

Introduction

This training package describes a course for builders constructing village infrastructure and houses, common in South-East Asia and the South Pacific region.

It describes typical design and construction problems common in the region.

A range of standard Partner Housing designs is provided.

The package also describes the use and care of common tools.



Building Skills Basic Training

Purpose

The purpose is to provide the basic building skills to trainees, with a view to enabling them to work as builders in the future.

Trainer

The Trainer will be an experienced builder, who has received instruction in the use of this material.

Training Resource Material

The training resource material consists of Power Point presentations, that can be used as:

- Teaching presentations
- Printed work books, to be given to the trainees as a permanent reference
- Printed and laminated posters, that are placed on site
- As a source of details, which can be copied and placed onto project drawings.

Building Skills Basic Training Program - Practical and Theoretical Program

Week	Practical Stage	Theoretical Teaching Module	Theory
Week 1	Setting out Footings	(1) Introduction (2) Design and Setting Out (3) Concrete	1 Day
Week 2	Subfloor Posts Floor framing	(4) Timber Sub-floors (5) Bracing and Anchorage (6) Concrete Slab-on-Ground	2 Days
Week 3	Wall Framing Roof Framing	(7) Timber Wall Frames (8) Steel Framing (9) Timber Roof Frames	1 Day
Week 4	Direct Anchorage System	(10) Direct Anchorage System	2 Days
Week 5	Roof sheeting Doors, Windows Ceiling Framing	(11) Roof Sheeting, Flooring, Cladding & Lining (12) Doors and Windows (13) Reinforced Concrete Blockwork Walls	1 Day
Week 6	External Cladding	(14) Concrete Block Manufacture	1 Day
Week 7	Electrical, Plumbing	(15) Plumbing and Electrical	1 Day
Week 8	Internal Wall & Ceiling Lining	(16) Costing, Quoting, Budgeting	1 Day
Week 9	Stairs, Trimmings		
Week 10	Plumbing fixtures, Tiling		
Week 11	Guttering, Electrical, Cabinetry		
Week 12	Painting		

Building Skills Basic Training Program - Theoretical Teaching Modules

Part	Content
1	Introduction (training course, what else can go wrong, use and care of tools, site safety)
2	Design, drawings, specifications, setting out, profiles, pegs, grid lines, levels
3	Concrete (materials, reinforcement, formwork, concrete mix, placement, curing)
4	Timber sub-floors, floors, stairs and verandas (materials, piers, posts, bearers, joists, bracing)
5	Improving cyclone, earthquake and tsunami resistance (bracing and anchors), basic shelter
6	Concrete slab-on-ground (reinforcement, formwork, mix, placement, curing)
7	Timber wall frames (materials, top and bottom plates, studs, noggings, lintels)
8	Steel framing (materials, posts, bracing, welding, bolting)
9	Timber roof frames (materials, rafters, underpurlins, roof battens)
10	Timber direct anchorage system
11	Roof sheeting, flooring, wall cladding, wall lining
12	Doors and windows
13	Reinforced concrete masonry houses (reinforcement, mortar, grout, construction)
14	Concrete block manufacture
15	Plumbing and electrical (including septic tank construction)
16	Costing, quoting and budgeting

Construction Problems Under Cyclone, Earthquake & Tsunami

Let us pause for a moment,
and remember those killed in natural disasters
(just ordinary people like you and me)
in the wrong place at the wrong time.



Cyclone Damage

Cook Islands, February 2010



Photos: Cyclone Damage on Aitutaki in the Cook Islands
Courtesy of D Kaunitz (Emergency Architects Australia)



Earthquake Damage

Aceh Indonesia, December, 2004



Tsunami Damage

Indonesia, Thailand, India, Sri Lanka – December 2004



Earthquake and Tsunami Damage

Solomon Islands, April 2007



Architectural Considerations

The **architectural design of shelter must consider a diverse range of variables** - culture, occupier aspirations, owner-occupier versus rental, land availability, planning rules, populations density, available infrastructure, low rise versus high rise - to name but a few.



Engineering Considerations

By comparison, providing buildings with resilience (structural reliability) is relatively simple.....

1. A **regulator** determines the acceptable probabilities of collapse and unserviceability under various combinations of permanent load, imposed load, wind load, earthquake load, tsunami load and other loads.
2. **Design standards** are formulated and adopted into building regulations.
3. Structural engineers produce **drawings, details and specifications** in accordance with the design rules.
4. Builders **construct in accordance with the drawings, details and specifications**.

..... or so it should be!



Engineering Consideration - Villages

- Village housing in developing countries often incorporates **traditional materials and detailing, which do not have the resilience** implicit in modern building regulations.
- This presentation suggests a **systematic approach** to achieving acceptable resilience in shelter provided as part of development and reconstruction projects, with particular emphasis on village housing in the Asia/Pacific region.



Some buildings are less prone to damage than others

Although subjected to the same earthquake and tsunami, some houses remain virtually unscathed while others are destroyed or rendered unusable.

The following two houses, side by side, were both subjected to the 2007 Solomon Islands earthquake and tsunami. The more substantial green “timber and concrete house” includes adequate horizontal load resistance (in the form of a strong lower storey room), while the adjacent brown “leaf house” (without any bracing) is now unserviceable and requires temporary props to prevent collapse.

The common feature of **all surviving houses is that they are well-built and braced** (in some cases by braced lower storey walls, in other cases by diagonal bracing).



Poor design and construction contributes to failures

The following pages show various examples of good and bad design or construction.



Lack of bracing



Compaction under Footings, Ring Beams and Slab-on-Ground

Pad Footings and Column Reinforcement Thailand



Pad Footings and Column Reinforcement India (Villupurum)



Unreinforced concrete slab-on-ground Sri Lanka (Trincomalee)



Reinforcement in Footings & Ring Beam

Sufficient reinforcement in ring beam and grouted stone footings
Aceh (Tibang)



Too much reinforcement in ring beam, columns and footings wastes money and difficult to compact concrete
Aceh (Lam Kruet)



Water in Concrete

Reference: *Beware of excess water*, Cement Concrete & Aggregates Australia, March 2006:

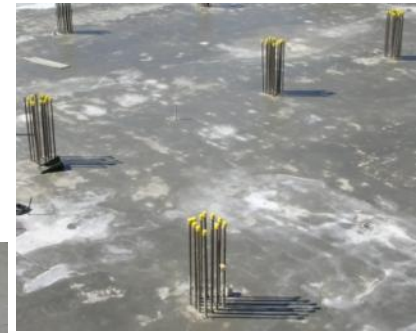
Strength – The strength of the concrete, and hence its ability to support loads, can be severely diminished by too much water in the mix.

Cracking – As water evaporates from concrete during the hardening process, there is a tendency for “early-age cracking” and “drying shrinkage cracking”. The width and extent of cracks will increase as the amount of water is increased.

Delamination – If concrete is too wet when finished, it could dry and shrink at the surface, which remaining moist underneath, causing delamination to occur.

Abrasion / Surface Dusting - Excessive moisture in concrete can lead to reduced abrasion resistance of the surface, leading to ‘dusting’ and possibly to exposure of the coarse aggregate

Durability – Concrete with excess water will be more prone to penetration by water and salts, and may exhibit increased risk of reinforcement corrosion and spalling of the surface (concrete cancer).



Reinforcement Cover in Concrete

Steel reinforcement must be surrounded with sufficient thickness of well compacted concrete to prevent corrosion of the steel and spalling of the concrete, commonly known as “concrete cancer”.



Suspended concrete roof corrosion (India)



Concrete wall corrosion (Australia)



Concrete lintel reinforcement corrosion (India)

Sub-floor Bracing

Inadequate Bracing
(Solomon Islands)



Bolts too close to the end of timber brace
Papua New Guinea (Mt Hagen)



Wall Framing & Bracing

Improvised Connectors – PNG



Inappropriate Joint in Top Plate – PNG



Wall Bracing – PNG (Mt Hagen)



Inadequate Wall Bracing – Australia



Anchorage of Roof Tiles or Roof Sheeting



Tiles tied down – Thailand



Roof sheeting tied down – Indonesia



Tiles not tied down – India



Tiles not tied down – Sri Lanka

Anchorage of Roof Framing



Skew Nail - India



Welded Reinforcement - Thailand



Bent reinforcement – Aceh



Framed Roof - Aceh

Fixing Masonry Walls Into the Structure



Brick to Concrete Columns
Indonesia (Aceh)



Bonded Masonry - Sri Lanka (Trincomalee & Batticaloa)



No ties between columns and masonry – Sri Lanka (Galle)

Quality of Bricks, Blocks & Mortar

Clay Bricks & Mortar
India (Villupuram)



Concrete Blocks & Mortar
Sri Lanka (Batticaloa)

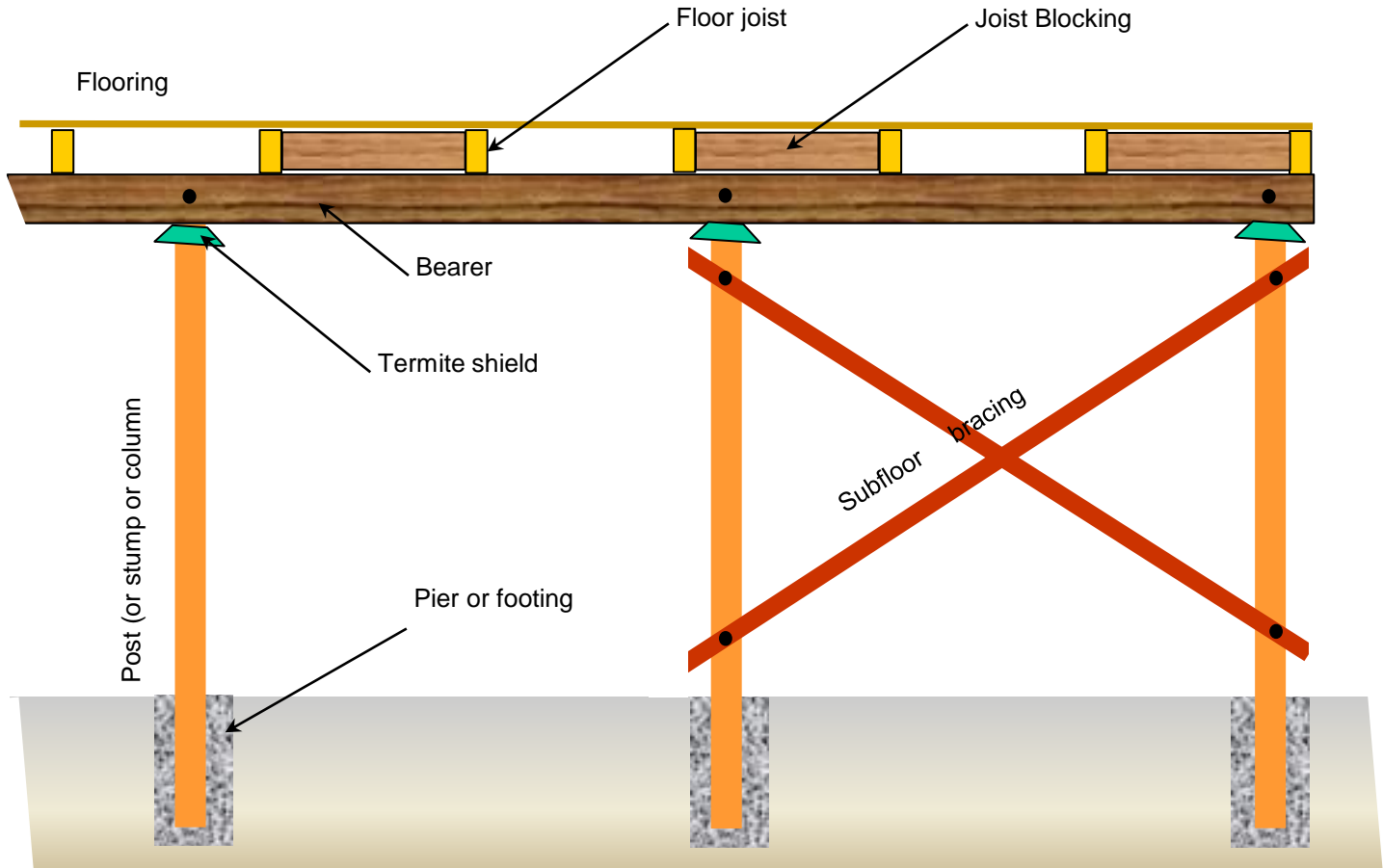


Definitions

This training module defines the terminology for the timber framing members for sub-floor, internal and external walls, and framed roofs of simple elevated timbers houses.

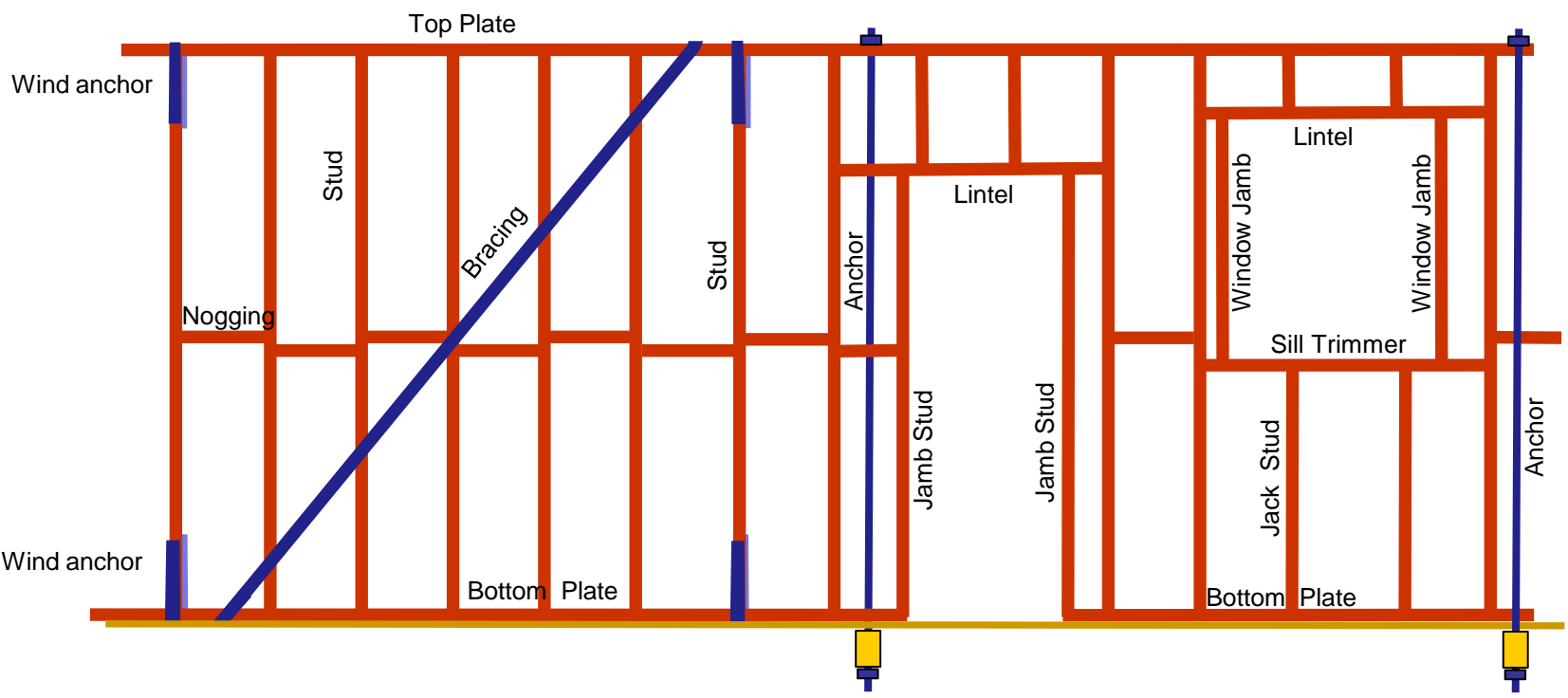


Definitions - Subfloor



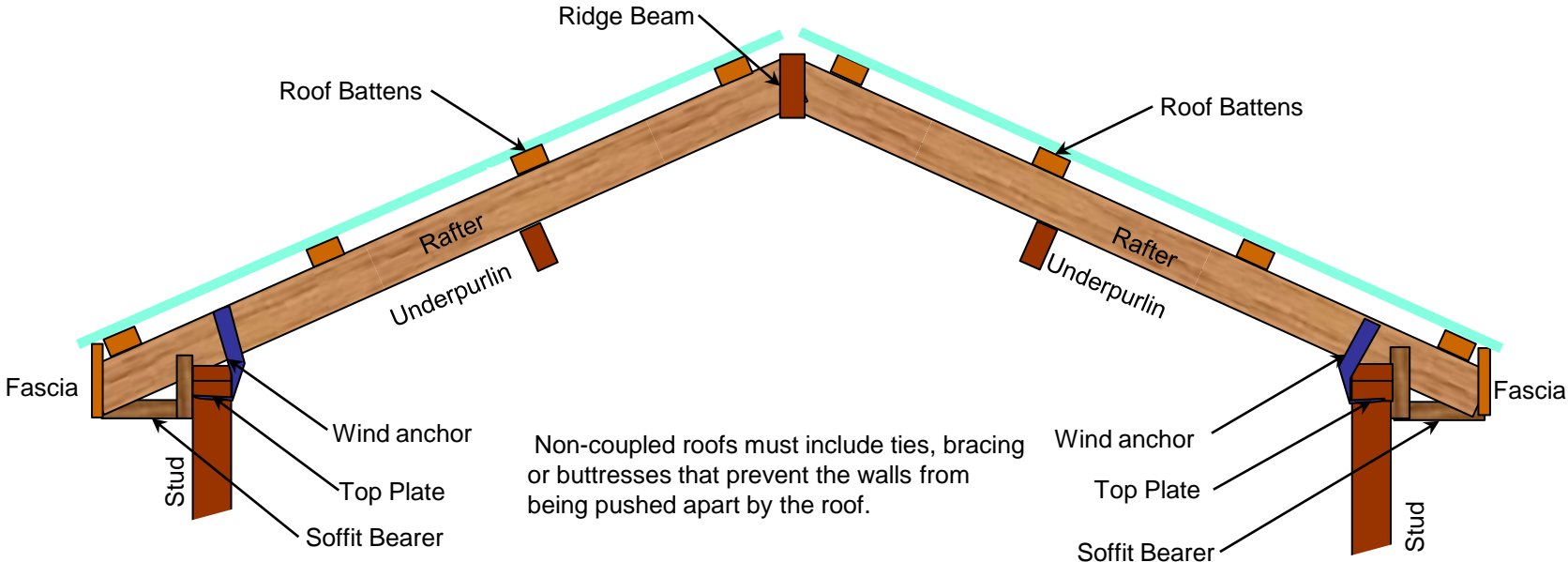
In this training package the term "pier" is used for the deep footing (not for the post)

Definitions - Walls



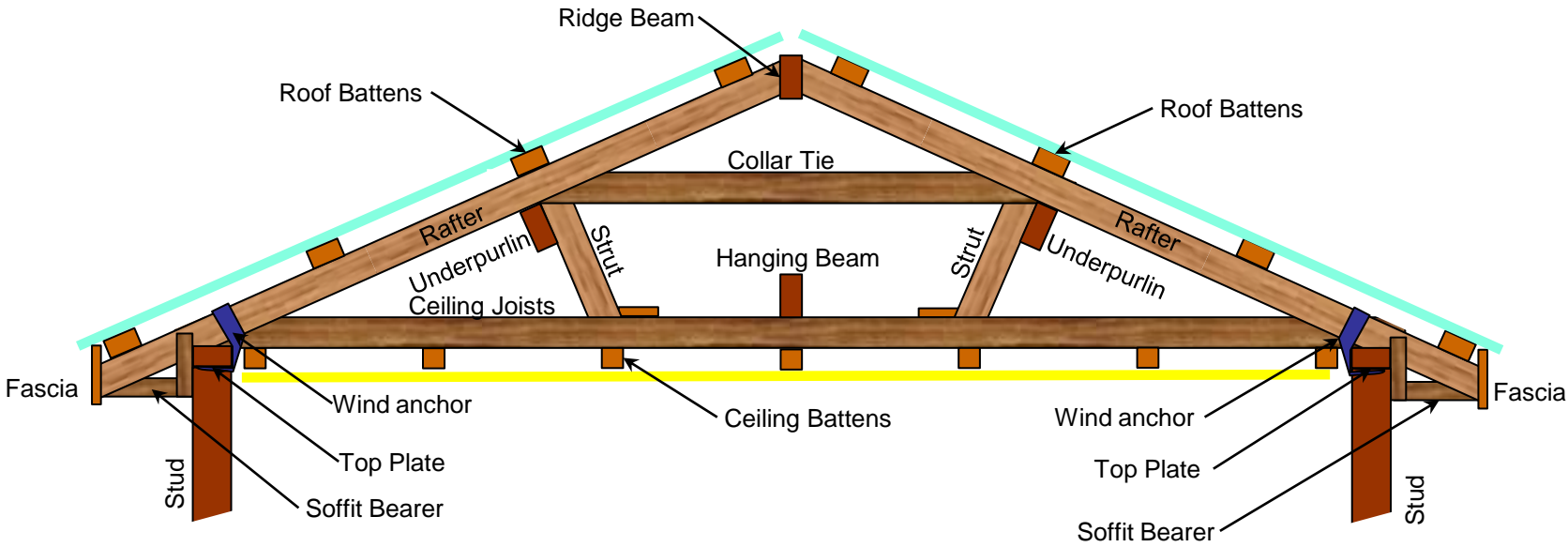
Definitions – Non-coupled Roof

Non-coupled roofs include cathedral roofs and the like, with or without a ceiling. They must include ties, bracing or buttresses that prevent the walls from being pushed apart by the roof.



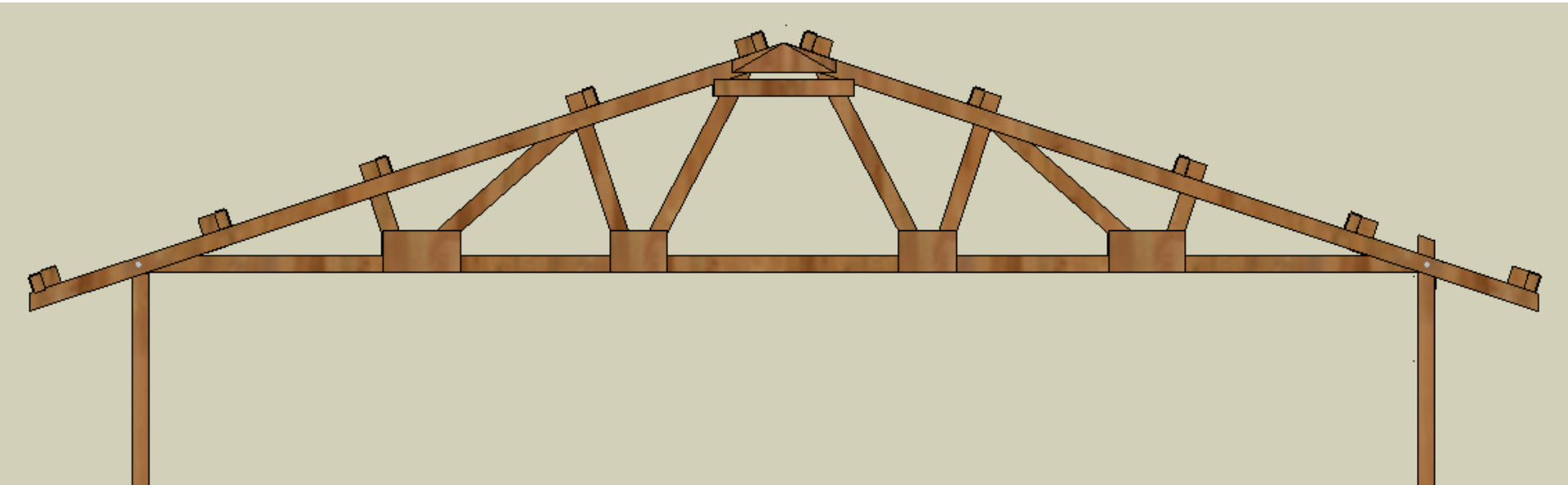
Definitions – Coupled Roof

Coupled roofs include collar ties and ceiling joists, which prevent the roof from pushing the walls apart.



Definitions – Truss Roof

Truss roofs, which span large distances and prevent the roof from pushing the walls apart.



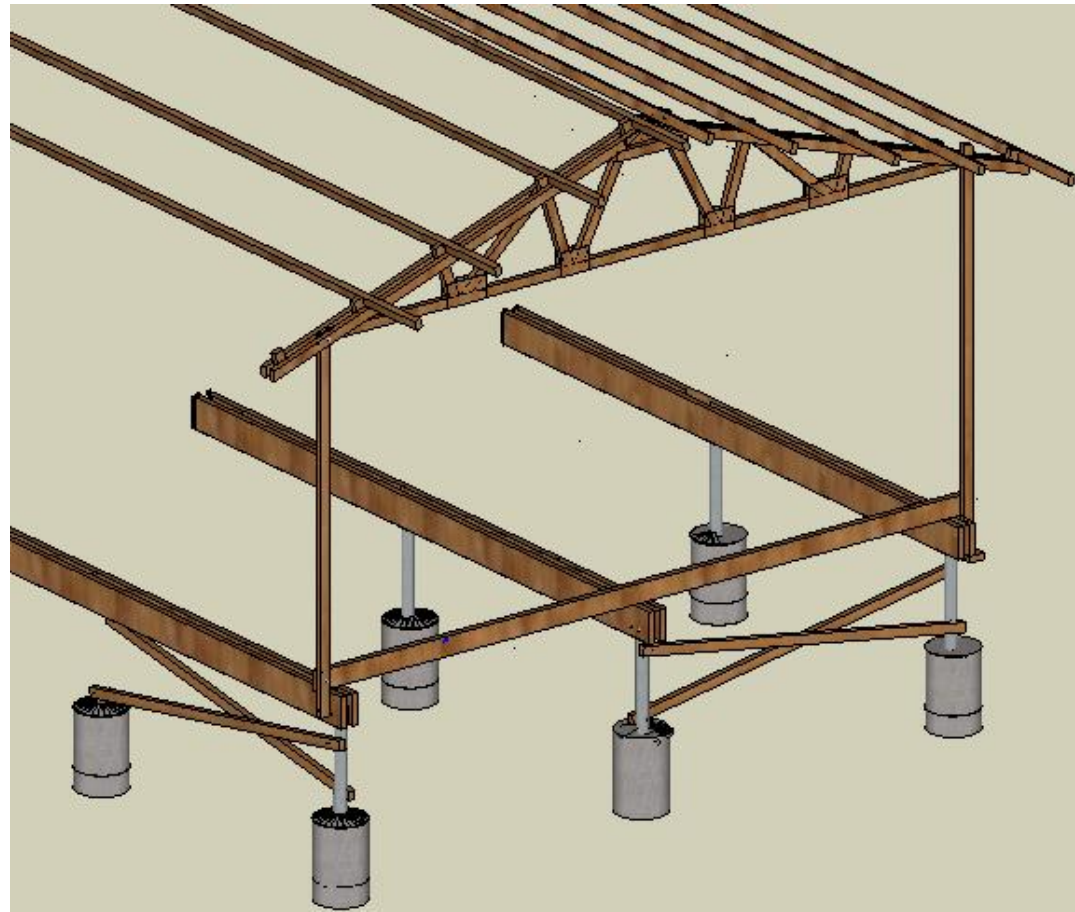
Definitions – Timber Direct Anchorage System

Steel roof sheeting is fixed through every second rib to timber roof purlins at 900 mm centres, which are side fixed to the lacing of timber roof trusses which are also at 900 mm centres.

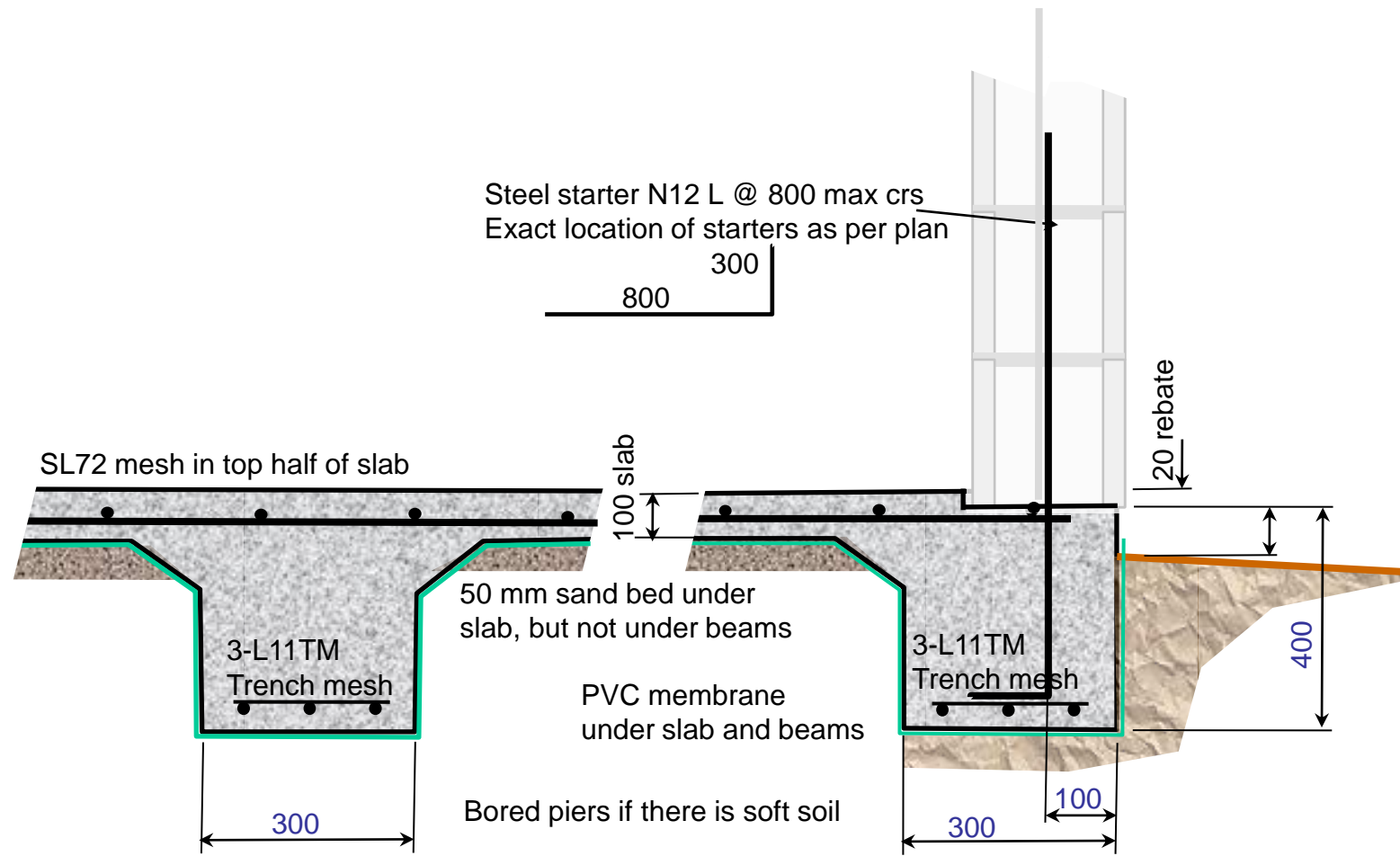
The timber lacing is nailed between double top chords of the timber trusses and fixed by nailing plates to the bottom chord.

The trusses are bolted to anchorage studs (at 900 mm centres) which are bolted and nailed directly to the floor joists and bearers, which are bolted to steel posts on a 2.7 m grid set in concrete piers.

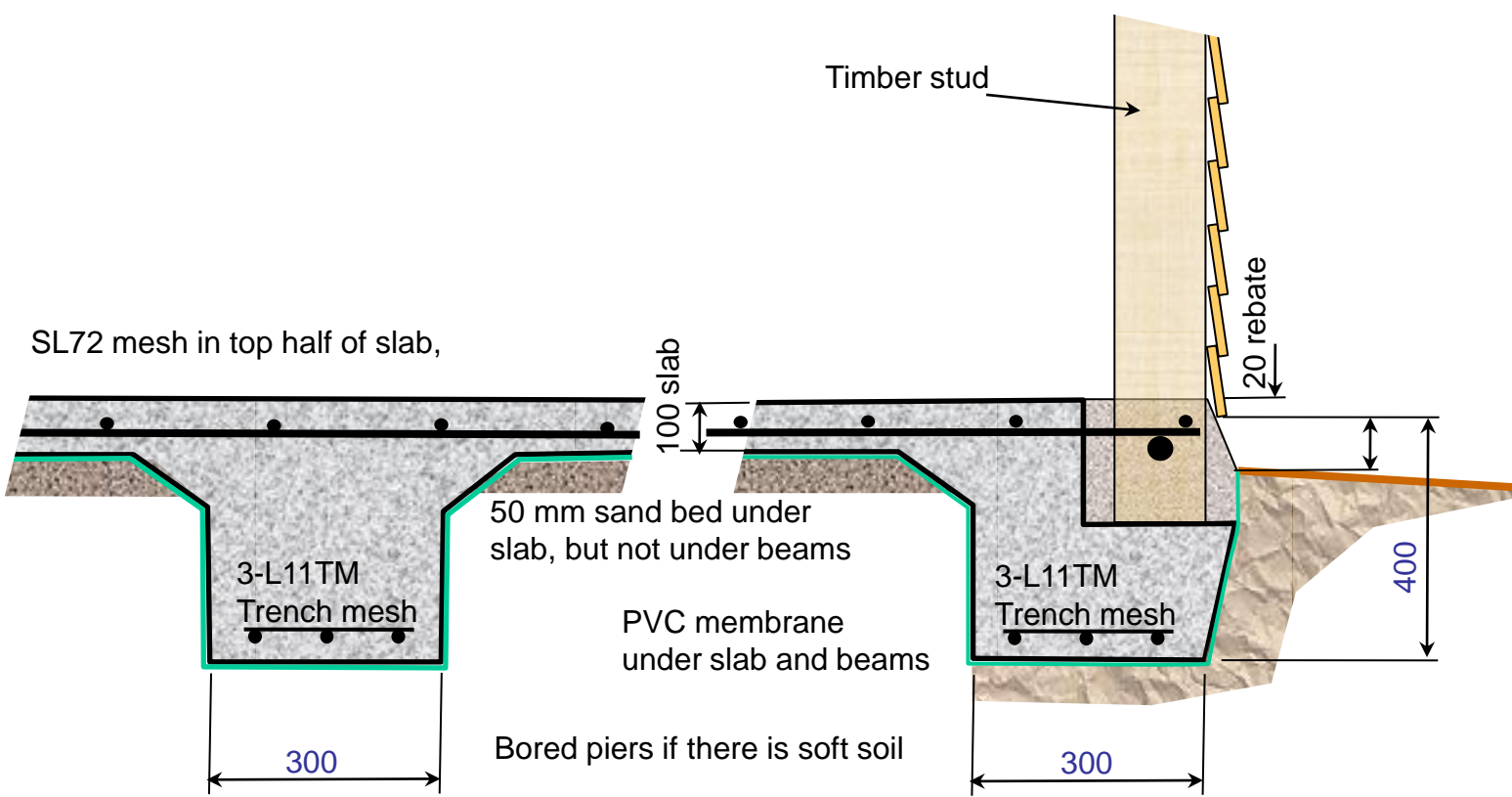
The whole system is braced by plywood wall bracing and sub-floor timber bracing.



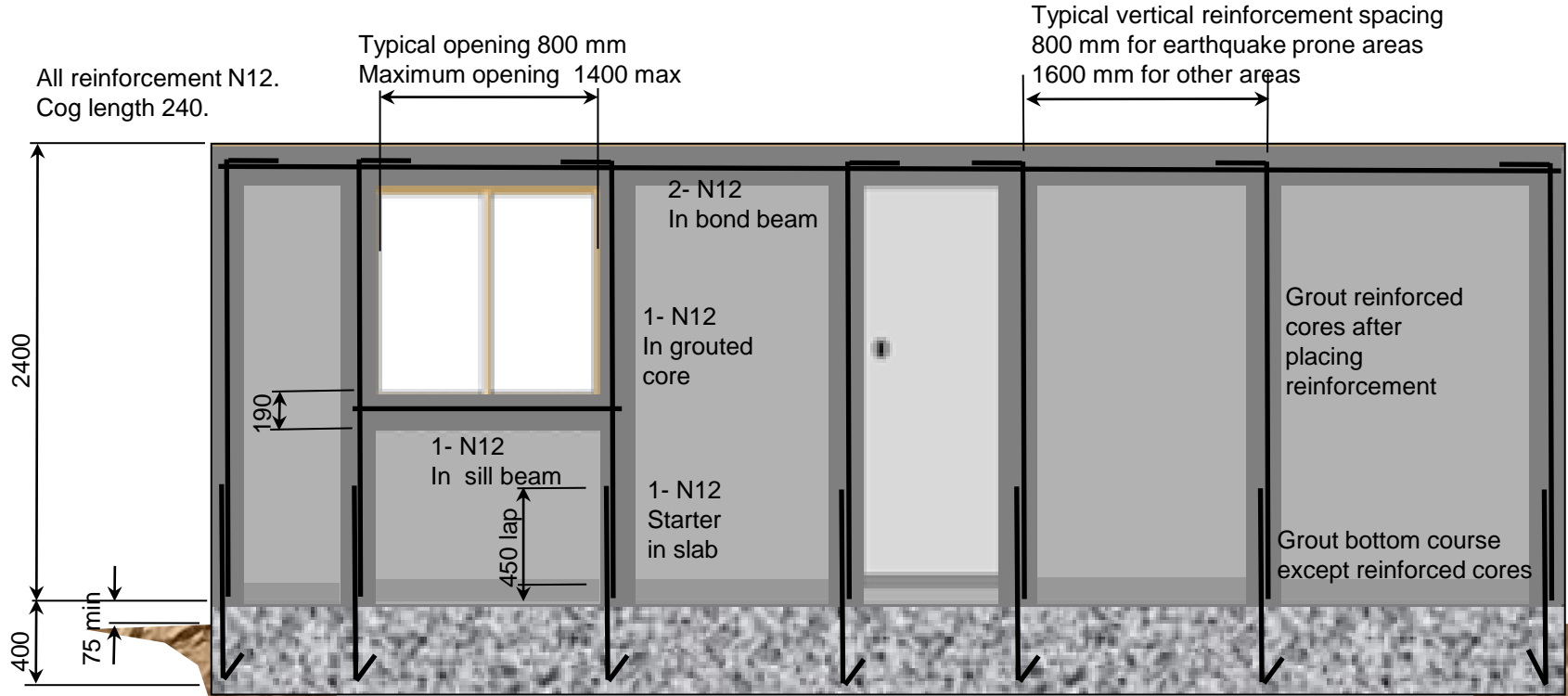
Definitions – Concrete Slab-on-Ground with Masonry Superstructure



Definitions – Concrete Slab-on-Ground with Timber Superstructure



Definitions – Reinforced Concrete Masonry Wall System

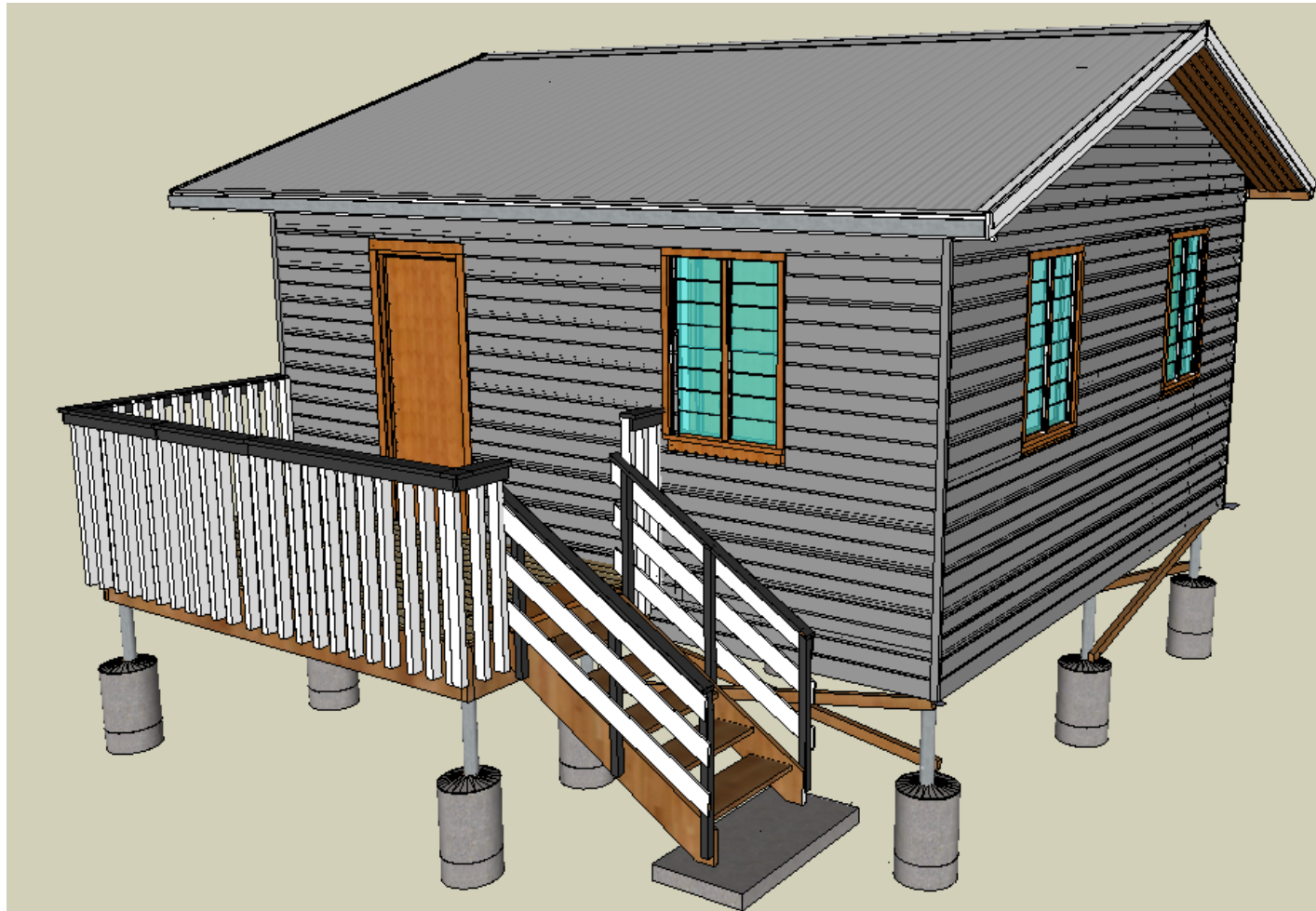


Concrete slab/footing/pier system, including sand bed, reinforcement, membrane etc, designed to AS 2870. Typically edge beams and cross beams, 300 x 300 mm, 3-11TM trench mesh. 100 mm concrete slab, SL72 mesh.

Typical Arrangement of Reinforcement

Partner Housing Standard Designs

Following are the range of standard houses, clinics and school buildings offered by Partner Housing. Variations from these standards are also available, as are customised buildings.



**Partner Housing No
1575712TNH**

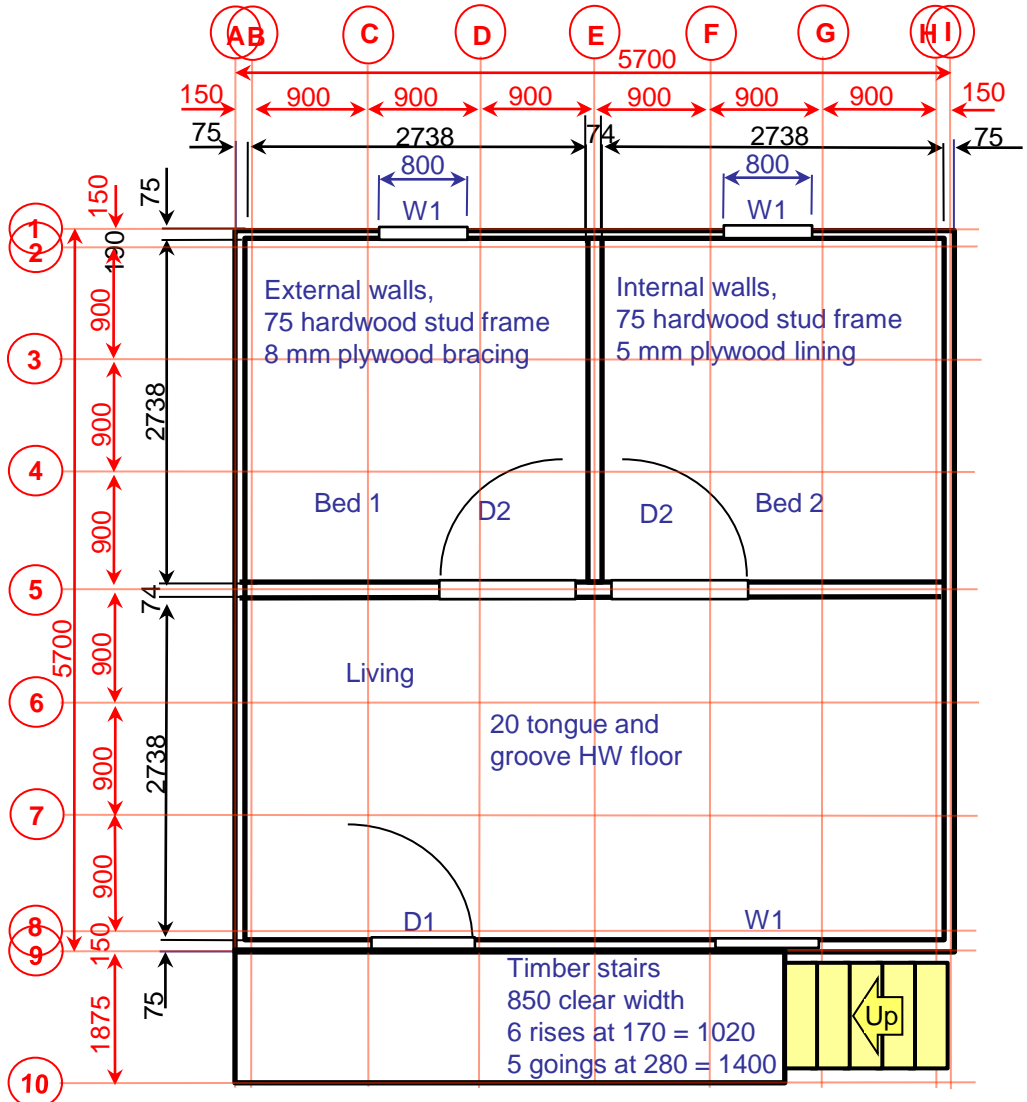
House – Non-cyclonic
Single storey
5.7 x 5.7 + 1.2 veranda

Floor – 75 x 50 F11 hardwood
20 F11 hardwood flooring

Walls – 75 x 50 F11 hardwood
F11 Hardwood cladding

Roof – 75 x 50 F11 hardwood
trusses and purlins

Alternative timber 70 x 45 MGP10



**Partner Housing No
1575712TCH**

House – Cyclonic
Single storey
5.7 x 5.7 + 1.2 veranda

Floor – 100 x 50 F11 hardwood
20 F11 hardwood flooring

Walls – 100 x 50 F11 hardwood
F11 Hardwood cladding

Roof – 100 x 50 F11 hardwood
trusses and purlins

Alternative timber 90 x 45 MGP10

Partner Housing No 1846519TNH

House – Non-cyclonic
Single storey
8.4 x 6.525 + 1.875 veranda

Floor – 75 x 50 F11 hardwood
F11 hardwood flooring

Walls – 75 x 50 F11 hardwood
F11 Hardwood cladding

Roof – 75 x 50 F11 hardwood
trusses and purlins

Alternative timber 70 x 45 MGP10

Partner Housing No 1846519TCH

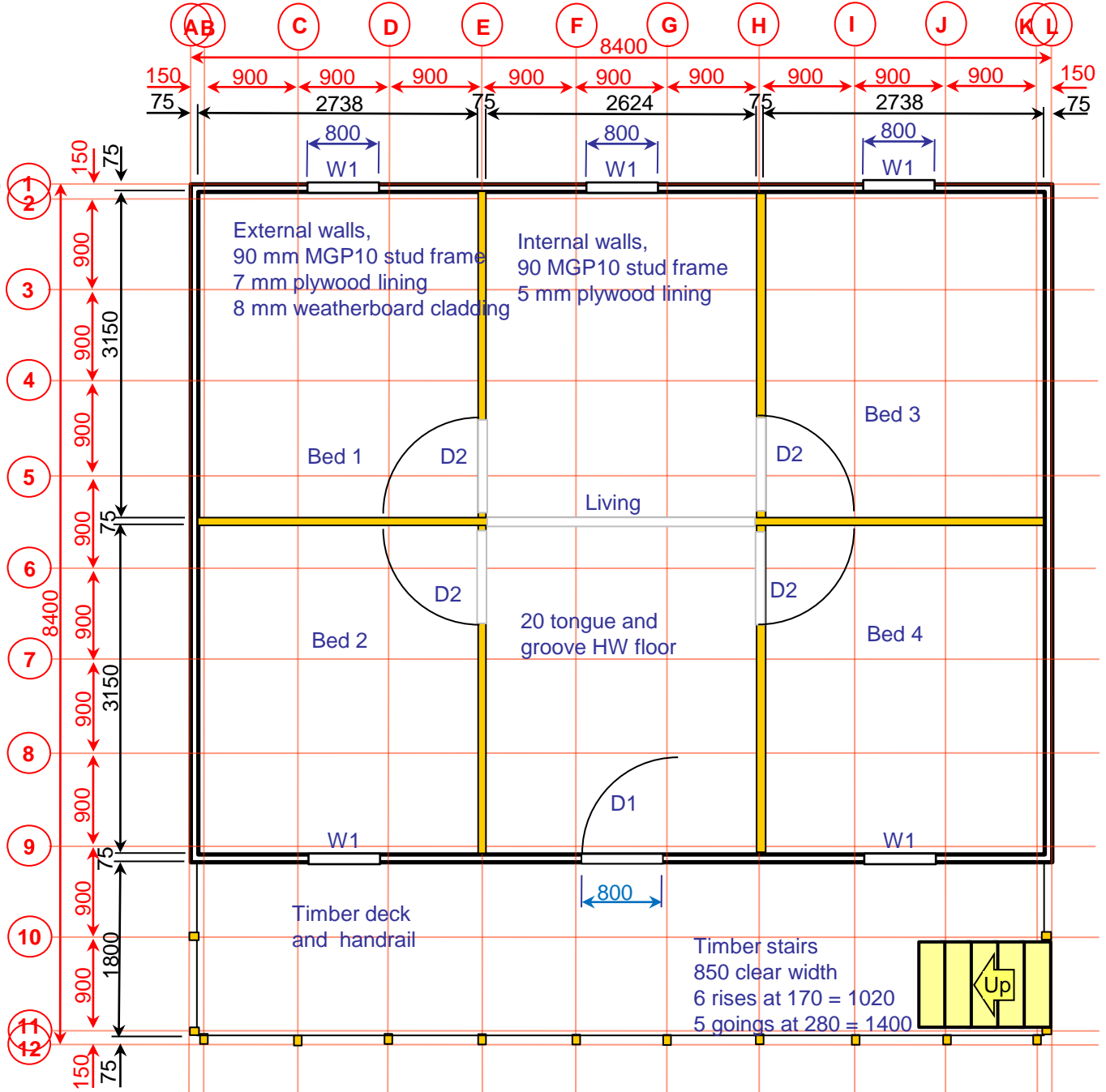
House – Cyclonic
Single storey
8.4 x 6.525 + 1.875 veranda

Floor – 100 x 50 F11 hardwood
20 F11 hardwood flooring

Walls – 100 x 50 F11 hardwood
F11 Hardwood cladding

Roof – 100 x 50 F11 hardwood
trusses and purlins

Alternative timber 90 x 45 MGP10



**Partner Housing No
1575712MNH**

House – Non-cyclonic
Single storey
5.7 x 5.7 + 1.2 veranda
Floor – 100 concrete slab-on-ground

Walls – 190 reinforced concrete masonry

Roof – 75 x 50 F11 hardwood trusses and purlins

Alternative timber 70 x 45 MGP10

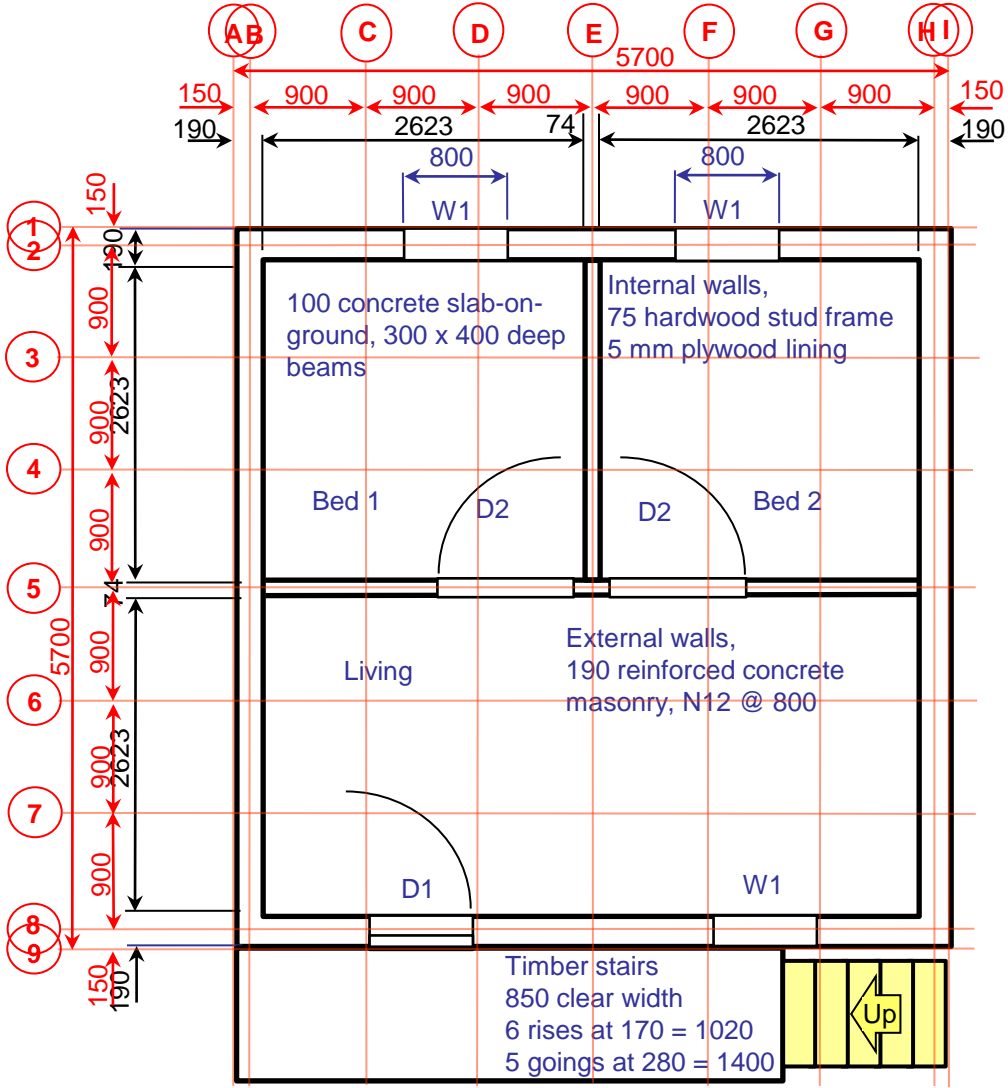
**Partner Housing
1575712MCH**

House – Cyclonic
Single storey
5.7 x 5.7 + 1.2 veranda
Floor – 100 concrete slab-on-ground

Walls – 190 reinforced concrete masonry

Roof – 100 x 50 F11 hardwood trusses and purlins

Alternative timber 90 x 45 MGP10



Partner Housing No 1846519MNH

House – Non-cyclonic
 Single storey
 8.4 x 6.525 + 1.875 veranda
 Floor – 100 concrete slab-on-ground

Walls – 190 reinforced concrete masonry

Roof – 75 x 50 F11 hardwood trusses and purlins

Alternative timber 70 x 45 MGP10

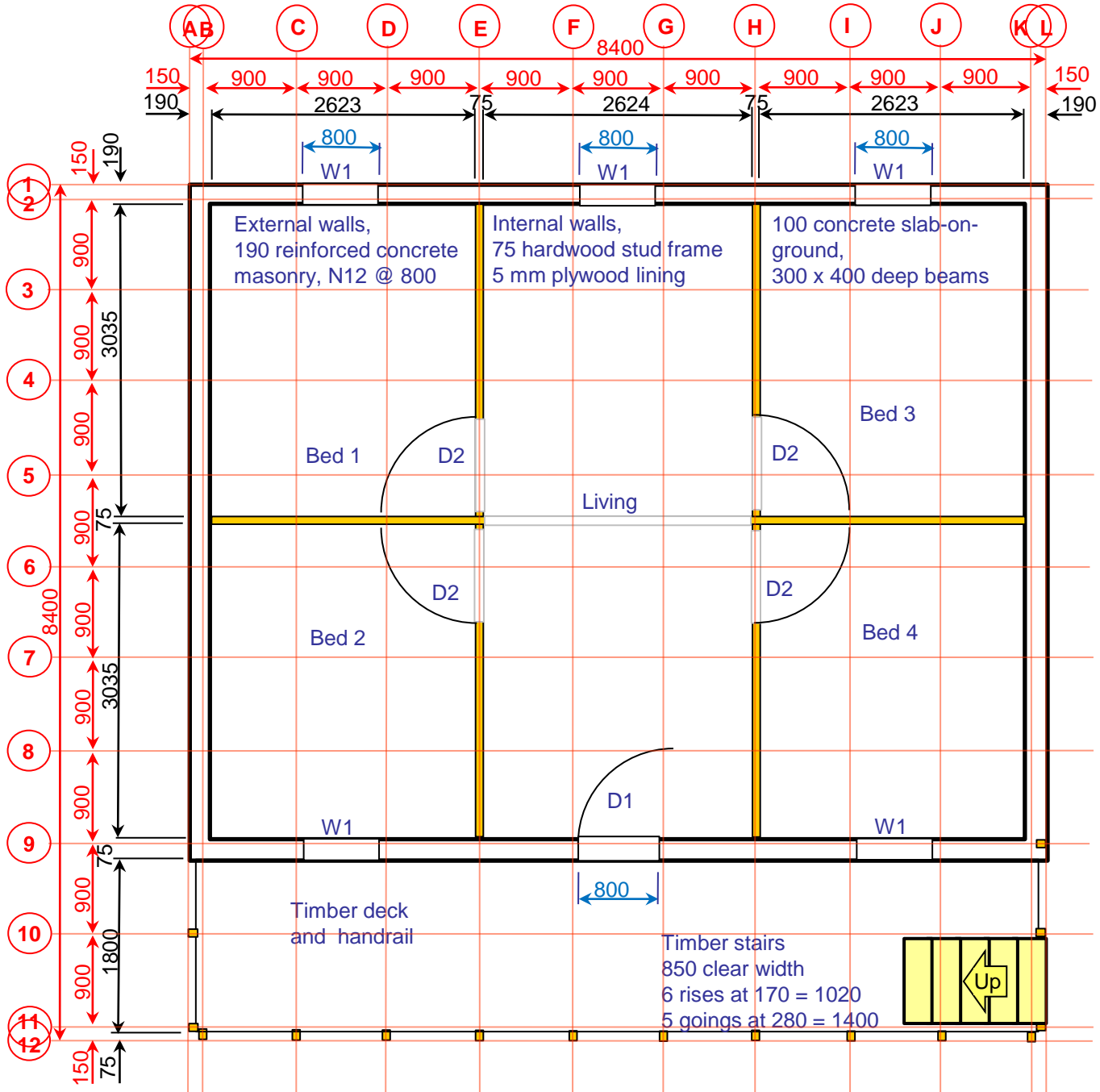
Partner Housing No 1846519MCH

House – Cyclonic
 Single storey
 8.4 x 6.525 + 1.875 veranda
 Floor – 100 concrete slab-on-ground

Walls – 190 reinforced concrete masonry

Roof – 100 x 50 F11 hardwood trusses and purlins

Alternative timber 90 x 45 MGP10



**Partner Housing No
1575712TNH**

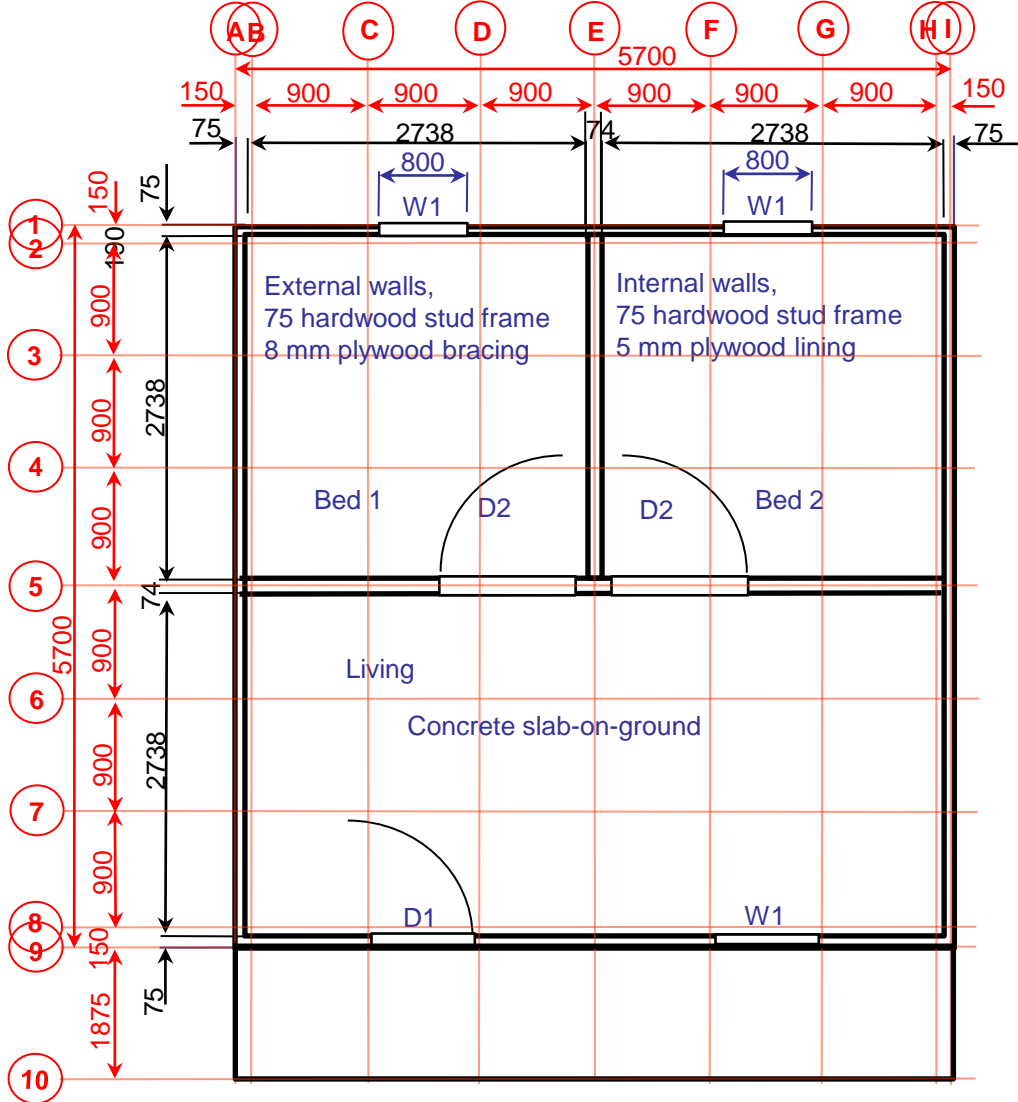
House – Non-cyclonic
Single storey
5.7 x 5.7 + 1.2 veranda

Floor – 75 x 50 F11 hardwood
20 F11 hardwood flooring

Walls – 75 x 50 F11 hardwood
F11 Hardwood cladding

Roof – 75 x 50 F11 hardwood
trusses and purlins

Alternative timber 70 x 45 MGP10



**Partner Housing No
1575712TCH**

House – Cyclonic
Single storey
5.7 x 5.7 + 1.2 veranda

Floor – 100 x 50 F11 hardwood
20 F11 hardwood flooring

Walls – 100 x 50 F11 hardwood
F11 Hardwood cladding

Roof – 100 x 50 F11 hardwood
trusses and purlins

Alternative timber 90 x 45 MGP10

Partner Housing No 1846519TNH

House – Non-cyclonic
Single storey
8.4 x 6.525 + 1.875 veranda

Floor – 75 x 50 F11 hardwood
F11 hardwood flooring

Walls – 75 x 50 F11 hardwood
F11 Hardwood cladding

Roof – 75 x 50 F11 hardwood
trusses and purlins

Alternative timber 70 x 45 MGP10

Partner Housing No 1846519TCH

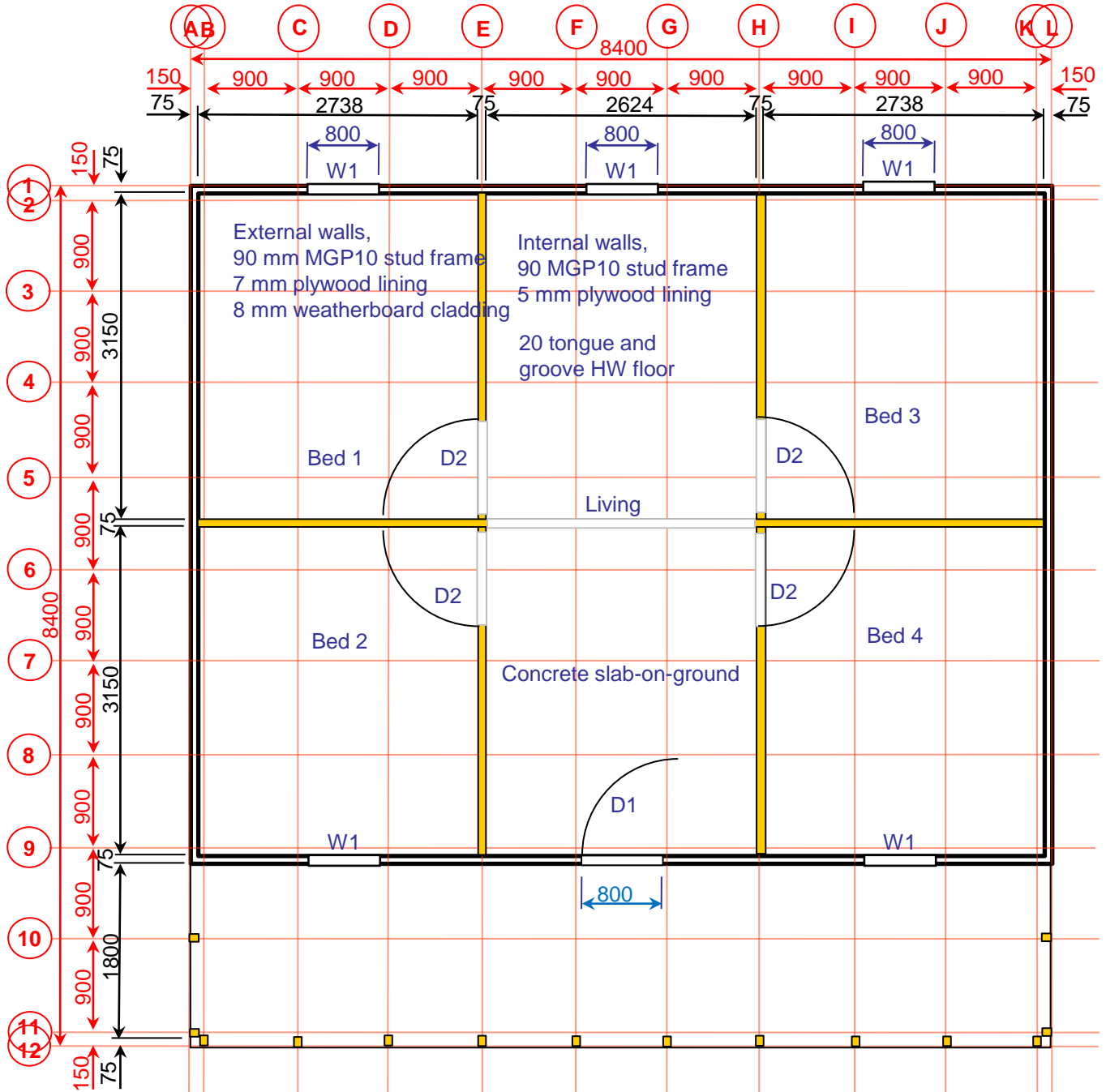
House – Cyclonic
Single storey
8.4 x 6.525 + 1.875 veranda

Floor – 100 x 50 F11 hardwood
20 F11 hardwood flooring

Walls – 100 x 50 F11 hardwood
F11 Hardwood cladding

Roof – 100 x 50 F11 hardwood
trusses and purlins

Alternative timber 90 x 45 MGP10



Partner Housing 2846519MNH

House – Non-cyclonic
Two storey
8.4 x 6.525 + 1.875 veranda
Floor – 100 concrete slab-on-ground

Walls – 190 reinforced concrete masonry

Roof – 75 x 50 F11 hardwood trusses and purlins

Alternative timber 70 x 45 MGP10

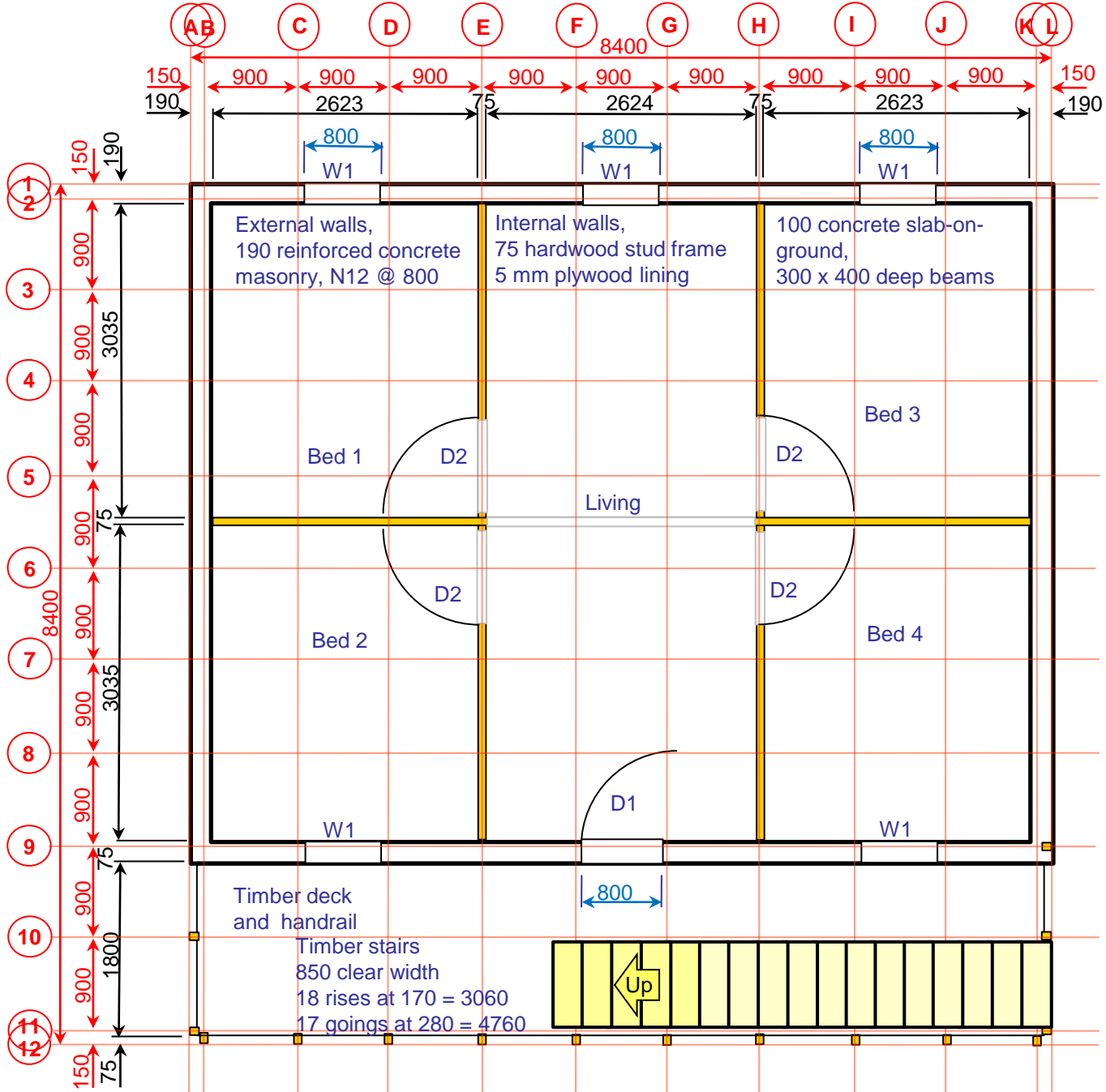
Partner Housing 2846519MCH

House – Cyclonic
Two storey
8.4 x 6.525 + 1.875 veranda
Floor – 100 concrete slab-on-ground

Walls – 190 reinforced concrete masonry

Roof – 100 x 50 F11 hardwood trusses and purlins

Alternative timber 90 x 45 MGP10



**Partner Housing No
1846519TNC**

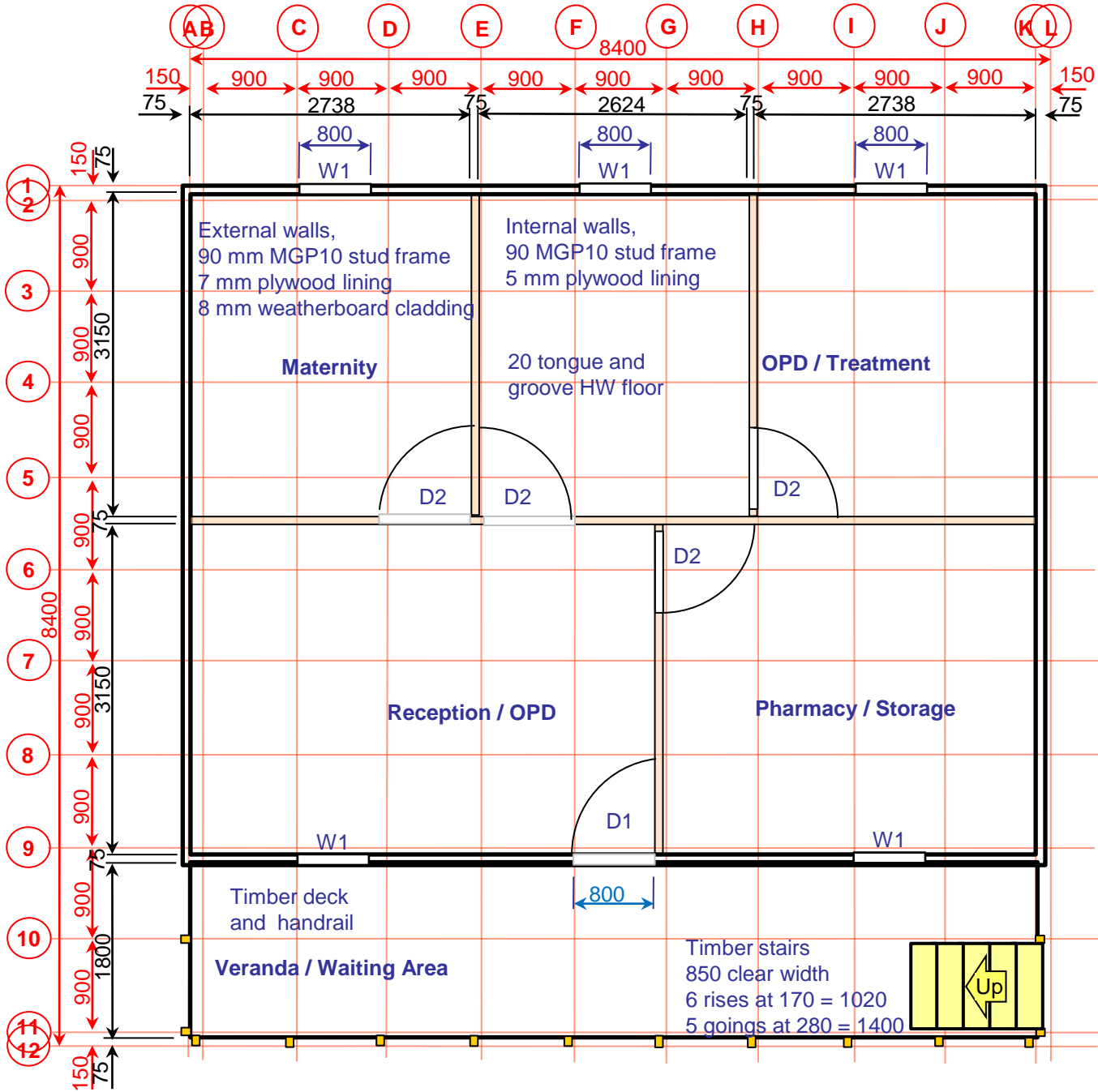
House – Non-cyclonic
Single storey
8.4 x 6.525 + 1.865 veranda
Floor – 75 x 50 F11 hardwood 20
F11 hardwood flooring

Walls – 75 x 50 F11 hardwood
F11 Hardwood cladding
Roof – 75 x 50 F11 hardwood
trusses and purlins
Alternative timber 70 x 45 MGP10

**Partner Housing No
1846519TCC**

House – Cyclonic
Single storey
8.4 x 6.525 + 1.875 veranda
Floor – 100 x 50 F11 hardwood
20 F11 hardwood flooring

Walls – 100 x 50 F11 hardwood
F11 Hardwood cladding
Roof – 100 x 50 F11 hardwood
trusses and purlins
Alternative timber 90 x 45 MGP10



Partner Housing 1846519MNC

House – Non-cyclonic
Single storey
8.4 x 6.525 + 1.875 veranda
Floor – 100 concrete slab-on-ground

Walls – 190 reinforced concrete masonry

Roof – 75 x 50 F11 hardwood trusses and purlins

Alternative timber 70 x 45 MGP10

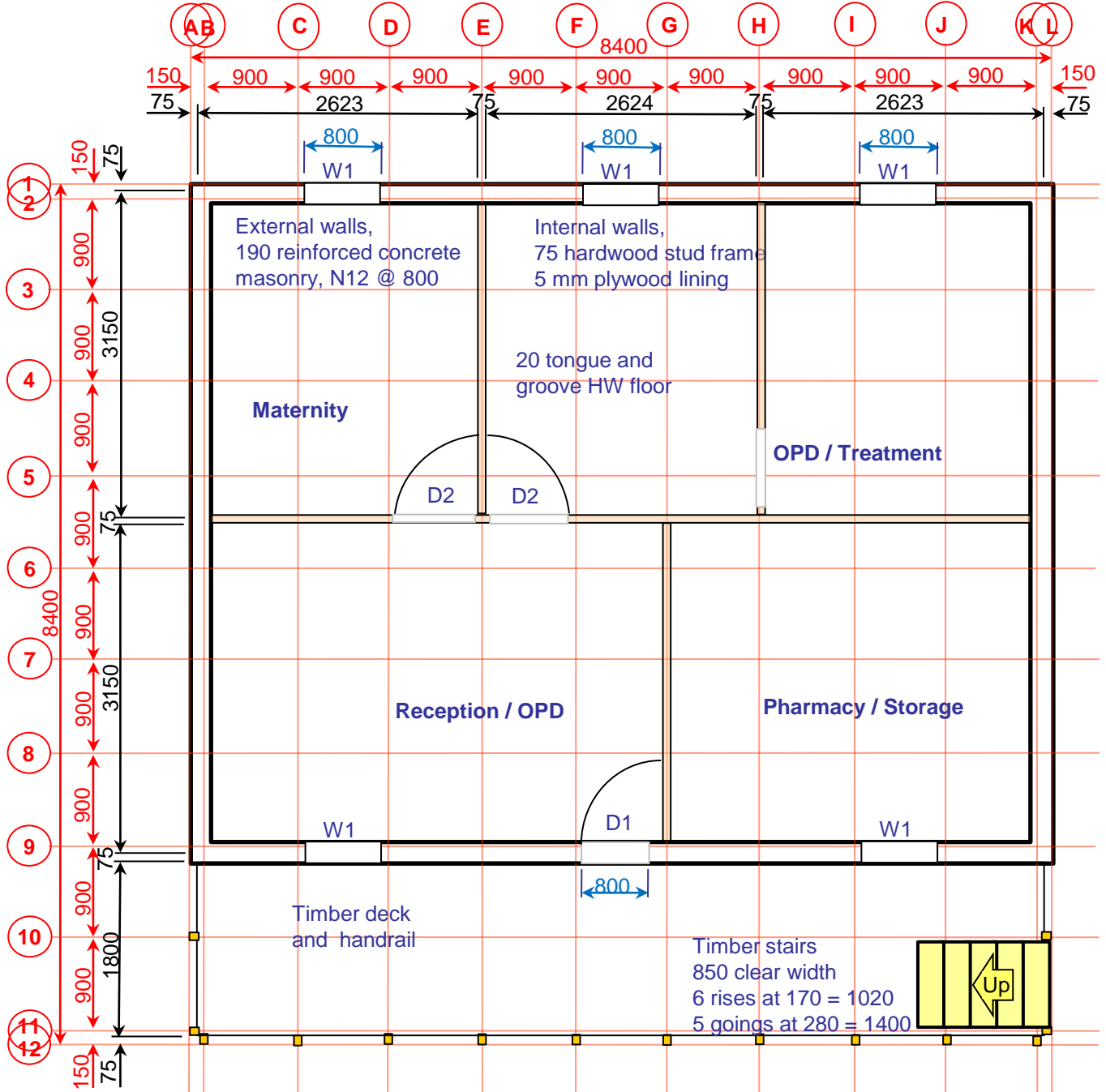
Partner Housing No 1846519MCC

House – Cyclonic
Single storey
8.4 x 6.525 + 1.875 veranda
Floor – 100 concrete slab-on-ground

Walls – 190 reinforced concrete masonry

Roof – 100 x 50 F11 hardwood trusses and purlins

Alternative timber 90 x 45 MGP10



Partner Housing

1303000TNH

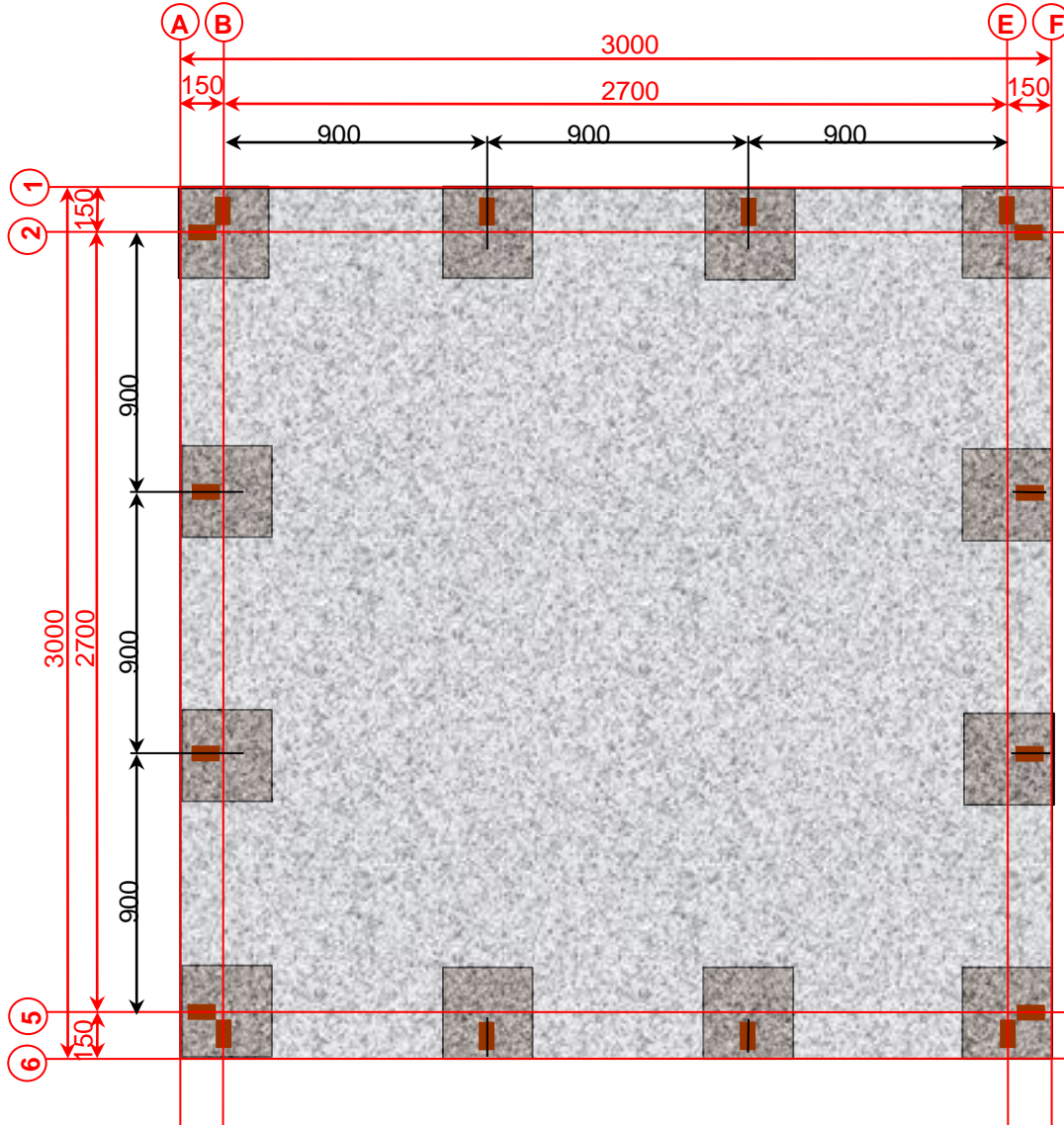
Basic Shelter– Non-cyclonic
Single storey
3.0 x 3.0 No veranda

Floor – 75 concrete slab-on-ground

Walls – 75 x 50 F11 Hardwood
4 mm plywood

Roof – 75 x 50 F11 hardwood
rafters and purlins

Alternative timber 70 x 45 MGP10



Partner Housing

1303000TCH

Basic Shelter – Cyclonic
Two storey
3.0 x 3.0 No veranda

Floor – 100 concrete slab-on-ground

Walls – 75 x 50 F11 Hardwood
7 mm plywood

Roof – 75 x 50 F11 hardwood
rafters and purlins

Alternative timber 90 x 45 MGP10

Partner Housing

1603600TNH

Transition House– Non-cyclonic

Single storey

6.0 x 3.6 No veranda

Floor – 75 concrete slab-on-ground

Walls – 75 x 50 F11 Hardwood
No cladding

Roof – 75 x 50 F11 hardwood
rafters and purlins

Alternative timber 70 x 45 MGP10

Partner Housing

1603600TCH

Transition House– Cyclonic

Two storey

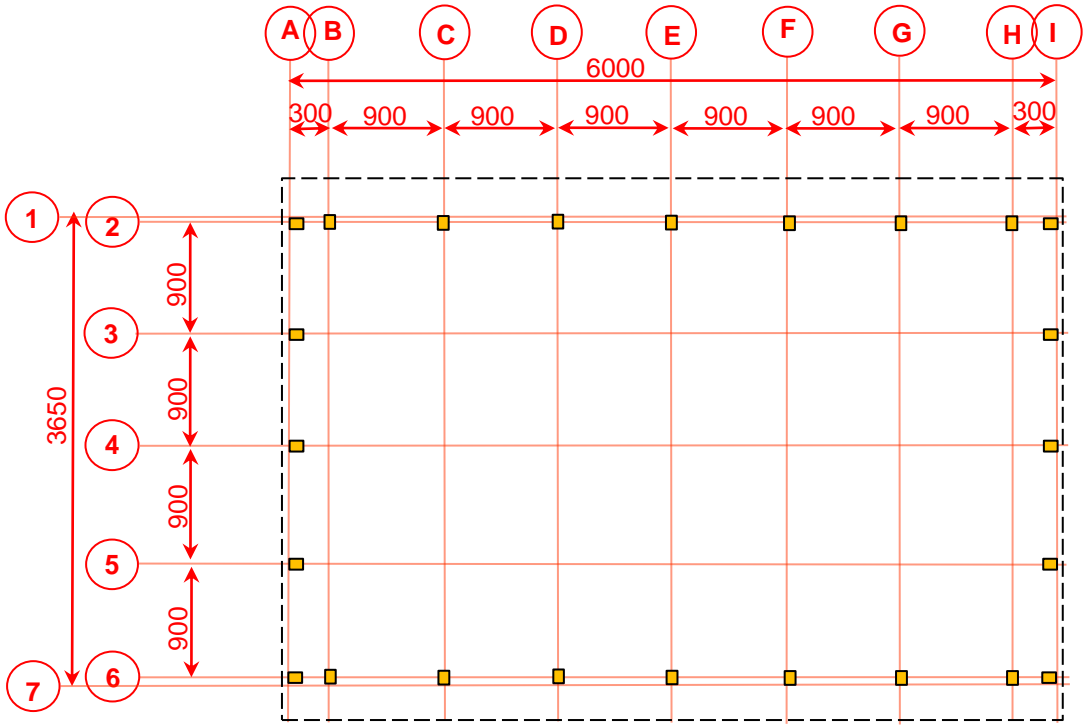
6.0 x 3.6 No veranda

Floor – 100 concrete slab-on-ground

Walls – 75 x 50 F11 Hardwood
No cladding

Roof – 75 x 50 F11 hardwood
rafters and purlins

Alternative timber 90 x 45 MGP10


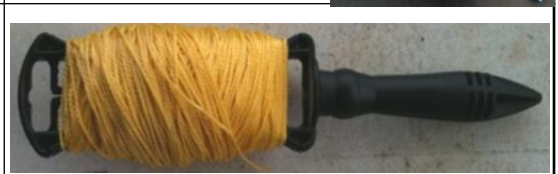





Use and Care of Tools








This training module describes the principal tools in use on house construction sites in rural parts of South-East Asia and the South Pacific region. It also outlines appropriate care of tools.



Setting Out and Measuring Tools





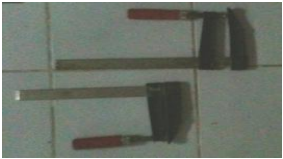


Tool	Use and Maintenance	Photo
Tape	Used by all trades to measure lengths. Common useful lengths are 8 metres and 30 metres. Ensure the end stop is not damaged. Store in a clean dry place.	
Stringline	Used by all trades to mark grid lines, levels and plan positions. Store in a clean dry place, and ensure that the string does not unravel.	
Pegs	Timber pegs may be used to set out the corners of buildings, gridlines, and services. Store in a place where they will not be lost.	
Hammer	Used to hammer in pegs and the like. Store in a clean dry place.	
Electronic digital theodolite	Generally used by surveyors or major builders. Store in a clean dry secure place.	

Leveling Instruments





Tool	Use and Maintenance	Photo
Laser level	Generally used by surveyors or major builders. Store in a clean dry place.	
Automatic level	Generally used by surveyors or major builders. Store in a clean dry place.	
Dumpy level or tilting level	Less common on modern building sites. Store in a clean dry place.	
Water level gauge	Only used in remote locations where surveyor's levels are not available. Store in a clean dry place.	
Spirit level	Store in a clean dry place.	
Staff	Used in conjunction with automatic levels and tilting levels. Store in a clean dry place.	
Tripod	Used to support surveying instruments. Store in a clean dry place.	

Carpentry Tools




(hand tools)

Tool	Use and Maintenance	Photo
Hand saws e.g. rip saw, tenon saw	Cutting timber along or across the grain. Rub soap on the blade to prevent sticking in the cut. Store in a clean dry place. When not in use, rub oil on surface.	
Brace and bit	Used for boring holes in timber for bolts or screws. Store in a clean dry place.	
Hammer	Used for driving nails and removing nails. Store in a clean dry place.	
Chisel	Used to remove slithers of timber. Ensure chisels are kept sharp and the blade protected. Store in a clean dry place.	
Clamp	Used to hold pieces of timber together while they are cut, drilled, screwed, glued and/or nailed. Store in a clean dry place.	
Spirit level	Used to determine ensure timber members are level during erection. Store in a clean dry place.	
Squares	Used to determine ensure timber members are perpendicular to each other during erection. Other angles are possible. Store in a clean dry place.	






Plumbing Tools 1 of 2

Tool	Use and Maintenance	Photo
Hacksaw	Used to cut thick metal sections. Store in a clean dry place.	
Tin snips	Used to cut thin metal sections . Store in a clean dry place.	
Drill and drill bits	Used to drill holes for screw or rivets. Store in a clean dry place.	
Rivet gun	Used to expand rivets in pre-drilled holes. Store in a clean dry place.	
Silicon gun	Used to extrude silicone and other sealants from cartridges to seal joints in sheet metal. Store in a clean dry place.	
Pliers	Used to pull and bed metal. Store in a clean dry place.	
Screw driver	Used to drive and remove screws. May be flat, Philips-head, Allen key or multiple shapes. Store in a clean dry place	





Plumbing Tools 2 of 2

Tool	Use and Maintenance	Photo
Clamp	Used to hold pieces of metal together while they are cut, drilled or screwed. Store in a clean dry place.	
Squares	Used to determine ensure metal members are perpendicular to each other during erection. Other angles are possible. Store in a clean dry place.	
Spirit level	Used to determine ensure metal members are level during erection. Store in a clean dry place.	
Stilson wrench	Used to tighten or loosen threaded plumbing fittings. Store in a clean dry place.	
Shifting spanner	Used to tighten or loosen nuts and bolts. Store in a clean dry place.	
Multigrips	Used to tighten or loosen threaded plumbing fittings. Store in a clean dry place.	






Mechanical and Electrical Tools

Tool	Use and Maintenance	Photo
Electric drill	May also include “hammer drill” for drilling concrete and masonry, using a masonry bit. Store in a secure, clean dry place.	
Electric saw	Store in a clean dry place.	
Cut-off saw	Store in a clean dry place.	
Angle grinder	Store in a clean dry place.	
Diesel generator	Used to generate electricity on sites where there is no power supply. Store in a clean dry place.	

Bricklaying and Blocklaying Tools

Tool	Use and Maintenance	Photo
Trowel	Used to place mortar bed joints and perpendicular joints. Store in a clean dry place.	
Shovel	Used to place cement, lime and sand in a mixer to mix mortar. Store in a clean dry place.	
Mixer	Used to mix cement, lime and sand for mortar. Store in a clean dry place.	
String line	Used to establish level bed joints. Store in a clean dry place.	
Spirit level	Used to establish level bed joints. Store in a clean dry place.	

Concrete Tools

Tool	Use and Maintenance	Photo
Bolt cutters	Cutting steel reinforcement up to 10 mm diameter. Store in a clean dry place. Rub with oil when stored for long periods.	
Hacksaw	Cutting steel reinforcement 10 mm diameter and above. Store in a clean dry place. Rub with oil when stored for long periods	
Screed	Levelling wet concrete after it has been moved to approximately the correct position and vibrated. Wash clean of any concrete. Store in a clean dry place.	
Float	Used to smooth the surface of screeded concrete. May be steel float, wood float, sponge. Store in a clean dry place.	
Broom	A stiff broom may be used over floated concrete to provide a “non-slip” finish. Store in a clean dry place.	
Vibrator	Compacting wet concrete to maximise its density. Store in a clean dry place.	
Spade, shovel	A shovel is used to move wet concrete from place to place. A spade is smaller and easier to use. Rub in oil and store in a clean dry place.	

Pro-forma Inspection Schedules

The close control of construction is critical to the correct function of a building structure.

The following slides provide a sample Inspection Schedule to indicate the type of inspection that may be warranted. These can be adapted to assist in the site control function.

The details of any Inspection Schedule should be developed by the designer to suit the particular requirements of the application.



Inspection Schedules

Throughout this Training Package, the following format is used to specify Inspection Requirements. Schedules of this type should be prepared and edited, and included in the “Specifications” document.

Item or Product	Inspection Required	Accept Criteria	Hold Witness
Drawings & Specifications	Inspect	In file	Hold
Mains connection	View application	Copy in file	Hold
Holes, chases, trenches	Visual	Correct position	Hold
Pipes	Visual	Correct position	Hold
Operation of all systems	Audible	No water hammer Unrestricted flow	Hold
Testing - Cold water supply	AS/NZS 3500.1.2 Section 13	AS/NZS 3500.1 criteria	Hold
Testing - Sanitary plumbing & drainage, Soil pipe, Waste pipe, Vent pipe, Discharge pipe, Sanitary fixtures Below ground drains	AS/NZS 3500.2.2 Section 12	AS/NZS 3500.2 criteria	Hold
Testing - Stormwater drainage Downpipes within buildings Drainage pipes, Rainwater storage tanks Stormwater, On-Site Detention	AS/NZS 3500.3.2 Section 10	AS/NZS 3500.3 criteria	Hold
Testing - Hot water supply	AS/NZS 3500.4.2 Section 8	AS/NZS 3500.4 criteria	Hold

Inspection Checklists

Inspection checklists, for use by inspectors on site, may be compiled by editing the standard specifications as follows:

- Add three columns to the right side of the schedule - Date, Inspector, Comment
- Add additional rows to fully describe all of the items to be inspected, together with the inspections required, acceptance criteria and hold/witness status.

Item or Product	Inspection Required	Accept Criteria	Hold Witness	Date	Inspector	Comment
Drawings & Specifications	Inspect	In file	Hold			
Mains connection	View application	Copy in file	Hold			
Holes, chases, trenches	Visual	Correct position	Hold			
Pipes	Visual	Correct position	Hold			
Operation of all systems	Audible	No water hammer Unrestricted flow	Hold			
Testing - Cold water supply	AS/NZS 3500.1.2 Section 13	AS/NZS 3500.1 criteria	Hold			
Testing - Sanitary plumbing & drainage, Soil pipe, Waste pipe, Vent pipe, Discharge pipe, Sanitary fixtures Below ground drains	AS/NZS 3500.2.2 Section 12	AS/NZS 3500.2 criteria	Hold			
Testing - Stormwater drainage Downpipes within buildings Drainage pipes, Rainwater storage tanks Stormwater, On-Site Detention	AS/NZS 3500.3.2 Section 10	AS/NZS 3500.3 criteria	Hold			
Testing - Hot water supply	AS/NZS 3500.4.2 Section 8	AS/NZS 3500.4 criteria	Hold			

How to Create a Comprehensive Inspection Schedule

“Item or Product” is a list of the principal items to be inspected during the construction process, including (if necessary) a description of their location. The number of rows in the generic inspection schedule in the specification can be expanded to provide inspection records with comprehensive coverage of the entire project. See the example below.

Item or Product	Inspection Required	Accept Criteria	Hold Witness	Date	Inspector	Comment
Drawings & Specifications	Inspect	In file	Hold			
Mains connection	View application	Copy in file	Hold			
Holes, chases, trenches	Visual	Correct position	Hold			
Pipes	Visual	Correct position	Hold			
Operation of all systems	Audible	No water hammer Unrestricted flow	Hold			
Testing - Cold water supply	AS/NZS 3500.1.2 Section 13	AS/NZS 3500.1 criteria	Hold			
Testing - Sanitary plumbing & drainage, Soil pipe, Waste pipe, Vent pipe, Discharge pipe, Sanitary fixtures Below ground drains	AS/NZS 3500.2.2 Section 12	AS/NZS 3500.2 criteria	Hold			
Testing - Stormwater drainage Downpipes within buildings Drainage pipes, Rainwater storage tanks Stormwater, On-Site Detention	AS/NZS 3500.3.2 Section 10	AS/NZS 3500.3 criteria	Hold			
Testing - Hot water supply	AS/NZS 3500.4.2 Section 8	AS/NZS 3500.4 criteria	Hold			

How to Create a Comprehensive Inspection Schedule

“Inspection Required” is a very brief description of the type of inspection to be carried out e.g. spot check dimensions, inspect delivery dockets, count the number of items etc. If necessary, refer to the relevant Australian Standard. Where the type of inspection is repeated, use ditto marks (“ ”). See the example below.

Item or Product	Inspection Required	Accept Criteria	Hold Witness	Date	Inspector	Comment
Drawings & Specifications	Inspect	In file	Hold			
Mains connection	View application	Copy in file	Hold			
Holes, chases, trenches	Visual	Correct position	Hold			
Pipes	Visual	Correct position	Hold			
Operation of all systems	Audible	No water hammer Unrestricted flow	Hold			
Testing - Cold water supply	AS/NZS 3500.1.2 Section 13	AS/NZS 3500.1 criteria	Hold			
Testing - Sanitary plumbing & drainage, Soil pipe, Waste pipe, Vent pipe, Discharge pipe, Sanitary fixtures Below ground drains	AS/NZS 3500.2.2 Section 12	AS/NZS 3500.2 criteria	Hold			
Testing - Stormwater drainage Downpipes within buildings Drainage pipes, Rainwater storage tanks Stormwater, On-Site Detention	AS/NZS 3500.3.2 Section 10	AS/NZS 3500.3 criteria	Hold			
Testing - Hot water supply	AS/NZS 3500.4.2 Section 8	AS/NZS 3500.4 criteria	Hold			

How to Create a Comprehensive Inspection Schedule

“Accept Criteria” is a very brief description of the acceptance/rejection criteria. These may be in the form of references to the specification, references to an Australian Standard clause, or inclusion of a tolerance. Where a criterion is repeated, use ditto marks (“ ”). See the example below.

Item or Product	Inspection Required	Accept Criteria	Hold Witness	Date	Inspector	Comment
Drawings & Specifications	Inspect	In file	Hold			
Mains connection	View application	Copy in file	Hold			
Holes, chases, trenches	Visual	Correct position	Hold			
Pipes	Visual	Correct position	Hold			
Operation of all systems	Audible	No water hammer Unrestricted flow	Hold			
Testing - Cold water supply	AS/NZS 3500.1.2 Section 13	AS/NZS 3500.1 criteria	Hold			
Testing - Sanitary plumbing & drainage, Soil pipe, Waste pipe, Vent pipe, Discharge pipe, Sanitary fixtures Below ground drains	AS/NZS 3500.2.2 Section 12	AS/NZS 3500.2 criteria	Hold			
Testing - Stormwater drainage Downpipes within buildings Drainage pipes, Rainwater storage tanks Stormwater, On-Site Detention	AS/NZS 3500.3.2 Section 10	AS/NZS 3500.3 criteria	Hold			
Testing - Hot water supply	AS/NZS 3500.4.2 Section 8	AS/NZS 3500.4 criteria	Hold			

How to Create a Comprehensive Inspection Schedule

“Hold / Witness” provides the specifier with the opportunity to signal whether the construction process must be halted (Hold) until the inspection is completed, or whether the construction may proceed, with the inspection taking place during the execution of the work (Witness).

Where a requirement is repeated, use ditto marks (“ ”) See the example below.

Item or Product	Inspection Required	Accept Criteria	Hold Witness	Date	Inspector	Comment
Drawings & Specifications	Inspect	In file	Hold			
Mains connection	View application	Copy in file	Hold			
Holes, chases, trenches	Visual	Correct position	Hold			
Pipes	Visual	Correct position	Hold			
Operation of all systems	Audible	No water hammer Unrestricted flow	Hold			
Testing - Cold water supply	AS/NZS 3500.1.2 Section 13	AS/NZS 3500.1 criteria	Hold			
Testing - Sanitary plumbing & drainage, Soil pipe, Waste pipe, Vent pipe, Discharge pipe, Sanitary fixtures Below ground drains	AS/NZS 3500.2.2 Section 12	AS/NZS 3500.2 criteria	Hold			
Testing - Stormwater drainage Downpipes within buildings Drainage pipes, Rainwater storage tanks Stormwater, On-Site Detention	AS/NZS 3500.3.2 Section 10	AS/NZS 3500.3 criteria	Hold			
Testing - Hot water supply	AS/NZS 3500.4.2 Section 8	AS/NZS 3500.4 criteria	Hold			

How to Create a Comprehensive Inspection Schedule

“Date / Inspector / Comment” provides the inspector with the opportunity to record the results of the inspection. Further comments should be added to the bottom of the checklist.

Item or Product	Inspection Required	Accept Criteria	Hold Witness	Date	Inspector	Comment
Drawings & Specifications	Inspect	In file	Hold			
Mains connection	View application	Copy in file	Hold			
Holes, chases, trenches	Visual	Correct position	Hold			
Pipes	Visual	Correct position	Hold			
Operation of all systems	Audible	No water hammer Unrestricted flow	Hold			
Testing - Cold water supply	AS/NZS 3500.1.2 Section 13	AS/NZS 3500.1 criteria	Hold			
Testing - Sanitary plumbing & drainage, Soil pipe, Waste pipe, Vent pipe, Discharge pipe, Sanitary fixtures Below ground drains	AS/NZS 3500.2.2 Section 12	AS/NZS 3500.2 criteria	Hold			
Testing - Stormwater drainage Downpipes within buildings Drainage pipes, Rainwater storage tanks Stormwater, On-Site Detention	AS/NZS 3500.3.2 Section 10	AS/NZS 3500.3 criteria	Hold			
Testing - Hot water supply	AS/NZS 3500.4.2 Section 8	AS/NZS 3500.4 criteria	Hold			

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Disclaimer

This training package covers broad engineering principles and building practices, with particular emphasis on affordable housing and associated village infrastructure in the Asia-Pacific region. These broad principles and practices must be translated into specific requirements for particular projects by professional architects, engineers or builders with the requisite qualifications and experience. Associated sample specifications and drawings are available in electronic format, with the express intention that architects, engineers and builders will edit them to suit the particular requirements of specific projects. The design, construction and costing of structures must be carried out by qualified and experienced architects, engineers and builders, who must make themselves aware of any changes to the applicable standards, building regulations and other relevant regulations. The authors, publishers and distributors of these documents, specifications and associated drawings do not accept any responsibility for incorrect, inappropriate or incomplete use of this information.

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