

## National Spotlight

### On-Site Near You

- **Columbus State University Housing, Theater & Parking Deck**  
Columbus, GA
- **Monarch Plastics**  
Kenosha, WI
- **Millennium Ethanol Plant**  
Marion, SD
- **Ritz Carlton Highlands Resort**  
Truckee, CA
- **Ft. MacArthur Air Force Base MSE Wall**  
San Pedro, CA
- **Kane County Judicial Center**  
St. Charles, IL
- **Casino Queen Hotel & Casino**  
East St. Louis, IL
- **Certaineed Manufacturing**  
Tara Haute, IN
- **US 90A and State Highway 6**  
Sugarland, TX
- **Echelon Pointe at Carillon**  
St. Petersburg, FL
- **Arkansas State Hospital**  
Little Rock, AR
- **Bay State Commons Retail Development**  
Westborough, MA
- **Castle Port Morris Oil Tanks**  
Bronx, NY
- **Usana Office Building & Parking Deck**  
West Valley City, Utah

### Upcoming Events

- **Infrastructure Canada**  
11/29/06 – 11/30/06
- **Transportation Research Board Annual Meeting**  
January 2007

## Ethanol Plant... (continued from cover story)

asked Christiansen to evaluate the Geopier® Rammed Aggregate Pier™ Foundation System as a possible third option.

"I wasn't familiar with the system, but the request made me learn about it," Christiansen says. "From my research, it looked like an ideal application for the Geopier System. It offers good tolerances for total and differential settlement."

"Performance-wise each system had to meet the same standard," Drinkwine notes. "But we decided to go with the Geopier RAPs System because it was easier to deal with once finished and a better fit for our time frame."

### Geopier RAPs Installation Keeps Project on Schedule

Geopier Foundation Company – Midwest designer Dick Gernant, P.E., worked closely with Christiansen and the project Structural Engineers to recommend installing 1,300 Geopier Ramped Aggregate Piers (RAPs) to depths of 15 to 19 feet to reinforce the soft soils to provide the required strength and stiffness necessary to support the project's tanks and other structures. "Each structure required foundations designed for 4,000 to 5,000 psf bearing pressures," he says. "Our differential settlement tolerance for most structures was generally less than 1 inch but up to 4 inches for the digester structure."

The design/build team accepted Gernant's recommendation, and work to reinforce the construction area ran from mid 2005 to early 2006. Geopier licensee Peterson Contractors, Inc. (PCI) handled the deadline-sensitive installation.

"Staying on schedule was critical for us and the owner," says Jordan Muller, PCI's project manager. "There were challenging areas, but the Geopier RAPs installation process allowed us to work quickly and stay ahead of the other contractors who were lined up to come on-site."

Modulus testing completed by PCI showed less than 0.5 inch of deflection at design stresses of up to 19,350 psf on all three compressive tests performed. The results confirmed the levels of strength and stiffness assumed in the design approach. In addition to the modulus testing, the general contractor conducted a hydro test on the two large digesters to confirm containment integrity. During this test, tank settlements were measured under a full load when filled with water.

Collected data indicated the tanks moved less than 1 inch overall, which is significantly less than the 4-inch maximum settlement criteria.



Dick Gernant, Geopier Foundation Company - Midwest

### Recycled Material Replaces Aggregate

Aggregate shortages are common in the region, Muller says, but PCI was able to avoid this potential problem by importing recycled material from a nearby source.

"Suppliers are often 75 to 100 miles away in this part of the country," Muller notes. "But we were able to use recycled aggregate on this job. That saved the owner lots of time and money." Piers were installed using 1.25-inch recycled base and 2-inch clean recycled aggregate. A number of piers were installed with uplift hardware to resist uplift loads.

Asked how he would characterize the project overall, Drinkwine says, "We had the good luck to only have poor soils down to a depth of 30 feet. With those conditions, Geopier RAPs were a very site friendly and cost-effective soil-stabilization strategy. It was the right solution for us."

The project has also given Thiele Geotech a new foundation strategy for clients. "It's definitely one of our solutions," Christiansen says. "It's something we recommend as an option to consider." ■



Foundation Systems of Unsurpassed Strength and Stiffness

## Tech Talk

### Innovative stabilization of peat soils for railroad foundation using Ramped Aggregate Pier™ Systems

This paper discusses the Freight Rail Improvement Project (FRIP) and construction of a third line adjacent to two existing Amtrak lines that will accommodate a new freight rail service. Due to the existence of a layer of peat below the boat section, the original design called for the use of piles for foundation support. Through value engineering, the costly deep foundations were eliminated and replaced with the Ramped Aggregate Pier™ System, designed to stabilize the organic soils and allow for the use of slab-on-grade construction.

Results from the modulus test and inclinometer measurements demonstrate that the Ramped Aggregate Pier™ (RAP) System was sufficiently strong to withstand the

applied loads without bulging. In addition, the RAPs were also adequately stiff to achieve the required pier modulus value for settlement control. The piezometer readings indicated that excess pore pressure build-up within the organic layer during RAP installation quickly dissipates.

For more information about these testing results that demonstrate Geopier RAPs are a cost-effective system for stabilizing organic soils to allow the use of shallow foundations and limit post-construction settlements, request this paper. ■

## Request Your FREE Copy

### Stabilization of Peat Soils

Contact  
Geopier Foundation Company  
at 800-371-7470 or more@geopier.com



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# THE FOUNDATION

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## Ethanol Plant Breaks New Ground With Site-Friendly, Cost-Effective Foundation Solution



E3 BioFuels Facility - Mead, NE

Ethanol made Brazil energy independent, and many investors believe it can do the same thing for the USA—if production costs can be brought in line with traditional energy sources. The design/build team of Katzen International Inc. and Dilling Mechanical Inc. may have the answer with its new E3 BioFuels facility, located about two miles south of Mead, Neb. The plant uses a patented closed-loop system that integrates ethanol production, a large cattle feedlot, and a biogas generating manure digester.

"It's an integrated system for producing about 20 million gallons of ethanol a year," says Bill Drinkwine, the project's construction manager. In a closed-loop system, the operators are able to process onsite manure in a digester and use the methane byproduct to produce steam for the ethanol plant. Grains left over from distillation provide a nutritious feed for cattle in the feedlot.

### Client Request Reveals Ideal Foundation Strategy

To keep construction costs down, Drinkwine was tasked with evaluating foundation strategies for the facility's massive fermentation tanks, beer well tank, digester tanks, grain silo, and utility corridor. As part of the process, he asked Thiele Geotech, Inc., of Omaha, Neb., to conduct a geotechnical exploration and make foundation recommendations for the site.

"We found a soil profile with 15 to 20 feet of soft-to-medium-stiff loessial clay over medium-dense-to-dense sand," says John Christiansen, P.E., the firm's senior project engineer. "Deep foundations or overexcavation to 20 foot depth were our initial thoughts for soil stabilization."

Drinkwine had cost and availability concerns about a deep foundation with auger cast piles or concrete piers. He also thought overexcavation and replacement might be difficult if work extended into the cold weather months. So he

"We had the good luck to only have poor soils down to a depth of 30 feet. With those conditions, Geopier RAPs were a very site-friendly and cost-effective soil-stabilization strategy. It was the right solution for us."

Bill Drinkwine,  
Project Construction Manager,  
Katzen International Inc. and  
Dilling Mechanical Inc.

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Stabilization of Peat Soils



The Intermediate Foundation System

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The Intermediate Foundation System

## Outpatient Center Picks Displacement Impact® Rammed Aggregate Piers to Mitigate Liquefaction Risk



James Johnson, Geopier Northwest

Longview, Wash., sits at the confluence of the Cowlitz and Columbia rivers in a region of the country where earthquakes are commonplace. So when the Gilbo Corporation of Bellevue, Wash., started planning a new two-story, 40,000 square medical facility for the city, providing suitable foundation support and mitigating the liquefaction potential within the building area were top concerns.

"They wanted the Pacific Surgical Institute to be survivable in the event of an earthquake," says project engineer Tim Blackwood, P.E., formerly of GeoEngineers and now president of Pacific Geotechnical LLC in Oregon City, Ore. "We were considering piles, stone columns, and the Rammed Aggregate Pier™ (RAP) System as possible solutions."

Subsurface conditions generally consisted of soft-to-medium-stiff sandy silt and organic silt in the upper 10 to 15 feet underlain by loose to medium-dense sand. Groundwater was encountered at a depth of 5 feet.

### RAPs Deliver Optimal Performance

"The customer decided to go with the Displacement Impact® RAP System because it provided advantages at this site compared to the Geopier RAP System" says James Johnson, P.E., of Geopier Northwest, Inc. "We were able to install them in the loose sandy silt soils without any sloughing or onsite spoilage."

The Displacement Impact RAP System uses a displacement mandrel and tamper foot to ram thin lifts of aggregate and create a stable pier to depths of up to 35 feet or more. Spoils are displaced laterally using a large static force augmented by dynamic vertical impact energy. The mandrel is withdrawn a specified distance as lifts are placed and rammed in place to create a RAP with high strength and stiffness.

### System Key to More Affordable Foundation

"This approach allowed us to use shallow spread footings with an allowable bearing pressure of 4,000 psf," Blackwood says. "We were also able to mitigate the potential for differential settlement to less than one-half inch, which was a key concern for the project owners."

With a green light from architects Taylor Gregory Butterfield of Edmonds, Wash., Geopier Northwest, Inc. began the process of installing uniformly spaced RAPs to depths of 12 to 20 feet to reduce the liquefaction potential. To further stabilize the liquefaction soils and provide foundation support, the design also included a perimeter row of RAPs outside the building lines as well as additional piers beneath wall and column footings to achieve high stiffness levels.

"We wanted to reduce the chance of liquefaction in the area immediately adjacent to the building," Johnson says. "Overall, everyone was satisfied we provided a solution that was technically sound and cost effective."



Pacific Surgical Institute - Longview, WA

General Contractor Lehr Construction was pleased that the Impact RAP system met expectations. Laying out the RAPs and moving the installation equipment around the compact site was easy. Quality control was uncomplicated and observable. The entire project took only ten working days which is an important time savings on any project. A Lehr representative commented that they would certainly use the Impact® RAP Foundation System again whenever possible. ■

## Richmond Airport Expansion Takes Off With Geopier® Rammed Aggregate Pier™ System



Richmond International Airport - Richmond, VA  
Reprinted with permission of the project architect: Gresham Smith & Partners

Richmond International Airport (RIC) located five miles east of Richmond, Va., has been in growth mode for the last 10 years. Currently, the airport is engaged in its biggest financial investment to-date: a \$46.8-million, two-level terminal that's scheduled to open in spring 2007. When completed, the new terminal will deliver more than 296,000 square feet of new space for the traveling public and on-site staff.

### Schnabel Engineering Associates Seek Better Way to Build

Schnabel Engineering Associates, Inc. in Richmond was engaged to explore the proposed site and determine the most suitable foundation system for the project. Right from the beginning the firm embraced the owner's desire for fast and affordable construction, notes principal Paul E. Diggs, P.E.

"Money and time of construction were chief factors," Diggs says. "Time equates to money in the airport business. If they could get this project online faster, it would become a revenue engine more quickly."

### Poor Soils No Barrier to Spread Footing

Schnabel Engineering considered multiple strategies, including over-excavation and replacement and

concrete piers. Both approaches were complicated by poor soils, buried obstructions, and a compact worksite. During one meeting, Diggs' colleague, Ed Drahos, suggested using the Geopier® Rammed Aggregate Pier™ (RAP) System to reinforce the site's poor soils to support conventional spread footing.

"We were already looking at another site in Indiana to use Geopier RAPs," Diggs says. "And I was somewhat familiar with the technology. I didn't know about any cost benefit, but I certainly wanted to look at it."

A preliminary foundation layout with Geopier RAPs suggested it would remove a substantial amount of cost from the project's intermediate design stage. Based on those findings, Diggs recommended converting the foundation from piles with pile caps to a RAP stabilized subgrade supporting conventional spread footings.

### Flexibility of Geopier RAP System Keeps Project on Track

Installation of the piers was handled by GeoStructures, Inc.'s Raleigh, North Carolina office. The company's crew was tasked with installing 626 piers with lengths ranging from 8 to 18 feet.

The soil profile at the site consists of a 4 to 12 foot thick layer of clay to clayey and silty sand fill. The fill is underlain by medium-stiff to stiff clay and medium-dense silty sand, sand, and dense gravel. Work proceeded at a rapid pace despite on-site congestion and hidden obstacles, Diggs observes.

"The Geopier System takes these issues in stride," Diggs says. "I was impressed the first time they found concrete. I learned that they just carry on with augering. If it gets oversized, they would backfill the hole and re-auger it. I thought that was pretty intriguing."

Obviously, if we were doing a pile installation, we'd probably have to back away, refigure another pile layout, and reengineer the pile cap—and that would slow the project down."

### Soil Reinforcement Save Time and Money

Bart Robeson, senior project manager for general contractor Hunt Construction Group, Inc., was impressed by how quickly work is progressing. "The Geopier installer did a good job of beating the schedule we laid out for them," he says. "I can see this being a big advantage and imagine a lot more people will be looking into the system."

David Spriggs, structural engineer with Draper Aden Associates in Richmond agrees and notes that the Geopier System has proven to be a good choice for the airport.

"The biggest challenge was getting the expansion built while still maintaining an operating airport," Spriggs says. "While there is some noise and vibration, it is much less than you would expect with a big pile rig. Plus, from an engineering standpoint, it seemed like overkill to put concrete piles in when the unsuitable material was only 6 to 15 feet deep. Geopier RAPs were the perfect alternative for this situation."



Nyle Hothem, GeoStructures, Inc.

## Engineers To Serve You

Join us in welcoming Amabelle Aponte, Mark Tigchelaar and Gerry Kehler



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We are pleased to announce that Amabelle Aponte has joined Geopier Foundation Company as a Regional Engineer. In her role with GFC, Amabelle will work directly with project team members on the planning, design, bidding and construction of projects in Puerto Rico and also in the Caribbean region. She holds a Bachelor of Science in Civil Engineering and a Masters of Engineering in Geotechnical Engineering from the University of Puerto Rico. Prior to joining GFC, Amabelle worked in the design area of the Puerto Rico Highway and Transportation Authority Engineering Soils Office. She also was a Geotechnical Engineer for a geotechnical consulting company, Suelos, Inc.



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Mark Tigchelaar is the Principal Engineer for GeoSolv Design-Build Incorporated. In his position, Mark will be responsible for business development and project management of the Rammed Aggregate Pier™ system through a turnkey design-build process. He looks forward to providing soft soil improvement expertise to the engineering and construction community in Ontario. Mark received his B.A.Sc. in Engineering at the University of Waterloo and is a licensed P.E. in the Province of Ontario.

Gerry Kehler has made the move to Geopier Foundation Company as a Regional Engineer, after working with Tensar Earth Technologies for the last six years. While at TET, he was in the MSE Retaining Wall Division, managed the Engineering group, performed senior engineering design and engineer-of-record responsibilities and also was Operations Project Manager. Gerry is a registered professional engineer in ten states and five Canadian provinces. He graduated from the University of Saskatchewan in 1993 with a Bachelor of Science in Civil Engineering.

## In The News

GFC Headquarters Moves to Charlotte, NC



With the change in seasons also came the change of location for Geopier Foundation Company headquarters. Now centrally located just

north of Charlotte, a growing metropolitan area, the new site allows for quicker access to major airports and interstates.

Our New Address Is:

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