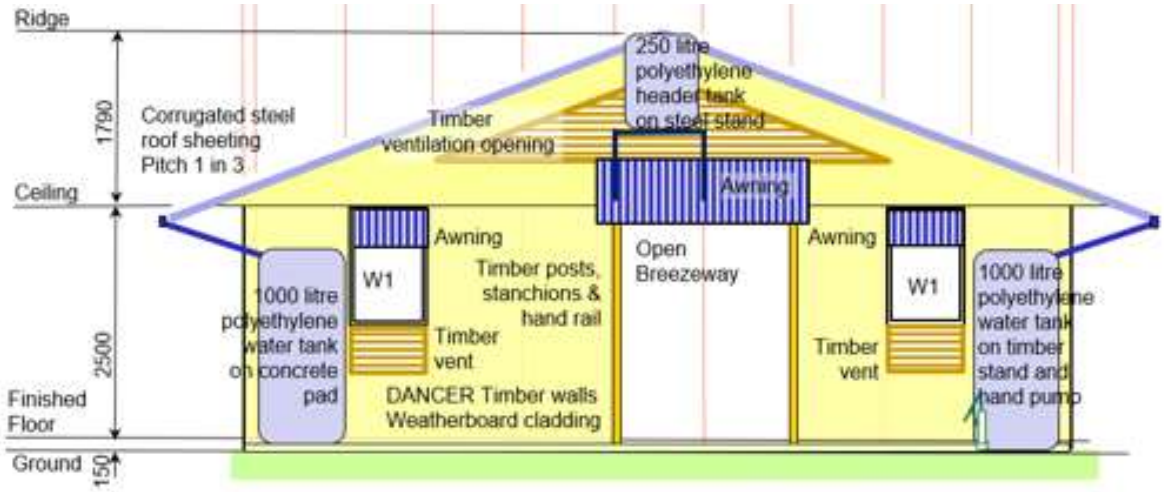
DANCER 8.4 x 5.7 Modular House

Timber roof + Timber superstructure + concrete slab-on-ground



Quasar
Management Services Pty Ltd

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Quasar Management Services[1] Pty Limited is consulting civil engineer and management consultancy (a wholly owned subsidiary of Partner Housing Australasia), providing probono and fee-for-service professional design and governance services, for village-based construction projects in the South Pacific.

[1] Quasar Management Services Pty Limited trading as Quasar Management Services

Contents

Revisions

This document, and its component parts, constitute a working file, which is updated progressively and periodically formalised as work is undertaken. The revision dates represent when the consolidated information herein was activated.

260327(TST)-1 27/3/26 Format update and routine update

Limited Structural Certification

Quasar
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1. The purpose and intention of this document are to describe, in **generic** terms, the design and detailing of the DANCER Building System for **a Generic DANCER 8.4 x 5.7 Modular House consisting of Timber roof + timber superstructure + concrete slab-on-ground).**
2. These designs are suitable for adaption for specific sites in the Papua New Guinea (PNG) Highlands and other non-cyclonic regions of PNG.
3. Adaptation of these generic designs for specific sites must be performed by a suitably qualified and experienced structural engineer, with the authority and responsibility to monitor and certify the design and construction.
4. Quasar Management Services, its employees, contractors and sub-consultants do not accept any responsibility for the execution, monitoring or certification of the adaptation process specified herein.
5. This certification is applicable only to the designs described herein, including the stated external dimensions, member sizes, materials, connection details, fixings and internal layout. Any deviation in any way from the designs and specifications herein renders this certification invalid for the particular project.
6. This certification is applicable only to the construction by builders (e.g. Vision for Homes [PNG]) that have been approved and trained by Quasar Management Services. This certification is rendered invalid for construction by all other builders or contractors.
7. The designs herein may not be used for applications that do not comply with the building, locations and designs listed below.

   Location: Papua New Guinea Generic

   Building: Small detached village building; Presenting a low degree of hazard to life and other property in case of failure;

   Single storey; Cladding on elevated braced timber frame complying with the DANCER design principles;

   Maximum dimensions: 16.5 x 8.4 m, 2.7 m storey, Maximum eaves height 6.0 m, Maximum ridge height 8.5 m, Maximum pitch 35^{o}

   Design: Design life 50 years; Annual probability of exceedance 1 in 500; Probability of exceedance during design life: 0.10

   Soil: Based on a rectangular footing 450 mm wide founded 600 mm deep in compacted soil.

Soil Type	AS 2870 Site Classification	Characteristic internal friction angle, degrees	Characteristic cohesion, kPa	Characteristic ultimate bearing capacity, kPa
Sand or rock	A	36^{o}	0 kPa	1060 kPa
Slightly reactive clay	S	30^{o}	3 kPa	670 kPa
Moderately reactive clay	M	27^{o}	6 kPa	640 kPa

   Permanent Loads: Elevated timber building, w = 2.5 kN/m^2 (floor area), Reinforced masonry building w = 3.5 kN/m^2 (floor area)

Imposed Loads: Floor load 1.5 kPa; Roof load 0.25 kPa

Wind: Most of the country except south-east. (refer also to map for reduced velocities)

Noncyclonic Level I $V_{u\ 500\ (3,10)}$ = 40 m/s $k_{p\ 500}$ = 1.0, $k_{p\ 250}$ = 0.90

Resulting in wind Classification of N2 or N1 (to AS 4055)

Earthquake: Probability $k_{p\ 500}$ = 1.0, $k_{p\ 250}$ = 0.75; Hazard Z_{500} = As per table below; Subsoil = C; Ordinate $C_{h(T1)}$ = 3.68; Ductility, μ = 2.00; Performance, S_p = 0.77

Location	Hazard Z_{500}
Zone 3 (Moderate Hazard) – Central region of the mainland, Northern Province, D'Entrecasteaux and Trobriand Islands, Northern New Ireland and Admiralty Islands (Includes Mendi, Kerema, Klunga, Wabag, Mt Hagen, Kundiawa, Goroko, Bulolo, Wau, Popondetta, Lombrum, Lorengau, Kayieng)	0.24
Zone 4 (Very Low Hazard) – Papuan Peninsula - Louisiade Archipelago and St. Mathias Group (Includes Daru, Port Moresby, Alotau)	0.16

Tsunami: Not applicable. For each site, determine that the combination of distance from high water mark, height of finished floor above mean sea level, distance from high earthquake area (Z > 0.4), are such that the Tsunami Risk Factor is zero.

Flood: Not applicable. For each site, determine that the distance to closest water course OR height of finished floor above normal level of water course OR funnelling of catchment runoff past structure are such that the Flooding Risk Factor is 0.

Subject to the conditions above, I certify that the generic building described in this document complies with: principles of structural mechanics for strength, stability and serviceability; and the specific requirements of the relevant Australian Standards.

Buildings outside the scope described above must be designed for the relevant applicable local wind classifications and other relevant factors, using the principles described herein, by a suitably qualified and experienced structural engineer.

This is not a Construction Certificate.

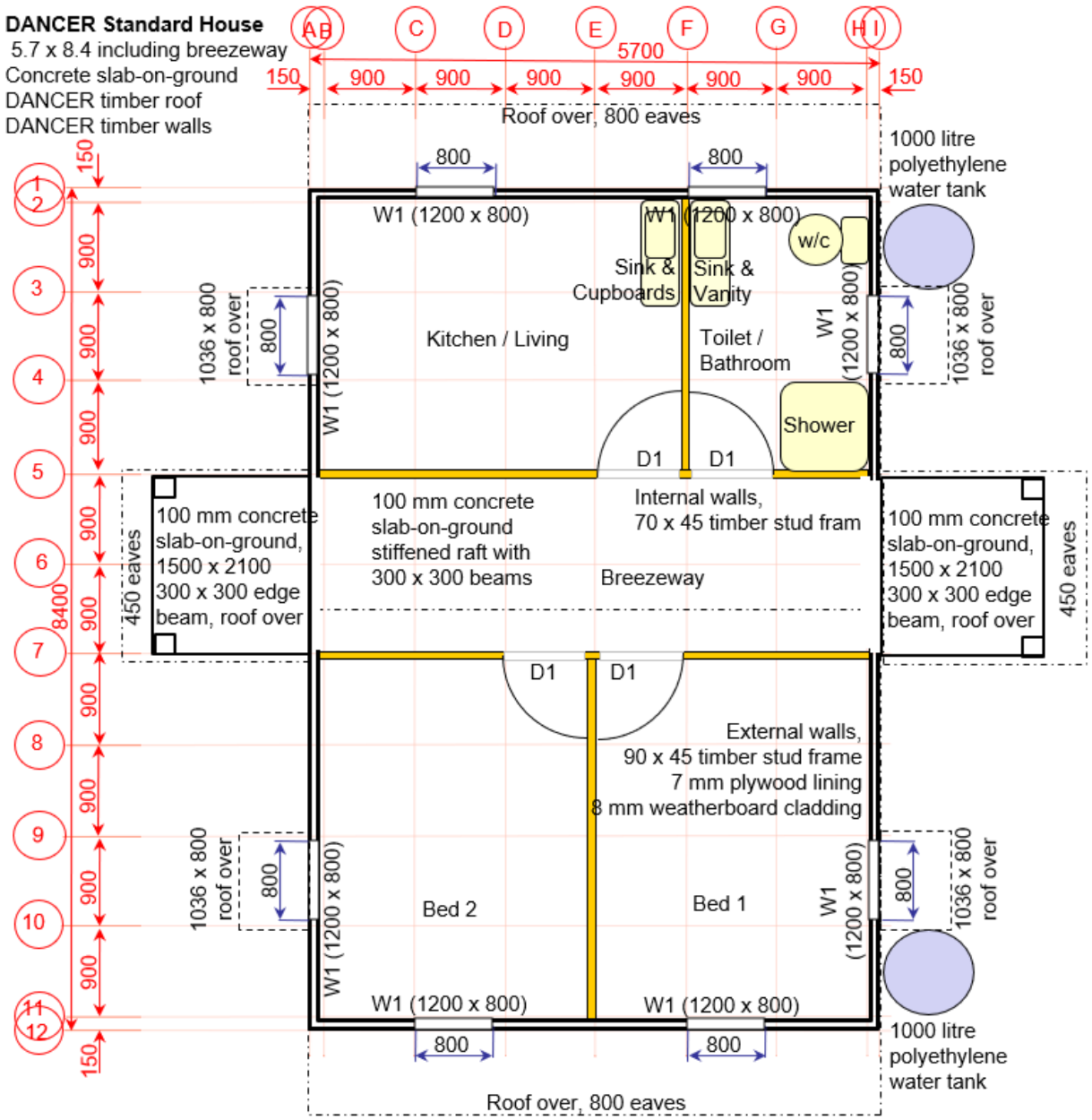
Rod Johnston

B Tech, M Eng Sc, MICD, MIE Aust, Life-Member Consult Australia
Managing Director – Quasar Management Services Pty Ltd

Part 1 – Planning and Architectural Design

Locality Plan

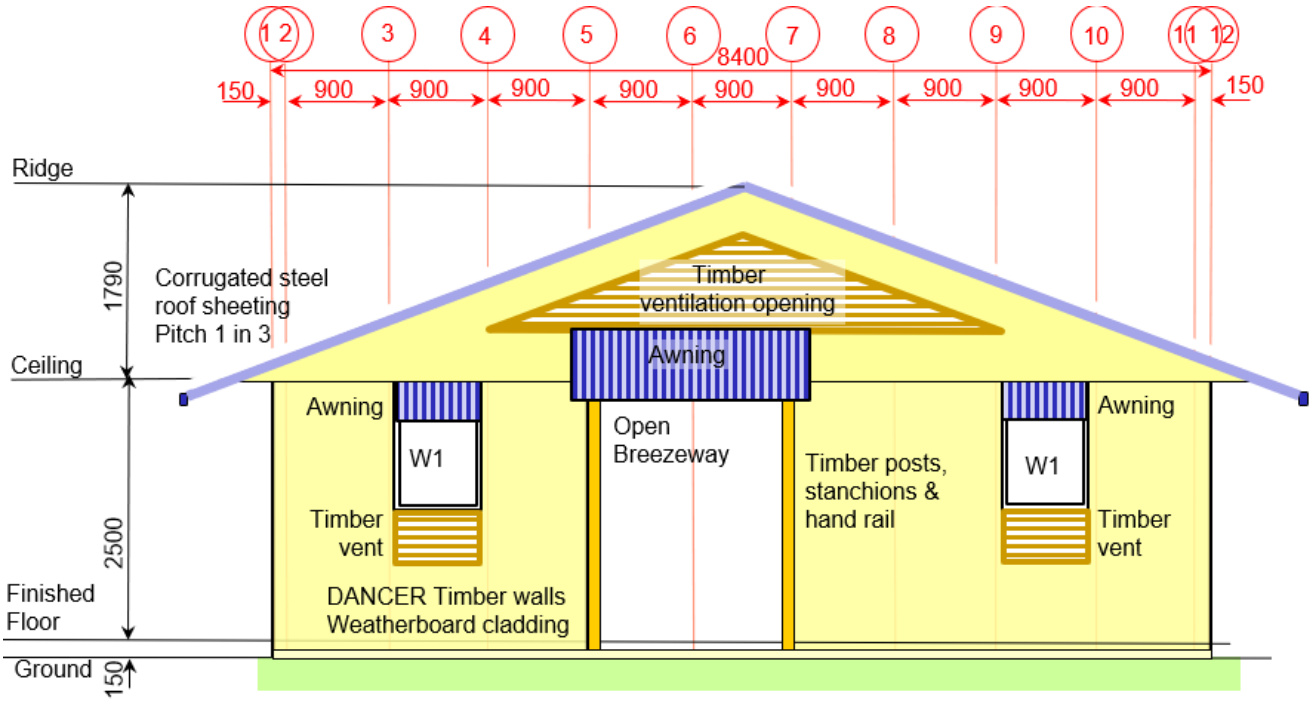
Site Plan



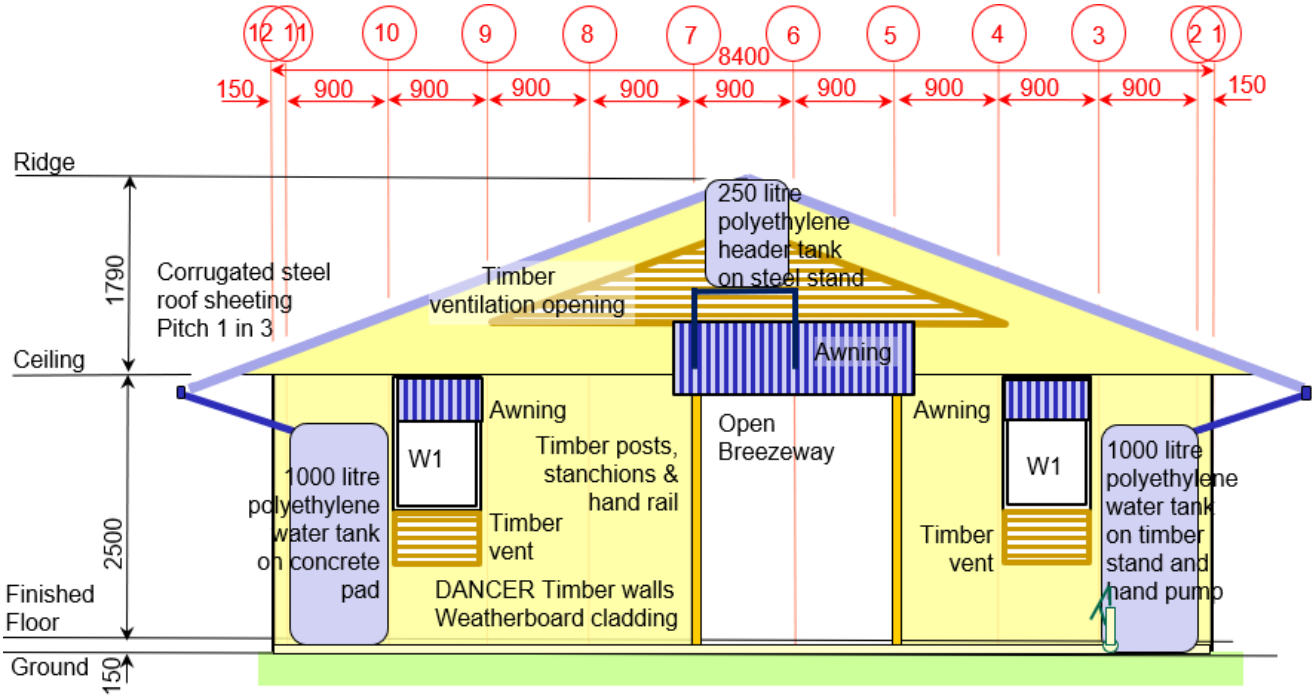
Floor Plan

This house has been designed to meet the dual criteria of cultural sensitivity and structural resistance to cyclonic wind and earthquake. The architectural features include a breezeway, increased roof slope, roof space ventilation, window and breezeway awnings and enlarged window ventilation. The house is capable of accommodating further cultural enhancement by the retrofitted palm leaf roof and palm leaf wall veneers if required.

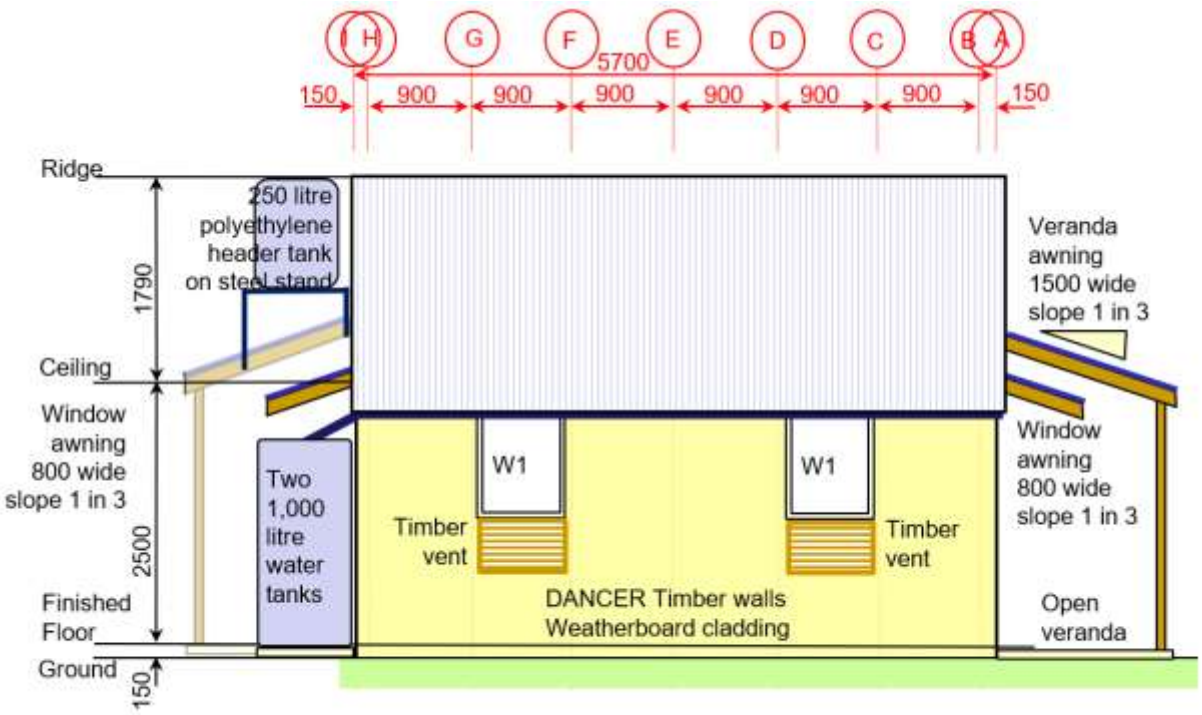
Elevations



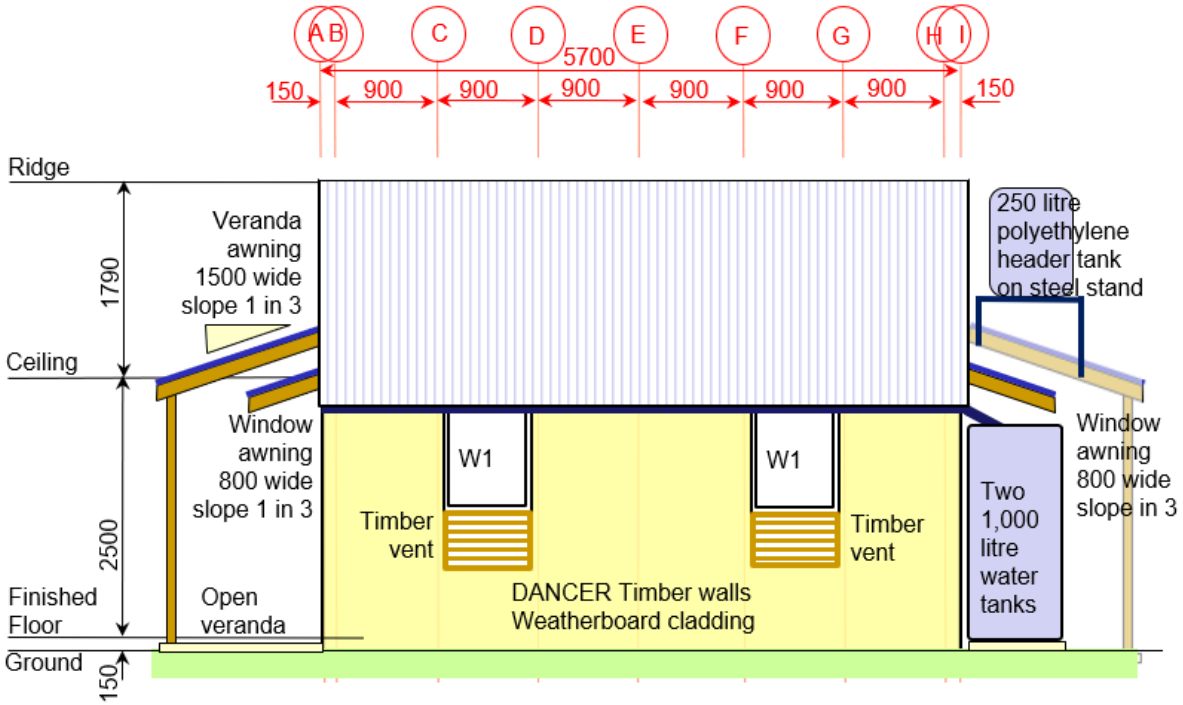
West Elevation



East Elevation

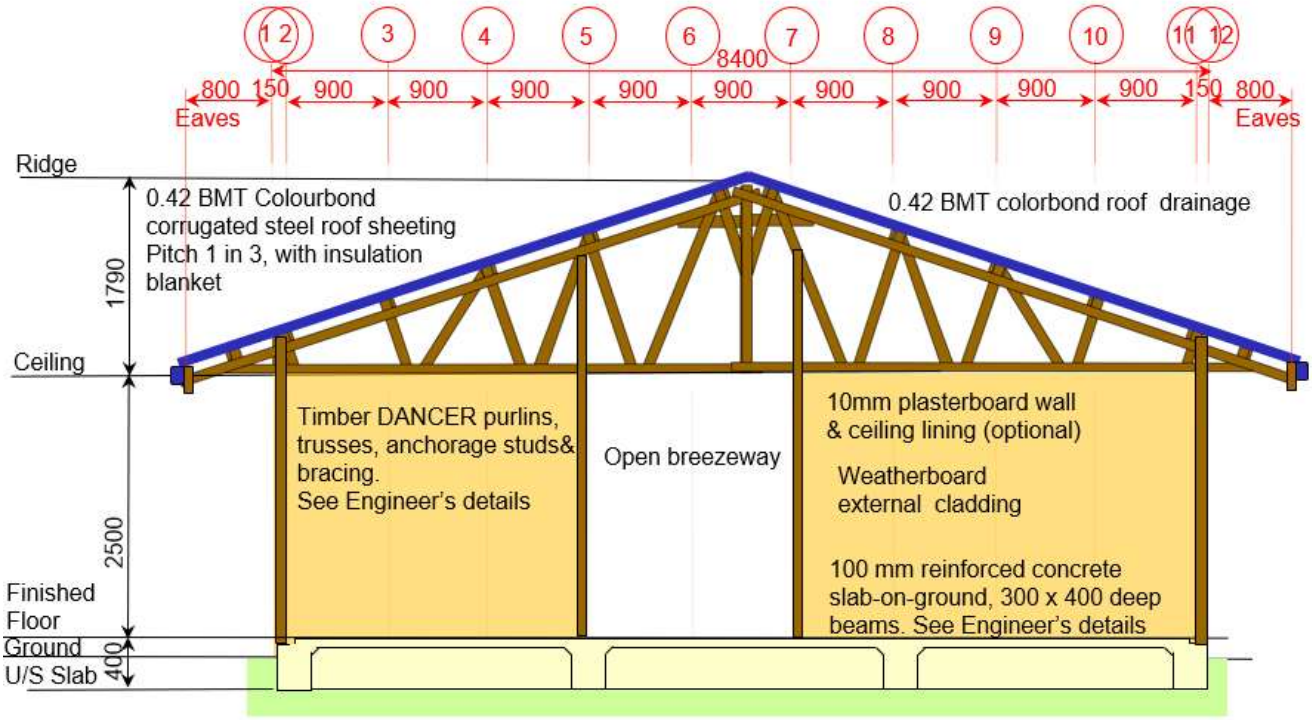


North Elevation



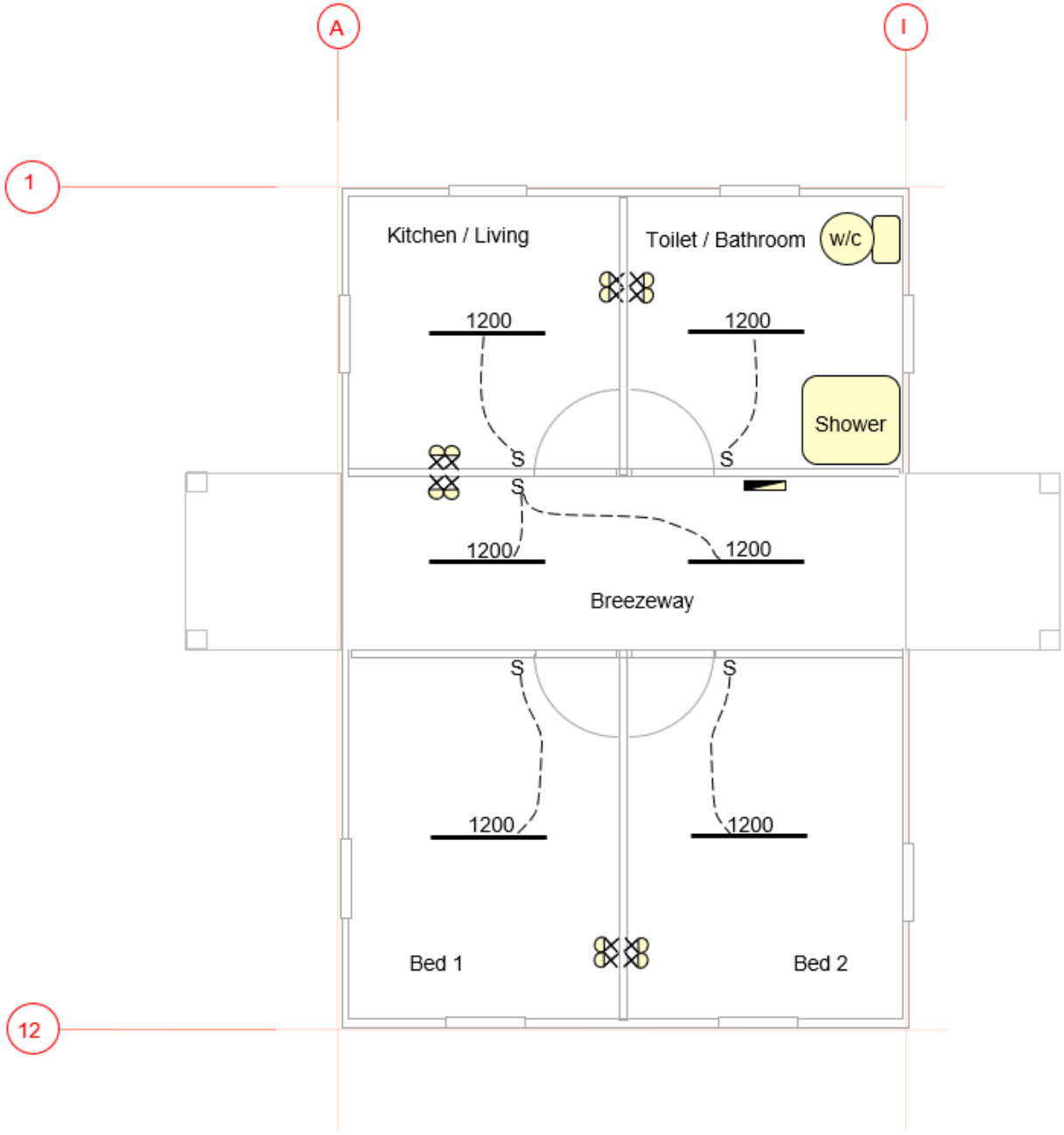
South Elevation

Section



Section

Electrical Services



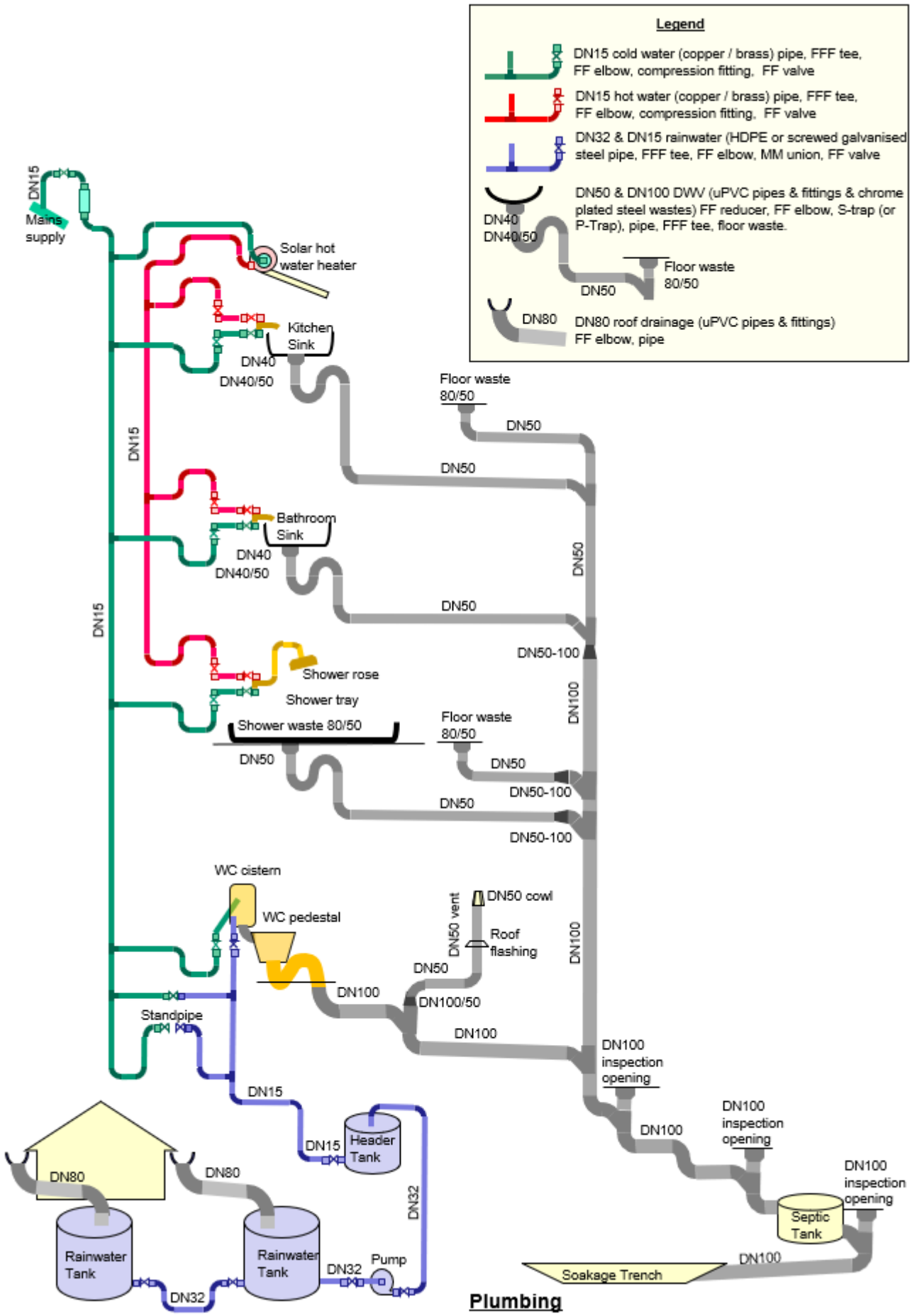
Notes:

1. All electrical installation shall comply with AS 3000 and the Specification, relevant to a 240 volt single-phase supply
2. Mains supply and/or solar power supply to be designed separately.

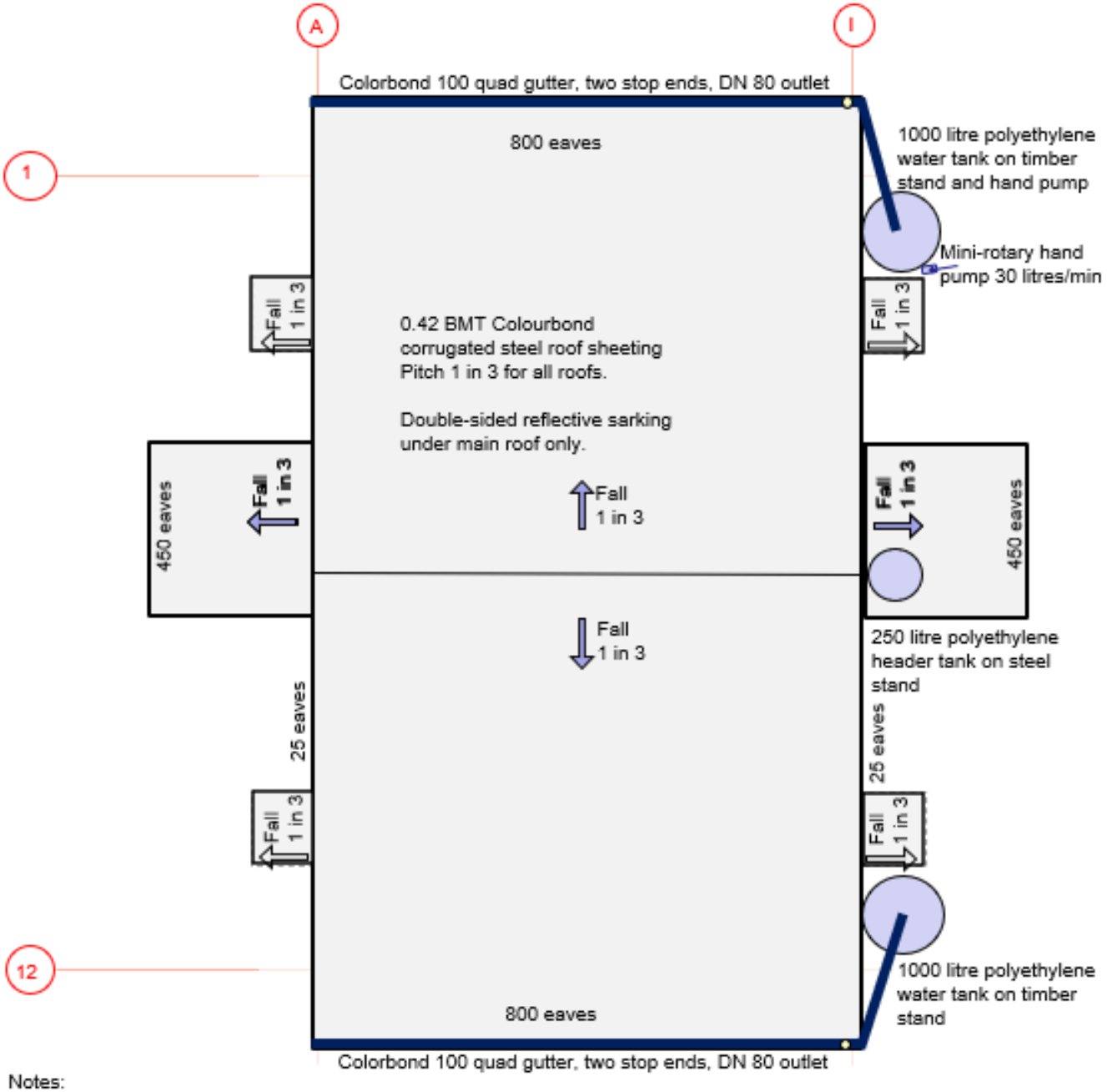
Electrical Services

S	Switch, 1200 above floor
	Double GPO, 300 above floor
	Switch board
1200	Light, 1 x 36W, 1222 x 26mm bare batten fluorescent tube

Plumbing


Legend
DN15 cold water (copper / brass) pipe, FFF tee, FF elbow, compression fitting, FF valve
DN15 hot water (copper / brass) pipe, FFF tee, FF elbow, compression fitting, FF valve
DN32 & DN15 rainwater (HDPE or screwed galvanised steel pipe, FFF tee, FF elbow, MM union, FF valve
DN50 & DN100 DWV (uPVC pipes & fittings & chrome plated steel wastes) FF reducer, FF elbow, S-trap (or P-Trap), pipe, FFF tee, floor waste.
DN40
DN40/50
DN50
Floor waste 80/50
DN80
DN80 roof drainage (uPVC pipes & fittings) FF elbow, pipe
DN15
Mains supply
Solar hot water heater
Kitchen Sink
DN40
DN40/50
Floor waste 80/50
DN50
DN50
DN15
Bathroom Sink
DN40
DN40/50
DN50
DN50
DN50-100
DN15
Shower rose
Shower tray
Shower waste 80/50
DN50
Floor waste 80/50
DN50
DN50-100
DN50
DN50-100
DN100
WC cistern
WC pedestal
DN50 vent
DN50 cowl
Roof flashing
DN50
DN100
DN100/50
DN100
DN100
Standpipe
DN15
DN15
Header Tank
DN32
DN80
DN80
Rainwater Tank
Rainwater Tank
DN32
Pump
DN32
DN100 inspection opening
DN100
DN100 inspection opening
DN100 inspection opening
Septic Tank
Soakage Trench
DN100
Plumbing

Roof Plumbing

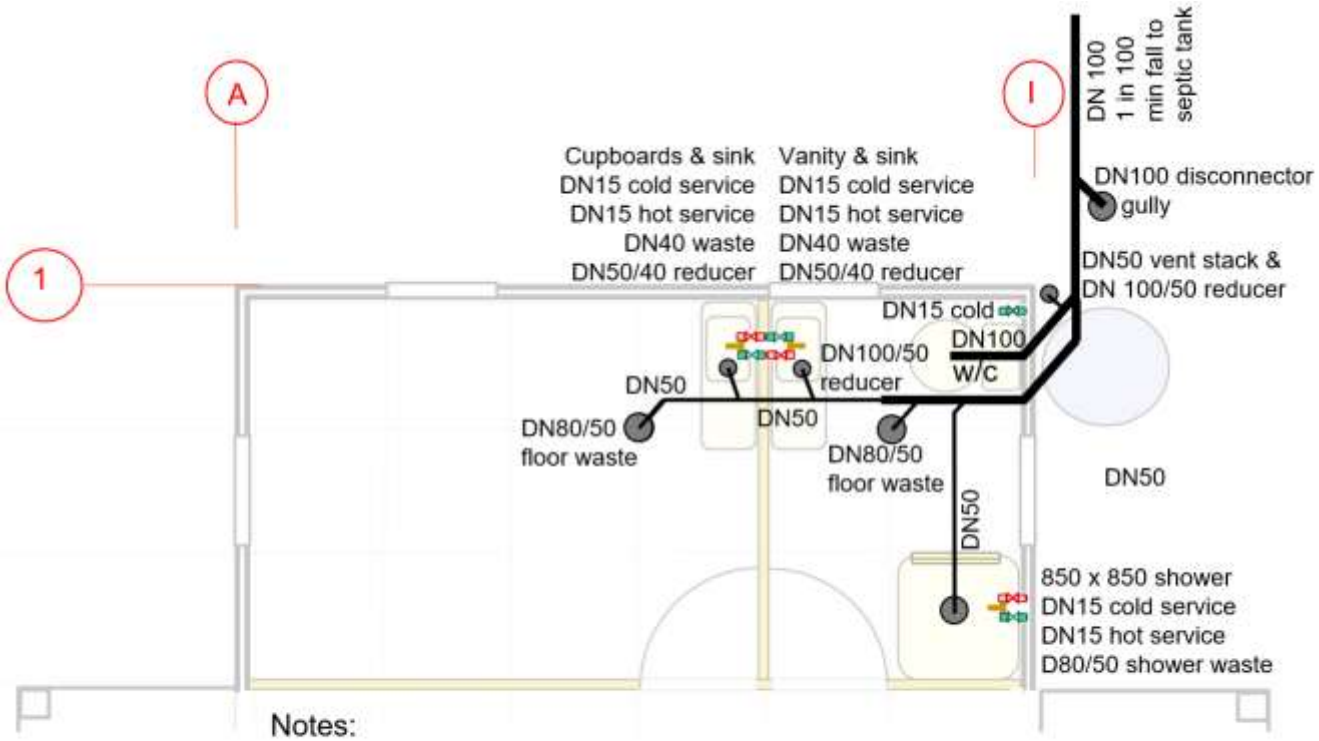


Notes:

1. All roofing – 0.42 BMT Colourbond corrugated steel roof sheeting (pitch 1 in 3), fixed with cyclone washers, 12-14x35 T17 HD/TG HH Class, top-lock hex galv roofing screws & plastic washers, screw spacing (main part of roof including 1.2 m from ends) – 80 mm (at every rib)
2. Sarking (for main roof only) – Double sided reflective insulation placed between roof sheet and timber purlins Roof Insulation (optional alternative to sarking for main roof only) - R1.8 reflective foil & glass fibre blanket
3. Eaves gutter and rainwater collection - DN80 roof drainage (uPVC pipes, inlet & FF 88 elbows). Refer to plumbing schematic for further details.
4. Colorbond 100 quad eaves gutter, Colorbond 100 quad stop ends, 12-14x35 T17 HD/TG HH Class 3 screws, Colorbond DN80 clip saddles
5. Colorbond steel 200 x 0.6 mm thick ridge flashing, Colorbond steel 0.6 mm thick barge moulds, fixings galv roofing nails 65 x 3.75mm and jolt head nails 125 x 5.6mm fixings for flashing & barge moulds

Roof Plumbing

Hot & Cold Water and Sanitary Plumbing



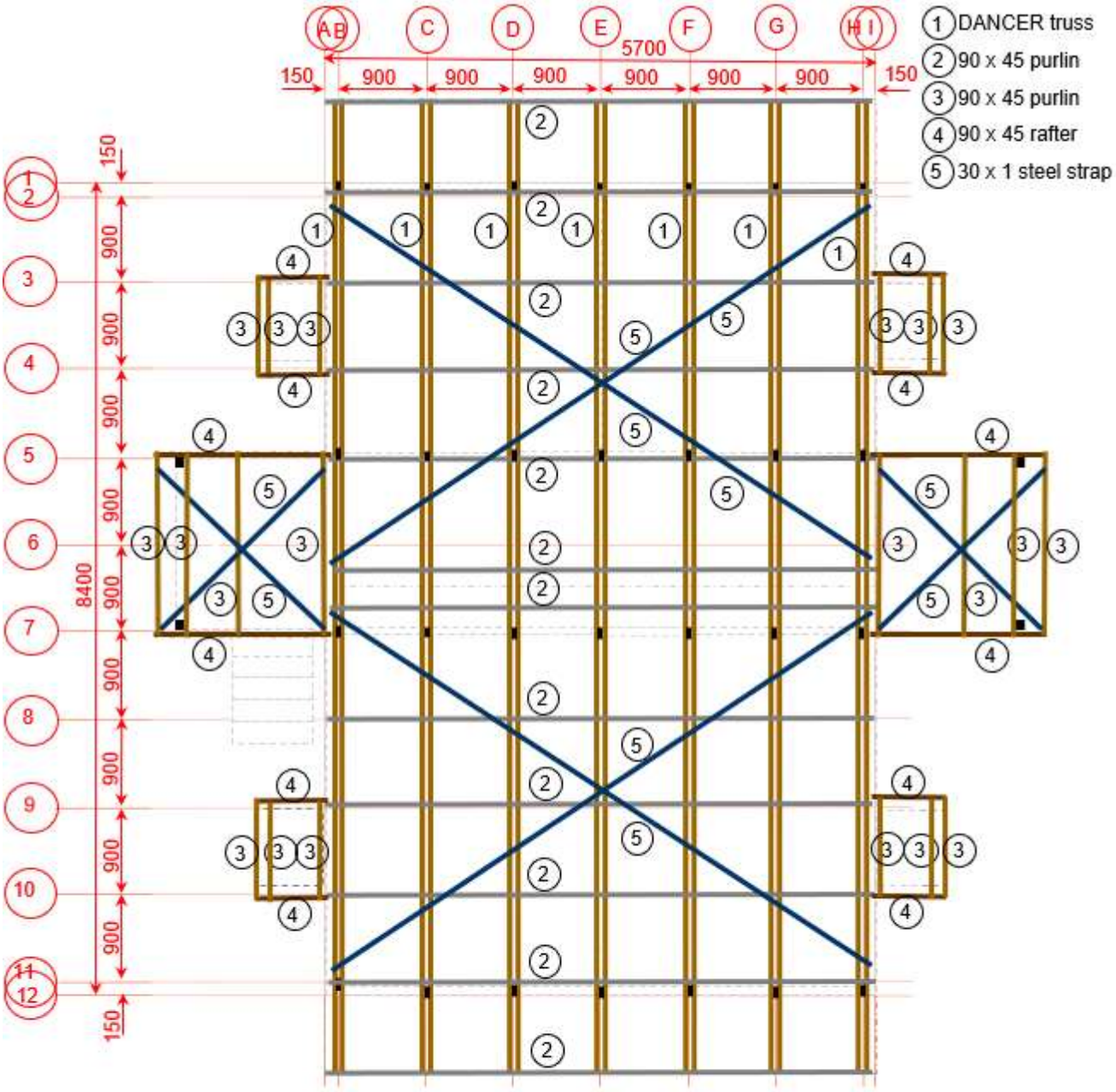
Notes:

1. All plumbing shall comply with AS/NZS 3500.5.

Hot & Cold Water and Sanitary Plumbing

Part 2 – Engineering Design

Timber Roof Framing



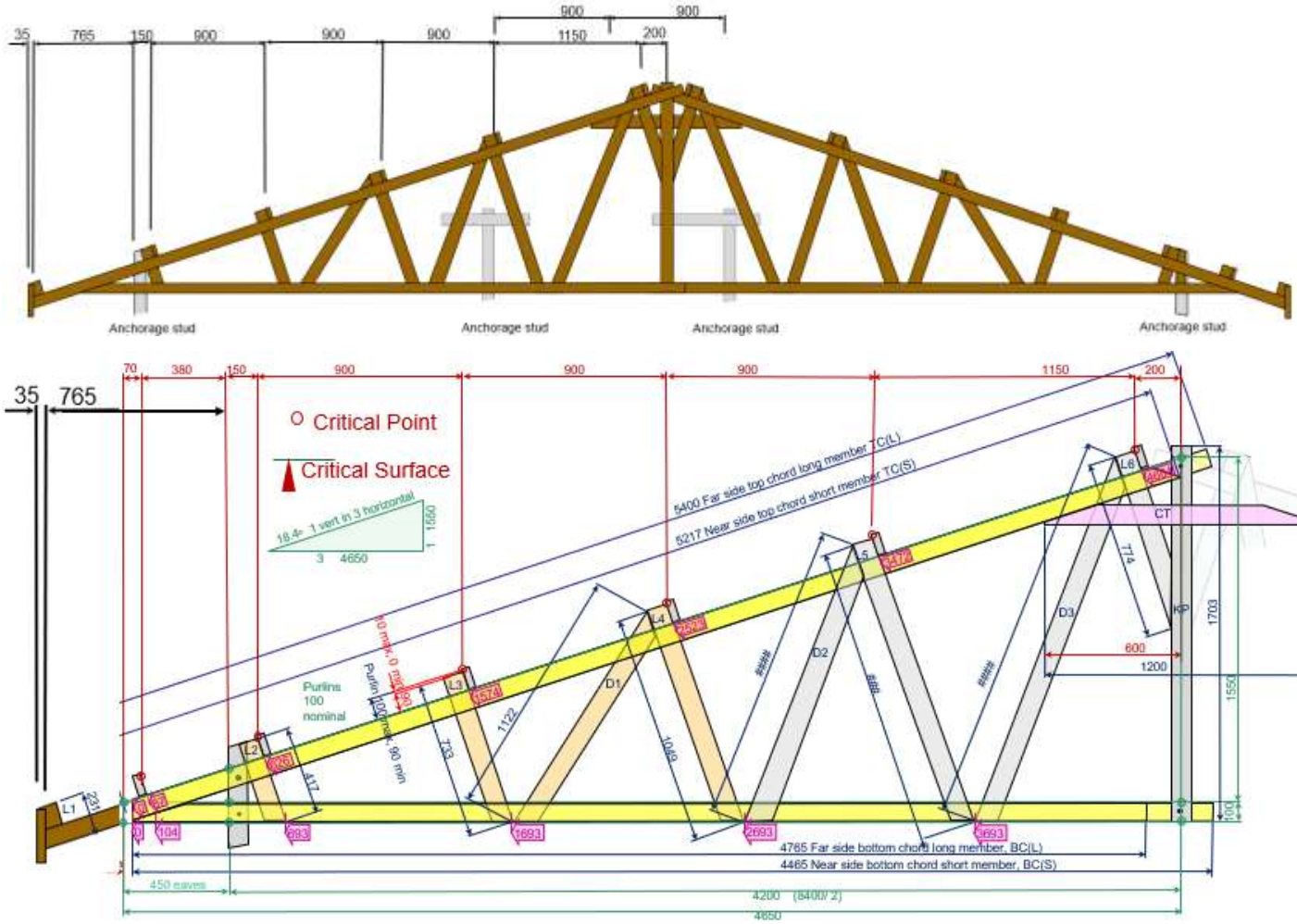
Notes:

1. All timber shall be graded F7, SD6, JD4 or stronger. Australian and New Zealand Seasoned Radiata Pine are deemed to meet this specification.
2. For all other items, substitution of other sizes must be approved by the Engineer.
3. Refer to Engineer's Details for fixings, connections and associated members.

Timber Roof Framing

Details of DANCER Trusses

The following dimensions are for the Standard **DANCER** 8.4 Truss, with eaves overhang of 800 mm.
All members shall be 90 x 45 MGP10 Strength group SD5, Joint group JD4 (or better)



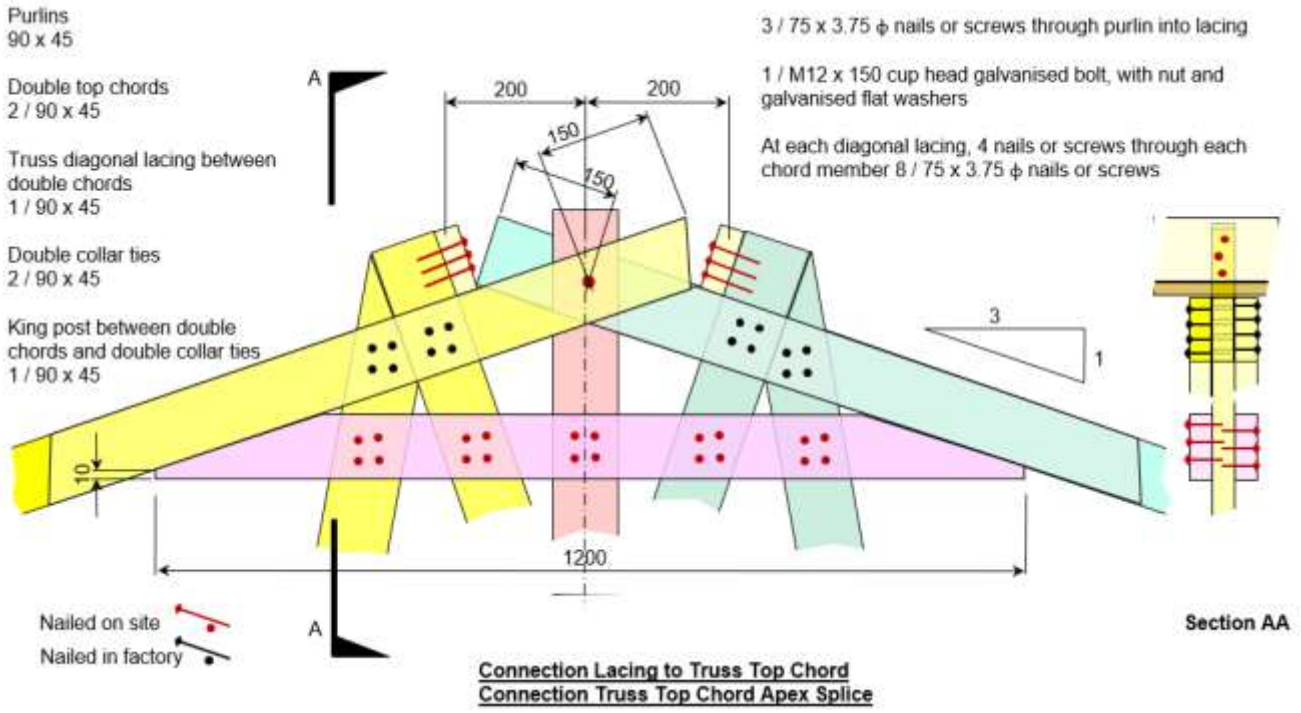
Roof Trusses		8400 span + 800 eaves				
Item	Component	Section mm	x	mm		Length mm
TC(L)	Truss Top Chord (or R	90	x	45	F7	5,417
TC(S)	Truss Top Chord (or R	90	x	45	F7	5,234
BC(L)	Truss Bottom Chord (a	90	x	45	F7	4,765
BC(S)	Truss Bottom Chord (a	90	x	45	F7	4,455
CT	Collar Tie	90	x	45	F7	1,200
KP	King Post	90	x	45	F7	1,735
L1	Lacing at eaves	90	x	45	F7	232
L2	Lacing at anchorage st	90	x	45	F7	417
L3	Lacing	90	x	45	F7	734
L4	Lacing	90	x	45	F7	1,050
L5	Lacing	90	x	45	F7	1,367
L6	Lacing	90	x	45	F7	760
D1	Diagonal	90	x	45	F7	1,129
D2	Diagonal	90	x	45	F7	1,357
D3	Diagonal	90	x	45	F7	1,777

DANCER Truss Bolted Apex Splice

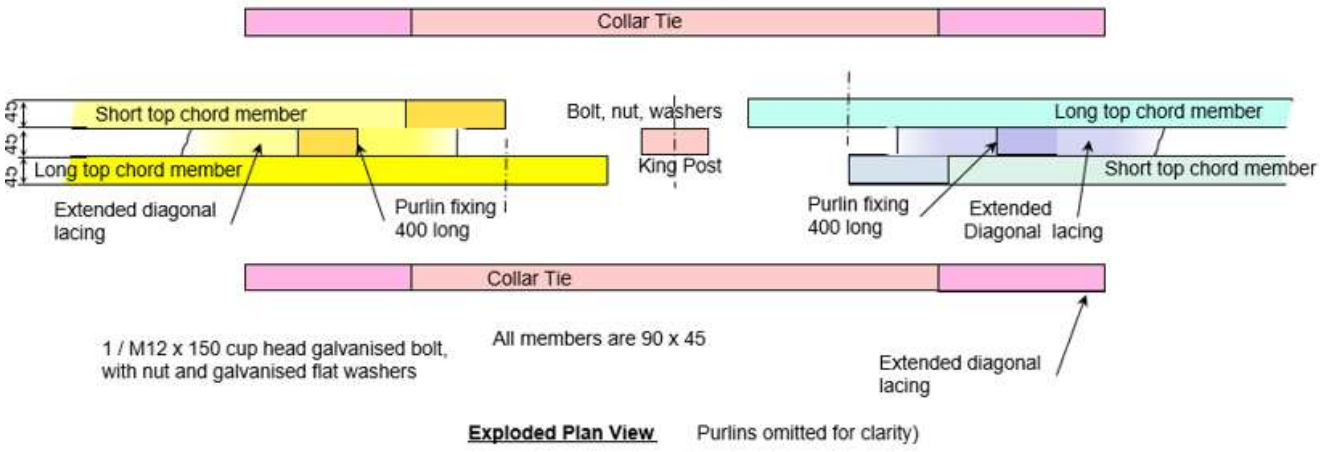
Trusses longer than 3.5 metres cannot be easily transported over significant distances.

They must be fabricated in two sections and joined on site. In this case the top chords must be joined with a bolted connection, and the bottom chords must be joined by a bolted connection.

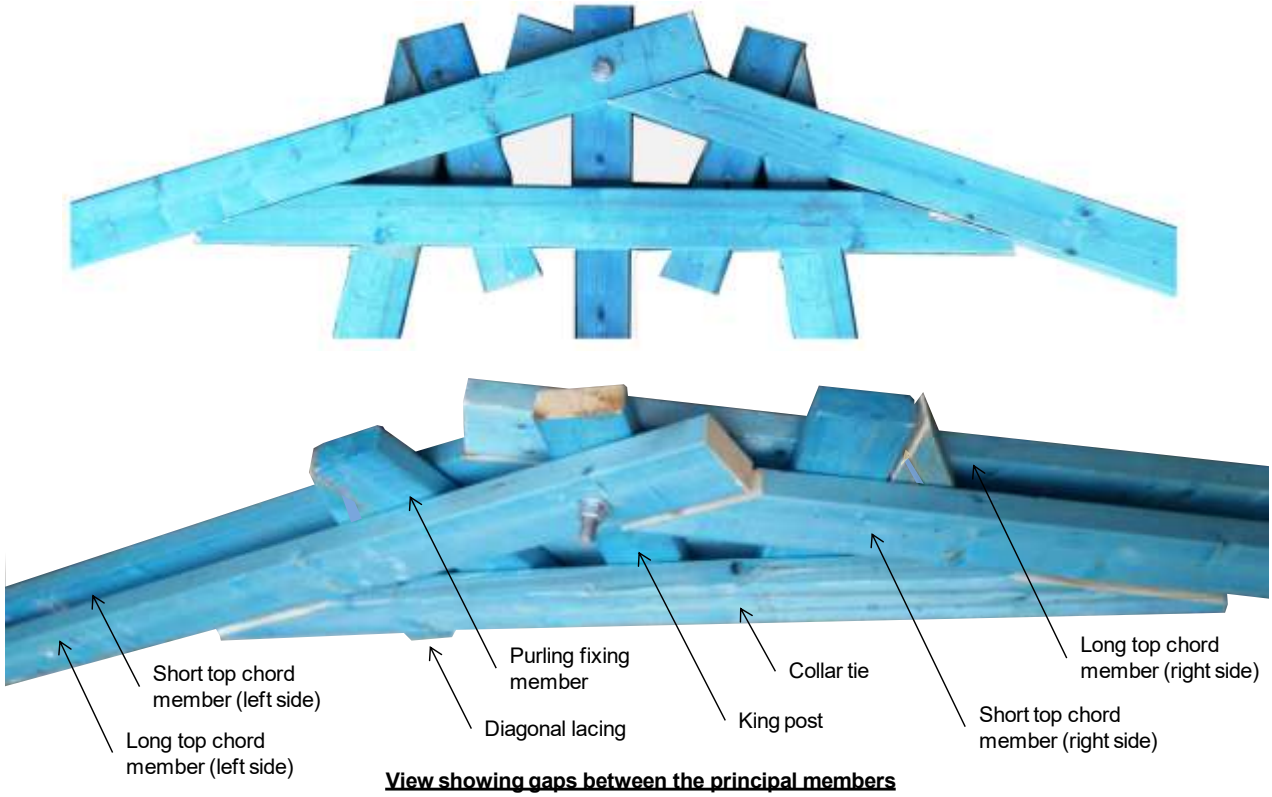
Bolted connections must not incorporate nails, since the premature failure of the nails could disrupt the timber and destroy the bolted connection before it has time to be effective.



Connection Lacing to Truss Top Chord
Connection Truss Top Chord Apex Splice



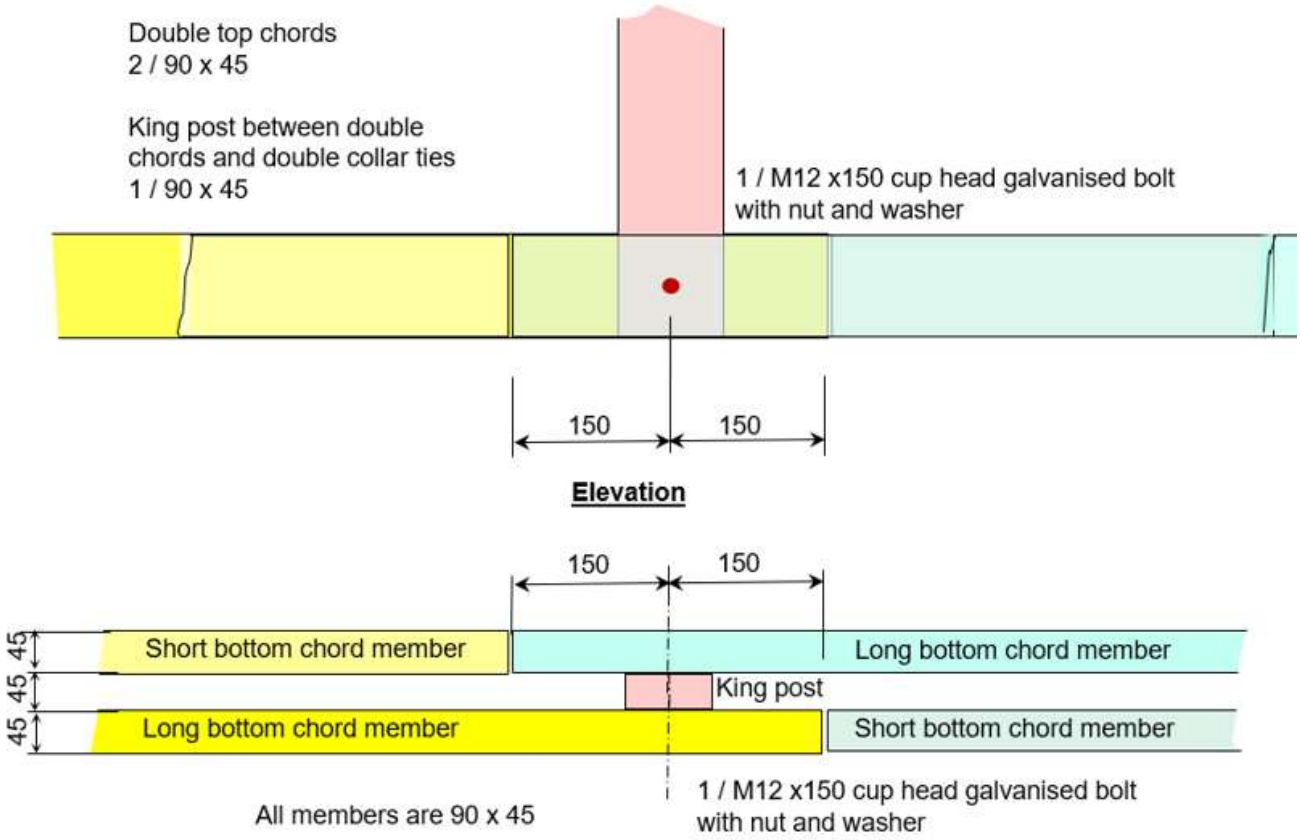
Exploded Plan View Purlins omitted for clarity)



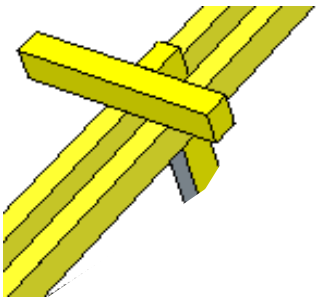
View showing gaps between the principal members

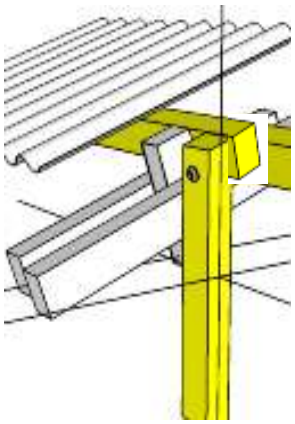
DANCER Truss Bolted Bottom Chord Splice

The Bottom Chords shall be spliced in a lapped double chord arrangement (similar to the top chord).

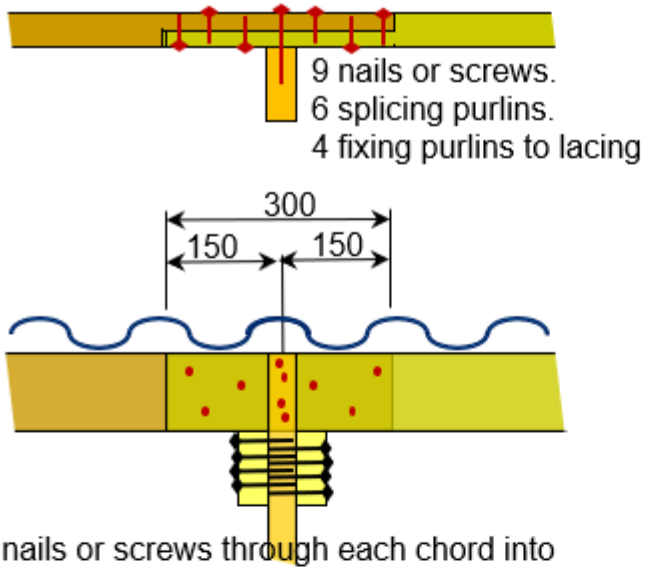


Connection Truss Bottom Chord Splice

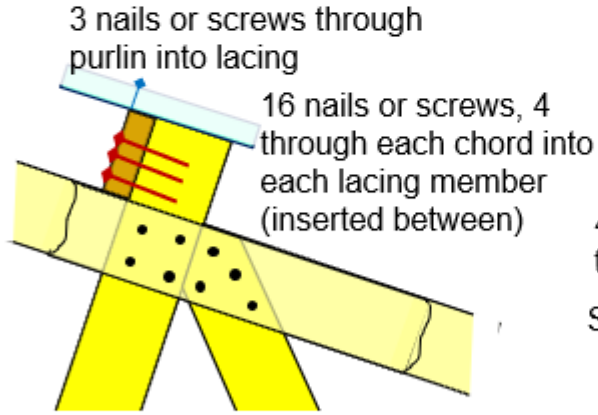




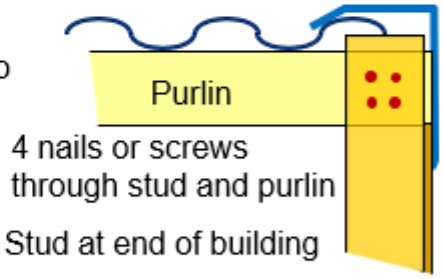
Purlin, Diagonal Lacing and Double Top Chord Connections



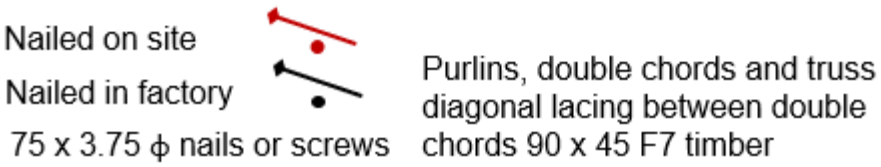
Purlin Splice (Preferred Detail)



Connection Purlin to Double Top Chord
Connection Lacing to Double Top Chord



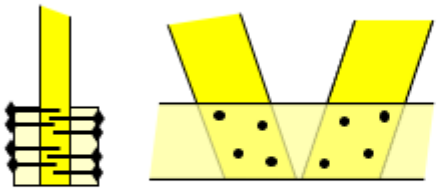
Connection Purlin to End Wall Stud



Top Chord, Lacing, Purlin Fixing and Purlin Splice

Double Bottom Chord, Anchorage Stud and Eaves Connections

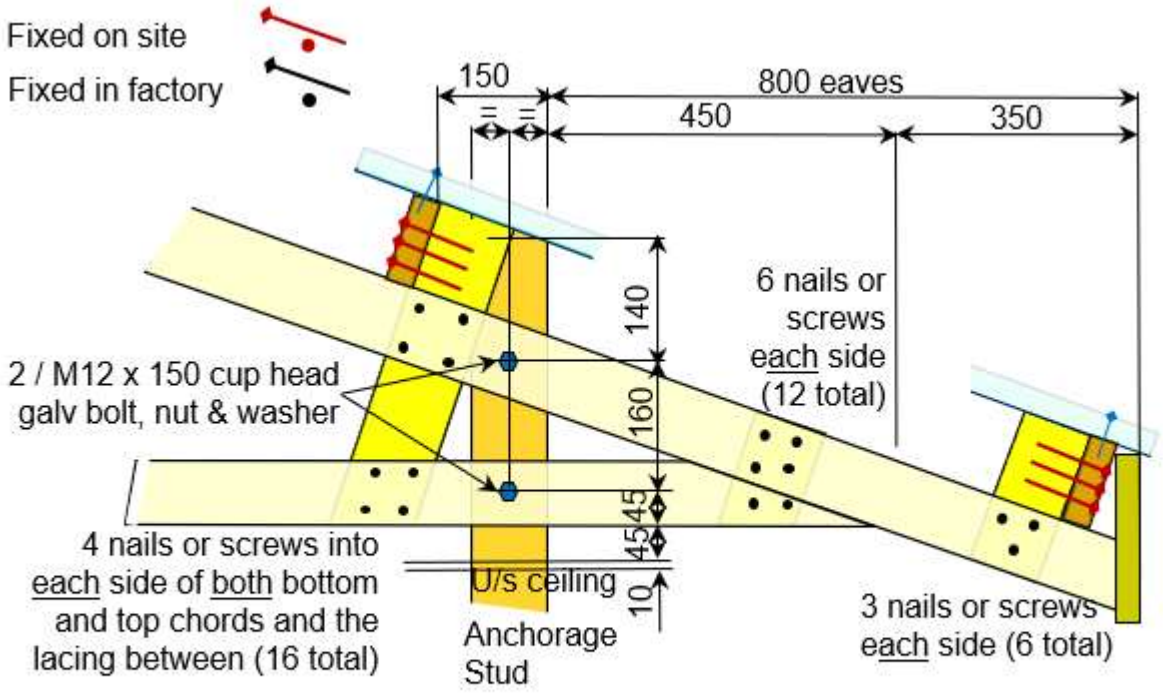
75 x 3.75 ϕ nails or screws Fixed in factory



Purlins, double chords and truss diagonal lacing between double chords are all 90 x 45 F7

4 nails or screws through <u>each</u> side of <u>both</u> bottom chords into lacing at <u>both lacing</u> (16 total)

<u>Connection of Lacing to Bottom Chords</u>



<u>Top Chord to Bottom Chord</u>
<u>Top Chord to Anchorage Stud</u>

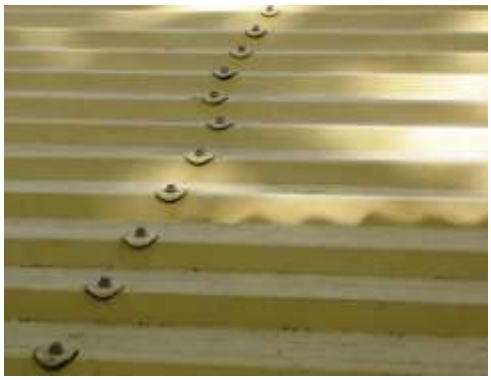
800 Eaves

Roof Fixings and Cyclone Washers

Cyclonic wind can suck roof sheeting (and wall sheeting) off the framing if there is an insufficient number of appropriate roofing screws, or if the screws have been installed without cyclone washers.

Roof sheets should be fixed through the high point of the ribs using long screws, not valley fixed. Roof sheets shall be laid in continuous lengths where practical, with the upper end turned up using the correct tool.

In very high wind areas, turn the sheets down into the eaves gutter at the lower end.



Refer to the Lysaght Design Manual

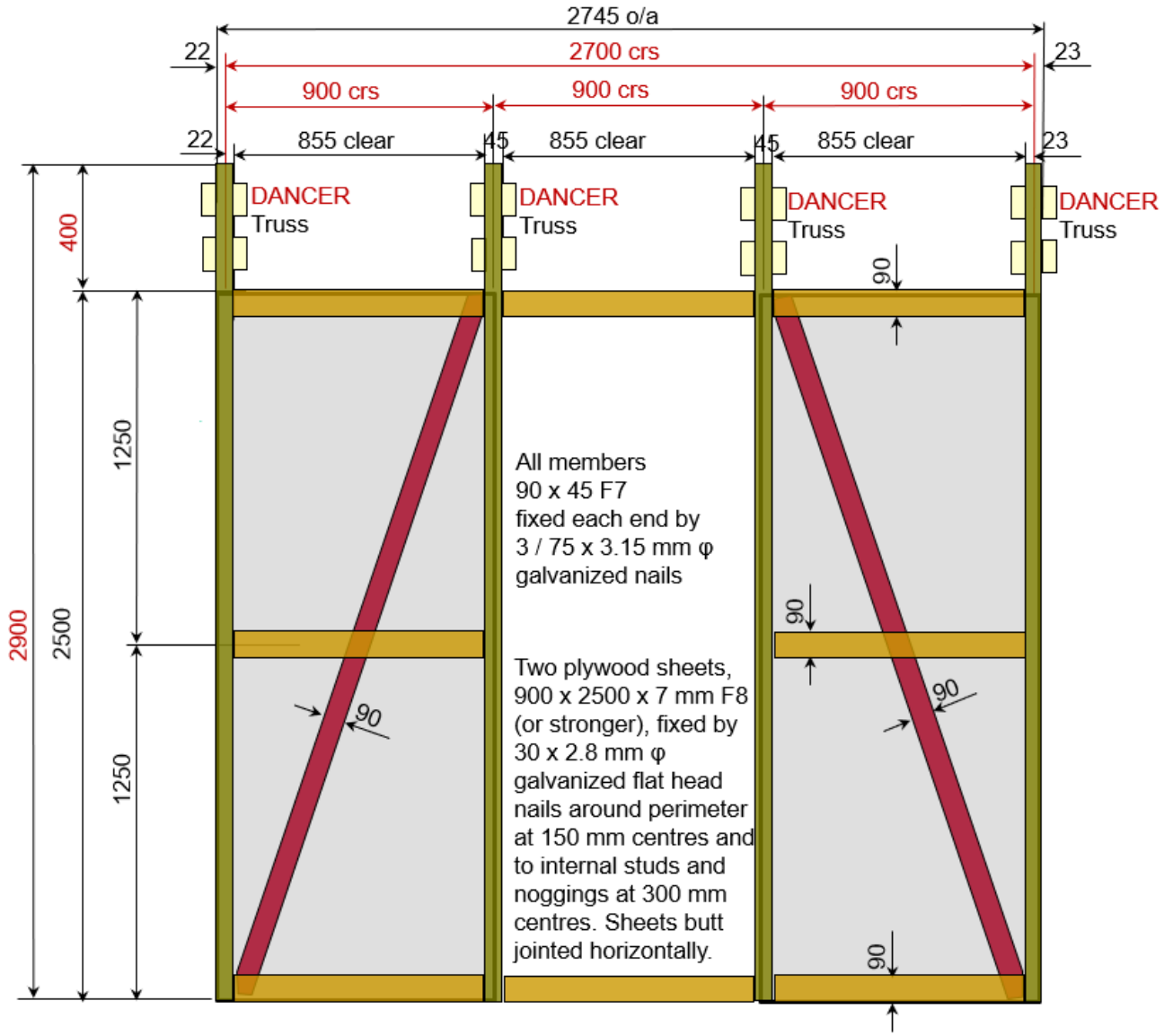
CUSTOM ORB®/CUSTOM BLUE ORB®

Table 4.2

CUSTOM ORB® 0.42mm BMT.

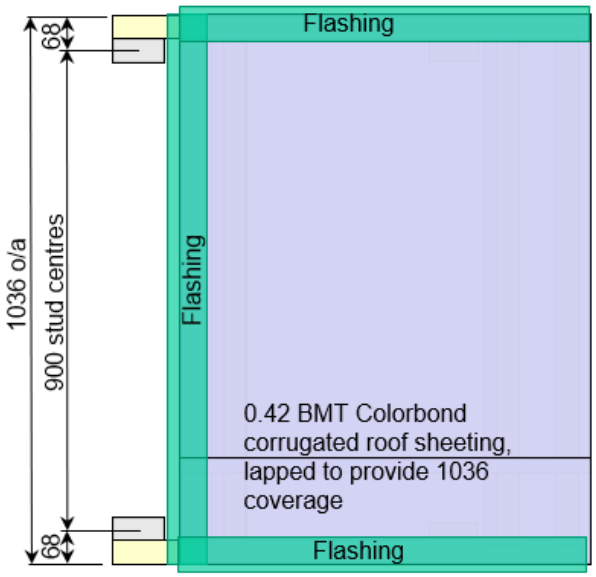
Span (mm)	Roof			
	Crest fixed	With cyclonic washers		
	3.75kPa	5.58kPa	8.21kPa	10.8kPa
450	OK	OK	OK	X
600	OK	OK	OK	X
750	OK	OK	OK	X
900	OK	OK	X	X

External DANCER Wall Framing

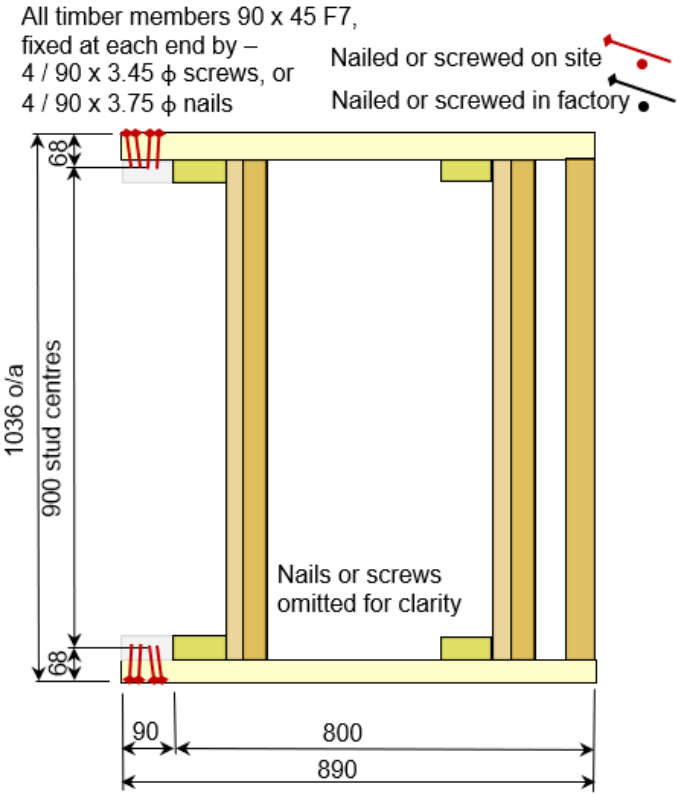


Typical Long Wall Framing, Trusses at 900 mm centres

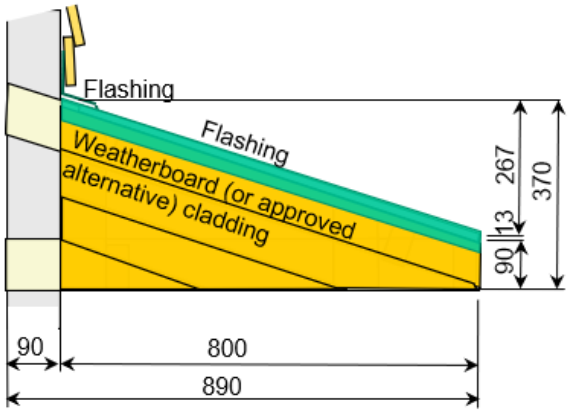
Window Shades



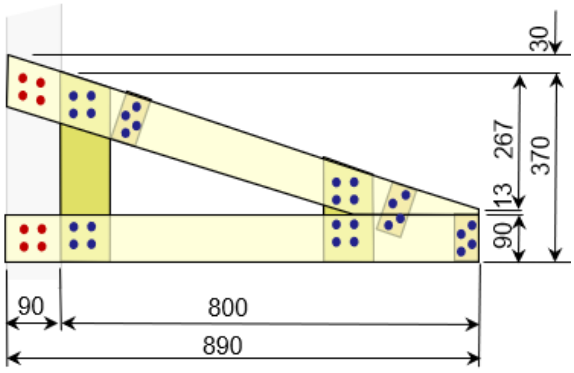
Plan of Window Shade



Plan of Window Shade Frame

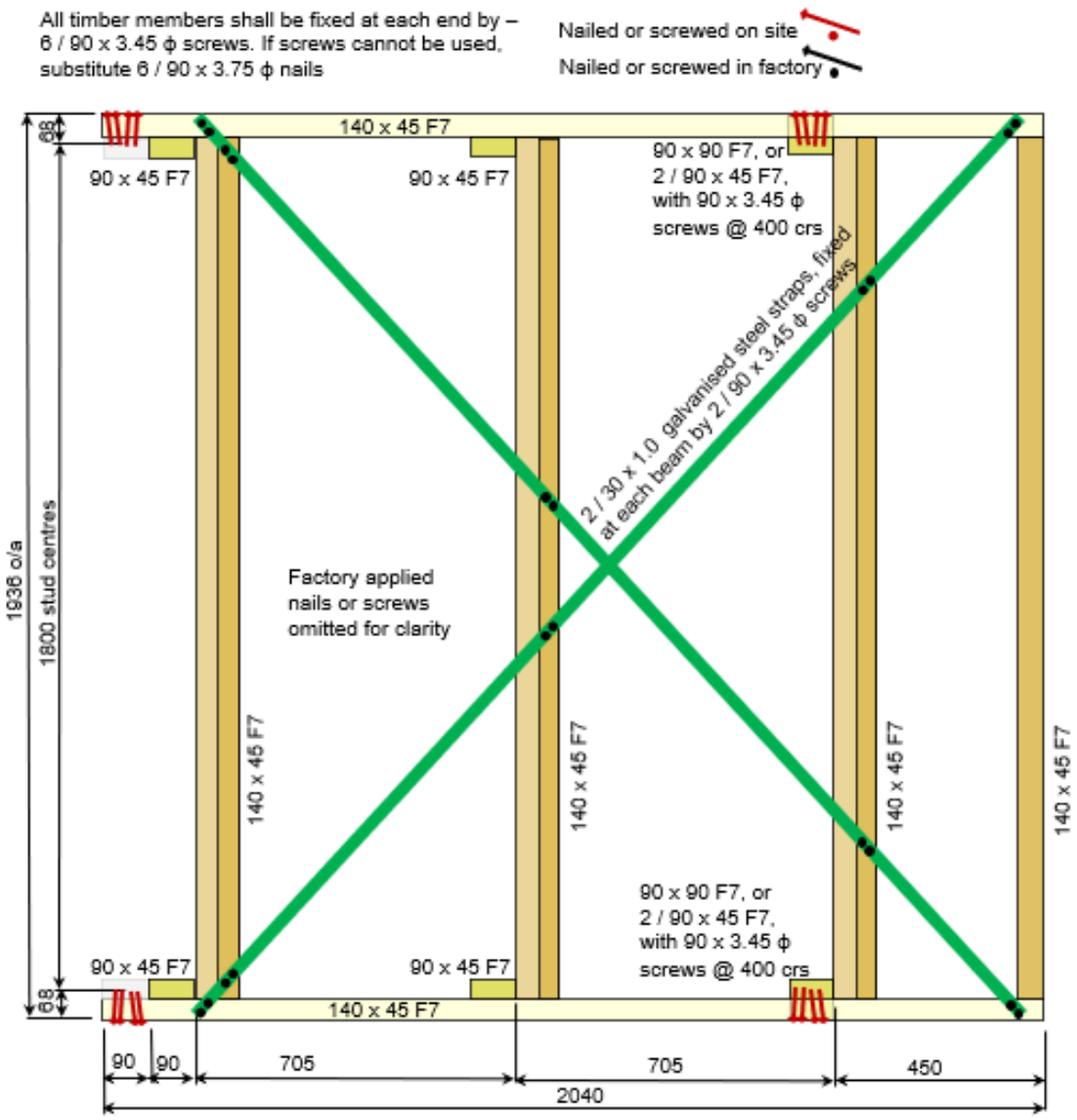


Elevation of Window Shade

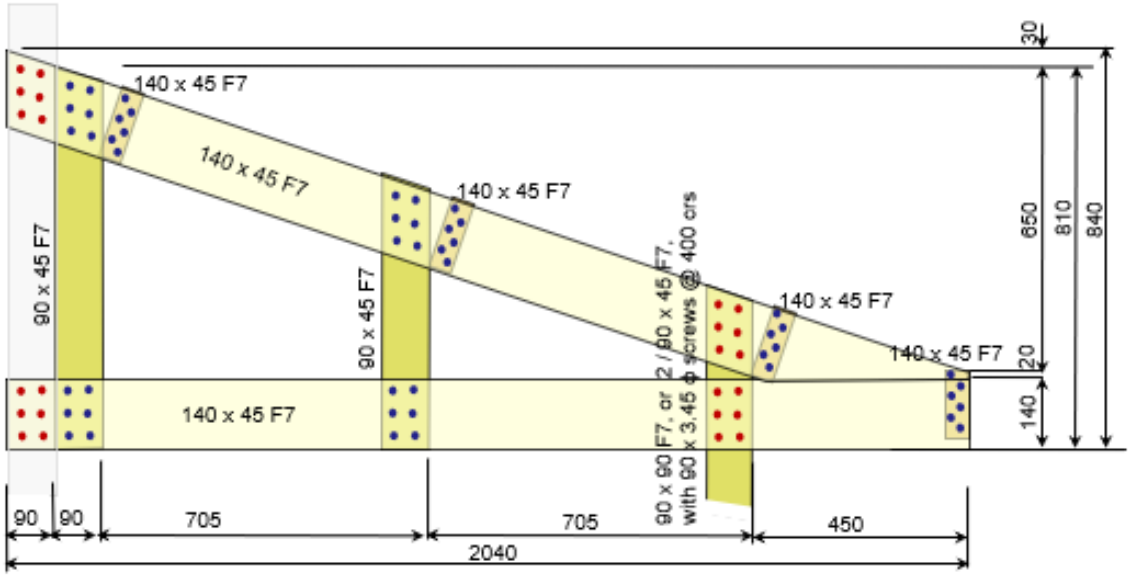


Elevation of Window Shade Frame

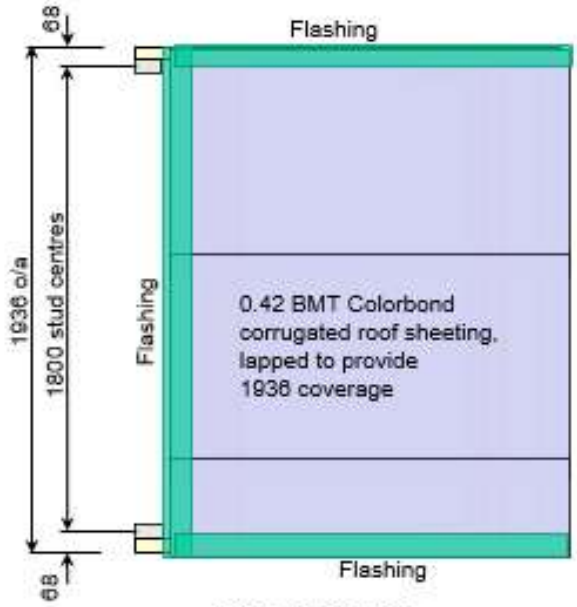
Awning



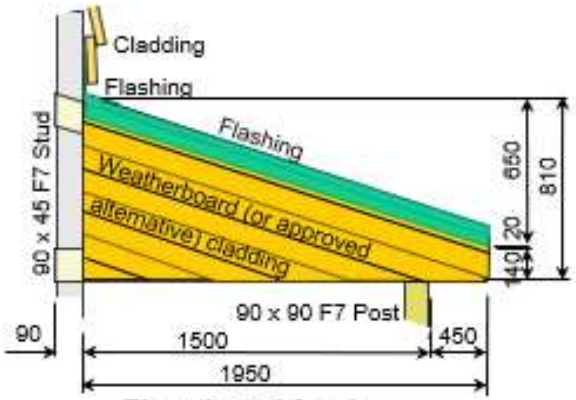
Plan of Awning Frame



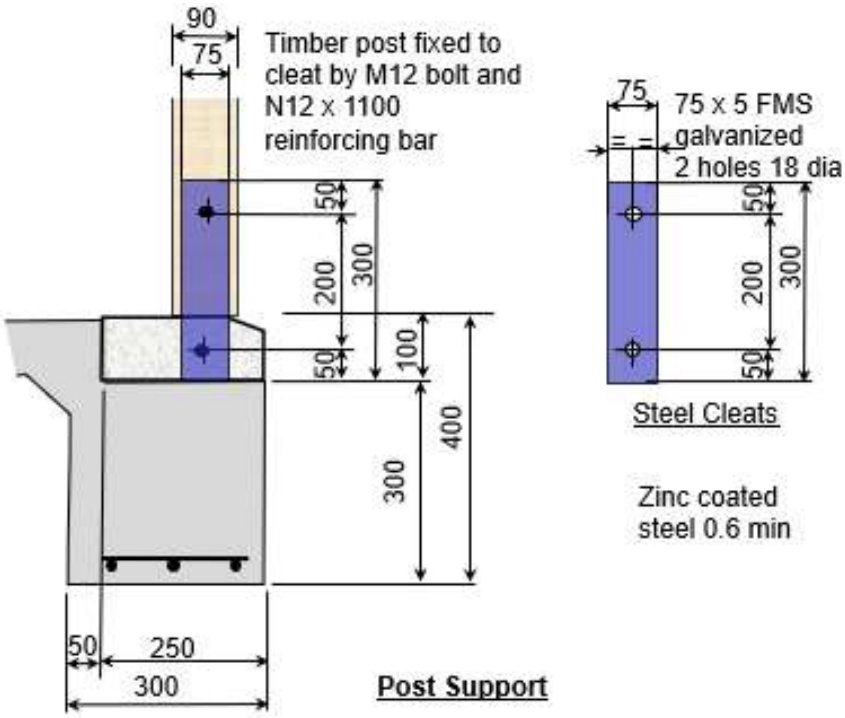
Elevation of Awning Frame



Plan of Awning

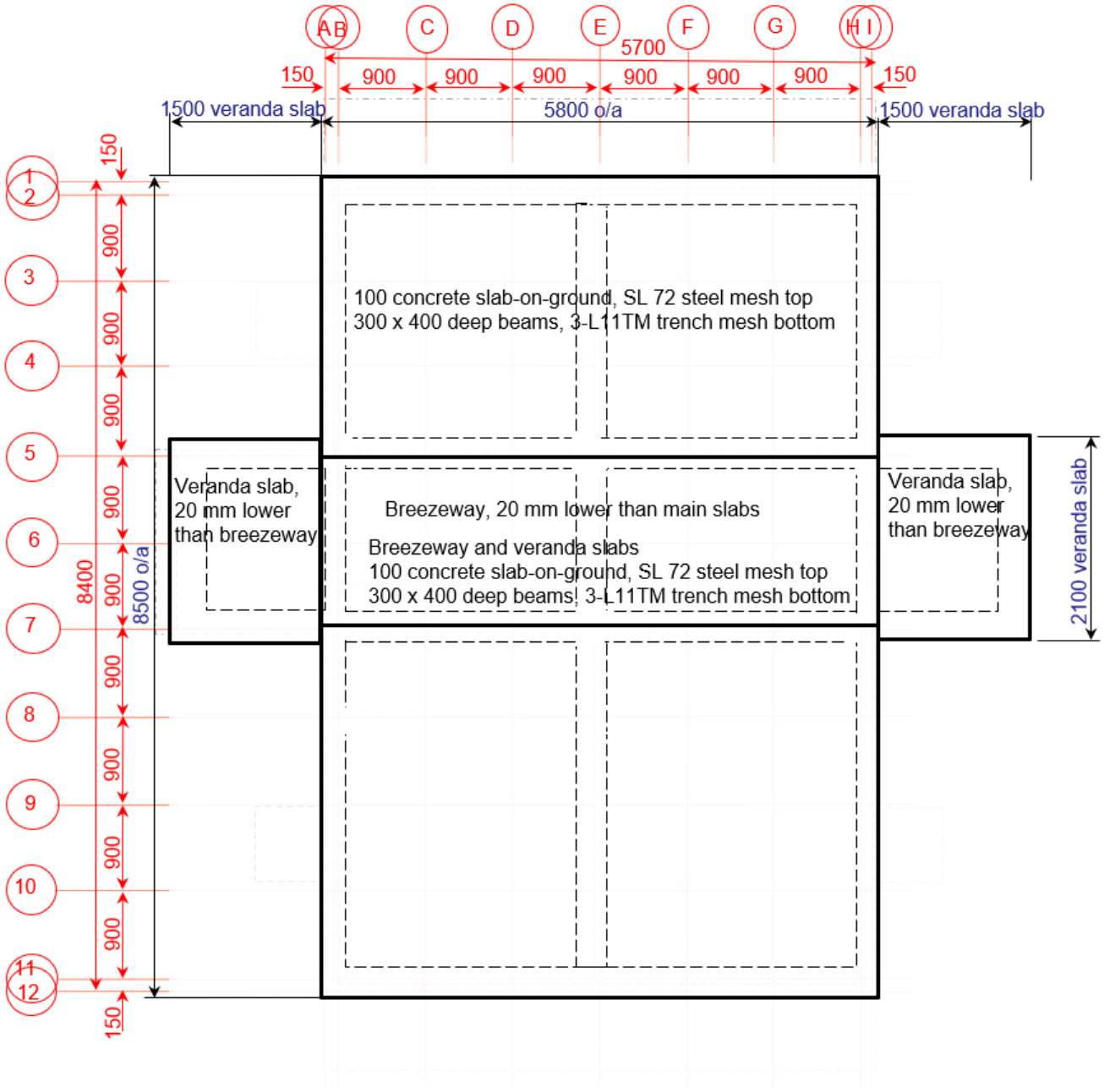


Elevation of Awning



Post Support

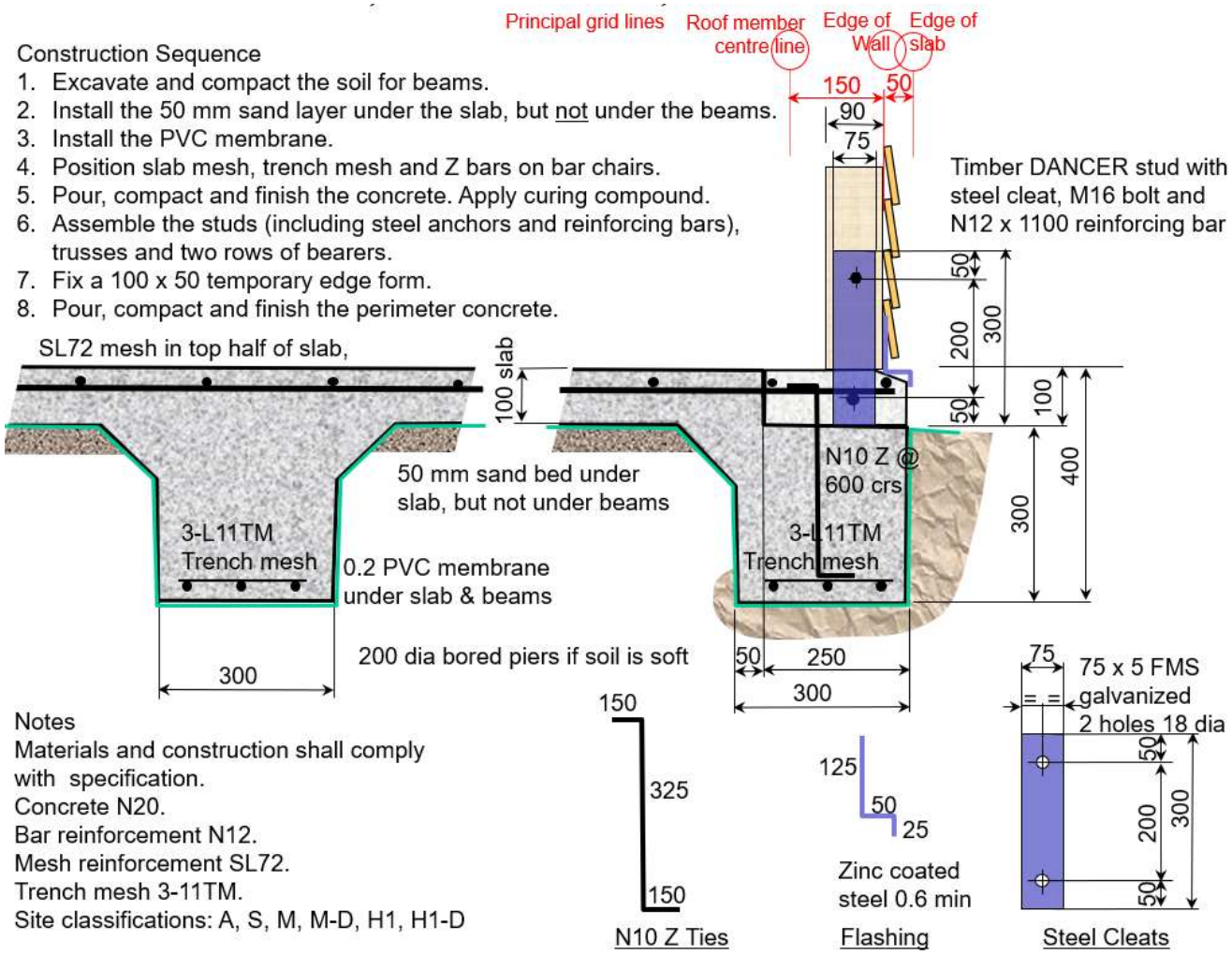
Concrete Slab-on-Ground



Concrete Slab-on-Ground for Timber Superstructure

Construction Sequence

1. Excavate and compact the soil for beams.
2. Install the 50 mm sand layer under the slab, but not under the beams.
3. Install the PVC membrane.
4. Position slab mesh, trench mesh and Z bars on bar chairs.
5. Pour, compact and finish the concrete. Apply curing compound.
6. Assemble the studs (including steel anchors and reinforcing bars), trusses and two rows of bearers.
7. Fix a 100 x 50 temporary edge form.
8. Pour, compact and finish the perimeter concrete.



Notes
Materials and construction shall comply with specification.
Concrete N20.
Bar reinforcement N12.
Mesh reinforcement SL72.
Trench mesh 3-11TM.
Site classifications: A, S, M, M-D, H1, H1-D

N10 Z Ties

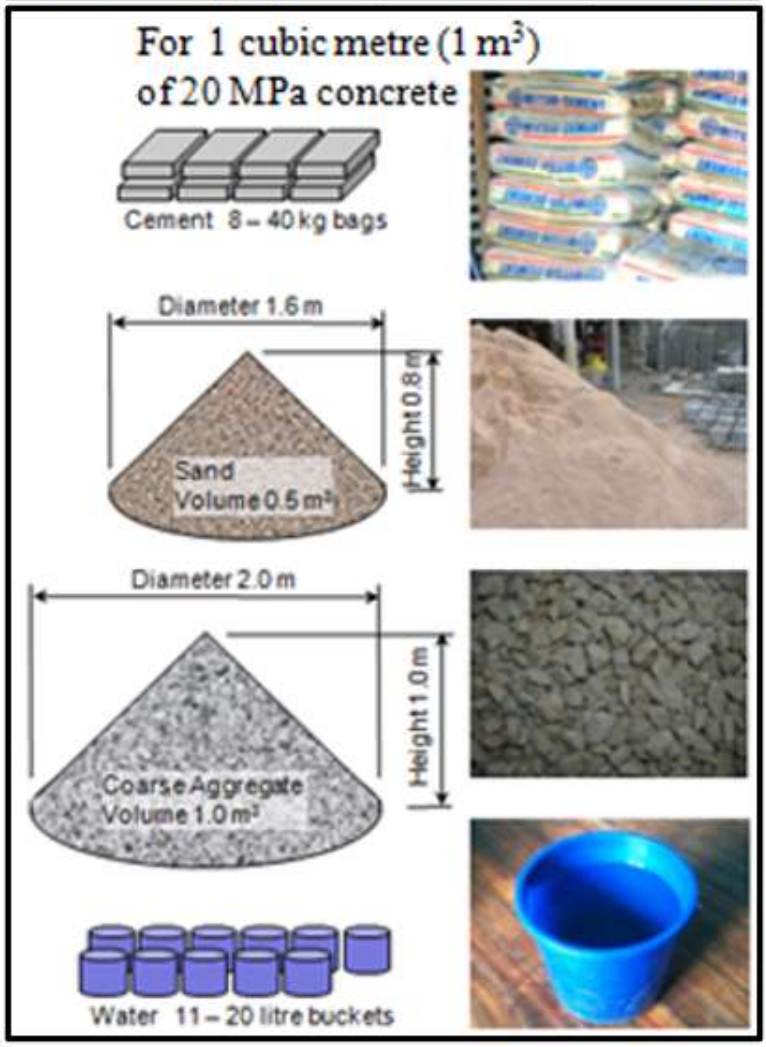
Zinc coated steel 0.6 min Flashing

Steel Cleats

Section through Concrete Slab-on-Ground and Stud Acnchorage

Concrete Slabs and Footings

20 MPa mix (by volume) 1 : 2 : 4		
Volume of concrete	m^3	1.0
Wastage included	%	
GP or GB cement	40 kg bags	8
Clean sharp sand	m^3	0.5
20 mm rock aggregate	m^3	1.0



Part 3 – Specifications

All construction shall comply with the comprehensive project specifications are published in a separate document. The following is a summary of some key parts of that specification.

Concrete Slabs-on-Ground and Footings

Scope

This section covers the construction of the following concrete members for small to medium sized buildings:

- Concrete footings
- Concrete ground beams
- Concrete slab-on-ground

Building Regulations and Standards

All materials and construction shall comply with the most recent version of:

- the relevant parts of the Building Regulations;
- the Standards referred to therein;
- other Standards nominated in this specification; and
- other relevant Regulations.

Relevant Standards

AS 3600 Concrete Structures

AS 3610 Formwork for concrete

AS 3660.1 Termite management – New Building work

AS 3660.2 Termite management – In and around existing buildings and structures – Guidelines

AS 3660.3 Termite management – Assessment criteria for termite management systems

AS 1379 Specification and supply of concrete

AS 1478.2 Chemical admixtures for concrete, mortar and grout

AS 2870 Residential slabs and footings - Construction

AS 3799 Liquid membrane-forming curing compounds for concrete

AS 4200.1 Pliable building membranes and underlays - Materials

AS/NZS 4671 Steel reinforcing materials

Commencement

Work shall commence as soon as practical after, but not before,

(a) The Builder has issued:

- a written order
- the relevant contract drawings, specifications and schedule of work
- written approval of any details provided by the Contractor

(b) Completion of the survey and establishment of pegs and profiles, and

(c) Completion of bulk earthworks under and adjacent to the building.

Definitions

Site Classifications (based on AS 2870)

Class A – Most sand and rock sites with little or no ground movement from moisture changes

Class S – Slightly reactive clay sites with only slight ground movement from moisture changes

Class M – Moderately reactive clay or silt sites, which can experience moderate ground movement from moisture changes

Class H – Highly reactive clay sites, which can experience high ground movement from moisture changes

Class E – Extremely reactive sites, which can experience extreme ground movement from moisture changes

Class P – Filled sites including soft or unstable foundation, soils, such as soft clay or silt or loose sands, landslip, mine subsidence, collapsing soils, soils subject to erosion, reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise.

Note:

For deep-seated movements, typical of dry climates and corresponding to a design depth of suction change equal to or greater than 3 metres, the classification Classes M, H and E shall be modified to M-D, H-D or E-D.

Sand Bedding

A bedding sand layer 50 to 100 mm in thickness shall be placed over the compacted soil base to the level of the underside of the slab.

Vapour Barrier

The vapour barrier shall be installed immediately beneath the concrete slab-on-ground and footings. The vapour barrier shall not be punctured. Laps shall be 200 mm at joints. Plumbing penetrations shall be taped or sealed with a close fitting sleeve. Where shallow bulk piers are used, the vapour barrier shall line the pier hole to enable the piers and footings to be poured integrally.

Reinforcement

Reinforcement shall be placed in accordance with the drawings such that the following laps and cover are achieved. Three N12 corner bars 2.0 metre long shall be placed at all re-entrant corners.

Reinforcement	Minimum Required Laps
Bars	500 mm
Fabric	2 cross wires overlapping
Trench mesh	500 mm

Bar chairs shall be placed at one metre centres both ways. Bar chairs shall incorporate wide bases and be placed on metal bases that do not puncture the vapour barrier. Where fabric with 7 mm bars at 200 mm centres (SL72), or lighter, is used, the bar chair spacing shall be reduced to 800 mm. Bar chairs shall be placed to give the following clear cover.

- 40 mm in concrete in contact with unprotected ground
- 40 mm in concrete exposed externally
- 30 mm to a sealed vapour barrier
- 20 mm to the internal surface

Placing Concrete

Trenches and footing excavations shall be dewatered and cleaned prior to concrete placement so that no softened or loosened material remains.

All concrete shall be compacted by mechanical immersion vibrator.

Finishing Concrete

Concrete surfaces shall be finished as noted below unless specified otherwise.

- Floor slabs - Steel float.
- External paths, driveways and parking areas at less than 10% slope - Fine broomed steel float.
- External paths, driveways and parking areas at greater than 10% slope - Coarse broomed steel float.
- Vertical surfaces exposed in the completed building - Rubbed back to fill all voids and provide smooth surface.
- Vertical surfaces not exposed in the completed building - Off form finish.

Curing Concrete

All concrete shall be cured using a sprayed curing compound.

Wax-based compounds shall not be used in areas requiring the subsequent application of curing adhesives.

Stripping Formwork

Unless adverse weather or the use of retarders delays the hardening of concrete, the minimum stripping time for formwork shall be 3 days.

Sand Bedding

Sand bedding shall comply with the Drawings, Building Regulations and relevant Standard (AS 2758.1). Unless stated otherwise, sand shall be clean, free from salts, vegetable matter and impurities, and with the following grading:

Sieve	Percent Passing
4.75 mm	90 to 100
2.36 mm	60 to 100
1.18 mm	30 to 85
0.600 mm	15 to 60
0.300 mm	5 to 30
0.150 mm	0 to 15
0.075 mm	0 to 10

Vapour Barrier

Vapour barriers shall comply with the Drawings, Building Regulations and relevant Standard (AS 4200). Unless stated otherwise, vapour barriers shall be not less than medium impact resistance polyethylene vapour barrier 0.2 mm thick.

Adhesive tape shall be PVC for normal applications, or polyethylene tape for fixing to higher strength or thicker membranes.

Bar Chairs

Bar chairs shall comply with the Drawings, Building Regulations and relevant Standard. Unless stated otherwise, properties shall such that:

- Reinforcement is positioned in the top half of the concrete slab
- Reinforcement in footings has 40 mm in concrete in contact with unprotected ground and 30 mm to a sealed vapour barrier

Reinforcement

Reinforcement shall comply with the Drawings, Building Regulations and relevant Standard (AS 4671, AS 2870). Unless stated otherwise, properties shall be not less than:

- Deformed bars - 500 MPa, normal ductility (N)
- Square fabric, rectangular fabric and trench mesh - 500 MPa, low (L) or normal (N) ductility ribbed wires
- Fitments -500 MPa, low (L) or normal (N) ductility ribbed wires
- Round bar (e.g. R250 N10 for dowels) - 250 MPa round

Concrete

Concrete shall comply with the Drawings, Building Regulations and relevant Standard (AS 3600 or AS 2870). Unless stated otherwise, properties shall be not less than:

Characteristic compressive strength of 20 MPa (Strength grade N20) for residential ground slabs and footings to AS 2870

Characteristic compressive strength of 25 MPa (Strength grade N25) for other structures to AS 3600

Maximum aggregate size of 20 mm

Of sufficient slump to facilitate the nominated means of placement

Subject to plant control testing.

Admixtures may be used only if approved by the Engineer.

Formwork

Formwork shall comply with the Drawings, Building Regulations and relevant Standard (AS 3610).

Curing Compounds

Curing compounds shall comply with the Drawings, Building Regulations and relevant Standard (AS 3799). Unless stated otherwise, curing compounds shall be hydrocarbon, solvent-based acrylic, water-based acrylic or wax-based acrylic. Wax-based compounds shall not be used in areas requiring the subsequent application of curing adhesives.

Joint Material

Joint material shall comply with the Drawings, Building Regulations and relevant Standard (AS 2870). Unless stated otherwise:

- Backing rod for control joints, expansion joints and articulation joints shall be expanded polystyrene tube or bead or, rigid steel backing profile with closed cell foam adhered to the metal profile face.
- Joint sealant shall be gun grade multi-purpose polyurethane sealant.

Termite Protection

Scope

This section covers installation of termite barriers.

Building Regulations and Standards

All materials and construction shall comply with the most recent version of:

- the relevant parts of the Building Regulations;
- the Standards referred to therein;
- other Standards nominated in this specification; and
- other relevant Regulations.

Relevant Standards

AS 3660.1 Termite management – New Building work

AS 3600 Concrete structures

AS 3700 Masonry structures

AS 4773.1 Residential masonry – Design

AS 4773.2 Residential masonry - Construction

Commencement

Work shall commence as soon as practical after, but not before,

(a) The Builder has issued:

- a written order
- the relevant contract drawings, specifications and schedule of work
- written approval of any details provided by the Contractor

(b) The structure is complete to a stage to receive termite protection:

- For protection placed in wet concrete - formwork is in position
- For protection placed on slab or masonry – concrete has hardened and lower masonry courses constructed.

Termite Barriers

Termite protection measures shall comply with the Building Regulations and the relevant Standard (AS 3660.1)

Note

The aim of most termite barriers is to force the termites to the surface of the structure, where they are visible and can be easily eradicated. Some termite barriers also include chemicals that deter the termites from passing. Other systems, involving chemical dosing and graded stone barriers may be applicable, but must be properly maintained. Refer to the relevant materials specifications.

Termite Barrier Components in Concrete Footings or Concrete Slabs

Components in concrete footings or concrete slabs acting as a termite barrier shall comply with the Drawings, Building Regulations and relevant Standard (AS 3660.1).

Unless stated otherwise, properties shall be not less than the following:

- Structural elements below a termite barrier shall be manufactured from a termite resistant material.
- Components, used to assist a concrete footing or concrete slab to act as a termite barrier, shall be such that no cracks or openings exceed a width of 1 mm. The following components are deemed suitable for this application:
- Pipe collars, manufactured from unplasticized polyvinyl chloride (PVC) with a minimum thickness of 1 mm with hardness not less than Shore D 80 (instantaneous), provided they are either clamped or parged to the penetrating service, or are tight fitting to the penetrating service such as to prevent any gap giving access to termites.
- Pipe collars, manufactured from woven stainless-steel mesh with a 50 mm annulus, attached to the penetrating service by a stainless-steel clamp. Such collars shall be:
    - Embedded in the concrete; or
    - Clamped and parged to the top surface of the slab, and protected from damage by covering with a tile mortar bed or a false floors of cupboards or vanities. The clamp shall be sealed with the parging mix.

Termite Barriers Consisting of Woven Stainless-Steel Mesh

Woven stainless steel mesh acting as a termite barrier shall comply with the Drawings, Building Regulations and relevant Standard (AS 3660.1). Unless stated otherwise, properties shall be not less than the following:

- Mesh shall be woven wire from a fine wire loom.
- Wire shall be stainless steel grade 304 or 316 (AS 1449).
- Wire diameter shall be not less than 0.18 mm.
- Aperture size shall be not greater than 0.66 mm × 0.45 mm, except in those locations where a very small species of heterotermes vagus is present (e.g. parts of northern Australia), the aperture shall be reduced to a maximum of 0.40 × 0.40 mm

Pipe collars, manufactured from woven stainless-steel mesh with a 50 mm annulus, shall be attached to any penetrating service by a stainless-steel clamp. Such collars shall be:

- Embedded in concrete; or
- Clamped and parged to the top surface of the slab, and protected from damage by covering with a tile mortar bed or a false floors of cupboards or vanities. The clamp shall be sealed with the parging mix.

Termite Barrier Parging Material for Woven Stainless-Steel Mesh

Parging material, for woven stainless-steel mesh acting as a termite barrier, shall comply with the Drawings, Building Regulations and relevant Standard (AS 3660.1). Unless stated otherwise, parging material shall be a highly modified cementitious grout of a water-dispersed copolymer with a dry mixture of Type GP portland cement and sieved aggregate of a size that passes readily through the woven stainless-steel mesh.

Hardened parging material shall provide:

- Termite resistance, when in contact with soil and termite workings;
- Bond strength (mesh to substrate) of not less than 1 kN/m at 28 days for a temperature range of 10°C to 30°C at a relative humidity range of 10%RH to 70%RH; and for at least 60 freeze-thaw cycles in saline solution between −15°C and 18°C.

Termite Barriers Consisting of Composite Fibre Blanket and Plastic Membrane with Termiticide Impregnation

Termite barriers, consisting of composite fibre blanket and plastic membrane with termiticide impregnation, shall comply with the Drawings, Building Regulations and relevant Standard (AS 3660.1). Unless stated otherwise, properties shall be not less than:

- Internal non-woven fibre blanket, not less than 200 grams per square metre,
- Impregnated with termiticide of pyrethroid deltametherin crystals to a loading of not less than 1 gram per square metre (low toxicity to warm blooded animals which both strongly repels and kills termites),
- Bonded to a top moisture vapour barrier of low density polyethylene (LDPE), not less than 200 microns thick,
- Bonded to a bottom membrane of low density polyethylene (LDPE) not less than 50 microns thick, to prevent the termiticide leaching into soil.

Installation

Termite protection shall provide a continuous barrier that prevents termites from entering the building undetected. The critical areas for termite entry, including the external perimeter, construction joints and plumbing penetrations, shall be protected and treated by a termite management system. The system installation shall conform to the manufacturer's guidelines.

A manufacturer's warranty for a minimum of fifty (50) years shall be provided. The warranty shall be renewable on an annual basis, base on annual inspection by the system installation organisation. Such a warranty shall provide for timber replacement should a system breach occur.

A certificate permanently fixed to the building in a prominent location, such as a meter box, kitchen cupboard, or similar, shall indicate the following:

- Method of protection.
- Date of installation.
- Life expectancy of any termiticide and the required re-injection date.
- Installer's or manufacturer's recommendations for the scope and frequency of future inspections for termite activity, not greater than 12 months.

Concrete footing or concrete slab acting as a termite barrier

A concrete footing or concrete slab, which is used as a termite barrier, shall be such that no cracks through it exceed a width of 1 mm. Except for joints tied by steel reinforcement between a footing and slab, all joints shall include a termite barrier, integral with the concrete slab. All interfaces, between penetrations and the surrounding concrete of a footing or slab, shall be protected by an integral barrier.

Sheet material acting as a termite barrier

Sheet material barriers and their joints shall be constructed of termite-resistant materials, such that termites are unable to pass through them. The maximum aperture size of a perforated sheet material barrier shall be sufficiently small as to deny access to foraging termite species of the region. Combinations of materials likely to cause electrolytic reaction shall not be used, e.g. stainless-steel mesh shall not be used in contact with mild steel reinforcement.

Barriers need only be physical, but could also include chemical impregnation if this is available. Options are:

- Sheet metal barrier, similar to a metal flashing.
- Stainless steel mesh barrier, joined and fixed by resistant adhesive.
- Non-toxic waterproof compound impregnated into a geotextile.
- Internal non-woven fibre blanket impregnated with deltametherin crystals (low toxicity to warm blooded animals) which both strongly repels and (where necessary) kills termites, bonded within casing layers, top plastic layer (200 microns), which doubles as a moisture vapour layer, and bottom plastic layer (50 microns) prevents termiticide leaching into soil.

Timber Structural Framing

Scope

This section covers timber framing, such as columns, posts, beams, battens, rafters, trusses and the like, consisting of sawn timber, plywood and glued-laminated timber.

Building Regulations and Standards

All materials and construction shall comply with the most recent version of:

- the relevant parts of the Building Regulations;
- the Standards referred to therein;
- other Standards nominated in this specification; and
- other relevant Regulations.

Relevant Standards

AS 1684.1 Residential Timber Framed Construction – Design Criteria

AS 1684.3 Residential Timber Framed Construction – Cyclonic areas

AS 1720.1 Timber structures - Part 1 Design methods

AS 1720.2 Timber structures - Part 2 Timber properties

AS 1604 Timber – Preservative treated – Sawn and round

AS 2082 Visually stress-graded hardwood for structural purposes

AS 2858 Visually stress-graded softwood for structural purposes

AS 2878 Timbers – Classification into strength groups

AS 3519 Timber – Machine proof grading

AS/NZS 1748 Timber – Stress graded – Product requirements for mechanically stress-graded timber

AS/NZS 2098 Methods of test for veneer and plywood

AS/NZS 2269 Plywood – Structural

AS/NZS 4063 Timber – Stress graded In-grade strength and stiffness evaluation

AS/NZS 4357 Structural laminated veneer lumber

AS/NZS 4490 Timber – Procedures for monitoring structural properties

AS/NZS 4491 Timber – Glossary of terms in timber related Standards

AS 1111 ISO metric hexagon commercial bolts and screws

AS 1397 Steel sheet and strip

AS 2334 Steel nails – Metric series

AS 3566 Screws – Self drilling – For the building and construction industries

AS 3660 Protection of buildings from subterranean termites

Commencement

Work shall commence as soon as practical after, but not before,

(a) the Builder has issued:

- a written order
- the relevant contract drawings, specifications and schedule of work
- written approval of any details provided by the Contractor

(b) concrete slabs, footings or other structures that support the frame are in place.

Levels, Dimensions, Squareness and Setting Out

The structure upon which the framing is to be constructed shall be within the specified tolerances, with particular attention given to levels, dimensions, squareness and setting out.

Notes

(a) Levels: It is critical that all floor framing is level. Before commencing the set out, check that slab or timber floor framing is level. It may be necessary to pack the frames in the low areas or to rectify the high areas.

(b) Dimensions and Squareness: Check the position and squareness of the concrete slab or footings before commencing construction. Measure diagonals to check squareness.

(c) Setting Out: When setting out the wall framing, a small error in position can lead to misalignment of the other components, such as the roof. Base the set out on the longest side of a building, since this will reduce the likelihood of errors in squareness.

(d) Prefabricated Trusses or Roof Framing: If there are setting-out errors in the walls, there is a possibility that prefabricated roof trusses or framing may fail to engage the required supports. In complicated buildings, check the position of walls, before constructing the roof. It is critical that all wall framing be fixed and braced plumb.

Bracing and Tie-Down

All buildings shall be adequately supported against lateral wind loads, as specified in the relevant Standard (AS 1170.2 or AS 4055). In some cases, lateral earthquake loads may be a design criterion. The bracing requirements shall be determined for the appropriate Region, Terrain Category, Topography and Shielding and recorded on the drawings by the design engineer.

Tie Down

All buildings shall be adequately tied down to resist overturning due to wind loads, as specified in the relevant Standard (AS 1170.2 or AS 4055). The tie-down requirements should be determined for the appropriate Region, Terrain Category, Topography and Shielding and recorded on the drawings by the design engineer. Ensure that all tie-down systems are continuous to the footings or to the specified location on the structure.

Nailing

Where architraves are required to be subsequently removed during construction, the nails shall be temporarily left proud. On completion they shall be driven in and punched where appropriate.

Timber Shrinkage

Provision shall be made for timber shrinkage. Gaps that result from timber splitting shall be repaired, filled with wood filler and sanded smooth before completion.

Notes

(a) Timber shrinks in cross section, although, due to the grain structure, it remains relatively stable in length. Cover strips should be provided at the edges of timber paneling to allow for shrinkage. The use of kiln-dried timbers will reduce shrinkage.

(b) As timber dries, it shrinks, and in some circumstances, cracks can open. The moisture content varies with type and the degree of seasoning. Seasoned timber has moisture content in the range approximately 10% to 15%, and a variation of up to 2% within any lot of timber. Dense close-grained hardwoods dry more slowly than softwoods.

Preservatives

Timber in exposed applications shall be treated with pyrethroid- and metal-based light organic solvent preservatives (LOSPs) to minimize fungal decay and attack by insects.

Health Warnings and Precautions

Precautions shall be in accordance with the requirements of the relevant Regulations and, where applicable, the recommendations of the following reference *RIC Good Wood Project & the Good Wood Advisory Centre, Victoria, Preservatives.*

Light Organic Solvent Preservative (LOSP)

- LOSP is a solvent-based treatment, which inhibits fungal invasion of timber. It contains copper naphthenate, zinc naphthenate, tri-butyl tin oxide (TBTO) or pentachlorophenol (PCP), with resin or wax to improve its retention and to increase its ability to repel water.
- LOSP will release, to the atmosphere, 30-40 litres of hydrocarbon solvent per cubic metre of treated timber.
- LOSP is suitable for above-ground applications where dimensional-stability is important, is used principally in external applications (e.g. fences, decks and outdoor furniture).
- LOSP is not suitable for in-ground applications because it does not chemically fix in the wood, and will leach into the soil.
- LOSP must not be used for food storage, except where LOSP formulation is of very low toxicity.
- Where LOSP treated timber is exposed, cut or drilled, the exposed surface should be coated with a post-protection treatment.

Although previously in use, the following timber preservatives shall not be used.

(a) *Creosote*: Creosote gives off a vapour that irritates the eyes and skin; and is therefore not recommended.

(b) Pigment Emulsified Creosote (PEC): PEC is a combination of coal tar, with a heavy metal pigment used to stabilize it. PEC is not suitable for normal building applications.

(c) Pentachlorophenol (PCP): PCP (derived from sodium pentachlorophenate) is an organochlorine family, of the same chemical group as DDT and Agent Orange. PCP can cause fatigue, fever, weight loss and nausea. PCP dioxins can also cause birth defects, allergies or cancer. PCPs can be passed on to successive generations through sperm and breast milk. PCP must be disposed of without special technology and facilities. It is recommended that PCPs should not be used.

(d) *Copper Chrome Arsenate (CCA)*: CCA consists of heavy metals, copper, chromium and arsenic, which may leach from the timber and pose a health risk. CCA shall not be used; and when timber treatment is required, one of the alternatives listed above may be used.

If CCA-treated timber is already in use, the following precautions should be taken:

- Wear protective equipment when handling CCA treated timber.
- Wash hands thoroughly after handling CCA treated timber.
- Do not allow food to come into contact with CCA treated timber.
- Do not burn CCA treated timber in open fires, stoves, fireplaces or the like.

(e) Ammoniacal copper quaternary (ACQ)

(f) Copper azole

(g) Boron

Design and Construction

Timber structures shall comply with the Drawings, Building Regulations and relevant Standard, AS 1684.1 and AS 1720.1 [general applications]).

Minimum Strength Grade

Timber used for structural framing purposes shall have a strength grade not less than MGP10 as applicable.

Timber Type, Properties, Preservation and Application

Timber and timber products shall comply with the Drawings, Building Regulations and relevant Standard (AS 1684.1, AS 1684.3 or AS 1720.1 and shall be of the nominated stress grade (or strength group), durability class, and (where appropriate) lyctid susceptibility, shrinkage and ignitability.

1. The following tables are based on AS 1684.2 & 3 Table H1. For additional properties and definitions refer to source document.
2. Preservative requirement: P = Should be preservative treated, S = Should be seasoned ,O = Commonly used untreated
3. Availability: R = Readily available, L = Limited Availability

4. Durability Class: 1 = Highest natural durability to 4 = Lowest natural durability.
5. Where required to achieve particular resistance to termite and/or borer attack, the species listed herein shall be treated to achieve the hazard levels listed in AS 1684.2 & 3 Table C1.
6. Lyctid Susceptible: S = Susceptible, N = Not susceptible, R = Rarely susceptible

Timber and Timber Products for Use Below Ground Level

Timber and timber products shall not be used in direct contact with the ground. If timber is required to be embedded below ground level, it shall be encased in Grade N20 concrete (20 MPa) of sufficient thickness to provide not less than 50 mm cover to all parts of the timber.

Part 4 – Cutting Lists

	Floor	Material List						Cutting Schedule		
Item	Component	Section			Material	Quantity		No	@	Length
		mm	x	mm		x	m			mm
FB	Floor Bearer	140	x	45	F7	x	99.0	30	@	3,000
FBS	Floor Bearer Spacer	140	x	45	F7	x	6.6	20	@	300
FJ	Floor Joist	140	x	45	F7	x	264.0	80	@	3,000

	Roof Trusses	Material List						Cutting Schedule		
Roof Trusses										**6.600**
Item	Component	Section			Material	Quantity		No	@	Length
		mm	x	mm		x	m			mm
TC(L)	Truss Top Chord (or R	90	x	45	F7	x	81.2	18	@	4,100
TC(S)	Truss Top Chord (or R	90	x	45	F7	x	77.5	18	@	3,916
BC(L)	Truss Bottom Chord (a	90	x	45	F7	x	76.5	18	@	3,865
BC(S)	Truss Bottom Chord (a	90	x	45	F7	x	70.4	18	@	3,555
CT	Collar Tie	90	x	45	F7	x	23.8	18	@	1,200
KP	King Post	90	x	45	F7	x	28.4	18	@	1,435
L1	Lacing at eaves	90	x	45	F7	x	4.6	18	@	232
L2	Lacing at anchorage st	90	x	45	F7	x	8.3	18	@	417
L3	Lacing	90	x	45	F7	x	14.5	18	@	734
L4	Lacing	90	x	45	F7	x	20.8	18	@	1,050
L5	Lacing	90	x	45	F7	x	0.0	0	@	**0**
L6	Lacing	90	x	45	F7	x	15.1	18	@	760
D1	Diagonal	90	x	45	F7	x	22.1	18	@	1,118
D2	Diagonal	90	x	45	F7	x	27.4	18	@	**1,385**
D3	Diagonal	90	x	45	F7	x	0.0	0	@	**0**

	Purlins, Veranda, Fascias, Barge Boards							Cutting Schedule		
Item	Component	Section			Material	Quantity		No	@	Length
		mm	x	mm		x	m			mm
CJ	Ceiling Joist (additiona	45	x	90	F7	x	41.3	9	@	3,300
CBa	Ceiling Batten	45	x	90	F7	x	172.8	64	@	2,700
VRa	Veranda Rafter	90	x	45	F7	x	18.4	9	@	1,862
VBe	Veranda Beam	0	x	0		x	17.2	4	@	3,900
RDB	Roof Bracing	90	x	45	F7	x	24.3	4	@	5,532
FaB	Fascia Board	230	x	45	F7	x	24.4	6	@	3,700
BaB	Barge Board	230	x	45	F7	x	21.8	4	@	4,954
RPu	Roof Purlin (or Roofing	90	x	45	F7	x	165.1	45	@	3,300

	Walls	Material List						Cutting Schedule		
Item	Component	Section			Material	Quantity		No	@	Length
		mm	x	mm		x	m			mm
	External Anchorage Walls									
AS1	Anchorage Stud	90	x	45	F7	x	35.2	10	@	3,200
AS2	Anchorage Stud	90	x	45	F7	x	26.9	8	@	3,060
AS3	Anchorage Stud	90	x	45	F7	x	68.9	26	@	2,410
AN1	Anchorage Nogging	90	x	45	F7	x	38.8	28	@	1,260
AN2	Anchorage Nogging	90	x	45	F7	x	5.7	4	@	1,305
AN3	Anchorage Nogging	90	x	45	F7	x	9.3	14	@	607
AN4	Anchorage Nogging	90	x	45	F7	x	16.9	18	@	855
AN5	Anchorage Nogging	90	x	45	F7	x	2.8	7	@	360
AN6	Anchorage Nogging	90	x	45	F7	x	0.9	2	@	405
WB1	Wall Brace	90	x	45	F7	x	36.7	24	@	1,390
	External End Walls									
ES1	End Stud	90	x	45	F7	x	13.5	4	@	3,060
ES2	End Stud	90	x	45	F7	x	14.3	4	@	3,260
ES3	End Stud	90	x	45	F7	x	15.0	4	@	3,410
ES4	End Stud	90	x	45	F7	x	15.7	4	@	3,560
ES5	End Stud	90	x	45	F7	x	16.3	4	@	3,710
ES6	End Stud	90	x	45	F7	x	17.0	4	@	3,860
ES7	End Stud	90	x	45	F7	x	17.6	4	@	4,010
ES8	End Stud	90	x	45	F7	x	9.2	2	@	4,160
ES9		0		0			0.0	0		4,310
ES10		0		0			0.0	0		4,460
EN1	End Nogging	90	x	45	F7	x	23.8	60	@	360
EN2	End Nogging	90	x	45	F7	x	8.2	12	@	622
EN3	End Nogging	90	x	45	F7	x	6.5	12	@	496
EP1	End Packer	90	x	45	F7	x	26.4	6	@	4,000
VP	Veranda Post	90	x	45	F7	x	25.6	9	@	2,583
	Internal Walls									
CS 2	Common Stud	90	x	45	F7	x	146.0	55	@	2,410
BP	Wall Bottom Plate	45	x	90	F7	x	77.9	14	@	5,400
TP	Wall Top Plate	45	x	90	F7	x	155.8	29	@	5,400
NG	Wall Nogging	90	x	45	F7	x	77.9	14	@	5,400
DB	Additional Diagonal Wa	30	x	1	Steel	x	13.8	8	@	1,570
LI	Lintel	90	x	45	F7	x	15.0	3	@	5,400
	Studs, Plates, Nogging	90	x	45	F7	x	937.7	393	@	
WB	Wall Bracing (First Sto	Input	mm		External plywood			Plywood		2,500