BROWN

SOPA Residential Development
Burroway Road, Wentworth Point

Structural Design Report

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Prepared for Payce

Smart Consulting

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1. Introduction

The following report offers a description of the structure of the proposed development at TNT Bay Park, Burroway Road, Wentworth Point, Sydney and sets out the structural design criteria and performance parameters for the basis of the design of the structure.

The proposed development consists of three levels of basement car parking covering approximately three quarters of the site and of which the typical lowest level is at RL -6.900. Above this is a podium level of retail space and open communal area. Rising above the podium are three towers each containing 8 levels of residential apartments. All of the towers reduce in footprint at level 6. Each tower is also split into two with a bridge connecting the two sections at each level. Further information can be found on the architectural drawings by Rice Daubney Architects.

The site is positioned close to the corner of Burroway Road and Hill Road in Wentworth Point, close to Homebush Bay in western Sydney. The Parramatta River is located to the north of the site and the Sydney Olympic Park ferry terminal is adjacent to the site. The river is approximately 45m away from the basement wall at it's closest position.

The basement and superstructure is proposed to be a concrete building frame structure. The building will be supported on reinforced concrete load bearing columns and walls. Lateral forces from earthquake and wind loads will be resisted by the concrete lift and stair cores.

At this stage, it is anticipated that the perimeter basement walls will be a cased secant piled 'cut off' wall to provide a waterproof wall.

Foundations are likely to be deep piles extending to rock.

The basement floors will be banded post-tensioned slabs and the upper residential levels will be post-tensioned flat plates. Transfer structures will be required to transfer the load bearing elements between the upper residential level and lower car parking levels, which will be setout on a different structural grid. The transfer structural will be required at Ground Floor and Level 2 in different areas of the development.

The existing site is generally relatively flat at levels between RL 2.0 and RL 3.5.

2. Site Data

2.1 Geotechnical

2.1.1 Current Reports

Geotechnical reports by are available and are as listed below:

- 'Preliminary Geotechnical Investigation' by Jeffrey and Katauskas Pty Ltd (now JK Geotechnics) dated 14 May 2010 (Ref: 23907ZArpt)
- 'Geotechnical Investigation' by Pells Sullivan Meynink dated 26 November 2012 (Ref: PSM2043-003R)

2.2.1 Geotechnical Issues of Design Parameters

The geotechnical investigations undertaken by JK Geotechnics and PSM consist of various boreholes drilled across the site. As a general summary, the boreholes show the typical underlying strata to be up to 2.6m of fill over alluvial sands and clays over Class III and IV sandstone. The Class IV sandstone starts at approximately 12-14m depth from the existing ground levels.

The investigations indicate that groundwater was encountered at between 1.0 to 2.0m below ground level. Temporary dewatering of the site will be required during the basement excavation. Care should be taken during the dewatering process to ensure that uncontrolled and excessive lowering of the groundwater table does not lead to excessive movement or cracking of the neighbouring structures.

Geotechnical design parameters for both the support of vertical loads on the piles and of the lateral loads to the perimeter cut off wall are included in the reports. The reader should refer to the geotechnical reports for more detailed information on the ground conditions.

It is advised by JK Geotechnics that a piling platform will be required for the piling rig.

A suitably qualified geotechnical engineer will be required to be engaged by the contractor to undertake a geotechnical surveying and monitoring role during the excavation works.

2.2 Contamination Report

Refer to Environmental Investigation Services (EIS) report ' Preliminary Environmental Site Investigation for Proposed mixed use development at Wentworth Point Ferry Wharf Site, Burroway Road, Sydney Olympic Park, NSW' dated 14 May 2010 (ref: E23907K-rpt) for further details of the contamination testing on site.

2.3 Existing In Ground Services

Refer to the services engineer's drawings and to the civil engineering drawings for details of any in ground services.

2.4 Foundations Types

Both geotechnical reports advise that the structure should be supported on piles founding onto the sandstone bedrock.

2.5 Retention Systems

As mentioned in Section 1 above, it is anticipated that the basement walls will be a cased secant piled 'cut off' wall consisting of interlocking hard and soft piles to provide a waterproof wall. The piles will be socketed into the underlying sandstone in order to control water ingress into the basement. Any water ingress through the lower levels of the cut off wall or through the sandstone will be drained by providing a drainage layer under the lowest B3 slab and pumping any groundwater that is collected away.

Piling tolerances will inevitably cause the piles to deviate from their ground level position as the depth of the drilled pile increases. To allow for such tolerances and ensure that the piles are still interlocking at depth, a larger pile diameter of 750 to 900mm is proposed.

Temporary ground anchors will be required to support the cut off wall during excavation until the building slabs are in place to support the wall in the permanent condition. Should any ground anchors extend beyond the site boundary, agreement will be required from the neighbours or relevant authority.

It is currently anticipated that the perimeter shoring wall will be part of a Design and Construct contract. Brown Consulting and an independent geotechnical engineer (to be engaged by Payce Consolidated) will undertake a design review of the D&C design.

2.6 BCA Report

A BCA report has been developed by Vic Lilli and Partners dated 4 February 201 (ref: J140058).

2.7 Fire Report

A fire report is not yet available.

3. Structural

3.1 Temporary Works

The design of all temporary works are the responsibility of the Builder.

3.2 Lateral Stability

Lateral stability for the buildings will be provided by the concrete stair and lift cores.

The lateral bracing system shall be designed to withstand all lateral load actions from wind, earthquake and robustness.

Brown Consulting will model the all the towers and basement using ETABS finite element computer analysis program to assess the lateral loads and building movements.

3.3 Columns and Walls

All columns and walls are reinforced concrete columns or walls designed in accordance with AS3600 for strength, fire rating and durability.

Columns will typically be braced by the lateral system and will not be considered as sway columns.

Concrete strengths for are the columns and walls are anticipated to vary from between 40 MPa to 50 or 65 MPa.

3.4 Floor Systems

The permanent floors for the typical residential tower slabs are proposed to be post-tensioned. It is anticipated that the final design of the post-tensioned floors will be undertaken by a sub-contractor as part of a design and construct package. Brown Consulting will undertake initial design to confirm slab and beam thicknesses. We will also provide a design review of the D&C sub-contractors proposals.

Brown Consulting will undertake their design of the slabs with the use of the RAPT and Ram Concert computer design programs.

4. Design Standards

The structural design of the development shall be carried out in accordance with the provisions of the relevant Australian Standards, Council Standards and the Building Code of Australia, and in accordance with the accepted practice and principles of structural engineering.

Where there is no relevant Australian Standard or Code, use may be made of appropriate overseas standards or recognised methods of analysis, design or testing.

The following Australian Standards have been identified as relevant:

AS1170.0 – Structural Design Actions: General principles

AS1170.1 – Structural Design Actions: Permanent, imposed and other actions

AS1170.2 – Structural Design Actions: Wind Actions

AS1170.4 – Structural Design Actions: Earthquake Actions

AS2159 – Piling

AS3600 – Concrete Structures

AS3700 – Masonry Structures

AS4100 – Steel Structures

AS4600 – Cold Formed Steel Structures

4.1 Specifications

The following Technical Specifications are to be prepared. The specifications will be based on Natspec and follow the standard format and details adopted for Natspec specifications

- Concrete including post tensioned concrete
- Structural Steel
- Piling

5. Loads

Generally, all loadings and load combinations will be in accordance with the latest version of AS1170.

Loading diagrams reflecting the design loads are provided for each floor.

5.1 Dead Load

Dead loads shall be calculated as provided for in the latest version of AS1170.1 Dead and Live Loads. The major dead loads to be used in design include the following:

Material Density

» Reinforced concrete generally	25kN/m^3.
» Lightweight concrete	18kN/m^3
» Water (in Storage Tanks)	9.8kN/m^3
» Masonry	To be determined but not less than: (kN/m^2 vertical) 140mm hollow block 1.8 190mm hollow block 2.1 Single skin brick 2.55 Double skin brick 5.10

» Soil (in planters)	18kN/m^3
» Glazed panels (windows, doors)	25kN/m^3.
» Structural Steel	78kN/m^3.
» Timber Softwood Hardwoods	 6kN/m^3 minimum 10kN/m^3 minimum
» Tiling and grout	To be determined but not less than 20kN/m^3

Note: Moveable partitions are to be treated as a live load in the load factor and combination phase.

5.2 Superimposed Dead Load

Superimposed dead load on the structure for instance floor finishes, blockwork etc.

Lower values should be adopted where we have uplift as a key design consideration. This is additional to any other code factor.

» Ceilings and miscellaneous dead load	0.25kPa. minimum
» Services Ducts, Lighting etc.	0.25kPa. minimum
» Lightweight Partitions	0.5kPa (vertical)
» Glazed Facades	1.0 kPa
» Floor Finishes	1.25kPa/50mm thickness
» Applied Toppings	1.5kPa/50mm thickness
» Landscaped Areas	18kPa/m thickness

5.3 Earth Pressures

The geotechnical reports by JK Geotechnics and PSM shall be referred to and their recommendations adopted when assessing earth pressures on retaining walls.

In addition, where there are footings that will influence the retaining wall, the lateral effects of these loads shall be incorporated into the design of the wall. The wall shall be rigid enough to control settlement of adjacent footings. Estimated loads of the existing neighbouring structures will be assessed and included in the design.

5.4 Hydrostatic Pressures

The permanent basement shoring walls shall be designed to support the required hydrostatic pressures.

The basement slab will be provided with subfloor drainage consisting of a drainage base layer and a number of drainage pipes and sumps to minimise the potential for any hydrostatic uplift pressures. Regular clean out points should be allowed for.

5.5 Live Load

Live loads shall be calculated as provided for by the latest version of AS1170.1 – Permanent, Imposed and other Actions.

Typical Live Loads to be adopted will be as follows:

- Residential (typical) - 1.5 kPa
- Residential (balconies) - 2.2 kPa
- Residential communal areas - 4.0 kPa
- Retail - 4.0 kPa
- Communal Open Spaces - 5.0 kPa
- Plant - 7.5 kPa minimum (or as required for specific equipment)

Loading drawings for the live loads will be prepared for each floor.

5.6 Wind Loads

The structure shall comply with the provisions of AD 1170.2.

5.7 Seismic Loads

Code	AS1170.4:2007	
Structure Classification	Importance Level	3
	Location	Sydney
	Annual Probability of Exceedance	1/1000
	Probability Factor	Kp =1.30
	Hazard Factor	Z=0.08
	Founded	Class E_e
	Structure height	H<50m
Earthquake Design Category		EDC II

5.8 Surcharge Load

Additional requirement will be incorporated into the design as required. The final design of the retaining walls is to consider the surcharge from adjacent roads, buildings and landscape mounds. Particular requirements for this project are noted below;

- Construction Loadings – To be agreed with the Builder
- Adjacent structures - as calculated
- Public Road – 15 kPa
- Perimeter basement retaining wall – 5 kPa minimum or more as required
- Landscaping walls – To AS 4678 (Earth Retaining Structures) as a minimum or more as required

During construction, no surcharge load from construction traffic has currently been assumed adjacent to any retaining walls. Any such surcharge would need to be advised to Brown Consulting by the Builder once their construction management plan was in place.

5.9 Load Combinations

All elements of the structure shall be checked for load combinations set out in AS1170.1 Section 2.

5.10 Live Load Reductions

Live load reduction will be applied to vertical elements in accordance with AS1170.1.

Live load reduction will not be applied to slab/ beam elements in accordance with AS1170.1.

5.11 Robustness

Minimum parameters for robustness shall be considered

6. Structural Design Criteria

6.1 Deflection

Maximum serviceability or deflection limits on the structure:

- Slabs and beams - span/250 or 30mm maximum long term deflection
- Transfer beams – span/100 incremental deflection

6.2 Horizontal Building Deflection

Lateral deflection to be Height/500 maximum.

6.3 Concrete Strength

Typical concrete strengths are indicated below. Please refer to the structural drawings for confirmed concrete strengths.

- Floor slabs and beams – 40MPa typically but refer to structural drawings
- Walls and columns – Refer to wall elevations and column schedule
- Foundations – 32MPa typical
- Piles – 40MPa
- Slab on grade – 32MPa

Design life 50 years in accordance with AS3600.

6.3. 1 Exposure Category

To AS 3600

- Exterior elements – B1
- Interior elements – A2 typically. A1 to the residential areas.

6.3. 2 Crack Control

Crack control requirements to AS 3600.

- Interior - Moderate
- Exterior – Strong

6.4 Fire Rating

AS3600/AS3700/AS4100 as appropriate and the Building Code of Australia.

We also refer the reader to section 2.6 and 2.7 of this report.

6.5 Post-Tensioned Concrete

6.5.1 Concrete

Maximum 56 day shrinkage strain to be 650μm when tested in accordance with AS 1012.

Required concrete strengths at time of stressing.

- Initial tendon stress at 24 hours minimum after finish of pour – 7 MPa
- Final tendon stress at 5 days minimum after finish of pour -22MPa (12.7 dia strands)
- Final tendon stress at 5 days minimum after finish of pour -25MPa (15.2 dia strands)

All concrete cylinders to be stored and cured on site prior to testing, in accordance with clause 19.6.2.8 of AS 3600.

6.5.2 Design for durability

Provide sufficient post-tensioning and reinforcement shall be provided in both directions so as to satisfy crack control provisions for moderate degree of cracking as per AS3600 Clause 9.4.3.2 and Clause 9.4.3.4

If post-tensioning alone is to provide crack control, a minimum level of 1.2MPa after final losses shall be maintained.

All external slab areas are required to be designed as watertight. Brown Consulting currently nominate a minimum P/A of 2.0 MPa and additional mesh in the top layer of any external slabs to achieve this. Refer to general notes drawings for further details. Any alternate proposal by the post tensioning subcontractor to achieve watertightness in these slabs may be submitted to Brown Consulting and the Builder for review prior to design. Any change to current proposal to be approved by Brown Consulting and the Builder prior to commencement of design.

All areas restrained from piers, core walls and other vertical elements is likely to reduce the level of prestress below the minimum level is to have adequate reinforcement to provide to properly control shrinkage cracking in the slabs and bands as noted above.

6.5.3 Post Tension Design Criteria

6.5.4. 1 Shop Drawings

The Post tension subcontractor shall prepare shop drawings showing the cable layout, all cable profiles, and theoretical extensions including details of all required anchorages, couplers and antiburst anchorage reinforcement. Drawings of the flexural and shear reinforcement are also to be provided. The shop drawings are to be submitted to the Engineer for approval at least 5 working days prior to installation of tendons on site.

6.5.4. 2 Stressing Tendons

All strands shall be 12.7 diameter 7 wire-super-grade, stress relieved, low relaxation strands to ASI311 with a minimum breaking load of 184 kN. 15.2 diameter strands may only be used with prior agreement with Brown Consulting.

Ducts, tendons and anchorages shall be firmly supported to prevent displacement during subsequent operations. They shall be placed with a vertical tolerance of plus or minus 3mm in concrete dimensions of 200mm of less, plus or minus 5mm in concrete dimensions between 200mm and 600mm, and plus or minus 15 mm in concrete dimensions over 600mm.

Bands shall be nominally reinforced with stirrups at 1000mm centres and N12 horizontal reinforcement. Maximum stirrup leg spacing to be 600mm. Slab tendons are to be supported on the top band reinforcement where tendons cross the bands.

Band stirrup legs and hooks are to be detailed to avoid clashing with the band tendon layout.

6.5.4. 3 Tendon Grouting

Tendon extensions are to be reviewed and approved by Brown Consulting prior to trimming.

All tendons are to be grouted and grout cured prior to formwork stripping.

On completion of grouting stressing pockets and pans are to be mortar filled.

6.5.4 Design and Supervision

6.5.4.1 Design

Any amendments to the general arranged drawings provided are to be approved by Brown Consulting prior to their utilisation in the design.

Design calculations are to be provided to Brown Consulting on request. Where frame analysis is used reduced column stiffness down to 20% of the gross column stiffness maybe used for band and beam analysis, 5% for slab analysis. However full column stiffness is to be used in the punching shear design.

Stressing access and construction joint positions is to be confirmed by the builder prior to the commencement of the design. Any requirement for under- slab stressing is to be approved by the builder

6.5.4.2 Supervision

Site inspections and sign-off of the tendon and reinforcement insulation are to be provided by the post tension subcontractor at each pour prior to the placement of concrete.

The post tension subcontractor is the provide site supervision during concrete placement to monitor and correct any displacement of tendons and grout tubes during the pour.

6.5.4.3 Certification

On completion of the project the post tension subcontractor is to certify their design and installation including the grouting of all tendons.

7. Materials

7.1 Concrete

Reinforced and prestressed concrete, including elements reinforced with permanent steel formwork and plain concrete, shall comply with the provisions of AS3600 and the standards referenced therein, in terms of analysis, design, and specification of constituent materials including reinforcement.

7.2 Steelwork

Structural steel, including steel used in composite construction and connections, shall comply with the provision of AS4100 and standards referenced therein, in terms of analysis, design and the specification of constituent materials.

Structural steel with strength grades higher than provided for by AS4100 may be used subject to compliance with suitable overseas standards, research results or accepted practice.

7.3 Masonry

Masonry structures shall comply with the provisions of AS3700 and the standards referenced therein, in terms of analysis, design and the specification of constituent materials.

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