glazed System U-Value (W/m <sup>2</sup> .K)	SHGC	Outside Reflectance	Inside Reflectance	Visual Light Transmittance (VLT) (%)
2.6	0.16	4%	13%	7%

## 4 Daylight Modelling Methodology

The following points outline particulars of the modelling methodology.

- > Calculation Method: Point-by-point plus radiosity
- > Illuminance: Planar on the horizontal
- > Margin: 0.25 meters
- > Calculation Quality: medium with 0.5 meter grid size
- > Reflections: Full inter-reflections (progressive radiosity)
- > Daylighting: CIE Uniform (overcast) sky – horizontal illuminance 10,000 lux

## 5 Daylight Factor Simulation Results

The distribution of Daylight Factor and lux levels across the typical floor is shown in Figure 2 and Figure 3 respectively. A summary of the average Daylight Factor within each suite is shown in Table 6.

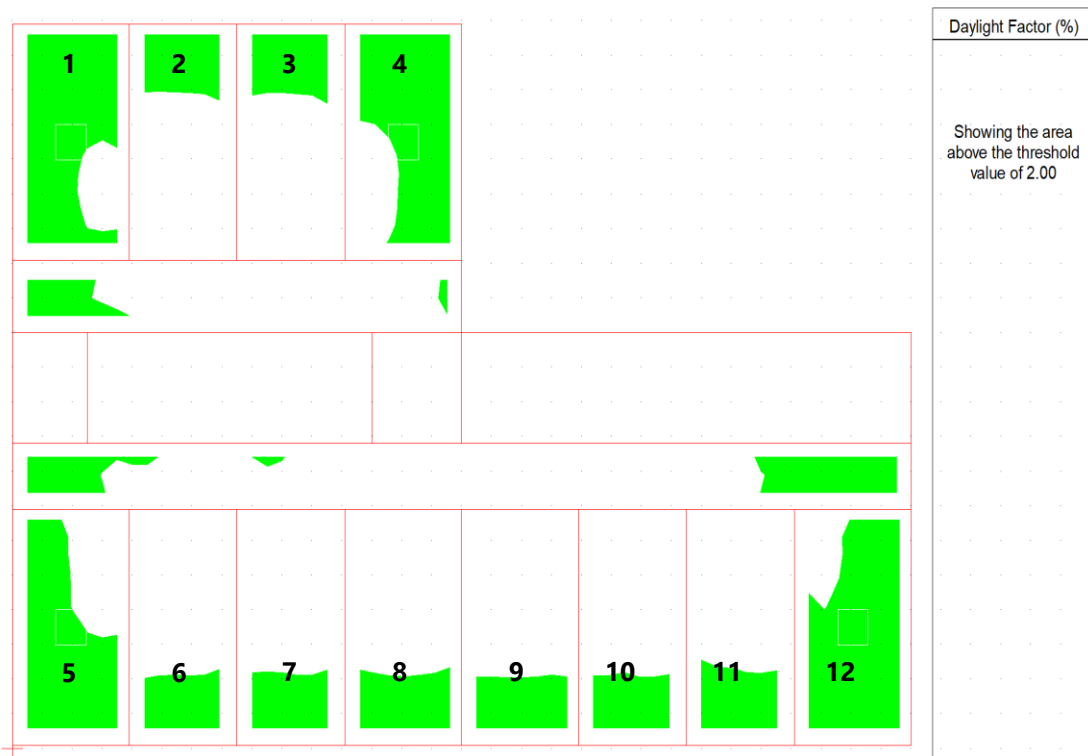


Figure 2: Proportion of Daylight Factor of at least 2% within each room (Highlighted in Green)

In Figure 2, the green highlighted areas indicate areas with a DF of at least 2%. Suites with glazing on multiple aspects (Suites 1, 4, 5 and 12) receive good levels of daylight. The single aspect suites experience less daylight penetration with an ideal DF limited to the close proximity of the glazed façade. However, the back-end of these suites are likely to accommodate bathrooms which do not require adequate daylight.

In Figure 3, the lux levels towards the façade glazing are at least 200lux in single-aspect suites and 300lux in dual-aspect suites.

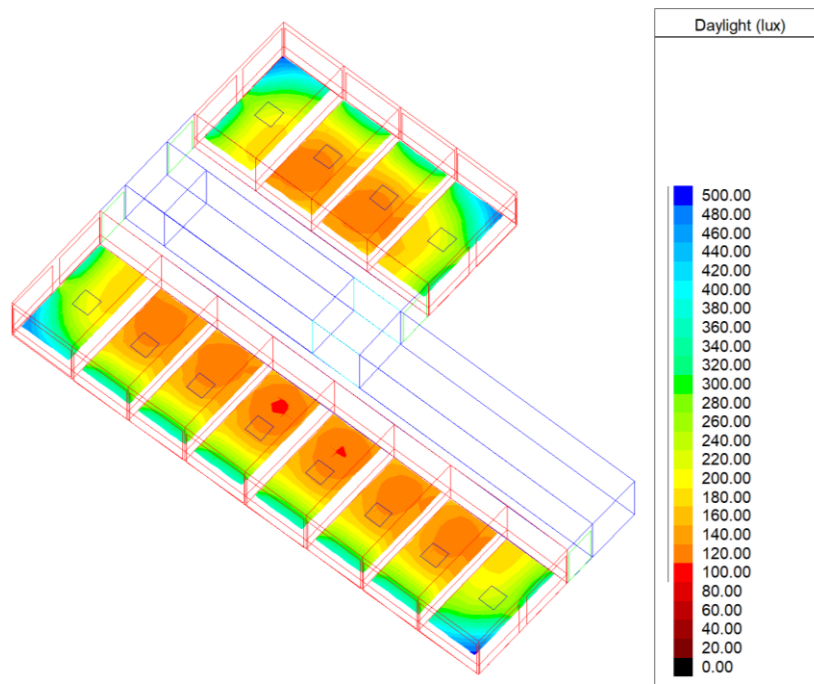


Figure 3: Lux Distribution within each Guest Suite

As shown in Table 6, the Daylight Factor in the guest rooms ranges between 1.8% to 2.9%. The average Daylight Factor across all suites is 2.2%. The suites with a Daylight Factor below 2% would benefit with an increase in daylight ingress.

Table 6: Proportion of Daylight Factor of at least 2% within each room

Room	Floor area (m <sup>2</sup> )	Floor area ≥ 2% DF (m <sup>2</sup> )	Percentage floor area ≥ 2% DF (%)	Average DF (%)
1	21.420	17.889	83.5	2.82
2	19.530	6.009	30.8	1.89
3	19.530	6.009	30.8	1.91
4	21.420	16.477	76.9	2.82
5	21.420	15.065	70.3	2.66
6	19.530	5.508	28.2	1.84
7	19.530	6.009	30.8	1.87
8	21.420	6.120	28.6	1.83
9	21.420	5.178	24.2	1.80
10	19.530	5.008	25.6	1.83
11	19.530	6.009	30.8	1.90
12	21.420	17.889	83.5	2.88

## 6 Increasing Spandrel Area

The minimum Deemed-to-Satisfy (DTS) thermal performance and corresponding VLT of the proposed glazing can be relaxed with the reduction in glazed area to the façade.

By introducing a 500mm upstand to each suite, a glazing product with a higher VLT of 20% was applied to the daylight model. The higher VLT percentage allows more visible light to penetrate the room, despite the reduction in glazing and enabling higher floor areas to receive a Daylight Factor greater than 2%.

The distribution of Daylight Factor and lux across the typical floor is shown in Figure 4 and Figure 3 respectively. A summary of the average Daylight Factor within each suite is shown in Table 7.

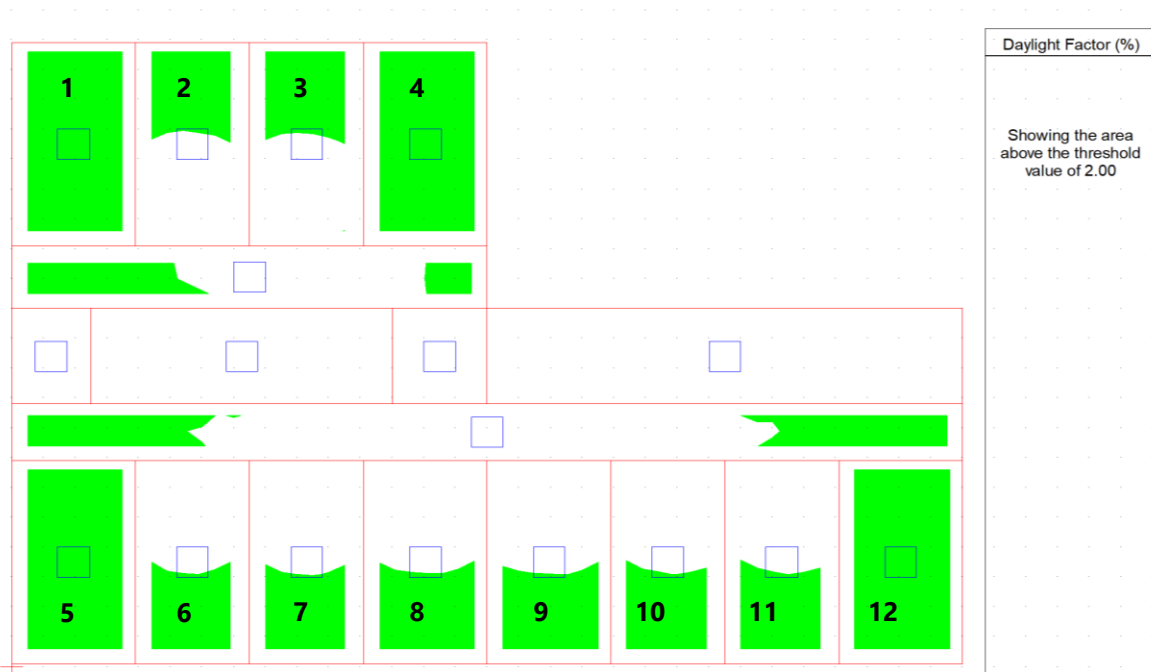


Figure 4: floor areas with a Daylight Factor of 2% or greater (500mm Upstand to Façade)

Compared to the previous results in Section 5, the proportion of floor area with at least a 2% Daylight Factor has increased in each suite.

In Figure 5, the lux levels towards the façade glazing have increased to at least 300 lux in single-aspect suites and 500lux in dual-aspect suites.

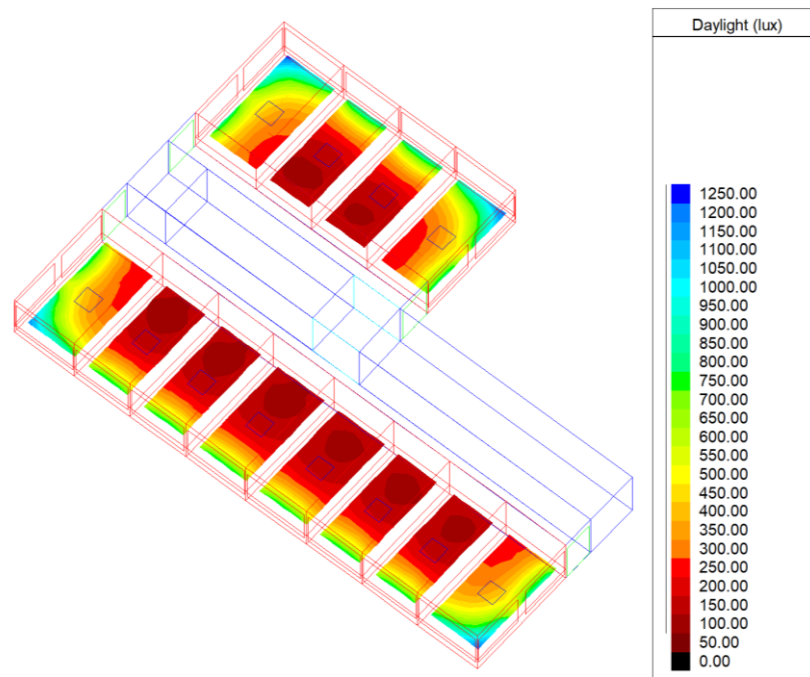


Figure 5: Lux Distribution within each Guest Suite (500mm Upstand to Façade)

As shown in Table 7, Daylight Factor has improved across the guest rooms; varying between 2.74% to 5.68%. The average Daylight Factor has increased to 3.8%. All suites meet the minimum ideal 2% Daylight Factor.

Table 7: Proportion of Daylight Factor of at least 2% within each room

Room	Floor area (m <sup>2</sup> )	Floor area $\geq$ 2% DF (m <sup>2</sup> )	Percentage floor area $\geq$ 2% DF (%)	Average DF (%)
1	21.420	21.420	100.0	5.39
2	19.530	9.014	46.2	2.76
3	19.530	8.513	43.6	2.74
4	21.420	9.886	46.2	2.75
5	21.420	9.651	45.1	2.76
6	19.530	8.763	44.9	2.78
7	19.530	8.763	44.9	2.80
8	21.420	21.420	100.0	5.59
9	21.420	21.420	100.0	5.68
10	19.530	9.264	47.4	3.03
11	19.530	9.515	48.7	3.06
12	21.420	21.420	100.0	5.56

## 7 Conclusion

A daylight analysis was undertaken for the proposed 757 – 763 George Street development. As per the current design a single glazing type with a system U-value of 2.6 W/m<sup>2</sup>.K and a system SHGC of 0.16 can be used across the each façade as permitted under Method 2 of the NCC 2019 Façade Calculator.

This would correlate a glass type with the following specifications:

- > Visual Light Transmittance: 7%
- > Outside Reflectance: 13%
- > Inside Reflectance: 4%

The results of the daylight analysis indicated adequate Daylight Factor in dual-aspect suites. The average Daylight Factor was below 2% to some single-aspect suites; requiring increased daylight ingress.

The addition of a 500mm upstand to the spandrel allows for a glazed product with a higher VLT of 20% to be used as part of the construction, and provide significant internal daylighting benefits to the guest suites; particularly to the single-aspect suites.



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