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

March 2012

The Clay Research Group

CONTENTS

Issue 82, March, 2012

ASTON UNIVERSITY
BIRMINGHAM

The Annual Subsidence Conference
20th June, 2012

The annual conference has been well attended over the last 10 years with a range of speakers from the fields of adjusting, insurance, academia, arboriculture, underwriting and the soil sciences.

It also provides a platform to review the work of the CRG.

This year's program is just being finalised, and tickets will be available from Helen Mallinson 0121 204 3593 or Claire Wallis 0121 204 3624. Contact them by E-mail on

cpd-seas@aston.ac.uk

Our continued thanks to Aldenham School who have kindly provided the research site in North London, giving access to monitor two mature trees, on fine grained soil, over several years, and to monitor nearby buildings as well as undertake a range of tests at various times.

Thanks also to Innovation for primary funding, Crawford & Company for meeting the cost of precise level monitoring and Marishal Thompson for the purchase of the weather station. Also thanks to OCA for regular weather updates and of course the academic team for sharing their findings in several areas of innovative research.

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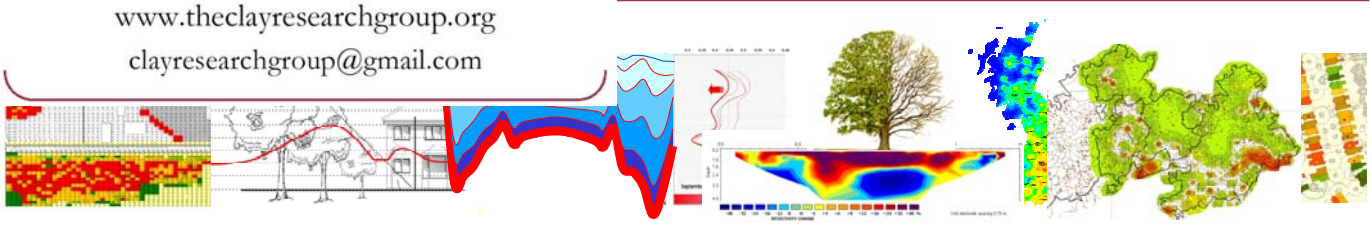

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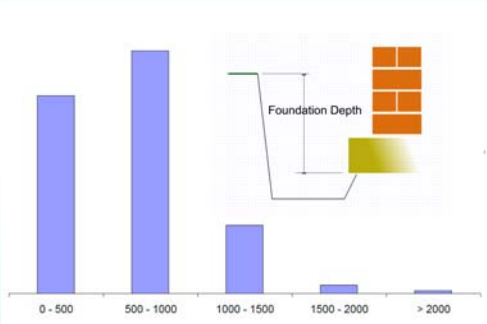
Weather Update

David Shohet has taken over collecting the weather station data from the weather station at Aldenham and there will be a review in next month's edition following the recent dry spell.

We hope to compare the weather data with precise levels taken by GeoServ Ltd., to detect any trends.

FOUNDATION DEPTHS

From a sample of around 5,000 investigations, the foundation depths are usually less than 1m bGL, as one might expect when handling subsidence claims perhaps.

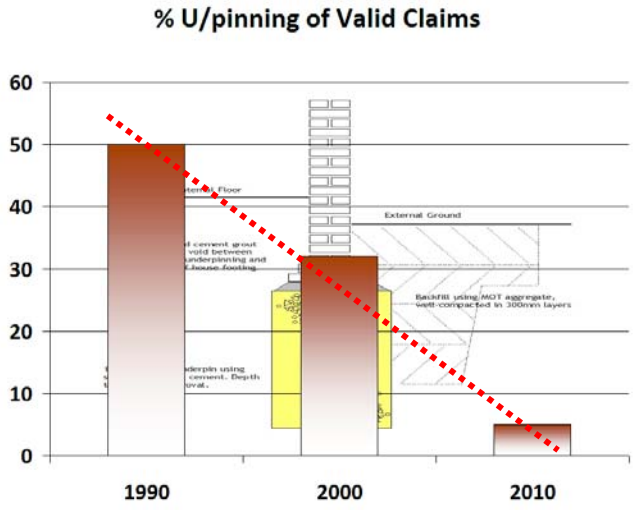


The sample includes both concrete strip and brick footings.

Underpinning Frequency

Claim costs have fallen in real terms over the last 25 years, and a major contributory factor is the reduction in underpinning schemes.

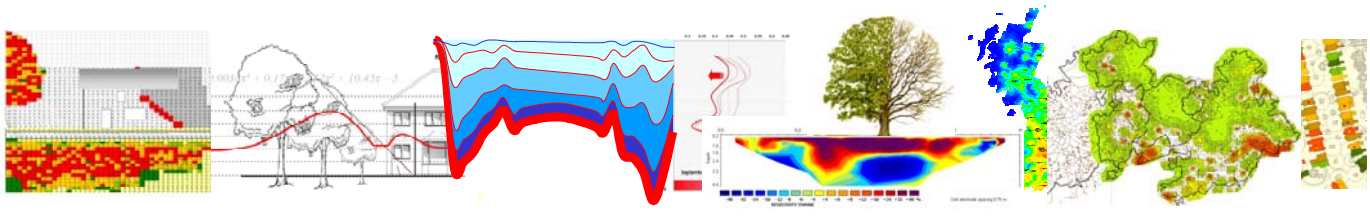
The graph below illustrates how underpinning has fallen out of favour since 1990 and despite warnings that this would result in large numbers of claims re-opening, nothing very much has changed.



The falling cost of subsidence repairs must, in part at least, be linked to the reduction in underpinning. An improved understanding of geotechnics combined with the efforts to remove the cause have all helped.

In fact, many of the re-opened claims that we audit involve situations where houses have been underpinned, or extensions demolished and rebuilt off a piled foundation, only to fail again.

The evidence suggests that the safest remedy of all is removing the cause of the damage. In most cases involving a recurrence of damage, the tree that caused the original problem remained in place.



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Westminster Palace

We understand that the Houses of Parliament, completed in 1870, are suffering an episode of subsidence, and there isn't a tree in sight!

Initial reports suggested that the deep excavation of the Commons underground car park may have been a contributory factor, or vibration from London Underground Jubilee Line running nearby and completed in 1990.

The tower housing Big Ben now leans by around 450mm.

The cost of repairs is estimated at £1bn, which equates to the building's value.

Professor John Burland, from Imperial College was less concerned, and said it would take 10,000 years for the famous tower to tilt as much as the Leaning Tower of Pisa. He added: "It's moving incredibly slowly and always has done so and there really is no immediate danger at all."

Prof. Burland designed a five-storey car park underneath the Palace of Westminster, and confirmed that the clock tower's tilt is nothing new.

"It's been there for years," he told BBC Radio 4's Today programme. "When I first started work on the car park it was obvious that it was leaning.

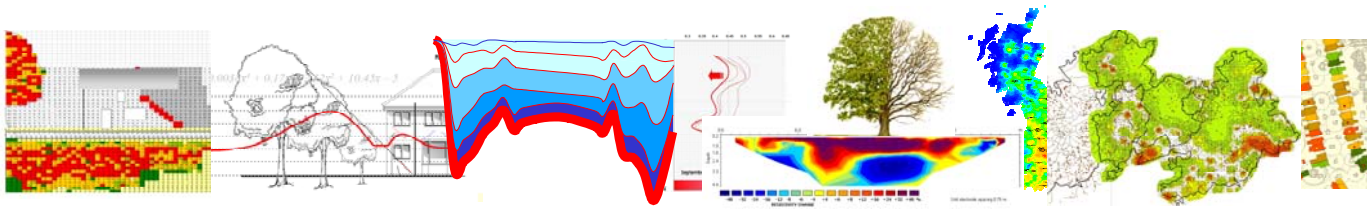
"We made measurements on it. It was leaning at one in 250 to the vertical, which is just about visible. That's the break point between looking vertical and looking like a slight lean."

Burland said the lean had probably developed early on as there was no cracking in the cladding.

"We think it probably leant while they were building it and before they put the cladding on," he said. "That was a long time ago and buildings do lean a little bit."

Burland added that the cracks, which he said was not caused by the tube's Jubilee Line or the car park, was actually good for the palace. "They're beneficial because the building moves thermally more than is caused by the Jubilee Line and the movements concentrated around the cracks and, if they didn't, there would be cracking elsewhere," he told Today.

He also said the clock tower's lean was visible to the naked eye: "If you stand in Parliament Square and look towards it, you can just see that it moves very slightly to the left – but I wouldn't put any political slant on that."



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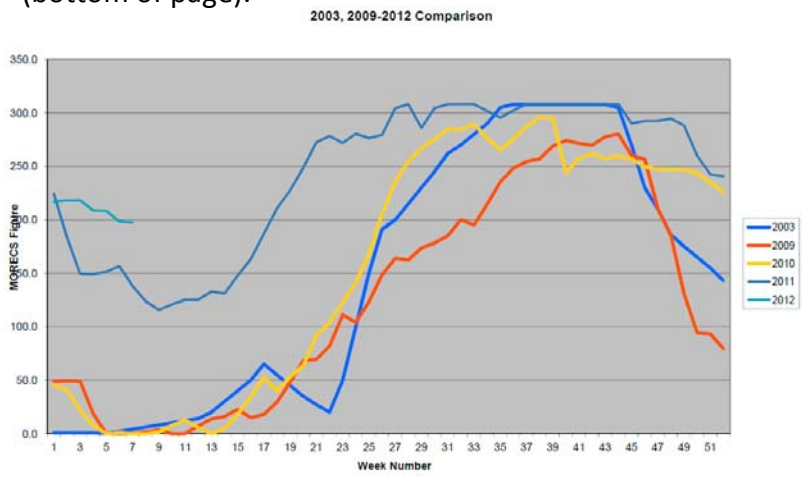
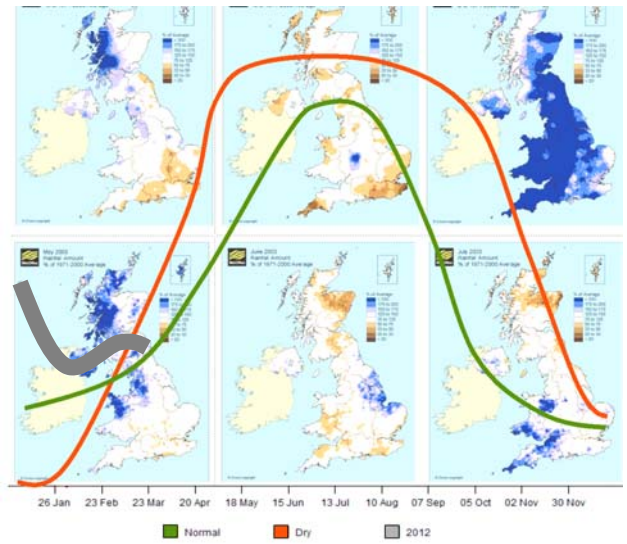
2012 Weather Update

The two graphs below plot the Soil Moisture Deficit (SMD data supplied by Meteorological Office) under trees (top, supplied by Michael Lawson of OCA), and for grass cover (bottom of page).



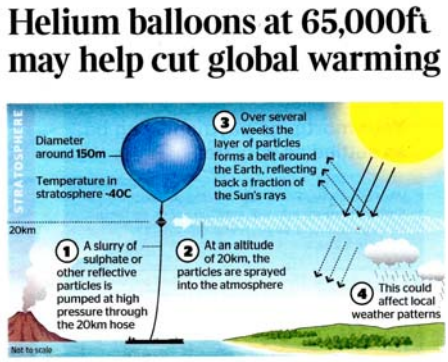
By any standards, the year has started off very dry with warnings from DEFRA that, "the South East of England is now at a high risk of drought due to continued low rainfall and central, eastern and south eastern England are unlikely to see a full recovery from drought conditions during 2012."



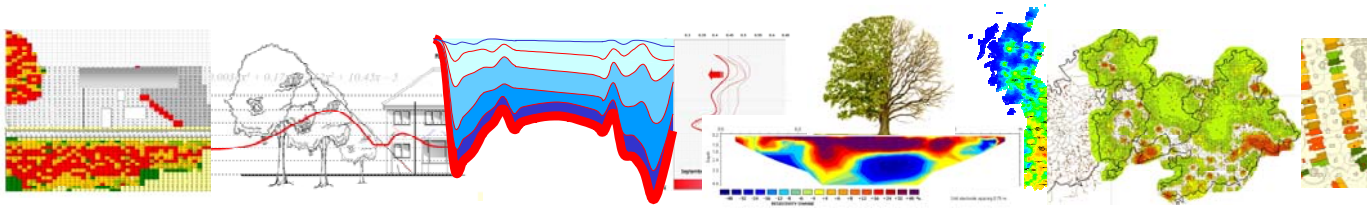
FROM CRISIS TO CATASTROPHE

After recovering from the threat of a looming ice age in the late 1970s associated with atmospheric pollution (the so-called 'nuclear winter') we tumbled into the threat of rising groundwater levels associated with a reduction in water use by industry in the late 1980s, only to be assailed by the threat of a meteorite colliding with the earth.

The human condition is based on anxiety it might seem, but things could shortly take a turn for the worse.



Will the remedy cause more damage than the problem? We can only hope that the latest idea, widely reported in the press, of adding a sulphate slurry to the atmosphere to reflect the heat from the sun remains just an idea.



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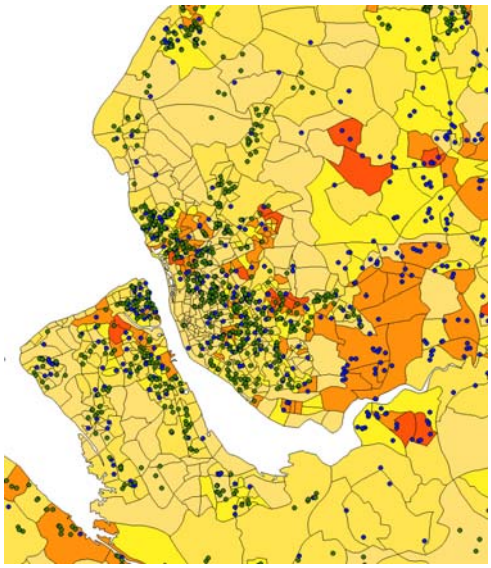


DEPRIVATION –v- REPUDIATION

Is there a link between deprivation and repudiations? If so, it might be a useful addition to the Triage model.

The map, left, calculates deprivation based on a range of factors including Housing Association tenancies, unemployment, house and car ownership and occupation.

Claims have been superimposed, with blue dots representing repudiations and green dots valid claims. A more detailed analysis is underway to establish if the concentration of either is linked to deprivation, and whether or not that link is robust.

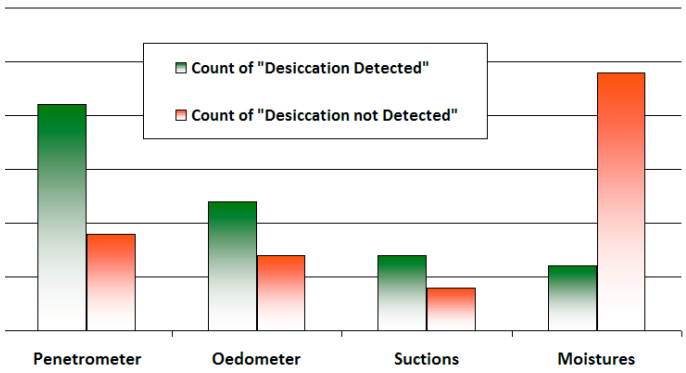
Winter Soil Testing

Testing soils to establish desiccation is often fraught with problems in the winter months.

We have made a comparison using a small sample of 32 claims, all situated on London clay to avoid the confusion that testing Boulder clays and other variable deposits can produce.

If the value of the test lies in the detection of desiccation, then penetrometers provide the most effective method of measuring root induced clay shrinkage, and certainly in the winter months, as we see from the graph, right.

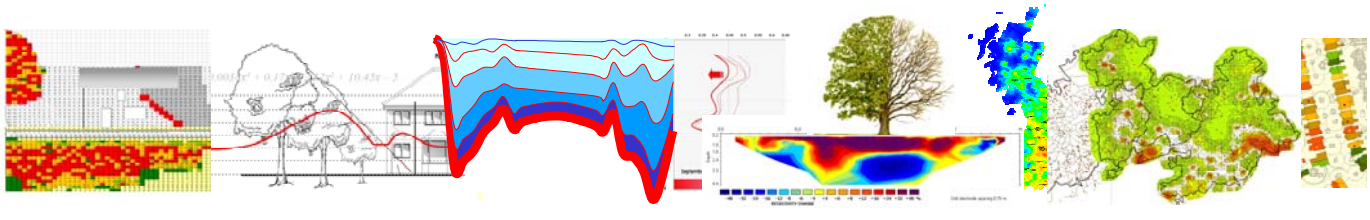
When the tests were undertaken, the penetrometer was nearly twice as effective as the oedometer and over three times more effective than suctions or moistures.



The criteria was based on the detection of a bulge in all tests, of sufficient size to avoid undue debate between reasonable engineers A definition which is itself open to much discussion.

In the case of moistures, we have used the liquidity index. For the other tests, we have adjusted the equilibrium line to coincide with upper and lower readings, rather than taking some notional fixed value.

More data will be added over the next few months.



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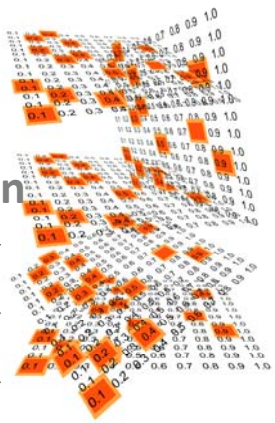
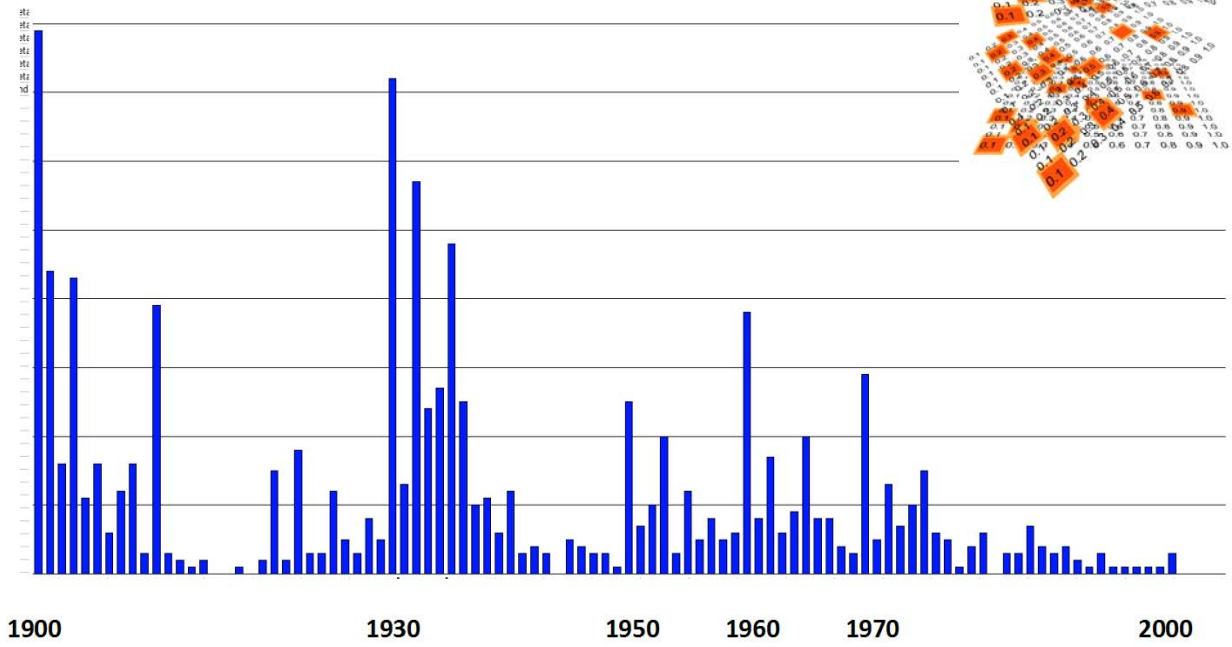


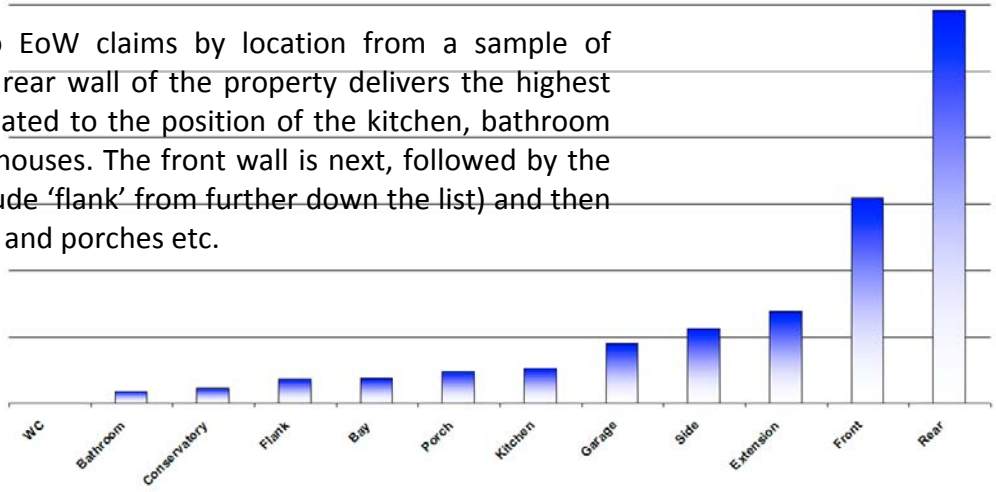
Escape of Water Claims by Year of Construction

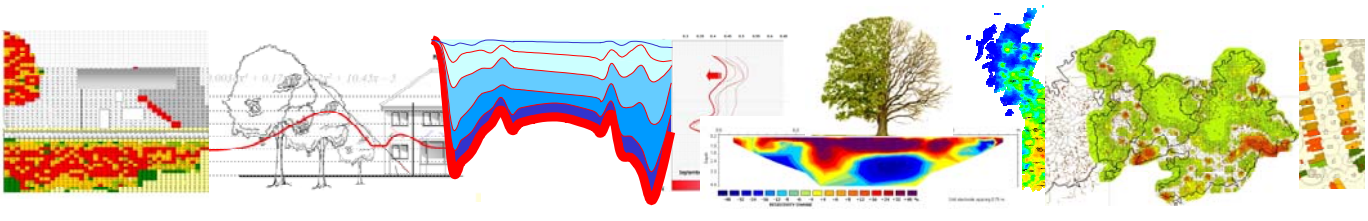


Continuing the theme from last month's edition, plotted above are the count of Escape of Water (EoW) claims by year of property construction. There are peaks from properties built around the 1900's, between and just after the World Wars, diminishing with the advent of flexible drains and couplers. The occurrence of peaks reflects the use of "1970's", or "1960's" broad categorisation by the engineer when exact dates are not known. The distribution generally follows house builds.

EoW by Damage Location

Damage related to EoW claims by location from a sample of 10,000 claims. The rear wall of the property delivers the highest count, no doubt related to the position of the kitchen, bathroom and toilet in many houses. The front wall is next, followed by the side wall (if we include 'flank' from further down the list) and then extensions, garages and porches etc.





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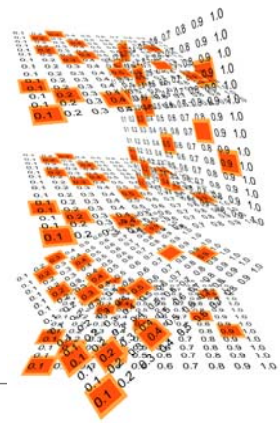
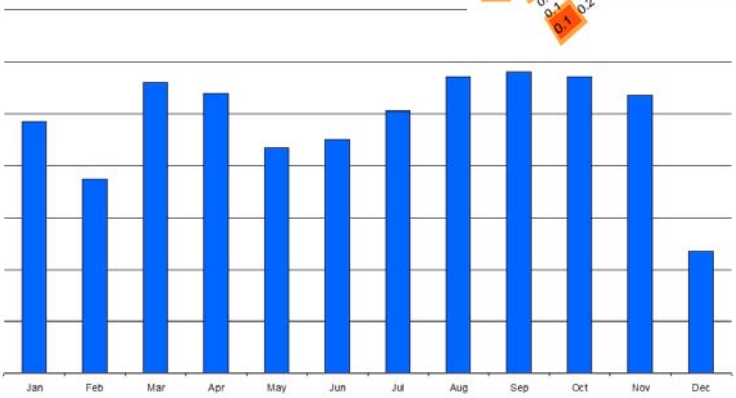


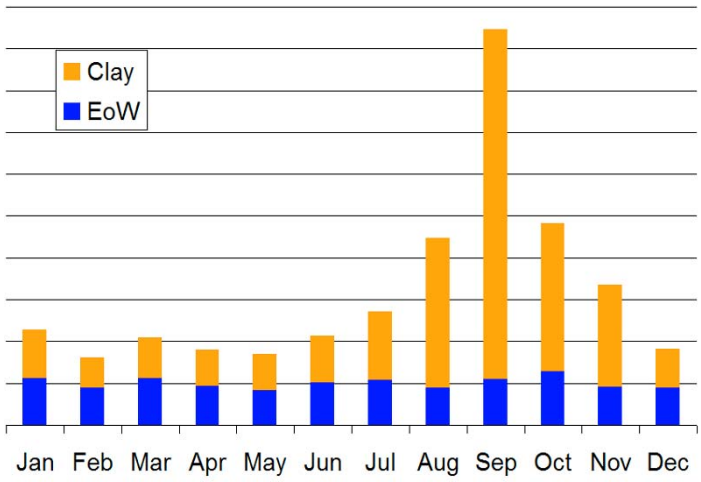
EoW by Month

Count of Escape of Water claims by month is shown right. There is no discernible pattern, unlike clay shrinkage claims – see below.



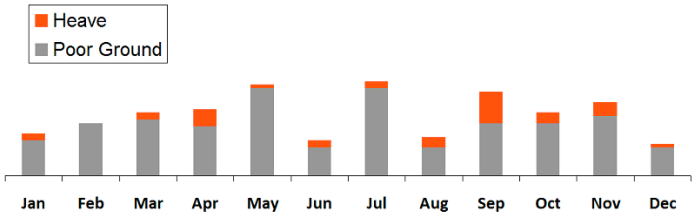
Clay Shrinkage by Month

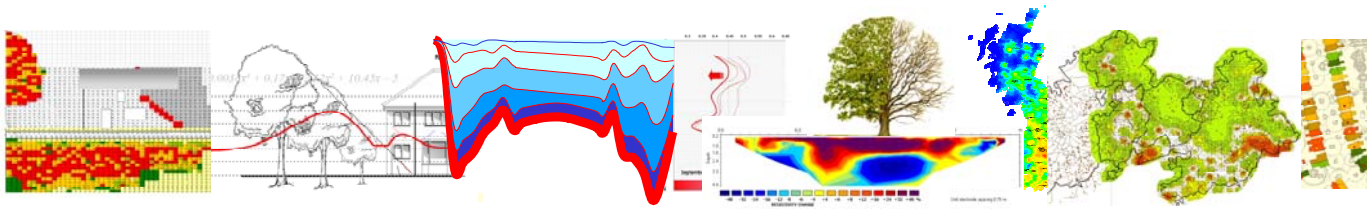
The periodic signature of clay shrinkage claims superimposed onto escape of water. The graph reveals clay shrinkage claims peaking around September and the relative count of each, with escape of water claims accounting for around 50% of the claims notified early in the year, but making a reduced contribution in the summer.



Heave & Poor Ground

Little evidence of a seasonal pattern to heave, or claims involving poor ground. The risk presented by heave claims tends to be related to age of construction rather than month of notification, with new developments being riskier. Poor ground is a wide definition and might cover aerobic decomposition of peat with higher notifications in the summer, whilst loose fill might perhaps be more vulnerable in the winter months.





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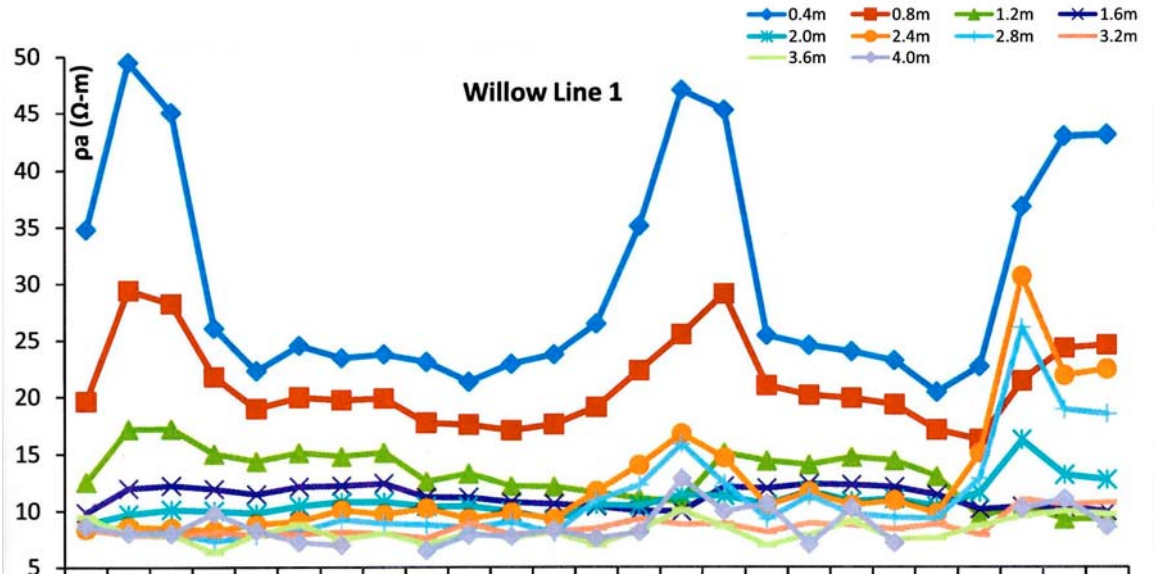
ELECTRICAL RESISTIVITY REVIEW



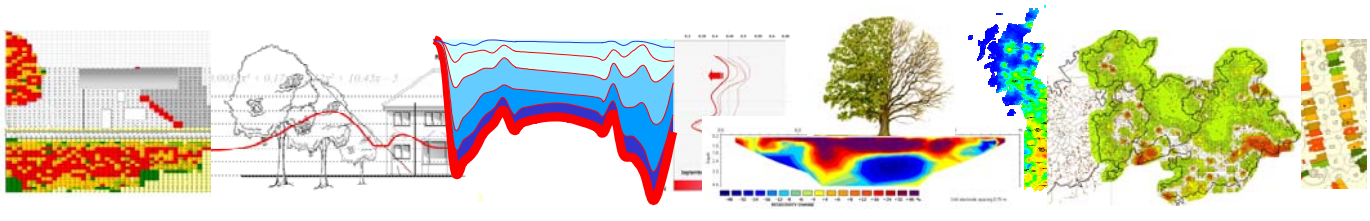
Electrical Resistivity Line 1 – Aldenham Willow

The above graph is an extract from Glenda Jones's PhD and shows the electrical resistance of the soil in the vicinity of the Aldenham Willow for the period July 2006 through to September 2008. The dark blue line, top, reflects the soil dryness 0.4m from the tree. This is the highest reading, and interestingly (as Glenda pointed out) it remains high throughout the winter, confirming the presence of a persistent deficit closer to the tree.

The red line, second from the top, measures the electrical resistance 0.8m from the tree and has similar properties – i.e. dry throughout the winter.

4mtrs away from the tree (the furthest station in this exercise) and close to the drip line (the canopy measures 10mtrs across), the soil appears to be at equilibrium level throughout the monitoring term.

The paper makes several recommendations to develop an improved system for the routine investigation of root induced clay shrinkage claims. The existing system suffers as a result of drying shrinkage of the soil around the ground pins. Glenda also makes suggestions to improve the interpretation software.



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CLAY SHRINKAGE S.I.

Investigations are aimed at providing information on the nature of the soil (shrinkable or not), presence of tree roots, depth of the foundations and evidence of desiccation. In complex cases, the engineer might want evidence of movement. Adding temperature readings from site would be useful.

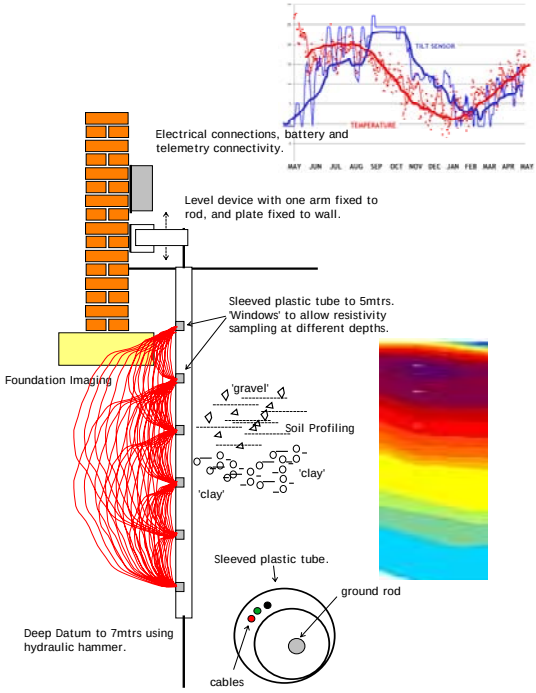
We understand from the ERI work undertaken by Glenda (previous page) that various soil types have been characterised – i.e. it is possible to distinguish clay from gravel for example, and hopefully to distinguish concrete from soil.

Then we want to record building movement. A simple sliding couple, with a fixing to the building and another to the ground rod, linked to an electronic transducer would record vertical movement accurately.

Sinking the bore to install the device provides the opportunity to retrieve roots and soil samples if needed.

What would this device look like? See the sketch, right. Aldenham had telemetry links to transmit data without the need for visits. An 'ideal' device might offer the same functionality.

Measuring the correlation between soil drying, building movement and temperature over time isn't that difficult. Adding basic information regarding soil type, foundation depth etc., should provide sufficient information to determine if movement is caused by root induced clay shrinkage.



In summary, one borehole would be needed, not two. No trial hole would be required, reducing the time on site and the associated disruption. The quality of the information obtained would be superior to that provided by soil testing alone.

A sleeved plastic tube containing wiring to the resistivity pins would house a deep seated ground rod, sunk to 7mtrs bGL, providing a reliable datum – better than a nearby gully or manhole. The ERI imaging would detail the foundation depth and the soil characteristics, as well as provide evidence of desiccation.

Building movement would be monitored every hour or every day, linked to the ERI imaging. Is the building subsiding as the ground is drying as the temperature is rising?

One visit by one crew, delivering high quality dynamic evidence linking the various components of a root induced clay shrinkage claim.