BOWRAL AND DISTRICT HOSPITAL REDEVELOPMENT

STATE SIGNIFICANT DEVELOPMENT APPLICATION – STRUCTURAL DESIGN REPORT

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Executive Summary

The purpose of this report is to present the structural engineering design associated with the State Significant Development Application (SSDA) for the Bowral and District Hospital Redevelopment. This report describes the proposed structural engineering strategy to meet the requirements of the Bowral and District Hospital architectural plans that have been developed by McConnel Smith and Johnson covering the following:

- Condition of existing structures and suitability for re-use in future phases;
- Structural engineering options for the proposed new buildings;
- Interaction of proposed new structures with existing hospital structures;
- Key structural engineering issues and risks.

This Structural Design Report has been prepared to set the basis of the structural engineering requirements for the proposed development works on the site for the delivery phase of the project.

The structural principles and schemes developed during the design phase of the project specifically address issues including:

- The new structures will utilise the HI systemised design approach with column grids at 8.4m x 8.4m centres to maximise efficiency and flexibility where possible;
- Design in accordance with HI floor vibration requirements (i.e. RF = 2 performance typically in all areas & RF = 1 performance in operating theatre areas, etc. and other vibration sensitive areas);
- Structure to be efficient and make adequate allowance for future flexibility in accordance with HI guidelines. A 50mm thick non-structural topping screed to be provided in all areas (except for plant areas and the Ground Floor) typically to allow for future flexibility. The lateral structural system is to consist of a hybrid shear wall/sway frame system utilising the lift/stair core walls in combination with sway frame action from concrete columns and floorplates;
- Structural systems will need to be developed to minimise disruption to existing services on site.

The proposed structural system for the development is as follows:

- A piled foundation system (as per the geotechnical advice) with a suspended concrete Ground floor slab or stiffened concrete raft slab system.
- The new building will be a concrete framed building with post-tensioned suspended concrete floorplates and a lightweight steel roof typically.
- Hybrid shear wall/sway frame lateral system.

The works to date have undertaken non-invasive investigations of the relevant existing structures to confirm the suitability for refurbishment and identification of structural systems to provide input into demolition requirements of these buildings. However, it is noted that as is the case with all works on existing structures, until construction works are commenced and the existing structure fully exposed, there remains a risk of additional structural works being required due to the unexpected deterioration or arrangement of existing structure. To minimise this risk, ongoing investigation into the existing structures has been undertaken during the development of the structural design, however the risk cannot be eliminated until such time as the structure is completely exposed during construction works.

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1 Introduction

enstruct group have been engaged by Health Infrastructure NSW (HI) as civil and structural engineering consultant on the Bowral and District Hospital Redevelopment planning project.

This report outlines and assess the condition of existing structural assets on site and provides outline structural guidance to meet the requirements of the proposed works for this project.

This report is based on the works undertaken to date with the project team and a walkover site inspection carried out by Tim Boulton (Director) and Brian Healy (Senior Associate) on 3rd May 2016 and a review of available structural documentation.

This report confirms the structural framework for the proposed works on site and outlines the structural design principles for the preferred development option as discussed in this report.

2 Available Documents for Existing Structures

A small number of structural engineering drawings of the existing construction where found to be held by the maintenance engineers on the site, however documentation for a number of buildings could not be located and hence a full set of documents was not found to be available. The following is a summary of buildings for which existing Structural documentation was found on site with varying ranges of completeness:

- Paeds & SSU Refurbishment
- New Cardiac Centre (Watson Building Extension);
- Maternity Block Fire Escape Stairs;
- Medical Imaging Building;

We note also that there are a number of additional drawings held by the NSW Department of Public Works however these drawings were not available for review at the time of writing of this report.

Given the number of buildings on site and age of facilities (original building constructed over 100 years ago), it is expected that there will be a number of existing buildings for which documentation will not be available.

While the drawings gathered to date by no means form a complete set of all drawings, in combination with the site inspection undertaken to date by enstruct they provide sufficient coverage to allow an appropriate understanding of the structural works required at this planning phase within existing structures or for new works abutting existing structures. These drawings, supported by ongoing specific on site confirmation inspections and investigative works provide sufficient detail to facilitate the detailed design of interfaces between the new and existing structures.

3 Site Existing Conditions

3.1 Geotechnical Conditions

To assist with this planning phase of the project, HI have commissioned Douglas Partners to undertake a geotechnical investigation of geotechnical, groundwater, soil contamination and hazardous building material risks on the site. A detailed geotechnical investigation and geotechnical report was completed by Douglas Partners in October 2016. The following summary of site geotechnical conditions is provided in the Douglas Partners report:

The proposed upgrade is to be located in the northern section of the grounds of Bowral & District Hospital (Lot 4 in DP858938), access from the southern side of Bowral Street at Bowral. Maximum north-south and east-west dimensions of the development area are approximately 90 metres and 100 metres respectively. Surface levels fall in the northerly direction (i.e. towards Bowral Street) at grades of 1 in 35 to 1 in 60 with an overall difference in level estimated to be about 2 metres from the highest point of the development footprint to the lowest. The site is bounded to the north by Bowral Street, to the west by Southern Highlands Private Hospital, to the south by existing hospital buildings and to the east by lightly grassed hospital grounds. At the time of the investigation, the building footprint comprised a single level hospital building and asphalt paved car park. The remainder of the footprint was lightly grassed.

Reference to the 1:100,000 Southern Coalfield Regional Geology Sheet indicates that the site is underlain by rocks belonging to the Wianamatta Group of Triassic age. This formation typically comprises shale, laminate and siltstone. The results of the field investigation were consistent with the broad-scale geological mapping with sandstone or shale intersected in seven of the eight boreholes.

The only previous geotechnical information that is available at this point of the project is a previous geotechnical report carried out by Auswide Geotechnical for the Maternity Block Fire Escape project dated 28th July 2000. A copy of this report is contained in the enstruct Structural Concept Design Report.

The following is a summary of the findings of the above available geotechnical investigations:

- Geotechnical report by Douglas Partners (dated October 2016):
  - Geology – Reference to the 1:100,000 Southern Coalfield Regional Geology Sheet indicates that the site is underlain by rocks belonging to the Wianamatta Group of Triassic age. This formation typically comprises shale, laminate and siltstone;
  - Site Classification in accordance with AS2870 – Residential Slabs and Footings Code – Due to the presence of filling of variable composition and consistency to depths in excess of 0.4m (in part) and variable strength of the natural clay, the site (at the time of investigation) is classified as Class P in accordance with the requirements of AS2870-2011. Notwithstanding the P classification, the underlying stiff clay profile would be equivalent to Class M (moderately reactive) conditions.
  - Average Soil Profile:
    - 0.0m to 1.5m – Fill;
    - 1.5m to 3.3m – Silty Clay;
    - 1.5m to 6m – Bedrock (Shale).
  - Groundwater – Free groundwater was observed at depths of 1.1m (RL 679) and 1.2m (RL 678.4) in two boreholes during drilling. No free groundwater was observed in the remaining boreholes during auger drilling. It is noted that the use of water as a drilling fluid precluded groundwater observations whilst coring. Furthermore, all boreholes were backfilled following the field work which precluded long term monitoring of groundwater level. Groundwater levels are dependent on preceding climatic conditions and soil permeability and can therefore fluctuate with time.
- Auswide Geotechnical Report for the Maternity Block Fire Escape project (dated 28th July 2000):
  - Site Classification in accordance with AS2870 – Residential Slabs and Footings Code – Site classification of the existing clay was expected to be in the range of a Class M site in accordance with AS2870, however the presence of fill gave the site an overall classification of P;
  - Average Soil Profile:
    - 0.0m to 0.8m – Fill;
    - 0.8m to 1.5m – Firm Sandy Clay;
    - 1.5m to 2.5m – Stiff to very Stiff Sandy Clay;
    - 2.5m to 5.0m – Extremely Weathered Shale.
  - Groundwater – No groundwater table was encountered during drilling;
  - Allowable Bearing Pressures – 600kPa to extremely weathered rock.

All existing buildings inspected on site have been found to be founded on either high level pad foundations or integral raft/slab foundations. The inspection of these buildings found that they appear to be performing satisfactorily with no evidence of damage of any significance due to foundation movement.

3.2 Existing Buildings

During the Master Plan phase of the project, enstruct has undertaken a walk through inspection of all existing buildings on site identified as possibly being impacted by the redevelopment works.

The inspection of the existing buildings was limited to a walk through site inspection and review of structural drawings available (Note: not all buildings had structural drawings available) and was not a detailed or invasive inspection.

The following are the buildings that were inspected during the Master Plan phase with details contained in the enstruct Structural Master Plan Site and Option Assessment Report:

- Old Hospital;
- University of Wollongong Building (Old Hospital);
- Berrima Cottage/Mental Health;
- Emergency Accommodation Units;
- Staff Amenities/Outpatients Building;
- Watson Building;
- Stores/Linen/Maintenance/Kitchen;
- Administration Building (New Hospital);
- Milton Park Building;
- Medical Imaging;
- Emergency.

4 Structural Engineering Design Principles

All new structures will utilise the HI systemised design approach and be designed in accordance with the following structural principles and parameters.

4.1 Design Standards

The structural design shall be in accordance with the latest revision of all relevant structural Australian Standards, relevant structural sections of the BCA and other statutory requirements.

In particular the structural design will be in accordance with the following relevant Australian Standards:

- AS/NZS 1170.0 (2002) – Structural Design Actions Part 0 General Principles
- AS/NZS 1170.1 (2002) – Structural Design Actions Part 1 Permanent, Imposed and Other Actions
- AS/NZS 1170.2 (2011) – Structural Design Actions Part 2 Wind Loads
- AS 1170.4 (2007) – Structural Design Actions Part 4 Earthquake Actions in Australia
- AS 2159 (2009) – Piling – Design and Installation
- AS 2670.1 (2001) – Evaluation of Human Exposure to Whole-Body Vibration – General Requirements
- AS 2670.2 (1990) – Evaluation of Human Exposure to Whole-Body Vibration – Continuous and Shock-Induced Vibration in Buildings (1 to 80Hz)
- AS 3600 (2009) – Concrete Structures
- AS 3700 (2011) – Masonry Code
- AS 4100(1998) – Steel Structures
- AS 4678 (2002) – Earth Retaining Structures

4.2 Design Life

The building structure will be designed to provide adequate performance for a minimum period of 50 years with a typical structural maintenance system.

4.3 Materials

The following structural materials are proposed to be used in the works. Typical values for the properties of these materials are listed. These values are to be adjusted where appropriate.

4.3.1 Concrete

4.3.1.1 Properties

Co-efficient of thermal expansion	12×10^{-6} per ^{0}C
Basic shrinkage strain	In accordance with AS 3600 Clause 3.1.7
Basic creep factor	In accordance with AS 3600 Clause 3.1.8
Poisson's ratio	0.2
Density	24 kN/m^3

4.3.1.2 Proposed Concrete Grades

Footings	40MPa
Suspended Slabs and Beam	40MPa
Columns	40 to 50MPa
Walls	40 to 50MPa
Other areas (UNO)	40MPa

4.3.2 Reinforcement

4.3.2.1 Properties

Plain bars (R)	fsy = 250 MPa
Deformed bars (N)	fsy = 500 MPa
Welded wire fabric (L)	fsy = 500 MPa
Young's modulus	200 x 10^3 MPa

4.3.3 Structural steel

4.3.3.1 Properties

Grade (UNO)	300MPa
Steelwork density:	7850 kg/m^3
Young's modulus:	2.05 x 10^5 MPa
Poisson's ratio:	0.3
Coefficient of thermal expansion:	12 x 10 $^{-6}$

4.3.4 Blockwork

4.3.4.1 Properties

Characteristic Strength	15 MPa.	
Mortar mix (cement:lime:sand)	1 : 1 : 6	Unreinforced Blockwork
	1 :0.5: 4.5	Reinforced Blockwork
Core fill grout	25 MPa	

4.4 Loading

4.4.1 Vertical

- Typical Floor Areas:
  - SDL = 1.8kPa (excluding sacrificial topping);
  - LL = 3.0kPa;
- Plantrooms:
  - SDL = 2.5kPa;
  - LL = 7.5kPa;
- Stairs:
  - SDL = 0kPa;
  - LL = 4.0kPa;
- Toilets/Bathrooms/Kitchens:
  - SDL = 1.8kPa (excluding sacrificial topping);
  - LL = 2.0kPa;
- Non-Trafficable Metal Deck Roof Areas:
  - SDL = 0.5kPa;
  - LL = 0.25kPa;
- Trafficable Concrete Roof Areas:
  - SDL = 2.5kPa;
  - LL = 4.0kPa

4.4.2 Wind

Wind loading is in accordance with AS/NZS 1170.2 – Structural Design Actions – Wind Actions with the following parameters:

- Annual probability of exceedance – 1:2000;
- Region A2;
- V_{2000} – 48m/s;
- Terrain Category TC3.

4.4.3 Robustness

Robustness loading in accordance with AS/NZS 1170.0 – Structural Design Actions General Principles with the following parameters:

- 1.5% of (G + ψ_cQ) load case;

4.4.4 Earthquake

Earthquake loading in accordance with AS 1170.4 – Structural Design Actions – Earthquake Actions for Australia with the following parameters:

- Annual probability of exceedance – 1:1500;
- k_p = 1.5;
- Z = 0.09;
- Class C_e;
- Earthquake Design Category II;
- Static Analysis allowed, however Dynamic Analysis will be used.

4.5 Serviceability

4.5.1 Deflection limits

4.5.1.1 Vertical

Maximum vertical deflections shall be in accordance with Table 2.3.2 of AS 3600 – 2009.

4.5.1.2 Lateral

The lateral drift of the building will be limited to the following:

- Under Serviceability Wind Actions – Height/500
- Under Earthquake Actions (AS 1170.4 clause 7.5) – Height/67

4.5.2 Floor Vibrations

The design of the floor structure will ensure that vibration due to footfall excitation is kept within acceptable limits. These limits will be based on Health Infrastructure Design Guidance Note 1 – Structural Design Criteria Guidelines (refer Appendix A) and the recommendations of AS 2670.2 adjusted for the intended occupancy and approximate duration of vibration. The vibration design parameters for the project will be as follows:

Area	Damping	Footfall Frequency (Hz)	Sacrificial Topping Considered Structurally	Response Factor
Clinical Areas	2.5%	2.1Hz Typically 2.5Hz Corridors	Yes	2
Operating Theatres/ Imaging Areas/ Procedural Areas	2.5%	2.1Hz	Yes	1
Plantrooms and External Areas	Not Considered			

A structural solution for minimising the structural floor plate system in areas required RF=1 performance if the provision of steel serviceability posts connecting the floor to either the adjacent floor above or below to mobilise additional mass and stiffness to achieve the RF=1 performance. This is expected to allow the entire concrete floor plate to be designed for RF=2 with the steel serviceability posts increasing vibration performance in the areas required without structural slab depth and cost penalty and providing full future flexibility for operating theatre relocation.

During the design stage of the project, structural systems have been developed for concrete floor plates to achieve RF=1 in all Operating Theatre/Imaging/Procedural Areas and other inpatient areas to achieve RF=2 and a review with HI and the project team undertaken to compare this with the structural option of the provision of steel serviceability post in areas requiring increased vibration performance to determine the preferred approach.

All equipment which may be a possible source of vibration will be isolated from the structure through the provision of isolation mounts.

4.6 Fire resistance levels for structural elements

Fire resistance levels for structural elements will be in accordance with the structural requirements of the BCA and will developed with the project BCA consultant. Design of individual structural elements to achieve the required FRL will be in accordance with the appropriate materials design code.

4.7 Foundations

Given the size of the proposed new building (up to 3 storeys), the geotechnical design advice from Douglas Partners recommends that the proposed new building be supported by piled foundations that bear onto the underlying bedrock. The geotechnical engineer has advised that if the foundation system for the new building was a raft slab founded in the upper residual clay, the settlements (both total and differential) would be beyond tolerable limits for the structure due to the magnitude of the proposed loads. Accordingly, it has been advised by the geotechnical engineer that all footings found on a uniform bearing stratum of low to medium strength rock. The main advantage with founding on rock is that settlements (both total and differential) would be negligible under the anticipated loads.

It has also been noted by the geotechnical engineer that due to the presence of seepage at relatively shallow depths, allowance should be made for the inclusion of temporary or permanent casing to mitigate groundwater inflow and provide sidewall stability in the overburden soils. Socket adhesion is to be neglected over those sections which are cased. Socket adhesion should also be neglected in the overburden clays.

4.8 Retaining Walls

The structural and civil design has focused on avoiding retaining walls for the project where possible. Systems available for areas that may require site retention will be:

- Batter slope in areas with sufficient space available to avoid retaining walls;
- Cantilevered reinforced blockwork retaining wall on high level reinforced concrete strip footing, suitable for heights up to approximately 2.4m;
- Propped reinforced blockwork or concrete retaining wall on high level reinforced concrete strip footing, suitable for heights up to approximately 4.5m;
- Piled retaining walls of either soldier pile with shotcrete infill or contiguous pile construction.

4.9 Lateral System

Lateral structure for the new building will be a hybrid system of the reinforced concrete shear walls (utilising stair and lift shafts required by planning) and the sway frame structure (utilising the stiffness of the floor plate and building columns). The lateral structure for the building will be further developed as the planning progresses into detailed design with definition of stair and lift core locations.

4.10 Vertical Structure

All columns for the primary building structure will be constructed from reinforced concrete with columns for lightweight structures (i.e. plantroom roofs etc.) also to be reinforced concrete columns.

4.11 Column Grid

In accordance with HI Design Guidance Note 1 – Structural Design Criteria Guidelines the column grid across the new buildings will be 8.4m x 8.4m typically. The architectural floor layout has several areas where the typical columns grid of 8.4m x 8.4m has not been adhered to with column grids less than 8.4m in these areas. The areas that deviate from the typical column grid of 8.4m x 8.4m has been discussed and agreed with the ERG as acceptable due to the size of the building.

4.12 Ground Level Floorplate

The area of the Ground Level floorplate that has been allocated to future ED will be designed and constructed at a future date that is beyond the scope of this project. The structure above the future ED will be designed and constructed as part of the works to allow for the future ED area to be used for carparking temporarily. Provisions in the Ground Level floorplate will need to be provided to ensure that the interface between the Ground Level floorplate and the future floorplate of the future ED has been appropriately designed and allowed for. This may include (but not limited to) reinforcement bar couplers, roughening of the interface surface, provision of appropriate differential movements, etc.

The Ground Level floorplate has currently been designed to be a post-tensioned suspended floorplate consisting of post-tensioned concrete band beams in one direction with one way post-tensioned concrete slabs spanning in the other direction. Due to the presence of filling of variable composition and consistency to depths in excess of 0.4m (in part) and variable strength of the natural clay, the site (at the time of the investigation) is classified as a Class P site in accordance with the requirements of AS 2870-2011 "*Residential Slabs and Footings*".

To account for the reactive soil movements and reduce restraint to the post-tensioned floorplate, a layer of collapsible void former will be required between the Ground Level floorplate and the natural fill/soils to ensure that there is an air void between the Ground Level floorplate and natural fill/soils in the permanent condition.

An alternative option that has been proposed for the Ground Level Floorplate is a stiffened raft slab system that has been designed in accordance with the requirements of AS 2870-2011 "*Residential Slabs and Footings*". For this alternative option, the existing fill will need to be excavated and replaced with compacted fill prepared in accordance with the recommendations of the Douglas Partners geotechnical report to ensure that the site satisfies the requirements of a Class M site classification as per AS2870-2011.

Further assessment and review of these Ground floor slab options for the project will be undertaken with key members of the project team (i.e. project manager, cost consultant and geotechnical engineer) during the next phase of the project to determine which Ground floor slab option will be used after review of parameters such as cost, feasibility, buildability, etc

4.13 Suspended Floor Plate

It is proposed that the suspended floor plates (Levels 1, 2 and 3) be designed to achieve vibration performance of response factor 2.0 throughout with strengthening at areas requiring increased vibration performance (e.g. Operating Theatres on Level 1) via increased structural depth in the floorplate to improve vibration performance. This option has been chosen instead of utilising serviceability posts as the Ground Level area allocated to future ED will be designed and constructed at a later date. Areas which will require increased vibration performance are those which either house sensitive equipment, (i.e. areas medical imaging) and areas in which invasive procedures are undertaken (i.e. operating theatres).

The following options for floorplate structural systems that were considered for the project are listed below:

- Reinforced or post tensioned concrete flat slab with drop panels at columns;
- Reinforced or post tensioned concrete band beams in short direction of the floor plate with one way slabs in the long direction of the floor plate;
- Reinforced or post tensioned concrete band beams in long direction of the floor plate with one way slabs in the short direction of the floor plate;
- Steel framed floor plate (composite and non-composite depending on decking profile) with concrete slab formed on self-supporting on metal decking.

The suspended floorplates have currently been designed to be post-tensioned floorplates consisting of post-tensioned concrete band beams in one direction with one way post-tensioned concrete slabs spanning in the other direction. This floorplate structural system was chosen due to the cost efficiency and ease of construction of a post-tensioned band beam and one way slab system.

The floor plates will be designed to allow for future penetrations to maintain the future flexibility of the structure in accordance with Health Infrastructure Design Guidance Note 1 – Structural Design Criteria Guidelines.

Movement joints will be required where the new and existing facilities interconnect and these will need to allow for earthquake and wind loading movements

4.14 Non-Structural Screed

4.14.1 Ground Level Floorplate

It is proposed that no allowance for a non-structural screed be provided on the Ground Level floorplate given that for any new wet areas the structural slab will have to be demolished to allow for the installation of new hydraulic services and when the slab is re-constructed it can be built with the necessary set-downs.

4.14.2 Suspended Floor Plate

A non-structural zone of 50mm is to be provided on all suspended floor plates (excluding plant areas) in accordance with the Health Infrastructure Design Guidance Note 1 – Structural Design Criteria Guidelines. This non-structural screed is to be cast integrally with the structural slab to avoid having a second concrete pour and finish with a post applied screed, resulting in program and cost benefits for the project. To accommodate the integral non-structural zone the top cover to all reinforcing and post tensioning will be set at 70mm to ensure that in locations were the non-structural zone is removed 20mm cover (code minimum) is maintained. To allow the removal of the integral non-structural zone in the future saw cutting at close centres will be required to ensure that removal of the zone does not extend past the 50mm allowed zone;

4.15 Lifts and Stairs

Internal stair shafts and lift shafts will be constructed from either precast or in-situ reinforced concrete walls, expected to be approximately 200mm to 250mm thick.

All stairs will be constructed from reinforced concrete with the construction methodology to be either cast in-situ, stairmaster (or similar light gauge steel form system) or precast.

4.16 Roof Structure

Current planning allows for concrete slabs to be provided at roof level of all clinical areas of new buildings with the roof structure over the concrete slabs to be a lightweight steel roof fixed off the concrete slab with the steel roof cladding providing water tightness.

As part of the review of potential cost savings for the project during the design phase, it was proposed that the concrete roof slab with lightweight steel roof over would be replaced with a lightweight steel roof only for the northern wing of the proposed new building only. The option were assessed and reviewed by key members of the project team (i.e. project manager, cost consultant, etc.) and it was determined that the project would proceed with the option to have a lightweight steel roof only (without concrete roof slab) for the northern wing of the building.

All other roof structures such as plantrooms (or similar) will be portal type steel framed structures supported off the concrete slab below and clad with lightweight cladding.

4.17 Green Star

Structural influence on Green Star targets for a building of this nature is limited to the following criteria:

- Mat-5 Concrete;
- Mat-6 Steel.

The points targeted for these items should be those which have nil or negligible impact on the project structural cost. Outlined below are the points that we would recommend be targeted for the project with nil or minimal cost impact on the project.

4.17.1 Mat-5 Concrete

Given the location of the project and size of local concrete suppliers it is expected that the existing local concrete plants would not have the bin and silo arrangement required to readily accommodate the use of supplementary materials for the binder and replacement recycled products for the concrete aggregates. On this basis we would recommend that only 1 Green Star point be targeted for the Mat-5 Concrete credit, with one point for aggregate replacement.

4.17.2 Mat-6 Steel

For a building of this nature we would recommend that 1 Green Star point be targeted for the Mat-6 Steel credit by requiring the following of the reinforcing used in the project;

- At least 95% of reinforcing is sourced from a responsible steel maker;
- At least 95% of all reinforcing bar and mesh meets or exceeds 500MPa strength grade, and at least 60% of all reinforcing steel is produced using energy-reducing processes in its manufacture.

4.18 Links between New and Existing Structures

Connections will be required between the new and existing structures. These links will be designed to be either connected to the new building structure or free standing subject to development of the planning for these links, with either arrangements the link structures will be independent of the existing building structure to ensure that there is no modification to the existing structural loading and arrangement. As the link will be independent of the existing building a movement joint will be provided at the junction between the new link structure and the existing building structure. The movement joint will be detailed to accommodate all building movements, i.e. wind and earthquake loading, for both serviceability and ultimate limit state loading conditions.

The location of the link connection to the existing structure will need to avoid existing steel/concrete columns supporting the existing roof structure to ensure that modification works to the existing building structure can be avoided with the works to the existing building limited to the creation of an opening to allow for the link between the buildings.

4.19 Future Expansion

Structurally it is preferred that allowances for future expansion be made for horizontally. Vertical expansion over existing structures can cause disruptions to the operating facilities below.

To maximise site utilisation, it is preferable that the new building be constructed to maximum height in this first phase of development to avoid the need for vertical expansion of additional floor space over an operating clinical area. Where this is not possible and vertical expansion is required, special provisions will be required in the design and construction of the initial structure to minimise the impact on the existing facilities during the construction of subsequent phases. In the design phase of the proposed new building, allowances have been made in the structure to allow for a maximum 3 storey building to accommodate potential future expansion in the northern wing of the new building.

5 Key Delivery, Staging and Procurement Issues

5.1 Interface Issues with Existing Structure

The development of the relationship between the new and existing structures will need to ensure that construction activities can be effectively undertaken without cost or program penalty while ensuring that the existing hospital continues to function without impact to services. Key structural items for consideration are as follows:

- Provision of sufficient separation between new and existing structures to ensure that noise and vibration generated by the construction works is controlled to an acceptable level within the existing hospital areas;
- Arrangement of new works or phasing of works must ensure that unencumbered ambulance access to the hospital is maintained at all stages of works;
- Development of layout for new works ensuring that materials handling and staging areas can be readily provided adjacent to the works area in a location that is removed from the existing hospital operations to allow the contractor to operate independently of the existing hospital. This layout also needs to consider material handling requirements ensuring that the number of cranes and alimak is minimized without impacting on construction efficiencies.

All new structures will be designed to be supported independently of existing structures ensuring that all new works are compliant with current code and legislative requirements which avoids the potential need to provide upgrading to existing structures that do not comply with current code requirements to achieve building certification.

Movement joints will be provided between all existing and new structural interfaces with these joints designed to ensure that all required strength is maintained under ultimate loading conditions (movement in rare and major structural loading events, i.e. earthquake) and that the joint and surrounding non-structural elements remain serviceable during serviceability events (movement that is expected to occur on numerous occasions throughout the building life, i.e. 25 year return period wind loading), these movements will be clearly nominated on the structural drawings to ensure that all members of the design team are able to incorporate into their relevant design elements.

5.2 Staging and Constructability Issues

Key structural staging issues are as follows:

- Ensuring that packages of works can be completed within single mobilisations and as one construction activity. These works should be planned to ensure that they can be undertaken essentially as single construction activity moving between stages of works to avoid multiple site mobilisations which will minimise project cost and program;
- Provision of sufficient clearance between new and existing works to allow efficient construction – New free standing buildings can be built abutting existing structures with a project cost and program, given the Master Plan demonstrates sufficient site areas for future phases of development project cost and program efficiencies will be achieved via the provision of adequate separation between new and existing buildings to allow for suitable site access, hoardings, scaffolding and construction circulation;
- Provision of suitable site access and site staging areas – To allow for efficient construction of main works suitable access and site staging areas should be provided via a combination of consideration of these requirements during development of building layout for this phase of development and implementation of appropriate enabling works to provide clear site access and staging areas once main works commence;
- Extension of the lift shafts will require temporary decommissioning of the lift and the installation of a temporary work platform to allow for demolition of the existing concrete roof to the lift shafts.
- Extensions of existing stair walls will require the stairwells to be temporarily closed off to allow for construction access to form and pour the new walls

6 *Staging and Early/Enabling Works*

From a structural perspective, enabling works for the site to allow for main construction works for the proposed new building and ensuring operation of the hospital is not impacted by construction works will include:

- Relocation of existing ambulance access to ED – This will involve construction of an interim ambulance access ramp to ED to allow for construction works for the proposed new building. The interim ED drop off ramp will consist of steel beams and concrete bondek slabs to form a composite steel structural system. This will be supported by steel columns on piles that are founded in bedrock to ensure that settlements of the interim ED drop off ramp are not excessive. Additionally, modifications to the existing ED building will be required to allow for an appropriate entrance into the existing ED building from the interim ramp. The extent of details of the modifications will be confirmed upon receipt of architectural details and site confirmation of the existing structure within the existing building to be conducted in the detailed design phase of the project;

- Partial demolition of the existing CID building – This will involve partial demolition of the existing CID building and strengthening works to the existing structure required to allow for construction works for the proposed new building. Certain parts of the existing structure will need to be strengthened to ensure that the stability of the existing structure is not adversely affected. Additionally, due to the partial demolition of the existing CID building, the floor usage of the existing CID building will need to be adjusted. As a result, the existing structure will need to be strengthened due to increased floor loadings on the existing structure. The strengthening works will include additional steel beams, additional steel bracing, additional wall bracing, additional steel columns and additional pad footings to ensure that the stability of the existing structure is not adversely affected;

- Adjustment to ED ambulance drop off bay to allow partial demolition of this area – Partial demolition of the existing structure in this area is required to allow for the construction of the proposed new building. As a result, this will require certain parts of the existing concrete slab structure to be strengthened with the used of structural steel beams and bracing. Additional concrete slabs with structural steelwork will also be required in certain areas to ensure that the adjustments to the ED ambulance drop off bay meet the architectural intent.

7 Risk Assessment

The key risks in relation to structure for the redevelopment are identified in the table below:

Risk	Risk Strategy	Risk Rating with Risk Strategy Implemented	Risk Value
Variability in ground conditions for foundations	Detailed geotechnical investigation of works area to be undertaken in initial phases of the project to ensure detailed understanding of the subsoil conditions is in place	Low	High if adverse geotechnical conditions are not identified prior to works on site commencing
Ground Contamination	Detailed ground contamination investigation of works area to be undertaken in initial phases of the project to ensure detailed understanding of the subsoil contamination conditions is in place. Areas below existing buildings are also of risk as they are typically on-grade structures with some level of filling and these areas must be included in the investigation works	Low	High if adverse ground contamination conditions are not identified prior to works on site commencing
Construction vibration impacting existing hospital	Excavation adjacent to existing facilities can cause vibrations that may impact on the existing building structure and hospital operations. A combination of sufficient clearance between the new works and the existing structures and appropriate excavation techniques will be required to limit the vibration response within the existing buildings to an acceptable level. The minimum spacing and excavation techniques will need to be developed with the geotechnical engineer once their site investigation works commence.	Low – Subject to planning providing sufficient clearance between new and existing structures	Nil subject to appropriate clearance allowance in planning
Structural condition of existing buildings intended for re-use/refurbishment.	Increasing level of investigation of existing structures will be undertaken to determine suitability of areas proposed for re-use/connection as concepts and planning develop.	Low	Moderate to high if adverse structural conditions are not identified prior to commencement of works on site
Hazardous materials within existing buildings	Once areas of existing buildings to be re-used/refurbished is confirmed a detailed hazardous materials assessment of these areas will be undertaken by a specialist sub-contractor. The hospital has a current hazard register and through the re validation of this register via further assessment these items should be able to be identified and appropriate strategies put in place for removal and disposal of this material	Low	Moderate to high if the elements are identified after construction works commence
Connections between new and existing structures	All new structures will be designed to be self-supporting to ensure that there is no reliance on existing buildings for structural capacity and the new construction does not modify the existing building structures. Movement joints at these interfaces will be design to allow existing and new buildings to act independently	Low	Low
Clearance between existing structure and new structure for construction	To accommodate an efficient construction of the new buildings, sufficient clearances between the new and existing buildings should be provided to accommodate hoardings, scaffolding sufficient zones for access and loading of material around the building. This can be reduced to nil, however there are construction and program costs associated with this and should be avoided if planning can accommodate.	Low – Subject to planning providing sufficient clearance between new and existing structures	Nil subject to appropriate allowance in planning
Ongoing maintenance	Possible higher levels of ongoing maintenance for structures that are re-used with aging infrastructure in areas of refurbishment.	Low	To be developed as extent of refurbishment areas is developed
HI Standards of existing structures	Existing structures that are re-used may not satisfy current HI standards for a modern hospital facility. In particular the vibration sensitivity of the floor structures of the current ward building. Planning will need to ensure that appropriate uses are allocated to existing building stock that is to be re-used that is compatible with the performance characteristics of these buildings which will be assessed in detail as the planning of the refurbishment planning progresses.	Low - Subject to Appropriate Planning	Nil subject to flexibility in planning to accommodate capacity of existing building stock
Disruption to existing hospital services during construction of lift shaft and stair wall extensions.	A detailed staging plan will need to be developed with the hospital to allow for all access and egress during temporary decommission of the lift and closing of stairwells.	Low	High if a detailed staging plan is not produced and implemented

APPENDIX A

HI Structural Design Guidance Note

STRUCTURAL DESIGN CRITERIA GUIDELINES

The purpose of this Design Guidance Note is to record and communicate the main guidelines developed from a Health Infrastructure (HI) structural design criteria workshop.

The intended audience for this Design Guidance Note is HI engaged structural engineering consultants with a view to standardising the structural design criteria across HI projects.

This Design Guidance Note is intended as a guideline only and it is considered that project specific circumstances will require these principles to be reviewed by each project team to confirm appropriateness.

BACKGROUND

On Tuesday 18 April 2012, HI convened a structural design criteria workshop with the view of standardising structural design criteria arising from the 'Systemised Design Brief'. The workshop was facilitated in response to both queries from HI structural engineering consultants regarding design criteria and also due to awareness by HI that different project teams were adopting different design criteria in the similar circumstances, in particular with regard to vibration and provisioning for future use.

The workshop was attended by selected Structural Engineering Consultants engaged on current HI projects, the representatives of the HI ERG and a HI PD representative.

STRUCTURAL DESIGN CRITERIA GUIDELINES

The workshop outcomes resulted in the recommendation of the following guidelines for structural design criteria:

1. Preference for a standard 8.4 x 8.4m design grid.

2. Sacrificial Cover for future provisioning of wet areas.

Preference is for an additional 40mm integral, unreinforced sacrificial cover above the minimum 20mm cover.

It was viewed that if design was not progressed sufficiently at time of construction to allow set out of wet areas, then preference was to install oversized set-downs in approximate wet areas locations in lieu of installing a future topping screed. Reasoning for this;

- 40-50mm topping screed – concerns with bonding / drummyness. 75mm considered minimum.
- Topping screed to whole slab will be on fit out critical path rather than local cutting out that can occur concurrently with fit out.

It was agreed that a sample should be carried out to assess the noise impacts of the removal of the topping – this would best occur on a current project.

3. Design criterion.

- Deflection limitation to be in accordance with relevant Australian Standards, ie AS 3600, and total long term deflection of Span/250 or 25mm whichever is more onerous.
- Design to consider two design criterion to ensure that ultimate strength, minimum strength and crack control requirements are met for all initial and future arrangements. The two design criterion to be considered are:
  - Structural Design Criteria 1 – Vibration Design - Integral 40mm sacrificial zone considered as structural in analysis.

  - Structural Design Criteria 2 – Limit State and Serviceability design (Strength & deflection) - 40mm sacrificial zone considered as non-structural, i.e. as a superimposed dead load.

Refer to **Attachment A** – Structural Design Criteria for details.

- Loading – Specific loading areas to be assessed on a case-by-case basis to meet the relevant standards. As a guideline for future flexibility:
  - Superimposed Dead Load (SDL) – To make allowance for partitions, ceilings, services etc and any non-structural screed zones. Refer to Attachment A for details. Live Load (LL) - Generally 3kPa (minimum) unless there are specific loading code requirements.
- Structural Vibration
  - Self-weight – Full self-weight applied in vibration analysis.
  - Vibration excitation sources to be considered are continuous or intermittent sources of vibration such as footfall or vibration from non-isolated plant.
  - Response Factor (RF):
    - At the commencement of structural design, the proposed structural design criteria is to be submitted to HI for review in the format of Attachment B.
    - RF of 1.0 to areas (including immediate floor above) for theatres, imaging and other sensitive areas. Consideration should be also given to podium levels or other that may be considered to require a higher degree of future flexibility.
    - RF of 2.0 generally for clinical and common areas.
    - Plant areas, basements and other back of house areas not likely to be subject to future flexibility to comply with ISO 10137 2007 (Basis for design of structures).
    - Steel serviceability posts should not be introduced to meet RF design criteria without express approval as can limit future use.

4. Typical penetration arrangement adjacent to columns and zone for future penetrations.

Various arrangements were reviewed and concerns with punching shear when penetrations located on two sides of columns. The following typical arrangement is preferred (on one side of column only for internal columns). It is noted that this preference will also be a determining factor in the specification of band width and separation in a post tensioned banded slab design.

Refer **Attachment C** - Sketch Typical Peno.

5. Two way slabs (drop panels) Vs 1 way slabs (banded).

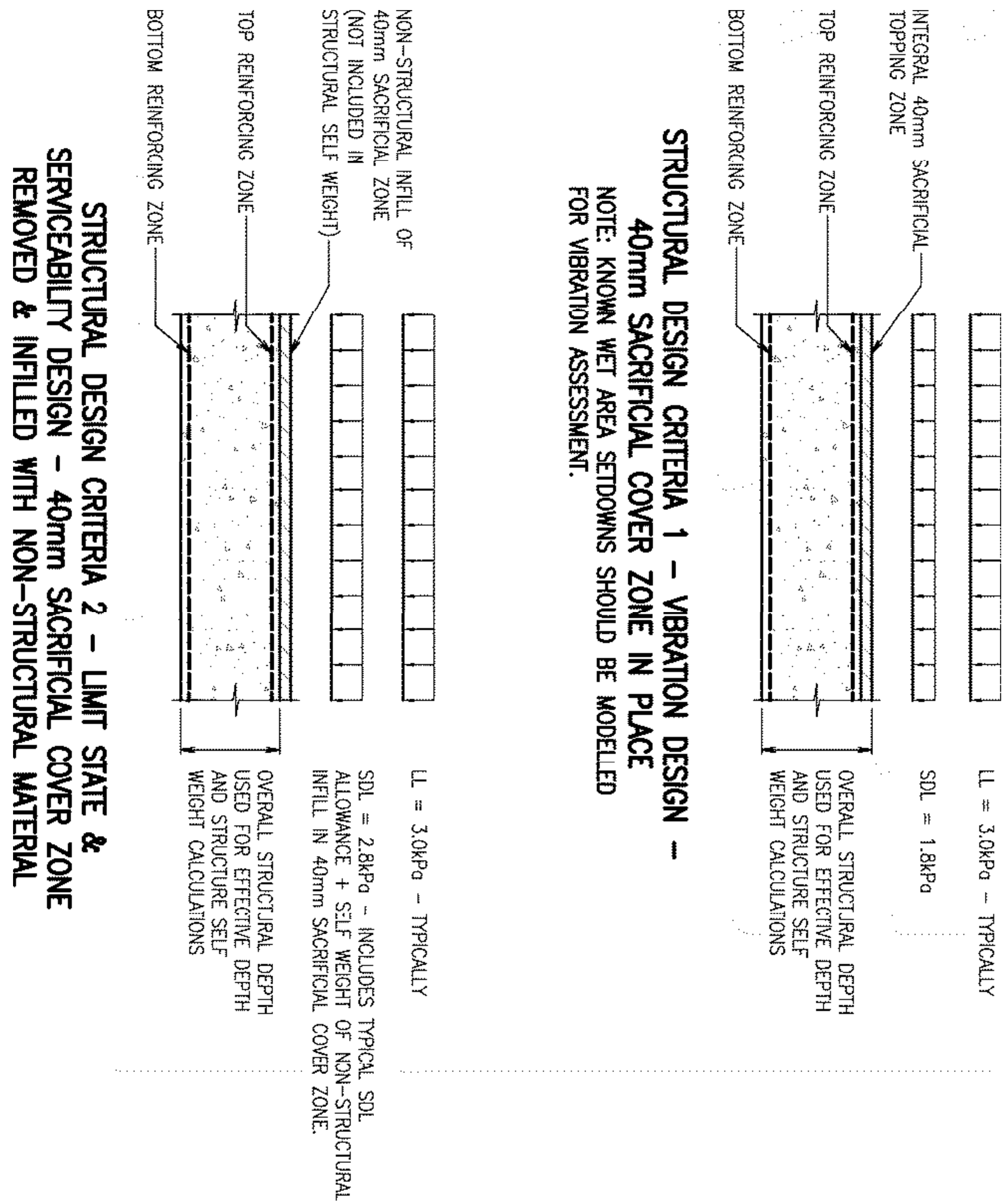
- To be determined on a project by project basis considering floor to floor heights and services coordination constraints
- Floor to floor heights of less than 4.2m likely to require drop panels and acknowledged that with 4.2m floor to floor min that banded slabs generally provide sufficient ceiling zone for services coordination.
- Acknowledged that market preference from a formwork perspective is for banded slabs due to programme and cost benefit.
- Designs for banded slabs to always allow for option of conventional formwork if design based on proprietary systems ie Ultra Shell band beams or Bondek/KingFlor to slab soffits etc.
- To accommodate typical penetration arrangement above, band beams should not be documented less that 2200 wide. (This would not necessarily apply where the band beam runs parallel to the 600 dimension of the penetration. In this case Band beam design to be of

sufficient width to accommodate the future penetration requirements). This will need to be assessed on a case by case basis.

ATTACHMENTS

Attachment A - Structural Design Criteria
Attachment B - Structural Design Criteria
Attachment C - Sketch Typical Peno

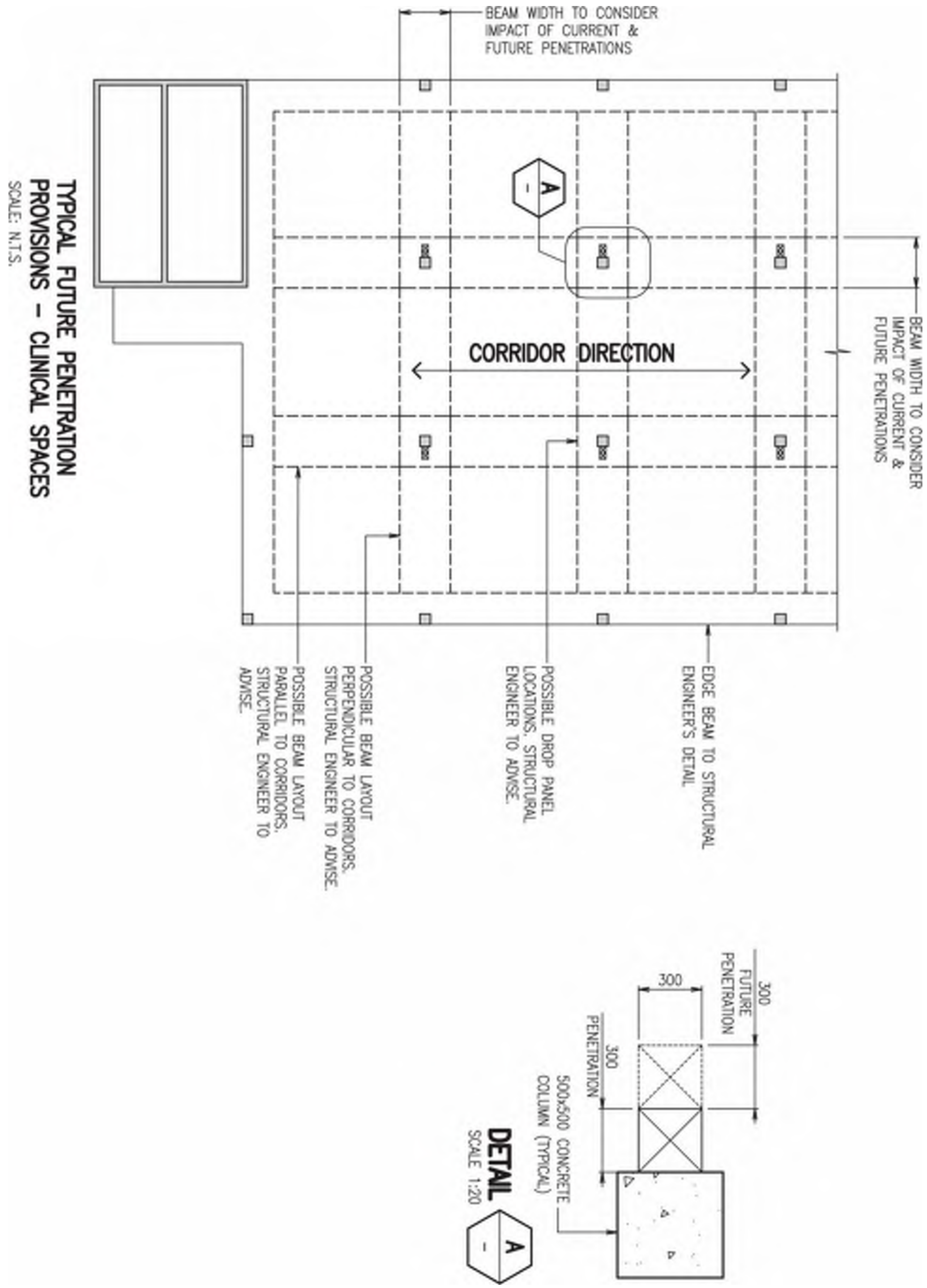
Attachment A - Structural Design Criteria

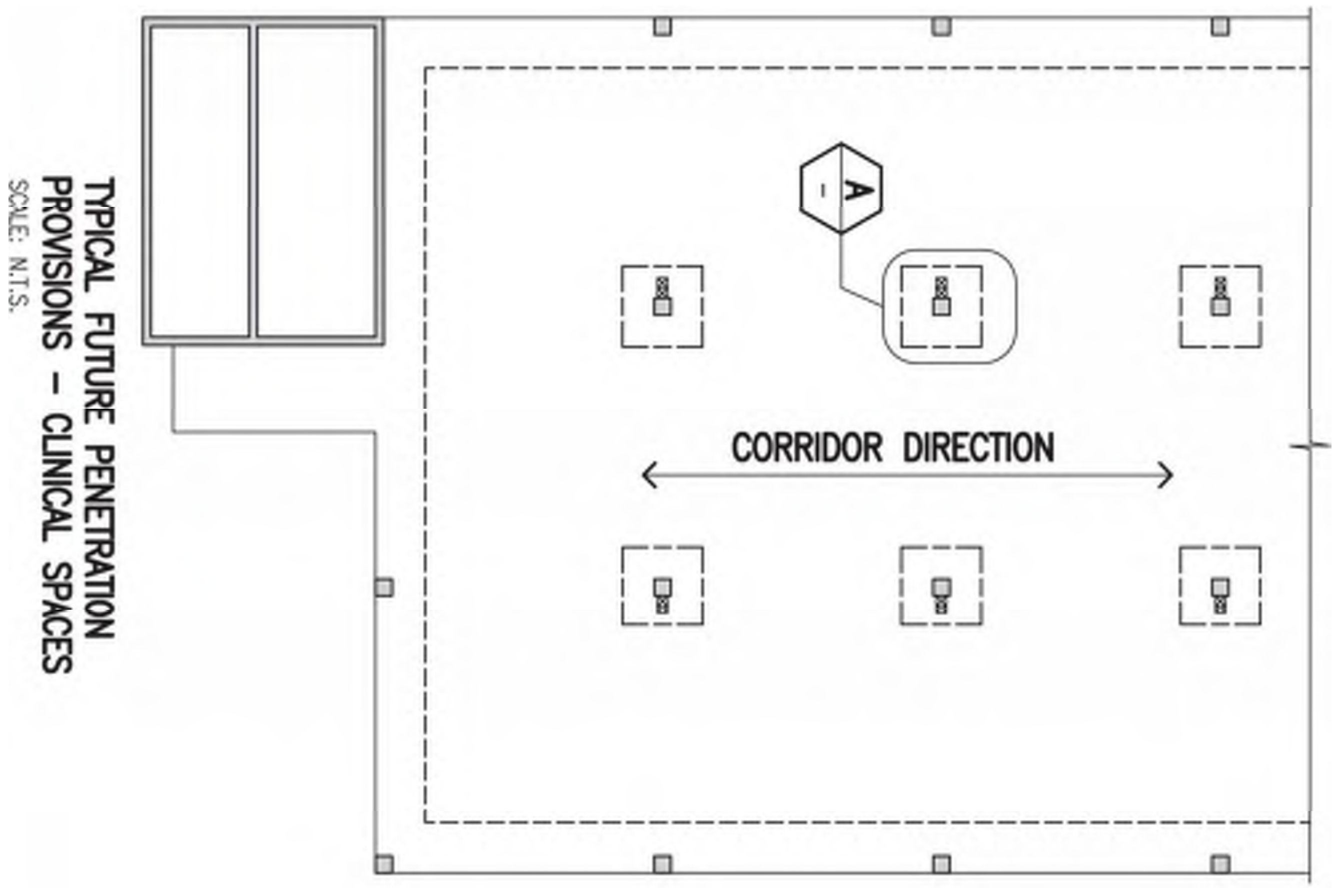


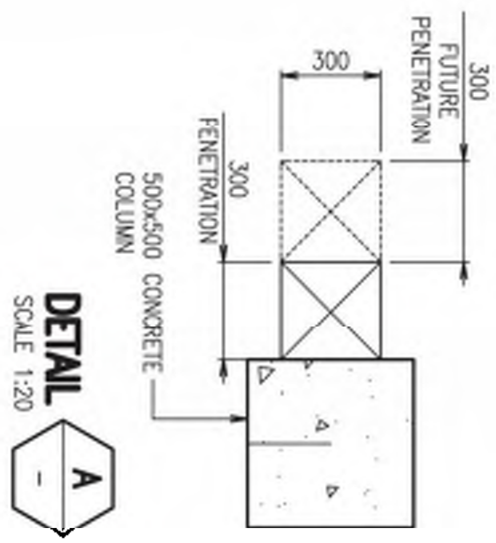
Attachment B - Structural Design Criteria

Criteria	Guide	Adopted
Damping	3.0-3.5%	
Walking Pace Frequency (rooms / corridors)	2.1-2.5Hz	
Walking Pace Frequency (Theatres / imaging)	2.1-2.5Hz	
Sacrificial topping included	Yes	
Adopted RF to project		
- Theatres / imaging		
- IPU levels		
- Emergency		
- Podium Levels		
- Other		

Attachment C - Sketch Typical Peno




TYPICAL FUTURE PENETRATION PROVISIONS – CLINICAL SPACES
SCALE: N.T.S.
CORRIDOR DIRECTION
A
1


DETAIL
SCALE 1:20
A
1
300
300
FUTURE PENETRATION
300
PENETRATION
500x500 CONCRETE COLUMN

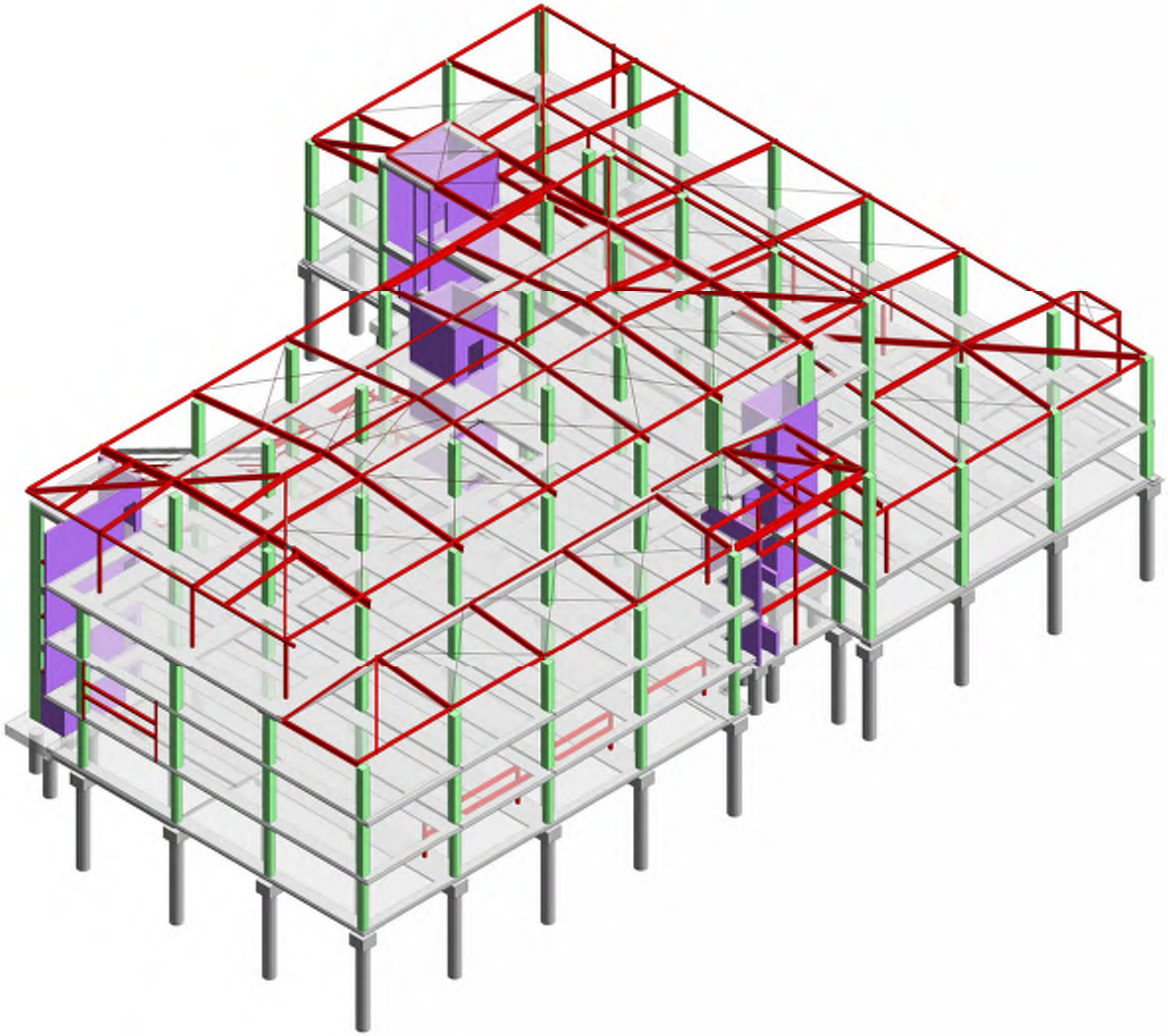
APPENDIX B

Structural Design Documentation

BOWRAL & DISTRICT HOSPITAL REDEVELOPMENT

enstruct

STRUCTURAL DRAWING LIST	
SHEET NUMBER	SHEET NAME
000-00	COVER SHEET
001-01	GENERAL NOTES
003-00	FOUNDATION GENERAL ARRANGEMENT
005-41	COLUMN TRANSITION DETAILS
005-51	TYPICAL R.C. WALL DETAILS
005-53	TYPICAL R.C. WALL DETAILS (PENETRATIONS)
005-56	R.C. WALL ELEVATIONS - STAIR 1
005-57	R.C. WALL ELEVATIONS - STAIR 2
005-58	R.C. WALL ELEVATIONS - STAIR 3
005-60	R.C. WALL ELEVATIONS - STAFF LIFT
005-61	R.C. WALL ELEVATIONS - PUBLIC LIFT
011-31	TYPICAL BRICKWORK DETAILS
100-00	GROUND FLOOR GENERAL ARRANGEMENT
100-07	GROUND FLOOR 3D VIEWS
100-50	GROUND FLOOR MEZZANINE PART PLAN
101-00	LEVEL 01 GENERAL ARRANGEMENT PLAN
101-07	LEVEL 01 3D VIEWS
102-00	LEVEL 02 GENERAL ARRANGEMENT PLAN
102-07	LEVEL 02 3D VIEWS
103-00	LEVEL 03 GENERAL ARRANGEMENT PLAN
103-07	LEVEL 03 3D VIEWS
104-00	LEVEL 04 STEEL ROOF GENERAL ARRANGEMENT
104-07	LEVEL 04 3D VIEWS
104-50	BUILDING SECTIONS
166-00	FACADE ELEVATIONS



AMENDMENTS

ISSUE	DATE	SUBJECT	AUTH
1	19.10.17	PRELIMINARY ISSUE	ECT
2	04.12.17	PRELIMINARY SCHEMATIC DESIGN ISSUE	ECT
3	06.12.17	SCHEMATIC DESIGN ISSUE	AN
4	19.12.17	SCHEMATIC DESIGN ISSUE	AN

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CLIENT
NSW Health Infrastructure

PROJECT MANAGER
TSA MANAGEMENT

PROJECT
BOWRAL & DISTRICT HOSPITAL REDEVELOPMENT
97-103 BOWRAL ST,
BOWRAL NSW 2576

DRAWING NUMBER
ENS-ST-DWG-000-00

DRAWING NAME
COVER SHEET

REV
4

N
0m 2m 4m 6m 8m 10m
SCALE 1:100 @ B1

ISSUE DATE
19.12.17

GENERAL

26. Structure has not been designed to be water retaining. All waterproofing is the responsibility of the architect and the contractor
27. Do not scale from drawings.

LOADING

1. All loadings have been assessed in accordance with AS1170.0 and the national construction code (NCC)
2. The structural components in these drawings have been designed for the following loadings:

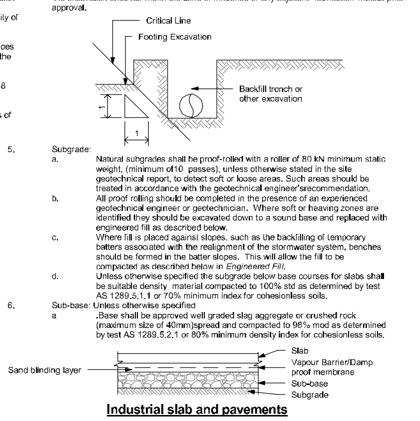
FUNCTION	SDL (kPa)	LL (kPa)
General	1.8	3.0
Offices	1.5	3.0
Lobby	1.8	4.0
Car parking	0.25	2.5
Roof Concrete	2.5	4.0
Roof Steel	0.5	0.25
Toilets/Bathrooms/Kitchens	3.0	2.0
Wards	1.8	3.0
Ward Corridors	1.8	4.0
Stairs	0	4.0
Substation	7.5	10.0
Compactus	1.0	7.5
Plantroom	2.5	7.5

3. The design wind criteria to AS1170.2 are as follows:
   - Design Life: 50 years
   - Region: A2
   - Importance Level: 4
   - Terrain Category: 3
   - Regional Wind Speed:
     - Ultimate Vu: 48m/s
     - Service Vs: 39m/s
4. The design earthquake criteria to AS1170.4 are as follows:
   - Importance Level: 4
   - Probability Factor, kp: 1.5
   - Hazard Factor, Z: 0.08
   - Site Subsoil Class: Ce
   - Earthquake Design Category (EDC): III
5. Do not place or store building materials on concrete members without the contract administrator's approval.

LEGEND / ABBREVIATIONS

Abbreviation	Description
HORIZ	HORIZONTAL
VERT	VERTICAL
CENTRAL	CENTRALLY PLACED
CRS	CENTRES
T or TOP	TOP or TOP FACE
B or BTM	BOTTOM or BOTTOM FACE
T&B	TOP & BOTTOM
NF	NEAR FACE
FF	FAR FACE
INTF	INTERNAL FACE
EXTF	EXTERNAL FACE
EF	EACH FACE
EW	EACH WAY
EQ	EQUAL
NSOP	NOT SHOWN ON PLAN
NSOE	NOT SHOWN ON ELEVATION
UNO	UNLESS NOTED OTHERWISE
TYP	TYPICAL
CL	CENTRE LINE
PL	PLATE
SV	SIZE VARIES
STG	STAGGERED
N/S	NEAR SIDE
F/S	FAR SIDE
B/S	BOTH SIDES
U/S	UNDER SIDE
L	LENGTH/LONG
W	WIDTH/WIDE
H	HEIGHT/HIGH
D	DEPTH/DEEP
NOM	NOMINAL
REQ'D	REQUIRED
REINF	REINFORCEMENT
OPP	OPPOSITE
SIM	SIMILAR
GA	GENERAL ARRANGEMENT
PT	POST TENSION
DRG	DRAWINGS
NTS	NOT TO SCALE
LV	LENGTH VARIES
ABR	ALTERNATE BAR REVERSED
MAX	MAXIMUM
MIN	MINIMUM
CONT	CONTINUOUS
FFL	FINISHED FLOOR LEVEL
SSL	STRUCTURAL SLAB LEVEL
Galv.	GALVANISED
COS	CONFIRM ON SITE
(U)	UNDER
(O)	OVER
(B)	BEYOND

FOUNDATIONS



FORMWORK

CONCRETE

10. Any cast in elements, such as conduits and piping, not indicated on the structural drawings, are to be approved by the engineer. Where pipes and conduits are cast in slabs and walls, these are to be placed in the mid third depth of the member in between the layers of reinforcement. Where conduits are to be cast in slabs on ground and there is only one layer of reinforcement, the minimum gap between the conduit and the reinforcement is to be 50mm.
11. Formwork for all external corners of exposed concrete shall incorporate a 20 by 20 fillet, unless noted otherwise.
12. Unless noted otherwise, the characteristic strength and clear cover to the reinforcement, including fitments shall be as follows:

ELEMENT	EXTERNAL	INTERNAL
	Grade (MPa)	Grade (MPa)
Blinding and mass concrete	N25	N25
Footings	S65	S65
Pile Caps	S65	S65
Slabs and beams	S40	S40
Columns	S50	S50
Stairs	S40	S40
Retaining walls	S40	S40
Non-loadbearing precast walls	S40	S40
R.C. insitu walls	S40	S40

ELEMENT	EXPOSURE CONDITION			
	CAST AGAINST FORMS (mm)		CAST AGAINST FORMS WATERPROOF MEMBRANE (mm)	CAST AGAINST GROUND (mm)
	INTERNAL	EXTERNAL		
Footings	40	40	40	75
Slab on ground				
Top	25	40		
Bottom			30	75
Columns	30	40		
Walls	30	40		
Beams	30	40	40	75
Suspended slabs				
Top	30	35		
Bottom	30	35	40	

13. No brickwork or partition walls are to be constructed on suspended slabs until all propping is removed and the slab has undertaken its dead load deflection.
14. All concrete, including slabs on ground, shall be deposited in place using approved methods, in uniform layers and shall be compacted using mechanical means such as insertion vibrators. Insertion vibrators shall not be used to move concrete in the forms. A spare vibrator shall be kept on site at all times during concrete pours.
15. All concrete surfaces required to receive additional concrete from subsequent pours shall be suitable roughened by mechanical means to remove laitance and other soft material.

PILING

MASONRY

1. All materials and workmanship to be in accordance with AS 3700, AS4455 and AS4773.
2. Minimum durability classification of built in components to be R3 unless noted otherwise to AS 4773.
3. Minimum cover to reinforcement and tendons in grouted cavities or cores to be 30mm unless noted otherwise, measured from inside face of block core.
4. Strengths of bricks, class of blocks, type of mortar and maximum joint spacing shall be as follows:Bricks shall be solid or perforated to a maximum of 25%. The contractor shall submit to the engineer,before construction commences, expected moisture expansion characteristic values for the bricks to be used on the project.

ELEMENT	MATERIAL	Strength (f,uc)	Mortar classifi-cations	Mortar Mix C : L : S	Maximum joint spacing
Reinforced Blockwork	Concrete Block	15 MPa	M4	1 : 0.5 : 4.5	10
Unreinforced Blockwork External face finished, rendered and or painted	Concrete Block	15 MPa	M3	1 : 1 : 6	7
Unreinforced Blockwork External with openings more than 900mm in height	Concrete Block	15 MPa	M3	1 : 1 : 6	5
Unreinforced Blockwork Internal face finished or sheeted	Concrete Block	15 MPa	M3	1 : 1 : 6	6
Unreinforced Blockwork Internal rendered and or painted	Concrete Block	15 MPa	M3	1 : 1 : 6	5
Load-bearing Brickwork	Brick	20 MPa	M3	1 : 1 : 6	6

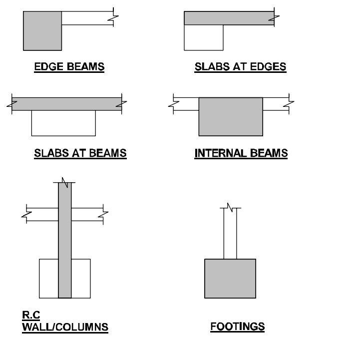
Load-bearing masonry shall have full bedded joint unless noted otherwise. All mortar joints to be finished with standard tooling rods to produce compacted joints to a maximum depth of 3mm. Perpends shall be fully filled.

5. Mortar admixtures shall not be used without the written approval of the engineer.
6. All masonry supporting or supported by concrete floors shall be provided with vertical joints to match any control joints in the concrete.
7. For joint locations in brickwork and blockwork, refer to architectural drawings Joints in straight continuous walls shall not exceed the values given in Note 4.Joints to be 10mm wide unless noted otherwise.

POST TENSIONING

CONCRETE REQUIREMENTS FOR POST TENSIONING

REINFORCEMENT



STRUCTURAL STEELWORK

1. All workmanship and materials in accordance with AS 4100 and AS 4600.
2. Steel shall have the following minimum properties unless noted otherwise:

COMPONENT	STANDARD	GRADE
Plates	AS 3678	350
Hot rolled sections	AS 3679	300
CHS	AS 1163	C350
RHS and SHS	AS 1163	C450
Welded beams and columns	AS 3679	300
Flat bars and Rods	AS 3679	300
Purlins and grits	AS 1397	450

3. All bolts shall be M20 Grade 8.8/s in 22mm diameter holes with a minimum of two bolts per connection unless noted otherwise. A washer shall be placed under the nut in all cases and where the head of the bolt is to be tightened anadditional washer is to be placed under the bolt head.
4. Where slotted or oversize holes are permitted, a hardened plate washer of 8mm minimum thickness shall be placed under the nut and the bolt head to completely cover the slot. Unless noted otherwise, the washer shall be 6mm continuous fillet welded to the element containing the slot.
5. After tightening bolts shall project beyond the nut a minimum of 1 full thread.
6. All welding is to be in accordance with AS 1554, special purpose (SP) using E48XXX electrodes in accordance with AS1553. All welding shall be carried out by suitable qualified personnel. Testing of welds to be carried out by qualified testers in accordance with AS 2214 and notes on the drawings.

TIMBER

TIMBER ROOF

EXISTING STRUCTURE

EXISTING SERVICES

LIGHT STEEL FRAMING

EXCAVATION & DEMOLITION NOTES

AMENDMENTS

ISSUE	DATE	SUBJECT	AUTH
1	15.10.17	PRELIMINARY ISSUE	ECT
2	[illegible].12.17	PRELIMINARY SCHEMATIC DESIGN ISSUE	ECT
3	06.12.17	SCHEMATIC DESIGN ISSUE	AN

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CLIENT: NSW Health Infrastructure

PROJECT MANAGER: TSA Management

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97-103 BOWRAL ST,
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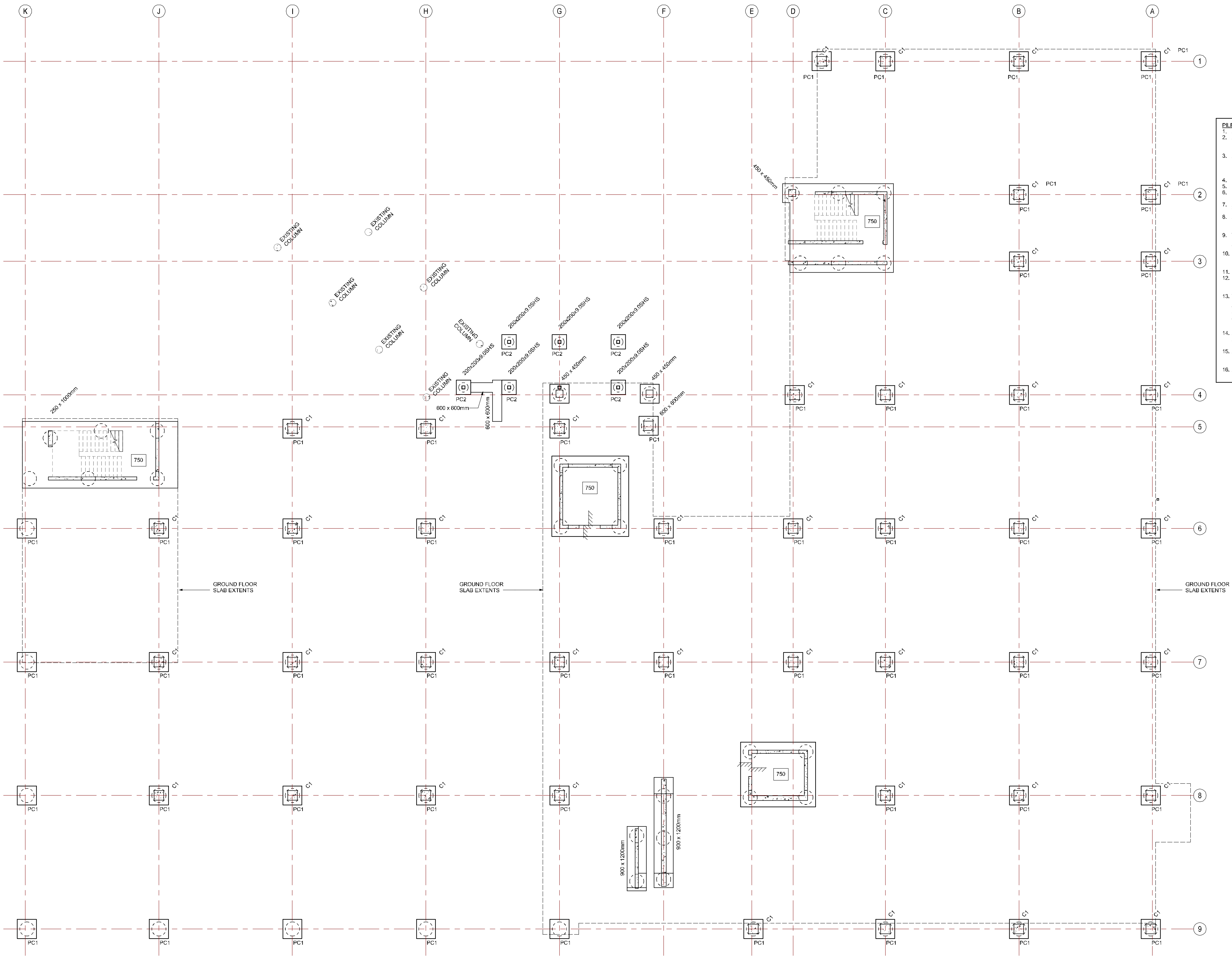
DRAWING NUMBER
ENS-ST-DWG-001-01

DRAWING NAME
GENERAL NOTES

REV 3

SCALE 1:100 @ B1

ISSUE DATE 06.12.17



FOUNDATION PLAN

SCALE: 1 : 100

PILE CAP SCHEDULE				
MARK	LENGTH	WIDTH	DEPTH	PILE Dia.
PC1	1200mm	1200mm	900mm	900mm
PC2	900mm	900mm	900mm	600mm

PILE NOTES:

1. ALL PILES TO BE 900mm DIAMETER TYPICALLY U.N.O.
2. ALL PILES TO BE DESIGNED AND DETAILED BY SPECIALIST PILING CONTRACTOR IN ACCORDANCE WITH AS2159 AND TO THE DESIGN AND DETAIL OF THE PILING CONTRACTOR.
3. ALL PILES TO BE SOCKETED AN AVERAGE LENGTH OF 11 METRES INTO MEDIUM STRENGTH ROCK TO ACHIEVE ALLOWABLE SHAFT ADHESION CAPACITY OF 150kPa AND ALLOWABLE BEARING CAPACITY OF 1500kPa IN ACCORDANCE WITH DOUGLAS PARTNERS GEOTECHNICAL REPORT.
4. CONCRETE COVER TO PILES 75mm.
5. CONCRETE STRENGTH TO BE 50 MPa.
6. PILES TO BE LOCATED WITHIN 75mm OF POSITION NOMINATED AND BE WITHIN 1:100 FOR OUT OF PLUMB.
7. ALL PILES TO BE INSPECTED BY A QUALIFIED GEOTECHNICAL ENGINEER TO VERIFY DESIGN BEARING PRESSURES.
8. ALL PILE BORINGS ARE TO BE INSPECTED TO ENSURE THEY ARE CLEANED AND FREE OF LOOSE MATERIAL AND WATER PRIOR TO POURING CONCRETE, WHICH SHOULD BE WITH MINIMAL DELAY AND ON THE SAME DAY AS BORING.
9. THE INSPECTION SHOULD ENSURE ADEQUATE ROUGHNESS IS ACHIEVED IN THE PILE SHAFT TO GUARANTEE SHAFT ADHESION, THE USE OF A ROUGHENING TOOL IS RECOMMENDED.
10. SOME GROUNDWATER SEEPAGE INTO PILES CAN BE EXPECTED. WATER SHOULD BE PUMPED FROM THE PILES IMMEDIATELY PRIOR TO POURING CONCRETE, TREMIE METHODS SHOULD BE USED FOR ALL PILES
11. OBSTRUCTIONS MAY BE EXPECTED WHEN DRILLING THROUGH EXISTING FILL.
12. INFORMATION RELATING TO GROUND CONDITIONS HAS BEEN BASED ON DOUGLAS PARTNERS GEOTECHNICAL REPORT DATED OCTOBER 2016 (PROJECT NO. 89199)
13. THE CONTRACTOR SHALL SATISFY THEMSELVES TO THE CORRECTNESS, OR OTHERWISE, OF THE ESTIMATED TOP OF ROCK LEVEL GIVEN IN THIS SCHEDULE. THE CONTRACTOR SHALL MAKE ALL ALLOWANCES NECESSARY TO COVER FOR VARIANCE BETWEEN ESTIMATED ROCK LEVEL AND ACTUAL ROCK LEVEL. NO TIME OR COST VARIATION WILL BE GIVEN SHOULD THERE EXIST A DIFFERENCE BETWEEN ACTUAL ROCK LEVEL AND ESTIMATED ROCK LEVEL.
14. ALL PILES MUST BE CAPABLE OF CARRYING THE LOADS NOMINATED AND IN ADDITION A MINIMUM LATERAL LOAD EQUIVALENT TO 2.5% OF VERTICAL LOAD U.N.O.
15. ALL PILES TO BE FOUNDED ON SANDSTONE ROCK WITH A MINIMUM ALLOWABLE BEARING CAPACITY OF 1500kPa AND MINIMUM ALLOWABLE SHAFT ADHESION CAPACITY OF 150kPa. TYPICALLY U.N.O.
16. ALL PILES TO HAVE A SOCKET LENGTH OF 2 x PILE DIAMETER MINIMUM INTO NOMINATED BEARING STRATUM.

AMENDMENTS

ISSUE	DATE	SUBJECT	AUTH
1	18.10.17	PRELIMINARY ISSUE	ECT
2	04.12.17	PRELIMINARY SCHEMATIC DESIGN ISSUE	ECT
3	06.12.17	SCHEMATIC DESIGN ISSUE	AN
4	19.12.17	SCHEMATIC DESIGN ISSUE	AN

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CLIENT

Health Infrastructure

PROJECT MANAGER

TSA MANAGEMENT

PROJECT

BOWRAL & DISTRICT HOSPITAL REDEVELOPMENT

97-103 BOWRAL ST,
BOWRAL NSW 2576

DRAWING NUMBER
ENS-ST-DWG-003-00

DRAWING NAME
FOUNDATION GENERAL ARRANGEMENT

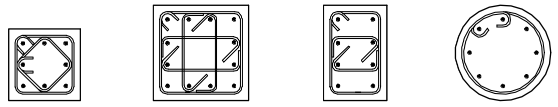
REV
4

N

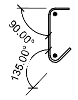
0m 2m 4m 6m 8m 10m

SCALE 1:100 @ B1

ISSUE DATE
19.12.17

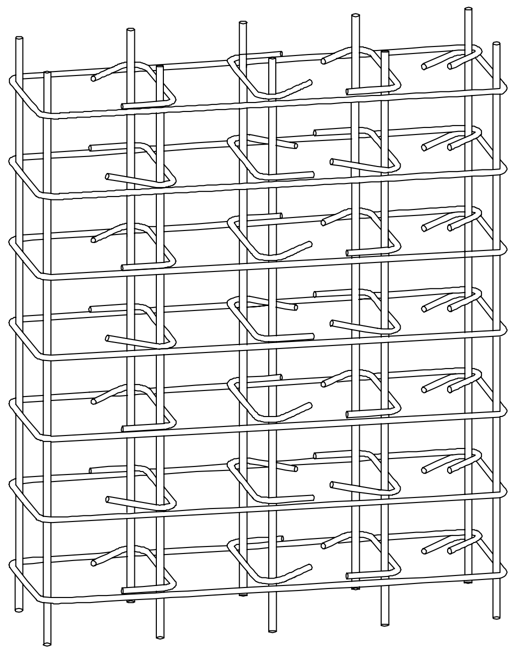


REFER TO COLUMN SCHEDULE FOR COLUMN SIZE AND REINFORCEMENT

TYPICAL SECONDARY TIES	
OPTION 1	OPTION 2
 (COLUMN TIE ARRANGEMENT MUST ALTERNATE HORIZONTALLY AND VERTICALLY)	 (IF PREFERRED TO OPTION 1)

COL TYPE	BAR SIZE	STARTER BAR LAP LENGTH
1	N16	650
2	N20	850
3	N24	1000
4	N28	1250
5	N32	1500

- COG LENGTH DEFINED BY AS3600



SECONDARY COLUMN TIES TO ALTERNATE HORIZONTALLY AND VERTICALLY

OPTION 1 COLUMN TIE ARRANGEMENT

AMENDMENTS

ISSUE	DATE	SUBJECT	AUTH
1	19.12.17	SCHEMATIC DESIGN ISSUE	AN

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97-103 BOWRAL ST,
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DRAWING NUMBER
ENS-ST-DWG-005-31

DRAWING NAME
COLUMN DETAILS

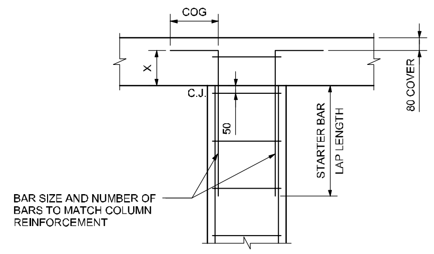
REV
1

N

0m 2m 4m 6m 8m 10m

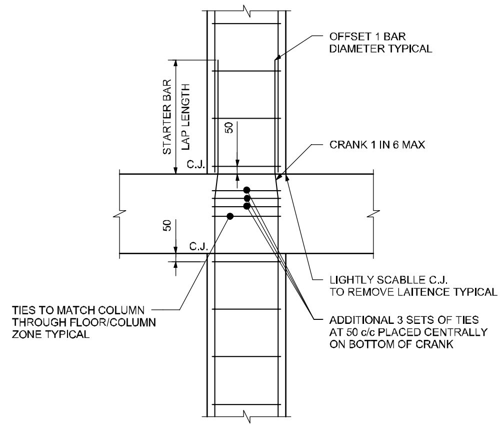
SCALE 1:100 @ B1

ISSUE DATE
19.12.17

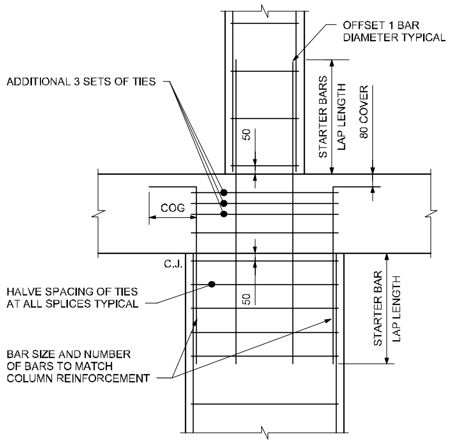


NOTE:
COGS FOR TERMINATING COLUMN REINFORCEMENT
CAN BE OMITTED WHERE X >=Lsyt

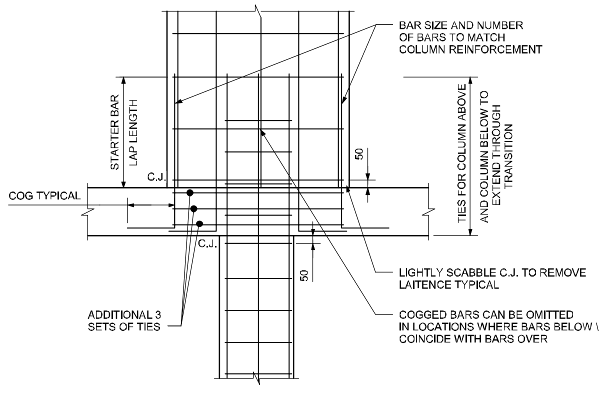
SPLICE DETAIL TYPE 5
TYPICAL TERMINATING COLUMN DETAIL



SPLICE DETAIL TYPE 2
TYPICAL CONTINUOUS COLUMN DETAIL

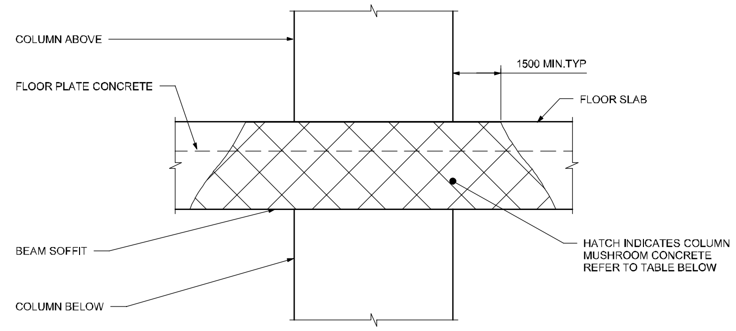


SPLICE DETAIL TYPE 3



TYPICAL COG LENGTH = 400mm

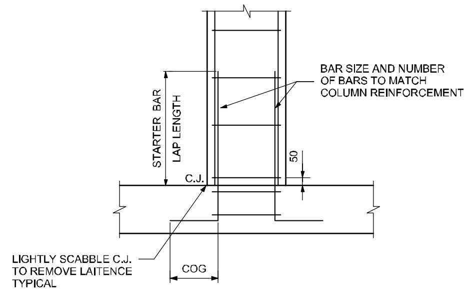
SPLICE DETAIL TYPE 4
LONG FACE OF COLUMN ELEVATED



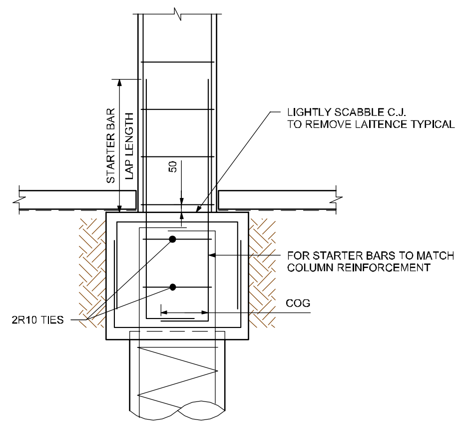
TYPICAL COLUMN MUSHROOMING DETAIL

MAX. COLUMN ABOVE/BELOW f'c (MPa)	MIN. COLUMN MUSHROOM CONCRETE 90 DAY STRENGTH (MPa)
100	75
80	60
65	50*

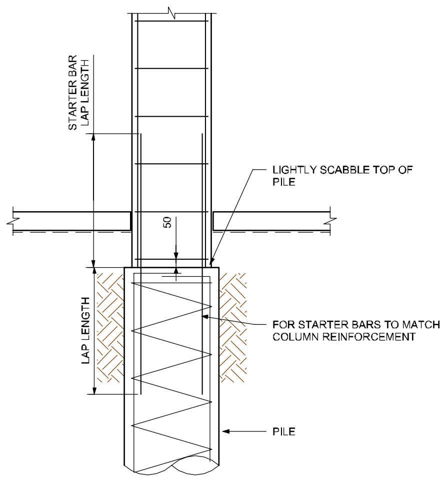
* DENOTES MUSHROOM NOT REQUIRED FOR f'c = 65 MPa COLUMNS
IF 40 MPa SLAB/BEAM CONCRETE CAN ACHIEVE 90 DAY
COMPRESSIVE STRENGTH OF AT LEAST f'c =50 MPa



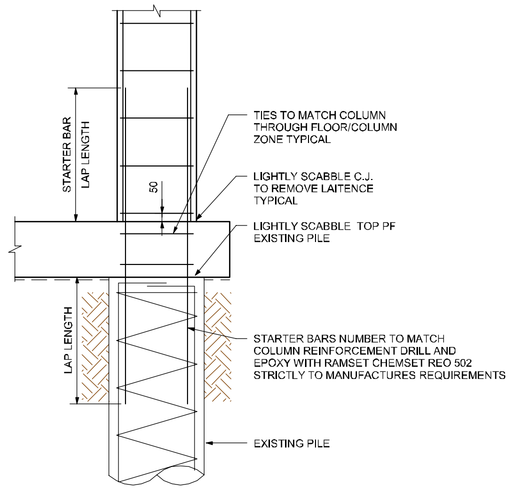
SPLICE DETAIL TYPE 1
TYPICAL COLUMNS STARTER DETAIL
SLAB/BEAM



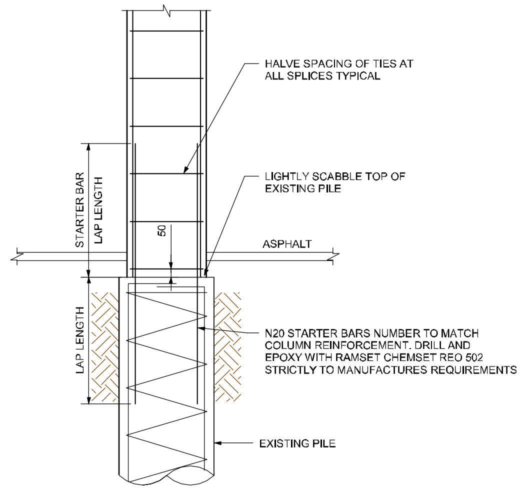
TYPICAL STARTER DETAIL - PILE CAPS



TYPICAL STARTER DETAIL
NEW PILE ONLY



TYPICAL STARTER DETAIL
EXISTING PILE PLUS NEW STRUCTURE



TYPICAL STARTER DETAIL
EXISTING PILE ONLY

AMENDMENTS

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DRAWING NUMBER
ENS-ST-DWG-005-41

DRAWING NAME
COLUMN TRANSITION DETAILS

REV
1

N
0m 2m 4m 6m 8m 10m
SCALE 1:100 @ B1

ISSUE DATE
06.12.17