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When Size Matters

Rehabilitating large inverted siphons in Louisiana

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The Sabine River Authority (SRA) was created in 1949 to equitably distribute the waters of the Sabine River and its tributaries. As part of this distribution, “We provide surface water to 11 industrial customers, such as Conoco and Louisiana Pigment, for cooling and processing,” says SRA facility manager Mike Carr. This water is conveyed mostly via a 35-mile-long open canal, but where that canal must cross under roadways and railroad tracks the water passes through inverted siphons.

The siphons are made from reinforced concrete pipe that is typically used in storm sewers and other low-pressure applications. But the siphons are usually full, and with wear and movement over time, leaks and structural cracks have occurred. “Most of this concrete pipe went in back in the ‘70s,” explains Carr, “and now we’re seeing broken lips at the joints, a lot of leakage, and sediment is getting into the water and compromising quality. Also, the possibility of collapse at the crossings is a danger to the public and the railways. So when we see problems, we have to fix them.”

SRA is systematically rehabilitating all 40 siphon crossings in its network. The preferred method is cured-in-place pipe (CIPP), and SRA has a long history with this method. But CIPP hasn’t worked well in large-diameter pipe, and there have even been problems requiring cured linings to be cut out and removed.

Two crossings in particular were problematic. One was a roadway crossing with three 84-inch-diameter siphons running in parallel for 180 feet. The other was a railroad crossing with two 78-inch siphons running in parallel for 185 feet. Both were bid for CIPP. “We’ve used linings before with a lot of success, but that was mainly on pipes up to 42 inches,” explains Carr. “We tried to use cured linings on pipe this size and we ran into problems.” In fact, the first attempt at cured-in-place lining one of the 78-inch siphons was a disaster; the lining collapsed and had to be laboriously cut out and removed. A second attempt was successful, but not totally satisfactory. There was visible sagging at siphon ends, and SRA was uneasy about the structural integrity. Carr asked the project engineer, Meyer and Associates, to look into alternatives. The contractor, Boh Brothers Construction Company LLC, also wanted an alternative for the larger-diameter siphons and suggested CentriPipe, a centrifugally cast lining solution used by one of its associated firms, RePipe-Texas. CentriPipe turned out to be a successful alternative for these troublesome large-diameter crossings.

A Perfect Storm

It’s important to keep in mind that several factors—size, heat, equipment availability, and staging area requirements—combined to make CIPP impractical on this project. “Linings this big can be installed,” explains Wayne Harris, P.E.,

project manager at Meyer and Associates, “but the necessary equipment is hard to find and lease—there just aren’t that many setups available.”

And Harris says that heat was a major factor. “It was the middle of July when it’s very hot, and it was extremely difficult to keep the lining cool until it was in place and ready to be cured.” Staging, too, was a consideration. For linings this size, several cranes are needed for handling, along with other bulky equipment, which means that very large pads are needed at both ends of the siphons. Sometimes, the necessary space simply isn’t available.

For all these reasons, CIPP is also proportionally more expensive at larger diameters. Harris realized that there were very good reasons to look into CentriPipe. If it could overcome the challenges that made cured lining impractical, it could solve a very real problem for the Sabine River Authority.

Large-diameter siphons running in parallel

Centrifugally Cast Concrete Pipe

CentriPipe, from AP/M Permaform, is a process also known as centrifugally cast concrete pipe (CCCP). This system was initially developed for manhole rehabilitation and other vertical uses, but improvements in materials and casting control have made CCCP effective for large horizontal pipes. For example, the Florida Department of Transportation has used CentriPipe to line a 13-foot-diameter culvert near Jacksonville.

Basically, the CentriPipe system uses an automated retrieval system and spincaster to apply thin, precisely calculated layers of high-strength cementitious grout to pipe interiors; the spincaster is inserted into the pipe and pulled back slowly as the structural liner is applied.

The cementitious grout applied was PL-8000 from AP/M Permaform. PL-8000 is a fiber-reinforced high-strength cementitious grout that can be mixed onsite and used with the CentriPipe spincaster. It can be applied to most substrates (brick, concrete, metal, etc.) and it is waterproof, corrosion-resistant, and structurally sound even in relatively thin layers. It also adheres extremely well, even when the substrate is damp—which was the case on the SRA siphons. Because flows were active in the parallel siphons while the bypassed siphons were being repaired, serious infiltration from the saturated soils was occurring.

The finished thickness was calculated according to projected loads, and the minimum thickness was determined to be 2 inches. SRA opted for a 2.75-inch thickness under the railway crossing as a hedge against heavier loads and vibration. These thicknesses were applied in five full-length continuous passes.

The July heat was a factor in deciding which process to use.

Despite the multiple passes, CCCP was still efficient compared to CIPP. “On the 78-inch crossing—which was two, basically identical, siphons—we did one with CIPP and one with CentriPipe,” explains Harris. “It’s hard to compare precisely, because there was a learning curve with both processes, but I’d say the CentriPipe was faster.”

Cost comparisons are also favorable. For larger-diameter pipe, CentriPipe clearly cost less per foot than CIPP. “We also considered spot repairing as an option, and that would have cost less than either CIPP or CentriPipe,” says Harris. “But if we’d done that, we wouldn’t have ended up with a fully lined pipe.”

A Satisfactory Solution

By being open to a relatively new infrastructure solution, SRA ended up with fully rehabilitated pipes that are smooth, structurally sound, and completely sealed with minimal flow disruption during the procedure. Carr is still waiting to see how CentriPipe performs in the long run but is very satisfied with initial results. “I like the look of it. Its smooth bore doesn’t restrict flow and there are no known leaks. We’re happy.”

“We’ll consider it in the future,” adds Harris, “especially for larger pipe, and places where space is an issue. It appears to be a good product. We’ll be dewatering and inspecting repairs eventually, and, if CentriPipe performs like it should, I can see us using it for all of the larger siphons in the system.”

Topics: Project design,BMP Manufactured,Maintenance