Wet Work: Space Center Boulevard Storm Sewer Reconstruction

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Fig. 1: Contractors prepare to go underground to perform rehabilitation on large-diameter concrete pipes. All photos courtesy of the authors.

In May 2015, an existing storm sewer line along the median of Space Centre Boulevard in Harris County, Texas required repair after several sinkholes were observed.

A closed-circuit television (CCTV) study was performed inside the storm sewer system, which consisted of 24-to-66-inch-diameter reinforced concrete pipe (RCP), with invert depths from 6.2 to 13.5 feet below grade. The CCTV inspection indicated that most of the pipes and manholes had experienced extensive movement, significant changes in elevations and high water infiltration. Some of the RCP pipes were broken, with the highest damage levels in segments of the storm sewer located between Stations 105 and 108.

Historic emergency repairs had been attempted utilizing urethane injection to seal broken RCP joints, lift the storm sewer back to its original flowline and perform soil stabilization surrounding the system. These repairs did not restore the flow line to its design parameters or stop the water infiltration into the RCP pipe.

The Harris County Engineering Department (HCED) Architecture & Engineering. Division (AED) performed test soundings and a groundwater and soil study along the storm sewer alignment to develop repair options. Based on the results, it was decided that the severely damaged segment of the storm sewer would be replaced, while other portions of the storm sewer be repaired subject to associated costs.

The rehabilitation project consisted of installing 5,850 linear feet of colloidal silica concrete penetrating treatment sealer, high-density polyurethane foam and a robotically applied pure polyurea structural liner to the existing storm sewer, including all RCPs, RBCs, inlets and manholes. The RCP diameters varied from 24 inches to 66 inches, and each RBC was approximately 4-feet-by-7-feet in size.

This was a very high-profile project for Harris County as rectification attempts over the previous 25 years were unsuccessful, with repeated failure of the storm water system resulting in roadway flooding, sinkholes and undermining of the adjacent road structures.

As the recent events of Hurricane Harvey have shown, in this region, the groundwater table increases during and after heavy rains, and significantly increases when ground water reaches saturation. The storm-sewer system and the adjacent road structures run directly through a swamp, resulting in a substantial amount of groundwater constantly present in most locations. Several lateral pipes and catch basins were unstable and out of alignment due to settling.

Most of these lateral pipes from the catch basins to the main storm sewer-line had significant breaches at the RCP joints, and were pumping groundwater into the pipe, even when there was no surface water and the catch basins were dry.

Following a complete review of the various reports, including; soil conditions, design drawings, and historical repair history, it was determined that the proper installation of a tube-in-tube liner system would resolve the water ingress and egress problems of the storm sewer. The ingress of groundwater into the system, when surface water was not present, and the egress of storm water from the system during heavy rain, were the root causes of the problem, resulting in constant soil erosion and surface conditions. This erosion and deformation of the area surrounding the storm sewer was washing away larger granular soil structures.

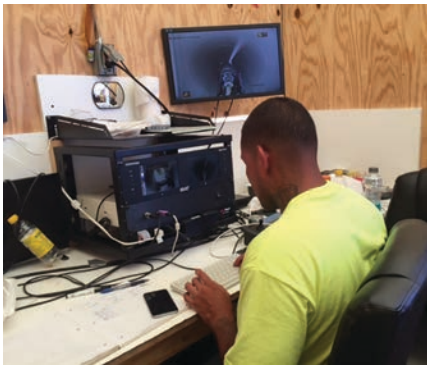

Fig. 2 (above): The lining system was applied to the pipe interiors with a 360-degree robotic spray system, controlled remotely on-site by contractor personnel.

The lining system solution developed for rehabilitation of the sewer line needed to deny ingress of groundwater into the system and deny egress of the collected storm water into the ground surrounding the system. The installed system would have to resist any potential hydrostatic pressures possible in this location, structurally span deteriorating RCP sections, eliminate further erosion, and remain intact even with substantial movement of the pipe and manhole structures.

The pure polyurea lining chosen provided a fast gel time, resistance to chemical exposure, was applicable with high moisture and high temperatures and had low volatile organic compound (VOC) content, among other features. The lining was spray-applied directly to the substrate using a plural-component proportioning robotic spray system at a dry film thickness of 240 mils to 480 mils, depending on the condition of the

Fig. 3 (above): In addition to the pipe interiors, the contractors also spray-applied coatings to catch basins, manholes and other related structures.

Fig. 4 (center and above): The finished, polyurea-lined pipeline was inspected and found to have rectified the historical problems with water intrusion and degradation at this site.

system in different locations. The robotic spray system could apply at rates of up to 300 lineal feet of RCP per day.

Performing underground pipe rehabilitation is always complicated, but this project involved working around a combination of extremely high groundwater levels, constant heavy stormwater runoff, and heavy vehicular traffic flows surrounding the work area. The key factors for success was the proper sequencing of the work including; dewatering, injection of hydrophobic resins and surface cleaning, in advance of the robotic application of the liner. The installed liner successfully rectified the historical problems with the project.