BRAWO® SYSTEMS

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REFERENCES

Trenchless rehabilitation of buildings and properties

BRAWO® Magnavity

smart • efficient • strong

LIGHT CURING ON THE NEXT LEVEL!

Experience fast, reliable and above all smart light curing with BRAWO® Magnavity.
Guaranteed with the usual installation safety and high quality from BRAWO® Tech.

The innovative and unique LED heads allow simultaneous retraction with inversion of the liner. Curing is thus carried out immediately after installation of the liner, without the need for additional insertion of the eel.

smart

- Exchangeable LED heads with integrated operating hours monitoring
- Installation log and interface to mobile end device (USB, W-LAN)
- Reversible dual camera
- Intelligent LED heads with integrated magnetic coupling for electromagnetic remote unlocking
- Plug & Play: Automatic recognition of the LED head used

efficient

- Low power consumption with high light output
- 96 / 192 high-performance UV LEDs with extremely high efficiency
- Saves a complete operation, only one access point necessary
- " Turtle" function for safe curing in the inlet area

powerful

- Very fast curing
- Very good bend flexibility, 87° bends possible from DN 100
- Easy transportation thanks to modular, lightweight construction

BRAWO® Pico

smart • efficient • small

NEW!

NEW LED LIGHT CURING SYSTEM FOR THE SMALLEST DIMENSIONS

Our innovative light curing system is the first system specifically designed for use in very small waste water pipes. It ensures a fast, reliable and especially smart light curing for small nominal diameters.

CONTENTS:

The market for in-house rehabilitation encompasses 47.5 million buildings

Figure 1: BRAWOLINER® rehabilitation of downpipes above the roofs of Helsinki

Rehabilitation of waste water pipes without cutting and demolition work inside buildings using the example of Finland

How it all began ...

Moist walls, musty odours and mould formation are common types of damage in buildings.

The cause of this is often leaking waste water pipes, from which waste water or rainwater leak into the surrounding masonry. A strong reduction in the quality of living and associated high rehabilitation costs are often the result. In this context, it should be noted that the building stock is getting older and many drainage systems have already exceeded the usual service life.

Until the middle of the 2000s, damaged waste water pipes in buildings in Scandinavia were renewed in the traditional way.

To renew these waste water pipes, walls and floors were generally prised open and the old pipes replaced by new ones. High costs and weeks of disturbance for the residents were often part and parcel of the work.

However, with the introduction of spray-sling systems for trenchless rehabilitation (coating process) in the early 2000s, the market changed rapidly. More and more frequently, waste water pipes in buildings have been rehabilitated without cutting and demolition work. The first service providers and engineers, who used the coating process instead of the conventional opening of walls and ceilings, were still considered pioneers of their time.

The advantages, such as in particular a significantly shorter construction period, fewer disturbances for the residents, usually no cutting and demolition work and, consequently, significant cost savings have quickly prevailed.

In 2009, for the first time, the hose lining process was also used for the rehabilitation of downpipes. The process was very well known from the rehabilitation of underground pipelines and was further developed for use in the building.

As a result, it was possible to rehabilitate the entire sewage pipe and pipeline infrastructure of buildings and land without cutting and demolition work. The basis for the market development was created.

The hose lining technology is used to restore impermeability, functional reliability and stability.

Spraying processes are used in particular for the rehabilitation of smaller nominal widths and for the rehabilitation of the impermeability as well as the corrosion protection, as e.g. in nominal widths smaller than DN 150.

It is usually used where the hose lining process meets its technical and economic application limits, such as the rehabilitation of a DN 50 pipe with a large number of bends.

A market volume of 120 million euros per year – in Finland alone

Not least thanks to a legislative initiative of the Finnish government in 2010, the market for in-house rehabilitation, especially in Finland, was boosted considerably.

While the market for trenchless rehabilitation of waste water pipes within buildings was virtually zero at the beginning of the 2000s, the current market in Finland is estimated by market participants to be over 100 million euro in 2017 with over 1,000 workers in this area.

If these figures are extrapolated linearly to the German market, it will have a theoretical market volume of 3–6 million kilometres net length (in-house only) and a turnover of 1.79 billion euros per year.

In-house rehabilitation with BRAWOLINER® in Helsinki-Pehlajesto

Picote Service Oy Ltd. based in Porvoo in Finland has already been rehabilitating waste water pipes inside buildings for more than 10 years. More than 50 employees in four to six columns worked daily on the rehabilitation of drainage systems both in large residential and apartment buildings as well as in single and small apartment buildings. The BRAWOLINER® hose liner process was almost exclusively used.

Figure 2: Typical residential buildings in Helsinki-Pehlajesto, a suburb of Helsinki

Since April 2017 in Helsinki-Pehlajesto, a suburb of the Finnish capital, the drainage systems of several residential buildings have been rehabilitated by Picote Service. The district is characterised by a large number of multi-storey residential and apartment blocks which were built mainly in the 50s and 60s.

In three of these residential buildings, the complete drainage pipes have been rehabilitated without trenches between April and October 2017. In the residential buildings, which were completed in the early 70s, mainly first generation PVC pipes were installed. In the years before the start of rehabilitation, the first damage to the drainage system had already been partially repaired.

These are predominantly leaks that were detected locally by owners or tenants. Against this background and especially considering the fact that the drainage system was at the time nearly 50 years old and had reached a normal service life, the owners had decided to rehabilitate the entire network.

For rehabilitation, a total of more than 1,700 metres of BRAWOLINER® were used in nominal sizes between DN 50 and DN 200. The characteristic data for BRAWOLINER® in-house rehabilitation in Helsinki-Pehlajesto are summarised in Table 1.

Table 1: Characteristics of the BRAWOLINER® in-house rehabilitation in Helsinki-Pehlajesto

Info box: Practical example Helsinki-Pehlajesto	
Number of residential buildings or apartment buildings	3
Completion and commissioning	1971
Number of homes / apartments	126
Number of floors	7 + basement
Material drainage network	PVC, first generation
Length of the vertical downpipes in the building	780 meters in DN 100 to DN 150
Length of the horizontal downpipes in the building	450 meters in DN 50 to DN 70
Number of connections and feeders	Approx. 640
Pipe length and nominal width of the unterground pipes	420 meters in DN 150 to DN 200
Reason for the rehabilitation of the drainage systems	Proactive rehabilitation after approx. 50 years service life; to some extent leaks, brittle pipes
Time for decommissioning drainage per unit	1 to 2 weeks
Total construction time	April 2017 to October 2017
Rehabilitation procedure	BRAWOLINER® DN 50, BRAWOLINER® 3D DN 70 to DN 100, BRAWOLINER® 3D DN 100 – DN 150, BRAWOLINER® 3D DN 150 – DN 200

«Proactive instead of reactive“» – rehabilitation strategies in Scandinavia

In contrast to the frequently used firefighting strategy in Central Europe (only rehabilitate in case of damage, often only selectively), in many cases Finland and the other Scandinavian countries act „proactively instead of reactively“. If drainage networks have reached or exceeded a normal operating time, the networks will be completely rehabilitated. This procedure is comparable in Central Europe and especially in Germany, for example with power lines and the electrical system in residential buildings, which should always be renewed every 30 to 40 years.

The procedure for commissioning a rehabilitation measure is as follows: The owner of the building first decides on the complete rehabilitation of the drainage system. In the case of owner associations (for example, owner-occupied flats), resolutions are initially taken in the context of owner meetings and up to five owners‘ representatives are elected. The owner commissions a specialised engineering office with the further planning. This office organises and accompanies the solicitation, commissioning, building construction and acceptance.

Pipe rehabilitation BRAWOLINER® DN 50

From planning to the building inspection …

For a successful construction process of the often very complex measures, i.e. in particular as little disturbance as possible for the inhabitants of the properties, planning and organization are the key to success. Because rehabilitation is usually done in inhabited living spaces *(see Figure 3)*.

Figure 3: Rehabilitation in inhabited living spaces *Picture credits: Picote*

The procedure for planning and at the same time costing a job basically runs according to a comparable system. The basis for planning and costing are usually existing inventory plans (see Figure 4). Unlike in civil engineering, these plans often largely coincide with the construction work. Discrepancies and a reconciliation of the plans are usually checked or carried out as part of a site visit prior to the submission of a tender. In most cases, a complete inspection of the drainage system before submitting a tender will be dispensed with, since the inventory plans, the site visit and in particular the experience from comparable rehabilitation work from the last 10 years usually suffice very well for the planning and costing. Dispensing with the recording the entire condition before submitting a tender means a significant increase in efficiency, as such an inspection is carried out immediately before the rehabilitation anyway and duplicate work is thus avoided.

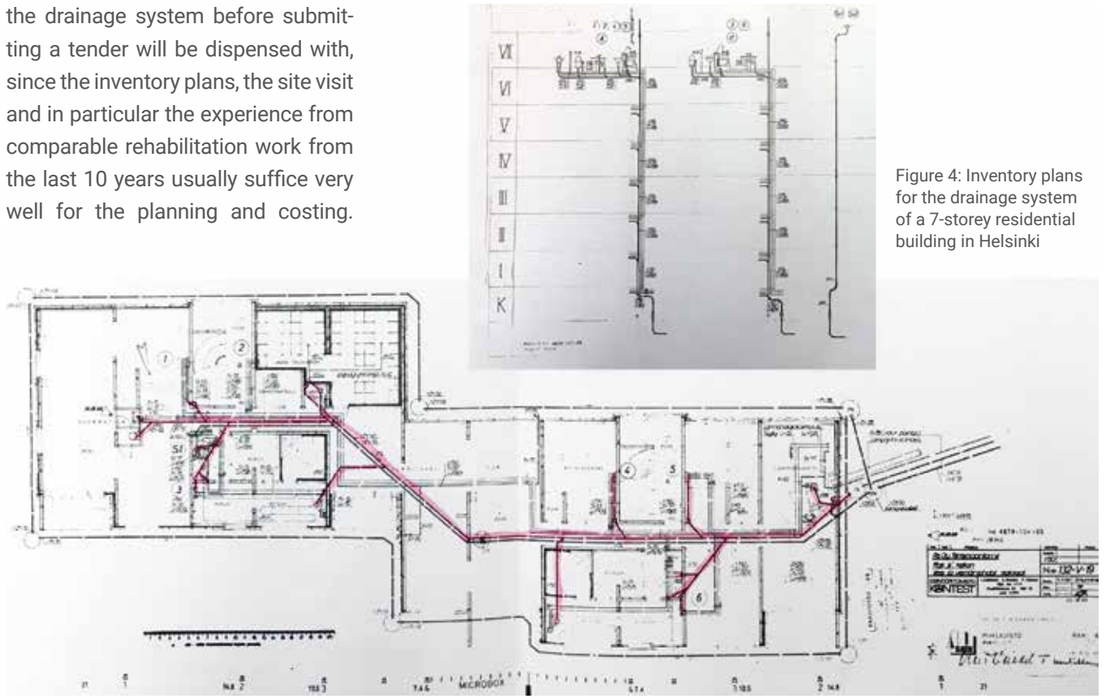


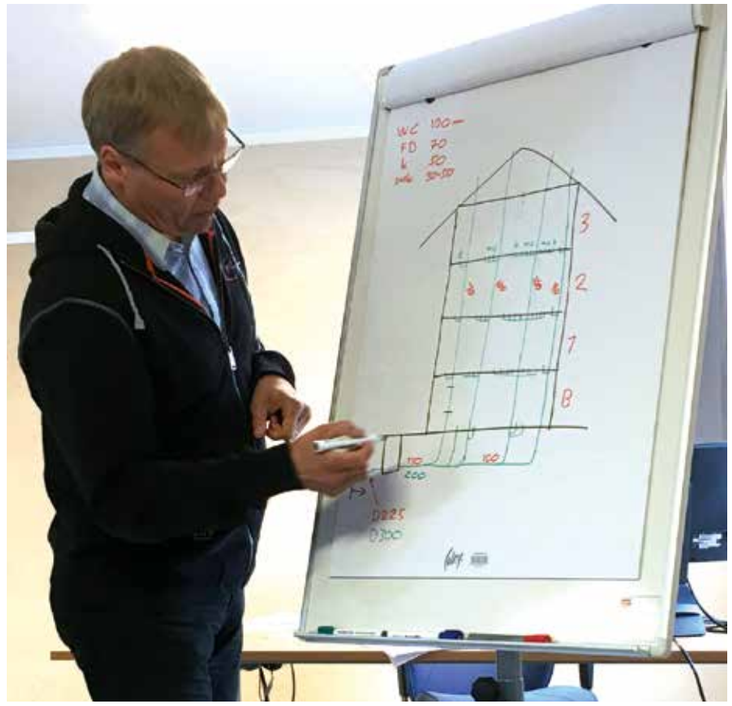
Figure 4: Inventory plans for the drainage system of a 7-storey residential building in Helsinki

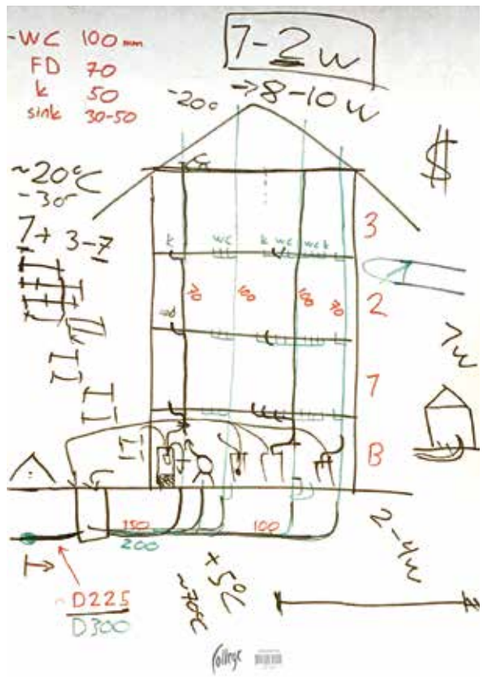
Important influencing factors for the planning and costing are:

- Number of apartments in the building
- Number of floors in the building
- Number of downpipes
- Number of branches and connections
- Length of the waste water pipes (downpipes, connecting pipes)
- Size of the overall job (required number of engineers, project manager on site)
- Personnel costs
- Distance to the operation site
- Supplementary excavation and chiselling work if required
- Sanitary engineering work required

The diameters of the pipes play only a minor role, as, according to experience, these vary between DN 50 and DN 70 for horizontal connecting pipes and between DN 100 and DN 150 vertical downpipes. In some cases, local chiselling and demolition work is required for complex pipelines. These are also – as far as possible – already taken into account in the planning phase.

The scheduling as well as the preparation and organization are very important for a smooth construction process. Beforehand, among other things, it is specified exactly how and where to start, which and how many pipes are to be rehabilitated in a day, and when the construction work will be completed *(see Fig. 5 and 5a)*.





Obove Figure 5: Scheduling, preparation and organization of in-house rehabilitation

Left Figure Bild 5a: Scheduling, preparation and organization of in-house rehabilitation

The construction process usually takes place in eight stages

Step 1: Work preparations

All required materials and technical equipment are transported to the construction site. For larger jobs, a site container is set up for this purpose. Larger jobs are generally multi-storey apartment buildings with 15 to more than 60 residential units. The required materials are stored in the site container. In addition, the affected residents can go here to find out about the construction progress among other things from the responsible contact persons during the construction period *(see Figure 6)*.

Before the corridors and apartments are covered, previous damage and abnormalities are photographed for evidence purposes. After that the premises are completely covered to protect them using cardboard or protective paper among other things. All drainage fixtures are then taken out of service and covered, and the accesses are cleared for cleaning, inspection and rehabilitation *(see Fig. 7)*.

Figure 6: Site container with technical equipment on the construction site in Helsinki-Pehlajesto

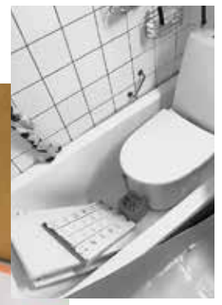


Figure 7: Covering the hallway and removing the drainage fixtures

Figure 8 and 8a: Collecting the solids when cleaning the drainage systems

Step 2:
Cleaning the drainage system

Depending on the material and condition, different tools are used to clean the pipes. Chains and high-pressure rinsing are used, for example, for the cast iron pipelines frequently laid in the past. For plastic pipes made of PVC, for example, gentle tools are used. The cleaning work is usually carried out from the lower floors up to the upper floors so that the pipes near the bottom are not blocked by flushed out sediments.

In order to avoid blockages in the building connection duct, the pipes in the basement area are capped and the waste water is fed into large drums during cleaning (*see Fig. 8 and 8a*). The solids settle in the bottom of the tank and the waste water on top is pumped towards the connection duct.

Step 3:
TV inspection

In the next step, all pipelines are driven through using a TV inspection system. During this process, the actual diameter of the pipes, the pipe lengths and the number and positions of the inlets and junctions are determined.

In addition, the TV inspection is used to record possible peculiarities, such as severe distortions, damage and junctions incapable of rehabilitation, so that possible solutions can be planned directly for these special cases (e.g. chiselling and demolition work).

Step 4:
Rehabilitation and opening of junctions and inlets

In order to optimize the construction process, the pipe liners are already cut to length and prepared at the Porvoo plant before being installed (*see Fig. 9 and 9a*).

The rehabilitation basically starts with the downpipes from the roof to the basement (*see Figure 10*). The liners are inverted, pressurized with compressed air and then sealed with a pressure lid. The curing usually takes place at ambient temperature. For this purpose, the compressed air is left in the liner overnight.

A specially designed monitoring device permanently measures the air pressure. The monitor is coupled with an app on a smartphone used by the crew carrying out the job so that, if reported, an employee can quickly locate and fix the fault on site.

Next day, the junctions and inlets are opened. As a rule these are reamed on the inlet side with the vortex cutter, first with a drill head, and in a second operation they are surface milled with grinding panels. Depending on local conditions, an experienced engineer is able to ream several inlets and junctions in an hour.

Depending on the material of the old pipe, various tools are available for this purpose. In multifamily dwellings with more than 25 residential units, several hundred inlets and junctions often need opening.

In the next step, the horizontal connection pipes are rehabilitated. Firstly, the horizontal pipes to the downpipe and then – if present – the even smaller horizontal pipes to the drainage fixtures are rehabilitated.

The liners in the small side pipes are inverted on Picote construction sites with a specially developed „liner gun“ using the open-end method (*see Figure 11*). The liner ends are pre-glued with a specially designed cap, which is pulled by a tether once completely cured.

Figure 9 and 9a: Pre-cut pipe liners for the construction project

Figure 10: BRAWOLINER® inversion of a downpipe from the roof to the basement

Figure 11: Liner inversion in the nominal diameter range DN 50 to DN 70 with a „liner gun“

In principle, three different options are used for the transition and connection or rehabilitation of the junctions and inlets (*see Fig. 12*):

❶ overlapping installation
❷ surface-milled transition and
❸ using a BRAWOLINER® connection sleeve

If further connections and connection pipes are connected to the lateral connecting pipes, the processes described above are repeated. With good preparation and organization, Picote is able to install more than 40 liners per day.

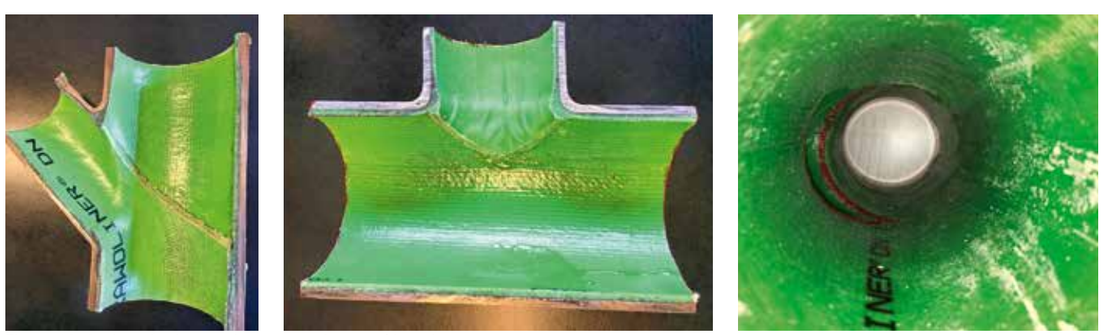


Figure 12: Options for integrating connections and junctions

Step 5: Restoring the connections for drainage fixtures

After completing the rehabilitation, the drainage fixtures are reconnected. For connection to the rehabilitated pipes, Picote uses a specially developed seal, which is connected to the system with epoxy resin (*see Figure 13*).

Step 6: Completion of work in the flats / apartments

After the entire pipeline network has been rehabilitated and the drainage fixtures are reconnected, the construction site is cleared up and the residents can put the drainage system back into operation.

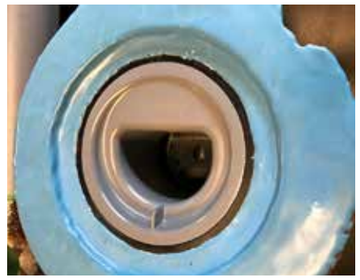
Step 7: Rehabilitation of the building connection duct

The building connection and underground pipelines are also rehabilitated as a side business so to speak in terms of length and the technical feasibility of rehabilitation, these plays only a minor role compared to the pipes inside the building in the context of a whole job.

Step 8: Building inspection and quality assurance

Finally, the building inspection and quality assurance takes place. All rehabilitated pipes are driven through using a TV inspection system and the videos are handed

Figure 13: Connection of the drainage fixtures with a specially developed seal



CONSTRUCTION TIMES ...

Usually between 1 to 2 weeks

With the described construction process, rehabilitations of multi-storey apartment buildings are usually completed in a very short time. For example, in the case of the construction project in Helsinki-Pehlajesto, where there are 42 apartments in the rehabilitated residential building, the construction time was 2 weeks. During this period, the drainage fixtures were taken out of service. For less complex multi-family dwellings, a week of pure construction time is usually required, i.e. without usability of the drainage system. In the area of single-family homes, the construction time is much shorter. To ensure that the construction process is adhered to, the planning and organization of the job critically important.

Downpipe rehabilitation whilst business continue at a holiday complex

CANN'A'QUA Kanalsanierung for rehabilitating downpipes above the rooftops of Bad Harzburg

At a glance

Where:	Bad Harzburg; holiday complex
Company:	CANN'A'QUA Kanalsanierung
Pipe:	50 m downpipe with up to 26 inlets
Liner:	BRAWOLINER® HT DN 100 and DN 125
Curing method:	steam

CANN'A'QUA Kanalsanierung from Bad Harzburg successfully in action

The rehabilitation of waste water downpipes with the hose lining method is not (yet) very wide-spread in Germany compared to the rehabilitation of underground mains and connecting pipes.

The technical constraints, particularly such as rehabilitation in small nominal diameters from DN 50, dimension changes, bends up to 90° and opening up side branches and inlets, besides requiring suitable equipment technology also takes skilled craftsmanship above all. The company CANN'A'QUA Kanalsanierung from Bad Harzburg has been facing up to these challenges for years and, besides underground pipes, also rehabilitates waste water pipes inside buildings without chiselling and demolition work. In a successful project, the downpipes carrying waste water away at a holiday complex in Bad Harzburg were rehabilitated without digging trenches and whilst holiday business continued. Below is a construction site report about the measures that are far from commonplace.

Drainage network with defects typical for its age

The holiday complex built in the 70s features around 400 freehold apartments in 3 apartment blocks. The complex originally served as a hotel for holidaymakers from the surrounding cities. Around 20 years ago the hotel business was discontinued and the complex was converted into holiday apartments.

The apartment blocks have 16 storeys with a total height of up to 55 metres. The drainage system dates back to the 70s and consists of steel pipes in the case of the waste water conduits. The downpipes are part of the communal property, whilst the drainage pipes in the apartments belong to the respective apartment owners. The downpipes have lengths of up to 50 metres corresponding to the height of the apartment buildings. The pipes in the apartments are very short at up to 2 metres in length.

For some time, owners have been repeatedly reporting damages caused by leaking waste water pipes. The downpipes exhibit cracks among other things as well as serious corrosion in many parts where the pipes are connected. The reports of damage have become increasingly frequent over recent months and years.

Against this background, the association of owners decided to completely rehabilitate the downpipes. As the pipes could only be completely replaced with an excessively high amount of expense as well as chiselling and demolition work throughout all residential units, alternative methods were very quickly taken into consideration. The decision ultimately fell to a combination of the hose lining method for the downpipes and the spraying method for the pipes inside the holiday apartments. In this way, chiselling and demolition work can largely be avoided.

Holiday complex with freehold apartments on the outskirts of Bad Harzburg

Working when and where others are on holiday – and doing so under time pressure

The contract to rehabilitate the waste water pipes without chiselling and demolition work was awarded to the local company, CANN'A'QUA Kanalsanierung, from Bad Harzburg. The company has had experience for years in the rehabilitation both of underground waste water pipes and those inside buildings. As a user for many years of the BRAWOLINER® hose lining method, the company also has the necessary equipment for the demanding rehabilitation of waste water pipes inside buildings.

The biggest challenge when it came to rehabilitating the waste water pipes in the holiday complex in Bad Harzburg was that the work had to be done whilst day-to-day business continued. Restrictions and disruptions for the residents thus had to be kept as brief as possible. The aim and specification was to rehabilitate the downpipes, including up to 26 inlets per drain pipe, in just a few hours so that the residents only had to do without the drainage system between 8 am and 4 pm at most.

Corroded pipe connection in the steel pipe after around 50 years of use

CANN'A'QUA Kanalsanierung from Bad Harzburg in action

Professional Planning and preparation are the key to success

In order to comply with the tight and challenging schedule of a maximum of 8 hours of rehabilition time per downpipe including reopening the inlets, the planning and preparation were the key to success. In this context, important aspects were considered beforehand and the following work carried out in advance:

- Creation of inspection openings on some intermediate floor levels
- Distribution and posting of information for residents,
- Setting up the construction site and
- Cleaning the drainage system

On some intermediate floor levels, new inspection openings were fitted in accessible areas. On the one hand this enabled the installation of the liner during the inversion process to be checked in these areas. It was checked whether the liner fitted tightly during the installation and that there were no imperfections. On the other hand the inspection openings were used to position and introduce the cutting robot to open the inlets. The inspection openings can also be used for subsequent inspection and maintenance purposes.

Furthermore, ahead of the construction work, information was distributed to residents and complemented by notices in the entrance halls and lift. The residents were notified that the work was to take place at a certain time and that it would not be possible to use the drainage system during this period. It was also explicitly pointed out to them that the workers on site would be recording their own work with body cams. Experiences from previous projects have shown that without providing a corresponding notification of this kind, there are a higher number of reports to insurance companies about damage. Since such notifications have been put up, reports of this kind have practically dropped to zero.

In order to keep to the timetable, it was also very important to carefully set up the construction site in advance. Among other things, the hoses and equipment for the liner installation, the steam unit, the compressor, the inversion unit and the emergency compressed air unit were deployed and positioned accordingly. Over and above this, it was made sure in advance that the access points and enough space were available for the work on the day of the inversion.

Cleaning and a final inspection of the drainage system were carried out the day before so that soaking the liner and the inversion could be started in the morning straight away.

Newly created inspection openings on some intermediate floor levels of the holiday complex

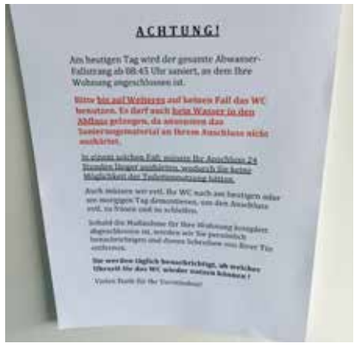
Timetable adhered to: 50-metre downpipe with up to 26 inlets rehabilitated in 8 hours

All in all, nine downpipes were rehabilitated on nine days. The timetable was kept to an each day. An example of a daily routine for rehabilitating a downpipe is illustrated below:

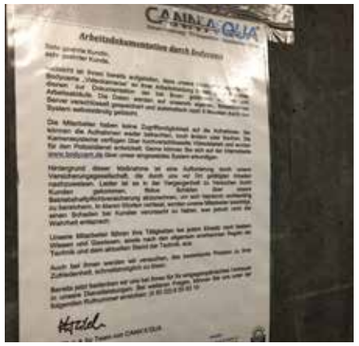
8:00 am: Arrival of the rehabilitation crew on the construction site (normally 4 persons).

8:30 am: The pipeline is blocked and run through for the last time with a TV inspection. In the meantime the hose liner is already being soaked and rolled to the required wall thickness.

9:15 am: The hose liner is brought onto the roof and the inversion started from top to bottom. The inversi-



note not to use drainage

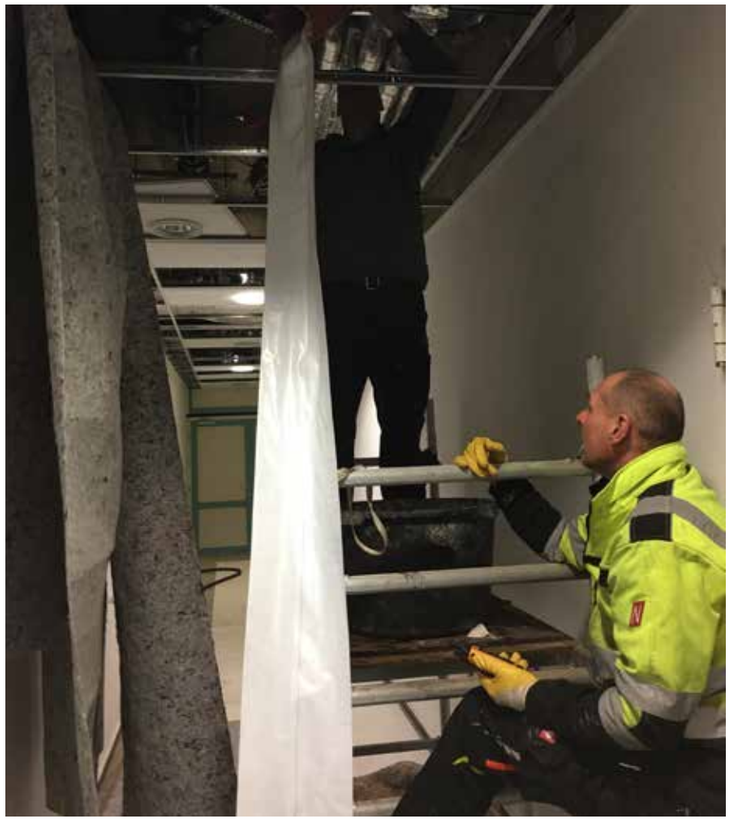


note indicating use of body cams

Soaking the BRAWOLINER® HT hose liner (DN 125) on the construction site

Transporting the hose liner onto the roof

Inversion of the hose liner from the roof



Hose liner arrived at the inversion end on the bottom floor

on and liner progression are checked in the inspection openings on the intermediate floor levels. The inversion is finished as soon as the liner reaches the endpoint on the bottom floor.

10:00 am: The steam unit is started and the curing phase begins.

11:15 am: The hose liner is cured and the cooling phase begins. The hose liner is cut off flush at the starting point and at the inversion end. The pipeline is connected back to the drainage network. In the meantime, the hose liner continues to be cooled from above with air.

11:45 am: The inspection openings on the intermediate floor levels are opened using an angle grinder. The hose liner is sealed with a special silicone in the inspection openings area on the intermediate floor levels

DN 100 inlet opened from a DN 125 downpipe with the cutting robot

12:00 pm/noon: Opening the connections with the cutting robot is started from the downpipe. Work is carried out from the bottom upwards. Opening an inlet takes an experienced fitter much less than 10 minutes (5 to 6 minutes on average). From the 1st to the 9th floor the work is completed by around 1:30 pm and up to 13 inlets opened. The residents can use the drainage system again as soon as the inlet has been opened.

2:00 pm: The cutting robot is brought to the 16th floor and starts opening the inlets from floor 10 to 16. The cutting work is completed around 3:30 pm. After that, all the drainage fixtures in the building can be put back into operation.

4:00 pm: The construction site is tidied up and the work finished.

All 9 downpipes with up to 26 inlets, which were all opened from the downpipe, were successfully rehabilitated within a similar timetable using the hose lining method. If opening the inlets from the inside did not lead to an acceptable result after an optical evaluation, the connections were re-ground on the inlet side with the Vortex cutter. For this purpose, however, it was necessary to carry out work in the residential units and the existing drainage fixtures had to be unscrewed. This option only had to be used in a very few individual cases, however.

Pipes in the apartments and Downtownpipes with BRAWOLINER® HT

As part of the construction work, 9 downpipes altogether in DN 100 and DN 125 were rehabilitated with the BRAWOLINER® HT hose liner specially approved for the in-house sector. The liner is used in particular to comply with the fire protection (class B2) requirements and the thermal dimensional stability (> 93°C) in the in-house sector. It should be noted that the downpipes are part of the communal property and the contract was awarded by the association of owners. The drainage pipes inside the apartments are installed in the nominal diameters of DN 50, DN 70 and DN 100 (kitchen and WC connections). The rehabilitation of these pipes can also be instructed by the apartment owners in connection with the construction work. This must be done by each apartment owner itself, however. Once the contract is awarded, the very short pipes are rehabilitated by CANN'A'QUA Kanalsanierung.

Steam curing the hose liner

Using the cutting robot (IMS Robotics) in the DN 125 downpipe to open the inlets

Three construction stages in three years with BRAWOLINER®

The project was carried out between 2016 and 2018 over three years in total. Every year all the downpipes in one apartment block were rehabilitated. As only one downpipe was rehabilitated each day, disruptions and restrictions for the residents were able to be kept to a minimum.

In-house rehabilitation in the city of love – easily done thanks to BRAWO® SYSTEMS

Magnificent view of the Eiffel Tower during the installation of the BRAWOLINER® HT DN 100

TELEREP rehabilitates 38-metre-long downpipe on a multi-storey apartment building within two hours in the middle of Paris

TELEREP is a specialist in trenchless sewer rehabilitation and the market leader for in-house rehabilitation work in France. TELEREP is part of the SARP Group, a sewerage and drainage company with over 80 years of experience.

The day before the rehabilitation, TELEREP prepared the construction site to ensure a smooth workflow. The first challenge at this construction site was to get the compressor onto the roof of the twelve-storey apartment building. This one had to be transported upwards from outside, along the wall of the building. The other equipment was able to be brought onto the roof using the lift and an access window.

At a glance

Where:	Paris; multi-storey apartment
Company:	TELEREP
Pipe:	38 m downpipe
Liner:	BRAWOLINER® HT DN 100
Curing method:	steam (BRAWO® SteamGenerator 50 UL)

Facade of the twelve-storey apartment building in the middle of Paris

Control of the inversion with the BRAWO® Control Box

During steam curing

The length of the downpipe to be rehabilitated was 38 metres. In order to rehabilitate the downpipe in one piece, TELEREP needed a flexible and reliable rehabilitation system. The main difficulty was to impregnate the liner and install it promptly in the pipe before it cured. Thanks to TELEREP's experienced installers, the rehabilitation went quickly.

To speed up the curing process, the BRAWO® Steam Generator 50 UL was used, which generates steam with only a small volume of water. Especially for the rehabilitation of downpipes, steam curing offers great advantages.

The BRAWO® Control Box was used to check and regulate the temperature of the steam and the air pressure during the curing process. It took the three TELEREP employees 25 minutes to impregnate the liner and within eight minutes it was possible to wind it up in the inversion drum. In total, the installation including curing took about 2 hours.

During the work, the installers were secured with safety harnesses. After installation, the liner ends were milled open to then reconnect the downpipe to the horizontal connections to the kitchens and bathrooms.

Yaker Ait from BRAWO® SYSTEMS Sales, France, is pleased about the increasingly intensive cooperation with TELEREP: *„Our customer sees the many possibilities with BRAWO® SYSTEMS equipment, appreciates the quality and our experience with our rehabilitation system. I am often at the construction sites in person, helping and supporting our customers. In this way, I train my colleagues directly at the construction site and in the field. Customers appreciate our global service, which in my view, makes a not insignificant difference! Telerep has again shown that the company is capable of handling even difficult in-house rehabilitation jobs in an extremely professional manner. The view of the Eiffel Tower was a special bonus in this case.“*

Entrance to the sewer downpipe

Final inspection of the work with the camera

In-house rehabilitation in Barthels Hof with the BRAWOLINER® HT

The Barthels Hof in Leipzig. In the past, people traded here and came across warehouses, stables, banqueting halls and distinguished living quarters. Today, beautiful courtyards, shops and other commercial properties as well as the Barthels Hof restaurant characterise the historic building complex. | Photo: Pipe Bull

It is the conditions on site that make the rehabilitation of all the waste water pipes in the historic Barthels Hof in Leipzig a particularly challenging project. The contracting company, Pipe Bull, has opted for the BRAWOLINER® HT and a special brush coating system as well as other special technology.

Barthels Hof in Leipzig is a historic building complex with shops, other commercially used premises, apartments as well as the restaurant of the same name in the heart of the city and also one of the most important tourist attractions in the Saxony city. Baroque parts of the ensemble of buildings from the 18th century have remained preserved to this day.

The rehabilitation of the waste water pipes in Barthels Hof is the last part of extensive renovation work on and in the building complex. The so-called in-house rehabilitation has been ongoing since September 2020 and is expected to be concluded by the end of this year. „No single pipe in Barthels Hof will be left out during the work – from the DN40 shower pipe to the DN 200 main pipe," says Thomas Miller, managing director of Pipe Bull GmbH, which was awarded the tender for the pipe rehabilitation work. The recently founded company from Landau in the Palatinate region specialises in the rehabilitation of property and building drainage pipes using different methods including preliminary work such as TV inspection and sewer cleaning. Its employees, who are now 19 strong, operate throughout Germany.

Trenchless more practical and economical

At the outset, the client also considered replacing the downpipes, collecting and main pipes using an open construction method. That proved disadvantageous for several reasons, however: „A particular feature of this project was the difficult accessibility to the pipe shafts spanning multiple floors. These are concreted on three sides and partly bricked in on one side," explains Sven Heuermann from the engineering firm responsible, Drews Gebäudetechnik from Berlin. „In addition, the shafts between the individual storeys are open, meaning that accessible floors would have to have been installed in case of entire rehabilitation using open construction," Heuermann goes on to say. Added to this is the fact that trenchless rehabilitation proved to be more cost-effective than an open replacement of the pipes.

At a glance

Where:	Leipzig; Barthels Hof
Company:	Pipe Bull
Pipe:	1.2 km length to be rehabilitated
Liner:	BRAWOLINER® HT
Curing method:	steam / ambient temperature

Pipes give cause for concern

The pipe length needing to be rehabilitated amounts to a considerable 1.2 km. A challenge when it comes to rehabilitation are the many bends in the pipe run, which are often encountered in Germany. „Sometimes we find six to seven 90-degree bends on the DN50 pipes over a length of just two metres," says Miller describing the situation in Barthels Hof, „and the DN 100 downpipes do not run straight from top to bottom, but instead also have another five to six 90-degree bends over approximately 40 metres. This requires good preparation and plenty of skill," says Miller. And the many and often unexpected changes in dimensions do not make the rehabilitation work any easier either.

Over recent years, Barthels Hof has had to battle with water damage. A TV inspection revealed the extent of the damage: „The plain-end pipes installed are extremely damaged and show signs of burst pipes, cracks and severe corrosion," describes Heuermann. Among the damage profiles, there are also cracks measuring several centimetres or even broken pipes in places.

Due to the pipe runs and the damage profiles, Pipe Bull adapted its own milling tools for the rehabilitation preparation work. It has now been and is possible to easily use them in pipes with bends as well as in the highly damaged grey cast iron pipes, without them breaking apart. Extremely corroded pipes, some of which broke off as part of the preliminary work, were „bridged" using short liners for stabilisation purposes during the previous course of rehabilitation. „In this respect, a change of plan at short notice was necessary," says Miller.

BRAWOLINER®

As part of the pipe rehabilitation in Barthels Hof, Pipe Bull mainly opted for the BRAWOLINER® HT, specially developed for rehabilitation inside buildings and approved for this by the DIBt. Besides this, the brush coating method as well as open construction in many places are also used – the latter for instance for suspended pipes, which are directly accessible, or for changes in dimension that appeared unnecessary.

Pipe Bull has been working closely with the BRAWOLINER® manufacturer, BRAWO® SYSTEMS, since the company was founded in 2017 and has been impressed by the quality of the BRAWOLINER® ever since. The seamless textile hose with seamless film coating is suitable for the rehabilitation of pipes with nominal widths from DN 50 to DN 400. For the Barthels Hof project, its flexibility and the resulting possible applications in defective pipes with bends up to 90° and up to two changes in dimension are decisive benefits.

The liners previously impregnated with epoxy resin are inverted with compressed air using so-called liner cannons and then cured using steam or ambient temperature. „The liner cannons are connected to each other by a pressure measurement probe or a Bluetooth monitoring box, which constantly measure the air pressure where compressed air remains in the liner for a certain time for curing purposes. If the pressure drops, the monitoring equipment sends a warning by SMS," Miller explains.

The pipes were mainly rehabilitated with the BRAWOLINER® HT. | Photo: Pipe Bull

The BRAWOLINER® HT is installed with an open end (open-end method): calibration hoses and liner end caps are sometimes used. Once the liners have cured, the inlets are opened. Pipe Bull makes do here completely without pneumatic milling robots and instead uses compact, electrically operated vortex cutters for all inlets, for which no compressor is needed. „In this respect it is a pilot project for us," says Miller. „But so far it has worked very well – despite the complicate pipe runs."

Brush coating

Wherever the BRAWOLINER® is unable to be used, for example on DN40 pipes, or where the damage is not so serious, Pipe Bull in Leipzig employs the brush coating method up to DN 100. This is a brush coating system from Picote Solutions, with which epoxy resin is applied to the pipe via a hose and rotating brushes attached to it. „The hose is pushed into the pipe in the flow direction. Whilst moving backwards, two to three brushes distribute the resin evenly onto the pipe wall," says Miller describing the process. An important aspect here, he says, is that the brushes are always bigger than the internal dimen-

sion of the pipe, meaning that the resin touches the inner pipe wall along every centimetre.

Good coordination, adequate communication, keeping to deadlines

Because Barthels Hof is located directly in the inner city, it is only possible to deliver the materials little by little in smaller quantities. On the other hand, an empty commercial unit was available for equipment at Barthels Hof. Work is carried out on site in three groups: „The first group is responsible for the preliminary work. The second group performs the rehabilitation, whereby the choice of the respective method is down to the project manager. Finally, the third group is responsible for the acceptance inspection and repairs any faults if necessary," Miller explains.

During an in-house rehabilitation, the acceptance of the owners or tenants in the building for the measures and hence their willingness to cooperate are factors that should not be underestimated. After all, the rehabilitation company works in very sensitive areas. Although relatively unproblematic in Scandinavia, in these parts much more persuasive effort is usually needed. That is why, according to Miller, great emphasis has been placed on the communication with the tenants before and during the rehabilitation process. Alongside this, Thomas Miller also points out the importance of time management: „From the pipe cleaning up to the final inspection, certain time windows are clearly specified, which with regard to the acceptance of the in-house rehabilitation among the tenants also have to kept to at all costs."

In the meantime the project has largely been completed; work is currently being carried out on the fifth of six inlets. Pipe Bull reckons it will finish the in-house rehabilitation by the end of this year.

Hotel tower with 32 levels

Close to Montparnasse: rehabilitation of 50-year-old inhouse pipes in the Pullmann Hotel, Paris

With more than 3000 m of BRAWOLINER® 3D DN 100-150 and 4 tonnes of BRAWO® resin, the company AFS Chemisage rehabilitated the vertical wastewater pipes of the Pullmann Hotel in Paris.

Before the start of the rehabilitation project, the situation was as follows:

The hotel building and the pipelines were from the 70s. The vertical wastewater pipes were made of cast iron and the building had to undergo a major renovation that would take four years. Originally, all the wastewater pipes were to be replaced. However, during the renovation, the replacement of the pipes was cancelled due to the high costs and time involved.

After flooding on some floors due to damaged pipes, the work was re-evaluated:

The end customer took the relining method option due to time and costs.

The challenge was the very short time frame of only five weeks. To repair 42 vertical cast iron DN 125 down pipes with the lengths of 70 m and 64 m each. We needed four people to install the liners and ten people to re-open the connections.

"The work was cleaning, relining, re-opening connections and reconnecting.

Because of the big job site we had a lot of equipment and people, so the tight supply demands had to be delivered just in time on the job site," Yaker Ait from BRAWO® SYSTEMS described. "We managed the supply and service of this big volume in spite of the extreme length of the liner just as planned."

BRAWOLINER® 3D DN 100-150

The BRAWOLINER® 3D was used in this project due to its extraordinary properties.

As it was specially developed for large dimensional changes or several jumps in dimension in succession, the BRAWOLINER® 3D could be used in widths from DN 70 to DN 400. The seamlessly knitted liner adapts optimally to any pipe diameter and impresses with an excellent installation result.

The extremely flexible polyester loop construction allows for enormous lateral expansion. This makes the BRAWOLINER® 3D an optimal rehabilitation solution for difficult wastewater systems.

The BRAWOLINER® 3D was able to demonstrate these unique properties in the Pullmann project. After the installation work, the liners fitted perfectly and crease-free to the old pipes in the Pullmann Hotel.

Lining of stag pipes from the top floor

Impregnation of the 70 metres of BRAWOLINER®

Three installations at the same time

Fast hardening due to steam curing.

In the Pullmann Hotel the new BRAWO® SteamGenerator 50 UL was used. Its low weight and mobility on the job site is ideal for installations in small areas and tight conditions e. g. like hotel floors or hotel rooms. This led to a fast rehabilitation process and the vertical pipes could be rehabilitated in a few hours in each case.

At a glance

Where:	Paris; Pullmann Hotel
Company:	AFS Chemisage
Pipe:	42 downpipes DN 125 each 64 m or 70 m
Liner:	BRAWOLINER® 3D DN 100 – 150
Curing method:	steam (BRAWO® SteamGenerator 50 UL)

Complex rehabilitation under extreme conditions: quick & simple with BRAWO® Magnavity and BRAWOLINER® 3D DN 200 – 300

Shortly before installation: preparing the installation of the BRAWOLINER®

At a glance

Where:	Wetter
Company:	Lobbe Kanaltechnik GmbH & Co KG
Pipe:	pipeline with 4 pipes and pipeline with 2 pipes (each 32 m or 35 m)
Liner:	BRAWOLINER® 3D DN 200 – 300
Curing method:	light (BRAWO® Magnavity with LED head Mega)

Lobbe Kanaltechnik GmbH & Co KG, known as LKT for short, is a fourth-generation family business that provides comprehensive sewer services.

It is particularly noteworthy that LKT was the very first BRAWO® SYSTEMS customer and has now been working enthusiastically with BRAWO® SYSTEMS products for over two decades. Now, for the first time, the new BRAWO® Magnavity light curing system with the new Mega LED head and the new BRAWOLINER® 3D DN 200 – 300 have been used in an LKT construction project.

During this operation, a transport pipeline with 4 pipes in nominal sizes DN 250 and DN 300 made of stoneware had to be rehabilitated in a difficult-to-access woodland area and, in a second construction contract, two DN 250 pipes made of stoneware had to be rehabilitated behind a residential building below staircases.

The construction sections had a length of 32 metres to 38 metres.

The large gradient of the pipes and the starting shafts that could not be accessed directly were challenging; the receiving water also had to be maintained during the work. The rehabilitation therefore had to be done quickly.

This was particularly important because the access shafts were unable to be reached due to the difficult accessibility in the woodland area and the slope with stairs, and the equipment had to be brought to the site with muscle power.

Here, the enormous advantage of the transportable curing technology became apparent.

Beforehand, the rehabilitation team impregnated the BRAWOLINER® in a hall within three hours. Packed in wooden crates and protected from light, the pre-impregnated BRAWOLINER® were driven to the site the next day with a wheeled loader. As standard, the pipes were flushed with high pressure before the rehabilitation process. The BRAWOLINER® were then placed in the inversion drum and inverted into the ducts beings rehabilitated. Curing then took place at the speed of light due to the pipe dimensions using the new Mega LED head and the BRAWO® Magnavity light curing system.

It only took about two and a half hours to rehabilitate each of the 32 and 35-metre pipes.

All in all, the construction site, which was extremely difficult due to the local conditions, was completed on schedule within 3 days, including all preparatory and finishing work.

Jaap Sanders, Sales Germany West of BRAWO® SYSTEMS, was there on site: „Thanks to pre-impregnation and light curing, there were no technical problems with this demanding rehabilitation measure. The BRAWO® Magnavity writes the rehabilitation protocol on the spot during installation, thus eliminating the need for manual documentation, which is a huge advantage. For example, the temperature in the light head and the retraction speed are documented.

„We are delighted to have worked with BRAWO® SYSTEMS to complete the construction site so successfully for our client. Without the BRAWO® Magnavity light curing system, such a short construction time would not have been possible," says Gerhard Michel, Managing Director of LKT.

Interesting facts about the BRAWO® SYSTEMS products used

The new BRAWOLINER® 3D DN 200 – 300

BRAWOLINER® 3D – A liner for all applications in building and property drainage

The BRAWOLINER® 3D was specially developed for large dimensional changes or several jumps in dimension in succession. In nominal widths from DN 70 to DN 400, the seamlessly knitted liner adapts optimally to any pipe diameter and impresses with an excellent installation result.

Curing process with the BRAWO® Magnavity

The unique, extremely flexible polyester loop construction allows for enormous lateral expansion. This makes the BRAWOLINER® 3D an optimal rehabilitation solution for difficult sewer systems.

The BRAWOLINER® 3D was also able to demonstrate these unique properties in various special profiles. Due to the enormous lateral expansion, the liner fits perfectly and crease-free to the side and pipe bottom of an egg profile. Here, too, multiple dimensional changes and bends of up to 90 degrees are no problem.

BRAWO® Magnavity & LED head Mega

The new light curing system consists of an intelligent LED head with 96 high-performance UV LEDs, a 50-metre long combination hose with integrated power and compressed air supply, a retraction unit and a control box. You save time and effort.

The innovative and unique LED heads allow simultaneous retraction with inversion of the liner. Curing is thus carried out immediately after installation of the liner, without the need for additional insertion of the eel.

As a result, only one access point is needed for the rehabilitation of a 50-m long segment. In many cases, this is the only way to make rehabilitation possible at all, since no additional access opening (e.g. inspection opening, shaft) is necessary, which cannot be created easily or only with considerable effort in most construction measures.

Thanks to the 192 high-power UV LEDs and the associated greater light output, up to approx. 70% faster curing is possible compared to the Nano LED head. The Mega LED head is suitable for rehabilitating the dimension ranges DN 125 to DN 300. From a pipe diameter of DN 150 upwards, pipes with bends can also be rehabilitated economically and efficiently.

The steel cap enables decoupling of the MEGA LED head at the liner end

BRAWO® SYSTEMS

The benefits for your building and property at a glance:

- Extremely quick modernisation
- Reduction in maintenance costs by up to 50 %
- Hardly any impact on traffic and living quality during the rehabilitation
- Prevents downtimes
- High level of customer and tenant satisfaction

Rehabilitation with the BRAWOLINER® System

- Without excavation and chiselling work
- Suitable for nearly all damage profiles and pipe materials
- Environmentally friendly, sustainable and permanent
- Lasts for over 50 years

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