Basic Structures

This training package defines the major components of village buildings in South-east Asia and the South Pacific.

Architectural Considerations

The architectural design of buildings must consider a diverse range of variables –
Culture, cost, occupier aspirations, owner-occupier versus rental, land availability, planning rules, population 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!

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.

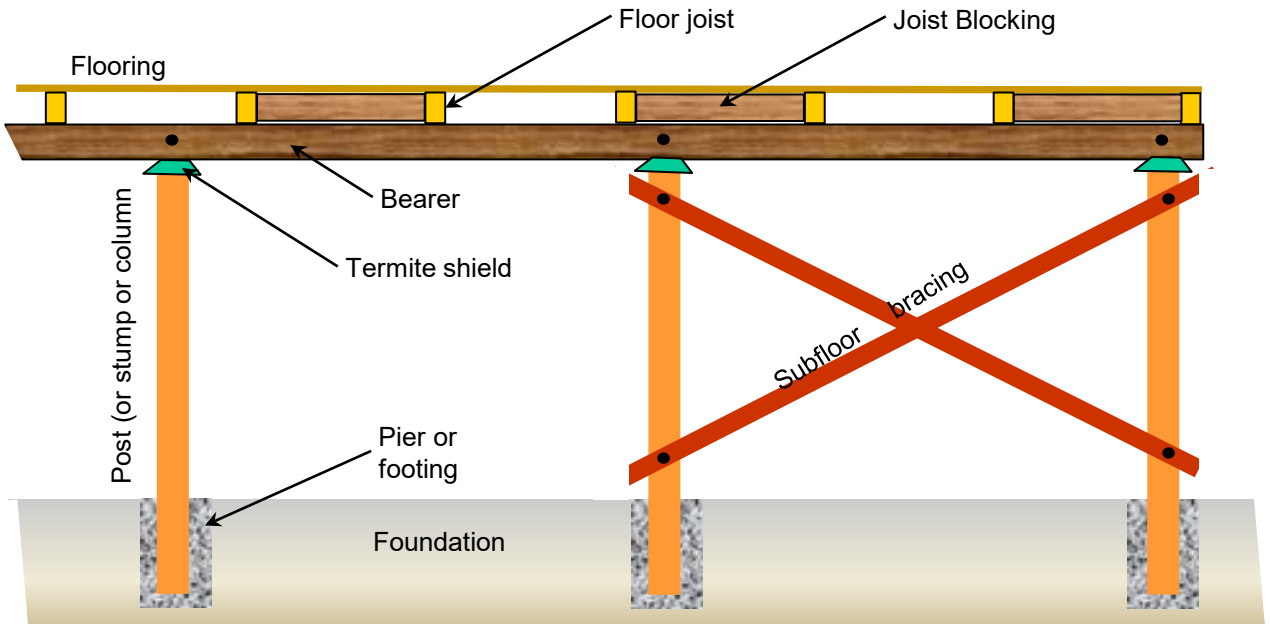
The following two houses, side by side, were both subjected to the 2007 Solomon Islands earthquake and tsunami. The more substantial green “timber and concrete house” includes adequate horizontal load resistance (in the form of a strong lower storey room), while the adjacent brown “leaf house” (without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

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

Definitions – Subfloor

The sub-floor is that part of an elevated timber building below floor level, and must include the following –

- The foundation is the earth or rock below ground level and must be compacted correctly.
- The piers or footings support the structure, and are constructed of concrete. Large footing are reinforced by steel. Isolated concrete piers with embedded steel posts do not include reinforcement.
- The stumps, columns or posts are steel, concrete, masonry or timber.
- Steel termite shields must isolate the timber bearers from the concrete, masonry or timber.
- Timber (or steel) bearers span between the posts.
- Timber joists are fixed to the bearers and support the floor.
- The sub-floor system must be braced horizontally by diagonal sub-floor bracing.



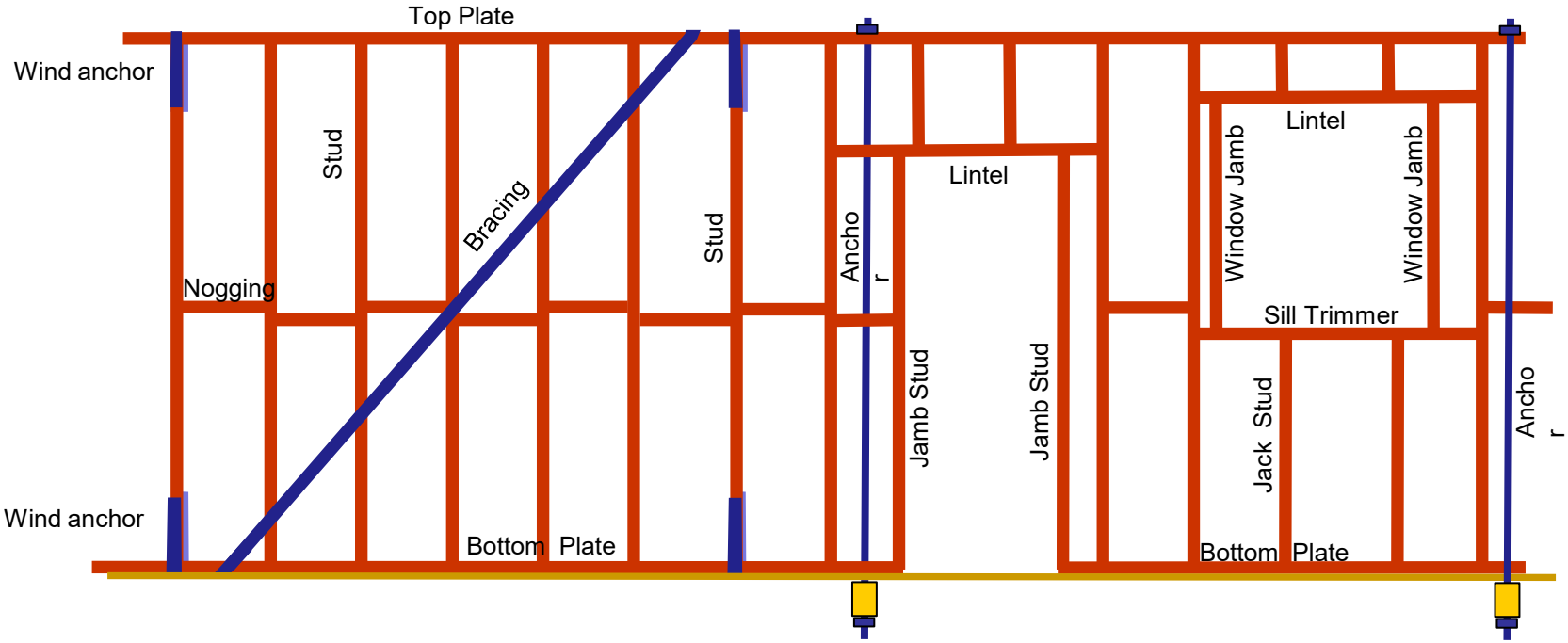
In this training package the term "pier" is used for the deep footing (not for the post)

Definitions – Walls

In conventional forms of house construction –

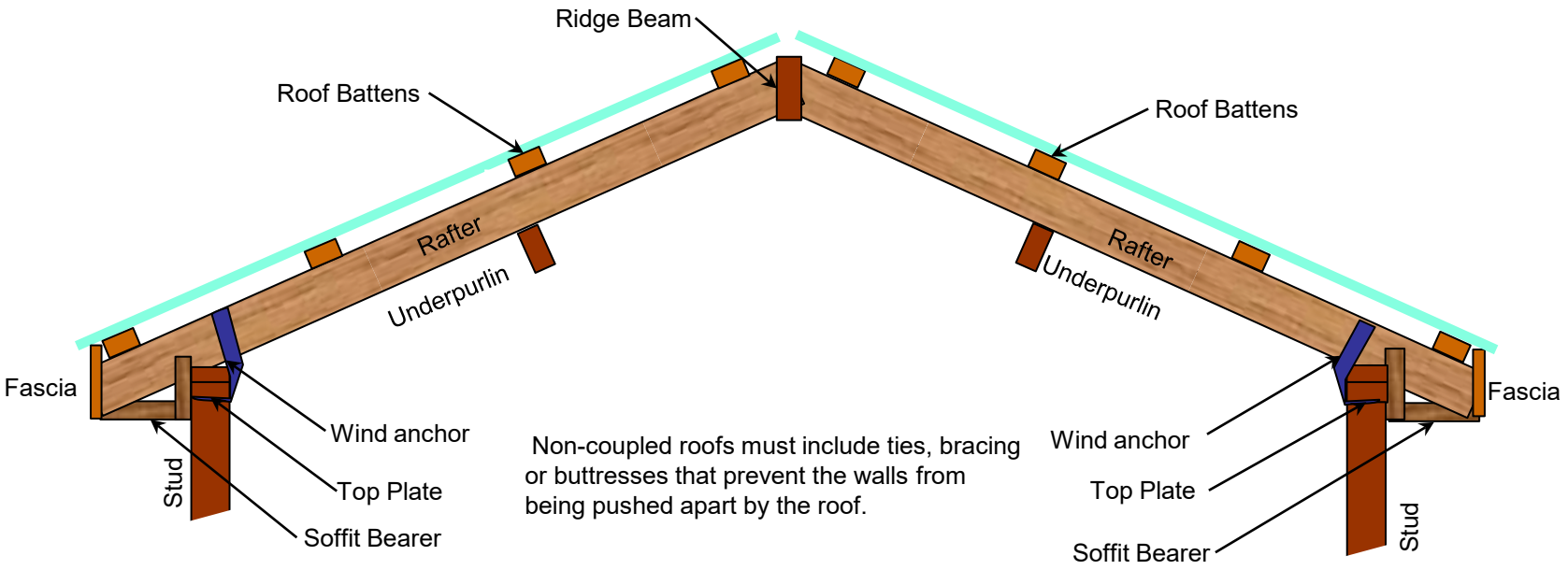
1. The bottom plate is the timber member fixed to the floor.
2. Studs are the timber members to which the wall cladding and lining is fixed. They must support the roof vertical loads and the horizontal wind loads.
3. Noggings are fixed between the studs to prevent them from buckling sideways.
4. The top plate is the timber member fixed to the top of the studs, supporting the roof structure.
5. Walls must include racking bracing and tie-down anchors.

The **DANCER** building system uses a different wall member arrangement to achieve support and anchorage.



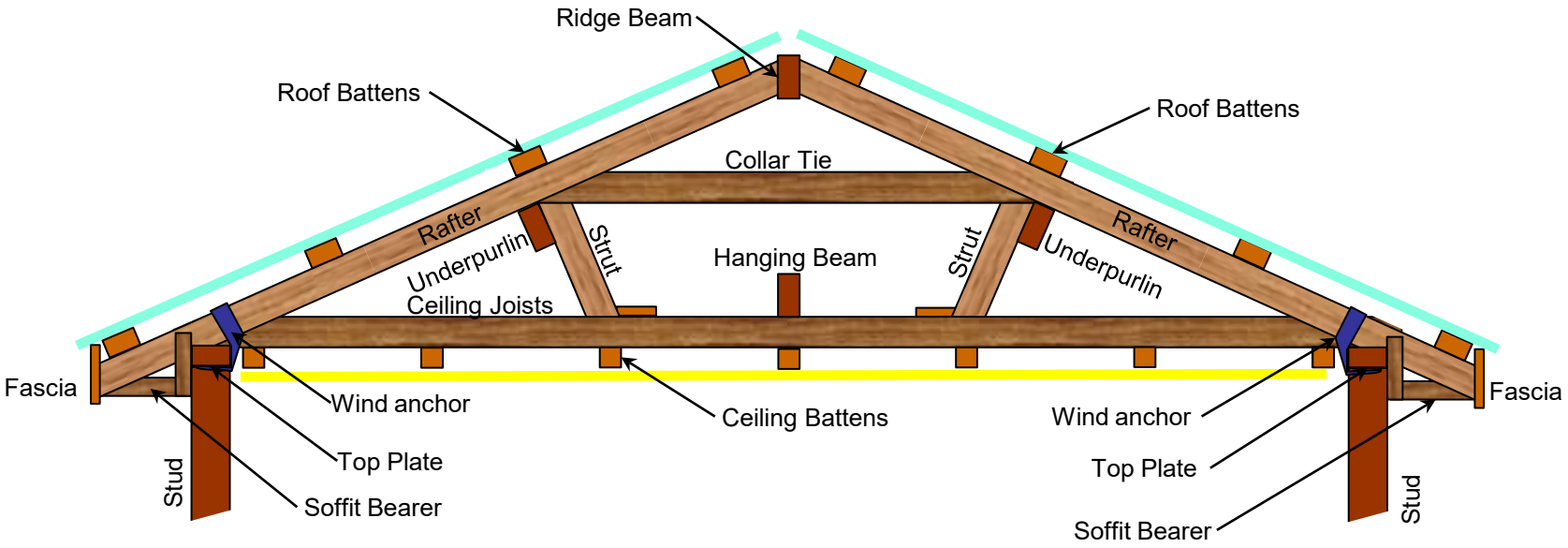
Definitions – Non-coupled Roof

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.



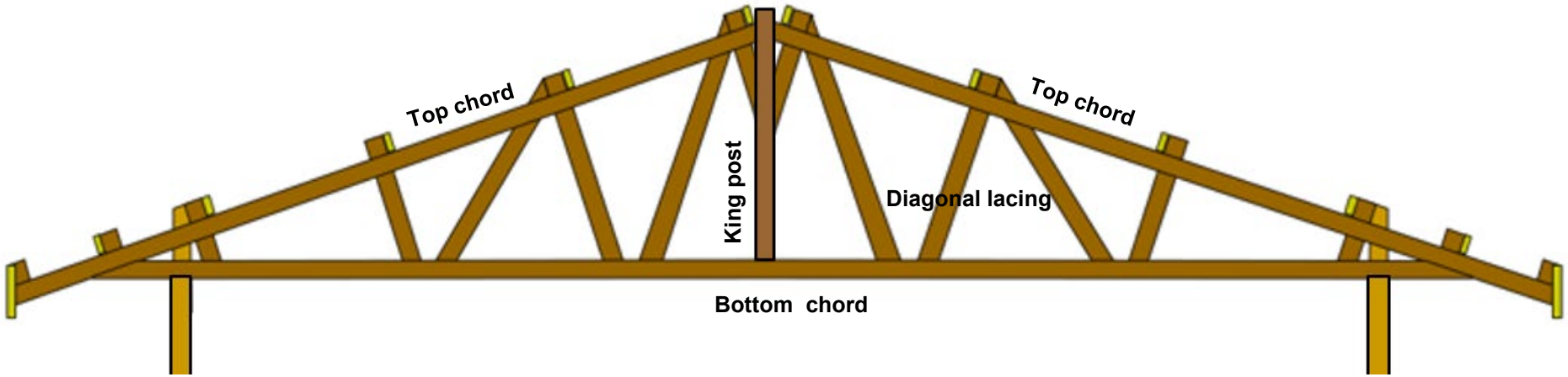
Definitions – Coupled Roof

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



Definitions – Truss Roof

Truss roofs span large distances. They also provide the tie that prevents the roof from pushing the walls apart.



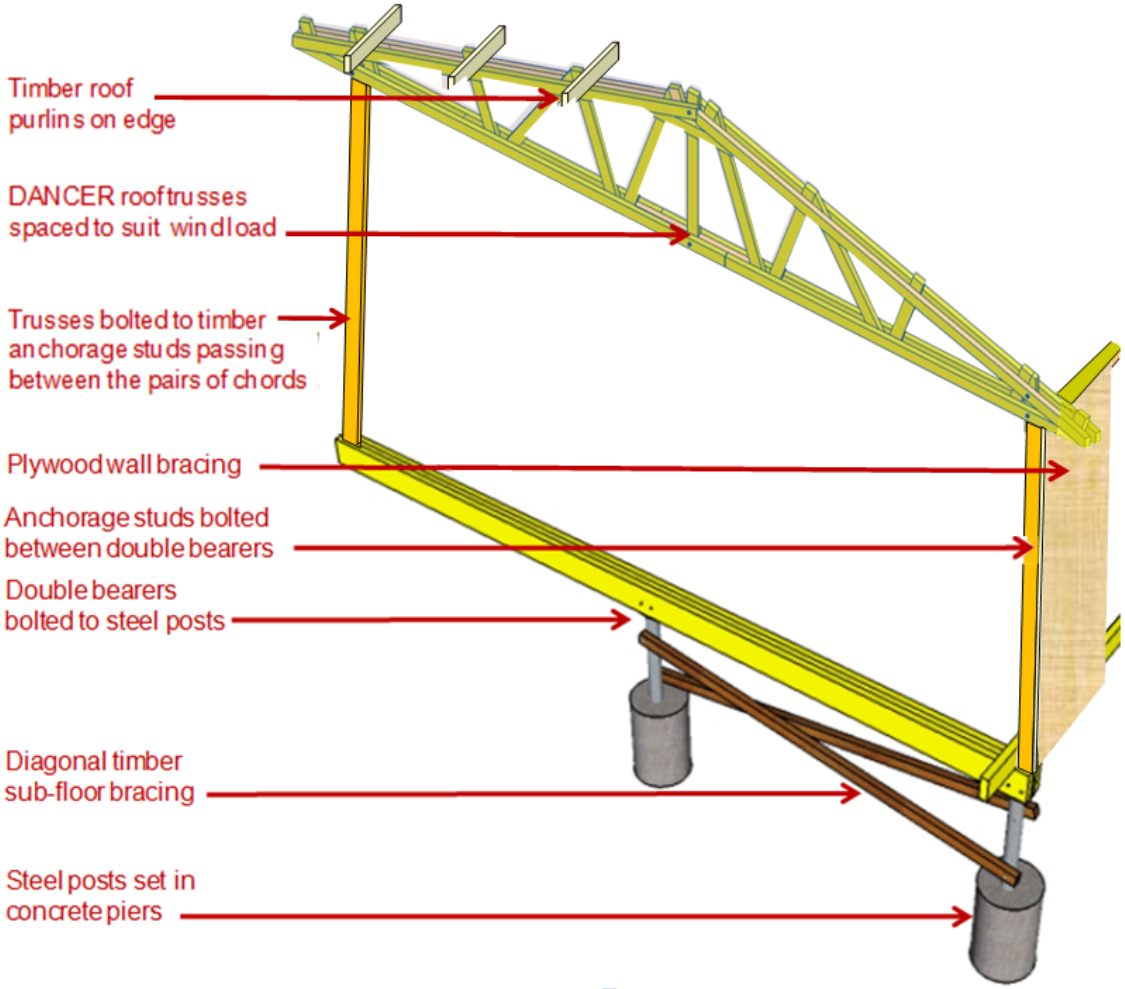
Definitions – DANCER Timber Direct Anchorage System

The DANCER building system consists of a strong timber roof system that is tied directly to the ground via wall anchorage studs, bearers and steel posts – using only readily available materials such as roofing steel, timber, nuts, bolts and screws, and steel posts set in concrete.

Steel roof sheeting is fixed through every second rib to timber roof purlins, side-fixed on edge to the lacing of timber roof trusses.

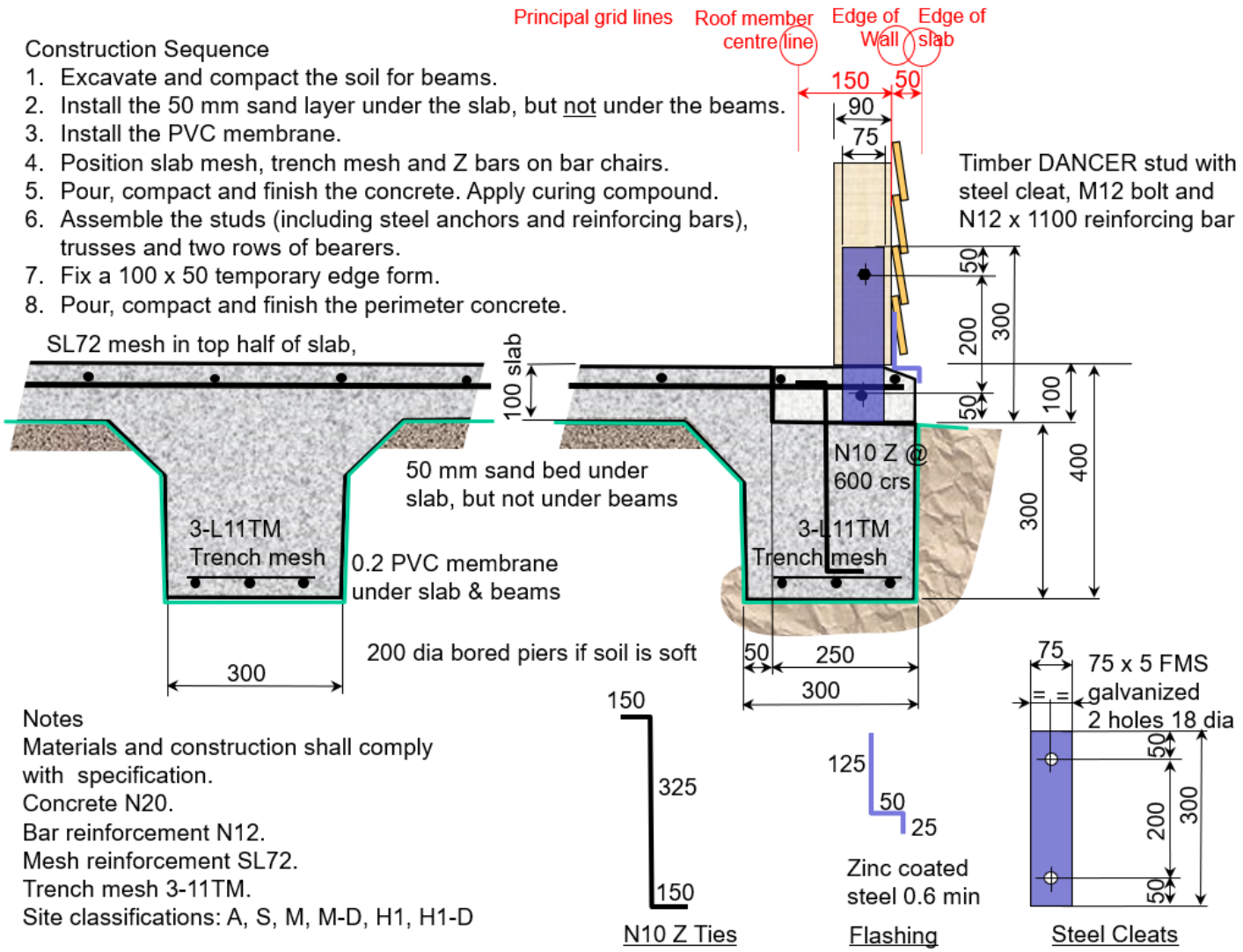
The timber lacing is screwed between the double top and bottom chords of the timber trusses. These are double-bolted to the timber anchorage studs, which are bolted and nailed directly to the floor bearers. These bearers are bolted to steel posts on a 2.7 m grid set in concrete piers.

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



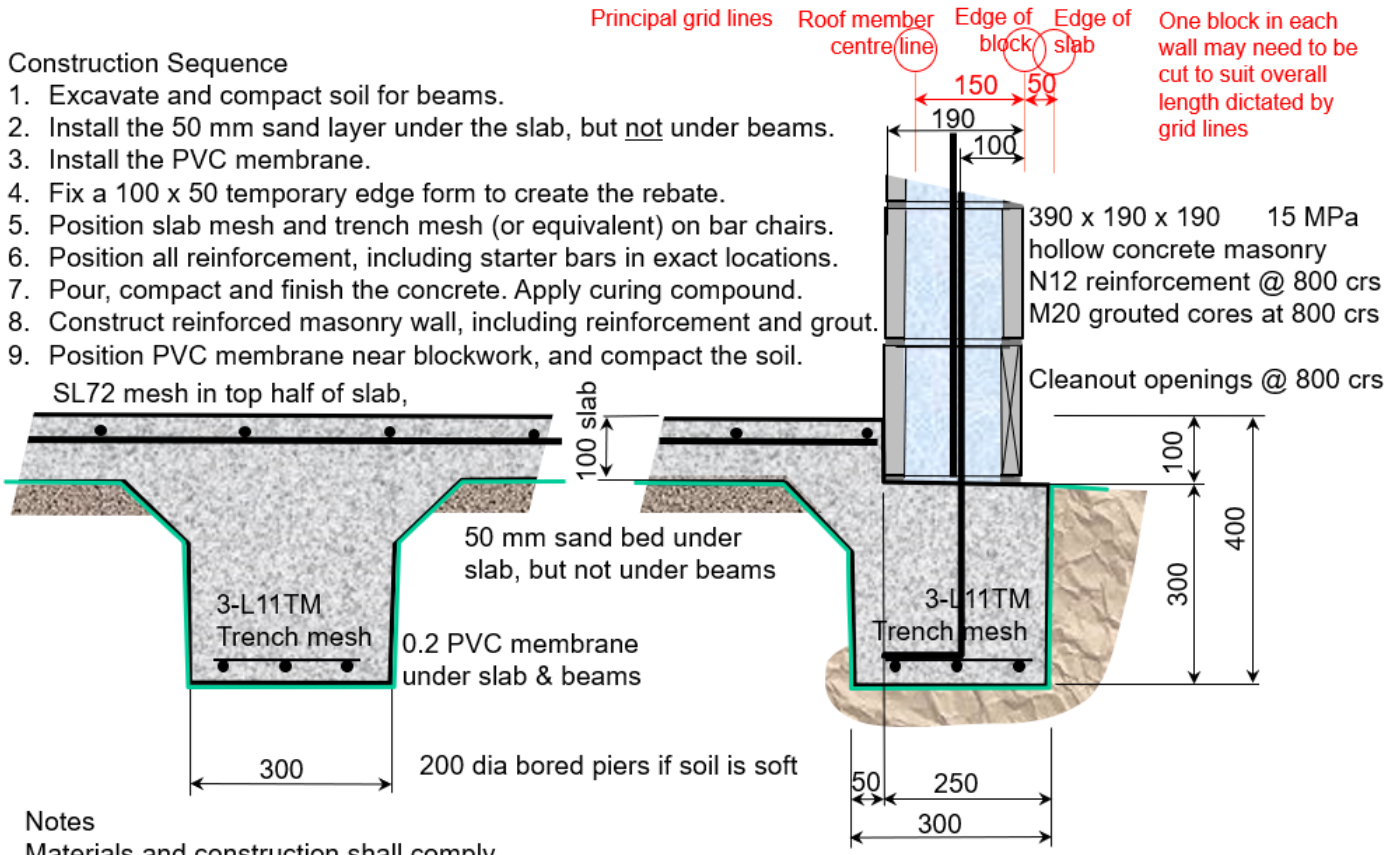
Definitions – Concrete Slab-on-Ground for Timber Superstructure

Concrete slab-on-ground construction may provide the floor of buildings whose superstructures are brick veneer, cavity brickwork, single-leaf reinforced concrete masonry, clad timber frames or clad steel frames. This illustration is for clad timber frames.



Definitions – Concrete Slab-on-Ground with Reinforced Masonry Superstructure

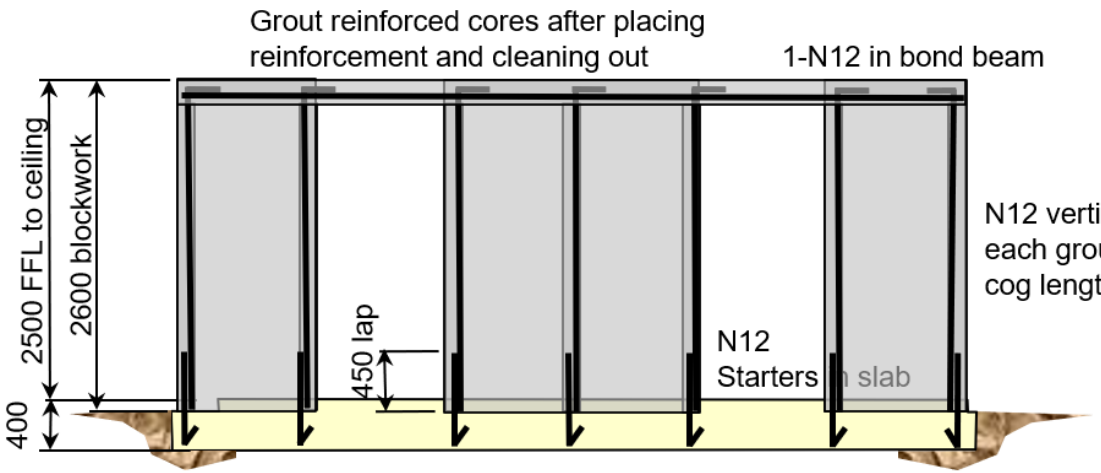
Concrete slab-on-ground construction may be built integrally with single-leaf reinforced concrete masonry walls. This system forms a very strong "stiff box" form of construction.

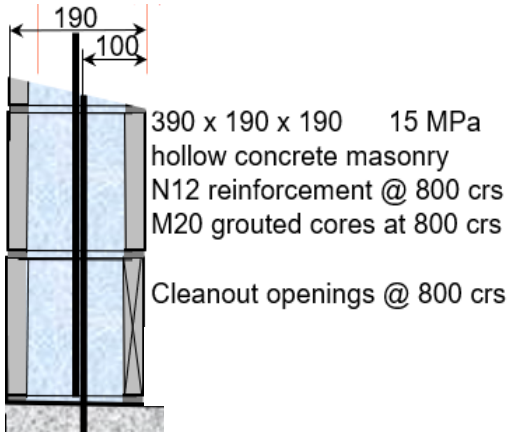


Definitions – Reinforced Concrete Masonry Wall System

Single leaf reinforced hollow concrete masonry walls, built integrally with the concrete footings, with steel starter bars, vertical "wide spaced" reinforcement and a continuous horizontal bond beam behave like a "stiff box", without significant deflection or cracking. The system consists of the following –

- 190 mm hollow concrete blockwork.
- N12 steel reinforcement starter bars and N12 vertically reinforced cores at centres at 900 mm centres for cyclonic regions or up to a maximum of 1,800 mm centres
- Continuous bond beam, with 1-N12 reinforcing bars.
- Articulation joints are not required.
- The system must have sufficient bending and shear strength, particularly at door and window openings.





Concrete slab/beam system, including sand bed, reinforcement, membrane etc, designed to AS 2870. Edge beams and cross beams, 400 x 300 mm, 3-11TM trench mesh. 100 mm concrete slab,SL72 mesh.

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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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