Structural Design Brief – Raft Foundation Option

101 Albert Street, Brisbane

Job Number: 22131

Revision: T01

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Report Amendment Register

Issue Ref	Amended Section(s)	Issue/Amendment Details	Author(s)	Reviewer	Date
T01	All	For Tender	Nicholas Doyle	Mark Avery	21 March 2025

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Contents

1. Introduction

1.1 Purpose of Report

This report sets out the proposed design codes and standards, proposed loading information, and proposed design criteria for the structural design solution at 80% Design Development **(80%DD)** based on the alternative raft foundation option, carried out by Robert Bird Group (**RBG**) on the commercial development on Lot 2 Albert Street Brisbane (**101 Albert Street or Project**) for Queensland Investment Corporation **(QIC)**.

Additionally, this report also outlines the adjoining Cross River Rail (**CRR**) assets and imposed site constraints, sets out the basic parameters used in the structural design of the project. It is the main reference document to obtain critical design information, including loads, material properties, and performance criteria. This document references codes and standards and provides a history of structural design and how it has developed to date.

This report should be read in conjunction with the Project Movement and Tolerance Report ALB-RBG-REP-ST-00-000-03 and Design Development Report – Raft Foundation Option ALB-RBG-REP-ST-00-000-05.

This report is a live document and will be updated throughout the life of the project. Items shown Red or yellow are live items that require close-out. Updates may be proposed by any member of the RBG engineering team. Updates will only be made with the authority of the Project Engineer. At the end of the project, this document will form part of RBG's record of the structural design.

1.2 Site Details

The proposed 101 Albert Street Development and Project is located on Lot 2 of the Albert Street Station site for CRR. The site is located opposite the proposed Albert Street CRR Station. The site is noted as FOSD Lot 2 on the map below.

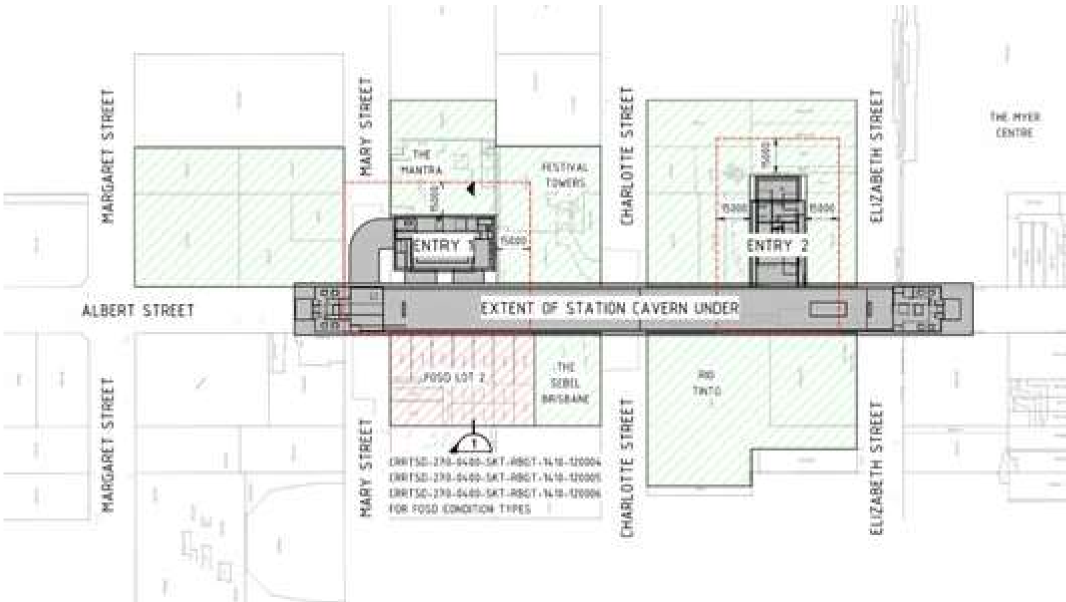


Figure 1 - Site Map

The site abuts the Station Cavern that runs under Albert Street and sits between Mary Street and the Brisbane Sebel **(The Sebel)** development. Two developments abut the Northern boundary, being 110 Mary Street and 119 Charlotte Street. The site 3D view is presented in Figure 2 is taken from the structural Revit model and shows the site during the basement construction stage where the temporary struts and walers are in position to brace the shoring and retention wall.

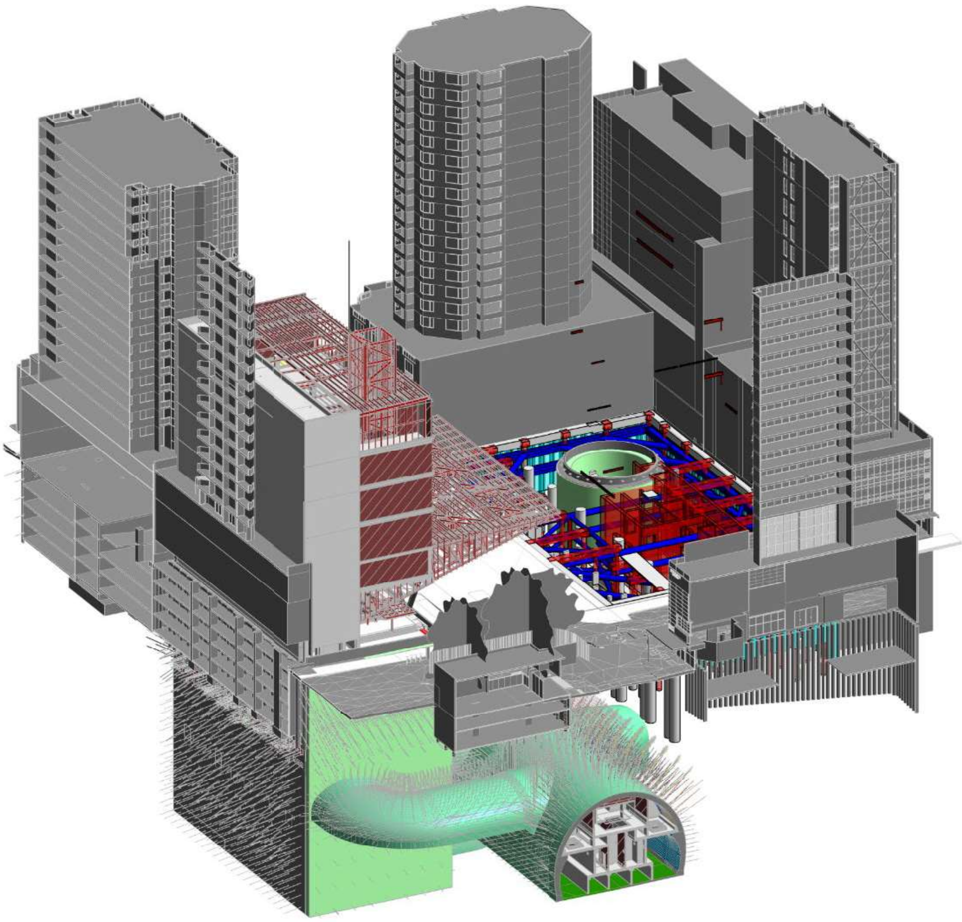


Figure 2 - 3D Site View from Model

1.2.1 Bounding Commercial Structures

As per Figure 3, the site is fronted by Albert Street and Mary Street with adjoining buildings 110 Mary Street and 119 Charlotte Street to the North, and the Brisbane Sebel **(The Sebel)** to the West.

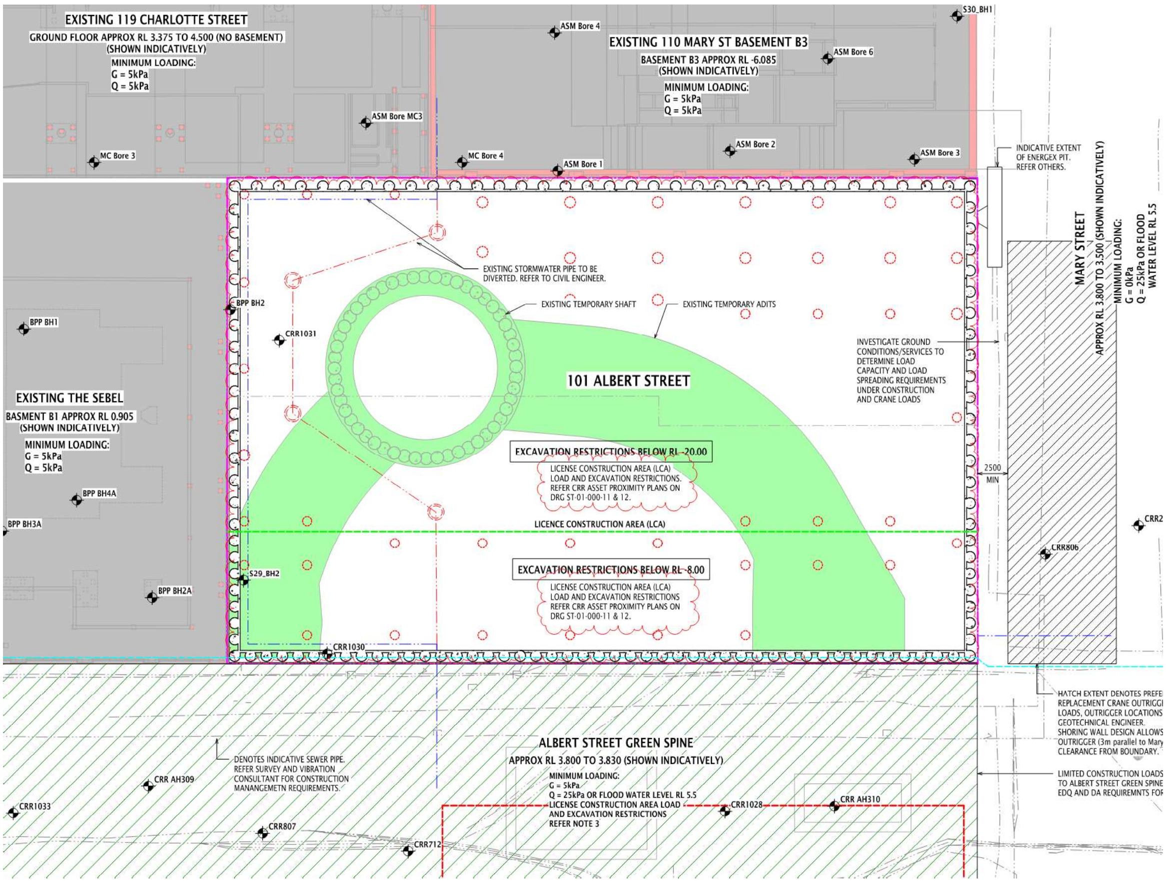


Figure 3: Site Plan

Brisbane Sebel – The Sebel tower was designed by Robert Bird Group (Refer Job No.96246) and constructed in 1996. It includes a single basement that is set back away from the property boundaries. The basement edge setback is circa 3.0m from the common boundary with the Project. The building features a reinforced concrete frame with 32 levels above the ground floor. The building is founded on driven precast piles driven to the refusal in the medium strength rock. There are driven 350 mm square piles whose centreline is circa 500 mm from the common property boundary with the Project. Piles are estimated to be found below RL-10m based on the geotechnical report for The Sebel and are, therefore not anticipated to surcharge the proposed excavation of the Project basement. Due consideration must be made to the precast piles and their stability during shoring and retention works. Both the Ground Floor and the Basement Floor are designed as spanning slabs and therefore do not surcharge the soil or proposed shoring to the Project. The Sebel boundary wall to the Project is supported on a continuous reinforced concrete ground beam that spans between pile caps that support the boundary columns.

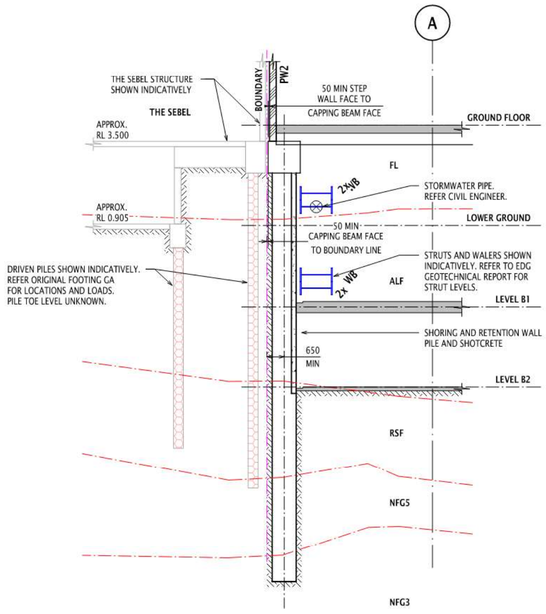


Figure 4 – Typical Boundary Section – The Sebel

110 Mary Street – The 110 Mary Street building (Matisse Tower) was constructed circa 2006 and was designed by Bruce Lemcke Engineering (Job No 06995). The tower is a reinforced and post-tensioned concrete frame with 22 levels above ground and three basements. The basements extend to the site boundary. The retention system is a diaphragm wall which is stated to be found at RL-11.8m. The lowest basement B3 has a finished floor level that varies between RL-5.42m & RL-6.085m. The building is founded on reinforced concrete barrettes that are generally 2700mm by 600mm that found in medium to high-strength rock. This was estimated to be between 18m and 21m below the original surface level (circa RL4m), giving a founding level of at least RL-14m. The lowest basement is designed as a suspended slab on grade over a drainage layer. The basement floor is not designed as hydrostatic and is designed to be drained via the drainage layer to pump out pits. As the basement, retention system, and barrettes are found below the proposed basement of the Project, there will be no surcharge to the retention system of the Project from 110 Mary Street.

Construction activities on the Project site will need to consider the retention of 110 Mary Street and limit surcharges during construction works. The designers of 110 Mary may need to be consulted to understand the wall's surcharge capacity for temporary loading conditions.

The design drawings do not provide retention wall details as it is noted as a "Design and Construct" item by others. Given the proposed basement to the Project is at a similar level to 110 Mary Street, there is not likely to be an issue with surcharge impacts from the Project on 110 Mary under permanent load conditions. The shoring system should be designed to support the 110 Mary Street job against out-of-balance soil loads from 120 Mary Street.

119 Charlotte Street – The 119 Charlotte Street project (Martin Campus) was constructed circa 2000 and was designed by Robert Bird Group (Job No.99166). The building is a 12-storey concrete framed education facility with no basement. The building is supported on driven precast piles that are found in the low-strength rock (estimated top of weak rock between RL-4.0m – RL-8.0m advised in the project geotechnical report by Butler Partners).

Based on a review of this geotechnical report for the project the area adjacent to the Project shows the top of the low-strength rock at RL-8.0m to RL-8.6m along the common boundary implying the Martin Campus piles will be founded well below the proposed basement to the Project. The ground floor was designed as a suspended slab on grade and varies in finished level from RL3m to RL4.5m. Precast boundary walls were supported on pile-supported reinforced concrete ground beams. On the Project boundary, the driven piles were located 600mm from the boundary to the centreline of the piles. Piles closest to the boundary are 300mm square driven precast piles.

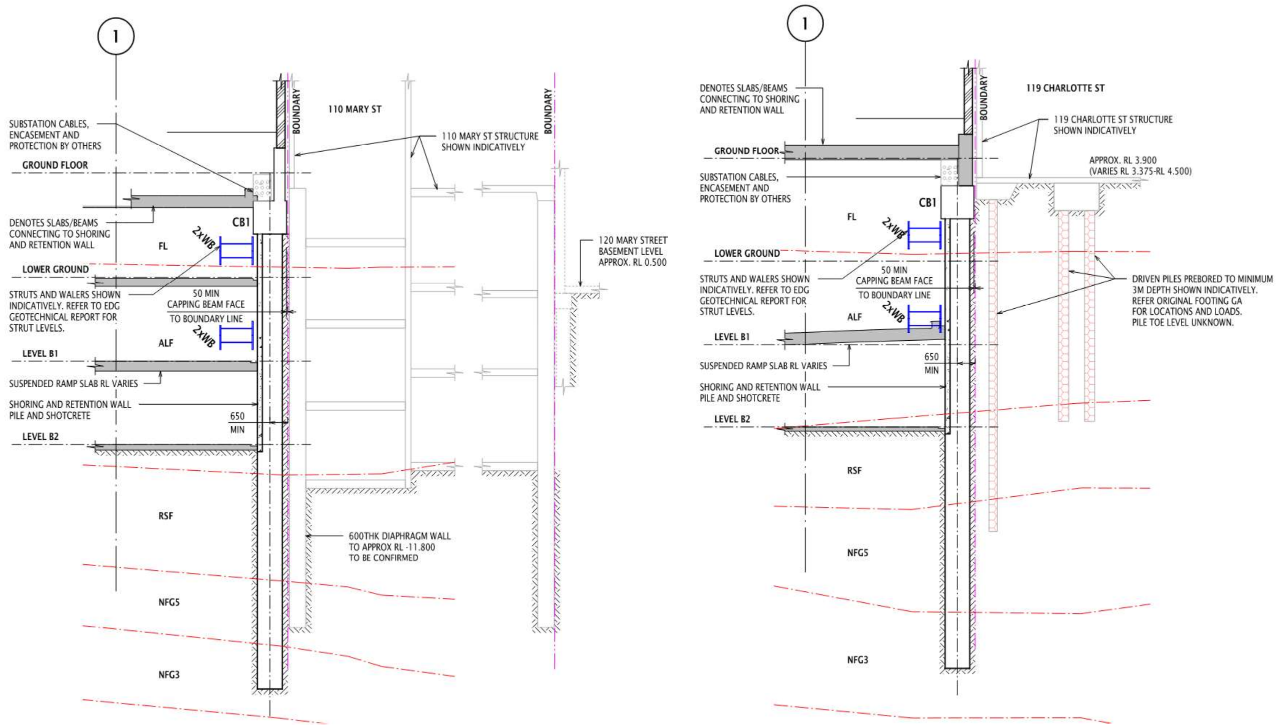


Figure 5 – Typical Boundary Section – 110 Mary Street and 119 Charlotte Street

1.2.2 Surrounding Heritage Structures and Sensitive Inground Services

The proposed Project adjoins the The Sebel, 119 Charlotte Street, and 110 Mary Street buildings. None of these structures is listed on the State or BCC Heritage structures register.

The nearest listed heritage structures are as follows:

- Mooneys Building 130-132 Mary Street – 40m to Project at the closest point.
- 138 Mary Street – 60m to Project at the closest point.
- Perry House 167 Albert Street – 115m to Project at the closest point.
- Charlotte House 139-145 Charlotte Street - 60m to Project at the closest point.
- Brisbane Synagogue 98 Margaret Street – 150m to Project at the closest point.

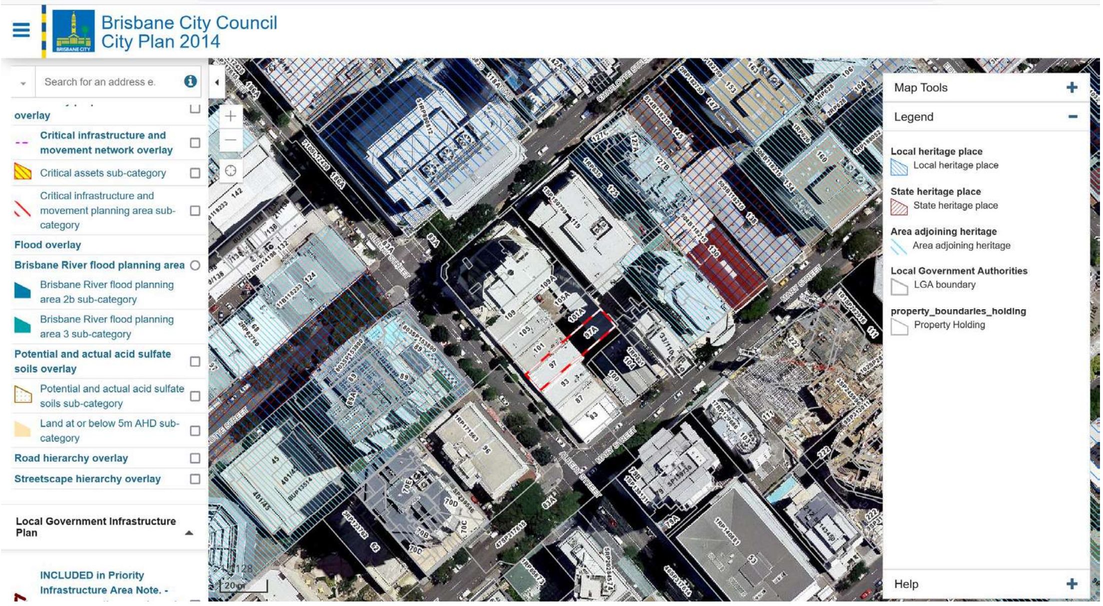


Figure 6: City Plan Heritage Sites Overlay

The proposed basement to the Project requires an excavation of circa 12.9m depth maximum at the boundary. The zone of influence for the retention system will not exceed twice the retained height (26m). Based on this, there are no listed buildings in the influence zone of the retention system.

The existing static water table is below the level of the proposed basement excavation. Local perched areas of groundwater are likely to be encountered; however, the static water table is below the proposed Basement 2 level. As such, the Project is not anticipated to impact groundwater levels which could impact adjoining structures (particularly heritage structures).

The excavation is substantially in the existing fill and alluvial material, with possible local areas of extremely weak rock just exposed by the excavation. There is minimal excavation in the weak rock (generally classified as Neranleigh Fernvale Group NFG4 and NFG5). The use of heavy rock-breaking equipment is not anticipated with the removal of material by conventional excavators and dozers.

The building foundations will consist of a raft foundation in combination with the retention system. Bored soldier piles are currently anticipated for the retention system. The use of driven piles is not anticipated. As such there are no major sources of excessive construction-generated vibration. The influence zone for vibration is unlikely to extend beyond the same 26m influence zone expected for retention influence. Therefore there are no heritage structures in the influence zone of construction-generated vibration.

There is a 450mm diameter sewer (S1 sewer) that runs centrally under Albert Street at an approximate depth of 3m which is regarded as a piece of sensitive infrastructure. This sewer service pre-dated the station works that involved significant blasting and excavation in rock. During Station construction, a vibration limit of 25mm/s was applied to this service, and works were completed with no known impact. Given the nature of the proposed works on the Project, site vibration is unlikely to approach the previous limit imposed for this service. Bored piling generally is regarded as producing accelerations less than 5mm/s at a distance of 5m. Similarly, the use of a large excavator (45t) is unlikely to produce accelerations greater than 5mm/s at distances greater than 5m. However, the final vibration limit applicable to the project needs to be confirmed with the Queensland Urban Utilities **(QUU)** and could be more stringent than the 25mm/s as discussed in the Vibration Reports.

To protect the S1 sewer we have proposed a reduced lateral movement criteria of 15mm maximum for the Albert St boundary shoring which is subject to geotechnical modelling. For comparison the Mary Street performance criteria is 25mm. CCTV condition inspection of accessible services in Mary and Albert Street is recommended to be undertaken prior to Operational Works approval.

1.2.3 Cross River Rail Assets

The Project site is adjacent to, and partially over major CRR Assets associated with the Albert Street Station. The major adjoining asset of most importance is the CRR Cavern that runs under Albert Street. This cavern sits just under the site boundary of Albert Street. The cavern is a mined arched structure with its base at circa RL-30m and its crown at circa RL-13m. There are duct and escape passages below the cavern that link back to the primary station structure located on the opposite side of Albert Street.

Figure 7 illustrates the location of the cavern and station relative to the development site.

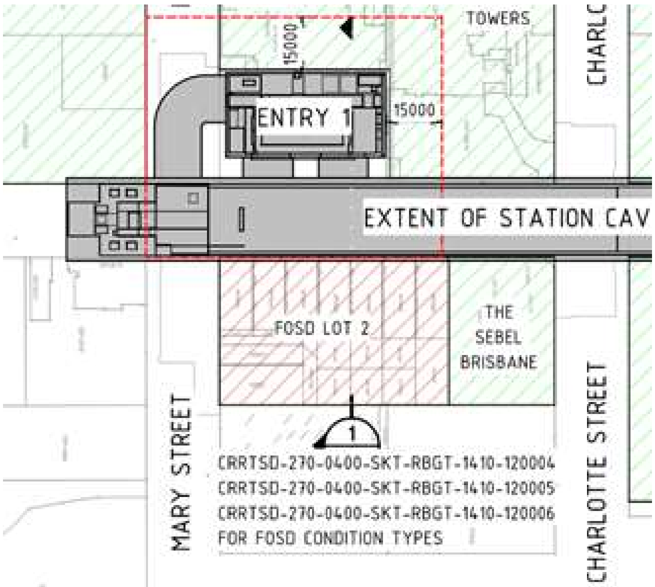


Figure 7: Development Site and CRR Assets

Figure 8 below illustrates a section through the Project site and the adjacent cavern and station structure. The extent of the proposed basement on the development site is also illustrated.

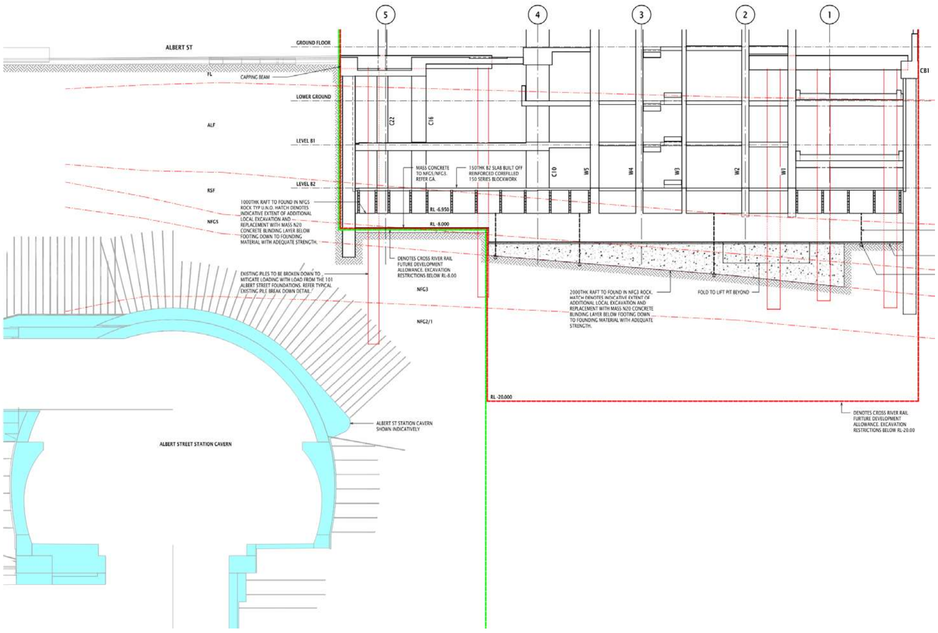


Figure 8: Section through the Project site and CRR Assets

The development site is currently occupied by an acoustic shed as part of the construction of the Albert Street Station. Within the shed is a 12m diameter temporary access shaft that extends down to nearly RL-30m. This access shaft links to two temporary adits that curve and join to the station cavern.

The acoustic shed, access shaft, and connecting adits are all temporary structures. Upon completion of the station, we understand that the acoustic shed and its base slab will be removed. The adits and the access shaft, we understand, will be filled with cementitious material to be confirmed.

Existing pile heads will be cut down below the proposed new basement and/or foundation. New shoring and retention piles will be positioned to be clear of existing piles.

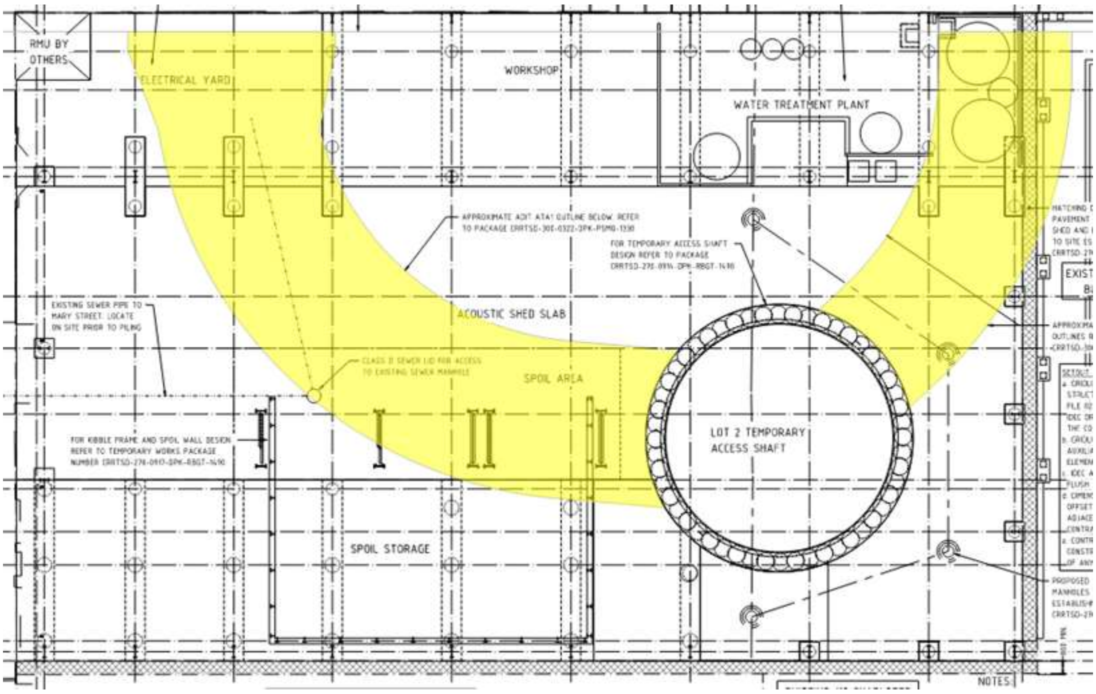


Figure 9: Acoustic Shed, Access Shaft and Temporary Adits

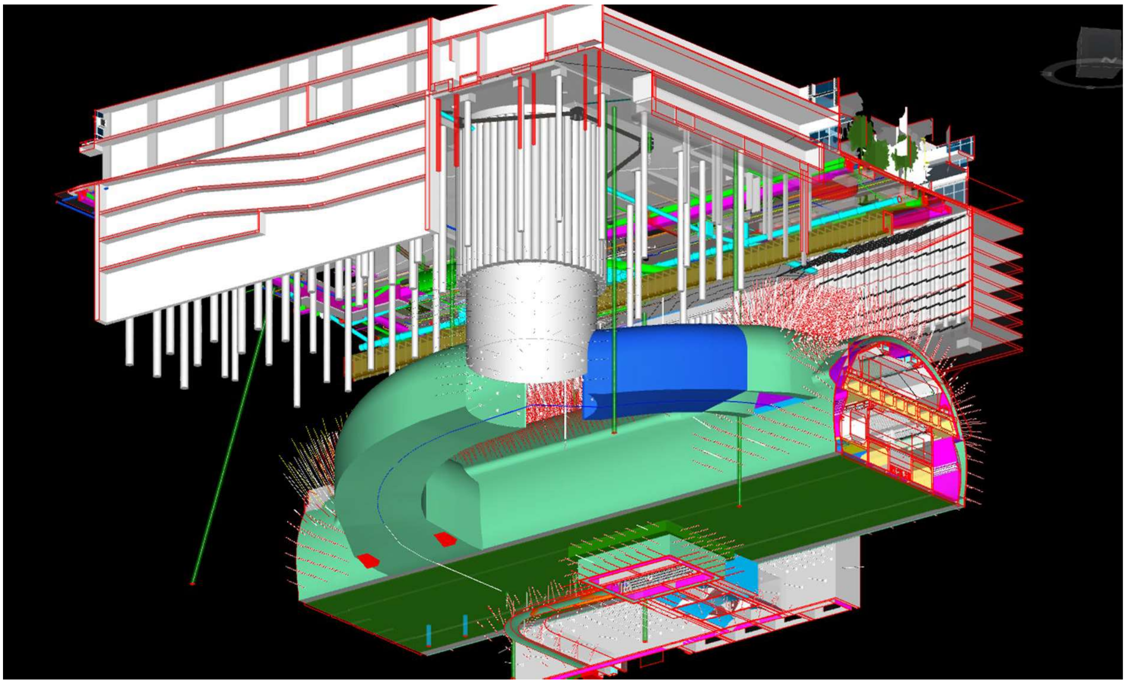


Figure 10: Extract of CRR BIM Model below Lot 2

1.3 Proposed Development

The proposed project development is to comprise of a predominantly commercial tower that will sit above Podium Retail, Amenities and Terraces, and Public Plaza with Basement parking below ground. The building will include three-level underground basement levels over the full site, with B1 containing the Loading Facilities with the balance of B1 and B2 being car parking. A part-size basement level between B1 and Ground will house the End of Trip **(EOT)** facilities. The finished floor level of B2 is currently proposed at RL-5.2m. Figure 11 shows the basic usage of the proposed development.

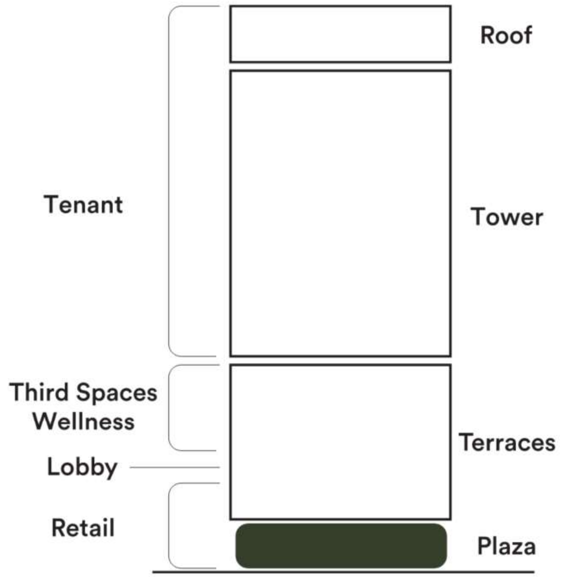


Figure 11 - Proposed Building Stack (By Henning Larsen/Architectus)

The Podium Retail, Amenities and Terraces consist of a mix of internal and external spaces with the external edges continually changing or eroding throughout the height of the terrace floors as illustrated by Figures 12 and 13 below.

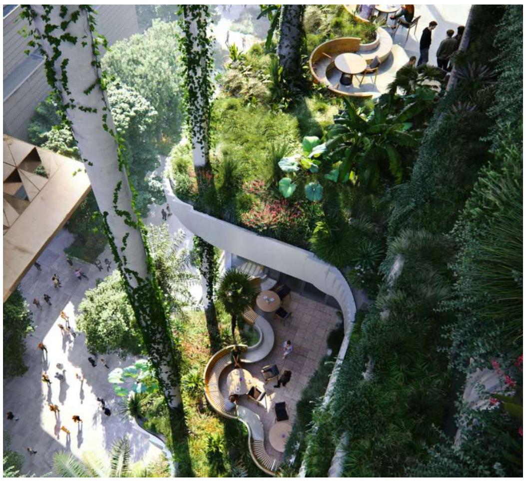
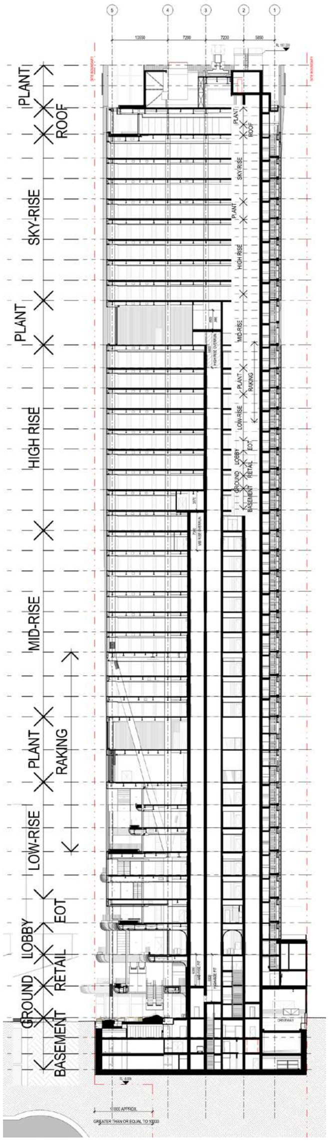


Figure 12 and Figure 13 - Proposed Terraces (By Henning Larsen/Architectus)

The commercial tower will be split into four rises, Low **(LR)**, Mid **(MR)**, High **(HR)** and Sky **(SR)**. Above the SR commercial stack at L38 will be a Destination Rooftop with an external terrace. Plant levels split the LR and MR stacks and the HR and SR Stacks.



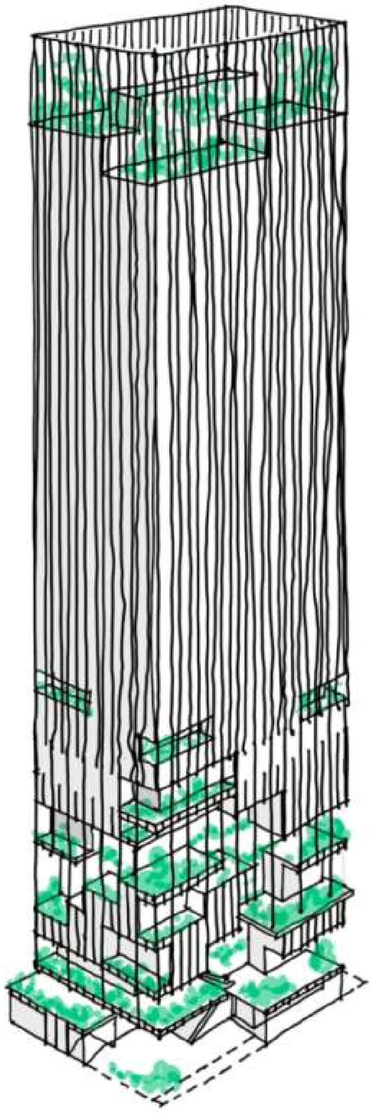


Figure 14 and Figure 15 - Proposed Section and Render (By Henning Larsen/Architectus)

2. Referenced Documents

2.1 Project Documents

Other Project documents relied upon when developing, or referenced within, this document are as follows:

- RWDI site specific wind report, document title RWDII-RPT-WE-0003 1.
- RWDI structural loads assessment report, document title RWDII-RPT-WE-0010 2.
- EDG geotechnical report, document title B01493-1BC - 101 Albert St Geotechnical Report IFT Issue-1.
- EDG supplementary geotechnical reports, document titles *B01493-1BA_RevB and Updated Shoring Pile Spring Stiffness.*
- RBG Movement and Tolerance Report, document title *ALB-RBG-REP-ST-00-000-03 [T02].*

- RBG Design Development Report – Raft Foundation Option, document title *ALB-RBG-REP-ST-00-000-05 [T01].*
- Fire Engineering Brief, document title BNE0776.
- Façade Engineering Report, document title EOC-ENG-RPT-FA-0001[03]. In particular Sections 9 and 5.2.2.
- Heilig and Partners vibration and monitoring reports, document titles IMP 101 ALBERT ST FINAL, SMVR 101 ALBERT ST FINAL, TSMR 101 ALBERT ST FINAL and Revised modelling results for Albert St raft piling with plates.

2.2 Standards and Codes

The following Standards and Codes are applicable to the design of the structural elements:

- National Construction Code of Australia – 2019
- AS1170.0:2002 General Principles (Up to and Including Amdt 5)
- AS1170.1:2002 Imposed Loads (Up to and Including Amdt 2)
- AS1170.2:2021 Wind Code
- AS1170.4:2007 Earthquake Code (Up to and Including Amdt 2)
- AS3600:2018 Concrete Structures (Up to and Including Amdt 2)
- AS3735:2001 Concrete Structures Retaining Liquid (Up to and Including Supp1)
- AS3700-2018 Masonry Structures
- AS4100-2020 Steel Structures (Up to and Including Amdt 1)
- AS5131-2016 Structural Steelwork Fabrication and Erection
- AS4678:2002 Earth-retaining structures (Up to and Including Amdt 2)
- AS2327-2017 Composite Structures – Simply Supported Beams (Up to and Including Amdt 1)
- AS2159-2009 Piling – Design and Installation (Up to and Including Amdt 1)

Any code referenced in this report is to be interpreted as the revisions specified above.

2.3 Referenced Cross River Rail Reports

In preparing RBG's design response, we have made reference to and placed reliance on several existing documents. These include but are not limited to:

- Design Manual – Stations **CRRTSD-000-0401-MAN-RBGT-1470-191101**
- Design Manual – Driven Tunnels **CRRTSD-000-0300-MAN-PSMQ-1320-100044**
- Geotechnical Interpretive Report **(GIR) CRRTSD-000-351DPK-PSMQ-1120-000100**
- Hydrogeological Interpretive Report **(HIR) CRRTSD-000-0354-RPT-PSMQ-1120-040028**
- Albert Street Temporary Access Shaft – **Rev C CRRTSD_270-0460-DAN-PSMQ-1120**
- Factual Report on Geotechnical Investigation Cross River Rail-Tunnel, Stations, and Development – Douglas Partners – **CRRTSD- 97335.00.IFI.00.01**
- Albert Street Station Main and Northern Entrance Shafts – **CRRTSD-270-0940-DAN-PSMQ-1490-230078**

- Station Cavern and Adit Loads – **CRRTSD-000-0401- DAN-RBGT-1490-190380**
- Albert Street Station Utilities Assessment - **CRRTSD-000-0352-DAN-PSMQ-1124-060063**
- Geotechnical Interpretive Report (GIR) – **CRRTSD-000-0351-RPT-PSMQ-1120-030021**
- Albert Street Station – **CRRTSD-270-0904-DPK-RBGT-1490-000100**
- Albert Street Lot 2: Temporary Retention and Bulk Excavation – **CRRTSD-270-0914-DPK-RBGT-1490-231400**
- Albert Street Station Design of Acoustic Shed and Foundations - **CRRTSD-270-0904-DPK-RBGT-1490-000100**
- Permanent Works Design report – Permanent Lining (Tunnel- Albert Street) – **CRRTSD-300-0323-RPT-PSMQ-1330-190089**

3. Design Life/Durability/Fire Resistance Periods

Much of the information contained within this section is extracted from the General Notes of the Structural Drawing set. Where discrepancies occur, the Structural Drawings are to take precedence.

3.1 NCC Structural Importance Level

The structural importance levels assessed under the National Construction Code 2019: Building Code of Australia – Volume 1 (**NCC**) for this project are as follows:

Table 1: Structural Importance Levels

Project Component	Importance Level
Primary Structure	3
Unattached Canopies[1]	2

Notes:

1. *There are currently no unattached canopies proposed for the project.*

3.2 Design Life

The structures will be designed to meet durability requirements for a design life of 50 years. Design life is the period for which a structure or structural member is to remain fit for use for its designed purpose with appropriate maintenance.

3.3 Annual Probabilities of Exceedance

Probabilities of exceedance for determining design loads are to be as follows. These have been extracted from the General Notes on the Robert Bird Group Structural Engineering Drawings. If discrepancies occur the General Notes take precedence.

Table 2: Annual Probabilities of Exceedance

Load Type	Ultimate	Permissible	Service
Wind (Non-Cyclonic)	1:1000	1:100	1:25
Seismic	1:1000	-	1:25

3.4 Durability

3.4.1 Concrete

Minimum durability parameters for concrete elements will be as follows. In all instances the project's Structural Drawings take precedence.

Table 3: Concrete Durability Parameters

Environment	Exposure Classification[1]	Minimum Reinforcement Cover[2]
In-ground	A2[3]	50mm, 75mm for piles
Internal	A2	25mm
External	B1	30mm

Notes:
1. *In accordance with AS3600.*
2. *Cover will be assessed on an element-by-element basis and represented on the Structural Drawings. These are nominal minimums for reinforcement. Post-tensioning will be assessed separately.*
3. *Subject to confirmation of soil characteristics by Geotechnical Engineer.*

3.4.2 Steel

Minimum steel durability parameters will be as follows. These have been extracted from the General Notes on the Robert Bird Group Structural Engineering Drawings. If discrepancies occur the General Notes take precedence.

Table 4: Steel Durability Parameters

Parameter	Assumption
Life to First Maintenance	25 Years
Atmospheric Corrosivity Category[1]	Internal air-conditioned space – C1 Internal otherwise – C2 External protected within ceiling – C3 External exposed – C3

Notes:
1. *In accordance with AS4312.*

3.5 Fire Performance

The Project Fire Engineer in conjunction with the Principal Certifying Authority will confirm the Fire Resistance Level requirements for structural elements on completion of the Fire Engineering Report. The Project

Architect will present this information on Fire Performance Plans. While Fire Performance Plans are in development the following advice has been provided by the Fire Engineer and Certifier:

Occupancy/Element/Area	Deemed-to-Satisfy FRLs	Proposed FRLs
Car Parking	120/120/120	120/120/120
Retail	180/180/180	120/120/120
Plant and Lift Motor Rooms (LMRs)	120/120/120	120/120/120
End of Trip (EOT) – amenities and bike/scooter parking	120/120/120	120/120/120
Commercial	120/120/120	90/90/90 for floor slab 90/90/90 for primary beams -/-/- for secondary beams 120/120/120 for columns
Substation	240/240/240	240/240/240
Loading Dock	TBC[1]	240/120/120
Lobbies	-	-
Core Walls Bounding Fire Stair	120/120/120	120/120/120 generally -/-/- for elements of structure which are fully enclosed within the fire stair
Miscellaneous Basement Compartments (i.e. pumprooms, storage, services rooms, facilities office, bin room)	TBC[1]	TBC 120/120/120 generally[1] Pump Room = DtS[1] Storage = DtS[1] Services Rooms = DtS[1] Bin Room = DtS[1]
Low-rise Terraces and areas outside primary glazing line	120/120/120	90/90/90 for floor slab 90/90/90 for primary beams -/-/- for secondary beams 120/120/120 for columns
Level 37 Terrace	120/120/120	-/-/- for columns/beams/structure supporting the awning[2] 120/120/120 for beams/structure supporting the plant deck 120/120/120 for all other columns
Level 3	120/120/120	90/90/90 for floor slab

Figure 16: Table 10 excerpt from ADP document BNE0776.

Note that these are a guide only, and the Architectural Fire Compartment Plans should be referred to for detailed design. Where required, steelwork fire ratings are to be achieved by fire protective cladding/coatings to Architectural details, in accordance with the NCC.

3.6 Footfall Vibration

Assumptions for footfall vibration calculations will be as follows.

Table 5: Footfall Vibration Parameters

Parameter	Value
Minimum Walking Pace[1]	1.80Hz – 2.20Hz
Minimum Walking Pace	1.00Hz
Damping, % of Critical	2.5%
Walker Weight	746N
Weighting Curve	Wb

Notes:

1. *Maximum walking pace of 2.20 Hz applies to open areas such as corridors, and 1.80 Hz applies to cellular spaces such as amenities and pod areas.*

3.7 Steel Fabrication

Steel fabrication parameters will be as follows. These have been extracted from the General Notes on the Robert Bird Group Structural Engineering Drawings and the Steelwork Specification. If discrepancies occur the General Notes take precedence followed by this document and then the Specification. If discrepancies occur in the specification of AESS the Architectural Documents take precedence.

Table 6: Steel Fabrication Parameters

Parameter	101 Albert St Tower
Importance Level (Refer Section 3.1)	IL3
Service Category[1]	SC1
Fabrication Category[1]	FC2
Construction Category[1]	CC3
Treatment Grade[1]	P2 Typically P3 AESS Nil for Galvanising Unless AESS
Coating Quality Level[1]	PC1 Internal Steelwork[2] PC2 Otherwise
AESS Category[1]	AESS 2 Unless noted otherwise AESS 3 Exposed columns and crown steelwork AESS 4 Albert St podium exposed column splices

Notes:

1. *In accordance with AS5131.*
2. *Only steelwork within the primary building façade is to be regarded as internal. For example, steel elements contained within the ceiling space of an otherwise external area (terrace, balcony, etc.) shall be treated as external.*

4. Design Loads

The following outlines the structural design loading criteria for the development. An effort will be made to ensure all permanent loads that the structural design is based on are shown on the Robert Bird Group loading plans. Where provided in advance and where reasonable, temporary loads will also be shown.

4.1 Gravity Loads

4.1.1 Structure Self-Weight

The structure self-weight will be calculated from the unit weight of materials in AS1170.1 Table A1 Appendix A or the unit weight of materials in technical specifications provided by contractors/suppliers as appropriate for the specific material.

For the purpose of the design of slabs, beams, and the strength design of walls and columns, the self-weight of concrete will be taken as 24 kN/m^3.

For axial shortening calculations and vibration analysis, concrete self-weight shall be taken as per the supplier's recommendations but not less than 23.5 kN/m^3.

The self-weight of structural steel sections will be as per the manufacturers' data. For fabricated sections, the self-weight of structural steel shall be taken as 78.5 kN/m^3.

4.1.2 Superimposed Dead and Imposed Live Loads

The Superimposed Dead Loads (**SDL**) and Live Loads (**LL**) are established based on the Architectural floor plans and in accordance with the Principal's Project Requirements.

Uniformly distributed SDL and Live Loads are represented on the Robert Bird Group loading plans (drawing series ALB-RBG-DWG-ST-09-). SDLs represent the combination of floor finishes/build-up, partitioning, ceiling(s), and ceiling services.

Live load reduction in accordance with AS1170.1 will be incorporated into the design of columns and walls. The classification of Live Load Reducible or Unreducible is based on code recommendations and common practice.

Pattern live loading will be considered for all elements where required by AS1170.1.

4.1.3 Façade

Table 7 summarises façade and cladding loading in accordance with AS3600 2018.

Table 7: Façade and Cladding Load Summary

Façade Option	Load [kPa]
Curtain Walls and External Walls – lateral loading	As specified in the façade wind pressure study by the wind engineer for the project
Typical Curtain Wall Façade[1]	1.20
Single storey glazing systems	0.75

Notes:

1. *Refer to EOC-ENG-RPT-FA-0001[03] Section 5.2.2.*

4.1.4 Other Dead and Live Loads

Other permanent loads that will be considered and included on the loading plans:

- Transfers.
- Operable walls.
- Non-typical façade elements (e.g. canopies, multi-storey).
- Building maintenance (davits, BMU if relevant) – to be provided by Access Consultant.
- Lift pits (where suspended) – to be provided by Vertical Transportation Engineer or Lift Subcontractor.
- Lift motor and motor room rigging – to be provided by Vertical Transportation Engineer or Lift Subcontractor.

4.1.5 Building Maintenance Unit (BMU) Load

The building is proposed to be serviced by a single BMU. The BMU is proposed to be located above the high-rise lift core structure. BMU loads will be in accordance with *240421 Provisional BMU Loads AS1418.13* provided by EOC until confirmed otherwise.

4.1.6 Temporary Loads

Where temporary loads are required to be resisted by the permanent structure, they are provided in sufficient advance, and designing for these loads is within Robert Bird Group's Scope, they will be incorporated into the structural design. An effort will be made to show these loads on the Robert Bird Group loading plans.

4.1.7 Flood

The flood condition is to be based on the full hydrostatic load during the permanent condition, once construction is complete, with the water level at the adopted Project design flood level of RL5.5m (RL5.2 AEP100 + 300mm freeboard).

4.2 Lateral Loads

4.2.1 Wind

The design wind loading for the structure will be based on the wind speeds derived from the wind climate study and wind tunnel study by the wind engineering consultant. Refer to documents RWDII-RPT-WE-0003 1 and RWDII-RPT-WE-0010 2 respectively. The project design wind speed is proposed at 55.7 m/s, which is based on the climate study speed with an additional 'resilience factor' of 5% per client direction. Where any exclusions in the reports occur, the following Code wind parameters are to be adopted:

Table 8: Wind Loading Parameters

Parameter	101 Albert St
Importance Level (refer Section 3.1)	3
Design Life (refer Section 3.2)	50 Years
ULS AEP	1:1000
SLS AEP	1:25
Wind Region	B1
$V_{R,ULS}$	60
V_{50}	44
V_{25}	39
Wind Direction Multiplier (M_d)	Varies
Terrain Category	4
Terrain/Height Multiplier	Varies
Shielding Multiplier (M_s)	1.00
Topographic Multiplier (M_t)	1.00

Parameter	101 Albert St
Internal Pressure Coefficient[2]	+0.2, -0.3

Notes:
1. *AEP denotes the Annual Probability of Exceedance*
2. *Internal wind pressures assume all building openings (e.g. doors, windows) are closed in a SLS wind event or above.*

Wind pressures for the design of façade elements or external walls, and their immediate supporting elements, will be in accordance with the façade wind pressure study by the Project Wind Engineer (refer to Reference Documents).

4.2.2 Seismic

Seismic loads will be calculated in accordance with AS1170.4 for the design of the primary structure comprising the superstructure lateral load-resisting frame, below-ground works, and foundations. Robert Bird Group assumes a design specification will be provided by others for the design of non-structural components and their connections, such as services.

For the primary structure, parameters for use in determining seismic loads are as below. These have been extracted from the General Notes on the Robert Bird Group Structural Engineering Drawings. If discrepancies occur the General Notes take precedence.

Table 9: Seismic Loading Parameters

Parameter	101 Albert St
Importance Level (refer Section 3.1)	3
Design Life (refer Section 3.2)	50 Years
ULS AEP	1:1000
SLS AEP	1:25
k_p	1.30
Site Sub-Soil Class	C_e
Z	0.08
k_pZ	0.104
μ	1.00
S_p	0.77
EDC (Minimum)	EDCIII

4.2.3 Earth

4.2.3.1 Shoring Walls

Shoring walls will be designed by detailed analysis by the Geotechnical Engineer. Modelling is to include the following characteristics:

- Site and wall specific strata profile.

- Site and wall specific water table.
- Flood condition.
- Construction staging.

4.2.3.2 Out of Balance

Variation in the retained ground level across the site results in out-of-balance earth pressures which must be resisted by the structure. Pragmatically, only differential permanent earth loads will be considered in the design, and variation in surcharge loading around the site perimeter will not be considered.

Simplified parameters for use in determining out-of-balance earth loads are as below.

Table 10: Out of Balance Design Parameters

Parameter	Value
K_0	0.50
γ	20 kN/m^3
Hydrostatic Height	max(H/2,h_w)[1]

Notes:
1. *Greater of H/2 or groundwater table height as advised by a Geotechnical engineer.*

4.2.4 Robustness

Design for Robustness will be carried out to satisfy the requirements of AS 1170.0 Section 6 and verified for Performance Requirements of Section B Subsections BP1.1(a) and BV2 of NCC 2022. Alternative load paths will be investigated for the diaphragm floor systems at level 6 and level 14.

4.3 Other Loads

4.3.1 Substation Blast Loading

Substation blast loading is to be confirmed. Typically, substation bounding structures (walls, slabs) are designed for a minimum 2.0 kPa blast loading.

4.3.2 Adjacent Structures and Boundary Surcharges

Loads at the base of adjacent buildings, from adjacent structures, and general boundary surcharges are represented on the Site and Shoring Plan in the Robert Bird Group Structural Drawings.

4.3.3 Balustrades

Balustrades where required will be designed by the D&C Contractor for imposed live and wind loads as appropriate. Balustrade imposed live loading to be in accordance with AS/NZS 1170.1 as follows:

Table 11: Balustrade Live Loading

Use	Occupancy Type to AS1170.1	Top Edge & Handrail Design Loads					Infill
		Top Edge Horizontal [kN/m]	Handrail Horizontal [kN/m][3, 4]	Vertical [kN/m]	In, Out, Down [kN]	Horizontal [kPa]	Any Direction [kN][1]
Protecting lethal fall AND adjacent area is accessible by large volume of people	Modified C5	1.50	+3.0, -1.50 (±1.50)	0.75	0.60	1.50	1.50
Protecting lethal fall AND adjacent area is intended for public access	C1	1.50	±1.50	0.75	0.60	1.50	1.50
In maintenance space not easily accessible by public	C3	0.75	±0.75	0.75	0.60	1.0	0.5
Adjacent tables and/or seating and protecting a fall	C1	1.50	±1.50	0.75	0.60	1.50	1.50

Notes:

2. *Applied over a panel of 2000 mm2 or over two adjacent vertical balustrades, as appropriate. For example, where a balustrade is comprised of vertical fins/spindles at 125 mm spacing or less, this load can be shared between two adjacent fins/spindles.*
3. *Balustrade designed for serviceability using loads in brackets (##).*
4. *Positive loading acts outwards, and negative loads act inwards.*
5. *Handrail horizontal loads to apply at handrail level or 900 mm above the finished floor level where there is no handrail. Where there is no handrail the handrail horizontal load is to be applied directly to the infill. Where the infill is comprised of individual elements (e.g. fins, spindles) then the handrail load can be evenly distributed between them.*

Wind loads for external balustrades are to be determined in accordance with AS/NZS 1170.2 Appendix D2. A minimum net pressure coefficient of 1.80 shall be considered for external balustrades. Pressure coefficients for wind loading of internal balustrades are to be determined from a rational assessment based on the location of the balustrade, its vicinity to building openings, and the likely internal air pressures. A minimum net pressure coefficient of 0.3 is to be considered for internal balustrades.

Interlinking handrails are to be provided for all glazed balustrades. Glass panels and interlinking handrails are to be designed for a panel breakage to working stress design.

4.3.4 Vehicle Barrier Loads

Where required, vehicle barrier loads will be in accordance with AS/NZS 1170.1 as follows:

Table 12: Barrier Loading Parameters

Vehicle Barrier Description	Barrier Load
Light traffic areas, vehicles <2.5t GVM	30kN

4.4 Load Combinations

4.4.1 Ultimate Strength and Stability

Design load combinations for the primary structure will be in accordance with AS1170.0 Section 4, and AS 4678 Appendix J. Generally, the following base combinations will be considered:

1. $1.35G$
2. $0.9G$
3. $1.2G+1.5Q$
4. $1.2G+W_U+\Psi_C Q$, $0.9G+W_U+\Psi_C Q$
5. $1.2G+S_U+\Psi_C Q$
6. $G+E_U+\Psi_E Q$

The out-of-balance soil loads are considered permanent loads and are to be accounted for in all load combinations where applicable.

4.4.2 Serviceability

Load combinations for serviceability will be derived from AS1170. Generally, the following base load combinations will be considered:

1. $G+\Psi_S Q$
2. $G+\Psi_L Q$
3. $G+W_S+\Psi_C Q$
4. $G+E_S+\Psi_C Q$
5. $G+S_S+\Psi_C Q$

5. Design Performance Criteria

5.1 Deflection

The deflection criteria defined by Robert Bird Group are based on a combination of code guidance, common practice, and experience. Refer to Section 4 of ALB-RBG-REP-ST-00-000-03 Robert Bird Group Movement and Tolerance Report for performance criteria.

5.1.1 Creep and Shrinkage

Action effects of creep and shrinkage will be included in the analysis and design of the superstructure and components.

5.1.2 Shoring, Retention and Foundations

Refer to Movement and Tolerance report, RBG document ALB-RBG-REP-ST-00-000-03, Section 4.1 for Shoring and Retention Wall criteria.

5.1.3 Lateral

Refer to Movement and Tolerance report, RBG document ALB-RBG-REP-ST-00-000-03, Section 4.3 for Building Lateral Criteria.

5.1.4 Floor

Refer to Movement and Tolerance report, RBG document ALB-RBG-REP-ST-00-000-03, Section 4.4 for Floor Deflection Criteria.

5.1.5 Steel Roof and Wall Elements

Refer to Movement and Tolerance report, RBG document ALB-RBG-REP-ST-00-000-03, Section 4.6 for Wall Element Deflection Criteria.

5.1.6 Crown Steelwork

Refer to Movement and Tolerance report, RBG document ALB-RBG-REP-ST-00-000-03, Section 4.7 for Crown Steelwork Deflection Criteria.

5.1.7 Balustrades

Refer to Movement and Tolerance report, RBG document ALB-RBG-REP-ST-00-000-03, Section 4.8 for Balustrade Deflection Criteria.

5.1.8 Axial Shortening

Refer to Movement and Tolerance report, RBG document ALB-RBG-REP-ST-00-000-03, Section 4.9 for Axial Shortening Design Criteria.

5.2 Vibration

5.2.1 Footfall Vibration

The footfall vibration criteria, in accordance with AS ISO 2631.2, targeting a 'low probability of adverse comment' are as follows. These are based on experience and a rational assessment of how vibrations would be perceived in the context of each area's use.

Table 13: Footfall Vibration Design Citeria

Area Description	Maximum Response Factor
Corridors and Open Spaces	RF10
Offices	RF8

In addition to the above, the typical commercial floor plate will be designed to achieve a multiplying factor for exposure to continuous vibration (Response Factor) of RF 6 for 90% of the Lettable floor area in accordance with the recommendations of SCI P354.

5.2.2 Construction Vibration

Limiting vibrations from construction is generally beyond the scope of the Structural Engineer as it is related to construction methods and procedures. Where a specialist Vibration Consultant has been appointed a Structural Engineer can coordinate and interpret feedback as part of the wider project team, but implementing mitigation is generally the responsibility of the contractor.

Construction vibration monitoring notes will be included in the General Notes of the Structural Engineering Drawings as guidance prior to a Contractor being appointed. These recommendations are based on past project experience. The below guidance is extracted from the General Notes on the Robert Bird Group Structural Engineering Drawings. If discrepancies occur the General Notes take precedence.

Construction vibration monitoring should be undertaken wherever there are:

- Existing structures in close proximity to planned construction activities where vibration may result in damage to finishes or affect building performance.
- Other sensitive elements in close proximity to planned construction activities, such as critical services, historical landmarks/buildings and high-quality finished pavements.
- Neighbouring areas, shops or buildings that will remain operational during construction and where adverse comments from occupants are to be avoided.
- Stakeholders from affected, neighbouring properties and communities should be engaged with to discuss and agree on appropriate limits to be adopted during construction.
- Where monitoring is deemed to be required a detailed monitoring plan shall prepared by a specialist consultant prior to operational works approval. The following minimum requirements are suggested to limit damage to structures and critical infrastructure only:
    - Monitoring should commence one month prior to undertaking any site works to establish a baseline.
    - Triaxial geophone assemblies with three-channel recording, live monitoring and an alert system should be adopted. Alert criteria should be set as follows:
        - <5mm/s – no action required.
        - >5mm/s but less than 10mm/s – log alert and notify the Principal and construction personnel. Assess activities and reduce if possible, or continue to monitor closely to ensure vibrations remain below the upper limit.
        - >10mm/s – cease works, notify Principal and construction personnel. Undertake an assessment of the construction activities generating the vibration and devise mitigation measures to reduce vibrations to below the limit.
- Monitoring devices should be mechanically fixed in place and be actively monitored at least throughout the completion of the following high-risk activities:

- Demolition.
- Site clearing and levelling.
- Piling to building and retention system.
- Bulk excavation and detailed foundation excavation.

5.3 Cross River Rail (Extracted Design Criteria)

This section excerpts some of the key Performance Requirements related to Cross River Rail.

Design loads and excavation criteria for the Albert Street Station Cavern are set out in the PSM Design Manual – Driven Tunnels – Document CRRTSD-000-0300-MAN-PSMQ-1320-100044

Section 11.6 of the above document is extracted below.

11.6 Over Station Development (OSD) and Future Over Station Development (FOSD)

11.6.1 Project-wide Requirements

Section 5.2.3.9 of the PSTR Annexure B outlines the future development loads which must be accounted for in the permanent support design:

- *The design shall allow for the future development of the land above and adjacent to the Tunnel and Underground Structures by designing and constructing for loading and unloading in addition to the applicable design loads* (TUS-64)
- *Tunnel and Underground Structures shall be designed for additional loading and unloading from future developments which have been approved by BCC or the State, current at the date of execution of the Project Agreement* (TUS-65)
- *Tunnel and Underground Structures at or adjacent to Underground Stations shall be designed for the Over Station Development (OSD) and Future Over Station Development (FOSD) loading and unloading as specified in Section 5.6* (TUS-66)
- *Tunnel and Underground Structures (excluding cut and cover structures) which pass beneath or adjacent to developable land shall, as a minimum, be designed for the additional loading and unloading cases as detailed in Appendix B2 Table B2 A for case 1 and Table B2 B for case 2* (TUS-67). Refer to Table 19 and to Figures 12 to 15.

For primary support design, the timing of when the FOSD to be constructed will be taken into account.

Table 19 Future development allowance

Case	Additional Loading	Excavation / Distortion
1	Vertical load of 50kPa acting on the ground 1 m from the Tunnel crown (assumed to apply on lining directly)	Continuous Excavation i) Up to 7m below natural surface to allow for future development ii) with a minimum of 'X'm residual ground cover above the Tunnel crown iii) with a minimum 'X'm pillar width between the side wall of the Tunnel and any adjacent building basement excavation. 'X'=7m for running tunnels and 10m for station caverns
	20kPa applied at ground surface	
2	Live load surcharge of 75kPa applied at ground surface	Distortion Permanent support to accommodate additional distortion of 15mm/span. This is analysed by reducing the horizontal / vertical ground load to produce the additional distortion
	20kPa applied at ground surface	

Note: Loading and excavation / distortion to be applied separately and together, including asymmetrical arrangements, and in any order to give the most unfavourable loading condition.

Figure 17: Extract PSM Tunnel Design Manual – Section 11.6

The Project development at Lot 2 is also designed for specific criteria as set out in section 11.6.2 of the above report, which states the following:

- PSTR OSD-31, OSD-46, OSD-47, and OSD-48 nominate site-specific FOSD requirements for Lot 2 at Albert Street. Paragraph OSD-48 permits excavation down to RL -20m, except within 10m horizontally from the cavern sidewall (Figure 16). Within this area excavation down to RL -8m is to be considered (OSD-46).

The referenced Figure 18 from the PSM Design manual is extracted below:

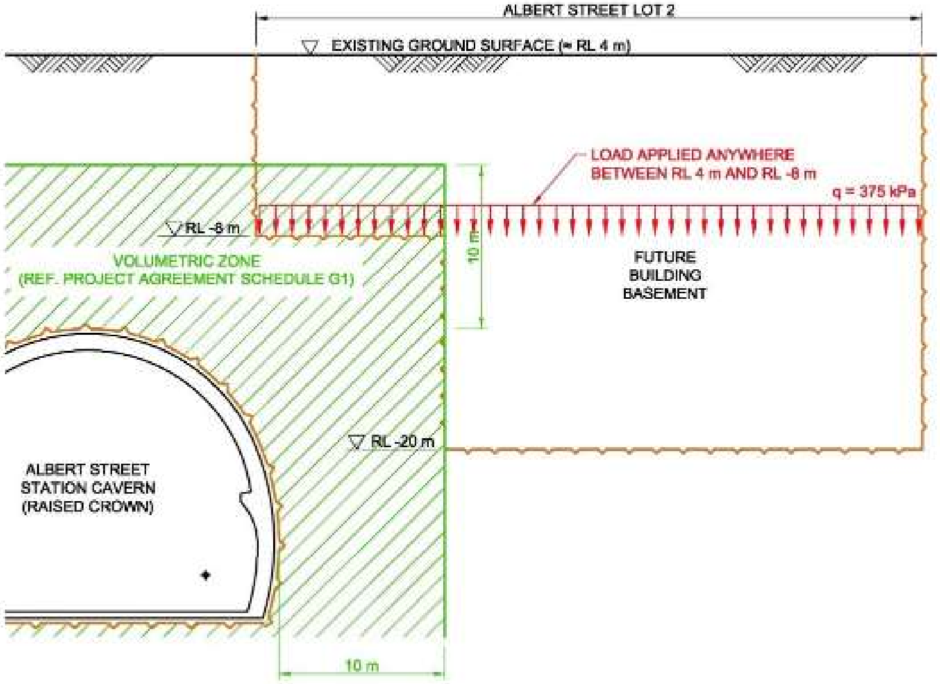


Figure 16 FOSD requirements for Albert Street Lot 2.

Figure 18: Extract of Figure 16 from PSM Tunnel Design Manual

The design of the Albert Street Station is covered in a separate design manual by Robert Bird Group – Document No. CCCTSD-000-0401-MAN-RBGT-1470-191101.

Section 6.2.6 of the above report covers design allowances for over-station development and future over-station developments. It also sets out the specific PSTR Clauses relevant to future OSDs. It is extracted below:

6.2.6 Over Station Development (OSD) and Future Over Station Development (FOSD) Allowances

The loadings described in this section are applied to Underground Structures constructed by open cut bottom up construction technique only, referred to in the PSTR interchangeably as "station boxes", "station shafts" and/or "station cut-and-cover structures". They do not apply to underground caverns, tunnels or adits; the reader should refer to relevant reports for OSD and FOSD loadings on these structures.

Loads applied to the Underground Station Structures due to OSD and FOSD are in accordance with the PSTR requirements interpreted as described in Table 34. Table 35 addressed ODS and FOSD loads only. Refer to other relevant sections of this report for other surface loadings.

Table 34 OSD and FOSD Load Interpretation

PSTR Clause	Requirement	Interpretation & Practical Application
TUS-64	The design shall allow for the future development of the land above and adjacent to the Tunnel and Underground Structures by designing and constructing for loading and unloading in addition to the applicable design loads.	Station Underground Structures designed for OSD and FOSD loads as described in Table 35 and sketches in Appendix B.
TUS-65	Tunnel and Underground Structures shall be designed for additional loading and unloading from future developments which have been approved by BCC or the State, current at the date of execution of the Project Agreement.	Station Underground Structures designed for OSD and FOSD loads as described in Table 35 and sketches in Appendix B.
TUS-66	Tunnel and Underground Structures at or adjacent to Underground Stations shall be designed for the Future Over Station Development (FOSD) loading and unloading as specified in Section 5.6.	Refer to Table 35 which defines how the loads specified in PSTR Annexure B Section 5.6 have been applied to the Primary Underground Structures.
TUS-68	Cut and cover Tunnel and Underground Structures which pass beneath or adjacent to developable land shall, as a minimum, be designed for the additional loading and unloading as detailed in Appendix B2 Table B2-C.	Loading and unloading requirements Station Underground Structures as per PSTR Appendix B2 Table B2-C have been applied to developable land. Extent of developable land as defined in sketches in Appendix B.
TUS-69	For each future development scenario, the Tunnel and Underground Structure design shall allow for the additional loading and unloading to be applied separately and together in any order, including asymmetrical arrangements, to give the most unfavourable condition.	The loads described in this Table 35 are applied in accordance with the clause.
OSD-1	Provision for FOSD shall be made at Roma Street Station, Woolloongabba Station and Boggo Road Station.	Station Underground Structures designed for FOSD loads as described in Table 35 and sketches in Appendix B.
OSD-2	Provision for FOSD shall be made at Albert Street Station.	Albert Street Station Underground Structure designed for FOSD loads as described in Table 35 and sketches in Appendix B2.
OSD-8	The Underground Station design shall provide a structural arrangement that facilitates the construction of the functional FOSD to the maximum permissible building envelope of the relevant planning provisions.	Station Underground Structures designed for FOSD loads as described in Table 35 and sketches in Appendix B. FOSD loads in excess of those allowed for will need to be supported by piled foundations which do not transmit load (vertical or lateral) onto the Station Underground Structures.
OSD-19	The anticipated vertical loadings, either temporary, construction or permanent loadings, of the FOSD shall be allowed for in the structural design of the Underground Stations	Temporary, construction and permanent loads to comply with the loading allowances nominated in Table 35 and sketches in Appendix B.
OSD-20	The anticipated lateral loadings, either temporary, construction or permanent loadings, of the FOSD shall be allowed for in the structural design of the Underground Stations.	Temporary, construction and permanent loads to comply with the loading allowances nominated in Table 35 and sketches in Appendix B.

Table 35 Station Specific OSD and FOSD Application

Underground Station	PSTR Clause	Requirement	Interpretation & Practical Application
Roma Street	OSD-23	• FOSD to be the most onerous of hotel or commercial uses, both above and beside the station.	FOSD loading allowed for on adjacent developable land as indicated on sketch CRRTSD-250-0400-SKT-RBGT-1410-110001-01 in Appendix B1.
	OSD-26	• Allow for future excavation to minimum of 3 m horizontally from outside edge of permanent station	• Future excavation allowed for to minimum 3m horizontally from outside edge of permanent station wall within

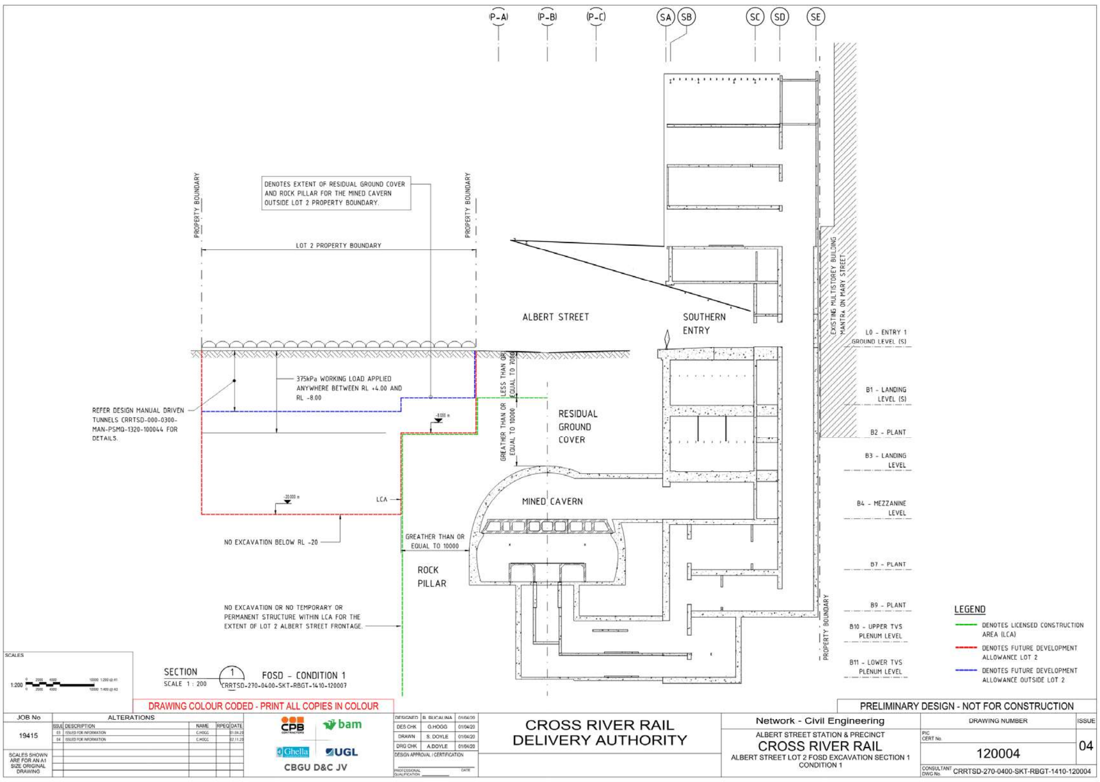
Underground Station	PSTR Clause	Requirement	Interpretation & Practical Application
		wall, to maximum depth of either 10 m from finish surface level or 10 m differential.	developable land footprint. Maximum excavation depth 10m measured from finished design surface level, including unbalanced cases due to 10m deep excavation on one side, with no excavation on the opposite side. Refer to sketch CRRTSD-250-0400-SKT-RBGT-1410-110001-01 in Appendix B1.
	OSD-27	• Allow for additional development loading to and excavation to be applied separately and together, including asymmetrical arrangements, and in any order to give the most unfavourable conditions on the station.	• The loads and excavations described above are applied in accordance with this requirement.
Albert Street	OSD-31	• Allow for FOSD loading of 375kPa working load applied over all or part of Albert Street Lot 2 site, applied between RL +4.0m and -8.0m, to give the most unfavourable loading conditions on the station	• 375kPa applied as indicated on sketch CRRTSD-270-0400-SKT-RBGT-1410-120004-01 in Appendix B2.
	OSD-46	• Allow for excavation of the entire Lot 2 site to RL -8.0m	• Excavation allowed for to RL -8.0 as indicated on sketch CRRTSD-270-0400-SKT-RBGT-1410-120005-01 in Appendix B2.
	OSD-47	• Allow for excavation over the entire Albert Street Lot 2 site (excluding the volumetric zone described in the Project Agreement Schedule G1) to RL-20.0m.	• Excavation allowed for to RL -20.0 as indicated on sketch CRRTSD-270-0400-SKT-RBGT-1410-120006-01 in Appendix B2.
	OSD-48	• Allow for future development loading and unloading cases as detailed in Appendix B2 Table B2-A for case 1 and Table B2-B for case 2.	This clause is assumed to apply to developable land adjacent to Albert Street Underground Station Entry Buildings other than Lot 2. Refer to sketch CRRTSD-270-0400-SKT-RBGT-1410-120007-01 in Appendix B2 for assumed extent of developable load. Loads applied to the Underground Station Entry Buildings from Tables B2-A and B2-B have been applied as follows: Additional Loading • 75kPa live load surcharge applied at ground level (finished design surface level) **AND** • 20kPa surcharge due to surface level buildup Continuous Excavation

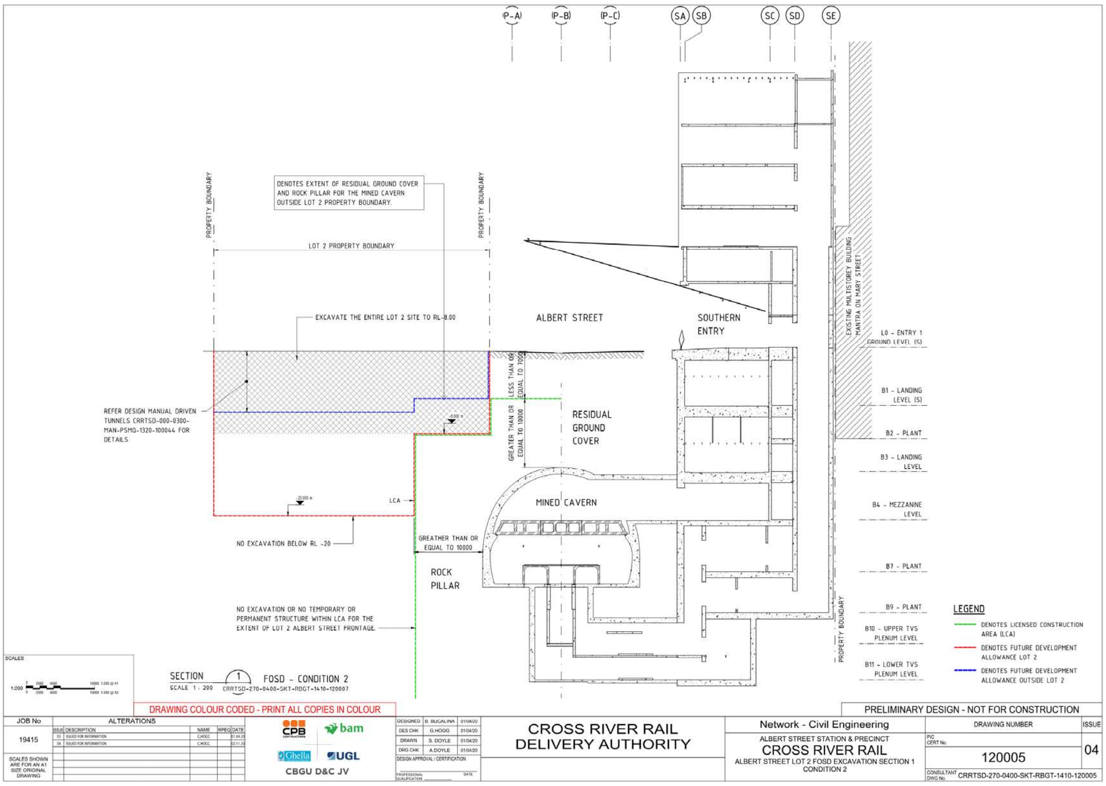
Underground Station	PSTR Clause	Requirement	Interpretation & Practical Application
			• Up to 7m below natural surface (existing street) level for future development • With a minimum 7m residual cover over running tunnels and 10m over station caverns • With a minimum pillar width of 15m between perimeter wall of station boxes and any future adjacent building basement excavation
Woolloongabba	OSD-35	• FOSD to be the most onerous of retail, hotel, and commercial uses beside the station.	• FOSD loading allowed for on adjacent developable land as indicated on sketch CRRTSD-410-0400-SKT-RBGT-1410-130012-01 in Appendix B3.
	OSD-37	• Allow for future excavation to minimum 3m horizontally from outside edge of permanent station wall, to maximum depth of either 10 m from finished surface level or 10 m differential.	• Future excavation allowed for to minimum 3m horizontally from outside edge of permanent station wall within developable land footprint. Maximum excavation depth 10m measured from finished design surface level, including unbalanced cases due to 10m deep excavation on one side, with no excavation on the opposite side. Refer to sketch CRRTSD-410-0400-SKT-RBGT-1410-130012-01 in Appendix B3.
	OSD-38	• Allow for additional development loading and excavation to be applied separately and together, including asymmetrical arrangements, and in any order to give the most unfavourable conditions on the station.	The loads and excavations described above are applied in accordance with this requirement.
Boggo Road	OSD-39	• FOSD to be the most onerous of commercial, science, medical, or education uses, both above and beside the station.	3kPa live load allowance adopted for the 12 storey high FOSD. This includes the following uses in accordance with AS1170.1: • Offices for general use • Operating theatres, X-ray rooms, laboratories • Residential activities including hotel rooms • Institutional assembly areas including classrooms and lecture theatres • Refer to sketch CRRTSD-420-0400-SKT-RBGT-1410-140007-01 in Appendix B4 for further details.

Underground Station	PSTR Clause	Requirement	Interpretation & Practical Application
	OSD-41	• Boggo Road Station and the Tunnel shall provision for loading from a minimum 12 storey high FOSD on the Lot 2 on Plan SP217441.	• 12 storey building allowed for in accordance with sketches in Appendix B4.
	OSD-44	• The roof slab of the Boggo Road Station, over the Boggo Road Lot 2 on Plan SP217441, shall allow FOSD loadings applied at roof slab level. These FOSD loads are to assume the ground is removed above the Underground Station/Tunnel roof slab	• Loads on roof allowed for in accordance with sketches in Appendix B4.
	OSD-45	• Allowance shall be made for FOSD loadings to be placed on the Boggo Road Station box perimeter walls.	• Loads on station box perimeter walls allowed for in accordance with sketches in Appendix B4.

Figure 19: Extract of PSTR Clauses from RBG Station Design Manual

Appendix B of the RBG Station Design Manual contains drawings that illustrate the design considerations for the Project. These drawings are extracted below.





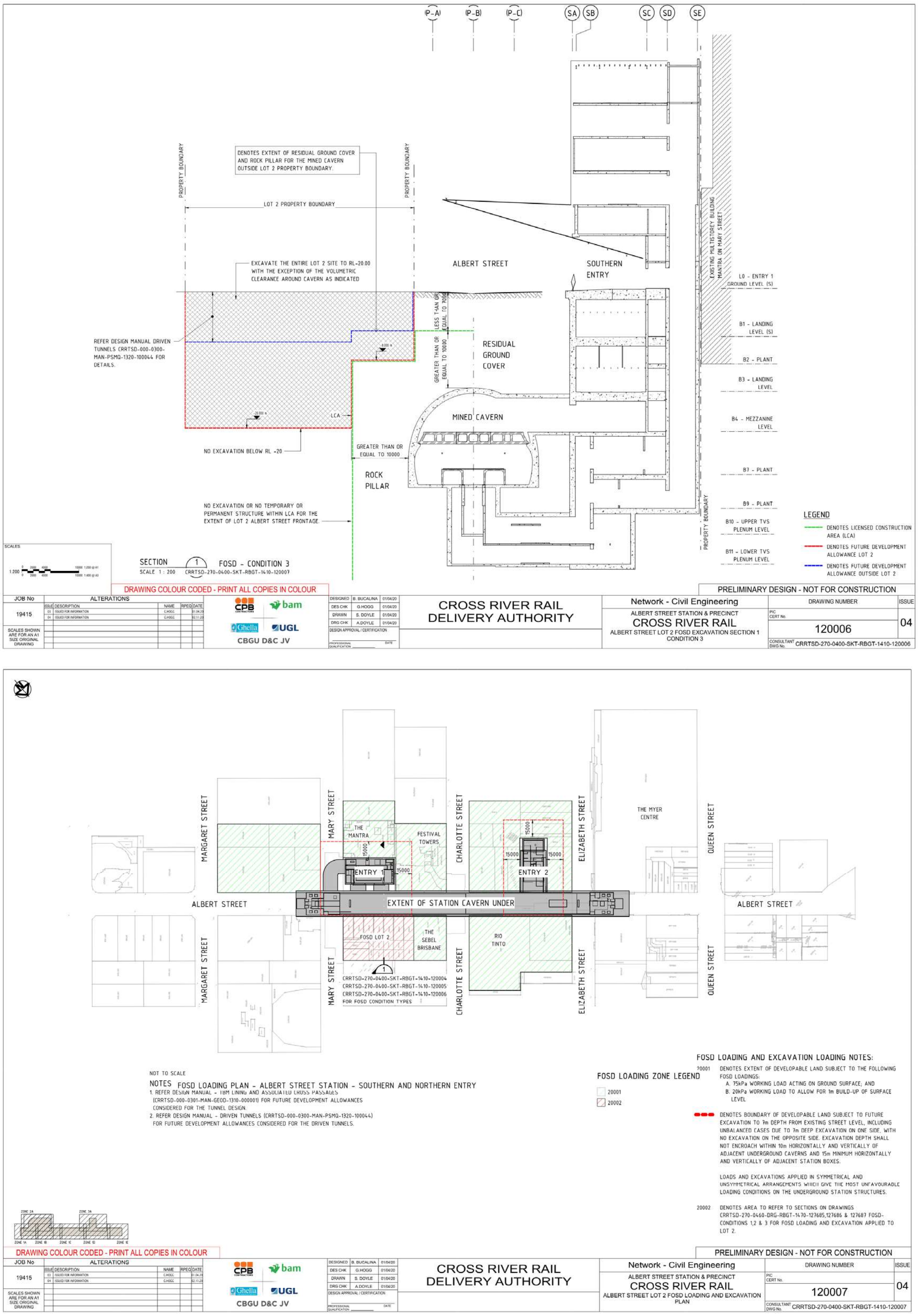
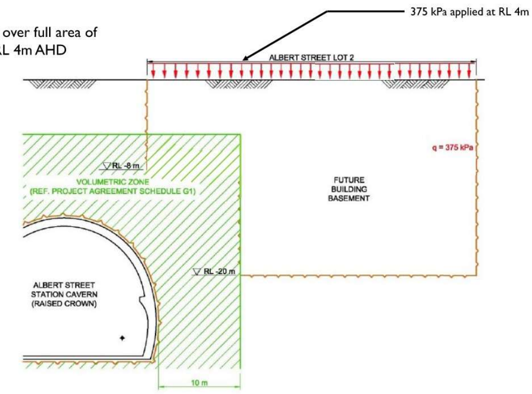


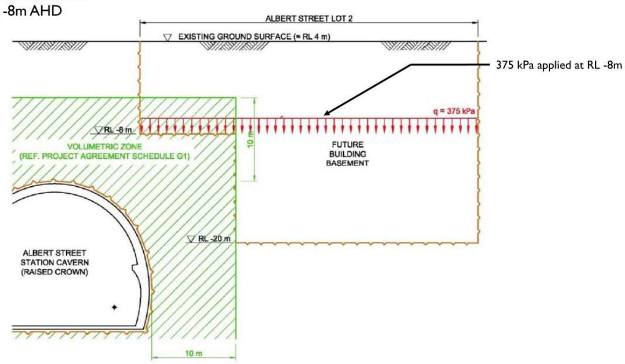
Figure 20: Extracts RBG Station Design Manual

The summary of the above CRR PSTR load and excavation cases, as referenced in the EDG Geotechnical Report – B01493-1BC, are shown below:

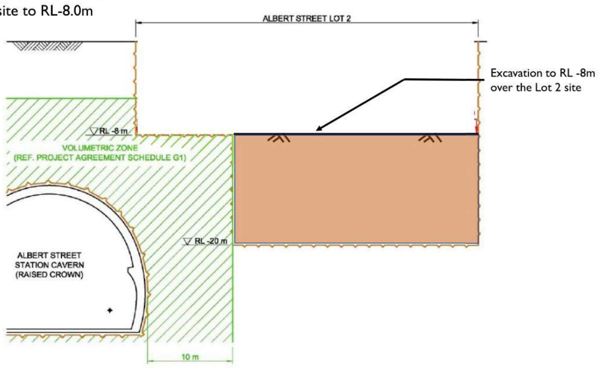
Case 1 – 375kPa over full area of Lot 2, applied at RL 4m AHD **(OSD-31)**



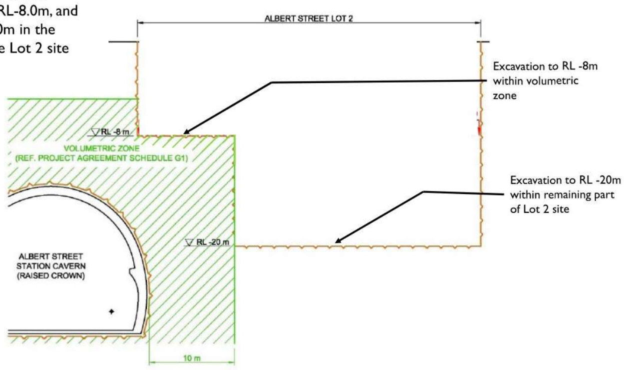
Case 2 – 375kPa over full area of Lot 2, applied at RL -8m AHD **(OSD-31)**



Case 3 – Excavation over the entire Albert Street Lot 2 site to RL-8.0m **(OSD-46)**



Case 4 – Excavation in the volumetric zone to RL-8.0m, and excavation to RL -20m in the remaining part of the Lot 2 site **(OSD-47)**



Case 5:

- 50kPa applied at 1m above cavern crown
- 20kPa applied at ground surface

(OSD-48)

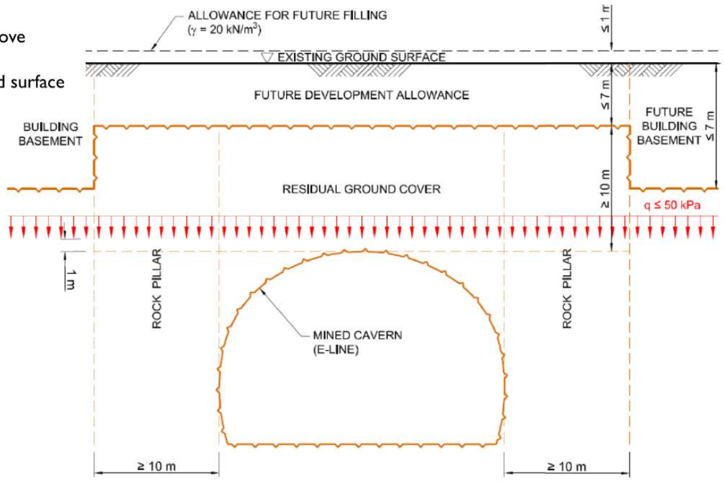


Figure 13 FOSD loading for caverns – Future development allowance Case 1 (Ref. Table B2-A, Annexure B, PSTR)

Case 6:

- 7m excavation over Lot 2 site to RL -3m

(OSD-48)

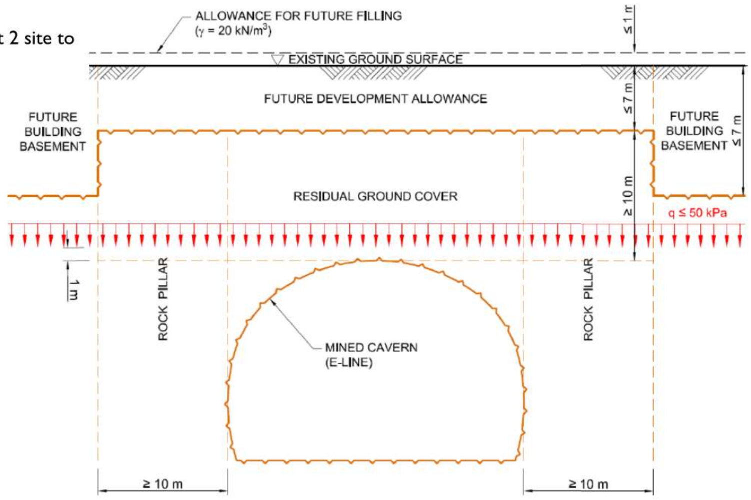


Figure 13 FOSD loading for caverns – Future development allowance Case 1 (Ref. Table B2-A, Annexure B, PSTR)

Case 7:

- 75kPa applied at ground surface
- 20kPa applied at ground surface
- Additional cavern distortion of ±15mm on diameter

(OSD-48)

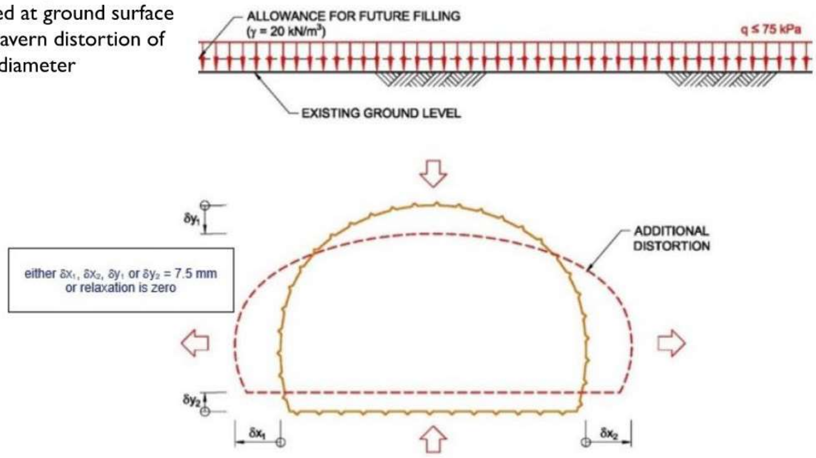


Figure 15 FOSD loading for caverns – Future development allowance Case 2 (Ref. Table B2-B, Annexure B, PSTR)

Figure 21: Extracts EDG Cavern Assessment Report

6. Other Design Aspects

6.1 Dilapidation Study

Given the limited influence zone of the proposed Project on Lot 2 dilapidation study of the following properties and infrastructure is recommended:

- Martin Campus 119 Charlotte Street
- The Sebel Brisbane Corner Albert and Charlotte Streets
- Matisse Tower 110 Mary Street
- Albert Street Station Cavern – Lot 2 site plus extend 50m on each side of Lot 2
- Albert Street Station Box
- Albert Street and both Albert Street footpaths from Charlotte to Mary Street
- Mary Street and both Mary Street footpaths from the station side to the east corner of 110 Mary Street site
- CCTV inspection of accessible sewer and stormwater pipes for extent of site frontages to Mary and Albert Street

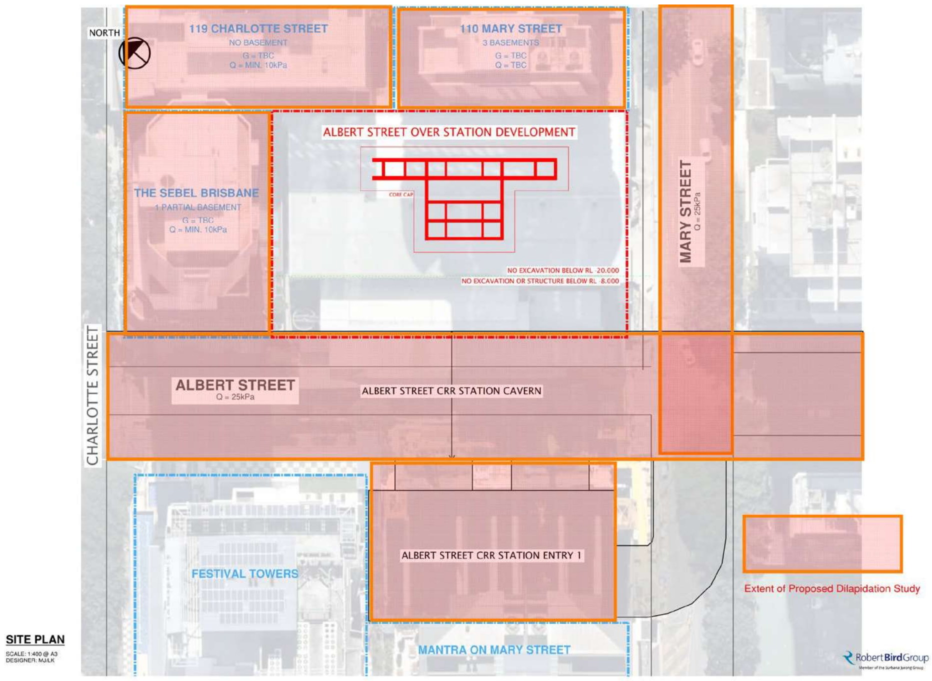


Figure 22: Extent of Sites Recommended for Dilapidation Surveys

Dilapidation surveys are to include inspection of all accessible spaces for each nominated building/infrastructure with a photographic record of all observed defects, including cracking, spalling, settlement, differential movement, separation at building joints, damaged finishes, water leaks or points of mechanical damage. Photos must be dated, time-stamped, and referenced to the relevant building and location.

Inspections of the streets and footpaths are to include a photographic record of all observed defects, including cracking, loose pavement, potholes, kerb or finish damage, damaged service covers, damaged line marking or damaged signage, and any areas of local subsidence, together with photographs showing the general condition of street and footpath pavement. Photos must be dated and time-stamped and referenced to the relevant location.

Dilapidation studies must be provided in electronic PDF Format with separate reports for each building and street and CRRDA Asset. Original Photo files are to be retained for reference by the author for the duration of the project and defects period.

6.2 Monitoring

6.2.1 Shoring and Retention System

Monitoring of the shoring and retention system along all boundaries is recommended due to the proximity of neighbouring buildings and CRR assets. Movement monitoring is to commence prior to demolition and continue until completion of the basement up to and including the completion of the ground floor slab. Monitoring is to include survey pins on the proposed retention capping beam, fixed siting prisms on neighbouring existing buildings, survey pins on Albert Street paving, and inclinometers on the retention system.

The accuracy of movement monitoring is to be +/-0.2 mm. Inclinometers are to measure the wall movement during bulk excavation and basement construction. The inclinometers are to be bi-axial type inclinometers installed such that the axes are perpendicular and parallel to the wall. Measurements are to be taken at 0.5m intervals over the full height of the wall. In the event an inclinometer is damaged, all work in the area is to cease unless, in the opinion of the Geotechnical and Structural Engineer, such work is required to stabilise the excavation. The top of the inclinometers is to be surveyed, and the measurements are reported in a baseline report prior to any excavation work.

The results reported shall include the following:

- A full survey of each survey point, including Northing, Easting, and RL, before any demolition or new works commence.
- Monitoring during the works shall be at the frequencies noted above.
- Full survey to be also carried out at the completion of Ground Floor.
- Intermediate surveys can be in the direction of concern only.

Figure 23 shows an initial monitoring plan proposal, however the final monitoring plan and execution of this plan is the responsibility of the contractor.

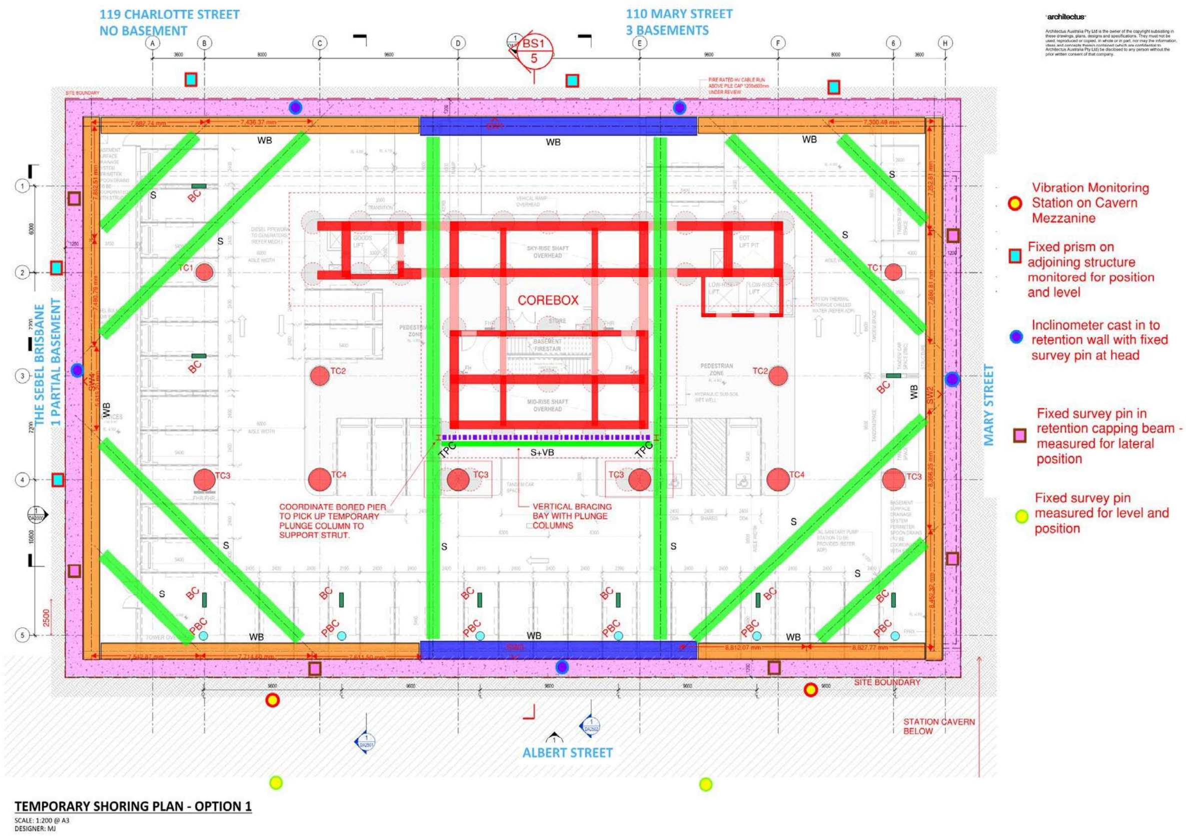


Figure 23: Extent Survey and Monitoring Points

6.2.2 Construction Vibration

Refer to Section 5.2.2.

6.2.3 Crack Monitoring of CRR Assets

In addition to the proposed dilapidation survey, crack monitoring is recommended for the Cavern's internal concrete lining. The extent of cracks to be monitored is to be determined following the dilapidation inspection. Fixed crack monitoring locations are to be agreed upon with CRRDA. Crack monitoring is to be undertaken monthly unless a condition red report for movement is received or if a vibration event greater than the threshold agreed occurs (greater than 10mm/s) at which point crack monitoring shall increase to weekly (if no change in crack widths is detected (within accuracy range) and daily if an increase in crack width is detected. The accuracy of crack monitoring shall be to +/- 0.01 mm.

6.2.4 Monitoring Procedure

Limiting criteria will be provided for each monitored item. All measurements taken during construction are to be assessed in comparison to the limiting criteria. The limiting movement criteria for retention are set out in Section 5.2.2 above. The following criteria will be used to evaluate the results.

Condition Green for values	0 to 75% of limiting criteria
Condition Amber for values	75% to 90% of limiting criteria
Condition Red for values	90% to 100% of limiting criteria

If condition Red is reached, then a review of the consequences of exceeding the limiting criteria is required, and the need for remedial work is considered before work continues. The frequency of monitoring shall increase with each condition.

The frequency of monitoring is to be as follows:

- Weekly under condition Green.
- Every 4 Calendar days condition Amber.
- Daily condition Red.

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