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HOME OWNER'S REFERENCE GUIDE

STA CONSULTING ENGINEERS

Certification of Soils and Design Report - Obligations of the Home Owner/Occupier

The performance of the footings and slab or both is largely depended upon a responsible approach by the owner/occupier towards vegetation and site drainage.

THE HOME OWNER'S REFERENCE GUIDE VERSION v10 1 October 2013

1. Is part of this Foundation Design Report for the use of the homeowner/occupier;
2. Must be read and understood where appropriate by the homeowner/occupier;
3. Contains mandatory requirements, and all mandatory requirements must be complied with by the homeowner/occupier;
4. Contains recommendations, and all recommendations should be complied with by the homeowner/occupier.

Where there is ANY FAILURE of the homeowner/occupier to comply with the above obligations then the RESPONSIBILITY for ANY FAILURE rests with the homeowner/occupier.

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SECTION 1. INTRODUCTION

1.01 GLOSSARY OF TERMS

The following are definitions of words used in this report and attached documents.

"Allowable Bearing Capacity" – Maximum bearing pressure that can be sustained by the foundation from the proposed footing system under service loads which should avoid failure or excessive settlement.

"Articulated full masonry" – full masonry construction in which special provision is made for movement by articulation.

"Articulated masonry veneer" – masonry veneer construction in which the provisions for articulated masonry have been applied to the masonry veneer.

"Bored pier" – in-situ concrete cylindrical load support element.

"Bulk pier" – in-situ concrete load support element excavated by backhoe or similar.

"Clad frame"- timber or metal frame construction with the exterior wall clad with timber or sheet material not sensitive to minor movements. Includes substructure masonry walls up to 1.5m high.

"Clay" – fine grained soil with plastic properties when wet. Includes sandy or silty clays.

"Continuous footing" – footing of rectangular section.

"Controlled fill" – material that has been placed and compacted in layers by compaction equipment within a defined moisture range to a defined density requirement in accordance with Clause 6.4.2(a) and AS 3798.

"Dynamic Cone Penetrometer (D.C.P)" – field equipment used to determine underlying soil strength by measuring the penetration of the device into the soil after each hammer blow.

"Edge beam" – beam at the edge of a slab-on ground or stiffened raft.

"Edge footing" – footing at the edge of a footing slab.

"Foundation" – ground which supports the building.

"Footing"- construction which transfers the load from the building to the foundation.

"Footing system" – general term used to refer to slabs, footings, piers and pile systems used to transfer load from the structure to the foundations.

"Full masonry" –construction with masonry double-leaf external walls and masonry single-leaf internal walls without full articulation.

"House" – detached single dwelling constructed as Class 1 , or Class 10a as defined in the "Building Code of Australia", with limitations as stated in this standard.

"Liquid limit (wl)" – moisture content at which the soil passes from plastic to the liquid state as determined by the liquid limit test.

"Linear Shrinkage (LS)" – decrease in length expressed as a percentage of the original length when a sample of soil is oven dried from a moisture content of about the liquid limit as determined by the linear shrinkage test.

"Load- bearing wall"- any wall imposing on the footing or slab a service load greater than 10 kN/m.

"Masonry" – stone, brick, terracotta block, concrete block, or other similar building unit single or in combination assembled together unit by unit.

"Masonry veneer" – house construction consisting of a load-bearing frame clad with an outer leaf of masonry.

"Pad footing"- concrete footing used to support a pier or stump.

"Pier and Beam" – footing system incorporating bored piers, bulk piers or piles supporting a suspended slab and including a slab partly supported on piers and partly supported on ground.

"Plastic limit (wp)" – moisture content at which the soil becomes too dry to be in a plastic condition as determined by the plastic limit test.

"Plasticity index (Ip)" – numerical difference between the liquid limit and the plastic limit of a soil.

"Pocket penetrometer (PP)" – instrument used to evaluate consistency and approximate unconfined compressive strength of saturated cohesive soils.

"Rock" – strong material including shaley material and strongly cemented sand or gravel that does not soften in water. Material that cannot readily be excavated by a backhoe may be taken to be rock.

"Reactive site" – site consisting of a clay soil which swells on wetting and shrinks on drying by an amount that can damage buildings on light strip footings or unstiffened slabs. Includes sites classified as S, M, H, or E in accordance with Clause 2.1 of AS 2870.

"Sand" – granular soil that may contain a small proportion of fines including silt or clay. The amount of fines may be assessed as small by visual inspection or if the amount passing a 425 um sieve is 15% or less. Material with a higher proportion of fines shall be treated as silt or clay.

"Services" – means all under ground services to the site including but not limited to power, telephone, sewerage, water & storm water.

"Site" – (insert the address and/or lot description)

"Silt"- fine grained soil that is non-cohesive and non plastic when wet, can include some sand and clay.

"Slab-on-ground" – concrete floor supported on the ground and incorporating integral edge beams.

"Surface movement (Ys)" – design movement at the surface of a reactive site caused by moisture changes.

"Standard residential allotment" – means that if the lot/allotment is larger than 650 metres square then the builder/home owner/developer needs to identify where the proposed dwelling structure is to be erected.

"Stiffened raft" – concrete slab on ground stiffened by integral beams and a grid of internal beams.

"Stump" – element supported on a footing used for the support of a frame construction.

"Waffle raft" – a stiffened raft with closely spaced ribs constructed on the ground and with slab panels suspended between ribs.

1.02 QBSA SUBSIDENCE - LEGISLATIVE REQUIREMENTS

The Policy that everyone plays a part

In April 2003 the Queensland Building Services Board instigated a review of the causes of footing and slab movement. The review focused on design and construction of footings and slabs including legislation and standards as well as skill levels and education of practitioners. It also considered the escalating costs to BSA's statutory fund.

Preliminary findings of a research project commenced in May 2003 identified two areas that required special attention. They were: Engineering Investigation and Design and Construction Practices.

After informing industry of the review in September 2003, the Queensland Building Services Board recently endorsed a new Policy for Rectification of Building Work in residential construction. This includes work that causes footing slab movement.

A Fact Book, distributed throughout Queensland, is aimed at ensuring that all participants in the building industry are properly informed about, and understand how to comply with, the no fault provisions of the new policy. Similarly, a further BSA education initiative will endeavour to ensure home owners are made more aware of their responsibilities for the ongoing maintenance of their homes.

Please read your requirements and make use of the resources from BSA's website, ensure you fully comprehend the requirements of the relevant sections of the Building Code of Australia and have an understanding of Australian Standard 2870.

Your understanding and compliance with these requirements and your assistance in ensuring you as home owners are aware of your own maintenance responsibilities will help minimise the incidence of footing and slab movement. This in turn will reduce your costs for rectification, and ultimately, the burden that industry bears due to problems created by defective work.

QBSA Subsidence Policy.

RESPONSIBILITIES – *Everyone has their own.*

Previous Policy

To avoid responsibility for rectification of subsidence under the previous policy, the contractor only had to rely on information provided by an engineer, follow the requirements of the engineer as specified and have the work certified by a competent person.

This is NOT the case now.

Where contracts or preliminary agreements are entered into after 1 September 2004, the contractor and owner must also ensure that the engineer is provided with all the information relevant to the construction. The contractor must also ensure that the engineer provides a design and certifies that it complies with the information the contractor has provided and the requirements of the relevant codes and standards.

Both the performance of footing and slab systems and the continued serviceability of buildings rely on the contractor and the homeowner complying with construction practices and site maintenance conditions. The Australian Standard relies on normal conditions being maintained throughout the life of buildings.

Both the contractor and the home owner have a duty to know their individual responsibilities.

SECTION 2. SITE MAINTENANCE PARAMETERS

2.01 SITE CLASS AND POTENTIAL SURFACE MOVEMENT

Methods adopted are in accordance with guidelines specified in AS 2870 – 2011, appendix D. Potential surface movement and the resultant site classification are therefore consideration of the local depth of the zone of consideration of significant soil moisture variations and the entire ground profile. This includes the influence of "reactive" clay based soils and/or the presence of fill, as well as the effect of "stable" materials such as dense sands or shallow rock. Site classification is divided into various classes, dependent upon the "Ys" (potential movement). Classifications are;

Site Classification Symbols	Description
....."*A".....	Most shallow rock sites and some sand sites with little potential for movement through moisture change.
....."*S".....	Slightly reactive sites, have only slight potential for ground movement through moisture change.
....."M".....	Moderately reactive sites, can under go moderate ground movement through moisture change, May be considered as your average site.
....."H".....	Highly reactive sites, can experience a high level of ground movement. Additional costs are generally incurred in building on such sites.
....."E".....	Extremely reactive sites can experience extremely high amounts of ground movement. Special considerations should be taken into account when building on these sites
....."P".....	Problem sites which generally have soils associated with uncontrolled fill, mine subsidence, landslip, or soft or collapsing soils.

Additional costs can be incurred on sites due to possible difficulties in excavations/earthworks.

2.02 FIELD AND LABORATORY PROCEDURES

Site testing is constructed in strict accordance with AS 1726 – 1993, "Geotechnical site investigations". Insitu scala-cone penetrometer and shear vane testing are converted to allowable bearing pressures. Refer respectively to "Determination of Allowable Bearing Pressures Under Small Structures" (1977) by MJ Stockwell and "Skemptons's Theorem" (1954). Clay based soils are sampled and tested for their plasticity parameters, in accordance with AS 1289 3.1.2, 3.4.1 and 6.3.2. STA Consulting Group Pty Ltd trading as STA Consulting Engineers is also NATA (National Association Testing Authorities) accredited for appropriate test procedures.

2.03 SITE MAINTENANCE

The performance of the footings and/or slab is largely dependant upon a responsible approach by the builder and the owner/occupant towards vegetation and site drainage. It is not recommended to have trees within a distance from the residence equivalent to:

75% of the mature tree height, for class "M" sites
100% of the mature tree height, for class "H" sites
150% of the mature tree height, for class "E" sites

Alternatively, root barriers MUST be adopted if the removal of some trees is not possible. A root barrier is usually installed between the foundations and adjacent trees within their mature height from the foundation and where there is expansive clay soil to prevent tree roots from consuming moisture from the soil under the area of concern.

Root barriers can be made of any impermeable durable material that can withstand burial in soil for an extended period of time. The depth required for the root barrier is greatly dependant on the tree species, as the root systems on different tree types will vary in depth at which they are embedded. It is recommended that a qualified horticulturist be consulted prior to the installation of a root barrier if there is concern for the health of the tree whose roots are to be cut.

Removal of large trees may cause an adverse affect, as soil moisture is gradually restored, and this may cause clays to swell and may lift shallow footings. Water MUST never be permitted to pond around foundations.

Additional Critical Issues are:

- Water must not be permitted to pond in or around footings
- Garden Beds adjacent to the house should be avoided
- The development of gardens should not interfere with effective site drainage
- Moderated watering of the garden is preferred to indiscriminative neglect and/or irregular saturation
- Plumbing leaks and in particular damaged storm water pipes should be repaired promptly
- Grated drain inlets are to be positioned under exterior taps which are located adjacent to the residence

The previously mentioned restrictions may seem onerous for new home owners, however the lack of site maintenance on a reactive clay site can cause damage to the house. The damage to houses caused by reactive clays is mostly unsightly cracks in the brickwork. In the typical Australian brick veneer house, the brickwork does not support the structure. It is the timber frame that carries the walls and roof loads, so brick cracks do not affect the structural safety of the house.

2.04 SUB SURFACE MINING/SLOPE STABILITY

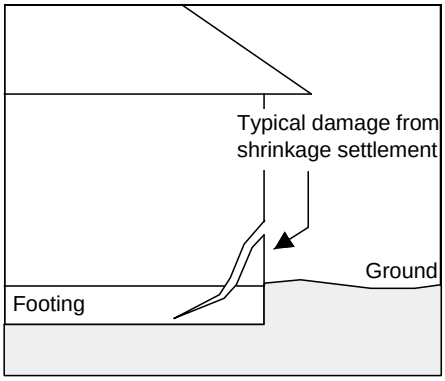
Unless STA Consulting Group Pty Ltd trading as STA Consulting Engineers has been instructed about existing or proposed mining projects or slope instability, any of which can adversely influence ground conditions then the findings and recommendations contained in this report are not relevant and can not be relied upon.

2.05 ROOT BARRIERS

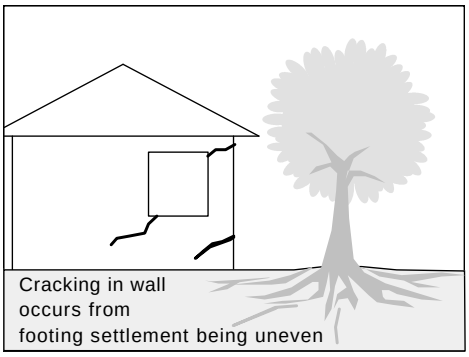
Root Barrier Requirements

Trees and large shrubs require amounts of water to survive. Tree roots absorb moisture from in the soil, and as soils dry around the root systems they will naturally extend and grow in the direction of soil moisture. This drying out of soil can cause considerable movement of the ground level, especially when combined with highly reactive (clay) soils can result in uneven settlement of foundations.

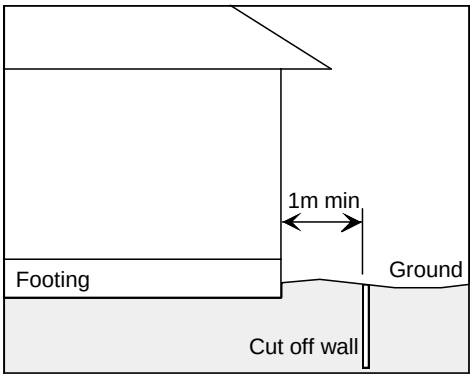
This uneven settlement may cause substantial damage to the foundations of building and walls as well as driveways & pathways.



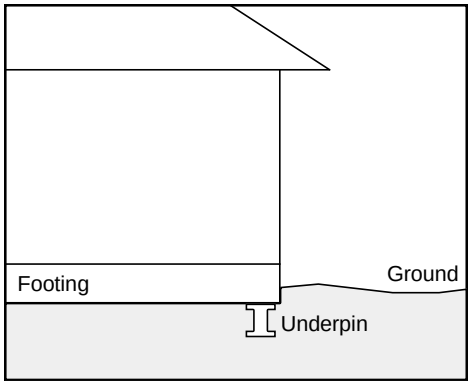
Local corner settlement



Wall Cracking



Cut-off wall

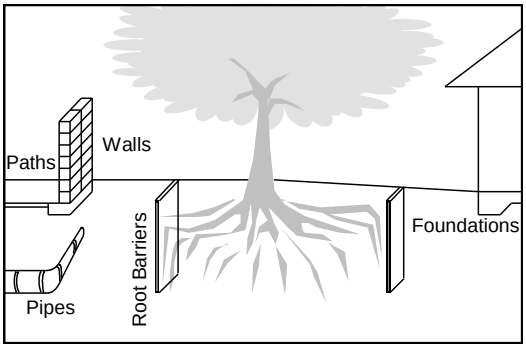


Underpinning

After damage has occurred, underpinning of footings and more costly repairs (even the most drastic, demolition) is often the only option.

Installation of Root Barriers will protect house foundations as well as pipes, walls and paths and will eliminate the problem of uneven settlement of foundations. With the installation of a Root Barrier, trees which in the past had to be removed because of their damaging effects can remain and exist quite happily alongside of buildings without causing any problems underground.

It is not recommended to have trees within a distance from the residence equivalent to;



- 75% of the mature tree height, for Class “M” sites
- 100% of the mature tree height, for Class “H” sites
- 150% of the mature tree height, for Class “E” sites

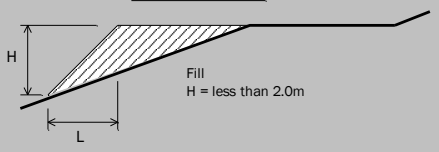
Where trees are located within the recommended distances outlined above, the construction of a vertical cut-off wall will be required to effectively prevent tree roots from gaining access to structures, therefore stabilising the soil by greatly reducing moisture movement. The vertical cut off wall should be constructed a minimum of 1 metre from the footings of the structure and generally 1 metre in depth, however this may depend on soil types.

2.06 BATTER ANGLES FOR EMBANKMENTS

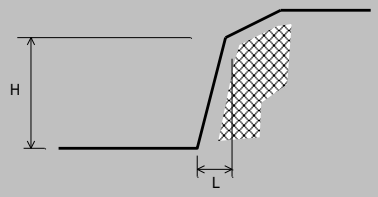
Batter angles must comply with local government requirements and are to conform as follows;

Note : Retaining walls or other form of soil retaining methods must be adopted where the slope ratio is greater than that indicated in the table below :-

FILL EMBANKMENTS



CUT EMBANKMENTS



MATERIAL TYPE (refer soils report)		EMBANKMENT SLOPES (Height : Length)	
		Compacted Fill	Cutting
Stable Rock (A*)		2 : 3	8 : 1
Sand (A*)		1 : 2	2 : 3
Silt (P*)		1 : 4	1 : 4
Clay	Firm Clay	1 : 2	1 : 1
	Soft Clay	Not Suitable	2 : 3
Soft Soils (P*)		Not Suitable	Not Suitable

2.07 FILL MATERIAL AND COMPACTION

For totally filling the pad to level, CBR 15 or decomposed rock is recommended. Fill placed behind a brick cavity is to be of a granular base consisting of either sand, CBR 15, decomposed rock or “crusher – dust”. Highly reactive clay based soil is not recommended for use as fill. Fill is to be placed in 150 mm deep layers, moistened and compacted to achieve the equivalent of 95% standard compaction. Compaction testing is to be in accordance with AS 1289, section 5.2.1. A vibrating “sheeps-foot” roller is recommended for compaction of the totally filled pad. A “vibrating-plate” or a “wacker-packer” is recommended for compaction of fill restrained by a brick-cavity.

Note; Fill is not to be compacted within 500 mm of the brick cavity base (retaining wall).

2.08 FLOOR TILES REQUIREMENTS

When it is proposed to adopt the use of floor tiles it is recommended that:

- tiles are not laid for a minimum period of two months after the slab has been poured.
- the slab is cured
- flexible adhesive and flexible grout is adopted
- for the extensive use of tiles, a system of expansion joints should be used to divide up the floor area into grids to minimise the potential problem of tile growth / shrinkage.

2.09 BUILDING OVER THE SITE OF A RECENTLY-REMOVED STRUCTURE

If previous structures such as tennis courts and slabs for large sheds/other buildings are removed to allow construction of the dwelling, then uneven ground movements may result since possible ground movements due to moisture changes may have already occurred under the removed slab. Such conditions should be identified at the time of the site inspection, and allowed for in the design.

2.10 DRAINS, CHANNELS, PONDS, DAMS, OR TANKS

The ground around this type of feature will normally be quite wet and any ground movement due to moisture would probably have already occurred. Again, if building over these areas, differential ground movements and the possible loss of bearing capacity should be allowed for in the design and detailing of the building.

2.11 PAVING

Paths, driveways and other paving all act as impermeable membranes in terms of soil moisture and, similar to the house slab, will cause ground movements due to moisture changes in the soil. Paving provides an excellent 'buffer zone' around the house that assists in reducing moisture variations around the footings. However, to work effectively, it is essential that paving has sufficient crossfall away from the house for the expected reactivity or ground movement of the site **Figure 4.9.** If laying pavements in summer, care should be taken to ensure that crossfalls are adequate to accommodate soil swelling in winter. All surface water should be drained to the stormwater system. Variations in paving between one side of the house and the other should be minimised, as this may cause differential movement of the footings. Further, if it is not possible to construct any planned paving immediately, then plastic sheeting with gravel spread on the top, graded away from the house, provides a practical temporary measure to facilitate the reaching of stable moisture condition.

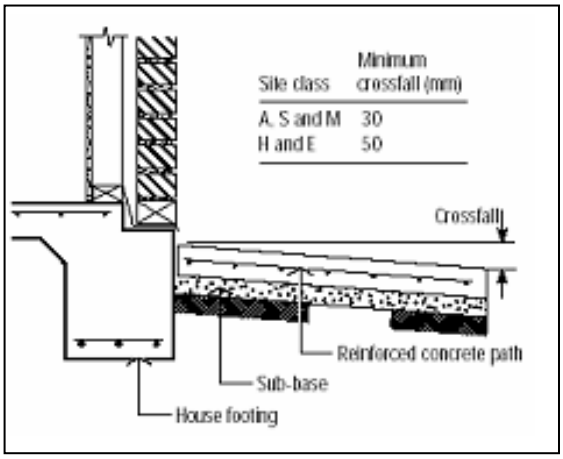


Figure 4.9 Minimum crossfall of paving for given site classifications

2.12 DRAINAGE

How will any earthworks affect natural site drainage? What measures will need to be taken to keep water away from footings? To minimise variations in moisture content in the foundation, especially under the footing, an effective drainage system must be installed and maintained for the site and building. This involves directing both surface and subsurface water away from the house. This is particularly pertinent when cuts are involved with slabs supported on ground. The minimum requirement will be that the ground be sloped away from the slab with a dish drain at the base of the batter or retaining wall to take surface water away from the high side of the house. On clay sites, sealed surface drains should be used since subsoil drains may introduce moisture into the foundation. Dish drains on the high side of unprotected batters may also be required if the face is likely to be eroded by run-off.

Storm water is the greatest source of surface runoff and large quantities are collected by the roof of a house. To ensure effective drainage, all downpipes need to be connected to an adequate stormwater system and directed away from the house, generally to the street or other stormwater drain. (Note: Some authorities prefer drainage to be retained on site where possible or held for a time before discharging into stormwater.) Similarly, paved areas should be graded to collection points that are connected to the stormwater system and are accessible for cleaning.

Individual sites, especially cut-and-fill sites, will have specific drainage requirements which should be detailed on a site or drainage plan prepared by the engineer or builder. On cut-and-fill sites, all batters and drainage should ensure adequate site drainage, spoon/dish drains and/or agricultural drains will generally be required to prevent surface and subsurface water draining towards the house **Figure 4.10.** Agricultural drains are also used in low-lying areas or on sites that have a tendency to collect excessive water.

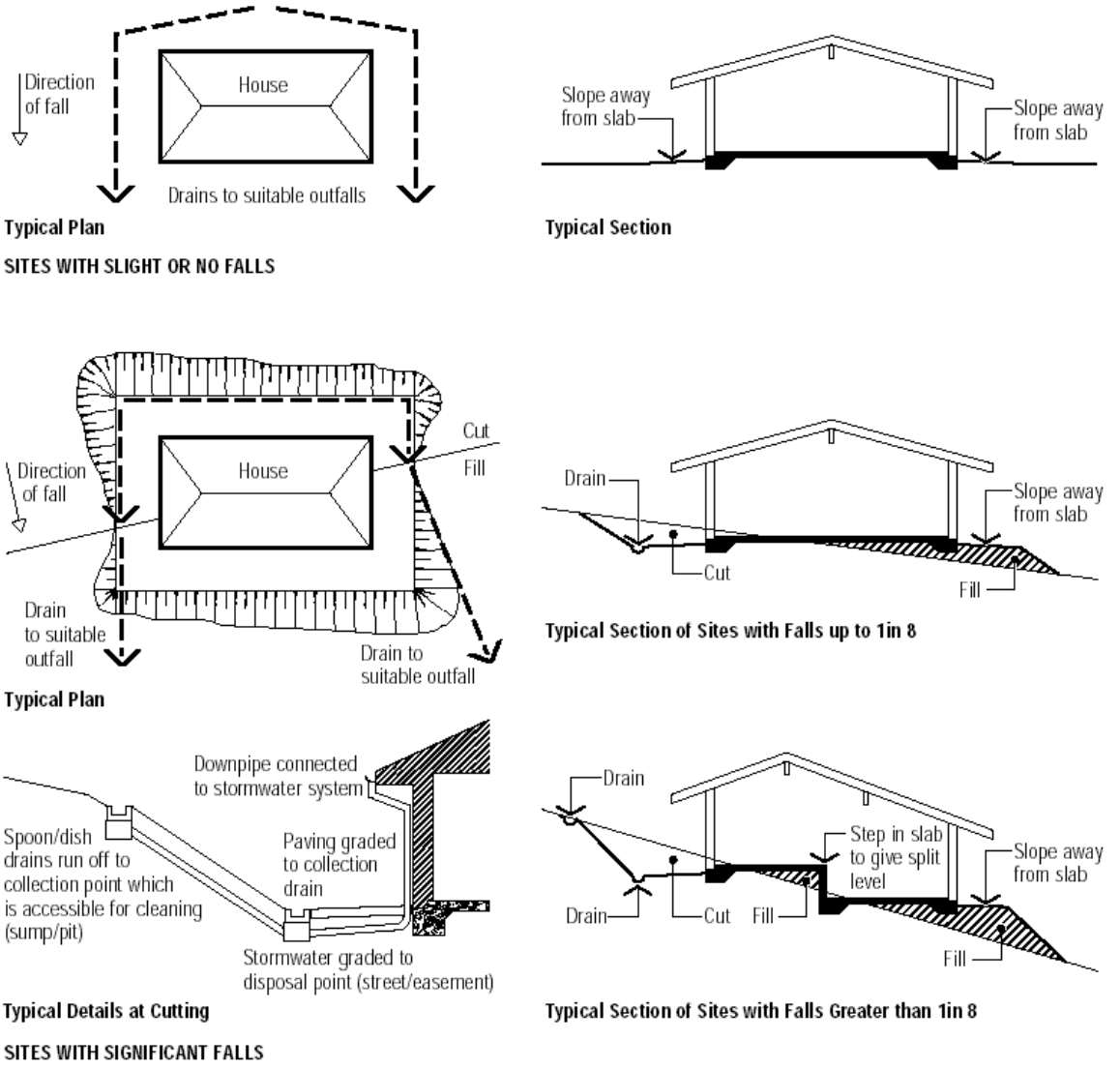


Figure 4.10 Stormwater drainage

2.13 MAINTENANCE

The maintenance of the site around a new home is an important factor in the long-term performance of the footing system. The primary objective of this maintenance is to minimise the variation in soil moisture levels around the footings that could lead to excessive soil movement and possible distress of the superstructure and/or footing. When the slab forms part of the termite barrier system for the house, then it is also necessary to maintain the effectiveness of that barrier with appropriate maintenance activities.

When a concrete slab-on-ground is used as part of the termite barrier system as outlined in AS 3660.1, then it cannot be too highly stressed that regular inspections and maintenance of the slab and surroundings by a competent professional is required to ensure that any termite infestation is detected and treated promptly.

Ongoing maintenance and inspections on a regular basis is a requirement of AS 3660.1 and owners should be clearly advised of their responsibilities to ensure that their investment is properly protected.

Leaking taps, downpipes, sewers, gutters and drains can also affect the moisture content of the soil and these must be inspected regularly to ensure against damage to the footings. Similarly, gutters, downpipes and collection points can get blocked with leaves and other debris, preventing the effective drainage of stormwater away from the house. Again, regular inspections and maintenance should be carried out to prevent blockages.

It is important for the builder to make the homeowner aware of the maintenance issues associated with ensuring the long-term performance of the footing system.

SECTION 3. RETAINING WALLS

3.01 INTRODUCTION

As the supply of level building sites diminishes, the need to level or terrace to create level building platforms for house construction will increase. Also, on many developed sites there is often a need to level the front and/or back yards to fully utilise the space for carports, gardens, play and entertainment areas.

Cut-and-fill is a common method of achieving level areas but if a batter is used between the level areas so created, a maximum area of level round will not be achieved. Furthermore, on some sites suitable fill may have to be imported and on others spoil disposed of, both of which will add to the cost. The alternative is to use retaining walls.

Apart from retaining the soil, retaining walls can also help protect against erosion on susceptible sites. The requirements of a functional retaining wall include: structural stability, durability against the exposed environment, and provision or drainage. Appearance will also usually be important.

Concrete retaining walls provide a durable solution that is required of a structure in contact with soil and exposed to constant wetting and drying. Concrete does not rot and will not be eaten away by termites. The wide range of available options ensures that a suitable solution can be found for any situation.

Important Considerations

The first step in any retaining-wall project is to check with the local authority to see if planning approval is required. This varies between authorities and is usually related to wall height and drainage provisions.
Authorities may require drawings showing a site plan and structural details accompanied by a consultant's design certification. Except for minor low-rise garden walls, up to, say, 600mm high, engineering advice should be sought on the wall deign for the given site.
Drainage is an important aspect of any retaining-wall project. Water must not be allowed to build up behind the wall. Retaining walls are designed to resist earth pressures exerted by only the weight of soil retained. These are much less than the hydrostatic pressure exerted by water dammed behind the wall.

The following parameters influence the design of the retaining wall:

- Wall height
- Soil type
- Sloping land below and/or above the retaining wall
- Loads above and behind the retaining wall, eg parked cars.

Apart from retaining the soil, retaining walls can also help protect against erosion and susceptible sites.

3.02 GENERAL DESIGN PRINCIPLES

Soil restrained by a vertical or near-vertical retaining wall exerts a lateral pressure against the wall. This pressure tends to cause sliding and /or rotation of the wall which must therefore be designed to resist these forces over the intended design life. Apart from structural design, durability and drainage must also be given particular attention. The design should be undertaken by a professionally qualified consultant to suit the particular building site parameters.

3.03 TYPE OF RETAINING WALLS

Retaining walls can be grouped into two distinct categories by considering the way in which they resist the lateral force exerted by the soil:

Gravity retaining walls these walls use their own weight and/or captured soil weight to resist the lateral soil forces. **Figure 1.**

Piled retaining walls These walls use the embedded depth of vertical posts and the strength of the posts to resist lateral soil forces **Figure 2.**

Within these two categories there are a number of different and innovative concrete retaining wall types available. Some manufacturers offer technical support, in the form of brochures showing engineer-designed details, for their particular wall type.

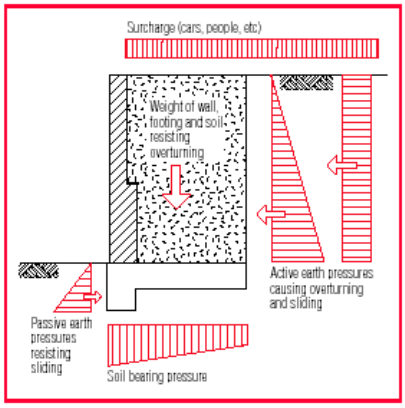


Figure 1 Gravity wall

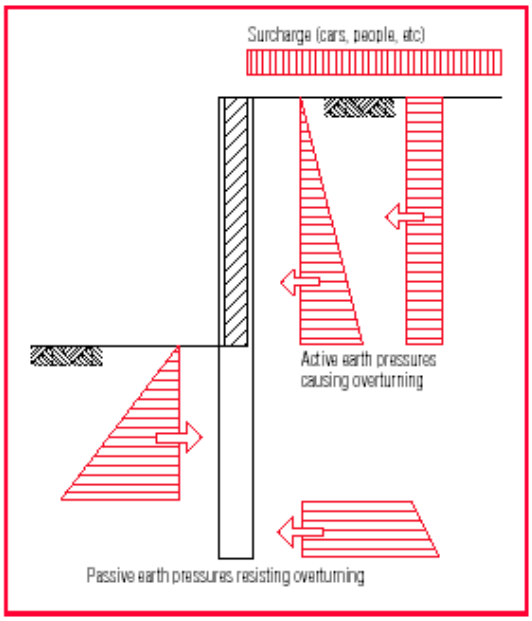


Figure 2 Piled wall

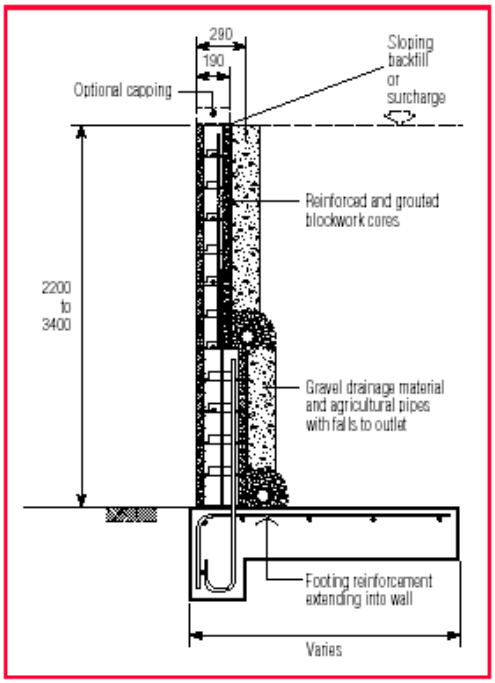


Figure 3 Concrete masonry

3.04 RETAINING WALL SYSTEMS

Reinforced concrete masonry walls

Reinforced concrete core-filled hollow concrete blocks are laid on a reinforced concrete footing to form a cantilever gravity retaining wall. This is an extremely popular system offering benefits that include zero lot lines, a vertical wall face and a range of possible finishes. They are economical to around 3 m in height. Full details of block wall construction is provided in *Masonry Wall 4 design for Earth Loads – Retaining Walls* published by the Concrete Masonry Association of Australia.

Gravity wall

Gravity wall

Piled wall

Insitu concrete walls
Cantilever gravity walls can be constructed entirely from reinforced concrete. They are similar to reinforced masonry walls. The wall is cast on site and the exposed vertical face can be treated in many ways, including the use of textured form liners to give particular patterns or motifs.

Dry stacked segmental block walls
Low-height retaining walls (generally 1 m and less) can be constructed from dry stacking specially-manufactured segmental concrete masonry blocks. The blocks interlock, which provides a positive connection between blocks. These walls behave as a gravity wall and are available in a variety of colour and face finishes. They are extremely popular for DIY installations as they are easy to erect. Local concrete masonry suppliers should be contacted for specific system details.

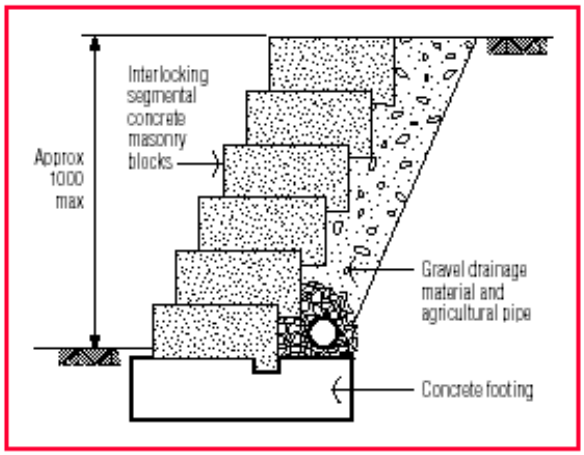


Figure 4 Segmental block

Segmental block with soil reinforcement walls

Walls of similar appearance to dry-stacked segmental concrete masonry block walls but without the height limitation can be constructed by dry stacking similar segmental concrete masonry blocks connected to layers of horizontal geo-synthetic soil reinforcement placed in the backfill behind the wall units. The blocks have an interlocking shape, which provides a positive connection between the blocks and the soil reinforcement. These walls are a gravity system. However, unlike the earlier segmental block walls, they utilise the soil mass behind the wall to help resist the lateral soil forces. This is usually referred to as 'reinforced soil technology'. It is an engineering solution and requires supervision by a competent contractor.
Local concrete masonry suppliers should be contacted for specific system details.

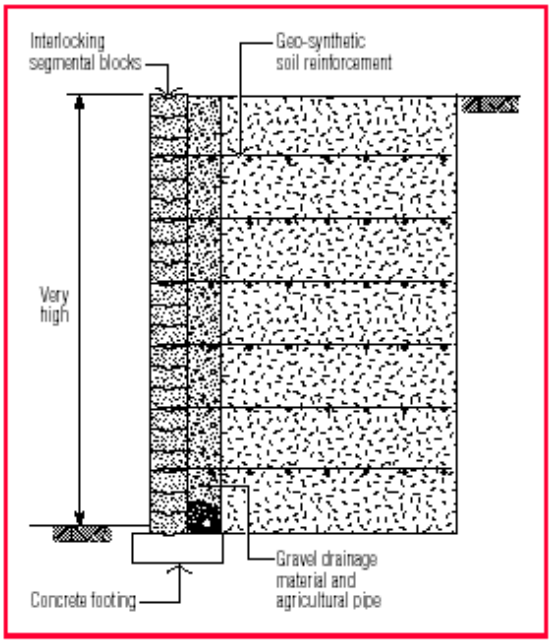


Figure 5 Soil reinforced segmental block

Crib walls
Crib walls are constructed from precast concrete components that interlock and form an open crib. The spaces between the units are filled with gravel making the system free draining. Crib walls can be economically designed and built for a wide range of wall heights. Wall aesthetics can be enhanced by planting vines on top to the wall and in the spaces above the cribs to drape down over and soften the appearance of the wall face.

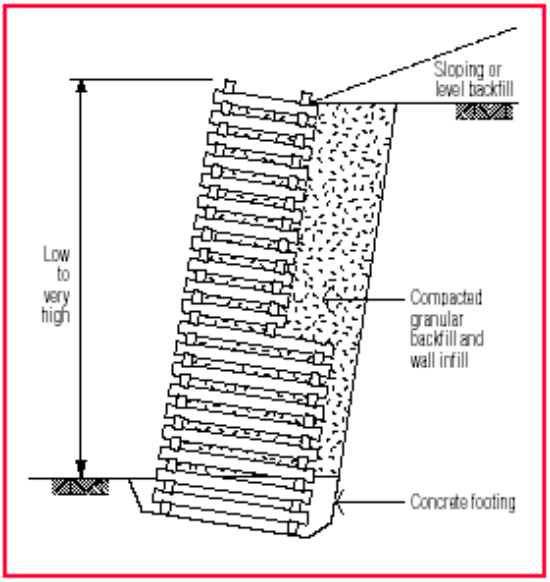


Figure 6 Crib wall

*Concrete offers a wide range of retaining wall options to suit a particular project's requirements. For the various manufactured systems check with the suppliers for details and advice.

Concrete sleeper

Precast concrete sleeper planks span horizontally between vertical precast concrete posts that are embedded into the ground. Usually the posts are cast into a bored insitu concrete footing. This is a piled system that relies on the embedment and strength of the post and sleeper units to resist lateral soil forces. It is a low-cost system and can achieve 'zero-lot-line construction'. Posts and sleepers can be coloured and face textured to resemble timber grain, slate, etc.

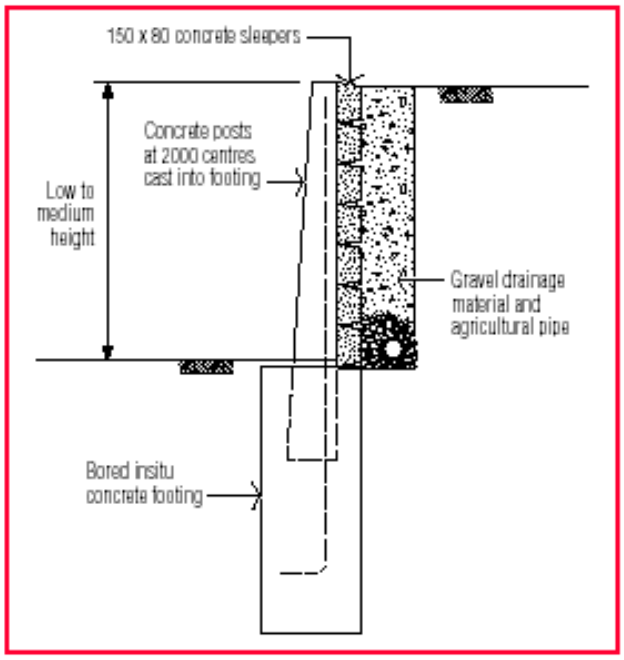


Figure 7 Concrete sleeper wall

SUMMARY

Concrete offers a wide range of retaining wall options to suit a particular project's requirements. For the various manufactured systems check with the suppliers for details and advice. Remember that for all walls, foundation preparation, drainage and good workmanship are essential. Engineering advice should always be sought and council requirements ascertained prior to retaining wall construction.

DEED OF AGREEMENT

BETWEEN: STA CONSULTING GROUP PTY LTD TRADING AS STA CONSULTING ENGINEERS ABN 69 153 047 566 of 241 Milton Road, Milton Qld 4064 (hereinafter referred to as "the Engineer")

AND: (hereinafter collectively referred to as "the Builder"

AND: **(**hereinafter collectively referred to as "the Owner")

RECITALS:

A. The Owner is or will be the registered Proprietor of the site address (hereinafter referred to as "the Land")

B. This Deed is part of the Foundation Design Report prepared by the Engineer for the Land dated Project Job no. ("the Report")

C. The Engineer and the Builder seek to ensure that the Owner is aware of the Owner's responsibilities for the Land.

OPERATIVE:

1. For the Report and the Home Owner's Reference Guide version 6002.1.1, the Owner:

   Acknowledges receipt of this document;

   Acknowledges an obligation to read and understand where applicable the document;

   Acknowledges that the document contain requirements and recommendations and that all requirements and recommendations must be complied with by the Owner.

2. The Owner must –

   Advise immediately the Engineer in writing of any structural problems with any of the structures on the Land as set out in the Report as soon as any such structural problem is observed by the Owner and in particular any foundation movement, major cracking of the brickwork or the slab that shows differential movement.

   Read and understand section 2.09 of the Home Owner's Reference Guide version 6002.1.1 which is restated here as follows: "2.09 Excavations, retaining walls, swimming pools and other structures which are built after the Report may change the soil conditions and the Engineer or another engineer must be consulted prior to any such work being undertaken. Should soil conditions vary significantly from those indicated in the Report, or if the proposed building

   design or proposed site preparation details are changed, the Engineer is to be contacted immediately in order to present amended recommendations.";

Together with the Owner's successors and assigns, not sell or transfer the Land without first advising the buyer or transferee of this agreement that has been entered into; That is the deed with the Engineer and the Builder.

3. If the Owner breaches any term of this Deed then the owner acknowledges that any loss and damage suffered as a result of any breach, is the Owner's sole responsibility.

4. This Deed is governed by a law of the State in which the Land is situated.

5. In the event that the whole or any part or parts of any clause in this Deed is found to be unenforceable by a court or tribunal then such clause or part thereof shall be to that extent severed from this Deed without effect to the validity and enforceability of the remainder of the terms of this Deed.

SIGNED SEALED AND DELIVERED by the Owner (insert full name or names of owner))))) ……..……

……..
Witness

……..
Print full name of witness