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1. PRELIMINARY AND GENERAL

1. SCOPE OF THE PROJECT

This specification describes the standard of workmanship and the work to be done the plant, materials and labor to be supplied for the construction of the building shown in the attached approved building consent plans. The scope includes all other work described in this Specification, and on the Approved Building Consent Plans or in the Conditions of Contract.

In particular, the Contractor is expected to be familiar with the site and the current New Zealand Building Code requirements and all current clauses of N.Z.S. 3604 applicable to the contract.

2. CONTRACT DOCUMENTS

The contract documents shall consist of:

- (a) The Contract Agreement*
- (b) The Conditions of Contract*
- (c) Special Conditions of Contract*
- (d) This Specification

* To be supplied by Owner.

3. NEW ZEALAND STANDARDS

All NZS Specifications/Code of Practices quoted within this Specification shall be considered to be part of this Specification, in particular NZS 3604:2011 or the most current version of this document at the time of construction.

4. NEW ZEALAND BUILDING CODE

Specification references made to BIA Approved Documents, which are made up of the appropriate Building Code clause with the addition of Acceptable Solutions that are a means of compliance, shall be considered to be part of this Specification.

The following is a list of Approved Documents referred to in this Specification. There may be

other Approved Documents that need to be complied with but which are not required parts of this specification.

B1/AS1 Structure - General
B1/AS2 Structure - Timber Barriers
B1/AS3 Structure - Small Chimneys
B1/AS4 Structure - Foundations
B2/AS1 Durability
B2/VM1 Durability
C1/AS1 Outbreak of Fire
D1/AS1 Access Routes
E1/AS1 Surface Water
E2/AS1 External Moisture
E3/AS1 Internal Moisture
F2/AS2 Hazardous Materials
F4/AS1 Safety from Falling
F5/AS1 Construction and Demolition Hazards
G1/AS1 Personal Hygiene
G2/AS1 Laundering
G3/AS1 Food Preparation/Storage and Utensil Washing
G4/AS1 Ventilation
G6/AS1 Airborne and Impact Sound
G7/AS1 Natural Light
G8/VM1 Artificial Light
G9/VM1 Electricity
G10/AS1 Piped Services
G11/AS1 Gas as an Energy Source
G12/AS1 Water Supplies
G13/AS1 VM1 Foul Water - Sanitary Plumbing
G13/AS2 VM2 Foul Water - Drainage
H1/AS1 Energy Efficiency

5. BUILDING CONSENTS

The Contractor shall comply with the New Zealand Building Code and the requirements of the Territorial Authority. The Contractor shall apply for and obtain a Project Information Memorandum for the project and all necessary Building Consents also all Code of Compliance Certificates must be applied for and obtained at the end of the project. All fees applicable for the above items must be paid to the Territorial Authority.

The Contractor shall apply within the time specified by the Territorial Authority for all necessary Territorial Authority inspections as are required during the course of the works and shall comply with all directions given by Territorial Authority inspectors.

6. HEALTH AND SAFETY IN EMPLOYMENT ACT 1992 AND CONSTRUCTION

SAFETY

The provision of the Health and Safety in Employment Act 1992 and regulations and the BIA Approved Documents NZBC F5/AS1 Construction and Demolition Hazards are deemed to be part of this Contract.

7. PROVIDE AND FIX

The words “provide” and “fix” shall be construed to mean “provide and fix” where mentioned separately unless otherwise mentioned.

8. INTERPRETATION

Work or materials shown on the approved building consent plans or specified and not shown, must be supplied as though both shown and specified.

Materials shown but not specified must be of the kind commonly employed for the service they are intended to perform.

All figured dimensions shall be taken in preference to scaled dimensions.

The Contractor shall be held responsible for the setting out of work and he shall make good at his own expense any errors that occur through his lack of checking for faulty workmanship.

9. SITE

The Contractor shall be deemed to have inspected and examined the site and ascertained the nature and extent of the work and the rights and interests that may be interfered with and any other matter that may influence the making up of a tender or the

carrying out of the Contract in its entirety.

The levels shown on the approved building consent plans are approximately correct but tenderers shall verify these as no claims for extras will be allowed on the basis of incorrect levels shown.

The working area made available to the Contractor including that required for storage of materials and location of sheds and plant will be limited to the property under the control of the Owner or as otherwise indicated on the approved building consent plans.

Any further requirements deemed necessary by the Contractor shall be arranged by him at his own cost and inability to make any such arrangements shall not relieve the Contractor of his responsibility to carry out the work specified.

The Contractor shall inform the Owner of any such arrangements made.

10. STABILITY

The Contractor shall carefully brace and support all parts of his work against damage by wind and protect from the elements as necessary during construction.

11. PROTECTION OF PROPERTY

The Contractor shall protect adjoining properties during the Contract and shall make good all damage at his own expense.

12.INSURANCE / INDEMNITIES

The Contractor shall have in force for the duration of the Contract Works (including the maintenance period):

(a) An insurance policy covering the full amount of the contract sum to cover loss or damage through fire, theft or any other claims arising out of the construction maintenance of the contract works.

(b) Any liability incurred by the Owner in respect to injuries to persons, or damage to property (including neighbouring property) which may arise out of the construction, or maintenance of the contract works.

All policies shall remain in force until the building is taken over by the Owner (or to the end of the maintenance period). Fire insurance is to be in the joint names of the Owner and the Contractor.

13. MATERIALS

Materials are to be new unless otherwise stated, the best quality of their respective kinds, and complying with the relevant BIA Approved Documents, New Zealand Standards and Regulations.

Any materials here in specified that are not procurable at the time that they are required, thus tending to retard the progress of the Contract, may be Substituted with

other similar materials, providing that the substituted materials conform to the New Zealand Building Code BIA Approved Documents, New Zealand Standards and Regulations and have equivalent Durability in terms of NZBC B2/AS1 and NZS 3604:2011 or the current equivalent and to also have the formal approval of the Owner.

The Contractor is first to notify the Owner of any change proposed and at the completion of the Contract will adjust any difference in cost.

Supply all materials, labour, services, temporary works, equipment and plant for the proper excavation and completion of the works.

The Contractor shall make suitable arrangements for Principal Supplied Materials in their handling, storage and installation.

14. DURABILITY VERIFICATION

The requirements for durability of specific building elements required by the New Zealand Building Code are set out in Table 1 of Acceptable Solution B2/AS1 and also in NZS 3604:2011 Section 4.

In supplying products, components or materials (henceforth termed "products") for incorporation into the contract works, the Contractor shall be deemed to have either:

- (a) Obtained a current CODEMARK Accreditation Certificate for the products involved; or
- (b) Obtained an Appraisal Statement from a reputable Technical Assessment organisation (such as B.R.A.N.Z.) for the products involved to the effect that the products, when installed to the manufacturer's instructions, will meet the performance requirements of the NZBC Approved Documents Acceptable Solution B2/AS1 in respect of durability for the specified life of the element as stated in B2/AS1 Table 1.

Where such certificates, or statements are not available, the Contractor shall be deemed to have verified, to his/her satisfaction that the products involved will satisfy NZBC B2 Durability by proof of performance in use, using one or more methods set out in the verification methods, taking account of:

- (i) Service History;
- (ii) Laboratory Testing.

As set out in Method B2/VM1, tests which relate to the particular application of the product to the satisfaction of the contract works.

At the end of the project, the Contractor shall supply to the Owner/Architect a Producer Statement to the effect that all materials incorporated satisfy the above requirements.

15. WORKMANSHIP

All work shall be carried out in accordance with good New Zealand trade practice and to the relevant codes, in strict conformity with the approved building consent plans and specifications and to the satisfaction of the Owner. All work is to be level, plumb, and true to line and face. Only experienced and competent work people shall be utilised on the Contract.

All defective or damaged work shall be removed and made good to the satisfaction of the Owner.

16. CONTINGENCIES

Provision is to be made by the Contractor and Owner to meet any contingencies that may arise due to the fluctuations in the price of various materials or labour.

Should there be either a rise or fall in the price of labour or materials, from the date that the tender is submitted until final payment, an adjustment to the Contract price, is to be made accordingly provided that the Contract price has been affected by such rise or fall in prices. The Contractor is to submit to the Owner proof of any increases claimed for by way of invoices or labour costs.

17. DAMAGE/NUISANCE

The Contractor shall make good at his own expense and to the satisfaction of controlling authorities, any damage done to footpaths, kerbs, drainage etc., or other property under control of such authorities.

Each trade shall take care to prevent' damage or disfigurement of the work of other trades and will be responsible for the cost of restoring the same.

The Contractor shall take all reasonable precautions to prevent damage and nuisance from water, fire, smoke, vehicles, dust, rubbish, noise and any other causes resulting from construction works. Comply with the requirements of the Territorial Authority and relevant Acts and Standards.

18. CLEANING

The Contractor, at the conclusion of the Contract, shall have all ceilings, walls, and woodwork carefully dusted and wiped down, windows washed inside and out, and glass free from scratches, floors brushed and wiped down and all services operating and any mechanical parts in good working order.

19. MAINTENANCE

The maintenance period shall be three calendar months, commencing on and from the date the Owner takes possession. Any defects in materials, workmanship or any part or parts that require replacing or adjusting, which have been included in the Contract, shall be adjusted or replaced at the Contractor's expense.

20. GUARANTEES

Guarantees stating the period and any special obligation, may be called for in any work section of this Specification. The general terms of such guarantees are covered by the Conditions of Contract but in no case shall the terms or conditions accepted negate the minimum remedies available under common law as if no guarantee had been offered or accepted.

2. EXCAVATOR

1. PRELIMINARY AND GENERAL

Note where Preliminary and General clauses apply to this trade.

2. ALLOWANCE IN TENDERING

Allow for foundation depths shown on approved building consent plans.

3. SETTING OUT

Set out the work as shown or implied on the approved building consent plans. Check accuracy in terms of position, level and square.

4. CLEAR SITE

Remove vegetation, trees, roots and .150mm of topsoil within the area to be covered by the works. Do not remove any other trees without the Owner's consent. Deposit topsoil in a pile and placed as directed by the main Contractor or Owner and to avoid covering with subsoil subsequently excavated.

5. LEVELLING AND BULK EXCAVATION

Excavate for all site levelling, foundation walls and/or pipes, underground services and subsoil drains etc. to correct levels, to firm bearing.

6. FOUNDATION TRENCHES

Take out trenches straight, level and to proper width and keep free of water and loose material. Concrete shall not be placed until excavations approved. If other than under item 2 of this section, trenches are dug too deeply then such excess depth shall be filled with concrete, as specified for foundation, at the Contractor's expense.

7. HARDFILL

Use only approved fill not less than .100mm thick and well compacted under concrete ground floors and where otherwise specified. Blind surface of fill with not less than .20mm of sand.

8. SITE DAMAGE

Take out land drainage trenches to adequate depth and falls to prevent dampness under the building. Provide for perforated plastic drainage pipe bedded on scoria. Backfill with clean graded

scoria from .50mm to fine.

9. BUILDING DRAINAGE

See Drainlayer's Section.

10. BACKFILL AND TOPSOIL

Backfill and consolidate well in .100mm layers to foundation walls, pile footings and service trenches. Spread previously excavated topsoil as directed. Do not damage any waterproof coatings protecting foundation walls from ground water entry.

3. RIBRAFT FOUNDATION

1. OVERVIEW

The Firth RibRaft Floor System is a reinforced concrete waffle raft floor slab-on-ground. It consists of an 85mm thick slab supported by a grid of ribs normally 100mm wide at 1200mm x 1200mm centres. The overall depth is 305mm. Edge beams and ribs under load bearing walls are 300mm wide to provide for the extra load carried by these members. Where heating coils of less than 25mm diameter are embedded in the topping, the slab concrete thickness shall be 110mm meaning the overall thickness is 330mm.

2. PODS

Firth RibRaft polystyrene pods 1100mm square and 220mm thick are placed directly on levelled ground and are arranged in such a way as to form a reinforced concrete floor slab with a grid of reinforced concrete ribs and edge beams when concrete is placed onto them. Pods may be cut to suit specific architecture layout and also to accommodate services. (300mm thick pods are available if needed for deeper edge beams and internal ribs for construction following specific engineering design. Such uses are outside the scope of this document.)

3. STEEL

Reinforcing steel in the slab shall consist of Welded Reinforcing Mesh complying with AS/NZS 4671:2001 with a minimum weight of 2.27kg/m², a lower RibRaft Floor System - Section 1 Design Information

characteristic stress of 500MPa, square configuration of orthogonal bars between 150 to 300mm centres, and ductility class L or E, hereafter referred to as “665 mesh, or mesh”. The reinforcing bars in the ribs and edge beams shall conform to AS/NZS 4671:2001 “Steel Reinforcing Materials”. Specifically designed spacers are used to position the polystyrene pods and the rib and edge beam reinforcing steel bars in a secure manner until the concrete is placed. The reinforcing mesh is held in place by mesh chairs. Conventional timber or steel formwork is used to form the edge of the slab.

4. CONCRETE

For buildings constructed in sea spray zone please use one of the following options:

1) Raftmix25 – a 25MPa 100mm slump structural mix available in either a 13mm or more usually a 19mm nominal aggregate size. This mix is normally placed in the floor straight from the concrete truck chute and if necessary by wheelbarrow over planks set up over the pods.

2) Raftmix Pump25 – a 25MPa 100mm slump pump mix available in either a 13mm or more

commonly a 19mm nominal aggregate size. The selection of aggregate size may be determined either by the capability of the available concrete pump or by the concrete placer's preference.

APPROVED

4. VERTICAL SHIPLAP WEATHERBOARD CLADDING

General

JSC VertiClad weatherboards are available in 18.5mm, 22mm, 28mm or 39mm thickness and in a variety of cover widths.

A random length supply of weatherboards range from .9m to 5.1m with select lengths and longer lengths available on request.

Band-Sawn face (BSF) recommended when staining, Dressed Face (DF) (check with coating manufacturer for sanding requirements) - and other custom options available.

Weatherboards are usually supplied as PC1 grade, with PC2 and sound tight knot grades (STK) available. Any loose or bark encased knots or natural timber defects should be removed during installation. All grades may require some docking.

Handling & Storage

JSC Timber products will be delivered dry, unmarked and undamaged from freight and handling (grade characteristics excluded). Do not sign or accept delivery if this is not the case. Contact JSC immediately if you have any concerns.

Store weatherboards and battens on site in a cool, dry place out of direct sunlight, laid flat on timber bearers above ground. Fillet if long delays are anticipated. Keep covered until you are ready to install. Protect edges and ends where possible.

Coating

In-line factory coating options include both oil and water based coating systems from Resene, Wattyl, Dryden, WOCA, Dulux, CD50 and Cabots.

When a dark colour stain is to be applied, consideration should be given to using a weatherboard with an effective cover of 115mm or narrower, vertical grain boards and/or thicker boards which will all give added stability and be less prone to movement. This is particularly relevant to apply a high reflective coating to North and West elevations. For more information, please contact us at tech@jsctimber.co.nz or refer to our Dark Colour statement available at www.jsctimber.co.nz.

Paint Finish

Boards must be primed on all four sides with all cut ends and bare timber surfaces primed during installation. Nails are to be punched and holes to be primed without delay. Fill holes with a suitable filler. Filled holes to be primed and sanded once dry. Two top coats should be applied as per coating manufacturers' instructions. Most profiles can be machined as a paint profile (2mm radius edges) on request. During installation all end grain and cut edges are to be sealed with suitable coating prior to installation and manufacturer's coating schedules adhered to. Once installed cladding must be cleaned and inspected for damage annually. JSC maintenance schedule available on request from specifications@jsctimber.co.nz

Maintenance

Responsibility is on the building owner to clean and maintain their JSC Weatherboards. This includes an annual inspection and regular clean with a soft brush, warm water and detergent. Repairs to damaged areas or areas where signs of deterioration are evident, must be repaired immediately and recoating should be at intervals of approx. 2-3 years in accordance with JSC installation details and coating manufacturers' guidelines. More exposed Northern and Western faces will require more frequent recoating. Maintenance guidelines available at www.jsctimber.co.nz or tech@jsctimber.co.nz Installer to ensure owner has Maintenance Schedule Guidelines as required by JSC Timber and coating manufacturer. Also Refer to E2/AS1 - Maintenance - general 2.5 and regular maintenance 2.5.1.

Installation

JSC VertiClad must be installed by a suitably qualified and experienced tradesperson. Where restricted Building Work (RBW) applies the installer shall be a Licensed Building Practitioner (LBP) or supervised by an LBP.

5. BEVELBACK WEATHERBOARD CLADDING

Timber Weatherboard Cladding System

Horizontal Bevel Back Weatherboard Cladding profile to comply with nzs3617 and E2/AS1
All boards to have weather grooves to Branz recommendations. boards fixed to framing @600mm or 400mm crs with a single nail located immediately above. but within 10mm of lap. Nails shall be 90mmx3.15mm galv. steel (or stainless steel if cedar or redwood used). Joints shall be drilled for nailing and mitred. end grain shall be sealed against moisture by painting. Horizontal laps for rebated bevel back boards shall have 25mm minimum horizontal lap and be fitted with a 2mm gap against moisture by painting

6. CARPENTER

1. PRELIMINARY AND GENERAL

Read and note all clauses of the Preliminary and General section of this specification which apply to all works of this section.

2. EXTENT OF WORK

The work of this section shall include all labour, materials, equipment necessary to carry out and complete the carpentry as shown, or as required by this specification. Together with any other items or work reasonably inferred as part of this section.

3. ATTENDANCE AND PROTECTION

Attend upon all other trades providing all blockings, fixings, trims and nogging as necessary for the full completion of their respective works and make good after all trades.

4. MATERIALS AND WORKMANSHIP

All materials shall be the best of their respective class and type specified. Any materials, which in the opinion of the Owner or Territorial Authority are not up to standard, are to be removed immediately from the site. All work shall be carried out in a workman like manner in accordance with best trade practice and as/or where especially specified.

Any work that is intended for the proper completion of the building shall be included. All work shall comply with the relevant NZS requirements, in particular NZS 3604: 2.0 II .

5. TIMBER

All timber shall conform to NZS 3602 " Code of Practice for Specifying Timber and wood-based products for use in building". Timber used shall have the appropriate treatment for their use with the approved preservative process in plants licensed by the Timber Preservation Authority.

6. DAMP PROOFING

All timber is to be protected from dampness with 3-ply bituminous felt or other approved damp proofing material when in contact with concrete or brickwork, except as provided for use under clause 2.3.3 Of NZS 3604:2011.

7. PRIMING

All exterior finishing timber, all timber in contact with concrete blockwork and all external faces,

rebates, etc. of all doors, windows, frames and all woodwork of sashes, shall be primed before fixing unless otherwise specified.

8. CLEANING

The Contractor at the conclusion of the contract shall have all ceilings, walls and woodwork carefully dusted and wiped down. Windows washed and glass free from scratches and paint. Floors brushed and the entire building and site left in a clean condition for occupation.

9. FASTENING AND FABRICATION

The Contractor should especially note that all aspects of fastening and fabrication of framing members and wood-based products in this contract shall accord with the appropriate clauses/appendices of NZS 3604:2011 .

10. BUILDING PAPER

Fix breather type building paper to all exterior walls in accordance with NZS 3604:2011 .

12. GENERAL FRAMING

All framing to be 100x50mm stud or 75x50mm with .100mm wide studs to all openings not exceeding 3 meters span where supporting only one storey. All studs to be at 400mm centres unless otherwise noted on the approved building consent plans. Provide two rows of nogs/dwangs to full height of each wall unless otherwise stated on the approved building consent plans.

13. BRACING

Provide all wall bracing as shown on the approved building consent plans and attached wall bracing calculation and in accordance NZS 3604:2011 and manufacturer's specifications. Provide all necessary roof bracing in accordance with NZS 3604:2011 and the approved building consent plans.

14. ROOF CONSTRUCTION

(a) Construct roof framing by the method indicated on the approved building consent plans and in accordance with NZS 3604:2011 Section 10.

(b) Trussed Roofs

The approved building consent plans show clearly the type, pitch, span, spacing and overhangs of roof trusses and details of roof cladding that shall comply with Sections 10 and 11 of NZS 3604:2011. Trusses shall carry the name of the assembly factory.

(c) Framed Roofs

Roofs shall be framed up as shown in the approved building consent plans and in accordance with NZS 3604:2011 Section 10.

(d) Purlins, Eaves and Gable Ends

Construct and furnish as specified and shown on the approved building consent plans and in accordance with NZS 3604:2011 Section 10.

15. FASCIA BOARDS, ETC.

Fix fascia, barge, frieze boards, etc. to suit roofing selected and to best trade practice and in accordance with the approved plans and relevant New Zealand standards.

16. POST AND BEAM

Construct and secure as specified in NZS 3604:2011, unless otherwise stated.

17. WALL LININGS

Generally shall be 9.5mm Gibraltar board or similar and shall be nailed and fixed as per NZS 3604:2011 Section 12, or manufacturer's specifications and stopped to the same specifications in particular where contributing to wall bracing.

19. CEILING FRAMING

(a) Drowning of ceilings is not permitted unless otherwise stated/shown.

(b) Strap the underside of joists or roof members using 75x40mm battens at 400mm maximum centres for gibraltar board and 450mm maximum centres for fibrous plaster providing continuous backing for linings at all margins.

20. CEILING LININGS

(a) Refer to the approved building consent plans for the type of ceiling lining to be used.

(b) Gibraltar Board

9.5mm gibraltar board or equivalent shall be installed in accordance with the manufacturer's recommendations and NZS 3604:2011 Section 13.

(c) Fibrous Plaster

Refer to the Fibrous Plaster section of this specification.

21. SHELVING

Provide shelving as follows:

(a) Linen Cupboard

Five equally spaced full-depth shelves of 75x25mm slats spaced 15mm apart, supported on 75x25mm bearers.

(b) Wardrobes

One full length 300x25mm shelf supported on 150x25mm bearers.

(c) Coat Cupboard

As for wardrobes.

(d) Cylinder Cupboard

As detailed.

22. FINISHING WORK

Provide as follows unless specifically detailed on the approved plans or as specified by the owner:

(a) Cornice

Fix timber cornice to profile 7 at all ceiling and wall junctions, including inside cupboards, and at junctions of ceiling and built-in fittings. Mitre unless otherwise specified by the Owner.

(b) Skirtings

Fix skirting to profile 20 to all walls including framed-up cupboards. Mitre joints unless otherwise specified by the Owner.

(c) Architraves

Where required fix architraves to profile 19 around framed openings. Mitre comers unless specified otherwise by the Owner.

(d) Trim

Provide and fix all necessary beads and mouldings as detailed or as directed to neatly finish the work.

23. GENERAL HARDWARE

Allow to take delivery and fix hinges and butts for all doors and windows as specified by the Owner.

24. INTERNAL STAIRCASE

Consult the owner on the construction of the internal stairs.

7. JOINER

1. PROTECTION

All exterior joinery shall be either primed or treated with an approved water repellent before leaving the factory.

2. WINDOWS

- (a) Refer to approved plans and schedule of components for type of windows to be used.
- (b) All windows shall comply with their appropriate New Zealand standards.
- (c) Aluminum windows shall have condensation channels with sealed ends at sill level.
- (d) Each aluminum window sash shall be fitted with two approved double action catches. Timber windows shall have similar.
- (e) Aluminum windows shall be powder-coat finished and the colour to the Owner's choice unless otherwise specified.

3. DOORS

- (a) All doors shall be constructed and hung in accordance with the appropriate New Zealand standards.
- (b) The Owner shall select exterior doors unless otherwise stated.

4. CUPBOARD FITTINGS

The Owner shall select the style of cupboard fittings. Allow a P.C. sum of \$.....
for the supply of cupboard fittings only. The Contractor shall allow for installation.

8. ROOFER

1. PRELIMINARY AND GENERAL

Read and note all clauses under the Preliminary and General section this specification where they apply to this trade.

2. SCOPE

Comprises of all roof coverings, sealants, accessories and related items necessary to complete the work indicated on the approved building consent drawings and as further specified

3. ROOFING

Provide underlay as required by NZS 3604:2011 Section 11 and Table 11.1 and fixed in accordance with underlay manufacturer's recommendations.

4. ROOF CLADDING MATERIALS AND COMPONENTS

(a) Refer to the approved plans and the Schedule of Components for the type of roof to be used.

(b) Materials selected shall be set out and fixed by approved fixers and all shall accord with the manufacturer's specification and in all cases with other New Zealand standards as appropriate, i.e.

NZS 3403:1978 "Specification for hot-dip galvanised corrugated steel sheet for building purposes".

NZS 4206: 1992 "Concrete interlocking roofing tiles",

NZS 4217:---- Part 1:1980 "Specification for roofing tiles and their accessories" and also Part 2:1980 "Code of practice for preparation of the structure and the laying and fixing of metal roofing tiles".

(c) Thickness of materials unless otherwise specified shall be not less than the following:

Aluminum 0.7mm

Galvanised Steel 0.6mm

Copper 0.6mm

Lead flashings to small

Diameter vent pipes 1.7mm

Other lead flashings 2.0mm

5. GUARANTEES

On completion of all roofing, thoroughly clean down and furnish Owner with written guarantees to water tightness and security of the roof cladding. Guarantees to be signed by approved fixer/s and to run for a period of three years from the date of completion of the building.

9. PLUMBER

1. PRELIMINARY AND GENERAL

Read and note all clauses in the Preliminary and General section of this specification, which shall apply to all work in this section.

2. SCOPE

Comprises all gutters, downpipes, flashings, sanitary fittings, water supply, wastes, vents and related items necessary to complete the work indicated on the approved building consent plans and as further specified.

3. GENERAL

All work shall be carried out in accordance with best trade practice. All work shall conform to the requirements of the New Zealand Building Code 1991 and in particular the following relevant sections:

NZBC B2 Durability
 E1 Surface Water
 E3 Internal Moisture
 G10 Piped Services
 G12 Water Supplies
 G13 Foul Water

All work must also comply with all the relevant New Zealand, British and Australian standards that are specified as Acceptable Solutions in the N.Z. Building Code Handbook and in NZS 3604:2011 and in particular AS/NZS 3500.2.2003.

No connections to sanitary fittings or main shall be made except by a Registered Plumber. The Plumber shall arrange all building consents, connection and testing fees for any work for which he is solely responsible for completing as part of the contract.

4. DURABILITY

All elements to be used in the plumbing of the building I.e. sanitary fixtures and piping materials shall meet the performance standard of NZBC B2 Durability.

5. SPOUTING AND DOWN PIPES

Spouting shall be purpose made; metal or PVC, installed to recommended methods with an even fall to the down pipes. Connect to down pipes fixed as shown on the approved building consent

cleaning eyes to all waste pipes at junctions and all necessary overflow pipes.
All this work shall comply with NZBC G13 Foul Water.

11. FLASHINGS

Where possible use purpose made flashings to suit the purpose. Flashings to doors and windows shall be provided in one piece, each .150mm longer than the head it is to protect.

10. DRAIN LAYER

1. PRELIMINARY AND GENERAL

Read and note all clauses under the Preliminary" and General section of this specification where they apply to this trade.

2. SCOPE

Comprises all surface and foul water drainage up to above ground level to connect to the Plumber's work. The Drainlayer shall confer with the Plumber and shall arrange with the Contractor before the foundations are laid to fix the exact position of all connections of wastes and drains.

3. STANDARD OF WORK

All work shall be carried out in accordance with the best trade practice. ,

All work shall comply with all the requirements of the New Zealand Building Code 1991 and in particular the following relevant sections:

NZBC B1 Durability
 E1 Surface water
 G10 Piped Services
 AS/NZS 3500.2.2003

All work must also comply with all the relevant New Zealand, British and Australian standards that are specified as Acceptable Solutions in the N.Z. Building Code Handbook and in NZS 3604:2011 and in particular AS/NZS 3500.2.2003 ';

All required consents will be obtained, all notices served and all tests to be arranged.

4. DURABILITY

All elements to be used shall meet the performance standard NZBC B2 for Durability.

5. CONNEC~ION TO EXISTING DRAINAGE

The Drainlayer is responsible for verifying the position and depth of the connections and to commence laying his drains from this point.

6. INSTALLATION OF DRAINAGE

The foul water drainage system shall be laid, installed and completed to the requirements of AS/NZS 3500.2.2003 Foul Water Drainage and as directed on the approved building consent plans.

11. ELECTRICIAN

1. PRELIMINARY AND GENERAL

Read and note all clauses under the Preliminary and General section of this specification where they apply to this trade.

2. FEES

Pay all fees charged and obtain all necessary permits for the trade.

3. SCOPE OF WORK

Carry out the whole of the electrical installations in strict accordance with
AS/NZS 3000:2002 Wiring Rules
NZECP34:2001 Electrical safety distances
NZECP36:1993 Harmonic levels
NZECP54:2001 Installation of accessed L/A equipment
NZECP51:2004 Homeowner/ Occupants Electrical wiring work in domestic installations

4. MATERIALS AND WORKMANSHIP

All materials used under this contract shall be of approved New Zealand or British specification. Allow for all materials necessary to complete the contract whether specified or not. All work shall be carried out by a Registered Electrician in accordance with the regulations and best trade practice and in a manner which will cause minimum inconvenience to other workman and the work as a whole. Do all cutting away for the entry of cables.

5. CO-OPERATION

Co-operation with the Contractor in all phases of work. Give ample notice to enable the Contractor to arrange the necessary void, chase data etc.

6. COMPLETION AND CONNECTION OF POWER

Leave work complete, pay all charges and arrange for all inspections and test for the connection of power to the works. It is the responsibility of the Electrical Contractor to ensure that no delay is caused to the job once the contract is completed.

7. CONNECTION TO ELECTRICITY SUPPLIER

It is the responsibility of the Electrical Contractor to arrange all connections to the Electrical Supplier and to allow for and pay all fees for the connection of the supply to the building.

8. METER BOX

Provide and install a recessed meter box in accordance with the Electrical Supplier's requirements.
Confer with the carpenter about trimming the same.

9. MAIN SWITCHBOARD

Provide and install in recess the main switchboard complete with all necessary control and auxiliary equipment.

10. COOKING APPLIANCES

Allow the P.C. Sum of \$..... for the supply of cooking appliances, (see approved plans for location) to be selected by the Owner. Allow for the connection of these appliances.

11. WATER HEATER

Allow for the permanent connection of the water heater/s to the electrical system. Provide and install 3kw element and thermostat to hot water cylinder/s provided by the Plumber.

12. POWER OUTLETS

All power outlets shall be standard PDL 500 series outlets. Install plugs .300mm above the floor or .225mm above benchtops. Points to washer/drier space and refrigerator 1200mm from the floor. The exact position of power outlets shall be determined on the job by the Owner.

Allow for installing a total ofpower outlets in the building.

13. LIGHTS

All lights to be first quality, plastic batten holders shall be reinforced. All roses and holders not covered by fittings shall be white

Allow for installing a total oflight fixtures in the building.

14. LIGHT SWITCHES

Light switches shall be standard PDL 500 series fittings fixed 1200mm above the floor.

12. PAINTER

1. PRELIMINARY AND GENERAL

Read and note all clauses under the Preliminary and General section of this specification which shall apply to this section of the work.

2. MATERIALS

Generally all materials shall be of New Zealand manufacture of approved brands and of the paint selected. respective coats shall be of the same brand.

3. WORKMANSHIP

All work shall be carried out in accordance with good trade practice. Surfaces shall be clean and properly prepared before coating and the work shall be in accordance with AS/NZS 2311: 2000 "Guide to the painting of buildings".

4. COLOUR SCHEME

The Owner will select from the Standard Colour Charts. colours he will require and the Contractor is to allow for picking out sashes. Doors. porches or any other reasonable colour change required.

5. STOPPING

After priming, all nail holes or joints are to be stopped and cleaned off before undercoating for painted work. For varnished work. holes etc. are to be stopped with matching putty after the first coat of sealer.

6. PAINTING OF EXTERNAL WORK

After priming all external woodwork and adjacent metal work such as flashings, and spouting if metal. is to be given one good coat of undercoat followed by a finishing coat of high gloss paint. The priming coat before painting shall be well brushed in and all faces shall be covered. ends of laps and tops and sides of sashes. doors etc.

7. PAINTING OF INTERIOR SURFACES

Wallboard and ceilings as required are to be given one coat of sealer and finished with two coats of approved paint finishing flat or semi-gloss as required. Where full gloss is required with wet wall areas such as bathrooms the finishing coat shall be full gloss enamel.

13. GAS SERVICES

1. PRELIMINARY AND GENERAL

Read and note all clauses under the preliminary and general section of this specification where they apply to this trade.

2. FEES

Pay all fees charged and obtain all necessary permits for the trade.

3. SCOPE OF WORK

Carry out the whole of the gas installation in strict accordance with Building code clause G10 and G110r NZS5261 appendix D.

4. MATERIALS AND WORKMANSHIP

All materials used under this contract shall be of approved New Zealand specification. Allow for all material necessary to complete the contract whether specified or not. All work shall be carried out by a Registered gas fitter in accordance with the regulations and best trade practice and in a manner which will cause minimum inconvenience to other workman and the work as a whole. Do all cutting away for the entry of cables.

5. CO-OPERATION

CO-operation with the contraction in all phases of work. Give ample notice to enable the contractor to arrange the necessary void, chase data etc.

6. COMPLETION AND CONNECTION OF GAS

Leave work complete, pay all charges and arrange for all inspections and test for the connection of gas to the works. It is the responsibility of the Gas contractor to ensure that no delay is caused to the job once the contract is completed.

7. CONNECTION TO GAS SUPPLIER

It is responsibility of the gas contractor to arrange all connections to the Gas Supplier and to allow for and pay all fees for connection of the supply to the building.

9. WATER HEATER

Allow for the permanent connection for the gas water heater to gas system.

BRANZ NZS 4218:2009 CALCULATION METHOD TOOL

PROJECT SUMMARY

Project name	21069
Address	22 Johnson Street, Tuakau, Waikato, 2121
Designer	Alison Ho
Address	13 William Pickering Drive, Rosedale 0632
Phone	09 475 9599
Date	21/05/2022
Reference number	

Climate zone	1: Northland, Auckland, Thames-Coromandel districts							
Wall construction type	1: Any wall type							
If mixed wall types	<table border="1"> <tr> <td><input type="text" value="0"/></td> <td>Percentage of wall area solid timber construction</td> </tr> <tr> <td><input type="text" value="0"/></td> <td>Percentage of wall area high thermal mass construction</td> </tr> <tr> <td><input type="text" value="100"/></td> <td>Percentage of wall area "Any wall type"</td> </tr> </table>	<input type="text" value="0"/>	Percentage of wall area solid timber construction	<input type="text" value="0"/>	Percentage of wall area high thermal mass construction	<input type="text" value="100"/>	Percentage of wall area "Any wall type"	
<input type="text" value="0"/>	Percentage of wall area solid timber construction							
<input type="text" value="0"/>	Percentage of wall area high thermal mass construction							
<input type="text" value="100"/>	Percentage of wall area "Any wall type"							
If solid timber wall	3: External 90 mm thick solid timber and solid timber internal walls 45 mm thick							
Is there just one wall construction R-value (R_{Wall}) and one door (R_{Door}) construction R-value (but different to the walls) for the building?	no							

Summary of calculation method heat loss

Element	Area (m ²)	Proposed building heat loss (W/°C)	Reference building heat loss (W/°C)
Roofs/ceilings	181.5	56.9	62.6
Walls	290.0	141.9	158.4
Floors	173.9	124.2	133.8
Vertical glazing	60.0	230.8	416.5
Skylights	0.0	0.0	-
Doors (Attributable)	11.0	0.0	-
Total		553.8	771.3 W/°C

Glazing percentage: 17%
Glazing <50%: Yes
Minimum R-values OK: Yes
Issues to check:

PASS/FAIL **PASS**

BRANZ NZS 4218:2009 CALCULATION METHOD TOOL

BUILDING ELEMENTS

Roofs/ceilings: Skylights are not included here. Enter them in the skylights table below.

Roof/ceiling element	Description	Area (m ²)	Construction R-value	Heat loss
1	SHINGLE	181.5	3.19	56.9
2				
3				
4				
5				

Total area 181.5 m²

Total roofs/ceilings heat loss W/°C

Skylights: Skylights are at an angle of 60° or less to the horizontal. If the skylight R-value is not known, use a value of 0.15.

Skylight	Description	Area (m ²)	Construction R-value	Heat loss
1				
2				
3				
4				
From Skylight Schedule		0.0		0.0

Total area 0.0 m²

Total skylight heat loss W/°C

Walls: Doors are not included here. Enter them in the door table.

Each wall area is the total wall area less the glazing and door area for that wall

Wall element	Description	Area (m ²)	Construction R-value	Heat loss
1	90mm Brick Veneer	33.0	1.95	16.9
2	BLOCK	54.0	2.03	26.6
3	VERTICAL SHIPLAP	39.0	2.00	19.5
4	BEVEL-BACK WEATHERBOARD	164.0	2.08	78.8
5				
6				
7				
8				
9				
10				

Total area 290.0 m²

Total wall heat loss W/°C

Floors: Only include the ground or exterior floors. Intermediate floors not exposed to the exterior are excluded.

IH1/AS1 is not perm

Floor element	Description	Area (m ²)	Construction R-value	Heat loss
1	CONCRETE FOUNDATION	173.9	1.40	124.2
2				
3				
4				
5				

Total area 173.9 m²

Floor heat loss W/°C

Vertical glazing: Vertical glazing only (steeper than 60°), including glazing in doors. Skylights are on the Skylight table.

If the glazing R-value is not known, use a value of 0.15

Glazing element	Description	Area (m ²)	Construction R-value	Heat loss
1	Aluminium frame with double glazing	60.0	0.26	230.8
2				
3				
4				
5				
6				
7				
8				
9				
10				
From Glazing Schedule		0.0		0.0

Total area 60.0 m²

Total vertical glazing heat loss W/°C

Doors: Only the non-glazed area of doors is included. The glazed area of doors must be entered in the Glazing table.

The heat loss of doors is automatically set to 0 if the total door area is ≤ 6m² or 6% of the total wall area.

If the area of doors are above 6m² or 6% of the total wall area then the marginal heat loss needs to be considered.

If the insulation values of the walls are different or the insulation value of the doors are different then

the assignable heat loss due to doors can not be calculated using this tool.

If the R-value of a door is not entered a default value of R 0.18 is automatically used.

Door element	Description	Area (m ²)	Construction R-value	Heat loss
1	Garage Door	11.0	0.18	61.1
2				0.0
3				0.0
4				0.0
5				0.0
From Door Schedule		0.0		0.0

Total area 11.0 m²

Attributable 0.0 W/°C

21.66

0.18



Construction R-value Calculator

Waikato District Council
Building Consent Number
BLD2096/22

APPROVED

This webpage calculates the R-value of walls, roofs and suspended floors for most insulation material R-values. It uses the "iso-thermal planes" method, the same method as used in NZS4214:2006.

Some of the possible material combinations may not be suitable for actual constructions, i.e. EPS based claddings directly fixed on timber framing. Please make sure to select only appropriate material combinations.

If your construction is not listed, please send an e-mail to designnavigator@gmail.com with a description and a detail drawing (pdf) of it or use the new [Design Navigator message board](#) [i](#).

Please select the element type. Then choose the construction details and enter the R-value of the insulation either directly in the text box or by choosing a product from the right panel [i](#).

- Floors
- Walls
- Roofs

Asphalt Shingles
3.19 m²C/W

Type: Roof: Timber framed Roof, direct fixed or battened flat Ceiling ▼

Timber framed Roof, direct fixed or battened flat Ceiling view detail

external surface 0.03

Roofing : Asphalt shingles on 15mm T&G construction plywood ▼

R-value: 0.13

Insulation :

Timber Frame & Cavity :

90mm rafters or joists @ 900mm, battens covered with insulation ▼

Roof Frame Area: 5.0% Cavity Area: 95.0%

Roof space (still air) Roof space (still air)

Framing :
R-value: 0.75

Insulation :

Roof Lining : Gypsum plasterboard 10mm ▼

R-value: 0.04

internal surface 0.09

Non-IC-rated recessed downlights

Ceiling Area [m²]: Number of downlights: Clearance from lamp holder side [m]: [i](#)

[Print Page](#)

Current NZS4218:2009 Schedule Method minimum R-value Targets (non-solid construction) [i](#):

	Zone 1	Zone 2	Zone 3
Roof	R-2.9	R-2.9	R-3.3
Wall	R-1.9	R-1.9	R-2.0
Floor	R-1.3	R-1.3	R-1.3
Glazing (vertical)	R-0.26	R-0.26	R-0.26
Glazing (skylights)	R-0.26	R-0.26	R-0.31

Australian Building Code Targets [i](#):

	All Zones except NSW	NSW
Roof	R-4.1	R-6.3

Wall R-2.9 R-3.8

Waikato District Council
Building Consent Number
BLD2096/22



APPROVED



Construction R-value Calculator

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Please select the element type. Then choose the construction details and enter the R-value of the insulation either directly in the text box or by choosing a product from the right panel [i](#).

Floors

Walls

Roofs

Bevel-Back Weatherboard
2.08 m²C/W

Type: Wall: Timber Frame with vented Cavity ▼

Timber Frame with vented Cavity view detail

external surface 0.03	
Cladding : Bevelled weatherboard with building paper ▼	<i>R-value: 0.28</i>
Air Barrier : Building paper ▼	<i>R-value: 0.01</i>
Timber Frame & Cavity : 90mm, studs @ 400mm, dwangs @ 800mm ▼	
<i>Wall Frame Area: 17.9%</i>	<i>Cavity Area: 82.1%</i>
15-90mm vented cavity (all R-values on ext. side of cavity will be halved), R: 0.08	15-90mm vented cavity (all R-values on ext. side of cavity will be halved), R: 0.08
Framing : <i>R-value: 0.75</i>	Insulation : 2.2
still Airgap: none ▼	
<i>R-value: 0.00</i>	
Wall Lining : Gypsum plasterboard 10mm ▼	<i>R-value: 0.04</i>
internal surface 0.09	

Print Page

Current NZS4218:2009 Schedule Method minimum R-value Targets (non-solid construction) [i](#):

	Zone 1	Zone 2	Zone 3
Roof	R-2.9	R-2.9	R-3.3
Wall	R-1.9	R-1.9	R-2.0
Floor	R-1.3	R-1.3	R-1.3
Glazing (vertical)	R-0.26	R-0.26	R-0.26
Glazing (skylights)	R-0.26	R-0.26	R-0.31

Australian Building Code Targets [i](#):

	All Zones except NSW	NSW
Roof	R-4.1	R-6.3
Wall	R-2.9	R-3.8



Construction R-value Calculator

This webpage calculates the R-value of walls, roofs and suspended floors for most insulation material R-values. It uses the "iso-thermal planes" method, the same method as used in NZS4214:2006.

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If your construction is not listed, please send an e-mail to designnavigator@gmail.com with a description and a detail drawing (pdf) of it or use the new [Design Navigator message board](#)

Please select the element type. Then choose the construction details and enter the R-value of the insulation either directly in the text box or by choosing a product from the right panel .

- Floors
- Walls
- Roofs

20 Series Block with 70mm Strapping
2.03 m²C/W

Type: Wall: Solid Wall (concrete, masonry or other) without vented Cavity, with internal Insulation ▼

Solid Wall (concrete, masonry or other) without vented Cavity, with internal Insulation view detail

external surface 0.03	
Cladding : None (facing outside air) ▼	<i>R-value: 0.00</i>
Solid Masonry : Standard Blocks, 200mm, no cells filled ▼	<i>R-value: 0.19</i>
Strapping : Timber batten, 70mm deep, 45mm wide @ 600mm centers ▼	
<i>Strapping Area: 11.0%</i>	<i>Cavity Area: 89.0%</i>
Thermal Break : none ▼	<i>R-value: 0.00</i>
Strapping : 	<i>R-value: 0.58</i>
<div style="display: flex; justify-content: space-between;"> Expol Platinum R-2.19 Block Wall 2.19 </div>	
still Airgap: none ▼	<i>R-value: 0.00</i>
Wall Lining : Gypsum plasterboard 10mm ▼	
<i>R-value: 0.04</i>	
internal surface 0.09	

Print Page

Current NZS4218:2009 Schedule Method minimum R-value Targets (non-solid construction)

	Zone 1	Zone 2	Zone 3
Roof	R-2.9	R-2.9	R-3.3
Wall	R-1.9	R-1.9	R-2.0
Floor	R-1.3	R-1.3	R-1.3
Glazing (vertical)	R-0.26	R-0.26	R-0.26
Glazing (skylights)	R-0.26	R-0.26	R-0.31

Australian Building Code Targets

	All Zones except NSW	NSW
Roof	R-4.1	R-6.3
Wall	R-2.9	R-3.8



Construction R-value Calculator

This webpage calculates the R-value of walls, roofs and suspended floors for most insulation material R-values. It uses the "iso-thermal planes" method, the same method as used in NZS4214:2006.

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If your construction is not listed, please send an e-mail to designnavigator@gmail.com with a description and a detail drawing (pdf) of it or use the [Design Navigator message board](#).

Please select the element type. Then choose the construction details and enter the R-value of the insulation either directly in the text box or by choosing a product from the right panel.

- Floors
- Walls
- Roofs

90mm Masonry Veneer
1.95 m²C/W

Type: Wall: Timber Frame with vented Cavity

Timber Frame with vented Cavity view detail

external surface 0.03	
Cladding : 90mm brick	R-value: 0.08
Air Barrier : Building paper	R-value: 0.01
Timber Frame & Cavity : 90mm, studs @ 400mm, dwangs @ 800mm	
Wall Frame Area: 17.9%	Cavity Area: 82.1%
15-90mm vented cavity (all R-values on ext. side of cavity will be halved), R: 0.08	15-90mm vented cavity (all R-values on ext. side of cavity will be halved), R: 0.08
Framing : R-value: 0.75	Insulation : 2.2
	still Airgap: none R-value: 0.00
Wall Lining : Gypsum plasterboard 10mm	
R-value: 0.04	
internal surface 0.09	

Print Page

Current NZS4218:2009 Schedule Method minimum R-value Targets (non-solid construction) [i](#):

	Zone 1	Zone 2	Zone 3
Roof	R-2.9	R-2.9	R-3.3
Wall	R-1.9	R-1.9	R-2.0
Floor	R-1.3	R-1.3	R-1.3
Glazing (vertical)	R-0.26	R-0.26	R-0.26
Glazing (skylights)	R-0.26	R-0.26	R-0.31

Australian Building Code Targets [i](#):

	All Zones except NSW	NSW
Roof	R-4.1	R-6.3
Wall	R-2.9	R-3.8





Construction R-value Calculator

This webpage calculates the R-value of walls, roofs and suspended floors for most insulation material R-values. It uses the "iso-thermal planes" method, the same method as used in NZS4214:2006.

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Please select the element type. Then choose the construction details and enter the R-value of the insulation either directly in the text box or by choosing a product from the right panel [i](#).

- Floors
- Walls
- Roofs

Vertical Shiplap Weatherboard
2.00 m²C/W

Type: Wall: Timber Frame with vented Cavity ▼

Timber Frame with vented Cavity view detail

external surface 0.03	
Cladding : Rusticated or shiplap weatherboard ▼	
<i>R-value: 0.16</i>	
Air Barrier : Building paper ▼	
<i>R-value: 0.01</i>	
Timber Frame & Cavity : 90mm, studs @ 400mm, dwangs @ 800mm ▼	
<i>Wall Frame Area: 17.9%</i> <i>Cavity Area: 82.1%</i>	
15-90mm vented cavity (all R-values on ext. side of cavity will be halved), R: 0.08	15-90mm vented cavity (all R-values on ext. side of cavity will be halved), R: 0.08
Framing : <i>R-value: 0.75</i>	Insulation : 2.2
still Airgap: none ▼	
<i>R-value: 0.00</i>	
Wall Lining : Gypsum plasterboard 10mm ▼	
<i>R-value: 0.04</i>	
internal surface 0.09	

[Print Page](#)

Current NZS4218:2009 Schedule Method minimum R-value Targets (non-solid construction) [i](#):

	Zone 1	Zone 2	Zone 3
Roof	R-2.9	R-2.9	R-3.3
Wall	R-1.9	R-1.9	R-2.0
Floor	R-1.3	R-1.3	R-1.3
Glazing (vertical)	R-0.26	R-0.26	R-0.26
Glazing (skylights)	R-0.26	R-0.26	R-0.31

Australian Building Code Targets [i](#):

	All Zones except NSW	NSW
Roof	R-4.1	R-6.3
Wall	R-2.9	R-3.8



Construction R-value Calculator

This webpage calculates the R-value of walls, roofs and suspended floors for most insulation material R-values. It uses the "iso-thermal planes" method, the same method as used in NZS4214:2006.

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Some of the possible material combinations may not be suitable for actual constructions, i.e. EPS based claddings directly fixed on timber framing. Please make sure to select only appropriate material combinations.

If your construction is not listed, please send an e-mail to designnavigator@gmail.com with a description and a detail drawing (pdf) of it or use the new [Design Navigator message board](#).

Please select the element type. Then choose the construction details and enter the R-value of the insulation either directly in the text box or by choosing a product from the right panel.

- Floors
- Walls
- Roofs

Concrete Foundation 1.40 m²C/W

Type: Floor: Slab floor

Slab floor

internal surface 0.09	
Flooring :	none (Example: polished surface of a concrete floor) R-value: 0.00
Slab Insulation	
Slab floor area [m ²]:	160
Perimeter length [m]:	63.3
External wall thickness [mm]:	90 i
Soil conductivity [W/m °C]	1.2 i
Underslab insulation:	none Insulation : <input type="text"/> i
Piles Footings:	Number: <input type="text"/> Penetration Diameter: <input type="text"/>
Slab edge insulation:	none Insulation : <input type="text"/> i

Print Page

Current NZS4218:2009 Schedule Method minimum R-value Targets (non-solid construction) [i](#):

	Zone 1	Zone 2	Zone 3
Roof	R-2.9	R-2.9	R-3.3
Wall	R-1.9	R-1.9	R-2.0
Floor	R-1.3	R-1.3	R-1.3
Glazing (vertical)	R-0.26	R-0.26	R-0.26
Glazing (skylights)	R-0.26	R-0.26	R-0.31

Australian Building Code Targets [i](#):

	All Zones except NSW	NSW
Roof	R-4.1	R-6.3
Wall	R-2.9	R-3.8



APRIL 14, 2022

K DESIGN GEROUP LTD

STRUCTURAL CALCULATION REPORT

PREPARED FOR:

220952-LW-22 JOHNSON ST, TUAKAU, WAIKATO

**CLIENT: SRUJITH SIRIKONDA & ANUSHA RAO
KOLUGURI**

REF: 220952



DOCUMENT CONTROL RECORD

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Report Title					
Client	Srujith Sirikonda		Project Number	220952	
Rev	Date	Revision Details	Author	Reviewer	Approved By
0	14 APR 2022		AY	WD	KS
Current Revision		0			

Approval					
Author Signature	<u>AY</u>	Reviewer Signature	<u>WD</u>	Approver Signature	<u>KS</u>
Name	ALLEN YAN	Name	WADE DENG	Name	KIMI SHENG
Title	Structural Engineer	Title	Structural Engineer	Title	Structural Engineer

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b) Using the documents or data for any purpose not agreed to in writing by K Design Group Ltd.



Design Features Report

These calculations pertain to an alteration two-storey house at 4 Orbit Dr, Rosedale and cover the following design aspects:

1. Gravity framing design – beams, columns, connections etc
2. Bracing design – as per NZS3604:2011
3. Foundation design – shallow rib raft + pad footing
4. SED roof system SED rafter
5. Structural steel
6. Retaining wall design – block wall + timber pole retaining wall

1.0 Standards referenced

- Design loads to NZS1170.0, 1, 2, 5
- NZS3603:1993 Timber Design (Amendment 4)
- NZS3604:2011 Timber Framed Buildings
- NZS3101:2006 Concrete Structure (Amendment 3)
- NZS3404:1997 Steel Structure Standard
- NZS4229:2013 Concrete Masonry Buildings
- AS2870:2011 Residential slabs and footing

2.0 Wind loads

Wind zone: High (44m/s) to NZS3604:2011

3.0 Dead loads

Items	Roof	Floor	Internal walls	External walls	Brick veneer (if any)	Deck (if any)
Description	Lightweight	Lightweight	/	Lightweight	70/90 series	Slatted /Membrane
Unit load (kPa)	0.5	0.5	0.3	0.4	1.4/1.8	0.4/0.8

Live loads

Items	Roof	Floor	Deck
Distributed load (kPa)	0.25	1.5	2.0

Barrier loads

Designed using requirements of clauses 3.6 and 3.8 of AS/NZS 1170.1 as modified by B1/VM1 (clauses 2.2.7 and 2.2.8) with imposed actions as specified in Table 3.3 of AS/NZS 1170.1.

	Horizontal	Vertical	Any direction
Top edge	0.35kN/m	0.35kN/m	0.6kN
Infill	0.5kPa	-	0.25kN



4.0 Ductility and deflections

Light timber framed buildings per NZS 3604 have an assumed ductility of 3.5. The specifically designed PFC portal frame has been assigned a ductility of 1.0 as per NZS 1170 and NZS 3404, and scaled up the ultimate load accordingly. For serviceability limited state, lateral deflection criterion is $H/300$ max.

5.0 Seismic coefficient

Figures in the table below are for a house being built in Auckland, with a near-fault factor of 1, importance level of 2. The $Z=0.13$ for the NZS 3604 bracing element is the isoseismal for Zone 3 in NZS 3604 and Auckland is within this zone.

6.0 Soil parameters

Soil report prepared by: G.DECO, dated 09/03/2022, ref: G22-A0037

Soil expansivity class: Class M to AS2870:2011

Soil type: C (Shallow)

Shallow foundation:

- Ultimate Bearing Capacity = 300kPa
- Design Bearing Capacity = 150kPa

7.0 Earthquake Zone

- EQ Zone = Zone 1

8.0 Corrosion

Corrosion zone: Zone B (Low Risk)



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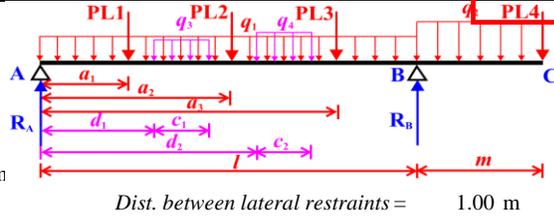
Beam/Lintel Design

Member NO. **B1**

Use as: **Floor beam**

$l = 4.1$ m

$m =$ m



UDL Loads:

Load source	Non-cantilever q_1 (UDL over whole span)					Cantilever q_2 (UDL over whole cantilever span)				
	Load dim m	Dead Load D (kPa)	Live Load L (kPa)	D kN/m	L kN/m	Load dim m	Dead Load D (kPa)	Live Load L (kPa)	D kN/m	L kN/m
Roof		0.50	0.25	0.00	0.00		0.50	0.25	0.00	0.00
Floor	1.70	0.50	1.50	0.85	2.55		0.50	1.50	0.00	0.00
Wall	2.70	0.40		1.08	0.00		0.40		0.00	0.00
Deck		0.80	2.00	0.00	0.00		0.80	2.00	0.00	0.00
other				0.00	0.00				0.00	0.00
Self-weight				0.23	0.00				0.23	0.00
Total				2.16	2.55				0.23	0.00

Local UDL:	Non-cantilever q_3					Non-cantilever q_4				
	Load position	$d1 =$	0.00	$c1 =$	1.40	Load position	$d2 =$	0.00	$c2 =$	0.00
Roof	4.30	0.50	0.25	2.15	1.08		0.50	0.25	0.00	0.00
Floor		0.50	1.50	0.00	0.00		0.50	1.50	0.00	0.00
Wall		0.40		0.00	0.00		0.40		0.00	0.00
Other				0.00	0.00				0.00	0.00
Total				2.15	1.08				0.00	0.00

Point Loads:	$a_1/a_2/a_3(m)$	Load area(m ²)	D (kPa or kN)	L (kPa or kN)	PL _D (kN)	PL _L (kN)
PL1 from DJ	1.40	1.00	0.53	1.37	0.53	1.37
PL2 from GT	1.20	10.00	0.50	0.25	5.00	2.50
PL3 from					0.00	0.00
PL from	- (beam end)	1.00	0.00	0.00	0.00	0.00

ULS Demand (1.2D+1.5L):

$M^* = 25.0$ kN·m (Positive) 0.0 kN·m (Negative)

$V^* = 26.7$ kN

Try **200x75PFC**

Selfweight = 0.2 kN/m

$I = 19.1 \times 10^6$ mm⁴

$E = 200.0 \times 10^3$ MPa

$\phi M_n = 55.1$ kN·m $> M^*$, **OK!** (Ratio) 2.20

$\phi V_n = 207.0$ kN $> V^*$, **OK!** 7.76

SLS Long-term Deflection (D+ ψ_s L) (for timber only):

$\delta_{nl} = 5.8$ mm (L/705)

$\delta_{ic} = 0.0$ mm

deflection limit: $\delta_{maxll} = \min(\text{span}/300, 12) = 12.0$ mm

deflection limit: $\delta_{maxlc} = \min(\text{span}/200, 10) = 0.0$ mm

$\psi_l = 0.4$ $k_2 = 1.0$

$< \delta_{maxll}$, **OK!**

$< \delta_{maxlc}$, **OK!**

(non-cantilever)

(cantilever)

SLS Short-term Deflection (D+ ψ_s L):

$\delta_{st} = 7.0$ mm (L/587)

$\delta_{sc} = 0.0$ mm

deflection limit: $\delta_{maxsl} = \min(\text{span}/300, 12) = 12.0$ mm

deflection limit: $\delta_{maxsc} = \min(\text{span}/200, 10) = 0.0$ mm

$\psi_s = 0.7$ $k_2 = 1.0$

$< \delta_{maxsl}$, **OK!**

$< \delta_{maxsc}$, **OK!**

(non-cantilever)

(cantilever)

Reactions:

R_A :		R_B :	
D=	10.8 kN	D=	6.6 kN
L=	9.1 kN	L=	6.7 kN
1.2D+1.5L=	26.7 kN	1.2D+1.5L=	17.9 kN

Standard connection OK!

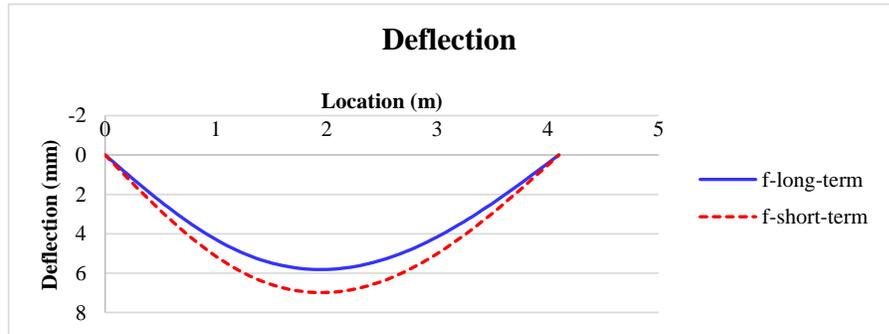
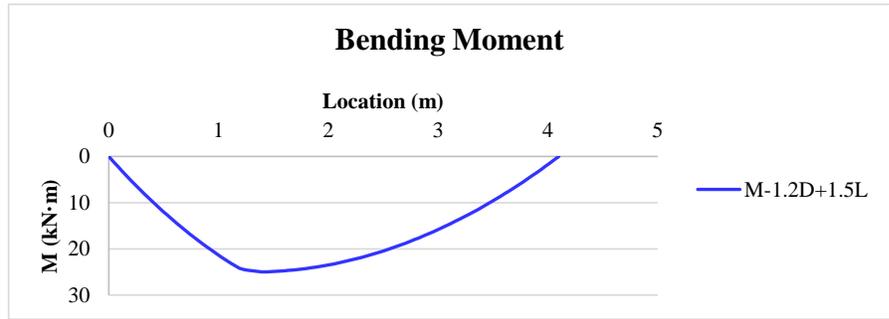
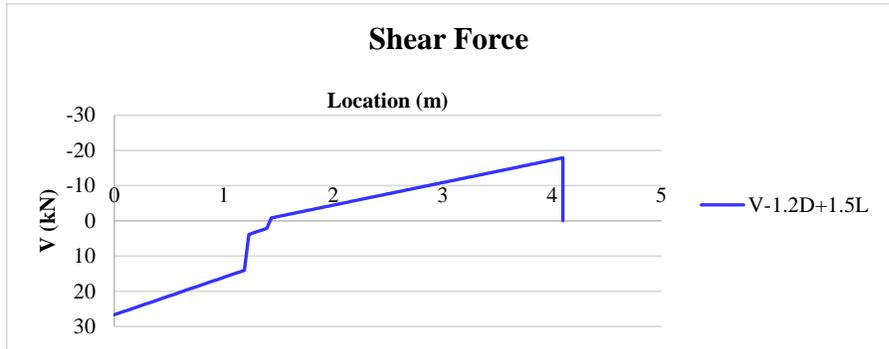


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Beam/Lintel Design

Member NO. **B1**





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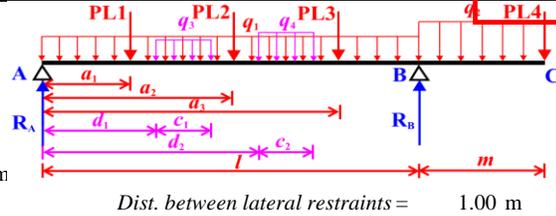
Beam/Lintel Design

Member NO. **B2**

Use as: **Floor beam**

$l = 5.8$ m

$m = 0.6$ m



Dist. between lateral restraints = 1.00 m

UDL Loads:

Load source	Non-cantilever q_1 (UDL over whole span)					Cantilever q_2 (UDL over whole cantilever span)				
	Load dim m	Dead Load D (kPa)	Live Load L (kPa)	D kN/m	L kN/m	Load dim m	Dead Load D (kPa)	Live Load L (kPa)	D kN/m	L kN/m
Roof		0.50	0.25	0.00	0.00		0.50	0.25	0.00	0.00
Floor	3.00	0.50	1.50	1.50	4.50	3.00	0.50	1.50	1.50	4.50
Wall	2.70	0.40		1.08	0.00	2.70	0.40		1.08	0.00
Deck		0.80	2.00	0.00	0.00		0.80	2.00	0.00	0.00
other				0.00	0.00				0.00	0.00
Self-weight				0.37	0.00				0.37	0.00
Total				2.95	4.50				2.95	4.50

Local UDL:	Non-cantilever q_3				Non-cantilever q_4			
	Load position	$d1 =$	$c1 =$		Load position	$d2 =$	$c2 =$	
Roof		0.50	0.25	0.00		0.50	0.25	0.00
Floor		0.50	1.50	0.00		0.50	1.50	0.00
Wall		0.40		0.00		0.40		0.00
Other				0.00				0.00
Total				0.00				0.00

Point Loads:	$a_1/a_2/a_3$ (m)	Load area (m ²)	D (kPa or kN)	L (kPa or kN)	PL _D (kN)	PL _L (kN)	
PL1 from					0.00	0.00	
PL2 from					0.00	0.00	
PL3 from					0.00	0.00	
PL from	B3	- (beam end)	1.00	5.39	1.63	5.39	1.63

ULS Demand (1.2D+1.5L):

$M^* = 39.7$ kN·m (Positive) -7.2 kN·m (Negative)

$V^* = 31.1$ kN

Try **250UB37.3**

Selfweight = 0.4 kN/m

$I = 55.7 \times 10^6$ mm⁴

$E = 200.0 \times 10^3$ MPa

$\phi M_n = 137.1$ kN·m $> M^*$, **OK!** 3.45 (Ratio)

$\phi V_n = 283.0$ kN $> V^*$, **OK!** 9.11

SLS Long-term Deflection (D+ ψ L) (for timber only):

$\delta_{ll} = 5.4$ mm (L/1067)

$\delta_{lc} = 1.6$ mm (L/383)

deflection limit: $\delta_{maxll} = \min(\text{span}/300, 12) = 12.0$ mm

deflection limit: $\delta_{maxlc} = \min(\text{span}/200, 10) = 3.0$ mm

$\psi_l = 0.4$ $k_2 = 1.0$

$< \delta_{maxll}$, **OK!**

$< \delta_{maxlc}$, **OK!**

(non-cantilever)

(cantilever)

SLS Short-term Deflection (D+ ψ L):

$\delta_{st} = 7.1$ mm (L/815)

$\delta_{sc} = 2.1$ mm (L/286)

deflection limit: $\delta_{maxst} = \min(\text{span}/300, 12) = 12.0$ mm

deflection limit: $\delta_{maxsc} = \min(\text{span}/200, 10) = 3.0$ mm

$\psi_s = 0.7$ $k_2 = 1.0$

$< \delta_{maxst}$, **OK!**

$< \delta_{maxsc}$, **OK!**

(non-cantilever)

(cantilever)

Reactions:

R_A :		R_B :	
D=	7.9 kN	D=	16.3 kN
L=	12.7 kN	L=	17.7 kN
1.2D+1.5L=	28.6 kN	1.2D+1.5L=	46.1 kN

Connection to be designed!

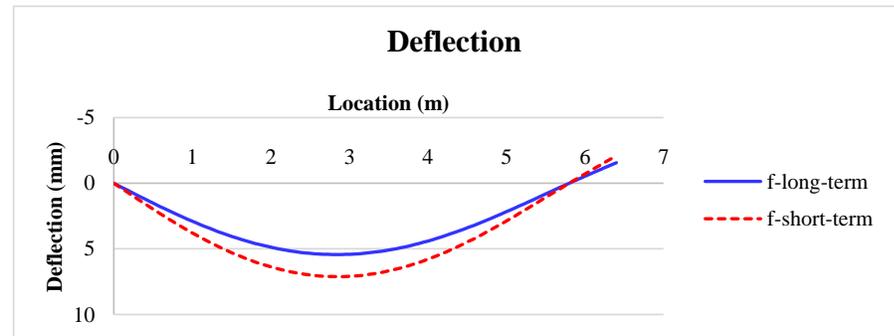
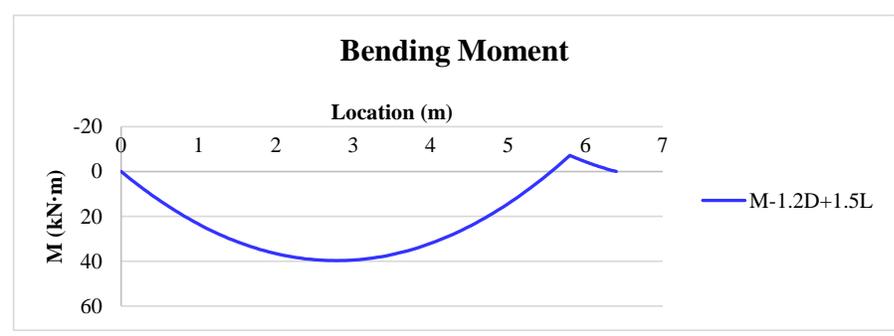
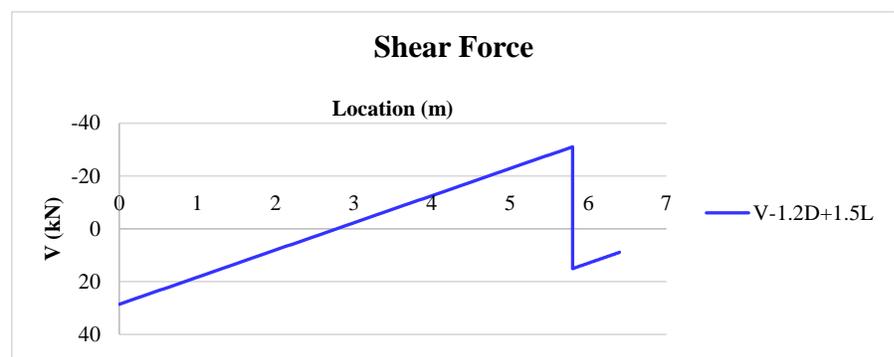


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Beam/Lintel Design

Member NO. **B2**





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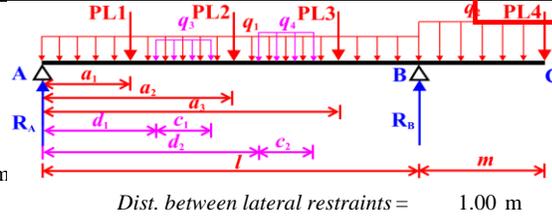
Beam/Lintel Design

Member NO. **B3**

Use as: **Floor beam**

$l = 3.1$ m

$m =$ m



UDL Loads:

Load source	Non-cantilever q_1 (UDL over whole span)					Cantilever q_2 (UDL over whole cantilever span)				
	Load dim m	Dead Load D (kPa)	Live Load L (kPa)	D kN/m	L kN/m	Load dim m	Dead Load D (kPa)	Live Load L (kPa)	D kN/m	L kN/m
Roof	0.90	0.50	0.25	0.45	0.23		0.50	0.25	0.00	0.00
Floor	0.20	0.50	1.50	0.10	0.30		0.50	1.50	0.00	0.00
Wall	2.70	0.40		1.08	0.00		0.40		0.00	0.00
Deck		0.80	2.00	0.00	0.00		0.80	2.00	0.00	0.00
other				0.00	0.00				0.00	0.00
Self-weight				0.11	0.00				0.11	0.00
Total				1.74	0.53				0.11	0.00

Local UDL:	Non-cantilever q_3				Non-cantilever q_4			
	Load position	$d1 =$	$c1 =$		Load position	$d2 =$	$c2 =$	
Roof		0.50	0.25	0.00		0.50	0.25	0.00
Floor		0.50	1.50	0.00		0.50	1.50	0.00
Wall		0.40		0.00		0.40		0.00
Other				0.00				0.00
Total				0.00				0.00

Point Loads:	$a_1/a_2/a_3$ (m)	Load area (m ²)	D (kPa or kN)	L (kPa or kN)	PL _D (kN)	PL _L (kN)
PL1 from					0.00	0.00
PL2 from					0.00	0.00
PL3 from					0.00	0.00
PL from	- (beam end)	1.00	0.00	0.00	0.00	0.00

ULS Demand (1.2D+1.5L):

$M^* = 3.5$ kN·m (Positive) 0.0 kN·m (Negative)
 $V^* = 4.5$ kN

Try **2/240x45**

Selfweight = 0.1 kN/m
 $I = 103.7 \times 10^6$ mm⁴
 $E = 6.7 \times 10^3$ MPa (Ratio)
 $\phi M_n = 7.7$ kN·m $> M^*$, **OK!** 2.24
 $\phi V_n = 25.2$ kN $> V^*$, **OK!** 5.66

SLS Long-term Deflection (D+ ψ_s L) (for timber only):

$\psi_l = 0.4$ $k_2 = 2.0$
 $\delta_{ll} = 6.7$ mm (L/460) $< \delta_{maxll}$, **OK!**
 $\delta_{lc} = 0.0$ mm $< \delta_{maxlc}$, **OK!**
deflection limit: $\delta_{maxll} = \min(\text{span}/300, 12) = 10.3$ mm (non-cantilever)
deflection limit: $\delta_{maxlc} = \min(\text{span}/200, 10) = 0.0$ mm (cantilever)

SLS Short-term Deflection (D+ ψ_s L):

$\psi_s = 0.7$ $k_2 = 1.0$
 $\delta_{st} = 3.6$ mm (L/851) $< \delta_{maxst}$, **OK!**
 $\delta_{sc} = 0.0$ mm $< \delta_{maxsc}$, **OK!**
deflection limit: $\delta_{maxst} = \min(\text{span}/300, 12) = 10.3$ mm (non-cantilever)
deflection limit: $\delta_{maxsc} = \min(\text{span}/200, 10) = 0.0$ mm (cantilever)

Reactions:

R_A :	R_B :
D = 2.7 kN	D = 2.7 kN
L = 0.8 kN	L = 0.8 kN
1.2D+1.5L = 4.5 kN	1.2D+1.5L = 4.5 kN

OK!

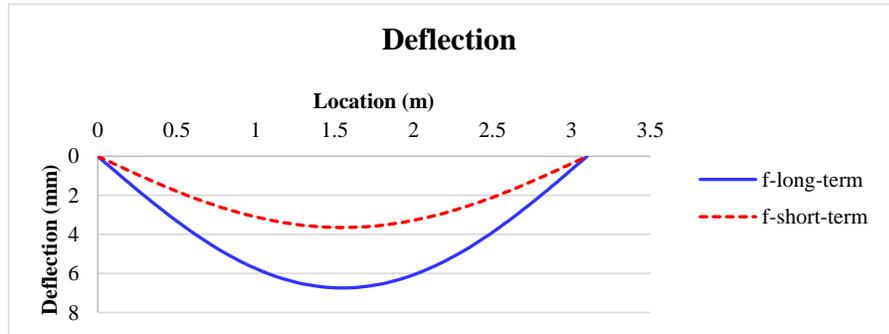
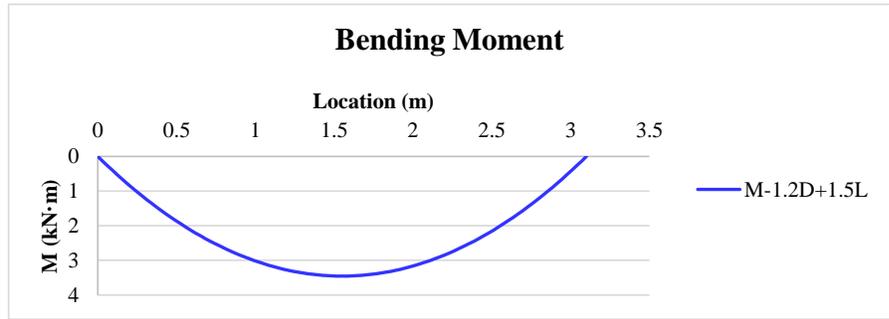
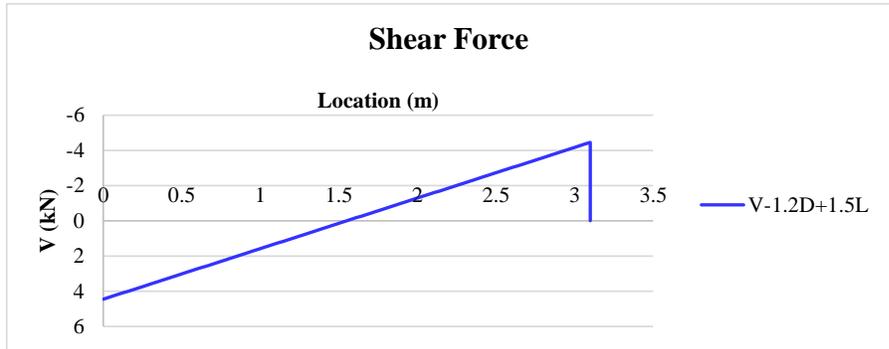


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Beam/Lintel Design

Member NO. **B3**





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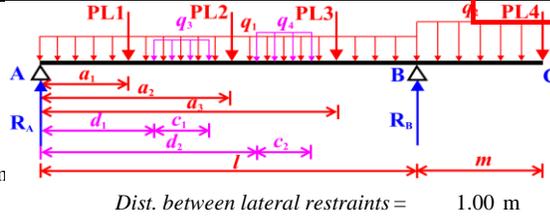
Member NO. **B4**

Use as: **Floor beam**

$l = 1.7$ m

$m = 0.6$ m

D



UDL Loads:

Load source	Non-cantilever q_1 (UDL over whole span)					Cantilever q_2 (UDL over whole cantilever span)				
	Load dim m	Dead Load D (kPa)	Live Load L (kPa)	D kN/m	L kN/m	Load dim m	Dead Load D (kPa)	Live Load L (kPa)	D kN/m	L kN/m
Roof	4.30	0.50	0.25	2.15	1.08	6.00	0.50	0.25	3.00	1.50
Floor	1.50	0.50	1.50	0.75	2.25	1.50	0.50	1.50	0.75	2.25
Wall	2.70	0.40		1.08	0.00	2.70	0.50		1.35	0.00
Deck		0.80	2.00	0.00	0.00		0.80	2.00	0.00	0.00
other				0.00	0.00				0.00	0.00
Self-weight				0.11	0.00				0.11	0.00
Total				4.09	3.33				5.21	3.75

Local UDL:	Non-cantilever q_3				Non-cantilever q_4			
	Load position	$d1 =$	$c1 =$		Load position	$d2 =$	$c2 =$	
Roof		0.50	0.25	0.00		0.50	0.25	0.00
Floor		0.50	1.50	0.00		0.50	1.50	0.00
Wall		0.40		0.00		0.40		0.00
Other				0.00				0.00
Total				0.00				0.00

Point Loads:	$a_1/a_2/a_3$ (m)	Load area (m ²)	D (kPa or kN)	L (kPa or kN)	PL _D (kN)	PL _L (kN)	
PL1 from					0.00	0.00	
PL2 from					0.00	0.00	
PL3 from					0.00	0.00	
PL from	B3	- (beam end)	1.00	2.69	0.81	2.69	0.81

ULS Demand (1.2D+1.5L):

$M^* = 1.6$ kN·m (Positive) -4.8 kN·m (Negative)

$V^* = 11.6$ kN

Try **2/240x45**

Selfweight = 0.1 kN/m

$I = 103.7 \times 10^6$ mm⁴

$E = 6.7 \times 10^3$ MPa

$\phi M_n = 7.7$ kN·m $> M^*$, **OK!**

$\phi V_n = 25.2$ kN $> V^*$, **OK!**

(Ratio)

1.61

2.18

SLS Long-term Deflection (D+ ψ L) (for timber only):

$\delta_{ll} = 0.2$ mm (L/7191)

$\delta_{lc} = 2.0$ mm (L/303)

deflection limit: $\delta_{maxll} = \min(\text{span}/300, 12) = 5.7$ mm

deflection limit: $\delta_{maxlc} = \min(\text{span}/200, 10) = 3.0$ mm

$\psi_l = 0.4$

$k_2 = 2.0$

$< \delta_{maxll}$, **OK!**

$< \delta_{maxlc}$, **OK!**

5.7 mm (non-cantilever)

3.0 mm (cantilever)

SLS Short-term Deflection (D+ ψ L):

$\delta_{st} = 0.2$ mm (L/9393)

$\delta_{sc} = 1.0$ mm (L/580)

deflection limit: $\delta_{maxst} = \min(\text{span}/300, 12) = 5.7$ mm

deflection limit: $\delta_{maxsc} = \min(\text{span}/200, 10) = 3.0$ mm

$\psi_s = 0.7$

$k_2 = 1.0$

$< \delta_{maxst}$, **OK!**

$< \delta_{maxsc}$, **OK!**

5.7 mm (non-cantilever)

3.0 mm (cantilever)

Reactions:

R_A :		R_B :	
D=	2.0 kN	D=	10.8 kN
L=	2.1 kN	L=	6.6 kN
1.2D+1.5L=	5.6 kN	1.2D+1.5L=	22.8 kN

OK!

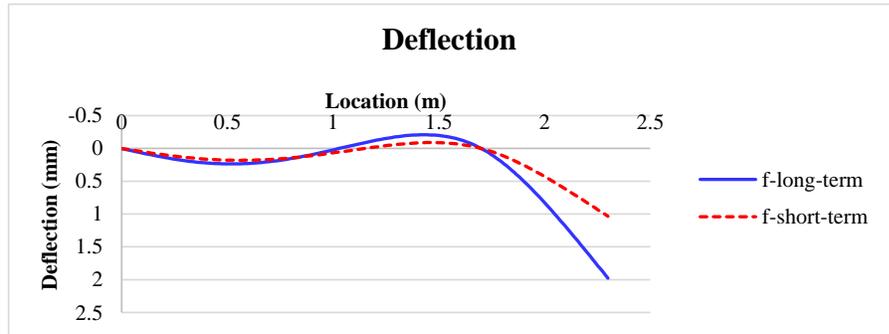
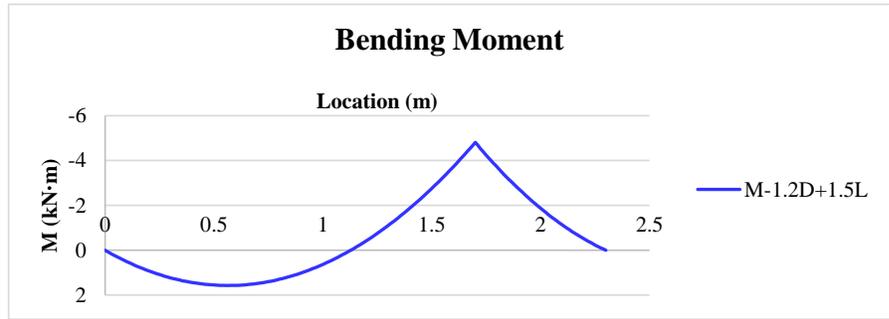
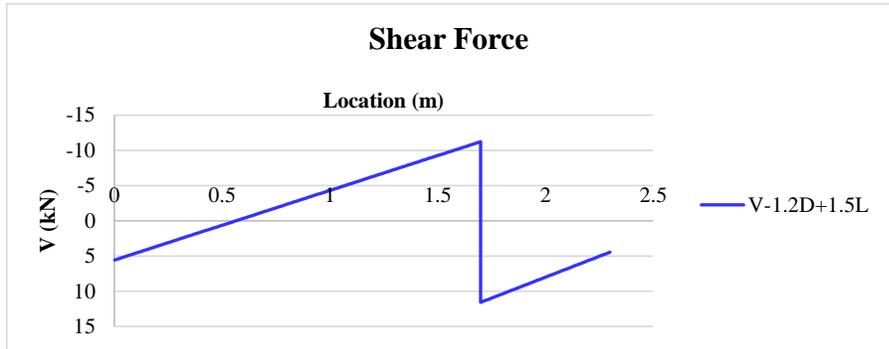


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Beam/Lintel Design

Member NO. **B4**





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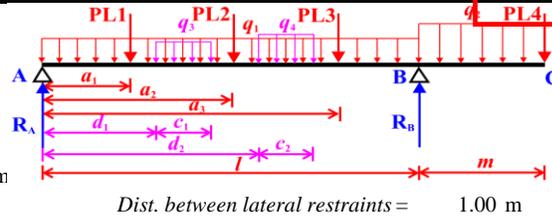
Beam/Lintel Design

Member NO. **B5**

Use as: **Floor beam**

$l = 3.2$ m

$m =$ m



Dist. between lateral restraints = 1.00 m

UDL Loads:

Load source	Non-cantilever q_1 (UDL over whole span)					Cantilever q_2 (UDL over whole cantilever span)				
	Load dim m	Dead Load D (kPa)	Live Load L (kPa)	D kN/m	L kN/m	Load dim m	Dead Load D (kPa)	Live Load L (kPa)	D kN/m	L kN/m
Roof	0.75	0.50	0.25	0.38	0.19					
Floor	0.20	0.50	1.50	0.10	0.30					
Wall	2.70	0.50		1.35	0.00					
Deck		0.80	2.00	0.00	0.00					
other				0.00	0.00					
Self-weight				0.13	0.00					
Total				1.96	0.49				0.13	0.00

Local UDL:	Non-cantilever q_3				Non-cantilever q_4			
	Load position	$d1 =$	$c1 =$		Load position	$d2 =$	$c2 =$	
Roof		0.50	0.25	0.00		0.50	0.25	0.00
Floor		0.50	1.50	0.00		0.50	1.50	0.00
Wall		0.40		0.00		0.40		0.00
Other				0.00				0.00
Total				0.00				0.00

Point Loads:	$a_1/a_2/a_3$ (m)	Load area (m ²)	D (kPa or kN)	L (kPa or kN)	PL _D (kN)	PL _L (kN)
PL1 from					0.00	0.00
PL2 from					0.00	0.00
PL3 from					0.00	0.00
PL from	- (beam end)	1.00	0.00	0.00	0.00	0.00

ULS Demand (1.2D+1.5L):

$M^* = 3.9$ kN·m (Positive) 0.0 kN·m (Negative)

$V^* = 4.9$ kN

Try **2/240x45 hySPAN**

Selfweight = 0.1 kN/m

$I = 103.7 \times 10^6$ mm⁴

$E = 13.2 \times 10^3$ MPa

$\phi M_n = 23.0$ kN·m $> M^*$, **OK!** 5.84 (Ratio)

$\phi V_n = 47.7$ kN $> V^*$, **OK!** 9.68

SLS Long-term Deflection (D+ ψ_s L) (for timber only):

$\delta_{ll} = 4.3$ mm (L/745)

$\delta_{lc} = 0.0$ mm

deflection limit: $\delta_{maxll} = \min(\text{span}/300, 12) = 10.7$ mm

deflection limit: $\delta_{maxlc} = \min(\text{span}/200, 10) = 0.0$ mm

$\psi_l = 0.4$ $k_2 = 2.0$

$< \delta_{maxll}$, **OK!**

$< \delta_{maxlc}$, **OK!**

(non-cantilever)

(cantilever)

SLS Short-term Deflection (D+ ψ_s L):

$\delta_{st} = 2.3$ mm (L/1396)

$\delta_{sc} = 0.0$ mm

deflection limit: $\delta_{maxst} = \min(\text{span}/300, 12) = 10.7$ mm

deflection limit: $\delta_{maxsc} = \min(\text{span}/200, 10) = 0.0$ mm

$\psi_s = 0.7$ $k_2 = 1.0$

$< \delta_{maxst}$, **OK!**

$< \delta_{maxsc}$, **OK!**

(non-cantilever)

(cantilever)

Reactions:

R_A :	R_B :
D = 3.1 kN	D = 3.1 kN
L = 0.8 kN	L = 0.8 kN
1.2D+1.5L = 4.9 kN	1.2D+1.5L = 4.9 kN

OK!

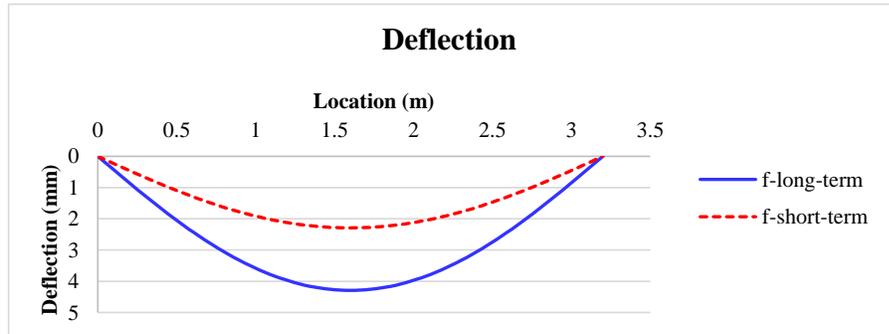
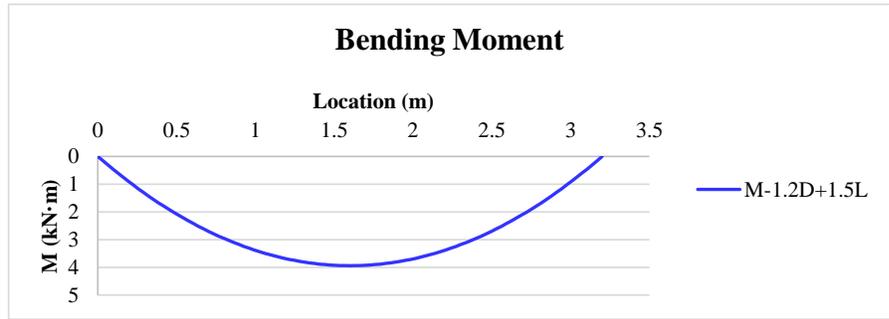
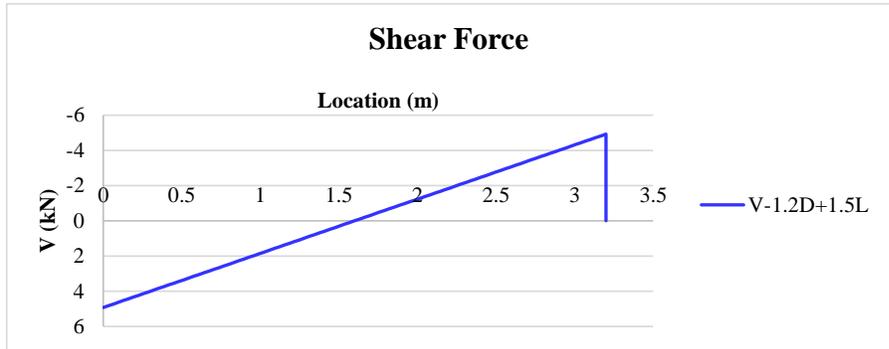


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Beam/Lintel Design

Member NO. **B5**





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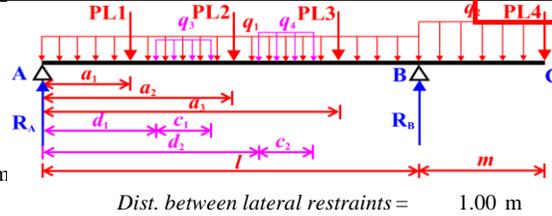
Beam/Lintel Design

Member NO. **B6**

Use as: **Floor beam**

$l = 3.0$ m

$m =$ m



UDL Loads:

Load source	Non-cantilever q_1 (UDL over whole span)					Cantilever q_2 (UDL over whole cantilever span)				
	Load dim m	Dead Load D (kPa)	Live Load L (kPa)	D kN/m	L kN/m	Load dim m	Dead Load D (kPa)	Live Load L (kPa)	D kN/m	L kN/m
Roof	0.75	0.50	0.25	0.38	0.19					
Floor	0.20	0.50	1.50	0.10	0.30					
Wall	2.70	0.50		1.35	0.00		0.40		0.00	0.00
Deck		0.80	2.00	0.00	0.00		0.80	2.00	0.00	0.00
other				0.00	0.00				0.00	0.00
Self-weight				0.13	0.00				0.13	0.00
Total				1.96	0.49				0.13	0.00

Local UDL:	Non-cantilever q_3				Non-cantilever q_4			
	Load position	$d1 =$	$c1 =$		Load position	$d2 =$	$c2 =$	
Roof		0.50	0.25	0.00		0.50	0.25	0.00
Floor		0.50	1.50	0.00		0.50	1.50	0.00
Wall		0.40		0.00		0.40		0.00
Other				0.00				0.00
Total				0.00				0.00

Point Loads:	$a_1/a_2/a_3$ (m)	Load area (m ²)	D (kPa or kN)	L (kPa or kN)	PL _D (kN)	PL _L (kN)
PL1 from DJ	1.00	1.00	1.40	1.21	1.40	1.21
PL2 from					0.00	0.00
PL3 from					0.00	0.00
PL from	- (beam end)	1.00	0.00	0.00	0.00	0.00

ULS Demand (1.2D+1.5L):

$M^* = 5.4$ kN·m (Positive) 0.0 kN·m (Negative)
 $V^* = 6.9$ kN

Try **2/240x45 hySPAN**

Selfweight = 0.1 kN/m
 $I = 103.7 \times 10^6$ mm⁴
 $E = 13.2 \times 10^3$ MPa (Ratio)
 $\phi M_n = 23.0$ kN·m $> M^*$, OK! 4.24
 $\phi V_n = 47.7$ kN $> V^*$, OK! 6.87

SLS Long-term Deflection (D+ ψ_s L) (for timber only):

$\delta_{ll} = 4.6$ mm ($L/647$) $\psi_l = 0.4$ $k_2 = 2.0$
 $\delta_{lc} = 0.0$ mm $< \delta_{maxll}$, OK!
 $< \delta_{maxlc}$, OK!
deflection limit: $\delta_{maxll} = \min(\text{span}/300, 12) = 10.0$ mm (non-cantilever)
deflection limit: $\delta_{maxlc} = \min(\text{span}/200, 10) = 0.0$ mm (cantilever)

SLS Short-term Deflection (D+ ψ_s L):

$\delta_{st} = 2.6$ mm ($L/1173$) $\psi_s = 0.7$ $k_2 = 1.0$
 $\delta_{sc} = 0.0$ mm $< \delta_{maxsl}$, OK!
 $< \delta_{maxsc}$, OK!
deflection limit: $\delta_{maxsl} = \min(\text{span}/300, 12) = 10.0$ mm (non-cantilever)
deflection limit: $\delta_{maxsc} = \min(\text{span}/200, 10) = 0.0$ mm (cantilever)

Reactions:

R_A :	R_B :
D = 3.9 kN	D = 3.4 kN
L = 1.5 kN	L = 1.1 kN
1.2D+1.5L = 6.9 kN	1.2D+1.5L = 5.8 kN

OK!

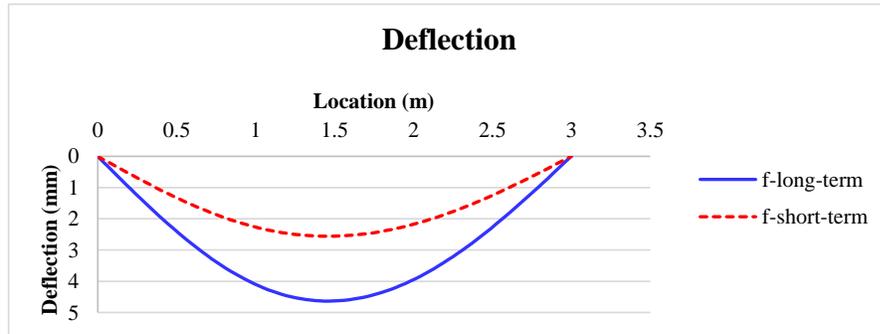
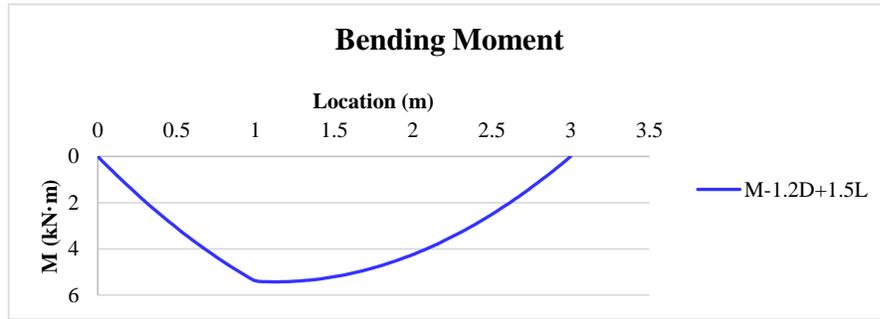
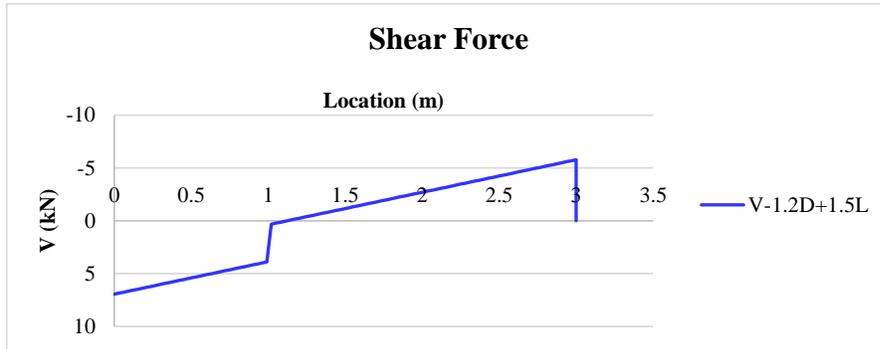


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Beam/Lintel Design

Member NO. **B6**





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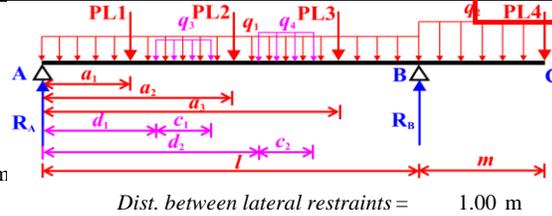
Beam/Lintel Design

Member NO. **B7**

Use as: **Floor beam**

$l = 1.6$ m

$m = 0.8$ m



UDL Loads:

Load source	Non-cantilever q_1 (UDL over whole span)					Cantilever q_2 (UDL over whole cantilever span)				
	Load dim m	Dead Load D (kPa)	Live Load L (kPa)	D kN/m	L kN/m	Load dim m	Dead Load D (kPa)	Live Load L (kPa)	D kN/m	L kN/m
Roof		0.50	0.25	0.00	0.00	4.40	0.50	0.25	2.20	1.10
Floor	3.10	0.50	1.50	1.55	4.65	2.10	0.50	1.50	1.05	3.15
Wall	2.70	0.40		1.08	0.00	2.70	0.40		1.08	0.00
Deck		0.80	2.00	0.00	0.00		0.80	2.00	0.00	0.00
other				0.00	0.00				0.00	0.00
Self-weight				0.24	0.00				0.24	0.00
Total				2.87	4.65				4.57	4.25

Local UDL:	Non-cantilever q_3				Non-cantilever q_4			
	Load position	$d1 =$	$c1 =$		Load position	$d2 =$	$c2 =$	
Roof		0.50	0.25	0.00		0.50	0.25	0.00
Floor		0.50	1.50	0.00		0.50	1.50	0.00
Wall		0.40		0.00		0.40		0.00
Other				0.00				0.00
Total				0.00				0.00

Point Loads:	$a_1/a_2/a_3$ (m)	Load area (m ²)	D (kPa or kN)	L (kPa or kN)	PL _D (kN)	PL _L (kN)
PL1 from					0.00	0.00
PL2 from					0.00	0.00
PL3 from					0.00	0.00
PL from	B5+B6	- (beam end)	1.00	6.99	2.32	6.99 , 2.32

ULS Demand (1.2D+1.5L):

$M^* = 0.0$ kN·m (Positive) -13.3 kN·m (Negative)
 $V^* = 21.4$ kN

Try **FB25M**

Selfweight = 0.2 kN/m
 $I = 352.7 \times 10^6$ mm⁴
 $E = 8.0 \times 10^3$ MPa (Ratio)
 $\phi M_n = 26.3$ kN·m $> M^*$, **OK!** 1.98
 $\phi V_n = 122.9$ kN $> V^*$, **OK!** 5.75

SLS Long-term Deflection (D+ ψ L) (for timber only):

$\delta_{ll} = 0.7$ mm (L/2296) $\psi_l = 0.4$ $k_2 = 2.0$
 $\delta_{lc} = 3.3$ mm (L/246) $< \delta_{maxll}$, **OK!**
 $< \delta_{maxlc}$, **OK!**
deflection limit: $\delta_{maxll} = \min(\text{span}/300, 12) = 5.3$ mm (non-cantilever)
deflection limit: $\delta_{maxlc} = \min(\text{span}/200, 10) = 4.0$ mm (cantilever)

SLS Short-term Deflection (D+ ψ L):

$\delta_{sl} = 0.4$ mm (L/4388) $\psi_s = 0.7$ $k_2 = 1.0$
 $\delta_{sc} = 1.8$ mm (L/452) $< \delta_{maxsl}$, **OK!**
 $< \delta_{maxsc}$, **OK!**
deflection limit: $\delta_{maxsl} = \min(\text{span}/300, 12) = 5.3$ mm (non-cantilever)
deflection limit: $\delta_{maxsc} = \min(\text{span}/200, 10) = 4.0$ mm (cantilever)

Reactions:

R_A :	R_B :
D = -2.1 kN	D = 17.4 kN
L = 1.7 kN	L = 11.4 kN
1.2D+1.5L = 0.0 kN	1.2D+1.5L = 38.0 kN

OK!

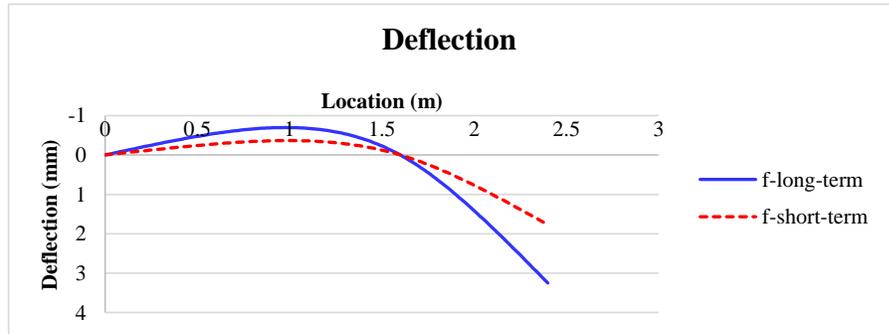
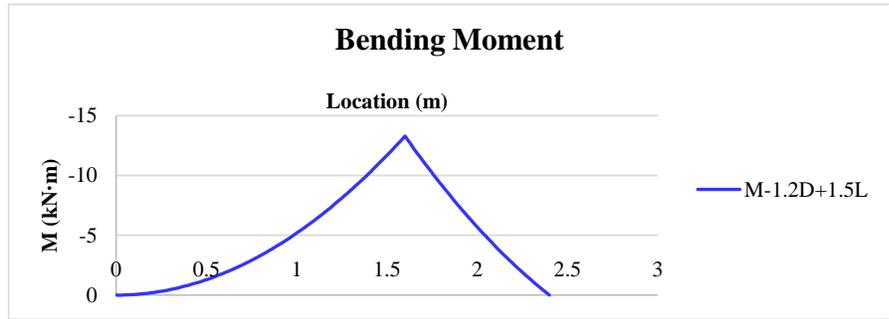
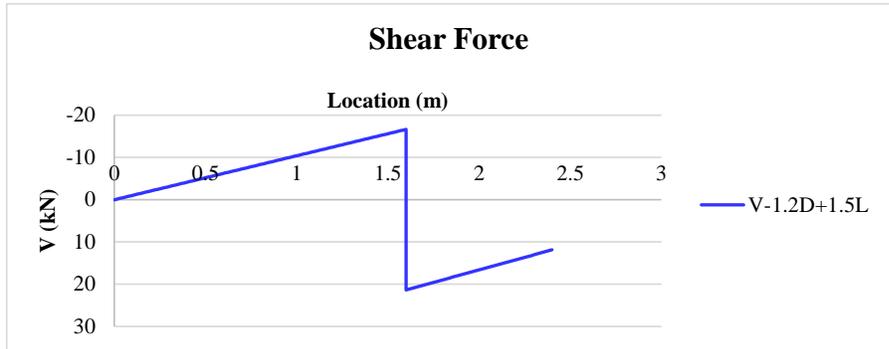


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Beam/Lintel Design

Member NO. **B7**





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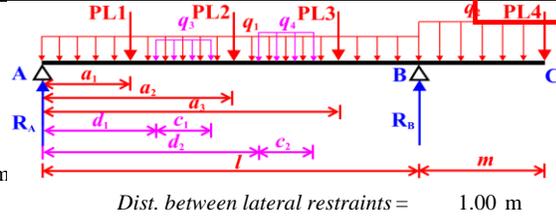
Beam/Lintel Design

Member NO. **B8**

Use as: **Floor beam**

$l = 2.0$ m

$m = 0.8$ m



UDL Loads:

Load source	Non-cantilever q_1 (UDL over whole span)					Cantilever q_2 (UDL over whole cantilever span)				
	Load dim m	Dead Load D (kPa)	Live Load L (kPa)	D kN/m	L kN/m	Load dim m	Dead Load D (kPa)	Live Load L (kPa)	D kN/m	L kN/m
Roof		0.50	0.25	0.00	0.00	1.35	0.50	0.25	0.68	0.34
Floor	2.90	0.50	1.50	1.45	4.35	0.90	0.50	1.50	0.45	1.35
Wall	2.70	0.40		1.08	0.00	2.70	0.50		1.35	0.00
Deck		0.80	2.00	0.00	0.00		0.80	2.00	0.00	0.00
other				0.00	0.00				0.00	0.00
Self-weight				0.11	0.00				0.11	0.00
Total				2.64	4.35				2.58	1.69

Local UDL:	Non-cantilever q_3				Non-cantilever q_4			
	Load position	$d1 =$	$c1 =$		Load position	$d2 =$	$c2 =$	
Roof		0.50	0.25	0.00		0.50	0.25	0.00
Floor		0.50	1.50	0.00		0.50	1.50	0.00
Wall		0.40		0.00		0.40		0.00
Other				0.00				0.00
Total				0.00				0.00

Point Loads:	$a_1/a_2/a_3$ (m)	Load area (m ²)	D (kPa or kN)	L (kPa or kN)	PL _D (kN)	PL _L (kN)
PL1 from					0.00	0.00
PL2 from					0.00	0.00
PL3 from					0.00	0.00
PL from	- (beam end)	1.00	0.00	0.00	0.00	0.00

ULS Demand (1.2D+1.5L):

$M^* = 4.0$ kN·m (Positive) -1.8 kN·m (Negative)

$V^* = 10.6$ kN

Try **2/240x45**

Selfweight = 0.1 kN/m

$I = 103.7 \times 10^6$ mm⁴

$E = 6.7 \times 10^3$ MPa

$\phi M_n = 7.7$ kN·m $> M^*$, **OK!** (Ratio) 1.94

$\phi V_n = 25.2$ kN $> V^*$, **OK!** 2.38

SLS Long-term Deflection (D+ ψ L) (for timber only):

$\delta_{ll} = 1.9$ mm (L/1063)

$\delta_{lc} = 1.3$ mm (L/625)

deflection limit: $\delta_{maxll} = \min(\text{span}/300, 12) = 6.7$ mm

deflection limit: $\delta_{maxlc} = \min(\text{span}/200, 10) = 4.0$ mm

$\psi_l = 0.4$ $k_2 = 2.0$

$< \delta_{maxll}$, **OK!**

$< \delta_{maxlc}$, **OK!**

6.7 mm (non-cantilever)

4.0 mm (cantilever)

SLS Short-term Deflection (D+ ψ L):

$\delta_{st} = 1.3$ mm (L/1570)

$\delta_{sc} = 1.0$ mm (L/817)

deflection limit: $\delta_{maxst} = \min(\text{span}/300, 12) = 6.7$ mm

deflection limit: $\delta_{maxsc} = \min(\text{span}/200, 10) = 4.0$ mm

$\psi_s = 0.7$ $k_2 = 1.0$

$< \delta_{maxst}$, **OK!**

$< \delta_{maxsc}$, **OK!**

6.7 mm (non-cantilever)

4.0 mm (cantilever)

Reactions:

R_A :		R_B :	
D=	2.2 kN	D=	5.1 kN
L=	4.1 kN	L=	6.0 kN
1.2D+1.5L=	8.8 kN	1.2D+1.5L=	15.1 kN

OK!

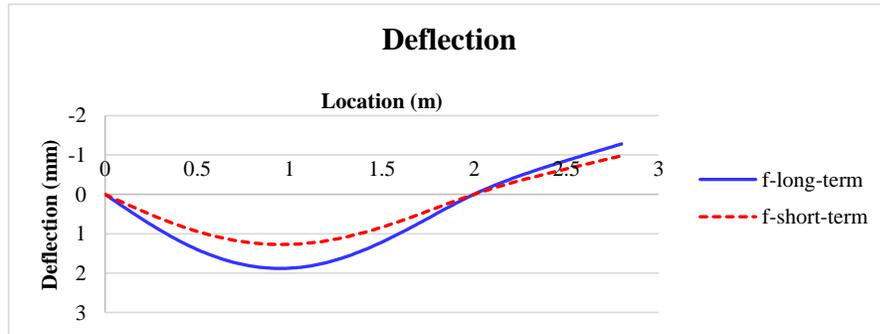
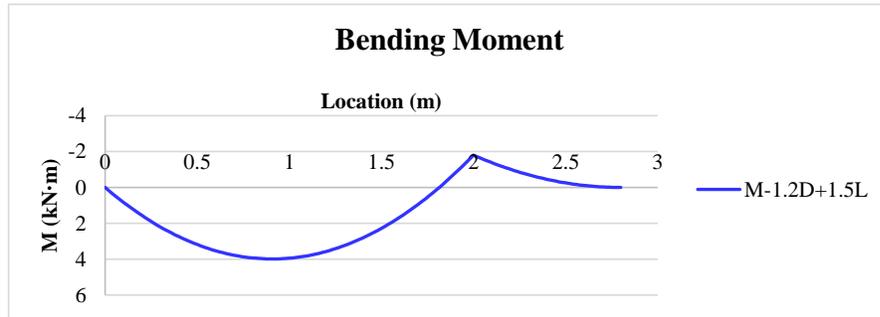
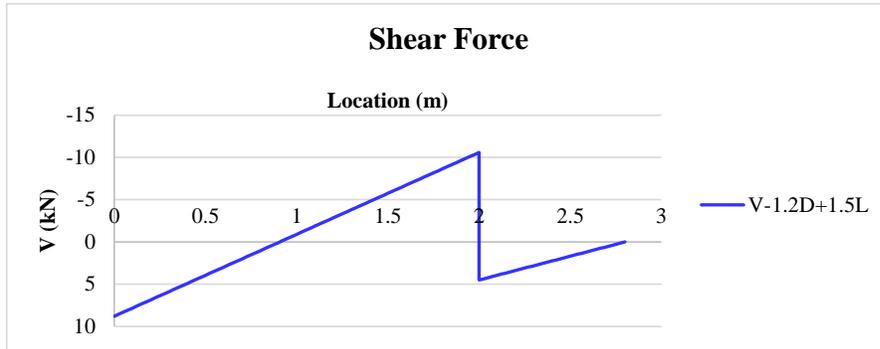


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Beam/Lintel Design

Member NO. **B8**





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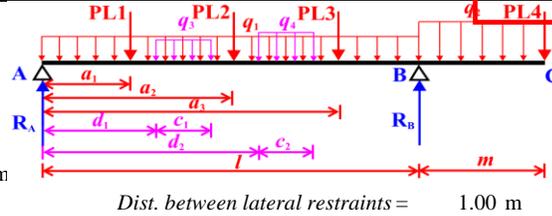
Beam/Lintel Design

Member NO. **L5**

Use as: **Floor beam**

$l = 1.4$ m

$m =$ m



UDL Loads:

Load source	Non-cantilever q_1 (UDL over whole span)					Cantilever q_2 (UDL over whole cantilever span)				
	Load dim m	Dead Load D (kPa)	Live Load L (kPa)	D kN/m	L kN/m	Load dim m	Dead Load D (kPa)	Live Load L (kPa)	D kN/m	L kN/m
Roof		0.50	0.25	0.00	0.00		0.50	0.25	0.00	0.00
Floor	0.40	0.50	1.50	0.20	0.60		0.50	1.50	0.00	0.00
Wall		0.40		0.00	0.00		0.40		0.00	0.00
Deck		0.80	2.00	0.00	0.00		0.80	2.00	0.00	0.00
other				0.00	0.00				0.00	0.00
Self-weight				0.13	0.00				0.13	0.00
Total				0.33	0.60				0.13	0.00

Local UDL:	Non-cantilever q_3				Non-cantilever q_4			
	Load position	$d1 =$	$c1 =$		Load position	$d2 =$	$c2 =$	
Roof		0.50	0.25	0.00		0.50	0.25	0.00
Floor		0.50	1.50	0.00		0.50	1.50	0.00
Wall		0.40		0.00		0.40		0.00
Other				0.00				0.00
Total				0.00				0.00

Point Loads:	$a_1/a_2/a_3$ (m)	Load area (m ²)	D (kPa or kN)	L (kPa or kN)	PL _D (kN)	PL _L (kN)
PL1 from B7	0.40	1.00	17.36	11.45	17.36	11.45
PL2 from					0.00	0.00
PL3 from					0.00	0.00
PL from - (beam end)		1.00	0.00	0.00	0.00	0.00

ULS Demand (1.2D+1.5L):

$M^* = 11.1$ kN·m (Positive) 0.0 kN·m (Negative)

$V^* = 28.1$ kN

Try **2/240x45 hySPAN**

Selfweight = 0.1 kN/m
 $I = 103.7 \times 10^6$ mm⁴
 $E = 13.2 \times 10^3$ MPa (Ratio)
 $\phi M_n = 23.0$ kN·m $> M^*$, **OK!** 2.08
 $\phi V_n = 47.7$ kN $> V^*$, **OK!** 1.70

SLS Long-term Deflection (D+ ψ_s L) (for timber only):

$\delta_{ll} = 1.5$ mm ($L/959$) $\psi_l = 0.4$ $k_2 = 2.0$
 $\delta_{lc} = 0.0$ mm $< \delta_{maxll}$, **OK!**
 $< \delta_{maxlc}$, **OK!**
deflection limit: $\delta_{maxll} = \min(\text{span}/300, 12) = 4.7$ mm (non-cantilever)
deflection limit: $\delta_{maxlc} = \min(\text{span}/200, 10) = 0.0$ mm (cantilever)

SLS Short-term Deflection (D+ ψ_s L):

$\delta_{sl} = 0.8$ mm ($L/1651$) $\psi_s = 0.7$ $k_2 = 1.0$
 $\delta_{sc} = 0.0$ mm $< \delta_{maxsl}$, **OK!**
 $< \delta_{maxsc}$, **OK!**
deflection limit: $\delta_{maxsl} = \min(\text{span}/300, 12) = 4.7$ mm (non-cantilever)
deflection limit: $\delta_{maxsc} = \min(\text{span}/200, 10) = 0.0$ mm (cantilever)

Reactions:

R_A :	R_B :
D = 12.6 kN	D = 5.2 kN
L = 8.6 kN	L = 3.7 kN
1.2D+1.5L = 28.1 kN	1.2D+1.5L = 11.8 kN

OK!

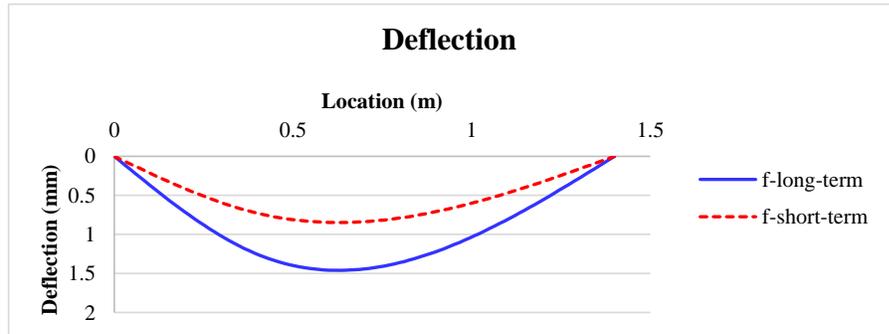
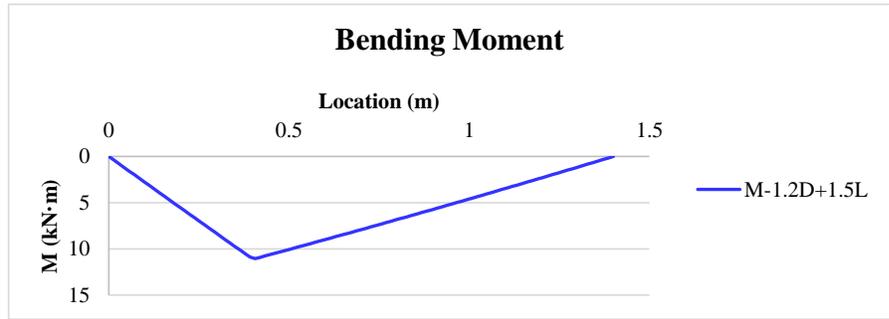
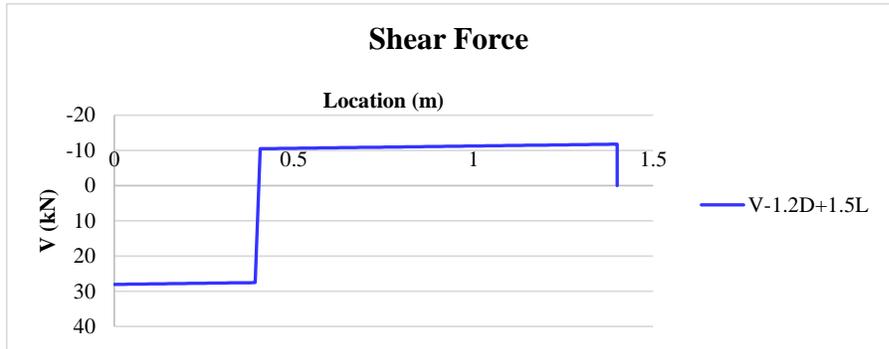


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Beam/Lintel Design

Member NO. **L5**





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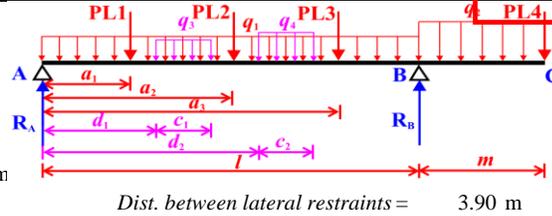
Beam/Lintel Design

Member NO. **PF**

Use as: **Lintel**

$l = 5.2$ m

$m = 0.0$ m



UDL Loads:

Load source	Non-cantilever q_1 (UDL over whole span)					Cantilever q_2 (UDL over whole cantilever span)				
	Load dim m	Dead Load D (kPa)	Live Load L (kPa)	D kN/m	L kN/m	Load dim m	Dead Load D (kPa)	Live Load L (kPa)	D kN/m	L kN/m
Roof		0.50	0.25	0.00	0.00		0.50	0.25	0.00	0.00
Floor		0.50	1.50	0.00	0.00		0.50	1.50	0.00	0.00
Wall		0.40		0.00	0.00		0.40		0.00	0.00
Deck		0.80	2.00	0.00	0.00		0.80	2.00	0.00	0.00
other				0.00	0.00				0.00	0.00
Self-weight				0.35	0.00				0.35	0.00
Total				0.35	0.00				0.35	0.00

Local UDL:	Non-cantilever q_3				Non-cantilever q_4			
	Load position	$d1 =$	$c1 =$		Load position	$d2 =$	$c2 =$	
Roof		0.40	0.25	0.00		0.40	0.25	0.00
Floor		0.50	1.50	0.00		0.50	1.50	0.00
Wall		0.40		0.00		0.35		0.00
Other				0.00				0.00
Total				0.00				0.00

Point Loads:	$a_1/a_2/a_3$ (m)	Load area (m ²)	D (kPa or kN)	L (kPa or kN)	PL _D (kN)	PL _L (kN)
PL1 from B2	2.70	1.00	16.35	17.69	16.35	17.69
PL2 from					0.00	0.00
PL3 from					0.00	0.00
PL from	- (beam end)	1.00			0.00	0.00

ULS Demand (1.2D+1.5L):

$M^* = 61.2$ kN·m (Positive) 0.0 kN·m (Negative)
 $V^* = 25.0$ kN

Try **250x90PFC**

Selfweight = 0.3 kN/m
 $I = 45.1 \times 10^6$ mm⁴
 $E = 200.0 \times 10^3$ MPa (Ratio)
 $\phi M_n = 62.8$ kN·m $> M^*$, **OK!** 1.03
 $\phi V_n = 346.0$ kN $> V^*$, **OK!** 13.81

SLS Long-term Deflection (D+ ψ_s L) (for timber only):

$\psi_l = 0.4$ $k_2 = 1.0$
 $\delta_{ll} = 8.0$ mm ($L/653$) $< \delta_{maxll}$, **OK!**
 $\delta_{lc} = 0.0$ mm $< \delta_{maxlc}$, **OK!**
deflection limit: $\delta_{maxll} = \min(\text{span}/300, 12) = 12.0$ mm (non-cantilever)
deflection limit: $\delta_{maxlc} = \min(\text{span}/200, 10) = 0.0$ mm (cantilever)

SLS Short-term Deflection (D+ ψ_s L):

$\psi_s = 0.7$ $k_2 = 1.0$
 $\delta_{st} = 9.7$ mm ($L/537$) $< \delta_{maxst}$, **OK!**
 $\delta_{sc} = 0.0$ mm $< \delta_{maxsc}$, **OK!**
deflection limit: $\delta_{maxst} = \min(\text{span}/300, 12) = 12.0$ mm (non-cantilever)
deflection limit: $\delta_{maxsc} = \min(\text{span}/200, 10) = 0.0$ mm (cantilever)

Reactions:

R_A :	R_B :
D = 8.8 kN	D = 9.4 kN
L = 8.5 kN	L = 9.2 kN
1.2D+1.5L = 23.3 kN	1.2D+1.5L = 25.0 kN

Standard connection OK!

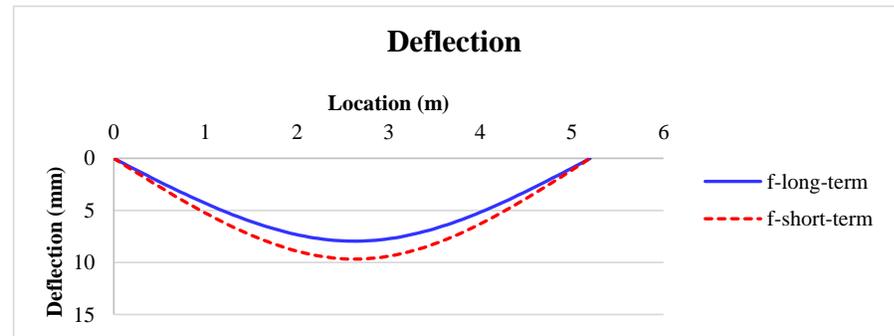
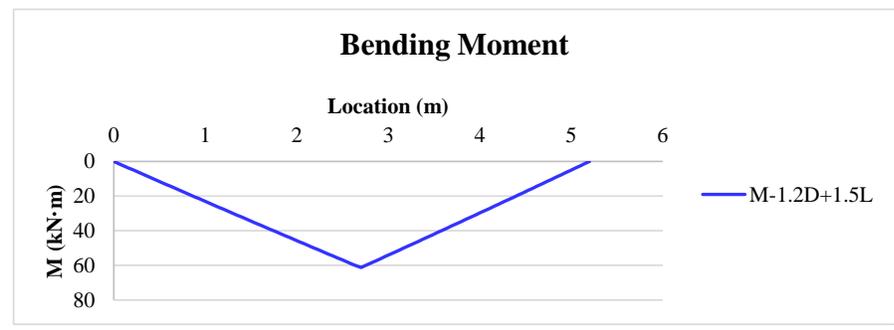
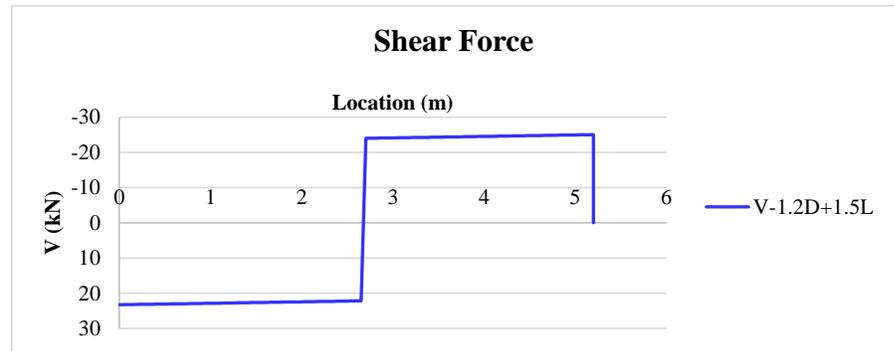


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Beam/Lintel Design

Member NO. **PF**





Project Name:
22 Johnson St, Tuakau

Project No: 220952

Author: AY

Date:

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Parameters

Beam no. = RB1

Wind zone = High

Beam Span = 1.0 m

Base wind pressure p^* = 1.13 kPa

$k_{l\text{eff}}$ = 1.0

	Wind Zones			Auckland		m/s
	Low	Med	High	V High	SD	
V=	45	45	45	45	50	
Mr, Ms=	1.00	1.00	1.00	1.00	1.00	
Mz, cat=	0.83	0.83	0.83	0.83	0.83	
Mt=	0.86	1.00	1.16	1.32	1.48	
Vbasic=	32.1	37.4	43.3	49.3	61.4	
NZS3604	32	37	44	50	55	
Pbasic=	0.62	0.84	1.13	1.46	2.26	kPa

Design Loads

UDL1	G=		kPa	x		=	0.00	kN/m	Note: Floor
	Q=		kPa	x	0.00 m	=	0.00	kN/m	
	W_{up} =	-1.13	kPa	x	(1. x 0.9 + 0.) x	0.00 m	=	0.00	kN/m
	W_{down} =	1.13	kPa	x	(1. x 0.5 + 0.3) x	0.00 m	=	0.00	kN/m
	Snow=	0.00	kPa	x	0.00 m	=	0.00	kN/m	
	a=	0.00	m		b = 1.00	m		c = 0.00	m

UDL2	G=		kPa	x		=	0.00	kN/m	Note: Wall
	Q=		kPa	x	0.00 m	=	0.00	kN/m	
	W_{up} =	-1.13	kPa	x	(1. x 0.9 + 0.) x	0.00 m	=	0.00	kN/m
	W_{down} =	1.13	kPa	x	(1. x 0.5 + 0.3) x	0.00 m	=	0.00	kN/m
	Snow=	0.00	kPa	x	0.00 m	=	0.00	kN/m	
	a=	0.00	m		b = 1.00	m		c = 0.00	m

UDL3	G=	0.50	kPa	x	1.85 m	=	0.93	kN/m	Note: Roof
	Q=	0.25	kPa	x	1.85 m	=	0.46	kN/m	
	W_{up} =	-1.13	kPa	x	(1. x 0.9 + 0.2) x	1.85 m	=	-2.29	kN/m
	W_{down} =	1.13	kPa	x	(1. x 0.5 + 0.3) x	1.85 m	=	1.67	kN/m
	Snow=	0.00	kPa	x	1.85 m	=	0.00	kN/m	
	a=	0.00	m		b = 1.00	m		c = 0.00	m

UDL4	G=		kPa	x		=	0.00	kN/m	Note:
	Q=		kPa	x	0.00 m	=	0.00	kN/m	
	W_{up} =	0.00	kPa	x	(1. x 0.9) x + 0.) x	0.00 m	=	0.00	kN/m
	W_{down} =	0.00	kPa	x	(1. x 0.5) x + 0.3) x	0.00 m	=	0.00	kN/m
	Snow=	0.00	kPa	x	0.00 m	=	0.00	kN/m	
	a=	0.00	m		b = 1.00	m		c = 0.00	m

PL1	G=		kN
	Q=		kN
	W_{up} =		kN
	W_{down} =		kN
	Snow=		kN
	a=		m

PL2	G=		kN
	Q=		kN
	W_{up} =		kN
	W_{down} =		kN
	Snow=		kN
	b=		m

Flexural & Shear Design

Bending Moment:

Shear Force:



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[1.35G] = 0.16	kNm	[1.35G] = 0.62	kN
[1.2G+1.5Q] = 0.23	kNm	[1.2G+1.5Q] = 0.90	kN
[1.2G+W _{down}] = 0.35	kNm	[1.2G+W _{down}] = 1.39	kN
[0.9G+W _{up}] = -0.20	kNm	[0.9G+W _{up}] = 0.73	kN
[1.2G+S _u] = 0.14	kNm	[1.2G+S _u] = 0.56	kN

Deflection

[G]	-0.1	mm	L/9227	OK	k ₂	2	for long term dead load
[G+Ψ _s Q]	-0.1	mm	L/6835	OK	Short-term factor Ψ _s UDL	0.7	
[k ₂ (G+Ψ ₁ Q)]	-0.3	mm	L/3845	OK	Long-term factor Ψ ₁ UDL	0.4	
[W _{up} SLS]	0.2	mm	L/5476	OK	Short-term factor Ψ _s PL	1.0	
[G+W _{down} SLS]	-0.2	mm	L/4169	OK	Long-term factor Ψ ₁ PL	0.6	
[G+S _u SLS]	-0.1	mm	L/9227	OK			

Size selection

Radiata Pine	
Moisture content	Dry

Use 2.0 no. of 140x45 SG8

E_{lb} 5.4 GPa
I_x 20.6 ×10⁶ mm⁴

ΦM_n 3.00 kNm OK
ΦV_n 23.27 kN OK

Reaction to supporting elements

Left	∑V1_G	0.46 kN
	∑V1_Q	0.23 kN
	∑V1_Wup	-1.15 kN
	∑V1_Wdown	0.83 kN
	∑V1_Su	0.00 kN
Right	∑V2_G	0.46 kN
	∑V2_Q	0.23 kN
	∑V2_Wup	-1.15 kN
	∑V2_Wdown	0.83 kN
	∑V2_Su	0.00 kN



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Parameters
Beam no. = RB2
Wind zone = High
Beam Span = 2.7 m
Base wind pressure p^* = 1.13 kPa
 $k_{l\text{eff}}$ = 1.0

	Wind Zones			Auckland		m/s
	Low	Med	High	V High	SD	
V=	45	45	45	45	50	
Mr, Ms=	1.00	1.00	1.00	1.00	1.00	
Mz, cat=	0.83	0.83	0.83	0.83	0.83	
Mt=	0.86	1.00	1.16	1.32	1.48	
Vbasic=	32.1	37.4	43.3	49.3	61.4	
NZS3604	32	37	44	50	55	
Pbasic=	0.62	0.84	1.13	1.46	2.26	kPa

Design Loads

UDL1	G=		kPa	x		=	0.00	kN/m	Note: Floor
	Q=		kPa	x	0.00 m	=	0.00	kN/m	
	W_{up} =	-1.13	kPa	x	(1. x 0.9 + 0.) x	0.00 m	=	0.00	kN/m
	W_{down} =	1.13	kPa	x	(1. x 0.5 + 0.3) x	0.00 m	=	0.00	kN/m
	Snow=	0.00	kPa	x	0.00 m	=	0.00	kN/m	
	a=	0.00	m		b = 2.70	m		c = 0.00	m

UDL2	G=		kPa	x		=	0.00	kN/m	Note: Wall
	Q=		kPa	x	0.00 m	=	0.00	kN/m	
	W_{up} =	-1.13	kPa	x	(1. x 0.9 + 0.) x	0.00 m	=	0.00	kN/m
	W_{down} =	1.13	kPa	x	(1. x 0.5 + 0.3) x	0.00 m	=	0.00	kN/m
	Snow=	0.00	kPa	x	0.00 m	=	0.00	kN/m	
	a=	0.00	m		b = 2.70	m		c = 0.00	m

UDL3	G=	0.50	kPa	x	0.75 m	=	0.38	kN/m	Note: Roof
	Q=	0.25	kPa	x	0.75 m	=	0.19	kN/m	
	W_{up} =	-1.13	kPa	x	(1. x 0.9 + 0.2) x	0.75 m	=	-0.93	kN/m
	W_{down} =	1.13	kPa	x	(1. x 0.5 + 0.3) x	0.75 m	=	0.68	kN/m
	Snow=	0.00	kPa	x	0.75 m	=	0.00	kN/m	
	a=	0.00	m		b = 2.70	m		c = 0.00	m

UDL4	G=		kPa	x		=	0.00	kN/m	Note:
	Q=		kPa	x	0.00 m	=	0.00	kN/m	
	W_{up} =	0.00	kPa	x	(1. x 0.9) x + 0.) x	0.00 m	=	0.00	kN/m
	W_{down} =	0.00	kPa	x	(1. x 0.5) x + 0.3) x	0.00 m	=	0.00	kN/m
	Snow=	0.00	kPa	x	0.00 m	=	0.00	kN/m	
	a=	0.00	m		b = 2.70	m		c = 0.00	m

PL1	G=		kN
	Q=		kN
	W_{up} =		kN
	W_{down} =		kN
	Snow=		kN
	a=		m

PL2	G=		kN
	Q=		kN
	W_{up} =		kN
	W_{down} =		kN
	Snow=		kN
	b=		m

Flexural & Shear Design
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$[1.35G] = 0.46$	kNm	$[1.35G] = 0.68$	kN
$[1.2G+1.5Q] = 0.67$	kNm	$[1.2G+1.5Q] = 0.99$	kN
$[1.2G+W_{down}] = 1.03$	kNm	$[1.2G+W_{down}] = 1.52$	kN
$[0.9G+W_{up}] = -0.60$	kNm	$[0.9G+W_{up}] = 0.80$	kN
$[1.2G+S_u] = 0.41$	kNm	$[1.2G+S_u] = 0.61$	kN

Deflection

[G]	-2.3	mm	L/1156	OK	k_2	2	for long term dead load
[G+ $\Psi_s Q$]	-3.2	mm	L/857	OK	Short-term factor $\Psi_{s,UDL}$	0.7	
[$k_2(G+\Psi_1 Q)$]	-5.6	mm	L/482	OK	Long-term factor $\Psi_{1,UDL}$	0.4	
[$W_{up,SLS}$]	3.9	mm	L/686	OK	Short-term factor $\Psi_{s,PL}$	1.0	
[G+ $W_{down,SLS}$]	-5.2	mm	L/522	OK	Long-term factor $\Psi_{1,PL}$	0.6	
[G+ $S_{u,SLS}$]	-2.3	mm	L/1156	OK			

Size selection

Radiata Pine	
Moisture content	Dry

Use 2.0 no. of 140x45 SG8

E_{lb} 5.4 GPa
 I_x 20.6 $\times 10^6$ mm⁴

ΦM_n 3.00 kNm OK
 ΦV_n 23.27 kN OK

Reaction to supporting elements

Left	$\sum V1_G$	0.51 kN
	$\sum V1_Q$	0.25 kN
	$\sum V1_{Wup}$	-1.25 kN
	$\sum V1_{Wdown}$	0.91 kN
	$\sum V1_{Su}$	0.00 kN
Right	$\sum V2_G$	0.51 kN
	$\sum V2_Q$	0.25 kN
	$\sum V2_{Wup}$	-1.25 kN
	$\sum V2_{Wdown}$	0.91 kN
	$\sum V2_{Su}$	0.00 kN



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Wind Studs/Beam:
Wind zone HIGH **Span**= 5.7 m
 Max. ultimate limit state wind speed= 44 m/s NZS 3604:2011 pa
 Max. serviceability limit state wind speed= 35.48 m/s
 Design wind pressure $q(z)=0.6Vd(z)^2*10^3$ (kPa)= 1.16 kPa NZS4203,Eq.5.5.1
 serviceability= 0.76 kPa
 Cpe= 0.7
 Cpi= 0.3
 Cfig = Cp,n Ka Kl= 1.0

LOADINGS ON BEAM

LOAD	LOAD WIDTH (m)	Wu kPa	Ws kPa	Wu kN/m	Ws kN/m	Wu kN/m
Wind	1.50	1.16	0.76	1.74	1.13	1.74
OTHER						
TOTALS				1.74	1.13	1.74

DEFLECTION CRITERIA

Material modulus of elasticity, E= 200000 MPa
 Max allowable deflection criterion = 0.0033 * span / 300
 Max allowable deflection, d= 19.0 mm
 Minimum moment of inertia, I= 4.10 mm⁴ x 10⁶

STUDS/BEAM SELECTION

try 5 x 125 x 6 SHS

Steel strength grade = 300 MPa
 Beam No.= 1
 Beam depth= 100 mm
 Beam weight per meter= 0.2098591 kg/m
 Beams Ix-x= 6.29 mm⁴ x 10⁶
 Beams Z= 120 mm³ x 10³

STUDS/BEAM BEHAVIOUR

Maximum moment action, M*= 7.08 kN-m
 Strength reduction factor, f= 0.9
 Nominal Moment, Ms= 36.00 kN-m
 f Ms= 32.40 kN-m

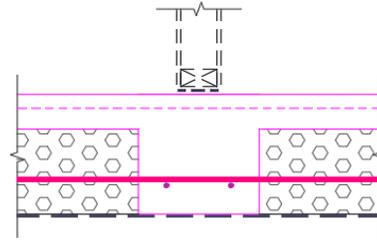
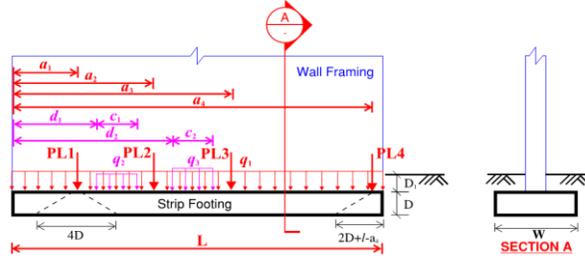
 Ws, deflection= 12.37 0.002171 *span
 D/span=1/ 461

END REACTIONS

Left Rwu= 4.97 kN
 Left Rws= 3.23 kN

So, Wind Studs / Beam	125 x 125 x 6 SHS
-----------------------	-------------------

Internal Load Bearing 300mm Wide Footing



UDL Loads:	q_1				
	Load dim	Dead Load	Live Load	D	L
	m	D (kPa)	L (KPa)	kN/m	kN/m
Roof	0	0.5	0.25	0	0
Floor	3	0.5	1.5	1.5	4.5
Wall	6	0.5	0	3	0
Deck	0	0.5	2	0	0
Soil	-	-	-	0	-
Concrete	-	-	-	2.232	-
Total	-	-	-	6.732	4.5

Considered strip footing length L=	1 m
Strip footing depth D=	310 mm
Strip footing width W=	300 mm
Wall width W_1 =	90 mm
Top soil depth D_1 =	0 mm
Slab-on-grade depth=	0 mm
f'_c =	20 MPa
Reinforcing=	HD 12 @ 150
f_y =	500 MPa
Concrete cover=	75 mm

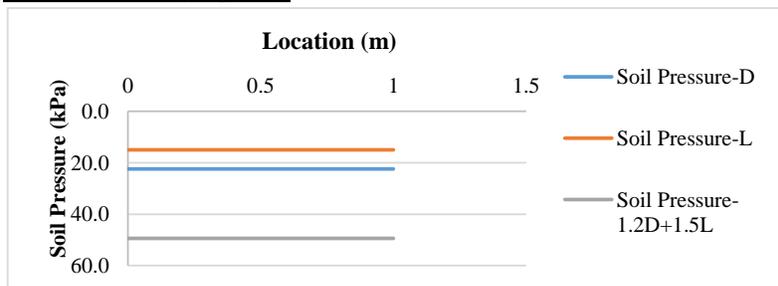
Point Loads:

	PL1	PL2	PL3	PL4
D (kN)	0.0	0.0	0.0	0.0
L (kN)	0.0	0.0	0.0	0.0
$a_1/a_2/a_3/a_4$ (m)	0.0	1.0	2.0	3.0
Enlarged W_2 (mm)	600	400	300	300

Local UDL Loads:

	q_2	q_3
D (kN/m)	0.0	0.0
L (kN/m)	0.0	0.0
$d_1/c_1/d_2/c_2$ (m)	0.5	2.0
	1.0	4.0

Check soil bearing capacity:



Maximum soil pressure= **49.4 kPa**
 $<$
 Soil bearing capacity= **150 kPa, OK!**

Check column punching shear:

$\phi = 0.75$

Check footing flexural:

$\phi = 0.85$

d=	229 mm	$k_{ds} = 0.93$
$\alpha_s = 10$		corner column

Critical L= 620 mm
 Critical $M^* = 2.9$ kN·m
 $A_s = 226.2$ mm²
 $T = A_s f_y = 113.10$ kN
 min. $A_s = 260$ mm² **NG!**
 $a = T / (0.85 b f'_c) = 22.18$ mm
 $jd = d - 0.5a = 217.91$ mm
 $\phi M_n = \phi \cdot T \cdot jd = 20.9$ kN·m, **OK!**

	PL1	PL2	PL3	PL4
Col. W at section A (mm)	90	90	-	-
Col. L along footing (mm)	90	90	-	-
B_0 (mm)	548	400	-	-
L_0 (mm)	319	274	-	-
b_0 (mm)	1047	854	-	-
β_c	1.72	1.46	-	-
v_c (MPa)	1.39	1.39	-	-
$\phi V_c = \phi v_c b_0 d$ (kN)	250.5	204.3	-	-
Punching capacity	OK!	OK!	-	-

2 bars at Section A for strip footing
HD12@150 for pad footing (if any)



Project Name: 22 Johnson St, Tuakau, Waikato	Date:
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Author: AY	Sheet No.

RIB RAFT DESIGN ON EXPANSIVE SOIL

Building

	Trib H/W	Type	G	Q
Roof	0.9	Light	0.5 kPa	0.25 kPa
External walls 2nd floor	0	Light	0.5 kPa	
Internal floor 2nd floor	0	Light	0.5 kPa	1.5 kPa
Deck 2nd floor	0	Light	0.5 kPa	2 kPa
External walls 1st floor	2.7	Light	0.5 kPa	
Internal floor 1st floor	0.7	Light	0.5 kPa	1.5 kPa
Deck 1st floor	0	Light	0.5 kPa	2 kPa
External walls ground	2.7	Light	0.5 kPa	

Ribs

Edge Beam width	400	Rib thickness	100
Pod Depth	220	Rib spacing	1200
Slab topping	90	Rib depth	310 mm

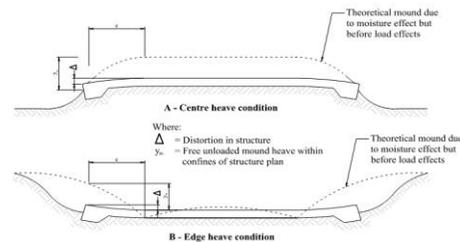


Figure F1: Soil structure interaction (from HB 28:1997 Figures 1.6 and 5.4)

Geotechnical Parameters

Dependable soil bearing	150	kPa
Soil classification	M	Moderately reactive
Surface movement y_s	40	mm Table 2.3 in AS2870
Differential mound movement y_m	28	mm 70% of y_s , AS2870 Clause F2 Mitchell method
Soil suction change depth H_s	1.5	m

Loadings

Roof					
G	Light		$0.5 \text{ kPa} \times 0.9 \text{ m} =$	0.45	kN/m
Q			$0.25 \text{ kPa} \times 0.9 \text{ m} =$	0.225	kN/m

2nd Floor					
G	External walls 2nd floor		$0.5 \text{ kPa} \times 0 \text{ m} =$	0	kN/m
	Internal floor		$0.5 \text{ kPa} \times 0 \text{ m} =$	0	kN/m
	Deck		$0.5 \text{ kPa} \times 0 \text{ m} =$	0	kN/m
Q	Internal floor		$1.5 \text{ kPa} \times 0 \text{ m} =$	0	kN/m
	Deck		$2 \text{ kPa} \times 0 \text{ m} =$	0	kN/m

1st Floor					
G	External walls 1st floor		$0.5 \text{ kPa} \times 2.7 \text{ m} =$	1.35	kN/m
	Internal floor		$0.5 \text{ kPa} \times 0.7 \text{ m} =$	0.35	kN/m
	Deck		$0.5 \text{ kPa} \times 0 \text{ m} =$	0	kN/m
Q	Internal floor		$1.5 \text{ kPa} \times 0.7 \text{ m} =$	1.05	kN/m
	Deck		$2 \text{ kPa} \times 0 \text{ m} =$	0	kN/m

Ground					
G	External walls ground		$0.5 \text{ kPa} \times 2.7 \text{ m} =$	1.35	kN/m
	Ribs			2.98	kN/m

Extra		
G	0	kN/m
Q	0	kN/m

Total G	6.48 kN/m
Total Q	1.275 kN/m
On edge beam	

Loading combination

ULS	1.35G =	8.7	kN/m
ULS	1.2G+1.5Q =	9.7	kN/m
SLS	G+0.7Q =	7.4	kN/m

Standard bearing check

ULS loading =	9.7	kN/m	
Bearing pressure p* =	24.2	kPa	
Bearing capacity =	150	kPa	OK

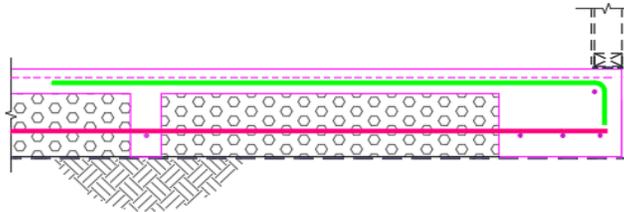
Centre heave mound

Edge distance $e = H_g/8 + y_m/36 =$	0.97	m
--------------------------------------	------	---

Edge beam spanning between cantilevered ribs (assumed simply supported)

Edge beam span =	1.2	m	Concrete f_c	20	MPa
ULS loading =	9.7	kN/m	Flexural f_y	500	MPa
$M^* =$	1.74	kNm	Shear f_{vy}	300	MPa
$V^* =$	5.8	kN			

Edge beam width	400.0	mm
Edge beam depth	310.0	mm
Bottom cover	50.0	mm



Flexural reinforcement

$A_{s,req} =$	16.2	mm ²	
Adopt	2HD12	Bottom bars	
Total $A_s =$	226	mm ²	OK

Shear reinforcement

$A_{v,req} =$	0	mm ² /m	
$A_{v,min} =$	0	mm ² /m	
Adopt	None	125	stirrups 1 leg only
$A_{v,prov} =$	0.0	mm ² /m	OK

Summary

Adopt 400mm wide by 310 mm deep edge beam with 2HD12 bottom rebar and 1HD12 top bar



Project Name: 22 Johnson St, Tuakau, Waikato	Date:
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APPROVED

RIB RAFT DESIGN ON EXPANSIVE SOIL

Ribs and topping

Rib thickness	100 mm	Top cover	30 mm
Rib spacing	1200 mm	Topping	90 mm
Rib depth	310 mm	Mesh	SE62

Centre heave mound

$$\text{Edge distance } e = H_s/8 + y_m/36 = 0.97 \text{ m}$$

Loadings and Design actions

Loadings from edge beam	G =	6.48 kN/m	Q =	1.28 kN/m
Tip load on cantilevered ribs	G =	6.476 kN/m x 1.2 m =	7.8 kN	
	Q =	1.275 kN/m x 1.2 m =	1.5 kN	
Extra point load at tip	G =	2.2 kN	Q =	2.1 kN
Rib and slab	G =	3.34 kN/m		
	Q =	1.80 kN/m		(assumed 1.5kPa live load at ground)
Cantilevered design moment M^*_{ULS} =		19.9 kNm		per rib
Cantilevered design shear V^*_{ULS} =		23.9 kN		per rib

Flexural capacity of cantilevered ribs

M^*_{ULS} =	19.9	kNm		
Top cover =	30	mm		
Concrete f_c =	20	MPa		
Required A_s =	190.6	mm ² /m		
Try	HD12 starters	@ 1200 c-c	A_s =	94.2 mm ² /m
Steel mesh	SE62		A_s =	147 mm ² /m
			Total A_s =	241.2 mm ² /m OK

Shear capacity of cantilevered ribs

ULS V^* =	23.9	kN	
Top cover =	30	mm	
$A_{v,req}$ =	0	mm ² /m	
$A_{v,min}$ =	0	mm ² /m	
Not require shear stirrups			
Try	None @	125 stirrups one leg only	
$A_{v,prov}$ =	0.0	mm ² /m	OK

Cracking Moment

$M_{cr} = f_r I_g / y_t$			
I_g =	615.92	x10 ⁶ mm ⁴	Moment of inertia of gross concrete section about centroidal axis
y_t =	71.23	mm	distance from neutral axis to extreme tension fibre
f_r =	1.79	MPa	modulus of rupture
M_{cr} =	15.5	kNm	
M^*_{SLS} =	8.5	kNm	per rib OK

Summary

Adopt 100 mm thick rib @ 1200 mm spacing, depth to be 310 mm, with HD12 starters each rib
 Starters to be minimum 1686 mm long into slab



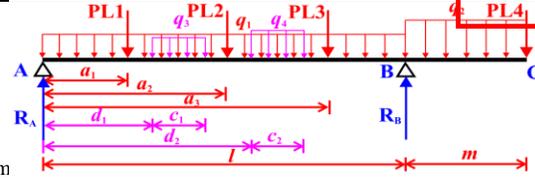
Project Address:	LW-22 Johnson St, Tuakau, Waikato	Date:	
Project No:	220952	Revision:	
Author:	AY	Sheet No.	

Waikato District Council
Building Consent Number
BLD2096/22

APPROVED

Beam/Lintel Design

Member NO. **KD RC Beam Design**



$l = 2.6$ m

$m =$ m

UDL Loads:

Load source	Non-cantilever q_1 (UDL over whole span)					Cantilever q_2 (UDL over whole cantilever span)				
	Load dim m	Dead Load D (kPa)	Live Load L (kPa)	D kN/m	L kN/m	Load dim m	Dead Load D (kPa)	Live Load L (kPa)	D kN/m	L kN/m
Roof	3.00	0.50	0.25	1.50	0.75				0.00	0.00
Floor				0.00	0.00				0.00	0.00
Wall slab	3.00	0.50		1.50	0.00				0.00	0.00
other	0.60	2.40	1.50	1.44	0.90				0.00	0.00
Self-weight				3.07	0.00				0.00	0.00
Total				7.51	1.65				0.00	0.00

Local UDL:	Non-cantilever q_3					Non-cantilever q_4				
	Load position	$d1 =$	0.00	$c1 =$	0.00	Load position	$d2 =$	0.00	$c2 =$	0.00
Roof				0.00	0.00				0.00	0.00
Floor				0.00	0.00				0.00	0.00
Wall				0.00	0.00				0.00	0.00
Other				0.00	0.00				0.00	0.00
Total				0.00	0.00				0.00	0.00

Point Loads:	$a_1/a_2/a_3$ (m)	Load area (m ²)	D (kPa or kN)	L (kPa or kN)	PL _D (kN)	PL _L (kN)
PL1 from					0.00	0.00
PL2 from					0.00	0.00
PL3 from					0.00	0.00
PL from	- (beam end)	1.00			0.00	0.00

ULS Demand (1.2D+1.5L):

$M^* = 9.7$ kN·m (Positive) $M^* = 0.0$ kN·m (Negative)
 $V^* = 14.9$ kN

Reinforced Concrete Beam Check

Try $b =$	400 mm	$h =$	320 mm	cover =	75 mm (beam bottom)
Selfweight =	3.1 kN/m	$I =$	1092.3×10^6 mm ⁴	cover =	30 mm (beam top)
Compressive strength $f_c =$	20 MPa	$E =$	21.0×10^3 MPa	cover =	0 mm (beam side)

Check bending

Try longitudinal bars	6 HD 12	$f_y =$	500 MPa
min. $A_s = \max \left(\frac{\sqrt{f_c}}{4f_y} b_w d, 1.4 b_w d / f_y \right) = 261$ mm ²			
$A_s =$	678.6 mm ²	OK!	$T = A_s f_y = 339.3$ kN
$a = T / (0.85 b f_c) =$	49.9 mm		$d = h - \text{cover} - D_q / 2 - d_v = 233.0$ mm
$j_d = h - 0.5a =$	208.1 mm		$\phi M_n = \phi \cdot T \cdot j_d = 60.0$ kN·m > M* , OK!
$p_w =$	0.530%		

Check shear

$ka =$	1.0	$kd =$	0.9
$v_b =$	0.6 MPa	$v_c =$	0.5 MPa
$Acv =$	0.0932 m ²	$V_c =$	46.1 kN
$V^* > 0.5V_c ?$	FALSE	Stirrups not required	

Try stirrups

Try stirrups	1 R 6 @ 200
$\Phi_v =$	0.75
$\phi (V_s + V_c) =$	42.0 kN > V* = 14.9 kN OK!

Reactions:

	R_A:	R_B:
D =	9.8 kN	D = 9.8 kN
L =	2.1 kN	L = 2.1 kN
1.2D+1.5L =	14.9 kN	1.2D+1.5L = 14.9 kN

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Concrete pile	P1
Soil assumed complying with	Geotechnical Report Round RC Pile
Footing Dia&edge length=	400 mm
Load on pile, R =	15.00 kN
Ultimate end bearing capacity =	300 kPa
Ultimate side adhesion =	15 kPa
strength reduction factor ϕ =	0.5
Assumed top soil thickness =	0.4 m
Minimum embedment =	1.5 m
s of no contribution for Skin ficktion from top =	1 m
Resistance from Skin friction =	4.7 kN
Resistance from end bearing =	18.8 kN
Total resistance=	23.6 kN
	> 15.00 OK
Therefore R.C. pile 400mm dia. 1.5m min. into firm natural ground	

Timber retaining wall 0.5 m & 2.5 kPa Surcharge

Load factors

Soil	1.5
LL	1.5
Φ	0.5

Surcharge

W	2.5 kPa
---	---------

Soil Parameters

$$K_a = \text{Cos}\omega \times \frac{\text{Cos}\omega - \sqrt{(\text{cos}^2\omega - \text{cos}^2\phi)}}{\text{Cos}\omega + \sqrt{(\text{cos}^2\omega - \text{cos}^2\phi)}}$$

K _a	0.343
γ _{soil}	18
S _u	70
φ-friction °	30
α	8

H	0.50 m
D _s	0.35 m
S-spacing	1.00 m
P*=ΣF	1.8 kN

Try embedment length L **0.8 m**

Reduction for spacing n=0.25S/D_s

n	0.71
f _o = 1.5D _s	0.53 m
f = {ΣF*y}/P*	0.20 m
f+f _o	0.72 m
f+L	1.01 m
L+2f+f _o	1.73 m

$$H_u = 9S_u * D_s [\sqrt{2}[(f+L)^2 + (f+f_o)^2] - (L+2f+f_o)]$$

H _u	3.8 kN
ΦH _u	1.9 kN

Find Maximum Bending Moment

$$g_c = (H_u/9S_u D_s) + f_o = 0.54 \text{ m}$$

$$BIA, M_{max} = H(f+f_o + H_u/18S_u D_s) = 1.3 \text{ kNm}$$

M_{max}

Calculate Section bending capacity

For Square Pole ΦMn = ΦK₁K₈f_bZ where Z = bd²/6
 For Round Pole ΦMn = ΦK₁K₈K₂₀K₂₁f_bZ where Z = πd³/32

Φ	K ₁	K ₈	d	b	D @ G.L	Z x 10 ⁶	K ₂₀	K ₂₁	f _b	f _s
0.8	0.8	1	#N/A	#N/A	156 mm	0.37 mm ³	0.90	0.85	38.0 Mpa	3.1 Mpa

ΦMn **7.0 kNm**
 Bending Capacity O.K ✓

Calculate Section Shear capacity

For Square Pole ΦVn = ΦK₁K₄f_sAs Where As = 2bd/3
 For Round Pole ΦVn = ΦK₁K₄K₂₀K₂₁f_sAs Where As = (3πD²)/16

K ₂₀	As [mm ²]
1	14382

ΦVn **24.3 kN**
 Shear Capacity O.K ✓

Check rails capacity

$$W^* = (P_3 + P_4) * b = 0.8 \text{ kN/m}$$

$$M^* = W^* S^2 / 8 = 0.1 \text{ kNm}$$

Average of lower 0.5m



b	d	f _b	K ₈	K ₄	Z = bd ² /6
150	50	11.7	1	1	0.063

$$\Phi M_n = \Phi K_1 K_8 f_b Z$$

Continuous over 3 spans min.

ΦMn **0.47 kNm**

Rail Capacity O.K ✓

$$W^* = (P_3 + P_4) * b = 0.7 \text{ kN/m}$$

$$M^* = W^* S^2 / 8 = 0.1 \text{ kNm}$$

Average of lower 0.5m



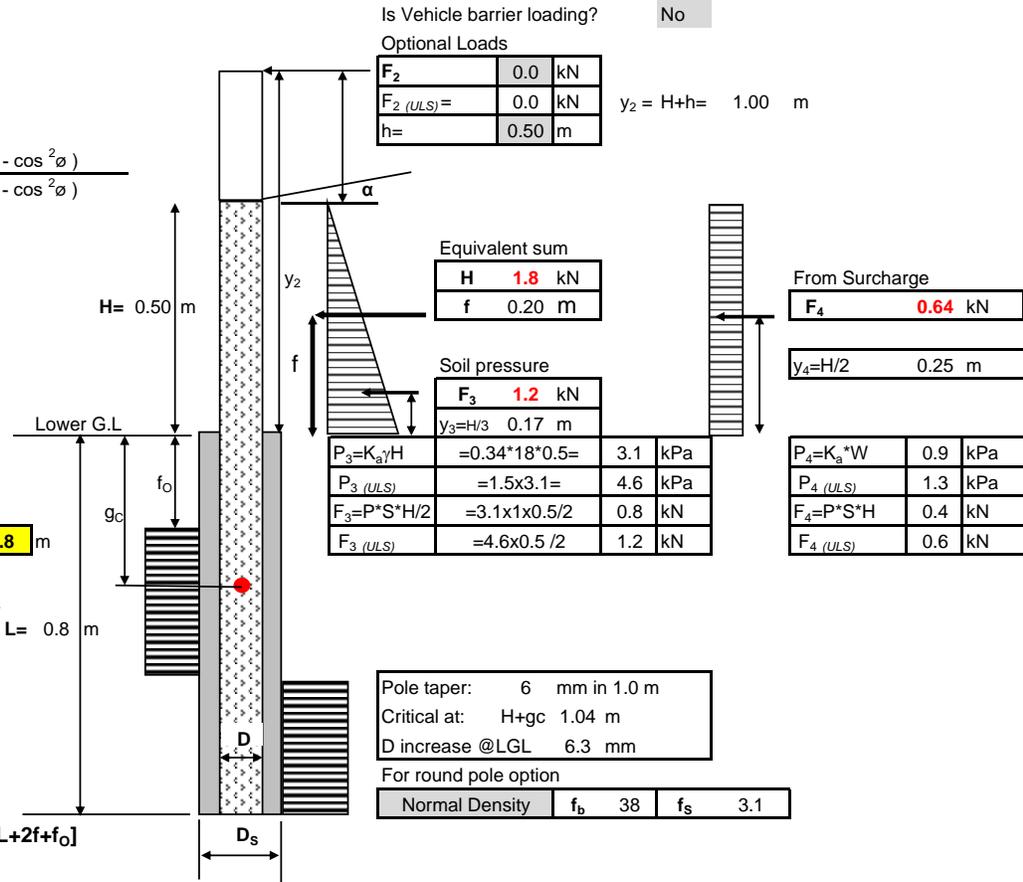
b	dia	f _b	K ₂₀	K ₂₁	Z = πd ³ /32
N/A	125	38.0	0.90	0.85	0.192

$$\Phi M_n = \Phi K_1 K_8 K_{20} K_{21} f_b Z$$

ΦMn **3.57 kNm**

Rail Capacity O.K ✓

Summary Use 150 mm H5 Pole @ 1 m c/c in a 0.35 m Hole Rails 150 x 50 mm



Is Vehicle barrier loading? No

Optional Loads

F ₂	0.0 kN
F _{2 (ULS)}	0.0 kN
h	0.50 m

Equivalent sum

H	1.8 kN
f	0.20 m

Soil pressure

F ₃	1.2 kN
y ₃ = H/3	0.17 m
P ₃ = K _a γH	= 0.34 * 18 * 0.5 = 3.1 kPa
P _{3 (ULS)}	= 1.5 * 3.1 = 4.6 kPa
F ₃ = P * S * H / 2	= 3.1 * 1 * 0.5 / 2 = 0.8 kN
F _{3 (ULS)}	= 4.6 * 0.5 / 2 = 1.2 kN

From Surcharge

F ₄	0.64 kN
----------------	---------

y ₄ = H/2	0.25 m
----------------------	--------

P ₄ = K _a * W	0.9 kPa
P _{4 (ULS)}	1.3 kPa
F ₄ = P * S * H	0.4 kN
F _{4 (ULS)}	0.6 kN

Pole taper: 6 mm in 1.0 m
 Critical at: H+g_c 1.04 m
 D increase @ LGL 6.3 mm

For round pole option

Normal Density	f _b	38	f _s	3.1
----------------	----------------	----	----------------	-----

Timber retaining wall 0.8 m & 2.5 kPa Surcharge

Load factors

Soil	1.5
LL	1.5
Φ	0.5

Surcharge

W	2.5 kPa
---	---------

Soil Parameters

$$K_a = \text{Cos}\omega \times \frac{\text{Cos}\omega - \sqrt{(\text{cos}^2\omega - \text{cos}^2\phi)}}{\text{Cos}\omega + \sqrt{(\text{cos}^2\omega - \text{cos}^2\phi)}}$$

K _a	0.343
γ _{soil}	18
S _u	70
φ-friction °	30
α	8

H	0.80 m
D _s	0.35 m
S-spacing	1.00 m
P*=ΣF	4.0 kN

Try embedment length L **1.0 m**

Reduction for spacing n=0.25S/D_s

n	0.71
f _o = 1.5D _s	0.53 m
f = {ΣF*y}/P*	0.30 m
f+f _o	0.83 m
f+L	1.3 m
L+2f+f _o	2.13 m

$$H_u = 9S_u * D_s [\sqrt{2}[(f+L)^2 + (f+f_o)^2] - (L+2f+f_o)]$$

H _u	8.2 kN
ΦH _u	4.1 kN

Find Maximum Bending Moment

$$g_c = (H_u/9S_u D_s) + f_o = 0.56 \text{ m}$$

$$BIA, M_{max} = H(f+f_o) + H_u/18S_u D_s = \mathbf{3.4} \text{ kNm}$$

M_{max}

Calculate Section bending capacity

For Square Pole ΦMn = ΦK₁K₈f_bZ where Z = bd²/6
 For Round Pole ΦMn = ΦK₁K₈K₂₀K₂₁f_bZ where Z = πd³/32

Φ	K ₁	K ₈	d	b	D @ G.L	Z x 10 ⁶	K ₂₀	K ₂₁	f _b	f _s
0.8	0.8	1	#N/A	#N/A	158 mm	0.39 mm ³	0.90	0.85	38.0 Mpa	3.1 Mpa

$$\Phi M_n = \mathbf{7.2} \text{ kNm}$$

Bending Capacity O.K ✓

Calculate Section Shear capacity

For Square Pole ΦVn = ΦK₁K₄f_sAs Where As = 2bd/3
 For Round Pole ΦVn = ΦK₁K₄K₂₀K₂₁f_sAs Where As = (3πD²)/16

K ₂₀	As [mm ²]
1	14737

$$\Phi V_n = \mathbf{24.9} \text{ kN}$$

Shear Capacity O.K ✓

Check rails capacity

$$W^* = (P_3 + P_4) * b = 1.2 \text{ kN/m}$$

$$M^* = W^* S^2 / 8 = \mathbf{0.1} \text{ kNm}$$

Average of lower 0.5m

b	d	f _b	K ₈	K ₄	Z = bd ² /6	ΦMn = ΦK ₁ K ₈ f _b Z
150	50	11.7	1	1	0.063	ΦMn = 0.47 kNm

Continuous over 3 spans min.

$$\Phi M_n = \mathbf{0.47} \text{ kNm}$$

Rail Capacity O.K ✓

$$W^* = (P_3 + P_4) * b = 1.0 \text{ kN/m}$$

$$M^* = W^* S^2 / 8 = \mathbf{0.1} \text{ kNm}$$

Average of lower 0.5m

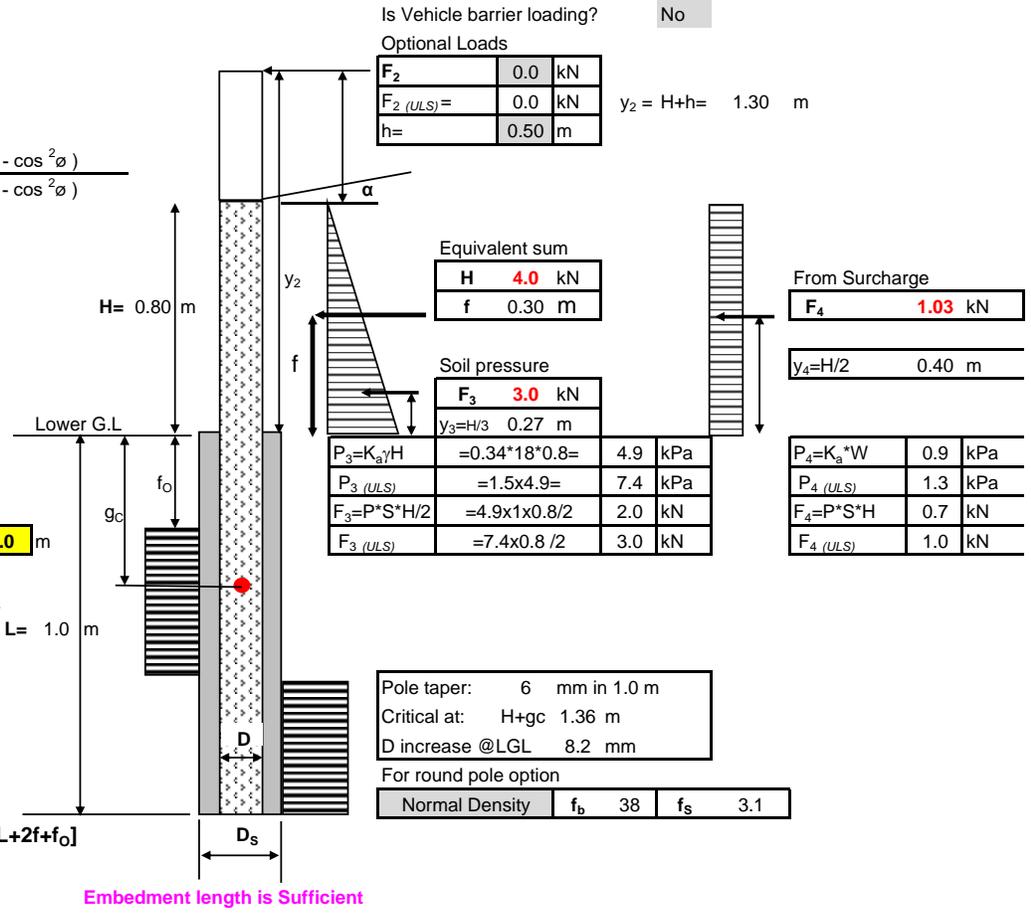
b	dia	f _b	K ₂₀	K ₂₁	Z = πd ³ /32	ΦMn = ΦK ₁ K ₈ K ₂₀ K ₂₁ f _b Z
N/A	125	38.0	0.90	0.85	0.192	ΦMn = 3.57 kNm

$$\Phi M_n = \mathbf{3.57} \text{ kNm}$$

Rail Capacity O.K ✓

Summary

Use 150 mm H5 Pole @ 1 m c/c in a 0.35 m Hole Rails 150 x 50 mm



Embedment length is Sufficient

Select pole type **Round** Select Section size **150**

Timber retaining wall 1 m & 2.5 kPa Surcharge

Load factors

Soil	1.5
LL	1.5
Φ	0.5

Surcharge

W	2.5 kPa
---	---------

Soil Parameters

$$K_a = \cos\omega \times \frac{\cos\omega - \sqrt{(\cos^2\omega - \cos^2\phi)}}{\cos\omega + \sqrt{(\cos^2\omega - \cos^2\phi)}}$$

K _a	0.343
γ _{soil}	18
S _u	70
φ-friction °	30
α	8

H	1.00 m
D _s	0.35 m
S-spacing	1.00 m
P*=ΣF	5.9 kN

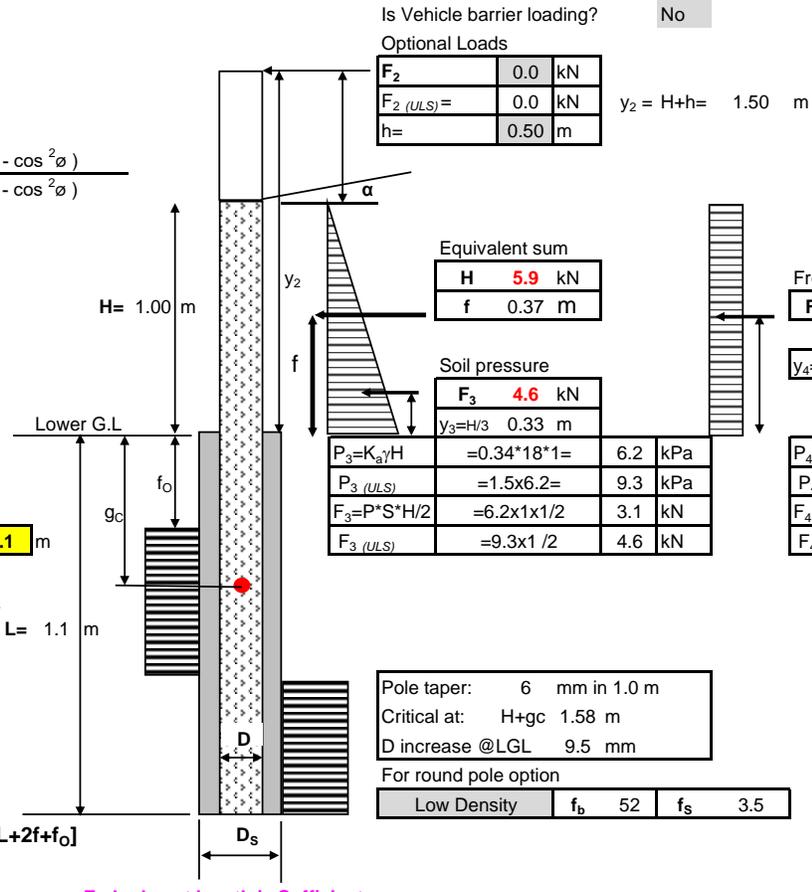
Try embedment length L 1.1 m

Reduction for spacing n=0.25S/D_s

n	0.71
f _o = 1.5D _s	0.53 m
f = {ΣF*y}/P*	0.37 m
f+f _o	0.89 m
f+L	1.51 m
L+2f+f _o	2.4 m

$$H_u = 9S_u * D_s [\sqrt{2}[(f+L)^2 + (f+f_o)^2] - (L+2f+f_o)]$$

H _u	12.0 kN
ΦH _u	6.0 kN



Embedment length is Sufficient

Find Maximum Bending Moment

$$g_c = (H_u/9S_u D_s) + f_o = 0.58 \text{ m}$$

$$BIA, M_{max} = H(f+f_o) + H_u/18S_u D_s = 5.5 \text{ kNm}$$

M_{max}

Select pole type Round Select Section size 175

Calculate Section bending capacity

For Square Pole ΦMn = ΦK₁K₈f_bZ where Z = bd²/6
 For Round Pole ΦMn = ΦK₁K₈K₂₀K₂₁f_bZ where Z = πd³/32

Φ	K ₁	K ₈	d	b	D @ G.L	Z x 10 ⁶	K ₂₀	K ₂₁	f _b	f _s
0.8	0.8	1	#N/A	#N/A	184 mm	0.62 mm ³	0.90	0.85	52.0 Mpa	3.5 Mpa

ΦMn 15.7 kNm
 Bending Capacity O.K ✓

Calculate Section Shear capacity

For Square Pole ΦVn = ΦK₁K₄f_sAs Where As = 2bd/3
 For Round Pole ΦVn = ΦK₁K₄K₂₀K₂₁f_sAs Where As = (3πD²)/16

K ₂₀	As [mm ²]
1	20047

ΦVn 38.2 kN
 Shear Capacity O.K ✓

Check rails capacity

$$W^* = (P_3 + P_4) * b = 1.4 \text{ kN/m}$$

$$M^* = W^* S^2 / 8 = 0.2 \text{ kNm}$$

Average of lower 0.5m

b	d	f _b	K ₈	K ₄	Z = bd ² /6	ΦMn = ΦK ₁ K ₈ f _b Z
150	50	11.7	1	1	0.063	ΦMn 0.47 kNm

Continuous over 3 spans min.
 ΦMn 0.47 kNm
 Rail Capacity O.K ✓

$$W^* = (P_3 + P_4) * b = 1.2 \text{ kN/m}$$

$$M^* = W^* S^2 / 8 = 0.2 \text{ kNm}$$

Average of lower 0.5m

b	dia	f _b	K ₂₀	K ₂₁	Z = πd ³ /32	ΦMn = ΦK ₁ K ₈ K ₂₀ K ₂₁ f _b Z
N/A	125	38.0	0.90	0.85	0.192	ΦMn 3.57 kNm

ΦMn 3.57 kNm
 Rail Capacity O.K ✓

Summary Use 175 mm H5 Pole @ 1 m c/c in a 0.35 m Hole Rails 150 x 50 mm

Timber retaining wall 1.2 m & 2.5 kPa Surcharge

Load factors

Soil	1.5
LL	1.5
Φ	0.5

Surcharge

W	2.5 kPa
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Soil Parameters

$$K_a = \cos \omega \times \frac{\cos \omega - \sqrt{(\cos^2 \omega - \cos^2 \phi)}}{\cos \omega + \sqrt{(\cos^2 \omega - \cos^2 \phi)}}$$

K_a	0.343
γ_{soil}	18
S_u	70
φ-friction °	30
α	8

H	1.20 m
D_s	0.40 m
S-spacing	1.00 m
P*=ΣF	8.2 kN

Try embedment length L **1.4 m**

Reduction for spacing n=0.25S/D_s

n	0.63
f_o = 1.5D_s	0.6 m
f = {ΣF*y}/P*	0.44 m
f+f_o	1.04 m
f+L	1.82 m
L+2f+f_o	2.86 m

$$H_u = 9S_u * D_s [\sqrt{2}[(f+L)^2 + (f+f_o)^2] - (L+2f+f_o)]$$

H_u	16.6 kN
ΦH_u	8.3 kN

Find Maximum Bending Moment

$$g_c = (H_u / 9S_u D_s) + f_o = 0.67 \text{ m}$$

$$BIA, M_{max} = H(f+f_o) + H_u / 18 S_u D_s = \mathbf{8.8 \text{ kNm}}$$

M_{max}

Calculate Section bending capacity

For Square Pole ΦMn = ΦK₁K₈f_bZ where Z = bd²/6
 For Round Pole ΦMn = ΦK₁K₈K₂₀K₂₁f_bZ where Z = πd³/32

Φ	K ₁	K ₈	d	b	D @ G.L	Z x 10 ⁶	K ₂₀	K ₂₁	f _b	f _s
0.8	0.8	1	#N/A	#N/A	213 mm	0.95 mm ³	0.90	0.85	38.0 Mpa	3.1 Mpa

ΦMn **17.7 kNm**
Bending Capacity O.K ✓

Calculate Section Shear capacity

For Square Pole ΦVn = ΦK₁K₄f_sAs Where As = 2bd/3
 For Round Pole ΦVn = ΦK₁K₄K₂₀K₂₁f_sAs Where As = (3πD²)/16

K ₂₀	As [mm ²]
1	26740

ΦVn **45.1 kN**
Shear Capacity O.K ✓

Check rails capacity

$$W^* = (P_3 + P_4) * b = 1.7 \text{ kN/m}$$

$$M^* = W^* S^2 / 8 = \mathbf{0.2 \text{ kNm}}$$

Average of lower 0.5m

b	d	f _b	K ₈	K ₄	Z = bd ² /6	ΦMn = ΦK ₁ K ₈ f _b Z
150	50	11.7	1	1	0.063	ΦMn 0.47 kNm

Continuous over 3 spans min.
 ΦMn **0.47 kNm**
Rail Capacity O.K ✓

$$W^* = (P_3 + P_4) * b = 1.4 \text{ kN/m}$$

$$M^* = W^* S^2 / 8 = \mathbf{0.2 \text{ kNm}}$$

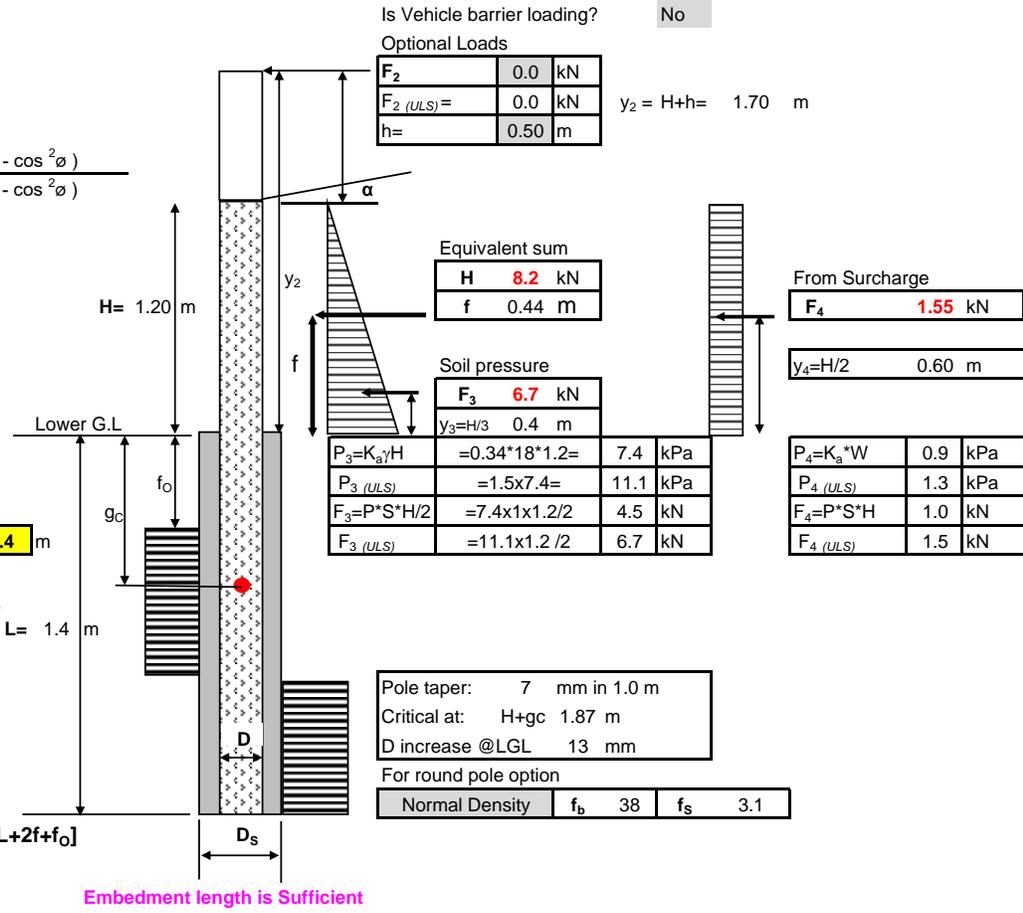
Average of lower 0.5m

b	dia	f _b	K ₂₀	K ₂₁	Z = πd ³ /32	ΦMn = ΦK ₁ K ₈ K ₂₀ K ₂₁ f _b Z
N/A	125	38.0	0.90	0.85	0.192	ΦMn 3.57 kNm

ΦMn **3.57 kNm**
Rail Capacity O.K ✓

Summary

Use 200 mm H5 Pole @ 1 m c/c in a 0.40 m Hole Rails 150 x 50 mm



Timber retaining wall 1.4 m & 2.5 kPa Surcharge

Load factors

Soil	1.5
LL	1.5
Φ	0.5

Surcharge

W	2.5 kPa
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Soil Parameters

$$K_a = \text{Cos}\omega \times \frac{\text{Cos}\omega - \sqrt{(\text{cos}^2\omega - \text{cos}^2\phi)}}{\text{Cos}\omega + \sqrt{(\text{cos}^2\omega - \text{cos}^2\phi)}}$$

K _a	0.343
γ _{soil}	18
S _u	70
φ-friction °	30
α	8

H	1.40 m
D _s	0.45 m
S-spacing	1.00 m
P*=ΣF	10.9 kN

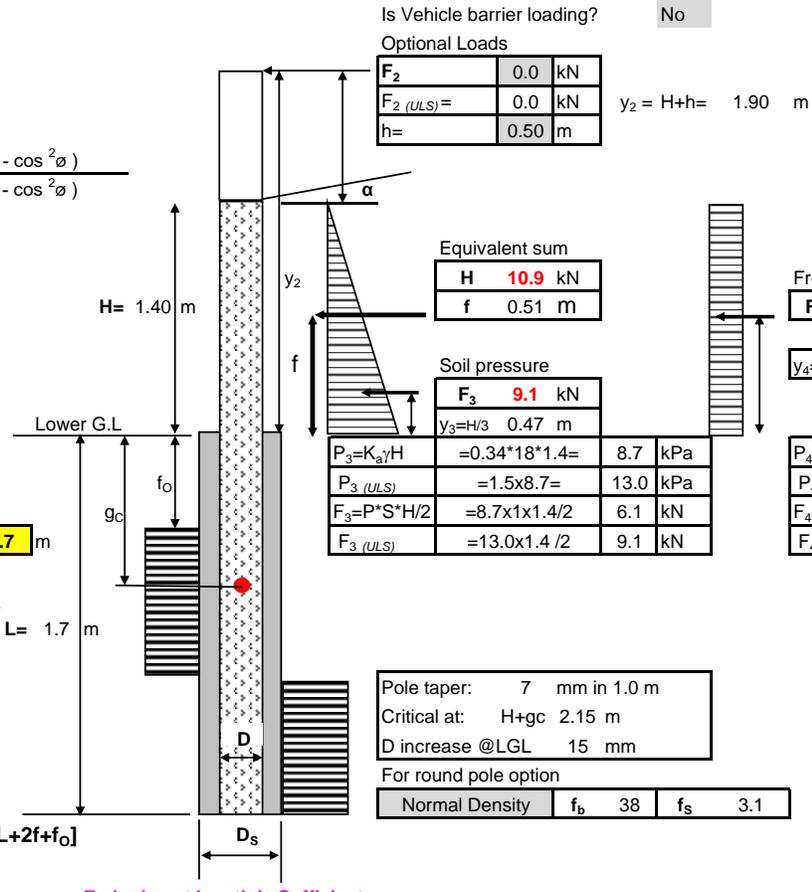
Try embedment length L **1.7 m**

Reduction for spacing n=0.25S/D_s

n	0.56
f _o = 1.5D _s	0.68 m
f = {ΣF*y}/P*	0.51 m
f+f _o	1.18 m
f+L	2.16 m
L+2f+f _o	3.34 m

$$H_u = 9S_u * D_s [\sqrt{2[(f+L)^2 + (f+f_o)^2]} - (L+2f+f_o)]$$

H _u	22.0 kN
ΦH _u	11.0 kN



Is Vehicle barrier loading? **No**

Optional Loads

F ₂	0.0 kN
F _{2 (ULS)}	0.0 kN
h	0.50 m

y₂ = H+h = 1.90 m

Equivalent sum

H	10.9 kN
f	0.51 m

Soil pressure

F ₃	9.1 kN
y ₃ =H/3	0.47 m

P ₃ =K _a γH	=0.34*18*1.4=	8.7 kPa
P _{3 (ULS)}	=1.5x8.7=	13.0 kPa
F ₃ =P*S*H/2	=8.7x1x1.4/2	6.1 kN
F _{3 (ULS)}	=13.0x1.4 /2	9.1 kN

From Surcharge

F ₄	1.80 kN
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y ₄ =H/2	0.70 m
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P ₄ =K _a *W	0.9 kPa
P _{4 (ULS)}	1.3 kPa
F ₄ =P*S*H	1.2 kN
F _{4 (ULS)}	1.8 kN

Pole taper: 7 mm in 1.0 m
 Critical at: H+g_c 2.15 m
 D increase @LGL 15 mm

For round pole option

Normal Density	f _b	38	f _s	3.1
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Embedment length is Sufficient

Find Maximum Bending Moment

$$BIA, M_{max} = H(f+f_o) + H_u/18S_uD_s$$

$$g_c = (H_u/9S_uD_s) + f_o = 0.75 m$$

Select pole type **Round** Select Section size **225**

M_{max}

Calculate Section bending capacity

For Square Pole ΦMn = ΦK₁K₈f_bZ where Z = bd²/6
 For Round Pole ΦMn = ΦK₁K₈K₂₀K₂₁f_bZ where Z = πd³/32

Φ	K ₁	K ₈	d	b	D @ G.L	Z x 10 ⁶	K ₂₀	K ₂₁	f _b	f _s
0.8	0.8	1	#N/A	#N/A	240 mm	1.36 mm ³	0.90	0.85	38.0 Mpa	3.1 Mpa

ΦMn **25.3 kNm**
 Bending Capacity O.K ✓

Calculate Section Shear capacity

For Square Pole ΦVn = ΦK₁K₄f_sAs Where As = 2bd/3
 For Round Pole ΦVn = ΦK₁K₄K₂₀K₂₁f_sAs Where As = (3πD²)/16

K ₂₀	As [mm ²]
1	33948

ΦVn **57.3 kN**
 Shear Capacity O.K ✓

Check rails capacity

$$W^* = (P_3 + P_4) * b = 1.9 \text{ kN/m}$$

$$M^* = W^* S^2 / 8 = 0.2 \text{ kNm}$$

Average of lower 0.5m

b	d	f _b	K ₈	K ₄	Z = bd ² /6	ΦMn = ΦK ₁ K ₈ f _b Z
150	50	11.7	1	1	0.063	ΦMn = 0.47 kNm

Continuous over 3 spans min.
 ΦMn **0.47 kNm**
 Rail Capacity O.K ✓

$$W^* = (P_3 + P_4) * b = 1.6 \text{ kN/m}$$

$$M^* = W^* S^2 / 8 = 0.2 \text{ kNm}$$

Average of lower 0.5m

b	dia	f _b	K ₂₀	K ₂₁	Z = πd ³ /32	ΦMn = ΦK ₁ K ₈ K ₂₀ K ₂₁ f _b Z
N/A	125	38.0	0.90	0.85	0.192	ΦMn = 3.57 kNm

ΦMn **3.57 kNm**
 Rail Capacity O.K ✓

Summary Use 225 mm H5 Pole @ 1 m c/c in a 0.45 m Hole Rails 150 x 50 mm

Timber retaining wall 1.7 m & 2.5 kPa Surcharge

TYPE **A** WALL: **2.5 kPa Surcharge**

Load factors

Soil	1.5
LL	1.5
Φ	0.5

Surcharge

W	2.5 kPa
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Soil Parameters

$$K_a = \cos \omega \times \frac{\cos \omega - \sqrt{(\cos^2 \omega - \cos^2 \phi)}}{\cos \omega + \sqrt{(\cos^2 \omega - \cos^2 \phi)}}$$

K _a	0.343
γ _{soil}	18
S _u	70
φ-friction °	30
α	8

H	1.70 m
D _s	0.45 m
S-spacing	1.00 m
P*=ΣF	15.6 kN

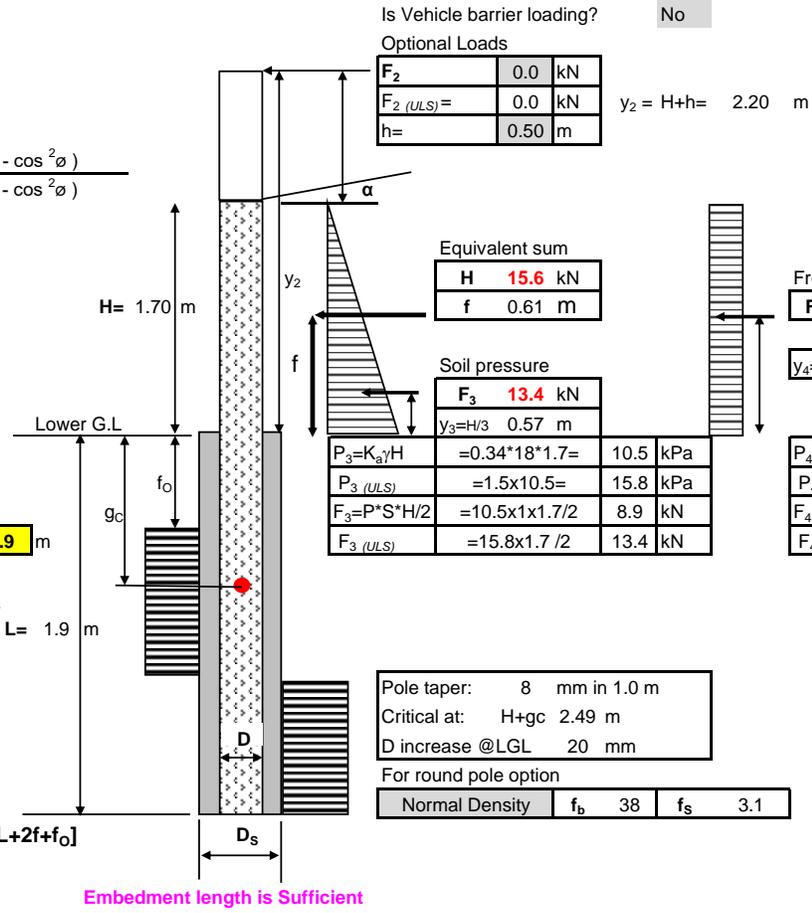
Try embedment length L **1.9 m**

Reduction for spacing n=0.25S/D_s

n	0.56
f _o = 1.5D _s	0.68 m
f = {ΣF*y}/P*	0.61 m
f+f _o	1.28 m
f+L	2.53 m
L+2f+f _o	3.81 m

$$H_u = 9S_u * D_s [\sqrt{2}[(f+L)^2 + (f+f_o)^2] - (L+2f+f_o)]$$

H _u	31.4 kN
ΦH _u	15.7 kN



Embedment length is Sufficient

Find Maximum Bending Moment

BIA, M_{max}=H(f+f_o+H_u/18S_uD_s) **20.8 kNm**

g_c=(H_u/9S_uD_s)+f_o= 0.79 m

M_{max}

Select pole type **Round** Select Section size **250**

Calculate Section bending capacity

For Square Pole ΦMn=ΦK₁K₈f_bZ where Z=bd²/6
For Round Pole ΦMn=ΦK₁K₈K₂₀K₂₁f_bZ where Z=πd³/32

Φ	K ₁	K ₈	d	b	D @ G.L	Z x 10 ⁶	K ₂₀	K ₂₁	f _b	f _s
0.8	0.8	1	#N/A	#N/A	270 mm	1.93 mm ³	0.90	0.85	38.0 Mpa	3.1 Mpa

ΦMn **35.9 kNm**
Bending Capacity O.K ✓

Calculate Section Shear capacity

For Square Pole ΦVn=ΦK₁K₄f_sAs Where As=2bd/3
For Round Pole ΦVn=ΦK₁K₄K₂₀K₂₁f_sAs Where As=(3πD²)/16

K ₂₀	As [mm ²]
1	42905

ΦVn **72.4 kN**
Shear Capacity O.K ✓

Check rails capacity

W*=(P₃+P₄)*b 2.3 kN/m
M*=W*S²/8= **0.3 kNm**
Average of lower 0.5m

b	d	f _b	K ₈	K ₄	Z=bd ² /6	ΦMn=ΦK ₁ K ₈ f _b Z
150	50	11.7	1	1	0.063	ΦMn = 0.47 kNm

Continuous over 3 spans min.
ΦMn **0.47 kNm**
Rail Capacity O.K ✓

W*=(P₃+P₄)*b 1.9 kN/m
M*=W*S²/8= **0.2 kNm**
Average of lower 0.5m

b	dia	f _b	K ₂₀	K ₂₁	Z=πd ³ /32	ΦMn=ΦK ₁ K ₈ K ₂₀ K ₂₁ f _b Z
N/A	125	38.0	0.90	0.85	0.192	ΦMn = 3.57 kNm

ΦMn **3.57 kNm**
Rail Capacity O.K ✓

Summary Use 250 mm H5 Pole @ 1 m c/c in a 0.45 m Hole Rails 150 x 50 mm

Timber retaining wall 1.9 m & 2.5 kPa Surcharge

TYPE **A** WALL: **2.5 kPa Surcharge**

Load factors

Soil	1.5
LL	1.5
Φ	0.5

Surcharge

W	2.5 kPa
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Soil Parameters

$$K_a = \cos \omega \times \frac{\cos \omega - \sqrt{(\cos^2 \omega - \cos^2 \phi)}}{\cos \omega + \sqrt{(\cos^2 \omega - \cos^2 \phi)}}$$

K _a	0.343
γ _{soil}	18
S _u	70
φ-friction °	30
α	8

H	1.90 m
D _s	0.50 m
S-spacing	1.00 m
P* = ΣF	19.2 kN

Try embedment length L **2.2** m

Reduction for spacing n=0.25S/D_s

n	0.5
f _o = 1.5D _s	0.75 m
f = {ΣF*y}/P*	0.67 m
f+f _o	1.42 m
f+L	2.9 m
L+2f+f _o	4.32 m

$$H_u = 9S_u * D_s [\sqrt{2}[(f+L)^2 + (f+f_o)^2] - (L+2f+f_o)]$$

H _u	38.6 kN
ΦH _u	19.3 kN

Find Maximum Bending Moment

$$g_c = (H_u/9S_u D_s) + f_o = 0.87 \text{ m}$$

$$BIA, M_{max} = H(f+f_o) + H_u/18S_u D_s = \mathbf{28.5} \text{ kNm}$$

M_{max}

Calculate Section bending capacity

For Square Pole ΦMn = ΦK₁K₈f_bZ where Z = bd²/6
 For Round Pole ΦMn = ΦK₁K₈K₂₀K₂₁f_bZ where Z = πd³/32

Φ	K ₁	K ₈	d	b	D @ G.L	Z x 10 ⁶	K ₂₀	K ₂₁	f _b	f _s
0.8	0.8	1	#N/A	#N/A	297 mm	2.58 mm ³	0.90	0.85	38.0 Mpa	3.1 Mpa

ΦMn **47.9** kNm

Bending Capacity O.K ✓

Calculate Section Shear capacity

For Square Pole ΦVn = ΦK₁K₄f_sAs Where As = 2bd/3
 For Round Pole ΦVn = ΦK₁K₄K₂₀K₂₁f_sAs Where As = (3πD²)/16

K ₂₀	As [mm ²]
1	52022

ΦVn **87.7** kN

Shear Capacity O.K ✓

Check rails capacity

$$W^* = (P_3 + P_4) * b = 2.6 \text{ kN/m}$$

$$M^* = W^* S^2 / 8 = \mathbf{0.3} \text{ kNm}$$

Average of lower 0.5m

b	d	f _b	K ₈	K ₄	Z = bd ² /6	ΦMn = ΦK ₁ K ₈ f _b Z
150	50	11.7	1	1	0.063	ΦMn 0.47 kNm

Continuous over 3 spans min.

Rail Capacity O.K ✓

$$W^* = (P_3 + P_4) * b = 2.1 \text{ kN/m}$$

$$M^* = W^* S^2 / 8 = \mathbf{0.3} \text{ kNm}$$

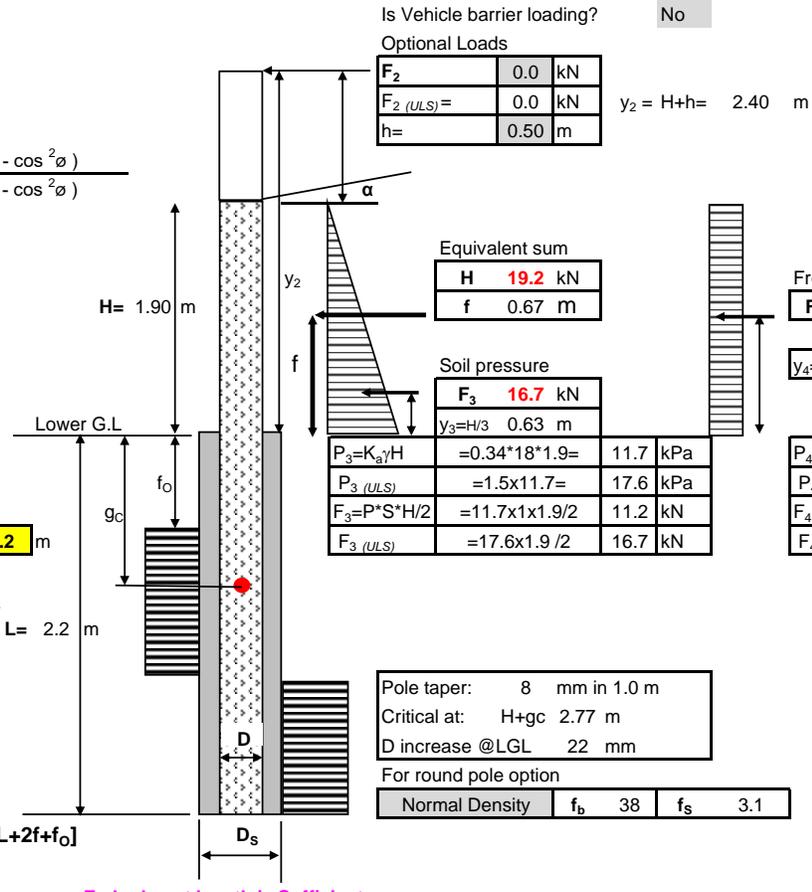
Average of lower 0.5m

b	dia	f _b	K ₂₀	K ₂₁	Z = πd ³ /32	ΦMn = ΦK ₁ K ₈ K ₂₀ K ₂₁ f _b Z
N/A	125	38.0	0.90	0.85	0.192	ΦMn 3.57 kNm

Rail Capacity O.K ✓

Summary

Use 275 mm H5 Pole @ 1 m c/c in a 0.50 m Hole Rails 150 x 50 mm



Is Vehicle barrier loading? No

Optional Loads	
F ₂	0.0 kN
F _{2 (ULS)}	0.0 kN
h	0.50 m

$$y_2 = H+h = 2.40 \text{ m}$$

Equivalent sum	
H	19.2 kN
f	0.67 m

Soil pressure	
F ₃	16.7 kN
y ₃ = H/3	0.63 m

P ₃ = K _a γH	= 0.34 * 18 * 1.9 =	11.7 kPa
P _{3 (ULS)}	= 1.5 * 11.7 =	17.6 kPa
F ₃ = P * S * H / 2	= 11.7 * 1 * 1.9 / 2	11.2 kN
F _{3 (ULS)}	= 17.6 * 1.9 / 2	16.7 kN

From Surcharge	
F ₄	2.45 kN

y ₄ = H/2	0.95 m
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P ₄ = K _a * W	0.9 kPa
P _{4 (ULS)}	1.3 kPa
F ₄ = P * S * H	1.6 kN
F _{4 (ULS)}	2.4 kN

Pole taper: 8 mm in 1.0 m
 Critical at: H+g_c 2.77 m
 D increase @ LGL 22 mm

For round pole option		
Normal Density	f _b 38	f _s 3.1

Embedment length is Sufficient

Timber retaining wall 2 m & 2.5 kPa Surcharge

TYPE **A** WALL: **2.5 kPa Surcharge**

Load factors

Soil	1.5
LL	1.5
Φ	0.5

Surcharge

W	2.5 kPa
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Soil Parameters

$$K_a = \cos \omega \times \frac{\cos \omega - \sqrt{(\cos^2 \omega - \cos^2 \phi)}}{\cos \omega + \sqrt{(\cos^2 \omega - \cos^2 \phi)}}$$

K _a	0.343
γ _{soil}	18
S _u	70
φ-friction °	30
α	8

H	2.00 m
D _s	0.50 m
S-spacing	1.00 m
P*=ΣF	21.1 kN

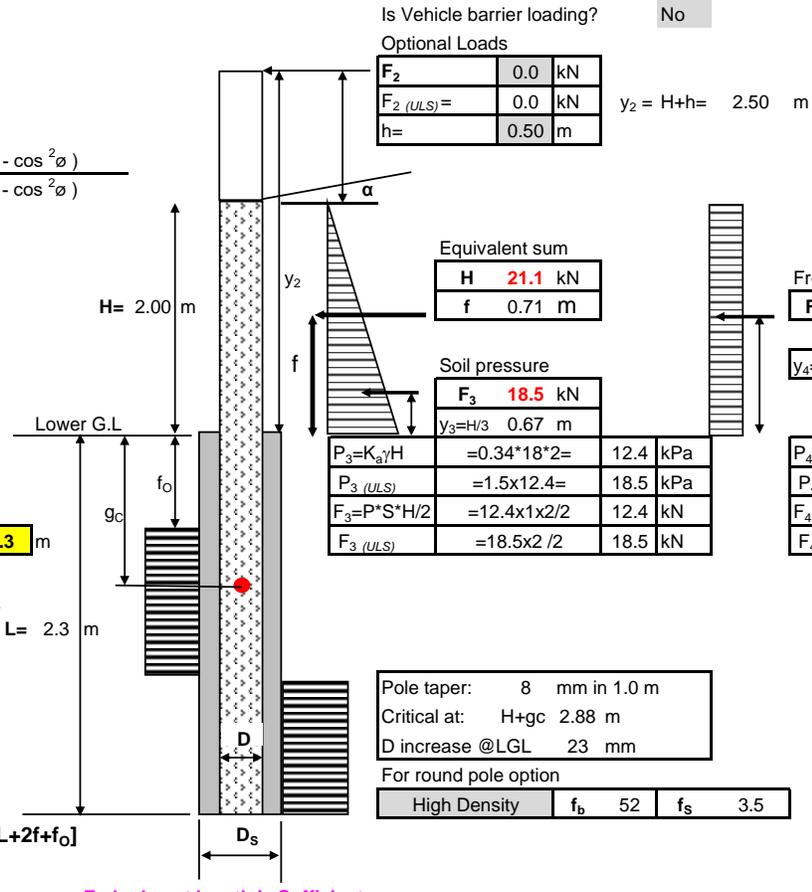
Try embedment length L **2.3** m

Reduction for spacing n=0.25S/D_s

n	0.5
f _o = 1.5D _s	0.75 m
f = {ΣF*y}/P*	0.71 m
f+f _o	1.46 m
f+L	3.04 m
L+2f+f _o	4.49 m

$$H_u = 9S_u * D_s [\sqrt{2[(f+L)^2 + (f+f_o)^2]} - (L+2f+f_o)]$$

H _u	42.4 kN
ΦH _u	21.2 kN



Embedment length is Sufficient

Find Maximum Bending Moment

$$g_c = (H_u/9S_u D_s) + f_o = 0.88 \text{ m}$$

$$BIA, M_{max} = H(f+f_o) + H_u/18S_u D_s = \mathbf{32.2} \text{ kNm}$$

M_{max}

Select pole type **Round** Select Section size **275**

Calculate Section bending capacity

For Square Pole ΦMn = ΦK₁K₈f_bZ where Z = bd²/6
For Round Pole ΦMn = ΦK₁K₈K₂₀K₂₁f_bZ where Z = πd³/32

Φ	K ₁	K ₈	d	b	D @ G.L	Z x 10 ⁶	K ₂₀	K ₂₁	f _b	f _s
0.8	0.8	1	#N/A	#N/A	298 mm	2.60 mm ³	0.90	0.85	52.0 Mpa	3.5 Mpa

ΦMn **66.2** kNm
Bending Capacity O.K ✓

Calculate Section Shear capacity

For Square Pole ΦVn = ΦK₁K₄f_sAs Where As = 2bd/3
For Round Pole ΦVn = ΦK₁K₄K₂₀K₂₁f_sAs Where As = (3πD²)/16

K ₂₀	As [mm ²]
1	52337

ΦVn **99.7** kN
Shear Capacity O.K ✓

Check rails capacity

W* = (P₃+P₄)*b = 2.7 kN/m
M* = W*S²/8 = **0.3** kNm
Average of lower 0.5m

b	d	f _b	K ₈	K ₄	Z=bd ² /6	ΦMn=ΦK ₁ K ₈ f _b Z
150	50	11.7	1	1	0.063	

Continuous over 3 spans min.
ΦMn **0.47** kNm
Rail Capacity O.K ✓

W* = (P₃+P₄)*b = 2.2 kN/m
M* = W*S²/8 = **0.3** kNm
Average of lower 0.5m

b	dia	f _b	K ₂₀	K ₂₁	Z=πd ³ /32	ΦMn=ΦK ₁ K ₈ K ₂₀ K ₂₁ f _b Z
N/A	125	38.0	0.90	0.85	0.192	

ΦMn **3.57** kNm
Rail Capacity O.K ✓

Summary Use **275 mm H5 Pole @ 1 m c/c in a 0.50 m Hole** Rails **150 x 50 mm**

Timber retaining wall 2.2 m & 2.5 kPa Surcharge

Load factors

Soil	1.5
LL	1.5
Φ	0.5

Surcharge

W	2.5 kPa
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Soil Parameters

$$K_a = \text{Cos}\omega \times \frac{\text{Cos}\omega - \sqrt{(\text{cos}^2\omega - \text{cos}^2\phi)}}{\text{Cos}\omega + \sqrt{(\text{cos}^2\omega - \text{cos}^2\phi)}}$$

K _a	0.343
γ _{soil}	18
S _u	70
φ-friction °	30
α	8

H	2.20	m
D _s	0.50	m
S-spacing	1.00	m
P*=ΣF	25.3	kN

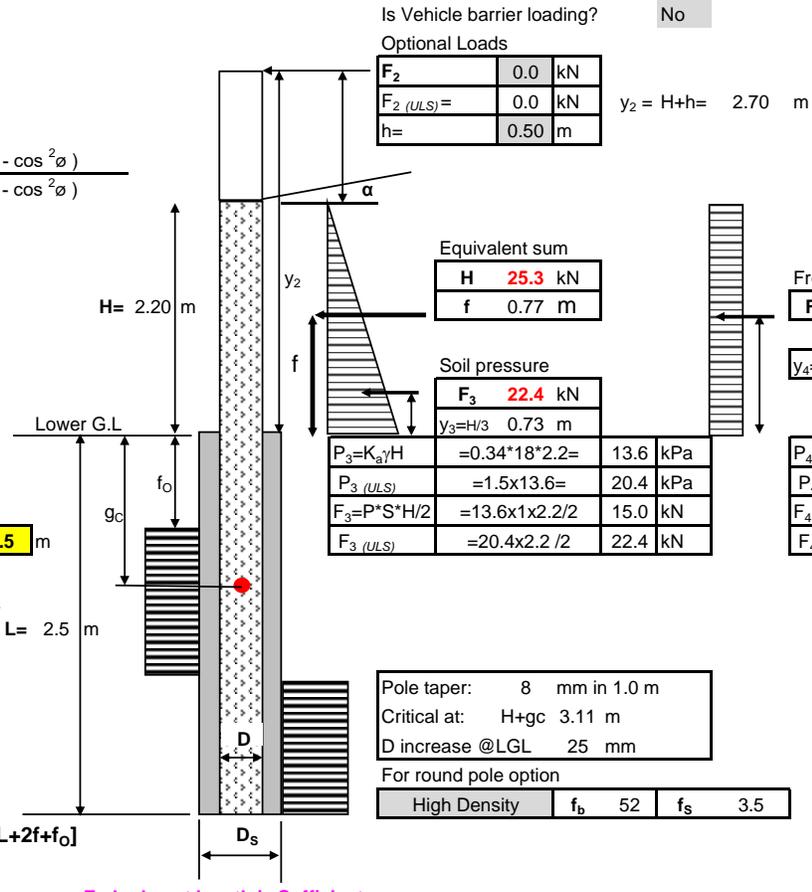
Try embedment length L **2.5** m

Reduction for spacing n=0.25S/D_s

n	0.5	
f _o = 1.5D _s	0.75	m
f = {ΣF*y}/P*	0.77	m
f+f _o	1.52	m
f+L	3.32	m
L+2f+f _o	4.85	m

$$H_u = 9S_u * D_s [\sqrt{2}[(f+L)^2 + (f+f_o)^2] - (L+2f+f_o)]$$

H _u	50.8	kN
ΦH _u	25.4	kN



Is Vehicle barrier loading? No

Optional Loads

F ₂	0.0	kN
F _{2 (ULS)}	0.0	kN
h	0.50	m

y₂ = H+h = 2.70 m

Equivalent sum

H	25.3	kN
f	0.77	m

Soil pressure

F ₃	22.4	kN
y ₃ =H/3	0.73	m

P ₃ =K _a γH	=0.34*18*2.2=	13.6	kPa
P _{3 (ULS)}	=1.5x13.6=	20.4	kPa
F ₃ =P*S*H/2	=13.6x1x2.2/2	15.0	kN
F _{3 (ULS)}	=20.4x2.2/2	22.4	kN

From Surcharge

F ₄	2.83	kN
----------------	------	----

y ₄ =H/2	1.10	m
---------------------	------	---

P ₄ =K _a *W	0.9	kPa
P _{4 (ULS)}	1.3	kPa
F ₄ =P*S*H	1.9	kN
F _{4 (ULS)}	2.8	kN

Pole taper: 8 mm in 1.0 m
 Critical at: H+g_c 3.11 m
 D increase @LGL 25 mm

For round pole option

High Density	f _b	52	f _s	3.5
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Embedment length is Sufficient

Find Maximum Bending Moment

$$BIA, M_{max} = H(f+f_o) + H_u/18S_uD_s$$

$$g_c = (H_u/9S_uD_s) + f_o = 0.91 \text{ m}$$

Select pole type **Round** Select Section size **275**

M_{max}

Calculate Section bending capacity

For Square Pole ΦMn = ΦK₁K₈f_bZ where Z = bd²/6
 For Round Pole ΦMn = ΦK₁K₈K₂₀K₂₁f_bZ where Z = πd³/32

Φ	K ₁	K ₈	d	b	D @ G.L	Z x 10 ⁶	K ₂₀	K ₂₁	f _b	f _s				
0.8	0.8	1	#N/A	#N/A	300	mm	2.65	mm ³	0.90	0.85	52.0	Mpa	3.5	Mpa

ΦMn	67.4	kNm
-----	------	-----

Bending Capacity O.K ✓

Calculate Section Shear capacity

For Square Pole ΦVn = ΦK₁K₄f_sAs Where As = 2bd/3
 For Round Pole ΦVn = ΦK₁K₄K₂₀K₂₁f_sAs Where As = (3πD²)/16

K ₂₀	As [mm ²]
1	52975

ΦVn	100.9	kN
-----	-------	----

Shear Capacity O.K ✓

Check rails capacity

$$W^* = (P_3 + P_4) * b = 2.9 \text{ kN/m}$$

$$M^* = W^* S^2 / 8 = 0.4 \text{ kNm}$$

Average of lower 0.5m

b	d	f _b	K ₈	K ₄	Z=bd ² /6	ΦMn=ΦK ₁ K ₈ f _b Z
150	100	11.7	1	1	0.250	

Continuous over 3 spans min.

ΦMn	1.87	kNm
-----	------	-----

Rail Capacity O.K ✓

$$W^* = (P_3 + P_4) * b = 2.5 \text{ kN/m}$$

$$M^* = W^* S^2 / 8 = 0.3 \text{ kNm}$$

Average of lower 0.5m

b	dia	f _b	K ₂₀	K ₂₁	Z=πd ³ /32	ΦMn=ΦK ₁ K ₈ K ₂₀ K ₂₁ f _b Z
N/A	125	38.0	0.90	0.85	0.192	

ΦMn	3.57	kNm
-----	------	-----

Rail Capacity O.K ✓

Summary Use 275 mm H5 Pole @ 1 m c/c in a 0.50 m Hole Rails 150 x 100 mm

Timber retaining wall 2.4 m & 2.5 kPa Surcharge

TYPE **A** WALL: **2.5 kPa Surcharge**

Load factors

Soil	1.5
LL	1.5
Φ	0.5

Surcharge

W	2.5 kPa
---	---------

Soil Parameters

$$K_a = \text{Cos}\omega \times \frac{\text{Cos}\omega - \sqrt{(\text{cos}^2\omega - \text{cos}^2\phi)}}{\text{Cos}\omega + \sqrt{(\text{cos}^2\omega - \text{cos}^2\phi)}}$$

K _a	0.343
γ _{soil}	18
S _u	70
φ-friction °	30
α	8

H	2.40 m
D _s	0.50 m
S-spacing	1.00 m
P*=ΣF	29.8 kN

Try embedment length L **2.8 m**

Reduction for spacing n=0.25S/D_s

n	0.5
f _o = 1.5D _s	0.75 m
f = {ΣF*y}/P*	0.84 m
f+f _o	1.59 m
f+L	3.62 m
L+2f+f _o	5.21 m

$$H_u = 9S_u * D_s [\sqrt{2}[(f+L)^2 + (f+f_o)^2] - (L+2f+f_o)]$$

H _u	59.8 kN
ΦH _u	29.9 kN

Find Maximum Bending Moment

$$g_c = (H_u/9S_u D_s) + f_o = 0.94 \text{ m}$$

$$BIA, M_{max} = H(f+f_o + H_u/18S_u D_s) = 50.3 \text{ kNm}$$

M_{max}

Calculate Section bending capacity

For Square Pole ΦMn = ΦK₁K₈f_bZ where Z = bd²/6
For Round Pole ΦMn = ΦK₁K₈K₂₀K₂₁f_bZ where Z = πd³/32

Φ	K ₁	K ₈	d	b	D @ G.L	Z x 10 ⁶	K ₂₀	K ₂₁	f _b	f _s
0.8	0.8	1	#N/A	#N/A	327 mm	3.42 mm ³	0.90	0.85	52.0 Mpa	3.5 Mpa

ΦMn **87.2 kNm**

Bending Capacity O.K ✓

Calculate Section Shear capacity

For Square Pole ΦVn = ΦK₁K₄f_sAs Where As = 2bd/3
For Round Pole ΦVn = ΦK₁K₄K₂₀K₂₁f_sAs Where As = (3πD²)/16

K ₂₀	As [mm ²]
1	62878

ΦVn **119.7 kN**

Shear Capacity O.K ✓

Check rails capacity

$$W^* = (P_3 + P_4) * b = 3.2 \text{ kN/m}$$

$$M^* = W^* S^2 / 8 = 0.4 \text{ kNm}$$

Average of lower 0.5m

$$W^* = (P_3 + P_4) * b = 2.7 \text{ kN/m}$$

$$M^* = W^* S^2 / 8 = 0.3 \text{ kNm}$$

Average of lower 0.5m

b	d	f _b	K ₈	K ₄	Z = bd ² /6	ΦMn = ΦK ₁ K ₈ f _b Z
150	100	11.7	1	1	0.250	ΦMn 1.87 kNm

Continuous over 3 spans min.

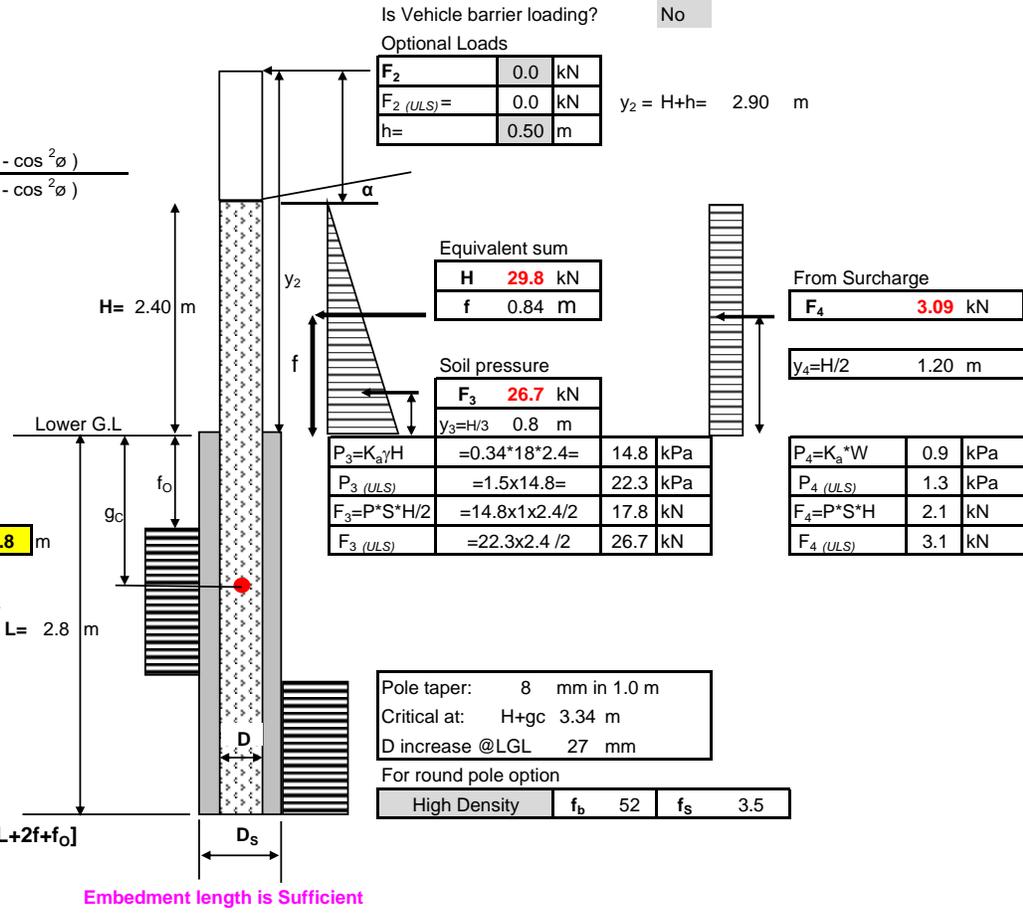
Rail Capacity O.K ✓

b	dia	f _b	K ₂₀	K ₂₁	Z = πd ³ /32	ΦMn = ΦK ₁ K ₈ K ₂₀ K ₂₁ f _b Z
N/A	125	38.0	0.90	0.85	0.192	ΦMn 3.57 kNm

Rail Capacity O.K ✓

Summary

Use 300 mm H5 Pole @ 1 m c/c in a 0.50 m Hole Rails 150 x 100 mm



Is Vehicle barrier loading? **No**

Optional Loads

F ₂	0.0 kN
F _{2 (ULS)}	0.0 kN
h	0.50 m

$$y_2 = H+h = 2.90 \text{ m}$$

Equivalent sum

H	29.8 kN
f	0.84 m

Soil pressure

F ₃	26.7 kN
y ₃ =H/3	0.8 m

P ₃ = K _a γH	= 0.34 * 18 * 2.4 =	14.8 kPa
P _{3 (ULS)}	= 1.5 * 14.8 =	22.3 kPa
F ₃ = P * S * H / 2	= 14.8 * 1 * 2.4 / 2 =	17.8 kN
F _{3 (ULS)}	= 22.3 * 2.4 / 2 =	26.7 kN

From Surcharge

F ₄	3.09 kN
----------------	---------

$$y_4 = H/2 = 1.20 \text{ m}$$

P ₄ = K _a * W	0.9 kPa
P _{4 (ULS)}	1.3 kPa
F ₄ = P * S * H	2.1 kN
F _{4 (ULS)}	3.1 kN

Pole taper: 8 mm in 1.0 m
Critical at: H+g_c 3.34 m
D increase @ LGL 27 mm

For round pole option

High Density	f _b	f _s
	52	3.5

Embedment length is Sufficient

Timber retaining wall 2.6 m & 2.5 kPa Surcharge

Load factors

Soil	1.5
LL	1.5
Φ	0.5

Surcharge

W	2.5 kPa
---	---------

Soil Parameters

$$K_a = \text{Cos}\omega \times \frac{\text{Cos}\omega - \sqrt{(\text{cos}^2\omega - \text{cos}^2\phi)}}{\text{Cos}\omega + \sqrt{(\text{cos}^2\omega - \text{cos}^2\phi)}}$$

K _a	0.343
γ _{soil}	18
S _u	70
φ-friction °	30
α	8

H	2.60 m
D _s	0.50 m
S-spacing	1.00 m
P*=ΣF	34.7 kN

Try embedment length L **3.0 m**

Reduction for spacing n=0.25S/D_s

n	0.5
f _o = 1.5D _s	0.75 m
f = {ΣF*y}/P*	0.91 m
f+f _o	1.658 m
f+L	3.923 m
L+2f+f _o	5.581 m

$$H_u = 9S_u * D_s [\sqrt{2[(f+L)^2 + (f+f_o)^2]} - (L+2f+f_o)]$$

H _u	69.6 kN
ΦH _u	34.8 kN

Find Maximum Bending Moment

$$g_c = (H_u/9S_u D_s) + f_o = 0.97 \text{ m}$$

$$\text{BIA, } M_{max} = H(f+f_o) + H_u/18S_u D_s \quad \mathbf{61.4 \text{ kNm}}$$

M_{max}

Calculate Section bending capacity

For Square Pole ΦMn = ΦK₁K₈f_bZ where Z = bd²/6
 For Round Pole ΦMn = ΦK₁K₈K₂₀K₂₁f_bZ where Z = πd³/32

Φ	K ₁	K ₈	d	b	D @ G.L	Z x 10 ⁶	K ₂₀	K ₂₁	f _b	f _s
0.8	0.8	1	#N/A	#N/A	354 mm	4.34 mm ³	0.90	0.85	38.0 Mpa	3.1 Mpa

ΦMn **80.7 kNm**
Bending Capacity O.K ✓

Calculate Section Shear capacity

For Square Pole ΦVn = ΦK₁K₄f_sAs Where As = 2bd/3
 For Round Pole ΦVn = ΦK₁K₄K₂₀K₂₁f_sAs Where As = (3πD²)/16

K ₂₀	As [mm ²]
1	73637

ΦVn **124.2 kN**
Shear Capacity O.K ✓

Check rails capacity

$$W^* = (P_3 + P_4) * b \quad 3.4 \text{ kN/m}$$

$$M^* = W^* S^2 / 8 = \mathbf{0.4 \text{ kNm}}$$

Average of lower 0.5m

b	d	f _b	K ₈	K ₄	Z = bd ² /6	ΦMn = ΦK ₁ K ₈ f _b Z
150	100	11.7	1	1	0.250	ΦMn 1.87 kNm

Continuous over 3 spans min.
ΦMn **1.87 kNm**
Rail Capacity O.K ✓

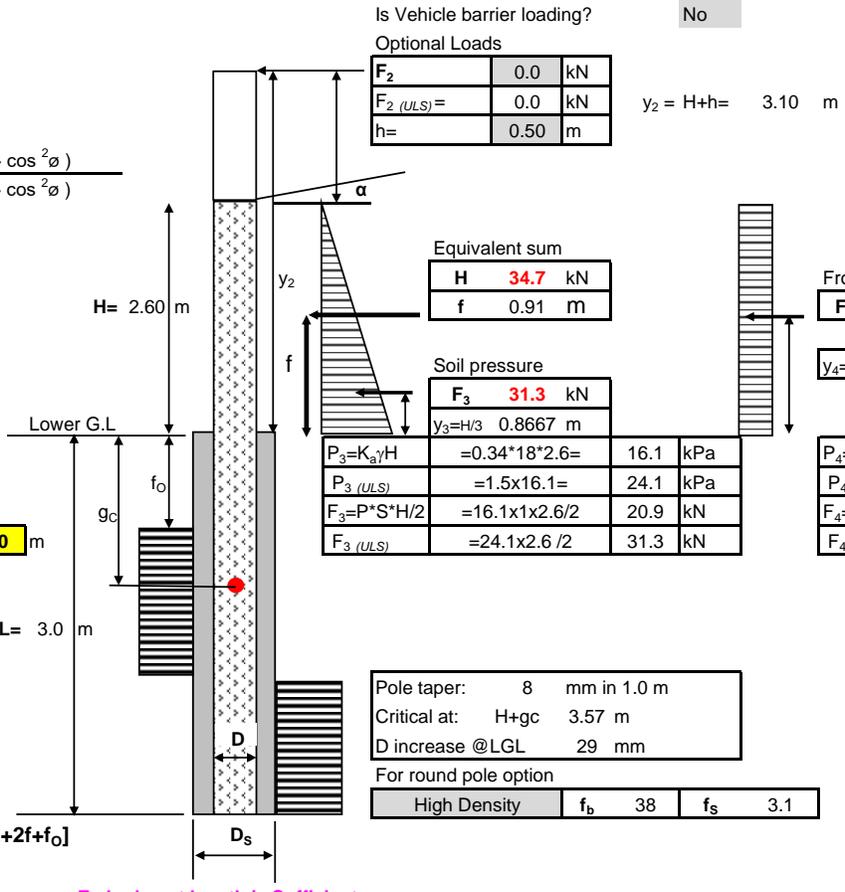
$$W^* = (P_3 + P_4) * b \quad 3.4 \text{ kN/m}$$

$$M^* = W^* S^2 / 8 = \mathbf{0.4 \text{ kNm}}$$

Average of lower 0.5m

b	dia	f _b	K ₂₀	K ₂₁	Z = πd ³ /32	ΦMn = ΦK ₁ K ₈ K ₂₀ K ₂₁ f _b Z
N/A	150	38.0	0.90	0.85	0.331	ΦMn 6.16 kNm

ΦMn **6.16 kNm**
Rail Capacity O.K ✓



Is Vehicle barrier loading? **No**

Optional Loads

F ₂	0.0 kN
F _{2 (ULS)}	0.0 kN
h	0.50 m

y₂ = H+h = 3.10 m

Equivalent sum

H	34.7 kN
f	0.91 m

Soil pressure

F ₃	31.3 kN
y ₃ = H/3	0.8667 m
P ₃ = K _a γH	= 0.34 * 18 * 2.6 = 16.1 kPa
P _{3 (ULS)}	= 1.5 * 16.1 = 24.1 kPa
F ₃ = P * S * H / 2	= 16.1 * 1 * 2.6 / 2 = 20.9 kN
F _{3 (ULS)}	= 24.1 * 2.6 / 2 = 31.3 kN

From Surcharge

F ₄	3.35 kN
y ₄ = H/2	1.30 m

P ₄ = K _a * W	0.9 kPa
P _{4 (ULS)}	1.3 kPa
F ₄ = P * S * H	2.2 kN
F _{4 (ULS)}	3.3 kN

Pole taper: 8 mm in 1.0 m
 Critical at: H+g_c 3.57 m
 D increase @ LGL 29 mm

For round pole option

High Density	f _b	f _s
	38	3.1

Embedment length is Sufficient

Summary Use 325 mm H5 Pole @ 1 m c/c in a 0.50 m Hole Rails 150 x 100 mm



Project Name:	Date:
Project No:	Revision:
Author:	Sheet No.

TYPE A WALL: 2.5 kPa Surcharge

APPROVED

Timber retaining wall 2.8 m & 2.5 kPa Surcharge

Load factors

Soil	1.5
LL	1.5
Φ	0.5

Surcharge

W	2.5 kPa
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Soil Parameters

$$K_a = \text{Cos}\omega \times \frac{\text{Cos}\omega - \sqrt{(\text{cos}^2\omega - \text{cos}^2\phi)}}{\text{Cos}\omega + \sqrt{(\text{cos}^2\omega - \text{cos}^2\phi)}}$$

K _a	0.343
γ _{soil}	18
S _u	70
φ-friction °	30
α	8

H	2.80 m
D _s	0.50 m
S-spacing	1.00 m
P*=ΣF	40.0 kN

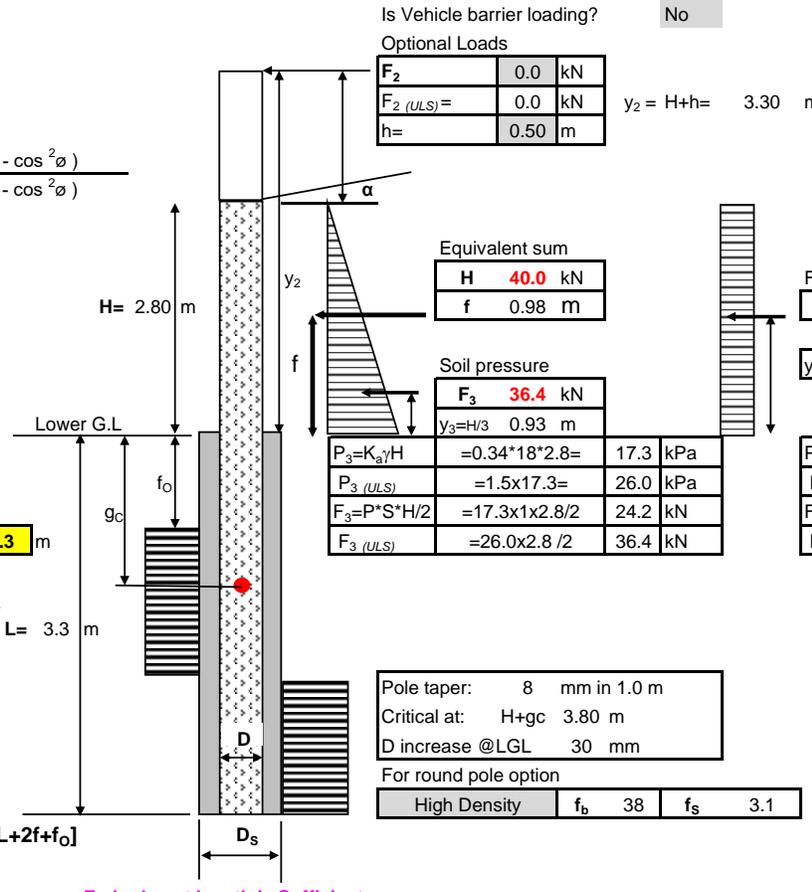
Try embedment length L **3.3 m**

Reduction for spacing n=0.25S/D_s

n	0.5
f _o = 1.5D _s	0.75 m
f = {ΣF*y}/P*	0.98 m
f+f _o	1.73 m
f+L	4.24 m
L+2f+f _o	5.97 m

$$H_u = 9S_u * D_s [\sqrt{2[(f+L)^2 + (f+f_o)^2]} - (L+2f+f_o)]$$

H _u	80.1 kN
ΦH _u	40.1 kN



Is Vehicle barrier loading?	No
Optional Loads	
F ₂	0.0 kN
F _{2 (ULS)}	0.0 kN
h	0.50 m

Equivalent sum	
H	40.0 kN
f	0.98 m

Soil pressure	
F ₃	36.4 kN
y ₃ =H/3	0.93 m

P ₃ =K _a γH	=0.34*18*2.8=	17.3 kPa
P _{3 (ULS)}	=1.5x17.3=	26.0 kPa
F ₃ =P*S*H/2	=17.3x1x2.8/2	24.2 kN
F _{3 (ULS)}	=26.0x2.8/2	36.4 kN

From Surcharge	
F ₄	3.61 kN
y ₄ =H/2	1.40 m

P ₄ =K _a *W	0.9 kPa
P _{4 (ULS)}	1.3 kPa
F ₄ =P*S*H	2.4 kN
F _{4 (ULS)}	3.6 kN

Pole taper: 8 mm in 1.0 m
Critical at: H+g_c 3.80 m
D increase @LGL 30 mm

For round pole option		
High Density	f _b 38	f _s 3.1

Embedment length is Sufficient

Find Maximum Bending Moment

$$BIA, M_{max} = H(f+f_o + H_u/18S_uD_s) \quad \mathbf{74.0 \text{ kNm}}$$

$$g_c = (H_u/9S_uD_s) + f_o = 1.00 \text{ m}$$

Select pole type **Round** Select Section size **325**

M_{max}

Calculate Section bending capacity

For Square Pole ΦMn = ΦK₁K₈f_bZ where Z = bd²/6
For Round Pole ΦMn = ΦK₁K₈K₂₀K₂₁f_bZ where Z = πd³/32

Φ	K ₁	K ₈	d	b	D @ G.L	Z x 10 ⁶	K ₂₀	K ₂₁	f _b	f _s
0.8	0.8	1	#N/A	#N/A	355 mm	4.41 mm ³	0.90	0.85	38.0 Mpa	3.1 Mpa

ΦMn **82.0 kNm**
Bending Capacity O.K ✓

Calculate Section Shear capacity

For Square Pole ΦVn = ΦK₁K₄f_sAs Where As = 2bd/3
For Round Pole ΦVn = ΦK₁K₄K₂₀K₂₁f_sAs Where As = (3πD²)/16

K ₂₀	As [mm ²]
1	74417

ΦVn **125.5 kN**
Shear Capacity O.K ✓

Check rails capacity

$$W^* = (P_3 + P_4) * b \quad 3.7 \text{ kN/m}$$

$$M^* = W^* S^2 / 8 = \mathbf{0.5 \text{ kNm}}$$

Average of lower 0.5m

b	d	f _b	K ₈	K ₄	Z = bd ² /6	ΦMn = ΦK ₁ K ₈ f _b Z
150	100	11.7	1	1	0.250	ΦMn 1.87 kNm

Continuous over 3 spans min.

Rail Capacity O.K ✓

$$W^* = (P_3 + P_4) * b \quad 3.1 \text{ kN/m}$$

$$M^* = W^* S^2 / 8 = \mathbf{0.4 \text{ kNm}}$$

Average of lower 0.5m

b	dia	f _b	K ₂₀	K ₂₁	Z = πd ³ /32	ΦMn = ΦK ₁ K ₈ K ₂₀ K ₂₁ f _b Z
N/A	125	38.0	0.90	0.85	0.192	ΦMn 3.57 kNm

Rail Capacity O.K ✓

Summary	Use	325 mm H5 Pole @	1 m c/c in a	0.50 m Hole	Rails	150 x 100 mm
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Retaining Wall Design - Free Top

Wall Properties:

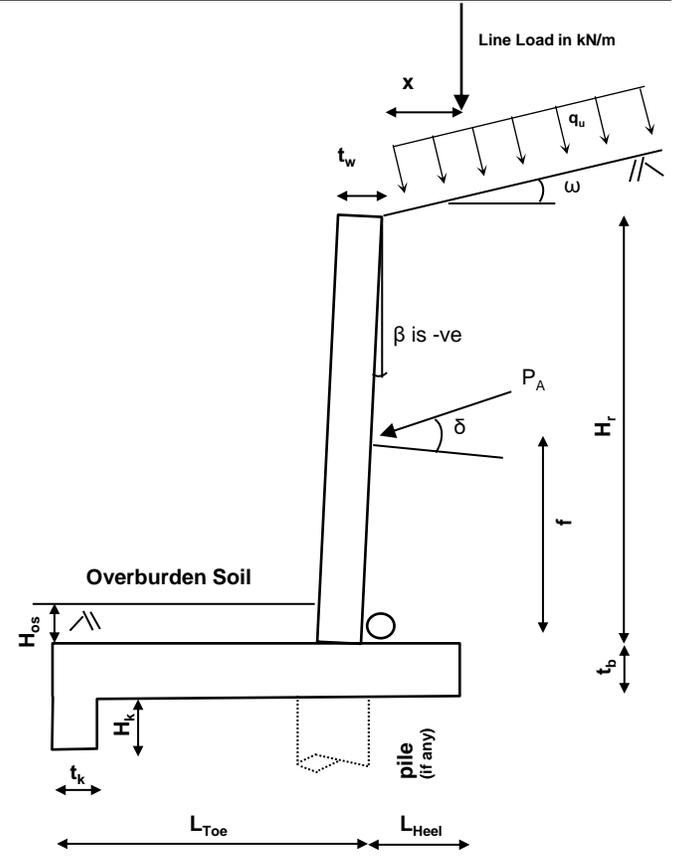
Wall Type	Block
Wall density	22.0 kN/m ³
Wall Slope	β 0.0 deg
Retained Height	H_r 2.75 m
Wall Thickness	t_w 0.24 m
Base Thickness	t_b 0.30 m
Key Depth	H_k 0.00 m
Key Thickness	t_k 0.00 m
Heel Length	L_{heel} 0.20 m
Toe Length	L_{toe} 2.30 m
Shear key pile dia.	d 0.40 m
Shear key pile depth	D 1.00 m
Shear key pile spacing	s 1.00 m
Lower slab available?	Yes

Reinforcement Properties:

Wall Vertical Bar	500 Mpa
Wall Horizontal Bar	500 Mpa
Base Main Bar	500 Mpa

Soil Properties:

Density of soil	γ 18.0 kN/m ³
Angle of shearing resistance	Φ 30.0 deg
Angle of wall friction	δ 0.0 deg
Backfill slope	ω 10.0 deg
Ultimate Soil Bearing	Q_{ult} 300 kPa
Dependable Soil Bearing	Q_{dep} 150 kPa
Overburden soil	H_{os} 0.00 m
Soil undrained shear strength	S_u 70 kPa



L_{toe} is dist from toe end to wall edge not key
 t_k better to be equal to t_w

Loadings:

Load Factors	α_{EP_static}	1.5
	α_{G_stab}	0.9
	α_{G_destab}	1.2
	Φ_{SL}	0.8
	Φ_{bc}	0.5
	Φ_p	0.5
Surcharge	q_u	1.5 kPa
Line Load	Q_l	0.0 kN/m
Line Load Distance from wall	x_l	0.0 m
Line Load Lever Arm (to footing)	$L_{lineload}$	2.68 m
Line Load Resultant Force	P_{HL}	0.00 kN

Amplification factor for earth pressure, gravity case (de-stabilising)
 Reduction Factor factor for gravity (Stabilising)
 Amplification Load factor for gravity (de-stabilising)
 Reduction Factor for sliding capacity, gravity case
 Reduction Factor for soil bearing capacity
 Reduction Factor for passive earth pressure, gravity case

Design Actions:

Active Soil Pressure Coefficient	K_0	0.52
Passive Soil Pressure Coefficient	K_p	4.08
Active Soil Force	P^*_A	56.8 kN per linear m

At Rest including additional surcharge due to back slope
 (Coulomb Theory)

Retaining Wall Design - Free Top

Resolved Horizontal Force	P^*_{AH}	56.8 kN per linear m
Resolved Vertical Force	P^*_{AV}	0.00 kN per linear m
Location of Active Thrust	f	0.94 m to the footing top surface

Wall Bending:

Bending Moment

at BASE of wall	53.5 kNm/m
at 0.60 m above base	26.2 kNm/m

Concrete cover $c=$ 70 mm (from back)

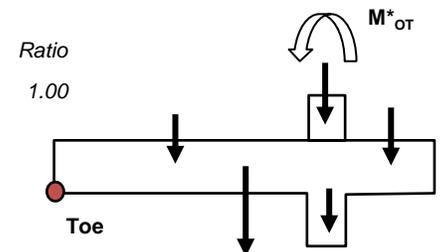
Vertical Reinforcement	Φ_b	0.85	Wall thickness	0.24 m
	f_y	500 Mpa	d_w	0.17 m
	f_c	12 Mpa	β_1	0.85
	$A_{s,bal}$	1205.9 mm ² /m	$A_{s,min}$	238 mm ² /m

Base of Wall (Starter bars)	Use	HD	16 @	200 mm c/c	
	$A_{s,prov}$	=	1005.3 mm ² /m		OK
	ΦM_n	=	62.1 kNm/m		OK

0.60 m above base (Vertical bars)	Use	HD	12 @	200 mm c/c	
	$A_{s,prov}$	=	565.5 mm ² /m		OK
	ΦM_n	=	37.5 kNm/m		OK

Footing Overturning Stability:

Counter weight	W_{wall}	=	14.5 kN/m	W_{key}	=	0.0 kN/m
	W_{base}	=	18.0 kN/m	$W_{soil Heel}$	=	9.9 kN/m
	P^*_{AV}	=	0.00 kN/m	$W_{soil Toe}$	=	0.0 kN/m
	Q_{uheel}	=	0.3 kN/m	W_{extra}	=	0 kN/m
	ΣW_{total}	=	42.7 kN/m			
Overturning about Toe	M^*_{OT}	=	70.6 kNm/m			
Restoring about Toe	M^*_{RES}	=	70.8 kNm/m			OK



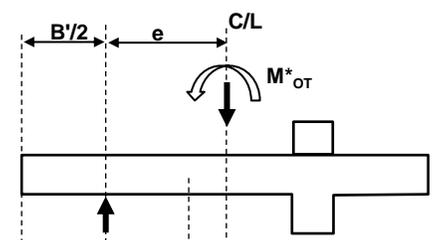
(assume mini slab width $B=$ 2.0 m)

Footing Sliding Stability:

Sliding force	=	56.8 kN	
Base friction = $\phi_{SL} \cdot \tan(2/3 \phi) W_s$	=	12.4 kN	
Base Cohesion = $\phi_{SL} \cdot 0.5 S_u \cdot B'$	=	41.4 kN	
Lower slab Cohesion = $\phi_{SL} \cdot 0.5 S_u \cdot B'$	=	56.0 kN	
Passive soil	=	1.2 kN	$K_p= 3.0$
Shear key pile	=	12.0 kN	
		<u>110.6 kN</u>	OK

Soil Bearing:

M_{OT} about Base C/L	M^*_{OT}	=	21.8 kNm/m	OK
Eccentricity	e	=	0.51 m	OK
Soil bearing length	B'	=	1.48 m	
Soil ultimate bearing	p^*	=	28.9 kPa	OK
Uniform across the bearing length				



Footing Bending: (starter bent into base)

Retaining Wall Design - Free Top

Bending at wall edge $M^*_b = 53.5 \text{ kN/m}$

$\Phi_b = 0.85$ for concrete $t_{base} = 0.3 \text{ m}$

$f_y = 500 \text{ Mpa}$ $dw = 0.225 \text{ m}$ 75 mm cover

$f_c = 20 \text{ Mpa}$ $\beta_1 = 0.85$

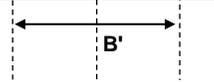
$A_{s,bal} = 2660.1 \text{ mm}^2/\text{m}$

Use HD 16 @ 200 mm c/c

$A_{s,prov} = 1005 \text{ mm}^2/\text{m}$

$\Phi M_n = 89.8 \text{ kNm/m}$

OK



Retaining Wall Design - Propped Cantilever

Wall Properties:

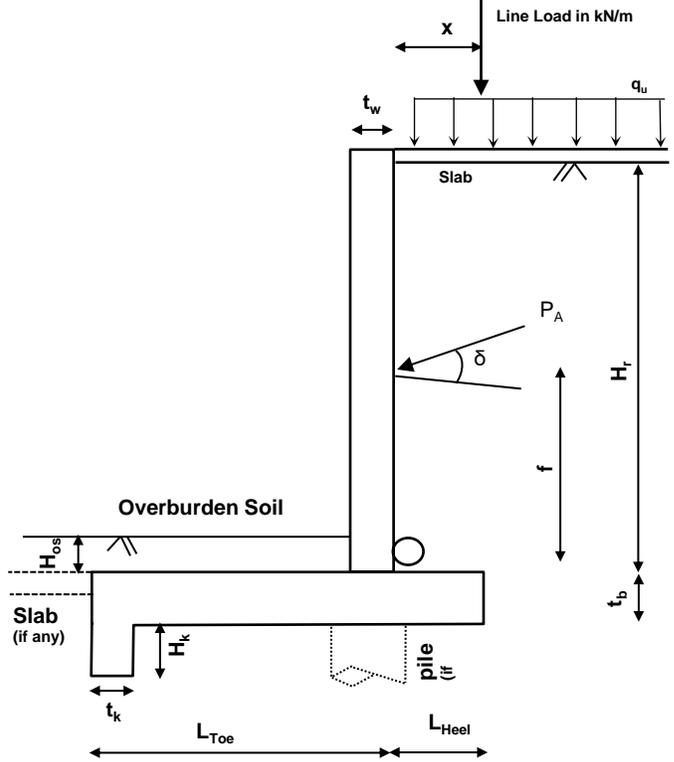
Wall Type		Block
Wall density		22.0 kN/m ³
Retained Height	H _r	2.75 m
Wall Thickness	t _w	0.24 m
Base Thickness	t _b	0.30 m
Key Depth	H _k	0.00 m
Key Thickness	t _k	0.00 m
Heel Length	L _{heel}	0.20 m
Toe Length	L _{toe}	2.00 m
Shear key pile dia.	d	0.00 m
Shear key pile depth	D	0.00 m
Shear key pile spacing	s	0.00 m
Lower slab available?		Yes

Reinforcement Properties:

Wall Vertical Bar	500 Mpa
Wall Horizontal Bar	500 Mpa
Base Main Bar	500 Mpa

Soil Properties:

Density of soil	γ	18.0 kN/m ³
Angle of shearing resistance	Φ	30.0 deg
Angle of wall friction	δ	0.0 deg
Ultimate Soil Bearing	Q _{ult}	300 kPa
Dependable Soil Bearing	Q _{dep}	150 kPa
Overburden soil	H _{os}	0.00 m
Soil undrained shear strength	S _u	70 kPa



L_{toe} is dist from toe end to wall edge not key
 t_k better to be equal to t_w

Loadings:

Load Factor for static	α _{EP_static}	1.5	Amplification factor for earth pressure, gravity case (de-stabilising)
	α _{G_stab}	0.9	Reduction Factor factor for gravity (Stabilising)
	α _{G_destab}	1.2	Amplification Load factor for gravity (de-stabilising)
	Φ _{SL}	0.8	Reduction Factor for sliding capacity, gravity case
	Φ _{bc}	0.5	Reduction Factor for soil bearing capacity
	Φ _p	0.5	Reduction Factor for passive earth pressure, gravity case
Surcharge	q _u	2.5 kPa	
Line Load	Q _l	0.0 kN/m	
Line Load Distance from wall	x _l	0.0 m	
Line Load Lever Arm (to footing)	L _{lineload}	2.68 m	(Boussinesq equation modified after Terzaghi)
Line Load Resultant Force	P _{HL}	0.00 kN	

Design Actions:

Active Soil Pressure Coefficient	K ₀	0.50	At Rest
Passive Soil Pressure Coefficient	K _p	3.00	
Active Soil Force on wall	P* _A	56.20 kN per linear m	(Coulomb Theory)
Resolved Horizontal Force	P* _{AH}	56.20 kN per linear m	

Retaining Wall Design - Propped Cantilever

Resolved Vertical Force	P_{AV}^*	0.00 kN per linear m
Sliding force at base	P_{SL}^*	44.06 kN per linear m

Wall Bending:

Bending Moment

at base of wall	20.5 kNm/m	(maximum negative moment)
at 1.51 m from bottom	9.3 kNm/m	(maximum positive moment)
Concrete cover $c=$	70 mm	(from back)

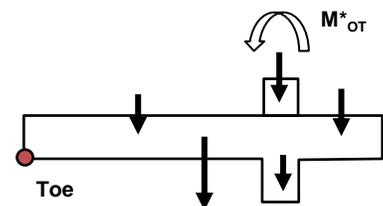
Vertical Reinforcement	Φ_b	0.85	Wall thickness	0.24 m
	f_y	500 Mpa	d_w	0.162 m
	f_c	12 Mpa	β_1	0.85
	$A_{s,bal}$	1149.2 mm ² /m	$A_{s,min}$	226.8 mm ² /m

Base of Wall	Use	HD	16 @	400 mm c/c	
(Starter bars)	$A_{s,prov}$	=	502.7 mm ² /m		OK
	ΦM_n	=	32.0 kNm/m		OK

Vertical bars centrally placed			d_w	0.12 m	
at 1.51 m height	Use	HD	12 @	400 mm c/c	
(Vertical bars)	$A_{s,prov}$	=	282.7 mm ² /m		OK
	ΦM_n	=	13.6 kNm/m		OK

Footing Overturning Stability:

Counter weight	W_{wall}	=	14.5 kN/m	W_{key}	=	0.0 kN/m
	W_{base}	=	15.8 kN/m	$W_{soil Heel}$	=	9.9 kN/m
	P_{AV}^*	=	0.00 kN/m	$W_{soil Toe}$	=	0.0 kN/m
	Q_{uheel}	=	0.5 kN/m	W_{extra}	=	0 kN/m
	ΣW_{total}	=	40.8 kN/m			
Overturning about Toe	M_{OT}^*	=	27.0 kN/m	Ratio		
Restoring about Toe	M_{RES}^*	=	59.9 kN/m	2.22		

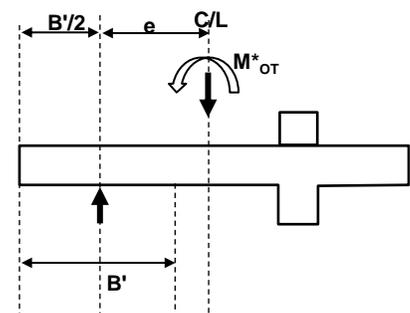

Footing Sliding Stability:

Sliding force =	44.1 kN	
Base friction = $\phi_{SL} \cdot \tan(2/3 \phi) W_s$ =	11.9 kN	
Base Cohesion = $\phi_{SL} \cdot 0.5 S_u \cdot B'$ =	45.1 kN	
Lower slab Cohesion = $\phi_{SL} \cdot 0.5 S_u \cdot B'$ =	56.0 kN	
Passive soil =	1.2 kN	$K_p = 3.0$
Shear key pile =	0.0 kN	
	<u>102.4 kN</u>	OK

 (assume mini slab width $B = 2.0$ m)

Soil Bearing:

M_{OT} about Base C/L	M_{OT}^*	=	11.98 kN/m	OK
Eccentricity	e	=	0.29 m	OK
Soil bearing length	B'	=	1.61 m	OK
Soil ultimate bearing	p^*	=	25.28 kPa	OK
			Uniform across the bearing length	


Footing Bending:

Bending at wall edge	M_b^*	=	20.5 kN/m
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K DESIGN GROUP LTD

Project Name: nson St, Tuakau, Waikato

Date:

Project No: 220952

Revision:

Author: AY

Sheet No.

Waikato District Council

April 2022

Building Consent Number

BLD2096/22

APPROVED

Retaining Wall Design - Propped Cantilever

Φ_b	0.85 for concrete	t_{base}	0.3 m	
f_{yf}	500 Mpa	d_f	0.225 m	75 mm cover
f_{cf}	20 Mpa	β_{1f}	0.85	
$A_{s,bal}$	2660 mm ² /m			

Use	HD	12 @	400 mm c/c	$A_{s,prov} =$	282.74 mm ² /m	
				$\Phi M_n =$	26.5 kNm/m	OK



Fabricator / Designer Statement

Job Ref:

20382
APPROVED

Waikato District Council
Building Consent Number
Date: 30-03-2022
Ver: 1.5
BLD 2096/22

This statement may be used by the Building Consent Authority for compliance purposes and is issued by a licensed truss fabricator using the Pryda Build software.

CLIENT Name: *LW Architecture Ltd*

SITE Details:

Address : 22 Johnson Street
Tuakau, Waikato

Nominal Design Criteria:

- Design working life: 50 years
- Building importance: Residential (Importance Level 2)
- Roofing: American shingles on 15mm ply (20.0 kg/sq.m)
- Ceiling: 10mm Gib-board (6.8 kg/sq.m)
- Top chord battens: 600 mm
- BC restraints: Battens at 400 mm crs
- Standard truss spacing: 900 mm
- Standard roof pitch: 22.50 deg.
- Ult. design wind speed: 44 m/s (wind classification = High)
- Max. eaves height: 6 m
- Max. ridge height: 8 m
- Int pressure coeff. up: 0.2
- Overhang Condition: No fascia

- Design roof snow load: 0 Pa (incl. probability factor)
- Ground snow load: 0 Pa
- Location: Region N0 - upper Nth Island
- Altitude above sea level: 100 m

The correctness of the Design Criteria used by the Pryda Build truss design software is the responsibility of the fabricator.

Note : Where relevant, a structural fascia beam is required at all hip and dutch hip corners to support the short creeper/rafter overhangs, as shown in AS4440-2004

Note: This statement must be read in conjunction with the truss layout and detail sheets.

Note: Some trusses in this job support ceiling materials that are different to this nominal data (see individual truss detail sheets).

Note: The Structural Timber products supplied in this building stores approximately '1000' kg of carbon.

All truss designs and their connections have been designed using Pryda design software. Additional items such as roof/ceiling plane bracing, special notes, supplementary timber, etc., which may be shown on the plan drawings are the responsibility of others.

All trusses have been manufactured in accordance with the fabrication specifications provided by Pryda, and shall be installed, connected and braced in accordance with the recommendations given in - : AS4440:2004 "Installation of nailplated timber roof trusses" and any other supplementary details that may be provided, such as the Pryda Installation Guides.

Timber verification and grading values are in accordance with clause B1 and timber treatment in accordance with clause B2 of the New Zealand Building Code.

I/we confirm that the trusses for this project have been designed in accordance with the fabrication specifications provided by Pryda New Zealand.

Name: Kurt van Leeuwen

Position: Designer

Signed: KURT VAN LEEUWEN

Date: 30-03-2022

This producer statement applies to the structural engineering design software "Pryda Build" supplied by Pryda NZ to
Buildable Layouts Ltd

These truss designs are in accordance with sound and widely accepted engineering principles. I believe on reasonable grounds that if constructed in accordance with the design, the trusses will comply with relevant requirements of the New Zealand Building Code, Clause B1 and Verification Method B1/VM1. The durability shall comply with the New Zealand Building Code, Clause B2, for building importance level 2 and a design working life of 50 years.

In addition to the above, this software also complies in part with:

ANSI / TPI 1 - 2002 National Design Standard for metal plate connected wood truss construction.

AS 1649 - 2001 Timber - Methods of test for mechanical fasteners and connectors - Basic working loads and characteristic strengths.

The truss designs require that the supporting structure is stable in its own right, and that the trusses will be braced in accordance with the New Zealand Building Code Standard NZS 3604:2011, and any supplementary details provided, including but not limited to Pryda Installation Guides.

Pryda NZ holds a current policy of Professional Indemnity Insurance with cover no less than NZ\$2 million. The policy includes the engineering design processes used in the software.

On behalf of Pryda NZ (a division of ITW New Zealand)



André van Blerk

Chartered Professional Engineer

BSc (Eng) CMEngNZ (214689), CPEng, IntPE



Fabricator / Designer Statement

Job Ref:

20882
APPROVED

Design Information for Building Consent Application

CLIENT Name: LW Architecture Ltd

SITE Details:

Address: 22 Johnson Street
Tuakau, Waikato

Nominal Design Criteria:

Design working life: 50 years
Building importance: Residential (Importance Level 2)
Roofing: American shingles on 15mm ply (20.0 kg/sq.m)
Ceiling: 10mm Gib-board (6.8 kg/sq.m)
Standard roof pitch: 22.50 deg.
Ult. design wind speed: 44 m/s (wind classification = High)
Max. eaves height: 6 m
Max. ridge height: 8 m
Int pressure coeff. up: 0.2

Design roof snow load: 0 Pa
(incl. probability factor)
Ground snow load: 0 Pa
Location: Region N0 - upper Nth Island
Altitude above sea level: 100 m

Note: This statement must be read in conjunction with the wall layout and detail sheets.

Note: The Structural Timber products supplied in this building stores approximately '1000' kg of carbon.

All lintels, beams and associated components are to be installed and connected in accordance with the recommendations given in - : NZS3604: 2011 "Timber Framed Buildings" and any other supplementary details that may be provided, such as the Pryda Builders Guides, and the supporting structure shall be stable in its own right.

Timber verification and grading values are in accordance with clause B1 and timber treatment in accordance with clause B2 of the New Zealand Building Code.

Name: Kurt van Leeuwen

Position: Designer

Signed: KURT VAN LEEUWEN

Date: 30-03-2022

This producer statement applies to the structural engineering design software "Pryda Build" supplied by Pryda NZ to
Buildable Layouts Ltd

These lintel, beam and associated component designs are in accordance with sound and widely accepted engineering principles. I believe on reasonable grounds that if constructed in accordance with the design, the lintels, beams and associated components will comply with relevant requirements of the New Zealand Building Code, Clause B1 and Verification Method B1/VM1. The durability shall comply with the New Zealand Building Code, Clause B2, for building importance level 2 and a design working life of 50 years.

In addition to the above, this software also complies in part with:

ANSI / TPI 1 - 2002 National Design Standard for metal plate connected wood truss construction.

AS 1649 - 2001 Timber - Methods of test for mechanical fasteners and connectors - Basic working loads and characteristic strengths.

The lintel, beam and associated component designs require that the supporting structure is stable in its own right, and that the lintels, beams and associated components will be installed in accordance with the New Zealand Building Code Standard NZS 3604:2011, and any supplementary details provided, including but not limited to Pryda Installation Guides.

Pryda NZ holds a current policy of Professional Indemnity Insurance with cover no less than NZ\$2 million. The policy includes the engineering design processes used in the software.

On behalf of Pryda NZ (a division of ITW New Zealand)



André van Blerk

Chartered Professional Engineer

BSc (Eng) CMEngNZ (214689), CPEng, IntPE



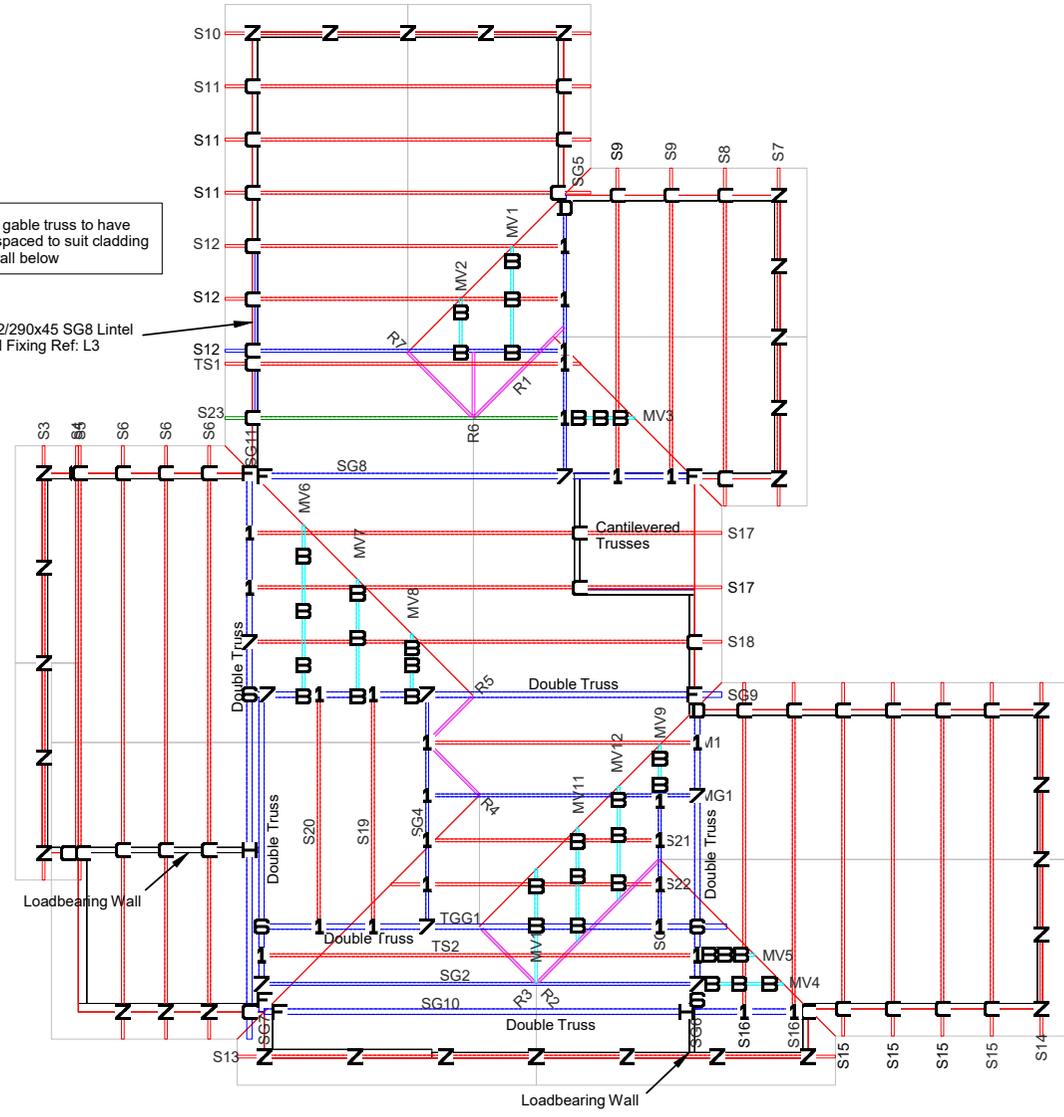
Truss Connections

- Trusses need to be fixed at each timber support with 2/90x3.15 dia Skew Nails unless otherwise noted.

- Z** 30 x 2/Z Z nail
- F** 6 x 1/QHS6 Cyclone strap 600
- C** 40 x 2/MGL Multigrip (long)
- H** 2 x 2/QHS6 Cyclone strap 600
- D** 2 x 1/QHS4 Cyclone strap 400
- 1** 26 x 1/FB4590 Joist hanger
- 6** 4 x 1/TBHD75 Truss boot (heavy duty)
- 7** 8 x 2/NPPC8 Purlin cleat
- B** 34 x 1/MGL Multigrip (long)

Non-structural gable truss to have vertical webs spaced to suit cladding and studs in wall below

L1 - 2/290x45 SG8 Lintel
 Lintel Fixing Ref: L3



BUILDABLE TRUSS LAYOUT

Job Reference: 20382
 Wednesday, 30 March 2022

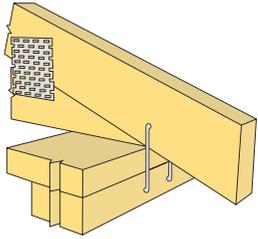
Client: LW Architecture Ltd
 Address: 22 Johnson Street
 Tuakau, Waikato

Roof Pitch: 22.50 Deg.
 Truss Spacing: 900
 Roofing Material: American shingles on 15mm ply
 Design Wind Velocity: 44.00 m/s (Ult.)
 Ceiling Material: 10mm Gib-board (6.8 kg/sq.m.)

Note: For Consent purposes. Truss Manufacturer to provide as-built documents upon completion of job. Auckland Council PS1 Reg. No: 1901



Z



Z-Nail Tie Down X2

Consent Doc. Ref: Z

Product Code: ZR & ZL (right & left hand), ZU (U-nail)

Durability: Also sold as MPZR, MPZL & MPZU

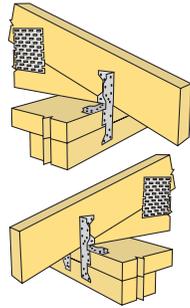
Suitable for all roof spaces that are closed. Stainless required in open

soffits. Compliant with Table 4.1 of NZS3604:2011.

Application: Used in pairs when employed as a truss tie down.

Note: The Z-nails should extend to the lower wall plate and may not terminate in the ceiling plate. *This is a reduced value from code values recently published but takes into account the serviceability of connection.

B C



Multigrip (Long) Tie Down X, X2

Consent Doc. Ref: B,C

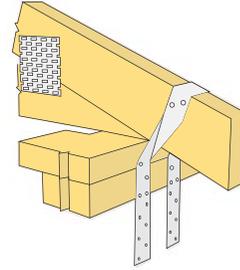
Product Code: MGL

Durability: Suitable for all roof spaces that are closed. Stainless required in open soffits with MG/S with single top plate. Compliant with Table 4.1 of NZS3604:2011.

Application: All holes filled with 30 x 3.15mm Pryda product nails.

Note: MG (short) shall not be used in a double top plate scenario.

D F J



Cyclone Strap Tie Down

Consent Doc. Ref: Q4, Q6, Q9, Q6*, Q9*

Product Code: MPQHS4, MPQHS6, QHS9

Durability: Suitable for all closed roof spaces. Stainless not available.

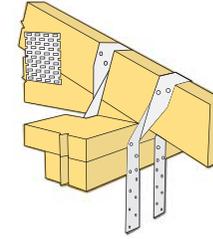
Compliant with Table 4.1 of NZS3604:2011.

Application: All holes filled with 30 x 3.15mm Pryda product nails.

Note: Values based on 5 nails per leg, except for MPQHS4 which can only hold 4 nails per leg

*With strap wrapped under support member. Single windstrap to be placed on the outside face of wall. The ceiling plate plate requires notching on the inside when used in double strap scenario.

H



Cyclone Strap Tie Down X2

Consent Doc. Ref: Q4, Q6, Q9, Q6*, Q9*

Product Code: MPQHS4, MPQHS6, QHS9

Durability: Suitable for all closed roof spaces. Stainless not available.

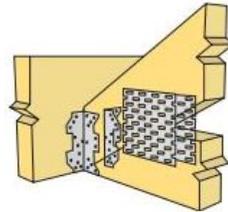
Compliant with Table 4.1 of NZS3604:2011.

Application: All holes filled with 30 x 3.15mm Pryda product nails.

Note: Values based on 5 nails per leg, except for MPQHS4 which can only hold 4 nails per leg

*With strap wrapped under support member. Single windstrap to be placed on the outside face of wall. The ceiling plate plate requires notching on the inside when used in double strap scenario.

B C



Multigrip (Long) Truss Support X, X2

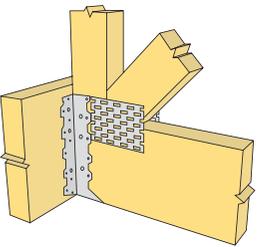
Consent Doc. Ref: B,C

Product Code: MGL

Durability: Suitable for all roof spaces that are closed. Stainless required in open soffits with MG/S with single top plate. Compliant with Table 4.1 of NZS3604:2011.

Application: All holes filled with 30 x 3.15mm Pryda product nails.

1 2 3



Framing Bracket

Consent Doc. Ref: 1,2,3

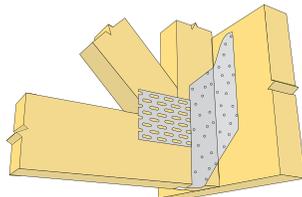
Product Code: MPFB4590, MPFB45120, MPFB45180, FB94/152

Durability: Suitable for all closed roof spaces. Stainless steel required in open roofs in Zone D in order to be compliant with Table 4.1 of NZS3604:2011.

Application: All holes filled with 30 x 3.15mm Pryda product nails or Type 17 12g x 35mm hex head screws unless otherwise noted. Reduced nailing requirements are possible but should be checked with Pryda engineers.

Note: Greater downward capacity than uplift due to fewer nails in joist flanges

5



Heavy Duty Nail-on Hanger Truss Support

Consent Doc. Ref: E, F, K

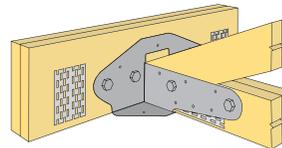
Product Code: JHH75, JHH100, JHHS

Durability: Suitable for all closed roof spaces. Compliant with Table 4.1 of NZS3604:2011.

Application: Heavy Duty connection option. All holes filled with 30 x 3.15mm Pryda product nails unless otherwise noted. reduced nailing requirements are possible but should be checked with Pryda engineers. Call Pryda on 0800 88 22 44

Note: High capacity hanger with good uplift resistance.

6



Truss Boot

Consent Doc. Ref: TB

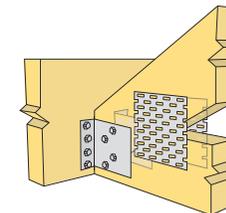
Product Code: TB45/16, TBHD75

Durability: Suitable for all closed roof spaces. Compliant with Table 4.1 of NZS3604:2011.

Application: Heavy duty uplift and downward loading. TBHD75 - All bolt holes filled

Note: High capacity bracket with good uplift resistance.

7



Concealed Purlin Cleat Truss Support

Consent Doc. Ref: NC8

Product Code: NPCC8

Durability: Suitable for all closed roof spaces. Compliant with Table 4.1 of NZS3604:2011.

Application: Variable width connection utilising screws. All screw holes filled.

Waikato District Council
Building Consent Number
BLD2096/22

APPROVED



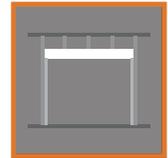
BUILDABLE LAYOUTS

TRUSS DESIGN + FRAME DESIGN + FLOOR DESIGN

P.O. Box 99456 Newmarket, AUCKLAND 149

0800 LAYOUTS

TRUSS FIXING
DETAILS



TRUSS DETAILS (DESIGN)

Job Ref: 20382

Truss Reference : SG10 (Double Truss)

Truss type: Standard

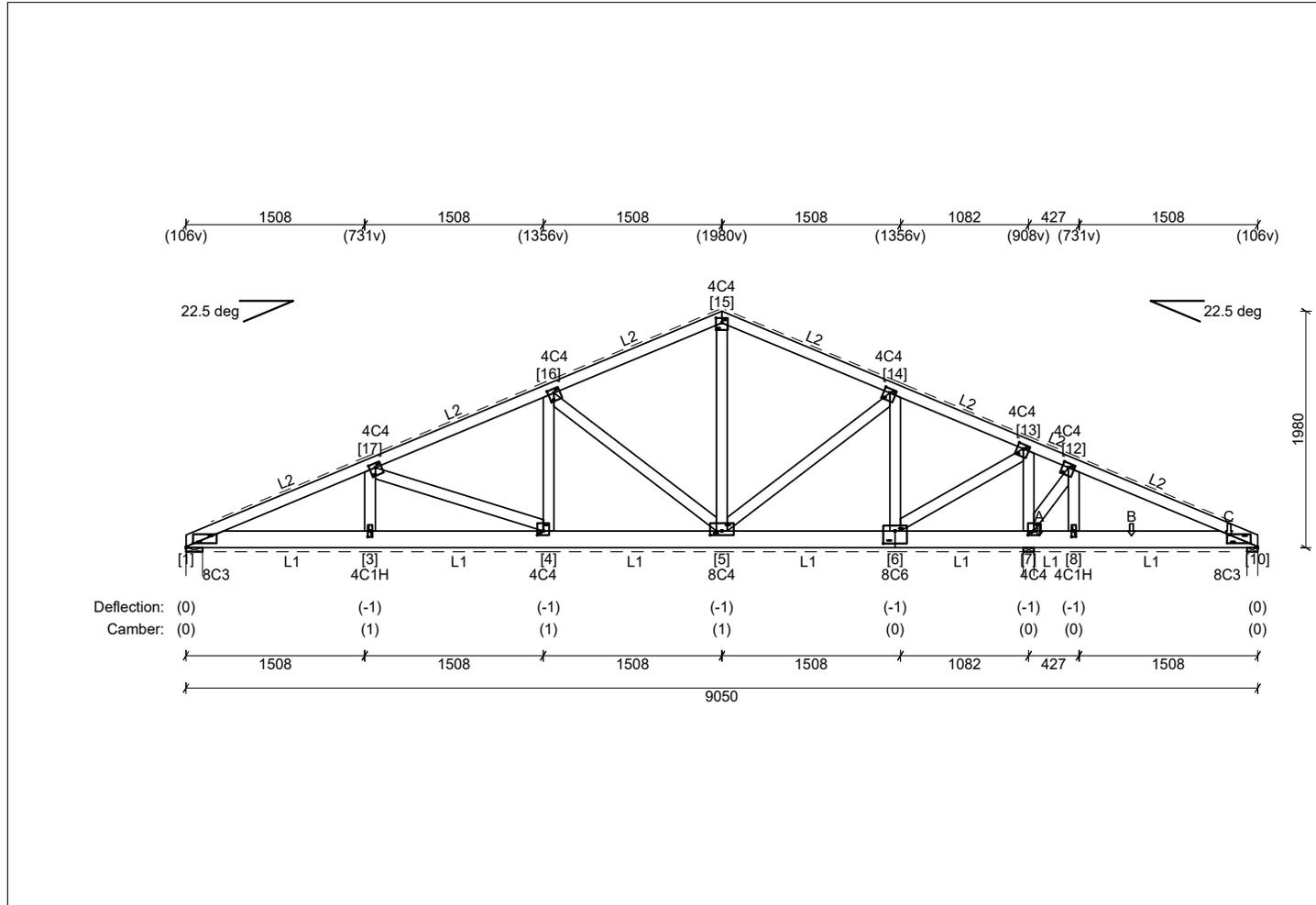
No. plies : 2x45mm

Design spacing : 900mm

No. of : 1

Building type: Residential

APPROVED



Linings

L1: 10mm Gib-board (6.8 kg/sq.m).

Battens @ 400mm.

L2: American shingles on 15mm ply (20.0 kg/sq.m).

Direct (nail/screw restraint) @ 600mm.

Timber

Top Chords 2 / 90x45 MSG8 H1_2 uno

Bottom Chords 2 / 140x45 MSG8 H1_2 uno

Webs 2 / 90x45 MSG8 H1_2 uno

Supported trusses / Applied point loads

A: SG6 (7205)

B: S16 (7984)

C: S16 (8808)

Note: numbers in brackets denote distance from left of truss.

Notes

1. Deflection = permanent load deflection including creep (negative = downward movement).
2. Overhang condition: No fascia.
3. Safety plank on BC : Required if head height exceeds 1.2m.
4. Refer to Pryda Installation Guide for full bracing details.
5. Refer to layout for overall truss bracing.
6. Truss close to gable end: YES

Fixings

Double Truss - Fix plies with 75 x 3.05 dia nails at 250 crs (staggered) in chords and webs (1 row for timber widths up to 100mm, 2 rows up to 200mm, otherwise 3 rows).

Major supports and factored reactions

Joint	Type	Width	Perm.	Max. down (LC)	Uplift	Tie-down	Connector
1	Wall Ext	140	2.1 kN	3.6 kN (Gc+Wd3)	-2.5 kN	1/QHS6	-
10	Wall Ext	90	2.3 kN	3.9 kN (Gc+Q2r)	-4.2 kN	2/MGL	-
7	Wall Int	90	10.7 kN	16.1 kN (Gc+Q2r)	-11.4 kN	2/QHS6	-

Note: Refer to Truss Connections Report / Producer Statement for fixing details.

TRUSS DETAILS (DESIGN)

Job Ref: 20382

Truss Reference : S6 (Single Truss)

Truss type: Standard

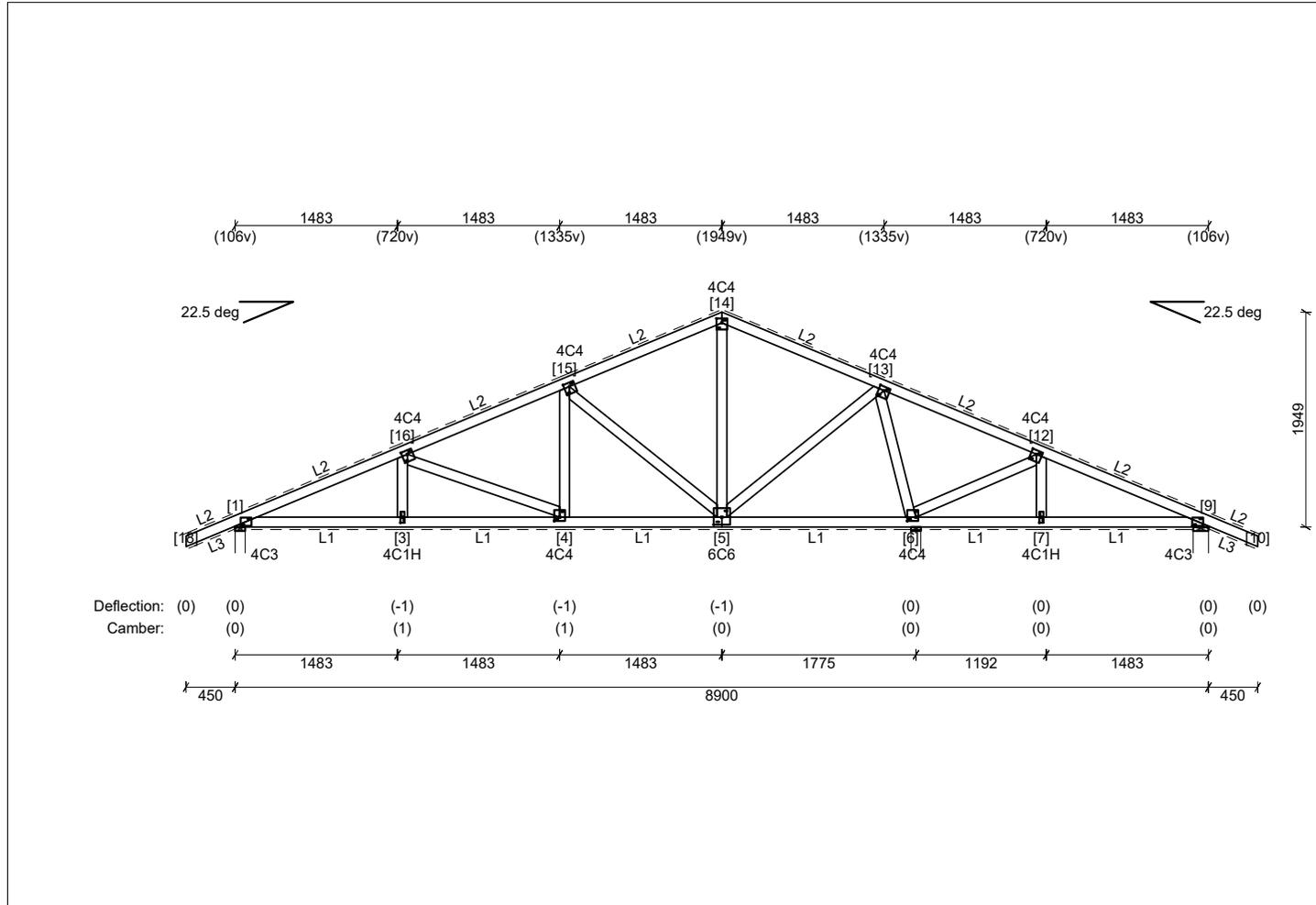
No. plies : 1x45mm

Design spacing : 717mm

No. of : 3

Building type: Residential

APPROVED



Linings

L1: 10mm Gib-board (6.8 kg/sq.m).

Battens @ 400mm.

L2: American shingles on 15mm ply (20.0 kg/sq.m).

Direct (nail/screw restraint) @ 600mm.

L3: Fibrecement (6mm) (9.5 kg/sq.m).

Battens @ 600mm.

Timber

Top Chords 1 / 90x45 MSG8 H1_2 uno

Bottom Chords 1 / 90x45 MSG8 H1_2 uno

Webs 1 / 90x45 MSG8 H1_2 uno

Notes

1. Deflection = permanent load deflection including creep (negative = downward movement).
2. Overhang condition: No fascia.
3. Safety plank on BC : Required if head height exceeds 1.2m.
4. Refer to Pryda Installation Guide for full bracing details.
5. Refer to layout for overall truss bracing.
6. Truss close to gable end: YES

Major supports and factored reactions

Joint	Type	Width	Perm.	Max. down (LC)	Uplift	Tie-down	Connector
1	Wall Ext	90	1.2 kN	2.7 kN (Gc+Qj)	-1.7 kN	2/MGL	-
9	Wall Ext	140	0.4 kN	2.0 kN (Gc+Qp)	-0.5 kN	2/Z	-
6	Wall Int	90	2.1 kN	3.8 kN (Gc+Wd3)	-3.1 kN	2/MGL	-

Note: Refer to Truss Connections Report / Producer Statement for fixing details.

TRUSS DETAILS (DESIGN)

Job Ref: 20382

Truss Reference : S11 (Single Truss)

Truss type: Standard

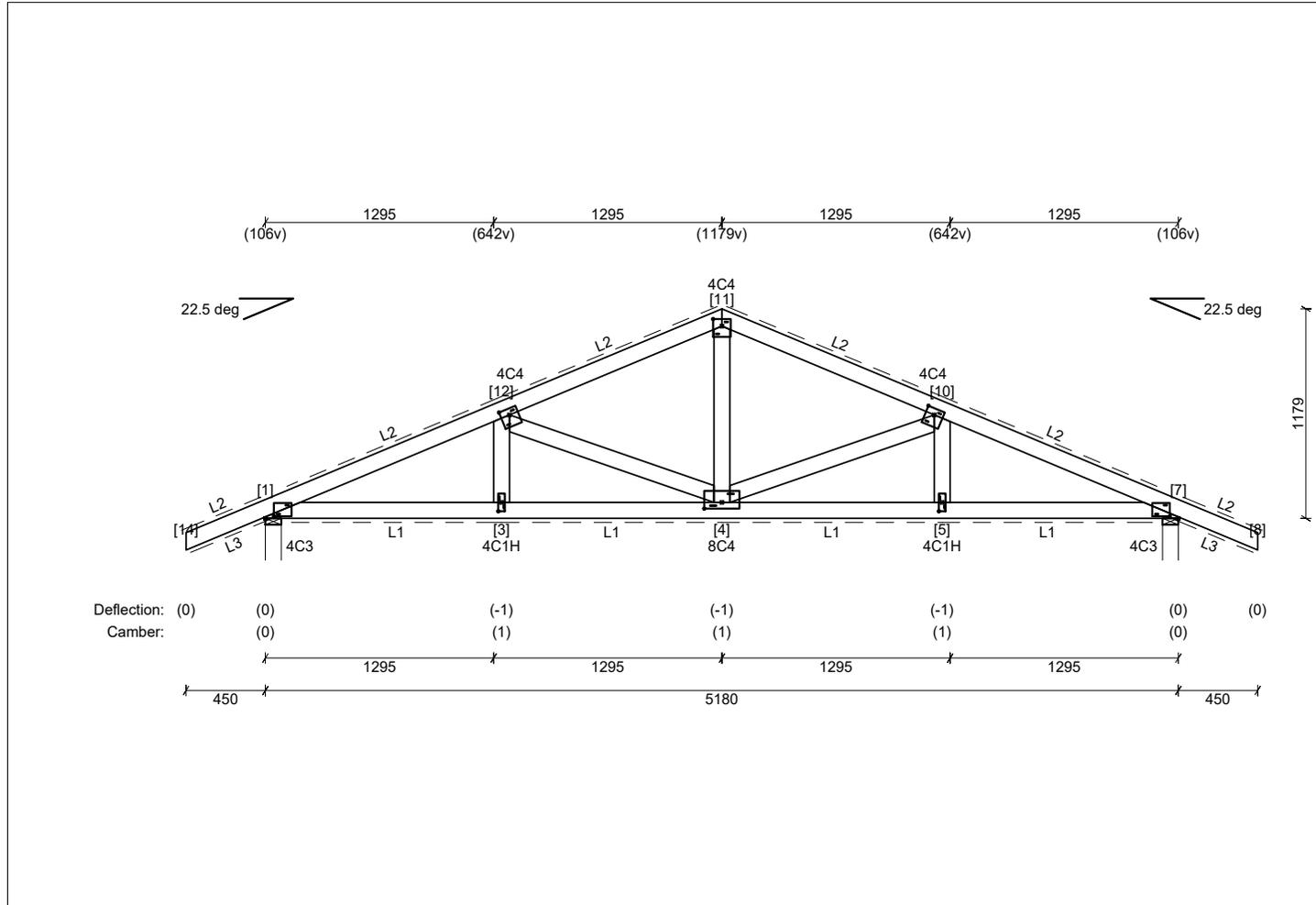
No. plies : 1x45mm

Design spacing : 878mm

No. of : 3

Building type: Residential

APPROVED



Linings

L1: 10mm Gib-board (6.8 kg/sq.m).

Battens @ 400mm.

L2: American shingles on 15mm ply (20.0 kg/sq.m).

Direct (nail/screw restraint) @ 600mm.

L3: Fibrecement (6mm) (9.5 kg/sq.m).

Battens @ 600mm.

Timber

Top Chords 1 / 90x45 MSG8 H1_2 uno

Bottom Chords 1 / 90x45 MSG8 H1_2 uno

Webs 1 / 90x45 MSG8 H1_2 uno

Notes

1. Deflection = permanent load deflection including creep (negative = downward movement).
2. Overhang condition: No fascia.
3. Safety plank on BC : Required if head height exceeds 1.2m.
4. Refer to Pryda Installation Guide for full bracing details.
5. Refer to layout for overall truss bracing.
6. Truss close to gable end: YES

Major supports and factored reactions

Joint	Type	Width	Perm.	Max. down (LC)	Uplift	Tie-down	Connector
1	Wall Ext	90	1.3 kN	2.8 kN (Gc+Qj)	-2.4 kN	2/MGL	-
7	Wall Ext	90	1.3 kN	2.8 kN (Gc+Qj)	-2.4 kN	2/MGL	-

Note: Refer to Truss Connections Report / Producer Statement for fixing details.

TRUSS DETAILS (DESIGN)

Job Ref: 20382

Truss Reference : S8 (Single Truss)

Truss type: Standard

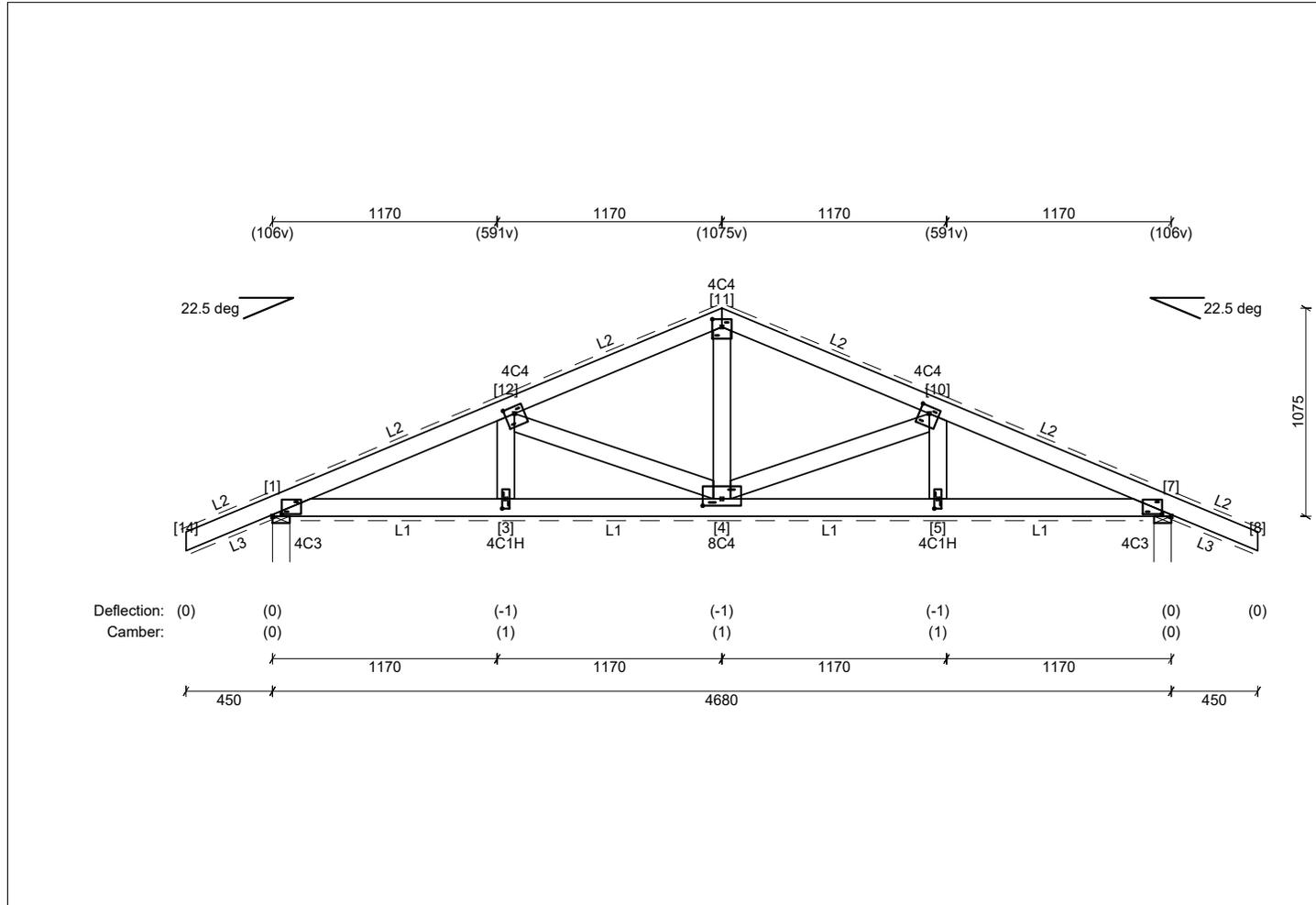
No. plies : 1x45mm

Design spacing : 894mm

No. of : 1

Building type: Residential

APPROVED



Linings

L1: 10mm Gib-board (6.8 kg/sq.m).

Battens @ 400mm.

L2: American shingles on 15mm ply (20.0 kg/sq.m).

Direct (nail/screw restraint) @ 600mm.

L3: Fibrecement (6mm) (9.5 kg/sq.m).

Battens @ 600mm.

Timber

Top Chords 1 / 90x45 MSG8 H1_2 uno

Bottom Chords 1 / 90x45 MSG8 H1_2 uno

Webs 1 / 90x45 MSG8 H1_2 uno

Notes

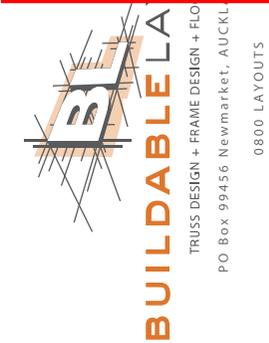
1. Deflection = permanent load deflection including creep (negative = downward movement).
2. Overhang condition: No fascia.
3. Safety plank on BC : Required if head height exceeds 1.2m.
4. Refer to Pryda Installation Guide for full bracing details.
5. Refer to layout for overall truss bracing.
6. Truss close to gable end: YES

Major supports and factored reactions

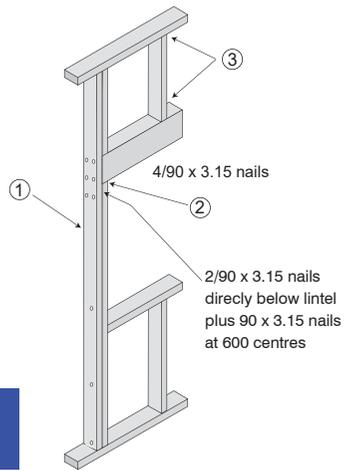
Joint	Type	Width	Perm.	Max. down (LC)	Uplift	Tie-down	Connector
1	Wall Ext	90	1.2 kN	2.8 kN (Gc+Qj)	-2.3 kN	2/MGL	-
7	Wall Ext	90	1.2 kN	2.8 kN (Gc+Qj)	-2.3 kN	2/MGL	-

Note: Refer to Truss Connections Report / Producer Statement for fixing details.

APPROVED

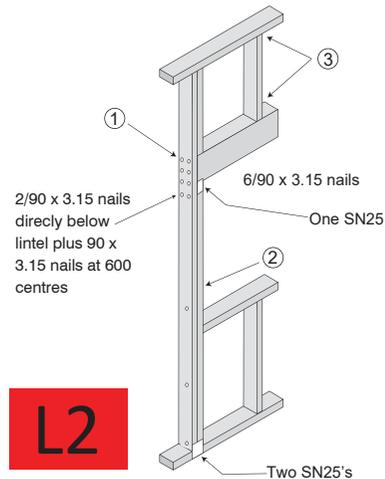


0800 LAYOUTS



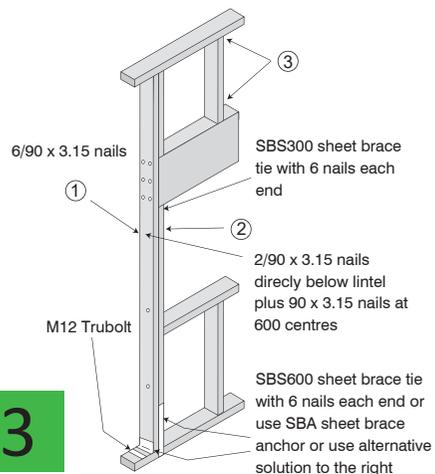
L1

Timber Lintel Fixing - 1.4kN
 Consent Doc. Ref. L1



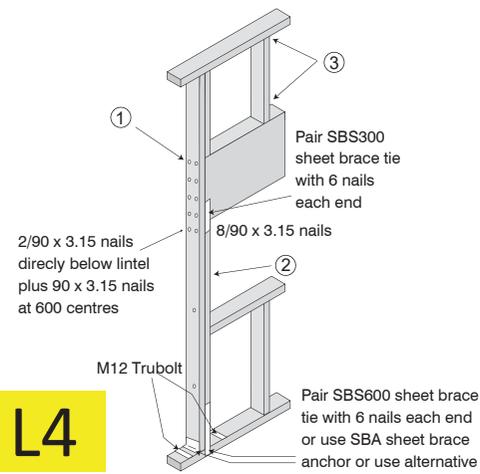
L2

Timber Lintel Fixing - 2.8kN
 Consent Doc. Ref. L2



L3

Timber Lintel Fixing - 8.0kN
 Consent Doc. Ref. L3



L4

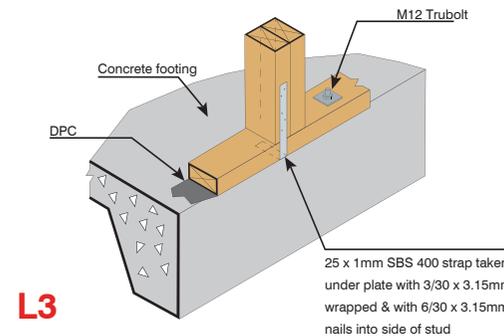
Timber Lintel Fixing - 14.0kN
 Consent Doc. Ref. L4

1. For trimming stud thickness refer to Table 8.5 NZS 3604:2011. Additional studs to that shown have a minimum stud to stud fixing off 11/90 x 3.15 nails.

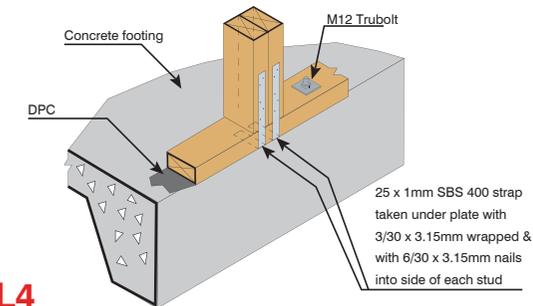
2. Where a double stud which provides support for a lintel is shorter by 300mm or more than the full stud height, its thickness shall not be included as contributing to the thickness of trimming studs.

3. Studs & Jacks Studs to be fixed in accordance with the Pruda Top Plate to Stud Fixing Guide.

Alternative solution for L3 & L4 SBS use

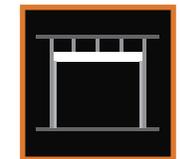


L3



L4

LINTEL FIXING DETAILS



DETAIL SHEET - COMPONENT DESIGN - Solid Timber

Job Ref: 20382

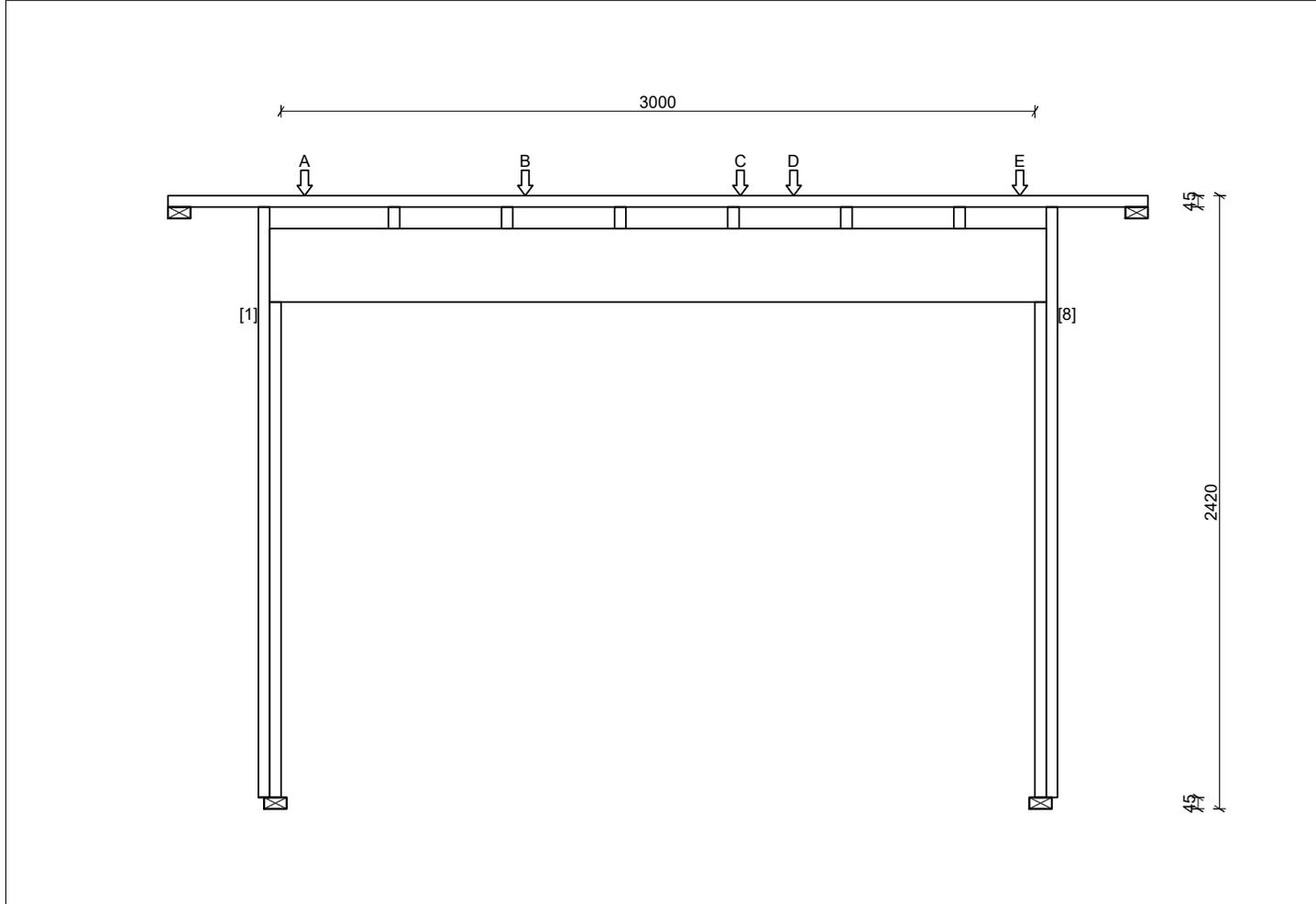
Opening Reference : L1

Beam type : Solid Timber

No. of : 1

Opening width: 3000 mm

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Timber components

- 2 / 290x45 MSG8 H1_2 lintel
- 1 / 45x90 MSG8 H1_2 top plate (specified by user)
- 2 / 45x90 MSG8 H1_2 jamb stud - LHS
- 2 / 45x90 MSG8 H1_2 jamb stud - RHS

Loads on lintel

ID	Location x co-ord	Perm G	Imposed Qr	Qf	Wind		Snow S
					WuUp	WuDn	
Point loads (kN)							
A	S12 (94)	0.99	0.67		-3.31	1.56	
B	S12 (972)	0.99	0.67		-3.31	1.56	
C	SG3 (1828)	1.02	0.69		-3.40	1.60	
D	TS1 (2040)	0.73	0.46		-1.70	0.80	
E	S23 (2940)	0.99	0.67		-2.45	1.46	

Notes

1. Long-term permanent load deflection = 3 mm.
2. LHS jamb stud details : 1/full length + 1/understud
3. RHS jamb stud details : 1/full length + 1/understud

Major supports and factored reactions

Joint	Type	Width	Perm.	Max. down (LC)	Uplift	Tie-down	Connector
1	Wall Ext	90	3.4 kN	6.5 kN (Gc+Wd1)	-5.1 kN	-	-
8	Wall Ext	90	3.6 kN	6.7 kN (Gc+Wd1)	-4.2 kN	-	-

Note: Refer to Truss Connections Report / Producer Statement for fixing details.

NAME: Srujith Sirikonda & Anusha Rao Koluguri
ADDRESS: 22 Johnson Street, Tuakau, Waikato 2121
DATE: 21/05/2022 CONSENT AUTHORITY: WAIKATO COUNCIL

THIS PS1 DOES NOT CONSTITUTE A SITE SPECIFIC REVIEW BY THE ENGINEERING COMPANY BELOW AND IS ONLY APPLICABLE FOR STANDARD FIXINGS AND DESIGN PARAMETERS AS DETAILED IN THE RELEVANT MANUAL



Waikato District Council
Building Consent Number
JURALCO
BLD2096/22

APPROVED



Building Code Clause(s) B1, F2, F4

PRODUCER STATEMENT – PS1 – DESIGN

(Guidance on use of Producer Statements (formerly page 2) is available at www.engineeringnz.org)

ISSUED BY: Lautrec Technology Group Ltd
(Design Firm)
TO: Juralco Aluminium Building Products Ltd
(Owner/Developer)
TO BE SUPPLIED TO: All Building Consent Authorities in NZ
(Building Consent Authority)
IN RESPECT OF: JURALCO EDGETEC® DOUBLE DISC ANCHOR BALUSTRADE SYSTEMS
(Description of Building Work)
AT: N/A (all locations within NZ Wind Zone)
(Address)
LOT DP SO

We have been engaged by the owner/developer referred to above to provide Specific Engineering Design Structural Components Only services in respect of the requirements of B1 Structure of the building code for Aluminium Joinery structure & fixings, F2 Hazardous building materials, F4 safety from falling (For reviewed items) Clause(s) 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: B1/VM1:NZS 1170:2011; NZS 1664.1:1997; NZS 3603:1993; NZS 3101:2006

Compliance Documents issued by the Ministry of Business, Innovation & Employment Or (verification method / acceptable solution)
 Alternative solution as per the attached schedule.

The proposed building work covered by this producer statement is described on the report titled "Juralco Edgetec Double Disc Balustrade PS1 Report_30.03.22" together with Juralco product manual "Juralco Edgetec® Double Disc Anchor Balustrade System Issue 2-22 V1"

together with the specification, and other documents set out in the schedule attached to this statement.

On behalf of the Design Firm, and subject to:

- (i) Site verification of the following design assumptions Adequate Support Structure by others
- (ii) 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 (Engineering Categories) or as per agreement with owner/developer (Architectural)

I, Kevin Brown am: CPEng 140404 #
(Name of Design Professional) Reg Arch #

I am a member of: Engineering New Zealand NZIA and hold the following qualifications: BE, CMEngNZ, CPEng, IntPE(NZ), MBA
The Design Firm issuing this statement holds a current policy of Professional Indemnity Insurance no less than \$200,000*.
The Design Firm is a member of ACENZ:

SIGNED BY Kevin Brown ON BEHALF OF Lautrec Technology Group Ltd
(Design Firm)

Date 31/03/2022 (signature)

Note: This statement shall only be 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.

Our Ref: 20602

Tuesday, February 8, 2022

Dear Sir/Madam,

RE: B2 COMPLIANCE - JURALCO DOUBLE DISC BALUSTRADE SYSTEM

You have requested a Producer Statement for Design-PS1 for Clause B2 of the Building Code – Structural Durability.

We are not able to provide this because there is no effective verification method for B2 contained within the Building Code.

As these balustrade systems can be installed in a variety of settings, including internal and exposed environments, it is not deemed practical to specify durability requirements for the sub structure.

Timber treatments, mild steel corrosion protection coatings, concrete and masonry covers are therefore up to the building designer to specify in accordance with the relevant recognised standards.

However we can confirm that for the structure elements shown in our documentation:

Connections

Stainless steel fixings have been specified throughout in accordance with NZ Building Code B2/AS1 acceptable solution NZS3604.

Aluminium

Aluminium has been provided in accordance with NZS1664, and all aluminium components are powder coated in house by Juralco. We note that this is on a time to first maintenance basis.

We trust this provides the information that you are seeking.

Yours faithfully,


Jade Vaotogo



Building Code Clause(s)..... **B1**

PRODUCER STATEMENT – PS1 – DESIGN

ISSUED BY: K Design Group Limited [Author No. 123846]
(Design Firm)
TO: SRUJITH SIRIKONDA & ANUSHA RAO KOLUGURI
(Owner/Developer)
TO BE SUPPLIED TO: Waikato District Council
(Building Consent Authority)
IN RESPECT OF: Proposed New Dwelling
(Description of Building Work)
AT: 22 JOHNSON ST, TUAKAU, WAIKATO
(Address)
Town/City: WAIKATO **LOT** 26 **DP** 354076 **SO**
(Address)

We have been engaged by the owner/developer referred to above to provide:
Structural Engineering Design for
Timber Pole Retaining Wall, Masonry Block Retaining Wall (Type B Observation), RC Piles, Waffle Raft Slab Foundation, Ground/1ST
Floor Bracing, Lintels, Beams, SED Posts ONLY.
.....
(Extent of Engagement)

services in respect of the requirements of Clause(s)..... **B1 Only**of the Building Code for:
 All or Part only (as specified in the attachment to this statement), of the proposed building work.
(Part = Structural Items Covered In Calculations By K Design Group Limited Only)
The design carried out by us has been prepared in accordance with:
 Compliance Documents issued by the Ministry of Business, Innovation & Employment..... **B1/VM1, VM4**or
(verification method/acceptable solution)
 Alternative solution as per the attached schedule.....

The proposed building work covered by this producer statement is described on the drawings titled:
22 JOHNSON ST, TUAKAU, WAIKATO Job No. 220952and numbered as per Drawing List;
together with the specification, and other documents set out in the schedule attached to this statement.

On behalf of the Design Firm, and subject to: With 300kPa Ultimate Bearing Capacity
(i) Site verification of the following design assumptions Soil Expansivity Class 'M' as per Geotechnical Report by G.DECO
(ii) All proprietary products meeting their performance specification requirements; Ref: G22-A0037; Dated 09/03/2021
(iii) All Design Assumptions To Be Verified By The Inspecting Engineer On Site.

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 (Engineering Categories)

I, Kailiang (Kimi) Sheng am: CPEng # 1153987
(Name of Design Professional)

I am a member of: Engineering New Zealand and hold the following qualifications: BE, ME, CMEngNZ, CPEng

The Design Firm issuing this statement holds a current policy of Professional Indemnity Insurance no less than \$200,000*.
The Design Firm is a member of ACE New Zealand:

SIGNED BY Kailiang (Kimi) Sheng (Signature).....

ON BEHALF OF K Design Group Limited Date: 14 / 04 / 2022
(Design Firm)

Note: This statement shall only be 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.
THIS FORM AND ITS CONDITIONS ARE COPYRIGHT TO ACE NEW ZEALAND AND ENGINEERING NEW ZEALAND

GUIDANCE ON USE OF PRODUCER STATEMENTS

Producer statements were first introduced with the Building Act 1991. The producer statements were developed by a combined task committee consisting of members of the New Zealand Institute of Architects, Institution of Professional Engineers New Zealand (now Engineering New Zealand), ACE New Zealand in consultation with the Building Officials Institute of New Zealand. The original suit of producer statements has been revised at the date of this form as a result of enactment of the Building Act (2004) by these organisations to ensure standard use within the industry.

The producer statement system is intended to provide Building Consent Authorities (BCAs) with reasonable grounds for the issue of a Building Consent or a Code Compliance Certificate, without having to duplicate design or construction checking undertaken by others.

PS1 Design Intended for use by a suitably qualified independent design professional in circumstances where the BCA accepts a producer statement for establishing reasonable grounds to issue a Building Consent;

PS2 Design Review Intended for use by a suitably qualified independent design professional where the BCA accepts an independent design professional's review as the basis for establishing reasonable grounds to issue a Building Consent;

PS3 Construction Forms commonly used as a certificate of completion of building work are Schedule 6 of NZS 3910:2013 or Schedules E1/E2 of NZIA's SCC 2011²

PS4 Construction Review Intended for use by a suitably qualified independent design professional who undertakes construction monitoring of the building works where the BCA requests a producer statement prior to issuing a Code Compliance Certificate.

This must be accompanied by a statement of completion of building work (Schedule 6).

The following guidelines are provided by ACE New Zealand and Engineering New Zealand to interpret the Producer Statement.

Competence of Design Professional

This statement is made by a Design Firm that has undertaken a contract of services for the services named, and is signed by a person authorised by that firm to verify the processes within the firm and competence of its designers.

A competent design professional will have a professional qualification and proven current competence through registration on a national competence based register as a Chartered Professional Engineer (CPEng).

Membership of a professional body, such as Engineering New Zealand (formerly IPENZ) provides additional assurance of the designer's standing within the profession. If the design firm is a member of ACE New Zealand, this provides additional assurance about the standing of the firm.

Persons or firms meeting these criteria satisfy the term "suitably qualified independent design professional".

*Professional Indemnity Insurance

As part of membership requirements, ACE New Zealand requires all member firms to hold Professional Indemnity Insurance to a minimum level.

The PI Insurance minimum stated on the front of this form reflects standard, small projects. If the parties deem this inappropriate for large projects the minimum may be up to \$500,000.

Professional Services during Construction Phase

There are several levels of service which a Design Firm may provide during the construction phase of a project (CM1-CM5 for Engineers³). The Building Consent Authority is encouraged to require that the service to be provided by the Design Firm is appropriate for the project concerned.

Requirement to provide Producer Statement PS4

Building Consent Authorities should ensure that the applicant is aware of any requirement for producer statements for the construction phase of building work at the time the building consent is issued as no design professional should be expected to provide a producer statement unless such a requirement forms part of the Design firm's engagement.

Attached Particulars

Attached particulars referred to in this producer statement refer to supplementary information appended to the producer statement.

Refer Also:

- 1 Conditions of Contract for Building & Civil Engineering Construction
NZS 3910: 2013
- 2 NZIA Standard Conditions of Contract SCC 2011

Guideline on the Briefing & Engagement for Consulting Engineering Services
(ACE New Zealand/Engineering New Zealand 2004)
- 4 PN Guidelines on Producer Statements

www.acenz.org.nz
www.engineeringnz.org



association of
consulting and
engineering



To the Building Official,
Auckland Council

In respect of Proposed New Dwelling

At 22 JOHNSON ST, TUAKAU, WAIKATO
Auckland

Compliance with Building Code Clause B2 – Durability

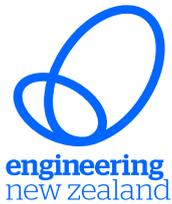
The purpose of this letter is to demonstrate how compliance with Clause B2 (Durability) of the Building Code will be achieved for the above project. We can confirm that for specifically designed structural elements that are included within our design documentation:

Material	Means of compliance	Details
Reinforced Concrete	B2/AS1	Concrete cover to reinforcing has been selected in accordance with NZS3101, Part 1, Section 3
Structural Timber	B2/AS1	Timber treatment has been selected in accordance with Table 1A of B2/AS1
Mild Steel Structure	Alternative Solution	Protection for mild steel has been specified in accordance with SNZ TS 3404 – Durability requirements for steel structures and components and AS/NZS2312 – Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings. This guide works on a time to first maintenance basis and assumes on-going maintenance.

Yours faithfully,

Kailiang (Kimi) Sheng

For and on behalf of
K Design Group Limited



CERTIFICATE OF DESIGN WORK MEMORANDUM FROM LICENSED BUILDING PRACTITIONER

Section 30C and Section 45, Building Act 2004

The Building			
Street address	22 JOHNSON ST, TUAKAU, WAIKATO		
Suburb	TUAKAU	Town/city	WAIKATO
Postcode	2121	Building consent no.	TBA
The Owner			
Name(s)	SRUJITH SIRIKONDA & ANUSHA RAO KOLUGURI		
Email	srujith.s@gmail.com	Phone	0223187443
Address	19 Black Shed Rd, Flatbush, Auckland		

Basis for providing this memorandum

I am providing this memorandum in my role as the **specialist** designer who carried out or supervised specific Primary structure elements of restricted building work (RBW) design work as described in this memorandum. Other designers will provide memoranda covering the remaining RBW design work. Refer also to the attached PSI.

Identification of restricted building work (RBW) design work

I, **Kailiang (Kimi) Sheng** carried out or supervised the following RBW design work:

Primary structure: B1

Design work that is RBW	Description (as required) and reference to plans and specifications	Carried out or supervised
Foundations and subfloor framing ✓	Waffle Raft Slab Foundation as per Foundation Plans	Supervised
Retaining walls ✓	Timber Pole Retaining Wall, Masonry Block Retaining Wall, as per Foundation Plans	Supervised
Beams ✓	SED Beams & Lintels as per Framing Plans	Supervised
Portal ✓	SED Steel Portal Frame as per Framing Plans	Supervised
Bracing ✓	Bracing Design to NZS3604:2011 and AS/NZS1170:2,5 as per Bracing Plans	Supervised
Other (primary) ✓	SED Framing Design, SED Post Design, Rafter Design to NZS3604:2011 as per Framing Plans	Supervised

Note: SED = Elements subject to Specific Engineering Design outside of the scope of NZS3604:2011, unless otherwise noted.

Initial  Date 14 / 04 / 2022

Waivers and modifications

Are waivers or modifications of the Building Code required?

No

If yes, please provide details of the waivers or modifications:

Building Code clause	Waiver/modification required
Not Applicable	

Issued by

Name	Kailiang (Kimi) Sheng	Design entity/company	K Design Group Limited
Chartered status	CPEng	Chartered no.	1153987
Email	kimi@kdgroup.co.nz	Website	www.kdgroup.co.nz
Phone (daytime)	09 930 9977	Phone (after hours)	
Mobile	022 601 2346		
Postal address	Unit G3, 4 Orbit Drive, Rosedale, Auckland 0632		
Physical address	Unit G3, 4 Orbit Drive, Rosedale, Auckland 0632		

Declaration

I, Kailiang (Kimi) Sheng, ~~LBP~~ state that I have applied the skills and care reasonably required of a competent design professional in carrying out or supervising the RBW described in this memorandum and that based on this, I certify that the RBW described in this memorandum:

- complies with the Building Code; ~~or~~
- ~~complies with the Building Code subject to any waiver or modification of the Building Code described in this memorandum.~~

Signature



Date 14 / 04 / 2022

Demand Calculation Sheet

APPROVED

Job Details

Name: 22 Johnson St, Tuakau, Waikato
 Street and Number: 22 Johnson St, Tuakau, Waikato
 Lot and DP Number: Lot 26 DP 354076
 City/Town/District: waikato
 Designer: AY
 Company: DESIGN
 Date: Friday, 25 March 2022

Building Specification

Number of Storeys 1
 Floor Loading 2 kPa
 Foundation Type Slab

Single

Cladding Weight Light
 Roof Weight Light
 Room in Roof Space No
 Roof Pitch (degrees) 22.5
 Roof Height above Eaves (m) 2.0
 Building Height to Apex (m) 5
 Ground to Lower Floor (m) 0.2

Average Stud Height (m) 2.7
 Building Length (m) 17
 Building Width (m) 16.6
 Building Plan Area (m²) 182.4

Building Location

Wind Zone = High

Earthquake Zone 1

Soil Type C (Shallow)
 Annual Prob. of Exceedance: 1 in 500 (Default)

Bracing Units required for Wind

	Along	Across
Single Level	889	835

Bracing Units required for Earthquake

	Along & Across
Single Level	334

Single Level Along Resistance Sheet

APPROVED

Job Name: 22 Johnson St, Tuakau, Waikato

									Wind	EQ
									Demand	
									889	334
									Achieved	
Line	Element	Length (m)	Angle (degrees)	Stud Ht. (m)	Type	Supplier	Wind (BUs)	EQ (BUs)	1237	1112
									139%	333%
A	1	0.50		2.7	GS1-N	GIB®	24	26		
	2	1.00		2.7	BL1-H	GIB®	105	92		
	3	0.50		2.7	GS1-N	GIB®	24	26		
External Length =							8.9		154 OK	143 OK
B	1	0.60		2.7	GS1-N	GIB®	30	31		
	2	1.10		2.7	GS1-N	GIB®	66	58		
	3	0.80		2.7	GS1-N	GIB®	43	42		
	4	2.20		2.7	GS1-N	GIB®	135	117		
External Length =									274 OK	249 OK
C	1	2.70		2.7	GS1-N	GIB®	166	144		
	2	1.60		2.7	GS1-N	GIB®	98	85		
	3	2.40		2.7	GS1-N	GIB®	147	128		
External Length =									411 OK	357 OK
D	1	0.60		2.7	BL1-H	GIB®	53	54		
	2	0.60		2.7	BL1-H	GIB®	53	54		
	3	2.40		2.7	GS1-N	GIB®	147	128		
External Length =									253 OK	236 OK
E	1	1.10		2.7	BL1-H	GIB®	120	101		
	2	0.50		2.7	GS1-N	GIB®	24	26		
External Length =							5		145 OK	127 OK

Single Level Across Resistance Sheet

APPROVED

Job Name: 22 Johnson St, Tuakau, Waikato

Line	Element	Length (m)	Angle (degrees)	Stud Ht. (m)	Type	Supplier	Wind (BUs)	EQ (BUs)	Wind	EQ
									1237	1115
									Demand	
									835	334
									Achieved	
									148%	334%
1	1	1.50		2.7	GS1-N	GIB®	92	80		
	2	1.50		2.7	GS1-N	GIB®	92	80		
	External Length = 5									184 OK
2	1	0.80		2.7	BL1-H	GIB®	77	73		
	2	0.70		2.7	BL1-H	GIB®	64	63		
	External Length = 3.6									142 OK
3	1	2.80		2.7	GS1-N	GIB®	172	149		
	2	2.40		2.7	GS1-N	GIB®	147	128		
										319 OK
4	1	2.40		2.7	GS1-N	GIB®	147	128		
	2	1.80		2.7	GS1-N	GIB®	110	96		
	3	1.40		2.7	GS1-N	GIB®	86	75		
									343 OK	299 OK
5	1	0.55		2.7	BL1-H	GIB®	47	49		
	2	0.55		2.7	BL1-H	GIB®	47	49		
	3	0.80		2.7	BL1-H	GIB®	77	73		
	4	0.80		2.7	BL1-H	GIB®	77	73		
External Length = 16									248 OK	244 OK

Demand Calculation Sheet

APPROVED

Job Details

Name: 22 Johnson St, Tuakau, Waikato
 Street and Number: 22 Johnson St, Tuakau, Waikato
 Lot and DP Number: Lot 26 DP 354076
 City/Town/District: waikato
 Designer: AY
 Company: DESIGN
 Date: Friday, 25 March 2022

Building Specification

Number of Storeys 2
 Floor Loading 2 kPa
 Foundation Type Slab

	Upper	Lower
Cladding Weight	Light	Heavy
Roof Weight	Light	Light
Room in Roof Space	No	No
Roof Pitch (degrees)	22.5	22.5
Roof Height above Eaves (m)	2.0	0.3
Building Height to Apex (m)	7.6	
Ground to Lower Floor (m)	0.2	
Lower to Upper Floor (m)		2.7
Average Stud Height (m)	2.7	2.4
Building Length (m)	9.8	9.8
Building Width (m)	16	16
Building Plan Area (m ²)	106.2	106.2

Building Location

Wind Zone = High

Earthquake Zone 1

Soil Type C (Shallow)
 Annual Prob. of Exceedance: 1 in 500 (Default)

Bracing Units required for Wind

	Along	Across
Upper Level	839	470
Lower Level	1803	1061

Bracing Units required for Earthquake

	Along & Across
Upper Level	325
Lower Level	714

GIB EzyBrace® Bracing Software

Waikato District Council
 Building Consent Number
 BLD2096/01

Lower Level Along Resistance Sheet

APPROVED

Job Name: 22 Johnson St, Tuakau, Waikato

									Wind	EQ
									Demand	
									1803	714
									Achieved	
Line	Element	Length (m)	Angle (degrees)	Stud Ht. (m)	Type	Supplier	Wind (BUs)	EQ (BUs)	1974	1855
A	1	2.00		2.4	PF	PF	300	300	109%	260%
										300 OK
B	1	4.10		2.4	BLK-1.5-3	BLK	410	410		
	2	3.60		2.4	GS1-N	GIB®	248	216		
									658 OK	626 OK
C	1	3.30		2.4	BL1-H	GIB®	422	343		
										422 OK
D	1	0.70		2.4	BL1-H	GIB®	73	71		
	2	0.80		2.4	BL1-H	GIB®	87	82		
	3	1.70		2.4	BL1-H	GIB®	218	177		
									377 OK	329 OK
E	1	1.80		2.4	EP1-0.4	ECOPLY	144	171		
	2	0.90		2.4	EP1-0.4	ECOPLY	72	86		
External Length = 5									216 OK	257 OK

GIB EzyBrace® Bracing Software

Waikato District Council
 Building Consent Number
 BLD2096/01

Lower Level Across Resistance Sheet

APPROVED

Job Name: 22 Johnson St, Tuakau, Waikato

Line	Element	Length (m)	Angle (degrees)	Stud Ht. (m)	Type	Supplier	Wind (BUs)	EQ (BUs)	Wind	EQ
									Demand	Demand
									2326	2277
									219%	319%
1	1	6.00		2.4	BLK-0.75-1.5	BLK	252	252		
									252 OK	252 OK
2	1	10.00		2.4	BLK-3	BLK	1500	1500		
									1500 OK	1500 OK
3	1	1.50		2.4	GS1-N	GIB®	104	90		
	2	1.60		2.4	GS1-N	GIB®	110	96		
	3	1.20		2.4	GS1-N	GIB®	83	72		
					External Length =	6			297 OK	258 OK
4	1	0.40		2.4	GS1-N	GIB®	21	23		
	2	1.20		2.4	GS1-N	GIB®	83	72		
	3	0.60		2.4	BL1-H	GIB®	59	61		
	4	0.50		2.4	GS1-N	GIB®	28	29		
	5	0.80		2.4	BL1-H	GIB®	87	82		
					External Length =	16			278 OK	267 OK

Custom Wall Elements

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Supplier	System	Min. Length m	Wind BUs/m	EQ BUs/m
PF	PF	1	200	200
ecoply	EPG-0.4	0.4	100	115
anchor pile	anchor pile	1	160	120
braced pile	braced pile	1	160	120
ECOPLY	EP1-0.4	0.4	80	95
BLK	BLK-0.75-1.5	1	42	42
BLK	BLK-1.5-3	1	100	100
BLK	BLK-3	1	150	150
ECOPLY	EP1-0.6	0.6	95	105
ECOPLY	EP1-1.2	1.2	120	135

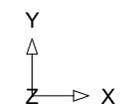
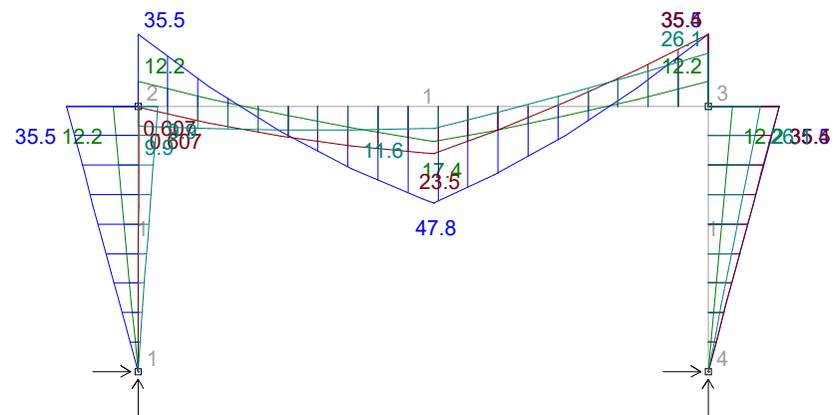
Job: 220952-LW-22 Johnson St, Tuakau, Waikato
 Portal Frame PF1

Load Cases:

- 5 C 1.35G (ULS)
- 6 C 1.2G + 1.5Q (ULS)
- 7 C 1.2G + 0.4Q + Wu (ULS)
- 8 C 0.9G + Wu (ULS)

Sections:

- 1 250PFC Y



theta: 270 phi: 0

Bending Moment, Mz

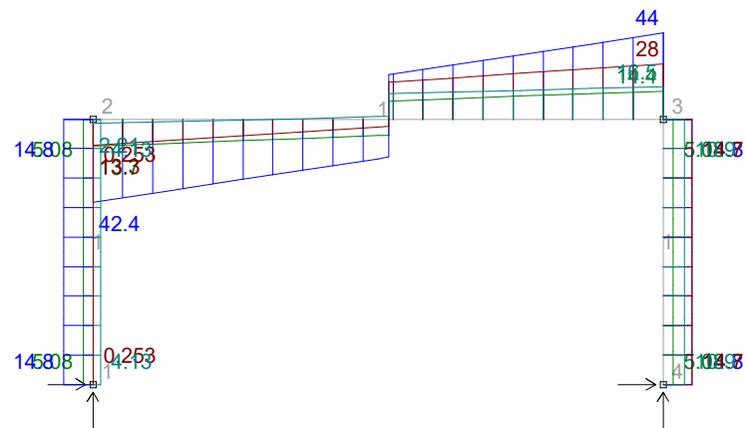
Job: 220952-LW-22 Johnson St, Tuakau, Waikato
 Portal Frame PF1

Load Cases:

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- 6 C 1.2G + 1.5Q (ULS)
- 7 C 1.2G + 0.4Q + Wu (ULS)
- 8 C 0.9G + Wu (ULS)

Sections:

- 1 250PFC Y



Y
 ↑
 Z → X

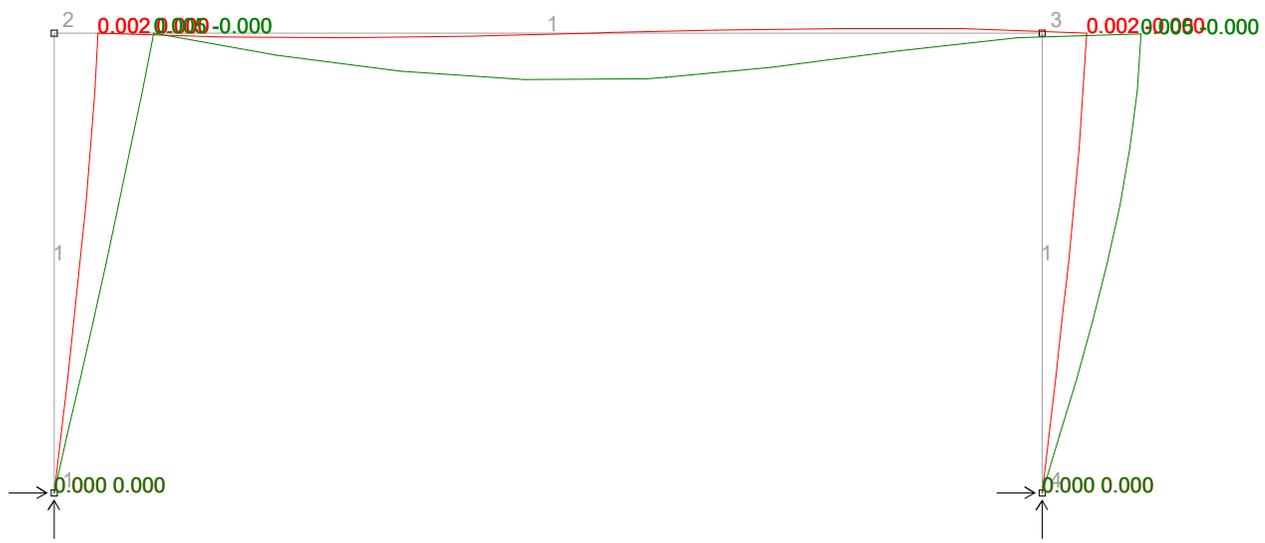
theta: 270 phi: 0

Shear Force, Fy

Job: 220952-LW-22 Johnson St, Tuakau, Waikato
 Portal Frame PF1

Load Cases:
 13 C 0.3Eu (SLS)
 14 C G + 0.68Wu (SLS)

Sections:
 1 250PFC Y

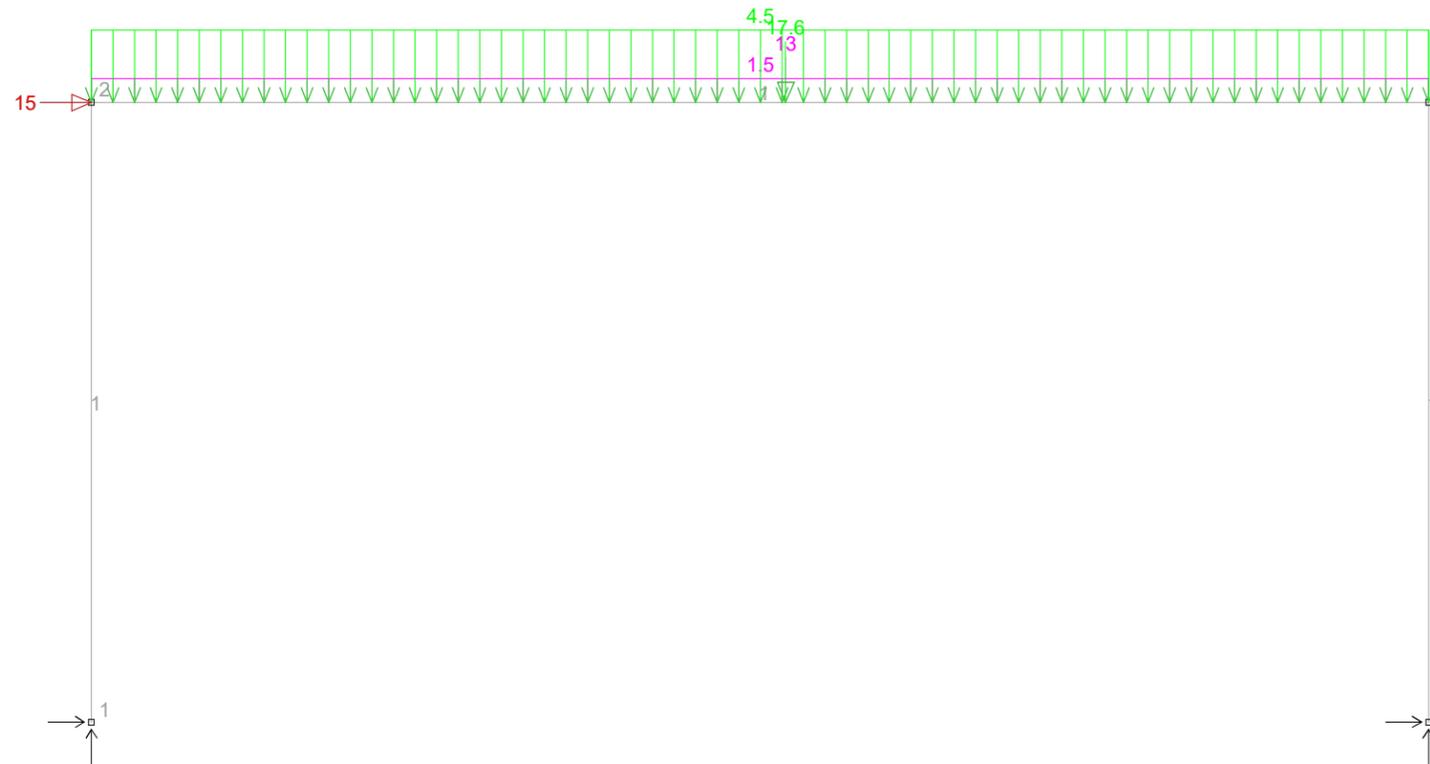


Y
 ↑
 Z → X
 theta: 270 phi: 0

Displaced Shape

Load Cases:
 1 P G
 2 P Q
 3 P Wu
 4 P Eu

Sections:
 1 250PFC Y



NODE REACTIONS - Node: 1 Restraint Code: 111000

Case	Fx	Fy	Fz	Mx	My	Mz
1	3.760	10.150	0.000	0.000	0.000	0.000
2	6.861	20.162	0.000	0.000	0.000	0.000
3	-7.510	-6.923	0.000	0.000	0.000	0.000
4	-7.510	-6.923	0.000	0.000	0.000	0.000
5	5.077	13.702	0.000	0.000	0.000	0.000
6	14.805	42.422	0.000	0.000	0.000	0.000
7	-0.253	13.322	0.000	0.000	0.000	0.000
8	-4.126	2.212	0.000	0.000	0.000	0.000
9	-1.691	9.275	0.000	0.000	0.000	0.000
10	3.760	10.150	0.000	0.000	0.000	0.000
11	4.803	14.113	0.000	0.000	0.000	0.000
12	-5.107	-4.708	0.000	0.000	0.000	0.000
13	-2.253	-2.077	0.000	0.000	0.000	0.000
14	-1.346	5.442	0.000	0.000	0.000	0.000

NODE REACTIONS - Node: 4 Restraint Code: 111000

Case	Fx	Fy	Fz	Mx	My	Mz
1	-3.760	10.650	0.000	0.000	0.000	0.000
2	-6.861	20.838	0.000	0.000	0.000	0.000
3	-7.490	6.923	0.000	0.000	0.000	0.000
4	-7.490	6.923	0.000	0.000	0.000	0.000
5	-5.077	14.378	0.000	0.000	0.000	0.000
6	-14.805	44.038	0.000	0.000	0.000	0.000
7	-14.747	28.038	0.000	0.000	0.000	0.000
8	-10.874	16.508	0.000	0.000	0.000	0.000
9	-13.309	23.825	0.000	0.000	0.000	0.000
10	-3.760	10.650	0.000	0.000	0.000	0.000
11	-4.803	14.587	0.000	0.000	0.000	0.000
12	-5.093	4.708	0.000	0.000	0.000	0.000
13	-2.247	2.077	0.000	0.000	0.000	0.000
14	-8.854	15.358	0.000	0.000	0.000	0.000

Y
 ↑
 Z → X
 theta: 270 phi: 0



SCHEDULE OF INSPECTIONS

(22 Johnson Street, Tuakau, Waikato)

Inspection Items	Elements to be inspected
1. Timber Pole Inspection	<ul style="list-style-type: none">• Pole details and bore hole details
2. RC Piles inspection	<ul style="list-style-type: none">• RC pile depth and reinforcements
3. Block wall footing and Ground beam	<ul style="list-style-type: none">• Footing reinforcement
4. Block wall inspection	<ul style="list-style-type: none">• Block wall
5. Concrete slab pre-pour	<ul style="list-style-type: none">• Slab reinforcement
6. Framing	<ul style="list-style-type: none">• SED beam and connection inspection

The actual number of site inspections depends on the Contractor's construction programme and council requirements. We recommend meeting with the contractor prior to construction to provide our technical interpretation of the plans and specification.

The construction monitoring level is **CM2 or as per Agreement with Owner**. At this level engineers only review, preferably at the earliest opportunity, a sample of each important work procedure, the material of construction and component for compliance with the requirements of the plans and specifications. It is appropriate to review a representative sample of each important completed work prior to enclosure or completion.

Inspections can be arranged by calling K Design Group on **09 930 9977**. A minimum of **48 hours' notice** is required prior to each inspection.

The Contractor must be satisfied that the works have been completed in accordance with the drawings and specification before confirming an inspection by the Engineer. If during construction any part of the work shows signs of distress, excessive deflection, conflict of structural components or other indications of a problem, the Contractor shall immediately notify the Engineer who shall investigate and issue such instructions as are considered necessary.