617-621 Pacific Hwy, St Leonards

Preliminary Building Services and Structural Description

Anson Group

28 July 2016

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1 Executive Summary

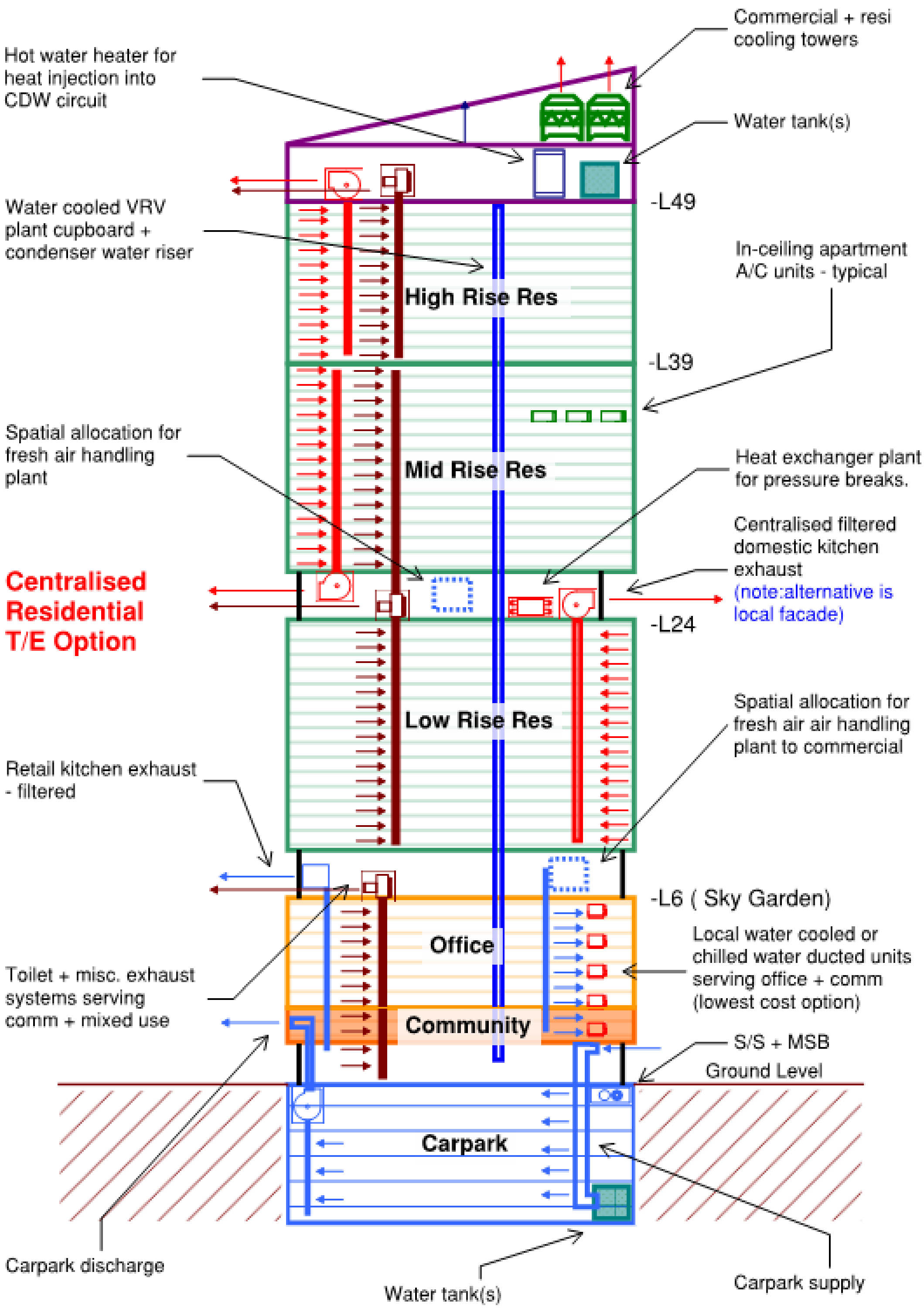
Aurecon have been engaged by Anson Group to provide preliminary advice in relation to building services planning and the Structural concept such as to inform the feasibility of the development. The advice thus far has related to preliminary building services planning requirements for risers and plant, as well as undertaking a vertical transportation study.

The advice has been used to test whether the proposed building configuration and design incorporates appropriate planning principles/allowances to accommodate ongoing design development.

The current building planning does not represent a completed design, as the project is still in preliminary stages, however the configuration of plant areas and general allocation for vertical risers within the footprint outline a feasible development. The vertical transport strategy comprising 4 passenger lifts serving the apartment tower will result in an appropriate level of service predicted to meet “luxury” performance standards.

The project will need to progress further through subsequent design stages to refine allowances and prepare building services design briefs and ongoing design coordination.

Preliminary Primary Services Planning



2 Introduction

This statement has been prepared to assist Anson group in addressing North Sydney Council commentary regarding the proposed development at the aforementioned site.

Aurecon have assisted Anson Group and Kann Finch in reviewing the proposed building form in relation to services planning. The project is in the early stages of design development and further works will be necessary to develop the design. However the intent of this review is to identify likely servicing strategies and outline key planning requirements in order to inform the building planning. This is at a level to inform project feasibility rather than design development.

2.1 Overview of Proposed Development

The development comprises approximately 50 levels above ground and a multi-storey below ground basement carpark as part of a mixed use development. The breakdown of building components / typology is as follows:

Basement carpark: Multiple levels

Ground floor and retail: Lower ground and ground floors

Community spaces: notionally level 1 and 2

Commercial office: notionally level 3 through 5

Sky garden plus plant: Level 6

Lo – rise residential: 17 floors

Plant floor: Level 24

Midrise residential: 14 floors

Hi rise residential: 10 floors

Roof plant: Level 49

2.2 Area Summary

Site Area		1067m²
Non-Residential GFA		
Retail		440 m²
Community		1770 m²
Office		2620 m²
		4830 m²
Residential GFA		
Low-Rise		7990 m²
Mid-Rise		6580 m²
High-Rise		4290 m²
		18860 m²
Apartment Summary		
Low-Rise (17x5)	85 apartments	
Mid-Rise (14x5)	70 apartments	
High-Rise (10x4)	40 apartments	
	195 apartments	
1 bedroom (55m²)	41	21%
2 bedroom (76 to 77 m²)	62	32%
2 bedroom + study (86 to 91 m²)	82	42%
3 bedroom (124 m²)	10	5%

(As referenced from Kann Finch Concept design report 09 August 2016.)

3 Electrical Services

3.1 Infrastructure

Electrical power infrastructure for the project has been developed for the power to arrive at site via Ausgrid feeders. The building will have a dedicated substation that will be situated on the western side of Basement Level 1 to service retail, commercial and residential loads. Access hatches will be required in the external ground plane as well as dual egress stair provisions.

Low voltage electrical supplies will originate from the buildings main switchroom located on Basement Level 1 adjacent to the buildings substation.

The building will have its own consumer's providing cabling and distribution to apartments, as well as house services loads. Fire rated consumers mains will be provided as required by the NCC and AS3000.

The main switchboards will be designed to accommodate the full load of the consumer's mains capacity, plus 20% spare capacity. A minimum of 20% spare space in the main switchroom will be provided for future use. The main switchboards will be of Form 4b construction complying with AS3439, with submain protection provided by circuit breakers.

Standby generation will be provided as part of site development. Additional capacity will be provided in this generator to provide standby power to lifts in the building and for essential life safety systems to facilitate evacuation of the building in the event of an extended power interruption.

Power factor correction equipment will be installed where required to maintain the house services to a minimum power factor of 0.9 at all times.

Initial investigations suggest sufficient spatial allowances for the buildings required electrical infrastructure.

3.2 Substation

The proposed buildings will accommodate a 2 x 1500kVA substation on Basement Level 1. The location, size and spatial requirements of substations has been coordinated with the buildings predicted loads. The building size provides suitable area for the substation spatial requirements.

3.3 Main Switch Rooms

There will be a low voltage (LV) main switchroom located on Basement Level 1, directly adjacent to the buildings dedicated substation. Initial investigations of the building sizes indicate sufficient spatial areas to house the main switch room.

Plant rooms located on higher levels will be utilised to house main switch rooms, for the purpose of limiting voltage drop levels when servicing the high rise residential apartments.

The switchrooms will be two-hour fire rated construction with dual egress as well as sufficient access for plant replacement and maintenance via full height double swing doors. Clear pathways will be co-ordinated for major cable reticulation routes from the main switchboards to the central risers serving each building. The impact of EMR will be reduced by locating these high current sources including main reticulation routes away from permanently occupied spaces.

3.4 Risers

The proposed building riser is located centrally within the building and will be designed with one entry point for trade and maintenance personnel access.

The riser rooms will been designed so as to avoid where possible the transition of other services (namely wet services). The final layout of all water, gas will require review so as to minimise the risk of mixing services trades.

3.5 Switchboards

3.5.1 Main Switchboards

The switch room will house main switchboards (MSBs) that will be each supplied from the buildings adjacent substation.

Switchboards will be provided with 20% spare switchgear space and will be expandable on one end to accommodate the 20% spare capacity in the transformer.

The main switchboards will be back connected for ease of maintenance and will all be included with a provision for future connection of photovoltaic cells.

3.5.2 Distribution Boards

Distribution Boards (DB's) will be located throughout the building in readily accessible locations, situated in main switchrooms, riser cupboards or plant rooms depending on their location. Outgoing circuits will be protected by circuit breakers. A minimum of 20% spare poles will be provided for future use.

Apartment DBs will be located within apartment cupboards/joinery. Commercial and retail DB's will be located in tenancy cupboards/joinery with infrastructural coordination.

3.6 Standby Generators

A 1000kVA standby diesel generators will be located on the top floor plant room to provide standby power to lifts in the building and for essential life safety systems to facilitate evacuation of the building in the event of an extended power interruption. Fuel will be supplied from dedicated bulk fuel tanks.

The choice for generators is still subject to client value and market drivers and will be determined at later stages.

3.7 Submains and sub-circuit cabling

Sub mains cables will be installed in accordance with the requirements of BCA (Essential Services), AS3000, AS3008 and AS3009.

Retail and commercial tenants will have separately metered non-essential sub mains directly from the main boards.

Submains and sub-circuits will be sized with 20% spare capacity remaining at completion. The maximum demand will be calculated using the diversified connected load. Submains will utilise the buildings electrical risers to reticulate LV power to the tenancies.

3.8 Lightning Protection and Surge Protection

Lightning protection is to be provided in accordance with AS/NZS 1768.

This will include features such as:

- Surge Protection at the building's main switchboard;
- Bonding of metallic elements on the roof;
- Finials on the roof, which may be approximately 3 metres in length;
- Use of the steel reinforcing in the concrete as a down conductor, and
- Use of the basement steel reinforcing in the concrete as the earth electrode

3.9 Earthing and bonding

Earthing will be carried out in accordance with the requirements of AS/NZS3000 as well as the requirements of the supply authority network standards.

Main switchboard multiple earth neutral (MEN) system earthing will be supplemented as required by technical earthing systems such as telecommunications system earthing, equipotential earthing.

Earthing cables will be sized to AS/NZS3000 for disconnection and be dedicated for each sub main cable.

3.10 Maximum Demand

The Maximum Demand has been derived from the concept design completed on the buildings predicted load.

A summary of the overall Maximum demand is outlined in the table below.

Area	Total (KVA)
Retail	84
Community	248
Commercial	367
Low-rise residential	510
Mid-rise residential	420
High-rise residential	320
Lower Ground	41
Basement floors	74
Total Power (kVA)	2064
Factor of Safety (FOS)	20%
Total Power with FOS (kVA)	2477

4 Communications

4.1 Infrastructure

The St Leonards building will be serviced with incoming telecommunications services (broadband and telephone) by Telecommunications Service Providers (TSPs). Lead-in cabling will enter the site via a bank of ducts sufficient for the TSP's service requirements. The TSPs selected to service the residential, commercial and retail building will be agreed by the relevant stakeholders.

Buildings will be serviced via a basement level Building Distributor (BD) Room which is suitable for installation of passive and active equipment.

Communication risers will be utilised to service the building's network requirements.

Initial investigations suggest sufficient spatial allowances to be available for the buildings required communication infrastructure. Further investigation and coordination with the coexisting infrastructure will allow for efficient spatial utilisation.

4.2 Reticulation and Cable Management

Each retail tenant or residential apartment will be provided with a dedicated incoming telecommunications service cable via an Optical Network Terminal (ONT). Horizontal cabling within the residential apartments and for all converged network building service equipment will be provided with a minimum performance of Category 6 U/UTP balanced pair copper cabling via the ONT and multiport ONT respectively. No horizontal cabling will be provided within the retail tenancies.

4.3 Fibre-to-the-Premises (FTTP) Carrier Network

The site will utilise an NBN compliant wholesale telecommunications carrier for the Fibre-to-the Premises (FTTP) Carrier Network. The FTTP headend will be located in an equipment cabinet within FTTP Room, which will be collocated within the Basement Level BD Room. The network will provide telecommunications services (broadband and telephone) via OS2 single mode optical fibre cabling, where the cables terminate at the fibre wall outlet (FWO). The FWO is patched to each residential apartment optical network terminal (ONT) and retail tenancy ONT respectively.

4.4 Communications Building Distributor

Buildings will be serviced via ground level Communication BD Room which is suitable for installation of passive and active equipment.

4.5 Communication Risers

Communication risers will be utilised to services the buildings network requirements. These risers will coordinated with communication floor cupboards.

4.6 Communication Floor Cupboards

Communications floor cupboards will be utilised on every residential floor located centrally near the core to service the floors residencies.

4.7 Structured Cabling Referenced Standards

The communications services installation and materials shall comply with the relevant statutory requirements and requirements of the following Australian and New Zealand Standards:

- AS/NZS HB 252 Communications cabling manual - Module 3: Residential communications cabling handbook
- AS/CA S008 Requirements for customer cabling products
- AS/CA S009 Installation requirements for customer cabling (Wiring Rules)
- AS/NZS ISO/IEC 14763.3 Telecommunications installations - Implementation and operation of customer premises cabling - Testing of optical fibre cabling (ISO/IEC 14763-3:2011, MOD)
- AS/NZS ISO/IEC 15018 Information technology—Generic cabling for homes
- AS/NZS ISO/IEC 24702 Telecommunications installations—Generic cabling—Industrial premises
- AS/NZS 3080 Information technology - Generic cabling for customer premises (ISO/IEC 11801:2011, MOD)
- AS/NZS 3084 Telecommunications installations—Telecommunications pathways and spaces for commercial buildings
- AS/NZS 14763-2:2014, Information technology - Implementation and operation of Client premises cabling - Part 2: Planning and installation
- AS/NZS 3085.1 Telecommunications installations—Administration of communications cabling systems—Basic requirements
- AS/NZS IEC 61935.1 Specification for the testing of balanced and coaxial information technology cabling-Installed balanced cabling as specified in ISO/IEC 11801 and related standards (IEC 61935-1, Ed.3.0 (2009) MOD)
- AS/NZS IEC 61935.2 Testing of balanced communication cabling in accordance with ISO/IEC 11801—Patch cords and work area cords
- AS/NZS 14763-3, Telecommunications installations – Generic cabling systems – Specification for the testing of optical fibre communication cabling
- AS/NZS 1367, Coaxial cable and optical fibre systems for the RF distribution of analog and digital television and sound signals in single and multiple dwelling installations
- AS/NZS 3000, Electrical Wiring Rules (Mandatory at Law)
- AS/NZS 2967, Optical Fibre Communication Systems – Safety
- FOXTEL (FD-T-E-2325) -Transparent Digital Transmodulator (TDT) Network Specification
- Australian Communications and Media Authority (ACMA) and Telecommunications Service Provider Guidelines
- 2014 Mobile Carrier Forum (MCF) DAS Design Specification Guidelines
- ARPANSA Radiation Protection Series No. 3
- National Construction Code (NCC), Volume One and Volume Two
- NSW Electrical Service and Installation Rules

5 Security

5.1 Infrastructure

Security infrastructure will be utilised across the building in accordance with residential, commercial and retail tenancy security level requirements.

The building's security system headend will be housed in a communications room located within the specified basement location; as well as any necessary data gathering panels distributed within the building risers that will be required to be monitored. Security infrastructure including intercoms, CCTV and access control/intruder detection panels will generally be Internet Protocol (IP) based.

Initial investigation suggest sufficient spatial allocations for security infrastructure requirements.

5.2 Access Control

The proposed buildings, where required, will be provided with access control systems. Control access will generally be provided in line with the following table as applicable:

Location	Equipment/Function
Automatic Revolving Entrance Doors	- 2x Reed Switches
After Hours Entrance Doors	- Card reader in - Electric Strike - Reed switch
Social Areas (Pool, gym, lounge, etc)	Single Doors - Card reader in - Electric strike - Reed switch Double Doors - Card reader in - Double electromagnetic lock - 2x Reed Switches - Push to exit button - Breakglass button
Mail Room	- Card reader in - Electric strike - Reed switch
Back of House Areas	- Card reader in - Electric strike - Reed switch
Fire exit doors (Ground floor, opening to the perimeter)	- Reed Switch - Passive Infrared Detector (PIR)
Fire stair doors	- Numerous (See Fire Stair Configuration document)
Lifts	- Card Reader inside each lift

A fire stair re-entry system will be provided in accordance with NCC requirements. Specific fire stair configurations are detailed in the below table:

Floor/s	Function
General	- All FS doors will have Electric Strikes and will be monitored by Reed Switches - All FS doors will be fire tripped
Ground floor internal exits	- No entry into the FS (except when fire tripped) - Free exit onto the floor
Ground floor perimeter exits	- No entry into FS (except when fire tripped, and through Fire Department keying system) - Free exit to the external of the building - Passive infrared detector on egress
Podium floors	- No entry into FS (except when fire tripped) - Card swipe onto floor
Plant Rooms	- No entry into FS (except when fire tripped) - Card swipe onto floor, fire tripped

Typical Floor	- No entry into FS (except when fire tripped) - Card swipe onto floor, fire tripped - Intercom every fourth floor as per NCC requirements

5.3 CCTV

Buildings will generally be provided with a CCTV surveillance system in accordance with the tenancy functionality requirements.

5.4 Intruder Detection

All perimeter doors, fire stair doors, plant room doors and access controlled doors will be monitored via reed switches, with monitoring and alarms via the standalone security head end system.

Where fire stairs are secured to prevent re-entry, intercoms and/or warning systems will be provided to meet the requirements of the NCC and these systems will be connected to the intruder detection system for monitoring.

5.5 Standards and Design

The building security services installation will be developed in accordance with the following standards, or the current relevant Standards:

- AS/NZS 2201 Intruder Alarm Systems, Parts 1-5
- AS 4806 Closed Circuit Television (CCTV), Parts 1-4

6 Mechanical Services

6.1 Cooling Plant & General

Cooling plant will be a combination of systems, suited to the specific areas served. Preliminary design has identified the following opportunities and spatial allowances has generally been provided to accommodate the associated infrastructure

Residential: Water cooled Variable refrigerant Flow (VRF) with heat rejection to roof top cooling towers

Commercial: Either water cooled or chilled water local ceiling mounted Fan Coil Units with heat rejection to roof cooling towers

Retail: The building allows either air cooled, water cooled or chilled water local ceiling mounted Fan Coil Unit system options

Community spaces: The building allows either air cooled, water cooled or chilled water local ceiling mounted Fan Coil Unit system options

Design development will continue the alignment and sizing of risers as well as refinement of plant spatial requirements.

6.2 Heating Plant

The buildings spatial planning allows for a centralised natural gas fired heating hot water generator system to be located within a high rise plant room in the residential tower to provide heating hot water to the building either directly or via heat injection into a condenser water loop circuit. The system is capable of serving the apartments, commercial, podiums and retail via segmented plant systems as required, and to be informed by design development.

6.3 Design Criteria

The following external ambient design conditions used for the Sydney CBD are appropriate to apply for this development.

- Summer: 32°C Dry Bulb, 23°C Wet Bulb
- Winter: 7°C Dry Bulb

The following internal values will be applied to the design for the residential apartments, with assessment for modification as noted.

- Summer 24.0°C Dry Bulb ± 2°C
- Winter 21.0°C Dry Bulb ± 2°C.

Humidity will not be directly controlled. However the air conditioning systems, when operating, should limit the internal relative humidity to 65% under most ambient conditions and remain above 35% for most of the year.

Lift Lobbies are to be supplied with tempered outside air. Outside air will generally be provided to meet the requirements of the National Construction Code (NCC).

Mechanical ventilation will generally be provided to AS1668.2:2012.

The proposed A/C and ventilation systems for the residential component will be reviewed against the Basix requirements during Design Development.

6.3.1 Apartment heat loads and use of Internal Blinds

The use of internal blinds is recommended and the air conditioning unit sizing will assume that internal blinds are reasonably deployed. It is noted however that the use of internal blinds are crucial to allow building occupants to maximise their comfort levels and limit temperature variance across the room. Occupants exposed to direct sun will feel warmer due to the radiative effects of the sun. These effects are not offset by air conditioning.

Final provisions in relation to this would be determined through ongoing briefing.

6.3.2 Façade and Fabric Performance

Facade and Fabric performance is required to be designed and installed to meet or exceed the requirements of BCA section J.

6.4 Heating and Cooling Strategy

6.4.1 General

The choice of air conditioning system is somewhat flexible and can be developed further during subsequent design development stages

6.4.2 Apartments

The preliminary design assessment has identified that the use of a water cooled VRF (Variable Refrigerant Flow) system will provide a high quality design outcome commensurate with the scale and nature of the project. Key elements of this system are:

- Floor by floor equipment cupboards to house the water cooled condenser equipment. These systems remove the need for remote air cooled condensers located typically on balconies. The system therefore can result in an improved balcony design.
- Vertical rising pipe risers connecting the condenser cupboards throughout the height of the building and reticulating to Roof plant mounted cooling towers.
- Reverse cycle operation of the equipment to provide heating. Heat augmentation to the condenser water system during winter is provided via gas fired hot water heaters.
- Natural heat recovery from systems sharing different thermal zones.
- Ceiling bulkhead mounted ducted air conditioning.
- Very good energy efficiency.

The building design can also accommodate alternatives such as chilled water fan coil units or air cooled split or multi split systems if desired.

6.4.3 Lobbies, Podiums and Foyers

The lift lobbies are proposed to be served by common general ventilation via a vertical shaft. Shafts will be fed from fans within the plantroom levels (low, mid and roof plant). Design development will consider the use of Air handling units to provide minor tempering to lobbies if required. The plant room floors facilitate this design outcome if necessary.

Air conditioned podium common areas will be served by local ceiling mounted Fan Coil Units, either water cooled packaged systems or sourced from common chilled water. The conditioned air will be mixed with outside air, filtered then ducted to the space served via insulated ductwork and grilles. These units will generally be controlled by the BMCS.

Lift Motor Rooms will be conditioned to Australian Standard requirements using the chilled water system.

6.4.4 Retail

Each Retail tenancy shall be served by dedicated air conditioning systems located at high level within the tenancy ceiling void space, powered from the tenant distribution. Outside air will be ducted to the fan coil units via an intake louvre at high level along the shop front. Systems may be air cooled with outdoor plant within the plant floors or water cooled packaged unit coupled to the central condenser water system. Final choice subject to design development.

6.4.5 Commercial and Community Floors

To minimise plant room space take the commercial and community space floors are proposed to be served by local ceiling mounted Fan Coil Units with either water cooled or shared chilled water. In the case of chilled water plant space in the low rise plant room will contain chiller. In the case of packaged water cooled option the heat exchange equipment would be located in said plant room. The design planning currently affords a level of flexibility in system choice. This will be refined as design develops.

6.5 Mechanical Ventilation

6.5.1 Toilet and Laundry Exhaust System

The planning allows for the residential apartments to be provided with a centralised toilet exhaust system. Typically each apartment will be provided with one or more toilet exhaust systems depending on its layout, complete with booster fan, controls and ductwork to a toilet exhaust riser. Toilet exhaust will serve the bathrooms, powder rooms and laundries. The toilet exhaust riser and central fan system is typically sized at a diversity of peak exhaust rates for the riser. Toilet exhaust will be ducted to an exhaust fan in the plantroom and then horizontally discharged at plantroom level. Laundries will be provided with a general grille connected to the Toilet system (with separate spigot for Dryer exhaust)

The local apartment toilet exhaust booster fan will be interlocked with each bathroom lighting circuit and also be provide with an electrical interlock to the laundry dryer.

Centralised toilet exhaust system will be variable speed fan systems, controlled to maintain a pre-set minimum negative pressure with the central exhaust shafts.

Centralised fan systems are allocated within the low mid and roof plant rooms.

The alternative option for localised façade discharges could be explored at design development stage in order to minimise the extent of centralised plant.

6.5.2 Residential General Exhaust System – Kitchen Hoods

The kitchen exhaust hoods and flow rate for domestic type installations associated with the apartments is independent of room size and will not trigger the need to comply with Section 11 of AS/NZS 1668.1:1998 which is intended to cover kitchen hood exhaust associated with commercial type installations. Residential type Kitchen exhaust hoods (specified by others and is required to be provided with grease filters and hood fan) will be connected to a mechanical exhaust system.

The building planning allows potential for a general exhaust system comprising of exhaust risers serving multiple apartments kitchen range hoods. Typically each ducted riser and system will be sized to serve one apartment per floor with a diversity on peak exhaust rates for that riser.

Exhaust air flow rates would be designed based on cooktop manufacturer's guidelines but they are not a complete guarantee that all smoke and odour will be captured via the hood.

The exhaust will be ducted to the plantrooms where it is filtered from grease and treated for odours prior to discharge to outside.

The alternative for local façade discharges is also possible and should be reviewed during design development.

6.5.3 Make-up Air System

Filtered (and potentially tempered) outdoor air will be transferred from each lift lobby into each residential apartment via transfer duct and fire damper to provide make-up air for the apartments mechanical exhaust systems.

Consideration will be given to local façade makeup air and/or reliance on general building leakage or natural ventilation to augment the makeup air delivered via lobby ventilation.

Plant, stairs and other areas will be ventilated or pressurised to Australian Standard requirements.

6.5.4 Retail Kitchen Exhaust System

It is anticipated that retail kitchen exhaust will be required and provisions will be made. Exhaust systems will use an auto clean , 2-stage electrostatic precipitator (ESP) filtration system comprising of a 50% pleated pre filter, a Electrostatic Precipitator with front and rear wash, a 95% bag filter, and an activated carbon panel filter to filter smoke, grease and odour. Particle Removal Efficiency is to be approximately 99%.

Make-up air via tenant installed Make-up Air System, complete with intake above shopfront on façade.

The kitchen exhaust system will be a common system ducted to each tenancy and capped off for connection to kitchen hoods by tenant.

Systems are proposed to be located within the plant room above the commercial office floor although lower level discharge will also be considered where possible.

6.5.5 General Ventilation

The Garbage shaft will be provided with a dedicated roof mounted fan to exhaust the garbage riser. The shaft of the garbage chute will be used to exhaust each garbage room on each floor with the provision of an egg crate grille on the wall complete with fire damper.

The Electrical rooms in the central core will be provided with a dedicated exhaust system to reduce heat build-up within the space and provide ventilation from the adjacent lobby corridor.

6.5.6 Carpark and Kitchen Exhaust Discharge

The Carpark Exhaust and Retail Kitchen exhaust discharge points will be located above ground and in a series of horizontal discharges at podium level and at the low rise plant room above the office floors.

It is recommended to assess possibility of incorporating retail kitchen exhaust at lower levels to maximise dispersion between the discharge and residential above.

6.6 Smoke Hazard Management

The smoke hazard management systems will operate in accordance with the requirements of the NCC, and the relevant Australian Standards.

The fire stairs located within the core of the building will be provided with stair pressurisation systems to suit the system shut down strategy.

The mechanical system will operate during Fire Mode and comprise of stair pressurisation shafts to serve each of the scissor stairs. Air will be relieved from the affected corridors via the stair pressurisation relief / lobby supply air shaft via a sub duct complete with motorised damper and discharged to atmosphere at plantroom level.

7 Vertical Transport

Aurecon understands that North Sydney Council have made observations regarding the vertical transport provisions for this project. Aurecon have reviewed the advice from North Sydney Council on this project and provide the commentary below to outline the design rationale and performance outcomes expected.

The vertical transportation design needs to take into account a number of parameters including:

- The number of bedrooms (used to derive the total building population)
- The building height, the building quality targeted
- The number of entry floors
- The number of car park floors
- The percentage of the population that accesses the building from the car park
- The lift car speed and the lift car load.

In developing any VT design Aurecon and other designers typically employ the ***CIBSE Guide D*** criteria which is an established criteria that has been developed over many years of high rise development within the UK and Europe.

The criteria consists of many aspects such as the apartment type (1, 2 or 3 bedroom), the quality of development targeted (Low income/Normal/Luxury), handling capacity (number of people to be moved in a five minute period, and a maximum average waiting interval:

From CIBSE Guide D 3.12.3 Residential Buildings

Population Calculation - Table 3.12

Type	Luxury	Normal	Low Income
Studio	1	1.5	2
1 Bedroom	1.5	1.8	2
2 Bedroom	2	3	4
3 Bedroom	3	4	6

Design Criteria (5 minute, two way)

Type	Luxury	Normal	Low Income
Interval(s)	45 - 50	50 - 60	50 - 70
Two Way HC	8%	6 - 8%	5 - 7%

The project is seeking to achieve performance of “luxury” levels of service therefore in this issue of the report we have increased levels of service and removed the lower levels as previously reported.

Aurecon have carried out several revised traffic simulations (based on the current building height as reduced from previous revisions of the analysis) to predict the achievable levels of service. Scenarios have included assessment for three, four and eight lifts at varying speeds in order to inform the sensitivity of the changes. The outcomes from this assessment is detailed in the tables below.

It should also be noted that, if a separate goods lift is not provided, the main passenger lift group will be impacted by goods lift activities essentially removing one lift from the main passenger lift group. In view of this we have also indicated the performance of only 3 lifts are operating within the group.

		Waiting Interval (s)		
Handling Capacity	**Speed**	**Three Lifts**	**Four Lifts**	**Eight Lifts**
8%	6.0mps	46.0 sec	25.9 sec	Less than 13 seconds
8%	5.0mps	49.3 sec	40.9 sec	Less than 13 seconds

As is evident, three (3) lifts will deliver acceptable levels of service to a luxury development (up to 8% HC). However, it should be noted that performance should also consider the performance outcomes should one lift be removed from service when used as a goods lift. During this time the service levels will drop well below normal expectations, (124.5 second waiting interval). Consequently, it is recommended to proceed with the four lift configuration. This option would enable acceptable service with speeds between 5-6mps, maintaining opportunity to explore multiple lift service providers and products.

It is noted that with a simulation for 8 lifts the waiting intervals become significantly lower than what would be considered appropriate and in our opinion such a design outcome is not practical. In our experience waiting intervals at this level significantly affect the viability of the project due to the impact of the additional lifting on capital cost and space utilisation.

The above assessment outcomes assume all lifts extend to the car park as would be normal for Luxury branded developments.

In conclusion, four passenger lifts are recommended for the apartment tower and can meet predicted performance outcomes to meet criteria established for a “Luxury” quality residential offering, as defined by CIBSE criteria. It is worth noting that these user expectations can be subjective and it is difficult to precisely put boundaries around perceived performance due to diversity in use, ownership influencers etc.

In some applications the use of a number of apartments per lift (as referenced in the Council correspondence) can be a useful benchmark however in this instance the nature of the building, its scale and configuration requires the lifting to be determined via performance assessment to ensure the design response is realistic and appropriate.

One lift will be allocated for “goods” use in relation to occupant furniture installation and removal. This lift will be provided with increased handling capacity and finishes to suit.

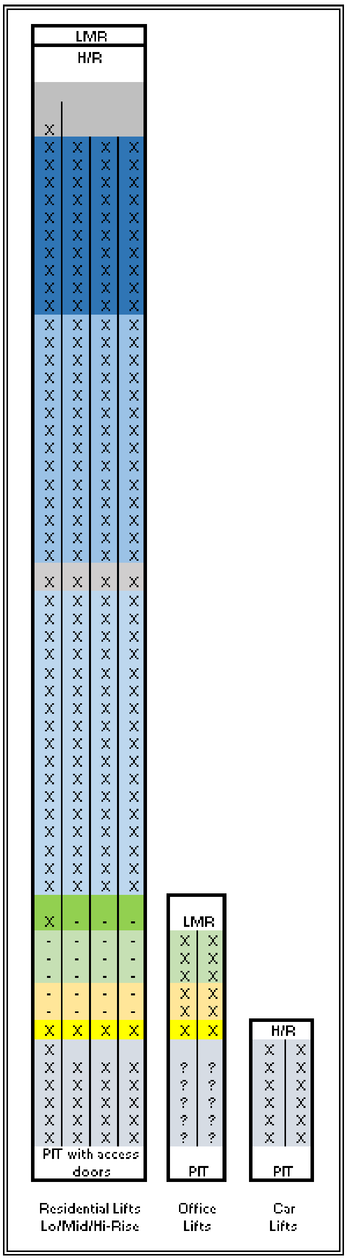
Vertical Transport Assessment Inputs

617 - 621 Pacific Highway, St Leonards

Rev 9 - 28/07/2016

Apartment Mix
Luxury Criteria CIBSE

		Height	RL	1 1B 1.5	2 2B 2	3 3B 3	I Bed	Population	
Level 50	Roof		263						
Level 49	Plant	6	257						
Level 48	High Rise Residential	3.1	254	1	2	1	8	9	
Level 47	High Rise Residential	3.1	251	1	2	1	8	9	
Level 46	High Rise Residential	3.1	248	1	2	1	8	9	
Level 45	High Rise Residential	3.1	245	1	2	1	8	9	
Level 44	High Rise Residential	3.1	241	1	2	1	8	9	
Level 43	High Rise Residential	3.1	238	1	2	1	8	9	
Level 42	High Rise Residential	3.1	235	1	2	1	8	9	
Level 41	High Rise Residential	3.1	232	1	2	1	8	9	
Level 40	High Rise Residential	3.1	229	1	2	1	8	9	
Level 39	High Rise Residential	3.1	226	1	2	1	8	9	
Level 38	Mid- Rise Residential	3.1	223	1	4	0	9	10	
Level 37	Mid- Rise Residential	3.1	220	1	4	0	9	10	
Level 36	Mid- Rise Residential	3.1	217	1	4	0	9	10	
Level 35	Mid- Rise Residential	3.1	214	1	4	0	9	10	
Level 34	Mid- Rise Residential	3.1	210	1	4	0	9	10	
Level 33	Mid- Rise Residential	3.1	207	1	4	0	9	10	
Level 32	Mid- Rise Residential	3.1	204	1	4	0	9	10	
Level 31	Mid- Rise Residential	3.1	201	1	4	0	9	10	
Level 30	Mid- Rise Residential	3.1	198	1	4	0	9	10	
Level 29	Mid- Rise Residential	3.1	195	1	4	0	9	10	
Level 28	Mid- Rise Residential	3.1	192	1	4	0	9	10	
Level 27	Mid- Rise Residential	3.1	189	1	4	0	9	10	
Level 26	Mid- Rise Residential	3.1	186	1	4	0	9	10	
Level 25	Mid- Rise Residential	3.1	183	1	4	0	9	10	
Level 24	Plant	6	177						
Level 23	Lo-Rise Residential	3.1	173	1	4	0	9	10	
Level 22	Lo-Rise Residential	3.1	170	1	4	0	9	10	
Level 21	Lo-Rise Residential	3.1	167	1	4	0	9	10	
Level 20	Lo-Rise Residential	3.1	164	1	4	0	9	10	
Level 19	Lo-Rise Residential	3.1	161	1	4	0	9	10	
Level 18	Lo-Rise Residential	3.1	158	1	4	0	9	10	
Level 17	Lo-Rise Residential	3.1	155	1	4	0	9	10	
Level 16	Lo-Rise Residential	3.1	152	1	4	0	9	10	
Level 15	Lo-Rise Residential	3.1	149	1	4	0	9	10	
Level 14	Lo-Rise Residential	3.1	146	1	4	0	9	10	
Level 13	Lo-Rise Residential	3.1	142	1	4	0	9	10	
Level 12	Lo-Rise Residential	3.1	139	1	4	0	9	10	
Level 11	Lo-Rise Residential	3.1	136	1	4	0	9	10	
Level 10	Lo-Rise Residential	3.1	133	1	4	0	9	10	
Level 9	Lo-Rise Residential	3.1	130	1	4	0	9	10	
Level 8	Lo-Rise Residential	3.1	127	1	4	0	9	10	
Level 7	Lo-Rise Residential	3.1	124	1	4	0	9	10	
Level 6	Sky Garden	6	118						
Level 5	Commercial	4	114	842				70	
Level 4	Commercial	4	110	842				70	
Level 3	Commercial	4	106	842		29		70	
Level 2	Community	4	102	842				70	
Level 1	Community	4	97.8	842				70	
Ground	Lobby / Retail	9	88.8						-68.4%
Lower Ground	Loading Dock / Car Pa	5.85	83						Bias
Basement 1	Car Park	3.35	79.7		16			24	6.3%
Basement 2	Car Park	3.4	76.3		16			24	6.3%
Basement 3	Car Park	3.4	72.9		16			24	6.3%
Basement 4	Car Park	3.4	69.5		16			24	6.3%
Basement 5	Car Park	3.4	66.1		16			24	6.3%



BUILDING TOTALS

Total Apartments	195	
Total Beds	359	
Resi Population	380	
Commercial Population	351	
Number of Residential Car Parks	80	
Residents using car parks (1.5 persons per car	120	rounded

The above image outlines the various inputs we have assumed in preparing this advice.

Assumptions include:

- All commercial office traffic to enter at Ground Floor
- All car parking to be allocated to residential
- Minimum of one lift will be required to cater for goods lift duties suggest minimum 2000Kg
- Pit access doors will be required where pits exceed 3.0m deep such as towed lifts
- Machine room will be required for tower lifts
- All office car lifts will be machine room less (MRL)
- Anticipated Residential Passenger Lift Car Size is 1400W X 2000D (pass/goods lift will be larger)

Comparative Projects – For information

The following are some current reference project examples. It is difficult to compare projects as specifics of the buildings contribute to the performance. However the following can be used for comparison purposes:

- Project A: 60 storey Sydney residential with 53 served residential floors. 6 to 8 apartments per floor. 3 lifts. Vert transport designed by others.
- Project B: 62 storey Sydney residential with 61 served residential floors plus podiums. Ultra-premium luxury offering. 6 lifts in total, 3 lifts distributed over two rises. 6 apartments per floor. Vert transport designed by others.
- Project C: Lumierre apartments, Sydney. Circa 60 storey building with 50 storeys of luxury residential. 5 passenger lifts plus a goods lift.
- Additionally the following projects are noted. The vertical transport design for these projects targeted 5-7% HC and 50-70 sec interval (at ground floor). This broadly relates to a “normal” quality lifting service. Again it is noted that there are variabilities in each project and a simplistic calculation based on lift numbers versus apartments is not a recommended approach to assess lifting performance.

Queens Place, Melbourne

- 78 levels
- 742 apartments / approx. 1650 people within the building.
- 6 Lifts

CUB Site Towers, Sydney

- 58 levels
- 764 apartments / approx. 1500 people
- 5 lifts

150 Queen Street, Brisbane

- 72 levels
- 551 Apartments / approx. 1100 people
- 4 Lifts

Wrap Apartments, Melbourne

- 40 levels
- 294 apartments / approx. 900 people

- 3 lifts

Lacrosse Apartments, Melbourne

- 23 levels
- 305 apartments / approx. 900 people
- 3 lifts

A'Beckett Street, Melbourne

- 65 levels
- 520 apartments / approx. 900 people
- 4 Lifts.

8 Hydraulic and Fire

8.1 Hydraulic Services – Systems

Hydraulic services for the building include the following systems:

- Site sanitary drainage infrastructure serviced sewer connections to the authority mains.
- Site potable water mains connected to the authority water main
- Sanitary plumbing and drainage.
- Trade and grease waste systems
- Back flow prevention as required.
- Centralised gas fired hot water plants located in each of the low mid and high rise plant rooms to distribute heat through the building, segregated for the different building types. A plant will be located in the low plant room to serve commercial floors. Separate plant will be located in mid and high rise plants to serve the residential floors.
- Incoming site natural gas main and meter assembly to service the building
- Rain water drainage to the civil site infrastructure.
- Natural gas reticulation.
- Rainwater gravity downpipes.
- Syphonics system if required

8.1.1 Design Criteria

The Hydraulic Services will be designed to the following criteria:

Discipline	Performance Criteria
Building Regulations	Building Code of Australia/National Construction Code
Plumbing Rules and Regulations	Plumbing Code of Australia
Water Supply	AS 3500.1
Sanitary Drainage	AS 3500.2
Stormwater Drainage	City of Sydney Council AR&R Guidelines AS 3500.3
Hot Water	AS 3500.4
Fire Hose Reels	AS 1221 AS 2441

Fire Hydrants	AS 2419.1
Gas	AS 5601
Products for use in contact with drinking water	AS 4020

8.1.2 Roof Gutters and Downpipes

The roof drainage will consist of a system incorporating gutters and downpipes designed to accept 1:100yr design Average Recurrence Interval (ARI as determined by Australia Rainfall and Runoff) 100% overflow provision will be provided to the roofed areas in accordance with AS3500. Lower roofed section with direct overflow to outside (eaves gutters) will be designed to a 1:20ARI

8.1.3 Stormwater Drainage (downpipes)

The roof drainage shall be designed for a 1:100 year storm Overflow provisions to be designed for 100% blockage of the primary drainage system.

The main roof will be provided with either a conventional or Syphonic system pending the detailed design of the roof layout.

Terraces and other open areas are to be provided with floor drains/rain water outlets on a grid by grid type system.

8.1.4 Sewer and Sanitary Drainage

The Sanitary drainage system will discharge in to Sydney Water's Sewer system. The sewer system shall collect all waste from toilets, urinals, basins, showers, cleaners' sinks and other sanitary fixtures as required. The sanitary drainage system will be in accordance with AS3500.

The design intention is to provide a sewer connection by gravity. During the design of the building, sanitary drainage pump out systems may be required, particularly for the basement floors. 1 day's storage will be designed into the tanks if a pump out system is designed in.

The drainage stack system to the tower shall be installed utilising a fully vented modified sanitary drainage system of plumbing and drainage with a series of soil stacks and horizontal branch drains throughout the tower in accordance with AS 3500 Part 2 Sanitary Plumbing and Drainage.

Drainage stacks shall be designed to collect discharge from areas above. The stack system will be designed to accommodate sanitary discharge the areas.

Noise shall be limited so as to maintain environmental quality within apartments. Attention will also be drawn to the acoustic requirements for pipe supports.

Floor drains in plantrooms are to be provided as required. Tundishes are to be provided adjacent to mechanical equipment so that drains are not run above the floor.

8.1.5 Trade and Grease Waste Drainage

Allowance will potentially be made for trade waste to retail floors. The trade and grease waste drainage system will discharge in to the sewer via a treatment devices as required (such as grease arrestors). The trade and grease waste system will collect waste from all food tenancies and kitchens.

Grease interceptor traps will be provided to serve any restaurant kitchens and food preparation areas. Provision shall be made to facilitate the hygienic removal and disposal of the grease via a suction pipe extended to the adjacent loading dock if the final location of the trade waste devices noes not have direct access to the loading dock

Silt traps and basket arrestors will be provided in areas such as bin wash and equipment cleaning and carpark floor drains.

8.1.6 Cold Water Service

Domestic cold water currently is served from Sydney Water. Water meter assemblies will be required to be accessible for maintenance purposes.

A series of potable mains water risers shall be located throughout the building within plant rooms and services risers to deliver potable water throughout in accordance with AS 3500 part 1: Water Services.

Reduced pressure zone back flow prevention devices shall be fitted to the incoming water supplies.

Cold water booster pumps will be installed to boost the cold water system during periods of peak demand.

Cold water demand shall be based on frequency of use fixtures in this type of facility. Measured consumption figures shall be used in the design.

8.1.7 Water Storage

It is not proposed to provide water storage to this project however the spatial planning can accommodate tanks within basement or any of the midrise plantrooms. Requirements for this will be developed during design development.

8.1.8 Backflow Prevention

Reduced pressure backflow prevention devices (RPZD) to be installed as required in AS3500

8.1.9 Hot Water Service

Hot water systems will be provided to the separate building typologies. Commercial and community will be provided with central heating within the commercial plant floor although local heating units will also be considered. Spatial provisions afford centralised gas fired systems for the residential apartments. Design development will assess options for standalone systems in lieu of centralised.

All ablution fixtures shall be protected by in wall thermostatic mixing valves to protect the general public (if required) from scalding in accordance with AS 3500 Part 4 Heated water services.

As required, 50° water will be provided to ablution fixtures with 43° water extending to disabled amenities

Where centralised systems are provided, a hot water flow and return system will be incorporated within the design

Hot water requirements include:

- Central gas fired semi-instantaneous hot water system with storage and significant recovery capacity.
- Storage in accordance with AS3500
- Local electric boost hot water units to be provided in areas requiring temperatures in excess of 60C.
- Local electric hot water in locations remote from the central system.
- Where temperature reduction is required outlets shall be fitted with thermostatic mixing valves to code requirements.
- Hot water dead legs to be to code requirements and kept to a minimum
- Boiling hot water units equal to “Zip 4 in 1 BCH 100/125” units in locations requiring boiling water.

8.1.10 Gas Service

Natural gas supply shall be provided for the hot water systems, cooking equipment and mechanical services. Generally equipment operates on 2.75kPa however the boilers may require a 7kPa supply. A 7kPa natural gas system (ring main) with regulators to branches operating at 2.75kPa.

The Gas supply will connect into the existing authority infrastructure. A gas meter will be provided to the new food and kitchen areas (retail) and other high use areas.

The gas system will be designed to AS5601.

8.1.11 Sanitary Ware and Tapware

As a minimum, 4 star WELS rated Australian Sanitary and tapware shall be utilised throughout the development, coupled with a maximum 0.8 litre flush wall hung urinals for corporate areas and solenoid operated maintenance flush stainless steel trough type urinals for general public areas.

Push button timed flow tapware shall be utilised in all general public ablution areas as a means of water saving ESD initiatives. Requirements will meet Basix requirements which are yet to be established.

8.1.12 Fire Hydrants and Hose Reels

Internal fire hydrants are to be installed at all levels of the proposed stands and located to maintain coverage as highlighted in AS 2419.1

External hydrants are to be strategically located at ground floor level. Both internal and external hydrants are to be fed by the proposed fire services infrastructure as highlighted above.

A new booster valve assembly shall be located in accordance with AS2419.1.

The fire hydrant system will be designed to meet the requirements stated in the fire engineering brief.

8.2 Fire - Australian Standards

AS/NZS 1668.1-1998	The use of ventilation and air-conditioning in buildings – Fire and smoke control in multi-compartment buildings
AS1670.1-2004	Fire detection, warning, control and intercom systems – System design, installation and commissioning – Fire
AS1670.4-2004	Fire detection, warning, control and intercom systems – System design, installation and commissioning – Sound systems and intercom systems for emergency purposes
AS2118.1-1999	Automatic Fire Sprinkler Systems – General requirements
AS2118.6 – 2015	Automatic Fire Sprinkler Systems: Combined sprinkler and hydrant systems in multi-storey buildings
AS2419.1-2005	Fire Hydrant Installations
AS2441-2005	Installation of fire hose reels
AS2444-2001	Portable fire extinguishers and fire blankets – Selection and location
AS3786-2015	Smoke Alarms

8.3 Combined Fire Sprinkler and Hydrant System

An integrated system of a sprinkler and hydrant system complying with AS2118.6-2012 is proposed to provide automatic means of fire suppression and fire hydrant fighting capabilities throughout the building. The combined fire hydrant and sprinkler system uses combined piping reticulation and water supplies designed to simultaneously supply sufficient water to meet the flow and pressure requirements of both sprinkler and hydrant system.

Water storage tanks providing the required total water supplies of approximately 150-180kL to the combined fire hydrant and sprinkler system will be located at the lower ground floor and split in a 50/50 configuration and will be supported by a combination of both an electric and diesel pump located within the pump room on the lower ground level to provide the required pressures for the combined system.

Due to the nature of the combined fire sprinkler and hydrant system, the location and access to the fire main isolating valve will be located within a 'fire-isolated exit'. Access to sprinkler floor isolating valves and fire hydrants will be located on the floor from which it serves within the 'fire-isolated exit'.

The fire hydrant and sprinkler booster assembly will be located within an enclosure and labelled as required to ensure visibility from approaching fire brigade in the event of a fire incident.

8.4 Automatic Fire Detection System

An automatic fire detection system complying with AS1670.1-2004 will provide early means of smoke and heat detection in areas not protected by the sprinkler system. The smoke and heat detectors will be connected to the Fire Indicator Panel (FIP) located within the Fire Control Room at the upper ground level from within the commercial lobby. The Fire Indicator Panel will connected to an Alarm Signalling Equipment (ASE) monitored remotely and will transmit a signal to the Fire Brigade in the event of a general fire alarm.

8.4.1 Mimic Panel

Due to nature of the layout of the building, Mimic panels will be installed at the designated entry points lobby entrance to relay information including all alarm/fault/isolates status of the fire panel to the fire brigade.

8.5 Fire Control Room

A Fire Control Room complying with Specification E1.8 will be located on upper ground level. The Fire Control Centre will provide fire brigade personnel the ability to conduct fire-fighting operations and control and monitor the Fire Indicator Panel and SSISEP panels.

8.6 Fire Hose Reels

Fire hose reel systems shall be provided under the Building Code of Australia and installed to comply with the requirements of AS2441-2005 and located in all areas excluding the residential floors of the building. Fire hose reels will be mounted in vandal resistant cabinets and located within 4m of each fire stair door.

8.7 Fire Hydrant System

A complete Fire Hydrant system will be installed throughout the building as required under the BCA and installed to comply with AS2419.1-2005. Fire hydrant landing valves will be installed on all floors in which it serves located within the fire-isolated stairs.

8.8 Portable Fire Extinguishers and Fire Blankets

Portable Fire Extinguishers and Fire Blankets shall be provided throughout the building, complete with suitable brackets, mountings, cabinets and statutory signage in accordance with AS2444-2001.

8.9 Smoke Alarms

Smoke Alarms will be provided in class 2, 3, and 4 parts of a building as required under BCA Spec E2.2a. The smoke alarm system will be installed to comply with AS3786-2012 and will be installed in locations between each part of the sole-occupancy unit containing bedrooms and in hallways serving bedrooms to provide audible alert signals to wake up sleeping occupants.

8.10 Sound System and Intercom Systems for Emergency Purposes (SSISEP)

A Sound System and Intercom Systems for Emergency Purposes (SSISEP) installed in accordance with AS1670.4-2004 will serve the building. The system will use an array of speakers and horns to provide audible warnings in all rooms, and strobes will provide visual warnings in technical spaces and plant rooms where background noise is excessive.

Emergency Call Points (ECPs), in the form of white break glass type alarm buttons, will be provided at every entrance to fire stairs adjacent to the WIP phones for manual activation of the SSISEP (evacuation only with cascading – no alarm to the ASE)

The SSISEP panel will be located adjacent the Fire Indicator Panel within the fire control room at the upper ground level.

9 Structural

9.1 Introduction and Scope of Study

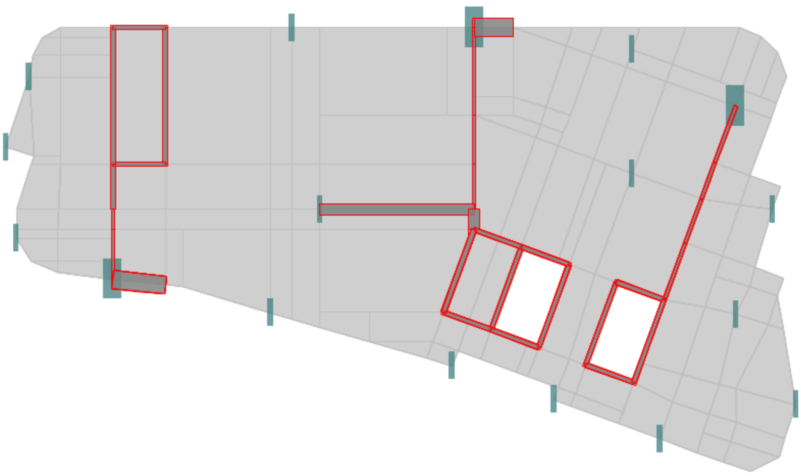
The building is a slender building with an aspect ratio of 9:1 (Height to width ratio) Aurecon have undertaken sufficient analysis be able to arrive at a conclusion as to whether such a slender building can be achieved and still perform under wind loading with respect to the comfort levels of the occupants .

9.2 Description of structure:

The building structure consists of the core walls which are concrete elements which form the walls around the lifts and fire stairs.

These walls are supplemented by outrigger walls which link the exterior mega columns to the core walls.

We have outlined below a typical shear wall layout



Some of the outrigger walls are curtailed and vary in thickness. We have summarised below some of the thicknesses of the elements

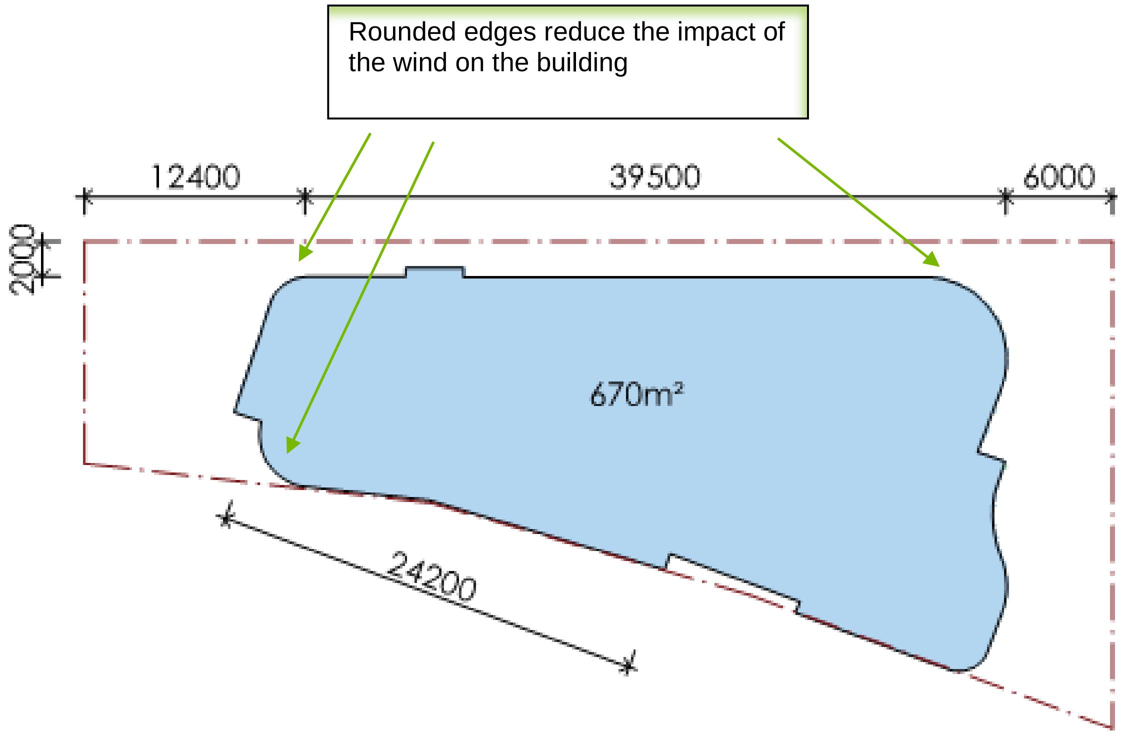
Walls vary from 600 mm at the basement to 200 mm at the top.

The outrigger walls links the core walls to the Mega columns on the perimeter. The location of the walls are centred around Levels 23 and extend for 4 level Mega columns on the perimeter

9.3 Building Shape

The shape of the building was carefully workshopped with the architect to produce a more aerodynamically efficient shape.

The dynamic wind loading is a result of the vortex shedding of the wind creating a flutter effect of the wind as it passes around the building edges. By rounding the building edges, this creates a more a smoother fluid flow around the building thus minimizing the cross wind response of the building to the wind



9.4 Analysis

The Analysis of the structure was undertaken using ETABS (integrated software package for the structural analysis and design of buildings)

This analysis was undertaken using the preliminary architectural and structural concept

The main output from this analysis is the natural frequency of the structure for the first 3 modes of vibration and it was this output that was used in order to estimate the response of the building to the dynamic wind loads

9.5 Results

The output was used to calculate the peak acceleration for an occupied floor under a serviceability wind. There are set criteria for both office buildings and residential buildings and we have summarised the criteria for the various guidelines

Guideline	R.P.	n-0	gR	a_{peak} (milli-g)		Note
	(year)	(Hz)		Resi.	Office	
NBCC	10			10.0	30.0	
CTBUH	10			15.0	25.0	Upper bound
				10.0	20.0	Lower bound
Melbourne	10	0.19	3.1	25.7	25.7	
	5	0.19	3.1	22.6	22.6	
	1	0.19	3.1	15.3	15.3	
ISO-1984	5	0.19	3.1	22.6	22.6	
	1	0.19	3.1	16.2	16.2	
ISO-2007	5	0.19	3.1	13.1	19.7	
	1	0.19	3.1	8.63	13.0	

Aurecon have adopted the ISO Criteria.

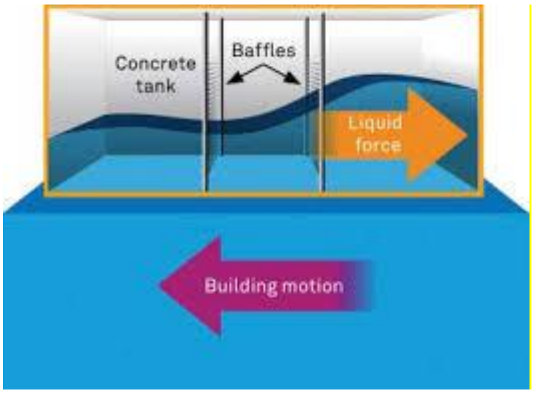
Based on the most likely structural solution the Peak acceleration for the wind for the various directions are outlined below

9.6 Results

Wind at 0 degrees	
Na natural Frequency Mode 1	4.2 seconds
Natural frequency Mode 2	5.1 seconds
Across wind response	11.6 m/s2
Along Wind response	4.7 m/s2
ISO Criterion	12.7 m/s2
Wind at 90 degrees	
Na natural Frequency Mode 1	5.1 seconds
Natural frequency Mode 2	4.2 seconds
Across wind response	9.5 m/s2
Along Wind response	2.8 m/s2
ISO Criterion	11.7 m/s2

9.7 Use of Mass Dampers

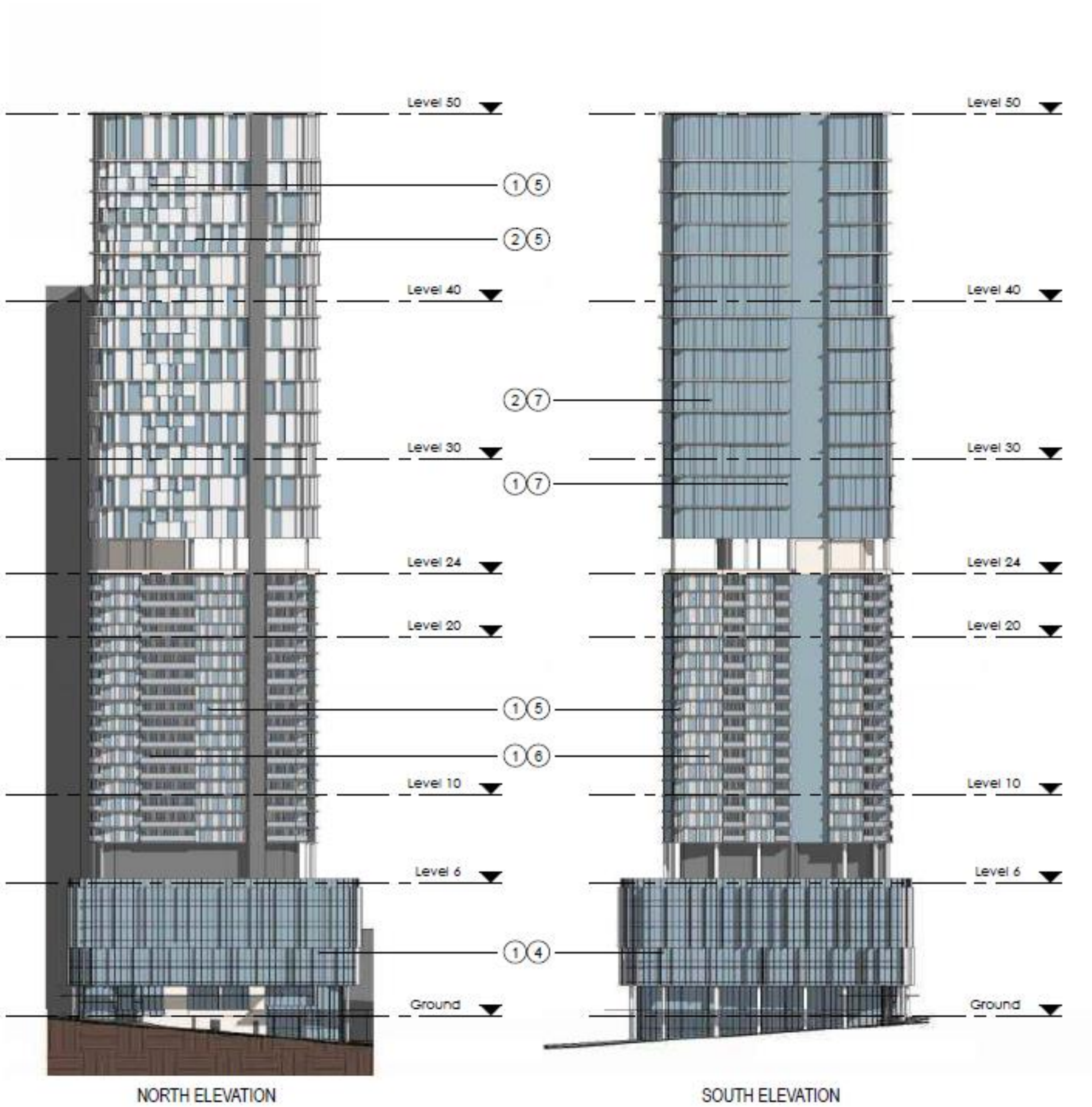
In order to control the accelerations at the top of the building, it is proposed to include a tuned mass damper which would be located on the roof of the building. The liquid within the damper would act contrarily to the actions of the wind thus enhancing the natural damping of the building. We propose 3 stack of water tanks (comprising of 10 cells) 4.4 x 3.6 x 6 m H



9.8 Conclusions

Based on the preliminary study undertaken Aurecon are of the view that the building is structural feasible.

Appendix A
Façade Study A



EAST ELEVATION WEST ELEVATION

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