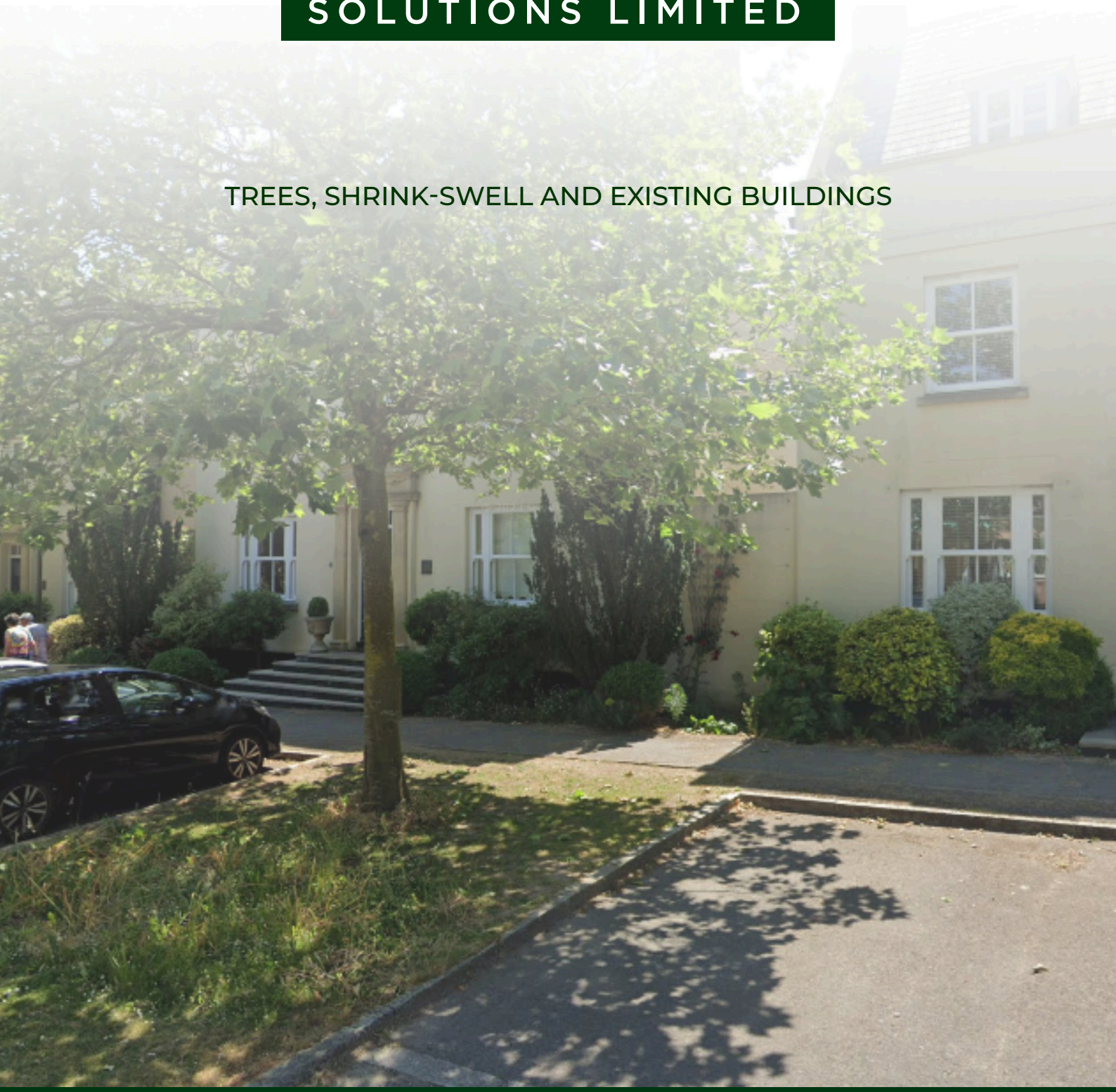
HELLIS

SOLUTIONS LIMITED

TREES, SHRINK-SWELL AND EXISTING BUILDINGS



TREES, SHRINK-SWELL AND EXISTING BUILDINGS

The following is a brief introduction to tree related shrink-swell (often referred to as subsidence and heave) and relates to existing low-rise commercial and domestic buildings.

INTRODUCTION

Shrink-swell is the most damaging geohazard in Britain today, costing the economy £540 million following a drought in 1991. Heat waves in 2003 and 2006 led to peaks in shrink-swell claims. More recently, the Association of British Insurers (ABI) reported that over 10,000 households made claims worth a total of £64 million during July to September in 2018 (ABI, 2018). The ABI stated that the 350 per cent increase in the value of claims during July to September 2018 was the highest quarterly jump since records started more than 25 years ago.

In the USA, the estimated damage to buildings and infrastructure exceeds $15 billion annually. The American Society of Civil Engineers estimates that one in four homes have some damage caused by shrink–swell soils; in a typical year, such soils cause a greater financial loss to property owners than earthquakes, floods, hurricanes and tornadoes combined (Nelson and Miller, 1992).

British Geological Survey

WHAT IS A SHRINK-SWELL?

Shrink-swell only occurs where there are geological stability hazards; these geological stability hazards may be natural or man-made.

The six most common ground stability hazards are:

a) **collapsible ground**
b) **compressible ground**
c) **ground dissolution**
d) **landslips**
e) **running sand**
f) **swelling clay**

Mining is an entirely man-made stability hazard.

Ground instability refers to the propensity for upward, lateral or downward movement of the ground. Some movements may be gradual and of millimetre or centimetre scale, whilst others may be sudden and of metre or tens of metres scale.

Tree related shrink swell only occurs on swelling clay. Trees do not contribute to shrink swell damage associated with the other five common ground stability hazards.

Shrinkage can cause differential settlement in buildings and structures whilst swelling can cause lifting.

SWELLING CLAYS

Shrink-swell damage occurs on swelling clays, as a result of changes in the moisture content. The changes in moisture content cause a change in volume of the clay resulting in either the ground shrinking or swelling.

Shrinkage can cause differential settlement in buildings and structures whilst swelling can cause lifting of buildings and structures.

Moisture content can and does vary naturally with the seasons and hence clay rich deposits will naturally shrink and swell during the course of the year.

Soil moisture content can be influenced by a wide range of factors, including but not limited to, the presence of trees. This report does not consider the wider range of factors that may influence soil moisture content.



Image: Chris Page.

LEFT: Differential subsidence due to the downslope side of the house moving on shrinkable deposit.

RIGHT: Damage to the corner of a house by heave.



Image: Peter Kelse.

TREES AND SHRINK-SWELL

There are five primary factors to be considered when assessing the likelihood of trees causing or contributing to shrink-swell (subsidence or heave). These factors are:

a) **swelling clays - the presence or lack of**
b) **tree species**
c) **tree height**
d) **distance of the tree from the building**
e) **depth of foundations**

Trees including shrubs and hedgerows extract moisture from the ground and on swelling clays this can cause shrinkage in volume. The extent to which a tree extracts moisture from the ground is determined by the species of the tree and the zone of influence. The zone of influence defines the lateral extent from which a tree extracts moisture. The zone of influence of a tree is determined by the water demand, and the mature height of the tree, please see Table 1 below 'Water demand of tree species in relation to their height -selected trees'. The zone of influence of a tree is given in table 2 below.

TABLE 1. Water demand of tree species in relation to their height - selected trees

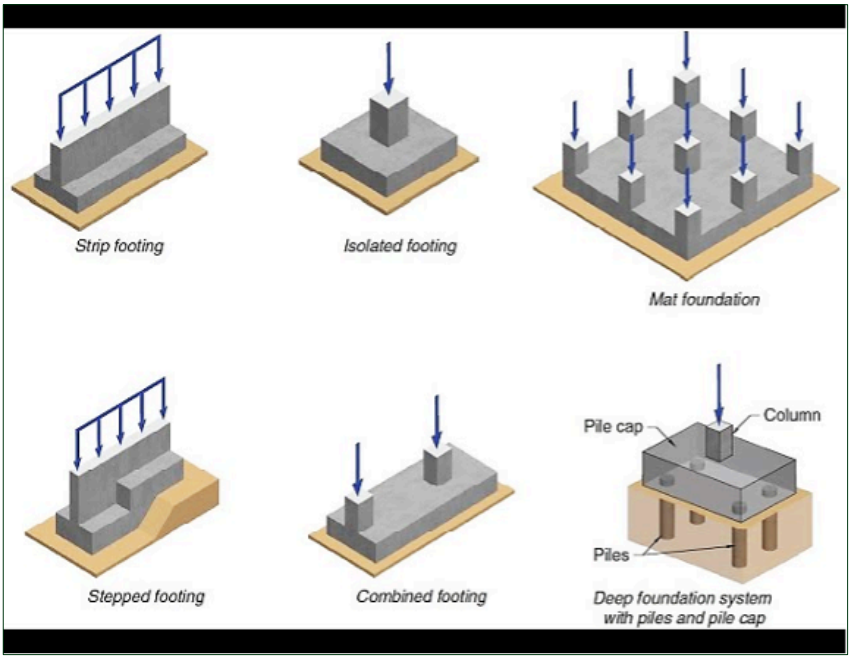
WATER DEMAND	SPECIES	MATURE HEIGHT
High	Cypress	20
	Hawthorn	10
	Oak - English	20
	Turkey Oak	24
	Willow - Weeping	16
	Crack Willow	24
	Eucalyptus	18
	White Poplar	15
Moderate	Apple	10
	Beech	20
	Blackthorn	8
	Pine - all	20
	Horse Chestnut	20
	Mountain Ash	11
	Sycamore	22
Low	Birch	14
	Hazel	8
	Holly	12
	Magnolia	9
	Fig	8
	Hornbeam	17
	Tulip Tree	20

TABLE 2. The Zone of Influence of a tree

WATER DEMAND	ZONE OF INFLUENCE
High	1.25 x mature height
Moderate	0.75 x mature height
Low	0.5 x mature height

EXAMPLES: An English oak can extract soil moisture at a distance of 25.0m from a building whereas a holly tree can extract soil moisture at a distance of 6.0m from a building.

NATIONAL HOUSE BUILDING COUNCIL (NHBC)



The combination of swelling clays and trees, hedgerows or shrubs represents a potential hazard to structures that requires special consideration. Trees, hedgerows, and shrubs take moisture from the ground, and, in swelling clays, this can cause significant volume changes resulting in ground movement. This has the potential to affect foundations and damage the supported structure. In order to minimise this risk, foundations should be designed to accommodate the movement or be taken to a depth where the likelihood of damaging movement is low.

The NHBC provide guidance for common foundation types to deal with the hazard and includes suitable foundation depths which have been established from field data, research, NHBC data and practical experience. The depths are not those at which root activity, desiccation and ground movement are non-existent, but they are intended to provide an acceptable level of risk. However, if significant quantities of roots are unexpectedly encountered in the base of the trench, the excavation may need to be deepened.

Consideration has been given to the potential effects of climate change in the guidance provided.

TREES, SHRINK-SWELL AND EXISTING BUILDINGS - A SUMMARY

Trees can cause or contribute to shrink-swell in the presence of swelling clays when the foundations of an existing building are inadequate. Conversely, when the foundations are adequate, regardless of the presence of swelling clays or the presence of trees, the risk of shrink-swell is insignificant.

Buildings, constructed after 1989, are assumed to comply with technical requirements of the National House Building Council, and the risk posed to the supported structure by trees, hedgerows or shrubs is deemed to be acceptable.

REFERENCES

National House Building Council Chapter 4.2 Building near trees 2021

British Geological Survey Note Ground shrinking and swelling - May 2012

A British Geological Survey Natural Ground Stability Report - December 2023