BRANZ

ISSUE 498 BULLETIN

Preparation for concrete floor slabs

June 2008

- Careful preparation of the building platform and excavations is required to construct the basis of a good quality floor slab.
- Specific requirements apply to the laying and compaction of hardfill under the slab.
- This Bulletin describes the steps required to construct a sound base on which to lay a traditional domestic concrete floor slab.

1.0 SCOPE

1.0.1 This Bulletin describes the steps required to construct a sound base on which to lay a good quality domestic concrete floor slab. It goes up to, but does not include, placement of the concrete.

2.0 BUILDING CODE REQUIREMENTS

2.0.1 Concrete floor slabs are required to comply with New Zealand Building Code clauses:
- B1 Structure
- B2 Durability
- E1 Surface water
- E2 External moisture
- E3 Internal moisture
- H1 Energy efficiency.

2.0.2 The Standards which provide an Acceptable Solution for timber or masonry structures will provide design solutions for most domestic concrete floor slabs. These Standards are:
- NZS 3604 Timber framed buildings
- NZS 4229 Concrete masonry buildings not requiring specific engineering design.

2.0.3 Other requirements applicable to slab construction include:
- Health and Safety in Employment Act
- Building Code clause F4 *Safety from falling*
- notifiable work – excavations taller than 1.5 m may require precautions to protect against collapse and a consent from the territorial authority.

3.0 SITE INVESTIGATION

3.0.1 The first step in designing a concrete floor slab is to ensure that the site and ground conditions are suitable. Aspects of the site which will affect the design and laying of the floor slab are:
- site dimensions, slope and levels
- bearing capacity of the ground
- proximity to the sea or geothermal vents
- presence of expansive clays or poorly compacted fill
- access for excavation and concrete placing equipment.

3.1 LEVELS

3.1.1 Concrete floor slabs are most suitable for level ground. Changes in level require the slab to be supported on foundation walls and hard fill or on a beam and column structure.

3.1.2 For concrete floor slabs to be designed in accordance with NZS 3604 or NZS 4229 no more than 600 mm of hardfill under the slab is permitted. Where fill greater than 600 mm is required the slab and footings need to have specific engineering design.

3.1.3 NZS 3604 allows a footing to be stepped to accommodate the slope of the site.

3.2 GROUND CLEARANCES

3.2.1 Having established ground levels the designer will need to take into account:
- the amount of cut and/or fill required to establish a building platform
- the required floor clearances (refer E2/AS1) at the highest point of the prepared platform
- the need to provide fall away from the building of 1 in 25 for one metre away from the building
- the final landscaping levels to maintain ground clearances.

3.2.2 The finished ground floor slab level must provide for a minimum distance above the finished ground level of:
- 225 mm for any cladding adjacent to unpaved ground
- 150 mm for any cladding adjacent to paving
- 150 mm for brick veneer cladding adjacent to unpaved ground
- 100 mm for brick veneer cladding adjacent to paving.

3.2.3 The finished slab level must be referenced to a specific permanent datum to allow accurate set out of the formwork or foundation wall.

3.3 GOOD GROUND

3.3.1 A domestic concrete floor slab, within the terms of NZS 3604, must be constructed on good ground. This is defined in the Standard as ground with a bearing capacity of at least 300 kPa.

3.3.2 Good ground can be established by:
- initially, observing that adjacent and similar buildings on similar ground show no sign of unsatisfactory behaviour
- Scala penetrometer testing (described in BRANZ Bulletin 438) to show the ground has more than 300 kPa bearing capacity.
- investigation by a geotechnical engineer.

3.3.3 The concrete floor slab cannot be laid on:
- landslip areas
- uncertified fill
- organic topsoil, soft peat or soft clay
- expansive clay soils not meeting good ground requirements.

3.3.4 It may be possible to lay the slab over buried council services in some cases, but this must be subject to specific structural design of the floor to bridge the services and the need for inspection access to the services.

4.0 SITE PREPARATION

4.0.1 All organic matter and topsoil should be removed to provide a cleared ground level and before any set-out is done.

4.1 SET OUT

4.1.1 To minimise excavation and accurately position the slab within the section and at the correct level, accurate set-out is required.

4.1.2 Designers should specify a fixed:
- permanent reference point(s) on which the set out is based
- datum
- location of the site boundaries
- invert level of council drainage services or connection points.

4.1.3 Set out will include providing profiles. Profiles are temporary guides constructed at the corners of the building area to establish the edges and corners of the slab and foundation. Profiles are built about 1-2 metres clear of the building to allow working space (Figure 1).

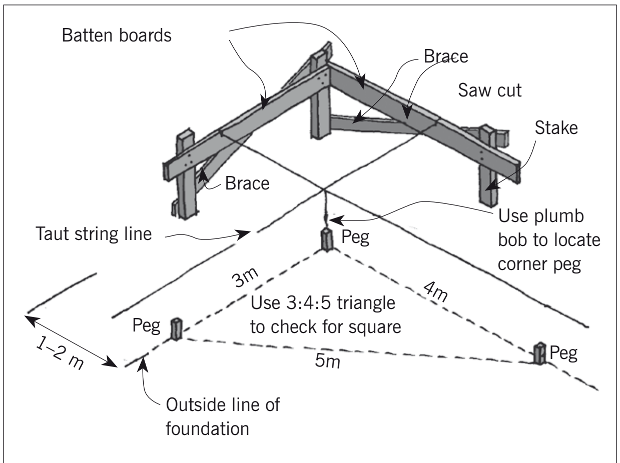

Figure 1. Building profiles.

4.1.4 Before starting to dig ensure that the exact locations of buried services have been identified and clearly marked.

4.2 REMOVAL OF TOP SOIL

4.2.1 The removal of vegetable matter and topsoil, and on sloping sites the formation of the building platform, will normally be carried out by machine.

4.2.2 It is important to remove all top soil down to good ground, but not to excavate below this level as this will require the ground to be made up with imported hardfill.

4.2.3 Any areas of soft ground must also be fully excavated and filled in as described in 5.0.4.

5.0 EXCAVATION

5.0.1 Excavation for the footing or slab thickening at the edge, or for slab thickenings within the slab area, is normally carried out by hand. This should be at least 200 mm into the undisturbed ground and bearing on a solid base of good ground.

5.0.2 Where good ground is at a depth greater than 600 mm, the excavation between the base of the excavation and the bottom of the footing may be filled with 10 MPa concrete.

5.0.3 The base of the excavation must be level and kept free of water or loose soil. (For sloping sites see Figure 6.12 in NZS 3604.)

5.0.4 Where fill is required on a sloping site to bring the platform up level, an engineer must certify that the fill is suitable in terms of NZS 4431 *Code of practice for earth fill for residential development.*

6.0 FORMWORK

6.0.1 For slab-on-ground on a level site the formwork is typically required to the perimeter only. Figure 2 shows the prepared excavation and the formwork installed to provide the formed edge of the slab, the excavated ground providing the shape to the underside of the slab and edge thickening.

6.0.2 On sloping sites a separate foundation wall may be required. This can be formed using shuttered formwork (Figure 3).

7.0 HARDFILL

7.0.1 Once the formwork has been placed the hardfill can be laid to bring the level to 125 mm below the finished floor slab level (for 100 mm thick slabs with 25 mm blinding). Where a separate foundation

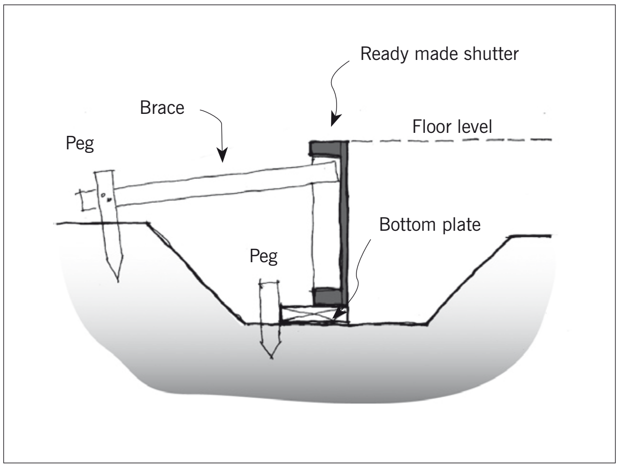

Figure 2. Formwork for slab with thickened edge on flat site.

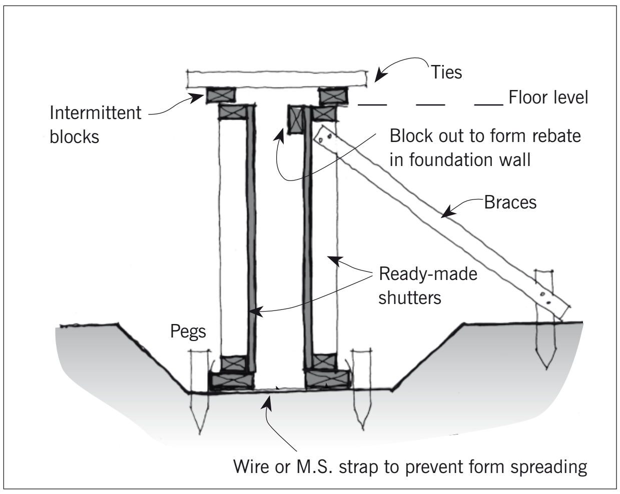

Figure 3. Shuttered formwork for foundation wall.

wall is required this will normally be poured prior to laying hardfill. The hardfill can then be laid within the foundation walls.

7.0.2 The finished level of the hardfill has to allow for sand blinding thickness and insulation thickness as well as specified slab thickness and specific reinforcing cover.

7.1 DESCRIPTION

7.1.1 Hardfill is a granular fill material composed of rounded gravel, crushed rock or scoria material. The material will need to be approved by the local building consent authority (BCA) and no more than 5% should be able to pass through a 2.2 mm sieve. All particles should pass through a 19 mm sieve. Particles up to 37.5 mm are allowed where the hardfill is deeper than 100 mm.

7.1.2 Where it can be demonstrated to the BCA that because of site conditions fine particles will not draw water up to the underside of the slab, the BCA may approve fill material with fine particles such as pit metal or sand.

7.2 PLACING

7.2.1 Place hard fill in 150 mm layers over the whole area. Compact the layer so that the material is tightly bound together and does not deform under the weight of a pressed adult heel. Once the first layer has been compacted place and compact the next 150 mm layer.

7.2.2 The minimum amount of fill permitted is 75 mm. If more than 600 mm of fill is necessary, then specific engineering design is required.

7.2.3 Compact each layer using either:
- a vibrating plate compactor
- a vibrating roller
- a mechanical tamper.

7.2.4 If necessary, water the fill as the work proceeds to achieve optimum density.

7.2.5 Shape slab thickenings within the body of the slab after the hardfill is placed (see Figure 7.19 in NZS 3604).

8.0 INSTALLING SERVICES

8.0.1 Waste pipes and other piped services (e.g. water supply, central vacuum system pipes) are normally laid into the hardfill (Figure 4). Electric wires should be fully sleeved. Soil pipes will be laid deeper (Figure 5), before the hardfill is placed.

8.0.2 When waste pipes are located in the hardfill it is often easier to lay and compact the hardfill, then excavate into it for the pipework.

8.0.3 Pipes must be accurately located, with allowance made for the expansion and contraction and kept clean. The pipework will therefore be:
- bedded in clean, free running fill such as pea metal when beneath the slab
- installed within a larger diameter pipe (sleeve) where the pipe is within concrete
- wrapped with proprietary petroleum jelly-impregnated tape where a pipe penetrates the slab
- held firmly in place to prevent displacement when laying hardfill or concrete
- fitted with a temporary cover, such as taped-on polythene sheet, to prevent debris and concrete entering the pipe.

9.0 SAND BLINDING

9.0.1 Once all the services have been placed and the hardfill re-compacted and smoothed, a 25 mm layer of sand is laid over the hardfill. This will protect the DPM from puncture. The sand also allows final adjustments in level to be made. If the sand is very dry it can be dampened and compacted.

9.0.2 Placing a damp proof membrane (DPM) directly over sharp edged hardfill could cause it to puncture.

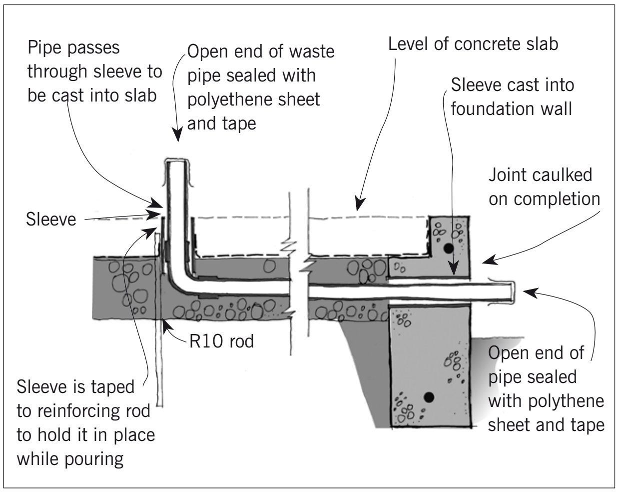

Figure 4. Waste pipe laid in hardfill.

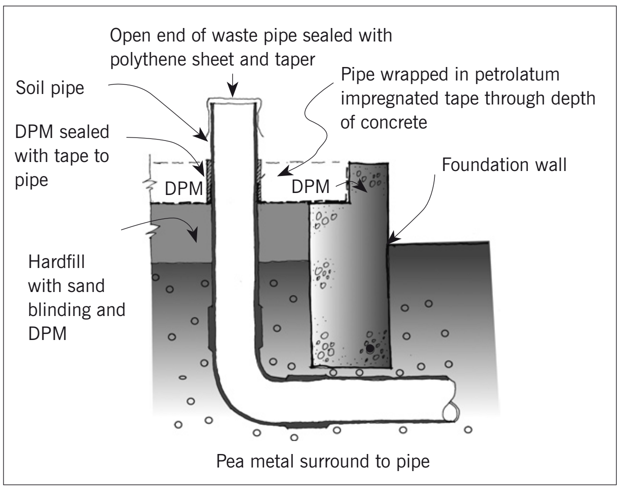

Figure 5. Soil pipe laid under hardfill.

10.0 DAMP PROOF MEMBRANE

10.0.1 A DPM must resist penetration by both liquid water and water vapour.

10.0.2 To meet the Building Code performance requirements of E2/AS1, the DPM must have a water vapour flow resistance of not less than 90 MNs/g and be continuous under the whole slab.

10.0.3 The most common DPM is a 0.25 mm thick sheet of polyethylene, commonly called polythene. Sheet polythene is also available reinforced and laminated, 0.25 thick, which has better resistance to puncturing.

10.0.4 Other types of DPMs include:
- modified bituminous sheet with a polythene backing, with or without layers of fabric reinforcement
- synthetic rubber sheet.

10.0.5 The sheet DPM should be laid to:
- the complete slab area and turned up at the foundation or turned down into the trench
- have no wrinkles in the body of the sheet
- minimise the number of joints
- lap 150 mm at joins
- have all joints taped with pressure sensitive tape
- be cut neatly around penetrations and the penetrations sealed with tape.

10.0.6 Once laid, take care when installing the insulation, steel and/or heating pipes over the DPM so that it is not holed. Care is also required when placing concrete to prevent damage.

10.0.7 Bulletin 469 *Damp-proof membranes to Concrete Slabs* provides more detailed information.

11.0 INSULATION

11.0.1 Insulation should be laid over the DPM. Where edge only (1200 mm wide) insulation is used, a small recess should be formed in the hardfill to prevent the thickness of the slab being reduced (Figure 6).

11.0.2 Polystyrene insulation should be placed immediately before placing steel mesh, especially in windy conditions so that it will be held in place.

Figure 6. A beam trench showing mesh reinforcing, bottom steel, DPM and insulation. (Note that chairs to support the mesh are still to be placed.)

12.0 REINFORCING

12.0.1 Reinforcing to slab edge thickenings should be supported from the formwork. Steel mesh to the body of the slab must be supported on masonry blocks or plastic reinforcing chairs. Ensure that the steel is placed according to the documentation with the correct laps and cover and securely supported or tied in place with wire ties.

12.0.2 Shrinkage control joints (typically saw cuts) are required in almost all completed slabs. Mesh reinforcing to the slab must stop each side of the joint. Refer to NZS 3604 clause 7.5.8.6 for full details of joint location requirements.

12.0.3 During pouring it is important that the reinforcing steel stays in its correct location.

13.0 EMBEDDED FLOOR HEATING

13.0.1 Embedded floor heating can take the form of electric cable elements or hot water circulation through tubing. In either case they must:
- be laid strictly as designed
- not pass through construction joints
- be laid out after all below-slab services are installed
- be taped or tied to the reinforcing (Figure 7)
- be tested prior to pouring the slab
- be protected with a PVC sleeve where they exit the floor slab

Figure 7. Hot water heating pipes tied to reinforcing with nylon ties. (Note that chairs to support the mesh are still to be placed.)

13.0.2 Shrinkage control joint positions should be marked out before the cables or pipes are laid.

13.0.3 With heated floors, the position of the saw cuts should be marked on the DPM/insulation and on the formwork so that the pipes/cables will not be cut when shrinkage control joints are made.

13.0.4 Extra care is required to ensure that the cables and pipes are not dislodged or damaged during concreting.

13.0.5 A small increase in the thickness of the floor slab may be required to maintain the required coverage to reinforcing or heating elements.

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