# MEMORANDUM

**Missouri Department of Transportation**
**Project Operations-Construction**
**District 5**

KT

VE # 08-02

RECEIVED
JAN 23 2008
Construction & Materials

**TO:** Pat McDaniel
Technical Support Engineer

**CC:** Charles Sullivan

**FROM:** Duane Kliethermes
District Final Plans Processor

**DATE:** January 22, 2008

**SUBJECT:** District 5
V.E. Proposal
Job No. J5P0907 & J5P0907B
Contract I.D. 070928-503
Route 63, Boone County

Attached is a value engineering proposal submitted by Emery Sapp & Sons on the above mentioned project.

The contractor proposes to eliminate the shear keys under the MSE Wals A7591 & A7594 and replace them with Rammed Aggregate Piers.

We concur with our Resident Engineer and recommend this proposal be approved.

The potential savings involved are covered in the attachments

cc: File

EMERY SAPP & SONS, INC.

2602 N. Stadium Blvd.
Columbia, MO 65202
O: 573.445.8331
F: 573.445.0266

140 Walnut St.
Kansas City, MO 64106
O: 816.221.3500
F: 816.421.9333

January 16, 2008

Mr. Charles Sullivan, R.E.
Missouri Dept. of Transportation
511 Conley Rd
Columbia, MO 65201

**RE: VALUE ENGINEERING PROPOSAL,**
**Rte. 63, Boone County,**
**Job No. J5P0907 & Job No. J5P0907B**

Mr. Sullivan:

Attached to this letter is Form C-104, Construction Value Engineering Concept Proposal. This VE Proposal involves eliminating the shear keys under the MSE Walls A7591 & A7594 and replace them with Rammed Aggregate Piers (RAP).

**Total Savings from acceptance of VE Proposal: $35,648.00**

Notes to this Proposal:

1. Attached are GEOPIER Foundation Company's recommendations for the Rammed Aggregate Piers.
2. A breakdown of the cost to place the Sand Drain beneath both MSE walls is also attached per Allstate's recommendation.
3. Besides the cost savings from changing from the Shear Keys to the Rammed Aggregate Piers, this proposal will save on time.
4. In order to realize the full advantage of the time savings this proposal offers, we need a fairly quick response because we will need to have GEOPIER begin their Professionally Sealed plans for submittals to MoDOT.

We believe that this proposal includes numerous advantages – including cost savings and time. If you have any questions, please contact me at (573) 489-9211. Thank you for your consideration of this proposal.

Sincerely,

Emery Sapp & Sons, Inc.

Josh Doerhoff
Project Manager

Form C-104
Rev. 2/01

# CONSTRUCTION VALUE ENGINEERING CONCEPT PROPOSAL
# MISSOURI DEPARTMENT OF TRANSPORTATION

**Date** 01/16/2008

**Contract ID** 070928-503 **Job No.** J5P0907 & J5P0907B

**County** Boone **Route** 63 **Original Bid Cost** $7,926,096.98

**Contractor** Emery Sapp & Sons, Inc. **By** (Chip) Nolan Jones

**Designed By** Geopier **Phone** (573) 445-8331

VE # - 08-02

1. **Description of existing requirements and proposed change(s). Advantages/Disadvantages**

   Eliminate the Shear Keys under the MSE Walls A7591 & A7594 and replace with Rammed Aggregate Piers. Information regarding the Rammed Aggregate Piers (RAP) are attached. Will save on time to construct the MSE Walls and abutments for Bridge A7588.

2. **Estimate of reduction in construction costs.** $35,648.00

3. **Prediction of any effects the proposed change(s) will have on other department costs, such as maintenance and operations.**

   Should not have an effect on other department cost.

4. **Anticipated date for submittal of detailed change(s) of items required by Section 104.6 of the Specifications.**

   02/08/2008
   (date)

5. **Deadline for issuing a change order to obtain maximum cost reduction, noting the effect of contract completion time or delivery schedule.**

   01/25/2008 (date) — Could delay the start of construction on MSE Walls (effect)

6. **Dates of any previous or concurrent submission of the same proposal.**

   10/29/2007
   (date and/or dates)

**Additional Comments:**

** *Portion Below This Line To Be Filled Out by MoDOT* **

**Comments:** This proposal has incorporated everything requested by MoDOT and Consultant. Drainage included. Looks good to go.

Charles Stallmann — 1-18-08

Submitted By Resident Engineer — Date

**Comments:** Given that this proposal now includes methods to address drainage concerns, I recommend approval.

☒ Approval Recommended
☐ Rejection Recommended

Roger Schwartze — 1/22/08

District Engineer — Date

**Comments:** Approval based upon above comments.

☑ Approval
☐ Rejection

PLM for Dave Ahlvers — 1-23-08

State Operations Engineer — Date

Distribution: Resident Engineer, District Operations Engineer, State Operations Engineer
*Value Engineering Administrator - *MoDOT, P.O. Box 270, Jefferson City, MO 65102

***BOONE HWY 63 GANS RD INTERCHANGE VALUE ENGINEERING PROPOSAL***

***Price for Placement of Sand Drain Beneath MSE walls***

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Supt | X | 8.00 | HRS | X | $ | 60.00 | / HR | = | $ | 480.00 |
| 1 | PC 220 Trackhoe | X | 20.00 | HRS | X | $ | 82.00 | / HR | = | $ | 1,640.00 |
| 1 | Operator | X | 20.00 | HRS | X | $ | 58.00 | / HR | = | $ | 1,160.00 |
| 1 | 953 Loader | X | 8.00 | HRS | X | $ | 57.00 | / HR | = | $ | 456.00 |
| 1 | Operator | X | 8.00 | HRS | X | $ | 58.00 | / HR | = | $ | 464.00 |
| 1 | Laborers | X | 20.00 | HRS | X | $ | 47.00 | / HR | = | $ | 940.00 |
| 1 | Class A Exc West Side | X | 1,066.00 | CY | X | $ | 3.35 | / CY | = | $ | 3,571.10 |
| 1 | 6" Drainage Pipe w cloth | X | 600.00 | LF | X | $ | 1.12 | / LF | = | $ | 672.00 |
| 1 | State Concrete Sand | X | 637.19 | TNS | X | $ | 12.00 | / TN | = | $ | 7,646.22 |
| 1 | CMP Pile Spacers | X | -250.00 | LF | X | $ | 13.44 | / LF | = | $ | (3,360.00) |

**SUBTOTAL = $ 13,669.32**

**ESS overhead an profit 5% = $ 14,352.00**

**GEOPIER® Foundation Company – St. Louis**
"The Intermediate Foundation System"

October 23, 2007

Mr. Russell Crane, P.E.
Emery Sapp & Sons, Inc.
2602 N. Stadium Blvd.
Columbia, Missouri 65202

Re: Geopier Foundation Recommendations
MSE Walls A7591 and A7594 at Gans Road over Highway 63
Columbia, Missouri
GFC Project No.: PSL-00202

Dear Mr. Crane -

Thank you for your interest in a *Geopier®* soil reinforcement solution for the support of Mechanically Stabilized Earth (MSE) retaining walls A7591 and A7594 to be located at the intersection of Gans Road with Highway 63 in Columbia, Missouri. Our review of project details and subsurface conditions indicates that Geopier Rammed Aggregate Piers will provide the required factors of safety for slope stability and provide settlement control to meet the project criteria. Our design has been reviewed and approved by Geopier Foundation Company, Inc. (GFC).

*PROJECT INFORMATION*

We have been provided a copy of the project bid documents and the geotechnical report dated June 14, 2007, prepared by Allstate Consultants. The project consists of providing support for the north and south abutment MSE walls, which will be approximately 20 feet in height. In addition, a permanent 7-foot high surcharge and a 250 psf traffic load will be included behind the fill face of the end bents. The design bearing pressure of 6,000 psf has been indicated in the bid documents.

The subsurface conditions at the site consist of medium stiff to stiff clay extending to depths of approximately 7 to 14 feet, overlying weathered rock to the maximum explored depth. Groundwater was encountered as shallow as 2 feet below the existing ground surface. Approximately 10 feet of clay fill will be placed to attain the bottom-of-wall elevation.

*TYPICAL GEOPIER DESIGN AND CONSTRUCTION PROCESS*

Rammed Aggregate Pier (RAP) elements are installed by drilling 30-inch diameter holes and ramming thin lifts of open-graded aggregate within the holes to form very stiff, high-density aggregate piers. The drilled holes typically extend from 7 to 30 feet below grade. The first lift of aggregate forms a bulb below the bottoms of the piers, thereby pre-stressing and pre-straining the soils to a depth equal to at least one pier diameter below drill depths. Subsequent lifts are typically about 12 inches in thickness. Ramming takes place with a high-energy beveled tamper that both densifies the aggregate and forces the aggregate laterally into the sidewalls of the hole. This action increases the lateral stress in surrounding soil; thereby further stiffening the stabilized composite soil mass. The result of rammed aggregate pier installation is significant strengthening

and stiffening of subsurface soils that support high bearing pressures loaded by MSE walls and embankments.

Rammed aggregate piers exhibit high angles of internal friction as a result of the high density achieved during the ramming process. Friction angles ranging between 49 and 52 degrees have been measured in direct shear tests and triaxial tests (Fox and Cowell 1998, White et al. 2002). The high friction angle provides increases in the composite shear strength of the reinforced matrix soil. The increased composite shear strength affords greater factors of safety against bearing capacity instability and global instability beneath retaining walls.

Settlement computations are based on a two-layer settlement analysis as described by Lawton et al. (1994) and in our Geopier Reference Manual. Settlements within the "upper zone" (zone of soil that is reinforced with Geopier elements) are computed using a weighted modulus method that accounts for the stiffness of the Geopier elements, the stiffness of the matrix soil, and the area coverage of Geopier elements. Settlements within the "lower zone" (zone of soils beneath the upper zone which receives lower intensity stresses) are computed using conventional geotechnical settlement methods.

## *GEOPIER FOUNDATION DESIGN CONSIDERATIONS*

The Geopier RAP solution for this project is designed to replace the specified granular shear key, which would require significant over-excavation and replacement. The Geopier RAP solution has been designed to provide the required factor of safety against global instability, and to control settlement beneath the proposed MSE wall. The details of our design are described as follows:

1. We recommend that new fill should be placed to bring the grade to the proposed bottom-of-wall elevation prior to Geopier RAP installation, and should consist of clay. Geopier RAP elements will be installed to penetrate the newly placed fill and existing clay.
2. All new fill should be placed in accordance with the project specifications for structural fill. GFC should be provided a copy of the compaction test results for our information.
3. We have performed slope stability analyses to evaluate the global stability of the wall. The slope geometry and shear strength parameter values were provided by the wall designer. Table 1, below, summarizes the strength parameter values used in our analysis.

**Table 1 – Shear Strength Parameter Values**

| Soil Type | Drained | | Undrained | |
|---|---|---|---|---|
| | c' (psf) | $\phi$' (degrees) | c (psf) | $\phi$ (degrees) |
| Clay Fill | 24 | 200 | 1200 | 0 |
| Native Clay | 17 | 250 | 500 | 0 |
| Weathered Rock | 25 | 500 | 5000 | 0 |

4. Our analysis for drained and undrained conditions indicates that an area replacement ratio of 20 percent provides the required soil strength to increase the

factors of safety of 1.5 or greater. The RAP-reinforced zone would extend 12 feet behind the wall face at the maximum wall height.

5. We estimate that the Geopier RAP soil reinforcement will limit total settlement to less than 2 inches, with less than 1 inch of post-construction settlement. Most of the settlement will occur during construction. With the Geopier RAP solution, the temporary surcharge recommended by the geotechnical engineer will not be required above the footprint of the RAP-reinforced MSE foundation.
6. A Geopier modulus test will be performed as part of construction to confirm the stiffness of the Geopier elements. The tested Geopier will be constructed in a manner similar to production Geopier elements. The modulus test should be witnessed by a representative of the project geotechnical engineer.

***GEOPIER RAMMED AGGREGATE PIER PROPOSAL***

On behalf of Foundation Services Corp. (FSC) and *Geopier*® Foundation Company – St. Louis, we are pleased to present the attached Design/Build proposal for designing and installing the Geopier soil reinforcement system.

Geopier RAP systems are delivered turn-key, and a complete Geopier design and construction package will be bid for this project. Geopier design is provided by Geopier Foundation Company and construction is provided by a FSC, a licensed installer of the Geopier foundation system. Geopier soil reinforcing elements will be installed at this site as described herein, and in accordance with GFC's final design and construction documents. Geopier elements will reinforce the existing soils to control settlement and provide the required factor of safety against global instability.

Geopier Foundation Company is the pioneer in the development and installation of Rammed Aggregate Pier soil reinforcement. GFC's experience and superior long-term performance are evident in thousands of successful projects and satisfied customers worldwide. Attached and included herein are FSC's detailed proposal, and examples of our project experience, including a project summary for an MSE-support project at the I-170/I-270 interchange in Hazelwood, Missouri, for MODOT.

Our lump-sum bid includes the following:

- Installation of 160 Geopier elements,
- One mobilization and demobilization from the site,
- Geopier design and preparation of construction drawings.

Items not included in this proposal are:

- Spoil removal from the jobsite, and
- Surveying/layout of the Geopier elements in the field.

We consider our engineering efforts proprietary, and appreciate your willingness to keep our proposed methods and costs confidential. Should our bid be accepted, your contract would be with FSC, the licensed Geopier installer for this area. Please call Jordan Muller at FSC (319/269-5916) to determine the project start date and schedule.

This appears to be an excellent site for Geopier subgrade improvement. Geopier foundations should offer economy to this project, and will likely provide schedule savings as well. If you have any questions concerning this report, or if I can be of further assistance, please contact this office.

Sincerely,
***GEOPIER*® Foundation Company – St. Louis**

Renee Guttmann, P.E.
Regional Engineer

Attachments: Geopier Foundation Bid
Examples of related project experience

# FOUNDATION SERVICE CORP.

ADDRESS REPLY TO:
220 WATERLOO ROAD
PO BOX 120
HUDSON, IA 50643

PHONE: (319) 988-9802
FAX: (319) 988-9839

October 23, 2007

Russell Crane
Emery Sapp & Sons, Inc.
2602 N. Stadium Blvd
Columbia, MO 65202

Re: *Rammed Aggregate Pier*™ Foundation System
MSE Wall Support – Columbia, MO

Dear Mr. Crane,

Foundation Service Corp. (FSC) proposes to install *Rammed Aggregate Pier*™ *(RAP*™*)* soil reinforcing elements for the above referenced project. This proposal is based on information presented in the geotechnical investigation report and *RAP*™ design calculations performed by Geopier® Foundation Company, Inc. FSC is a licensed installer for the *RAP*™ system.

FSC will place a total of 160 *Rammed Aggregate Pier*™ elements, which will be up to 23 feet long with an average length of 18 feet. This proposal is based on FSC providing all supervision, labor, equipment and materials. One operator per machine is included. Additional labor, including, but not limited to an oiler, apprentice, master mechanics and laborers are not included and will need to be supplied by others if local labor agreements require them. One mobilization is included in this proposal. One *RAP*™ modulus test is included in this quotation to verify design parameter values. This test is to be monitored by an approved geotechnical firm. The modulus test may show that more *RAP*™ elements are required if the test results do not meet design criteria. **Survey and layout for the *RAP*™ elements are to be provided by others. Spoil removal from drilling operations is also by others. Settlement monitoring by others. Granular blanket and leveling pad by others. Minimum 35' level working bench required. This proposal assumes drilling clean compacted cohesive fill, soil drilling only.**

The *RAP*™ soil reinforcement system has been designed by *Geopier*® Foundation Company of Mooresville, NC. FSC does not provide professional liability insurance or design services. However, FSC has a contractual relationship with GFC for this design work and professional liability insurance can be provided by Geopier® Foundation Company upon request. The aggregate used for the *RAP*™ elements will be a combination of road base and clean rock.

This proposal is based on work to be performed during regular business hours, Monday through Friday with the understanding that FSC is a union company. As part of the general conditions, the Owner or General Contractor will furnish the items and agree to conditions as listed on the attached **Exhibit B** of this proposal at no charge to FSC.

An insurance certificate will be furnished by FSC upon request. Terms of this proposal will remain

firm until November 23, 2007. FSC requires at least 7 working days for contract review. **Upon receipt of a signed and executed contract, FSC will arrange a schedule for this work.** **We have based this proposal on common law indemnification. FSC reserves the right to adjust pricing for broader forms of indemnification requirements, unusual insurance coverage limits, or other onerous contract provisions. FSC reserves the right to refuse to sign any agreement not in its best interest.**

FSC can include additional insured endorsements CG D3 16 07 04 and CG D2 46 08 05. A copy of these endorsements can be provided by emailing al@foundationservicecorp.com

Foundation Service Corp. proposes to perform the above mentioned work for the lump sum consideration of:

$ **115,000.00** /Lump Sum

Add 1% to the above Lump Sum amount if FSC is to provide a performance and payment bond.

No credit will be allowed for reduction in the stated quantity.

The above pricing is considered a lump sum conditional upon acceptance of terms in **Exhibit B**. This pricing is based on the project design at bid time. If the project is modified or unforeseen conditions occur, the following alternates are provided for your review and acceptance:

| | |
|---|---|
| Additional installed *RAP*™ elements | $ **530.00** / Each |
| Add for casing holes | $ **25.00** / LF |
| Additional mobilizations | $ **20,000.00** / Ea. |
| Additional modulus test | $ **10,000.00** / Ea. |

The opportunity to be considered for this work is appreciated and we look forward to being of service to you in the construction of this project. Please do not hesitate to contact us with questions regarding this proposal.

Sincerely,

FOUNDATION SERVICE CORP.

Jordan Muller, Project Manager
DC/jm
Enclosures

## FOUNDATION SERVICE CORP. EXHIBIT B

*Rammed Aggregate Pier*™ Foundation installation requirements

To Be Provided By General Contractor at No Cost to FSC

1. General Contractor shall provide all site grades within six inches of finish subgrade elevations prior to aggregate pier installation work.

2. General Contractor shall provide access to site for wheeled and track aggregate pier equipment and shall keep site and access ramps (if any) trafficable for equipment.

3. General Contractor shall locate the center of all *RAP*™ elements. In addition, a bottom of footing elevation must be provided at these locations for *RAP*™ construction.

4. General Contractor shall provide aggregate stockpile areas within 100 feet of installation areas and within excavations requiring *RAP*™ elements (if any). Stockpile areas shall be large enough to hold at least six tandem dump truck loads of aggregate.

5. General Contractor shall move and dispose of spoils from drilling operation. General Contractor shall be responsible for site work and traffic control.

6. General Contractor shall insure that excavations have safe wall slopes and working conditions in accordance with OSHA requirements.

7. General Contractor shall insure that site is properly drained and maintained to allow movement of wheeled and tracked construction equipment needed for *RAP*™ installation work, and to allow proper installation of *Rammed Aggregate Piers*™.

8. General Contractor shall remove any underground or above ground obstructions or unsuitable materials, and replace with suitable materials compacted to required or approved densities. This includes buried concrete, pipes, utilities, etc. FSC will not accept any liability for damage to buried or concealed utilities unless their precise nature and location have been provided to FSC prior to commencement of work.

9. General Contractor shall compact exposed footing bottoms and exposed aggregate pier surfaces with hand-operated, mechanical compaction equipment after each footing excavation is completed and prior to placing steel or concrete.

10. Retainage for this project, if any, is not to exceed the General Contractors rate or a maximum of 10% of the value of the completed work, whichever is lower. Such retainage shall be reduced to 5% at completion of our work and total release no later than 6 months after our personnel leave the job site. If the contract amount is equal to or less than $200,000.00, PCI expects to be paid in full in 30 days from the date of our personnel leaving the jobsite.

11. General Contractor to provide adequate source or supply of water, within 200 feet of the aggregate stockpiles, for moisture control of graded aggregate. Garden hose supply volume is acceptable.

12. General Contractor/Owner shall provide geotechnical testing and observation services for all new Geopier installation, and any additional Geotechnical soil borings, if required, to delineate areas of questionable soils.

13. FSC assumes that the drilled holes will stand open without caving. If casing becomes necessary or is required, FSC will adjust its price accordingly.

14. General Contractor to furnish portable toilet facilities on site for FSC employees.

15. General Contractor acknowledges that FSC does not provide professional liability insurance or design services. However, FSC has a contractual relationship with GFC for this design work and professional liability insurance can be provided by Geopier® Foundation Company upon request.

# Contract ID: 070928-503 J5P0907 & J5P0907B

Wall No. A7591 - J5P0907

| Line No | | | | |
|---|---|---|---|---|
| 1855 | 6059901 Misc. Sheanky & Drain | LS | $65,000 | |

Wall No A7594 - J5P0907

| | | | | |
|---|---|---|---|---|
| 1985 | 6059901 Misc Sheanky & Drain | LS | $100,000 | |

Sheanky & Drain Savings $165,000.00

Freshell Drain - 14,352.00

Freshell RAP's - 115,000.00

Total Savings → $35,648.00