University of Arkansas- Fayetteville Thinks "Outside the Box"

A Tight Summer Deadline and Watertight Performance

Required Everyone to Raise the Bar for This Unique Project

By Michael R. Miller, Press-Seal Gasket Corporation

The Background

When the University of Arkansas, Fayetteville, needed to add a new buried service tunnel alongside existing classroom buildings, they quickly realized that if it were not completed during the summer holiday, more than just students would be inconvenienced. The new building it was to service would be thrown off schedule and that would mean delays in a tightly coordinated series of moves around campus. It had to be done on time. U of A officials also wanted to make sure that this underground conveyance would be permanently watertight, as utility tunnels are fifty-plus-year capital assets.

The original design from McClelland Consulting Engineers, Inc. in Fayetteville, Arkansas, specified a poured-in-place design. This was what had been used successfully in previous similar construction on campus, but it quickly became apparent that this construction methodology would require extensive open excavation and not meet the deadline of the project. University officials were firm – their timetable had to be met. They were also firm in wanting a system that offered the best resistance to water infiltration to maintain longevity of the infrastructure.

The project team, consisting of University Utility Operations, McClelland engineers, and the Construction Manager, CDI Contractors, LLC, Little Rock, knew they had to entertain alternative designs. Since there had been problems in the past on Campus with precast tunnel sections leaking at the joints, it was apparent that some new technology was needed. Scott Turley, Director of Utility Operations, suggested that the group think in terms of a pressure piping application rather than a stormwater application to find a solution that would have positive joint sealing.

Scurlock Industries, Fayetteville, stepped in and proposed the solution – precast concrete box culvert sections in place of the formed and poured-in-place construction. But unlike box sections used in other projects, these would have precision joints and rubber gaskets – a true watertight design – based on sealing technology used for low-pressure concrete piping. The University, CDI Contractors, LLC, McClelland, and NEC Contractors, the underground subcontractor for the project, all agreed to give it a try. It was the only chance for them to make their deadline.

Over the past few years, Scurlock Industries had been active in promoting precast box culverts in construction where pour-in-place was common in the past. Not only were they promoting it, but they also made the financial and engineering commitment to ensure its success. Brad Johnson, General Manager of Scurlock Industries, Fayetteville, and Matt Scurlock, Director, agreed that this project would be a big step up for the company – a high-profile, watertight project with tough conditions and a tight timetable. Of course, they didn't hesitate to take it on.

The Precast

Scurlock had existing modular drycast box culvert equipment from Mid-America Manufacturing, Jonesboro, Arkansas, that had been used for several other projects where non-precision, mortar-type joints were acceptable. For this project, they set the form up for 8' x8' with a 6' laying length. This length allowed their trucks to haul two pieces at a time, while negotiating the tight streets around the construction site. It also reduced the capacity of the equipment required for product handling on-site, allowing a more compact crane to be used. With a very confined work area and close proximity to existing buildings, every inch counted.

For the watertight joint requirement of this project, Scurlock invested in 10 sets of precision machined modular pallets and headers. Purchased from American Manufacturing Group, Jonesboro, Arkansas, these modular units are able to be configured in a variety of spans and rises. Unlike conventional mortar-joint designs which have wide tolerances, these pallets and headers had to make joints with tolerances measured in thousandths of an inch. And the precision is required not only in the metal, but also in the concrete. Any loss of precision would create assembly problems or leaks, and Scurlock was determined to prevent both.

To ensure a consistent high-quality product, Brad Johnson worked with his production and quality staff to start on the right foot with the very first step. Equipment was carefully assembled and an initial pour was made. This product was removed and in Brad's words, "Measured, measured, measured." The first piece was also water-tested to make sure that the casting process wouldn't give any surprises. Staff was pleased that the initial setup required almost no changes before production could begin.

Tipping Out a Precast Box Culvert Section

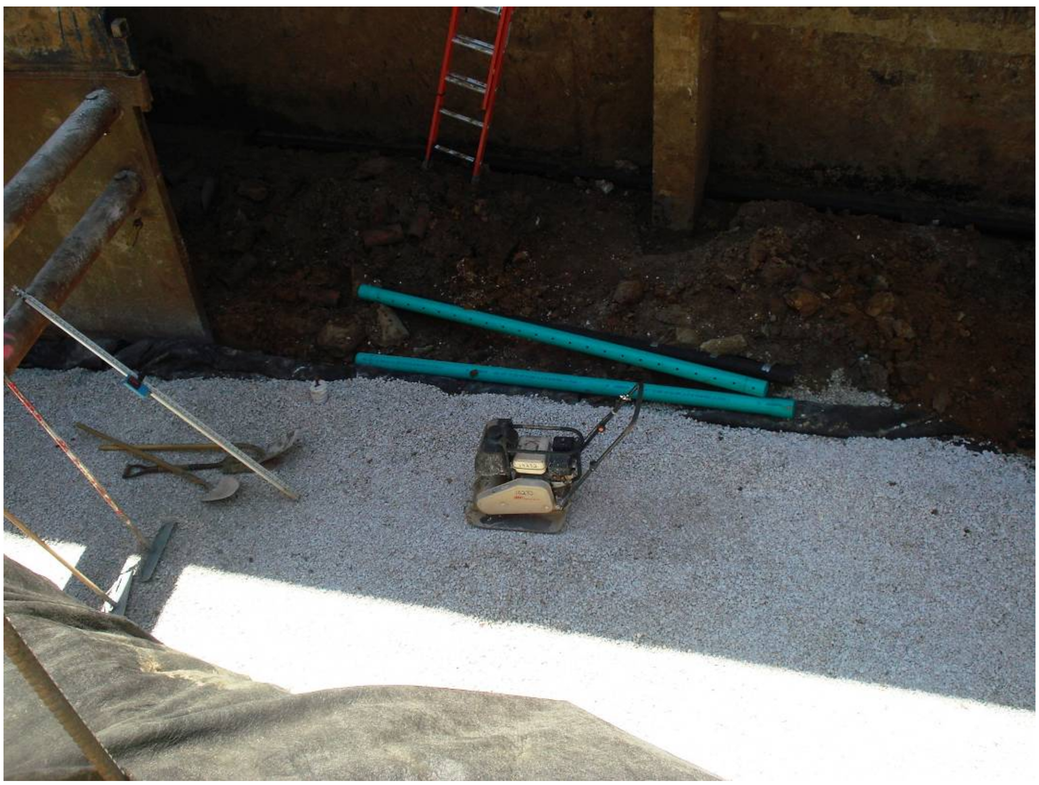
The production schedule was set to make ten pieces each day. Usually, these were completed by noon and set to cure until the next day. While this fast timeline might look like it was "pushing it", Johnson felt that the best product is made when a production rhythm is achieved, so that production flows. To ensure that NEC would have no problems on-site, Scurlock tested 25% of all joints in their plant. And measured. And measured some more. While they didn't see any significant changes in their product during production, they felt that this extra care was well worth the time and trouble.

Before the box sections left for the jobsite, they had rubber gaskets installed on their joining surfaces. RFS: Reduced Friction Seal Pre-Lubricated Pipe Gaskets from Press-Seal Gasket, Fort Wayne, Indiana, were selected for the project. Installation consisted of stretching the gaskets around the tongue of the joint and carefully gluing them into place. The adhesive maintained the gaskets in position during transport and pipe assembly. The pre-lubricated design of the gaskets meant that each section was received ready to install. Kevin Necessary of NEC Contractors described this as a "luxury" and a "big time-saver" over either using joint sealant or conventional gaskets.

The Scurlock production schedule ensured that all of the boxes required for the project were completed before excavation was begun. Kevin Necessary, was relieved to know that his progress wouldn't be held up waiting for the precast. And that proved to be a very good thing, as Mother Nature and construction conditions were lying in wait for his crew.

The Project Design

Extending more than 600 feet, the tunnel would carry many different utilities, including primary electrical distribution, district heating, and hot and chilled water, so the design incorporated features to channel any residual piping leaks safely to the side of each run. To do this, the core form for the precast box was modified with a steel piece that established a slope to one side. This continued for the length of the run. McClelland noted that flat tunnel floors typically had some moisture that would cover the floor, encouraging organic growth and creating a slippery surface for walking. They felt that channeling the water to one side would reduce or eliminate this and they report good results to date. The tunnel profile forms a rough "Vee", with the precast boxes forming two straight elements which converge at a center low point. The center structure, again a PIP element, contains sumps and pumps for removing any water which might accumulate in the tunnel.



Graded Fill Compacted to Roadbase Standards

McClelland specified a Class Seven base under the tunnel, similar to what would be put under a roadbed. This required even deeper-than-normal excavation, as well as additional graded, compacted backfill materials. The effect of this base was to support the sections firmly and maintain their alignment, even with 6-12 feet of backfill above.

To minimize intrusion into existing utility lines, McClelland specified bury depths of 14-23 feet. Actual excavation width averaged 14 feet due to constraints from existing buildings and pavement. This meant that placing the structures had to be done with very little room for maneuvering in the trench.

The Construction

In any underground construction, locating, avoiding or moving utilities is always a given. Added to that was working a very deep, narrow excavation between the basement of an existing classroom building and the street. As the basement wall was revealed, temporary support had to be installed to prevent its dislocation. Naturally, the operators spent much of their time carefully excavating soil, weaving around utilities, and making sure that they were moving as efficiently as they could. Fortunately, their skill moved the job along as quickly as possible, and they managed to clear off the basement wall without disturbing it or the utilities entering it.

Construction began with excavation of the subgrade and installation of a French drain alongside the trench to gather groundwater and direct it to a sump at the low point of the construction. The special base was started and formwork for the first of six PIP structures was begun. The PIP was needed to accommodate both the overall size and steep grade changes at the ends and midpoints of each run. The first box section installed had exposed reinforcing to tie into the PIP structure.

Setting the First Section

Joining the First Gasketed Joint

Once this box was set, a second gasketed section was installed into it. NEC rented a hydraulic pipe puller to join the boxes together. This allowed better control of the joint and freed the excavator for other work. The gasketed joints were all closed to within ½” all around, creating good compression of the gasket and a watertight joint. To keep backfill from entering the joints, each was covered with mastic-coated wrap material and finally, non-woven filter cloth wrapped the entire structure.

Dodging Existing Utilities in Narrow Work Area

Despite epic rainstorms which periodically shut down the project for days at a time, progress during good weather was better than expected, with 3-4 sections (18-24 feet) average per day. Work would slow when a PIP structure had to be constructed, and then pick back up on the other side. Backfill followed rapidly as the box sections did not need time to set and be inspected. This allowed the backfill materials to achieve better settlement in less time. Throughout the project, McClelland maintained full-time inspection of the construction.

Making Rapid Progress

Finally, the last boxes were set at the bottom of the vee and the final PIP structure was formed and poured. Incorporated into the bottom structure were two sumps for gathering and removing groundwater from the underdrains and process water from inside the tunnel. These would also serve to clear the tunnel in the event that there was a leak from the enclosed piping systems. After curing and inspection, the entire job was reinspected and approved as completed – on time and in budget. Paving and sidewalks were completed as required and the area was ready for the return of students this fall.

The Outcome

The Finished Product

In discussing this project, everyone involved was pleased with the outcome. The University of Arkansas - Fayetteville was able to keep its commitment to staff and students to have the improved facilities available on time. McClelland Engineers got a finished project that worked as it was designed and that was constructed in a very short time. CDI and NEC had a chance to show how they could be counted on to develop the methods to install watertight box culverts quickly and successfully. Scurlock Industries could take pride in stretching out their capabilities and delivering on their promises. The future looks bright for gasketed box culverts in Arkansas due to the success and visibility of this project.