A joint venture between Arcadis Australia Pty Ltd and Mott MacDonald Australia Pty Ltd.
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# OSD Detailed SSD DA - STRUCTURAL STATEMENT

## Victoria Cross Over Station Development

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## Victoria Cross Over Station Development

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| *Technical Checker* | *Station Structural Lead* | *Max Kraus* | *2 July 2019* |
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| *Approved by* | *OSD Design Manager* | *Stephen Canty* | *21 August 2019* |

## Amendment Record

Changes made to this document since its last revision, which affect its scope or sense, are marked in the right margin by a vertical bar ( | ).

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| 21/08/2019 | C | Sydney Metro Comments to Section 1.4 incorporated | Stephen Canty |
| | | | |

# Contents

# Acronyms

| Abbreviation | Description |
|---|---|
| **OSD** | Over Station Development |
| **ISD** | Integrated Station Development |
| **TfNSW** | Transport for New South Wales |
| **CSSI** | Critical State Significant Infrastructure |
| **SEARs** | Secretary's Environmental Assessment Requirements |
| **TSOM** | Train Systems Operations & Maintenance |
| **TSE** | Tunnel & Station Excavation |
| **AEO** | Authorised Engineering Organisation |

# 1. Introduction

## 1.1 Overview

This report has been prepared to accompany a detailed State Significant Development (SSD) development application (DA) for a commercial mixed-use Over Station Development (OSD) above the new Sydney Metro Victoria Cross Station. The detailed SSD DA is consistent with the Concept Approval (SSD 17_8874) 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 (NSW DPE) for assessment.

This report has been prepared in response to the requirements contained within the Secretary's Environmental Assessment Requirements (SEARs) dated 6 May 2019. Specifically, this report has been prepared to respond to the following SEARs:

6. Integration with Sydney Metro Infrastructure

- Demonstrate how the SSD will integrate with the CSSI infrastructure such as structural design…

The detailed SSD DA seeks development consent for:

- Construction of a new commercial office tower with a maximum building height of RL 230 or 168 metres (approximately 42 storeys).
- The commercial tower includes a maximum GFA of approximately 61,500sqm, excluding floor space approved in the CSSI
- Integration with the approved CSSI proposal including though not limited to:
  - Structures, mechanical and electronic systems, and services; and
  - Vertical transfers;
- Use of spaces within the CSSI 'metro box' building envelope for the purposes of:
  - Retail tenancies;
  - Commercial office lobbies and space;
  - 161 car parking spaces within the basement for the purposes of the commercial office and retail use;
  - End of trip facilities; and
  - Loading and services access.
- Utilities and services provision.
- Signage locations (building identification signs).
- Stratum subdivision (staged).

## 1.2 The site

The site is generally described as 155-167 Miller Street, 181 Miller Street, 187-189 Miller Street, and part of 65 Berry Street, North Sydney (the site). The site occupies various addresses/allotments and is legally described as follows:

- 155-167 Miller Street (SP 35644) (which incorporates lots 40 and 41 of Strata Plan 81092 and lots 37, 38 and 39 of Strata Plan 79612)
- 181 Miller Street (Lot 15/DP 69345, Lot 1 & 2/DP 123056, Lot 10/DP 70667)
- 187 Miller Street (Lot A/DP 160018)
- 189 Miller Street (Lot 1/DP 633088)
- Formerly part 65 Berry Street (Lot 1/DP 1230458)

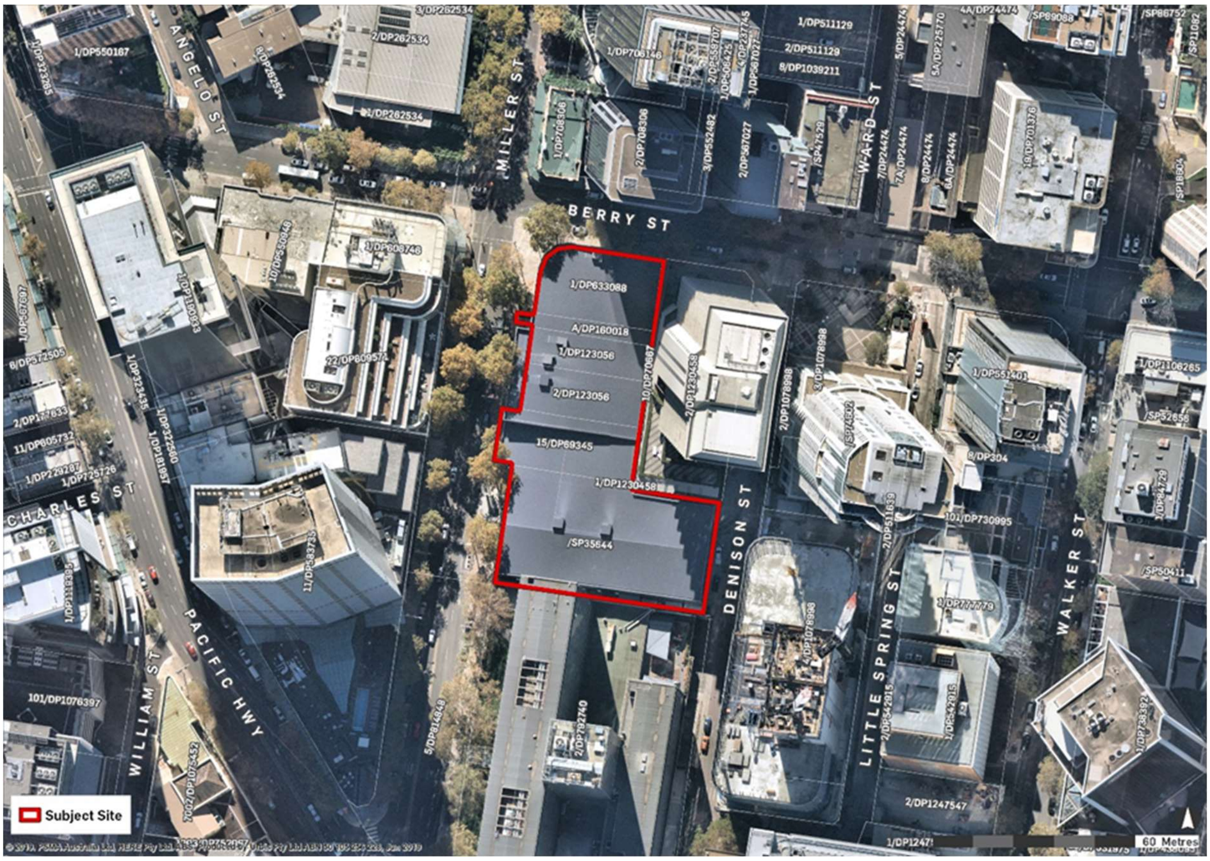



**Figure 01 – Site Aerial**

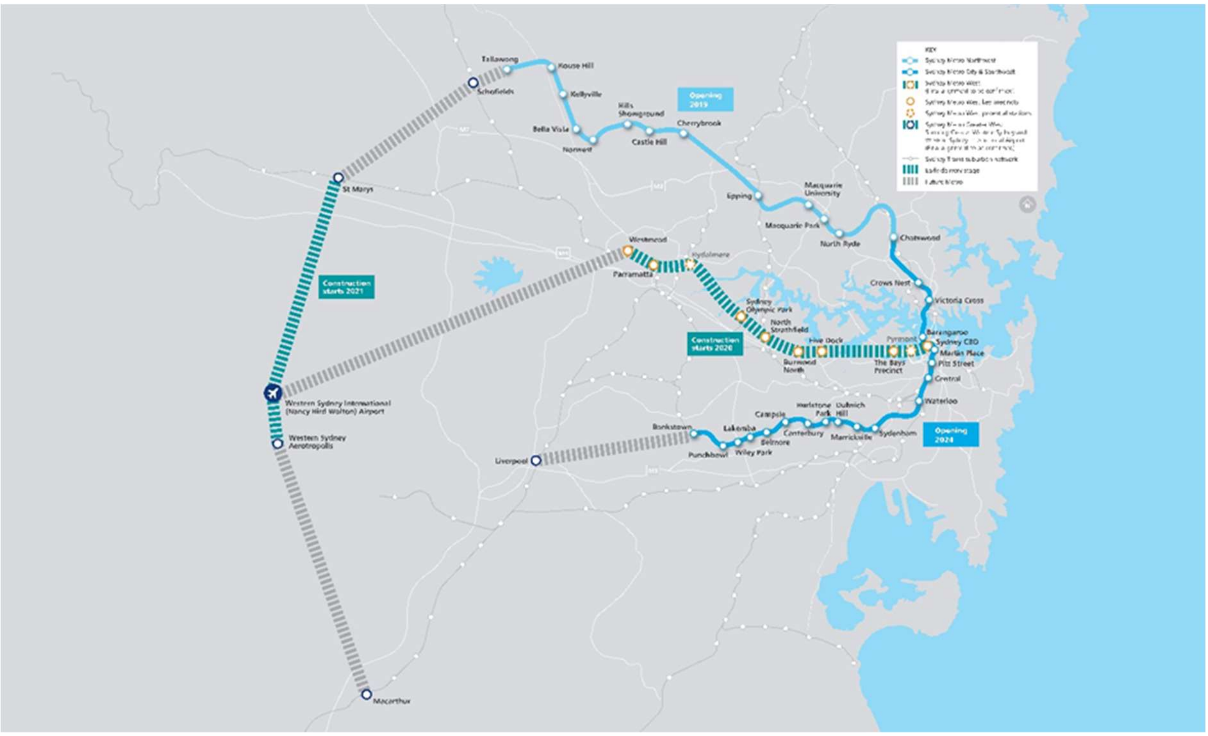
### 1.3 Sydney Metro Description

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. Metro rail will be extended into the CBD and beyond to Bankstown in 2024. There will be new metro railway stations underground at Crows Nest, Victoria Cross, Barangaroo, Martin Place, Pitt Street, Waterloo and new metro platforms under Central.

In 2024, Sydney will have 31 metro railway stations and a 66 km standalone metro railway system – the biggest urban rail project in Australian history. There will be ultimate capacity for a metro train every two minutes in each direction under the Sydney city centre. The Sydney Metro project is illustrated in the Figure below.

On 9 January 2017, the Minister for Planning approved the Sydney Metro City & Southwest - Chatswood to Sydenham project as a Critical State Significant Infrastructure project (reference SSI 15_7400) (CSSI Approval). The terms of the CSSI Approval includes all works required to construct the Sydney Metro Victoria Cross Station, including the demolition of existing buildings and structures on both sites. The CSSI Approval also includes construction of below and above ground improvements with the metro station structure for appropriate integration with the OSD.

With regards to CSSI related works, any changes to the “metro 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 detailed SSD DA for the OSD.




Source: Sydney Metro

**Figure 02 – Sydney Metro Alignment Map**

# 2. Structural Philosophy

The structural philosophy of the project is developed around the requirements of the transport authorities for the station development and the requirements of Lendlease for the retail and commercial office tower components of the buildings. Whilst the development is integrated in terms of architecture and functionality, the [definition] of the station elements as CSSI, as distinct from the OSD elements as SSD, will mean differences in a number of aspects of the design and design criteria.

## 2.1 Excavation

The southern metro entrance shaft will be carried out as an open cut excavation by the Sydney Metro TSE contractor. The upper section of the excavation will be situated in layers of weathered sandstone and residual/fill material which will be retained by temporary retaining walls. The majority of the excavation below this will be in vertically cut, Class I and II Hawkesbury sandstone. Mined pedestrian adit tunnels connect the lower section of the shaft to the main rail platform cavern beneath Miller Street.

Note that excavation work is approved under separate CSSI consent and approval is not sought under this SSDA application; however it is included for context.

## 2.2 OSD Tower Overview

The OSD Tower is a reinforced concrete structure consisting of 35 levels of commercial floors, a mid rise plant level and two levels of plant at the top. It is subdivided into 3 commercial zones namely: low-rise, mid-rise and high-rise zones. It interfaces with the Station Structure at Level 04.

The structural design of the OSD Tower is driven by the architectural and station spatial requirements. For instance, while vertical continuity is a key aspect for structural design, ‘transfer’ elements are introduced in some locations to satisfy the station structures’ requirements. The stations’ requirements of an open space for public use at the podium level (Ground Floor to Level 04) also influenced the selection of the structural floor system in these areas. This meant that internal columns are avoided whenever possible. These design philosophies are reflected in the current structural scheme.

The Victoria Cross Station OSD Tower shaft forms the base of the Tower itself. The two structures are both designed, and are to be constructed, as one integrated structure from foundation to rooftop.

The following figure shows a snapshot of the OSD Tower:

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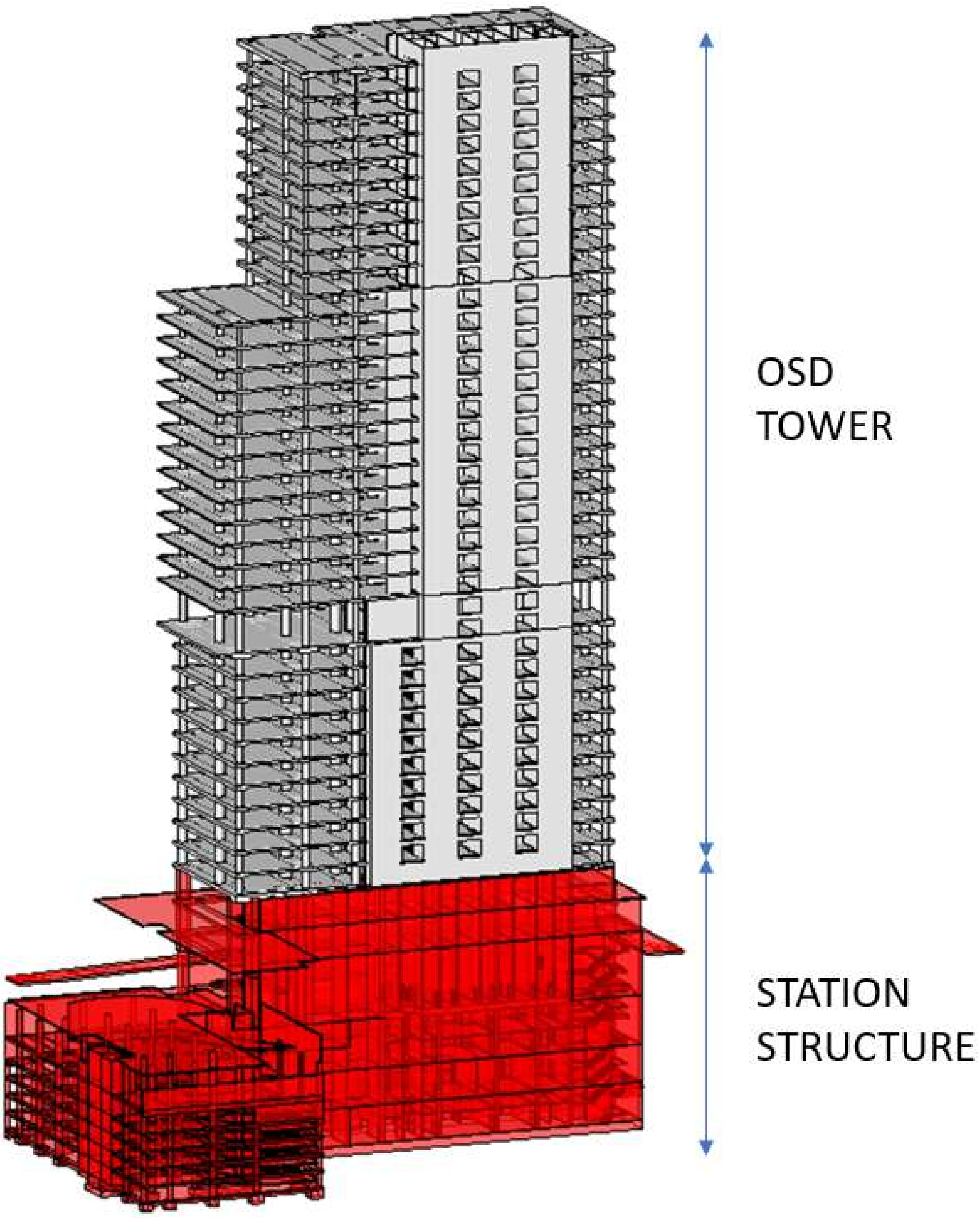


**Figure 03 – OSD Tower Perspective**

## 2.3 OSD Tower lateral system

A coupled core-wall system together with perimeter basement walls form the main lateral stability system of the OSD Tower. These elements are designed to cope with the vertical gravity loads and lateral loads imposed by wind or earthquake forces.

Along with the main core-wall, the OSD Tower also has perimeter and internal columns. These elements are designed to take compression loads from combined actions of gravity and lateral loads.

Given the height of the structure, this structural stability system is ideally suited to provide the required strength and stiffness to transfer the gravity and lateral loads from the superstructure to the foundation.

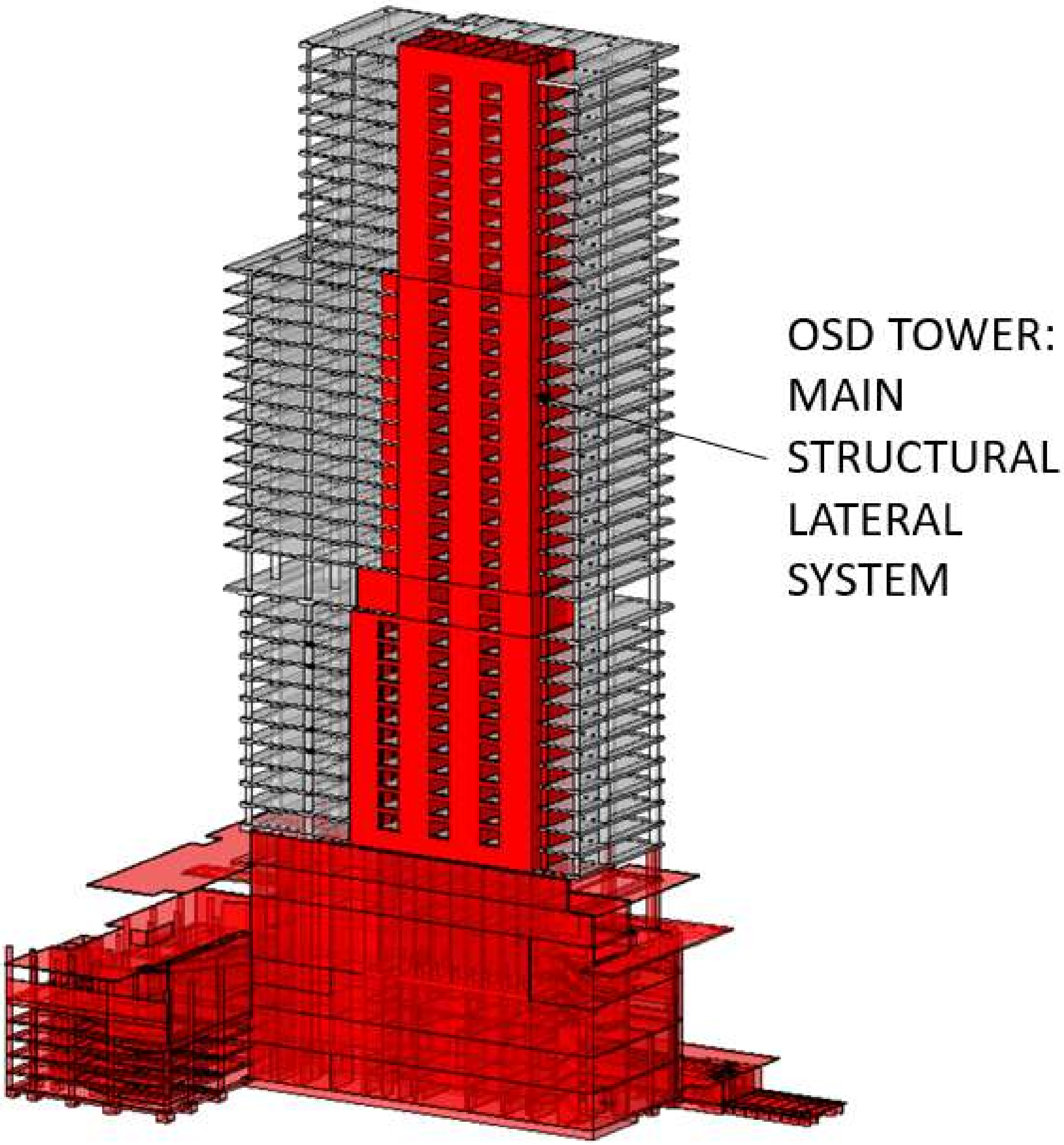


Figure 04 – OSD Tower Main Structural Stability System

## 2.4 Gravity Load Transfer

Gravity loads from the self-weight of the structure, plant and equipment loads, superimposed dead loads and live loads are transferred by floor slabs to the band beams then to the reinforced concrete columns and walls, and down to the foundation pads. Where columns transitions are offset, tie beams are introduced to tie back the horizontal loads into the main core-wall.

## 2.5 Floor Plate Structures

### 2.5.1 General

For the floor plates, a one-way post-tensioned (PT) beam and slab is adopted for the OSD Tower. Wide band-beams are utilized to reduce the slab spans and aid in reducing the slab depths. Notches have been incorporated into the PT band beams in conjunction with the building services design and architectural requirements for floor to floor and floor to ceiling heights.

This system is selected owing to the following advantages:

- Conventional concrete construction.
- Caters to an easier distribution of building services around the floor plate.
- Provides flexibility with regards to future floor modifications.
- Allows easier formwork and local market experience is readily available.

The following figures show the structural floor layout for the typical floors for low-rise, mid-rise and high-rise floors of the OSD Tower.

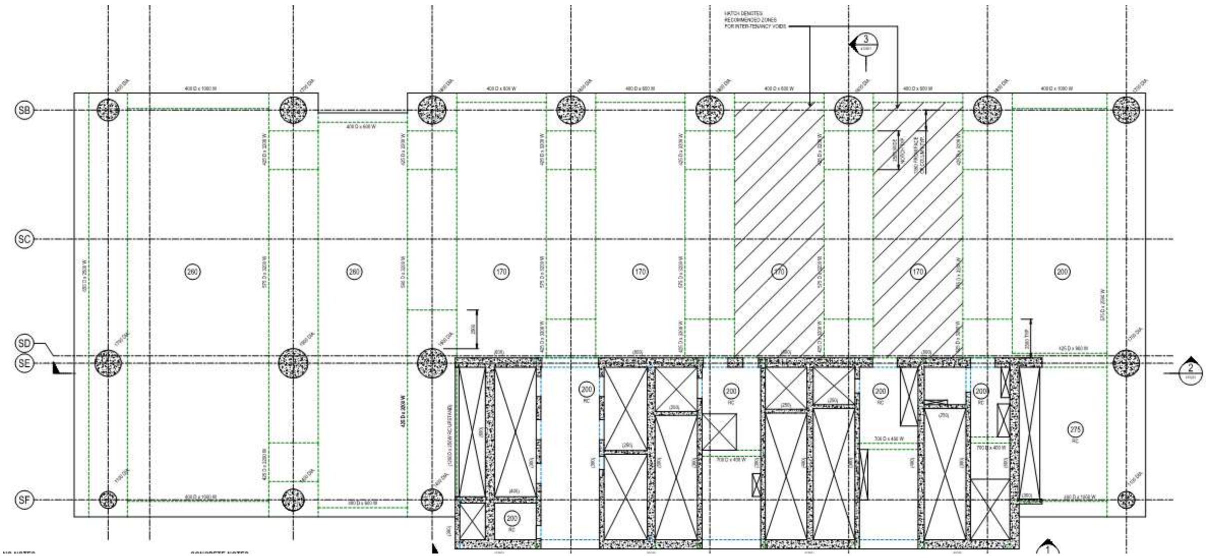

Figure 05 - OSD Tower Typical Low Rise Floors

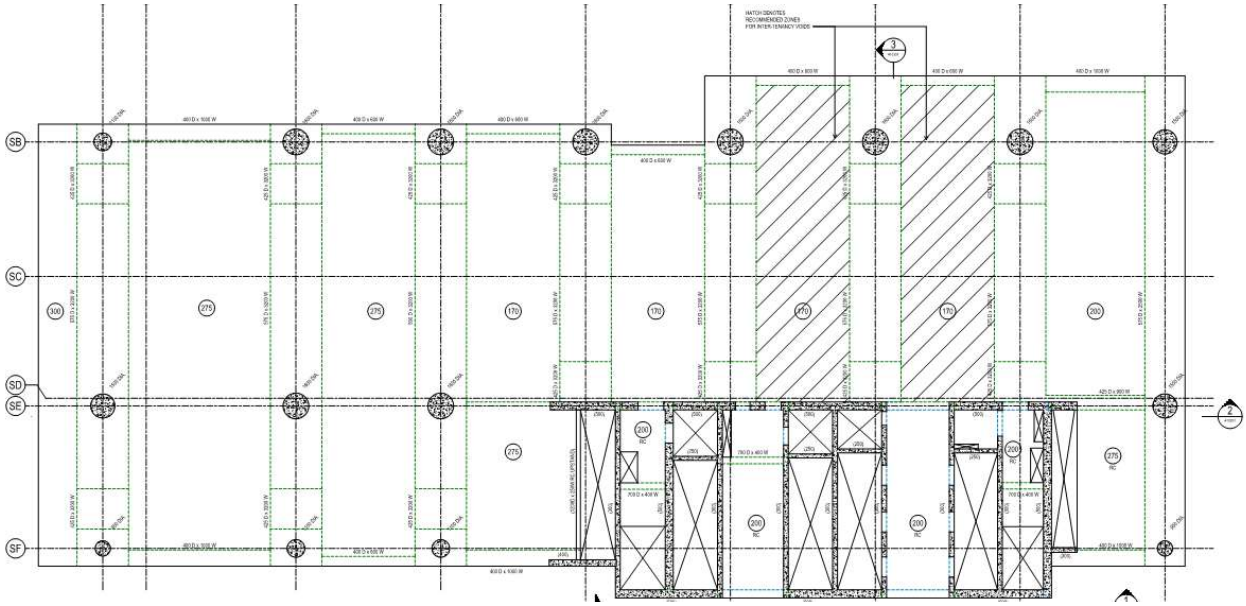


**Figure 6 - OSD Tower Typical Mid-Rise Floors**

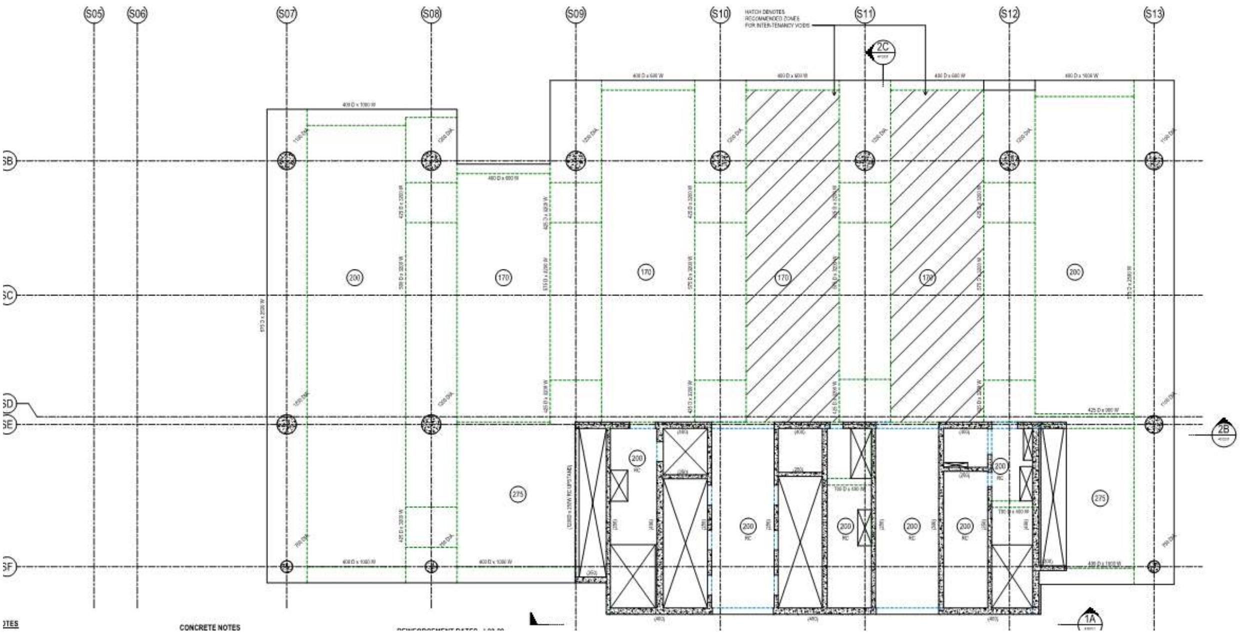


**Figure 7 - OSD Tower Typical High-Rise Floors**

## 2.6 Transfer Systems

The spatial requirements of the Station Structure required some of the OSD Tower columns to be 'transferred' to walls or slabs. These transfer elements include the following:

- a full height transfer wall above the Station adit (between Denison Street to B01 Level) supporting an OSD Tower column
- a thick floor plate transfer slab above the ventilation shafts at Level 4 supporting an OSD Tower column
- a thick floor plate slab at Miller Street Level supporting internal core walls which terminate at this location.

Any impacts associated with OSD Tower building services on the Sydney Metro rail corridor are addressed through the design. The OSD Tower building services are designed to be independent of the station building services, with the interfaces to be managed via building management control systems interfaces and the Building Management Statement, developed concurrently with the design.

## 2.7 Future Basement Connection

The design of the basement loading dock area incorporates soft zones within the structural perimeter walls that do not require remediation works to permanent structural elements to allow for a future breakthrough into the adjacent MLC basement, for the connection of vehicle access via a shared loading dock as required in the SWTC's.

# 3. Design Criteria

The structures will comply with:

- All current relevant Australian Standards;
- Building Code of Australia NCC 2019;
- Sydney Metro/TfNSW standards and requirements where applicable;
- Sydney Metro Victoria Cross Scope of Works and Technical Criteria where applicable;

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# 4. Agency Consultations

## 4.1 Engagement with Sydney Metro

Lendlease continues to engage with Sydney Metro throughout the Victoria Cross ISD design phase including OSD Concept Design and Design Stage 2 of the station. The approved Stage 1 Design provided by Sydney Metro was submitted and approved by the Sydney Metro Configuration Control Board Gate 2 (CCB 2). The purpose of CCB 2 is for the designer to assure Sydney Metro that the proposed development is a safe design solution, which is compatible with existing and future proposed railway infrastructure and has satisfies requirements established by Sydney Metro.

CCB 2 was conducted on 18 October 2017, where the scheme was passed by the CCB. The next CCB gateway, CCB Gate 3, must be passed prior to issuing “for-construction”documentation. This will be conducted prior to commencement of construction.

## 4.2 Engagement with TSOM and Linewide

Engagement with TSOM and Line Wide is ongoing. The Station Stage 1 designers provided technical input to Sydney Metro throughout the CCB2 phase, which was used by Sydney Metro to inform engagement with TSOM and Line wide. TSOM and Linewide are a key stakeholder at CCB3.

## 4.3 Engagement with Tunnels and Stations Excavation Contractor

Excavation, piling, and foundation works will be undertaken by the Sydney Metro Tunnel and Station Excavation (TSE) Contractor and as such will be fully assured and procured by the TSE Contractor as an AEO. ARCMAC has provided technical input to the TSE Contractor via Sydney Metro. As the design develops coordination and collaboration between the Metro Victoria Cross team and the TSE Contractor will continue.

# 5. Conclusion

The design of the OSD Tower integrated with the construction of the future Victoria Cross Station and Sydney Metro City and Southwest rail corridor has been developed in line with the architectural intent of the OSD Tower and Station.

The structural design considered all relevant design and planning criteria as well as well as integration with the other engineering services. In addition, the structural design allows for the provision of a future link to the adjacent MLC building via the basement loading dock.