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issue 2 07

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Welcome to Issue 2 2007 of Going Underground Magazine

As we go to press with this edition floods are the major news story across the UK. The combination of climate change and inadequate flood defences along with out of date drainage systems have led to serious flooding problems across the UK. We will be addressing all of these concerns in the next edition of Going Underground when we call upon some of the major industry experts to discuss these issues.

In this edition I have included a comprehensive piece on underground mapping on page 11. This article takes a look at the current state of utility mapping and at what needs to be done to improve it with the aim of obtaining a clearer view of what lies beneath the surface.

Russell Fairhurst of UKSTT takes a look at the relationship between trenchless technology and cabling on page 17. Russell has also contributed a further piece in this edition on the use of trenchless technology across the utilities market within the UK.

In addition to this I have included a preview of Civils 2007, which takes place at Earls Court in November. This promises to be an exciting event.

Once again, I would like to take this opportunity to thank all those who have taken the time to submit editorial for this edition.

If you, your company, or association would like to contribute to future editions please contact me on
Tel: 0161 8326000,
Fax: 0161 8324176.

If you have any advertising queries please contact Ian Clappison on
Tel: 0161 8326000,
Fax: 0161 8324176.

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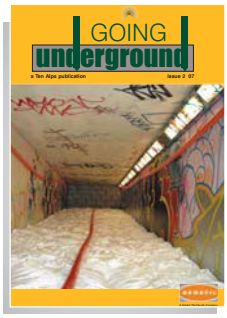
Kate Simpson

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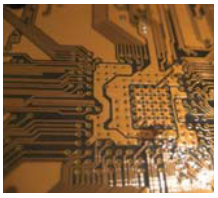
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COMPANY NEWS

TT-UK at IGEM gas engineering update seminar

TT-UK recently supported as a sponsor the IGEM Gas Engineering Update Seminar.

TT-UK's Don Wilkinson commented that the seminars were well organised and supported and felt the five minute advertorial offered the seminar attendees a short introduction into developments in both established techniques and new innovations all of which are yielding significant growth within the utilities sector.

As a company TT focused on:

- Grundomat, the well-established industry preferred pneumatic impact mole with a range of 45mm to 180mm diameters for non-steered pipe and cable installations.
- Grundoburst, a range of five innovative Hydraulic QuickLock rod (ladder-type) pipe bursters capable of on-line pipe replacement up to 1 Mtr diameter. These pipe bursters continue to grow in popularity because of their high productivity.
- Grundodrill, the latest N range of Horizontal Directional Drilling rigs are currently produced in 17T and 25T and complete the range the TT Group offers of HDD rigs from 4T to 500T capacity.
- Grundowinch Twin capstan pipe insertion and cable pulling winches that are manufactured in the range 2T to 40Tonne pulling force. Grundowinch has historically been an established winch with over 19 years successful history in the UK.
  Slipfast Gas Industry Award winning Hydraulic Pipe pusher that is being used as an alternative to winching. The unit has features that allow for one unit without additional equipment to push from 63mm to 125mm coiled pipes.
- PE Pipe Coil Trailer designed and built to the highest quality. Safe loading and unloading were of paramount importance before designs were started on this trailer.
- TTUK/RSP Suction Excavator Emerging technology in the UK that has been established in mainland Europe for over 13 years. In the past vacuum excavation has proven to have limited capabilities but with the TTUK/RSP suction excavator materials can be removed using high volumes of airflow and a negative pressure.

For more information on the above or other Trenchless Technology products please contact TT UK Ltd either through the telephone on 01234 342566 or via the internet on www.tt-uk.co.uk or www.tt-uk.com

Marley Eternit offers improved Glasal T for tunnel linings

Marley Eternit has brought several decades and millions of square metres of expertise in supplying fibre cement tunnel linings to an enhancement of their popular Glasal cladding panel.

Glasal T is an improvement to the standard autoclaved panel already used in underpasses and tunnels such as the Limehouse Link in London and in Belgium, China, South America and Malaysia. It has been in development for 18 months and successfully tested in the re-lining of the Mont Blanc tunnel.

Original 7.5mm Glasal was so well suited to the particularly onerous task of lining tunnels, with their corrosive atmospheres and the increasing demands of cleaning, that further enhancement has been simple.

The Glasal T panel has an extra protective coating in addition to the double mineral paint layer already applied, to make it completely impermeable to the atmospheric conditions that necessitate frequent mechanical cleaning of the 1,220mm-wide panels.

Lightweight with a semi-matt mineral enamel finish, Glasal panels are colourfast and easily meet the current European (EN 13501-1 A2-s1-d) and British Standards (Class 0) with regard to the limit of flame spread.

Optically flat, Glasal panels allow perfect diffusion of light and eliminate glare and dazzle which could be dangerous to drivers. Available in a range of mineral-enamelled colours, they typically reflect up to 87% of light rays, reducing the operator's reliance on artificial light.

For further information contact Marley Eternit on,
T: 01283 722588,
Web: www.marleyeternit.co.uk,
Email: cladding@marleyeternit.co.uk

COMPANY NEWS

PMP show engineering scope on a rope

Confined space contracting specialists, PMP, demonstrated another aspect of their services with a roped access project recently. The versatile engineers were called at short notice to drill drainage holes into viaducts carrying the Thirlmere Aqueduct in Cumbria and Lancashire.

The company frequently conducts internal pipeline repairs, using the Amex-10-seal. Unusually for PMP this project was high above ground, but with the usual stringent safety implications and access difficulties.

The weep/relief holes were needed to enable any accumulated groundwater to drain away from the structures, following lining and repair works to the aqueduct. Stonbury Ltd carried out the lining and repairs for United Utilities, bringing PMP in to complete the work requiring roped access.

In order for the aqueduct to be returned to service as quickly as possible at the three locations, PMP were on site within 12 hours of the callout, ready to perform the drilling.

On each viaduct the procedure involved drilling 10 holes to 600mm depth using rotary percussive drills. As the holes were required at a level several metres below the parapet, IRATA-trained PMP engineers rigged a bosun's chair, using three-point anchoring.

The work is part of United Utilities £350 million programme to clean and repair its largest water mains and aqueducts. The eight-year project is the largest of its kind in Europe.

For further information contact PMP Ltd on, T: +44 (0)1706 836110, Email: info@pmp-ltd.co.uk, Website: www.pmp-ltd.co.uk

Tunnel extending Docklands Light Railway to Woolwich completed

The tunnel extending the Dockland Light Railway under the River Thames to Woolwich Arsenal was completed on time as the 540-tonne boring machine broke through the earth south of the Thames.

The £180 million, 2.5km extension will link Woolwich south of the river with Docklands Light Railway station, King George V, in North Woolwich, one stop away from London City Airport. The extension will be important in improving the whole transport network in the run up to the 2012 Games.

The extension will provide a direct link from Woolwich to central London (Bank station) in under half an hour, London City Airport in five minutes, Canary Wharf in 19 minutes and Stratford in 20 minutes. In peak periods, trains could run every four minutes. There will also be an interchange with mainline services on the North Kent line.

Ken Livingstone, Mayor of London, said: "This is another example of Transport for London delivering major transport projects on time and within budget. The Docklands Light Railway is a fantastic success story for London with steadily rising passenger numbers and more and more areas being linked to improve access to new jobs and housing, helping to transform areas of East London.

"The extension to Woolwich will boost the local economy and completes another piece of the transport improvements the 2012 Games are already bringing to London."

Hugh Sumner, Director of Olympic Transport of the Olympic Delivery Authority, said: 'The completion of this impressive tunnelling project marks a significant milestone on the road to the London 2012 Olympic and Paralympic Games. The Woolwich Arsenal extension will provide a fast and efficient link between the Olympic Park and the equestrian and shooting events. And it will leave an important legacy for the communities it will serve in the years after 2012.'

New hi-tech pipeline mapping introduced to the UK

With over 25 years of experience in the field of surveying and mapping of buried utilities and other services, Infotec is pleased to announce the introduction of the new 'PipeTrack' pipeline mapping system into its equipment and services portfolio.

A major advantage of the PipeTrack system is that, unlike most of the technologies currently used in buried service mapping operations, it is not affected by any electromagnetic field that may be generated by nearby existing buried utilities, such as power carrying cables etc.

Originally developed in Holland to map newly constructed HDD bores, the new 'PipeTrack' concept offers accurate, simple and flexible 3D mapping of a pipeline providing pinpoint data of not just its route in plan view but also its depth, a vital consideration given current thinking on asset management and remediation of utilities.

Using the PipeTrack unit, a trained team has the capability to map up to 500m of pipeline in a single stretch in less than one hour, including set-up and breakdown time. This capacity ensures both minimum interruption to pipeline services and consumer downtime.

The PipeTrack unit records data autonomously using an on-board storage system and therefore has no restrictions on depth of working or length of survey achievable. Accurate and rapid data storage is achieved using the patented X-Traction™ data processing software.

For further information contact Infotec on, T: +44 (0)1702 421390, Email: info@infotec1.net, Website: www.infotec1.net

Ordnance Survey vision helps shape a VISTA for underground assets

A national project looking to increase the visualisation of underground assets via 3-D mapping is being supported by geographic data and satellite navigation technology from Ordnance Survey as core components.

VISTA (Visualising integrated information on buried assets to reduce street works) is a collaboration of 21 organisations developing an integrated infrastructure to enable data sharing for all buried assets across Great Britain.

Ordnance Survey's intelligent large-scale data OS MasterMap Topography Layer is the reference base underpinning preliminary trials by researchers at Leeds and Nottingham Universities to integrate disparate records of buried pipes, cables, ducts and wires.

VISTA will combine this information with in-situ survey observations using real-time centimetre level services provided by OS Net, Ordnance Survey's GPS correction network, and by Leica Geosystems' SmartNet, which is enabled by OS Net. OS Net is a network of more than 90 GPS base stations that improves the standard accuracy of raw GPS readings to augment any application that requires GPS positioning.

The national mapping agency's digital geographic information (GI) will reference this data to assets visible in the street to create a virtual 3D image of buried infrastructure. The information will be dynamically merged to give utilities and contractors instant two- and three dimensional visualisations of the underground pipe and cable network via a portable device. This would enable more efficient scheduling of works to help minimise disruption and potentially reduce their size and duration.

Utilities open up four million holes in the United Kingdom's streets each year at an estimated cost of £1 billion, with indirect costs of £4 billion due to traffic delays and damage to highways, for example. With 4.7 million kilometres of buried infrastructure in the UK, there are large potential savings to be made in the rapid and accurate location of assets without inflicting damage to third-party equipment.

OS MasterMap Topography Layer contains around half a billion geographic features. Each is allocated a 16 digit Topographic Identifier (TOID), a unique reference that can be associated to data above and below the ground. This enables the consistent georeferencing of assets, streamlining the exchange of third-party data and referencing it to a definitive geographic base. Common encoding standards will help build a communal knowledge of all underground assets, removing potential guesswork into the location, nature and ownership of buried services.

VISTA's data integration and exchange concept is being developed according to the Digital National Framework (DNF), a set of industry-wide principles and operational rules to provide a consistent, flexible way to identify, collect, exchange, reuse and record GI (www.dnf.org). OS MasterMap was developed in compliance with the DNF, facilitating the integration of georeferenced information from multiple sources onto this intelligent geographic framework.

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A Contractor's Perspective

Luke Mosley, UKSTT Young Engineer's Award recipient

Luke Mosley, UKSTT Young Engineer's Award recipient, talking to Ken Pearson of the N.S.W. Chamber of Commerce at 'No-Dig Down Under'.

During my recent UKSTT prize funded visit to the International No-Dig conference in Brisbane, Australia, I was fortunate enough to have the opportunity to hear what many of the leading figures in the field of Trenchless Technology had to say. Pondering the wealth of information delivered, it struck me that only a small proportion seemed to incorporate or acknowledge the contractor's perspective. So, for what it's worth, I offer mine.

Its seems pretty unanimous that Sustainability is an important concept; 'fulfilling today's needs without compromising those of tomorrow'- who would argue with that? Well, indirectly, it seems that many would, in the form of under utilisation of Trenchless Technology. When we're planning the way we install and maintain our utilities, achieving sustainable development requires us to look at *all* the costs involved; economic, environmental and social. Using a tool like the 'Sustainability Assessment Model' (SAM) helps us to do this in a quantifiable, tangible way; by measuring an array of sustainability indicators it is possible to put in to hard cash terms the less recognisable, yet quite significant costs of a proposed methodology. Once that's done it soon becomes clear that it's not a very good idea to carry on digging the place up! One paper delivered at the conference suggested that businesses in the vicinity of streetworks are likely to suffer about a 30% reduction of revenue for the duration of the work. Add to that the environmental cost of quarrying aggregates for backfill and destroying/replacing perfectly good bituminous surfaces, and you have to ask yourself if what is being carried out really is 'Essential'? Every time I hear the phrase "I could dig it up for less", I wonder if this statement reflects a rigorous analysis of all the costs involved.

Trenchless Technology's sole purpose in life is to reduce the negative side-effects of getting gas, water, and electricity to our homes and businesses. You would therefore think that it would be top of the list, option one, the *preferred method*. So why is it that a recent survey showed that less than half of the new utilities installed in the UK last year were done so using Trenchless Technology?

Obviously, the reasons are many and complex, but from what I can see there are two that stand out above the others. Firstly, although academics and practitioners in our field are united in proclaiming Trenchless Technology as 'essential to sustainable development'; the message needs to get through to those that hold the purse strings, the policy makers. I realise that a lot of work has been done in attempting to educate those in power as to what we can do, but until the top-down process is more effectively set in place it will always be an uphill struggle for those touting a 'new fangled gizmo' to change the industry's habits. How often do you come across legislative documents that actually call for the use of a No-Dig technique? So often a point is reached in the route to a solution when someone pipes-up with something like 'let's just dig it up; it'll be easier'. Can't something more be done to prevent the 'good ol' dig-up' from being the path of least resistance?

The 'No-Dig Down Under' exhibition

Secondly, and more significantly I believe, is the unwillingness of all parties involved to sit down and fairly distribute the risk. The concept of 'Relationship Contracting' encourages alliances between supplier and buyer in order to reach cost-effective successful project outcomes (thus reducing the price paid by all stakeholders). This sounds great but still seems to be a bit of a blurry fantasy existing far more in theory than in practice. Until we are willing to "share the pain", as it was put succinctly by the Chairman of Brisbane Water in the conference opening speech, risk premiums built into contracts will always push up the cost of using Trenchless Technologies. There's an old Dutch saying that translates along the lines of 'the more I have to promise, the less I can give'. It makes me think of all the projects that could have been, yet were set aside because guarantees of success could not be given.

Is there a simple answer? Well, maybe there is; use the 'S.A.M.' to tangibly quantify the benefits of a Trenchless Technology solution, agree to "share the pain" and proceed with the project at a reasonable price while applying good Risk Management.

Subtechnics Limited

Subtechnics Limited was born out of a personal desire to prove that it is possible to accurately map buried utility positions and provide clear and easy to read survey quality drawings that were suitable for both the guy digging in the street and the design engineer working remotely. A mixture of hard work and an un-changed ethos has taken Subtechnics Limited from a single employee to its current resource of seven fully equipped radar survey teams. Now in the ninth year of trading, the company is facing a new challenge.

When radar first started to be used for utility mapping projects, the market quickly became sceptical about the technology's capability to generate useable results. Indeed, many so called utility surveys actually generated more questions than answers and subsequently faith in the technology began to fade. After many trial surveys, often involving verification by excavation, Subtechnics Limited began to restore the lost faith amongst a few key clients. With new clients being introduced mostly through recommendation, the approach began to become widely accepted once more, and across a greater market.

As with any infant industry growing at a steady rate, the competition has increased dramatically over the last two years. This is to be expected and should provide benefit to clients through more competitive pricing and enhanced services with companies jockeying for the work being offered. Instead, what we are witnessing is a huge drop in pricing, matched with an equally huge drop in quality, accuracy, care and ability. It takes time to comprehensively radar scan an area, to lift and inspect every cover, to thread transmitters along every duct or drainage pipe encountered. It takes time to connect to every accessible service, to trace them and to passively search the area whilst adhering to the required Health and Safety legislation. More time is required to topographically position every relevant point within a site and yet more time to analyse all the data, create CAD models and produce reliable survey drawings.

Unfortunately, some surveys are being bought under the misconception that all the above activity is taking place; by the time the results are found to be less than reliable the project is already experiencing problems.

Every approach has its uses and applications. For instance, why radar an entire field if you are just interested in locating a power cable that crosses it. For a fraction of the cost of employing radar, a radio frequency locator could solve the problem far more quickly. Alternatively free scanning with a radar in Liverpool Street, London, will not be as effective as fully covering the area with a closely spaced grid of radar measurements and post processing the subsequent data.

There are many different radar systems, many different CAT type scanners and many different ways of deploying each technology. So how do you know if what you are buying will provide the information and accuracy you require?

The answer is to try and generalise the types of deployment and suggest where they will work and where they are less likely to be of use. This is a subject that many of the professional organisations within this industry want to try and advertise. If we can all start working to a menu of some description, then at least the purchasers of these services will start getting what they are paying for!

General Types of Survey

Passive Radio Frequency Search – Often following utility company record drawings, the designated area is simply traversed with a receiver system and any responses correlated with the stat plans. Located positions are marked on the grounds surface using site marking paint. A good option for identifying immediate or potential risks in front of an excavation crew.

Full Radio Frequency Search – As above but with all inspection covers being lifted and interrogated, both within and immediately outside the search area. An attempt to trace every encountered service is made by means of a direct connection, an inserted transmitter or a cable clamp. Again located utility positions are marked on the ground's surface using site marking paint. This methodology should form the base of any credible utility survey.

Single Service Trace – Using one of the methods above, preferably using a direct connection, an inserted transmitter or cable clamp. Ground Probing Radar is also an effective technique and can be deployed in a free-scanning manner or, if the situation is complicated, in a grid of regularly spaced measurements.

Full Radio Frequency Search with Free-Scanning Radar – As described within a type 2 survey with the added enhancement of a radar system being deployed. The radar will normally be used to scan around surface features indicating a potential utility, often where the radio frequency locator has found nothing. This methodology is cost effective and a reasonable solution in a sparsely populated underground environment. It is however, very reliant on the experience and ability of the operator.

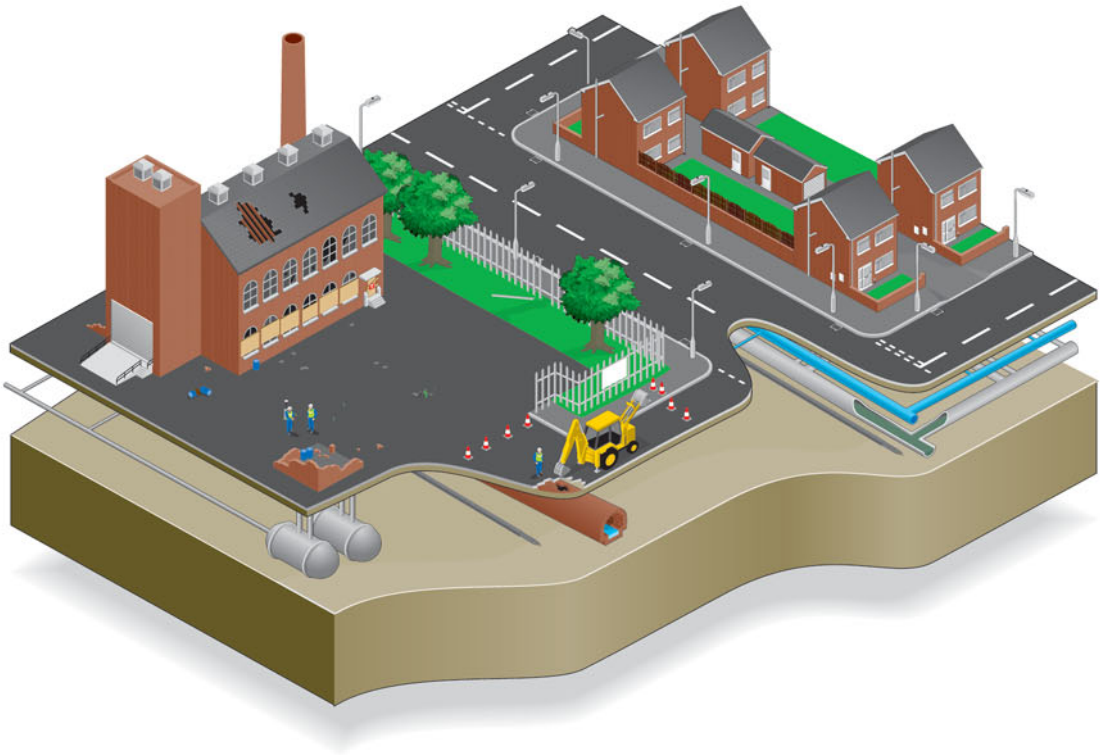
Full Radio Frequency Search with Strategic Radar – Again as above, except the radar is deployed in key areas using a uniform grid of measurements. For instance, the perimeter of a site and any areas where excavation is planned. The data is recorded and post processed to ensure the best results are obtained from the radar. This type of survey should be topographically positioned to ensure the highest level of accuracy.

Full Utility Survey – As described under a type 2 survey but with radar deployed evenly, in two directions (Orthogonal) over the entire search area. The data is interrogated and correlated with the conventionally detected utility positions post survey. This methodology is the most reliable as services that have no access, that show no sign of being present on the surface, can be readily located. Again, to maintain accuracy, the results of this type of survey should be topographically positioned.

Are you sure you are not requesting a type 6 survey but being sold a passive radio search with a free scanning radar survey?

Utility surveying

to map above and below ground utilities



APPLICATIONS

- GPR scanning to detect non-metallic utilities
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- Highly experienced survey crews
- Review of available utility plans
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- Mapping services fit-for-purpose – marking out to 2D/3D CAD drawings

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utilitysurveys

Underground infrastructure: assets or obstacles?


C D F Rogers


A M Thomas


N Metje


D N Chapman

Do you look at utility maps and see a plethora of delays, unexpected costs and even health and safety incidents? Do you feel that society's growing need for new and improved water, waste, energy and communications infrastructure is outpacing our ability to adequately locate and record it? Often these utilities are described as assets, but all too often they are obstacles to be avoided during construction works and present major problems to those working in the street, because they are often poorly recorded and prone to appear unexpectedly during excavation.

If you agree with these sentiments then you are in good company. A major UK based research project, named Mapping the Underworld (MTU), also perceives poorly recorded utilities as obstacles to development, but is currently striving to make utility location and mapping an aspect of UK utility engineering to be proud of. MTU, which enjoys funding and practical support from the UK Engineering and Physical Sciences Research Council (EPSRC) and UK Water Industry Research (UKWIR), is producing a concerted effort to address the problem by bringing together seven leading UK universities in an attempt to combine improved detection, improved location, integrated mapping and data visualisation into a single integrated, and stakeholder friendly, asset management system.

Fine words, you may say, but how does MTU know what is stakeholder friendly? Well, firstly, they have been busy arranging workshops that allow them to share information with stakeholders, while also getting invaluable feedback to help guide the project. Three of these have already been held - one on sensors, one on location technology and one on knowledge integration. Dr Gethin Roberts, who was responsible for managing the location technology event, reports "The workshop was a great success and everyone who attended went away with the knowledge that their involvement had pushed the boundaries of utility location ever further forward."

Future MTU Workshops

The fourth workshop concerns condition assessment (or how to assess the condition and failure potential of utilities). It is due to be held at Sheffield University in Autumn 2007 and promises to provide at least the same level of lively stakeholder interaction as the previous events. If you are an interested stakeholder, please consider attending. As well as gaining much useful information you will also be contributing your experience to the future of utility location and mapping.

A further workshop is also currently being planned, this being on novel technologies for future utility provision (Oxford, Spring 2008).

Full details of the workshops can be found on the MTU website at: *http://www.mappingtheunderworld.ac.uk/workshop.html*.

Another method of stakeholder engagement undertaken by MTU was an online questionnaire, which has proved a success in obtaining data on the depths of interest and accuracy requirements of stakeholders (the latter also forming the basis of a novel new method of assessing location accuracy weighted to the needs of stakeholders). In addition, respondents were given the opportunity to give the project any comments they considered important in terms of utility location. It is perhaps an indication of the strength of feeling in industry, about the difficulties that poorly located utilities cause, that over half of the respondents found the time to give comments - all of which have provided a valuable insight into industry needs and the direction in which MTU needs to be steered.

The MTU Questionnaire

The MTU questionnaire has gained more than eighty responses, and the first seventy have been analysed in some detail. In terms of depths of interest, it appears that most location surveys concern the first four metres beneath the ground surface, with rarer work extending up to ten metres in depth (although 10% replied that absolute maximum depths were between 20m and 250m). Also, accuracy requirements showed that utility location needs to be more accurate than ±100mm if it is to meet the needs of stakeholders, with ±300mm being the lowest accuracy that is acceptable for most respondents (although it should be noted that around 10% considered accuracies worse than ±450mm acceptable). These accuracy requirements are being analysed for each individual service type, both in terms of plan and depth, and the resulting data will hopefully be published in the near future.

Delegates at the Birmingham Sensors workshop

The comments received from respondents were very illuminating, and illustrated that many stakeholders are concerned about the current quality and accuracy of service records and particularly in regard to the health and safety problems associated with poorly located utilities. The comments also showed that there is a need for improved location technology that provides accurate location data in a clear and user friendly format.

The response of one stakeholder encapsulates much of the work currently being undertaken by MTU: "*Accuracy requirements are job specific and if a mapping contractor cannot provide the accuracy I need there is no point in using him*".

For more information, please visit:
http://www.mappingtheunderworld.ac.uk/questionnaire.html

However, knowing where stakeholders want them to go is one thing, but following requires novel tactics if MTU is to succeed. This is where the MTU team are not content with merely using current techniques and equipment. Instead they intend to improve them and extend their functionality with novel additions. To this end, each of the universities is tackling individual utility location problems using state-of-the-art equipment and methods under the coordinating eye of the project's lead investigator, Professor Chris Rogers from the University of Birmingham.

The Core MTU research areas

As well as coordinating the project, the University of Birmingham is working on an exciting new technology that utilises very low frequency electromagnetics to detect the changes in electric current flow through soil that occur due to the presence of utilities. They are also researching an important area of uncertainty: the effect that soil has on all geophysical signals.

Southampton University, through the Institute for Sound and Vibration Research, is exploring new methods for exciting both the ground and utilities to provide surface detectable vibrations that can be used to find hard-to-detect materials such as those used in plastic pipes.

If you are among the stakeholders concerned with the detectability of newly installed utility services using modern materials, such as plastics, you may be interested to hear that the University of Oxford is developing small tags that can easily and cheaply be attached to utilities during manufacture or installation. As well as not requiring their own power source, these tags should significantly enhance reflections from buried utilities during GPR surveys.

Not content just to improve on current ground penetrating radar (GPR), the University of Bath is devising a new system that can be used inside even very small conduits (such as pipes and ducts) to detect surrounding utilities. As well as increasing the distance over which GPR is usable in the ground, the 'direct line of sight' method being employed also provides the potential for detecting utilities without the need to rely on signals being reflected from them.

At the University of Nottingham, state-of-the-art location technology is being improved to provide accurate positioning of newly located services in three dimensions within a few millimetres, through combining data from the various forms of global positioning satellites, supplemented with ground based pseudo-satellite data. They are also developing associated data visualisation techniques, such as augmented reality, to improve data representation and so reduce human error.

Allied to the work of Nottingham is the need for a user-friendly framework in which to accurately record utility locations, and the task of providing this is being progressed by the University of Leeds. Recognising the inherent difficulties associated with trying to create a single, combined, utility map of the UK (including the difficulties of data ownership), they are working on novel ways of integrating data from the individual utility databases. In this way, utility companies retain responsibility for their own data recording, but representation of those data geographically is combined with that of other utility companies through a single GIS portal.

While all of the above provide novel ways to enhance utility location, and will be combined to provide a new multi-sensor location device, there is a need to ensure that stakeholders are able to see just how accurate all location technologies are. This is where the effort of Sheffield University is directed. One of the main goals is to provide a state of the art UK test facility, incorporating a variety of different utility types, soils and surface materials that reflect the challenging environments practical location work has to cope with. This facility will allow the accuracy of survey equipment to be determined within very tight tolerances, providing a reliable assessment of the efficacy of devices for the location of utilities.

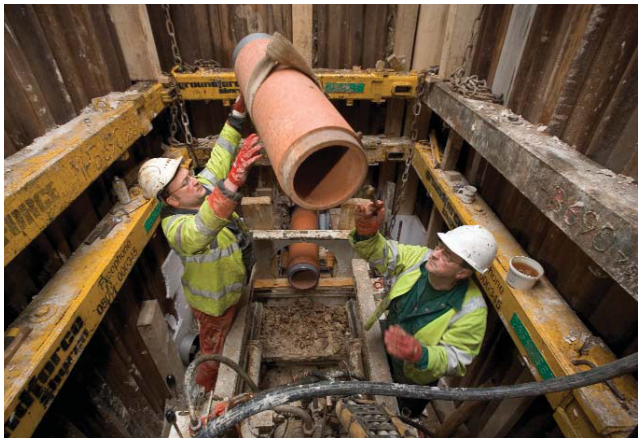
To conclude, in light of all these exciting developments, it is not surprising that Professor Rogers says that "Development currently comes with an unacceptable cost due to the obstacles posed by inadequate utility location and mapping. It is the goal of MTU to improve significantly on the *status quo,* by making utility recording an asset that can be used to expedite safe and cost efficient underground construction." If you agree with those sentiments, and want to see the underworld reclaimed through better utility location, why not find out more about the work of MTU.

Finding out more about MTU

If you would like to know more about the project, or its workshops and questionnaire, please visit: *http://www.mappingtheunderworld.ac.uk*

The website also allows you to contact the project team, download leaflets on the workshops, read an update on the questionnaire analysis, or simply learn a little more about the problems of utility location.

How to lay pipe without having to dig deep



Introducing the time and money saving alternative to open-cut trenches.

Terebro Ltd are a specialist plant hire and sales company and an official supplier of Bohrtec auger boring equipment for the UK and Ireland. Established in 2001 and based in Scunthorpe in North Lincolnshire, Terebro Ltd has fast become renowned for its customer focus and getting the job done, often in difficult circumstances. Operating on a national basis and in Ireland, Terebro Ltd hires guided auger equipment with a trained operator to install pipes and ducts to a high degree of accuracy.

What is Guided Auger Boring?

Guided auger boring is a three-step method of installing pipelines using trenchless technology, that is fast becoming the norm on many civil engineering projects across the country. The process involves three steps:-

Step 1. Pilot rods are accurately guided (+/- 25mm for line and level over 50m) through the ground using a theodolite-camera and LED target.

Step 2. Steel casings containing auger drills are attached to the last pilot rod and pushed through the ground. Excavated material is conveyed back to the launch pit as the pilot rods are pushed into the reception pit.

Step 3. The product pipe is installed behind the steel casings that are pushed into the reception pit.

Who benefits from auger boring?

In truth, apart from being a fast and cost-efficient way to install sewers, ducting or pipework, it's also the most environmentally-friendly method too. With the ever increasing cost of aggregate, tarmac, spoil disposal and fuel, guided auger boring is becoming more and more common-place on the construction site and a cost effective alternative to open cut techniques.

Where is it most useful?

Wherever you need to get a pipe from A to B, particularly where there's limited room, such as beneath a busy road, in limited access areas such as country lanes, in poor ground conditions or railway crossing to name a few. Terebro's machinery is launched from a shaft that can be as small as a 2.1m circular shaft or a 2.0m square pit and the reception pit can be just 1.5m square. What's more, the circular launch shaft can be made into a manhole or inspection chamber following the installation process and with bore lengths of 50 – 60m being common place then the system lends itself well to first time sewerage schemes.

What are the benefits of auger boring?

Unlike open-cut, guided auger boring does little damage to the environment. There is no surface heave or settlement. It limits disruption to rail services, traffic and local residences. It doesn't uproot trees or damage structures and it's not affected by groundwater. Furthermore production is not affected by depth, whether you require a pipe at 1.5m or 8.5m deep production is largely the same.

What are Terebro's capabilities?

Terebro have completed guided augerbore projects across the country for both large multinational clients and local house builders alike. We have installed pipe diameters from as small as 150mm ID to 900mm OD, and have completed schemes that range from 15m to in excess of 1km in length. Terebro have a modern up to date fleet of guided augerbore machines with highly trained and competent operators and a second-to-none support system.

Why hire from Terebro?

Apart from the high level of expertise, quality of equipment and operator competence, you get a company that will work together with you as the contractor to get the job done. And when problems are encountered, because you will get problems with any operation underground, you won't be hit with a massive claim for unforeseen ground and the like, which is the norm for many a subcontractor, but you will get good advice and more often than not a working solution to overcome the problem from a specialist hire company.

For more information on guided auger boring and the services Terebro Ltd can offer, please contact Adam Clarke at: Terebro Trenchless Solutions
Unit G4, Mercia Way,
Foxhills Industrial Estate, Scunthorpe,
North Lincolnshire DN15 8RE
Tel: 01724 855501
Fax: 01724 855502
Email: info@terebro.net
www.terebro.net

Surveying above and below!

Rory Stanbridge

Secretary General, The Survey Association

There are many types of survey, not just those that ask for opinions. This article describes the aims and aspirations of The UK Land & Hydrographic Survey Association, more commonly known as The Survey Association, and what its members can do for you, whether this be above or below ground.

As every engineer knows, foundations are the critical starting point for all construction work whether this be for a new superstore or a tunnel. Likewise, accurate surveys are the critical starting point of all designs. Why is it then that so often the survey is an afterthought or that members of design teams do not consult or communicate with each other regarding extents, scopes and specifications of surveys? Why is the surveyor just regarded as a supplier of information and not as a critical member of the design team? On smaller projects the surveyor may not be required beyond the initial provision of survey drawings but his input to the initial stages could be highly beneficial to both the team and the client.

We are not talking about quantity surveying here. We are referring to a whole range of technical surveys for instance and not exhaustively: land, measured building, aerial, hydrographic, utility, geophysical, LiDAR, laser scanning, underground, monitoring and setting out. Technology has changed dramatically over the last ten years with the introduction of electronic instruments, GPR, laser scanning, GPS and a host of other innovative solutions.

What can the surveyor bring to the table? Today's surveyor brings expertise not only in surveying, but also an awareness of modern techniques and appropriate methods for your particular project. The professional surveyor can advise on specifications and accuracies, sometimes this might save costs initially or providing a more detailed survey specification initially at higher cost may give savings down the line. Surveying has many specialisms and if the surveyor does not have expertise in an appropriate field he/she can advise which Company or specialist would be more appropriate. This is where the TSA comes into its own. If your surveyor is a TSA member company and is not experienced in a particular field, the company will know or can find out through his TSA contacts another member with the relevant expertise.

So what is TSA? TSA, known generally as The Survey Association, is the trade body for land, hydrographic and technical survey companies in the UK. The association was formed 29 years ago to give a focus for the private sector businesses in land and hydrographic survey. Today, TSA has over 100 companies in membership as full, associate or supplier members directly involved in the survey business. The full and associate member companies together employ over 3000 people and had a turnover in 2006 of almost £150 million.

The role of the TSA is to promote best practice amongst its members, provide a forum for members for discussion, debate and continuing professional development and to the wider audience, such as engineers, provide guidance on new methods and techniques and a list of suitably qualified and experienced companies. TSA is also heavily involved in lobbying Government and other agencies such as the Environment Agency, regarding policies likely to affect or involve the survey industry. The TSA also liaises with the RICS and ICES on a range of issues and has established a group called the SLG, or Survey Liaison Group. This body meets at regular interval to examine matters of mutual interest and to ensure that there is little or no duplication of effort by the three bodies. TSA recently produced a simple survey specification for architects, having been asked so to do by the RIBA, and has also been involved with the NUAG working group.

Any company applying for membership of TSA has to provide substantial trade and professional references. It is also a requirement of membership that the applicant company must have been trading for at least three years with sound supporting evidence of financial stability. The final requirement for membership is the examination of recent projects by at least three members of TSA Council, all professional surveyors themselves, and an assessment visit by the Secretary General of the association.

What guarantees does TSA provide in respect of its members and their performance? After a company has been admitted into membership, there is still an ongoing annual assessment of the company, particularly of the members' financial standing. TSA has a complaints procedure to address any client complaints about a member company. However it is fair to say that in the twenty six years since the formation of TSA, the number of complaints can be counted on the fingers of one hand. An indication of the quality of the companies within TSA membership!

What does TSA do for its clients and its members? TSA offers a number of members' services and operates a very active website. TSA produces an annual directory and regular newsletter of which four thousand are despatched regularly. Information leaflets on specialist surveying applications are available also. If you are interested in any of these, you can sign up for them on TSA's website at www.tsa-uk.org.uk

Benefil expands Uretek options

Having pioneered geopolymer resin injection around the world for the past 25 years, specialist contractor Uretek UK Ltd have extended its range by launching the bulk void filling BENEFIL system.

A pre-expanded, super-lightweight structural resin, BENEFIL is particularly suitable for filling large voids without risk of imposing local ground loading. The material is rapidly applied from a self-contained vehicle.

Over the past year, the advantages of fast completion times, minimal disruption and a low carbon footprint have attracted a wide range of applications. BENEFIL is more versatile than alternatives. Produced on-site, it can be poured, pumped or injected into holes, voids and interstitial spaces, or laterally over long distances. BENEFIL will displace residual liquids, can be applied underwater, and can even be injected uphill because it only flows under pressure, it will not run out. Environmentally, it is inert, solvent-free, non-toxic and non-flammable, making it perfectly safe for plants, grass and wildlife.

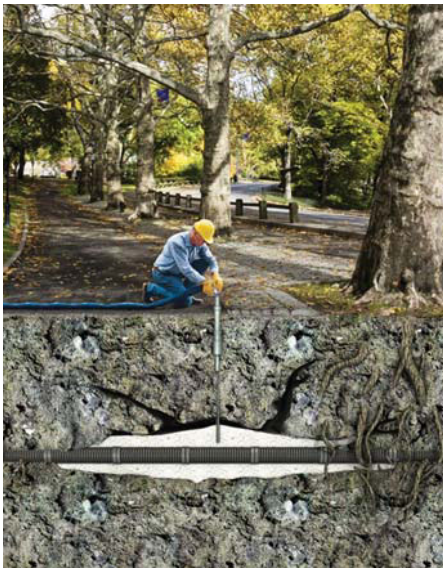
A further environmental advantage is that multiple deliveries to site are unnecessary. One delivery of raw materials for BENEFIL is sufficient for most applications.

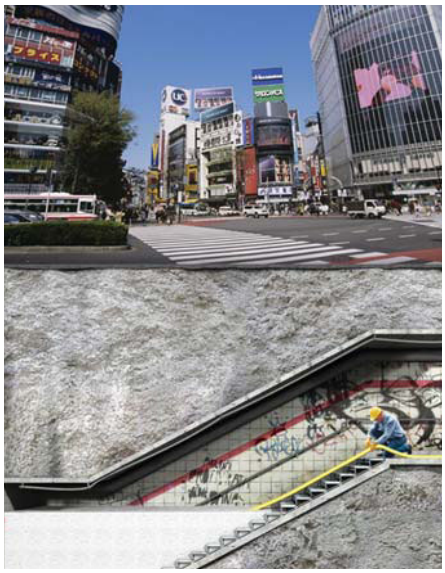
A projects carbon footprint is becoming important to clients, says Chris Davies, Managing Director of Uretek UK. Companies who are able to offer speed, lack of disruption and a low carbon footprint will benefit now that clients are considering the overall environmental impact of the work.

BENEFIL environmental credentials made it the solution of choice for filling redundant drainage pipes at a sensitive Site of Special Scientific Interest in Scotland last year, while the lack of disruption gained from minimal site deliveries has been a major factor in applications ranging from filling man-made cave systems in Kent to an abandoned subway in Rochdale.

The Rochdale work was commissioned by the Impact Partnership, a joint venture between Rochdale Borough Council and Mouchel Parkman. The Partnership wanted to fill a 350 cubic metre underpass near the Town Hall, as it was no longer used by the public and was of uncertain structural integrity.

Difficult access problems helped to determine the choice of solution.





We chose BENEFIL because it was a lot easier than using concrete or granular fill, explains John Ashley, Senior Engineer for Rochdale Borough Council. If we had concrete, for example, there are access problems and multiple deliveries would have been necessary. Plus if you pump in concrete, you have to top it off and grout it up, and so on. BENEFIL is like a one-hit wonder, if you like.

Services were isolated from the site and the client built a solid 9 thick wall at one end of the subway, with a similar wall prepared at the other end, with a hatchway to permit access for hoses.

The BENEFIL team, headed by Steve Woolley, designed the optimum grade of material, and strapped to the ceiling a 60mm pipe which they extended 30 metres to the furthest end of the subway. A second pipe was placed to half the distance, and a third to about 5 metres.

With a carrying capacity of 100 metres on the self-contained operating vehicle, and a total subway volume of about 300 cubic metres, the team knew from the outset that they could accomplish the work in three days, a result which was achieved.

Day one saw backfilling from the far block wall. On day two, the team utilised the pre-prepared pipe at mid-distance and used the foam injected on day one to backfill against. Finally on day three a similar procedure was used via the hose at 5 metres inside the subway.

We contined to fill until we reached the hatchway, reports Steve Woolley. There will be a small degree of shrinkage, so we return in about 6 weeks to top up.

Having left the pipes in, and blown the material out of them, we can still backfill from them, which is not an option available with concrete.

The Impact Partnership were satisfied with the outcome, and, says Steve Woolley, the speed of the work can be replicated for a wide variety of applications.

We can achieve the same timescale on any asset, he explains. There is nothing unusual about the subway. It could equally have been a mineshaft or mine adit, a pipeline, a culvert we could fill them all at the same rate, of about 40 cubic metres per hour.Åh

For further information contact Uretek UK Ltd on, T: 01695 50525, or visit their website at, www.uretek.co.uk

Is trenchless technology good for the UK cable-based utilities - yes or no?

Russell Fairhurst
Chairman, UKSTT

For many years the development of trenchless technology across most of the UK utility sector has moved on apace. This is particularly true in the gas, water and wastewater sectors. There has, however, been an apparent lack of penetration of the various trenchless installation technologies into the cable-based industries for power distribution and telecommunications.

A 'spot survey' carried for UKSTT last year (2006) showed that in the region of 65% of buried service works in the water, wastewater and gas sectors are now completed using trenchless systems (including both installation and renovation). Unfortunately, little response to this survey was received from either side of the cable sector. It was decided therefore to follow up the original study with a more direct approach to the cable sector itself. In speaking to these companies the response highlighted to some extent why there was little feedback in relation to the first survey.

For the telecommunications sector, the two largest network operators were approached. The more 'senior' company, when asked what proportion of works were undertaken using trenchless systems replied that they were used very rarely and then the use was largely driven by other 'parties' or authorities insisting that trenchless options be used. Overall the company involved said that probably less than 1% of its installations were completed using trenchless techniques. On the brighter side however, the company did comment that up to 5% of its 'street to property' service connection works were now being completed using trenchless systems in order to reduce the impact on customers by not digging through gardens or other private accesses/facilities.

In replying to the same question the second largest telecoms provider in the UK simply said that, 'Other than when specifically asked to use trenchless technology by a particular authority or company, it saw no requirement for using the techniques in its installation and replacement work and hasn't done for the past decade or so.'

Within the power distribution sector, whilst most companies are aware of the available technology there appears to be very little use, if any. The general response suggested that these companies utilise trenchless systems on approximately <1% to 5% of works.

Why so little use in the UK?

When asked why the use of trenchless technology was at such a low level the response, from the larger telecommunications company, was quite simple. The 'problem' is that pretty much all of its systems are already in place and have been for a very long time. They are installed across the country at an accepted and recognised depth which, even in the modern age, would make it impractical to change without replacing the whole network. To go deeper would also mean impinging on other existing utilities which currently lay depths below telecoms systems or would mean going deeper than these existing services, which in turn would mean more interference with existing networks through which access to the new telecoms cable networks would have to be gained.

Using an impact mole to install underground cables

ROAD TESTING PIPETRACK FOR A LEADING UK WATER COMPANY

Following the introduction of the new and revolutionary PipeTrack gyroscopic pipeline tracking system at the No-Dig Live 2006 exhibition, Infotec was recently given the opportunity to trial it 'in anger' by Thames Water. The trial project required the accurate determination of the routes of numerous private lateral connections emanating from a major public trunk sewer. The test site provided a far from ideal opportunity of demonstrating the unique advantages the PipeTrack system, for reasons that will be explained later.

The accurate determination of the position of the laterals, in both the vertical and horizontal dimensions, was required to avoid the potential for damage to existing drainage services during the construction of a proposed new rail tunnel. Within the tunnel design route, its crown was destined to pass adjacent to the sewer, at some distance above its invert level.

DIFFICULT CONDITIONS

The difficulty with this particular project was, in this instance, that the trunk sewer itself was a brick, egg shape of only 1,200 mm x 813 mm. The accessible bore was also further reduced by a 200 mm depth of silt in the invert. Several of the 20+ lateral service connections that were due to be mapped were also found to be silted. However, as this adequately determined their lack of use, this meant there was no requirement for a survey of these particular laterals.

A total survey station in a main sewer.

The remaining laterals were tracked from their point of connection with the trunk sewer for sufficient distance determine their required route in relation to the proposed tunnel. This information was issued to Thames Water in a CAD format, along with a topographic survey, which included the cross-sectional profiling, also required for the trunk sewer.

The accuracy achieved using PipeTrack was less than 0.1% in the vertical plane and 0.25% in the horizontal. No currently available alternative method would provide this level of information, as the accuracy achievable using sewer probing or similar techniques would not have been sufficient for the purpose in hand.

Also, given the depth of the system, which was about 10 m, combined with the close proximity of many existing shallow services, including power and communications cables, gas and water pipes and traffic control sensors, the use of sewer probing systems would have proven largely unsuccessful.

Given the depth and the prevailing soil conditions and density of services, Ground Penetrating Radar scanning would also provide no acceptable alternative.

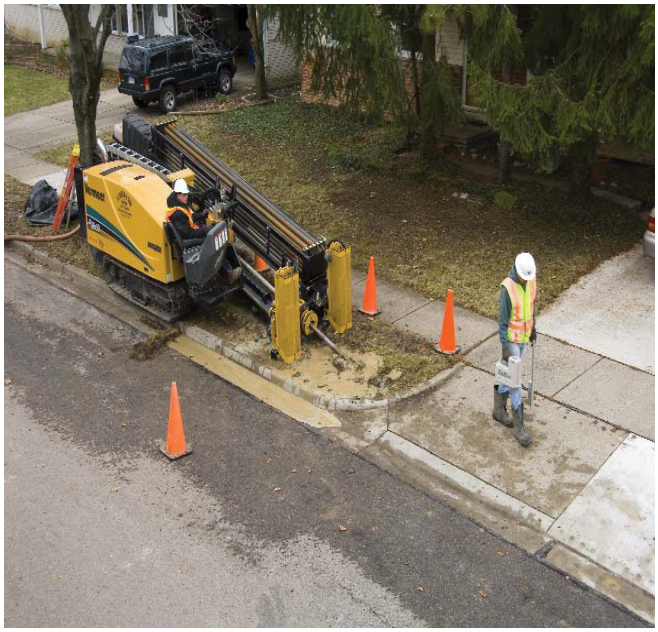
THE PIPETRACK CONCEPT

Launching the PipeTrack unit from a manhole.

PipeTrack is the world's first, fully self-contained pipe and duct route mapping system. It is capable of mapping either between two known points, or from a single point of entry such as a lateral connection or rising main etc. The data, which determines the route taken, is recorded within the on-board data storage system and requires no surface tracking or personnel access over the pipe route, eliminating the need to provide expensive and potentially disruptive traffic management procedures, as well as risk to survey personnel. The system has no set limit on the length of survey (other than the data storage capacity of the system), and it is possible therefore to consider several kilometres of survey without a need for intermittent downloading of data.

Accurate data can be obtained at speeds of over 4.0 m/sec. This enables utility owners and/or their contractors to map entire catchment areas or pipeline networks at an extremely low cost per metre. The ability of the system to precisely determine the presence of backfalls or bellies in a pipe's route also, uniquely, provides engineers with the opportunity to determine the location of 'hotspots', or to identify specific areas requiring remedial repair. This is an advantage not currently provided using either CCTV or probing systems. In addition, neither of these commonly used systems would enable subsequent groundwork's or repairs to be clearly identified between a start and finish coordinate. This further enhances effective budgetary control on remedial repair costs.

Over the next 12 months, Infotec Consulting will be staging a series of Roadshows to demonstrate the system and its benefits. Infotec Consulting is also acting as the UK distribution agent for PipeTrack. For details contact Infotec on 01702 421390 or visit: www.infotec1.net



HDD drilling rigs being used to install cables or cable ducting underground in the USA

As most of the current cable network ducting etc. is available for use, why change it? In terms of new installations, much of the new cabling infrastructure is likely to take place on development sites, which would allow open cut work without additional disruptive surface interference, so again no need for trenchless. Keeping these new installations at the prevailing shallower depth also means easy connection to the remainder of the existing networks.

The reasoning for the lack of use in the power sector was most often that much of the distribution system comprises either overhead cables, new installation on development sites which would not call for trenchless or, in existing urban situations, there is too much existing plant from other utilities to risk using the technology. This, once again, brings the question of accurate mapping and data availability to the fore across the utility sector as a whole.

Limitations on buried power cables

In terms of 'on-going' research, organisations across the UK are investigating various options for using trenchless systems for power cable works.

The idea of burying power cables to minimise power outs due to storms, icing, and lightning strikes etc, has always been around, particularly from the consumers' viewpoint, even when current technology means that pylon-based distribution is an effective minimum power loss solution. In recent years, interest has increased in the buried service options particularly to protect strategic power supplies from potential terrorist actions. Responses to questions to power supply companies also show however that there are practical problems with this option.

Cables runs over vast distances to provide power continuously so must be easy to install at a reasonable cost. They must also be accessible for regular inspections, repairs or replacement with minimum service interruption.

However, one of the biggest questions for the higher voltage cables has been the provision of adequate cooling to remove the heat generated by electrical losses in the cable. This has acted against the burial option, but this issue is now attracting increasing interest.

A research project being undertaken by Newcastle University in the UK is investigating the practical mechanics of cooling cables that are installed in small diameter tunnels and ducts. The research has investigated cable-cooling options and shown that, in terms of design simplicity, ease of installation and economy, air cooling of commercial solid conductors appears to be the most financially attractive solution, using support equipment as necessary.

This research is on-going and is aiding further work that is investigating how long length cable installations may be achieved from a practical civil engineering standpoint. Indicating that, as so often happens, demand for practical solutions is raising the interest in providing them. This is however directed largely at high voltage cables over long distances. Cable manufacturers are also looking into this problem and are developing improved cables with greater insulation etc. that are more conducive to buried operations.

However, they still do not see low voltage systems being placed underground using trenchless systems despite the heat generation problem being much reduced.

Is the UK situation typical worldwide?

Given the responses from the UK-based cable utility companies, this raises the question, 'Are we just one of numerous countries in this situation?' Not necessarily, I think is the answer here. A quick 'ask' around contacts and a search of the press in some of the major developed and heavily populated countries and regions around the world shows that attitudes can be significantly different outside the UK.

For instance in common with other sources when investigating TT usage in USA, one source stated, 'There are no data sources relating to trenchless use for high-voltage cables (69 kV and higher) but, saying that, there are many projects underway in the U.S. There are a great many installations using jacking and boring installation techniques under highways, railroads, etc., but that is not new in the US. Over the past two years, there have also been numerous HDD installations, several of them quite long (2,100 m or greater) putting power cables into carrier pipes. Also in the US, more installations of extruded-dielectric cables are being undertaken, typically at distances less than 760 m.'

Shepherd's Bush piling contract

Installation of reinforcement on the East Shaft

Bachy Soletanche Limited has completed a piling contract at Shepherd's Bush underground station – constructing two shafts for step-free access. The shafts were constructed for the redevelopment using the Hard/Firm secant wall piling method during a five-month programme.

Shepherd's Bush Central line is undergoing a major upgrade. It is expected that 60 per cent of people visiting the massive Westfield London, which lies to the north of the Shepherd's Bush site, will come by public transport. The project will help the station to accommodate the influx of people.

The site is sandwiched between Shepherd's Bush underground station, the bus station and busy roads. Careful co-ordination was essential to the smooth running of the project, as both sides of the site were tight and surrounded by traffic and pedestrians during most of the working day.

The site consists of two sections – the east shaft and west shaft – with the bus station sandwiched between the two.

The two shafts were constructed using the secant wall piling method, incorporating 900mm large diameter auger (LDA) piles, which were drilled to a depth of 19m for the east shaft, and 24m for the west shaft. As the west shaft was larger, sixty-eight piles were constructed compared to the fifty-six installed at the east shaft.

The time consuming LDA process was utilised due to the accurate drilling tolerances required of better than 1:200 verticality, the 300mm cut on the female piles and the required concrete strength of 30n/mm^2 in the female piles. Some of the piles also required further strengthening meaning thirteen of the female piles from each shaft had full length steel beams inserted into the piles before concreting. The position of the beams gave little room for error as the male piles were cut full depth and with less than 50mm between the casings and the beams at surface level.

Close proximity to existing underground station

Utilising a heavy-duty rig helped the programme on the east shaft when work became hampered by existing reinforced concrete piles, which were discovered once drilling began. These piles had to be cored out to the new pile depth of 19metres before installation of the secant piles.

Despite the lengthy coring process the project ran very smoothly, with all works complete and the site cleared by the project deadline.

Without revealing any specifics of company or region, but again in the US, one manufacturer said of its own equipment, 'In one area alone, there were in the region of 500 impact moles being used to install telecoms cables, at some 920 m per week **per tool** over 48 to 50 weeks per year, (or around 23,000 km per year of cable installation using these moles alone).'

In other areas the trend is towards using HDD rigs for installation works and/or impact moles/piercing tools, with the decision being based on the price obtainable per unit length from the telecom or cable company by the small contractors putting the cables in, but still trenchless systems are used.

Further, a recent announcement in India shows that, particularly in the lower voltage ranges for power cables and where there is a will, trenchless systems can be planned for very effectively. Annual summer power shortages are a regular occurrence in New Delhi, India and the New Delhi Municipal District Council (NDMC) electrical department is to utilise 'new' technology and equipment to avoid a crisis situation. According to NDMC the plan is to 'Augment the entire distribution system. As part of the reforms, around 4,000 km of electric cables, from 400 volts to 66 kV will be laid. In order to save power and prevent theft, all of these cables will be better insulated and all of the cables would be laid underground using trenchless technology.'

Cabling for the future in the UK

The UK does not, however, seem to have the same approach. When it comes to re-cabling motorways for the extension and installation of the traffic management signage system across the country, much of the work, particularly the road crossing installations are being completed using HDD.

In addition there have been instances where some of the major cable installations over the past decade or so have been 'trenchless'. There have been major cable tunnel projects across London and in other areas, which have been promoted as trenchless. But when it comes to more 'normal' direct lay work there appears to be very limited use of trenchless installation systems.

This is not to say however that the companies involved are not aware of trenchless technology, far from it. Although perhaps not so obvious, most companies use trenchless systems of some sort or another, though they may not see them as such. For example once a cable duct is in place the use of drum trailers, cable pushers and winches are just a part of the trenchless technology equipment family that are used without second thought.

This does not mean however that there is no trenchless installation work for power cables in the UK. In one encouraging response from just one company working in the northern part of the UK there was indeed a ray of hope. Currently the company utilises trenchless options for some 10% of its installations, but is claiming that it plans to increase this to around 30% over the next few years. The company also stated that it uses mole-ploughing techniques for longer distance cabling in open country as well as HDD techniques in sensitive or congested areas. Moling is also used for some service connection replacement work.

The question is 'How does the UKSTT bring the installation technologies to the attention of these companies to a point where they are seen as obvious options for future works'? Tunnelling and microtunnelling are possibly the most obvious options in that they offer the more traditional cable tunnel solution with which the companies work fairly regularly already, if at a price. HDD and moles, which would generally be cheaper, are rather less utilised.

Visiting trenchless shows and conferences on a regular basis has shown that very few engineers from the cable sector attend such events. Perhaps we should ask why that is.

It could be a number of reasons:

1. Do they know the events are on? Generally the answer here is yes – having worked with the UKSTT's events partner for almost two decades in one capacity or another, I know the cable industries are targeted as much as any other with marketing 'blurb' and invites to events.
2. Is there an inherent disinterest in the technology? – Possibly, given the responses outlined above, if they have no thought that the technology will be of use they simply will not come to events nor investigate what the latest technology is or, more disappointingly, how it might be of use to them.
3. Do the senior management of the cable sector companies really understand what trenchless technology is and what it can offer? If not they are unlikely to require their workforce to seek out new innovative and possible more cost effective, least disruptive options because they think they already have what they need.
4. Is there something in the psychology of the cable sector and its contractors and operators that they simply do not want to have to make the change and give excuses of the 'lack of suitable power cable products' or 'shallow depth of services' or too much plant in the ground to override any thought of looking to future opportunities to improve service and reliability which could offer protection of the service to their customers?

If 'existing services' are no good reason for other utilities to abandon trenchless options, why should it be so for the cable sector?

Burying cables could provide a significant improvement in service reliability, particularly if Global Warming predictions prove true or if the National Security situation deteriorates further. As weather patterns change and power outs and telecoms services fall victim to increasingly poor weather conditions or if extremist groups decide to target supply lines that are easily accessible, should cable companies look more closely at what trenchless systems can offer to effectively put these services 'safely' and 'reliably' underground.

UKSTT, the United Kingdom Society for Trenchless Technology, can play its part in this process of education and awareness by offering contacts, for equipment, training and engineering expertise that cable-based companies might not currently have in-house and which can then be, if not brought to their door, effectively demonstrated on site almost anywhere in the country.

In answer to the titled question – It would seem the industry (although apparently not all of it) seems to think NO, but given a fair chance maybe we can change their minds?

For further information contact:
UK Society for Trenchless Technology
38 Holly Walk, Leamington Spa, Warwickshire CV32 4LY
United Kingdom
Tel: +44 (0)1926 330 935 Fax: +44 (0)1926 330 935
Email: admin@ukstt.org.uk Website: www.ukstt.org.uk

Innovation award for Waterflow

The Waterflow team accept the UKSTT 2007 Innovation Award at the recent Annual Awards Dinner

In April, at the United Kingdom Society for Trenchless Technology (UKSTT) Annual Awards Dinner in Birmingham, the prestigious 2007 Innovation Award, which recognises technological advances that further construction and rehabilitation techniques with minimum environmental impact, was presented to the Waterflow Group Plc for its UV-cure pipe lining system.

The UV cure system is applicable to wastewater 'gravity' drains, sewers, land drainage pipes and particularly railway track drainage (where work times are often limited).

A novel robotic drill was also developed to perforate lined land or track drainage pipeline, allowing a typical 30 metre length of drain to be completely renovated in just two 3.5 hour overnight shifts.

Waterflow Director, Roger Kern, commented, "We are delighted that the effort we have put into developing this new system has been recognised by UKSTT and it is a great encouragement to everyone working on the project."

For further details contact Waterflow on,
T: 01753 810999 Fax: 01753 681442
Email: sales@waterflow.co.uk
Website: www.waterflow.co.uk

Trenchless technology penetration pushes ahead in the UK utility market

Russell Fairhurst
Chairman, UKSTT

Over the past few months, UKSTT has been undertaking a 'spot survey' to try to gain some understanding of how effectively trenchless technology has penetrated the UK utility construction sector since the technology first became popular some 20 years ago. Some 39 utilities were contacted, of which 16 responded with information comparing the use of open cut techniques and trenchless systems. Whilst by no means a definitive study, the results and the research have highlighted some interesting points and useful figures.

One interesting finding was that, provided the correct contact person was approached, the information requested was generally available. However, in several organisations the information was not in general circulation with PR departments not having such potentially important information to hand.

In praise of the technology, this was generally because trenchless systems are now often seen as 'just another tool in the box', each being used as, when and where economically or technically appropriate. Therefore, there was no need to have trenchless records immediately available. It was disappointing to find that other utilities simply did not respond to the information request.

Unfortunately the telecoms sector did not respond and only one reply was received from both the gas and electrical power sectors. The power sector respondent indicated that as the majority of the company's works are with HV cables little use is made of trenchless systems except when deemed a suitable option.

The gas respondent did come up with a very high trenchless usage figure with some 90% of works being carried out using the trenchless techniques available. It may be safe to assume that the other main UK gas networks provider uses a similar trenchless percentage as the, now separate, companies were until recently one operator.

Where replies were received the response was quite varied. Some, indicted trenchless usage of up to 97%, whilst others showed less than 10%. The majority usage is in pipeline replacement and rehabilitation works, with new lay and new development installations generally being very low (<10%). There were exceptions with up to 20% trenchless work for new lay.

The study did not cover the domestic services market where increasingly trenchless options are offered. This could make another interesting study.

It was clear from the current study that trenchless technology is known to most utilities, at least in the water, wastewater, power and gas sectors. There also seems to be a preference for trenchless if it offers a viable cost option whilst minimising disruption and environmental impact. Projects are also more likely to be planned from the start with trenchless systems in mind.

Even within this limited 'spot study' there have been obvious major improvements in the use of trenchless techniques over the past 15 years or so. However, the general 'feel' is that there is still some way to go in improving market penetration for trenchless systems in the cable based utilities, although the current position is difficult to judge as few companies responded to the survey. In addition there appears to be a lack of overall perception of trenchless systems and their advantages.

Given some of the responses, it does seem that if more trenchless information was kept 'to-hand' the figures could well help to positively influence those sectors not yet fully involved.

Availability and use of such figures across the media could also improve the perception of the public as to the efforts being made by utility companies, helping to mitigate some of the negative PR and increasing public complaints. Greater public understanding can lead to greater tolerance about

A typical pipe bursting rig in operation

Develop your technical training

Training with tailor-made solutions is primarily focused around competency assessment

In January, the new Networks Construction Operations (Water) NVQ at levels 1, 2S, 2M and 3 to the water sector was launched. The scheme, which is awarded by CABWI, covers the full range of roles and activities for those performing work on the water network infrastructure.
This range extends from entry level qualification for new people joining the industry (NVQ Level 1) through to the more complex qualifications needed by craftspersons at levels 2 and 3.

UKSTT, via its strategic partnership with technical training providers 'Develop', is offering accredited development programmes for utility companies and their water network engineers involved in the installation of potable water mains and services.

UKSTT and Develop recognise the main challenge for members undertaking this new qualification structure is to establish trust in their training provider, this will be driven by promoting best value for money whilst maintaining impeccable safety standards via a robust quality provision.

For further information about utility training requirements, contact Develop on Tel: 0870 240 4039
E-mail: enquiries@develop-solutions.co.uk
or visit: www.develop-solutions.co.uk.
For further information about UKSTT call: 01926 330935,
E-mail: admin@ukstt.org.uk or visit: www.ukstt.org.uk

A pipe lining project in the UK

services and road works.

As the figures also point out, the utility market still often uses open cut works as standard, with arguments still occurring as to the relevance, viability and effectiveness of some trenchless systems.

With comparative records it would be easier to highlight how economically and environmentally effective trenchless systems are, both in the UK and globally. They may also help to show improvements in terms of customer satisfaction.

That much used word 'Accountability' springs to mind, and with utility services and prices rising evermore rapidly across the globe, the need to show cost effectiveness to all stakeholders has to be taken into account.

In the UK, utility companies do not seem to utilise their information effectively to support their operations, particularly when dealing with their customers. Keeping such figures to hand would offer a means of openly, quantitatively and effectively justifying works to the public.

When it is clear that the best option is being used, both technically and in cost/value terms, the public will better understand, and possibly accept, what is happening around them. Improving customer perception in this way can only improve relations between utilities and their consumers.

The figures obtained in the study showed that approximately 58% of buried service works are now being undertaken using trenchless technologies. This figure includes 'New lay' works which are largely on brown field or green field development sites. With anything up to 20% of 'New Lay' installations using trenchless systems, the total percentage is significantly higher than might be expected.

Looking at the figure without including new lay work, the usage figure for trenchless technology on replacement or renovation works rises to about 65%. As this is where trenchless technology has always claimed that it could be best used technically, economically and environmentally, this shows that a very significant proportion of the work is currently being completed using trenchless technologies of all forms.

Bearing in mind this 'average' is based on figures ranging up to as much as 90% trenchless technology usage, comparing it with the estimated 'average' of between 5 and 10% usage from less than 20 years ago, the change seen in these figures is of great significance and should be applauded.

Is it time perhaps that this sort of information made the National News headlines, with utilities being praised for once for the efforts they are making, that often go unseen by the population in general? Then again, maybe that would be the wrong sort of news for some media sectors!

For further information contact the UK Society for Trenchless Technology on, T: +44 (0)1926 330 935

Propex Concrete Systems

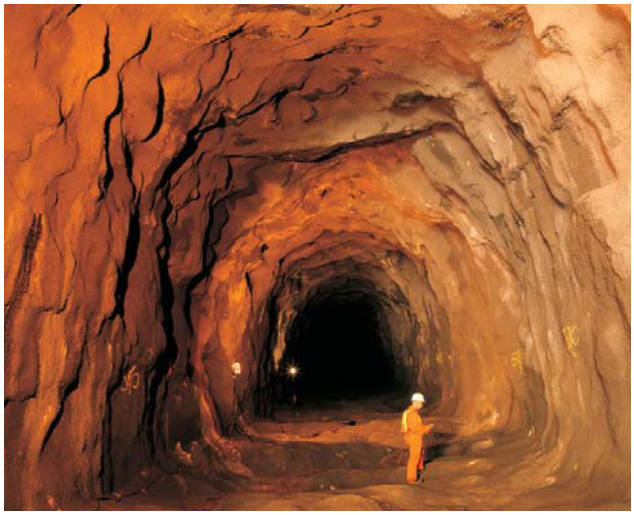
Propex Concrete Systems is a leading global provider of Fibre Reinforcement Solutions offering a complete range of polypropylene, steel and synthetic macro reinforcement fibres for tunnelling and mining projects. Our world-renowned range of Fibermesh® polypropylene and Novocon® steel fibres, offer proven technical, practical and economic advantages when used in underground applications as an alternative to traditional wire mesh reinforcement. Propex Concrete Systems has also pioneered the development of High Performance Polymer (HPP) and ENDURO® synthetic macro fibres, primarily for cast and sprayed concrete tunnel linings. Propex Concrete Systems has built a reputation for quality, customer service and our ability to offer innovative and unbiased solutions for the fibre reinforcement of concrete. The Company has more than 20 years experience developing fibre reinforcement products, backed by a world-wide team of reinforcement engineers using performance test data and new product research.

Fibre Reinforcement – making good concrete better ® NOVOCON® - Steel Fibres

Our Novocon® range of steel fibres for underground applications comprise of cold drawn, high tensile strength wire fibres which offer an economical, high performance solution for precast, sprayed concrete and cast in-place tunnel linings. Novocon® steel fibres are engineered to provide uniform distribution throughout the concrete, without the need for any special gluing, and provide exceptional technical performance while maintaining excellent mixing and finishing attributes. Our Novocon® range includes Novocon FE flat-end fibres and Novocon HE hooked-end fibres for high performance applications. The range is completed by our Xorex® undulating fibre which provides an extremely cost effective solution for slope stabilisation and other less demanding applications.

ENDURO® - Macro Synthetic Fibres

As a market leader in fibre reinforcement, Propex Concrete Systems is at the forefront of fibre technology and innovation and have pioneered the development of high performance synthetic macro fibres, which now offer a serious alternative to steel fibre reinforcement. Based on years of experience in the sprayed concrete field and research by Propex Concrete Systems engineers, ENDURO® builds upon the heritage and technology of our industry proven HPP (High Performance Polymer) product. ENDURO® is specifically designed to address the ever-increasing demands of modern day shotcrete application techniques and provides a quantum leap forward in shotcrete performance, as measured by energy absorption in the Round Determinate Panel and Efnarc test procedures.



FIBERMESH® - Micro Synthetic Fibres

Our Fibermesh® range of polypropylene fibres provide a unique internal support system in concrete that substantially reduces plastic settlement and shrinkage cracks by increasing the tensile strain capacity of plastic concrete. The fibres also improve the cohesive properties of the concrete resulting in reduced fallout and rebound. Our Fibermesh 150, fine monofilament fibre is recognised to provide resistance to Explosive Spalling with minimal effect on the workability of concrete. Verification of the effect on explosive spalling has been obtained from internationally recognised test laboratories including VSH Hagerbach underground test facility in Switzerland. Fibermesh 150 has been specified and used on several major international underground road and rail tunnel projects for the prevention of explosive spalling. These include Dublin Port Tunnel (Eire), CTRL (London, UK) and Gotthard Base Tunnel (Switzerland)

NOVOMESH® - Fibre Blends

Our ability to offer a complete range of fibres has led to the development of Novomesh®, an innovative system of reinforcement combining the multiple benefits of Fibermesh®, Novocon®, HPP and ENDURO® fibres, which is designed to offer fibre solutions for the most challenging concrete performance projects.

Whatever your reinforcement requirement - Propex Concrete Systems has a fibre solution

For further information contact Propex Concrete Systems on, Tl: + 44 (0)1246 564200, F: + 44 (0)1246 564201, e-mail: trevor.atkinson@propexinc.co.uk

PROPEX

CONCRETE SYSTEMS

Sprayed concrete linings - time for some common sense

Benoît Jones

Research Engineer,
University of Southampton

Sprayed concrete lined (SCL) tunnels, sometimes referred to as 'NATM' tunnels, are frequently characterised as complex and risky. This article seeks to challenge these notions and apply a bit of common sense.

SCL is usually the most economical option for short lengths of tunnel, tunnel junctions and other complex geometries. On the other hand, a tunnel boring machine (TBM) is usually the most economical option for long lengths of constant diameter circular tunnel. The alternatives to SCL in these situations, such as excavating by hand using timber supports, or indeed using a TBM, will be shown to introduce additional technical problems and risks.

Using timber as primary support is slower and does not provide the immediate, intimate support to the ground that SCL provides. The primary objective of using sprayed concrete for ground support was to avoid loosening of the ground mass due to slow introduction of timber support with poor contact with the ground. There is thus virtually no present-day situation in which using timber is more desirable than SCL.

Using a TBM may only be possible in some of the situations described above, for instance the construction of platform tunnels in a metro station where there is a shaft at both ends for launching and recovering the TBM. These platform tunnels will usually include 5-10 openings for cross-passages, ventilation and equipment rooms. Creating junctions in a segmental lining is far more complex than in a sprayed concrete lining. Sometimes special cast iron segments are used that already contain the opening. However, in many cases it will be necessary to use temporary propping to brace the tunnel, to cut and/or remove segments to break through the lining, and then to install a permanent frame inside the opening to take the loads from the broken rings. Creating junctions using sprayed concrete is by comparison very simple and will in most cases only require a local thickening of the sprayed concrete and perhaps some additional reinforcement.

The open face of an SCL tunnel means that it has the potential to be vulnerable to face instability, usually caused by low cohesion or by water inflows from permeable layers. These risks should be identified by the ground investigation. There are a number of tools in the SCL toolkit to mitigate this risk, from dewatering using wells drilled from the surface to ground freezing around the tunnel perimeter to prevent water ingress. Spiles or grouted canopy tubes can provide support to the excavation perimeter in soils with low cohesion. Dividing the face into partial headings that are immediately sprayed with a sealing layer of sprayed concrete is usually sufficient if water inflow is not a major problem.

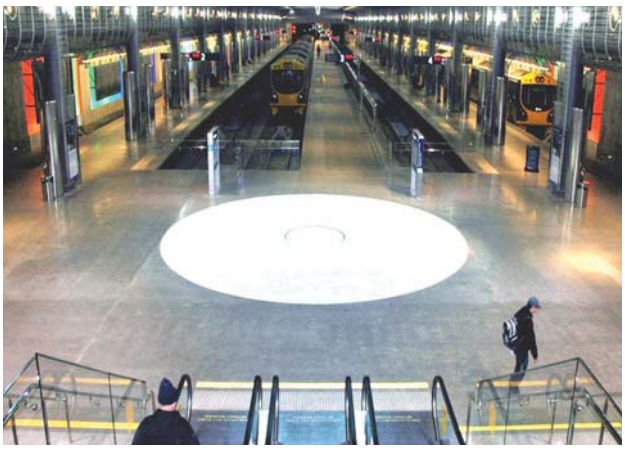
Heathrow Express crossover, which was constructed using sprayed concrete

An open face TBM will have the same vulnerability to face instability, but the ability to probe ahead of the face or to apply additional support measures such as spiles or canopy tubes will be limited. A closed face earth pressure balance (EPB) or slurry TBM that can apply a pressure to the face and thus prevent face instability removes this risk but introduces other problems. These machines require significant backup systems, which for a short length of tunnel may need to be sited on the surface. For shallow tunnels, there is a risk of blow-out if the face pressure is too high. It is also possible that the TBM is found to be inappropriate for the ground conditions encountered. Finally, since the face is closed, assessment of ground conditions is limited and there is a risk of over-excavation. It could be argued that all these risks may be dealt with using modern TBM technology, but the risks associated with SCL may also be dealt with using appropriate methods and without introducing significant additional complexity.

SCL is often characterised as being highly dependent on the quality of workmanship, on experienced supervision. Daily review meetings of the latest monitoring and quality control data and the proposed excavation and support for the following day are now standard practice. Expert panels and peer review are often used to scrutinise designs or proposed changes during construction. It could be argued that this Achilles heel has actually become a great strength, since no other underground construction method is subject to the same level of control.

In conclusion, SCL has come of age. When considering using SCL, clients should no longer perceive it as a risky, complex or new method, but as a mature tunnelling method that has been applied with considerable success.

Rawell Environmental Limited



Since changing from being a distributor of imported dry bentonite products, to a manufacturer and exporter of its prehydrated RAWMAT® HDB system in 1993, Merseyside based Rawell Environmental Limited has had an integral involvement in major tunnel developments around the world. Rawell's development of this amazing clay, which swells on contact with water and thereby forms an impermeable barrier, has provided many renowned projects with a robust waterproofing system that overcomes the limitations of rival products.

In 1994, RAWMAT® HDB membranes and RAWSEAL® hydrophilic waterstops were supplied for the construction of the Airport Rail Link between Hong Kong Island and the newly constructed Chek Lap Kok Airport. This would prove to be the first of many major projects for Rawell Environmental Limited, who also supplied their products to the Heathrow Expressway tunnel in the UK whilst the Hong Kong projects were underway.

RAWMAT® HDB prehydrated bentonite membranes, uniquely, have the capacity to function in the kind of saline and calcium rich environments which would render other bentonite systems ineffective. These properties were recognised and the RAWMAT® HDB system adopted by the design teams of such major tunnel projects as the Copenhagen Metro (1997) and the Preveza to Aktion Crossing in Greece (completed in 1999). In very corrosive ground containing high sulphate and sulphide concentrations, RAWMAT® HDB membranes were utilized to waterproof the cut and cover portals of the Immersed Tube section of the Preveza-Aktion Tunnel. RAWMAT® HDB membranes proved to be a simple, effective barrier that were swift and uncomplicated to install.

Following on from the projects in Copenhagen, the RAWMAT® HDB system was adopted for waterproofing to a number of cut and cover tunnel sections of the Gardermobenen, a high speed railway line between Oslo and Eidsvoll. Norway's extremely low winter-time temperatures and need for de-icing fluids meant that the waterproofing needed to withstand these chemicals. RAWMAT® HDB proved to be flexible enough to be installed in such low temperatures, as well as being demonstrably resistant to potassium acetates and ethylene glycols.

In 2001 Rawell became involved in the waterproofing designs of Britomart Transport Centre, built on reclaimed land, in the centre of the former Commercial Bay docks of Auckland, New Zealand. Acting as the Northern Terminus for the North Island Main Trunk Line, Britomart combines a bus interchange and a railway station in a converted Edwardian era post-office, with the ferry terminal nearby. The tunnel is 300m long, 45m wide and 12m deep and involved 200,000 m^3 of excavation, 14 km of piling and 40,000m^3 of concrete. The resulting station, the only underground diesel station in the world, although initially received with much criticism due to being designed well in excess of its capacity, has received a multitude of awards due to the iconic "glasshouse", skylights and vivid lighting.

The location of the site, and the resultant high saline ground water provided a challenge to the performance of the prehydrated RAWMAT® HDB membranes and RAWSEAL® hydrophilic bentonite waterstops. Due to cost considerations, the RAWSEAL® waterstops were used as the only form of waterproofing to the joints in the floor slabs. On the tunnel's west side, the walls were waterproofed by nailing the self-healing RAWMAT® HDB membrane to the prepared rock formation and using this as the backshutter. The east side of the tunnel required the RAWMAT® HDB to be post-applied by nailing to the external face of the cast in-situ walls.

The RAWMAT® HDB membrane was also laid across the roof of the tunnel and detailed around the " light volcanos" before being covered with a concrete screed and a block paved car park. The RAWMAT® HDB membrane and RAWSEAL® waterstops, were both proved to swell in the contaminated saline ground water by on-site testing carried out by the engineers, and provide a waterproofing system which was able to withstand the minor movements of the tunnel.

Following discussions with Matterhorn Gotthard Bahn (MGB) and their engineers Schneller Ritz und Partner AG, Rawell has supplied its RAWMAT® HDB membrane to the Projekt Ostausfahrt Bahnhof Brig on the Swiss Italian border. The project is an interchange which passes beneath the entrance to the 12 mile long Simplon Tunnel, a famous rail tunnel, originally built in 1906.

Continued on page 30

Continued from page 29

Constructed into the gneiss rock, the cutting and tunnel are 6m deep and 7m wide. The walls to the cutting have been formed by piles which have been exposed and shot-creted to provide an application surface. The self-sealing RAWMAT® HDB membrane sheets are shot-fired onto walls in vertical strips, with the sheets forming a self-sealing overlap. The vertical membrane is lapped onto the membrane which is laid across the compacted sub-base prior to the 1.06m thick slab, once the slab is constructed the vertical concrete walls are poured and confine the RAWMAT® HDB between the shot-crete and the structural walls.

The close proximity of the project to the Simplon Tunnel caused a number of headaches for the designers and contractors, as the new line was designed to pass under both the south bound and north bound tracks. This issue was overcome by casting the 60cm thick roof slabs adjacent to the tracks, waterproofing them with the RAWMAT® HDB membrane protected with a concrete screed. The Simplon track was then closed over a weekend to allow the tracks to be lifted, the roof of the tunnel to be jacked into position and connected to the wall roof supports. The waterproofing of the tunnel was completed in Autumn 2006.

Rawell's enviable track record in tunnelling projects across the globe continues as the company has recently supplied its RAWSEAL® waterstops to the Eastlink tunnel in Melbourne Australia and is preparing to supply its simple and effective waterproofing system to a landmark scheme in South Korea.

Civils 2007

Civils 2007 will be even bigger and better this year, offering something for everyone working in civil engineering and the built environment.

This year's Civils will be held between 20th and 22nd November 2007 at its new home – London's Earls Court 2. The bigger and better venue will allow more exhibitors and visitors to attend the show than ever before, creating more opportunities for attendees to network, discuss technical matters and to do business.

Civils is the UK's biggest and best civil engineering event, with over 5,500 professionals gathering at Olympia in London in November 2006. Each year the entire civil engineering supply chain – clients, contractors, consultants and suppliers – converges at Civils to find out what's new in the industry.

Visitors and exhibitors hear from industry experts on new legislation and guidance and innovative design and construction methods at the Civils Conference, find out about innovative new techniques in the technical seminars and meet contacts old and new at the many networking events running throughout the three days.

Civils has grown since its launch in 1998 to become much more than a trade show. It is all about bringing the civil engineering community and built environment industry together to network, learn and exchange ideas and to share innovation, and to reinforce and forge new relationships – face-to-face.

This is backed up by research following last year's event, which once again showed that networking was a key objective for nearly all who attended. This year, the additional space offered by the new venue will allow for more networking areas, including the show bar and pavilion and large informal seating areas.

For more information on this year's show and to find out how to exhibit and to pre-register as a visitor (saving the £20 entrance fee), visit www.civils.com

The Civil Engineering Conference

As far as Civils visitors are concerned, content is king and the key element of the event is the Civil Engineering Conference, which this year will be held in a large purpose-built theatre at the heart of the show.

This three-day programme of modular sessions will appeal to all types and grades of professionals from across the civil engineering and built environment industry. Senior industry experts will present and debate a wide range of issues affecting the sector, under the themes of environment, transport and regeneration.

The theatre will be divided in two, giving delegates even more choice in which sessions they attend. One half of the theatre will focus on environmental issues on all three days, with Tuesday examining sustainable energy generation, renewable energy and the future of nuclear energy.

Sessions on Wednesday will cover carbon policy and emissions reduction, sustainable engineering and the zero carbon agenda and airport expansion.

Thursday will look at climate change, specifically around coastal development, sustainable flood risk management and planning policy and floodplain development.

The other half of the theatre will host sessions on opportunities in regeneration, remediation of contaminated land and waste management, regulation, infrastructure and protocol on the Tuesday.

Roads will take centre stage on the Wednesday, with sessions on road transport policy, sustainable transport, traffic management and congestion reduction.

Thursday will look at rail, with sessions on the national rail strategy, developments and opportunities in London rail infrastructure and creating sustainable rail infrastructure.

Show Pavilion

A new feature for Civils 2007 is the show pavilion in the centre of the exhibition floor. Featuring a bar and relaxed seating for networking and a stage for keynote speeches, the opening of the show and the presentation of the 2007 Civils Innovation Awards, the pavilion will also feature displays from regional development agencies and local authorities, showing civil engineering work and future development and regeneration strategies for their regions.

Technical Seminars

Most Civils visitors cite "getting an overview of the market" is their prime reason for attending the exhibition and three quarters of them say this is achieved by attending the ever-popular technical seminar series (it was standing room only in many seminars last year).

The free-to-attend seminars offer a platform for exhibiting companies to present new and innovative projects, products and case studies to visitors in the semi-informal setting of the red, blue and green seminar theatres.

Exhibitors

With 70% of the exhibition sold out, Civils 2007 is shaping up to have the usual great mix of the entire civil engineering supply chain, including clients such as the Highways agency; consultants including Scott Wilson, Gifford and Mott MacDonald; contractors such as Norwest Holst and Ritchies; a wealth of geotechnical firms including Phi Group and Pennine; and manufacturers and suppliers including ACO and MGF. Along with the ICE, other industry bodies such as Ciria and Constructing Excellence will also have stands.

Information technology exhibitors will also benefit from the new IT demonstration zone, allowing exhibitors to showcase software and systems to visitors.

A full exhibitor list, along with profiles, services and product information is available on the Civils website.

Emerging Engineering Design Award and Civils 2007 Networking Dinner

NCE's Emerging Engineering Design Award will once again be presented at the Civils 2007 Networking Dinner. Held on the night of 20 November at a top London hotel, the dinner is sure to attract the good and the great from across the industry to celebrate the work of the best young civil engineering designers.

The dinner also allows Civils visitors, exhibitors and their guests to enjoy an informal evening of entertainment and dining away from the show floor, making new contacts and building business relationships. Last year over 300 people were entertained by The Right Hon Boris Johnson MP. More details of the awards can be found at www.nceplus.co.uk/eeda

Polluted tunnels blown away!

Civil engineering in railway tunnels can be a hazardous undertaking. When you consider the dust and fumes being generated from the work undertaken, not to mention the frequently moving plant equipment within a confined space, you can appreciate these are places where you certainly need to keep your wits about you.

To help in managing this problem Factair has developed the most extensive range of temporary ventilation and monitoring equipment on the market. Factair has been supplying tunnel ventilation and air quality monitoring services to the rail industry for over 13 years. In that time it has developed a comprehensive fleet of ventilation fans, which can be deployed in a variety of configurations, this is supported by a sophisticated range of instruments to monitor the air quality in the tunnel and respiratory protective equipment for individuals working in the dustiest applications.

Should you have a tunnel renewal project, where you suspect fumes and pollution could be a problem, contact Factair on T: 01473 746400.

Sealing a tunnel under the Thames

George Burgess

Trelleborg Engineered Systems

Tunnelling through the waterlogged ground close to and beneath the River Thames in London requires high-quality seals. Trelleborg does its part to strengthen London's transport infrastructure for the 2012 Olympics. Pre-cast specialist Buchan Concrete Solutions is part of the AMEC Group, constructing the GBP 177 M Docklands Light Railway Woolwich Arsenal Extension (DLR-WAX) due to be completed in February 2009. Technical Manager for the project, Colin Rowley, wanted the best. "Trelleborg probably has the most specialized people in the market. If you have an application subject to demanding conditions, it will create the gasket you need. It will design and test the product, so that you can have the confidence you need when doing your job," says Rowley.

Buchan, which provides pre-cast concrete solutions for subterranean and surface projects from tunnels to hotels and university buildings, decided to manufacture the concrete tunnel-lining segments on-site. The DLR-Wax tunnel will run from an intensely built-up area close to London's City Airport to Woolwich in two curved tunnels requiring a total of 2,425 rings. Each ring comprises eight 2.25-metric ton segments, which are individually sealed using Trelleborg gaskets. The tunnel will be bored by "Carla" – a unique 98m long, 6m diameter, 600-metric ton tunnelboring machine made by Lovat Inc. in Canada and shipped to Liverpool in three pieces. A 1,000-tonne crane will move Carla into position to start her work.

On-site production was more than a convenience. AMEC decided it was better for the environment than transporting segments from the main Buchan plant more than 200 miles away, saving around 2,000 heavy vehicle journeys through London. Trelleborg has worked closely with Buchan to ensure gaskets are available just when required. As Rowley said, "We started production in November using our own moulds and high-spec concrete. We employed local labour but brought

The gigantic tunnel-boring machine had to be shipped in three parts

It is crucial the gasket has the right volume of rubber and must fit the groove in the concrete segments precisely

experienced people to instruct and train people here." The 28-strong workforce is producing 64 units a day in a schedule calculated very carefully to prepare sufficient stock (but not too much) and a steady supply when tunnelling starts this April. There will be a lull next autumn when the first tunnel is completed and Carla has to be dismantled and returned to the start, because by tunneling from north to south the spoil can be removed by barges, greatly reducing road haulage and environmental impact. Rowley emphasizes the tough demands on everyone involved in the manufacture of the concrete segments and the Trelleborg gaskets, as the tunnel has a designed life of 120 years. "Everything is checked 100 percent by the inspectors and there's a secondary inspection of one in 20 segments by the works manager or me." As tunnels don't run in conveniently straight lines, linings must be adjustable to allow changes in alignment and levels without compromising the fit of the concrete segments or gasket seals. "You have to be able to steer the machine in any direction, so there are four different types of tapered segment per ring requiring four different types of gasket," he says. "These aren't solid but cellular so the gasket deforms predictably when it's squeezed into place by the tunnelling machine, preventing the high-pressure ground water from leaking in."

Each tunnel is unique

"Preparation for the 2012 Olympics will increase the number of infrastructure projects like this and Trelleborg is determined to play a major role in these projects, maintaining its preeminent position in the UK. Winning the DLR and the Lea Valley cable tunnel is the start of this process," says George Burgess, a longtimer at Heinke, which was acquired by Trelleborg last spring. Trelleborg has supplied gaskets for hundreds of immersed and bored tunnels all over the world and Burgess stresses that each is unique. "Tunnels are always different sizes. Each one requires its own tunneling machine. There are different gaskets for different water pressures and, in this case, they will encounter pressures of about 55psi (pounds per square inch) 30 metres below the river surface," he explains. "It is crucial the gasket has the right volume of rubber and must fit the groove in the concrete segments precisely. The gaskets used for this tunnel are CS005s, developed four years ago to cope with deeper tunnels and the relatively tight bends of metro systems."

For further information contact George Burgess at, email: george.burgess@trelleborg.com

Fire safety in subsurface construction

Roger Wilton
Assistant Technical Manager,
Fire Industry Association (FIA)
Former Fire Safety Engineer
for London Underground

When construction work is undertaken in an underground location, the project plan for safety, and in particular fire safety, needs to address the extra risks associated with work in an area that by definition will have limited means of escape. The area will also inevitably be one in which ventilation will be restricted and of course lighting will be another prime consideration.

Managing an emergency successfully is a matter of planning, having the correct equipment in place and in a serviceable condition. The first essential is a risk assessment undertaken by a competent person and documented. Particularly on a construction site, the risk assessment needs to be a dynamic working document that changes as the work progresses. The ownership and authorship of the document needs to be one of the project manager's prime responsibilities. It should link to a site project fire and safety strategy document that indicates how the risks identified are being managed and how the process for emergencies is to be handled.

For example if a fire risk from mechanical plant operating in the underground location is identified, the strategy may be to require that the plant containing volatile fuel or gas be fitted with an automatic fire suppression system and that during operation a specified number and type(s) of portable fire extinguisher be available.

The strategy document may also require that persons operating the equipment undertake specific training on the use of fire extinguishers and evacuation procedures.

Fire risk assessment and fire strategy are the tools of the trade for preventing injury, driving down financial loss, minimising project delay and ultimately preventing fatalities.

A fire risk assessment follows a logical pattern

- Identify fire hazards
- Identify people particularly at risk
- Evaluate the findings
- Remove and/or reduce risks and provide protection from remaining hazards
- Record, plan, instruct, inform and train
- Review the plan.

Specific fire risks in construction work underground are determined on a site by site basis as no two sites are identical and have the same risks. However all such work will need to consider the following when producing the essential fire strategy:

1) Earliest possible detection of fire
2) Difficulties in providing means of escape
3) Enclosed environment ventilation issues
4) First aid fire fighting provision
5) Access for emergency services
6) Special high risk hazards such as welding, storage of fuel, etc.

During a construction project the first requirement of a risk assessment – that of identifying the fire hazards – may be one of the most challenging. The hazards will change as the construction progresses. The risk will increase as initial construction gives way to first and second fix.

Control of the area by a permit to work system that includes the CSCS (Construction Skills Certification Scheme) requirements helps ensure that both full time and temporary contractors are aware of the fire risks and evacuation procedures. The site may benefit from the installation of a temporary fire alarm system that can assist in the risk reduction process.

The materials used in construction are often delivered in flammable packaging to prevent transit damage. A management process for safe storage and for efficient removal of packaging materials is required. The need for fire extinguishers suitable for class A fires, i.e. fires involving solid materials such as paper wood or textiles, is also apparent as is the need to make sure these extinguishers are functional and have been serviced regularly in accordance with the relevant BAFE (British Approvals for Fire Equipment) scheme.

The construction programme can be part of the risk control programme. For example the completion of enclosed stair routes before other work proceeds can help address safe escape routes as can the appointment of someone with the responsibility of ensuring that the escape routes are always clear and well signed. Early provision of a ventilation system will assist in control of the environment to help facilitate the means of escape.

All of the above underlines the assertion that the risk assessment needs to be a dynamic working document that changes as the work progresses and that a responsible person has his finger on the pulse, always alert to the changing environment and in a position to make things happen.

Awareness of health and safety issues has grown almost exponentially over the past few years and some will have the view that it has gone too far. However fire in an underground construction site is a killer and too much care cannot be taken. With the change in fire safety legislation, which came into effect in October 2006, the need for a documented risk assessment to be undertaken by a competent person is mandatory. The responsible person is left in no doubt as is the legal need to use competent people to provide fire protection measures. The legislation puts the legal responsibility squarely on the shoulders of "owner / occupier". This should be seen as essential safety and not a burden.

A search facility for fire protection companies that operate BAFE Schemes can be accessed by clicking onto www.bafe.org.uk

River diversion for surface mining

Gábor Mérö
Trelleborg Building Systems

When managers at Kolubara, Serbia's largest coal mine, began talking about widening their operations, they immediately ran into a rather large snag – there was a river in the way.

"The Kolubara coal basin comprises an eastern and western part, divided by the Kolubara river," explains Ivan Kovac, marketing manager of Hidrotehnika-Hidroenergetika, the Serbian civil engineering construction company in charge of the expansion project.

The eastern part of the basin, which represents 20 per cent of the mine's total productive surface, covers about 120 km², but much of the area has long since been exhausted. However, the western part of the basin – spanning 480 km² – at the opposite side of the river, remains unexploited. With its four open-cast pits and 26 million tonnes of annual production, the Kolubara mine (located some 40 kilometers southwest of Belgrade) supplies coal to several large thermal plants situated in the close vicinity, so finding a quick, reliable solution was vital to the local and national economy. "There is enough coal across the water to satisfy Serbia's needs for decades to come," enthuses Kovac. "But first, we have to get there!"

Hidrotehnika-Hidroenergetika issued a tender for a solution to the problem and against stiff international opposition, Trelleborg was chosen. "Rather than try to dig under the river, it was decided to divert it eastwards, into the already worked out areas," explains Nebojša Miletic, managing director of Neshvyl Ltd., which represents Trelleborg in Serbia and Montenegro, Bosnia and Macedonia. "But because of the instability of the soil underneath we needed to line parts of the five-kilometer-long riverbed with a material that would ensure that the movement in the underlying soil would be absorbed". The answer? Trelleborg's EPDM rubber membrane. "The point is, rubber is elastic – it's not just flexible," points out Miletic. "It always reverts to its original form. Its characteristics are almost unaffected by water, cold, heat, stretching or whatever." Phase 1 of the project will be finished by the end of 2006 with further diversions planned over the coming few years. The river's new course will take it through an enormous pit which was originally dug to store ash from one of the nearby power plants but will now serve as a recreational lake for local residents. "It will be a fantastic area for recreation," says Hidrotehnika- Hidroenergetika's Kovac smiling. "One thing that prompted us to choose Trelleborg is that it's a global company – experts from Sweden and Budapest are flying in to supervise and advise; yet on the other hand, it has a local mindset that enables it to think of specifically local needs…like a boating lake!"

Need for speed

For the Kolubara managers planning their mine's expansion, speed was essential – and only Trelleborg EPDM geomembrane system could meet that challenge. EPDM (Ethylene Propylene Diene Monomer) is a synthetic rubber whose balance of physical properties and chemical resistance make it ideal for a wide variety of rubber applications. The membranes are laminated with a thin layer of thermoplastic elastomer, a thermoplastic olefine that has many of the characteristics of vulcanized rubber, and then spliced using a new, patented splicing technique – Thermobond™ – whereby the seams are produced with a hot wedge in the form of two parallel welds with an air channel between them which enables the joins to be tested using compressed air. "We make something that is extremely robust yet adaptable, as well as resistant to heat, cold and moisture. Consequently, we were able to promise we would continue to install the membranes through the winter," says Gábor Mérö, managing director of Trelleborg Industri Hungary, Trelleborg's trading and logistics centre in Central Europe, which is the source of the EPDM geomembrane solution to the Kolubara mine. "I don't care if Serbia has its coldest, wettest winter ever this year. We'll still get the job done!"

Challenge: To expand Serbia's largest coal mine by diverting the course of a river for five kilometers along a path with a partly unstable surface.

Solution: Trelleborg's EPDM rubber membrane will be used to line parts of the new riverbed and stabilize the soil underneath.

Expanding the Kolubara mine is vital to the local and national economy

Road tunnel and portal air quality

SPECIAL REPORT

TRL are the United Kingdom's Transport Research Laboratory. TRL is an internationally recognised centre of excellence providing world class research, consultancy, advice and testing for all aspects of transport.

One of our main areas of concentration is to assist local authorities, planners, developers and others to measure, model, understand and improve air quality.

We have been working in air quality for over 40 years and have strong relationships with local authorities, central government, universities and environmental consultancies and provide a wide range of services which can be tailored to individual requirements.

With new legislative measures being introduced and increased awareness of global environmental issues, the depredation of vehicular pollutants with reference to road tunnel and portal air quality is but one of the subjects under debate, although one of extreme significance.

Vehicles emit pollutants along the entire length of a road section. The total quantity of the pollutants emitted is entirely dependent upon two key factors; these being both the volume and the operation of the traffic.

On open roads the emissions are subject to the normal processes of dilution and dispersion into the immediate atmosphere by process of natural diffusion. However, when a vehicle enters a tunnel these processes are modified and unless there is sufficient venting of polluted air or injection of fresh air, pollutant concentrations increase linearly from entrance to the exit and emissions are concentrated portals. Atmospheric concentrations of vehicle derived pollutants can therefore be particularly high inside road tunnels and in the vicinity of tunnel portals due to these dynamics. The predominance of Nitrogen Oxide (NOx) concentration increases as the vehicle travels through the tunnel and achieves its highest parts per billion (ppb) values as the tunnel ends. As the vehicle exits the tunnel the NOx concentration experiences a sharp incline due to the previously discussed natural dissipation.

Air pollutants are subject to two main forms of legislation in the UK;

- Ambient air quality standards (outdoor exposure situations)
- Occupational Standards (workplace atmospheres)

Traffic related air pollution is associated with adverse respiratory effects. Indeed, a recent study by the European Respiratory Journal illustrated that road tunnel air pollution induces bronchoalveolar inflammation even in healthy subjects.

Because of the mitigated implications and health risks involved, UK law requires employers to control exposure to hazardous substances to prevent ill health under the Control of

Substances Hazardous to Health Regulations (COSSH) mandate. The maximum allowable levels of pollution exposure are defined by the Health and Safety Executive (HSE) in EH40, a new directive which stipulates occupational exposure limits (OEL).

All tunnel operators are responsible for ensuring compliance with the HSE standards, not only for employees such as maintenance workers, police and toll booth operators, but also for members of the public. Within the UK we have in excess of 200 road tunnels, all posing the same design and environmental challenges.

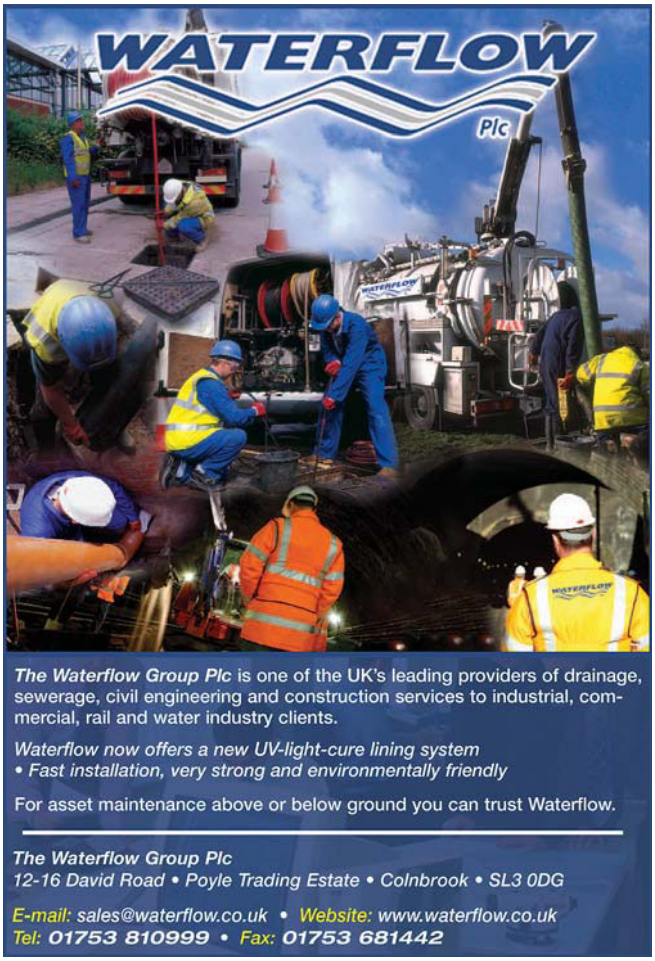
Guidelines for the calculation of the fresh air requirements of tunnel ventilation systems are presented by the World Road Association (PIARC). Rationally, ventilation has been designed in relation to Carbon Monoxide (CO) and in the past most CO was emitted by petrol-engine vehicles. Nevertheless following improvements in emission control and the increased market penetration of diesel vehicles, there have been significant reductions in CO emissions from road transport as a whole. Visibility and NOx concentrations have now become more important for tunnel ventilation design.

Some countries have introduced Nitrogen Dioxide (NO^2) as the target pollutant for in-tunnel air quality. PIARC (2000) recommended an in-tunnel standard of 1 ppm for NO^2 should be maintained.

Tunnel sensors are used to start mechanical ventilation in stages before the measured pollution level of any gas reaches its limit level. If pollution levels appear set to rise above the EH40 limits tunnel closure procedures are implemented. Technological advances such as these are essential to the continuance and safeguarding of both the tunnels themselves, and the thousands of road users who pass through them on a daily basis.

Inevitably, the requirement for more tunnel construction in the future will enlarge in tandem with increased road users and the necessity for more road infrastructure projects. Nonetheless, environmental issues will provide inherent nuisance to the designers and architects of such projects.

Until the full integration of next generation fuels systems the problem of road tunnel and portal air quality will continue. In order to help provide solutions to such problems TRL will continue to study such pressing issues in order to help offer the answers.



Waterflow wins Thames renovation services contract

Despite stiff competition, the Waterflow Group Plc recently won a major sewer renovation contract for Thames Water. The contract will utilise Waterflow's latest UV Light Cured CIPP lining techniques. This environmentally friendly technique, used extensively throughout Europe, has many important benefits over more traditional sewer renovation methods, particularly in environmental terms.

Several renovation projects have already been completed for Thames Water using the UV-cure technique, including some difficult lining installations in sewers located beneath railway tracks. The contract runs for three years and during this time Waterflow expects this clean, fast and cost-effective pipe rehabilitation process to become fully established across the UK. Waterflow is also using UV-cure lining to renovate track drainage systems on the London Underground rail network.

For further information contact Waterflow on, T: 01753 810999, Email: sales@waterflow.co.uk Website: www.waterflow.co.uk

Leaktightness testing of full length and localised sewer renovation systems

Dr Andy Russell
WRc plc

This article introduces the cured-in-place pipe lining technique which is used to install full length and localised linings within drains and sewers. Physical testing has been undertaken on these systems which has led to the development of a hydrostatic pressure test which can demonstrate that individual systems are leaktight. These results will be of great interest to water and sewerage companies who are working to minimise infiltration into their sewerage network.

For over 30 years cured-in-place pipe linings have been used to renovate underground pipelines from small diameter drains to large stormwater conduits. The basic principle of inverting a felt lining impregnated with a thermosetting resin into a pipeline and curing this in-situ has not altered much over time but a vast range lining materials, reinforcement materials, lining coatings, resins, curing methods and installation methods are now available.

The initial systems were for full length (manhole to manhole) linings but shorter systems typically 0.5 to 3m long, often referred to as patch repairs, have been developed so that localised defects such as holes in pipework or a defective joint can be repaired individually.

The 'wetted-out' lining material is wrapped around an inflatable rubber packer which is winched into position within the sewer under the careful eye of a closed circuit television (CCTV) unit. Once correctly positioned the packer is inflated and the patch repair pushed against the inside of the defective sewer. The resin cures either at ambient temperature, or it can be cured by the application of heat, and once fully cured the packer is deflated and removed.

In the early 1990s patch repairs systems were being increasingly used by Water and Sewerage companies (WaSCs). This was partly because their capital expenditure budget was based on renovating manhole to manhole lengths. If a section of sewer only contained one or two defects then it was much cheaper to patch repair these than to line the complete length.

Unlike the extensive research that had been undertaken on full length linings there was very little independent research on these repair systems at the time. In 1995 WRc started conducting research on localised sewer repairs techniques which included full scale structural loading trials within the WRc Underground Testing Facility. The structural performance of buried clay pipes was measured with and without patch repairs and the main conclusion was that the performance of the repaired pipe was such that the patch repair did not have to be structurally designed.

The most important issue was that the resulting repaired pipe needed to be leaktight so that infiltration would not occur. Infiltration has the potential to erode the ground surrounding the pipe which in turn can reduce the support the pipe receives, eventually resulting in collapse.

Hydrostatic testing

A short term external hydrostatic pressure test was subsequently developed whereby 300mm clay pipes with a defect cut out at the centre are repaired with a patch repair. Water pressure is then applied externally and any infiltration through the repaired defect is measured. This test has now been developed into a six month long test during which the external water pressure is varied daily and there are also wet and dry periods. These variations are intended to simulate tidal and seasonal variations in groundwater levels.

Infiltration through the repaired defect is measured and a pass/fail level has been set which is equivalent to that allowed for a new sewer. This leaktightness test is also now a requirement of compliance with the WRc Drain Repair Book, 2nd edition.

The hydrostatic test has also been developed so that joint sealing and flood grouting systems can be tested. WRc is also currently modifying the test procedure for lateral connection 'top-hat' (CIPP) systems so that they can also have their leaktightness measured.

Full length linings

One of the benefits of CIPP linings often quoted was leaktightness, but recent testing on CIPP lined clay pipes above ground has demonstrated that the majority of resins used shrink. This forms a small annulus between the lining and host pipe and in the ground this annulus allows any groundwater present to track between the lining and host pipe and exit into the sewer at unsealed locations, e.g. lateral connections and manholes.

WRc is currently running a collaborative research project (reference CP308 Infiltration reduction capabilities of cured-in-place linings, more details www.waterportfolio.com/CP308) to quantify the amount of infiltration that CIPP systems allow.

The major conclusion to date is that systems which have passed the leaktightness test use epoxy resin which does not shrink as much as the more commonly used, and cheaper, polyester resin. The testing to date has resulted in a lot of the manufacturers and suppliers having to re-think their products and do further development work on their systems as well as being careful what they claim!

For further information contact WRc at andy.russell@wrcplc.co.uk

Successful tunnel communications

Radiocoms Systems Ltd (Radiocoms) is a specialist hire and equipment sales company for two-way radio communication solutions. Radiocoms was founded in 1974 and has become a leading provider of communications, supplying predominantly the construction, petro-chemical and offshore industries, defence and public sectors, with clients including the MOD and many fire services nationwide.

Radiocoms has built its name around quality, reliability and professionalism throughout the UK and Europe by providing a solutions-oriented approach to every project undertaken.

Within each industry sector, there is now an increasing requirement for tunnel communication systems that can encompass not only two-way radios but provide telemetry remote control and monitoring.

'Leaky Feeder'

Above ground, two-way radio communication is feasible by using a surface antenna system to boost the radio signal. However, this method does not work in underground situations such as in tunnels because the radio frequency suffers from a high level of attenuation. The solution is to replace the antenna system with a cable that is designed to leak the radio frequency at regular intervals, allowing the radio transmissions to continue; this cable is known as 'Leaky Feeder'.

The so called 'Leaky Feeder' system can support two-way voice and data applications as well as full telemetry control of remote equipment.

Provided that the leaky feeder system in place is of sufficient quality, it will enhance the functionality of the system through a Supervisory Control and Data Acquisition (SCADA) interface package.

The benefits of such a system include:

- Remote control of fans and pumps
- Adjustment of ventilation flow control
- Gas Detection Monitoring
- Rapid relocation and provision of control over fans when connected to the leaky feeder

Inherent signal loss compensation

Dependent upon the length of the cable run, there may be an inherent signal loss; however, one can compensate for this with the use of bi-directional amplifiers that are used to maintain consistent signal strength throughout the network.

System configuration

The head-end equipment operates the leaky feeder system by connecting to the leaky feeder cable and a surface antenna (for above ground communications). This provides modulation and demodulation of the radio signals, splitting and combining multiple channels, powering the leaky feeder network and providing the necessary diagnostics in a control room via a transparent link.

Who will benefit from a Leaky Feeder System?

With the ever increasing demands of health & safety, precautions against terrorist attacks, automation and the need to communicate in extreme environments; effective tunnel communications have never been so important, so whenever users are working in a tunnel environment, a reliable and high quality communication system will be required.

Typical applications for such systems include:

- Train Tunnels
- Viaducts
- Road Tunnels
- Mines
- Cabling Tunnels
- Bridge

Two-way radio options

'The leaky feeder cable will always remain the back bone of any tunnel communication system. The only variations will be the equipment that utilise it and the different radio handsets available.' says Richard Hemmings, Radiocoms' tunnel communication specialist.

As Radiocoms is an independent supplier of two-way radios, there are numerous radio options and manufacturers to choose from, depending on the user preference and suitability for the application.

Typically, radios used are enabled with a 5-tone facility, as this allows the radio user to identify the 'caller' via the radio display. Further, with the advent of channel annunciation and call vibrate, the radios have acquired functions best suited to working underground and providing simple, safe operation for the user.

Why use Radiocoms?

Radiocoms is a solutions-orientated company that has a wealth of experience of providing high-quality tunnel communication systems. With plant equipment technology and wireless communications advancing dramatically over the last 10 years, the need for automation of remote devices is an ever increasing requirement. Radiocoms is able to bring together existing tunnel communication technologies (leaky feeder) and match them with today's demands to ensure suitable tunnel communication systems that are effective and delivered on time.

For consultation, tenders or general information on tunnel communications, please contact Richard Hemmings at Radiocoms Systems Ltd on, T: 0208 6801585, F: 0208 686 9433

Underground communications

Philip Smye-Rumsby
and
Craig Turpie

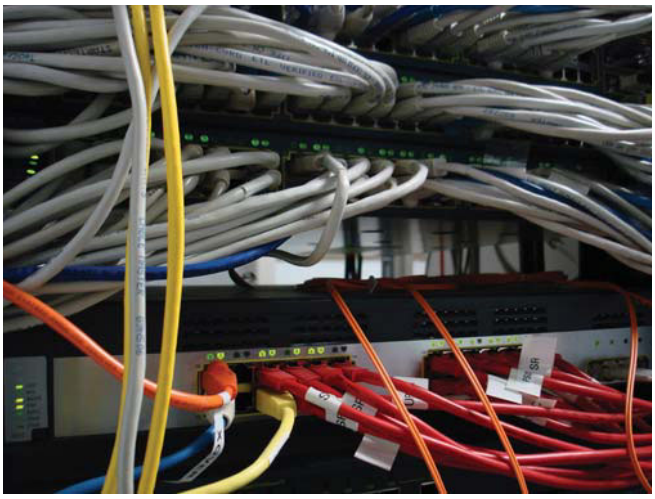
Currently there are realistically only two methods of communications for use underground. These are either via a hard wired network or radio link.

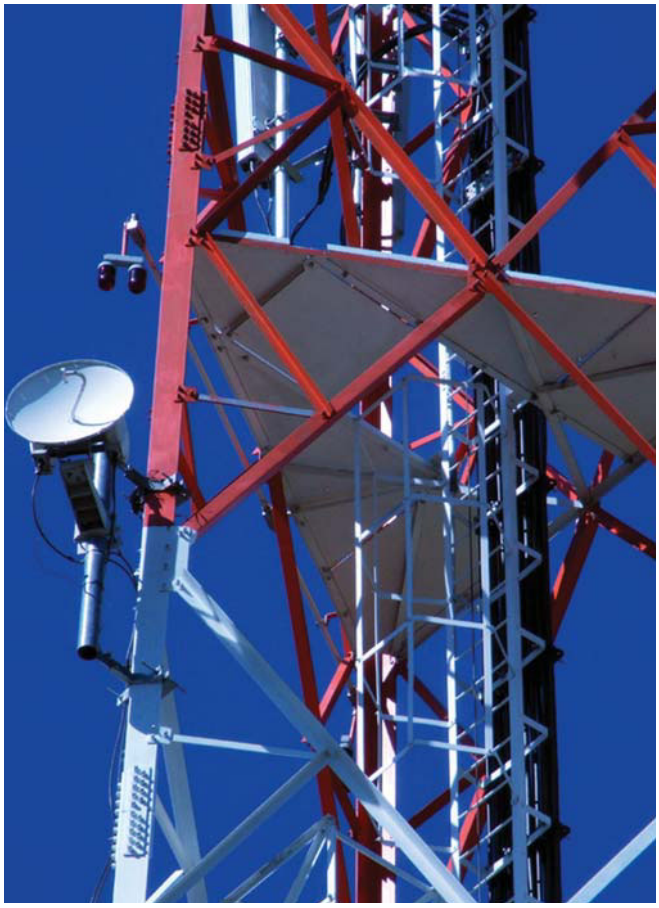
In the hard wired systems it is common practice to use either a telephone based system or an intercom arrangement. Both these tend to be used for general and emergency communications. However the restriction is that you need to be local to a telephone/intercom terminal in order to communicate effectively. Headsets with leads can be plugged into a local point allowing a certain amount of freedom. External speakers on the systems allow a general broadcast to be made, often in conjunction with a flashing light in the event that the environment is noisy. With the advent of Bluetooth, the ability to work further away and unattached from the terminal will expand their usability.

Where hard wired systems come into their own is in highly explosive environments, where the use of radio is virtually prohibitive.

Radio communications gives far more freedom than the hard wired systems; however the planning of it is generally quite involved as signal losses have to be taken into consideration. Do you use a distributed antenna or leaky feeder (radiating cable) system? Well, this depends on many factors. As a rule of thumb the wider and straighter the tunnel/underground site an antenna configuration is probably the preferred option; the costs being generally lower.

This involves installing antennas, sometimes back to back, along the length of the site. If the amount of antennas and length cause the signal to fall away, amplifiers are used to restore the levels. The problem with using antennas in confined spaces is that not only do you have to contend with their physical size and mounting, which may cause an obstruction, but also signal cancellation, meaning the range will be seriously affected, hence the use of leaky feeder.





Underground Communications

Smye-Rumsby Ltd has been in business for nearly sixty years and in communications since 1957.

Over the years we have been asked to design systems for customers not only in the UK but also oversees to meet their needs.

Our first venture into the use of using communications in confined spaces was for English Heritage where they needed to cover a network of tunnels they were opening to the public. This has worked well except for the time when the leaky feeder was covered with metallic paint.

Ferry and cruise liner companies have used our expertise to cover parts of the ship that were RF sterile, by the use of antenna distribution or leaky feeder networks.

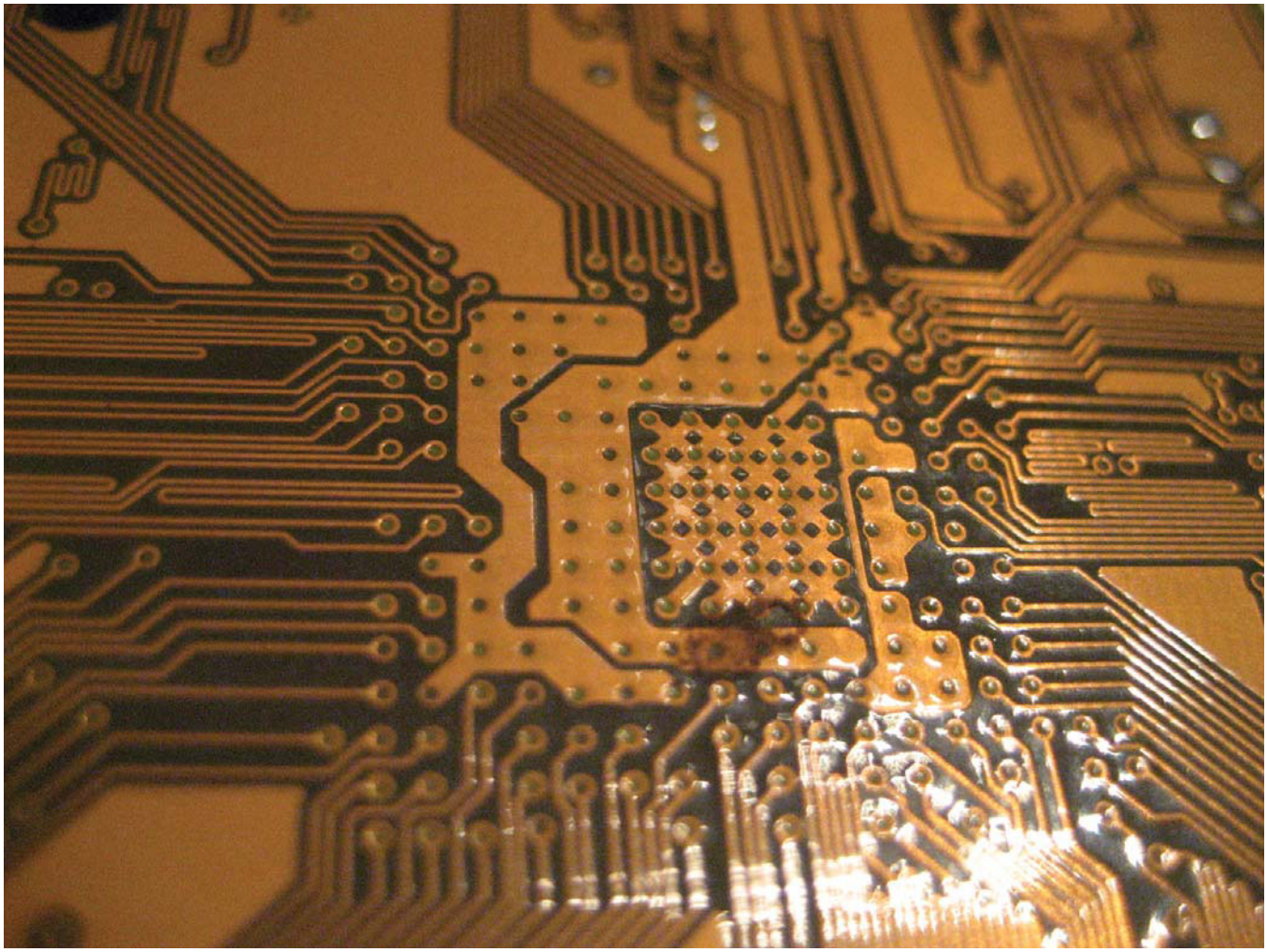
Throughout the construction of the channel tunnel we supplied 24/7 service and support for the communication system which included all the underground tunnels.

We have over several years supplied sub-contract services to the main maintenance contractor by supplying permanent underground communications for the UK wide BT tunnel networks.

In the course of supplying materials for main contractors we were asked if there were a more cost effective radiating cable for temporary installations. We designed and had manufactured a low cost fire retardant LSF 6mm cable that could be re-wound once finished with. From being temporary some of our customers have used it for permanent installations.

Using our experience in providing communications in confined spaces we have manufactured a specialist antenna; not an antenna in the truest sense of the word but a radiating element. This is for use on sites or cranes where height causes the transmission and reception of unwanted signals. This unit restricts the signal to the local area. It has been successfully trialled at the Paradise Street construction project in Liverpool, where the cranes were picking up distant unwanted communications.

We have worked with Aerial Facilities for many years and use their equipment in many of the projects we have undertaken, with them providing line amplifiers, splitters, couplers and combiners where required in both standard and ATEX formats. We consider their equipment is second to none.



What is leaky feeder? The best analogy is a water irrigation system. The pipe has holes in it to 'leak' the water; the larger the holes the more the leakage, but with the trade off of less water further down the pipe. The reverse applies, the smaller the holes the less water closer to the source but more water further down. Size does make a difference! The larger the pipe size the less the losses for a greater distance.

The same applies to leaky feeder systems. The cable is specially designed to leak signal along its length and equally take in. Manufacturers make the cable in many different styles to accommodate the range of requirements and give cable losses vs. frequency. Calculations for signal strengths when using leaky feeder are based on a typical distance of two metres and coupling loss between cable and radio of typically 65dB, with the same loss allowances having to be made as in antennas systems. Every passive splitter introduced will result in a minimum of -3dB signal reduction with couplers at -0.3dB. Losses have to be calculated in both directions which are unlikely to be the same and have to be taken into consideration in the system design; that is, allowing for the weakest link. For example in an ATEX environment the radio power is limited to below 1w, so there is already a deficit to allow for.

Why not use leaky feeder all the time? Well, cost can be a significant factor, but ultimately the coupling and feeder losses will mean that you are limited as to how far you can be from the leaky feeder cable, where an antenna system would still be well within its operational capabilities.

Boosting or amplifying the signal in long tunnels or large areas is expensive and there is unfortunately a limited amount of times; typically eight, that the signal can be boosted. This is due to unavoidable induced noise during amplification.

Can multiple frequencies be used? The underground radio communication system can be treated as any top side installation with antenna combining equipment, the only difference being that an antenna/leaky feeder network is connected instead of an antenna(s); trunk radio is often used at busy sites. However the losses as a result of combining and possibly site amplification, when factored in, can increase the cost of the system quite substantially depending on frequency choice.

To compensate in large systems other designs employ RF amplifiers fed by fibre optics, where a lower power master transceiver is used as the source and reception of the signals. By being fibre optic concerns over signal delays that could cause serious distortion are all but eliminated except runs which have a significant length difference.

Latest European Tunnel Assessment programme results

The latest results of the European Tunnel Assessment programme (EuroTAP) place a Croatian tunnel, the "Brinje", at the top of the list as the best tunnel in Europe in 2007.

EuroTAP 2007 inspected 51 major road tunnels important for transEuropean road traffic located in 13 countries across Europe and concluded that none could beat this Croatian tunnel despite the fact that since 2004 tunnels in the European Union must comply with a Directive prescribing minimum safety standards for road tunnels. The Brinje, a 1.57km tunnel opened in 2004, located on the A1 between Zagreb and Split displayed winning features in all safety categories: low risk traffic flows using two tubes, 24 hour monitoring from a tunnel control centre manned by trained staff; immediate notification of traffic disruptions, use of lay-bys or emergency facilities; additional escape and rescue routes well marked by evacuation lighting and good indications of the escape direction and the distance to the nearest exit. Over the life of EuroTAP, Croatian tunnels have received surprisingly good ratings. Despite the high standards already achieved, Croatia's operators want to optimise their tunnels further.

At the other end of the scale the Paci 2 tunnel located in southern Italy on the A3 between Salerno and Reggio Calabria was the clear loser of the 2007 EuroTAP assessment. This tunnel is nothing more than a "black hole" which has not been refurbished at any time in the last four decades. Even more depressing, it would appear that this situation is unlikely to change any time soon.

It is worrying that three years after the adoption of the European minimum safety standards for road tunnels EuroTAP is revealing that one in five tunnels is sub-standard and fails to meet the minimum requirements. Current research shows that optimal road infrastructure plays a crucial role in minimising road deaths and serious injuries. Road tunnels are important for reducing congestion, improving traffic flow and often offer a safer transit than the open road. However when an accident occurs in such a confined space the consequences can be disastrous. The provisions of the directive are intended to put in place the necessary preventative, mitigating and remedial measures to assure the safety of road tunnel users.

The 12 independent European motoring organisations that make up the EuroTAP platform are committed to eliminating from the transEuropean road network tunnels that are no more than "black holes". At the same time EuroTAP is collaborating with operators, national and European legislators and the wider public to promote excellence, identify innovations in tunnel safety and inform tunnel users of these developments. Ultimately the automobile clubs believe that their members and mobile consumers generally should be sufficiently informed to demand the quality and safety they deserve.

Promising innovations in 2007 include the creation of an online database containing all publicly available information on the EuroTAP tested tunnels. In Austria, new steps have been taken to separate bi-directional traffic in single tube tunnels.

An example of a road tunnel

The Trebsing tunnel in Austria is a shining example of EuroTAP's concept of tunnel safety with smooth traffic flows and minimal risk of accidents. In this single tube tunnel, a concrete wall has been installed to separate the bi-directional traffic. In a single strike the risk of head-on collisions has been completely annihilated. This elegant solution also minimises the financial and ecological impact of a tunnel. It is particularly suited to tunnels with lower traffic volume where the building of a second tube would not be sustainable.

It is encouraging to see that EuroTAP reports and recommendations have prompted positive reactions among tunnel operators and public authorities including increased investment together with the upgrading of a whole series of tunnels across Europe like the Rovira Tunnel in Spain or the Ganzstein in Austria. These innovations and improvements go in the right direction if lives are to be saved in the event of tunnel accidents.

Reinhard Rack, member of the European Parliament, author of the European Parliaments Report on minimum safety standards in road tunnels said in 2004, "We have developed and adopted the Directives and Recommendations on how to build and operate safe road tunnels. Now we need to educate road users."

On 9th May 2007 EuroTAP joined Professor Rack, the European Commission and other international experts to examine what progress has been made. This dinner debate focused on what is still needed to optimise "The future of road tunnel safety in Europe".

Insuring tunnelling projects

A special report from Heath Lambert

In the article "Insurance – Managing the Risk of Tunnelling" in the first edition of Going Underground, the emphasis of the story was on how insurers looked to understand the risks involved in tunnelling projects and how they like to work together with the contractor and principal to try and reduce risk to a minimum level.

In this article, we will look at the role of the Insurance Broker in this process and the relationship between broker, client and underwriter, which is critical for the successful placement of an insurance programme for a tunnelling project.

We will also look a bit more at the insurance covers available for this type of project and the need for clear and unambiguous claims settlement procedures.

Tunnelling and tunnelling works, as we all know are a high risk business.

The many variables involved, in terms of ground conditions, methodology, fire protections and other risk management issues along with potential delay to the completion of the project, all lead to the requirement of a "fail-safe" protection in the event of physical loss or damage to the project.

The normal solution under this scenario is risk transfer to insurers.

However, the choice of insurance broker, who acts as intermediary between the insured and the underwriters, is often overlooked when it comes to identifying the real issues for the risk transfer solution and, it is often left to unprepared or un-knowledgeable generalists to have to go to the insurance markets of the world to place risks of this nature.

In order to go to underwriters to get the right terms and conditions for a risk of this nature, it is essential that the broker must fully understand all of the technical aspects of the project. To do this they must employ their own engineering specialists who are fully conversant with all aspects of tunnelling – from soil mechanics to methodology and beyond into risk management and the operational aspects of the works.

From an insurer's perspective, underwriters will need as a minimum the following information:

- Full Design details including, but not limited to soil investigations, risk assessments and ground reference conditions.
- The contract value broken down between major areas of work
- The contract conditions to be employed and under which the work is being carried out
- Project location and exposure to natural catastrophe perils (e.g. Earthquake)
- The construction, testing & maintenance (defects liability) periods of the project
- Key methodology statements
- Details of the Risk Register for both design and site operations
- Schedule of surrounding 3rd party infrastructure
- Project Risk Management Plans including site organisation plans, Training plans, inspection and test plans and risk assessments
- Independent Risk Assurance
- Plant selection criteria
- Management Plan
- Audit Plan
- Value Engineering Proposals

Once this information has been provided it will be the broker's job to put the information into a market presentation in a meaningful and concise manner that will aid and assist underwriters in their deliberations. A key job here will be to analyse the detail provided and show the fit of the project in line with the Joint Code of Practice for Tunnelling Risks which most major insurers who operate in this area will want to see clear compliance to.

The extent of cover available from insurance markets will largely depend on a number of factors some of which are detailed below;

- Contractor's experience & loss history
- Risk Management procedures to be introduced into the project
- Tunnelling method and ground conditions
- Use of explosives
- Extent of Contractors Plant and TBMs
- Selection of self insured retention / deductible levels
- Extent of Temporary Works
- Whether cover is required for works handed over from subcontractor to contractor or from contractor to employer

Once underwriters have established the risk criteria key elements of cover will be decided. These largely relate to the following;

- Cover for defective design, materials and workmanship
- Cover for defects liability following project completion
- Cover requirements for Advanced Loss of Profits (ALOP) or Delay in Start Up (DSU)
- Cover requirements for contractor's plant & equipment (CPE)
- The level of deductible required and in what circumstances each party is to be responsible for this.

One final consideration will be to establish a claims handling procedure and the selection of a pre agreed Loss Adjuster with experience in tunnelling will be of paramount importance. It will also be essential to have pre agreed points of contact between all parties and to have in place a service level agreement.

Ultimately, the success or failure of protecting a tunnelling project through traditional risk transfer methods will largely depend on the knowledge and experience of the placing broker and his ability to understand and recognise the key factors involved. To do this he should employ his own civil engineering experts who have the necessary expertise to help the principal and contractor and their project to underwriters in the best possible light.

The use of repumpable emulsions in underground tunnelling

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The production of explosives has always been considered a tricky operation. It is the reason why industrial plants are managed under strict health and safety rules. Since the development of slurry and emulsion products, the sensitivity of the explosives has been greatly reduced. Likewise, safety during production has increased. It is therefore possible to move the production unit closer to the user site.

In France, EPC Group has operated some Mobile Manufacturing Units (MMUs) for the production of ANFO for several years. Since 1995, EPC Group has developed its technologies for the production of Heavy ANFO (HANFO) and pumpable emulsion for open pit mines and quarries.

In 1997, the EPC Group completed its range of products and services with a module for production of bulk emulsion in underground operations.

Underground bulk emulsions

In underground mining operations, drilling is mainly done with diameters from 35 mm to 64 mm, and preferably in diameter 45 mm. Only a pure emulsion could meet the needs of a pumpable, waterproof and small diameter sensitive explosive. The last important goal to reach was to move the sensitisation step to as late as possible in the process.

EPC Group, as with its packaged or bulk open-air emulsion, has chosen the gassing process for sensitisation.

The unit, called Morse, is made of:

- One removable bin able to store the non explosive matrix (classified 5.1),
- One volumetric metering pump (positive displacement pump, Moineau type),
- Several tanks and pumps for gassing agents and lubricating water,
- Two flexible hoses, for loading the emulsion in the bore holes,
- A PLC computer to control all the safety, production and quality parameters.

Because none of the raw materials loaded in the tanks are explosive, transportation and storage are greatly facilitated. The sensitisation of the matrix takes place at the end of each flexible hose by means of a static mixer, allowing the minimisation of the explosive amount in the whole process to less than 50 g per hose.

The matrix and the gassing agents travel together to the end of the hose where they are sheared through the static mixer. Only from that point do the different ingredients start to react and to release the inert gas, which will sensitise the matrix. When that reaction is complete, we get booster sensitive emulsion.

Quality control

The quality of the raw materials delivered to the site has been controlled beforehand in the production plant. On site the quality control is reduced to checking the pumping process and the efficiency of the gassing agents. The first condition is carried out by the way of on-line flow meters (with high and low flow alarms). Homogeneity and density can be controlled once per blast with a calibrated vessel and a portable scale. Thanks to the kinetics of chemical reaction, the final sensitivity and density are reached a few minutes after the product has been pumped into the borehole.

The Morse Unit

The MORSE (Repumping and Sensitising Emulsion Module) is built in a stainless steel frame, fitted for different handling possibilities, crane or forklift truck. The removable tank can hold more than one ton of matrix. Two hydraulic motors powered by electricity drive all the pumps. The Morse unit is fitted with two flexible hoses. Their external diameter is 25 mm and their usual length is about 25 meters. On the end of each hose is a static mixer and a spraying nozzle. The pumping and sensitisation cycle is started from a remote control box. An air-powered actuator operates a three-way valve to feed one or the other hose. A blue light displayed on the control box indicates if the line is working or ready to be used.

The operator can use the nozzle to push the booster and the detonator to the end of the borehole. A mark on the hose will help him to check the correct depth of the hole. When he presses the button, the PLC computer ensures the correct sequence of the cycle. It checks the different pumps' rotation speeds and the flows of additives, which are the guarantee of a

good quality production. It also checks parameters like pumping temperature and pressure, no flow and position of valves, which are conditions of prime importance for safe operation. A warning light on the control cabinet indicates any minor fault. Any major trouble, like over temperature or over pressure causes an immediate stop of the MORSE. A safety message is displayed on the control screen.

During pumping, the pressure in the nozzle pushes out the hose, providing a perfect filling of the borehole. The light on the control box indicates the end of the cycle to the operator. A mark on the hose allows to check the empty length of hole left. Pumping rate can be adjusted from 30 to 60 kg / min. It takes usually only a few seconds to load a borehole.

The New Morse Unit

The first Morse unit used in France was a research and development tool. In the light to the first experimental tests, a stainless steel frame was built. An integrated multi channel display screen also replaced the individual displays, which was more convenient.

The Sigirino Tunnel

The field tests started in April 1999 in the Sigirino tunnel (located in the TESSIN canton). This tunnel is a project already 2500 meters long driven in very homogeneous hard gneiss. The final length should be about 3000 metres. The delivery of matrix from the production plant was done with several 1-ton bins. A crane was used to empty these containers in the Morse tank.

Additives were delivered in 50 kg drums. For the loading the Morse truck backed close to the drill where connections for electricity and compressed air were available.

Conclusion of the campaign

People have quickly trusted the unit because it delivered a reliable quantity of material. The operators were less tired handling the hoses instead of cartridges. The tunnel manager has appreciated the reduction of the explosives stored and handled. In term of mining, the bulk emulsion is well adapted for underground use.

The optimised blasting pattern allows a reduction of explosive energy of about 30%. The relative low weight energy compared to stronger cartridge explosive is compensated by the complete filling of the boreholes and the better transfer of the explosion energy to the rock mass. Once again, the high performance of the bulk emulsion in underground blasting is proved.

Mitholtz Tunnel

While the trials were driven in Sigirine, two other Morse units were built by Nitrochemie to be sent in the Mitholtz tunnel. This work is a piece of the tunnel project called Alp Transit. Two other small all terrain trucks received the units N° 2 and N° 3. They were operational at the beginning of September 99.

The Mitholtz project is made of four distinct headings advancing from a central starting point. An access gallery leads to that central position from the open-air road in the Kandertal valley.

SSE has established a base inside the central part of the tunnel. At that place were located the matrix storage tank, the plastic tanks for gassing agents and the means necessary to handle the products. Matrix bins were brought from the factory straight to this place with a standard truck. A small building for minor maintenance operations and operators' lockers was available. The two trucks were parked in that area and they rarely went out of the tunnel.

Blasting pattern

Because the use of Morse units has been intensive in this project, a lot of different patterns have been used. However, the most representative blasting pattern is the following:

- Section: 62 m^2
- 93 holes with 25 profile holes
- Drilling diameter: 45 mm
- Pattern: 1.10 m x 1.10 m
- Burn cut with 2 void holes (diameter 105 mm)
- Vibration problems then 4 void holes 105 mm
- Length: 4.40 m
- Boosters: 0.420 g TOVEX SE
- Priming: Dynashoc LP
- Volume blasted: 272 m^3
- Explosives
- Bulk emulsion: 381 kg
- TOVEX SE: 28.5 kg

From September 99 to April 2000, the two Morse units were operated several times per day. Almost 300 tonnes of emulsion have been successfully fired without major difficulties. It represents about 780 blasts achieved by the consortium workers, trained by SSE. The average time necessary to load the face, using the two nozzles has been less than 30 min; the fastest loading has been done in 19 min.

This second industrial operation shows that time is saved by using Morse technology instead of traditional method by:

- The increase of the pattern: 1.1 per 1.1
- the rapidity of loading with the Morse module in all conditions encountered during the blasts.

Conclusions

EPC Group has chosen a pragmatic method to develop and improve the Morse system. The total amount of bulk emulsion produced with the Morse technology in Switzerland represents at the end of April 2000 more than 450 tonnes and more than 900 blasts.

The total amount of explosives pumped with this system on seven projects is 1000 tonnes over 2500 blasts.

In the light of the different operations driven in the Swiss Alps, the Morse technology is safe, simple and reliable to use in underground industrial operations:

- For operators, the benefits are the reduction of risks and pain due to the handling of explosives and the reduction of the noxiousness of fumes.
- For the contractors, beyond the reduction of explosives stock control, productivity is increased due to the extension of the medium pattern, the rapidity of explosive loading and the shorter ventilation time.
- In terms of blasts results, the bulk emulsion stand the comparison to dynamite or aluminised slurry.

EPC group, with the collaboration of SSE is still improving the Morse technology. At the end of 2004, 16 Morse units are operational with additional units being manufactured for Europe and other parts of the world.

South North pipeline

Malcolm Barber

and

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Penspen Limited

The Republic of Ireland and Northern Ireland currently have two independent gas transmission systems. Northern Ireland's gas is supplied entirely by the Scotland-Northern Ireland Pipeline (SNIP) from southwest Scotland and serves the city of Belfast. BGE recently completed the North West Pipeline serving Coolkeeragh power station, and additional industrial, commercial and residential customers are being supplied as the system is further developed by Firmus Energy.

The Republic of Ireland currently imports 90% of its gas through two inter-connector pipelines from southwest Scotland. This is supplemented by diminishing supplies from the Kinsale Head field, offshore of Cork.

The Corrib field, offshore west of County Mayo, is currently being developed and will cut the proportion of gas imported from Scotland by approximately 50% in due course.

Bord Gáis Éireann (BGE) owns and operates the Republic of Ireland's gas transmission system. BGE recently constructed and commissioned a 18 inch diameter welded steel transmission pipeline. It links the Gormanston gas terminal in the Republic to the North West Pipeline at the Ballyalbanagh terminal (near Ballymena) in Northern Ireland, a distance of 157kms. This important new pipeline will provide much needed gas to several towns in Northern Ireland.

To ensure a safe and reliable operating system, several above ground block valve stations were also built along the route, serving the new pipeline.

The pipeline route

Great care was taken to comply with the views and conditions applied by Local Councils, and future planning issues were noted. Landowner matters were dealt with directly by BGE's own wayleaves department and a team of Agricultural Liaison Officers on the ground. An Environmental Statement was prepared to support the pipeline planning application which considered environmentally sensitive areas and known archaeological sites. It offered means of mitigation as agreed by the Authorities in granting BGE authorisation to build the Pipeline during 2006 with final land reinstatement due for completion in 2007.

In the Republic of Ireland, the southern terminal of the South-North Pipeline is an Above Ground Installation (AGI) at Gormanston, close to the landfall of the Second Inter-connector Pipeline from Scotland, built in 2001. From this terminal, that lies on the East coast and about 40km north of Dublin, the pipeline crosses beneath the M1 and runs generally parallel with the motorway on its western side. It passes to the west of Drogheda where it crosses 20 metres beneath the bed of the environmentally sensitive River Boyne.

Near to the border town of Dundalk, the pipeline runs through the undulating countryside of South Armagh which is dominated by *Slieve Gullion*, a hill that rises 573 metres above sea level. The pipeline passes to the west of Camlough, Bessbrook and Newry and northwards through "drumlin" country, comprising of mounds and low ridges of rock. Several river valleys are crossed, and also two railways. Northern Ireland's two motorways, were crossed using trenchless drilling techniques.

South North Pipeline

Pipeline construction

BGE let the construction of the Pipeline to two separate joint venture contractors. Work began in January 2006 with Penspen/RPS managing the project on site for BGE. With a mild winter, the contractors were able to access the land during February to begin the task of fencing off a 30 metres working width (spread) and removing top-soil. They cleared approximately 1200 metres per day using teams of bull-dozers, earth-movers and excavators.

Prior to this, BGE had received the AGI materials at their Cork premises and Penspen/RPS had received nearly 9,000 steel pipes in 18metres lengths and more than a hundred factory pipeline bends from Germany, at three pipe dumps. Each contractor transported its share of pipes to the spread, welded them together achieving a rate of 1,000 metres per day, with every welded joint inspected and x-rayed.

A team of archaeologists watched top-soil removal for signs of archaeological debris. Despite geo-physical surveys and studies of existing records, numerous sites were unearthed.

Elsewhere, specialists were drilling beneath the major crossings using various techniques such as: Horizontal Directional Drilling at the River Boyne, and auger-boring or pipe-jacking under roads and micro-tunnelling below rivers. Several rivers and a railway were carefully open cut due to the hardness of the rock that denied the use of drilling.

Once the pipes were welded into several manageable tubes they were lowered into a two metres deep trench and the trench was then backfilled using selected and compacted material. The pipeline was then hydrostatically tested in sections as a final confirmation of its integrity and fitness for purpose. Meanwhile, civil and mechanical workers built nine above ground installations and then the whole pipeline was tied-in for a final calliper pig test to prove the integrity of the pipeline dimensions.

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