Finley Hospital Redevelopment

Schematic Design Report – Civil & Structural Engineering

NSW Health Infrastructure

HI22654F
23 January 2024
Ref: 222539_FinleySchematicDesignRpt_CivilStructural_FINAL

Building exceptional outcomes together

Document History and Status

Rev	Description	Author	Reviewed	Approved	Date
0	Finley Schematic Design Report Civil Structural - FINAL	AT/BO	SC	SC	23/01/2024

Contents

Project: Finley Hospital Redevelopment | Schematic Design Report – Civil & Structural Engineering
Client: NSW Health Infrastructure
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1 Executive Summary

Structural Engineering

The current architectural scheme dated 15 December 2023 maintains most of the existing hospital structure with majority of the changes made towards the front of house (FOH) area, upgrades to existing corridors and a new in-patient-unit (IPU) extension towards the Western end of the building. Demolition works will mainly involve demolition of internal load bearing and non-load bearing walls within the FOH areas. Construction of the new IPU extensions and refurbishment to the FOH will most likely adopt similar structural elements as per the existing structure being reinforced concrete slabs for the floors, masonry load bearing walls and timber roof framing. Alternatively, subject to compliance with fire-resistance (FRL) and acoustic requirements, light-weight stud wall system with suitable fire-protection and sound insulation can be adopted in lieu of masonry load bearing walls.

Apart from the main hospital building, no other structural alterations are to be made to the other buildings within the site. There are parts of the existing space within the main hospital building that will be left vacant in the current scheme. Unless determined otherwise by the relevant authorities, these vacant areas in the main hospital building and surrounding buildings within the site are not part of the scope of this report.

Civil Engineering

The civil engineering design will involve stormwater drainage connections for the proposed building extensions and reinstatement of deteriorated infrastructure to support the redevelopment of the hospital.

A site investigation of Finley hospital informed the condition of asphaltic pavement, internal road and carparking layouts, existing drainage infrastructure, stormwater connection points and overall topography and imperviousness of the site.

Topographically, the site is extremely flat – representing maximum grades of approximately 0.2% longitudinal fall in both the road network and within the site.

The existing underground drainage network is expected to cater for the proposed minor building works approximated to an additional roof catchment of some 226 m^2 without requiring downstream upgrades or detention facilities.

2 Scope and Limitation

This report has been prepared by Tonkin for NSW Health Infrastructure and my only be used and relied on by NSW Health Infrastructure for the purpose agreed between Tonkin and NSW Health Infrastructure.

Tonkin disclaims responsibility to any person other than NSW Health Infrastructure arising in connection with this report. Tonkin also excludes implied warranties and conditions, to the extent of legally permissible.

The services undertaken by Tonkin in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. Tonkin has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in the report are based on information provided to us to date and assumptions made by Tonkin described in this report. Tonkin disclaims liability arising from any of the assumptions being incorrect.

3 Introduction

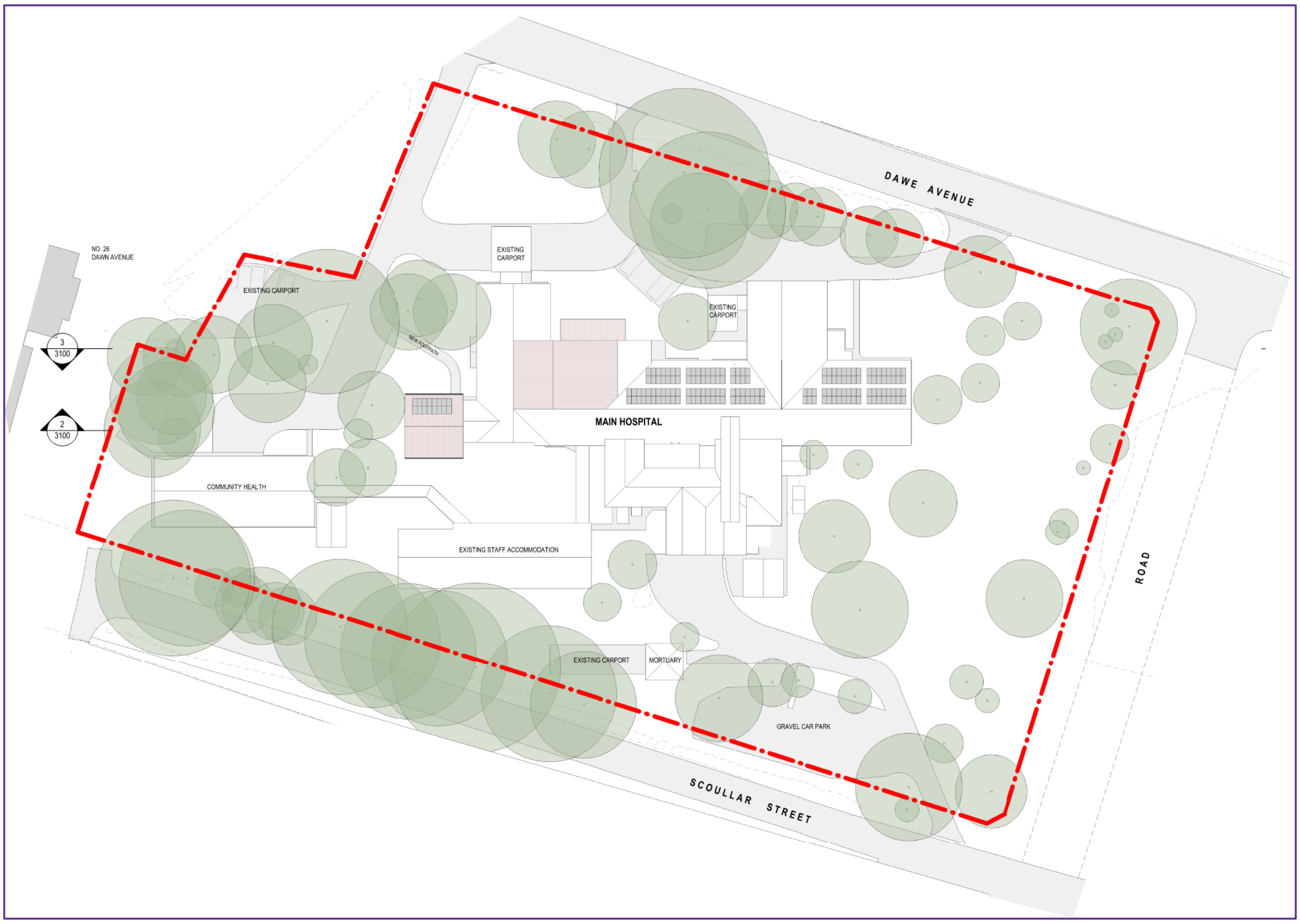
Tonkin has been engaged by NSW Health Infrastructure to complete Parts 1 to 9 for Civil and Structural engineering services for Finley Hospital Development (Contract HI22654F). This is a schematic design report for civil and structural engineering services based on HDR architectural scheme dated 15 December 2023. Apart from the front of house area and new IPU extension to the main hospital building, no new structural works will be undertaken on the existing buildings within the site. This report is developed further to our site inspections in March and July 2023 and on-going coordination between disciplines.

Existing Finley Hospital (view from Dawe Avenue)

<u>Proposed Finley Hospital Re-development – 15 December 2023</u>

4 Structural Engineering

4.1 Existing Building Structures



Finley Hospital – Existing buildings and proposed works

Main Hospital Building

Currently, the main hospital building is located on relatively flat site. Much of the single storey main hospital building structure was completed in the 1960s with the North-Western wing and other smaller areas added during the 1980s and 1990s. Much of the building was constructed with double skin external brickwork wall, metal roof sheeting over timber roof framing, concrete slab-on-ground, internal single skin brickwork wall with plasterboard cladding and fibre cement ceilings.

Existing termite damage (treated)

Roof space of Main Hospital Building

Staff Accommodation & Allied Health (Community Health) Buildings

Similar to the main hospital building, both of these buildings are single storey structures with brick external walls, metal roof and internal brickwork walls with plasterboard ceilings. No modification or refurbishment works are to be undertaken to these buildings under the current scheme.

Typical structural elements of staff accommodation and community health buildings

Structural issues with the existing buildings

Below are some of the structural inadequacies that were observed on the existing main hospital and staff accommodation buildings:

- Existing structures do not comply with current standards and codes.
- Based on the visual inspection undertaken, the existing hospital and staff accommodation do not seem to be suitably designed for lateral force effects such as wind and earthquake loadings. Structural upgrades to bring them up to current standards will be extensive and costly relative to the demolition and rebuild option.
- Considering most of the existing walls are load bearing, any modifications to them (e.g. demolition to create new openings) will be limited and restrictive and require steel underpinning beams and or steel frames which can be costly and would require temporary propping and staging to execute in a safe manner.
- Existing concrete floor slab may not have sufficient structural capacity to support weight of new equipment or suitable to meet their operational requirements (i.e. vibration damping). Hence extensive structural upgrades will be required to the floor structure that may also have a material impact on head height for the level below.
- Creation of new set-downs to wet areas may not be structurally feasible as scabbling of existing slab may compromise the structural integrity of the slab.
- Generally, there will be costly on-going structural maintenance works required for older buildings.
- Although successfully treated, evidence of termite infestation could be noted but we could not ascertain if the damage has been extended into the roof space and damaged the existing timber roof rafters. Furthermore, considering past infestation, future infestation cannot be rules out.

4.2 Hazardous Building Materials

A due diligence report (dated September 2022) was prepared by Northrop Consulting Engineers to provide an assessment on the structural condition of the buildings. The report noted that works to remove asbestos from the buildings had commenced but had not been completed.

Further investigations were undertaken by JK Environments (JKE) on site between 8th May to 10th May 2023 to ascertain the extent of the hazardous materials. Both friable and bonded asbestos containing materials were identified within the interior and exteriors of the existing buildings.

Building No. and reference	Friable asbestos	Bonded asbestos	SMF materials	Lead based paint	Lead in dust	PCB cont. electrical equipment
1. Main Hospital	**Yes**	**Yes**	**Yes**	**Yes**	No	**Yes**
2. Mortuary	No	**Yes**	No	No	No	**Yes**
3. Community Health	No	**Yes**	**Yes**	No	No	No
4. Staff Accommodation	No	**Yes**	**Yes**	No	No	No

Potential HAZMAT presence in buildings

From JKE's assessment, it appears that all existing buildings contain bonded asbestos as it was commonly used as building materials in those times.

4.3 Geotechnical-Structural Interactions

Between 8th May 2023 and 10th May 2023, geotechnical investigation works were carried out by JK Geotechnics on site. A total of 12 borehole samples were taken. Locations of these bores are as show on the following diagram.

Geotechnical investigation boreholes

Below are some of the critical parameters extracted from the geotechnical report that are relevant for the structural design works.

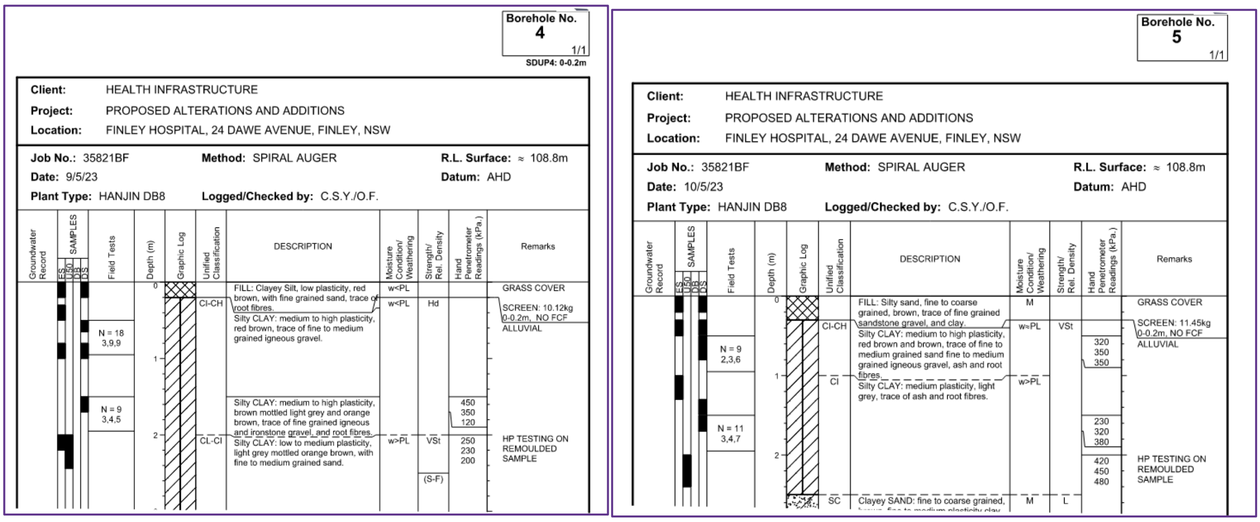
- Finley Hospital is located within the southern Riverina Plain in a landscape characterised by a typical flood plain with near level topography.
- The site is underlain by Quartenary age Reverine deposits comprising of unconsolidated clay, silt, sand and gravel.
- Generally, fill level was encountered from ground level and extended to depths of 0.2m to 0.8m.
- CBR values between 1% and 2.5%. Pavement thickness should be based on a soaked CBR of 1%.
- All existing fill to be removed and excavated to natural subgrade prior to building foundation and slab construction. Excavated fill to be removed as they are not suitable to be re-used. However, uncontaminated gravelly fill can be reused as engineered fill, provided they are separately stockpiles, inspected and approved by the geotechnical engineer.
- Excavated topsoil to be stockpiled and reuse for landscaping.
- For the building structures, all slab-on-ground (other than stiffened raft) should be isolated from the footings supporting columns and walls.
- Recommended that the excavation of fill extend to at least 1m beyond the building footprint.
- Subgrade to be proof-rolled with 6 passes with at least an 8-tonne smooth drum roller used in static or non-vibratory mode. Thickness of compaction layers shall not exceed 200mm to a minimum dry density of 98%.
- Site is classified as class "P" in accordance with AS2870-2011 "Residential slabs and footings".
- Preference to have all new structures to be uniformly founded on upper alluvial clays. Existing fill is unsuitable as founding materials.
- Stiffened raft slab foundation is the likely to be the most appropriate foundation system for the site.
- Allowable bearing pressure of 150kpa is anticipated if raft slab is founded within natural clay of at least very stiff strength. It should be noted that soft to firm soils were encountered at depths of about 2m to 2.5m and footings founded in the very stiff clay must be founded sufficient depth above these softer clays such that they are not within the zone of influence of the footing.
- No ground water table is anticipated for the excavations.
- For earthquake design, Hazard factor (Z) = 0.1 and Class De soil profile for deep or soft soil site.
- Site does not fall within an identified Mine Subsidence District and therefore does not require approval from Subsidence Advisory NSW.

4.4 Proposed Building Refurbishment Works

The proposed structural system for the new IPU extension will be similar with the rest of the existing building.

4.4.1 Slabs and Foundation

The IPU extension will consists of reinforced concrete raft slab on ground with loadbearing masonry wall supporting roof structure above. As a guide, slab on ground will be around 150mm thick with localised thickening internal and edge beams of 300mm wide by 700mm deep. Sand or concrete blinding shall be required with damp-proof membrane under slab. The raft slabs are designed to be founded on clay, in which as noted on boreholes 4 and 5 to be 100mm and 150mm below existing ground level respectively. Concrete strength to be minimum of 32Mpa and reinforcement not less that the requirements of AS3600. Apart from dowel joints to the existing slabs, the new slab will be designed without any sawcut or dowel joints.



Borehole No. 4 1/1 SDUP4: 0-0.2m

Client: HEALTH INFRASTRUCTURE
Project: PROPOSED ALTERATIONS AND ADDITIONS
Location: FINLEY HOSPITAL, 24 DAWE AVENUE, FINLEY, NSW

Job No.: 35821BF Method: SPIRAL AUGER R.L. Surface: ≈ 108.8m
Date: 9/5/23 Datum: AHD
Plant Type: HANJIN DB8 Logged/Checked by: C.S.Y./O.F.

Groundwater Record	SAMPLES	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			0			FILL: Clayey Silt, low plasticity, red brown, with fine grained sand, trace of root fibres.	w<PL			GRASS COVER
		N = 18 3,9,9			CI-CH	Silty CLAY: medium to high plasticity, red brown, trace of fine to medium grained igneous gravel.	w<PL	Hd		SCREEN: 10.12kg 0-0.2m, NO FCF ALLUVIAL
		N = 9 3,4,5	1			Silty CLAY: medium to high plasticity, brown mottled light grey and orange brown, trace of fine grained igneous and ironstone gravel, and root fibres.			450 350 120	
			2		CL-CI	Silty CLAY: low to medium plasticity, light grey mottled orange brown, with fine to medium grained sand.	w>PL	VSt (S-F)	250 230 200	HP TESTING ON REMOULDED SAMPLE

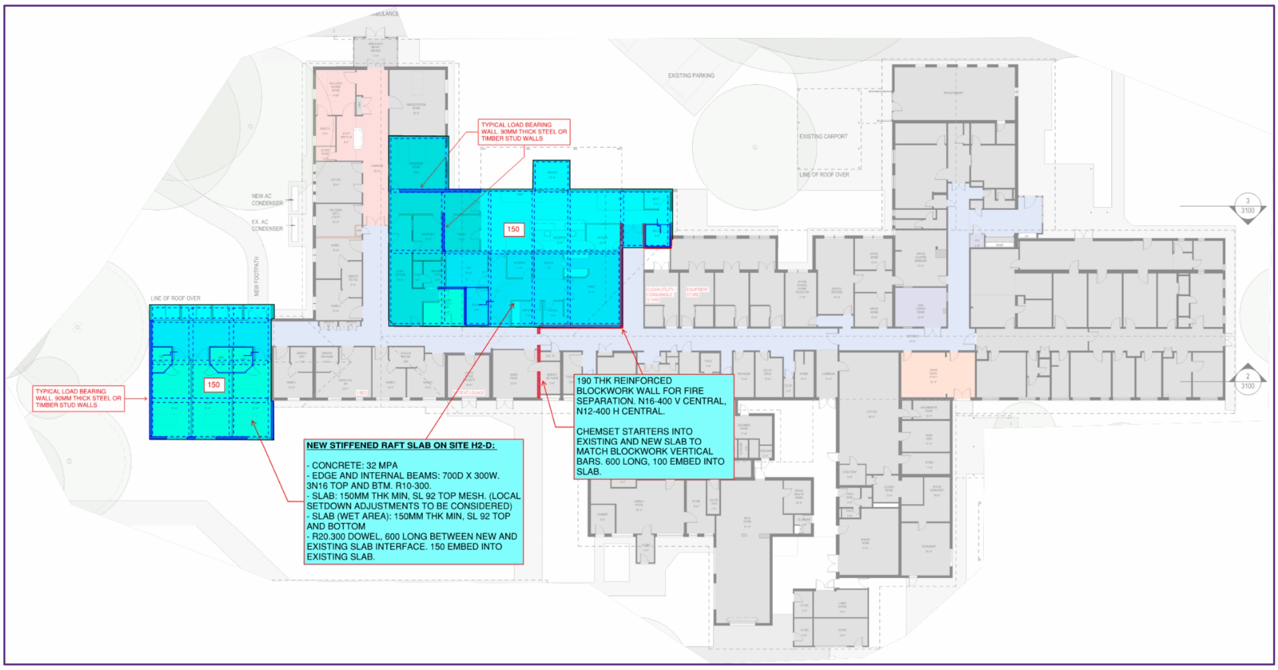
Borehole No. 5 1/1

Client: HEALTH INFRASTRUCTURE
Project: PROPOSED ALTERATIONS AND ADDITIONS
Location: FINLEY HOSPITAL, 24 DAWE AVENUE, FINLEY, NSW

Job No.: 35821BF Method: SPIRAL AUGER R.L. Surface: ≈ 108.8m
Date: 10/5/23 Datum: AHD
Plant Type: HANJIN DB8 Logged/Checked by: C.S.Y./O.F.

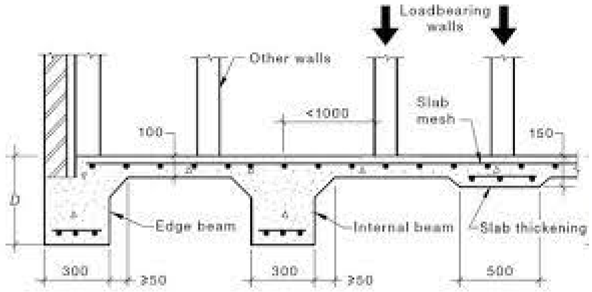
Groundwater Record	SAMPLES	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			0			FILL: Silty sand, fine to coarse grained, brown, trace of fine grained sandstone gravel, and clay.	M			GRASS COVER
		N = 9 2,3,6			CI-CH	Silty CLAY: medium to high plasticity, red brown and brown, trace of fine to medium grained sand fine to medium grained igneous gravel, ash and root fibres.	w≈PL	VSt	320 350 350	SCREEN: 11.45kg 0-0.2m, NO FCF ALLUVIAL
		N = 11 3,4,7	1		CI	Silty CLAY: medium plasticity, light grey, trace of ash and root fibres.	w>PL		230 320 380	
			2						420 450 480	HP TESTING ON REMOULDED SAMPLE
					SC	Clayey SAND: fine to coarse grained,	M	L		

Boreholes 4 and 5. Clay layers are found 100mm and 150mm respectively below existing ground level

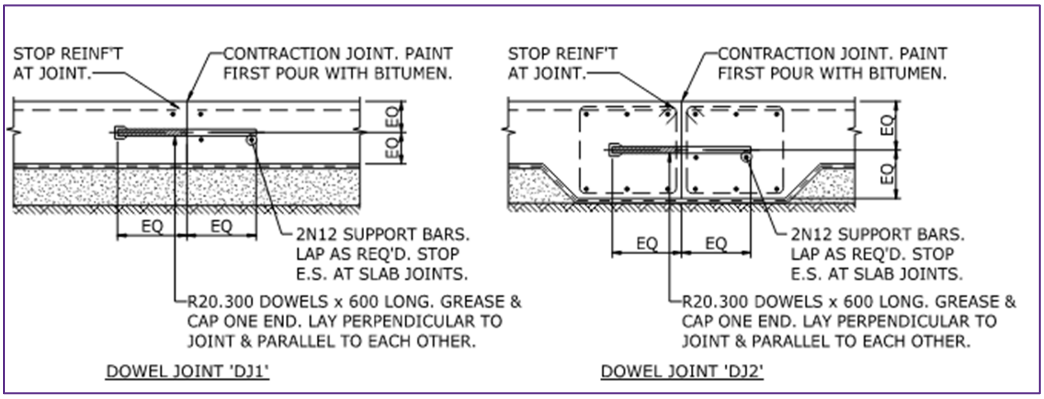


Structural schematic design for slab and foundation

For refurbishment works on the existing slabs, it is likely the slab may need to be locally demolished full depth to have the new wet area set-downs to be installed. Existing surface chasing may not be structurally feasible without affecting the integrity of the surrounding slabs. Similarly, full depth local demolition to existing slab is recommended in areas where new services are required to be installed (e.g. hydraulics)



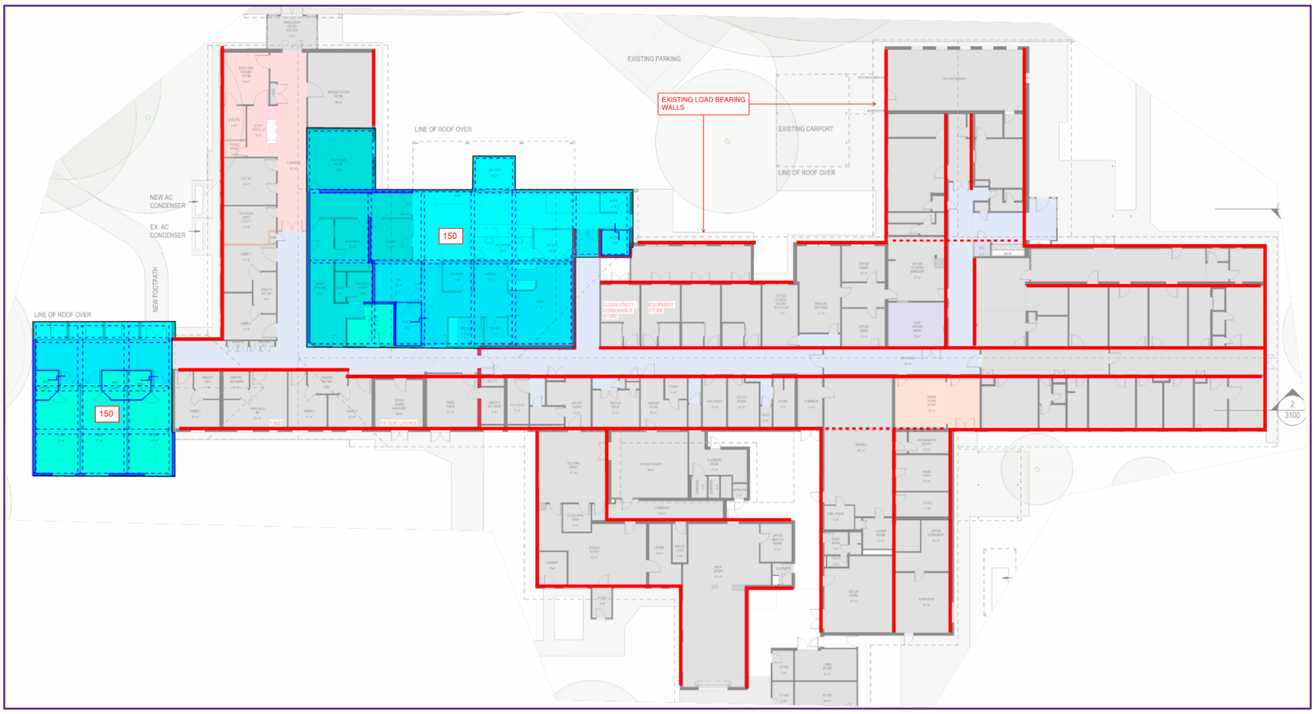
Proposed slab-on-ground to new IPU extension and refurbishment of the FOH areas



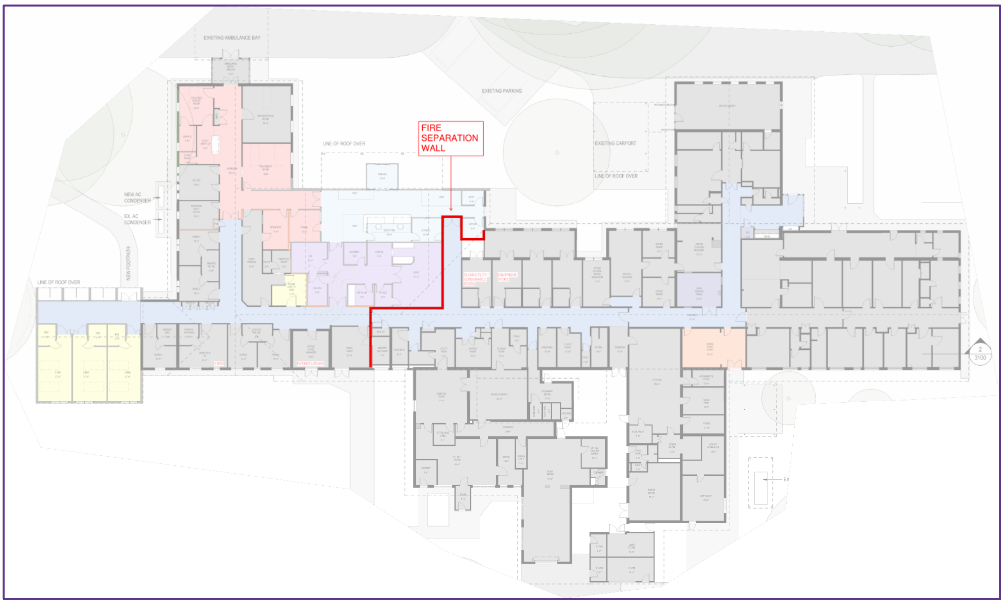
Proposed dowel joint details between new and existing slab interfaces

4.4.2 Load-bearing and fire separation walls

Main load bearing walls to consist of concrete filled masonry wall for their strength, robustness and fire resistance capabilities. Alternatively, if fire rating or fire separation is not required, a more cost-effective alternative is to adopt light-weight steel stud framing. Note however, with suitable fire-check installed external to the light-weight stud walls, the required fire-rating may also be achieved. With the light-weight steel stud wall frames, strap bracing will be introduced within wall to provide lateral stability to the superstructure (i.e. walls and roof system) under effects such as wind and earthquake. See figure below for the extent of the identified existing load bearing walls, proposed new walls and roof beams.



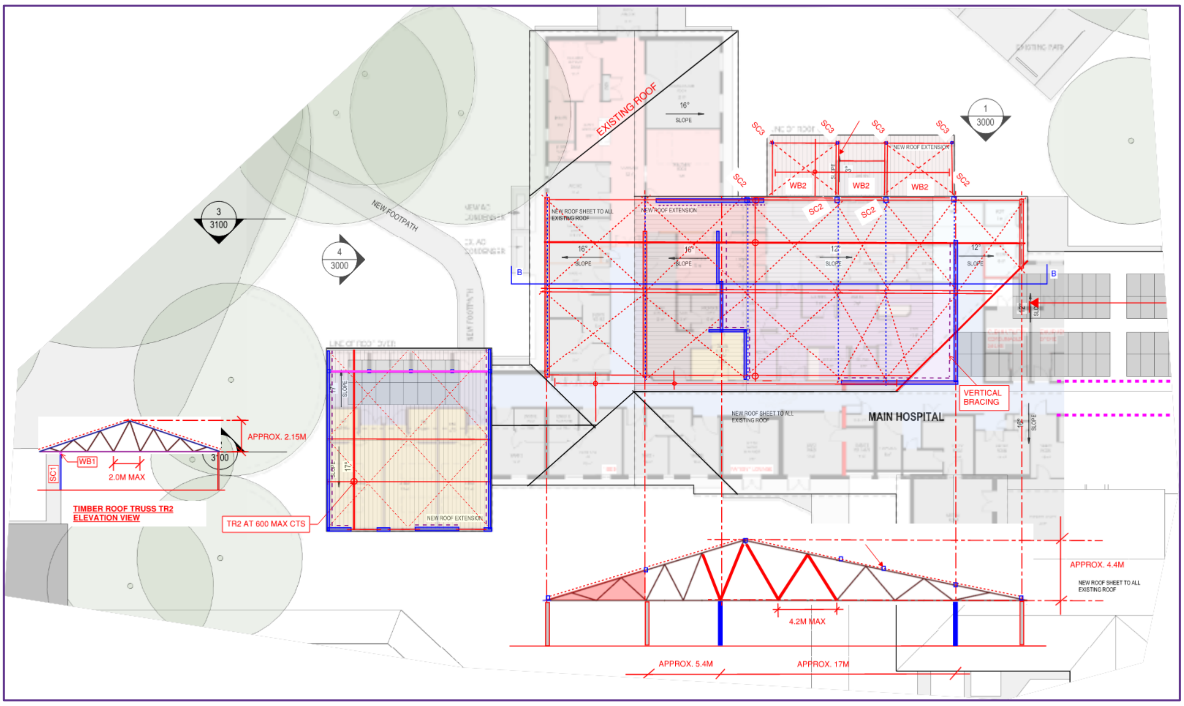
Existing load bearing walls (red)



Fire separation

4.4.3 Roof

As per the current architectural scheme, it is understood that the existing roof sheeting, battens and sarking to be completely replace with new. However, the existing structural timber roof rafters will be maintained. Under the current structural scheme, the roof over the new IPU extension to consist of either prefabricated timber roof trusses or site-assembled timber roof trusses. Additional timber roof framing will also be required over the FOH area to match the architectural intent for the new gable end roof profile.



New roof structure over IPU and FOH areas

MEMBER SCHEDULE
ALL TIMBER TRUSSES ARE OUT OF F17 SEASONED HARDWOOD (MIN. JD3 JOINT GROUP)

MAIN ROOF

TC1 - 120x45	TIMBER TRUSS TOP CHORD
TC2 - 120x45	TIMBER TRUSS BOTTOM CHORD
TD1 - 90x45	TIMBER TRUSS DIAGONALS
TD2 - 90x45 + 2x90x35	TIMBER TRUSS DIAGONALS
(1 EACH SIDE AND FIX TO DIAGONAL)	
T1 - 90x45	TIMBER NOGGINS/ STRUT
R1 - 140x45	TIMBER RAFTER
TP1 - 90 X 90	TIMBER STUB COLUMN ON EXISTING WALL

AWNING

SC2 - 150x100x4 RHS	STEEL COLUMN
SC3 - 60X3.6 CHS	STEEL COLUMN
SB1 - 150PFC	STEEL BEAM
R2 - 140x45	TIMBER RAFTER
TB1 - 2x140x45	TIMBER BEAM
WB2 - 150x5 SHS	STEEL WIND BEAM AT AWNING ROOF LEVEL

-ROOF BRACING - PRYDA 'SPEED BRACE' OR APPROVED EQUIVALENT. BRACING ANGLE TO BE BETWEEN 30 TO 45

- PROVIDE PRYDA TIMBER TRUSS NAIL ON PLATE EACH FACE PER TRUSS JOINT OR APPROVED EQUIVALENT

-PROVIDE CYCLONE TIES TO CONNECT TRUSSES TO EXISTING LOAD BEARING WALLS AND NEW LOAD BEARING STUD WALLS

WESTERN ROOF

TC3 - 120x45	TIMBER TRUSS TOP CHORD
TC4 - 120x45	TIMBER TRUSS TOP CHORD
TD2 - 90x45	TIMBER TRUSS DIAGONALS
WB1 - 150x5 SHS	STEEL WIND BEAM
SC1 - 89x3.4 SHS	STEEL COLUMN

DESIGN PARAMETERS

WIND

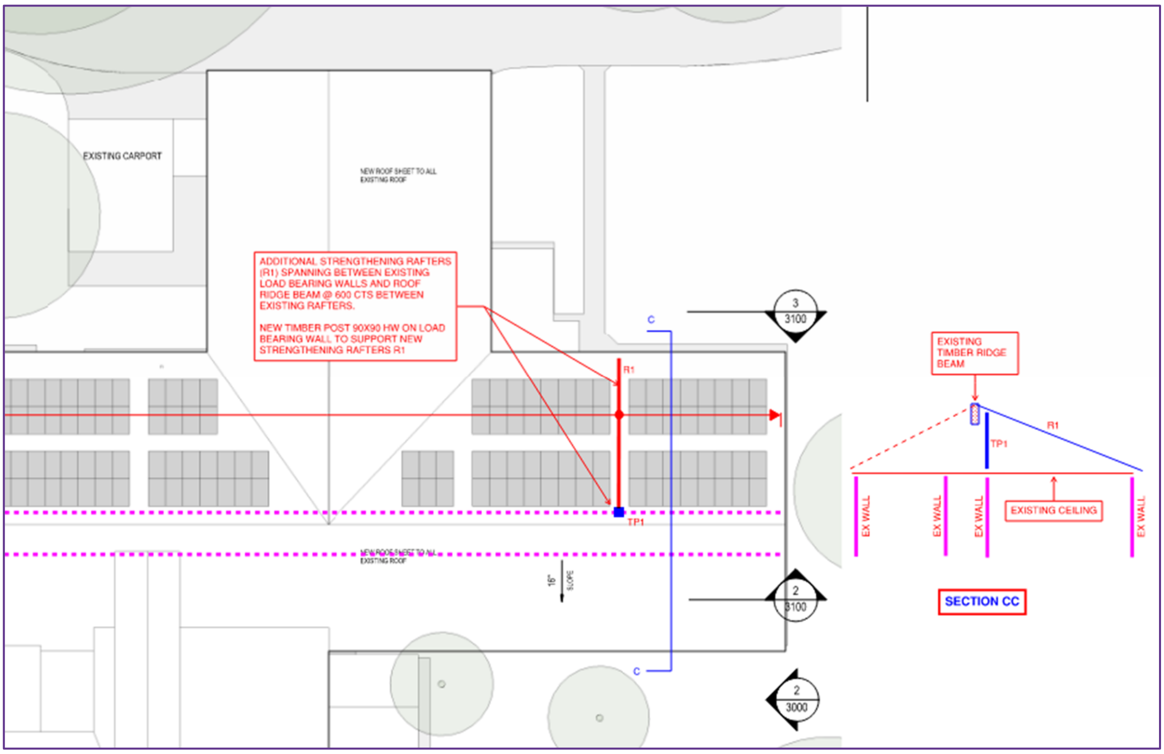
MPORTANCE LEVEL = 3
WIND ARI = 1:1000
REGION = A0
TERRAIN CATEGORY = 2
REGIONAL WIND SPEED = 46 m/s
DESIGN BASE WIND PRESSURE (ULTIMATE):
(NORTH/SOUTH/EAST) = 1.05kPa x Cshp
(WEST) = 0.82kPa x Cshp

GRAVITY

ROOF DEAD LOAD (WITH CEILING) = 0.85kPa
SOLAR PANEL = 0.15kPa
LIVE LOAD = 0.25kPa (1.4kN CONCENTRATED LOAD)

Structural Schematic design of roof and wall framing elements

Subject to final design of the PV system, strengthening roof rafters may also be required over the existing roof in the Eastern half of the building to support the additional weight.



Roof strengthening rafters to support new PV loads

At the time of writing, it is understood that no new building services mechanical plant equipment are to be place on the roof structure.

4.5 Structural design parameters

Unless instructed otherwise by relevant authorities, the following design loadings and parameters will be applicable for the development and will be used throughout the design phase of the structural elements.

Items	Value	NCC Reference and Notes
Building classification	9a	**A6G10:** a healthcare building including any parts of the building set aside as laboratories, and includes a health care building used as a residential care building
Importance level	3	**Table B1D3a:** buildings or structures that are designed to contain a large number of people
Annual probability of exceedance for non-cyclonic wind	1:1000	**Table B1D3b:** Design events for safety (Importance level, IL 3, as confirmed by BMG)
Annual probability of exceedance for earthquake	1:1000	**Table B1D3b:** Design events for safety

Type of construction required	C	**Table C2D2:** Types of construction required for a building with Rise of storeys = 1, Building Class = 9
Type C FRL to load-bearing common and fire walls	FRL 90/90/90	**Table S5C24c**
Type C FRL for roof	0/0/0	**Table S5C24e**

4.5.1 Dead Loads

Dead loads shall be in accordance with the materials specifications from suppliers or if this is not available, shall be derived from Table A1 of *AS1170.1 – Permanent, imposed and other actions.* See below.

UNIT WEIGHTS OF MATERIALS AND CONSTRUCTION

Material	Weight per cubic metre kN/m³
Aluminium	26.7
Asphalt	21.2
Bitumen	10 to 14
Brass	83.5
Concrete, dense aggregate, un-reinforced (add 0.6 for each 1% by volume of steel reinforcement)	24.0
Copper	86.3
Cork	
—normal	1.7
—compressed	3.7
Fibre cement sheet	
—uncompressed	14.2
—compressed	17.2
—fire resistant lining sheet	9.1
—insulating sheet	6.9
Glass—window (soda-lime)	25.5
Granite, basalt, trachyte	26.4
Iron, cast	70.7
Granite, basalt, trachyte	26.4
Iron, cast	70.7
Lead	111
Limestone	
—dense	24.5
—Mt. Gambier	12.5
Marble	26.4
Sandstone	22.5
Steel	76.9
Timbers, at 12% moisture content (see also AS 1720.2)	
Pine (Radiata) (Australian)	5.3
(New Zealand)	4.6
Cypress (Australian)	7.0
Douglas fir	5.5
Hoop	5.3
Blackbutt	8.7

BUILDING MATERIALS AND CONSTRUCTION

Material or construction	Force/unit area kN/m²
Ceilings	
Fibrous plaster, 10 mm thick	0.09
Gypsum plaster, 13 mm thick	0.13
Lime plaster, 13 mm thick	0.24
Portland cement plaster, 13 mm thick	0.29
Suspended metal lath and gypsum plaster FRL—1 h	0.25
FRL—2 h	0.50
No fire rate	0.15
Floors	
Asphalt, 25 mm thick	0.53
Cinder-concrete filling, 25 mm thick	0.43
Clay tiling, 13 mm thick	0.27
Compressed fibre cement sheet, 15 mm thick	0.23
Magnesium oxychloride—	
normal (sawdust filler), 25 mm thick	0.35
heavy duty (mineral filler), 25 mm thick	0.53
Terrazzo paving, 16 mm thick	0.43
Roofs	
Fibre cement, corrugated sheeting—	
6 mm thick, (standard corrugations)	0.11
6 mm thick, incl. lap and fastenings	0.13
6 mm thick, (deep corrugations)	0.12
6 mm thick, incl. lap and fastenings	0.16
Fibre-cement shingles	0.22
Bituminous felt (5-ply) and gravel	0.43
Metal, troughed sheeting other than given elsewhere	Actual mass to be determined
Acrylic resin sheet, corrugated—	
3 mm thick, standard corrugations	0.04
3 mm thick, deep corrugations	0.06
Slates—10 mm thick	0.70
Steel sheet, flat galvanized, per mm thickness	0.08

Material or construction	Force/unit area kN/m²
Steel, galvanized standard corrugated sheeting—	
1.00 mm, incl. lap and fastenings	0.12
0.80 mm, incl. lap and fastenings	0.10
0.60 mm, incl. lap and fastenings	0.08
0.50 mm, incl. lap and fastenings	0.05
Tiles—	
Terracotta (French pattern)	0.57
Concrete	0.53
Zinc sheet per 10 mm thick	0.76
Walls and partitions (see Note 1)	
Acrylic resin sheet, flat, per 1.0 mm of thickness	0.01
Autoclaved aerated concrete block masonry—100 mm thick	0.05 to 0.065
Fibre cement sheet—	
4.5 mm thick	0.07
6.0 mm thick	0.11
Fibre-cement compressed decking 15 mm thick	0.26
Fibre-cement sheet—fire resistant	
lining sheet, 9 mm thick	0.08
insulating sheet, 15 mm thick	0.10
Brick masonry, solid—	
burnt clay, per 10 mm of thickness	0.19
calcium silicate (sand-lime), per 10 mm of thickness	0.18
Concrete hollow block masonry (see Note 2)—	
Standard aggregate:	
90 mm thick	1.45
140 mm thick	1.83
190 mm thick	2.10
Lightweight aggregate:	
90 mm thick	1.20
140 mm thick	1.51
190 mm thick	1.82
Fibre insulation board, per 100 mm of thickness (see Note 3)	0.34
Fibrous plaster board, per 100 mm of thickness	0.92
Hardboard, per 100 mm of thickness	0.96
Particle or flakeboard, per 100 mm of thickness	0.66
Plaster board, per 100 mm of thickness	0.76
Plaster	
Portland cement, per 10 mm of thickness	0.23
Lime, per 10 mm of thickness	0.19
Gypsum, per 10 mm of thickness	0.17
Plywood	0.4–1.2
PVC homopolymer sheet, per 10 mm of thickness	0.15

Unit weight of construction materials

4.5.2 Live Loads

Live loads shall be in accordance with recommendations of *AS1170.0 – General Principles* and *AS1170.1 – Structural design actions – Permanent, imposed and other actions.*

Element types	Uniformly imposed loads (kPa)	Imposed point loads (kN)	Superimposed dead loads (kPa)
Stairs, ramps	4	4.5	0.5
Lobby, corridors	5	4.5	2
Wards areas	2	1.8	2
Clinical areas	3	4.5	2
Plant rooms	7.5	4.5	2

Roof (Non-trafficable, inclusive of PV panels)	0.25	1.4	1.0

4.5.3 Wind Load parameters

Wind loadings on the buildings shall be applied based on the requirements as set out in AS1170.2

Item	Value
Location	A0
Terrain Category	2
Importance level	3 (Confirmed by BMG)
Ultimate wind speed	46m/s (V_{1000})
Serviceability wind speed	37m/s (V_{20})
Shielding Multiplier, Ms	1.00
Terrain Multiplier, Mz.cat	0.91
Directional Multiplier, Md	1.00

4.5.4 Earthquake load parameters

Earthquake loadings on the buildings shall be applied based on the requirements as set out in AS1170.4

Item	Value
Importance level	3
Probability factor	1.3
Hazard factor, Z	0.1
Sub-soil Class	De
Earthquake Design Category	II
Structural ductility factor, μ	2
Structural performance factor, Sp	0.77

4.5.5 Floor vibration

For floor vibration assessment, the Footfall response will be assessed in accordance with the Concrete Centre Design Guide. The Footfall frequencies and corresponding response factors defined within the NSW Health Design Guidance Note No.1 which the different floor areas will be checked for compliance with the Concrete Centre Design Guide are given in the table below.

Facility/Equipment/Use	Design Response Factor	Footfall Frequency (Hz)
Generally procedure rooms, laboratories, and general surgery	2	2.2
Corridors, circulation spaces, offices, and other non-vibration sensitive areas	4	2.2
Imaging Suite and operating theatres	1	1.8
Plant areas	N/A	N/A
Roof areas	N/A	N/A

Footfall Response Factor Design Parameter – Concrete Centre Method

4.5.6 Deflection Limits

Deflection limits in accordance with AS/NZS1170.0 Table C1 shall apply unless more stringent deflection limits are required for special conditions:

Table C1 Suggested Serviceability Limit State Criteria

Element	Phenomenon controlled	Serviceability Parameter	Applied Action	Element Response (see Notes 1 and 2)
Roof cladding				
Metal roof cladding	Indentation	Residual deformation	Q = 1 kN	Span/600 but <0.5 mm
Concrete or ceramic roof cladding	De-coupling	Mid-span deflection	[G, $\psi_s Q$]	Span/120
	Cracking	Mid-span deflection	[G, $\psi_s Q$]	Span/400
Roof-supporting elements				
Roof members (trusses, rafters, etc.)	Sag	Mid-span deflection	[G, ψ_l Q]	Span/300
Roof elements supporting brittle claddings	Cracking	Mid-span deflection	[G, $\psi_s Q$] or [W_s]	Span/400
Ceiling and ceiling supports				
Ceilings with matt or gloss paint finish	Ripple	Mid-span deflection	G	Span/500 (see Note 3)
Ceilings with textured finish	Ripple	Mid-span deflection	G	Span/300
Suspended ceilings	Ripple	Mid-span deflection	G	Span/360
Ceiling support framing	Sag	Mid-span deflection	G	Span/360
Ceilings with plaster finish	Cracking	Mid-span deflection	[G, $\psi_s Q$] or [W_s]	Span/200
Wall elements				
Columns	Side sway	Deflection at top	W_s	Height/500
Portal frames (frame racking action)	Roof damage	Deflection at top	[W_s] or [E_s]	Spacing/200 (Note 4)
Lintel beams (vertical sag)	Doors/windows jam	Mid-span deflection	W_s	Span/240 but <12 mm (see Note 5)
Walls—General (face loaded)	Discerned movement	Mid-height deflection	W_s	Height/150
	Impact: soft body (neighbours notice)	Mid-height deflection	Q = 0.7 kN	Height/200 but <12 mm (see Note 6)
	Supported elements rattle	Mid-height deflection	W_s	Height/1000
Walls—Specific claddings (see Note 7):				
Brittle cladding (ceramic) face loaded	Cracking	Mid-height deflection	W_s	Height/500
Masonry walls (in plane)	Noticeable cracking	Deflection at top	[W_s] or [E_s]	Height/600
(face loading)	Noticeable cracking	Deflection at top	[W_s] or [E_s]	Height/400
Plaster/gypsum walls (in plane)	Lining damage	Mid-height deflection	Ws	Height/300
(face loading)	Lining damage	Mid-height deflection	[W_s] or [E_s]	Height/200
Movable partitions (soft body impact)	System damage	Deflection at top	Q = 0.7 kN	Height/160
Glazing systems	Bowing	Mid-span deflection	W_s	Span/400
Windows, facades, curtain walls	Facade damage	Mid-span deflection	[W_s] *or* [E_s]	Span/250
Fixed glazing systems	Glass damage	Deflection	[W_s] *or* [E_s]	2 × glass clearance (see Note 3)
Floors and floor supports				
Beams where line-of-sight is along invert	Sag	Mid-span deflection	[G, ψ_l Q]	Span/500 (see Notes 8, 9)
Beams where line-of-sight is across soffit	Sag	Mid-span deflection	[G, ψ_l Q]	Span/250
Flooring				
Floor joists/beams	Ripple	Mid-span deflection	[G, ψ_l Q]	Span/300
Floors	Sag	Mid-span deflection	[G, ψ_l Q]	Span/300
	Vibration	Static midspan deflection	Q = 1.0 kN	less than 1 to 2 mm (see Note 10)
Normal floor systems	Noticeable sag	Mid-span deflection	[G, ψ_l Q]	Span/400
Specialist floor systems	Noticeable sag	Mid-span deflection	[G, ψ_l Q]	Span/600
Floors—Side-sway (acceleration)	Sway	Acceleration at floor	W_s (P=5)	<0.01g (see Note 11)
Floors—Supporting masonry walls	Wall cracking	Mid-span deflection	[G, ψ_l Q]	Span/500
Floors—Supporting plaster lined walls	Cracks in lining	Mid-span deflection	[G, ψ_l Q]	Span/300
Floors supporting existing masonry walls—Underpinning floors	Wall cracking	Mid-span deflection	[G, ψ_l Q]	Span/750
Floors—For access for working by operators and maintenance	Sag	Midspan deflection	Q = 1 kN	Span/250
Handrails—Post and rail system	Side sway	Mid-span system deflection	Q = 1.5 kN/m	Height/60 + Span/240

4.6 Sustainability

Together with all structural design works and specific material selection, embodied carbon calculations will also be undertaken to ensure that the total embodied carbon for the structural elements adopted for the new buildings satisfy the sustainability requirements of the project.

ESD Targets (provided by GHD)

Category	Code	Credit Criteria	Points Available	Points TBC	Points not targeted	Discipline
Life Cycle Impacts	13.2	Engineered Wood Products	1	1		Structural
Life Cycle Impacts	19B.1	Concrete	3	2		Structural
Life Cycle Impacts	19B.2	Steel	1	1		Structural
Life Cycle Impacts	19B.4	Structural Timber	4	2		Structural
Responsible Building Materials	20.1	Structural & Reinforcing Steel	1	1		Structural
Stormwater	26.1	Stormwater Peak Discharge	1	1		Civil
Stormwater	26.2	Stormwater Pollution Targets	1	1		Civil

4.7 Design Australian Standards

The structural design shall be in accordance with the latest issue of all relevant Australian Design Standards, Codes and other statutory requirements. As a minimum requirement, the design shall be based on, but not limited to:

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 – 2021	Structural Design Actions Part 2 Wind Actions
AS 1170.4 – 2007	Structural Design Actions Part 4 Earthquake Actions in Australia
AS 1720.1– 2010	Timber Structures Part 1 Design Methods
AS 2312.1 - 2014	Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings - Paint coatings
AS/NZS 2312.2 - 2014	Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings - Hot dip galvanizing
AS 2870 – 2011	Residential Slabs and Footings
AS 3600 – 2018	Concrete Structures
AS 3700 – 2018	Masonry Structures
AS 4100 – 2020	Steel Structures

AS/NZS 4600 – 2005	Cold-Formed Steel Structures
AS 4678 – 2002	Earth Retaining Structures

Structural aspects of the Building Code of Australia

4.8 Material Properties for Design

Generally the following minimum material grades shall be used:

4.8.1 Concrete

Strength Grade	Structural Item
32 MPa	Footings, Piles
40 MPa	Slabs on Grade, Suspended Slab
40/50 MPa	Transfer Slabs, Columns, Precast Concrete

4.8.2 Steel

Strength Grade	Structural Item
250 MPa	CHS (C250LO), Plates
300 MPa	Rolled sections, Welded Beams Grade 300
350 MPa	CHS (C350LO), RHS (C35OLO), SHS(C350LO)
400 MPa	Welded Beams Grade 400
450 MPa	RHS(C450LO), SHS(C450LO)
500 MPa	N-Grade Reinforcement

4.9 Durability

4.9.1 Concrete

The structure shall be designed given due consideration to durability and the functionality of the building and its components. All concrete elements shall be designed for the following exposure classifications in accordance with AS3600

Interior	A1
Exterior	A2

4.9.2 Steelwork

Steelwork protection shall give due consideration to 'time to first maintenance' based on AS 2312.1 – 2014: Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings - Paint coatings and AS 2312.2 – 2014: Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings - Hot dip galvanizing.

Time to first maintenance: 25 years

4.10 Work by Others

4.10.1 Waterproofing

Waterproofing details shall be provided by a waterproofing specialist. Structural drawings may include details as provided by the specialist.

4.10.2 Vehicular Barriers

These are proprietary elements. Tonkin will assess the suitability of this and impact they have on the structural base elements designed by us.

4.10.3 Non Load Bearing Walls

Proprietary elements normally procured by the contractors.

4.10.4 Facades

Primary support members will be documented in the structural package, secondary support members and façade fixing details will be documented by the façade engineer or subcontractor. Façade consultants to provide advice on loadings imposed by the façade on the primary façade support members.

4.11 Temporary Works During Construction

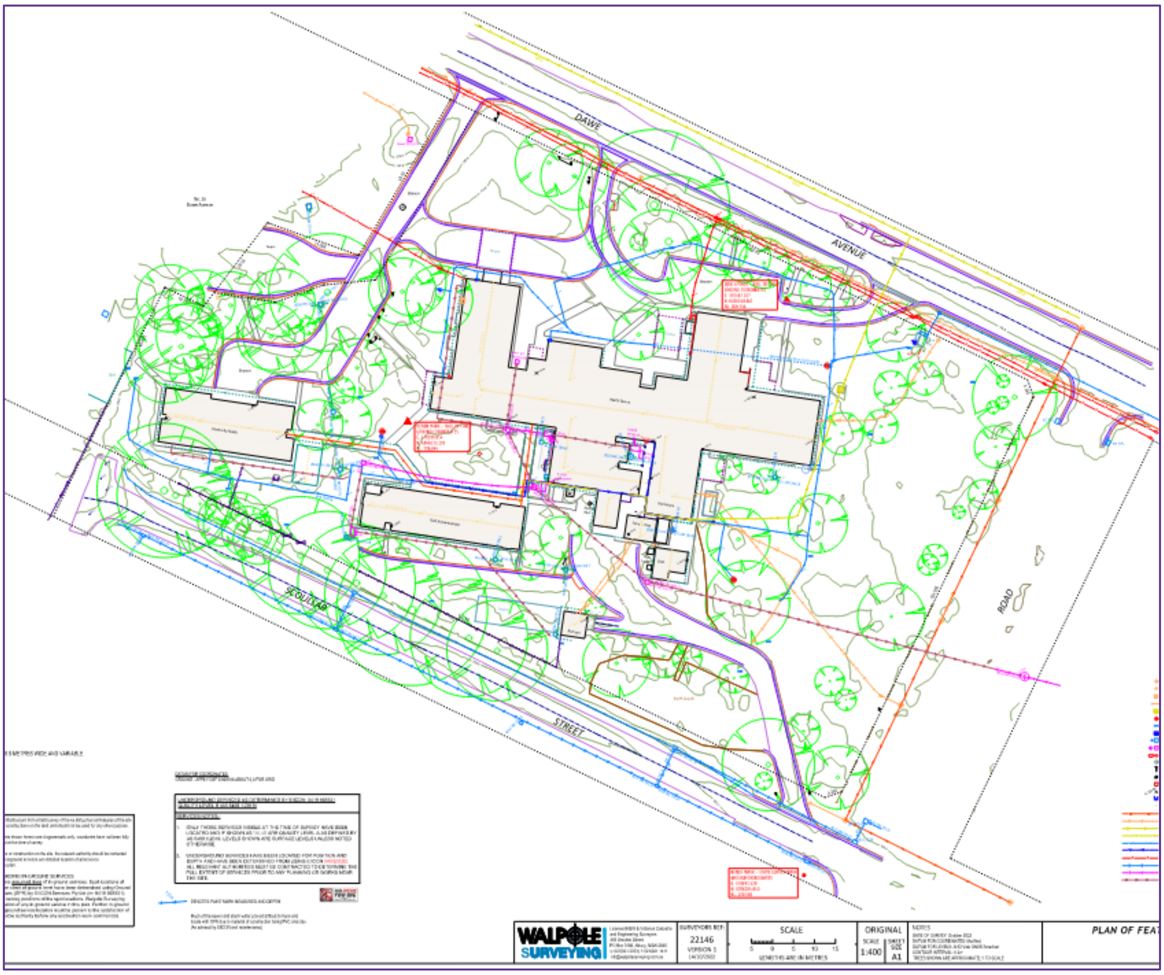
It is envisaged that temporary works support to existing structures will be required to the main hospital building during staged demolition. As is the case with all works on existing structures, that until construction works are commenced and the existing structures are fully exposed, there remain risks of additional temporary structural works being required during construction due to unexpected deterioration or arrangement of existing structures. The considerations will extend to vertical support and lateral stability of existing building.

To minimise this risk, ongoing investigation into the existing structures will need to be undertaken during the following planning and delivery phases of the works however the risk cannot be eliminated until such time as the structure is completely exposed during construction works.

5 Civil Engineering

5.1 Detailed Survey and Topography

Detailed site survey undertaken by Walpole Surveying (October 2022) informed the existing topography and services within the hospital site. A site investigation was undertaken by Tonkin in March 2023.



Detailed Survey of Finley Hospital (Walpole Surveying)

The site is bounded by Scoullar Street to the south and Dawe Avenue to the north. Both roads exhibit extremely low longitudinal falls of 0.1 to 0.2% from east to west. Public parking is accessed via the northern driveway entries off Dawe Avenue. Staff parking is available to the south of the site, accessed via Scoullar Street.

L-Scoullar Street looking East, R-Dawe Avenue looking West

Driveway Entries off Dawe Avenue (L-East, R-West)

Driveway Entries off Scoullar Street (L-East, R-West)

The main hospital and surrounds are typically concrete hardstand areas and footpaths for pedestrian circulation. Asphalt internal roads provide for vehicular circulation. Outside of the hardstand and roadway areas; the terrain is predominantly flat grassed areas and trees.

DDA carparking spaces are located at the flatter grades immediately adjacent to the main buildings.

DDA Carparking spaces, Dish Drain and Circulation Areas

L- Flat Grassy Externals with Trees

Staff Accommodation Parking (L-Gravel Internal Driveway, R-Vehicular Entry off Scoullar)

5.2 Scope of Civil Works

Pavement and kerb reinstatement will be undertaken in accordance with Austroads – Guide to Pavement Technology, Berrigan Shire Council Standards, Health Infrastructure standards.

New stormwater pits will typically be required to facilitate the connection of new downpipes (roof reticulation by GHD Hydraulics) from the IPU extension and the new roof of Front of House (FOH) to the existing stormwater system.

A new footpath will be provided to the building extension to the west which replaces the existing arrangement.

Civil works will be supported by sediment erosion controls in accordance with the Blue Book – Managing Urban Stormwater: Soils and Construction (Landcom, 2004).

5.3 Reinstatement of Pavement and Kerb

The internal pavement appears to be in relatively decent condition in the northern part of the site. However, there is evidence of pavement, kerb and dish drain damage closer to the vehicular entries off Dawe Avenue.

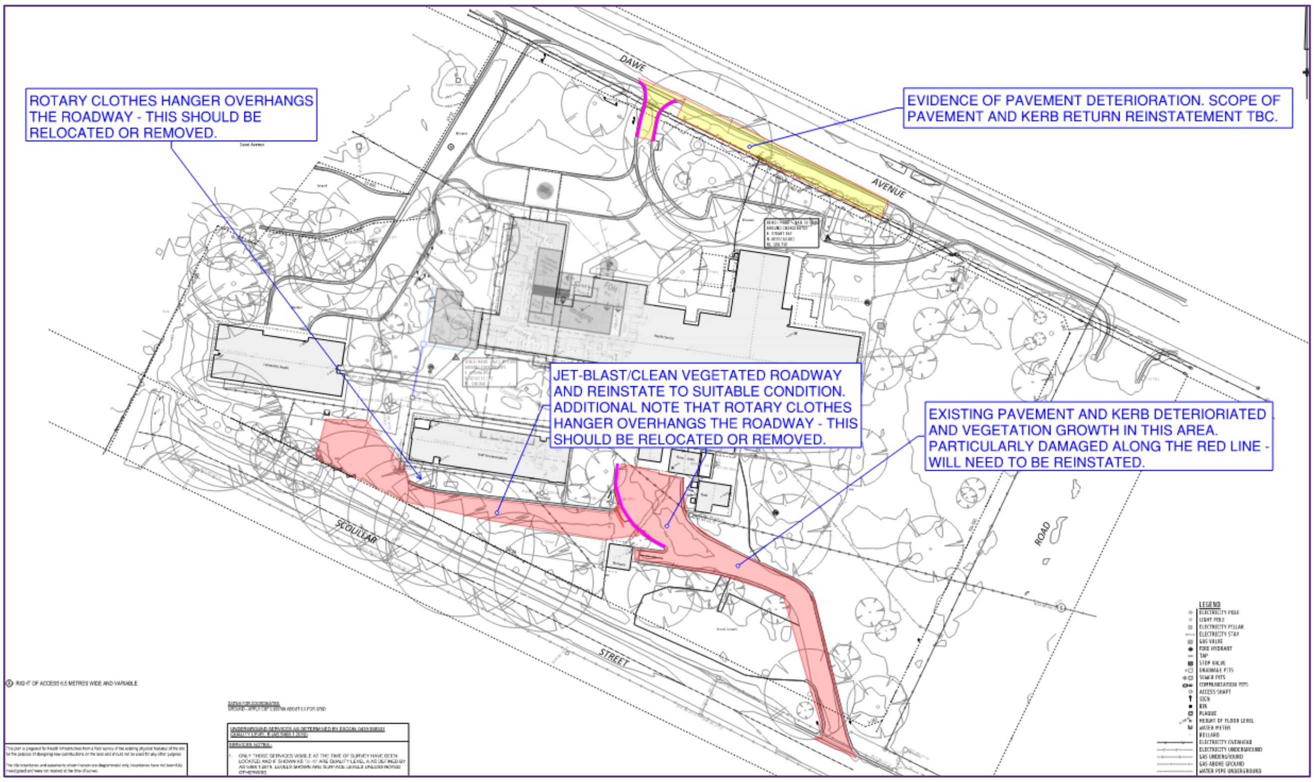
The condition of the pavement and kerbing in the southern part of the site near the staff accommodation and Scoullar Street is very poor – with evidence of kerb uplift, pavement damage and heavy silting.

Refurbishment scope should incorporate removal of vegetation overgrowth within roadways, removal of overhang of domestic installations (including clotheslines within the roadway) and make good of local pavement and kerbed areas to provide a safe and usable roadway.

Deteriorated kerb and pavement in southern part of site

Damaged kerb and pavement in the northern part of site

A schematic reinstatement extent area is denoted below.



Kerb and Pavement Reinstatement Schematic Plan

5.4 Existing Stormwater Drainage

As per the detailed survey, existing underground drainage comprises of a series of 100-200mm diameter pipes which drain the existing buildings via an internal in-ground stormwater line to the western part of site. A drainage line running north-south then discharges this to the Scoullar Street drainage network.

The existing stormwater pits within the site are typically concrete cover finishes which indicates that only roof water being is conveyed underground. It is expected that stormwater runoff will be conveyed overland directly to the public road system. There are no visible swales or natural channels.

The Scoullar Street drainage network comprises of 300-375mm reinforced concrete pipes within the southern half of the road. There are two drainage crossings to the northern half road.

The verges on both half roads of Scoullar Street are lined by natural unkerbed swales with butterfly type inlet drainage pits within the invert of the depression.

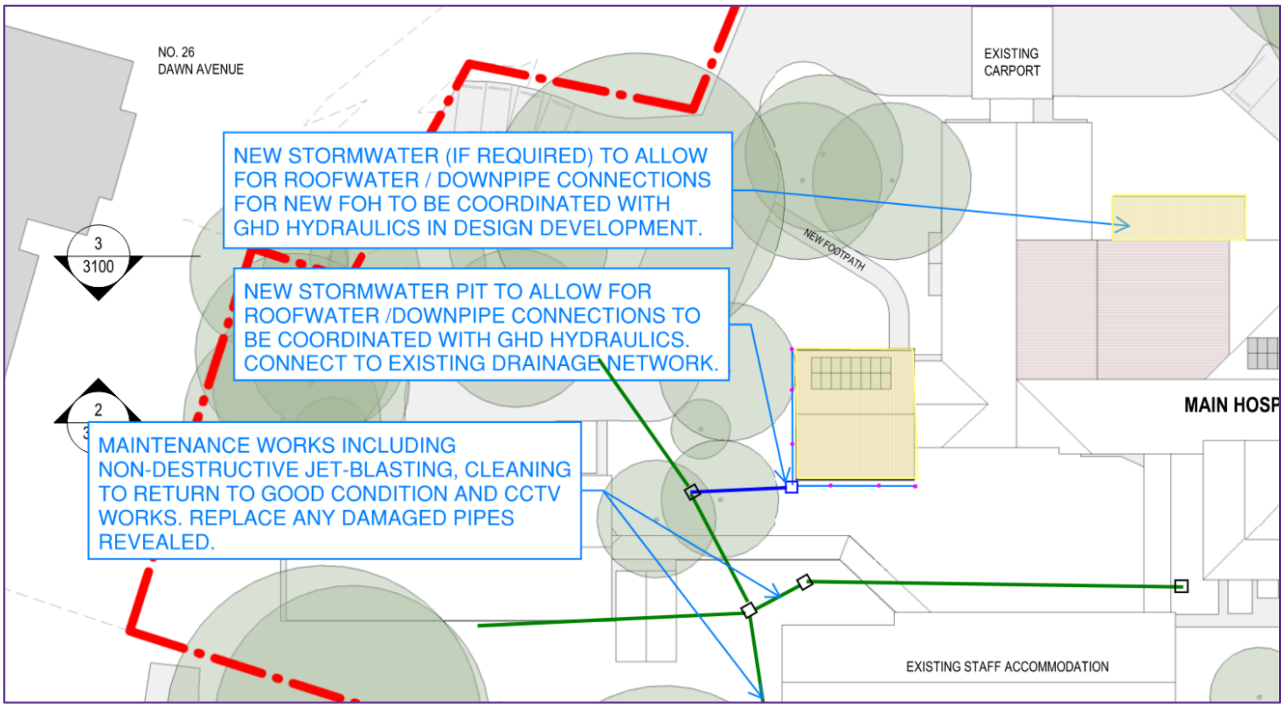
Existing Stormwater Alignment (N-S), Pits with Concrete Covers

5.5 Proposed Stormwater Works

The existing stormwater system should be jet-blasted and cleaned as part of the redevelopment works. Any damaged drainage sections can then be revealed via CCTV and remediated/replaced to ensure it is returned to good condition.

New stormwater pits will typically be required to facilitate the connection of new downpipes (roof reticulation by GHD Hydraulics) from the IPU extension and the new roof of Front of House (FOH) to the existing stormwater system.

The existing underground drainage network is expected to cater for minor building works and additional roof catchment of approximately of 226 m^2 without downstream upgrades or detention facilities.



Schematic Drainage Works Plan

A suitable typical transition for roofwater into in-ground connections to stormwater are likely to provide an improvement (locally) as compared to the legacy daylighted outlets as seen on site. (See figure below).

L-Existing Downpipes and lawn scour, R-Typical V-Drain Inlets along Scoullar Street

5.6 Flooding

As per Annex A within *Volume 2 – Hazard and Risk in Berrigan Shire* (Berrigan Shire Local Flood Plan, NSW SES State Emergency Service, June 2009) - The available historical information describes that Finley only experiences nuisance drainage issues in the locality. Floodwaters from the Murray River even in historically severe flood events have been noted to be contained and cut off by Native Dog Creek which continues downstream from Tocumwal towards the west. Finley is anticipated to remain largely unaffected by severe flooding or dam break.

It is also noted in the *Finley Hospital Site Due Diligence Report* (Northrop, September 2022) that previous discussions with Berrigan Shire Council noted that the site is not flood affected.