DANCER 13.8 x 8.4 Duplex House

Timber roof + Timber superstructure + steel posts

Quasar Management Services Pty Limited
ABN 21 003 954 210
Not-for-profit consulting structural and civil engineer
Subsidiary of Partner Housing Australasia (Building) Incorporated
69 Renwick Street, Redfern NSW 2016, Australia
Phone: +61 432 611 550
Email: RodJohnstonAUS@gmail.com

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(DH ET)-1 a 8/4/26 Format update and routine update

Limited Structural Certification

Quasar
Management Services Pty Ltd

Quasar Management Services Pty Limited
ABN 21 003 954 210 Member of Consult Australia
Not-for-profit consulting structural and civil engineer
69 Renwick Street, Redfern NSW 2016, Australia
Phone: +61 432 611 550
Email: RodJohnstonAUS@gmail.com

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 + steel posts).**
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 also contingent on the recording of complying construction on the Construction Checklist included herein, and the provision of photographs of complying construction. 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

Planning and Architectural Design

Description

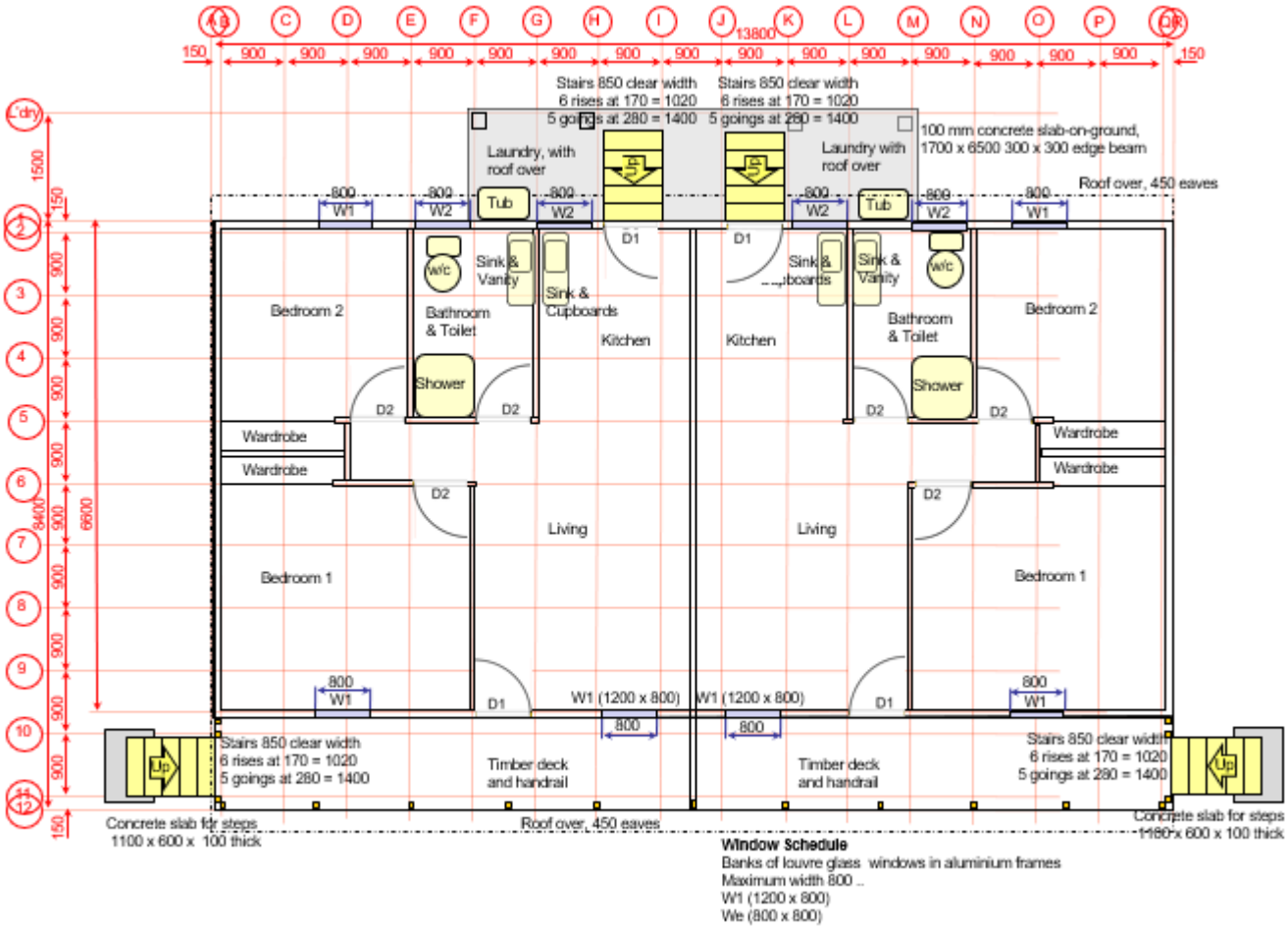
The standard “Duplex Staff Houses” building consists of –

Two standard DANCER 6.9 x 8.4 (6.6) “Single Houses”, each with –

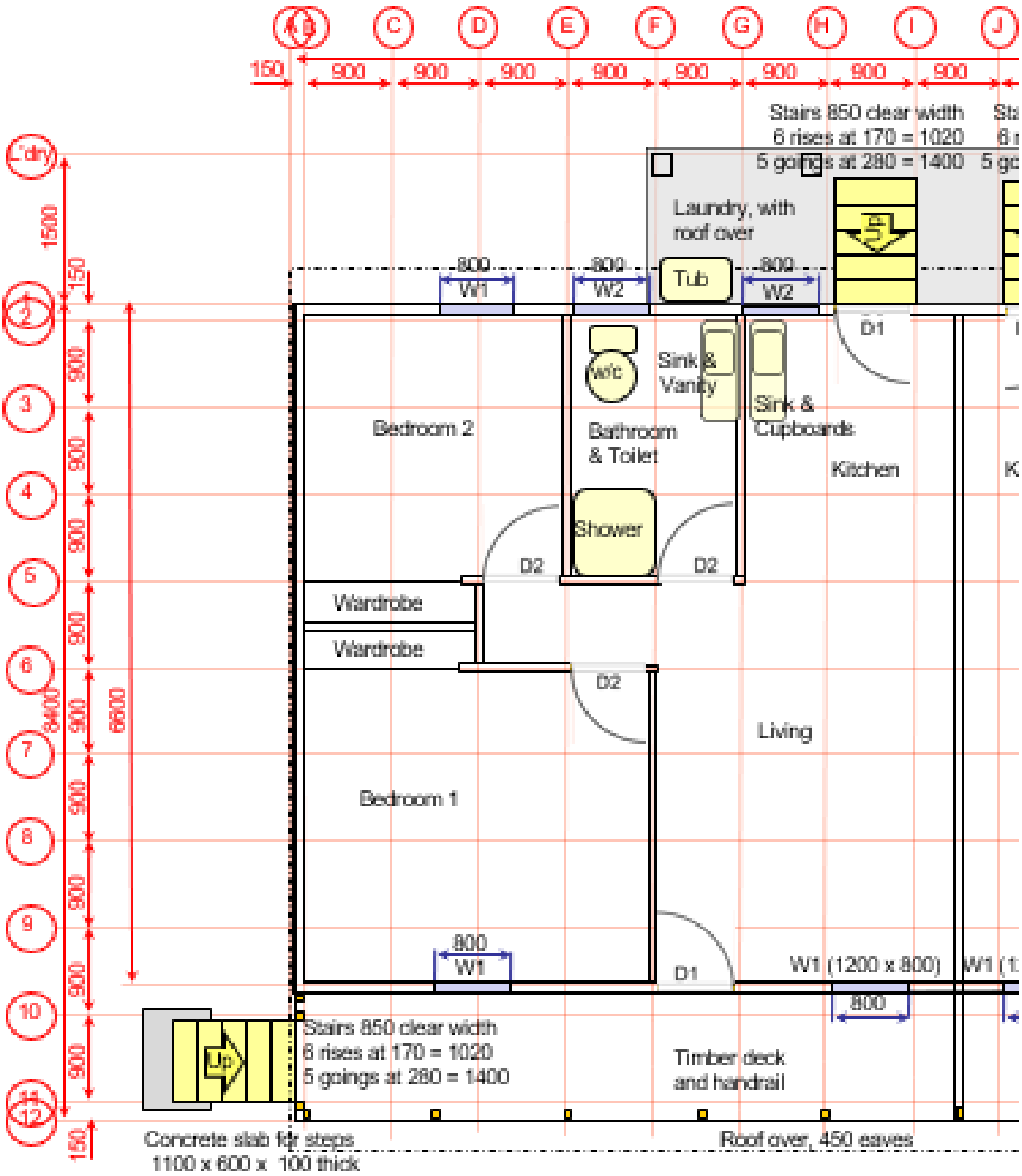
- 5 No 1200 x 800 louvre windows,
- 2 No 2040 x 820 external door;
- 3 No 2040 x 820 internal doors,
- kitchen,
- family room,
- bathroom/toilet,
- two bedrooms, and
- a veranda.
- An external laundry shelter is also provided.

This building has been designed to meet the dual criteria of cultural sensitivity and structural resistance to non-cyclonic wind and moderate earthquake.

General Arrangement and Floor Plan



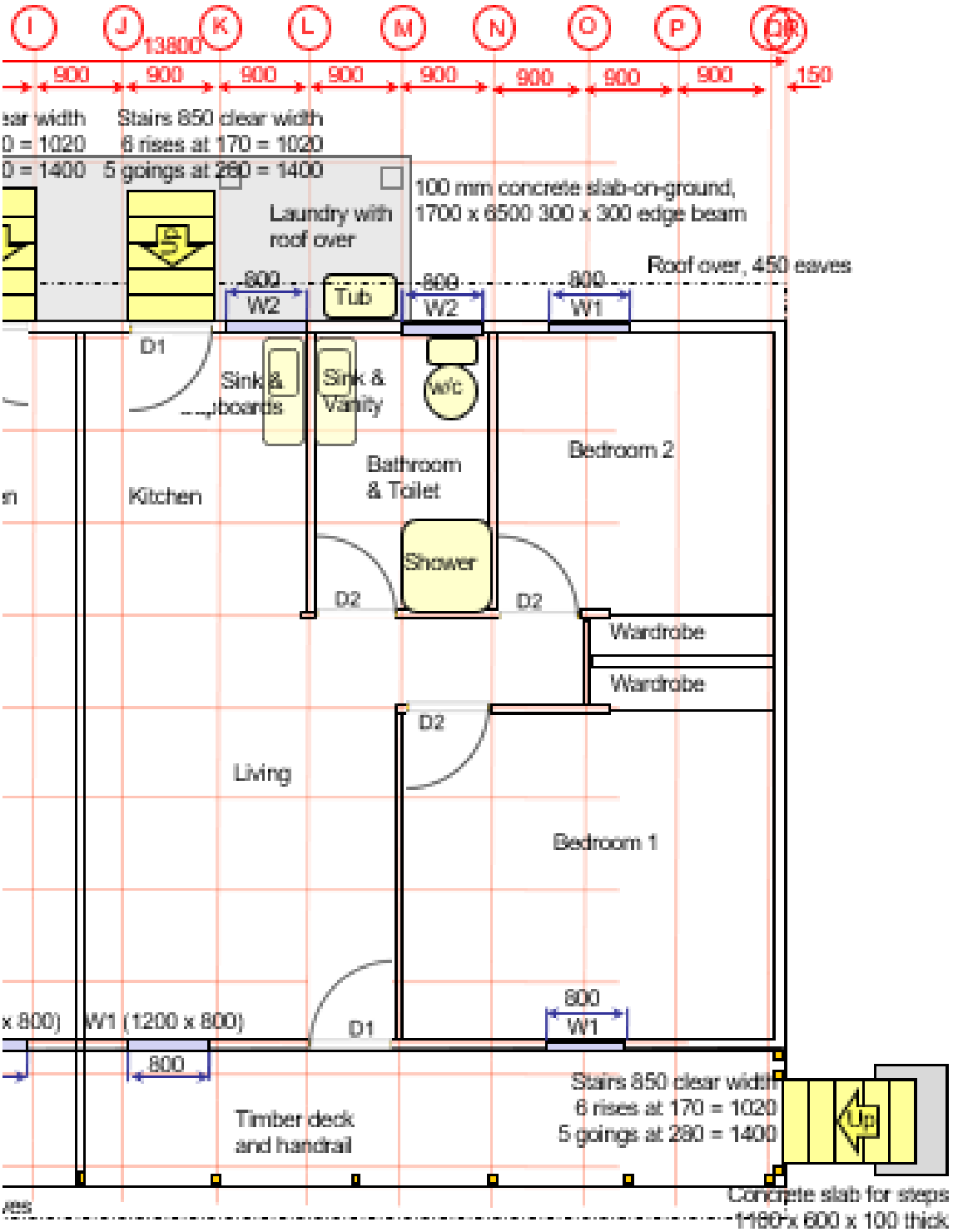
Plan of Duplex House



Window Schedule
Banks of louvre glass
windows in aluminium frames
Maximum width 800 ..
W1 (1200 x 800)
We (800 x 800)

Plan of Duplex House

Tanks not shown for clarity

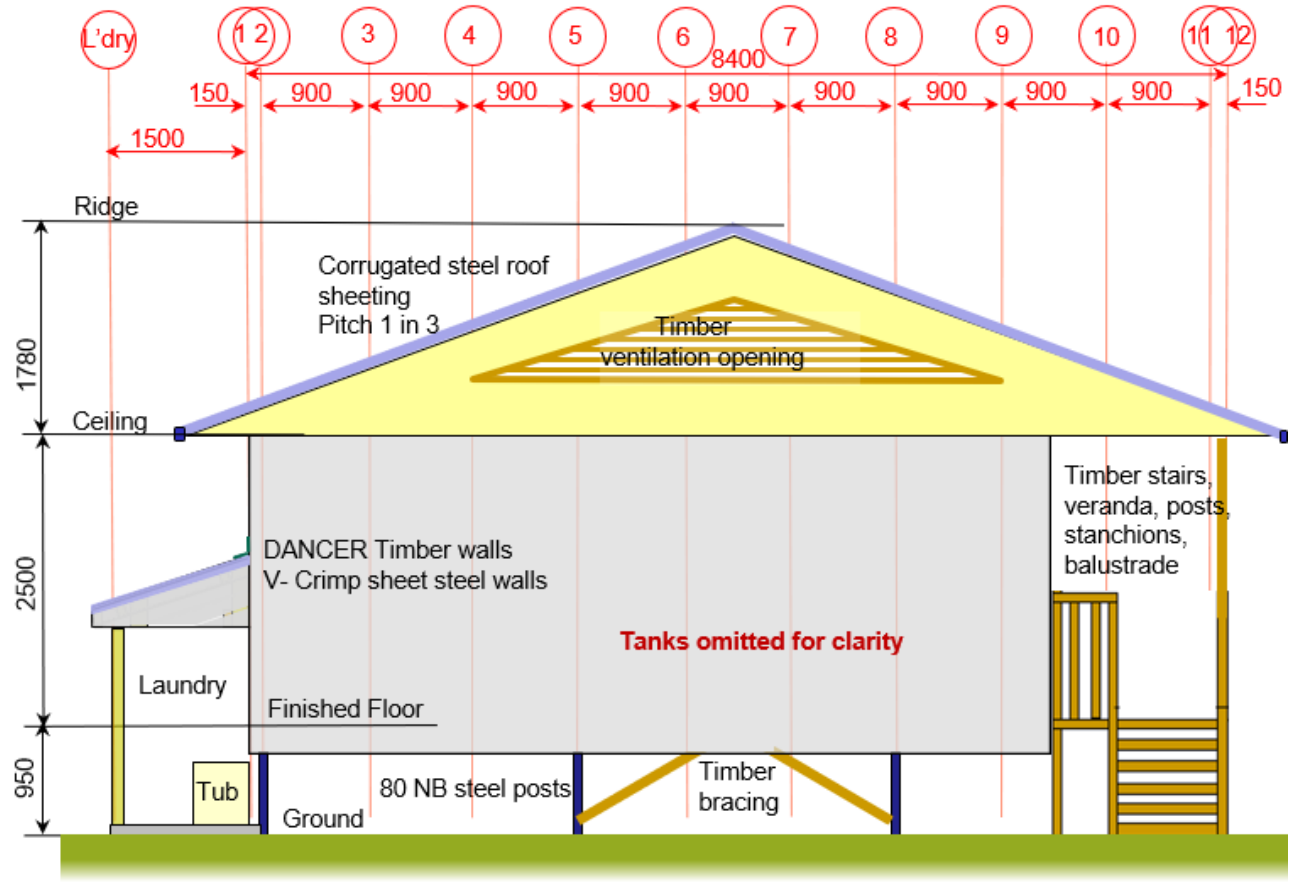


Window Schedule
Banks of louvre glass
windows in aluminium frames
Maximum width 800 ..
W1 (1200 x 800)
We (800 x 800)

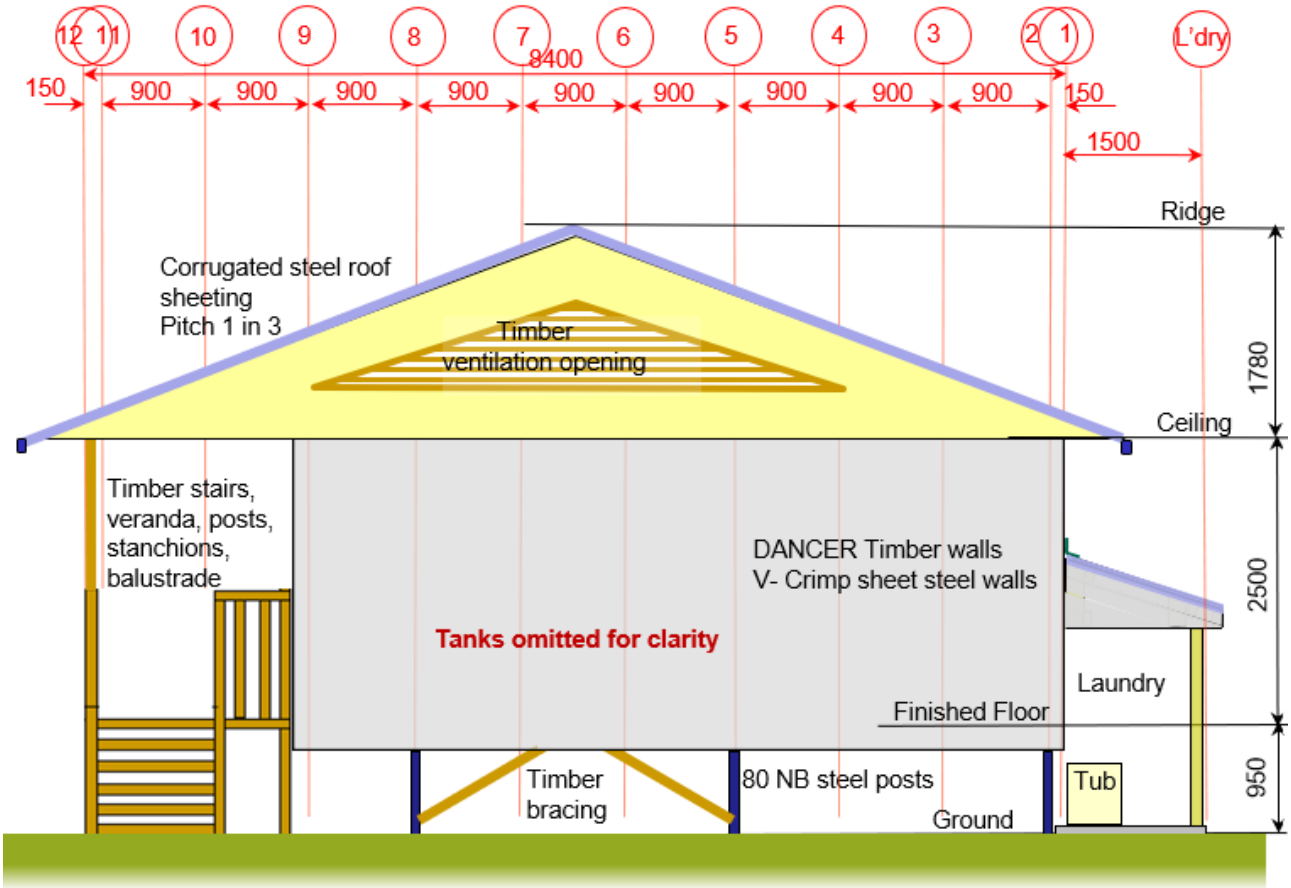
Plan of Duplex House

Tanks not shown for clarity

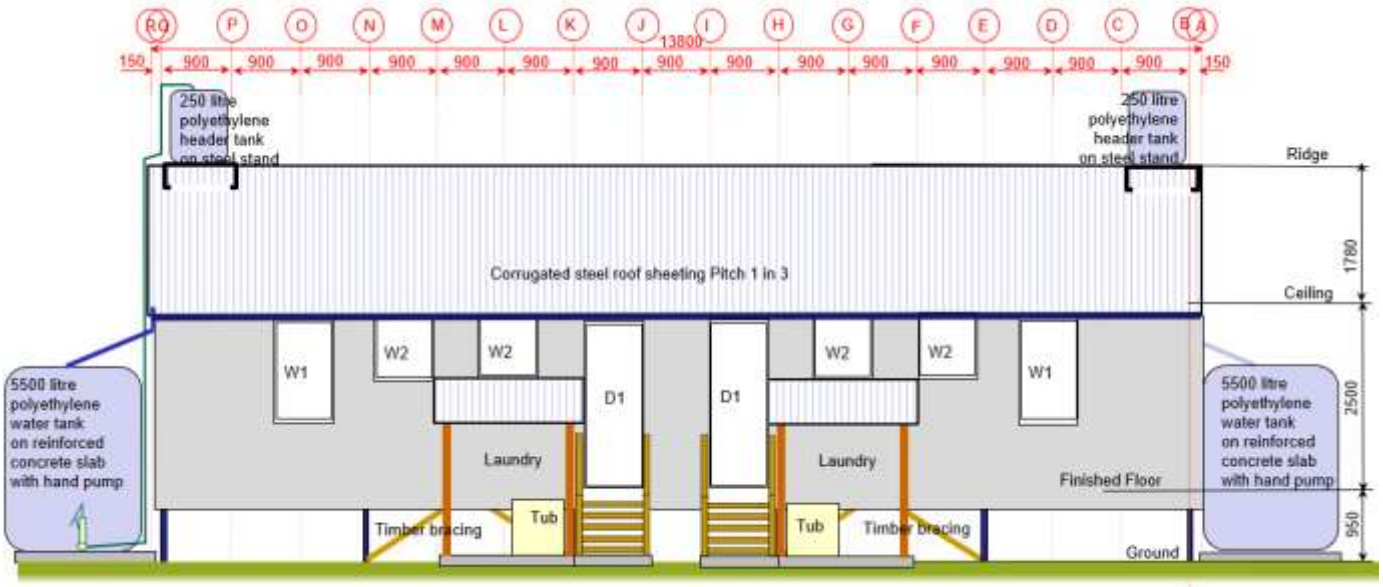
Elevations



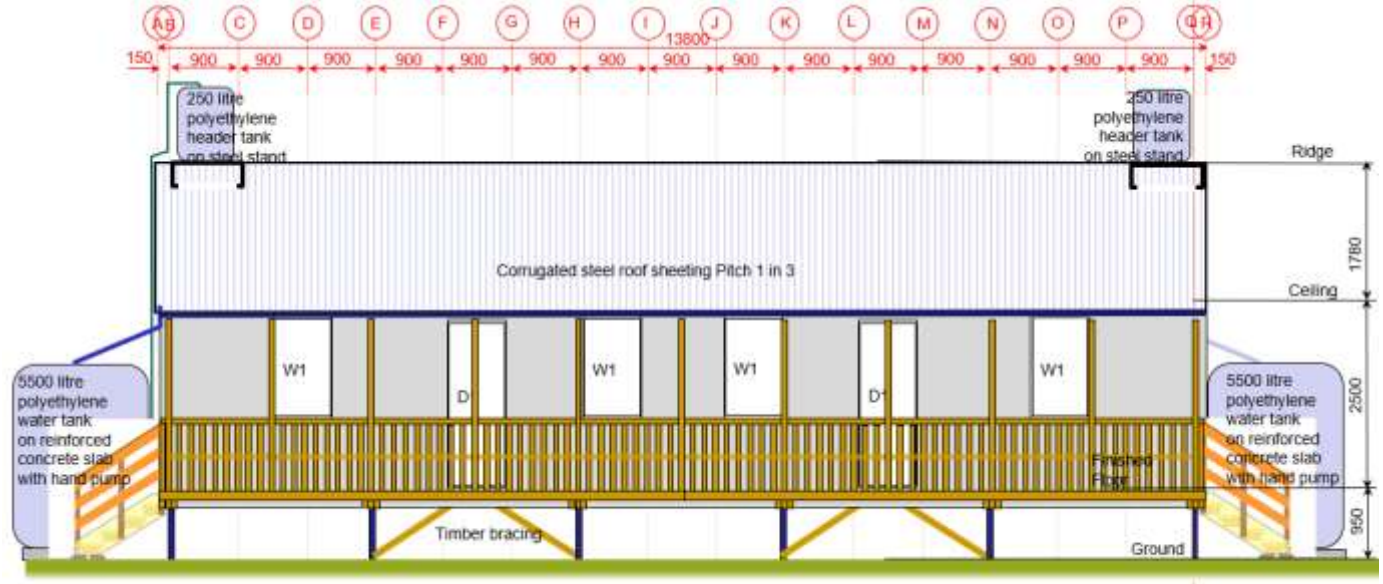
Left End Elevation



Right End Elevation

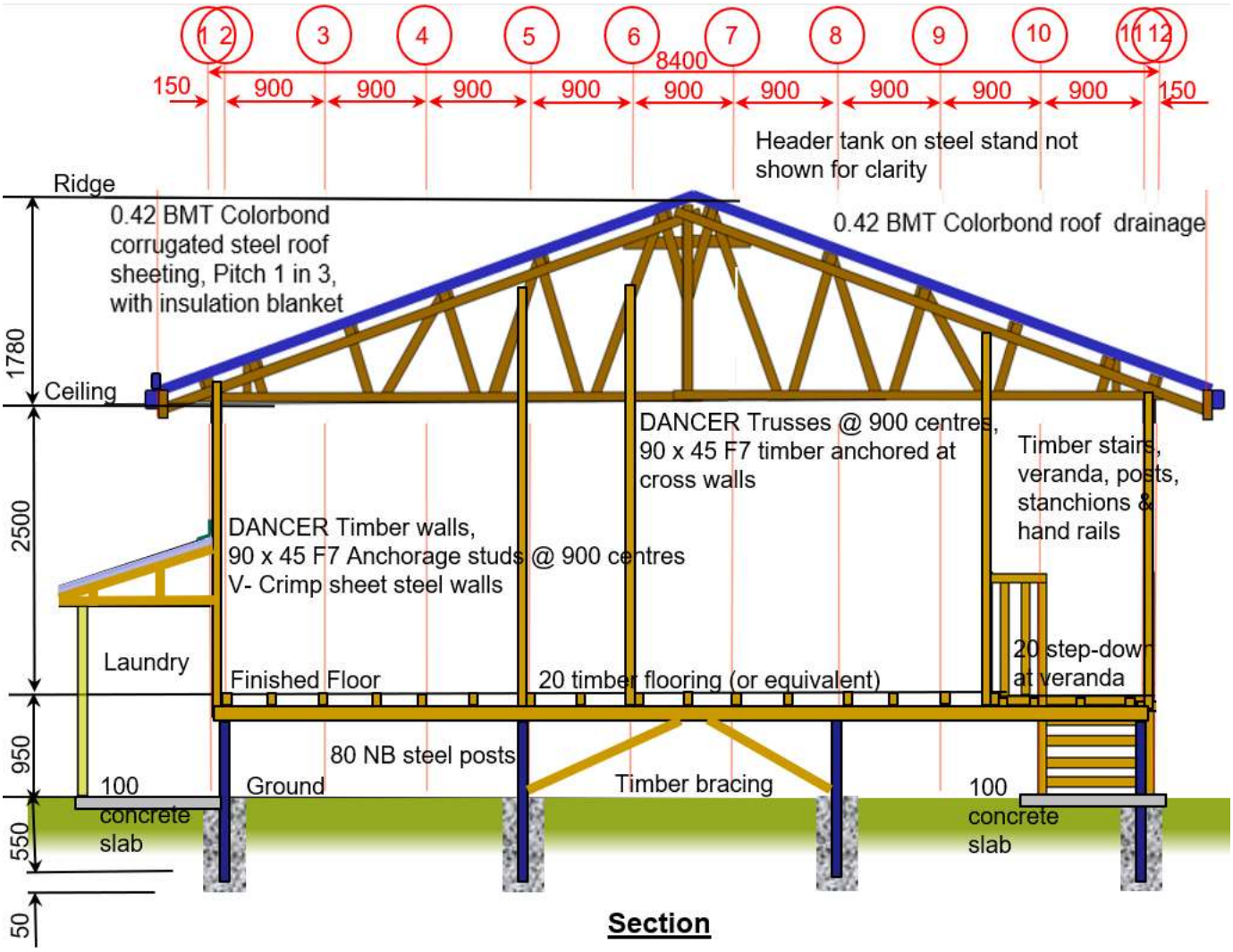


Rear Elevation



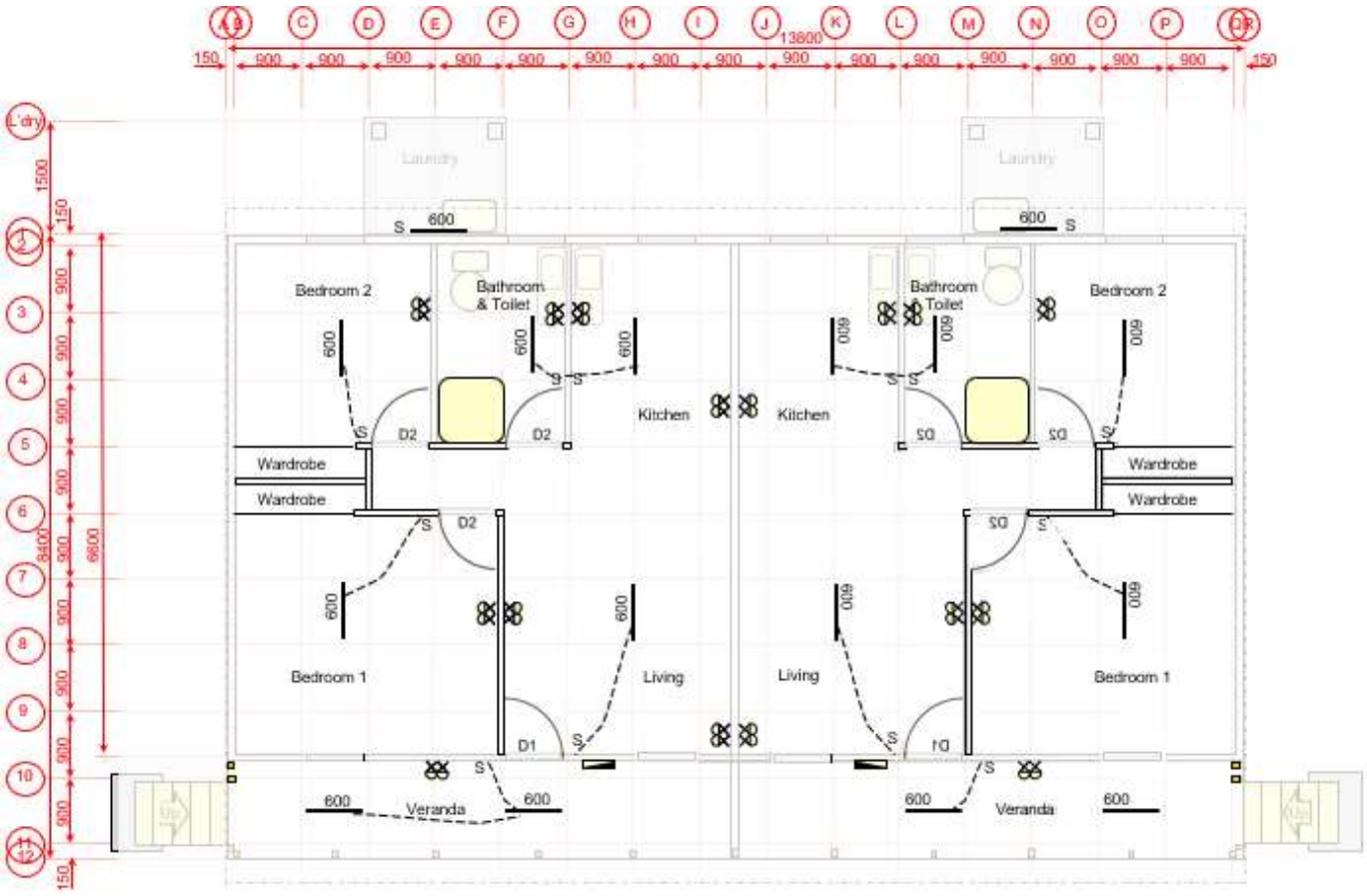
Front Elevation

Sections



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.

S — Switch, 1200 above floor

Double GPO, 300 above floor

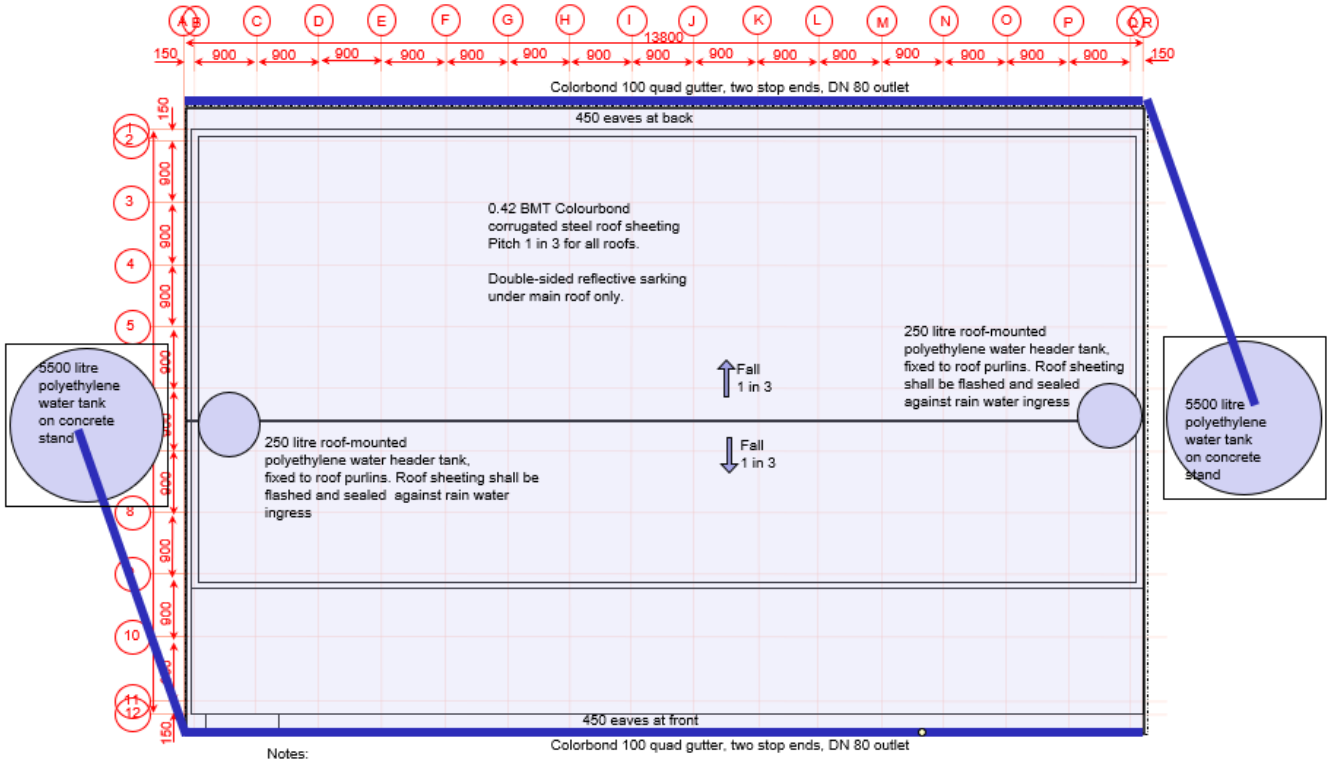
Switch board

600 — Light, 1 x 18W, 613 x 26mm bare batten fluorescent tube

1200 — Light, 1 x 18W, 613 x 26mm bare batten fluorescent tube

Electrical Services

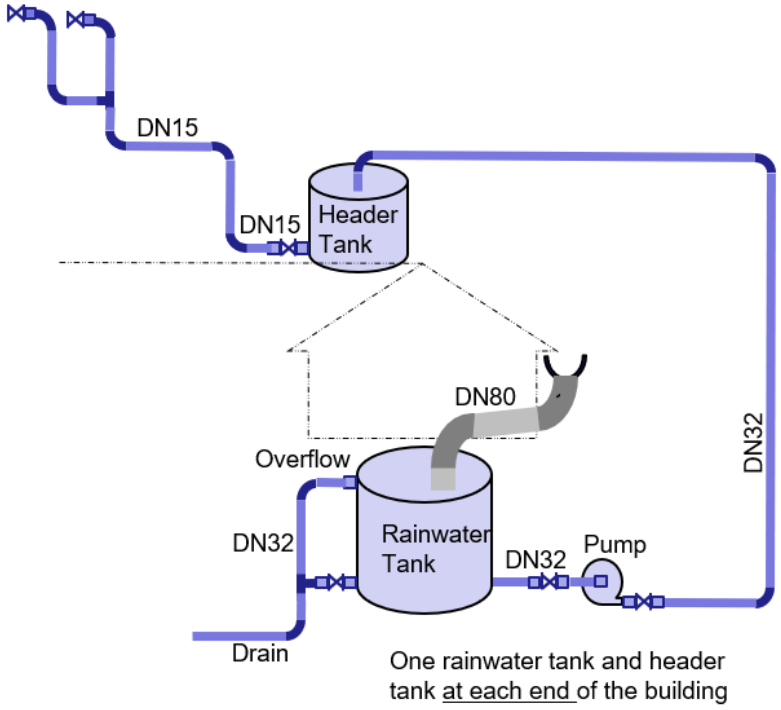
Roof Plumbing, Rainwater Tanks and Header Tanks



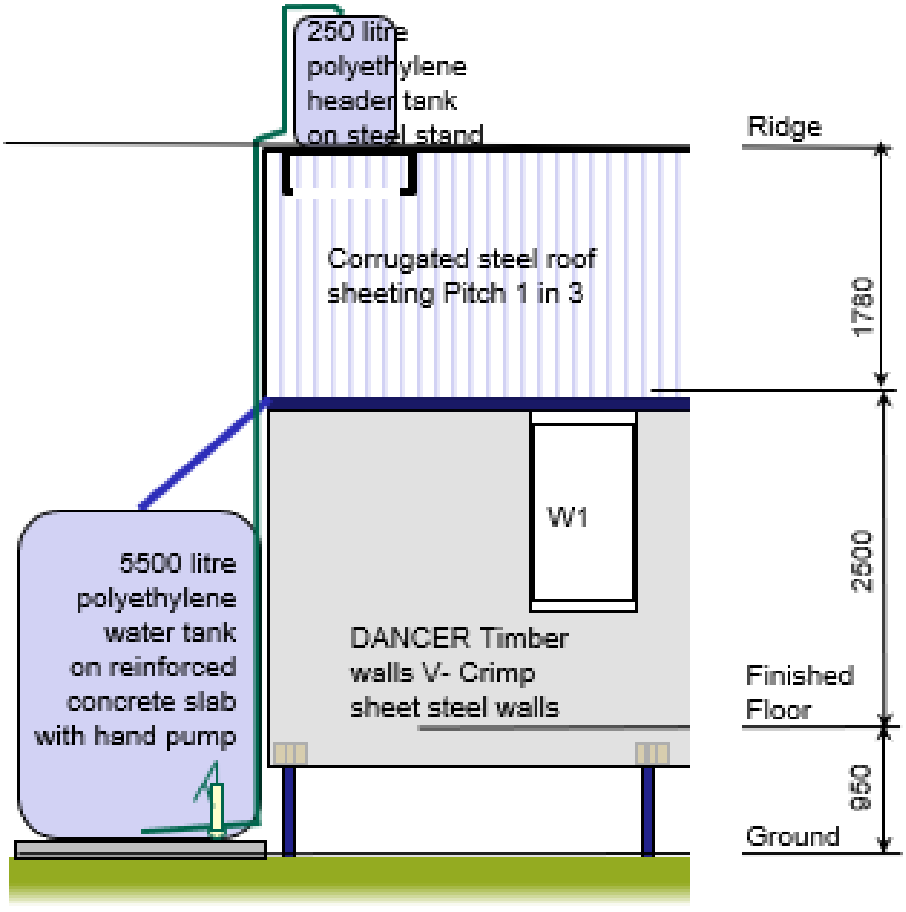
Notes:

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

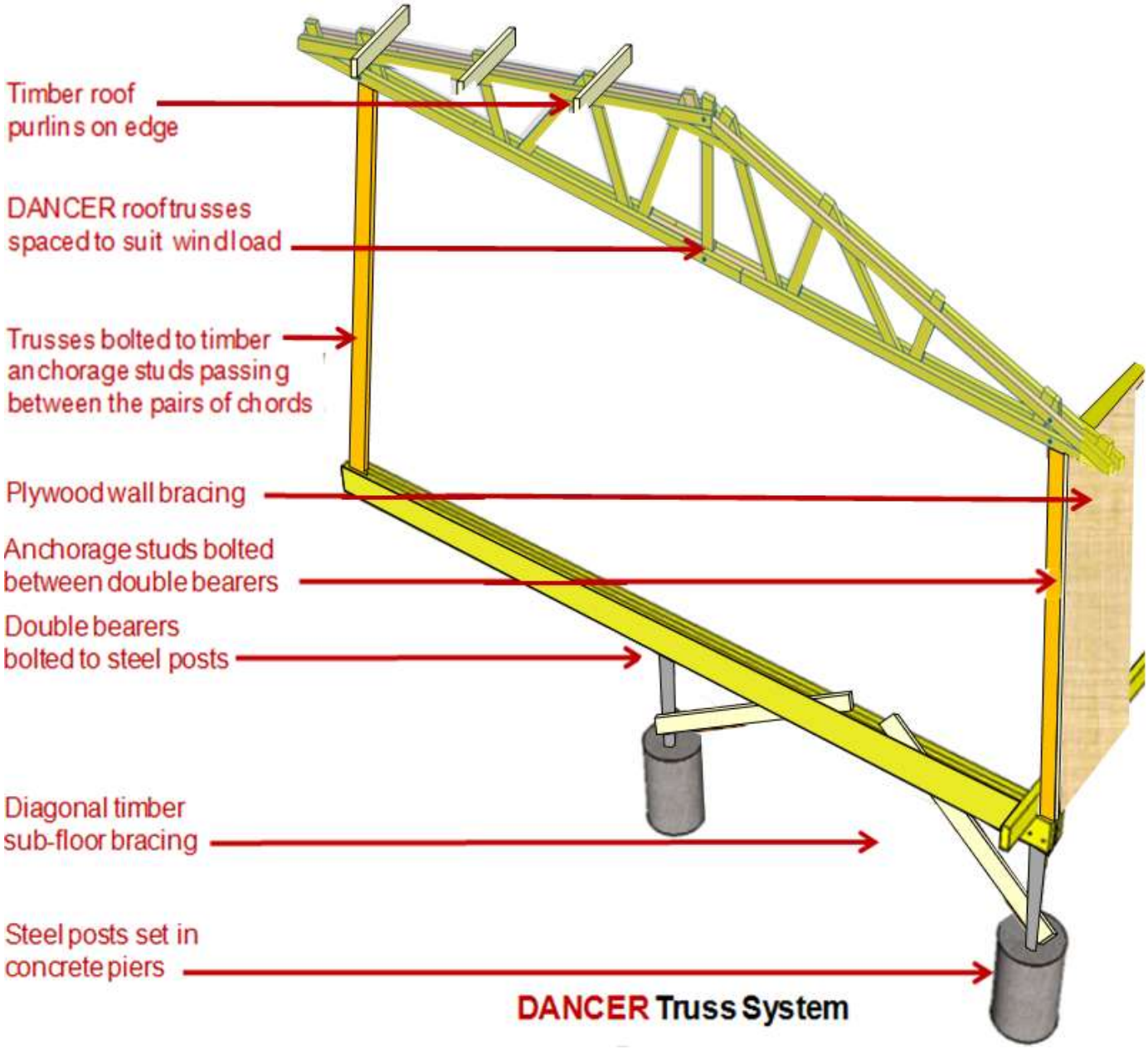


Rainwater Tanks and Header Tanks

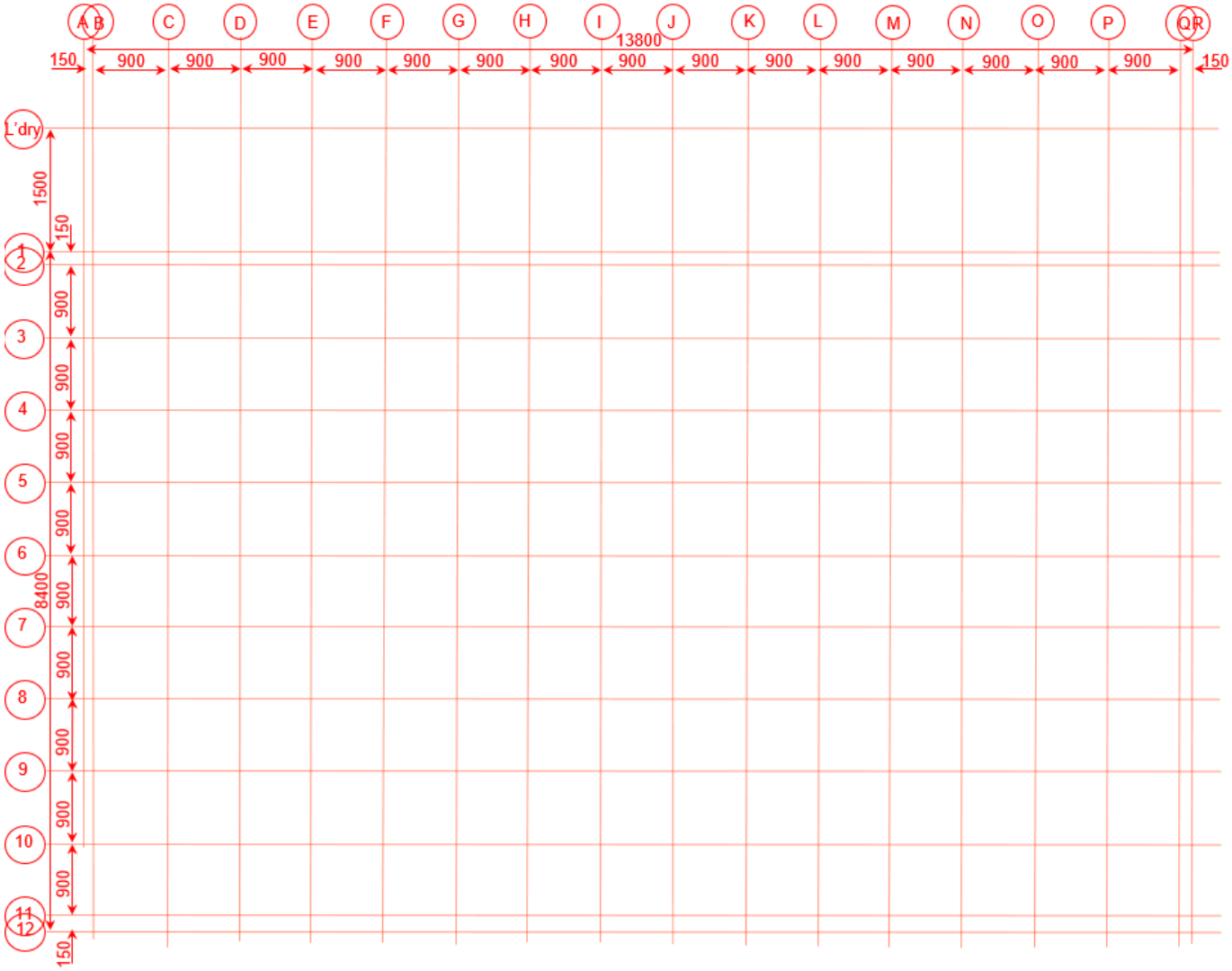


Tank Arrangement

DANCER Building System

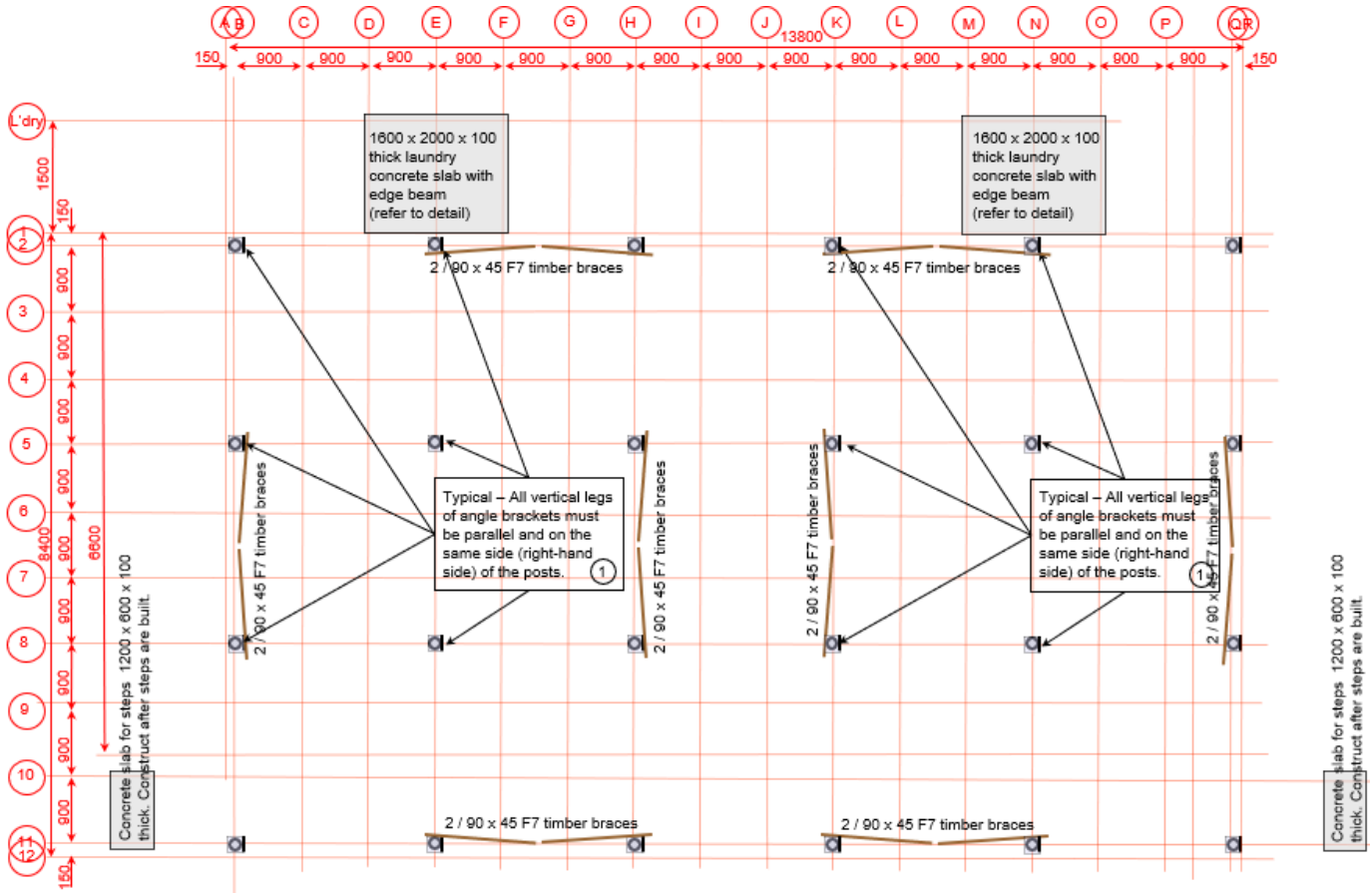


Gridlines



Grid Lines for Duplex House

Subfloor Pier, Post and Bracing Arrangement



Concrete piers, 400 diameter x 600 deep. Steel Posts – 80 NB x 6.5 galvanized pipe x 1194 long, with 125 x 75 x 6 L x 150, drilled 2-14 mm holes, 6 cfw (continuous fillet weld) to top of pipe, and 2-10 dia x 150 bars 6 cfw (continuous fillet weld) to bottom of pipe.

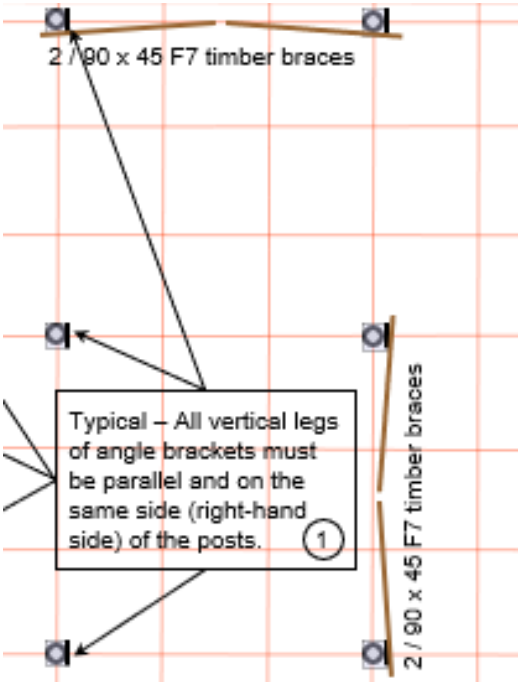
Concrete pad for steps – 1,200 x 600 x 100 mm thick. 5 / N10 x 550 reinforcing bars and 3 / N10 x 1150 reinforcing bars. Top surface of slab nominally 60 mm above ground level. If the slab surface is low, grout (up to a maximum thickness of 20 mm) under both stringers to make up required height. If the slab surface is high, trim the bottom surface of the stringers.

Concrete laundry slabs – 1600 x 2000 x 100 thick laundry concrete slab, reinforced with SL 72 fabric, with 300 wide x 400 deep edge beam with 3 N10 bars in the bottom. Refer to detail). Top surface of slab nominally 60 mm above ground level..

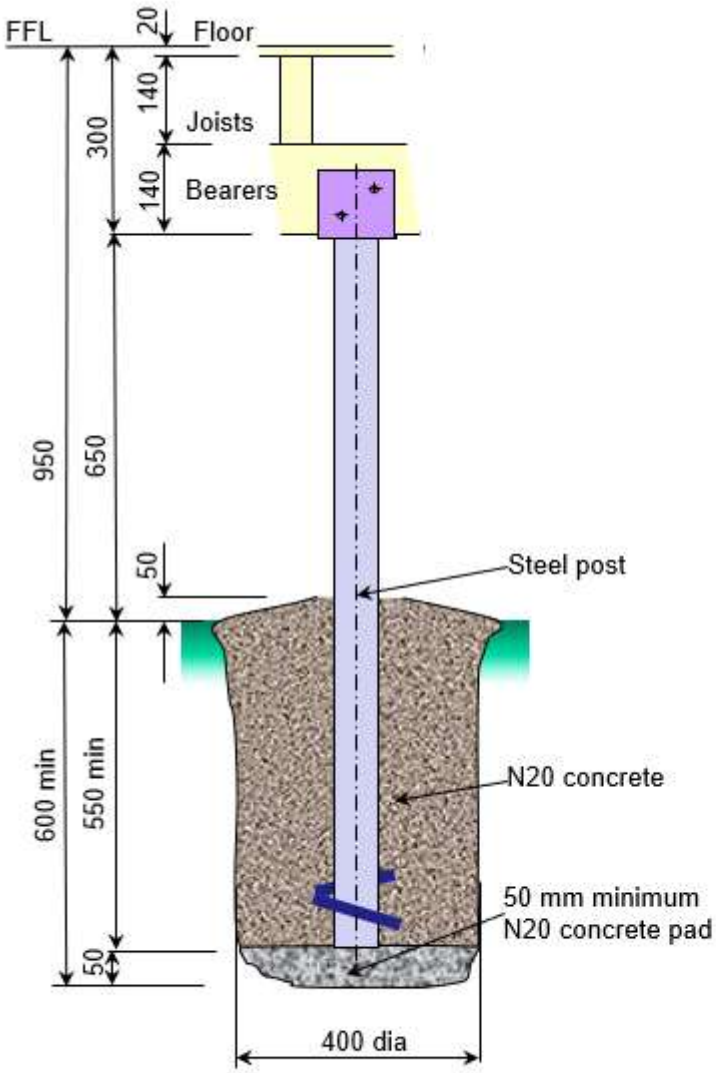
Notes:

1. N20 Concrete
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.

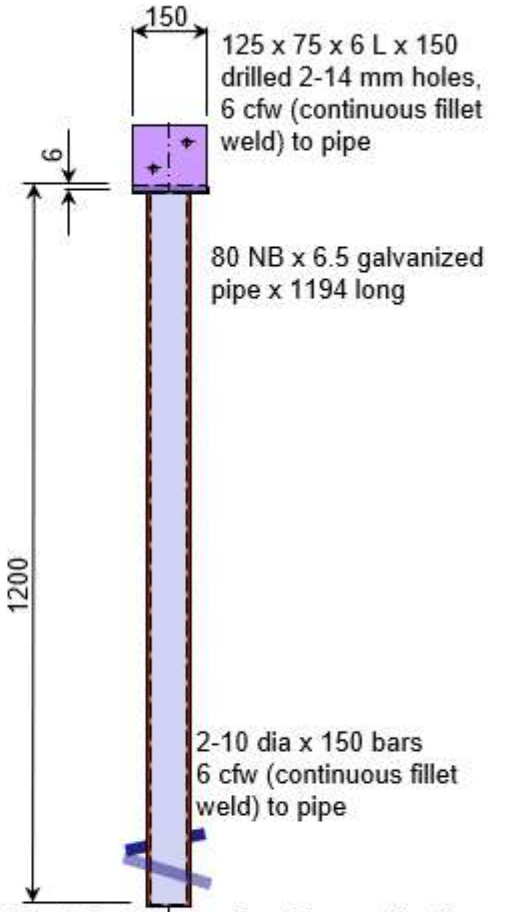
Subfloor Pier, Post and Bracing Arrangement



Concrete Piers and Steel Posts



Concrete Pier, Steel Posts and Timber Floor

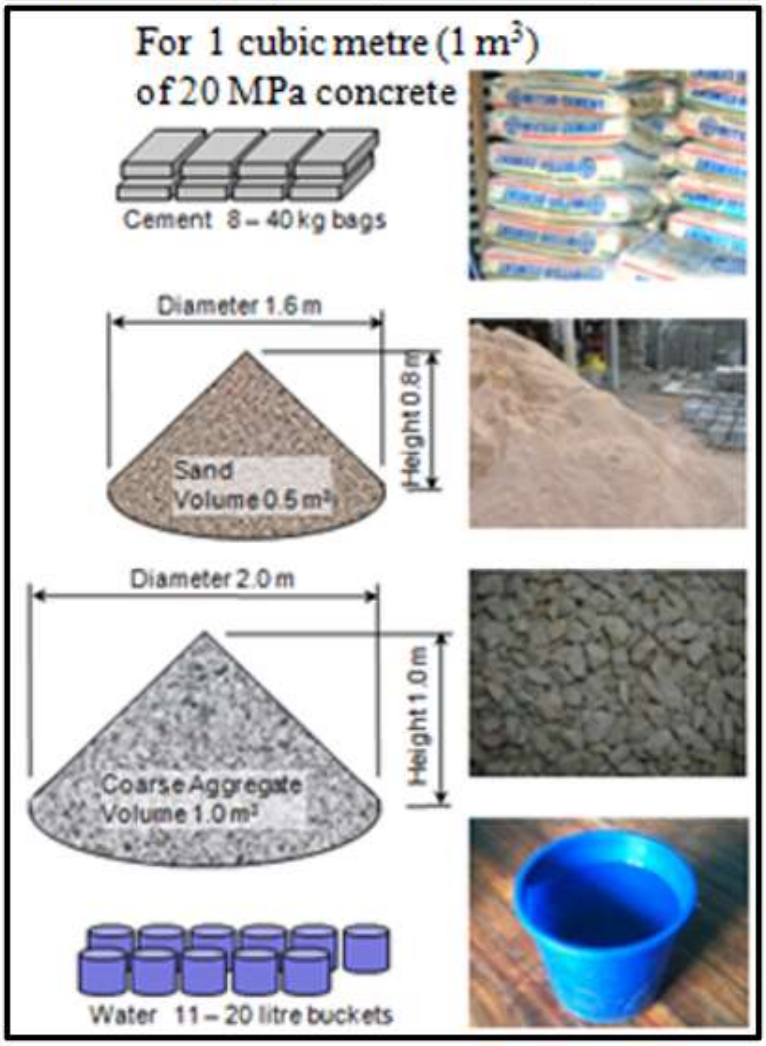


Fabricated posts meeting this specification (or similar) may be available from hardware retailers. If the length of the post is different, the height of the finished floor level and the details of the steps may need to be adjusted.

Steel Posts

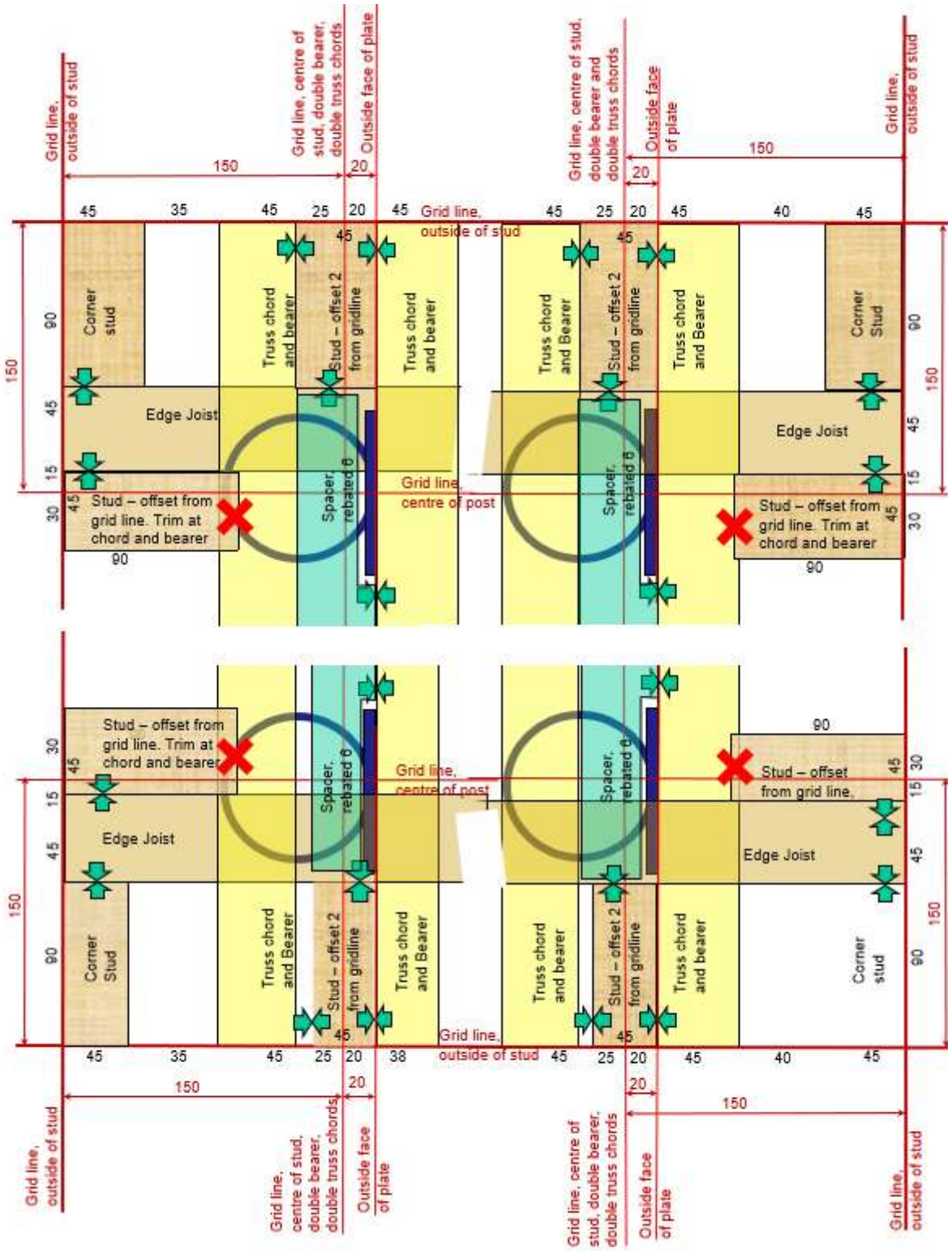
Concrete Mix for Piers and Footings

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



Plan of Corner Showing Bearer, Joist, Post and Studs

The following plan views show the relative positions of the double bearer (including the spacer), edge joist, steel post, anchorage stud and corner stud. The outside vertical face of the steel angle must be offset 20 mm from the gridline and **must be on the same side for every post**. If this is not done, prefabricated wall framing will not fit properly. The spacer timbers at the posts (shown in green) must be rebated 6 mm for a 150 mm length, to fit past the steel section. The plan (for 90 x 35 dressed timber) below is typical of the arrangement.

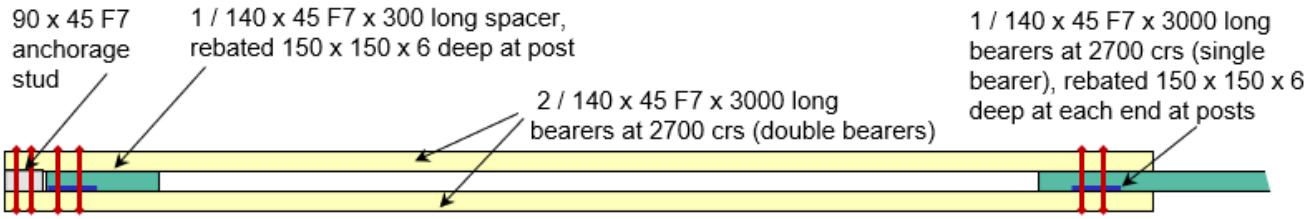


Arrangement at the Corner of Building for 90 x 45 studs and 140 x 45 bearers

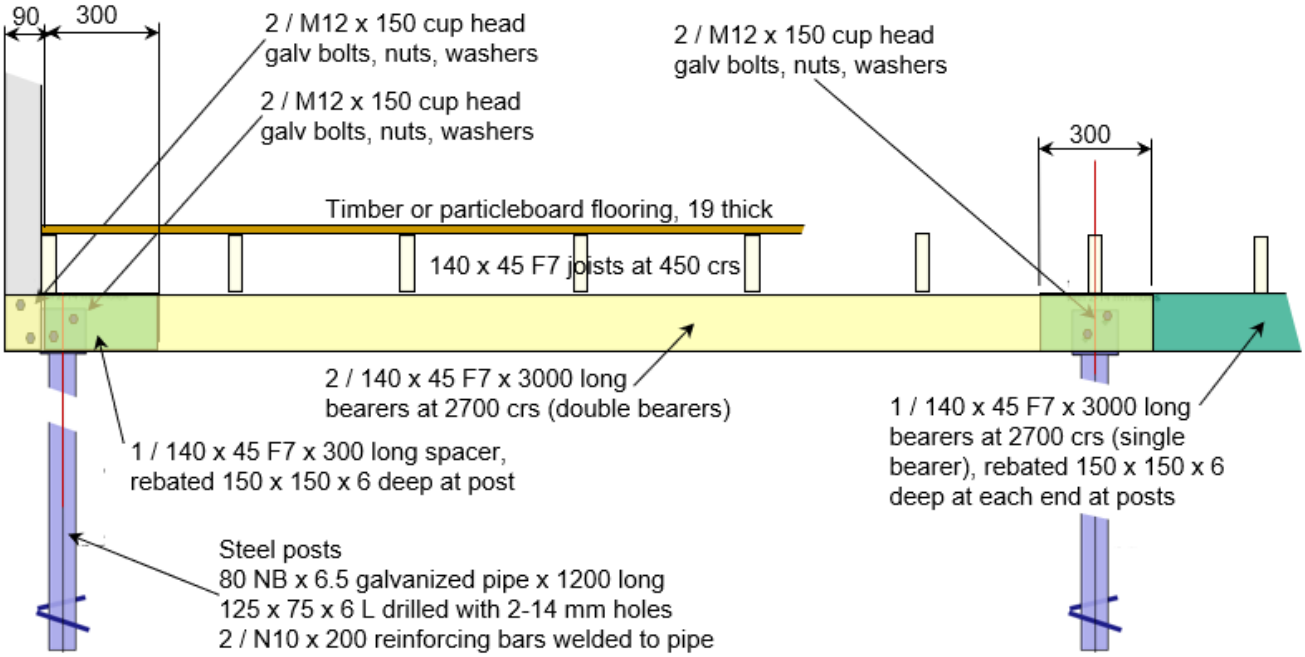
Bearers, Joists, Floor, Posts and Stud Arrangement

Bearer Details and Fixings to Posts

For standards buildings on a 2.700 x 2.700 grid with 0.150 overhangs, the bearer timbers will all be 3,000 long, giving a 300 lap, which is screwed to provide stiffness and minimise sag.



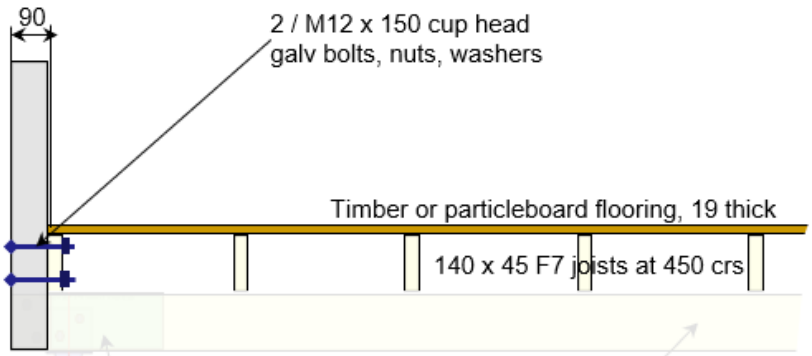
Plan Showing Anchorage Studs, Double & Single Bearers



Bearers in external bays are double bearers, bearers in internal bays are single bearers.
Except where specified otherwise in these drawings or specifications, all details shall comply with AS 1684.3

Section Showing Anchorage Studs, Joists, Double & Single Bearers and Posts

Bearer Fixings to Trimmer Joists between Posts



2 / 140 x 45 F7 x 3000 long
bearers at 2700 crs (double bearers)

1 / 140 x 45 F7 x 300 long spacer,
rebated 150 x 150 x 6 deep at post

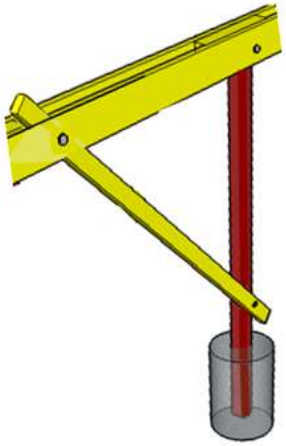
Steel posts
80 NB x 6.5 galvanized pipe x 1200 long
125 x 75 x 6 L drilled with 2-14 mm holes
2 / N10 x 200 reinforcing bars welded to pipe

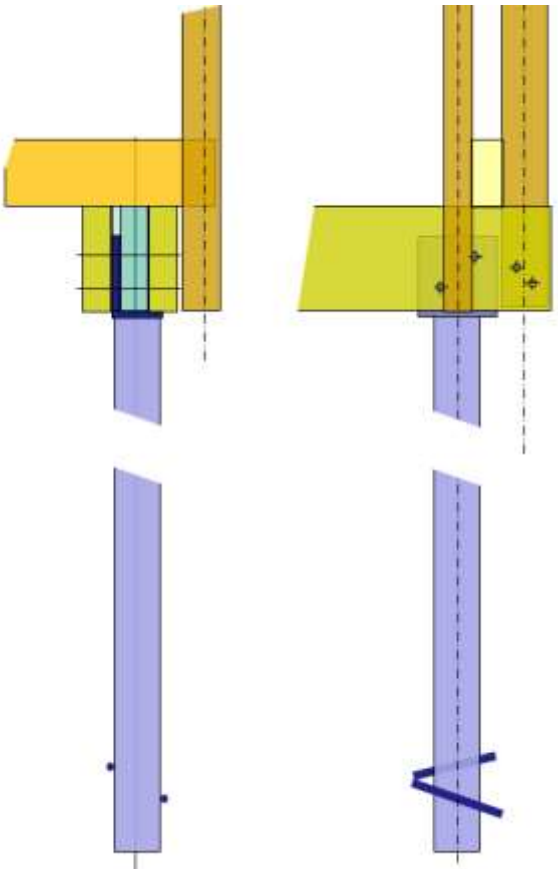
Bearers in external bays are double bearers, bearers in internal bays are single bearers.
Except where specified otherwise in these drawings or specifications, all details shall comply with AS 1684.3

Section Showing Anchorage Studs and Joists where there are no Bearers or Posts

Diagonal Sub-floor Bracing and Steel Posts

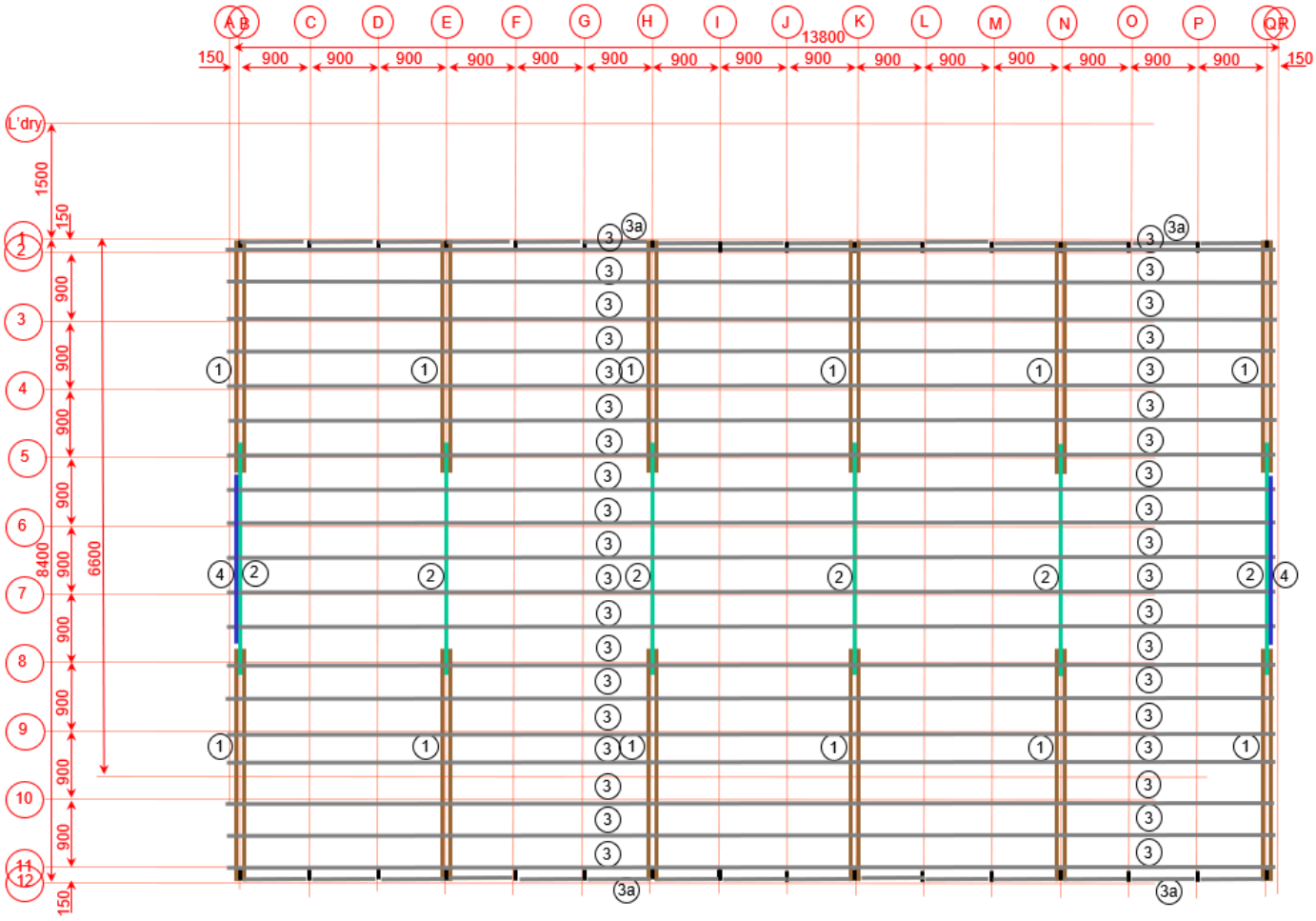
Typical 90 x 45 F7 timber sub-floor diagonal brace, fixed at the top to the bearers or joist (depending on the direction) and at the bottom to the steel post, by 1 / M12 x 150 cup-head galvanised bolt (at each end)





Connections at floor of steel posts with additional cleats

Bearer & Joist Arrangement



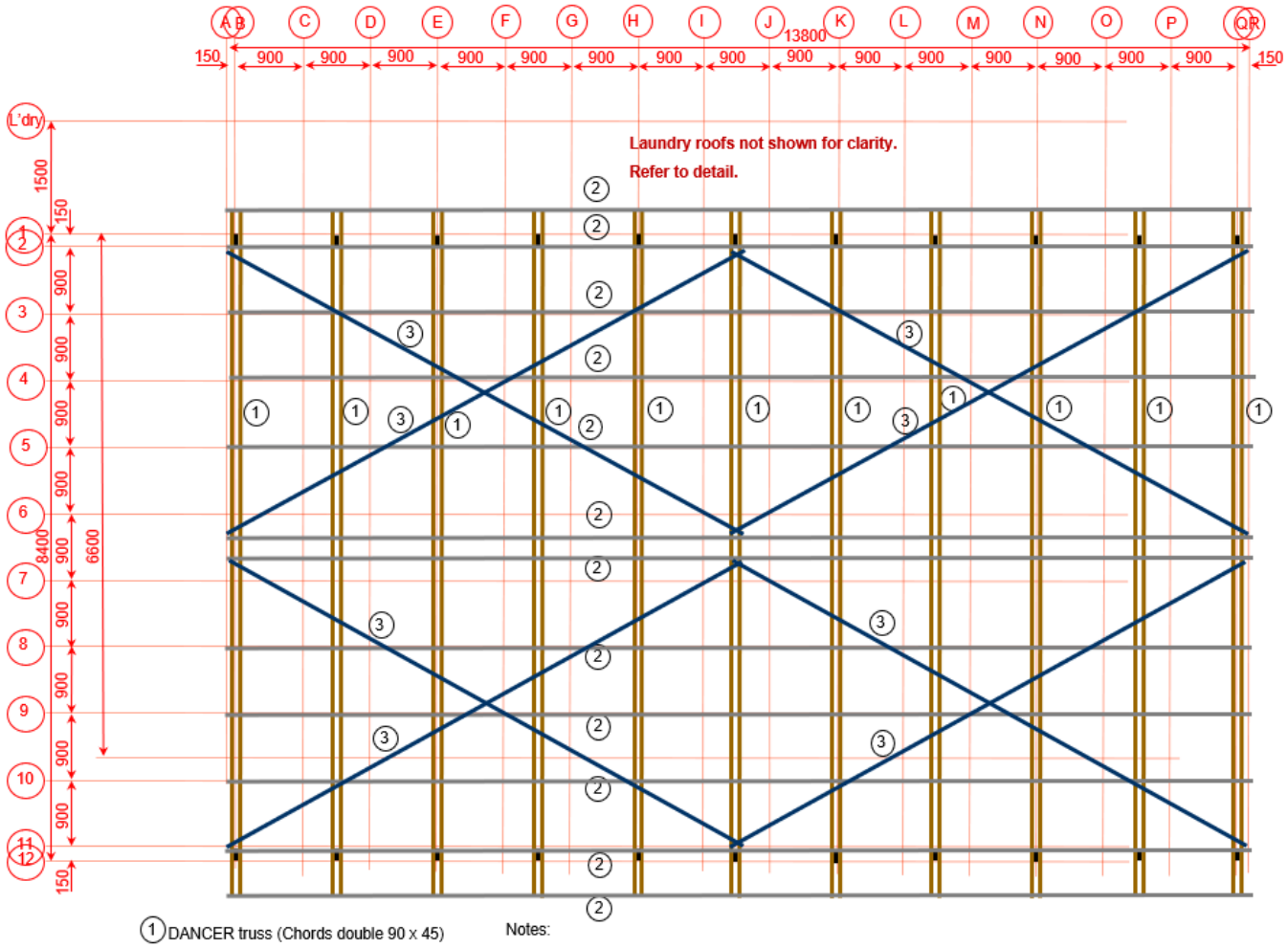
1. Double Bearers (2 / 140 x 45 x 3000 long, lapped)
2. Single Bearers (1 / 140 x 45 x 3000 long, lapped)
3. Joists (140 x 45 x 3000 long, lapped)
4. End Wall Spacer (1 / 140 x 45 x 2400 long)

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.

Bearer & Joist Arrangement

Roof Truss, Purlin & Bracing Arrangement



(1) DANCER truss (Chords double 90 x 45)

(2) Purlin P1 (90 x 45)

(3) Steel strap (30 x 1)

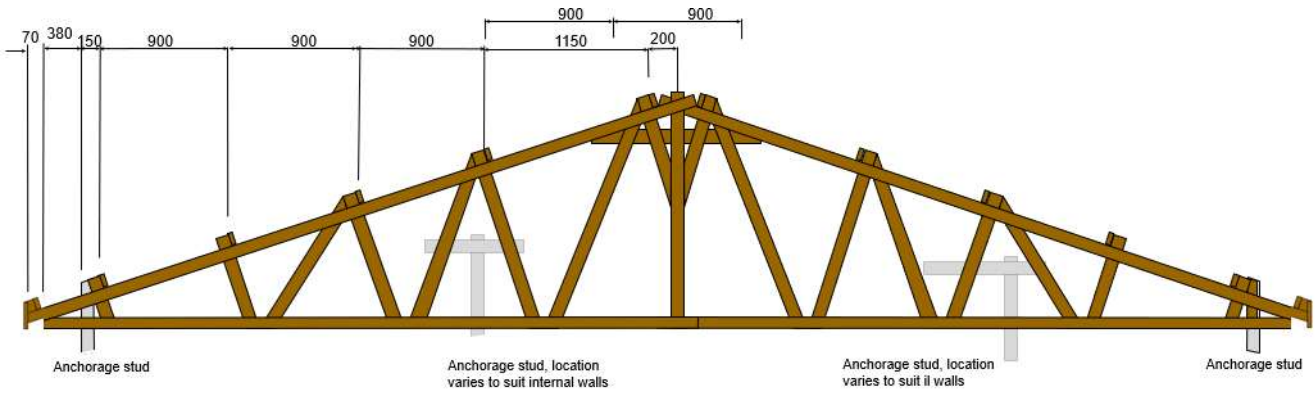
Notes:

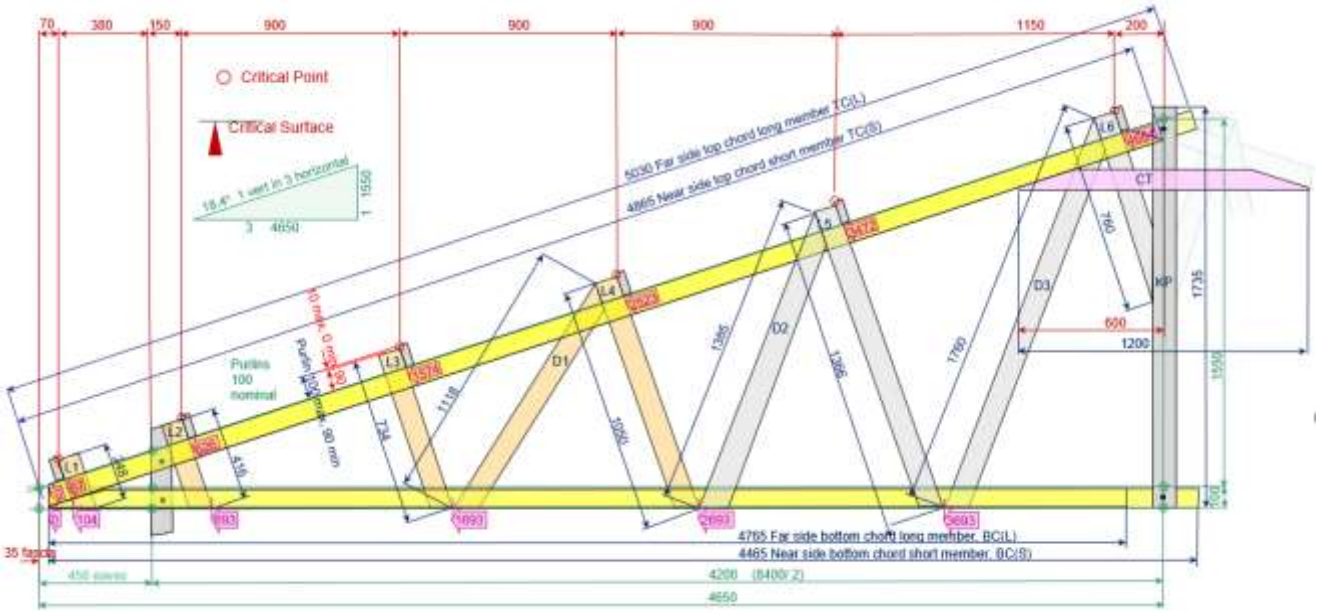
1. All timber shall be graded F7, SD6, JD4 or stronger. Australian and New Zealand Seasoned Radiata Pine are deemed to meet this specification.
2. For all other items, substitution of other sizes must be approved by the Engineer.
3. Refer to Engineer's Details for fixings, connections and associated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

Roof Truss, Purlin & Bracing Arrangement

Details of DANCER Trusses

The following dimensions are for the Standard **DANCER** 8.4 Truss, with eaves overhang of 450 mm. All members shall be 90 x 45 F7 Strength group SD5, Joint group JD4 (or better)

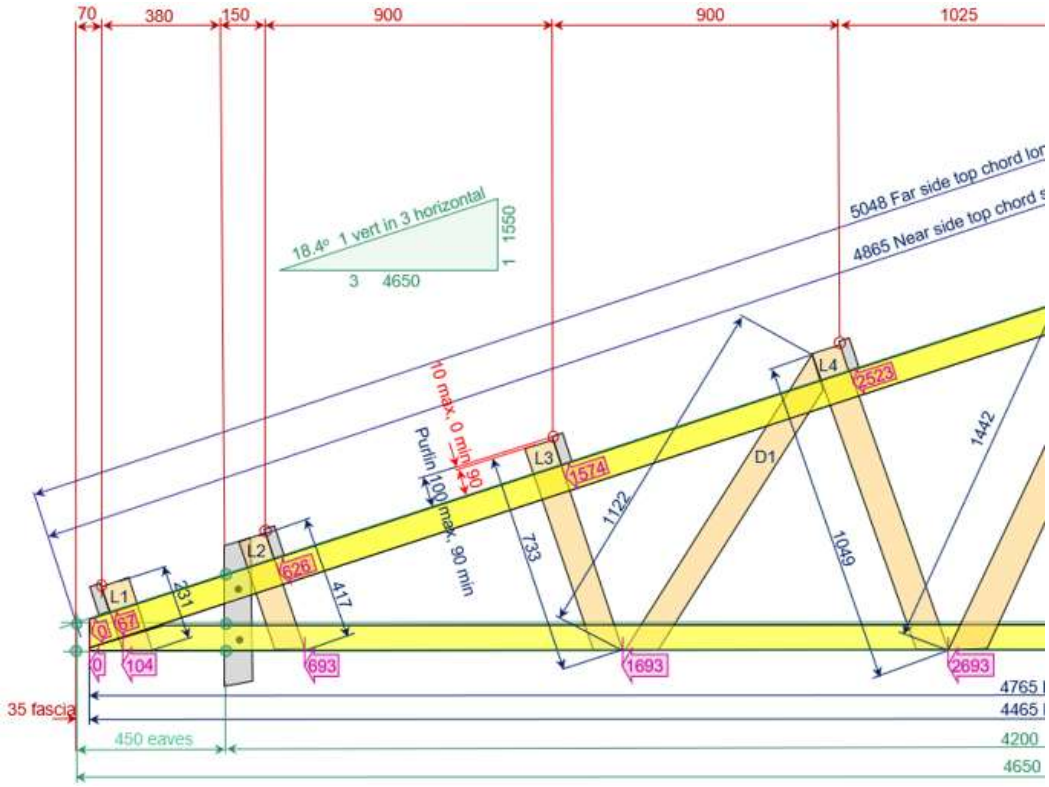


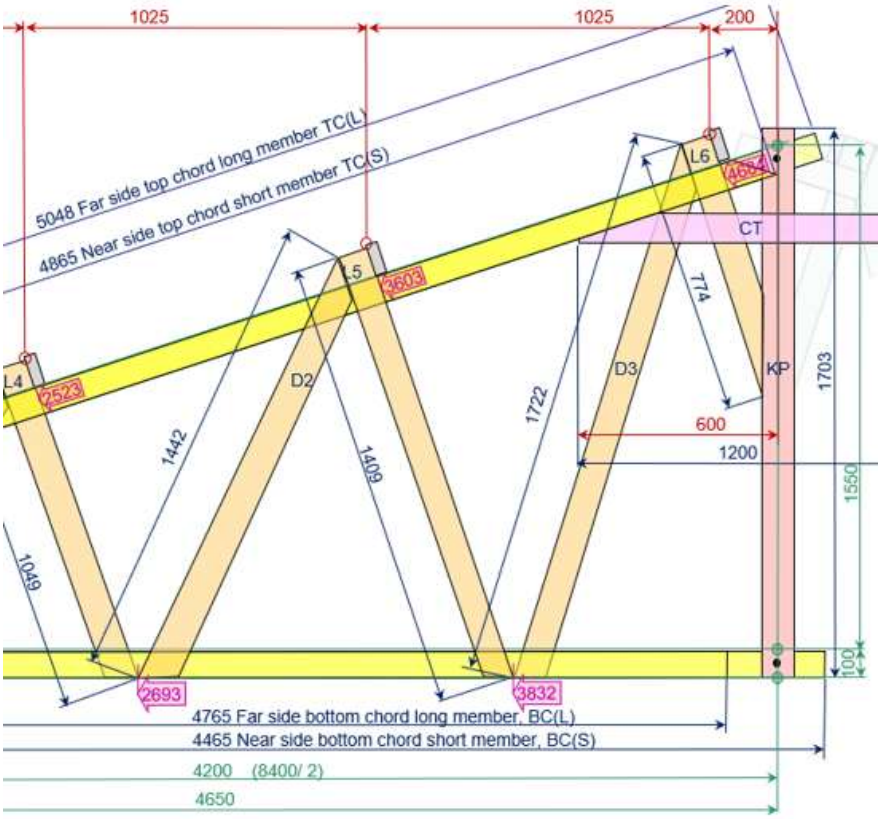


Roof Trusses						8.400
Item	Component	Section mm	x	mm	Material	Length mm
TC(L)	Truss Top Chord (or R	90	x	45	F7	5,030
TC(S)	Truss Top Chord (or R	90	x	45	F7	4,865
BC(L)	Truss Bottom Chord (a	90	x	45	F7	4,765
BC(S)	Truss Bottom Chord (a	90	x	45	F7	4,465
CT	Collar Tie	90	x	45	F7	1,200
KP	King Post	90	x	45	F7	1,735
L1	Lacing at eaves	90	x	45	F7	248
L2	Lacing at anchorage st	90	x	45	F7	416
L3	Lacing	90	x	45	F7	734
L4	Lacing	90	x	45	F7	1,050
L5	Lacing	90	x	45	F7	1,366
L6	Lacing	90	x	45	F7	760
D1	Diagonal	90	x	45	F7	1,118
D2	Diagonal	90	x	45	F7	1,385
D3	Diagonal	90	x	45	F7	1,762

Jig for Fabricating DANCER Trusses

The purple numbers in the arrows are the distances along the top and bottom chords at their critical surfaces, allowing for a 35 mm fascia.



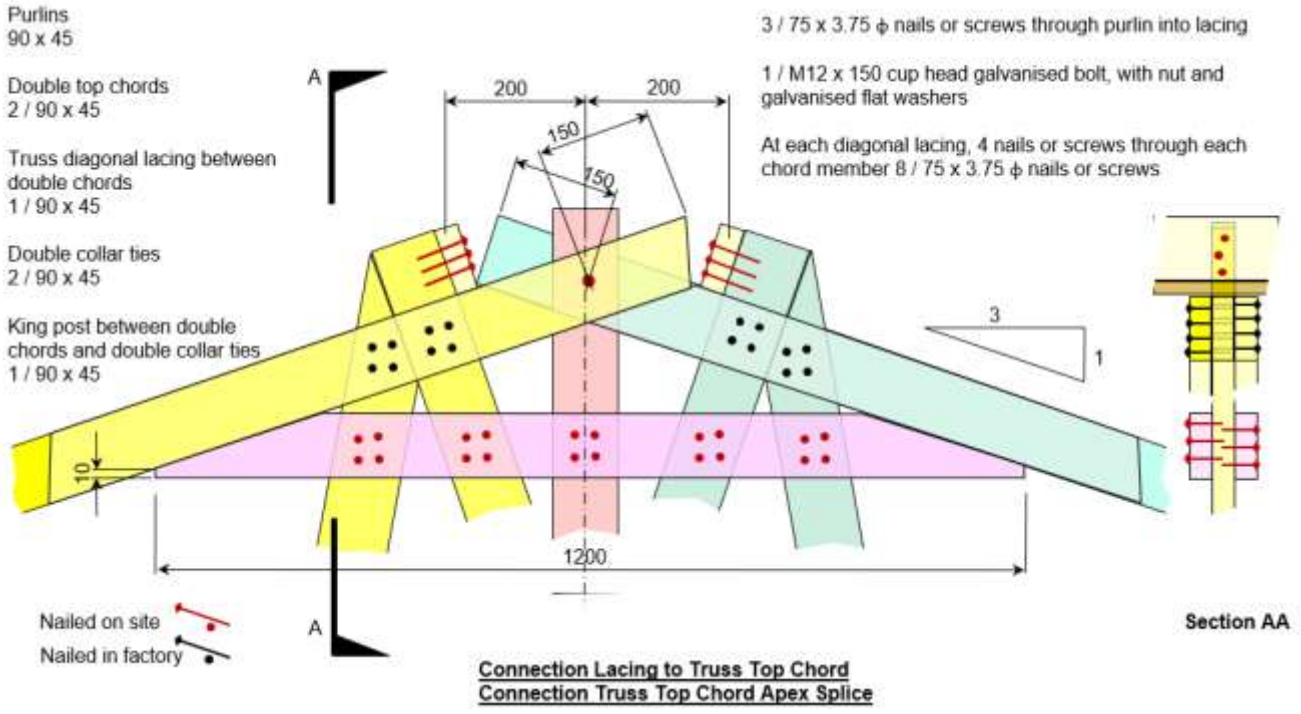


DANCER Truss Bolted Apex Splice

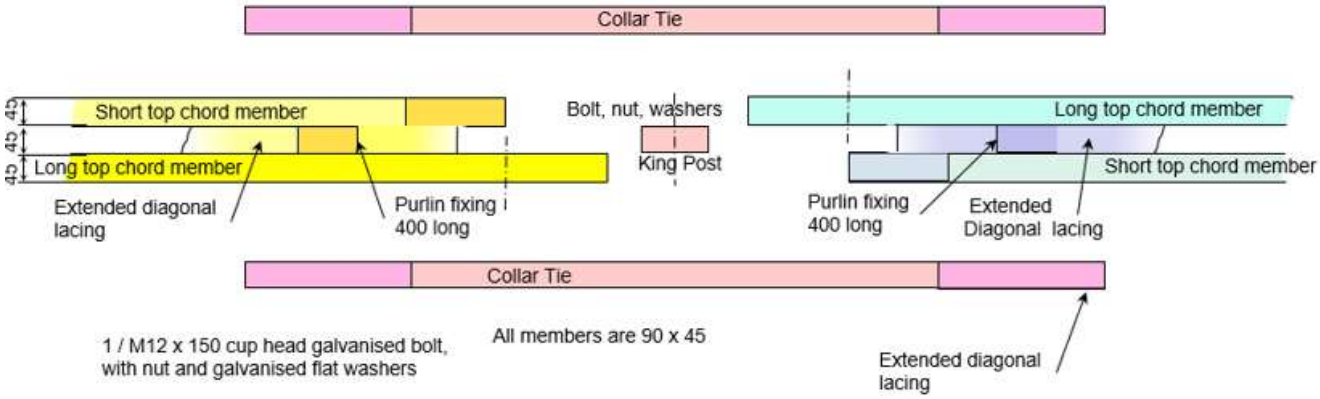
Trusses longer than 3.5 metres cannot be easily transported over significant distances.

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.

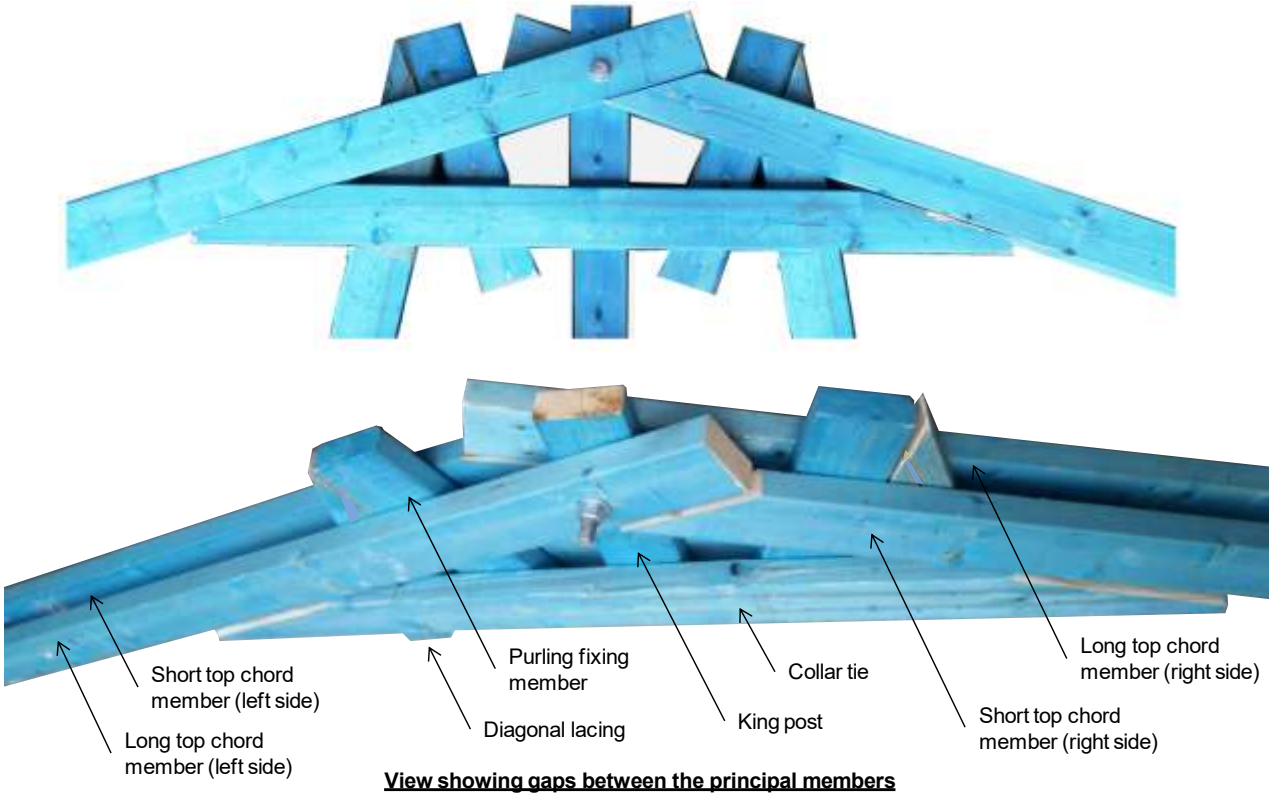
Bolted connections must not incorporate nails, since the premature failure of the nails could disrupt the timber and destroy the bolted connection before it has time to be effective.



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



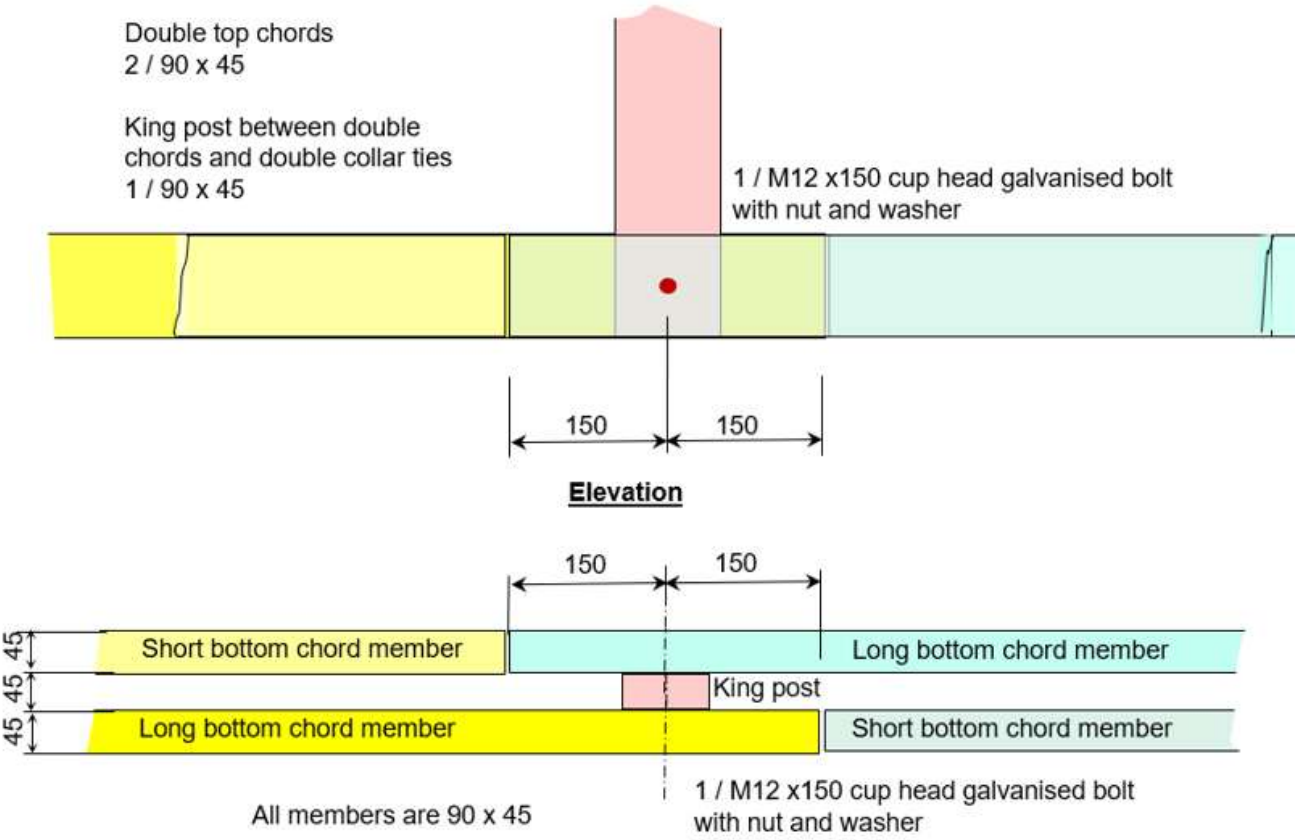
Exploded Plan View Purlins omitted for clarity)



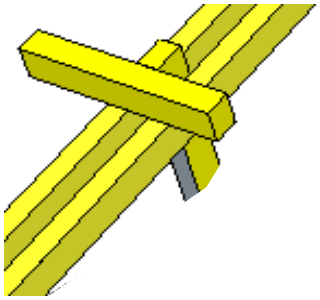
View showing gaps between the principal members

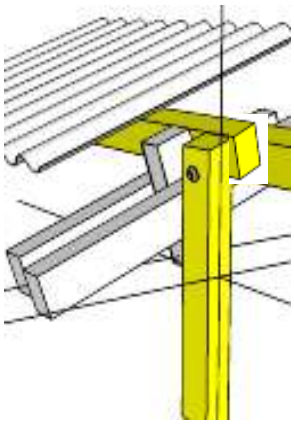
DANCER Truss Bolted Bottom Chord Splice

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

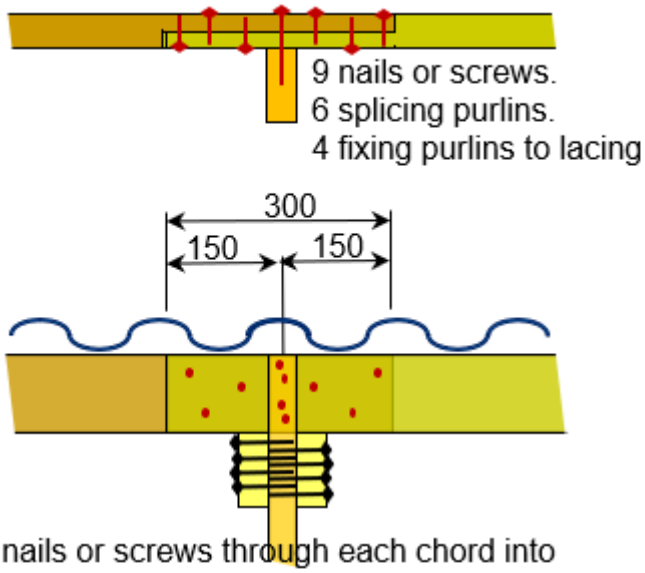


Connection Truss Bottom Chord Splice

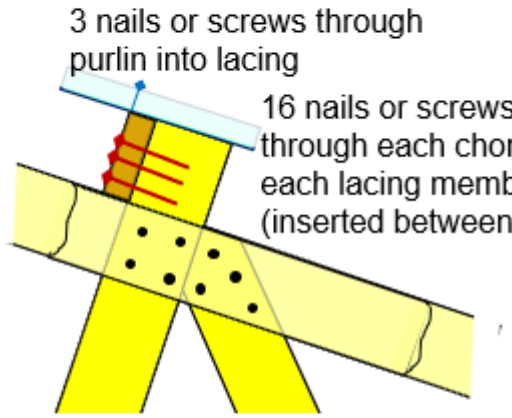




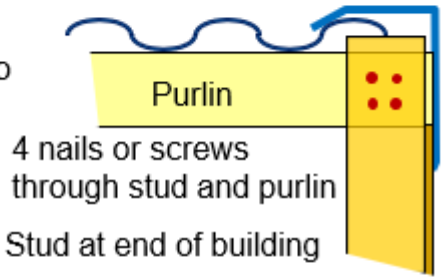
Purlin, Diagonal Lacing and Double Top Chord Connections



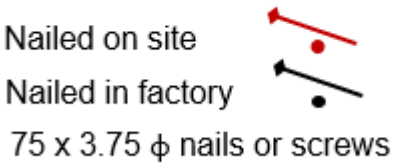
Purlin Splice (Preferred Detail)



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



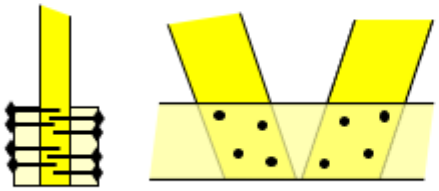
Connection Purlin to End Wall Stud



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

Top Chord, Lacing, Purlin Fixing and Purlin Splice

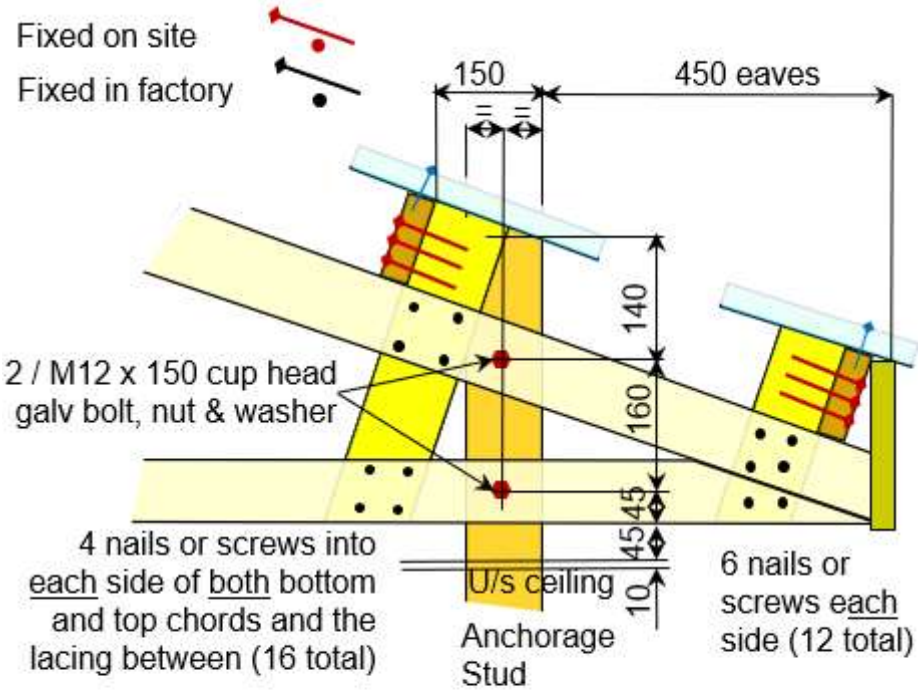
75 x 3.75 ϕ nails or screws Fixed in factory



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

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

Connection of Lacing to Bottom Chords



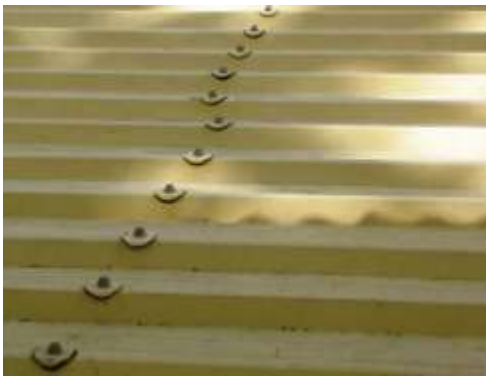
Top Chord to Bottom Chord
Top Chord to Anchorage Stud **450 Eaves**

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

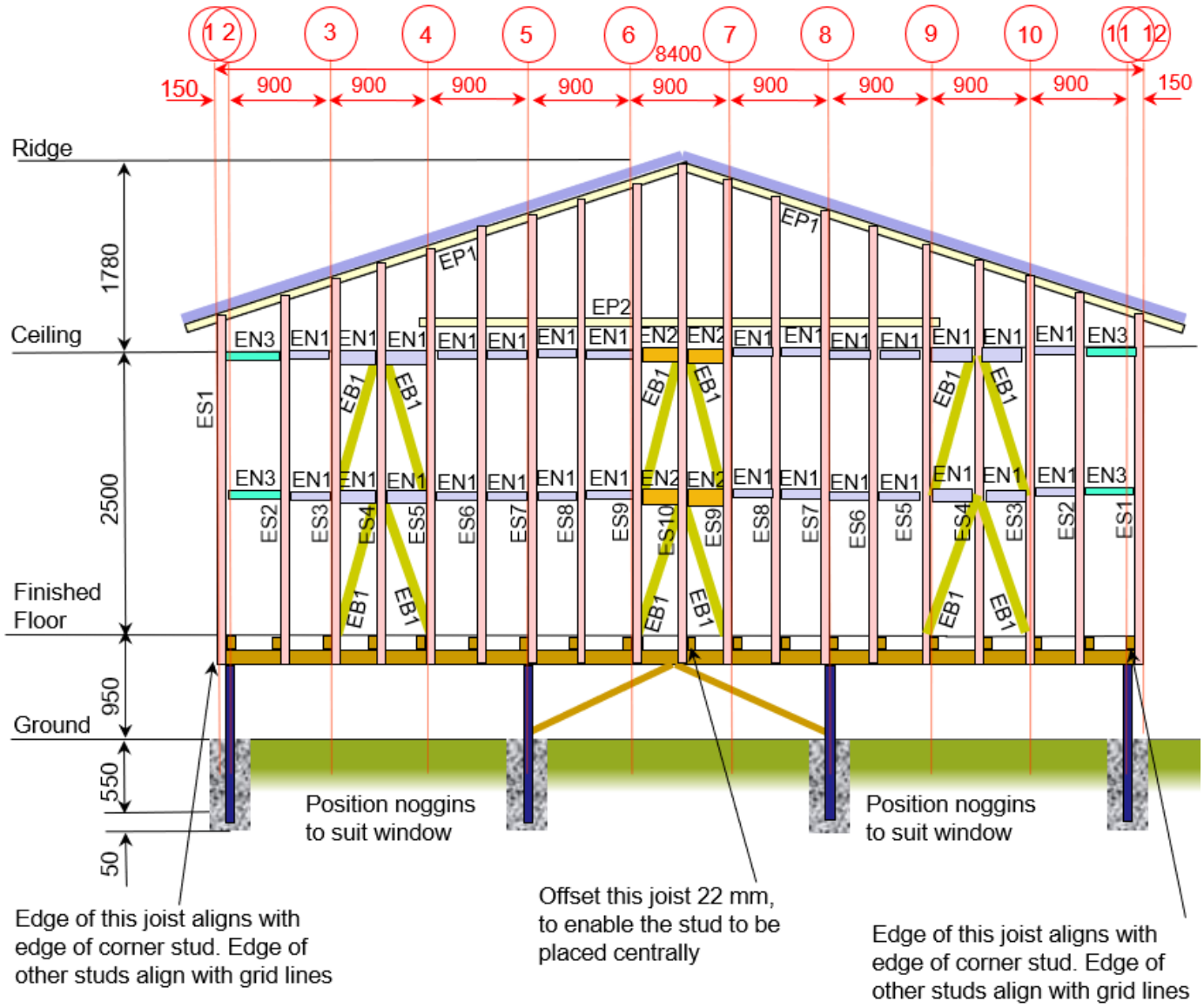
CUSTOM ORB®/CUSTOM BLUE ORB®

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

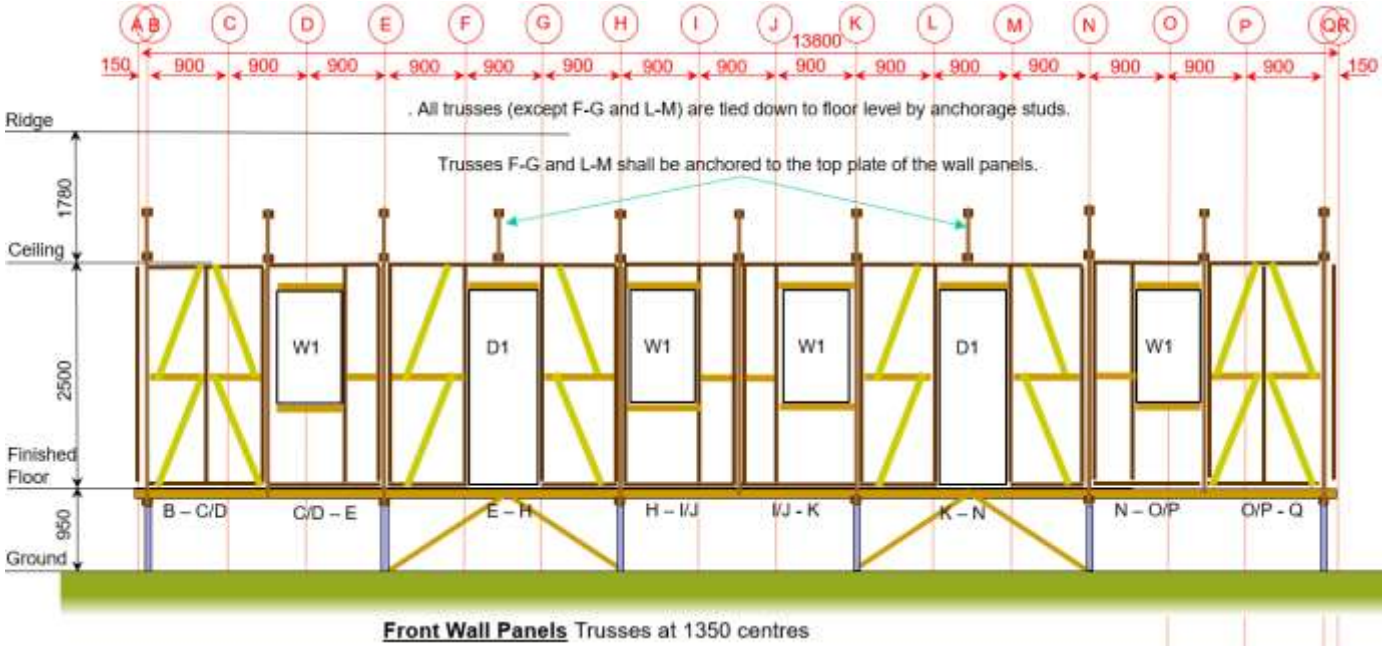
End Wall Framing Arrangement



Notch the studs (ES3, ES4, ES5; ES9, ES10, ES9; ES5, ES4, ES3) where the diagonal braces (WB1) cross these studs. Fix nogging (EN1 and EN2) with 90 dimension vertical where these braced are located.

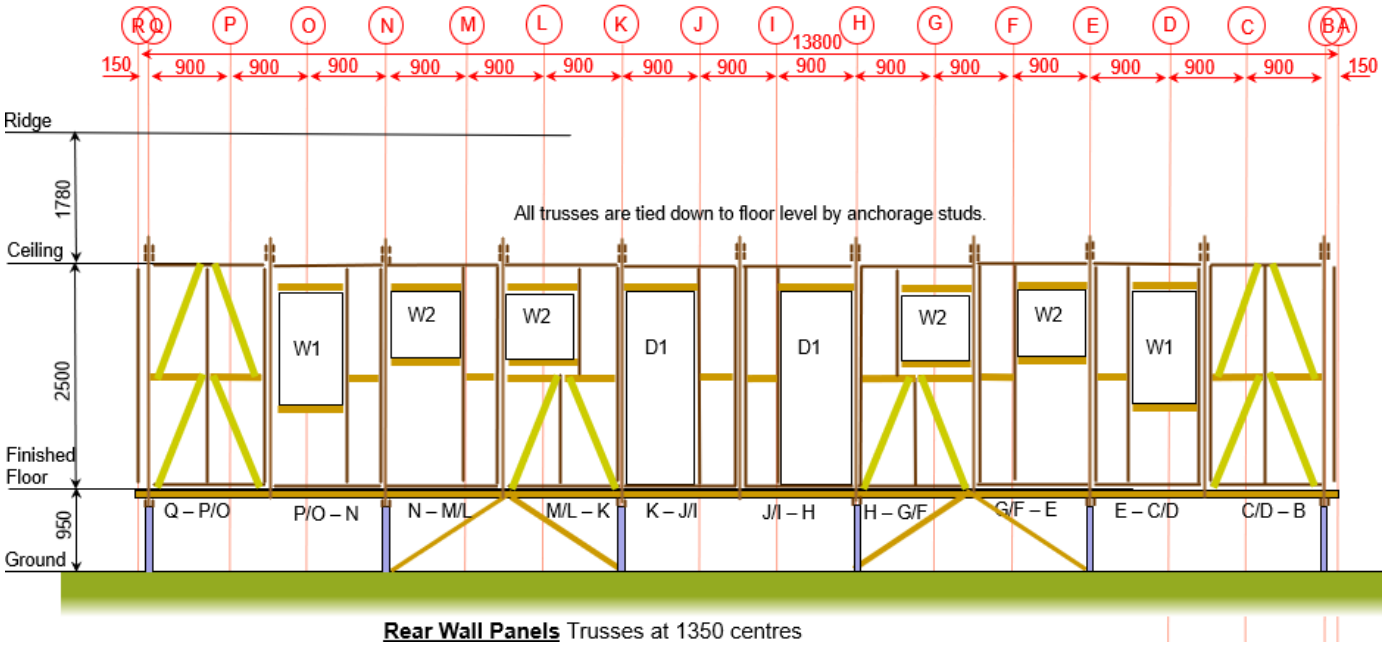
Section Through End Walls

Front Wall Framing



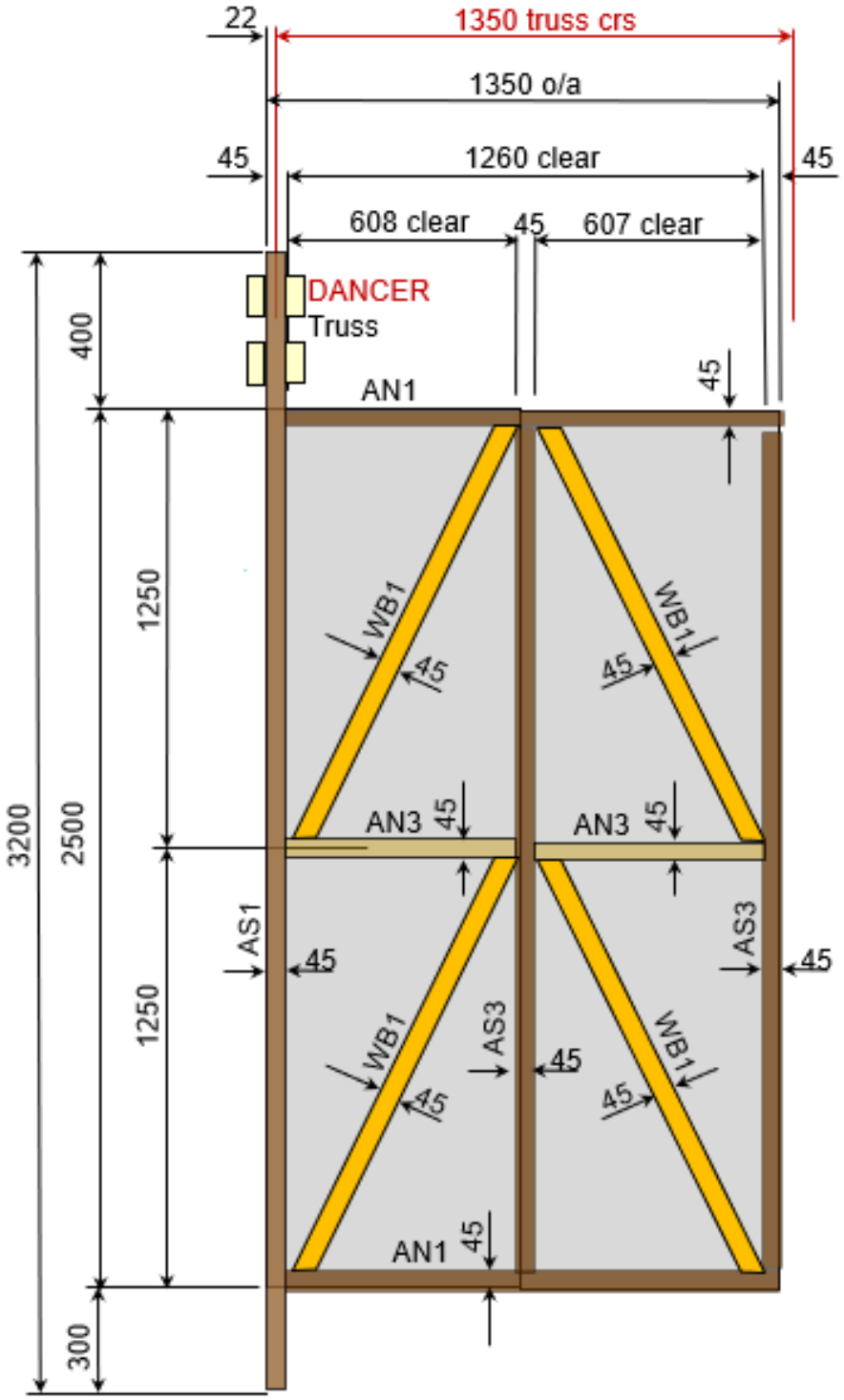
Front Wall Panels Trusses at 1350 centres

Rear Wall Framing



Rear Wall Panels Trusses at 1350 centres

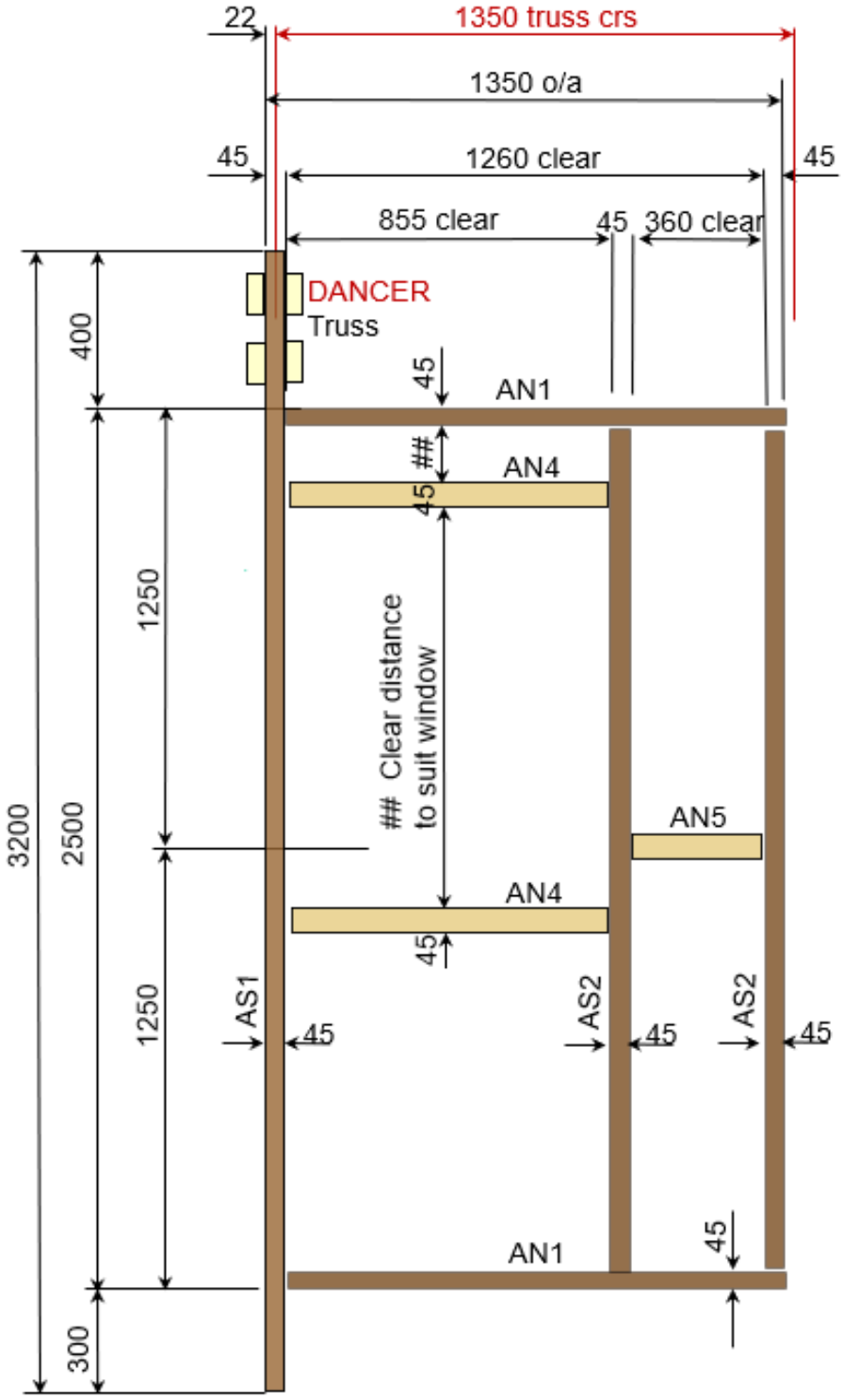
Typical Side Wall Bracing Details



2 / 620 x 2500 x 7 mm F8 (or stronger) plywood, fixed to inside of studs, noggings & diagonals by 30 x 2.8 mm φ galvanized flat head nails at 150 mm centres. Sheets butt jointed vertically.

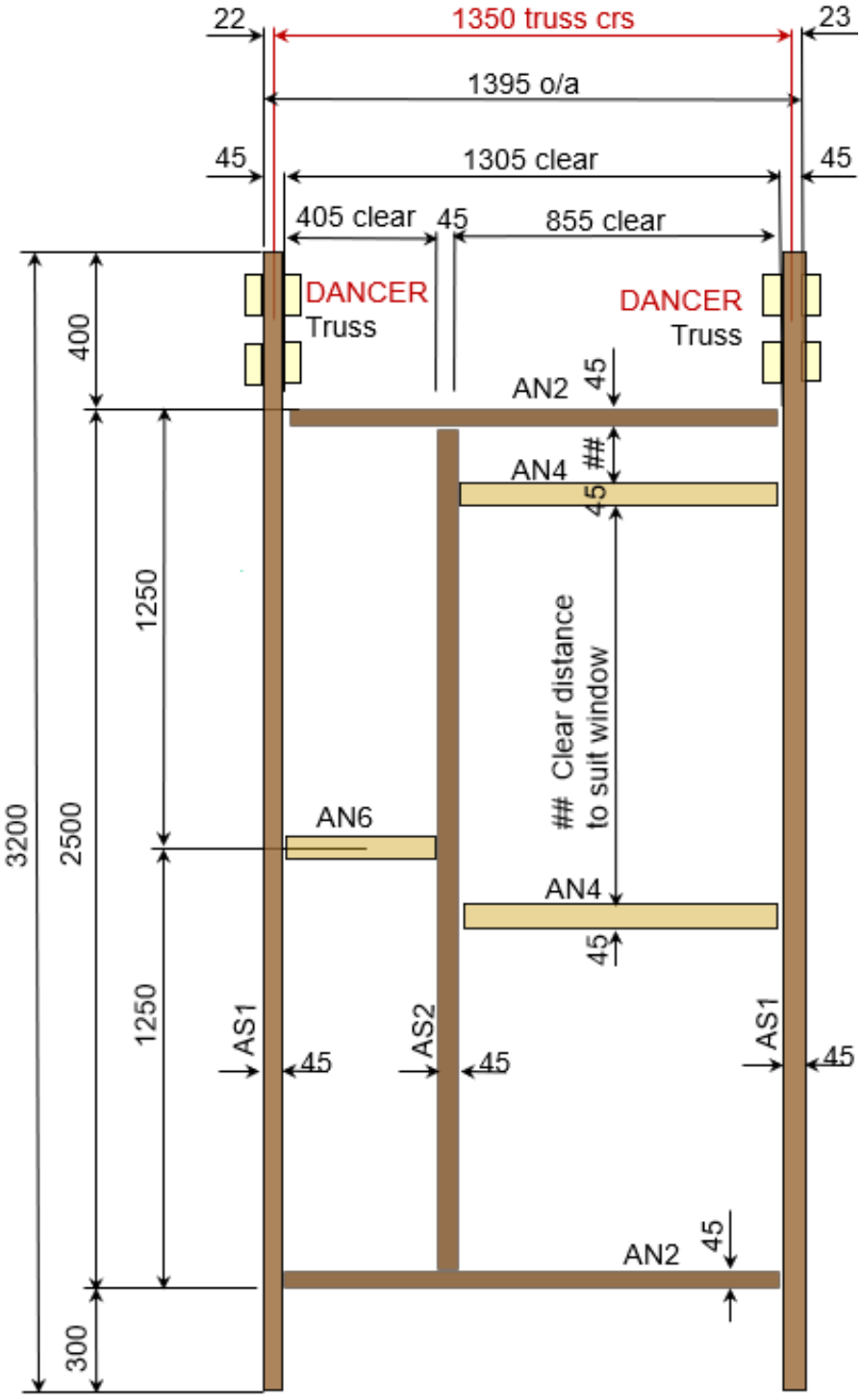
All members, 90 x 45 F7, fixed each end by 3 / 75 x 3.15 mm φ galvanized nails or screws

Typical Wall Framing 1350 long with Bracing



All members, 90 x 45 F7, fixed each end by
3 / 75 x 3.15 mm φ galvanized nails or screws

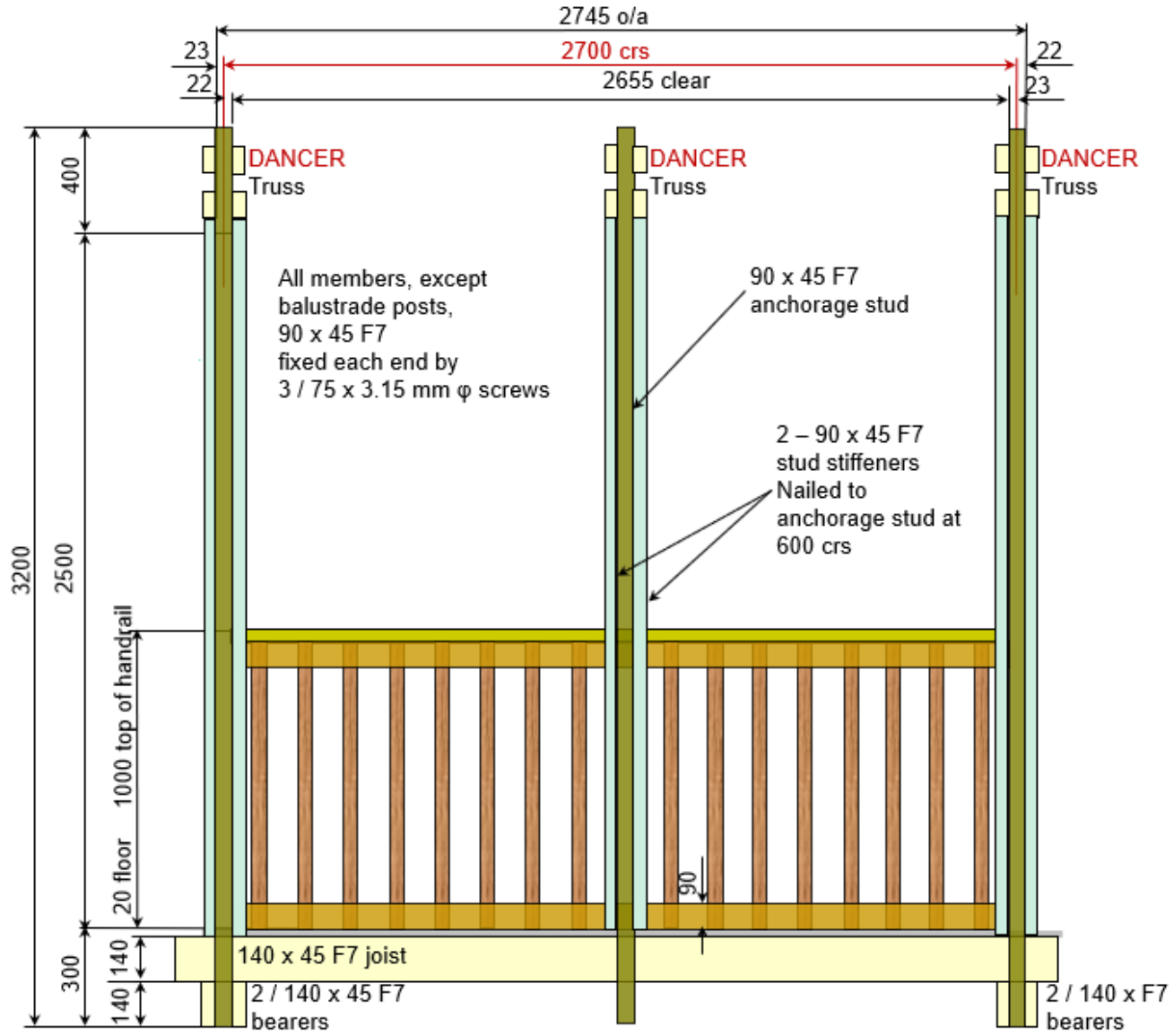
Typical Wall Framing 1350 long with Window



All members, 90 x 45 F7, fixed each end by
3 / 75 x 3.15 mm φ galvanized nails or screws

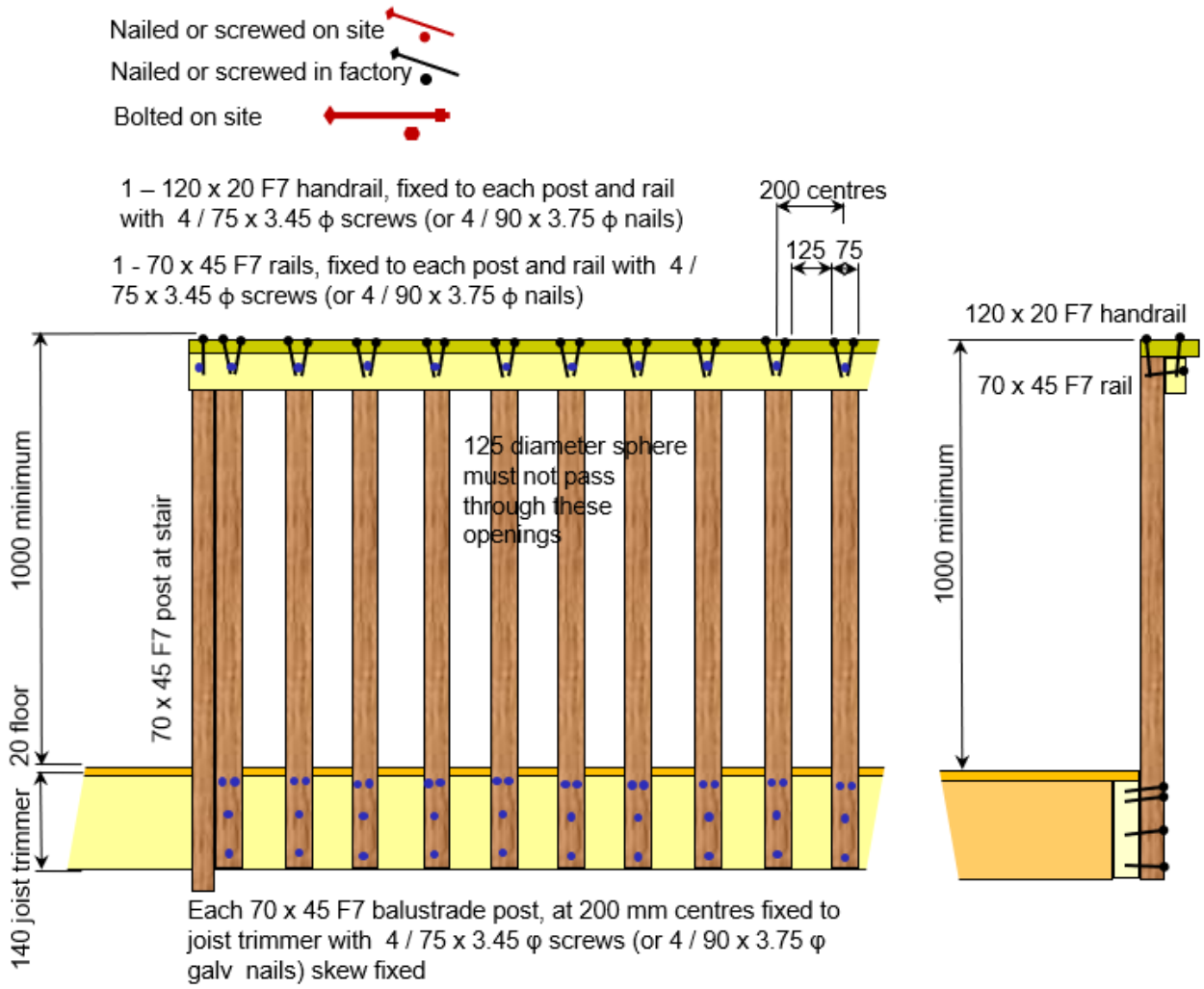
"Make-up" Wall Framing 1345 long(with Window)

Veranda Stud Stiffening



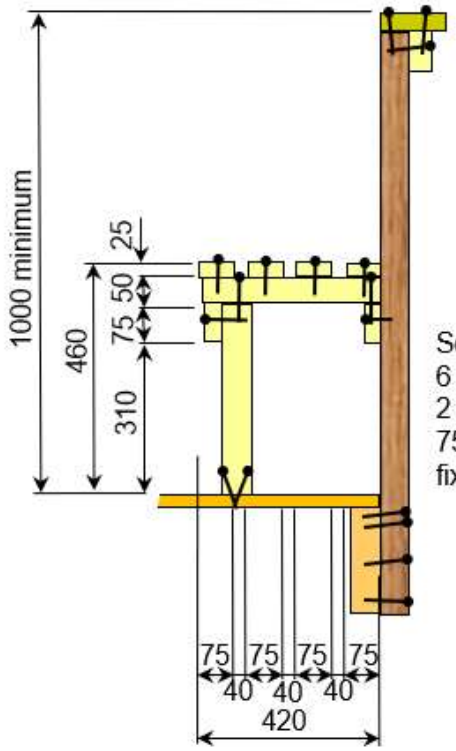
Veranda Wall Framing supporting DANCER Trusses at 1350 centres

Veranda Balustrade



Elevation of Typical Veranda Balustrade **Section through Veranda Balustrade**

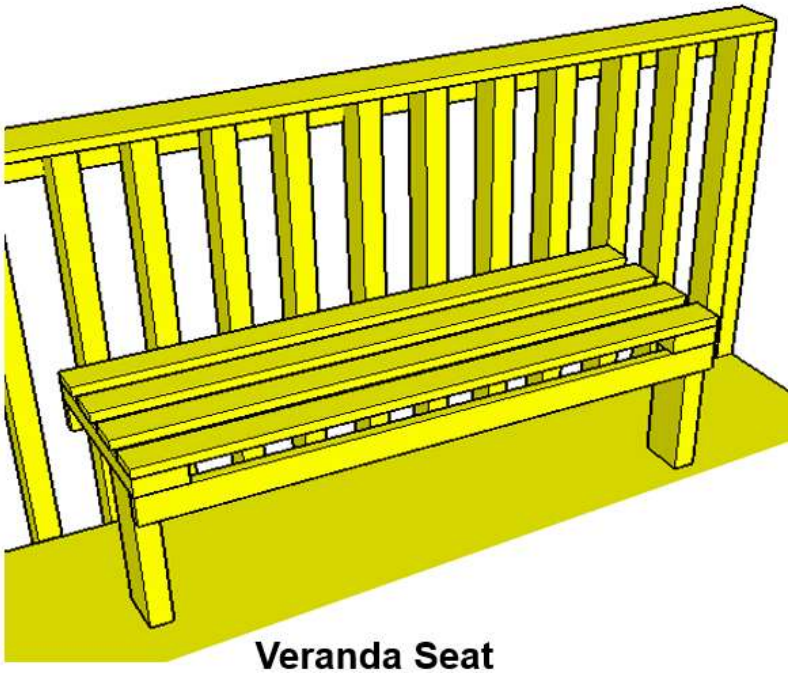
Veranda Seat



Seat consisting of
6 / 75 x 25 F7 longitudinal seat members,
2 / 75 x 25 F7 longitudinal rail members,
75 x 50 F7 legs at 900 centres,
fixed by 65 x 3.05 screw (or galvanized nails)

Veranda seat is optional. Length must be specified.

Section through Veranda Seat



Veranda Seat

Stair Options

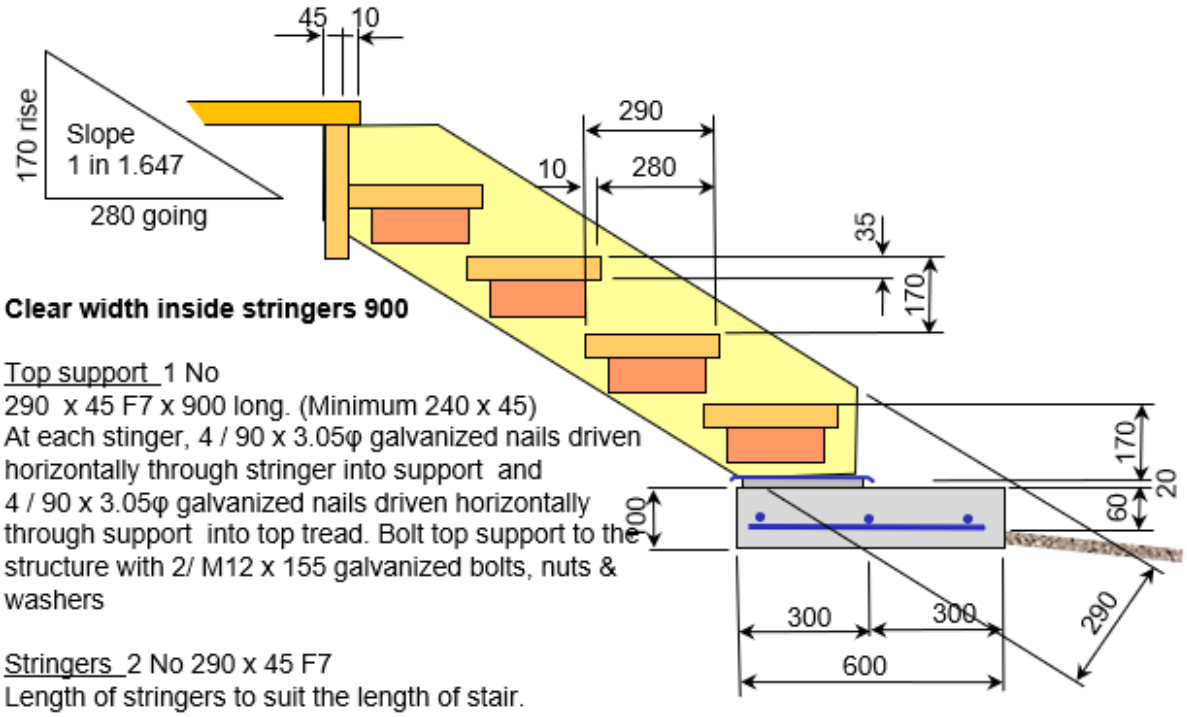
Stairs may be either timber (with timber balustrades) or concrete (with steel balustrades).

Concrete stairs shall be formed to the dimensions shown, and reinforced with N10 reinforcing bars. Alternatively, concrete stairs may be formed using hollow concrete blocks, provided the specified rises and goings are achieved.

For other finished floor level FFL heights (above ground level GL), the stairs shall be proportioned in accordance with the following table –

Stair Dimensions					
Stair going			280 mm		
Stair rise			170 mm		
Mortar thickness			0 mm		
Step down from FFL to veranda			20 mm		
Height of slab above ground			80 mm		
No of Rises	No of Goings	Stair Rise	Stair Going	Veranda Height	FFL Height
18	17	3060	4760	3140	3160
17	16	2890	4480	2970	2990
16	15	2720	4200	2800	2820
15	14	2550	3920	2630	2650
14	13	2380	3640	2460	2480
13	12	2210	3360	2290	2310
12	11	2040	3080	2120	2140
11	10	1870	2800	1950	1970
10	9	1700	2520	1780	1800
9	8	1530	2240	1610	1630
8	7	1360	1960	1440	1460
7	6	1190	1680	1270	1290
6	5	1020	1400	1100	1120
5	4	850	1120	930	950
4	3	680	840	760	780
3	2	510	560	590	610
2	1	340	280	420	440
1	0	170	0	250	270

Timber Stairs



Clear width inside stringers 900

Top support 1 No
290 x 45 F7 x 900 long. (Minimum 240 x 45)
At each stinger, 4 / 90 x 3.05φ galvanized nails driven horizontally through stringer into support and
4 / 90 x 3.05φ galvanized nails driven horizontally through support into top tread. Bolt top support to the structure with 2/ M12 x 155 galvanized bolts, nuts & washers

Stringers 2 No 290 x 45 F7
Length of stringers to suit the length of stair.

Treads – Number of treads to suit length of stair
290 x 45 F7 x 920 long. Slot the treads into rebates, 10 mm deep in the stringers to give 900 clear width.
At each stinger, 2 / 90 x 3.05φ galvanized nails driven horizontally through stringer into tread and 2 / 90 x 3.05φ galvanized nails driven vertically through stringer into support

Tread supports –
2 per tread. 90 x 45 F7 x 260 long
3 / 90 x 3.05φ galvanized nails driven horizontally through support into stringer

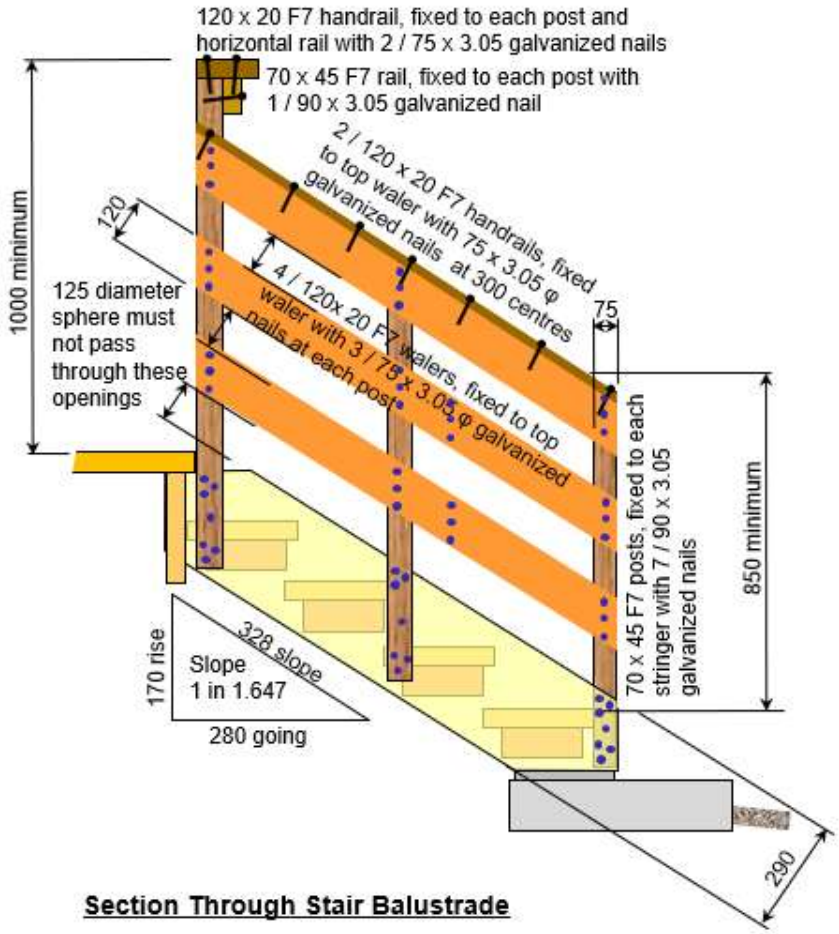
Stair Dimensions				
Stair going		280	mm	
Stair rise		170	mm	
Grout thickness		0	mm	
Height of slab above ground		80	mm	
No of Rises	No of Goings	Stair Rise	Stair Going	Veranda Height
5	4	850	1120	930

Termite shield – 2 / 100 x 3 x 350 galvanized steel strips, folded down 20 mm around edges, nailed to the underside of the stair stringer and kept clear of debris.

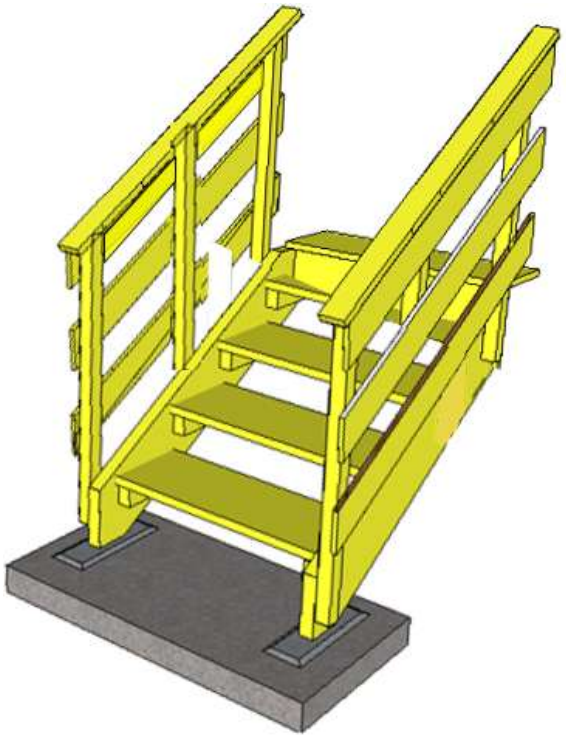
Concrete Pad – 1,200 x 600 x 100 mm thick
5 / N10 x 550 reinforcing bars and
3 / N10 x 1150 reinforcing bars
Top surface of slab nominally 60 mm above ground level. If the slab surface is low, grout (up to a maximum thickness of 20 mm) under both stringers to make up required height. If the slab surface is high, trim the bottom surface of the stringers.

Section Through Timber Stairs

Timber Stair Balustrades

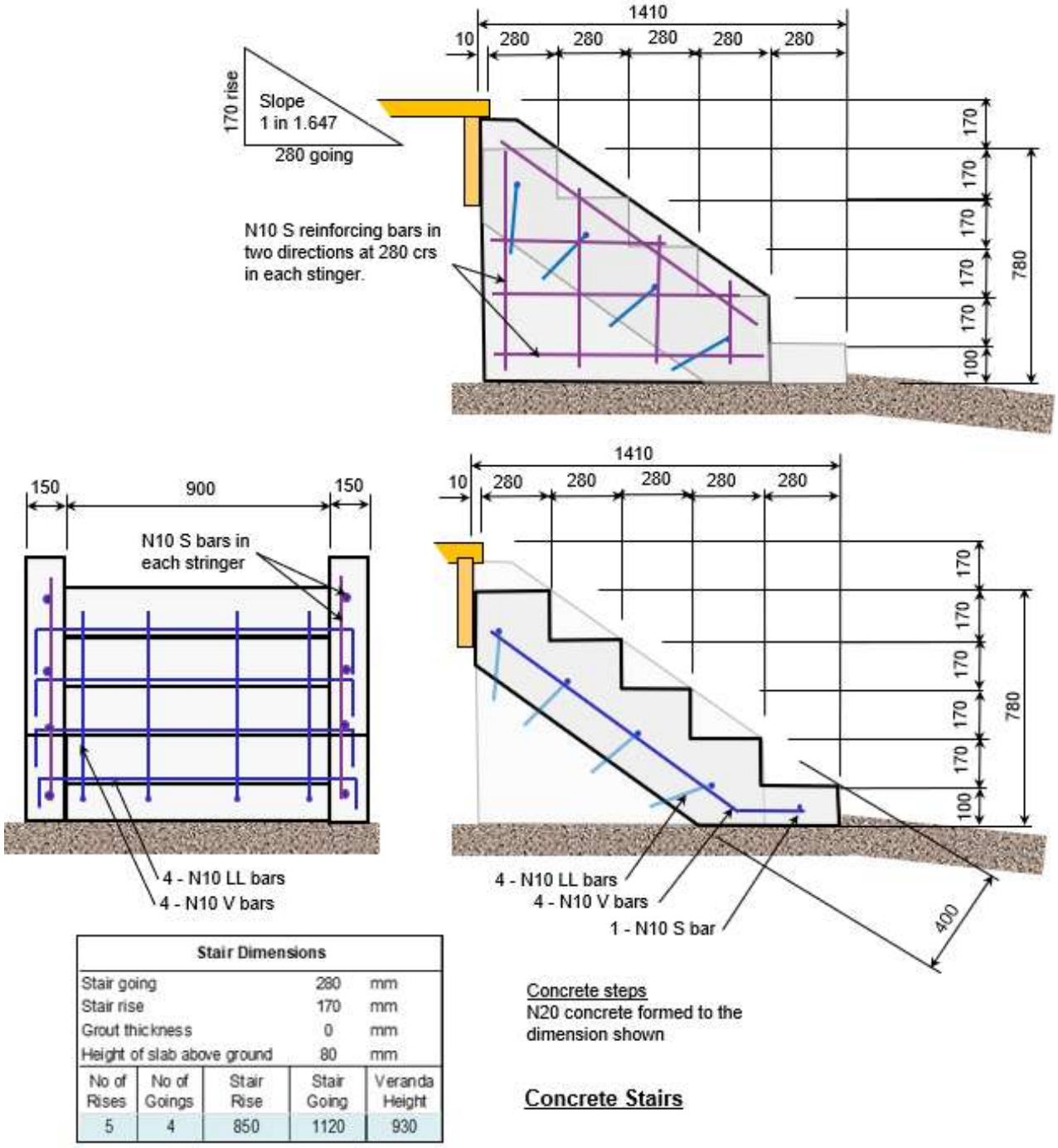


Section Through Stair Balustrade



Typical Timber Stairs – 5 Rises

Concrete Stairs



Stair Dimensions		
Stair going	280	mm
Stair rise	170	mm
Grout thickness	0	mm
Height of slab above ground	80	mm

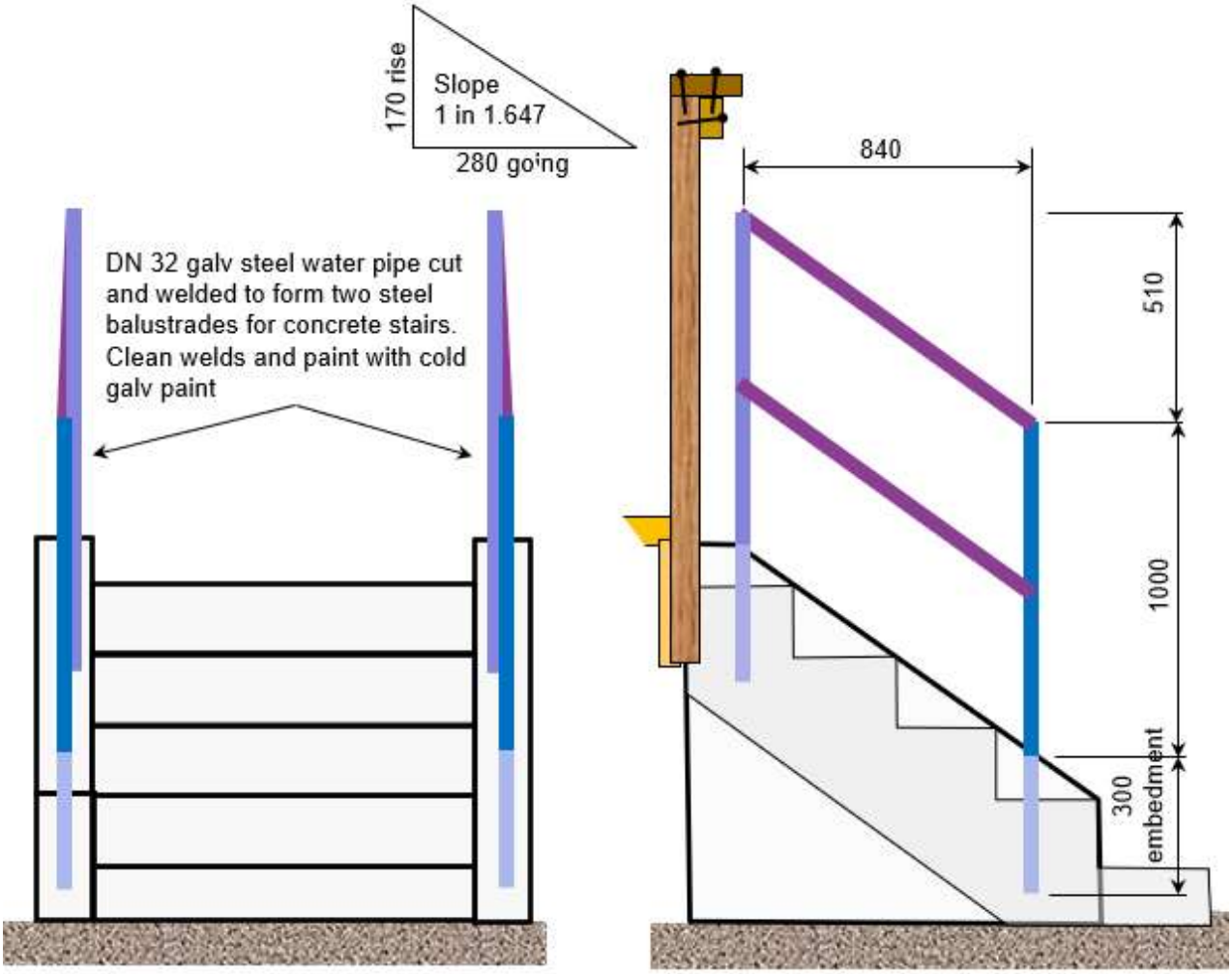
No of Rises	No of Goings	Stair Rise	Stair Going	Veranda Height
5	4	850	1120	930

Concrete steps
N20 concrete formed to the dimension shown

Concrete Stairs

Alternative designs using concrete blocks may be acceptable, provided that the same rises and goings are achieved, and the stairs have adequate reinforcement to prevent cracking.

Steel Balustrade for Concrete Stairs



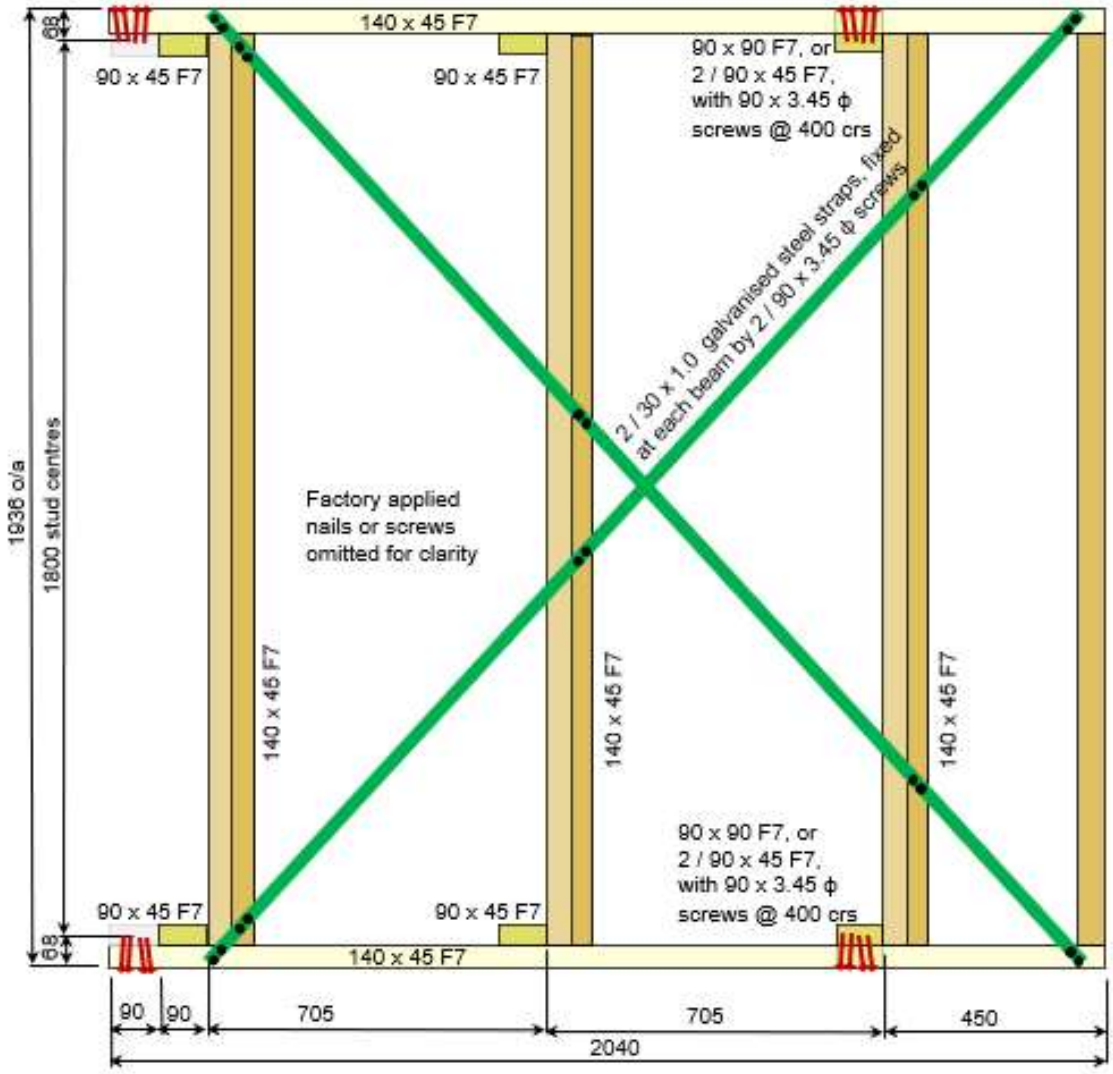
Balustrade stanchions embedded 300 mm in N20 concrete steps to the dimensions shown

Laundry Annex Roof Framing

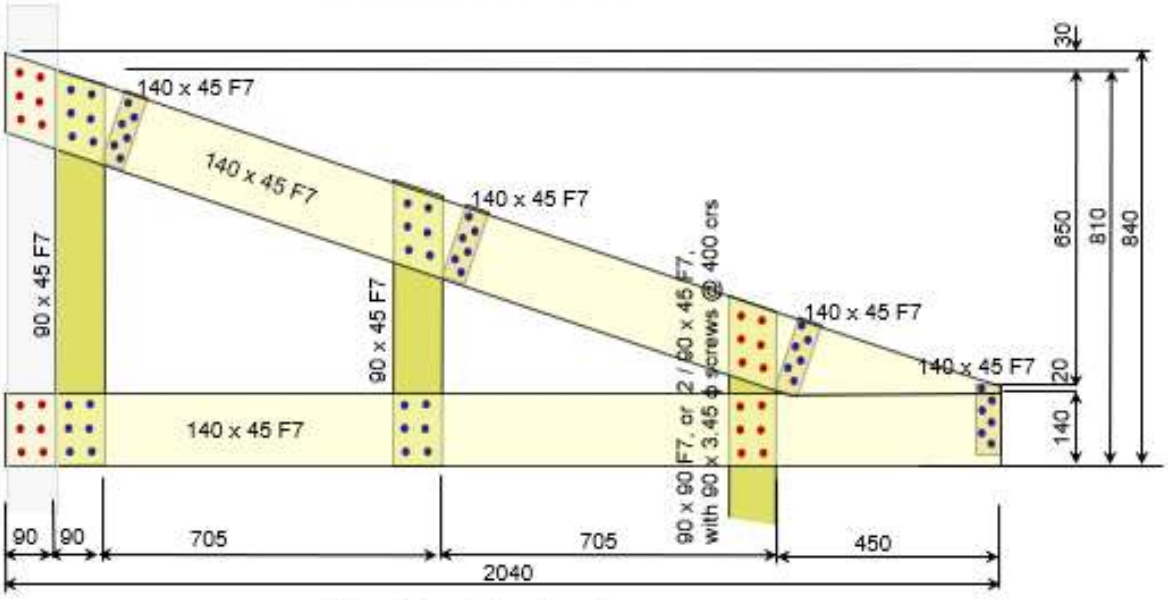
All timber members shall be fixed at each end by – 6 / 90 x 3.45 ϕ screws. If screws cannot be used, substitute 6 / 90 x 3.75 ϕ nails

Nailed or screwed on site

Nailed or screwed in factory

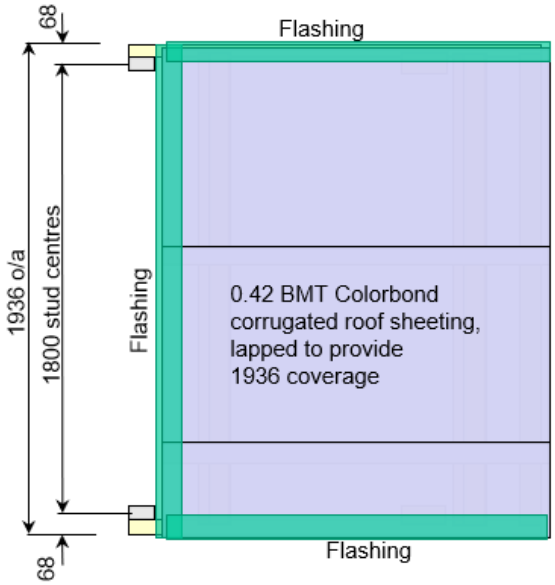


Plan of Awning Frame

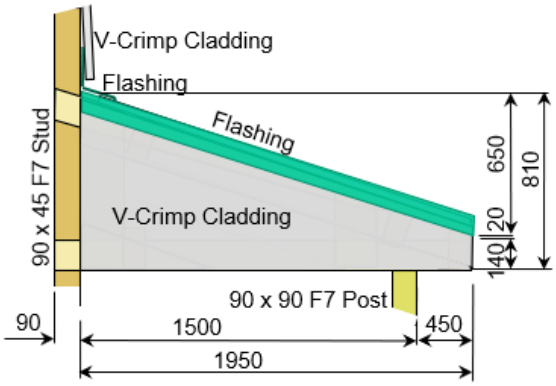


Elevation of Awning Frame

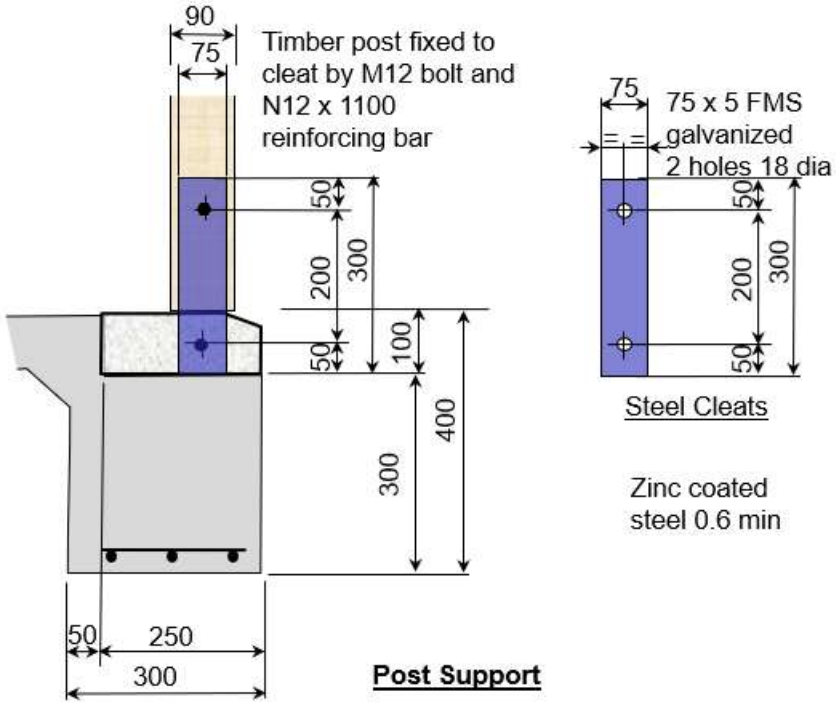
Laundry Annex Roof and Posts



Plan of Awning



Elevation of Awning



Post Support

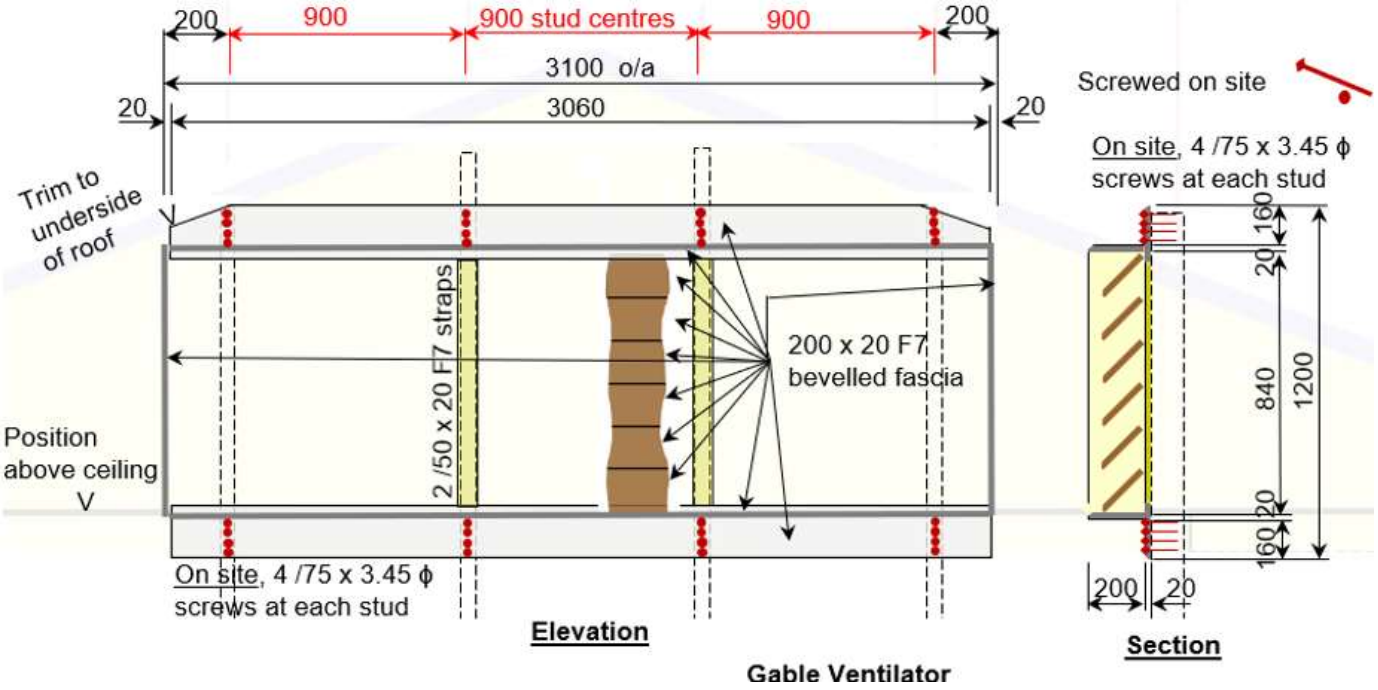
Gable Ventilator

Gable ventilators, when used in combination with a ridge ventilator and/or a breezeway (without a ceiling), will provide cooling. They will also relieve internal roof wind pressure, and thus reduce the risk of structural failure in strong winds. The opening area of each ventilator is 1.53 m^2.

Details are for one gable ventilator, 3.100 m long (fixed in one gable).
The ventilator may be prefabricated, transported to site, positioned by fixing to the end studs and weatherproofed by flashing.

Framing – 200 x 20 F7 bevelled fascia board
Slats – 200 x 20 F7 bevelled fascia board
Straps – 50 x 20 F7
Screws – 75 x 3.45 ϕ

In the factory, the 6 / 200 x 20 F7 bevelled fascia frame members are fixed by 75 x 3.45 ϕ screws at 200 mm centres. The 6 / 200 x 20 F7 bevelled fascia slats are inserted at 45º slope, and fixed at each end by 5 / 75 x 3.45 ϕ screws. Two 50 x 20 F7 straps may also be screwed to each slat to provided additional rigidity.

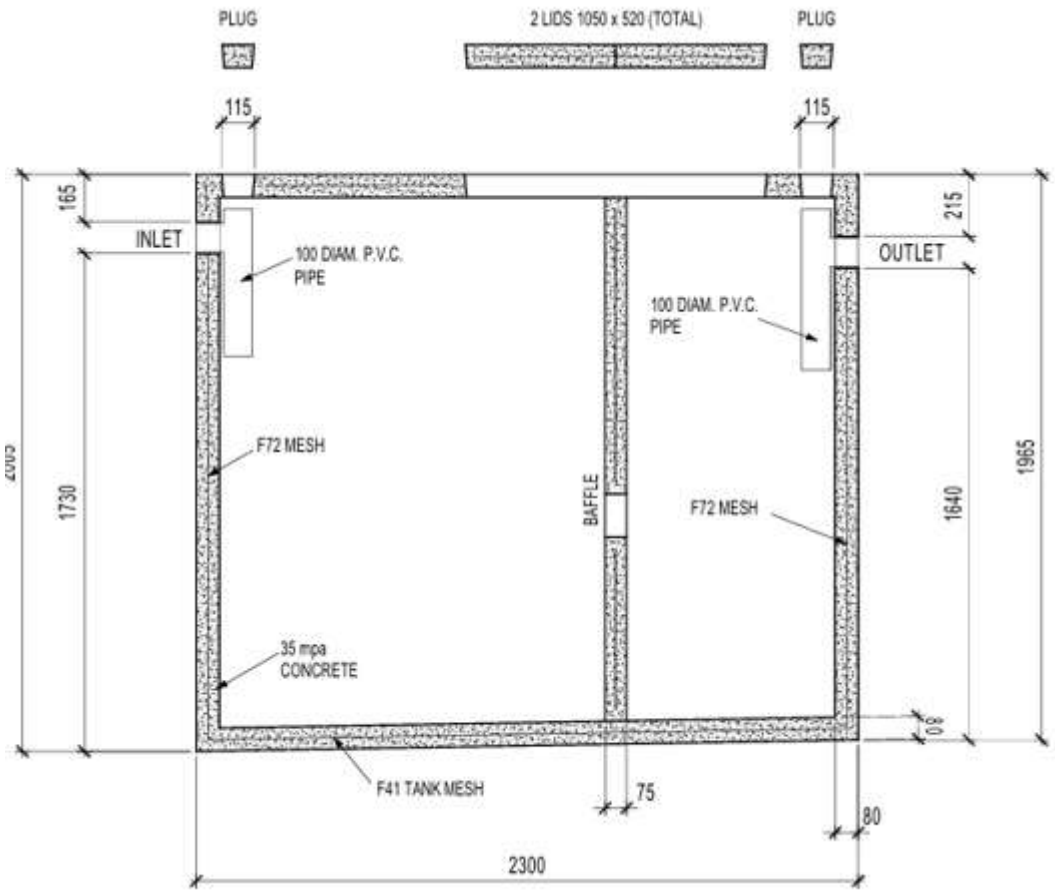


Gable Ventilator

Septic Tank

Temporary detail shown below. To be adapted for PNG.

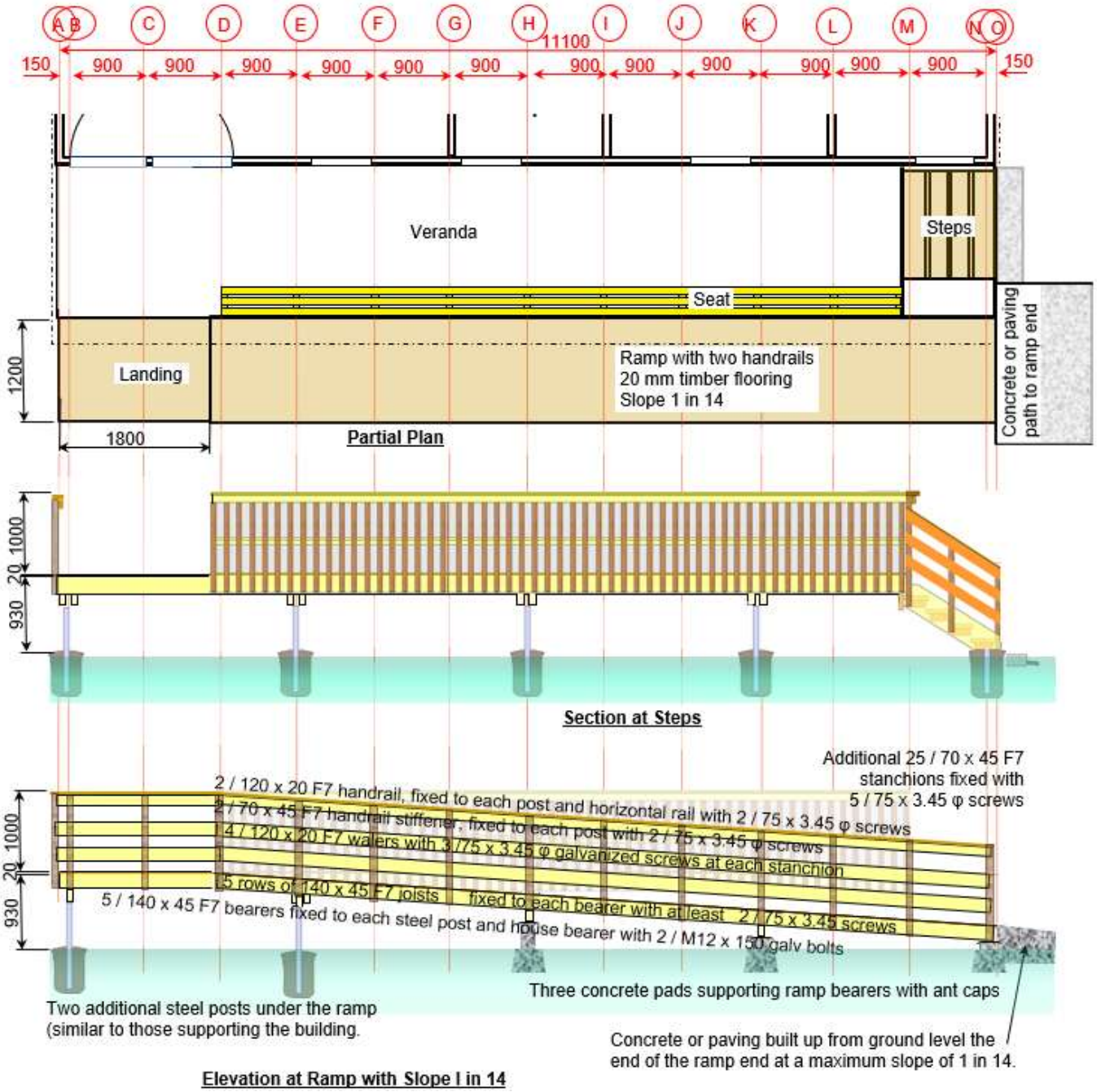
Source: Internet [5000 litre circular septic tank drawings - Search]



Additional Non-standard Details

Wheelchair Ramp

The following wheelchair access ramp is an optional extra, which can be constructed, if required.



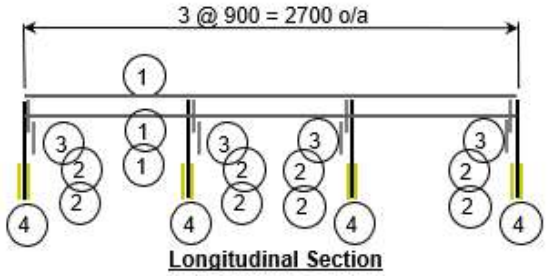
Ridge Ventilator

The following ridge ventilator is an optional extra, which can be constructed, if additional ventilation required.

A ridge ventilator, when used in combination with gable ventilators and/or a breezeway (without a ceiling), will provide cooling. It will also relieve internal roof wind pressure, and thus reduce the risk of structural failure in strong winds.

Details for one ridge ventilator, 2.7 m long (fixed to four trusses at 900 mm crs). The ventilators are prefabricated, transporter to site, and positioned by slipping the legs (Item 4) between the truss top chords of four trusses. They are screwed in position by 3 screws from each side and three screws through the purlin.

The overall length of each ventilator is 2700 mm, such that ventilators can be erected in adjacent bays without interfering with each other. Items 2 and 3 must be within the 2.7 m length. Item 4 is shared with adjacent ventilators.

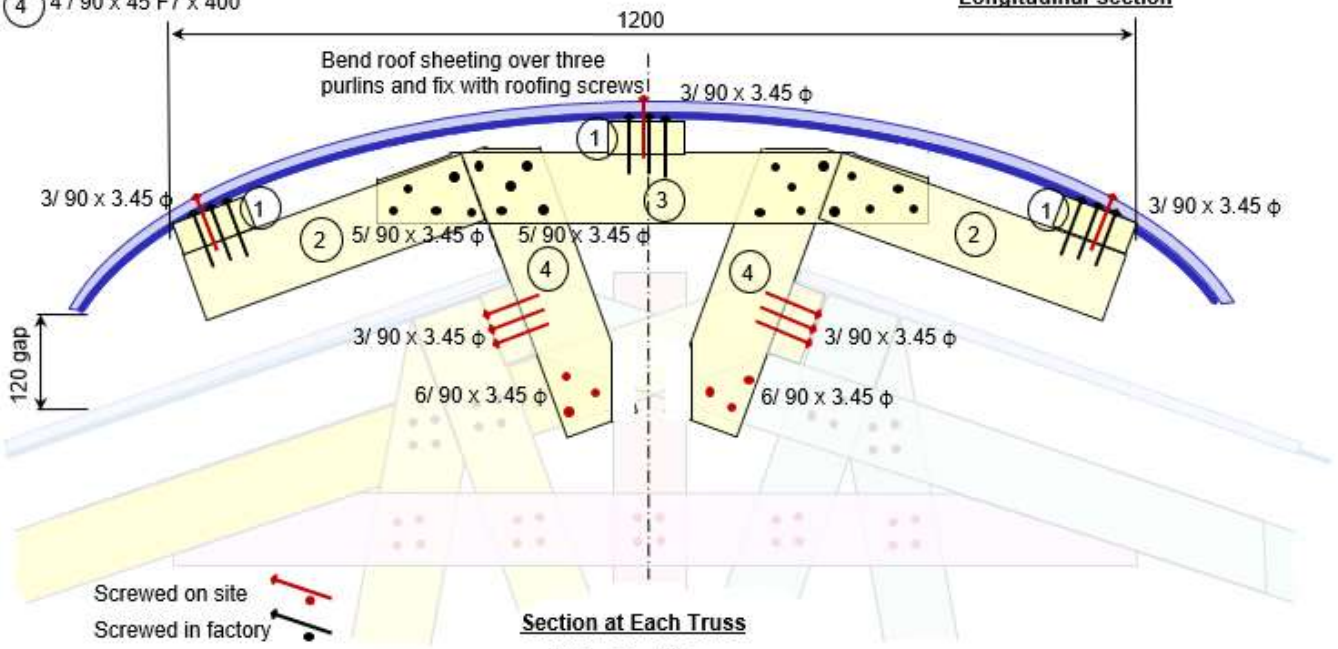


Longitudinal Section

1. 3 / 90 x 45 F7 x 2700
2. 8 / 90 x 45 F7 x 400
3. 4 / 90 x 45 F7 x 700
4. 4 / 90 x 45 F7 x 400

All screws shall be 90 x 3.45 ϕ

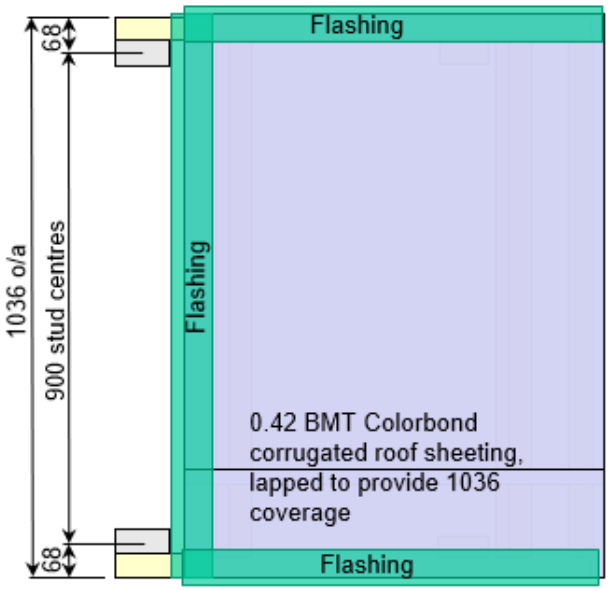
Flash the exposed ends of each ventilator to prevent rain from entering.



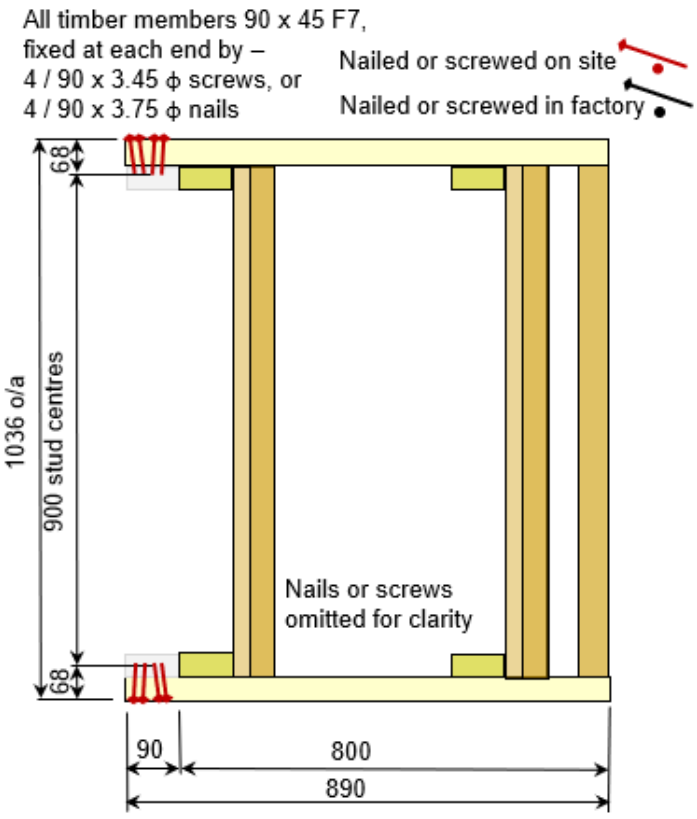
Section at Each Truss

Ridge Ventilator

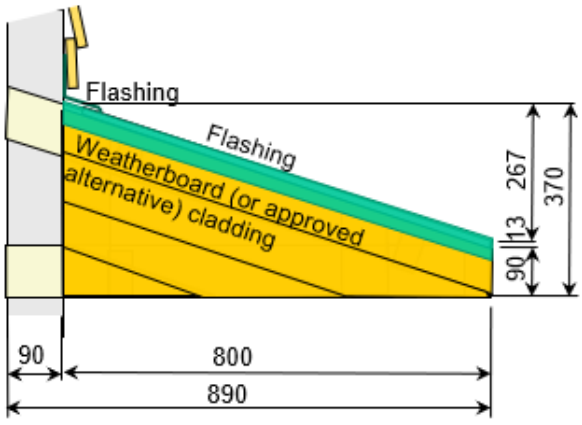
800 mm Window Shade on Timber Superstructure



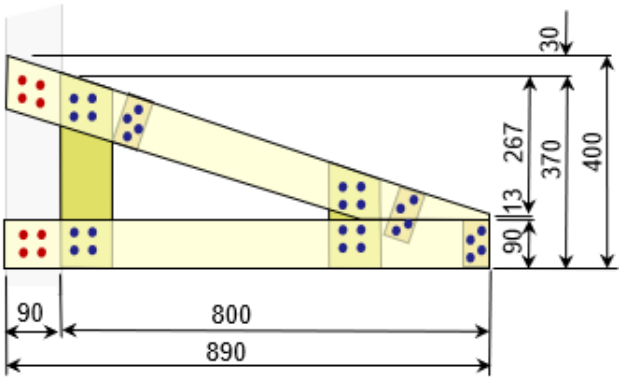
Plan of Window Shade



Plan of Window Shade Frame



Elevation of Window Shade



Elevation of Window Shade Frame

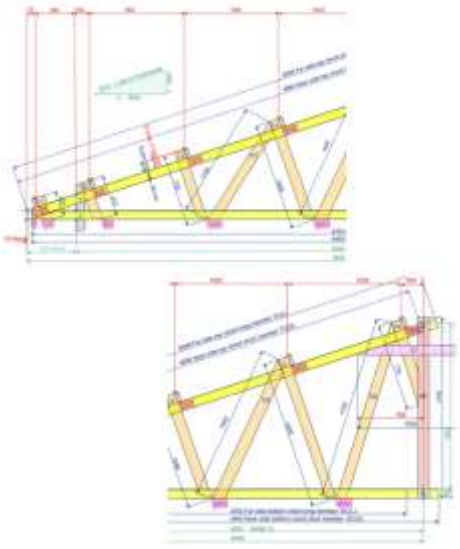
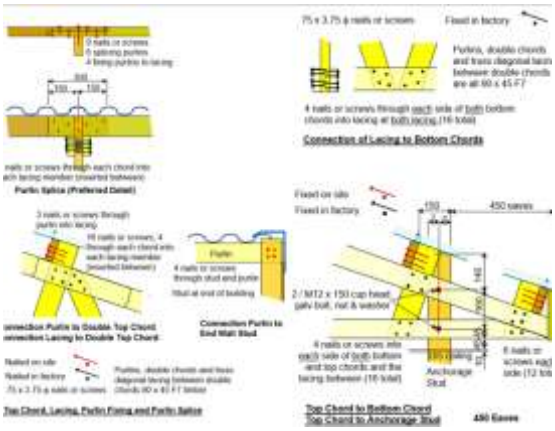
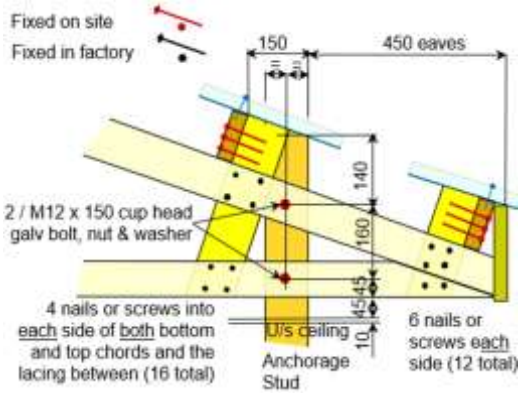
Construction Checklist

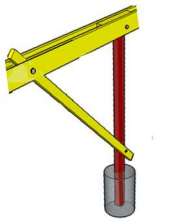
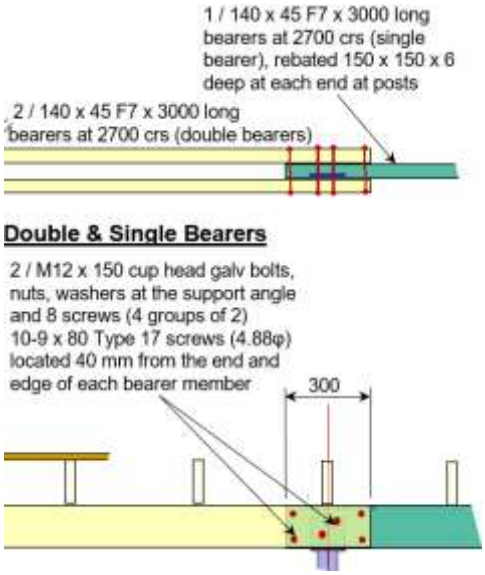
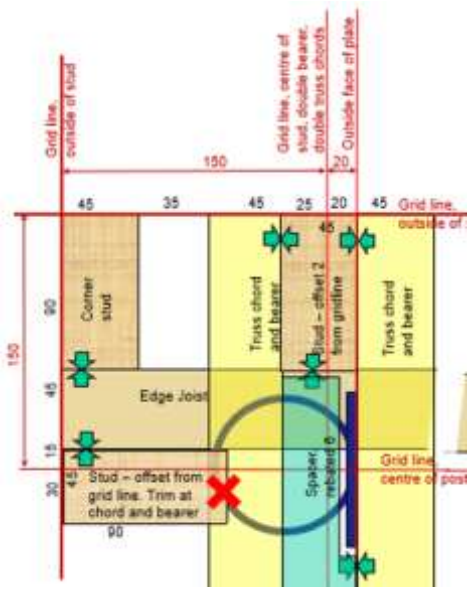
The following details have been the source of deviations from the design drawings on previous projects.

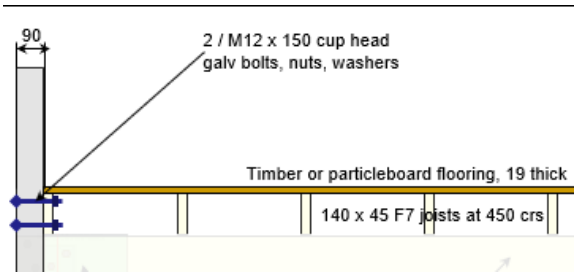
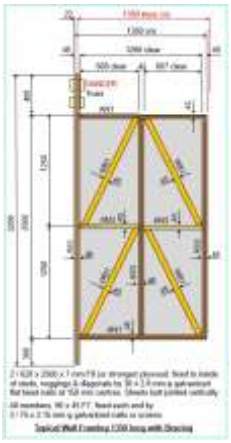
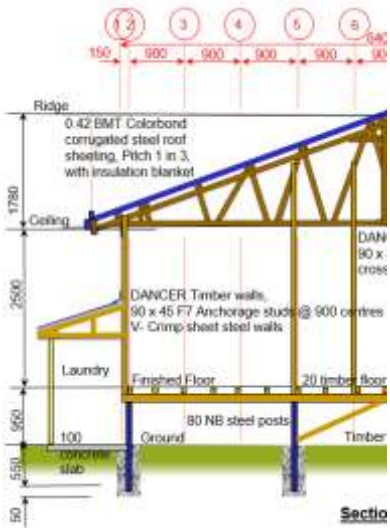
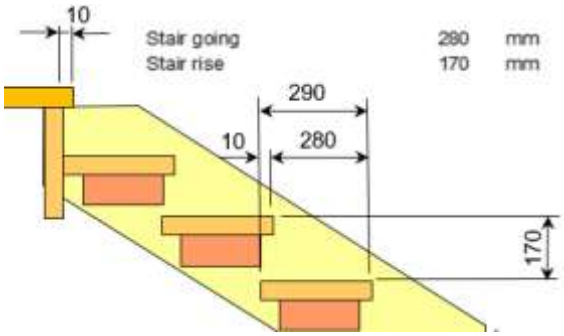
They represent potential errors, which require monitoring to ensure that these deviations do not occur in future projects.

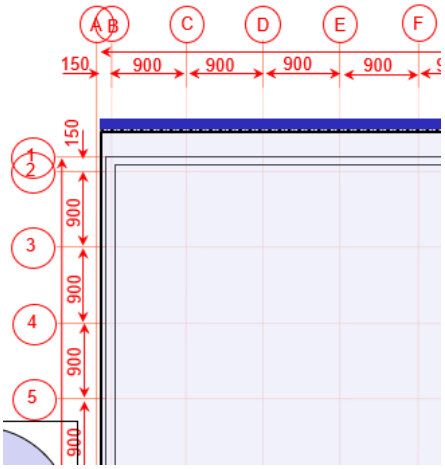
They are presented in the form of a checklist, to be completed during the fabrication and construction stages of each project.

Project:		
Construction Check Record who performed the check, and the comments. Photograph one typical detail, and send it (with this checklist) advising of all deviations to the Project Manager.	**Detail** Refer to the design file for large scale details.	**Reason for checking this detail** Deviations from the design documents may cause failures of the building, and will prevent the Engineer from certifying the construction.
Check that orders for materials correspond to the BOQ. Advise the designer of any deviations. **Checked by:** **Date:** **Comment:**	Use the BOQ as the basis of placing the order.	Applications for funding depend on accurate building costs, which are calculated from the same software used to produce the Bill of Quantities (BOQ). If orders deviate from the BOQ, the costs will be inaccurate, and the funding requested will be inadequate.
Check the timber stress grade and density. It must be at lease F7 and 670 kg/m^3. **Checked by:** **Date:** **Comment:**	Cut a piece of timber, approximately 90 x 45 x 90 long, and place it in a bucket of water to determine density and if it is softwood or hardwood. Density = % immersed x 10 (kg/m^3) 67% below water = softwood 670 kg/m^3 80% below water = hardwood 800 kg/m^3 95% below water = hardwood 950 kg/m^3	The designs are based on at least a good quality F7 softwood, with a density of at least 670 kg/m^3, or hardwood.   

Check that each truss is assembled in the steel jig. **Checked by:** **Date:** **Comment:**		While stacking half-trusses in pairs has the advantage of checking that they will fit together, fabricating half-trusses in a stack (each measured from the one below) runs the risk of dimensions progressively becoming out of tolerance. 
Check truss connections are visible screwed from both sides. **Checked by:** **Date:** **Comment:**		Trusses should be screwed in preference to nailing. They should be screwed from both sides to provide strength. Tthe screws should be visible for verification and certification. 
Check that structural members are cut to accurate length, not spliced **Checked by:** **Date:** **Comment:**	**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 s 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	Splicing members leads to structural failure. The cutting lists give accurate cutting lengths for major members. 
Check each truss joint to anchorage studs have two bolts. **Checked by:** **Date:** **Comment:**		Two bolts are required to connect each Anchorage Stud to each end of each DANCER truss, to ensure adequate resistance to wind and earthquake. 

Check that the sub-floor diagonal braces are bolted both top and bottom. **Checked by:** **Date:** **Comment:**	Typical 90 x 45 F7 timber sub-floor diagonal brace, fixed at the top to the bearers or joist (depending on the direction) and at the bottom to the steel post, by 1 / M12 x 150 cup-head galvanised bolt (at each end) 	
Check that the single bearers are lapped 300 mm with the double bearers, bolted and screwed as per drawings. **Checked by:** **Date:** **Comment:**	 1 / 140 x 45 F7 x 3000 long bearers at 2700 crs (single bearer), rebated 150 x 150 x 6 deep at each end at posts 2 / 140 x 45 F7 x 3000 long bearers at 2700 crs (double bearers) **Double & Single Bearers** 2 / M12 x 150 cup head galv bolts, nuts, washers at the support angle and 8 screws (4 groups of 2) 10-9 x 80 Type 17 screws (4.88φ) located 40 mm from the end and edge of each bearer member 300	Failing to lap and screw bearers may lead to sag of single bearers.   
Check that a rebate of not more than 6 mm deep is provided in a spacer at the steel posts to accommodate the fixing plate. **Checked by:** **Date:** **Comment:**	 	The 90 x 45 mm spacer is required to be rebated 6 mm into the timber at the steel cleat, to achieve the correct spacing between the double bearers. If the rebate is too deep, the bearers will be too close together (as is the case in this photo) requiring the studs to be rebated. The depth of the spacer rebate must be limited to no more than 6 mm. 

Check end wall studs and common studs are fixed by two M12 x 150 cuphead galvanized bolts to a trimmer bearer or trimmer joist. Checked by: Date: Comment:		 
Check that the diagonal wall bracing is not cut. **Checked by:** **Date:** **Comment:**		Where an internal wall meets the external wall, it does <u>not</u> require an extra stud in the external wall. The end stud of the internal wall may be flush with the inside face of the external wall. 
Check that the ceiling battens are fixed directly to the bottom chord of the trusses. **Checked by:** **Date:** **Comment:**		If the ceiling battens are not fixed to the underside of the trusses, the roof will be higher than designed, and anchorage studs will be too short. Also, more timber is used. 
Check that all stair rises are 170 and all goings are 280 mm. In particular, check top rise is 170 mm. **Checked by:**		To prevent falls, all stair rises and goings must be even throughout the flight, particularly the top rise.

Date: **Comment:**		
Check that end gable eaves are not included. **Checked by:** **Date:** **Comment:**		The standard DANCER building design does not include end wall eaves. This is intentional, because it reduces the area (and cost) of the roof sheeting. It also enables the standardisation of the roof purlins at 3,000 mm length. 

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	7.9	24	@	300
FJ	Floor Joist	140	x	45	F7	x	330.0	100	@	3,000
FT	Floor Trimmer Joist	140	x	45	F7	x	30.4	6	@	4,600

	Roof Trusses	Material List						Cutting Schedule		
Roof Trusses										**8.400**
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	121.7	22	@	5,030
TC(S)	Truss Top Chord (or R	90	x	45	F7	x	117.7	22	@	4,865
BC(L)	Truss Bottom Chord (C	90	x	45	F7	x	115.3	22	@	4,765
BC(S)	Truss Bottom Chord (C	90	x	45	F7	x	108.1	22	@	4,465
CT	Collar Tie	90	x	45	F7	x	29.0	22	@	1,200
KP	King Post	90	x	45	F7	x	21.0	11	@	1,735
L1	Lacing at eaves	90	x	45	F7	x	6.0	22	@	248
L2	Lacing at anchorage st	90	x	45	F7	x	10.1	22	@	416
L3	Lacing	90	x	45	F7	x	17.8	22	@	734
L4	Lacing	90	x	45	F7	x	25.4	22	@	1,050
L5	Lacing	90	x	45	F7	x	33.1	22	@	1,366
L6	Lacing	90	x	45	F7	x	18.4	22	@	760
D1	Diagonal	90	x	45	F7	x	27.0	22	@	1,118
D2	Diagonal	90	x	45	F7	x	33.5	22	@	1,385
D3	Diagonal	90	x	45	F7	x	42.6	22	@	1,762
	Roof trusses	90	x	45	F7		726.7	319		

	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	52.0	**12**	@	3,000
CBa	Ceiling Batten	45	x	90	F7	x	270.0	100	@	2,700
VRa	Veranda Rafter	90	x	45	F7	x	0.0	**0**	@	0
VBe	Veranda Beam	240	x	45	F7	x	0.0	**0**	@	4,800
RDB	Roof Bracing	25	x	1	Steel	x	27.1	4	@	6,155
FaB	Fascia Board	140	x	70	F7	x	30.4	**6**	@	4,600
BaB	Barge Board	140	x	70	F7	x	21.6	**4**	@	**4,902**
RPu	Roof Purlin	90	x	45	F7	x	198.0	**60**	@	3,000

	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	116.2	**33**	@	3,200
AS2	External Stud	90	x	45	F7	x	106.0	**40**	@	2,410
AT1	Anchor Tie	90	x	45	F7	x	30.5	**22**	@	1,260
AN1	Anchorage Nogging	90	x	45	F7	x	55.4	**40**	@	1,260
AN2	Anchorage Nogging	90	x	45	F7	x	5.7	**4**	@	1,305
AN3	Anchorage Nogging	90	x	45	F7	x	12.1	**18**	@	607
AN4	Anchorage Nogging	90	x	45	F7	x	20.6	**22**	@	855
AN5	Anchorage Nogging	90	x	45	F7	x	3.5	**9**	@	360
AN6	Anchorage Nogging	90	x	45	F7	x	0.9	**2**	@	405
WB1	Wall Brace	90	x	45	F7	x	55.3	**36**	@	1,390
	External End Walls									
ES1	End Stud	90	x	45	F7	x	7.0	**2**	@	**3,200**
ES2	End Stud	90	x	45	F7	x	7.4	**2**	@	**3,360**
ES3	End Stud	90	x	45	F7	x	8.3	**2**	@	**3,760**
ES4	End Stud	90	x	45	F7	x	9.2	**2**	@	**4,160**
ES5	End Stud	90	x	45	F7	x	9.1	**2**	@	**4,560**
ES6	End Stud	90	x	45	F7	x	9.1	**2**	@	**4,560**
ES7	End Stud	90	x	45	F7	x	8.3	**2**	@	**4,160**
ES8	End Stud	90	x	45	F7	x	7.5	**2**	@	**3,760**
ES9	End Stud	90	x	45	F7	x	7.5	**2**	@	**3,760**
ES10	End Stud	90	x	45	F7	x	7.2	**2**	@	**3,600**
EN1	End Nogging	90	x	45	F7	x	52.7	**56**	@	**855**
EN2	End Nogging (corner)	90	x	45	F7	x	58.3	**56**	@	**946**
EN3	End Nogging (centre)	90	x	45	F7	x	9.2	**10**	@	**840**
EP1		0		0			0.0	**0**		0
VP	Veranda Post	0		0		x	0.0	0	@	0
	Internal Walls									
CS 2	Common Stud	90	x	45	F7	x	187.9	71	@	2,410
BP	Wall Bottom Plate	45	x	90	F7	x	89.8	17	@	5,400
TP	Wall Top Plate	45	x	90	F7	x	179.5	33	@	5,400
NG	Wall Nogging	90	x	45	F7	x	89.8	17	@	5,400
DB	Extra Diagonal Wall Br	30	x	1	Steel	x	13.8	8	@	1,570
LI	Lintel	90	x	45	F7	x	16.7	3	@	5,400
	Studs, Plates, Nogging	90	x	45	F7	x	1,184.6	517	@	
WB	Wall Bracing (First Sto	Input	mm		External plywood			Plywood		2,500

	Stairs, Balustrade, Seats								Cutting Schedule		
Item	Component	Section			Material	Quantity			No	@	Length
		mm	x	mm		x	m				mm
SSt	Stair Stringer	290	x	45	F7	x	3.5		2	@	1,586
STr	Stair Tread	290	x	45	F7	x	4.0		4	@	920
STS	Tread support	70	x	45	F7	x	2.3		8	@	260
SSS	Stair stringer support	290	x	45	F7	x	1.0		1	@	920
SPo	Stair post	90	x	45	F7	x	6.4		6	@	975
SMR	Stair wales	120	x	20	F7	x	10.5		6	@	1,586
SHR	Stair hand rail	120	x	20	F7	x	3.5		2	@	1,586
VBP	Veranda Balustrade Po	90	x	45	F7	x	139.2		113	@	1,120
FVB	Front Veranda Balustra	120	x	20	F7	x	4.0		2	@	1,800
FVB	Front Veranda Balustra	120	x	20	F7	x	14.2		4	@	3,225
BVB	Back Veranda Balustra	120	x	20	F7	x	0.0		0	@	0
BVB	Back Veranda Balustra	120	x	20	F7	x	0.0		0	@	0
FVS	Front Veranda Stinger	70	x	45	F7	x	4.0		2	@	1,800
FVS	Front Veranda Stringer	70	x	45	F7	x	14.2		4	@	3,225
SeS	Seat & Stingers	0	x	0		x	0.0		0	@	3,225
BVS	Seat support	0	x	0		x	0.0		0	@	420
BVS	Seat leg	0	x	0		x	0.0		0	@	310

	Steel Posts								Cutting Schedule		
Item	Component	Section			Material	Quantity			No	@	Length
		mm	x	mm		x	m				mm
SP1	Steel Post	80 NB			galv med wall pipe		28.8		24	@	1,200
SP2	Steel support angle	125 x 125 x 6 L					3.1		24	@	130
SP3	Reinforcing bar	N12	x		300		7.2		24	@	300

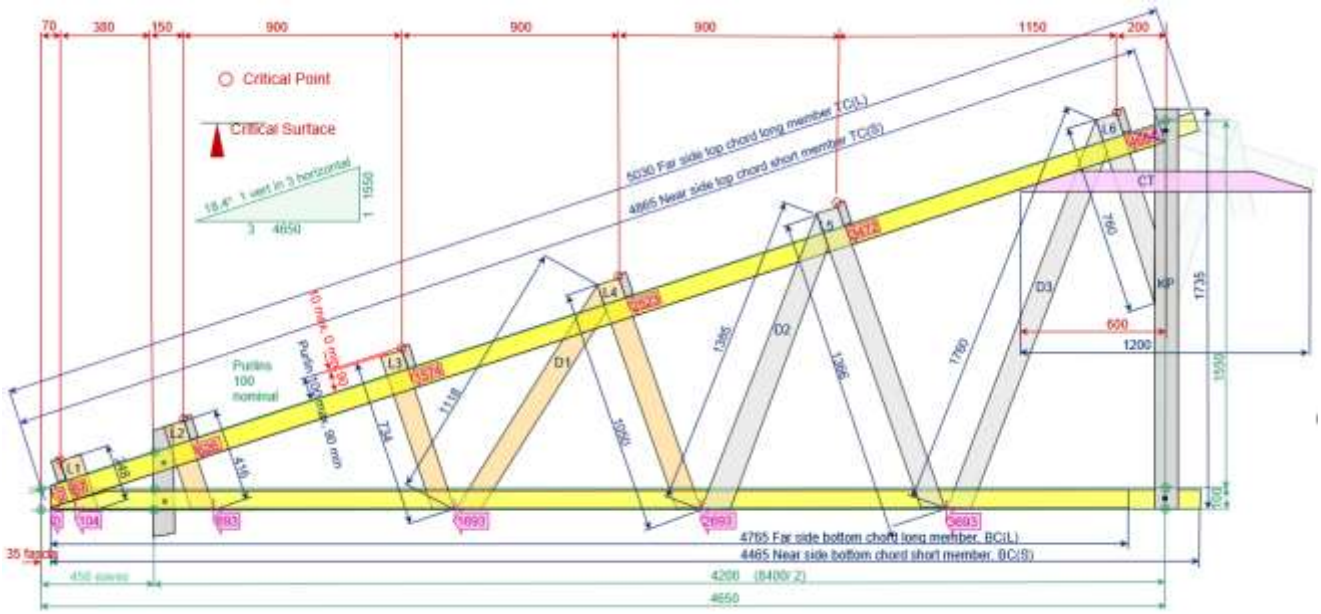
	Bolts, Nuts & Washe	Material List						Cutting Schedule		
Item	Component	Section x length			Type	Quantity		No	@	Length
Bolt 1	Bolts fixing bearers to	**M12**	x	150	M12 x 150 cuphea	53		48	@	
Bolt 2	Bolts fixing subfloor bra	M12	x	**150**	M12 x 150 cuphea	31		**28**	@	
Bolt 3		M12	x	150	M12 x 150 cuphea	0			@	
Bolt 4		M12	x	150	M12 x 150 cuphea	0			@	
Bolt 5	Bolts fixing anchorage	M12	x	150	M12 x 150 cuphea	48		44	@	
Bolt 6	Bolts fixing top chord t	**M12**	x	150	M12 x 150 cuphea	24		22	@	
Bolt 7	Bolts fixing bottom cho	**M12**	x	150	M12 x 150 cuphea	24		22	@	
Bolt 8	Bolts fixing stairs to joi	**M12**	x	150	M12 x 150 cuphea	2		2	@	
Wash1	Washers	M12			M12 galv flat was	182		No		
Wash2	Washers	M16			M16 galv flat was	0		No		
Scr1	10-9 x 80 T17 Class 3	4.88	x	80	Screws	**200**		No		
Scr2	12-11 x 50 T17 HD/TG	HH Class 3		(5.59 ϕ	Screws	**1**		No		
Nail1	Jolt head nails	100	x	4.50	100 x 4.5 ϕ Jolt he	**87**		kg		
Nail2	Jolt head nails	75	x	3.75	75 x 3.75 ϕ Jolt he	**87**		kg		
Nail3	Jolt head nails	50	x	3.75	50 x 4.5 ϕ Jolt hea	**37**		kg		
Nail4	Jolt head nails	25	x	2.50	25 x 3.75 ϕ Jolt he	**10**		kg		
Strap	Steel strap bracing	25	x	0.8	25 x 0.8 x 30 m g	3		30m roll		90.00

Jig for Fabricating DANCER 8.4 Trusses

All members of the jig should be cut to the lengths and shapes of the production truss members (except the "short" top chord and "short" bottom chord members are not required).

The lacing and diagonal members should be fixed <u>over</u> and fixed to the "long" top chord and "long" bottom chord members. i.e., They <u>should not be cut to fit between</u> the chords.

This jig may be constructed of RHS steel (for repeated use) or timber (for a single project).



Roof Trusses						8.400
Item	Component	Section			Material	Length
		mm	x	mm		mm
TC(L)	Truss Top Chord (or R	90	x	45	F7	5,030
TC(S)	Truss Top Chord (or R	90	x	45	F7	4,865
BC(L)	Truss Bottom Chord (a	90	x	45	F7	4,765
BC(S)	Truss Bottom Chord (a	90	x	45	F7	4,465
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	248
L2	Lacing at anchorage st	90	x	45	F7	416
L3	Lacing	90	x	45	F7	734
L4	Lacing	90	x	45	F7	1,050
L5	Lacing	90	x	45	F7	1,366
L6	Lacing	90	x	45	F7	760
D1	Diagonal	90	x	45	F7	1,118
D2	Diagonal	90	x	45	F7	1,385
D3	Diagonal	90	x	45	F7	1,762

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.

Timber

Scope

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

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 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

Levels, Dimensions, Square 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, square and setting out.

Bracing

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.

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.

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 [residential applications], AS 1720 [general applications]).

Minimum Strength Grade

Timber used for structural framing purposes shall have a strength grade not less than MGP10 (or F11 if applicable.

Timber Type, Properties, Preservation and Application

Timber and timber products shall comply with the Drawings, Building Regulations and relevant Standard (AS 1684 [residential applications], AS 1720 [non-residential applications]), 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 Found 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 painted with high-build latex paint to a height 100 mm above the concrete surface and fully encased in Grade N20 concrete (20 MPa) of sufficient thickness to provide not less than 50 mm cover to all parts of the timber.

Concrete

Scope

This section covers the construction of the following concrete members for small to medium sized buildings - Concrete footings and concrete piers.

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 2870 Residential slabs and footings - Construction

AS 3799 Liquid membrane-forming curing compounds for concrete

AS/NZS 4671 Steel reinforcing materials

Definitions

Site Classifications (based on AS 2870)

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

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

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

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.

Reinforcement Cover - The lapping of welded fabric reinforcement in the top face of a slab will significantly increase the thickness of reinforcement and reduce the cover. The slab thickness shall be such as to provide both sufficient cover and sufficient effective depth.

Bill of Quantities

Project	Kwip Dau Secondary School Duplex Houses
Partners	Vision for Homes
Use	Duplex Houses
Nominal plan dimensions (allowing for external cladding appr	13.8 m x 8.4 m overall, 1 veranda under roof, 2 No 1.8 x 1.5 laundries separate
External elevation	One habitable storey, gable roof
Internal arrangment	Duplex houses with a front veranda, 2 covered laundries on concrete slabs, solar hot water, septic tank
Sub-floor, walls, roof	Steel posts, anchored timber wall & cladding, anchored timber roof
Country	Papua New Guinea
Location	Highlands
Tsunami exposure	0
Earthquake hazard, z	0.24
Cyclonic / Non-cyclonic	Non-cyclonic
Wind classification	N2
Return period	500 years
Basic wind speed	28 m/s
Road distance from nearest fabrication centre	30 km

Details		
Building type	Duplex school staff houses	
Importance Level	2	
Ground floor type	Elevated	
Roof (skillion/gable/hip)	g	
Roof pitch	18.4	o
Shape (R = Rectangle)	R	
No of habitable storeys	1	
Total length (O/A ext studs)	13.800	m
Habitable width incl porch, excl veranda	6.600	m
Total width (O/A ext studs incl covered veranda or porch)	8.400	m
Thickness of ext walls	0.090	m
Thickness of int walls	0.090	m
Habitable area (inc walls, excl veranda)	91.1	m2
Internal area habitable rooms (excl walls, excl veranda)	83.0	m2
FFL to U/S ceiling	2.500	m
Top storey height FFL to ceiling	0.000	m
Bottom storey height FFL to ceiling	2.500	m
Minimum sub-floor FFL	0.950	m
Eaves overhang (length)	0.000	m
Eaves overhang (width)	0.450	m
Is roof truss over verandas or porchs?	Yes	
Plan length of roof	13.800	m
Plan width of roof	9.300	m
Is there a ceiling?	Yes	
Is there eaves lining?	Yes	
Bottom bolt to top bolt	0.160	m
Bottom bolt to u/s chord	0.045	m
Ceiling joist depth	0.045	m
Ceiling depth+ allowance	0.004	m
Roof rise ceiling to purlins top	1.781	m
External wall height from ground	3.450	m
Total height to ridge	5.231	m
U/S Ceiling to FFL above	0.000	m
Front veranda length under roof (incl studs)	13.800	m
Front veranda width under roof (incl studs)	1.800	m
Back veranda length under roof (incl studs)	0.000	m
Back veranda width unde roof (incl studs)	0.000	m
Rise of stairs	0.950	m
Number of external doors	2	
Number of internal doors	6	
Number of windows	10	
Area of windows	9.60	m2
Length of internal walls	49.2	m
Roof sheeting	Steel sheet	
Roof structure	Direct Anchorage Timber	
External walls	Steel sheet	
Internal walls	Timber frame	
Footings for building	Concrete piers	
Footings for steps	Concrete pad footings	
Subfloor post type	Steel	
Is subfloor post embedded?	Yes	
Floor	Elevated timber	

Site Establishment

Item	1

Earthworks & Site Drainage

Clear site	1
Construct site drainage	1
Excavate for concrete piers	1

Concrete

Notes

Installation

Form, place, compact & cure concrete

Concrete Piers

Number of concrete piers	24	No
Pier shape, "Square" or "Circular"	Square	
Pier depth	600	mm
Pier width (or diameter)	400	mm
Pier length (effective)	400	mm
Bearing area	3.84	m2
Post embedment or (clearance)	450	mm
Depth of concrete	600	mm
Volume of concrete per pier	0.096	m3
Wasteage	10%	
Total volume of concrete in piers	2.5344	m3
Cement in concrete	21	40 kg l
Sand in concrete	1.27	m3
Gravel in concrete	2.53	m3
Cement in concrete	0.81	tonnes
Sand in concrete	1.90	tonnes
Gravel in concrete	4.56	tonnes
Reinforcement	N10	
Reinforcement	0.00	m

Concrete footings for timber steps

Number of footings	2	No
Footing depth	100	mm
Footing width	600	mm
Footing length	1200	mm
Bearing area	1.44	m2
Wasteage	10%	
Total volume of concrete in strip footings	0.1584	m3
Cement in concrete	2	40 kg bags
Sand in concrete	0.0792	m3
Gravel in concrete	0.1584	m3
Cement in concrete	0.050688	tonnes
Sand in concrete	0.1188	tonnes
Gravel in concrete	0.28512	tonnes
Footing reinforcement	N10	0
Footing reinforcement	13.64	m

Steel Posts

Notes: 20

Installation

Erect steel posts

Fabricated Steel Posts	24		24.0	No

Timber Framing

Notes:

Installation

Construct timber framing

Materials

Timber Specification	Seasoned		F7		Soft		Volume	14.13	m3	
Number of trusses	11	No					Volume / Area	0.16	m3/m2	
			Depth mm		Width mm		Length mm	Total m		Wasteage
Bracing for Steel Posts	14	No	90	x	45	x	1,760	27.1	m	10%
Floor Bearer	30	No	140	x	45	x	3,000	99.0	m	10%
Floor Joist	100	No	140	x	45	x	3,000	330.0	m	10%
Floor Trimmer Joist	6	No	140	x	45	x	4,600	30.4	m	10%
Studs, Plates, Noggings	517	No	90	x	45	x	0	1,184.6	m	10%
Roof trusses	319	No	90	x	45	x	0	726.7	m	10%
Ceiling Joist (additional to truss bottom ch	12	No	45	x	90	x	3,000	52.0	m	44%
Ceiling Batten	100	No	45	x	90	x	2,700	270.0	m	0%
Fascia Board	6	No	140	x	70	x	4,600	30.4	m	10%
Barge Board	4	No	140	x	70	x	4,902	21.6	m	10%
Roof Purlin	60	No	90	x	45	x	3,000	198.0	m	10%
Stair Stringer	2	No	290	x	45	x	1,586	3.5	m	10%
Stair Tread	4	No	290	x	45	x	920	4.0	m	10%
Tread support	8	No	70	x	45	x	260	2.3	m	10%
Stair stringer support	1	No	290	x	45	x	920	1.0	m	10%
Stair post	6	No	90	x	45	x	975	6.4	m	10%
Stair wales	6	No	120	x	20	x	1,586	10.5	m	10%
Stair hand rail	2	No	120	x	20	x	1,586	3.5	m	10%
Veranda Balustrade Post	113	No	90	x	45	x	1,120	139.2	m	10%
Front Veranda Balustrade	2	No	120	x	20	x	1,800	4.0	m	10%
Front Veranda Balustrade	4	No	120	x	20	x	3,225	14.2	m	10%
Front Veranda Stinger	2	No	70	x	45	x	1,800	4.0	m	10%
Front Veranda Stringer	4	No	70	x	45	x	3,225	14.2	m	10%

Total timber length								3,176.5	m	PGK 0
Total quantities	Total Length (including wasteage)						Total Volume (including	ncluding wasteage)		
70 x 45 F7	20.4	m						0.1	m3	
90 x 45 F7	2,604.1	m						10.5	m3	
140 x 45 F7	459.4	m						2.9	m3	
120 x 20 F7	32.1	m						0.1	m3	
290 x 45 F7	8.5	m						0.1	m3	
140 x 70 F7 dressed fascia section	51.9	m						0.4	m3	Average section
Total timber length	3,176.5	m						14.1	m3	98.8 x 45
Roof Bracing	4	No	25	x	1	x	6,155	27.1	m	10%

Bolts, Nuts, Washers, Screws and Nails

Bolts

Bolts fixing bearers to posts	53	No	M12 x 1
Bolts fixing subfloor bracing	31	No	M12 x 1
Bolts fixing anchorage studs to bearers	48	No	M12 x 1
Bolts fixing top chord to anchorage studs	24	No	M12 x 1
Bolts fixing bottom chords to anchorage st	24	No	M12 x 1
Bolts fixing stairs to joist	2	No	M12 x 1
Total number of bolts			
M12 x 150 cuphead galv bolts & nuts	182	No	
Washers			
Washers	182	No	M12 gal
Screws			
10-9 x 80 T17 Class 3 screw (4.88 ϕ)	200	No	Screws
12-11 x 50 T17 HD/TG HH Class 3 (5.59	1	No	Screws
Jolt head nails	87	kg	100 x 4.
Jolt head nails	87	kg	75 x 3.7
Jolt head nails	37	kg	50 x 4.5
Jolt head nails	10	kg	25 x 3.7
Steel strap bracing	3	30m rc	25 x 0.8

Cornice, skirting, cupboards

Notes

Installation

Instal cornice, skirting, cupboards & joinei

Cornice

19 x 19 Cornice quad	118	m
No of 3.5 m lengths \	48	No

Skirting

50 x 25 Arch skirting	118	m
No of 3.5 m lengths	48	No

Cupboards

Cupboard type	Bench, sink,	
Bench, sink, 2 cupboards under	2	No

Flooring

Notes

Installation

Install flooring

Materials		
Nominal floor thickness	25	
Internal general area		
Area internal general area	82.6	m2
100 x 25 timber flooring	Yes	
Area of 100 x 25 timber flooring	82.6	m2
Internal wet area		
Area external wet area	4.9	m2
19mm compressed fibre-cement sheet flo	Yes	
19mm compressed fibre-cement sheet flo	4.9	m2
100 x 25 timber flooring	Yes	
Area of 100 x 25 timber flooring	4.9	m2
Veranda or Porch		
Area veranda or porch	24.8	m2
100 x 25 timber flooring	Yes	
Area of 100 x 25 timber flooring	24.8	m2
Total areas		
19mm compressed fibre-cement sheet flo	4.9	m2
100 x 25 timber flooring	112.3	m2
Wasteage		
19mm compressed fibre-cement sheet flo	0.1	
100 x 25 timber flooring	0.1	
Total areas		
19mm particleboard flooring	0.0	m2
19mm compressed fibre-cement sheet flo	5.3	m2
100 x 25 timber flooring	123.5	m2
Fixings		
Flooring screws	0.0	kg
Flooring screws	0.0	kg
Flooring screws	0.0	kg

Doors

Notes

Installation

Instal doors and door furniture as listed be

Door D1	External Door	
No of 2040 x 830 x 35 solid core external	2	No
Height	2040	mm
Width	820	mm
Thickness	35	mm
Material	Solid core external	
Butt hinge set (100mm, 3)	2	No
Lock set (single deadbold cylinder lock)	2	No
Closer	2	No

Door D2	Internal Door	
No of 2040 x 830 x 35 hollow core internal	6	No
Height	2040	mm
Width	820	mm
Thickness	35	mm
Material	Hollow core internal	
Butt hinge set (75mm, 3)	6	No
Lock set (single deadbold cylinder lock)	6	No
Closer	6	No

Windows

Notes

Installation

Instal windows & screens

Window W1	1200 x 850 l	
No of 1200 x 850 louvres	10	
Frame Height	1190	mm
Frame Length	842	mm
Clear opening height	1200	mm
Clear opening Lenth	855	mm
Vertical clearance	10	mm
Horizontal clearance	13	mm
Frame material	Aluminium	
Frame operation	Louvre	
Latch	Single lever	
Lock	Key lock	
Glass blade type	Clear float g	
Glass blade thickness	5	mm
Glass blade width	150	mm
Glass blade length	762	mm
Glass blade coverage	140	mm
No of blades per window	8	
Total No of blades (150 x 762, clear float g	80	
No of flyscreens for 1200 x 850 louvres	10	
Width each flyscreen mesh	910	mm
Length each flyscreen mesh	1190	mm
Total lengh flyscreen mesh	11.9	m
Wastage	10%	
Order lengh flyscreen mesh	13.1	m
No security screens (4 mm wires welded a	10	
Width of welded mesh sheets (4 mm wires	2000	mm
Length of welded mesh sheets (4 mm wire	3000	mm
No in width of one sheet	1	No
No in length of one sheet	2	No
No flyscreen mesh sheets	5	No

Window Consumables

Louvre screws (8g x 30mm)	2	Packs
Crack filler	4	Packs
Sealant	2	Packs

Roof Cladding

Notes:

Installation

Install roof cladding

Materials

Total area	128.3	m2		area	128.3	m2		Wasteage
Corrugated steel roof sheeting, 0.42 BMT,	106.4	m		idth	762	mm	**Front half of roof**	14%
Corrugated steel roof sheeting, 0.42 BMT,	106.4	m		idth	762	mm	**Rear half of roof**	14%
12-11 x 50 T17 HD/TG HH Class 3 (5.59 (	983		Top-lock					30%

Roof Sarking and Insulation

Notes:

Installation

Instal sarking & insulation

Roof Sarking

Roof sarking type	Single- side	
Roof area	96.0	m2
Wasteage	10%	
Roof sarking area	105.6	m2

Roof Plumbing

Notes:

Installation

Instal roof plumbing

Materials

Stock length of quad gutter	2.44	m
Stock length of rainwater downpipe	5.8	m
Finish of roof plumbing	Colorbond	
Wasteage	10%	

Specifications

Eaves gutter	Colorbond 1
Eaves gutter stop-ends	Colorbond 1
Eaves gutter brackets	Colorbond 1
Eaves gutter screws	12-11 x 50 T
Rainwater downpipes	DN80 PVC F
Rainwater downpipe inlets	DN80 PVC i
Rainwater downpipe bends	DN80 PVC 8
Rainwater downpipe brackets	Colorbond D
Rainwater downpipe bracket screws	12-11 x 50 T
Barge moulds	Colorbond s
Gable flashing	Colorbond s
Flashing & barge fixings	Galv roofing
Flashing & barge fixings	Jolt head na

Quantities before wasteage

Eaves gutter	27.6	m
Eaves gutter stop-ends	4	No
Eaves gutter brackets	46	No
Eaves gutter screws	184	No
RWDPs (Rainwater downpipes)	0.0	m
RWDP inlets	0	No
RWDP bends	0	No
RWDP brackets	0	No
RWDP bracket screws	0	No
Ridge flashing	13.8	m
Barge moulds	19.6	m
Flashing & barge fixings	10	kg
Flashing & barge fixings	2.5	kg

Quantities to order

Colorbond 100 quad eaves gutter	29.3	m	Eaves gutter
Colorbond 100 quad stop ends	4	No	Eaves gutter stop-ends
Colorbond 100 quad brackets	51	No	Eaves gutter brackets
12-11 x 50 T17 HD/TG HH Class 3 (5.59 (	202	No	Eaves gutter screws
DN80 PVC RWDP	0.0	m	RWDPs (Rainwater downpipes)
DN80 PVC inlet	0	No	RWDP inlets
DN80 PVC 88 bend	0	No	RWDP bends
Colorbond DN80 clip saddles	0	No	RWDP brackets
12-11 x 50 T17 HD/TG HH Class 3 (5.59 (	0	No	RWDP bracket screws
Colorbond steel 0.6 mm thick	16.0	m	Ridge flashing
Colorbond steel 0.6 mm thick	22.0	m	Barge moulds
Galv roofing nails 65 x 3.75mm x 500g	11	kg	Flashing & barge fixings
Jolt head nails 125 x 5.6mm x 500g	3	kg	Flashing & barge fixings

External Wall Cladding

Notes

Installation

Install external wall cladding

Cladding

0.40mm BMT zincalume steel sheet (6 No	138.8	m2

Fixings

12-11 x 50 T17 HD/TG HH Class 3 (5.59 (	1262	No

Ceiling and Wall Linings

Notes

Installation

Install ceiling lining
Install wall lining
Install eaves lining

Ceiling Lining

Plywood Ceiling Lining

Plywood thickness	4.0	mm
Plywood sheet length	2.400	m
Plywood sheet width	1.200	m
Plywood wall area	87.4	m2
Wasteage	5%	
No of plywood sheets	32	No

Internal Wall Lining

Plywood Wall Lining		
Plywood thickness	4.0	mm
Plywood sheet length	2.400	m
Plywood sheet width	1.200	m
Plywood wall area	287.7	m2
Wasteage	10%	
No of plywood sheets	110	No

Plywood at Wet Areas

Plywood thickness	17.0	mm
Plywood sheet length	2.400	m
Plywood sheet width	1.200	m
Plywood wall area	7.74	m2
Wasteage	10%	
No of plywood sheets	5	No

Eaves & Veranda Ceiling

Fibre-cement Eaves & Veranda Ceiling	Yes	
Eaves & veranda ceiling thickness	4.5	mm
Eaves & veranda ceiling sheet length	2.400	m
Eaves & veranda ceiling sheet width	1.200	m
Eaves & veranda ceiling required length of	34.5	m
Wasteage	10%	
No of fibre-cement sheets	15	No

Painting

Notes:

Installation

Paint all exposed surfaces where specifie

Required primer volume

External walls (timber)	0.0	litres	Latex wood primer 10A
External barge, fascia, gables (timber)	4.0	litres	Latex wood primer 10A
External eaves (timber, fibre-cement)	4.0	litres	Latex wood primer 10A
External doors & other (timber)	4.0	litres	Latex wood primer 10A
External metalwork (steel)	4.0	litres	Metal primer for zinc-coated surfaces 11
Internal walls (plywood, plasterboard)	8.0	litres	Latex plasterboard sealer 16
Internal ceilings (plywood, plasterboard)	4.0	litres	Latex plasterboard sealer 16
Internal doors (timber)	4.0	litres	Latex plasterboard sealer 16
Internal windows & other (timber)	4.0	litres	Latex plasterboard sealer 16
Internal metalwork (steel, aluminium)	4.0	litres	Metal primer for zinc-coated surfaces 11

Required top-coat volume

External walls (timber)	0.0	litres	Semi-gloss washable exterior latex 8
External barge, fascia, gables (timber)	4.0	litres	Semi-gloss washable exterior latex 8
External eaves (timber, fibre-cement)	4.0	litres	Semi-gloss washable exterior latex 8
External doors & other (timber)	4.0	litres	Gloss washable exterior latex 9
External metalwork (steel)	4.0	litres	Gloss washable exterior latex 9
Internal walls (plywood, plasterboard)	20.0	litres	Semi-gloss mould resistant latex 8
Internal ceilings (plywood, plasterboard)	8.0	litres	Semi-gloss mould resistant latex 8
Internal doors (timber)	4.0	litres	Solvent-borne gloss interior 9
Internal windows & other (timber)	4.0	litres	Solvent-borne gloss interior 9
Internal metalwork (steel, aluminium)	4.0	litres	Solvent-borne gloss interior 9

Painting Consumables

Paint roller tray kit	2	No
Paint brushes (100 mm)	3	No
Paint brushes (75 mm)	3	No
Paint brushes (50 mm)	3	No
Paint brushes (38 mm)	3	No
Turps (4 litres)	2	No

Electrical Installation

Note: Inclusion of electrical installation is s

Installation

Install electical system
Connect to electical mains
Connect solar hot water

Building Wiring

Meter box	1	No	Meter box 300 x 300 x 250 mm
Load centre	1	No	PVC 6 Pole Load Centre (PVC Modern)
Circuit breaker 63 A (Main)	1	No	Circuit Breaker Single Pole 63A Tesla MCB1P63
Circuit breaker 16 A (Power)	7	No	Circuit Breaker Single Pole 16A (Power) MCB16
Circuit breaker 10 A (Light)	3	No	Circuit Breaker 1 Pole 10A (Light) MCB10
Cable (mains) 10 mm	20	m	Cable Mains Twin & Earth 10 mm
Cable (GPOs) 2.5 mm	60	m	Cable Twin & Earth 2.5 mm
Cable(Lights) 1.5 mm	200	m	Cable Twin+ECC 1.5 mm TPS 'DN 100mt
Cable (Twin active TPS 1.5. PR LM)	0	m	Cable Twin Active TPS 1.5 mm PR LM
Cable (Earthwire [green & yellow])	20	m	Earthwire Yellow& Green Stripe
Single GPO outlets	0	No	Single GPO 10A 250V ED(EDWGPO1)
Double GPO outlets	14	No	Double GPO2 10A Tesla
0	0	No	Switch single power point 10A AS 314
External weatherproof switch	4	No	Weatherproof 10A 2 Gang Surf/Switch
Internal light switch	10	No	Wall light switch 2 Gang (AS314)
Security light switch	0	No	Switch Eye Day Light 10A (Natec)
Lights (1 x 18W, 613 x 26mm bare batten	16	No	Light Fittings 1 x 18 Watt (Davis LPB118)
Lights (1 x 36W, 1222 x 26mm bare batte	0	No	Light Fittings 1 x 36 Watt (Davis LPB136)
Stud brackets	25	No	DN Stud Brackeds Vertical & Horizontal
Wire connectors	38	No	Connectors Single Screw Loose
Hex head screws (10-16x 16 mm)	319	No	Hex head screws (10-16x 16 mm)
Insulation tape	3	No	PVC Electrical Insultion Tape 18mmx 20m Red

Mains Supply

J Hook	1	No	Mains Entry Box 2 way single phase
Dead ends	2	No	Dead ends with rubber 10-16mm DIS 80610
Copper earth stake	1	No	Copper earth stake 13mmx1.4 m E/CLIP

Floor & Wall Tiling

Note: Inclusion of tiling is subject to instruc

Installation

Install floor tiles
Install floor tiles
Install miscellaneous tiling

Ceramic Floor Tiling

Length bathroom floor	1.8	m
Width bathroom floor	2.7	m
Total ceramic floor tile area	4.9	m2
Half total perimeter	4.5	m
Ceramic floor tile length	300	mm
Ceramic floor tile width	300	mm
Area wasteage	5%	
Perimeter wasteage	5%	
Ceramic floor tile pack size	12	No
Number ceramic floor tile	73.0	No
No of ceramic floor tile packs	7	No
Ceramic floor tile adhesive coverage	2.408	kg/m2
Ceramic floor tile adhesive pack size	20	kg
Ceramic floor tile adhesive packs	1	No
Ceramic floor tile grout coverage	0.56	kg/m2
Ceramic floor tile grout pack size	20	kg
Ceramic floor tile grout packs	1	No
Additional adhesive packs	8	No

Ceramic Wall Tiling 0

Height shower wall	1.8	m
Length shower wall	3.6	m
Height toilet wall	1.2	m
Length wall wall	0.9	m
Height splash-back	0.2	m
Length splash-back	0.9	m
Total area	7.74	m2
Half total perimeter	8.6	m
Ceramic wall tile length	200	mm
Ceramic wall tile width	200	mm
Area wasteage	5%	
Perimeter wasteage	5%	
Ceramic wall tile pack size	25	No
Number of ceramic wall tiles	249	No
Ceramic wall tile packs	10	No
Ceramic wall tile adhesive coverage	2.408	kg/m2
Ceramic wall tile adhesive pack size	20	kg
Ceramic wall tile adhesive packs	1	No
Ceramic wall tile grout coverage	0.56	kg/m2
Ceramic wall tile grout pack size	20	kg
Ceramic wall tile grout packs	1	No

Plumbing

Notes:

Installation

Install plumbing furniture
Install cold water
Install hot water
Install solar hot water
Install tanks

Toilet

WC Toilet seat	2	No
WC Pan & P trap	2	No
WC Cistern (Dual 6L / 3L)	2	No
DWV Pan collar 100 mm Adjustable M&F	2	No
Mini-cistern set tap & flexible connector (1	0	Set
Mini-cistern 15mm tap	2	No (loc
Flexible connector 15mm x 600 mm st	2	No (loc
Wall plate 15mm chrome	6	No
DN50 uPVC pipe (DWV vent stack)	7.5	m
DN50 uPVC cowl (DWV vent stack)	2	No
Roof penetration & flashing	2	No
DN100 uPVC pipe	4	No
DN100 uPVC FF elbow	34.8	m
DN100 uPVC FFF tee	4	No
DN 80/100 reducer	2	No
DN 80 floor waste	2	No

Shower

Shower tray (900 x 900 mm, white)	2	No
Shower tap set (2 taps & spout)	2	No
Shower pipe combination (200 x 300 tail)	2	No
Shower rose set (15mm, white)	2	No
Wall stop (easy clean anti-vandal)	2	No
Shower waste (80 x 50mm, chrome platec	2	No

Basin

Wall mounted basin	2	No
Basin tap set (2 taps & spout)	2	No
Basin pipe combination	2	No

Sinks

Sink	2	No
Sink tap set (2 taps & spout)	2	No
Sink pipe combination	2	No

External Taps

External taps	2	No
Compression unions	2	No
Compression elbows	2	No
Compression tees	2	No

Cold Water Copper Pipe

Copper pipe specification	DN15 coppe	
Brass fittings specification	DN15 brass	
Wasteage	10%	
Copper pipe length (DN15)	52.36	m
Brass FF unions (DN15)	14	No
Brass FF elbows (DN15)	14	No
Brass FFF tees (DN15)	14	No

Hot Water Copper Pipe

Copper pipe specification	DN15 coppe	
Brass fittings specification	DN15 brass	
Wasteage	10%	
Pipe length	54.8	m
Brass FF unions	28	No
Brass FF elbows	28	No
Brass FFF tees	28	No

Cold & Hot Water Plumbing Consumables

PTFE Tape Seal	2	No
Nylon compression olives (15mm)	5	Packs

DVW Plumbing Consumables

Priming fluid (250 ml pack)	2	No
Glue Blue (250 ml pack)	2	No

Rainwater and Header Tanks

Notes:

Installation

Instal rainwater tank, header tank, pipewo

Materials

Rainwater tank specification	Polyethylene	
Rainwater tank volume	5500	litres
Number of rainwater tanks	2	No
Header tank specification	Polyethylene	
Header tank volume	200	litres
Number of header tanks	1	No
Electric pump specification	Centrifugal 1	
Electric pump capacity	60	l/m
Number of electric pumps	0	No
Hand pump specification	Mini rotary h	
Hand pump capacity	30	l/m
Number of hand pumps	1	No

Rainwater uPVC Pipe (roof gutter to tank

uPVC pipe specification	DN80 uPVC	
uPVC fittings specification	DN80 uPVC	
Wasteage	10%	
uPVC pipe length	30.4	m
uPVC FF elbows	4	No
uPVC gutter inlet	4	No

Rainwater HDPE Pipe (tanks & pump to h

Pipe specification	DN32 HDPE	
Fittings specification	DN32 HDPE	
Wasteage	10%	
Pipe length (DN32 HDPE pipe)	14.6	m
Unions (DN32 HDPE pipe)	6	No
Elbows (DN32 HDPE pipe)	7	No
Tees (DN32 HDPE pipe)	0	No
Valves (brass FF gate valves)	3	No

Rainwater Copper Pipe (into building)

Copper pipe specification	DN15 coppe	
Brass fittings specification	DN15 brass	
Wasteage	10%	
Pipe length	7.4	m
Brass FF unions	4	No
Brass FF elbows	4	No
Brass FFF tees	4	No
Other brass fittings	0	No
Other fittings	0	No

Rainwater Plumbing Consumables

PTFE Tape Seal	2	No
Nylon compression olives (15mm)	5	Packs

DVW Rainwater Plumbing Consumables

Priming fluid (250 ml pack)	1	No
Glue Blue (250 ml pack)	1	No

Solar Hot Water Service

Notes: Default prici

Installation

Install solar hot water system, including pi

Materials

Solar hot water system specification	SolarHart 3(	
Solar hot water capacity	300	litres
No of solar hot water systems	2	No

Laundry Awnings

Awnings are subject to client instruction.

Installation

Install awnings.

Veranda Awnings

Number of awnings	2	No
Wall system	Steel sheet	
Security door frame length	1,800	mm
Opening length	1,800	mm
Overall length	1,936	mm
Covered width (protruding from studs/mas	1,500	mm
Eaves (beyond covered width)	450	mm
Total width (protruding from studs/masonr	1,950	mm
Slope	18	o

Gable cladding

Gable cladding type	90 x 19 Wea	
Gable cladding area each shade	1.89	m2
Wasteage	10%	
Gable cladding total area	4.16	m2

Roof sheeting

Roof sheeting type	0.42 BMT sl	
Coverage width	762	mm
Roof sheeting area each shade	3.98	m2
Wasteage	10%	
Roof sheeting total area	8.75	m2
Length of sheet required	11.49	m

Wall / roof flashing

Wall /roof flashing type	200 x 0.5 cc	
Wall /roof flashing length each shade	1.94	m
Wasteage	10%	
Wall /roof flashing total length	4.26	m

Barge flashing

Barge flashing type	200 x 0.5 cc	
Barge flashing length each shade	4.11	m
Wasteage	10%	
Barge flashing total length	9.04	m

Timber framing

Top chord, bottom chord, purlins	140 x 45 F7
Vertical members	90 x 45 F7
Vertical near wall	90 x 90 F7
Posts	90 x 90 F7

Cutting List

Top chord	2	No
140 x 45 F7	2,150	mm
Bottom chord	2	No
140 x 45 F7	2,040	mm
Purlins	4	No
140 x 45 F7	1,846	mm
Vertical furthest from wall	2	No
90 x 45 F7	340	mm
Intermediate vertical	2	No
90 x 45 F7	575	mm
Vertical near wall	2	No
90 x 90 F7	810	mm
Post	2	No
90 x 90 F7	2,660	mm

BOQ

Wasteage	10%	
90 x 45 F7	4.0	m
140 x 45 F7	34.7	m
90 x 90 F7	15.3	m

Timber Screws

Timber screw size	10-9 x 80 T	
No of timber screws each shade	120	No
Wasteage	30%	
Total No of timber screws	312	No

Bolts

Bolt size	M12 x 200 g	
No bolts each shade	4	No
Wasteage	0%	0
Total No bolts & nuts	8	No

Roofing Screws

Roofing screw type	12-11 x 50 T	
Roofing screws	132	No
Wasteage	30%	
Total number of roofing screws	172	No

Flashing Screws

Flashing screw size	12-11 x 50 T	
No of flashing screws each shade	58	No
Wasteage	30%	
Total No flashing screws	151	No

Laundry Concrete Slabs

Concret slabs are subject to client instruct

Installation

Install concrete slabs.

Veranda Concrete Slabs

No concrete slabs	2	No
Wall system	Steel sheet	
Overall length	1,936	mm
Covered width (protruding from studs/mas	1,500	mm
Concrete slab slength	2,100	mm
Concrete slab width	1,500	mm
Concrete slab depth	100	mm
Concrete beam depth (including slab)	400	mm
Concrete beam width	300	mm
Concrete fillet	100	mm
Concrete wasteage	10%	
Concrete strength grade	N20	
Concrete volume	2.07	m3
Cement in concrete	17.00	40 kg l
Sand in concrete	1.04	m3
Gravel in concrete	2.07	m3
Cement in concrete	0.66	tonnes
Sand in concrete	1.55	tonnes
Gravel in concrete	3.73	tonnes
Slab reinforcement	SL72	
Slab reinforcement	6.30	m2
Edge beam reinforcement	3-L11TM	
Edge beam reinforcement	14.40	m
N10 reinforcement	4.80	m
75 x 5 FMS galv steel post anchors	4	No
M12 x 150 galv cuphead bolts, nuts, wash	4	No

Gable Ventilators

Gable ventilators are subject to client instr

Installation

Install gable ventilators.

Gable Ventilators

Number of gable ventilators	2	
Opening length of each ventilator	3.060	
Overall length of each ventilator	3.100	
Opening height of each ventilator	0.840	
Overall height of each ventilator	1.200	

Flashing

Flashing type	150 x 0.5 cc	
Flashing length in each ventilator	5.50	m
Wasteage	10%	
Flashing total length	12.10	m

Timber framing

Horizontal top and bottom reveals & flange	200 x 20 F7	
Vertical side reveals	200 x 20 F7	
Diagonal ventilator slats	200 x 20 F7	
Vertical straps	50 x 20 F7	

Cutting List

Horizontal top and bottom reveals & flange	0	No
200 x 20 F7	3,060	mm
Vertical side reveals	0	No
200 x 20 F7	880	mm
Diagonal ventilator slats	0	No
200 x 20 F7	3,060	mm
Vertical straps	0	No
50 x 20 F7	840	mm

BOQ

Wasteage	10%	
200 x 20 F7	0.00	m
200 x 20 F7	0.00	m
200 x 20 F7	0.00	m
50 x 20 F7	0.00	m

Timber Screws

Timber screw size	10-9 x 80 T	
No of timber screws each ventilator	140	No
Wasteage	30%	
Total No of timber screws	364	No

Roofing & Flashing Screws

Flashing screw size	12-11 x 50 T	
No of flashing screws each ventilator	52	No
Wasteage	30%	
Total No flashing screws	135	No

Civil Works		0
Septic Tank		0
Note: Inclusion of retaining walls is subject		0
PC provision for septic tank	1	0
0	0	0

Calculations

Refer to the Excel Workbook “DANCER Building Design 220614”, retained in the following directory –

C:\Users\rod\Documents\0Q QMS-PHA\220406 PHA VFH-PNG Kitip-Runimb 2 Classrooms & Office

A screen shot of the cover page is shown below. Refer to the workbook for all calculations

Quasar
Management Services Pty Ltd

Quasar Management Services Pty Limited
ABN 21 003 954 210 Member of Consult Australia
Not-for-profit consulting structural and civil engineer.
A subsidiary of Partner Housing Australasia (Building) Incorporated
272 Blackwall Road, Woy Woy NSW 2256, Australia
Phone: +61 432 611 550
Email: rod@electronicblueprint.com.au

Building Design & Construction

Designation		
Project	**p**	**p**
Partner Organisation	V	
Coordination	P	
Design	Q	
Design Check	Q	
Builder	V	
Site Inspection	Q	
Use	**H**	**H**
Length, width, (habitablel width), verandas,porche	13.8 x 8.4 (6.6), 0, 1	**13.8 x 8.4 (6.6), 0, 1**
No of storeys, roof type	1, g	
No of private rooms, window width	4, 800	**4, 800**
Sub-floor, walls, roof frame	s, t, t	
Summary		
Project	Kwip Dau Secondary School Duplex H	Kwip Dau Secondary School Duple
Partners	Vision for Homes	
Use	Duplex Houses	Duplex Houses
Nominal plan dimensions (allowing for external cladding approximately 20 mm)	13.8 m x 8.4 m overall, 1 veranda under roof, 2 No 1.8 x 1.5 laundries separate	13.8 m x 8.4 m overall, 1 veranda under roof, 2 No 1.8 x 1.5 laundries separate
External elevation	One habitable storey, gable roof	
Internal arrangment	Duplex houses with a front veranda, 2 covered laundries on concrete slabs, solar hot water, septic tank	Duplex houses with a front veranda, 2 covered laundries on concrete slabs, solar hot water, septic tank
Sub-floor, walls, roof	Steel posts, anchored timber wall & cladding, anchored timber roof	
Country	Papua New Guinea	
Location	Highlands	
Tsunami exposure	0.00	
Earthquake hazard, z	0.24	
Cyclonic / Non-cyclonic	Non-cyclonic	
Wind classification	N2	N2
Return period	500	
Region	Highlands	
Basic wind speed	28.0	
Basic wind speed	28.0	
Basic wind speed error?	OK	
Road distance from nearest fabrication centre	30 km	

Building Parameters			
Building type	Duplex school staff houses		Duplex school staff houses
Importance Level	2		
Ground floor type	Elevated		
Roof (skillion/gable/hip)	g		
Roof pitch	18.43	°	
Shape (R = Rectangle)	R		
No of habitable storeys	1		
Total length (O/A ext studs)	**13.800**	m	13.800
Habitable width incl porch, excl veranda	**6.600**	m	6.600
Total width (O/A ext studs incl covered veranda o	**8.400**	m	8.400
Thickness of ext walls	0.090	m	
Thickness of int walls	0.090	m	
Habitable area (inc walls, excl veranda)	91.1	m^2	
Internal area habitable rooms (excl walls, excl ver	83.0	m^2	
FFL to U/S ceiling	2.500	m	
Top storey height FFL to ceiling	0.000	m	
Bottom storey height FFL to ceiling	2.500	m	
Minimum sub-floor FFL	0.950	m	
Eaves overhang (length)	0.000	m	
Eaves overhang (width)	0.450	m	
Is roof truss over verandas or porchs?	Yes		
Plan length of roof	13.800	m	
Plan width of roof	9.300	m	
Is there a ceiling?	Yes		
Is there eaves lining?	Yes		
Bottom bolt to top bolt	0.160	m	
Bottom bolt to u/s chord	0.045	m	
Ceiling joist depth	0.045	m	
Ceiling depth+ allowance	0.004	m	
Roof rise ceiling to purlins top	1.781	m	
External wall height from ground	3.450	m	
Total height to ridge	5.231	m	
U/S Ceiling to FFL above	0.000	m	
Front veranda length under roof (incl studs)	13.800	m	
Front veranda width under roof (incl studs)	1.800	m	
Back veranda length under roof (incl studs)	0.000	m	
Back veranda width unde roof (incl studs)	0.000	m	
Rise of stairs	0.950	m	
Number of external doors	2		2
Number of internal doors	6		6
Number of windows	10		10
Area of windows	9.60	m^2	
Length of internal walls	49.2	m	49.2
Roof sheeting	Steel sheet		
Roof structure	Direct Anchorage Timber		
External walls	Steel sheet		
Internal walls	Timber frame		
Footings for building	Concrete piers		
Footings for steps	Concrete pad footings		
Subfloor post type	Steel		
Is subfloor post embedded?	Yes		
Lines of posts supporting bearers	4		
Lines of bearers supporting joists	6		
Posts under roof	24		
Additional veranda posts (not under roof)	0		
Total number of posts	24		
Transverse post spacing	2,700	mm	
Longitudinal post spacing	2,700	mm	
Floor	Elevated timber		
Is veranda seat required?	No		
Is veranda beam required?	No		

Structural Design Parameters		
Foundations		
Foundations	Moderate clay	
Site classification (A, S, M, H, P)	M	
Characteristic compaced density	20	kN/m^3
Characteristic internal friction angle	27	°
Characteristic cohesion	6	kPa
Characteristic external friction angle (rough surfac	35	°
Is pier "Square" or "Circular"	Square	
Nominal footing width	0.45	m
Effective footing width	0.45	m
Nominal footing depth	0.60	m
N_q	13.20	-
N_c	23.94	-
N_q	14.47	-
z_q	1.00	-
z_{qi}	1.00	-
z_{qt}	1.00	-
z_c	1.00	-
z_{ci}	1.00	-
z_{ct}	1.00	-
z_q	1.00	-
z_{qi}	1.00	-
z_{qt}	1.00	-
Ultimate bearing capacity	816	kPa
Capacity reduction factor to working stress	0.33	-
Working bearing capacity	272	kPa
Skin friction resisting uplift	4.5	kN/pier
Tsunami		
Distance from high water mark	500	km
Height of finished floor above mean sea level	800	m
Distance from high earthquake area (Z > 0.4)	100	km
Site specific exposure	1.0	
Tsunami risk factor	0.00	
Flooding		
Distance to closest water course	300	m
Height of finished floor above normal level of wate	3.0	m
Catchment area	30	km^2
Concentration of catchment runoff past structure	1.0	
Flash flooding risk factor	0.00	
Earthquake		
Use	Duplex Houses	
Importance level	2	
Hazard factor	0.24	
Subsoil classification	Ce	
Wind		
Use	Duplex Houses	
Country	Papua New Guinea	
Location	Highlands	
Cyclonic or non-cyclonic ?	Non-cyclonic	
Cardinal direction	Any direction	
Terrain category	2.0	
Shielding (NS, PS, FS)	PS	
Topographic classification	T0	
Region	Highlands	
Wind classification (AS4055)	N1	
Roof general wind uplift	0.47	kPa
Wall general wind suctions	0.30	kPa
Snow		
Location	Papua New Guinea	
Hazard factor	No snow	