ceNEWS
for the business of civil engineering
April 2010

EXCLUSIVE
Top Civil Firms 2010

GEOFOAM LIGHTENS LOADS

2010 Integrated Project Delivery eConference
April 22, see page 17

AEC Technologies Strategies 2010 Conference
May 20, see page 23

www.cenews.com
Stagnito MEDIA

Lighter loads

Geofoam shortens construction schedules by reducing the weight of embankment fill and settlement time.

By Terry Meier

Projects

I-15 reconstruction, Utah
West Valley TRAX light rail, Salt Lake City

Participants

Wasach Constructors
Utah Transit Authority

Product application

Geofoam from ACH Foam Technologies decreases soil and embankment fill settlement times in highway and rail projects.

Seven areas along the West Valley TRAX line required the use ACH Foam Technologies' EPS geofoam.

Placement and settlement of traditional fill materials or consolidation of soils underlying embankments can significantly impact transportation project costs and schedules. Consequently, in a National Deployment Statement, the Federal Highway Administration (FHWA) urged all states to consider using alternative fill materials such as expanded polystyrene (EPS) geofoam when planning fill and embankment projects. Its National Deployment Goal, as stated on the FHWA's Corporate Research and Technology website (www.fhwa.dot.gov/crt/lifecycle/geofoam.cfm), is that "by October 2010, EPS geofoam will be a routinely used lightweight fill alternative for state DOTs on embankment projects where the construction schedule is of concern. By October 2011, all states will have evaluated EPS geofoam as a lightweight fill alternative."

Geofoam, which weighs 1 to 3 pounds per cubic foot (pcf), is 100 times lighter than soil and 20 to 30 times lighter than alternative lightweight fill materials, according to FHWA. This difference in unit weight, compared with other materials, makes EPS geofoam an attractive fill material to accelerate construction schedules significantly.

EPS geofoam can be used as an embankment fill to reduce loads on underlying soils, or to build highways quickly without staged construction. It has been used to repair slope failures, reduce lateral loads behind retaining structures, accelerate construction on fill for approach embankments, and minimize differential settlement at bridge abutments.

Additionally, FHWA reported, large earthmoving equipment is not required for construction because of geofoam's light weight. After the blocks are delivered to the construction site, they can easily be trimmed to size and placed by hand. In areas where right-of-way is limited, geofoam can be constructed vertically and faced, unlike most other lightweight fill alternatives, FHWA said. It is also unaffected by adverse weather conditions.

The first uses of polystyrene in the 1970s in transportation applications were to ameliorate frost heaves. Placing EPS insulation below the roadway reduced frost penetration and freezing of subgrade frost-suceptible soils and created flat, even heat flow.

Success with this frost heave application gave birth to the idea of using much thicker layers of EPS foam to reduce vertical pressure on soft subsoils, which eliminated settlement concerns.

When using geofoam, blocks are installed below grade. EPS geofoam greatly reduces vertical pressure by a 120 to 1 ratio. Geofoam embankments can be designed to produce zero net load on the foundation soils by full load compensation or by removing a volume equal to the weight added by the new construction.

Lateral weight reduction

Not only is the vertical pressure decreased by the use of geofoam, it also exerts no horizontal forces on a bridge abutment and supporting walls as do other traditional fill materials. Soil creates approximately 40 pcf of lateral pressure. If a structure is below ground level, this lateral pressure increases by a factor of 10. This lateral pressure is completely eliminated with the use of EPS geofoam.

For example, with a foundation wall extending 30 feet below grade, the compacted soil will create 3,750 pounds of vertical pressure at the wall base and 1,250 pounds of lateral pressure at the base of the foundation wall. The use of geofoam will greatly reduce lateral and vertical pressure.

Most areas of the United States have had experience with geofoam in large and small highway projects. ACH Foam Technologies has supplied geofoam and expertise to the two largest U.S. projects located in Utah: I-15, which was completed in 2001; and the TRAX light rail project, which will be completed in 2012.

However, geofoam is not restricted to transportation applications and has been supplied nationwide by ACH Foam Technologies for commercial projects such as landscape fill for Millennium Park in Chicago; green roof and landscape fill for the California Academy of Sciences in San Francisco; green roof fill for the Fidelity Tower Condos in Kansas City; erosion control material for the Hanging Lake Tunnel in Colorado; slope stabilization material for retaining walls in Dubuque, Iowa; and stadium seating fill for theatres and auditoriums.

Utah's I-15 project

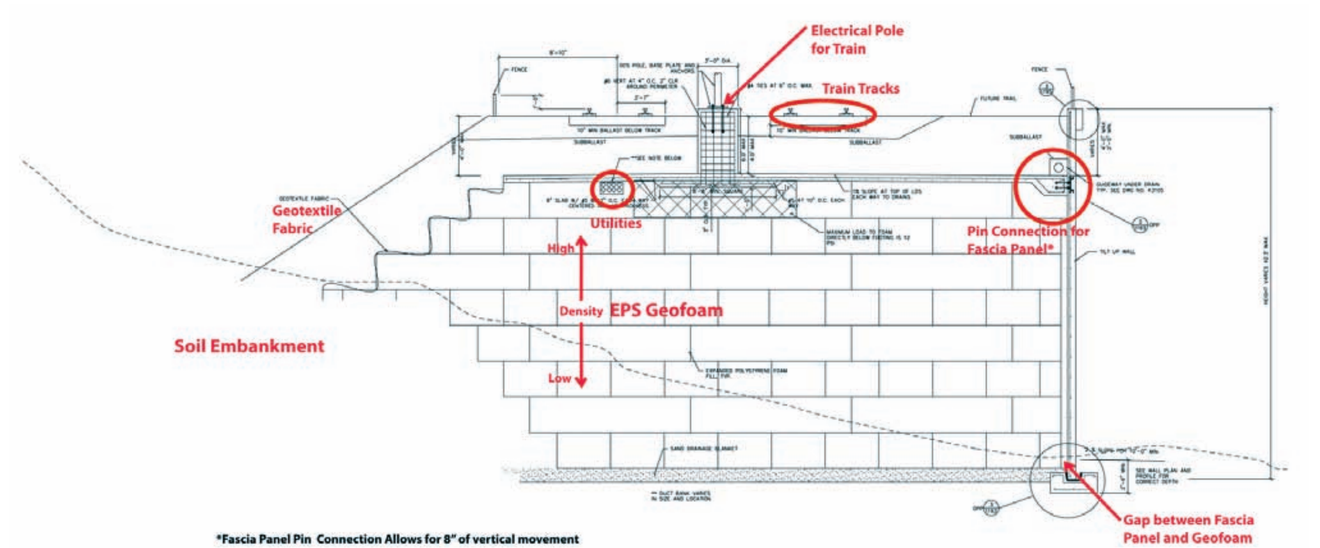
In the largest geofoam project in the United States, geofoam was used as embankment fill and utility protection in reconstruction of 17 miles of I-15 in Utah from May 1997 to July 2001. The project consumed 100,000 cubic meters of geofoam. ACH Foam Technologies provided 100,000 Cubic Meters of ASTM D6817 Type EPS 19 geofoam measuring 32-1/4 inches thick (plus a small quantity of 16-inch-thick material) for the I-15 project.

Wasatch Constructors was the engineer and contractor on the project. According to Wasatch's Mark Kimble, "Conventional settlement solutions for I-15 would have been costly, timely, and would have interrupted utility service. Geofoam was used to reduce settlement on buried utilities, improve the slope stability of embankments, and allow rapid installation in time-critical areas."

Several proven methods could have been used to speed up soil consolidation and construction. For example, installation of wick drains and surcharging speed up soil consolidation by driving the water and air pockets out of the soil faster. Regular construction without wick drains or surcharging would have taken two to three years for the subsoil to fully settle. With wick drains and surcharging, settlement would have been reduced to approximately one year. With geofoam used for fill, there was no settlement and the installation took just weeks.

In addition, settlement under soil embankments affects not only the ground below the embankment, but also neighboring structures. A conventional, 20-foot-tall embankment on soft soil can cause settlement as much as 40 feet away from the embankment,

A geofoam installation cross-section drawing shows a fascia panel connection on the right side of the geofoam fill and a soil embankment on the left side. Down drains were placed within the fill to allow for stormwater runoff to be drained away from the structure. *Marv Cook/Oracle Group*



or two times the height of the embankment itself.

Using geofoam for embankments eliminated the possibility of settlement beneath nearby structures, including utility poles. Use of soil for certain embankments would have required relocation of utility poles at a cost of more than $100,000 per pole. And, because the entire utility alignment must be moved (not just a single pole), four or five poles would have had to be moved at a cost of roughly $450,000.

West Valley TRAX light rail

On June 18, 2008, Utah Transit Authority (UTA) began construction on a line to a new West Valley city hub. The project is projected to cost $250 million and will span 5.1 miles. The West Valley line is anticipated to open in 2011 with 3,500 daily commuters.

As the second largest geofoam project in the United States, TRAX used an estimated 2.1 million cubic feet (70,000 cubic yards) or 639 truckloads of EPS geofoam. The first shipments of geofoam arrived in February 2009; geofoam installation was completed in January 2010.

Ryan Snow, project manager at UTA, explained the conditions that indicated geofoam would be the most advantageous solution: "TRAX required construction of embankments up to 40 feet high. The problem was caused by the Lake Bonneville deposits in the area. The Salt Lake Basin used to be under Lake Bonneville. That basin left deposits under Lake Bonneville that are subject to settlement. Geotechnical reports stated that in the construction areas, the existing soil could have settled up to 5 feet and that would have taken up to three years [for settlement]. We didn't have that much time. The existing soil conditions dictated that geofoam would be the most appropriate fill material."

A tall geofoam embankment will support the West Valley TRAX light rail line adjacent to the Jordan River.

Once installed along the West Valley TRAX rail line, geofoam was covered with a geotextile fabric or a load-distribution slab to protect it from potential chemical spills, such as petroleum.

Snow estimated that the six-month-long geofoam installation for TRAX would have taken about three years, had traditional fill been used. "We saved potentially two and a half years. If we had used soil, we would have waited for settlement, or maybe filled partially and then waited some more, and then finished construction later. There are geotechnical methods to expedite settlements, such as soil stabilization and wick drains, but those would also add costs. In the end, geofoam proved to be the most economical choice.

According to Snow, the UTA is always looking for means and methods to do things more efficiently. Future UTA transportation projects using geofoam include other light rail and embankment projects. The 2015 program will provide 70 miles of rail in seven years.

ACH Foam Technologies' geofoam, used in geotechnical applications worldwide for more than 30 years, helped both the I-15 and TRAX projects maintain extremely tight construction schedules that would not have allowed enough time for conventional embankment construction. Both projects illustrated the ease and speed with which EPS geofoam can be constructed for highway embankments. ■

Terry Meier is geofoam specialist for Denver-based ACH Foam Technologies. Meier can be contacted at tmeier@achfoam.com.