KRAH™ PIPES
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The magazine for large **Plastic Pipe Technology** (up to DN/ID 5000mm)
No.20 / 2019
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IMPROFIL

New city in Egypt "Galala"
built on Krah Pipes

Polypipe Civils, UK
Case study collection

Chamber systems - Specific design
Sewage network for Sundsvall, Sweden

Sludge separator plant
for Municipality Stord in South Norway

Airport application
in Napoli, Italy and Frankfurt, Germany

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Dear 8100 readers

only a few days left until the world's biggest plastic exhibition starts in Düsseldorf – the K 2019. Until then, a lot must be prepared. Brochures are designed and printed, numerous of phone calls were made, lists are written and parcels packed. But slowly, the excitement is overweighing the stress. I am looking forward to meeting old friends from all over the world again, to make new ones and to present our products. I cordially invite you all to our stand and hope to see many familiar faces, enjoying our legendary cocktail bar, good food and interesting talks.

Of course, we haven't only been preparing the K exhibition this year. Recently, the pictures for the photo shooting for our legendary calendar were shot. But let´s face again our main business: our sales team, technical designers and workers have been hardworking again. The KR800-MAX, our latest and most powerful machine with a production output of over 1500kg/h, was installed in Egypt and is on the way to the Philippines. These two customers already have purchased the new development additionally to their older Krah plants and are already successfully producing pipes with it. That shows me, that customers are willing to continue investing if the machines work well and the products are good. That makes me very happy and motivates me to keep going. Fascinating reports about these two projects you can read in this issue. But also other reports from Italy, Russia, the Oman, Egypt, Norway and from here will provide you with an exciting insight into the possibilities with which our products can be used and what Krah has achieved all around the world.

Even though we have already achieved a lot this year, of course, we will not rest on our laurels. We already have some very good ideas for 2020 – be excited, it will be a good one! But before we think about the new year, I hope to see you in Düsseldorf in hall 16 stand D77.

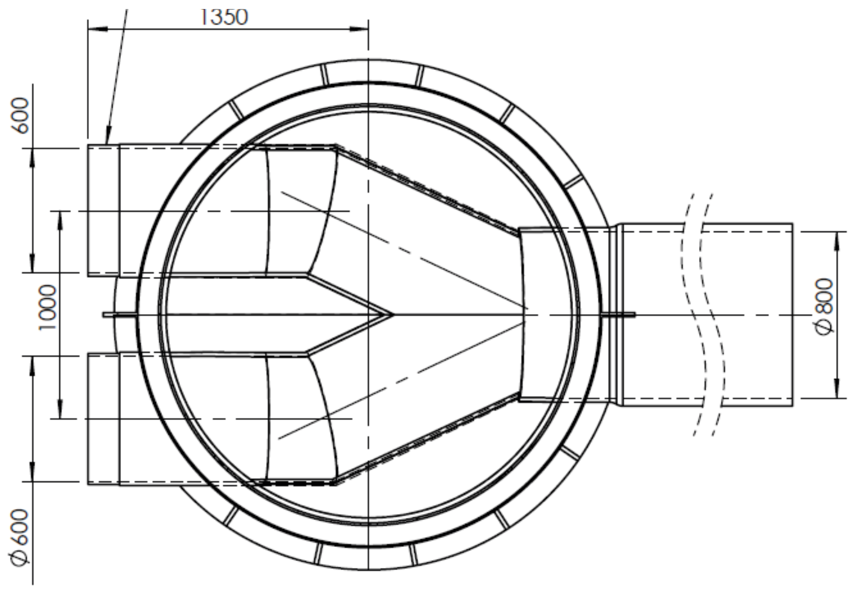
Specific design of chamber system

installed directly to a working sewage network

The city of Sundsvall in Sweden is continuosly investing into renovation and development of its sewage and stormwater networks. The project Strandgatan, as one of those development projects, was comprised of ID1000, 1200 and 1400 pipelines installed with the Krah integrated electro fusion connection. In addition to the pipelines several chambers were to be installed alongside with the pipes. During the final design and before the installation phase, we learned that the local municipality is facing a challenge related to the installation of the pipelines in this specific project. Part of the pipelines in this project were installed as a new independent network, other part was designed to substitute a actual working sewage system. This provided a big challenge, as a sewage network in use cannot just be cut off. A complete solution was required to install the new pipeline and switch from an old network to the new one while keeping the stoppage time as short as possible. There was an additional challenge to solve the question at hand – the location of the pipelines to be merged would have new pipelines criss-crossing the whole area available for us, so we needed to consider also the vertical alignment of the pipes in the area. A special solution was developed by KRAH Estonia and presented to the Sundsvall municipality by Wavin Svenska AB, our partner in Sweden. The solution comprised of two prefabricated chambers joined to one chamber system:

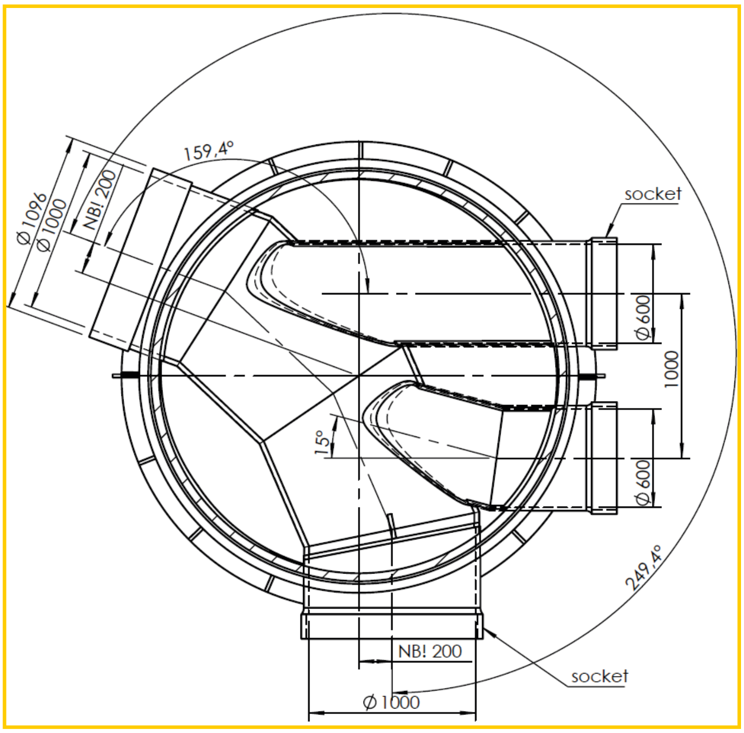
- ID2000 chamber with ID800 inlet and 2x ID600 outlet pipes. The ID800 inlet pipe was a special design solid wall pipe to be connected to an existing concrete

sewage pipeline DN800. ID600 outlets were to be jointed to the network by Krah electrofusion connection. The chamber bottom was to be executed with the half pipe flow path design, corresponding to the inlet and outlet diameters.



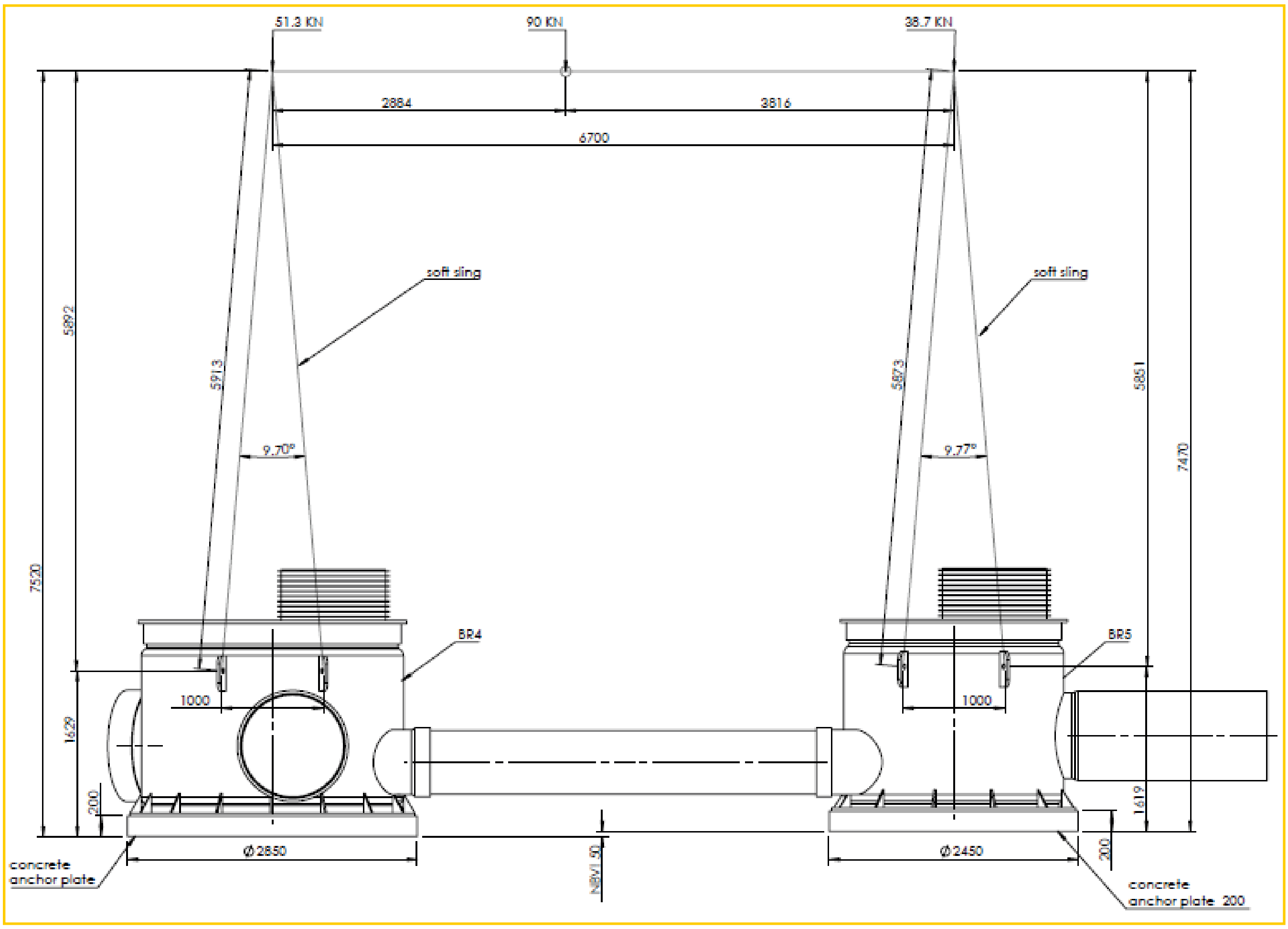
- ID2400 chamber with 2x ID600 and ID1000 inlet pipes and ID1000 outlet pipe. The chamber bottom was to be executed with the half pipe flow path design, corresponding to the inlet and outlet diameters. All inlets and outlets were to be jointed to the network with Krah electrofusion connection.The two chambers were joined and shipped as one complete system, ready for the installation including for example concrete base slabs. Basically it was finished to a plug and play level – just to be connected to the existing network in place. The chamber system was delivered with exact strapping and lifting instructions. At the installation site an existing sewage pipeline was cut off and blocked. The flowing sewage water was temporarily pumped to an old receiving chamber. The chamber

system produced by Krah Pipes was lifted from the truck directly to the final installation area and connected to the old sewage network from one side and to new network systems on the other side. The local municipality had to cut off and redirect the sewage flow for the duration of those installation works, totalling mere 5 hours. The sewage flow was restored from the old network to the new one immediately after the installation was finished.



Author:

Peeter Kirtsi
Krah Pipes OÜ



Conveyance of the first rainwater

from the aircraft APRON2 to the public sewer system

CENTRALTUBI S.p.A. has delivered the artifacts designed and built for the construction of the first rain water treatment system in a APRON square of the international airport of Capodichino (Naples – Italy). The system was built homogeneously, i.e. entirely with PE pipes.

Project details:

Contracting authority: NAPLES INTERNATIONAL AIRPORT (Italy)
Title of the work: Conveyance of the first rainwater from the aircraft APRON2 to the public sewer system
Period: delivery materials in July 2018

The materials used were:

• PE pipes with structured wall profiles, SGK spiralled type, ID 2000 mm (DIN 16961 SN8 equipped with electrofusion socket system), for the construction of battery accumulation volumes of the first rain water

• smooth PE pipes, with solid wall profile, OD 500 mm SDR26 (UNI EN 12666 SN8) connected by electrofusion sleeves, for connections between tanks

• smooth PE pipes, with solid wall profile, OD 250 mm SDR17 (UNI EN 12201-2 PN10), for the realization of the bottom connections for emptying of the system.

System useful volume = 280 m3.

The system also required the realization of the following special pieces, necessary for adaptations to the available surfaces and to avoid interference with existing sub-services, as well as for access to the inspection and maintenance operations of the system:

• n. 1 rainwater intake manhole, the vertical body of which is made with a spiraled pipe DN 2000 mm (SGK), with a pedestrian loads resistance of the lid made of PE sheet with galvanized steel tube reinforcement, with provision for inspection entrance DN 800 mm, with pre-installed aluminum ladder, and equipped with a rainwater inlet socket for connection with corrugated PE pipe DN 800 mm SN8

• n. 4 90° bends DN 2000 mm SN8 (from SGK spiral pipes)

• n. 1 TEE 90° DN 2000 mm SN8 (from SGK spiral pipes)

• n. 10 predispositions for inspections DN 800 mm

• n. 20 extensions molded in PE, DN 800 mm, H 1000 mm each

The pumps of the emptying system are housed in a special pit, lower than the bottom of the tanks to allow total emptying and avoid stagnation of putrid water.

This lowered pit is made up of a smooth PE pipe OD 1000 mm, with a bottom made of welded PE sheets, equipped with threaded stainless steel fittings for anchoring the coupling feet of two submersible pumps, including stainless steel delivery pipes, ball check valves, DN80 cast iron gate valves and ATEX IEC/EX approved level device regolators. The system works to fill the accumulation volumes in sequence using successive overflow points. This system is aimed at reducing the fouling of the tanks due to small meteorological events, thus optimizing the maintenance costs of the storage volumes. The system is emptied at the same time on all tanks, thanks to the bottom connections and the lifting station integrated with the run-off water inlet tank.

The main success factors were:

- general versatility of the system, homogeneous and modular, by means of PE pipes (both in terms of design and construction)
- high quality of design support taking place from CENTRALTUBI S.p.A. (with the centralized technical department of the SYSTEM GROUP)
- factory production speed and preparation of modules and special prefabricated parts(all identified by numbers to help the site staff executing an easier and correct installation, together with one of our workman)
- very quick installation time on site (installed in just five days)
- "lightness" and reduced safety charges high expectations of durability, also in view of potential local seismic events
- high degree of customization (→ optimization = reduction of maintenance costs)
- system sealing safety (welding with filling material carried out in the factory by qualified and expert personnel + connections on site using proven electrofusion socket technology)

ENAC
ENTE NAZIONALE PER L'AVIAZIONE CIVILE

AEROPORTO INTERNAZIONALE di NAPOLI

AEROPORTO INTERNAZIONALE di NAPOLI

CONVOGLIAMENTO IN PUBBLICA FOGNATURA DELLE ACQUE DI PRIMA PIOGGIA DI DILAVAMENTO DEL PIAZZALE AEROMOBILI APRON2

PROGETTO ESECUTIVO

CAPITOLATO SPECIALE D'APPALTO
PRESCRIZIONI TECNICHE

IL CAPO COMMESSA	IL RESPONSABILE PROGETTAZIONE	IL PROGETTISTA
	Ing. Antonio Cozzolino Ord. Ing. Napoli N. 13700	MAJONE&PARTNERS

RIFERIMENTO ELABORATO

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RESPONSABILE SERVIZI OPERATIVI	RESPONSABILE MANUTENZIONE
Aniello Matiesa	Ing. Valerio Di Lorenzo

PM PROGETTAZIONE E RESPONSABILE DEL PROCEDIMENTO	
Ing. Claudio Cuzzarese Ord. Ing. Napoli N. 13082	AEROPORTO INTERNAZIONALE di NAPOLI

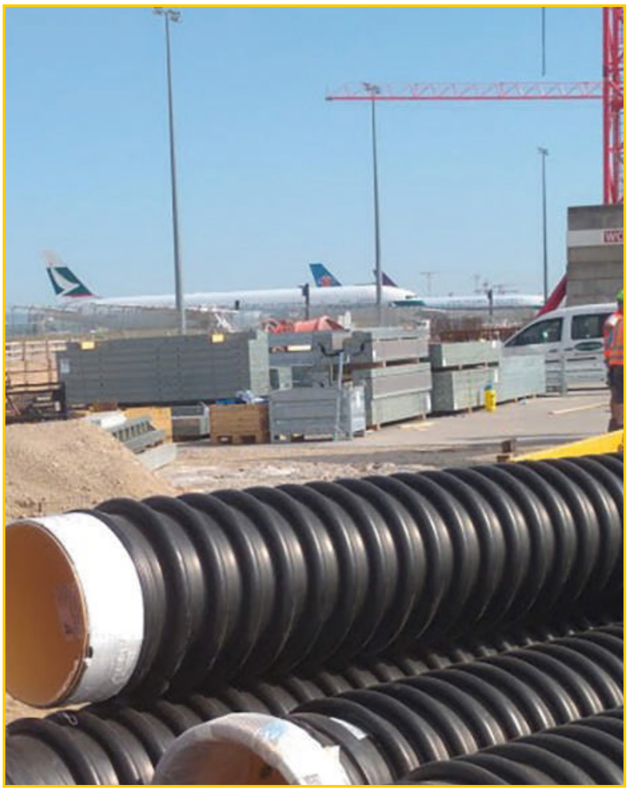
Author:

Centraltubi S.p.A.
Lunano, Italy

Germany's biggest airport uses Krah pipes

Fraport works together with Frank for new south apron

The construction work for the expansion of Germany's largest commercial airport is in full swing - and FRANK pipes are being used underground to transport the surface water away on the new south apron. In the south of the airport, Terminal 3 and the associated southern apron with the parking positions for the aircraft (ramps) are being built on the areas of the former US military base. Prior to the tendering phase, the airport operator had opted for a tightly welded pipe system made of homogeneous solid wall pipe according to DIN 8074/8075 with an inspection-friendly inner surface. After several discussions with the responsible planning office, our profiled sewer pipe system (PKS) was approved as an alternative to the tendered system due to its technical advantages (easy handling due to integrated electrofusion socket, low weight and larger internal diameter) - and finally also awarded the contract.

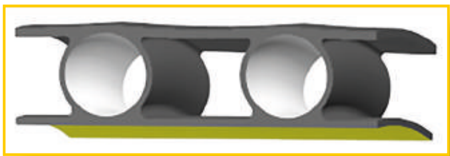


Pipe material and production

The production of the wound PKS sewer pipes made of PE 100 took place at FRANK Kunststofftechnik GmbH in Wölfersheim, Hessen. Polyethylene (PE 100) is a thermoplastic which, in addition to its low specific weight, also exhibits excellent processability, weldability and formability. Polyethylene is particularly resistant to aggressive media (acids and alkalis). Furthermore, the molecular structure of the material, which is composed of carbon and hydrogen, enables material recycling. Polyethylene is 100% recyclable. The PE 100 moulding compound is wound onto a metal drum in a spiral as a continuous, overlapping strip in the molten state. For the static design of the pipes, the load diagrams of the A380-800 and A340-600 design aircraft had to be used. These were taken into account in the static design. For each DN and load case, static calculations according to ATV A 127 were prepared and the critical load cases were made available to the AG in a tested form. Due to the high requirements, a PKS-plus profile was used, which is specially designed for very high external loads.

PKS® profile type PKS®plus (DN 300 to DN 3500)

PKS® profiles of the type PKS®plus achieve very high long-term ring stiffness due to the compact profile structure with smooth and closed pipe outside. They are therefore used for very high external loads. Due to the smooth outer wall of the pipes, they are ideally suited for the construction of shafts and other structures with pipe penetrations. The PKS® pipes of this type can be adapted to the respective ring



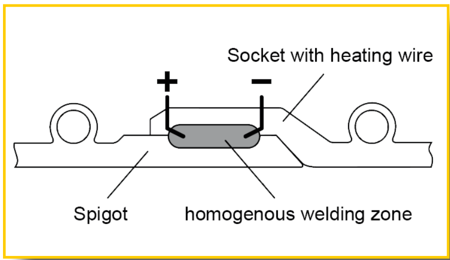
stiffness requirements or the basic wall thickness can be determined according to customer requirements. The individual pipes can be joined up to DN 2400 using electrofusion welding. Extrusion welding can be used from DN 300 to DN 3500, whereby the pipes are manufactured with spigot ends and sleeves as standard, as with the PR profile type.

Welded joints

Welded PKS pipes were used in this project. In the PKS® pipe system (profile duct pipe system), the individual pipes (but also manholes / components) are welded as standard with the integrated heating coil sleeve (E sleeve) - this connection technology is available up to DN 2400. During the manufacturing process, the socket and spigot end are formed onto the pipe. During installation on site, the spigot end is inserted into the socket and then welded. The welding parameters are transferred to the welding machine via a barcode. The welding machine automatically records the welding process.

Scope of delivery

- 240 m PKS sewer pipe DN 400
- 90 m PKS sewer pipe DN 500
- 190 m PKS sewer pipe DN 700
- 390 m PKS sewer pipe DN 800



- 180 m PKS sewer pipe DN 900
- 480 m PKS sewer pipe DN 1000
- 40 m PKS sewer pipe DN 1100

For further information please contact:
r.schwarz@frank-gmbh.de

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Deutschland

New city "Galala" in Egypt

built on Krah pipes

Galala now...

..and in the near future!

Krah Misr Egypt, who has been successfully producing Krah pipes for over a decade now and has recently installed its second Krah production machine and was appointed to deliver the infrastructure system for an incomparable project: A new city for Egypt, called Galala. Galala will be located on the highest mount plateau in the Red Sea area between Ain Sokhna and Zafarana, about 150km from Egypt´s capital Cairo. The plateau sits over 700 meters above sea level at its highest elevation. The new city is one of the Egyptian government's national efforts to develop the vast and empty eastern desert to solve Cairo's population congestion and create work and living opportunities for the youth as well as generating investment opportunities.

The infrastructure project and its challenges

Due to the extraordinary landscape, the project includes some challenges to be faced:

- Cost of delivery of pipes to 700 meter above sea level
- cost and risk of handling and installation of the networks in mountain
- Project time frame to be accomplish was only 6 months

After an intense study and careful comparison between the different pipe materials concrete, GRP and the Krah HDPE pipe, the construction company Hassan Allam Construction, a leading engineering, construction and infrastructure company, founded in 1936, awarded Krah Misr for this project. The main reasons for this decision, not mentioning the unbeatable pipe quality compared with the other materials, were the price – performance and quality ratio as well as short delivery times.

The project scope and its delivery

In total, 12 Km of pipes for sewage and storm water networks from 600 up to 2500mm were supplied, equipped with 150 manhole and its backdrops to round off a homogenous and sustainable pipe system. As stipulated, the complete range of pipes, fittings and manholes were delivered to the construction site within 6 months` time. All pipes and components were equipped with the typical yellow inside surface for an easy inspection and maintenance.

Tailormade manhole design according to customer requirements

According to the pipeline diameter different kinds of manholes are installed in the project. For pipes in diameters up to DN/ID 1000mm centric manholes are used, where the pipeline axis passes by the manhole vertical axis. For Pipelines DN/ID 1200mm and bigger, tangential manholes are used, where the pipeline axis is eccentric from the manhole's vertical axis. To balance the level difference of inlet and outlet, Krah-Pipes MISR provided in cooperation with the customer different kind of solutions. For pipelines smaller than DN/ID 1200 mm a backdrop is integrated and in case of inlet - outlet level difference more than 1 meter a backdrop before manhole inlet is used. According to customer´s drawings, special manholes are installed with different level and angle of inlet, outlet and house connections with a depth of more than 6 meters. For the back drop at pipelines bigger than DN/ID 1200 mm the traditional back drop would not be economically, so a S curve back drop is installed to maintain the pipeline level difference. During the construction phase, concrete manholes were used as well. In a direct installation comparison, the advantages of PE manholes became very clear very quickly. Especially remarkable is the shorter installation time and the significantly better surface quality. Additionally, there is a possibility of customer-oriented and tailored design.

The whole concept eventually convinced the project partners.

Centric manholes

Tangential manholes

Manhole with external backdrop

Tailormade manhole design

S curve back drop connected to tangential manhole

Krah pipe PE100 and concrete manhole in direct comparison

Networks testing

The tightness test was also a challenge, considering the costs of getting water

to site, 700 meter above sea level, not even mentioning the needed amount for pipelines up to 2500mm. To fulfil and facilitate the testing procedures, Krah Misr invested in pipe plugs to test the whole pipelines up to 2200mm and with special Krah pipe joint tester up to 2500mm. Having successfully delivered the infrastructure system for the first phase of the great Galala City construction, Krah Misr is now keenly awaiting the next phases to start and being part of this outstanding project.

Author:
Peter Youssef, Krah Misr, Egypt

Krah Pipes breaking the limits

in marine applications

During the last years, Krah Pipes made of HDPE have become the best alternative for seawater Intake & Outfall pipelines. The flexibility and chemical resistance of the HDPE together with the advantage of being simply welded avoiding 'gasket connections' provide an incomparable solution which can be installed easier and with a guaranteed long-term behaviour.

Larger pipes, though, imply higher ring stiffness and solid wall requirements. It is really a challenge not only to increase the pipe size but also keeping the solution inside the economical frame defined by the market. The production technologies were forced to evolve and KRAH understood this market need before others. The advantages provided by this technology as to produce pipes based on their internal diameter, to produce any solid wall thickness reinforced (or not) with internal/external helical structured profiles in order to optimize the pipe wall (right balance between ring and axial stiffness), the possibility of producing any reinforcement for the fittings,… and all this up to 4 meters or nowadays even 5 meters internal diameter have allowed the HDPE to cross unthinkable limits especially in marine applications.

The largest HDPE pipes

During the last years, several projects have been performed with 3.000 mm internal diameter HDPE pipes produced by KRAH technology. It is worth mentioning that pipes with internal diameter 3.000 mm reach an external diameter of 3.400 mm.

The longest HDPE pipe strings with larger diameters

One of the important advantages of the HDPE is to allow to weld the pipes on shore in order to produce pipe strings which are installed off shore in one shot. In this way, the risk that implies to work subjected to the sea conditions is limited and the project schedule is optimized. As longer the pipe strings are fastest will be the marine installation. Pipe strings of 3.000 mm diameter pipes prefabricated on shore with lengths up to 600 meters have been successfully installed in Saudi Arabia for SAUDI ARAMCO in the Project JAZAN INTEGRATED GASIFICATION COMBINED CYCLE SEA WATER SYSTEM EPC - 6. A total amount of 15 Km x 3 meters internal Diameter HDPE pipes was installed for this project using pipe strings of lengths up to 600 meters allowing to finalise the pipes installation in 13 months.

The largest twin pipes

One awesome way of improving even more the pipes installation schedule is to install two pipes at the same time.

One more record has been achieved by the HDPE pipes produced by KRAH technology. Twin HDPE pipes with Internal Diameter 1.800 mm installed in pipe strings of around 550 m length. This is, 1.100 m of pipes with external diameter 2.100 mm installed in one shot.

The marine applications are one of the most critical tests for any pipe solution in the market. Tight schedules with unforeseen incidents, related with the sea conditions, complex and expensive installations which don´t allow any failure or delay, corrosive environments with limited options for long term maintenance make this field of application so special and challenging. This field has forced us to improve combining the right production technology with the state-of-the-art engineering in order to provide the market with a reliable solution which is breaking limits once and again.

Author:
Juan Maria Ramos
PPA&KRAH, S.A
Spain

Desalination Project in Salalah, Oman

Water is the most vital asset for human life and a necessity for all enterprises. The countries in the Middle East region have arid and semi-arid regions where rainfall is rare and evaporation rates are high. Surface water is limited and there are no permanent streams. The increase in population and socio-economic development has led to an imbalance between supply and demand of water. These countries mainly depend on desalination to meet the growing water needs.

Project

Acwa Power, a major Saudi developer and operator of power and desalinated water plants, along with its cooperation with Veolia, a French water and energy management company and Oman-based Dhofar International Development and Investment Holding Company (DIDIC) was awarded the Salalah Independent Water Project in Oman. The project is being procured by Oman Power and Water Procurement Company SAOC (OPWP) under a build-own-operate framework on the back of a 20-year Water Purchase Agreement.

Dhofar Desalination Company, the project company, will be jointly owned by Acwa Power, Veolia Middle East and Dhofar International Development & Investment Holding (DIDIC). The facility, to be located at Salalah in Dhofar region, will have a capacity to generate 25 million gallons per day of desalinated water using reverse osmosis technology, UGPM Scope in this project is the design, manufacture & supply of HDPE Pipes with an internal Diameter 1400mm (1100 meters) & Internal Diameter 800 mm (1520 mtrs) and fittings such as bends, manholes, stub-ends & diffusers. The ID 1400mm & ID 800mm solid wall pipes were produced as per ISO 4427 specification utilizing KRAH technology and tested as per the specification requirements. The pipes were produced in 6 mtrs length and welded using butt fusion welding technique in the factory to make 12 mtrs lengths; this reduced the site welding activity for the contractor.

صناعات الخليج المتحدة للأنابيب ش.م.م
UNITED GULF PIPE MANUFACTURING CO. LLC

KRAH SOLID WALL PIPE DETAILS

Raw material: PE100
Minimum Required Strength (MRS): 10 Mpa
Design Stress: 8.0 Mpa
Standard Dimension Radtio (SDR): 26
Nominal Pressure: PN6

Wall thickness in mm		Krah Pipe ID in mm	Pipe outer diamter in mm	
min	max		min	max
58.3	67.1	1400	1516.6	1530

Pipe dimension data sheet ID1400

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KRAH SOLID WALL PIPE DETAILS

Raw material: PE100
Minimum Required Strength (MRS): 10 Mpa
Design Stress: 8.0 Mpa
Standard Dimension Radtio (SDR): 26
Nominal Pressure: PN6

Wall thickness in mm		Krah Pipe ID in mm	Pipe outer diamter in mm	
min	max		min	max
33.34	38.34	800	866.67	874.5

Pipe dimension data sheet ID800

Conclusion: Pipes & Fittings supplied as per the contractor project schedule. Completed project with good spirit.

Author:

Mohammed Al Hashani
United Gulf Pipe Manufacturing, Oman

Overview of the big installation site in Salalah

Polypipe Ridgistorm XL

Case study collection

Polypipe has been manufacturing and supplying Ridgistorm XL for over 10 years from its manufacturing site based in Loughborough. This large diameter pipe system enables value engineering solutions to be designed into each customer project by optimising the stiffness class of the pipework to suit the installation conditions and flexibility of design to minimise cost of fittings and chambers wherever possible. Polypipe utilises technology from Krah Germany to produce the Ridgistorm XL product range. This technology is used worldwide in the manufacture and supply of large diameter polymer pipes.

The below illustrated case studies describe impressively the possibilities and advantages of large diameter plastic pipe solutions for a modern and sustainable water management:

Dairy processor to capture excess surface water

Over 250 metres of Polypipe's popular Ridgistorm-XL has been installed for the expansion of an established dairy processor that has been in operation since 1938. As part of a large-scale renovation to increase yard space, Cotteswold Dairy has seen Polypipe's thermoplastic Ridgistorm-XL solution utilised to capture and attenuate excess surface water and potential milk leakages. The complete system included 10 fabricated fittings, including 90° bends and double T sections to aid water discharge at a consistent rate into an existing water course. The

spigot design of Polypipe's system and fittings made pipe alignment easy and fully compatible with the electro-fusion jointing method. This in turn led to a more efficient and quicker installation process.

Innovative drainage solution for £8m Darlington development

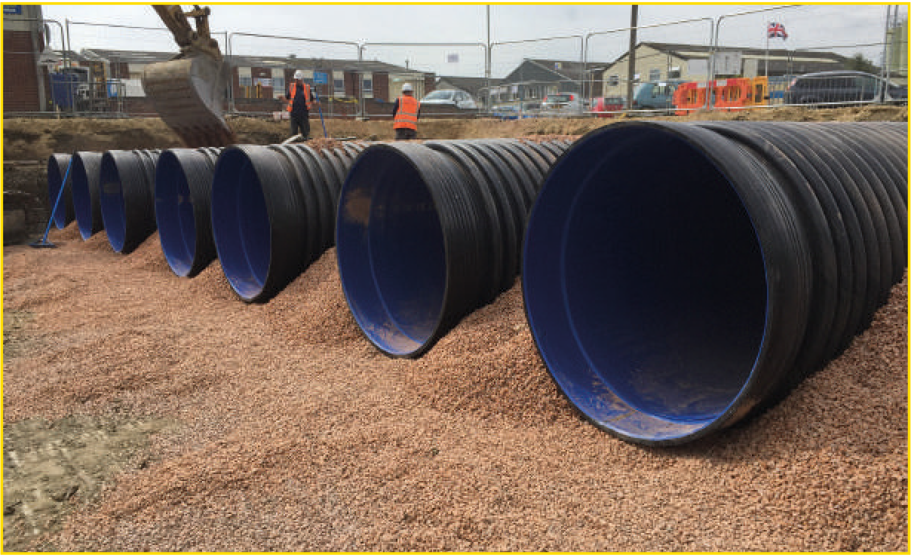
Polypipe has delivered a tailored drainage and attenuation solution for the £8 million Haughton Road residential development in Darlington. The development will include 73 new rental homes and will incorporate the site's historic engine shed, built in 1844. The original specification for the drainage and attenuation solution included a concrete system, however due to their strong existing relationship with Polypipe, Hewitson Limited asked the manufacturer to suggest an alternative option. Polypipe tailored a solution to meet the specific requirements of Northumbrian Water. Polypipe demonstrated that its ability to provide Ridgistorm-XL pipework in bespoke pipe lengths and stiffness classifications made it one of the most adaptable large diameter piping systems in the UK, and in this instance the ideal system to meet the project's needs. Polypipe's Ridgistorm-XL is robust, reliable and long lasting, as well as being up to 94% lighter in weight than concrete.

New attenuation systems reduced on-site installation time at Wynyard Park

Close to the A19, north of Teesside, Wynyard Park is an exclusive community of new housing and amenities located within the historic grounds of Wynyard country estate. The original attenuation specification for the site included a box

Pipe installation at Wynard Park

culvert design, however Polypipe was able to provide a more cost-efficient, site-specific solution that reduced installation time and material wastage. Polypipe worked closely with the project's contractor and consultant engineer to deliver an intelligently engineered solution using its Ridgistorm-XL large diameter plastic pipe system, pre-fabricated C sections, and twin leg runs.



Polypipe's Ridgistorm-XL specified for multimillion pound Hull residential project

Polypipe has provided a complete water conveyance and attenuation solution for a new Keepmoat Regeneration residential development in Hull.The engineered system design gained full Section 104 approval for the adoption of surface water run-off into their watercourse, and Section 38 approval for the installation of the system on the development site. The final design incorporated over 231m of Polypipe's 1,200mm Ridgistorm-XL large diameter plastic pipework. The adaptability of the thermoplastic system meant that the Polypipe pre-fabrication team could manufacture the pipework in a stiffness class tailored to the specific ground conditions at the location, without sacrificing overall strength and resilience.

Author:

Polypipe Civils Head, UK

The world's largest sludge separator plant solv

Municipality Stord in South Norway

This innovative and trend leading solution was put in service in July 2017. This is the first of 3 plants and will be finalized in 2020/2021. Totally will these cov-er 18.000 PE.

This first plant covers 6.700 PE and is designed with Ø3m pipes that consist of 5 tanks with lengths from 35—45 m. The system is constructed by Stord Municipality and the consulting firm Norconsult AS. All these where produced at Haplast AS at Furuflaten in 15-18m lengths. Trans-ported by ship to Stord and then finally installed on 5 m depth. The whole sys-tem, except for the entrance and the show room, is under ground, and you can hardly see anything on the surface. The whole system works without any pumps or mechanical cleaning. The needed service includes inspection and emptying of the sludge storage tanks when these are full. The system consist of 1 central valve tank with 84 valves to control the emp-tying of bottom sludge on the 2 settling tanks and transport it by even fall to the 2 sludge storage tanks. Only driven by the hydraulic height difference.

Production and delivery

The tanks were produced at Haplast AS at the North of Norway from 6m length. These were welded together to the needed tank lengths and included all connections between tanks and the in and outlet of sewer systems. When the production was finished, the tanks were transported to a neighbouring harbour, stored and lifted on the deck and transported to Stord. (Only 200m from the installation site).

Installation at the site

The valve tank was installed by the com-pany Servitech AS at Furuflaten. Meaning that the only needed job for the PE welders at the installation site, were to connect the tanks together and connect the piping systems around. Haplast delivered the tanks and all the needed distribution chambers in the project.

The client's remarks

The client was very satisfied with the cooperation and the work done by all suppliers and installers in this project. Further he had the option to install the next 2 plant with the same actors involved. This work is already ongoing and sched-uled delivery of the next 2. plant is in June 2020 and the delivery of the 3. plant is expected late 2020.

Haplast AS

Haplast is a pipe producer established in 1961 by Svein Hamnvik at Furuflaten. The small village Furuflaten is located near Tromso. (Above the Artic Circle in North Norway). The main product was PE pipes up to maximum Dy=1,0m. The factory could produce long pipelines directly into the sea. In 1978 the factory started to produce KRAH pipes with BAUKU Technology in South Norway and the line was moved to Furuflaten in 1984. The Technology was step by step changed into KRAH Technology and then in 2013 the production line was rebuild to the newest KRAH Technol-ogy and the dimension limit expanded to Ø3m. The development has continued and today Haplast produce many solutions made from KRAH pipes/ Technology possibilities.

Some other special solutions:

- Water chambers which are 100% waterproof.
- Chemical Tanks with 1 or 2 barriers.
- Water magazines
- Solutions to road Authorities.
- Long length PE pressure pipelines

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ved with Krah technology

Glass fiber reinforced Polyethylene pipes teste

Presented at the 19th Plastic Pipes Conference PPXIX

Introduction

Agricultural water is mainly supplied by waterway etc. laid on the ground. Recently, pipelines laid in the ground have been increasing from the viewpoints of water effective utilization, maintenance and pumping. Selection of the places in which the pipelines are laid is difficult, and the places are determined by planning routes and cost performance, and states of ground structure. Therefore, the pipelines are used in soften ground referred to as the peat soil in several cases. The peat generally means a material mainly formed of naturally accumulating putrefaction of hygrophyte while the decomposition is insufficient for many years under conditions of low temperature and high humid. Most of them are distributed in Hokkaido in Japan, but they are scattered also from Tohoku District to Kyushu District although in a small scale. The peatland as wide as about 2.000 km^2 is reputedly distributed in Hokkaido, which corresponds to about 2,4 % of the total area of Hokkaido, or about 6 % of the plain area. In general, such a soften ground reputedly has about 1/4 to 1/6 of ground reaction in comparison with sand or sandy soil, from properties of low shear strength, high compressibility, and a high groundwater level, and differential settlement is caused in the pipelines. The fiberglass reinforced plastic mortar (FRPM) pipes having low density, light weight and inexpensiveness have been utilized in many cases, rather than the pipe materials having high density, such as steel pipes and ductile iron pipes against the differential settlement in Japan. However, it is reported that the FRPM pipes are flattened to the designed value or higher by vertical soil pressure in the pipe circumferential direction, leading to damage in the soften ground in which the ground reaction is unstable and accidents of causing water leak are never ended. Therefore, we conducted the following applicability tests using glass fiber reinforced polyethylene pipes.

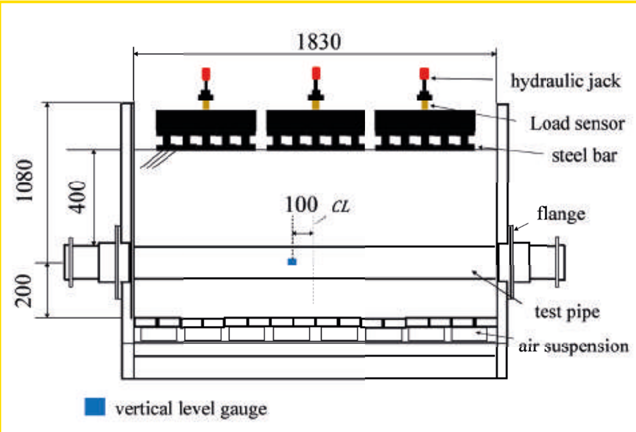

Fig. 1: Large scale sand box

1) Evaluation tests using a large soil tank. The differential settlement is forcibly reproduced in the state of applying a load equivalent to T14 and the internal pressure of 0.5 MPa.

2) Evaluation tests using on-site field.

Experimental methods

Evaluation using a large soil tank

Test conditions

The pipe was laid in a large soil tank having a width of 635 mm, a length of 1830 mm and a depth of 1080 mm shown in Fig. 1. After backfilling, the upper part was provided with forcible loading by using hydraulic jacks. Then, air springs arranged on the bottom part of the sample pipe were deflated to reproduce ground settlement. As the pipes, a glass fiber reinforced polyethylene pipe (inner diameter: 205 mm, pipe thickness: 8,5 mm) or a high density polyethylene pipe (inner diameter: 205 mm, pipe thickness: 11,5 mm) were applied, and Fig. 2 summarizes the test cases.

$$S_{R,v} = \frac{E_v \times I_v}{D^3} \quad \dots \text{Eq. (1)}$$
$$S_{R,A} = E_A \times I_A \quad \dots \text{Eq. (2)}$$

where,

$S_{R,V}$: pipe circumferential ring stiffness (kN/m)

$S_{R,A}$: pipe axial ring stiffness (kNm^2)

E_V: pipe circumferential elastic modulus (MPa)

E_A: pipe axial elastic modulus (MPa)

I_V: pipe circumferential moment of inertia of area (m^4/m)

I_A: pipe axial moment of inertia of area (m^4/m)

D: outer diameter (m)

As the pipe thickness, ring stiffness values in the pipe circumferential direction as determined from Eq. (1) and Eq. (2) were adjusted to be substantially equivalent, and the tests were conducted. As backfilling soil, No. 6 to 7 mixed silica sand was used, and Table 2 show the properties. Backfilling was performed by setting a spreading thickness to 100 mm

d at soft ground

Table 1: Test case			
case	material	$S_{R,V}$	$S_{R,A}$
1	PE-sGF	12,7	42,2
2	PE100	12,4	45,0

Table 2: Characteristics of soil		
Items	Unit	Characeristics
Density of soil particles	g/cm^3	2.63
Maximum drying sensity	g/cm^3	1.575
Minimum drying sensity	g/cm^3	1.232
Relative density	%	25
Uniformity coefficient	-	1.936

and finished to 400 mm in covering of the above of pipe to be 25% in relative density. After backfilling, the sample pipe was evaluated according to the following procedures. Both ends of the sample pipe were connected to flange pipes by using BUTT fused joints to construct the closed pipeline.

a) Backfilling

b) The whole upper part was provided with a vertical load of 55.9 kN/m2 by using hydraulic jacks.

c) Depressurizing the air springs arranged on the bottom surface of the sample pipe to cause sedimentation of the pipes at a sedimentation speed of 1 mm/min to simulate ground settlement.

d) The operation was performed to a sedimentation level of 30 mm.

Measurement conditions

Table 3 shows the measurement conditions. A settlement level of the pipe was measured by forming a structure in which a wire displacement gauge was protected with a cylindrical bar to prevent the wire displacement gauge from being interfered with sand. The displacement of the pipe was measured by attaching strain gauges in positions divided into 18 in the pipe axial direction as shown in Fig. 2 and in positions divided into 24 at a maximum for 5 sections in the pipe circumferential direction as shown in Fig. 3.

The internal pressure was measured thereon in a state of holding the water pressure in the sample pipe by using a pressure gauge attached at the end of the sample pipe. The internal water pressure was adjusted to 0.5 MPa. As the load, the magnitude of the vertical load by the hydraulic jacks was measured. The loads in three places in the upper part by the hydraulic jacks were regarded as uniformly distributed loads and adjusted to 55.9 kN/m2. The magnitude of the load was expressed in terms of values corresponding to the prescribed standard strength values (T-14) for pavements and agricultural roads by the Road Structure Ordinance.

Table 3: Measurement conditions		
Items	Equipment	Quantity
Settlement	Displacement sensor	1
Strain for axial	Strain gauge	36
Strain for vertical	Strain gauge	88
Internat pressure	Pressure gauge	1
Uniformity coefficient	-	1.936

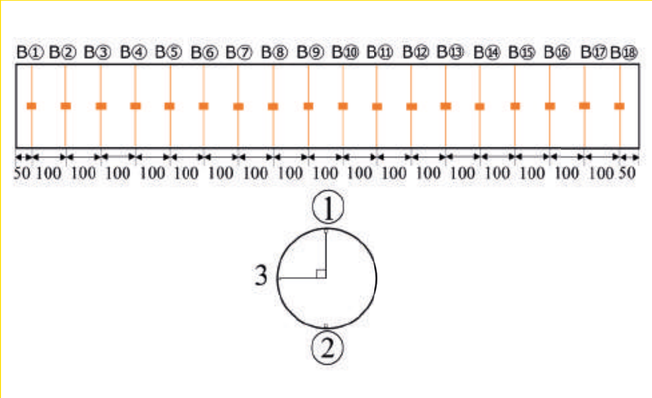

Fig. 2: Strain gauge for axial direction

Field test 2 (Evaluation using on-site field)

Evaluation using the test field was performed in Nishi-bibaicho, Bibai, Hokkaido, Japan, in which in the peat soil is spread. According to the boring exploration conducted in the test field, the N-value was 0 to 1 down to a depth of 6 m.

Test conditions

As the sample pipes, three glass fiber reinforced polyethylene pipes (inner diameter: 610 mm, pipe thickness: 20 mm) having a length of 11 m were arranged and jointed by electrofusion (EF joint.) to form an integrated pipeline having a length of 33 m. Both ends were connected to flange pipes to construct the closed pipeline. BUTT fused joints were arranged in the central part of the pipe and EF joint parts were provided in positions of 5 m from the both ends, respectively. Wooden piers each having a length of 7.2 m were buried below the EF joint parts, and the supporting points for

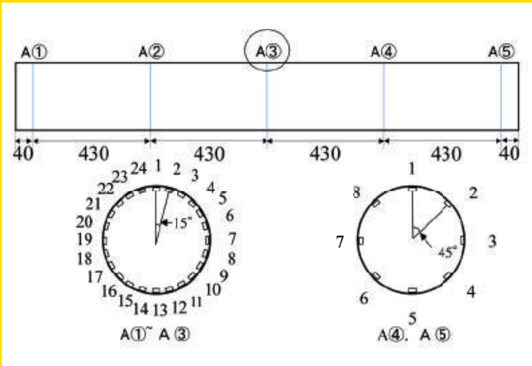

Fig. 3: Strain gauge for vertical direction

suppressing the vertical displacement were provided. The central part of the pipeline was provided with the forcible loading by using the hydraulic jacks in simulation of the flat plate loading test method. Forcible loading, unloading and leaving to stand for 12 hours were repeated three times to verify the behavior of the respective pipes. Fig. 4 shows a schematic diagram of the test field.

Design conditions of the pipes

The calculation expression for the pipe thickness determined from the internal and external pressure acting on the sample pipe was determined based on Eq. (3) according to the Land Improvement Business Plan Design Criterion and Commentary, issued by the Japanese Society of Irrigation, Drainage and Rural Engineering.

Excavation and backfilling conditions

As excavation, the peat ground was excavated in sections shown in Fig. 5, and the sample pipe was laid. Table.4 shows material properties of the on-site ground. An excavation gradient was adjusted to 1 : 0.3 according to the properties of cohesive soil. Backfilling was finished from the above of pipe up to 1200 mm for every 300 mm by using the peat soil by using a wooden ram and the final layer was finished to be 1400 mm in height from a height of 200 mm. The ground density and the ground reaction coefficient on the side surface of pipe were 1.06 g/cm3 and 250 kN/m2, respectively. After backfilling, the test was performed according to the following procedures. Both ends of the sample pipe were connected to flange pipes by using BUTT fusion to construct the closed pipeline.

a) Conditions after backfilling

b) Loading of an extra load of 200 kN (loading speed: 50 mm/min)

c) Unloading (unloading speed: 1000 mm/min)

d) Repeating of loading and unloading (repeating number of times: three times)

e) Leaving to stand for 12 hours Airtight test.

$$t \geq \frac{0.5 \times D \cdot H + \sqrt{(0.5D \cdot H)^2 + 24\alpha \cdot \sigma_a \cdot M}}{2\sigma_a} \dots \text{Eq. (3)}$$

where,

t: required pipe thickness determined from stress calculation (mm)

D: inner diameter (mm)

H: design water pressure (MPa) M: maximum bending moment caused in the pipe body per 1 mm extension by the external pressure (N·mm/mm)

α: tensile stress/bending stress

σa: allowable tensile unit stress (N/mm²)

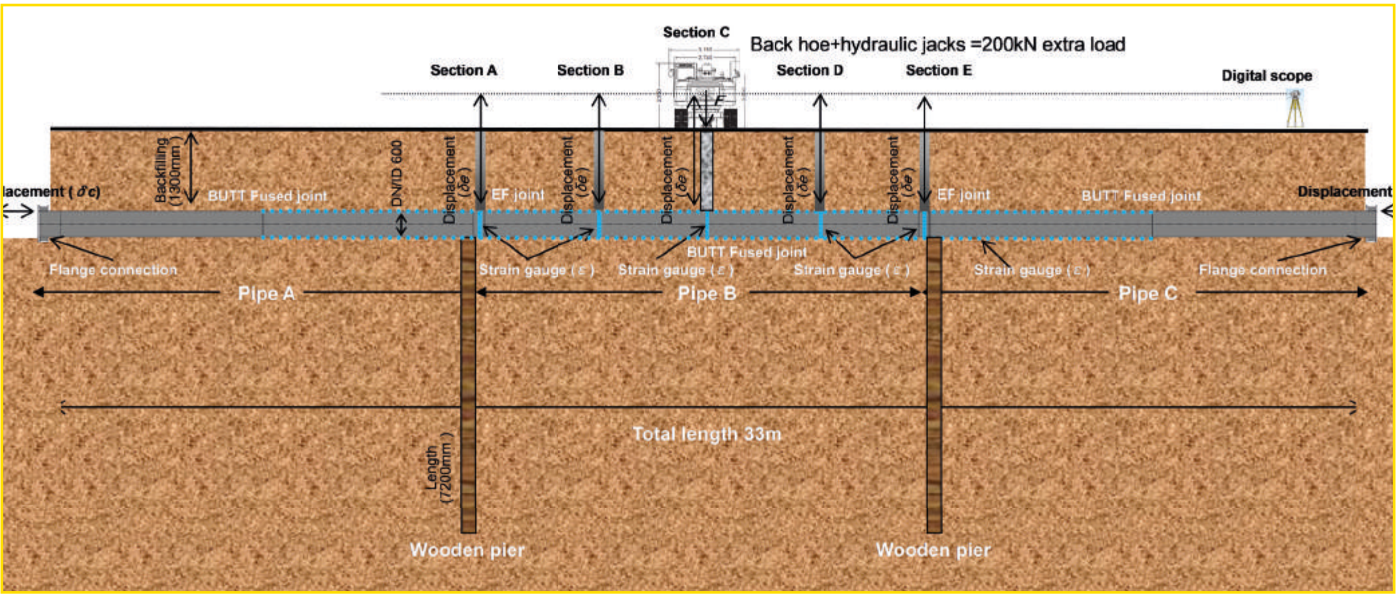

Fig. 4: Field test 2

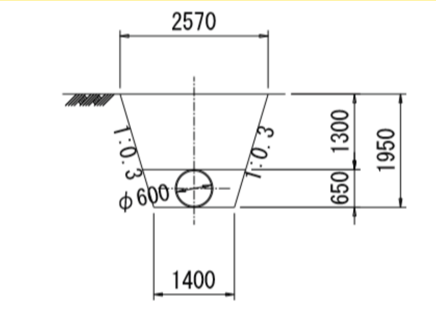

Fig. 5: Cross section

Measurement conditions

The sedimentation levels were measured by installing the gauges vertically in 5 points in A to E sections, the pipe axial strain was measured by attaching uniaxial strain gauges in 40 points for every 250 mm from the center of the bottom part of pipe on the pipe outer surface in the pipe axial direction. On the other hand, the pipe circumferential strain was measured by attaching pipe circumferential strain gauges to 48 points formed by uniformly dividing A to C sections into 16 (× 3 sections) at 22.5° in the pipe circumferential direction. The soil pressure was measured by installing soil pressure gauges on the above of pipe, the side of pipe and the bottom of pipe in A to C sections. However, no gauges were installed on the top part of pipe in the C section from influence of loading jigs. As the internal pressure, water was injected from the flange at the pipe end, and pressurized up to an internal water pressure of 0.5 MPa by using the plunger pump. Presence or absence of leak was confirmed using the pressure gauge.

Table 4: Characteristics of soil

Items	Unit	Characteristics
Soil particle density	g/cm^3	1.742
Dry density	g/cm^3	0.169
Bulk density	g/cm^3	0.984
Water content	%	485
Unconfined compressive strength	kN/m^2	20
N-value		0~1

Table 5: Measurement conditions

Measurement object	Measurement method	Number of points
Sedimentation level	Displacement gauge	5
Pipe axial strain	Strain gauge	40
Pipe circumferential strain	Strain gauge	48
Soil pressure	Soil pressure gauge	8
Internal pressure	Internal pressure gauge	1
Supercharge load	Load gauge	1

Results

Evaluation results using a large soil tank

1) Pipe axial strain

Fig. 6 shows changes in strain of PE-sGF pipes caused in the pipe axial direction, in which a black line in the figure indicates strain immediately after backfilling to the above of pipe, red lines indicate strain at starting settlement, and blue lines indicate strain when settlement progressed to 30 mm. Similarly, Fig. 7 shows changes in strain of PE pipes caused in the pipe axial direction. In all the cases, the pipes are found to be deflected downward because compressive strain is caused on the above of pipe and tensile strain is caused in the bottom of pipe. Moreover, the strain caused in the bottom of pipe is larger than the strain caused on the above of pipe. The reason is considered that compressive strength is larger than tensile strength generally in the polyethylene material. PE-sGF reinforced with glass fibers is found to have the same trend. When unloading was performed after completion of measurement, the sample pipes were confirmed to be restored and returned to the original states in all the cases, which is considered to be resulted from exhibiting elastic response. On the other hand, as a result of comparison of PE-sGF with PE, although the ring stiffness in the pipe axial direction is substantially equivalent to each other, the tensile strain and also the compressive strain are found to be larger in PE.

2) Pipe circumferential strain

Fig. 8 shows changes in strain of PE-sGF pipes caused in the pipe circumferential direction, in which a black line in the figure indicates strain immediately after backfilling to the above of pipe, red lines indicate strain at starting settlement, and blue lines indicates strain when settlement progressed to 30 mm. Similarly, Fig. 9 shows changes in strain of PE pipes caused in the pipe circumferential direction. In all the cases,

Table 6: Comparison of deflection ratio and maximum strain

Pipes	Internal water pressure	Ring stifness (kN/m^2)	Deflection rate (%)	Maximum strain (μ)
PE-GF	No load	12.7	1.41	3398
	Load		0.88	1945
PE	No load	12.4	2.54	8862
	Load		1.10	6030

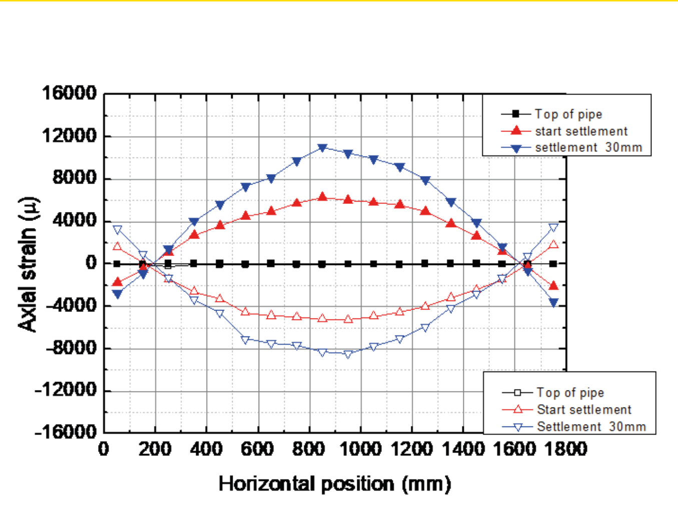

Fig. 6: Axial strain of PE-GF

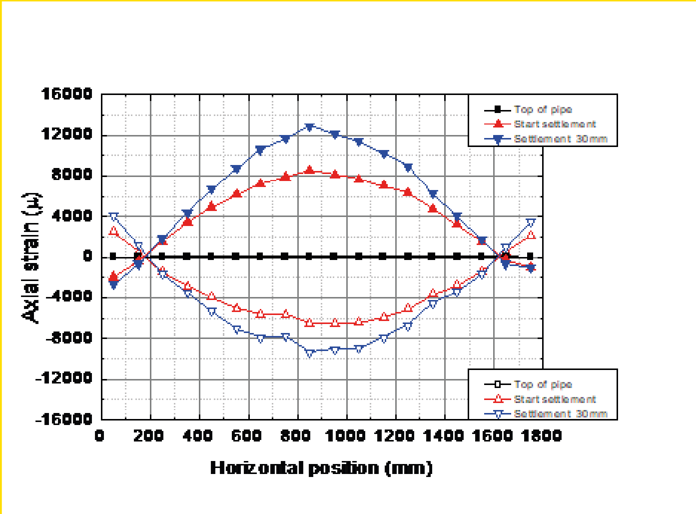

Fig. 7: Axial strain of PE

it is found that the compression is caused on the above of pipe and tension is caused on the side of pipe. The trend in which the compression on the above of pipe becomes larger than the tension in the bottom of pipe was found in PE, which is considered to be resulted from causing further significant elliptic deformation of PE in comparison with PE-sGF.

Table.6 summarizes comparison of deflection rates and the maximum strain depending on differences in pipe types and loading states of internal water pressure. Although the ring stiffness is equivalent to each other, both the deflection rates and the maximum strain are found to be larger in PE pipes, which is assumed that the deformation (ground followability) in the axial direction influences the pipe circumferential strain. The deflection rate of PE-GF under no pressure loading was about a half of the rate of PE pipes, and PE-GF is found to keep a circular shape even though PE-GF is deformed in the pipe axis.

Field test 2 (Evaluation results using on-site field)

1) Vertical settlement level

Fig. 11 shows transitions of vertical settlement levels after backfilling. A line of ◇ shown in Fig. 10 shows a state immediately after backfilling, a line of □ shows a state after elapse of 10 hours from backfilling, a line of Δ shows a state after further 2 days, and a line of ○ shows the settlement levels when providing the pipe with the extra load of 200 kN. A to E shown in the X axis indicate each section in Fig. 4, in which the wooden piers are fixed in A and E sections in the vertical direction from the bottom of pipe. The reason why the sedimentation progresses in A and E sections after 10 hours from backfilling is considered that the ground is softer than the circumference under an influence of performing joint excavation of the vicinity ground because the sections are connected with the Electrofusion joints.

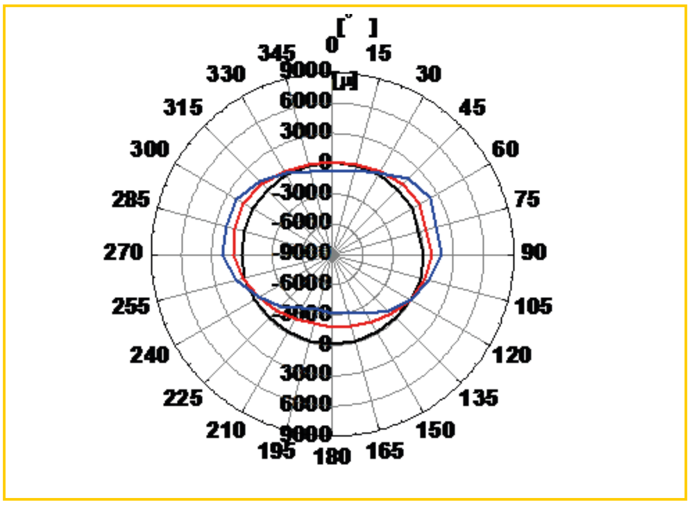

Fig. 8: Vertical strain of PE-sGF

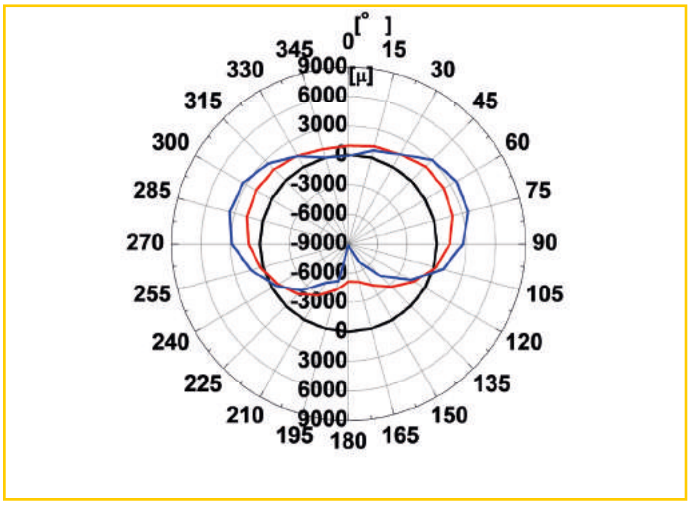

Fig. 9: Vertical strain of PE

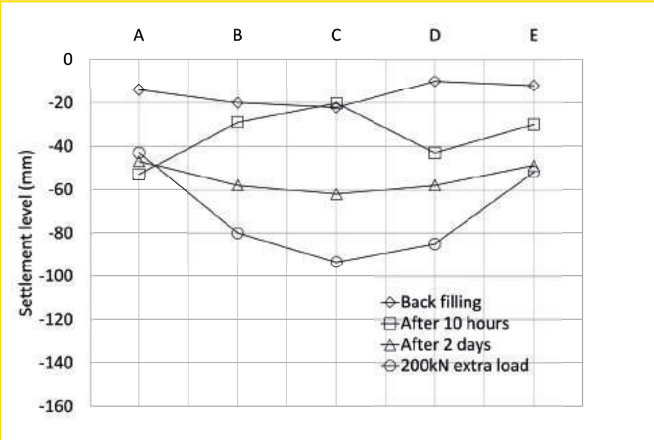

Fig. 10: Settlement level after embankment

The bottom part of pipe is found to reach the wooden piers because the sedimentation of A and E sections stopped at about -60 mm. An aspect in which the C section in the central part causes sedimentation by a concentrated load can be observed.

Fig.11 shows vertical settlement levels under forcible loading, in which a line of ◇ in the figure shows a state before loading, a line of ○ line shows the settlement levels when the extra load of 200 kN was loaded, and a state immediately after unloading thereafter was shown by a line of ×, and an aspect when 12 hours further elapsed from unloading is shown by a line of *. No change was observed in the displacement in A and E sections because the wooden piers are installed in the bottom part in each section. The pipes are found to be substantially restored when 12 hours elapsed after unloading. The results obtained by repeating this process 3 times were confirmed to be the same for all.

2) Pipe axial strain

Fig.12 shows changes in pipe axial strain in the bottom part of pipe by forcible loading, in which a line of × in the figure shows a state before loading, and a line of ○ shows strain levels when the extra load of 200 kN was loaded, and an aspect after 10 hours from unloading thereafter was shown by a line of □, and an aspect when two days further elapsed from unloading was shown by a line of Δ. The strain in the bottom part of pipe was output on the tensile side in the central part forcibly loaded, and the compressive strain was confirmed in A and E sections served as the supporting point. The strain was 0.2 % at a maximum in the central part of the bottom of pipe.

3) Pipe circumferential strain

Fig. 13 to Fig. 15 show changes in the pipe circumferential strain by forcible loading. Fig. 13 shows the A section and Fig. 14 shows the B section, but no influence of forcible loading is found. On the other hand, Fig. 15 shows the C section, in which a blue line in the figure shows a state before loading, a red line shows strain levels when the extra load of 200 kN was loaded, and a state immediately after unloading thereafter was shown by a green line, and an aspect when 12 hours further elapsed after unloading was shown by a purple line. The pipes are deformed in such a manner that the deformation in the places in contact with the loading jig as shown in Fig. 16 is transferred in the C section, but the pipes are found to be substantially restored after unloading.

4) Soil pressure

Fig. 17 to Fig. 19 show measurement results of soil pressure. Theoretical values of soil pressure on the above of pipe were determined by the vertical soil

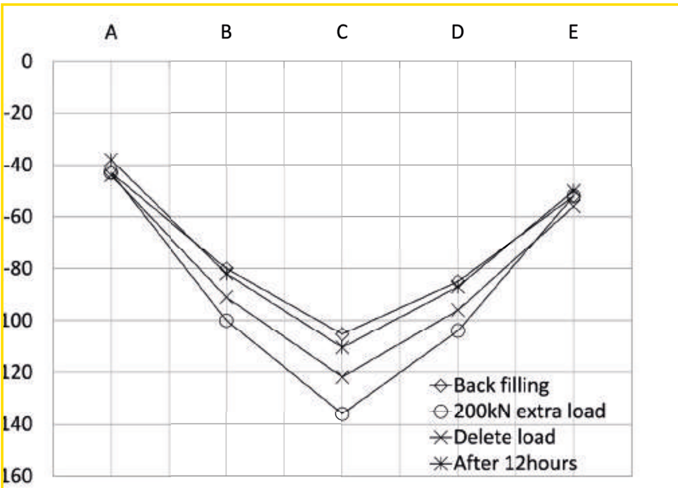

Fig. 11: Actual settlement of extra load

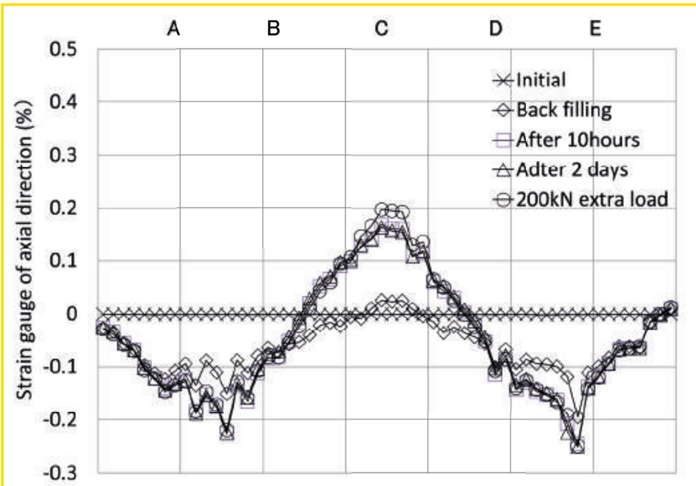

Fig. 12: Actual strain of axial direction

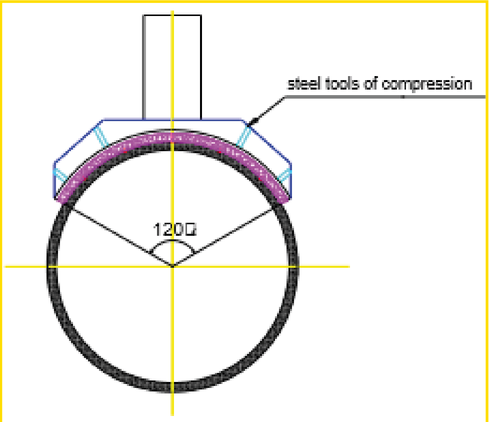

Fig. 16: Loading jig

Table.7 shows the properties of the circumferential ground. Fig. 17 shows actual values of soil pressure on the above of pipe and on the bottom of pipe in A section and theoretical values of soil pressure on the above of pipe in A section. The actual values of the initial soil pressure are consistent with the theoretical values, and no particular displacement is found. In and after the third times, the actual values are found to be reduced in comparison with the theoretical values. The reason is considered that only deformation of the pipe was restored while the circumferential ground was settled in and after the first time loading. Fig. 18 shows actual values and theoretical values of soil pressure on the side of pipe in A section. The soil pressure caused on the side of pipe is found to be substantially consistent with the theoretical values. The reason is considered that no local deformation is caused on the pipe. Fig. 19 shows actual values of soil pressure on the side of pipe and on the bottom of pipe in C section.

pressure equation (Eq. (4)). Theoretical values of soil pressure on the side of pipe were determined by Eq. (5) based on horizontal deflection levels determined by Marston-Spangler's Equation (Eq. (6))˙

$$W_v = \gamma \cdot H \ldots \text{ Eq. (4)}$$

$$P_v = \frac{1}{F_1} \cdot \frac{e'}{R} \cdot \frac{\Delta X_1}{2} \ldots \text{ Eq. (5)}$$

$$\Delta X_1 = F_1 \frac{2(K \cdot W_v R^4 + K_0 \cdot w_0 \cdot R^5 + K_P \cdot W_P \cdot R^4)}{E \cdot I + 0.061 e' \cdot R^3} \ldots \text{ Eq. (6)}$$

where,

WV: vertical soil pressure applied on the pipe body by backfilled soil (kN/m2)

γ: unit volume weight of backfilled soil (kN/m3)

H: depth from the backfilled surface to the above of pipe (m)

PV: horizontal soil pressure acting on the center on the pipe body side (kN/m2)

F1: deformation lag coefficient e': reaction coefficient of base material (kN/m2)

R: central radius of pipe thickness (m)

ΔX1: horizontal deflection level (m)

K: coefficient determined by a support angle of the base

K0: coefficient determined by a support angle of the base

W0: unit volume weight of water (kN/m2)

KP: coefficient determined by a support angle of the base

WP: weight per unit volume of the pipe body (kN/m2)

E: Young's modulus of pipe material (kN/m2)

I: moment of inertia of area of the pipe wall per 1 mm of pipe extension with the pipe axial direction as an axis (m4/m)

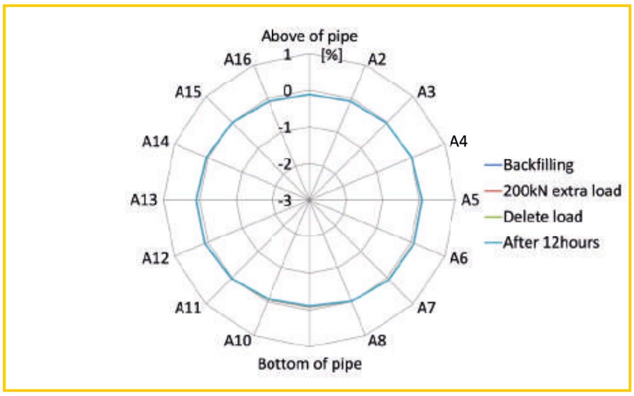

Fig. 13: Actual strain for vertical of section A

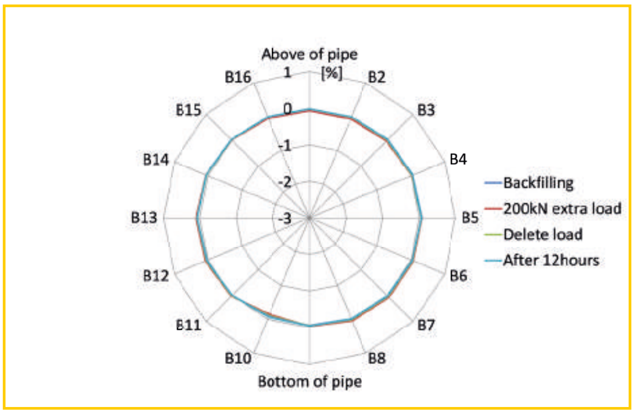

Fig. 14: Actual strain for vertical of section B

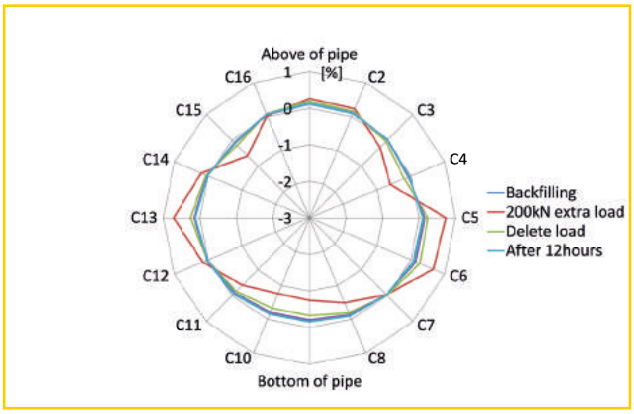

Fig. 15: Actual strain for vertical of section C

No gauges are installed on the above of pipe under an influence from the loading jig shown in Fig. 16. The soil pressure on the bottom part of pipe was confirmed to be 70 to 80 kPa by the forcible loading. Meanwhile, the soil pressure on the side part of pipe was confirmed to be constant, irrespective of the change. These results are considered to be caused by a small change of the pipe in the sectional direction. From the phenomenon in which the soil pressure on the bottom of pipe returns to the original in 24 hour, it is estimated that voids are gradually lost in the circumferential ground, while the sample pipe was quickly restored on the contrary.

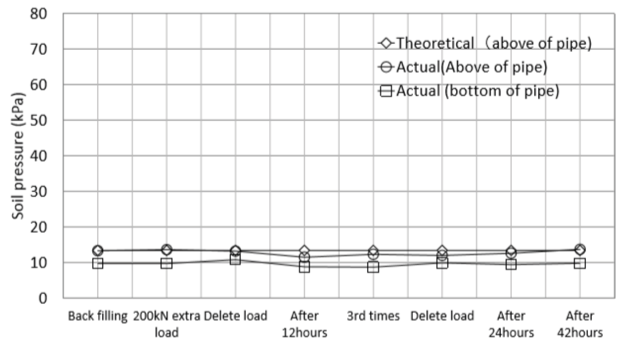

Fig. 17: Actual soil pressure of section A

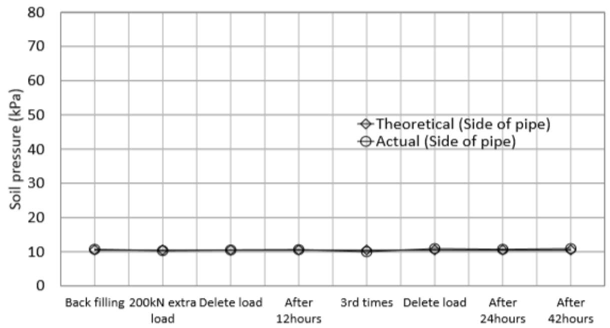

Fig. 18: Actual soil pressure of section B

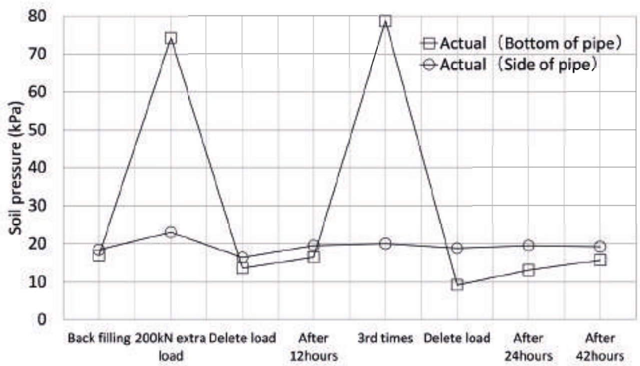

Fig. 19: Actual strain for vertical of section C

Table 7: Properties of the circumferential ground

Items	Terms	Unit	Characteristics Values
Unit volume weight	γ	kN/m³	10.3
Depth	H	m	1.3
Deformation lag coefficient	F_1	-	1.5
Reaction coefficient of base material	e¹	kN/m²	700
Mean diameter	R	m	0.315

Conclusions

(1) Evaluation results using large soil tank

The following results were found:

• Although the ring stiffness was equivalent, both the deflection rate and the maximum strain were larger in the PE pipes.

• The pipe circumferential strain was output in a level smaller in PE-sGF than the pipe axial strain.

• The tensile strains was larger than the compressive strain in PE-sGF.

• PE-sGF was found to follow the ground displacement, while the shape was maintained in the pipe circumferential direction.

(2) Evaluation results using the test field

The following results were found.

• The pipes followed the change in the ground in the state of being buried, and even if bending was caused in the pipe axial direction, the shape in the pipe circumferential direction was maintained.

• The pipes exhibited the elastic response even in the peat ground.

• With regard to the restoration speed of the PE-sGF pipes, the restoration was responded at a speed faster than the restoration in the peat ground.

Authors

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The full report can be requested from Dainippon Plastics, Japan.

Reconstruction of a water tower

using CORSYS Plus / Krah pipe technology

Clean potable water, its delivery and storage has always been very important for humans. Use of water towers, a simple method was created at one point of history. They had been previously made of bricks and currently they are made of steel.

Water towers are kept all over the world as historic cultural heritage. However, in small villages of Russia they are still in operation. Operation of modern PE pipes with dated facilities often create a contradiction. It is very difficult to achieve good quality water in the systems with a weak links.

In 2018, the management of Kalugaoblvodokanal, a state water company in Kaluga Region, had contacted POLYPLASTIC Group to see whether they could provide renovation of the old water tower using modern plastic materials.

The water tower in Mosalsk, Kaluga Region, was a very old brick structure completely out of order by the time of renovation request. The specialists of POLYPLASTIC Group offered PE reservoir renovation using Krah technique and chose an ID=3 metres reservoir, based on the required measurements. As a result of renovation the reservoir capacity was increased from 12 to 30 cubic metres, so, apart from obvious advantages of the PE installation, the major operational parameter more than doubled.

The reservoir was produced at Klimovsk Pipe Plant. It was designed as a completely self-supporting construction with the bottom and the top lid reinforced with numerous stiffening ribs. From the technical features it should be noted that the design is self-supporting, the bottom and the top cover of the tank are reinforced with numerous stiffening ribs. The reservoir was lifted using a crane and inserted into the water tower through the previously dismantled roof.

All installation works took less than half a day. Flawless operation of the restored water tower has proved that the choice of the solution was a success. There is currently one more reservoir being produced and expected to be installed at another water tower.

Fig. 1. The appearance of the water tower tank

Fig. 2. Installation of the reservoir

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Krah Pipes – Emerging solution for Philippines

Flooding problem solved with German technology

After the success of Boracay Island's drainage rehabilitation and road widening last November of 2018 (*we reported in ImProfil magazine no. 18*), the Department of Public Works and Highways (DPWH)—the agency which spearheads the development of the country's various infrastructure and major roads and highways, drainage system projects, has fully accepted the benefits of changing the conventional reinforced concrete pipelines and box culverts to Krah Pipe's innovative technology of large HDPE pipes.

New roads in Boracay with Krah pipes as drainage in both sides

In December 2017, DPWH has issued Department Order No. 147 adding item no. 706.14.2 Structured Walled Pipes in their Standards and Specifications book which contains all accredited materials that can be programmed and utilized to DPWH various projects. This was approved by the Bureau of Research and Standards (BRS) under the leadership of Director Reynaldo Tagudando. The Boracay Island rehabilitation phase 1; which comprises to a total of 7.5 km of Krah Pipe diameters ranging from DN/ID 1000mm to 1500mm and was completed in a span of 4 months, under the DPWH Region VI in the Visayas region was a breakthrough for the other implementing regions to adopt Krah Pipes in various projects on improving their major drainage systems in their respective cities and provinces.

Boracay Rehabilitation Phase 2

In the first quarter of 2019, under the Tourism and Infrastructure Enterprise Zone Authority (TIEZA) with the support of Department of Environment and Natural Resources (DENR) and DPWH, the continuation of Boracay Island's rehab commenced. Krah Pipes structured wall of diameter DN/ID 1800mm, the largest diameter yet supplied and manufactured in Krah Pipes Manila plant, are being installed with a total length of 1.4 km along the secondary roads of the island that was originally designed by the agency as box culverts for drainage outfall. The general contractor's site engineer, Mr. James Dalupang stated that "sa original design na box culvert, siguradong matatagalan" (with the original box culvert design, the installation will be too long). With the use of krah pipes, they are having an output of 12 lm/hr which is three times the installation speed with concrete box culverts.

Davao City Pilot Project

Davao City is known to be the main trade, commerce and industry hub in Mindanao and the Durian capital of the Philippines. It is also the hometown of the country's incumbent president, Honorable Rodrigo Roa Duterte. With the spearheading of Regional Director, Engr. Allan Borromeo of DPWH Region XI together with Director Reynaldo Tagudando of BRS, krah pipes were first installed in Mindanao for a drainage system pilot project last June 2019 along Damaso Suazo St., Davao City.

DN/ID 1000mm pipes were installed with a total length of 200 lm that was completed in a span of 8 days. In line with the support that DPWH Region XI has given, new large projects were programmed with Krah Pipes, namely Davao Coastal Road—a 4km major highway, Tagum Coastal Road—21 km highway of DN/ID 2000mm in Davao Del Norte and La Verna Flood control project—1 km of DN/ID

No heavy machinery is needed, pure manpower can install a Krah pipeline!

Electrofusion jointing off-trench of DN/ID 1800 mm along Brgy. Balagbag in Boracay Island

Installation and placement of the pipeline in the streets of Boracay

3000mm all of which will be implemented in 2019.

Metro Manila's Adaptation of Krah Pipes

Alongside with Davao City, Manila—the country's capital with an area of about 38 square meter, one of the oldest cities in the world and was named 2018's most densely populated city proper in the world, has also implemented a flood control project using load-bearing Krah

Pipes with a diameter of DN/ID 1200mm that were installed along Zapote road, Las Piñas City in Metro Manila.

It was implemented by DPWH District Engineers office of Muntinlupa and Las Piñas City. Zapote road is a busy highway connecting to Cavite Expressway that leads to Ninoy Aquino International Airport and various major highways like CP Garcia and South Luzon Expressway.

Due to its location, the rehabilitation of existing concrete pipe lines were originally expected to result in heavier traffic and clamor from nearby stakeholders and the public. But the concerns were addressed by the replacement of concrete pipes by Krah Pipes. It made all the necessary easiness of installation and expedited the process with a guarantee of long lifespan after installation. The jointing of pipes via electrofusion was done along the trench beside the traffic of cars and other vehicles and the project was completed in less than a month. With the continuous support of DPWH and its regional and district implementing offices, more drainage and flood control projects are being programmed with Krah structured wall pipes. Together with our commitment is to be a solution provider, we render our cooperation with the government's initiatives and the president's Build, Build, Build program for a better Philippines!

Author:

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Krah Pipes Manila, Inc.

Krah on fire

It's 6:30 pm in the quiet, rural town "Schutzbach" in Germany, the headquarter of Krah. All employees are already at home, looking forward to the weekend. The doors and gates are closed, all lights are turned off. Suddenly, there are sirens coming closer – probably yet another car crash on the main street. material out of the cars. Then comes the order: "Charge the hose!". The hoses fill with water and off we go. Hundreds of liters of water hit our company, the first injured are taken care of by the German Red Cross and led into ambulances. One could think that the worst case has arrived in Schutzbach: The company is their bad-looking injuries still talk and laugh, some can even walk. The children are excited and tense, but nevertheless it slowly becomes clear that this is luckily not an emergency, but an exercise.

The fire brigades of different villages around Schutzbach and the German

You can now see over 10 fire trucks and ambulances – but instead of passing the company building, they turn right onto the yard, before the sirens and the blue light turn off. Dozens of people jump out of the vehicles and start running, connect water pipelines to the hydrants. The German Red Cross prepares for a lot of injured victims, spreads thick duvets on the floor and gets bandage on fire and nobody knows how many people are still in the building. But when you take a closer look, you get suspicious: The firefighters are all quite young, laughing people can be seen between the tense faces, and numerous spectators observe the whole thing and take pictures and videos. Something is also wrong with the injured. Children care for wounded adults, who despite Red Cross had chosen our company as the location for the annual exercise. Throughout the whole year the fire brigades and the German Red Cross had practiced the individual steps again and again. "In an emergency it must go fast. However, there can be no panic at any times", explains the fire chief. The children and adolescents were able to see their tension, yet all of them concentrated on their tasks and performed them with the necessary calm. After the supposed "fire" had been extinguished and all the injured had been cared for, the tension slowly subsided. The laughter was louder again and there was a lot of talk about the exercise. "Really cool", "exciting" and "totally exhausting" were just a few words you could pick up. Parents, siblings and other relatives were really proud. Afterwards, the Krah Group donated Pizza and Coke for all children. Exhausted, full and happy the children returned home We are also grateful for the exciting exercise, which showed us that we don't have to worry about the future of the fire brigade and the German Red Cross – and that our headquarter is always safe – even in emergencies.

Authors:
Lisa & Jenny, Krah

"Being able to help injured people is the best thing"

We took the chance to interview two of the young helpers during the excercise.

Jeremy from the fire brigade and Florian from the German Red Cross, two friends who have been actively working in the groups for almost a year now, tell us that they take such exercises very seriously. "The best thing for me personally is to being able to help injured people. Once the fire brigade has saved potential victims from burning buildings etc, they bring them to us and we take care of them with band aids, oxygen masks and take them to the hospital, if necessary", says Florian. Jeremy adds, that although they are still very young, they will one day be "real" firemen and livesafers. That's what makes him proud.

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