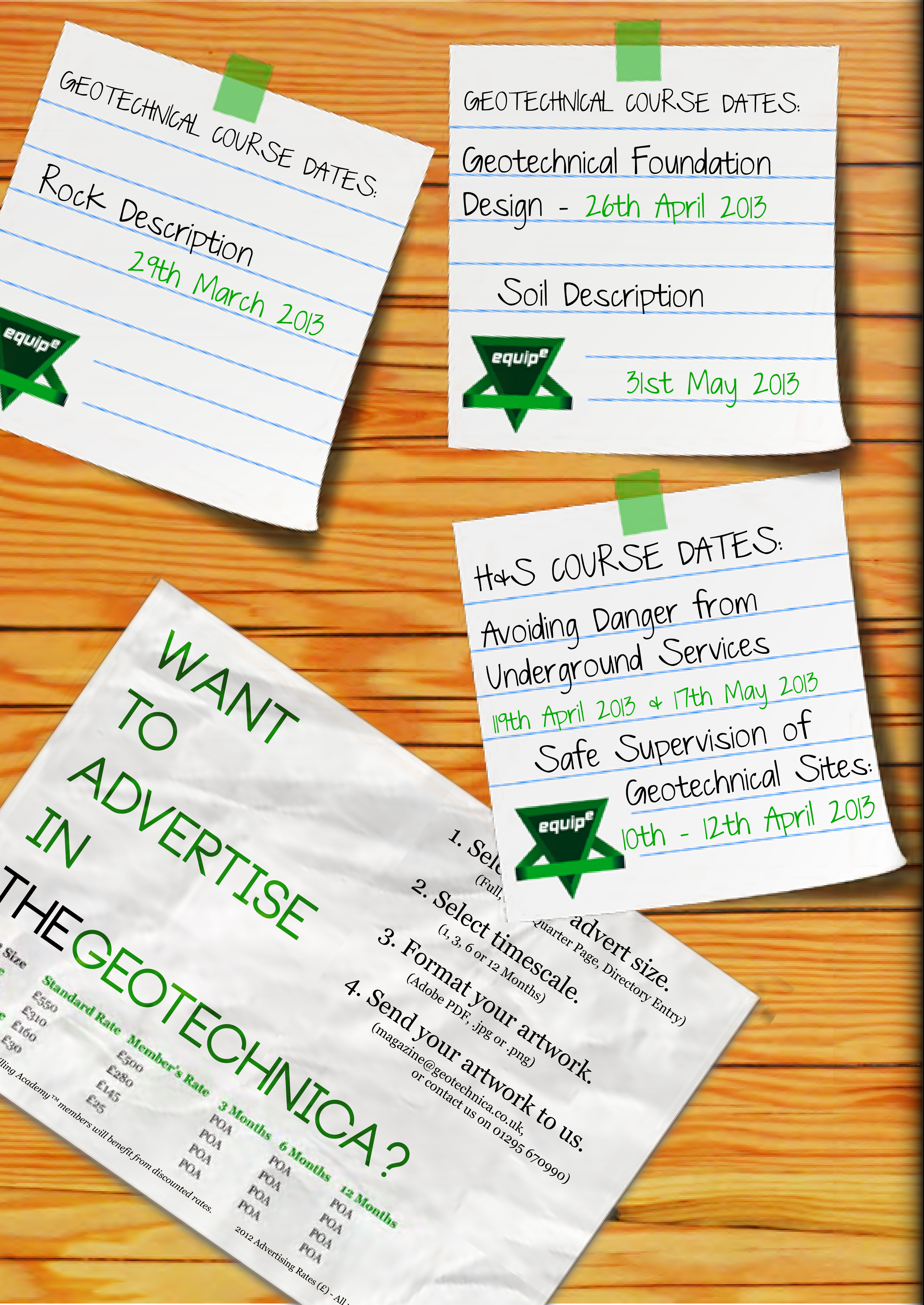

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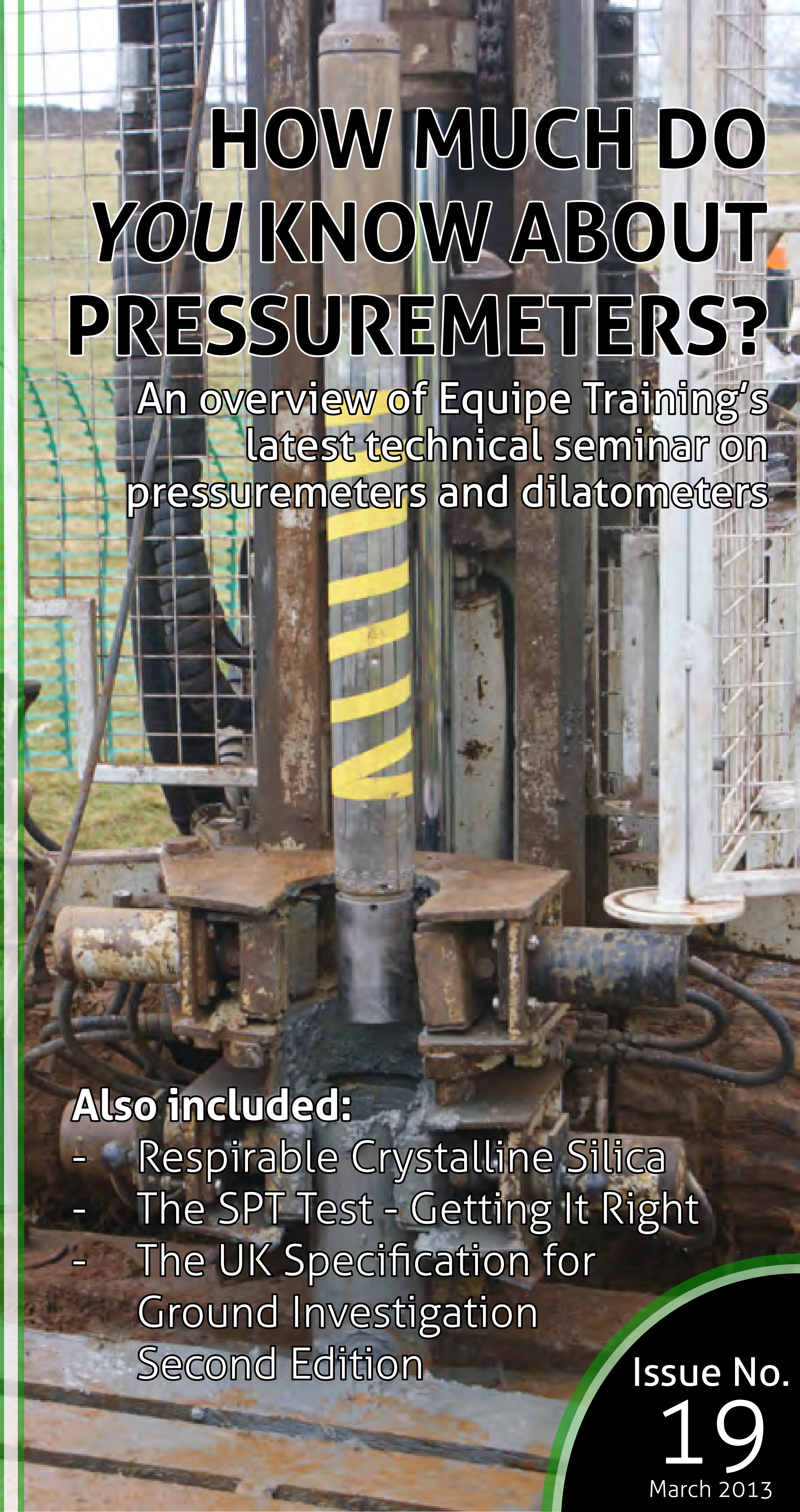

HOW MUCH DO *YOU* KNOW ABOUT PRESSUREMETERS?

An overview of Equipe Training's latest technical seminar on pressuremeters and dilatometers

Also included:

- Respirable Crystalline Silica
- The SPT Test - Getting It Right
- The UK Specification for Ground Investigation Second Edition

Issue No. 19
March 2013

Contents

Welcome

Welcome to the 19th Edition of **theGeotechnica** - the UK's fastest growing online geotechnically focussed e-magazine.

This issue, along with next month's, are largely dedicated to the recent Pressuremeter and Dilatometer Seminar that was organised by Equipe Training. The seminar, which ran at the end of February 2013, featured demonstrations and technical presentations of Cambridge Insitu's Self-Boring Pressuremeter, as well as Marchetti DMT's Dilatometer. This month in theGeotechnica we have the first of a two-part series focussing on the Self-Boring Pressuremeter. The article is an insightful overview of the presentation given by Cambridge Insitu's Robert Whittle on the methods behind and the values of the self-boring pressuremeter.

The second article featured in this issue comes from our resident Health and Safety expert, Tom Phillips of RPA Safety Services. This month Tom discusses the dangers that can lurk in our laboratories unbeknownst to us. Respirable Crystalline Silica (RCS) is the topic of discussion this month, with Tom offering advice on how to tell if you lab has an RCS problem and what you can do to manage it.

Article three of this issue is the third in our series from the experts at the Equipe Group on successful management and application on drilling sites. This month we focus on the SPT Test. The results obtained from an SPT are arguably the most important of all works carried out during a site investigation, however all too often SPTs are carried out incorrectly or without the necessary care and attention. This month's article strives to aid drillers in making sure that all SPTs undertaken on their sites are done so correctly.

"This month's article strives to aid drillers in making sure that all SPTs undertaken on their sites are done so correctly."

Finally we have an article from Julian Lovell, Managing Director of the Equipe Group. Recently Julian was the keynote speaker at an ICE North East event run in conjunction with the Northern Geotechnical Group and the BGA. The article in **theGeotechnica** this month is the first in a series that will build upon Julian's presentation regarding the UK Specification for Ground Investigation: Second Edition. This month sees Julian begin to explain what the second edition of the 'Yellow Book' means for the rest of the ground investigation community.

We also have entries in the Directory and Jobs sections, with positions available at Geotechnical Engineering as well as Gardline Geosciences.

As with every new edition of the magazine, the Editorial Team here at **theGeotechnica** will be on the lookout for even more new, original and interesting content from all corners of the sector, and would actively encourage all readers to come forward with even the slightest bit of appropriate and relevant content - whether it be a small news item or a detailed case study of works recently completed or being undertaken. If this content is media rich and interactive, then all the better. We are looking to increase the already large readership of the magazine through better social media integration and promotion, as well as improving content month on month.

Once again, for any content that is submitted we will ensure that advertising space, proportionate to the quality of content provided, is available for that single edition of the magazine. From then on, if you have submitted content, you will receive a discount on all further advertisements placed within **theGeotechnica**.

We hope you enjoy this month's edition of the magazine and are inspired to contribute your own content for the coming editions of **theGeotechnica**.

Editorial Team,
theGeotechnica

THE SELF-BORING PRESSUREMETER AND DILATOMETER

The latest in the series of technical seminars held by Equipe Training took place on the 26th of February at their offices and training facilities just outside of Banbury. The event examined the use of pressuremeters and dilatometers with particular emphasis on the self-boring pressuremeter and the seismic dilatometer.

The presentations were given by Clive Dalton of Cambridge Insitu, considered by many to be the world's leading expert on the self-boring pressuremeter and Dr Sara Amoroso of Marchetti DMT (Italy). Sara's highly acclaimed PhD thesis looked at the use and interpretation of the seismic dilatometer to obtain geotechnical parameters.

The seminar was planned to coincide with the imminent publication of Eurocodes 22476 parts 4,5,6,7 and 8.

4 Menard pressuremeter: Publication soon?
5 Flexible dilatometer: Publication soon?
6 Self-boring pressuremeter: Enquiry complete
7 Borehole jacking test: Publication soon?
8 Full displacement p/meter: Enquiry complete

The pressuremeter test is something which has been sparsely used by geotechnical engineers in the United Kingdom and is often poorly understood. The day was designed to inform attendees of the application, theory and interpretation of these instruments. This information included lectures by the distinguished guests and practical demonstrations of the use of the equipment in the field followed by interpretation of the results. The day started with Clive Dalton explaining the use and data obtained from the pressuremeter and in particular the self-boring pressuremeter. Later Robert Whittle also from Cambridge Insitu presented the interpretation of results from the self-boring pressuremeter.

*The next two issues of **theGeotechnica** are devoted to these tests and the presentations given by Dalton; Whittle and Amoroso. The following is Part One of an overview of the presentations given by Clive Dalton and Robert Whittle of Cambridge Insitu. Part Two will be published in next month's issue.*

Part 1 – what is a pressuremeter?

Pressuremeters are devices for carrying out insitu testing of soils and rocks to obtain strength and stiffness parameters. The devices are cylindrical and part of the length is covered by a flexible membrane.

Pressuremeters can be pushed, inserted into a pre-bored hole or by self bored where the instrument makes its own hole. Once in the ground, increments of pressure are applied to the inside of the membrane forcing it to press against the soil and so loading a cylindrical cavity.

A test consists of a series of readings of pressure and the consequent displacement of the cavity wall, and the loading curve so obtained may be analysed using rigorous solutions for cylindrical cavity expansion and contraction. It is this avoidance of empiricism that makes the pressuremeter test potentially so attractive.

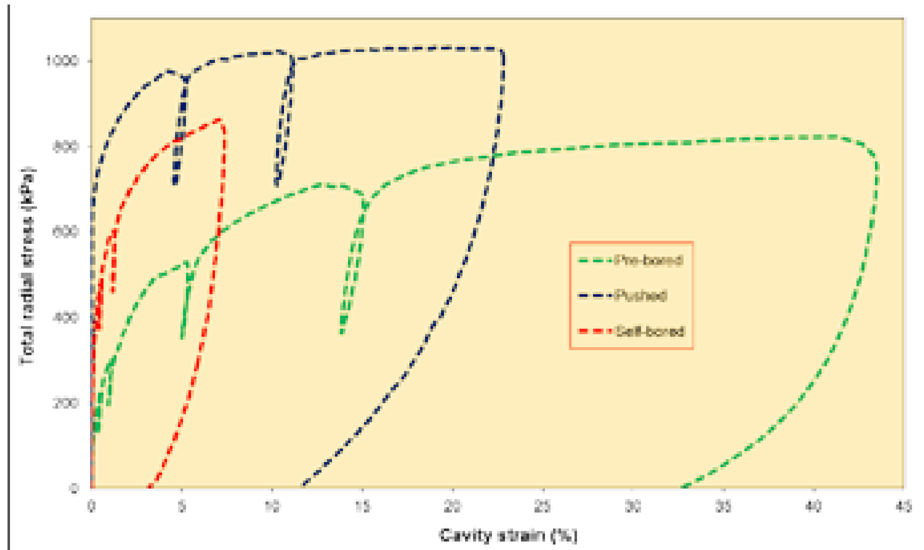

Figure 1. Test curves for 3 types of probe in Gault clay at about 5mBGL

The test is usually carried out in a vertical hole so the derived parameters are those appropriate to the horizontal plane.

"The interpretation of the pressuremeter test must take account of the disturbance caused by the method used to place the probe in the ground."

The interpretation of the pressuremeter test must take account of the disturbance caused by the method used to place the probe in the ground. The least disruptive of the methods is self boring where disturbance is often small enough to lie within the elastic range of the material and is therefore recoverable. This is the only technique with the potential to determine directly the insitu lateral stress, σ_{ho}, the major source of uncertainty when calculating the coefficient of earth pressure at rest, k_o. However all methods allow the confining stress to be inferred.

The disturbance caused by pre-boring and pushing is never recoverable. However for any pressuremeter test it is possible to erase the stress history of the loaded material by taking it to a significantly higher stress than it has previously seen, and then to reverse the direction of loading. The point of reversal is a new origin and the stress:strain response will be that due to the undisturbed properties of the material. Figure 1 shows tests which were carried out at the same location (a heavily over-consolidated Gault clay site) at similar depths and give similar results for strength

"Although the loading paths appear very different there are similarities in the unloading paths..."

and stiffness. Although the loading paths appear very different there are similarities in the unloading paths and whenever a small rebound cycle is taken. These cycles are of particular importance. No matter how disturbed the material prior to insertion all types of pressuremeter test have the potential to make repeatable measurement of shear stiffness with increasing strain.

The prebored method of insertion requires a pocket to be formed in the ground by conventional drilling tools and the instrument is subsequently placed in the pre-formed hole.

"The major defect in this method is the complete unloading of the cavity that takes place in the interval between removing the boring tool and pressurising the probe."

The major defect in this method is the complete unloading of the cavity that takes place in the interval between removing the boring tool and pressurising the probe. The material must be capable of standing open and so the method is best suited to rock. As Figure 1 indicates it is possible to make a test in stiff clay. However comparing the pre-bored curve to the self-bored shows how much further the cavity may have to be expanded before the influence of insertion disturbance can erased. The method can be used in dense sand if drilling muds are used to support the open borehole but it is unlikely to be suitable for loose sands. The Ménard pressuremeter widely used in France is an example of a pre-bored device. In the UK the High Pressure Dilatometer (the terms "dilatometer" and "pressuremeter" are interchangeable in this context) is available and is used in rocks and materials such as boulder clay, and dense sands. A pre-bored operation will require the assistance of a drilling rig. Unlike the other insertion methods, if the hole is cored then it may be possible to make laboratory tests on material that is directly comparable to that being tested by the

"Pre-bored pressuremeter testing in a vertical hole has been carried out to depths greater than 500 metres and depths of 200 metres are routine."

pressuremeter. Pre-bored pressuremeter testing in a vertical hole has been carried out to depths greater than 500 metres and depths of 200 metres are routine.

Pushed-in pressuremeters are forced into the ground so raising the state of stress in the surrounding soil. A special case of this approach is the Cone Pressuremeter (CPM) where a 15cm 2 cone is connected to a pressuremeter unit of the same diameter. The disturbance

caused to the material is total and the only parameter that can be obtained from the loading path is the limit pressure of the soil. The 'pushed' curve in Figure 1 is an example of a CPM test and shows a clear plateau after the cavity has been expanded by about 15%. Strength parameters are derived from the contraction curve and stiffness parameters from the response of small

"The method is fast and can make a test in any material into which a cone can be inserted."

rebound cycles. The method is fast and can make a test in any material into which a cone can be inserted. The coupling of the profiling capability of the cone with the ability to make direct measurements of strength and stiffness is especially advantageous.

However as Figure 1 indicates the stresses required to make a satisfactory test are much higher than for the other methods, and at these levels of stress it is probable that crushing of the soil particles

"This may be a significant factor especially for tests in sand."

is taking place. This may be a significant factor especially for tests in sand. Also obtaining reaction for pushing the probe may present difficulties – a jacking force of 10 tonnes or more is not unusual.

The Cambridge self boring pressuremeter is a miniature tunnelling machine that makes a pocket in the ground into which the device very exactly fits. The foot of the device is fitted with a sharp edged internally tapered cutting shoe. When boring, the instrument is jacked into the ground, and the material being cut by the shoe is sliced into small pieces by a rotating cutting device. The distance between the leading edge of the shoe and the start of the cutter is important and can be optimised for a particular material. If too close to the cutting edge the ground suffers stress relief before

"If the cutter is too far behind the shoe edge then the instrument begins to resemble a close ended pile."

being sheared. If the cutter is too far behind the shoe edge then the instrument begins to resemble a close ended pile. In stiff materials the usual setting is flush with the cutting shoe edge. The cutting device takes many forms. In soft clays it is generally a small drag bit, in more brittle material a

rock roller is often used.

The instrument is connected to the jacking system by a drill

"This is in two parts, an outer fixed casing to transmit the jacking force and an inner rotating rod to drive the cutter device."

string. This is in two parts, an outer fixed casing to transmit the jacking force and an inner rotating rod to drive the cutter device. The drill string is extended in one metre lengths as necessary to allow continuous boring to take place. All the cut material is flushed back to the surface through the instrument annulus, there is no erosion of the cavity wall. Normally water is used but air and drilling muds have been successfully applied.

Self boring is effective in materials from loose sands and soft clays to very stiff clays and weak rock. It will not operate in gravel and materials hard enough to damage the sharp

"In principle the probe can be made to enter the ground with negligible disturbance. In practice, self boring results in a small degree of disturbance..."

cutting edge. In principle the probe can be made to enter the ground with negligible disturbance. In practice, self boring results in a small degree of disturbance that must be assessed before deciding a value for the insitu lateral stress. Experience has shown that the self boring disturbance is low enough to remain within the elastic range of the material.

The SBP requires a modest amount of reaction. On some soft clay sites it is possible for the self boring kit to operate without support from other drilling tools. The minimum interval between tests is one metre. Where tests are more widely spaced or in materials with occasional bands of hostile layers the SBP can be used in conjunction with a cable percussion system, or be driven by a rotary rig using

"Self boring in a vertical hole is routinely carried out to depths of 60 metres or more."

special adaptors. Self boring in a vertical hole is routinely carried out to depths of 60 metres or more.

There are many designs of pressuremeter in current use, some of which are of complex construction. Figure 2 is a view of the inside of a 6 arm Cambridge self boring pressuremeter. There are transducers for measuring the radial displacement of the membrane at 6 places and the total and effective pressure being applied to the cavity wall. The electronics for the signal conditioning including the conversion from analogue to digital is contained in the probe itself. Apart from supplying power, the output of the probe may be connected directly to the serial port of a small computer. This approach is necessary in order to obtain

Figure 2: Inside a 6 arm SBP

a high resolution free of noise. Pressuremeters with local instrumentation are able to resolve without difficulty displacements of 0.5 microns and pressure changes of 0.1kPa.

Pressuremeters can be expanded using air or a non-conducting fluid such as

"There are automated systems for pressurising the equipment."

light transformer oil. There are automated systems for pressurising the equipment. Automation allows the expansion of the cavity to occur at a constant rate of strain. It is conventional to log the output of the pressuremeter on computer and to plot the loading curve in real time.

Meticulous calibration of the equipment is vital. The transducers must be calibrated regularly both for sensitivity and drift. Almost all pressuremeters suffer the defect that the output of the transducers is governed by the movements and pressure on the inside of the membrane, where what is required is the displacements and stresses acting on the cavity wall. The properties of the pressuremeter membrane can be a significant source of uncertainty. It requires an amount of work to make it move, and an additional component to keep it moving. This is relevant to tests in soft soils. The membrane contribution may be estimated by carrying out membrane expansion tests in free air.

The other major influence on the measurements is system compliance, or the contribution of the probe itself to the measured stiffness. This can be a significant source of error if the probe is used in very stiff soils or weak rock. This contribution may be estimated by inflating the instrument to full working load inside a metal sleeve of known elastic properties.

"The importance of the various calibrations depends on the type of pressuremeter and where it is being used."

The importance of the various calibrations depends on the type of pressuremeter and where it is being used. For example the contribution of the hose supplying pressure to the probe is highly relevant if volume changes are being measured at the surface, but is of no importance at all for a probe with internal instrumentation, such as the Cambridge family of devices. ■

Next month's issue of theGeotechnica will be a continuation of this article, focusing on the Advantages and Limitations of the Pressuremeter Test, as well as what parameters can be obtained from the tests.

DOES A SILENT KILLER LURK IN YOUR LABS?

*Writing for **theGeotechnica** once again is **Tom Phillips** of RPA Safety Services. This month Tom discusses the danger of Respirable Crystalline Silica (RCS), a dangerous dust commonly found in our laboratories that is produced during the abrasion or cutting of rock.*

Respirable Crystalline Silica (RCS) is deadly! The dust produced during the abrasion or cutting of rock and sand based products, can produce fine dusts and powders, which penetrate deep in to the lungs and cause severe lung diseases.

> **"Diseases such as silicosis and lung cancer are not uncommon in those who work with crystalline silica..."**

Diseases such as silicosis and lung cancer are not uncommon in those who work with crystalline silica and if anyone working in an environment where RCS is present develops asthma, this then becomes a RIDDOR reportable disease and a visit from the HSE is highly likely.

For those managing work in laboratories, the risk of working with RCS, is too often unidentified and

> **"The first clues to if you have a problem is when lab staff complain of brown mucous when blowing their noses..."**

misunderstood. The first clues to if you have a problem is when lab staff complain of brown mucous when blowing their noses, or there is always a film of dust on work surfaces caused by inadequate control. Although the main processes of concern are sieving's and grading's and crushing, simple actions such as brushing down clothing or sweeping up, can cause elevated levels of RCS in the air which are unacceptable.

Crystalline silica is most commonly found in the form of quartz and is a component of sand, sandstone, granite, slate, coal, is present in most common rocks, almost every mineral, and occurs in most

> **"When it is cut or abraded, the finer particles become respirable, which means they are able to penetrate deep into the lungs of those working with it."**

soils. When it is cut or abraded, the finer particles become respirable, which means they are able to penetrate deep into the lungs of those working with it. As geotechnical labs are generally dusty and dirty due to the materials processed, most of them, contain this deadly substance.

But the question is, to what extent do labs have a problem? Well it largely depends on

> **"If your work involves the drying, sorting, sieving, grading of any potentially crystalline silica containing material, you will have some in the air."**

what you do in the lab. If your work involves the drying, sorting, sieving, grading of any potentially crystalline silica containing material, you will have some in the air. The question is, how much is in the air and is it respirable?

The current limit imposed by the HSE (0.1mg/m3) refers to those particles which, using suitable measuring equipment, are deemed of a suitable aerodynamic diameter to pass deep into the lungs and cause long term problems. The limit is expressed as an amount over an 8-hour working day as a Time Weighted Average (TWA) and this cannot be exceeded.

> **"Penalties for exceeding these levels or exposing staff can include prohibition notices and hefty prosecutions."**

Penalties for exceeding these levels or exposing staff can include prohibition notices and hefty prosecutions.

The first stage in managing RCS is to measure the levels in the air to see if there is

> **"This can only be accomplished using equipment and techniques as laid down by the HSE / HSC and developed by the Institute of Occupational Medicine (IOM)."**

a problem or not. This can only be accomplished using equipment and techniques as laid down by the HSE / HSC and developed by the Institute of Occupational Medicine (IOM). These techniques involve air sampling followed by laboratory analysis of the gathered samples. The key is to determine what level of dust is in the air and how much of it contains RCS.

If you do have an RCS problem, then prevention of the dust during work is the primary control. The company must ask itself if testing can be accomplished without liberating RCS and if it can't, then it must be done under controlled conditions. Where RCS is still generated then Local Exhaust Ventilation (LEV), air-fed masks with certified air, suitable clothing and cleaning procedures are all essential.

Health surveillance is normally required for staff working in areas of concern and training of staff to recognise the importance

> **"Don't get caught out. Where the HSE impose fines these are similar to those passed down for asbestos exposure incidents."**

Don't get caught out. Where the HSE impose fines these are similar to those passed down for asbestos exposure incidents. Although new cases of silicosis are falling year on year, it is still too frequent and there are many who remain undiagnosed. ■

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*N.B. Those aspects shown in bold will be practical activities outside.

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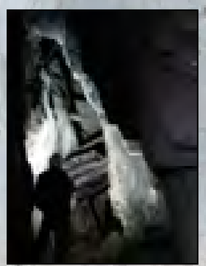

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K4 SOILS

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Equipe Training are offering comprehensive Rotary Drilling Training that will take place over the course of three days. Each day will focus on a specific aspect of rotary drilling with the aim to give all attendees a high level of understanding of the skills, techniques and knowledge required to safely and effectively operate rotary drilling rigs.

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- Flushing Media
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- Equipment
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THE SPT TEST: GETTING IT RIGHT

*This is the third in a series of articles on safely managing all working geotechnical sites, penned for **theGeotechnica** by the experts at the Equipe Group. This month we focus on the SPT Test - notably how you should correctly prepare for and carry out the test.*

It is difficult to emphasize just how important the accuracy of SPT results can be. Currently within the Ground Investigation industry it is the single most highly used piece of information for design. The N value is often relied upon as the only meaningful information used from the site work.

"... all too often the reliability of the test results are, at best, suspect and sometimes very misleading due to poor practice and understanding."

Unfortunately all too often the reliability of the test results are, at best, suspect and sometimes very misleading due to poor practice and understanding. In theory it is a very simple test which should be very reliable, but it is how the test is understood and carried out which is most often the cause of problem. So how exactly should the test be carried out to ensure the results obtained are as reliable as possible?

Equipment

The majority of SPT hammers comprise of a two claw/ pawl spring loaded lifting mechanism - however hammers with three claws have also been manufactured. The SPT hammer drop weight is lifted using the winch rope on the rig and is automatically tripped when the pawls reach a raised section on the guide rod. This raised section moves the pawls outwards thus releasing the 63.5kg drop-weight. The distance from the anvil to the raised section is called the drop height. This height should be 760mm. Other types of SPT equipment can comprise of chain driven drop weights – this is standard mechanism used on Dynamic Sampling rigs. The mechanism is comprised of a weight which is lifted up by one or two guide rods on arms, which are all within the chain. These then move away from the weight at the required drop height. As the test is carried out the carriage carrying the drop weight follows the weight down. More recently rigs have been equipped with a new type of hammer which is also chain driven, but after each blow the carriage is automatically lifted from the drop weight ensuring that only the weight of the hammer performs the test.

An SPT Calibration on a Cable Percussion rig.

Measuring the drop-height.

"Whichever type of hammer is used the test itself is carried out in exactly the same fashion."

Whichever type of hammer is used the test itself is carried out in exactly the same fashion.

Preparation

To carry out an SPT test it is first necessary to clean the base of the borehole at the required depth measure and record this accurately using a tape measure. If there is groundwater in the hole it is essential that this is measured and recorded. Should the strata be granular and should water have been encountered within the hole then it is necessary to ensure that boiling or blowing does not occur. If this is allowed to happen then any values recorded can be very inaccurate. To prevent blowing-boiling from happening a positive head of water must be maintained in the hole. This means keeping the water level in the borehole above the standing water level - the head of water needs to be in place prior to the cleaning of the borehole and be maintained

"It is just as important that the casing is not driven below the base of the borehole..."

during the test itself. It is just as important that the casing is not driven below the base of the borehole, this will cause disturbance of the material being tested and even lead to plugging of the casing leading to very inaccurate values being produced.

The borehole, casing and water level at the start of the test must be recorded on the drilling log. The driller needs to decide if he is going to use a split spoon or solid cone to carry out the test. This decision is dependent on the material the test is to

"If the soil is fine grained, a silt sand or clay a split spoon must be used. If the soil to be tested comprises or contains gravel then a solid cone must be used."

be carried out in. If the soil is fine grained, a silt sand or clay a split spoon must be used. If the soil to be tested comprises or contains gravel then a solid cone must be used.

The cone or split spoon should be clean and have a sharp cutting edge or point. Blunt / damaged shoes or rounded cones will lead to poor results being obtained. The tool should be screwed tightly to the rods and each rod must be tightened so that the thread shoulder meets the end of the thread. The rods must be lowered to the base of the hole and never dropped - as is often the case with dynamic sampling rigs with a rod handling system. With sufficient rods added, the SPT tool should be placed on the base of the hole. The rod should be marked level with the top of the casing. Only then should the hammer be attached and the weight of the assembly be allowed to rest in the bottom of the hole. Any penetration under self-weight should be monitored and recorded. The rods should then be re-marked in intervals of 75mm up from where they are level with the top of the casing. If casing has not been used then some other datum point should be used.

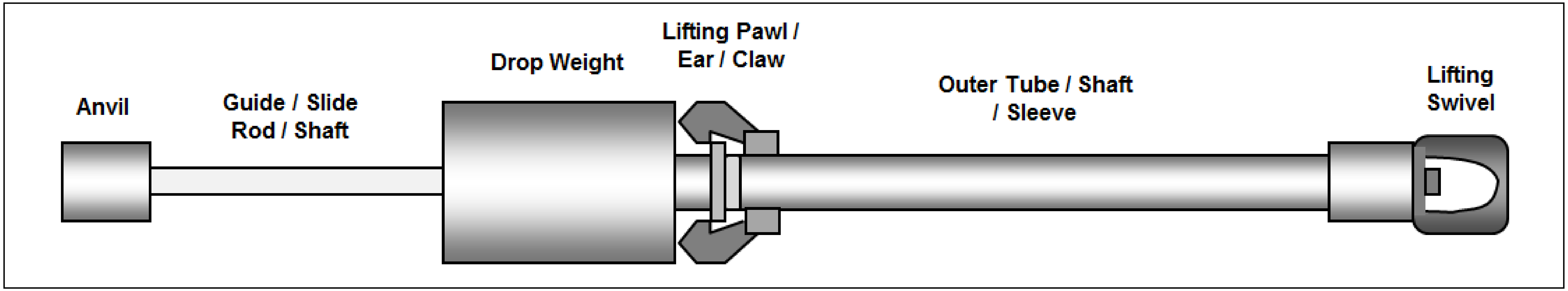
Blows should be delivered with the hammer assembly held vertical; the weight should drop cleanly and freely in order

"This can be achieved by utilising the casing clamps on a Rotary Rig to loosely close around the rod, or by use of a rod guide (as shown) in the case of a Cable Percussion rig."

to strike the anvil squarely. This can be achieved by utilising the casing clamps on a Rotary Rig to loosely close around the rod, or by use of a rod guide (as shown) in the case of a Cable Percussion rig. Dynamic Sampling rigs hold the ▶▶


A worn CPT Cone


A rod guide.



rods central without assistance however care must be taken to ensure the rig is completely levelled before use to ensure vertical movement of the hammer. The drop height should be monitored with regard to the engine RPM of a Dynamic Sampling rig - incorrect setting of the RPM can result in either high (throwing) or low drop heights of the hammer.

The Test

Within Eurocode 22473 Part 3 spacings of the SPT increments are stated as being at 150mm intervals, however within the UK best practice advises us to use increments spaced at 75mm for greater accuracy. We will therefore use this best practice to explain the test. The first two increments comprise the seating blows -

"If 25 blows are achieved before the full 150mm has been driven then the seating drive should be stopped..."

the combined blows to achieve seating should not exceed 25. If 25 blows are achieved before the full 150mm has been driven then the seating drive should be stopped and the penetration achieved at 25 blows should be recorded. If this is the case the rods should be remarked from the depth achieved again into divisions of 75mm for a distance of 300mm.

The test can now be started. The number of blows required to achieve each of the 75mm penetrations should be recorded as below in Figure 1.

Should the number of blows reach 50 before the full 300mm has been driven then the test must be stopped and recorded as below in Figure 2.

Split spoon samplers are not designed to be driven beyond the 50 blow region as it may cause distortion in the barrel assembly. The rods can then be withdrawn from the borehole.

"If the split spoon has been used it should be dismantled, the sample described and the sample and shoe sample should now be removed from the sampler into a jar or tub."

If the split spoon has been used it should be dismantled, the sample described and the sample and shoe sample should now be removed from the sampler into a jar or tub. It is important that the sample is placed in a solid container and not a bag to retain its structure. It is important that the shoe sample is retained on all tests and not discarded. If the test has been conducted using a cone SPT/C a sample should be recovered over the tested length.

Depth		Standard Penetration Test										Casing	Water
From	To	Self-Weight	75	75	PEN	75	75	75	75	PEN	N	Depth (M)	Level (M)
12.00	12.45	0	7	9	150	9	9	10	12	300	40	12.00	6.70

Figure 1: Test Record.

Depth		Standard Penetration Test										Casing	Water
From	To	Self-Weight	75	75	PEN	75	75	75	75	PEN	N	Depth (M)	Level (M)
13.00	13.35	0	10	15	100	16	18	22		225	N/A	12.50	6.70

Figure 2: Test Record where 50 blows are reached before full 300mm drive.

Checks of the test equipment and its correct functioning should be carried out at regular intervals - a basic check of the equipment should be

"All parts should be clean and dry and free from dirt or grease. An annual check of the energy ratio must be carried out and a certificate made available..."

carried out daily. All parts should be clean and dry and free from dirt or grease. An annual check of the energy ratio must be carried out and a certificate made available - hammers should have a clear permanent identification mark for calibration validation purposes (these may stamped or in some cases welded on). The energy ratio is particularly important on sites where more than one hammer is being used - variations in energy ratios of different hammers can be as high as 50%, which if unknown can lead to huge variations in

"The drop-hammer weight and the drop height should be checked, as should the straightness of the rods being used. Also, threads should be clean with the thread screw fully up."

foundation design. The drop-hammer weight and the drop height should be checked, as should the straightness of the rods being used. Also, threads should be clean with the thread screw fully up. Square rods should never be used to carry out an SPT test.

The drilling logs must include the details of Hammer ID, an energy ratio, which should be checked to correspond to the relevant certificate, along with the type of drill rod used to carry out the test.

Providing that the equipment is properly looked after, the energy ratio is known and that the test is carried out and recorded by a competent person, then comparable accurate results can be obtained.

The experts at the Equipe Group have created a simple to follow SPT Test Checksheet that outlines the methodology of the SPT Test, as well as pre-test and test checks that must be carried out for successful and accurate results to be obtained. To view and download this checklist, click here...

THE UK SPECIFICATION FOR GROUND INVESTIGATION
SECOND EDITION EXPLAINED

*Writing for **theGeotechnica** once again are the experts at the Equipe Group - notably Managing Director Julian Lovell This month sees the first in a series of articles that will look at the background to and principle changes made within the revision and final publication of the UK Specification for Ground Investigation – Second Edition.*

In 2003 the process to carry out a revision of Part 3 of the Site Investigation Steering Group (SISG) series of documents entitled Site Investigation in Construction was commenced. The First Edition of Part 3: The Specification for Ground Investigation, commonly known as the 'Yellow Book', was published in 1993 and was very successful and the top seller from the series. It was, however, recognised that a revision was required to bring the document up to date with current practice, legislation and guidance.

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After some initial delays, the process started in earnest in 2006 through a Working Party formed by the AGS (Association of Geotechnical and Geoenvironmental Specialists) and Soil Mechanics acting as their Lead Author. AGS were tasked by SISG with producing a revision of the 'Yellow Book' and not a complete re-write and therefore the main structure was to be maintained i.e. Specification, Bill of Quantities and Schedules together with Notes for Guidance.

The new title of 'UK Specification for Ground Investigation' required the Second Edition to be written in a way to enable it to be more widely accepted and to be more flexible to allow it to be used for very simple projects to very complicated projects. The AGS Working Party were also keen for the final document to be published using an interactive on-line format to discourage the use of 'cut and paste'.

"The AGS Working Party were also keen for the final document to be published using an interactive on-line format..."

The main areas of revision included:

- Notes for Guidance expanded and available alongside main text
- Change in terminology for 'ground specialists'
- Introduction of an Investigation Supervisor
- Changes to incorporate new environmental legislation
- Changes to incorporate new H&S legislation
- Changes to incorporate new technical standards (principally Eurocode)
- Introduce new techniques and technology
- Work with the Publisher to create an e/on-line version

Change in direction

In 2007, the Highways Agency (HA), who were already actively engaged on the AGS Working Party, indicated that they wished to fully adopt the Specification but would want to use it with their existing contract documents, method of measurements and bills of quantities. SISG and AGS both considered that full HA support was a significant step forward and reflected a significant recognition of the new document b y a very important client. Agreement was therefore made with the HA that the structure and approach of the Second Edition would be altered to make it contract neutral and the bill of quantities would be moved to the back of the document.

"Whilst writing the Second Edition, many discussions were held regarding the competency level of the specifier and hence what level of detail was required in the document."

Assumptions

Whilst writing the Second Edition, many discussions were held regarding the competency level of the specifier and hence what level of detail was required in the document. It was decided that, as this was never meant to be a text/reference book, a common sense approach should be adopted. This approach assumed that inexperienced engineers would not be used to complete a specification.

It also assumed that geoenvironmental specialists with little or no experience in geotechnical engineering and/or ground investigation would not be used to specify a ground investigation which included geotechnical engineering aspects. In hindsight, this perhaps should have been more clearly stated.

"In hindsight, this perhaps should have been more clearly stated."

Part 2 of the series will start to look at some of the principle changes starting with Competency and Training.

- Site Investigation
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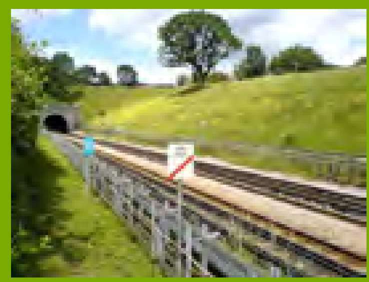

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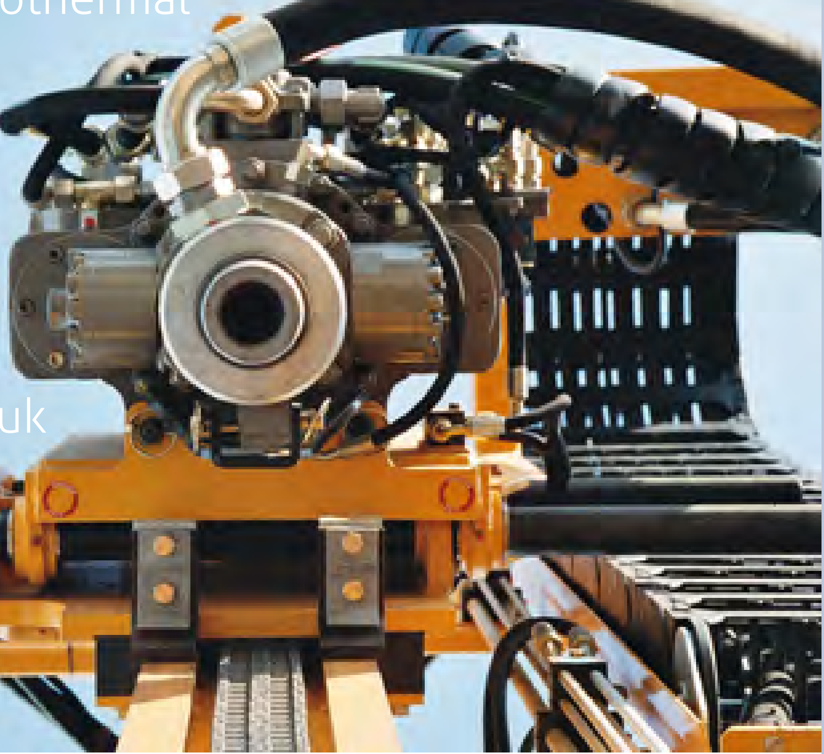

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