Project Documentation
Gebäude-Dokumentation

ID: 6488

Abstract | Zusammenfassung

Woodside Building for Technology and Design , Melbourne Australia

Data of building | Gebäudedaten

Year of construction/	2020	**Space heating / Heizwärmebedarf**	**9 kWh/(m²a)**
U-value external wall/ U-Wert Außenwand	Various		
U-value basement ceiling/ U-Wert Kellerdecke	Various	**Primary Energy Renewable (PER) / Erneuerbare Primärenergie (PER)**	74 kWh/(m²a)
U-value roof/ U-Wert Dach	Various	**Generation of renewable energy / Erzeugung erneuerb. Energie**	64kWh/(m²a)
U-value window/ U-Wert Fenster	Various	**Non-renewable Primary Energy (PE) / Nicht erneuerbare Primärenergie (PE)**	10 kWh/(m²a)
Heat recovery/ Wärmerückgewinnung	75 %	Pressure test n_{50} / Drucktest n_{50}	0.6 h-1
Special features/ Besonderheiten	Solar power generation, heat recovery, CO2 heat pump hot water , generation , high performance VRV heat recovery heating and cooling ,rainwater utilisation		

Brief Description

The Woodside Building for Technology and Design is one of the most efficient and innovative teaching buildings of its type in the world.The Woodside Building for Technology and Design has been created to enable Monash University engineering and IT students and researchers to embrace innovation, design and cutting-edge technology to develop new solutions in sustainable energy.

The building houses many learning spaces, including an interactive tiered space accommodating 360 people. The five-storey building provides a vibrant and collaborative new home for the university's engineering and IT students. Designed as a 'living laboratory', the building features extensive exposed building services, structural elements and unique features such as structural health monitoring systems and thermal piles to help students learn from the building.
It allows students and researchers to explore new energy possibilities to solve tomorrow's questions for the good of current and future generations, through exposed building services, structural elements and unique features.

Buildings Mechancial System Design

The entire building has been designed for optimum efficiency:

- The building's mechanical system has been specifically designed and installed to minimise losses and optimise efficiency. The duct work and pipe work have been designed to reduce resistance in the system and therefore operate at a higher efficiency level. This reduces the building's operational costs and greenhouse gas emissions. All mechanical equipment is selected from high efficiency products with average COP of 4.
- A dedicated outdoor air system has been equipped with heat recovery heat exchanger which recovers heat that would normally be dissipated to the environment and turns this back into useful energy for the building.
- Unusually for a building of this size, it features a highly efficient Variable Refrigerant Flow (VRF) inverter air conditioning system, which offers a significant improvement in peak and part load energy efficiency over conventional air conditioning.
- High-efficiency R744 (CO_2) refrigerant heat pumps allow the building to produce its own domestic hot water. All stormwater and pipeworks for the hydraulic systems have been specially designed, thermally treated and tested to minimise heat gains or heat losses.
- Being an all-electric building, no natural gas or fossil fuel is used in the building
- A range of thermal comfort features ensure the building is a pleasant environment for users to enjoy. It has adequate outdoor air for all spaces and features a mechanical system that can regulate and control humidity, carbon dioxide levels and temperature according to each space's purpose.
- The building fabric and shading elements were developed in collaboration with the project architect to optimise daylight while minimising unnecessary heat loads from the sun. It provides a barrier against the external weather conditions and creates an isolated space that can be controlled more easily when the mechanical system in the building is operating.

Responsible project participants
Verantwortliche Projektbeteiligte

Architect/ Entwurfsverfasser	Grimshaw Architects https://grimshaw.global/
Implementation planning/ Ausführungsplanung	-
Building Services/ Haustechnik	Aurecon https://www.aurecongroup.com/projects/property/woodside-building-technology-design
Structural engineering/ Baustatik	Aurecon https://www.aurecongroup.com/projects/property/woodside-building-technology-design
Building physics/ Bauphysik	Aurecon https://www.aurecongroup.com/projects/property/woodside-building-technology-design
Passive House project planning/ Passivhaus-Projektierung	Aurecon https://www.aurecongroup.com/projects/property/woodside-building-technology-design
Construction management/ Bauleitung	Lendleae https://www.lendlease.com/au/

Certifying body
Zertifizierungsstelle

Passive House Institute Darmstadt www.passiv.de

Certification ID

6488	Project-ID (www.passivehouse-database.org) Projekt-ID (www.passivhausprojekte.de)

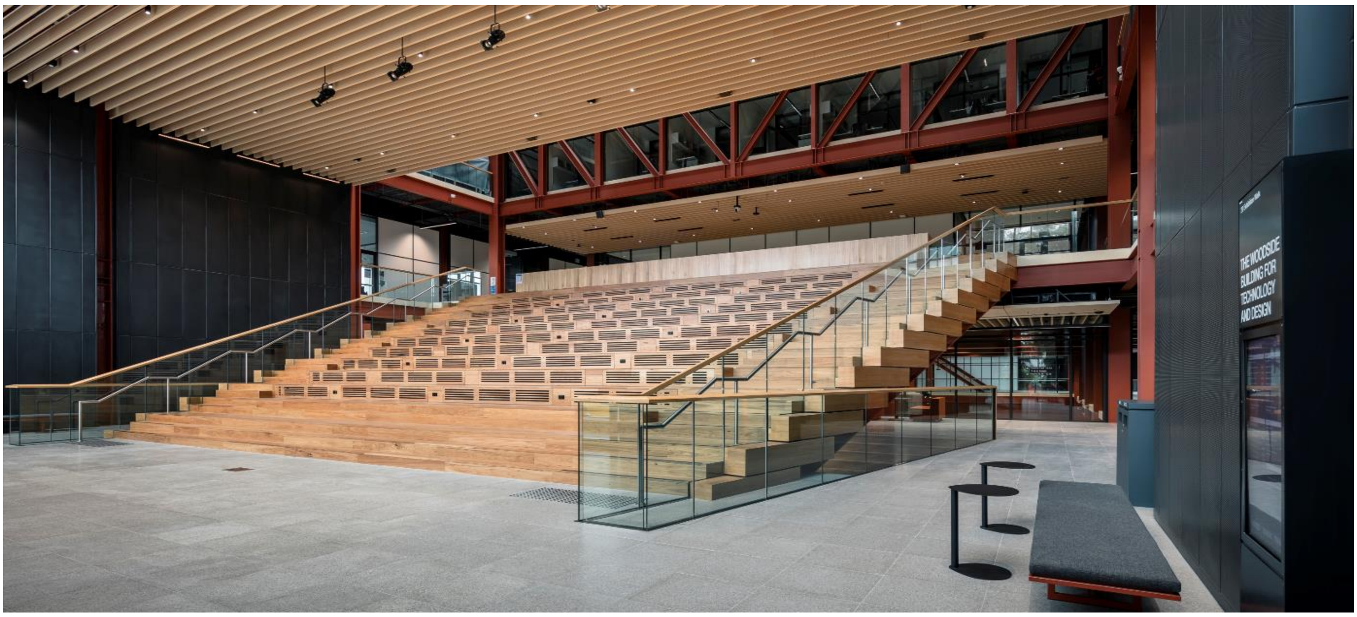
Author of project documentation
Verfasser der Gebäude-Dokumentation

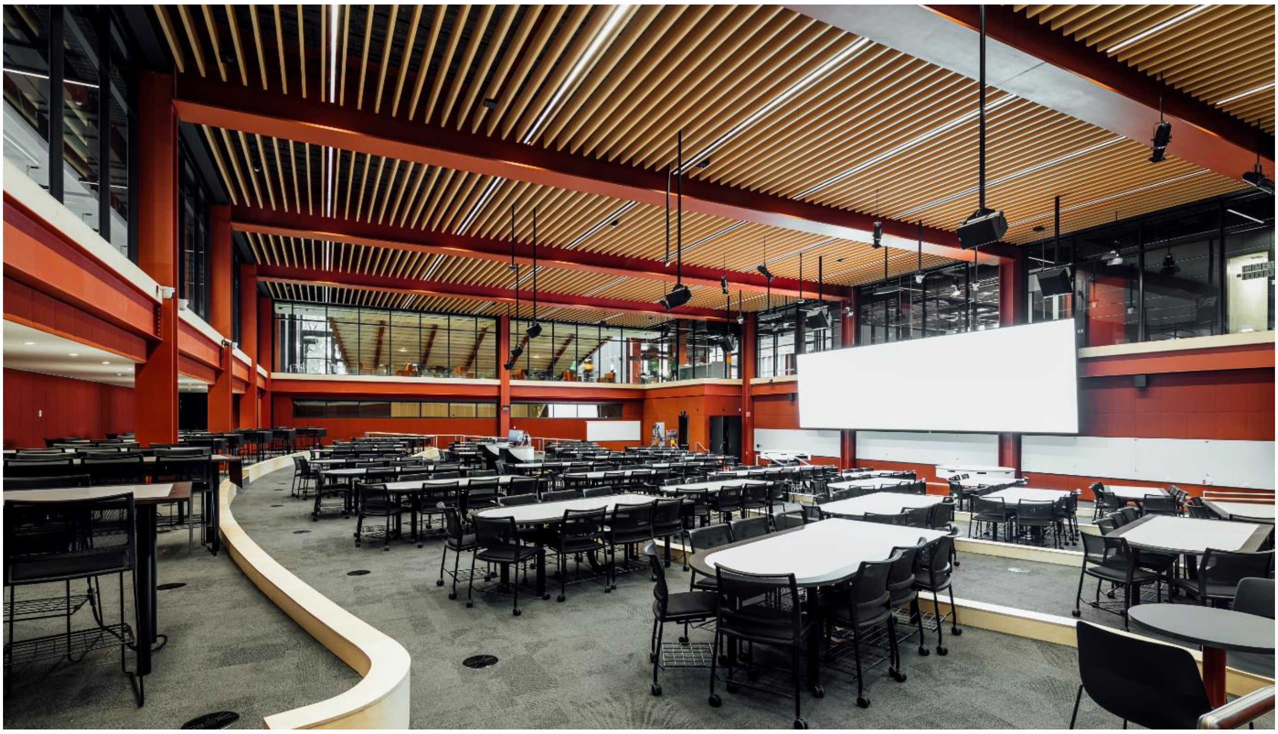
Aurecon
https://www.aurecongroup.com/projects/property/woodside-building-technology-design

Date Datum	Signature Unterschrift
24.02.2021	

1. ELEVATIONS

2. Interior photo exemplary



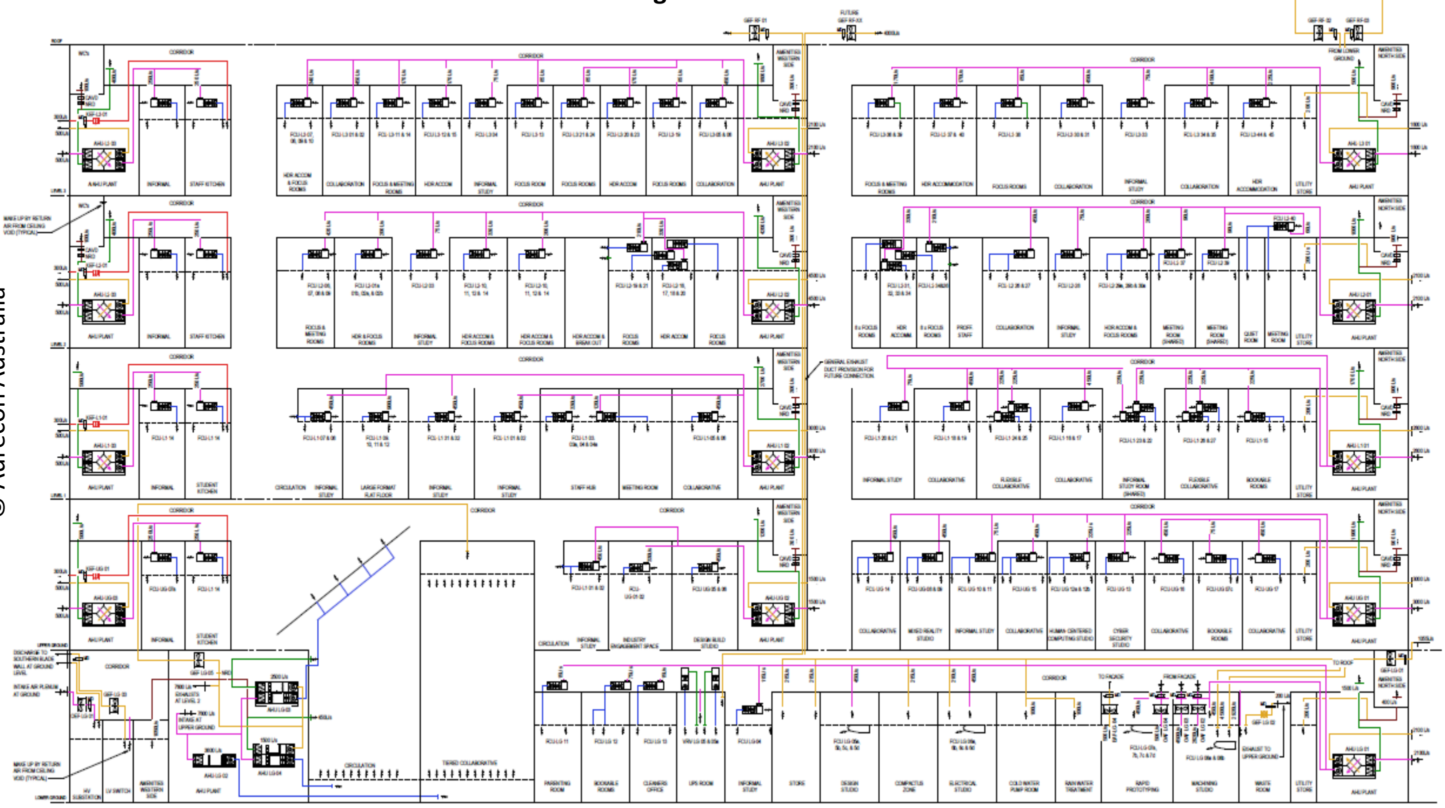


3. SECTION OF 3D MECHANICAL PLANT

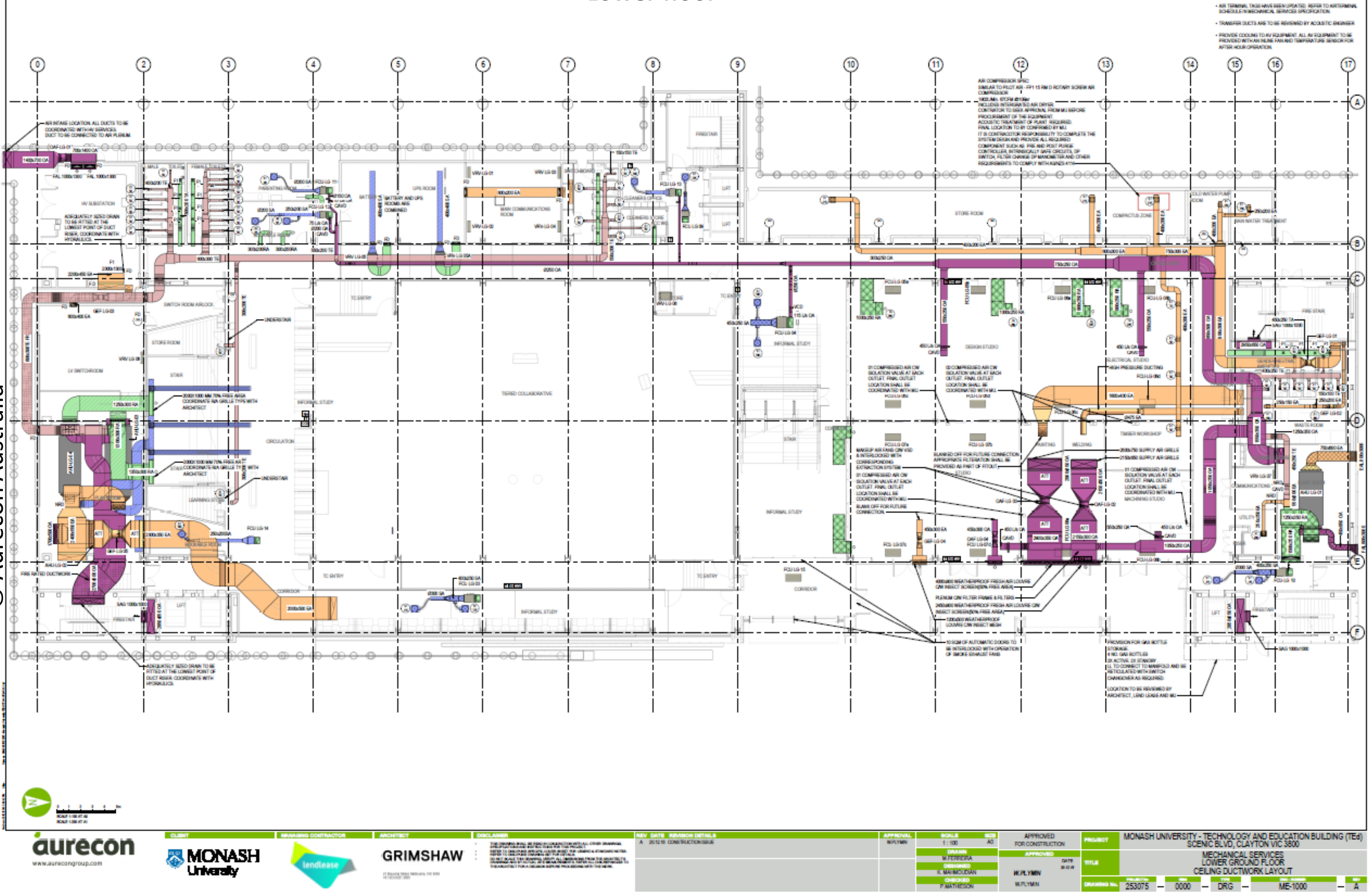
© Aurecon Australia

4. Floor plansand Air schematic (Mechanical Services)

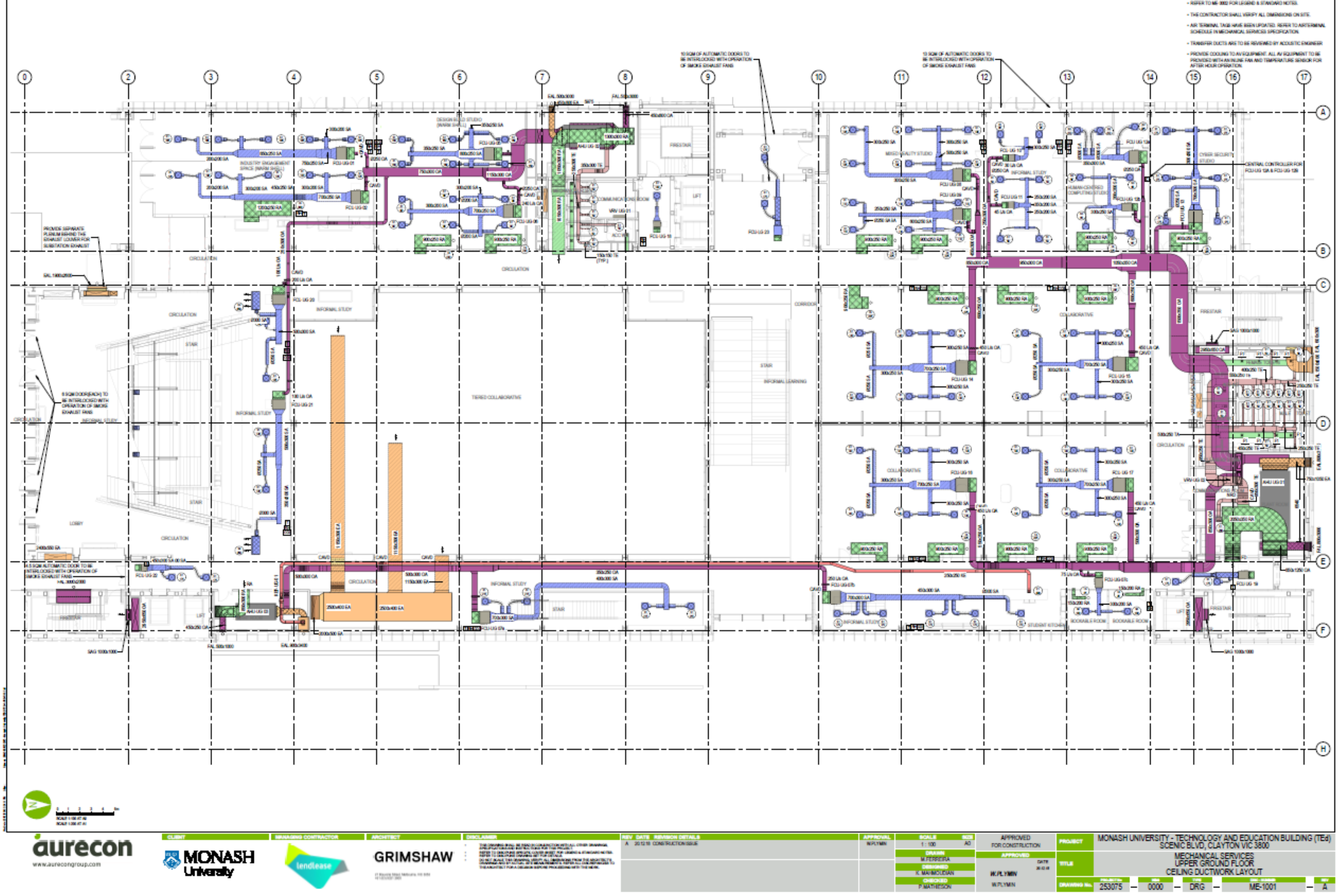
Building air schematic



Lower floor



Upper Ground floor



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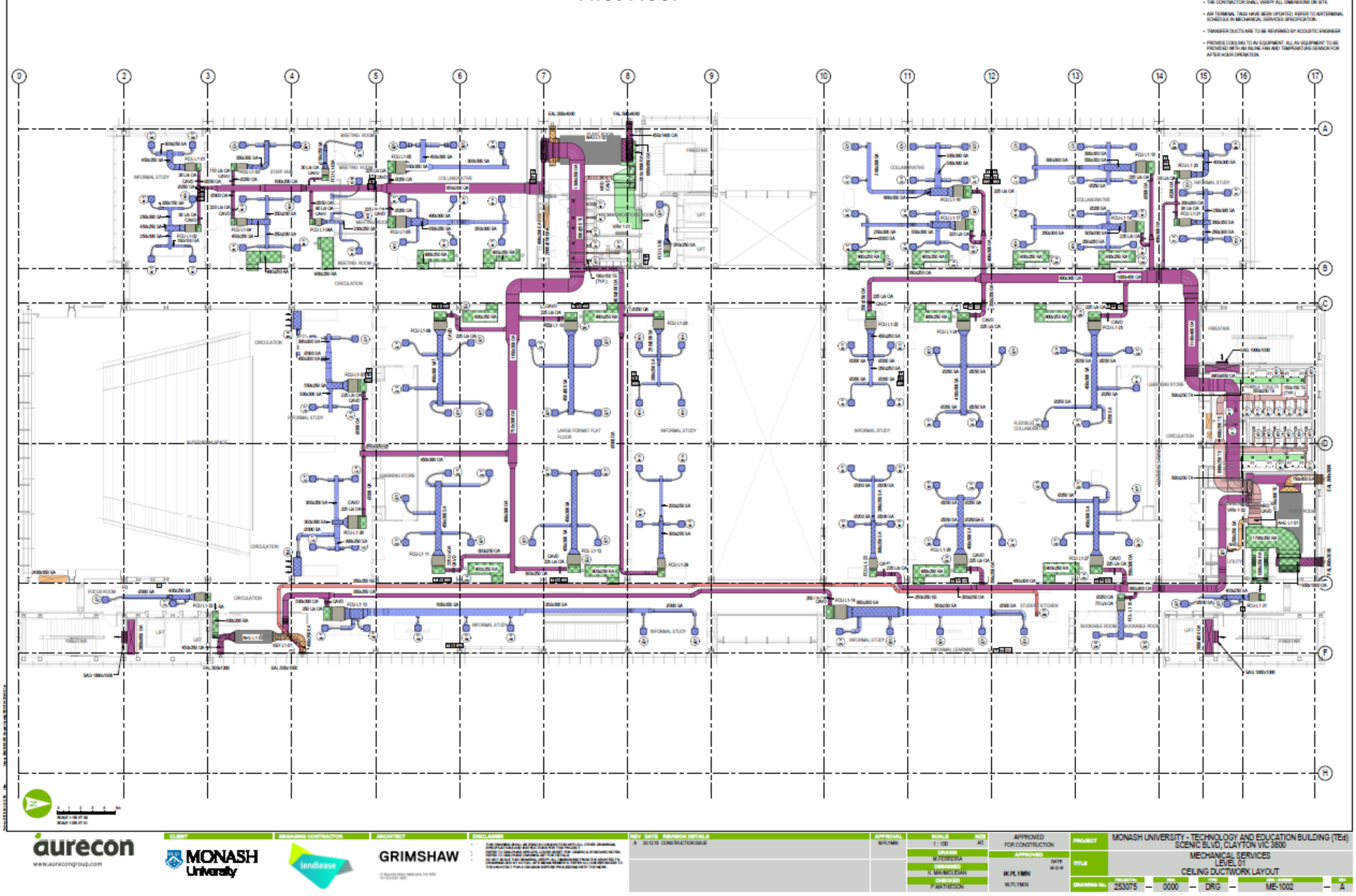
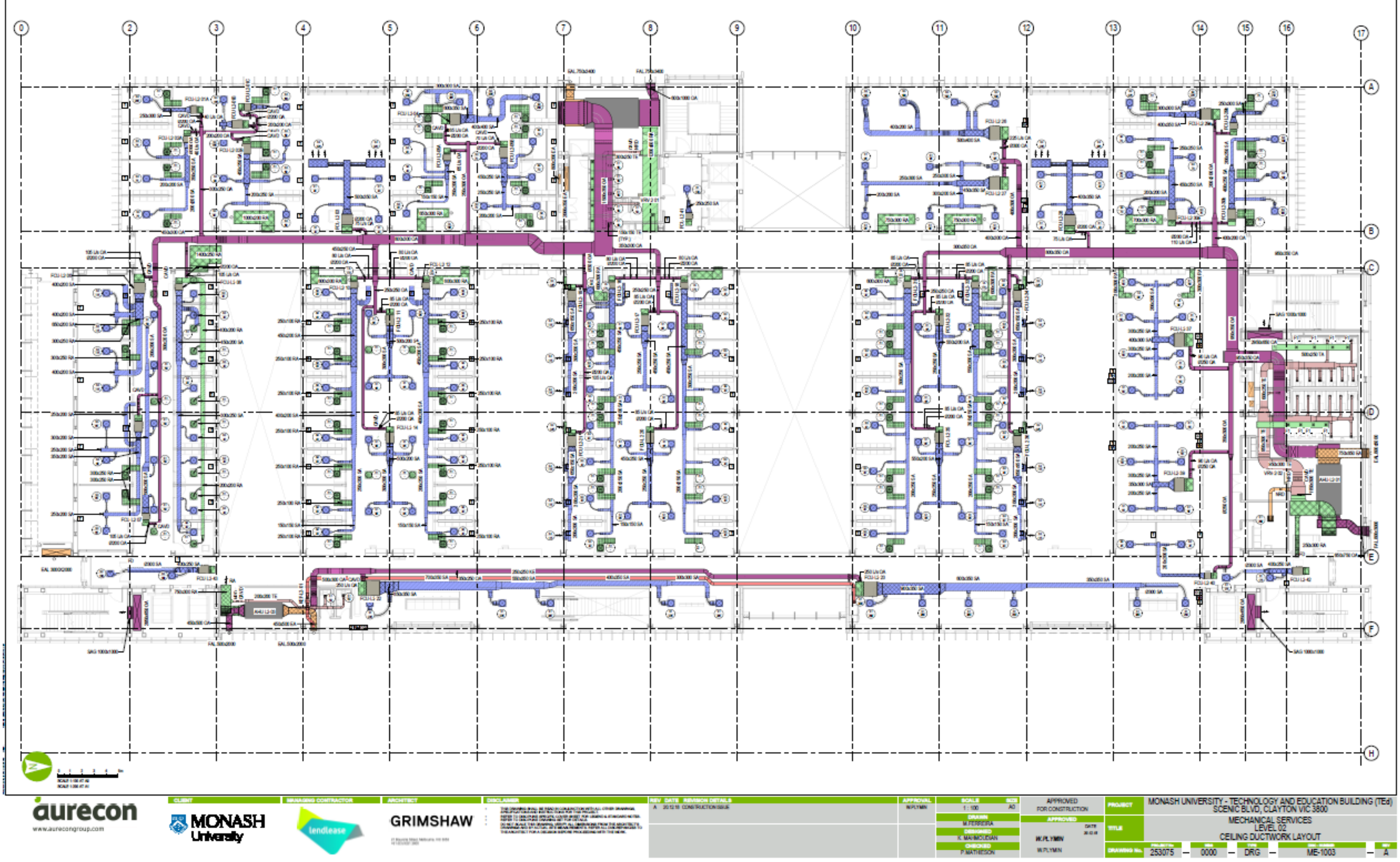
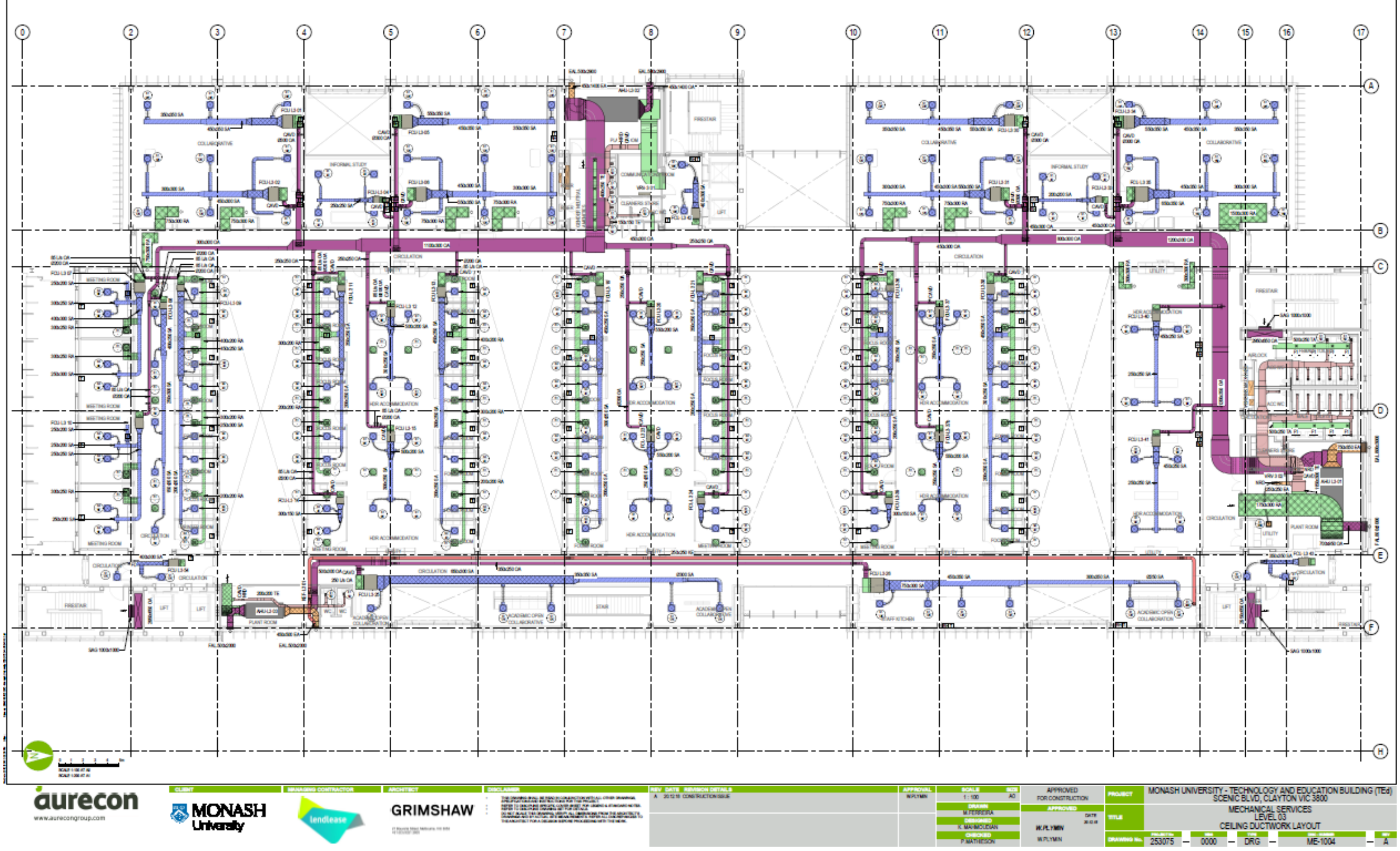
First Floor

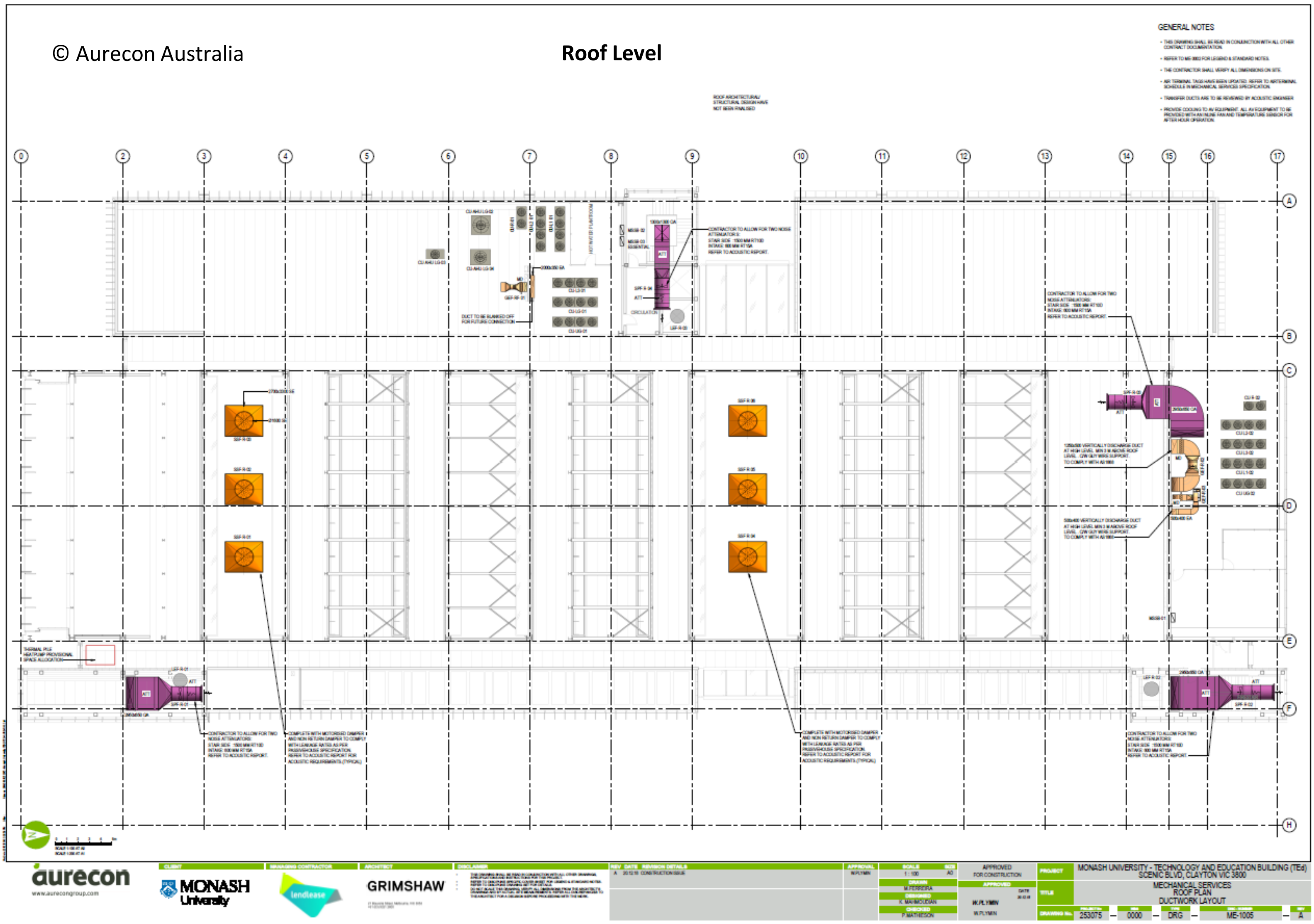


Second floor



Third floor





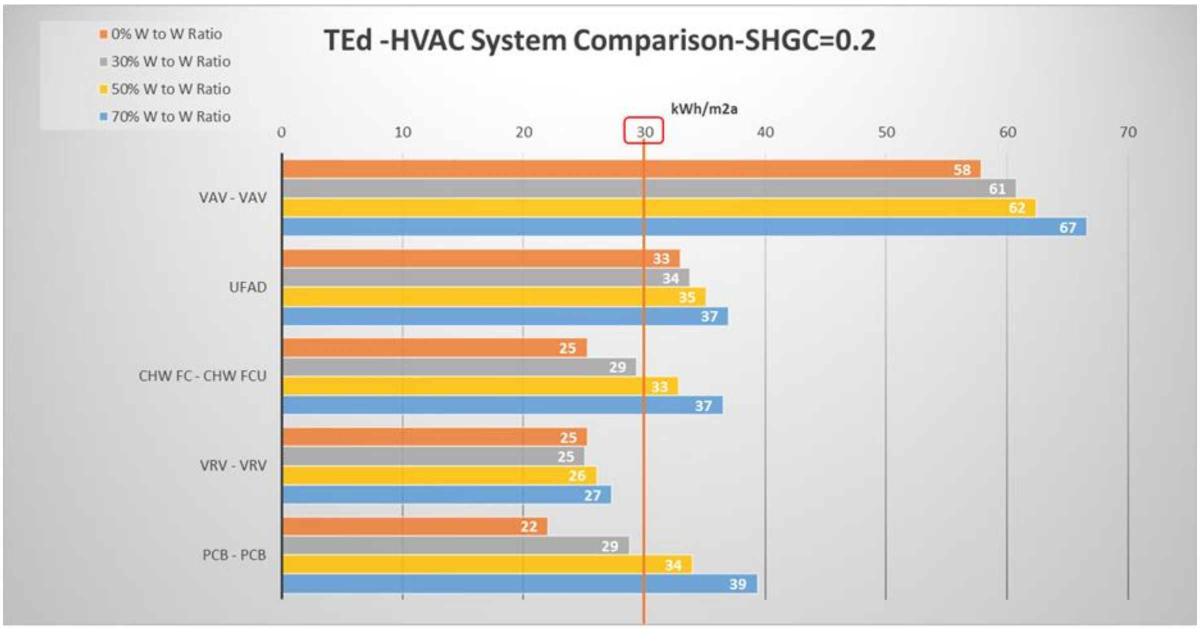
5.HEATING, COOLING AND VENTILATION STRATEGY

By far the most significant challenge in this project was designing a mechanical system that would comply with the Passive House standards. As the Woodside Building is the first commercial building in Australia built to the Passive House criteria, there was really no precedent to follow, so Aurecon needed to develop a solution that was tailormade for the building and delivered the functionality Monash University was seeking for the first time in Australian context.

We created more than six different simulations for possible mechanical systems and used dynamic energy simulation software to model the energy performance and resulting thermal comfort of the building. With the solution decided on, Aurecon then went through the design process to identify the other factors that would impact the building's energy consumption such air distribution systems and thermal plant overall efficiency.

The entire building has been designed for optimum efficiency, superb IAQ and maximum thermal comfort with special focus on building physics principals, the building's mechanical system has been specifically designed to minimise losses and optimise efficiency. The air distribution systems have been designed to minimise inefficiencies and resistance. A dedicated outdoor air system has been equipped with heat recovery heat exchanger.
Tailormade for functional spaces, air-condition system of the building comprises of overhead supply, underfloor air distribution and radiant in-slab heating and cooling systems connected to modular heat recovery Variable Refrigerant Flow system enabling the system to serve spaces when needed without adversely impacting the system efficiency.

Figure below shows HVAC system energy consumption comparison , UFAD system had potentials to meet the energy performance requirements of the project however VRV and CHW fancoil unit system could be very good options. It also reveals that internal heat loads such as lighting,equipment and people loads are the most dominant loads in the building and require to be managed well in order to reduce the overall impact on the mechanical system

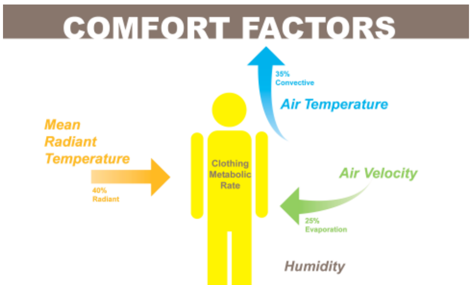


The perception of thermal comfort varies from person to person based on many variables, including activity level, clothing level, properties of the surrounding thermal ambient, such as air temperature, radiant temperature, body surrounding air velocity and humidity of the air.

As documented in ISO 7730, most of the building occupants would experience good thermal comfort if:

- The air is not too humid;
- Air speeds remain within the acceptable limits (for speeds under 0.08 m/s, less than 6% of people will feel a draft);
- The difference between radiant and air temperature remains small;
- The difference of the radiant temperature in different directions remains small (less than 5°C; "radiation temperature asymmetry");
- The room air temperature stratification is less than 2°C between head and feet of a sitting person;

The perceived temperature varies less than 0.8°C



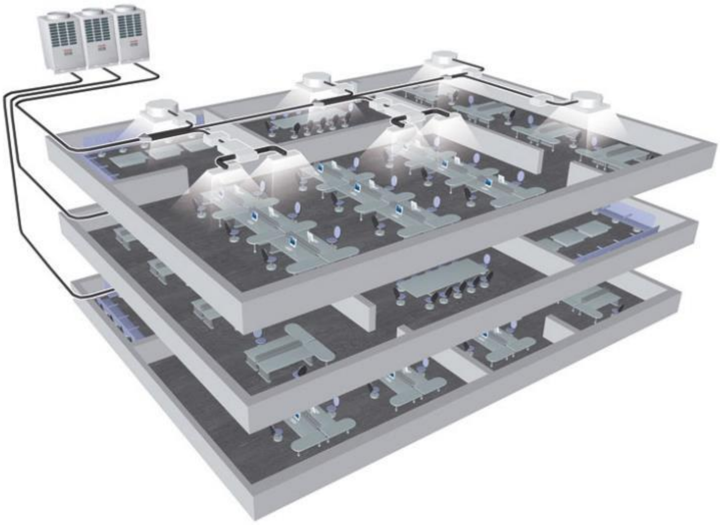
By achieving Passive House certification, the building is designed for high occupant comfort. This is ensured through the following measures:

- The high performance thermal envelope reduces the heat flow between the interior and exterior;
- The high performance thermal envelope reduces interior draughts as the interior surface temperatures vary only slightly from the surrounding temperature in the room, resulting in low radiant temperature differences between interior surfaces;
- An airtight envelope reduces draughts and uncontrolled air movement;
- Exterior shading reduces glare and non-useful solar heat gains in summer;
- Provision of 100% fresh air via heat recovery ventilation;
- Occupant control of operable windows, internal blinds and ventilation systems.

6.VRV CONDENSER UNITS INSTALLATION ON ELEVATED ROOF PLATFORM

Air-cooled VRV heat recovery

Air-cooled Variable Refrigerant Volume (VRV or VRF) systems is a packaged solution that uses refrigerants as the primary heat transfer medium. Different units are able to operate in cooling or heating at the same time which may increase the system overall efficiency as the heat removed from one area can be used for heating elsewhere in the building. This solution is reasonably cost effective but requires a reasonable area of roof space to accommodate the condenser units. System sizes are limited to reduce the potential hazards with refrigerant leaks in the building.



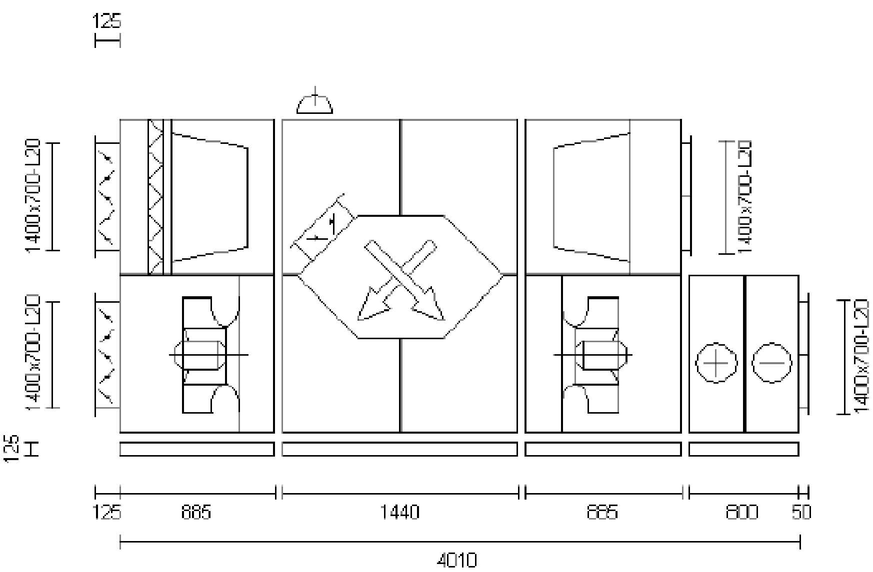
7.Internal Insulated Rigid and Flexible Ductworks

8.High Efficiency CO2 heat pump for Hot Water Production

Buildings domestic hot water is produced using high efficiency CO2 heat pump units with COP ranging from 5 to 7 depending on ambient condition. This allowed the building to be fully electric building with no reliance on natural gas or any fossil fuels, this allows Monash University to achieve their net zero target as soon as possible.

9. HEAT RECOVERY UNITS WITH BY PASS DAMPERS

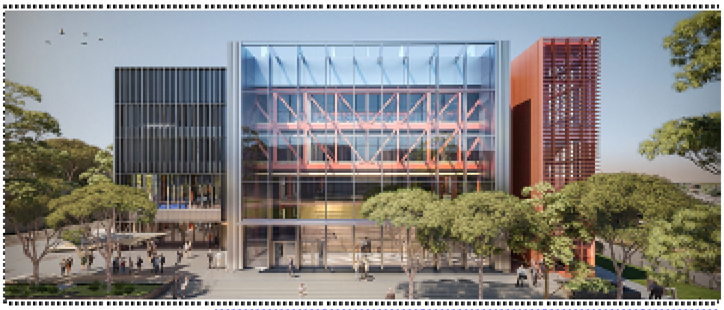
Under Passive House there is recommended to incorporate heat recovery into the ventilation system. AS part of the ventilation strategy cross flow plate heat exchanger heat recovery system was used . The heat recovery units used on this projects are all Eurovent certified (A+ grade) ,thermally broken heat exchanger recovery rate is generally between 81 to 83% in order to recover sufficient heat from the exhaust air and transfer to supply air stream to the building.



Make and Model	**Komfovent –A+ energy efficiecny units**
Heat Recovery Efficiency	81 TO 83 %
Heat exchanger type	Plate HEX NRVU

10. PHPP Results

Passive House Verification



Building:	Woodside Building for Technology and Design
Street:	Wellington Rd, Clayton
Postcode/City:	3800 Melbourne
Province/Country:	Victoria AU-Australia
Building type:	Educational
Climate data set:	ud---01-PHI Updated Weather File
Climate zone:	5: Warm; Altitude of location: 94 m
Home owner / Client:	Monash University
Street:	Wellington Rd, Clayton
Postcode/City:	3800 Melbourne
Province/Country:	Victoria AU-Australia

Architecture:	Grimshaw Architects	Mechanical engineer:	Aurecon
Street:	Level 2, 333 George Street	Street:	850 Collins St, Docklands
Postcode/City:	2000 Sydney	Postcode/City:	3008 Melbourne
Province/Country:	New South Wales AU-Australia	Province/Country:	Victoria
Energy consultancy:	Aurecon	Certification:	Passive House Institute
Street:	850 Collins Street	Street:	Rheinstrasse 44-46
Postcode/City:	3008 Melbourne	Postcode/City:	64283 Darmstadt
Province/Country:	Victoria AU-Australia	Province/Country:	Hessen DE-Germany

Year of construction:	2020	Interior temperature winter [°C]:	20,0	Interior temp. summer [°C]:	25,0
No. of dwelling units:	1	Internal heat gains (IHG) heating case [W/m²]:	11,1	IHG cooling case [W/m²]:	11,1
No. of occupants:	2719,0	Specific capacity [Wh/K per m² TFA]:	132	Mechanical cooling:	x

Specific building characteristics with reference to the treated floor area

		Unit	Value		Criteria	Alternative criteria	Fullfilled?[2]
	Treated floor area	m²	15860,0				
Space heating	Heating demand	kWh/(m²a)	9	≤	15	-	yes
	Heating load	W/m²	13	≤	-	10	
Space cooling	Cooling & dehum. demand	kWh/(m²a)	14,32	≤	15	18	yes
	Cooling load	W/m²	30	≤	-	19	
	Frequency of overheating (> 25 °C)	%	-	≤	-		-
	Frequency of excessively high humidity (> 12 g/kg)	%	0	≤	10		yes
Airtightness	Pressurization test result n_{50}	1/h	0,6	≤	0,6		yes
Non-renewable Primary Energy (PE)	PE demand	kWh/(m²a)	169	≤	-		-
Primary Energy Renewable (PER)	PER demand	kWh/(m²a)	74	≤	60	74	yes
	Generation of renewable energy (in relation to pro-jected building footprint area)	kWh/(m²a)	64	≥	-	45	

[2] Empty field: Data missing; '-': No requirement

I confirm that the values given herein have been determined following the PHPP methodology and based on the characteristic values of the building. The PHPP calculations are attached to this verification.

Passive House Classic? yes

Task:	First name:	Surname:	Signature:
2-Certifier	Dragos	Arnautu	

Certificate ID	Issued on:	City:
27722-27880_PHI_PH_20200818_DA	18.08.20	Darmstadt

11 BUILDING INFORMATION

Construction Cost	**$170 mil AUD**
Year of construction	2020
Heat exchanger type	Plate HEX NRVU

12 USER'S EXPERIENCES

Due to COVID 19 building has not been fully utilised however overall feedback from users and building mangers has been very positive.
Monash University indented to collect building energy consumption data ,weather data and occupancy levels for university students review and analysis.

13 AIRTIGHTNESS CONSIDERATIONS FOR MECHANICAL SERVICES

The Passive House Classic standard requires that an air change rate per hour of 0.6 (ACH) be achieved @50 Pa. To ensure this target is reached considerations regarding airtight barrier implementation was needed to be continually examined as the project progresses. Attaining an airtight building is a function of many variables which include:

•Minimising services penetrations through the airtight barrier;
•Designating responsibility of airtight barrier execution during design and construction;
•Testing of bespoke elements of the building prior to utilisation on site to determine performance of the product;
•Testing of the envelope prior to fitout and paying close attention to junctions as this can have a significant impact on achieving an airtight building.

- Minimise service penetrations, where penetration were required they generally located in one accessible location where airtightness barrier or caulking can easily be applied to (e.g. 300mm clearance).
- All duct risers penetrating airtightness barrier were capped at the top or provided with proprietary products, such as dampers and collars.