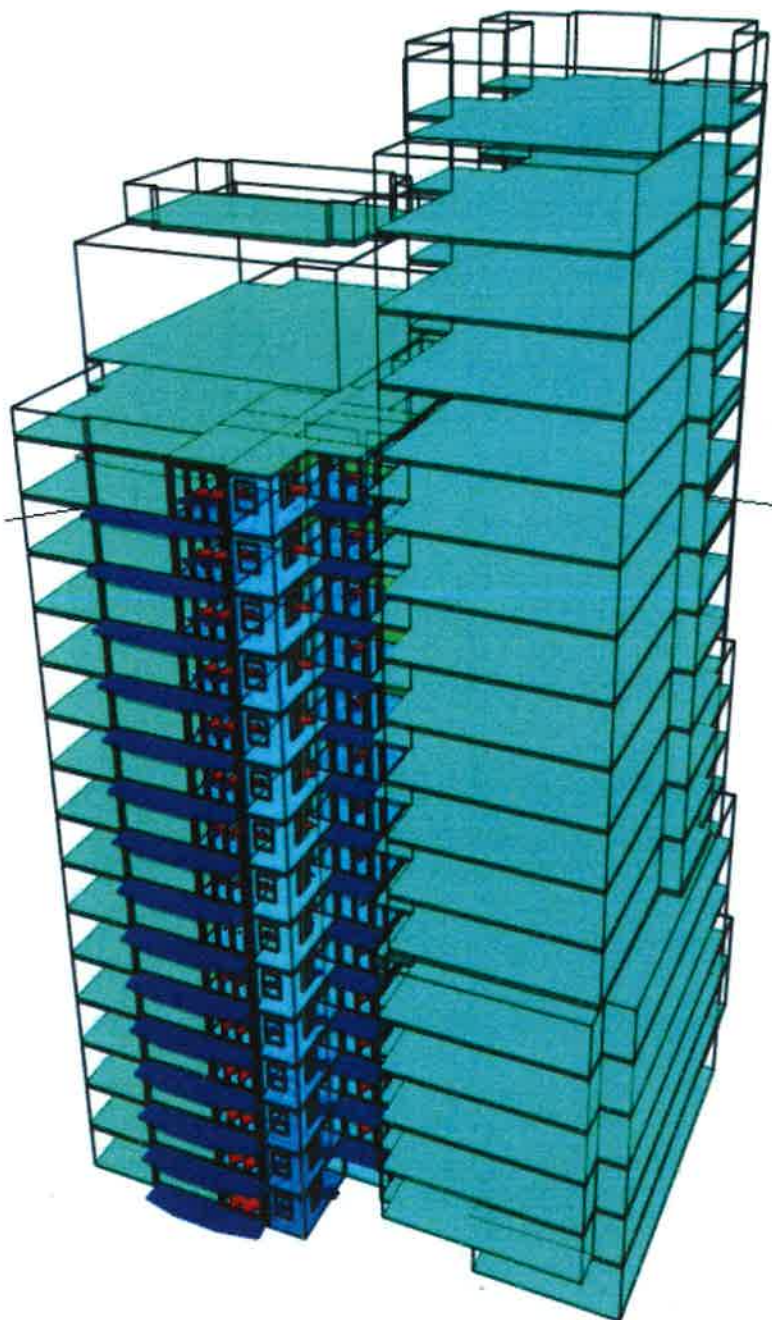




231 MILLER STREET, NORTH SYDNEY
COMPARATIVE PERFORMANCE STUDY

DATE: 27/08/2015

REVISION: 03



**PARSONS
BRINCKERHOFF**

INTRODUCTION

WSP's high performance building design team, Built Ecology, has been engaged by Platino Properties to undertake a comparative performance study to analyse the effect of the proposed development at 231 Miller Street, North Sydney on the neighbouring building at 237 Miller Street, North Sydney. The proposed development constitutes two architectural designs - the original DA architectural design and a modified S96 architectural design. These architectural designs are assessed and compared in terms of the associated natural cross ventilation and daylight performance of the lightwell-connected apartments in the neighbouring building.

The original DA and modified S96 architectural designs applied in this comparative performance study are fully derived/informed on the basis of the conclusions drawn in the Council Assessment Report to the Joint Regional Planning Panel (JRPP), dated 1 July 2015. Before the proposed development could be recommended for approval, it was required to be modified such that:

- A northern boundary setback of 1.5m opposite the lightwell and 1.5m setback continuing to the rear boundary from Level 5 be applied (represented by the original DA architectural design)
- OR
- A 3m setback opposite the lightwell to double the size of the lightwell be applied (represented by the modified S96 architectural design)

Thus two comparative thermal models have been developed that depict the geometry of the building envelope of the proposed development (the original DA and modified S96 architectural designs) and the neighbouring building. This is detailed in Figures 1 and 2. Figure 2 outlines the key design variance between the two comparative thermal models, i.e. the setback (DA) option vs. the extended lightwell (S96) option.

The neighbouring building's lightwell-connected apartments have been fully detailed in the modelling to accurately reflect their natural cross ventilation and daylight behaviour.

The thermal models have been developed based on the following information:

- DA architectural floor plans provided by Platino Properties, dated 13/07/2015
- S96 architectural floor plans provided by Platino Properties, dated 13/07/2015
- Architectural model provided by Platino Properties, dated 13/07/2015

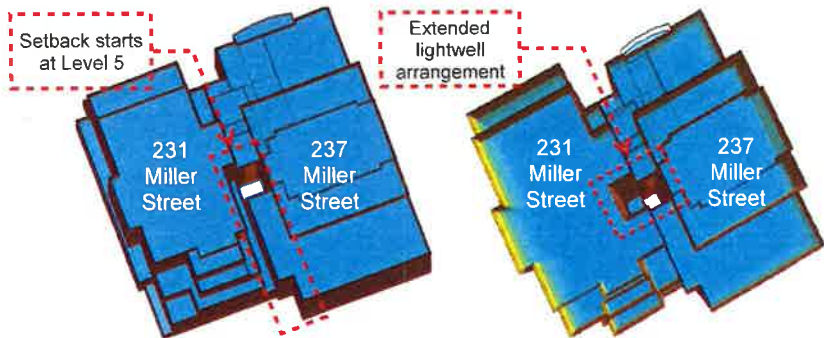


Figure 2: DA architectural plan view (left) and S96 architectural plan view (right)

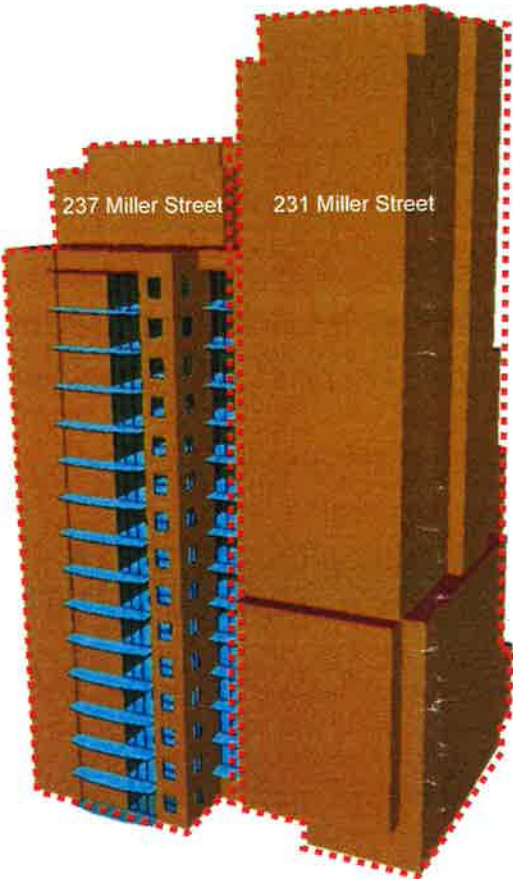


Figure 1: Thermal model of the proposed development and neighbouring building

Internal conditions and building envelope thermal performance parameters have been developed for the lightwell-connected apartments based on appropriate occupancy and operation profiles, and Section J Deemed-to-Satisfy (DtS) provisions, respectively.

Internal Conditions

The internal conditions applied are detailed in Table 1. A space heating internal temperature set point of 21°C is applied.

Building Envelope Performance

External wall:
R-value 2.8 m².K/W
Roof:
R-value 3.2 m².K/W
Glazing:
Clear float single glazing | U-value 5.7 W/m².K | SHGC 0.82 | Standard aluminium frame

Table 1: Internal condition parameters applied

SPACE	INFILTRATION RATE	LIGHTING GAIN	NUMBER OF OCCUPANTS	OCCUPANCY LATENT GAIN	OCCUPANCY SENSIBLE GAIN	EQUIPMENT SENSIBLE GAIN	EQUIPMENT LATENT GAIN	POLLUTANT GENERATION	OCCUPANCY SCHEDULE
	ACH	W/m²	People	W/m²	W/m²	W/m²	W/m²	L/(CO₂)/hr/m²	Occupied period
Bathroom	1.5	8	1	1.12	1.12	1.67	11.25	-	8am to 10am and 8pm to 11pm
Bedroom	1.5	6	1-2	1.40	3.10	2.90	0.68	1.25	11pm to 9am
Circulation	-	6	-	1.40	1.40	1.57	-	-	8am to 12am
Dining	1.5	8	2	11.10	11.10	3.06	-	11.13	7am to 10am and 7pm to 10pm
Kitchen	1.5	15	1	11.80	11.80	20.59	9.69	11.83	8am to 10am and 8pm to 11pm
Lounge	1.5	8	2	3.00	6.70	3.90	-	3.35	7pm to 11pm

Aperture Functionality

Figure 3 depicts the functionality applied to the operable elements of the balcony doors and windows of the lightwell-connected apartments. Sliding doors and windows, awning windows and internal doors are assumed to have an approx. free area of 90%, 50% and 80%, respectively. When the dry bulb temperature in the adjacent zone reaches 21.5°C, the sliding doors and windows, and awning windows will open. These will be fully open when the dry bulb temperature in the adjacent zone reaches 22.5°C. The sliding doors and windows, and awning windows will begin to close if the external temperature exceeds the internal temperature.

The internal doors to the bedrooms are open when the space is unoccupied and closed when the space is occupied.



Figure 3: Aperture configuration - front of lightwell-connected apartment (left); lightwell-connected bedroom window (right); F denotes the fixed windows/doors | O denotes the operable windows/doors

NATURAL CROSS VENTILATION

Natural cross ventilation is tested using two key performance metrics:

- Adaptive thermal comfort (ATC) - the percentage of annual occupied hours considered to be comfortable by the occupants
- Indoor air quality (IAQ) - the percentage of annual occupied hours where the level of indoor pollutants – carbon dioxide (CO₂) – in a space exceeds pre-defined thresholds

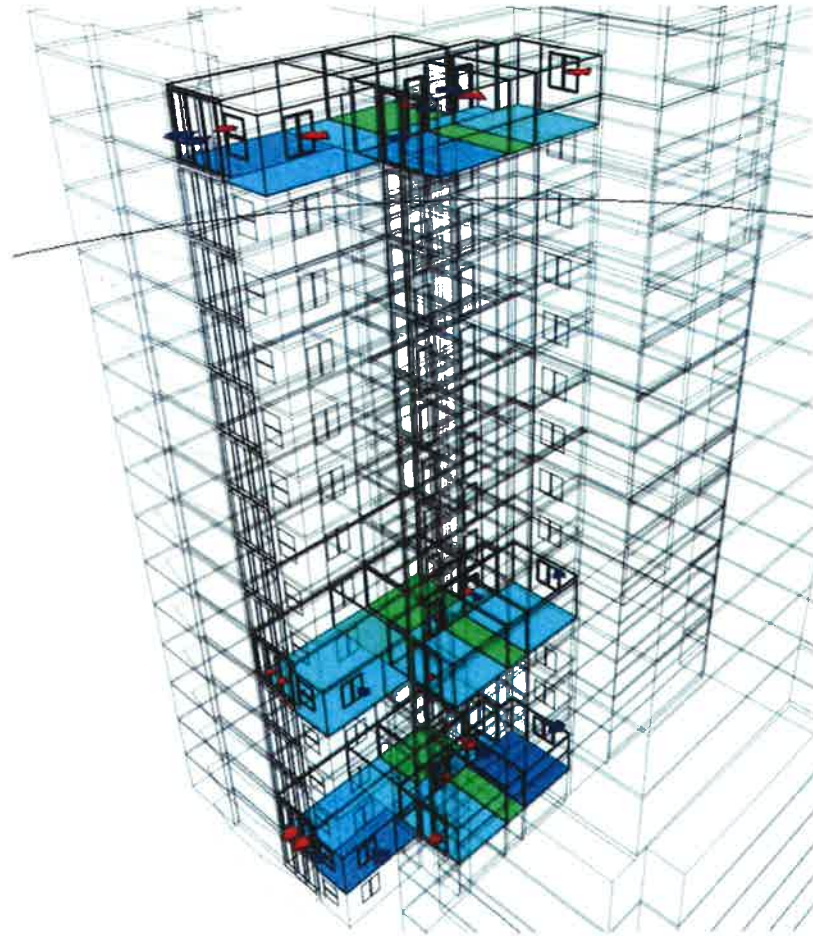


Figure 4: Natural cross ventilation illustrative performance for the S96 lightwell-connected apartments at Levels 1, 5 and 14 | red and blue arrows indicate air flow out of and into each space, respectively

Adaptive Thermal Comfort

For naturally ventilated dwellings, the appropriate thermal comfort standard is ASHRAE Standard 55-2010 "Thermal Environmental Conditions for Human Occupancy". This standard is based on the fact that the range of temperatures in which occupants feel comfortable will be dependent on the mean monthly outdoor temperature, as people are naturally adapted to their environment (see Figure 5).

The adaptive thermal comfort (ATC) standard considers the following parameters:

- Dry Bulb Temperature - the air temperature of the space
- Mean Radiant Temperature - a measure of the amount of radiant heat an occupant experiences

The prevalent connection to the external environment in the case of naturally ventilated spaces changes the occupant expectation/perception of internal thermal comfort performance. This results in a broader tolerance for air movement, air temperature, relative humidity and radiant temperature.

This standard accepts that occupants are naturally adapted to their environment and will dress appropriately (Clothing Level) for the activity level (Metabolic Rate) in the space.

Indoor Air Quality

With any ventilation strategy there is the risk of the air not moving effectively through the space, creating pockets of "dead" or stagnant air, and resulting in relatively high pollutant (CO₂) levels.

Different standards represent a wide range of recommendations as to the appropriate pollutant levels in an occupied space.

- British Standards EN 13779 recommend that CO₂ levels should not exceed 750 parts per million (ppm) in an occupied space for a high quality indoor air quality
- AIRAH Technical Handbook 2007 recommends that CO₂ levels should not exceed 1,000ppm
- ANSI/ASHRAE Standard 62.1-2007 recommends that CO₂ levels should not exceed 5,000ppm

For the purposes of this comparative performance study, the percentage of the annual occupied period that exceeds 750ppm and 1,000ppm is determined.

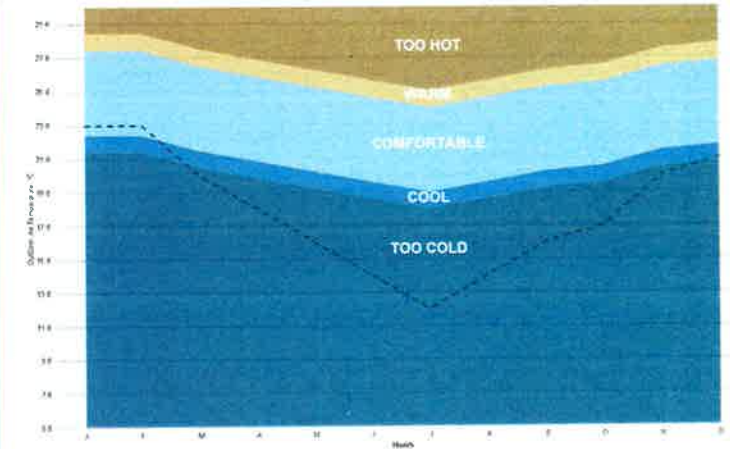


Figure 5: Adaptive thermal comfort graph for Sydney

Software

The computer package used for the comparative performance study is Tas version 9.3.3, by Environmental Design Solutions Limited. It is an EN ISO 13791 validated dynamic simulation modelling (DSM) software tool.

Weather

The Sydney Test Reference Year (TRY) has been applied to this comparative performance study. This weather file data has been selected as it represents typical weather patterns for Sydney. It is based on a set of real measured hourly values for: dry temperature, global, diffuse and direct normal solar radiation, and for wind direction and speed. The data is in true sequence within each month. The months are selected from a multiple year data set of observations for a given location such that the resulting TRY is typical for the location.

Pollutant Generation

Carbon dioxide pollution generation levels due to occupants have been based on a resting/low activity work metabolic rates.

Expert

Alan Davis has a Bachelor of Science in Mechanical Engineering and a Master of Science in Sustainable Energy Engineering. He is an Associate Director – Sustainability of WSP | Parsons Brinckerhoff. Alan has eleven years of experience in thermal modelling and building code compliance reporting. He is a Green Star and Infrastructure Sustainability Accredited Professional.

NATURAL CROSS VENTILATION

Adaptive Thermal Comfort Performance - Findings

As seen in Table 2 and Figure 6, there is a no variance in the ATC performance between the original DA and modified S96 architectural designs for the Ground to Level 14 lightwell-connected apartments in the neighbouring building.

The modified S96 architectural design poses no additional impact to the ATC performance of the neighbouring building.

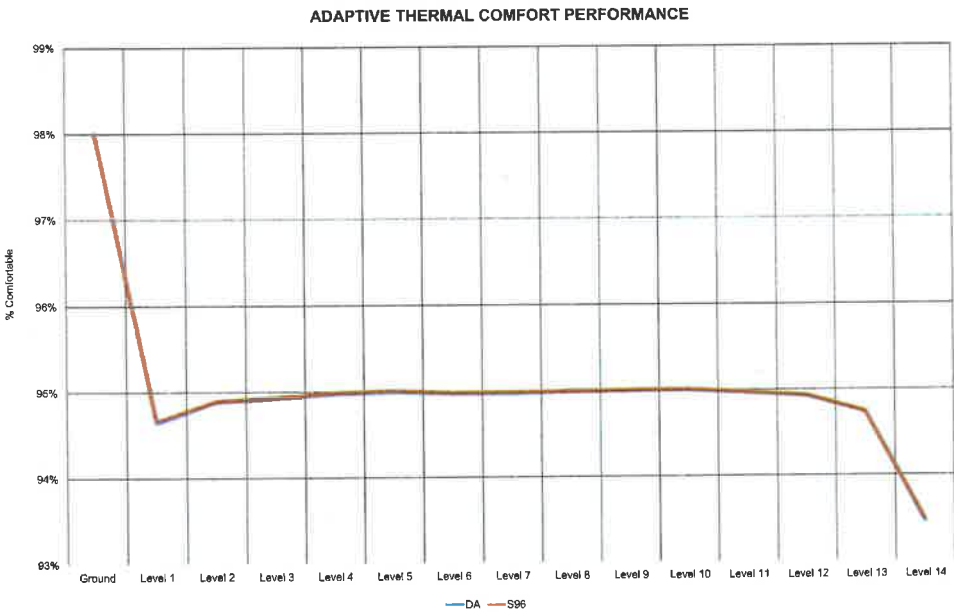


Figure 6: Area-weighted percentage of annual occupied hours deemed comfortable for each lightwell-connected apartment

Table 2: Adaptive thermal comfort performance for all the lightwell-connected apartments

	DA Design					S96 Design				
	Too Cold	Cool	Comfortable	Warm	Too Hot	Too Cold	Cool	Comfortable	Warm	Too Hot
Ground	0.0%	1.7%	98.0%	0.3%	0.1%	0.0%	1.6%	98.0%	0.3%	0.1%
Level 1	0.0%	4.5%	94.7%	0.6%	0.3%	0.0%	4.5%	94.7%	0.6%	0.3%
Level 2	0.0%	4.2%	94.9%	0.6%	0.3%	0.0%	4.2%	94.9%	0.6%	0.3%
Level 3	0.0%	4.2%	94.9%	0.6%	0.3%	0.0%	4.2%	94.9%	0.6%	0.3%
Level 4	0.0%	4.1%	95.0%	0.6%	0.3%	0.0%	4.1%	95.0%	0.6%	0.3%
Level 5	0.0%	4.1%	95.0%	0.6%	0.3%	0.0%	4.1%	95.0%	0.6%	0.3%
Level 6	0.0%	4.1%	95.0%	0.6%	0.3%	0.0%	4.1%	95.0%	0.6%	0.3%
Level 7	0.0%	4.1%	95.0%	0.6%	0.3%	0.0%	4.1%	95.0%	0.6%	0.3%
Level 8	0.0%	4.1%	95.0%	0.6%	0.4%	0.0%	4.1%	95.0%	0.6%	0.4%
Level 9	0.0%	4.1%	95.0%	0.6%	0.4%	0.0%	4.0%	95.0%	0.6%	0.4%
Level 10	0.0%	4.0%	95.0%	0.6%	0.4%	0.0%	4.0%	95.0%	0.6%	0.4%
Level 11	0.0%	4.1%	95.0%	0.6%	0.4%	0.0%	4.1%	95.0%	0.6%	0.4%
Level 12	0.0%	4.1%	94.9%	0.6%	0.4%	0.0%	4.1%	94.9%	0.6%	0.4%
Level 13	0.0%	4.3%	94.8%	0.6%	0.3%	0.0%	4.3%	94.8%	0.6%	0.4%
Level 14	0.0%	5.7%	93.5%	0.5%	0.3%	0.0%	5.7%	93.5%	0.5%	0.3%

68 hours of the year or 1 of 52 weeks deemed cool

3,935 hours of the year or 51 of 52 weeks deemed comfortable

Indoor Air Quality - Findings

As seen in Figure 7, there is no negligible variance in the IAQ performance between the original DA and modified S96 architectural designs for the Ground to Level 14 lightwell-connected apartments in the neighbouring building.

The modified S96 architectural design poses no additional impact to the IAQ performance of the neighbouring building.

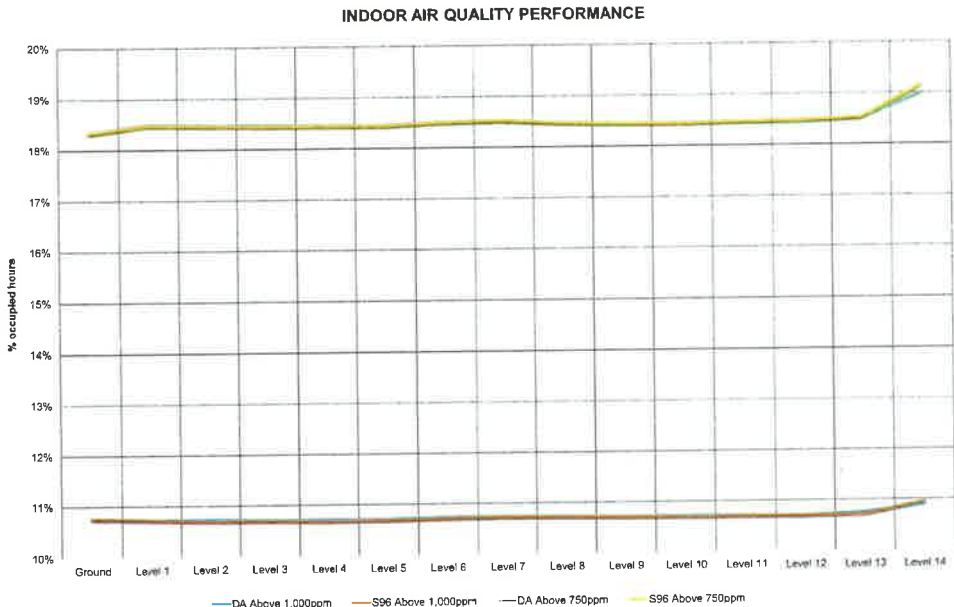


Figure 7: Area-weighted percentage on annual occupied hours of 750ppm and 1,000ppm exceedances for each lightwell-connected apartment

The modified S96 architectural design demonstrates the same natural cross ventilation performance in the neighbouring building as the original DA architectural design.

DAYLIGHT ANALYSIS

Daylight analysis is the investigation of how much sunlight enters a building. This has been measured using the following unit:

- Lux level – the amount of illumination at 0.7m above finished floor level

The daylight calculations have been undertaken using the analysis tools embedded within the Tas version 9.3.3 software tool. Daylight performance has only been assessed for the lightwell-connected bedrooms attributed to the neighbouring building. The analysis is based on a CIE uniform design sky at midday on the 21st of December (summer) and the 21st of June (winter). The surface reflectance of the walls along the lightwell has also been considered as shown in Figure 8. These values are based on the external paint to be used for the proposed development.

Daylight Analysis - Findings

Figure 8 details the solar reflectance performance of the lightwell and setback walls under the original DA and modified S96 architectural design proposals. The original DA architectural design aligns with consent condition C40, i.e. assumes an appropriate finish to improve reflected light within the lightwell. The modified S96 architectural design seeks to enhance this outcome by further increasing the surface reflectance.

Table 3, and Figures 9-13 show the results of the daylight analysis for both the original DA and modified S96 architectural designs. There is an imperceptible variance in the daylight performance in the lightwell-connected bedrooms from the Ground Level through to Level 11. Variances from Levels 12 to 14 may be perceived but they are unlikely to impact amenity.

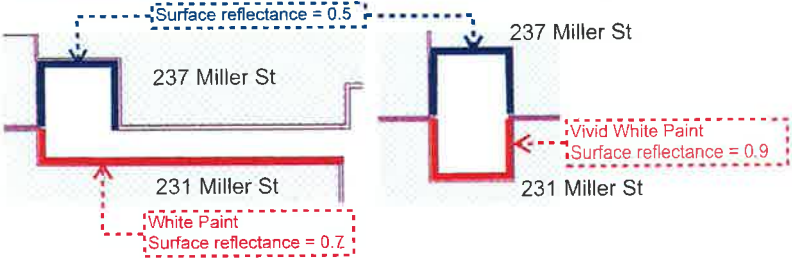


Figure 8: Surface reflectance of the lightwell and setback walls: DA design (left) and S96 design (right)

Table 3: Comparative daylight analysis results

LEVEL	DA - AVERAGE LUX		S96 - AVERAGE LUX	
	Summer	Winter	Summer	Winter
Ground	0.05	0.02	0.06	0.02
Level 1	0.05	0.02	0.06	0.02
Level 2	0.07	0.03	0.08	0.03
Level 3	0.11	0.04	0.10	0.04
Level 4	0.21	0.08	0.16	0.06
Level 5	0.53	0.20	0.28	0.10
Level 6	1.46	0.55	0.43	0.16
Level 7	2.36	0.88	0.73	0.28
Level 8	3.25	1.21	1.34	0.50
Level 9	4.64	1.82	2.63	1.04
Level 10	8.23	3.09	5.83	2.15
Level 11	16.83	6.26	13.12	4.95
Level 12	34.77	13.08	28.16	10.55
Level 13	81.47	30.50	65.02	24.25
Level 14	231.94	87.27	182.29	68.56

IMPERCEPTIBLE VARIANCE IN DAYLIGHT LEVELS

VARIANCE IN DAYLIGHT LEVELS MAY BE PERCEIVED BUT UNLIKELY TO IMPACT AMENITY

Daylight Performance

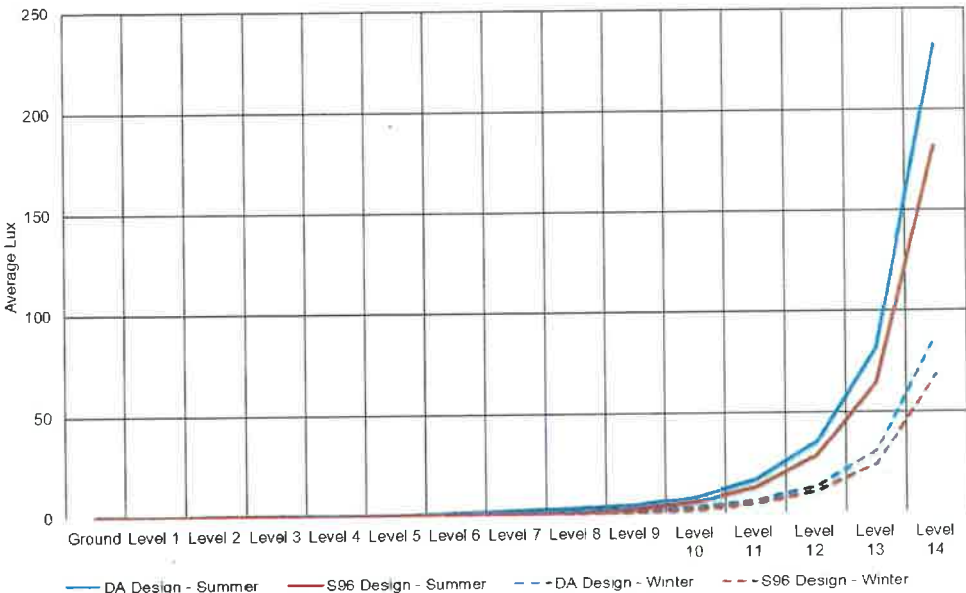


Figure 9: Summer and winter average Lux performance of each lightwell-connected bedroom



Figure 10: DA design - summer Lux levels in the lightwell-connected bedrooms at Levels 1, 5 and 14

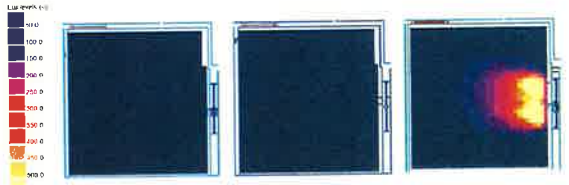


Figure 12: DA design - winter Lux levels in the lightwell-connected bedrooms at Levels 1, 5 and 14

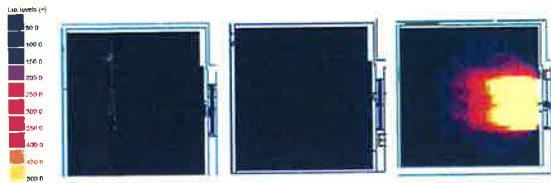


Figure 11: S96 design - summer Lux levels in the lightwell-connected bedrooms at Levels 1, 5 and 14



Figure 13: S96 design - winter Lux levels in the lightwell-connected bedrooms at Levels 1, 5 and 14

DAYLIGHT ANALYSIS

Daylight Analysis - Alternative Solution

Figure 14 presents a recommended enhancement to the surface reflectance of the lightwell walls under the modified S96 architectural design, i.e. the application of a high surface reflectance finish to both the lightwell walls of 231 and 237 Miller Street.

Table 4, and Figures 15-19 show the results of the daylight analysis for both the original DA and modified S96 architectural designs with this further surface reflectance enhancement. There is an imperceptible variance in the daylight performance in the lightwell-connected bedrooms. Overall, the modified S96 architectural design shows an improved performance over the original DA architectural design.

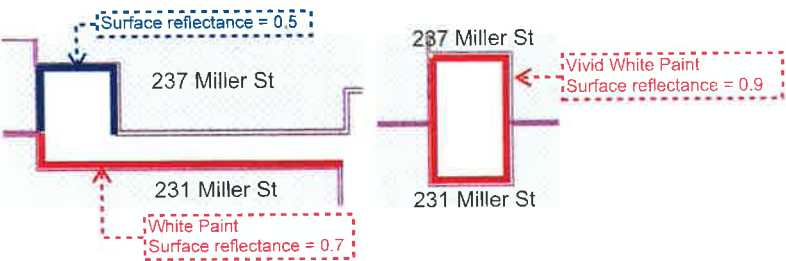


Figure 14: Surface reflectance of the lightwell and setback walls: DA design (left) and S96 design (right)

Table 4: Comparative daylight analysis results if the lightwell walls for both properties have been enhanced

LEVEL	DA - AVERAGE LUX		S96 - AVERAGE LUX	
	Summer	Winter	Summer	Winter
Ground	0.05	0.02	0.26	0.10
Level 1	0.05	0.02	0.13	0.05
Level 2	0.07	0.03	0.16	0.06
Level 3	0.11	0.04	0.21	0.09
Level 4	0.21	0.08	0.33	0.12
Level 5	0.53	0.20	0.57	0.21
Level 6	1.46	0.55	0.97	0.37
Level 7	2.36	0.88	1.89	0.72
Level 8	3.25	1.21	3.84	1.44
Level 9	4.64	1.82	7.97	3.03
Level 10	8.23	3.09	15.62	5.81
Level 11	16.83	6.26	29.48	11.07
Level 12	34.77	13.08	53.82	20.15
Level 13	81.47	30.50	103.49	38.66
Level 14	231.94	87.27	230.06	86.46

IMPERCEPTIBLE VARIANCE IN DAYLIGHT LEVELS

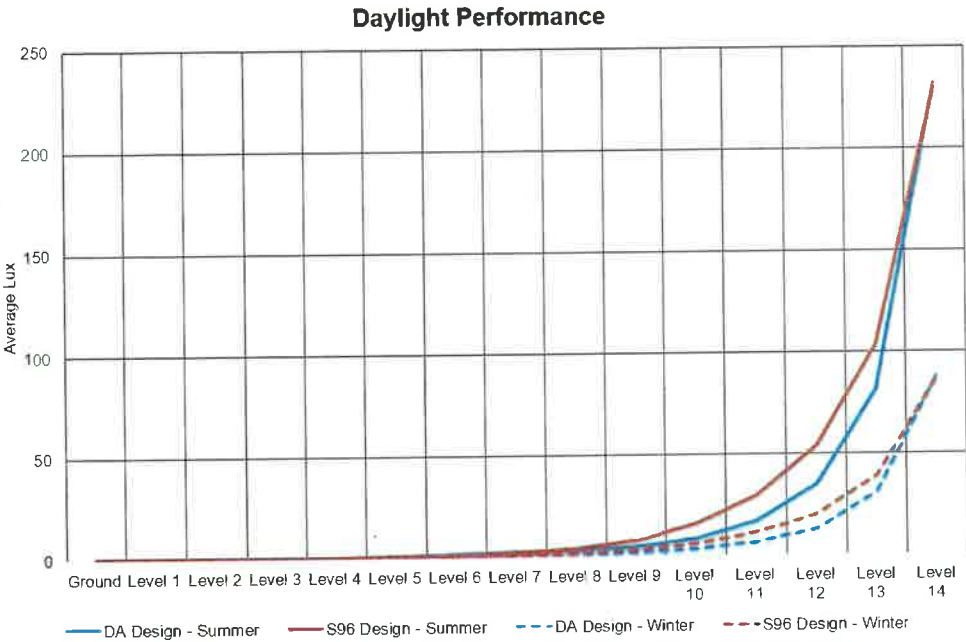


Figure 15: Summer and winter average Lux performance of each lightwell-connected bedroom

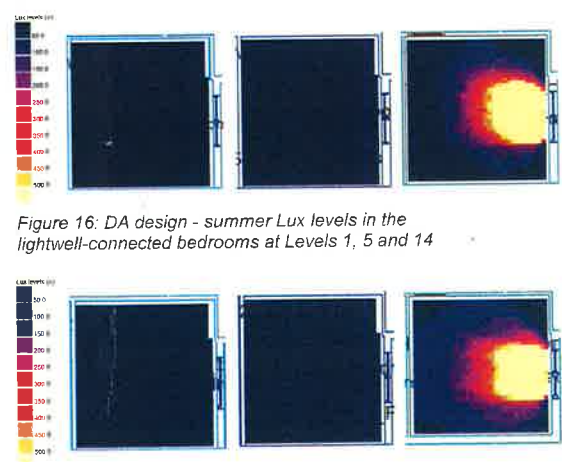


Figure 16: DA design - summer Lux levels in the lightwell-connected bedrooms at Levels 1, 5 and 14

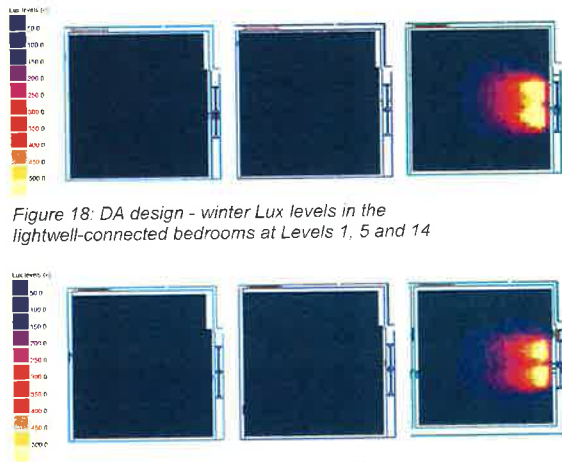


Figure 18: DA design - winter Lux levels in the lightwell-connected bedrooms at Levels 1, 5 and 14

Figure 17: S96 design - summer Lux levels in the lightwell-connected bedrooms at Levels 1, 5 and 14

Figure 19: S96 design - winter Lux levels in the lightwell-connected bedrooms at Levels 1, 5 and 14

CONCLUSIONS

The comparative performance study has determined the following:

1. NATURAL CROSS VENTILATION PERFORMANCE

The natural cross ventilation performance of the lightwell-connected apartments associated with 237 Miller Street, North Sydney is the same under both of the architectural design options for the proposed development at 231 Miller Street, North Sydney - the original DA and modified S96 architectural designs. This is demonstrated on the basis of a consistent adaptive thermal comfort and indoor air quality performance for all levels (Ground Floor to Level 14) under the two comparative thermal models developed.

2. DAYLIGHT PERFORMANCE

A variance in the daylight performance of the lightwell-connected bedrooms associated with 237 Miller Street, North Sydney may be perceived for Levels 12 - 14 but is unlikely to impact amenity. The application of a recommended enhancement to increase the surface reflectance of the lightwell wall of the neighbouring building results in an improved daylight performance over the original DA architectural design.

Thus it can be demonstrated that the original conclusions put to the JRPP by Council within their Council Assessment Report - setback and extended lightwell strategies (see Figure 2) - deliver the same amenity to the lightwell-connected apartments associated with 237 Miller Street, North Sydney.

The proposals presented under the modified S96 architectural design align with the Council's intent to mitigate any impact to the amenity of the lightwell-connected apartments associated with 237 Miller Street, North Sydney. This is demonstrated by the comparative performance study undertaken and the results presented in this report.

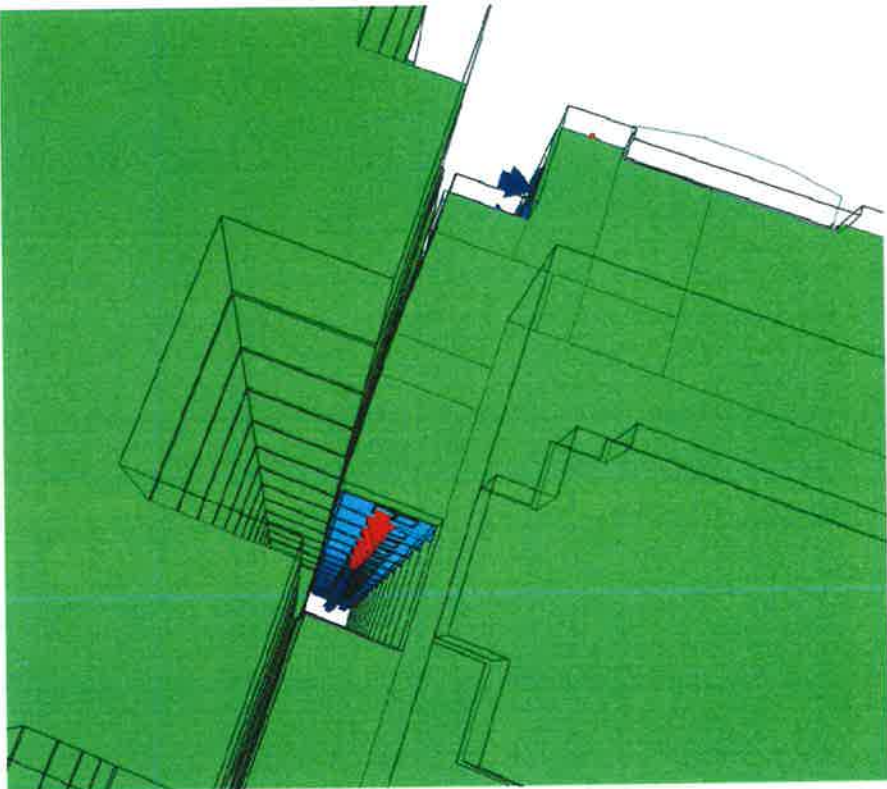


Figure 20: S96 design - natural cross ventilation effectiveness of the extended lightwell option