Design Options Report - Structural

JOB NUMBER: 23-0438

Cambridge Water Tower, Payne Park, Cambridge

PROJECT

Waipa District Council

CLIENT

Client Options Report – REV 2

11 August 2023

Design Features Report- Structural

Cambridge Water Tower **Payne Park, Cambridge**

Prepared for: Waipa District Council
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Prepared by:

Sam Simpson
HAMILTON OFFICE MANAGER
BCD Group Ltd

Reviewed and approved for release by:

Clark Taylor
SENIOR STRUCTURAL ENGINEER
BCD Group Ltd

Adam Langsford
STRUCTURAL MANAGER
BCD Group Ltd

Contents

1 GENERAL

1.1 Objective

The Design Features Report (DFR) is a detailed document defining the building's design criteria and recording key decisions or outcomes. It outlines design loading, structural modelling assumptions, material properties, foundation requirements and design standards. The DFR also defines the calculation procedure and checking principles to be followed, providing a clear explanation of the full building design.

The purpose of this document has been adapted as a design options report to outline various different options that have been considered with regards to mitigating the risk of the existing water tower on its surrounding neighbours and too the general public as a high profile council asset.

All options assume that a new aluminium tank will be installed at the top of the tower in keeping with heritage requirements and also to ensure weather tightness of the internal of the tower which is currently an ongoing issue.

In general, as per discussions with Waipa DC and the agreed criteria for seismic strengthening, generally the seismic strengthening options have been considered to Importance Level 2 (IL2), however due to budget constraints there have been a number of options considered as an IL1 option also.

Despite regulatory time lines for seismic strengthening as outlined in section 1.5 below, it is recommended that seismic strengthening of the tower is completed as soon as practicable due to the potential risk to people and property within the neighbouring properties.

1.2 Scope

The scope is in accordance with the Design Brief and Conditions of Engagement. This engagement also included a detailed review and indicative budgets to be prepared by a suitably qualified Quantity Surveyor to assist with cost estimations while assessing the various different options.

- 23-07-05 SIGNED IFS - BCD 23-0438

1.3 Executive Summary

In general terms, the scope of work being undertaken by BCD Group Ltd is as follows for the risk mitigation of the Cambridge Water Tower at Payne Park, Cambridge to better assist with allocated budgets:

- Option 1 – Seismic Strengthening to 67% NBS (IL2).
- Option 2 – Seismic Strengthening of lower portion of tower to 34% (IL2). This generally strengthens the tower to the underside of the windows which may be a natural weak point where collapse could occur without specifically weakening the tower.
- Option 3 – Seismic Restraint of lower portion of tower to 34% (IL2). This generally strengthens the tower to the underside of the windows which may be a natural weak point where collapse could occur without specifically weakening the tower.
- Option 4 – Seismic Strengthening of tower using post tensioned cables (not considered in costings – refer report).
- Option 5 – Document existing tower to IL1 standard to improve NBS 50% (IL1) score in conjunction with Waipa DC land swap (not considered in costings – refer report).

The below table has been prepared as a summary of the options for high level review. The perceived risks categorised within this table are based on knowledge of the design solution, the potential costs to construct, the potential health and safety requirements to complete the construction and the potential risk at the completion of the works. Note these risks identified are different to that identified by NZSEE when categorising seismic risk on buildings, and have

been prepared solely on the basis for informed decisions to be made on the next steps for Cambridge Water Tower which would currently be classified as a high to very high risk based on its current seismic rating.

The outputs within this table are based on high level calculations for options 1, 2 and 3 and use of engineering judgement for options 4 and 5. The costings prepared within this report have been prepared by a suitably qualified Quantity Surveyor. In addition to this additional high level discussion has been had on a confidential basis with a select number of contractors/sub trades to better understand the potential risks and associated costs of construction of each option.

Option	Return Period ULS Annual probability for exceedance based on 50-year design life	Description	Design Risk	Construction Risk	Construction Cost	Client Risk
1 – Seismic Strengthening to 67% IL2	1/300	New steel frame, new foundations, new timber supports to brick	Low – each element fully detailed to reduce seismic risk to Grade B	Medium – as per SiD register the work is complex both logistically and from a constructability perspective, however with collaborative approach a work-able solution is possible	High – refer QS estimates	Low – design and documented to 67%IL2 which puts life and property risk to a seismic grade B
2 – Seismic Strengthening to 34% IL2	1/150	New steel frame, new foundations and new timber support of brick – allowance for top of tower to collapse circa 10m	Medium – purpose of the design is to protect neighbouring properties to seismic grade C	Medium – similar to option 1, but marginally lower due to less demolition required and less construction time inside tower required	Medium – refer QS estimates	Medium – design and documented to 34%IL2 which puts life and property risk to a seismic grade C
3 – Seismic Restraint to 34% IL2	1/150	New steel ring beams, new foundations and post tensioned cables to prevent collapse of tower towards neighbouring properties – as above	Medium – purpose of the design is to protect neighbouring properties to seismic grade C	Medium – similar to option 1, but marginally lower due to less demolition required and less construction time inside tower required	Medium – refer QS estimates	Medium – design and documented to 34%IL2 which puts life and property risk to a seismic grade C
4 – Post tensioning to existing tower	1/150	Seismic strengthening using new technology via concrete capping tensioned with steel tendons tied to a foundation within the structure to stabilise the brickwork	High – purpose of the design is to protect neighbouring properties and design intent is still being developed at an industry level. This option requires specialty engineering for the alternate solution	High – unknown of skilled labour to complete the nature of the work	Assumed High – foundations similar to option 1, Macalloy bar, concrete capping/ring beam and steel work for load transfer	Medium - design and documented to 34%IL2 which puts life and property risk to a seismic grade C
5 – Land Swap to 50% IL1	1/50	Land swap between Waipa DC and neighbouring properties to remove life safety risk from tower perimeter	Low – removal of people and property to mitigate potential risk rather than improving the source directly	Low – no works required other than fencing and removal of existing buildings from neighbouring properties	Assumed Low – note does not consider any cost for land swap, legal fees, surveying costs, titles, extent of demarcation, costs for Resthaven to replace affected area etc....	Low to medium – presents lowest risk from construction perspective, and reduces the property risk by removing other people and critical infrastructure from the near vicinity of the tower

1.4 Means of Compliance

The design of the structure is in compliance with the New Zealand Building Code (NZBC), section B1.

The following standards have been used:

1. AS/NZS1170:1-3,5 (1170.0:2002, 1170.1:2002, 1170.5:2004)
2. NZS3101:2006
3. NZS3404:1997
4. NZS3603:1993
5. SNZ TS 3404:2018

1.5 Alternative Solutions

The following alternative solutions have been adopted in the design of the structure:

- The Technical Guidelines for Engineering Assessments July 2017

1.6 Detailed Seismic Assessment Summary

This seismic strengthening design options follow on from the Detailed Seismic Assessment (DSA) undertaken by Stiles & Hooker in March 2013.

The results of their DSA indicated the building's earthquake rating to be 25%*NBS* (IL2) assessed in accordance with the guideline document *The Seismic Assessment of Existing Buildings-Technical Guidelines for Engineering Assessments*, dated June 2012. The earthquake rating assumes that Importance Level 2 (IL2), in accordance with the Joint Australian/ New Zealand Standard – Structural Design Actions Part 0, AS/NZS 1170.0:2002, is appropriate.

Therefore this is a Grade D building following the NZSEE grading scheme. Grade D buildings represent a risk to occupants 10-20 times that expected for a new building, indicating a high risk exposure.

A building with an earthquake rating less than 34%*NBS* fulfils one of the requirements for the Territorial Authority to consider it to be an Earthquake-Prone Building (EPB) in terms of the Building Act 2004. A building rating less than 67%*NBS* is considered as an Earthquake Risk Building (ERB) by the New Zealand Society for Earthquake Engineering. The Cambridge Water Tower is therefore categorised as an Earthquake Risk Building and also it meets one of the criteria that could categorise it as an Earthquake Prone Building.

In accordance with the provisions of the Earthquake Prone Building requirements of the Building Act 2004 the determined earthquake rating requires the following actions for this building:

The Cambridge Water Tower does not appear to be currently listed on the NZ government's Earthquake Prone Building Register, which may be because it has been deemed to be exempt under section 133AA of the building act. If it is not exempt and if council does determine the building to be earthquake prone, the timeframe would be 25 years until the building is either strengthened or demolished, assuming it isn't a priority building, otherwise the timeframe would be 12.5 years. Despite the minimum regulatory time frames, given the known potential risk of the tower by the client to the public and surrounding property BCD would recommend that strengthening of the tower is completed as soon as practicable.

2 THE STRUCTURE

2.1 General

The structure is the Cambridge Water Tower.

The location of the structure is Payne Park, Cambridge, adjacent to the northern boundary of the Resthaven retirement village.

The legal address is Pt Allot 6, Cambridge Town Belt, Recreation Reserve, SO 44982, South Auckland Land District.

The design life of the structure is 50 years.

In order to better understand the potential collapse of the tower and the associated risks in relation to people and neighbouring properties a typical collapse zone has been prepared based on the full height of the tower and half the height of the tower as outlined below (inclusive of structure at top of tower):

Option 1: Seismic strengthening to full height of tower to 67% IL2 to seismic grade B

Option 2: Seismic strengthening to half height of tower to 34% IL2 to seismic grade C, assumes top of tower collapses inside circa 10m safe zone.

Option 3: Similar to above

Option 4: Seismic strengthening to full height of tower to 34% IL2 to seismic grade C

Option 5: No strengthening to tower – utilise a land swap deal to classify tower as an isolated structure which allows reduction to IL1 category. Based on current condition it would achieve 50% IL1.

2.2 Gravity Structure

The existing structure of the water tower primarily consists of brickwork circular in plan with an internal diameter of approximately 5.5m and an external base diameter of approximately 6.6m. The total height of the water tower is 23.0m which includes the 3.5m high head water tank. The existing foundations are assumed to be widened brick below ground level based on the existing drawings, but this hasn't been confirmed on site.

The proposed seismic strengthening schemes are outlined below:

1. **Seismic Strengthening to 67% IL2**
   Add a 5-storey steel k-frame structure within the tower, supported on new reinforced concrete ground beams crossing through the tower and supported on steel screw piles outside the tower.

2. **Seismic Strengthening to 34% IL2**
   Add a 2-storey steel k-frame structure within the tower supported on new reinforced mass concrete foundation internally above the existing foundation. This strengthening option is limited to the underside of the existing windows. Note with this option it is anticipated that the top of the tower is likely to collapse above the design level earthquake but will be inside a designated safe zone.

3. **Seismic Restraint to 34% IL2**
   Add new ring beams at regular two levels on the internal of the tower with new tensions cables externally supported on new foundations outside the tower. Note with this option it is anticipated that the top of the tower is likely to collapse above the design level earthquake but will be inside a designated safe zone.

4. **Post Tensioning to Existing Tower**
   New concrete ring beam/cap at top of tower, new post tension cables and new reinforced mass concrete foundation internally above the existing foundation.

5. **Land Swap to 50% IL1**
   No new structure added.

2.3 Lateral Load Resisting Structure

The lateral load resisting structure for the strengthening schemes are outlined below:

1. **Seismic Strengthening to 67% IL2**
   5 storey steel k-frame in both directions - the lateral loading is transferred to the primary structure timber studs fixed into the brick, spanning vertically between curved SHS steel beams at each level of the k-frame - sliding of the building at foundation level is resisted by a combination of passive resistance of the foundations and shear in the overbored head of the screw piles.

2. **Seismic Strengthening to 34% IL2**
   2 storey steel k-frame in both directions – the lateral loading is transferred to the primary structure timber studs fixed into the brick spanning vertically between curved SHS steel beams at the 2 levels – sliding is resisted by the passive resistance on the foundations and sliding friction of the foundations.

3. **Seismic Restraint to 34% IL2**
   Steel ring beams at 2 levels supported on external post tensioned cables – lateral load is transferred to the primary structure through timber studs fixed to the brick spanning vertically between steel ring beams. The ring beams have timber joists and ply flooring fixed internally to act as a diaphragm to distribute the forces induced by the tensile cables – sliding is resisted by the passive resistance of the foundations and screw piles. Note with this option it is anticipated that the top of the tower is likely to collapse above the design level earthquake but will be inside a designated safe zone as outlined above.

4. **Post Tensioning to Existing Tower**
   The post tensioned cables would put the whole structure into compression, hand it is anticipated that the structure would act like a rocking structure which essentially assumed the tower will have significant movement and drift during a ULS Seismic event. In principle the rocking would dissipate the seismic force

such that the forces are much lower than experienced with other design options. The risk with this option is that given the age and condition of the tower it is currently unknown how the structure would perform with the levels of deformation required to achieve a rocking structure including the bricks capacity out of plane – this design option is subject to further investigation upon release of new industry information expected in October 2023.

5. **Land Swap to 50% IL1**
   No new structure added – tower downgraded to IL1 and people / property are removed from the area to mitigate potential risk from collapse as a result of a potential land swap deal with neighbouring property owners.

2.4 Significant Design Features

The temporary works and sequencing requires careful consideration and planning to manage health & safety risks, particularly while excavating to pour the new foundations.

2.5 Existing Information

The seismic strengthening design options has been based on the following existing information:

- What appears to be an original drawing, assumed to be dated between 1900-1903;
- Three recreated architectural drawings assumed to be dated 1974 by UoA architectural student Dennis M. Holmes;
- The heritage report dated March 2010 by the New Zealand Historic Places Trust;
- The Detailed Seismic Assessment dated March 2013 by Stiles & Hooker, including their preliminary structural assessment from October 1994;
- The draft conservation plan dated June 2014 by Laura Kellaway;
- The geotechnical investigation report, structural strengthening drawings and structural survey report all dated June 2014 by BCD Group;
- The detailed engineering evaluation report dated July 2014 by BCD Group;
- The option assessment report dated November 2014 by BCD Group;
- The seismic strengthening options report dated September 2016 by BCD Group;
- The planning advisory letter dated February 2017 by Mitchell Daysh;
- The seismic strengthening option sketches dated late 2018 by BCD Group;
- The structural survey reports dated October 2019 & August 2022 by BCD Group;
- The structural draft drawings dated April 2022 by GDC for the concrete roof and steel lattice tank;
- The structural design calculations and drawings dated February 2023 by GDC for the temporary timber roof;
- The concept seismic strengthening sketches dated February 2023 by Meinhardt;

2.6 Seismic Strengthening Options

The heritage value of the water tower is understood to restrict any changes to the external appearance, other than those previously proposed by GDC being:

- removal of the external ladder and walkway
- removal of the tank and replacement with a concrete ring beam and temporary timber framed roof, to be later replaced by a concrete roof and steel skeleton structure above to give the illusion of the water tank

The previously proposed Flexus technology for the shotcrete lining is understood to no longer be available in New Zealand, and the additional weight added by the concrete would require larger foundations causing more risk of destabilising the tower during construction, and so for this reason has not been considered.

It is understood that Waipa DC will discuss further options direct with Heritage NZ due to previously identified budget constraints so that all five options proposed within this report can be considered.

Options one, two and three as presented above are the more traditional approaches. Option four may be a viable option subject to further industry advice expected to be released in October 2023.

Option four with the post-tensioned vertical rods would likely require a significant volume of concrete to be poured at the base of the tower to anchor the rods. This concrete could make the existing doorway inaccessible. This solution also assumes that the brick can span out of plane with no strengthening required.

All options have a varying degree of risk from a design, construction, cost and client perspective. Whilst likely to have the highest cost, option one presents a lower design risk and lower client risk, however the costs may be prohibitive to move forward with this solution. Option two and three generally present medium risks across the considered criteria and so may be the preferred options to move forward with. Options four and five are likely to have the least cost risk, however likely present the highest client risk and so may not be progressed beyond this design stage.

3 SOIL CONDITIONS

3.1 Description of Site Soil Conditions

Refer to the Soils report by BCD Group Ltd titled geotechnical Liquefaction Assessment Report Rev 2 dated 17/05/2023.

The site is generally flat with the tower raised a few hundred mm above the surrounding ground, spread out as a gentle slope over a few metres in each direction. The site has a shallow layer of topsoil underlain by mostly sands with interbedded clay and silts. The water table is around 9m deep.

Slope stability, liquefaction induced settlement and lateral spread at 67%ULS(Ultimate Limit State) shaking are not considered to be a significant risk for the proposed development.

Static settlement is a potential risk due to some softer layers identified in the hand augers outside the tower between around 1.2m bgl (below ground level) and the termination depth of 3.0m bgl. Good ground is not achieved for shallow foundation design, with bearing capacity around half that of 'good ground'.

3.2 Soil Design Values

3.2.1 Ultimate Soil Strengths

Geotechnical Ultimate Bearing Capacity is 150kPa.

3.2.2 Strength Reduction Factors

Ultimate limit state strength reduction factors: φ = 0.5 (static & seismic)

3.2.3 Piling

Screw pile design hasn't been carried out by BCD, but approximate screw pile details have been provided based on another project with similar soil and loads. The detailed design of the screw piles is to be completed by the piling subcontractor. The screw pile demands will be supplied by BCD. The head of pile vertical settlement must be limited to 10% of the pile helix diameter at the unfactored ultimate geotechnical strength.

Test piling is required. Test piling to consist of one (1) test pile installed at locations to be specified by the engineer. Test piles may be production piles provided that approval from the relevant territorial authority is obtained if testing prior to granting of building consent.

For the design of the overbored tops of the screw piles, the following parameters shall be used:

- Y_s = 17 kN/m^3
- Ø = 30°

4 DESIGN LOADS

4.1 General

For the purposes of consideration of loading, this structure is Importance Level 2 in accordance with AS/NZS 1170.0:2002. The loads below have prepared on the basis of option 1, however there are similar comparisons for the other option which could be further refined once a final option has been selected.

4.2 Imposed Loads

4.2.1 Vertical Loads

The table below summarizes all vertical loads including both superimposed dead and live loads. An allowance has been made for new lightweight internal stairs and platforms.

Table 1: Imposed Gravity Loads

Level/Area	Use*	Dead Load	Live Load	Superimposed Dead Load
Floor (Option 1)	Stairs (C3)	0.5kPa	4.0kPa/4.5kN	Nil
Floor (All other Options)	Stairs (A2)	0.5kPa	2.0kPa/1.8kN	Nil
Roof		3.0kPa	0.25kPa/1.1kN	28kN for the steel lattice tank/Aluminium Tank

*Note bracketed notation relates to Table 3.1 AS/NZS 1170.1:2002

4.2.2 Barriers and Handrails

The following loads apply for all barriers and handrails.

Table 2: Barriers and Handrails

Level/Area	Occupancy type	Top Edge			Infill	
		Horizontal	Vertical	Inwards, Outwards, or Downwards	Horizontal	Any Direction
		kN/m	kN/m	kN	kPa	kN
Internal Stair and Walkways (Option 1)	C3	0.75	0.75	0.6	1.0	0.5
Internal Stair and Walkways	B2	0.35	0.35	0.6	N/A	N/A

4.3 Wind Loads

Wind loads have not been specifically assessed as the new structure is internal and assumed to be governed by seismic loading. In addition to this, the external wind pressures are deemed to be no worse then the existing state and therefore not deemed critical within the body of this report.

4.4 Snow and Ice Roads

The structure is in Region Upper North Island, and the elevation is 67m above sea level. Snow and ice are not significant loads for this structure.

4.5 Seismic Loads

4.5.1 Site Parameters

Site subsoil class:	D
Proximity to fault:	>20km
Zone factor,	Z = 0.18, effectively reduced to 0.121 for 67%ULS (IL2) shaking and 0.061 for 34%ULS (IL2)

4.5.2 Analysis Methodology

The seismic analysis has been completed in accordance with AS/NZS 1170.5:2004, using the equivalent static method.

Design Spectra are in accordance with AS/NZS 1170.5:2004 for site subsoil class D.

For the purpose of the analysis, the project longitudinal and transverse directions are considered to be the project north and east directions, respectively.

4.5.3 Seismic Load Coefficient

In accordance with AS/NZS 1170.5:2004.

Spectral shape factor	$C_h(T)$ = 1.93
Near Fault Factor	N (T,D) = 1.0
Elastic Site Spectra	C = 0.233
Period,	T_1 = 1.0s
Ductility	μ = 1.0
Structural Performance	S_p = 1.0
	k_μ = 1.0
Design coefficient	**$C_d(T_1)_{67\%NBS(IL2)}$ = 0.233g $C_d(T_1)_{34\%NBS(IL2)}$ = 0.118g**

4.5.4 Parts and Components

In accordance with AS/NZS 1170.5:2004 section 8.

The following elements of the structure have been designed considering parts and components loading:

- The timber studs including their connections, and the fixings into the brick

- The curved SHS beams that support the timber studs, including their connections to the steel columns

4.6 Construction Loads

The temporary propping and handling of all insitu concrete and structural steel / timber capacity shall be in accordance with the specification. Generally, this will be the Contractors responsibility to ensure compliance with the Building Code and all health and safety regulations.

It is expected that a temporary steel frame may be required on the outside of the tower to help stabilise it while localised excavations are made for the new foundations and during construction of the seismic strengthening for option 1. Ground stabilising such as grout injection may also be required to mitigate ground movements during excavation and new foundation construction for option 1.

For all other options allowances have been made for a temporary steel frame of a smaller scale to provide support to the structure and some structural stability from a Health and Safety perspective to mitigate the risk of tower collapse during construction of the works

Refer BCD preliminary Safety In Design register to outline some of the critical construction loads and construction methodologies.

5 SERVICE CRITERIA

5.1 Seismic Deflections

Refer to calculations – File 23-05-17 Structural calculations 23-0438

Type of Analysis: Static

Maximum Allowable: ULS ≤ 2.5%

SLS in accordance with Table C1 AS/NZS 1170.0:2002, although this isn't a requirement for seismic strengthening which focuses on life safety.

5.2 Gravity Deflections

Particular elements are designed to the recommended serviceability deflection limits of AS/NZS 1170.0:2002, Table C1.

5.3 Design Life for Durability

Particular elements are designed to the recommended serviceability deflection limits of AS/NZS 1170.0:2002, Table C1.

5.3.1 Design Life

Foundations: 50 yrs

Superstructure: 50 yrs

Note: non-structural elements and cladding specification are by others and are not covered by this design features report.

5.3.2 Durability Provisions

Durability provisions are achieved by:

Building Code Verification method

Durability provisions are achieved by the following acceptable solutions B2/AS1:

Structural Timber	NZS 3640:2003
Reinforced Concrete	NZS 3101: 2006
Exposure classification	Internal A2
	External A2
Structural Steel	SNZ TS 3404:2018 and AS/NZS 2312:2014
Exposure classification	Internal exposed C3

5.3.3 Summary of Surface Treatments – Structural Steel

The table below summarises the surface treatments for the structural elements covered by this design features report.

Element	Design Life	Exposure Category	Surface Treatment in accordance with NZS/AS 2312 / SNZ TS 3404	Time to first major maintenance
Internal Damp (exposed)	50	C3	HDG600	40 years

Maintenance Requirements of Surface Treatments

The maintenance requirements for the above protective coating systems specified above are as per SNZ TS 3404:2018. The criteria for determining when the time to first major maintenance is reached are:

- For scattered general breakdown of protective coatings: when a specified percentage of rust is visible. This varies from under 0.5% of the total area for barrier coat systems, which exclude air and water from the steel surface, up to 2% of the total area for sacrificial zinc-based systems which protect by galvanic action.
- For more severe localised breakdown of the corrosion protection system, for example missed or undercoated areas: when a specified percentage from 2% to 20% of the total area has occurred; and
- Where widespread blistering, flaking or rusting under the corrosion protection system is evident.

5.4 Floor Vibration

5.4.1 Timber framed floors / simple supporting beams

For option 1 the effects of vibration in floor beams have been accounted for by checking the deflection under a 1kN footfall complies with table C1 of AS/NZS 1170.0:2002. This clause has not been considered for all other options as considered service platforms only in all other options.

5.5 Fire Resistance Ratings

5.5.1 Fire Report Summary

No fire report has been carried out as it is understood that the client currently doesn't intend to have people accessing inside the tower.

If access inside the tower was desired later on, it may be possible to justify that people can escape the tower during a fire before the structure loses structural stability which was the approach recently for a 3 storey viewing tower in Hamilton. However, this approach would need to be confirmed specific for this tower with a fire engineer and the local building authority in coordination with the structural engineer.

6 SOFTWARE

The following computer applications have been used:

Table 3: Software Used

Analysis Type	Software Used	Archive Files
Modal analysis	ETABS	23-05-16 Tower steel frame spring base 23-0438
3D frame analysis	Microstran	23-05-16.1 Tower steel frame 23-0438
General spreadsheet design	Excel	23-05-15 Timber ULS Combined Actions 23-0438 23-05-16 Concrete - Beam Bending 23-0438 23-05-16 Foundation Cantilever Pile 23-0438 23-05-16 Loads - Seismic 23-0438
Steel member design	Memdes	23-05-16 Level 2-3 columns 23-0438 23-05-16 Level G-1 columns 23-0438

7 DRAWING AND SPECIFICATIONS NOTES

The purpose of this section is to ensure that the design requirements are included in the drawings and the specification.

7.1 Floors

7.1.1 Design Loads

Refer to Section 4 Design Loads, and Section 5.4 Floor Vibration.

7.1.2 Fire Rating Requirements

Refer to Section 5.5 Fire Resistance Ratings

7.1.3 Propping Requirements

Generally, the temporary propping of structure is the responsibility of the contractor.

7.2 Foundations

Refer to the Excavation and Concrete – General sections of the specification which discuss in detail all requirements for the foundations.

7.3 Material Properties (Typical)

7.3.1 Concrete Strengths

Foundations:	35 MPa
Ground Floor Slab:	25 MPa
Site Concrete	7 MPa

7.3.2 Reinforcing Steel

Foundation Rein:	500 MPa
Slab Rein:	500 MPa

7.3.3 Structural Steel

Rolled Steel Sections:	300 MPa – Grade 300 to AS 3679.1
Steel Plate General:	300 MPa – Grade HA300 to AS1594
Steel Plate (Special):	350 MPa – Grade HA350 to AS1594
SHS Hollow Sections:	AS 1163 – 350 MPa – Grade C350
Bolt grades	Grade 4.6 mild steel for timber to steel connections and grade 8.8 high strength for steel to steel connections
Tensioning Requirements for 8.8 bolts	Bolts nominated /S are to be snug tight. Bolts nominated /TB are to be tensioned using the part turn method in accordance with NZS3404.

7.3.4 Timber

Timber Studs	GL8/H5
Timber Nogging	SG8/H3.2

7.3.5 Timber Connections

Interior Exposed	Grade 304 Stainless

8 PROPRIETARY SYSTEMS

The following proprietary elements are included in the project.

- Sika 212 grout below column baseplates
- Python fixings

8.1 Manufacturer Design Requirements

Manufacturer design requirements are as follows:

Design of the screw piles by the subcontractor to include a PS1.

8.2 Manufacturer Construction Requirements

Inspection QA requirements are as follows:

- A PS3 is required by the steelwork manufacturer for the erection of structural steelwork and this must include the coating specified.
- A PS3 is required for all other construction covered by the structural documentation.

9 CONSTRUCTION MONITORING

The design is based on the verification of specific design aspects of the construction by a suitably qualified Chartered Professional Engineer in accordance with ACENZ/ Engineering NZ level CM 3.

9.1 Soil Testing and Verification

Site verification by a Chartered Professional Engineer that the bored pile holes are consistent with the assumed soil properties.

9.2 Material Testing

Pull out testing requirements of Python anchors may be required. Contractor expectation and engineer observation / evidence required to be confirmed before building consent.

9.3 Temporary Support and Shoring

As noted in section 4.6, it is expected that a temporary steel frame may be required on the outside of the tower to help stabilise it while localised excavations are made for the new foundations and during construction of the seismic strengthening. Ground stabilising such as grout injection may also be required to mitigate ground movements during excavation and new foundation construction.

9.4 Inspection Requirements

The following schedule of inspections is to be met in order to meet the required level of Construction Monitoring, and to ensure the intent of the design is met:

Table 4: Schedule of Inspections

Inspection	Stage	Reason	Person		
			Territorial Authority	Structural	Geotech
Pre-Start				S	S
Stripped Site	Excavation complete	Benching check			S
Screw Piles	Test Piling and main piling	Observe test piling and random sampling of main piling		S, M	
Foundation beams	Pre pour	Check reinforcing, dimensions and hold downs		C	

Floor Slab	Pre pour	Check reinforcing, rebates and dimensions		C	
Structural Steelwork	Erection and completion	Progress during erection and completion prior to enclosing		M, C	
Wall Framing	Completion		C		

Key: S = Start/ M = Monitor ongoing progress/ C = Completion

10 MECHANICAL SERVICES

No mechanical services are currently required, however if there will be regular access such as heritage tours, mechanical ventilation will likely be required, as well as lightning and potentially fire detection services. These are all anticipated to be light weight with negligible affect on the structure, and no structural penetrations required.

APPENDIX A – SAFETY IN DESIGN REGISTER

Job Name Cambridge Water Tower
Job # 21-3015
Client Waipa District Council
Date Created 11/05/2023
Last Updated 11/08/2023
Revision 2

RISK MATRIX		Likelihood				
		Rare (1)	Unlikely (2)	Possible (3)	Probable (4)	Very Likely (5)
Consequence	Major (5)	5	10	15	20	25
	High (4)	4	8	12	16	20
	Medium (3)	3	6	9	12	15
	Low (2)	2	4	6	8	10
	Minor (1)	1	2	3	4	5

OPTION 1 - SAFETY IN DESIGN REGISTER

		Design Risk					Mitigation					Approval		Close Out		Comment
Reference	Category	Guide Word	Description of Risk / Hazard	Risk			Risk owner	Recommendation / Action	Residual Risk			Client Approval	Date	Action By	Status	
				Likelihood	Consequence	Risk			C	L	R					
1.00	**Demolition**	Access/egress	Removal of internal walkways/stairwells and water pipes + temporary timber roof externally	4	5	20	Contractor/Client	Detailed construction / demolition methodology for removal of internal structure including required monitoring	5	1	5					
		Site caused environment	Risk of settlement/movement of existing building	4	3	12	Contractor/Client	Temporary propping recommended as part of design to support structure during demolition works	3	1	3					
						0					0					
2.00	**Site**	Toxicity / Hazardous substances	Risk of working in potential confined space, alongside requirement to remove build up of toxic excrement	3	3	9	Contractor/Client	linked to construction methodology and wearing appropiate PPE/Removal of risk completely	1	1	1					
		Interfaces external to project	On publicly accessed land	4	1	4	Contractor/Client	Currently managed by site hoarding in place, with additional likely once construction starts	4	1	4					
		Position / location	Locality of existing tower to other potentially occupied buildings	2	4	8	Contractor/Client/I	Neighbouring properties currently vacated which assistis in minimsing risk	4	1	4					
		Heights / Depths	All demolition and construction works involve working from height with crane access/rope access	4	3	12	Contractor	Foundation options minimise the excavation works	1	3	3					
											0					
3.00	**Design**	Load / Force / Energy	Earthquake prone building which required strengthening	4	5	20	Engineer	Seismic strengthening of building to reduce overall risk of building	5	2	10					
		Foundations	Undermining existing tower/foundations - extent of existing foundations currently partially unknown	4	4	16	Engineer/Contracto	Temporary works in place including grout injection of surrounding soils, deep screw pile foundations to minimise excavation, construction sequencing of opening 1 at a time, pile caps outside zone of influence of existing foundations, minimised number of penetrations required, finally prepare detailed installation methodology with contractor	4	1	4					
		Structural Steel	Confined spaces, crane access and use around construction staff	3	3	9	Engineer/Contracto	Detailed methodology for sequencing, specific detailing of structure to be within manageable lift and erection tolerances including point cloud surveys	3	1	3					
		Timber	Confined spaces, crane access and use around construction staff	3	3	9	Engineer/Contracto	Detailed methodology for installation and erection of timber works point cloud surveys	3	1	3					
		Fixing of brick	Drilling into the brick which may affect the inegrity of brick, confined spaces, noise/vibration etc....	3	3	9	Engineer/Contracto	Detailed methodology for installation of brick ties - tyoically done off internal scaffold and safe working platforms	3	1	3					
		Re-pointing	Working at heights	3	3	9	Engineer/Contracto	Detailed methodology for re pointing - tyoically done off internal scaffold and safe working platforms	3	1	3					
						0					0					
4	**Construction**	General Construction	Woring at heights, confined spaces, high risk structure	5	5	25	Enginere/Contracto	Put in place internal and external scaffold as required to form working platforms, install temporary works as outlined in design costings, point cloud surveys to confirm tolerances and reduce crane times, structrual monitoring during construction for potential movement, removal of toxic material from base of tower as part of demolition	5	1	5					
						0					0					
5	**Operations & Maintenance**	General	Existing windows and doors are not secure	3	3	9	Client/Contractor	Recommend to install new mesh to windows and new lockable door to secure space	3	1	3					

Job Name Cambridge Water Tower
Job # 21-3015
Client Waipa District Council
Date Created 11/05/2023
Last Updated 11/08/2023
Revision 2

RISK MATRIX		Likelihood				
		Rare (1)	Unlikely (2)	Possible (3)	Probable (4)	Very Likely (5)
Consequence	Major (5)	5	10	15	20	25
	High (4)	4	8	12	16	20
	Medium (3)	3	6	9	12	15
	Low (2)	2	4	6	8	10
	Minor (1)	1	2	3	4	5

OPTION 2- SAFETY IN DESIGN REGISTER

		Design Risk					Mitigation					Approval		Close Out		Comment
				Risk					Residual Risk							
Reference	Category	Guide Word	Description of Risk / Hazard	Likelihood	Consequence	Risk	Risk owner	Recommendation / Action	C	L	R	Client Approval	Date	Action By	Status	
1.00	**Demolition**	Access/egress	Removal of some of internal walkways/stairwells and water pipes + temporary timber roof externally	4	5	20	Contractor/Client	Detailed construction / demolition methodology for removal of internal structure including required monitoring	5	1	5					
		Site caused environment	Risk of settlement/movement of existing building	4	3	12	Contractor/Client	Temporary propping recommended as part of design to support structure during demolition works	3	1	3					
						0					0					
2.00	**Site**	Toxicity / Hazardous substances	Risk of working in potential confined space, alongside requirement to remove build up of toxic excrement	3	3	9	Contractor/Client	linked to construction methodology and wearing appropiate PPE/Removal of risk completely	1	1	1					
		Interfaces external to project	On publicly accessed land	4	1	4	Contractor/Client	Currently managed by site hoarding in place, with additional likely once construction starts	4	1	4					
		Position / location	Locality of existing tower to other potentially occupied buildings	2	4	8	Contractor/Client/I	Neighbouring properties currently vacated which assistis in minimsing risk	4	1	4					
		Heights / Depths	All demolition and construction works involve working from height with crane access/rope access	4	3	12	Contractor	Foundation options minimise the excavation works	1	3	3					
											0					
3.00	**Design**	Load / Force / Energy	Earthquake prone building which required strengthening	4	5	20	Engineer	Seismic strengthening of building to reduce overall risk of building	4	3	12					
		Foundations	Undermining existing tower/foundations - extent of existing foundations currently partially unknown	3	3	9	Engineer/Contracto	Temporary works in place including grout injection of surrounding soils, deep screw pile foundations to minimise excavation, construction sequencing of opening 1 at a time, pile caps outside zone of influence of existing foundations, minimised number of penetrations required, finally prepare detailed installation methodology with contractor	4	1	4					
		Structural Steel	Confined spaces, crane access and use around construction staff	3	3	9	Engineer/Contracto	Detailed methodology for sequencing, specific detailing of structure to be within manageable lift and erection tolerances including point cloud surveys	3	1	3					
		Timber	Confined spaces, crane access and use around construction staff	3	3	9	Engineer/Contracto	Detailed methodology for installation and erection of timber works point cloud surveys	3	1	3					
		Fixing of brick	Drilling into the brick which may affect the inegrity of brick, confined spaces, noise/vibration etc....	3	3	9	Engineer/Contracto	Detailed methodology for installation of brick ties - tyoically done off internal scaffold and safe working platforms	3	1	3					
		Re-pointing	Working at heights	3	3	9	Engineer/Contracto	Detailed methodology for re pointing - tyoically done off internal scaffold and safe working platforms	3	1	3					
						0					0					
4	**Construction**	General Construction	Working at heights, confined spaces, high risk structure	5	5	25	Enginere/Contracto	Put in place internal and external scaffold as required to form working platforms, install temporary works as outlined in design costings, point cloud surveys to confirm tolerances and reduce crane times, structrual monitoring during construction for potential movement, removal of toxic material from base of tower as part of demolition	5	1	5					
						0					0					
5	**Operations & Maintenance**	General	Existing windows and doors are not secure	3	3	9	Client/Contractor	Recommend to install new mesh to windows and new lockable door to secure space	3	1	3					

Job Name Cambridge Water Tower
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Client Waipa District Council
Date Created 11/05/2023
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Revision 2

RISK MATRIX		Likelihood				
		Rare (1)	Unlikely (2)	Possible (3)	Probable (4)	Very Likely (5)
Consequence	Major (5)	5	10	15	20	25
	High (4)	4	8	12	16	20
	Medium (3)	3	6	9	12	15
	Low (2)	2	4	6	8	10
	Minor (1)	1	2	3	4	5

OPTION 3 - SAFETY IN DESIGN REGISTER

		Design Risk					Mitigation					Approval		Close Out		Comment
				Risk					Residual Risk							
Reference	Category	Guide Word	Description of Risk / Hazard	Likelihood	Consequence	Risk	Risk owner	Recommendation / Action	C	L	R	Client Approval	Date	Action By	Status	
1.00	**Demolition**	Access/egress	Removal of some of internal walkways/stairwells and water pipes + temporary timber roof externally	3	5	15	Contractor/Client	Detailed construction / demolition methodology for removal of internal structure including required monitoring	5	1	5					
		Site caused environment	Risk of settlement/movement of existing building	3	3	9	Contractor/Client	Temporary propping recommended as part of design to support structure during demolition works	3	1	3					
						0					0					
2.00	**Site**	Toxicity / Hazardous substances	Risk of working in potential confined space, alongside requirement to remove build up of toxic excrement	3	3	9	Contractor/Client	linked to construction methodology and wearing appropiate PPE/Removal of risk completely	1	1	1					
		Interfaces external to project	On publicly accessed land	4	1	4	Contractor/Client	Currently managed by site hoarding in place, with additional likely once construction starts	4	1	4					
		Position / location	Locality of existing tower to other potentially occupied buildings	2	4	8	Contractor/Client/I	Neighbouring properties currently vacated which assistis in minimsing risk	4	1	4					
		Heights / Depths	All demolition and construction works involve working from height with crane access/rope access	4	3	12	Contractor	Foundation options minimise the excavation works	1	3	3					
											0					
3.00	**Design**	Load / Force / Energy	Earthquake prone building which required strengthening	4	5	20	Engineer	Seismic strengthening of building to reduce overall risk of building	4	3	12					
		Foundations	Undermining existing tower/foundations - extent of existing foundations currently partially unknown	2	2	4	Engineer/Contracto	Temporary works in place including grout injection of surrounding soils, deep screw pile foundations to minimise excavation, construction sequencing of opening 1 at a time, pile caps outside zone of influence of existing foundations, minimised number of penetrations required, finally prepare detailed installation methodology with contractor	2	1	2					
		Structural Steel	Confined spaces, crane access and use around construction staff	3	3	9	Engineer/Contracto	Detailed methodology for sequencing, specific detailing of structure to be within manageable lift and erection tolerances including point cloud surveys	3	1	3					
		Timber	Confined spaces, crane access and use around construction staff	3	3	9	Engineer/Contracto	Detailed methodology for installation and erection of timber works point cloud surveys	3	1	3					
		Fixing of brick	Drilling into the brick which may affect the inegrity of brick, confined spaces, noise/vibration etc....	3	3	9	Engineer/Contracto	Detailed methodology for installation of brick ties - tyoically done off internal scaffold and safe working platforms	3	1	3					
		Re-pointing	Working at heights	3	3	9	Engineer/Contracto	Detailed methodology for re pointing - tyoically done off internal scaffold and safe working platforms	3	1	3					
						0					0					
4	**Construction**	General Construction	Woring at heights, confined spaces, high risk structure	5	5	25	Enginere/Contracto	Put in place internal and external scaffold as required to form working platforms, install temporary works as outlined in design costings, point cloud surveys to confirm tolerances and reduce crane times, structrual monitoring during construction for potential movement, removal of toxic material from base of tower as part of demolition	5	1	5					
						0					0					
5	**Operations & Maintenance**	General	Existing windows and doors are not secure	3	3	9	Client/Contractor	Recommend to install new mesh to windows and new lockable door to secure space	3	1	3					

Job Name Cambridge Water Tower
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Date Created 11/05/2023
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Revision 2

RISK MATRIX		Likelihood				
		Rare (1)	Unlikely (2)	Possible (3)	Probable (4)	Very Likely (5)
Consequence	Major (5)	5	10	15	20	25
	High (4)	4	8	12	16	20
	Medium (3)	3	6	9	12	15
	Low (2)	2	4	6	8	10
	Minor (1)	1	2	3	4	5

OPTION 4 - SAFETY IN DESIGN REGISTER

		Design Risk					Mitigation					Approval		Close Out		Comment
				Risk					Residual Risk							
Reference	Category	Guide Word	Description of Risk / Hazard	Likelihood	Consequence	Risk	Risk owner	Recommendation / Action	C	L	R	Client Approval	Date	Action By	Status	
1.00	**Demolition**	Access/egress	Removal of internal walkways/stairwells and water pipes + temporary timber roof externally	4	5	20	Contractor/Client	Detailed construction / demolition methodology for removal of internal structure including required monitoring	5	1	5					
		Site caused environment	Risk of settlement/movement of existing building	4	3	12	Contractor/Client	Temporary propping recommended as part of design to support structure during demolition works	3	1	3					
						0					0					
2.00	**Site**	Toxicity / Hazardous substances	Risk of working in potential confined space, alongside requirement to remove build up of toxic excrement	3	3	9	Contractor/Client	linked to construction methodology and wearing appropiate PPE/Removal of risk completely	1	1	1					
		Interfaces external to project	On publicly accessed land	4	1	4	Contractor/Client	Currently managed by site hoarding in place, with additional likely once construction starts	4	1	4					
		Position / location	Locality of existing tower to other potentially occupied buildings	2	4	8	Contractor/Client/I	Neighbouring properties currently vacated which assistis in minimsing risk	4	1	4					
		Heights / Depths	All demolition and construction works involve working from height with crane access/rope access	4	3	12	Contractor	Foundation options minimise the excavation works	1	3	3					
											0					
3.00	**Design**	Load / Force / Energy	Earthquake prone building which required strengthening	4	5	20	Engineer	Seismic strengthening of building to reduce overall risk of building	5	2	10					
		Foundations	Undermining existing tower/foundations - extent of existing foundations currently partially unknown	4	4	16	Engineer/Contracto	Temporary works in place including grout injection of surrounding soils, deep screw pile foundations to minimise excavation, construction sequencing of opening 1 at a time, pile caps outside zone of influence of existing foundations, minimised number of penetrations required, finally prepare detailed installation methodology with contractor	4	1	4					
		Structural Steel	Confined spaces, crane access and use around construction staff	3	3	9	Engineer/Contracto	Detailed methodology for sequencing, specific detailing of structure to be within manageable lift and erection tolerances including point cloud surveys	3	1	3					
		Timber	Confined spaces, crane access and use around construction staff	3	3	9	Engineer/Contracto	Detailed methodology for installation and erection of timber works point cloud surveys	3	1	3					
		Fixing of brick	Drilling into the brick which may affect the inegrity of brick, confined spaces, noise/vibration etc....	3	3	9	Engineer/Contracto	Detailed methodology for installation of brick ties - tyoically done off internal scaffold and safe working platforms	3	1	3					
		Re-pointing	Working at heights	3	3	9	Engineer/Contracto	Detailed methodology for re pointing - tyoically done off internal scaffold and safe working platforms	3	1	3					
						0					0					
4	**Construction**	General Construction	Woring at heights, confined spaces, high risk structure	5	5	25	Enginere/Contracto	Put in place internal and external scaffold as required to form working platforms, install temporary works as outlined in design costings, point cloud surveys to confirm tolerances and reduce crane times, structrual monitoring during construction for potential movement, removal of toxic material from base of tower as part of demolition	5	1	5					
						0					0					
5	**Operations & Maintenance**	General	Existing windows and doors are not secure	3	3	9	Client/Contractor	Recommend to install new mesh to windows and new lockable door to secure space	3	1	3					

Job Name Cambridge Water Tower
Job # 21-3015
Client Waipa District Council
Date Created 11/05/2023
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Revision 2

RISK MATRIX		Likelihood				
		Rare (1)	Unlikely (2)	Possible (3)	Probable (4)	Very Likely (5)
Consequence	Major (5)	5	10	15	20	25
	High (4)	4	8	12	16	20
	Medium (3)	3	6	9	12	15
	Low (2)	2	4	6	8	10
	Minor (1)	1	2	3	4	5

OPTION 5 - SAFETY IN DESIGN REGISTER

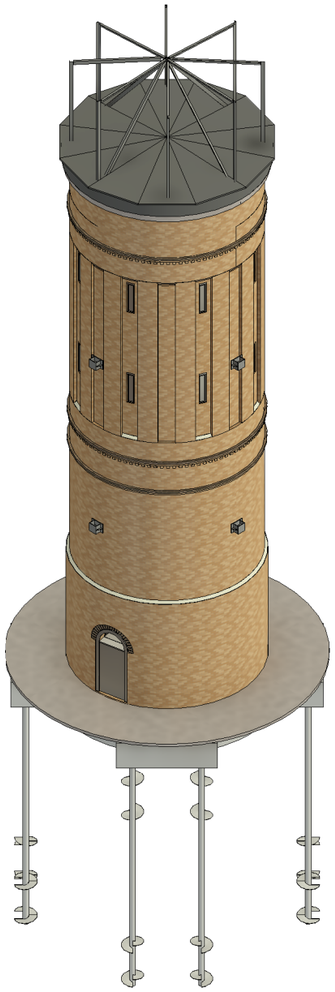
		Design Risk					Mitigation					Approval		Close Out		Comment
Reference	Category	Guide Word	Description of Risk / Hazard	Risk			Risk owner	Recommendation / Action	Residual Risk			Client Approval	Date	Action By	Status	
				Likelihood	Consequence	Risk			C	L	R					
1.00	**Demolition**	Access/egress	Removal of internal walkways/stairwells and water pipes + temporary timber roof externally	2	5	10	Contractor/Client	Detailed construction / demolition methodology for removal of internal structure including required monitoring	5	1	5					
		Site caused environment	Risk of settlement/movement of existing building	2	3	6	Contractor/Client	Temporary propping recommended as part of design to support structure during demolition works	3	1	3					
						0					0					
2.00	**Site**	Toxicity / Hazardous substances	Risk of working in potential confined space, alongside requirement to remove build up of toxic excrement	2	3	6	Contractor/Client	linked to construction methodology and wearing appropiate PPE/Removal of risk completely	1	1	1					
		Interfaces external to project	On publicly accessed land	4	1	4	Contractor/Client	Currently managed by site hoarding in place, with additional likely once construction starts	4	1	4					
		Position / location	Locality of existing tower to other potentially occupied buildings	2	4	8	Contractor/Client/I	Neighbouring properties currently vacated which assistis in minimsing risk	4	1	4					
		Heights / Depths	All demolition and construction works involve working from height with crane access/rope access	4	3	12	Contractor	Foundation options minimise the excavation works	1	3	3					
											0					
3.00	**Design**	Load / Force / Energy	Earthquake prone building which required strengthening	4	5	20	Engineer	Risk of tower itself remains, however by removing people and property risk without the need for design then the risk is reduced	5	1	5					
		Fixing of brick	Drilling into the brick which may affect the inegrity of brick, confined spaces, noise/vibration etc....	3	3	9	Engineer/Contracto	Detailed methodology for installation of brick ties - tyoically done off internal scaffold and safe working platforms	3	1	3					
		Re-pointing	Working at heights	3	3	9	Engineer/Contracto	Detailed methodology for re pointing - tyoically done off internal scaffold and safe working platforms	3	1	3					
						0					0					
4	**Construction**	General Construction	Woring at heights, confined spaces, high risk structure	1	5	5	Enginere/Contracto	By removing people and neighbouring properties no detailed construction is required and therefore reduces risk	5	1	5					
						0					0					
5	**Operations & Maintenance**	General	Existing windows and doors are not secure	3	3	9	Client/Contractor	Recommend to install new mesh to windows and new lockable door to secure space	3	1	3					

APPENDIX B – OPTIONS DRAWINGS

JOB NUMBER: 23-0438

CAMBRIDGE WATER TOWER
6 VOGEL STREET, CAMBRIDGE

bcdgroup.nz



Standard Abbreviations

Structural Abbreviations

BW	butt weld
CHS	circular hollow section
CJ	control joint
CON	concrete
DT	drossbach tube
EA	equal angle
EJ	expansion joint
FP	full penetration
FT	flat
FWAR	fillet weld all round
G	grade
galv	galvanised
HDG	hot dip galvanised
MS	mild steel
PC	precast concrete panel
PFC	parallel flange channel
PLY	plywood
RHS	rectangle hollow section
SHS	square hollow section
SP	splice
SS	stainless steel
TFB	tapered flange beam
UA	unequal angle
UB	universal beam
UC	universal column
WB	welded beam

Foundation / Reinforcing Abbreviations

BF	both faces
crs	centres
EF	each face
EW	each way
horiz	horizontal reinforcing
vert	vertical reinforcing
IF	inside face
OF	outside face
SSL	structural slab level
T & B	top & bottom

Civil Abbreviations

B.C.	base course
C.P.	catch pit
I.C.	inspection chamber
I.L.	invert level
L.L.	lid level
M.H.	man hole
R.O.W.	right of way
S.B.	sub base
S.G.	sub grade
S.S.	sanitary sewer
S.W.	stormwater
WM/S	water main/supply
W.W.	waste water

General Abbreviations

APPR	approved
BLDG	building
C.L.	centre line
CNR	corner
C.O.S.	confirm on site
DIM	dimension
D.T.F.	document transmittal form
EX	existing
F.F.L.	finish floor level
m	metre
max	maximum
min	minimum
misc	miscellaneous
mm	millimeter
NO	number
N.T.S.	not to scale
N.Z.S.	New Zealand Standard
R	radius
REF	reference
R.L.	reduce level
SK	sketch
SPEC	specification
T.B.C.	to be confirmed
TYP	typical

Plumbing Abbreviations

DIA	diameter
D.P.	down pipe
F.W.G.	floor waste gully
G.T.	gully trap
H.T.	hose tap
I.D.	inside diameter
I.L.	invert level
L.L.	lid level
O.D.	outside diameter
O.F.	over flow
O.F.O.	over flow outlet
O.R.G.	over flow relief gully
T.V.	terminal vent
W.C.	water closet
I.J.	inspection junction
I.B.	inspection bend
A.A.V.	air admitance valve

Architectural Abbreviations

BMT	base metal thickness
DPC	damp proof course
DPM	damp proof membrane

DRAWING LIST

SHEET NUMBER	SHEET NAME	CURRENT REVISION DATE	REVISION
000	INDEX & STANDARD NOTES	19-05-2023	1
A-001	SITE LOCATION PLAN	14-08-2023	2
A-100	EXISTING FLOOR PLANS AND SECTION - STAGE 1	19-05-2023	1
A-101	DEMOLITION PLANS AND SECTION	19-05-2023	1
A-101a	OPTION 2 - DEMOLITION PLANS AND SECTION	14-08-2023	1
A-101b	OPTION 3 - DEMOLITION PLANS AND SECTION	14-08-2023	1
A-110	ELEVATIONS	19-05-2023	1
S-500	STANDARD REINFORCED CONCRETE DETAILS	19-05-2023	1
S-501	FOUNDATION PLAN & DETAILS	19-05-2023	1
S-502	TIMBER ROOF PLAN AND SECTION- STAGE 2	14-08-2023	2
S-503	STRENGTHENING PLANS - STAGE 3	19-05-2023	1
S-503a	OPTION 2 - STRENGTHENING PLANS - STAGE 3	14-08-2023	2
S-503b	OPTION 3 - STRENGTHENING PLANS - STAGE 3	14-08-2023	2
S-504	CONCRETE ROOF PLAN AND SECTION - STAGE 4	14-08-2023	2
S-800	STEEL ELEVATIONS	19-05-2023	1
S-800a	ALT OPTION 1 - STEEL ELEVATIONS	19-05-2023	1
S-801	STEEL ELEVATIONS	19-05-2023	1
S-801a	ALT OPTION 1 - STEEL ELEVATIONS	19-05-2023	1
S-900	STANDARD STEEL DETAILS	19-05-2023	1
S-901	STEEL DETAILS	19-05-2023	1
S-1000	STRUCTURAL 3D VIEW	19-05-2023	1
S-1000a	OPTION 2 AND 3 - STRUCTURAL 3D VIEW	14-08-2023	1

Notes

1. Drawings issued prior to the completion of Building Consent issue are for the purpose of enabling the client/contractor to prepare, submit and negotiate a cost competitive and compliant tender for the project only.
2. The client acknowledges that the Preliminary Design is an incomplete design, prepared with a limited time frame, with input provided by the client, other organisations and third parties and in many respects relied on experienced engineering judgement. Accordingly, amendments to the design may be required when further information is obtained as design/construction progresses. Such amendments may include additional work, increased quantities and or additional time. The consultant shall not be responsible for the cost of such additional work, quantities or time unless the consultant is proven to have been negligent in preparation of the design. Furthermore, the consultant shall not be liable for any inaccuracies or incompleteness of any information not collected under the consultants direct control notwithstanding any coordination or management role undertaken by the consultants part of the services.
   To mitigate such risks of errors or omissions, the consultant will exercise due care and diligence in preparing the Design Documentation and will be available at the clients request to participate in a cost risk analysis with the client to enable a contingency sum for risk to be included in the tendered price for the project.
3. The parties agree that:
   a. The services and design documents do not and cannot constitute a complete Engineering Design and are likely to contain differences from the final engineering design when produced.
   b. The risk of any such differences and any consequences that may flow from such differences (whether in relation to cost or otherwise) are solely the risk of the client.
   c. BCD has provided Preliminary Design information and such information cannot be considered to be a fully detailed and checked design and that the client will prepare and price tender generally having regard to issues which arise as a result of not having such a fully detailed and checked design.
4. The client must act in good faith and use all reasonable endeavours to work on a regular basis with the consultant to minimise the risk of error to develop solutions that fulfil the project requirements and embrace the clients preferred construction methodologies and practices.

Sheet Setouts

A-100 series - floor plans
S-500 series - structural ground floor and mid floor plans
S-550 series - foundation details
S-560 series - mid floor details
S-600 series - precast & masonry elevations & details
S-620 series - precast stairs & details
S-700 series - holding down bolt plans
S-705 series - structural roof framing plans
S-800 series - structural elevations and sections
S-900 series - structural details
S-1000 series - 3D views

Hamilton Auckland
Tauranga Napier
New Plymouth
Ph: 0508 BCD GROUP (223 47687) Website: bcdgroup.nz

original in colour

Client: Waipa DISTRICT COUNCIL

Contractor:

BCD GROUP

Sheet: INDEX & STANDARD NOTES

Project Title: CAMBRIDGE WATER TOWER

6 VOGEL STREET, CAMBRIDGE

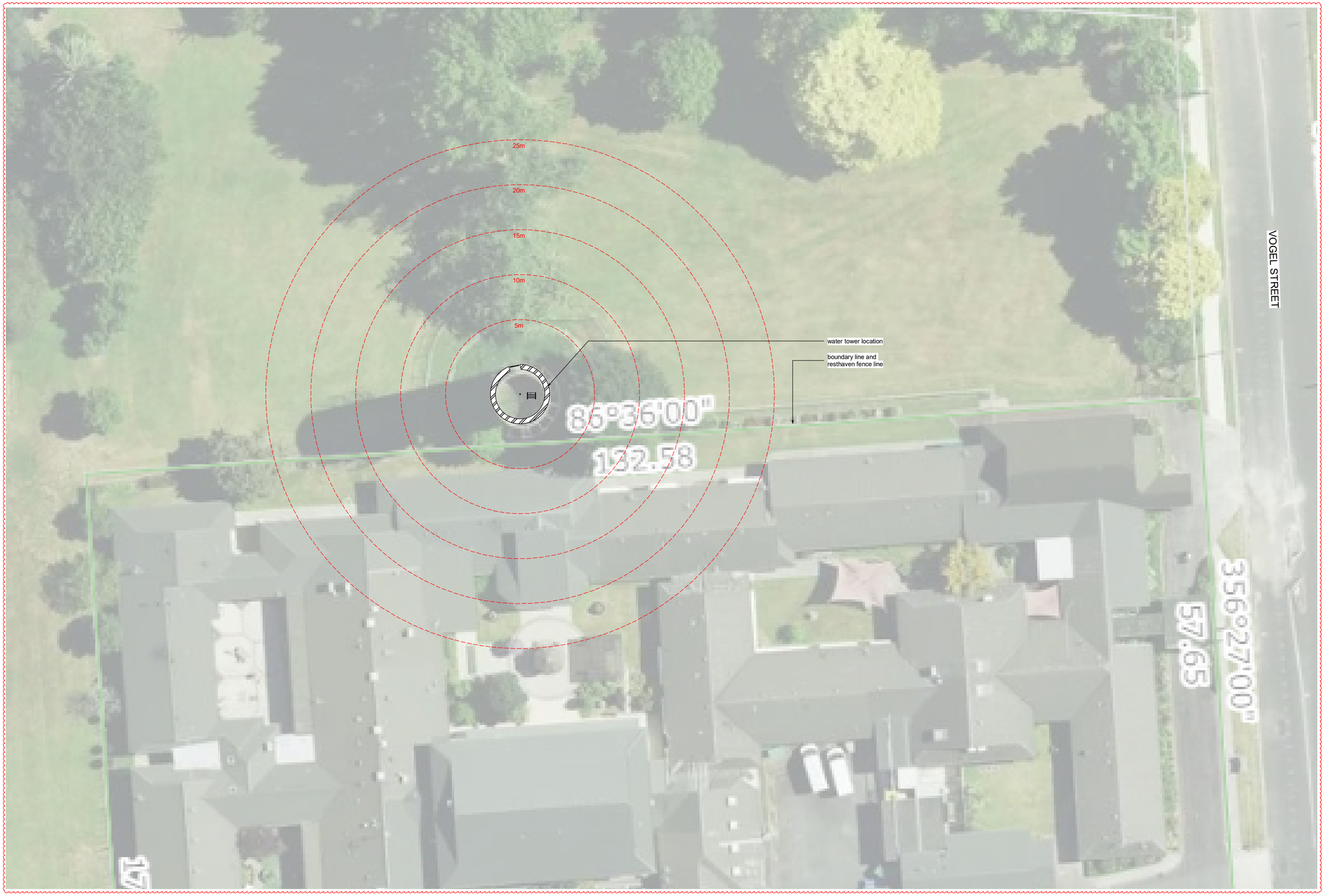
Rev	Date	by	Reason
1	19-05-2023	LSB	50% DETAILED DESIGN

Drawn: LSB Scale: 1 : 10 at A1

Engineer: CT

Job No:	Sheet No:	Revision
23-0438	000	1

all dimensions to be verified on site before making any shop drawings or commencing any work.



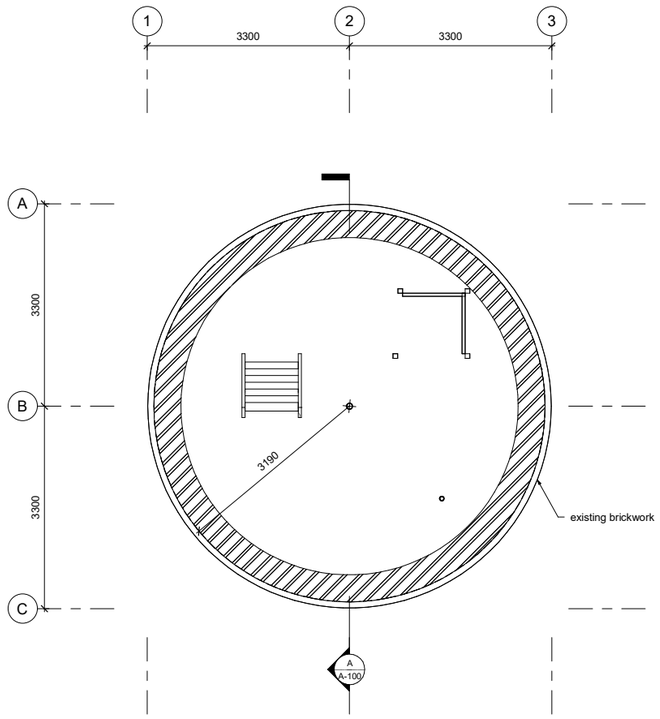
NORTH

original in colour

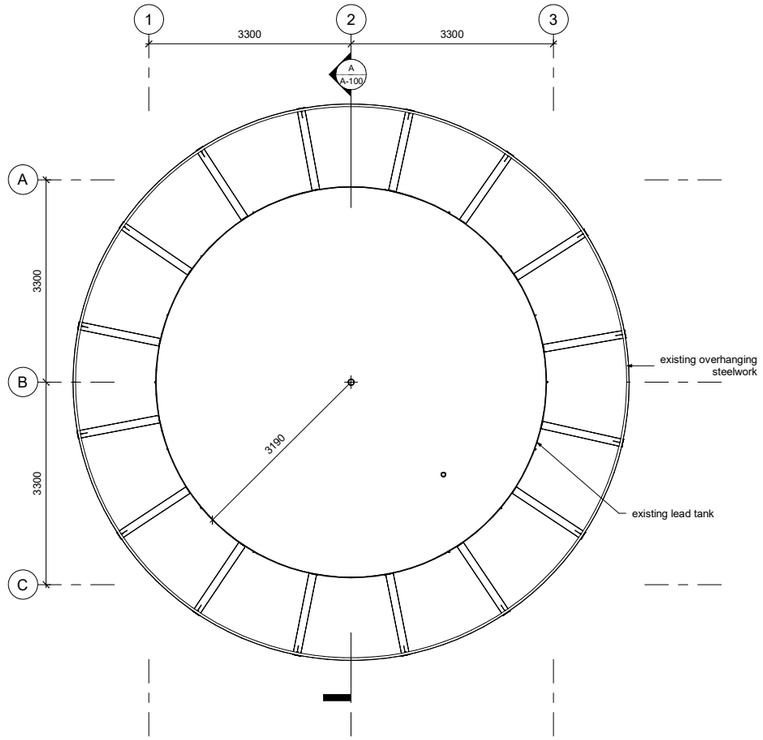
Client: Waipa DISTRICT COUNCIL	Contractor	Sheet: SITE LOCATION PLAN	Drawn: LSB · Scale: 1 : 200 at A1
		Project Title: CAMBRIDGE WATER TOWER	Engineer: CT
		6 VOGEL STREET, CAMBRIDGE	Job No: 23-0438 · Sheet No: A-001 · Revision: 2

Rev	Date	by	Reason
2	14-08-2023	KT	FOR INFORMATION
1	19-05-2023	LSB	50% DETAILED DESIGN

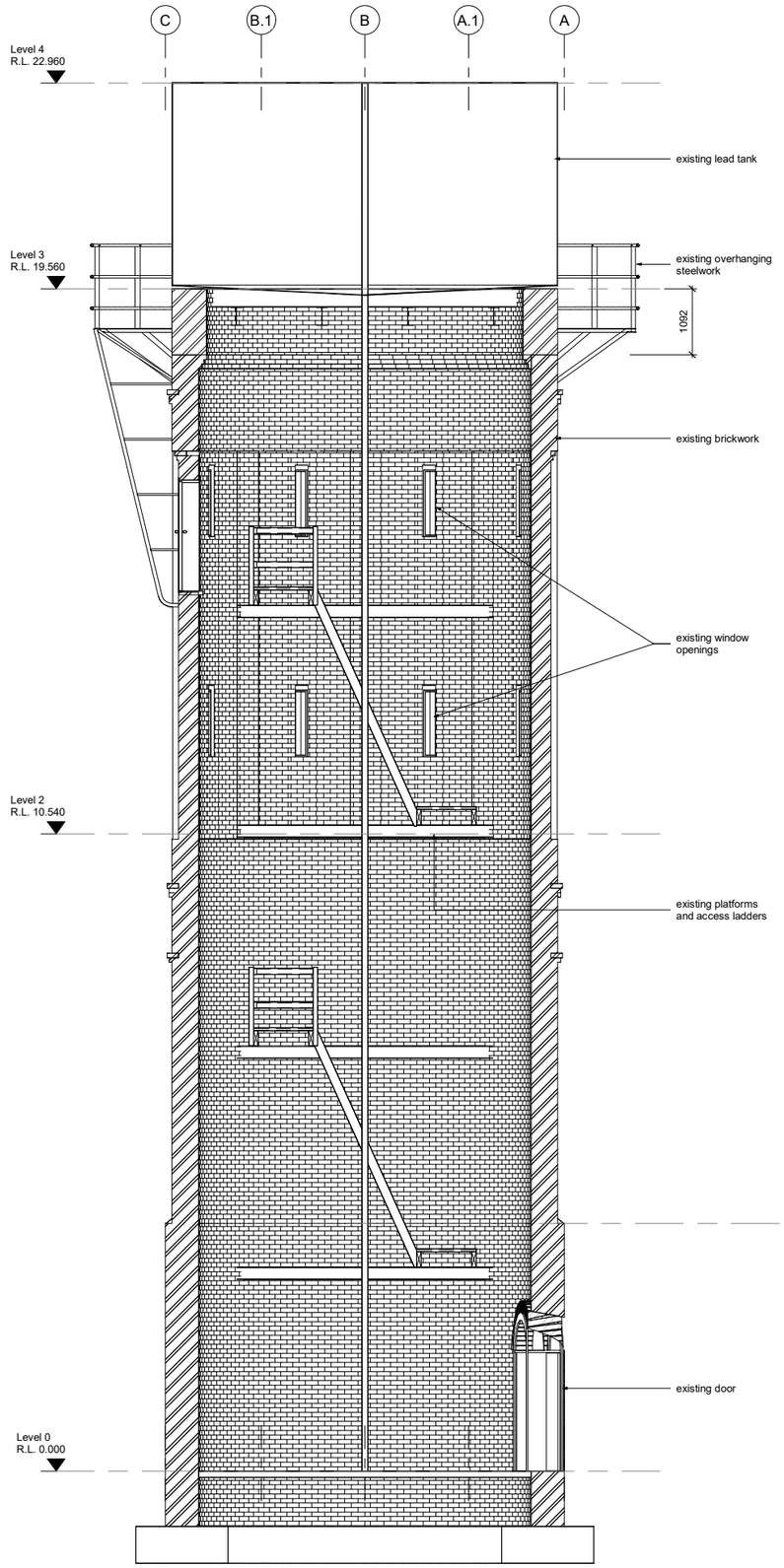
all dimensions to be verified on site before making any shop drawings or commencing any work.



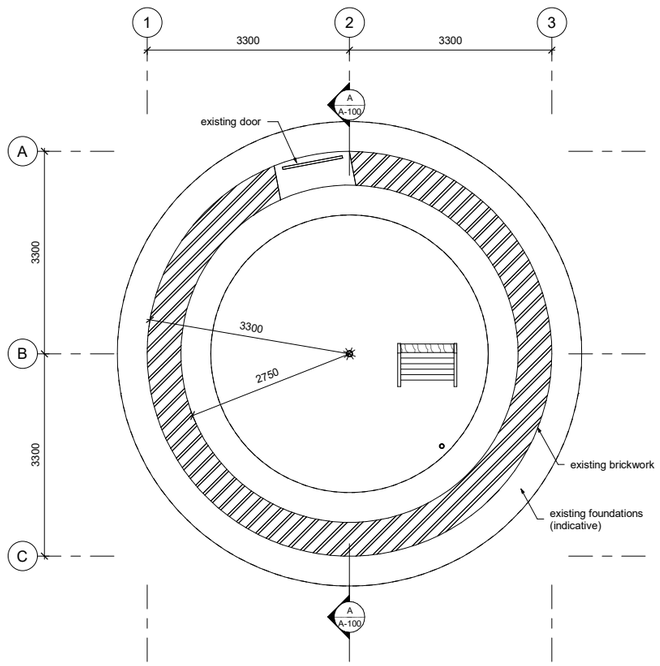
Level 1 Existing Floor Plan
1 : 50



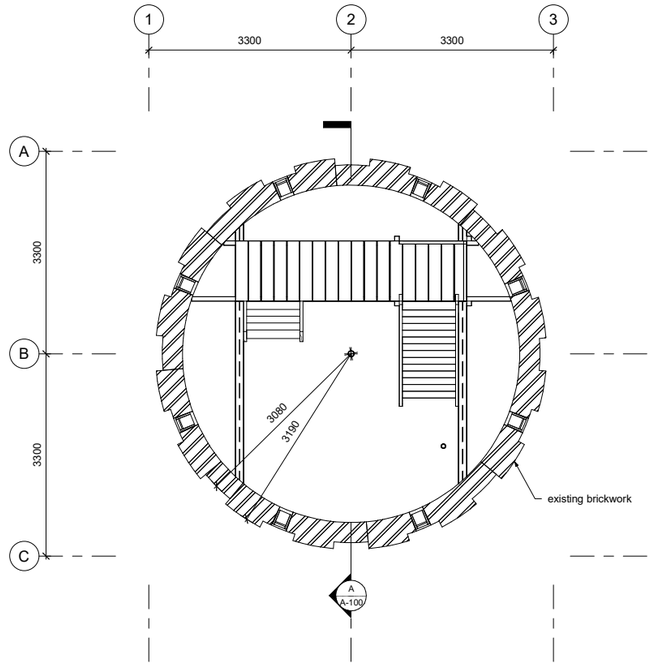
Level 3 Existing Floor Plan
1 : 50



A Section A-A - Existing
A-100 1 : 50



Level 0 Existing Floor Plan
1 : 50



Level 2 Existing Floor Plan
1 : 50

Client: Waipa District Council

Contractor:

BCD GROUP

Sheet: EXISTING FLOOR PLANS AND SECTION - STAGE 1

Project Title: CAMBRIDGE WATER TOWER

6 VOGEL STREET, CAMBRIDGE

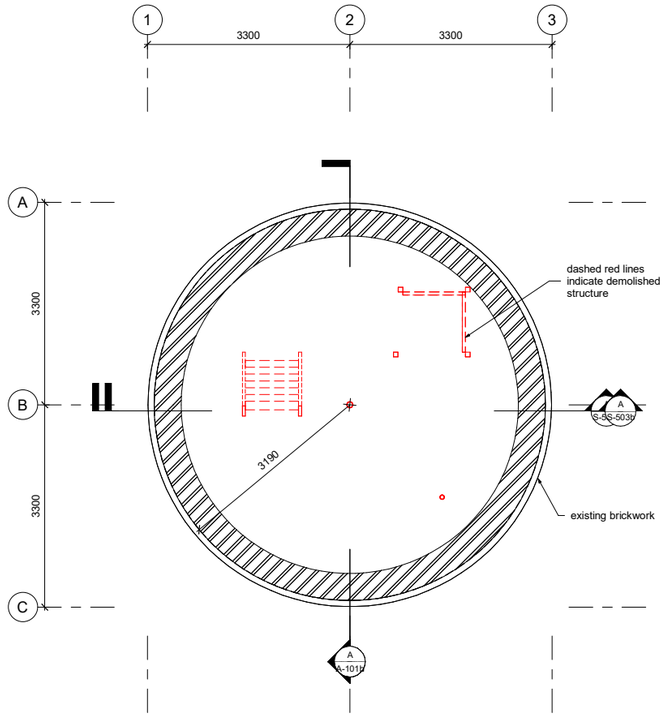
Rev	Date	by	Reason
1	19-05-2023	LSB	50% DETAILED DESIGN

Drawn: LSB | Scale: 1 : 50 | at A1

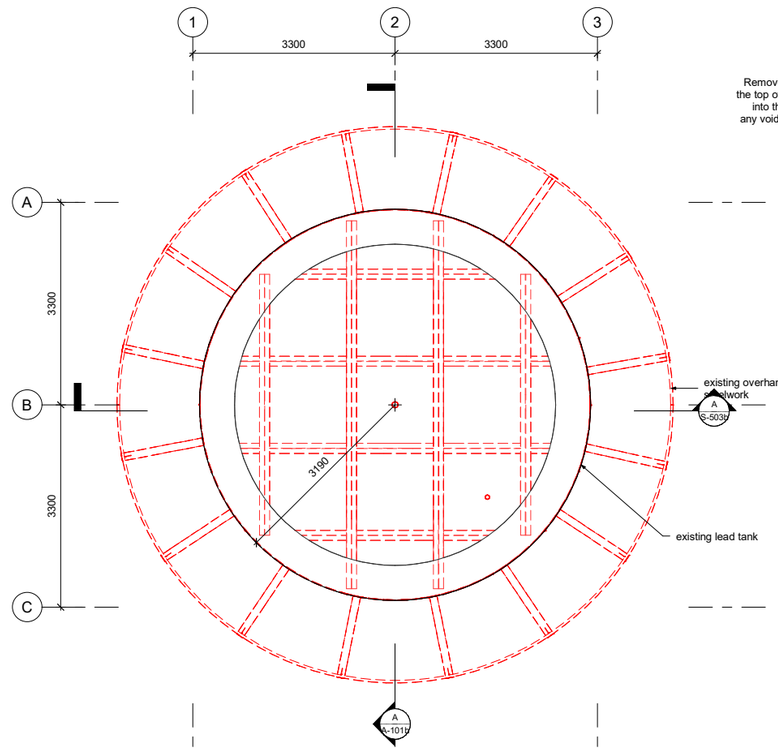
Reviewer: Checker

Job No: 23-0438 | Sheet No: A-100 | Revision: 1

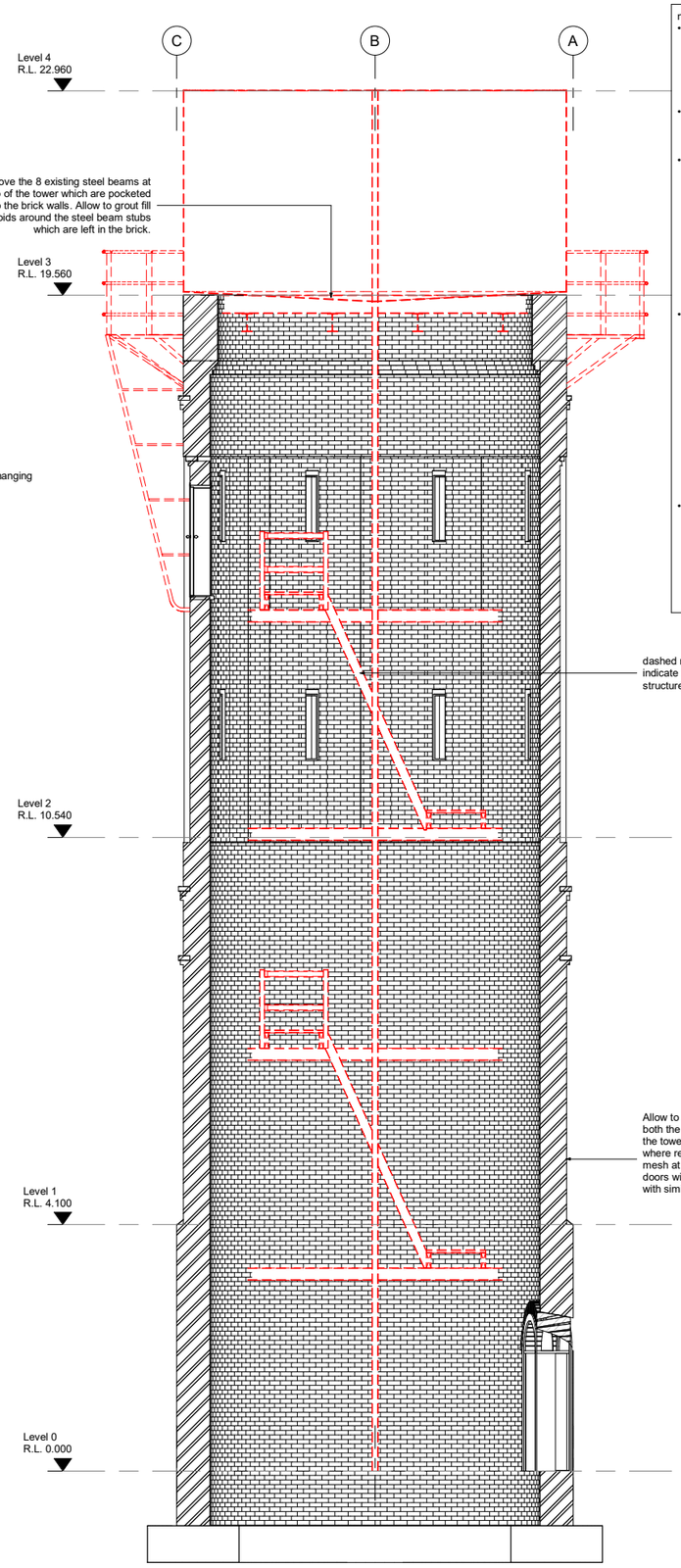
all dimensions to be verified on site before making any shop drawings or commencing any work.



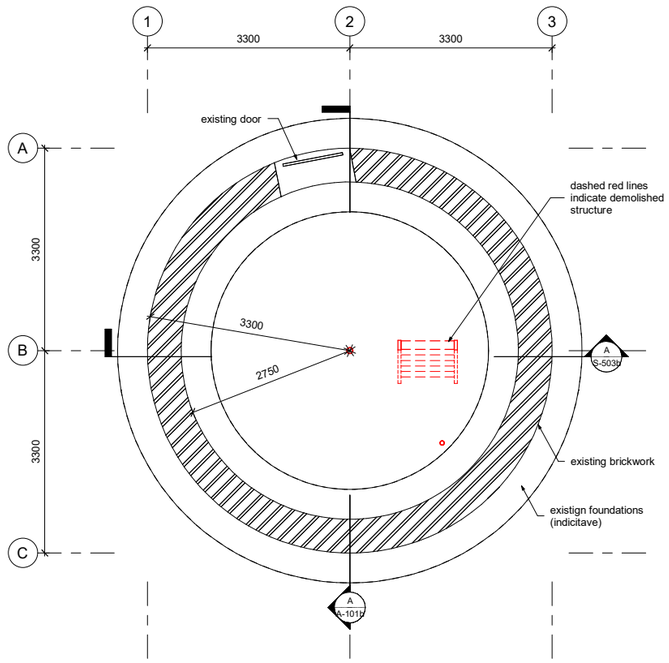
Level 1 Demolition Floor Plan
1 : 50



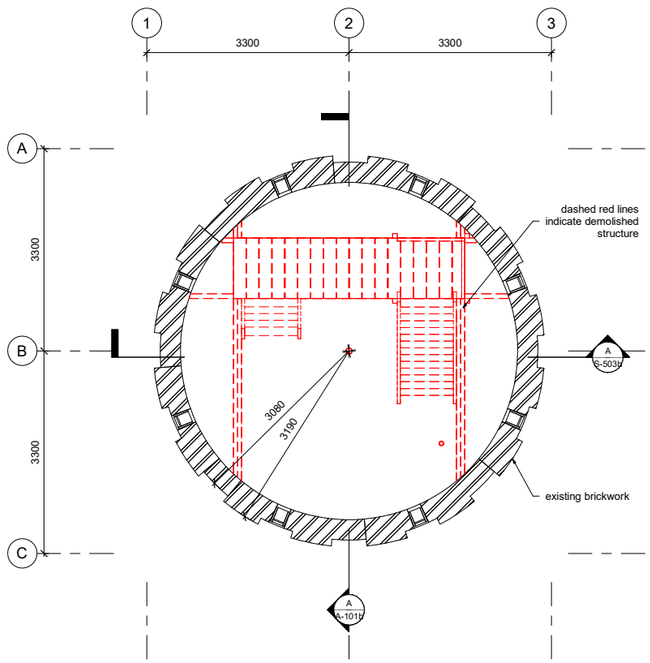
Level 3 Demolition Floor Plan
1 : 50



note:
- Allow to wash down and clean both the inside and outside of the tower. Repair bricks/mortal where required. Replace bird mesh at windows. Replace 2 doors with new secure doors with similar heritage look.
- Allow for point cloud survey of the inside of the tower to confirm internal dimensions to inform steelwork shop drawings.
- Allow for installation of temporary scaffold internal to tower – build it level by level from bottom up to allow access to the old walkways and remove the walkways through the bottom. Typically this is 2 steel beams at each level pocketed into the brick walls, supporting timber beams and planks for the platforms and timber/steel ladders, there are 4 levels. Allow to grout fill any voids around the steel beam stubs which are left in the brick.
- Remove the 2 existing steel pipes running up the height of the tower. This will likely require the temporary timber roof to be removed to allow the pipes to be cut at the base and carried out the door with the crane holding on to the top of the pipe, until the pipe is short enough to lift out from the top. Allow for a temporary roof be made up that can be lifted in place each night to help weather proof the construction from now until the permanent concrete roof is installed at the end of the strengthening works.
- Prior to demolition and during construction, allow 4 x steel frames similar to that of the Waikato Regional Theatre with two screw pile foundations each. Where the frames fix into the brick tower, steel ring beams will be required around the tower to encapsulate it, allow for these beams at 2 levels.



Level 0 Demolition Floor Plan
1 : 50



Level 2 Demolition Floor Plan
1 : 50

A-101 Section A-A - Demolition
1 : 50

original in colour

Client: Waipa DISTRICT COUNCIL
Contractor:
BCD GROUP

Sheet: DEMOLITION PLANS AND SECTION
Project Title: CAMBRIDGE WATER TOWER
6 VOGEL STREET, CAMBRIDGE

Rev	Date	by	Reason
1	19-05-2023	LSB	50% DETAILED DESIGN

Drawn: Author | Scale: 1 : 50 | at A1
Engineer: Designer
Job No: 23-0438 | Sheet No: A-101 | Revision: 1

all dimensions to be verified on site before making any shop drawings or commencing any work.

Exposure Classification

- A1 - Protected by damp proof membrane
  - Fully enclosed within a building except for a brief period of weather exposure during construction.
- A2 - In non aggressive soils
  - Above ground exterior in an inland environment.
- B1 - In building parts there of where members may be subject to repeated wetting and drying.
  - Above ground exterior in a coastal environment.
- B2 - Within 100m of high tide mark or between 100-500m of the high tide mark in direction of a prevailing or common wind.

- Where concrete is cast in formwork complying with NZS 3109 and compacted in accordance with NZS 3109, the cover shall be not less than the value given in the table below, appropriate to the exposure classification and specified concrete strength.

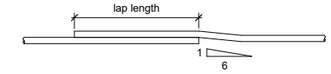
- Where concrete is cast on or against ground and compacted in accordance with NZS 3109, the minimum cover for a surface in contact with the ground shall be 75mm or 50mm if using a damp-proof membrane between the ground and the concrete to be cast.

Minimum required cover to reinforcing steel and tendons

Exposure Classification	Specified Compressive Strength F'c (MPa)								
	17.5	20	25	30	35	40	50	60	70
	Minimum Required Cover (mm)								
A1	30	25	25	20	20	20	20	15	15
A2	50	40	35	30	30	25	25	20	20
B1	60	50	40	35	35	30	30	25	25
B2	-	-	-	45	40	35	30	30	25

Concrete Strengths

• Concrete to Foundations	35MPa with 80mm slump
• Slabs on Grade (no vehicular traffic)	25MPa
• Site concrete and concrete required to make good excavations at 28 days or better	7MPa



NOTES

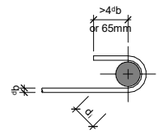
- All reinforcing hook, bends and lap lengths to comply with NZS 3101.

Minimum Lap Length of Grade 300E Bars						
Bar Diameter (mm)	Concrete Strength (MPa)					
	20	25	30	35	40	
10	350	300	275	275	250	
12	425	375	350	325	300	
16	550	500	450	425	400	
20	675	600	550	525	475	
25	850	750	700	650	600	
32	1075	975	900	825	775	
40	1350	1200	1100	1025	950	

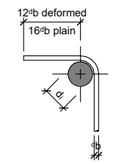
Minimum Lap Length of Grade 500E Bars						
Bar Diameter (mm)	Concrete Strength (MPa)					
	20	25	30	35	40	
10	550	500	450	425	400	
12	675	600	550	500	475	
16	900	800	725	675	625	
20	1125	1000	925	850	800	
25	1400	1250	1150	1050	1000	
32	1800	1600	1450	1350	1275	
40	2225	2000	1825	1700	1575	

Standard Reinforcing Lap Lengths

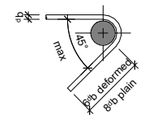
for pour depth less than 300mm, multiply by 1.3 for pour depths greater than 300mm



Standard Semi-circular Hook



Standard 90° Hook

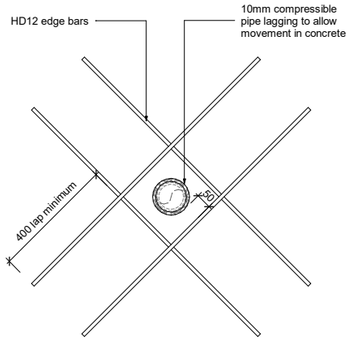


Standard Stirrup Hook or Tie

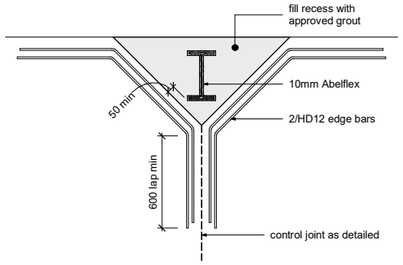
f_y (MPa)	Reinforcing Bar Type	Bar Diameter d_b (mm)	Minimum Diameter of bend d_i (mm)	
			Plain Bars	Deformed Bars
300 or 500	Main Bar	6-20	$5d_b$	
		24-40	$6d_b$	
	Stirrups & Ties	6-20	$2d_b$	$4d_b$
		24-40	$3d_b$	$6d_b$

note: where deformed bars are galvanized before bending, the minimum bend diameter shall be:
(a) $5d_b$ for bar diameters of 16mm or less.
(b) $8d_b$ for bar diameters of 20mm or greater.

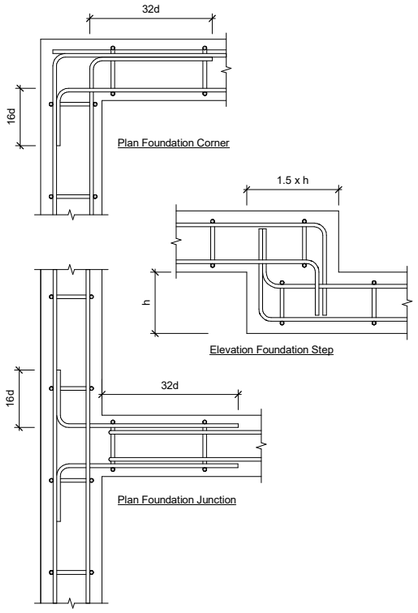
Standard Reinforcing Hooks & Bends

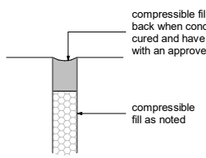


Typical Slab Isolated Penetration Detail

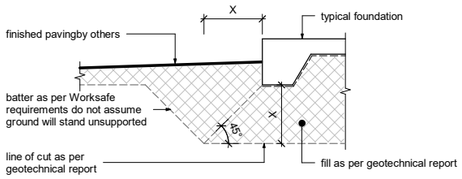


Standard Column Isolation
- Control Joints & Soffcuts
- Type 02 at Slab Edge





Standard Column Isolation Joint Finishing



Foundation Excavation Zone

NOTE: this is a guideline only and should be read in conjunction with the geotechnical report for all cut and fill requirements

Foundation Details

d = bar diameter

NOTE: applicable to simple strip footings only. Foundation beam systems have specific detailing.

Client: Waipa District Council

Contractor:

BCD GROUP

Sheet: **STANDARD REINFORCED CONCRETE DETAILS**

Project Title: **CAMBRIDGE WATER TOWER**

6 VOGEL STREET, CAMBRIDGE

Rev	Date	by	Reason
1	19-05-2023	LSB	50% DETAILED DESIGN

Drawn: LSB | Scale: As indicated | at A1

Engineer: CT

Job No: 23-0438 | Sheet No: S-500 | Revision: 1

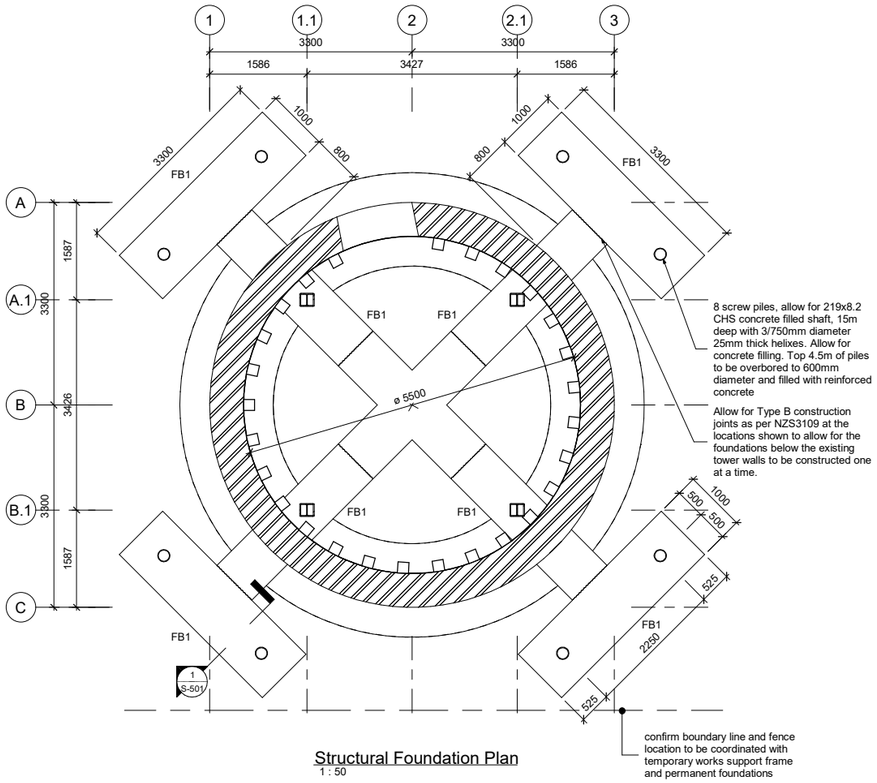
all dimensions to be verified on site before making any shop drawings or commencing any work.

Structural Floor Notes

- It is the responsibility of the contractor to ensure testing and compliance of mesh to acceptable standards as per NZ standards. Independent test results from an IANZ certified laboratory are to be provided to the engineer before any mesh is delivered to site.

Structural Column...

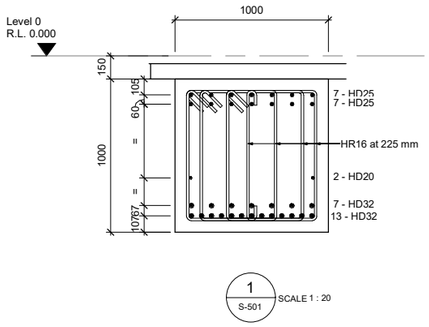
Type Mark	Type
C1	200 UC 46
C2	200 UC 60



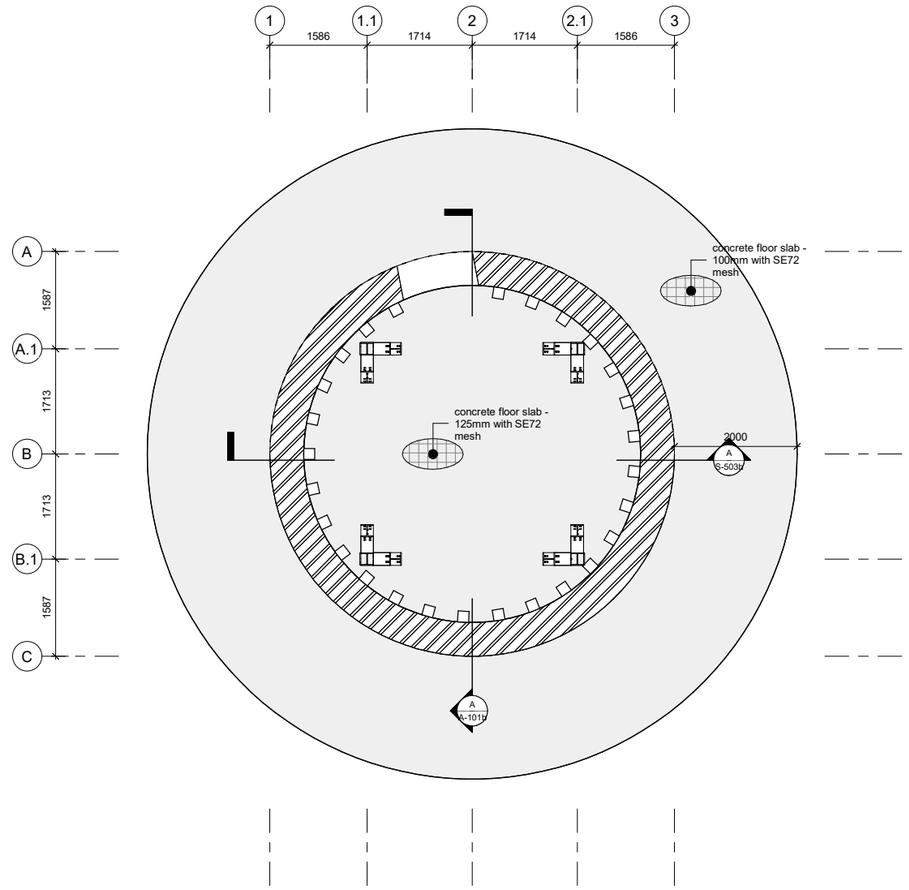
Structural Foundation Plan

1 : 50

note:
Allow for grout injection to existing ground each side of ground beam below the tower to support tower during construction



1 / S-501 SCALE 1 : 20



Structural Floor Plan

1 : 50

Structural Foundation Schedule

Type Mark	Type (h x w x l)	Reinforcing
FB1	1000 x 1000mm Foundation Beam	20/HD32 bottom bars 2/HD20 middle bars 14/HD25 top bars with 7 HR16 stirrups at 225crs

Foundation Notes

FP = foundation pad
S = stabiliser
SF = strip footing
TF = panel tongue footing
FB = foundation beam
TB = tie beam
SE = slab edge thickening

Client: Waipa DISTRICT COUNCIL

Contractor:

BCD GROUP

Sheet: **FOUNDATION PLAN & DETAILS**

Project Title: **CAMBRIDGE WATER TOWER**

6 VOGEL STREET, CAMBRIDGE

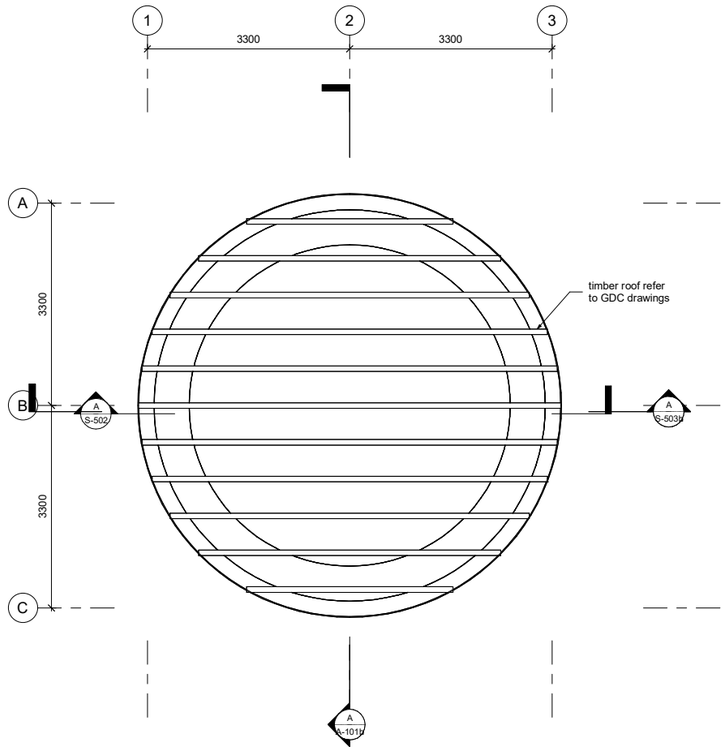
Rev	Date	by	Reason
1	19-05-2023	LSB	50% DETAILED DESIGN

Drawn: LSB | Scale: As indicated | at A1

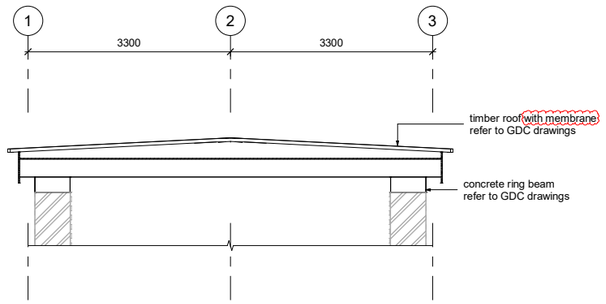
Engineer: CT

Job No:	Sheet No:	Revision
23-0438	S-501	1

all dimensions to be verified on site before making any shop drawings or commencing any work.



Level 3 Timber Roof Stage 2
1 : 50



A S-502 Section A-A - Stage 2
1 : 50

original in colour

Client: Waipa District Council

Contractor:

BCD GROUP

Sheet: TIMBER ROOF PLAN AND SECTION- STAGE 2

Project Title: CAMBRIDGE WATER TOWER

6 VOGEL STREET, CAMBRIDGE

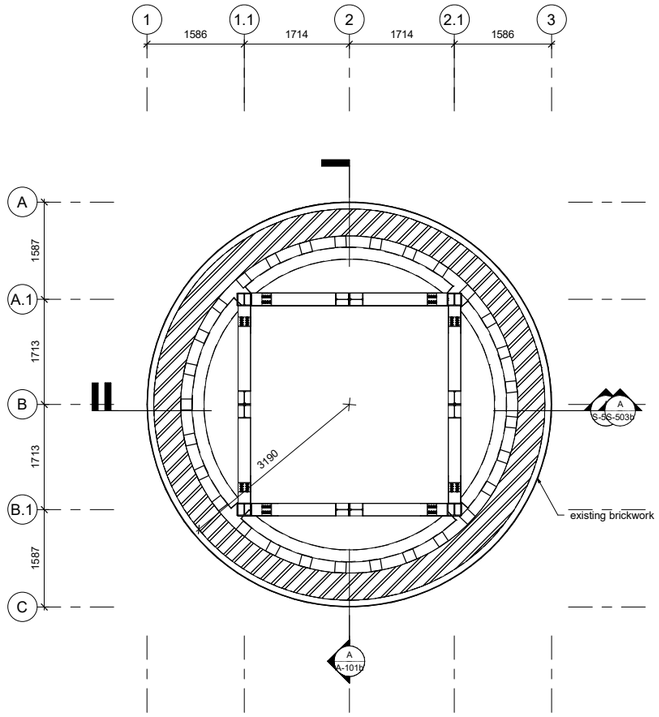
Rev	Date	by	Reason
2	14-08-2023	KT	FOR INFORMATION
1	19-05-2023	LSB	50% DETAILED DESIGN

Drawn: LSB | Scale: 1 : 50 | at A1

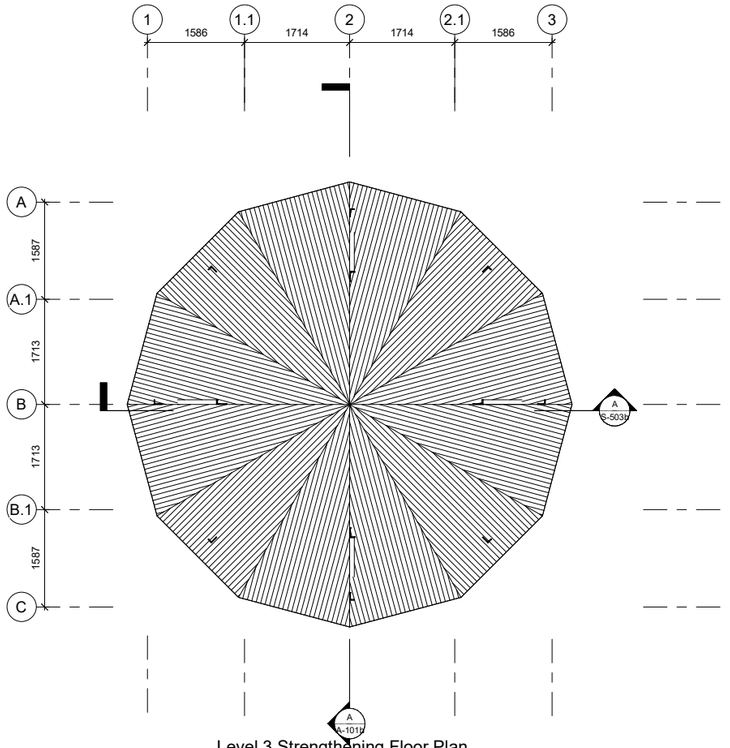
Engineer: CT

Job No:	Sheet No:	Revision
23-0438	S-502	2

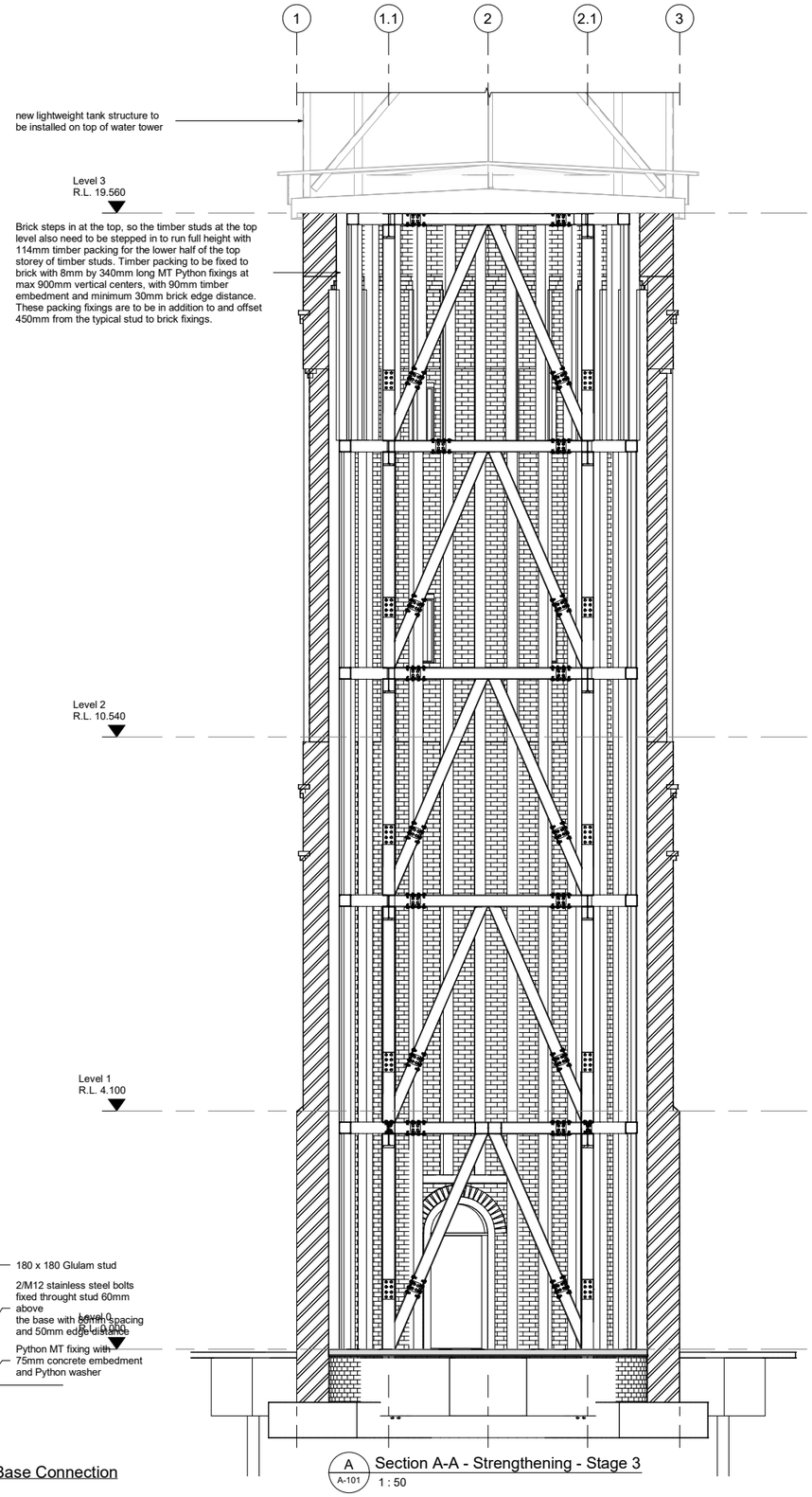
all dimensions to be verified on site before making any shop drawings or commencing any work.



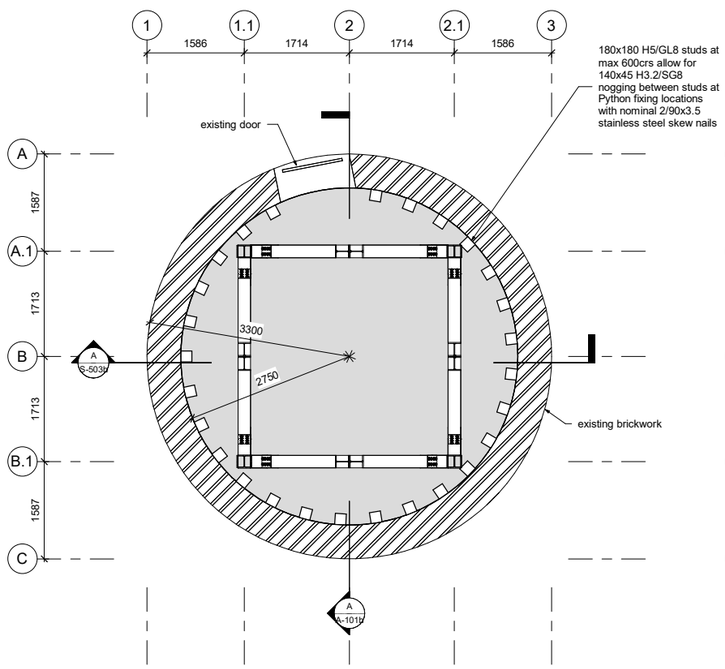
Level 1 Strengthening Floor Plan
1 : 50



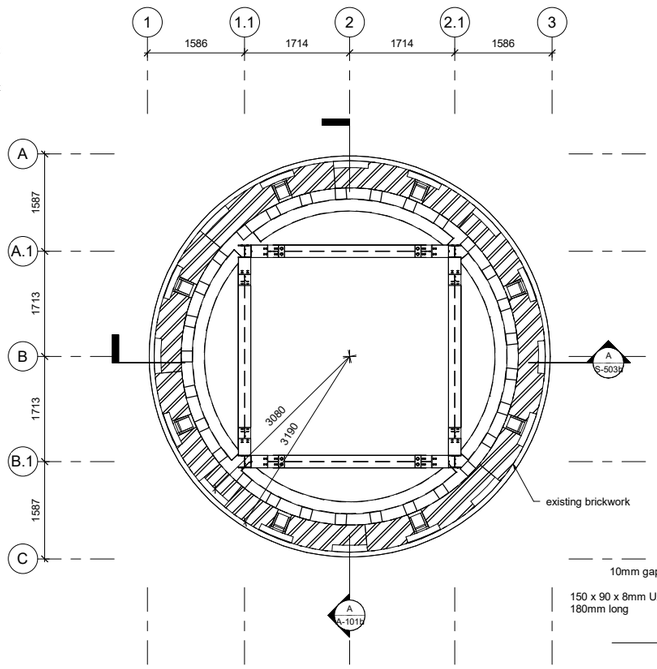
Level 3 Strengthening Floor Plan
1 : 50



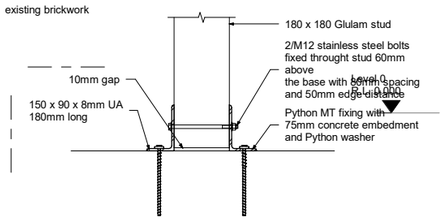
A Section A-A - Strengthening - Stage 3
A-101
1 : 50



Level 0 Strengthening Floor Plan
1 : 50
note:
Typically fix centre of timber studs to brick with 8mm by 340mm long MT Python fixings at max 900mm vertical centres, with 90mm timber embedment and with minimum 30mm brick edge distance



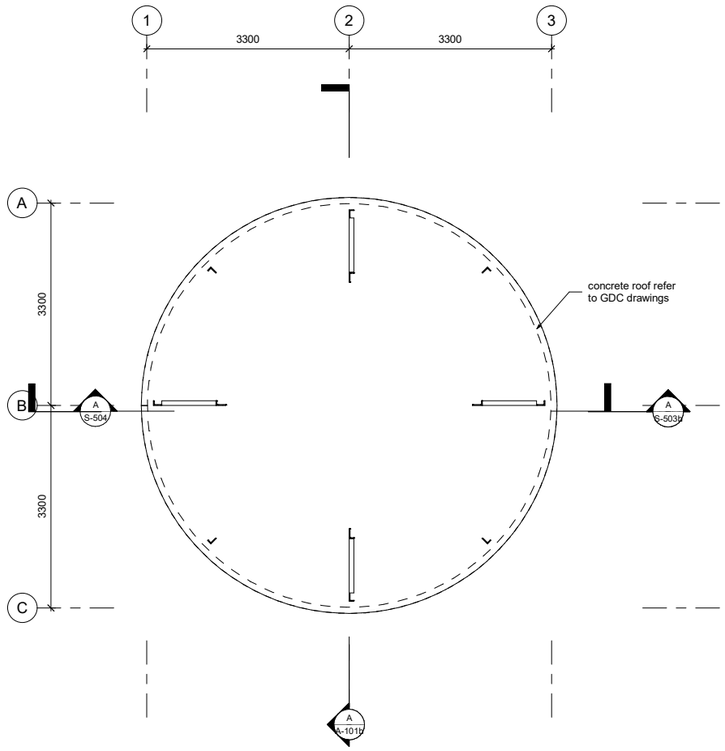
Level 2 Strengthening Floor Plan
1 : 50



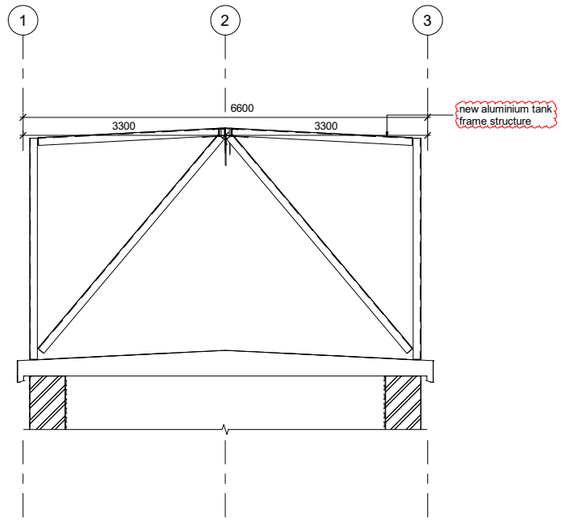
Typical 180 x 180 Gluelam Base Connection
1 : 10

Client	Waipa DISTRICT COUNCIL	Contractor	
Sheet	STRENGTHENING PLANS - STAGE 3	Drawn: LSB	Scale: As indicated at A1
Project Title	CAMBRIDGE WATER TOWER	Engineer: CT	
	6 VOGEL STREET, CAMBRIDGE	Job No: 23-0438	Sheet No: S-503
		Revision: 1	

Rev	Date	by	Reason
1	19-05-2023	LSB	50% DETAILED DESIGN



Level 3 Concrete Roof Stage 4
1 : 50



A S-504 Section A-A - Stage 4
1 : 50

Client: Waipa District Council

Contractor:

BCD GROUP

Sheet: CONCRETE ROOF PLAN AND SECTION - STAGE 4

Project Title: CAMBRIDGE WATER TOWER

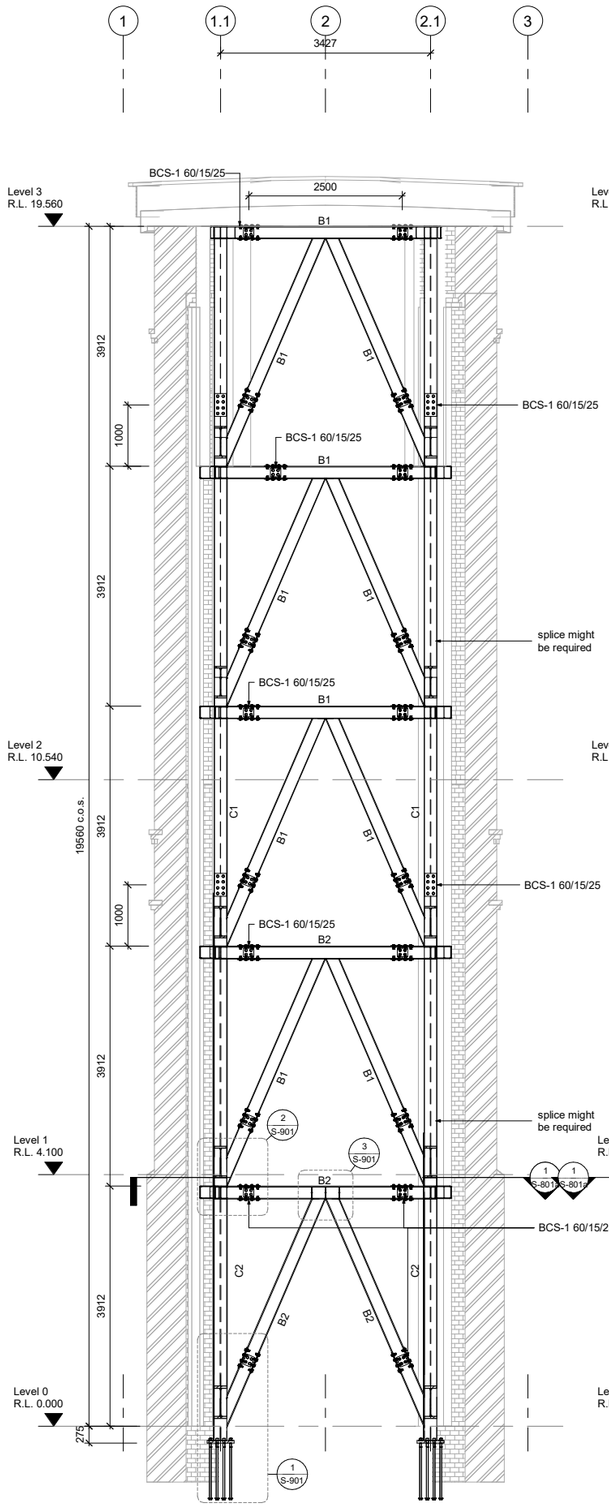
6 VOGEL STREET, CAMBRIDGE

Rev	Date	by	Reason
2	14-08-2023	KT	FOR INFORMATION
1	19-05-2023	LSB	50% DETAILED DESIGN

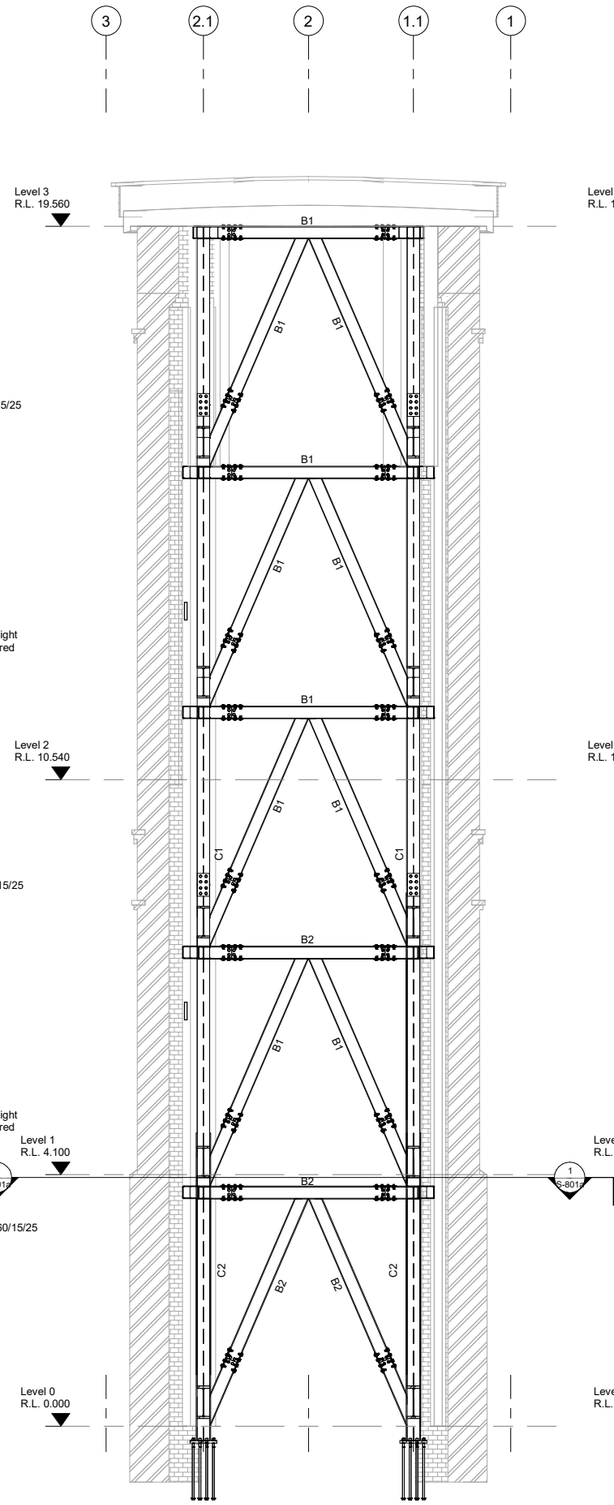
Drawn: LSB | Scale: 1 : 50 | at A1

Engineer: CT

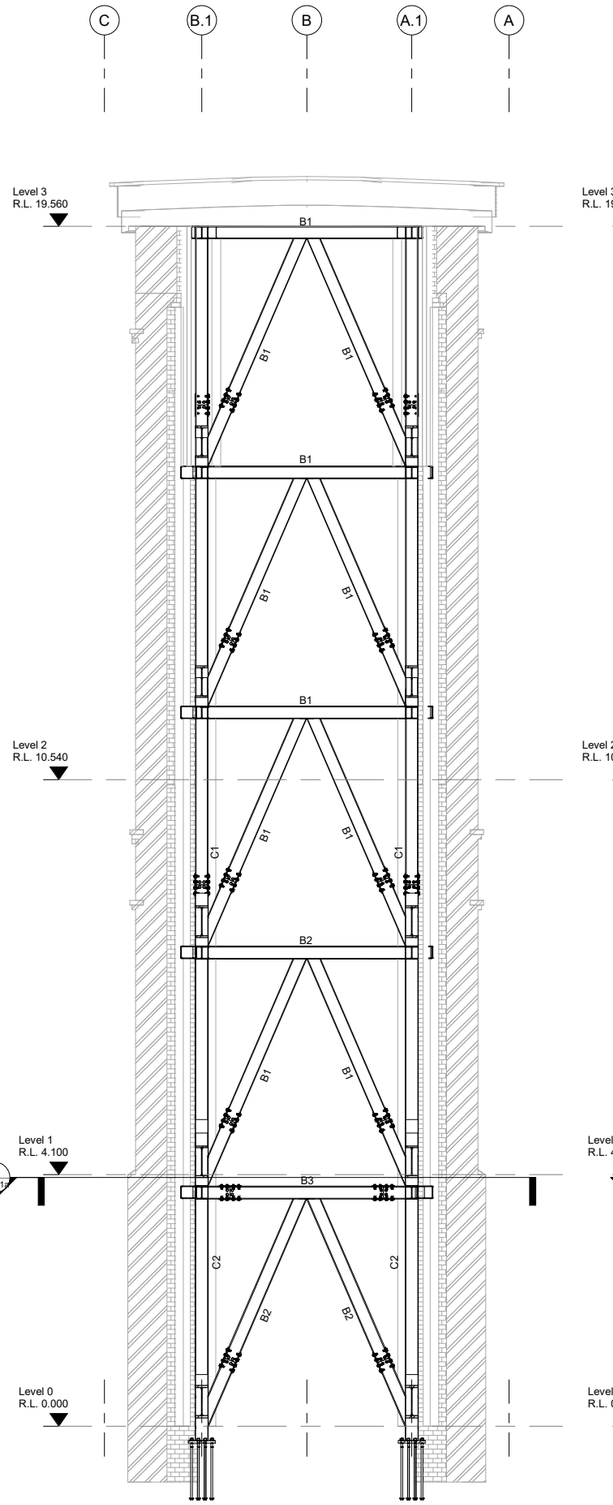
Job No:	Sheet No:	Revision
23-0438	S-504	2



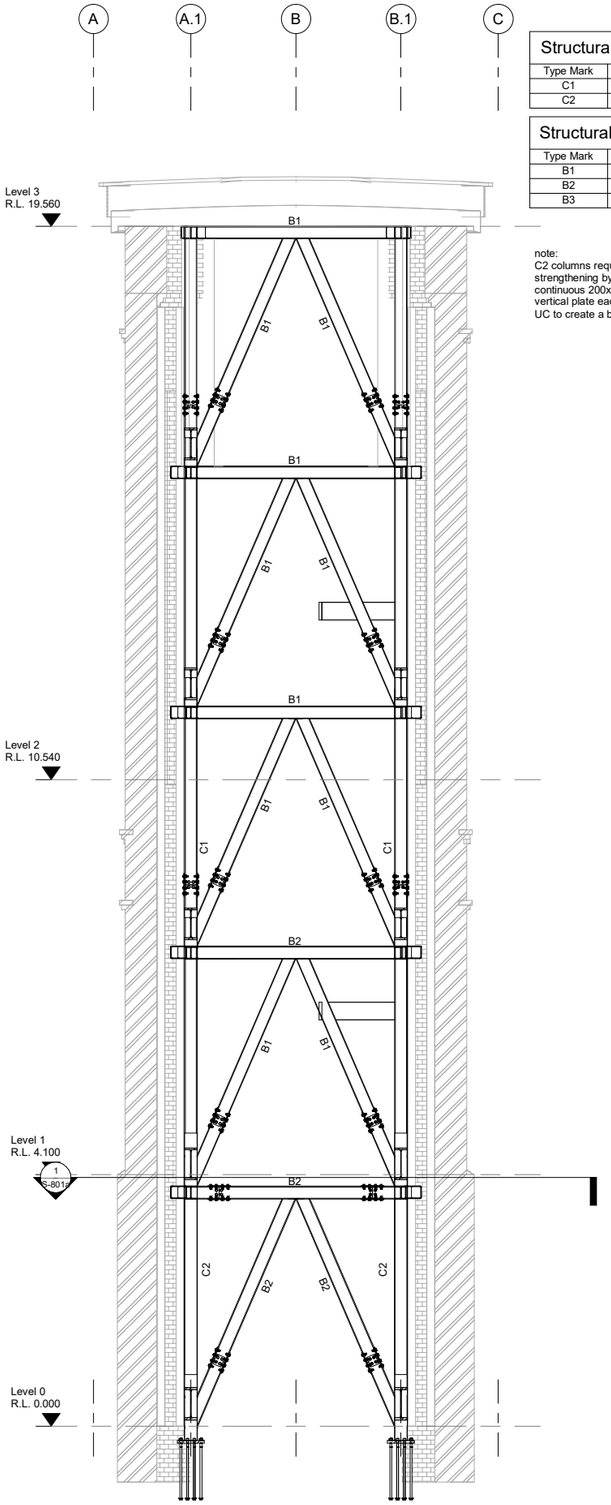
Steel Elevation grid Line A.1
1 : 50



Steel Elevation grid Line B.1
1 : 50



Steel Elevation grid Line 1.1
1 : 50



Steel Elevation grid Line 2.1
1 : 50

Structural Column...	
Type Mark	Type
C1	200 UC 46
C2	200 UC 60

Structural Framing...	
Type Mark	Type
B1	200 UC 46
B2	200 UC 60
B3	200 x 6 SHS

note:
C2 columns require strengthening by welding on a continuous 200x16mm vertical plate each side of the UC to create a box section

Client: Waipa District Council
Contractor:
BCD GROUP

Sheet: **STEEL ELEVATIONS**
Project Title: **CAMBRIDGE WATER TOWER**
6 VOGEL STREET, CAMBRIDGE

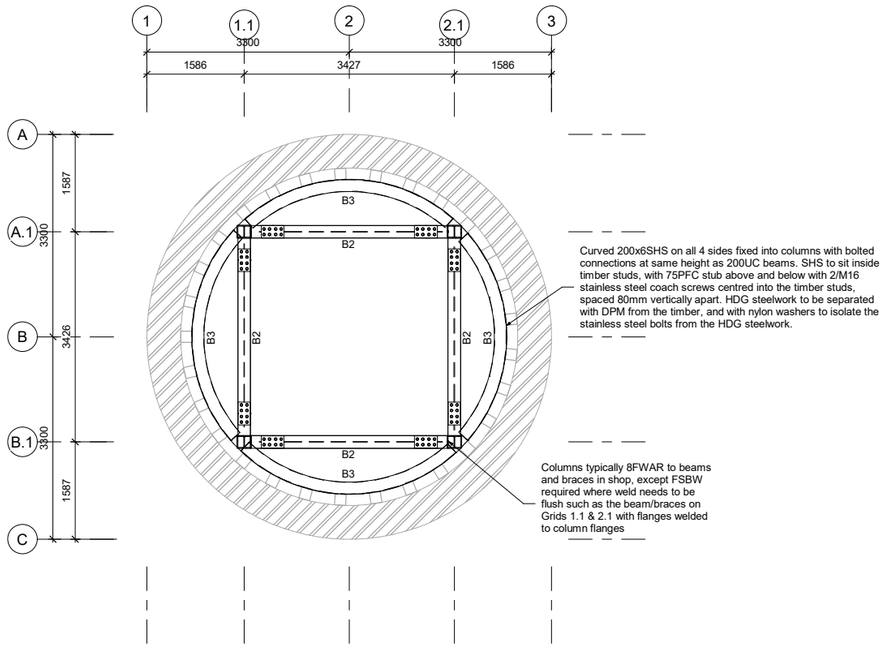
Rev	Date	by	Reason
1	19-05-2023	LSB	50% DETAILED DESIGN

Drawn: LSB | Scale: As indicated | at A1
Engineer: CT
Job No: 23-0438 | Sheet No: S-800 | Revision: 1

all dimensions to be verified on site before making any shop drawings or commencing any work.

Structural Column...	
Type Mark	Type
C1	200 UC 46
C2	200 UC 60

Structural Framing...	
Type Mark	Type
B1	200 UC 46
B2	200 UC 60
B3	200 x 6 SHS



1 / S-800 Steel Plan Detail
1 : 50

Client: Waipa DISTRICT COUNCIL
Contractor:

BCD GROUP

Sheet: STEEL ELEVATIONS
Project Title: CAMBRIDGE WATER TOWER
6 VOGEL STREET, CAMBRIDGE

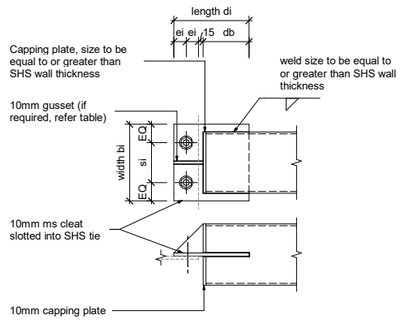
Rev	Date	by	Reason
1	19-05-2023	LSB	50% DETAILED DESIGN

Drawn: LSB | Scale: As indicated | at A1
Engineer: CT
Job No: 23-0438 | Sheet No: S-801 | Revision: 1

all dimensions to be verified on site before making any shop drawings or commencing any work.

STRUCTURAL STEEL NOTES

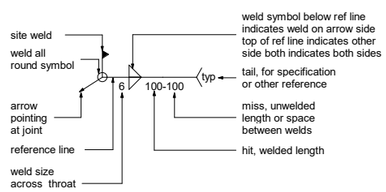
- All splice connections, moment end plates, and SCNZ connections to be grade 8.8/TB.
- All other bolts to be M20 grade 8.8/S unless noted otherwise.
- All welds to be 8mm fillet weld with weld material to be E49XX unless noted otherwise.
- All welds to primary structure to be Structural Purpose.
- To be read in conjunction with BCD structural steelwork specification.
- For all plates and stiffeners refer to BCD specification for grades of steel.
- All hold down bolts to be grade 8.8/S.
- Allow crusher tubes to all steel hollow sections with fixings passing through.



SHS Tie

Weld Symbols

Basic Gas and Arc Welding Symbols		Supplementary Welding Symbols	
6	fillet		weld all round
	bead		flush contour
	general butt		weld on site
	square butt		backing strip or bar
	single bevel butt		flush surface finish
	single vee butt		convex surface finish
	single 'U' butt	6	concave surface finish
h	single 'J' butt		backing weld run
	plug or slot	typ	tail, for notes
	stud		
	surfacing		

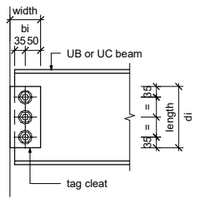


SHS Tie Dimensions

Section	Cleat						
	Width (bi)	Length (di)	Length 2 (db)	Bolt edge distance length (ei)	Bolt spacing (si)	Bolts	Gusset required?
89SHS	140	195	100	40	70	2/M20	no
100SHS	140	195	100	40	70	2/M20	no
125SHS	150	195	100	40	80	2/M20	no
150SHS	180	195	100	40	80	2/M20	no
200SHS	250	265	150	50	130	2/M24	yes

Note:
- All bolts to be grade 8.8/s unless noted otherwise.

C - C

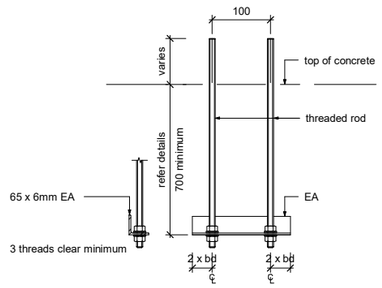


Simply Cleated Beam Connection

Simply Cleated Beam Connection

Section	Cleat			Bolts
	Width (bi)	Length (di)	Thickness (ti) (minimum)	Number of bolts
180UB	100	130	8mm	2
200UB	100	140	8mm	2
250UB	100	140	8mm	2
310UB	100	210	10mm	3
360UB	100	210	10mm	3
410UB	100	280	10mm	4
460UB	100	350	12mm	5
530UB	100	420	12mm	6
610UB	100	490	12mm	7

NOTE:
- All bolts to be M20 grade 8.8/s unless noted otherwise.
- connections are based on 30% shear.
- refer to structural calculations and SCNZ connections guide in the first instance.



Holding Down Bolts

Client: Waipa DISTRICT COUNCIL

Contractor:

BCD GROUP

Sheet: STANDARD STEEL DETAILS

Project Title: CAMBRIDGE WATER TOWER

6 VOGEL STREET, CAMBRIDGE

Rev	Date	by	Reason
1	19-05-2023	LSB	50% DETAILED DESIGN

Drawn: LSB | Scale: 1 : 10 | at A1

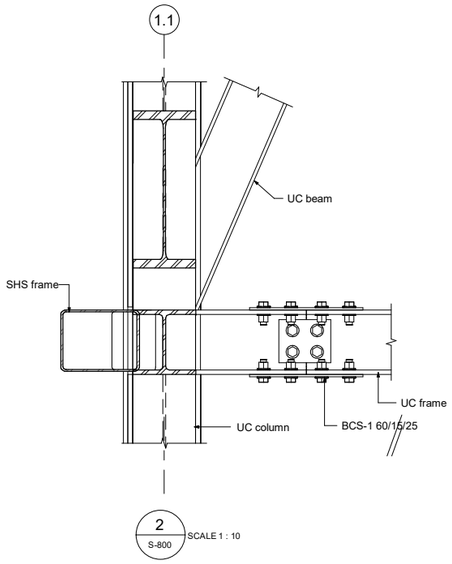
Engineer: CT

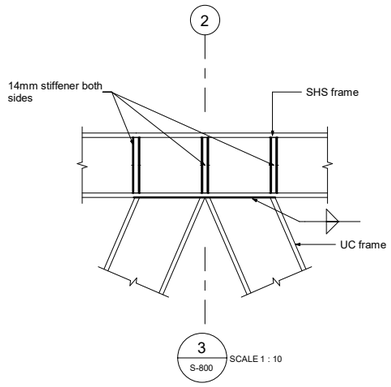
Job No: 23-0438 | Sheet No: S-900 | Revision: 1

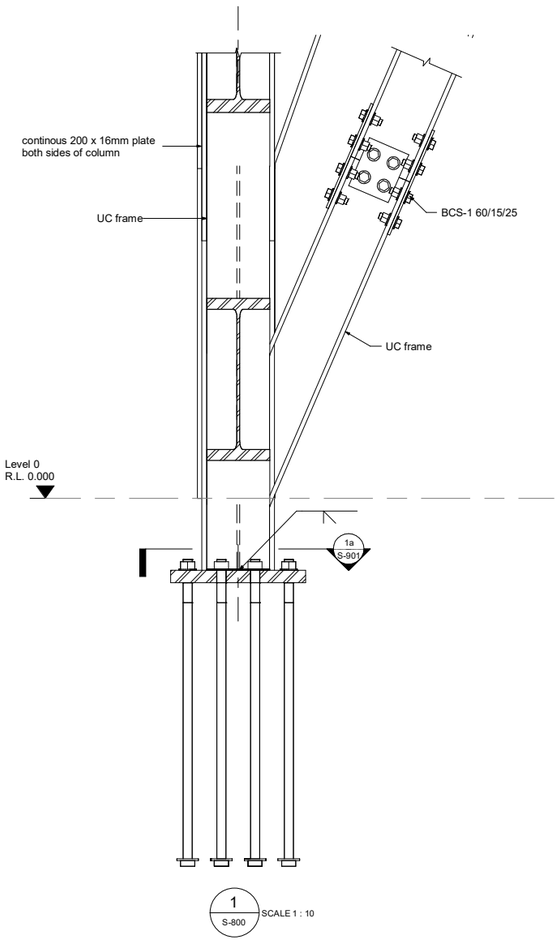
all dimensions to be verified on site before making any shop drawings or commencing any work.

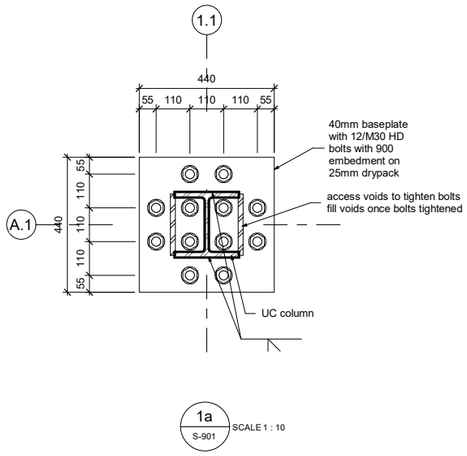
STRUCTURAL STEEL NOTES

- All splice connections, moment end plates, and SCNZ connections to be grade 8.8/TB.
- All other bolts to be M20 grade 8.8/S unless noted otherwise.
- All welds to be 8mm fillet weld with weld material to be E49XX unless noted otherwise.
- All welds to primary structure to be Structural Purpose.
- To be read in conjunction with BCD structural steelwork specification.
- For all plates and stiffeners refer to BCD specification for grades of steel.
- All hold down bolts to be grade 8.8/S.
- Allow crusher tubes to all steel hollow sections with fixings passing through.



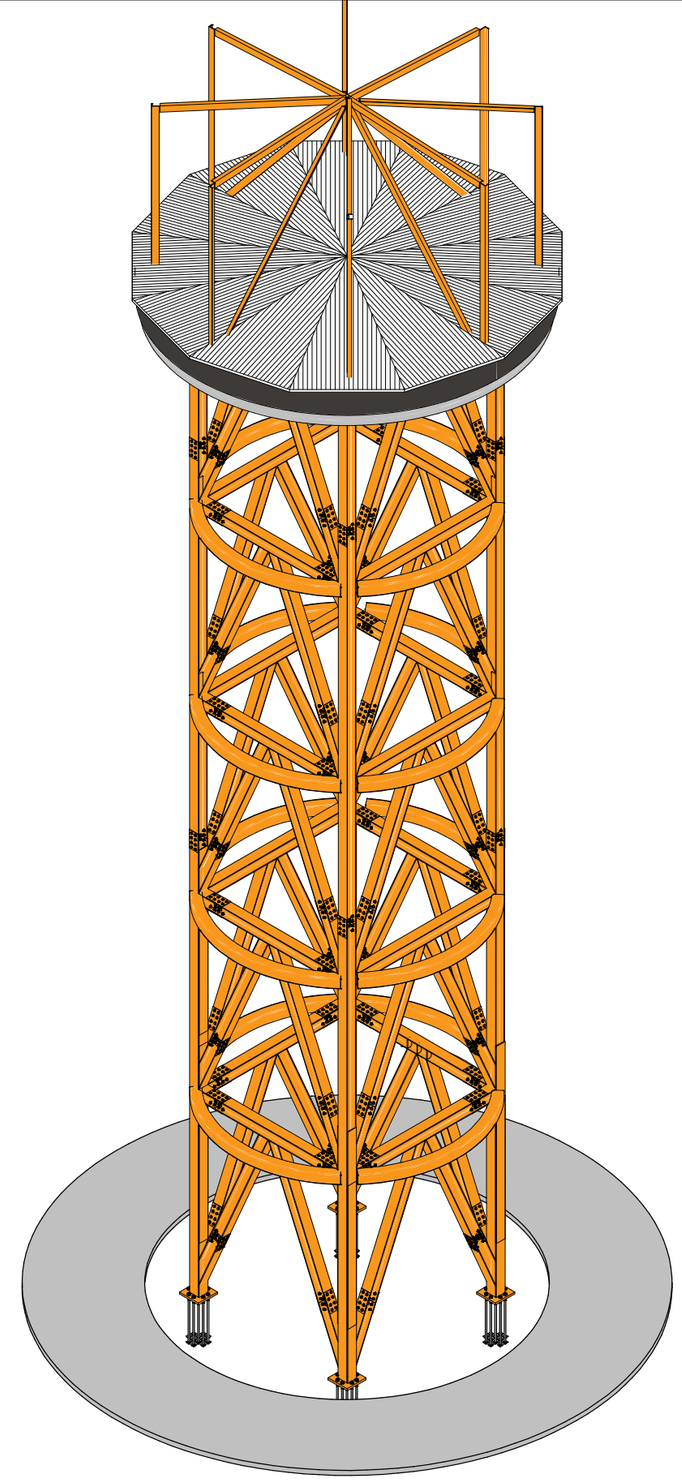






Client: Waipa District Council	Contractor	BCD GROUP	Sheet: STEEL DETAILS	Drawn: LSB	Scale: 1 : 10 at A1
			Project Title: CAMBRIDGE WATER TOWER	Engineer: CT	
			6 VOGEL STREET, CAMBRIDGE	Job No: 23-0438	Sheet No: S-901
					Revision: 1

Rev	Date	by	Reason
1	19-05-2023	LSB	50% DETAILED DESIGN



BIM MODEL NOTES

- BIM models shown are for visual purposes only and do not and cannot constitute a complete Engineering Design and are likely to contain differences from the final engineering design.

Client: Waipa DISTRICT COUNCIL

Contractor:

BCD GROUP

Sheet: **STRUCTURAL 3D VIEW**

Project Title: **CAMBRIDGE WATER TOWER**

6 VOGEL STREET, CAMBRIDGE

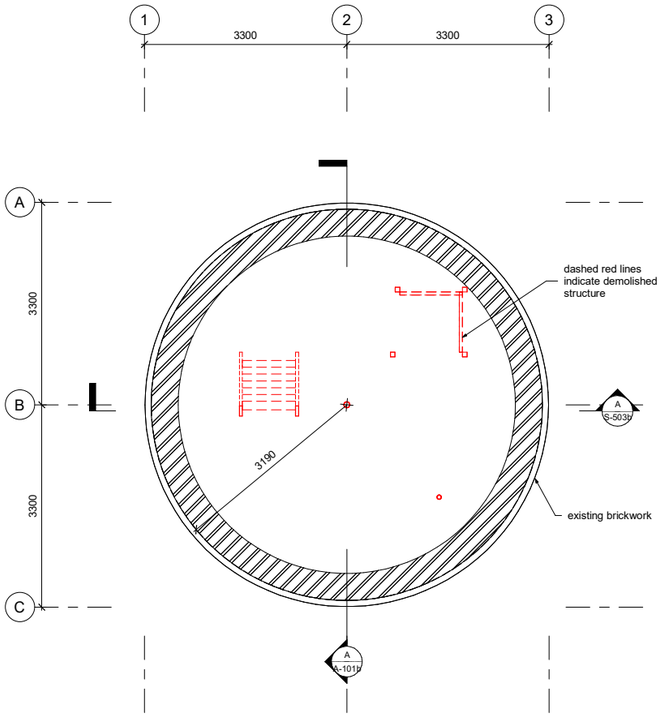
Rev	Date	by	Reason
1	19-05-2023	LSB	50% DETAILED DESIGN

Drawn: LSB | Scale: at A1

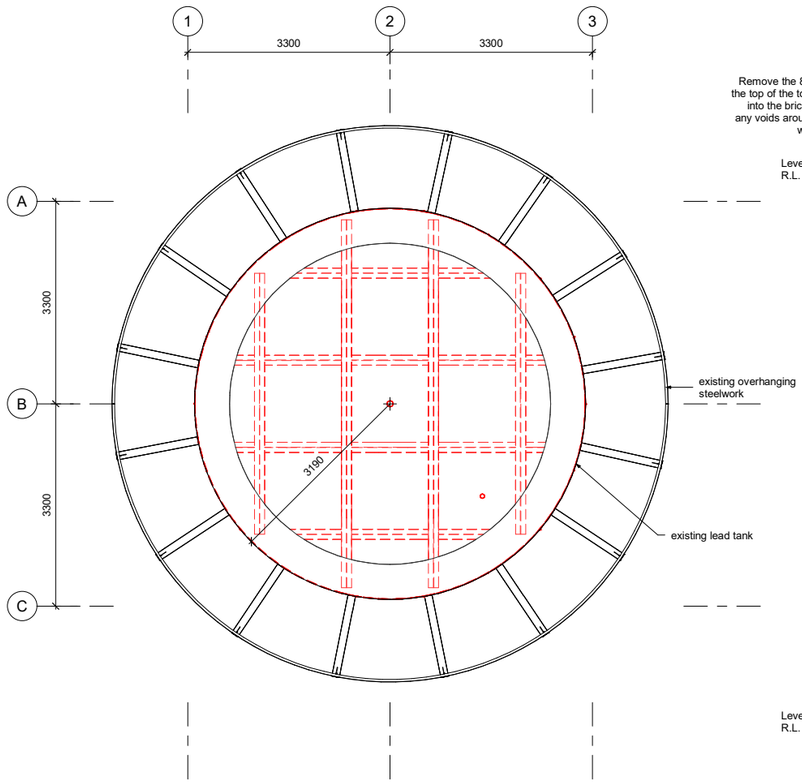
Engineer: CT

Job No:	Sheet No:	Revision
23-0438	S-1000	1

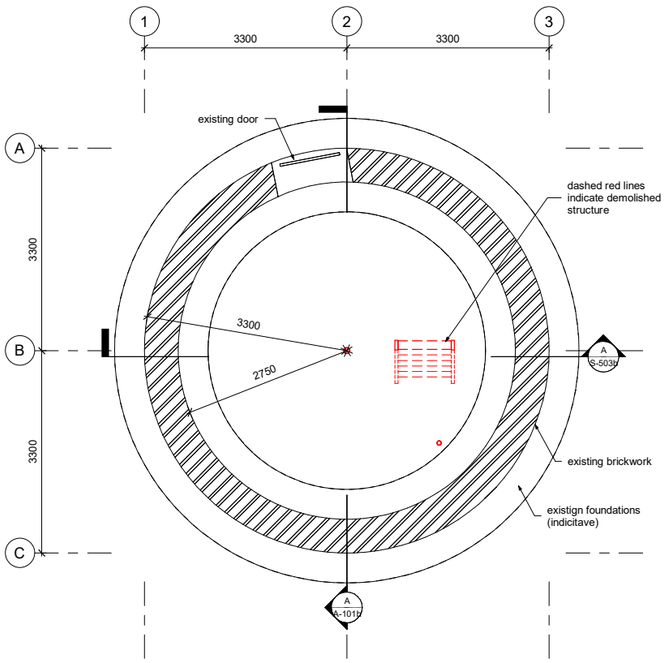
all dimensions to be verified on site before making any shop drawings or commencing any work.



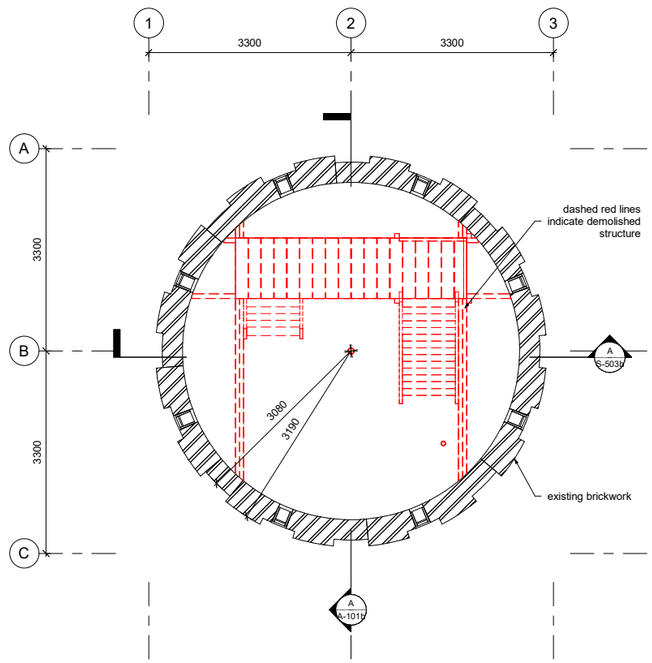
Level 1 Demolition Floor Plan - Alternitive Option 1
1 : 50



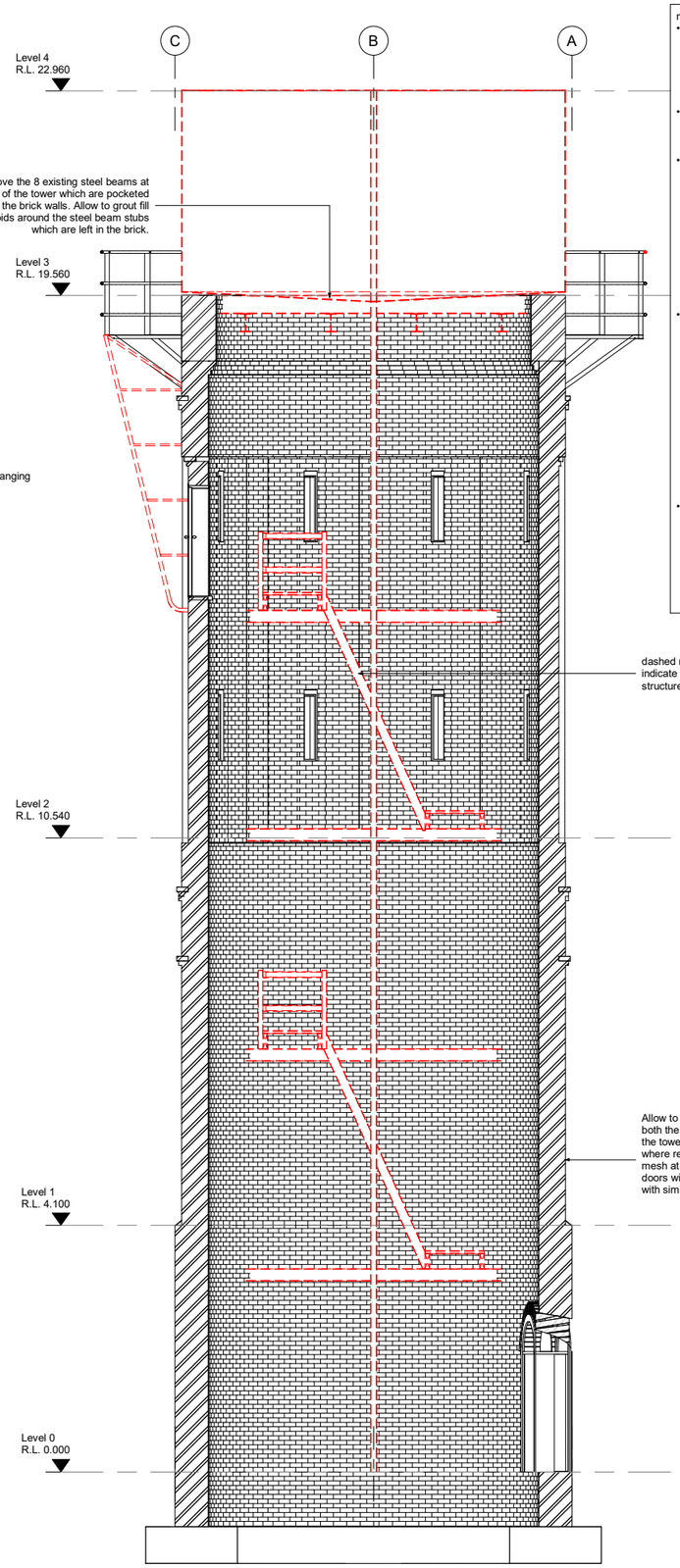
Level 3 Demolition Floor Plan - Alternitive Option 1
1 : 50



Level 0 Demolition Floor Plan - Alternitive Option 1
1 : 50



Level 2 Demolition Floor Plan - Alternitive Option 1
1 : 50



note:
- Allow to wash down and clean both the inside and outside of the tower. Repair bricks/mortal where required. Replace bird mesh at windows. Replace 2 doors with new secure doors with similar heritage look.
- Allow for point cloud survey of the inside of the tower to confirm internal dimensions to inform steelwork shop drawings.
- Allow for installation of temporary scaffold internal to tower – build it level by level from bottom up to allow access to the old walkways and remove the walkways through the bottom. Typically this is 2 steel beams at each level pocketed into the brick walls, supporting timber beams and planks for the platforms and timber/steel ladders, there are 4 levels. Allow to grout fill any voids around the steel beam stubs which are left in the brick.
- Remove the 2 existing steel pipes running up the height of the tower. This will likely require the temporary timber roof to be removed to allow the pipes to be cut at the base and carried out the door with the crane holding on to the top of the pipe, until the pipe is short enough to lift out from the top. Allow for a temporary roof be made up that can be lifted in place each night to help weather proof the construction from now until the permanent concrete roof is installed at the end of the strengthening works.
- Prior to demolition and during construction, allow 4 x steel frames similar to that of the Waikato Regional Theatre with two screw pile foundations each. Where the frames fix into the brick tower, steel ring beams will be required around the tower to encapsulate it, allow for these beams at 2 levels.

A
A-101
Section A-A - Demolition - Alternitive Option 1
1 : 50

original in colour

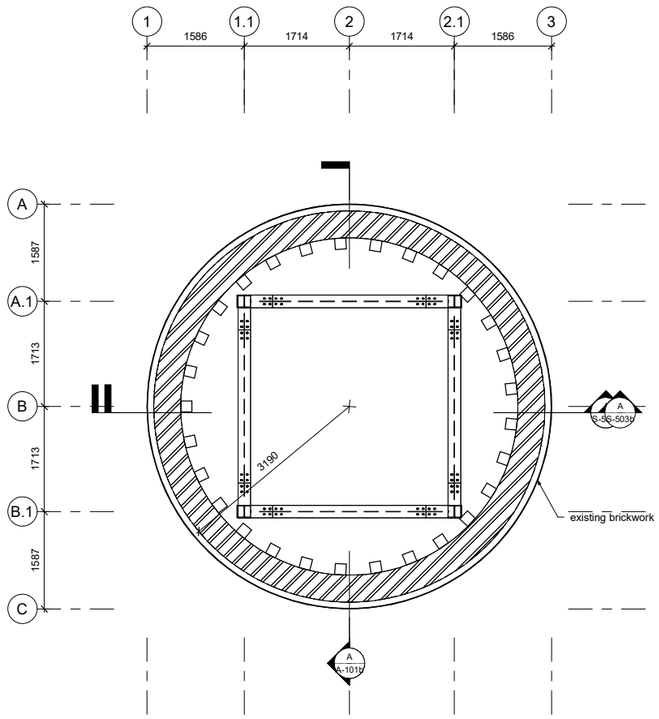
Client: Waipa DISTRICT COUNCIL
Contractor:
BCD GROUP

Sheet
OPTION 2 - DEMOLITION PLANS AND SECTION
Project Title
CAMBRIDGE WATER TOWER
6 VOGEL STREET, CAMBRIDGE

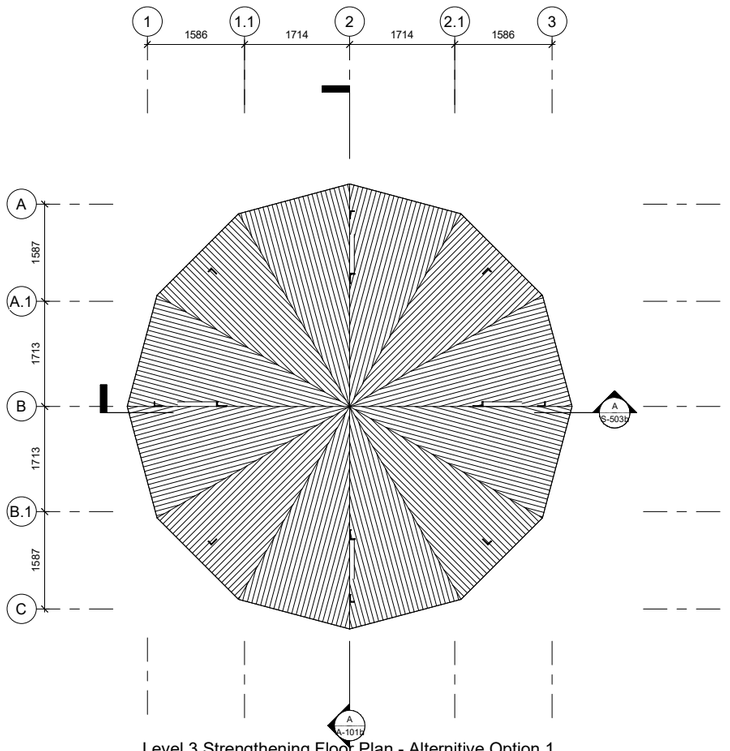
Rev	Date	by	Reason
1	14-08-2023	KT	FOR INFORMATION

Drawn: Author | Scale: 1 : 50 | at A1
Engineer: Designer
Job No: 23-0438 | Sheet No: A-101a | Revision 1

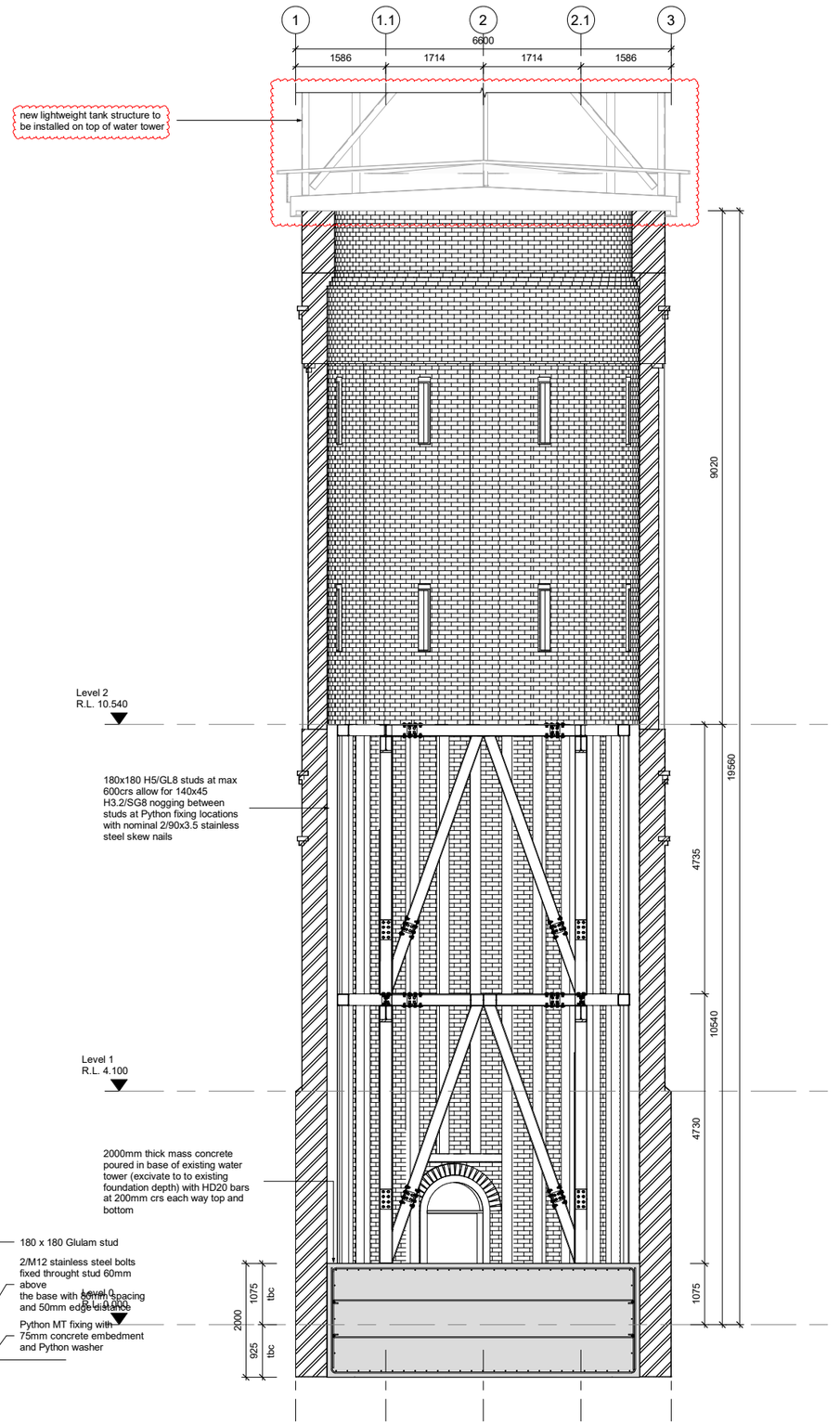
all dimensions to be verified on site before making any shop drawings or commencing any work.



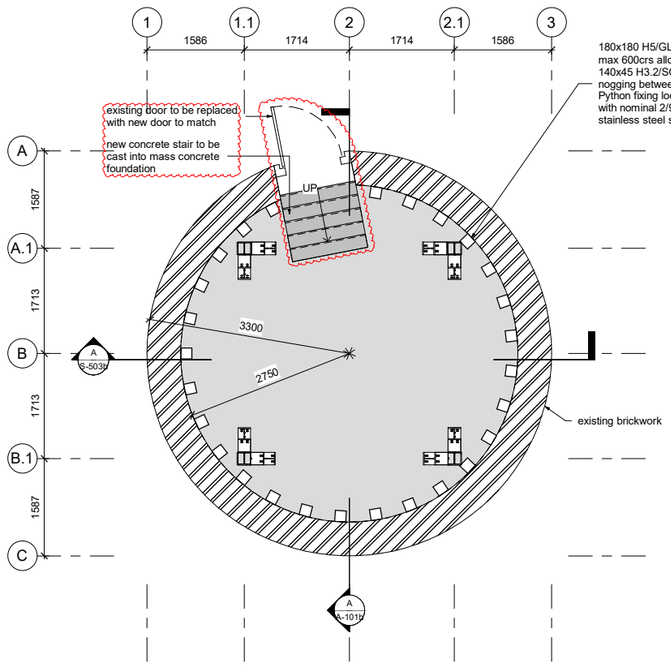
Level 1 Strengthening Floor Plan - Alternitive Option 1
1 : 50



Level 3 Strengthening Floor Plan - Alternitive Option 1
1 : 50

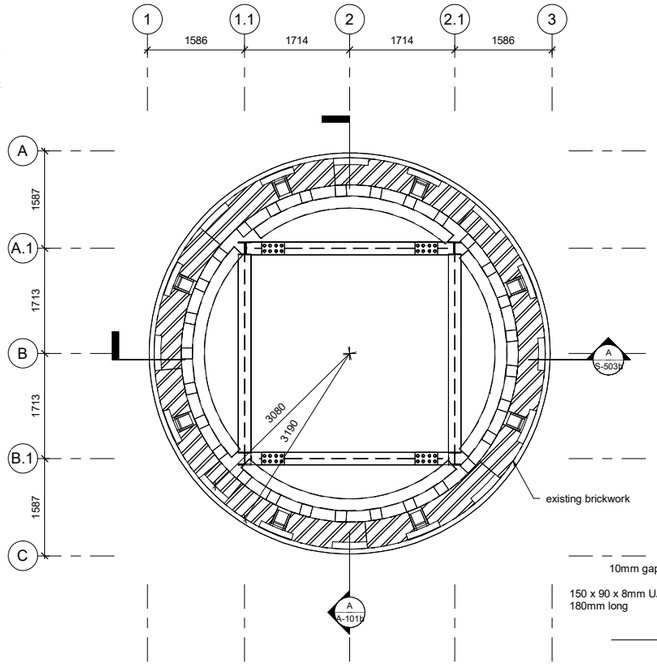


A Section A-A - Strengthening - Stage 3 - Alternitive Option 1
A-101
1 : 50

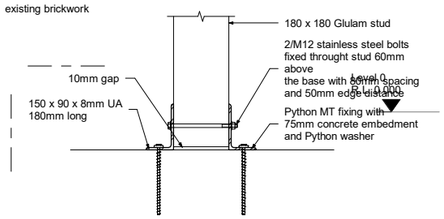


Level 0 Strengthening Floor - Alternitive Option 1
1 : 50

note:
Typically fix centre of timber studs to brick with 8mm by 340mm long MT Python fixings at max 900mm vertical centres, with 90mm timber embedment and with minimum 30mm brick edge distance



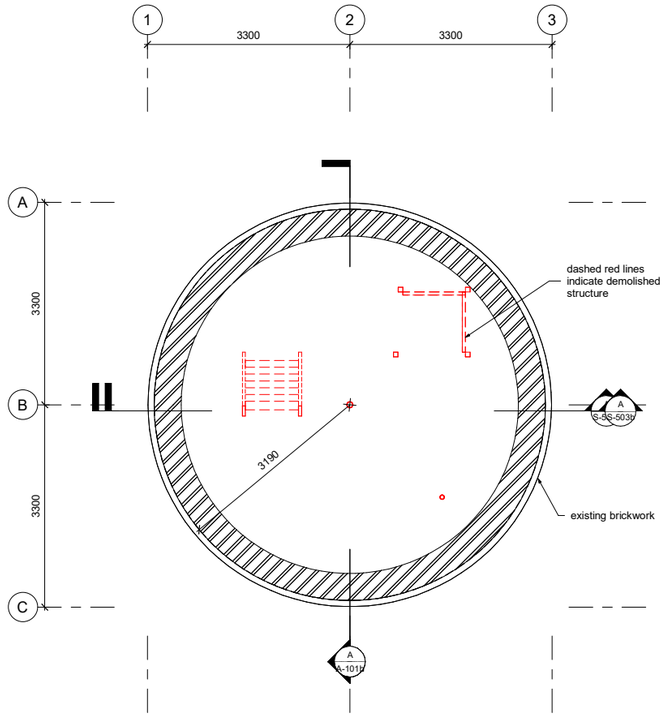
Level 2 Strengthening Floor - Alternitive Option 1
1 : 50



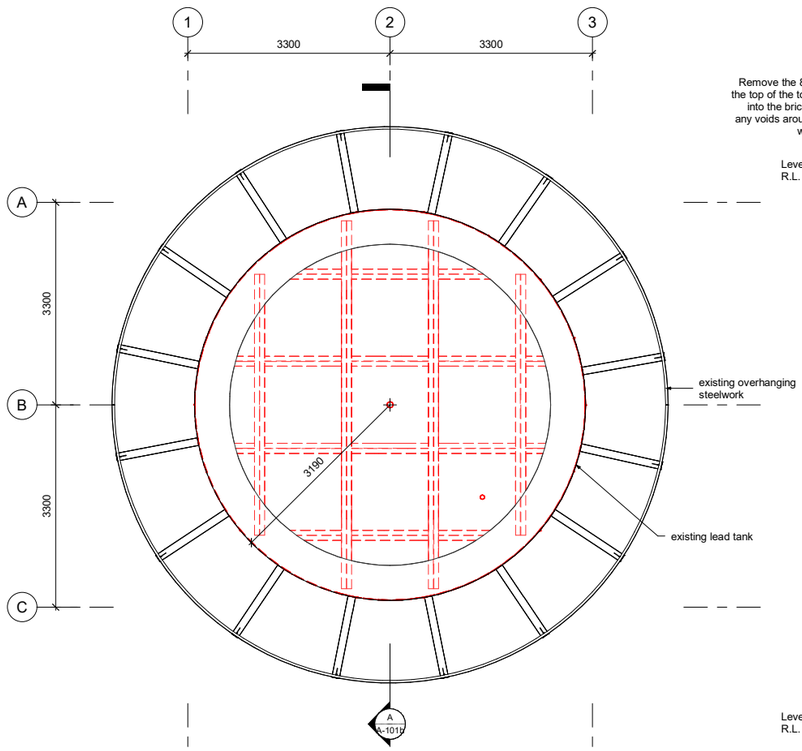
Typical 180 x 180 Gluelam Base Connection - Alternitive Option 1
1 : 10

Client	Contractor	Sheet	Drawn: LSB	Scale: As indicated	at A1
Waipa DISTRICT COUNCIL	BCD GROUP	OPTION 2 - STRENGTHENING PLANS - STAGE 3	Engineer: CT		
		Project Title: CAMBRIDGE WATER TOWER, 6 VOGEL STREET, CAMBRIDGE	Job No: 23-0438	Sheet No: S-503a	Revision 2

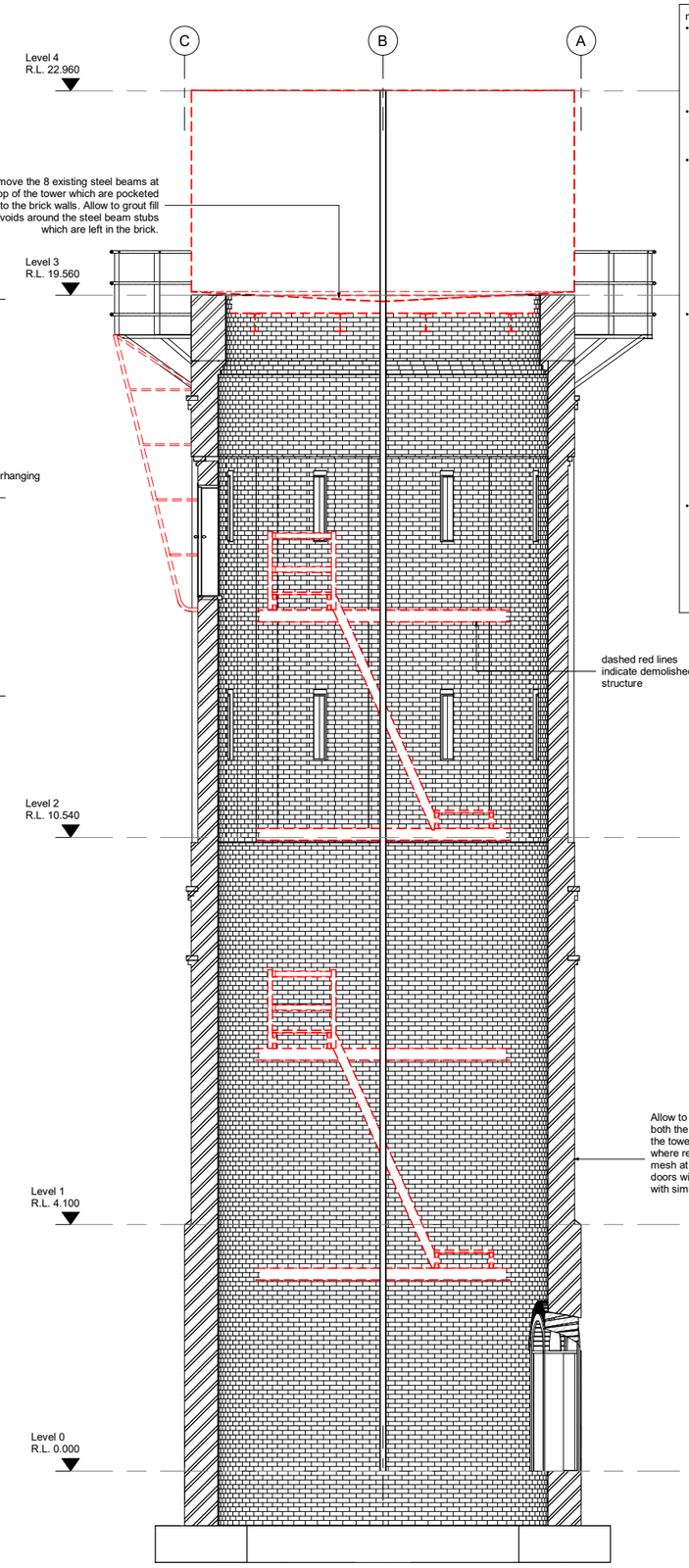
Rev	Date	by	Reason
2	14-08-2023	KT	FOR INFORMATION
1	13-07-2023	KT	ALTERNITIVE STRENGTHENING OPTIONS



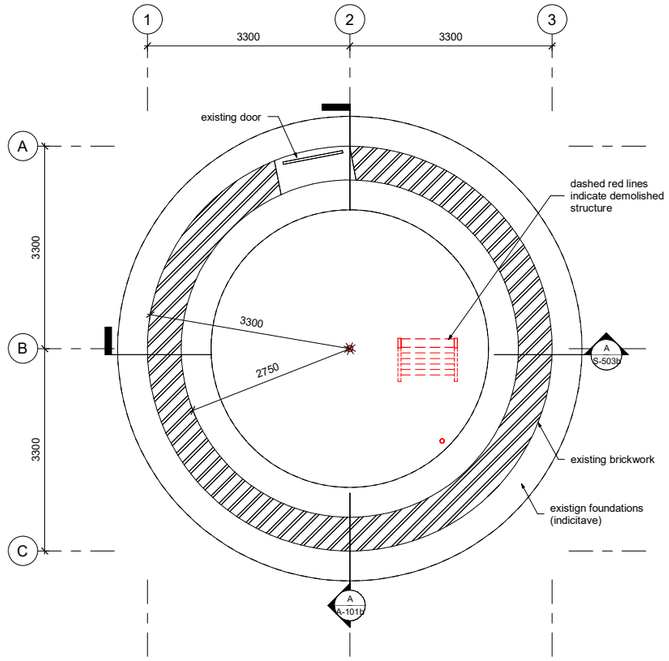
Level 1 Demolition Floor Plan Copy 2
1 : 50



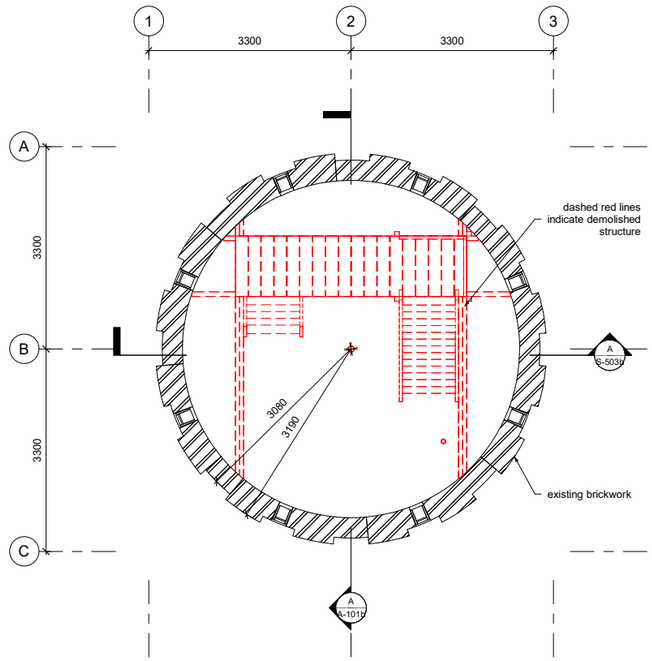
Level 3 Demolition Floor Plan Copy 2
1 : 50



note:
- Allow to wash down and clean both the inside and outside of the tower. Repair bricks/mortal where required. Replace bird mesh at windows. Replace 2 doors with new secure doors with similar heritage look.
- Allow for point cloud survey of the inside of the tower to confirm internal dimensions to inform steelwork shop drawings.
- Allow for installation of temporary scaffold internal to tower – build it level by level from bottom up to allow access to the old walkways and remove the walkways through the bottom. Typically this is 2 steel beams at each level pocketed into the brick walls, supporting timber beams and planks for the platforms and timber/steel ladders, there are 4 levels. Allow to grout fill any voids around the steel beam stubs which are left in the brick.
- Remove the 2 existing steel pipes running up the height of the tower. This will likely require the temporary timber roof to be removed to allow the pipes to be cut at the base and carried out the door with the crane holding on to the top of the pipe, until the pipe is short enough to lift out from the top. Allow for a temporary roof be made up that can be lifted in place each night to help weather proof the construction from now until the permanent concrete roof is installed at the end of the strengthening works.
- Prior to demolition and during construction, allow 4 x steel frames similar to that of the Waikato Regional Theatre with two screw pile foundations each. Where the frames fix into the brick tower, steel ring beams will be required around the tower to encapsulate it, allow for these beams at 2 levels.



Level 0 Demolition Floor Plan Copy 2
1 : 50



Level 2 Demolition Floor Plan Copy 2
1 : 50

A A-101 Section A-A - Demolition Copy 2
1 : 50

original in colour

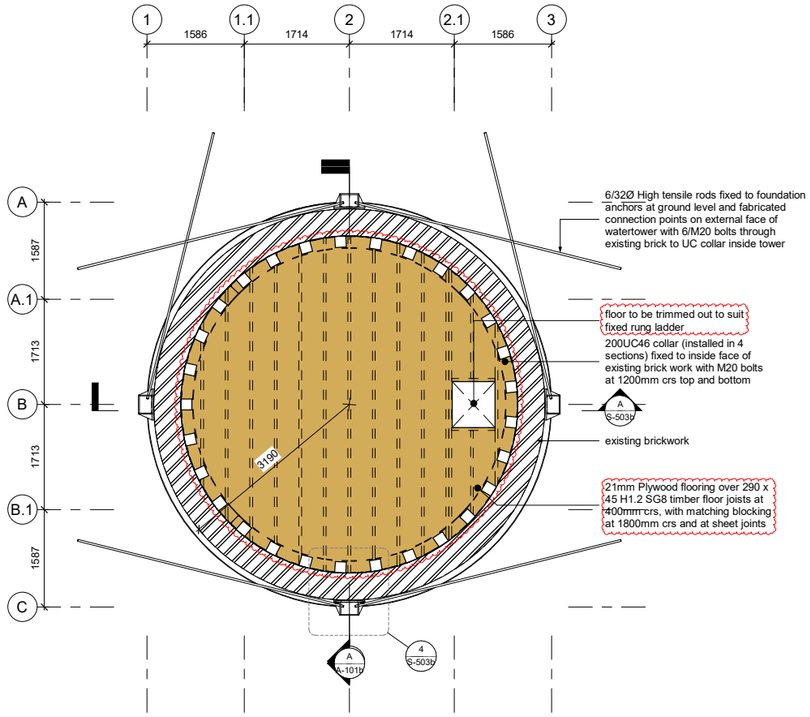
Client: Waipa DISTRICT COUNCIL
Contractor:
BCD GROUP

Sheet: OPTION 3 - DEMOLITION PLANS AND SECTION
Project Title: CAMBRIDGE WATER TOWER
6 VOGEL STREET, CAMBRIDGE

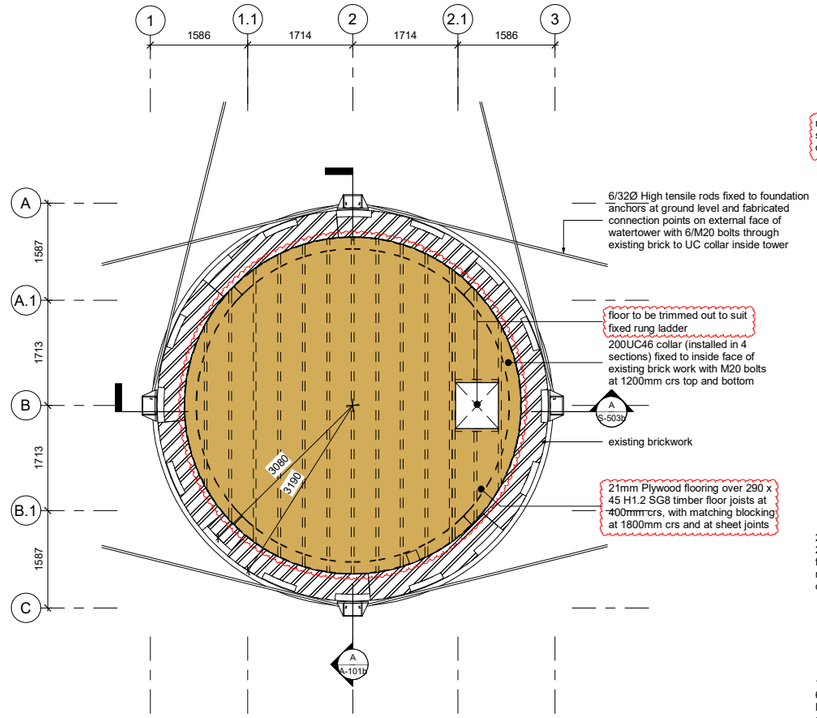
Rev	Date	by	Reason
1	14-08-2023	KT	FOR INFORMATION

Drawn: Author | Scale: 1 : 50 | at A1
Engineer: Designer
Job No: 23-0438 | Sheet No: A-101b | Revision: 1

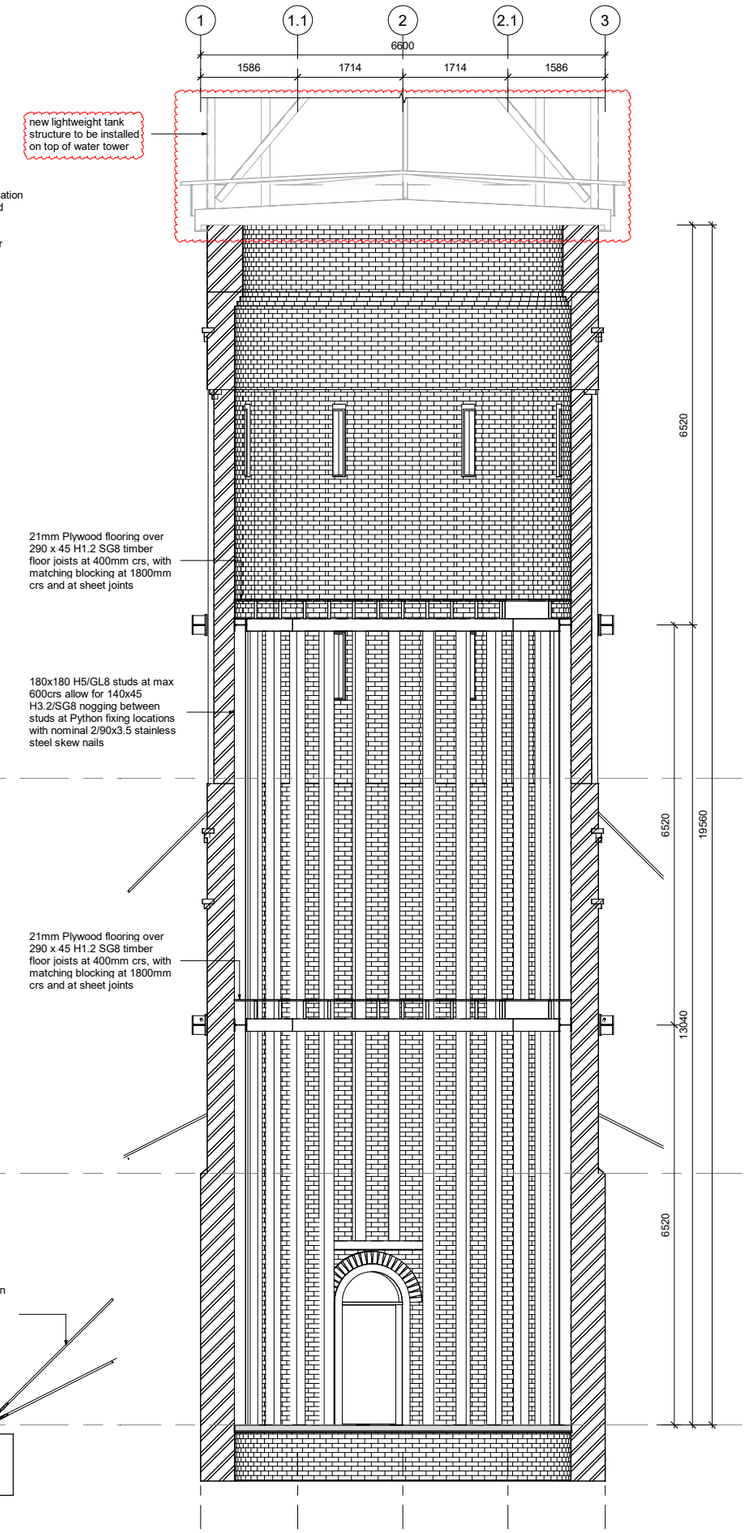
all dimensions to be verified on site before making any shop drawings or commencing any work.



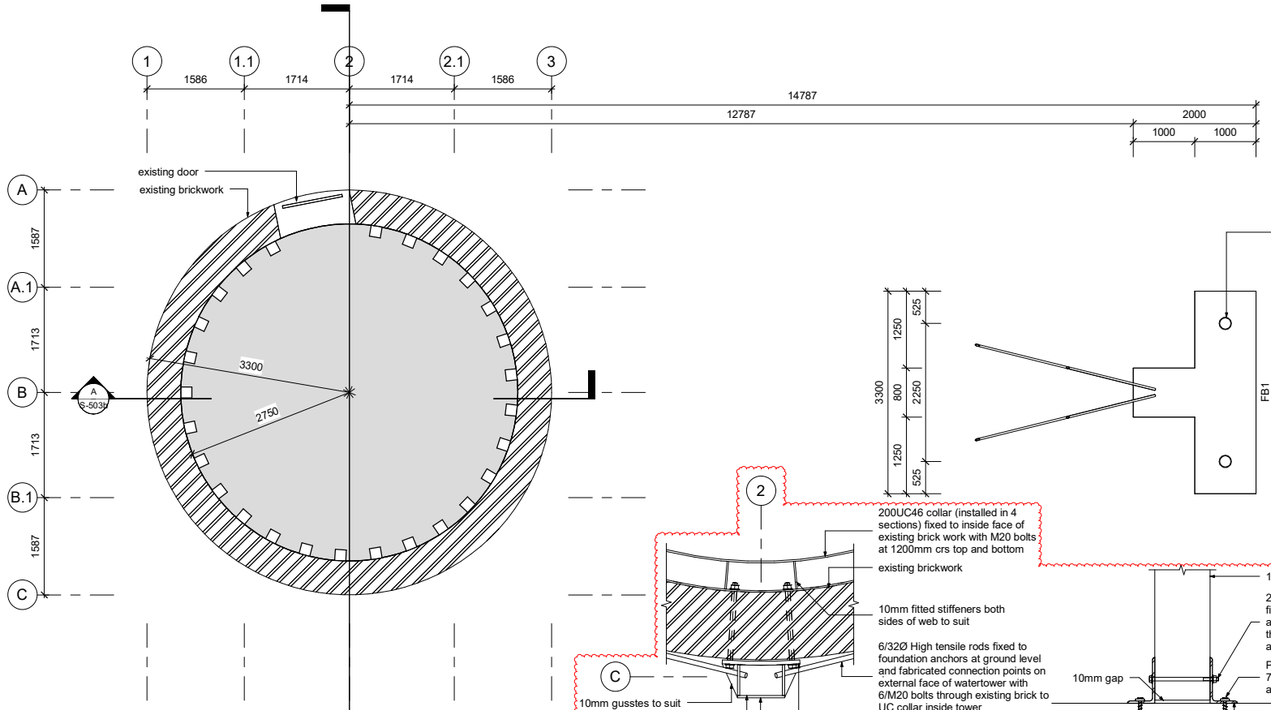
Level 1 Strengthening Floor Plan - Alternitive Option 2
1 : 50



Level 2 Strengthening Floor - Alternitive Option 2
1 : 50



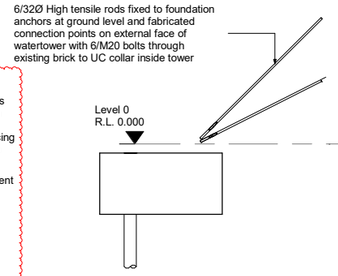
A A-101 Section A-A - Strengthening - Stage 3 - Alternitive Option 2
1 : 50



Level 0 Strengthening Floor - Alternitive Option 2
1 : 50

note:
Typically fix centre of timber studs to brick with 8mm by 340mm long MT Python fixings at max 900mm vertical centres, with 90mm timber embedment and with minimum 30mm brick edge distance

Typical 180 x 180 Gluelam Base Connection.
1 : 10



Client: Waipa District Council

Contractor:

BCD GROUP

Sheet: OPTION 3 - STRENGTHENING PLANS - STAGE 3

Project Title: CAMBRIDGE WATER TOWER

6 VOGEL STREET, CAMBRIDGE

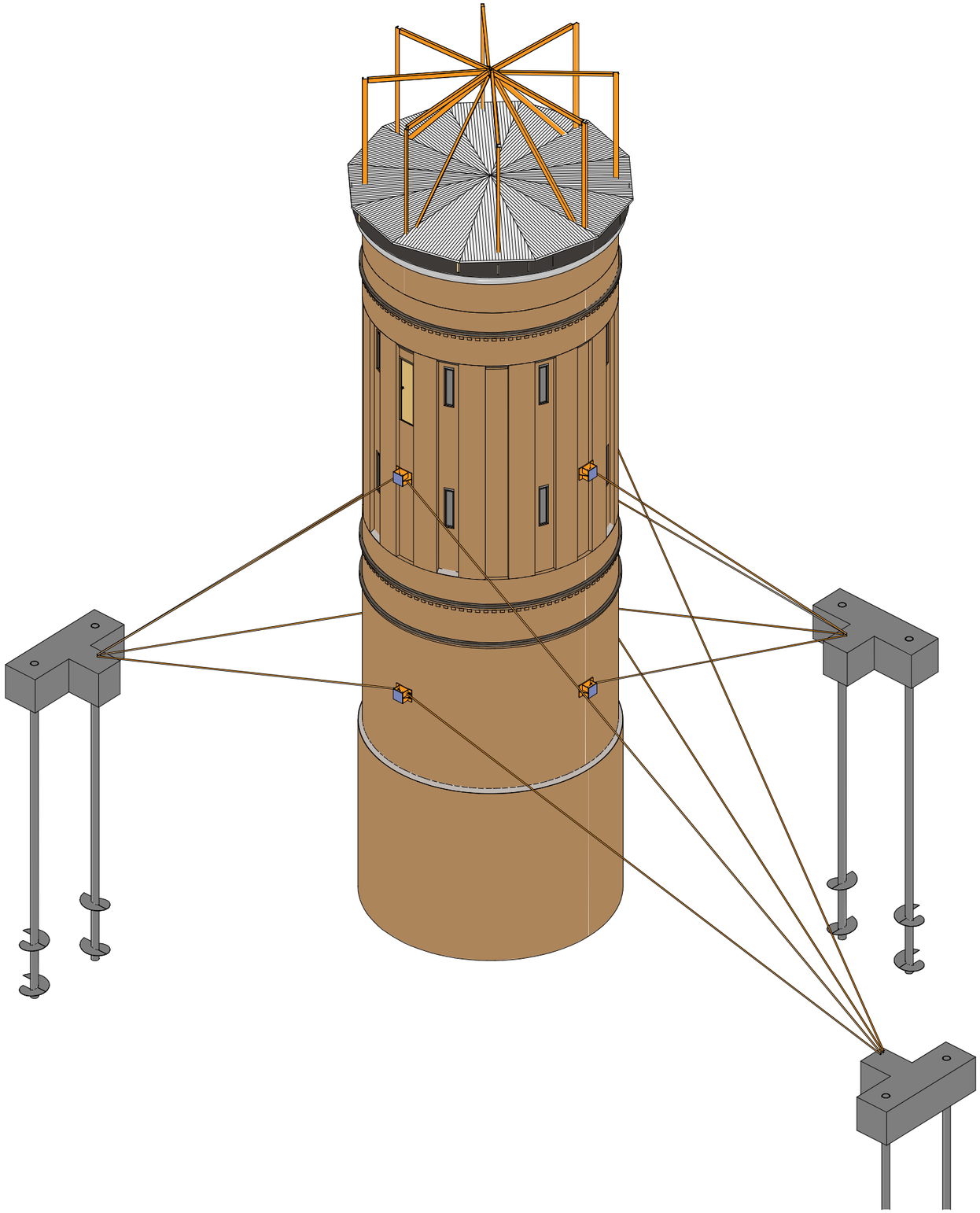
Rev	Date	by	Reason
2	14-08-2023	KT	FOR INFORMATION
1	13-07-2023	KT	ALTERNITIVE STRENGTHENING OPTIONS

Drawn: LSB | Scale: As indicated | at A1
Engineer: CT
Job No: 23-0438 | Sheet No: S-503b | Revision: 2

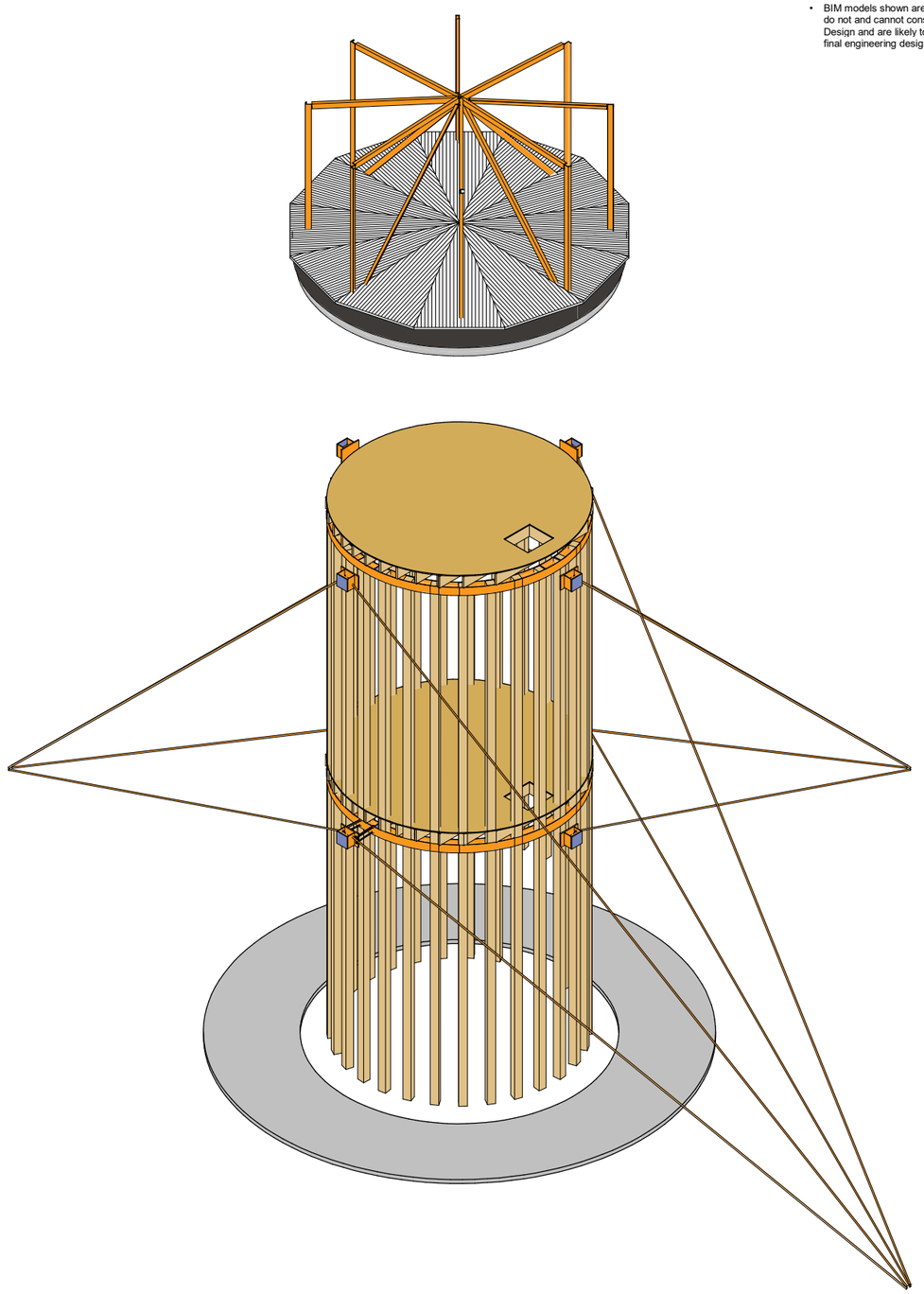
all dimensions to be verified on site before making any shop drawings or commencing any work.

BIM MODEL NOTES

- BIM models shown are for visual purposes only and do not and cannot constitute a complete Engineering Design and are likely to contain differences from the final engineering design.



3D Architectural View - Alternitive Option 2



3D Structural View - Alternitive Option 2

Client: Waipa DISTRICT COUNCIL

Contractor:

BCD GROUP

Sheet: OPTION 2 AND 3 - STRUCTURAL 3D VIEW

Project Title: CAMBRIDGE WATER TOWER

6 VOGEL STREET, CAMBRIDGE

Rev	Date	by	Reason
1	14-08-2023	KT	FOR INFORMATION

Drawn: LSB | Scale: at A1

Engineer: CT

Job No:	Sheet No:	Revision
23-0438	S-1000a	1

APPENDIX C – QUANTITY SURVEYOR REPORTS

Mark
ANZIQS, Reg. QS
phone (021) 841 972
email mark@jewkesboyd.co.nz

Glenn
FNZIQS
phone (0274) 986 010
email glenn@jewkesboyd.co.nz

PO Box 9221 Hamilton 3240
www.jewkesboyd.co.nz

11 August 2023

Waipa District Council
c/- BCD Group
PO Box 9421
HAMILTON

Attention: Samuel Simpson, Hamilton Office Manager

Dear Sam

Cambridge Water Tower
6 Vogel Street, Cambridge
Estimate based on Design Options

Introduction

Jewkes Boyd Cost Management has been engaged by the Waipa District Council / BCD Group to prepare an Estimate of Cost based on Design Options for the above. This has been carried out in conjunction with BCD Group.

Basis of Estimate

- → BCD Group:
  - *Cambridge Water Tower Drawing set, dated 11 August 2023 (Option 1)*
  - *Drawing S-503a, dated 11 August 2023 (Option 2)*
  - *Drawing S-503b, dated 11 August 2023 (Option 3)*
- → Photos of existing
- → Related discussions and correspondence

JewkesBoyd
Cost Management

Estimate Summary

	Option 1 (67% IL2)	*Option 2 (34% IL2)*	*Option 3 (34% IL2)*
Baseline Costs *(Common to all options)*	1,250,000	1,250,000	1,250,000
Option-Specific Costs *(Option 1 – strengthened to 67% IL2 - full scope of foundations and internal structural steel frame, as per previous estimate)* *(Option 2 – strengthened to 34% IL2 - partial scope of foundations and internal structural steel frame)* *(Option 3 – strengthened to 34% IL2 - high tensile rod restraints to exterior of water tower, timber work to interior)*	2,225,000	825,000	850,000
SUBTOTAL	**$ 3,475,000**	**$ 2,075,000**	**$ 2,100,000**
Estimating/Design Contingency *(For unforeseens during balance of Design Phase)* *(Higher percentage reflects nature of project)*	350,000	200,000	425,000
Escalation/Fluctuations/Procurement Contingency* *(PROVISIONAL ALLOWANCE)* *(Design, consenting, holding, procurement phase – assume duration of two years)* *(Construction phase – assume duration of eighteen weeks)*	325,000	200,000	225,000
Professional Fees *(Limited to - Geotech Engineering, Structural Engineering, Quantity Surveying)*	225,000	150,000	225,000
Construction Contingency *(For unforeseens during Construction Phase)* *(Higher percentage reflects nature of project)*	650,000	400,000	450,000
Building Consent fees *(PROVISIONAL ALLOWANCE)*	25,000	25,000	25,000
TOTAL (excluding GST)	**$ 5,050,000**	**$ 3,050,000**	**$ 3,450,000**

*Current Market Volatility

- → There is significant volatility in the market currently due to many factors including:
  - *Opposing forces of ongoing material price increases versus the early stages of a cooling in market demand – the extent to which this affects project costs is currently unclear, and will likely change over time*
  - *The Covid 19 pandemic*
  - *Global issues, such as the Russia/Ukraine situation and the like*
- → The approach we have taken in preparing this estimate is as follows:
  - *Measure the scope of work, then apply rates based on pricing from recent/current experience*
  - *Plus the inclusion of a notional 'Escalation/Fluctuations/Procurement Contingency' in an attempt to allow for the cost impact of current market volatility*
- → The level of accuracy of this Estimate is obviously impacted by the above. While we have applied reasonable endeavours in preparing this Estimate, we are unable to accept any liability should project cost extend beyond Estimate allowances due to Current Market Volatility.

Items subject to wide variance in cost

- → Items for which there may possibly be a wide variance in cost include:
  - *Foundations*
  - *Seismic strengthening*
  - *Main Contractor Preliminary and General project-specific overheads ('P&G') and Profit Margin – refer to comments above regarding Current Market Volatility*

Assumptions

- → Programme (assume roughly common to all options):
  - *Design, consenting, holding, procurement phase – say two years*
  - *Construction phase – say eighteen weeks*
- → Procurement:
  - *Either negotiated or competitively-priced ('tendered') Contract Sum with suitable Main Contractor before entering into Contract, including the necessary due diligence by Client*
  - *Competitive pricing generally*
- → For option 1 - assume existing floor slab of water tower is able to be partially removed to enable construction of new foundations, i.e. assume no requirement for 'tunnelling' under or through existing foundations
- → Lightweight timber/plywood/membrane roof, as opposed to concrete ring beam and precast concrete roof as previously designed by GDC
- → No requirement for roof access hatch and/or 'safety from falling' systems or the like
- → No requirement for any landscaping adjacent to water tower
- → No requirement for performance bond
- → Work carried out within normal business hours
- → Contractor on-site overheads ('Preliminary and General') is the same across options – in reality this will likely differ slightly due to different levels of scaffolding and crane-age, for example

Exclusions

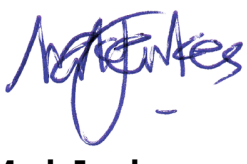
- → Work to inside of water tower as noted below – additional cost could be in the order of $500,000, including associated P&G, margin, contingencies, design fees, consent fees, etc., excluding GST
  - *Internal stairs and landings*
  - *Lighting*
  - *Mechanical ventilation*
  - *Fire protection systems*
- → Legal costs
- → Finance costs
- → Holding costs
- → Unidentified ground conditions (e.g. contaminated soil)
- → Testing and/or removal of toxic materials (e.g. asbestos)
- → Diversion of existing services
- → Temporary ground retainment
- → Dewatering
- → Any work to adjacent Resthaven buildings, such as underpinning, temporary support, etc.
- → Cost to relocate Resthaven residents as may be required during construction
- → Costs related to purchase of part of Resthaven property, to create 'exclusion zone' or the like
- → Any costs related to possible input from Heritage New Zealand
- → Resource Consent Fees, Levies, Development Contributions, or the like
- → Insurances, or the like
- → Historical project-related costs to date
- → Waipa DC internal costs
- → GST

Level of Accuracy

- → The level of accuracy of this Estimate is commensurate with the design stage. We recommend that further cost checking is carried out as design develops.
- → We have endeavoured to reflect the quantum and nature of work within rates allowed. However, actual cost will depend on many factors including scope confirmation, procurement methodology, design development/management, project timeframes, selection of Tenderers, market at time of Tender, etc.
- → *Refer also to 'Current Market Volatility' comments above.*

We trust that this information is of assistance to you. Should you have any queries, however, please do not hesitate to contact the writer.

Yours faithfully



Mark Jewkes
ANZIQS, Reg.QS

PROJECT - CAMBRIDGE WATER TOWER - OPTION 1 (67% IL2)

LOCATION - 6 VOGEL STREET, CAMBRIDGE

CLIENT - WAIPA DISTRICT COUNCIL, C/- BCD GROUP

ESTIMATE BASED ON DESIGN OPTIONS - 11 AUGUST 2023

Ref	*Description*		*$ TOTAL*
	SUMMARY		
1	Baseline Costs *(Common to all options)*		1,250,000
2	Option-Specific Costs - Option 1 *(New foundations underneath water tower, seismic strengthening to inside of water tower, etc.)* *(Refer generally to BCD Group WIP drawings, dated 17 May 2023)*		2,225,000
	Subtotal		*3,475,000*
3	Estimating/Design Contingency *(For unforeseens during balance of Design Phase)*	10.0 %	350,000
	Subtotal		*3,825,000*
4	Escalation/Fluctuations/Procurement Contingency *(PROVISIONAL ALLOWANCE)* *(Design, consenting, holding, procurement phase - assume duration of two years)* *(Construction phase - assume duration of eighteen weeks)*	8.5 %	325,000
	Subtotal		*4,150,000*
5	Professional Fees *(Limited to - Geotech Engineering, Structural Engineering, Quantity Surveying)*	5.5 %	225,000
	Subtotal		*4,375,000*
6	Construction Contingency *(For unforeseens during Construction Phase)* *(Higher percentage reflects nature of project)*	15.0 %	650,000
	Subtotal		*5,025,000*

PROJECT - CAMBRIDGE WATER TOWER - OPTION 1 (67% IL2)

LOCATION - 6 VOGEL STREET, CAMBRIDGE

CLIENT - WAIPA DISTRICT COUNCIL, C/- BCD GROUP

ESTIMATE BASED ON DESIGN OPTIONS - 11 AUGUST 2023

Ref	*Description*	*$ TOTAL*
7	Building Consent Fees, say *(PROVISIONAL ALLOWANCE)*	25,000
8	**TOTAL (excluding GST)**	**5,050,000**

Quantity and Rate columns within Estimate workings rounded. $ TOTAL column within Estimate workings not rounded however.

PROJECT - CAMBRIDGE WATER TOWER - OPTION 1 (67% IL2)

LOCATION - 6 VOGEL STREET, CAMBRIDGE

CLIENT - WAIPA DISTRICT COUNCIL, C/- BCD GROUP

ESTIMATE BASED ON DESIGN OPTIONS - 11 AUGUST 2023

Ref	*Description*	*Quantity*	*Unit*	*Rate*	*$ TOTAL*	*%*
1	**BASELINE COSTS**				**1,250,000**	
1.1	**Baseline Costs**				**808,660**	*64.7*
	Enabling Works:					
1.1.1	Relocate existing Resthaven boundary fencing, gardens, etc., including reinstatement at completion of project, scope as yet undefined but assume relatively minor (PROVISIONAL ALLOWANCE)	1	SUM	10,000	10,000	
1.1.2	Grout injection to surrounding soil prior to foundation excavation, scope as yet undefined (PROVISIONAL ALLOWANCE)	1	SUM	25,000	25,000	
1.1.3	Temporary support to exterior of water tower - say 4 No steel frames similar to the Waikato Regional Theatre, including associated screw piles and possible secondary steel to circumference of tower - assume location of temporary support positioned to avoid new footings	1	SUM	400,000	400,000	
	Demolition:					
1.1.4	Demolish and remove existing water tank, internal pipework, remnants of high-level walkway, ladder, netting at window openings, etc.	1	SUM	25,000	25,000	
1.1.5	Clean existing debris, bird waste, etc.	1	SUM	5,000	5,000	
1.1.6	Demolish and remove existing internal steelwork, timber work, stairs and landings complete, assume embedded steelwork 'gas axed' at wall	1	SUM	25,000	25,000	
1.1.7	NOTE - cranes included in P&G section of Estimate, below					
1.1.8	NOTE - temporary lightweight 'roof' for weather protection included in P&G section of Estimate, below					
	Foundations:					
1.1.9	Refer to Option-Specific Costs section of Estimate					
	Scaffold internal to Water Tower:					
1.1.10	Refer to Option-Specific Costs section of Estimate					
	Steel framing:					
1.1.11	Refer to Option-Specific Costs section of Estimate					
	Timber framing:					
1.1.12	Refer to Option-Specific Costs section of Estimate					
	Python screws:					
1.1.13	Refer to Option-Specific Costs section of Estimate					
	Windows and doors:					
1.1.14	New screens to window openings, for bird-proofing	16	No	500	8,000	

Ref	Description	Quantity	Unit	Rate	$ TOTAL	%
1.1.15	New door	2	No	4,000	8,000	
	Brickwork:					
1.1.16	Carefully clean/wash exterior of water tower, to remove moss, etc.	1	SUM	10,000	10,000	
1.1.17	Make good pointing to brickwork, scope as yet undefined but assume isolated areas (PROVISIONAL ALLOWANCE)	392	m2	125	49,000	
1.1.18	NOTE - assume all work to exterior of water tower can be accessed via elevated working platforms rather than full scaffold					
	Roof:					
1.1.19	Steel roof support framework as noted on GDC drawings (assume new steel is required to replace existing), scope/sizes as yet undefined but say 50kg/m	2,200	kg	27.5	60,500	
1.1.20	Allowance for brackets, cleats, bolts, drypack, etc. (based on say 25% of main member weight above) (PROVISIONAL ALLOWANCE)	550	kg	32.5	17,875	
1.1.21	NOTE - provisional $/kg rate has been included above for steelwork - this is higher than normal given nature of work - rate deemed to include all subcontractor costs including shop drawings, RFI's, document management, etc.					
1.1.22	Hot dipped galvanising to steelwork	2,750	kg	3	8,250	
1.1.23	New lightweight timber/plywood roof complete	1	SUM	20,000	20,000	
1.1.24	New waterproofing to roof - say membrane roofing or similar	39	m2	350	13,650	
1.1.25	NOTE - assume no requirement for concrete ring beam given that lightweight roof					
1.1.26	NOTE - assume no requirement for gutters, downpipes, or the like					
	Aluminium Tank Frame:					
1.1.27	Aluminium tank frame, as alternative to structural steel frame previously designed by GCD, scope as yet undefined (PROVISIONAL ALLOWANCE)	1	SUM	100,000	100,000	
	External works:					
1.1.28	External feature lighting, scope as yet undefined (PROVISIONAL ALLOWANCE)	1	SUM	20,000	20,000	
1.1.29	Signage, assume modest	1	SUM	5,000	5,000	
1.1.30	NOTE - making good to topsoil and grassing included in P&G, below					
1.1.31	NOTE - assume no requirement for landscaping generally					
1.1.32	Rounding	1	SUM	-1,615	-1,615	

ESTIMATE BASED ON DESIGN OPTIONS - 11 AUGUST 2023

Ref	*Description*	*Quantity*	*Unit*	*Rate*	*$ TOTAL*	*%*
1.2	**Contractor's On-Site Overheads ('Preliminary and General), where common to all options**				**278,300**	*22.3*
	Site establishment:					
1.2.1	Initial Main Contractor sundry costs related to project setup and site establishment, including dilapidation report, setting up Aconex or similar, etc.	1	SUM	5,000	5,000	
	Temporary access:					
1.2.2	NOTE - assume access to site comes off road through Resthaven village					
1.2.3	Form temporary access road, including site preparation prior to commencement and making good to topsoil and grassing at completion, assume 165m long x 4m wide (which could include area for setting-down steel or the like)	660	m2	80	52,800	
1.2.4	Extra value, for forming temporary street crossing including reinstating existing at project completion	1	SUM	10,000	10,000	
1.2.5	Extra value, for temporary relocation of cycle way, including reinstating existing at project completion	1	SUM	25,000	25,000	
1.2.6	NOTE - assume no requirement for traffic management					
	Temporary accommodation and facilities:					
1.2.7	Site shed, portaloos, etc. - allowance includes transport, establishment at commencement, rental while in use, strike and removal at completion, maintenance during construction	18	weeks	750	13,500	
	Temporary services:					
1.2.8	Temporary services, etc. - potable water tanks, temporary power supply, assume no wastewater drainage required given portaloos used	1	SUM	10,000	10,000	
1.2.9	Power, water, temporary fire protection, etc.	18	weeks	100	1,800	
1.2.10	Phones, data cards, etc.	18	weeks	100	1,800	
	Temporary hoarding, fencing, etc.:					
1.2.11	Hoarding, fencing, gates - supply, erect and dismantle - say yard 100m long x 25m wide	250	m	10	2,500	
1.2.12	Hoarding, fencing - ongoing hire	18	weeks	500	9,000	
	Supervision:					
1.2.13	Project Manager - say 10% of time	18	weeks	500	9,000	
1.2.14	Site Manager / Foreman - say 100% of time	18	weeks	3,000	54,000	
1.2.15	QS - say 25% of time	18	weeks	850	15,300	
1.2.16	Health and Safety Manager - say 5% of time	18	weeks	150	2,700	
1.2.17	NOTE - assume no requirement for BIM manager or the like					

ESTIMATE BASED ON DESIGN OPTIONS - 11 AUGUST 2023

Ref	*Description*	*Quantity*	*Unit*	*Rate*	*$ TOTAL*	*%*
	Surveying:					
1.2.18	Initial survey and site setout, including 3D scanning of internals to assist with fine tolerances	1	SUM	10,000	10,000	
1.2.19	Monitoring during construction	18	weeks	500	9,000	
	Cranes and access:					
1.2.20	Refer to Option-Specific Costs section of Estimate					
	Scaffold and fall protection:					
1.2.21	Refer to Option-Specific Costs section of Estimate					
	Temporary protection while working in enclosed space:					
1.2.22	Refer to Option-Specific Costs section of Estimate					
	Temporary weather protection:					
1.2.23	Refer to Option-Specific Costs section of Estimate					
	Travel and accommodation:					
1.2.24	Vehicles	18	weeks	250	4,500	
1.2.25	Accommodation - assume nil	18	weeks		0	
	Rubbish and cleaning:					
1.2.26	Rubbish removal (assume scrap value of existing steel off-sets disposal costs)	18	weeks	250	4,500	
1.2.27	Final site clean and making good	1	SUM	10,000	10,000	
	Sundry:					
1.2.28	Signage	1	SUM	2,500	2,500	
1.2.29	Health and safety - equipment, consumables, etc.	1	SUM	5,000	5,000	
1.2.30	Security, assume static camera, plus periodic security visits rather than constant security presence	18	weeks	250	4,500	
1.2.31	Plant and small tools	18	weeks	50	900	
	Completion:					
1.2.32	Site demobilisation	1	SUM	5,000	5,000	
1.2.33	Project close-out, warranties, management of defects, handover, etc.	1	SUM	10,000	10,000	
1.2.34	Rounding	1	SUM	0	0	
1.3	**Contractor's Off-Site Overheads and Profit Margin**	15.0	%		**163,040**	*13.0*
1.4	**Baseline Costs**				**1,250,000**	***100.0***

ESTIMATE BASED ON DESIGN OPTIONS - 11 AUGUST 2023

Ref	*Description*	*Quantity*	*Unit*	*Rate*	*$ TOTAL*	*%*
2	**OPTION-SPECIFIC COSTS - OPTION 1**				**2,225,000**	
2.1	**Option-Specific Costs - Option 1**				**1,640,790**	*73.7*
	Enabling Works:					
2.1.1	Refer to Baseline Costs section of Estimate					
	Demolition:					
2.1.2	Refer to Baseline Costs section of Estimate					
	Foundations:					
2.1.3	NOTE - construction methodology TBC but assume possible to remove parts of existing floor slab to construct new foundations, rather than tunneling' under or through existing foundations					
2.1.4	Demolition and excavation for new foundations, assume all work carried out carefully/by hand, including 1/ sawcutting and demolition of existing slab, 2/ 'breaking through' existing footings in 4 No locations, 3/ disposal of spoil (PROVISIONAL ALLOWANCE)	1	SUM	50,000	50,000	
2.1.5	NOTE - assume that no requirement for underpinning of existing water tower foundations given that surrounding soils are stabilised through grout injection					
2.1.6	Site concrete to base of excavations	50	m2	100	5,000	
2.1.7	Screw piles, including formation of pad to support piling rig	8	No	12,500	100,000	
2.1.8	Extra value, for overbore 4.5m deep to each pile, to 600mm diameter	8	No	4,000	32,000	
2.1.9	Extra value, for piling subcontractor design, test piles, etc.	1	SUM	25,000	25,000	
2.1.10	New 1000x1000mm concrete beams under existing water tower, including all associated formwork (excepting under building, where 'poured to country'), DPC, reinforcing steel (assume formed into cages and 'slid' under water tower), concrete, etc.	30	m	7,800	234,000	
2.1.11	Make good to existing floor slab where removed for new footings, plus new 125mm thick slab to base of existing water tower, including all associated formwork (to form pockets for steel baseplates), DPC, reinforcing steel, concrete, etc.	24	m2	400	9,600	
2.1.12	New 2m wide concrete 'skirt' to exterior of water tower at ground level, say 150mm thick slab, including all associated formwork, DPC, reinforcing steel, concrete, etc.	57	m2	300	17,100	
2.1.13	Backfill with imported materials as required, around foundations where outside of building line	1	SUM	5,000	5,000	
	Scaffold internal to Water Tower:					
2.1.14	NOTE - scaffold included in P&G section of Estimate, below					

ESTIMATE BASED ON DESIGN OPTIONS - 11 AUGUST 2023

Ref	Description	Quantity	Unit	Rate	$ TOTAL	%
	Steel framing:					
2.1.15	Columns - 200UC46	2,208	kg	27.5	60,720	
2.1.16	Columns - 200UC60, with 200x16 plate each side to create box section	3,206	kg	27.5	88,165	
2.1.17	Beams - 200UC46	8,418	kg	27.5	231,495	
2.1.18	Beams - 200UC60	3,720	kg	27.5	102,300	
2.1.19	Beams - 200x6 SHS, curved	2,848	kg	37.5	106,800	
2.1.20	Allowance for brackets, cleats, bolts, drypack, etc. (based on say 25% of main member weight above) (PROVISIONAL ALLOWANCE)	5,100	kg	32.5	165,750	
2.1.21	NOTE - provisional $/kg rate has been included above for steelwork - this is higher than normal given nature of work, including stop/start to suit 4m high lifts and working-in with timber framing installation - rate deemed to include all subcontractor costs including shop drawings, RFI's, document management, etc.					
2.1.22	Hot dipped galvanising to steelwork	25,500	kg	3	76,500	
	Timber framing:					
2.1.23	Studs, generally 180x180mm H5/GL8	568	m	300	170,400	
2.1.24	Extra value, for connection between studs and concrete slab, each including: 2 No 150x90x8UA brackets, 180mm long 2 No M12 stainless steel bolts fixing bracket to stud 4 No Python MT fixings with Python washer, fixing bracket to concrete slab	29	No	750	21,750	
2.1.25	Extra value, for timber packing to studs where brick steps in at top of tower	116	m	150	17,400	
2.1.26	Extra value, for offsetting studs where required to avoid clash with windows	1	SUM	5,000	5,000	
2.1.27	Extra value, for drilling through studs and timber packing for Python fixings	696	No	10	6,960	
2.1.28	Nogs, generally 140x45mm H3.2/SG8	385	m	150	57,750	
2.1.29	Lintels above windows and doors	1	SUM	5,000	5,000	
	Python screws:					
2.1.30	MT Python fixings, 340mm long	696	No	75	52,200	
	Windows and doors:					
2.1.31	Refer to Baseline Costs section of Estimate					
	Brickwork:					
2.1.32	Refer to Baseline Costs section of Estimate					
	Roof:					
2.1.33	Refer to Baseline Costs section of Estimate					

ESTIMATE BASED ON DESIGN OPTIONS - 11 AUGUST 2023

Ref	*Description*	*Quantity*	*Unit*	*Rate*	*$ TOTAL*	*%*
	Steel Tank Frame:					
2.1.34	Refer to Baseline Costs section of Estimate					
	External works:					
2.1.35	Refer to Baseline Costs section of Estimate					
2.1.36	Rounding	1	SUM	-5,100	-5,100	
2.2	**Contractor's On-Site Overheads ('Preliminary and General) - where option-specific**				**294,000**	*13.2*
	Cranes and access:					
2.2.1	Cranes, EWP's, etc.	1	SUM	100,000	100,000	
	Scaffold and fall protection:					
2.2.2	Scaffold, fall protection, etc. - assume only required to inside of water tower	1	SUM	150,000	150,000	
	Temporary protection while working in enclosed space:					
2.2.3	Temporary protection while work being carried out within water tower - scope as yet undefined, but may include 1/ shielding to protect from falling objects, 2/ mechanical ventilation to provide adequate fresh air (PROVISIONAL ALLOWANCE)	1	SUM	25,000	25,000	
	Temporary weather protection:					
2.2.4	Construction of temporary lightweight 'roof' to provide protection from weather when access not required	1	SUM	10,000	10,000	
2.2.5	Extra value, for removal and replacement of temporary roof as required to provide access, on a regular basis	18	weeks	500	9,000	
2.2.6	Rounding	1	SUM	0	0	
2.2.7	NOTE - all other items deemed included in P&G where common to all options, refer to Baseline Costs section of Estimate above					
2.3	**Contractor's Off-Site Overheads and Profit Margin**	15.0	%		**290,210**	*13.0*
2.4	**OPTION-SPECIFIC COSTS - OPTION 1**				**2,225,000**	***100.0***

PROJECT - CAMBRIDGE WATER TOWER - OPTION 2 (34% IL2)

LOCATION - 6 VOGEL STREET, CAMBRIDGE

CLIENT - WAIPA DISTRICT COUNCIL, C/- BCD GROUP

ESTIMATE BASED ON DESIGN OPTIONS - 11 AUGUST 2023

Ref	Description		$ TOTAL
	SUMMARY		
1	Baseline Costs *(Common to all options)* *(Refer to Option 1 for workings)*		1,250,000
2	Option-Specific Costs - Option 2 *(New mass concrete foundation within water tower, partial seismic strengthening to inside of water tower, etc.)* *(Refer BCD Group drawing S-503a, dated 13 July 2023)*		825,000
	Subtotal		*2,075,000*
3	Estimating/Design Contingency *(For unforeseens during balance of Design Phase)*	10.0 %	200,000
	Subtotal		*2,275,000*
4	Escalation/Fluctuations/Procurement Contingency *(PROVISIONAL ALLOWANCE)* *(Design, consenting, holding, procurement phase - assume duration of two years)* *(Construction phase - assume duration of eighteen weeks)*	8.5 %	200,000
	Subtotal		*2,475,000*
5	Professional Fees *(Limited to - Geotech Engineering, Structural Engineering, Quantity Surveying)*	6.0 %	150,000
	Subtotal		*2,625,000*
6	Construction Contingency *(For unforeseens during Construction Phase)* *(Higher percentage reflects nature of project)*	15.0 %	400,000

PROJECT - CAMBRIDGE WATER TOWER - OPTION 2 (34% IL2)

LOCATION - 6 VOGEL STREET, CAMBRIDGE

CLIENT - WAIPA DISTRICT COUNCIL, C/- BCD GROUP

ESTIMATE BASED ON DESIGN OPTIONS - 11 AUGUST 2023

Ref	*Description*	*$ TOTAL*
	Subtotal	*3,025,000*
7	Building Consent Fees, say *(PROVISIONAL ALLOWANCE)*	25,000
8	**TOTAL (excluding GST)**	**3,050,000**

Quantity and Rate columns within Estimate workings rounded. $ TOTAL column within Estimate workings not rounded however.

ESTIMATE BASED ON DESIGN OPTIONS - 11 AUGUST 2023

Ref	*Description*	*Quantity*	*Unit*	*Rate*	*$ TOTAL*	*%*
2	**OPTION-SPECIFIC COSTS - OPTION 2**				**825,000**	
2.1	**Option-Specific Costs - Option 2**				**548,400**	*66.5*
	Enabling Works:					
2.1.1	Refer to Baseline Costs section of Estimate					
	Demolition:					
2.1.2	Refer to Baseline Costs section of Estimate					
	Foundations:					
2.1.3	Demolition and excavation down to level of existing foundations, assume all work carried out carefully/by hand, including 1/ sawcutting and demolition of existing slab, 2/ disposal of spoil (PROVISIONAL ALLOWANCE)	1	SUM	12,500	12,500	
2.1.4	NOTE - assume that no requirement for underpinning of existing water tower foundations given that surrounding soils are stabilised through grout injection					
2.1.5	2000mm thick mass concrete footing, including D20 reinforcing steel	1	SUM	75,000	75,000	
	Scaffold internal to Water Tower:					
2.1.6	NOTE - scaffold included in P&G section of Estimate, below					
	Steel framing:					
2.1.7	Columns and beams - assume, say, 40% of total weight of Option 1	10,200	kg	27.5	280,500	
2.1.8	NOTE - provisional $/kg rate has been included above for steelwork - this is higher than normal given nature of work, including stop/start to suit 4m high lifts and working-in with timber framing installation - rate deemed to include all subcontractor costs including shop drawings, RFI's, document management, etc.					
2.1.9	Hot dipped galvanising to steelwork	10,200	kg	3	30,600	
	Timber framing:					
2.1.10	Studs, generally 180x180mm H5/GL8	232	m	300	69,600	
2.1.11	Extra value, for connection between studs and concrete slab, each including:	29	No	750	21,750	
	2 No 150x90x8UA brackets, 180mm long					
	2 No M12 stainless steel bolts fixing bracket to stud					
	4 No Python MT fixings with Python washer, fixing bracket to concrete slab					
2.1.12	Extra value, for offsetting studs where required to avoid clash with windows	1	SUM	2,500	2,500	
2.1.13	Extra value, for drilling through studs and timber packing for Python fixings	290	No	10	2,900	

Ref	*Description*	*Quantity*	*Unit*	*Rate*	*$ TOTAL*	*%*
2.1.14	Nogs, generally 140x45mm H3.2/SG8	160	m	150	24,000	
2.1.15	Lintels above windows and doors	1	SUM	2,500	2,500	
	Python screws:					
2.1.16	MT Python fixings, 340mm long	290	No	75	21,750	
	Windows and doors:					
2.1.17	Refer to Baseline Costs section of Estimate					
	Brickwork:					
2.1.18	Refer to Baseline Costs section of Estimate					
	Roof:					
2.1.19	Refer to Baseline Costs section of Estimate					
	Steel Tank Frame:					
2.1.20	Refer to Baseline Costs section of Estimate					
	External works:					
2.1.21	Refer to Baseline Costs section of Estimate					
2.1.22	Rounding	1	SUM	4,800	4,800	
2.2	**Contractor's On-Site Overheads ('Preliminary and General) - where option-specific**				**169,000**	*20.5*
	Cranes and access:					
2.2.1	Cranes, EWP's, etc.	1	SUM	50,000	50,000	
	Scaffold and fall protection:					
2.2.2	Scaffold, fall protection, etc. - assume only required to inside of water tower	1	SUM	75,000	75,000	
	Temporary protection while working in enclosed space:					
2.2.3	Temporary protection while work being carried out within water tower - scope as yet undefined, but may include 1/ shielding to protect from falling objects, 2/ mechanical ventilation to provide adequate fresh air (PROVISIONAL ALLOWANCE)	1	SUM	25,000	25,000	
	Temporary weather protection:					
2.2.4	Construction of temporary lightweight 'roof' to provide protection from weather when access not required	1	SUM	10,000	10,000	
2.2.5	Extra value, for removal and replacement of temporary roof as required to provide access, on a regular basis	18	weeks	500	9,000	
2.2.6	Rounding	1	SUM	0	0	
2.2.7	NOTE - all other items deemed included in P&G where common to all options, refer to Baseline Costs section of Estimate above					

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LOCATION - 6 VOGEL STREET, CAMBRIDGE

CLIENT - WAIPA DISTRICT COUNCIL, C/- BCD GROUP

ESTIMATE BASED ON DESIGN OPTIONS - 11 AUGUST 2023

Ref	*Description*	*Quantity*	*Unit*	*Rate*	*$ TOTAL*	*%*
2.3	**Contractor's Off-Site Overheads and Profit Margin**	15.0 %			**107,600**	*13.0*
2.4	**OPTION-SPECIFIC COSTS - OPTION 2**				**825,000**	***100.0***

PROJECT - CAMBRIDGE WATER TOWER - OPTION 3 (34% IL2)

LOCATION - 6 VOGEL STREET, CAMBRIDGE

CLIENT - WAIPA DISTRICT COUNCIL, C/- BCD GROUP

ESTIMATE BASED ON DESIGN OPTIONS - 11 AUGUST 2023

Ref	*Description*		*$ TOTAL*
	SUMMARY		
1	Baseline Costs *(Common to all options)* *(Refer to Option 1 for workings)*		1,250,000
2	Option-Specific Costs - Option 3 *(Timber work within water tower / high tensile rod restraints to outside of water tower including associated footings)* *(Refer BCD Group drawing S-503b, dated 13 July 2023)*		850,000
	Subtotal		*2,100,000*
3	Estimating/Design Contingency *(For unforeseens during balance of Design Phase)* *(Higher percentage reflects nature of project, and lack of design development for this option in particular)*	20.0 %	425,000
	Subtotal		*2,525,000*
4	Escalation/Fluctuations/Procurement Contingency *(PROVISIONAL ALLOWANCE)* *(Design, consenting, holding, procurement phase - assume duration of two years)* *(Construction phase - assume duration of eighteen weeks)*	8.5 %	225,000
	Subtotal		*2,750,000*
5	Professional Fees *(Limited to - Geotech Engineering, Structural Engineering, Quantity Surveying)* *(Higher percentage reflects lack of design development to date for this option in particular)*	8.0 %	225,000
	Subtotal		*2,975,000*

PROJECT - CAMBRIDGE WATER TOWER - OPTION 3 (34% IL2)

LOCATION - 6 VOGEL STREET, CAMBRIDGE

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ESTIMATE BASED ON DESIGN OPTIONS - 11 AUGUST 2023

Ref	*Description*		*$ TOTAL*
6	Construction Contingency	15.0 %	450,000
	(For unforeseens during Construction Phase)		
	(Higher percentage reflects nature of project)		
	Subtotal		*3,425,000*
7	Building Consent Fees, say		25,000
	(PROVISIONAL ALLOWANCE)		
8	**TOTAL (excluding GST)**		**3,450,000**

Quantity and Rate columns within Estimate workings rounded. $ TOTAL column within Estimate workings not rounded however.

ESTIMATE BASED ON DESIGN OPTIONS - 11 AUGUST 2023

Ref	*Description*	*Quantity*	*Unit*	*Rate*	*$ TOTAL*	*%*
2	**OPTION-SPECIFIC COSTS - OPTION 3**				**850,000**	
2.1	**Option-Specific Costs - Option 3**				**570,140**	*67.1*
	Enabling Works:					
2.1.1	Refer to Baseline Costs section of Estimate					
	Demolition:					
2.1.2	Refer to Baseline Costs section of Estimate					
	Foundations:					
2.1.3	Excavation (and backfill) for new foundations	1	SUM	25,000	25,000	
2.1.4	NOTE - assume that no requirement for underpinning of existing water tower foundations given that surrounding soils are stabilised through grout injection					
2.1.5	Site concrete to base of excavations	13	m2	100	1,300	
2.1.6	Screw piles, including formation of pad to support piling rig	6	No	12,500	75,000	
2.1.7	Extra value, for overbore 4.5m deep to each pile, to 600mm diameter	6	No	4,000	24,000	
2.1.8	Extra value, for piling subcontractor design, test piles, etc.	1	SUM	25,000	25,000	
2.1.9	New concrete footings, including all associated formwork, DPC, reinforcing steel, concrete, etc.	3	No	15,000	45,000	
	Scaffold internal to Water Tower:					
2.1.10	NOTE - scaffold included in P&G section of Estimate, below					
	Steel framing:					
2.1.11	High tensile rods, including associated connection points to foundations and water tower, and steel collars (2 No) to inside of water tower	1	SUM	175,000	175,000	
	Timber framing:					
2.1.12	Studs, generally 180x180mm H5/GL8	305	m	300	91,500	
2.1.13	Extra value, for connection between studs and concrete slab, each including:	29	No	750	21,750	
	2 No 150x90x8UA brackets, 180mm long					
	2 No M12 stainless steel bolts fixing bracket to stud					
	4 No Python MT fixings with Python washer, fixing bracket to concrete slab					
2.1.14	Extra value, for offsetting studs where required to avoid clash with windows	1	SUM	2,500	2,500	
2.1.15	Extra value, for drilling through studs and timber packing for Python fixings	377	No	10	3,770	
2.1.16	Nogs, generally 140x45mm H3.2/SG8	208	m	150	31,200	
2.1.17	Lintels above windows and doors	1	SUM	2,500	2,500	

Ref	*Description*	*Quantity*	*Unit*	*Rate*	*$ TOTAL*	*%*
2.1.18	Timber framing and plywood infill, in between steel collars (2 No)	15	m2	750	11,250	
	Python screws:					
2.1.19	MT Python fixings, 340mm long	377	No	75	28,275	
	Windows and doors:					
2.1.20	Refer to Baseline Costs section of Estimate					
	Brickwork:					
2.1.21	Refer to Baseline Costs section of Estimate					
	Roof:					
2.1.22	Refer to Baseline Costs section of Estimate					
	Steel Tank Frame:					
2.1.23	Refer to Baseline Costs section of Estimate					
	External works:					
2.1.24	Refer to Baseline Costs section of Estimate					
2.1.25	Rounding	1	SUM	7,095	7,095	
2.2	**Contractor's On-Site Overheads ('Preliminary and General) - where option-specific**				**169,000**	*19.9*
	Cranes and access:					
2.2.1	Cranes, EWP's, etc.	1	SUM	50,000	50,000	
	Scaffold and fall protection:					
2.2.2	Scaffold, fall protection, etc. - assume only required to inside of water tower	1	SUM	75,000	75,000	
	Temporary protection while working in enclosed space:					
2.2.3	Temporary protection while work being carried out within water tower - scope as yet undefined, but may include 1/ shielding to protect from falling objects, 2/ mechanical ventilation to provide adequate fresh air (PROVISIONAL ALLOWANCE)	1	SUM	25,000	25,000	
	Temporary weather protection:					
2.2.4	Construction of temporary lightweight 'roof' to provide protection from weather when access not required	1	SUM	10,000	10,000	
2.2.5	Extra value, for removal and replacement of temporary roof as required to provide access, on a regular basis	18	weeks	500	9,000	
2.2.6	Rounding	1	SUM	0	0	
2.2.7	NOTE - all other items deemed included in P&G where common to all options, refer to Baseline Costs section of Estimate above					

PROJECT - CAMBRIDGE WATER TOWER - OPTION 3 (34% IL2)

LOCATION - 6 VOGEL STREET, CAMBRIDGE

CLIENT - WAIPA DISTRICT COUNCIL, C/- BCD GROUP

ESTIMATE BASED ON DESIGN OPTIONS - 11 AUGUST 2023

Ref	*Description*	*Quantity*	*Unit*	*Rate*	*$ TOTAL*	*%*
2.3	**Contractor's Off-Site Overheads and Profit Margin**	15.0 %			**110,860**	*13.0*
2.4	**OPTION-SPECIFIC COSTS - OPTION 3**				**850,000**	***100.0***