Storey		Facade an	996													
evel	60	N	NE	E	SE	S	SW	w	NW	Internal	P					
	Option A	26.1m <sup>2</sup>	29.6m <sup>2</sup>	53.9m <sup>2</sup>	28.2m <sup>2</sup>	7.58m <sup>2</sup>		28.3m <sup>2</sup>	30.6m <sup>2</sup>							
	Option B	1														
	Glazing area (A)	22.2m²	25.1m²	45.8m²	23.9m²	6.44m²	********	24m²	26m²							
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_	GLAZING ELEMENTS, ORIEN	ITATION SE	ECTOR, SIZ	E and PER	FORMANC	E CHARAC	TERISTICS	1	SHA	DING	Ċ.	ALCUL	ATED OUT	ICOMES (	DK (if inp	uts are valid)
<u> </u>	Glazing element	Facing	sector		Size		Perfor	mance	P&H or	device	Sha	ding	Multi	pliers	Size	Outcomes
TID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m <sup>2</sup> )	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S <sub>H</sub> )	Cooling (Sc)	Area used (m <sup>2</sup> )	Element share of % of allowance use
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2											ROW		and the second second	if intenti		
3	PSuite_W	W		2.95		24.04	2.2	0.17	1			0.00	1.00	1.00		100% of 92%
4					-	05.40					ROW			if intenti		
	PSuite_W	NE		2.95		25.13	1.4	0.15	-		DOM	0.00	1.00	1.00 if intenti		100% of 100%
6	Suite A E	E		2.95	-	45.80	2.2	0.17			ROW	0.00	1.00	1.00		100% of 95%
8	Suite A_L	-		2.55		45.00	LIL	0.11			ROW			if intenti		100 /0 01 33 /0
	Suite A SE	SE	E.	2.95		23.90	2.8	0.18				0.00	1.00	1.00		100% of 98%
10										1	ROW	SKIPP	ED (OK	if intenti	onal)	
	PSuite_N	N		2.95		22.16	2.8	0.18		-		0.00	1.00	1.00		100% of 96%
11		NW									ROW			if intenti		
12	PSuite_NW			2.95		26.03	2.8	0.18				0.00	1.00	1.00	26.03	100% of 95%

Figure 21: NCC Glazing Calculator - The Star North Tower – Level 60 Glazing

## WSP 2305180U

N       NE       E       SE       S       SW       W       NW       Internal         Option A       31.4m²       32.3m²       58.9m²       31.6m²       8.3m²       37.1m²       27.3m²         Option B       Glazing area (A)       26.7m²       27.5m²       50.1m²       26.9m²       7.05m²	ne star - n	lorth Tower - Sky V	llas			-		-		-		1	other	_	-		5
Option A Option B Glazing size (A)         31.4m <sup>3</sup> 32.3m <sup>3</sup> 31.4m <sup>2</sup> 8.3m <sup>3</sup> 37.1m <sup>3</sup> 27.3m <sup>3</sup> unber of rows preferred in table below         14         (cs currently displayed)           GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS         SHADING         CALCULATED OUTCOMES OK (if inputs are valid)           Glazing element         Facing sector         Size         Performance         P8H or device         Shading         Multipliers         Size         Outcomes           Use proteinal         Facades         facades         facades         (m)         (m)         Total (m)         System         System         PH         PH         G         Heating Cooling (S_s)         Size         Outcomes           1         PSuite_SW         S         3.20         7.05         2.9         0.25         ROW SKIPPED (OK if intentional)         100% of 92%           2         Continue         Size         0.00         1.00         1.00         3.154         100% of 92%           3         PSuite_SW         S         3.20         27.49         1.4         0.15         0.00         1.00         1.00         7.05           2         Continue         Size         Size         0.25<	torey	-	1	100								0					
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<b>14</b> (as currently displayed)         GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS       SHADING       CALCULATED OUTCOMES OK (if inputs are valid)         Glazing element       Facing sector       Size       Performance       P&H or device       Shading       Multipliers       Size       Outcomes         Description (optional)       Option A       Option B       Height (m)       Width       Area (m <sup>o</sup> )       Total U-Value       Total System       System System       P       H       P/H       G       Heating Cooling used       Area of % of allowance use         1       PSuite_SW       S       3.20       7.05       2.9       0.25       0.00       1.00       1.00       7.05       100% of 92%         2       -       -       ROW SKIPPED (OK if intentional)       100% of 92%         3       PSuite_W       3.20       27.49       1.4       0.15       0.00       1.00       1.00       27.49       100% of 92%         6       -       -       -       ROW SKIPPED (OK if intentional)       7.09       2.0       0.00       1.00       1.00       27.49       100% of 100%         3       PSuite_W       NE       3.20       27.49       1.4			26 7m <sup>2</sup>	27.5m <sup>2</sup>	50 1m <sup>2</sup>	26.9m <sup>2</sup>	7.05m <sup>2</sup>		31.5m <sup>2</sup>	23.2m <sup>2</sup>	-						
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3       PSuite_W       W       3.20       31.54       2.2       0.17       0.00       1.00       31.54       100% of 92%         4		te_SW	S		3.20		7.05	2.9	0.25	-		POM		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		1,00000, T 2, 7 8, 8, 9, 9	100% of 92%
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6       7       Suite A_E       E       3.20       50.10       2.8       0.18       0.00       1.00       1.00       50.10       100% of 100%         8       ROW SKIPPED (OK if intentional)         9       Suite A_SE       SE       3.20       26.89       2.8       0.18       0.00       1.00       1.00       26.89       100% of 98%         10       ROW SKIPPED (OK if intentional)         11       PSuite N       N       3.20       26.66       2.8       0.18       0.00       1.00       1.00       26.66       100% of 96%         12       ROW SKIPPED (OK if intentional)					0120		01101			-	1	ROW					100 10 01 02 10
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	14	-								1	-				1 1100		

Figure 22: NCC Glazing Calculator - The Star North Tower – Level 61 Glazing

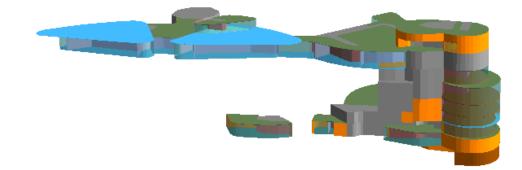
## WSP 2305180U

APPENDIX C NABERS FOR HOTEL ENERGY AND WATER 2305180U

# THE STAR, SYDNEY RITZ CARLTON HOTEL

NABERS FOR HOTELS ENERGY AND WATER PREDICTIVE MODELLING AND ASSESSMENT







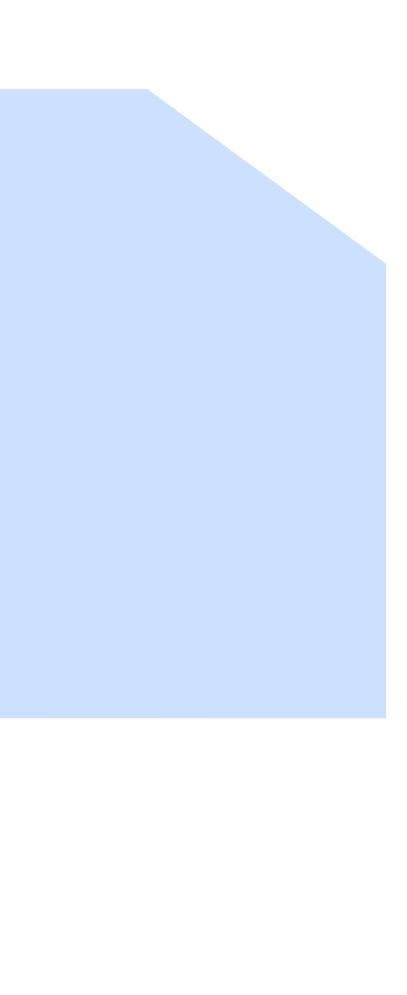


## THE STAR, SYDNEY RITZ CARLTON HOTEL

Prepared for The Star Entertainment Group Ltd

Project: 2305180U Date: 09/06/2017

WSP Buildings Pty Ltd Level 27, 680 George St Sydney NSW 2000 Australia





## QUALITY MANAGEMENT

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## **EXECUTIVE SUMMARY**

This report outlines the results of a preliminary National Australian Built Environment Rating System (NABERS) assessment of the predicted annual energy and water consumption of the Ritz Carlton Hotel development at The Star, Sydney at 80 Pyrmont Street, Pyrmont, NSW.

The energy simulation modelling has been undertaken in accordance with the NABERS 'Energy Guide to Building Energy Estimation Version, June 2011' and where appropriate the Green Star Design & As Built 'Energy Consumption and Greenhouse Gas Emissions Calculation Guide, May 2016'. The simulation was carried out utilising the software package TAS version 9.4. by Environmental Design Solutions Limited.

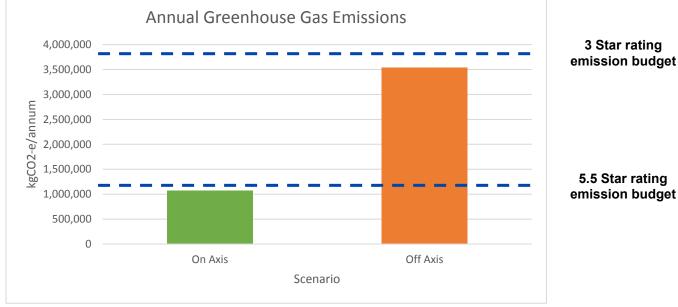
Two energy models have been developed for the project and represent the following scenarios:

- $\rightarrow$ "On Axis" this model represents the building with the construction, commissioning and system efficiencies all working as per the design
- "Off Axis" this model represents the building with inefficiencies and faults incorporated into the model  $\rightarrow$

The initial results of the energy simulation indicate that the Ritz Carlton Hotel is capable of achieving a 5.5 Star NABERS Energy for Hotels rating under "On Axis" conditions and a 3 Star rating under the "Off Axis" condition.

## Table 1: NABERS for Hotels energy modeling results

Scenario	Energy Consumption (MJ/annum)	Greenhouse Gas Emissions (kgCO2- e/annum)	NABERS Star Rating	% Improvement on Current Star Rating
On Axis	75,866	1,070,368	5.5	16%
Off Axis	82,987	3,539,117	3.0	7%



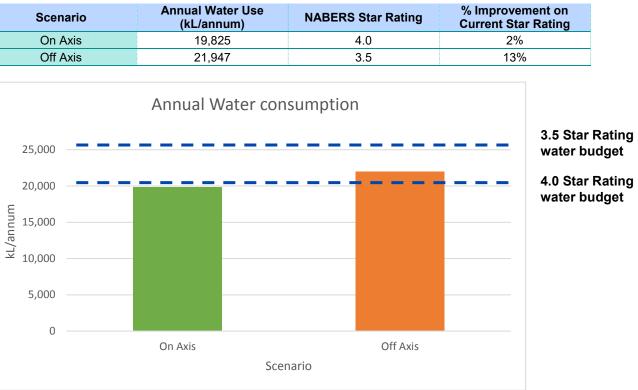
## Figure 1: "On Axis" and "Off Axis" greenhouse gas emission results

As evident in Figure 1 the "On Axis" scenario achieves a 16% improvement over the NABERS Energy for Hotels Rating of 5.5 Star emission budget. Similarly, the Off Axis scenario achieves a 7% improvement over the NABERS Energy for Hotels Rating of 3.0 Star emission budget.

The preliminary results of the water simulation indicate that the Ritz Carlton Hotel can achieve a 4 Star NABERS Water for Hotels rating under the "On Axis" condition and a 3.5 Star rating under the "Off Axis" condition, where the hotel's annual water consumption is increased by 10% for a conservative assessment.

### **Table 2: NABERS for Hotels water modeling results**

Annual Water Use (kL/annum)	NABERS Star	
19,825	4.0	
21,947	3.5	
	<b>(kL/annum)</b> 19,825	



## Figure 2: On axis and off axis water modelling results

3 Star rating emission budget As evident in Figure 2 the "On Axis" scenario achieves a 2% improvement over the NABERS Water for Hotels Rating of 4.0 Stars. Similarly, the "Off Axis" scenario achieves a 13% improvement over the NABERS Water for Hotels Rating of 3.5 Stars.

The above results are based on the current information available to the project team, and the predicted operation of the Ritz Carlton Hotel. It is a requirement that appropriate metering services will exist to separate the hotel's energy (electrical and thermal) and water consumption from the rest of the development in accordance with the NABERS rules. Without appropriate metering, the project will risk being ineligible to achieve a rating.

## **DISCLAIMER**

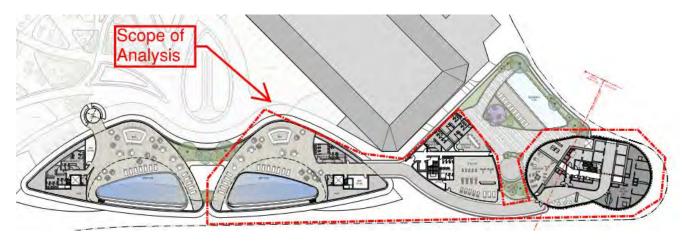
Computer building simulation provides an estimate of building performance. This estimate is based on a necessarily simplified and idealised version of the building that does not and cannot fully represent all of the intricacies of the building once built. As a result, simulation results only represent an interpretation of the potential performance of the building. No guarantee or warrantee of building performance in practice can be based on simulation results alone.



# INTRODUCTION AND METHODOLOGY

#### BACKGROUND 1.1

WSP has been engaged by The Star Entertainment Group Ltd (SEGL) to provide NABERS advisory services with respect to the Ritz Carlton Hotel development within The Star, Sydney site at 80 Pyrmont Road, Pyrmont, NSW. This exercise has been undertaken to determine the potential ratings achievable through the NABERS Energy and Water Rating. The calculations have considered hotel rooms, lobbies, car parking facilities and function rooms within the Ritz Carlton Hotel development as highlighted in Figure 3 below.



## Figure 3: Ritz Carlton Hotel elevation – Scope of NABERS assessment

This report outlines the methodology, inputs, assumptions and results of the NABERS Energy and Water for Hotels modelling exercise undertaken. This exercise has involved necessary simplifications of highly automated systems. Whilst all assumptions and inputs have been incorporated to produce an accurate result, it should be noted that due to the dynamic nature of energy consumption, the actual energy and water consumption of the site is likely to differ from the predicted result.

#### MODELLING SOFTWARE PACKAGE 1.2

The computer simulation package used for the thermal simulation was Tas version 9.4. by Environmental Design Solutions Limited. It is an EN ISO 13791 validated dynamic simulation modelling (DSM) software tool and is approved under the ABCB Protocol for Building Energy Analysis Software, Version 2006.1.

The tri-generation system has been modelled using a utility modelling software package energyPRO. Energy PRO is a sophisticated urban utility, techno-economic modelling software package from EMD International.

#### 1.3 **CLIMATE DATA**

Climate data for the dynamic thermal simulation includes:

- Global radiation  $\rightarrow$
- $\rightarrow$ Diffuse radiation
- Cloud cover  $\rightarrow$
- Dry bulb temperature  $\rightarrow$
- $\rightarrow$ Relative humidity

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- → Wind speed
- Wind direction

The building is located on the current The Star, Sydney site at 80 Pyrmont Road, Pyrmont, NSW approximately 1.5km away from the Sydney CBD, hence the Sydney 1987 TRY weather file is used for the simulation. A 'TRY weather file' is a weather file for a year without unusual extremes in temperature, which is suitable for energy simulation modelling.

The weather file used in the simulation is listed in Table 3.

## Table 3: Climate data used in the building simulations

WEATHER FILE	AUS_SYDNEY_TRY
Location	Sydney, NSW (Lat -33.87, Long 151.02)
Year	1987
Altitude	0.0m
Ground Temperature	22°C

#### **REFERENCE DRAWINGS AND SCHEDULES** 1.4

The NABERS energy and water modeling has been based on the best available information and drawings at the time of the analysis. The following sources of information have been used to form the basis of the energy and water modelling:

- Architectural plan, elevation and section drawings prepared by FJMT
- $\rightarrow$ The Star – Ritz Carlton Hotel and Residential Tower Green Star Design & As Built Greenhouse Gas **Emissions Report**

The modelling is based on the design in the early development phase, as such, necessary simplifications and assumptions have been made in the energy modelling process. Where building components, operational and energy consumption attributes have yet to be specified, values and schedules have been based on the most appropriate source available, primarily the following sources:

- NABERS 'Energy Guide to Building Energy Estimation Version, June 2011'  $\rightarrow$
- National Construction Code Series 2016, Volume 1, Building Code of Australia.
- $\rightarrow$ Green Star Design & As Built 'Energy Consumption and Greenhouse Gas Emissions Calculation Guide, May 2016'



## 1.5 ON AXIS AND OFF AXIS SCENARIO MODELING

Two energy models have been developed for the project and represent the following scenarios:

- → "On Axis" this model represents the building with the construction, commissioning and system efficiencies all working as per the design
- → "Off Axis" this model represents the building with inefficiencies and faults incorporated into the model

Their purpose of the "Off Axis" model is to demonstrate the building energy and water performance if it were not properly maintained, commissioned, tuned or operated to ensure efficient operations. An "Off Axis" scenario has been included into the analysis for the energy and water models and are detailed in Table 4 below.

## Table 4: "Off Axis" model inputs

MODEL	OFF AXIS SCENARIO DETAILS
Energy	Exclusion of the proposed low carbon tri-generation system. All electrical demands for the hotel are provided by grid electricity and thermal loads met by the existing central energy plant located in the existing Star Sydney site.
Water	A 10% increase in annual onsite water consumption.



# NABERS CALCULATOR INPUTS

#### 2.1 NUMBER OF GUEST ROOMS

number of guest rooms. This figure is used, along with other factors, to adjust the allowable energy and water budget for each development. This ensures a fair comparison can be made between hotels of different size and service level.

Based on the current drawing set, the hotel will have 220 guest rooms.

## 2.2

The overall range and quality of the hotel's services is measured through the hotel star rating. This is based on Australia's official accommodation accreditation program, the Star Rating Scheme, managed by Star Ratings Australia.

The rating provides an index of the overall level of service, with hotels generally rating between 2 stars (budget brands) and 5 stars (luxury brands). A wide range of energy consuming services, features and facilities within hotels correlate with this rating and is very important in determining the energy and water consumption of the hotel.

The Ritz Carlton hotel will target a 6 star rating. As NABERS only distinguished hotels with ratings between 2 and 5 stars, for the purpose of this modeling it has been assumed that the hotel will achieve 5 stars, the maximum available rating.

#### LAUNDRY SERVICED ROOMS 2.3

The potential impact of on-site laundry services is measured through the number of guest rooms that the onsite laundry services within the hotel. This figure is adjusted by the scale of service provided, being either full service (towel and bed linen) or half service (towels or bed linen).

For the purpose of this assessment it has been assumed that all laundry will be services through external laundry facilities.

#### 2.4 FUNCTION ROOM SEATS

The potential impact of on-site function room facilities is measured through the function room seats. This figure is compiled from the maximum occupancy of the hotel's function room facilities.

There is currently no plan to include a hotel function room in the project.

#### AREA OF HEATED POOL 2.5

The potential impact of heated swimming pools and spas is accounted for through the area of the heated pool. This figure is calculated for all swimming pools (indoor and outdoor) that are heated for at least 6 months a vear.

There is currently no onsite pool dedicated specifically for the exclusive use of hotel patrons. As such no heated pool allowances have been included.

Within the NABERS Energy and Water for hotel rating tool, the size of the hotel is measured through the

## HOTEL STAR RATING

WATER COVERAGE 2.7

Day spas with guest use

ENERGY COVERAGE

Vertical transportation servicing the hotel

The following end uses have been included within the scope of water coverage for this assessment:

Water for taps and sinks, both back and front of house  $\rightarrow$ 

Common area, guest room and back of house HVAC

Small light and power for both front and back of house

- Water used in air conditioning and other base building services  $\rightarrow$
- All water used for services supplied to guests  $\rightarrow$
- Water use in fire services  $\rightarrow$
- $\rightarrow$ Water used in restaurants that have charge-to-room facilities for guests
- Water used for toilets  $\rightarrow$

Gyms quest use

2.6

 $\rightarrow$ 

 $\rightarrow$ 

 $\rightarrow$ 

 $\rightarrow$ 

 $\rightarrow$ 

 $\rightarrow$  $\rightarrow$ 

The following end uses have been included within the scope of energy coverage for this assessment:

Common area, guest room, exterior and back of house lighting

Car park lighting and ventilation, where provided for the exclusive use of hotel guests or hotel staff On-site hotel kitchens and restaurants servicing guests with charge-to-room facilities

Lighting, power and HVAC services to any function rooms on site



#### PREDICTED ANNUAL ENERGY DEMAND 3.1

The total hotel annual energy demand for the Ritz Carlton Hotel development is as itemised in Table 5 and Figure 4.

### Table 5: Predicted annual electricity consumption

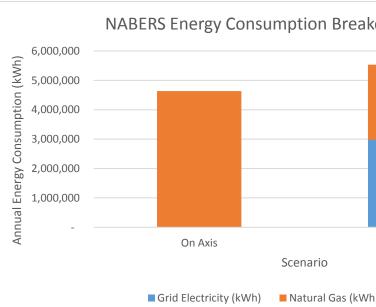
ENERGY END-USE	ELECTRICITY DEMAND (KWH-E)	COOLING DEMAND (MJ)	HEATING DEMAND (MJ)
Internal Lighting	222,439	-	-
Exterior Lighting	6,951	-	-
Appliances	170,693	-	-
Vertical Transport	107,900	-	-
Domestic Hot Water	-	-	1,773,499
Space Heating	-	-	1,241,743
Space Cooling	-	3,729,825	-
Heat Rejection	73,361	-	-
HVAC Fans	716,081	-	-
HVAC Pumps	71,062	-	-
Diesel Generator	_	-	-
Total	1,368,488	3,729,825	3,015,242



The total "On Axis" and "Off Axis" annual energy consumption for the Ritz Carlton Hotel is itemised by energy source in Table 6 and Figure 5 below.

Table 6: Predicted On Axis and Off Axis annual electricity consumption by energy type

ENERGY SOURCE	ON AXIS	OFF AXIS
Grid Electricity (kWh/annum)	-	2,979,500
Natural Gas (MJ/annum)	16,690,600	9,190,900





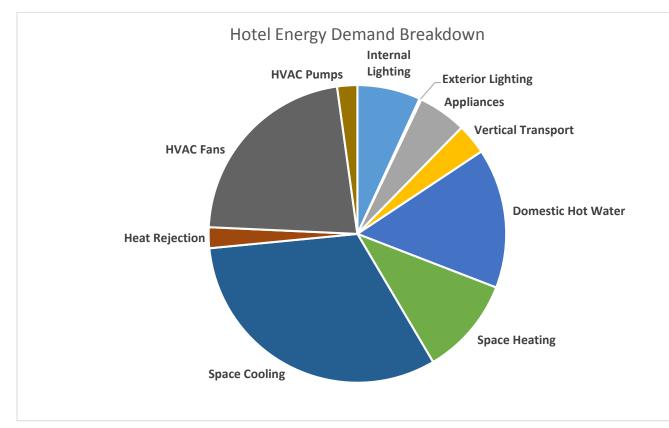


Figure 4: NABERS Hotel Energy demand breakdown

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down	
Off Axis	
ı)	



#### 3.3 NABERS FOR HOTELS ENERGY RATING

The energy modelling results of the Ritz Carlton Hotel indicate that the hotel can potentially achieve a 5.5 Star NABERS Energy for Hotels rating under the "On Axis" scenario, and a 3.0 Star rating under the "Off Axis" scenario. The results are summarised below in Table 7 and Figure 6.

## Table 7: NABERS Energy for Hotels energy modelling results

Scenario	Energy Intensity (MJ/m² annum)	Greenhouse Gas Emissions (kgCO2- e/annum)	NABERS Star Rating	% Improvement on Current Star Rating
On Axis	75,866	1,070,368	5.5	16%
Off Axis	82,987	3,539,117	3.0	7%

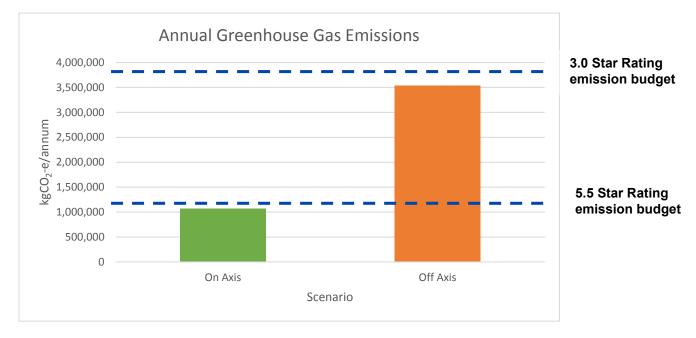


Figure 6: "On Axis" and "Off Axis" greenhouse gas emission results

As evident in Figure 6 the "On Axis" scenario achieves a 16% improvement over the NABERS Energy for Hotels Rating of 5.5 Star emission budget. Similarly, the Off Axis scenario achieves a 7% improvement over the NABERS Energy for Hotels Rating of 3.0 Star emission budget.

NABERS calculator extracts are presented in Appendix A.

#### PREDICTED ANNUAL WATER CONSUMPTION 3.4

The total "On Axis" and "Off Axis" annual water consumption for the Ritz Carlton Hotel is outlined in Table 8 below.

### Table 8: Predicted "On Axis" and "Off Axis" annual water consumption

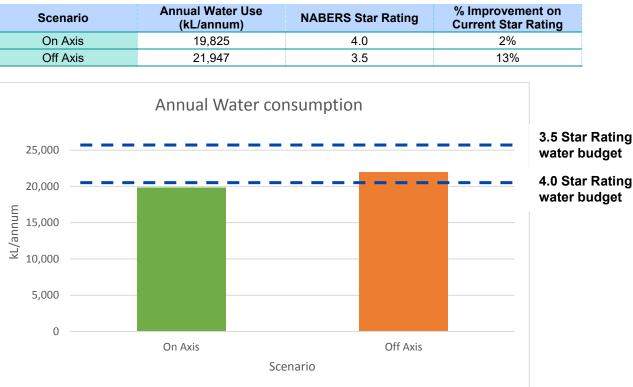
	ON AXIS	OFF AXIS
Water Consumption (kL/annum)	19,825	21,947

#### 3.5 NABERS FOR HOTELS WATER RATING

The preliminary results of the water simulation indicate that the Ritz Carlton Hotel can achieve a 4 Star NABERS Water for Hotels rating under the "On Axis" condition and a 3.5 Star rating under the "Off Axis" condition, where the hotel's annual water consumption is increased by 10% for a conservative assessment. These results are presented below in Table 9 and Figure 7.

### Table 9: NABERS Water for Hotels water modeling results

Scenario	Annual Water Use (kL/annum)	NABERS Sta
On Axis	19,825	4.0
Off Axis	21,947	3.5



### Figure 7: "On Axis" and "Off Axis" water modelling results

As evident in Figure 7 the "On Axis" scenario achieves a 2% improvement over the NABERS Water for Hotels Rating of 4.0 Stars. Similarly, the "Off Axis" scenario achieves a 13% improvement over the NABERS Water for Hotels Rating of 3.5 Stars.

NABERS calculator extracts are presented in Appendix A.

#### METERING REQUIREMENTS 3.6

The above results are based on the current information available around the expected design and operation of the Ritz Carlton Hotel. In order to allow for the hotel to be eligible for a NABERS for Hotels Energy and Water rating, appropriate metering services will must be installed to separate the hotel's energy (electrical and thermal) and water consumption from the rest of the development in accordance with the NABERS rules. The consultants below in Table 10 will be responsible for ensuring the new and existing plant is metered appropriately to apportion all greenhouse gas emissions to the hotel, separate from other areas on the site served by the central plant.



## Table 10: NABERS metering responsibilities

METER TYPE	Repsponsibility
Electrical metering	Electrical consultant
Thermal metering	Mechanical consultant
Water metering	Hydraulic consultant

The meters are to allow the separation and apportioning of energy and water consumption to the hotel only. This will require a mix of electrical, thermal and water meters and will be addressed during detailed design. As a minimum, the meters will provide the energy and water coverage through new and existing meters as follows:

- → Harbour heat rejection pump set, condenser water loop pump set, chilled water loop pump set, domestic hot water pump set, hydraulic and fire system pump set, stormwater and subsoil pump set
- → Fan coil units, outside air fans, relief air fans, exhaust air fans, kitchen exhaust fans, toilet exhaust fans, smoke exhaust fans, stair pressurisation fans, carpark supply and exhaust fans
- → Electric chillers (thermal and electrical)
- $\rightarrow$  Gas boilers and tri-generation system (thermal and gas)
- → Lifts
- → Car stacker system
- → Internal lighting, external lighting, carpark lighting
- → Miscellaneous plug loads



7

## **APPENDIX A NABERS CALCULATOR**

## Nabers rating calculator results



Premise type	Hotel	Guest rooms	220
Building details	The Star, Pirrama Road,	Guest rooms with full	a
State and postcode	PYRMONT 2009	service laundering	
Hotel star rating	S stars.	Function room seats	240
	1.00 M	Surface area of heated	0

Energy Star rating (Calculator version number: 2.0 )

Excellent performance

Your hotel demonstrates excellent greenhouse performance and reflecting excellent design and management practices, high efficiency systems and equipment and/or energy sources with low emissions.

Results for the 12 months rating period	Nabers energy ra	ting	Nabers energy GreenPower	rating without
Star rating	5.5 stars		5,5 stars	
GreenPower included	α	%	0	%
Energy intensity	75866	MJ/m <sup>2</sup>	75866	MJ/m <sup>2</sup>
Total greenhouse gas emissions (Full fuel cycle - scope 1,2 & 3)	1070368	kg CO <sub>2</sub> -e p.a.	1070368	kg CO <sub>2</sub> -e p.a.
Actual greenhouse gas emissions per room	4865	kg CO <sub>2</sub> -e/m <sup>2</sup> p.a.	4865	kg CO <sub>2</sub> -e/m <sup>2</sup> p.a
Predicted average greenhouse gas emissions for a comparable hotel performing at 5 stars	18463	kg CQ <sub>2</sub> -e/m <sup>2</sup> p.a.	18463	kg CO <sub>2</sub> -e/m <sup>7</sup> p.a

## Your energy data source inputs

Fuel type	Quantity	Unit	Emissions (Full fuel cycled -	Scope 1,2 & 3)	GreenPower	
Electricity	~	kWh			0	%
Gas	16690600 0	LIM	1070368	kg CO <sub>2</sub> e p.a	Not applicabl	9
Deisel	~	6	~		Not applicabl	9
Coal		T			Not applicabl	

Figure 8 NABERS Energy for Hotels "On Axis" calculator extract

## Nabers rating calculator results

Premise type	Hotel
Building details	North Tower, Pirrama Road
State and postcode	PYRMONT 2009
Hotel star rating	5 stars

Energy Star rating (Calculator version number: 2.0 )

### Above average performance

Your hotel is performing better than the current market average in terms of greenhouse performance. There are still opportunities for reducing emissions and improving energy efficiency in your hotel.

Results for the 12 months rating period	Nabers energy ra	ting	Nabers energy GreenPower	rating without
Star rating	3 stars		3 stars	
GreenPower included	o	%	0	%
Energy intensity	90532	MJ/m <sup>2</sup>	90532	MJ/m <sup>2</sup>
Total greenhouse gas emissions (Full fuel cycle - scope 1,2 & 3)	3539117	kg CO <sub>2</sub> -e p.a.	3539117	kg CO <sub>2</sub> -e p.a.
Actual greenhouse gas emissions per room	16087	kg CO <sub>2</sub> -e/m <sup>2</sup> p.a.	16087	kg CO <sub>2</sub> -e/m <sup>2</sup> p.a
Predicted average greenhouse gas emissions for a comparable hotel performing at 5 stars	18463	kg CO₂-e/m <sup>2</sup> p.a.	18463	kg CO <sub>2</sub> -e/m <sup>2</sup> p.a

Fuel type	Quantity	Unit	Emissions (Full fuel cycled -	Scope 1,2 & 3)	GreenPower	
Electricity	2979500.0	kWh	2949705	kg CO <sub>2</sub> -e p.a	0	%
Gas	9190900.0	MJ	589412	kg CO <sub>2</sub> e p.a.	Not applicable	
Deisel	4.000 C	L	9		Not applicable	
Coal	-	T.			Not applicable	

Figure 9 NABERS Energy for Hotels "Off Axis" calculator extract



Guest rooms	220	
Guest rooms with full service laundering	D	
Function room seats	240	
Surface area of heated pools	٥	a?



8

## Nabors rating calculator results



d

Premise type	Hotel	Guest rooms	220	
Building details	The Star, Pirrama Road,	Guest rooms with full	0	
State and postcode	PYRMONT 2009	service laundaring	-	
Hotel star rating	5 stars	Function room seats	240	
Nove her heart		Surface area of heated pools	a	

Water star rating (Calculator version number: 2.0 )

Strong performance

Your hotel has good water performance, reflecting good equipment and management practices.

Results for the 12 months rating period	Nabers water ratio externally supplied		Nabers water ratio supplied recycled	
Star rating	4 stars		3.5 stars	
% of externally supplied water that is recycled water	Б.4.	9/m	0	5%
Total water use, excluding externally supplied recycled water	19825.0	kL p.a.	21180.0	k∟p.a.
Water use per room, excluding externally supplied recycled water	90,11	kL/room p.a.	96.28	kL/room p.a
Predicted average water consumption for a hotel with the same facilities performing at 5 stars	146.69	kL/room p.a.	146.69	kL/room p.a

### Your water data source inputs

Externally supplied water (excluding recycled water)	19825.0	KL.
Recycled water	1355.6	ĸL
Recycled water	4,300 1,200	KL.

Figure 10 NABERS Water for Hotels "On Axis" calculator extract

## Nabers rating calculator results

Premise type	Hote)	Guer
Building details	North Tower, Pirrama Road.	Gues
State and postcode	PYRMONT 2009	servi
Hotel star rating	5 stars	Func
		Surfa
		pool

Water star rating (Calculator version number: 2.0 )

### Above average performance

Your hotel has above average water performance. Your building probably has some water efficient equipment and management practices and reflects an awareness of the importance of conserving water. Some improvements may still be possible.

Results for the 12 months rating period	Nabers water ratir externally supplie	· · · · · · · · · · · · · · · · · · ·
Star rating	3.5 stars	
% of externally supplied water that is recycled water	5,8	%
Total water use, excluding externally supplied recycled water	21947.0	KL p.a
Water use per room, excluding externally supplied recycled water	99,76	kL/room p.
Predicted average water consumption for a hotel with the same facilities performing at 5 stars	n 146.69 kL/m	
Your water data source inputs		
Externally supplied water (excluding recycled water)	21947.2	
Recycled water	1351.3	

Figure 11 NABERS Water for Hotels "Off Axis" calculator extract





st rooms st rooms with full

ice laundering

ion room seats

	Nabers water rating supplied recycled	- 1
	3.5 stars	
	ö	%
	23299.0	кL р.а.
a.	105.90	kL/room p.a.
a	146.69	kL/room p.a.

κĽ	
ĸL	



The Star, Sydney - Ritz Carlton Hotel NABERS Energy and Water for Hotels Assessment 24/03/2017 2305180U





APPENDIX D GREEN STAR PATHWAY AND DOCUMENTATION

THE STAR ENTERTAINMENT GROUP PTY LTD

## Greenhouse Gas Emission Report ENE-1

THE STAR, SYDNEY - RITZ CARLTON HOTEL AND RESIDENTIAL TOWER

FEBRUARY 2017



## Greenhouse Gas Emission Report ENE-1

THE STAR, SYDNEY - RITZ CARLTON HOTEL AND RESIDENTIAL TOWER

The Star Entertainment Group Pty Ltd

REV	DATE	DETAILS
00	28/02/2017	For Planning Submission
01	24/03/2017	Updated For Planning Submission
02	30/06/2017	Updated For Planning Submission

## AUTHOR, REVIEWER AND APPROVER DETAILS

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## EXECUTIVE SUMMARY

This report details the preliminary energy and greenhouse gas emissions modelling process and results for the Ritz Carlton Hotel and Residential Tower development at the existing site of The Star, Sydney in Pyrmont, NSW. All procedures in this report have been based on the requirements in the GBCA's Energy Consumption and Greenhouse Gas Emissions Calculation Guide, May 2016.

The proposed development is a 61 story tower consisting of hotel rooms, serviced apartments as well as a community centre, restaurant and club lounge. The proposed design is the result of a design competition won by Francis-Jones Morehen Thorp (FJMT). The development is being documented for planning approval submission in July 2017.

The building fabric and glazing performance requirements comply with NCC Section J which has been demonstrated using a Performance Solution, Verification Method JV3.

The following building models are defined within the Green Star Guidelines.

- → Proposed building. The proposed design of the development with parameters linked to the performance of the designed / installed building.
- → Reference building. The performance criteria are generally in line with the Deemed-to-Satisfy criteria in the Building Code of Australia (BCA), unless variations specified in the Green Star Guidelines.
- > Intermediate building. Proposed building fabric but all services modelled as per the reference building.

A **Benchmark Building** is subsequently established as a building representing a 10% reduction in greenhouse gas emissions compared to the reference building.

To be eligible for a Green Star rating, the predicted greenhouse gas emissions of the proposed building model must be lower than that of the Benchmark Building. Furthermore, Credit 15E *'Greenhouse Gas Emissions- Reference Building Pathway'* awards up to 20 points on a sliding scale as follows:

- → 4 points available for reductions in predicted operational energy of the intermediate building vs. the reference building (1 point per 5%)
- → 16 points available for reductions in predicted greenhouse gas emissions of the proposed building vs. the benchmark building (1.6 point per 10%)

Table 1.1 summarises the results of the predictive energy modelling for the proposed building design and the reference building.

The proposed building achieves an improved greenhouse gas emissions performance compared to the Benchmark Building. Therefore, it meets the conditional energy requirement to be eligible for a Green Star rating.

The results of the modelling show that the development achieves a 76% reduction in greenhouse gas emissions compared with the Benchmark Building. The project is therefore eligible to claim 12.14 points out of 16 for the Credit 15 *Greenhouse Gas Emissions*. An improvement in building fabric (Intermediate building energy consumption compared against the Reference Building energy) is also targeted for this project. The project achieves a 4% reduction in energy consumption under this pathway. The project is therefore eligible to claim 0.69 points out of 4 under this pathway of the credit. Combined, the project therefore claims 12.8 out of 20 points for Credit 15 *Greenhouse Gas Emissions*.

Table 1.1	Summary of energy results for the Ritz Carlton Hotel and Residential Tower

	Units
31077802	MJ/annum
29729601	MJ/annum
4%	Percentage
0.69	Points
6778535	kgCO2e/annum
3931379	kgCO2e/annum
1634542	kgCO2e/annum
PASS	
76%	Percentage
12.14	Points
0	
0	
12.8	
	29729601 4% 0.69 6778535 3931379 1634542 PASS 76% 12.14 0 0

# INTRODUCTION

This report details the preliminary energy and greenhouse gas emissions modelling process and results for the Ritz Carlton Hotel and Residential Tower development at the existing site of The Star, Sydney in Pyrmont, NSW. The content and structure of this report are as per the requirements of the Green Star Design & As-Built 'Energy Consumption and Greenhouse Gas Emissions Calculation Guide. May 2016' These guidelines set out the energy modelling methodology to benchmark the greenhouse gas emissions performance of a proposed design for Green Star purposes.

The proposed development is a 61 story tower consisting of hotel rooms, serviced apartments as well as a community centre, restaurant and club lounge. The proposed design is the result of a design competition won by Francis-Jones Morehen Thorp (FJMT). The development is being documented for planning approval submission in July 2017.

The building fabric and glazing performance requirements comply with NCC Section J which has been demonstrated using a Performance Solution, Verification Method JV3.

The modelling process involves the development of three distinct models:

- $\rightarrow$ **Proposed building.** The proposed design of the development with parameters linked to the performance of the designed / installed building.
- Reference building. The performance criteria are generally in line with the Deemed-to-Satisfy criteria in  $\rightarrow$ the Building Code of Australia (BCA), unless variations specified in the Green Star Guidelines.
- Intermediate Building. Proposed building fabric but all services modelled as per the reference building.  $\rightarrow$

A Benchmark Building is a building representing a 10% reduction in greenhouse gas emissions compared to the Reference Building.

To be eligible for a Green Star rating, the predicted greenhouse gas emissions of the Proposed Building model must be lower than that of the Benchmark Building.

Furthermore, Credit 15 'Greenhouse Gas Emissions' awards 20 points on a sliding scale as follows:

- 4 points available for reductions in predicted operational energy of the intermediate building vs. the  $\rightarrow$ reference building (1 point per 5%)
- 16 points available for reductions in predicted greenhouse gas emissions of the proposed building vs.  $\rightarrow$ the benchmark building (1.6 point per 10%)

Dynamic thermal modelling of the development has been undertaken in EDSL's Thermal Analysis Software v9.4 (TAS) package to predict the annual energy consumption of all primary HVAC systems, internal lighting and equipment. The energy consumption from systems such as external lighting, exhaust ventilation, domestic hot water, vertical transport and car stacker have been calculated through static calculation.

The proposed building will be serviced by the existing central energy plant as well as a proposed trigeneration system. To determine the annual greenhouse gas intensity of the thermal and electrical energy provided to the proposed building, the energyPRO software package has been used. energyPRO is an urban utility modelling software package from EMD International.

The annual electricity and gas consumption for the reference, intermediate and proposed building models has been entered in the Green Star Greenhouse Gas Emissions Calculator to determine the points achieved for Credit 15 Greenhouse Gas Emissions.

5

## 1.1 Sourc es of info rmation

The following sources of information have been used in this report:

- → Green Star Design & As Built v1.1 Submission Guidelines
- → Green Star Design & As Built 'Energy Consumption and Greenhouse Gas Emissions Calculation Guide, May 2016'
- → National Construction Code Series 2016, Volume 1, Building Code of Australia.
- → Architectural plan, elevation and section drawings prepared by FJMT 23/11/2016
- → NCC Section J Glazing Calculators Appendix A

## 1.2 Limi tations

This report is intended to provide only an indication of this development's performance with respect to greenhouse gas emissions against the Green Star energy modelling criteria for greenhouse gas emission benchmarking. To this end, assumptions have been made about the development's energy consumption that may not reflect the true consumption of the building. Many factors relating to the tenancy of the building, such as process equipment loads, occupancy rates and schedules of operations, will affect the building's actual energy consumption. As a result, any information pertaining to the specific energy consumption and greenhouse gas emissions of this development is not likely to truly represent the building's performance.

Instead, this report can provide a guide to how well the development is likely to perform against a standard practice similar development with similar form and function, for benchmarking purposes in Green Star only.

# 2 ANALYSIS SOFTWARE

The Green Star Design & As Built *'Energy Consumption and Greenhouse Gas Emissions Calculation Guide, May 2016'* detail the methodology used for the predictive energy modelling. The requirements include the usage of appropriate software to simulate the dynamic performance of the building for certain energy categories (i.e. HVAC services). The software used for this report to perform the thermal modelling is EDSL TAS Building Designer v 9.4. TAS meets the criteria of the ABCB Protocol of Building Energy Analysis Software (v2006-1) and is therefore listed as compliant software in the GBCA's Energy Consumption and Greenhouse Gas Emissions Calculation Guide May 2016). The following four applications of the EDSL TAS Suite have been used in the modelling of HVAC loads and energy consumption of the development:

- TAS 3D Modeller
- TAS Building Designer
- → TAS Results Viewer
- TAS Systems

The model requires the following input information:

- → Geometry of building form and all associated exposure of surfaces,
- → All material constructions,
- → All internal diversified load profiles for people, lights and equipment,
- → Shadowing and overshadowing of the building.

To accurately model the dynamic nature of buildings thermal response, hourly-recorded weather data is used in the thermal simulation. Such weather data contains records of radiation, temperature, humidity, sunshine duration and additionally wind speed and direction.

A Test Reference Year for Sydney has been used for this study. A Test Reference Year is hourly weather data for a year for use in simulation of the performance of active and passive solar energy systems, building energy consumption and indoor climate calculations.

The software models the solar gain through glazing accurately, calculating this value dynamically using material parameters, including solar transmittance, external solar reflectance, internal solar reflectance, external emissivity and internal emissivity, for each pane of glass in the glazing system and the internal and external conditions at each calculation time step. The software represents the U-values and shading coefficient of the glazing and the frame, calculating a total U-value and shading coefficient for the total window.

Air conditioning systems are modelled using TAS Systems, part of the EDSL TAS v 9.4 suite (Outlined in Table 2.1). TAS Systems is a component based simulation program, which allows systems to be developed from their component parts and control arcs from which parameters are set. The simulation procedure traces the thermal state of the system and that of the building as it is installed, enabling a detailed analysis for each hour throughout the year. The outputs from TAS System, allows plant sizing, prediction of energy consumption, energy targeting and assessment of energy conservation options.

## Table 2.1 Energy Simulation analysis software reporting requirements

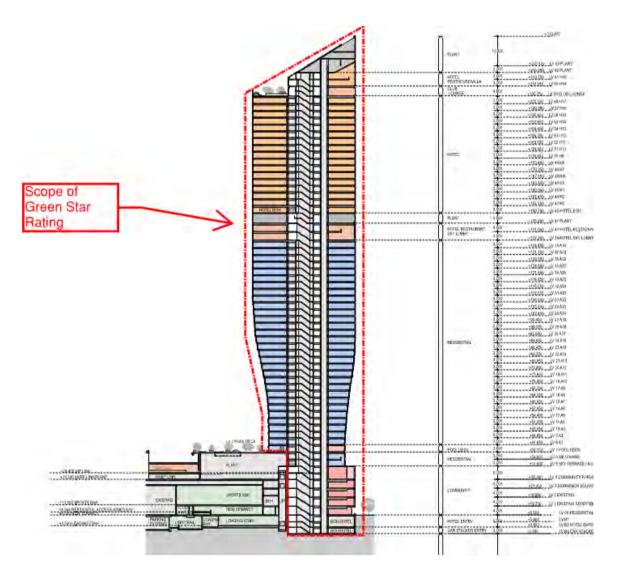
Software name and version	EDSL TAS v 9.4
Software Developer	EDSL
Software validation standard (evidence of developer's compliance to be provided)	TAS Building Designer v 9.4 TAS meets the criteria of the ABCB Protocol of Building Energy Analysis Software (v2006-1)
Simulator's name (include description of training and experience with software)	Martin Timperley

# **3** ENERGY MODELLING CRITERIA

This section outlines the parameters used in the energy modelling process for both the reference and the proposed building models.

## 3.1 Building Description

The Ritz Carlton Hotel and Residential Hotel development is a mixed use tower consisting of hotel rooms and serviced apartments as well as a community centre, restaurant and club lounge, as outlined in red in illustrated in Figure 3.1 below.



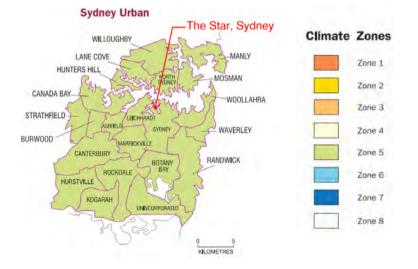


The building is located within the current Star Sydney site on 80 Pyrmont Road, Pyrmont NSW.

Table 3.1 below provides some of the essential building parameters used in the energy modelling.

Parameter	Proposed	Reference	
Climate zone	Sydney Urban, Climate Zone 5	Sydney Urban, Climate Zone 5	
Weather data (location and data format)	Sydney, Test Reference Year (TRY)	Sydney, Test Reference Year (TRY)	
Number of building storeys (below ground/above ground)	61	61	
Heating fuel(s)	Natural Gas	Natural Gas	
Cooling fuel(s)	Electricity	Electricity + Natural Gas	

 Table 3.1
 General parameters reporting requirements



## Figure 3.2 Site location and climate zone

## 3.2 Building form

The geometry of building has been accurately modelled using the in-built geometry creator in TAS and is shown in Figure 3.3 and Figure 3.4. The geometry of the model, including orientation, glazing extent and shading is as documented in the architectural drawings.

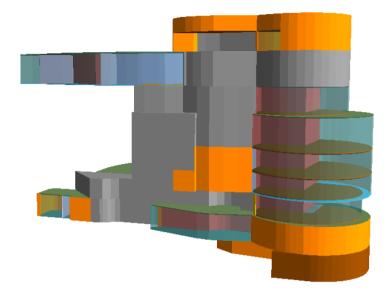
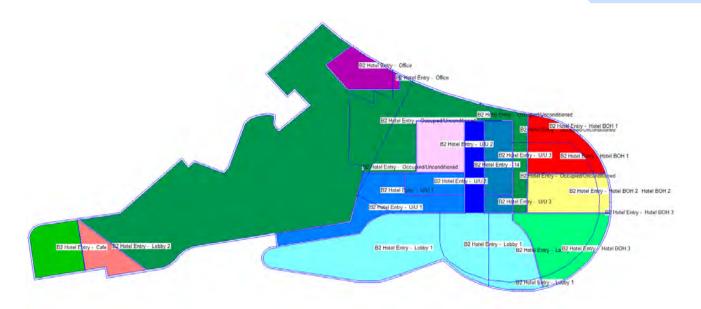


Figure 3.3: 3D Model – North-east Facade of the Ritz Carlton Hotel and Residential Tower podium



Figure 3.4 3D Model – North-east facade of the Ritz Carlton Hotel and Residential Tower

The HVAC zoning of the building has been modelled (as shown in Figures 5 to 11) to be consistent with the HVAC design. Note that different coloured areas represent distinct HVAC zones. Perimeter and internal zoning has been implemented where appropriate.





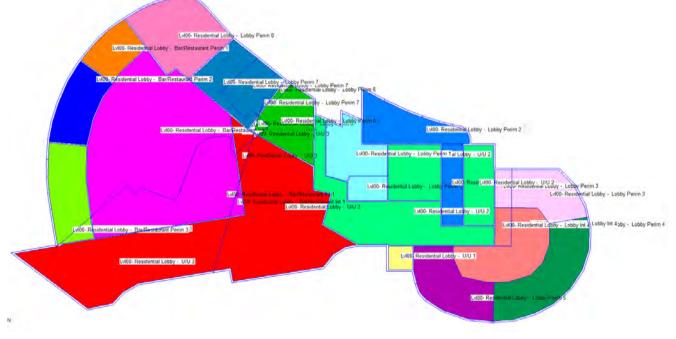


Figure 3.6 Ground Floor Residential Lobby HVAC Zoning

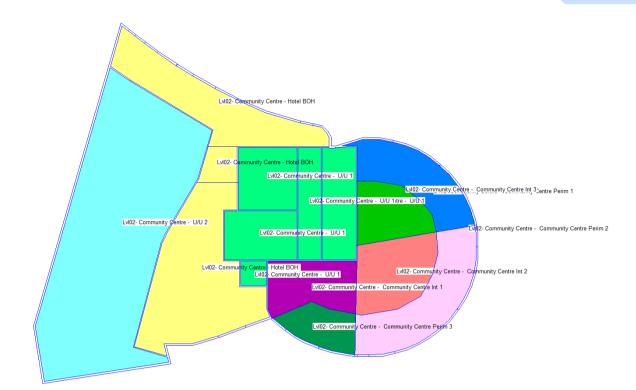


Figure 3.7 Level L2 – Community Centre - HVAC Zoning

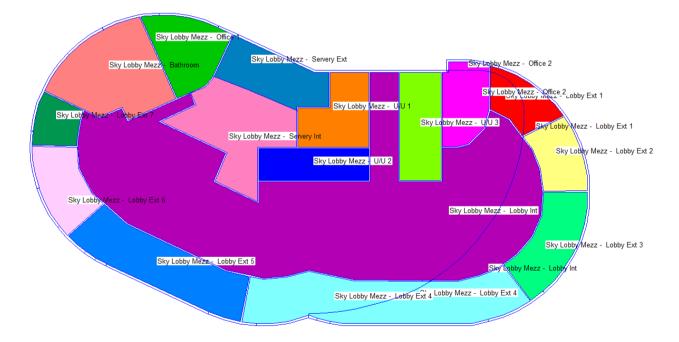


Figure 3.8 Level 40 - Sky Lobby Mezzanine – HVAC Zoning

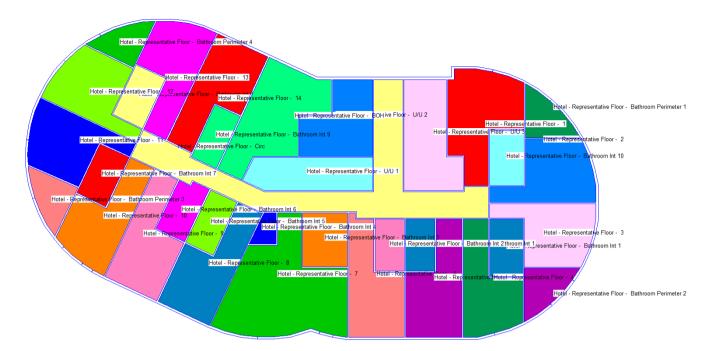


Figure 3.9 Typical Hotel Floor - HVAC Zoning

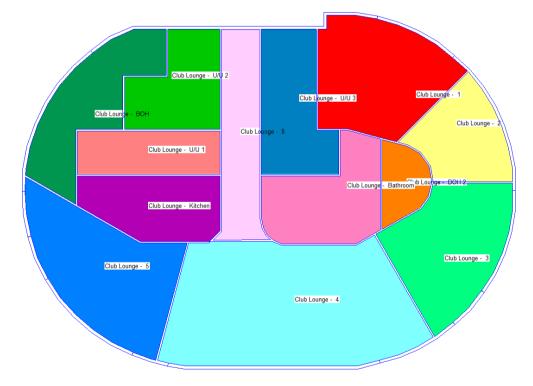
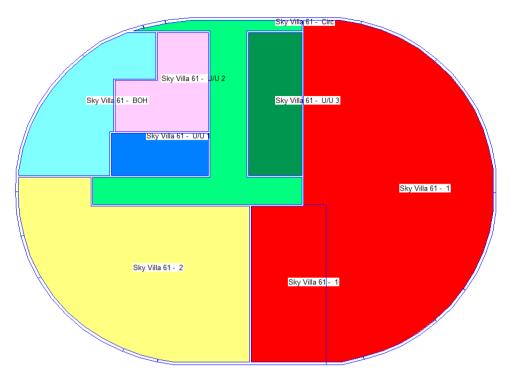


Figure 3.10 Level 60 - Club Lounge - HVAC Zoning



### Figure 3.11 Level 62 – Sky Villa – HVAC Zoning

### 3.3 Shading

The level 01 community centre exposed floor (as shown below in Figure 3.12) provide shading to the ground floor residential lobby. At this stage of the design development no other shading features have been included in the envelope construction, therefore no additional shading features have been included in the model. As such there is no requirement to include shading to achieve the results presented in this report.

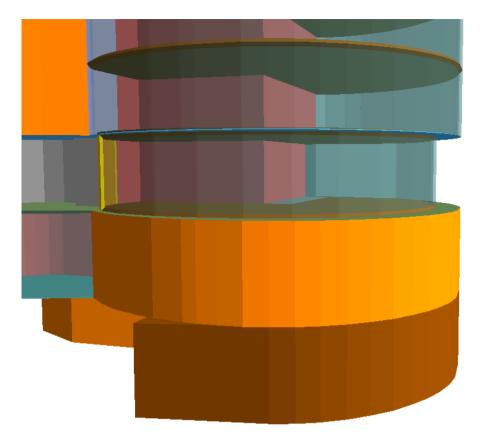


Figure 3.12 External shading on to the ground floor residential lobby from the exposed floor of the L01 community centre

### 3.4 Overshadowing

There are no surrounding buildings or structures that would provide any significant overshadowing to the Star Ritz Carlton Hotel and Residential Tower development. Thus, no adjacent buildings or overshadowing features have been incorporated in the geometry of the model.



Figure 3.13 Aerial photograph showing surrounding buildings



Figure 3.14 Street view of northern aspect of the Ritz Carlton Hotel and Residential Tower site, Pyrmont NSW

### 3.5 Building Simulation I nput s

There are many inputs which contribute to a dynamic thermal simulation. They can broadly be categorised into internal and external inputs.

Building simulation internal inputs specific to define the building's internal loads and include:

- → Temperature control range and operational schedule
- → Occupancy density and profile
- → Occupant sensible and latent loads
- → Equipment sensible and latent loads and profile
- → Lighting loads and profile

Each of these inputs apart from the internal lighting loads have remained constant across the Reference Building and Proposed Building. The project will be implementing a high efficiency LED lighting system.

The occupancy density, occupant sensible and latent loads and equipment sensible and latent loads within each space type has been determined in accordance with the recommended values from The National Construction Code Series 2016, Volume 1, Building Code of Australia and is outlined in Table 3.2.

Operating profiles have been modelled as per the tables outlined in Section 14.3 - Green Star Energy Consumption and Greenhouse Emissions Calculation Guide. If no appropriate GBCA profile could be sourced from the Data Green Star Energy Modelling Guidelines then operating profiles were sourced from Section 2 of Specification JV – Annual Energy Consumption Criteria of the 2016 National Construction Code (denoted by NCC).

Table 5.1 in Section 5 presents the lighting power densities modelled for the Proposed Building and the Reference Building, including the incorporation of the high efficiency LED lighting system.

The temperature bandwidth has been determined in accordance with the best practice for each space type and is outlined in Table 3.2.

External inputs include dynamic weather conditions for the site. The weather file used for the has been outlined in Section 3, Table 3.1.

Space Type	Operating Profile Applied	Temperature Control Range (°C)	Occupancy Density (m²/person)	Occupant Sensible Load (W/m²)	Occupant Latent Load (W/m²)	Equipment Load (W/m²)
Hotel room	GS Table 57 (apartment living space) and GS Table 58 (apartment bedroom)	21-24	15	5	3.7	5
Conditioned Apartment	GS Table 57 (apartment living space) and GS Table 58 (apartment bedroom)	21-24	15	5	3.7	5
Circulation	GS Table 35	21-24	10	7.5	5.5	0
Club lounge	NCC Table 2d	21-24	1	80	80	5
Bar/Restaurant	NCC Table 2d	21-24	1	80	80	5
Kitchen	GS Table 34	21-24	10	8	8	5
Lobby	GS Table 49	21-24	15	5	3.7	0
Office	GS Table 27	21-24	10	7.5	5.5	15
Community Centre	GS Table 27	21-24	10	7.5	5.5	15
Gym/Spa	GS Table 44	21-24	3	26.9	44.6	35
Back of house (conditioned)	GS Table 37	21-24	30	2.5	1.8	0

### Table 3.2 Simulation input summary reporting requirements

### 3.6 Building Fa bric

The opaque building fabric for the reference building and the proposed building has been modelled as per the "Deemed to Satisfy" provisions of The National Construction Code (NCC) 2016. Table 3.3 outlines the thermal performances used for the opaque building envelope elements.

### Table 3.3 Building opaque fabric parameters reporting requirements

Parameter	Reference Model Thermal Performance (W/m <sub>2</sub> K)	Proposed Model Thermal Performance (W/m₂K)
External above-grade envelope wall construction and R value	R 2.8	R 2.8
External below-grade envelope wall construction and R value	R 2.8	R 2.8
Internal envelope wall construction and R value	R 1.8	R 1.8
Roof construction, solar absorptance and R value	R 3.2 Solar Absorptance 0.7	R 3.2 Solar Absorptance 0.7
Floor construction and R value	Suspended floor to unconditioned space below: R 2.0	Suspended floor to unconditioned space below: R 2.0
	Slab on ground: Nil	Slab on ground: Nil

### 3.7 Transparent Fabric Components

For both the reference building, the NCC DTS Glazing Calculations have been completed and are presented in Appendix A.

Table 3.4 outlines the thermal performance used for the visual glazing elements of the Proposed Building.

### Table 3.4 Proposed Building visual glazing element thermal performance values (MID PANE)

Building Transparent fabric Proposed Building parameters		Reference Building
	China southern 6SJ68S-1 on Clear +12A + 6C, Aluminium Frame	See Appendix A for NCC DTS
All glazing	U-Value: 1.67	Glazing Calculators
	SHGC: 0.32	

## 4 HVAC SERVICES DESCRIPTION

The modelling parameters for the air-conditioning and ventilation systems for the Star Ritz Carlton Hotel and Residential Tower development Reference Building and Proposed Building designs are outlined in this section.

### 4.1 Air Condit ioning S ystem Parameters

Heating and cooling is provided to the entire development via a four pipe Fan Coil Unit (FCU) system.

The reference mechanical systems are as defined by the Green Star Design & As Built 'Energy Consumption and Greenhouse Gas Emissions Calculation Guide, May 2016'. As a non-residential building with less than 2,300m<sup>2</sup> of conditioned area, HVAC system type 1 is applicable.<sup>1</sup>

However, a VAV system type is unsuitable as a benchmark for a development of this type, as such the Reference Building has been modelled with a DTS compliance four pipe FCU system.

System details are presented below in Table 4.1.

#### Table 4.1 Air conditioning system parameters

Parameter	Proposed	Reference
Primary air conditioning system type	Four Pipe Fab Coil Unit (FCU) System	Four Pipe Fab Coil Unit (FCU) System
Other air conditioning system type(s)	NA	NA
Space served	All conditioned areas	All conditioned areas
Design supply air temperature difference (C)	8°C	8°C
Supply air temperature control	Temperature sensors in zones	Temperature sensors in zones
Outdoor air design volume flow rate (L/s)	See Table 4.2	See Table 4.2
Fan design supply air volume flow rate (L/s)	See Table 4.2	See Table 4.2

#### Table 4.2 Fan motor power to air ratio used for supply and relief air fans (W/L/S)

Zone Reference	Nominal Flow Rate (L/s)		Fan Power to Air Ratio (W/L/s)			
			Reference	Building	Proposed	Building
	Outside Air Fan	Relief Air Fan	Outside Air Fan	Relief Air Fan	Outside Air Fan	Relief Air Fan
Hotel - Representative Floor - 1	31	158	1.32	1.32	0.1	0.15
Hotel - Representative Floor - 2	25	102	1.54	1.54	0.1	0.15

<sup>1</sup> As per Table 61: Reference project HVAC system types by project type, Energy Consumption and Greenhouse Gas Emissions Calculation Guide, May 2016

Hotel - Representative Floor - 3	24	93	1.66	1.66	0.1	0.15
Hotel - Representative Floor - 4	24	278	1.14	1.14	0.1	0.15
Hotel - Representative Floor - 5	26	272	0.69	0.69	0.1	0.15
Hotel - Representative Floor - 6	26	271	0.69	0.69	0.1	0.15
Hotel - Representative Floor - 7	53	490	0.78	0.78	0.1	0.15
Hotel - Representative Floor - 8	27	167	1.09	1.09	0.1	0.15
Hotel - Representative Floor - 9	26	174	1.03	1.03	0.1	0.15
Hotel - Representative Floor - 10	25	191	0.93	0.93	0.1	0.15
Hotel - Representative Floor - 11	25	97	1.61	1.61	0.1	0.15
Hotel - Representative Floor - 12	25	112	1.43	1.43	0.1	0.15
Hotel - Representative Floor - 13	25	136	1.22	1.22	0.1	0.15
Hotel - Representative Floor - 14	26	122	1.39	1.39	0.1	0.15
Hotel - Representative Floor - Circ	92	234	1.50	1.50	0.1	0.15
Sky Villa 60 -  1	192	785	1.56	1.56	0.1	0.15
Sky Villa 60 -  2	101	974	0.75	0.75	0.1	0.15
Sky Villa 61 -  1	192	1,008	1.27	1.27	0.1	0.15
Sky Villa 61 -  2	101	852	0.84	0.84	0.1	0.15
vl01- Community Centre - Community Centre Perim 1	63	599	0.91	0.91	0.6	0.25
Lvl01- Community Centre - Community Centre Perim 2	80	1,050	0.98	0.98	0.6	0.25
vl01- Community Centre - Community Centre Perim 3	32	532	1.27	1.27	0.6	0.25
Lvl02- Community Centre - Community Centre Perim 1	63	654	0.84	0.84	0.6	0.25
Lvl02- Community Centre - Community Centre Perim 2	80	1,118	0.92	0.92	0.6	0.25
Lvl02- Community Centre - Community Centre Perim 3	32	593	1.15	1.15	0.6	0.25
LvI03- Community Centre - Community Centre Perim 1	64	1,143	1.18	1.18	0.6	0.25
vl03- Community Centre - Community Centre Perim 2	87	1,705	1.08	1.08	0.6	0.25
vl03- Community Centre - Community Centre Perim 3	32	1,283	0.29	0.29	0.6	0.25

LvI05- Community Centre - Community Centre Perim 1	57	633	0.78	0.78	0.6	0.25
LvI05- Community Centre - Community Centre Perim 2	39	593	0.85	0.85	0.6	0.25
Lvl05- Community Centre - Community Centre Perim 3	61	565	0.92	0.92	0.6	0.25
Lvl01- Community Centre - Community Centre Int 1	52	184	1.17	1.17	0.6	0.25
Lvl01- Community Centre - Community Centre Int 2	62	172	1.40	1.40	0.6	0.25
Lvl01- Community Centre - Community Centre Int 3	45	136	1.32	1.32	0.6	0.25
Lvl02- Community Centre - Community Centre Int 1	52	198	1.10	1.10	0.6	0.25
Lvl02- Community Centre - Community Centre Int 2	62	180	1.36	1.36	0.6	0.25
Lvl02- Community Centre - Community Centre Int 3	45	149	1.23	1.23	0.6	0.25
Lvl03- Community Centre - Community Centre Int 1	52	297	0.79	0.79	0.6	0.25
Lvl03- Community Centre - Community Centre Int 2	55	215	1.08	1.08	0.6	0.25
Lvl03- Community Centre - Community Centre Int 3	44	198	0.97	0.97	0.6	0.25
Lvl05- Community Centre - Community Centre Int 1	26	124	0.93	0.93	0.6	0.25
Lvl00- Residential Lobby - Bar/Restaurant Perim 1	303	397	0.96	0.96	0.6	0.25
Lvl00- Residential Lobby - Bar/Restaurant Perim 2	433	582	0.95	0.95	0.6	0.25
Lvl00- Residential Lobby - Bar/Restaurant Perim 3	546	932	1.13	1.13	0.6	0.25
B2 Hotel Entry - Cafe	454	853	1.07	1.07	0.6	0.25
B2 Hotel Entry - Bar/Restaurant	1,658	3,128	1.06	1.06	0.6	0.25
Sky Lobby Restaurant - Pvt Room 1	262	342	0.96	0.96	0.6	0.25
Sky Lobby Restaurant - Pvt Room 2	376	443	1.02	1.02	0.6	0.25
Sky Lobby Restaurant - Restaurant Ext 1	436	655	1.23	1.23	0.6	0.25

Sky Lobby Restaurant - Restaurant Ext 2	648	974	1.23	1.23	0.6	0.25
Sky Lobby Restaurant - Restaurant Ext 4	262	414	1.19	1.19	0.6	0.25
Lvl00- Residential Lobby - Bar/Restaurant Int 1	3,138	3,174	1.10	1.10	0.6	0.25
Sky Lobby Restaurant - Restaurant Int	2,946	2,847	1.13	1.13	0.6	0.25
B2 Hotel Entry - Hotel BOH 1	20	71	3.43	3.43	0.1	0.15
32 Hotel Entry - Hotel BOH 2	19	66	3.56	3.56	0.1	0.15
32 Hotel Entry - Hotel BOH 3	26	128	2.72	2.72	0.1	0.15
_vl02- Community Centre - Hotel 3OH	89	384	3.00	3.00	0.1	0.15
vl01- Community Centre - Hotel 3OH	53	179	3.64	3.64	0.1	0.15
34 Hotel BOH - BOH	148	227	6.27	6.27	0.1	0.15
Hotel BOH - BOH Ext 1	23	999	0.92	0.92	0.1	0.15
Hotel BOH - BOH Ext 2	11	379	0.79	0.79	0.1	0.15
Hotel BOH - BOH Ext 3	12	176	0.99	0.99	0.1	0.15
Hotel BOH - BOH Ext 4	9	236	1.07	1.07	0.1	0.15
Hotel BOH - BOH Ext 5	18	395	0.69	0.69	0.1	0.15
Hotel BOH - BOH Ext 6	1	56	0.91	0.91	0.1	0.15
Hotel BOH - BOH Int	83	401	2.73	2.73	0.1	0.15
₋vl09- Resi Gym -  Spa Perim 1	76	172	0.88	0.88	0.6	0.25
₋vl09- Resi Gym - Spa Perim 2	221	486	0.90	0.90	0.6	0.25
_vl09- Resi Gym - Spa Perim 3	220	547	0.83	0.83	0.6	0.25
₋vl09- Resi Gym - Gym Perim 1	147	533	0.89	0.89	0.6	0.25
_vl09- Resi Gym - Gym Perim 2	283	768	1.11	1.11	0.6	0.25
₋vl10-Resi Gym + Adj Resi - Gym Perim	201	678	0.95	0.95	0.6	0.25
Club Lounge - 1	602	713	1.02	1.02	0.6	0.25
Club Lounge - 2	337	475	0.92	0.92	0.6	0.25
Club Lounge - 3	573	717	0.99	0.99	0.6	0.25
Club Lounge - 4	1,287	1,423	1.05	1.05	0.6	0.25
Club Lounge - 5	686	816	1.01	1.01	0.6	0.25

Club Lounge - 6	367	361	1.12	1.12	0.6	0.25
Club Lounge - Kitchen	13	118	1.49	1.49	0.6	0.25
Sky Lobby Mezz - Servery Ext	13	327	1.06	1.06	0.6	0.25
Sky Lobby Restaurant - Kitchen Ext 1	8	235	0.89	0.89	0.6	0.25
Sky Lobby Restaurant - Kitchen Ext 2	20	489	1.07	1.07	0.6	0.25
Sky Lobby Mezz - Servery Int	22	181	1.64	1.64	0.6	0.25
Sky Lobby Restaurant -  Kitchen Int	41	333	1.67	1.67	0.6	0.25
Sky Villa 60 - Circ	61	286	0.93	0.93	0.1	0.15
Sky Villa 61 -  Circ	61	317	0.85	0.85	0.1	0.15
B2 Hotel Entry - Office	35	125	1.15	1.15	0.1	0.15
Sky Lobby Mezz - Office 1	37	295	1.05	1.05	0.1	0.15
Sky Lobby Mezz - Office 2	29	187	0.70	0.70	0.1	0.15
B2 Hotel Entry - Lobby 1	187	3,491	1.04	1.04	0.6	0.25
B2 Hotel Entry - Lobby 2	20	656	0.97	0.97	0.6	0.25
Lvl00- Residential Lobby - Lobby Int 4	48	242	1.30	1.30	0.6	0.25
Lvl00- Residential Lobby - Lobby Perim 1	38	180	1.37	1.37	0.6	0.25
Lvl00- Residential Lobby - Lobby Perim 2	49	781	0.84	0.84	0.6	0.25
Lvl00- Residential Lobby - Lobby Perim 3	35	382	0.67	0.67	0.6	0.25
Lvl00- Residential Lobby - Lobby Perim 4	48	470	0.74	0.74	0.6	0.25
Lvl00- Residential Lobby - Lobby Perim 5	38	552	0.92	0.92	0.6	0.25
Lvl00- Residential Lobby - Lobby Perim 6	31	262	0.85	0.85	0.6	0.25
Lvl00- Residential Lobby - Lobby Perim 7	42	437	0.70	0.70	0.6	0.25
Lvl00- Residential Lobby - Lobby Perim 8	51	386	0.92	0.92	0.6	0.25
Sky Lobby Mezz - Lobby Ext 1	15	284	1.04	1.04	0.6	0.25
Sky Lobby Mezz - Lobby Ext 2	17	243	0.92	0.92	0.6	0.25
Sky Lobby Mezz - Lobby Ext 3	26	441	0.78	0.78	0.6	0.25

Sky Lobby Mezz - Lobby Ext 4	65	2,118	0.98	0.98	0.6	0.25
Sky Lobby Mezz - Lobby Ext 5	43	1,106	1.25	1.25	0.6	0.25
Sky Lobby Mezz - Lobby Ext 6	20	463	0.84	0.84	0.6	0.25
Sky Lobby Mezz - Lobby Ext 7	11	143	1.01	1.01	0.6	0.25
Sky Lobby Mezz - Lobby Int	279	1,264	1.44	1.44	0.6	0.25

### Table 4.3 Supply Air Specific Fan power zone summary

Zone Reference	Supply air specific fan pressure (W/L/s)			
	Reference Building	Proposed Building		
Hotel - Representative Floor - 1	1.10	0.25		
Hotel - Representative Floor - 2	1.24	0.25		
Hotel - Representative Floor - 3	1.31	0.25		
Hotel - Representative Floor - 4	1.05	0.25		
Hotel - Representative Floor - 5	0.63	0.25		
Hotel - Representative Floor - 6	0.63	0.25		
Hotel - Representative Floor - 7	0.70	0.25		
Hotel - Representative Floor - 8	0.94	0.25		
Hotel - Representative Floor - 9	0.90	0.25		
Hotel - Representative Floor - 10	0.82	0.25		
Hotel - Representative Floor - 11	1.28	0.25		
Hotel - Representative Floor - 12	1.17	0.25		
Hotel - Representative Floor - 13	1.04	0.25		
Hotel - Representative Floor - 14	1.14	0.25		
Hotel - Representative Floor - Circ	1.08	0.25		
Sky Villa 60 -  1	1.81	0.25		
Sky Villa 60 - 2	1.75	0.25		
Sky Villa 61 - 1	1.88	0.25		
Sky Villa 61 - 2	1.69	0.25		
LvI01- Community Centre - Community Centre Perim 1	1.89	0.6		
LvI01- Community Centre - Community Centre Perim 2	1.89	0.6		
LvI01- Community Centre - Community Centre Perim 3	1.88	0.6		

Lvl02- Community Centre - Community Centre Perim 1	1.89	0.6
LvI02- Community Centre - Community Centre Perim 2	1.89	0.6
LvI02- Community Centre - Community Centre Perim 3	1.89	0.6
LvI03- Community Centre - Community Centre Perim 1	0.93	0.6
LvI03- Community Centre - Community Centre Perim 2	1.24	0.6
LvI03- Community Centre - Community Centre Perim 3	1.29	0.6
LvI05- Community Centre - Community Centre Perim 1	0.82	0.6
LvI05- Community Centre - Community Centre Perim 2	1.26	0.6
LvI05- Community Centre - Community Centre Perim 3	0.68	0.6
LvI01- Community Centre - Community Centre Int 1	1.07	0.6
LvI01- Community Centre - Community Centre Int 2	0.75	0.6
LvI01- Community Centre - Community Centre Int 3	0.82	0.6
LvI02- Community Centre - Community Centre Int 1	0.91	0.6
LvI02- Community Centre - Community Centre Int 2	1.20	0.6
LvI02- Community Centre - Community Centre Int 3	0.76	0.6
LvI03- Community Centre - Community Centre Int 1	0.86	0.6
LvI03- Community Centre - Community Centre Int 2	1.09	0.6
LvI03- Community Centre - Community Centre Int 3	1.12	0.6
LvI05- Community Centre - Community Centre Int 1	1.03	0.6
Lvl00- Residential Lobby - Bar/Restaurant Perim 1	0.29	0.6
Lvl00- Residential Lobby - Bar/Restaurant Perim 2	0.72	0.6
Lvl00- Residential Lobby - Bar/Restaurant Perim 3	0.80	0.6
B2 Hotel Entry - Cafe	0.83	0.6
B2 Hotel Entry - Bar/Restaurant	0.91	0.6
Sky Lobby Restaurant - Pvt Room 1	1.03	0.6
Sky Lobby Restaurant - Pvt Room 2	0.99	0.6
Sky Lobby Restaurant - Restaurant Ext 1	0.87	0.6
Sky Lobby Restaurant - Restaurant Ext 2	1.01	0.6
Sky Lobby Restaurant - Restaurant Ext 4	0.95	0.6
Lvl00- Residential Lobby - Bar/Restaurant Int 1	0.67	0.6
Sky Lobby Restaurant - Restaurant Int	0.86	0.6
B2 Hotel Entry - Hotel BOH 1	0.79	0.25

B2 Hotel Entry - Hotel BOH 2	0.77	0.25
B2 Hotel Entry - Hotel BOH 3	0.55	0.25
Lvl02- Community Centre - Hotel BOH	0.54	0.25
Lvl01- Community Centre - Hotel BOH	0.72	0.25
B4 Hotel BOH - BOH	0.70	0.25
Hotel BOH - BOH Ext 1	0.70	0.25
Hotel BOH - BOH Ext 2	0.55	0.25
Hotel BOH - BOH Ext 3	0.55	0.25
Hotel BOH - BOH Ext 4	0.74	0.25
Hotel BOH - BOH Ext 5	0.74	0.25
Hotel BOH - BOH Ext 6	0.73	0.25
Hotel BOH - BOH Int	0.55	0.25
Lvl09- Resi Gym - Spa Perim 1	0.55	0.6
Lvl09- Resi Gym - Spa Perim 2	2.69	0.6
Lvl09- Resi Gym - Spa Perim 3	2.76	0.6
Lvl09- Resi Gym - Gym Perim 1	2.25	0.6
Lvl09- Resi Gym - Gym Perim 2	2.43	0.6
LvI10-Resi Gym + Adj Resi - Gym Perim	2.81	0.6
Club Lounge - 1	3.80	0.6
Club Lounge - 2	0.90	0.6
Club Lounge - 3	0.77	0.6
Club Lounge - 4	0.93	0.6
Club Lounge - 5	1.03	0.6
Club Lounge - 6	0.66	0.6
Club Lounge - Kitchen	0.89	0.6
Sky Lobby Mezz - Servery Ext	2.26	0.6
Sky Lobby Restaurant - Kitchen Ext 1	0.61	0.6
Sky Lobby Restaurant - Kitchen Ext 2	0.62	0.6
Sky Lobby Mezz - Servery Int	0.59	0.6
Sky Lobby Restaurant - Kitchen Int	0.70	0.6
Sky Villa 60 - Circ	0.81	0.25
Sky Villa 61 - Circ	0.73	0.25

B2 Hotel Entry - Office	0.55	0.25
Sky Lobby Mezz - Office 1	0.54	0.25
Sky Lobby Mezz - Office 2	0.55	0.6
B2 Hotel Entry - Lobby 1	0.55	0.6
B2 Hotel Entry - Lobby 2	0.55	0.6
Lvl00- Residential Lobby - Lobby Int 4	0.55	0.6
Lvl00- Residential Lobby - Lobby Perim 1	1.34	0.6
LvI00- Residential Lobby - Lobby Perim 2	1.01	0.6
LvI00- Residential Lobby - Lobby Perim 3	0.86	0.6
Lvl00- Residential Lobby - Lobby Perim 4	1.03	0.6
Lvl00- Residential Lobby - Lobby Perim 5	1.47	0.6
Lvl00- Residential Lobby - Lobby Perim 6	1.49	0.6
Lvl00- Residential Lobby - Lobby Perim 7	0.76	0.6
Lvl00- Residential Lobby - Lobby Perim 8	0.71	0.6
Sky Lobby Mezz - Lobby Ext 1	0.90	0.6
Sky Lobby Mezz - Lobby Ext 2	0.93	0.6
Sky Lobby Mezz - Lobby Ext 3	0.61	0.6
Sky Lobby Mezz - Lobby Ext 4	0.99	0.6
Sky Lobby Mezz - Lobby Ext 5	0.94	0.6
Sky Lobby Mezz - Lobby Ext 6	1.09	0.6
Sky Lobby Mezz - Lobby Ext 7	1.14	0.6
Sky Lobby Mezz - Lobby Int	0.79	0.6

### 4.2 Cooling a nd Heat Rejection Pl ant

Presented below in Table 4.4 is the modelled cooling system and heat rejection plant for the project.

Parameter	Proposed	Reference	
Chiller type	Electric	Electric, Absorption	
Chiller capacity (kWr)	2MW	2MWth, 0.3MWth	
Design CHW flow temperature (°C)	6	6	
Design CHW temperature difference (K)	6	6	
Design CCW entering temperature (°C)	29.5	29.5	
Design CCW temperature difference (K)	5.5	5.5	
Chiller full-load performance (EER)	4.2	6.4 / 0.7	
Chiller part-load performance (NPLV)	5.2	6.4 / 0	

### Table 4.4 Cooling and heat rejection plant details

### 4.3 Heating Pl ant

Presented below in Table 4.4 is the modelled heating system for the project.

Parameter	Proposed	Reference
Heat source type	Natural gas	Natural gas, Cogeneration
Heat source capacity (kWr)	800kW	800kW / 1.5MW
Design HHW flow temperature (°C)	80	80
Design HHW temperature difference (K)	20	20
Heat source full-load performance (gross efficiency)	83	83 / heat recovered

### 4.4 Tri-generation Systems Description

Presented below in Table 4.6 is the modelled tri-generation system for the project.

Proposed Project
Capstone C1000 Series Microturbine System
1,000
1,500
Unspecified
3226
1% (modular microturbine system)
Nil
0
Unspecified
Electrically Driven Operation
300
Unspecified
Cooling
Unspecified

 Table 4.6
 Tri-generation plant details

## **5** LIGHTING DESCRIPTION

### 5.1 Inter nal lighting

Lighting forms a major component of the energy consumption in the Ritz Carlton Hotel and Residential Tower development. Hours of operation are as per the profiles specified in Table 3.2 for both the Reference Building and Proposed Building model. As defined in the Greenhouse Gas Emissions Calculation Guidelines v1.1, May 2016, the lighting power densities used in the Reference Building model are as per the DTS requirements of the BCA, with no adjustment factors.

The Proposed Building model uses lighting power densities that are typically achievable through the utilisation of LED lighting technologies. The Reference Building and Proposed Building lighting power densities have also been used as the internal gains for the HVAC modelling as prescribed in the Greenhouse Gas Emissions Calculation Guidelines v1.1, May 2016. Table 5.1 presents the lighting power densities modelled for the Proposed Building and the Reference Building.

Space type	Daylight	sensor -		hting power density (W/M²)	
Space type	controls	controls	applied	Reference	Proposed
Hotel room	N/A	N/A	N/A	5	4
Conditioned Apartment	N/A	N/A	N/A	5	4
Circulation	N/A	N/A	N/A	8	5
Club lounge	N/A	N/A	N/A	18	6
Bar/Restaurant	N/A	N/A	N/A	18	6
Kitchen	N/A	N/A	N/A	8	5
Lobby	N/A	N/A	N/A	15	6
Office	N/A	N/A	N/A	9	7
Community Centre	N/A	N/A	N/A	10	7
Gym/Spa	N/A	N/A	N/A	8	6
Back of house (conditioned)	N/A	N/A	N/A	8	5

### Table 5.1 Internal lighting parameters per space type

### 5.2 Internal lighting calculations

A summary of the energy consumption for internal lighting is summarised in Table 5.2.

### Table 5.2 Summary of internal lighting energy consumption

Model	Energy consumption (per year) Fuel Source	
Reference Building	842,076 kWh	Electricity
Proposed Building	521,092 kWh	Electricity

### 5.3 External lighting

The proposed external lighting types will comply with AS1158.3.1 based on their relevant category. These category values have been used in the calculation of the Reference Building, as per the Green Star – Greenhouse Gas Emissions Calculator Guide and are presented below in Table 5.3. Table 5.4 summarises the annual external lighting energy consumption for both Reference Building and Proposed Building.

 Table 5.3
 External lighting parameters reporting requirements

Parameter	Reference	Proposed
Lighting type	Unspecified	LED
Lighting category	P6	P6
Design lighting power density (W/m²)	4.0	1.0
Modelled lighting power density (W/m²)	4.0	1.0
Controls	N/A	N/A

 Table 5.4
 Summary of External Lighting Energy Use

Model	Energy consumption (per year)	Fuel Source
Reference Building	68,836 kWh	Electricity
Proposed Building	17,209 kWh	Electricity

### 6 DOMESTIC HOT WATER SERVICES DESCRIPTION

The Domestic Hot Water demand (DHW) for the Reference Building and Proposed Building has been determined based on the Green Star Potable Water Calculator and used for the calculation as per Section 6.9 in the Green Star Design & As Built 'Energy Consumption and Greenhouse Gas Emissions Calculation Guide, May 2016' Table 6.1 lists the parameters used in the calculation of Domestic Hot Water heating energy consumption.

Parameter	Reference	Proposed
System type	Unspecified	Unspecified
System heat source	Natural Gas	Natural Gas
Solar thermal collector (Y/N)	Ν	Ν
Hot water usage (L/annum)	24,737,242	28,631,842
System storage capacity (L)	0	0
Storage tank volume, each (L)	0	0
Heater thermal efficiency (%)	83	83
System supply water temperature (°C)	8	60
System make up water temperature (°C)	18	18
Recirculation pump (Y/N)	Ν	Ν
Operating days (days/annum)	365	365
No. of connected outlets	Unspecified	Unspecified
System standing loss factor <sup>2</sup>	0.03	0.03
System distribution loss factor <sup>3</sup>	0.13	0.13
Total Energy Demand (MJ/year)	6,079,427	7,036,564

#### Table 6.1 Domestic hot water services parameters reporting requirements

Energy consumption of circulation pumps have been accounted for in this energy model using dynamic thermal modelling within the TAS systems applications based on the expected DHW demand. The following parameters have been used in this analysis and are presented below in Table 6.2.

<sup>&</sup>lt;sup>2</sup> Standing loss factor for gas fired instantaneous and continuous flow water heaters, as per Table in Section 14.4.4, Energy Consumption and Greenhouse Gas Emissions Calculation Guide

<sup>&</sup>lt;sup>3</sup> Distribution loss factor for a system with Recirculation pumps, as per Table in Section 14.4.4, Energy Consumption and Greenhouse Gas Emissions Calculation Guide

Parameter	Proposed	Reference
Pump efficiency	0.75	0.75
Peak pressure (kPa)	100	100
Days/yr	365	365
Hours/day	24	24
Total circulation energy (kWh/yr)	289	289

### Table 6.2 Circulation pump energy calculation parameters

## 7 APPLIANCES DESCRIPTION

The current design is not developed in enough detail to specify the energy performance of the appliances to be included as part of the fitout of the residential (BCA class 2) areas of the development. For the purposes of energy modelling, an appliance load of 5W/m2 has been applied to the, kitchen, living, dining and bedroom areas of the residential apartments, based on Table 2h of Specification JV – Annual Energy Consumption Criteria of the 2016 National Construction Code (NCC).

## 8 LIFT ENERGY CONSUMPTION

The building has six lifts servicing all floors with an additional lift servicing the podium levels (B4 to L09). The total expected energy use has been calculated as per the methodology outlined in Section 14.4.6 of the Energy Consumption and Greenhouse Gas Emissions Calculation Guide. The results are detailed below in Table 8.1, Table 8.2 and Table 8.3.

Lift	Trips per day	Trips per year	Ave trip time (s)	Motor size (kW)	Standby power (W)	Standby hours per day	Standby days per year
Reference Building	600	219,000	36.24	15.56	0.15	24	365
Proposed Building	600	219,000	36.24	15.56	0.15	24	365

### Table 8.1 Lift energy calculation Inputs comparison

Additionally, a car stacker is located in the basement to store vehicles for residents and hotel patrons. Based on preliminary details of the expected system, following parameters have been used to model the annual energy use of this system, based on information provided by the product supplier.

### Table 8.2 Car stacker calculation inputs comparison

Parameter	Reference Building	Proposed Building
Cars stacked per day	500	500
Number of stacker lifts	2	2
Stacker lift rated power (kW)	2	30
Average stacker lift trip time (s)	12	12
Number of entry lifts	2	2
Entry lift rated power (kW)	30	30
Average entry lift trip time (s)	9	9
Number of shuttles	7	7
Shuttles rated power (kW)	2.2	2.2
Average shuttle trip time (s)	20	20
Number of car pickers	2	2
Car picker rated power (kW)	2.2	2.2
Average car picker operation time (s)	14	14
Number of turn tables	2	2
Turn table rated power (kW)	0.5	0.5
Average turn table operation time (s)	20	20

### Table 8.3 Summary of lift energy use

Model	Lift Energy Consumption (kWh)	Car Stacker Energy Consumption (kwh)	Total Vertical Transport Energy Consumption (kwh)	Fuel
Reference Building	35,629	72,270	107,900	Electricity
Proposed Building	35,629	72,270	107,900	Electricity

## 9 PEAK ELECTRICITY DEMAND REDUCTION – CREDIT 16

The Peak Electricity Demand reduction is calculated based on an analysis of the building's peak hourly electrical demand, as per Section 10 and 12 of the Energy Consumption and Greenhouse Gas Emissions Calculator Guide, v1.1.

The utility modelling software package energyPRO has been utilised to determine the peak electrical demand of the Proposed Building, taking into account the utilisation of the tri-generation system. With the intent to dedicate 1MWe of the total 8MWe of the tri-generation system's electrical generation capacity to the Ritz Carlton Hotel and Residential Tower development it is expected that the site will not need to draw electricity from the grid at all throughout the year, even during peak events. Additionally, the peak electrical demand of the site if further reduced due to 300kW of chilled water demand to be provided by an absorption chiller fuelled by waste heat from the tri-generation system. These findings are outlined in Table 9.1 below.

Parameter	Reference	Proposed
Time	Day 16, Hour 19	N/A
HVAC (kWh)	492.20	363.12
Lighting (kWh)	147.10	91.59
Equipment (kWh)	156.84	156.85
Fan Energy (kWh)	508.33	157.22
DHW (kWh)	0	0
Hydraulic pumps (kWh)	21.15	16.40
Lift Energy (kWh)	56.94	56.95
TOTAL	1383.48	748.37
Tri-generation electrical production during day 16, hour 19	N/A	748.37
TOTAL including PV generation	1383.48	0
% Improvement	N/A	100%

### Table 9.1 Peak Electricity Demand - Hourly consumption of proposed and reference building

The annual total electrical and cooling load profiles for the proposed project can be seen in Figure 9.1, identifying the peak hour of demand. The percentage improvement above the reference building is 100% due to the ability of the tri-generation unit to meet the entire peak electrical demand of the site. Therefore, the Ritz Carlton Hotel and Residential Tower development is eligible for 2 Green Star points for Credit 16, Peak Electricity Demand Reduction

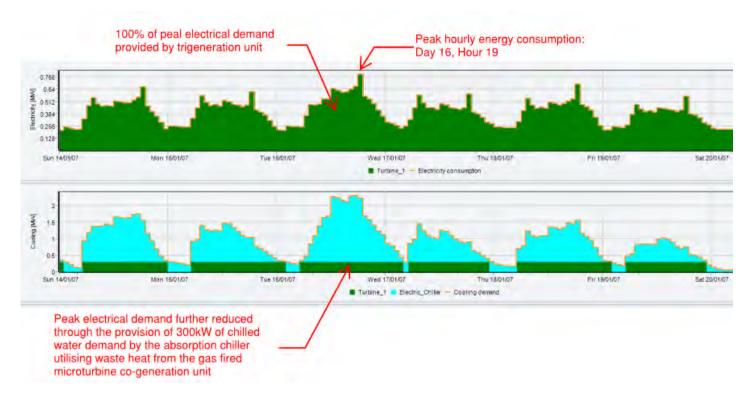


Figure 9.1 Hourly electrical and cooling load profile - Proposed Building

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# 10 RESULTS

The results of the Ritz Carlton Hotel and Residential Tower development energy modelling analysis are summarised in this section of the report. Overall, an improvement of 4% is predicted from the Intermediate Building to Reference Building in terms of energy. An improvement of 76% is expected for the Proposed Building when compared to the Benchmark Building in terms of greenhouse gas emissions. Ritz Carlton Hotel and Residential Tower development is therefore eligible to claim a total of 12.8 points for Credit 15 – Greenhouse Gas Emissions.

### 10.1 Annual Energy Usage

Table 10.1 to Table 10.4 has been taken from the Green Star Design and As-Built Greenhouse Gas Emissions Calculator – 15E Modelled Pathway. These tables present a summary of the inputs and results of the energy analysis for the Ritz Carlton Hotel and Residential Tower development.

### Table 10.1 Green Star Design and As-Built Greenhouse Gas Emissions Calculator - HVAC

	R	eference Buildin	g	Intermediat	e Building	Р	roposed Buildin	g
HVAC	Source	Annual Energy Consumption	GHG Emissions	Annual Energy Consumption	GHG Emissions	Source	Annual Energy Consumption	GHG Emissions
Heating (MJ/yr)	Natural Gas	1,494,964	95,872	1,170,500	75,064	District DHW	3,097,115	252,540
Cooling (kWh/yr)	Grid Electricity	645,401	677,671	702,628	737,760	District Electricity	340,431	99,932
Heat Rejection (kWh/yr)	Grid Electricity	645,401	677,671	702,628	737,760	District Electricity	340,431	99,932
Air Conditioning Fans (kWh/yr)	Grid Electricity	4,323,989	4,540,189	3,994,134	4,193,841	District Electricity	1,325,795	389,182
Pumps (kWh/year)	Grid Electricity	185,053	194,306	179,285	188,249	District Electricity	143,344	42,078

	R	eference Buildin	g	Intermediat	e Building	Р	roposed Buildin	g
Services	Source	Annual Energy Consumption	GHG Emissions	Annual Energy Consumption	GHG Emissions	Source	Annual Energy Consumption	GHG Emissions
Domestic Hot Water (MJ/yr)	Natural Gas	5,240,886	336,098	5,240,886	336,098	District DHW	6,170,078	503,112
DHW Circulators and Controls (kWh/yr)	Grid Electricity	288	303	288	303	District Electricity	288	85
DCW Pumps and Controls (kWh/yr)	Grid Electricity	-	-	-	-	District Electricity	-	-
Lifts (kWh/yr)	Grid Electricity	107,900	113,295	107,900	113,295	District Electricity	107,900	31,673
Artificial Lighting – Internal (kWh/yr)	Grid Electricity	842,077	884,180	842,077	884,180	District Electricity	521,092	152,964
Artificial Lighting – External (kWh/yr)	Grid Electricity	68,836	72,278	68,836	72,278	District Electricity	17,209	5,052
Appliances (kWh/yr)	Grid Electricity	388,020	407,421	388,020	407,421	District Electricity	388,020	113,902
TOTALS (MJ/year)		31,077,802	7,531,706	29,729,601	7,212,308		20,045,751	1,634,542

### Table 10.2 Green Star Design and As-Built Greenhouse Gas Emissions Calculator - SERVICES

### Table 10.3 Green Star Design and As-Built Greenhouse Gas Emissions Calculator - Greenhouse Gas Emissions

Subtotal GHG Emissions	Reference	Building	Intermediat	e Building	Proposed	Building
	Annual Energy Consumption	GHG Emissions	Annual Energy Consumption	GHG Emissions	Annual Energy Consumption	GHG Emissions
Grid Electricity (KWh/yr)	6,761,653	7,099,736	6,477,282	6,801,146	-	-
Natural Gas (MJ/yr)	6,735,850	431,970	6,411,386	411,162	-	-
District CHW (MJ/yr)	-	-	-	-	1,225,552	99,932
District HHW (MJ/yr)	-	-	-	-	3,097,115	252,540
District DHW (MJ/yr)	-	-	-	-	6,170,078	503,112
District Electricity (kWh/yr)	-	-	-	-	2,653,613	778,957
Total (kWh/yr)					13,146,358	1,634,542

Table 10.4 Green Star Design and As-Built Greenhouse	Gas Emissions Calcul	alor - RESULTS
<b>RESULTS</b> - Energy Consumption Reduction		Units
Reference Building Energy	31,077,802	MJ/annum
Intermediate Building Energy	29,729,601	MJ/annum
Improvement	4%	
Energy Consumption Reduction Points	69%	
Greenhouse Gas Emissions Reduction		
Benchmark Building GHG	6,778,535	kgCO2e/annum
Proposed Building GHG (excluding off-site supply)	3,633,502	kgCO2e/annum
Proposed Building GHG	1,634,542	kgCO2e/annum
Conditional Requirement	PASS	
Improvement	76%	
Off-site supply max points	7.42	
GHG Emissions Reduction Points	12.14	
Renewable GHG Reduction (excluding GreenPower)	0	
Innovation - Renewable Energy	0	
Total Points Achieved	12.84	
Total Points Available	20.00	

### Table 10.4 Green Star Design and As-Built Greenhouse Gas Emissions Calculator - RESULTS

### 10.2 Peak Electric it y Demand Reduc tion

Table 9.1 in Section 9 provides a summary of the peak electricity demand reductions. A total reduction of 100% has been achieved for the Proposed Building compared with the Reference Building. This project hence is eligible for 2 out of 2 points for Credit 16 – Peak Electricity Demand Reduction.

## **11** SUMMARY AND CONCLUSION

Building energy modelling has been undertaken in accordance with the Green Star Design & As-Built *Building Energy Consumption and Greenhouse Gas Emissions Calculations Guidelines v1.1, May 2016'*. Three building models were created of the development: the Proposed Building, an Intermediate Building and a Reference Building. A Benchmark Building is established as a 10% improvement in energy consumption compared to the reference building.

The modelling has been undertaken on the basis of post competition design documentation. Furthermore, the purpose of the energy modelling conducted in this report is for benchmarking purposes for the Green Star Design & As-Built v1.1 Credit 15 Greenhouse Gas Emissions. The energy modelling methodology stated in the Green Star guidelines and consequently the energy modelling results presented in this report may therefore not necessarily form an accurate prediction of the actual energy consumption for the development.

The predicted building greenhouse gas emissions consumption of the Intermediate Building is a 4% improvement on the Reference Building. Furthermore, the Proposed Building achieves a 76% reduction in greenhouse gas emissions compared to the Benchmark Building. The development therefore meets the conditional energy performance requirement necessary to be eligible for a Green Star Design & As-Built rating and claims 12.8 points out of an available 20 for Credit 15 *Greenhouse Gas Emissions*.



WSP Project No 2305180U

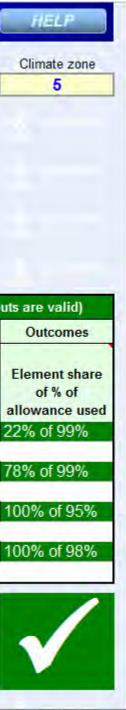
### NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014)

Building	g name/descri	iption								_			Applica	ition		
The S	tar - North	n Tower - Hote	el Entry										shop	display		
Storey			Facade are	eas												
	ment 2		N	NE	E	SE	S	SW	W	(AVA)	internal					
		Option A		195m <sup>2</sup>	36.3m <sup>2</sup>	36m <sup>2</sup>										
		Option B								1	i de					
		Glazing area (	(A)	162m <sup>2</sup>	30.9m <sup>2</sup>	30.7m <sup>2</sup>				-						
Vumber		erred in table belo ELEMENTS, ORI			(as current) ZE and PER		<u>.</u>	ACTERISTIC	s	SHAE	DING	c	ALCUL	ATED OU	TCOMES	OK (if in
•	Glazing e	element	Facing	sector		Size		Perform	mance	P&H or	device	Sha	ading	Multi	ipliers	Size
, <b>⊤</b> ID		escription optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	₽/H	G (m)	Heating (S <sub>H</sub> )	Cooling (S <sub>c</sub> )	Area used (m²)
1	Retail1_N		NE		9.65	5.85		4.4	0.43	4.450	4.850	0.92		0.22	0.37	56.45
2												ROW	SKIP	ED (OK	if intenti	
3	Retail2_N	IE	NE		4.85	21.76		4.4	0.43	2.110	4.850	0.44		0.80	0.66	######
4	-	-										ROW			if intenti	
	Retail2_E	4	E		4.85	6.37		2.9	0.25		-		0.00	1.00	1.00	30.89
6												ROW			if intenti	
7	Retail2_S	Æ	SE		4.85	6.32		3.0	0.43		-		0.00	1.00	1.00	30.65
8				<u> </u>					-							
The Gla While th	azing Calculat he ABCB beli	CE AND DISCLAIN tor has been deve ieves that the Gla. , including that it i	eloped by the A azing Calculato	ABCB to as: or, if used co	sist in develo orrectly, will	loping a bett I produce ac	ter underst courate res	sults, it is pro	ovided "as is				ation or		inputs ai	re valid

Your use of the Glazing Calculator is entirely at your own risk and the ABCB accepts no liability of any kind.

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Figure 11.1 NCC Glazing Calculator – Retail Glazing



### NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014)

HALP

Building name/description Application Climate zone The Star - North Tower - Hotel Entry other 5 Storey Facade areas Basement 2 NE E SE S SW W NW interna N Option A 65.1m<sup>2</sup> 149m<sup>2</sup> 10.4m<sup>2</sup> 6.67m<sup>2</sup> 10.4m<sup>2</sup> Option B 12 (as currently displayed) Number of rows preferred in table below GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS SHADING CALCULATED OUTCOMES OK (if inputs are valid) **Glazing element** Facing sector Performance P&H or device Shading Multipliers Size Size Outcomes Total Total System System Area **Element share** Description Option A Option B Height Width Area **U-Value** SHGC Ρ Η P/H G Heating Cooling used of % of facades facades (m²) (AFRC) (AFRC) (m) allowance used (optional) (m) (m) (m) (m) (S<sub>H</sub>)  $(S_c)$  $(m^2)$ T ID 1 Hotel SW SW 4.85 2.7 2.00 0.00 0.39 0.34 8.82 8.82 0.65 device 100% of 86% ROW SKIPPED (OK if intentional) 2 2.00 0.00 0.64 0.54 5.67 100% of 89% S 4.85 5.67 0.25 3 Hotel S 2.9 device ROW SKIPPED (OK if intentional) 4 5 Hotel SE SE 4.85 8.82 2.7 0.65 device 2.00 0.00 0.39 0.32 8.82 100% of 91% ROW SKIPPED (OK if intentional) 6 Е 4.85 64.92 4.4 0.53 7.660 4.850 1.58 0.00 0.30 64.92 56% of 93% 7 Hotel E 0.02 1.00 17.44 44% of 93% 0.00 1.00 8 Hotel E Е 4.85 17.44 4.4 0.53 ROW SKIPPED (OK if intentional) 9 10 Hotel NE NE 4.85 48.21 4.4 0.43 0.680 0.450 1.51 -4.40 0.00 0.24 48.21 58% of 87% 1.00 7.12 42% of 87% 11 Hotel\_NE NE 4.85 7.12 4.4 0.43 0.00 1.00

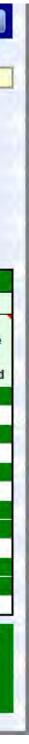
IMPORTANT NOTICE AND DISCLAIMER IN RESPECT OF THE GLAZING CALCULATOR

if inputs are valid

The Glazing Calculator has been developed by the ABCB to assist in developing a better understanding of glazing energy efficiency parameters. While the ABCB believes that the Glazing Calculator, if used correctly, will produce accurate results, it is provided "as is" and without any representation or warranty of any kind, including that it is fit for any purpose or of merchantable quality, or functions as intended or at all. Your use of the Glazing Calculator is entirely at your own risk and the ABCB accepts no liability of any kind.

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Figure 11.2 NCC Glazing Calculator – Hotel Lobby Glazing



WSP Project No 2305180U

Description Option A Option B Height (m) (m) (m) (m2) (AFRC) (M) (m		name/description				_	_		_		_		Applica				Climate zone
N       NE       E       SE       S       SW       W       NW       Internal         Option A Option B Glazing area (A)       81.9m <sup>2</sup> A       A	The Sta	ar - North Tower - Hote	el										other	<u>-</u>			5
Option A Option B Glazing area (A)       81.9m <sup>2</sup> Image: Construction of the second sec	torey		Facade are	as													
Option B Glazing area (A)       Solution B       Solution B <t< th=""><th>Basem</th><th>ient 2</th><th>NI.</th><th>NE</th><th>Е</th><th>SE</th><th>S</th><th>SW</th><th>VV</th><th>NIVV</th><th>internal</th><th></th><th></th><th></th><th></th><th></th><th></th></t<>	Basem	ient 2	NI.	NE	Е	SE	S	SW	VV	NIVV	internal						
Glazing area (A)       25.1m <sup>2</sup> Stating area (A)       Stating area (A)         Stating area (A)		Option A		81.9m <sup>2</sup>													
Sumber of rows preferred in table below       5 (as currently displayed)         GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS       SHADING       CALCULATED OUTCOMES OK (if inputs are valid)         Glazing element       Facing sector       Size       Performance       P&H or device       Shading       Multipliers       Size       Outcome         Description       Option A       Option B       Height (m)       Vidth       Area       Element sh of % of allowance         Description       Option A       Option B       Height (m)       Vidth       Area       Element sh of % of allowance         ID       (optional)       Option B       Height (m)       Vidth       Area       Element sh of % of allowance																	
GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS       SHADING       CALCULATED OUTCOMES OK (if inputs are valid inputs of the sector)         Glazing element       Facing sector       Size       Performance       P&H or device       Shading       Multipliers       Size       Outcome         Description       Option A       Option B       Height (m)       Width (m)       Area (m²)       Total (AFRC)       System       P       H       P/H       G       Heating       Cooling used of % of allowance																	
GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS       SHADING       CALCULATED OUTCOMES OK (if inputs are valid inputs of the sector)         Glazing element       Facing sector       Size       Performance       P&H or device       Shading       Multipliers       Size       Outcome         Description       Option A       Option B       Height (m)       Width (m)       Area (m²)       Total (AFRC)       System       P       H       P/H       G       Heating Cooling (SH)       Area (SH)       Area (SH)       Area (SH)       Area (M²)       Area (AFRC)       SHGC       P       H       P/H       G       Heating (Sh)       Cooling (SH)       (m²)       allowance	umber (	of rows preferred in table belo	w	5	las current	lu displayod											
Glazing element       Facing sector       Size       Performance       P&H or device       Shading       Multipliers       Size       Outcome         Description (optional)       Option A facades       Option B facades       Height (m)       Width (m)       Area (m <sup>2</sup> )       Total System (M <sup>2</sup> )       Total System (AFRC)       Total (M       Total (M       Facades       Area (M       Area (M <sup>2</sup> )       Area (M <sup>2</sup> )       System (AFRC)       SHGC       P       H       P/H       G       Heating (M)       Cooling (S <sub>H</sub> )       Area (S <sub>C</sub> )       Element sh of % of allowance	annoor o																
Description       Option A       Option B       Height       Width       Area (m)       Total       System       System       P       H       P/H       G       Heating       Cooling       Area       Element sh         ID       (optional)       facades       facades       (m)       (m)       (m)       (m)       (m)       (AFRC)       (AFRC)       (m)					-			CTERISTIC	s	SHAD	DING	с	ALCUL	ATED OUT	COMES	)K (if in	outs are valid)
		GLAZING ELEMENTS, ORI	ENTATION SE	ECTOR, SIZ	-	FORMANC											
	•	GLAZING ELEMENTS, ORI Glazing element Description	ENTATION SE Facing Option A	Sector	E and PER	RFORMANC Size Width	E CHARA	Perform Total System U-Value	mance Total System SHGC	P&H or P	device H	Sha	ding G	Multi Heating	pliers Cooling	Size Area used	Outcomes Element share of % of
4	TID	GLAZING ELEMENTS, ORI Glazing element Description (optional)	ENTATION SI Facing Option A facades	Sector	E and PER Height (m)	RFORMANC Size Width (m)	E CHARA	Perform Total System U-Value (AFRC)	Total System SHGC (AFRC)	P&H or P (m)	device H (m)	Sha P/H	ding G (m)	Multi Heating (S <sub>H</sub> )	Cooling (S <sub>C</sub> )	Size Area used (m²)	Outcomes Element share
	r ID	GLAZING ELEMENTS, ORI Glazing element Description (optional)	ENTATION SI Facing Option A facades	Sector	E and PER Height (m)	RFORMANC Size Width (m)	E CHARA	Perform Total System U-Value (AFRC)	Total System SHGC (AFRC)	P&H or P (m)	device H (m)	Sha P/H	ding G (m)	Multi Heating (S <sub>H</sub> )	Cooling (S <sub>C</sub> )	Size Area used (m²)	Outcomes Element share of % of allowance use
	TID	GLAZING ELEMENTS, ORI Glazing element Description (optional)	ENTATION SI Facing Option A facades	Sector	E and PER Height (m)	RFORMANC Size Width (m)	E CHARA	Perform Total System U-Value (AFRC)	Total System SHGC (AFRC)	P&H or P (m)	device H (m)	Sha P/H	ding G (m)	Multi Heating (S <sub>H</sub> )	Cooling (S <sub>C</sub> )	Size Area used (m²)	Outcomes Element share of % of allowance use
	TID	GLAZING ELEMENTS, ORI Glazing element Description (optional) Ribbon_NE	ENTATION SE Facing Option A facades NE MER IN RESP	Option B facades	Height (m) 9.65	RFORMANC Size Width (m) 2.60	E CHARA Area (m²)	Perform Total System U-Value (AFRC) 6.2	mance Total System SHGC (AFRC) 0.79	P&H or P (m) 7.110	device H (m) 4.850	Sha P/H 1.47	ding G (m)	Multi Heating (S <sub>H</sub> ) 0.00	Cooling (S <sub>C</sub> )	Size Area used (m²) 25.09	Outcomes Element shar of % of allowance us 100% of 43%
he Glazing Calculator has been developed by the ABCB to assist in developing a better understanding of glazing energy efficiency parameters. /hile the ABCB believes that the Glazing Calculator, if used correctly, will produce accurate results, it is provided "as is" and without any representation or	T ID 1 4 4 5	GLAZING ELEMENTS, ORI Glazing element Description (optional) Ribbon_NE ANT NOTICE AND DISCLAIM ing Calculator has been deve	ENTATION SE Facing Option A facades NE MER IN RESP loped by the A	Option B facades	Height (m) 9.65 HE GLAZING	EFORMANC Size Width (m) 2.60 G CALCULA	Area (m <sup>2</sup> )	Perform Total System U-Value (AFRC) 6.2	mance Total System SHGC (AFRC) 0.79	P&H or P (m) 7.110	H (m) 4.850	Sha P/H 1.47	ding G (m) -4.80	Multi Heating (S <sub>H</sub> ) 0.00	Cooling (Sc) 0.25	Size Area used (m²) 25.09	Outcomes Element share of % of allowance use 100% of 43%

Figure 11.3 NCC Glazing Calculator – Ribbon Lobby Glazing

ne Star - North Tower - Res		ABG	8		ABCB			8.68			Applica	ition			Climate zone
	i .										other				5
orey	Facade ar	eas													
round	N	NE	Е	SE	S	S₩	V	NV	internal						
Option A	28.7m <sup>2</sup>	29.1m <sup>2</sup>	31m²	39m²	73.1m <sup>2</sup>		112m <sup>2</sup>	47.8m²							
Option B									nta						
Glazing area (A	/ 23.6m²	23.9m²	25.3m²	23.3m²	22.4m²		83.6m²	37.4m²							
		· · · · · · · · · · · · · · · · · · ·													
imber of rows preferred in table belo	W	26	(as curren	tly displayet	17										
AZING ELEMENTS, ORIENT	ATION SE	CTOR, SI	ZE and Pl	RFORM	ANCE CI	HARACTE	RISTICS	SHAD	DING	CAL	CULAT	ED OUT	COMES	OK (if i	nputs are vali
Glazing element	Facing	sector		Size		Perfor	mance	P&H or	device	Sha	ding	Multi	oliers	Size	Outcome
						Total	Total				-				Element sha
	Option					System	System					Heatin		Area	of % of
Description	A	Option B	Height	Vidth	Area	U-Value	SHGC	Р	н	P/H	G	g	Coolin	used	allowance
ID (optional)	facades	facades	(m)	(m)	(m³)	(AFRC)	(AFRC)	(m)	(m)		(m)	(S <sub>H</sub> )	g (Sc)	(m³)	used
1 Apartment Lobby_S	S		3.95	2.54		6.2	0.79			POW		1.00 ED (OK i	1.00 Fintentia	10.03	45% of 68%
3 Apartment Lobby_W	w		3.95	8.76		2.8	0.20			Non	0.00	1.00	1.00	34.60	42% of 95%
4			0100	0.110		210	0120			ROW		ED (OK i			1210 01 0010
5 Apartment Loby_NW	NW		3.95	0.52		2.8	0.20	0.750	3.950	0.19		0.95	0.85		5% of 93%
6										ROW	SKIPP	ED (OK i	f intentio	onal)	_
7 Apartment Lobby_N	N		3.95	0.75		2.8	0.20	device		2.00	0.00	0.00	0.19	2.96	
8												ED (OK i			
9 Resi1_W	W		3.95	4.95		2.8	0.20	2.350	4.550	0.52	0.60	0.95	0.91		22% of 95%
10 11 Resi1 NW	NW		3.95	5.32		2.8	0.20	1.840	4.550	0.40	0.60	<b>ЕD (ОК</b> і 0.99	0.93	21.01	55% of 93%
12			5.55	0.02		2.0	0.20	1.040	4.550		L	ED (OK			3378 01 3378
13 Resi1_N	N		3.95	5.23		2.8	0.20	1.840	4.550	0.40	0.60	0.99	0.90		100% of 80%
14										ROW	SKIPP	ED (OK i	f intentio		
	NE		3.95	6.06		2.9	0.25	4.840	4.550	1.06	0.60	0.87	0.65	23.94	100% of 97%
15 Resi1_NE												ED (OK i			
16			3.95	6.40		2.8	0.18	0.720	4.550	0.16	0.60	0.99 ED (OK i	0.98		100% of 95%
16 17 Resi1_E	E		0.00								SNIFF		<i>i</i> milenuo	лац	
16 17 Resi1_E 18				3.14		6.2	0.79				0.00	· · ·	1.00	12 40	55% of 68%
16 17 Resi1_E	S		3.95	3.14		6.2	0.79				0.00 SKIPP	1.00 ED (OK	1.00 Fintentio		55% of 68%
16 17 Resi1_E 18 19 Resi1_S				3.14 5.90		6.2 2.9	0.79					1.00 ED (OK i			
16         17       Resi1_E         18       E         19       Resi1_S         20       E         21       Resi2_SE         22       E	S SE		3.95			2.9				ROW	SKIPP 0.00 SKIPP	1.00 ED (OK i 1.00 ED (OK i	f intentio 1.00 f intentio	onal) 23.31 onal)	100% of 100
16         17       Resi1_E         18         19       Resi1_S         20         21       Resi2_SE         22         ##       Resi2_W	S		3.95							ROW	SKIPP 0.00 SKIPP 0.00	1.00 ED (OK i 1.00 ED (OK i 1.00	f intentio 1.00 f intentio 1.00	23.31 29.47	100% of 100
16           17         Resi1_E           18         End           19         Resi1_S           20         End           21         Resi2_SE           22         End	S SE		3.95 3.95	5.90		2.9	0.43			ROW	SKIPP 0.00 SKIPP 0.00	1.00 ED (OK i 1.00 ED (OK i	f intentio 1.00 f intentio 1.00 f intentio	23.31 29.47 29.47	55% of 68% 100% of 100 36% of 95% 41% of 93%

Figure 11.4 NCC Glazing Calculator – Residential Lobby Glazing

WSP Project No 2305180U

ie Ju	ar - North Tower - Resi		6									other				5
orey		Facade an							-							
vel (		N	NE	E	SE	S.	SW	W	NW	internal						
	Option A	39.1m <sup>2</sup>	39.1m <sup>2</sup>	42m <sup>2</sup>	19.9m <sup>2</sup>		20.1m <sup>2</sup>	33.6m <sup>2</sup>	39.6m <sup>2</sup>	-						
	Option B	047.3	04.4.3	044.2	0.00.7	-	40.0.2	07.0.3	00 4 3	0-						
	Glazing area (A	) 31./m²	31.4m²	34.1m <sup>2</sup>	2.63m <sup>2</sup>	********	. 16.3m²	27.2m <sup>2</sup>	32.1m <sup>2</sup>							
	of rows preferred in table belo GLAZING ELEMENTS, ORIE	NTATION SI	ECTOR, SIZ						SHAL							uts are valid)
-	Glazing element	Facing	sector		Size			mance	Part or	device	Sha	ding	Mult	pliers	Size	Outcomes
ID	Description (optional)	Option A	Option B facades	Height (m)	Width (m)	Area (m <sup>2</sup> )	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S <sub>H</sub> )	Cooling (Sc)	Area used (m <sup>2</sup> )	Element sha of % of allowance us
	Resi SW	SW		3.65	4.46		2.9	0.25	<i>v-1</i>	0.0		0.00	1.00	1.00	16.28	100% of 97%
2										-	ROW	SKIPP	ED (OK	if intenti		
3	Resi_W	W		3.65	7.46		2.8	0.18				0.00	1.00	1.00	27.23	100% of 97%
4			·	-							ROW			if intenti	-	
	Resi_NW	NVV		3.65	8.80	_	2.8	0.18				0.00	1.00			100% of 91%
6	D		-	2.05	0.00	_	2.0	0.40	-		ROW			if intentio		10000-5040
8	Resi_N	N	-	3.65	8.69	-	2.8	0.18	-		POW	0.00		1.00 if intentio		100% of 91%
-	Resi NE	NE	-	3.65	8.60	_	1.4	0.15	-		NOW	0.00	1.00			100% of 95%
10	ton_nc	III.	-	5.05	0.00		1.4	0.15	-		ROW			if intentio		10070 01 007
	Resi E	E		3.65	9.33	-	2.8	0.18				0.00			-	100% of 96%
12			·								ROW	SKIPP	ED (OK	if intentio		
	Resi_SE	SE		3.65	0.72		6.2	0.79				0.00	1.00	1.00	2.63	100% of 44%
13	and the second se	-	-					-		-						100 C 10 C 10 C 10 C

Figure 11.5 NCC Glazing Calculator – Level 1 Glazing

WSP Project No 2305180U

Iding name/description		_							_		Applica	tion			Climate zone
he Star - North Tower - Resi				_					-		other	-			5
orey	Facade ar					-			_						
evel 02	N	NE	E	SE	5	SW	W	NW	internal						
Option A	43.5m <sup>2</sup>	44.5m <sup>2</sup>	46.7m <sup>2</sup>	22.2m <sup>2</sup>		24.4m <sup>2</sup>	37.3m <sup>2</sup>	44m <sup>2</sup>	-						
Option B					-				0.2						
Glazing area ()	4) 36.1m <sup>2</sup>	35.7m²	38.7m <sup>2</sup>	2.99m <sup>2</sup>	********	. 18.5m²	31m²	36.5m²							
nber of rows preferred in table be GLAZING ELEMENTS, ORI	ENTATION SE	ECTOR, SIZ	(as curren	FORMANC				SHAD							uts are valid)
Glazing element	Facing	sector		Size			mance	P&H or o	levice	Sha	ding	Multi	pliers	Size	Outcomes
Description ID (optional)	Option A		Height	Width	Area	Total System U-Value	Total System SHGC	P	H	P/H	G		Cooling	Area used	Element shar of % of
	SW	facades	(m) 4.15	(m) 4.46	(m²)	(AFRC) 2.9	(AFRC) 0.25	(m)	(m)		(m)	(S <sub>H</sub> )	(S <sub>c</sub> )	(m²)	allowance use
1 Resi_SW	244		4.13	4.40		2.9	0.25		_	POW	D.00	1.00	if intentio	18.51	100% of 91%
3 Resi W	W	-	4.15	7.46		2.8	0.18			non	0.00	1.00	1.00		100% of 100%
4						210	0110		-	ROW			if intentio		10070 01 1001
5 Resi NW	NW		4.15	8.80	_	2.8	0.18				0.00	1.00			100% of 93%
6		1				11 23			1	ROW	SKIPP	ED (OK	if intentio	onal)	-
7 Resi_N	N		4.15	8.69	-	2.8	0.18				0.00	1.00	1.00		100% of 93%
8	-			-						ROW			if intentio		
9 Resi_NE	NE		4.15	8.60		1.4	0.15	_			0.00	1.00	1.00	35.69	100% of 94%
10	_	-							_	ROW			if intentio		
11 Resi_E	E		4.15	9.33	_	2.8	0.18	_	_	DOM:	0.00	1.00	1.00	38.72	100% of 98%
12 Deal CE	CT.		1.45	0.72	-	6.2	0.70			ROW			if intentio		1009/ -5 150/
13 Resi_SE	SE		4.10	0.72	-	0.2	0.79	-	_		0.00	1.00	1.00	2.99	100% 0145%
13 Resi_SE PORTANT NOTICE AND DISCLAIM The Glazing Calculator has been develowed thile the ABCB believes that the Glazing warranty of any kind, including that	loped by the A ing Calculator	ABCB to as , if used co	sist in deve rrectly, will	loping a bet produce ac	ter underst courate res	ults, it is pro	ovided "as i	s" and with			D.00 tation	1.00 if i	1.00 inputs ar	2.99 e valid	100% of 45

Figure 11.6 NCC Glazing Calculator – Level 2 Glazing

	orth Tower - Resi	-					_					other	_			5
rey vel 03	1	Facade are	NE	E	SE	5	SW	W	NW	internal						
Verus	Option A	60.8m <sup>2</sup>	60.8m <sup>2</sup>	65.3m <sup>2</sup>	31m <sup>2</sup>	2	35.2m <sup>2</sup>	52.2m <sup>2</sup>	61.6m <sup>2</sup>	Incinal						
	Option B	00.011	00.0111	00.011			UULIII	OLILINI	o nom	105						
	Glazing area (A)	53 4m <sup>2</sup>	53 4m <sup>2</sup>	57.4m <sup>2</sup>	4 43m <sup>2</sup>		27 4m <sup>2</sup>	45.9m <sup>2</sup>	54.1m <sup>2</sup>							
	s preferred in table belov		Too a second	(as current												
	ZING ELEMENTS, ORIEN	-		E and PER		E CHARAC	-		SHAD P&H or (							uts are valid)
Glaz	ing element	Facing	sector		Size		Total	mance Total	Part of C	Jevice	Sna	ding	Multi	pliers	Size	Outcomes
	Description	Option A	Option B	Height	Width	Area	System U-Value	System SHGC	P	н	P/H	G	Heating	Cooling	Area	Element share of % of
ID	(optional)	facades	facades	(m)	(m)	(m²)	(AFRC)	(AFRC)	(m)	(m)		(m)	(S <sub>H</sub> )	(Sc)	(m²)	allowance us
1 Resi	SW	SW		6.15	4.46		2.9	0.25				0.00	1.00	1.00	27.43	100% of 93%
2			1								ROW	SKIPP	ED (OK	if intentio		
3 Resi	W	W		6.15	7.46		1.4	0.15			-	0.00	1.00	1.00	45.88	100% of 79%
4	114/	10.07		6.46	0.00			0.45			ROW		-	if intentio		1000/ -5070/
5 Resi	NVV	NW	-	6.15	8.80	-	1.4	0.15	-	-	ROW	0.00	1.00	1.00 if intentio	54.12	100% of 87%
7 Resi	N	N		6.15	8.69		1.4	0.15			non.	0.00	1.00	1.00		100% of 92%
8				0.10	0.00			0.10	-		ROW			if intentio		10070 01 02 /0
9 Resi	NE	NE	-	6.15	8.68		1.2	0.13				0.00	1.00	1.00		100% of 90%
10											ROW	SKIPP	ED (OK	if intentio		
11 Resi	E	E		6.15	9.33		1.4	0.15				0.00	1.00	1.00	57.38	100% of 86%
12			1	1	-					-	ROW		ED (OK	if intentio		
13 Resi	SE	SE	-	6.15	0.72		6.2	0.79				0.00	1.00	1.00	4.43	100% of 48%
14	And all a second second			-	-								-	_		_
PORTANT N	OTICE AND DISCLAIME	R IN RESPE	CT OF THE	GLAZING	CALCULA	TOR							if i	nputs ar	e valid	

Figure 11.7 NCC Glazing Calculator – Level 3 Glazing

## NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014)

Building	g name/des	cription											Applica	tion			
The S	star - Nor	th Tower - Resi	-	-									other				
Storey			Facade are	eas													
Level	05		N	NE	E	SE	S	SŴ	W	NW	internal	I					
		Option A	50m <sup>2</sup>	45.8m <sup>2</sup>	34.3m <sup>2</sup>				25.9m <sup>2</sup>	39.8m <sup>2</sup>							
		Option B									-						
		Glazing area (A)	42.6m <sup>2</sup>	38.9m²	29.1m <sup>2</sup>				22.1m <sup>2</sup>	33.9m²							
Numbe	r of rows pr	eferred in table below		10	(as current	ly displayed	)										
	GLAZIN	G ELEMENTS, ORIEN	TATION SE	ECTOR, SIZ	ZE and PER	FORMANC	E CHARA	CTERISTIC	S	SHAL	DING	C	ALCUL	ATED OUT	<b>ICOMES</b>	OK (if inp	ou
	Glazin	g element	Facing	sector		Size		Perfor	mance	P&H or	device	Sha	ding	Multi	pliers	Size	
,⊤ ID		Description (optional)	Option A facades	Option El	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S <sub>H</sub> )	Cooling (S <sub>c</sub> )	Area used (m <sup>2</sup> )	
1	Resi_W		W	Incharco S	4.85	4.55	fur )	2.2	0.17	(in)	(111)		0.00	1.00	1.00	22.07	
2							-					ROW		ED (OK			
3	Resi_N	W	NW		4.85	6.99		2.8	0.18				0.00	1.00	1.00	33.90	1
4							-	1	1.1			ROW		PED (OK			
	Resi_N		- N		4.85	8.78	-	2.8	0.18	· · · · · · · ·			0.00		-		1
6					-			1				ROW		PED (OK			_
7	Resi_N	E	NE		4.85	8.03		1.4	0.15				0.00	1.00	1.00		1
8				1								ROW		PED (OK		-	
9	Resi_E		E		4.85	6.01	-	2.8	0.18				0.00	1.00	1.00	29.15	1
10					_	-	-				-	5					
<b>9</b> 10		TCE AND DISCLAIME	E ER IN RESP	PECT OF TI	4.85	6.01 G CALCUL	ATOR	2.8	0.18			ROW	0.00	1.00	1.00	29.15	

The Glazing Calculator has been developed by the ABCB to assist in developing a better understanding of glazing energy efficiency parameters:

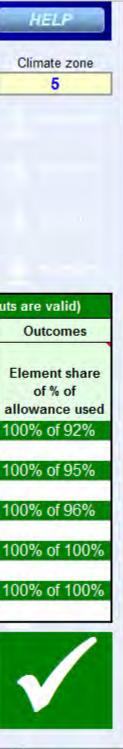
While the ABCB believes that the Glazing Calculator, if used correctly, will produce accurate results, it is provided "as is" and without any representation or

warranty of any kind, including that it is fit for any purpose or of merchantable quality, or functions as intended or at all.

Your use of the Glazing Calculator is entirely at your own risk and the ABCB accepts no liability of any kind.

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Figure 11.8 NCC Glazing Calculator – Level 5 Glazing



Py rel 07         Option A Option B Giscing grees (A)         Note 100	ling name/description											Applica				Climate zone
Non 07         Non 0600 A         Non 0600 A         Non 0700 B         Non 0700 B<	Star - North Tower - Ribbo	on/Functio	on & Bus	ness Cer	ntre						DNE	other				5
Option A Glazing area (A)         111mrt         68/amrt         32/amrt         121mrt         154mrt         552mrt         355mrt         180mrt         and and and and and and and and and and																
Open B         Open B         Open B         Open B         Open B           Classing size (A)         107m <sup>2</sup> Size         Size (Classing	VOLUME VOLUME									internal	DNE					
Glazing see (A) 107m <sup>2</sup> 580m <sup>2</sup> 479m <sup>2</sup> 124m <sup>2</sup> 154m <sup>2</sup> 510m <sup>2</sup> 342m <sup>2</sup> 152m <sup>2</sup> de or rows pretered in table below           de (accorredy diployed)           Statum generet         Statum generet         Statum generet         Statum generet           Description         Option A         Option A </td <td></td> <td>114m-</td> <td>684m*</td> <td>532m-</td> <td>129m*</td> <td>164m-</td> <td>552m-</td> <td>3650-</td> <td>168m*</td> <td>a la</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>		114m-	684m*	532m-	129m*	164m-	552m-	3650-	168m*	a la						
16 (a correctly displayed)           CALCURA LECERT A DOI SECTOR, SEZ and PERFORMANCE CHARACTERSTIC:         No. CALCURATE CONCOUNTS OF THE CONTROL OF T		107m <sup>2</sup>	580m²	170m <sup>2</sup>	121m <sup>2</sup>	15/m <sup>2</sup>	510m <sup>2</sup>	3/2m <sup>2</sup>	152m <sup>2</sup>	ri/a						
Det of travel         10 (ab cametry departed protoc)         10 (ab cametry departed protoc)<	Giazing area (A)		000111	413111	AB 68	10411	01011	042111	102111							
Det of United patients         Det (abcurretty absupped)         Statute         CALCUE LUNETS, OBERTIATAND SECTOR, SZZ of PERFORMANCE CHARACTERNETS         SHADIG         CALCUE LUNETS, OBERTIATAND SECTOR, SZZ of PERFORMANCE CHARACTERNETS         SHADIG         CALCUE LUNETS, OBERTIATAND SECTOR, SZZ of PERFORMANCE CHARACTERNETS         SHADIG         CALCUE LUNETS, OBERTIATAND SECTOR, SZZ of PERFORMANCE CHARACTERNETS         SHADIG         CALCUE LUNETS, OBERTIATAND SECTOR, SZZ of PERFORMANCE CHARACTERNETS         SHADIG         CALCUE LUNETS, OBERTIATAND SECTOR, SZZ of PERFORMANCE CHARACTERNETS         SHADIG         Multipliers         Size         Outcom           0         Option A         Option A         Incide M         Incide M         Incide M         PERFORMANCE (MRC)         H         H         H         H         H         Heating Cooling (mrc)         Incide M         Incid M         Incide M         Incid M																
GLZING ELEMENTS, ORIENTATION SECTOR, SZE and PERFORMANCE CHARACTERISTICS         SHADMG         CALCULATED OUTCOMES ON (if inputs are valid for the second s	ber of rows preferred in table belo	QNE 🤇	46	(as curren	tlv displave	d) E ONE										
Glazing element         Facing sector         Size         Performance         PAI or divice         Shading         Multipliers         Size         Outcom           D         Option A (option A) fracedes         Option A (not b)         Neght         Ares (me)         Ares (MRC)         Ares (me)	- ABCB	A.			ABCB	· · · ·	ABCB		ABCB			ABCB			BCB	A
Description 0 (option b) (option b) (option b) (sector b)         Option A (sector b) (sector b) (se		1		E and PER		E CHARAC	-									-
Description (optional)         Option A (second)         Option A (second)         Height (m)         With (m)         Are (m)         System (m)         System (m)         System (m)         System (m)         System (m)         Note (m)         Mass (m)         Are (m)	Glazing element	Facing	sector		Size				Panore	levice	Sna	aing	Muiti	ollers	Size	Outcomes
Description         Openion A (space)         Height (with)         Area         U'Alue         SHC         P         H         M         G         Height (with)         Sub         of 's c         gate         sub         sub <td></td> <td>Area</td> <td>Element sha</td>															Area	Element sha
1 Kitchen/BOH SW         SW         6.75         2.47         2.8         0.20         NO         1.00         1.67         Kwets33           3         Kitchen/BOH W         W         6.75         20.71         2.8         0.20         ROW SKRPED (OK intentional)         51% of 98         51% of 98           4         Kitchen/BOH NW         NW         6.75         2.9         2.8         0.20         ROW SKRPED (OK intentional)         92% of 95           6         -         -         -         -         -         ROW SKRPED (OK intentional)         92% of 95           7         Kitchen/BOH N         N         6.75         2.9         2.8         0.20         1.00		Option A	Option B	Height	Width	Area	-		Р	н	P/H	G	Heating	Cooling		of % of
2         Control         Cont	D (optional)	facades	facades	(m)	(m)	(m²)	(AFRC)	(AFRC)	(m)	(m)		(m)	(S <sub>H</sub> )	(S <sub>c</sub> )	(m²)	allowance us
3       Kitchew/BOH W       W       6.75       20.71       2.8       0.20        0.01       1.00       µmmeres 518 (95)         5       Kitchew/BOH JW       NW       6.75       19.57       2.8       0.16       0.01       1.00       1.00       µmmeres 528 (95)         6       -       -       -       ROW SKIPPED (OK # finestor-and 20)       1.00       1.00       1.00       1.00       µmmeres 528 (95)         6       -       -       -       ROW SKIPPED (OK # finestor-and 20)       1.00       1		SW		6.75	2.47		2.8	0.20								4% of 93%
4       Filthen/BOH NW       6.75       19.57       2.3       0.18       FOW SKIPPED (OK II Intentional)       POW SKIPPED (OK II Intentional)         7       Kitchen/BOH N       N       6.75       2.59       2.8       0.20       0.00       1.00		10/		6.75	20.74		2.0	0.20			ROW					F40( -6000/
5         Kitchen/BOH NW         NW         6.75         19.57         2.3         0.18         0.00         1.00		VV		6.73	20.71		2.8	0.20			ROW					51% 0198%
6         Row SKUPPED (OK II Intentional)           7         Kitchen/BOH N         N         6.75         2.9         2.8         0.20         ROW SKUPPED (OK II Intentional)           9         Kitchen/BOH S         S         6.75         16.46         2.9         0.25         0.00         1.00		NW		6.75	19.57		2.8	0.18			Non		-		-	92% of 96%
7       Kitchen/BOH_N       N       6.75       2.59       2.8       0.20       Image: Constraint of the constraint				0.10	10.01		2.0	0.10			ROW					5270 OF 5070
9         Kitchen/BOH_S         5         6.75         16.46         2.9         0.25         0         100 <th< td=""><td></td><td>N</td><td></td><td>6.75</td><td>2.59</td><td></td><td>2.8</td><td>0.20</td><td></td><td></td><td></td><td>0.00</td><td>1.00</td><td>1.00</td><td>17.48</td><td>20% of 97%</td></th<>		N		6.75	2.59		2.8	0.20				0.00	1.00	1.00	17.48	20% of 97%
10       Control       ROW SKIPPED (OK if intentional)       Control       Control <thcontrol< th="">       Control</thcontrol<>	8										ROW	SKIPF	PED (OK			
It         kitchen/BOH E         E         6.75         3.23         2.9         0.25         0.00         1.00         2.10         2.10         2.00         1.00         2.10         2.10         2.00         1.00         2.10         2.10         2.00         2.00         1.00         2.00         2.10         2.00         2.00         2.00         2.00         2.00         0.00         0.00         1.00         2.01         2.00         0.00         0.00         1.00         2.00         2.00         0.00		S		6.75	16.46		2.9	0.25								73% of 100%
12       12       12       13       Kitchn/BOH_SE       SE       6.75       2.99       2.2       0.17       0.00       1.01       1.01       <		-		0.75	0.00						ROW		-		-	70/ 6000/
Sitchen/BOH_SE       SE       6.75       2.99       2.2       0.17       0.00       1.00 <td></td> <td>E</td> <td></td> <td>6.75</td> <td>3.23</td> <td></td> <td>2.9</td> <td>0.25</td> <td></td> <td></td> <td>DOM</td> <td></td> <td></td> <td></td> <td></td> <td>7% of 99%</td>		E		6.75	3.23		2.9	0.25			DOM					7% of 99%
14       14       15       Pre Function NE       NE       6.75       33.90       2.8       0.20       0.00       1.00       1.00       #####       50% of 84         15       Pre Function NE       NE       6.75       37.83       2.8       0.20       6.200       6.750       0.50       0.50       0.51       ######       50% of 84         17       Restaurant NE       NE       6.75       37.83       2.8       0.20       3.340       6.750       0.50       0.00       0.73       6.18       ######       1% of 64         18       Bar / NE       NE       6.75       2.72       2.2       0.17       3.070       6.750       0.45       0.00       0.74       0.61       13.73       1% of 64         21       Bar / SE       SE       6.75       3.61       2.9       0.25       3.070       6.750       0.45       0.00       0.00       1.00       60% of 90       0.00       1.00		SE		6 75	2 99		22	0.17			ROW		•		· ·	18% of 86%
15       Pre Function NE       NE       6.75       32.90       2.8       0.20       6.750       0.50       1.00       1.00       1.00       #####       50% of 84         16       Pre Function NE       NE       6.75       12.13       2.8       0.20       4.360       6.750       0.92       0.00       0.21       0.37       61.88       7% of 844         18       Bar / IE       NE       6.75       2.04       2.8       0.20       4.360       6.750       0.49       0.00       0.01       0.01       #####       6.75       0.49       0.00       0.01       0.01       #####       6.75       0.49       0.00       0.01       0.01       1.01       ####       6.75       0.49       0.00       0.01       0.01       0.01       ####       6.75       0.45       0.00       0.00       0.00       1.00       ####       6.75       0.45       0.00       0.00       0.00       ####       0.00       ####       0.00       ####       0.00       ####       0.00       ####       0.00       ####       0.00       ####       0.00       ####       0.00       ####       0.00       ####       0.00       ####       0.00       ####<		JL		0.15	2.55		2.2	0.11			ROW					1070 01 0070
17       Restaurant NE       NE       6.75       37.83       2.8       0.20       4.360       6.750       0.65       0.00       0.59       0.51       ######       31% of 84         18       NE       6.75       2.04       2.8       0.20       3.340       6.750       0.49       0.00       0.57       0.51       ######       31% of 84         20       Restaurant SE       SE       6.75       2.72       2.2       0.17       3.070       6.750       0.45       0.00       0.67       0.45       0.00       0.47       0.83       13.39       9% of 88         21       Bar SE       SE       6.75       2.07       2.2       0.17       9.780       6.750       1.45       0.00       0.47       0.38       1.33       14% of 9%       0.66       6.75       0.05       0.05       0.00       0.07       0.66       0.00       0.47       0.38       0.00       0.47       0.38       0.33       14% of 9%       0.66       0.00       0.07       0.66       0.00       0.07       0.66       0.00       0.07       0.66       0.00       0.07       0.66       0.00       0.06       0.07       0.67       0.06       0.07		NE		6.75	33.90		2.8	0.20					-			60% of 84%
18       Bar NE       NE       6.75       2.04       2.8       0.20       3.340       6.750       0.49       0.00       0.74       0.61       13.77       2% of 849         19       0       0       0.74       0.61       13.77       2% of 849         19       0       0.74       0.61       13.77       2% of 849         20       Restaurant_SE       SE       6.75       2.72       2.2       0.17       3.070       6.750       0.45       0.00       0.74       0.61       13.87       9% of 88         21       Bar SE       SE       6.75       2.07       2.2       0.17       9.700       6.750       0.45       0.00       0.00       1.00       8.04       39% of 88         22       Bar/Restaurant_SE       S       6.75       2.76       2.9       0.25       5.750       6.750       0.45       0.00       0.85       0.79       24.37       16% of 10       12% of 89       28       0.85       0.00       0.76       0.67       18.83       12% of 99       28       0.25       5.750       6.750       0.26       0.00       0.00       0.00       0.00       1.00       1.00       1.00       1.2% of 99		NE		6.75	12.13		2.8	0.20	6.200	6.750	0.92	0.00	0.21	0.37	81.88	7% of 84%
19       Restaurant_SE       SE       6.75       2.72       2.2       0.17       3.070       6.750       0.45       0.00       0.76       0.69       18.36       14% of 86         21       Bar SE       SE       6.75       2.07       2.2       0.17       3.070       6.750       1.45       0.00       0.76       0.69       18.36       14% of 86         22       Bar/Restaurant_SE       SE       6.75       10.08       2.2       0.17       9.780       6.750       1.45       0.00       1.00       1.00       6.80       59% of 86         23       Bar/Restaurant_SE       S       6.75       3.61       2.9       0.25       3.070       6.750       0.85       0.00       0.76       16% of 10         26       Bar       S       6.75       2.76       2.9       0.25       5.750       6.750       0.85       0.00       0.76       0.53       12% of 10         27       PreFunction_E       E       6.75       2.72       2.9       0.25       6.250       0.00       0.00       0.00       2.6       2% of 93       2% of 93 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>																
20         Restaurant_SE         SE         6.75         2.72         2.2         0.17         3.070         6.750         0.45         0.00         0.76         0.69         18.36         14% of 86           21         Bar SE         SE         6.75         10.08         2.2         0.17         9.780         6.750         1.45         0.00         0.47         0.38         13.97         9% of 86           22         Bar/Restaurant_SE         SE         6.75         10.08         2.2         0.17         9.780         6.750         0.45         0.00         0.47         0.38         13.97         9% of 86           23         Bar/Restaurant_SE         S         6.75         3.61         2.9         0.25         3.070         6.750         0.45         0.00         0.85         0.79         24.37         16% of 10           28         Bar S         S         6.75         2.72         2.9         0.25         6.750         0.85         0.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00		NE		6.75	2.04		2.8	0.20	3.340	6.750						2% of 84%
21       Bar SE       SE       6.75       2.07       2.2       0.17       9.780       6.750       1.45       0.00       0.47       0.38       13.97       9% of 869         23       Bar/Restaurant_SE       SE       6.75       10.08       2.2       0.17       0.00       1.00       1.00       6.04       59% of 86         23       E       6.75       10.08       2.2       0.17       0.00       1.00       8.00       0.79       24.37       16% of 10         25       Bar_S       S       6.75       2.76       2.9       0.25       5.750       6.750       0.85       0.00       0.76       0.67       18.63       12% of 10         26       E       6.75       2.72       2.9       0.25       6.750       0.85       0.00       1.00       1.00       ######       31% of 99         27       Pre Function E       E       6.75       2.72       2.9       0.25       6.230       6.750       0.92       0.00       1.00       ######       30% of 93         28       Bar_E       E       6.75       2.511       2.8       0.20       6.750       0.92       0.00       1.00       #######       36%		SE		6 75	2 72		22	0.17	3 070	6 750						14% of 86%
22       Bar/Restaurant_SE       SE       6.75       10.08       2.2       0.17       0.00       1.00       1.00       68.04       59% of 86         23       A       Restaurant_S       S       6.75       3.61       2.9       0.25       3.070       6.750       0.45       0.00       0.85       0.07       24.37       16% of 10         25       Bar_S       S       6.75       2.76       2.9       0.25       5.750       6.750       0.85       0.00       0.67       18.63       12% of 10         26       Arr       E       6.75       2.72       2.9       0.25       6.700       0.80       0.00       1.00       #####       51% of 99         28       Bar_E       E       6.75       2.72       2.9       0.25       6.200       6.700       0.00       <																
24         Restaurant_S         S         6.75         3.61         2.9         0.25         3.070         6.750         0.45         0.00         0.85         0.79         24.37         16% of 10           25         Bar_S         S         6.75         2.76         2.9         0.25         5.750         6.750         0.85         0.00         0.76         0.67         18.63         12% of 10           26																59% of 86%
25       Bar_S       S       6.75       2.76       2.9       0.25       5.750       6.750       0.86       0.00       0.76       0.67       18.63       12% of 10         26       Pre Function_E       E       6.75       24.28       2.9       0.25       0.00       1.00       1.00       #####       51% of 99         28       Restaurant_E       E       6.75       2.72       2.9       0.25       device       2.00       0.00       0.00       0.01       1.00       #####       51% of 99         28       Bar_E       E       6.75       2.025       device       2.00       0.00       0.00       0.01       0.01       1.00       #####       51% of 99         30       Bar_SW       SW       6.75       31.51       2.8       0.20       4.740       6.750       0.70       0.00       0.70       0.60       #####       39% of 93         31       Bar/Restaurant_SW       SW       6.75       0.51       2.8       0.20       6.750       0.50       0.70       0.00       0.70       0.60       1.01       #####       39% of 93         32       Bar/Restaurant_SW       SW       6.75       0.51       2.	23										ROW	SKIPF	PED (OK	if intentio	onal)	
28       ROW SKIPPED (OK if intentional)         27       Pre Function E       E       6.75       24.28       2.9       0.25       0.00       1.00       1.00       ######       51% of 99         28       Restaurant E       E       6.75       2.72       2.9       0.25       device       2.00       0.00       0.00       226       18.36       2% of 999         29       Bar E       E       6.75       31.51       2.8       0.20       4.740       6.750       0.92       0.00       0.00       0.00       1.00       #####       39% of 93         32       Bar/Restaurant_SW       SW       6.75       25.11       2.8       0.20       4.740       6.750       0.70       0.00       1.00       #####       39% of 93         33       Restaurant_SW       SW       6.75       2.72       2.8       0.20       6.750       0.52       0.00       0.10       1.00       #####       39% of 93         34       Fre Function N       N       6.75       2.72       2.8       0.20       6.750       0.92       0.00       0.12       0.31       3.44       1% of 97%         36       Bar N       N       6.75 <t< td=""><td>24 Restaurant_S</td><td>S</td><td>-</td><td>6.75</td><td>3.61</td><td></td><td>2.9</td><td>0.25</td><td>3.070</td><td>6.750</td><td>0.45</td><td>0.00</td><td>0.85</td><td>0.79</td><td>24.37</td><td>16% of 100%</td></t<>	24 Restaurant_S	S	-	6.75	3.61		2.9	0.25	3.070	6.750	0.45	0.00	0.85	0.79	24.37	16% of 100%
Z2       Pre Function E       E       6.75       24.28       2.9       0.25       0.00       1.00       1.00       ######       51% of 939         28       Restaurant E       E       6.75       2.72       2.9       0.25       device       2.00       0.00 <td< td=""><td>25 Bar_S</td><td>S</td><td></td><td>6.75</td><td>2.76</td><td>-</td><td>2.9</td><td>0.25</td><td>5.750</td><td>6.750</td><td></td><td></td><td></td><td></td><td></td><td>12% of 100%</td></td<>	25 Bar_S	S		6.75	2.76	-	2.9	0.25	5.750	6.750						12% of 100%
28       Restaurant_E       E       6.75       2.72       2.9       0.25       device       2.00       0.00       0.00       0.25       18.36       2% of 999         29       Bar_E       E       6.75       40.68       2.9       0.25       6.230       6.750       0.92       0.00       0.30       0.45       ######       40% of 99         30       Grow SKIPED (OK if intentional)       ROW SKIPED (OK if intentional)       ROW SKIPED (OK if intentional)       39% of 93         31       Bar_SW       SW       6.75       2.511       2.8       0.20       4.740       6.750       0.50       0.70       0.00       1						-	-				ROW					
29       Bar_E       E       6.75       40.68       2.9       0.25       6.230       6.75       0.92       0.00       0.30       0.45       #####       40% of 99         30       31       Bar_SW       SW       6.75       31.51       2.8       0.20       4.740       6.750       0.70       0.00       0.70       0.66       #####       39% of 93         32       Bar/Restaurant_SW       SW       6.75       25.11       2.8       0.20       3.540       6.750       0.52       0.00       1.00       #####       39% of 93         33       Restaurant_SW       SW       6.75       2.04       2.8       0.20       3.540       6.750       0.52       0.00       0.70       0.68       13.77       3% of 93%         34       6.75       0.51       2.04       2.8       0.20       6.750       0.92       0.00       0.12       0.31       3.44       1% of 97%         36       Bar_N       N       6.75       2.72       2.8       0.20       6.750       0.42       0.00       1.00       8.04       79% of 97         38       Bar_NW       NW       6.75       2.92       2.8       0.18       3.07						_			4		2.00					51% of 99%
30       31       Bar_SW       SW       6.75       31.51       2.8       0.20       4.740       6.750       0.70       0.00       0.70       0.60       ####################################		-								6 750						
31       Bar_SW       SW       6.75       31.51       2.8       0.20       4.740       6.750       0.70       0.00       0.70       0.60       ######       39% of 93         32       Bar/Restaurant_SW       SW       6.75       25.11       2.8       0.20       0.00       1.00       1.00       #####       36% of 93         33       Restaurant_SW       SW       6.75       2.04       2.8       0.20       3.540       6.750       0.52       0.00       0.77       0.68       13.77       3% of 93%         34		-		0.15	40.00		2.5	0.25	0.250	0.150	10 - L - L - L		1	1		4076 01 3376
33       Restaurant_SW       SW       6.75       2.04       2.8       0.20       3.540       6.75       0.52       0.00       0.77       0.68       13.77       3% of 93%         34       78       79% of 93%       78       78       79% of 93%       79% of 93%       70% of 93%       7		SW	-	6.75	31.51		2.8	0.20	4.740	6.750			-			39% of 93%
34	32 Bar/Restaurant_SW	SW		6.75	25.11		2.8	0.20		1.000		0.00	1.00	1.00	****	36% of 93%
35       Pre Function_N       N       6.75       0.51       2.8       0.20       6.70       0.92       0.00       0.12       0.31       3.44       1% of 97%         36       Bar_N       N       6.75       2.72       2.8       0.20       device       2.00       0.00       0.12       0.31       3.44       1% of 97%         37       Bar/Restaurant_N       N       6.75       2.72       2.8       0.20       device       2.00       0.00       0.00       0.19       18.36       7% of 97%         38       Gas       Gas       Cas       0.20       Cas       0.00       1.00       6.03       19.71       8% of 96%         39       Bar_NW       NW       6.75       2.92       2.8       0.18       3.070       6.75       0.45       0.00       0.81       0.63       19.71       8% of 96%         40       Cas       Cas       Cas       0.18       3.070       6.75       0.44       0.00       0.81       0.63       19.71       8% of 96%         41       Bar_W       W       6.75       2.72       2.8       0.20       3.220       6.750       0.48       0.00       0.75       6.67	33 Restaurant_SW	SW		6.75	2.04		2.8	0.20	3,540	6.750						3% of 93%
36       Bar N       N       6.75       2.72       2.8       0.20       device       2.00       0.00       0.19       18.36         37       Bar/Restaurant N       N       6.75       10.08       2.8       0.20       0.00       0.00       1.00       68.04       79% of 97         38       ROW SKIPED (OK if intentional)       ROW SKIPED (OK if intentional)       8% of 96%         39       Bar NW       NW       6.75       2.92       2.8       0.18       3.070       6.75       0.45       0.00       0.81       0.63       19.71       8% of 96%         40			-	6.75	0.54		20	0.20	0.000	0.750			-			10/ -6.070/
37       Bar/Restaurant_N       N       6.75       10.08       2.8       0.20       0.00       1.00       68.04       79% of 97         38       Row SKIPED (OK if intentional)       ROW SKIPED (OK if intentional)       ROW SKIPED (OK if intentional)       8       8       9						-				6.750				and the second second		1% of 97%
38		-							device		2.00					79% of 97%
39       Bar_NW       NW       6.75       2.92       2.8       0.18       3.070       6.75       0.45       0.00       0.81       0.63       19.71       8% of 96%         40			-	5.15	10.00		210	VILV			ROW					010 01 01 00
40       ROW SKIPPED (OK if intentional)         41       Bar_W       W       6.75       2.72       2.8       0.20       3.220       6.75       0.48       0.00       0.75       0.67       18.36       5% of 98%         42       Restaurant W       W       6.75       27.24       2.8       0.20       4.540       6.75       0.67       0.00       18.36       5% of 98%         43       Prefunction/Restaurant       SW       6.75       8.91       2.8       0.20       3.900       6.75       0.65       60.14       11% of 93         44       Prefunction/Restaurant       SW       6.75       5.50       2.8       0.20       3.900       6.75       0.56       60.14       11% of 93         45       Prefunction/Restaurant       SW       6.75       5.50       2.8       0.20       0.00       1.00       3.713       8% of 93%		NVV		6.75	2.92		2.8	0.18	3.070	6.750						8% of 96%
42         Restaurant W         W         6.75         27.24         2.8         0.20         4.540         6.750         0.67         0.00         0.60         0.57         ######         44% of 98           43         Prefunction/Restaurant         SW         6.75         8.91         2.8         0.20         3.900         6.75         0.58         0.00         0.57         ######         44% of 98           44         Prefunction/Restaurant         SW         6.75         8.91         2.8         0.20         3.900         6.75         0.56         60.14         11% of 93           45         Prefunction/Restaurant         SW         6.75         5.50         2.8         0.20         0.00         1.00         3.713         8% of 93%			1.1.1										-			
43         74 <th74< th="">         74         74         74<!--</td--><td></td><td>-</td><td>1</td><td></td><td></td><td>_</td><td></td><td></td><td></td><td></td><td>10 Sec. 10 Sec. 10</td><td></td><td></td><td></td><td></td><td></td></th74<>		-	1			_					10 Sec. 10 Sec. 10					
44         Prefunction/Restaurant         SW         6.75         8.91         2.8         0.20         3.900         6.75         0.65         60.14         11% of 93           45         Prefunction/Restaurant         SW         6.75         5.50         2.8         0.20         0.00         1.00         37.13         8% of 93%		W	1	6.75	27.24	_	2.8	0.20	4.540	6.750						44% of 98%
45         Prefunction/Restaurant         SW         6.75         5.50         2.8         0.20         0.00         1.00         1.00         37 13         8% of 93%		CIM		6.75	9.04		20	0.20	3 000	6 750	100 CT 100					110/ 05 020/
		-							5.900	0.750	0.50					
		300		0.15	5.50		2.0	0.20		-		0.00	1.00	1.00	UT 12	070 01 00 70
PORTANT NOTICE AND DISCLAIMER IN RESPECT OF THE GLAZING CALCULATOR if inputs are valid											-					-

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Figure 11.9 NCC Glazing Calculator – Level 7 Ribbon Glazing

NC	C VOLUME ONE	GLAZ	ING C	ALCL	ILATO	DR (fir	st issu	ied wi	ith NC	C 20	14)					HELP
Building	name/description	1		ABCB			ABCB			ABCB		Applic	ation	ABCB		Climate zone
	itar – North Tower –H	otel Gyr	n/Hotel	Spa							1	othe				5
Storey		Facade ar	tas ON E		VOLUM	EONE	<b>S</b>	VOLUME	ONE	<b>N</b>	VOLU	JME O	NE		VOLUMI	E ONE 📣
Leve	09	N	NE	E	SE	s	S₩	×	NV	internal	1					
	Option A	47m*	106m³	47m²		69m²	34m*	67m²	37m*							
	Option B									n/a	VOLU					
	Glasing area (A)	40m²	30m²	40m°		53m²	29m°	57m²	31m²							
Number	of rows preferred in table below	VOLUM	E ON 28	(as curren	thy displaye	ayo n e										
GLAZI	NG ELEMENTS, ORIENT/	TION SE	CTOR, SI	ZE and P	ERFORM	ANCE CH	IARACTE	RISTICS	SHAI	DING	CALC	ULATI	ED OUT	COMES	OK (if i	aputs are valid)
•	Glazing element	Facing	sector		Size		Perfor	mance	P&H or	device	Sha	ding	Multi	pliers	Size	Outcomes
,T ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m')	System U- Value (AFRC)	Total System SHGC (AFRC)	<b>P</b> (m)	H (m)	P/H	<b>G</b> (m)	Heatin g (Sµ)	Cooli ng (Sc)	Area used (m')	Element share of 2 of allowance used
1	Hotel Gym_W	V V		3.85		38.86	2.8	0.20	0.820	****	0.21	0.00	0.91	0.86		67% of 99%
2						4.70			1 100				ED (OK		· · · · ·	
3	Hotel Gym_NW	NV		3.85		4.70	2.8	0.20	1.480	****			0.86 ED (OK	0.68		11% of 92%
4	Hotel Gym_N	N		3.85		11.01	2.8	0.20	1.480			0.00	· ·	0.63		18% of 85%
6	noter Oyiii_N			0.00		11.01	2.0	0.20	1.400				ED (OK			107. 01 007.
7	Hotel Gym_NE	NE		3.85		70.19	2.8	0.20	1.480		0.38	0.00	0.84	0.69	70.19	71% of 91%
8											ROW		ED (OK		-	
9	Hotel Gym_E	E		3.85		12.44	2.8	0.20	device	•	***	0.00				13% of 81%
10	Hotel Gym_S	S		3.85		42.38	2.9	0.43	2.270				ED (OK		· · ·	71% of 85%
11	notel Gym_5	3		3.03		42.30	2.3	0.43	2.210				ED (OK			riz. orosz.
	Hotel Gym_S₩	S₩		3.85		18.19	2.9	0.25	2.270		0.59	0.00	0.74	0.65	18.19	59% of 91%
14											ROW	SKIPF	ED (OK			
15	Hotel Spa_W	<b>.</b>		3.85		18.19	2.8	0.20	0.400	****			0.96			33% of 99%
16				0.05				0.00	0.400				ED (OK			
17 18	Hotel Spa_NW	NV		3.85		26.66	2.8	0.20	0.400	****			0.97 ED (OK			89% of 92%
	Hotel Spa_N	N		3.85		29.17	2.8	0.20	0.400				0.98		· · ·	82% of 85%
20	noter opd_n			0.00		20.11	2.0	0.20	0.100				ED (OK			02/10/00/
	Hotel Spa_NE	NE		3.85		20.28	2.8	0.20	0.400	****	0.10	0.00	0.97	0.92	20.28	29% of 91%
22													ED (OK			
	Hotel Spa_E	E		3.85		27.15	2.8	0.20	0.400	****		0.00		0.93		87% of 81%
24	Hatal San SU	S₩		3.85		10.63	2.9	0.25			ROW	0.00	ер (ок 1.00			41% of 91%
26	Hotel Spa_S₩	3₩		3.05		10.03	2.3	0.23			ROW		ED (OK			412. or 312.
	Hotel Spa_S	S		3.85		16.66	2.9	0.43				0.00	1.00		· · · · · · · · · · · · · · · · · · ·	29% of 85%
28																

### IMPORTANT NOTICE AND DISCLAIMER IN RESPECT OF THE GLAZING CALCULATOR

if inputs are valid The Glazing Calculator has been developed by the ABCB to assist in developing a better understanding of glazing energy efficiency parameters. While the ABCB believes that the Glazing Calculator, if used correctly, will produce accurate results, it is provided "as is" and without any representation or warranty of any kind, including that it is fit for any purpose or of merchantable quality, or functions as intended or at all. Your use of the Glazing Calculator is entirely at your own risk and the ABCB accepts no liability of any kind.

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Figure 11.10 NCC Glazing Calculator – Level 9 Glazing – Hotel Gym/Spa

	name/description t <mark>ar - North Tower - Resi</mark> /	Gym										Applica other	tion			Climate zone 5
orey		Facade are	eas									-				
evel	09	N	NE	E	SE	S	SW	W	NVV.	internal						
	Option A				27.8m <sup>2</sup>	26.7m <sup>2</sup>	53.5m <sup>2</sup>	11.9m <sup>2</sup>		-						
	Option B Glazing area (A)				14.9m <sup>2</sup>	25 1m <sup>2</sup>	50.3m <sup>2</sup>	10.7m <sup>2</sup>	-	1008						
iber	of rows preferred in table below GLAZING ELEMENTS, ORIEI			(as current			CTERISTIC	s	SHAD	DING	C	ALCULA	TED OUT	TCOMES	OK (if inr	outs are valid)
<u> </u>	Glazing element	1	sector		Size			mance	P&H or o			ding		pliers	Size	Outcomes
ID	Description (optional)	Option A facades		Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S <sub>H</sub> )		Area used (m²)	Element shar of % of allowance use
	Resi Gym_W	W	100000	3.85	2.79	()	2.8	0.20	0.300	0.700	0.43	-3.15	0.78	0.70	10.74	100% of 89%
2			1								1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1			if intenti	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	6
	Resi Gym_SW	SW		3.85	13.06	_	2.8	0.20	0.300	0.700		-3.15		0.73	50.28	100% of 91%
4	Desi Curre C	•		3.85	6.52		2.0	0.20	0.200	0.700	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1			if intenti 0.80	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	100% of 07%
о 6	Resi Gym_S	S		0.60	0.02		2.8	0.20	0.300	0.700				if intenti		100% of 97%
	Resi Gym_SE	SE		3.85	3.86		4.4	0.43	0.300	0.700	1. 1 p. 1 h	-3.15		0.70	14.86	100% of 96%
Glaz	ANT NOTICE AND DISCLAIM zing Calculator has been develo e ABCB believes that the Glazi	ped by the Ang Calculate	ABCB to as: or, if used co	sist in devel prrectly, will	loping a bel produce a	ter underst		ovided "as is		0		ation or	if ii	nputs ar	re valid	

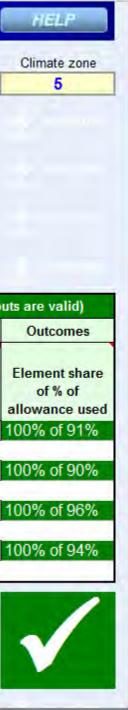
Figure 11.11 NCC Glazing Calculator – Level 9 Glazing – Resi Gym/Spa

# NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014)

Building n	name/description										. 1	Applica	ation		
The Sta	ar - North Tower - Res	si/Gym										other			
Storey		Facade are	eas												
Level 1	0	N	NE	E	SE	S	SW	W	NW	internal					
	Option A				21.4m <sup>2</sup>	20.5m <sup>2</sup>	41.1m <sup>2</sup>	8.95m <sup>2</sup>							
	Option B								1	1.12					
	Glazing area	(A)			. 11.2m <sup>2</sup>	18.9m <sup>2</sup>	37.9m <sup>2</sup>	8.24m <sup>2</sup>							
	of rows preferred in table bel			(as currenti											
	GLAZING ELEMENTS, OR			E and PEP		E CHARA	•			DING				ITCOMES (	
	Glazing element	Facing	g sector		Size	1		rmance	P&H or	device	Sha	ading	Multi	tipliers	Size
TID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S <sub>H</sub> )	g Cooling (S <sub>c</sub> )	Area used (m <sup>2</sup> )
	Resi Gym_W	W	Thomas	2.90	2.84		2.8	0.20	0.300		0.43				
2	tear oym_n										1 22.0			( if intentio	
	Resi Gym_SW	SW		2.90	13.06		2.8	0.20	0.300	0.700		-2.20			
4			/								RON	/ SKIPF	PED (OK	( if intentio	ional)
5 F	Resi Gym_S	S		2.90	6.52		2.8	0.20	0.300	0.700	0.43	-2.20	0.86	0.80	18.91
6			/											( if intentio	
7 6	Resi Gym_SE	SE		2.90	3.86		4.4	0.43	0.300	0.700	0.43	-2.20	0.77	0.70	11.19
8											_				
The Glazir	ANT NOTICE AND DISCLA ing Calculator has been dev ABCB believes that the Gla	veloped by the A	ABCB to ass	sist in devel	eloping a bet	tter underst				-		tation or		inputs ar	re valid
While the warranty of	ABCB believes that the Gla of any kind, including that it of the Glazing Calculator is	lazing Calculator it is fit for any pu	or, if used co urpose or of	orrectly, will f merchantat	Il produce ac able quality,	or functions	sults, it is pro ns as intende	rovided "as is ed or at all.		-		ation or			

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Figure 11.12 NCC Glazing Calculator – Level 10 Glazing



	name/description ar - North Tower - Hote	BOH										Applica other	tion		-	Climate zone
		Facade are										outer				
orey evel 3	19	N N	NE	E	SE	S	SW	W	NW.	internal	1					
	Option A	-	1.41-	35.8m <sup>2</sup>	42.3m <sup>2</sup>	45m <sup>2</sup>	41.4m <sup>2</sup>	77.1m <sup>2</sup>	1	Internet						
	Option B	-								1 mar						
	Glazing area (/	4)		30.4m <sup>2</sup>	36m²	38.3m <sup>2</sup>	35.2m²	65.5m <sup>2</sup>			1					
nhor (	of rows preferred in table belo	in	10	(as current	lly displayo	-0										
nuci (					1		TEDISTIC	c	CUA	DING	-	AL CUL		CONES	OK (if in	ute ere veltel)
	GLAZING ELEMENTS, ORI Glazing element		sector		Size	LE CHARA		mance		device		ding		pliers	Size	outs are valid) Outcomes
	Description	Option A		Height	Width	Area	Total System U-Value	Total System SHGC	Р	Н	P/H	G	Heating		Area used	Element sha
ID	(optional)	facades	facades	(m)	(m)	(m <sup>2</sup> )	(AFRC)	(AFRC)	(m)	(m)	E/II	(m)	(S <sub>H</sub> )	(S <sub>c</sub> )	(m <sup>2</sup> )	allowance us
1	Hotel BOH_SW	SW		4.45		35.21	2.8	0.20				0.00	1.00	1.00	35.21	100% of 93%
2			1								ROW		ED (OK			
3	Hotel BOH_W	W		4.45		65.52	2.2	0.17		_		0.00	1.00	1.00		100% of 92%
4		-		4.45		20.44	0.0	0.40		-	ROW		ED (OK			4000% -5400
6	Hotel BOH_E	E		4.45		30.44	2.8	0.18	-	-	POM	0.00	1.00 ED (OK	1.00		100% of 100
	Hotel BOH_SE	SE	-	4.45	-	35.99	2.8	0.18	-		Non	0.00	1.00	1.00	35.99	100% of 98%
8								0.10		1	ROW		ED (OK			100 /0 01 00 /
9	Hotel BOH S	S		4.45		38.27	2.9	0.25				0.00	1.00	1.00	38.27	100% of 92%
10			1													
	ANT NOTICE AND DISCLAII	loped by the A	ABCB to as	sist in deve	loping a be	tter underst			and the second second second second	C C		otion or	if ii	nputs al	re valid	

Figure 11.13 NCC Glazing Calculator – Level 39 Glazing

he S	g name/description i <mark>tar - North Tower - Sky L</mark>	obby(Ho	tel)						_	_		Applica other	Charles and the second s			5
orey		Facade are	eas													
evel	40	N	NE	E	SE	S	SV		NV	internal						
	Option A	68m²	87.3m <sup>2</sup>	179m <sup>2</sup>	38.7m²	23.1m <sup>2</sup>	10.1m <sup>2</sup>	151m <sup>2</sup>	74.8m <sup>2</sup>	1	]					
	Option B			1.	_											
	Glazing area (A)	57.8m²	74.2m²	152m²	32.9m²	19.7m²	8.6m²	128m²	63.6m²							
	r of rows preferred in table below			-12-1-1-1	dly displayed											
AZI	NG ELEMENTS, ORIENTA			ZE and Pl	ERFORM.	ANCE CI	HARACTE	RISTICS			CAL	CULAT	ED OUT	COMES	OK (if i	nputs are vali
· .	Glazing element	Facing	sector		Size		Perfor		P&H or	device	Sha	ding	Multi	pliers	Size	Outcomes
0	Description (optional)	Option A facades	Dption B Facades	Height (m)	Vidth (m)	Area (m²)	Total System U-Yalue (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	<b>G</b> (m)	Heatin g (Sµ)	Coolin g (Sc)	Area used (m <sup>3</sup> )	Element shar of % of allowance used
1	Office/Servery_SW	SW		3.65		8.60	2.8	0.20		1		0,00	1,00	1.00	8,60	100% of 93%
2					_			_			-			if intentio	-	
3			_							_	ROW	-		if intentio		harmonia
_	Office/Servery/Lounge_	W		3.65		58.72	2.2	0,17		-	-	0.00	1.00	1.00		46% of 92%
5	Office/Lounge_W	VV		1.15	-	69.77	2.2	0.17			ROW	-		if intentio	69.77	54% of 92%
	Lounge_NW	NW		7.75		63.58	2.8	0.18	-		non	0.00	1.00	1.00		100% of 95%
8							-				ROW			if intentio		
9	Lounge_N	N		7.75		57.80	2.8	0.18				0,00	1.00	1.00	57,80	100% of 96%
10		-	_				-				ROW			if intentio		
_	Lounge_NE	NE		3.65		10.64	1.4	0.15		_		0,00	1,00	1,00		14% of 100%
12	Lounge_NE	NE		7.75		63.58	1.4	0.15	-		ROW	0.00	1.00	1.00 if intentio	63.58	86% of 100%
	Lounge/Bar_E	E		3.65	-	58.79	2.8	0.18	-		non	0.00	1.00	1.00		39% of 100%
	Lounge/Bar E	E		7.75		93.43	2.8	0.18				0.00	1.00	1.00		61% of 100%
16											ROW	SKIPP	ED (OK	if intentio		
17	Bar_SE	SE		3.65	_	32.91	2.8	0.18				0,00	1,00	1.00		100% of 98%
18	<b>D</b> 0		-	2.05		10.05		0.05	-	-	ROW			if intentio		10000 - 50000
19	Bar_S	S		3.65	-	19.65	2.9	0.25	-		-	0,00	1,00	1,00	19,65	100% of 92%
21		-	-				-	_	-							
22							-									
		1														
-536							·									
- 25	-															

Figure 11.14 NCC Glazing Calculator – Level 40 Glazing

-	name/description tar - North Tower - Sky L	obby-Mez	zz (Hotel)	-							1	Applica other	tion			Climate zone 6
Storey		Facade are	eas							_						
evel	41	N	NE	E	SE	S	SW	W	NW	internal						
-	Option A		11.9m <sup>2</sup>	72.6m <sup>2</sup>	32.3m <sup>2</sup>	7.4m <sup>2</sup>	75.2m <sup>2</sup>	78.6m <sup>2</sup>								
	Option B	-								0.2						
	Glazing area (A)		10.1m <sup>2</sup>	61.7m²	27.4m²	6.29m²	64m²	66.8m²								
umber	of rows preferred in table below	N	15	(as curren	tly displaye	ed)										
	GLAZING ELEMENTS, ORIEN	ITATION SE	CTOR, SIZ	E and PER	FORMANC	E CHARAC	TERISTICS		SHA	DING	C	ALCUL	ATED OUT	COMES	DK (if inp	uts are valid)
	Glazing element	Facing	sector		Size		Perfor	mance	P&H or	device	Sha	ding	Multi	pliers	Size	Outcomes
TID	Description	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S <sub>H</sub> )	Cooling	Area used (m <sup>2</sup> )	Element share of % of allowance use
	(optional) Office/Servery SW	SW	lacauce	3.65	(iii)	63.95	1.0	0.10	(m)	(iii)		0.00	1.00	(S <sub>c</sub> )	63.95	100% of 78%
2	oncerservery_sw	500		5.05	-	03.33	1.0	0.10	-		ROW		100000	if intenti	1.002.0000.0000.0000.000	10076 017076
3							1000		-		and the second se			if intenti		
4	Office/Servery/Lounge	W		3.65	-	66.81	1.3	0.10	-		-	0.00	1.00	1.00	66.81	100% of 93%
5			_						1		ROW	SKIPP	ED (OK	if intenti	onal)	
6	Lounge_NE	NE		3.65		10.10	5.0	0.10				0.00		100 million (100 m		100% of 58%
7	1	1					1.000							if intenti		10000
8				0.05					_		ROW			if intenti	-	
	Lounge/Bar_E	E	-	3.65		61.71	1.7	0.10	-		DOM	0.00	1.00	1.00		100% of 96%
10					_			-			and the second se			if intenti if intenti		
	Bar SE	SE		3.65	-	27,44	1.0	0.10		-	non	0.00		1.00		100% of 80%
13	Dui_oc	J.		0.00	-	21144	110	0.10		1	ROW			if intenti		10070 01 0070
	Bar S	S		3.65		6.29	1.7	0.70	-	1		0.00	1.00		6.29	
14																

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Figure 11.15 NCC Glazing Calculator – Level 41 Glazing

		al Hotel F	lan									other	-			5
rey		Facade are	as	_						_						
vel 58		N	NE	E	SE	S	SW	W	NW	internal						
	Option A	22.9m <sup>2</sup>	24.8m <sup>2</sup>	101m <sup>2</sup>	8.26m <sup>2</sup>	26.8m <sup>2</sup>	10.6m <sup>2</sup>	58m²	13.6m <sup>2</sup>							
	Option B															
	Glazing area (A)	19.4m²	21.1m <sup>2</sup>	86.1m <sup>2</sup>	7.02m²	22.8m²	9.03m²	49.3m <sup>2</sup>	11.6m <sup>2</sup>							
GLAZI	NG ELEMENTS, ORIEN	TATION SE	CTOR, SIZ	(as curren E and PER	FORMANC				SHAD							uts are valid)
Glazin	g element	Facing	sector		Size	_	Perfor		P&H or o	levice	Sha	ding	Multi	pliers	Size	Outcomes
ID	Description (optional)	Option A facades	Option B facables	Height (m)	Width (m)	Area (m <sup>2</sup> )	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S <sub>H</sub> )	Cooling (Sc)	Area used (m <sup>2</sup> )	Element shar of % of allowance use
1 Typical		SW	1000000	2.95	(in)	9.03	2.8	0.20	(m)	(iii)		0.00	1.00	1.00	9.03	100% of 93%
2				-					1		ROW			if intentio	1	
3 Typical	_w	W		2.95		49.29	2.2	0.17				0.00	1.00	1.00	49.29	100% of 92%
4		1					1				ROW	SKIPP		if intentio		
5 Typical	_NE	NE		2.95	-	21.05	1.4	0.15				0.00	1.00	1.		100% of 100%
6	-	-		2.05		00.44	2.0	0.40	-		ROW			if intentio	4.4 m 17	10000 - 10000
7 Typical	E	E		2.95	_	86.14	2.8	0.18	-	-	POW	0.00	1.00	1.00 if intentio		100% of 100%
9 Typical	\$F	SE	-	2.95		7.02	2.8	0.18		_	NON	0.00	1.00	1.00		100% of 98%
10		SL.		2.00		1102	LIU	0.10			ROW		2	if intentio		10070 01 5070
11 Typical	N	N		2.95		19.45	2.8	0.18				0.00	1.00	1.00	19.45	100% of 96%
12	and the second sec			1						1	ROW	SKIPP	ED (OK	if intentio	onal)	
13 Typical	NW	NVV	-	2.95	-	11.56	2.8	0.18				0.00	1.00	1.00		100% of 95%
14							-		-		ROW		1-/8	if intentio		1000
15 Typical	_5	S		2.95		22.79	2.9	0.25		_		0.00	1.00	1.00	22.79	100% of 92%
					-								_			

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Figure 11.16 NCC Glazing Calculator – Level 58 Glazing – Representative Hotel Floor

e Star - N	orth Tower - Club	Lounge										other				5
rey	_	Facade an	eas	_	_	_		_	_	_						
vel 59		N	NE	E	SE	S	SW	W	NW	Internal						
	Option A	47.1m <sup>2</sup>	41.3m <sup>2</sup>	83.7m <sup>2</sup>	42.2m <sup>2</sup>	21.3m <sup>2</sup>	8.16m <sup>2</sup>	33.4m <sup>2</sup>	41.8m <sup>2</sup>							
	Option B	1								_						
	Glazing area (A)	) 40.8m <sup>2</sup>	35.7m²	72.3m <sup>2</sup>	36.5m²	18.4m <sup>2</sup>	7.06m <sup>2</sup>	28.8m²	36.1m <sup>2</sup>							
			40													
nber of rows	preferred in table belo	w	10	(as curren	tly displaye	(d)		_								
GLA	ZING ELEMENTS, ORIE	NTATION SE	ECTOR, SIZ	E and PER	FORMANC	E CHARAC	TERISTICS	\$	SHAD	ING	C	ALCUL	ATED OUT	COMES (	OK (if inp	uts are valid)
Glaz	ng element	Facing	sector		Size		Perfor	mance	P&H or o	levice	Sha	iding	Multi	pliers	Size	Outcomes
							Total	Total								
			-				System	System	-						Area	Element sha
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m <sup>2</sup> )	U-Value (AFRC)	SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	(S <sub>H</sub> )	Cooling (Sc)	used (m <sup>2</sup> )	of % of allowance us
1 Libra		SW	1000000	4.15	1.70	çin y	2.8	0.20	- Curly	()		0.00		1.00	7.06	100% of 94%
2	1										ROW		1000 AV A 44	if intenti	1. State 1997 - State	
3 Libra	y_W	W		4.15	6.95		2.2	0.17				0.00	1.00	1.00	28.84	100% of 94%
4			-								ROW	SKIP	PED (OK	if intenti		
5 Bar_N	E	NE		4.15	8.61	_	1.2	0.13		-		0.00	1.00			100% of 88%
6		-			17.10						ROW		-	if intenti	the second se	10000 0000
7 Dining	<u>]</u> E	E		4.15	17.43	-	2.2	0.17	-	-	DOM	0.00	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1.00 if intenti		100% of 96%
8 9 Dinin	SF	SE		4.15	8.80		2.8	0.18			ROW	0.00				100% of 100
10	_3L	JL		4.15	0.00	-	2.0	0.10			ROW	and the second second		if intenti		100 /8 01 100
11 Bar M	1	N	-	4.15	9.82	-	2.8	0.18				0.00	-	1.00	the second se	100% of 97%
12							1000	1			ROW	SKIP	ED (OK	if intenti		
13 Libra	y/Bar_NW	NVV		4.15	8.71		2.8	0.18				0.00		1.00		100% of 97%
14							-							if intenti		1
15 Dinin	<u>j_</u> S	S		4.15	4.44		2.9	0.25		_		0.00	1.00	1.00	18.43	100% of 93%
10.1							1.									

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Figure 11.17 NCC Glazing Calculator – Level 59 Glazing

ne star - Norti	Tower - Sky V	mas	-				-			_	1 1	other				5
torey	Facade areas									n.						
evel 60		N	NE	E	SE	S	SW	W	NW	Internal						
	Option A	26.1m <sup>2</sup>	29.6m <sup>2</sup>	53.9m <sup>2</sup>	28.2m <sup>2</sup>	7.58m <sup>2</sup>		28.3m <sup>2</sup>	30.6m <sup>2</sup>	-						
	Option B Glazing area (A)	22.2m <sup>2</sup>	25.1m <sup>2</sup>	45.8m <sup>2</sup>	23.9m <sup>2</sup>	6.44m <sup>2</sup>		24m²	26m <sup>2</sup>	_						
umber of rows pre	ferred in table below	W	14	(as curren	tly displaye	ed)										
GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS SHADING									C	ALCUL	ATED OU	TCOMES	DK (if inp	uts are valid)		
Glazing element		Facing sector		Size			Performance		P&H or device		Shading		Multipliers		Size	Outcomes
De	scription	Option A	Option B	Height	Width	Area	Total System U-Value	Total System SHGC	р	н	P/H	G	Heating	Cooling	Area	Element shar
	optional)	facades	facades	(m)	(m)	(m <sup>2</sup> )	(AFRC)	(AFRC)	(m)	(m)	E/II	(m)	(S <sub>H</sub> )	(S <sub>c</sub> )	(m²)	allowance use
1 PSuite_S	W	S		2.95		6.44	2.9	0.25				0.00	1.00	1.00	6.44	100% of 92%
2											ROW			if intenti		
3 PSuite_W		W		2.95	-	24.04	2.2	0.17	-		DOM	0.00	1.00	1.00 if intenti		100% of 92%
4 5 PSuite W		NE	-	2.95		25.13	1.4	0.15		-	RUW	0.00	1.00	1.00		100% of 100%
6				2.00		20.15	1.4	0.15		-	ROW	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	-	if intenti		100% 01 100%
7 Suite A_E		E		2.95		45.80	2.2	0.17	-	-		0.00	1.00	1.00	45.80	100% of 95%
8											ROW	SKIPF	ED (OK	if intenti	onal)	
9 Suite A	SE	SE		2.95		23.90	2.8	0.18				0.00	1.00	-		100% of 98%
10											ROW		-	if intenti		
11 PSuite_N		N		2.95		22.16	2.8	0.18		-	DOM	0.00	and the second second	the second second		100% of 96%
12 12 DEulte A	147	MIN		2.05		20.02	2.0	0.40	-	-	RUW			if intenti		1009/ === 059/
13 PSuite_N	vv	NW		2.95	-	26.03	2.8	0.18	1	-		0.00	1.00	1.00	26.03	100% of 95%
IDODTANT NOTIC	E AND DISCLAUME		CT OF THE	CI 4700C	CALCULA	TOP	-		-	-	-					
	E AND DISCLAIME or has been develo												if	inputs a	re valid	

Figure 11.18 NCC Glazing Calculator – Level 60 Glazing