



WATERLOO METRO QUARTER OVER STATION DEVELOPMENT

Environmental Impact Statement Appendix P – Structural Design Report

SSD-10437 Southern Precinct

Detailed State Significant Development
Development Application

Prepared for **Waterloo Developer Pty Ltd**

30 September 2020

Reference	Description
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1. Glossary and abbreviations

Reference	Description
ACHAR	Aboriginal Cultural Heritage Assessment Report
ADG	Apartment Design Guide
AHD	Australian height datum
AQIA	Air Quality Impact Assessment
BC Act	Biodiversity Conservation Act 2016
BCA	Building Code of Australia
BC Reg	Biodiversity Conservation Regulation 2017
BDAR	Biodiversity Development Assessment Report
CEEC	critically endangered ecological community
CIV	capital investment value
CMP	Construction Management Plan
Concept DA	A concept DA is a staged application often referred to as a 'Stage 1' DA. The subject application constitutes a detailed subsequent stage application to an approved concept DA (SSD 9393) lodged under section 4.22 of the EP&A Act.
Council	City of Sydney Council
CPTED	Crime Prevention Through Environmental Design
CSSI approval	critical State significant infrastructure approval
CTMP	Construction Traffic Management Plan
DA	development application
DPIE	NSW Department of Planning, Industry and Environment
DRP	Design Review Panel
EP&A Act	Environmental Planning and Assessment Act 1979
EPA	NSW Environment Protection Authority
EPA Regulation	Environmental Planning and Assessment Regulation 2000
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
ESD	ecologically sustainable design

Reference	Description
ETABS	Structural Engineering Software
GANSW	NSW Government Architect's Office
GFA	gross floor area
HIA	Heritage Impact Assessment
IAP	Interchange Access Plan
LGA	Local Government Area
NCC	National Construction Code
OSD	over station development
PIR	Preferred Infrastructure Report
POM	Plan of Management
PSI	Preliminary Site Investigation
RMS	Roads and Maritime Services
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SEPP 55	State Environmental Planning Policy No 55—Remediation of Land
SEPP 65	State Environmental Planning Policy No. 65 – Design Quality of Residential Apartment Development
SRD SEPP	State Environmental Planning Policy (State and Regional Development) 2009
SREP Sydney Harbour	State Regional Environmental Plan (Sydney Harbour Catchment) 2005
SSD	State significant development
SSD DA	State significant development application
SLEP	Sydney Local Environmental Plan 2012
Transport for NSW	Transport for New South Wales
TIA	Traffic Impact Assessment
The proposal	The proposed development which is the subject of the detailed SSD DA
The site	The site which is the subject of the detailed SSD DA

Reference	Description
VIA	Visual Impact Assessment
WMQ	Waterloo Metro Quarter
WMP	Waste Management Plan
WSUD	water sensitive urban design

2. Executive summary

This structural design report has been prepared by Robert Bird Group to accompany a detailed State significant development (SSD) development application (DA) for the Southern Precinct over station development (OSD) at the Waterloo Metro Quarter site.

The report outlines the structural principles to the buildings and their interface with the station structure and adjoining buildings (Waterloo Congregational Church).

This report concludes that the proposed Southern Precinct OSD is compliant to the relevant design standards and will not adversely impact on adjoining structures and warrants approval.

3. Introduction

This report has been prepared to accompany a detailed State significant development (SSD) development application (DA) for the Southern Precinct over station development (OSD) at the Waterloo Metro Quarter site. The detailed SSD DA is consistent with the concept approval (SSD 9393) granted for the maximum building envelope on the site, as proposed to be modified.

The Minister for Planning, or their delegate, is the consent authority for the SSD DA and this application is lodged with the NSW Department of Planning, Industry and Environment (DPIE) for assessment.

The detailed SSD DA seeks development consent for the design, construction and operation of:

- 25-storey residential building (Building 3) comprising student accommodation, to be delivered as a mixture of studio and twin apartments with approximate capacity of 474 students
- 9-storey residential building (Building 4) above the southern station box to accommodate 70 social housing dwellings
- ground level retail tenancies including Makerspace and gymnasium lobby, and loading facilities
- level 1 and level 2 gymnasium and student accommodation communal facilities
- landscaping and private and communal open space at podium and roof top levels to support the residential accommodation
- new public open space including the delivery of the Cope Street Plaza, including vehicle access to the site via a shared way from Cope Street, expanded footpaths on Botany and Wellington streets and public domain upgrades
- signage zone locations
- utilities and service provision
- stratum subdivision (staged).

The Secretary's Environmental Assessment Requirements (SEARs) dated 8 April 2020 does not reference any specific structural requirements, however the Southern Precinct is an integrated development with the Waterloo Station. Complex interfaces exist between the station and the development this report outlines how these interfaces are addressed.

4. The site

The site is located within the City of Sydney Local Government Area (LGA). The site is situated about 3.3 kilometres south of Sydney CBD and eight kilometres northeast of Sydney International Airport within the suburb of Waterloo.

The Waterloo Metro Quarter site comprises land to the west of Cope Street, east of Botany Road, south of Raglan Street and north of Wellington Street (refer to Figure 1). The heritage-listed Waterloo Congregational Church at 103–105 Botany Road is within this street block but does not form a part of the Waterloo Metro Quarter site boundaries.

The Waterloo Metro Quarter site is a rectangular shaped allotment with an overall site area of approximately 1.287 hectares.

The Waterloo Metro Quarter site comprises the following allotments and legal description at the date of this report. Following consolidation by Sydney Metro (the Principal) the land will be set out in deposited plan DP1257150.

- 1368 Raglan Street (Lot 4 DP 215751)
- 59 Botany Road (Lot 5 DP 215751)
- 65 Botany Road (Lot 1 DP 814205)
- 67 Botany Road (Lot 1 DP 228641)
- 124-128 Cope Street (Lot 2 DP 228641)
- 69-83 Botany Road (Lot 1, DP 1084919)
- 130-134 Cope Street (Lot 12 DP 399757)
- 136-144 Cope Street (Lots A-E DP 108312)
- 85 Botany Road (Lot 1 DP 27454)
- 87 Botany Road (Lot 2 DP 27454)
- 89-91 Botany Road (Lot 1 DP 996765)
- 93-101 Botany Road (Lot 1 DP 433969 and Lot 1 DP 738891)
- 119 Botany Road (Lot 1 DP 205942 and Lot 1 DP 436831)
- 156-160 Cope Street (Lot 31 DP 805384)
- 107-117A Botany Road (Lot 32 DP 805384 and Lot A DP 408116)
- 170-174 Cope Street (Lot 2 DP 205942).

The detailed SSD DA applies to the Southern Precinct (the site) of the Waterloo Metro Quarter site. The site has an area of approximately 4830sqm. The subject site comprises the following allotments and legal description at the date of this report.

- 130–134 Cope Street (Lot 12 DP 399757) (Part)
- 136–144 Cope Street (Lots A-E DP 108312) (Part)
- 93–101 Botany Road (Lot 1 DP 433969 and Lot 1 DP 738891) (Part)
- 156–160 Cope Street (Lot 31 DP 805384)
- 107–117A Botany Road (Lot 32 DP 805384 and Lot A DP 408116)
- 119 Botany Road (Lot 1 DP 205942 and Lot 1 DP 436831)
- 170–174 Cope Street (Lot 2 DP 205942).

The boundaries of the overall site are identified at Figure 1, and the subject site of the detailed SSD DA is identified at Figures 2 and 3. The site is reasonably flat with a slight fall to the south.

The site previously included three to five storeys commercial, light industrial and shop top housing buildings. All previous structures except for an office building at the corner of Botany Road and Wellington Street have been demolished to facilitate construction of the new Sydney Metro Waterloo station. As such the existing site is predominately vacant and being used as a construction site. Construction of the Sydney metro is currently underway on site in accordance with critical State significant infrastructure approval (CSSI 7400).



Figure 1 - Aerial image of the site
Source: Urbis

The area surrounding the site consists of commercial premises to the north, light industrial and mixed-use development to the south, residential development to the east and predominantly commercial and light industry uses to the west.

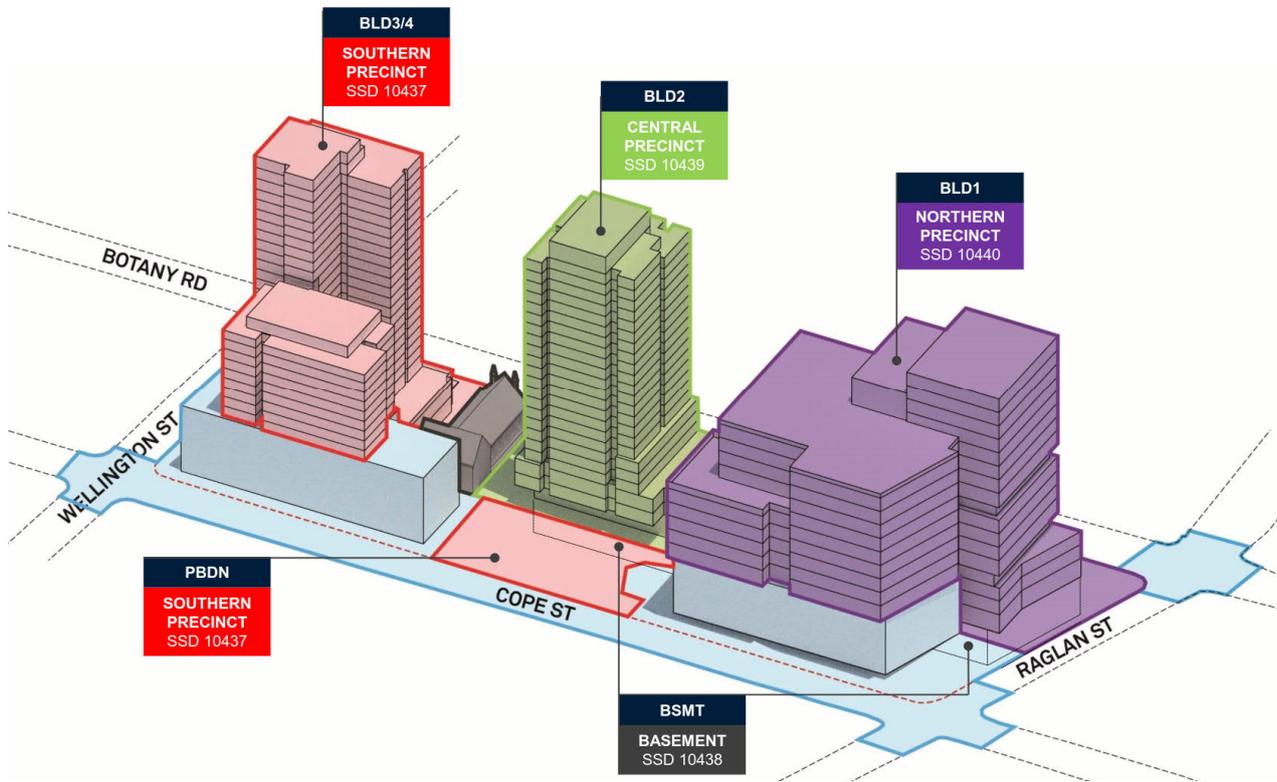


Figure 2 - Waterloo Metro Quarter site, with sub-precincts identified
Source: HASSELL

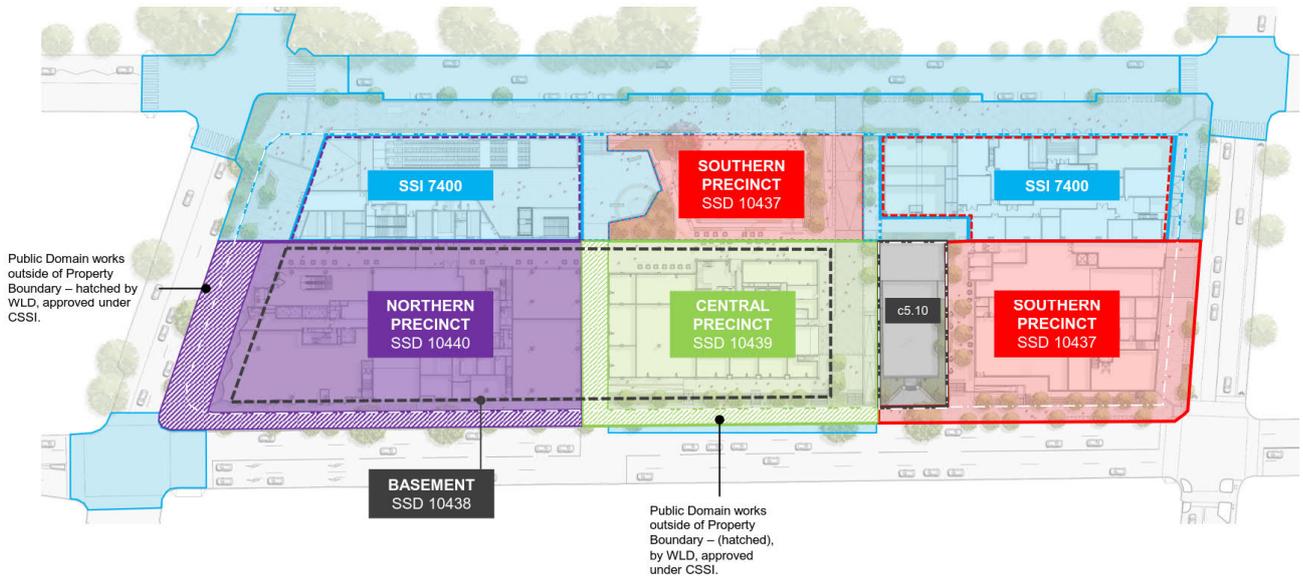


Figure 3 - Waterloo Metro Quarter site, with sub-precincts identified
Source: Waterloo Developer Pty Ltd

5. Background

5.1 About Sydney Metro

Sydney Metro is Australia's biggest public transport project. Services started in May 2019 in the city's North West with a train every four minutes in the peak. A new standalone railway, this 21st century network will revolutionise the way Sydney travels.

There are four core components:

5.1.1 Sydney Metro North West

This project is now complete and passenger services commenced in May 2019 between Rouse Hill and Chatswood, with a metro train every four minutes in the peak. The project was delivered on time and \$1 billion under budget.

5.1.2 Sydney Metro City & Southwest

Sydney Metro City & Southwest project includes a new 30km metro line extending metro rail from the end of Metro Northwest at Chatswood, under Sydney Harbour, through new CBD stations and southwest to Bankstown. It is due to open in 2024 with the ultimate capacity to run a metro train every two minutes each way through the centre of Sydney.

Sydney Metro City & Southwest will deliver new metro stations at Crows Nest, Victoria Cross, Barangaroo, Martin Place, Pitt Street, Waterloo and new underground metro platforms at Central Station. In addition, it will upgrade and convert all 11 stations between Sydenham and Bankstown to metro standards.

5.1.3 Sydney Metro West

Sydney Metro West is a new underground railway connecting Greater Parramatta and the Sydney CBD. This once-in-a-century infrastructure investment will transform Sydney for generations to come, doubling rail capacity between these two areas, linking new communities to rail services and supporting employment growth and housing supply between the two CBDs.

The locations of seven proposed metro stations have been confirmed at Westmead, Parramatta, Sydney Olympic Park, North Strathfield, Burwood North, Five Dock and The Bays.

The NSW Government is assessing an optional station at Pyrmont and further planning is underway to determine the location of a new metro station in the Sydney CBD.

5.1.4 Sydney Metro Greater West

Metro rail will also service Greater Western Sydney and the new Western Sydney International (Nancy Bird Walton) Airport. The new railway line will become the transport spine for the Western Parkland City's growth for generations to come, connecting communities and travellers with the rest of Sydney's public transport system with a fast, safe and easy metro service.

The Australian and NSW governments are equal partners in the delivery of this new railway.

The Sydney Metro project is illustrated below.

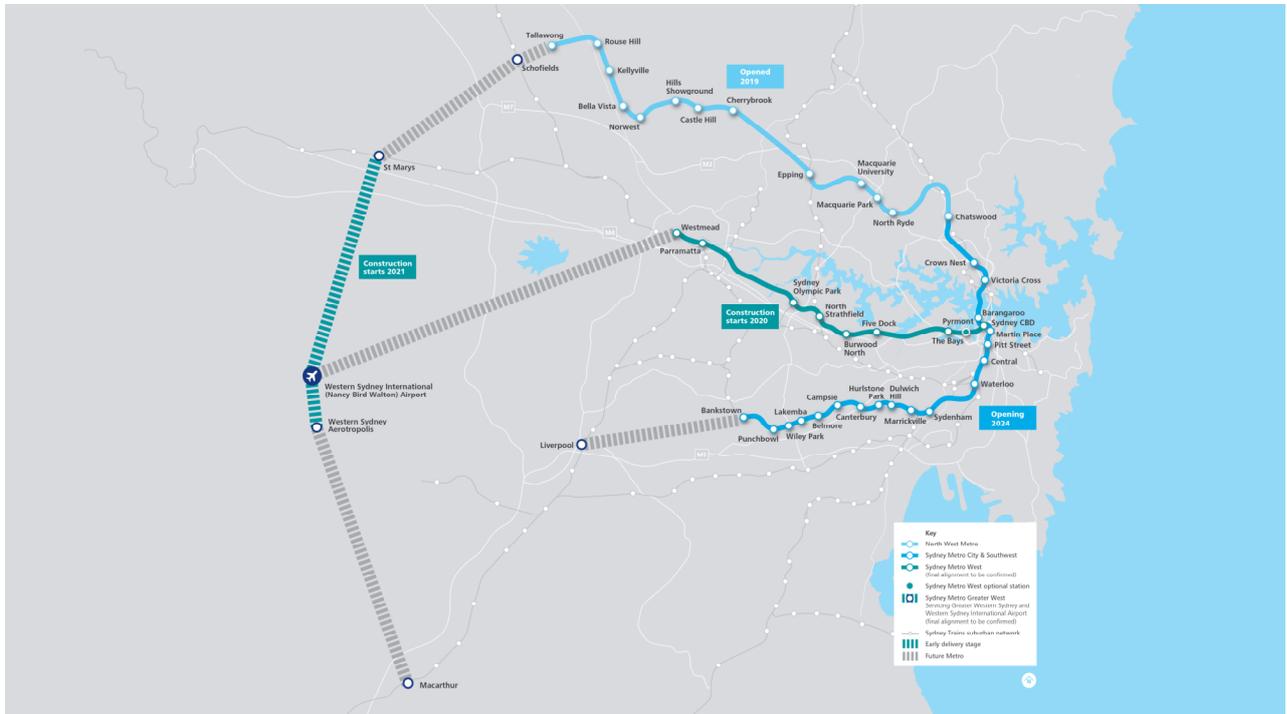


Figure 4 - Sydney Metro alignment map
Source: Sydney Metro

5.2 Sydney Metro CSSI Approval (SSI 7400)

On 9 January 2017, the Minister for Planning approved the Sydney Metro City & Southwest - Chatswood to Sydenham project as a critical State significant infrastructure (CSSI) project (reference SSI 7400) (CSSI approval). The terms of the CSSI approval includes all works required to construct the Sydney Metro Waterloo Station. The CSSI approval also includes the construction of below and above ground works within the metro station structure for appropriate integration with the OSD.

With regards to CSSI related works, any changes to the ‘metro station box’ envelope and public domain will be pursued in satisfaction of the CSSI conditions of approval and do not form part of the scope of the concept SSD DA or detailed SSD DA for the OSD.

Except to the extent described in the EIS or Preferred Infrastructure Report (PIR) submitted with the CSSI application, any OSD buildings and uses do not form part of the CSSI approval and will be subject to the relevant assessment pathway prescribed by the EP&A Act.

The delineation between the approved Sydney Metro works, generally described as within the two ‘metro station boxes’ and surrounding public domain works, and the OSD elements are illustrated in Figure 5.

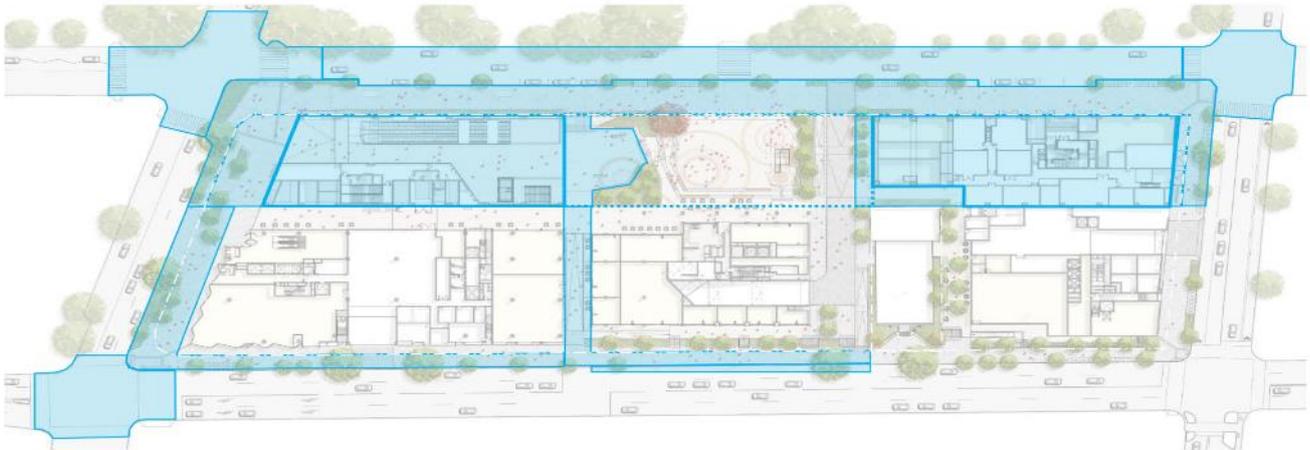


Figure 5 - CSSI Approval scope of works
Source: WL Developer Pty Ltd

5.3 Concept Approval (SSD 9393)

As per the requirements of clause 7.20 of the *Sydney Local Environmental Plan 2012 (SLEP)*, as the OSD exceeds a height of 25 metres above ground level (among other triggers), development consent is first required to be issued in a concept DA (formerly known as Stage 1 DA).

Development consent was granted on 10 December 2019 for the concept SSD DA (SSD 9393) for the Waterloo Metro Quarter OSD including:

- a maximum building envelope for podium, mid-rise and tower buildings
- a maximum gross floor area of 68,750sqm, excluding station floor space
- conceptual land use for non-residential and residential floor space
- minimum 12,000sqm of non-residential gross floor area including a minimum of 2,000sqm of community facilities
- minimum 5% residential gross floor area as affordable housing dwellings
- 70 social housing dwellings
- basement car parking, motorcycle parking, bicycle parking, and service vehicle spaces.

The detailed SSD DA seeks development consent for the OSD located within the Southern Precinct of the site, consistent with the parameters of this concept approval. Separate SSD DAs have been prepared and will be submitted for the Car Park, Central Precinct, Northern Precinct and basement car park proposed across the Waterloo Metro Quarter site.

A concurrent amending concept SSD DA has been prepared and submitted to the DPIE which proposed to make modifications to the approved building envelopes at the northern precinct and central building. This amending concept SSD DA does not impact the proposed development within the southern precinct.

6. Proposed development

6.1 Waterloo Metro Quarter Development

The Waterloo Metro Quarter OSD comprises four separate buildings, a basement carpark and public domain works adjacent to the Waterloo Metro station.

Separate SSD DAs will be submitted concurrently for the design, construction and operation of each building in the precinct;

- Southern precinct SSD-10437,
- Basement Car Park SSD-10438,
- Central precinct SSD-10439, and
- Northern precinct-SSD-10440.

An overview of the Development is included below for context. This detailed SSD DA seeks development consent for the design, construction and operation of the Southern Precinct :

6.1.1 Southern Precinct - Subject DA

The Southern Precinct comprises:

- 25-storey residential building (Building 3) comprising student accommodation, to be delivered as a mixture of studio and twin apartments with approximate capacity of 474 students
- 9 storey residential building (Building 4) above the southern station box to accommodate 70 social housing dwellings
- ground level retail tenancies including Makerspace and gymnasium lobby, and loading facilities
- level 1 and level 2 gymnasium and student accommodation communal facilities
- landscaping and private and communal open space at podium and roof top levels to support the residential accommodation
- new public open space including the delivery of the Cope Street Plaza, including vehicle access to the site via a shared way from Cope Street, expanded footpaths on Botany and Wellington Streets and public domain upgrades
- signage zone locations
- utilities and service provision
- stratum subdivision (staged).

6.1.2 Basement Car Park

The Basement Car Park comprises:

- 2-storey shared basement car park and associated excavation comprising
- Ground level structure
- Carparking for the Commercial Building 1, Residential Building 2, social housing Building 4, Waterloo Congregational Church and Sydney Metro
- Service vehicle bays
- commercial end of trip and bicycle storage facilities

- Retail end of trip and bicycle storage facilities
- residential storage facilities
- shared plant and services.

6.1.3 Central Precinct

The Central Precinct comprises:

- 24-storey residential building (Building 2) comprising approximately 126 market residential and 24 affordable housing apartments, to be delivered as a mixture of 1 bedroom, 2 bedroom and 3 bedroom apartments
- Ground level retail tenancies, community hub, precinct retail amenities and basement car park entry
- level 1 and level 2 community facilities (as defined in the SLEP) intended to be operated as a childcare centre
- landscaping and private and communal open space at roof top levels to support the residential accommodation
- new public open space including the delivery of the Church Square, including vehicle access to the basement via a shared way from Cope Street, expanded footpaths and public domain upgrades on Botany Road
- external licensed seating areas
- signage zone locations
- utilities and service provision
- stratum subdivision (staged).

6.1.4 Northern Precinct

The Northern Precinct comprises:

- 17-storey commercial building (Building 1) comprising Commercial floor space, with an approximate capacity of 4000 workers
- ground level retail tenancies, loading dock facilities serving the northern and central precinct including Waterloo metro station
- landscaping and private open space at podium and roof top levels to support the commercial tenants
- new public open space including the delivery of the Raglan Street Plaza, Raglan Walk and expanded footpaths on Raglan Street and Botany Road and public domain upgrades
- external licensed seating areas
- signage zone locations
- utilities and service provision
- stratum subdivision (staged).

7. Structural Design Standards

The structural design for the proposed development will be conducted in accordance with the current revision of all relevant Australian Standards. These standards will include, but are not limited to:

Standard	Title	Edition
AS 1170.0	Structural Design Actions Part 0: General Principles	2002
AS 1170.1	Structural Design Actions Part 1: Permanent, Imposed and other	2002
AS1170.2	Structural Design Actions Part 2: Wind Actions	2009
AS1170.4	Structural Design Actions Part 4: Earthquake Loads	2007
AS 3600	Concrete Structures	2018
AS 3700	Masonry Structures	2001
AS 4100	Steel Structures	1998

7.1 Design Life and Importance Level

The design life and importance level of the structure is given by the National Construction Code (NCC) requirements for the following building classifications:

Usage	Classification
Commercial / Retail	Class 6
Residential / Student accommodation	Class 2

Design Life	Importance Level
50 years	3

8. Design Loads

All loadings and load combinations shall be in accordance with Australian standards AS1170 Parts 0 to 4. The relevant design loads are defined in Section 9.1.1 to 9.1.4 of this report.

8.1.1 Permanent Actions – Dead Loads

Dead loads shall be the self-weight of the structure plus an allowance for toppings, partitions, ceilings and services. The additional dead loads are outlined below:

Usage	Uniform distributed load (kPa)
Retail / Commercial	2.0
Gym	2.0
Outdoor landscape	
• Paved	3.0
• Planters	7.5
Apartments	
• Indoor	1.5
• Balcony	2.0
Terrace	2.0
Plantroom	1.0
Roof	2.5

8.1.2 Imposed Loads – Live Loads

The design floor loadings are to be in accordance with the minimum provisions of AS1170.1 and are outlined below:

Usage	Uniform distributed load (kPa)	Concentrated Load (kN)
Retail / Commercial	5.0	4.5
Gym	7.5	4.5
Outdoor landscape		
• Paved	4.0	2.7
Apartments		
• Indoor	1.5	1.8
• Balcony	2.0	1.8
Terrace	5.0	4.5

Plantroom	5.0	4.5
Roof	2.0	2.7

8.1.3 Wind Loads

Wind pressures are in accordance with AS1170.2 using the following parameters:

Criteria	Value
Location	Sydney NSW
Region	A2
Importance level	3
Design event for strength	1:1000
Design event for serviceability	1:25
V ₁₀₀₀	46m/s
V ₂₀	37m/s
M _s	1.0
M _t	1.0
Terrain Category	3
Design Wind Speed	Varies 38m/s to 53m/s

Design of façade elements and their connections shall make provision for local peak wind pressure effects calculated using local pressure factors given in AS1170.2.

8.1.4 Earthquake Loads

Earthquake loadings are in accordance with AS1170.4 using the following parameters

Criteria	Value
Location	Sydney NSW
Importance level	3
Design event for strength	1:1000
Probability Factor K _p	1.3
Hazard Factor Z	0.09

Subsoil Class	C _e
Earthquake Design Category	EDCIII
Performance Factor S _p	0.77
Ductility Factor μ	2

8.2 Deflection Criteria

The deflection structural elements under service loads shall be controlled in accordance with the following criteria unless noted otherwise on Robert Bird Groups structural drawings:

Structural Element	Deflection Type	Limit
Overall Building Structure	Lateral sway from service wind load	Height/500
Overall Building Structure	Inter-storey drift from lateral sway due to ultimate earthquake load	Height/150
	Inter-storey drift from lateral sway due to serviceability wind loading	Height /500
Floor Slabs: No Sensitive Partitions	Long term total deflection	Lesser of Span/250 or 25mm
Floor Slabs: Sensitive Partitions	Long term incremental deflection	Lesser of Span/500 or 25mm

8.3 Fire Resistance

Structural elements are to be designed in accordance with the Building Code of Australia, the relevant Australian Standards and Building 3 & 4 “Fire Safety Strategy Report” (Rpt 8491100) prepared by Omnii to satisfy the required FRL levels for fire.

8.4 Durability

Structural elements will have a structural design life as nominated by their relevant Australian Standards.

Concrete works will be designed for the relevant exposure classifications.

9. Structural Design Building 3

9.1 Overview of structure

Building 3 is a concrete framed building with reinforced concrete columns and post tensioned floor slabs. A reinforced concrete core resists the lateral loads due to wind and earthquake. The building is supported by bored piles founded on class II sandstone. The building structure remains independent of the station development.

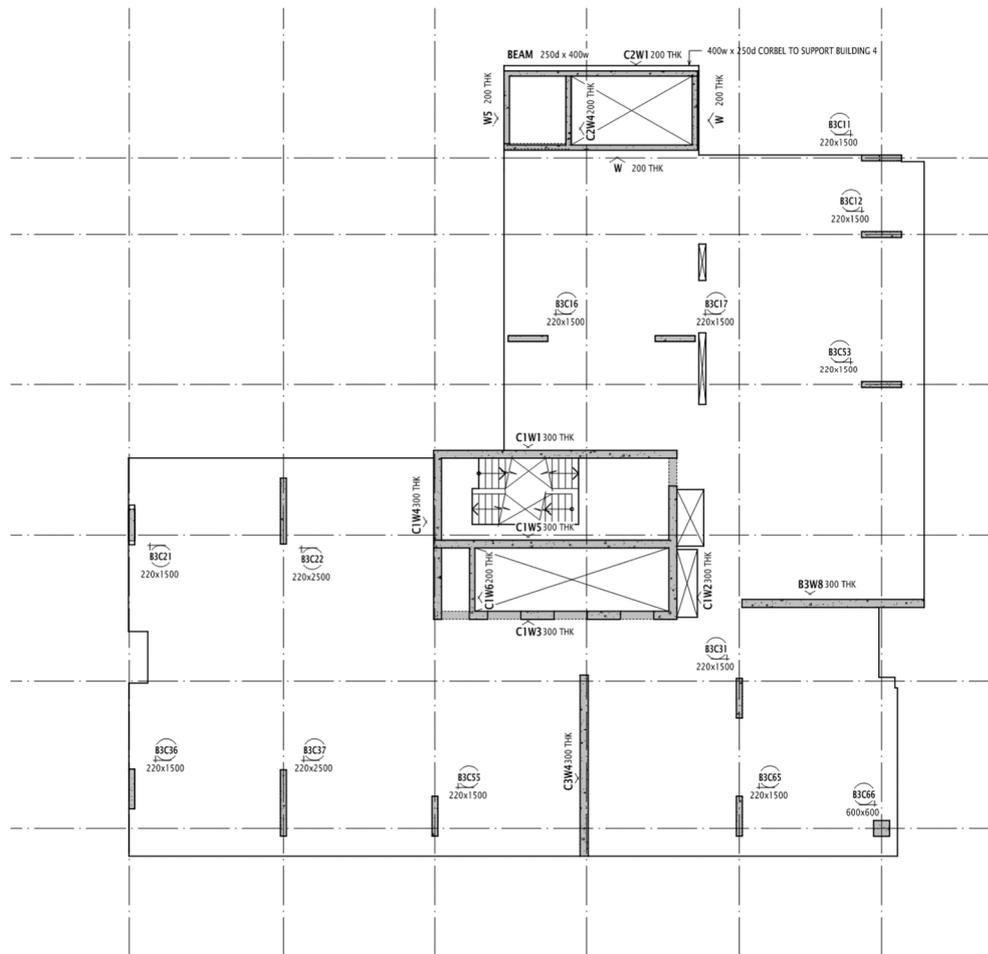
9.2 Lateral Stability

The lateral stability system has been designed to resist the site wind and earthquake loads for strength and serviceability. The lateral loads are resisted by a central stair / lift core which is carried up through the tower. To limit drifts to acceptable limits, addition shear walls are positioned on the western and southern sides of the core. An ETABS model was established to assess the lateral performance of the building. The typical floor plate showing the location of the core and shear walls is shown in the figure 6.

9.3 Floor Plates

The proposed building is a 23-storey building. The lower levels (Ground, Level 1 and Level 2) are designated for commercial and community facilities. Above these, the building comprises a level 1 gym and student accommodation above. The floor plates are generally consistent in their layout, with the lower community levels extending towards the north to provide external terrace areas. Residential terrace space is provided on level 22 and level 3. Mechanical and Hydraulic plant is located on level 23.

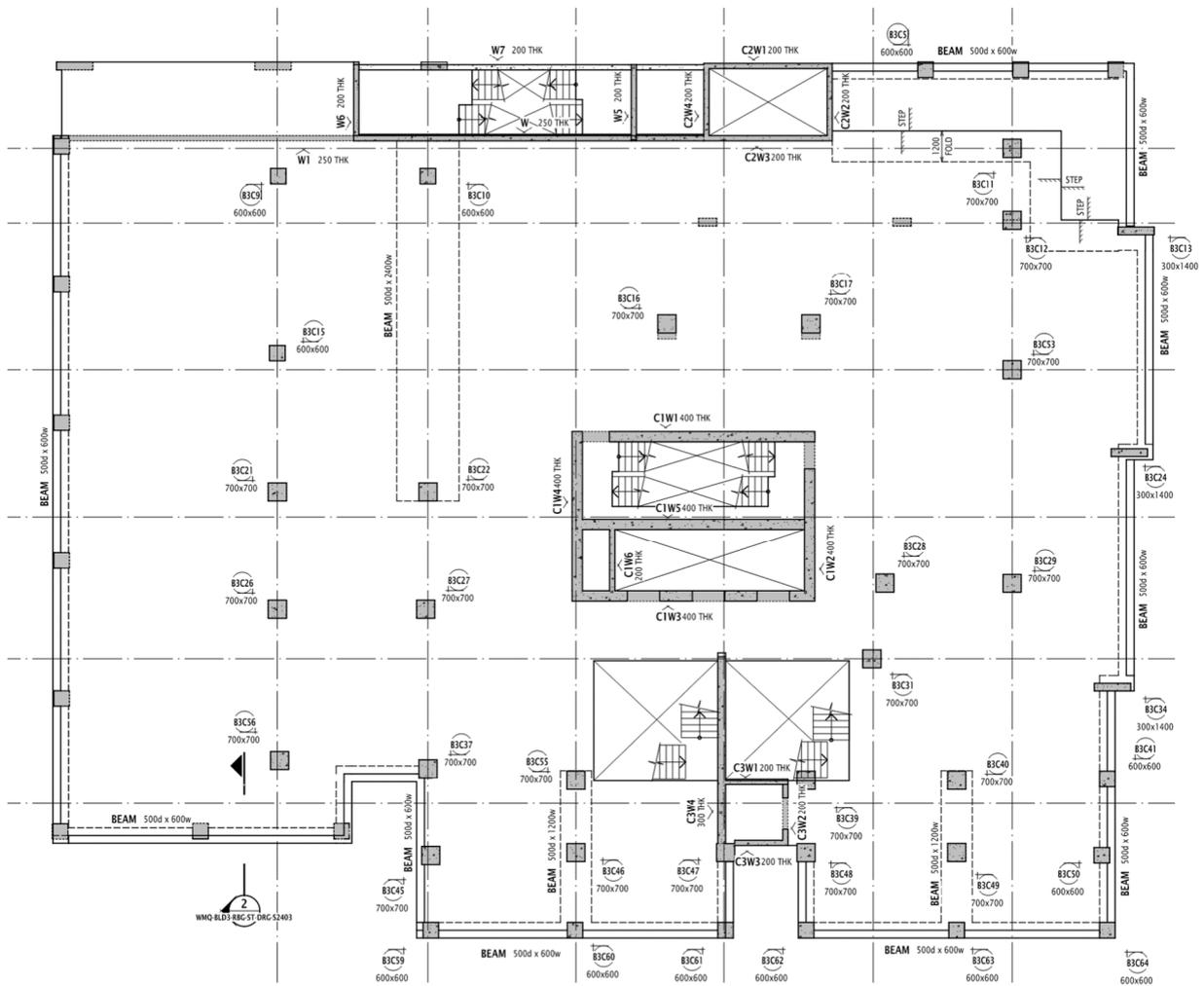
The floor plates for the accommodation portion of the building consist of a 200mm thick two way post tensioned flat plate slab. A 30mm set down for wet areas is accommodated within the slab for accessible units only. The slab thickness to the lower level commercial and community areas is increased to accommodate the larger superimposed loads.



LEVEL 06 GENERAL ARRANGEMENT PLAN (LEVEL 07-15 SIMILAR)
SCALE 1 : 100
SLAB TO BE 200 THK UNO

Figure 6 – Typical Slab Plan

The slab thickness for levels 1, 2 and 3 is increased to accommodate the larger superimposed loads (dead and live). Post tensioned beams are incorporated into the floor slabs along the western elevation to support the cantilevered portion of the building over the entry to the Gym and the student housing.



LEVEL 02 GENERAL ARRANGEMENT PLAN
SCALE 1 : 100
SLAB TO BE 250 THK UNO

Figure 7 – Level 2 Slab Plan (Level 1 & 3 similar)

The floor plates are supported by reinforced concrete columns which have been aligned vertically throughout the building eliminating the need for transfer.

9.4 Footings

The building is supported by reinforced concrete bored piers socketed into class II sandstone in accordance with the geotechnical engineers' requirements. Piles shall be founded below the zone of influence of the station excavation and sleeving of the piles within the zone of influence maybe required to prevent surcharge loading to the station box. This is subject to further geotechnical analysis during the detailed design phase of the project.

9.5 Adjoining Waterloo Congregational Church

The heritage listed Waterloo Congregation Church is located to the north of Building 3. Due to the age of the building the church is likely founded on high level pad footings. Building 3 does not contain a basement and will not require excavations near the church. Building 3 is supported on pile foundations and the loadings from the building will not impact on the church structure. Rock excavation will not be required for Building 3 however a vibration monitoring plan should be developed by the projects geotechnical engineer prior to any piling or excavations are undertaken.

A detailed dilapidation report of the church and surrounds should be prepared prior to works commencing on site. The report would provide a record of existing conditions prior to commencement of works.

10. Structural Design Building 4

10.1 Overview of structure

Building 4 is a concrete framed building with reinforced concrete columns and post tensioned floor slabs. A reinforced concrete core and shear walls resists the lateral loads due to wind and earthquake. The building is positioned over and directly supported by the station structure.

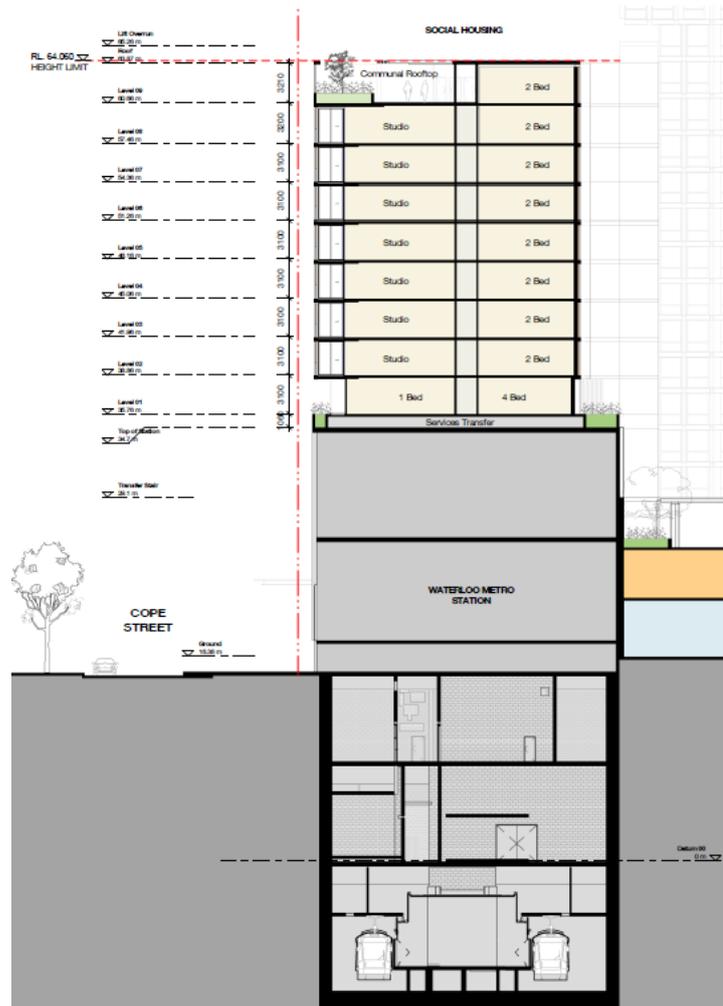


Figure 8 – Section through building 3 and station

10.2 Lateral Stability

The lateral stability system has been designed to resist the site wind and earthquake loads for strength and serviceability. The lateral loads are resisted by a central stair / lift core and shear walls which are carried up through the tower. The typical floor plate showing the location of the core and shear walls is shown in the figure 9.

The lateral loads from building 4 are transferred into and resisted wholly by the station structure. To model these actions a combined ETABS model was established to assess the lateral performance of the building and the station structure.

Both the WC and WLD teams have carry out this overall assessment to ensure each of the respective structures meets the Earthquake requirements.

The lift core on the western side of the building services Building 4 from ground level. The core is isolated from the building 4 via a corbel joint so as not to pick up lateral load from Building 4 or the station structure. The corbel joint and the building joint is to be designed to accommodate the combined movements of building 3 and 4 from wind, earthquake and thermal movements. The joint will need to be sized to prevent pounding of the buildings during design events.

10.3 Floor Plates

The floor plates for the building consist of a 220mm thick two way post tensioned flat plate slabs. A 20mm set down for wet areas is accommodated within the slab for wet areas setdowns. A 90mm set down is provided to balcony areas.

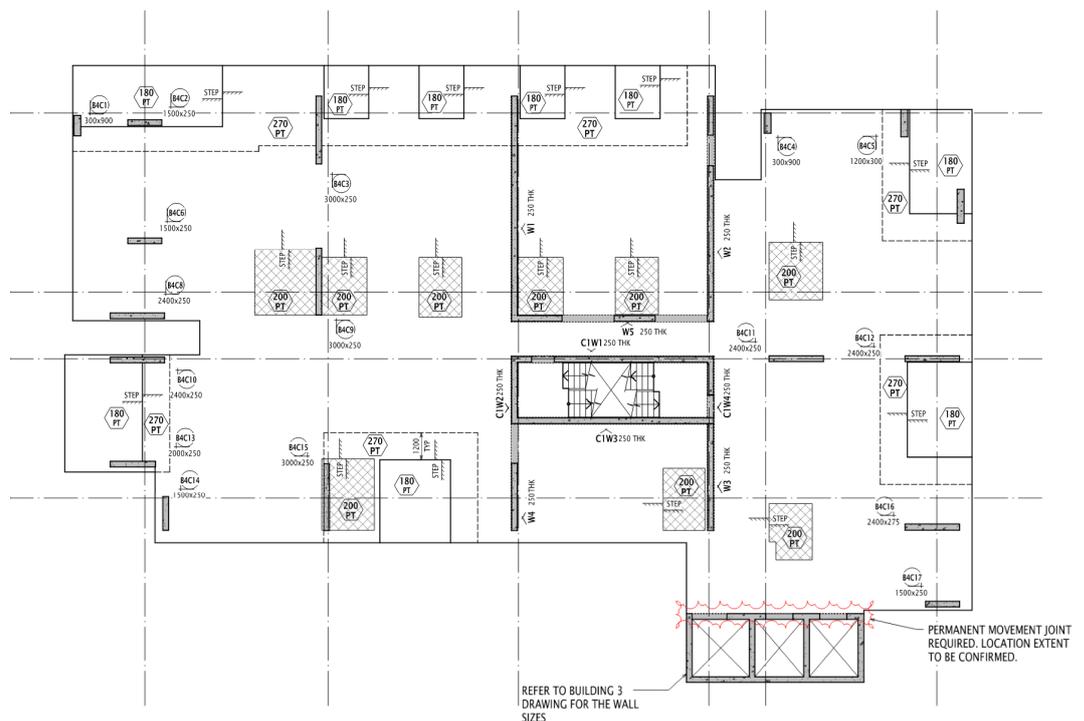


Figure 9 – Level 1 Slab Plan (Level 2 to 8 similar)

The roof slab (level 10) steps inboard of the typical levels and requires minor transfer beams to be incorporated into the level 9 slab. Level 9 also incorporates an outdoor terrace space.

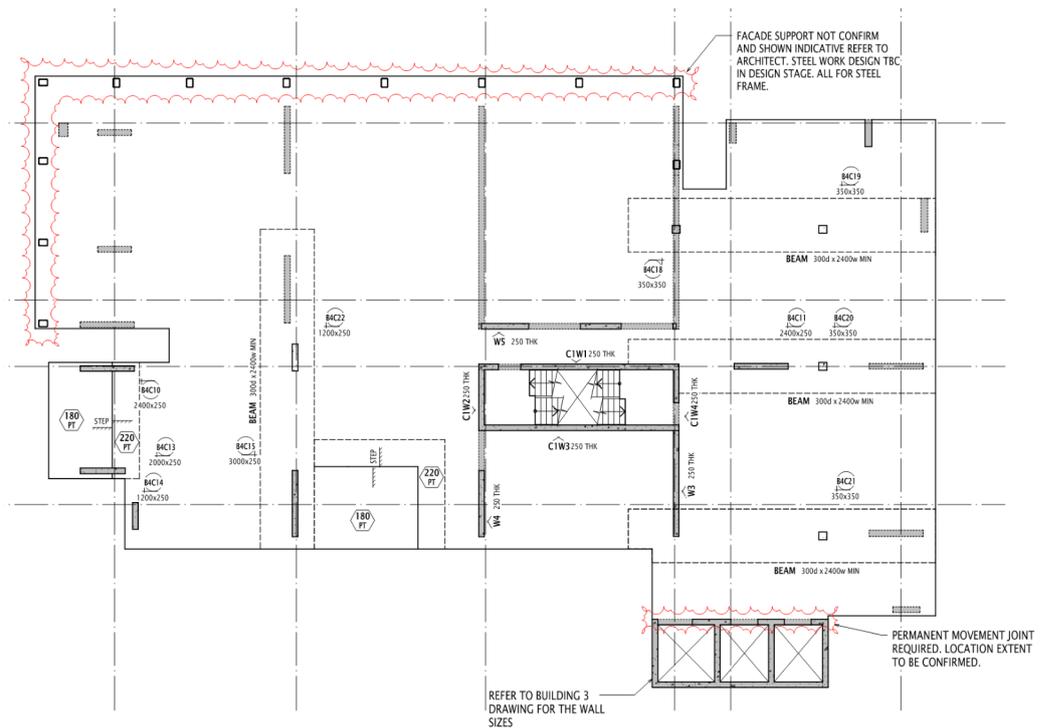


Figure 10 – Level 9 Slab Plan

The floor plates are supported by reinforced concrete columns and walls which have been generally aligned vertically throughout the building eliminating the need for major transfer.

The OSD building Structural framing above the station does not align with station grids and requires transfer via post tension beams.

The stair core is positioned over the station lift core however walls do not align. Wall loads are transferred through a thick slab.

10.4 Station loading

Building 4 is supported entirely by the station structure. The design teams from both the Waterloo Station contractor and the Over Station Developer have coordinated the interface to capture the required loadings both horizontal and vertical to accommodate the proposed development.

11. Structural Design Cope St Plaza

11.1 Structure

Cope St Plaza is a landscaped zone constructed above the roof to the station structure. The finished ground level of the podium varies from approximately 600mm above the station structure to approximately 1.4m above. To limit the loading on the station, roof the structure for the podium consist of a 250mm thick slab supported on blockwork walls. A polystyrene void former is provided under the planter areas to limit the depth of soil and the loading on the station roof. A 150mm (min) thick protection slab is provided over the waterproof membrane.

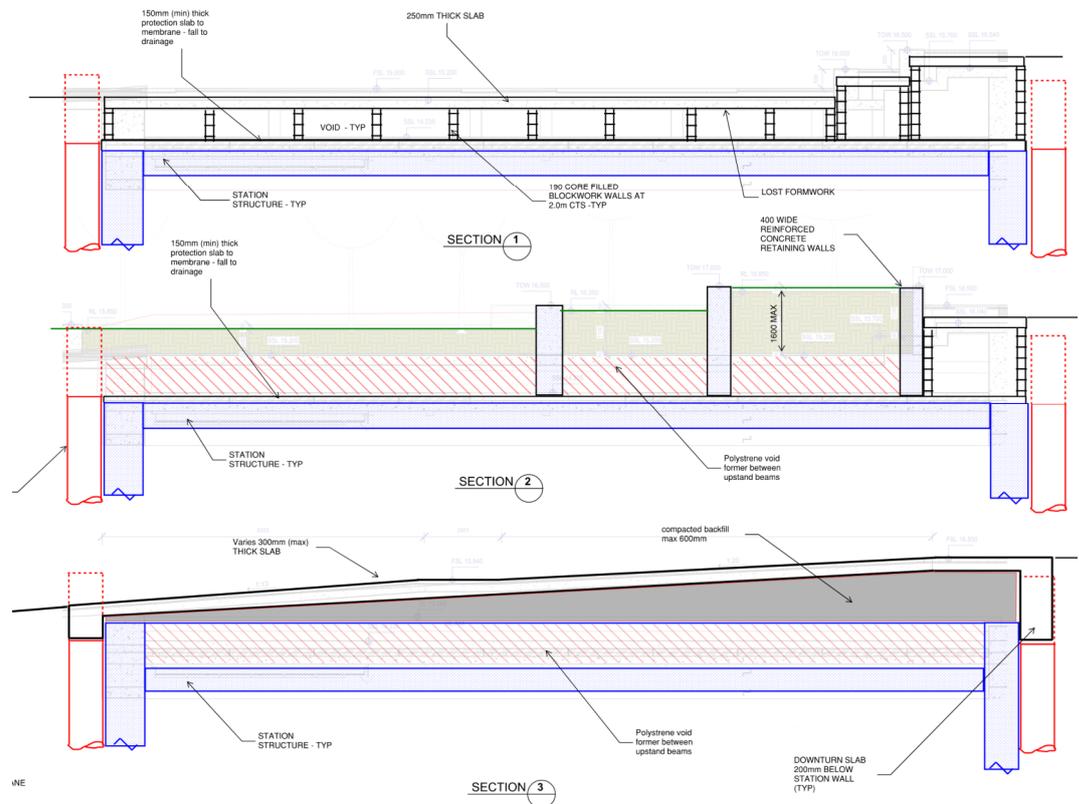


Figure 11 – Cope St Plaza

Cope St Plaza is supported entirely by the station structure. The Waterloo Station team have been provided with the full loadings from Cope St Plaza issued in a technical memorandum. The station contractor will accommodate these design requirements in coordination with the Waterloo ISD team.

12. Conclusion

The structural design of the Southern Precinct is an integrated design with the Waterloo Metro Station. During the SSD design development, Robert Bird Group have provided advice and input into wider design team by producing a structural scheme design, development of finite element building model ETABs and preparation interface loading advice. These inputs have allowed the station designers to make all necessary allowances in the design of the station structure to accommodate the building 4 structure. Preliminary coordination with other engineering consultants has been undertaken and further design development will be required for Construction Certificate. Further geotechnical analysis and modelling will be required to inform the design team to ensure the pile foundations do not adversely impact on the station structure.

The structural design is compliant to the relevant design and planning criteria and industry standards and will not adversely impact on adjoining structures.