# Structural Engineering Report

Roseville College SWELL Centre

80819303

Prepared for

Roseville College (c/- EPM)

4 October 2019

## Contact Information

**Cardno (NSW/ACT) Pty Ltd**
ABN 95 001 145 035

Level 7
203 Pacific Highway
St Leonards 2065
Australia

Phone +61 2 9496 7700
Fax +61 2 9439 5170

Author(s):

Rinay Singh

Structural Engineer

Approved By:

Kevin Leedow

Senior Structural Engineer

## Document Information

| | |
|---|---|
| Prepared for | Roseville College (c/- EPM) |
| Project Name | Roseville College SWELL Centre |
| File Reference | 80818379 DA Report |
| Job Reference | 80819303 |
| Date | 4 October 2019 |
| Version Number | 1 |
| Effective Date | 4/10/2019 |
| Date Approved | 4/10/2019 |

## Document History

| Version | Effective Date | Description of Revision | Prepared by | Reviewed by |
|---|---|---|---|---|
| 01 | 04/10/19 | DA Report | RS | KL |
| | | | | |

# Table of Contents

# 1 Introduction

Roseville College SWELL Centre construction can be described as a two storey carpark with a basement level and one semi-basement level, three roof top sports courts, storage areas, classrooms and an eight lane 25 metre swimming pool. The location of the site can be seen in figure 1-1.


**Figure 1-1 Indicative Site Plan**

The following report outlines the development of the DA design for the Roseville College SWELL Centre. It includes consideration of:

1. Engineering design guidelines for the site, including the assumed basis of design.
2. Identification of building class
3. Concept structural design
4. Structural design criteria
5. Structural infrastructure

# 2 Design Basis

The design will be undertaken in accordance with the following:

> AS 1170.0 Structural Design Principles
> AS 1170.1 Structural Design Actions (Dead and Live)
> AS 1170.2 Structural Design Actions (Wind)
> AS 1170.4 Structural Design Actions (Earthquake)
> AS 2159 Piling Code
> AS 3600 Concrete Structures Code
> AS 3700 Masonry Structures
> AS 4100 Structural Steel Code
> AS 4678 Earth Retaining Structures
> BCA Australia – Structural Provision
> BCA –Section B – Structure
> BCA – Section C – Fire Resistance

# 3 Building Classification and Fire Rating

The building has been classified as a 7a and 9b with 3 storeys. It has been conceptualised as a Type A construction with an effective height less than 20m.

Fire rating concession for the car park still needs to be confirmed by the BCA consultant.

| Roseville College SWELL Centre<br>Fire Rating Requirements | | |
|---|---|---|
| **Parameter** | **Value** | **Comments** |
| Rise in Storeys | 2 | |
| Number of Storeys | 3 | |
| Class | 7a, 9b | Building 7a - A building which is a car park.<br>Class 9b – An assembly building |
| Height of Building | < 25m | |
| Type of Construction | Type A Construction | |
| External load bearing walls and columns | 120/120/120 | |
| Load bearing internal walls, internal beams, trusses and columns | 120/-/- | |
| External columns | 120/-/- | |
| Internal walls – Load bearing Fire resisting lift shaft | 120/120/120 | Minimum concrete wall thickness 150 |
| Floors | 120/120/120 | |
| Roof | 120/60/30 | |

# 4 Design Criteria

## 4.1 Building Structure Loading

The general load design principles to comply with AS1170.0, AS1170.1, AS1170.2 and AS1170.4.

## 4.2 Floor Live Loading and Super-imposed Dead Loading

Design floor live loadings are to generally satisfy the minimum provisions of AS 1170.1 for the proposed usages.

**Basement Carpark**

- 2.5 kPa uniformly distributed Live Load (UDL)
- 1.0 kPa Services dead load

**Stairs and Lobby**

- 4.0kPa UDL
- 4.5kN Concentrated Point Load

**Plant Room Area**

- The general live loading allowance for the plant room is 5.0 kPa and 4.5 kN concentrated point load or as advised by specialist room consultant.

**Tennis Court Floor Loads**

- Dead Load = Approx. 6kPa
- Live Load = 5.0 kPa

**Classroom/Office Floor Loads**

- Dead Load = Approx. 4kPa
- Live Load = 4.0 kPa

**Roof Load**

- Dead Load = 1.0 kPa
- Live Load = 0.25 kPa

## 4.3 Tennis Court Slab Loading

The self-weight roof slab dead load:

Concrete Slab – approx. 250mm thick.

The super imposed roof slab dead load of 2.5kPa (levelling bed, cushioning and base).

## 4.4 Occupant Perceptions of Motion

Floor vibration design response to occupant activity is to generally comply with the recommendations of AS2670.

## 4.5 Cracking

Post-tensioning steel and reinforcement shall be designed to provide at least a ‘moderate’ degree of crack control in accordance with Clause 9.4.3 of AS3600. A high degree of crack control will be specified for the tennis court slab in conjunction with the architectural membrane specification.

## 4.6 Durability

All concrete elements shall have a design durability which complies with the recommendations of AS3600 for a 60-year design life.

# 5 Structural Infrastructure

## 5.1 Geotechnical Information

### 5.1.1 Subsurface Strata

Naturally occurring soil and rock was apparent at shallow depths across the subject site, residual soils generally comprised of Clays, Silty Clays and Sandy Clays between varying depths from 0.3 and 5.0m underlain by bedrock. The bedrock encountered across the subject site predominantly comprised of Shale.

The site has the following stratum depths:

- Fill – approx. 0.1m to 0.5m
- Stiff and very stiff silty clay – approx. 0.5m to 2.5m
- Bedrock – initially extremely low strength sandstone, generally increasing to medium and high strength sandstone/siltstone, with many extremely or very low strength rock bands. Below about 7 m depth, the lower strength bands are generally absent leaving medium and high strength sandstone to the bottom of the boreholes.
- No free groundwater was observed in the boreholes during push-tubing and the use of water as a flushing medium during rock coring precluded any further observations of groundwater.

### 5.1.2 Vibration and noise effects during excavation on adjacent buildings

It was noted by the geotechnical engineers that plant used for excavations could cause vibration damage to existing adjacent underground services and or structures. The following was recommended:

- Dilapidation surveys are carried out of underground services and neighbouring buildings.
- Vibration management plan setting threshold limits on peak particle velocity (PPV).
- Installation of monitoring systems for noise and vibration.

The transmitted vibrations quantitatively should be monitored during the excavation to assess the transmitted vibrations within the limit of 2mm/s2 or below for residential development. Where the transmitted vibrations are exceeded, smaller rock excavation equipment such as rock hammer, ripping hooks, rotary grinders or rock saws should be used. It is recommended that excavation using rock hammers should initially commence away from the neighbouring structures, and gradually move toward.

It is noted that medical imaging equipment located at a nearby site would require a smaller vibration limit of (<1mm/s2).

### 5.1.3 Methods of excavation

Excavation of topsoil, fill, natural clays and extremely low and very low strength rock can be removed by the use of conventional earthmoving equipment such as excavators. Excavation of medium and high strength rock will require bulldozers or hydraulic rock hammers and or ripping tynes fitted to larger excavators.

### 5.1.4 Groundwater conditions / seepage

Groundwater inflows are expected given that groundwater was encountered in BH401 and BH406. As a result, allowance for seepage and groundwater has been made in our structural design of the shoring wall with drainage along the perimeter of the structure and under the basement floor slab.

### 5.1.5 Excavation support during construction and permanent support

Where excavation is along another property the use of tied back (temporary anchors) contiguous or secant pile wall is recommended. However, taking the geotechnical advice into account, the eastern shoring can be designed as a typical shoring wall with solider piles and infill shotcrete walls. This typical shoring system will be applied to the northern, southern and western ends. The shoring walls will require temporary anchors and this requires negotiated agreement with the property owner for the right to install these into their property. The shoring wall can also be designed as a cantilever system, thus removing the requirements of installing temporary anchors.

### 5.1.6 Footing design parameters

Based on the geotechnical investigations, it is anticipated that at the base of the proposed excavation medium strength bedrock (sandstone/siltstone) will be exposed. As a result, strip or spread high level footings can be considered for supporting structures. Design will be based 3.5MPa end bearing pressure for high-level footings.

## 5.2 Foundations and Shoring

The shoring wall have piers with diameters of 600mm and spaced at 2400mm centres. The pile cap beam along the perimeter will generally be 700mm deep and 600 mm wide. These beams will carry slab/beam loads. The shoring piles will be temporary anchored and infilled with shotcrete. Alternatively, the shoring piles can be design as cantilevers to avoid the requirement of temporary anchors.

## 5.3 Levels 2 and 3.

Level 2 and 3 slabs will comprise of a suspended post tension slab/band system with one-way spanning slabs. The slab thickness is generally 250 mm. The bands are generally 450mm deep and 2400 mm wide. The maximum span of slabs and beams in these areas is 8.5m.

The beams over the swimming pool will have a depth of 1700mm and a tapered width of 1000mm at the top and 750mm at the bottom. The maximum span for the beam is 30m.

A propriety product called Ancon shear connectors will support the concrete slab and beams in Levels 2 and 3. These shear connectors will be installed after the piers have been casted. The advantages of this system is that they are simpler to install, ensure the necessary alignment required for movement and has a neater look and finish.

A corbelled expansion joint with a metal drain under the soffit of level 3 will be required. This is located approximately 3000mm to the east of gridline 4.

## 5.4 Level 1

Level 1 is detailed as a reinforced concrete slab on grade (with joints) with a nominal thickness of 150mm. This area will have shale and hence it is appropriate to adopt a reinforced concrete slab on ground in this area. The columns designed for this area will be founded on pad footings due to having bedrock at that depth.

## 5.5 Concrete Columns and Walls

The columns are detailed to carry building loads and to achieve 120-minute fire rating as stipulated in the BCA report.

The columns are typically 1000mm x 250mm and 500mm x 500mm with concrete strength 65 MPa. The columns supporting the beams above the pool will be 1500mm x 750mm with a concrete strength 50 MPa.

The lift walls and stair shaft are 180mm - 200 mm thick walls with concrete strength 32 MPa internally and 40 MPa where exposed.

## 5.6 Concrete Stairs

Concrete stairs will have a throat thickness of 230/250 mm and concrete strength 32 MPa. These stairs are supported at the landing level on a corbel/building joint at the slab levels.

## 5.7 Class Room Roof Structure

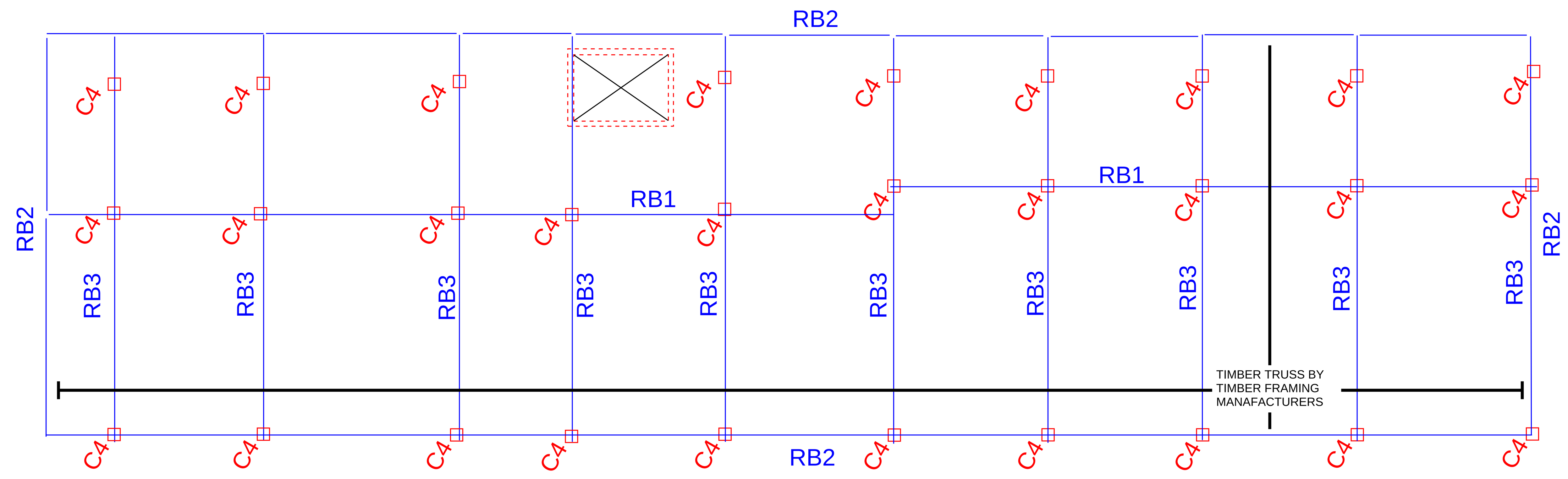
Rafters designed for the roof structure will comprise of 250UB25 and 310UB32 Steel Beams. The beams are supported by 100x100x6 SHS columns.

Timber trusses will be used to form the ridges/hips in the roof.

# 6 Appendices

## 6.1 Appendix A

| MARK | TYPE | SIZE | COMMENTS |
|---|---|---|---|
| RB1 | Roof Beam | 310UB32 | |
| RB2 | Roof Beam | 250UB25 | |
| RB3 | Roof Beam | 250UB25 | |
| C4 | Steel Column | 100x100x6 SHS | |

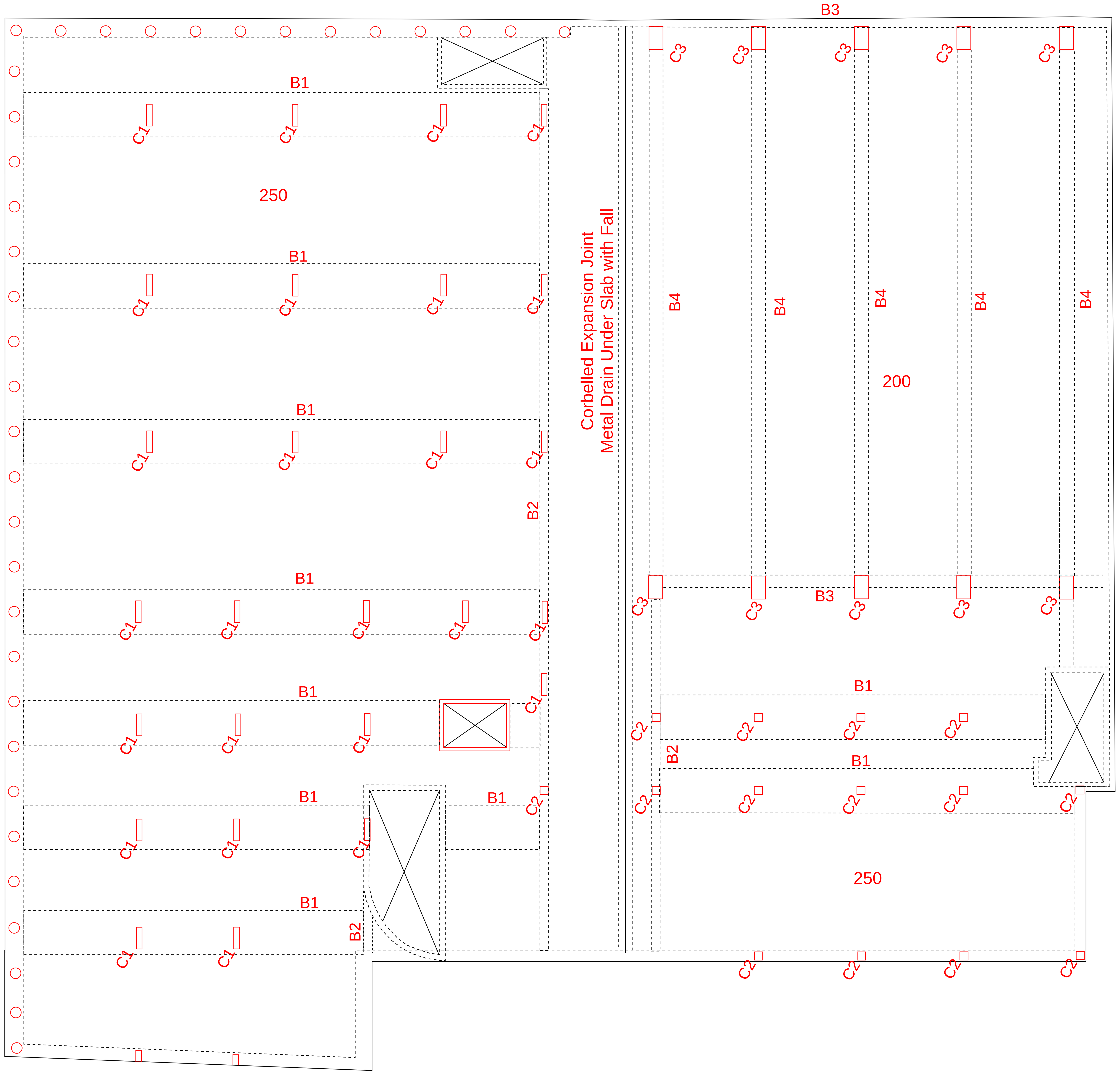



Cardno
Shaping the Future


Consulting Engineers
(A.C.N. 002 419 525 Incorporated in NSW)
Level 9, The Forum
203 Pacific Highway St Leonards NSW 2065
Telephone: (02) 9496 7700
Facsimile: (02) 9499 3902
Email: clh@cardno.com.au


| | |
|---|---|
| Project: **ROSEVILLE COLLEGE SWELL CENTRE** | Date: **OCTOBER 2019** |
| | Scale: **1:100 @ A0** |
| Drawing: **ROOF PLAN – DA SUBMISSION** | Job No: **808 19 303** |
| Architect: **BREWSTER HJORTH ARCHITECTS** | Drawing No: **SK 03** Issue **1** |

| MARK | TYPE | SIZE | COMMENTS |
|---|---|---|---|
| B1 | Beam | 2400(W) x 400 (D) | No Transfer |
| B2 | Beam | 500(W) x 600 (D) | No Transfer |
| B3 | Beam | 900(W) x 600 (D) | No Transfer |
| B4 | Beam | 1500(W) x 1700 (D) | Tapered 1500mm (W) Top 750mm (W) Bottom |
| C1 | Concrete Column | 1000 x 250 | Allowed for a total of 4 floors (1 additional floor) F'c = 65MPa |
| C2 | Concrete Column | 500 x 500 | Allowed for a total of 4 floors (1 additional floor) F'c = 65MPa |
| C3 | Concrete Column | 1500 x 750 | |

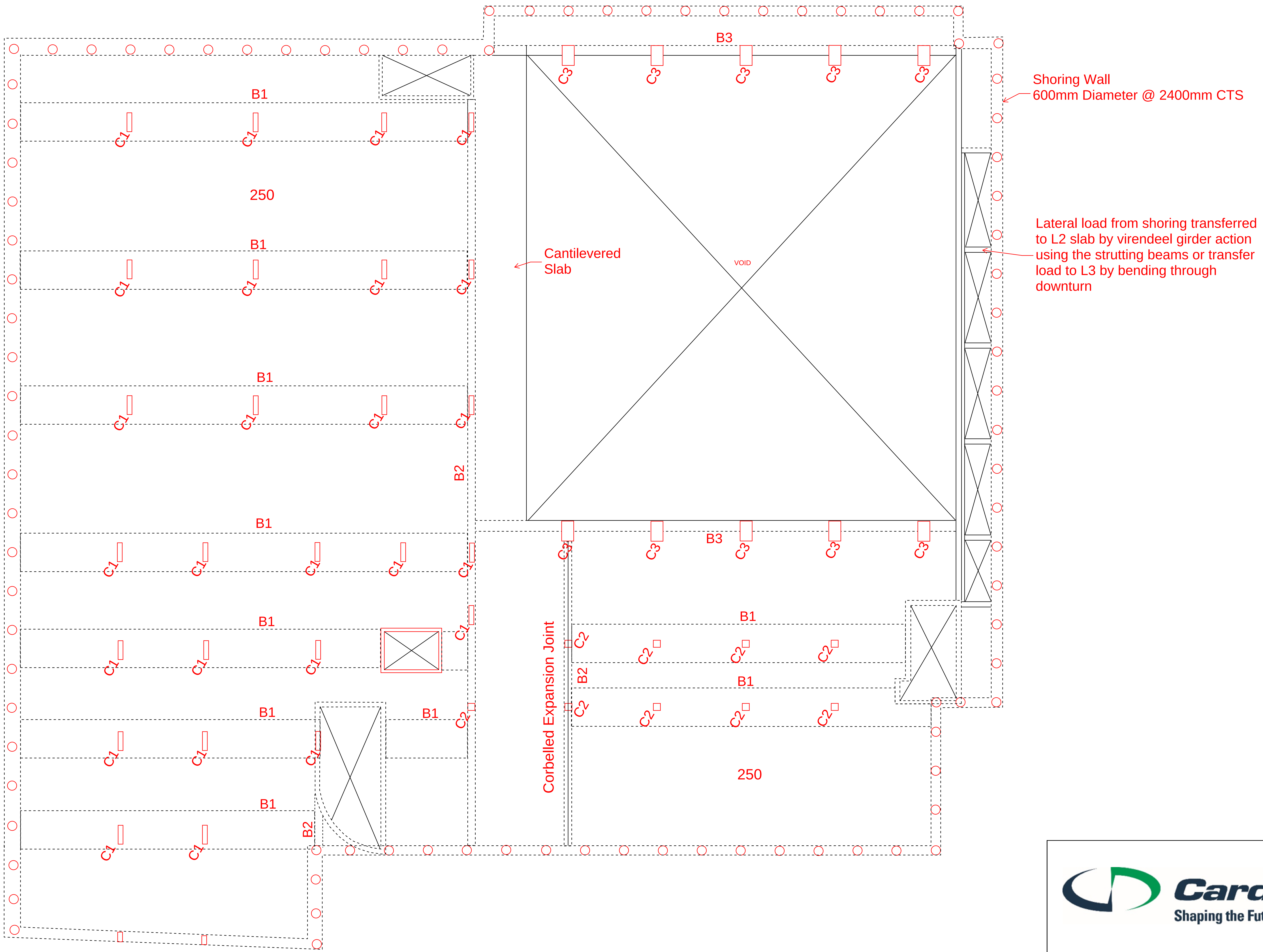



Consulting Engineers
(A.C.N. 002 419 525 Incorporated in NSW)
Level 9, The Forum
203 Pacific Highway St Leonards NSW 2065
Telephone: (02) 9496 7700
Facsimile: (02) 9499 3902
Email: clh@cardno.com.au

Cardno
Shaping the Future

| | |
|---|---|
| Project: ROSEVILLE COLLEGE SWELL CENTRE | Date: OCTOBER 2019 |
| | Scale: 1:100 @ A0 |
| Drawing: LEVEL 3 SLAB PLAN – DA SUBMISSION | Job No: 808 19 303 |
| Architect: BREWSTER HJORTH ARCHITECTS | Drawing No: SK 02 — Issue: 1 |

| MARK | TYPE | SIZE | COMMENTS |
|---|---|---|---|
| B1 | Beam | 2400(W) x 400 (D) | No Transfer |
| B2 | Beam | 500(W) x 600 (D) | No Transfer |
| B3 | Beam | 900(W) x 600 (D) | No Transfer |
| C1 | Concrete Column | 1000 x 250 | Allowed for a total of 4 floors (1 additional floor) F'c = 65MPa |
| C2 | Concrete Column | 500 x 500 | Allowed for a total of 4 floors (1 additional floor) F'c = 65MPa |
| C3 | Concrete Column | 1500 x 750 | |





Cardno
Shaping the Future

Consulting Engineers
(A.C.N. 002 419 525 Incorporated in NSW)
Level 9, The Forum
203 Pacific Highway St Leonards NSW 2065
Telephone: (02) 9496 7700
Facsimile: (02) 9499 3902
Email: clh@cardno.com.au


| | |
|---|---|
| Project: **ROSEVILLE COLLEGE SWELL CENTRE** | Date: **OCTOBER 2019** |
| | Scale: **1:100 @ A0** |
| Drawing: **LEVEL 2 SLAB PLAN – DA SUBMISSION** | Job No: **808 19 303** |
| Architect: **BREWSTER HJORTH ARCHITECTS** | Drawing No: **SK 01** Issue **1** |