

CONSULTANTS ADVICE

FOR 104-116 REGENT ST REDFERN NSW

PROJECT NAME:	104-116 Regent St Redfern NSW
Our Reference:	CA01- 046-2101
ATTENTION:	City of Sydney Council
FROM:	Ben Shojaei
Reference:	SSD-12618001 – Response to Council Comments – R/2020/17/A

This Consultants Advice has been prepared in relation to the Council's comments Ref: R/2020/17/A, File: 2022/059877.

The relevant items on Pages 5 and 8-9 have been addressed below.

City of Sydney Council:

Page 5

However, the ventilation report is unclear about whether air conditioning is proposed and provides no summary of which rooms are proposed as alternatively ventilated in line with the acoustic report recommendations. The ventilation report does not provide sufficient detail on how air is supplied or how the design of the ducts is integrated into the design of building and its interface with the facade.

Vipac Engineers:

We confirm that all rooms have access to air-conditioning. The reason for mechanical ventilation of the outside air is that Natural Ventilation may be limited due to acoustic reasons. Therefore, ducted ventilation is provided to ensure occupants' comfort and access to fresh air.

The operable windows will be always available as well as the ducted ventilation system, which is provided in addition to the operable windows.

Please note, the energy consumption of the proposed mechanical ventilation system is offset by the proposed Solar PV system and therefore the proposed system does not result in any additional carbon emission. The simulated energy generation for a 17.2 kW system, (i.e. what we can fit on the roof) is 24,424 kWh p.a., which is more than the simulated consumption for the mechanical ventilation system, 22,037kWh p.a.

The proposed Solar PV system is not a BASIX requirement (i.e. the development achieves BASIX compliance without Solar PV with Energy score of 28 out of 25).

Please refer to the latest revision of the *Alternative Performance Solution Report for Natural Ventilation* based on a 17.2 kW Solar PV system provided in Annexure A.

City of Sydney Council:

Page 8-9

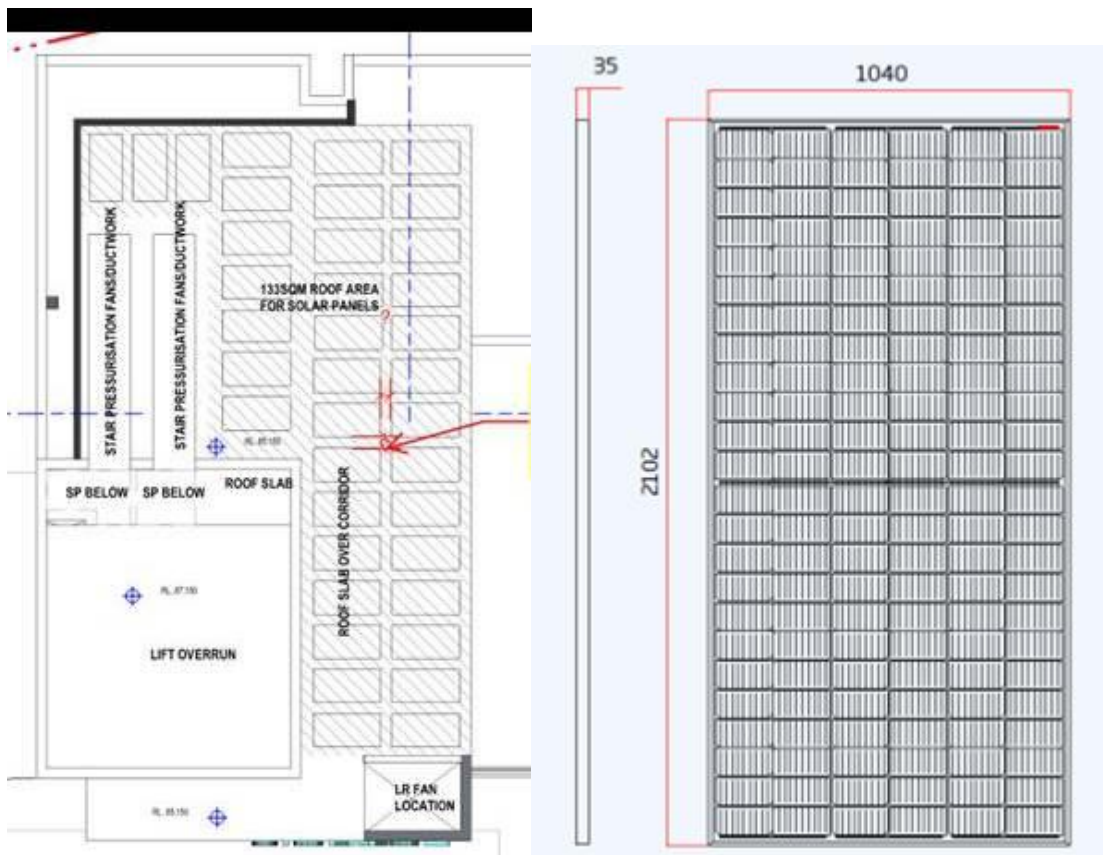
Further, there are discrepancies with the information submitted regarding the development's photovoltaic system. The submitted architectural plans indicate solar panels to be located on the roof. However, the BASIX requirements of 40-kilowatt peak capacity will require

approximately 280 square metres of roof area. This is confirmed in Vipac's Ventilation Report, that suggests 130 panels are needed. The Report also indicates that the development will house an on-site battery system to store renewable energy. The proposal must verify this intent and confirm that there is adequate roof area to accommodate the required solar panels. The system size in kilowatt peak is defined by BASIX and is not negotiable. Accordingly, the exact system sizing and configuration of the required solar panels must be confirmed and depicted in the architectural plans.

Vipac Engineers:

The proposed Solar PV system is voluntary and not a BASIX requirement. The development outperforms the BASIX energy compliance requirements without Solar PV, achieving an energy score of 28 out of 25.

Based on your comments, the PV system size has now been reduced to 17.2 kW (38 panels x 455W), see snapshot below for the roof layout and the PV panel dimensions. For clarity, whilst the design team will keep the Solar PV system, the system will be removed from the BASIX certificate to demonstrate that the development will achieve BASIX compliance without the PV System.



Signed on behalf of Vipac Engineers & Scientists.



Ben Shojaei

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Annexure A – Alternative Performance Solution Report for Natural Ventilation



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104-116 Regents St, Redfern NSW

Alternative Performance Solution for Natural
Ventilation

20E-21-0052-TRP-25845-1

3 June 2022

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Report Title: Alternative Performance Solution for Natural Ventilation	
Document Reference: 20E-21-0052-TRP-25845-	
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Executive Summary

VIPAC Engineers and Scientists have been engaged to perform CFD assessment and comment on the effectiveness of the proposed mechanical ventilation system for the student accommodation development at 104-116 Regent St, Redfern NSW.

Dynamic simulation (using Design Builder software) has been used to determine the percentage of the year in which minimum performance requirements have been met for the habitable rooms provided with alternative means of ventilation due to external noise level conditions. The proposed mechanical ventilation design has been evaluated using Computational Fluid Dynamic (CFD) simulation to determine the overall impact on the following:

- Energy Efficiency – reduction in the Air-conditioning energy consumption (given the reduced reliance on active air-conditioning),
- Age of the indoor air,
- Thermal Comfort (PMV).

Applicable rooms have been evaluated to demonstrate the following performance requirements are achieved for a minimum 90% of all hours of the year:

- If the habitable area is less than the threshold area: 10 litres/second/person for each apartment, where the number of people equals the number of bedrooms plus 1, or
- If the habitable area is more than or equal to the threshold area: 0.3 litres/second/m² for each apartment.

Each habitable room provided with alternative means of natural ventilation has also been assessed for adequate ventilation of 10 litres/second per person.

A tabulated summary of results is presented in Table 1 below. The results demonstrate that the assessed habitable rooms meet the minimum performance requirements for greater than 90% of all hours of the year. As such, the minimum level of ventilation has been met and adequate ventilation is achieved via the alternative ventilation proposal.

Table 1. Result Summary.





Unit Type	Apartment area (Conditioned area) (m ²)	Number of occupants	Required volume flow rate (l/s)	% of year achieved
Type 1: Unit 05.06 - Studio A	13 m ²	1	10	100%
Type 2.1: Unit 05.01 – Bedroom 1	8 m ²	1	10	100%
Type 2.2: Unit 05.01 – Bedroom 2	8 m ²	1	10	100%
Type 3.1: Unit 05.14 – Bedroom 1	8 m ²	1	10	100%
Type 3.2: Unit 05.14 – Bedroom 2	8 m ²	1	10	100%

Furthermore, the simulation has demonstrated that the proposed ventilation design will result in the following improvements:

- Overall Energy Efficiency,
- Thermal Comfort (i.e. PMV),
- Age of air (freshness of the air).

The improvements are listed in **Error! Reference source not found..**

Table 2.Improvements.

	Without Ventilation	With Ventilation	Improvement (%)
Heating (KWh p.a. for all tested units)	87	591	
Cooling (KWh p.a. for all tested units)	1789	978	
Total (KWh)	1876	1569	 16.4%
Energy Per Conditioned Building Area (KWh/m ²)	42	35	 16.4%
Fraction Operation Hours between 21-24 degrees (%)	98.3%	98.8%	 0.5%
Fraction Operation Hours PMV with between -1 and 1 (% Thermal Comfort)	98.2%	98.5%	 0.3%

The simulations also demonstrated that the energy generated by the proposed Solar PV system will be sufficient to offset the energy consumption of the proposed mechanical ventilation system (Table 3).

Table 3. Solar Energy Generation.

Solar Energy Generation vs. Mechanical Ventilation Energy Consumption	
Estimated Annual Energy Consumption for Mechanical Ventilation	22,037 kWh p.a.
Estimated Annual Solar PV Energy Generation (based on a 17.2 kW system)	26,105 kWh p.a.

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1 Introduction

This report has been prepared for the proposed student accommodation development at 104-116 Regent St, Redfern NSW. The location of the development is shown in Figure 1.

The purpose of this study is to assess the effectiveness of the proposed mechanical ventilation design for the habitable rooms provided with alternative means of ventilation due to external noise level conditions.



Figure 1. Location of the development – 104-116 Regent St Redfern NSW– Source: Google Map.

1.1. Reference Documents

The assessment is based on the following architectural drawings prepared by Antoniades Architects (Table 4).

Table 4. Drawing List.

Drawing Title	Drawing Number
GA Plans	DA3.02 to DA3.10
Sections	DA4.01
Elevations	DA5.01 to DA5.03

2 Modelling Parameters

2.1. Software

The ventilation simulations in this report are performed using the Design Builder (v7.0.0.082) modelling software.

2.2. Weather File

Historical hourly local weather data, in the form of twelve months' data, was used to represent the building external ambient data at the building location and to accurately model the dynamic nature of building thermal response. The weather data contains hourly records of radiation, temperature, humidity, sunshine duration and wind speed and direction for a typical meteorological year.

Based on the location of the development, the weather data from the closest weather station was used for the simulation of all models (Sydney Observatory Hill NSW, approx. 4km from the site). The weather station distance from site is illustrated in Figure 2. Table 5 outlines details of the simulation weather file. The Typical Meteorological Year (TMY) weather file represents a year without unusual extremes in temperature or typical average conditions, suitable for energy simulation modelling.

Table 5. Simulation weather file details.

Weather File Property	Value
Location	Sydney Observatory Hill
Weather File Type	The Typical Meteorological Year (TMY)

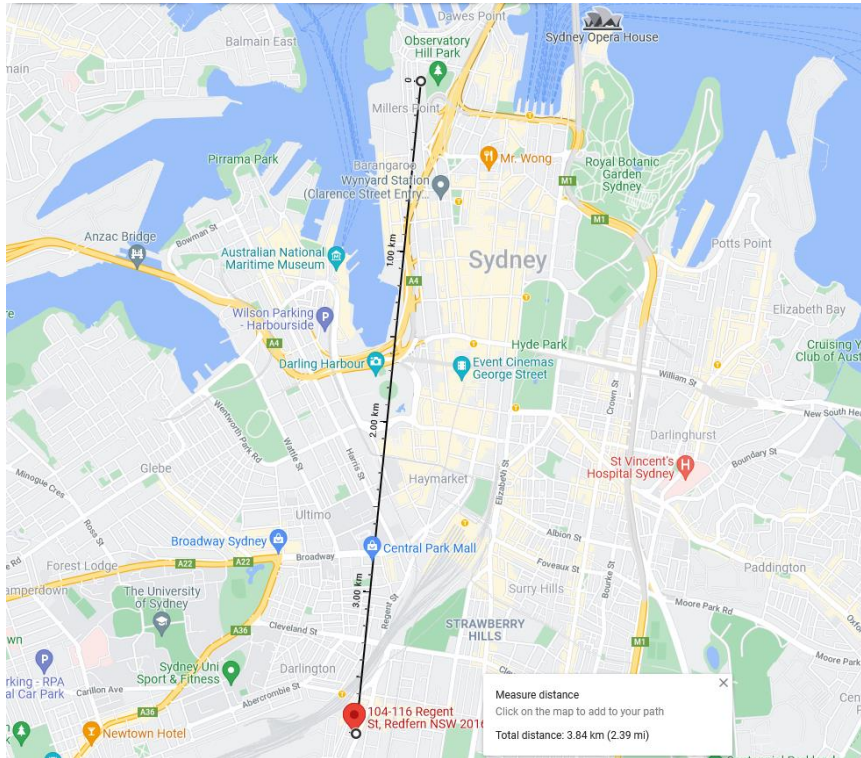


Figure 2. Weather Station distance from site.

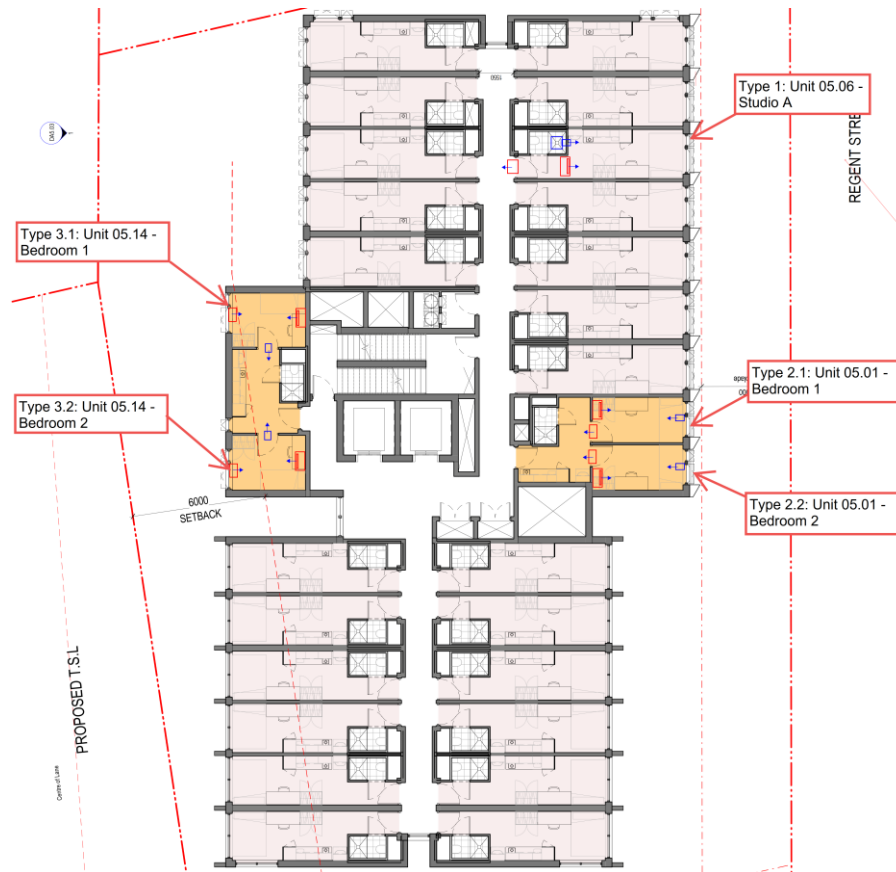
2.3. Site Data

In accordance with the Guidelines, a 'City' terrain type has been selected within the model.

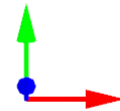
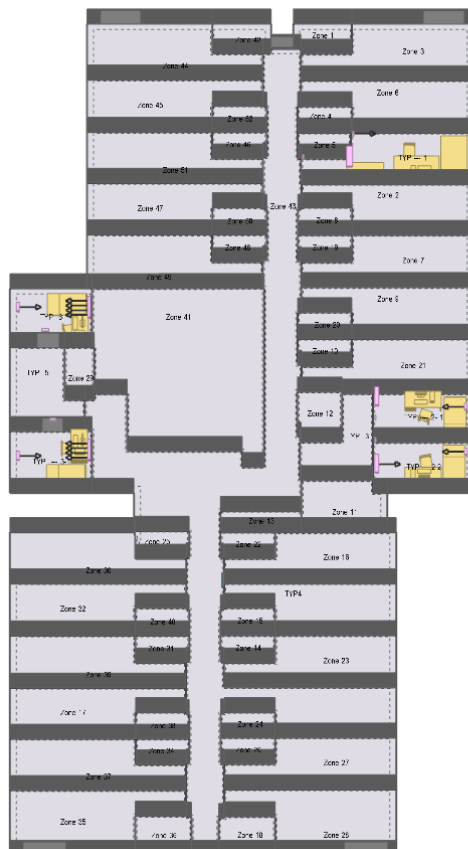
2.4. Assessed Rooms

The following worst-case scenario rooms (each unique layouts designs) have been assessed as part of this analysis. Arrangement and features of units have been modelled in the simulation.

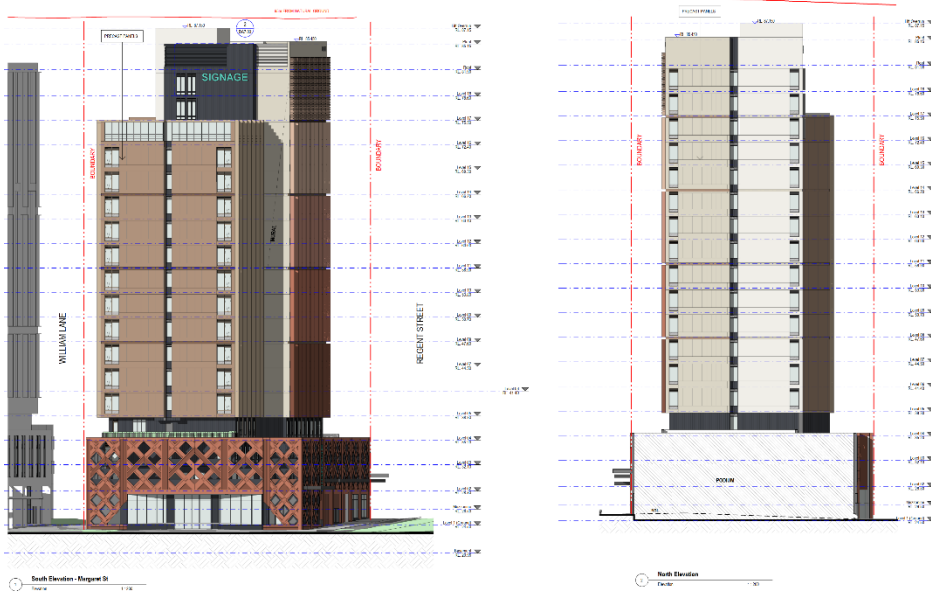
Floor Plans – Level 05 to 08 – Assessed Units:



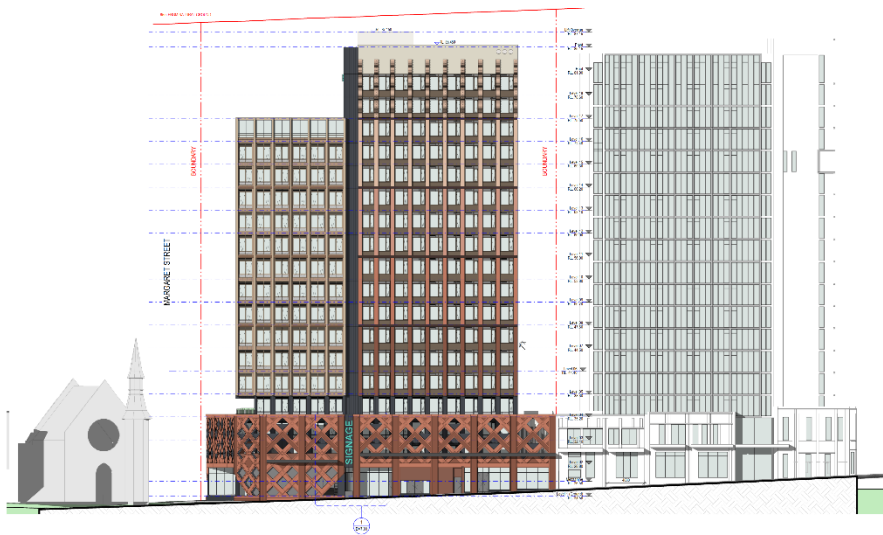
Design Builder Model of Level 5 to 8 and Assesses Units:



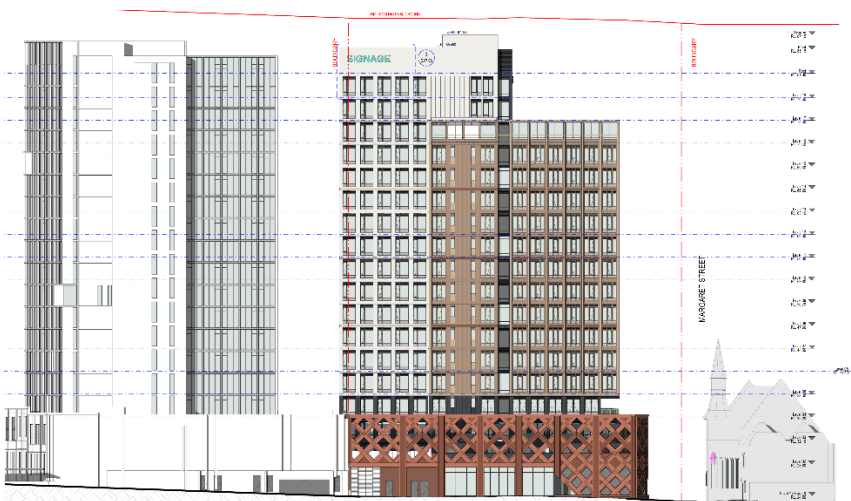
North and South Elevations



East Elevation



West Elevation



3 Simulation And Modelling Outcomes

3.1. Modelling

The CFD and energy simulations were performed using Design Builder (v7.0.0.082) modelling software.

3.2. Description of the Model

The following model was built to represent part of the CFD model represents the air that passes through the plenum from the outside to the rooms. The model geometry for the building is shown in Figure 3 below.

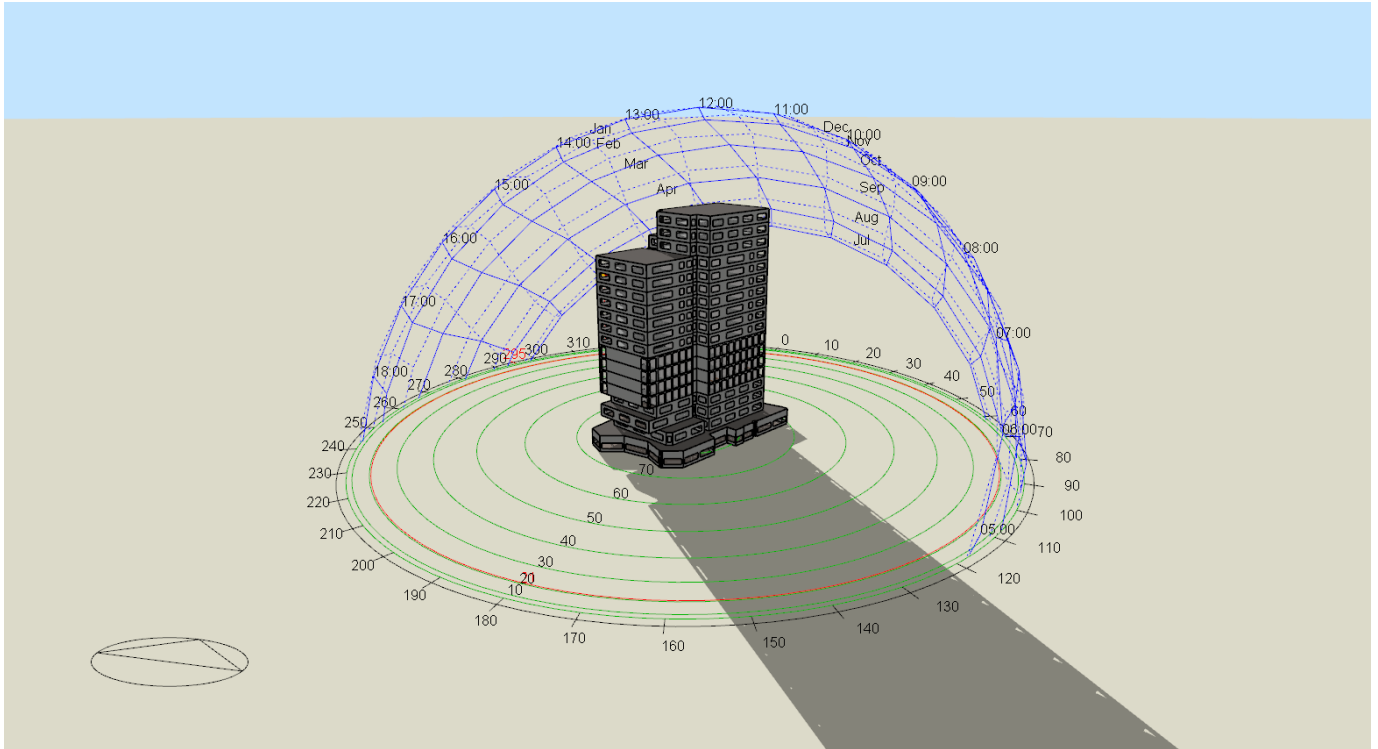


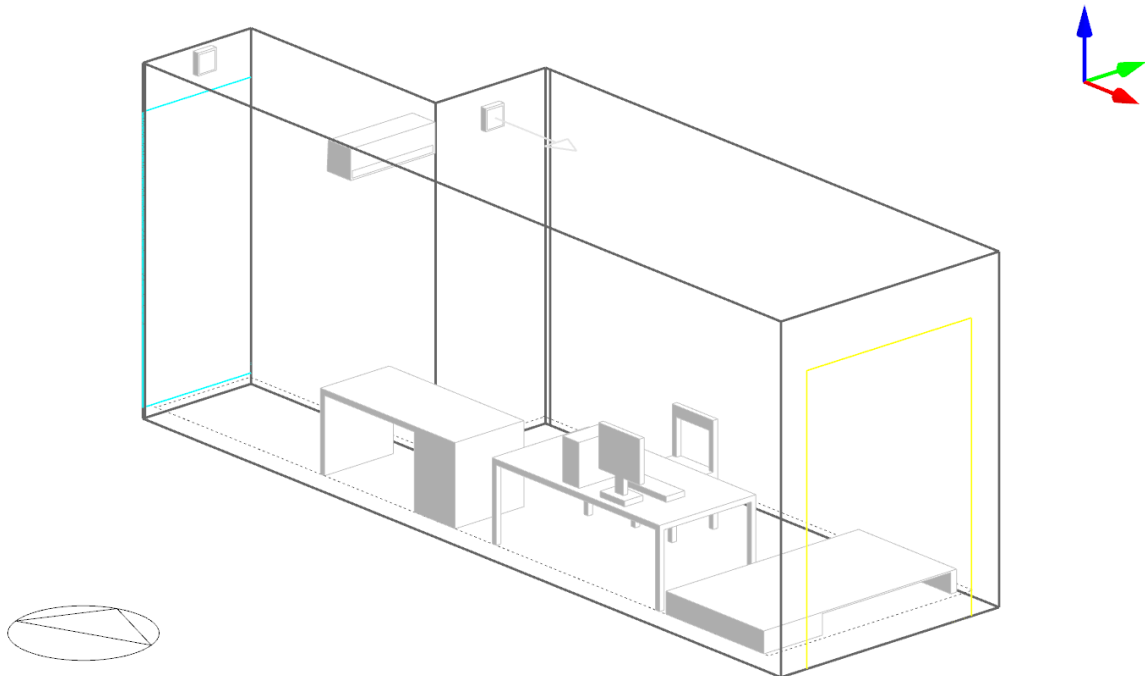
Figure 3. Design Builder Model Geometry – Overall View.

3.3. CFD Modelling Inputs

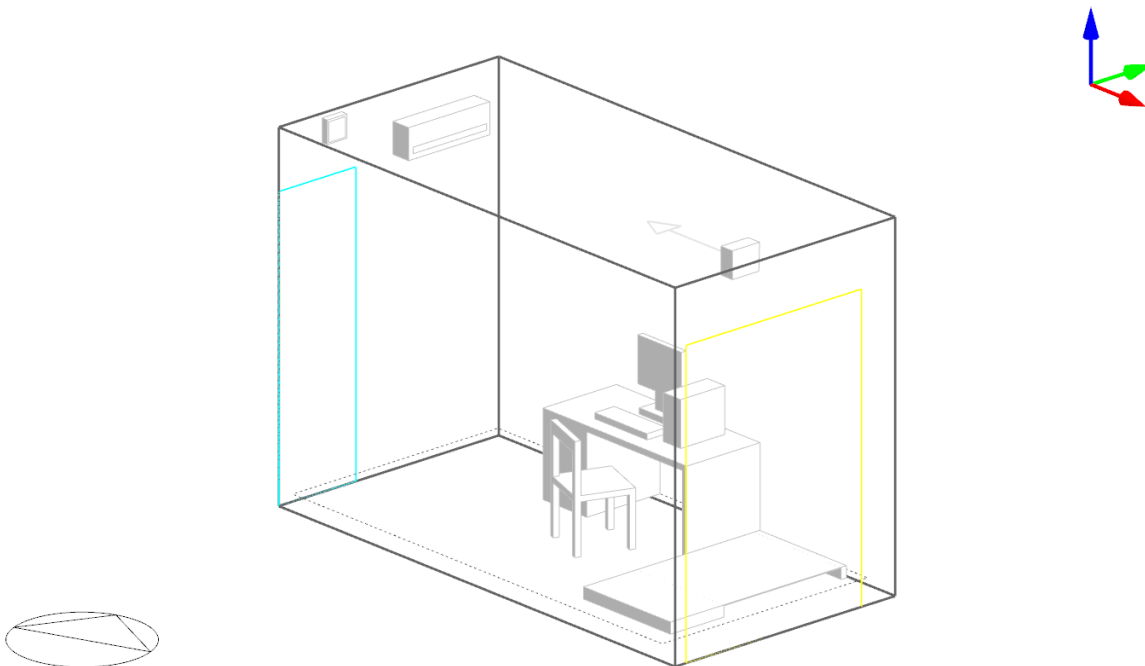
3.3.1. Geometry

Air is passed from the supply inlet to the ceiling mounted grill connected to the corridor via a rigid duct. All ventilation openings have been modelled to satisfy the mechanical design requirements for each layout type.

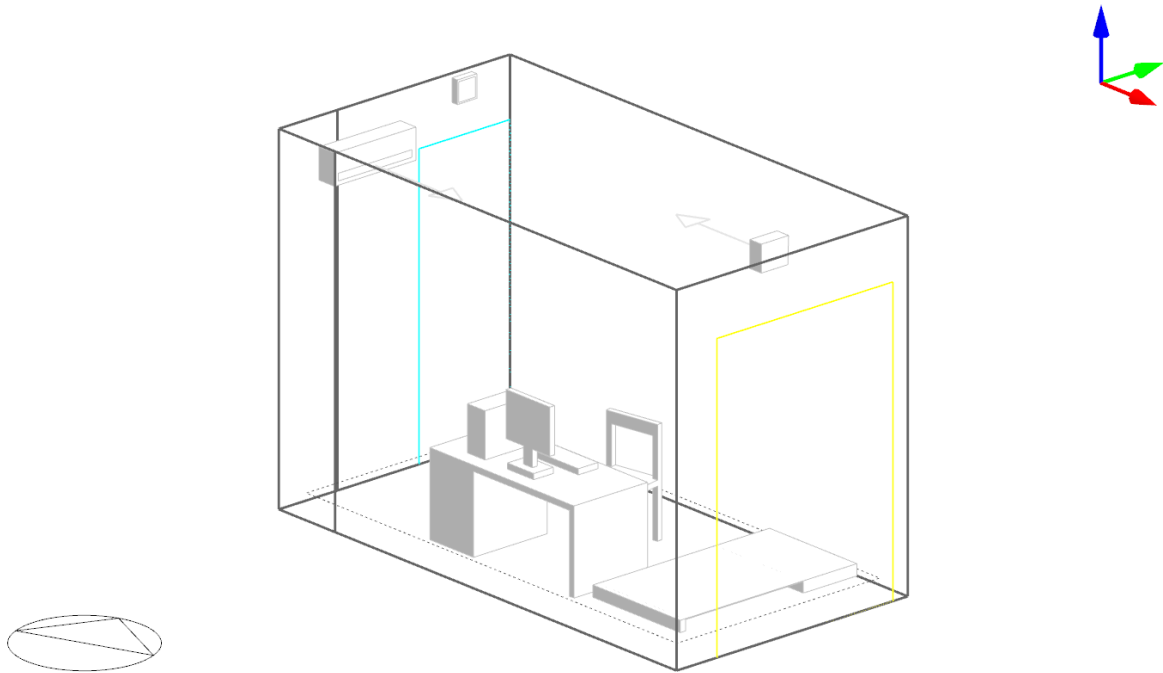
Type 1: Unit 05.06 - Studio A



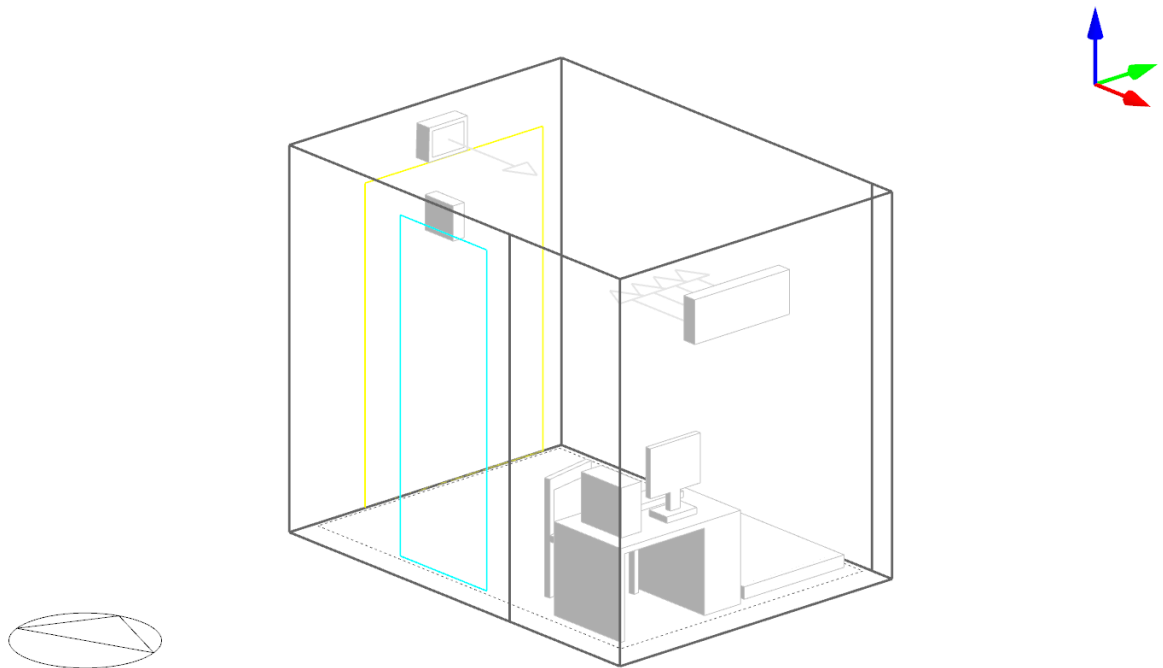
Type 2.1: Unit 05.01 – Bedroom 1



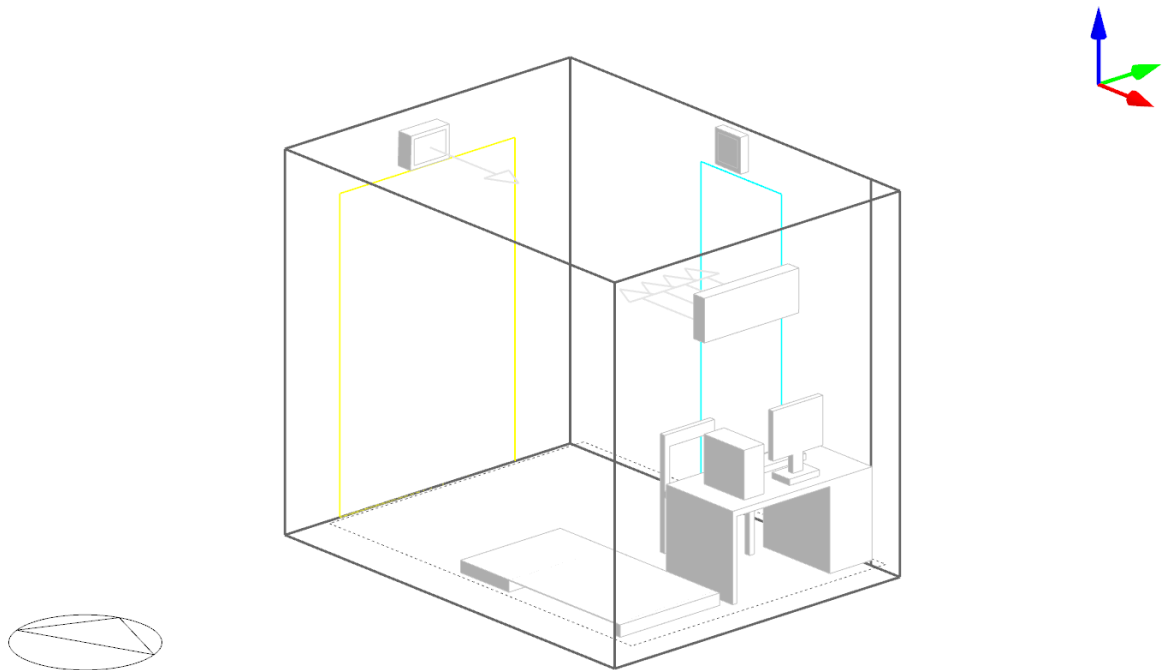
Type 2.2: Unit 05.01 – Bedroom 2



Type 3.1: Unit 05.14 – Bedroom 1

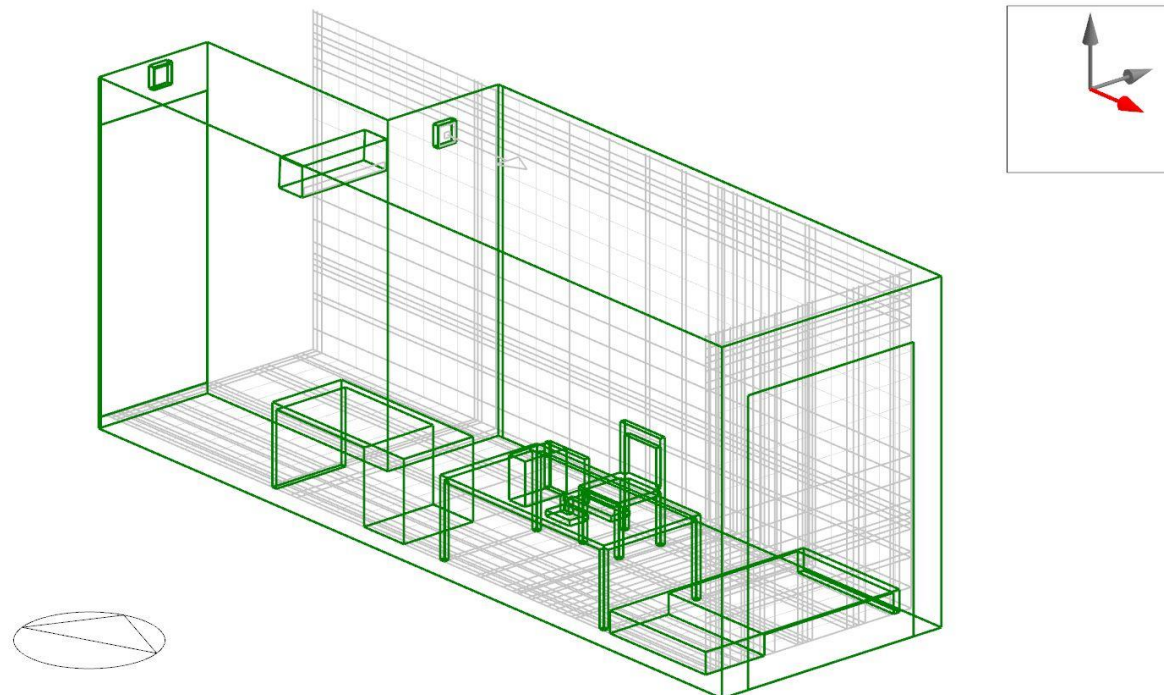


Type 3.2: Unit 05.14 – Bedroom 2

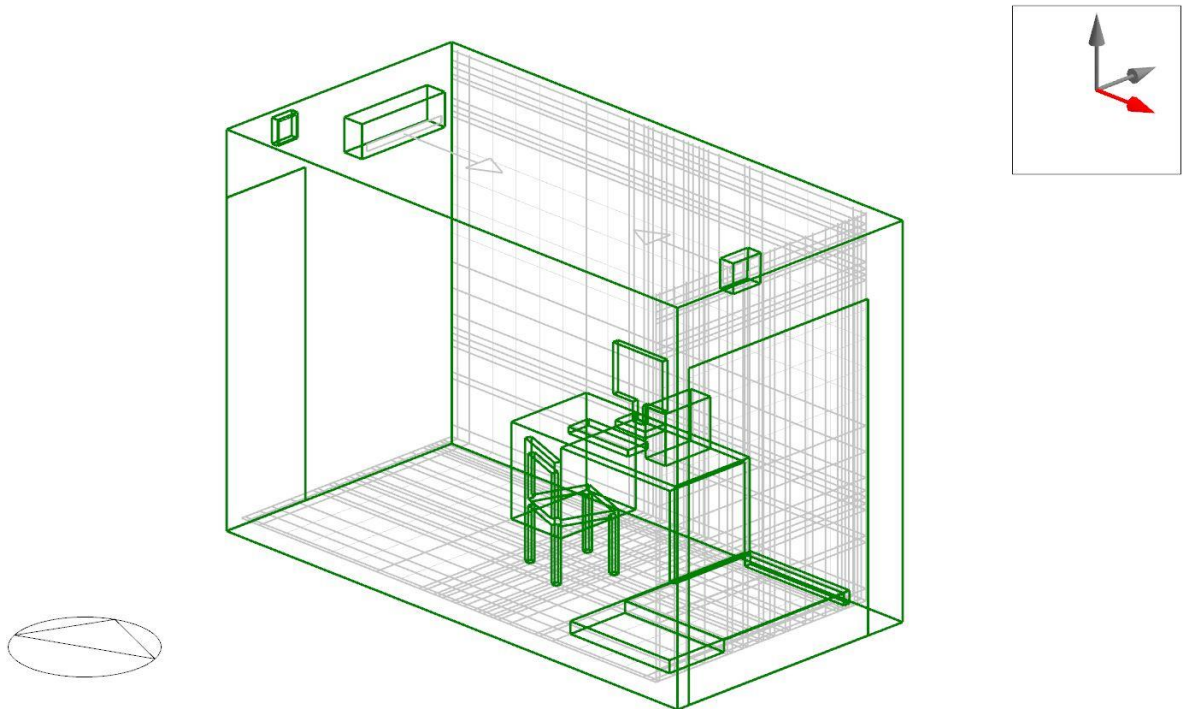


3.3.2. Mesh

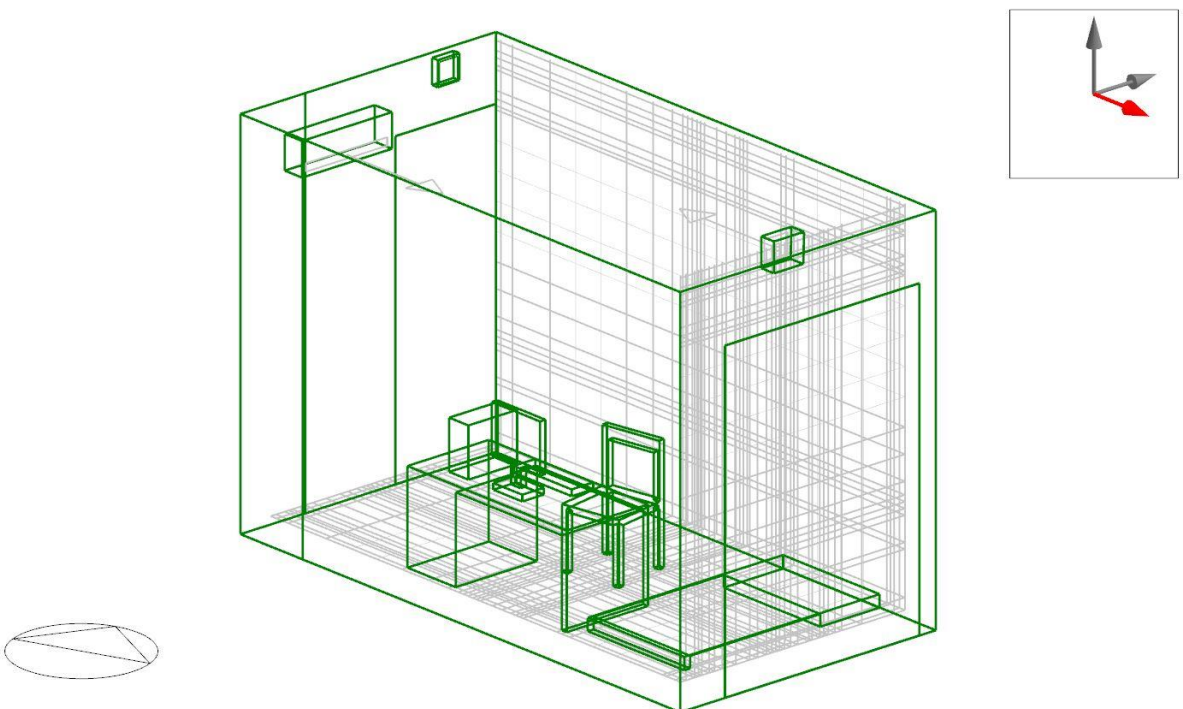
Type 1: Unit 05.06 - Studio A



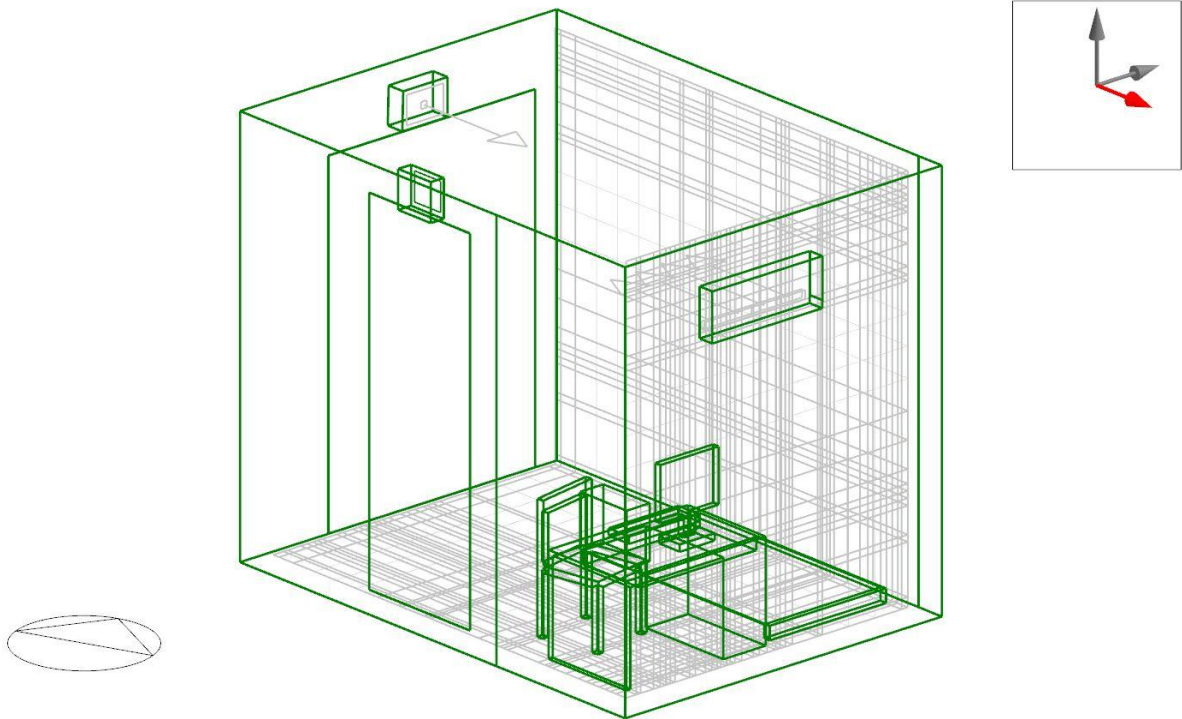
Type 2.1: Unit 05.01 – Bedroom 1



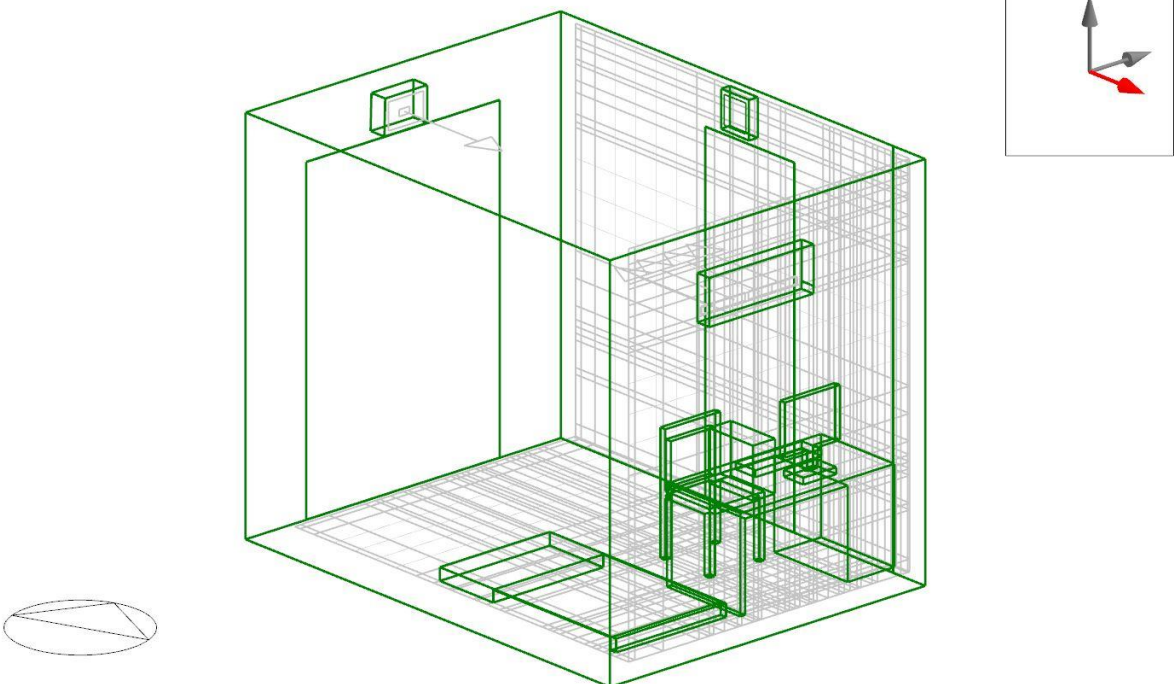
Type 2.2: Unit 05.01 – Bedroom 2



Type 3.1: Unit 05.14 – Bedroom 1



Type 3.2: Unit 05.14 – Bedroom 2



3.3.3. Boundary Conditions

The key boundary conditions applied to the model are shown in Figures below.

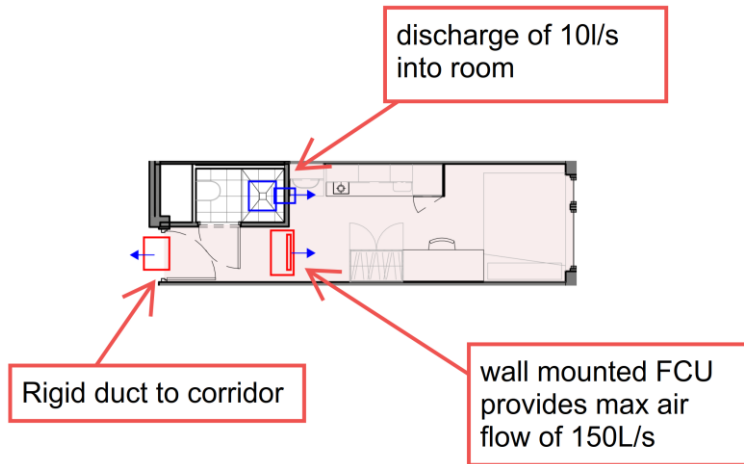


Figure 4. boundary conditions applied to the model – Unit Type 1.

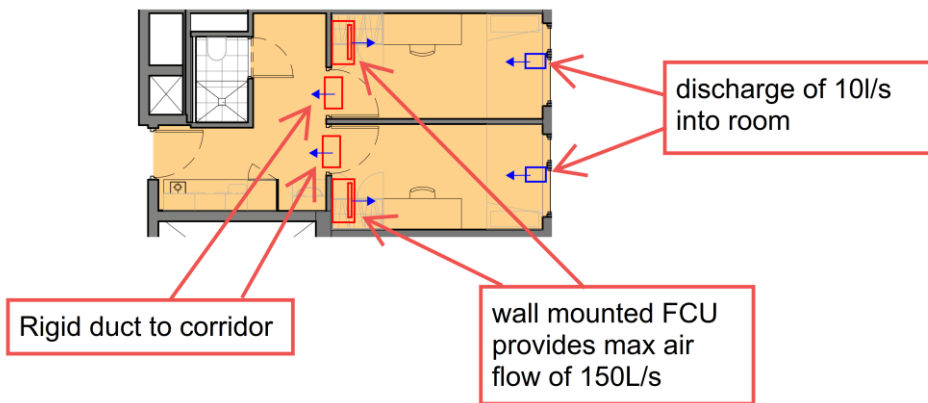


Figure 5. boundary conditions applied to the model – Units Type 2.

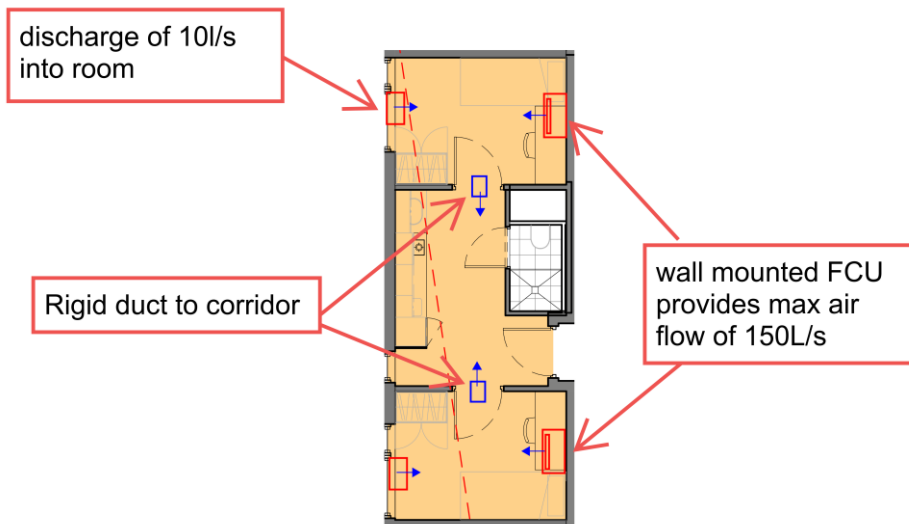
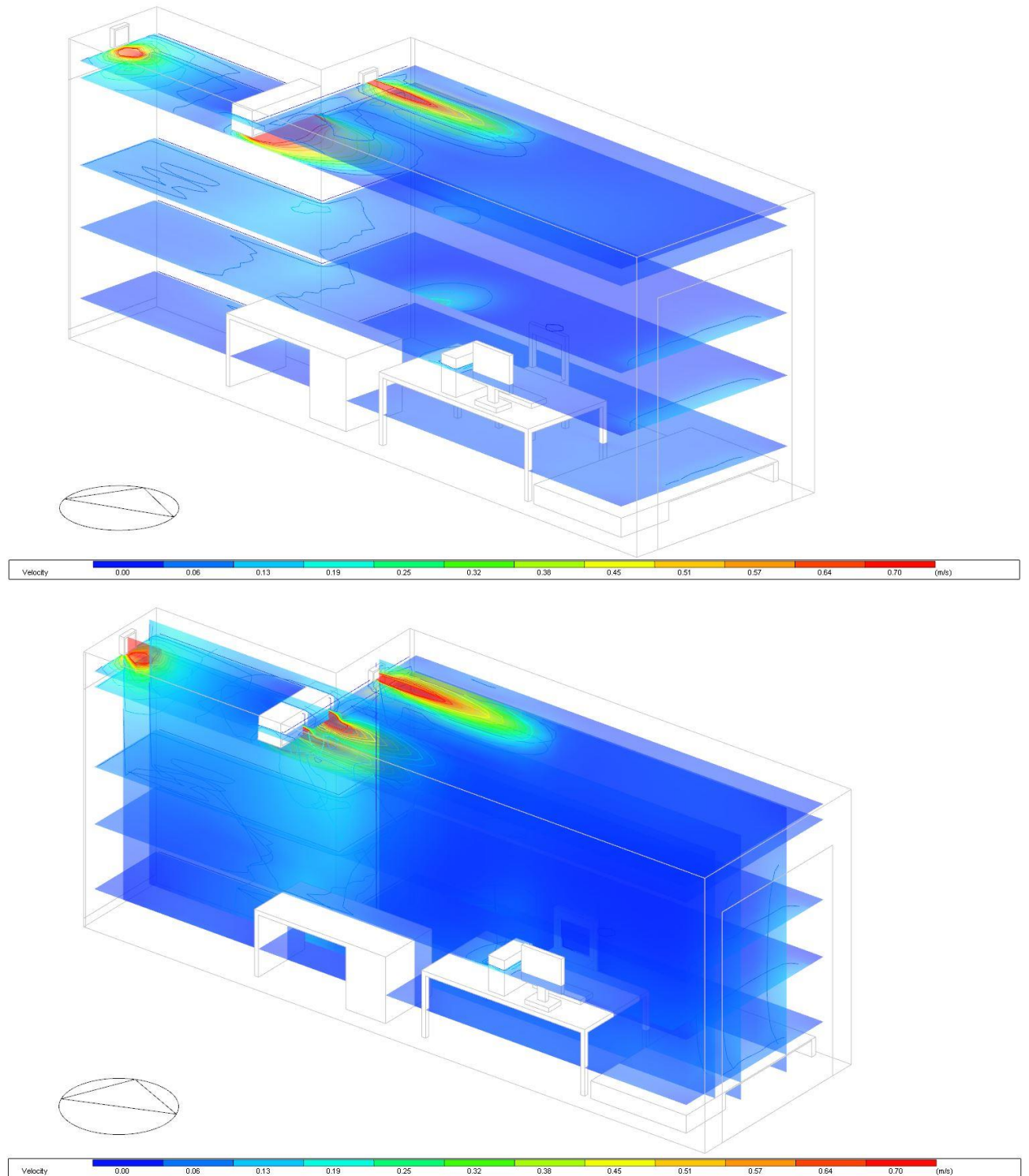


Figure 6. boundary conditions applied to the model – Units Type 3.

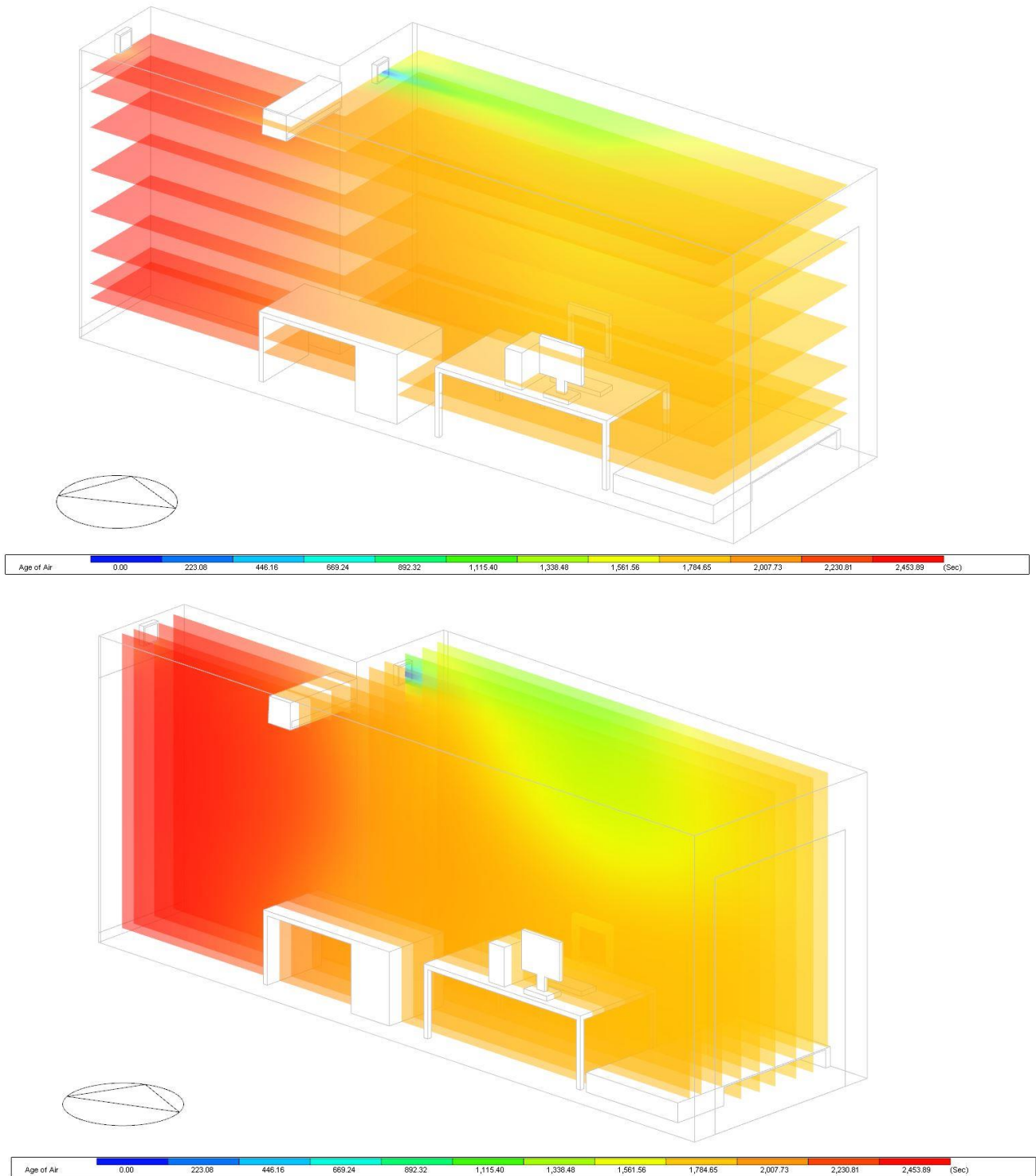
3.4. CFD Modelling Results

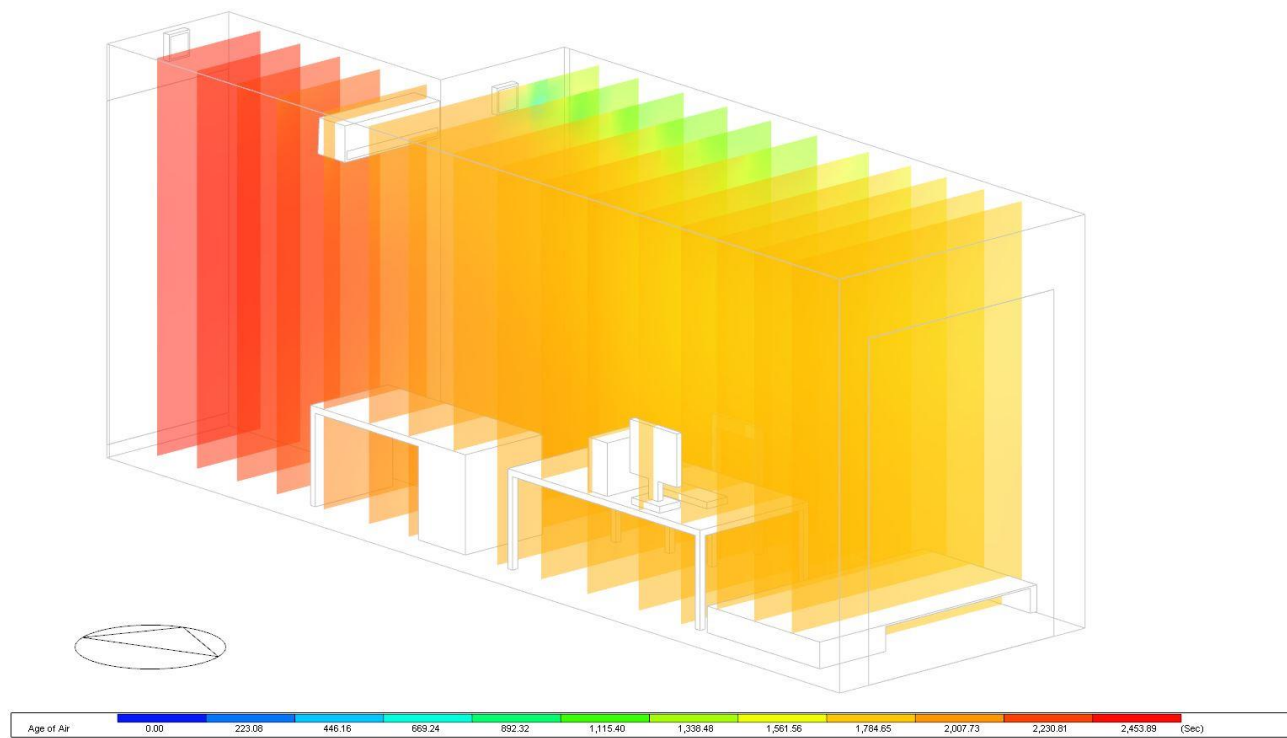
3.4.1. Unit Type 1

3.4.1.1. Velocity Contours



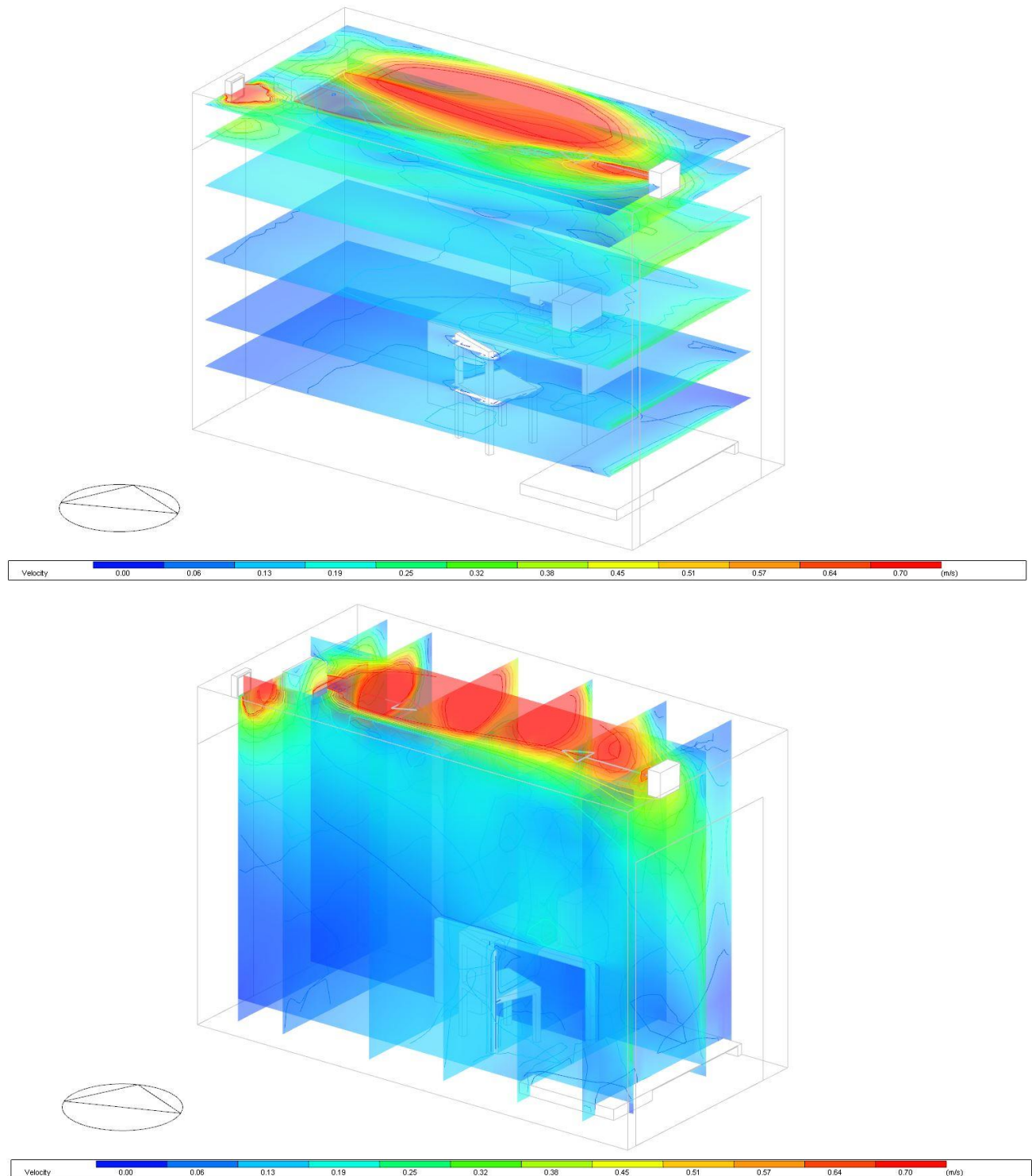
3.4.1.2. Age of Air Contours



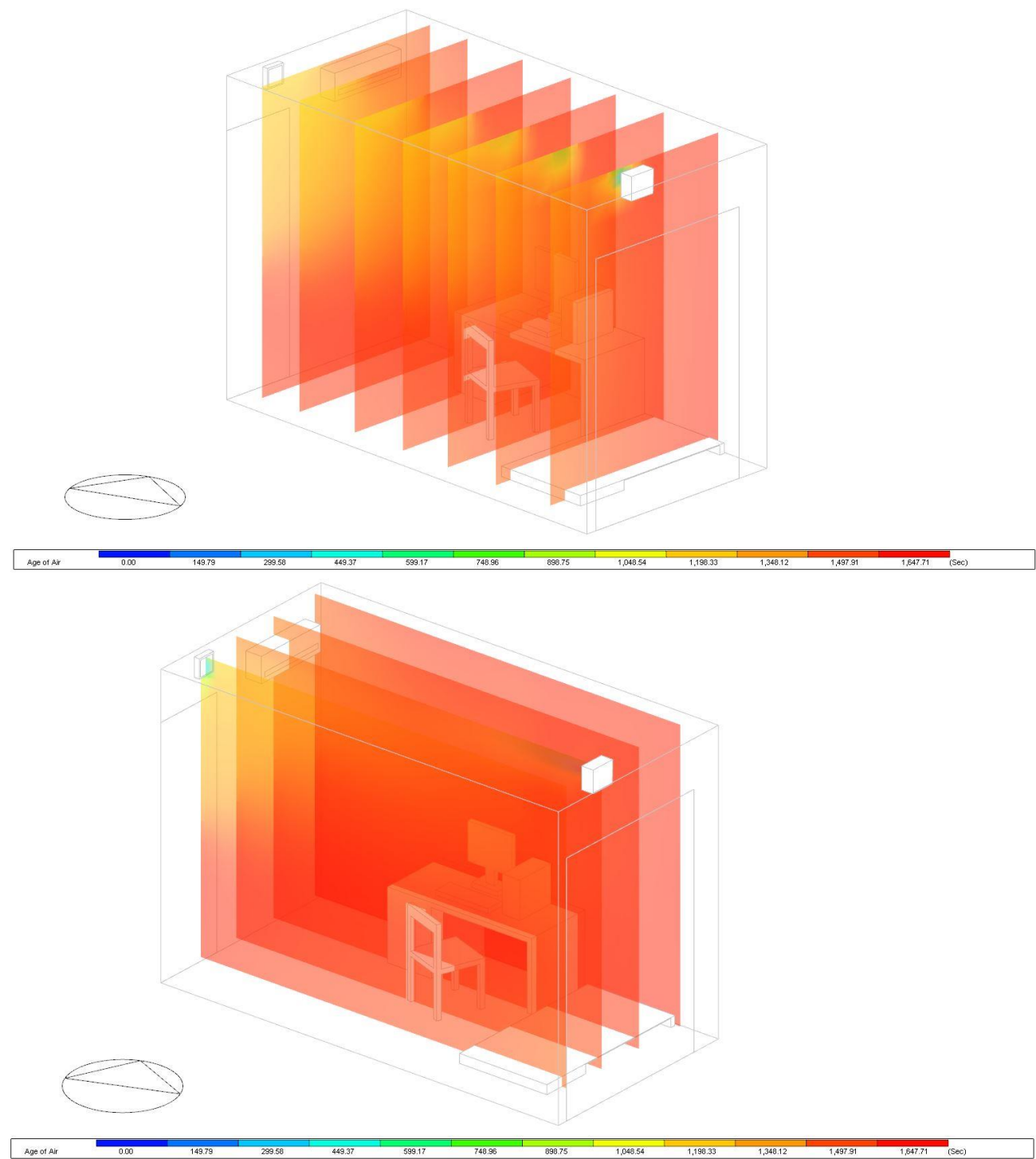


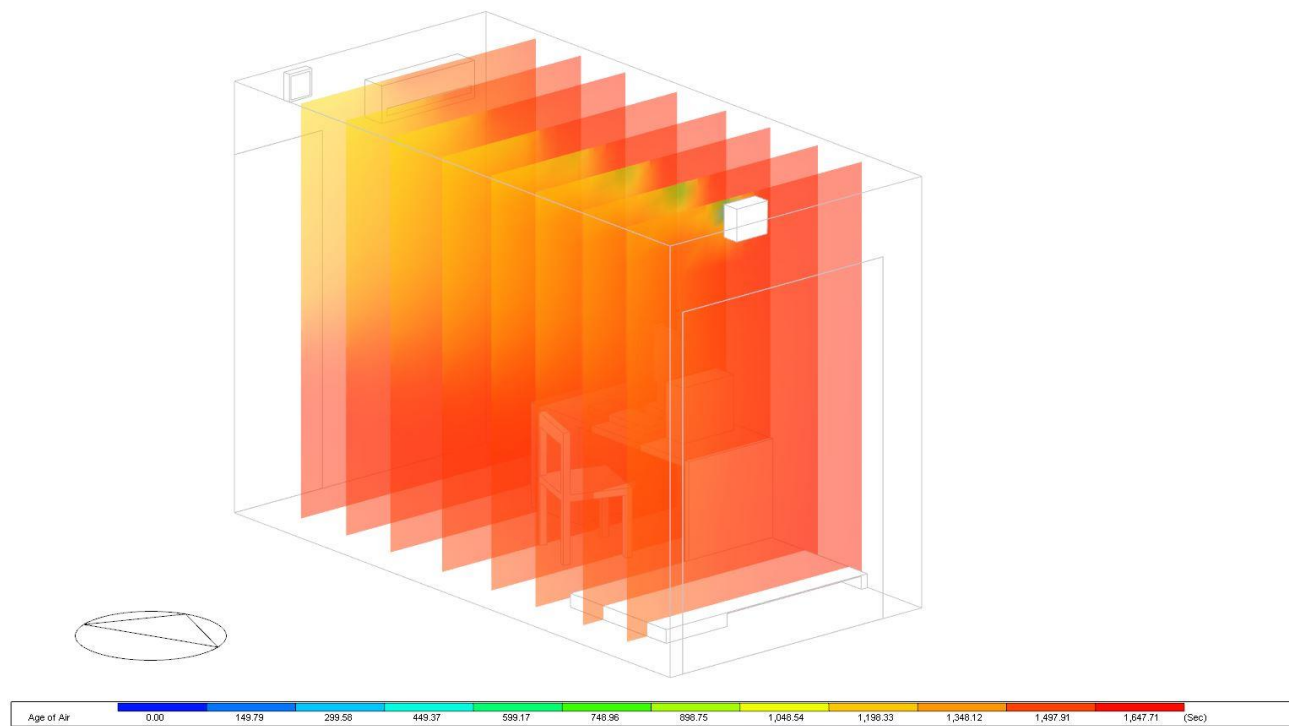
3.4.2. Unit Type 2.1

3.4.2.1. Velocity Contours



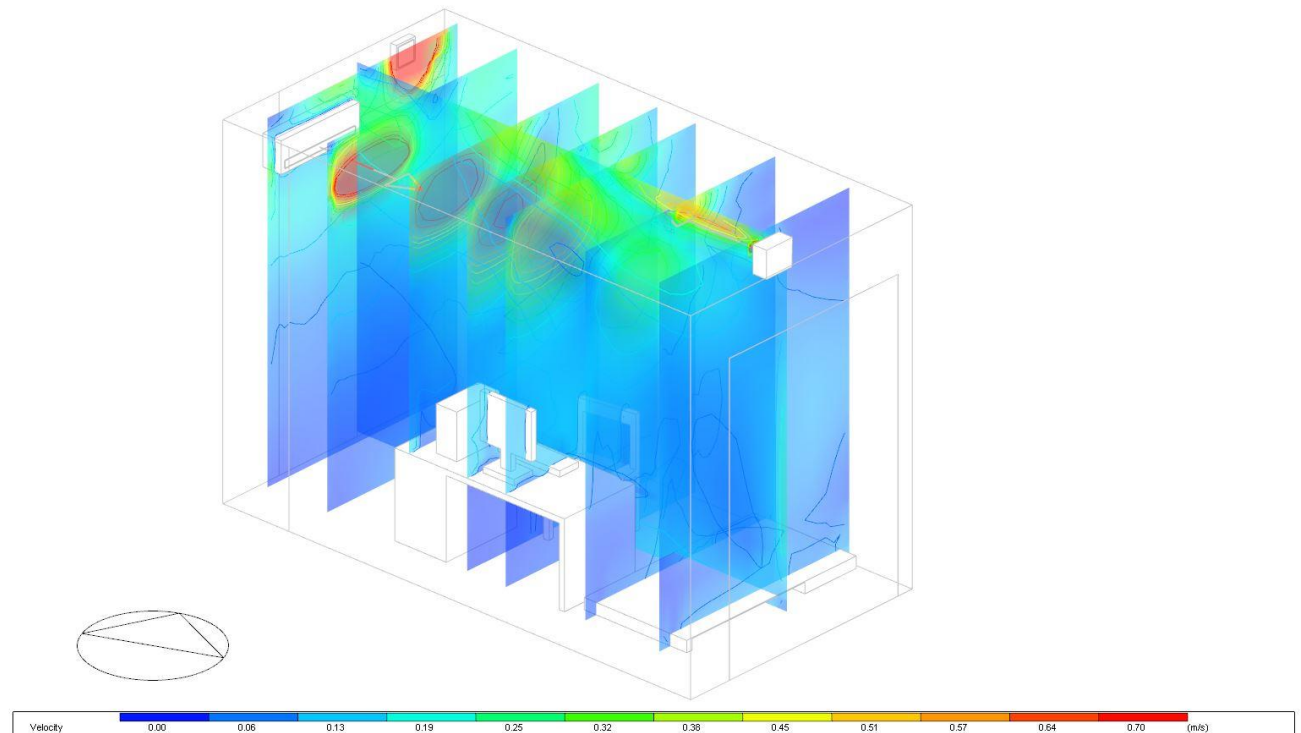
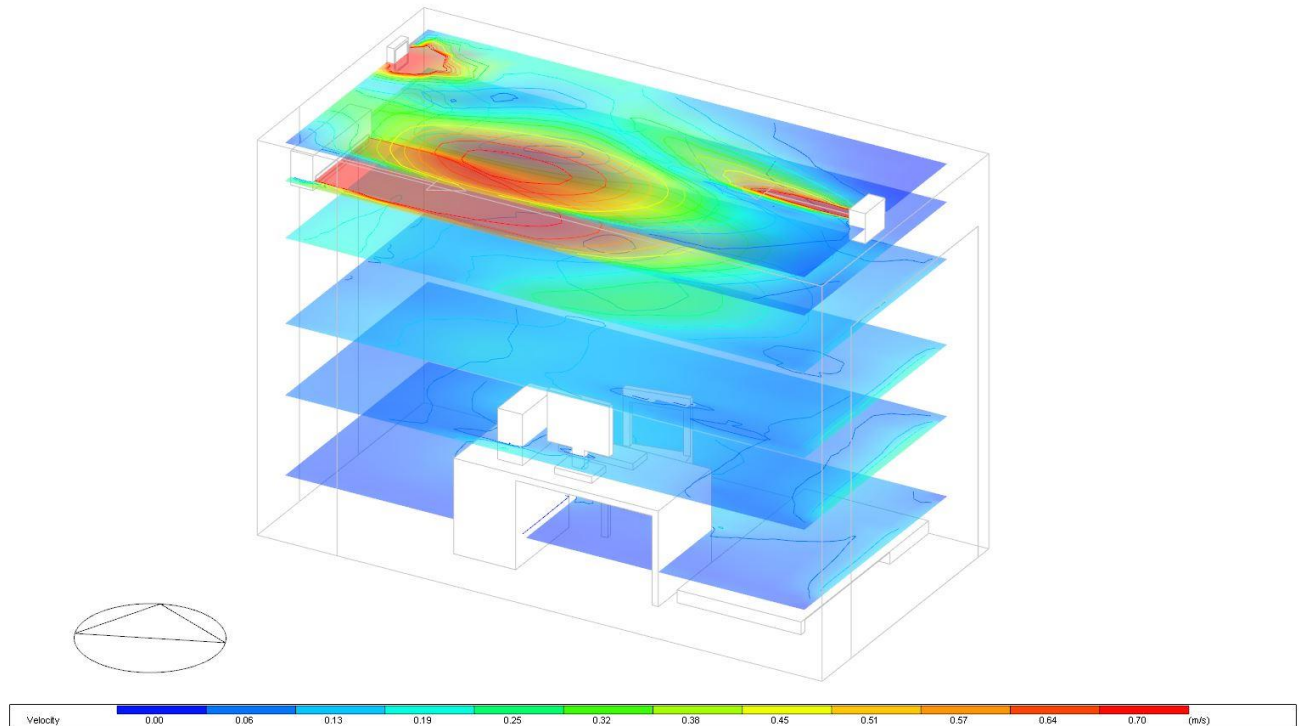
3.4.2.2. Age of Air Contours



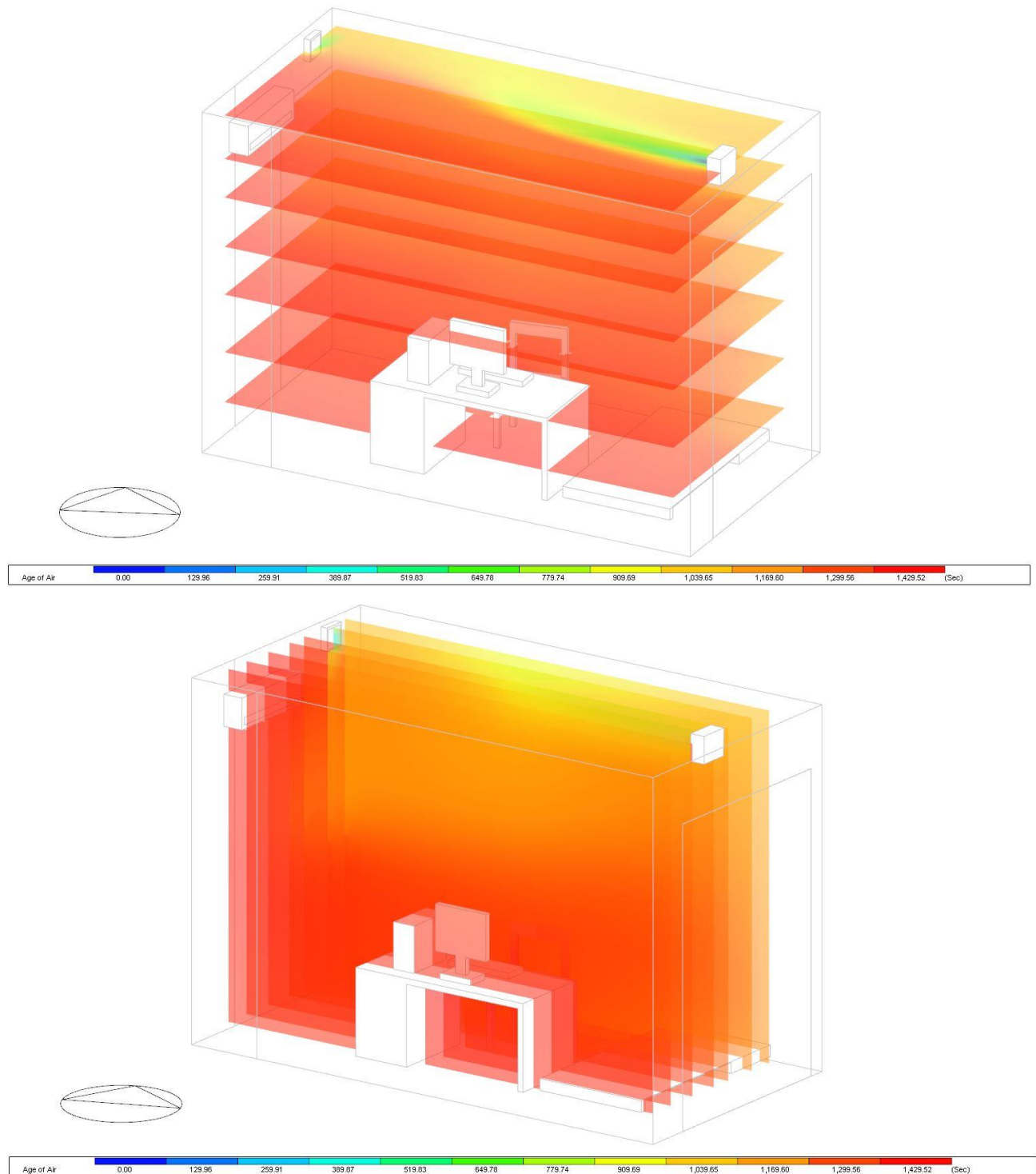


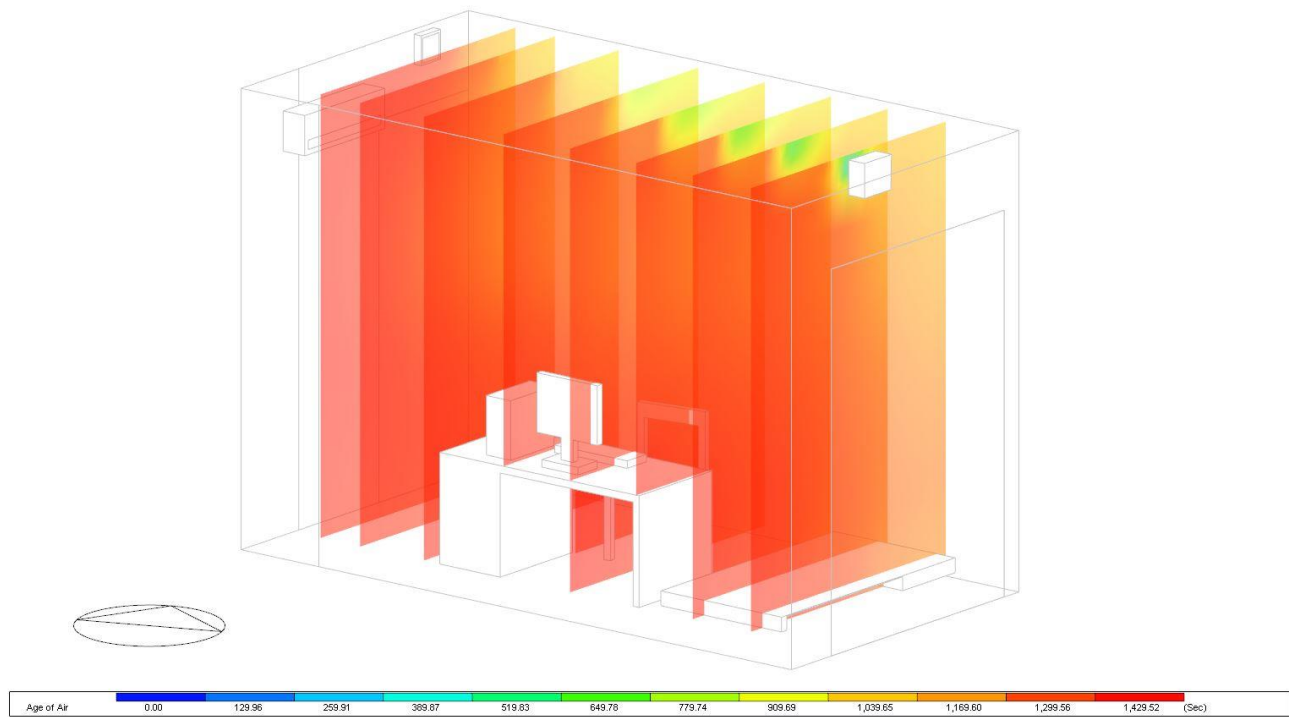
3.4.3. Unit Type 2.2

3.4.3.1. Velocity Contours



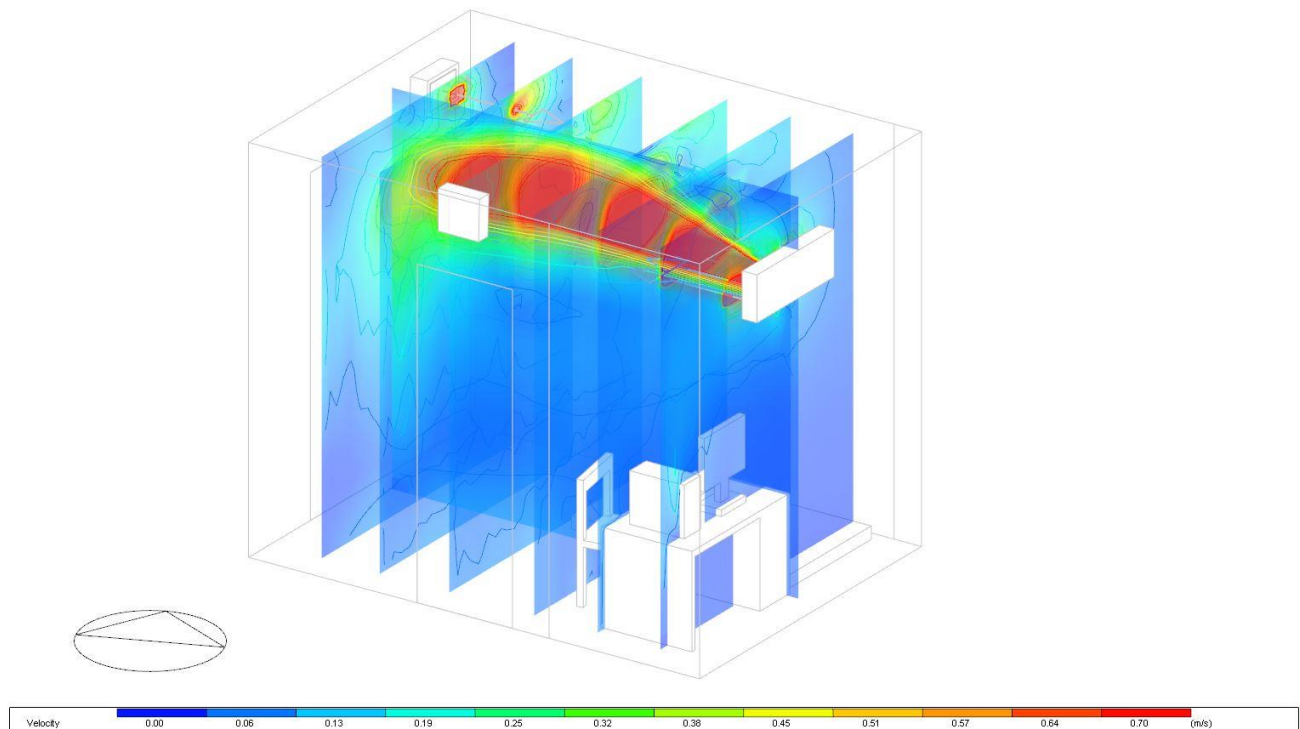
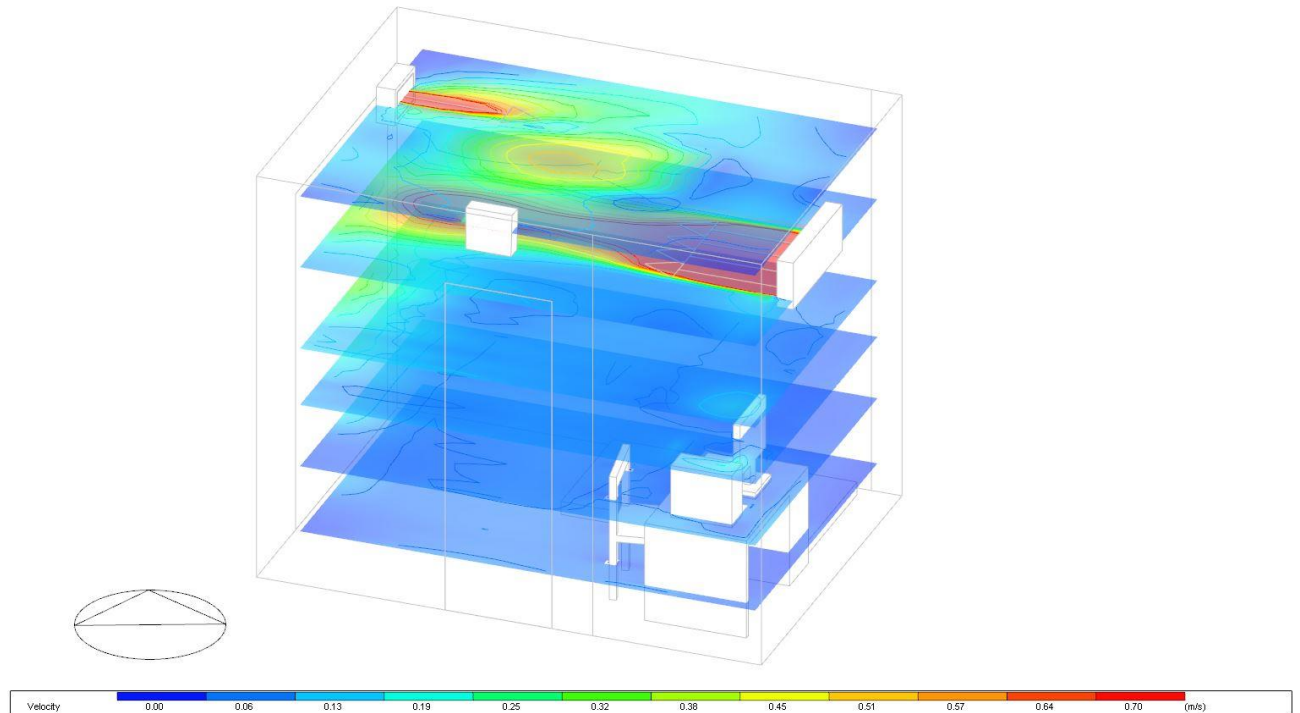
3.4.3.2. Age of Air Contours



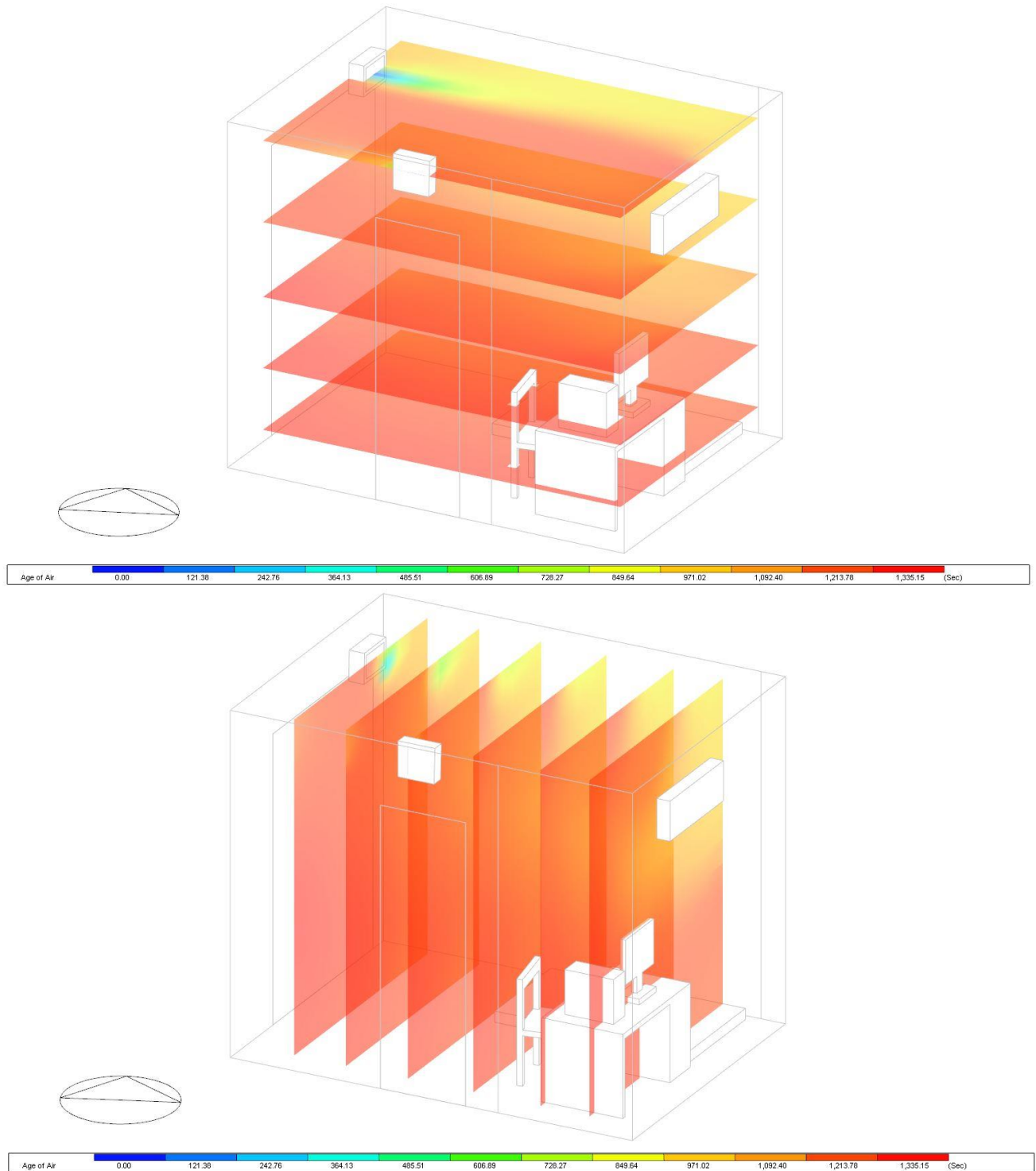


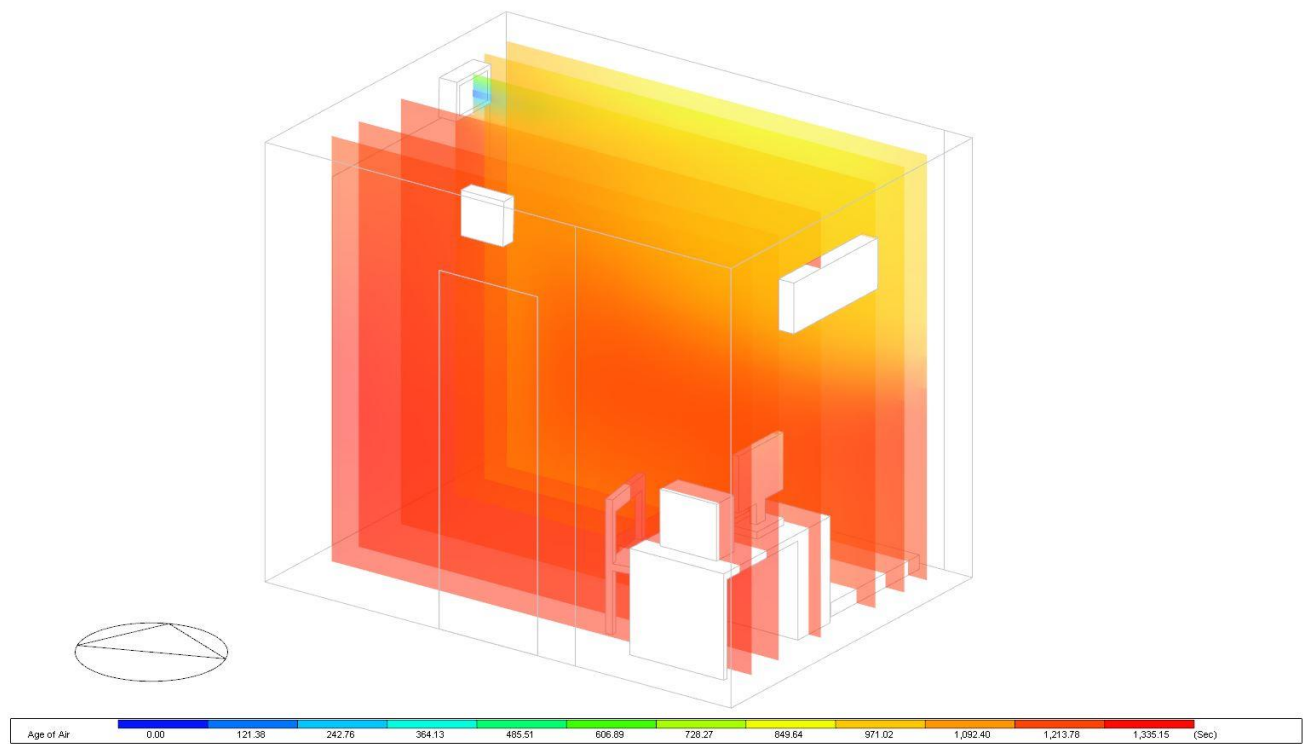
3.4.4. Unit Type 3.1

3.4.4.1. Velocity Contours



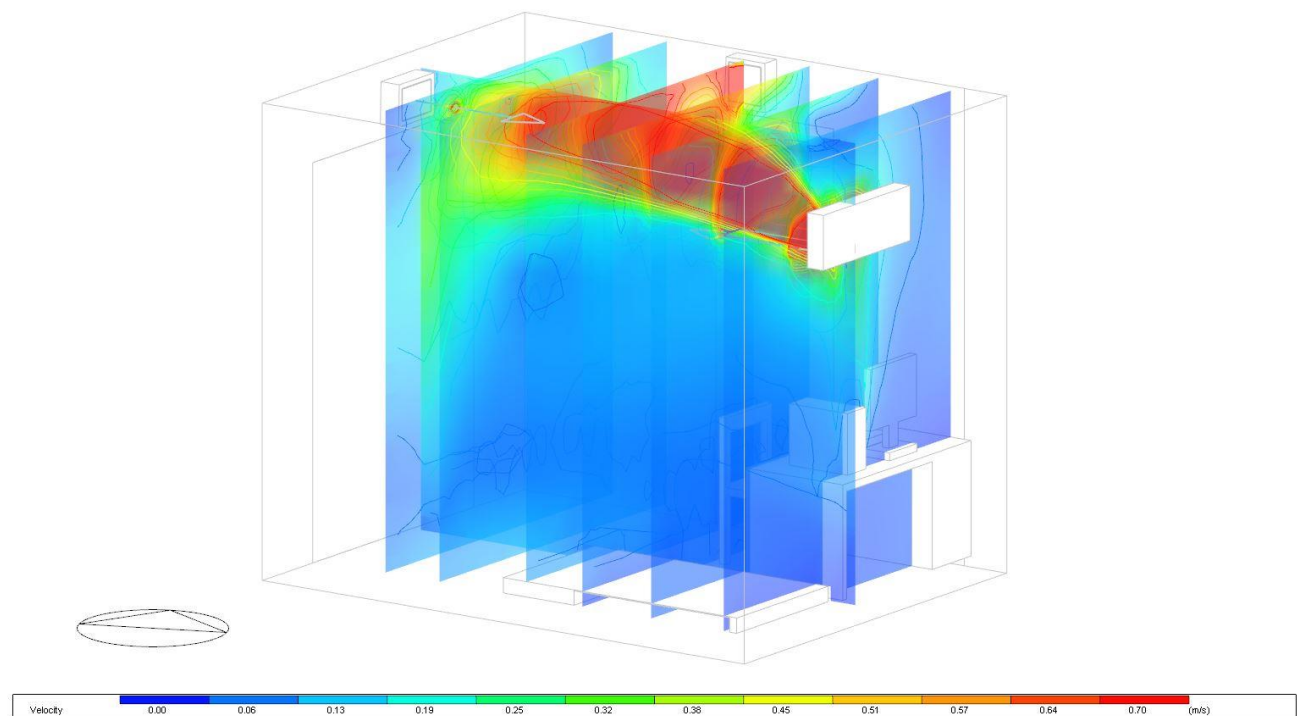
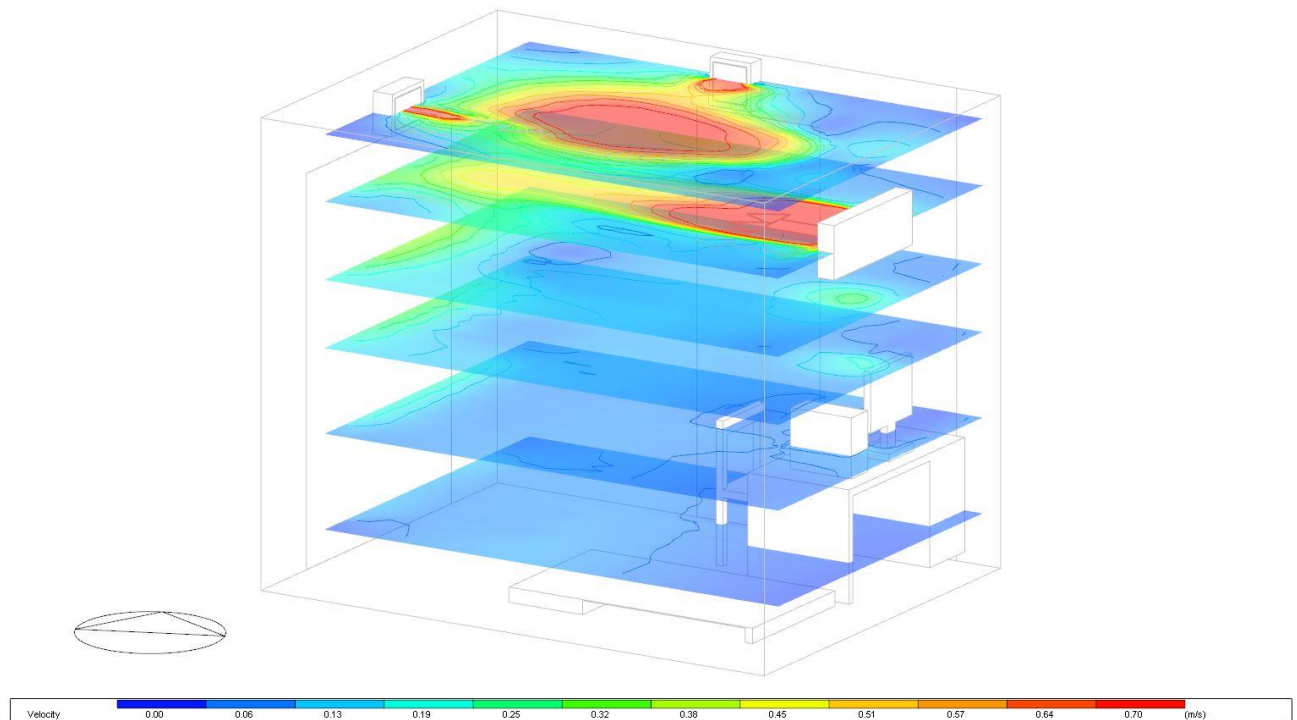
3.4.4.2. Age of Air Contours



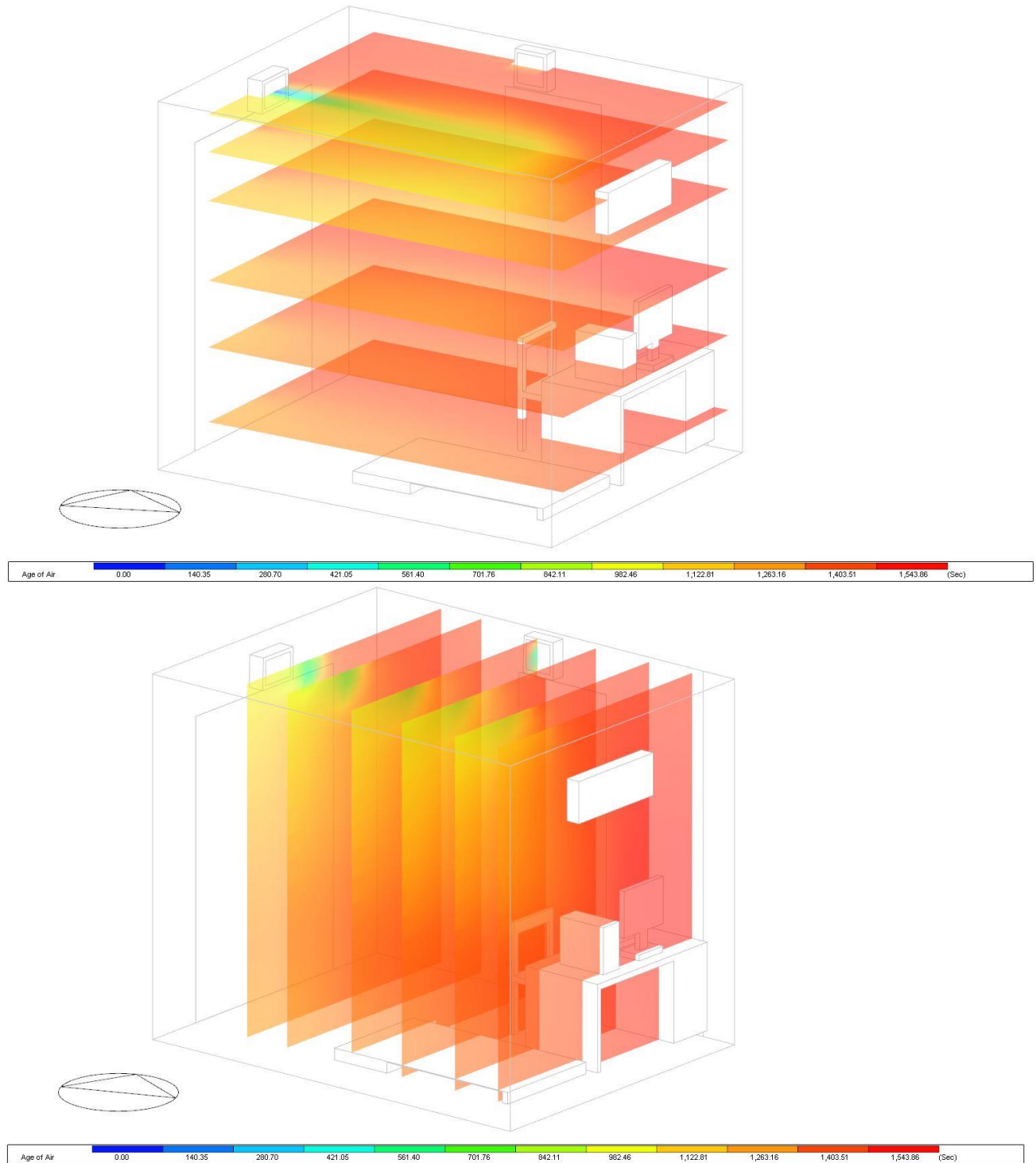


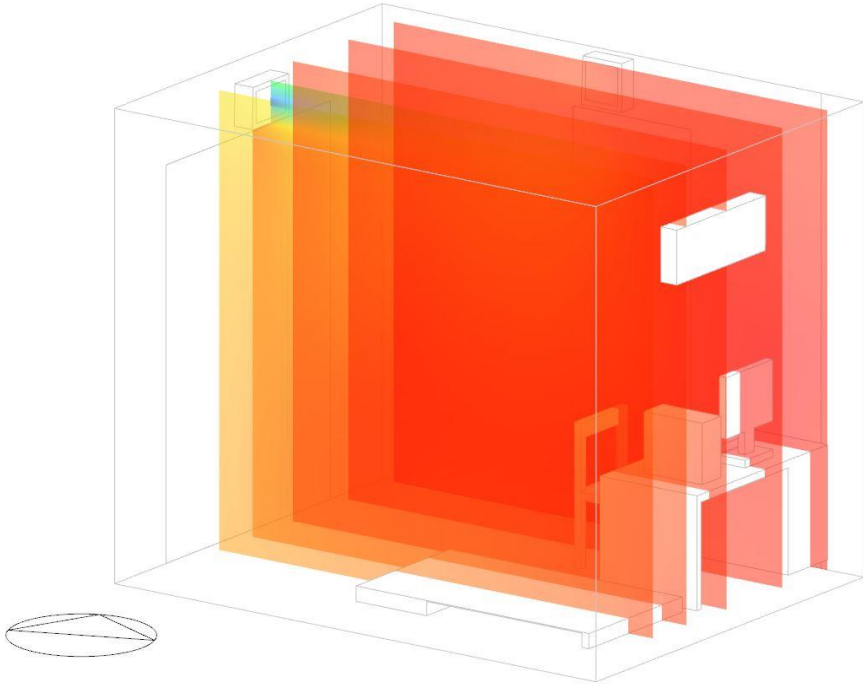
3.4.5. Unit Type 2.2

3.4.5.1. Velocity Contours



3.4.5.2. Age of Air Contours





4 Energy Consumption

4.1. Renewable Energy – Solar Photovoltaic (PV) System

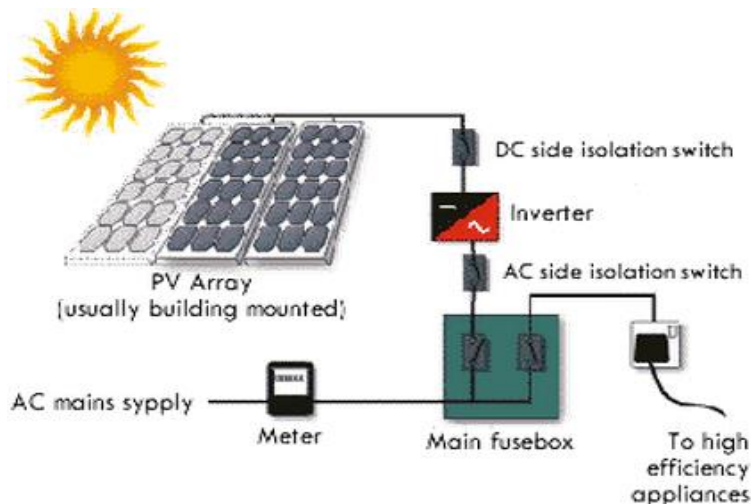
Photovoltaic (Solar PV) is a common and widely accepted technology to generate electricity onsite. The generated electricity can be harnessed and used to power any number of devices. It is proposed that the PV panels are mounted on the roof where they will be out of sight and produce the optimum energy output.

PV modules have a very long lifetime with many manufacturers guaranteeing an output of at least 80% of manufactured capacity for 20 years. Another benefit of PV is that it can be installed in various system sizes and the modular design of the systems allows retrofitting of additional panels if required in the future.

There are generally three types of solar panels available: mono-crystalline (proposed for this development), poly-crystalline and amorphous. Each of these have their advantages and disadvantages and efficiencies range from 6% for amorphous to 19% for mono-crystalline

A 17.2 kW PV system is currently considered for this development. The exact system sizing, configuration and final design will be completed during the design stage.

The expected renewable energy generation by the system is approx. 60.8 MWh per annum.



Solar PV - System Components

The Photovoltaic (PV) system may consist of the following main components or of equal capacity (**Error! Reference source not found.**).

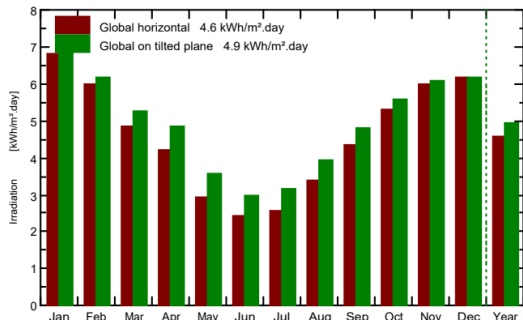
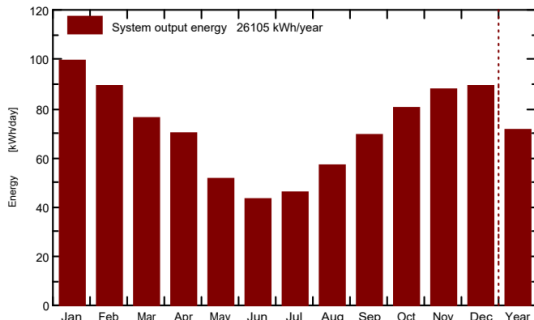
Total nominal power:	17.2 kW
Approx. roof space requirements:	133.5 m ²

Table 6. Main components of photovoltaic (PV) system.

Components	Brand, Model & Quantity
PV Inverter	SMA – Quantity: (3) x 5kW
PV Panels	Trina 455 – capacity: 455W - Quantity: 38 Approx.
PV mounting frame and system balance	Quantity: depending on the requirements and final design

The minimum onsite Solar PV capacity required for the development is 17.2 kW. The energy generated by the solar PV shall be consumed on site. The exact sizing, configuration and final design will be completed during the design stage. Please refer to Appendices A, B, C & D for technical data sheets of the proposed PV panels (LG or Trina), the grid-connected inverter (SMA), solar mounting systems and energy storage options (Tesla).

4.1.1. Expected Energy Generation by the Proposed Solar PV

PVSYST V6.81		03/06/22		Page 1/1	
Grid system presizing					
Geographical Site		Sydney Intl Airport		Country Australia	
Situation		Latitude -33.95° S		Longitude 151.18° E	
Time defined as		Legal Time Time zone UT+10		Altitude 3 m	
Collector Plane Orientation		Tilt 10°			
PV-field installation main features					
Module type		Standard			
Technology		Monocrystalline cells			
Mounting method		Facade or tilt roof			
Back ventilation properties		Ventilated			
System characteristics and pre-sizing evaluation					
PV-field nominal power (STC)		Pnom 17.2 kWp			
Collector area		Eyear 26.1 MWh			
Annual energy yield					
Economic gross evaluation					
Meteo and incident energy					
					
System output					
					
	Gl. horiz.	Coll. Plane	System output	System output	
	kWh/m².day	kWh/m².day	kWh/day	kWh	
Jan.	6.84	6.87	99.24	3076	
Feb.	5.98	6.18	89.37	2502	
Mar.	4.87	5.25	75.95	2355	
Apr.	4.22	4.85	70.09	2103	
May	2.93	3.56	51.43	1594	
June	2.41	2.99	43.27	1298	
July	2.58	3.18	45.92	1423	
Aug.	3.40	3.95	57.10	1770	
Sep.	4.37	4.81	69.48	2084	
Oct.	5.32	5.58	80.68	2501	
Nov.	5.99	6.07	87.76	2633	
Dec.	6.20	6.17	89.21	2765	
Year	4.58	4.95	71.52	26105	

4.2. Expected Energy Consumption by the Mechanical Ventilation System

The expected energy consumption by the mechanical ventilation system can be calculated by the following formula:

$$\mu_f = dp \cdot q / P$$

Where, μ_f is fan efficiency (values between 0-1), dp is total pressure (Pa), q is air volume delivered by the fan (m^3/s), and P is power used by the fan (W, Nm/s).

Based on the energy simulations, the estimated annual energy consumption of the ventilation fans is 22,037 kWh p.a. this is completely offset by the energy generation by the Solar PV system (26,105 kWh p.a.)

5 Results

Dynamic simulation (using Design Builder software) has been used to determine the percentage of the year in which minimum performance requirements have been met for the habitable rooms provided with alternative means of ventilation due to external noise level conditions.

The proposed mechanical ventilation design has been evaluated using Computational Fluid Dynamic (CFD) simulation to determine the overall impact on the following:

- Energy Efficiency – reduction in the Air-conditioning energy consumption (given the reduced reliance on active air-conditioning),
- Age of the indoor air,
- Thermal Comfort (PMV).

Applicable rooms have been evaluated to demonstrate the following performance requirements are achieved for a minimum 90% of all hours of the year:

- If the habitable area is less than the threshold area: 10 litres/second/person for each apartment, where the number of people equals the number of bedrooms plus 1, OR
- If the habitable area is more than or equal to the threshold area: 0.3 litres/second/m² for each apartment.

Each habitable room provided with alternative means of natural ventilation has also been assessed for adequate ventilation of 10 litres/second per person.

A tabulated summary of results is presented in Table 7 below. The results demonstrate that the assessed habitable rooms meet the minimum performance requirements for greater than 90% of the all hours of the year. As such, the minimum level of ventilation has been met and adequate ventilation is achieved via the alternative ventilation proposal.

Table 7. Result Summary.





Unit Type	Apartment area (Conditioned area) (m ²)	Number of occupants	Required volume flow rate (l/s)	% of year achieved
Type 1: Unit 05.06 - Studio A	13 m ²	1	10	100%
Type 2.1: Unit 05.01 – Bedroom 1	8 m ²	1	10	100%
Type 2.2: Unit 05.01 – Bedroom 2	8 m ²	1	10	100%
Type 3.1: Unit 05.14 – Bedroom 1	8 m ²	1	10	100%
Type 3.2: Unit 05.14 – Bedroom 2	8 m ²	1	10	100%

Furthermore, the simulation has demonstrated that the proposed ventilation design will result in the following improvements:

- Overall Energy Efficiency,
- Thermal Comfort (i.e. PMV),
- Age of air (freshness of the air).

The improvements are listed in Table 8.

Table 8. Improvements.

	Without Ventilation	With Ventilation	Improvement (%)
Heating (KWh p.a. for all tested units)	87	591	
Cooling (KWh p.a. for all tested units)	1789	978	
Total (KWh)	1876	1569	 16.4%
Energy Per Conditioned Building Area (KWh/m ²)	42	35	 16.4%
Fraction Operation Hours between 21-24 degrees (%)	98.3%	98.8%	 0.5%
Fraction Operation Hours PMV with between -1 and 1 (% Thermal Comfort)	98.2%	98.5%	 0.3%

The simulations demonstrated that the energy generated by the proposed Solar PV system will be sufficient to offset the energy consumption of the proposed mechanical ventilation system (Table 9).

Table 9. Solar Energy Generation.

Solar Energy Generation vs. Mechanical Ventilation Energy Consumption	
Estimated Annual Energy Consumption for Mechanical Ventilation	22,037 kWh p.a.
Estimated Annual Solar PV Energy Generation	26,105 kWh p.a.

6 Disclaimer

This report is prepared using the information described above and inputs from other consultants. Whilst VIPAC has endeavoured to ensure the information used is accurate, no responsibility or liability to any third party is accepted for any loss or damage arising out of the use of this report by any third party. Any third party wishing to act upon any material contained in this report should first contact VIPAC for detailed advice which will take into account that party's particular requirements.

Computer performance assessment 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 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. VIPAC and its employees and agents shall not be liable for any loss arising because of, any person using or relying on the Report and whether caused by reason or error, negligent act or omission in the report. This draft assessment has been prepared based on the preliminary building services and architectural design with the view to conduct a detailed assessment once the design is further developed.

Performance of the completed building may be significantly affected by the quality of construction; the quality of commissioning, ongoing management of the building, and the way the building is operated, monitored and maintained. Building fabric inputs require verifiable manufacturer data to confirm thermal properties.

APPENDIX A - TECHNICAL DATASHEET – SOLAR PV PANEL



LG NeON[®] 2

LG 350/355/360N1C-N5

THE HIGH PERFORMER

UP TO 20.8% MODULE EFFICIENCY



15 YEARS LONGER THAN INDUSTRY STANDARD OF 10 YEARS



Awards Received By LG Solar™



















THE NeON[®] 2 - THE PANEL OF THE FUTURE AVAILABLE TODAY

The LG NeON[®] 2 has seen many improvements in the past years, from longer warranties to lower degradation. This panel is ideal for homes seeking a visually pleasing solar panel and for roofs where space is tight or where future system expansions are considered e.g. to incorporate battery storage.

The LG NeON[®] 2 panels with their double sided cells and CELLO technology absorb light from the front and the back of the cell. This technology sets a new standard for innovation and was recognised with the Photovoltaic Innovation Award at the Intersolar Industry Event in Germany. LG also won the 2016 Intersolar award for our new NeON BiFacial range.



Great Visual Appearance

LG NeON[®] 2 panels have been designed with appearance in mind. Their black cells, black frames and thinner wire busbars give an aesthetically pleasing uniform black appearance. Your home deserves the LG NeON[®] 2.



More Power per Square Metre

LG NeON[®] 2's 360W are a similar physical size to many competing 330W panels. This means with the LG NeON[®] 2 360W you get 9% more electricity per square metre than a 330W panel. So you can install more kW of solar on your roof with the LG NeON[®] 2.



25 Years Product Warranty (Parts & Labour)

The LG product warranty is many years longer than many competitors standard 10 or 12 years. The Warranty is provided by LG Electronics Australia and New Zealand. The warranty includes replacement, labour and transport.



Improved 25 Year Performance Warranty

The initial degradation of the module has been improved from -3% to -2%, in the 1st year and the annual rate of degradation has fallen from -0.7%/year to -0.33%/ year thereafter. This brings an 90.08% warranted output after 25 years, compared to 80.7% for many competing panels.

Made in Korea










Call LG Solar on 1300 152 179

www.lgenergy.com.au

ABOUT LG ELECTRONICS

LG Electronics embarked on a solar energy research programme in 1985, using our vast experience in semi-conductors, chemistry and electronics. LG Solar modules are now available in over 50 countries. In 2013, 2015 and 2016 the LG NeON[®] range won the acclaimed Intersolar Award in Germany, which demonstrates LG Solar's lead in innovation and commitment to the renewable energy industry. Additionally, LG Solar™ won the Australian Top Brand Award in 2016, 2017, 2018, 2019 and 2020. LG Solar has also been voted WINNER Trusted Brands 2020 - SOLAR PANELS by Reader's Digest from over 3,000 Australian consumers surveyed. With many lesser known brand panels selling in Australia, LG Solar panels offer a peace of mind solution, as they are backed by an established global brand with a long local support history.

KEY ADVANTAGES

 <p>Proven Field Performance</p> <p>LG has been involved in a number of comparison tests of the LG panels against many other brand panels. LG NeON[®] 2 models are consistently among the best performing in these tests.</p>	 <p>Low LID</p> <p>The N-type doping of the NeON[®] cells results in extremely low Light Induced Degradation (LID) when compared with the standard P-type cells. This means more electricity generation over the life of the panel, as the panel degrades less.</p>
 <p>Additional Certification</p> <p>LG NeON[®] 2 panels have received additional certification including for; Salt Mist Corrosion to maximum severity 6. Ammonia Resistance certification and PID Resistance Tests.</p>	 <p>Extensive Testing Programme</p> <p>LG solar panels are tested at least up to 2 times the International Standards at our in-house testing laboratories, ensuring a very robust and longer lasting solar module.</p>
 <p>Strict Quality Control Reliable for the Future</p> <p>The quality control of LG world-class solar production is monitored and improved using Six Sigma techniques via 500+ monitoring points to effectively maintain and improve our uncompromising quality.</p>	 <p>Improved High Temperature Performance</p> <p>Solar panels slowly lose ability to generate power as they get hotter. LG NeON[®] 2, has an improved temperature co-efficient to standard modules, which means in hot weather LG NeON[®] 2 panels will deliver higher output.</p>
 <p>Multi Anti-reflective Coatings Increase Output</p> <p>LG Solar™ is using an anti-reflective coating on the panels glass as well as on the cell surface to ensure more light is absorbed in the panel and not reflected. More absorbed light means more electricity generation.</p>	 <p>Positive Tolerance (0/+3%)</p> <p>If you buy a 360 Watt panel then the flash test of this panel will show somewhere between 360W and 370W. Some competitor panels have +/- tolerance, so you could get a flash test result below the rated Watt, meaning you pay for Watts you never get.</p>
 <p>High Wind Load Resistance</p> <p>LG panels have a strong double walled frame. When it comes to wind forces (rear load) our panel under test withstood a wind load of 4000 Pascals.</p>	 <p>Anti PID Technology for Yield Security</p> <p>PID (Potential Induced Degradation) affects the long term ability of panels to produce high level electricity output. LG panels have anti PID technology and have been successfully tested by leading third party laboratories regarding PID resistance.</p>
 <p>"CELLO" Technology Increases Power</p> <p>"CELLO" Multi wire busbar cell technology lowers electrical resistance and increases panel efficiency, giving more power per panel and provides a more uniform look to the panel.</p>	 <p>Automated Production in South Korea</p> <p>All LG solar panels sold in Australia and New Zealand are manufactured in a custom designed and fully automated production line by LG in Gumi, South Korea ensuring extremely low tolerances. This means great quality and build consistency between panels.</p>

LG NeON[®] 2

LG NeON[®] 2 – ENHANCED. MORE EFFICIENT. ADVANCED.

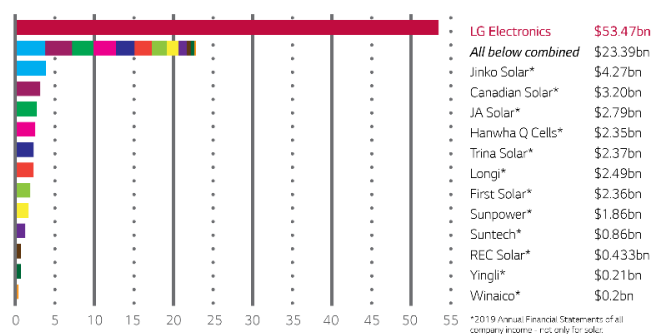
LG NeON[®] 2 solar panels now offer even more output. Featuring a classy design and with a total of 60 cells, it can withstand under test a static front panel load of 5400 pascals and rear wind load of 4000 pascals. LG has lengthened its product warranty to 25 years and has improved its linear performance guarantee to 90.08 % of nominal output after 25 years. The LG NeON[®] 2 is an excellent choice for high performing long lasting solar systems.

LOCAL WARRANTY, GLOBAL STRENGTH

LG Solar™ is part of LG Electronics Inc., a global and financially strong company, with over 50 years of experience in technology.

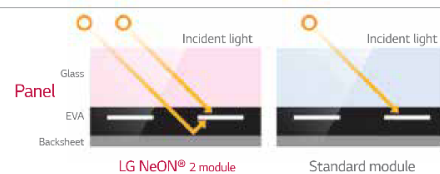
Good to know: LG Electronics Australia Pty Ltd is the warrantor in Australia and NZ for your solar modules. So LG support, via offices in every Australian mainland state and NZ and through our 80 strong, Australia wide dealer network, is only a phone call away, ph 1300 152 179.

The Warrantor's 2019 Sales in Billions of US Dollars*



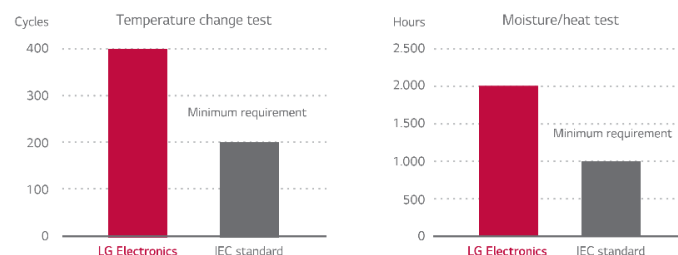
HIGHER OUTPUT, HIGHER YIELD

The NeON[®] Cell produces energy from both the front and the back of the cell. This innovative approach allows the absorption of light from the back of the cell which raises the panel's efficiency and power output. Standard panels only absorb light from the front.



EXCELLENT QUALITY, THOROUGHLY TESTED

You can rely on LG. We test our products with at least double the intensity specified in the IEC standard. (International Quality Solar Standard).



Awards Received By LG Solar™



Our panel range have won a string of Local and International Awards.

POWERFUL DESIGN, GUARANTEED ROBUST

With reinforced frame design, the LG NeON[®] 2 can under test withstand a front load of 5400 Pa which is the equivalent of 943 kg over the size of the panel. The rear load/wind load of the panel under test is 4000 Pa.



LG offers a longer 25 year parts and labour warranty than many competitors who provide 10 and 12 year warranties.



LG350N1C-N5 | LG355N1C-N5 | LG360N1C-N5

LG NeON²

Mechanical Properties

Cells	60 Cells (6 x 10)
Cell Vendor	LG
Cell Type	Monocrystalline / N-type
Number of Busbar	12EA
Dimensions (L x W x H)	1700 x 1016 x 40 mm
Front Load (test)	5400 Pa
Rear Load (test)	4000 Pa
Weight	18 kg
Connector Type	Genuine MC4, IP68 (Male: PV-KST4) (Female: PV-KBT4)
Junction Box	IP68 with 3 bypass diodes
Length of Cables	2 x 1000 mm
Glass (Material)	Tempered Glass with AR Coating
Frame	Anodised aluminum with protective matt black coating

Certifications and Warranty

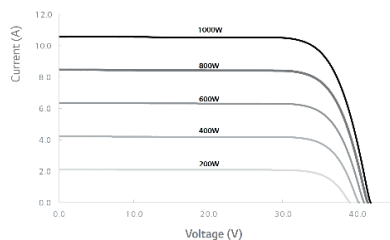
Certifications	ISO 9001, ISO 14001, ISO 50001 IEC 61215-1/-1-1/2:2016, IEC 61730-1/2:2016 OHSAS 18001
Salt Mist Corrosion Test	IEC 61701: 2012 Severity 6
Ammonia Corrosion Test	IEC 62716: 2013
Module Fire Performance	Class C (UL 790)
Product Warranty	25 Years
Output Warranty of Pmax (Measurement Tolerance ± 3%)	Linear Warranty ¹

¹ 1) 1st year: 98%, 2) After 1st year: 0.33% annual degradation, 3) 90.08% for 25 years.

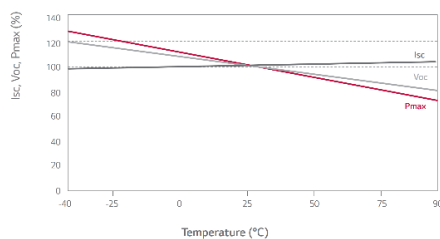
Temperature Characteristics

NMOT	42 ± 3 °C
Pmax	-0.34 %/°C
Voc	-0.26 %/°C
Isc	0.03 %/°C

Current – Voltage characteristics at various irradiance levels



Current – Voltage characteristics at various cell temperatures



Electrical Properties (STC²)

Module Type	LG350N1C-N5	LG355N1C-N5	LG360N1C-N5
Maximum Power Pmax (W)	350	355	360
MPP Voltage Vmpp (V)	34.3	34.7	35.1
MPP Current Imp (A)	10.22	10.25	10.28
Open Circuit Voltage Voc (V)	41.4	41.5	41.6
Short Circuit Current Isc (A)	10.76	10.80	10.84
Module Efficiency (%)	20.3	20.6	20.8
Operating Temperature (°C)	-40 ~ +90		
Maximum System Voltage (V)	1000		
Maximum Series Fuse Rating (A)	20		
Power Tolerance (%)	0 ~ +3		

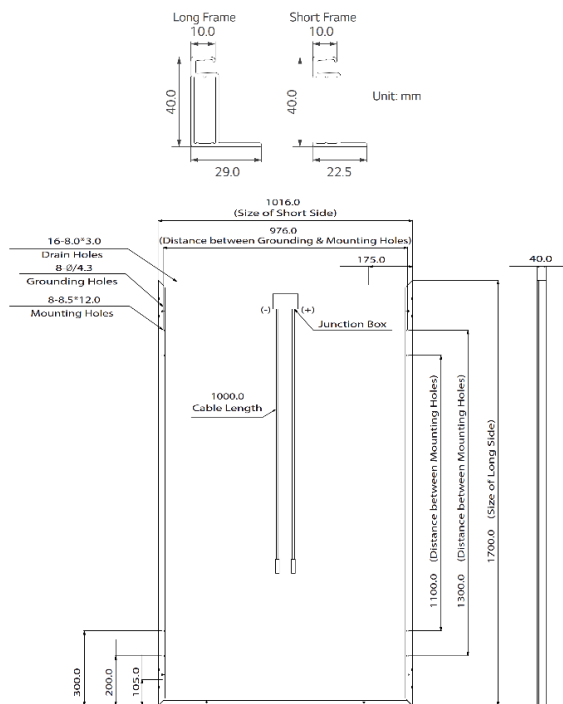
² STC (Standard Test Condition): Irradiance 1000 W/m², Module Temperature 25 °C, AM 1.5.
The nameplate power output is measured and determined by LG Electronics at its sole and absolute discretion.

Electrical Properties (NMOT³)

Module Type	LG350N1C-N5	LG355N1C-N5	LG360N1C-N5
Maximum Power Pmax (W)	262	266	270
MPP Voltage Vmpp (V)	32.2	32.6	33.0
MPP Current Imp (A)	8.15	8.17	8.20
Open Circuit Voltage Voc (V)	39.0	39.1	39.2
Short Circuit Current Isc (A)	8.64	8.68	8.71

³ NMOT (Nominal Module Operating Temperature): Irradiance 800 W/m², ambient temperature 20 °C, wind speed 1 m/s, Spectrum AM 1.5.

Dimensions (mm)



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Solar Business Group
2 Wonderland Drive, Eastern Creek, NSW 2766
Ph: 1300 152 179
E-Mail: solarsales@lge.com.au
Web: lgenergy.com.au

LG Electronics Inc.
Solar Business Division
Twin Building, Western Tower, 11F,
128, Yeouido-daero, Yeongdeungpo-gu,
Seoul, 07336, Korea
www.lg.com/global/business

Product specifications are subject to change
without prior notice.
Date: 08/2020

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APPENDIX B - TECHNICAL DATASHEET – SIMULATED PV INVERTER

SUNNY TRIPOWER
15000TL / 20000TL / 25000TL



STP 15000TL-30 / STP 20000TL-30 / STP 25000TL-30

Efficient

- Maximum efficiency of 98.4%

Safe

- DC surge arrester (SPD type II) can be integrated

Flexible

- DC input voltage of up to 1000 V
- Multistring capability for optimum system design
- Optional display

Innovative

- Cutting-edge grid management functions with Integrated Plant Control
- Reactive power available 24/7 (Q on Demand 24/7)

SUNNY TRIPOWER 15000TL / 20000TL / 25000TL

The versatile specialist for large-scale commercial plants and solar power plants

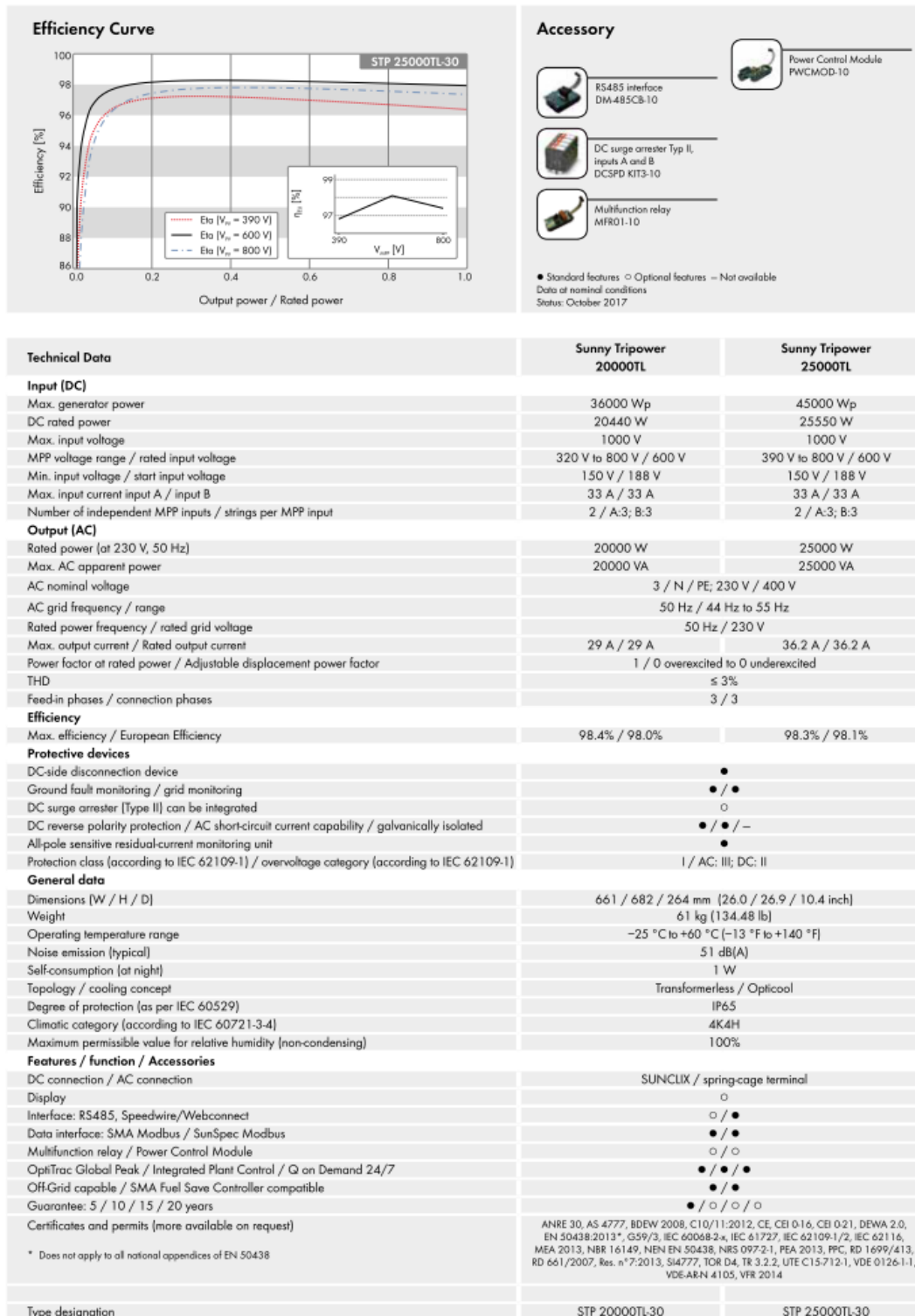
The Sunny Tripower is the ideal inverter for large-scale commercial and industrial plants. Not only does it deliver extraordinary high yields with an efficiency of 98.4%, but it also offers enormous design flexibility and compatibility with many PV modules thanks to its multistring capabilities and wide input voltage range.

The future is now: the Sunny Tripower comes with cutting-edge grid management functions such as Integrated Plant Control, which allows the inverter to regulate reactive power at the point of common coupling. Separate controllers are no longer needed, lowering system costs. Another new feature—reactive power provision on demand (Q on Demand 24/7).

SUNNY TRIPOWER

15000TL / 20000TL / 25000TL

Technical Data	Sunny Tripower 15000TL
Input (DC)	
Max. generator power	27000 Wp
DC rated power	15330 W
Max. input voltage	1000 V
MPP voltage range / rated input voltage	240 V to 800 V / 600 V
Min. input voltage / start input voltage	150 V / 188 V
Max. input current input A / input B	33 A / 33 A
Number of independent MPP inputs / strings per MPP input	2 / A:3; B:3
Output (AC)	
Rated power (at 230 V, 50 Hz)	15000 W
Max. AC apparent power	15000 VA
AC nominal voltage	3 / N / PE; 230 V / 400 V
AC grid frequency / range	50 Hz / 44 Hz to 55 Hz
Rated power frequency / rated grid voltage	50 Hz / 230 V
Max. output current / Rated output current	29 A / 21.7 A
Power factor at rated power / Adjustable displacement power factor	1 / 0 overexcited to 0 underexcited
THD	≤ 3%
Feed-in phases / connection phases	3 / 3
Efficiency	
Max. efficiency / European Efficiency	98.4% / 98.0%
Protective devices	
DC-side disconnection device	●
Ground fault monitoring / grid monitoring	● / ●
DC surge arrester (Type II) can be integrated	○
DC reverse polarity protection / AC short-circuit current capability / galvanically isolated	● / ● / -
All-pole sensitive residual-current monitoring unit	●
Protection class (according to IEC 62109-1) / overvoltage category (according to IEC 62109-1)	I / AC: III; DC: II
General data	
Dimensions (W / H / D)	661 / 682 / 264 mm [26.0 / 26.9 / 10.4 inch]
Weight	61 kg [134.48 lb]
Operating temperature range	-25 °C to +60 °C [-13 °F to +140 °F]
Noise emission (typical)	51 dB(A)
Self-consumption (at night)	1 W
Topology / cooling concept	Transformerless / Opticool
Degree of protection (as per IEC 60529)	IP65
Climatic category (according to IEC 60721-3-4)	4K4H
Maximum permissible value for relative humidity (non-condensing)	100%
Features / function / Accessories	
DC connection / AC connection	SUNCLIX / spring-cage terminal
Display	○
Interface: RS485, Speedwire/Webconnect	○ / ●
Data interface: SMA Modbus / SunSpec Modbus	● / ●
Multifunction relay / Power Control Module	○ / ○
OptiTrac Global Peak / Integrated Plant Control / Q on Demand 24/7	● / ● / ●
Off-Grid capable / SMA Fuel Save Controller compatible	● / ●
Guarantee: 5 / 10 / 15 / 20 years	● / ○ / ○ / ○
Planned certificates and permits	ANRE 30, AS 4777, BDEW 2008, C10/11:2012, CE, CBI 0-16, CBI 0-21, DEWA 2.0, EN 50438:2013*, G59/3, IEC 60668-2-x, IEC 61727, IEC 62109-1/2, IEC 62116, MEA 2013, NBR 16149, NEN EN 50438, NRS 097:2-1, PEA 2013, PPC, RD 1699/413, RD 661/2007, Res. n°7:2013, SI4777, TOR D4, TR 3.2.2, UTE C15-712-1, VDE 0126-1-1, VDE-AR-N 4103, VFR 2014
* Does not apply to all national appendices of EN 50438	
Type designation	STP 15000TL-30





www.SMA-Australia.com.au

SMA Solar Technology

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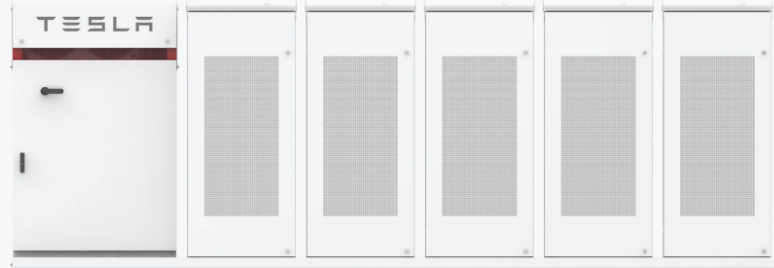
APPENDIX C - TECHNICAL DATASHEET FOR TESLA POWERPACK (Sample Storage system)

POWERPACK 2.5 SYSTEM

Tesla has been building integrated battery systems in cars for over 10 years. The same degree of expertise, quality control, and technological innovation has informed our process of developing high-performance energy storage systems.

The Powerpack System scales to the space, power and energy requirements of any site from 100 kWh+ to 100 MWh+.

Tesla offers a 10-year warranty at no additional cost. Extensions are also available under certain conditions.



Powerpack System includes an Inverter and DC Battery Packs

FULLY INTEGRATED SYSTEM

A complete energy storage system including DC batteries, bi-directional inverter, and a Powerpack Controller with intelligent software. This turnkey system is designed to maximize savings and prolong battery life.

OPTIMIZATION SOFTWARE

Powerpack Systems have the most advanced battery technology and dispatch optimization software to quickly learn and predict a facility's energy patterns. Tesla's proprietary storage dispatch software can charge and discharge autonomously to maximize customer value.

ENHANCED SYSTEM SAFETY

Powerpack's battery architecture consists of a low voltage battery with a DC/DC converter for added electrical isolation and safety. It also has an integrated liquid cooling and heating system for thermal safety and enhanced performance and reliability.

APPLICATIONS



PEAK SHAVING
Discharge at times of peak demand to reduce expensive demand charges



EMERGENCY BACKUP
Powers a facility when the grid goes down



CAPACITY FIRMING
Smooth out the intermittency of renewables by storing and dispatching when needed



LOAD SHIFTING
Shift energy consumption from one point in time to another



MICROGRID
Build a localized grid that can disconnect from the main power grid



TRANSMISSION AND DISTRIBUTION SUPPORT
Supply power at a distributed location to defer the need to upgrade aging infrastructure



DEMAND RESPONSE
Discharge or charge in response to signals from a demand response administrator



ANCILLARY SERVICES
Provide service to the grid in response to signals sent

POWERPACK 2.5 SPECIFICATIONS

- One Powerpack includes 16 battery Pods
- Each Pod has an isolated DC/DC converter and sensors to monitor cell level performance in real time
- Standard configurations:
 - 1.2-hour discharge duration (Frequency Regulation)
 - 1.6-hour discharge duration
 - 2-hour discharge duration
 - 4-hour discharge duration



INVERTER RATINGS

AC Voltage	380–480 VAC 3-phase
Nominal Frequency	50 or 60 Hz
Inverter Size (at 480 V)	Scalable up to 700 kVA

POWERPACK RATINGS

Configuration	Power/Energy ¹	Roundtrip ¹ System Efficiency
1.2 hr:	130 kW / 160 kWh	84.5% ²
1.6 hr	109 kW / 174 kWh	86%
2 hr	108 kW / 215 kWh	86.5%
4 hr	57 kW / 228 kWh	90%

¹ Net energy delivered at 25°C (77°F) including thermal control

² Frequency regulation and peak power options, available under certain conditions

MECHANICAL AND MOUNTING

Enclosure	IP67 (Pod) NEMA 3R / IP35 (Powerpack) NEMA 4 / IP66 (Inverter)
-----------	--

Powerpack Unit Dimensions	L: 1308 mm (51.5 in) W: 822 mm (32.4 in) H: 2235 mm (88 in)
---------------------------	---

Powerpack Unit Max Shipped Weight	2199 kg (4847 lbs)
-----------------------------------	--------------------

Inverter Dimensions	L: 1014 mm (39.9 in) W: 1254 mm (49.4 in) H: 2242 mm (88.3 in)
---------------------	--

Inverter Max Shipped Weight	1120 kg (2470 lbs)
-----------------------------	--------------------

Operating Ambient Temperature	–30°C to 50°C (–22°F to 122°F)
-------------------------------	--------------------------------

COMMUNICATIONS

Protocol	Modbus TCP DNP3 Rest API
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REGULATORY

Lithium-Ion Cells	NRTL listed to UL 1642
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System	NRTL listed to UL 1973, 9540, 1741 SA IEEE 1547 Compliant to grid codes and safety standards of all major markets. Full list provided upon request.
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INVERTER RATINGS

AC Voltage	380–480 VAC 3-phase
Nominal Frequency	50 or 60 Hz
Inverter Size (at 480 V)	Scalable up to 700 kVA

POWERPACK RATINGS

Configuration	Power/Energy ¹	Roundtrip ¹ System Efficiency
1.2 hr:	130 kW / 160 kWh	84.5% ²
1.6 hr	109 kW / 174 kWh	86%
2 hr	108 kW / 215 kWh	86.5%
4 hr	57 kW / 228 kWh	90%

¹ Net energy delivered at 25°C (77°F) including thermal control

² Frequency regulation and peak power options, available under certain conditions

COMMUNICATIONS

Protocol	Modbus TCP DNP3 Rest API
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The Trust Company (Australia) Ltd AFT WH Redfern Trust
104-116 Regents St, Redfern
Alternative Performance Solution for Natural Ventilation

MECHANICAL AND MOUNTING

Enclosure	IP67 (Pod) NEMA 3R / IP35 (Powerpack) NEMA 4 / IP66 (Inverter)
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Powerpack Unit Dimensions	L: 1308 mm (51.5 in) W: 822 mm (32.4 in) H: 2235 mm (88 in)
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Powerpack Unit Max Shipped Weight	2199 kg (4847 lbs)
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Inverter Dimensions	L: 1014 mm (39.9 in) W: 1254 mm (49.4 in) H: 2242 mm (88.3 in)
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Inverter Max Shipped Weight	1120 kg (2470 lbs)
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Operating Ambient Temperature	–30°C to 50°C (–22°F to 122°F)
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REGULATORY

Lithium-Ion Cells	NRTL listed to UL 1642
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System	NRTL listed to UL 1973, 9540, 1741 SA IEEE 1547 Compliant to grid codes and safety standards of all major markets. Full list provided upon request.
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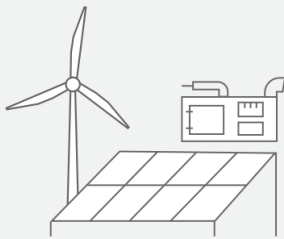
POWERPACK MICROGRID SYSTEM



T E S L A

TESLA MICROGRID SOLUTION

Microgrids and off-grid power systems consisting of a range of conventional and renewable generation sources, battery storage and grid connections present unique challenges that require robust solutions to maintain stable and sustainable power supply. Tesla's microgrid solution leverages existing unit-level controllers and a robust, frequency-based load sharing scheme to solve these challenges. The end result is a solution that delivers savings and stable, reliable power to a wide range of customers—from remote communities, commercial and industrial facilities to utility substations, military bases and mining operations.



GENERATION



STORAGE



LOAD

Tesla's microgrid solution revolves around the Tesla Powerpack energy storage technology and includes software, controls and services to effectively manage power and energy flow, while balancing demand needs and maximizing economic benefit over the life of the microgrid. This document details Tesla's comprehensive solution.

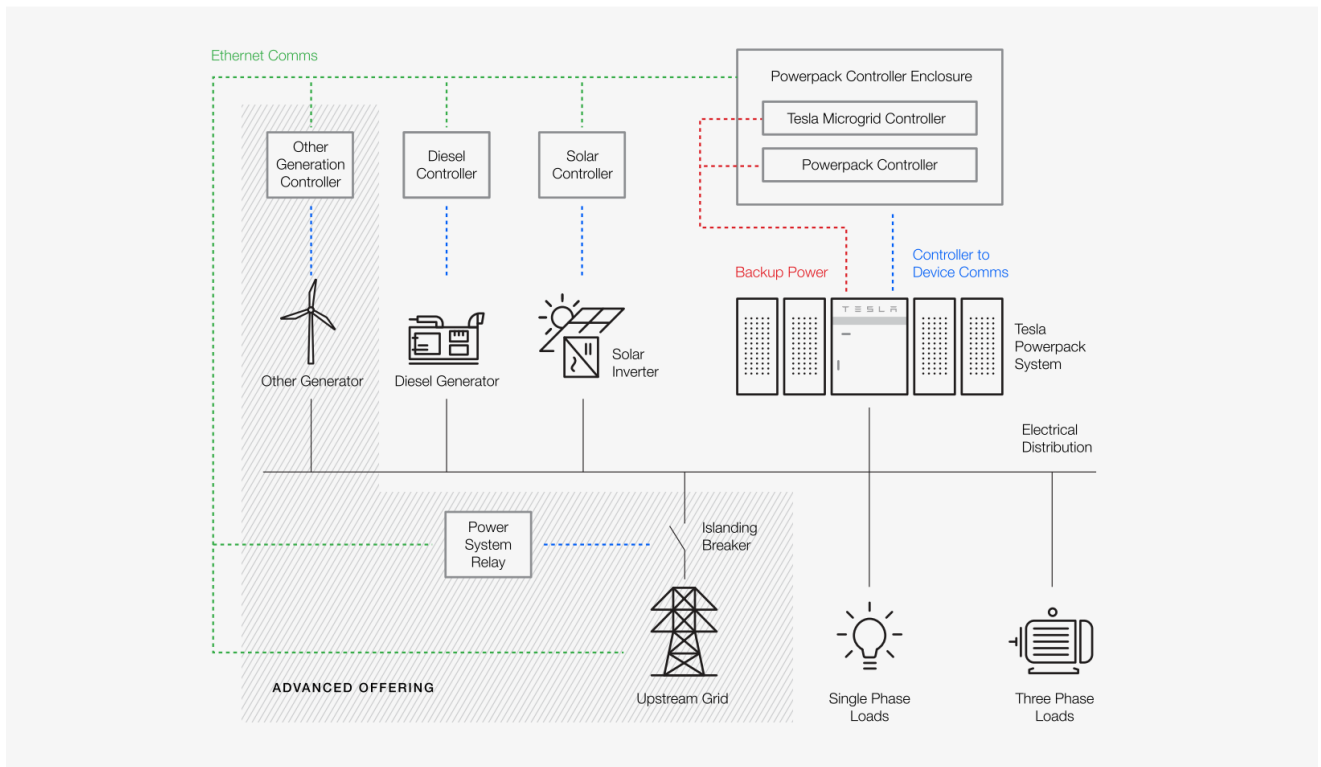
- > System Overview
- > Distributed Energy Resource Management
- > Islanding and Grid-Connected Control
- > Monitoring and Reporting
- > Networking and IT

Tesla offers industry-leading performance, reliability and value to implement microgrids that meet and exceed our customers expectations and requirements. For additional information please visit www.tesla.com/powerpack.

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SYSTEM OVERVIEW



Tesla's Microgrid Controller manages the various Distributed Energy Resources (DERs), such as the Tesla Powerpack system, diesel generators and solar PV to ensure reliable, low cost supply to the system loads.

The Microgrid Controller hardware is contained within the Tesla Powerpack Controller enclosure and includes a redundant, dual-feed DC power supply fed from within the Tesla Powerpack system. The controller utilizes a cost-based optimization algorithm that considers the priority and schedule of all DERs, dispatching generation and allocating power to loads dynamically. The controller easily allows generation sources to be made unavailable without interruption, and can island the microgrid from the upstream grid, and likewise controls the re-synchronization to the grid without interruption.

FEATURES

- > User configurable Priority List for all loads and generators
- > Cost-based optimization algorithm that utilizes the Priority Lists to dispatch or curtail generators and shed or reconnect loads in order to maintain system operation most cost-effectively
- > Management of power buffers (also known as spinning reserves) and energy buffers to account for fluctuations in load and non-dispatchable generation
- > System blackstart after a fault and safe system shutdown for maintenance
- > Forecasting electric demand and renewable generation in order to optimize schedule decision making*

*Advanced offering

TESLA

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DISTRIBUTED ENERGY RESOURCE MANAGEMENT

The Microgrid Controller manages DERs, such as Tesla Powerpack systems, generators and PV systems listed on Tesla's Approved Vendor List (AVL) through interfacing with OEM controllers. DERs may be added to the Approved Vendor List for an additional fee subject to Tesla approval. Generally, the management of DERs include:

- > Automatic start and stop of the DER
- > Management of real and reactive power sharing between DERs
- > DER Priority List and availability and management
- > Alarm management and monitoring



POWERPACK SYSTEMS

The Microgrid Controller manages Tesla Powerpack battery systems by interfacing with the Powerpack Controller. Management of Tesla Powerpack systems includes:

- > High State of Energy (SOE) management by curtailing generation
- > Low SOE management by increasing dispatchable generation output

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TRADITIONAL GENERATION

The Microgrid Controller manages generators by interfacing to the OEM generator controllers listed in the Approved Vendor List.

Generator Management includes:

- > Maintenance of the minimum run rate during steady-state operation and startup management
- > Time-of-use management
- > Generator loading optimization
- > Minimization of total operating cost*

LOADS

The Microgrid Controller manages generators by interfacing with the OEM load breakers and controllers listed in the Approved Equipment List. Load Management includes:

- > Automatic shedding and Automatic re-connection of load feeders*

*Advanced offering

SOLAR PV

The Microgrid Controller manages PV systems by interfacing with the OEM PV controllers listed in the Approved Vendor List.

Management of PV systems includes:

- > Maximization of renewable consumption
- > Curtailment to manage battery SOE, Powerpack inverter loading and non-export
- > "Wait for Energy" mode whereby in extreme low-energy situations the system will perform a safe shutdown with an energy buffer in order to wait for the next solar day*



ISLANDED AND GRID-CONNECTED CONTROL



A single connection to an external grid can be managed by the Microgrid Controller, which seamlessly transitions the microgrid between islanded (off grid) and grid-connected configurations using a power system protection relay to manage the islanding breaker/contactator.

Features:

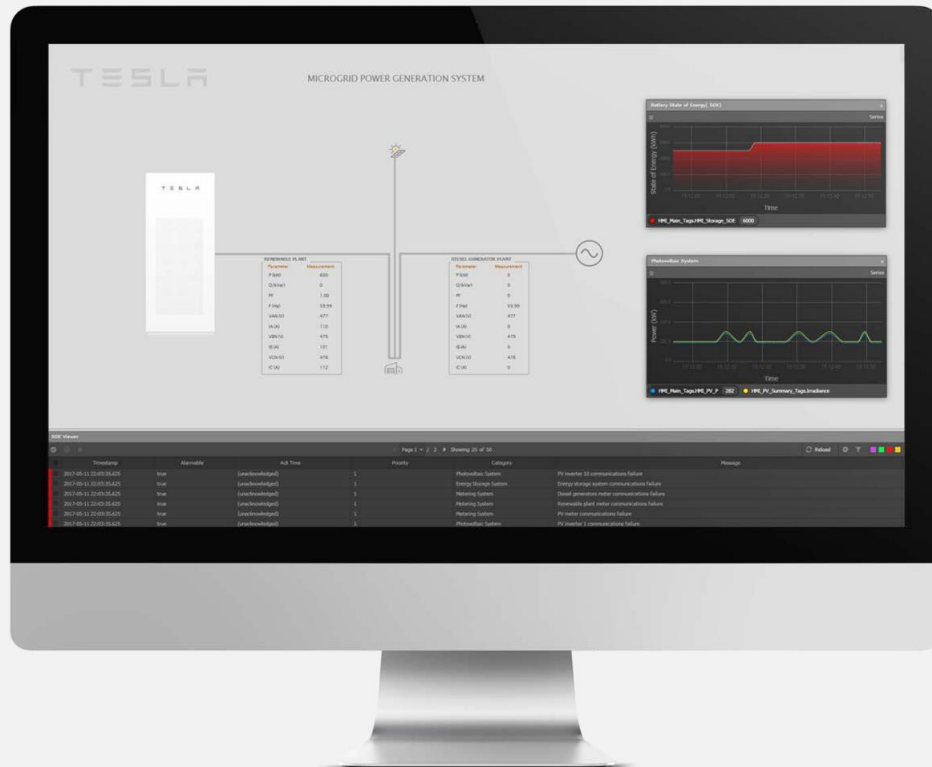
- > Transitions the microgrid between islanded and grid-connected configurations by managing the Microgrid generation
- > Automatic islanding in the event that a grid excursion is detected
- > Automatic re-synchronization when the grid returns or when initiated by customer
- > Intentional islanding may be requested by customer
- > When on grid, Tesla's vast on-grid experience using Opticaster can be used for tariff optimization or providing grid services, such as demand response, frequency response, or non-export
- > "Fast Backup" also available, contact Tesla for details*

*Advanced offering

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MONITORING AND REPORTING



The Microgrid Controller includes monitoring and historian functionalities that allow for system values and parameters to be viewed and exported from the system. The monitoring and historian functionalities are available through the web-based HMI, which is hosted as a HTTP page on the local network.

- > Data logged to Tesla servers for remote service and support
- > Local control (HTTP based)
- > HMI accessible via HTML5 browser to provide control and monitoring flexibility
- > Comprehensive HMI offering, includes site specific customization*

*Advanced offering

NETWORKING / IT

The Microgrid Controller relies on customer supplied Ethernet networking infrastructure. The Microgrid Controller communicates to the DERs via Ethernet-based communications (e.g. MODBUS TCP/IP). DER's communicate via OEM communications to the individual components. For components that require non-Ethernet communications (e.g. MODBUS Serial RTU) converters are required to allow these DERs to connect to the Ethernet network.

- > Ethernet-based communications
- > Redundant ring network recommended
- > Internet connection required to allow for, monitoring and historian functionality
- > Reporting of the system status and variables to upstream SCADA systems.



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