Proposed New Liverpool Primary School Development

Forbes Street, Liverpool, NSW

Structural SSD Report

Revision: 01

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Report Amendment Register

Rev. No.	Section & Page No.	Issue/Amendment	Author/Initials		Reviewer/Initials		Date
1		SSD Report	DR		AB		18/03/2021
A		SSD Report	DR		AB		15/06/2021

Introduction

Meinhardt Bonacci has been engaged by School Infrastructure NSW to provide structural engineering advice for the proposed development the New Liverpool Primary School.

This concept report summarizes investigation/analysis of the site conditions, authority requirements and relevant structural requirements, and provide general options

1. Site Description

1.1. Location

The new Liverpool Primary School (NLPS) is located within the grounds of the existing Liverpool Boys and Girls High School in the Liverpool Central Business District (CBD), at 18 Forbes Street, Liverpool. The proposed new Liverpool Primary School is located in the eastern portion of the existing school grounds (refer to figure 1.)
The site is legally described as Lot 1 in DP 1137425. The application seeks consent for the construction and operation of a new Liverpool Primary School. This will include construction of a new school building for core school facilities, teaching spaces, support units, preschools as well as associated landscaping and open space improvements. A detailed description of development is provided by Ethos Urban within the EIS.

The site slopes gently towards the south east with the ground surface levels falling from the corner of Forbes and Lachlan Street at about RL 13 m relative to the Australian Height Datum (AHD) to about RL 9 m AHD at the south eastern corner.

Figure 1. NLPS Site Plan

1.2. Existing Conditions

1.2.1. Topography

The site is approximately 7.5ha and generally slopes towards the southeast with levels varying from RL 13.80m to RL 9.00m from north to south. The gradient across the site approximately 1%.

2.2.2. Structural Condition

The site is currently used as play area for the existing Boys and Girls schools located in the west of the block. Site history information indicates that the site was used for agricultural purposes before the school.

3.2.3. Geotechnical Investigation

The geotechnical report indicated that conditions vary over the site. In the north western portion of the site the typical succession of strata comprised pavement, topsoil and filling up to 0.8 m in depth overlying residual silty clay the shale and laminite. In the eastern and southern portions of the site, the pavement, topsoil and filling were underlain by layers of alluvial clay and sand then shale and laminite, which typically increased in strength with depth. The depth of overburden soil typically increased towards the south eastern corner. Depth of shale was encountered between 3m and 10m below ground throughout the site.

4.2.4. Site proximity to Rail Corridor

The development site is located directly adjacent to three Sydney Trains Network lines (Cumberland Line, Inner West & Leppington Line and the Bankstown Line). Any development within 25m of these train lines (measured from rail boundary) requires the consultation and potential approval of Sydney Trains. Currently no excavation deeper than 2m are proposed for the new development hence based on Sydney Trains Design guidelines no adverse affect from this development is expected on rail corridor.

2. STRUCTURAL System

The final structural systems not only should be cost effective and complying with the NCC-National Construction Code- performance requirements- i.e. fire rating and acoustic- but also consider the site-specific constraints.

This report illustrates the current proposed structural system for the school.

Currently delivery of the project in form of DfMA- designed for manufacturing and assembly off site has been considered as the primary solution, meaning that the superstructure would be manufactured off site in a factory and then delivered to site and craned into the final location. Alternatively, kit of parts, or conventional structural systems can be adopted to suit the proposed development.

2.1. Footing Options

According to bore logs, the site is underlain by Shale and laminate at a depth of approximately 3.0m to 12.5m.

To accommodate the development construction the footing system will consist of bored piers or screw piles with pile caps or strip footings which will support the superstructure. The table below outlines the constraints and benefits of screw piles and bored piers. A sub floor under the lowest floor is expected for modular construction. The external slabs/pavements will be laid over firm natural ground or well compacted fill.

	Constraints/ Considerations	**Benefits**
Footing		
Screw Piles	Soil aggressivity could drive the screw pile base material thickness.	Speed of installation and reduced spoil removal.
Bored Piers	Requires 2m socket into high strength rock. Shown in Figure 5.1 below.	Durability

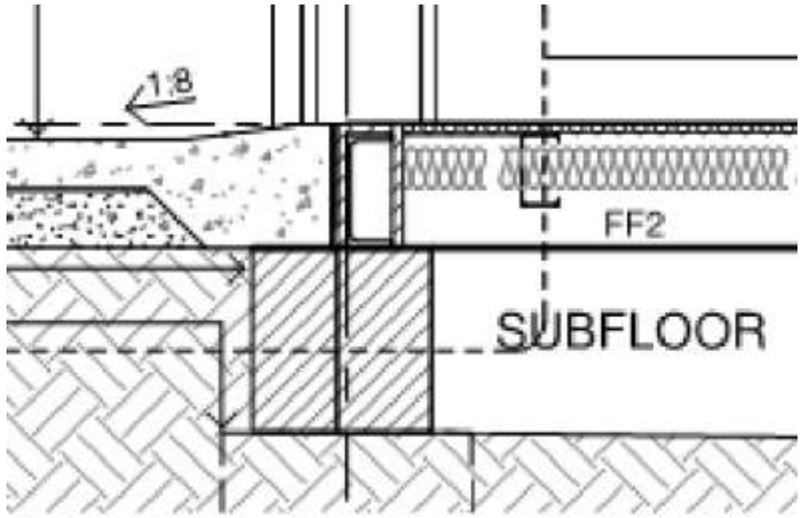

Figure 5-1: Bored Pier Footing Option

2.2. Super Structure

As discussed earlier, various structural system compatible with EFSG requirements can be considered depending on cost efficiency and other limitations surrounding the project.

Structural Design

Australian Standards and NCC

The following Australian Standards in combination with NCC 2019 are used in the structural design of this

project. AS/NZS 1170.0/2002 – Part 0: Structural design actions

AS/NZS 1170.1/2002 – Part 1: Permanent, imposed and other

actions AS/NZS 1170.2/2011 – Part 2: Wind actions

AS/NZS 1170.4/2007– Part 4: Earthquake

loads AS3600 – 2018: Concrete structures

AS4100 – 1998: Steel structures

AS1720- 2010: Timber

Structures AS2159 – 1995:

Piling

AS/NZS4600 – 2001: Cold-formed steel structures

AS/NZS3828 – Guidelines for the erection of building steelwork

Site specific information and ground conditions

Meinhardt Bonacci Group (NSW) assumes that external reports are professionally prepared by appropriately qualified sub-consultants and reviewed by the SINSW. Meinhardt Bonacci Group (NSW) rely on the information provided in these external reports and will not be held responsible for any of the recommendations or advice contained within these reports

Geotechnical Report
Full report received – Outlined in previous section.

Foundation Design and Concepts
All the footings are to be founded on the underlying sandstone laminate or hard clays- for screw pile option.

Site Retention/ Retaining Walls Including Temporary and Permanent Batters
Minor retaining walls will be required for sub floor areas under modules.

Groundwater Table
No ground water has been identified during the investigation.

Earthquake
The earthquake design will be carried out in accordance with the Earthquake Design Code AS1170.4-2007. Refer to Section 3.9 'Earthquake Loads' for design parameters.

Wind Tunnel Testing
None carried out by Meinhardt Bonacci Group. None will be required for this project as per wind code requirements.

Dilapidation Reports
None carried out by Meinhardt Bonacci Group.

Design Loading Information

Loads and their appropriate load combinations will be in accordance with AS1170.0, AS1170.1, AS1170.2 and AS1170.4. The applied loading is summarised in this section of this design brief.

This section is to be read in conjunction with the structural drawings, which will indicate the design loads of each floor on the concrete outline drawing. Note, masonry walls loads are excluded from these loading drawings and should be taken from the relevant architectural drawings.

Self-Weight Loads (SW)
Self-Weight loads shall be calculated as provided for in the current version of AS1170. Part 1: Permanent, imposed and other actions.

Material densities are taken from AS1170.1.

Super Imposed Live and Dead Loads
Live loads are taken from AS1170. Part 1: Permanent, imposed and other actions. The following table describes the more significant loading on the project, and further clarification of floor loads can be obtained by referring to the loading diagrams in the structural set of drawings.

Pattern Live loads shall be considered if applicable in accordance with Clause 2.4.4 of AS3600. Live load reduction shall be applied to AS1170.1 if appropriate for vertical elements.

Location	Dead Load	Live Load
Stores, canteen, gymnasium, technology, food, preparation areas, applied studies, computer areas, arts, plants	0.5 kPa	5 kPa
Classrooms	1 kPa	3.0 kPa
Gym	2.0 kPa	5.0 kPa
Community Facilities	2.0 kPa	5.0 kPa
Corridors	1.5 kPa	4.0 kPa
Lobbies, Corridors and stairs etc	1.5 kPa	4.0 kPa
Trafficable concrete roofs	2.5 kPa (Inclusive of Falls)	5.0 kPa
Lift Lids	1.5 kPa	2.0 kPa or Lifting loads
Roof top plant loads	2.5 kPa	7.5 kPa or plant loads, whichever is greater
Fire Stairs	0.5kPa	4.0kPa

Facade Loading

Assumed to be lightweight metal. TBC by architect.

Building Wind Loads

To AS1170.2 for a Region A2 wind and a Terrain Category 3.

Construction Live Loads

5KPa allowance should be made for construction loading on concrete floors/pavements.

Snow Loads

In accordance with AS1170.3 but not applicable for this project.

Earthquake Loads

Project will be designed in accordance with AS1170.4-2007 and the BCA 2015.

Hazard Factor:	Z = 0.08
Life Span:	50 years
Site Subsoil	Ce
Probability of exceedance	kp = 1.3
Importance Level	2

Robustness Loads

In accordance with the requirements of AS1170.0/2002 Amendment 3 the robustness load is taken as 1.5% of the gravity load (G + ψcQ).

Blast and Impact Loading

It is noted that the design of the building and structure and boundary walls if any has not been designed for any vehicle impact loads (other than car-park barriers loads taken from AS1170.1), nor has the building or its structure been designed for any blast/explosion loadings or terrorist induced loading events.

Limit State Design Criteria for Structural Elements

General Design Approach

The limit state design for strength, serviceability and stability of the relevant structural elements within the building will generally follow the established criteria in the relevant material design codes AS4100 and AS3600 unless noted otherwise below.

Structural Movements

Building Sways (Deflection) subject to service wind loads shall satisfy;

- Total lateral deflection to not exceed height/500.
- Inter-storey deflection to not exceed inter-storey/500 or 12mm, whichever is lesser

Floor Deflections to AS3600 and AS4100, limited to span/250 total and span/500 incremental for flexible partitions, and span/500 total and span/1000 incremental for (non flexible) rigid partition walls without regularly spaced movement joints. Deflections for transfer elements shall be limited to the lesser of Span/360 or 10mm max total deflection.

Fire Resistance

Fire rating to AS3600/AS3700/AS4100. Generally, the elements are to be designed for a FRL of;

- 120/120/120 TBC by BCA Consultant

Crack Control

Generally, all internal suspended slabs will be designed for a moderate degree of crack control, except for external roof slabs over living areas where a strong degree of crack control will be adopted. For Post tension slabs, this will result in a minimum post tension stress of 1.4MPa and 2.0MPa for moderate and strong degree of crack control, respectively. Refer to Section 4.8 for further minimum requirement to external slabs over living areas.

Pour strips or Temporary Movement Joints (TMJs) will be introduced where appropriate to minimise the long-term creep and shrinkage effect of the concrete and these will be co-ordinated with the builder construction programme.

Minimum Connection Requirements and Ties

All connections, including but not limited to beam/slabs to columns/wall, precast, etc, shall be designed to clause 6.2.3 AS1170.1 for the transfer of the lateral loads and robustness.

Durability

Durability to be to AS3600/AS4100/AS2311 / 2312. Maintenance levels and design life are to be nominated by the client with regard to surface coatings.

Floor Vibrations

Floors shall be designed to ensure that there are only slight perceptible vibrations under footfall effects, or from other internal or external sources.

Floors shall be designed to ensure they comply with the recommended acceleration and velocity limits in the relevant standards. The R value method outlined in Annex A of AS2670.2 and Appendix A of BS6472 will be used. A dynamic assessment shall be undertaken in accordance with SCI p354 Design Guidelines or approved equivalent. The floor structures shall be designed to achieve a maximum "Multiplying Factor" R value as appropriate.

The following parameters shall be used for the analysis:

- Weight of 1 person 746N (76kg x 9.81)
- Dynamic Concrete Modulus – of 1.2 x Ec as provided in AS3600 is to be used

Floors are not designed for vibration emanating from plant equipment, ducting, fans etc. All vibrations from plant are to be isolated at the source with dampers and vibration isolation devices.

Structural Steel Design Criteria

Vertical Deflection Criteria
The design criteria for vertical deflections of structural steel rafters and beams are as follows;

Total Deflection (after precambers)

Self-Weight and Dead Load:	Span/300 or 20mm
Self-Weight, Dead Load and short term Live Load:	Span/250

Incremental Deflection

Short Term Live Load or Wind Load:	Span/200 or 30mm
Ceiling Dead Load only:	Span/500

Notes

- Incremental and Total Deflection criteria are based on AS1170.0:2002 Table C1 for Rippling, sagging and cracking limit requirements for hung ceilings
- Incremental deflections to rafters and primary beams can be additional and consideration of suitable deflection heads to walls is required.
- It is assumed that appropriate movement and expansion joints are installed into brittle ceiling finishes and fixtures to assist in controlling cracking from the roof deflections described above.
- For Cantilever beams and rafters, the deflection limit at the ends of the cantilevers are based on the above limits but with the span being equivalent to twice the distance from the support to the end of the cantilever.

Construction Materials: Codes, Properties and Construction Practices

Concrete

The design, material properties and construction of all reinforced and pre-stressed concrete elements shall comply with the provisions of AS3600 and any other relevant reference noted in this brief

For detailed information on the specification of concrete elements refer to the Concrete Specification.

In particular take note of the curing requirements within the specification to prevent shrinkage and drying shrinkage cracking.

Structural steel

The design, material properties and construction of all structural steel elements shall comply with the provisions of AS4100 and any other relevant reference noted in this brief

For detailed information on the specification of concrete elements refer to the Structural Steel Specification.

Design Certification by Others

All the structural items are to be certified by relevant qualified designer.

Design and Certification of Waterproofing

All roofs, retaining walls, hydrostatic basement slabs, and balconies that require waterproofing will not be structurally designed to be watertight. It is not intended to rely on the inherent crack resistance of the reinforce/post-tensioned slabs and walls to resist water ingress. The crack control measures adopted for these concrete elements cannot be solely relied upon for water tightness. As such, the water tightness of the slab shall be achieved through the application of appropriate waterproofing membranes that are applied, designed, specified, and certified by another consultant.