The Clay Research Group

RESEARCH AREAS

Climate Change ◆ Data Analysis ◆ Electrical Resistivity Tomography
Time Domain Reflectometry ◆ BioSciences ◆ Ground Movement
Soil Testing Techniques ◆ Telemetry ◆ Numerical Modelling
Ground Remediation Techniques ◆ Risk Analysis
Mapping ◆ Software Analysis Tools

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www.theclayresearchgroup.org

February 2009

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What can we say?

This amazing feat of engineering in Dubai needs to be included – how could we not? Wow. Nearing 700mtrs tall (projected height 1km?), the Burj Dubai will be the worlds tallest building when completed. It would look a lot better with some tree planting.

Intervention Technique & Triage

We have just released our reports on the Intervention Technique and Triage to our primary sponsors, describing the research background and providing a step-by-step method for both.

The applications have been used on several claims and we will provide further information on them throughout the coming years.

London Government

We were pleased to hear from Jim Smith who is the London Tree and Woodland Framework Manager. We will be meeting at the Aldenham Research Site on the 26th February and anyone with an interest in the topic, or who simply wants to see the site, please contact us.

Jim is chair of the Joint Mitigation Protocol and we share the same objective – achieving an equitable claim resolution in a sensible timeframe with less litigation.

Extract from The Post

The Post published an article by Kieron Hart of Marishal Thompson a few weeks ago, explaining the real cost to the environment in terms of CO^2 consumption in concrete production when underpinning is undertaken.

If we understood the article correctly the benefits provided by the tree are lost when we underpin and saving the tree might be at the cost of the environment.

Kieron explains that the tree population in the UK is increasing and asks for a wider debate, reinforcing the view that retaining trees and avoiding underpinning has to be the best way forward.

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Annual Subsidence Conference

Anyone wanting to present on a monitoring/climate/clay soil/tree related topic at the Aston Conference this year should contact us with a brief outline of their talk. The conference has been a great success over the years and attracts a wide range of people from our industry.

Previous speakers include Richard Driscoll, Giles Biddle, Hilary Skinner, Tim Freeman, John Parvin and representatives from GAB Robins, Cunningham Lyndsey, InFront and Crawford.

Attendees have included staff from R&SA, LloydsTSB, AIG, L&G, NFU, Churchill, Direct Line, Liverpool Victoria, Halifax, The FOS, AXA, EIG, Groupama, Zurich Insurance as well as most London Boroughs (including the LTOA), Local Authorities from across the UK and private practitioners.

Last years conference was fully subscribed and we were only minutes off calling the police following a controversial delivery from Peter Osborne! Glenda Jones bought us up to date with the ERT project and Tony Greenfield from Plexus explained the current thinking on legal issues. The BGS explained how their maps help model risk and Marishal Thompson gave their view on the challenges we face.

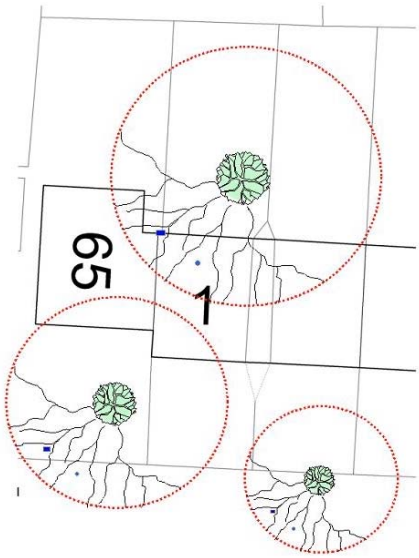
It is a good opportunity to meet colleagues and socialise whilst keeping up to date with research across various related areas. Please E-mail us – the conference is scheduled for June this year. Attendance fees are sensibly priced and an excellent lunch is included. Anyone wanting to exhibit please note that space is very limited and early booking is essential.

Building Vulnerability

The concept of building vulnerability isn't new but instead of considering the distribution of openings in the walls etc., consider its footprint in relation to the postulated root zone - see next column.

The plan was circulated to a small group of experienced subsidence engineers who were asked to guess which of the trees was most likely to be involved, and where that damage might arise.

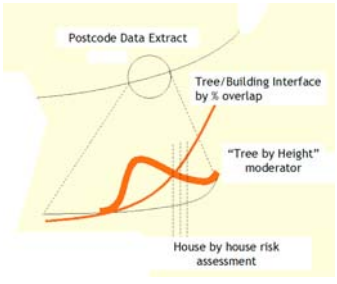
All came up with the same answer. See if you agree with them.

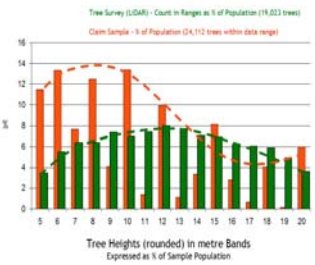


It isn't the usual meaning of building vulnerability, but it may provide an added factor when considering risk. See analysis below and on following page.

Trees and Risk

In earlier newsletters we have outlined the derivation of risk posed by trees, producing the following explanatory graphs.





On the following page we explore how we might refine our understanding of risk still further to avoid blighting too many houses with trees nearby.

Taking the above factors – *"what height of tree poses the greatest risk expressed in terms of claims related to population frequency"* – we believe we can reduce the 'at risk' category to match more closely claims experience.

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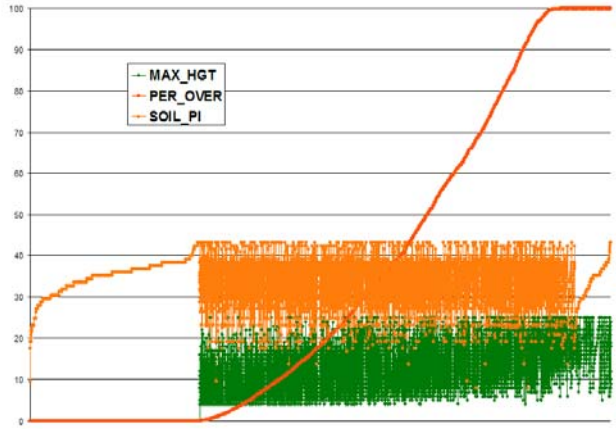
Risk Prediction using Claim Frequency, Trees and Soils Data

Below we have plotted the relationships between trees (measured using the LiDAR survey) and individual houses for a postcode in North London.

The data have initially been ranked according to (1) the estimated root zone encroaching beneath the house – "Percentage Overlap", (2) Height, (green line - MAX_HGT) all plotted against (3) the soil PI (orange line, bottom).



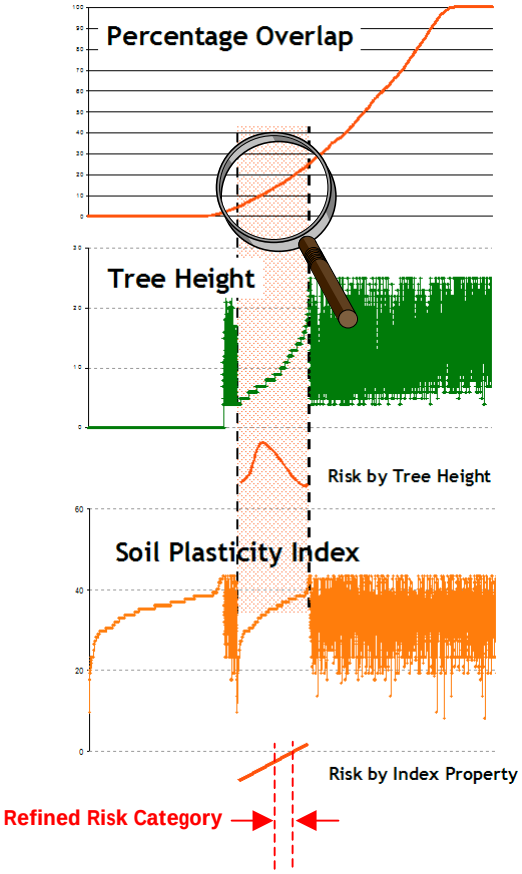
The objective is to determine if we can further refine our understanding of risk by comparing the outcome with claims frequency. Does the estimated number of properties at risk correspond sensibly to claim frequencies and is the model delivering a realistic output?

Clearly not all trees near to houses pose the same risk. A method of reducing the houses that could be blighted would be useful and may overcome some of the objections raised by the arboricultural community.

In the following example, we have shaded a band of trees in a high-risk category based on earlier work of root overlap zones from claims data.

This 'first pass' identifies around 16% of the houses at risk.

Having identified the broad category, we then re-order the graphs to take account of the tree height – are certain heights of tree associated with damage more frequently than others – and soil PI – the higher the shrink swell potential, the greater the risk. See below.



This 'second pass' reduces the count of houses at risk, identifying those at the upper end of the scale. By referring to claim frequencies, we can select a suitable number from the highest end of the risk spectrum.

Taking account of tree height and soil PI, the count of houses at risk is reduced to around 5%. A sensible comparison with anticipated claims over the next ten years, and recognising that not all trees close to houses pose the same threat.

Adding species and climate refines the assessment still further.

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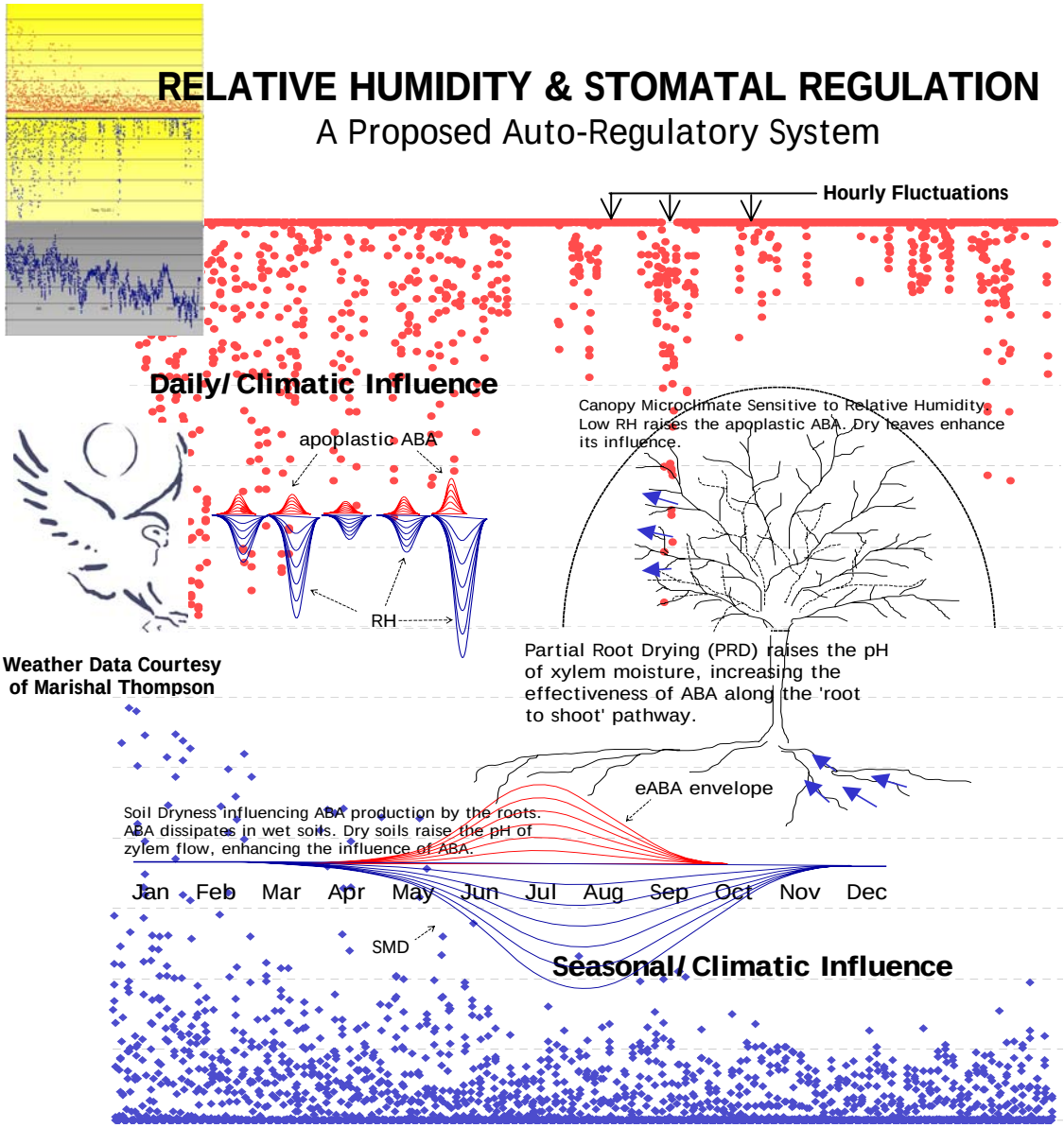

Soil dryness influences the production of Abscisic Acid (ABA) in the roots and we use the Soil Moisture Deficit (SMD) to model this.

It is known from the work of others that the concentration of apoplastic ABA in the leaf determines how the stoma respond to this important 'root to shoot' signalling hormone and our hope is that we can take account of this to further refine our model.

Relative Humidity (RH) will play a role at the leaf, reinforcing or suppressing the signal.

RH plays a major role in influence evapotranspiration. In simple terms, both leaves and roots combine to form a pump with an effective and simple means of regulating how much ABA is produced, and how effective it is – not just in any one location, but throughout its journey.

Climate provides the background (dry year/wet year) and atmosphere at the canopy drives dynamic change, adjusting daily, by the hour. The lower the RH – the longer it extends – the greater the influence of ABA.

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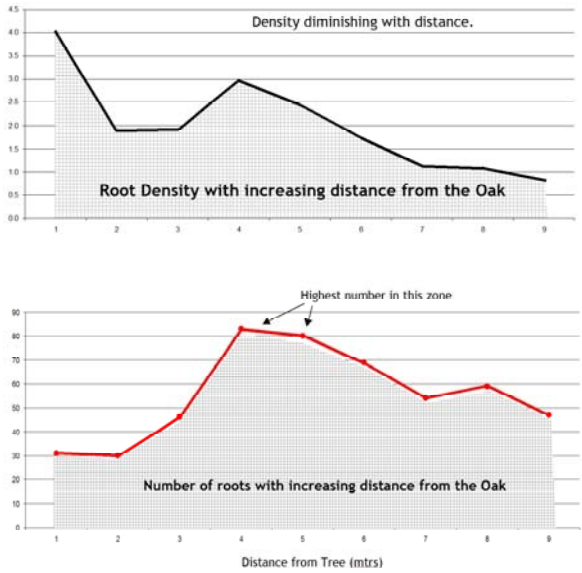
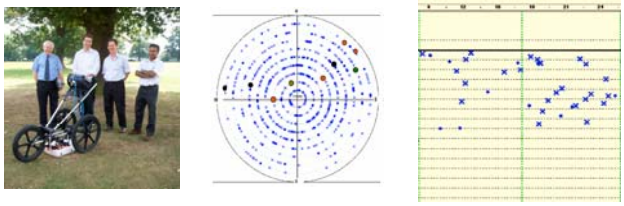
Root Imaging

Jon Heuch from Duramen Consulting carried out a root survey of the Aldenham Oak using radar imaging in 2006. The survey involved passing the sensor around the tree in concentric circles, increasing the radius by 1m at each pass.



It would appear that there are more roots and an increase in density at around 4-5mtrs from the tree, diminishing with distance. The survey was terminated 9mtrs away from the Oak.



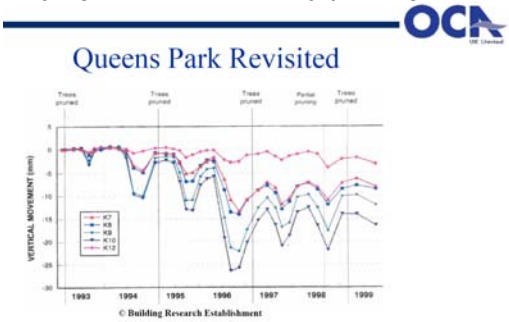
Jon explained that the sensor would only detect roots 5mm in diameter and above. The finer ones – the ones that abstract moisture – can't be detected.

It isn't possible to draw a direct comparison with the ground movement profiles on the following page to see if "more roots = more movement" because of the persistent deficit which obscures the picture, but the root imaging profiles do appear to suggest a general correlation.

Jon can be contacted by phone on 01233 713 466, and E-mail at jh@duramen.co.uk

Prune or Remove?

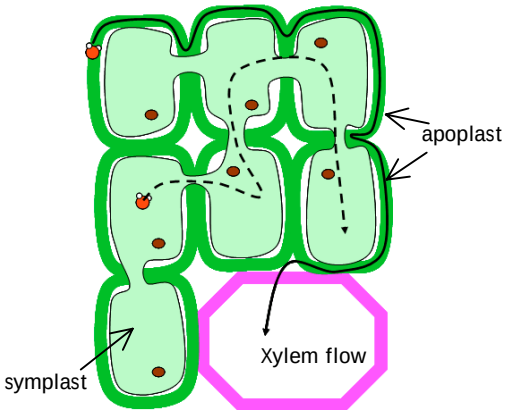
OCA have published details of the Queens Park project in their most recent newsletter. This was a study undertaken by the Building Research Establishment revealing the problems associated with trying to control trees by pruning.



The Queens Park study revealed how trees respond to pruning. In this example, ground movement increased year on year, following five episodes of pruning. Contact them for a copy at via info@oca-arb.co.uk

What's an Apoplast?

Just to clarify – we use the term 'apoplast' frequently when talking about ABA and water transport in trees.



It is the zone surrounding the cell where water can flow without crossing the membrane. The heavy green line in the picture above.

Put very simply, the apoplast is the space surrounding the cell and the symplast is the inner face of the cell membrane.

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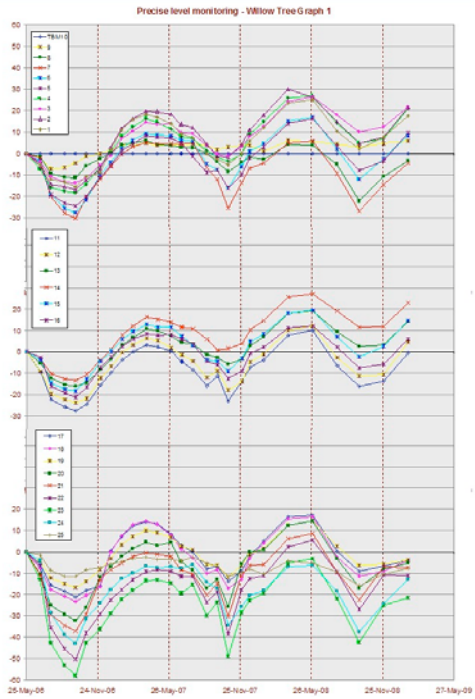
Periodic Signatures

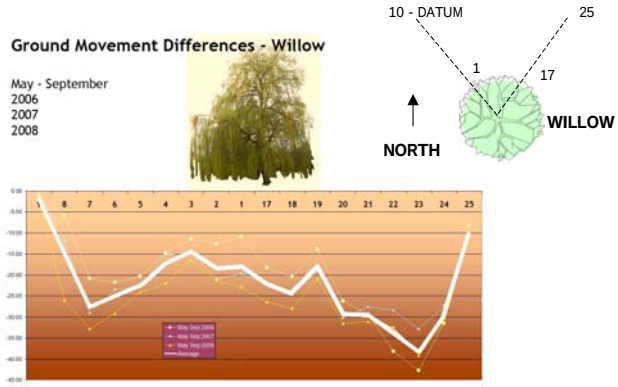
Right, graphs recording ground movement over time in the vicinity of the Aldenham Willow, through both wet and dry years. Each line represents an individual station.

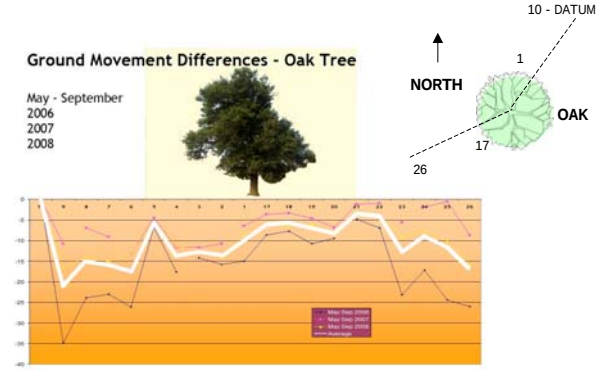


They appear to produce a remarkably regular pattern with small variations annually as we might expect.

Below are the average differences in ground movement beneath the Oak and Willow between May and September in 2006, 2007 and 2008. The output reveals how the risk varies around the perimeter of both of the trees and o9ffers an insight into how difficult it might be to model the risk of individual trees. The soil beneath the Oak is heterogeneous which may account for the lower amplitude of movement.

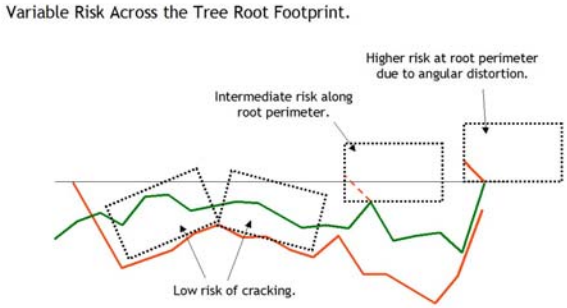
The questions arise, what level of angular distortion is needed to cause cracks to develop in low-rise masonry structures? With such a regular pattern, where is the fulcrum most likely to be? Is it possible to predict where it might fall?





Periodic Signatures

For both the Willow and the Oak we see that the amount of ground movement is different either side of each tree, varying by around 30%.



By modelling the relationship between measured ground movement and buildings (see above) it would appear that the fulcrum most likely to result in excessive tensile stresses lies at the periphery of the movement zone.

From previous studies we know the building itself becomes more vulnerable in terms of the Bending Moment at a location 0 – 4mtrs in from the tree-facing wall.

0 1 2 4 . . .