

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



June 2010

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CONTENTS

- ⊕ Mapping - LiDAR Imagery
- ⊕ Aston Conference Report
- ⊕ Triassic Clay - ERT
- ⊕ Water Uptake by Month
- ⊕ Developing Ground Movement Profiles
- ⊕ Ground Movement and Climate

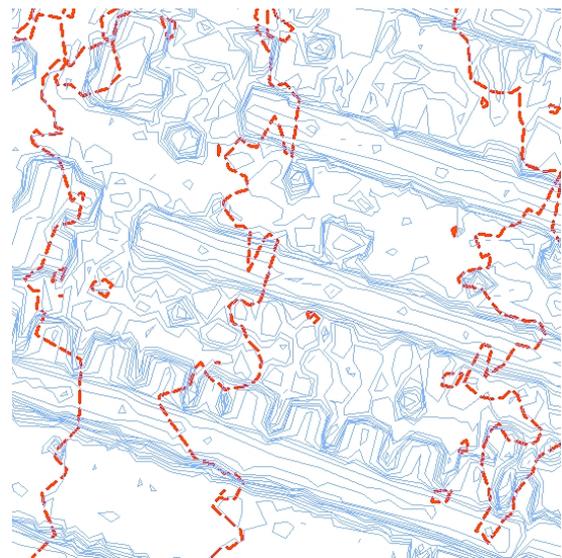
More on Mapping

Maps always provide attractive backdrops for data, and the latest LiDAR images are no exception. Resembling line drawings, the following contour maps fit perfectly against 'real world' aerial imagery as we see below.



The data has been provided by InfoTerra and BlueSky, revealing their capability to build complex terrain and contour maps using LiDAR imagery plotting both the underlying ground contour (with buildings and vegetation removed) and a more complex image showing the contours with them in place (blue outlines).

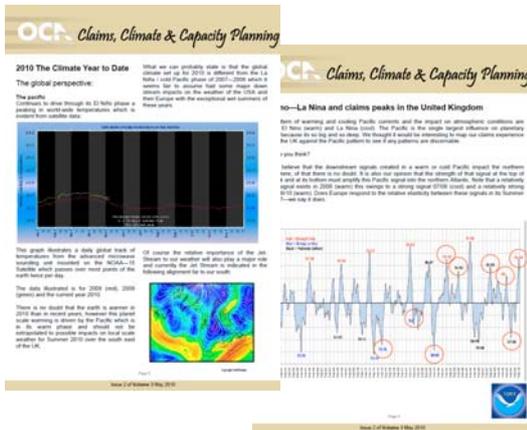
Both are plotted on the enlarged image below. The red broken lines are the ground contour profiles, and the blue lines map trees, buildings, roof slopes and even the outline of chimneys in many instances.



Combining the DTM (Digital Terrain Model - red) with the DSM (Digital Surface Model - blue) reveals underlying ground contours, together with buildings, trees and structures.

Claims & Climate

The OCA *Claims, Climate & Capacity Planning* Newsletter is available for download and Michael Lawson explores the idea that el Nino / La Nina oscillations deliver a "sling shot impact from one state to the other that may drive summer months across Europe"



OCA believe there is a real opportunity in exploring this further and anyone with an interest can contact Michael at michael.lawson@landscapeplanning.co.uk

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B I R M I N G H A M

The annual conference was well attended and speakers covered a wide range of topics. John Parvin, Zurich Insurance, gave an ‘insurers eye view’. He was the first chairperson of The Subsidence Forum and initiator of the JMP. John explained that, for the last few years at least, subsidence has suffered fairly low losses when compared with Escape of Water claims - leaking pipes, shower trays, plumbing etc.

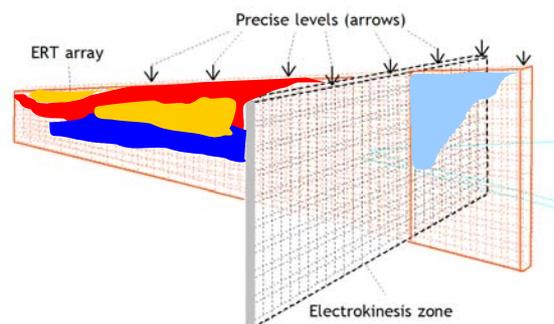
He went on to explain that the intention of the JMP was to bring groups together to resolve disputes amicably, agreeing a set of rules. More discussion around this topic at some future date no doubt.

Richard Rollit, Crawford & Co, considered the benefit of level monitoring and distortion profiles. He felt that an accurate distortion profile might – in some instances – be better than a range of elaborate site investigations. This led him to question the need for the tick-box approach suggested by the JMP. If one particular approach provided an answer, was it really necessary to do more?

Dr Nigel Cassidy, Keele University, outlined the benefits of ERT and felt that our current method of undertaking investigations could be improved, questioning if boreholes were required in every instance and challenging whether current methods of measuring moisture content were adequate when distinguishing between their different states.

Dr. Ian Jefferson from Birmingham University was in the audience (Ian is part of the team developing the electrokinesis project), and it was quickly evident there was a synergy between the work Nigel had carried out at Aldenham, and the electrokinesis project.

What better way to measure any change following ground treatment than ERT and precise levels?



Gary Strong explained that the RICS has a research budget and there may be an opportunity to work together, subject to agreeing scope etc. Early days, but certainly worth further discussion. He outlined the numerous professional groups within the RICS, and provided an update explaining that HIP packs will no longer be mandatory and it is likely legislation would be introduced in October 2010 to extend the Building Regulations to include conservatories

He also explained that the RICS was looking at subsidence and working with other groups (The Subsidence Forum etc.) to hopefully publish a range of guidelines aimed at improving standards across the industry.

Gary has created an insurance forum within the RICS and it is open to anyone with an interest in subsidence.

Steve Plante reviewed the work of The Clay Research Group over the last four years, outlining the original objectives and describing what has been delivered.

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The Effects of Tree Roots on the Electrical Resistivity of Triassic Clay

Jahnvi Conein & Dr Ron Barker
School of Earth Sciences
Birmingham University

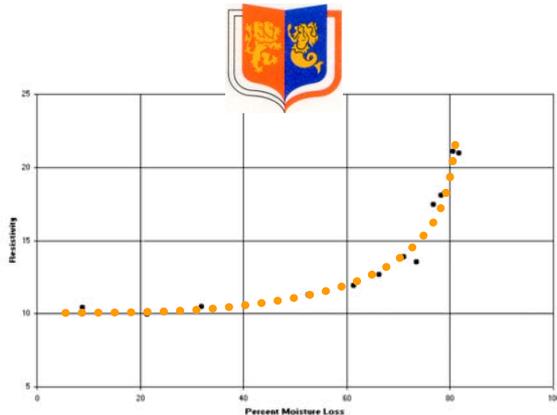


Figure 4: The variation of resistivity (Ωm) of Triassic marl with moisture loss (%).

The above graph has been taken from an unpublished paper provided by Jahnvi Conein when she was working on her MSc. Please note the ‘x’ axis records moisture loss, and not content.

As the soil dries, so the resistivity increases.

Jahnvi says ...

“The results of the drying experiment (Figure 4 - above) indicate a clear relationship between resistivity and moisture loss.”

She goes on to say, “However, the relationship is not exact as the sample of clay does not lose moisture evenly, but from the outer surface inwards.”

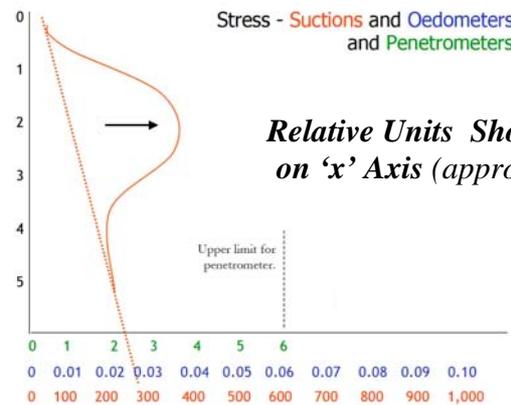
The effect of the drying does not become apparent in terms of resistivity until moisture is removed from the clay in the region around the electrodes and this takes several days. Nevertheless, the total effect of the possible natural drying is clear.”

Relative Units Suctions, Strains & Penetrometer Values

Using the oedometer as a starting point, and assuming a London clay with a PI of 45%, a strain of say 0.03 over a sample depth of 500mm produces swell of ...

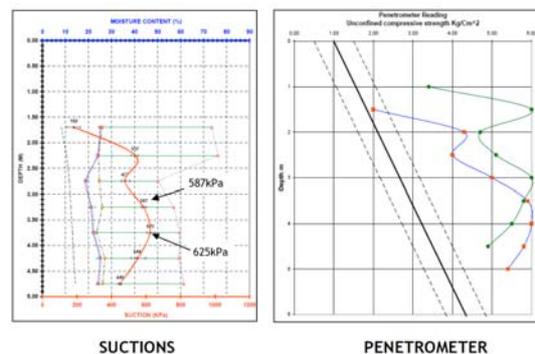
$$0.03 \times 500 = 15\text{mm.}$$

All estimates of swell are usually divided by a factor – most commonly 2 in the case of the oedometer – to account for the one dimensional consolidation/swell that is measured in the containing cell.



Relative Units Shown on ‘x’ Axis (approx).

Below is an example of how the units of stress compare from an actual investigation. The suction readings peak at around 600kPa, which coincides with the penetrometer values (in this case, 6 x 100 = 600).

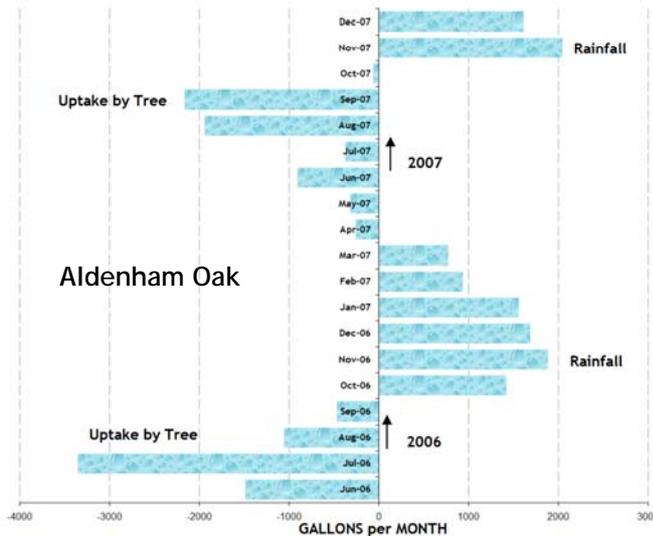


This relationship isn’t always as clear as shown here, but supports the view of Pugh and others that penetrometer values can provide a good indication of stress. We will be publishing more results from actual investigations in future editions.

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Water Uptake by Month

The Intervention Technique requires that we have some idea of water uptake by the tree, by month. The objective is that we ‘knock the top off’ the deficit to make surge years resemble normal years.



There is no suggestion that we have to meet the water demand in full – this would be almost impossible as others have explained. Giles Biddle makes the point that the tree will take whatever water is available. Pouring water into the ground with no controls in place simply leads to greater rates of transpiration.

Above we have estimated water uptake by the Oak tree using the ‘ground movement by month’ values as described before. This has little to do with how much the tree ‘drinks’ but everything to do with ground movement resulting from root activity.

If we record say 30mm of subsidence using precise level data, and can demonstrate the influence zone using the same method, soil shrinkage is a direct result of water loss.

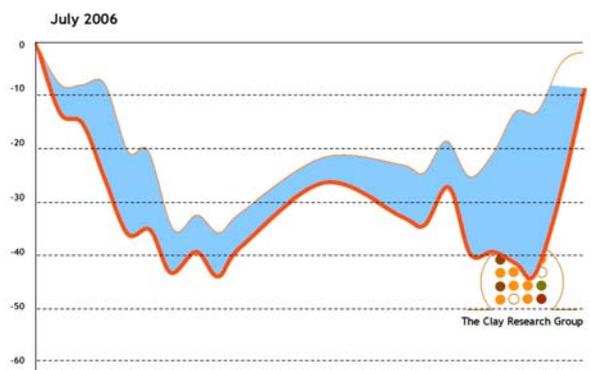
Using the Sidcup Road tree as an example, if the ground subsides by say 20mm and the root radius is 12mtrs, moisture loss sufficient to cause ground movement of this order would be $\Pi r^2 \times 0.02\text{mtrs} = 10\text{m}^3$ or 2,000 gallons.

For our purposes we can use the average over each of the layers - see below.

In July 2006, water uptake by the Oak (shown as a negative value in the adjoining chart) was around 3,300 gallons. The average ground movement was just over 12mm, but varied across the footprint in the range 5 – 30mm.

In the following month, recorded rainfall was 68mm. Harvesting chambers would deliver approximately 375 gallons. Around 11% of the requirement. Targeted over 10% of the root footprint – the area adjoining the building – that would be a significant contribution, quite possibly meeting the full deficit for the layer in that month.

Rather than losing water to the ground via gravity, the installation includes a naturally occurring mineral that matches low-level tree root suctions. The tree has to actively strive to absorb the moisture, which in turn triggers production of the ABA hormone.



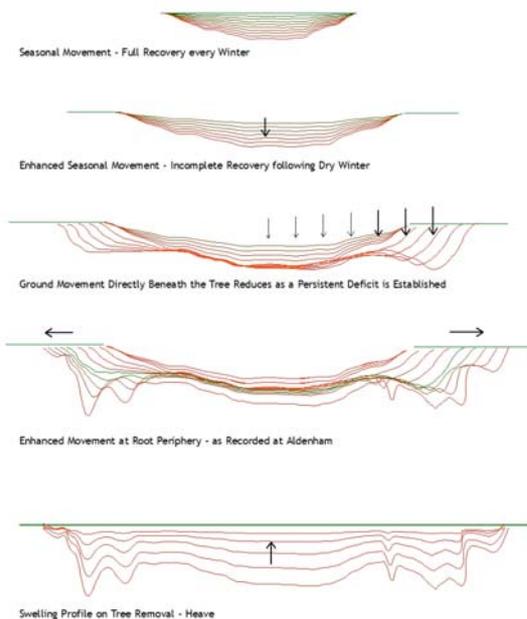
The July 2006 ‘layer’ of ground movement for the Oak. Around 12mm thick on average and accounting for moisture uptake by the tree of 3,300 gallons.

Our aim is to satisfy a small area in the region of the building, and not to meet the demand across the entire root footprint. The figure for the Sidcup Road tree might be closer to 10% = 2,000 x 0.1 = 200 gallons?

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Developing Profiles at Aldenham

Continuing the theme of ground movement over time, the development profiles below trace change over a period of years. The work of the BRE at Chattenden and that of Giles Biddle have recorded initial seasonal movement, with the ground recovering fully over the winter months, followed by the typical ‘saucer’ profile in the summer.



Over time and depending on species and situation, a persistent deficit can develop. The likelihood will be determined by available water, the hydraulic conductivity of the soil and the species and health of the tree.

In the case of the Aldenham Oak and Willow where a persistent deficit has developed, roots have travelled further afield and we see enhanced ground movement at the periphery. This situation is unusual but it does provide a glimpse of changes that could accompany Climate Change for these high risk species over the next twenty to forty years.



The annual Post Subsidence Conference will be held in London on the 16th June and the CRG will be talking about the link between geology and risk, and looking at where trees fit in.

One of the topics will be around foreseeability, and what the probability is that someone could actually predict which trees will cause damage, and when.

Jim Smith, London Tree and Woodland Framework Manager, will be updating us and putting the case in support of the JMP.

Regarding the JMP, we support Richard Rollit’s view, expressed at Aston University last month when he said that good evidence is better than more evidence.

The proposed standards put forward by the JMP exceed those required at law, and will most likely confound equitable settlements, rather than expedite them. One may take the view we are allowing the defendant to determine the evidential requirement.

As we have seen so often at Aldenham, the more tests that are undertaken, the more confusion arises and clearly the most appropriate method is precise levels. Winter recovery provides first class evidence as we have seen at the Headmasters House.

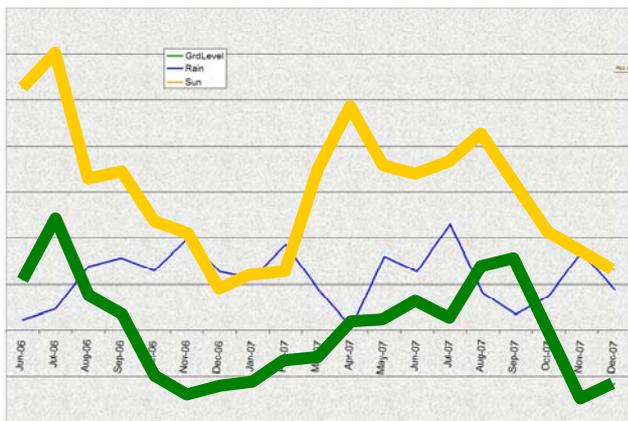
Speakers include Gary Strong and Alan Cripps (both from the RICS) who will be talking about industry issues. Resourcing and training etc.

John Faragher (Met Office), Swenja Surminski (ABI) and Jon Cawley (Zurich Financial Services) will be talking about climate change. Bill Jeffrey of GAB Robins is talking about process, service and fulfilment. Geoff Davies representing The Subsidence Forum is talking about maintaining quality in the face of procurement.

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Correlation between Ground Movement and Climate

Comparing weather data (hours of sunshine, min and max temperature, wind, rainfall and SMD) with the precise levelling profiles at Aldenham, beneath the Willow, illustrates which individual element contributes most in driving ground movement beneath trees.

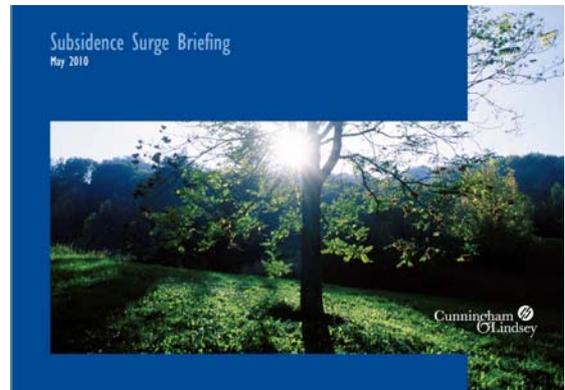


Correlation between Hours of Sunshine and Ground Movement = 0.88, and between ground movement and Max Temp = 0.82.

The correlation between ground movement (measured as “change per month”), temperature and hours of sunshine have a correlation of between 0.82 and 0.88, demonstrating a strong link.

Rainfall has a weaker relationship with a correlation of -0.48 . Heavy rainfall can interfere with this relationship from time to time, but the link with energy is clear.

As one would expect, the highest correlation is between SMD values for Tile 161, Medium AWAC, and ground movement. As a tool to estimate ground conditions, the SMD performs very well. For the period in question, the correlation is 0.9.



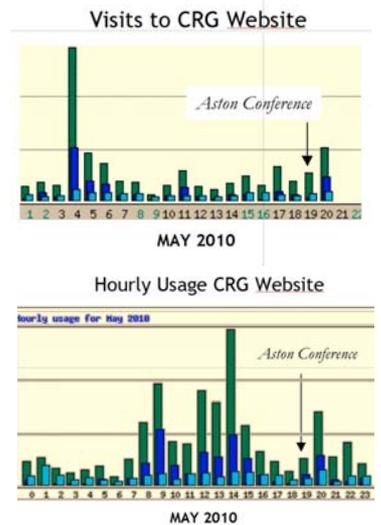
Cunningham Lindsey produce an excellent document on their web site, entitled “Summer Surge Briefing” which records weather patterns across different years. We understand that, at the present time at least, there is no suggestion of this being an event year and we understand that they will be providing updates as weather patterns develop.

ASTON CONFERENCE

The benefit of any conference is hard to determine.

Here are some graphs from the CRG web site related to the Aston Conference.

We see a ‘blip’ just prior to the event as people refresh their memories about its activities and then further visits after, which we hope is maintained into the future.



Nearly all of the speakers were scored as either ‘Excellent’ or ‘Good’ and the facilities were also highly rated. Feedback suggested a requirement for more detail. How would changes deliver commercial benefits? In a world where subsidence is regarded as a low priority, is there a will to make the investment?