STRUCTURAL REPORT

Alexandria Health Centre

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PREPARED FOR
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Structural Report

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Table of Contents

1. Executive Summary

This Structural Report has been prepared by Northop Consulting Engineers to accompany a detailed State Significant Development Application (**SSDA**) for the proposed mental health hospital and medical centre at 28-32 Bourke Road, Alexandria, NSW 2015 in the City of Sydney Local Government Area (**LGA**). The site is legally described as Lot 1-3 of DP324707.

This report has been prepared to address the Secretary's Environmental Assessment Requirements (**SEARs**) issued for the project (SSD-59006709) dated 8 June 2023.

1.1 Introduction

This report has been prepared to accompany a SSDA for the mental health hospital and medical centre at 28-32 Bourke Road, Alexandria, NSW 2015 (SSD-59006709).

The application seeks consent for the following in accordance with the Concept SSDA approval:

- Site establishment including earthworks.
- Construction of the Alexandria Health Centre:
  - Total GFA of 11,436sqm
  - Maximum FSR of 3.85:1
  - Maximum height of 36.95m, Max RL. 45.35
- Ancillary development including:
  - Car parking – 77 car parking spaces distributed across basement, ground, and ground mezzanine levels.
  - Utility infrastructure and services connections.
  - Building identification signage and wayfinding signage.
  - Stormwater management
  - Landscaping
- Laneway for vehicle and pedestrian access along with western boundary of the site
- Operation of the Alexandria Health Centre as a mental health hospital and medical centre with ancillary uses.

This report has been prepared to address the Secretary's Environmental Assessment Requirements (**SEARs**) issued for the project (SSD-59006709) dated 8 June 2023.

Specifically, this report has been prepared to respond to the SEARs requirement issued below.

Item	Description of Requirement	Section reference (this report)
B40. Structure	*Future development applications must include Structural Report, prepared by a suitably qualified professional that demonstrates the proposal can be constructed in accordance with the Building Code of Australia.*	*Section 3 -4*

2. Site Description

The site is known as 28-32 Bourke Road, Alexandria and is located within the City of Sydney Local Government Area (**LGA**). The site is legally described as Lot 1-3 within Deposited Plan 324707. The site is rectangular in shape and has an approximate area of 2,972m^2.

The site has a primary frontage along the northern boundary to Bourke Road of 40m. The site currently accommodates a single storey warehouse building used for the purposes of vehicle repairs as shown in Figure 1 below. Demolition will occur prior to SSDA 2 lodgment.

Figure 1 Site Context

The surrounding land uses include:

- **North**: Various light industrial and retail uses, including an NSW Fire and Rescue facility.
- **East**: Directly adjoining the site is 26 Bourke Road which comprises a single storey warehouse building. Further east of the site is the Green Square Town Centre. The Town Centre contains critical infrastructure such as the Green Square Railway Station and various other commercial/retail uses.
- **South**: Industrial and commercial uses as well as small lot residential properties. To the southeast of the site is the new Gunyama Park and Aquatic and Recreation Centre.
- **West**: 34-42 Bourke Road comprises a two-storey warehouse building that is owned and operated by the City of Sydney Council. West of the site is a mix of industrial and warehouse development with Sydney Park located further to the west adjacent to St Peters Station.

2.1 Geology

The geotechnical investigation report [MM/S1413 dated February 2022] was issued by Fortify Geotech during the design phase.

The geotechnical investigation report Section 4.1 notes that the site is underlain by the layers of uncontrolled fill, alluvial/residual soils, and sandstone bedrock. The layer of uncontrolled fill is directly below the surface level and has been estimated to be between 600mm to 1900mm thick. The sandstone bedrock layer begins at a depth in the order of 7.3 metres to 8.5 metres below the surface level. The bedrock layer is typically in accordance with a Class III sandstone at a depth in the order of 8.1 metres to 9 metres below the surface level. The underlying sandstone bedrock provides an excellent founding material for the support of the columns and core below the bulk excavation level. Pile foundations are to be provided so that the building will be founded on the underlying sandstone bedrock layer.

Vibration during excavation activities and installation of site retention systems may impact the amenity or condition of adjacent buildings during construction. The geotechnical engineer will advise on appropriate vibration criteria levels to mitigate these effects which will require monitoring during excavation and construction. The specific requirements imposed by adjacent building owners and tenants may need to be considered in the development of vibration limits – and the associated program implications considered. The site retention system (in both the temporary and permanent conditions) will need to be provided to ensure that any basement excavation does not adversely affect any adjacent structures during the proposed excavation and construction. Basement excavation is to be limited in depth where possible to minimise the amount of uncontrolled fill to be removed from the site and limit any exposure to existing groundwater on the site.

On adjacent site boundaries, it has been assumed that the proposed basement excavation does not undermine the existing building foundations of the adjacent building structures typically. However, this will need to be verified and confirmed through detailed surveys, etc. during the following design phases for this project. Site retention systems need to be designed to accommodate all required adjacent surcharge loadings (such as surcharge loading from adjacent roads).

2.2 Groundwater

The Fortify Geotech geotechnical investigation report [MM/S1413 dated February 2022] Section 4.3 indicates that the groundwater table is located between 1.8 – 3.0m below existing ground level. The basement level is to be above the groundwater table to avoid tanking the basement. Seepage of groundwater may be expected to occur in small quantities. Drainage systems should be installed (spoon drains and lowest level underfloor) to capture these modest inflows and pump out.

3. Design Criteria

3.1 Design Life & Building Importance Level

The design life of the building is to be 50 years.

Building importance level 3 in accordance with the National Construction Code (NCC) Table B1.2a and as advised by the Building Certifier.

Wind and earthquake loading will be based on the annual probability of exceedance for a building with the nominated importance level as outlined in the NCC Table B1.2b.

3.2 Vertical Loading

Dead and Live load allowances are outlined below and take into account the reference values of imposed actions outlined in AS/NZS 1170.1:2002 Tables 3.1 and 3.2.

	SDL – Finishes/Fit-out/Services (kPa)	Uniform Live Load (kPa)	Point Live Load (kN)
Medical Centre	2.0	3.0	2.7
Wards	2.0	3.0	2.7
Lift Lobbies/Corridors	1.5	4.0	4.5
Entrance Lobby	3.0	5.0	4.5
Stairs	0.5	4.0	4.5
Non-Accessible Roof Areas	2.5	2.5*	4.5
Accessible Roof Areas	5.0	4.0	4.5
Compactus	1.0	10.0	TBC
Car-parking	0.25	2.5	13.0
Loading Dock	0.5	15.0	38.0
Office	1.0	3.0	2.7
Retail	4.0	5.0	4.5
Plant rooms	2.4	5.0*	4.5
Substations	7.5	10.0*	TBC
Terrace	5.0 **	4.0	TBC**

* Minimum assumed load. Weights of equipment to be provided during detailed design phase to ensure this limit is not exceeded

** To be confirmed during detailed design phase once soil depths for planting have been finalised with landscape architect

3.3 Earthquake loading

Earthquake loading is calculated in accordance with AS1170.4 2007 with the following basic parameters. The site subsoil classification should be confirmed by the geotechnical engineer following further site investigation.

Criteria	AS1170.4 Value
Location	Sydney
Design Event for ULS	1:1000
Probability factor, kp	1.3
Hazard factor, Z	0.08
Subsoil class	C_e
Structure height, h_n	36 m
Earthquake design category	EDC II
Structural ducility factor, μ	2

3.4 Structural robustness loads

Section 6 of AS/NZS 1170.0:2002 outlines the minimum criteria for adequate structural robustness.

The structure shall be capable of carrying a lateral load of 1.5% (G+ψcQ) applied simultaneously at each floor level.

3.5 Earth pressure loading

Horizontal earth pressure coefficients and soil densities for the design of temporary and permanent retaining structure shall be determined through the detailed geotechnical investigation of the site.

Refer to the geotechnical report.

3.6 Vibration Requirements

No vibration requirements have been allowed for to any floor plates.

3.7 Movement limits

3.7.1 Building lateral movement limits

The building lateral restraint system will be designed for the following inter-storey drift limits for respective lateral load cases:

- Serviceability wind – H/500
- Earthquake – 1.5%H

The building movements will also be agreed with the façade engineer in future design phases. Additional drift requirements to prevent movement across the boundary or interference with other buildings may be required along the southern boundary upon detailed analysis.

3.7.2 Deflection limits for structural elements

The following deflection limits apply to primary structural elements.

In general, element stiffness and deflection criteria have been determined in accordance with AS 3600 and AS1170.0. However, an additional 30mm limit for maximum total long term concrete floor deflection is adopted. This limit will generally apply to long span concrete floors where the code limit of span/250 would otherwise allow larger deflections. The following table outlines requirements of AS 1170.0 and AS 3600 deemed critical for this project.

Element	Controlling	Action	Limit
Metal roof cladding	Indentation Decoupling	1kN $G+\psi_s Q$	span/600 but <0.5mm span/120
Roof trusses, rafters and purlins	Sag	$G+\psi_l Q$	span/300
Columns	Side-sway	W_s	height/500
Lintels	Door, window jam	W_s	span/240 but <12mm
Walls	Finish/furnish rattle	W_s	height/1000
Masonry walls	Noticeable cracking	W_s or E_s	span/600 in plane span/400 face loaded
Glazing systems	Bowing	W_s	span/400
Fixed glass	Glass damage	W_s or E_s	2 x glass clearance
Normal floor systems	Noticeable sag	$G+\psi_l Q$	span/250 max 30mm
Floors supporting masonry walls or brittle finishes	Wall / finish cracking	Incremental $G+\psi_l Q$	span/500 max 25mm
Floors supporting plaster lined walls	Cracks in lining	Incremental $G+\psi_l Q$	span/300 max 25mm
Floors - general	Vibration	Q = 1kN	< 2mm
Floor supporting vehicular traffic	Dynamic excitation	Q	Span/800

3.8 Fire resistance levels for structural elements

Fire resistance levels for structural elements will be 120 minutes unless altered by a Fire Engineered Solution.

Fire resistance of reinforced and post-tensioned concrete elements is to be achieved in accordance with AS 3600:2018. For structural steel elements, applied coatings or protection is to be provided to achieve nominated FRL's. All fire protection materials and coatings are to comply with relevant Australian standards.

4. Design Elements & Considerations

4.1 Structural System

A structural system has been developed in conjunction with the architect throughout this design phase to develop the proposed building design and ensure an efficient structural solution.

All structural elements have been designed to utilise conventional construction techniques which will allow for an efficient structural program for the building construction with the structural components and their arrangement being consistent with conventional Australian construction practice.

4.2 Foundations

Foundations for columns and walls consist of pile caps and pile foundations that are found on the underlying sandstone bedrock. The Fortify Geotech geotechnical investigation report notes that sandstone rock will be at least 8.1 metres to 9 metres below the existing ground level typically. The report also indicates the allowable bearing pressure (ABP) will be in the order of 3MPa for this layer of sandstone rock. This will need to be confirmed via on-site testing and presented in the final geotechnical report.

4.3 Basement Retention

Along the eastern boundary, the temporary and permanent site retention system will need to be designed to ensure that the stability of the adjacent existing structure is not adversely affected. A site retention system that is suitable for both temporary and permanent conditions, such as a secant pile wall system or soldier pile wall system, will be proposed.

Along the other site boundaries, it is expected that temporary batters can be implemented in accordance with the geotechnical engineer’s recommendations to allow the basement excavation to safely occur along these boundaries. A reinforced concrete retaining wall system will be provided to provide permanent site retention along these boundaries.

4.4 Columns

Columns have been designed based on the use of higher strength concrete ranging from 50MPa to 80MPa. The use of higher strength concrete for the columns achieves an efficient column design allowing both reinforcing quantities and column size to be minimised. Columns are typically square or rectangular with minimal size changes to ensure they can be quickly and efficiently constructed.

4.5 Lateral Stability

The lateral structure system consists of conventional reinforced concrete lift cores and stair cores throughout the height of the building. The lateral system has been designed to accommodate code calculated wind, earthquake, and robustness loading for both strength and serviceability requirements. Design of the building lateral structure will be refined as the project progresses. Under serviceability wind loading, the deflection criteria (including inter-storey drift requirements) will be further developed in conjunction with the requirements of the façade and vertical transport engineers. The core walls utilise the solid walls required for planning (i.e., services risers, lift shafts and fire stairs) to ensure that the lateral system has minimal impact on the functionality and flexibility of the typical floor plates. The closed arrangement of the core boxes that form part of the lateral structure at each level provides a high level of torsional stiffness to the building. Link beams are provided over each doorway to effectively couple all core wall elements into an integrated core structure. The core structure will be supported by a raft foundation on piles socketed into the underlying sandstone bedrock layer. The concrete core walls do not typically vary in plan arrangement from foundation level to roof level (other than walls dropping off due to the lift-rise terminating and wall thicknesses reducing) allowing the core structure to be readily constructed with a jump form system. The construction of the cores with a jump form system will allow construction to progress rapidly and efficiently so as to move off the project program critical path early in the construction program.

Additionally, as part of the structural core design, link beams (also known as 'header beams') are required over the top of door openings and lobby entries. These assist in linking the walls on either side of the opening to form a monolithic structure. It is critical that the link beams are of a maximum depth to link the walls together – specifically over the larger lobby openings.

4.6 Floorplates

All floorplates for this building development are typically post-tensioned suspended concrete floorplates. The floorplates generally consist of post-tensioned concrete band beams spanning between columns and walls, with post-tensioned one-way concrete slabs spanning between the band beams typically. The post-tensioned concrete band beam and one-way slab system was selected as this was the most structurally efficient floor system to support the required design loadings at the minimum depth. The concrete band beams are typically oriented to span in the longer direction between columns, with the post-tensioned one-way concrete slabs spanning in the shorter direction between columns to maximize the structural efficiency. Additionally, any service penetration required in the floorplates will need to be coordinated with the architect and services consultants in future design phases to ensure these requirements can be incorporated into the structural design.

4.7 ESD

Achieving a sustainable and environmentally conscious development is important to the end client, Centuria. Two keyways to minimise the developments carbon footprint in terms of structure are:

- Changing the building materiality to a lower carbon option e.g., green concrete
- Achieving structural efficiency to minimise carbon.

Green concrete and structural efficiency are further discussed below.

4.8 Green concrete

Green concrete is achieved by replacing a percentage of the Portland cement (PC) content with a recycled by-product such as fly ash, blast furnace slag or silica fume. The final strength of the concrete is the same as a standard mix meaning the structural design is not impacted – the same spans and section sizes can be achieved.

PC replacement does generally result in lower early strength than standard concrete. Lower early strength can impact the construction program, primarily by altering the post tension stressing times and therefore deck cycles. It may also impact stripping times of other elements such as walls and columns.

Newer products such as Envisia (by Boral) and EcoPact (by Holcim) use admixtures to create a higher early strength and minimise impacts on program.

From a structural perspective, Northrop sees no issues with such products and welcomes the opportunity to minimise our carbon footprint on this project. We recommend close consultation with the manufacturer to ensure program objectives can be achieved.

4.9 Structural Efficiency

Efficiency of the building structure means that structural materials are minimised and hence the carbon footprint. Although structural efficiency is a common goal on most projects, it is important to highlight the correlation between minimizing material usage and minimizing the carbon footprint. The volume of materials is one of the biggest drivers on the carbon footprint of a structure – particularly concrete structures.

Some ways that structural efficiency can be achieved are:

- Ensuring vertical alignment and removing/reducing required transfer structure
- Minimizing building weights e.g., lightweight, or shallow soil depths on the roof, locating pools at ground level

5. Structural Elements by Others

The design and certification of the following items will be undertaken by the project architect, other consultants, or a D&C contractor:

- Balustrades, glazing and façades.
- Spiral feature stair at Ground Level
- Waterproofing of structural building elements
- Piling and shoring design – should it be required.
- Post-tensioned slab design

6. Conclusion and Recommendations

All structural elements will be designed to utilize conventional construction techniques which will allow for an efficient structural design and their arrangement being consistent and compliant with the relevant Australian Codes and Building Practices. This will ensure that B40 SEARS requirement for structural design is met.