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Group

SSD – Structural Design Statement

Blacktown Hospital Redevelopment Stage 2

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1.0 Introduction

Robert Bird Group (RBG) has been engaged by Health Infrastructure (HI) NSW to provide structural advice on the building works for Stage 2 of the Blacktown Hospital Redevelopment (BMDH2). The stage two works include:

- Blacktown Campus
  - New Acute Services Building (ASB)
  - Refurbishment areas of the original Blacktown Hospital Building to accommodate the Inpatient Haemodialysis Unit (IHU)

2.0 Structural concept summary

2.1 Excavation Methodology, Shoring and Retention Systems

The excavation and shoring works are part of the early works package and a separate SSD covering these works has been submitted and approved previously. The following descriptions relating to excavation and shoring are included for information only.

Site Information

The proposed development includes 2 levels of sub-ground floors (L1 & L2) which align with levels 1 and 2 of the existing main and Stage 1 hospital buildings.

Retention System and Basement Excavation

Due to the relatively shallow depth to competent rock across the site, and the depth of the excavation, the proposed retention system is a combination of contiguous piles, soldier piles and temporary batters.

Refer to the Civil Infrastructure drawings (BEW3-CV-DG series) for the scope of works that is to be provided under that contract.

The piled shoring walls would be stabilised in the permanent case by –

- the reinforced concrete raft slab at L1
- post tensioned concrete L2 slab and the reinforced concrete raft slab at L2
- post tensioned concrete L3 slab (where it connects to the shoring wall)
- the reinforced concrete lift and stair cores – these would support any significant out-of-balance lateral earth pressures generated by the uneven soil pressures that may occur across the sloping site.

The design of the piled wall must be coordinated with the design and location of the permanent structural support elements as noted above.

Any temporary stability systems (anchors) would be de-stressed or de-commissioned once permanent supports have been installed and reach adequate concrete strength. These works will need to be coordinated with the main works contractor.

Temporary anchors are required for the shoring system around the perimeter of the excavation. The locations of the anchors will need to be coordinated with existing services to ensure no services are damaged during construction.

Groundwater Control

Small amounts of seepage can be expected through the shoring pile walls due to imperfections within the pile wall itself.

Isolated damp patches on the shoring wall may be deemed acceptable however will be subject to final inspection by the engineer. In the event areas of water ingress through the shoring wall are deemed to be unacceptable, these areas are expected to be fully repaired / sealed / plugged to a satisfactory level by the enabling works contractor.

The piled shoring walls and shotcrete infill panels are deemed 'wet' walls and will require a cavity created by a 'dry' wall to ensure the sub-ground plant levels are 'dry'. The cavity will need to include drainage to ensure any water seepage can be removed from the building.

Groundwater Control – During Construction

Please refer to the JK Geotechnics geotechnical report.

2.2 Footings

Rock is located at generally consistent depths below the building footprint across the site, falling at a gentle slope from south-east of the site down to north-west of the site. Class V rock is generally expected to be found from RL56.0 in the south-east of the site, down to RL52.0 in the north-west of the site. Class IV rock is generally expected to be found below the Class V rock with a varying thickness of 0.5m to 2.5m. Class III rock is generally expected to be found from RL50.0 across the site.

The structure will have footings at L1 (RL50.6), L2 (RL54.8) and L3 (RL59.0), therefore the structure will have footing founded in class III rock. It is good engineering practice where possible to found all footings in the same material to minimise the risk of differential settlements.

The footing system adopted consists of oversized bored piles, socketed into class III rock. Pile caps supported by pile groups at the double column locations, have also been adopted. The piles are to be designed to ultimate bearing capacities as provided by the geotechnical engineer as well as allowance for extra vertical loading from future vertical expansion.

2.3 Vertical Support and Structural Grids

Vertical support of the floor slabs is provided by a series of concrete columns, with reinforced concrete walls forming selected lift and stair cores, and major services risers.

The 8.4m column grid has been selected to: -

- Maximise floor slab spans
- Integrate with the modular room layout of the hospital wards
- Minimises the total number of columns required, giving maximum flexibility to the floor plate design for potential future "churn" or adaptive re-use

Generally three (3) column sizes have been proposed to allow the optimisation of cost versus spatial planning requirements.

The column grid has also been selected with the intention of being able to be transposed into the basement levels.

Columns are to be designed with allowance for extra vertical loading from future vertical expansion.

2.4 Floor Systems

Level 1

The slab at lowest sub-ground level will be a reinforced concrete slab-on-ground.

Level 2

The sub-ground L2 slab will comprise of a post-tensioned concrete slab with band beams and an edge beam, supported by concrete columns. Part of the L2 slab (western side) will be a reinforced concrete slab-on-ground.

Level 3

The L3 slab will comprise of a post-tensioned concrete slab with band beams and an edge beam, supported by concrete columns.

Slab over ambulance bay on level 2 are to be designed for 10kpa construction loading to form a Class B hoarding. This will minimise hospital operation disruption during the future vertical and horizontal expansion.

Level 4 to 9

The Level 4 to 9 suspended floor slabs will comprise of a post-tensioned concrete slab system with band beams, supported by concrete columns and walls. Beams has been selected to accommodate services requirements and for build ability and costing.

Slab thicknesses will remain generally consistent across the floor plate with local heavier zones in some end spans; however reinforcement & post-tensioning will vary depending on the usage of the slab area.

Level 10 - Plant Areas and Roof

The roof will comprise of a post-tensioned concrete slab system with band beams, supported by concrete columns and walls.

Slab thicknesses, reinforcement and post-tensioning will vary depending on the usage of the slab area.

On the basis that HI decided to use the floor space below the roof level, all roof slab will be designed to support 10kpa construction loads and form a Class B hoarding during the construction of the future expansion.

Future expansion (Level 11 and level 12)

Floor system of the future expansion levels is expected to be similar to level 4 to 9 slabs.

2.5 Lateral Load-Resisting System

The lateral load-resisting system for the building consists of –

- Reinforced concrete lift cores
- Reinforced concrete stair cores
- Reinforced concrete services riser cores
- Reinforced concrete shear walls

The lateral resisting system will be designed to resist lateral loading from the future expanded configuration with additional floors over the pre-expanded configurations.

Where required, ground anchors or tension piles will be utilised to ensure the overall lateral stability of the structure, and adequate transfer of wind, earthquake and robustness loads into the supporting foundation material.

2.6 Steel structures

Steel structures consist of steel roofs, façade framings and secondary steelworks for plants, etc.

2.7 Other

- Precast Concrete Elements (non-structural):
  - Specification is by Architect and Façade Engineer
  - Allow for coordination with cast-in / drilled in fixings
- Façade Elements:
  - Specification is by Architect and Façade Engineer
  - Allow for coordination with cast-in / drilled in fixings
- Balustrade Elements:
  - Specification is by Architect and Façade Engineer
  - Allow for coordination with cast-in / drilled in fixings

2.8 Permanent movement joint

A permanent movement joint is located on Grid E in the east-west direction for all levels of the main building. The proposed slab supports at movement joint are with corbel, proprietary shear connector or double columns.

2.9 Atrium structure

The atrium is a covered space linking the Stage 2, Stage 1 and existing hospital buildings. The structure consists of predominately floor-to-ceiling columns between level 3 to the roof and is generally enclosed with full-height glass façade.

The floors consist of:-

<u>Level 1:</u> The slab at lowest sub-ground level will be a reinforced concrete slab-on-ground.
<u>Level 2 and 3:</u> The slabs will comprise of a post-tensioned concrete slab with band beams and an edge beam, supported by concrete columns or retaining walls.

<u>Level 4 and 5:</u> The elevated walkways will comprise of composite slab with steel beams supporting reinforced concrete slab.

<u>Level 6:</u> Steel roof

Vertical support of the floor slabs is provided by a series of concrete columns for level 1 to 2 and Steel columns for level 3 and above.

The atrium is designed as an independent structure with separated lateral resisting system and permanent movement joint at interface to existing buildings.

2.10 Access tunnels

The Access Tunnel is a proposed two-level tunnel that will connect the existing hospital with the new Stage 2 clinical services building on Levels 1 and 2 (note that the existing hospital main entry is at Level 3).

Refer separate Access Tunnel Schematic Design Report.

2.11 Bridge link to Multi-story car park

The bridge link to multi story car park consists of pre-cast, prestress concrete decks supported on concrete columns with steel roof over the length of the bridge. The bridge decks are expected to be pre-assembled off site and lifted in place to minimise disruption to road traffic surrounding the site.

2.12 Refurbishment to existing buildings

The refurbishment of existing hospital building will comprise of the following:

- Refurbishment of original hospital building
- Expansion of roof plant area on Stage 1 building

The structural scope of works is still to be confirmed in detail but will comprise of:

- Core hole checks
- Slab penetrations checks
- Slab load capacity checks
- Slab vibration checks
- Minor modification of beams and walls
- Retention of existing shear walls

3.0 Design Loads

Structural advice will be issued based on the following loadings:

3.1 Vertical Loads

The vertical loads are to be determined according to AS1170.1.

3.2 Wind Loads

The wind loads are to be determined according to AS1170.2.

3.3 Earthquake Loads

The earthquake loads are to be determined according to AS1170.4.

3.4 Barrier Loads

The barrier loads are to be determined according to AS1170.1.

3.5 Design Standards

Structural design will be conducted in accordance with the current revision of all relevant Australian Standards. These standards will include, but are not limited to:

Standard	Title	Edition
AS/NZS 1170.0	Structural Design Actions Part 0: General Principles	2002
AS/NZS 1170.1	Structural Design Actions Part 1: Permanent, Imposed and Other Actions	2002
AS/NZS 1170.2	Structural Design Actions Part 2: Wind Actions	2002
AS1170.4	Structural Design Actions Part 3: Earthquake Loads	2007
AS 2159	Piling – Design and Installation	2009
AS 2670.1	Evaluation of human body exposure to whole-body vibration	2001
AS 3600	Concrete Structures	2009
AS 3700	Masonry Structures	2001
AS 4100	Steel Structures	1998

4.0 Serviceability Limits

Structural advice will be issued based on the following serviceability limits:

4.1 Deflection

The deflection criteria are to be determined according to AS1170.0.

4.2 Vibration Criteria

Vibration performance for the structural elements will be designed to address:

- Structural adequacy / durability
- Regenerated noise / acoustic performance
- Perception / comfort of building occupants
- Performance of sensitive equipment / processes

Relevant Codes and Standards

- SCI P354: Design of Floors for Vibration, A New Approach
- BS 6472.1 Guideline to Evaluation of Human Exposure to Vibration in Buildings
- TS11 by Health Infrastructure NSW

4.3 Fire Resistance

Structural elements are to be designed in accordance with the Building Code of Australia and the relevant Australian Standards to satisfy the required FRL levels for fire.

4.4 Crack Control in Concrete Elements

Structural concrete elements are to be designed to maintain serviceability and visual adequacy (i.e. generally a minor degree of crack control, moderate degree of crack control for areas with ‘brittle’ finishes as per AS3600) via movement controls.

4.5 Safety In Design

Safety in Design reviews on all structural elements will be completed at the following milestones during the course of the project –

- prior to issue of structural trade packages for tender
- prior to issue of structural drawings “For Construction”

4.6 Durability

The durability criteria are to be determined by relevant standards.

4.7 Sustainability

Sustainability is an important requirement for this building in particular and to developments in general undertaken by Health Infrastructure and will be monitored during the design phase.

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