	TRENCHLESS TECHNOLOGY RESOURCE CENTRE	
INTERNATIONAL SOCIETY FOR TRENCHLESS TECHNOLOGY	TRENCHLESS TECHNOLOGY GUIDELINES	THIRD EDITION
	SERVICEPIPE/LATERAL CONNECTION RENOVATION AND LOCALISED REPAIR TECHNIQUES AND SYSTEMS	LAST UPDATED NOVEMBER 2008

OVERVIEW

A lot of effort and emphasis has, over the years, been placed on the repair, renovation and replacement or new installation of 'main line' or 'trunk' utility services and other pipeline or cable networks using trenchless techniques. Within this there has been significant talk about reconnection of service pipes and lateral connections after the 'mains' work has been completed. Various studies have shown that whilst much of the work to prevent inflow and infiltration into sewer systems and to prevent leakage from pressure pipe networks such as the water supply has achieved good results, without treating the service pipe or lateral connections often the problem is not cured.

Many analysts now accept that for every 1 km of main line pipeline, be it pressure supply or waste removal, there is about 1 km of service pipe and lateral connection. Studies have also shown that many of the leakage/deterioration problems exhibited by pipeline services in general to and from residences and businesses are associated with the service pipe or lateral connection pipes. This of course means that treating the mains pipes only can only ever solve part of the problem.

The following will highlight the currently available trenchless systems that can be utilised to assist in solving the service pipe and lateral connection problems.

Also, whilst many trenchless techniques are aimed at larger scale operations, in the renovation sector it is not always the case that such 'whole system' techniques are required for either manhole-to-manhole sewer works or pressure pipe repairs. Where localised ground movement, root intrusion or joint failure/leakage has occurred, amongst other possible defects, there is a need for systems that can address a localised problem. Many of the major manufacturers have risen to this challenge, and developed a spectrum of techniques for this type of situation that addresses this situation in a more economic and practical way than total manhole-to-manhole renovation or replacement. As will be seen in the following, many of the systems developed for this industry sector are simply versions of the main line manhole-to-manhole techniques discussed elsewhere in these Guidelines.

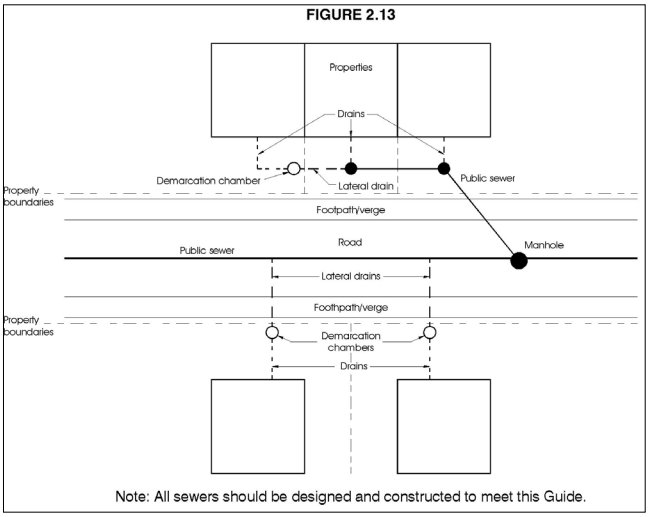
These smaller scale techniques often lead to less cost and disruption, even as compared to the larger scale manhole-to-manhole trenchless techniques used for pipeline renovation, and they can be very specifically defect targeted.

Disclaimer: This document is provided for historical reference only. This guideline has been replaced by the new Trenchless Technology Charts and Descriptions on the website. Be aware that some links may no longer work. Use this information at your own risk.

CONTENTS (click the highlighted more link to see the topic required)

SERVICE PIPES AND LATERAL CONNECTIONS

What is meant by a service pipe or lateral connection? In most cases, in most countries, these terms are used to define the section of pipeline that delivers a given utility or product to the end user. The pipe in question runs between the main or trunk delivery pipeline (in the case of services such as water or gas) or the trunk collection pipeline in the case of wastewater (both storm and foul if collected separately). In many, if not most, countries the responsibility for these pipelines rests with the owner of the property or land under which they run and not with the main utility or service provider, such as the local water company/authority for example.



A schematic showing lateral connections from the main pipeline to properties.
Picture courtesy of WRc.

This generally means that they are not inspected or monitored in any way unless they cause a problem or fail completely. At such a time, the cost of the repair or replacement also rests with the property owner.

More often than not this means that, provided the service has not failed completely, any leakage into or out of the pipeline is either unknown or ignored unless it causes disruption at the surface.

It is this deterioration in the pipelines that gives rise to the problems faced by water companies, et al, when it comes to minimising losses from delivery system or pollution from waste collection systems as it is generally not their responsibility to fix.

Some countries, currently the UK in particular, are investigating the potential for bringing these service pipes and lateral connections under the control and responsibility of the main utility providers to ensure that problems with the pipe can be dealt with in a timely and cost effective manner. This will also help to ensuring that repairs or replacements to or of the trunk mains on the networks are not simply wasted time and effort because of the problems emanating from the service pipes or lateral connections. In 2010 it is likely that the UK water companies in particular will be given responsibility for water service supply pipes and wastewater collection drains that run beneath private properties and the repair and maintenance requirements that these have.

With the estimate shown above that main : lateral pipelines run on about a 1:1 basis in terms of length, this will be a massive expansion of the asset responsibility for the individual water companies.

- Problems often associated with service pipes and lateral connections include:
- Leaking connections on pressure pipes, causing loss of costly fresh water supplies
- Tuberculation causing low water pressure as capacity is restricted
- Potential for ground destabilisation
- Low pressure of service to the customer
- Leaking joints/connections to the trunk main on sewers
- Pipe collapses
- Ovality

All of which have the potential for causing foul water contamination of the surrounding ground and possibly local fresh water sources, voiding and potential ground destabilisation, reduction in flow capacity, root intrusion etc.
All of the possible problems areas can be and are treated with different techniques and equipment. Given that service pipes and lateral connections generally have differing problems to solve, it is probably best to deal with the problems of each separately.

SERVICE PIPES OVERVIEW
The term Service Pipe is generally accepted to be pipeline or cable that provides a utility to a property rather than remove a flow from a property. This term would therefore include gas supply pipes, water supply pipes and power and telecoms cables. In terms of cables, as most are simply replaced if they fail, the option of using rehabilitation techniques would not normally be applicable.

Service Pipe – New Installation
Where a service is in such a condition to warrant complete replacement there are two options: Install a completely new service by open cut or by using a boring technique such as auger boring, HDD or utilising an impact moling/earth piercing hammer. This would normally mean installing a completely new pipe or cable into the ground, abandoning the old one, and making a completely new connection to the trunk main.
Open cutting of course carries all the usual disruptive disadvantages that are commonly accepted such as inconvenience to the property owners, interruption to business, excavation of possibly landscaped surface features etc.
Auger boring, HHD and impact hammer techniques are covered more fully in Section 3 of these Guidelines and details of the options available and how they differ can be found there. Each has differing advantages and disadvantages according to the circumstances prevailing at any individual site and the type size and length of service connection that needs to be made. Each system offers a variety of options for pipeline installations and also the option to lay pipe as a duct for cables.

Service Pipe – Replacement
The option to use Online Replacement to re-establish a service *insitu* has become increasingly popular over the past decade or so with the development of the various pipe replacement systems such as pipe bursting, pipe reaming and pipe pulling systems. These techniques are covered more fully in Section 4 of these Guidelines and full details can be found there.
In short however, Pipe pulling offers the potential to pull the old pipe out of the ground whilst placing the new pipe in the void thus created at the same time and generally utilises strong winching systems.
Pipe Bursting and Pipe Reaming entail destroying the old in the ground using a bursting head or cutter system pulled by a machine at one end of the lateral pipe length. At the same time as the old pipe is destroyed, the pieces are forced aside into the surrounding ground using an expansion head creating a void into which the new pipe can simultaneously be pulled.

Service Pipe – Renovation
To be able to effectively renovate a service pipe it would need to be of a size that was suited to renovation techniques. This often precludes the use of renovation systems in pressure pipes. In many cases simply cleaning the pipe may be sufficient to count the pipe as renovated. This does however mean that it has to be of sufficient diameter to accept cleaning

equipment such as a jetting head etc. If cleaning is not an option due to access difficulties then one of the options already mentioned should be considered.
If, once cleaned, the pipe is still in need of further renovation to make it serviceable other options are available. These include spray lining or full lining using either a 'soft' liner system that is suited to the utility in question or sliplining with a new, normally plastic pipe. Many services may be too small in diameter to utilise these options however.
Systems are available that offer temporary repair to seal a leaking pressure system from within (see later under Localised repair systems). This gains the engineer time to plan an effective ultimately long term solution to the problem.

LATERAL CONNECTIONS OVERVIEW

The term Lateral Connection is generally accepted mean a pipeline that carries wastewater from a property to the main sewer network. In some case there are two lateral types serving a property one for foul water flows and one for storm water flows, although in modern developments this may generally apply more to business sites than to residential ones.
This being the case the need to ensure that any work being carried out on the pipes has minimal affect on the local businesses is paramount. To this end there are various trenchless techniques that can be utilised for such work.

Lateral Connection – New Installation

For short limited impact pipeline installations the open cut techniques should not be ruled out. However, depending on the size, length and type of new installation required there are a variety of techniques that can also be utilised. Most of the following are covered in greater detail in Section 3 of these Guidelines.
Where the gradient of the installation is quite high and the alignment accuracy requirement is not, it would be possible to utilise an impact hammer system to install the new lateral pipe. Any significant changes in level over the length of the bore should be overcome by the fact that the general gradient is steep. Systems exist that offer the facility to use short start pits and so minimise the need for excavations at either end of the route. Where line and level and subject to more stringent requirements however the use of impact hammers is likely to be unacceptable unless a steerable mole is used. These however often require access from surface to modify steering, so over shorter length bores, steering access pits might be outweighed by the benefits of simply open cutting.

Pilot auger boring is used to install a new lateral connection pipeline.
Picture courtesy of Naylor Drainage

Improvements in directional control and the introduction of guidance systems which allow for more accurate grade control do open the possibility of using HDD techniques for such installations. However the costs of mobilisation of such systems may limit their use to longer individual lateral installations or a site where several new laterals need to be installed in the same area at the same time, making it more cost effective. The pipe installed using this system would generally be a plastic type.
On sites where there is a need for concrete or clay pipe installations there is the option to utilise pilot auger boring or microtunnelling techniques. Microtunnelling itself may prove to be an expensive option on short to medium length lateral bores of smaller diameters and is

therefore likely only to be used on long length larger diameter installations. However pilot auger boring is proving increasingly popular for this type of work as the launch shaft is generally of a lower specification than that for microtunnelling, whilst offering high accuracy on both line and level. The option to utilise shafts that are planned to be used later as manholes can also make the cost-effectiveness of the system more attractive.
In some countries, where legislation allows, a central single shaft can be used to install individual laterals to a number of properties from one point on the main collector sewer. Known to some as the 'Berlin Method' this option does mean that laterals may run beneath several properties over the length of the drive, a situation that may not be allowed or practical in countries where responsibility for maintenance and repair of the lateral will ultimately lay with the property owners.

Lateral Replacement
Where a lateral connection already exists and is in need of replacement, online replacement options are available such as pipe bursting and pipe reaming. Effectively both systems destroy the existing pipe *insitu* in the ground removing or pushing aside the old pipe fragments to create a void into which the new pipe can be pulled. The advantages of this are that the existing route of the pipeline is re-used so limiting the uptake of new pathways in the increasingly congested subsurface environment; the need to remove and dispose of potentially contaminated pipe is eliminated and the need to use dispose of waste pipe/soils etc in increasingly limited landfill sites is reduced.

A small footprint pipe bursting system (right) being utilised to replace a deteriorated PVC lateral pipe (left). *Picture courtesy of U Mole*

Pipe bursting both in the form of impact hammer systems and static rod bursting systems can be applied to such replacement works. Rod based bursting systems operational techniques are explained fully in Section 3. The impact hammer system would pull in the new pipe as the bursting hammer advances. Increasingly the smaller footprint, cable-based pipe bursting systems have gained popularity in this sector as they utilise minimal size access pits where rod based machine tend to require larger ones. The introduction and availability of segmental short length plastic and clay pipe has also meant increasingly popularity for the systems as this too minimises the need for large scale reception pits.
A further advantage to using pipe bursting techniques is that it is possible to increase the size/diameter and therefore the carrying capacity of the lateral connection if required. This may be necessary where a lateral is being replaced on an expanding business site where ultimately more users would need to feed in to the existing lateral connection.

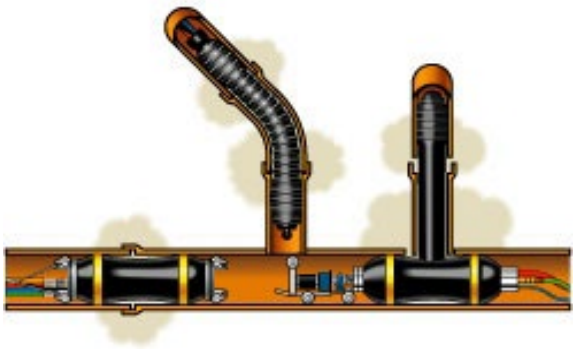
Lateral Renovation
If the structural integrity and condition of the old lateral pipe is sufficient there is also the option to line it to increase/expand its operational lifespan.
The available lining options are covered in greater detail in Section 5 of the Guidelines. Suffice to say that there are today many options in the lining sector that offer good sound

rehabilitation of the existing pipeline including standard CIPP, Steam Cure and UV cure options as well as ambient cure options in the right circumstances. Systems also exist that will allow renovation of the lateral and its connection point in a single operation from within the main trunk sewer pipeline.
The following section covering localised repairs also offers a selection of options that could enable deteriorated lateral connections to be brought up to an acceptable standard without the use of full length lining options. This will ultimately depend on the individual circumstances surrounding each pipe length and all options should be fully investigated before a decision one way or the other is taken.

LOCALISED REPAIR TECHNIQUES AND SYSTEMS

GROUT INJECTION

One of the most common techniques used for localised repairs is that of grout injection. The technique can be used in both main line situations and in lateral connections.
Once a pipeline has been surveyed to establish exactly where the defect or substandard joint is located, an inflatable rubber packer is inserted into the pipe using winching systems that are set up at access points (normally manholes) at either end of the damaged pipeline section. Using CCTV cameras to observe the operation, the specially designed packer is winched into place with its centre over the defect. Once in position the packer is inflated with compressed air. The packer design is such that the ends inflate in a way that forms a seal at either side of the defect isolating it from the remainder of the pipe.



Grout injection packers for main pipe, lateral only and main pipe and lateral repairs. *Picture courtesy of American Logiball, USA.*

The packer has feed pipes running through it, which carry the injection grout material, usually either an epoxy resin or mortar. In the case of the epoxy resin it may be that the feed is via twin pipes that combine at a static mixer just before the injection point to ensure that, once mixed, no hardening occurs in the feed pipes so they may be used time and again with only the static mixer needing replacement.
With the inflated packer in place, the injection grout is pumped under pressure into the space between the two sealed ends. The grout spreads around the packer to fill not only the space between the packer and the pipe wall but also defects in the pipe wall. The space around the packer is such that relatively small amounts of grout are required to achieve the repair and fill the pipe wall defects.
When the packer surround is full, the grout is held under pressure to allow it to harden in place so that no ‘back leakage’ occurs out of filled defects. Once the grout has hardened the pressure is released and the packer deflated and removed from the pipe, leaving a local repair with filled defects and a thin grout skin on the inside of the pipe. This minimises any capacity loss at the repair point due to the grouting process.
Depending on the severity of the defect and its size, packer units are available from as little as 1.2 m long up to 5 m long and from 150 mm diameter up to 2.5 m diameter from various manufactures around the world.
Some manufacturers also make packers that can be used to inject grout from inside a mainline pipe into a lateral, sealing not only defects in the main pipe at the lateral joint but

also defects in the lateral over the length of the packer in the lateral pipe. Operator training is an essential part of using such a system as this.
In terms of the sealing gels themselves, whilst the Acrylate products used in these sealing systems have proven very effective in many circumstances, on numerous sewer renovation projects where infiltration of ground water has been the major symptom, there has however been a suspicion of a potential problem. In certain circumstances, if ground water levels fall, the drying of the Acrylate product may have the potential to cause failure if it is allowed to dry significantly, because there is the potential for it to shrink and become less 'flexible' and ultimately crack. This has been known to lead to failure of the seal and new infiltration occurring when flow levels and ground water return.
From about 2006 over a two year period or so, a new product development programme has created a new gel type that is aimed at overcoming the problem.
Whilst the precise chemical make-up of the new product is commercially sensitive information, essentially it utilises a rubberised acrylate-based chemical to replace a certain amount of the water used in the sealing gel. This dramatically reduces the potential for shrinkage under dryer operating conditions and also keeps the seal flexible, effectively removing the potential of glassification, cracking and failure.

LOCALISED CIPP

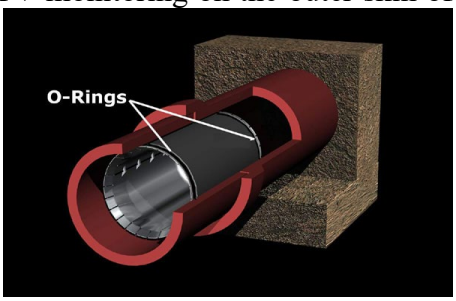
CIPP lining systems have also been developed for use over localised defects such as cracks and faulty pipe joints. Generally using ambient cure resins, the systems utilise short lengths of resin impregnated felt or fibreglass liners, which that are placed around inflatable packers which are winched into position using CCTV monitoring over the defect site. The packer is inflated and held in position for the time it takes for the resin to cure. Deflating the packer and removing it leaves the 'patch' in position over the defect. Various packers are available with some being 'flow through' units which means that the repair can be undertaken with some flow still remaining live in the pipe.
Where circumstances allow, such as the defect being close to an access manhole, the patch can be positioned using an inversion technique in the same way as would be used for manhole-to-manhole. In this instance however the inversion is achieved with a calibration sock/hose that is not resin impregnated and is used only to hold the patch in position during curing. It is designed such that once the patch is set it can be deflated and removed from the pipe. This technique is also very applicable to the lining of laterals from the main pipe, where access to the lateral from the 'customer end' may be limited or not desired.
The design of the liner patch is normally such that there is minimum capacity loss at the site of the repair. Operators familiar with full length CIPP should be able to install such patches with relative ease.
With reference to 'full' CIPP lining, which is covered in its entirety in Section 5 of these Guidelines, it is perhaps apt to touch on the latest utilisation of these 'localised' CIPP lining techniques. Increasingly, it appears, drainage repair contractors are utilising 'localised' inflatable packers to complete short, but full length renovation works as well as those project types described above. They are doing this because it minimises the need to mobilise major lining operations with the associated boilers, steam generators or robotics trucks and other support equipment to complete relatively short length installations. In response to this change some 'localised' systems manufacturers and inflatable packer suppliers have modified the packer ranges available to meet this demand. New packers from manufactures are now available in lengths up to 5 m and are applicable to pipe diameters from 100 mm to 600 mm. By installing overlapping 'localised' liners this enables the shorter length yet full manhole to manhole projects to be completed successfully with a minimal site footprint in an acceptable time frame and cost.

Also under the right circumstances 'full lining' of a lateral connection might be achieved at the same time as competing a lateral connection joint sealing operation (see lateral/main connection sealing section below).

JOINT SEALING

Whilst both Grout Injection and Localised CIPP are both highly applicable to the specific repair of damaged pipe joints, there are other technologies that can also be used to solve this type of problem.

Another commonly used technology is the internal repair collar. In most cases the internal repair collar is an expanding/locking metal cylinder that is surrounded by a rubberised seal. The sealing unit is either winched into position using CCTV monitoring on the outer skin of an inflatable packer or carried on a specially designed remote controlled robot (see later). Once in place the packer is inflated, or the robot activated, pushing/expanding the metal clip against the inner wall of the pipe across the faulty joint. The metal clip is designed with a locking system, so that once expanded to the degree required to compress the seal against the pipe wall, it will not collapse back into the pipe so making the joint repair.



Joint sealing with an expanding shell clip. *Picture courtesy of Link-Pipe Ltd, Canada.*

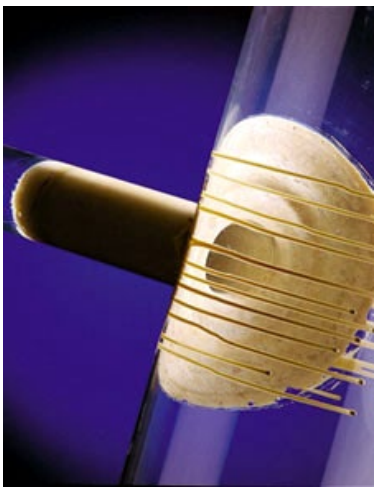
The sealing units are designed to minimise the capacity loss that will occur by using an internal seal of this kind.

These systems are available for pipes of relatively small diameter up to those of man-entry sizes, where the seals are often positioned and installed manually.

LATERAL/MAIN CONNECTION SEALING

Where main pipelines have been lined, in most cases the lateral/main connection has to be reopened using a robotic cutter to re-establish the lateral flow into the main. One long-term problem that has been of concern to engineers is the question of whether this allows infiltration or exfiltration to occur between the liner and the host pipe wall. Some researches say there is potential for a problem and other say not because of the bonding between liner and host pipe. Whatever the truth of the matter, various renovation manufacturers have been trying to address the potential problem with systems to negate it. Some systems utilise injection grout techniques to ensure that the 'joint' between lateral pipe and main is fully sealed.

One technique that has been successfully developed to achieve this is the 'Top Hat' lateral connection seal. This utilises a specially shaped liner, which looks just like a 'top hat' or inverted 'T'. The stem of the 'T' forms the section of liner that is placed into the lateral pipe whilst the 'T' crossbar sits against the inner wall of the main. Resin impregnation of the liner material allows it to be positioned, using a specially designed remote control robotic installer, and held in position for curing of the resin. Once cured, the robot and retention system are removed leaving the 'T'-shaped liner forming a seal across the lateral/main joint. The 'T' stem can be made to pass as deep into the lateral as may be required, which can also make this a specialist 'full' lateral repair system in its own right if the lateral connection is a relatively short one.



A 'Top Hat' lateral/main seal. *Picture courtesy of Trelleborg epros.*

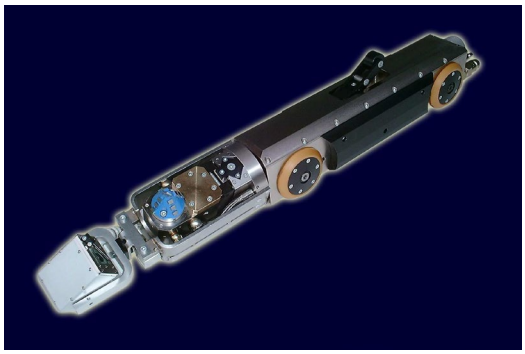
Advantages of this system are that it can be used on either lined or unlined mains if a faulty lateral joint is the only problem to be solved and does not necessarily need customer end access. Training by the manufacturer is often required as the operating system and process can be complicated at first, but once fully understood it becomes relative simple.

ROBOTIC SYSTEMS

As you will have seen in the accompanying Section 5 and text above, robotic systems play a significant part on the pipeline renovation. Not only are they used for surveying and preparation of a pipe before renovation operations, but also for placement and control and monitoring as an integral part of many of the technologies highlighted here.

One area of robotic application that has yet to be touched on is the use of robots themselves as the repair system.

Over the past decade of so, a number of different robot manufacturers have developed a selection of sophisticated, remote-controlled robots that, in themselves, constitute a pipe repair system. Operating as a single unit or in pairs, with the pipe section under repair isolated from the main flows, CCTV robots are first used to survey the pipe in question to determine the extent of damage and where it is positioned in the system.



A typical Grinding Robot with onboard CCTV monitoring system. *Picture courtesy of PMO, Switzerland.*

The second function is to prepare the pipe itself for repair. This usually entails using a hydraulically or compressed-air driven rotating motor mounted on a specially designed robot with onboard CCTV facility, to power a rotating grinding head which can be used to remove scale, root intrusions or displaced lateral pipe intrusions into the main pipe by remote operation from a surface control point. Where individual cracks and defects can be highlighted, the grinding head can also be used to clean these out and prepare them for specific repair.

The next phase, which is where the second robot comes into play on two-robot set ups, comprises using the robot to place repair compounds such as resins or mortars directly into the defects being repaired. This requires the robot to have either an on-board reservoir of grouting material that can be controlled remotely by the operator on surface, or a surface-based supply that can be pumped directly to the robot in the pipe as required via an umbilical.

With the repair grout in place, some robots also have a facility built in which allows them to smooth out the grout in the defect to make a smooth inner wall so as to reduce flow impedance as far as possible. Flows are prevented from running in the pipe for the time it takes for the grout to cure so as to prevent wash-out of the grout.

The CCTV facility then inspects the final repair to ensure that no further work is required at that specific point.

These systems normally require a significant degree of manufacturer training before operators can be deemed sufficiently experienced to operate them in the field alone.

LOCALISED FLOOD GROUTING

The basic technique for flood grouting is described extensively elsewhere in these Guidelines and the use of the technique on a localised problem is essentially the same. The technique for localised operation varies only slightly in that the section to be treated has to be isolated whist maintaining an access for the pumping in and out of the required fluids that affect the repair. Inflatable seals, pipe stoppers and other such equipment can be utilised for this purpose. Of

course, limiting the volume of pipeline in this way can mean that much less of the fluids needs to be handled for any one situation. The technique however is not known to be used extensively for very small, localised repairs due to the level of mobilisation required in terms of pumps, fluid transport trucks etc which tend to be the same as those used for major renovation operations anyway.

PRESSURE PIPE SEALING

Whilst most of the above systems deal with gravity sewer pipes, a recent development in the field of leak sealing without the need for excavation has recently undergone a series of successful field testing and early commercial application in pressure pipelines in the UK Water Industry.

The new system has already been successfully applied in the oil production industry, sealing leaks on water injection pipelines on production wells.

The technology itself is designed around the 'leak sealing' platelets used by the human body's blood circulation system. By adding platelets, specially designed using Biomimetics technology, to a fluid stream in a pipeline, the platelets flow along with the fluid (be it oil, water, gas etc) to a point where there is a leak.

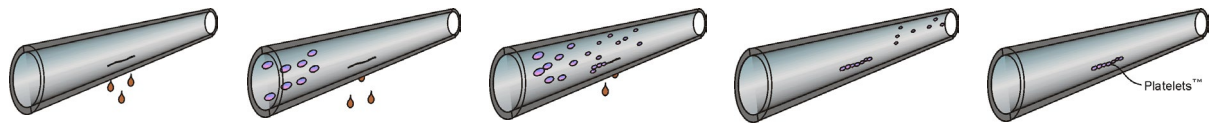
The Platelets, caught in the flow that passes through the leaking fault in the pipe wall, collect at the point of the leak so preventing further flow through the faulty pipe wall. This coagulation of platelets at the leak point then remains in place until the pipe is either lined or replaced.

The Platelets sealing system is not designed as a permanent repair but as a significant 'stop-gap' repair, enabling a more permanent solution to the leak problem to be developed and applied. Whilst not a permanent solution, previous examples of repairs using the system have been designed for an active life of between 6 to 12 months, and in practice the actual repairs have lasted up to 18 months after the initial application.

As part of the platelet design, they can be manufactured with either a radio or radioactive tracing system that enables precise detection of the leak point once the seal has been achieved, so ensuring minimum excavation requirements to access the leak as and when the permanent repair is applied.

In terms of use in domestic water supplies, the supplier manufactures the platelets in a way that is completely non-toxic, so ensuring that its use in potable water supplies is possible without risk to end users.

Operation of the platelet technology for sealing a pressure pipeline leak. *Picture courtesy of Brinker Technology.*



Loss of Containment event

Platelets® introduced and carried down the pipeline due to the fluid flow

Platelets®sealing leak

Seal achieved – excess Platelets® retrieved from the pipeline.

Detection process can be carried out.

MAINLINE CONNECTION

Once a Service pipe has been installed replaced or renovated it must of course be connected to the main pipeline. In many instances this is done using small open cut access pits.

However over recent years systems have been developed that will allow minimal footprint excavation or remote connection.

The first of these techniques is 'Keyhole' excavation, details of which can be found in Section 9 of these Guidelines. Essentially, the system requires a small diameter access hole to be bored or cut in the surface. A vacuum excavation system then removes soil to the depth of the connection point. The connection is made and the soils replaced either with new materials or with recycled original soil from the vacuum excavator if this is deemed useable. Finally the Key cut from the surface originally is replaced and grout into place or a new reinstatement is completed.
There has also been developed a system that allows the connection of a service pipe from within a renovated pressure pipe using a robotic unit. During the reconnection process, a remote operator uses a non-visual technology to locate the service connections from inside a lined main and robotically cuts through the liner at each service opening. A special device is used to tap each valve. As a final step, a sealing nut and gasket are installed in each threaded valve creating a water-tight seal.

SUMMARY

1. Localised repair techniques can be used to address specific defects where the cost of manhole to manhole renovation may not be viable.
2. In gravity systems, such techniques are used to repair lateral connections and short sections of damaged pipe.
3. In pressure pipes, the systems are most commonly used at leaking joints.
4. To be effective, all the systems must be fully understood and properly deployed by the project manager.

Bibliography: The Bibliography may be accessed via the TRC Home page. If none is currently available on-line, please contact ISTT – info@istt.com for further information.

1. ASTM F2454 - 05 Standard Practice for Sealing Lateral Connections and lines from the mainline Sewer Systems by the Lateral Packer Method, Using Chemical Grouting
2. ASTM F2561 - 06 Standard Practice for Rehabilitation of a Sewer Service Lateral and Its Connection to the Main Using a One Piece Main and Lateral Cured-in-Place Liner
3. ASTM Book of Standards Volume 08.04: Plastic Pipe and Building Products 2008 ISBN: 9780803158108
4. Trenchless Technology By Mohammad Najafi, Sanjiv B. Gokhale Published by McGraw-Hill Professional, 2004 ISBN 0071422668, 9780071422666
5. Sewers By Geoffrey F. Read, Ian G. Vickridge Published by Butterworth-Heinemann, 1996 ISBN 0340544724, 9780340544723
6. External Works, Roads and Drainage: A Practical Guide By Phil Pitman Published by Taylor & Francis, 2001 ISBN 0419257608, 9780419257608
7. Sewers for Adoption 6th Edition - a design and construction guide for developers Published by WRC ISBN 9781898920571

Conference Papers: These may be accessed by ISTT members via the TRC Home page Member login.

If there is any information that you consider to be missing from this Guideline or have seen any information that you feel is incorrect please contact ISTT directly stating the omission or incorrect item. ISTT will endeavour to correct any such omission or error subject to further investigation to validate any such claim. Email: info@istt.com