

105 Miller Street

SSDA Submission Structural Report (Education Scheme)



Prepared for: Investa
By: **enstruct** group pty ltd
Revision: 1
April 2024

105 Miller Street

SSDA Submission Structural Report (Education Scheme)

ISSUE AUTHORISATION

PROJECT: 105 Miller Street
Project No: PS214031

Rev	Date	Purpose of Issue / Nature of Revision	Prepared by	Reviewed by	Issue Authorise by
0	02/04/2025	SSDA Submission	DS	TB	TB



Contents

1	Executive Summary	4
2	Building Overview	5
2.1	Description	5
2.2	Extent of Retained Structure	6
2.3	Extent of Demolition and Rebuild	6
2.4	Justification for Demolition requirements	6
3	Proposed Structural System	6
3.1	Miller Street Wing:	6
3.2	Denison Street Wing:	7
3.3	Central Core:	7
3.4	Foundation System	7
3.5	Retention System	7
3.6	Slab on Ground	7
4	Design Standards	7
5	Design loads	7
5.1	Floor loads	7
5.2	Earthquake Loads	8
5.3	Wind Loads	8
6	Design Criteria	9
6.1	Design Life	9
6.2	Tall building Acceleration	9
6.3	Robustness	9
6.4	Suspended Floor Slab Deflection	9
6.5	Suspended Floor Shrinkage Crack Control	9
6.6	Vibration Limit	9

6.7	Impact on adjacent buildings and Metro tunnel	10
7	Materials	11
7.1	Concrete	11
7.2	Concrete Durability	11
7.3	Reinforcement	11
7.4	Structural Steel	11
7.5	Tendons	11
8	Design Software	11
9	References	11
	Geotechnical report - 86964.03.R.001.Rev0 GI SSD	11

1 **Executive Summary**

In the spirit of reconciliation, Enstruct acknowledges the Traditional Custodians across all the lands on which we work and their enduring connections to land, sea, and community. We pay our respect to Elders past and present and extend that respect to all First Nations peoples today.

This structural schematic report is submitted to the Department of Planning, Housing and Infrastructure (DPHI) on behalf of our client, Investa Custodian (2) Pty Ltd as Trustee for 105 Miller Street North Sydney Trust (Investa) to support a State Significant Development Application (SSDA) for the redevelopment and adaptive reuse of an existing state heritage building at 105 Miller Street, North Sydney (the site) as an education institution.

Specifically, the proposed works include the following:

- Adaptive reuse and restoration of the Miller Street wing;
- Demolition of the Denison Street wing, central core structure and pavilion on the northwestern corner of Miller Street;
- Construction of a new Denison Street wing, comprising ground level retail and educational establishment uses above;
- Construction of a new central core structure, comprising the lift core and building services;
- Alterations to the ground level to deliver a significantly enhanced public domain;
- Construction of an almost double height ground floor retail and the delivery of a new public open space along Miller Street; and
- Basement carparking and loading dock accessed from a relocated entry off Denison Street.

For a detailed project description, refer to the Environmental Impact Statement prepared by Beam Planning and the Architectural Drawings prepared by FJC.

The existing structure includes a six-storey Denison Wing and a 13-storey Miller Wing. The redevelopment project aims to extend the Denison Wing and central core to 22 (including plant) stories, while the Miller Wing retains its current height.

The building's structural strategy emphasizes retaining existing components wherever possible to preserve heritage elements and ensure sustainability, including full retention of the B2 slab on ground and perimeter retention walls and partial retention of the steel framing and lower-level concrete slabs. However, key areas require demolition and rebuilding to achieve compliance with modern standards. For example, the Denison Wing and central core must be demolished to provide the necessary structural capacity to meet modern seismic load, wind load, and fire safety standards.

Structural adjustments include upgrading floor thicknesses, revising slab designs, enhancing lateral stability systems, and replacing existing suspended floors with 150mm-thick profiled slabs to meet fire resistance and load requirements. Additionally, the ground floor slab in the Miller Wing will be raised to mitigate flood risk, while retaining much of its original structure.

The design and material standards outlined comply with the relevant Australian standards to ensure the building's safety, durability, and environmental efficiency. The selected load assumptions, durability classifications, reinforcement grades, and seismic requirements are outlined in detail, with careful attention to design life, vibration control, and crack resistance.

2 Building Overview

2.1 Description

The address of the site is 105-153 Miller Street, North Sydney and is legally described as Lot 2 in DP 792740. The site sits in the heart of the North Sydney Central Business District (CBD), immediately south of the Victoria Cross Metro Station and in walking distance of the North Sydney Train Station.

The site has a total area of 6,640m², with three street frontages, to Miller Street, Brett Whiteley Plaza and Denison Street. The Miller Street frontage is occupied by a landscaped area, pedestrian walkway and retail frontage. The site has a highly visible interface with Brett Whiteley Plaza, which is identified as a key public open space in North Sydney. A range of retail occupancies are located on the Denison Street frontage of the site, set back under a low awning. **Figure 1** shows the site and its context.

The North Sydney MLC Centre and associated turfed public domain currently occupy the site. The existing building comprises a modular building mass with a 13-storey north-south oriented western wing, a central service core and a 6-storey eastern wing, setback from the southern boundary.

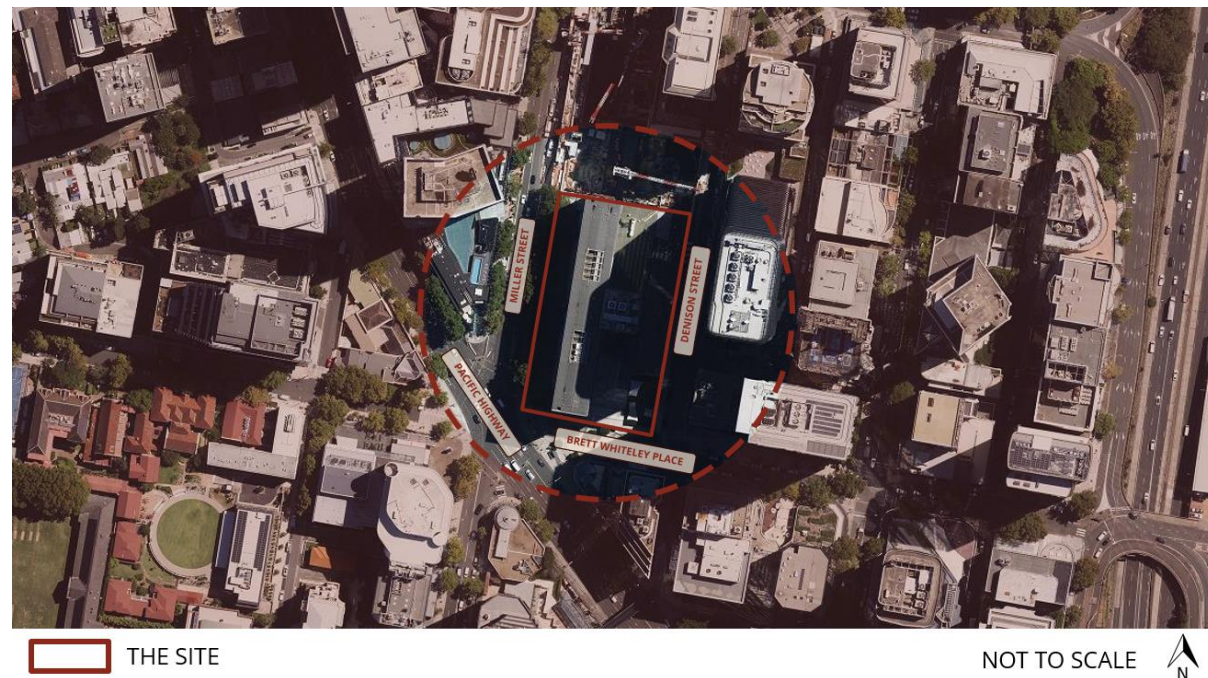


Figure 1 Aerial view of the site

The proposed re-development is to be designed to accommodate educational areas and is to extend vertically for the extent of the Denison Wing and the Central core to 22 storeys (including plant), with the Miller Wing to remain at its current height.

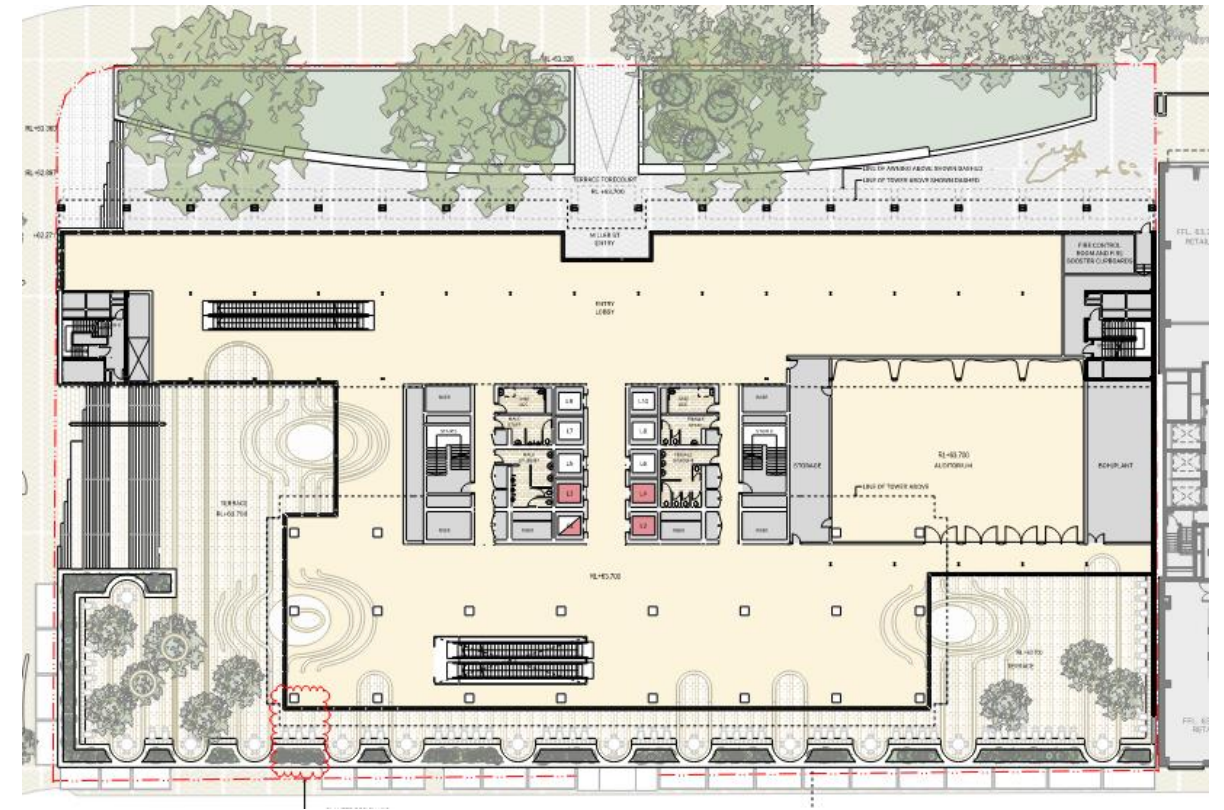


Figure 2 Proposed Ground Floor Layout

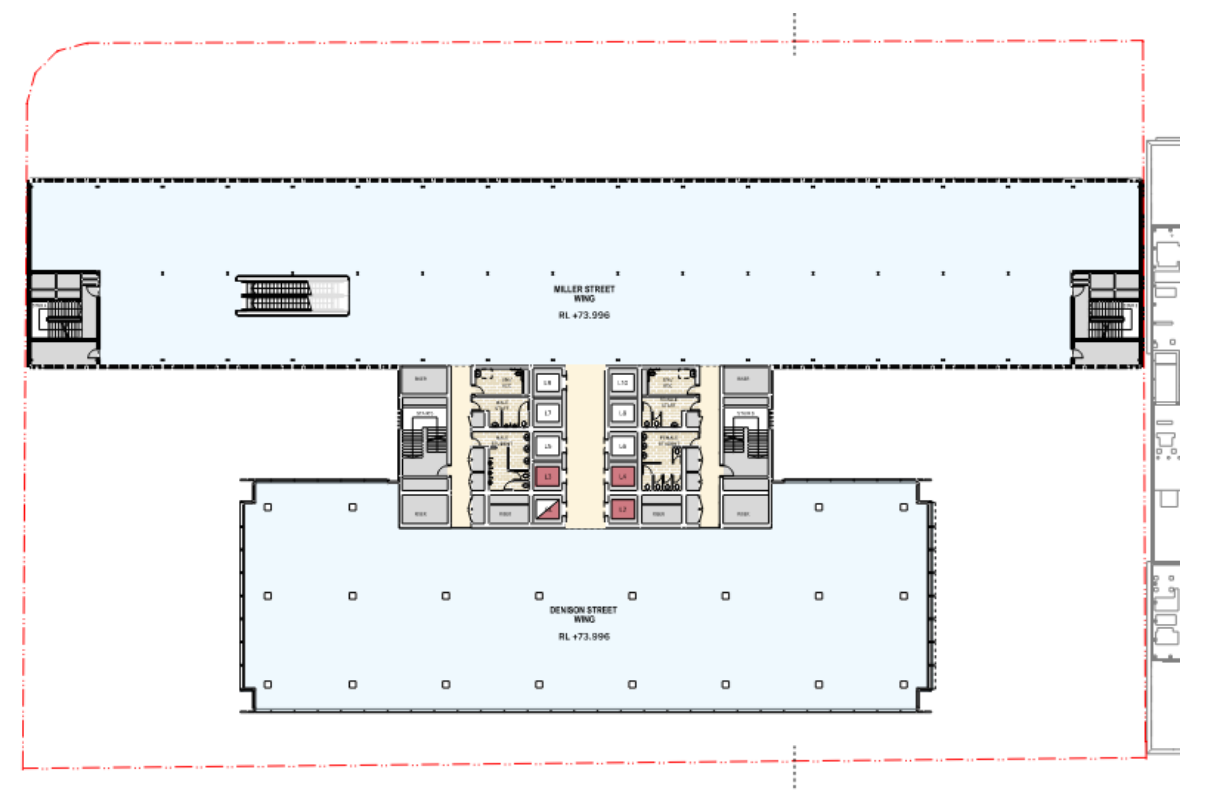


Figure 3 Proposed Typical Level Layout

Wherever possible, the structural intent has been to retain the existing structure to preserve heritage elements and improve sustainability. However, in order to achieve the new extent, comply with current standards and achieve architectural intent, a number of areas need to be demolished and re-built.

2.2 Extent of Retained Structure

- **B2 Level:** The existing B2 slab is proposed to be entirely retained except for local demolition where required to accommodate new footings.
- **Steel framing and existing walls in Miller Wing:** Existing steel columns and beams as well as non-load-bearing walls are to be preserved.
- **Slabs on lower levels in Miller Wing:** B1 and Ground Floor slabs are proposed to be retained within the extent of the Miller Wing along with the steel structure which is concrete encased on those levels.
- **Perimeter retaining walls**
- **Suspended structure supporting landscaping on Miller Street**

2.3 Extent of Demolition and Rebuild

- **Denison Wing:** This Denison Wing is to be entirely rebuilt and extended 22 storeys (including plant) along with a slight change in footprint.
- **Miller Wing slabs:** The Miller Wing concrete slab for all levels above ground level is to be replaced with 150mm thick profiled slab on metal deck.
- **Central Core:** The central core is to be entirely rebuilt and extended 22 storeys
- **B1 and Ground floor outside of the Miller Wing footprint.**

2.4 Justification for Demolition requirements

- **Monolithic Floor Design and Lateral Impact:** The existing monolithic floor plate design binds the Denison and Miller Street wings into a unified lateral system. Modifying either wing triggers the requirement for an upgrade under the Building Code of Australia. This coupled with the proposed additional floors requires strengthening of the lateral system.
- **Inadequate Slab Thickness in Miller Street Wing:** Suspended slabs in the Miller Street wing, at 63mm on a 100mm metal deck with minimal reinforcement, do not meet the 2-hour fire rating (requiring 120mm per AS3600) or the tension capacity for AS3600 and AS1170.4 in-plane diaphragm

forces under seismic loading. Replacing these slabs with thicker, reinforced concrete will ensure compliance with fire and seismic codes.

- **Load-Bearing Limitations in Denison Street Wing:** Originally designed to support only six storeys, the Denison Street wing cannot handle the weight of the proposed 22-storey expansion. Consequently, it must be demolished and replaced to provide the necessary load-bearing capacity for the new structure.

Inadequate Stability System: The current stability system of the building is not compliant to current standards and needs to be augmented/replaced. The current core in the “Central Tower” located in between the two wings, provides little more than nominal capacity. The existing core is therefore also required to be demolished and rebuilt with sufficient capacity for lateral and vertical loads.

- **Floor height constraints:** Outside the extent of the Miller Street wing, the podium levels are proposed to be demolished and rebuilt to allow for the floor height constraints set by the clearance requirements for retail, common areas, substation and loading dock access.

3 Proposed Structural System

3.1 Miller Street Wing:

- **Lower Levels – Retained Concrete-Encased Columns, Beams, and Slabs:** On the lower levels, the existing structural columns and beams are concrete-encased, providing the required 2-hour fire rating and structural strength. At these levels, the existing 125mm-thick slab will be retained.
- **Upper Levels – Slab Replacement:** For the upper levels of the Miller Street wing, existing slabs will be replaced with a profiled 150mm-thick concrete slab on a metal deck to meet load bearing, fire safety, and durability requirements. Adequate fire rating to the existing framing is to be provided to achieve the required 2hr fire rating.
- **Ground Floor Flood Mitigation and double height space:** The ground floor slab in the Miller Street wing is to be raised as part of the flood mitigation strategy while retaining the original slab structure. This will be achieved by constructing 140mm blockwork dwarf walls at 2.5-meter intervals, on top of which a 120mm-thick slab on metal decking is to be installed. Additionally, Level 1 will be demolished in the Miller Street wing, allowing for an almost double-height space on the ground floor across both wings. Existing columns within the double height space are to be strengthened to accommodate the increased buckling length.
- **Existing Non-load Bearing walls:** The existing non-load bearing walls at the North and South ends and around the existing stairwells are constructed out of concrete or masonry and are to be retained. They will be required to be restrained and/or structurally isolated from the stability system to ensure they do not fail under seismic loads and lead to a risk for public safety or egress. For the perimeter walls, the terracotta cladding they support is proposed to be replaced due to their poor condition. Structural works on these walls may be done concurrently if required.

3.2 Denison Street Wing:

- **Complete Reconstruction with New Concrete Structure:** The existing structure will be fully replaced with a reinforced concrete system to support the building's expanded height and load-bearing needs.
- **Floorplate Design for Podium and Typical Levels:** The podium levels will feature a post-tensioned (PT) banded beam system, while the typical levels will have a 200mm-thick PT flat plate system. Levels 21 and 22 are proposed to support plant loading and will be required to be approximately 300 thick flat plate.

3.3 Central Core:

The central core will be rebuilt with 250mm-thick concrete walls to provide critical lateral stability and support increased vertical loads. Extending through the full height of the building, this core will serve as the primary stability system for both wings, ensuring compliance with seismic and wind load standards. Floor plates within the central core are typically 200 thick.

3.4 Foundation System

The proposed foundation system consists of shallow footings, with pad footings provided to support columns and a raft provided to support the core. Ground anchors are to be provided to overcome tension forces generated by lateral loads.

3.5 Retention System

With the site sloping downwards between Miller Street and Denison Street, the extent below ground varies between 2 levels and 1 level. On the South, East and West edges of the building, the perimeter walls retain soil and are proposed to be retained and provided with temporary ground anchors during construction of the B1 and Ground floor levels.

3.6 Slab on Ground.

The existing slab on ground at B2 level is over 300mm thick and is adequate to support the plant loads proposed in this area.

4 Design Standards

The Structural Design components will be designed and detailed in accordance with the relevant Australian standards listed below –

AS/NZS 1170.0-2002	-	Structural Design Actions – General Principles
AS/NZS 1170.1-2002	-	Structural Design Actions – Permanent, Imposed and Other Actions
AS/NZS 1170.2-2021	-	Structural Design Actions – Wind Actions
AS/NZS 1170.4-2007	-	Structural Design Actions – Earthquake Actions in Australia AS 3600-2018
AS 3700-2001	-	Concrete Structures
AS 4100-2020	-	Masonry Standards AS
AS 4671.1-2001	-	Steel Structures
AS 2159-2009	-	Steel Reinforcing Materials AS
AS 4678-2002	-	Piling Design and Installation AS
AS 2670.2-1990	-	Earth Retaining Structures
	-	Evaluation of Human Exposure to Whole Body Vibration Continuous and Induced Vibration in Buildings

5 Design loads

Design loads for the buildings are to comply with Australian Standards, the Building Code of Australia and any additional loading requirements that arise following the review of the loading assumptions. Please refer below for loading assumptions of the main building usages:

5.1 Floor loads

The design load specifications for various areas in the building are as follows:

- **Carpark (Basement)**
 - Superimposed Dead Load: 0.5 kPa
 - Live Load (vehicles not exceeding 2500kg gross mass): 2.50 kPa
- **Loading Dock**
 - Superimposed Dead Load: 0.50 kPa
 - Final Live Load (TBC, dependent on truck requirements): 10.0 kPa
- **Retail Spaces**
 - Superimposed Dead Load: 2kPa
 - Reducible Live Load: 5.00 kPa
- **General Education**
 - Superimposed Dead Load:
 - Services/Ceiling: 0.50 kPa
 - Floor Finishes: 0.50 kPa

- Raised access floor: 0.50 kPa
 - Total SDL: 1.5 kPa
 - Live Load: 3.00 kPa
- **Compactus Zone**
 - Superimposed Dead Load:
 - Services/Ceiling: 0.50 kPa
 - Floor Finishes: 0.50 kPa
 - Raised access floor: 0.50 kPa
 - Total Dead Load: 1.50 kPa
 - Live Load: 7.50 kPa
 - Note: Applies to 5% of office area.
- **Terrace**
 - Superimposed Dead Load:
 - Services/Ceiling: 0.50 kPa
 - Floor Finishes (100mm Zone): 2.50 kPa
 - Total SDL: 3.00 kPa
 - Live Load: 4.00 kPa
- **Terrace Landscaping at Ground level (Localised Planters)**
 - Superimposed Dead Load (100mm Zone for Finishes): 2.50 kPa
 - Planter Zones (600mm Soil TBC): 12.00 kPa
 - Live Load: 0.5 kPa
- **Lift Motor Room**
 - Superimposed Dead Load: 2.50 kPa
 - Live Load: 7.50 kPa
- **Lift Overrun**
 - Superimposed Dead Load: 2.50 kPa
 - Live Load: 5.00 kPa
- **Plant Room**
 - Superimposed Dead Load (Plinths and Partitions): 3.00 kPa
 - Live Load: 5.00 kPa
- **Amenities**
 - Superimposed Dead Load: 2.00 kPa
 - Live Load: 5.00 kPa
- **Corridors & Lobbies**
 - Superimposed Dead Load: 2.00 kPa
 - Live Load: 4.00 kPa
- **Fire Stairs**

- Superimposed Dead Load: 0.5 kPa
- Live Load: 4.00 kPa

- **Façade**

- Glazed facade: 1kPa (~4 kN/m)

5.2 Earthquake Loads

The structure is assumed to be designed in accordance with AS1170.4 for the following criteria –

- Hazard Factor Z – 0.08;
- Site Sub-Soil Class – Be;
- Importance Factor – 3;
- Design Working Life – 50 Years;
- Earthquake Design Category – III;
- Earthquake Loading Return Period – 1 in 1000; and
- Probability Factor Kp – 1.3.

5.3 Wind Loads

The proposed wind loading in determining a suitable structural scheme will be based on the following factors in accordance with AS1170.2 unless more extensive wind studies are performed –

Wind Region	A2
Terrain Category	3
Ultimate Wind	1 in 1000, Velocity = 46 m/s
Serviceability Wind	1 in 25, Velocity = 37 m/s
Terrain Height Multiplier, Mz,cat	Refer AS1170.2
Damping Ratio (Ultimate)	3.0% of Critical Damping (TBC) Damping
Ratio (Serviceability)	1.0% of Critical Damping (TBC)

6 Design Criteria

6.1 Design Life

As a minimum standard, the concrete structure will be assumed to be designed to have a design life of 50 years in accordance with Cl.4.1 of AS3600-2018.

6.2 Tall building Acceleration

Peak building acceleration must be limited to the following for a 10-year return wind event –

ISO 10137-2007 Equation was extended by Melbourne and Cheung from $R = 1$ year to any R , for office buildings the equation expressed as peak acceleration in milli-g is:

$[Exp (-2.81-0.445 \ln (n))/0.68] \times [0.68 + \ln R / 5] \times [1000/9.81]$ (Melbourne and Cheung)

6.3 Robustness

Building robustness has a minimum lateral resistance equivalent to 1.5% of the characteristic dead load. This approach is commonly adopted in the industry.

6.4 Suspended Floor Slab Deflection

Suspended floor deflections are to be limited to ensure the floor space is suitable for the proposed usage. Deflections are also limited by the requirements of the façade system, sensitive internal partitions or other non-structural items.

- Floor members with span less than or equal to 12.5m –
 - With non-structural items insensitive to movement:
 - Total Deflection = Span/250 or 25mm
 - Incremental Deflection = Span/360
 - With brittle non-structural items:
 - Total Deflection = Span/250 or 25mm
 - Incremental Deflection = Span/500
- Floor members with span greater than 12.5m:
 - With non-structural items insensitive to movement:
 - Total Deflection = Span/250 or 30mm
 - Incremental Deflection = Span/360
 - With brittle non-structural items:
 - Total Deflection = Span/250 or 30mm
 - Incremental Deflection = Span/500
- Transfer members:
 - Total Deflection = Span/1000 or 10mm
 - Incremental Deflection = Span/1000
- Cantilever members:
 - Total Deflection = Span/125 or 25mm
 - Incremental Deflection = Span/250

6.5 Suspended Floor Shrinkage Crack Control

Suspended floor structures will be designed for a “Minor Degree of Crack Control” to AS 3600 - 2018 as a minimum. Certain elements such as roofs, balconies, areas with the concrete slab exposed (no floors coverings), terraces etc. will be designed for a “High Degree of Crack Control”. Tiled areas will be designed to a “Moderate Degree of crack control”

6.6 Vibration Limit

The education floors must meet standard vibration acceptance criteria specified for walking excitation.

Acceptance levels due to floor vibrations vary based on occupancy use.

The acceptance criteria nominated below is based on criteria as recommended by Australian Standard AS2670.2 – Evaluation of Human Exposure to whole body vibration Part 2: Continuous and shock induced vibration in buildings which is identical to the International Standards Organisation Standard ISO 2631-2, 1989.

For Educational space floors, Peak acceleration in frequency range 4-8 Hz NOT to exceed 0.5%g.

Criteria above apply to footfall-induced vibrations. The same criterion values apply to mechanical disturbances at a single frequency or at a number of widely separated frequencies. For disturbances at multiple, closely spaced frequencies, the criterion apply to disturbances observed in one-third-octave bands. Typically vibration generated by plant or equipment is controlled by vibration isolation mounts below the item or isolating the equipment from the main structural frame using a floating slab.

6.7 Impact on adjacent buildings and Metro tunnel

The structural design will ensure that the building and its foundations do not have an adverse effect on the metro tunnel to the west of the site and the adjacent buildings (in particular the metro station to the north of the site).

Considering the Miller Street wing columns and associated footings to the West of the site are proposed to remain in their current state and that the Main Denison Wing footings are located at least 20 metres away from any adjacent building structure, the impact of the development on the surrounding buildings is not expected to warrant extensive works.

Regarding the effect on the Metro Tunnel, coordination with Metro Sydney has started and will be further undertaken during the DA approval process. Our understanding is that the DA should be referred under both s2.98 and s2.99 as our development is adjacent to the rail corridor and we will be modifying the loading in the second reserve. We note that:

- The proposed foundation system consists of shallow footings with ground anchors below core (no piles required throughout site).
- Localised excavations may be required to repair or replace the existing footings however they will be to a depth of less than 2m.
- We are currently undertaking studies on the likely depth on the stormwater drainage and will provide a further update once the final depths are resolved, however these are likely to not sit within either the first or second reserve of the Metro.
- The expected foundation levels will be less than 2m below the existing basement FFLs.



Figure 4 Impact on Metro - Plan



Figure 5 Impact on Metro - Section

7 Materials

7.1 Concrete

The minimum concrete strengths for individual structural elements are shown on the structural drawings together with additional information regarding to their mix design.

The minimum strength required is the minimum 28-day strength of the concrete.

7.2 Concrete Durability

The building is to have adequate durability to achieve as a minimum the design life without requiring undue maintenance. Durability is to be incorporated into the structure through materials with properties complying with the recommendations for durability specified in the relevant Australian Standard, concrete mix design, appropriate protective coatings, attention of design details and good construction practice.

Concrete durability is in accordance with AS 3600 - 2018 Section 4 "Design for Durability".

Element	Classification
Exterior Concrete	B1
Interior Concrete	A2

For exposure classification refer to AS 3600 - 2018: Section 4.3 - 4.6 Exposure Classification.

7.3 Reinforcement

- Reinforcing bars to AS 4671-2001
- Deformed bars with $f_{sy} = 500$ MPa
- Welded wire to BS 4483 – 2005

7.4 Structural Steel

- Structural Steel to AS 4100-2020
- Steel decking to Grade G440

7.5 Tendons

All post-tensioned tendons to consist of 12.7mm or 15.2mm diameter strands, with a total jacking force of 156kN and 212kN respectively.

8 Design Software

- RAM Concept by Bentley - Suspended reinforced and post-tensioned concrete member design
- RAPT by PCDC - Reinforced and post-tensioned concrete design package
- ETABS by CSI – Finite element analysis and design package for building structures
- Space Gass by Space Gass Pty Ltd. – Beam and frame analysis package
- Structural Toolkit by Space Gass Pty Ltd. – Multi purpose design tool

9 References

Geotechnical report - 86964.03.R.001.Rev0 GI SSD