

PipeLine



Compendium 2009



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HOBAS® - and the Heat Is On

Relining Cooling Pipes in Bremen, Germany

The German city Bremen obtains a part of its required energy from one coal-fired cogeneration plant situated in the harbour and consisting of two blocks with an output of 400 MW. A medium-caloric power plant is currently constructed at the same site and will supply further 29 MW as well as district heat. This output covers the energy consumption of 90,000 households.

Special about this new power plant is that the use of the fossil fuel can be reduced considerably by using so-called medium-caloric fuels to generate power and heat. This fuel consists of a mixture of paper, plastic, wood and packaging materials. Until 2005, residual material like this was stored at waste dumps as it was unsuitable for recycling. Other than black coal, it primarily consists of renewable raw materials yet generates a similar heating value. Thus, the operator of the power plants, Bremen's public utility, is able to save over 90,000 tonnes of coal and reduce the environmentally harmful CO₂-emission by around 230,000 tonnes.

In summer 2008, corrosion was discovered on a cooling water pipe in the heating power plant. This asked for immediate repair under strict safety conditions, without restricting the energy production and without endangering the construction schedule of the new plant.

An open trench construction was not an option as the line crosses a coal storage area which would have had to be removed with tremendous effort. Under the given conditions, relining with HOBAS Pipes proved to be the ideal solution. The old steel line was rehabilitated by the company Michel Bau GmbH & Co. KG utilizing 180 m HOBAS CC-GRP Pressure Pipes HOBAS CC-GRP Pipe DN 1200, PN 6 with a wall thickness of only 27 mm. The thin walls and excellent hydraulic properties of HOBAS Pipes resulted in absolutely no loss in flow rate despite the reduced diameter compared to the old steel line. In addition to the 180 meter long straight section, two 20 m long curved branches DN 900 that merge into the larger cross-section were installed by open trench. Once more, the broad range of HOBAS Fittings, that is easily adapted to individual customer requirements, proved to be highly advantageous. The final pressure test was completed successfully and on the first attempt.

Bremen's public utility was very satisfied with the result, particularly with the fast and simple installation of HOBAS Pipes and the professional project support by HOBAS experts.

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Year of Construction

2008

Total Length of Pipe

200 m

Pressure Class

PN 6

Stiffness Class

SN 10000

Diameter

DN 900, 1200

Installation Method

Relining | open trench

Application

WaterLine®

Client

Stadtwerke Bremen

Contractor

Michel Bau GmbH & Co. KG

Advantages

easy installation, excellent flow properties thanks to the smooth inner pipe surface, corrosion resistance, broad range of fittings

You Can Count on HOBAS®

A New Sewer System in Trnava, SK

In 2006, Samsung, the Korean producer of LCD flat screens, went about looking for a suitable European production site with adequate infrastructure. Slovakia, Hungary and Poland soon turned out to be the favorites and were shortlisted.

Trnava in western Slovakia is an attractive location for international companies. Just as PSA Peugeot Citroen, Sony and other renowned companies, also Samsung saw the many advantages of this small town situated in the heart of Europe. Comparatively low tax charges, low direct and indirect labor costs, well trained and highly motivated employees, governmental support for industrial settlements and a long industrial tradition were some of the crucial reasons that this town of 70,000 inhabitants was chosen. The new Samsung production plant will provide 1200 jobs for the region. Approximately 400 million Euros will be invested until 2010.

Industrial facilities of this size require an adequate water supply and sewage disposal system. 2400 m HOBAS CC-GRP Pipe Systems of DN 1000 now collect and discharge the wastewater. Due to a required installation depth of 3.5 to 7 m, HOBAS Pipes were chosen with a nominal stiffness of SN 10000.

The project started off with quite some complications. Ground breaking was postponed over and over again and finally, a competitor of HOBAS won the tender. The first pipe delivery arrived on time yet those to follow were delayed and ended up in vain promises. These delays threatened to result in huge financial losses for the contractor and the situation demanded immediate action. When the pipe supplier repeatedly broke contract terms and could not meet deadlines, the contractor began looking for alternatives and opened up negotiations with HOBAS. Within 72 hours the contractor accepted the offer by HOBAS and signed the contract. On the very same day, 96 m HOBAS Pipes were delivered to the construction site. During the following weeks HOBAS delivered a total of 2400 m pipes according to the given schedule and on time, so that the construction of the pipeline was successfully completed after 50 days.

HOBAS CC-GRP Pipe Systems convinced the client with their excellent hydraulic properties, their long lifetime and their easy installation. The contractor highly appreciated the professional execution of the project and the punctual fulfillment of all requests. He was very satisfied with the supplied material and - after initial difficulties with the competing company - thankful for a smooth project completion.



Year of Construction

2007

Total Length of Pipe

2400 m

Pressure Class

PN 1

Stiffness Class

SN 10000

Diameter

DN 1000

Installation Method

open trench

Application

SewerLine®

Client

Samsung

Contractor

Staveko, s.r.o.

Advantages

excellent hydraulic properties, long lifetime, simple installation, reliable and punctual deliveries



Always a Winner with HOBAS®

Record Sliplining in Illinois, USA

The Metropolitan Water Reclamation District of Greater Chicago (District) collects, treats and disposes the wastewater from 168 independently owned and operated local sewer systems. Evanston, Illinois, is directly north of the windy city and shares many common attributes and was also the site of the longest, large diameter sliplining project on record for the District.

One of the most recent projects was Lake Street sewer rehab, including 2,100 m of DN 3000 semi-elliptic cast-in-place concrete sewer. The concrete sewer pipe had cracked at a number of places and had lime deposits at cracks and 'cold' joints, and the concrete had corroded due to the action of hydrogen sulfide and flowing water. In order to restore hydraulic and structural integrity the sewer needed to be rehabilitated.

Bid documents for the project included various options: segmental sliplining, cured in place (CIPP) lining and insertion of panels. Kenny Construction of Northbrook, Illinois, submitted the bid with the intent to slipline the sewer. The job was awarded to them based on rehabilitation by sliplining with HOBAS CC-GRP Pipe Systems.

Jack Callahan, vice president of the underground group with Kenny, said, "We thought it would be the most economical option due to timing and the size. We do a lot of CIPP, but this was a little too large for that method, considering the water situation, the bypass pumping that would have been required and everything else. It would have been more difficult and expensive."

Rehabilitation projects have many goals: reestablishing the structural integrity of the pipe, preventing leaking joints, and providing a corrosion resistant liner all the while maintaining flow. The design of the sewer lining was based on several conditions and parameters. The existing sewer was in a fully deteriorated state, loading due to overburden and hydrostatic conditions were evaluated, and the liner needed the ability to withstand the corrosive environment.

As with many projects, there were obstacles to overcome. The size and alignment of the sewer presented challenges, but nothing that could not be conquered. Sliplining pipe of this size is not like sliplining with smaller sizes. This was an uncommon project and the first time it was done in the area. The project ran smoothly and installation progressed well. The first 610 m of sliplining had been completed using HOBAS D_e 2900 mm flush relining pipes. Conditions prompted the installation of 0.7 m HOBAS pipes with an D_e of 2740 to be used for the remainder of the rehabilitation work.

Kenny Construction worked to find the best option for the grouting, which included several grout lifts in stages to prevent uplift. Although the grouting took some critical thinking, the pipe has a high stiffness and is performing well. Large diameter sliplining projects can be complicated and this project posed challenges that were all successfully overcome. HOBAS manufactures a unique product that meets the requirements of large diameter sliplining: smooth D_e, hydraulic capacity, high axial compressive strength and multiple diameters including many in-between sizes.

Year of Construction
2008

Total Length of Pipe
2100 m

Pipe Specifics
**PN 1, SN 5000,
D_e 2740, D_e 2900 mm**

Installation Method
Sliplining

Application
SewerLine®

Client
City of Evanston

Contractor
Kenny Construction

Advantages
**high hydraulic
capacities, long
longitudinal stiffness,
many available sizes,
lots of in-between
sizes**



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HOBAS® for a Positive CO₂ Balance VOEST Alpine Sets on Hydro Power

The world's largest producer of rails and turn-outs is VOEST Alpine Eisenbahn GmbH (VAEE). With its 700 employees it is also one of the largest employers in Zeltweg, Austria. A high demand on electricity is however necessary for the production so that the current high energy prices induced the management to look for a more attractive power source.

A hydro power station was erected on company property yet in co-operation with an existing small power plant of the company Penz at the estuary of the rivers Pöls and Mur. A total of 3 km pressure pipe DN 2400 were installed for the project. The 31 m head was calculated to produce a flow rate of 12 m³ per second. This asked for pipe material with high safety standards, and guaranteed leak tightness.

HOBAS CC-GRP Pipe Systems easily fulfilled all requirements. Since October 2008, HOBAS Pipe Austria has been delivering the unique HOBAS CC-GRP Pressure Pipe Systems including FW couplings to the new power plant Penz VAEE, which is operated by Mr. Rochus Penz, VAEE and the constructor Zotter.

The pipeline is installed in three phases, leading from the power plant Penz to the estuary of the rivers Pöls and Mur and finally to the power house on VAEE property.

The pressure line first runs through farmland and an adjacent housing area is bypassed along the river. Worthwhile mentioning is the installation of HOBAS Pipes beneath the river's groundwater level of. Despite the depth, the pipe bedding was completely dry due to dense soil, which resulted in fast and cost efficient installation.

Year of Construction

2008-2009

Total Length of Pipe

3 km

Pressure Class

PN 2-5

Stiffness Class

SN 5000

Diameter

DN 2400

Installation Method

open trench

Application

HydropowerLine®

Client

KW Penz GmbH

Contractor

Zotter GmbH

Advantages

quick installation, absolute

leak tightness, low weight,

corrosion resistance



The first phase, from the intake works Penz in Aichdorf to the Pöls Bridge, was initiated October 1st 2008 and will be completed in March and on schedule. Between March and June 2009 and for the second construction phase, pipes will be laid from a railway bridge to the power house. The third phase is planned to run from June to September 2009, when the lines shall finally meet between the railway bridge and the Pöls Bridge.

The two planned Kaplan spiral turbines have an average output of 12.9 million kWh p.a., which corresponds to the electricity needs of 6,000 families of four. Because the VAEE itself currently needs 8 million kWh, the excess can be delivered to the public network once the plant is completed.

Not only does the power plant bring relief in terms of costs, also the production process of VAEE can be optimized. Since the method to heat the rails with gas in order to shape them proved to be dissatisfactory, they will in future be heated by induction (with electricity), which will assure 100% process safety.

This independent power supply not only ensures the long term continuance of the factory in Zeltweg but it also contributes to a positive CO₂ balance of the company. The power plant is moreover built according to strict environmental regulations. For instance, a residual of 1,500 l water per second and up to 2,900 during the cold months is ensured and lies well above the requirements. With this, the plant has the largest amount of residual water in Styria – which works well for the benefit of the environment and fish population.

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Toulouse builds on HOBAS®

Cancéropôle Realized with CC-GRP Stormwater System, FR

Cancéropôle, an exceptional center of excellence dedicated to cancer research and treatment is erected on the grounds devastated by a chemical explosion on September 21st 2001. The stormwater network of such is realized with HOBAS CC-GRP Pipe Systems.



Year of Construction

2008

Total Length of Pipe

4,550 m

Pressure Class

PN 1

Stiffness Class

SN 10000

Diameter

DN 400 - DN 1500

Installation Method

open cut

Application

SewerLine®

Developer

Le Grand Toulouse

Client

**SCAM TP (GIESPER,
SOGEA, EXEDRA as
sub-contractors)**

Advantages

**chemical resistance,
absolute leak tightness,
long life**

The French city Toulouse is famous for being one of the world's top aerospace centers and home to the headquarters of aircraft manufacturer Airbus. On September 21st 2001, however, it gained notoriety when a large-scale chemical incident occurred in the southern outskirts of the city: Several hundred tons of ammonium nitrates stored in a warehouse for chemical waste exploded at a fertilizer factory. After the event, politicians, local experts and investors decided to create a medical center dedicated to both research and treatment against cancer on the former plant site. The project, that was launched in 2004, reflects modernity in its architecture and conforms with the country's current considerations such as sustainable development and environmental responsibility.

Great effort went into the clean-up operations from 2004 to 2007 to remove the hydrocarbons and other chemicals as far as possible from the contaminated soil at the site. Due to the remaining substances in the groundwater, the selection of the right material for all buried water networks was naturally extremely important. Le Grand Toulouse, as Technical Project Manager in agreement with SETOMIP, Design Engineer, decided to implement the stormwater network with one system only, namely a HOBAS CC-GRP Pipe System. Being from one source only, consistent high quality and leak tightness is guaranteed over the complete network including all involved items such as piping, fittings as well as manholes.

HOBAS Products have a wide range of advantages, which are rarely required altogether at once, as for this challenging project. Indeed their resistance to aggressive substances was particularly important.

The pipes were furthermore equipped with special nitrile rubber (NBR) couplings to ensure and maintain absolute and long term leak tightness of the complete system despite the given groundwater conditions. The light weight of the HOBAS GRP Pipe Systems was a facilitating feature considering necessary installation depths of up to 6 m. With a decline of only 2 to 3 mm per meter to the preliminary treatment facilities, the unique hydraulic properties of HOBAS products prove to be highly advantageous preventing sedimentation and optimizing the global system efficiency. Their high mechanical resistance is no surprise considering that for every project the products are designed to last a minimum of 50 years. This also guarantees a safe and reliable stormwater discharge for the Cancéropôle.

A total of 4.6 km of HOBAS Pipe DN 400 to DN 1500 were laid and no fewer than 148 different tailor made manholes were installed. On the construction site, managed by the French company SCAM TP, 5 different contractors such as SOGEA, GIESPER and EXEDRA simultaneously worked in five different places. The entire logistics were coordinated by MTP. It was the quality of their service that created a smooth workflow between all involved parties from June right through to October and therefore contributed significantly to the project's success. HOBAS Manholes are usually delivered including a ladder. Special requirements such as adapting the fixations in manhole production to fit locally provided ladders as well as extra access pipes to elongate the manholes to ground level were organized efficiently and with ease.

Once completed in 2012, Cancéropôle will provide around 4,000 jobs and supported by the infrastructure from HOBAS, hopefully develop promising innovations in this field.

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HOBAS® builds networks

Reliable wastewater disposal in Liberec, CZ

Year of Construction

2006 - 2008

Total Length of Pipe

1,597 m

Pressure Class

PN 1

Stiffness Class

SN 10000

Diameter

DN 250 - 1200

Installation Method

open trench

Application

SewerLine®

Client

Severočeská Vodárenská společnost a.s.

Contractor

SYNER, Ltd. Liberec and OHL ŽS, a.s. Brno

Advantages

**corrosion resistance,
easy installation,
excellent flow
characteristics**

Strict EU regulations apply to water supply and wastewater disposal. Like many other countries in Central Europe, the Czech Republic also has a lot to catch up with in this area. From 2006 - 2008, the entire water infrastructure in the basin of the river Lužická Nisa was therefore replaced and brought in line with the new EU-compliant Czech legislation. HOBAS CC-GRP Pipes were also used in this project, primarily in the sections with medium and large diameters. The total costs of the large-scale project amounted to 31.3 million Euros. Financing for the work partly came from EU funds, partly from the Czech Republic's environmental fund and partly from resources provided by Severočeská Vodárenská společnost a.s. in Teplice. The construction work was divided into subprojects. HOBAS Products were used in the following packages of measures:

Wastewater disposal

The subproject was aimed at rehabilitating the municipal wastewater treatment plant for Liberec. The plant had been treating the sewage from the city and its immediate vicinity for 12 years. Built in 1994 and designed for a population of 122,000, it was now out of date. Following more than a decade in use, it no longer complied with the requirements of the EU Directive concerning urban wastewater treatment and could not handle the volume of sewage that had risen over the years. Complete rebuilding and adaptation to a population equivalent of 190,000 was therefore urgently required. HOBAS CC-GRP Pipes were used in several areas of this subproject.

Wastewater system

The objective of this package of measures was to extend the wastewater system in the Liberec – Jablonec nad Nisou agglomeration. Here several districts had to be connected to the municipal wastewater system and storm sewers also had to be built. The wastewater from this area will subsequently be conducted to the treatment plant in Liberec. The length of the entire network is 11.8 kilometers and HOBAS CC-GRP Pipes were again used in various places.

HOBAS is famous for being a system supplier that can customize its products to the challenges presented by any site. Features such as corrosion resistance, simple, fast installation, and excellent flow characteristics are just some of the benefits of HOBAS CC-GRP Pipes. In this project HOBAS delivered all medium and big diameters. Pipelines with smaller diameters were realized with clay and thermoplastic pipes that were combined with the HOBAS Products without any problems. In Liberec and the surrounding area, they therefore helped to create the basis for long-term reliable wastewater disposal and played a significant role in taking greater responsibility for the environment.

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Almost Without a Trace

Microtunneling HOBAS® CC-GRP Pipes in Rome, IT

Farnesina is one of Rome's central quarters and is situated on the right bank of the Tiber River. With La Farnesina as headquarter of the Italian Foreign Ministry the area is home to the ancient Milvio Bridge (109 a.c.), two meaningful sports facilities, namely the Olympic stadium and the Foro Italico, but also the junction of the 2 most important roads: The Cassia and the Flaminia.

For wastewater disposal, the municipality of Rome designed a sewer bypass in Farnesina, which runs between two already established concrete DN 3500 collectors. Totalling a length of 320 m, the line was planned with a nominal diameter of 1400 mm.

Disruptions through works on site were to be kept to a minimum, so that the densely populated area would be able to keep up its busy flow, especially during sports events when thousands of visitors gather in the area. The trenchless solution microtunneling was chosen for installation. Apart from being non-disruptive it also kept the construction site comparably small.

SAFAB Spa., a renowned Italian contractor specialized in hydraulic applications was assigned for the job and worked in close cooperation with the company La Falce Spa., whose no-dig know-how is based on 50 years experience.

The tunnel was prepared with a slurry pipe and a so-called MTBM, a Microtunneling Boring Machine featuring a laser guidance control systems. Driving through different layers of soil, such as clay, sand and gravel, a daily advance of 6 to 15 m could be achieved.

The planned line consists of two straights (135 and 185 m) that are connected in a 60° angle with a manhole for access and inspection. The project's main jacking station was erected at this interconnecting point. It was designed as circle with 9 m diameter enabling drives in the two required directions from one single site. Two thrust shields were built to keep the relatively light machine, which was simply rotated to the right position, in place. The first stretch of 135 m was excavated with the thrust from the main station, whereas the longest stretch of 185 m had to be driven with an intermediate jacking station.

HOBAS CC-GRP Jacking Pipes DN 1400 with an external diameter 1,499 mm and a weight of 415 kg per meter were utilized for this project and allowed thrust forces up to 3476 kN. Thanks to the products' smooth outer surface and comparably small wall thickness, it was possible to reduce the amount of slurry as well as excavation material. In fact, it limited the use of bentonite based lubricant to the final sections of both drives and sped up the installation rate considerably. Also the standard pipe length of 6 m and the light weight of HOBAS Products proved to be highly advantageous, for these contributed to reducing installation cost while once again shortening installation times.



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Year of Construction	2008
Total Length of Pipe	320 m
Pressure Class	PN 1
Stiffness Class	SN 32000
Diameter	DN 1400
Installation Method	Microtunneling
Application	SewerLine®
Client	SAFAB Spa
Main Contractor	ACEA ATO 2
Advantages	

optimal hydraulic properties, low drive costs, less slurry, high installation rate, leak tight connections, practical standard pipe length, low weight, light material

All Show and All Substance in Tilburg, NL

Efficient Relining with HOBAS® NC Line® Wins No Dig Award

The sewer in Sint Josephstraat, The Netherlands, is part of the Tilburg main sewer and is an important link in the system of the waste water treatment plant and the rainwater overflow at the Wilhelmina Channel. Designed in 1927 and installed one year later, it consists of a concrete base with a masonry arch. Its transversal section is that of a reversed egg profile, with 1.90 m maximal width and 2.15 m height.

In the late 90's the road above the sewer constantly subsided. Inspection with radar equipment showed that this problem occurred due to the collapse of cavities beside the sewer. The cavities themselves developed because of sand being washed through cracks in the base of the construction. Repair works became imminent and resin was injected to stop the sand from passing through. This solution, however, proved to be unsuccessful so that the municipality of Tilburg was confronted with the question whether to take structural measures.

The problem was solved step by step and with the support of external consultancies and also HOBAS Benelux offered their expertise.

Step 1 - Research

To find the cause for the cracks in the sewer, drill samples were taken from the line. Each sample was strength tested. The masonry proved to be of excellent quality: strength > 60 N/m². The quality of the concrete base, however, did not exceed class B10 and calculations proved that the cracks evolved due to an overload on the structure.

Step 2 - Evaluation

The gravity and scope of damage had to be evaluated in order to determine which measures were to be taken and what should be prioritized. Sewer renovations ask for tailor-made solutions where local circumstances play an important role. Since repairs did not solve the problem, relining or the replacement of the sewer had to be taken into consideration. The latter option would have called for the destruction of the complete existing line in open trench whereas with relining the old structure would remain. The idea of replacing the sewer was soon set aside for it posed technical as well as implementation problems. Moreover it would have been the most costly method.

Basing the decision on the analysis, Tilburg chose prefabricated reinforced plastic (GRP) pipe elements to reline the whole affected section. An important precondition concerning pipe capacity was the maximal acceptable diameter reduction of 10 cm. This limited the number of sliplining methods ("lining with continuous" or "discrete pipes"). Another criterion was the length of the damaged section which does not except horizontal deviations (angle distortion) in the line.



The application of (cured-in-place) hose relining could not be implemented for several reasons, mainly concerning the uneven distribution on the non-circular sewer walls which would anticipate uneven load distribution as well as possible buckling because of the required wall thickness, deviations, angles, and for simply being irreversible once applied. Apart from this, there was little experience with hose relining in large non-circular constructions as such and the method does not allow temporary use of the sewer while being applied. HOBAS NC Line therefore promised to be the better solution. During its installation the sewage is redirected. At heavy rainfall, however, the HOBAS NC Line can be used temporarily and may be evacuated within 10 minutes.

Step 3 - Measures

The number of suppliers for non circular pipe segments that are manufactured in advance is limited. Tilburg soon selected sliplining and HOBAS NC Line Systems. Most important criteria were the guaranteed product quality, provided technical know-how for the implementation, tested and certified homogeneous pipe material and high strength with a relatively small reduction in flow volume.

The pipe design and implementation method were handled by the manufacturer and contractor. Also a wide range of fittings such as man-holes, inlets, etc. were included in the tender which the municipality released in 2007. Contractor Heijmans Infra techniek BV from Rosmalen won the bid.

Step 4 - Implementation

Preparing the implementation, the contractor had to prove that the design meets all specified requirements. The pipe strength was classified with an FEM (finite elements method) calculation which is based on the German directive ATV-DVWK-A-127 and particularly ATV-M-127-2.

The structural wall thickness of the pipe segments was calculated to be 26 mm. For installation, a special transportation vehicle was developed by the constructor. After assembly, the space between NC Line and original structure will be filled where the line needs to be kept in place, preventing it from buoying up.

Being an impressive trenchless solution efficiently realized with HOBAS NC Line, it rightly deserved its reward at the NSTT No Dig Award 2009.

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Year of Construction

2008

Construction Time

5 months

Total Length of Pipe

860 m

Pressure Class

PN 1

Diameter

2150/1900 mm

Installation Method

Relining

Application

SewerLine®

Client

Municipality Tilburg

Contractor

Heijmans Infra techniek BV

Advantages

made to measure profiles, complete leak tight system, high quality, small loss in relining diameter



HOBAS® Pipes Along the Mediterranean Coast

Waste Water Discharge from Izola, SI



The approximately 42 km long coast in Slovenia is home to different industries of which most depend on their location close to the sea. Apart from this, Slovenia boasts one of the biggest ports of the northern Adriatic Sea that is located in the town Koper. Another, predominantly touristic coastal town very close to Koper is Izola. Both share a wastewater treatment plant which is designed for 75,000 inhabitants. However, the 5 km distance between the sewer system in Koper and Izola first had to be overcome. HOBAS® SewerLine® DN 400, SN 10000 and PN 10, was chosen for this purpose.

The new sewer was installed on the route of an old narrow gauge railway, which had not been in operation since 1936 and which today serves as path for joggers and cyclists. Running along the sea, there are no differences in altitude so that the effluents are pumped through the 4.2 km line leading to the newly built wastewater treatment plant in Koper. HOBAS CC-GRP pressure pipes were therefore chosen.

Apart from a lack in altitude which did not allow a gravity sewer, the coastal area bears another challenge, namely to the pipe material itself. Since saltwater is highly corrosive, one of the main reasons for choosing HOBAS Pipe Systems was the products' corrosion resistance to such. Another crucial factor was to keep construction times as short as possible. The disruption of traffic on one of Slovenia's main highways, that happens to run along the pipeline route, should be kept to a minimum. The installation was accomplished without major traffic jams and by keeping one lane open for the traffic.

The investor Komunala Koper was very pleased with the installation speed. Thanks to a fast assembly facilitated by the easy handling of HOBAS Pipe Systems, the installation of the 4.4 km line could be accomplished within two months only. Apart from the HOBAS DN 400 SewerLine®, a lot of additional pipes with diameters ranging from DN 250 to DN 1800 were utilized around Koper. DN 600 Pipes, for instance, were installed at the water treatment plant in Koper transporting sewage to the cleaning basin.

The installation was carried out by open trench and in an average depth of 1 m. Due to the strength of the outer pipe layer, single grained 8-16 mm material could be utilized as covering material. The pipeline coverage was protected with geotextiles, which prevent it from being washed out by seawater in cases of high or strong waves or heavy rainfall.

Year of Construction
2007

Total Length of Pipe

4200 m

Pressure Class

PN 10

Stiffness Class

SN 10000

Diameter

DN 400

Installation Method

open cut

Application

SewerLine®

Client

Regeneracija Lesce

Planner

Hidroinženiring

Ljubljana; IEI Celje

Contractor

Komunala Koper

Constructor

Primorje d.d.

Advantages

quick installation, small

construction site, com-

plete leak tightness and

corrosion resistance,

low construction ex-

penses, long durability

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HOBAS® Safe and Sound under Hungarian Highway

Secure Raw Water Supply and Discharge from Pécs to Szekszárd

The National Infrastructure Development Co. Ltd. is responsible for the support and coordination of all road construction projects in Hungary. Recently, some 100 km of highway were finished in the east and west of the country opening new tracks as the M3, M6 and M7.

The most noteworthy project is the construction of highways M6 and M60 between the two cities Szekszárd and Pécs where 80 km of road were established by the Mecsek Highway Consortium lead by the Austrian company Strabag AG. Further members of the consortium were COLAS SA (France), Bouygues Travaux Publics SA (France), John Laing Infrastructure Ltd. (UK) and Intertoll-Europe Co. Ltd. (Hungary).

Running from Budapest in Hungary to the Croatian highway A5 in the Ivándárda at the Hungarian-Croatian border the M6 is furthermore a part of the so called V/C Helsinki corridor. Regarding the size of and international cooperation in this project it was no big surprise that it won the Project Finance International PPP (Public/Private Partnerships) Award 2008 for the region Europe-MiddleEast-Africa. Also HOBAS had its part in the constructions in the project and delivered CC-GRP WaterLine® Pipes DN 1200 for the protection of a raw water supply line as well as CC-GRP SewerLine® Pipes DN 700 running beneath the highway routes M60 and M6.

The design of the protection pipeline DN 1200 by HOBAS was based on a geological study of the soil. It has to withstand the heavy loads of trucks rolling along the M60 but was nevertheless light enough for a fast and trouble-free handling on site. The constructor Schuman-Fischer Ltd. had to keep a tight schedule installing the pipes and compacting the soil.

An already established concrete pipeline near Szekszárd transports purified water to the Danube. The hydrostatic and static condition of the line asked for it to be replaced where the line crosses beneath the M6 under the northern junction and exit of the highway. A relatively high salt concentration classified "aggressive II/1" according to Hungarian standards presumed optimal corrosion resistant pipe material. The high ground water levels were another issue which was overcome by pump draining the area through drilled holes along the excavated trench. Heavy rain falls in May did not facilitate this costly task and made a fast pipe installation all the more important. The city Szekszárd's water company and the contractor COLAS chose the corrosion resistant HOBAS CC-GRP Pipe System for replacing the highway section of the concrete line. Alisca Bau developed a small trolley to speedily transport the light HOBAS Pipes into the 2.2 m concrete tunnel that had been built below the M6.

Pressure tests finalized the successful pipe projects and the Water Company of Szekszárd officially approved the new HOBAS Pressure Pipeline which will ensure the region's safe water supply and discharge for the next decades.

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Year of Construction	2008	Application	WaterLine®, SewerLine®
Total Length of Pipe	658 m	Client	Strabag Ltd., COLAS
Pressure Class	PN 1, PN 6	Constructor	Hungária Ltd.
Stiffness Class	SN 10000	Advantages	quick installation,
Diameter	DN 1200, DN 700		complete leak tightness,
Installation Method	open cut		low weight, corrosion
			resistance

The Krakow DTW Is Built to Last – Economic Microtunneling with HOBAS Jacking Pipe Systems



Establishing the main collector of the Lower Bench of Vistula River (DTW - Dolnej Terasy Wisly) is very important for Krakow, the second largest city in Poland. The city's growth as well as EU requirements spurred on the extension and modernization of the existing water and sewage system. A large part of the projects is funded by the EU and also the DTW collector is a so-called ISPA project.

The DTW consists of a 6.5 km pipeline of which 6 are installed by microtunneling. Once completed, it will connect two sewage systems, one of them being overloaded and one having reserves. Its function is to even out the flow to the treatment plants Kujawy and Płaszów during heavy rainfall ensuring their optimal operation. In addition to this, areas which currently use septic tanks will be connected to the new collector, preventing the soil from further contamination and improving the groundwater quality. Construction works for the collector are conducted in three stages and in two parts regarding contractors.

DTW Collector Part I: The installation of the first part of the Vistula Lower Route collector in Krakow was initiated in March 2008, the line going into service within the next months. This part of the project is realized by a consortium consisting of Hydrobudowa 9 & PRG Metro. Microtunneling was chosen for mainly economic reasons. Since the planned pipeline route runs in 6 m depth nearby the Vistula River where water collects in layers of sand and gravel, the costs for dewatering and excavation works would have been considerably higher than for tunneling.

The pipes used for the project are HOBAS CC-GRP Jacking Pipes with outer diameters of 1,099 and 1,229 mm. Two independent microtunneling machines were utilized and the right amount of lubricant was applied to maximize the progress. The smooth and non-absorbent surface of the pipes doubled the effect of bentonite lubricant so that the installation ran smoothly over the 200 m long drives and without the help of intermediate stations. The latter would only have been activated if allowed jacking forces had been exceeded. Since their help was not needed, the installation speed was doubled. The achieved jacking rate of up to 25 m per 24 h was the result of the contractors' experience, the pipes' properties and good planning. The thrust and reception pits are made of steel piles. This solution has proved its worth in the past and is now an accepted technique in Poland. Pits of any required shape can be made this way, adapted to local conditions and the optimal pipe length, which in this case is 3 m. The piles are extracted once the pipe installation has been completed.

Concrete sunk shafts are utilized where intermediate stations are taken out after the pipe has been installed, to make way for a HOBAS CC-GRP Shaft. Due to the high precision of microtunneling it is possible to drill through the provided and temporarily sealed sparings in the reinforced concrete walls. Once the pipeline is laid, the intermediate jacking stations are lifted out and CC-GRP Shafts are placed in the 3 m diameter sunk shafts. Thanks to their comparatively small dimension and low weight, this is done with ease.

It was important for the contractor that all parts of the new collector, such as also manholes and fittings, were prefabricated and from one source, which together with microtunneling guarantee a complete high-quality leak tight system. It was furthermore of great importance to be able to continue installation works during the winter months. Taking the high durability of the pipeline system into account, a pressure line of the system will also be established with CC-GRP utilizing DN 500 Pipes PN 6.

Year of Construction

2008 - 2009

Total Length of Pipe

6.5 km

Pressure Class

PN 1, PN 6

Diameter

D_e 530, 1099, 1229

Installation

**Microtunneling,
open trench**

Application

SewerLine®

ShaftLine®

Client

Krakow Waterworks

Contractor

**HB 9, PRG Metro,
INKOP**

Advantages

**ideal for micro-
tunneling, low
friction, durability**

DTW Collector Part II: The remaining 3.4 km line is realized under the direction of INKOP, another contractor specialized in microtunneling. Its construction was commenced in September 2008 and is expected to be completed by the end of 2009.

The works were conducted under similar soil and groundwater conditions as for Part I. Outstanding progress was achieved with installation rates up to 24 m / 12 h. The intermediate stations once again stood still during all drives, even lengths up to 208 m were easily tackled without help. Optimal technological parameters, the smooth surface of HOBAS Pipes and sufficient lubrication applied every 21 m make an efficient and economic realization of the project possible.

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Bulgaria in Full Bloom

Irrigation Line Rehabilitation with HOBAS® Pressure Pipes

Thrace is one of the most fertile regions of Bulgaria. Its climate - hot summers and mild winters - is ideal for growing sunflowers, maize, and corn but also for viniculture and Bulgaria's renowned rose cultivation for the precious rose essence.

However, summer rainfalls are not sufficient for this agricultural abundance and a concrete irrigation system had therefore been built somewhat 30 years ago, bringing water from the river Striama and the Pyaschnik to supply the town Chirpan.

At the end of 2008 and with the decision of Bulgaria's Ministry of Environment and Water, a project was initiated to rehabilitate approximately 2.1 km of the line close to the town Rakovski. It was decided to utilize HOBAS® CC-GRP Pipe Systems DN 500, PN 6, due to the products' high quality, long lifetime, excellent hydraulic characteristics, long term static properties and their simple and fast installation.

The pipes' easy handling and comparably light weight were further important criteria for they had to be stored around 15 km away from the construction site and a small special truck had to transport one after the other to the site. Reason for this was that the road was far away from the construction site and the site itself lay between a wide wheat field and an impressively large vineyard.

Thanks to the outstanding cooperation of the Bulgarian contractor Lomstroy, who is specialized in hydraulic applications, HOBAS Bulgaria and the production facilities in Czech Republic and Romania, the first 500 m part could be installed within a week only. The remaining 1.6 km of the line were accomplished in merely three weeks. All in all, including installation time and pipe testing, added up to a month and a half.

The contractor and client Lomstroy confirmed that HOBAS Pipes were remarkably easy to handle, not only due to their light weight but also because of their simple push to fit couplings and compatibility with other materials. In the client's point of view, the success of HOBAS can be ascribed to the professional commitment of the HOBAS team as well as made-to-measure solutions. HOBAS Bulgaria does not simply sell pipes yet offers competent technical advice and strives to find the best solution for every individual situation. To ensure an optimal result, the construction team was technically advised on site and the thought-out logistics gained the clients trust.

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Year of Construction
2009

Total Length of Pipe
~ 2.1 km

Pipe Specifics
PN 6, SN 5000, DN 500

Installation

Open trench

Application

WaterLine®

Client | Contractor

Lomstroy Ltd.

Advantages

High quality, long service life, excellent hydraulic properties, longterm static properties, light weight, simple and fast installation

Isle of Grain Pipe Jacking HOBAS® CC-GRP Pipes for Great Britain

In addressing future demands for alternative supplies of gas, the UK has seen the construction of a number of new terminals for the importation of liquefied natural gas (LNG) one of which is sited at the Isle of Grain on the Thames estuary. For the most economic transportation of the gas it is cooled to achieve this liquid state and needs to go through a process of regasification for use in the UK gas grid. The latter process is no more than raising its temperature back to ambient. This requires heat and at the Isle of Grain this is being supplied by utilizing surplus heat from the existing Isle of Grain power station in the form of hot water. A twin pipeline system connects the station's two plants, part of which is installed inside tunnels using HOBAS CC-GRP jacking pipes.

For the first 2 drives the pipe lengths were two 3 m pipes behind the shield with the remaining pipes being 6 m long. Every third pipe was fitted with two bentonite injection points. The 144 m long drives were at relatively shallow depths and parallel to each other so that they could share the same jacking pits.

Shortly after starting the second drive an obstruction was encountered that stopped the machine, which was eventually found to be a large steel pipe crossing the top of the proposed alignment. This investigation involved a hand constructed adit cut through from the first drive in front of the second drive to determine the extent of the obstruction. The remedial action was to reverse the machine out by winching, to remove the first few pipes while at the same time backfilling in front of the shield and at the same rate using low density concrete to stabilize the void left. The drive was then restarted 1 m lower so as to go under the existing pipe.

The pipes in the third and fourth drive had to be installed at a depth of 23 m because they had to cross a gas main (2x DN 1400; main supply from London) a safe enough distance below it. To keep the construction costs for the 25 m deep jacking pit within reasonable limits, HOBAS demonstrated flexibility by supplying 3 m long pipes.



Year of Construction

2008 - 2009

Total length of pipe

522 m

Pressure Class

PN 1

Stiffness Class

SN 32000

Diameter

**D_e 2160 mm,
wall thickness 69 mm**

Installation Method

Jacking

Application

Protection pipe

Client

Stockton Drilling Ltd.

Contractor

**A E Yates Trenchless
Solutions**

Advantages

**Installation with a small
tunnelling machine,
smooth outer pipe sur-
face, flexible pipe length,
quick installation**

The shaft diameter was therefore minimized and expenditure substantially reduced. In order to reach the existing jacking pit for pipeline sections one and two, sections three and four had to be pushed an unbelievable 15 meters uphill over a length of 117 meters.

By selecting HOBAS CC-GRP Jacking Pipes, the building contractors were also able to use a smaller tunnel boring machine (a Herrenknecht AVN 1600 full face excavation machine) than would have been the case with concrete pipes of the same inside diameter. In the second case, an AVN 2000 would have been required.

Other benefits for HOBAS CC-GRP Jacking Pipes include smooth outer diameters for reduced jacking loads (here only 160 t) and the non-absorbent pipe surface lowering lubrication needs and the reduced excavation volume improving production rates and diminishing spoil disposal costs.

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Curved Pressure Pipe Jacking

Jacking HOBAS® Pressure Pipes beneath the River Rhine, CH

Novartis is one of the leading suppliers of innovative pharmaceutical products. The group operates in more than 140 countries worldwide and is strongly rooted in Switzerland.

Currently, the company is turning the industrial complex of the St. Johann Areal in Basel with its research and production facilities, office buildings and the international head quarters into a state-of-the-art center for research, development and management.

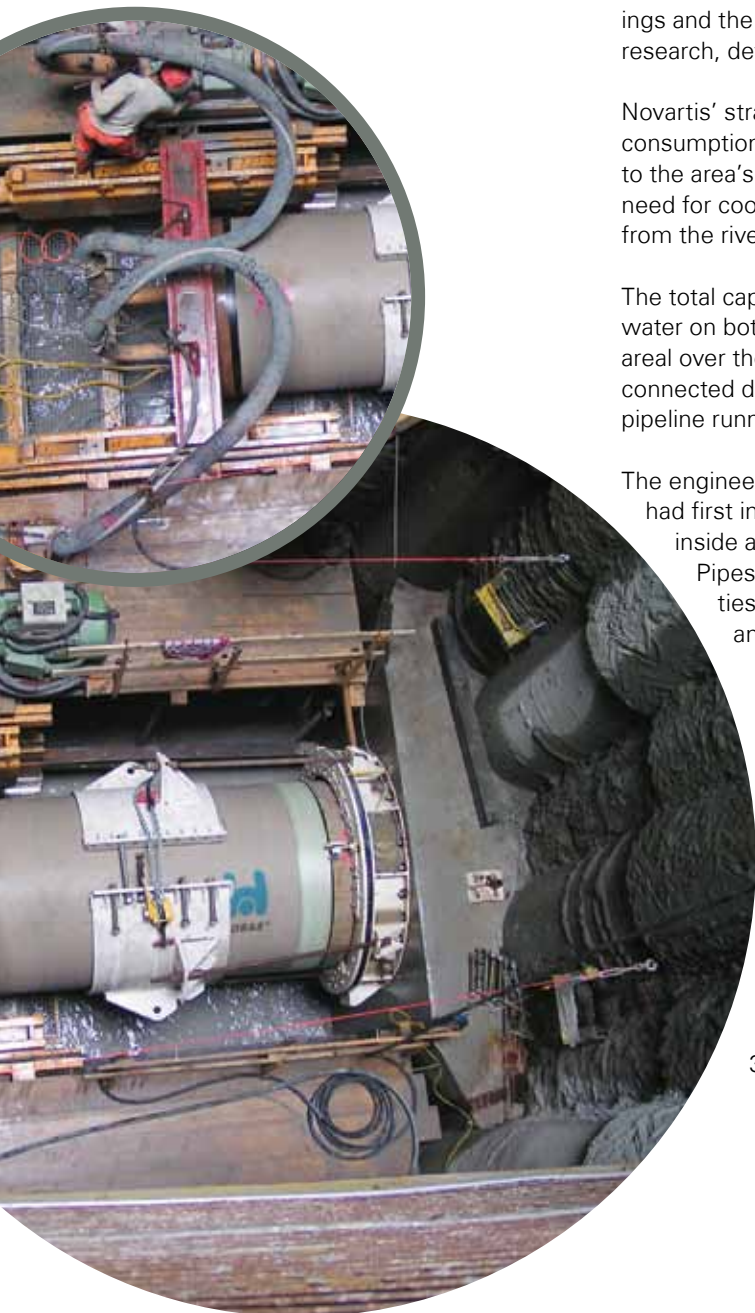
Novartis' strategic aim regarding sustainability is to reduce the energy consumption of the new buildings to a third of the former premises. Due to the area's development as well as alternative energy systems, the need for cooling water will increase over the coming years. Purified water from the river Rhine is used for this purpose.

The total capacity of the present purification plants for general service water on both sides of the Rhine will cover the increasing demands of the areal over the next 10 to 15 years. However, both plants first had to be connected due to altered technical requirements. This was realized with a pipeline running under the Rhine.

The engineering company Rapp Infra, who was in charge of the project, had first intended a double pipeline where a pressure line would run inside a reinforced concrete jacking pipe. Since HOBAS CC-GRP Pipes can be produced to unify both, pressure and jacking properties, Rapp Infra was soon convinced by the economic advantage and shorter construction time.

A further advantage was that the Swiss constructor Implenia dealing with jacking installation has already worked very closely with Product Managers and Technicians at HOBAS Switzerland and Germany and was thus already acquainted with the specialists' proficiency and the products' advantages.

Following thorough research and comparison of the various bids, HOBAS received the order and delivered the first jacking pipes mid-April 2009. Jacking and receiving pits for the pipes were excavated and retained by concrete bored pile walls. The main jacking pit was no less than 32 meters deep.





This great depth was required to avoid underground water courses (high groundwater table of over 20 m) and putting the Rhine water at risk. The pipeline runs under the Rhine with a safety margin of 6 m between the top edge of the HOBAS Pipe and the bottom edge of the river bed.

At this depth, it was possible to drive through one horizontal soil layer whereas traversing different formations beneath the Rhine would only have posed additional risks for what was already a highly complex project. As the receiving pit lay at a depth of 28 m, the pipes were driven four meters uphill over the length of 433 meters – another critical aspect that was easily overcome with the help of HOBAS Products.

Another requirement regarding installation was the curved jacking route. The reason for this was the border between Switzerland and France. If they had jacked in a straight line, they would have crossed the border into France. They therefore pushed the pressure jacking pipes in a curve with a radius of 1000 m.

In this project in Basel, pressure jacking pipes with the pressure class of PN 10 and an outside diameter of 1499 mm were used. As if all these incredible challenges were not enough, building contractor Implenia installed some 24 to 30 m of jacking pipes per day and completed the project in record time of one and a half months.

Without the excellent work by Implenia and outstanding cooperation and coordination between sales representatives, engineering, production and shipping departments in the various HOBAS organizations such top performance would not have been achieved. All parties involved can be truly proud of their contribution and satisfied with this unprecedented reference project.

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Year of Construction
2009

Construction Time
1.5 months

Total Length of Pipe
433 m

Pressure Class
PN 10

Stiffness Class
SN 160000

Diameter
D_e 1499,

wall thickness 79 mm

Installation Method
Jacking

Application

**WaterLine®
 (cooling water)**

Client

Novartis Basel, CH

Contractor

Implenia AG, CH

Advantages

**Jacking under the Rhine
 with high groundwater
 level, direct jacking of
 pressure pipes, very
 short construction time,
 injection nozzles,
 special logistic
 preconditions**



Trenchless Renovation - Out of Sight, Out of Mind – Dresden, Germany, Relines Old Town Collector with HOBAS® NC Line®

Year of Construction

2009

Installation Time

5 months

Total Length of Pipe

HOBAS Pipe: 880 m

Pressure Class

PN 1

Diameter

2157 x 2129,

2242 x 2195 mm inner

diameter (wall thickness

32 mm)

Installation Method

Relining with short profiles

Application

NC Line®

Client

Stadtentwässerung

Dresden GmbH

Constructor

Insituform Rohrsanie-

rungstechniken GmbH,

Dresden, and Heinrich

Lauber GmbH, Coswig

Advantages

Profiles made to fit origi-

nal sewer, no disruption

of tourism and traffic,

the special profiles bear

the full static loads

with comparatively thin

walls, top quality,

delivery reliability

Imagine you are responsible for a sewer system that is 100 years old and needs immediate renovation, you have to discharge 60 million cubic meters of wastewater per year, the pipeline runs directly along a river and thousands of tourists pass by to admire the historic center of your city with its numerous sights. What do you do? Exactly, you utilize HOBAS NC Line Pipes for relining.

The sewer mains were built over the last three decades of the 19th century. They run perpendicularly towards the Elbe and lead into collectors paralleling the river along the old and new town side. A survey showed that the so-called Old Town Collector of compressed concrete on the left side of the Elbe urgently needed to be renovated. There were several signs of damage and a safe load capacity was no longer guaranteed. The section to be renovated spans over 1.3 km and runs through the old town quarter and along the left bank of the Elbe.

Home to the Semper Opera House, the Zwinger Palace, the Old Masters Picture Gallery, the treasure chamber of the Electors and Kings of Saxony, etc. Dresden attracts around 7 million tourists per year. The only possibility to ensure Dresden's visitors a pleasant stay is to renovate the old sewer by trenchless means, namely relining. Compared to the open trench installation the construction time as well as inconveniences regarding traffic flow and tourism can be kept to a minimum. The renovation costs for the sewage collector amount to around 7 million Euros and construction works will be completed by the second half of 2010.

During construction works, the wastewater is diverted with a siphon pipe DN 1200 with a maximal flow rate of up to 1900 l/s. It runs on supports underneath the quay so as not to hamper the Saxon steamboats and above the quay wall beyond the Augustus Bridge. That the Stadtentwässerung Dresden GmbH was also able to turn the sheathing of the provisional pipeline into a further tourist attraction is demonstrated by the artistic design of the artist Christian Gerdorf.

After a thorough comparison Stadtentwässerung Dresden GmbH opted for the HOBAS NC Line® alongside other brands. With a k-value of less than 0.01 mm the smooth inner surface of the profiles proved to be a decisive advantage since hydraulic requirements are met despite the slightly reduced diameter of the relining profiles. During preparations technical details were arranged with the planning office ACI-Aquaprojekt Consult and contractors Insituform Rohrsanierungstechniken GmbH and Heinrich Lauber GmbH in Coswig. The contractors paid particular attention to meeting the required quality parameters and to technological processes. The existing pipe was first inspected and calibrated by laser scan and manually with a mold to determine the exact outer dimensions of the future profiles. This was necessary to maximize the capacity of the new sewer while ensuring an easy installation. A precise plan including standard and short profiles and some with special oblique couplings was worked out.



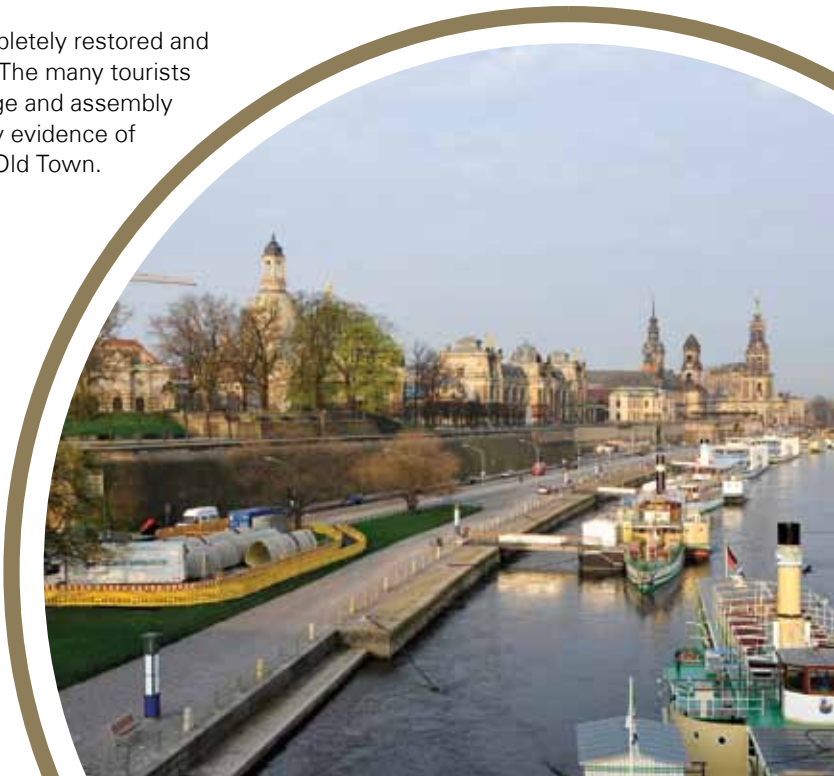
The static design is based on the rules and regulations M-127 T2 set by the ATV-DVWK (Abwassertechnische Vereinbarung – Agreement regarding Wastewater - and Deutscher Verband für Wasserwirtschaft und Kulturbau – the German Association for Water Management and Land Improvement). Because the condition of the existing sewer is categorized class III, the calculations by LGA Nürnberg / Ingsoft GmbH were carried out with due consideration of the special geometry and the grouting procedure. Here it proved advantageous that HOBAS NC Line® Profiles are manufactured with definable wall thicknesses, which keeps statically inconvenient imperfections to a minimum. Since the profiles are produced at the factory, there is no subsequent shrinkage that could lead to circular cracks. Because deformations due to inconsistencies in the old sewer are not transferred to the new pipe as would be the case with cured-in-place relining methods these need not be considered.



Special requirements were set to the quality of the NC Line® Profiles. The production facility was audited for production approval. This was done for inspection, to check the quality assurance system and to see if standards were kept according to specifications. The supplied product was analyzed in addition to the assessment. The engineering office Siebert und Knippschild therefore took specimens from the construction site and checked them for given parameters.

In two separate construction stages a 520 m and a 320 m stretch of HOBAS NC Line® Profiles were installed with internal dimensions of 2157 x 2129 mm and 2242 x 2195 mm. The 2.35 m long HOBAS Profiles were lowered into the assembly pits by crane. With a specially built transportation vehicle the profiles were fed into the old sewer and assembled. Using special technology ensured an optimal pipe transportation and installation. Finally, the new line was secured against uplift and the space between the old and new structure was grouted in accordance with the static calculations.

Once the project is finalized, the collector will be completely restored and should last for the next 100 years even during floods. The many tourists barely notice the works beneath their feet. Pipe storage and assembly pits that are set in relatively large intervals are the only evidence of the ongoing activities under the streets of Dresden's Old Town.



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HOBAS® Clears Traces of Time CC-GRP Pipe Systems for a Wastewater Treatment Plant in Slovakia

Year of Construction
2005

Installation Time
8 weeks

Total Length of Pipe
640 m, over 50 tailor-made fittings

Pressure Class
PN 1 – PN 6

Stiffness Class
SN 10000

Diameter
DN 350 – DN 1800

Application
SewerLine®

Installation Method
Open trench and on concrete supports of original line

Client
ZIPP a.s. Bratislava

Investor
Podtatranská vodárenská spoločnosť a.s.

Advantages
Corrosion resistance, made-to-measure fittings, fast installation, leak tightness, long lifetime

The construction of the Wastewater Treatment Plant in Poprad Town's quarter Matejovce, Slovakia, was initiated 20 years ago but came to a complete halt after 5 years. When the project was continued in 2004 the established constructions were no longer intact, neither were the pipelines that run between tanks and buildings.

Time and weather had left their traces on the original steel pipes that had been partially installed - they fell victim to corrosion. A suitable replacement had to be found which was fit enough to meet a row of requirements. Above all, however, it should have a long lifetime. Further requirements were set due to site conditions such as the nearby Poprad River and railway tracks: high groundwater levels and corrosion resistance needed to be considered in the choice for the right material. Product flexibility and variability were further criteria for the installation drawing had to include existing constructions and a simple and fast installation had to be given.

HOBAS CC-GRP Pipe Systems met all requirements. Especially the infinite range of made-to-measure fittings simplified and accelerated the installation.

A total of 640 m pipe and no less than 50 fittings were installed for the project. The pipelines between the pumping units were designed for the pressure class PN 6 and gravity pipes PN 1 were utilized between the tanks where the inclination sufficed for a correct flow. To suit the terrain and groundwater on site, the pipes were delivered with a stiffness class SN 10000.

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Auger Boring in Record Time Installing a Storm Sewer with HOBAS® CC-GRP Jacking Pipes, AT

Southeast Styria has recently had to contend with frequent flooding and mudslides. Torrential rains and the huge amounts of water occurring have caused considerable damage, giving rise to concern in the community. Fast action was required and the Feldbach town council therefore decided to implement a storm overflow project.

The project was the first in Austria to use HOBAS GRP Jacking Pipes D_e 924, SN 128000 for guided auger boring. A trenchless technique, which involves jacking the GRP Pipe into the ground and removing the excavated soil through the inside of the pipe with augers in a steel casing. As a result, the inside surfaces of the pipes are subject to substantial loads. HOBAS Pipes have an abrasion-resistant internal surface and during the project proved once again that they can also be used for this installation method.





Prior to laying the pipes, HOBAS experts developed the storm overflow concept in cooperation with Achim Konrad from Feldbach town council and Bernhard Schilcher from Lugitsch Ziviltechniker GmbH. It was at this stage that they also decided to use jacking pipes made of GRP. The decisive factor was not only the HOBAS team's commitment, but also the competitive quotation from HOBAS Pipe Austria for the 6 m pipes.

The project tender did not specify any particular installation technique. RBS Rohrbau-Schweißtechnik GmbH was awarded the contract for its proposal of auger boring and provided advice during project planning.

The only drilling company capable of boring the required diameter, RBS used HOBAS GRP Pipes for auger boring for the first time. After having adapted its drilling equipment to fit the outside diameter of the HOBAS Pipes, the company carried out boring quickly and without any trouble. Even a slight correction to the direction because the shaft became a little instable was no problem with the HOBAS Pipes and work was completed in record time of only six days.

The client, planners and contractors were all extremely pleased with the pipes. The storm sewer is an impressive demonstration of the fact that HOBAS Products are also suitable for use in auger boring.

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Aloha HOBAS®! HOBAS® SewerLine® Pipes Help Protect Hawaii's Beaches

Tourism is the engine of Hawaii's economy and its famous beaches are a top attraction. A break in an old sewer line could close the favorite beaches, Waikiki and Ala Moana, and contamination might attack the fragile coral reef and other marine life in the area. Small wonder that the city and county officials work so hard to protect the environment.

Several sewer projects with HOBAS Pipes were conducted in the last years. One of them was the Wanaao Road/Keolu Drive Reconstruction Sewer with installation of a gravity sewer line, which includes CC-GRP Jacking Pipes installed by Frank Coluccio Construction. Bijan Khamanian, HOBAS Division Manager, explained, "HOBAS Pipes are very well accepted in both Honolulu and Maui Counties. Currently we are supplying 1,341 m of D_ø 914 mm jacking pipe to the Wanaao Avenue sewer, which connects to the Kalaheo project already in place. In Maui, Pipes diameter 610 mm, PN 10 were used in the construction of Wailuku force main, which was completed in February 2009. As a follow-up, Maui County is also using HOBAS Pipes diameter 1067 mm in the construction of the Wailuku Wastewater Pump Station as well. The largest HOBAS Pipe specified in projects in Hawaii is approximately 1,770 m of 1830 mm for the Beachwalk WWPS and Force Main project in Waikiki, which will go into construction in the fourth quarter of 2009. In addition, projects in Ewa Beach and Pearl City will follow later in 2009 and early 2010."



Year of Construction	2009
Construction Time	6 days
Total Length of Pipe	80 m
Pipe Specifics	SN 128000
	DN 800 (D_ø 924 mm)
Installation Method	Jacking
Anwendung	SewerLine®
HOBAS Experts	Johann Fabach,
	Siegfried Kreuzer and
	Gerhard Szigeti
Client	Feldbach town council
Planner	Lugitsch Ziviltechniker GmbH
Contractor	RBS Rohrbau-Schweißtechnik GmbH
Advantages	Use of HOBAS Pipes for guided auger boring, abrasion resistance of the HOBAS Products' internal and external surfaces, rapid installation, professional advice from HOBAS experts

Kalaheo Avenue Sewer

One of the projects of special interest is the Kalaheo Avenue Sewer in Honolulu, Hawaii. The sewer serves most of the seaward areas of Honolulu and HOBAS supplied jacking pipes D_e 1219 mm to two separate contractors involved in the installation. The project included sewer reconstruction emergency work and a water line replacement project. This project involved a variety of trenchless methods. Aspects included rehabilitating 570 m of an existing D_e 1372 mm gravity flow sewer main, six man-holes and using microtunneling to install 1,617 m of a new sewer pipe.

Beachwalk Microtunneling Project

Work was launched following a devastating break in an aging sewer line under Kaiolu Street. The project involved river crossing underneath both the Ala Wai Canal and Kaiolu Street at a depth of 12 m. This old line was replaced by the two new lines (774 m HOBAS Pipes D_e 914) that hook up to an existing pipe on the bottom of the canal. This allowed contractors to dismantle and remove the aboveground pipes and pumps along the Ala Wai Boulevard.

The project team faced several initial challenges. This included the technical considerations of microtunneling, shaft construction methods, exact locations, sizes and depths, groundwater control and locating the existing underground utilities along the proposed route. The project originally called for temporary lines under Kaiolu Street, but was changed to make those lines part of the permanent fix to upgrade the city's sewer system. Also, original plans requested one microtunneled line, but that was changed to two lines, giving the city an emergency backup in the event one line goes down and also allowing greater flexibility for needed maintenance.

Honolulu Force Main Microtunneled

The original force main, a 50-year-old steel line, served about one third of the Honolulu area population. Several breaks made replacement a priority. The new line included 671 m of D_e 1219 mm HOBAS Pressure Jacking Pipes and more than a dozen custom designed fittings. The alignment crosses under the Honolulu harbor, the area's busiest port docks and a coastal highway. Facing these challenges, an all-trenchless installation was planned.

Project designers, Wilson Okamoto & Associates of Honolulu, specified only two products for the microtunneled pipes, concrete steel cylinder and CC-GRP. First, the pipes had to be both strong enough for jacking and capable of pressure service. Second, considering the seawater external environment and raw sanitary sewer flows inside, corrosion resistance was also important. Finally, reliability was paramount because of the difficulty of future access, depths up to 11 m and the critical nature of this application.

General contractor, Modern Continental of Boston, chose HOBAS Pipes as the most economical and reliable option. HOBAS Pipes were installed under the port docks and the highway to reach the main interceptor. The microtunneling was completed in two long and two short drives. The HOBAS Pipes performed flawlessly with no breaks and maximum loads of only 200 tons even on the 305 m push. One interjack station was inserted on each of the long drives, but neither was ever activated.

HOBAS fabricated a variety of fittings to match the required alignment. A bifurcation, reducers and several elbows were used to transition from two D_e 914 mm HDPE lines to the

- Year of Construction
2000 - 2009
- Total Length of Pipe
8,000 m
- Pressure Class
PN 1 – PN 10
- Stiffness Class
Various
- Diameter
450 - 1500 mm
- Application
SewerLine®
- Installation Method
Jacking, tunnel, direct bury
- Client
Various
- Contractor
Various
- Advantages
Leak free, corrosion resistant, light weight



single D_e 1219 mm HOBAS Portion. Flanges and a wye permitted assembly to two valves and a lateral. Accurate detailing and fabrication of the various fittings facilitated an easy, precision “fit-up” in these complex areas. The completed system easily passed the installed field hydrotest with no leaks or breaks in any of the pipes or gasket-sealed joints. The project proceeded so trouble free that it was completed four months ahead of schedule and under budget.

Despite the presence of a local concrete pipe producer, HOBAS has been supplying pipe manufactured in Houston, Texas, to the Hawaii islands for 12 years. The warm islands of Hawaii undoubtedly have some of the worst sewer environments known. The corrosion resistance along with the pipe’s leak-free joints is helping keeping Hawaiian beaches clean. Further reasons for the wide use and acceptance in Hawaii are the durability of the pipe, not only in final use but also during shipping and handling. With an aging sewer infrastructure, Honolulu has planned more applications for HOBAS Pipes including sliplining, rehabilitation and microtunneling installations.

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Central Bohemian Region Is Ready for the Future – Reconstruction and Extension of the Sewer Network Beroun, CZ

The royal town Beroun with its approximately 18,000 inhabitants is located near Prague and on the motorway that connects the capital with Germany. 2004 Beroun received 8 million Euros from the European Cohesion fund to cover 65% of the long-term reconstruction project, which had become immanent.

Initiated in 2005, the project involved the installation of no less than 16 km sewer pipe. Two years later, in 2007, the project was finalized and the towns Králův Dvůr and Zahořany were connected to the local network. Regarding environmental issues was part of the plan. Waste water treatment plants were therefore established in Beroun and Králův Dvůr to which the newly established sewer networks now link.

HOBAS® CC-GRP SewerLine® Pipes were utilized for the larger diameter pipelines DN 500 to 1400. A total of 8.5 km gravity pipes (PN 1) with a stiffness of SN 10000 were installed by open trench. HOBAS Czech Republic delivered a part of the pipes that are produced at 6 m standard length at 3 m lengths to facilitate the installation in the partly very deep and narrow trenches. Various HOBAS Fittings, Elbows and Shafts completed the provided system.

The company Skaska that headed the construction consortium drew from their experience in coordinating pipe orders with their simultaneous installation by numerous companies. Thanks to the good organization and the parallel construction on several sites, on time pipe deliveries and the supervision and advice by HOBAS Experts, this major sewer reconstruction and extension project was finalized smoothly and to everybody’s contentment.

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Year of Construction
2005 - 2007

Total Length of Pipe
8.5 km

Pipe Specifies
PN 1, SN 10000

DN 500 - 1400

Installation Method
open trench

Application
SewerLine®

Client
Beroun Town

Constructor
Skanska & Consortium

Advantages
Corrosion resistance, availability of pipe lengths other than standard 6 m, light weight, relatively small site area space required

With or without Trench - always with HOBAS®! Renovation of a Sewer Main in Strasbourg, France

The reconstruction of the sewer main for the Rhine Harbour of Strasbourg was a model example of the complementary nature of open-dig and trenchless installation. Where the working space would have been insufficient, rehabilitation was carried out by sliplining prefabricated GRP NC Line® panels. Wherever a trench was feasible, CC-GRP Pipes were laid in an excavated trench which was prepared in accordance with pipe installation standards and as the depth required.

The project, coordinated by the Water and Sanitation Division of the Urban Community of Strasbourg, involved the renovation of an egg shaped main dimensioned 1,400 x 1,900 mm that functions as combined sewer for domestic and industrial effluents. 980 m DN 1500 CC-GRP pipe were lowered into a trench with a depth varying between 3 and 9 m. Over a stretch of 550 m the existing egg shaped structure was sliplined utilizing GRP NC Line® panels with an internal dimension of 1230 x 1660 mm.

The concept and implementation of mixed installation techniques for the project was particularly innovative and pragmatic. All pipe material was supplied by HOBAS. "We were looking for the best techno-economical compromise and this led us to selecting these techniques for this project. The performance of the 2 methods and the pipe material had to be taken into account while keeping environmental impacts to a minimum. Trenchless installation enabled the industrial roadway to remain open for use and us to comply with budget and safety considerations", explains Marc Hunsinger, head of the CUS Water and Sanitation Networks department. This project was coordinated by a consortium where SMCE Réha was responsible for the trenchless section and EJM Alsace for the open-dig section.

The sewer main that was relined has a curved section and therefore required the use of panels in different lengths varying from 1 to 2.35 m. These were inserted in the main with the help of a trolley and fitted together with a hydraulic jack. Then the panels were held in place with wooden wedges and finally fixed by grouting the annulus.

For the structural rehabilitation, the 25 mm thick NC Line walls have been calculated to ensure the optimal performance of the new line. This system not only transfers vertical loads (ground and heavy industrial traffic) but above all withstands aggressive substances from effluents from agronomical industrial plants with pH levels ranging from 1 to 10. The sewer's leak tightness is guaranteed by EPDM rubber seal integrated in each PN 1 connection.



Year of Construction
2009

Construction Time
9 months

Total Length of Pipe
1530 m,
15 Tangential Shafts

Pipe Diameter
DN 1500, NC Profiles:
1230 x 1660 mm

Pressure Class
PN 1

Installation Method
open cut, relining

Application
SewerLine®, NC Line®

Client
CUS – Strasbourg
Urban Municipality

Engineering Office
CUS – Water and Sewer
Networks Department

Contractors
SMCE Réha, EJL Alsace

Advantages
Corrosion and abrasions resistance,
several installation methods possible
with one pipe material, light weight, easy installation

“The structure of the masonry sewer was very weak due to constant heavy loads from lorries. Furthermore, its crown has suffered because of corrosive exhaust emissions”, states Laurent Gerber, Managing Director of SMCE Réha.

The relined sections with GRP panels show high structural and mechanical strength, the flow rate is now considerably higher, and the new material is corrosion as well as abrasion resistant guaranteeing durability for at least 50 years. Mr. Laurent Gerber adds: “Trenchless rehabilitation was a good alternative installation method that allowed us to keep existing trees and moreover ensured open access to the industries of Strasbourg’s harbour. The sliplining only required 3 access pits over the 550 m stretch that was rehabilitated and therefore kept disruptions of a strongly frequented road to a minimum.”

The simultaneously excavated section called for special equipment as emphasized by Jean-Claude Bouvard, director of the EJL Fegersheim branch: “We deployed heavy machinery and a lot of manpower for the installation of the new sewer. For the maximal depth of 9 m we used high tonnage compact excavator types 944, 934 and 924 from Liebherr as well as heavy-duty double slide trench shields. The DN 1500 CC-GRP HOBAS Pipes weigh only 365 kg per meter, each standard unit being 6 m long. The therefore comparably light weight at the given diameter, the pipe length and mounted push-to-fit joints made handling easy. Besides, this was the first GRP project for the EJL construction team and we are delighted to see that all went well. In line with our commitment to environmental protection the excavated soil could be used as backfill material. Only the pipe embedment was supplied.”

Completing the system and in addition to the pipes, fifteen prefabricated HOBAS CC-GRP DN 1500 x DN 1000 tangential manholes have been installed for the open trench section. These special components are equipped with GRP couplings which connect to the standard centrifugally cast GRP pipes.

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Ready for Take-Off: HOBAS® and Schiphol Airport CC-GRP Pipes for Renovating Airport Drainage System, NL

Travelling by air is one of the safest, most accurate and fastest ways to travel. This reputation, however, makes high demands on air carriers as well as airports and one can easily deduce that these companies need to be equally demanding whenever they act as customers. Amsterdam Airport Schiphol is likewise known to be a critical client: a combination of high quality standards and short delivery times usually demands a great deal of contractors and suppliers. One may say that not every supplier comes into consideration to deliver to Schiphol.

HOBAS® CC-GRP Pipe Systems are being utilized at Schiphol Airport since 2003. The successful cooperation between HOBAS Benelux and Schiphol Airport led to an agreement in March 2008 to continue using HOBAS CC-GRP Pipes beneath the airport's airside.

Schiphol covers a total area of 2820 hectares, which is approximately 8 times the size of the Central Park in New York. With five runways and one small airstrip, the airside consists of 1.2 million m² asphalt and 3.8 million m² concrete. Stormwater is conveyed in 30 km culverts, 300 km stormwater sewers and 125 km concealed gutters – the complete drainage system totaling 455 km. Most of the reinforced concrete drainage underneath the airside's paving has been installed in the 1960s.

During the 1990s Schiphol Airport checked the condition of its old sewers. Video inspections showed cracks in the concrete pipe material. More examinations followed detecting the severest damages in areas that are most heavily frequented by arriving and departing planes. The traffic load condition was therefore reevaluated with the conclusion that the Boeing 747 is mainly responsible for the damages to the reinforced concrete pipes.

Renovation Plan

Due to this situation and bearing in mind that the airport will have to be able to cope with larger aircraft such as the new Airbus 380, Schiphol opted for a renovation plan based on new requirements. Static calculations were thus made using the aircraft class DAC 750 with a maximum weight of 750 tons. This class meets the requirements for the traffic loads of the latest generation of aircrafts.

The plan involved renovating all concrete pipes beneath the paved airfield. Heavily damaged pipes beneath runways and taxiways were prioritized and involved a variety of diameters ranging from 400 to 1500 mm at a total of 35 track crossings. Schiphol established a separate plan for each runway and taxiway for which the pipe section running directly under the airstrips were



kept as short as possible. Disruptions to air traffic should be minimized so that Schiphol opted for trenchless installation methods such as sliplining and jacking.

HOBAS® CC-GRP Pipes

For Schiphol Airport, HOBAS® produced GRP Pipes that withstand the exceptional traffic loads of current and future aircrafts. Their minimal nominal stiffness lies at 16000 N/m² and are fit to be installed directly beneath runways, taxiways and aprons.

3 types of HOBAS® CC-GRP Pipe Systems were employed for the project:

HOBAS® Relining Pipes were used for sliplining affected concrete culverts that cross the runways and taxiways and have a relatively small angular deflection. By inserting GRP pipes in the existing structure, the line withstands the full traffic loads and obtains the complete lifetime and amortization period of a new sewer. A crawler crane inserts the pipes into the given structure from a starting pit; no sliding devices were needed for this. The annular space between the old and new pipe was subsequently filled with grout to uniformly distribute the loads on the sliplined pipes. Masonry connections link the GRP Pipes to the concrete shafts.

HOBAS® Jacking Pipes were utilized where the pipe diameter had to be maintained and where opening a trench was not an option. After completion of the new line, which was installed on a different route, the existing pipe is filled with cellular concrete to avoid that it collapses.

HOBAS® SewerLine® Pipes were installed beneath all paved areas where an open trench was feasible but also on the open field.

A total of 7.3 km HOBAS GRP Pipes now contribute to the high safety standards at Schiphol airport - ready for take-off and landing of the Airbus 380.



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Year of Construction

2009

Total Length of Pipe

7.3 km

Diameter

DN 300 – 1600

Pressure Class

PN 1

Stiffness Class

SN 16000

Installation Method

Jacking, Sliplining, open trench

Application

SewerLine®

Client

Airport Schiphol, Amsterdam

Contractor

Various

Advantages

high stiffness and long lifetime, easy and fast installation, small reduction in diameter, smooth inner pipe surface, outstanding support by HOBAS Benelux.



HOBAS® Makes Assurance Double Sure

Double Pipe Sewer System for the Marche Region in Italy

Year of Construction

2009

Total Length of Pipe

1.4 km

Pressure Class

PN 1

Stiffness Class

SN 10000

Diameter

DN 400 + 500

Installation Method

Open trench

Application

**Double Pipe, SeweLine®,
ShaftLine®**

Client

Marche Multiservizi

Contractor

**Caruso Rocco Impresa
Edile (Pisticci/MT)**

Construction Company

**Simona Francolini –
Marche Multiservizi**

Advantages

**double assurance for
pipelines and joints,
leak-tight couplings,
low weight, simple
and fast installation,
tailor-made
solutions**

Marche Multiservizi is the most important multi-utility company for water management in the central Italian Marche region. 56 municipalities of the Pesaro-Urbino province make use of its services ranging from potable water supply to waste water treatment.

Recently the company realized its plan to connect the sewer network of a new urban settlement in Torraccia, in the western neighborhood of Pesaro, to the treatment plant of Borgheria. The sewer had to cross a water protection area with several water wells.

In order to protect the environment from being contaminated in cases of pipeline failure, environmental specifications require double security measures. The design engineers therefore opted for coaxial pipes: any leakage eventually coming out of the inner pipeline, would be retained by the outer pipe.

After a thorough comparison of today's large variety of available pipe material, Marche Multiservizi decided to utilize HOBAS® Products. The HOBAS Double Pipe, or as the Italians would say "Doppiotubo", is a pipe in pipe system made of CC-GRP Pipes. A wide range of HOBAS Accessories and Special Fittings complete the double safety system.

1.4 km of double pipe have been utilized for the Torraccia project, with inner and outer pipe diameters DN 400 and DN 500 respectively and a pipe stiffness of SN 10000. The inner pipes are kept in place with spacer rings. Special HOBAS Couplings with 4-lip rubber gaskets ensure complete leak tightness in both ways, namely from in- and outside the pipeline. The installation proceeded extremely fast and with ease thanks to the preassembled double pipes, and the relatively light weight of the pipe material.

Since the sewage system also includes manholes with inlets from nearby buildings the design engineers had to make sure that these are just as reliable as the rest of the line. HOBAS® Double Pipe Products were therefore favored also in this case: 22 special manholes featuring tight connections to both the inner and outer pipes as well as the PVC intakes from buildings, and special leak detectors were installed along the pipeline.

The extraordinary flexibility of HOBAS® CC-GRP Pipe Systems allowed customizing each single manhole and component to suit all requirements set by the Marche Multiservizi project. With a height ranging from 2.4 to 4.7 m and a shaft diameter of 1600 mm each manhole is equipped with a rust-proof ladder, a concrete plate to top the shaft, a 45° PVC intake, and a lipped base to avoid buoyancy.

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Something Old and Something New

HOBAS® SewerLine® Pipes Modernize Ljubljana, SI

The construction of the railway track from Vienna, Austria, to the port of Trieste at the Adriatic Coast in Italy began during the Austro-Hungarian Monarchy. The train route passes Ljubljana which today is Slovenia's capital. The railway station in Ljubljana was built in 1849 and is part of an infrastructure that at the time was very modern. It has in fact functionally stayed the same until today. The transportation of goods and the passenger traffic have, however, drastically increased. This led the municipality to modernize and extend the given structures. The construction of the "New Logistics Center Ljubljana", for instance, has already been initiated and further changes shall positively affect the development of the city.

Due to the worldwide crisis, modernization and extension projects were taken step for step. The erection of a business center situated nearby the railway station was initiated first. The basement of the planned skyscraper lies 20 m beneath the ground providing room for three floors of parking lots. Since an old concrete sewer pipeline established in the 1950s ran right through the construction site, the engineers decided to construct a bypass that would run around the planned building in approximately 40 m distance. HOBAS Pipes DN 2200 and DN 2400, PN 1, SN 10000 as well as several bends were chosen for this purpose.

Since the building site had already been excavated, the client attached great importance to the prompt delivery of the pipes. 36 m of pipes per day were delivered by truck. Their installation proceeded swiftly and trouble-free so that the whole line made up of 270 m could be completed within 23 working days.

Further 3 km of HOBAS CC-GRP SewerLine Pipes DN 1200, PN 1, SN 10000 were delivered to the south of Ljubljana, where a new waste water treatment plant was erected. The construction works for this pipe project that was implemented at the same time as the pipeline at the business center were completed within 9 months. To the satisfaction of the client HOBAS Experts offered practical support during the whole installation procedure. "Our client was very happy with our prompt deliveries and the outstanding quality of HOBAS Products", states Ernest Skok, Sales Representative at HOBAS Slovenia.

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Year of Construction

2008 - 2009

Total Length of Pipeline

3.275 m

Diameter

DN 1200 - 2400

Pressure Class

PN 1

Stiffness Class

SN 10000

Installation Method

open cut

Application

SewerLine®

Client

VOKA Ljubljana

Contractor

Regeneracija,

Hidrotehnika and

Kraski Zidar

Advantages

Absolute leak tightness,

corrosion resistance,

light weight, prompt

deliveries, fast

installation

No Rest for HOBAS Hungary Reconstruction and Extension of the Sewer Network Debrecen, HU

Debrecen in East Hungary is the second largest city of the country. In 2005 the city and its surrounding villages launched a massive reconstruction and extension project of their sewer system and waste water treatment plant for which 88.5 million Euros were invested.

The project was financed with funds from European Union (58%), by the Hungarian government (32%) and by involved municipalities (10%). Due to its complexity the project was broken down into five smaller lots of which two were realized with HOBAS CC-GRP Pipe Systems: the renovation of the old sewers and collectors in the city center and the construction of a new sewer main in the rapidly developing south-eastern part of Debrecen.

The sewer system of Debrecen's historical center was built during the first decades of the 20th century. A survey showed that the egg shaped collectors that had originally been established with concrete needed to be renovated urgently. Various signs of deterioration were detected and a safe discharge of the given amounts of water could no longer be guaranteed, especially not after heavy rains. It was not easy for the client to decide between the various renovation methods.

A complete hydraulic map of Debrecen had to be prepared first. This provided the minimal load capacity of the collector. A detailed hydraulic calculation and a first evaluation of the conditions and circumstances along the route and in the affected street (narrowness, traffic) soon made the decision clear: The installation would have to be conducted trenchless and mainly by relining. HOBAS® NC Line® Pipe Systems were chosen as most suitable pipe material. Since the groundwater contains aggressive substances corrosion resistance was one of the investor's greatest concerns. Leak tightness, a long lifespan and structural stability were criteria to which equally great importance was attached.



After a thorough preparation phase the construction works were taken up in June 2007. The pipes' diameters in the city center range from DN 350 to DN 1400 and have been produced with a stiffness of SN 10000. 3 m long HOBAS Pipes were used aside from the standard 6 m lengths to facilitate the installation in the narrow streets and deep trenches. Head of the construction consortium was the company Keviép and its partners were Betonút and KÖZGÉP.

The second lot that was implemented with HOBAS Products was situated in the rapidly growing south-eastern part of Debrecen where a 7.5 km long new collector was established with HOBAS® SewerLine® Pipes. The diameters of the SN 10000 pipes varied between DN 400 and DN 800. HOBAS® Pipe Systems were chosen because of the products' light weight and easy installation. The construction consortium for this project consisted of TEERAG-ASDAG and Swietelsky.

With two successfully completed projects in hand, HOBAS Hungary is kept on the go: The construction works for the extension of Debrecen's waste water treatment plant for which have already begun in October. Just as the proverb says, "there is no rest for the best".



Year of Construction
2007 - 2009

Installation Time
30 months

Total length of pipeline
12 km

Diameter
DN 350 – 1400,

NC Profiles:
400 x 600 mm –
1200 x 1800 mm

Pressure Class
PN 1

Stiffness Class
SN 10000

Installation Method
Relining

Application
NC Line®, SewerLine®

Client
Stadtverwaltung
Debrecen

Engineering Office
Keviterv Plusz,
Miskolc Ungarn

Contractors
Keviép, TEERAG-ASDAG

Advantages
Long lifetime, easy
installation, chemical
and corrosion resis-
tance, excellent
hydraulic
properties

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