

BOWRAL AND DISTRICT HOSPITAL REDEVELOPMENT STATE SIGNIFICANT DEVELOPMENT APPLICATION – STRUCTURAL DESIGN REPORT





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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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Introduction 1

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); ٠
- 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.



Site Existing Conditions 3

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).
- therefore fluctuate with time.
- July 2000):
 - 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.

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.

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• 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

Auswide Geotechnical Report for the Maternity Block Fire Escape project (dated 28th

 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

Groundwater – No groundwater table was encountered during drilling;

• Allowable Bearing Pressures – 600kPa to extremely weathered rock.

Existing Buildings 3.2

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.

Structural Engineering Design Principles 4

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

Design Standards 4.1

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
- Other Actions
- AS/NZS 1170.2 (2011) Structural Design Actions Part 2 Wind Loads
- AS 2159 (2009) Piling Design and Installation
- Requirements
- 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.

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• AS/NZS 1170.1 (2002) - Structural Design Actions Part 1 Permanent, Imposed and

• AS 1170.4 (2007) – Structural Design Actions Part 4 Earthquake Actions in Australia

• AS 2670.1 (2001) - Evaluation of Human Exposure to Whole-Body Vibration - General

• AS 2670.2 (1990) - Evaluation of Human Exposure to Whole-Body Vibration -

4.3	Mater	ials			4.	3.4	Blockw	vork
	The fol	lowing stru	uctural materials are proposed to be us	ed in the works. Typical values for the			4.3.4.1	Properties
	propert 4.3.1	ties of thes Concre	se materials are listed. These values are te	e to be adjusted where appropriate.				Characteristic Strength Mortar mix (cement:lime:sand)
		4.3.1.1	Properties					
			Co-efficient of thermal expansion Basic shrinkage strain Basic creep factor	12x10 ⁻⁶ per ⁰ C In accordance with AS 3600 Clause 3.1.7 In accordance with AS 3600 Clause 3.1.8	1.4 Lo	oadi	ing	Core fill grout
			Poisson's ratio Density	0.2 24 kN/m ³	4.	4.1	Vertical	
		4.3.1.2	Proposed Concrete Grades Footings Suspended Slabs and Beam Columns Walls Other areas (UNO)	40MPa 40MPa 40 to 50MPa 40 to 50MPa 40MPa			• F • S	 SDL = 1.8kPa (excluding sacr LL = 3.0kPa; Plantrooms: SDL = 2.5kPa; LL = 7.5kPa; Stairs: SDL = 0kPa; LL = 4.0kPa;
	4.3.2	Reinfor	cement					• SDL = 1.8kPa (excluding sacr
		4.3.2.1	Properties Plain bars (R) Deformed bars (N) Welded wire fabric (L) Young's modulus	fsy = 250 MPa fsy = 500 MPa fsy = 500 MPa $200 \times 10^3 MPa$				 LL = 2.0kPa; Non-Trafficable Metal Deck Roof Area SDL = 0.5kPa; LL = 0.25kPa; Trafficable Concrete Roof Areas: SDL = 2.5kPa; LL = 4.0kPa
	4.3.3	Structu	ral steel		А	10	Wind	
		4.3.3.1	Properties		4.	4.2	Wind	ding is in secondance with AC/NIZC 1

300MPa

12 x 10 ⁻⁶

0.3

7850 kg/m³ 2.05 x 10⁵ MPa

Grade (UNO)

Steelwork density:

Young's modulus:

Coefficient of thermal expansion:

Poisson's ratio:

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;
- V₂₀₀₀ 48m/s;
- Terrain Category TC3.

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15 MPa. 1:1:6 Blockwork 1 :0.5: 4.5 Blockwork 25 MPa

Unreinforced

Reinforced

acrificial topping);

acrificial topping);

reas:

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 $(G + \psi_c Q)$ 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 Cor	nsidered	

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 $8.4m \times 8.4m$ typically. The architectural floor layout has several areas where the typical columns grid of $8.4m \times 8.4m$ 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 $8.4m \times 8.4m$ 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.

Staging and Constructability Issues 5.2

Key structural staging issues are as follows:

- for suitable site access, hoardings, scaffolding and construction circulation;
- commence;
- roof to the lift shafts.
- to allow for construction access to form and pour the new walls

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 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

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

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

Extensions of existing stair walls will require the stairwells to be temporarily closed off

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	All new structures will be designed to be self-supporting	Low	Low
between new and	to ensure that there is no reliance on existing buildings		
existing structures	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		
Clearance	To accommodate an efficient construction of the new	Low – Subject to	Nil subject to
between existing	buildings, sufficient clearances between the new and	planning	appropriate
structure and new	existing buildings should be provided to accommodate	providing	allowance in
structure for	hoardings, scaffolding sufficient zones for access and	sufficient	planning
construction	loading of material around the building. This can be	clearance	
	reduced to nil, however there are construction and	between new	
	program costs associated with this and should be	and existing	
	avoided if planning can accommodate.	structures	
Ongoing	Possible higher levels of ongoing maintenance for	Low	To be developed as
maintenance	structures that are re-used with aging infrastructure in		extent of
	areas of refurbishment.		refurbishment
			areas is developed
HI Standards of	Existing structures that are re-used may not satisfy	Low - Subject to	Nil subject to
existing structures	current HI standards for a modern hospital facility. In	Appropriate	flexibility in
	particular the vibration sensitivity of the floor structures	Planning	planning to
	of the current ward building. Planning will need to		accommodate
	ensure that appropriate uses are allocated to existing		capacity of existing
	building stock that is to be re-used that is compatible		building stock
	with the performance characteristics of these buildings		
	which will be assessed in detail as the planning of the		
	refurbishment planning progresses.		
Disruption to	A detailed staging plan will need to be developed with	Low	High if a detailed
existing hospital	the hospital to allow for all access and egress during		staging plan is not
services during	temporary decommission of the lift and closing of		produced and
construction of lift	stairwells.		implemented
shaft and stair wall			-
extensions.			

APPENDIX A

HI Structural Design Guidance Note





DESIGN GUIDANCE NOTE No. 1

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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 gueries 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.



dead load.

Refer to Attachment A – Structural Design Criteria for details.

- standards. As a guideline for future flexibility:
- Structural Vibration
 - Self-weight Full self-weight applied in vibration analysis.

 - vibration such as footfall or vibration from non-isolated plant. • Response Factor (RF):

 - structures).
 - 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).

- coordination constraints
- coordination.
- programme and cost benefit.

DESIGN GUIDANCE NOTE No. 1

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

Loading – Specific loading areas to be assessed on a case-by-case basis to meet the relevant

 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.

Vibration excitation sources to be considered are continuous or intermittent-sources of

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

Steel serviceability posts should not be introduced to meet RF design criteria

• To be determined on a project by project basis considering floor to floor heights and services

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

Acknowledged that market preference from a formwork perspective is for banded slabs due to

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



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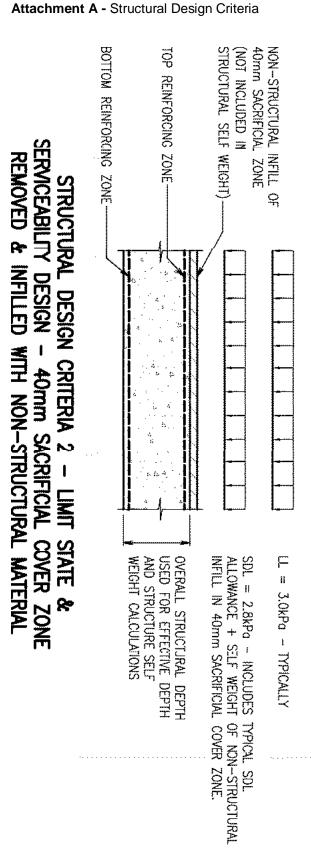


sufficient width to accommodate the future penetration requirements). This will need to be assessed on a case by case basis.

3

ATTACHMENTS

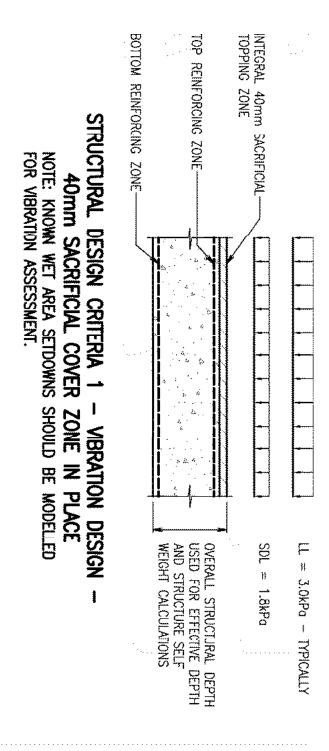
Attachment A - Structural Design Criteria Attachment B - Structural Design Criteria Attachment C - Sketch Typical Peno



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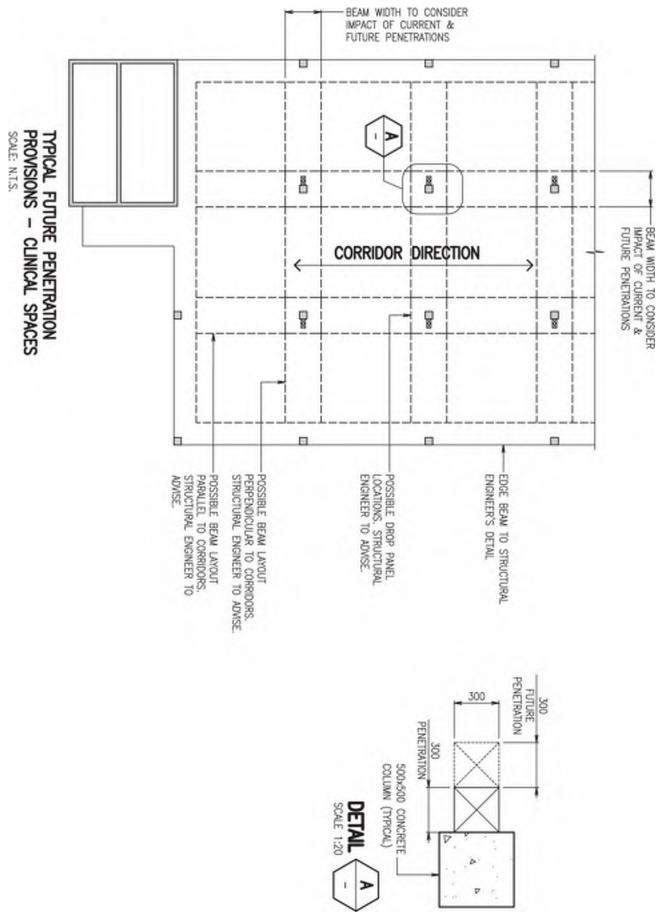


Attachment C - Sketch Typical Peno

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			

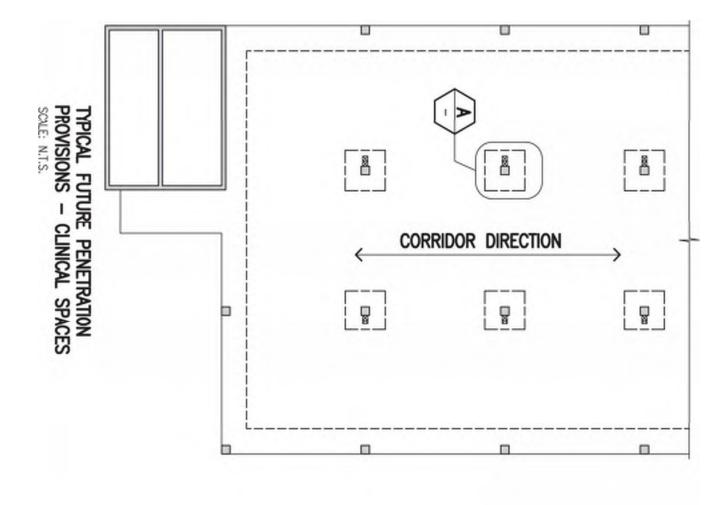
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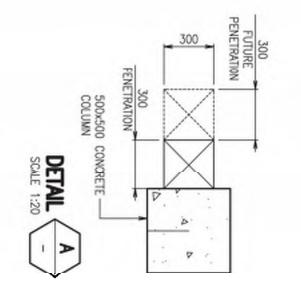
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APPENDIX B

Structural Design Documentation



BOWRAL & DISTRICT HOSPITAL REDEVELOPMENT enstruct

	1 ''	

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



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

PROJECT

DRAWING NUMBER ENS-ST-DWG-000-00 DRAWING NAME COVER SHEET

REV							ISSUE DATE
	0m	2m	4m	6m	8m	10m	
4	· ·	1:100 @	B1			-	19.12.17

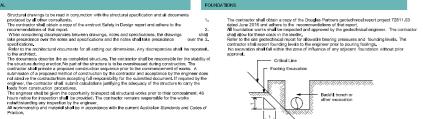
- Any variation to the structure, as described in the documents, shall be via a written request, copied to the erchitect, and vork relited to the variettion shall not proceed prior to the receipt or written approximately and the structure of the contractive including to the receipt Any dampies to the use that densing required by the contractive including to the relited to applicable houring resolution and exclusion of detailing will be charged at the applicable houring refer. Shall be contractive and applicable houring at the Should the contractor require the engineer to provide advice on temporary works, buildiability, constructions assumeding, temporary based and on alternate matrixes, applicable houring at the resolution in the contractor require the engineer to provide advice on temporary works, buildiability, and the contractor requires the engineer to provide advice on temporary works, buildiability, and the contractor requires the engineer to provide advice on temporary works, buildiability, and the contractor requires the engineer to provide advice to the more the applicable houring and the state of the temporary and the state of the temporary and the state of the temporary and the state of temporary and temporary and the state of temporary and the state of temporary and t
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- All loadings have been assessed in accordance with AS1170.0 and the national construction code (The structural components in these drawings have been designed for the following badings:
- FUNCTION SDL (kPa) LL (kPa) General 1.8 3.0 3.0 1.5 1.8 4.0 0.25 2.5 2.5 Roof Concrete 4.0 Roof Steel 0.5 0.25 Tollets/Bathrooms/Kitchens 2.0 3.0 1.8 1.8 3.0 1.8 4.0 Wards Ward Corridors 0 4.0 7.5 10.0 1.0 7.5 Stairs Compactus Plantroom 2.5 7.5 Training 2.5 The design vide citeria to AS1702 are as follows: Design Life 20 years models Life 20 years Marking 20 years Regional Vind Speed Terrain Category 3 Regional Vind Speed Service Vis 38ms Insportance Level 4 Insportance Level 4 Homor Analysis Contrain AS1704 are as follows: Insportance Level 4 Homor Astronometry 100 Site States Contrained Contraine



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- Sabb Sarrier/Damp Vepour Barrier/Damp Ductores Subjects Sand blinding layer ----
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- ELEMENT EXTERNAL NTERNAL Binding and mass N25 N25 Footings S65

Slabs and beams	S40	S40
Columns	S50	S50
Stairs	S40	S40
Relaining walls	S40	S40
Non-loadbearing precasl wats	\$40	S40
R.C. insitu walls	840	S40

ELEMENT		EXPOSURE CONDITION							
	CAST AGAINST	FORMS (mm)	CAST AGAINST FORMS WATERPROOF MEMBRANE	CAST AGAINS					
	INTERNAL	EXTERNAL	(mm)	GROUND (mm)					
Footings	40	40	40	75					
Slab on ground									
Тор	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						

The contractor shall be fully responsible for the design of all formwork, unless a product is specified on the drawings as being the responsibility of the engineer eg. a profiled steel decking acting composibility with the concrete, such as Boroldi, Condia Kr (religiter, All formwork shall be designed in accordance with \$8,3000 and AS 3610. Formwork shall service in a rigber addiated for the following minimum periods:

slaced on the freshly cals: concrete, before the site achieves sufficient strength in contribute to carry biologic contractor that built for review by the express. (In ideal of the program system proposed be used.) This shell include the weight of the formers system to be used and any heavy bading such as interformate built due on the biol short of the Staff. Review by the number does not over a the first system include the weight of the formers system to be used and any heavy bading such as interformate built due on the weight of system proposal to be used for the proposal shall include the means by which formation is to be reliesd to the required position and transported acreate the firstly calls, which due weight of system proposal to be used for that proposal construction bading on the structure, including trappedion of works regime by the engineer ating from the review. These costs will be contrary at careful chart here the structure of the large scale All eccosed formed togics shall have 20mm z accessful charts of the engineer ating the contrary scale to any cost on the infinite adde to formed or accessful charts of the opposite the to access of the opposite of the unified manifes added to formed or accessful charts of the opposite ating the contrary scale to any cost of the infinite scale to access the firstly cost of accessful to access the opposite of the access site of the contrary scale access the opposite ating to access the opposite of the contrary scale to access cost of the contrary scale to access cost of the contrary scale to a contrary costs of the contrary scale to access costs

otherwise. Unless noted otherwise, the characteristic strength and clear cover to the reinforcement, including fitments shall be as follows:

- No brickwork or partition weige are to be constructed on suspended states until all propping is removed and the state has undertaken its door load dicfloction. All doorners, including approved methods, in unform layers and shall be compared using mechanical means such as insertion whorkers. Feedine vibrators what not be used to more concrete in the forms. A space vibrator hab rates in the data and and in the busies of more concrete in the forms. A space vibrator hab rates on less at all times dating the data of the layer of the other states of the data of the 14
- concrete pours. Al concrete surfaces required to socially additional concrete from subsequent pours shall be suitable requirenced by instruminiar humans to revolution and and the suitable Coll or any other disketmour product spill on the surface of concrete shall be remove to the satisfaction of the any other. 16.
- ers of full width slip joint material such as Alcor or galvanised strip on top of masonry apport the concrete. The slip joint material shall be properly secured in place to ensure it is spution to support the contents, into support memory source or property source in parce to originate its of solardigat dimprovements, and the support of the support of the solarding to the statement in the participation without written permission from the engineer. No relationcement is to be util in making any persetation inthout indice approach from the engineer. No relationcement is to be util making any persetation inthout indice approach from the engineer. No relationcement is defined approach and the one means of focusing reinforcement and post ensiring hour an value of a formal defines approach and one means of focusing reinforcement and post ensiring hour an value of a formal defines approach and the solar integral approach and the solar to be solaring to the solar and the solar indices in the solar and the solar approach and the solar and the solar and the solar and the solar approach approach and the solar approach and the solar approach approach and the solar approach 18.
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- Ples and pling to be in accordance with AS 2199 and are to be designed by the specialist su-contractor, engaged by the contractor. The construct or stall investigate the presence of any existing services in the ground likely to be advected by the pling operations. Confirmation of the investigation and the find design advected by the pling operations. Confirmation of the investigation and the find design of advected to be consisted to the expression. For AD some of the operations of any pling on advected to the expression. To AD some for the operationers of any pling on advected to the expression. denving shet 69 Iomenue www.www.www. nater Roler geochenical information mete for site investigation information. The contractor is reponsible for the set cat of the piles. Maximum acceptable deviation from the contractor is reponsible for the set of the piles. Maximum acceptable deviation from the contractor is a 75mm. Maximum acceptable deviation from vertical alignment is 1 in contract position of piles is 75mm. Maximum acceptable deviation from vertical alignment is 1 in contractor and the set of the piles.
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- It is the superinterbal as include balance and parties commenced. The superinterbalance is an explore a start of the superinterbalance is used to a superinterbalance is a superinterbalance in the superinterbalance is a superinterbalance in the superinterbalance is a s
- Design checking by the engineer Assessment by the engineer of any rectification proposab Design of any rectification works Inspection by the engineer of any rectification works Costs for any work associated with these activities shall be payable by the contractor to the engineer at current houtry rates.
- The pling contractor is to design the ple reinforcement such that the ultimate tension force nominated on the relevant schedule is fully developed at the head of the pile cap in which it is protructing.

constructed with reintrocement adjusted being concerning immediate concerning immediate adjusted being concerning adjusted being adjusted being adjusted being concerning adjusted being adjusted being adjusted being continuous adjusted being a

All materials and workmanship to be in accordance with AS 3700, AS4435 and AS1770, the material model by classification of ball in components to be RS orfers noted otherwise to AS and the material and the series of the ser

ELEMENT	MATERIAL	Strength (f.uc)	Mortar dassifi- 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	мз	1:1:6	7
Unreinforced Blockwork External with openings more than 900mm in height	Cancrete Black	15 MPa	МЗ	1:1:6	5
Unreinforced Blockwork Internal face finished or sheeted	Concrete Block	15 MPa	мз	1:1:6	6
Unreinforced Blockwork Internal rendered and or painted	Cancrete Black	15 MPa	M3	1:1:6	5
Load-bearing Brickwork	Brick	20 MPa	М3	1:1:6	6

- Loss-beering manomy shall have full bedded joint unless noted otherwise, All monter joints to be finished with standard tooling nots to produce comparid joints to a maximum digit of time. Perpende table to the Pillan. All the standard tooling the standard tool to an engine analysis of the enginese. All manony supporting or supported by concrete flows shall be provided with vertical joints to another any control priors in the concrete. For joint locations is to be concrete. For joint locations is to be concrete. The standard distances and blockwerk, refer to architectural distances and using standard distances. To be provided the standard distances and the standard distances.
- For joint location is in bickwork and electronic, refer to architecture to energy on the second contracts was also and an electronic bickwork. All solutions be to them with outbals in the second second second second second second second second second No hoticettal or dispond characteristic data with the latence Multismum depth of writed character in one filted tocknotic to be 20mm. Characteristic data was also be to the second bases also no se inplementary data with the second bases and maximum second second second second second second second bases and maximum second second second second second second second bases and maximum second second second second second second bases reparate second second second second second second second bases reparate second second second second second second bases reparate second second second second second second second bases reparate second second second second second second second bases reparate second second second second second second second bases reparate second second second second second second second bases reparate second second second second second second second bases reparate second second second second second second second reparate second second second second second second second second components second second second second second second second second components second components second seco
- 23. 25.
- Before placing vertical environment, if any, cores are to be danaed of al morter fins and decomposition of the one of contents, which are not be obtained will inspected by the decomposition of the obtained of the obtained will be decomposition of the obtained of the Maximum continuous poor height of grout to be 3000mm. Backfill in relation grants in the first of the obtained of the obtained of the provide subsol forms to fills or vecus torics an endor. Refer also to fills 20, Provide subsol forms to fills or vecus torics are more. Refer also to fills 20, Provide subsol forms to fills or vecus torics are more. Refer also to fills 20, Provide subsol forms to fills or vecus torics are more. Refer also to fills are filled and to the top and bottom has been comparing lines to fills for the more allowed absolute strength. Contribution and the figure allowing taskfill and denoming lines to fills (or respective) provide the subsolute strength. Contribution with a fill not be backfilled in the strength and backging strength. Contribution with a data to the backfilled in the strength and backging terms fills or the subsolute strength. Joints at loss the backfilled in the strength of the strength and the strength of the stren 26.

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29. 30.

- The contractor shall submit the names of all propertary products proposes to or unever an measury contraction before commensation of the scars, and an analysis of the stars and the stars of the stars and the sta
- centres maximum. In solid masonry construction, lies between contiguous leaves shall be heavy duty spaced at 400mm x400mm centres. In holow block construction, grout fill end blocks (or use solid blocks) at control joints,door or window coemings.
- These basis consistences, grant in the basis of the second basis and the provide a centre previous of the second basis of the 39.
- 41.
- 42.

2. 3.

e: Stress all lendons to 25% ultimate tensile stress at approximately 24 hours after completion of pour. Fully stress lendons when concrete attains*fc = 22 MPa for 12.7mm diameter strand and fc = 25 MPa for 15.2mm diameter

1. 2.

10.

11. 12.

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16.

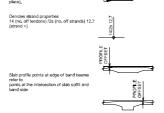
- Fully stress tendors when concretes attainet fc = 22 MPs for the stress tendors to the stress stress stress stress stress stress stress attained attained attained to the stress stress stress stress Jack tendors to 85% minimum breaking lack 164.6 kV for Jack tendors to 85% minimum breaking lack 164.6 kV for dist.Offset points are from the data softs to underside of dist.Offset points are included over supports and at findage that off is the concret of the softs to underside of the state stress stress stress stress stress stress stress paradice between high and for goots in each take of stretchard softs by the use of enderside stress burnes at grad ender softs by the use of enderside stress burnes at grad ender softs by the use of enderside stress burnes at grad ender softs by the use of enderside stress burnes at grad ender soft stress stress stress stress stress stress stress to be submitted for sogthord.
 - 9. 10.
 - T = Top Top T = Top EF = Each Face EW = Each Way NF = Near Face FF = Far Face At least 95% of all reinforcin grade, and at least 60% of a processes in its manufactur. At least 95% of all reinforcin 15% (by mass) of all reinforci techniques detailed in Table 11. 12.

7.

8.

R.C WALL/COLUMNS

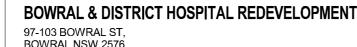
- agrowd. The second sec
- Denotes live stressing anchorage external. Denotes dead end anchorage. Denotes live stressing anchorage with pocket Denotes tendon profile point, with offset 4 Denotes live stressing anchor with coupler, (use swaged end couplers wired securely in place)



- CONCRETE REQUIREMENTS FOR POST TENSIONING

 - All suspended floors shall be 1°c + 40 MPa unless noted ofherwise. All convertes test cylindres hall be etic cured under conditions considers with the convetes pour, fummur in initiage strain a 50 days, meanward in accolations with AS 1972 part 13, shall be 650 for prevent damage to stressing fundons and reinforcement, converte pany lines shall be adapately restment damage to stressing fundons and reinforcement, converte pany lines shall be adapately restment damage to stressing fundons and reinforcement, due to be covered during the pour. Stary used to bicket the pany lines within the buck in dependent of the reinforcement. Pump lines shall be adapately allow used to bicket the pany lines within the buck in dependent of the reinforcement. Pump lines shall be adapated to be covered during the pany lines within the buck in dependent of the reinforcement. Pump lines shall be adapated to be covered during the pany lines within the buck in dependent of the reinforcement. Pump lines shall be adapated to be covered during the pany lines within the buck in dependent of the reinforcement. The pany lines that the stressing the pany lines within the buck in dependent of the reinforcement. The pany lines that the buck in the pany lines and the buck in the buck in the pany lines and the buck in the buck in the pany lines and the buck in the pany lines and the buck in the buck in

DRAWING NUMBER ENS-ST-DWG-001-01 DRAWING NAME GENERAL NOTES



PROJECT

22.

17.

PROJECT MANAGER

TSA

- Indexings. The second of the control of the second second

HORIZONTAL VERTICAL CENTRALLY PLACED CENTRAS TOP & TOP FACE BOTTOM & BOTTOM FA TOP & BOTTOM & BOTTOM NEAR FACE FAR FACE INTERNAL FACE EXTERNAL FACE

AMENDMENTS

 ISSUE
 CYTE
 SUBJECT

 1
 151/0.17
 PREL DIVARY ISSUE
 2

 2
 201/2.17
 PREL DIVARY SCHELATIC DESCRI SSUE
 3

 3
 1051/2.17
 SCHEMATIC JESTEN ISSUE
 3

STRUCTURAL ENGINEER

enstruct

Telephone (02) 8904 1444 Facsimile (02) 8904 1555 http: //www.enstruct.com

enstruct group pty lid Level 4, 2 Glen Street Milsons Point NSW 2061 Australia

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Wil:

NSW

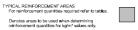
Health

Infrastructure

ORCEMENT			STRUC	TURAL STE
Symbols:			1.	All working
8	R: Structural grade plain	bars to AS/NZS 4671, ductility class N (250MPa)	2.	Steel sha
b. c.		IZS 4671, ductility class N (500 MPa)		
۵. ۵		ench mesh to AS/NZS 4671, ductility class L (500 MPa) /NZS 4671, ductility class L (500 MPa)		
6	RI : Rectancular rib mesi	h AS/NZS 4671, ductility class L (500 MPa)		Plates
	rec. recordingular no mos	in normal of the statistic of the statis		Het re
	cement bars to be Type N			
		ent bars in slabs shall be N12 at 300mm		CHS
	nless noted otherwise. Ref	er to reinforcement lap schedule for lap		RHS :
lengths. Minimum	ap for fabric shall be one i	mesh nius 25mm		
		wed without prior approval		Welde
		be supported in both directions at maximum		Flat b
centersf 1				
		n conduits as per AS3600 but not less than		Purlins
three dian	heters. Conduits in stabs to / the top reinforcement.	o be placed above the bottom reinforcement		
		oles are to have trimmer bars placed	3.	All bolts :
		(1600mm long), one tied to the underside of		unless n
top reinfor	rcement and the other lied	to the top of the bottom reinforcement.	4.	to be tigh Where si
		t thicker than 120mm and N16 for slabs not	4.	placed u
	an 180mm,			be 6mm
Where no	t shown bars to be N20 un ions used for reinforcemen	less noted otherwise.	5.	After tight
a,	BB = Bottom Bottom	Υ.	6.	All weldir
a.	B = Bottom			accordar
C.	TT = Top Top		7.	be carrie
d.	T = Top		<i>/</i> ·	Minimum testing in
e.	EF = Each Face		8.	The follo
f.	EW = Each Way		<i>w</i> .	a.
9- h.	NF = Near Face FF = Far Face			
n.	FF = Far Face			b.
At Loant Of	5% of all reinforming has as	nd mesh meets or exceeds 500 Mistrenath		
		rcing bar and mesh is produced using energy-reducing		с.
		ured by average mass by steel maker annually)		d
Al least 9	5% of all reinforcing steel i	meets or exceeds 500 MPa strength grade, and at least		·
15%(by m	ass) of a reinforcing stee	is assembled using off site optimal fabrication	9.	Conlact
technique	s detailed in Table 2 (Mat-	6 Steel, Green Building Council of Australia)	σ.	Bolts in "
				washers.
				Bolts that
			10.	Shop dra
	1	ł	11.	No steel
				the build satisfacti
			12	All plates
			13.	Allaxial
ED	GE BEAMS	SLABS AT EDGES		to the me
			14.	All hollow
			15.	Corrosio
-				a. b.
1	1	1 1		υ.
				C.
				d.
SL	ABS AT BEAMS	INTERNAL BEAMS		e.
	-			£
	TT			
				9.
<u> </u>		TVT		-
<u>٦</u>			16,	Grout un Builders
			17	Duilders







 To be officient office		
All workmanship and materials Steel shall have the following n		
COMPONENT	STANDARD	GRADE
Plates	AS 3678	350
Hot rolled sections	AS 3679	300

 Open sections
 AS 36/9
 3/U

 AS 1163
 CL50

 and SHS
 AS 1163
 CL50

 fold berns and columns
 AS 36/9
 300

 stars and Rods
 AS 36/9
 300

 stars and Rods
 AS 36/9
 300

 stars and Rods
 AS 36/9
 300
 ns and grits

Is a half be M20 Grade 8.8.8 in 22mm diameter holes with a minimum of two bolls per connection noted offenvise. A wather shall be placed under the nut in all cases and where the head of the bot is a boll of conversion of the second state of the shall be placed with the second of the minimum thickness half be durater the nut and the boll head to completely cover the slot. Unless noted cherwise, the wather shall no contratus. If diversion is a minimum to containing the adv. If the slot of the minimum thickness half be durater the nut and the boll head to completely cover the slot. Unless noted cherwise, the wather shall durate the boll head to the site and the contraining the adv. If the slot of the s

- 4.xb = Commercial badis (or state) costs), who as to AS 1111, bythmet to any syst. As 325 High strength tobis (or structure) badis (Sardia BA) as AS 1228, bythmet to sing tight condition using a standard wrench. 8.317 High strength tobis (or structure) badis, Grade 8.8 to AS 1225, bythmet resolution to AS 8.317 High strength badis (or structure) badis), Grade 8.8 to AS 1225, byth resolution to AS 8.318 High strength badis (or structure) badis), Grade 8.8 to AS 1225, byth resolution to AS 8.010, designed as badring type joint.
- 4100, desgred as a beam type part. Series in conversion assocrations TP type she to be fit uncertained units made of lowests series and the series of the series s. A hardward wather is to be glaced under the run or both head, whichever is to be related, there been fight series and series of the series. Series of the beam of the series of th
- tion. s to be 10mm thick unless noted otherwise. member connections (compression or tension) shall be capable of transferring a force equal
- member connections (compression or tension) shall be capable or t ember capacity. w sections to be sealed with a 3mm plate unless noted otherwise.

- v sections to be easied with a 3rm plate unless noted otherwise. In protection: Refer to the Stochastical Refer to the Stochastical Refer to the Stochastical With a minimum councing of 600 grams per square network. Bolls, nuss end variabres to be hit dio out-enneted to manufacturer's socializations, Extent, T-IM spaced in connection components to be hit dio glavihistical with a minimum linearability of approved paralitation, to aminum thibutess of 0.4 mm. Stochastica to the specified finals, istensiver, in contact with a minimum file/lineas of 0.4 mm. Stochastical is a comproved apprivation, and minimum thibutess of 0.4 mm. Stochastical and comproved apprivation, and the 3 minimum thibutes of 0.4 mm. Stochastical and an approved apprivation, with a minimum thibutes of 0.5 mm and be an expected in 2.5 dipertuision minimum thibutes of 0.4 mm. All seated hebox sections to be galamined with a minimum thibutes of the main. All seated hebox sections to be galamined and have vert heles as per manufacturer's and the stochastical and the stochastical and the distributes of the distributes of the distributes of the main.

All statistic heliow sections to be guivened will allow with release par manufacturer's Grout under base guies to be king strength centrolitious non-strink grout (Masterbue &TD Master Buldens or groupsed equivalent). An writing to extern groups grouture to be formed using Epson CB (or equivalent approved all chemical another is resisting concerned estimates and an external and the strength of the strength or table the strength of the strength or table to the strength of the strength of the strength of table to the strength of the strength or table to the table to the strength of the strength of table to the strength of the strength of the table to the table table to the strength of the strength of the strength of the strength of the table table table table to the strength of the strength of the strength of the table tab 18.

- 21.
- Husding the tool washes and nutix. Purfain and Olar Landra and Olar Science and Alexandra and Ale 22. 23.

All timber design, material and construction shall be to AS1720.1 and AS1720.2. Softword to be minimum stress grade F7 une, Hardword to be minimum grade F14 une, Submit suppliers conflicate as to stress grade of timber manifer. All finde that libe to brade. Estimate timber shall be informed an analysis (statis to 1 to AS1720.2 or improving prive grade F7, estimate as the stress grade of timber manifer. All finde that the total be total to a sufficience as to supporting documentation for presentative treatment. All bobs in timber construction shall be minimum M16 unless noted and shall be galvanised. Dots shall be relightment at the end of the maintainum grant, B5th total shall be drifted on more than 1 mm oversize Washers under all heads and ruls shall be drifted 2.5 times bot dismetiar.

SEASONED SOFTWOOD +5, -0mm	
UNSEASONED SOFTWOOD>F7+2,-3mm <f7+2,-4mm< td=""><td></td></f7+2,-4mm<>	
SEASONED HARDWOOD +2, 0mm	
UNSEASONED HARDWOOD +3, -3mm	
(SEE ALSO CLAUSE 1.6.2 IN AS 2082)	

- All timber juints and nothers are to be 100mm minimum away from foces knots, severe stoppn grain, grain week or other minor others, go platik with mala place considers, all well framing to be departed by the maintainance to AST2 and AS164. Munufacturer to supply of secondary design contribution for the dient plate to exactor, All as lis-downs to be firmer between the transmission and transmissions to AST2 and AS164. Munufacturer to supply of secondary design contribution for the dient plate to exactor, All as lis-downs to be firmer between the transmission and transmissions to an account of the ASC20. AS1748, ASS16 as appropriate, Cross braining neglited for timber structure to be proceed by common or and approved by Estatual.

ROOF

19 20

- Their roof trusses, anchorages, bracking and lateral stability to truss manufacturers design and detail is accordinate with AST (726 AST684 Date 2.2 Fe) (contenting) Live 0.2 SFA SS 2005 application of the stability of the stability of the stability Live 0.2 SFA SS 2005 application of the stability of the stability of the stability Live 0.2 SFA SS 2005 application of the stability of the stability of the stability 0.5 Sign onlings Ref to general notes (fra the stability on wind kedding). 0.5 Sign onlings Ref to general notes (fra the stability on wind kedding). 0.5 Sign onlings 0.5 S 2.

- 4
- light of all brustes and straining, an unanalized adheticit, Transes shall be pre-embered an ancount equal to dead finds difficulton, Maximum total albeable detection is sprand and ULS for candidense or 16mm whichever is less. The truss manufacture is to design roof bracing to transfer loads in the plane of the roof to the bracing walks shown on the locational details and roof is downs, The truss manufacture is to design and detail at roof is downs,

- The contractive is to obtain all existing structural drawings prior to works commencing. All assessments of existing structural oparabit have been based on the above mentioned drawing, No assist ordenations in the above mentioned structural prior of the structural drawing to confirm that as built geometry and reinforcement is as per existing structural drawings. All existing reinforcement expected by demotion of the tomatistic of the prediction to be exposed painted to prevent contracts. Boyo should be deved 30m beyond the appredictions to be exposed painted to prevent contracts. Boyo should be deved 30m beyond the appredictions to be provided to the structural drawings.

The location of existing services shall be checked before any excavation takes place by checking with all relevant authorities and survey data. The exact location of any services shown to exist on the site shall be verified by the contractor by hand excavation before proceeding with earthworks by machines.

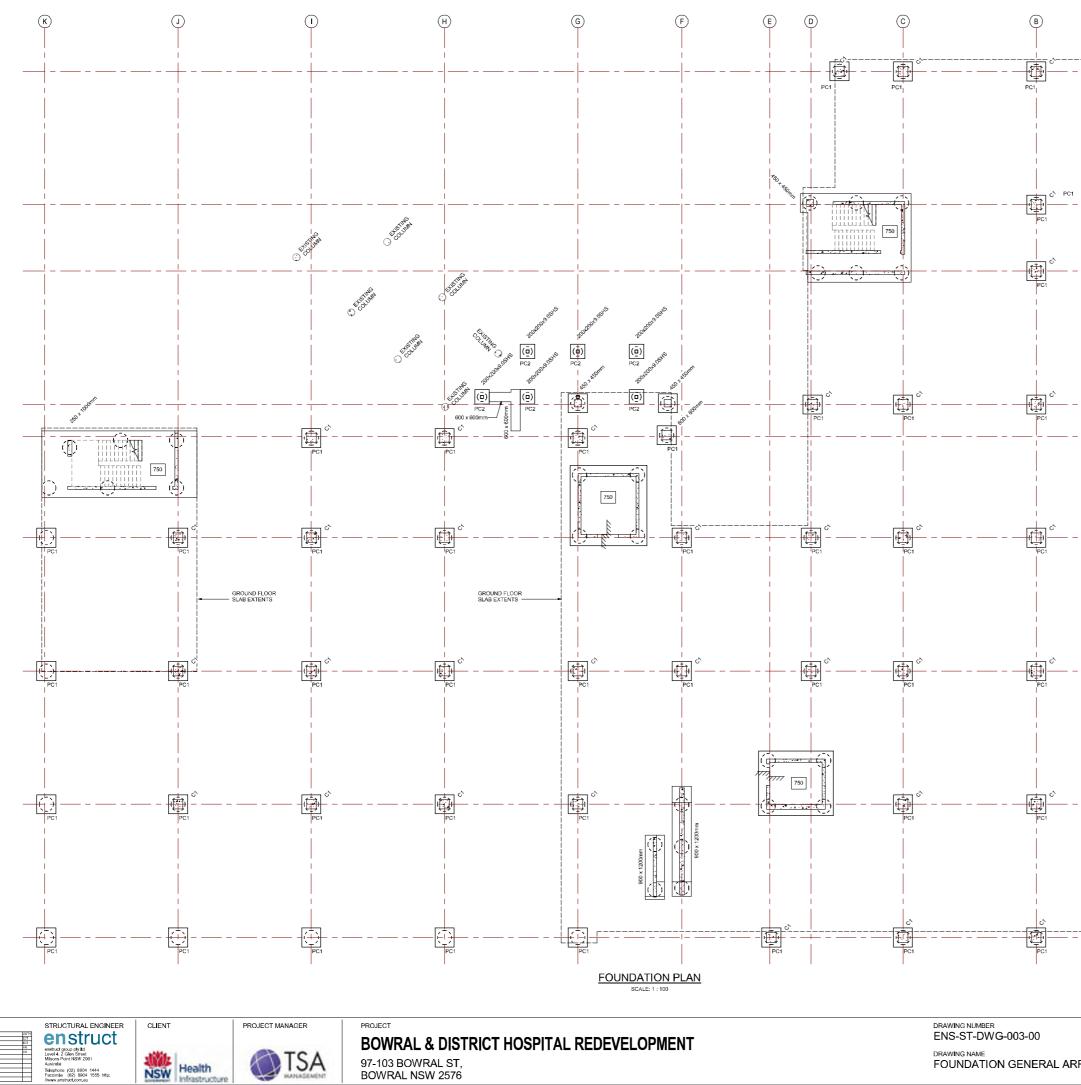
LIGHT STEEL FRAMING

All light steel framing to contractors design and detail in accordance with AS4600, Light weight construction where used shall be a tested system in accordance with the requirements of the BCA

ATION & DEMOLITION NOTES

- Prior to the commencement of any excavation or demotilion works, the contractor shall submit a detailed excavation and demotition construction methodology which will be reviewed and agreed by enstruct and the generativity of the second se
- violations at adjacent buildings within acceptable international limits which will be advised by the operativitied regime high temporary we had protection funding and regime anguited by Violatorer. All necessary approvals from submittles and adjacent property contrast must be obtained before commoncement of work, barrity and verify the location of existing adjacent envices and control deals with the engineer prior to the production property is an oracle, addees and adjacent property contrasts and adjacent property provide the production of existing adjacent envices and control deals with the engineer prior to the production enjoyeers is on motions. Addees, while any other adjacent for the Rock Bolls, Dowels, Rock Antonic, Concrete Parella, Solders, Wales, and Dania Hole. 4.

REV							ISSUE DATE
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DRAWING NAME FOUNDATION GENERAL ARRAN

97-103 BOWRAL ST, BOWRAL NSW 2576

Health

NSW

AMENDMENTS

ISSUE DATE 1 19/0.1/ PREDNARY BS



(A)

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

- PLE NOTES

 1. ALL PILES TO BE 000mm DIAMETER TYPICALLY U.N.O.

 2. ALL PILES TO BE 0050MED AND DETALED BY SPECIALIST PLING CONTRACTOR IN ACCORDANCE WITH AS2159 AND TO THE DESIGN AND DETAL OF THE PILING CONTRACTOR.

 3. ALL PILES TO BE SOCKETED AN AVERAGE LENGTH OF 11 METRES INTO MEDIUM STREINETH ROCK TO ACHIEVE ALLOWABLE SHAFT ADHESION CAPACITY OF 150kPa AND ALLOWABLE BEARING CAPACITY OF 150kPa NA CCORDANCE WITH DOUGLAS PARTNERS GEOTECHNICAL REPORT.

 4. CONCRETE STRENCTH TO PLES 75mm.

 5. CONCRETE STRENCTH TO PLES 75mm.

 6. CONCRETE STRENCTH TO PLES 75mm.

 7. ALL PILES TO BE SOCHTED WITHIN 75mm OF POSITION NOMINATED AND BE WITHIN ALL PILES TO BE INSPECTED BY A OUAL FED GEOTECHNICAL ENGINEER TO VERIFY DESIGN BEARING PRESSURES.

 8. ALL PILE FORMS ARE TO BE INSPECTED TO ENSURE THEY ARE CLEANED AND REE COLOSE MATERIAL AND WATER PRIOR TO POURING CONCRETE, WHICH SHOULD BE WITHIN MINIAL DELLY AND ON THE SAME DAY AS BORING.

 9. THE INSPECTION SOCIAL ENGINEES SI ACHIEVED IN THE PLE SHAFT TO GUARANTEE SHAFT ADHESION. THE USE OF A ROUGHEINING TOOL IS RECOMMENDED.

 10. SOME GROUNDATER SEEPAGE INTO PLES CAN BE EXPECTED. WATER SHOULD BE WITHIN STORE FOR THE PILLES MMEDIATELY PRIOR TO POURING CONCRETE. WHICH DETAILS MARKED AND RECENT ABEED ON DOUGLAS PARTNERS GEOTECHNICAL REPORT DATED OCTOBER 2016 (PROJECT NO.0 9199)

 13. THE CONTRACTOR SHALL SATISFY THEMSELUYES TO THE CORRECTNESS, OR OTHERWES, OF THE STIMATED TOO FOR CKLEVES TO THE CORRECTNESS, OR OTHERWES, OF THE STIMATED TOO FOR CKLEVES INTHE CAUST AD OVER FOR VARIANCE BETWEEN STIMATED FOR CONDITION HEAD SHAFT DO OVER FOR VARIANCE BETWEEN STIMATED FOR CONDED TO THE CAUST AD
- ADDITION A MEMINION LATERAL DUAL LOGITAL. TO SUM A MINIMUM ALLOWABLE UNA, 5. ALL PILES TO BE FOUNDED ON SANDSTONE ROCK WITH A MINIMUM ALLOWABLE BEARING CAPACITY OF 150KPa. TYPICALLY U.N.O. 6. ALL PILES TO HAVE A SOCKET LENGTH OF 2 x PILE DIAMETER MINIMUM INTO NOMINATED BEARING STRATUM.





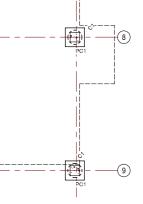
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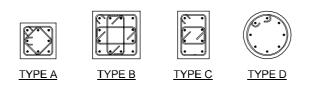




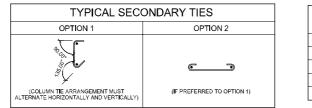




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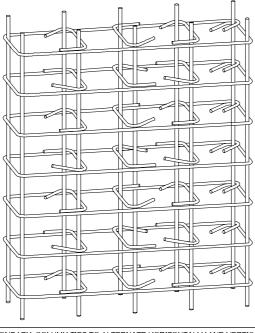


REFER TO COLUMN SCHEDULE FOR COLUMN SIZE AND REINFORCEMENT



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

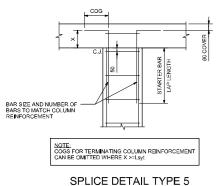


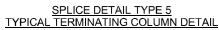
BOWRAL & DISTRICT HOSPITAL REDEVELOPMENT 97-103 BOWRAL ST, BOWRAL NSW 2576

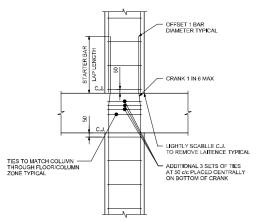
PROJECT

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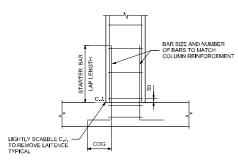
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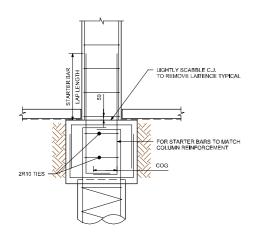




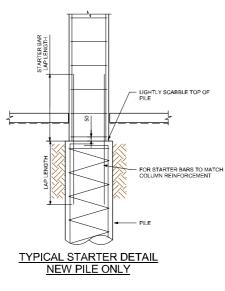
SPLICE DETAIL TYPE 2 TYPICAL CONTINUOUS COLUMN DETAIL



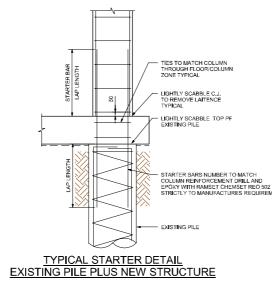
SPLICE DETAIL TYPE 1 TYPICAL COLUMNS STARTER DETAIL SLAB/BEAM

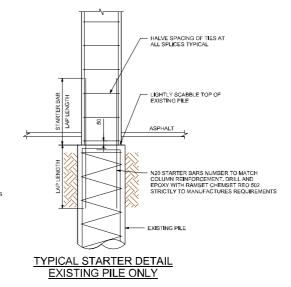


TYPICAL STARTER DETAIL - PILE CAPS



PROJECT

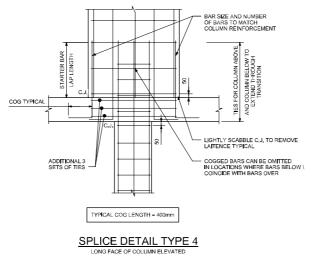


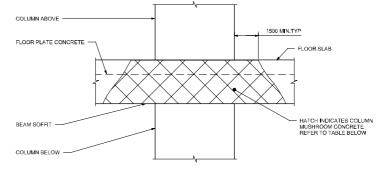




BOWRAL & DISTRICT HOSPITAL REDEVELOPMENT 97-103 BOWRAL ST, BOWRAL NSW 2576

DRAWING NUMBER DRAWING NAME COLUMN TRANSITION DETAILS





TYPICAL COLUMN MUSHROOMING DETAIL

MAX. COLUMN ABOVE/BELOW fc (MPa)	MIN. COLUMN CONCRETE 90 DAY
100	75
80	6
65	50
-	

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

SPLICE DETAIL TYPE 3

ENG

TART

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OFFSET 1 BAR DIAMETER TYPICAL

ADDITIONAL 3 SETS OF TIES

HALVE SPACING OF TIES AT ALL SPLICES TYPICAL

BAR SIZE AND NUMBER OF BARS TO MATCH COLUMN REINFORCEME

COG -

MUSHROOM STRENGTH (MPa)	
1	
•	l
65 MPa COLUMNS	

REV							ISSUE DATE
	0m	2m	4m	6m	8m	10m	
1	SCALE	1:100 @	B1		-	-+	06.12.17