GEOTECHNICAL COURSE DATES:

Rock Description Workshop
28th Jan 2015, 10th March 2015

In Situ Testing
5th March 2015

Lab Testing
27th Jan' 2015

GEOTECHNICAL COURSE DATES:

Geotechnical Foundation Design - 20th Jan' 2015

Soil Description Workshop
21st Jan' 2015
25th Feb' 2015

H&S COURSE DATES:

Avoiding Danger from Underground Services
30th Jan' 2015, 13th March 2015

Safe Supervision of Geotechnical Sites:
4th - 6th Feb' 2015

theGeotechnica

December 2014 | Issue 36

BIM proves that knowledge is power

Wider use of Building Information Modelling will help promote the concept that geotechnics is an integral part of every phase of a project

Contaminant of the Month: Vinyl Chloride

Properties, toxicity, assessment and analysis

Meridian completes Hemerdon project

Case study of Meridian's recently completed Hemerdon project

Is there a killer lurking in your lab?

The dangers of Respirable Crystalline Silica (RCS)

Contents

Welcome

Welcome to the 36th Edition of **theGeotechnica** - the UK's fastest growing online geotechnically focussed e-magazine.

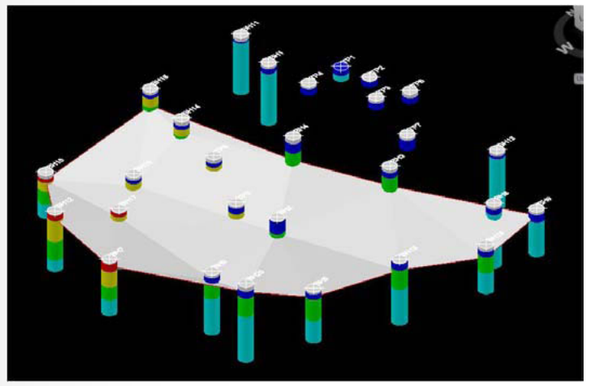
This month, once again, we have a fantastic line-up of insightful and informative articles that make for a must-read.

The first article of this month's issue comes from Geraint Williams of Alcontrol Laboratories. This month Geraint continues his highly popular contaminant of the month series of articles. This month he discusses the properties, toxicity, assessment and analysis of vinyl chloride in soil.

Writing our second article for this month is Gary Morin, Technical Director at Keynetix. This month Gary talks about BIM. Wider use of Building Information Modelling will help promote the concept that geotechnics is an integral part of every phase of a project but geotechnical practitioners must play their part.

The third article comes from Claire Savage of Accord PR on behalf of Meridian Drilling. In this article Claire presents a case study of Meridian's recently completed Hemerdon project - works carried out at a tungsten and tin mine.

Our fourth article this month comes from one of our regular contributors and resident Health and Safety Expert, Tom Phillips of RPA Safety Services. This month Tom discusses the dangers of Respirable



Crystalline Silica (RCS), a substance responsible for around 600 deaths a year in the UK through silicosis and lung cancer.

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 any 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.

Finally, for any content that is submitted we will ensure that an advertising space, proportionate to the quality of content provided, is reserved should you wish to place an advert in that single edition of the magazine. 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

CONTAMINANT OF THE MONTH: VINYL CHLORIDE

Writing for **theGeotechnica** *this month is Geraint Williams of* Alcontrol Laboratories*. This month Geraint discusses the properties, toxicity, assessment and analysis of vinyl chloride in soil.*

Vinyl chloride (CAS No 75-01-4) has a chemical formula C2H3Cl. It is a synthetic chemical obtained either by hydrochlorination of acetylene or by halogenation of ethylene. Synonyms include chloroethene, chloroethylene, 1-chloroethylene, ethylene monochloride, monochloroethene, monochloroethylene and vinyl chloride monomer or VCM.

"Vinyl chloride does not occur naturally in the environment and is produced as a chemical intermediate in the manufacture of other chemicals particularly PVC."

Vinyl chloride does not occur naturally in the environment. It is produced for use as a chemical intermediate in the manufacture of other chemicals, particularly PVC and several other copolymers. The largest use of PVC resins is in the production of plastic piping. Other important uses are in floor coverings, consumer goods, electrical and transport applications. Vinyl chloride was previously used as a refrigerant and as a propellant in aerosol sprays for a variety of products, such as pesticides, drugs and cosmetics. These have been banned since 1974 (Environment Agency 2008).

Vinyl chloride is a colourless gas (boiling point -13.4ºC) at room temperature and pressure with a slight sweet odour that polymerises in the presence of light (Defra and the Environment Agency, 2008). It has a water solubility of 2760 mg/l at 25ºC (SR7, 2008). Many salts have the ability to form complexes with vinyl chloride and can increase its solubility in water.

Vinyl chloride is highly volatile, easily evaporating from soil and surface waters. Vinyl chloride can be leached through the soil to groundwater. Additionally, the high solubility of vinyl chloride in many organic solvents may increase its mobility at specific locations

"Vinyl chloride can be formed as a degradation product of chlorinated solvents. Vinyl chloride is a common groundwater contaminant usually associated with higher order chlorinated aliphatic hydrocarbons such as trichloroethene and tetrachloroethene."

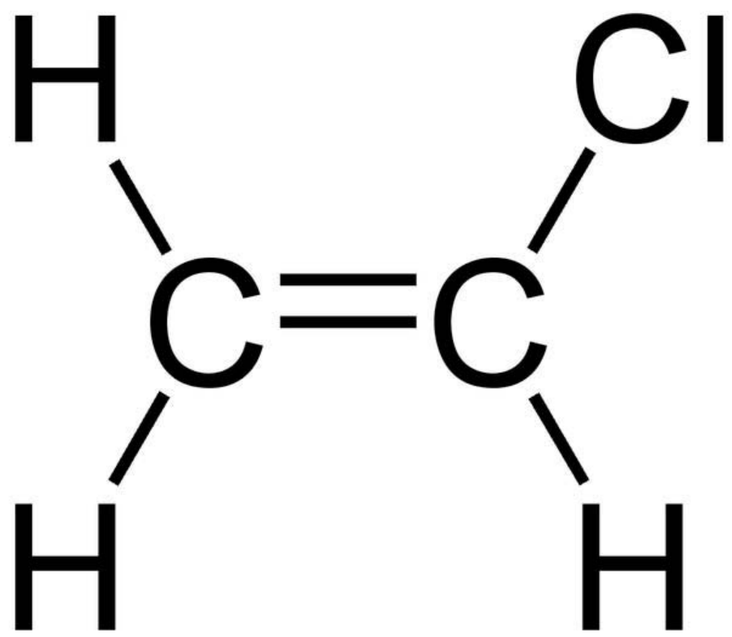
(landfill and waste disposal sites). It can readily migrate into groundwater, where it can remain unchanged for several months (WHO 1996).

Vinyl chloride can be formed as a degradation product of chlorinated solvents. Vinyl chloride is a common groundwater contaminant usually associated with higher order chlorinated aliphatic hydrocarbons such as trichloroethene and tetrachloroethene.

At high concentrations, the acute effects of vinyl chloride can cause dizziness, drowsiness, unconsciousness and at extremely high levels can cause death. Vinyl chloride is a respiratory irritant producing coughing, wheezing and breathlessness. Other effects include headache, ataxia and coma (PHE 2008).

Vinyl chloride has been classified as a human carcinogen (Group 1). The primary target organ for vinyl chloride exposure is the liver. There is strong and consistent evidence from epidemiological studies that vinyl chloride causes a rare tumour, angiosarcoma of the liver. A large proportion of the angiosarcoma cases were observed in the 1970s in occupationally exposed workers. In its evaluation of carcinogenicity the

"A large proportion of the angiosarcoma cases were observed in the 1970s in occupationally exposed workers."



International Agency for Research on Cancer (IARC) arrived at "sufficient evidence" in humans that vinyl chloride causes angiosarcoma of the liver and hepatocellular carcinoma. IARC's latest review of the carcinogenicity of vinyl chloride was published in 2012. The occurrence of angioarcoma of the liver in people occupationally exposed to vinyl chloride is very specific.

"There can be no doubt concerning causality, in view of the specific working history and the rareness and specificity of the tumour."

There can be no doubt concerning causality, in view of the specific working history and the rareness and specificity of the tumour. However, there is currently only limited data concerning the possible latency times.

"According to the ATSDR (2006) the human epidemiology data demonstrate a clear association between vinyl chloride and liver cancer... recentfollowupstudies do not demonstrate a consistent association between exposure and tumour formation in these organ systems."

According to the ATSDR (2006) the human epidemiology data demonstrate a clear association between vinyl chloride and liver cancer and, although other cancers have been previously reported for those occupationally exposed, recent follow up studies do not demonstrate a consistent association between exposure and tumour formation in these organ systems.

There is strong evidence that the carcinogenicity of vinyl chloride operates by a genotoxic mechanism that involves metabolic activation to reactive metabolites, binding of the metabolic activation to reactive metabolites, binding of the metabolites to DNA, promutagenic action of these adducts leading to mutations in proto-oncogenes and tumour-suppressor genes (IARC 2012). Defra and the Environment Agency concluded that vinyl chloride should be treated as a genotoxic carcinogen by the inhalation and oral routes of exposure and index doses applied to the different routes of exposure.

Land Quality Management and the Chartered Institute of Environmental Health published a set of Generic Assessment Criteria for vinyl chloride. At the time of writing, the 2009 2nd Edition LQM/CIEH GAC are about to be superseded by Suitable 4 Use Levels (S4ULs). For each substance, these S4ULs will

"For each substance, these S4ULs will reflect recent developments in human health risk assessment technical guidance and the latest research on toxicity, fate and transport of each substance under consideration including vinyl chloride."

reflect recent developments in human health risk assessment technical guidance and the latest research on toxicity, fate and transport of each substance under consideration including vinyl chloride.

Volatile Organic Compounds (VOCs) are determined using a headspace introduction system followed by GCMS. A typical VOC suite contains 64 target compounds and allows for Tentatively Identified Compounds (TICs) to be detected. In order to achieve the required very low-level limits of detection for vinyl chloride, laboratories are required to run the analysis in Selected Ion Monitoring mode where LoDs can be significantly lower than in full scan mode. ■

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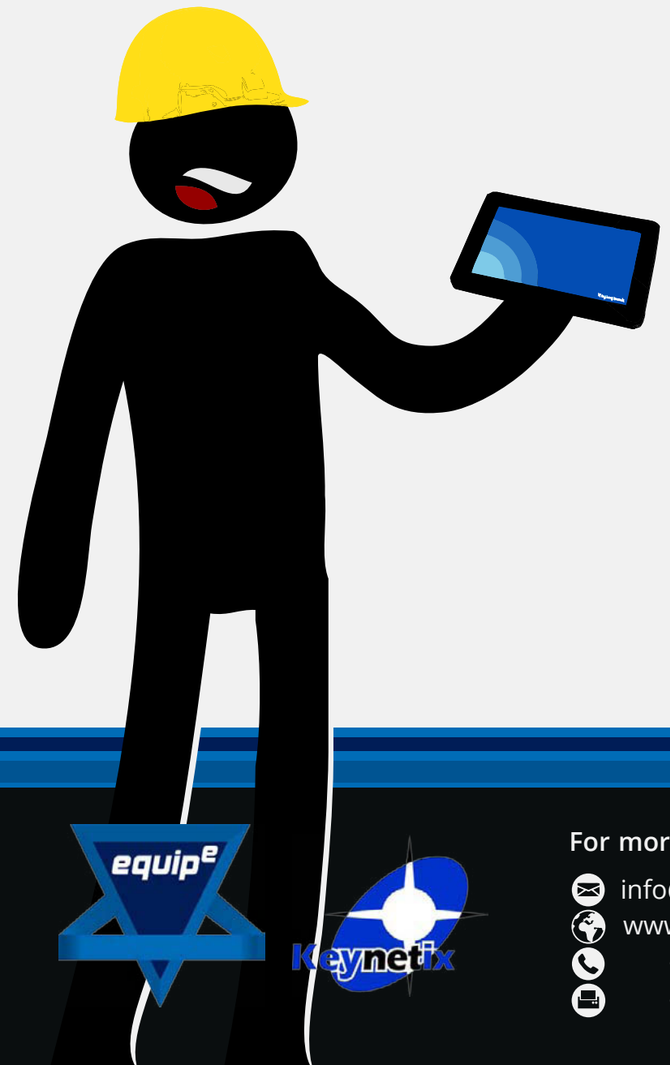

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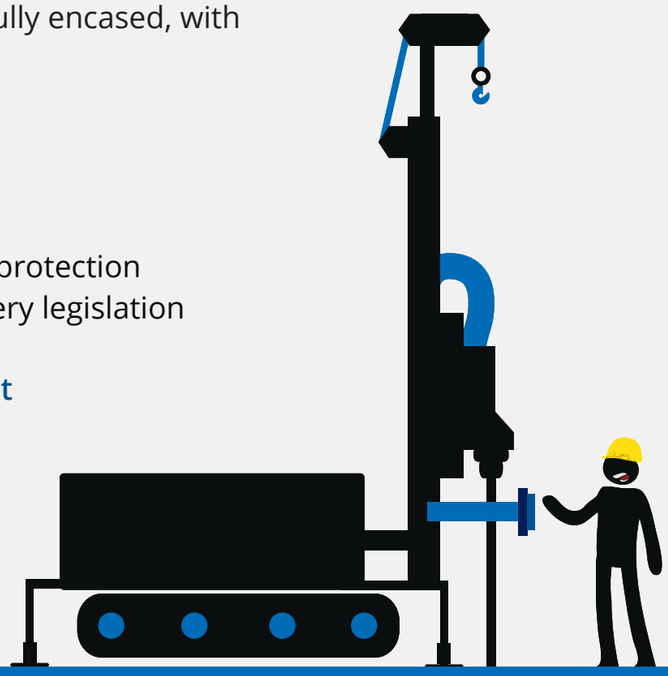

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www.equipegroup.com
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KNOWLEDGE IS POWER

Writing for **theGeotechnica** *this month is Gary Morin, Technical Director at Keynetix. This month Gary talks about BIM. Wider use of Building Information Modelling will help promote the concept that geotechnics is an integral part of every phase of a project but geotechnical practitioners must play their part.*

Building Information Modelling (BIM) is clearly a useful tool for building design and civil engineering, particularly for infrastructure design and construction. BIM encourages true collaboration, which is essential to reap its full benefit: faster, more economical projects with less environmental impact.

While, for the moment at least, BIM is primarily aimed at projects where the total spend is £50M plus, it is anticipated that smaller projects will start to use BIM (in fact, many of just £1M plus are employing BIM).

"In the UK the Government has stated that all public projects will "require fully collaborative 3D BIM… as a minimum by 2016"."

In the UK the Government has stated that all public projects will "require fully collaborative 3D BIM (with all project and asset information, documentation and data being electronic) as a minimum by 2016". The private sector is sure to follow, once it sees the benefits.

However, BIM models can sometimes neglect the geotechnical aspects of projects. They often appear to start from the ground up, with the subsurface considered as an homogenous substance. This implies there is no risk in the ground, which is clearly untrue.

"They often appear to start from the ground up, with the subsurface considered as an homogenous substance. This implies there is no risk in the ground, which is clearly untrue."

In fact, there is a host of benefits both to applying BIM principles to geotechnical data management and including geotechnical data in BIM: it allows considered design optioneering and refinement at the outset of a project; minimises geotechnical risk in construction and enables cost-effective repairs and maintenance of assets throughout the project's lifetime.

"Using BIM also means geotechnical contractors and consultants can collaborate easily."

Using BIM also means geotechnical contractors and consultants can collaborate easily. Data sharing and central data management can result in big improvements in efficiency and quality.

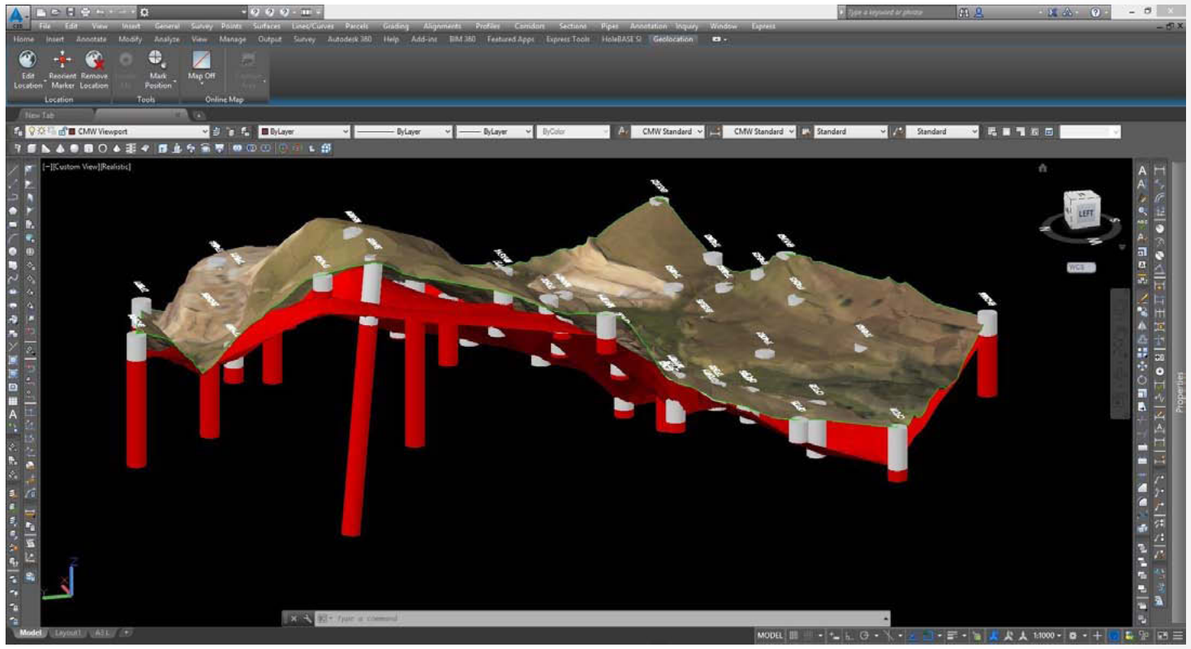
Of course, sharing of geotechnical data digitally is nothing new: The Association of Geotechnical and Geoenvironmental Specialists (AGS) began developing its digital transfer format in 1989 and its format is widely used and specified in the UK and is commonly available in a number of countries around the world.

However, while there are benefits in using this format, there are issues. AGS format is fine for factual data but does not currently allow the transfer of interpreted data, such as geological surfaces (although this is being considered for future versions).

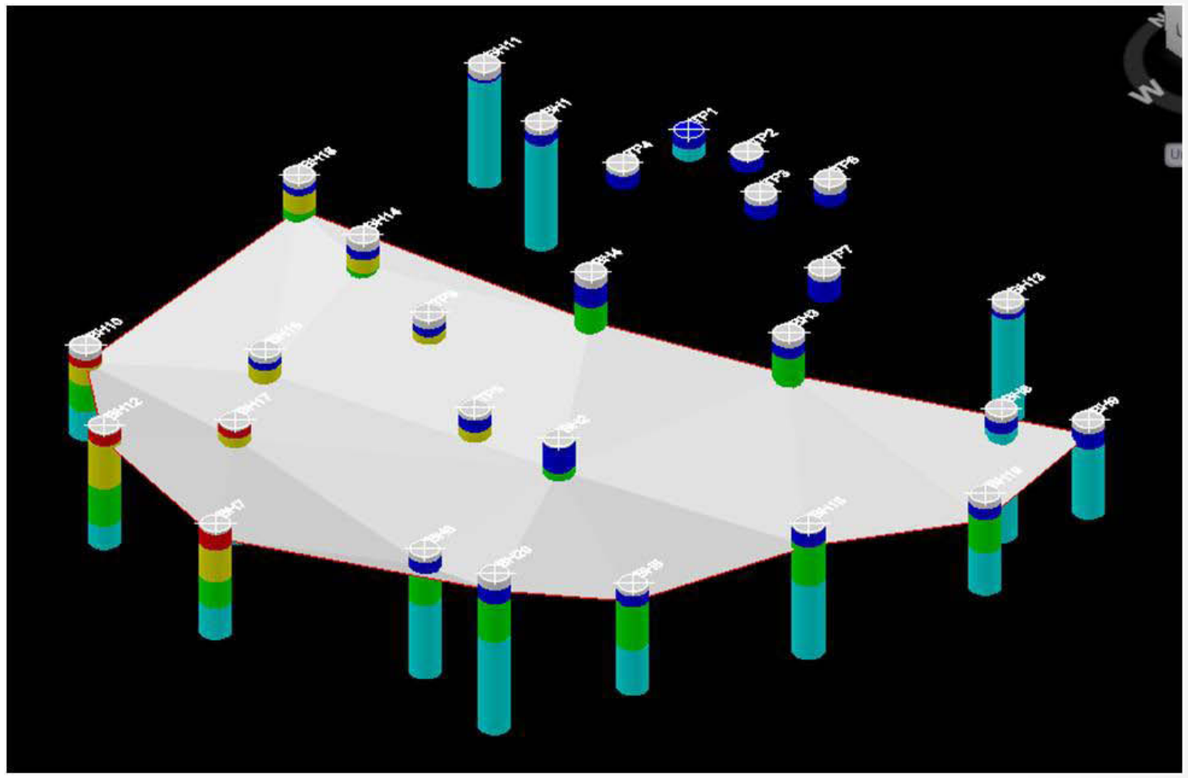
"Fortunately, geotechnical data management systems are available that can export both factual and interpreted data."

Fortunately, geotechnical data management systems are available that can export both factual and interpreted data. Keynetix's HoleBASE SI, for example, can manage all of a project's geotechnical data (including historical information) and its extension for AutoCAD Civil 3D allows visualisation of information such as geological surfaces for use in both BIM models and the AutoCAD environment.

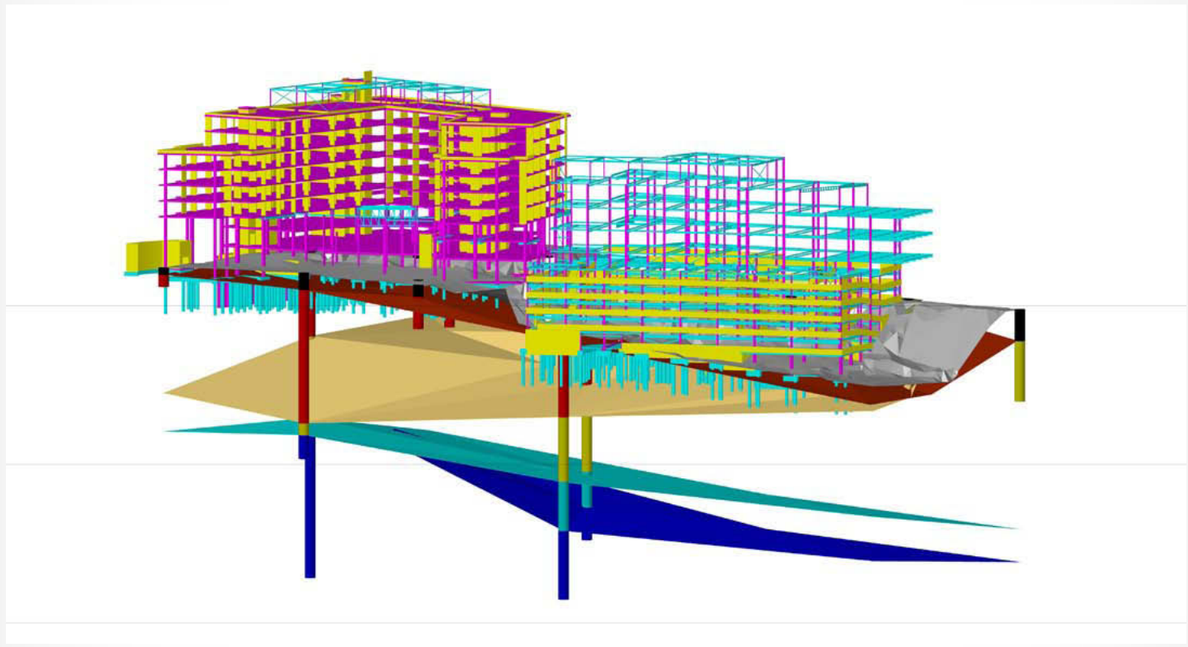
The sharing of interpreted data appears to be one of the main sticking points of incorporating geotechnical information in BIM. While sharing of geotechnical data is common between site investigation companies, laboratories and



Geotechnical modelling in BIM can lead to more complete understanding of project elements.



Dynamic Integration of geotechnical and site investigation data is now possible with the HoleBASE SI Extension for AutoCAD® Civil 3D.



Incorporating geotechnical data in BIM allows considered design optioneering and refinement at the outset of a project; minimises geotechnical risk in construction and enables cost-effective repairs and maintenance of assets throughout the project's lifetime. Image courtesy of Mott MacDonald.

"It appears many geotechnical teams are reluctant to supply digital data (rather than written reports) with the wider project team as they are unable to separate factual from interpreted information. This means they are concerned by the possibility of interpretative data being misused."

geotechnical consultants, anecdotal evidence suggests it is rarely shared with the rest of the project team.

It appears many geotechnical teams are reluctant to supply digital data (rather than written reports) with the wider project team as they are unable to separate factual from interpreted information. This means they are concerned by the possibility of interpretative data being misused.

In fact, better data sharing should actually lead to a more complete understanding of the project elements – resulting in more informed decision-making throughout the project lifetime – and improved collaboration should also reduce the risk of interpreted data being misused.

It should be recognised, however, that determining a geotechnical BIM strategy is difficult, as what works for one project may not work for another. It may therefore be a better approach to adopt a geotechnical BIM framework which can be adapted to each project.

"Having a clear image of the proposed design and access to full project information will also enable the geotechnical team to optimise the various phases of site investigation."

Having a clear image of the proposed design and access to full project information will also enable the geotechnical team to optimise the various phases of site investigation. During the desk study, for example, being able to view the latest site plans, is clearly of huge benefit in highlighting any potential points of concern and can help investigation planning.

“Furthermore, it is often very difficult, if not impossible, to change the focus of an investigation, without commissioning additional phases.”

Furthermore, it is often very difficult, if not impossible, to change the focus of an investigation, without commissioning additional phases. Having access to field data in real time and incorporating it into BIM almost immediately gives the opportunity to refocus sampling and testing mid-investigation. This should deliver more useful data, hence reducing risk and potentially saving money in the long term.

BIM will, without a doubt, become the norm in construction projects in the future. One of the biggest benefits of its adoption will be to give geotechnical teams the opportunity to share their visions and concerns for the ground conditions early in the design, as well as to provide input throughout the project, including the operation and maintenance phases.

More significantly, if there is a recognition by other project team members of the critical importance of high quality geotechnical information in creating an accurate BIM model, the messages that early and thorough site investigation can reduce project risk, and that geotechnical engineering is an integral part of the entire project, will be reinforced.

“More significantly, if there is a recognition by other project team members of the critical importance of high quality geotechnical information in creating an accurate BIM model, the messages that early and thorough site investigation can reduce project risk...”

The geotechnical profession has been working for many years to improve the standing of geotechnics and for this reason, if nothing else, it should be embracing BIM and helping to improve the way geotechnical data is managed and shared in the future. ■

CPD Approved Courses for Geotechnical Academy Alumni

Specifying Site Investigations
This one day course will look at the various methods available to carry out intrusive and non intrusive investigation. Whilst the course will concentrate on geotechnical methods some geo-environmental methods will be briefly discussed. The course will look at the aims of SI and categorise the various stages in an investigation.

Soil Description Workshop
From 2007 new European Standards have started replacing the British Standards (Codes) under which investigations in the UK have been carried out. UK working practice will have to change to meet these new requirements but few practitioners are aware of the changes or the timetable. The workshop will comprise a series of lectures on the changes, and lectures on soil description followed by practical sessions describing soil samples.

Rock Description Workshop
From 2007 new European Standards have started replacing the British Standards (Codes) under which investigations in the UK have been carried out. UK working practice will have to change to meet these new requirements but few practitioners are aware of the changes or the timetable. The workshop will comprise a series of lectures on the changes, and lectures on rock description followed by practical sessions describing rock and compiling mechanical logs of rock core.

In Situ Testing
The course will cover both the theory and the practice of various In Situ Testing techniques used on typical geotechnical projects. In addition the courses will consider the effect that Eurocodes will have on the UK's current practice. This course provides an overview of in situ tests used in common practice and some of the more specialist tests together with their advantages and limitations.

Field Instrumentation and Monitoring
The course comprises a comprehensive one day appreciation of the complete process involved in Instrumentation and Monitoring in the geotechnical environment. The course provides an overview of the current guidance documents and their requirements. The course will consider the design of both individual installations and the installation of suites of instruments in the wider site contex.

Geotechnical Foundation Design
This one day course will provide a general overview of foundation design. It will include an assessment of the use and choice of shallow foundations and piles. It will cover the derivation of bearing capacity formula and their use. Exercises will be carried out to calculate the working loads and settlement of simple foundations. The methods used to calculate these will be in accordance with those described in Eurocode.

Safe Working on Geotechnical Sites
This one day course is developed by industry specialists within RPA Safety Services and Equipe Training as a foundation to site safety. Its aim is to impart the core safety skills required of those working on geotechnical sites by building on their existing specialist technical skills. After attending the course, candidates should be able to identify hazards on site, understand basic safety legislation, participate fully and confidently in site safety consultation and manage priority risks to a sufficient standard.

IOSH Avoiding Danger from Underground Services
Partnering with RPA Safety Services once again, Equipe provide another IOSH certified health and safety course. This one day course is aimed at anybody involved in specifying, instructing, managing, supervising or actually breaking ground and really addresses the problems and risks related to underground services, which may be encountered during both planning and execution of geotechnical projects.

IOSH Safe Supervision of Geotechnical Sites
Equipe has partnered with RPA Safety Services, an independent occupational health and safety specialist, to provide a unique IOSH certified course for the Drilling and Geotechnics industry. The three day course is certified by IOSH, is specifically focussed on the geotechnical industry and provides a totally unique and relevant Health and Safety course for managers and supervisors.

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MERIDIAN COMPLETES WORK ON HEMERDON PROJECT

Writing for **theGeotechnica** *this month on behalf of* Meridian Drilling *is Claire Savage of Accord PR. In this article Claire presents a case study of Meridian's recently completed Hemerdon project - works carried out at a tungsten and tin mine.*

When Meridian Drilling took on its recent UK project at the Wolf Minerals tungsten and tin mine near Hemerdon in Devon, it drew on experience gained through projects in Europe and active mine sites in Africa.

The contract, at the Drakelands Mine Project, saw Meridian drilling 1,200m comprising of six 200m holes, to conduct a geotechnical assessment of the pit wall stability.

Jeremy Moore, MD of Meridian Drilling said: "As a company our most significant projects have been overseas, but our headquarters have remained in the UK.

"This was a great project for us to work on, not just because it was in our home country, but because of its global significance."

"Drilling holes of such depth in hard rock, using diamond wireline core drilling demanded a rig with a high rotation speed."

Diamond core drilling

Drilling holes of such depth in hard rock, using diamond wireline core drilling demanded a rig with a high rotation speed. The Meridian team also used angle drilling, not something that most UK geotechnical rigs are set up for.

Meridian Drilling MD Jeremy Moore explained that the Atlas Copco CS14 rig was customized specifically for the job: "The CS14 was stripped and fully rebuilt by Euro Repair after returning from four years on the Allana Potash Project in Ethiopia. It was also track mounted to cope with the ground conditions in Devon and adapted to include fully compliant UK HSE guarding."

Meridian provided oriented core using the Reflex ACT 2 digital orientation tool. In addition triple tube drilling provided high quality and well presented core, allowing the geologists to better examine the rock mass and associated discontinuities.

"In addition triple tube drilling provided high quality and well presented core..."

The team also conducted packer testing using wireline single and double packers to assess the permeability of the rock mass and installed groundwater monitoring into the holes.

Challenges

Meridian's contract was to provide the information to allow the possibility of a steeper pit wall design and, in turn, deeper mining there-by potentially increasing the life of the mine. Drilling supervisor Bill Pullen explained that, as with all sites, there were some challenges:

"The monitoring installation was quite simple, namely a 1 inch plastic pipe for measuring the depth of water," he said. "We had planned to grout the bottom of the holes but were unable to do so as the ground conditions meant that the cement washed away as fast as we could put it in.

Geotechnical: The Meridian team used an Atlas Copco CS14 rig, which was customized for the project.

Getting to the core: Wolf Minerals' mine planning manager Rick Taylor examines core samples with geotechnical engineer Polly Ainsley.

Safety on site: Before starting work the Meridian team completed training accredited by the Mineral Products Qualification Council.

"As an alternative we had to run Pea Gravel, which was a slow and difficult process. The hole was at an angle, and the gravel had a tendency to start bridging."

The team fed the Pea Gravel through the rods from the bottom up, before installing the monitoring pipe in place at the

"More gravel was run around the installation to near surface before it was sealed..."

required depth. More gravel was run around the installation to near surface before it was sealed and the hole capped off with cement and a cover installed.

HSE

While Meridian is familiar with working on active mine sites in Ethiopia and Republic of Congo, it brought in additional HSE safeguards for the Hemerdon site.

Moore said: "Before starting work our employees also completed training accredited by the Mineral Products Qualification Council to reinforce our standards and ensure safe working in a quarry environment."

Added to this, members of the Meridian team took a four-wheel driving test before they were allowed to drive on site, and were given a half-day induction by Wolf Minerals prior to entering the site.

Once fully operational, the Hemerdon project is expected

"The mine is expected to have a minimum 10-year lifespan. It is believed it may have potential for longer, but this would require new planning permission."

to supply 3.5per cent of global tungsten. The mine is expected to have a minimum 10-year lifespan. It is believed it may have potential for longer, but this would require new planning permission.

This was the second recent UK project for Meridian Drilling. The Bath-headquartered company recently worked with Treliver Minerals on projects near St Columb, Cornwall to explore for tin. ■

IS THERE A KILLER LURKING IN YOUR LAB?

*Our fourth article this month comes from one of our regular contributors and resident Health and Safety Expert, Tom Phillips of RPA Safety Services. This month Tom discusses **the dangers of Respirable Crystalline Silica (RCS), a substance responsible for around 600 deaths a year in the UK through silicosis and lung cancer.***

The headline isn't a sensationalist tabloid banner, but a real question – the answer to which may surprise you. The killer is well known but often invisible and one that doesn't

"Despite this, it is likely to be present in dangerous quantities in the majority of soils labs and is something you probably don't think about."

grab the headlines. Despite this, it is likely to be present in dangerous quantities in the majority of soils labs and is something you probably don't think about.

The substance in question is Respirable Crystalline Silica (RCS), a substance responsible for around 600 deaths a year in the UK through silicosis and lung cancer. It is also the cause of many thousands of cases of ill health and as a result, it is a major priority for construction contractors. The generation of dust is either eliminated through good design or there is suppression of dust through water during cutting.

In geotechnical laboratories very few people give it a second thought, but recent tests carried out by one of my clients, at our recommendation, have highlighted dangerous levels above the HSE limit. Their laboratory is no different to the majority of soil labs around the country – receiving and processing samples and carrying out physical tests such

"In actuality their lab is one of the cleanest I have encountered, so their elevated results should be a concern for others."

as compactions and sieves. In actuality their lab is one of the cleanest I have encountered, so their elevated results should be a concern for others.

The Workplace Exposure Limit (WEL) for RCS is 0.1mg/m3 over an 8 hour working day. Samples tested by my client following recognised standards (more about these later) highlighted levels approaching the WEL in most areas and in one area it was exceeded. As RCS is a carcinogen, it is insufficient just to achieve the WEL – the employer has to reduce the risk to a level as low as reasonably practicable so to this end, more now needs to be done.

"As RCS is a carcinogen, it is insufficient just to achieve the WEL – the employer has to reduce the risk to a level as low as reasonably practicable..."

The standard to be followed when measuring for RCS is defined in HSE publication MDHS101, which requires the use of wearable pumped air monitors, running over a known period, collecting dust on filter papers. These papers are then sent to a test laboratory such as the Institute of Occupation Medicine (IOM) who determine the levels. The test measures both quartz and cristobalite (both forms of crystalline silica) as determined by infrared spectroscopy and X-ray diffraction.

If it's silica, it's not just dust!

"In terms of the hierarchy of controls, eliminating the production of dust is the first option but as many tests rely on mechanical deformation of samples, this is not reasonably practicable."

So if high levels are found, what needs to be done?

In terms of the hierarchy of controls, eliminating the production of dust is the first option but as many tests rely on mechanical deformation of samples, this is not reasonably practicable. It is possible to extract dust through the use of local exhaust ventilation (LEV), coupled with the use of respiratory protective equipment, to achieve the required standard but this is not the end of the story. LEV needs to be carefully designed, inspected regularly and may need to be supplemented with air fed or face fit tested masks.

As the requirement is to get the levels as low as reasonably practicable, labs also need to consider how they are cleaned to reduce the liberation of dust (vacuuming rather than sweeping), wiping surfaces down after work and looking at how clothing is cleaned and laundered.

Although the WEL is a very stringent standard it can be achieved, but unless you know the extent of the problem, it is difficult to know when improvements have been

"It is important to ensure the tests are carried out correctly, the results properly interpreted and solutions correctly implemented."

made. It is important to ensure the tests are carried out correctly, the results properly interpreted and solutions correctly implemented.

It's peoples health after all – and what could be more important? ■

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Email: si@conceptconsultants.co.uk

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Derby, DE24 8ZF
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Tel: 01452 527743 **Fax:** 01452 729314
Email: geotech@geoeng.co.uk

RGI GEOTECHNICAL INVESTIGATION
Unit 37, Longfield Road, Sydenham Industrial Estate, Leamington Spa, Warwickshire, CV31 1XB
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Email: peter.noone@chemtest.co.uk

CONCEPT
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Tel: 020 8811 2880 **Fax:** 020 8811 2881
Email: si@conceptconsultants.co.uk

GEOLABS
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Email: admin@geolabs.co.uk

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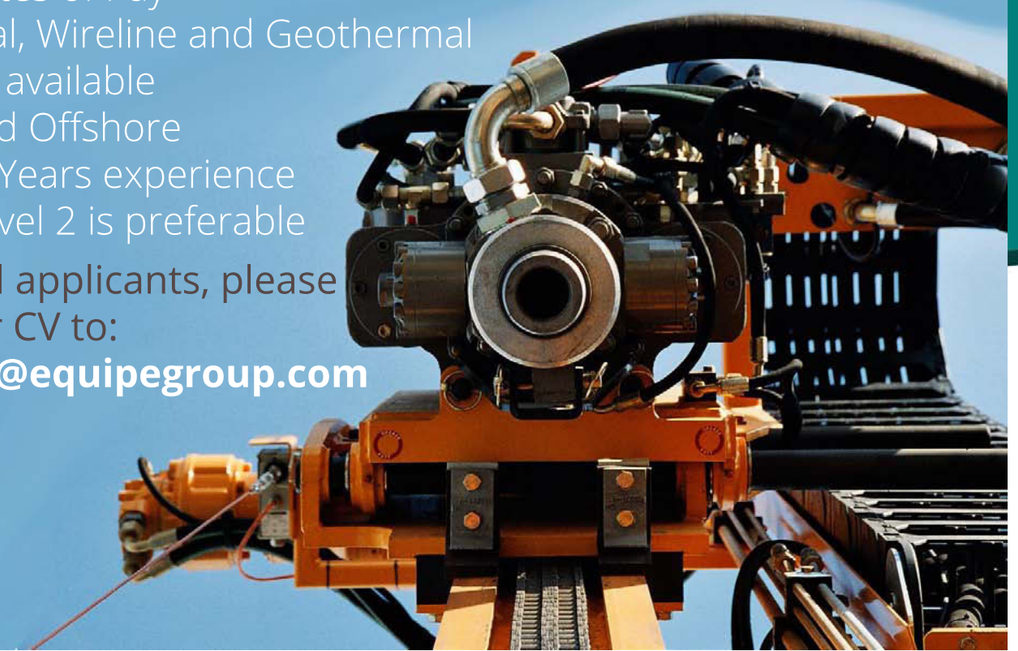

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