The Second Edition of European NO DIG Conference

Segrate (Milan), Italy
25TH May 2023

Paper 11

Partial renovation of a connection sewer at Paradeplatz in Rendsburg

Ing. Lorenzo Vidus Rosin[1]

[1] Società del Gres, Gruppo Steinzeug-Keramo, Bergamo, Italy

ABSTRACT: The client "Abwasserbeseitigung Rendsburg" asked the engineers of Wasser- und Verkehrs-Kontor GmbH to plan a rehabilitation of around 500 meters in length, starting from Paradeplatz in Rendsburg.
The major part of this project consisted of man-accessible standard concrete egg-shaped and circular pipes, which were renovated using traditional rehabilitation techniques such as CIPP. The rehabilitation contained also 18 meters of a rectangular profile measuring 1800 x 1790 mm. In order to improve the hydraulics and to realize a smooth transition from the DN 1500 inlet, a customized solution made of polymer concrete elements was used.
This solution from Steinzeug-Keramo's DURA.PC portfolio was individually adapted to the client's wishes based on measurements and inspections before and during the construction work. This resulted in a DN 1500 invert with a one-sided molded-on berm plate on the one side as well as a steep wall on the other side in order to catch all the incoming sewage water safely. The pre-fabricated elements have a wall thickness of 40 mm at a width of around 1.7 meters. For ease of installation, they were supplied with a dovetailed foot and a folded joint for secure bonding.
The solution is also sustainable: Since the wall thickness is usually dimensioned at the weakest point in static calculations, in this case the most stressed area at the transition from invert to berm was executed in a higher wall thickness due to the custom-made design. This saves valuable resources and costs.
The elements were installed by the contractor Rohrsanierung Jensen through an excavation pit, where they were moved with trolleys to their final position. The elements were then glued together and finally secured in place with a backfilling mortar. The result is a durable, resistant and high-quality solution using DURA.PC. It can be combined with virtually any rehabilitation technique available on the market. Thus, the GRP-laminated walls were seamlessly connected to the new profiles.

1. INTRODUCTION

Restoring an outdated pipeline involves a lot of skill in finding the best solution in each situation. The best solution in most cases means combining different technologies, so the design aspect and flexibility during the analysis and installation phase is of fundamental importance. In this case study we will present the use of segment pipe lining technology combined with the better known C.I.P.P.- Cured-in-Place-Pipe Lining.

2. GENERAL FRAMEWORK OF THE PROJECT

Outdated networks are waiting for major interventions. But this inevitably implies the opening of countless construction sites. As sewerage networks run underground in the city, the need to pursue integral sustainability goals becomes inescapable. The use of non-invasive technologies, pursuing the minimisation of excavations ("no-dig" or "trenchless" type interventions) allows the rehabilitation of important sewerage arteries with significantly less impact on the road network and with evident benefits with respect to the interruption of pedestrian and vehicular passages and consequent increase in traffic, the disposal of excavated materials, the acquisition, transport and installation of backfill material, the alteration of the aesthetic quality of the area involved, as well as with respect to noise and air pollution impacts.

Within this context is the city of Rendsburg, a city on the Kiel Canal in northeast Schleswig-Holstein, Germany. It is the capital of the Rendsburg-Eckernförde district and one of the most important port cities and therefore has a high volume of freight traffic.

The exponential increase of traffic in city centers is the inevitable consequence of this dynamic, with disruptive effects on the livability of urban environments in terms of congestion (time loss, stress) and environmental pollution. According to the figures in the European Commission's latest Green Paper, every year the European economy loses about 100 billion euros, or 1 per cent of GDP, due to congestion in cities. In addition, urban traffic generates 40 per cent of CO2 emissions and 70 per cent of other pollutant emissions from motor vehicles, and accounts for about one third of all fatal accidents, mainly to the detriment of pedestrians and cyclists.

For over 90 years, the water company Abwasserbeseitigung Rendsburg have been ensuring that wastewater is collected, transported and treated in Rendsburg and the surrounding area. The water company guarantees trouble-free wastewater disposal 365 days a year. Hidden under the streets in Rendsburg are around 250 kilometers of public sewers and pipes, which the water company Abwasserbeseitigung Rendsburg is responsible for the maintenance as cleaning, rehabilitating and constantly expanding.

About 30 employees ensure that every year about 4 million cubic meters of wastewater from the entire economic area of Rendsburg, where about 70,000 people live, reach Posthof sewage treatment plant via the sewer and pipe network and are treated there to a high standard.

The client “Abwasserbeseitigung Rendsburg” asked the engineers of Wasser- und Verkehrs-Kontor GmbH to plan a rehabilitation of around 500 meters in length, starting from Paradeplatz in Rendsburg.
The major part of this project consisted of man-accessible standard concrete egg-shaped and circular pipes, which were renovated using traditional rehabilitation techniques such as CIPP. The rehabilitation contained also 18 meters of a rectangular profile measuring 1800 x 1790 mm. Steinzeug-Keramo, together with the design office and building company, study a tailored made solution.

3. DESCRIPTION OF THE TECHNOLOGY AND MATERIAL USED

The methodology presented in this section is generally applied to big sewer where human access is permitted. Apart from this limitation, which sometimes prevents its use, the methodology is remarkable in that it allows for the rehabilitation of even irregularly shaped pipelines, as in this situation.

The plates are fixed to the wall of the host pipe by injecting cement grout. The distance to the host pipe is guaranteed by the presence of feet on the surface, which also allow permanent fixing. The material from which the plates are made must have excellent resistance to chemical attack and abrasion. The space between the host pipe and the new element is filled with cement mortar.

This technology of rehabilitation has a big advantage when the sewer has damage only in the invert or crown area and in case the static situation is in a good condition. Moreover, this technique of rehabilitation is particularly suitable for sewer with angles in the cross section. In this project, the design office chose the solution in polymer concrete, a material consisting of quartz of different grain sizes in a resin compound. This composition makes it an extremely strong, robust and durable material. The presence of quartz as a raw material makes the polymer concrete particularly resistant for abrasion and chemical aggression.

Table 1. Technical characteristic of polymer concrete

Technical characteristic	Value	units
Abrasion resistance	0,14	mm at 100.000 cycle with Darmstadt test
Flexural strength	> 20	N/mm^2
Fire protection	Class B1	
Fire rating	5.2 (hardly combustible)	
Chemical resistance	pH 2 to pH14	
Compressive strength	> 80	N/mm^2

E-modulus	18.000	N/mm^2
Mass Loss pH 14 (1 mol NaOH)	0,20	%
Mass Loss pH 1 (1 mol H_2SO_4)	0,17	%
Temperature resistance	Up to 80°	
Water absorption	< 0,13	% by weight
Water penetration depth	0	mm

4. DESCRIPTON OF THE PROJECT

After the first cleaning phase of the pipelines, TV inspections of all 500 meters had to be carried out in order to assess the condition of the entire length and understand the degradation situation of the network. From a static point of view, most of the sections were in good condition and had standard geometries. Most of the meters were of circular and ovoid geometry except for a short section. This section was the subject of discussion and analysis because if from a static point of view the situation was good, this could not be said of the hydraulic analysis. Due to the particular geometry of the section, it was necessary to find a durable but also flexible solution.

Figure 1. TV-inspection frame before the rehabilitation

The second analysis was to evaluate the inlet wells. This was easier to identify due to the large green area near the section being rehabilitated with polymer concrete. It was decided to enlarge the entrance well at both the beginning and the end of the section.

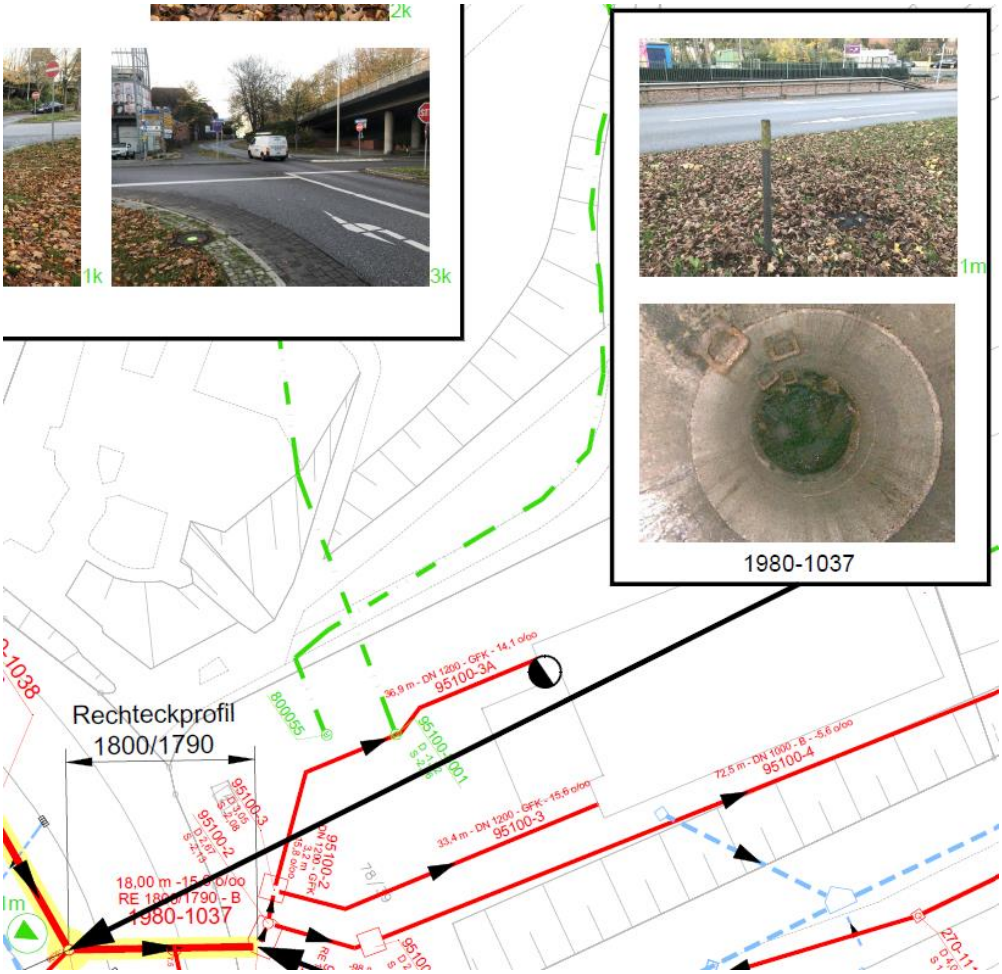

Figure 2. TV-inspection frame for the access manholes and the planimetry

The final design decision was to provide a 40-mm thick element for the rehabilitation of the bottom and GRP sheet covering of the remaining part. The design office thought of a particular section with the possibility of a walkway for inspection and an acute channel for wastewater. The flexibility in the production of polymer concrete elements made it possible to realise exactly the geometry envisaged by the design office.

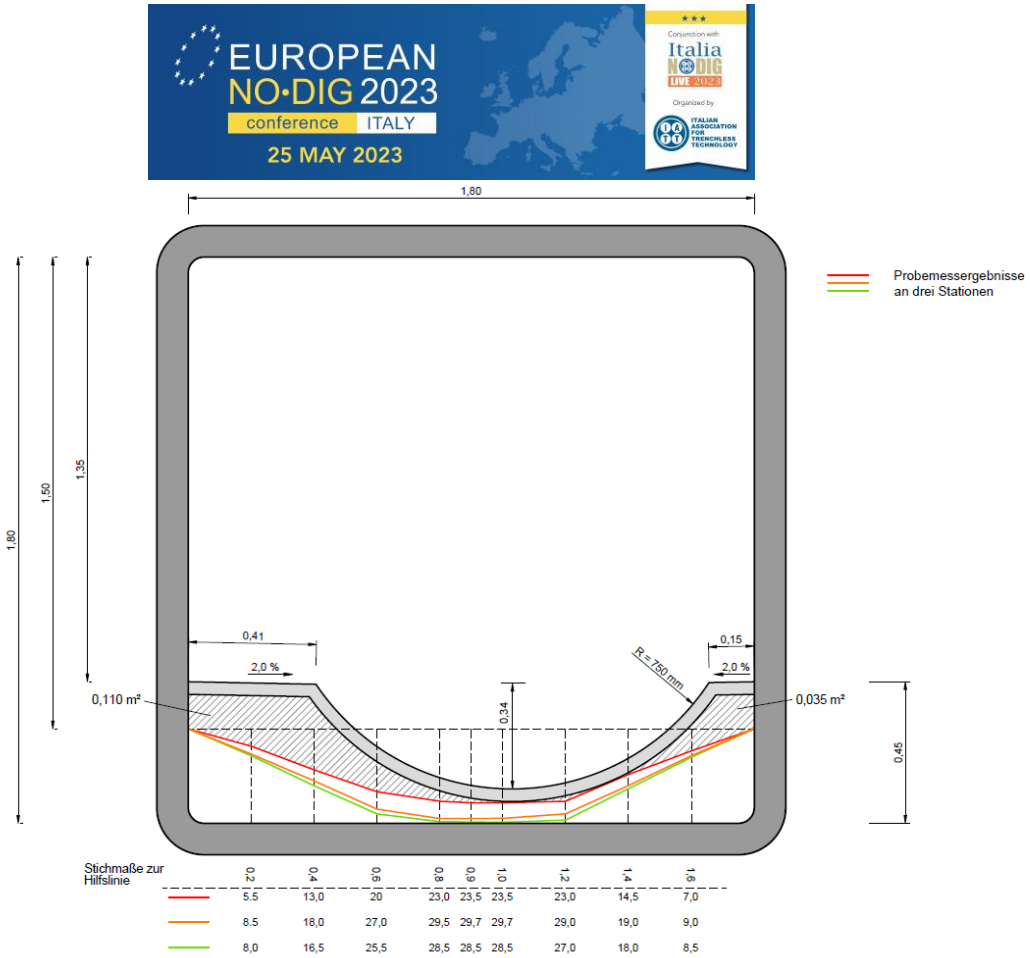

Figure 3. Technical drawing made by design office

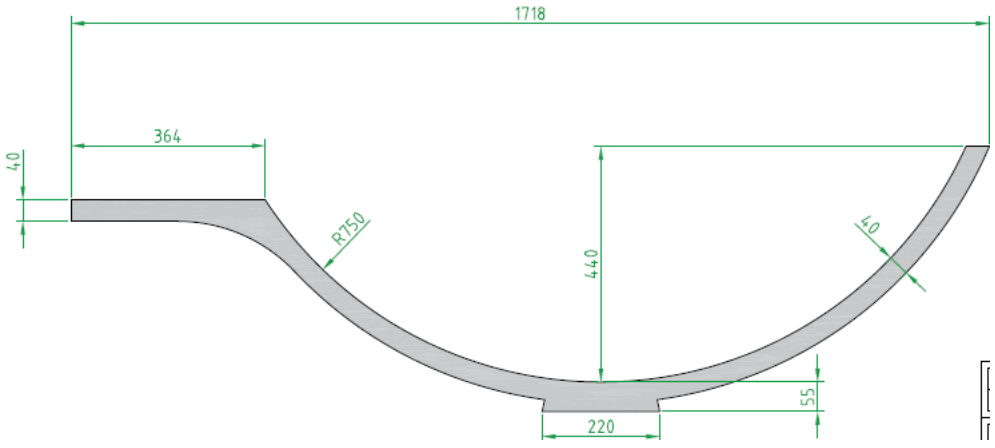

Figure 4. Technical drawing made by producer

Once the design phase was completed, the execution phase of the work began with the cleaning of the pipeline and the construction of the access manholes. After installing the wastewater by-pass, the 1-meter-long elements were laid. The feet at the base of the element facilitated the laying operations. Wooden wedges were used in each element to prevent the element from shifting when filling the area between the old pipe and the polymer concrete element.

Figure 5. Access manhole

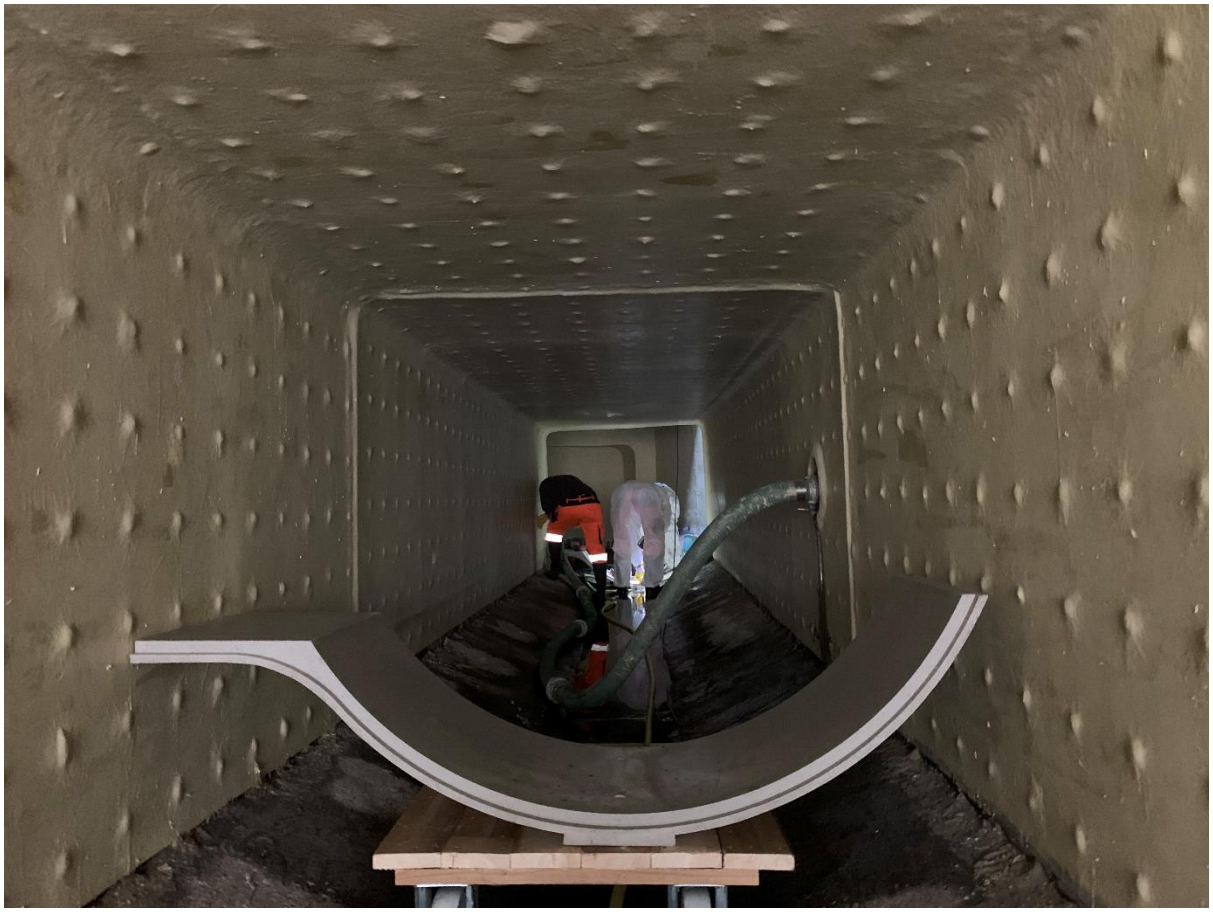

Figure 6. By-pass and starting the installation of the element

Figure 7. Wooden wedges were used in each element to prevent the element from shifting

Figure 8. Installation of the panels

Figure 9. Final result

The elements were installed by the contractor Rohrsanierung Jensen through an excavation pit, where they were moved with trolleys to their final position. The elements were then glued together and finally secured in place with a backfilling mortar. The result is a durable, resistant and high-quality solution using DURA.PC, the commercial name of the polymer concrete. It can be combined with virtually any rehabilitation technique available on the market. Thus, the GRP-laminated walls were seamlessly connected to the new profiles.

5. CONCLUSION

The combination of different technologies allowed the project to be realised efficiently and effectively both operationally and economically. The key aspect for the success of the work was flexibility, especially in the design phase. The contractor appreciated both the technology and the material for its ease of installation, which required simple tools but ensured a quality result.

6. REFERENCES

Mambretti, S., and Tani, S. (2018). *Tecniche di buona Condotta, L'innovazione nel rinnovamento delle reti de Servizio Idrico*