theGeotechnica

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inside this edition...

a new dawn for the industry?

digital borehole logging

Soil Engineering's mass implimentation of KeyLogbook

also included...

- a look at the issue of moisture content
- NEC3 contracts explained
- more on drilling fluids - the importance of flow rates

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an introduction

Welcome to the March edition of **theGeotechnica**. The first signs of spring are starting to show and by the end of the month the clocks will go forward. This signals longer more productive days on site. There does seem some optimism in the air with several companies seeing slightly better utilisation.

In this months' issue we have a really useful article from James Mansell on pumps. This is an area where some good guidance seems to be missing. James's' article helps by explaining what various pumps can deliver in plain English. The article is the forth in a series James has written around borehole muds and fluids.

We also have another Article from Kieran Dineen on the NEC form of contract. The NEC family of contracts will appear more often in the coming months and years being the ICE's preferred form of contract. There has been much mistrust and misuse of the contract in past years which has resulted in it not being adopted across the geotechnical industry however this new initiative together with explanations on its use in articles such as Kieran's will perhaps dispel the perception.

In the Geotechnical section we have an article on the moisture content test. This is the first in a number of articles we will be publishing to look at the tests we regularly schedule. Each will give advice on what samples are considered to be suitable for the test and some of the common reasons why they do not always give the results we think we should obtain.

In the Innovations section there is an article by Digby Harman of Soil Engineering explaining why they have decided to Equipe all their drilling rigs with KeyLogbook. Digby explains the advantages and cost savings the devices will deliver.

Also in this issue is a case history of a recent job carried out by Geotechnics and an obituary on one of the drilling industries best loved drillers Paul Blackledge, who sadly passed away recently. His funeral was attended by over 500 people, which pays testimony to his popularity.

Should you have any comments, suggestions or views on articles published or events within the geotechnical community, why not write or email the editorial team? We are always happy to publish the views of our readers provided they are not defamatory or blatant advertising.

It should be noted that the views expressed in any article in **theGeotechnica** are those of the author and do not necessarily reflect the views of the editorial team. Although every care is taken to ensure accuracy within articles, absolute accuracy is not claimed.

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Contents: What's in this issue?

geotechnical

contents

Geotechnics Limited has recently completed a ground investigation at Wimbleball Dam in North Somerset. The dam, which is some 50m in height, was constructed between 1974 and 1978 using mass concrete buttress foundations benched into the underlying bedrock, and has a storage capacity of around 21,500M litres.

The geology around the dam comprises the Upper Devonian Pickwell Down Beds which are formed of

"In places these beds are faulted and fractured..."

sandstones, siltstones, mudstones and slates. In places these beds are faulted and fractured, which necessitated the formation of a grout curtain at the time of the dam construction to form a seal around the dam shoulders.

A new grout curtain is now proposed for the southern end of the dam to address suspected leakage through the fractured rocks. In order to optimise the possible design solutions, Halcrow Group approached Geotechnics to devise a digitally controlled hydro-

static test to determine the permeability and pressure head data at a range of test depths up to 50m. Given the rock variability, it was important that the equipment was able to assess a wide range of potential rock mass permeability, with flows in the range 1 litre/min up to 20 litres/second, thereby requiring flow control and

"Halcrow also had a requirement to improve data quality and digital data storage..."

pressure measurement systems to suit. Halcrow also had a requirement to improve data quality and digital data storage to a level greater than that currently expected by British Standards, to ensure accurate determination of the permebilities values.

Geotechnics took the required Specification for the tests and designed and constructed digitally controlled Borehole Packer Equipment with data storage capacity. At the surface a digital flow meter is clamped to the valve control assembly which allows the flow rate to be monitored and adjusted by either a larger diameter valve control assembly or, at very low rates of flow, the use of a smaller diameter bypass valve

"The flow rate is calculated by measuring the transit time of acoustic pulses sent between transducers..."

arrangement. The flow rate is calculated by measuring the transit time of acoustic pulses sent between transducers mounted on the control valve assembly. The transit time down stream is less than the transit time upstream and the difference between the two is proportional to the velocity of the flowing liquid.

Pressure transducers/thermistors, placed above and below the Packer, were connected to a laptop computer at the surface, where real time pressure and flow rates were presented on screen continually throughout the test. In addition the ability to measure the water temperature above and below the packer provided additional data on the integrity of the seal made by the packer and the flow through the fracture zones.

"On this particular contract, the packer tests were carried out in rotary cored boreholes..."

On this particular contract, the packer tests were carried out in rotary cored boreholes, with test sections of up to 5m long. Injection pressures were set at hydrostatic pressure plus 1 bar for high flow situations, and up to a maximum of 10 bars for low flow situations. The tests are commenced at the set pressure, with flow rate being adjusted until a constant pressure over 5 mins is achieved, or for a period of up to 30 minutes. Calculation of permeability results used both the Jacob and Loham (1952) 'straight line method' and BS5930.

Having developed this equipment it is now available for use on other sites which demand the same high standards. ■

contents

Writing on behalf of the Equipe Group, Pete Reading writes for **theGeotechnica** about moisture content, what difference it makes, and how it can potentially affect you .

This article is the first in a series which will look at laboratory testing and the parameters we are trying to determine.

Moisture content is the most commonly used test in the laboratory. Almost every test made requires the moisture content to be determined but how accurate are these determinations and how does moisture content influence the result we are trying to measure. This article will attempt to answer these questions and perhaps reveal how important it is that we understand the mechanisms which will control what we term natural moisture content.

"The moisture content of our soil is determined by taking a representative sample of the soil in its natural condition and measuring its weight in air."

The moisture content of our soil is determined by taking a representative sample of the soil in its natural condition and measuring its weight in air. We then dry the sample out in an oven normally set to a temperature of 105 degrees centigrade until consecutive weighing show no decrease in weight. We can then weigh the dry soil mass and from the wet weight and dry weight and some simple maths we can assess the weight of water present in the initial sample and express this as a percentage of the dry weight.

Bulk sample cannot be adequately sealed to allow an accurate determination of the moisture content.

[(Wet weight - dry weight) / dry weight] x 100 = moisture content

This is all very straight forward, however how accurate is this result?

The answer to this question will depend on how we obtain the sample which we are using. In my experience this can be extremely variable, ranging from a tub of soil taken by a driller a bulk bag scooped from the spoil from a trial pit to a piece of soil carved from a tube sample.

All these samples can be good but can we rely on the results. If we use a tub, the sample in it must be representative of the soil, for the standard 1 Kg tub to qualify as representative it can only be used for finer soils clay silt and sand. Often the tub is found to be part filled, this is not adequate. The tub must be filled, removing as much air as possible and the tub should have an air tight lid. If one tub is not enough to obtain a representative sample then more should be taken or larger tubs used. Freezer bags are not adequate in any way.

Bulk bags, which should be made of sufficiently strong plastic are rarely going to be able to contain the samples in a suitable condition for moisture content testing, they may well contain a representative sample of the material but all tie systems will result in the bag not being totally air tight this may result in moisture being lost. If moisture contents of such strata are needed then it is recommended that tubs are used, these may well need to be large and could require several to obtain a representative sample.

"If moisture contents of such strata are needed then it is recommended that tubs are used..."

Tube samples have the potential of retrieving a good quality sample however unless great care is used the advantage may be quickly lost. It is often seen that the driller will line up his samples and write labels and seal the samples at the end of the day. In recent times the practice of sealing the end of the sample with wax has been abandoned by some. The excuse that health and safety has precluded the use of a gas ring to melt the wax is often given. This is not valid there are other methods of melting the wax which do not require the use of a gas burner and cylinder being carried in the support vehicle. Systems which use the power from the vehicle are readily available. Whichever method is used it is essential to ensure the sample is waxed as quickly as possible after the sample is brought to surface. Any less and moisture will be quickly lost.

"In recent times the practice of sealing the end of the sample with wax has been abandoned by some."

"The waxing of the sample is perhaps the least of our concerns..."

The waxing of the sample is perhaps the least of our concerns because the sampling method and its quality will affect the moisture content. The area ratio of the sample tube will have a significant effect on the quality, thicker walled samplers will develop suctions on the sampler wall as the sample is driven, this will result in moisture migration from the centre of the sample to the sample wall resulting in strain softening around its circumference. Or put a different way the moisture content near the centre of the sample will be reduced as moisture migrates to the outside of the sample making the wall softer.

Foundation failures can often be attributed to moisture change in the founding soils

This affect should be taken into account when tube samples are used for moisture content tests, ideally using discs rather than the centre of the sample to make the determination.

More detail on the use of different classes of sampling method can be found in BS EN ISO 22475 part 1.

Class	Test Type	Method
1	*Classification; moisture content, density, deformation and consolidation*	*Thin walled Rotary cored (wireline) Block samples*
2	*Classification; moisture content; density.*	*U100 form cable tool drilling or similar*
3	*Classification and moisture content*	*Thick walled sampler*
4	*Classification*	*Disturbed samples*
5	*None , sequence of strata only*	*Window/ windowless sampling*

Adaptation of Table 3.1 from BS EN 1997 Part 2 (2007).

It should be noted that the plasticity index test is not dependent on the sample quality it just requires a representative sample. To this end I would suggest that all sample classes are suitable for this test.

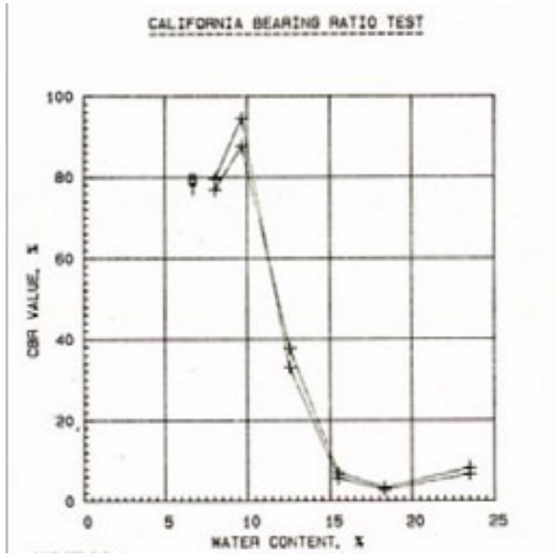
So why are do we need accurate moisture contents?

This is not such a straight forward question as it first seems, Moisture content is not a constant unlike for

instance the liquid and plastic limits where these values will remain unchanged by the general state of the soil. This will be developed further in a future article.

"Moisture content changes significantly in the upper 3 to 6m."

Moisture content changes significantly in the upper 3 to 6m. This is just the range where we would normally want to place our foundations. If the moisture content changes this will potentially result in a change in volume which will materialise itself as shrinkage or swelling depending on whether the soil is wetting or drying. Sometimes these movements will be significant and can cause serious structural damage.



Small changes in moisture content can have a dramatic effect on strength as demonstrated by this CBR/ moisture content plot.

This give us a dilemma because generally when we are sampling we are not sure or at least we do not tend to consider what state the ground is in when we take the sample and how this might change in the intervening period up to construction. It begs the question should we be sampling and testing over a period of time particularly focusing on periods of dry or wet weather?

Work carried out in the 60's and 70's by the Milton Keynes development corporation went a long way to consider this. Their research contributed significantly to the NHBC documents which consider the distance and depth of foundations which are placed in close proximity to trees. Whilst the information in the NHBC documents is good there may well be situations which are exceptions to the rule.

"It is essential that all situations are dealt with on a case by case study..."

It is essential that all situations are dealt with on a case by case study and the design should be assessed based on actual conditions which pertain over a period of time. This sits comfortably with the ethos is Eurocode and the limit state design philosophy. Perhaps this is something we should be considering right now having experienced one of the driest periods in the last decade.

In conclusion whilst at face value the humble moisture content is a simple test it is easy to overlook the factors which might significantly affect the results

"It is essential to be aware of the limitations of the sampling process..."

and influence the design outcomes. It is essential to be aware of the limitations of the sampling process poor practice here will certainly give very poor results. We also need to consider the design situation and in line with Eurocode consider all possible situations which may give rise to failures. This summer may well be a testing time for our designs if we continue to experience such dry weather. ■

part 2 - what are the NEC3 contracts?

specification and contract

contents

Writing for the second time for **theGeotechnica** are Kieran Dineen and Robert Gerrard from Thomas Telford Training. Here, they speak about NEC3 contracts, explaining what you need to know.

The current list of published NEC3 Contracts and a brief description of each is stated below. ■

With the exception of the AC, all other NEC contracts are drafted for use in a multi-party partnering arrangement utilising the provisions of Option X12 Partnering. Some of the above contracts have further amendments resulting from The Local Democracy, Economic Development and Construction Act 2009

NEC Title	Abbrv.	Brief Description
NEC3 Engineering and Construction Contract (June 2005, with amendments June 2006)	ECC	This contract should be used for the appointment of a contractor for engineering and construction work, including any level of design responsibility.
NEC3 Engineering and Construction Subcontract (June 2005, with amendments June 2006)	ECS	This contract should be used for the appointment of a subcontractor for engineering and construction work where the contractor has been appointed under the ECC.
NEC3 Engineering and Construction Short Contract (June 2005)	ECSC	This contract is an alternative to ECC and is for use with contracts which do not require sophisticated management techniques, comprise straightforward work and impose only low risks on both client and a contractor.
NEC3 Engineering and Construction Short Subcontract (June 2005)	ECSS	This contract can be used as a subcontract to ECC or ECSC. It should be used with contracts that do not require sophisticated management techniques, comprise straightforward work and impose only low risks on both the contractor and subcontractor.
NEC3 Professional Services Contract (June 2005, with amendments June 2006)	PSC	This contract should be used for the appointment of a supplier to provide professional services.
NEC3 Term Service Contract (June 2005, amendments June 2006)	TSC	This contract should be used for the appointment of a supplier for a period of time to manage and provide a service.
NEC3 Term Service Short Contract (September 2008)	TSSC	This contract should be used for the appointment of a supplier for a period of time to manage and provide a service. It is an alternative to the TSC and is for use with contracts which do not require sophisticated management techniques, comprise straightforward work and impose only low risks on both client and a contractor.
NEC3 Supply Contract (December 2009)	SC	This contract should be used for local and international procurement of high-value goods and related services including design.
NEC3 Supply Short Contract (December 2009)	SSC	This contract should be used for local and international procurement of goods under a single order or on a batch order basis and is for use with contracts which do not require sophisticated management techniques and impose only low risks on both client and a supplier.
NEC3 Framework Contract (June 2005)	FC	This contract should be used for the appointment of one or more suppliers to carry out construction work or to provide design or advisory services on an 'as instructed' basis over a set term.
NEC3 Adjudicator's Contract (June 2005)	AC	This contract should be used for the appointment of an Adjudicator to decide disputes under the NEC family of contracts. It may also be used for the appointment of an Adjudicator under other forms of contract.

drilling

contents

This is the fourth in a series of articles on borehole stabilisation and the use of drilling fluids and muds. In this issue of **theGeotechnica**, James Mansell of Clear Solutions International Ltd. once again imparts his knowledge on this very important subject.

Using the correct drilling fluid pump rates, pressures and rheological (flow) characteristics fundamentally improves rotary drilling rates and speeds up drilling operations.

In most rotary drilling applications drilling fluid is

"The drilling fluid is mixed on surface, and then pumped down the hole using the surface mud pump."

used to clean and stabilise the borehole. The drilling fluid is mixed on surface, and then pumped down the hole using the surface mud pump. The mud pump pressurises the drilling fluid, forcing it through the mud swivel (located in the drilling rigs rotary drive head), down the inside of the drill pipe, out through the jets which are located in the drill bit and back up the annular space between the outside of the drill pipe and the inside of the borehole wall/surface or casing. As the drilling fluid flows up the annulus, enough annular velocity must be generated to overcome the drilled cuttings natural tendency to settle back down the hole through the drilling fluid. By keeping the annular velocity higher than the drilled cuttings slip velocity (settling rate), the drilled cuttings will eventually be transported out of the borehole, back to surface.

"Clearly the faster the drilled cuttings are removed from the borehole the more productive and efficient the drilling operation becomes."

Clearly the faster the drilled cuttings are removed from the borehole the more productive and efficient the drilling operation becomes. Hole cleaning efficiency is governed by the following:

- The size, shape and density of the drilled cuttings.
- The borehole diameter and depth.
- The mud pumps maximum achievable flow rate and mud pressure.
- The drilling fluids ability to suspend and transport drilled solids.

The size, shape and density of the drilled cuttings

In simplistic terms a 10mm diameter cutting will fall through the drilling fluid 4 times faster than a 5mm cutting, which will fall through the fluid 4 times faster than a 2.5mm diameter cutting, so the smaller the cuttings are, the easier they are to remove from the borehole. More rounded and denser (heavier) particles will also settle more quickly. Clearly if we are drilling sand or gravel we must accept the particle size which is inherent within the formation and deal with it.

In rock and clay it is important that the drill bit cutting structure, jet velocity/direction, weight on bit, rotary speed and torque is optimised to maximise the penetration rate whilst creating small, drilled cuttings

"In clay... we want to avoid creating large 50mm pencil shaving type cuttings or larger, as they will be very difficult to lift out of the hole."

of a 1mm – 10mm size. In clay for example, we want to avoid creating large 50mm pencil shaving type cuttings or larger, as they will be very difficult to lift out of the hole. In addition poor hole cleaning or low jet velocity at the bit can cause the drill bit to re-cut the drilled cuttings, creating rock flour. It is important that this is avoided as it reduces the rate of penetration, whilst also making the drilling fluid very difficult to recycle/clean on surface. This also leads to a rapid build up of drilled solids within the drilling fluid, resulting in high and expensive dilution rates.

The borehole diameter

As a rule of thumb the optimum annular velocity (annular flow rate) for a typical rotary drilled water/geothermal borehole is around 25 – 50 metres per minute. As shown in the table below the hole diameter (drill bit/casing size) makes a huge difference to the annular velocity.

Hole Diameter	**Pump Rate** *litres per minute*	**Annular flow-rate** *metres per minute*
6"(152.4mm)	500 ltr/min	40 metre/min
8"(203.2mm)	500 ltr/min	18 metre/min
10"(254mm)	500 ltr/min	11 metre/min

So whilst 500ltr/min is an acceptable flow rate for a 6" diameter hole, if we increase the hole diameter we must also increase the flow rate to maintain efficient hole cleaning.

The mud pumps maximum achievable flow rate and mud pressure

"...the drilling fluid must be pressurised to enable it to flow through the circulating system."

What is also very important to consider is that the drilling fluid must be pressurised to enable it to flow through the circulating system.

We know that the fluid loses pressure as it flows through the circulating system, because if it left the borehole at the same pressure that it left the mud pump, we would see a seriously high fountain coming out of the borehole and this does not happen. The surface pump pressurises the drilling fluid, forcing it down the inside of the drill pipe, out of the jets in the drill bit and back up the annulus to surface. As the fluid flows through this circulating system it loses pressure as a result of frictional forces on the fluid, caused by resistance to flow.

To achieve optimum flow rates we either need to increase the surface mud pressure or reduce the circulating pressure loss (using shear thinning drilling fluids with a lower resistance to flow also helps).

On a typical 150m deep geothermal borehole the surface mud pump needs to pressurise the drilling fluid to a pressure of around 20bar to achieve optimum

"As we drill deeper the system pressure loss increases."

hole cleaning flow rates. As we drill deeper the system pressure loss increases. The net result is that as we drill deeper we either need to reduce the flow rate to limit the surface mud pressure or increase the mud pump pressure to maintain the optimum flow rate.

This picture provides an excellent example of shear thinning drilling fluids in action.

Whilst centrifugal pumps have many benefits and effectively transfer large volumes of fluid at the surface, they have significant limitations when used as the main mud pump. This is because centrifugal pumps do not generate a high enough pressure to overcome

the circulating pressure loss, which is created in a vertical borehole. Centrifugal pumps use a spinning impeller to move the fluid, as the fluid is pressurised the impeller starts to slip in the fluid, physically moving

"So as you drill deeper and the pressure increases this type of pump moves less and less fluid."

less of it. So as you drill deeper and the pressure increases this type of pump moves less and less fluid. Once a depth of around 50m is achieved the centrifugal pumps flow rate drops to a point where hole cleaning efficiency becomes seriously compromised and the drilling rate slows right down as the hole packs off with drilled cuttings.

To ensure maximum flow rates to improve productivity, it is critically important that a high-pressure, high flow rate, positive displacement, triplex pump is utilised as the main mud pump. We must use a triplex pump as it helps to avoid pressure surges, which can destabilise the formation. The pump must be correctly matched to the surface equipment, borehole diameter, depth and down hole tooling to achieve optimum mud pressure and flow rate. To enable these pumps to work to their best ability, they must also be run in conjunction with a highly efficient mud cleaning system or drilled solids will wear them out.

The drilling fluids ability to suspend and transport drilled solids

In addition, the drilling fluids mud weight, flow characteristics and ability to suspend and transport drilled solids have a significant impact on hole cleaning performance:

In the graph below the viscosity of two different drilling fluids at different flow rates have been measured.

Pure-Bore® is a unique, high yield environmentally friendly polymer, which is specifically formulated to optimise hole cleaning and borehole stability.

Liquimud® Polymer is a standard high yield, synthetic liquid co-polymer and is similar to many of the liquid PHPA co-polymers, which are commonly used within the land drilling industry.

Both fluids have been mixed to the same apparent viscosity (thickness) - the viscosity has then been measured at different flow rates and plotted on the graph.

"The difference between the two drilling fluids is their ability to shear thin as they flow faster."

The difference between the two drilling fluids is their ability to shear thin as they flow faster. As the two drilling fluids flow faster and faster (i.e inside the narrow drill pipe) they both shear down to generate a very low viscosity, close to the 1cP viscosity of water. This is good as our greatest circulating pressure loss occurs inside the constraining drill pipe, so we want the fluid to flow as easily as possible through this part of the circulating system with the lowest possible pump pressure.

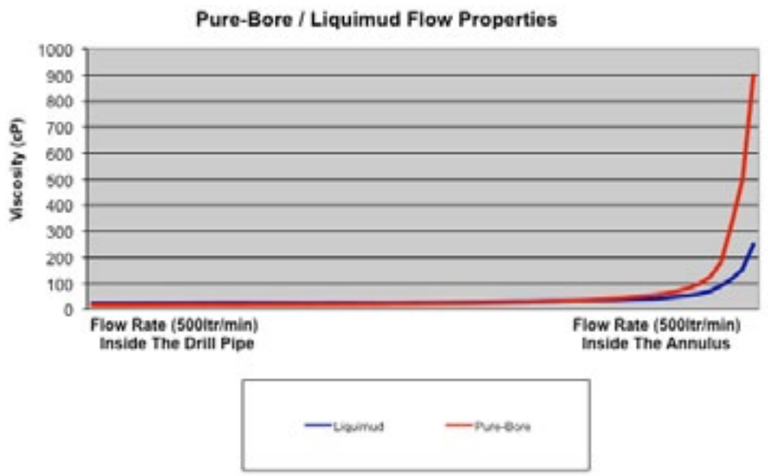
Conversely as the drilling fluid leaves the jets in the drill bit and enters the larger annular space, the fluid slows right down. It is at this point that we need the drilling fluids viscosity to increase to help to transport the drilled cuttings back to surface. As shown in the graph it is at this point that the Pure-Bore® drilling fluid generates a much higher viscosity to help to flush the drilled cuttings out of the borehole. In addition and unlike the liquid co-polymers, the Pure-Bore® drilling fluid also generates a high stable gel strength to help suspend drilled solids when the pumps are off.

To put some figures around this:

- The settling rate of a 1" cutting through the liquid polymer mud is around 40 m/min – if the annular flow rate is lower than this, we don't clean the hole.
- The settling rate of a 1" cutting through Pure-Bore® drilling fluid it is just 5 m/mi.

Clearly using Pure-Bore® makes a huge difference in terms of drilling efficiency – the cuttings are more quickly transported back to surface, the borehole is cleaner and drilling is significantly faster.

What is clear is that the Pure-Bore® drilling fluid creates a highly effective "conveyor belt" to efficiently transport drilled solids out of the hole whilst keeping the circulating pressure to a minimum. An added benefit of using Pure-Bore® is that it also forms a tight firm filter cake to aid borehole stability and lubricity whilst providing exceptional clay and shale inhibition and formation protection.



drilling

contents

FINAL CONSIDERATIONS

In the last article we discussed the importance of the efficient separation of the drilled solids from the drilling fluid. To significantly improve drilling productivity it is critical that the correct mud mixing and recycling plant is also matched to the correct high-pressure mud pump and drilling fluid as follows:

1. Run a highly shear thinning Pure-Bore® drilling fluid to optimise hole cleaning and borehole stability.
2. Utilise a high-pressure mud pump such as the Ultra-Flow-800™ mud pump, which is capable of achieving, flow rates of 800/ltr/min with mud pressures of over 50bar. In utilising such a high-pressure mud pump system, we can comfortably optimise hole cleaning without always needing to run the pump at maximum capacity – burning excess diesel, increasing wear etc.
3. Optimise the jet nozzles within the drill bit to

Ultra-Flow high pressure, high flow rate triplex mud pump for optimum drilling rates.

generate hydraulic horsepower to maximize near bit cleaning and penetration rate.
4. Combine all of this with a highly efficient Ultra-Clean-1000™ mud mixing and drilling fluid recycling system, utilising an ultra efficient high "g" force shale shaker. This drilling fluid system will quickly and efficiently mix adequate surface volume, whilst also efficiently cleaning the drilling fluid to protect the mud pump, reduce drilling fluid additive usage, minimise waste disposal costs and maintain the drilling fluids optimum operating parameters.

"When all of this is done it is possible to significantly improve drilling productivity."

When all of this is done it is possible to significantly improve drilling productivity. Purchasing this equipment, involves a significant capital investment but with correct site management and operator training, drilling rates will be more than doubled and the

"Operators who have made the investment have seen a significant increase in drilling productivity..."

corresponding pay back period is less than a year. Operators who have made the investment have seen a significant increase in drilling productivity combined with reduced downtime and a much cleaner/safer-working environment.

Clear Solutions International Ltd is a leading manufacturer of environmentally friendly drilling fluid additives, drilling fluid mixing, pumping and separation equipment for a wide range of drilling applications including the gas drilling, horizontal directional drilling, deep geothermal, tunnelling, microtunnelling and the slurry wall/foundation markets. As a company we are driven by our determination to optimise our customer's productivity through the supply of the highest performance products along with the very best technical support and training.

Our equipment and products are designed to work in conjunction with each other to minimise and control risk. Based on our world record-breaking performance in other drilling markets we are now using our experience and products to dramatically increase drilling productivity across a range of shallow drilling applications including the geothermal and water well drilling markets. ■

contents

It is with great sadness that we announce the loss of one of the most popular people within our industry; Paul Blackledge – owner of Paul Blackledge Drilling Ltd. Paul recently passed away aged just 47 after suffering with ocular melanoma, a rare eye cancer. Paul lost his battle against the condition after a very courageous fight of over 3 years.

For those of us who had the pleasure of knowing and working with Paul it was no surprise that he continued to work even after losing an eye to the disease and typically still worked until he was physically unable to do so just prior to Christmas. Paul and his wife, Nicola, have taken PB Drilling from a single cable tool rig in Dudley in the early 1990's, to one of the most prestigious suppliers of drilling and site investigation services in the North of England. They have continued to grow the business year on year after moving back to their home town of Wigan.

"Respect for Paul within the drilling world was clear for all to see at his funeral on the 24th February."

Respect for Paul within the drilling world was clear for all to see at his funeral on the 24th February. Hundreds of mourners packed not only into the Sacred Heart Catholic Church in Wigan, but also many of the surrounding roads. It was a fitting tribute that a PB Drilling Landrover was part of the funeral procession. Paul's popularity stretched far beyond the drilling world too, with hundreds of his fellow scooter riders joining the procession to the church and lining the streets.

Paul proudly taking delivery of PBDrilling's first Cable Tool rig.

"He will always be remembered within the drilling world for his honesty and as a hardworking character."

He will always be remembered within the drilling world for his honesty and as a hardworking character.

Paul was part of a very small group of young drillers who in the early 90's changed the pre-conceptions of subcontract drill crews - that they were all after a quick buck. From the outset he worked harder than anyone else, treated everybody he met with both respect and decency; in fact he lived by the adage; treat others as you would expect to be treated yourself.

Drillers always knew if it was Paul working the rig, as he was always there before them, left after them and just carried on working with his sandwich in his spare hand at lunch time. He was always striving not only to do it right but to also do it better than the others. At the same time, if he could help others out, he always would and always had time for you when you spoke to him.

"He was always striving not only to do it right but to also do it better than the others."

These were things not normally associated with drill crews and as he expanded, he always tried to employ like-minded individuals, who continued the company ethos. To this day his influence is echoed daily around his drill sites.

"...he always tried to employ like-minded individuals, who continued the company ethos."

It would be a poignant reminder of the industry's loss to try and conclude Paul's work and influence during this all too brief biography, however, the truth is that through Nicola, his family, his friends and P B Drilling, his culture and spirit will live on. We know they will strive to continue Paul's simple ethos, that if you are in the service industry then: "you best provide a service that people want."

"...through Nicola, his family, his friends and P B Drilling, his culture and spirit will live on."

Nicola, along with daughters Ashlee and Kate, are determined to raise as much money as they possibly can for cancer research. Out of respect for Paul, and also to help others whose lives are affected by cancer, they will be completing the 'Race for Life.' We are sure that many from the industry will wish to contribute to the cause and can do so by using the link below:

www.raceforlifesponsorme.org/drillers-darlings.

We are sure our industry will give generously and wish Nicola and the girls' success in their quest, not only to raise money for cancer research but in continuing Paul's legacy.

Soil Engineering impliments digital borehole logging

products and innovations

contents

Digby Harman, Innovations Manager at Soil Engineering write for **theGeotechnica**, reporting on Soil Engineering's recent implimentation of KeyLogbook - a digital borehole logging system - onto their sites across the country.

Over the last decade, Soil Engineering, the specialist geotechnical unit of Vinci Construction UK Ltd, has been committed to eliminating the use of hand-written daily progress sheets used to report ground investigation drilling, boring and sampling field operations, and instead operating a system which would allow the direct capture of this data in digital format at source.

The identified benefits to be gained from such an all-digital system include guaranteed collection of all data required by the relevant standards, the ability to send data immediately from site and thus enable better informed management of the works, and the elimination of the time, cost and potential errors arising from manual transcription of often semi legible field data sheets into the office-based systems used for formal reporting. An additional desirable feature was to incorporate bar-coded label printing for samples to allow improved control and traceability throughout the complete collection, transport, storage and laboratory testing process.

Over the period since 2002 a number of alternative approaches were tested and reviewed. These included commercially available PDA-based systems, proprietary rugged hand-held data capture devices used in overseas markets, in-house developed software running on early tablet computers and 'digital pen' based systems.

Frustratingly, all the alternatives were found wanting. The stylus operated PDA-based systems suffered both from being an inappropriate hardware form-factor for use by drillers, and because the available software did not reflect the true workflow of a typical drilling operation, being more appropriate for use by supervising engineers and geologists. The challenges of reconfiguring software originally developed for specific overseas markets to meet the requirements of UK and European standards were too great, and in-house developments were hampered by the limited performance available from early generation tablet computers. Digital pen technology was not found to be effective at dealing with the complexity and breadth of the data required to be captured.

Thus it was of considerable interest to Soil Engineering when, at the Geotechnica exhibition in 2009, Equipe Training introduced their digital borehole logging

"KeyLogbook... appeared to offer all of the objectives Soil Engineering had targeted for such a system..."

system KeyLogbook, which appeared to offer all of the objectives Soil Engineering had targeted for such a system. Recognising the potential, Soil Engineering immediately purchased two systems and joined the programme as Development Partners.

Following the successful completion of two years development and testing, Soil Engineering has now introduced KeyLogbook into its ground investigation business and is committed to progressively move their entire drilling fleet on to this technology instead of the traditional paper-based systems.

The KeyLogbook system, supplied by Equipe jointly with co-developer Keynetix, is a rugged, tablet computer based system which revolutionises the way in which site data from ground investigations is captured, recorded and disseminated. Soil Engineering has been instrumental in taking the system from initial concept to a contract-proven working system.

"Great effort has been made to make the system as easy as possible for a driller to use..."

Great effort has been made to make the system as easy as possible for a driller to use and to insulate them as much as possible from needing any knowledge of computers or their operating systems. The driller is presented with an intuitive touch screen user interface which is operated by finger touch.

This means that for the increasing numbers of drillers already familiar with smart-phone technology using KeyLogbook comes naturally, whilst even for the more traditional driller the change from old-style paper to a computer is straightforward to accomplish.

Originally conceived as running on a highly ruggedized (IP65 rated) but relatively slow tablet computer, Soil Engineering pioneered the use of the very latest ruggedized tablet from Motion Computers, the

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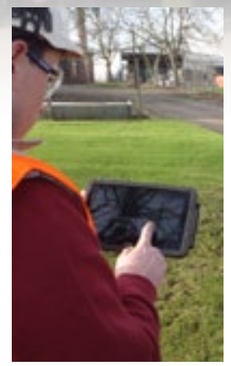
CL900. Although less proofed against extreme weather (IP52 rated) it was felt that this was not a critical problem as the normal location where the system was to be used was envisaged to be in a support vehicle or cabin rather than actually attached to the rig. The CL900 provides a near-perfect blend of performance, daylight screen visibility, size and cost and, perhaps for the first time, confirms this latest type of ruggedized tablet device as the hardware platform of choice for field based applications such as this.



When considering implementation of KeyLogbook careful consideration needs to be given to exactly how, where and in what manner it is to be used as this may determine the most appropriate hardware solution. Is it to be used directly on the rig or in a vehicle? Can it be continually powered from the rig or vehicle or will it need to run all day on battery power alone? Will it be used to record data entirely in real-time ie dispensing with the driller's notebook or will it only be used instead of the driller's daily report sheet?

"Exhaustive trials were carried out by Soil Engineering..."

Exhaustive trials were carried out by Soil Engineering and system enhancements were conceived and implemented before the equipment was put into use on its first contract commencing in autumn 2011. This involved the formation of approximately 200 boreholes of various types, the majority including installation of groundwater monitoring instrumentation, across multiple sites for a major 'blue- chip' Client.

Field data was entered directly by the drillers onto the KeyLogbook tablet computer. Using an intuitive system of on-screen prompts the system ensures that all data required by the relevant Eurocodes is completely and correctly collected directly at source, with the work flow being optimised dependant upon the drilling method i.e. cable percussion, rotary coring, open holing, or dynamic window or windowless sampling.

Sample labelling is made virtually instantaneous and hassle-free by the use of rugged label printers, linked to each tablet via Bluetooth, to produce the required number of sample labels. Each label carries a unique bar-coded sample identification number which offers

the future potential of aiding sample tracking from site to and throughout the subsequent sample storage and testing processes.

Despite the KeyLogbook system still being subject to ongoing enhancements Soil Engineering has already found multiple benefits from using the system. After initially sending data via e-mail all data from each rig is now transmitted at the push of a button on the tablet to an FTP site where it is automatically filed in its own

"Halcrow also had a requirement to improve data quality and digital data storage..."

folder. Data format comprises PDF files of the 'Drillers Daily Sheet' and any associated installation drawing or in situ permeability test results, together with the associated AGS data and measure sheet and even an invoice if required. This immediate availability of data has allowed for a quicker more efficient turnaround of borehole logs and thus enabled better informed operational and technical decisions to be made.

For the drillers it eliminates the chore (and time spent) of hand writing daily sheets and numerous sample labels and allows more time for productive activities. Absolute consistency of Client, Job and Borehole naming across the project is ensured because the data is only entered once and can even be uploaded to each tablet via email from the office or using a USB stick on site, along with the driller's instruction sheet which can be viewed on the tablet screen.

Benefits to the Client or Supervising Engineer include quicker availability of fully compliant data, including AGS, enabling informed decisions to be made e.g. about borehole termination and instrumentation requirements or laboratory test scheduling, as well as allowing improved budgetary control.

The facility exists within KeyLogbook to send data directly from site by email to a representative of the Client team but, were this to be used, in needs to be fully understood by all parties that the data being provided is entirely unchecked. This status will be included within the AGS data file.

Current development work is focussed on enhancing the provision of AGS data to ensure that it complies with the latest AGS version 4 standard and comprehensively transfers all the data captured by KeyLogbook.

"The existing AGS output... is not yet sufficiently complete..."

The existing AGS output (version 3.1), whilst providing key data such as sample listings, strata details and in situ test results, is not yet sufficiently complete to allow the elimination of all retyping from hand written sheets. It is hoped that direct import into our office-based Holebase system will then be possible, thus eliminating the duplicated effort of re-entering any data through a keyboard when it has already been done once - by the driller! All that would then be required is the addition of the full engineering description in lieu of the driller's description, combined of course with the usual checking process, to produce the final borehole log. Despite the fact that the benefits of full AGS entry and use of the unique bar-coded sample IDs for tracking have yet to be fully realised it is interesting to consider the savings in site operating costs alone that might be achieved using KeyLogbook as a result of the time normally spent hand-writing daily log sheets and numerous sample labels.

Allowing for purchase cost and financing, assuming a 3 year depreciation, software and hardware maintenance, provision of SIM cards and consumables and with an allowance for loss and damage, the cost of a complete KeyLogbook system works out at less than £15 per day.

If KeyLogbook enabled an additional half hour of productive chargeable work each day, not only would this pay for the provision of the KeyLogbook system but would also result in further gains of between £15 and £35 per day, per rig, dependent upon rig type ie dynamic sampling, cable percussion or rotary. For a fleet of 5 cable percussion and 5 rotary rigs this could amount to a saving of £55,000 per year, and remember this excludes the further savings in office and reporting costs arising from direct import of AGS data. For companies with larger drilling fleets such as Soil Engineering the potential savings are even more significant.

Having already proven beyond doubt the cost-effectiveness and technical benefits of the KeyLogbook system, Soil Engineering have now embarked upon a progressive programme of installation across their entire ground investigation fleet, which is one of the largest in the UK. This is the third strand of technical innovation that Soil Engineering have introduced to the UK ground investigation market over recent years following their success with the Corescan 2 digital core scanning system and Drilling Parameter Recording on their rotary drilling rigs. ■

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