The terminal overflow chamber in the “C” interceptor

in Prague - Bubeneč

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Figure 1
Location of the new overflow chamber in Prague – Bubeneč

Figure 2
Original overflow chamber – "frog mouth"

Figure 3
Inflow into the chamber through a well hole

Figure 4
Sewage flow in the chamber

Figure 5
Connection to the "K" interceptor (1200/1800 mm profile)

INTRODUCTION

A newly constructed terminal OK_1C overflow chamber located in the "C" interceptor beneath Maďarská Street in Prague - Bubeneč has replaced the original one, in terms of its capacity and the operational unsuitability of the previous "frog mouth" type chamber. The new chamber, with a straight crest primarily fulfils the control function in addition to partial retention.

ORIGINAL CONDITION

The overflow chamber represents the terminal chamber of the LII header in the "C" interceptor, prior to its connection to an inflow labyrinth of the Prague wastewater treatment plant (WWTP). The catchment area of the "C" interceptor covers an extensive area of the northwest of Prague, which comprises the southern part of the Petřiny housing estate, Břevnov, parts of Střešovice, Bubeneč, Dejvice and Hradčany. This entire area, with the exception of a small part of Břevnov, around the Břevnov Monastery, is drained by a combined sewer system.

The original overflow chamber of the "frog mouth" type (Figure 2) is no longer compliant in terms of its technical capacity and nor does it any longer meet the quality requirements for discharged overflow water as defined in the prescribed parameters established in the General Plan of Sewer and Drainage of the City of Prague for the assessment of overflow chambers. The inflow to the chamber was led through two egg-shaped sewers of the Prague Normal (PN) dimensions, PN X 1500/2300 mm and PN IV 900/1600 mm, with their confluence located in front of the chamber in a brick 1800/2600 mm egg-shaped sewer. The outflow from the chamber was also led through a brick PN I 600/1100 mm egg-shaped sewer. The storm flow was led separately through a circular sewer DN 2000 mm to the drain line and further on to the Vltava River.

NEW CHAMBER

The newly constructed overflow chamber primarily enables diverting the sewage flow and part of the storm flow from the "C" interceptor to the "K" interceptor, through a constructed connection. This diversion will enable relieving the terminal sections of the "C" interceptor prior to its connection to the inflow labyrinth of the Prague WWTP. In this manner part of stormwater, which would also have been discharged into the Vltava River, will be brought to the WWTP.

In terms of the hydraulics the overflow chamber is designed as a discharge type, with a straight crest. The groundplan of the chamber is rectangular with a sight size of 4 x 22 m; the headroom of the chamber is 5.5 m. These dimensions represent

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a retention capacity of cca. 100 m3 up to the top of the crest. The gate valve located at the outlet from the chamber enables controlling the outflow of wastewater into the "K" interceptor.

The design of the chamber was based on the results of the hydraulic study, which indicated the need for two separate inlets from the inflowing sewers. Due to the progress of altitude of the sewers these inlets have been provided with a well hole on each sewer (Figure 3). The sewage flow is fed through DN 400 mm well-hole pipes, made of cast basalt, into the groove in the bottom of the chamber formed from cast basalt bricks (Figure 4). From the chamber the flow is guided through the DN 1200 mm drain located in front of the crest into a brick connecting sewer with a 1200/1800 mm egg-shaped profile (Figure 5), that runs into the "K" interceptor, the circular profile of which, in this location, has a diameter of DN 3600 mm. Flow control is facilitated by the DN 1200 gate valve that is installed at the outlet from the chamber. This slide valve is mounted on a ring comprised of calibrated, cast basalt, radial-shape elements. Precision machining of the cast basalt ensures the maximum degree of tightness between the basalt and the gate valve (Figure 6). The storm flow spilled from the well holes at the inflow to the chamber is regulated by means of a baffle and it is then led through the chamber while at the end of the chamber it overflows via the straight crest into the existing DN 2000 mm sewer overflow (outlet). The new connection to the "K" interceptor enables the operational diversion of 4 m3/s of storm flow to the WWTP. Behind the crest of the chamber, a new entrance to the original PN I 600/1100 mm egg-shaped grooves has been constructed in the base, enabling the operational diversion and/or the discharge of wastewater through the "K" interceptor to the WWTP.

This design of the overflow chamber enables both the capturing and the drainage of stormwater that corresponds to rain with up to the annual incidence to the WWTP (Figure 7). In terms of its construction the overflow chamber is implemented as a lined, reinforced concrete panel wall structure (Figure 8), which sufficiently ensures its actual static function, while also creating the requisite environment for the normal functioning of the sewer system with regard to its operational hydraulic load, the load due to the dead weight of the structure, the impact of the surrounding geological environment and the effects of traffic on the surface.

The supporting reinforced concrete structure of the chamber is designed from C30/37-XA2 concrete, with a maximum in-depth leak of 40 mm. A concrete 50 mm cover is suggested. For reinforcing the concrete, B500B steel and B500 welded mesh are recommended. The basic dimensions of the rectangular reinforced concrete structure are 4.5 x 23 m, with a depth of 5.65 m and a wall thickness of 400 mm. The insulation of the construction joints has been addressed by utilising sealing sheets with an insulating coating applied to both sides.

The inner surface and the shape of the chamber are formed of a brick lining. The lining in the lower section is implemented using cast basalt bricks, while above it is constructed from sewer bricks (Figures 3 – 5). The cast basalt is affixed to the structure using EUFIX

Figure 6
Ring made from calibrated radial-shape cast basalt elements

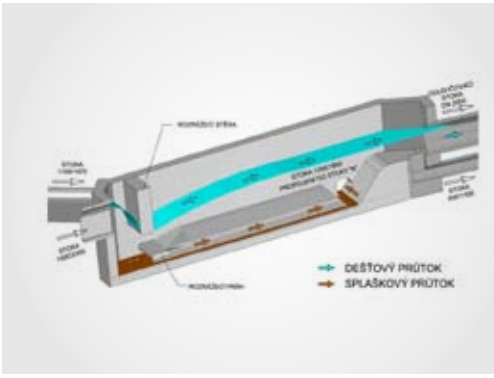
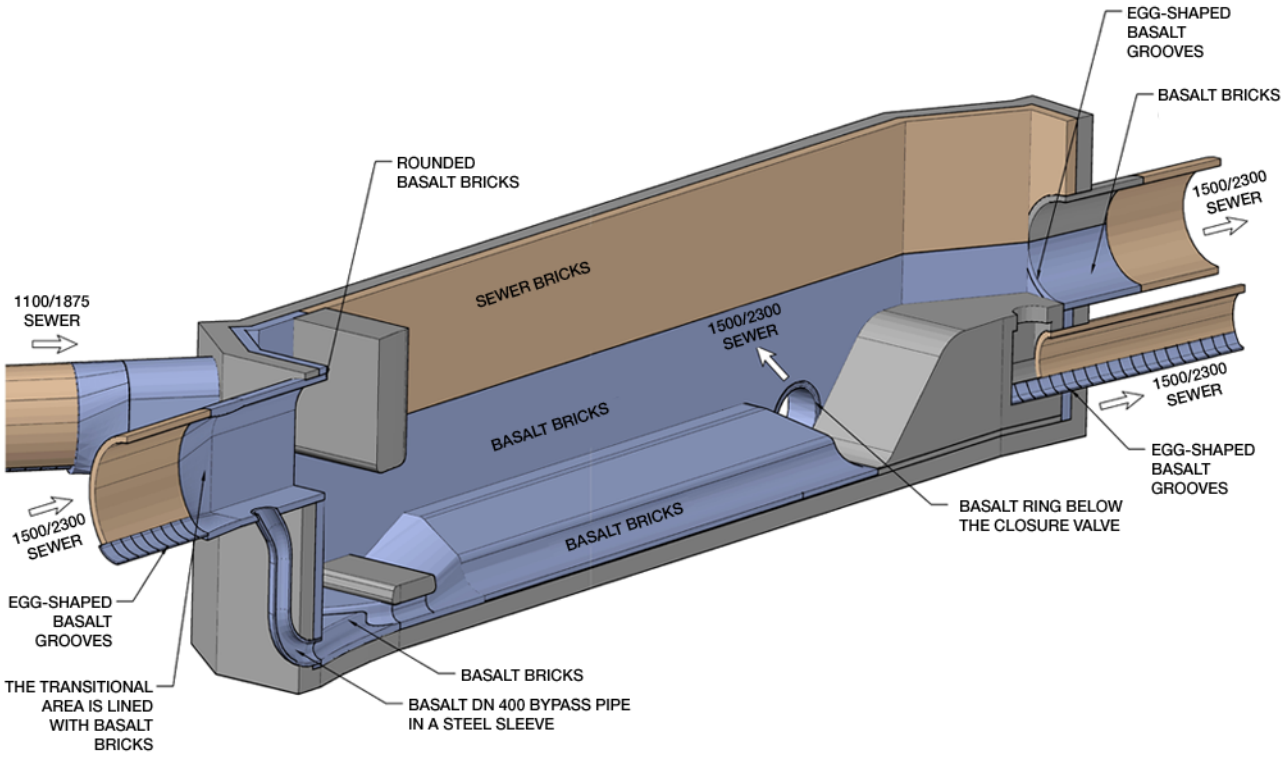


Figure 7
Model of the overflow chamber

Figure 8
Concreting of the walls

Figure 9
The opening into the "K" interceptor

Figure 10
The construction of the connector to the "K" interceptor



S special mortar, which ensures an adhesion level greater than 1.5 MPa. The jointing is also implemented using this mortar, which withstands exposure to the chemicals that are contained in the sewage water. The products made of cast basalt were chosen in preference to other materials, primarily in order to minimise any failures and to maximise the service life of the sewer, based on an anticipated transport speed greater than 5 m/s. The tests performed clearly indicated that, of all the materials tested, cast basalt has the highest degree of resistance to abrasion. By combining cast basalt and high-quality concrete a durable structure was created, one that is able to withstand the long-term impact of waste water flows.

OUTFLOW FROM THE CHAMBER – CONNECTION TO THE "K" INTERCEPTOR

A new outflow from the chamber – the sewer connecting to the "K" interceptor, is used to divert sewage and a portion of the storm flow. The walled connecting structure with a 1200/1800 mm egg-shaped profile is led via a new route that has a direct connection to the "K" interceptor. The connecting structure is lined with cast basalt sewer bricks with a hewn crest at the inlet to the interceptor. The total length of the connection is 33 m, with a longitudinal gradient of 14.3 ‰. A measuring shaft is located in the path of the connection that enables controlling the permanent specific profile of the wastewater running in front of the WWTP (Figure 5).

The construction of this connection was implemented by means of tunnelling. The temporary structure of the tunnel was comprised of K21 steel frames and Union boards. The excavation was implemented in a full profile, using manual disintegration.

CONCLUSION

To the maximum extent possible, the new overflow chamber utilises the existing space and operational and handling options for wastewater treatment in interceptors prior to its actual inflow to the WWTP. By combining cast basalt and sewer bricks with high-quality concrete a durable construction was created, one able to withstand the long-term impact of wastewater flows and with a service life expectancy of more than 150 years.

The proposed technical parameters are based on a conceptual solution for the entire catchment area of the "C" interceptor as it was processed in the General Plan of Sewer and Drainage of the City of Prague.

The construction of the new overflow chamber was implemented during 17 months of the years 2010 - 2012. Thanks to an experienced work team no serious technical complications occurred on the course of this construction.

Description of the construction of a new terminal OK_1C overflow chamber located in the "C" interceptor beneath Maďarská Street in Prague 6 - Bubeneč.

Investor:	Pražská vodohospodářská společnost a.s. (PVS)
Designer:	KO-KA s.r.o.
Contractor:	Čermák a Hrachovec a.s.
Implementation Period:	06/2010 – 01/2012

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