The Clay Research Group

Newsletter

January 2007

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Aldenham SCHOOL Supporting Research

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CLIMATE CHANGE

Southampton have recently published a paper in the prestigious **Geotechnique** journal outlining their predictions, the broad thrust of which are that we can expect event years every year in less than 50 years time – at least in terms of dryness if not claims.

Nearly all of the work at Aldenham has significance in understanding how the climate is changing and the influence on root induced clay shrinkage. The ground beneath both the Oak and Willow have persistent moisture deficits reflecting what could be a commonly encountered scenario in the coming years.

The data from the weather station, the various measures of moisture change and ground movements are all elements that contribute towards the model.

In summary, the research is relevant in terms of modelling the effects of climate change but also to gather sufficient data over time to allow us to refine the early warning indicators for predicting surge years.

BioScience

Since the identification of the Erecta gene (Nature, 2005) there have been several advances relating to both hormone production and most importantly, the receptor mechanism.

As most of 2006 was spent instrumenting the site at Aldenham no field studies had been commissioned to determine the response of the trees to the dry soil beneath their canopy.

However, all has not been lost. Precise levels are, after all, a measure of the combined influence of climate, soil mineralogy and tree physiology.

The fact we have a persistent moisture deficit means that the tree would almost certainly have been drought stressed in the summer months and at least a small proportion of the measured ground movement (or absence of) would have reflected hormonal influence.

The relevance of the BioSciences element is self-evident. Over 70% of valid subsidence claims are tree related. A study of the physiology of the tree is essential to improving our understanding and this year we discovered two very valuable and practical clues about (a) how we might detect risk earlier in the year and (b) what to do when that risk is discovered.

We have also seen how tree roots respond to dry conditions by seeking water at the root periphery.

TDR SENSORS

TDR sensors have been validated using comparisons with the neutron probe and ground movement and we are satisfied they provide a sensible record of volumetric moisture content.

The sensors can transmit data from site wirelessly via the internet and, in our view, provide a reliable and robust technique for determining moisture change over time.

We recommend their adoption as a cheap and reliable method for gathering evidence when investigating root induced clay shrinkage claims.

They must be installed at a depth not less than 1mtr bGL to avoid seasonal change alone, and we recommend that a datum is always installed for comparison purposes. When determining if a tree is implicated, we would recommend one sensor close to the building in line with the tree, and another fitted elsewhere, away from any damage.

Care is required with their installation and the sensors have to be installed in an inclined plane to avoid ponding. A Bentonite seal is advisable around the head of the probe. Care is needed to avoid bending the probes when inserting into a clay soil containing gravel.

It is essential to check that telephone network cover is available (Orange, O2 or Vodaphone for example) prior to installation and that the dataloggers are fitted at least 1m above ground level. Minor calibration may be required, but as we are measuring change, the absolute value is less important.

TELEMETRY

Our study has already yielded satisfactory results and on the basis of its findings SPPS have adopted telemetry for much of their 'next generation' monitoring.

Care has to be taken to ensure the sensors are fitted within the zone of the receiver in cases where wireless installations are selected and the network signal must always be checked prior to fixing. The datalogger should be fixed a minimum of 1m above ground level.

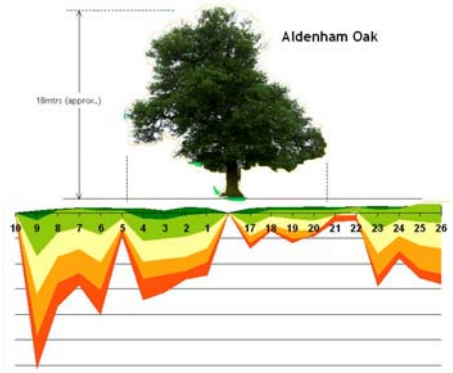
This sometimes means sensors have to be fitted higher on the building than would normally be specified, but only in cases where the signal is weak.

Electrolevels must be fitted below the line of cracking in all cases and we recommend that a datum is always used for comparison purposes.

Always ensure an angle bracket is used to ensure the device is measuring rotation in the plane of the sensor.

Loss of signal can be an intermittent problem but usually resolvable if the network supplier 'pings' the site.

PRECISE LEVELS



Precise levels have provided some invaluable information. Whilst other techniques measure specific elements, precise levels are the most efficient way of determining the combined interaction and effect of moisture change, root activity (including hormonal influence) and climate.

The image we see left has detected the persistent moisture deficit and revealed how roots extract water from the ground in such cases. They reveal the extent of root activity (over twice the height of the tree on both sites) and, in due course, how the ground responds to any of the treatments that we apply.

In November we saw the ground recover to a position above it's Spring 2006 levels following rainfall. Watering combined with rainfall over the next few months will reveal how effective this is in resolving root induced clay shrinkage claims.

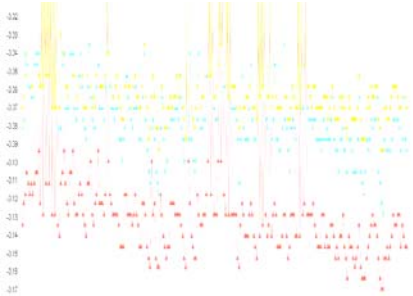
NEUTRON PROBE

The team from Southampton University have installed five neutron probe tubes aligned with the precise levelling stations and take readings every month that we can compare with ground movement and TDR sensor data.

The probes adjoin the ERT array for the Oak and provide an accurate estimate of soil moisture content by volume.

Left we see Dr's Derek Clarke and Joel Smethurst who are monitoring several sites across the UK to gather data to feed their climate change model – see Page 1.

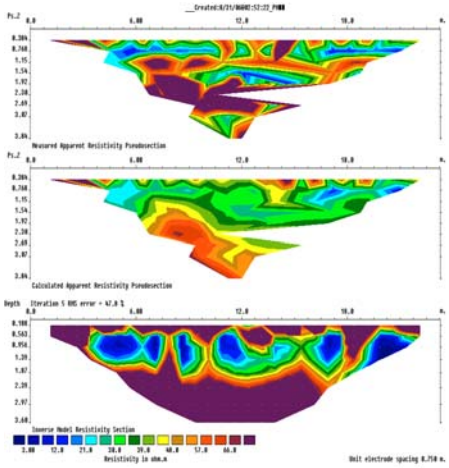
ELECTROLEVELS



Electrolevels detect fine movement very quickly which proved to be the case in 2006 when we identified the end of summer (in terms of ground movement) at the beginning of September.

The data is transmitted wirelessly to a datalogger and then via the web to a dedicated gateway where the information is XML'd to our own interpretation software which pattern matches against a series of characterised signatures for various perils, building a 'best fit' probability.

ELECTRICAL RESISTIVITY



Measuring the resistivity of a soil provides an indication of its moisture content, and although this is a well researched topic, work on fine grained London clay is relatively new and very relevant to our understanding of how moisture moves in relation to root extraction.

Keele University have taken readings at both sites every month and are using their software to image the resistivity using inversion techniques.

The study forms the basis of a PhD for Glenda Jones, under the supervision of Nigel Cassidy.

MODELLING GROUND MOVEMENT

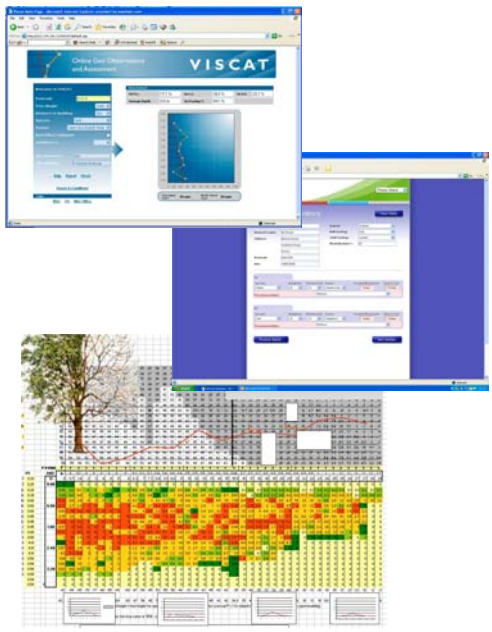
Statistical modelling of the interaction between trees, soils and climate is being tested and validated with the estimates compared with precise levels where we have them, and the estimates of swell from soils testing.

The models perform well and the more recent development of a 'disorder model' appears to account for the variables that we recognise confound a more linear approach. For example, we understand that two trees, identical in all physical aspects, behave differently to one another. We understand that root zones are unpredictable and that soils contain a mixture of sands, silts and so forth.

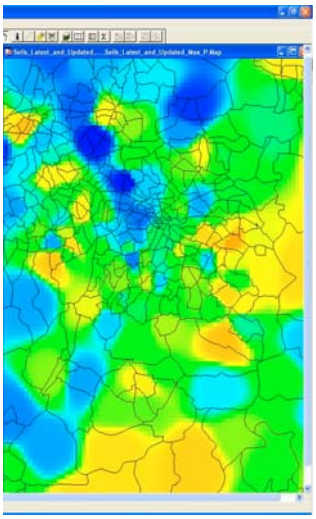
By introducing disorder, but within a bounding envelope of the statistically sensible, we appear to be able to estimate ground movement reasonably accurately.

Our objective is to remove investigations and delays where it is safe to do so, and the research is perhaps more directed to defining this 'where it is sensible' zone, rather than arriving at absolute values.

We are fairly confident that the model performs at least as well, if not better, than costly and disruptive soils investigations and should replace the need for an arboricultural report in all but the most complex of claims.



RISK MODELLING



Modelling risk is a natural output from the research. Understanding how the variables interact, plotting risk zones using claims data and developing the statistical theme.

The importance of frequency data has always been understood but illustrated in our comparisons between the major cities, where the count of claims is particularly high in London, but not too different from other major cities when we undertake a frequency assessment.

Data is difficult to obtain but without it – and without distributing the evaluation – we are unlikely to further our understanding of how the subsidence peril works. Without published analysis, every claim continues to be a surprise.

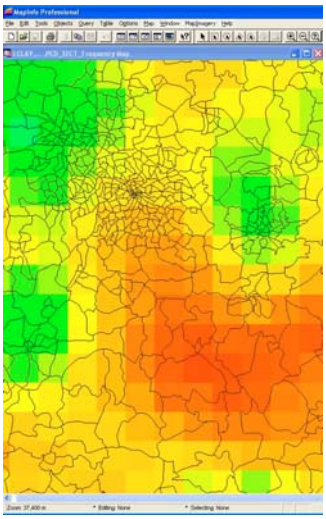
This is a by-product of our research that we hope delivers significant value in understanding that we can model risk.

A NEW GEOLOGY

Geology forms the basis of any risk model, as well as assisting in handling claims. We have built a unique 250m tiled grid of the UK geology using actual claims data and investigations.

Although the model is primarily for assessing the risk of root induced clay shrinkage claims, it can be used in the alternative when we see high claims numbers and a low risk from clay shrinkage to identify other perils.

The data are normalised to assess relative risk across the UK to a level not thought possible, and although the results of investigations have been extrapolated, the presence or absence of claims is in itself a powerful and reinforcing indicator.



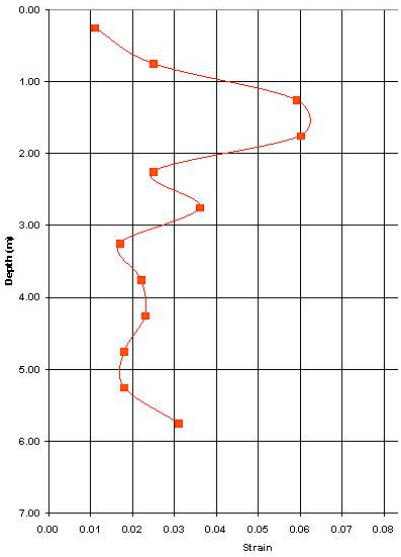
SOIL TESTING

Aldenham has been the centre for researching how oedometers cope with sample disturbance and determining whether they can be used as a routine to establish desiccation and derive an estimate of swell.

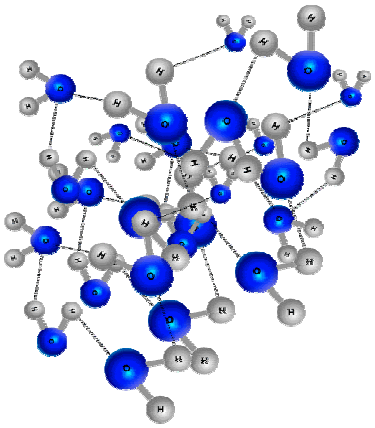
Results over the last 3 years suggest there is little difference between the filter paper test and the oedometer, provided the samples are prepared in a particular way. The benefits of the oedometer test are:-

1. It is a quicker test
2. It is cheaper
3. Avoids the need for moisture determination
4. Avoids the need for Atterberg Limit tests
5. Avoids the anomalous results yielded by the filter paper test in soils with a certain mineralogy.

The laboratory have been working with UKAS and the test is now accredited. MatLab are researching methods of shortening the test still further by using the consolidation curve and work done elsewhere.



GROUND TREATMENT



2006 was data gathering to see how the ground performed seasonally, and instrumentation of the site. In 2007 we hope to apply two or more ground treatments, in discrete zones adjoining the Oak and Willow trees.

The laboratory work in 2006 was fascinating. Our attempts to enhance the osmotic potential of the soil introduced a greater degree of consolidation than was caused by root induced moisture abstraction. In a sense it was more successful than we had hoped, but with limited practical application.

This year we hope to test electrokinesis – moving moisture and clay particles around in the soil matrix with a view to reducing its hydraulic conductivity.

Indirectly we will be putting the tree under stress in a very localised zone, and this fits in with the research outlined on Page 1.

The other area of research is simple rehydration. This has been very successful in the past but have not come across any published work of it resolving a persistent moisture deficit.

WEATHER STATION

Aldenham School are official providers of weather data to the Meteorological Office and have supplemented their existing equipment with this new weather station, courtesy of Marishal Thompson.

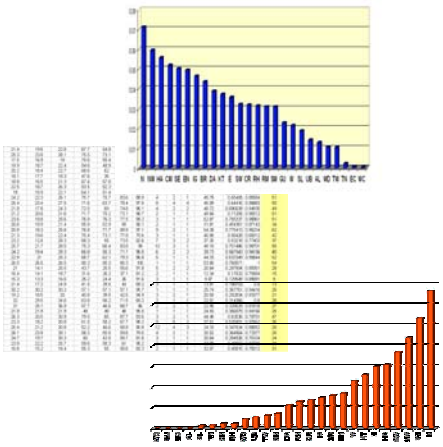
This fits in very well with several threads including the climate change modelling and comparing fluctuations in ground moisture relative to rainfall literally by the day.

INDUSTRY DATA

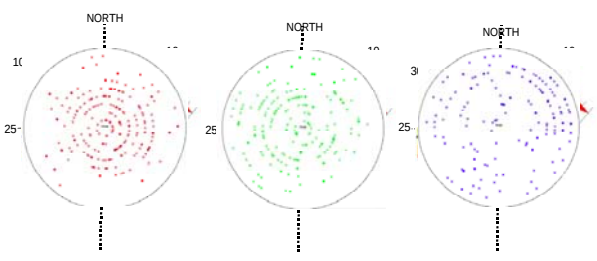
We are grateful to clients who supply data in the knowledge that it will only be used to add to our understanding of the subsidence risk.

Last year we listed the count of trees involved in subsidence claims by species, and the height at which they appear to present the most risk. We were able, after reviewing many claims, to detect the risk area of the root zone and how count of claims and frequency shed entirely different light on how major cities compare.

It isn't always possible to put these into the context of 'how many trees, of what species and at what height' are planted unfortunately, although we were able to provide a best estimate of exactly how many Council and Private trees were situated close to building within the M25, on London clay.



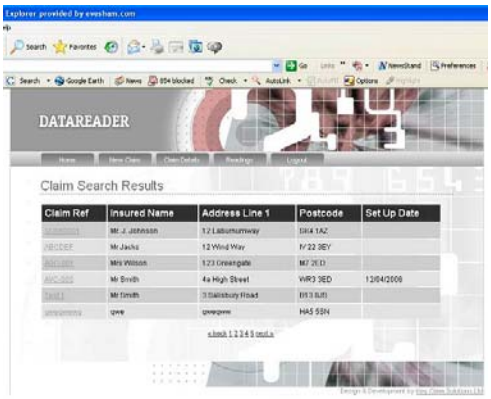
ROOT IMAGING



An example of the work undertaken by one of our associates is provide by Jon Heuch, of Duramen Consulting. Jon uses radar ground imaging techniques to detect roots above a certain diameter, and using software he is able to plot them by depth.

The benefit to Jon (hopefully) is that we have other data to allow comparisons to be made to validate his own research.

SOFTWARE APPLICATIONS



The DataReader application interprets a wide range of data from the telemetry applications, graphing movement, moisture and temperature change.

It resolves a variety of signatures, agnostic of units, and provides a probability match of the likely causes in rank order.

The application automatically retrieves data from the service providers gateway via the web and generates automated updates to the subscriber by E-mail when movement is detected, or by default, once a month.

Data is secure and viewing temperature against movement either a sensor at a time or as selected against the various characterised signatures makes interpretation much easier.

The application produces a report outlining movement, moisture and temperature change with an assessment that can be driven by the engineer using a drop down menu.

MEMBERS ACCESS

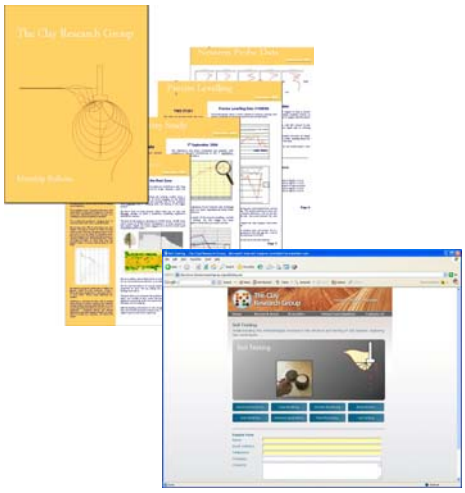
All of our work is shared within a few weeks of gathering the data via our newsletter, which can be accessed via the web site at www.theclayresearchgroup.org

Select 'newsletter' from the top tool bar, or view the interested parties that form The Clay Research Group.

We always welcome active participation from any of the members who have an interest or a project they would like to add. People can 'run their own project' within the group, as long as they are willing to share the information (the IP remains with the individual researchers) and provided there is no conflict with any of the existing team in terms of publications or instrumentation.

Companies or individuals can purchase their own equipment and install providing agreement is first obtained from the members and of course, and most importantly, the school.

It works very well in practice and we look forward to hearing from anyone who might be interested.



COMMUNITY

Most important of all is building a community of like-minded individuals from the industry and we have been delighted with the response over the last 12 months. The initial concerns around sharing potentially commercially sensitive material have been replaced with an appreciation of their technical benefit.

The Clay Research Group are looking at the technical investigation of a claim, rather than the commercials surrounding how it should be handled.

The parties listed below are amongst the members, and the list is growing.