Limited Site Classification

Lot 7 No.16 Bayview Road, Tea Gardens NSW

Site Classification	Soil Reactivity	Wind Classification	Water Penetration
AS2870:2011 - Section 2	AS2870:2011 - Section 2	AS4055:2021 - Section 2	AS2047:2014 - Section 1.3.7 / Table 2.4
P	**A**	**N2**	**200kPa**

Project: P20072-WR-17044
Written by: Peter Ross
Reviewed by: Khai Steele
Email: office@huntergeo.au
Client: MOJO Homes

Site Information

Builders Client:	Robert Lord	**Builder Job No:**	257039/016/01
Builder:	MOJO Homes	**HGS Job No:**	P20072-WR-17044
Site Adress:	Lot 7 No.16 Bayview Road, Tea Gardens NSW		
Fieldwork Date:	23/10/2024	**Fieldwork By:**	LB
Reported By:	PR	**Reviewed By:**	KS

Site Description

Slope Direction: Flat **Exisitng Fill:**
Slope Gradient: 1° - 2° **Controlled:**
Retaining Walls:
Vegetation:
Existing Development: Undeveloped

Borehole 1 Location: Refer to Site Plan Equipment: Trailer Mounted Drill Rig

Depth	Material	Colour	Consistency / Density	Moisture
0.00 - 0.40	Silty SAND	pale Gr Br	L	D
0.40 - 0.60	SAND	pale Gr	MD	D - M
0.00 - 3.00	SAND	pale Gr	MD	W
	Terminated at 3m			

Sample Recovered: N/A
Groundwater Encountered: 1.5
Rock Encountered: N/A

Borehole 2 Location: Refer to Site Plan Equipment: Trailer Mounted Drill Rig

Depth	Material	Colour	Consistency / Density	Moisture
0.00 - 0.40	Silty SAND	pale Gr Br	L	D
0.40 - 0.60	SAND	pale Gr	MD	D - M
0.00 - 3.00	SAND	pale Gr	MD	W
	Terminated at 3m			

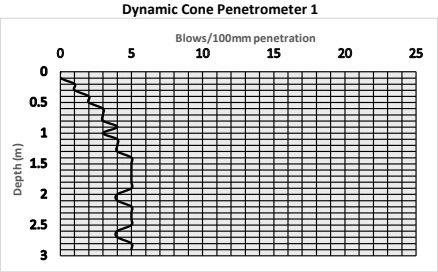
Sample Recovered: 0.2/0.4
Groundwater Encountered: 1.5
Rock Encountered: N/A

Location: Equipment:

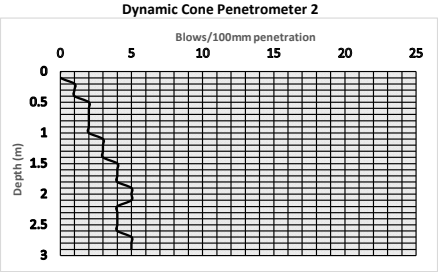
Depth	Material	Colour	Consistency / Density	Moisture

Sample Recovered:
Groundwater Encountered:
Rock Encountered:

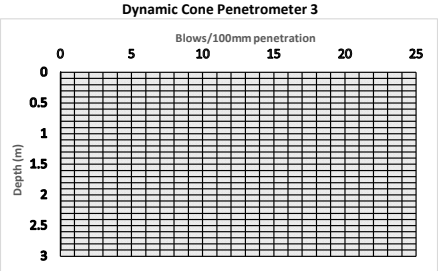
Dynamic Cone Penetrometer 1



Dynamic Cone Penetrometer 2



Dynamic Cone Penetrometer 3



Borehole Key

Material : w = with, t = trace, inclus = inclusions, XW = Extremely Weathered, DW = Distinctly Weathered, HW = Highly Weathered, MW = Moderatley Weathered, SW = Slighty Weathered, FR = Fresh, SAST = Sandstone, CLST = Claystone, SIST = Siltstone, CONG = Conglomerate

Colour: Bl = Black, W = White, Gr = Grey, R = Red, Br = Brown, O = Orange, Y = Yellow, P = Purple, G = Green, B = Blue

Consistency / Density: VS = Very Soft, S = Soft, F = Firm, St = Stiff, VSt = Very Stiff, H = Hard, Fr = Friable, VL = Very Loose, L = Loose, MD = Medium Dense, D = Dense, VD = Very Dense, Inf = Inferred

Moisture: D = Dry, M = Moist, W = Wet, <PL = Less than Plasticity Limit, ≈PL = Approximatley equal to Plasticity Limit, >PL Greater than Plasticity Limit, ≈LL = Approximatley equal to Liquid Limit, >LL = Greater than Liquid Limit

Site Classification to AS2870-2011

Suction Depth, H_s (m)	Chan & Mostyn	1.50
Linear Shrinkage (%)	AS1289 Clause 7.1.1, 7.1.2, 7.1.3	Non-Plastic
Estimated Depth 100kPa Allowable Bearing Achieved (m)	Clause 2.4.5	0.60
Assumed Cut / Fill (m)	Clause 2.5.2, Clause 2.5.3	**< 0.8 (Sand Fill)**
Tree-Induced Differential, Centre Heave, Mound Height, Ym (mm)	Clause 2.5	
Site Classification	Clause 2.1.3	**Class P**
Estimated Soil Reactivity	Clause 2.1.2 (Table 2.1)	**Class A**

Tree Score Effect

Tree Characteristics	Canopy	Medium
	Tree Height	15
	Stage of Growth	Mature
	Drought Resistant	
Ground and Site Conditions	Depth of Fill	
	Adverse Conditions	Yes
	Soil Reactivity Profile	
Tree Effect		**Moderate**

Design Tree Effect

Design Tree Effect, Y_t (mm)	

Classification comments: **The site was classified as Class P due to insufficient bearing capacity / Loose soils to a depth of 0.6m. Groundwater was also encountered at the site at a depth of 1.5 m. Thus in accordance with AS2870 foundations should be designed using engineering principles. Furthermore, it is recommended that a minimum Class M slab design be adopted for the Site.**

Wind Classification to AS4055-2021

Wind Region	Clause 2.2 (Figure 2.2)	Region A
Terrain Category	Clause 2.3	TC1
Topographic Class	Clause 2.4 (Table 2.4)	T0
Shielding Classification	Clause 2.5	PS

Wind Classification: **N2**

Note: Wind Classification shown herein is based on estimates of the future terain category and shielding for this site in five (5) years time

Water Penetration Pressures to AS2047-2014

Exposure	Penetration Pressure (kPa)
Exposed	200kPa

General Notes and Report Limitaitons

This investigation was completed by an experienced Geotechnical Officer per AS1726:2017 and does not make any allowances for any possible Mine Subsidence within the building envelope. Any existing fill during the investigation is assumed to be uncontrolled unless specified otherwise. This Site Classification is to be confirmed by a builder, engineering geologist or engineer. All works should be conducted in accordance with AS 3798. If filling is required relative compaction and oversize material of the selected fill is recommended to be controlled (refer AS3798 clause 4.3 a to d). Typically this will be obtained by a minimum STD MDD Ratio of 95%(AS3798 - Table 5.1) and moisture variation of +/-2% of optimum per 200mm compacted layer or uniform thickness (AS3798 6.2.2 & Table 8.1). If controlled fill is to be placed over existing fill it is assumed that the existing fill is controlled or will be reinstated in a controlled manner. Ys values for Cut/Fill are estimates only. If fill/cut is >0.4m for clay or >0.8m for sand fill the site should be reassessed in accordance with AS2870.

Borehole Location Plan

Lot 7 No.16 Bayview Road, Tea Gardens NSW

HGS Ref: P20072-WR-17044
Limited Site Classification

2D Siting Plan - Ground

Customer Details

Name:

Email:

Phone:

Address: 16 Bayview Road, Tea Gardens

Council: Mid-Coast Council

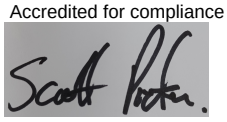
House Name: Enigma - 36

Material Test Report

Report Number:	**P20072-1107**
Issue Number:	1
Date Issued:	29/10/2024
Client:	MOJO Homes Pty Ltd
	PO Box 340, East Maitland NSW 2323
Project Number:	P20072
Project Name:	P20072 - Limited Site Classification
Project Location:	Lot 7 No.16 Bayview Road, Tea Gardens NSW
Client Reference:	257039/016/01
Work Request:	17044
Sample Number:	24-17044A
Date Sampled:	23/10/2024
Dates Tested:	23/10/2024 - 29/10/2024
Sampling Method:	AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location:	**bh2, Depth: 0.2/0.4m**
Material:	sand

Hunter Geotechnical Services
62 Sandringham Avenue Thornton NSW 2322
Phone: (02) 4966 1844
Email: sp@huntercivilab.com.au

Accredited for compliance with ISO/IEC 17025 - Testing



Approved Signatory: Scott Picton
Technician
NATA Accredited Laboratory Number: 14975

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)			
Cracking Crumbling Curling			
Linear shrinkage could not be determined as the liquid limit could not be obtained and the material is non-plastic.			

This document shall not be reproduced except in full without approval of the laboratory.
Results relate only to the items tested/sampled.

LSC Report Limitations

The purpose of this report is to provide information based on a limited geotechnical investigation by an experienced geotechnical officer, to estimate the Site Classification of the relevant Lot to AS2870:2011 - Residential slabs and footings.

This report has been prepared by Hunter Geotechnical Services (HGS) based on the limited investigation for the specific site and purposes described above. HGS will accept no responsibility or liability for the use of this report by any third party, without the express consent of HGS and the Client, or for use at any other site or purpose than that described above.

The classifications in this report are subject to the specific conditions encountered and the limited geotechnical data gathered at the site during the investigation, as well as stated assumptions about the site, as such all classifications provided in this report should be confirmed by a suitably qualified builder, Engineering Geologist or Engineer prior to commencing construction. If the site undergoes any earthworks, which vary the subsurface conditions from those outlined in this report, the site must be reassessed by a suitably qualified Engineering Geologist or Geotechnical Engineer.

The subsurface conditions and results presented in this report are indicative of the conditions encountered at the discrete sampling and testing locations within the site at the time of the investigation and within the depths investigated. Variations in ground conditions may exist between the locations that were investigated, and the subsurface profile cannot be inferred or extrapolated from the limited investigation conducted by HGS. For this reason, the report must be regarded as interpretative, rather than a factual document.

Subsurface conditions are subject to constant change and can vary abruptly as a result of human influences and/or natural geological and/or climatic processes and events. Conditions may exist at the site that could not be identified during or may develop after the current investigation has been conducted and as such, may impact the accuracy of this report. HGS should be contacted for further consultation and site re-assessment should subsurface conditions differ from those conditions identified in this report.

This report does not make allowances for any possible mine subsidence within the building envelope. Any existing fill encountered during the investigation is assumed to be uncontrolled unless specified otherwise.

All works should be conducted in accordance with AS3798-2007 – Guidelines on earthworks for commercial and residential developments. If filling is required, relative compaction and oversize material of the selected fill is recommended to be controlled (refer AS3798 clause 4.3 a to d). Typically this will be obtained by a minimum STD MDD Ratio of 95% (AS3798 - Table 5.1) and moisture variation of +/-2% of optimum per 200mm compacted layer or uniform thickness (AS3798 6.2.2 & Table 8.1). If controlled fill is to be placed over existing fill it is assumed that the existing fill is controlled or will be reinstated in a controlled manner.

Safety in design assessment is outside the current scope of work of this report. HGS has had no involvement in any design that relies upon the geotechnical advice contained in this report. HGS cannot

be held liable for any loss of life or property damage arising from any hazards that arise from the geotechnical advice.

HGS recommends geotechnical reports older than 5 years from the date shown on the report, reports submitted for a previous (unrelated) development application on the site, or sites that have been altered by earthworks be reviewed by a qualified geotechnical consultant to confirm that the scope of the investigation undertaken for the report and the contents of the report are appropriate for the current development being proposed.

Any and all previous report versions for 257039/016/01 are superseded by this report.

Foundation Maintenance and Footing Performance: A Homeowner's Guide

CSIRO PUBLISHING

BTF 18-2011 replaces Information Sheet 10/91

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870-2011, the Residential Slab and Footing Code.

Causes of Movement

Settlement due to construction

There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

Erosion

All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

Saturation

This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume, particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

Seasonal swelling and shrinkage of soil

All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

Shear failure

This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.

In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites, which may experience only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which may experience moderate ground movement from moisture changes
H1	Highly reactive clay sites, which may experience high ground movement from moisture changes
H2	Highly reactive clay sites, which may experience very high ground movement from moisture changes
E	Extremely reactive sites, which may experience extreme ground movement from moisture changes

Notes

1. Where controlled fill has been used, the site may be classified A to E according to the type of fill used.
2. Filled sites. Class P is used for sites which include soft fills, such as clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soil subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise.
3. Where deep-seated moisture changes exist on sites at depths of 3 m or greater, further classification is needed for Classes M to E (M-D, H1-D, H2-D and E-D).

Tree root growth
Trees and shrubs that are allowed to grow in the vicinity of footings can cause foundation soil movement in two ways:

- Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.
- Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.

Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

Effects of Uneven Soil Movement on Structures

Erosion and saturation
Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpends).

Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

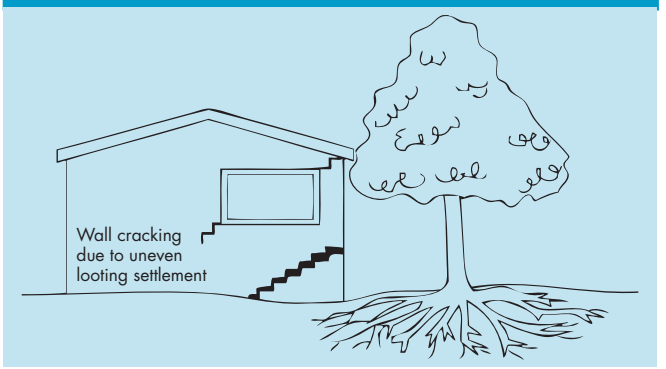
Seasonal swelling/shrinkage in clay
Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.

As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Trees can cause shrinkage and damage



Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

Movement caused by tree roots
In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

Complications caused by the structure itself
Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

Effects on full masonry structures
Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures
Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation causes a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

Effects on brick veneer structures
Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem. Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.
- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870-2011.

AS 2870-2011 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

Prevention/Cure

Plumbing
Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

Ground drainage
In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

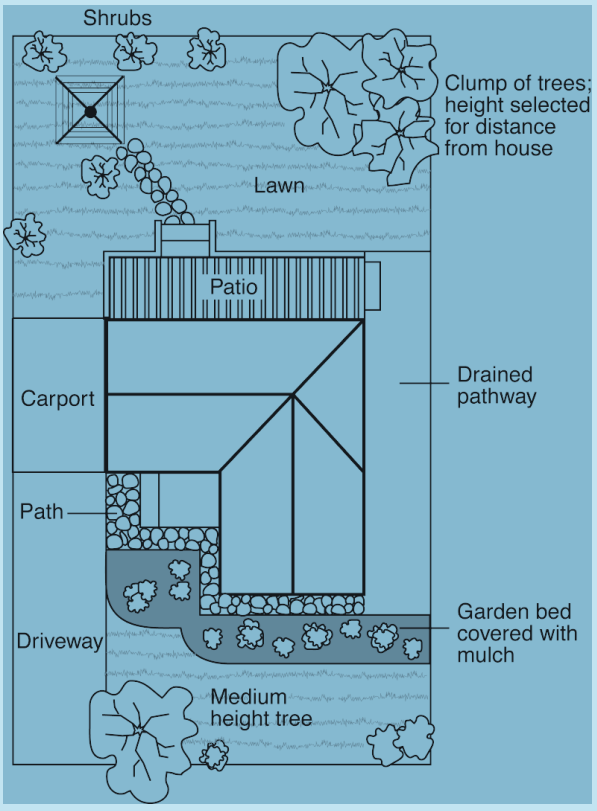
Protection of the building perimeter
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving should

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

Description of typical damage and required repair	Approximate crack width limit (see Note 3)	Damage category
Hairline cracks	<0.1 mm	0
Fine cracks which do not need repair	<1 mm	1
Cracks noticeable but easily filled. Doors and windows stick slightly.	<5 mm	2
Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired.	5–15 mm (or a number of cracks 3 mm or more in one group)	3
Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted.	15–25 mm but also depends on number of cracks	4

Gardens for a reactive site



extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

Warning: Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.

The information in this and other issues in the series was derived from various sources and was believed to be correct when published.

The information is advisory. It is provided in good faith and not claimed to be an exhaustive treatment of the relevant subject.

Further professional advice needs to be obtained before taking any action based on the information provided.

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