Report on Soil Risk Analysis

Estimate of Ground Movement

Property

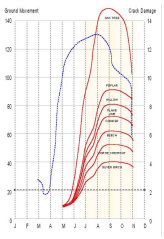
14a Downshire Hill
London
NW3 1

Claim Reference

SU1403227

Date

13 Oct 2014



Introduction

The likely effect of the interaction between soils in the area, climate, tree species, height and the distance of the tree to the building have been modelled to derive an estimate of ground movement.

The link between climate and ground movement is well established. We have referred to the published work of Ward[1], The Building Research Establishment[2], Cheney[3] and others to set the upper bound conditions prior to applying a finite difference technique to model ground movement and linked this to our extensive soils database.

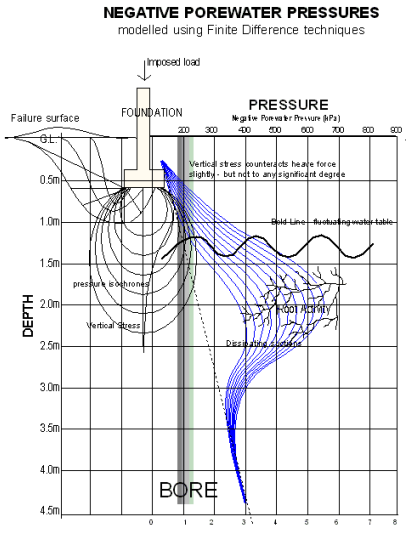
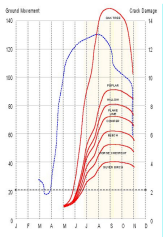


Figure 1
Finite difference technique for modelling ground movement.

The influence of trees is more difficult to model, and we have adopted a statistical approach, making comparisons with the results of precise level readings. We have the starting point of a tree rank order from The Building Research Establishment (and others) combined with our own empirical dataset, and established a risk value against most of the commonly occurring species.

[1] Ward W.H. (1953) "*Soil Movement and Weather*" Proc. 3rd Int. Conf. On Soil Mechnaics and Foundation Engineering. Vol 1. Pp 477 - 482
[2] Driscoll R.M.C. & Crilly M.S. (2001) "*Subsidence Damage to Domestic Buildings*" B.R.E.
[3] Cheney J.E. (1989) "*Long Term Heave of a Building Founded on Clay Soil after Tree Removal*" Conf. Geotechnical Instrumentation in Civil Engineering Projects. Nottingham.



The model uses the periodic signatures of the various elements – for example the curve of the Soil Moisture Deficit (SMD) values compared with ground movement – and to model the influence of trees we have utilised as a proxy the negative porewater pressure curve of root induced suctions.

The model has been validated against claims data gathered over a two-year period.

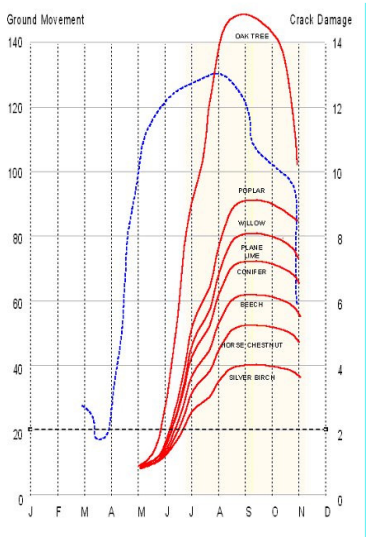
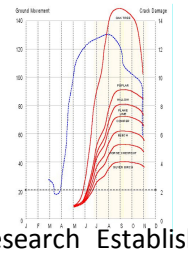


Figure 2
Relationship between climate (SMD – blue line) and ground movement (red lines) for a variety of mature trees, set in rank order of risk.

Much is often made of the difficulty in applying this technique to domestic subsidence and yet the N.H.B.C. tables are in common use and often used to design foundations without investigations. This is a simple extension of this approach. Difficulties are sometimes raised regarding the 'non-linearity' of the soil and root interaction due to anisotropy and inherent variability of the factors and yet we see from published (and unpublished) work that statistically, the association is robust.



Below we reproduce the results of work undertaken at The Building Research Establishment following removal of mature poplars from a site underlain by highly shrinkable clay. Levels were taken at varying distances from the tee and we can see a linear pattern to the ground movement.

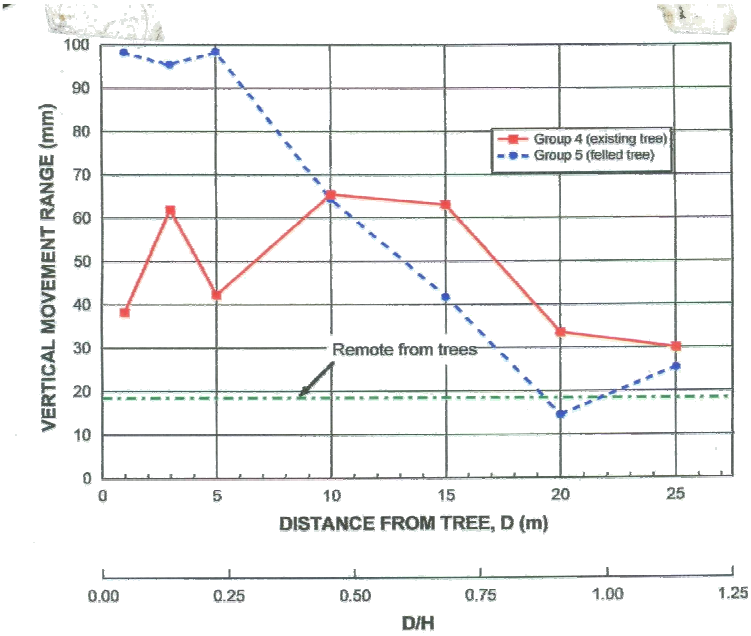
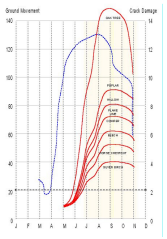


Figure 3
Measurement of ground Movement at Chattenden following removal of some mature Poplar trees, courtesy of B.R.E. The blue broken line represents linear 'recovery' of the soil for a distance almost equal to the height of the trees.

The method is certainly no less reliable than undertaking actual investigations when we consider that the measurement of moistures and their correlation to index properties of clay soils has no substance in published research. Suctions measurements using the filter paper technique are +/- 25% ignoring the fact that soil mineralogy can produce anomalous and misleading results.



Geology

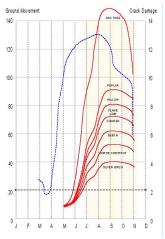
Clay soils are sedimentary deposits (marine or inland) with a fine particle size (less than 0.002mm). Due to their mineralogical composition they suffer volumetric change in direct relation to their moisture content. When they are dry, they shrink. On rehydration the clay soil will swell again.

The amount of swell depends on the soil mineralogy and its structure. Clays in this area are categorised as having a low shrink/swell potential[4, 5]

Sector Data

Average P.L.	No data available
Average L.L.	No data available
Average P.I.	No data available
Estimated Swell	4mm
Tree Species	Ash
Height	5m
Distance	2m
Season	Spring/Autumn

[4] Driscoll R. (1983) *"Influence of Vegetation on Clays"* Geotechnique. Vol 33.
[5] Table 1, Chapter 4.2, Para. 2.3 of N.H.B.C. Standards, 1986.



Estimated Swell

To derive an estimate of swell we have relied on statistical validation of our finite difference model which makes the following assumptions.

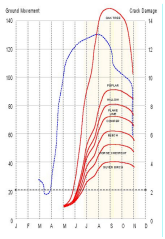
1. That the tree is younger than the house,

2. Where the tree has been pollarded or cut back, the user should enter an estimate of the tree height ***prior*** to surgery to properly account for the likely root zone.

Output

With the tree at its present height there is a potential for ground movement ‘ 2’ mtrs distant from the tree of 4mm.

If the tree is allowed to grow unchecked and there is an exceptionally dry summer, this figure increases to 77mm.



Modelled Moisture Deficiency

(Not to be used for establishing foundation depths)