HEDRA
Housing Engineering Design
& Research Association
ABN: 71 181 399 104

BUILDING & MAINTAINING YOUR HOUSE

This document is a plain language guide to what should be expected from the construction of single dwellings, townhouses or similar structures not situated vertically above or below another dwelling. It has been compiled by the HEDRA Task Force committee in the belief that the information contained is helpful to the parties mentioned, however no warranty of accuracy or reliability as to the information is given, and no responsibility for loss arising is accepted.

1. EXPLANATIONS

Footings (often incorrectly called foundations) are the "members" that support the building. They are commonly concrete slabs or timber floors supported by strips and stumps. (Fig 1, 2 & 3).
Foundation is the soil or rock supporting the footings. **Reactive Clay foundations** are those that shrink and swell with changing moisture and cause the building and paving to sink or lift. **Reverse slope** is one that slopes towards the building. (Fig 18) **Sand foundations** do not shrink or swell but if they are loose they can cause the building to sink. **The Australian Standards** for building footing construction permits minor wall and floor movements. If the foundation conditions are changed after construction the floor and walls may move more than allowed-for by these standards. The designs for building footings in Australian Standard 2870 will perform adequately provided the building site and surrounds have "normal" foundation conditions which are maintained. If the building site and surrounds have "abnormal" moisture conditions, special provisions must be followed by the design engineer, builder and owners. **(AS2870 defines "abnormal" moisture conditions).**

The "reactivity" of clays is their capacity to shrink and swell with changing moisture and is classified as follows :

A	Reactivity absent	
S	Slight	REACTIVITY
M	Moderate	
H1, H1-D	High	
H2, H2-D	Very High	
E, E-D	Extreme	

The greater the clay "reactivity" the greater the possibility of damage. Some minor cracking of walls is almost inevitable despite proper design, construction and maintenance. AS2870 suggests that cracks up to 1 mm wide are common and that cracks, up to 5 mm, may occur in clay sites subject to significant moisture changes. Some cracks are seasonal but if larger than 5 mm they are regarded as significant and should be investigated by a geotechnical engineer experienced in residential investigations.

Fig. 1 Stiffened Raft

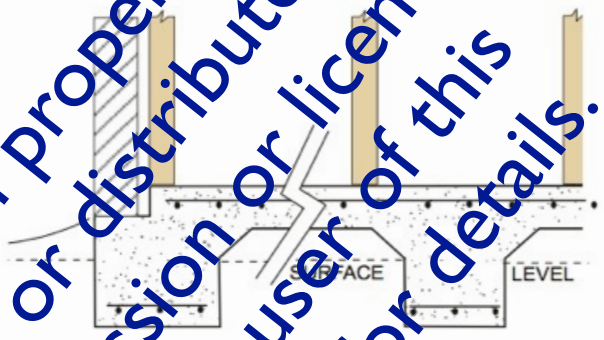


Fig. 2 Waffle Slab

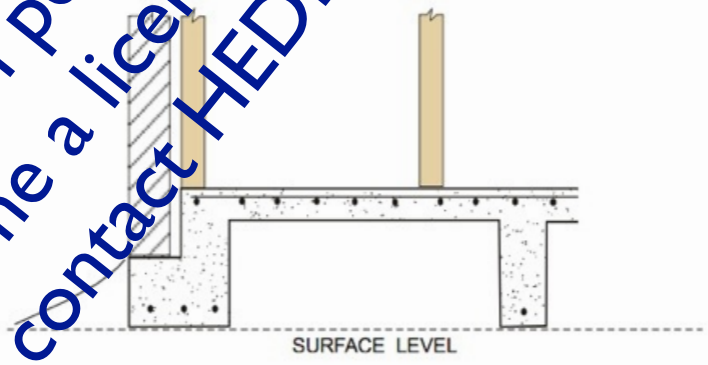
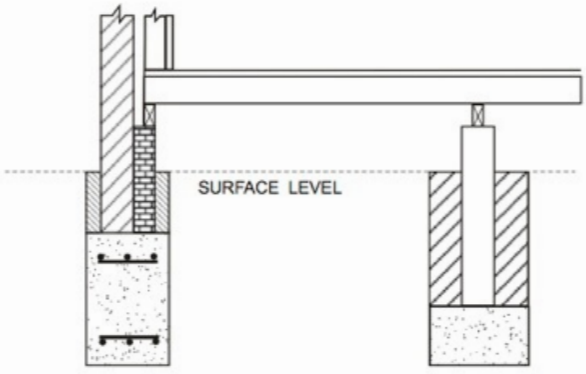


Fig. 3 Strip & Stump Footing System



2. ENGINEERING

The engineer designs house footings to ensure that they can cope with the soil and environmental conditions assessed at the time of the site classification.

3. BUILDING

The builder needs to comply the Building Code of Australia, relevant Australian Standards, engineering specifications and contract documents. The following are important aspects the builder will need to address:

- Builders should ensure that owners understand that failure to maintain adequate drainage may result in damage to the structure.

- Well-drained foundation conditions which will create "normal" soil moisture and adequate bearing capacity.

- Ensuring that excavations are well supported or are dug to avoid collapses. (Fig. 11)

- Constructing well-compacted and retained 'soil aprons' around the building to stop erosion in sandy areas.

- Special considerations if any excavations are to be dug near adjoining structures.(Fig. 14)

- Sloping the soil and paths away from the building by the minimum amount required by the building regulations to prevent water flowing towards the building foundations. (Fig. 10 & 18)

- Constructing soil drains or moisture barriers in sloping sites to prevent stormwater adversely affecting the building foundations.

- In highly or extremely reactive clay sites Australian Standard 2870 – "Residential slabs and footings" requires *mechanical flexible couplings* for sub-surface drainage pipes and for above-ground connections from the downpipe to the storm water drains. These allow for the movement of the soil and minimise the risk of pipe joints breaking and creating leakage problems. (Fig.6)

4. HOME OWNERS

The home owner should become familiar with the Site Classification report and the type of footing system used in the building. To comply with AS2870 (Residential slabs and footings) and achieve acceptable performance and safety during the design life of the house, the owner's shall maintain the garden and foundation soil moistures, paving and drainage systems. (Fig. 7)

Failure to maintain the foundation conditions can lead to cracking of walls and floors and if the damage is attributed to actions of the owner it could diminish the builder's warranty obligations, leaving the owner responsible for the cost of repairs.

Fig. 4

Houses to be constructed to the following:

- Building Code of Australia
- Australian Standards
- Engineers Design

Fig. 5 Well Drained Sites

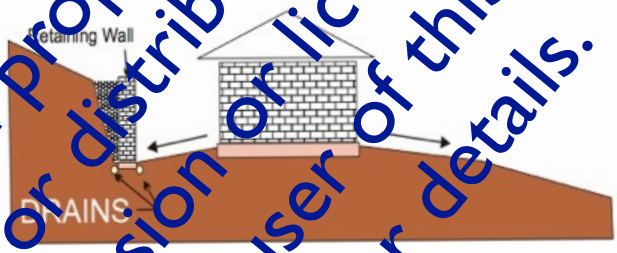


Fig. 6 Mechanical flexible couplings to reduce the potential of broken pipes in M, H1, H2 & E sites

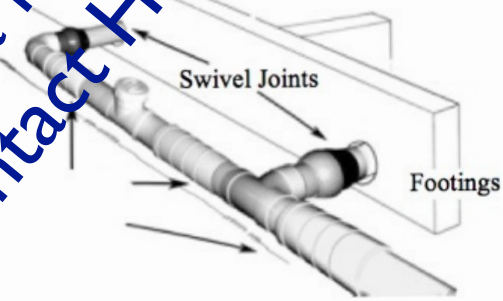


Fig.7

5. WORKS AFTER TAKING POSSESSION

In some cases foundation conditions are changed by the owner constructing new works such as:

- Sheds or outdoor roofed areas without connecting the roof drainage to storm water lines.

- Paving around the building without sufficient slope away from the building. (In Sandy soils and low and moderate "reactivity" clays, a slope of 25 mm for 1 metre away from the building is adequate. In highly reactive clays a slope of 50 mm for 1 metre is required and the water collected by a spoon drain in the edge of the paving and diverted to a collection pit. In large paved areas a drain and collection pit may be necessary). (Fig. 5 & 18)

- Australian Standard 2870, "Residential Slabs and Footings" requires soil drains and "normal" soil garden moisture in M, H1, H2, E, and P sites to be maintained by the owner. (Fig 10)

- Running machinery over shallow drain pipes may break them and can cause leaks and subsequent foundation movements.

- Any excavations close to building footings can cause them to sink by disturbing the foundation material or by drying the foundation clay. (Fig 11)

- Footings constructed in reactive clay sites during wet periods may be damaged if the garden is allowed to dry out excessively.

- Footings constructed in reactive clay sites during dry conditions may experience damage if the garden is watered unevenly or excessively.

6. LANDSCAPING AND TREES

Most modern allotments with clayey soils are too small to safely grow large trees without special footings. Generally the larger the root system of the tree(s) the greater the drying effect. If in doubt seek the advice of an expert arboriculturist and designing engineer.

If you are about to build in a clay area and you wish to grow, retain or remove trees near buildings, the builder should be advised of this prior to signing the building contract so that the engineer can design for these conditions.

- Trees can cause damage during their life and even for many months after their removal. If they do not receive sufficient water while alive their roots will dry the soil near buildings or under pavements.

Fig. 8 Drainage concerns

Fig. 9 Slab heave due to water ponding

Fig. 10 Soil Drainage Plan

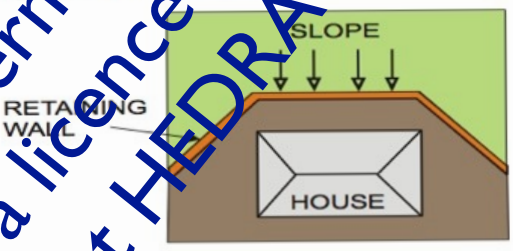


Fig. 11 De-stabilizing house foundations

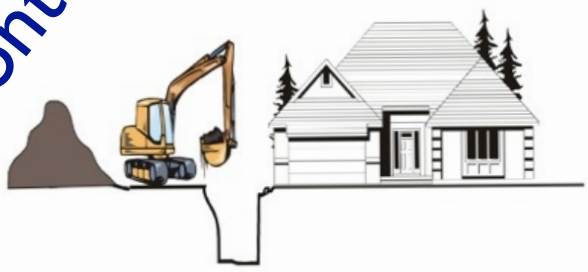
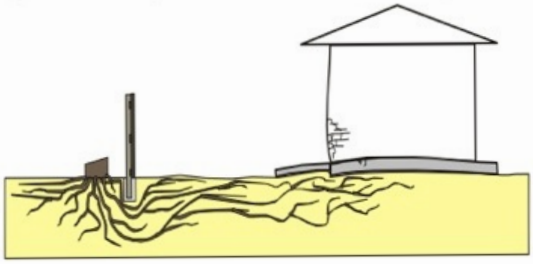


Fig. 12 Damage due to soil moisture changes



If you plan to remove trees after the building is constructed you should consult the designing engineer an expert arboriculturist or a geotechnical practitioner familiar with these problems.

Tree roots in sandy areas rarely cause any damage since sand does not shrink or swell, however if the root ball or large root is very close to a building it may grow and lift the footings of a light structure. (Fig. 13)

Foundation problems in clay sites may also be caused by :

- Excessive or under-watering of gardens.
- Watering systems that are overused or discharge water too close to building walls (Fig. 8)
- Constructing terraces, retaining walls or garden walls without good drainage. (Fig. 10)

7. POOR SITE MAINTENANCE

The change of foundation soil moisture is by far the greatest cause of building damage. Changes of drainage or garden watering conditions in adjoining properties can also create problems.

- A drainage system may be necessary if water flows near the building. All possible water leaks and sources should be repaired immediately, e.g.:
- Leaking or blocked roof gutters which cause water to overflow near building walls. (Fig. 14)
- Hot water systems relief valve pipes should be discharged into storm water lines. (Fig. 15)
- Air conditioners operating during hot humid weather that discharge water near the building footings. (Fig. 16)
- Leaking or overflowing water tanks near building footings. (Fig. 17)
- Sand or paving that slopes towards the building and cause rain water to flow near the building. (Fig. 18)
- Water from the failure to repair plumbing leaks or leaky taps, hoses or by regularly washing cars in areas near building walls. (Fig. 19)
- Water flowing near buildings (even from neighbouring properties) must be diverted away from the footings or collected. (Fig. 20)
- Poorly drained garden beds adjoining house walls collecting rain water or overwatered. (Fig. 8)

Fig. 13 Allow for tree growth.

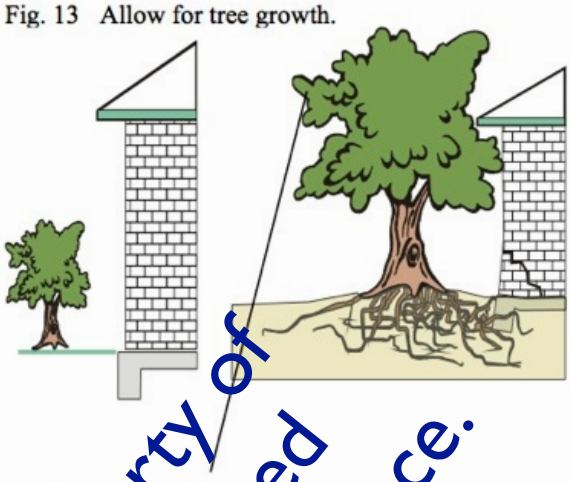


Fig. 14 Overflowing roof gutter

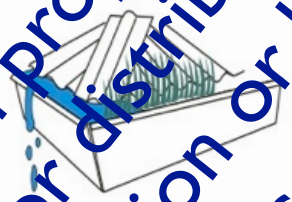


Fig. 15 Common leak source Relief Valve

Fig. 16 Air con. up to 35 l/day loss

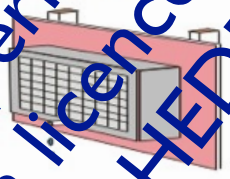


Fig.17 Leaky pipes

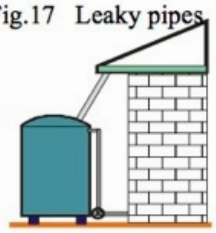


Fig. 18 Reverse Sloping paths

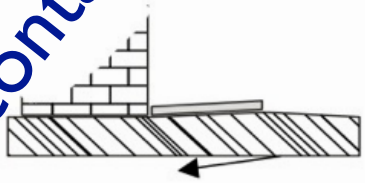


Fig 19 Leaking tap

Fig. 20 Water flows from adjoining property