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CITY OF LOS ANGELES CONDUCTS A TEST INSTALLATION OF A NON-CIRCULAR WOUND PIPELINE REHABILITATION METHOD

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Abstract: The City of Los Angeles has been working to develop biddable alternatives to rehabilitate its 60+ miles of large diameter semi-elliptical sewers. Prior to the project described in this paper, only one trial installation of a non-circular lining product had been installed. This paper describes the installation of a corrosion barrier into a rectangular channel using a winding technique developed by Sekisui. This represents the first installation of this product in the United States.

Figure 1. Hyperion Treatment Plant Emergency Bypass Channel

1. Project Description

The City of Los Angeles' Hyperion Treatment Plant treats an average of 350 million gallons of sewage per day. Flow through the plant is expedited by an Intermediate Pump Station using open flight screw pumps. Discharge from the plant is assisted by discharge pumps into the five mile outfall. While the plant has full electrical backup, an emergency bypass channel (EBC) is also in place to divert flow into empty tanks in the event of power outage, equipment failure, or emergency plant shut down. This channel is 13-feet wide, 5-feet 4-inches high and has an overall length of 260 feet. The EBC has a straight section 190 feet long and a curved section 70 feet long (Figure 1). It was discovered to have severe corrosion at the soffit. (Figure 2.)

Figure 2. *Soffit Corrosion*

The structural repair of the channel could have been accomplished in several ways. However, at the time that the EBC repair became an approved project the Wastewater Conveyance Engineering Division of the City of Los Angeles Bureau of Engineering was actively looking for a satisfactory test installation site for the Sekisui SPR product. Initially several candidate sites for a test installation were considered including both live sewer locations in the North Outfall Sewer, and an abandoned section of semi-elliptical sewer. It was determined that the EBC rehabilitation project would provide an ideal opportunity for a trial demonstration. Because of the location and level of use of the EBC, it could be done in a location that would allow close inspection of the method of installation and ready access to the finished product to review the results.

Figure 3. Sekisui SPR Profile

2. Method

The Sekisui method winds a continuous strip of interlocking plastic (Figure 3) into a shape that closely approximates the deteriorated host channel. Winding is accomplished using a relatively small winding machine that travels down the channel at the head end of the completed liner. (Figure 4) One feature of particular interest to the City is the ability of the machine to be installed into the channel, and lining material can be fed to the machine through a maintenance hole, without the need to open the street. For winding a non-circular shape the plastic profile strip is reinforced by a formed strip of steel that provides sufficient rigidity to hold the shape until temporary bracing is installed (Figure 5) and structural grout is injected behind the plastic liner (Figure 6).

Figure 4. Winding the Liner in the Emergency Bypass Channel

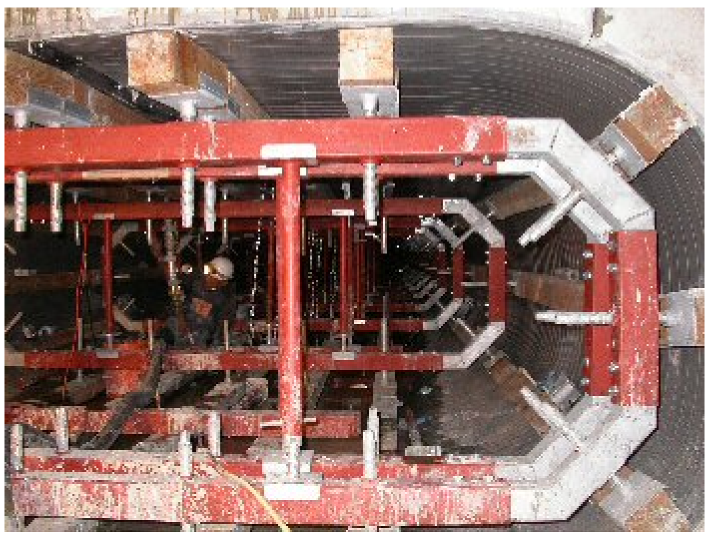

Figure 5. Installed Bracing

Figure 6. *Grout injection behind the braced liner*

3. Project Objectives

The Emergency Bypass Channel project was intended to demonstrate the installation of the Sekisui SPR product. For this project the repair was considered as a corrosion barrier only, with the structural portion of the repair to be done by conventional means. Soffit repair was carried out by high pressure water blasting corroded areas to expose sound concrete, damaged rebar was spliced and doweled into sound concrete, and the area of repair was formed and new concrete was placed. Debris from water blasting was left in the channel, and ends of the channel were sandbagged and allowed to fill partially with water to simulate a wet sewer environment for the installation of the corrosion liner.

Objectives were to:

1. Demonstrate the effectiveness of the joint and gas tight gasket seal
2. The effectiveness of grout penetration of the profile
3. Determine if the steel strip was able to function as reinforcing steel
4. Simulate the wet sewer environment by installing the liner in gritty water

Evaluation was as follows:

1. Joint and gasket gas tightness was to be demonstrated by spark testing with 20,000 volts.
2. Grout penetration was to be demonstrated by core samples taken at random locations as well as at locations determined by sounding the liner with a hammer.
3. The effectiveness of the steel strip as reinforcing was to be demonstrated by casting beam samples and breaking them. The method of failure was to be examined to determine if there was full engagement of the steel or if the sample failed before this occurred.
4. The wet sewer environment was simulated by leaving the debris from water blasting the concrete during structural repair and evaluating the core samples for debris inclusions.

The typical SPR rehabilitation in Japan includes the assumption of a composite final structure consisting of the host pipe and the newly installed liner. The City is not ready to accept full composite behavior, but was interested in whether the steel that is embedded in the grout can be assumed to be reinforcing steel. This would reduce the thickness of grout required for a standalone structural rehabilitation in the model accepted by the City.

Following discussion with the project team Sekisui modified the steel strip by perforating it to create a discrete physical bond between the steel and the grout that did not rely strictly on friction. Testing to verify the steel/grout bond was conducted on beams cut from four 2'x 4' box samples prepared specifically for producing beam specimens (Figure 7).

Figure 7. Cast box samples prior to cutting beams

The structural repair of the soffit of the channel was done in a conventional manner by the Prime Contractor, Mladden Buntich, prior to the installation of the Sekisui SPR liner. No special preparation of the host walls or ceiling was made. The invert of the channel was not cleaned following the patching of the invert and was filled with several inches of water to simulate a sewer condition.

A crew of Japanese engineers and technicians was brought to the job site by Sekisui to operate the equipment and to train the Prime Contractor's staff in the installation method. Sekisui also imported all of the equipment, sand, cement and additives to be used in the installation (Figure 8).

Figure 8. Material Imported From Japan

Winding of the Sekisui Lining into the straight section of the EBC was concluded in 13 days. The SPR machine is capable of traveling around curves, but the EBS radius was smaller than the SPR capability. A self supporting tube of SPR material was wound above ground, and cut into segments, installed by hand, and the joints were made with fiberglass. Bracing and grouting were concluded in 12 days. Grout injection ports were located at 0-feet, 100-ft, and 200-feet into the channel. Ten cylinder samples were taken during the grouting operation and showed an average compressive strength of 6,500 psi. Twelve core samples were taken from various locations to verify that the grout had successfully penetrated the back of the profile (Figure 9). The cores were also reviewed to determine if any of the grit that had been left in the bottom of the channel had been carried into the grouted annular space by the traveling winding machine. None was observed. Coring through the perforations in the steel winding strip show complete penetration of the grout into the steel. Spark testing was conducted on the final product which passed the spark test.

Figure 9. Grout Penetration Core Samples

Beam samples were cut from the box samples and tested per ASTM C78, *Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)*. At the time of submittal these beam tests are ongoing. Qualitatively however beam specimens with thick grout seem to fail before full engagement of the steel, specimens without thick grout do not.

Conclusion – The result of this trial installation is a confidence that the liner can be successfully installed and that the grout layer can be designed as a structural section. The ability to take the steel strip into account as reinforcing is still in question.

The next step will be a demonstration installation in a live sewer as part of a routinely bid non-circular rehabilitation project. It is anticipated that this will happen within the next year.