Taylor Thomson Whitting

Structural Schematic Design Report

Darlington Road Terraces Mixed Use Building Additions and Alterations to the Darlington Road Terraces and Public Domain Improvements

Prepared for the University of Sydney / 18 Nov 2016

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Bevan Botha	Dan Taylor	Draft	P2	21 Oct 2016
Bevan Botha	Dan Taylor	Final	F1	18 Nov 2016

1.0 Introduction

TTW have been engaged by the University of Sydney as the Structural Engineers for the Darlington Road Terraces Mixed Use Building Additions and Alterations to the Darlington Road Terraces and Public Domain Improvements project.

The development site is located along Darlington Road, Darlington NSW 2008. The site is bounded by Darlington Road to the north, Golden Grove Street to the west, Darlington Lane to the south (the lane is also included in the project works), and Codrington Street to the east. The site consists of a row of thirty-eight (38) late Victorian Terraces with rear gardens backing onto Darlington Lane. The terraces that are privately owned include 88-93, 97 &120 Darlington Road.

The University of Sydney is proposing building additions and alterations to the existing Darlington Road Terraces and H66 Darlington House for mixed uses integrating affordable student accommodation and other educational establishments.

The development will also include adaptive reuse of the existing Terraces and construction of four separate mixed use buildings within the rear yards for use by residents and the wider University community.

2.0 Structural Philosophy

2.1 Existing Terraces

It is intended to re-use the existing terraces as student accommodation. The terraces are currently being used for a range of purposes including student accommodation and as University offices.

The structural system of the terraces typically comprises load-bearing brick walls supporting timber floors and timber roofs. The foundations are shallow strip footings bearing on clay.

The lean-to extensions to the rear of the original terraces is proposed for demolition. Where lean-to extensions have a common wall with privately owned terraces; the common wall is to remain and the wall returns which are proposed for demolition are to be saw cut and demolished without damaging the common wall to remain.

In the terraces there will be some additional door penetrations cut through load-bearing brick walls which will require steel lintels to frame out the openings and support the brick walls and floors above. Existing stair voids will be infilled using timber joists bearing on the existing brick walls and new steel beams as required.

In the terraces that are being used as common spaces the existing brick cross walls on the lower level are being removed to create more open spaces. The Level 1 floors and brick walls above will be re-supported on new steel beams and steel columns on new footings.

Fire rating treatment of the existing masonry walls to common terraces and private terraces is to be upgraded as described in the BCA Consultants BCA Assessment Report dated 18th November 2016. The report also identifies that the existing timber floors in the common terraces will need to be upgraded to achieve the required fire-rating whilst the timber floors in the terraces with bedrooms are not required to be fire-rated.

There will be no additional acoustic treatment to the existing floors. Existing ceilings are to be retained and any ceilings that are to be removed to gain access to other elements will need to be replaced with like for like. There will therefore be no increase in loading on floor joists due to acoustic requirements.

TTW reviewed the existing terraces timber structure for the areas where removal of lining allowed inspection of the timber members and issued the Structural Timber Remediation Report on 19 August 2016. The report included the results of the structural adequacy check and proposed remediation works of the Units 102,104,110,111,112,118 and 125 timber structures where these had been exposed.

Due to limited access, further timber inspection is required by TTW and the Timber Inspector prior to and during demolition phase in order to identify other timber members in need of replacement and also to confirm the as-built arrangement of existing structure that was not able to be inspected during the first round of inspections.

The Coffey Geotechnical Investigation measured the depth of some of the existing footings in six locations by digging trial pits. The depth of all existing footings on the rear elevation of the terraces adjacent to the new buildings will need to be confirmed prior to construction. This is required in order to ensure the excavation for the proposed new buildings will not undermine the existing buildings footings. Where there is insufficient room to safely create a temporary batter, underpinning or shoring will be required to prevent any damage to the existing terrace footings and structure.

2.2 New Buildings to Darlington Lane

2.2.1 Summary

The new student accommodation building consists of four separate structures varying from one to four suspended levels. The structures will typically be post-tensioned concrete slabs supported on reinforced concrete columns and walls. The foundations will be bored piles.

2.2.2 Foundations

A Geotechnical Inspection and Report has been prepared by Coffey, report number GEOTLCOV25176AA-AF dated 27 March 2015.

The report has found that the site consists of Fill up to 1m deep overlying Silty Clay 1.1m to 2.3m deep. Class V shale was found below the Silty Clay and groundwater was measured at the following levels:

- RL 34.8m and RL 35.6m in BH 01 (Building A).
- RL 28.8m in BH 04 (Building D).

The boreholes were not taken deep enough to establish the depth to the Class IV Shale and Class III Shale. The Geotechnical Report for the neighbouring Abercrombie Business School gives the depths to these units. The footings are proposed to be bored piles.

Piles socketed into the Class V shale are an option although will not provide an economical solution given that there appears to be stronger rock at attainable depths within the Darlington site. As such, Coffey have been re-engaged to drill an additional 2 boreholes to suitable depth in order to locate and obtain design values for Class IV and III Shale.

2.2.3 Retaining walls and Shoring

Buildings A, B and C are cut into the existing slope of the site to give partial basements in these buildings. The southern elevation is typically the same level as Darlington Lane. Low cantilevered blockwork retaining walls will be provided on this elevation as required.

It is intended to over-excavate the basement and construct the retaining walls as reinforced core-filled blockwork or reinforced concrete walls. The choice of wall will need to take into account the waterproofing of the wall and is to be confirmed by the Architect. Drainage behind the retaining walls will need to be designed and documented by the Hydraulic or Civil Engineer.

The retaining walls will be designed as either cantilevered walls where the retained height is low enough or as propped walls where the walls are higher.

At the west end of the site and adjacent Building B lift pit a 450 diameter contiguous piled shoring wall may be required to enable the excavation adjacent to the existing 132 Darlington Road building and Darlington lane respectively. The shoring requirement will ultimately depend on the final proposed extent of Building A's basement plant room and also on whether Building B lift pit construction can be coordinated with the closing of Darlington lane. The contractor will need to allow for temporary sheet piling to all other sections adjacent Darlington lane so that the ground floor can be excavated and a permanent concrete wall can be built.

2.2.4 Superstructure

The geotechnical Report has identified the presence of Highly Reactive clays, and as such the lowest slab in each building will be designed as reinforced suspended slabs. These slabs will span between ground beams supported on piles and will be cast over a collapsible void former. The Hydraulic / Civil Engineer will need to design and document the drainage lines below the basement / ground slabs to pick up any groundwater seepage and avoid any hydrostatic pressure acting on the slabs.

The upper suspended slabs will be post-tensioned concrete flat plates supported on a combination of reinforced concrete columns, shear walls, lift and stair cores.

Where possible, columns will be located within party walls on the bedroom levels and will be co-ordinated with the Architect within the common areas.

2.2.5 Lateral Stability

Lateral stability for wind and earthquake loads will be provided by reinforced concrete shear walls, lift and shear cores in both directions.

2.2.6 Structural Vibration Limits

The residential vibration levels will be designed in accordance with typical residential building criteria and outlined in the TTW Structural Performance Specification.

2.2.7 Structural Deflection Limits

Structural deflections limits will follow AS 3600 (Concrete Structures) and AS 4100 (Steel structures) except the following more stringent limits are to be complied with for concrete floor slabs as outlined in the TTW Structural Performance Specification.

Building Type	**Maximum Deflection Limit**			
	Dead	**Incremental**	**Live**	**DL + LL**
Non masonry partitions	Span/360 25mm max.	-	L/500	Span/300 30mm max
Rendered masonry partitions	-	Span/1000 or Span/750 (articulated)	L/500	-
Compactus Area	-	Span/750 (1) 10mm max	L/500	-

Notes:
(1) Maximum incremental deflections after addition of compactus

Table 1 – Concrete floor deflection limits

3.0 Australian Standards

The structure will be designed to the following Australian Standards:

AS 1720.1 – Timber Structures

AS 2159 – Piling Design and Installation

AS 3600 – Concrete Structures

AS 4100 – Steel Structures

AS 3700 – Masonry Structures

AS1170.0 – Structural Design Actions

AS1170.1 - Dead and live loads and load combinations

AS 1170.2 - Wind Actions

AS 1170.4 - Earthquake Actions in Australia

4.0 Design Loads

New structure will be designed in accordance with the loading requirements of the Australian Standards AS 1170.0 - Structural Design Actions General Principles and AS 1170.1 – Dead and live loads and load combinations.

Typical Floor Design Loads

SDL = 1.5kPa

LL = 2kPa in rooms

LL = 4kPa in corridors and common areas

LL = 3kPa on roofs (typical – No Plant)

Refer TTW Performance Specification for any additional design loads not shown here.

Slab facade loads comprising of face brick and glazing to be allowed for in conjunction with the Architects drawings. All internal walls are assumed to be lightweight partitions. No masonry wall load has been allowed for internal walls.

5.0 Fire Rating

We are designing the new structure for a FRL of 90 minutes and the relevant areas of the existing terraces to be upgraded as required to FRL of 60 minutes as per the BCA Consultants 'BCA Assessment Report' dated 18th November 2016.

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