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

The Clay Research Group
www.theclayresearchgroup.org

May 2009

The Clay Research Group

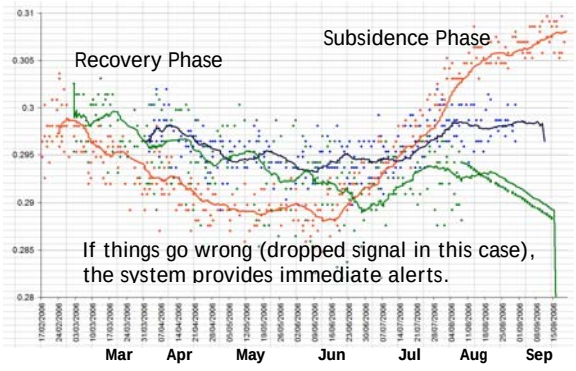
CONTENTS

This edition is devoted to the use of electrolevels. We look at diurnal movement, explore a few case studies and consider their use in determining the efficacy of the Intervention Technique, where frequent readings at regular intervals is essential.

Next month we reveal the geology at Aldenham, discuss the use of precise levels following the report commissioned from Giles Biddle by the Subsidence Forum, Event Prediction and why smaller trees might be riskier than their taller counterparts.

Electrolevels

We are revisiting the benefit of electrolevels in this edition and below is a plot of movement to a property on London Clay within influencing distance of trees. The claim was handled by Cyril Nazareth from InFront.

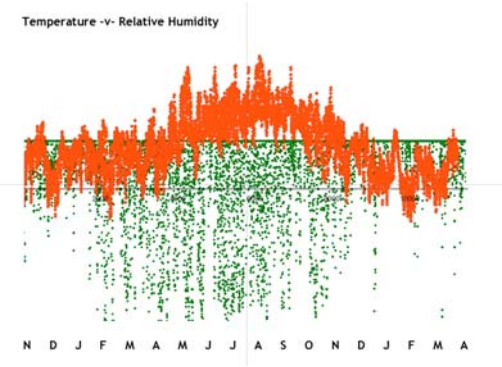


The variations in movement between the sensors reflects distance from the tree. Winter recovery is followed by subsidence commencing around June and July. 2006 started late, and the moisture deficit rose very sharply in the summer.

www.theclayresearchgroup.org
splante@hotmail.co.uk

Climate & Events

Although the weather has been warmer than usual recently, we have no evidence to suggest 2009 will be anything other than a normal year in terms of claim numbers. Visit our web site to view weekly updates.

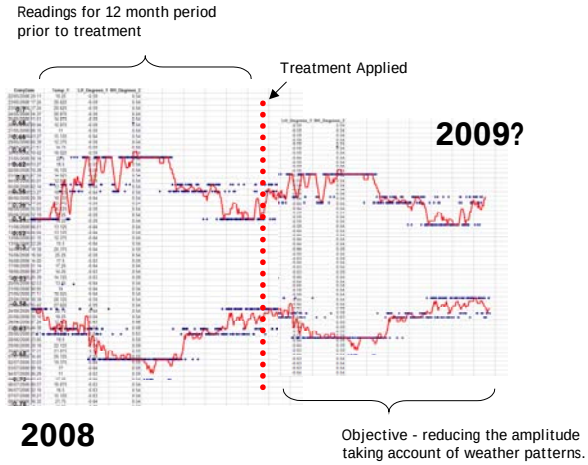


JMP & Subsidence Forum

The Subsidence Forum are proposing the wider use of precise levels as evidence and Giles Biddle has produced a paper for their consideration. We understand it is being presented to the JMP for discussion shortly.

Intervention

Research in this area continues. If successful the benefits will include quicker (and cheaper) claim settlements, an environmentally friendly and sustainable solution with reduced CO^2 emissions – whilst retaining the tree.



The Clay Research Group

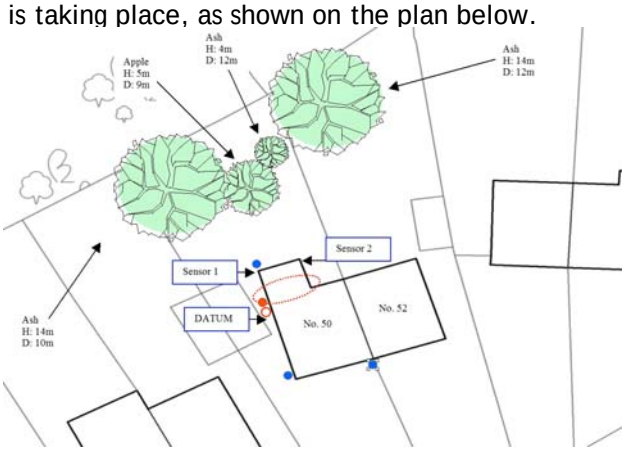
Electrolevels and the Intervention Technique

The project we describe here is being undertaken by Crawford & Co., and our thanks to Stephen Briant for alerting us and Jon Gray for data gathering and reporting. It is being supervised by Richard Rollit.

Briefly (we have reported the circumstances before) there is damage at the junction between a single storey extension and the original house. A group of trees, predominantly Ash, are implicated. The trees are 14mtrs high and between 10 and 12mtrs from the property.

The treatment was applied towards the end of February/beginning of March 2009.

To monitor the efficacy of the treatment, electrolevels were installed, one each side of the extension, and a datum fixed to the undamaged part of the house, remote from where movement is taking place, as shown on the plan below.



Crack monitoring has been undertaken, but as if to illustrate the problems with this technique, studs fell off from two of the stations, and readings are at uneven intervals – see following page.

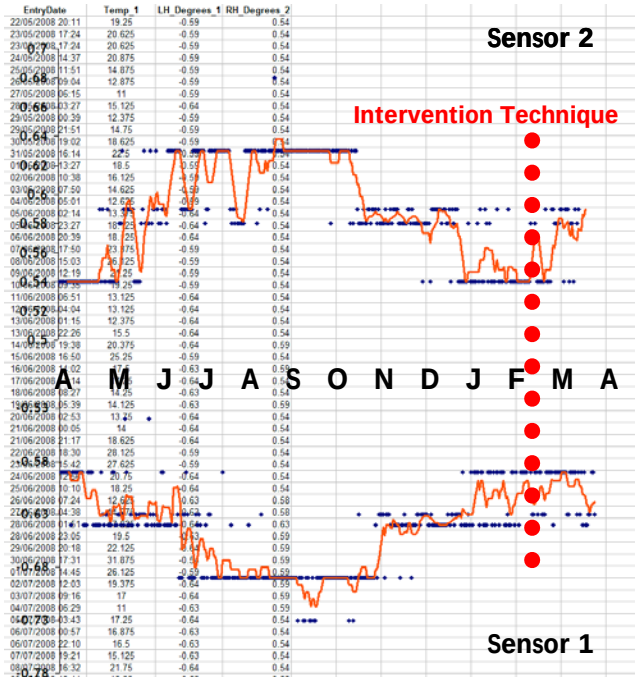
Movement in the order of 5mm was recorded between the summer and winter periods from the data that was gathered.

The electrolevels are fitted at low level to detect fine movements, and readings are transmitted once a day.

Electrolevel Readings

Below we reproduce the data from the electrolevels. Sensor 1 is fitted to the left-hand wall when viewed from the front pavement, and Sensor 2, is fitted to the right-hand wall.

Both follow similar patterns and amplitudes. Sensor 1 rotates anti-clockwise (i.e. negative readings) in the summer, with recovery following in the autumn.



The red lines plots a 6 Interval Moving Average used to reduce signal fluctuations

Sensor 2 shows the opposite, as we would expect, with positive (clockwise) rotation in the summer as the structure subsides towards the trees, changing to negative values in the winter.

The amount of rotation (around 0.1 degrees) is similar in both instances.

To determine the efficacy of the Intervention Treatment we will take readings daily throughout the coming year, comparing the output with the SMD data. We are hoping to see a reduced level of movement, taking into account climate.

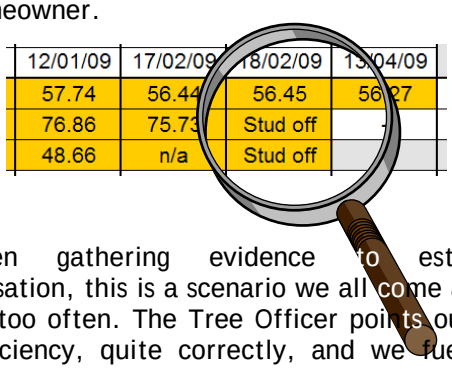
The Clay Research Group

Electrolevel Benefits

It is no reflection on anyone that all too often we lose data at important times in the claims cycle and the electrolevel site described on the previous page offers an example.

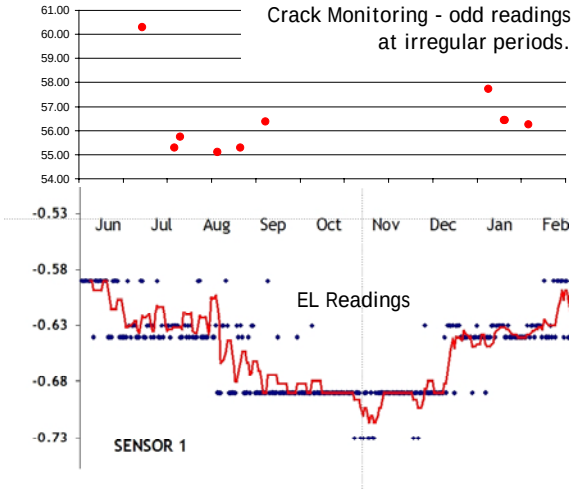
Below is an extract of what can go wrong.

Nothing to do with the operators – it is a sign of outdated technology that requires people to travel long distance to take manual readings periodically, delivering a large carbon footprint, taking time and inconveniencing the homeowner.



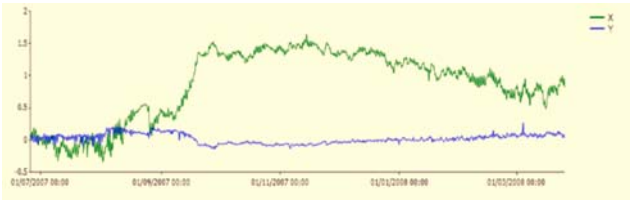
12/01/09	17/02/09	18/02/09	13/04/09
57.74	56.44	56.45	56.27
76.86	75.73	Stud off	
48.66	n/a	Stud off	

When gathering evidence to establish causation, this is a scenario we all come across far too often. The Tree Officer points out the deficiency, quite correctly, and we fuel the debate rather than resolve the claim.



Crack monitoring (upper of the two graphs) tells us there is enhanced periodic movement that implicates the tree, but we can hardly take comfort in delivering this level of service when an alternative technology, costing little more, delivering objective data at regular intervals, is available.

Graeme Phipps from SPPS was testing the telemetry device for measuring cracks at Aldenham, and provided the following output from 2007 and 2008.



Readings were taken every 8 hours, day and night, and sent direct to the web portal. We can see clearly the periodic signature implicating a nearby tree. In addition we detect diurnal movement – around 0.2mm on the 6th March.

05/03/2008 00:45:30	0.82
05/03/2008 08:45:31	0.95
05/03/2008 16:45:29	0.76
06/03/2008 00:45:30	0.72
06/03/2008 08:45:31	0.8
06/03/2008 16:45:28	0.71
07/03/2008 00:45:31	0.66

The benefit with this technology is that should anything go wrong we can receive alarms set to pre-determined levels.

This isn't a 'fix and leave' technology just yet, but it offers significant advantages. In the above graph we wonder about the hysteresis effect for example, linearity and repeatability but without testing in a variety of situations, we can't move forward.

Using traditional methods, we would have had far fewer readings, and very little insight into what was happening.

An assembly of 2 No. electrolevels and 2 No. TDR moisture sensors costs around £1,300 and assuming a 10 year lifespan the cost of gathering data, assuming each house was instrumented for 12 months, would be £130 per property, plus telemetry and installation costs.

This covers both monitoring and soil testing. We estimate comprehensive 'real time' data would be available covering both building movement and moisture change for around £1,200. Economic for high value tree root liability claims.

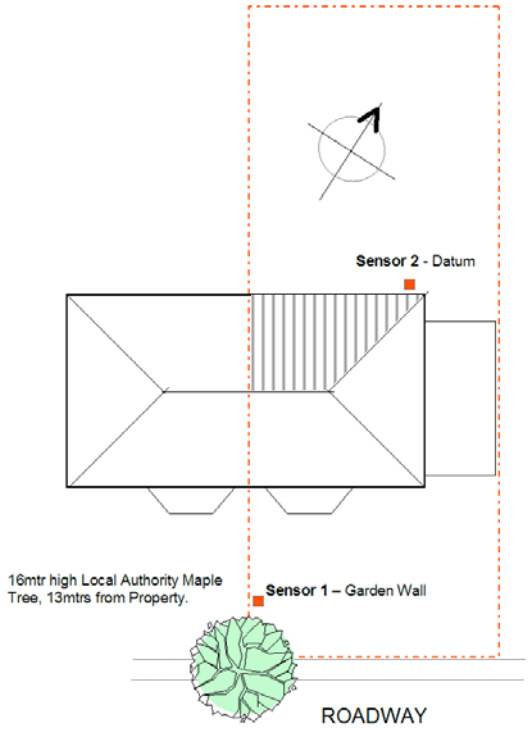
The Clay Research Group

EL CASE STUDY

This example relates to a semi-detached property in North London. The soil Plasticity Index was around 40 - 45% and there was a 16m tall Local Authority Maple tree 13mtrs from the front house wall.

Several sensors were installed around the house and an additional one (Sensor 1 below) was fitted to the garden wall, near to the tree.

The objective was to establish the difference in the signals between parts of the building that were moving, and others areas there were not.



Data collection commenced in July 2004, and ran for a 12 month term. Readings were taken every hour, 24 hours a day.

The signal delivery was good – the start readings tally almost exactly with the final readings - suggesting that drift and hysteresis aren't an issue.

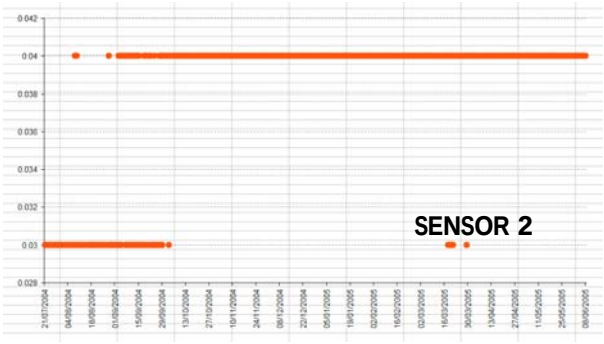
Recovery (rehydration of the soil) commences early in November, and continues through to the middle of May. Subsidence of the ground starts at the beginning of June, peaking in October.

This data relates to weather conditions in 2004 and 2005.

Sensor 2

Fitted to the rear of the house, remote from the tree and acting as a datum, recording 'normal' seasonal change – i.e. without any influence from tree root activity.

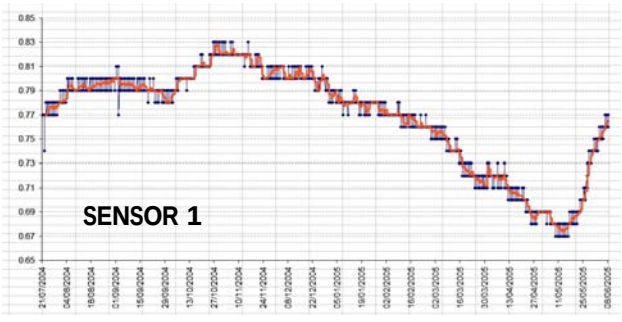
The flat line profile contrasts with the profile of Sensor 1. The 'step' is not unusual and might reflect some form of physical impact or simply a changed baseline following a change in voltage.



Sensor 1

Fitted to the side of a garden wall with shallow foundations – 200 – 300mm below ground level, variable across a slightly sloping topography.

The profile is characteristic of root induced ground movement



All readings measure degrees of rotation. Readings were taken every hour for a twelve month term. For details of the influence of climate on diurnal movement, see next issue.

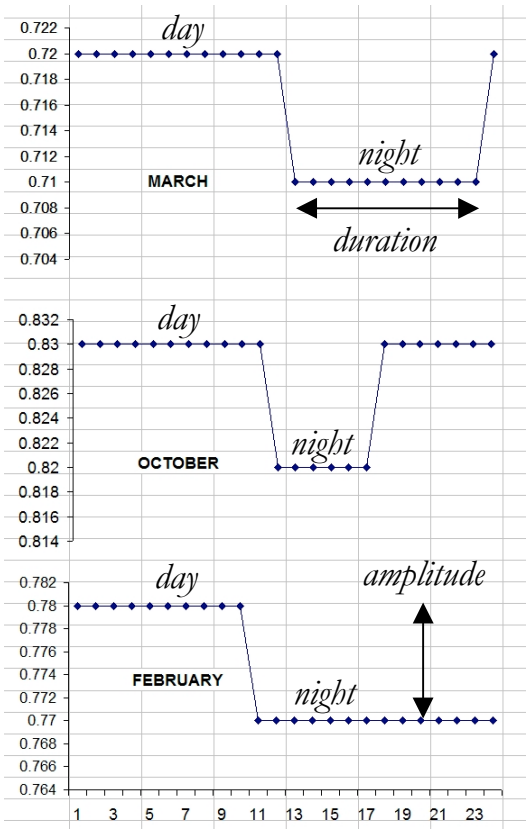
The Clay Research Group

DIURNAL MOVEMENT

Monitoring of the Mansion House in London by a team of experts some time ago revealed that buildings responded to temperature change diurnally, and we see evidence of this from the electrolevel sensors.

Movement is small, but we see a periodic signature in the order of 0.01 degrees.

Every 'dot' on the graph is an hourly reading.



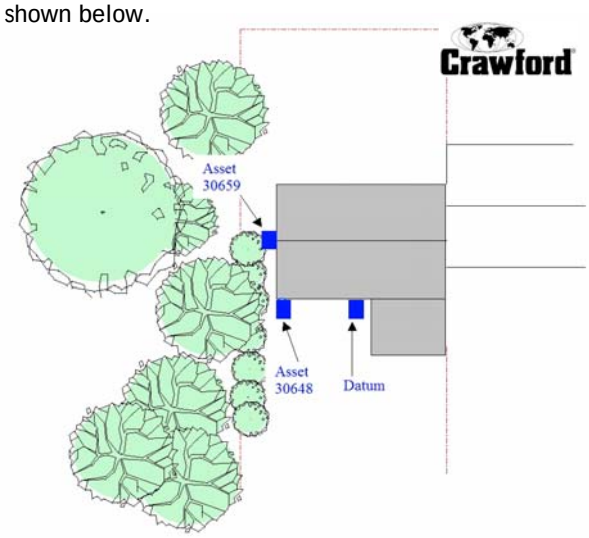
The interesting thing appears to be the fact the amplitude of movement doesn't change significantly over a typical season, but the length of the signal extends in the colder months. Buildings naturally take longer to warm up following cold nights.

Contrast the February readings with those collected in October. In the summer, the overnight change due to the drop in temperature extends for around 5 – 6hours.

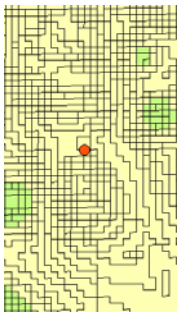
In the Spring the value is around 10 – 11 hours, and in the winter, 14 hours.

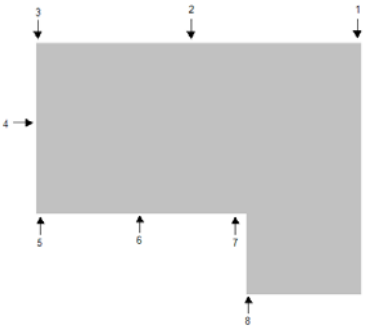
CASE STUDY

A further example of electrolevels being used on claims and provided by Jon Gray of Crawford & Co. This property, situated in Leicester, has a group of large trees close to the building, and 3 sensors have been installed as shown below.



The installation was undertaken in March 2009 and the objective is understanding the amount of movement we will see on Boulder Clay. Our geology model suggests a very low P.I. – around 10 – 15% taking account of percentage passing. Barely a shrinkable commodity.





Crawford are undertaking out precise levelling (below) to accompany this project and the results will be published every few months.