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OVER THE RIVER AND THROUGH THE WOODS ...

Pipeline project aims to replace 10 miles of water transmission mains

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PROTECTING YOUR PIPES

Geofoam can be effective in mitigating the effects of shifting, settling and seismic activity on infrastructure

By Terry Meier

A member of the Brian Head Public Works team, in Brian Head, Utah, works on repairs to a severed truss sewer pipe. The new ductile iron replacement pipe is on the left.

Sinkholes. Massive discharges of untreated wastewater. The consequences of pipeline ruptures and breaks can be disastrous.

Sewer and water pipelines are vulnerable to faulting, seismic activity and other ground movements, but ongoing research is showing EPS geofoam to be a material with great potential for protecting them.

Steven Bartlett, associate professor of civil engineering at the University of Utah, and his team have been examining geofoam's mitigating effects on pipeline damage due to seismic faulting since 2007. "If an earthquake occurs, pipelines are one of the most important items to protect," Bartlett says. "For example, if a gas pipeline ruptures and ignites, you essentially have a large blowtorch, which can be catastrophic."

Geofoam weighs roughly 1/100th the weight of soil. The goal of a geofoam cover system on top of a buried pipeline is to reduce the lateral, longitudinal and vertical forces induced on the pipe as the surrounding ground undergoes deformation. The properties of geofoam have distinct advantages that lead to improved pipeline performance during large ground deformation.

There are two main advantages that geofoam has over traditional earth cover materials. First is geofoam's low mass density, which reduces the vertical and horizontal stresses on buried utilities and compressive soils. This reduction in loading and deformation will likely improve the performance of a pipeline during and after a major seismic event along the fault area.

The second advantage of geofoam is its use as a compressible inclusion for systems undergoing static, monotonic and dynamic loadings. Geofoam is somewhat compressible, and controlled compression can be used to reduce earth pressure against buried structures as well as deformation induced by structural loadings.

Bartlett's team confirmed the loadings that cause compression may include static and dynamic lateral earth pressure swells, frost heave pressures, settlements of support soils, faulting, liquefaction, landslides and traffic loads.

A solution in Utah

In December 2013, Bartlett's research on EPS geofoam was put to use in the repair of a severed sewer pipe in Brian Head, Utah. This was the second time the sewer line had been severed due to the dewatering of a deep sandy layer beneath the pipe, which resulted in significant consolidation, settlement, deep cracks and fissures.

> **"We expect the foam will reduce the weight on top of the pipe sufficiently to slow or stop the settlement. A camera will be sent down the pipe intermittently to determine the status of the pipe by looking for indications of movement."**
>
> **– Tom Gurr**

(continued)

Geofoam provides a 24-inch verticle air gap above the new sewer line, which allows it to be adjusted vertically from the surface. A total of 7 feet of geofoam was used to reduce the weight of the backfill.

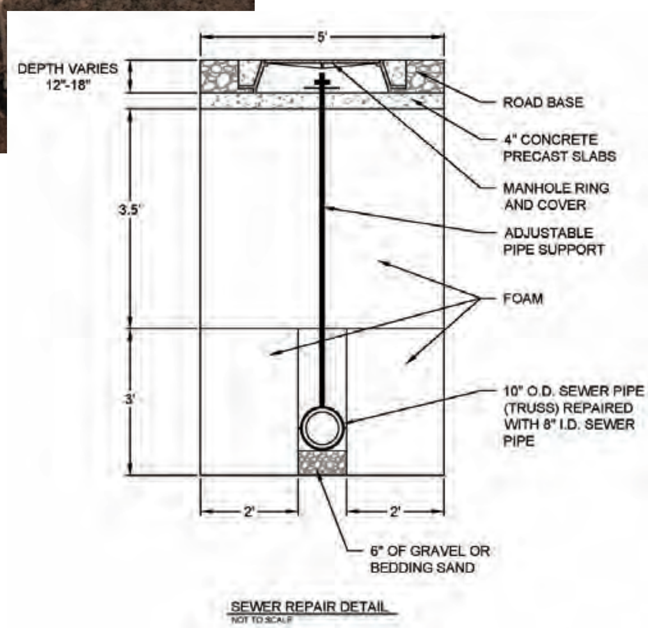
During the first repair, 10 inches of settlement and 6 inches of lateral movement were noted. Tom Stratton, Brian Head Public Works director, and his crew devised a plan to repair the damaged pipeline. After consulting with Bartlett and engineers Chet Hovey, P.E., of Advance Environmental Engineering, and Joel Myers, P.E., of Gem Engineering, the team concurred that geofoam should be incorporated into the repair in order to reduce settlement issues and protect the pipeline from future damage by allowing it to be adjusted vertically from the surface.

The old truss sewer pipe was severed about 3 feet downstream from a previous break, but the team never lost flow. "We didn't lose one drop of sewage during repair," says Tom Gurr, a supervisor with Brian Head Public Works. "At about 20 or 30 feet downstream from the break, the old sewer line had settled 18 inches at the lowest spot. We had to build up the bottom of the trench with road base and compact it to get the pipe and flow line back to their original depth."

An 8-inch sewer ball was used in the upstream manhole to stop flow during connection of the new pipe, which took about 40 minutes. Connections were done with stainless steel split repair couplers. The upstream sewer pipe and manholes provided enough storage that bypass pumping was not necessary. When the sewer ball was removed, flow was restored through the new pipe with no leaks.

The team then turned its attention to the installation of the geofoam blocks. The trench was checked for grade one more time as the first layer of geofoam blocks was installed. The second layer of geofoam was attached to the first layer of blocks using adhesive. This created a 24-inch air gap or "doghouse" above the new pipe. "This gap allows the pipe to be adjusted vertically from the surface using the pipe supports and threaded rods with nuts," Gurr explains.

Backfilling and compaction were done carefully in small increments on both sides of the foam blocks so as not to make them shift out of place. Four-inch precast concrete sections were placed on top of the foam.



Solid results

"With everything installed, the total system has a depth of 7 feet," Gurr says. "We installed a lifting ring about 10 feet downstream from where the break was. This involved a steel ring placed around the new pipe, connected to an 8-foot piece of all-thread and secured with a washer and nut. A ring and lid were placed on top of the precast concrete, allowing access to the nut and washer which are used to adjust the elevation of the pipe. We hope the all-thread, bolt, nut and washer will serve as an indicator of possible foam settlement, or help to suspend the pipe if earth settles below the pipe more than below the foam.

The new ductile iron pipe with locking gaskets is shown above the old abandoned line.

"We expect the foam will reduce the weight on top of the pipe sufficiently to slow or stop the settlement," Gurr continues. "A camera will be sent down the pipe intermittently to determine the status of the pipe by looking for indications of movement. Ten days after the repair was completed, no noticeable settling had occurred in the repaired area [approximately 80 feet of new pipe with 40 feet of foam block covering the worst section of settlement] except for one 3-foot-long crack, about one-half inch wide, just outside the repair area. This crack showed up about seven days after the repair was completed. Prior to this repair, cracking and settling had been much worse, requiring road and driveway repairs and fill over the sewer line area about every three days." ✦

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