Approved Building
Consent Documents
BC0817/16
Ashburton District Council

Fire Engineering Design Report

Infant Formula Blending Plant
9 Ashford Ave, Ashburton

Issue F
11 November 2016
Job No 15073

ASBIC
Fire Engineering Consultants

ASBIC Consultants Ltd, 229 Flag Swamp Rd, RD2, Waikouaiti 9472, Dunedin, NZ
P 03 465 8255 • M 027 270 5885 • office@asbic.co.nz

Approved Building
Consent Documents
BC0817/16
Ashburton District Council

Document Use

Note that this fire engineering design report is a performance document intended to be used by other consultants (Architect, Structural Engineer, Fire Protection Consultant, Electrical & Mechanical Consultants etc) to prepare working drawings and specifications for tender, consent & construction. It is not a detailed specification document for tender or construction purposes. The consultants whose documentation is required to incorporate the requirements of this fire engineering design are expected to have read this report, understood the implications as it affects their scope of work and have incorporated the relevant Protection from Fire requirements into their drawings and specifications.

If the fire safety features listed in this report are implemented ASBIC Consultants are satisfied on reasonable grounds that the objectives of the Building Act 2004 and the NZ Building Code will be satisfied. Please note that the fire safety features listed are the MINIMUM required to comply with the Building Act 2004 and the NZ Building Code and do not cover protection of the building and its contents.

Bruce A. Collins

Bruce Collins
NZCE, PMSFPE (Int) No 9423, MIAFSS
SBCG Producer Statement Author No PSA/2014/88
LBP No BP113748

Issue Status

Issue	Date	Details
A	30 November 2015	Draft Issue - not intended for the Territorial Authority or Fire Service
B	23 January 2016	Building Consent issue shell only
C	31 May 2016	Building Consent Issue whole building
D	7 October 2016	Processing area altered and tower added (as shown by line in margin)
E	27 October 2016	Co-ordination statement updated
F	11 November 2016	Changed to Alternative Solution. Changes shown by line in margin

Contents

Approved Building
Consent Documents
BC0817/16
Ashburton District Council

1. Summary of Fire Features Required

The main requirements of the report are summarised below however the full report needs to be read in its entirety to ensure all requirements are met. Read this summary in conjunction with the included plans.

Note that this consent will need to be sent by the Council to the NZ Fire Service Engineering Unit and an additional set of documents may be required.

1.1. Active Fire Systems

1.1.1. Install type 6 automatic fire sprinkler and manual call point system throughout the building. Alarm system to comply with NZBC Acceptable Solution F7/AS1 and NZS 4512:2010, and sprinklers to comply with NZS 4541:2013 (or NZS 4515:2009 if applicable).

1.1.2. Install supplementary smoke detection to both floors of the offices firecells. This is to extend permissible travel distance and Fire Service connection is not required.

1.1.3. Requirements:

a) An analogue addressable system is strongly recommended but not mandatory for NZ Building Code compliance. Confirm with building owner.
b) Alarm system to comply with NZBC Acceptable Solution F7/AS1 and NZS 4512:2010. Note that the alarm system must be certified by an IANZ accredited inspection body and a maintenance & inspection agreement entered into with an alarm company.
c) Sprinkler system to comply with NZS 4541:2013. Appendix B of Approved Document C/AS6 does not apply. Note that the sprinkler system must be certified by an accredited sprinkler system certifier (SSC).
d) Sprinkler and manual call point operation shall call the Fire Brigade and interface to the Fire Alarm system so that all the Fire Alarm Warning Devices operate thus causing a full building evacuation.
e) Note that security smoke detectors must not be installed on the fire alarm system. We do not recommend security smoke detectors unless installed completely in compliance with NZS 4512 (ie wiring, detector spacing, location, etc must comply).
f) Provide strobe lights in addition to sounders in areas of high ambient noise levels
g) Install interface with alarm systems for door activations. Refer below
h) Location of fire alarm panel to be agreed between designer and NZ Fire Service before construction commences. Suggested location shown on the attached plan.

1.1.4. Ensure ventilation systems (within the smoke detector protected area) not required or designed for fire safety, and excluding non-distributed ventilation and air-conditioning (such as typical domestic/commercial heat pump units) shut down on activation of the smoke detection system. Where the ventilation system is capable of providing a smoke clearance function provide a fire fan control switch adjacent the fire panel for Fire Service use.

1.1.5. Install emergency lighting, complying with NZ Building Code F6, Acceptable Solutions F6/AS1, G9/AS1, and AS/NZS 2293:1:2005, 2293:2:1995 & 2293:3:2005 (as modified by F6/AS1) to the following areas (refer attached plans):

a) In all exitways (1 lux)
b) At every change of level in an escape route (1 lux)
c) In an escape route from the point where the initial open path travel distance exceeds 20m (0.2 lux)

Emergency luminaires to be self-contained type that illuminate on power failure.

Approved Building
Consent Documents
BC0817/16
Ashburton District Council

1.1.6. Install illuminated "Exit" signage (white on green background) complying with NZ Building Code Acceptable Solution F8/AS1 to locations shown on the attached plan. Note that locations shown do not take into account possible obscuration by plant, fittings etc and supplementary signage may be needed. Similarly additional signs or non-standard large signs may be required to ensure sign height complies with viewing distance.

Provide illuminated "No Exit" (white on red background) sign at head of stairs where fire curtain descends.

Illuminated exit signage to be self-contained type that illuminates on power failure and smoke alarm activation (non-maintained) or is continuously illuminated (maintained) if smoke detectors are not present.

Photoluminescent signs are not permitted.

Exit signs shall display the words "Exit" or "Emergency Exit" or may be pictograms complying with F8/AS1. Note that pictograms must have directional arrows in all cases (apart from over the exit door) and the "running man" must be shown as running in the correct direction.

Where exit signs are provided to identify a door on an escape route the sign shall be positioned on the leaf, at or above handle height, or on a vertical surface within 600mm of the door.

1.2. Passive Fire Systems

1.2.1. Provide 30/30/30 fire rating to:

a) the mezzanine floor and its supporting walls.
b) the first floor of the office block
c) walls separating the north stair of the office block from adjoining spaces in the office block
d) walls around the two level space/stair in the office block at first floor level
e) ceiling to two level space/stair area.
f) vertical service ducts. Alternatively provide similar fire rating at floor level

1.2.2. Provide 60/60/60 fire rating to walls separating the office block from the factory & production areas

1.2.3. Provide 180/180/180 fire rating to precast concrete panels on east and west elevations. Doors and windows are not fire rated.

1.2.4. Ensure that:

a) all fire rated primary elements (as above) are designed to resist collapse under the fire and emergency conditions required by AS/NZS 1170 and any additional loads caused by the fire (refer Structural Engineer)
b) all supporting elements of the fire rated elements above (eg beams, columns, load bearing walls etc) also retain structural integrity under fire loadings (ie 60/-/- for a 60 minute FRR and 30/-/- for a 30 minute FRR) This may require encasing or the use of intumescent paints to steel beams and columns. Note that enclosing steelwork within fire rated walls and floor/ceiling systems is unlikely to provide sufficient fire rating to the steel unless Gib walls and ceilings are GBUW or GBUC type.
c) all fire rated walls extend to the underside of the fire rated floor above or the underside of the roof sheeting
d) all fire separations within ceiling voids, service risers etc are annotated at regular intervals with "x/x/x FIRE SEPARATION" where x is the fire rating. An alternative is the use of continuous plastic tape annotated "FIRE WALL" and fixed to the wall.
e) any intumescent coatings have the finished coating thickness confirmed by independent testing to verify thickness complies with the paint manufacturer's specification. Only intumescent coatings from Zone Architectural Products and Altex Coatings are recommended. Structural

Approved Building
Consent Documents
BC0817/16
Ashburton District Council

Engineer to confirm limiting steel temperatures to paint manufacturer or ensure limiting temperature is not more than 620°C.

1.2.5. Any gaps in, or services that penetrate through, fire rated construction (walls/floors/ceilings) are to be fire rated using certified systems such as fire collars, fire wraps, fire sealants, fire dampers etc. The systems are to be installed as required by the certification and manufacturer of the product. All to be installed by a person certified in the use of the product and under the supervision of a person holding Level 3 or Level 4 of the National Certificate in Passive Fire Protection. It is recommended that a single passive fire expert be responsible for all penetrations. Refer Appendix 1 of this report for further details and products that are acceptable. A register of all penetrations must be kept listing as a minimum the penetration number, location, description (with photo), product used, fire rating and installer. All penetrations are to be similarly labeled (on both sides for walls). Any hatches in fire rated ceilings to be certified fire rated hatches.

1.2.6. Provide smoke separations:

- To form a smoke lobby on the ground floor in front of the north stair of the offices.
- Around the stair in the processing tower

Note that smoke separations shall:

a) consist of rigid building elements capable of resisting without collapse a horizontal pressure of 0.1 kPa applied from either side, and self-weight plus the intended vertically applied live loads, and
b) form an imperforate barrier to the spread of smoke, and
c) be of non-combustible construction or achieve a FRR of 10/10/-, except that non-fire resisting glazing may be used if it is toughened or laminated safety glass

Note that glued plasterboard does not comply. All gaps and penetrations in smoke separations to be sealed to prevent the transfer of smoke.

1.2.7. Install fire/smoke curtain to head of south stairs/two level space in the office block. Curtain to be tested and certified to EN1634-1 or BS476:part 20 & 22 1987 with a fire rating of -/30/- and be installed complete with side guides, headbox etc. Activation of curtain to be by activation of the alarm system or power failure.

1.2.8. Doors:

a) Doors in 60 minute fire rated walls to be certified -/60/-sm fire doors. Doors in 30 minute fire rated walls to be certified -/30/-sm fire doors. Doors in smoke separation walls to be certified -/-/-sm smoke control doors. All to be complete with smoke seals, closers and tested hardware. Note that smoke seals must be provided to head, jambs and meeting stiles.
b) Ensure doors on escape routes can be readily opened at all times from the inside without the use of a key, and accessible doors have lever type handles (or pull handles etc in some cases – refer Acceptable Solution D1/AS1.
c) Door swings shown on the drawings comply and must not be changed without approval.
d) Doors into the office block north stair exitway and final exit door to have 875mm clear width when the doors are in the open position. Elsewhere 810mm doors comply.
e) Provide vision panels on doors that swing both ways, lead into, or are within, exitways that swing in the direction of escape, and to doors that subdivide corridors used as escape routes.
f) Ensure that doors on escape routes fitted with locks activated by keypad, swipe card, proximity reader etc release the lock automatically in the event of alarm activation, door malfunction or power failure. Unless the doors act under free handle provide a push button or switch (with appropriate signage) adjacent the doors to ensure they can be opened in the direction of escape at all times. This push button or switch may be placed behind a break glass panel but must be clearly labeled “Emergency door release”. If it is considered a security risk that locks can release in the event of power failure, an alternative is to provide battery backup to enable doors to operate normally.
g) Provide electromagnetic hold-open devices to doors subdividing long corridors, in fire

Approved Building
Consent Documents
BC0817/16
Ashburton District Council

separations where an escape route passes into an adjacent firecell, and in locations where, due to the type or volume of occupant traffic using the doors, the doors may be kept open by unauthorised means (refer attached plans). Hold-open devices to be able to hold the door open during normal use but automatically release the door on activation of the smoke detection system or power failure. Provide push button hold-open release adjacent each door. Hold-open's may be 'fire door holders' or closers with integral hold-open function. Smoke detectors for releasing hold-open devices shall be smoke detectors which are:

- Integral with the hold-open device or
- Located on the ceiling adjacent to the doorset on both sides of the doorset, or
- Part of an automatic smoke detection system on both sides of the doorset.

h) Provide Fire Door and Smoke Control Door signage complying with NZ Building Code Acceptable Solution F8/AS1. Fire and smoke control doors shall be identified with signs fixed to both sides of the door leaf adjacent to the handle or push plate, stating 'Fire Door, keep closed' or 'Smoke Control Door, keep closed'. Door leaves fitted with hold-open devices shall have a sign stating 'Fire Door' or 'Smoke Control Door' on the hidden side and a sign fixed to the exposed side of the door stating 'Fire Door (automatic closing) do not obstruct' or 'Smoke Control Door (automatic closing) do not obstruct' as appropriate.

1.2.9. Windows

- Windows in 60 minute fire rated walls to be certified -/60/- fire windows.
- Glazing in smoke separations to be toughened or laminated safety glass
- Window and door sizes in external east and west walls comply and are not allowed to increase in size without approval.

1.2.10. Ensure new interior surface finishes, floor coverings and suspended flexible fabrics comply with the requirements as outlined in Section 8.8.

1.2.11. Ensure Fire Service roading requirements comply with Section 10.1.

1.2.12. Switchboards shall not be installed in any exitway unless within a fire and smoke rated cabinet or cupboard. Switchboards installed within a cupboard etc in a corridor, lobby etc leading to an exitway must have doors sealed to prevent spread of smoke from the switchboard.

1.3. Other

1.3.1. As a condition of the approval of any Resource Consent the Territorial Authority may require compliance with SNZ PAS 4509:2008 "NZ Fire Service Fire Fighting Water Supplies Code of Practice". If noted on the Resource Consent this item should be discussed with the Territorial Authority and the Fire Service. If sufficient street water flow is not available, water storage or sprinklers may be required, or the building compartmented with fire separations.

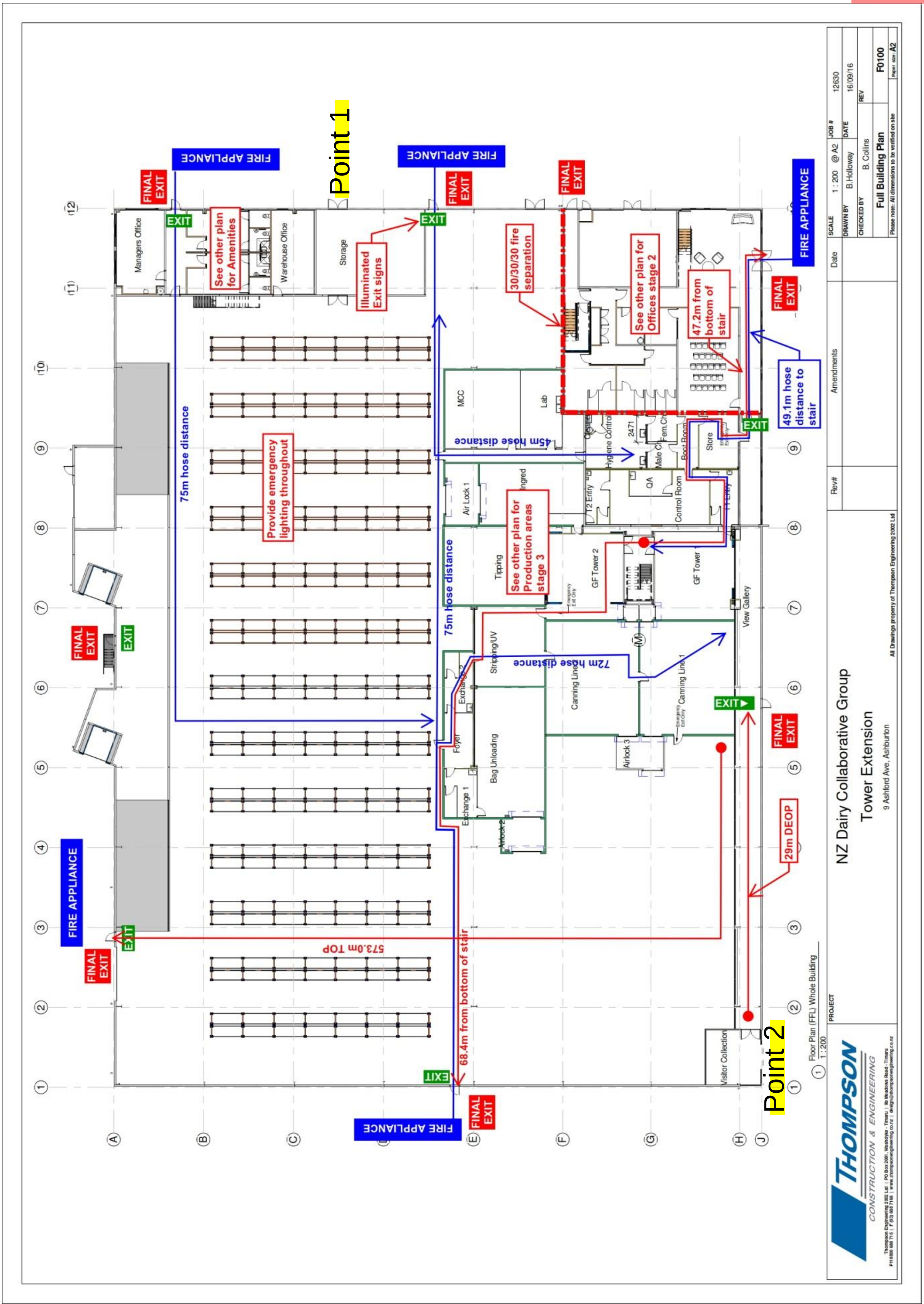
1.3.2. Provide Fire Evacuation Scheme as approved by the NZ Fire. The details of Evacuation Schemes do not come within the scope of this report and building owners should contact the NZ Fire Service for advice. Note that an Evacuation Scheme is not required for Building Consent but must be applied for (at the NZ Fire Service) not later than 30 days after the earlier of the date on which a Code Compliance Certificate is issued for the building or the date the building is first lawfully occupied.

Note that the Fire Service may require the installation of fire extinguishers in certain areas as a condition of approving the Fire Evacuation Scheme.

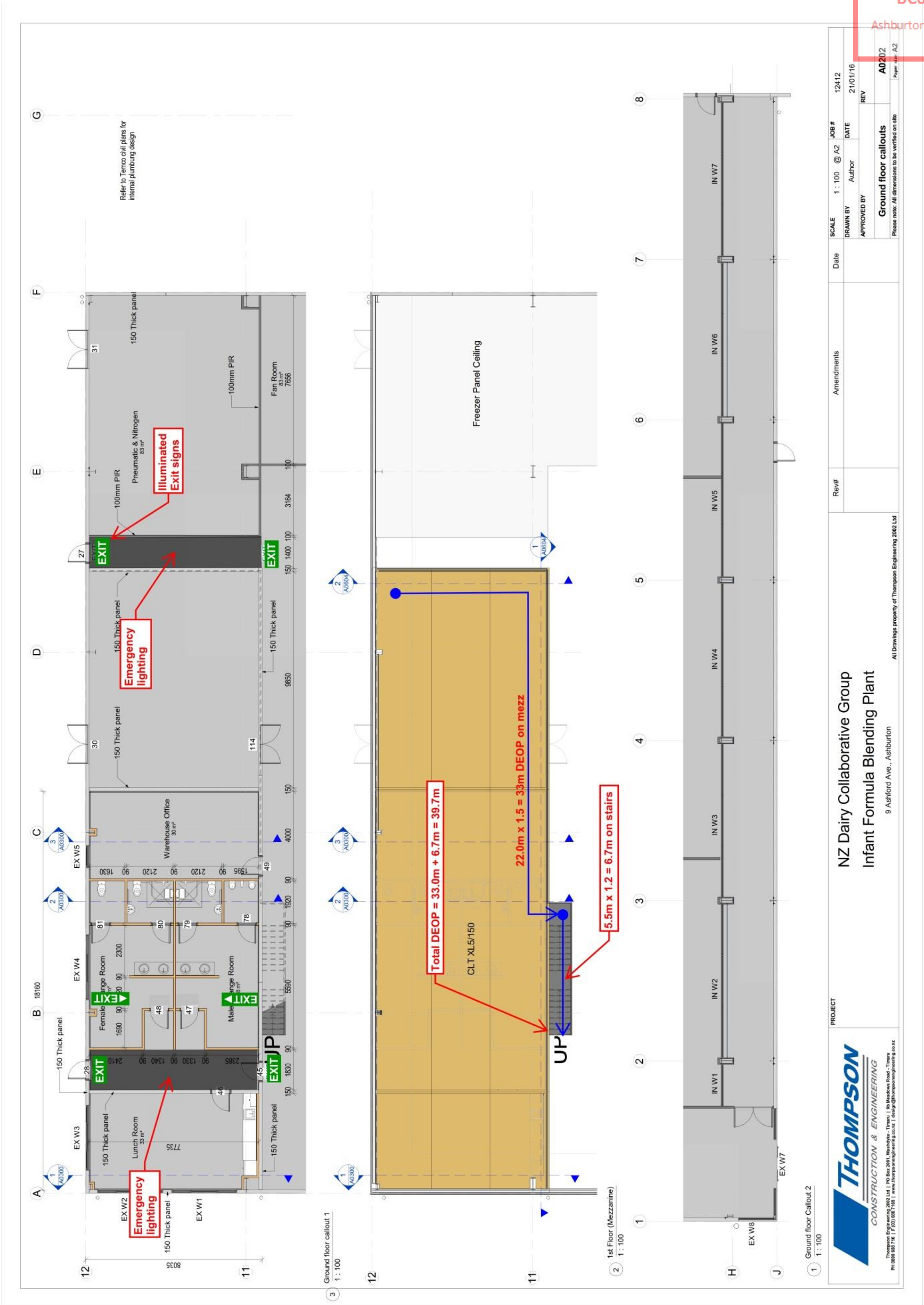
1.3.3. Compliance Schedules are not within the scope of this report however guidance is given in Appendix 2.

Approved Building
Consent Documents
BC0817/16
Ashburton District Council

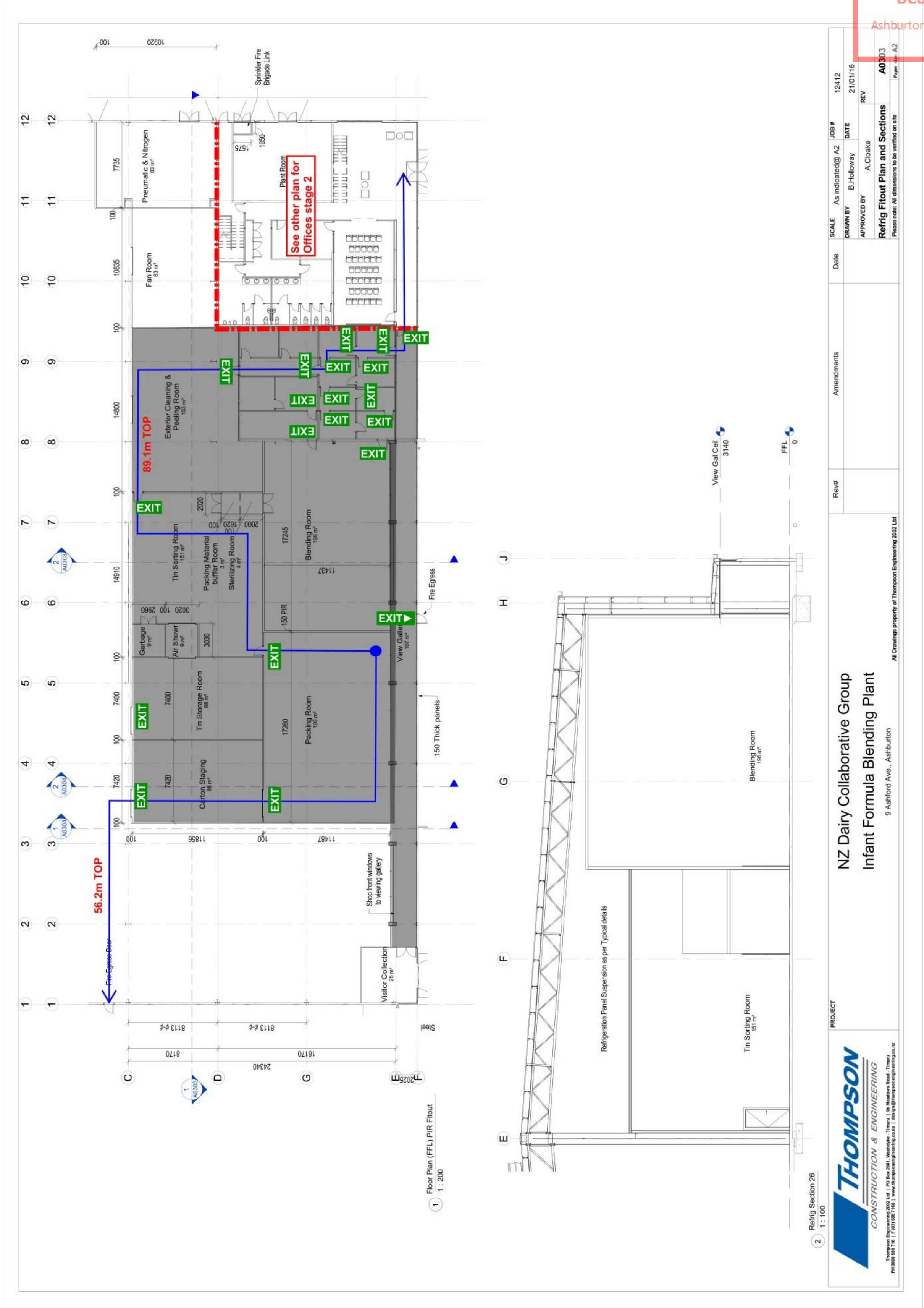
2. Plans



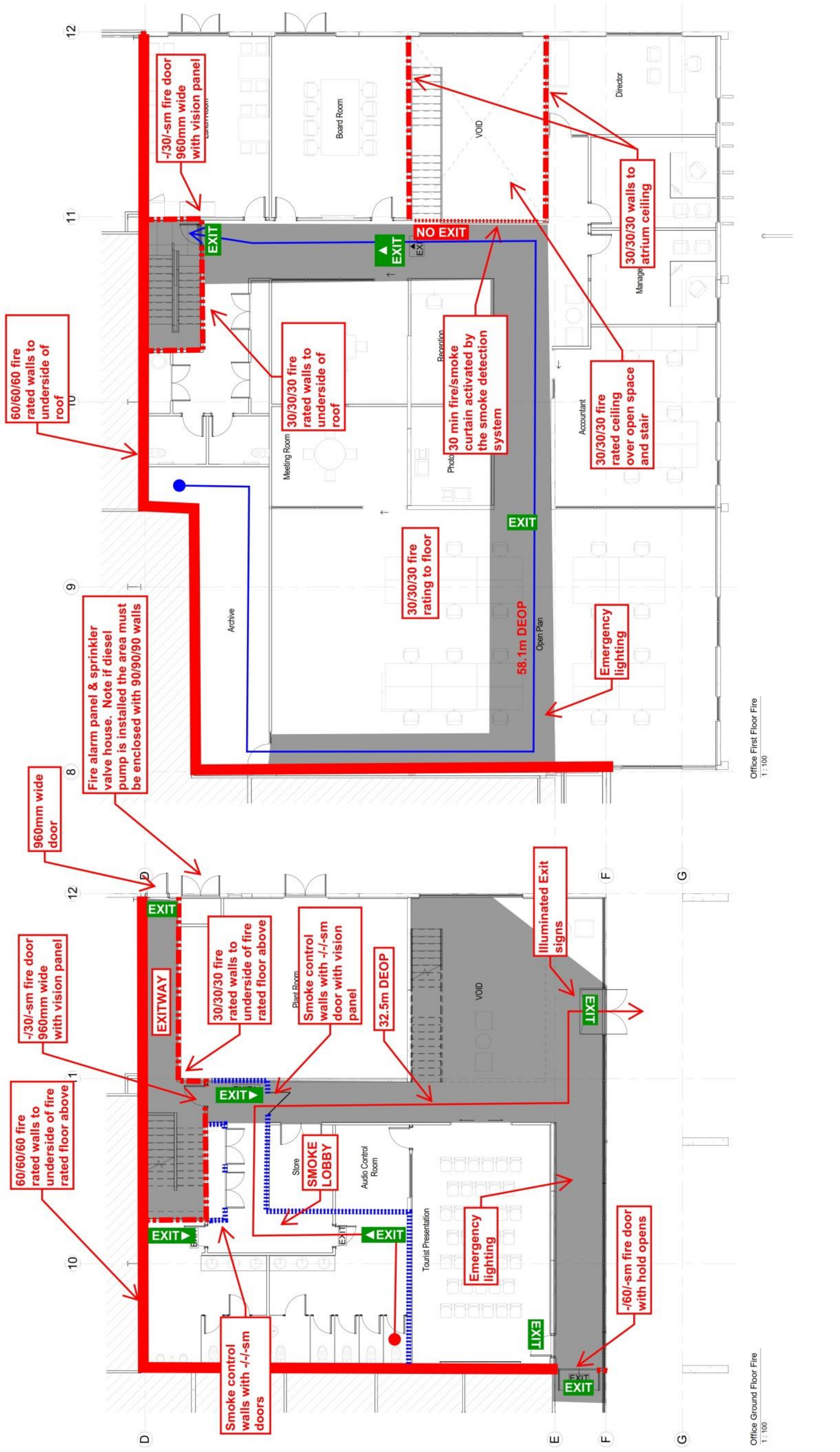
Approved Building
Consent Documents
BC0817/16
Ashburton District Council



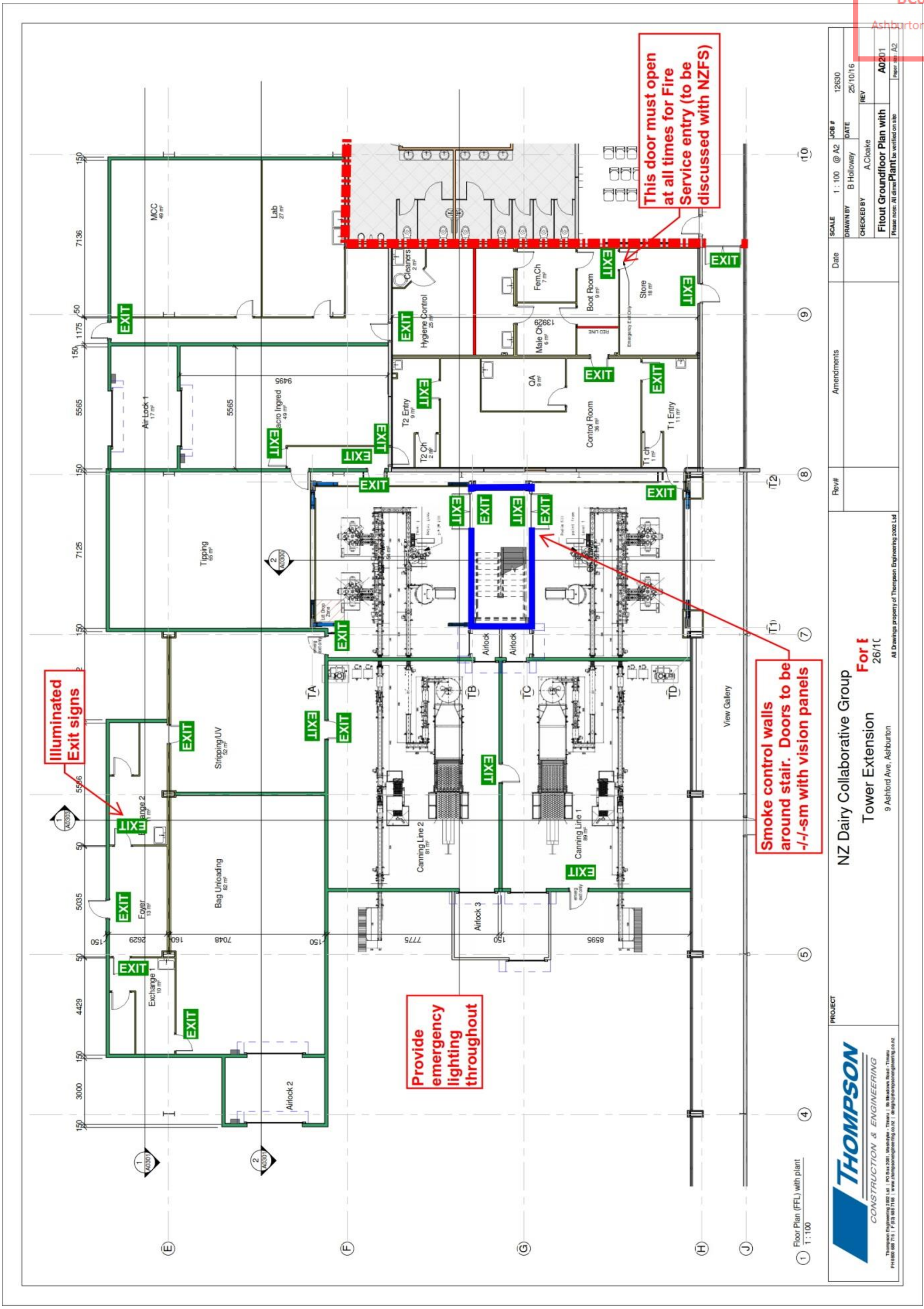
Approved Building
Consent Documents
BC0817/16
Ashburton District Council



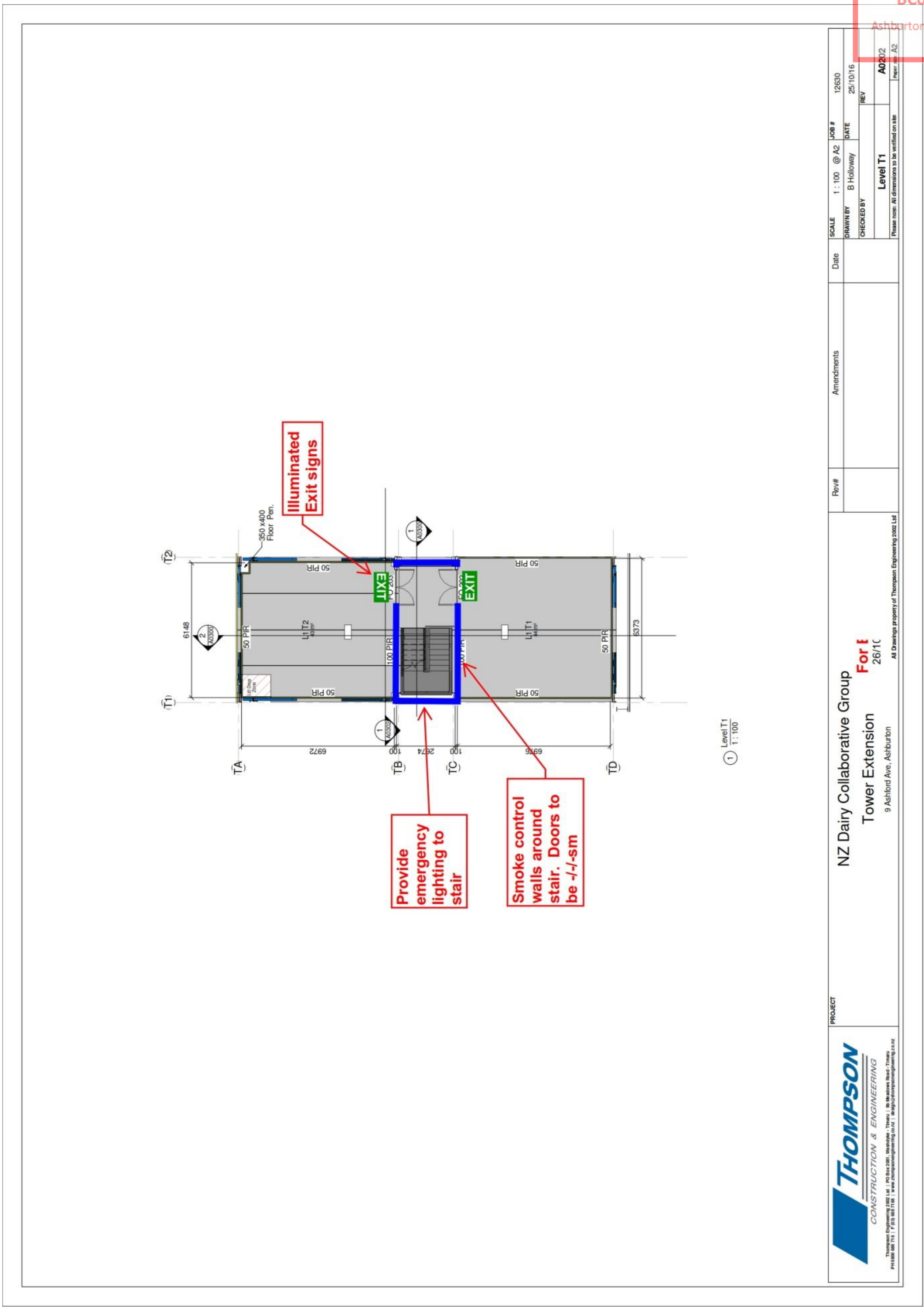
Approved Building
Consent Documents
BC0817/16
Ashburton District Council



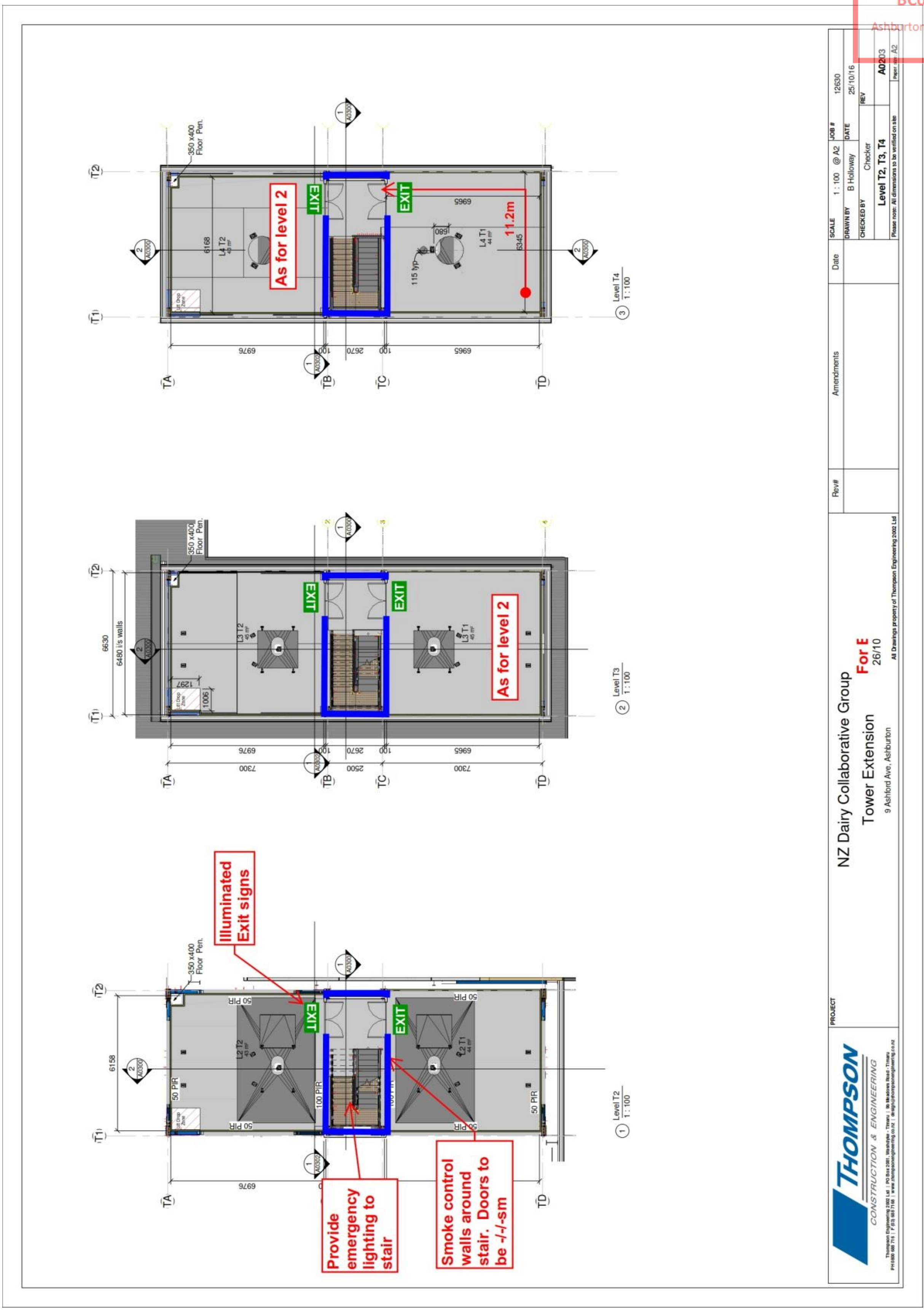
Approved Building
Consent Documents
BC0817/16
Ashburton District Council



Approved Building
Consent Documents
BC0817/16
Ashburton District Council



Approved Building
Consent Documents
BC0817/16
Ashburton District Council



Approved Building
Consent Documents
BC0817/16
Ashburton District Council

3. Introduction

3.1. Purpose

The purpose of this report is to show compliance with the NZ Building Code (NZBC) clauses C1 to C6 Protection from Fire, and associated fire related clauses in F6 (Visibility in Escape Routes), F7 (Warning Systems) and F8 (Signs).

This report is a Limited Scope Alternative Solution where the majority of the building complies with Acceptable Solutions C/AS5, C/AS6, F6/AS1 & F8/AS1. As these are already compliance documents to the Building Code in their own right those parts of the building will not be re-examined as an alternative Solution. The part of the building not coming within the Compliance Documents and examined as an alternative solution is the tower.

The Building Act 2004 and NZ Building Code concentrate mainly on the safety of people, and rely on building owners to provide additional features to provide for protection of buildings and their contents. This design complies with the requirements of the Building Act 2004 and the NZ Building Code and does not cover protection of the building nor its contents, although the sprinkler system will provide substantial protection.

3.2. General

The extent of the work is the construction of a new purpose built building for the production of blended infant formula milk powder.

- Stage 1 is the building shell excluding the two level office block.
- Stage 2 is the fitout and office block.
- Stage 3 is the processing area and tower.

This fire report examines the whole building.

<u>Location</u>

The building faces Ashford Ave to the south and is located 12m from the west boundary and 13.090m from the east boundary. The northern boundary is 26.6m from the building. Fire Service access is available to all four sides.

<u>Configuration</u>

The majority of the building is single level apart from a two level office block in the south east corner, a mezzanine in the north east corner and a four level processing tower. Each floor of the office block is considered a separate firecell while the remainder of the building is one firecell.

The floors in the processing tower are not considered as intermediate floors but rather as non fire rated maintenance platforms as they are only used for plant maintenance and rarely occupied. Traditionally in this kind of plant the floors would be constructed of steel but in this case the owners have opted for concrete floors supported by non fire rated steelwork.

Means of escape from the upper floor of the office block is via a safe path stair which discharges directly outside. There is an internal connection between the two levels but this is separated by a fire/smoke curtain in the event of a fire. Means of escape from the ground floor is via a number of external doors.

Means of escape from the processing tower is via a smoke separated stair to ground floor level where there are two separate escape routes. Due to its use a tower such as this could have an internal ladder or exposed stair but the owners have opted to be conservative and provide a smoke separated stair.

<u>Construction</u>

Exterior wall construction is generally metal cladding on steel framing above 2.4m high precast

Approved Building
Consent Documents
BC0817/16
Ashburton District Council

panels. The exterior upper walls of the offices are fibre cement on timber framing. Internal walls of the offices are timber framed while the production areas will be PIR sandwich panel. Roof construction is also metal cladding on steel framing. The office block upper floor is concrete.

<u>Fire protective & preventative measures</u>
A type 6 sprinkler system will be installed throughout with supplementary smoke detection in the office block to allow increased travel distances.

<u>Fire Classifications</u>

Building Importance -	Level 2
Risk group -	WB & WS
Purpose Group –	WL & WH (as Schedule 2 of the Building (Specified Systems, Change the Use, and Earthquake-prone Buildings Regulations 2005)
Fire Hazard category -	4

3.3. Commissioning

This Fire Engineering Design report was commissioned by Soloman Ling of New Zealand Dairy Collaborative Group Ltd.

3.4. Documents/Information

The report is based on the following information:

<u>Stage 1 drawings</u>
- Thompson Construction & Engineering – Job no 12412, drawings F0100, F0101, A0200, A0202, A0300, A0303-A0305, A0400, A0401, A0602-A0604, A1300, A1301, A1400, S0100,S0200-S0203, S0301-S0305, S0400-S0410, SO500, S0600-S0603, S0700, S0701, S0710, S0711, S0900, S0901.
- Rexel Lighting 2387 factory pages 1 and 2 and production pages 1 and 2.

<u>Stage 2 Office block drawings</u>
- Thompson Construction & Engineering – Job no 12413, drawings A0101, A0200(revision 5), A02091, A0300, A0301(5), A0302, A0400, A0500, A0501, A0600(3), A0601, A0602, A0603(3), A0604(4), A0700(3), A0701, A0702(3), A0703(3), A0800, A0801, A0802, A0803(5), A0900, A0901, A1000, A1001, A1100(4), A1101(4), A1102(4), A1103(4), A1200, A1201(5), A1300, A1301, A1303, S0200, S0201, S0202, S0301, S0302, S0303(3), S0304(3), S0305(3), S0306, S0307, S0308(1), S0400 to S0407, S0500, S0600, S0601, S0602(3), S0603, S0604, S0700 to S0705 (all rev 3).
- Rexel Lighting 2367 ground floor pages 1 and 2 and first floor pages 1 and 2.

<u>Stage 3 Production area drawings</u>
- Thompson Construction & Engineering – Job no 12630, drawings A0200-A0203, A0300-A0303, A0400, A0401, A0500, A0600, A1300-A1302 all Building Consent issue
- Rexel Lighting 2387 Production pages 1 & 2, Tower pages 1 to 3.

3.5. Disclaimer

Unless signed and stamped by ASBIC Consultants Ltd we are not able to confirm whether the drawings & specification submitted for a Building Consent are the same version as considered in this report.

The building is designed for the specific occupancy and risk group as described in this report. Any occupancy not coming within this classification may not comply with this report and may require additional fire precautions.

The mezzanine in the warehouse does not comply with C/AS6 and we understand this is discussed in a letter by Thompson Construction and Engineering to the Ashburton District Council. The mezzanine area is thus specifically excluded from this fire report.

Approved Building
Consent Documents
BC0817/16
Ashburton District Council

3.6. Design Co-ordination Statement

The documents listed above have been reviewed within the context of the fire engineering design to determine that the fire engineering design's intent for compliance with the NZ Building Code is correctly shown. Other documents have not been reviewed. This review does not relieve the other designers of their responsibilities for correctly interpreting the fire design or from ensuring the fire engineering requirements in their documents are correct and complete. This design co-ordination statement is provided specifically for building code compliance only.

Note that any changes to the drawings that have not been viewed and accepted by ASBIC Consultants Ltd may make this fire engineering design report non-compliant.

3.7. Construction monitoring

ASBIC Consultants Ltd have not been engaged to provide construction monitoring. There are no fire design features or safety related systems that require specific installation or commissioning inspections during construction and it is considered that Council inspection procedures will be sufficient.

4. Legal Environment

4.1. Building Act

As this is a new building all work must comply fully with the Building Act 2004 and the NZ Building Code.

4.2. NZ Fire Service Engineering Unit

Section 47 of the Building Act requires certain applications for Building Consent to be forwarded to the Engineering Unit of the NZ Fire Service for their comment and advice.

Clause 1 of NZ Gazette Notice 49/2012 specifies those applications as those types of buildings coming within section 21A of the Fire Service Act 1975. As amended by the Fire Service Amendment Act 2005 these include buildings:

a) for the gathering together, for any purpose, of 100 or more persons
b) providing employment facilities for 10 or more persons
c) providing accommodation for more than 5 persons (other than in 3 or fewer household units)
d) storing or processing hazardous substances in quantities exceeding the prescribed minimum amounts
e) providing early childhood facilities (other than in a household unit
f) providing nursing, medical, or geriatric care (other than in a household unit)
g) providing specialised care for persons with disabilities (other than in a household unit)
h) providing accommodation for persons under lawful detention(not being persons subject to home detention)

Clause 2 of the Gazette notice states that these applications mean an application:

a) where compliance with C1-6, D1, F6 or F8 of the Building Code is established other than by compliance with an applicable compliance document
b) where there is a waiver or modification (under section 67 of the Building Act 2004) of clauses C1-6, D1, F6 or F8 of the Building Code
c) where there is an alteration, change in use or subdivision and affects the fire safety systems, including any building work on a specified system relating to fire safety, except where the effect on the fire safety system is minor.

As this building comes within clause 1 and the work within clause 2 of Gazette Notice 49/2012 this Building Consent must be examined by the Engineering Unit of the NZ Fire Service.

Approved Building
Consent Documents
BC0817/16
Ashburton District Council

4.3. The Fire Safety and Evacuation of Building Regulations 2006

An evacuation scheme is required where any building or part thereof is used as a place providing employment facilities for 10 or more persons. The details of Evacuation Schemes do not come within the scope of this report and building owners should contact the NZ Fire Service for advice.

4.4. Hazardous Substances

This report does not examine any storage, ventilation or bunding requirements for hazardous substances as defined in Building Code clause F3, the Hazardous Substances and New Organisms Act 1996 (HSNO), and in particular the Hazardous Substances (classes 1 to 5) Regulations 2001. It is assumed that any hazardous substances not stored as required by the regulations are in such small quantities as to have minimal effect on the fire load of the building. Building owners should contact a HSNO Test Certifier for advice.

4.5. Resource Consent

A Resource Consent has not been viewed and this report does not examine any fire related issues if raised in any Resource Consent for the project.

4.6. Water Supply

SNZ PAS 4509:2008 "NZ Fire Service Fire Fighting Water Supplies Code of Practice" governs fire fighting water if mandated by the specific Territorial Authority or noted in the Resource Consent Conditions. This is a non Building Code issue.

5. Occupancy & Risk Groups

Location	Area m^2	Escape height m	Storage height m	Risk Group	Density m^2/p	People	Firecell Occupancy
Warehouse/Production							
Warehouse	3059	0	>5	WS	100	31	
Warehouse mezzanine	222	3.3	<3	WS	100	3	
Warehouse offices	63	0	0	WB	10	7	
Storage	75	0	<3	WB	100	1	
Viewing gallery	125	0	0	WB	5	25	
Circulation/toilets/airlocks		0	0	counted elsewhere			89
Tower maintenance floors		various	0	counted elsewhere			
Production areas	570	0	0	WB	30	19	
Laboratory	27	0	0	WB	10	3	
Process offices	70	0	0	WB	10	7	
Process store	18	0	<3	WB	100	1	
Ground floor offices							
Audio Control room	10	3.15	0	WB	10	1	
Theatre	53	3.15	0	WB	0.8	67	
Waiting	30	3.15	0	WB	10	3	75
Store	12	3.15	<3	WB	100	1	
Plant room	65	3.15	0	WB	30	3	
First floor offices							
Offices	308	3.15	0	WB	10	31	
Meeting				counted elsewhere			
Boardroom				as seats		10	42
Staffroom				counted elsewhere			
Store	71	3.15	<3	WB	100	1	

Approved Building
Consent Documents
BC0817/16
Ashburton District Council

Actual occupancy is clearly less than that calculated above. Total staff in the building is expected to be 40 people. Tourist presentation and viewing gallery is an occasional use and it expected to cater for a maximum of 40 people. First floor meeting rooms are for internal use and only the board room could receive external visitors. First floor staff room is similarly only for those on that floor.

Therefore under 1.4.6 the design occupancy will be:

Warehouse/production firecell - say 11 staff + max of 40 in viewing gallery = 51 people

Ground floor offices firecell – say 48 people.

First floor offices firecell – 42 people

6. Alternative Solution for Tower

This must demonstrate compliance with the Performance Requirements of the NZ Building Code.

6.1. NZBC Clause C2 – Prevention of fire occurring

There is no plant with surface temperatures exceeding 90°C or using controlled combustion. Therefore the tower complies with C2.

6.2. NZBC Clause C3 –fire affecting areas beyond the fire source

All materials and surface linings in the tower comply with the more conservative Compliance Documents and are thus considered to comply.

The tower (as is the whole of the building) is protected by an automatic sprinkler system thus reducing the risk of fire affecting areas beyond the fire source to an acceptable level and complying with C3.

6.3. NZBC Clause C4 – Movement to place of safety

Means of escape from the processing tower is via a smoke separated stair to ground floor level where there are two separate escape routes which are also smoke separated.

While the maintenance platforms of the tower are essentially unoccupied they are examined as if they could be occupied. Dead end travel distance from the top maintenance platform of the tower to the base of the stair is 55.9m, which includes 11.2m on the platform. At this point there are two smoke separated means of escape with the closest giving a total travel distance of 103.1m and the furthest of 124.3m.

Assuming a travel speed of 1.2m/sec on the flat and 0.85m/sec on stairs (C/VM2 et al) this gives a travel time of just under 2 minutes. As the escape routes are smoke separations they can be expected to withstand a fire for at least 10 minutes and this can be assumed to start at the same time that the temperature has reached sprinkler activation temperature (fire alarm activation). Therefore any occupants have eight minutes available for pre travel time which is conservative by any standards.

The performance requirement is only for a fractional exposure dose of CO greater than 0.3 which provides an even greater factor of safety to occupants. Thus the tower complies with C4.

6.4. NZBC Clause C5 – Access and safety for firefighting operations

Fire Service access is provided as required by clauses C5.3 and C5.4.

Hose distance to the bottom of the tower from hardstanding by the main office door is 49.1m and to the furthest point on the top platform of the tower is 105m. Considering the building is sprinklered

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Consent Documents
BC0817/16
Ashburton District Council

and the tower floors are essentially unoccupied this is considered satisfactory and akin to hose distance to a roof space. This satisfies clause C5.5.

C5.6 is satisfied by the sprinkler system and construction in PIR fire resistant panels.

C5.7 is satisfied by the provision of the fire alarm panel and NZFS/owner procedures.

Fire safety systems such as sprinklers are not assumed as failing and there are no other fire safety systems apart from smoke control doors. It is assumed that only one door would fail at any one event and this would not materially affect means of escape especially when considering the low or nil occupancy. Therefore it is considered that clause C5.8 is also satisfied.

6.5. NZBC Clause C6 – Structural Stability

The floors in the processing tower are not considered as intermediate floors but rather as non fire rated maintenance platforms as they are only used for plant maintenance and rarely occupied. Traditionally in this kind of plant these unoccupied floors would be constructed of steel but in this case the owners have opted for concrete floors supported by non fire rated steelwork. Walls are fire resistant PIR panel. As the tower (and the building as a whole) is protected with a sprinkler system it is considered that the performance requirements of C6 are met.

7. Fire Safety Systems, Fire Resistance Ratings

7.1. Fire Safety Systems

WB risk group <100 people, <3m storage height and ≤4m escape height

- Type 2 manual fire alarm system (direct connection to the Fire Service is not required if a phone is available at all times for 111 calls). System is not required if escape routes serve no more than 50 people in a single level building.
- Type 18 building fire hydrant system unless Fire Service hose distance from Fire Service vehicular access to any point on the floor is <75m

WS risk group ≤1000 people

- Type 6 auto fire sprinkler system, manual call points
- Type 18 building fire hydrant system where the height from the Fire Service attendance point to any floor is greater than 15m. Otherwise a type 18 system is required unless Fire Service hose distance from Fire Service vehicular access to any point on the floor is <75m

Fire Service hose distance from vehicular access is less than 75m and a type 18 hydrant is not required. Therefore a type 6 system shall be installed throughout the building. Refer later for smoke detection in the offices to increase path lengths.

7.2. Fire Resistance Ratings

WB risk group - As sprinklers are installed Life rating = 30 minutes, Property Rating = 60 minutes

WS risk group- Life rating = 60 minutes, Property Rating = 180 minutes

Therefore the walls between risk group firecells will be 60 minutes and the life rating within the WB risk group will be 30 minutes.

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Consent Documents
BC0817/16
Ashburton District Council

8. Means of Escape

8.1. Number of escape routes

The minimum number of escape routes from a floor level shall be 2 for up to 500 occupants. A single escape route is permitted from the first floor of the offices and mezzanine as:

- The open path length complies
- The total occupant load from all firecells on each level served by the escape route is no greater than 50
- The number of people with disabilities on any floor is not greater than 10
- The escape height is no greater than 10 m if unsprinklered, or 25 m if sprinklered
- In buildings with two or more floors the vertical safe path is preceded by a smoke lobby on all floors except the topmost floor

8.2. Height of escape routes

The clear height within escape routes shall be no less than 2100 mm across the full width, except that isolated ceiling fittings not exceeding 200 mm in diameter may project downwards to reduce this clearance by no more than 100 mm, and any door opening within, or giving access to, any escape route shall have a clear height of no less than 1955 mm for the required width of the opening.

8.3. Width of escape routes

The total combined width of all available escape routes shall allow 7mm/person for horizontal travel and 9 mm/person for vertical travel. If the escape route is an accessible route or stair, it shall have a minimum width of 1200 mm for horizontal travel and 1100mm for vertical travel. If not an accessible route or stair, it shall have a minimum width of 850 mm for horizontal travel and 1000 mm for vertical travel. If there is no requirement for people with disabilities, the occupant load is less than 50 and the escape route is within an open path, its width may be reduced to 700 mm for horizontal travel and 850 mm for vertical travel. If an escape route is within an exitway, its width shall be no less than 1000 mm.

For safe evacuation on stairs, all stairways shall have at least one handrail.

The following minor obstructions are acceptable within the width of an escape route:

- Minor projections complying with the requirements of Acceptable Solution D1/AS1 such as signs, switches, alarm sounders and similar projections.
- Handrails complying with Acceptable Solution D1/AS1, projecting no more than 100 mm into the width, and handrails subdividing wide stairways that reduce the width by no more than 100 mm.
- Door assemblies which reduce the width of an exitway by no more than 125 mm when the door is fully open.

8.4. Length of escape routes

Risk Group	Dead end open path		Total open path	
	Allowed	Actual	Allowed	Actual
WB	75m max (type 7)	58.1	150m max (type 7)	n/a
WS	50m max (type 6)	39.7	120m max (type 6)	89.1

Note that smoke detection is provided to the office block firecells to extend permissible travel distances.

8.5. Open paths

If two or more open paths are required, they shall be separated from each other, and remain separated until reaching an exitway or final exit. Separation shall be achieved by diverging (from the point where two escape routes are required), at an angle of no less than 90° until separated by a

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Consent Documents
BC0817/16
Ashburton District Council

distance of at least 8.0 m, or smoke separations and smoke control doors. The building complies.

8.6. Control of exitway activities

Exitways shall not be used for:

- Any storage of goods, solid waste or solid waste containers
- The location of furniture or other combustibles
- Storage of cloaks or linen
- A cleaner's cupboard not fire separated from the exitway
- The location of an electrical switchboard or similar

8.7. Doors

Doors on escape routes shall satisfy the following closing requirements:

- They shall be hinged or pivoted on one vertical edge only, except that sliding doors may be used where the space, including an exitway, has an occupant load of less than 20. Roller shutter doors or tilt doors shall not be used as escape route width except in an intermittently occupied space where the roller shutter door is the only access route and is open at all times the space is occupied
- Fire and smoke control doors shall be self-closing, and the self-closing device shall either be active at all times, or activated by releasing a hold-open device in response to operation of a smoke detector, or a self-closer that is activated by operation of a smoke detector but allows the door to swing freely at other times. The smoke detector requirements shall be the same as for a hold-open device
- If doors are required to be secure, they shall be fitted with simple fastenings that can be readily operated from the direction approached by people making an escape
- They shall have door handles which satisfy the requirements of Acceptable Solution D1/AS1 for use by people with disabilities
- They shall be constructed to ensure that the forces required to open these doors do not exceed those able to be applied with a single hand to release the latch (where fitted), and using two hands to set the door in motion, and using a single hand to open the door to the minimum required width.

If the building is occupied, locking devices shall :

- Be clearly visible, located where such a device would be normally expected and, in the event of fire , designed to be easily operated without a key or other security device and allow the door to open in the normal manner. If the operation of a locking device is unusual, such as the pressing of a button close to the door, it shall have signage that complies with NZBC F8.3.1, and F8/AS1
- If they are of an electromechanical type, they shall, in the event of a power failure or door malfunction, either automatically switch to the unlocked (fail-safe) condition, or be readily opened by an alternative method

Doors shall be hung to open in the direction of escape if the number of occupants using the door is greater than 50. If escape may be in either direction, doors shall swing both ways.

Doors on escape routes shall satisfy the following width requirements:

- In open paths, provide an unobstructed opening width of no less than 760 mm and, when multi-leaf, have no single leaf less than 500 mm wide. The minimum door opening width may be reduced to 600 mm if it is not required to be an accessible route.
- Within exitways (including entry and final exit doors), reduce the minimum exitway width by no more than the 125 mm per door leaf to:
  - 725 mm into horizontal safe paths
  - 875 within horizontal safe paths and in vertical safe paths,
- Open no less than 90°
- Open onto a floor area which extends for a distance of no less than the arc of the door swing, and is at the same level on both sides of the door for the full width of the escape route
- When opened, not cause the door swing to obstruct the minimum required width of any escape

Approved Building
Consent Documents
BC0817/16
Ashburton District Council

route.

Vision panels shall be provided on doors which are hung to swing both ways, or lead into, or are within, exitways that swing in the direction of escape, or subdivide corridors used as escape routes.

Detector activated hold-open devices shall be fitted to fire doors or smoke control doors:

- Between open paths and exitways if the occupant load is greater than 1000
- For subdividing long corridors
- In fire separations where an escape route passes into an adjacent firecell (eg between a horizontal safe path or smoke lobby and a vertical safe path)
- In locations where, due to the type or volume of occupant traffic using the doors, the doors may be kept open by unauthorised means

Detectors for releasing hold-open devices shall be smoke detectors which are integral with the hold-open device, or located on the ceiling adjacent to the doorset on both sides of the doorset, or part of an automatic smoke detection system on both sides of the doorset.

9. Control of Internal Fire & Smoke Spread

9.1. Glazing

Glazing in fire separations shall be fixed fire resisting glazing having the same FRR values for integrity and insulation as the fire separation, except where uninsulated glazing is permitted within vision panels and for sprinklered buildings. Uninsulated fire resisting glazing having the same integrity value as the fire separation is permitted in fire separations in sprinklered buildings and in external walls.

There is no restriction on the area of glazing in smoke separations (including smoke lobbies). Non-fire resisting glazing may be used if it is toughened or laminated safety glass. Glazing shall have at least the same smoke-stopping ability as the smoke separation.

Glazing in fire doors shall be fire resisting glazing having the same integrity value as the door. If the door requires an insulation value, an uninsulated vision panel may be used without downgrading the insulation value of the door. Vision panels shall comply with NZS 4520. Glazing in smoke control doors shall meet the requirements for smoke separations.

9.2. Structural Stability

The structural stability of primary building elements with a FRR are to be retained for the duration of that FRR. During a fire, primary elements shall resist collapse under the design dead and live loads required by NZBC B1, and any additional loads caused by the fire.

9.3. Fire Stopping

The continuity and effectiveness of fire separations shall be maintained around penetrations, and in gaps between or within building elements, by the use of fire stops. Fire stops shall have a FRR of no less than that required for the fire separation within which they are installed. A fire stop for a penetration is not required to have an insulation rating if means are provided to keep combustible materials at a distance of 300 mm away from the penetration and the fire stop to prevent ignition.

9.4. Junctions with roof

Vertical fire separations and external walls shall either:

a) Terminate as close as possible to the external roof cladding and primary elements providing roof support, with any gaps fully fire stopped or
b) Extend not less than 450 mm above the roof to form a parapet.

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BC0817/16
Ashburton District Council

9.5. Exitways

Safe paths shall be separated from all adjoining firecells by fire separations with an FRR in accordance with the life rating throughout its length.

9.6. Plant, boiler and incinerator rooms

Any space within a building containing an incinerator, plant, boiler or machinery which uses solid fuel, gas or petroleum products as the energy source (but excluding space and local water heating appliances) shall be a separate firecell with an FRR of no less than 90 minutes. In this case all plant is powered by electricity.

9.7. Intermediate floors

Intermediate floors and stairs used as access and their supporting primary elements within the firecell shall have FRRs of at least 30 minutes.

The intermediate floor requirements are:

- The levels of the intermediate floors differ by no more than 1m (complies)
- The total combined occupant load on the intermediate floors is not greater than 100 (complies)
- The total combined area of the intermediate floors is no greater than 40% of the area of the firecell floor not including the area of the intermediate floor as the intermediate floors are completely open (complies)
- 35m^2 for warehouses capable of storage >3m (does not comply)

The intermediate floor non-compliance is the subject of a letter from Thompson Construction and Engineering to the Ashburton District Council.

9.8. Fire dampers

Any duct (unless fully enclosed by construction with an FRR no less than required for the fire separation) that passes through a fire separation shall not reduce the fire resistance of the construction through which the duct passes. Where a fire damper is used to maintain the required fire resistance it shall:

- comply with AS/NZS 1668.1
- have a fire integrity and insulation rating no less than that of the fire separation, except that the damper blade is not required to have an insulation rating if the building is sprinkler protected or means are provided to prevent combustible materials being placed closer than 300 mm to the fire damper and air duct.

Fire dampers shall be capable of being readily accessed for servicing.

9.9. Interior Surface Finishes, floor coverings and suspended flexible fabrics

Interior surface finishes Group numbers must be tested to ISO 9705 or in some cases to ISO 5660.		
Type	**Location**	**Group Number**
Walls/ceilings	Exitways (safe paths)	1 or 2
Walls	Tourist theatre	1, 2 or 3
Ceilings	Tourist theatre	1 or 2
Walls/ceilings	All other occupied spaces	1, 2 or 3
HVAC ducts	Internal surfaces	1 or 2
HVAC ducts	External surfaces	1, 2 or 3
Acoustic treatment & pipe insulation in air handling plenums		1, 2 or 3

Approved Building
Consent Documents
BC0817/16
Ashburton District Council

Interior surface finishes Group numbers must be tested to ISO 9705 or in some cases to ISO 5660.		
Type	**Location**	**Group Number**
Foamed plastics	If foamed plastics building materials or combustible insulating materials form part of a wall, ceiling or roof system, the complete system shall achieve a Group Number as specified above and the foamed plastics shall comply with the flame propagation criteria as specified in AS 1366 for the material being used.	
Exceptions	Surface finish requirements do not apply to: • Small areas of non-conforming product within a firecell with a total aggregate surface area of not more than 5m2 • Electrical switches, outlets, cover plates and similar small discontinuous areas • Pipes and cables used to distribute power or services • Handrails and general decorative trim such as architraves, skirtings and window components, including reveals, provided these do not exceed 5% of the surface area of the wall or ceiling they are part of • Damp-proof courses, seals, caulking, flashings, thermal breaks and ground moisture barriers • Timber joinery and structural timber building elements constructed from solid wood, glulam or laminated veneer lumber. This includes heavy timber columns, beams, portals and shear walls not more than 3.0 m wide, but does not include exposed timber panels or permanent formwork on the underside of floor/ceiling systems • Individual doorsets • Continuous areas of permanently installed openable wall partitions having a surface area of not more than 25% of the divided room floor area or 5m2 , whichever is less.	

Note that the below coatings, or substrate without coating, are considered to achieve the noted Group Number without further evaluation (refer C/VM2 Appendix A):

- Group Number 1 or 1S - Waterborne or solvent based paint coatings ≤0.4mm thick on concrete/masonry (≥15mm thick), sheet metal (≥0.4mm thick) and fibre cement (≥6mm thick)
- Group Number 1 or 1S - Polymeric films ≤0.2mm thick on glass
- Group Number 2 or 2S - Waterborne or solvent based paint coatings ≤0.4mm thick on gypsum plasterboard ≥9.5mm thick, ≥400kg/m^3 core density and <5% organic contribution top board.
- Group Number 3 - Waterborne or solvent based paint coatings, varnish or stain ≤0.4mm thick and ≤100g/m^2 on solid wood or wood product ≥9.0mm thick and ≥600kg/m^3 for particle boards or ≥400kg/m^3 for other wood or wood products

Flooring Flexible finishes such as carpets, vinyl sheet or tiles, and to finished or unfinished floor surfaces	
Location	**Minimum critical radiant flux when tested to ISO 9239-1**
Exitways (safe paths)	2.2 kW/m^2
All other occupied spaces	1.2 kW/m^2

Suspended flexible fabrics Curtains, underlays etc
Suspended flexible fabrics shall be tested to AS 1530 Part 2 and within all occupied spaces including exitways have a flammability index of no greater than 12, and when used as underlay to roofing or exterior cladding that is exposed to view have a flammability index of no greater than 5.

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Consent Documents
BC0817/16
Ashburton District Council

9.10. Building services plant

When any smoke detection system is activated, it shall automatically turn off all air-conditioning and mechanical ventilation plant which is not required or designed for fire safety. Note: does not apply to non-distributed ventilation and air-conditioning such as typical domestic/commercial heat pump units.

9.11. Switchboards

AS/NZS 3000:2007 states that switchboards shall not be installed within a fire isolated stairway, passageway or ramp (exitways). However fire and smoke rated switchboards are acceptable. Similarly switchboards installed within a cupboard etc in a corridor, lobby etc leading to the exitway must have doors sealed to prevent spread of smoke from the switchboard.

10. Control of External Fire Spread

10.1. Horizontal fire spread from external walls

Specific separation requirements for unprotected areas in external walls shall be applied as there are unprotected areas in external walls facing a relevant boundary to other property at an angle of less than 90°. Protection is achieved by:

- Distance separation
- Limiting unprotected areas in external walls

10.2. External wall analysis

Wall elevation	Distance to boundary (m)	Firecell width (m)	Unprotected area (%)	
			Allowed	Actual
Warehouse North	>26	>20	100	
Warehouse East	13.09	>20	85	78.7*
Warehouse West	12	>20	80	78.8*
Warehouse South	40	>20	100	
Ground Offices East	13.09	>10	100	
Ground Offices South	40	>10	100	
First Offices East	13.09	>10	100	
First Offices South	36	>10	100	

* Note that maximum largest single unprotected opening does not apply as the building is greater than 6m from the boundary

10.3. Vertical fire spread between different levels

As the building is sprinklered there is no requirement to examine vertical fire spread.

10.4. Exterior surface finishes

As the building is greater than 1m from the relevant boundary exterior surface finish restrictions do not apply.

11. Firefighting

11.1. Fire Service vehicular access

If buildings are located remotely from the street boundaries of a property, pavements situated on the property and likely to be used for vehicular access by fire appliances shall:

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Consent Documents
BC0817/16
Ashburton District Council

a) Be able to withstand a laden weight of up to 25 tonnes with an axle load of 8 tonnes or have a load-bearing capacity of no less than the public roadway serving the property, whichever is the lower, and
b) Be trafficable in all weathers, and
c) Have a minimum width of 4.0 m, and
d) Provide a clear passageway of no less than 3.5 m in width and 4.0 m in height at site entrances, internal entrances and between buildings, and
e) Provide access to a hard-standing within 20 m of an entrance to the building, and any inlets to fire sprinkler or building fire hydrant systems.

12. Visibility in Escape Routes

F6/AS1 requires emergency lighting in the following areas:

- In all exitways (safe paths)
- At every change of level in an escape route
- In an escape route from the point where the initial open path travel distance exceeds 20m

Emergency lighting is required.

13. Signage

F8/AS1 requires that escape routes be identified by “Exit” signs which are clearly visible and located:

- At each point in the open path where a door giving access to a final exit or an exitway (safe path) is not visible in normal use.
- To clearly indicate each door giving access to a final exit or an exitway (safe path).
- To clearly identify the route of travel through the exitway (safe path)

“No Exit” signs shall be located where any door from an exitway leads to a lower or upper level and not to the final exit.

Exit signs in escape routes shall be illuminated in buildings required to have emergency lighting systems for providing visibility in escape routes as required by NZBC Clause F6.

Fire and smoke control doors shall be identified with signs fixed to both sides of the door leaf adjacent to the handle or push plate, stating ‘Fire Door, keep closed’ or ‘Smoke Control Door, keep closed’, except that door leaves fitted with hold-open devices shall have a sign stating only ‘Fire Door’ or ‘Smoke Control Door’. Fire doors and smoke control doors that have an automatic door closer shall have a sign fixed to the exposed side of the door stating ‘Fire Door (automatic closing) do not obstruct’ or ‘Smoke Control Door (automatic closing) do not obstruct’ as appropriate.

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Consent Documents
BC0817/16
Ashburton District Council

Appendix 1 – Penetrations & Gaps in Fire & Smoke Separations

A register of all penetrations must be kept listing as a minimum the penetration number, location, description (with photo), product used, fire rating and installer. An alternative is the use of the CID International system register (www.cidcert.com). All penetrations are to be similarly labeled (on both sides for walls).

We recommend products from Hilti. Other acceptable manufacturers/products are: 3M, Allproof, CSD, Firetherm and Pyropanel. **No other manufacturers/products are acceptable without prior approval.**

- Installers to be certified in the products they use and all penetrations to be installed under the supervision of a person holding Level 3 or Level 4 of the National Certificate in Passive Fire Protection.
- All penetrations seals must be tested in accordance with AS 1530.4 & AS 4072.1 and installed strictly in accordance with manufacturer's instructions.
- Note that instructions for one manufacturer may not apply to a similar product from another manufacturer.
- Ensure there is no mixing of systems/manufacturers on individual penetrations.
- Particular attention should be made to the selection of proprietary systems to ensure that the system is suitable for the:
  a) orientation of the building element which is being fire stopped
  b) type of construction through which the penetration passes (concrete, masonry, light timber frame etc)
  c) size of the gap being stopped
  d) size of the hole through which the penetration passes
  e) type of penetration (copper pipe, plastic pipe, data cabling etc
  f) proposed maximum filling rate

Type	System
Smoke separations	Sealants must be able to withstand temperatures of up to 200°C which generally requires the use of fire rated sealants as below. Gaps of up to 10mm may be closed with sealants, gaps larger than this must be closed with non-combustible materials prior to sealing.
Fire separations	As below
Construction type	Hollow structures (eg timber framing) will sometimes require a steel sleeve to contain the sealing product apart from single cable penetrations. This depends on product used. Note, if the plasterboard thickness is less than what a systems is tested to, (often 26mm) then the plasterboard thickness can be locally increased to the requirements of the tested system (refer GIB Fire rated systems book page 79). Confirm with manufacturer. Solid structures (eg concrete) do not require a sleeve as the mass of the structure will contain the sealing product. Floors must have the fire collar/sleeve/sealant etc applied at the soffit of the floor unless specifically stated otherwise. Walls must have fire collar/sleeve/sealant etc on both sides of the wall unless specifically stated otherwise. Some products require specific wall and floor thicknesses to comply.
Fire foam	Fire foam is only allowed to be used when filling narrow gaps in walls between solid materials such as concrete/masonry/timber. Note that maximum gap width is generally 15mm which requires the foam to be 100mm deep. Fire foam does not expand in a fire and should never be used with cables or be used in any situation where movement may occur. Fire foams are not generally recommended unless used as a backing for fire sealant. The only exception to this is Hilti CP660 which is the only intumescent (expands in a fire) fire foam currently available

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Consent Documents
BC0817/16
Ashburton District Council

Type	System
Single cable and small bundle penetrations	Use intumescent sealant. Refer to manufacture for maximum gap size, depth, expansion, bundle size etc. Fire foam is not to be used unless Hilti CP660
Multiple cable penetrations & cable trays	Use fire pillows, fire mortar, mineral fibre boards, intumescent fire stop blocks or fire collars in conjunction with intumescent fire sealant to manufacturer's requirements. Fire pillows are generally only to be used for temporary fire stopping. Fire foam is not to be used unless Hilti CP660. Note that bundling of many power cables may cause cable de-rating.
Plastic Pipe penetrations	Use fire sleeves or fire collars to manufacturer's requirements. Fire foam is not to be used. Note that pipes manufactured from different materials with different diameters and wall thicknesses behave differently in fires. Ensure that a particular collar/wrap has been tested for the specific type, size and wall thickness of pipe and the substrate it is installed in.
Metal Pipe penetrations	Use tested sealant, fire mortar or Hilti CP660. Refer to manufacturer for maximum gap size, depth, expansion etc
Multiple penetrations	Use fire mortar, mineral fibre boards or intumescent fire stop boards or blocks in conjunction with intumescent fire sealant to manufacturer's requirements. Fire pillows are generally only to be used for temporary fire stopping. Fire foam is not to be used unless Hilti CP660
Over-sized holes in floors (eg for shower wastes)	Either box out in fire rated materials and apply fire collar etc or use Allproof fire plate or 3M fire plate
Insulated pipes	Insulated pipes penetrating fire separations must have insulating intumescent pipe sleeves (eg Armaflex Protect etc) unless insulation is able to be cut back for sealing.
Fire dampers	Ensure dampers comply with AS/NZS 1668.1 and have a fire rating of -/x/x where x is the required FRR. Note that damper blades may have a FRR of -/x/- if the building is sprinklered or where a means to prevent combustible materials being placed closer to 300mm from the damper and duct is provided. Note that fire collars are not to be used on flexible ductwork.
Recessed fittings	Install proprietary intumescent fire blocks into all metal flush boxes and intumescent seal as required by the manufacturer. Note that 3M fire blocks must be installed in conjunction with intumescent moldable putty. Plastic flush boxes and other recesses in walls must be within fire rated recesses (refer Gib "Fire rated systems" booklet). Recessed ceiling fittings must be within fire rated recess or be protected by Firefly fire canopies and downlight covers.
Curtain Wall Seals	Use mineral wool products in conjunction with proprietary support systems
Joints in concrete/masonry walls	Use intumescent sealant generally with a backing rod
Top of fire wall junction to roof sheeting	Use proprietary mineral wool or fireseal strip products

Approved Building
Consent Documents
BC0817/16
Ashburton District Council

Appendix 2 – Compliance Schedule Information

Compliance Schedules do not come within the scope of the report. The list of specified systems relating to fire is listed below with indicative information needed to assist with the preparation of Compliance Schedules.

SS	Specified Systems	Performance Standard	Maintenance	Inspections	New	Modify
1	Automatic systems for fire suppression. **Type 6 sprinkler system**	NZS 4541:2013	In accordance with NZS 4541:2013	*By IQP* **Weekly, Monthly, Quarterly, Yearly etc**: In accordance with NZS 4541:2013	Yes	
2	Emergency warning systems for fire or other dangers **Type 4 automatic smoke detection system in office block firecells**	NZS 4512:2010	In accordance with NZS 4512:2010	*By IQP* **Monthly & Yearly**: In accordance with NZS 4512:2010	YES	
3/2	Access Controlled Doors **Swipe card/Proximity card/key pad access doors (to be confirmed)**		As Compliance Schedule Handbook	*By owner/occupier* **Monthly:** Check the doors can be opened and they are not locked, barred or blocked. *By IQP* **Half yearly:** Check battery backup, failsafe devices, interface with emergency warning system	YES	
3/3	Interfaced fire or smoke doors or windows **Electromagnetic hold-opens**	AS1851:2005	AS1851:2005 and Compliance Schedule Handbook	*By owner/occupier* **Monthly:** Check the doors can be opened and they are not locked, barred or blocked. *By IQP* **Yearly:** As above plus check failsafe devices, operation of manual release provisions, interface with emergency warning system	YES	
4	Emergency lighting systems **Emergency lighting**	AS 2293:2005 parts 1 & 3 as modified by F6/AS1	AS/NZS 2293.2:1995	*By IQP* **Half yearly:** In accordance with AS/NZS 2293.2	YES	

Approved Building
Consent Documents
BC0817/16
Ashburton District Council

SS	Specified Systems	Performance Standard	Maintenance	Inspections	New	Modify
9	Mechanical Ventilation or air conditioning systems **Fire dampers Shutdown/exhaust on smoke alarm**	AS 1668.1	AS1851	*By IQP* **Quarterly/Half yearly/yearly:** In accordance with AS1856	YES	
13/3	Smoke Curtains **Fire/smoke curtain to edge of two level space**	EN 12101.1	AS 1851	*By IQP* **Half yearly/yearly:** In accordance with AS1851	YES	
14/2	Signs relating to a system or feature specified above **Fire alarm call points/door activation signage/sprinkler storage**	Signs will be visible under all foreseeable conditions including interruption of mains power	As Compliance Schedule Handbook	*By owner/occupier* **Monthly:** Ensure signs are in place where required, they are legible and clean and are illuminated. Record in log book. *By IQP* **Yearly:** As above, complete report to owner and complete required forms	YES	
15/2	Final Exits **Designated final exits (refer attached plan)**		As Compliance Schedule Handbook	*By owner/occupier* **Monthly:** Check the doors can be opened fully and they are not locked, barred or blocked *By IQP* **Yearly:** As above, complete report to owner and complete required forms	YES	
15/3	Fire separations relating to means of escape **(refer attached plans)**	All fire separations shall remain imperforate and any closures in the separation shall ensure they would prevent the passage of fire for the period given as fire resistance rating.	As Compliance Schedule Handbook	*By owner/occupier* **Monthly:** Check for damage, including new penetrations, to separations and operation of doors and security of other closures. Any damage/failure of door operation or other closure to be repaired ASAP. *By IQP* **Yearly:** As above, complete report to owner and complete required forms	YES	

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Consent Documents
BC0817/16
Ashburton District Council

SS	Specified Systems	Performance Standard	Maintenance	Inspections	New	Modify
15/4	Signs for communicating information intended to facilitate evacuation **Exit signs**	AS 2293:2005 parts 1 & 3	AS/NZS 2293.2:1995	*By owner/occupier* **Monthly:** Ensure signs in place where required, they are legible and clean and are illuminated. *By IQP* **Half yearly/Yearly**: In accordance with AS/NZS 2293.2.	YES	
15/5	Smoke Separation **Smoke separations and lobbies**	All smoke separations shall remain imperforate and any closures in the separation shall ensure they would prevent the passage of smoke	All damage to smoke separations shall be repaired as soon as practicable. Doors and other closures shall be checked for operation and security of closure	*By owner/occupier* **Monthly:** Check for damage, including new penetrations, to separations and operation of doors and security of other closures. Any damage/failure of door operation or other closure to be repaired ASAP. *By IQP* **Yearly:** As above, complete report to owner and complete required forms	YES	

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BC0817/16
Ashburton District Council

Section 4 – Supporting Docs

Contents:

- Structural PS1
- Structural Design Features Report
- Structural Calculations

Prepared by Bryce Holloway, Thompson Construction and Engineering for the purpose of:

Building Consent Application
Name: NZDCG Infant Formula Blending Plant Fit Out
Address: 9 Ashford Ave, Ashburton

IPENZ ENGINEERS NEW ZEALAND

chapman CONSULTING ENGINEERS

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BC0817/16
Ashburton District Council

JOB No.: 151413

ISSUE: 1

PRODUCER STATEMENT – PS1 – DESIGN

ISSUED BY:	**Chapman Consulting Engineers Ltd**
DESIGN ENGINEER:	**Marga Lamoreaux**
TO:	**Thompson Construction and Engineering**
TO BE SUPPLIED TO:	**Ashburton District Council**
IN RESPECT OF:	**Tower Structure: Steel beams and braces, and associated connections; Purlins and girts, and associated connections; Precast concrete floor panels; Foundations; and Lateral Stability (bracing).**

AT: **9 Ashford Ave,**

ASHBURTON LOT: **17** DP: **427688**

We have been engaged by **Thompson Construction and Engineering** to provide **Structural Engineering Design only** services in respect of the requirements of Clause(s) **B1** of the Building Code for ☐ All or ☑ Part only (as specified in the attachment to this statement), of the proposed building work.

The design carried out by us has been prepared in accordance with:
☑ Compliance Documents issued by Ministry of Business, Innovation & Employment **B1/VM1 and B1/VM4** or
☐ Alternative solution as per the attached schedule.

The proposed building work covered by the producer statement is described on **Thompson Construction and Engineering's** drawings titled **"*NZ Dairy Collaborative Group – Tower Extension - 9 Ashford Ave., Ashburton*"** and numbered **S0200, S0300-0305, S0401-0405, S0500, S0600, S0603, S0700-0701, and S0703 all Rev -, all dated 27/10/16** together with the specification, and other documents set out in the schedule attached to this statement.

On behalf of Chapman Consulting Engineers Ltd, and subject to:

(i) Site verification of the following design assumptions: **an ultimate foundation bearing capacity of at least 300 kPa; determined in accordance with NZS 3604:2011**

(ii) **These works have been designed for a working life of 50 years**

(iii) **Unless specifically noted, compliance of the drawings to Non Specific codes such as NZS 3604 and NZS 4229 have not been checked by this practice**

(iv) **This certificate does not cover weather-tightness.**

(v) **This Producer Statement - Design is valid for a building consent issued within 1 year from the date of issue**

(vi) All proprietary products meeting their performance specification requirements;

I **believe on reasonable grounds** that a) the building, if constructed in accordance with the drawings, specifications, and other documents provided or listed in the attached schedule, will comply with the relevant provisions of the Building Code and that b), the persons who have undertaken the design have the necessary competency to do so. I also recommend the following level of construction monitoring/observation:
☐ CM1 ☐ CM2 ☑ CM3 ☐ CM4 ☐ CM5 or ☐ as per agreement with owner/developer **Inspections of the building to be completed by the Ashburton District Council. As Chapman Consulting Engineers Ltd are not undertaking inspections, we cannot issue a Producer Statement - PS4 - Construction Review.**

I, **Andrew James Chapman** am CPEng **1006515**. I am a Member of IPENZ and hold the following qualifications: **BE Civil (Hons), MIPENZ(Structural), CPEng, IntPE(NZ)**.

Chapman Consulting Engineers Ltd holds a current policy of Professional Indemnity Insurance no less than $200,000*. Chapman Consulting Engineers Ltd is a member of ACENZ ☐Yes ☑ No.

Signed by **Andrew James Chapman** on behalf of **Chapman Consulting Engineers Ltd** Date: **27 October 2016**

Note: This statement shall only by relied upon by the Building Consent Authority named above. Liability under this statement accrues to the Design Firm only. The total maximum amount of damages payable arising from this statement and all other statements provided to the Building Consent Authority in relation to this building work, whether in contract, tort or otherwise (including negligence), is limited to the sum of $200,000.*

This form is to accompany **Form 2 of the Building (Forms) Regulations 2004** for the application of a Building Consent

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Ashburton District Council

chapman
CONSULTING ENGINEERS

28 October 2016

Thompson Construction and Engineering
PO Box 2081
Washdyke
TIMARU

File No.: 151413

Attn: Bryce

DESIGN FEATURES SUMMARY – PROPOSED NEW EQUIPMENT TOWER FOR NZ DAIRY COLLABORATIVE GROUP - 9 ASHFORD AVE., ASHBURTON

General:

Loadings Standard Use:	AS/NZS 1170
Design working life:	50 years
Importance Level:	**2**

Site Specific Loads:

Live:

Roof:	0.25 kPa
Floor:	3.0 kPa
	+ equipment weight

Dead:

Roof:	0.35 kPa
Floor (Precast):	3.60 kPa
Walls:	0.35 kPa

Snow:

Height above sea level:	100 m
Snow Zone (AS/NZS1170.3)	N4
Ground Snow Load, Sg:	0.9 kPa
Design Snow Load, S:	**0.63 kPa**

Wind:

Wind Region:	A7
Terrain Category:	2
Lee Zone?:	No
Design Wind Speed (AS/NZS1170.2)	**45.4 m/s**

Seismic:

Ductility, μ:	3
Hazard Factor:	0.2
Subsoil Category:	D

Design Standards:

The following material standards have been used in the design of this structure:

- NZS 3404:1997 Steel Structures Standard
- NZS 3101:2006 Concrete Structures Standard

Yours Faithfully
CHAPMAN CONSULTING ENGINEERS LTD

ANDREW CHAPMAN
Director | BE Civil (Hons), MIPENZ, CPEng, IntPE(NZ)

C:\Users\Andrew\Dropbox (CCE)\CCE Team Folder (1)\Projects 2015\151413 NZ Collaborative Tower, Ashburton\3. ENGINEERING\a. Producer Statements\151413 DFR (1) 28 Oct 16 ajc.docx

chapman CONSULTING ENGINEERS

Job Name: NZ Dairy Tower Fdn.
Title:

Job No.: 15143
Date: 20.09.16
Name:
Sheet No.: P.01.

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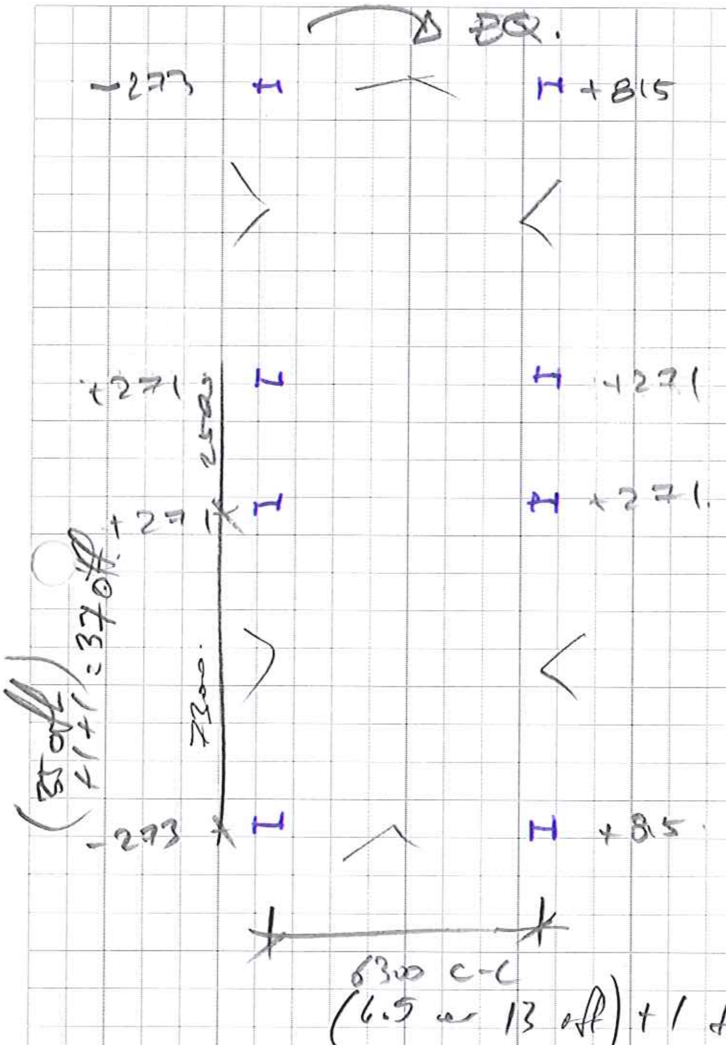


Modelled in Microstran.

Founded on gravels: Cow, q_{ult} = 450 kPa.

⇒ K_c = 17.5 MN/m³

x .5² = 4375 kN/m.

500 thk Pad: $d = 500 - 75\text{ cover} - 16 - \frac{16}{2} = 401$; b = 500 mm.

H16 @ 300 crs: ϕM_n = 55.0 kNm (per 0.5m to suit M.S. grid)

H16 @ 150 crs: ϕM_n = 109.7 kNm ✓.

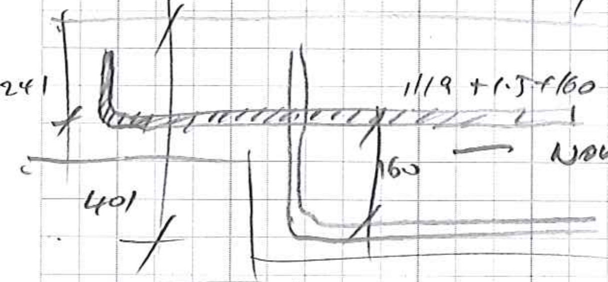
ϕV_n (No shear steel) = 77.8 kN.

Over Pads: d = ~~226~~ 241 mm. (~~50~~ 35 cover to avoid pad)

to achieve 99 kNm/500mm

A_{st} = 1170 mm²/
H20 @ ~~134~~ 145 crs.

H20 @ 150 crs.



1119 + 1.5 + 160 = ~~1358~~ 1400.

— Non-contact lap.

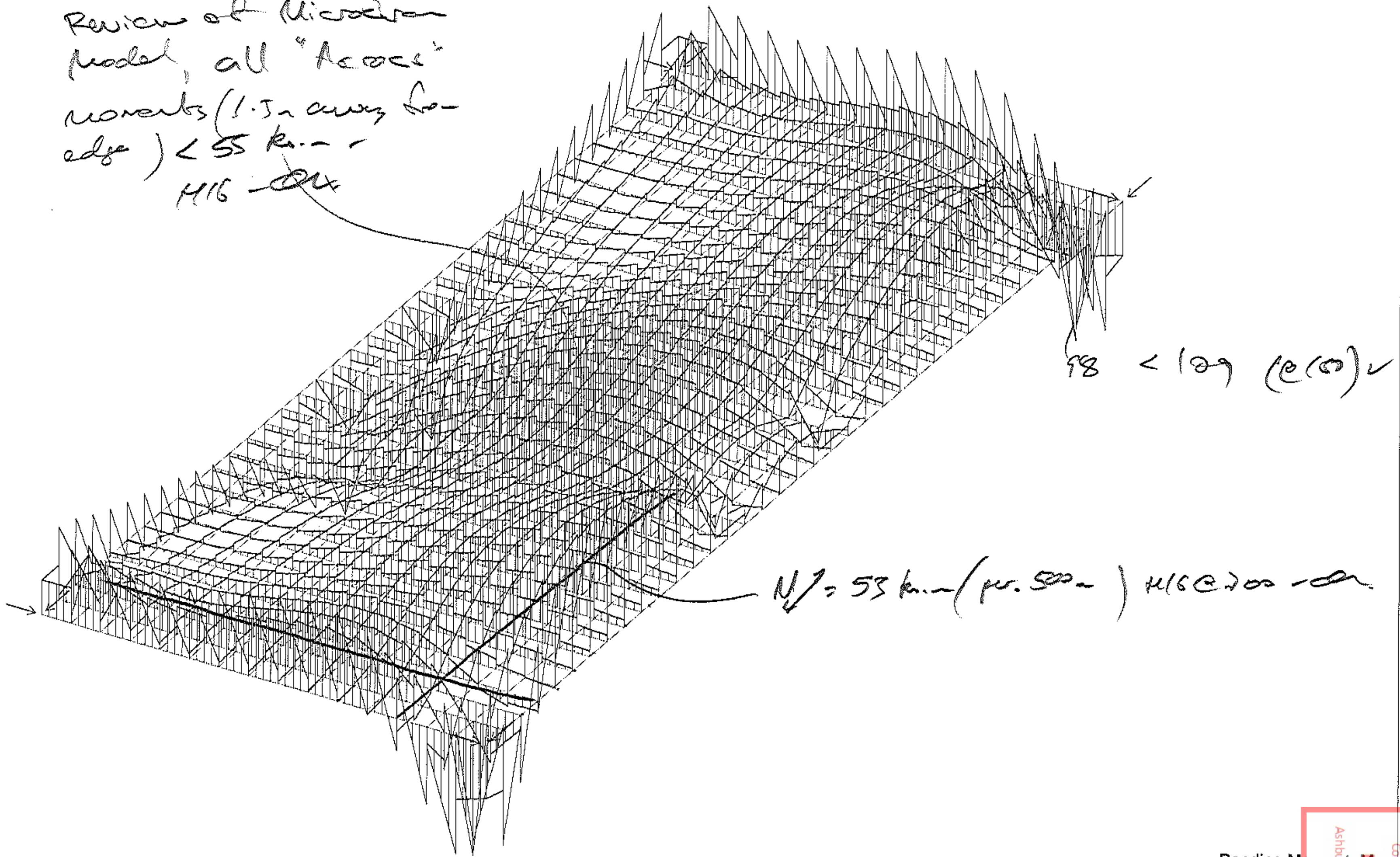
chapman CONSULTING ENGINEERS

Chapman Consulting Engineers Ltd
Job: 151413 ENG Fdn (1) 500 slab + 500 edge 20 Sep 16 ajc
151413 NZ Diary Tower
Foundations

20/09/2016
05:24:11 p.m.

Load Cases:
28 C ULS8: G + EQ

Review of Microstran model, all "Across" moments (1.5m away from edge) < 55 kNm - H16 - OK



theta: 300 phi: 30

Bending Moment, Mz

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BC0816/16
Ashburton District Council

F.02

Load Cases:
—— 28 C ULS8: G + EQ

Some legs on exty pads.
∴ h = 300 deep.
d = 300 - 50 - 16 - 8 = 226 mm.

2-D10 @ 49 crs.
or 6-D10 @ 144 crs
Max spacing = 226/2 = 113.

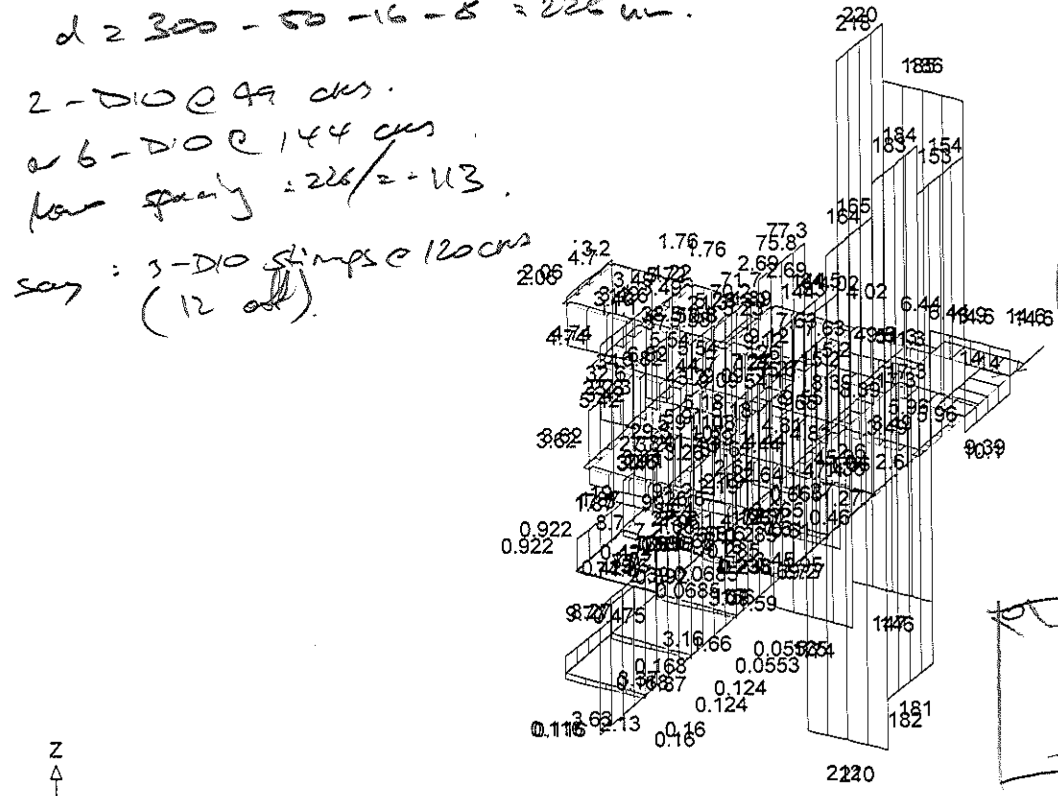
say: 3-D10 stirrups @ 120 crs (12 off).

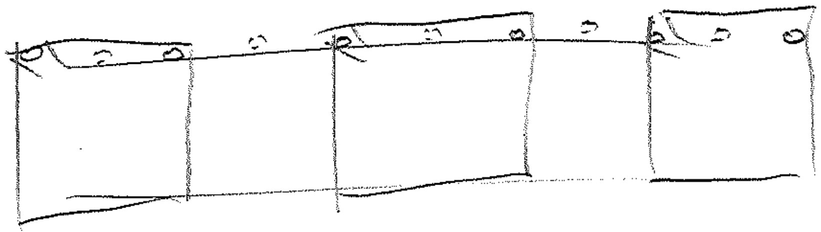
$V^* = 220$ kN.
d = 401 mm
f_{yt} = 300 MPa.
b = 500 mm
A_g = 2670 mm²

$v_n = 1.463$ MPa
$v_c = 0.517$
$A_v = 1576.5$ mm²/m.
2-D10 @ 100 crs

(Need shear reinforcing where $V^* > \frac{1}{2}\phi V_n$ = > 38.7.
or for 1.5m × 1.5m around legs.)

Max spacing: d/2 = 200 mm.





Shear Force, Fy
Shear Force, Fz

theta: 300 phi: 30

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BC0812/16
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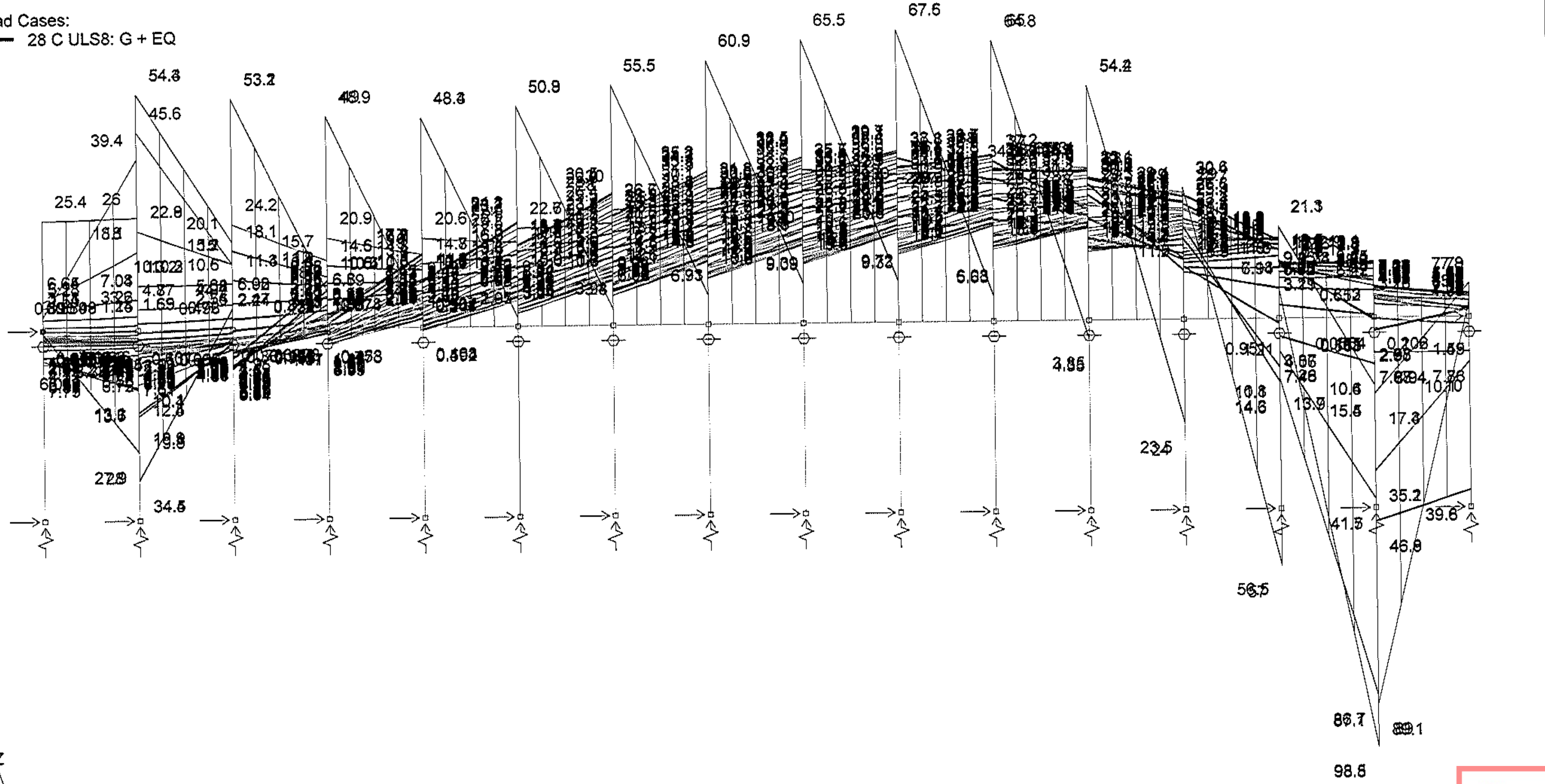
Chapman Consulting Engineers Ltd
Job: 151413 ENG Fdn (1) 500 slab + 500 edge 20 Sep 16 ajc
151413 NZ Diary Tower
Foundations

20/09/2016
05:19:31 p.m.

Load Cases:
28 C ULS8: G + EQ



theta: 270 phi: 0

Microstran V9.01.130911 {2508411}

...\151413 ENG Fdn (1) 500 slab + 500 edge 20 Sep 16 ajc

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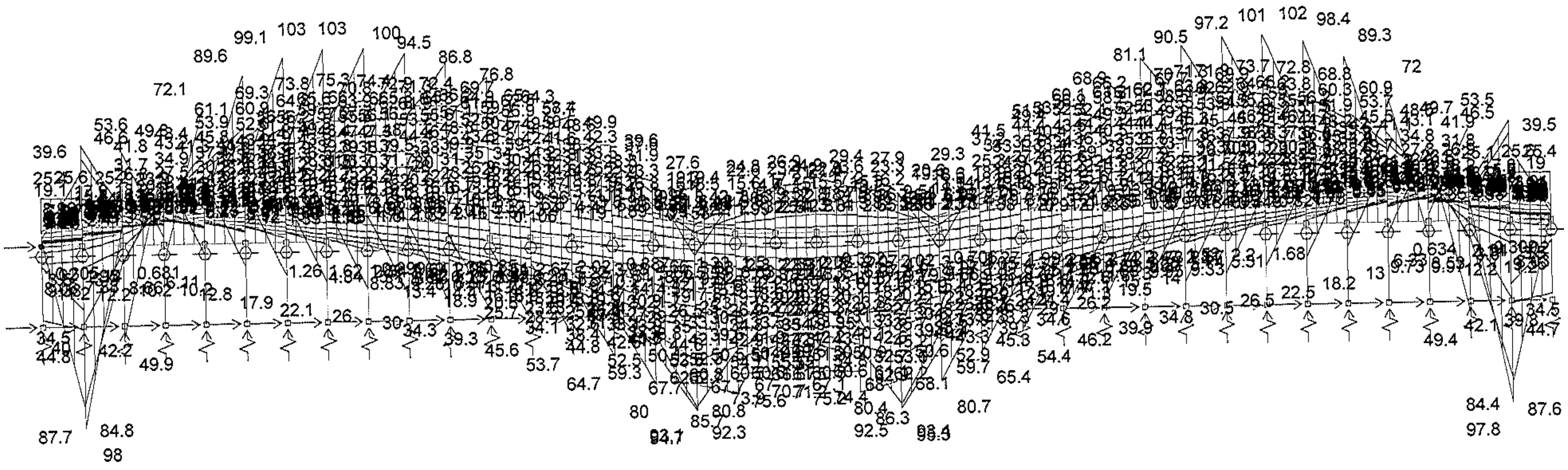
Chapman Consulting Engineers Ltd
Job: 151413 ENG Fdn (1) 500 slab + 500 edge 20 Sep 16 ajc
151413 NZ Diary Tower
Foundations

20/09/2016
05:19:43 p.m.

Load Cases:
28 C ULS8: G + EQ



Bending Moment, Mz

theta: 180 phi: 0

...\151413 ENG Fdn (1) 500 slab + 500 edge 20 Sep 16 ajc

Microstran V9.01.130911 {2508411}

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BC0817/16
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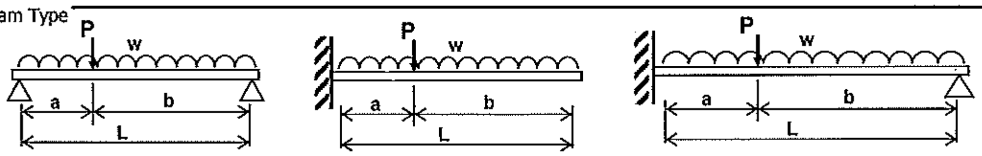
BC0817/16
Ashburton District Council

BEAM 1: ~~central balcony~~ **Date:** **Eng:** **Job No.:**

Beam Type



◉ Simply Supported   O Cantilever   O Proped Cantilever

BEAM TYPE IS: Simply Supported

Beam Layout

L =	**7300 mm**
a =	**3650 mm**

Loading

		ψ_s	Load Factor	k_2
Gudl =	**11.88 kN/m**	1.00	1.2	**2.0**
Qudl =	**9.90 kN/m**	0.70	1.5	**1.0**
Gpoint =	**0.00 kN**	1.00	1	**2.0**
Qpoint =	**0.00 kN**	0.70	1	**1.0**

Allow. Defn = **24.3 mm** **= L/ 300** or max. of 25.0 mm

TIMBER

E = 0.0 GPa

Ireq(timber) = #DIV/0! mm^4

B =   (Dmin = #DIV/0!)

D =

Actual Defn = **#DIV/0!** #DIV/0!

Max. Defn under 1 kN pt load = **#DIV/0!**

STEEL

E = 205 GPa

Ireq(steel) = 1.39E+08 mm^4

(139.431E+6)

410 UB 53.7 (1881E+6)

Actual Defn = **18.0 mm** = L/ 404

Max. Defn under 1 kN pt load = **0.2 mm**

k_1 =	0.80				
k_4 =	1.00 (1.0 for LVL)	**Le or Lay** =	3650 mm (zero for FLR)		
fb =	0.0 MPa	w(u) =	29.11 kN/m	α_m =	1.17
k_8 =	#DIV/0!	P(u) =	0.00 kN	α_s =	0.610
ϕMn =	**#DIV/0!**	**M*+ve =**	**193.88 kN.m** (Mid Span)	**ϕMbx =**	**217.11 kN.m**
ϕVn =	0.00 kN	**M*-ve =**	-	ϕMsx =	305.28 kN.m

	$R_{A,G}$ =	43.36 kN	$R_{B,G}$ =	43.36 kN
	$R_{A,Q}$ =	36.14 kN	$R_{B,Q}$ =	36.14 kN
Pad Ultimate	$R_{A,Ult}$ =	**106.24 kN**	$R_{B,Ult}$ =	**106.24 kN**

Bearing Pressure

q_{ult} =	300 kPa	Pad (300kPa) =	842 mm SQ	Pad (300kPa) =	842 mm SQ
Φ_{br} =	0.50				

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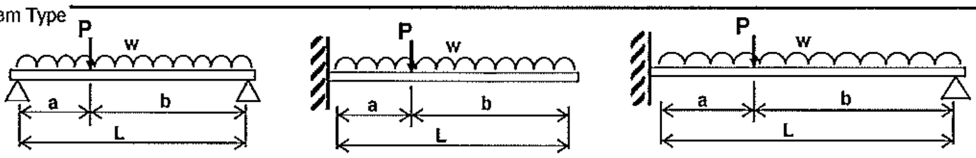
Consent Documents
BC0817/16
Ashburton District Council

BEAM 1: ~~central balcony~~ **Date:** **Eng:** **Job No.:**

Beam Type



● Simply Supported   O Cantilever   O Proped Cantilever

BEAM TYPE IS: Simply Supported

Beam Layout

L = 7300 mm
a = 3650 mm

Loading

		ψ_s	Load Factor	k_2
Gudl =	11.88 kN/m	1.00	1.2	2.0
Qudl =	9.90 kN/m	0.70	1.5	1.0
Gpoint =	0.00 kN	1.00	1	2.0
Qpoint =	0.00 kN	0.70	1	1.0

Allow. Defn = 24.3 mm = L/ 300 or max. of 25.0 mm

TIMBER

E = 0.0 GPa
Ireq(timber) = #DIV/0! mm^4
(Dmin = #DIV/0!)
B =
D =
Actual Defn = #DIV/0! #DIV/0!
Max. Defn under 1 kN pt load = #DIV/0!

STEEL

E = 205 GPa
Ireq(steel) = 1.39E+08 mm^4
(139.431E+6)
360 UB 56.7 (1611E+6)
Actual Defn = 21.1 mm = L/ 346
Max. Defn under 1 kN pt load = 0.2 mm

k_1 = 0.80
k_4 = 1.00 (1.0 for LVL)
fb = 0.0 MPa
k_8 = #DIV/0!
ϕMn = #DIV/0!
ϕVn = 0.00 kN

Le or Lay = 3650 mm (zero for FLR)
w(u) = 29.11 kN/m
P(u) = 0.00 kN
M*+ve = 193.88 kN.m (Mid Span)
M*-ve = -

α_m = 1.17
α_s = 0.650
ϕMbx = 206.60 kN.m
ϕMsx = 272.70 kN.m

$R_{A,G}$ = 43.36 kN $R_{B,G}$ = 43.36 kN
$R_{A,Q}$ = 36.14 kN $R_{B,Q}$ = 36.14 kN
Pad Ultimate $R_{A,Ult}$ = 106.24 kN $R_{B,Ult}$ = 106.24 kN

Bearing Pressure
q_{ult} = 300 kPa   Pad (300kPa) = 842 mm SQ   Pad (300kPa) = 842 mm SQ
Φ_{br} = 0.50

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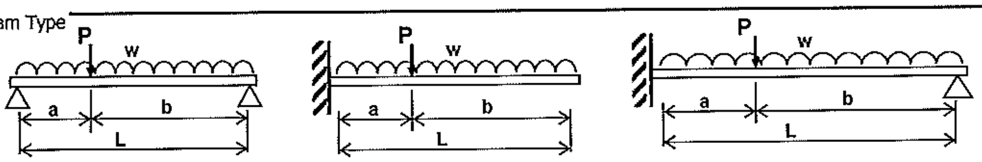
Consent Documents
BC0817/16
Ashburton District Council

BEAM 1: central balcony **Date:** **Eng:** **Job No.:**

Beam Type



◉ Simply Supported ○ Cantilever ○ Proped Cantilever

BEAM TYPE IS: Simply Supported

Beam Layout

L =	**6600 mm**
a =	**3300 mm**

Loading

		ψ_s	Load Factor	k_2
Gudl =	**13.14 kN/m**	1.00	1.2	**2.0**
Qudl =	**10.95 kN/m**	0.70	1.5	**1.0**
Gpoint =	**0.00 kN**	1.00	1	**2.0**
Qpoint =	**0.00 kN**	0.70	1	**1.0**

Allow. Defn = **22.0 mm** **= L/ 300** or max. of 25.0 mm

TIMBER

E = 0.0 GPa

Ireq(timber) = #DIV/0! mm^4

(Dmin = #DIV/0!)

B =

D =

Actual Defn = **#DIV/0!** #DIV/0!

Max. Defn under 1 kN pt load = **#DIV/0!**

STEEL

E = 205 GPa

Ireq(steel) = 1.14E+08 mm^4

(113.971E+6)

310 UB 40.4 (86.41E+6)

Actual Defn = **29.0 mm** = L/ 227

Max. Defn under 1 kN pt load = **0.3 mm**

k_1 = 0.80

k_4 = 1.00 (1.0 for LVL)

fb = 0.0 MPa

k_8 = #DIV/0!

ϕMn = **#DIV/0!**

ϕVn = 0.00 kN

Le or Lay = 0 mm (zero for FLR)

w(u) = 32.19 kN/m

P(u) = 0.00 kN

M*+ve = 175.29 kN.m (Mid Span)

M*-ve = -

α_m = 1.17

α_s = 1.000

ϕMbx = 182.30 kN.m

ϕMsx = 182.30 kN.m

$R_{A,G}$ = 43.36 kN $R_{B,G}$ = 43.36 kN

$R_{A,Q}$ = 36.14 kN $R_{B,Q}$ = 36.14 kN

Pad Ultimate **$R_{A,Ult}$ = 106.24 kN** **$R_{B,Ult}$ = 106.24 kN**

Bearing Pressure

q_{ult} = 300 kPa Pad (300kPa) = 842 mm SQ Pad (300kPa) = 842 mm SQ

Φ_{br} = 0.50

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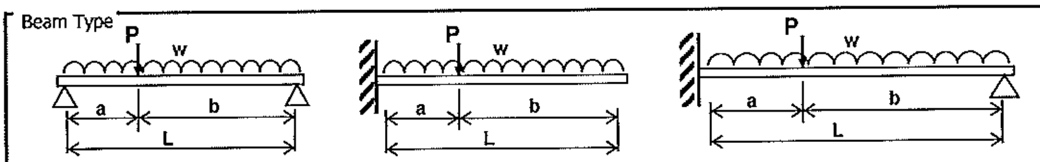
Consent Documents
BC0817/16
Ashburton District Council

BEAM 1: ~~central balcony~~ **Date:** **Eng:** **Job No.:**

Beam Type



◉ Simply Supported ○ Cantilever ○ Proped Cantilever

BEAM TYPE IS: Simply Supported

Beam Layout

L = 6600 mm
a = 3300 mm

Loading

		ψ_s	Load Factor	K_2
Gudl =	7.07 kN/m	1.00	1.2	2.0
Qudl =	5.48 kN/m	0.70	1.5	1.0
Gpoint =	0.00 kN	1.00	1	2.0
Qpoint =	0.00 kN	0.70	1	1.0

Allow. Defn = 22.0 mm = L/ 300 or max. of 25.0 mm

TIMBER

E = 0.0 GPa
Ireq(timber) = #DIV/0! mm^4
(Dmin = #DIV/0!)
B =
D =
Actual Defn = #DIV/0! #DIV/0!
Max. Defn under 1 kN pt load = #DIV/0!

STEEL

E = 205 GPa
Ireq(steel) = 5.97E+07 mm^4
(59.751E+6)
310 UB 32.0 (63.21E+6)
Actual Defn = 20.8 mm = L/ 317
Max. Defn under 1 kN pt load = 0.5 mm

k_1 = 0.80
k_4 = 1.00 (1.0 for LVL)
fb = 0.0 MPa
k_8 = #DIV/0!
ϕMn = #DIV/0!
ϕVn = 0.00 kN

Le or Lay = 0 mm (zero for FLR)
w(u) = 16.70 kN/m
P(u) = 0.00 kN
M*+ve = 90.95 kN.m (Mid Span)
M*-ve = -

α_m = 1.17
α_s = 1.000
ϕMbx = 136.80 kN.m
ϕMsx = 136.80 kN.m

$R_{A,G}$ = 23.33 kN
$R_{A,Q}$ = 18.08 kN
$R_{A,Ult}$ = 55.12 kN

$R_{B,G}$ = 23.33 kN
$R_{B,Q}$ = 18.08 kN
$R_{B,Ult}$ = 55.12 kN

Pad Ultimate Bearing Pressure
q_{ult} = 300 kPa
Φ_{br} = 0.50

Pad (300kPa) = 606 mm SQ
Pad (300kPa) = 606 mm SQ

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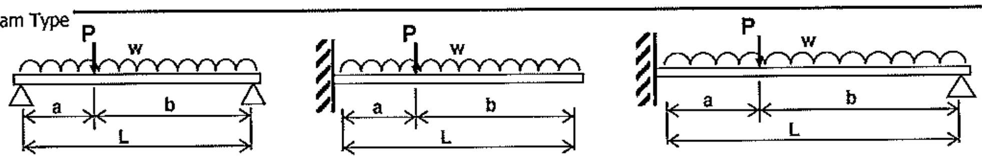
Consent Documents
BC0817/16
Ashburton District Council

BEAM 1: ~~central balcony~~ **Date:** **Eng:** **Job No.:**

Beam Type



◉ Simply Supported   O Cantilever   O Proped Cantilever

BEAM TYPE IS: Simply Supported

Beam Layout

L =	**7300 mm**
a =	**3650 mm**

Loading

		ψ_s	Load Factor	K_2
Gudl =	**11.88 kN/m**	1.00	1.2	**2.0**
Qudl =	**9.90 kN/m**	0.70	1.5	**1.0**
Gpoint =	**0.00 kN**	1.00	1	**2.0**
Qpoint =	**0.00 kN**	0.70	1	**1.0**

Allow. Defn = **24.3 mm** **= L/ 300** or max. of 25.0 mm

TIMBER

E = 0.0 GPa

Ireq(timber) = #DIV/0! mm^4

(Dmin = #DIV/0!)

B =

D =

Actual Defn = **#DIV/0!** #DIV/0!

Max. Defn under 1 kN pt load = **#DIV/0!**

STEEL

E = 205 GPa

Ireq(steel) = 1.39E+08 mm^4

(139.431E+6)

360 UB 50.7 (1421E+6)

Actual Defn = **23.9 mm** = L/ 306

Max. Defn under 1 kN pt load = **0.3 mm**

k_1 = 0.80

k_4 = 1.00 (1.0 for LVL)

fb = 0.0 MPa

k_8 = #DIV/0!

ϕMn = #DIV/0!

ϕVn = 0.00 kN

Le or Lay = 0 mm (zero for FLR)

w(u) = 29.11 kN/m

P(u) = 0.00 kN

M*+ve = 193.88 kN.m (Mid Span)

M*-ve = -

α_m = 1.17

α_s = 1.000

ϕMbx = 242.19 kN.m

ϕMsx = 242.19 kN.m

$R_{A,G}$ = 43.36 kN $R_{B,G}$ = 43.36 kN

$R_{A,Q}$ = 36.14 kN $R_{B,Q}$ = 36.14 kN

Pad Ultimate   **$R_{A,Ult}$ = 106.24 kN**   **$R_{B,Ult}$ = 106.24 kN**

Bearing Pressure

q_{ult} = 300 kPa   Pad (300kPa) = 842 mm SQ   Pad (300kPa) = 842 mm SQ

Φ_{br} = 0.50

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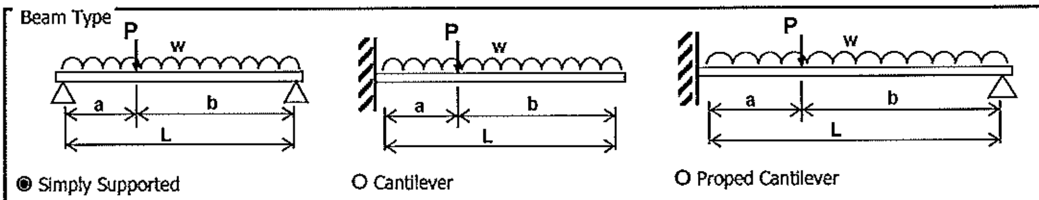
BEAM 1: ~~central balcony~~ **Date:** **Eng:** **Job No.:**



BEAM TYPE IS: Simply Supported

Beam Layout

L = 7300 mm
a = 3650 mm

Loading

		ψ_s	Load Factor	K_2
Gudl =	11.88 kN/m	1.00	1.2	2.0
Qudl =	9.90 kN/m	0.70	1.5	1.0
Gpoint =	0.00 kN	1.00	1	2.0
Qpoint =	81.00 kN	0.70	1.2	1.0

Allow. Defn = 24.3 mm = L/ 300 or max. of 25.0 mm

TIMBER

E = 0.0 GPa
Ireq(timber) = #DIV/0! mm^4
B = (Dmin = #DIV/0!)
D =
Actual Defn = #DIV/0! #DIV/0!
Max. Defn under 1 kN pt load = #DIV/0!

STEEL

E = 205 GPa
Ireq(steel) = 2.32E+08 mm^4
(231.551E+6)
460 UB 67.1 (2961E+6)
Actual Defn = 19.0 mm = L/ 383
Max. Defn under 1 kN pt load = 0.1 mm

k_1 = 0.80
k_4 = 1.00 (1.0 for LVL)
fb = 0.0 MPa
k_8 = #DIV/0!
ϕMn = #DIV/0!
ϕVn = 0.00 kN

Le or Lay = 0 mm (zero for FLR)
w(u) = 29.11 kN/m
P(u) = 97.20 kN
M*+ve = 371.27 kN.m (Mid Span)
M*-ve = -

α_m = 1.27
α_s = 1.000
ϕMbx = 399.60 kN.m
ϕMsx = 399.60 kN.m

$R_{A,G}$ = 43.36 kN
$R_{A,Q}$ = 76.64 kN
$R_{A,Ult}$ = 154.84 kN

$R_{B,G}$ = 43.36 kN
$R_{B,Q}$ = 76.64 kN
$R_{B,Ult}$ = 154.84 kN

Pad Ultimate Bearing Pressure

q_{ult} = 300 kPa
Φ_{br} = 0.50

Pad (300kPa) = 1016 mm SQ
Pad (300kPa) = 1016 mm SQ

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Job Name: NZ DAIRY TOWER

Title: BRACING

Job No.:
Date:
Name:
Sheet No.:

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ROOF

RB12

4

RB20

3

150x9 SHS 'K'

2

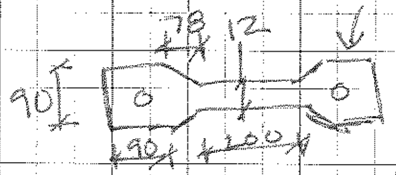
150x6 SHS 'K'

1

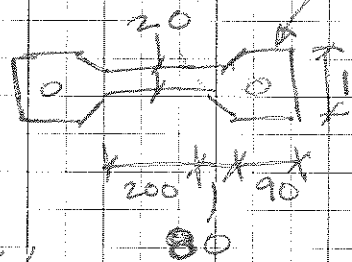
150x9SHS 'K'

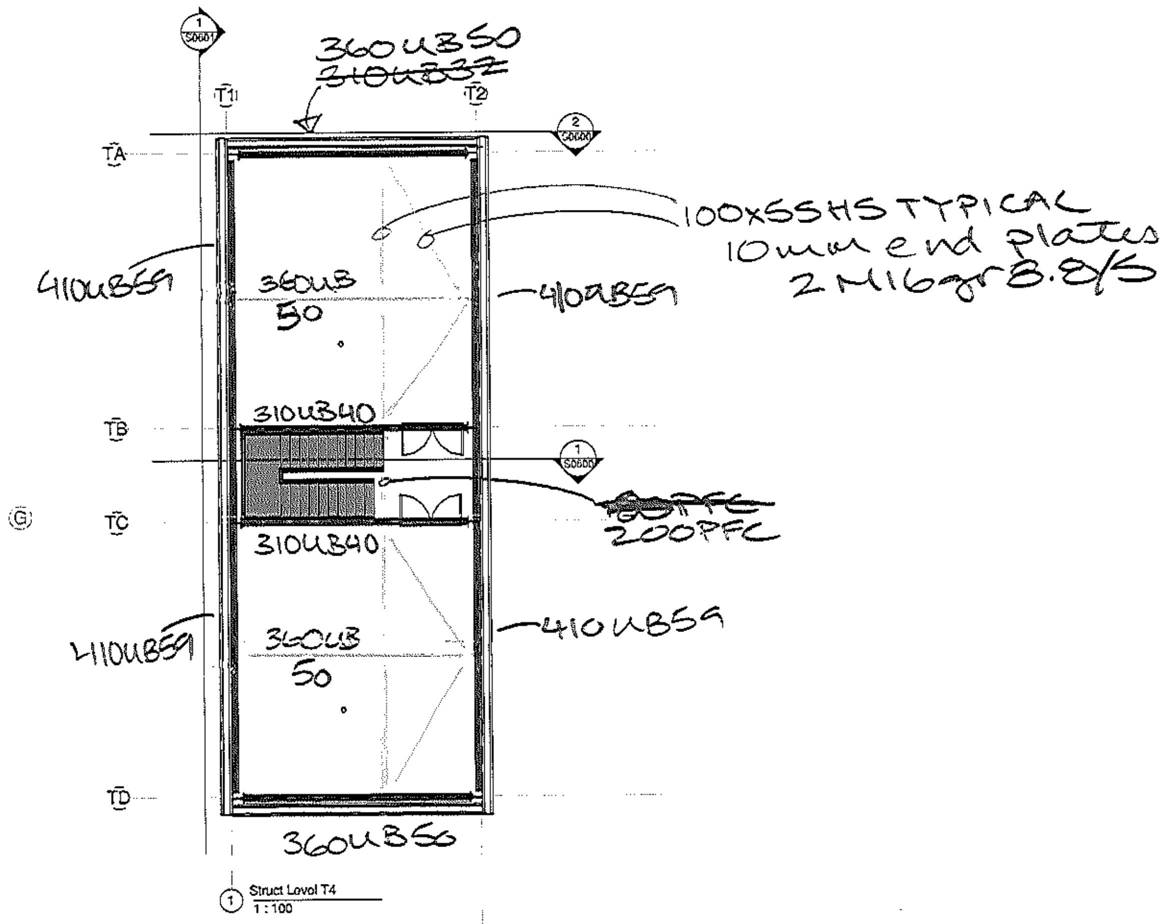
GROUND

M16gr8.8 bolt
12mm GR300 PL



M30gr8.8 bolt
20mm GR300 PL





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17/08/2016 11:23:34 a.m.

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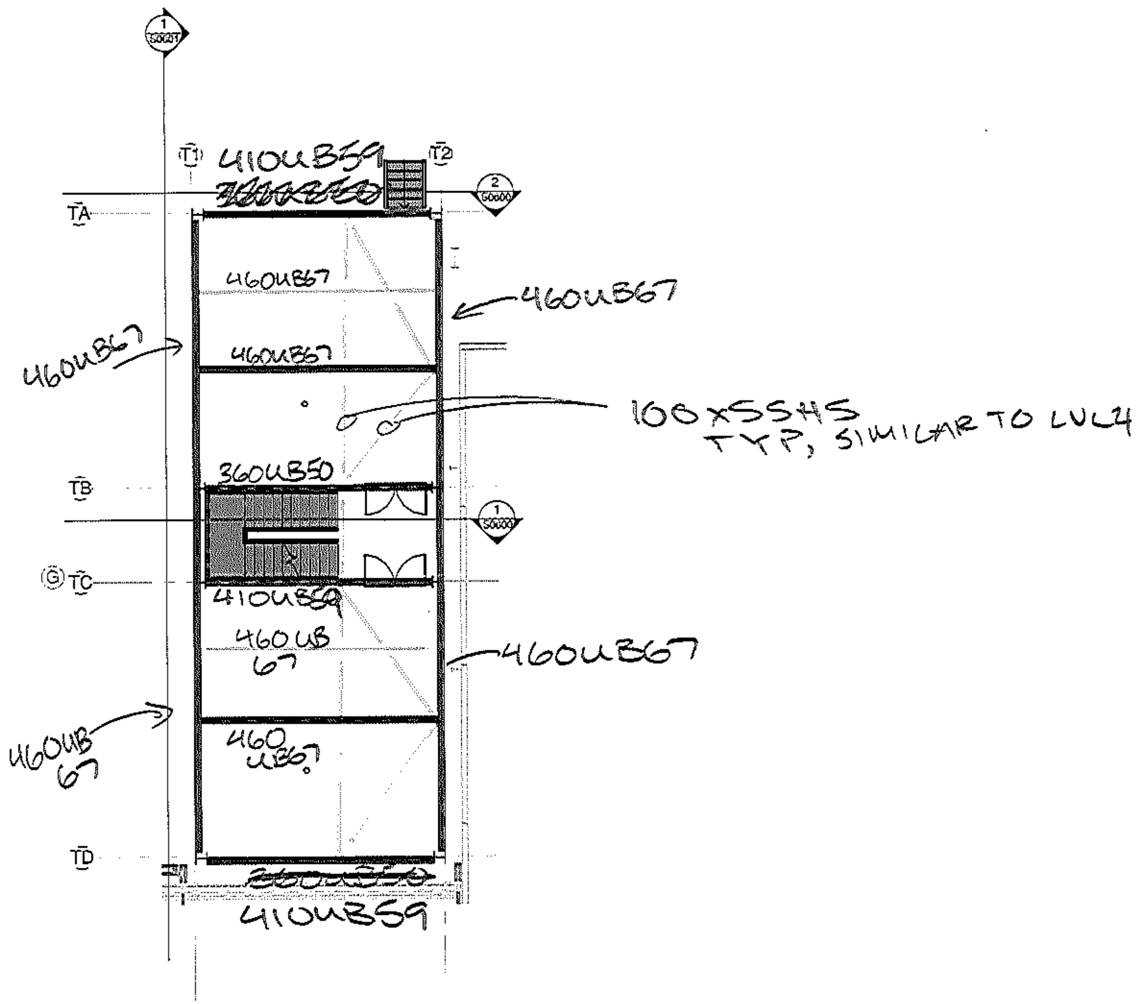
PH 0800 588 716 | F (03) 688 7168 | www.thompsonengineering.co.nz | design@thompsonengineering.co.nz

PROJECT	Rev#	Amendments	Date		
NZ Dairy Collaborative Group Tower Extension 9 Ashford Ave, Ashburton				SCALE 1 : 100 @ A2	JOB # 12930
				DRAWN BY B.Holloway	DATE 10/08/16
				CHECKED BY Checker	REV
				Tower Level 4	S0305

All Drawings property of Thompson Engineering 2002 Ltd

Please note: All dimensions to be verified on site

Paper size: A2



Struct Level T1
1 : 100

LVL 3

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PROJECT	NZ Dairy Collaborative Group Tower Extension 9 Ashford Ave, Ashburton
Rev#	
Amendments	
Date	
SCALE	1 : 100 @ A2
JOB #	12630
DRAWN BY	B.Holloway
DATE	10/08/16
CHECKED BY	Checker
REV	
	Tower Level 1
	S0302

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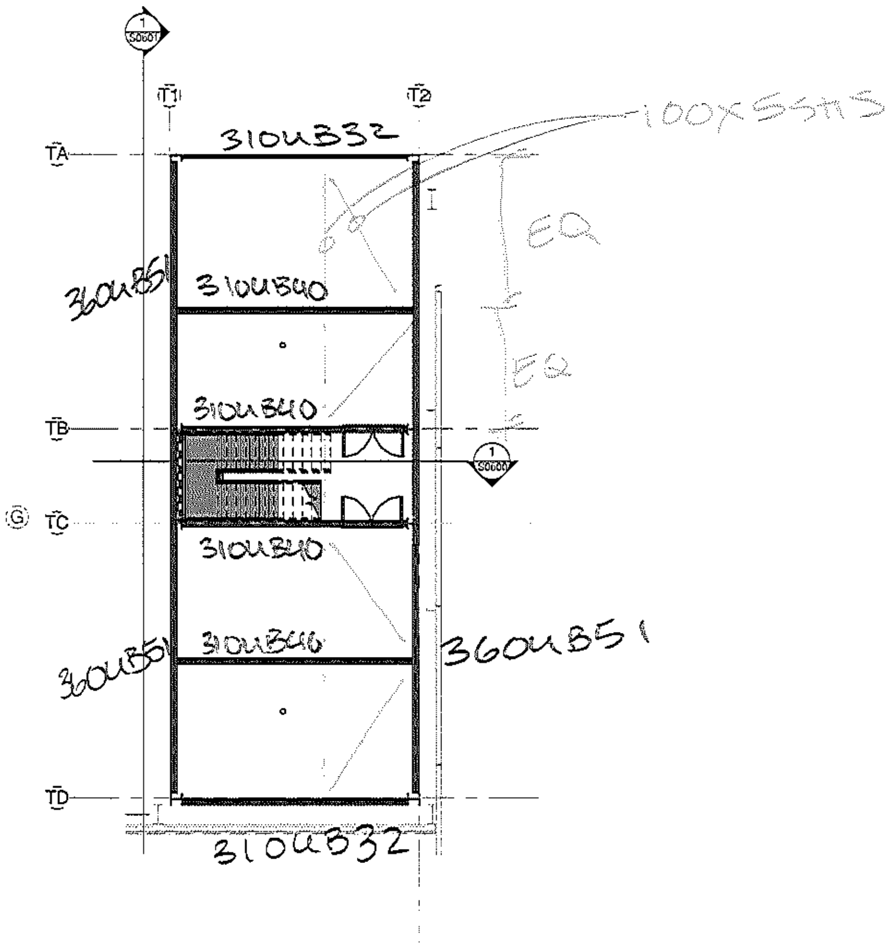
Please note: All dimensions to be verified on site

Paper size: A2



1 Struct Level T2
1 : 100

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17/08/2016 11:23:34 a.m.

w/ sim

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Ashburton District Council

THOMPSON CONSTRUCTION & ENGINEERING	PROJECT: NZ Dairy Collaborative Group Tower Extension 9 Ashford Ave, Ashburton	Rev#	Amendments	Date	SCALE 1 : 100 @ A2 DRAWN BY B.Holloway CHECKED BY Checker Tower Level 2
					JOB # 12630 DATE 10/08/16 REV S0303

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All Drawings property of Thompson Engineering 2002 Ltd

Please note: All dimensions to be verified on site
Paper size: A2

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Name:
Sheet No.:

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Job Name:

Title:

Job No.: Date: Name: Sheet No.:

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~~410UB~~

460UB67 V.link

360UB51

327kN
± 347kN } uplift seismic

832kN ↑

G = 271

= 561kN uplift

102kN in shear

360UB51 $\phi M_{sx} = 242$

$\phi V_v = 449$

$d_b < e_{link} < \frac{1.6 M_s}{V_w}$

360 < ec < 862 150<360

$V_{link} = V_c \frac{h_s}{L}$

$= 110^{kN} \times \frac{4000mm}{7300}$

$= 369^{kN} \times \frac{4}{7.3}$

$= 202 \div 2 = 101$ model says 110

180UB18

~~90w~~/150UB

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180UB18 $\phi M = 45.2^{kN\text{-}m}$

$\phi V = 151$ $V^* = 110$

~~$1.15 \frac{110}{151}$~~ $O/S = \frac{151}{110} \times 1.15$

$= \boxed{1.57}$

∴ Axial for holddown

$347(1.57) - 271 = \underline{273}^{kN}$

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	M	h	Mh		
4	619	15.6	9656	45.8%	F = 420
3	715	11.3	8080	31.7%	= 290
2	539	6.6	3557	15.2%	= 139
1	539	4.0	2156	7.3%	= 67
	Σ 2412		Σ 23449		

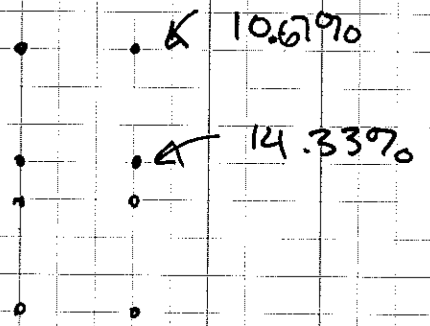
if T = 0.4 $C_d(T)_{\mu 1} = 0.47$

$\mu_{1.25} = 0.38$

$\mu_3 = 0.15$

$V_{b1.25} = 916\ kN$

57% of rough design



A = 112.86

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Revised Loads #2

①
150 slab 371
steel 51
~~walls~~ ~~24~~ 19
50mm Brader
47.4x3.3x0.12
Q (3kPa) 309 93

G = ~~446~~ 441
ΨQ = 93
[539]

②
AS ABOVE

③
150slab 371
steel 57
walls 32
Q3 309 93
QPLANT 162 162

G = 460
ΨQ = 255
[715]

④
150slab 371
steel ~~61~~ 57
walls 4.31 ~~46~~ 32
Q3 309 93
Qplant 48 48

G = ~~478~~ 460
ΨQ = 141
[~~619~~] 601

⑤ Roof 39.5
strut 25
walls 16

G = 81 kN

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A = 103

	M	h	Mh	EQ.ST.
4	743	15.6	11590	45.7%
3	964	11.3	10893	35.4%
2	546	6.6	3604	12.7%
1	546	4.0	2184	6.2%
	2799 kN		Σ 28271	

Base Shear (worst) =
~~TOTAL WEIGHT~~ = $\mu_{1.25}$ 1595 kN

for T = 0.4

$\mu_3 = 0.23$

$\mu_{1.25} = 0.57$

$\mu_1 = 0.71$

if over 2 bays...

$\frac{1595}{2} = 797$

Rough size columns

$797 \times \frac{4.0}{6.3}$

= 506 kN ↑↓

+

sw $\frac{2799}{8}$

N* = 855

V* = 398

410UB59

or 360 UB56

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	M	N	Mu	%	F3
R	81	19.9	1614	14.0	52
4	601	15.6	9376	34.9	129
3	715	11.3	8080	30.1	111
2	534	6.6	3524	13.1	49
1	534	4	2136	7.9	29
	Σ 2465		Σ 24730		

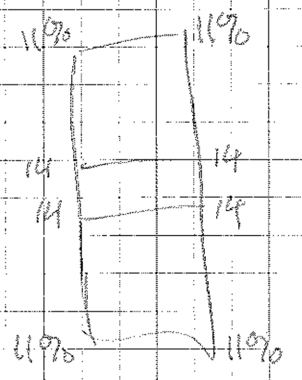
Assume 0.4 = T

	Vb
M_1 = 0.47	1159 kN
$M_{1.25}$ = 0.38	937 kN
M_3 = 0.15	370 kN

→ ~2 RB32 O/S w/ ductile link

863 mm gr300
25 x 34 PL

32 can handle
32 mm PL



M_3 Δ

84 mm y @ 19 m = 252
41 mm x @ 19 = 123 @ Max

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~~#2~~ 1

150slab	371			
steel	51			
walls	31			
17x2, 6.6x4				
h=3.5				
0.25kPa				
Q 3		309	93	546

2

slab	371			
steel	51			
walls	32			546
Q 3		309	93	

3

250slab	618			
steel	51			
walls	40			
Q3kPa ~~+plant~~		309 ~~103~~	x.3 92.7	964
plant		162	x1 162	

4

200slab	~~618~~ 494			
steel	51			
walls	58			743
Q3kPa ~~+plant~~		309 ~~103~~	x0.3 92	
plant		24x2	x1.0 48	

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Revised Loads

①

150 slab	371			
steel	51			G = 446
walls	24			ψQ = 93
Q (3kPa)		309	93	539

②

AS ABOVE

③

150 slab	371			
steel	57			G = 460
walls	32			ψQ = 255
Q3		309	93	715
Qplant		162	162	

④

150 slab	371			
steel	61			
walls	46			G = 478
Q3		309	93	ψQ = 141
Qplant		48	48	619

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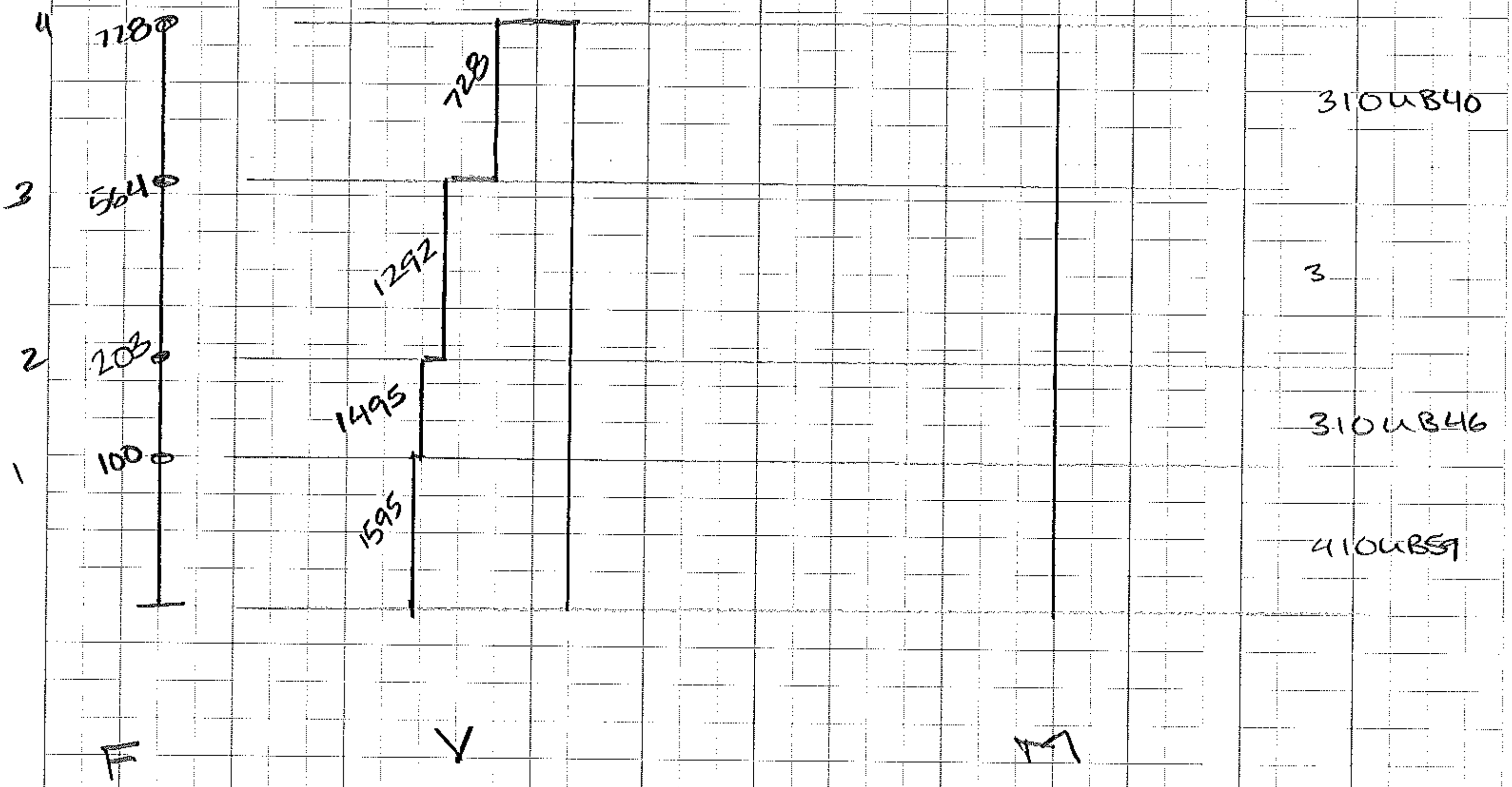

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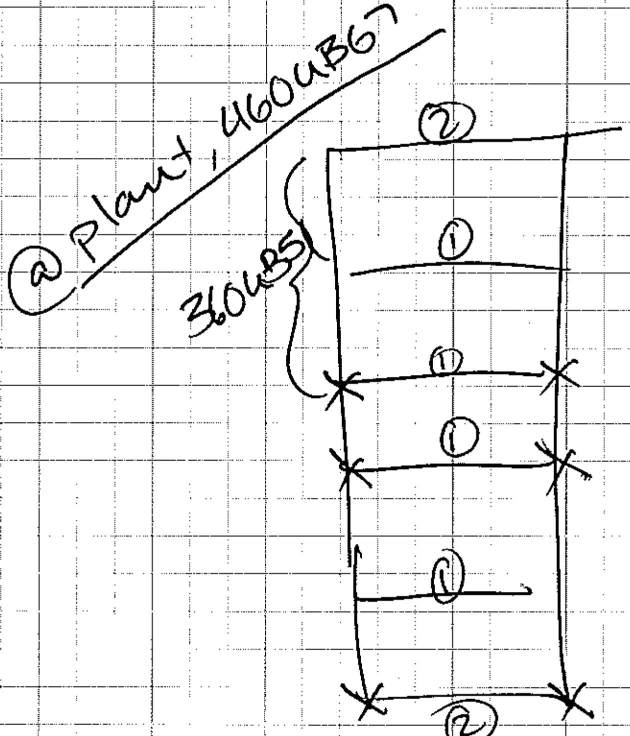
quick check other beams

150 PC   L = 6.6 m   TW = 1.85
                or 7.3 m   3.65 or
                                   3.3

normal 3 kPa live
        3.6 kPa dead

L = 7.3   Lvl 1 & 2 & non machine area : 410UB53
or   or 360UB5[illegible]



(1) 310UB40
(2) 310UB32

under plant
460UB67

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Job No:
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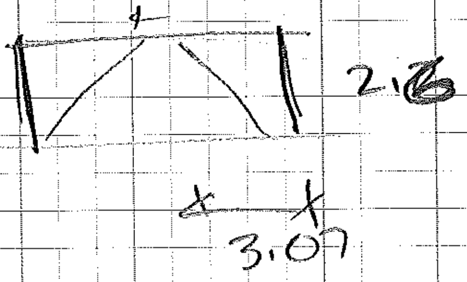

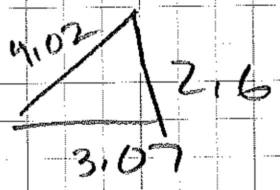

$\frac{741}{2} \times \frac{4.02}{3.07} = 485$

310UB40

~~B223~~

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Job Name:

Title:

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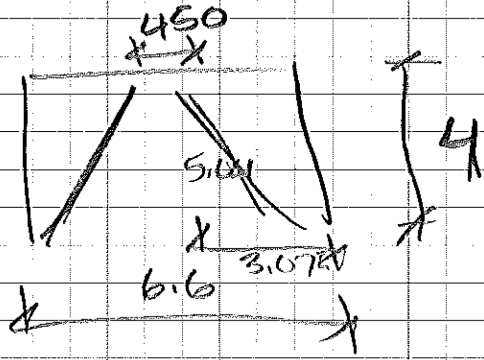
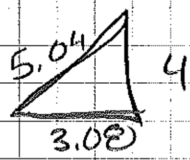
Rough size K brace

$797^{kN} \div 2 \times \frac{5.04}{3.08} = 652$



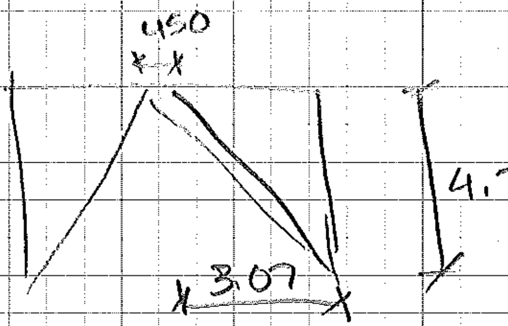


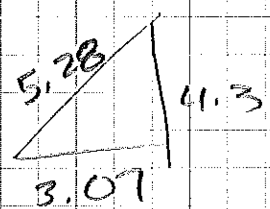
N =

Base

416UB57 @base

TOP





N = 313

$V = \frac{728}{2} \div 2 \times \frac{5.28}{3.07}$

~~310UB40~~

310UB40

3rd

$323 \times \frac{5.28}{3.07} = 555 \div$ ~~[illegible]~~

360UB56

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Job Name: NZ DAIRY

Title: CONNECTIONS

Job No.:
Date:
Name:
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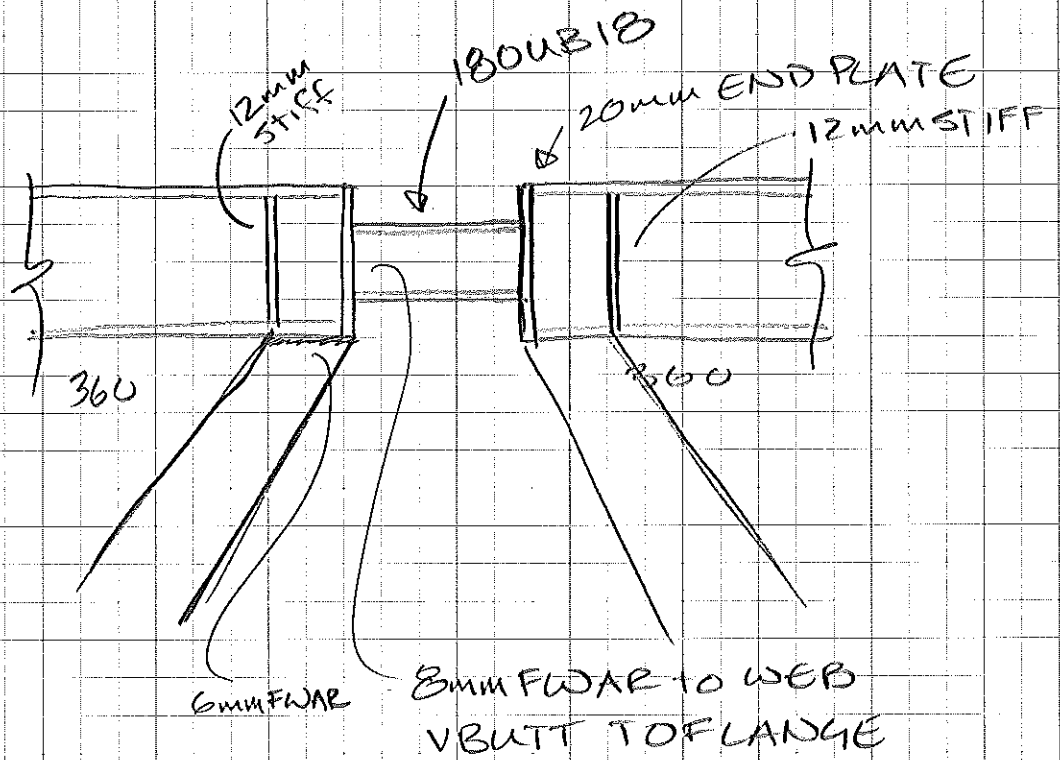
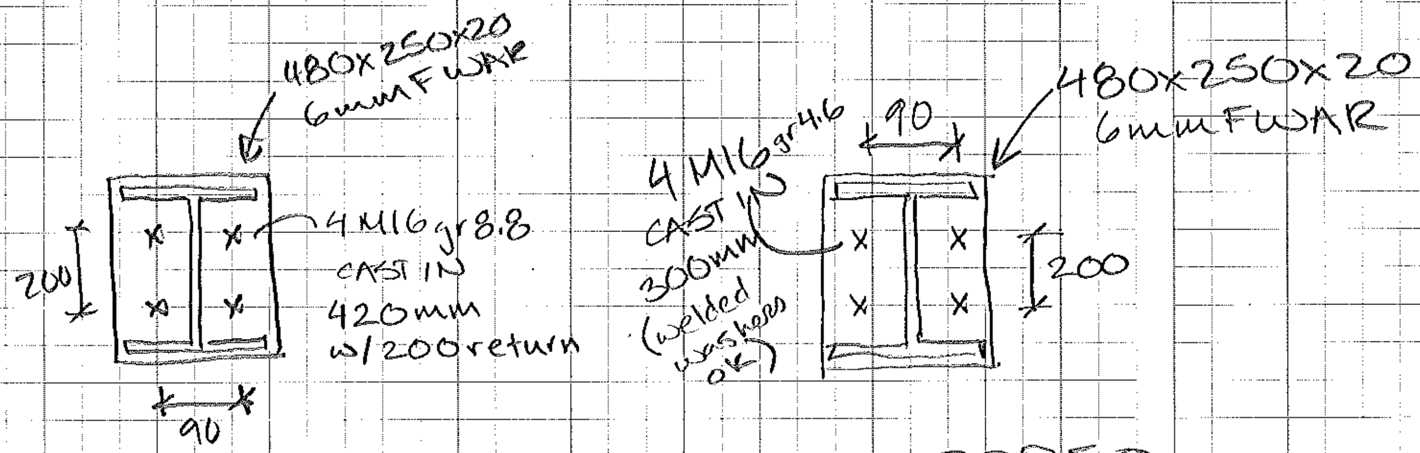
Level T1 & T2 only LINK



COLUMN SPLICE @ 1200 ABOVE FLOOR : BBS-1 30/15



BPP50

@ KBrace

@ All others

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MemDes Calculations @ 09:41:03 23-08-2016 by MRL

Project : nz dairy tower
Description : frame

Section : 310UB40 Grade 300+

Shear Calculations (Unstiffened Web)

Design Action V^*_x = 200.0 kN

Nominal Shear Yield capacity V_w = 356.0 kN

a_v = 2.43 >= 1.0 => full web shear capacity

$V_u = V_w$ = 356.0 kN

Shear capacity ratio = V^*_x / f V_u

= 0.62, ---- OK ----

Axial Calculations

Design Action N_d = 485.0 kN [Comp], LeAxx = 4.02 m, LeAxy = 4.02 m

= 1587.2 kN

Major axis buckling : Minor axis buckling : Minimum Capac. $N_c$min = 703.3

Axial buckling capac. Ratio = N_d / f $N_c$min

= 0.766, ---- OK ----

SUMMARY

**** U.L.S. Capacity Check Passed, Load Cap. Ratio = 0.77 ---- OK ----

MemDes v 3.3 : Calculations for New Zealand Steel
Project : nz dairy tower at 9:41:03 a.m. on 23/08/2016
Description : frame by MRL **Powered By Steltech** (http://www.steltech.co.nz)

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MemDes Calculations @ 09:41:55 23-08-2016 by MRL

==

Project : nz dairy tower
Description : frame

Section : 150x150x6.0 SHS Grade 350

Shear Calculations (Unstiffened Web)
Design Action V^*_x = 200.0 kN
Nominal Shear Yield capacity V_w = 347.8 kN
a_v = 9.08 >= 1.0 => full web shear capacity
$V_u = V_w$ = 347.8 kN
Shear capacity ratio = V^*_x / f V_u
= 0.64, ---- OK ----

Axial Calculations
Design Action N_d = 555.0 kN [Comp], LeAxx = 5.28 m, LeAxy = 5.28 m
= 1165.5 kN
Major axis buckling : Minor axis buckling : Minimum Capac. $N_c$min = 637.6
Axial buckling capac. Ratio = N_d / f $N_c$min
= 0.967, ---- OK ----

========================= SUMMARY =====================

**** U.L.S. Capacity Check Passed, Load Cap. Ratio = 0.97 ---- OK ----

==

MemDes v 3.3 : Calculations for New Zealand Steel
Project : nz dairy tower at 9:41:55 a.m. on 23/08/2016
Description : frame by MRL **Powered By Steltech (http://www.steltech.co.nz)**

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MemDes Calculations @ 09:41:55 23-08-2016 by MRL
====================================

Project : nz dairy tower
Description : frame

Section : 150x150x6.0 SHS Grade 350

Shear Calculations (Unstiffened Web)
Design Action V^*_x = 200.0 kN
Nominal Shear Yield capacity V_w = 347.8 kN
a_v = 9.08 >= 1.0 => full web shear capacity
V_u = V_w = 347.8 kN
Shear capacity ratio = V^*_x / f V_u
= 0.64, ---- OK ----

Axial Calculations
Design Action N_d = 555.0 kN [Comp], LeAxx = 5.28 m, LeAxy = 5.28 m
= 1165.5 kN
Major axis buckling : Minor axis buckling : Minimum Capac. $N_c$min = 637.6
Axial buckling capac. Ratio = N_d / f $N_c$min
= 0.967, ---- OK ----
======================== SUMMARY ====================
**** U.L.S. Capacity Check Passed, Load Cap. Ratio = 0.97 ---- OK ----

==
MemDes v 3.3 : Calculations for New Zealand Steel
Project : nz dairy tower at 9:41:55 a.m. on 23/08/2016
Description : frame by MRL **Powered By Steltech (http://www.steltech.co.nz)**

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MemDes Calculations @ 09:42:56 23-08-2016 by MRL

==

Project : nz dairy tower
Description : frame

Section : 150x150x5.0 SHS Grade 350

Shear Calculations (Unstiffened Web)
Design Action V^*_x = 200.0 kN
Nominal Shear Yield capacity V_w = 294.0 kN
a_v = 6.13 >= 1.0 => full web shear capacity
$V_u = V_w$ = 294.0 kN
Shear capacity ratio = V^*_x / f V_u
= 0.76, ---- OK ----

Axial Calculations
Design Action N_d = 313.0 kN [Comp], LeAxx = 5.28 m, LeAxy = 5.28 m
= 983.5 kN
Major axis buckling : Minor axis buckling : Minimum Capac. $N_c$min = 544.4
Axial buckling capac. Ratio = N_d / f $N_c$min
= 0.639, ---- OK ----

========================= SUMMARY ====================

**** U.L.S. Capacity Check Passed, Load Cap. Ratio = 0.76 ---- OK ----

===

MemDes v 3.3 : Calculations for New Zealand Steel
Project : nz dairy tower at 9:42:56 a.m. on 23/08/2016
Description : frame by MRL **Powered By Steltech (http://www.steltech.co.nz)**

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MemDes Calculations @ 09:43:44 23-08-2016 by MRL

==

Project : nz dairy tower
Description : frame

Section : 150x150x9.0 SHS Grade 350

Shear Calculations (Unstiffened Web)

Design Action V^*_x = 200.0 kN

Nominal Shear Yield capacity V_w = 499.0 kN

a_v = 22.33 >= 1.0 => full web shear capacity

$V_u = V_w$ = 499.0 kN

Shear capacity ratio = V^*_x / f V_u

= 0.45, ---- OK ----

Axial Calculations

Design Action N_d = 652.0 kN [Comp], LeAxx = 5.04 m, LeAxy = 5.04 m

= 1680.0 kN

Major axis buckling : Minor axis buckling : Minimum Capac. $N_c$min = 942.8

Axial buckling capac. Ratio = N_d / f $N_c$min

= 0.768, ---- OK ----

======================== SUMMARY ====================

**** U.L.S. Capacity Check Passed, Load Cap. Ratio = 0.77 ---- OK ----

==

MemDes v 3.3 : Calculations for New Zealand Steel
Project : nz dairy tower at 9:43:44 a.m. on 23/08/2016
Description : frame by MRL **Powered By Steltech (http://www.steltech.co.nz)**

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MemDes Calculations @ 09:44:12 23-08-2016 by MRL
==

Project : nz dairy tower
Description : frame

Section : 200x200x5.0 SHS Grade 350

Shear Calculations (Unstiffened Web)
Design Action V^*_x = 200.0 kN
Nominal Shear Yield capacity V_w = 399.0 kN
a_v = 3.33 >= 1.0 => full web shear capacity
$V_u = V_w$ = 399.0 kN
Shear capacity ratio = V^*_x / f V_u
= 0.56, ---- OK ----

Axial Calculations
Design Action N_d = 652.0 kN [Comp], LeAxx = 5.04 m, LeAxy = 5.04 m
= 1186.8 kN
Major axis buckling : Minor axis buckling : Minimum Capac. $N_c$min = 952.5
Axial buckling capac. Ratio = N_d / f $N_c$min
= 0.761, ---- OK ----
======================== SUMMARY =====================
**** U.L.S. Capacity Check Passed, Load Cap. Ratio = 0.76 ---- OK ----

==

MemDes v 3.3 : Calculations for New Zealand Steel
Project : nz dairy tower at 9:44:12 a.m. on 23/08/2016
Description : frame by MRL **Powered By Steltech (http://www.steltech.co.nz)**

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MemDes Calculations @ 09:45:14 23-08-2016 by MRL
==

Project : nz dairy tower
Description : frame

Section : 125x125x6.0 SHS Grade 350

Shear Calculations (Unstiffened Web)
Design Action V^*_x = 200.0 kN
Nominal Shear Yield capacity V_w = 284.8 kN
a_v = 13.54 >= 1.0 => full web shear capacity
$V_u = V_w$ = 284.8 kN
Shear capacity ratio = V^*_x / f V_u
= 0.78, ---- OK ----

Axial Calculations
Design Action N_d = 485.0 kN [Comp], LeAxx = 4.02 m, LeAxy = 4.02 m
= 955.5 kN
Major axis buckling : Minor axis buckling : Minimum Capac. $N_c$min = 580.0
Axial buckling capac. Ratio = N_d / f $N_c$min
= 0.929, ---- OK ----
======================== SUMMARY =====================
**** U.L.S. Capacity Check Passed, Load Cap. Ratio = 0.93 ---- OK ----

==

MemDes v 3.3 : Calculations for New Zealand Steel
Project : nz dairy tower at 9:45:14 a.m. on 23/08/2016
Description : frame by MRL **Powered By Steltech (http://www.steltech.co.nz)**

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MemDes Calculations @ 09:45:14 23-08-2016 by MRL
==

Project : nz dairy tower
Description : frame

Section : 125x125x6.0 SHS Grade 350

Shear Calculations (Unstiffened Web)
Design Action V^*_x = 200.0 kN
Nominal Shear Yield capacity V_w = 284.8 kN
a_v = 13.54 >= 1.0 => full web shear capacity
$V_u = V_w$ = 284.8 kN
Shear capacity ratio = V^*_x / f V_u
= 0.78, ---- OK ----

Axial Calculations
Design Action N_d = 485.0 kN [Comp], LeAxx = 4.02 m, LeAxy = 4.02 m
= 955.5 kN
Major axis buckling : Minor axis buckling : Minimum Capac. $N_c$min = 580.0
Axial buckling capac. Ratio = N_d / f $N_c$min
= 0.929, ---- OK ----
======================== SUMMARY ======================
**** U.L.S. Capacity Check Passed, Load Cap. Ratio = 0.93 ---- OK ----

==

MemDes v 3.3 : Calculations for New Zealand Steel
Project : nz dairy tower at 9:45:14 a.m. on 23/08/2016
Description : frame by MRL **Powered By Steltech (http://www.steltech.co.nz)**

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MemDes Calculations @ 09:11:43 23-08-2016 by MRL
====================================

Project : nz dairy tower
Description : frame

Section : 410UB59 Grade 300+

Shear Calculations (Unstiffened Web)
Design Action V^*_x = 398.0 kN
Nominal Shear Yield capacity V_w = 608.0 kN
a_v = 2.21 >= 1.0 => full web shear capacity
$V_u = V_w$ = 608.0 kN
Shear capacity ratio = V^*_x / f V_u
= 0.73, ---- OK ----

Axial Calculations
Design Action N_d = 855.0 kN [Comp], LeAxx = 4.00 m, LeAxy = 4.00 m
= 2207.7 kN
Major axis buckling : Minor axis buckling : Minimum Capac. $N_c$min = 1076.0
Axial buckling capac. Ratio = N_d / f $N_c$min
= 0.883, ---- OK ----
====================== SUMMARY ====================
**** U.L.S. Capacity Check Passed, Load Cap. Ratio = 0.88 ---- OK ----

==

MemDes v 3.3 : Calculations for New Zealand Steel
Project : nz dairy tower at 9:11:43 a.m. on 23/08/2016
Description : frame by MRL **Powered By Steltech (http://www.steltech.co.nz)**

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MemDes Calculations @ 09:12:41 23-08-2016 by MRL

=====================================

Project : nz dairy tower
Description : frame

Section : 410UB59 Grade 300+

Shear Calculations (Unstiffened Web)

Design Action V^*_x = 200.0 kN

Nominal Shear Yield capacity V_w = 608.0 kN

a_v = 2.21 >= 1.0 => full web shear capacity

$V_u = V_w$ = 608.0 kN

Shear capacity ratio = V^*_x / f V_u

= 0.37, ---- OK ----

Axial Calculations

Design Action N_d = 652.0 kN [Comp], LeAxx = 5.00 m, LeAxy = 5.00 m

= 2207.7 kN

Major axis buckling : Minor axis buckling : Minimum Capac. $N_c$min = 768.4

Axial buckling capac. Ratio = N_d / f $N_c$min

= 0.943, ---- OK ----

====================== SUMMARY ====================

**** U.L.S. Capacity Check Passed, Load Cap. Ratio = 0.94 ---- OK ----

==

MemDes v 3.3 : Calculations for New Zealand Steel
Project : nz dairy tower at 9:12:41 a.m. on 23/08/2016
Description : frame by MRL **Powered By Steltech (http://www.steltech.co.nz)**

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MemDes Calculations @ 09:24:57 23-08-2016 by MRL
======================================

Project : nz dairy tower
Description : frame

Section : 310UB40 Grade 300+

Shear Calculations (Unstiffened Web)
Design Action V^*_x = 200.0 kN
Nominal Shear Yield capacity V_w = 356.0 kN
a_v = 2.43 >= 1.0 => full web shear capacity
$V_u = V_w$ = 356.0 kN
Shear capacity ratio = V^*_x / f V_u
= 0.62, ---- OK ----

Axial Calculations
Design Action N_d = 313.0 kN [Comp], LeAxx = 5.00 m, LeAxy = 5.00 m
= 1587.2 kN
Major axis buckling : Minor axis buckling : Minimum Capac. $N_c$min = 498.4
Axial buckling capac. Ratio = N_d / f $N_c$min
= 0.698, ---- OK ----
======================= SUMMARY ====================
**** U.L.S. Capacity Check Passed, Load Cap. Ratio = 0.70 ---- OK ----

==
MemDes v 3.3 : Calculations for New Zealand Steel
Project : nz dairy tower at 9:24:57 a.m. on 23/08/2016
Description : frame by MRL **Powered By Steltech (http://www.steltech.co.nz)**

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MemDes Calculations @ 09:27:42 23-08-2016 by MRL

==

Project : nz dairy tower
Description : frame

Section : 310UB46 Grade 300+

Shear Calculations (Unstiffened Web)

Design Action V^*_x = 200.0 kN

Nominal Shear Yield capacity V_w = 394.9 kN

a_v = 2.94 >= 1.0 => full web shear capacity

$V_u = V_w$ = 394.9 kN

Shear capacity ratio = V^*_x / f V_u

= 0.56, ---- OK ----

Axial Calculations

Design Action N_d = 485.0 kN [Comp], LeAxx = 5.00 m, LeAxy = 5.00 m

= 1802.9 kN

Major axis buckling : Minor axis buckling : Minimum Capac. $N_c$min = 584.5

Axial buckling capac. Ratio = N_d / f $N_c$min

= 0.922, ---- OK ----

======================== SUMMARY =====================

**** U.L.S. Capacity Check Passed, Load Cap. Ratio = 0.92 ---- OK ----

==

MemDes v 3.3 : Calculations for New Zealand Steel
Project : nz dairy tower at 9:27:42 a.m. on 23/08/2016
Description : frame by MRL **Powered By Steltech (http://www.steltech.co.nz)**

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MemDes Calculations @ 09:30:18 23-08-2016 by MRL
=====================================

Project : nz dairy tower
Description : frame

Section : 310UB40 Grade 300+

Shear Calculations (Unstiffened Web)
Design Action V^*_x = 200.0 kN
Nominal Shear Yield capacity V_w = 356.0 kN
a_v = 2.43 >= 1.0 => full web shear capacity
$V_u = V_w$ = 356.0 kN
Shear capacity ratio = V^*_x / f V_u
= 0.62, ---- OK ----

Axial Calculations
Design Action N_d = 313.0 kN [Comp], LeAxx = 5.28 m, LeAxy = 5.28 m
= 1587.2 kN
Major axis buckling : Minor axis buckling : Minimum Capac. $N_c$min = 454.4
Axial buckling capac. Ratio = N_d / f $N_c$min
= 0.765, ---- OK ----
====================== SUMMARY ===================
**** U.L.S. Capacity Check Passed, Load Cap. Ratio = 0.77 ---- OK ----

===

MemDes v 3.3 : Calculations for New Zealand Steel
Project : nz dairy tower at 9:30:18 a.m. on 23/08/2016
Description : frame by MRL **Powered By Steltech (http://www.steltech.co.nz)**

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MemDes Calculations @ 09:31:39 23-08-2016 by MRL

=======================================

Project : nz dairy tower
Description : frame

Section : 360UB56 Grade 300+

Shear Calculations (Unstiffened Web)

Design Action V^*_x = 200.0 kN

Nominal Shear Yield capacity V_w = 551.4 kN

a_v = 3.03 >= 1.0 => full web shear capacity

$V_u = V_w$ = 551.4 kN

Shear capacity ratio = V^*_x / f V_u

= 0.40, ---- OK ----

Axial Calculations

Design Action N_d = 555.0 kN [Comp], LeAxx = 5.28 m, LeAxy = 5.28 m

= 2218.5 kN

Major axis buckling : Minor axis buckling : Minimum Capac. $N_c$min = 651.9

Axial buckling capac. Ratio = N_d / f $N_c$min

= 0.946, ---- OK ----

====================== SUMMARY ======================

**** U.L.S. Capacity Check Passed, Load Cap. Ratio = 0.95 ---- OK ----

==

MemDes v 3.3 : Calculations for New Zealand Steel
Project : nz dairy tower at 9:31:39 a.m. on 23/08/2016
Description : frame by MRL **Powered By Steltech (http://www.steltech.co.nz)**

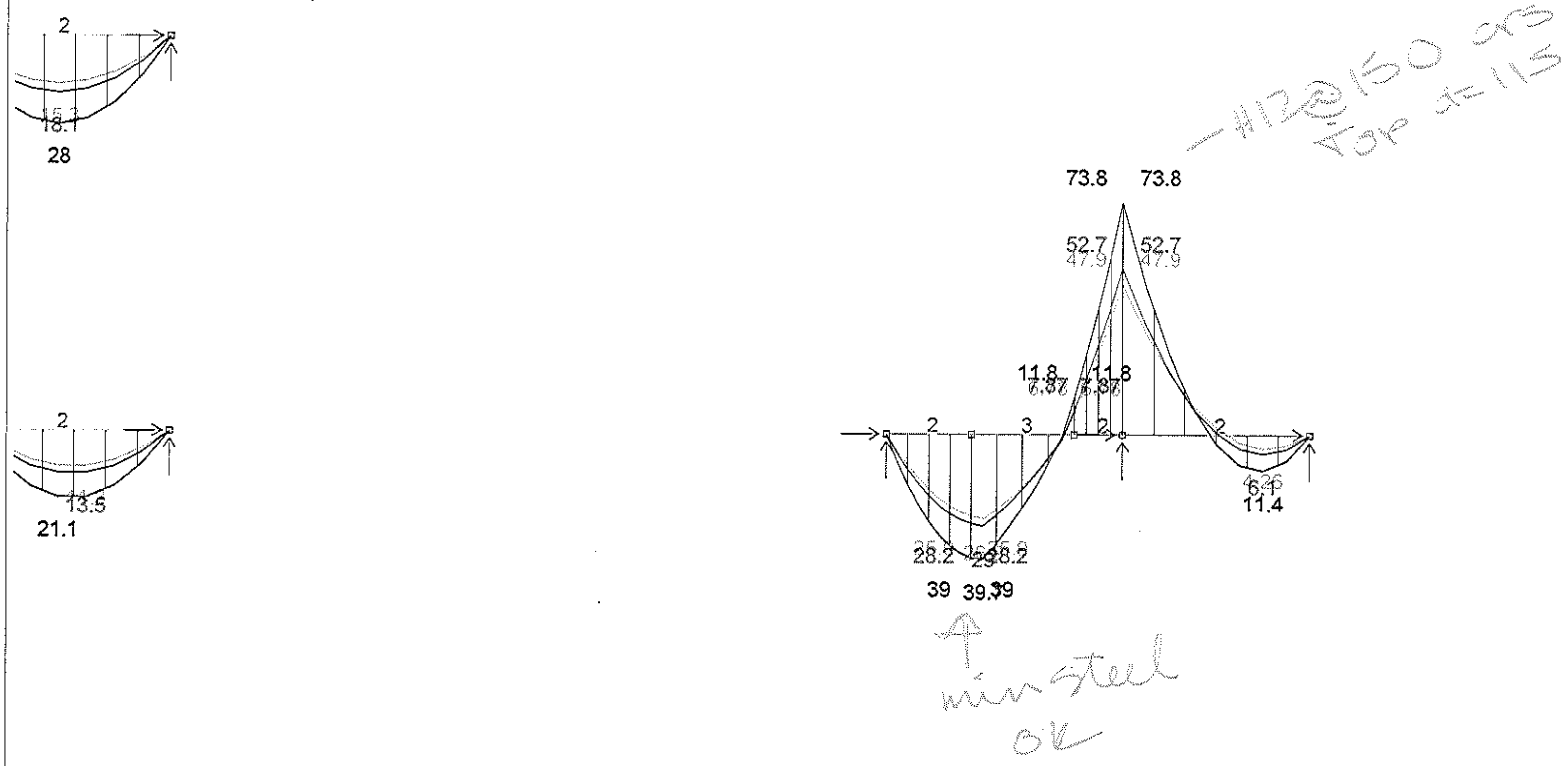
Microstran V9

Chapman Consulting Engineers Ltd
Job: 151413 pc slab check 2016.09.21
NZ dairy tower

23/09/2016
11:13:45 a.m.

Load Cases:
11 C SLS: G + 0.4Q
12 C SLS: G + 0.7Q
21 C ULS: 1.2G + 1.5Q

Sections:
1 460UB67.1 Y
2 150x1650
3 150x500
4 200PFC Y



theta: 270 phi: 0

Bending Moment, Mz

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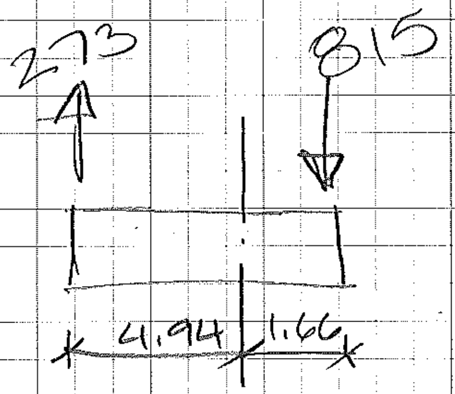

$273 \times A = 815(6.6 - A)$

$273A = -815A + 5379$

$1088A = 5379$

$A = 4.94$

$M^* = 1348$ kN-m

$SW = 0.6(2.5m)(24) = 36$ kN-m

$M = \frac{36(4.94)^2}{2} = 439$

$1348 - 439 = 909$

$4207\ mm^2/2.5$

$1682\ mm^2/m$

H20@200

chapman
CONSULTING ENGINEERS

Job Name:

Title:

Job No.:
Date:
Name:
Sheet No.:

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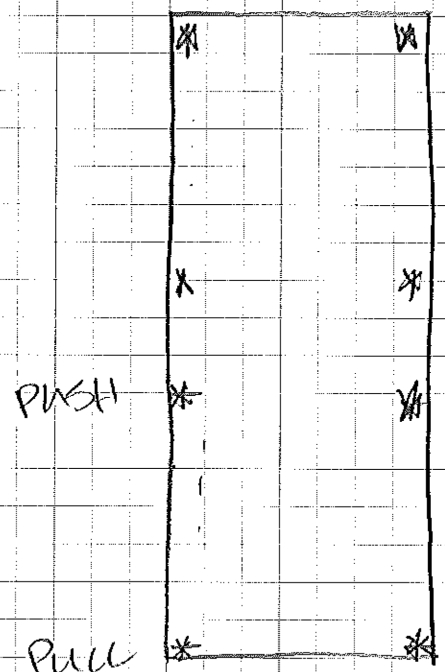
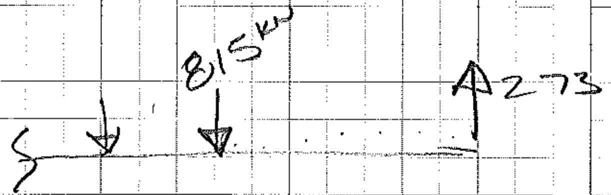
Look @ 1m strip — 273kN ↑

11 m³ conc





H16 @ 200crs

273 × 7.3 = 1992 kN-m

if 600deep, need to engage 2.5m

d = 525

30MPa

As = 9621

= 3848mm²/m

H32 @ 200crs T&B

But have S.W. of pad cancelling

SW = 14.4kPa

∴ if 2.5m engaged

36kN/m × 7.3²/2 = 959

M* = 1992 − 959 = 1033

As = 4802

÷ 2.5 = 1921mm²/m

H25 @ 250crs or H20 @ 170crs

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MemDes Calculations @ 11:39:49 13-09-2016 by MRL

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Project : nz dairy tower
Description : frame

Section : 410UB59 Grade 300+

Major Axis Bending
Design Action M^*_x = 0.0 kNm
User provided value for a_m = 1.00
a_s = 0.59
a_m a_s < 1.0, => Segment NOT Fully Restrained
M_{bx} = 1.00 * 0.59 * 360.0 = 211.5
Major axis capacity Ratio = M^*_x / f M_{bx}
= 0.00, ---- OK ----

Minor Axis Bending
Design Action M^*_y = 10.0 kNm
M_{by} = M_{sy} = 60.90 kNm
Minor axis capacity ratio = M^*_y / f M_{by}
= 0.18, ---- OK ----

Axial Calculations
Design Action N_d = 842.0 kN [Comp], LeAxx = 3.67 m, LeAxy = 3.67 m
= 2207.7 kN
Major axis buckling : Minor axis buckling : Minimum Capac. $N_c$min = 1203.2
Axial buckling capac. Ratio = N_d / f $N_c$min
= 0.778, ---- OK ----

Combined Actions Checks

Clause 8.3.3/4 :
M_{ry} = M_{sy} (1 - (N^*/ f N_s)^2) * 1.19, =< M_{sy} [Alt. Prov. OK]
= 59.5
Load / Capacity Ratio = M^*_y / 0.9 / M_{ry}
= 0.19, ---- OK ----

Clause 8.4.2.2 : Minor : M_{iy} = 13.5
Load / Capacity Ratio = M^*_m/ f M_i
= 0.820 ---- OK ----

======================== SUMMARY ======================

**** U.L.S. Capacity Check Passed, Load Cap. Ratio = 0.82 ---- OK ----

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MemDes v 3.3 : Calculations for New Zealand Steel
Project : nz dairy tower at 11:39:49 a.m. on 13/09/2016
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