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
Electrokinesis Osmosis
Intelligent Systems

Edition 148

September 2017

The Clay Research Group

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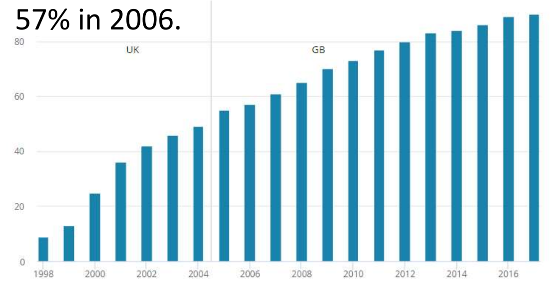
Edition 148, September, 2017

A Connected UK

The Office for National Statistics report that in 2017, 90% of households in the UK have internet access, an increase from 57% in 2006.



Source: Office for National Statistics

This is encouraging news for homeowners who want different channels to access their policy and to follow claims progress, in line with FCA recommendations.

TDAG Update

Sue James has been liaising with the NHBC, LABC and CRG to obtain costing (see article by ASUC in this issue) on the use of piled foundations for new housing on clay soils. Sue explains that the study will also require a review of Part A Building Regulations at some stage.

News that the Joint Mitigation Protocol, launched in 2008, may be revised and possibly simplified to make it easier to use.

TDAG web site: www.tdag.org.uk

ASUC have provided the picture, right, showing the risks associated with working in deep excavations.

Dates for the Diary

Subsidence Forum Training day open to members & non-members - Thursday 19th October
ASUC Awards - Friday 24th November.

Both are open to members & non-members.

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TDAG Initiative – ASUC Feedback

The June edition of the CRG newsletter (No. 145), explored the topic raised by TDAG of providing a piled foundation for all properties on a clay soil to facilitate tree planting closer to new buildings without the risk of causing damage. The article suggested the additional cost per property might be in the region of £25k. The have ASUC the following analysis.

ASUC Update on Costing

Rob Withers and Lisa Hennessey

ASUC were asked to look at costing regarding piled foundations. We have looked at two scenarios using averaged prices across our membership in the UK

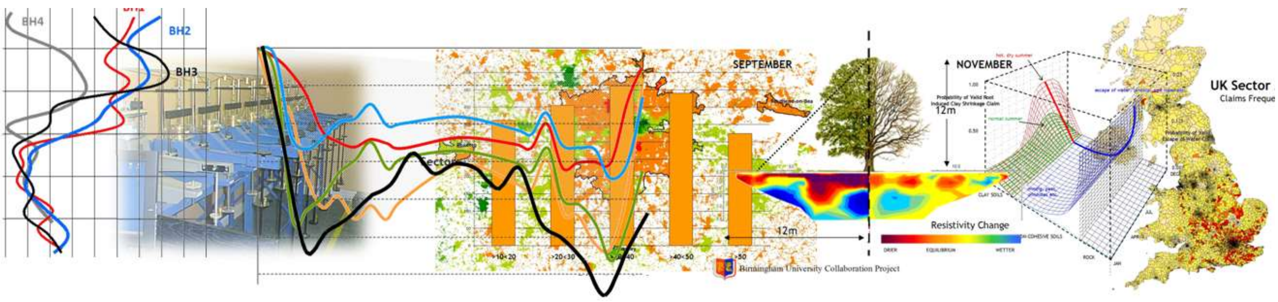
1 - The Clay Research Group example (17 sleeved piles, 56 sq m. footprint, suspended slab) considered in heave/shrinkage the engineered (piled) solution will be 8.5m deep. The engineered solution is £329.82/sq.m. Thus, a piled solution is cheaper than thought and the benefit being that any extra over costs for increase in depth in piles due to local ground conditions is minimal compared with traditional digging solutions and is a safer method of construction – total cost circa £18,500.00. Less than the £25k mentioned in June edition.

2 - the same layout but in non-cohesive soils, using driven piles to 6.0m for the engineered solution the cost of the engineered solution is £234.69/sq.m; circa £10,500.00. Again more cost effective in the event of depth of piles needing to increase locally and a safe method of construction

ASUC strongly believe that any foundation in excess of 1.5m deep should be engineered and our examples demonstrate that for a foundation depth of 1.75m or more, a piled solution will always be more cost effective and, with a mind to the environment and H&S issues, should be adopted.

Advantages: Less dig = less muck away and concrete – hence environmentally friendlier. H&S – it is simply not acceptable to risk employees in deep trenches when safer methods of work are available and cost effective.

NB – All ASUC members schemes including structural repairs come with a 12-year latent defects insurance warranty underwritten by an" A" rated UK insurer – no need to prove liability and no need for members to still be trading in order to initiate a claim. www.asuc.org.uk for full details of all ASUC warranty schemes.



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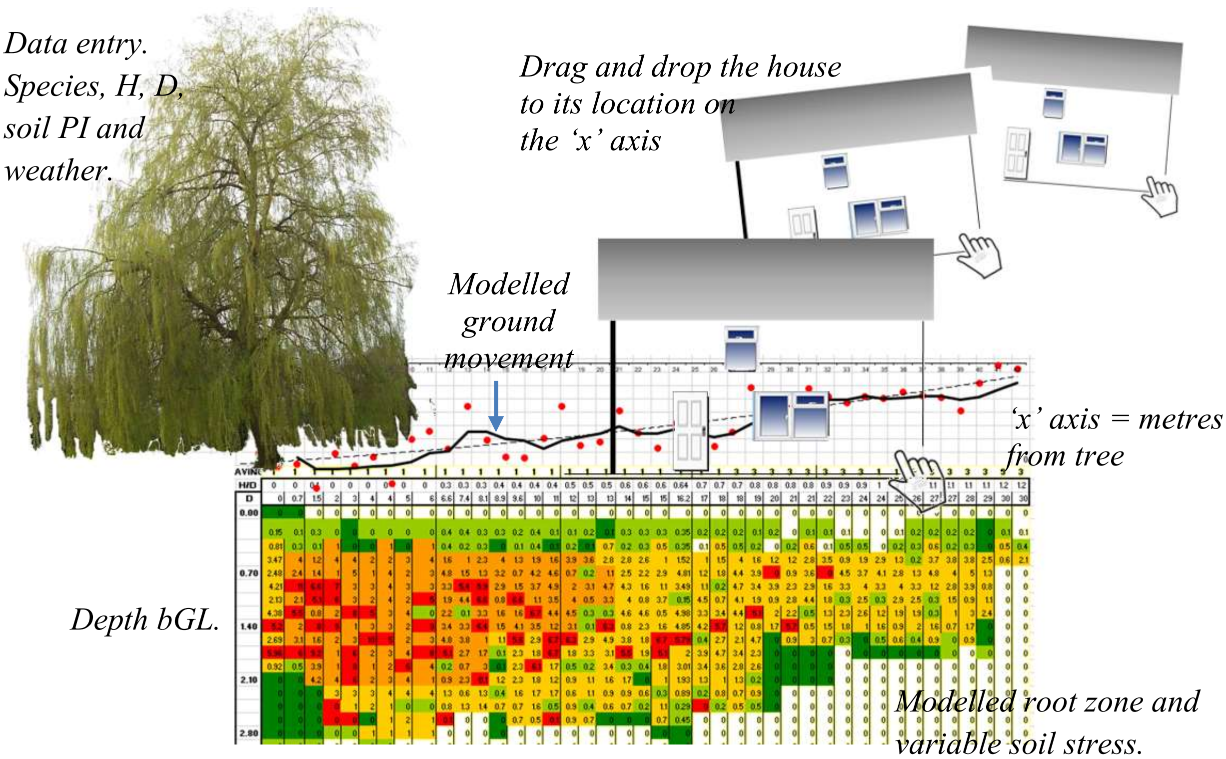
Modelling -v- Site Investigations and Soil Tests

Reviewing the Disorder Model

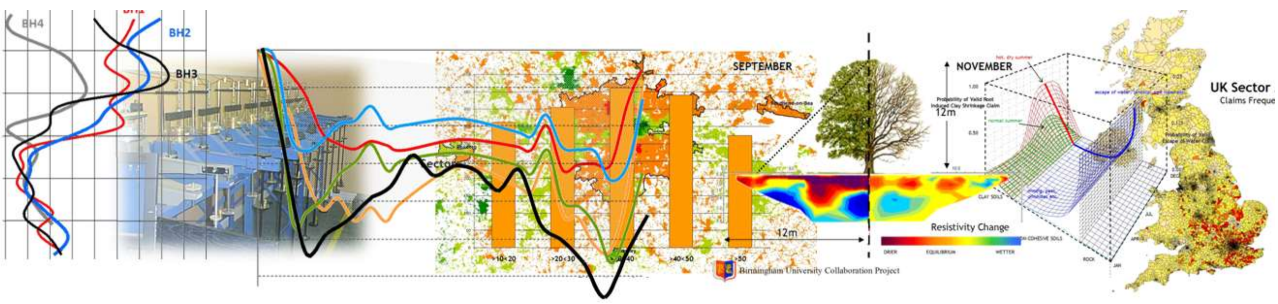
In last month's edition, the results of investigations and soil testing from three boreholes about 4mtrs from the Aldenham willow were reviewed. Suctions for undisturbed samples recorded 592kPa, and for disturbed samples, 1,035kPa. Estimates of swell were between 20 and 30mm for undisturbed and remoulded samples, and 60mm for disturbed.



Using the Disorder Model, suctions of between 650 - 700kPa were recorded, with estimates of subsidence/swell of 45mm.

The difference between the two approaches? Modelled suctions were 10% higher than the actual (undisturbed) test results, but lower than results obtained from testing the disturbed samples. Estimates of swell were higher than those derived testing undisturbed samples, but lower than the results obtained from testing the disturbed samples.

The real issue is that one cost thousands of pounds (site investigations and soil testing) and took over a month to deliver. The other cost a few pounds, and took minutes.



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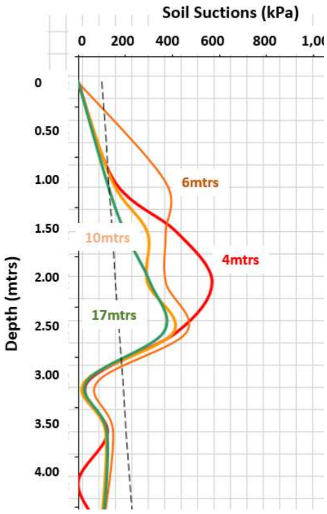
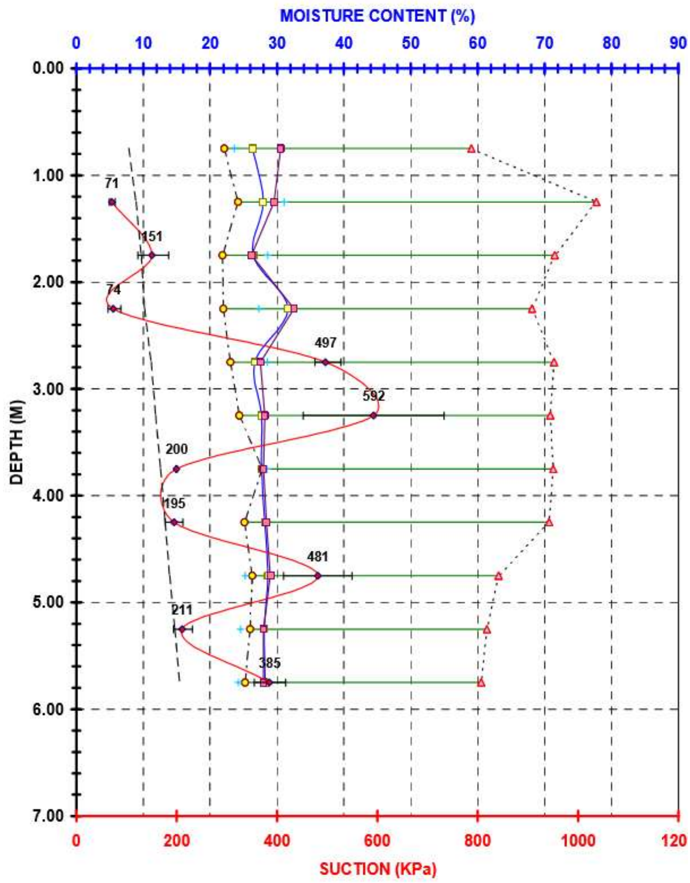
Modelled Results

Comparing output from the Disorder Model with the results of actual investigations undertaken at the site of the Aldenham willow. See last edition.





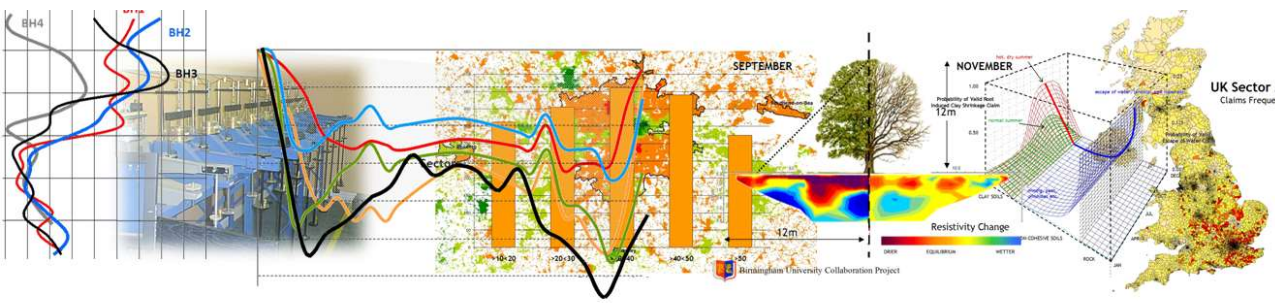
Above, results obtained using the Disorder Model. Maximum suctions of 600kPa peaking at around 2mtrs below ground.

Right, the results from actual soil testing showing maximum suctions of 592kPa at a depth of 3mtrs.

Very little difference between the desiccation values, although the depth below ground varies slightly.

The drawbacks of this efficiency? Perhaps the property sits on outcropping London clay according to the BGS map, but there is a localised anomaly. A backfilled pit for example. Otherwise, provided the pattern of damage is verified as subsidence, and the location of the damage fits with the modelled root zone of a LiDAR survey, the Disorder Model is probably as good as the alternative of site investigations and laboratory testing.

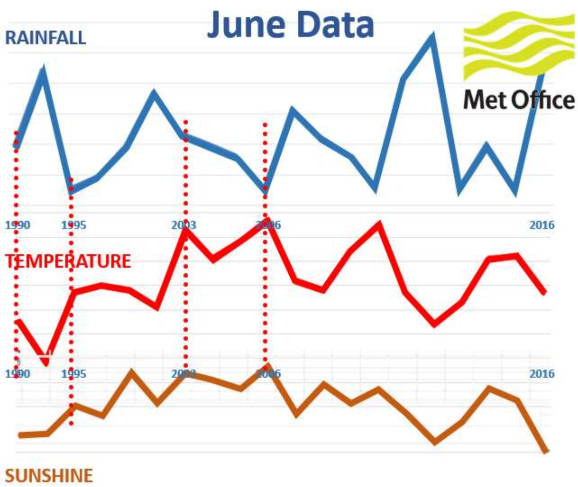
The definitive answer of course, is to measure building movement using precise levels, and look for recovery over the winter months to establish both desiccation and the presence of clay.



Event Years and Weather – is there a predictive link?

The following three charts plot the relationship between rainfall (blue), temperature (red) and hours of sunshine (orange) from data supplied by the Met Office for the Heathrow weather station. What are the drivers behind high subsidence claim numbers? Is it a question of ‘too dry’, ‘too hot’, ‘too much sun’ or some combination?

Each of the charts plots data for a specific month. June, July and August have been chosen as the most likely to influence root induced cay shrinkage claim numbers – the peril behind Event years. Each is plotted individually for the period 1990 – 2016, identifying 1990, 1995, 2003 and 2006 as years with high claim numbers. Does any specific month determine/influence claim numbers?



Left, the profiles for June reveal a high temperature and low rainfall in 2006, and low rainfall in 1995, but little else of note.

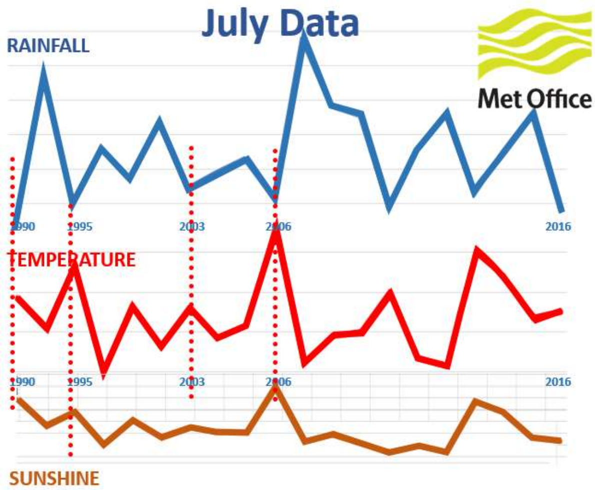
Interestingly 2010, a normal claims year, had low rainfall and high temperature.

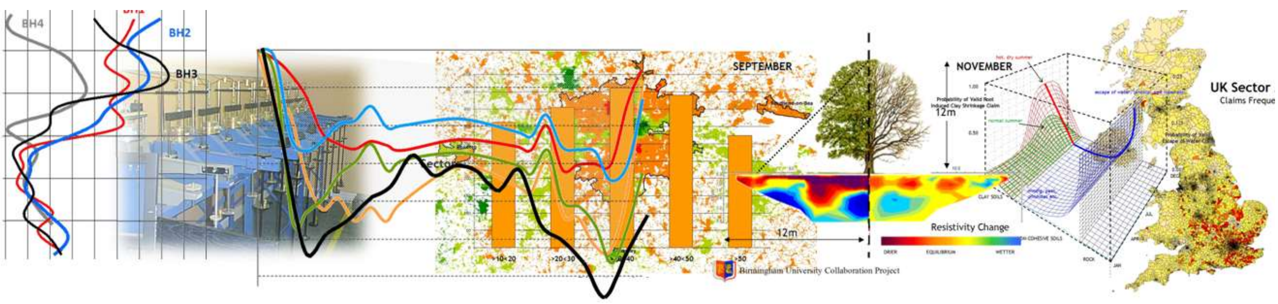
Below, data for July reveals low rainfall in 1990 and moderate temperature with lots of sunshine, as do 1995 and 2006.

The graph identifies 2006 as a possible event year with low rainfall coinciding with high temperatures (higher than 1990 and 1995) and significantly higher than average ‘hours of sunshine’.

However, the July plot misses 2003.

Event years may have links to a combination of these elements and particularly as previous research has revealed July to be a month of peak moisture uptake for some trees.





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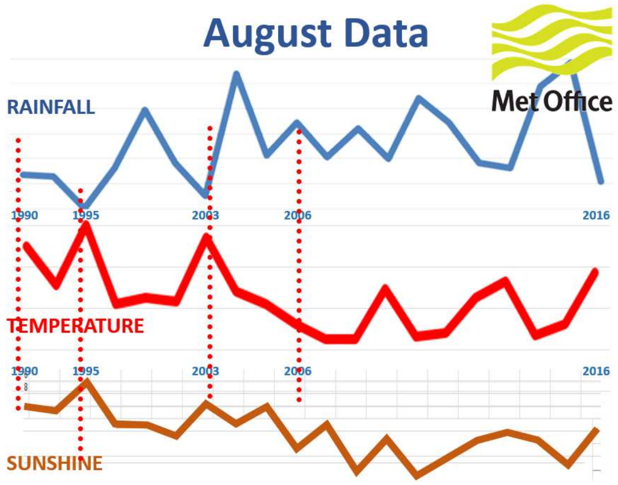


Data for August, left, reveals low rainfall in 1995 and 2003 and higher than average temperature with above average hours of sunshine.

There is little of note to identify 2006, and just a suggestion that 1990 might deliver high claim numbers.

Each event year has identifying characteristics of a month with higher than average temperatures and hours of sunshine, combined with low rainfall.

There is no individual month that can be relied on to determine the claims outcome.

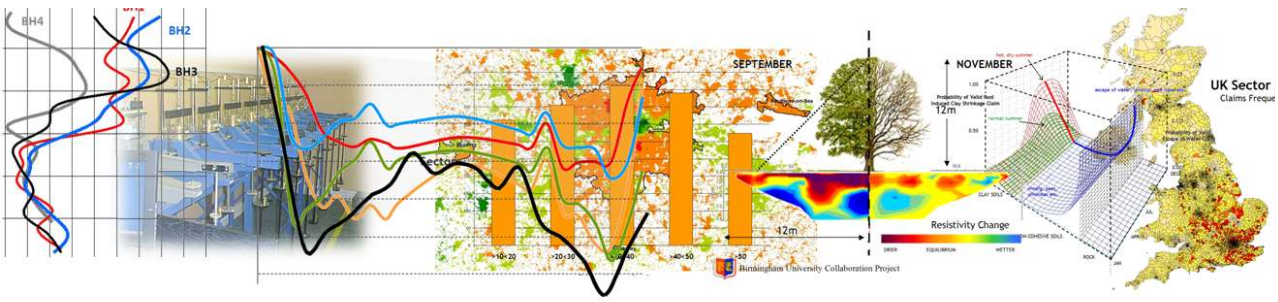
In summary, there is no 'magic month' that might trigger an event year. However, each event year (distinct from normal years) does have a combination of higher temperatures coinciding with lower than average rainfall and longer hours of sunshine in one of the three chosen.

2006 alone was identified by high temperature and low rainfall in June, although claim notifications developed quite late in the year. Hours of sunshine hints at a busy year in 2003 and 2006 but is of little help elsewhere on the timeline.

July identifies 1990, 1995 and 2006 but again, misses 2003. The hours-of-sunshine plot does well in 1990 and 1995 but offers little help identifying 2003.

August weather is the only month to identify 2003, along with 1995. Hours-of-sunshine identifies a risk in 1995 only.

The outcome isn't as helpful as hoped when starting the analysis, but it can be seen that any preceding month with the combination of low rainfall, higher than average temperatures and long hours of sunshine can be an indicator of high claim numbers to follow. The benefit? By tracking the figures, a 'reliable' means of foreseeing events may be found, although the warning period will be nominal – a month or so at best, and a few weeks if the warning signs emerge at the end of August. Not enough time to mobilise a workforce to cater for an increase in claim numbers in excess of 20,000.



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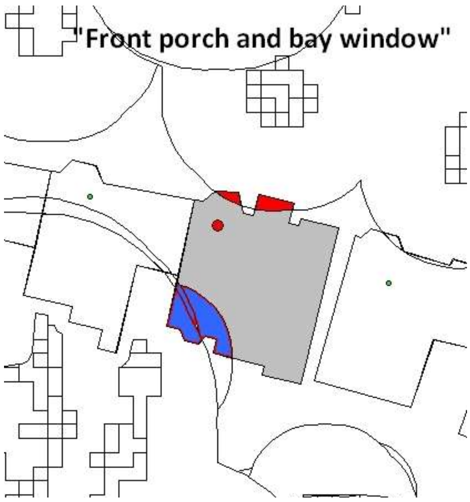
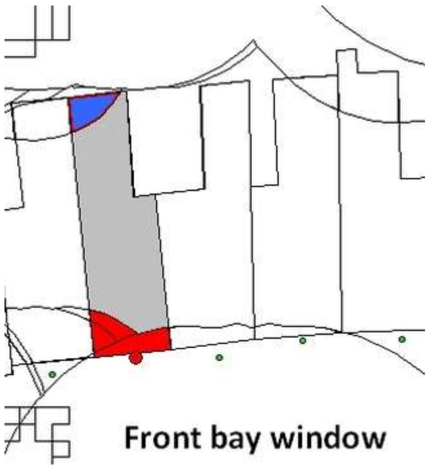
Modelling the Root Zone using the LiDAR Dataset

How do the modelled predictions compare with actual claim outcomes? The following examples have been taken from valid, root induced clay shrinkage claims to see if the initial modelled root zones were sensible and where adjustment or interpretation might be needed. The tree root radius was estimated as being 1.2 x the tree height at the time of the survey (2006). Blue shading has been used for root overlap at the rear of the property, and red for overlap to the front.

Below, two cases where the area of damage was 'described' by the modelled root zone. In both cases, the caption has been taken from the engineer's description of the damaged area.

Both have root zones front and rear. No damage was reported to the rear elevation in either case even though they fall within a modelled root zone, illustrating the 'taking their victims as they find them' phrase and the random nature of the problem.





At the time of first notification of loss using the proposed method, the intelligent system would have access to Ordnance Survey building outlines and the results of any nearby soils investigations and the BGS dataset of boreholes. In the event that the soil was a highly shrinkable clay, and if the claim was notified in the summer, in a sector with a high number of valid claims exhibiting a strong characteristic signature of a seasonal nature historically, the chances of the claim being valid, and due to root induced clay shrinkage, would be very high.

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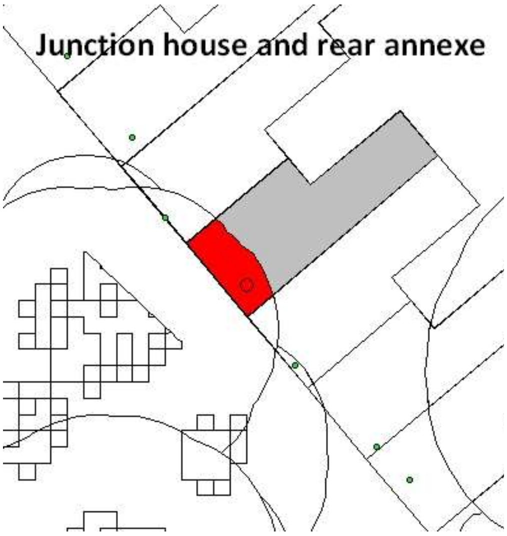
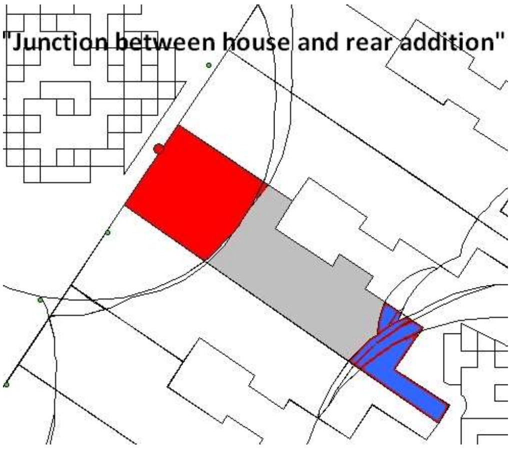
Modelling the Root Zone using the LiDAR Dataset

Right, a similar situation, but with a different outcome. Here, and in the following examples, the modelled root zone extends beneath the front house wall and the damage is at the junction between the main body of the house and the rear wing building, or annexe.



It will be seen from the following examples that the system could learn fairly quickly that root zones extending beneath the front, rear or both can cause flexure of the structure and result in tension at the junction between two parts of the house, each with differing strengths and sometimes, different foundation depths. It isn't unusual to find that the wing building has a shallower foundation than the main property.

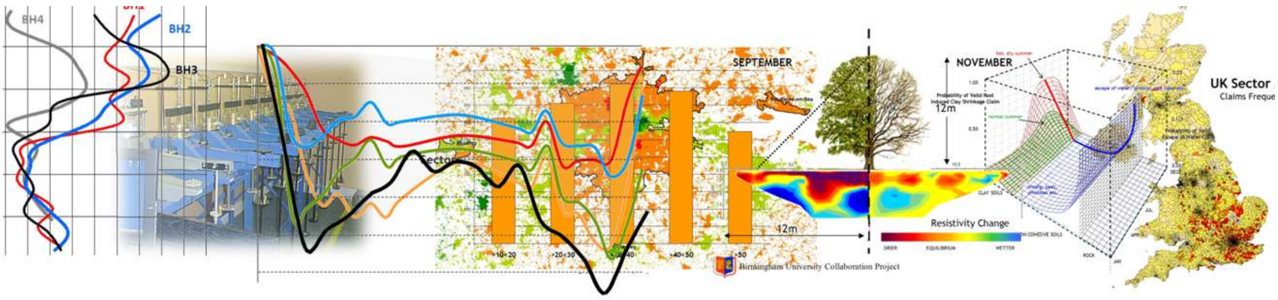


Left, a typical arrangement resulting in crack damage at the junction between the front and rear parts of the house.

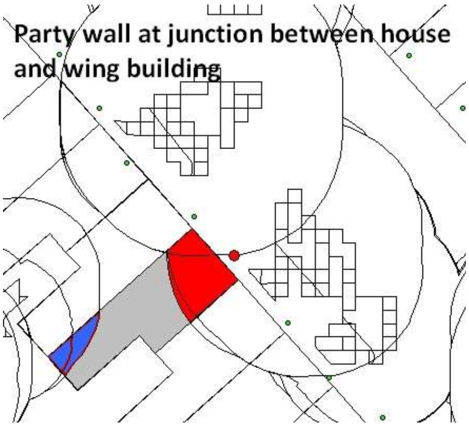
The example also illustrates the issue about capturing descriptions from the database. Above and elsewhere, engineers have used the term 'annexe' and, 'rear addition'. On the following page, we see 'wing building', 'junction' and 'party wall' all describing similar problems.

Analysing a large database would have to take account of this variable usage; perhaps best achieved by offering a list of drop-down options.

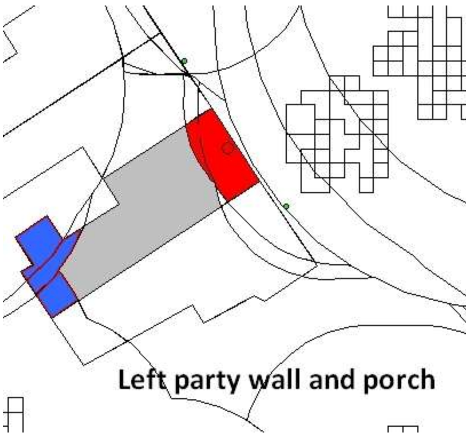
It's often the case that root intrusion beneath either the front or rear walls, or both, results in damage to the party wall at the junction between the main house and the rear wing building. Seeing the number of such cases decreases the surprise for less experienced engineers when carrying out a site assessment.

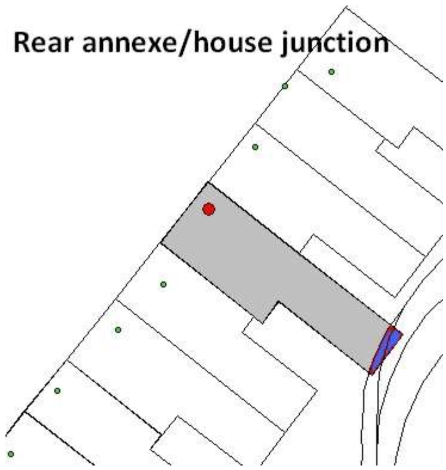


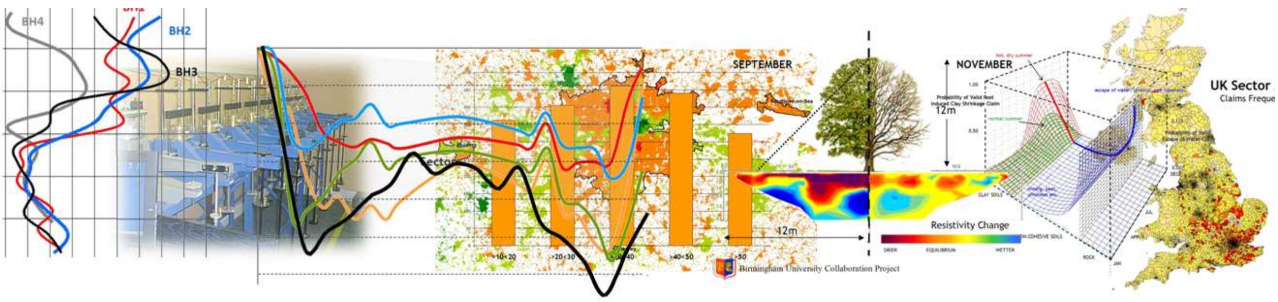
Modelling the Root Zone ... *cont.*



Some idea of the number of claims associated with this particular problem can be found in the last edition of the newsletter, page 11, Figures 3 & 4. In theory, 'Party Wall' is in 9th place in terms of likelihood of validity. It moves up the risk table if account is taken of the alternative descriptions which include locations like 'annexe', 'junction' and sometimes, 'addition'. Similarly, when looking at location, summing these classifications increases its occurrence.







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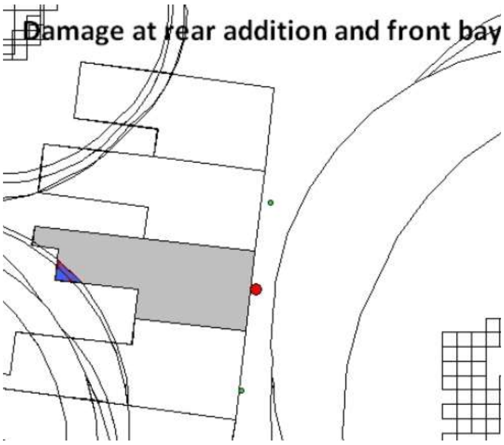
Modelling the Root Zone ... *cont.*



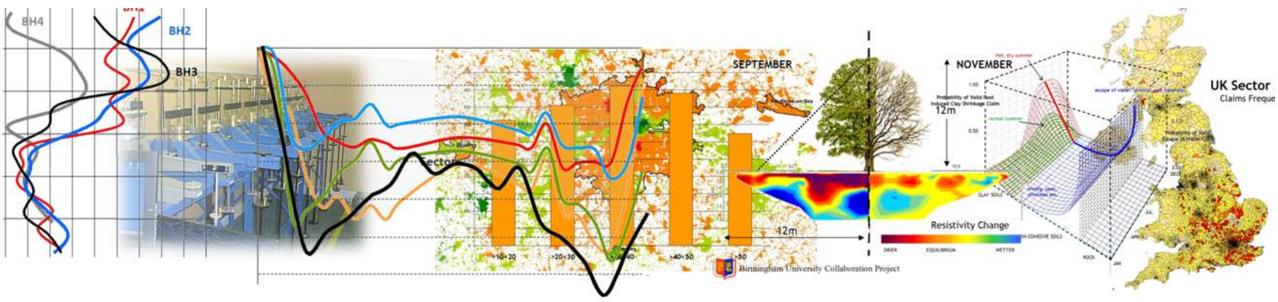
Does this mean that every claim for damage to the party wall should be accepted as valid if the model suggests there may be tree roots either beneath, or in the near vicinity of the building?

What are the alternatives? Sending an engineer, arborist, site investigation team to site, retrieving soils for testing, handling the claim for typically twelve months or so isn't efficient, whether the claim is valid or not.

Experience suggests that, in certain sectors, over 70% (see last edition and comments above) will be valid. If there are roots anywhere near the structure, it is likely laboratory testing will reveal desiccation in the summer months. It's just a question of magnitude.

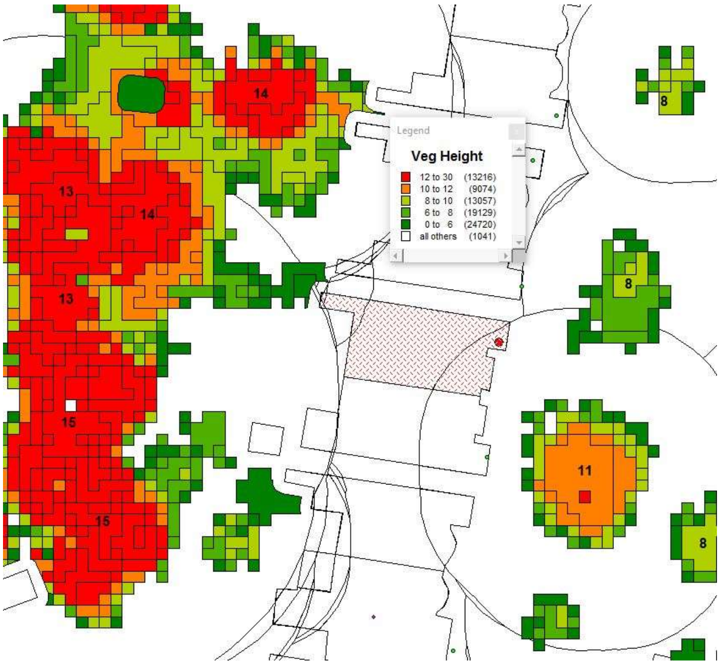
The most important question might be, is the soil clay? For more information, take precise levels. Alternatively, arrange for something to be done with the tree (variable by species, metrics and ownership) and instruct repairs using a standard 'party wall, terraced house' schedule.

Where there are doubts after considering photographs and/or video of the damage - perhaps time on cover, pre-inception issues, odd patterns of damage etc., then revert to a traditional approach, directed from the desk-top study.



As explained earlier, the suggestion isn't that all houses within a root zone will inevitably suffer damage, or where damage exists, the tree is inevitably the cause. The haphazard nature of the problem is illustrated below. Here, the house with the red dot and shaded floor plan suffered damage to the front bay window. The modelled root layout suggests what subsequent site investigations, soil testing and precise level monitoring confirmed – the cause was root induced clay shrinkage.

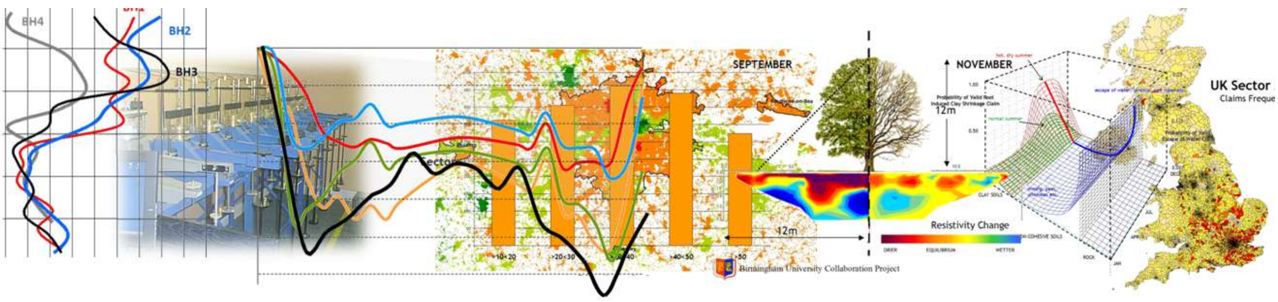
In this instance, the Intervention Technique was used to reduce the amplitude of seasonal movement, followed by superstructure repairs.



However, and as far as we are aware, the adjoining and nearby houses with similar root incursion have not suffered damage, even though the root distribution appears identical.

Any house with a shallow foundation (age of property as a proxy and no basement), bearing onto clay soil (BGS or map using results of investigations – or both) within influencing distance of as tree is at risk. To derive a probability of causation, claim validity and likelihood of the tree being involved, the Disorder Model is useful as an assessment tool when damage is reported.

The key is (a) there must be damage and (b) visual assessment based on a study of pictures, damage location, timing etc., provide positive indicators.



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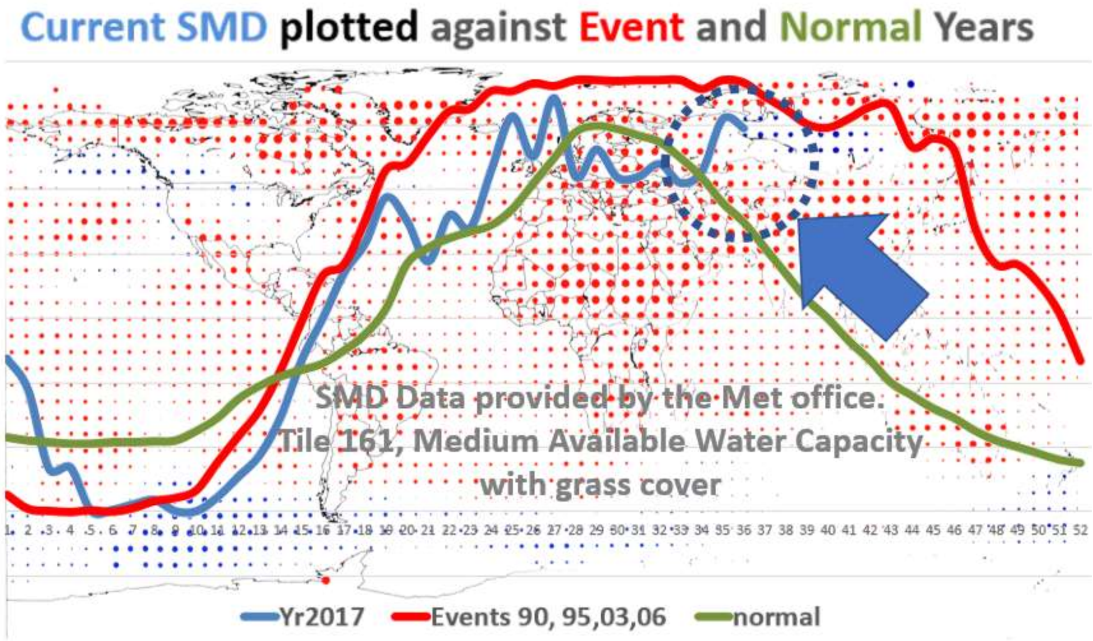
Soil Moisture Deficit Update

Following initial concerns earlier in 2017 as the SMD followed the profile of an event year, a sharp drop around week 19 and the ensuing 'saw tooth' profile suggests claim numbers should be around normal. 'Normal' over the last five years means claim numbers of 20,000 or less and maximum spend of £100m.



August 2017 – Met Office Update

http://www.metoffice.gov.uk/news/releases/2017/a-wet-summer-comes-to-a-close

The Met Office report *"the provisional UK mean temperature was 15.1 °C, which is equal to the 1981-2010 long-term average"*. Apparently, it was wetter in parts and drier in others, illustrating the problem with averages. Met Office climate scientist Dr Mark McCarthy said: *"People may well remember the 2017 summer as a bit of a damp squib, but interestingly although it has been notably wetter than average for many areas it has also be warmer than average. The warm settled periods at the end of June and the beginning of July helped boost the average temperatures."*