FOOTING SYSTEMS
Reference - As 2870 - Residential slabs and footings - construction and BCA.

Footings transfer building loads onto foundations. House design and shape must be designed before footing design can occur.

AS2870 is based upon inspecting site to determine soil type and designing footing to suit both foundation and structure to be built.

Footing construction

New footings are constructed from reinforced concrete in accordance with designs set out in AS 2870 or engineering principles.

Steel is extremely strong in tension and compression but it rusts.
Concrete is extremely strong in compression but relatively weak in tension. It covers the steel and protects it from moisture in the ground. Together they produce a composite material which is strong in compression and tension, easily shaped and durable.

Steel is always placed in areas of tension in all reinforced concrete members to stop the concrete cracking.

For domestic (residential housing) purposes steel is available in the following forms:

- **Trench mesh** -e.g. previously 3 - 8TM (now called L8) - 3 bars of 8mm diameter steel connected by cross wires to form a fabric laid in trenches for strip footings. No and diameter of bars varies. Comes in 6m lengths (strength of 300 Mpa).
- **Slab fabric** -e.g.previously called F62 (now SL 62)= fabric 6mm bars welded together in a 200mm square grid. Sheet size 2.4m X 6.0m. Available as F62, F72, F82, F92, F1018, etc. (strength of 300 Mpa).
- **Bars** -e.g. R10 = round 10mm diameter bar.
  -e.g. Y16 (now called N16)= deformed bar 16mm diameter - (Y= high yield strength of 410 Mpa +)

Bars can be ordered cogged (bent) to suit but must be transportable.

Basic types of footings

Common details
Min . strength concrete 20 Mpa.
Nominal aggregate size 20mm.

Pad footings
Also called blob footings. Is a solid mass of concrete (no reo) laid in ground to support brick, timber or steel piers / posts. Commonly used to support timber floor frames. With reo and engineering design can be used to support suspended concrete floors .

Details:
Brickwork not acceptable
Reo (if used) requires 40mm concrete cover.
Suitable for A, S, M, H class sites.
Sizes for pads is given in AS1684 Timber Framing code - size subject to area and load of floors. Minimum 400 x 400 x 200 high.

Isolated brick piers on pad footings

Strip footing
Reinforced strip of concrete laid in trench in ground. Used to support continuous brick walls.
Typically 300mmm deep x 300 - 400mm wide.
Process:

- Dig trench with backhoe or by hand.
- Tie up reinforcing cage.
- Lay reinforcing (reo) in trench.
- Support reo cage to ensure required concrete cover all round.
- Pour concrete and allow to cure before loading.

Details:

- Reo requires 40mm concrete cover.
- Lapping of bars min. 500mm or full width at T and L intersections.
- Stepping techniques - see As 2870 Clause 5.4.3
- Suitable for A, S, M, H class sites.

Strip footing trench with trench mesh reinforcement

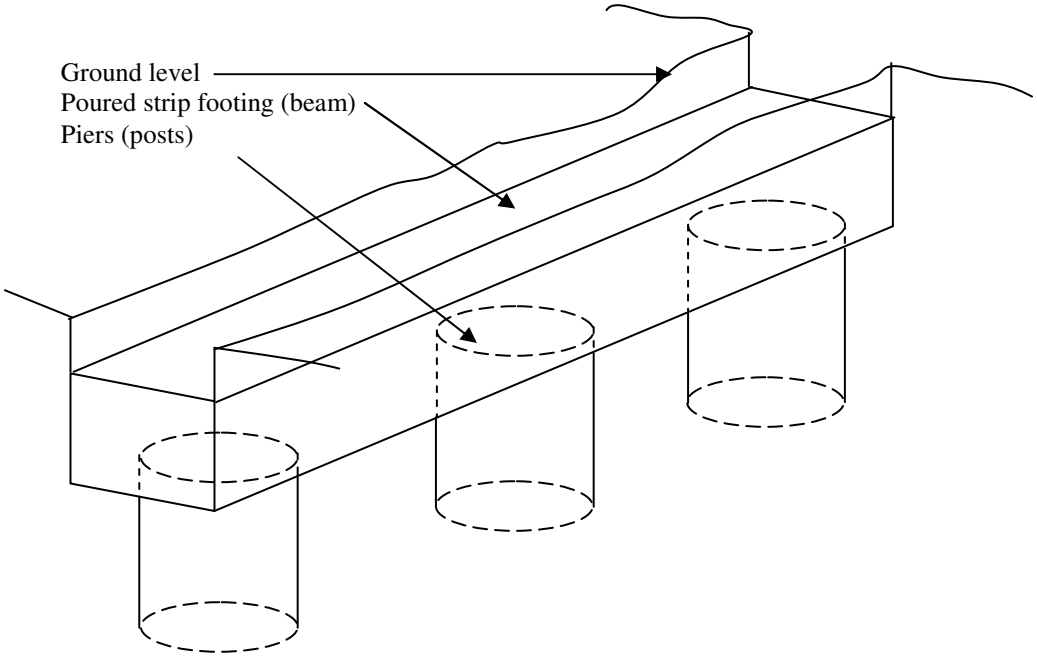
Strip footing after pouring of concrete

Pier and Beam

This system of footing basically a post and lintel method of load support. This concept permeates almost all structural elements of building. Its basic premise is that the lintel (horizontal member) carries a load from above and spreads it horizontally to the posts (vertical members).
The posts then pass the load to another supporting element or the foundation material.

The beam (lintel) is a strip footing which is deeper than it is wide. It is constructed in the same as a strip footing.
The pier (post) is a vertical cylinder of normally unreinforced concrete (up to 3.0 m deep) which is made by drillling a hole in the ground to the depth required to find a suitable ABP or pass below the reactive zones of a reactive soil.

The piers supports the beam at approximately 1800 - 2400 mm centres. Piles or piers may also be used in all forms of slabs on ground to find adequate ABP or bypass reactive areas.
The piers may or may not be tied to the beam by reo (see your engineer for details).
Process:
Drill pier holes as directed by engineer
Fill piers with concrete to level which coincides with bottom of beam then construct beam as per strip footing.
Piers are sometimes belled (enlarged) on the end to resist upheaval on reactive sites or reduce pressure by increasing surface contact area.
In highly reactive sites beam may require slip joint (2 layers of plastic membrane) to allow soil to slip past beam.
Often also utilizes compressible material (foam, corrugated steel, etc) under beam to accommodate ground heave.



Pile and Beam

Piles perform the same function as piers and piers are often called piles. The pile and beam system is identical to pier and beam except for the piles.

Piles are preformed units of timber (with steel collars or caps), reinforced concrete or steel which are hammered into the ground much the same as a nail is hammered into timber.

When piles are used in clusters (a group) for large buildings a pile cap (pad footing) is often poured on top to carry the load of the beam or slab.

When being hammered piles stop due to :

- Friction on the sides and end of the pile; or
- End resistance when the pile hits a very strong or hard foundation.

A 1000kg percussion hammer is often used to hammer the piles. Damage to neighbouring buildings from vibration or ground heave is of concern.

Piles are often used where collapsing soils exist on the site and drilling pier holes would result in collapsing holes

Raft slabs

All slabs cast on the ground are considered as raft slabs as they float on the soil. They vary in design to suit the type of foundation material.

Slab on Ground (SOG)

Consists of a flat slab sitting on a perimeter beam (similar to a strip footing). Poured as one integral unit.

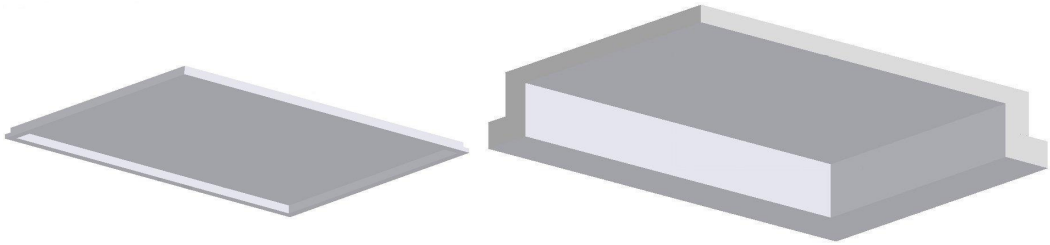
Is used primarily in conjunction with trussed roofs which impart no load to the internal area of the building.

Process:

- Use excavator to cut and fill site as necessary to provide flat building platform.
- Setout formwork
- Dig trenches for perimeter beam with backhoe or by hand.
- Install drainage pipes.
- Place blinding layer of sand.
- Pest spray the sand if required.
- Install vapour barrier
- Place reinforcement
- Pour concrete and allow to cure before loading.

Details:

- Suitable for A & S class sites.
- Reo used- slab fabric over entire area of slab; trench mesh in bottom of edge beam.
- Reo cover required:
  - Slab fabric where protection from moisture is provided by structure - 20mm
  - Trench mesh at bottom of edge beam protected by vapour barrier - 30mm
  - Trench mesh at bottom of edge beam **not** protected by vapour barrier - 40mm
- Uses edge rebate to stop horizontal moisture penetration at floor level and assist flashing system.
- Internal load bearing walls require the slab to be thickened by 50mm under the wall.
- Setdowns in top of slab matched by setdown in soffit of slab (special care with reo).
- Height of Finished Floor Level above ground level determined by:
  - Height of surcharge gully
  - Possibility of local flooding
  - Termite protection method
  - Effects of cut and fill
  - Foundation type and use of perimeter paving.



Slab on ground viewed from underneath showing flat slab on edge beams. Diagram on right hand side shows detail of one corner of a slab with a dropped edge beam. The interior of the slab also rests on soil as do the perimeter beams.

Footing slab

Identical to slab on ground except edge beam is poured separately from slab.
Useful on sloping sites or where soil is soft or collapsing.
May utilize brickwork between edge beam and slab on low sides of site.
R10 ligatures @ 500 centres used to tie edge beam to slab.

Stiffened raft slab
This is an extension of the slab on ground and is much stronger.
It utilizes internal beams @ 3.0 - 6.0 m centres in addition to the edge beams to provide a stiff grid of beams.
Suited to class M & H sites.
Process and details identical to those for SOG.

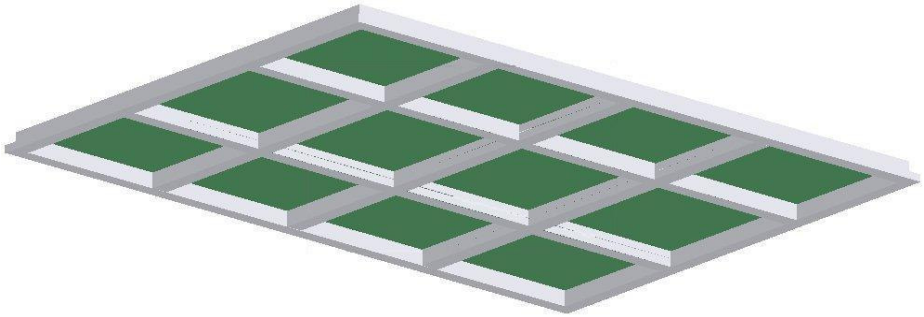
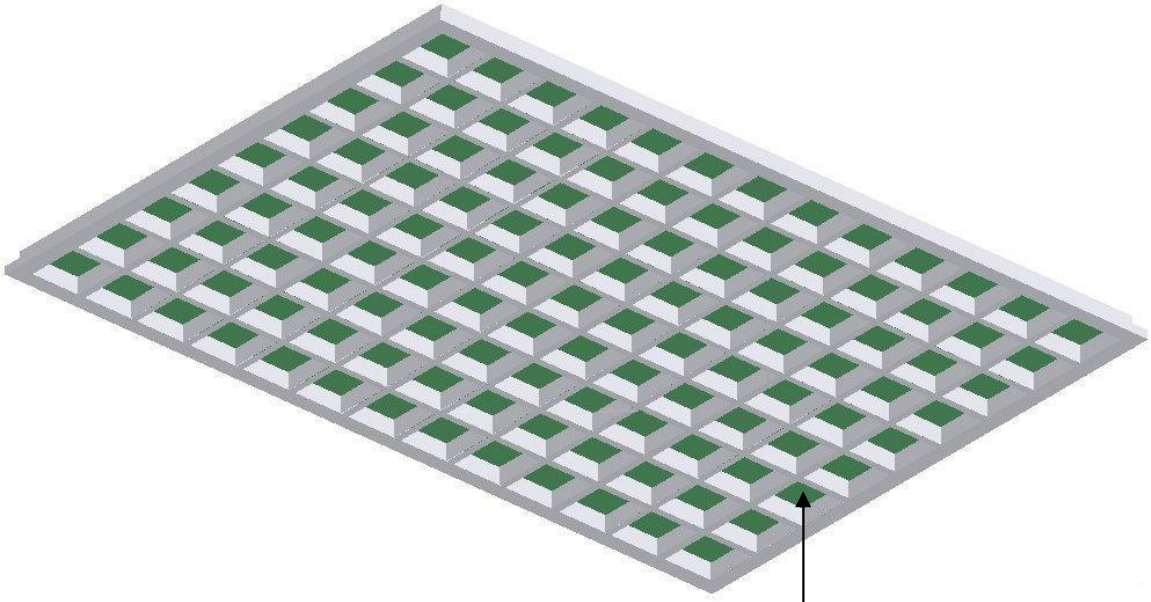


Diagram showing grid layout of internal and external beams.
The shaded section depicts the area of the slab only 100mm thick whilst the lighter areas are beams typically 400mm deep.

Waffle raft slab
This is the strongest form of standard slab.
Utilizes a closely spaced grid of 110 wide internal beams @ 1090mm max. centres in both directions.
Edge beams are min 150 high x 300 min wide.
Beams are formed by used of expanded polystyrene blocks set apart by spacers which also act as reo chairs.
Slab is formed above ground so eliminating trench excavation.
Uses N high strength bars instead of trench mesh in beams and uses standard slab fabric over slab area.
Slab may be 85 thick.
Advantage is accurate concrete quantity estimates.
Services cut in through waffle forms.
Suited to A, S, M, H class sites.



Egg crate layout of closely spaced beams in waffle slab construction