MATTER CONSULTING
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23-47 Villiers Street, North Melbourne

Structural Design Note – DD070 Melbourne Metro Tunnel

Project No.: 22106M

28 August 2024

Revision No. 1

REVISION	DATE	COMMENT	AUTHOR	CHECKER
1	28 August 2024	Final	GS	ES

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STRUCTURAL DESIGN NOTE – DDO MELBOURNE METRO TUNNEL

1. Background

This Structural Design Note relates to the construction of a proposed eleven-storey (Building A – Villiers St) and twelve-storey (Building B – Harcourt St) building located at 23-47 Villiers Street in North Melbourne. The south-eastern portion of the subject site is currently occupied by the existing Australian Red Cross head office (single storey building with a lower ground level / basement) and the north-western portion is occupied by an existing paved car park.

The new development comprises a residential tower that extends to the ground level along Little George Street, over a seven storey podium that steps down to a four storey podium along Harcourt Street and Villiers Street, a four storey podium along Mary Street and two levels (Basement 01 and Lower Ground 2) of basement car parking.

The subject site fronts Mary Street to the west, Harcourt Street to the north, Little George Street to the east, and Villiers Street to the south. The subject site covers a total combined area of 6,528m2.

The design loading adopted for the project is dictated by the requirements of the Building Code of Australia. Matter Consulting has not been notified of any additional performance requirements above these minimum standards.

The latest plans and survey information show that at the corner where Mary Street meets Villiers Street there is a triangular area of approximately 9m2 where the proposed building sits above the divested land area for the Melbourne Metro Tunnel project. This is shown in the following diagrams.

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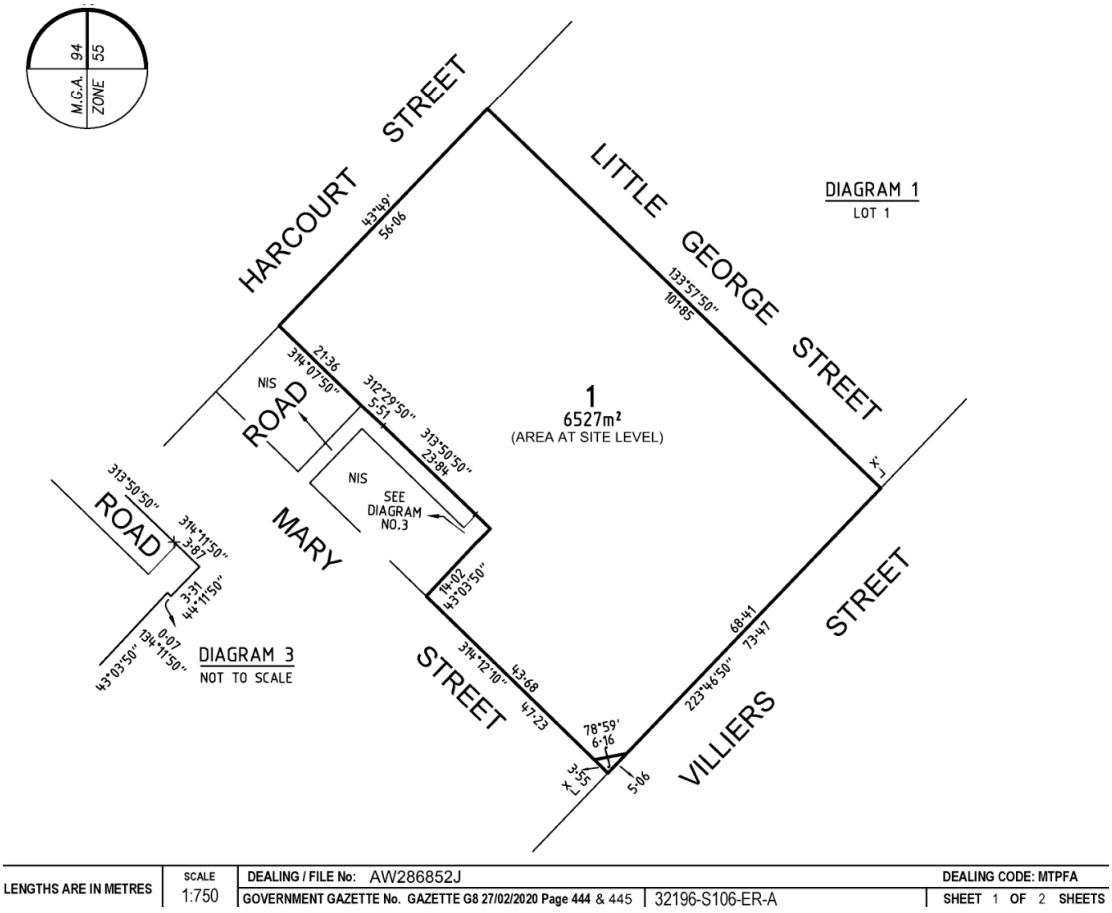
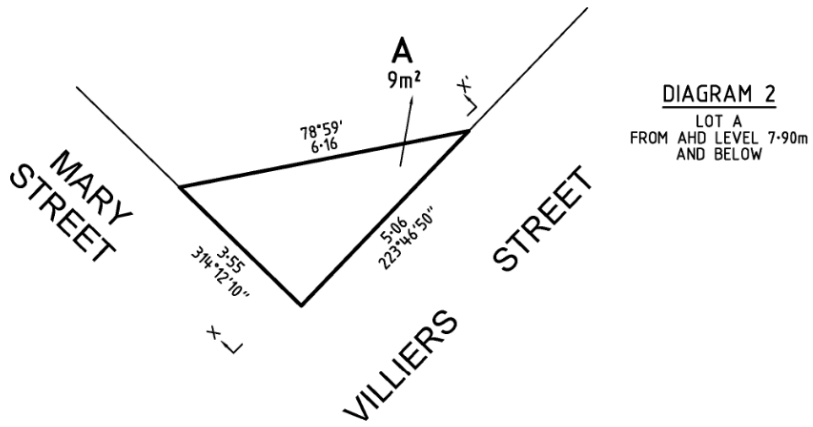


LENGTHS ARE IN METRES	SCALE 1:750	DEALING / FILE No: AW286852J	DEALING CODE: MTPFA
		GOVERNMENT GAZETTE No. GAZETTE G8 27/02/2020 Page 444 & 445 | 32196-S106-ER-A	SHEET 1 OF 2 SHEETS



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2. Construction Materials Description

Foundation System

- Concrete piles for the tower columns
- Concrete pad/strip footings or Concrete Piles for the podium area

Floor System

- Suspended post-tensioned slabs
    - Columns from the apartment levels continue down through the podium-level residential and services rooms
    - Columns from the apartment levels above shall generally align with the car park columns

Roof System

- Suspended post-tensioned slab tanked via a waterproof membrane to Architect's specification
- Hobs under plant screens and plinths supporting plant posts
- Plant equipment to sit on concrete plinths

Wall Systems

- Internal non-loadbearing walls: Timber/steel stud
- External non-loadbearing walls: Window wall system and/or two floor curtain wall system
- Load-bearing walls: ***Precast or in-situ concrete***
- Core walls: ***Precast or in-situ concrete***
- Stairs: Concrete

Columns

- Car park columns: ***In-situ or precast concrete***
- Apartment columns: ***In-situ or precast concrete***

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3. Site Constraints

For seeking planning permission for a development within the design and development overlay for the Melbourne Metro (DDO70), there is a requirement to demonstrate that the proposed development will not adversely affect construction or operation of the Metro Tunnel Project. In order to balance security of the tunnel's infrastructure with the future development of the surrounding areas, the Melbourne Metro Tunnels have been designed to incorporate allowances for existing surrounding developments as well as some potential future developments in its vicinity.

The loading allowances as prescribed by Rail Projects Victoria (RPV) are best summarised in the following section diagram.

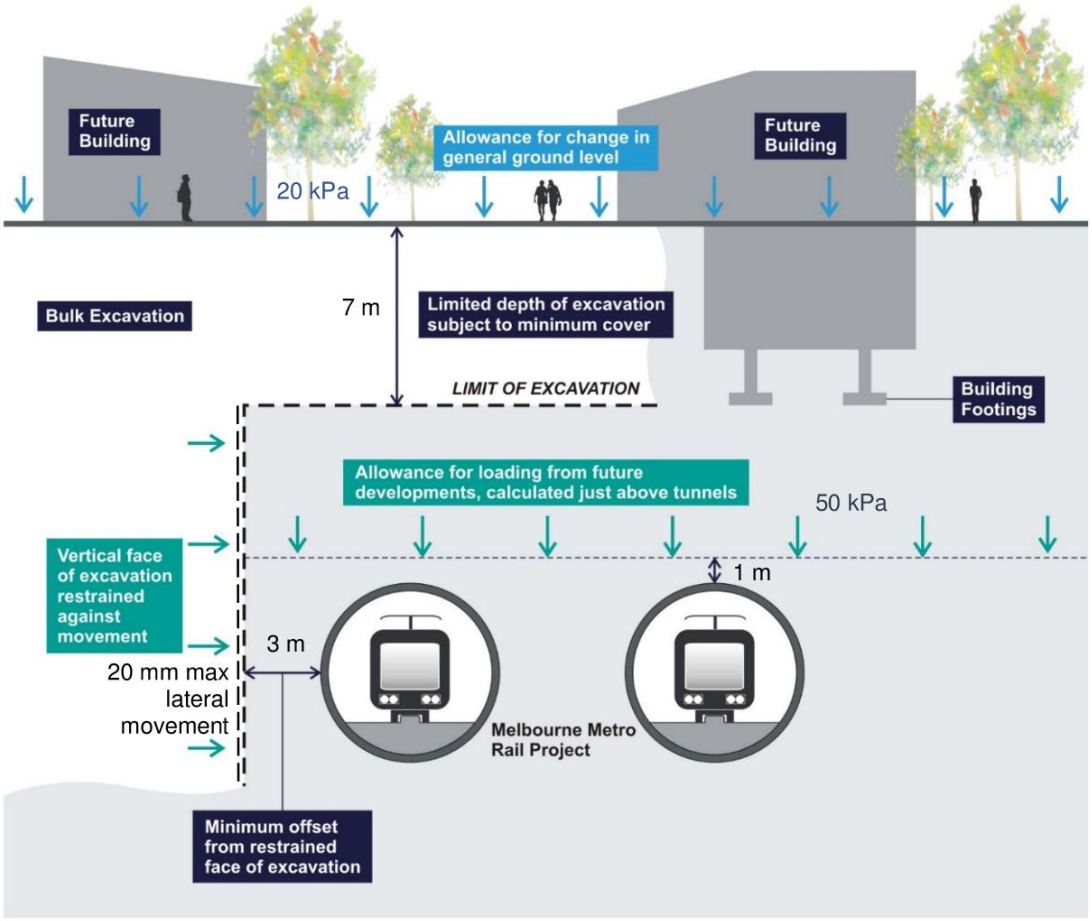

Figure 1 Loads from Future Developments considered in Metro Tunnel Project Design

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Developments that impose greater change than the above constraints could still be possible but this would require detailed technical and risk assessments and potentially physical mitigation measures to be incorporated in the design and construction, subject to approval by RPV.

Provided that the proposed building does not apply unloading or loading above the loading allowances as described above, the Metro Tunnel Design allows for the following clearances.

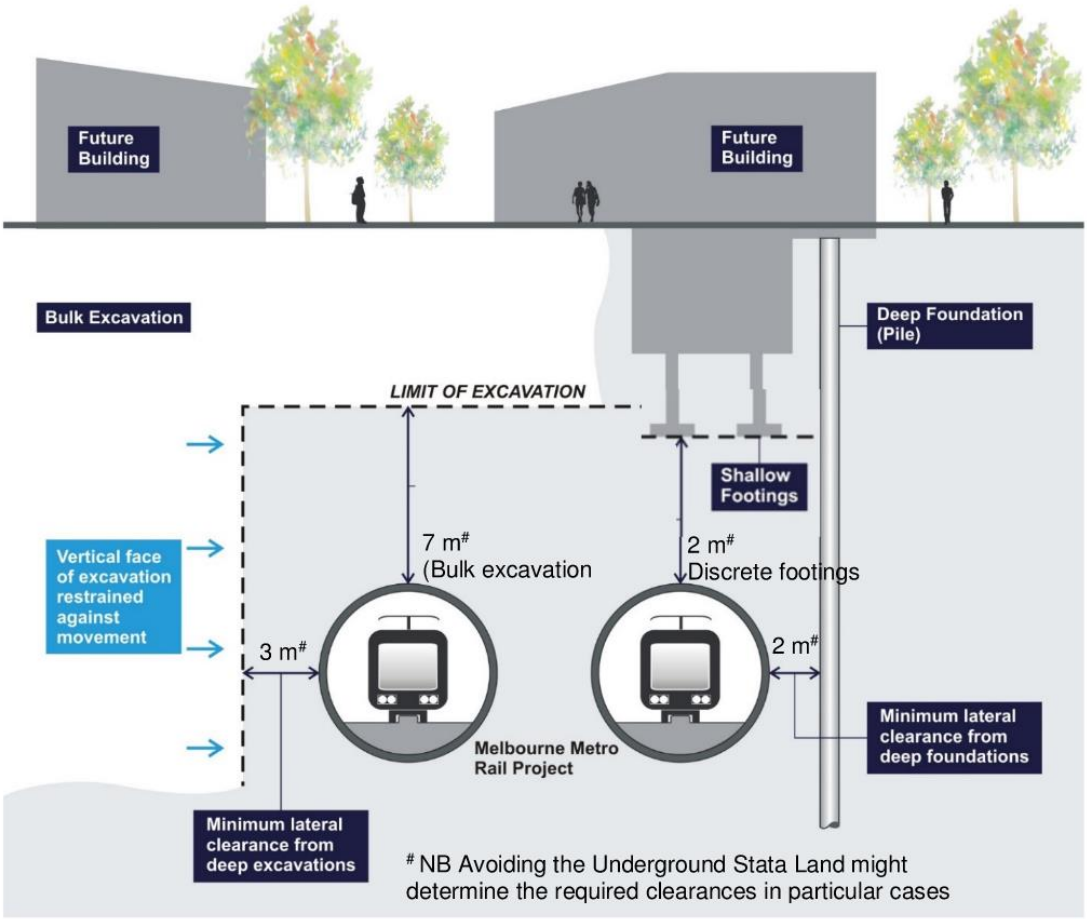

Figure 2 Clearances from Future Developments Considered in Metro Tunnel Project Design

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4. Rail Projects Victoria (RPV) Meeting Summary – 23rd March 2023

On March 23rd 2023 Elliot Smith from Matter Consulting and Anthony Cuzzupi from Sentinel met with Andrew Horne and Amanda Opie from Rail Projects Victoria to discuss the project and its interaction with the Melbourne Metro Tunnel.

The following notes summarise the discussions from that meeting which were used in conjunction with the constraints from section 3 to evaluate the impact of the proposed design.

- Tunnel diameter typically 7.2m excavated;
- Use classic formulas for footing load spread 1H:2V (30 degree from vertical);
- Can use net loss of soil from excavation to increase allowable bearing capacity if required;
- For 23 – 47 Villiers Street, the natural surface is approximately RL 21 m AHD but is subject to confirmation. Adopting RL 21 m AHD as the surface, the excavations for basements in the southern corner can extend down to RL 14 m, which is above the vertical clearance from the tunnel, RL 11.3m and above the acquired land at RL 7.9 m AHD;
- We can excavate up to 7M over the tunnel;
- 1 m above the tunnel can be taken as RL 5.3 m AHD;
- Consider vibration on piles next to the tunnel;
- 100-year design life for tunnel.

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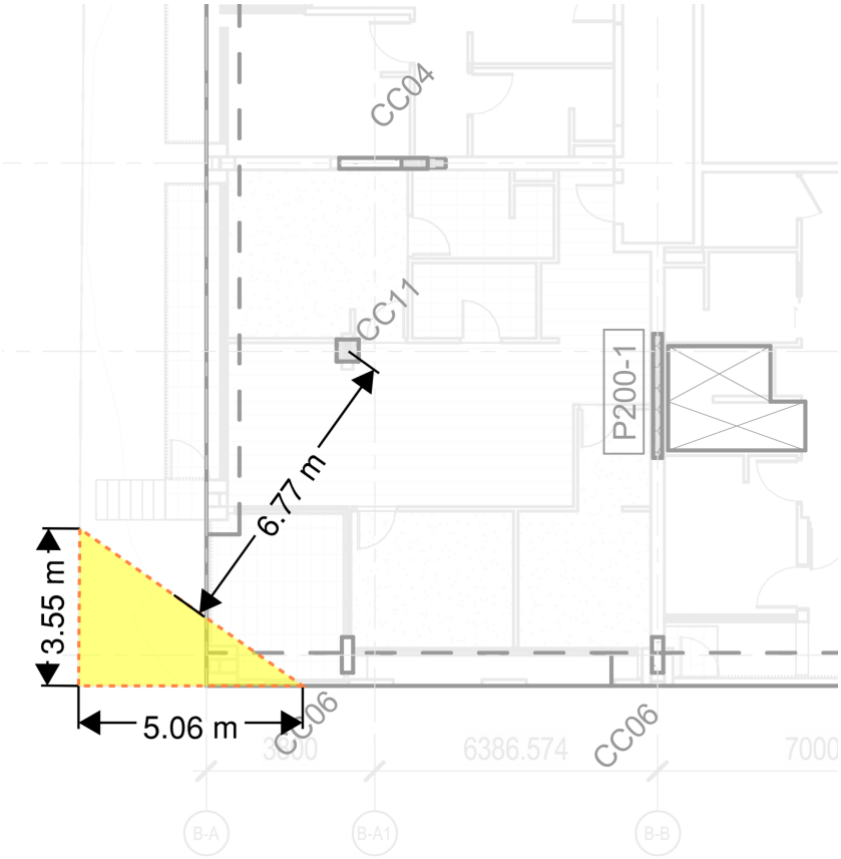
5. Design Evaluation

Based on the overlay of the subject site boundary and the location of the tunnel received as part of the title certification there is only a triangular wedge area of 9m2 where the subject site sits above the tunnel, on the corner of Villiers Street and Mary Street. This part of the plot is part of the four-storey above ground podium area of the subject site and should only affect one corner wall above the retention system and potentially one internal column footing. The sketch below shows the area of the Melbourne Metro divested land overlaid on the proposed structural layout and the structural elements which may interact with that zone.



Structural markup showing vertical elements interacting with tunnel crown zone

To illustrate how we foresee the foundations in this area remaining within the allowable clearances and loading limits figure 2 has been included based on our schematic loading assessment for these elements. For example, for the internal column shown a tributary area of 36m2 with a 200mm slab and a super

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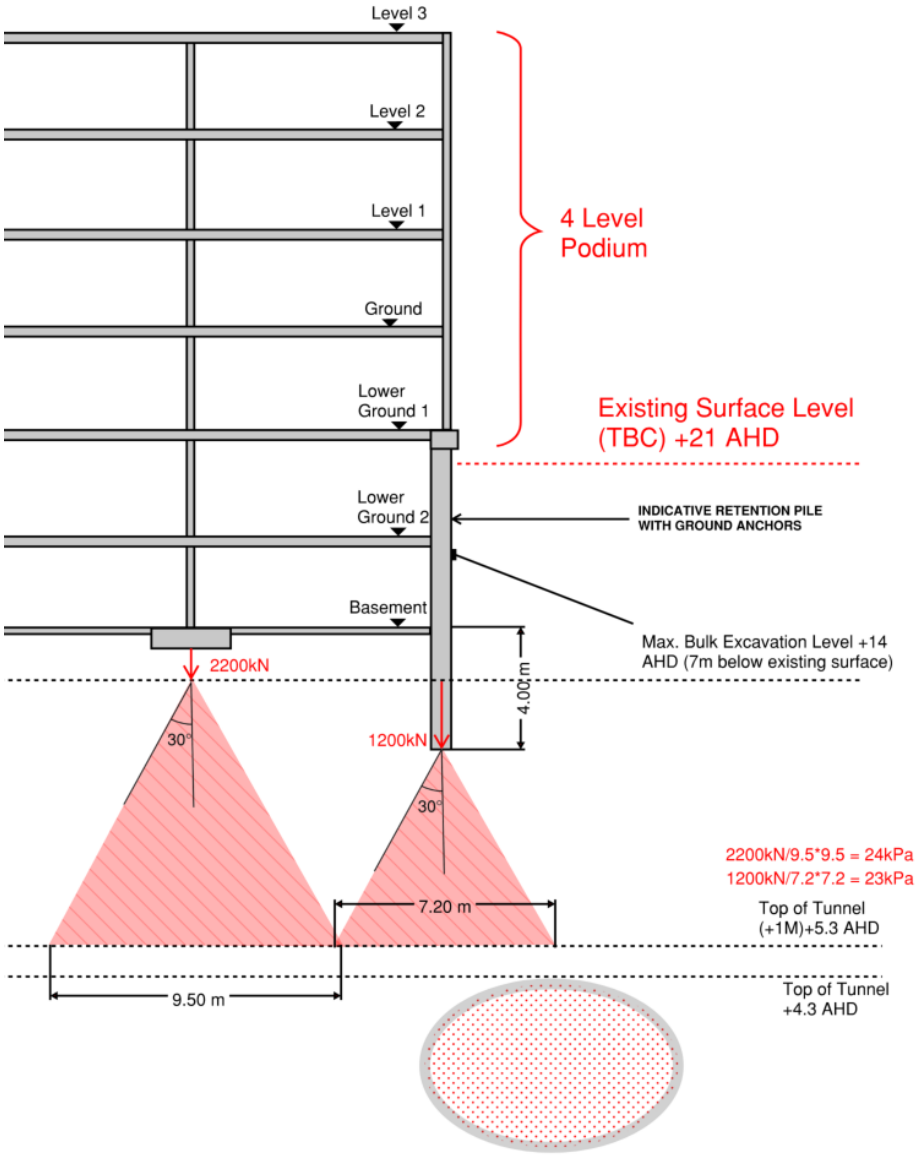
imposed dead load allowance of 1.5kPa and an imposed load of 2kPa (on average) over six storeys gives a load of approximately 2200kN with a 10% buffer allowance added on.
We have calculated the bearing area under these elements based on a 30-degree load spread from the bottom of the foundation to a square area at the depth located at 1m above the crown of the tunnel as prescribed in the guidance diagrams. As shown, the estimated maximum bearing pressure of 24kPa is significantly lower than the 50 kPa permissible pressure prescribed in the guidance by RPV.



Schematic of internal footing/retention pile loading over tunnel crown