Thakral Holdings Ltd

City One Wynyard

Structural and Geotechnical Assessment on Rail Corridors

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Contents

1 Introduction

1.1 General

Thakral Holdings Ltd proposes to redevelop the site between Carrington and George Streets over the entrance to Wynyard Station in Sydney. Hassell has been engaged as the project Architect. Arup Pty Ltd has been appointed to assist with engineering for the planning application.

1.2 The Report

This desktop report has been prepared by Arup as a basis to identify potential geotechnical and structural issues arising in the design of a Commercial Tower including new basement. It presents all relevant information that has been gathered on and in the vicinity of the site.

1.3 Limitations

This report has been prepared for the use of Thakral in connection with the planning application for the redevelopment of the City One site. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

This report has been prepared using information obtainable within the public domain. This information has been supplemented by information from nearby sites held in the internal Arup archive.

2 The Site

2.1 Site Location and Boundaries

The site is located at Wynyard in Sydney's Central Business District (CBD). The location of the site can be seen in Figure 1. The site is bound by Margaret Street to the north, Carrington Street to the west, George Street to the east, and existing buildings on the south. The main site is approximately 60m wide between George and Carrington.

2.2 Topography

A survey has indicated that the site has a 6.5m height difference south-east to north-west with approximate ground levels of +18.90mAHD on Carrington Street and +13.37mAHD on George Street.

2.3 Present Land Use

A commercial building, hotel and shopping arcade exist on the site. The commercial building, known as Thakral House, is a 12 storey building with a basement that extends across entire site. The basement has an approximate reduced level of +mAHD. Shell House is also included in the site and is a 10 storey building. The buildings are currently occupied.

2.4 Proposed Development

The proposed development by Thakral consists of

- a deep basement with 4 levels of carparking
- a new retail concourse for access to Wynyard Station and the Hunter Connection arcade over 2 levels.
- A new commercial foyer on Carrington St
- A 30-storey commercial tower.
- A 9 storey commercial building constructed within the existing façade.

This development will be a new build and will require the demolition of existing commercial and hotel buildings.

The proposed basement depth has two main base levels.

- The main basement is 30m below Carrington Street level and 24m below George Street. The reduced level at the bottom of the proposed basement will be approximately -10.83mAHD.
- The Shell House basement is approximately 20m below Carrington Street level. The reduced level at the bottom of the proposed basement will be approximately 0.0mAHD.

2.5 Adjacent Structures

The site has neighbouring buildings on the north-east and south boundaries.

2.6 Wynyard Station

Wynyard Station is located to the west of the proposed development. Wynyard station was constructed within an open excavation and is founded on sandstone. All railway lines are supported within the structural steel and reinforced concrete station box.

The closest lines to the proposed new development are platforms 5 and 6. At the closest point the station box is 40m from the proposed basement excavation at a depth of approximately +5mAHD which is 15 m above the base excavation level at -10.8m AHD.

As such the project site sits notionally within the Rail Protection Zone and is subject to RailCorp approval.

2.7 Metro Corridor

The preserved corridor of the proposed Sydney CBD Metro passes to the north of the site, between 3.4 and 5.7m below the base of excavation and includes dual 6.5m diameter (O.D. to inside of initial support lining) TBM tunnels 13.3m centre-to-centre. The crowns of the tunnels range from approximately -17mAHD to -19mAHD as they pass by the proposed development. Although the CBD Metro has been postponed it is necessary to preserve the corridor.

There is a ‘protected zone’ around the tunnels that forms a square with a minimum 2m clearance on all sides. The ‘zone of influence’ begins at the edge of this protected zone at tunnel invert level and rises at a slope of 1H:1V to ground surface. Details of the CBD Metro tunnels and the surrounding protection zone in relation to the project site have been drawn from previous studies.

3 Regional Geology

3.1 Regional Geology

The 1:100,000 Geological Map of the Sydney Region indicates the site is underlain by Hawkesbury Sandstone which is described as being a medium to coarse-grained quartz sandstone, with very minor shale and laminite lenses. The sandstone is generally well-cemented by quartz/siderite overgrowth and clay. The Hawkesbury Sandstone is generally massive or cross-bedded, near horizontally bedded.

The 1:100,000 Soil Landscape Map indicates that Hawkesbury Sandstone is overlain by erosional siliceous and leached sands with localised rock outcrop. The sand is noted to be of high permeability and low fertility. The site has a long

history of building developments which indicates that variable fill material is expected within the retained soil of the existing basement.

The paper “Map and selected details of near vertical structural features in the Sydney CBD” (Pells et al, 2004) indicates that the GPO Fault Zone, which trends in a NNE direction, crosses the Sydney CBD about 130m east of the project site. The fault comprises multiple crush zones and closely spaced jointing and faulting with normal and reverse fault offsets. No trace of the GPO Fault Zone is known to exist within the site.

Reference: Pells, Braybrooke, Och, 2004, Map and Selected Details of Near Vertical Structural Features in the Sydney CBD

3.2 Geological Structure

Widely spaced, vertical and sub-vertical joint sets with joint spacing of up to 3m are common in the Hawkesbury Sandstone. The angle of joint surfaces may vary in the range of 30 degrees on either side of vertical. Joints are usually open, with surfaces mostly rough and iron stained. Major jointing orientations in the Sydney region are NNE-SSW and ESE-WNW. The other common defects being weathered seams, bedding partings, shale/sandstone interfaces and shear zones.

3.3 Likely Site Conditions

Based on review of available information collected from locations near the site, subsurface conditions likely comprise manmade fill overlying Hawkesbury Sandstone. Manmade fill associated with previous developments may be present from the ground surface to a depth on the order of 2 to 3 meters; however, it is likely that fill and surficial soils were removed for construction of existing building foundations. If present, the composition and density of fill is uncertain, and may contain a variety of materials such as construction debris or uncompacted soil materials.

Hawkesbury Sandstone underlies surficial fills and soils in the Sydney CBD, and is expected to be present below surficial materials at the site. The sandstone is variably weathered and generally increases in competency with depth. Softer Class IV sandstone may comprise the upper few meters of the sandstone unit. The Class IV sandstone is underlain by stronger Class II and Class III sandstone.

The regional groundwater table is expected to be at or near sea level given the proximity of the site to Darling Harbor. Additionally, perched water in fill or the upper region of sandstone is expected.

4 Engineering Assessment of Impact of Proposed Development

4.1 Excavation

4.1.1 Excavatability

Construction of the basement will require a 24 to 30m deep excavation in soil and Class II to IV Sandstone. Part of this basement depth is occupied by an existing basement structure and will require demolition.

The excavatability of sandstone is highly dependent on rock strength, defect spacing and the direction of defects. The majority of excavation is expected to be in Class II or Class III Sandstone.

The stronger Class II and III sandstone however will require ripping with edges cut using a rock saw. Localised blasting may be necessary during bulk excavation as well as trimming for sides of excavations and for detailed excavation.

The floor of the excavation is expected to expose medium to high strength sandstone.

4.1.2 Excavation Support and Retention Systems

Support of overburden soils and weak rock will require a temporary retention system for support during excavation and construction. Common systems in Sydney include soldier pile walls or contiguous pile walls installed from ground surface through weak material and socketed as necessary into competent rock, typically Class III Sandstone. Support, if required, may take the form of cross bracing or anchors.

Excavation progress below the retention system in competent rock is largely self-supporting, with localised stabilising treatments as required.

4.1.3 Rock Face Stability

Localised stability of the rock face of the excavation will depend upon the quality of the rock and fracture orientations. The Class II and III sandstone is likely to be self supporting in a vertical exposure and will require less stabilisation than the weaker rock.

Conditions have been encountered within the fault zones in Sydney that have required extensive pattern bolting and structural shotcreting. These requirements will be finalised following completion of the ground investigation.

4.1.4 Excavation and Construction-Induced Movements

4.1.4.1 General

Adjacent ground movements due to stress relief will occur during excavation. Typical lateral movements in Sydney at the side of excavations are in the order of

0.5mm to 2.5mm per metre depth with 5mm or more occurring at distances greater than twice the excavated depth from the excavation. Lateral movements are affected by rock mass properties and the presence of local geological structures such as faults and bedding seams.

The effects of stress redistribution displacements on structures in the vicinity of the excavation should be assessed as part of the detailed design process. Usually, the risk of potential damage is difficult to quantify and not possible to avoid for deep excavations, but usually confined to properties located immediately on the boundary. The potential damage to adjacent structures is generally in the form of cosmetic cracking of masonry work.

4.2 Impact on Wynyard Station

The existing Wynyard rail station infrastructure consists of two main components: the station box and the unpaid retail concourse.

At the closest point the existing tracks are 40m from the face of the proposed excavation and the excavation is 15m below this track level. Movements in the station box due to construction and excavation at the proposed site are expected to be within acceptable limits.

The existing unpaid concourse and retail concourse connection to the east of the station connects to the proposed project site beneath Carrington St. The form of construction is reinforced concrete and appears to be founded on rock. Movements induced by the excavation will be more pronounced due to the closer proximity, but should be controllable and within acceptable limits due to good founding conditions using normal construction techniques and monitoring.

The loading from the proposed 30 storey tower will be supported on foundations at the base of the proposed excavation which is well below rail level and will have no significant impact on the existing rail infrastructure.

As some ground movements are possible within the Rail Protection Zone, arrangements for ongoing approval and monitoring of rail infrastructure will need to be agreed with RailCorp.

4.3 Impact on Proposed Metro

The potential conflict with CBD Metro tunnels was introduced in Section 2.7.

The Metro tunnels are not expected to be constructed until after the completion of this project. The critical interface issue becomes implementation of basement excavation and foundation solutions in the vicinity of the tunnels that do not impose stresses or cause displacements that impact the ability to develop the tunnels in the future.

The proposed development does not sit within the 1st reserve zone for the Metro corridor. The 2nd reserve proximity zone exists within a line drawn at 1:1 from the base of the tunnel to the surface. The approximate RL of the proposed Metro is approximately -19mAHD with a surface level of +16mAHD. The 2nd reserve will thus extend to 35m from the southern edge of the easement. This will cross the basement of Shell House on the corner of Carrington and Margaret St, but as there is an existing basement basement here, the actual new construction to make the

basement deeper is not within the proximity zone and will not inhibit construction of the tunnels in the future.

On the basis of this approach, it is not anticipated that the proposed Concept Plan Amendment would impede the metro rail corridor or affect the future operations of the Metro project should it proceed.

4.4 Impact on Adjacent Buildings

Due to the proximity of the excavation to adjacent buildings, it is likely that underpinning of some neighbouring building foundations will be required.

The relief of in-situ stress caused by excavation will result in ground movements. A detailed ground investigation will provide the necessary parameters for a detailed design assessment of likely movements and the impact on adjacent buildings and underground structures.

A monitoring regime will be required for continuous monitoring of movements during excavation. Regular inspection of adjacent buildings will be required during excavation to identify any minor structural damage to be repaired as required.

4.5 Recommended Future Investigations

It is recommended that a detailed geotechnical investigation is carried out to inform the proposed development. A full dilapidation survey of adjacent buildings and rail infrastructure in close proximity should be carried out before commencement of any work on site.

5 Conclusion

This report identifies and discusses geotechnical and structural issues relating to the construction of the proposed new building on the City One Wynyard site. The purpose of the assessment is to inform and accompany the planning application.

The geotechnical considerations highlighted in this report are appropriate for planning purposes and will require validation and refinement during further geotechnical investigation to input into detailed design.

Based on the understanding of the ground conditions presented herein, our conclusion is that the project presented in the proposed City One Wynyard Development Project Application can be designed and constructed utilising industry standard and proven design and construction techniques without impacting the existing Wynyard rail infrastructure or the proposed Metro rail corridor.