Municipal

CASE STUDY

CERTA-LOK® RJIB RESTRAINED JOINT PVC REDUCES GROUND SURFACE DISRUPTION AND IMPROVES PRODUCTIVITY FOR STATIC PIPE BURSTING PROJECT

Infrastructure upgrades for the City of Lloydminster included replacing an aging water main and sanitary sewer. The city had to consider the identified constraints in order to select the right pipe and installation method for the project: minimize surface disruption, reduce impact on shallow utilities, alleviate soil settlement concerns and shorten the project schedule.

Project Type:
Water Main and Gravity Sewer

Application:
Static Pipe Bursting

Owner:
City of Lloydminster

Product Used:
Certa-Lok® RJIB

General Contractor:
Rusway Construction

Contractor:
3D Pipe Bursting

Engineer:
BAR Engineering

CHALLENGE

Located on the border of Alberta and Saskatchewan provinces in Canada, the City of Lloydminster was tasked with replacing 138 m (453 ft) of 200 mm (8 in.) vitrified clay sanitary sewer and 83 m (272 ft) of asbestos cement water main that lay below the intersection of 44th Street and 62nd Avenue. After careful study, the city planned to replace the existing pipe for both projects with PVC pipe. The engineer on the project reviewed both open trench and static pipe bursting applications to determine which would best support the project challenges with soils, existing utilities, surrounding infrastructure and speed to completion. Disrupting shallow utilities and concerns over soil settlement were key considerations to move away from open trench installation as an option.

APPLICATION

The design engineer on this project, BAR Engineering, specified spline-lock DR 18 Certa-Lok® restrained-joint integral bell (RJIB) from Westlake Pipe & Fittings for the pipe replacement project. Three runs of existing pipe were designed for the pipe bursting application, two runs of sanitary sewer and one run of water main. The 138 m (453 ft) of 200 mm (8 in.) vitrified clay sanitary sewer will be replaced with 200 mm (8 in.) Certa-Lok pipe and the 83 m (272 ft) of asbestos cement water main will be replaced with 200 mm (8 in) of Certa-Lok. The engineer chose size-on-size pipe because an increase in pipe capacity was not required. A gravity sewer spline-lock pipe such as Certa-Flo® could also have been utilized for the sanitary sewer. The plan view drawing in Figure 1 shows the water main pipe burst in blue and the sanitary sewer in red. The aerial photo in Figure 2 shows the pipe burst setup for the 97 m (318 ft) length of sanitary sewer running north-south along 62nd Avenue. Certa-Lok spline-lock PVC was specified as the pipe material for both the sanitary sewer and water main replacements – the segmented nature with cartridge-style loading allows for ease of installation and a minimal assembly area.

SOLUTION

For static pipe bursting, an insertion pit and a machine pit must be dug prior to the new pipe installation. For this project, the pits were dug the day before the pipe installation. The bottom elevation of the two pits were dug just below the invert elevation of the existing pipe that will be receiving the new pipe.

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No mainline connections to laterals were required. The pits were dug at the manhole locations for the sanitary sewer and at the valve locations for the watermain. Access to 44th Street was temporarily closed to traffic, however, the Certa-Lok cartridge-style installation did not require a large staging area which allowed traffic access to 62nd Avenue and the businesses on either side of the street. With cartridge-style installation, there was no need to string out the pipe which would have blocked roadway access to traffic.

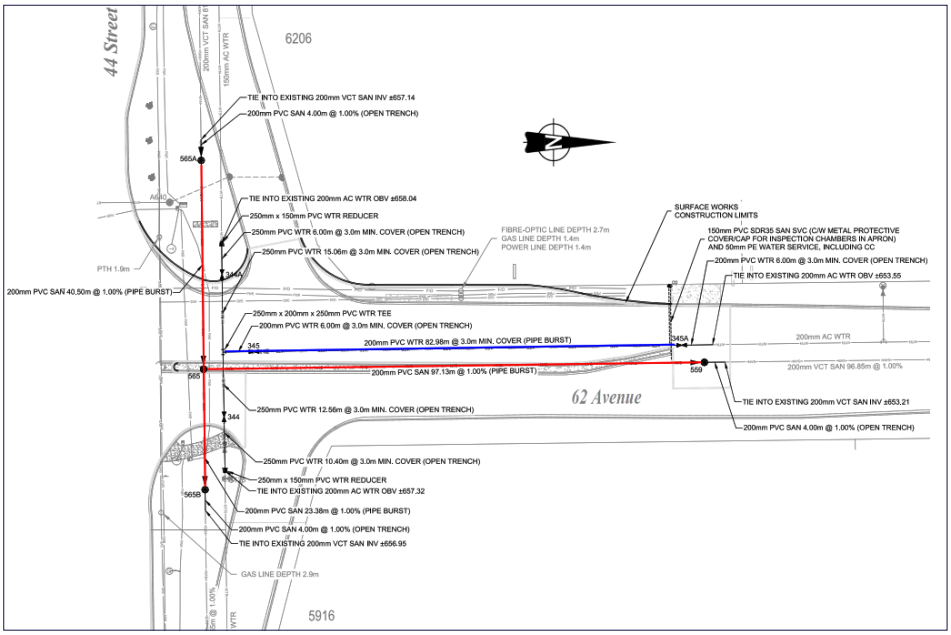

Figure 1. Plan View of Pipe Bursting Installations – 44th Street and 62nd Avenue

There were several reasons pipe bursting was the best choice for the project:

1. The minimum depth of cover for water mains in Lloydminster is 3 m (9.8 ft) due to ground frost conditions in the winter. The existing asbestos cement watermain had approximately 4 m (13.1 ft) of cover. Choosing pipe bursting allowed the city to leave the majority of the asbestos cement pipe in the ground.

2. Because of the flat topography in the area, sewer mains are deep in areas to allow for positive drainage. The two sections of sanitary sewer planned for pipe bursting have low grades at 1.0 % and have approximately 4m (13 ft) of cover. Open-cut pipe replacement would have required a significant amount of material to be removed and backfilled adding time and costs to the project, pipe bursting minimized these costs.

Figure 2. Aerial View of 200mm (8 in) Sanitary Pipe Bursting Installation – 62nd Avenue

3. Pipe bursting was chosen was to minimize surface disruptions. For this project, more disruption than normal can be seen along 62nd Avenue. This is because the road surface was removed and replaced with concrete pads having a 75-year lifespan and the median was replaced as the additional cost quoted by the contractor was minimal. Normally, excavation would only be required at the insertion pit, machine pit, and the service connects.

The machine pit was excavated at the north end of 62nd Avenue and was approximately 4.5 m (15 ft) long. The static pipe bursting machine used was a Hammerhead HB-125 model and was operated by the pipe bursting subcontractor, 3D Pipe Bursting. The machine was placed in the pit using an excavator and the hydraulic power pack was placed above the pit, pictured in Figure 3. The HB-125 model is designed for replacement pipes in the range of 150 mm (6 in.) to 500 mm (20 in.) with a max pull force of 125 US tons.

An insertion pit was excavated at the south end of 62nd Avenue and was approximately 9 m (30 ft) in length, see Figure 4. For segmented PVC pipe, the pit needs to be dug just long enough to allow the placement and attachment of one length of pipe to the previously installed segment of pipe. The pipe used on this project was DR18 Certa-Lok PVC with a length of 6.1 m (20 ft). The pipe is also available in 3.05 m (10 ft) lengths, which would allow a further reduction in the insertion pit size.

The first step was to feed the bursting rods through the existing pipe from the machine pit towards the insertion pit. The rods used on this project were 3 ft in length. Once the bursting rods reached the insertion pit, they were attached to the expander (bursting steelhead 12.75 in. diameter) and pulled back towards the machine pit with the new pipe following behind.

The expander used on the project is a two-piece assembly. As shown in Figure 5, the general contractor, Rusway Construction, attached the inside piece of the expander to the spigot end of the pipe. Next, Figure 6 shows the outer piece of the expander, which includes the bursting fins, attached to the inner section. This assembly was fully anchored to the new pipe and ready to be pulled into place. The expander head has an outside diameter measuring several inches larger than the outside diameter of both the existing and new pipes. This allows the hole to be expanded, pushing the soil to the side creating room for the new pipe.

After the expander head was attached to the new pipe, the pipe and expander were lowered into the insertion pit. The expander was then attached to the bursting rods which had already been fed through the existing pipe. The attachment of the expander to the bursting rod can also be seen in Figure 6. As the first 6.1 m (20 ft) length of pipe was being pulled back, the contractor in the pit assembled the joint, connecting the next segment of pipe. Segmented spline-lock pipe does not need to be pre-assembled, it can be assembled as the pipe is being pulled into place. This allows for a smaller staging area as the pipe does not need to be strung out prior to assembly.

Figure 3. Aerial View of Static Pipe Bursting Machine and Machine Pit– 62nd Avenue

Figure 4. Aerial View of Insertion Pit – 62nd Avenue

Figure 5. Attachment of Expander Head to the Pipe

Figure 6. Attachment of Pipe Bursting Expander to Bursting Rods

Figure 7. Assembly of Spline Lock PVC Pipe

Figure 8. Insertion of Spline into Spline Lock PVC Pipe

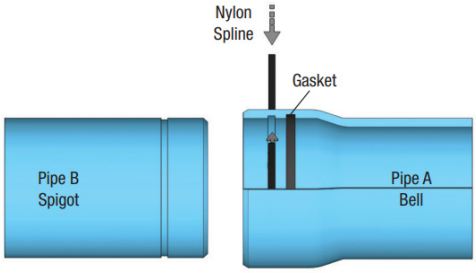

Figure 9. Spline Lock Configuration

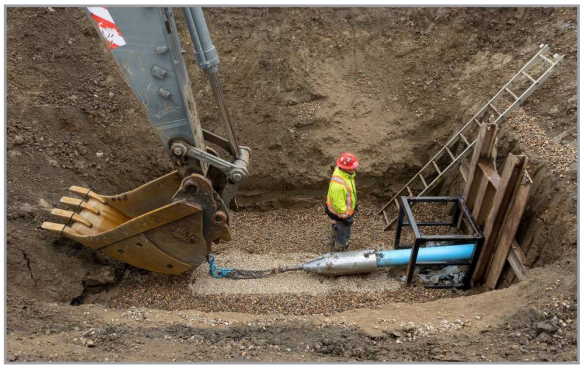

Figure 10. Removal of Bursting Head from Machine Pit

Figure 7 shows the spline lock joint being prepared for assembly. First, the contractor lubed the gasket inside the bell, careful not to lube the spline groove positioned before the gasket. Next, the contractor lubed the spigot end, again careful not to lube the spline groove.

In Figure 8, the contractor then inserted the spigot end into the bell end lining up the two spline grooves. Finally, the nylon spline was inserted into the spline insertion hole completing the "spline lock," and the joint was fully restrained. The assembled joint can handle a maximum safe pull force of 27,500 lbs (200 mm / 8 in. DR 18) with a safety factor of 2. Figure 9 shows a cross-section of the spline lock joint system. The nylon spline is inserted in the spline insertion hole, which is oriented near the top of the pipe, and then runs around the circumference of the pipe, through the matching spline grooves.

After the expander entered the machine pit and the full 97 m (318 ft) pipe string was pulled into place, the bursting machine was removed from the pit using the excavator. Figure 10 shows the excavator was also used to remove the expander from the pit. The assembly of this section of Certa-Lok PVC pipe took approximately one hour and the spline can be inserted in less than one minute.

The other two lengths (83 m/272 ft and 40.5 m/133 ft) also took an hour or less to install once the set-up was complete. The three pipe bursting installations were carried out over a three-day period.

The installation of the Certa-Lok spline-lock pipe was deemed to be a big success by the general contractor, pipe bursting subcontractor, design engineer and the municipality. Feedback included: the spline-lock system assembled very quickly and easily, the pipe pulled well and the segmented nature of the pipe allowed the contractor to minimize their staging area. The engineer realized an added benefit of pipe bursting during the project – it allowed the contractor to work through heavy rain without any delays, further improving the project schedule. The pipe bursting installations were carried out over three days by Rusway Construction and 3D Pipe Bursting. Spline-lock PVC allowed them to quickly assemble the joints, utilizing cartridge-style installation, without the need for specialized equipment. All of those involved in the project were very pleased with the outcome.

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