

made by a team that includes Beaver Engineering, General Contractor and APSU. We anticipate the injection locations will need to be shifted to sufficiently improve the subgrade.

SIDEWALK REPAIR

The sidewalk should be repaired to match the existing sidewalk. The sidewalk concrete should be at least 4 inches thick and supported with at least 4 inches of properly compacted gravel. Use air entrained concrete with a minimum 28 day compressive strength of 4000 PSI. The existing concrete has a turndown curb. The concrete repair should match the existing turndown curb.

FLEXIBLE PAVEMENT

Recommended sections based on the estimated CBR value of 4 are as follows:

| PAVEMENT SECTION | LIGHT DUTY THICKNESS 250 OR LESS 2 AXLE CARS OR VANS PER DAY | | MEDIUM DUTY THICKNESS 4 Or Less 4 Axle Trucks Per Day | HEAVY DUTY THICKNESS 40 Or Less 4 Axle Trucks Per Day |
|--------------------------|--|----|---|---|
| | | or | | |
| Asphalt Concrete Surface | 1.0 inches | or | 2.0 inches | 1.0 inches |
| Asphalt Concrete Base | 2.0 inches | | | 3.0 inches |
| Untreated Aggregate Base | 4.0 inches | | 7.0 inches | 6.0 inches |

| PAVEMENT MATERIALS | |
|---------------------------------|------------------------------|
| Asphalt Concrete Surface | |
| Marshall stability | 1,200 lbs. |
| Asphalt | 4-8% |
| Voids Total Mix | 3-5% |
| Gradation | TDOT 903.11-Gradation D or E |
| Asphalt Concrete Base | |
| Marshall stability | 1,000 lbs. |
| Asphalt | 3-7% |
| Voids Total Mix | 3-7% |
| Gradation | TDOT 903.06-Gradation B |

CAP GROUTING TREATMENT TO REDUCE FUTURE SINKHOLE RISK

I. GENERAL

A. Description of Work

The work to be performed under this Specification consists of cap grouting near the rock surface as a treatment to reduce future sinkhole risk. The cap grouting treatment is intended to fill voids and displace soft soils in an effort to improve the support to the upper soils. The work entails the injection of a thick, specially formulated grout using compaction grouting equipment. The work shall consist of furnishing all labor, equipment, and materials necessary to carry out the work. Specifically, includes submitting, prior to mobilization, a detailed description of the planned procedures for review by the Engineer, injection of the grout as described in this Specification, and providing experienced personnel to supervise the grouting operations. It shall be the Contractor's responsibility to design the systems to ensure that the objectives of the cap grouting treatment are realized.

The work shall include the following:

- Submittal of a detailed description of the cap grouting work procedures. This shall be submitted prior to equipment mobilization.
- Installation of steel casing to approximately 1 ft above the rock surface at each grout injection location.
- Injection of grout with supervision by experienced personnel.

The Contractor shall, throughout the duration of the cap grouting treatment, coordinate his work and cooperate with the Engineer and Owner. Specifically, the Contractor shall work closely with those concerned with any underground construction elements, existing or planned, which may require adjustment to the grout hole locations. The Contractor shall also provide at least one person who shall be present at the site at all times during casing installation and grouting who is familiar with the operations involved and will direct the work. The Contractor shall submit a schedule of all construction events and planning for review by the Owner and Engineer prior to mobilization.

B. RECOMMENDED STANDARDS AND PRACTICES

The following American Society for Testing and Materials (ASTM) standards referred to in this section are listed below with their complete designation and titled and are declared to be part of this section the same as if fully set forth herein.

C 150-18 Standard Specifications for Portland Cement

C 94-17 Standard Specifications for Ready Mix Concrete

C 144-18 Standard Specifications for Aggregate for Masonry Mortar

C 685-17 Concrete Made by Volumetric Batching and Continuous Mixing

C. PAYMENT FOR WORK ITEMS

1. Each bidder shall include in the Base Bid Amount an amount to cover the cost of estimated quantities shown on the Schedule of Quantities for Bid and the unit price upon which the cost of the estimated quantities of work was based.
2. Upon completion of the Work, the Contract Amount shall be adjusted as follows:
 - a. If more than the estimated quantities is required, the Contract Amount shall be increased by an amount equal to the product of the difference between the estimated quantities and the actual quantities required, multiplied by the unit prices.
 - b. If less than the estimated quantities is required, the Contract Amount shall be decreased by an amount equal to the product of the difference between the estimated quantities and the actual quantities required, multiplied by the unit prices.

D. SUBMITALS

The following shall be submitted to the Owner's representative by the grouting contractor with the bid documents:

1. A list of at least five previously completed projects of similar scope and purpose for approval by the Owner's representative. The list shall include a description of the project, relative size, and contact person with phone number.

The following shall be submitted to the Owner's representative by the grouting contractor prior to the start of the work:

1. Resumes of the management, supervisory, and key personnel, for approval by the Owner's representative,
2. A ground movement monitoring plan for existing structures and buried utilities in the work area.
3. A mix design for the project indicating sources and types of grout materials, with volumetric proportions, and field test data from previous projects indicating compressive strength and slump of 3 to 5 inches or less achieved. If the grouting contractor intends to deviate from the gradation of this specification, it shall submit, with the bid, evidence of satisfactory use of the proposed material from past projects with similar soil conditions.
4. Work procedures and control criteria (including volumes and pressure for each stage).
5. A general Work Procedures Plan outlining the spacing, location, depth and quantity of grout to achieve the specified criteria. Grout hole locations shall be shown on a plan view developed by the specialty contractor from existing project drawings.

II PRODUCTS

- A. Cement shall be Portland cement conforming to all requirements of ASTM C150-18, Type I or II.
- B. The aggregate shall be natural, siliceous sand consisting of hard, clean, strong, durable,

and uncoated particles conforming to ASTM C 144-18. The fine aggregate shall have a fines content of not less than 10% nor more than 30% passing the U.S. Standard screen No. 200. Additives to enhance flow or other performance criteria shall be permitted on approval of the Engineer.

C. Water shall be fresh, clean, and reasonably free of sewage, acid, alkali, salts, and organic matter.

D. The grout mix shall be approximately 3-6 sacks of Portland cement per cubic yard of grout. The grout mix design including all proposed additives and consideration of water to be added at the site (if grout is delivered from off-site) shall be submitted to the Engineer for approval prior to mobilization. Water will be added as required to achieve a pumpable mix of not more than a 6-inch slump. Injected grout shall have an average unconfined compressive strength of not less than 1,500 psi at 28 days. If agitated continuously, the grout may be held in the grout plant for not more than 2 hours.

E. Materials shall be properly delivered and handled to prevent the damage, contamination, and/or segregation of aggregates by proper arrangement and use of stockpiles. Cement stored on-site shall be covered to prevent dampness and contamination.

F. The cost of quality assurance testing of cement and aggregates shall be borne by the Owner. Certified test reports and certificates, when required, shall be submitted to the Owner and all other agencies and persons as he may designate.

III EXECUTION

A. GROUT INJECTION

The work consists of injecting approximate 3 to 5 inch slump grout under pressure into the grout holes. The slump will be measured with a standard slump cone. Grouting mixes, pressures, and pumping rate shall be determined in the field by the Contractor based on existing soil conditions and reaction and approved by the Engineer.

1. The on-site grout plant, if used, shall be designed to handle the specified materials for this type of work. The mixer shall be of the plaster and mortar type to ensure complete and uniform mixing of the materials used and shall be of sufficient capacity to continuously provide the pumping unit with mixed grout at its required pumping rate.

2. The pumping unit shall be capable of continuously delivering the specified grout materials at a pressure of at least 600 psi. Pressure gauges shall be supplied at the pump and at the grout lead pipe. An adequate communications system shall be maintained between the grout plant, pump, and injection location so as to allow strict control of the pumping operations. A total grout pumping capacity of at least 30 cubic yards per 8-hour shift shall be provided.

3. Grout holes shall be drilled and continuously cased to the top of the rock as indicated by refusal of the drilling tools or other method acceptable to the Engineer. Adjustments to the grout hole locations may be required, upon approval by the Engineer, to avoid existing and future underground elements. In addition, grout holes should be performed in a manner that no grout injection is performed in close proximity to a previous injection that has not cured for at least 24 hours.

Primary grout holes shall be located in a pattern as shown on the Plan of Primary Grout Hole Locations. Depending on field observation of the drilling and grouting operations, the Engineer may add additional intermediate secondary grout holes to the Contractor's scope of work at

the contract unit rates. A field layout of the primary grout holes and any required secondary grout holes shall be made by the Contractor during the grouting operations and provided to the Engineer on a daily basis.

4. Grout pipes shall be steel casing of adequate strength to withstand the required pumping, drilling and/ or jacking pressures. The pipes shall have an inside diameter of at least 2 inches in order to handle the specified low slump material without plugging. The pipes shall be installed by augering, drilling, and/ or jacking to the grouting depth in a manner that ensures that the grout pipes are free of soil and debris, and that a tight seal is made around the pipe sufficient to withstand the grouting pressures. The installation of the grout pipes shall be performed in such a manner as to extend the grout pipes to the interpreted top of the bedrock.

5. Grout pipe pulling jack shall be provided capable of withdrawing the steel. The Contractor shall adequately protect grout pipes from foreseeable hazards. After grouting at each grout hole location, the Contractor shall plug each hole and return the area to its original conditions.

6. At each grout hole location, the grout pipe shall installed to refusal of the drilling equipment as interpreted top of bedrock, then the grout pipe shall be lifted approximately 1 foot. Grout shall then be pumped into the subsurface using the following limiting criteria:

- When the increase in injection pressure at the grout pipe header exceeds 250 psi while injecting at a rate of approximately 0.25 cubic feet/ minute.
- When the upward movement of the soils occurs as determined by the visual observation.
- When the maximum quantity of grout has been injected. The maximum quantity of grout to be injected at any location shall be 2 times the theoretical volume of 8 cubic yards, for a maximum quantity of 16 cubic yards (not including the grout required to fill the grout hole itself) unless otherwise directed by the Engineer.
- When upward movement of nearby adjacent structures occurs as determined by the monitoring system.

7. At each grout injection location, the grout pipe shall be lifted in intervals of 2 feet to within 10 feet of the ground surface for compaction grouting. At each 2-foot interval, grout shall be pumped using the following limiting criteria.

- When the increase in injection pressure at the grout pipe header exceeds 250 psi while injecting at a rate of approximately 0.25 cubic feet/ minute.
- When the upward movement of the soils occurs as determined by the visual observation.
- When the maximum quantity of grout has been injected. The maximum quantity of grout to be injected at any location shall be 2 times the theoretical volume of 4 cubic feet per interval, for a maximum quantity of 8 cubic feet unless otherwise directed by the Engineer.
- When undesirable upward movement of nearby adjacent structures occurs as determined by the monitoring system.

The arrangement of the grouting equipment shall be so as to provide a continuous flow of grout to the injection point and to permit accurate pressure and flow rate control regardless of the magnitude of the grout take. During grouting operations, the Contractor shall take such precautions as may be

necessary to prevent drill cuttings, equipment exhaust, oil, wash water, and grout from defacing or damaging adjacent structures. The Contractor shall furnish such pumps as may be necessary to handle wastewater and grout from his operations, and will clean up all waste resulting from his operations. No waste (liquid or solid) shall be allowed to reach the gate structures.

The Contractor shall keep records of all grouting operations, such as logs of each grout hole, time and nature and each change in grouting conditions, pressures, rates of pumping, composition of grout mix and any other data which the Engineer deems as necessary. Such records shall be made available to the Owner and Engineer. Upon completion of the grouting procedures, the Contractor shall be responsible for confirming that contact has been restored between the subgrade material to the degree acceptable to the Engineer. Also, the Contractor shall restore the project area to its original condition to within reason. It is understood that grouting equipment can damaged surficial pavements, landscape areas, and manicured grasses.

B. MONITORING

It shall be adequate to monitor key movement in the area influenced by the grouting and the closest nearby existing structure whenever grouting is taking place. After the completion of the grouting program all grout holes shall be filled and the surface restored as indicated in this Specification.

IV PAY ITEMS

The Work shall be conducted on the basis of a lump sum with estimated quantities and additional unit rates for the actual quantities required to achieve the purposes of the project

| | | | | |
|---|-----|----|----|-----------------|
| Mobilization/ Demobilization | 1 | EA | \$ | Per each |
| Primary Grout Injections - up to 85' depth and up to 15 CY of grout | 17 | EA | \$ | Per each |
| Secondary Grout Injections to be field located - up to 85' depth and up to 15 CY of grout | 4 | EA | \$ | Per each |
| Additional Casing (> 85 ft ea) | 0 | LF | \$ | Per linear feet |
| Additional Grout (>15 CY ea) | 0 | CY | \$ | Per cubic yard |
| Sidewalk Demolition | 25 | SF | \$ | Per square foot |
| Asphalt Demolition | 150 | SF | \$ | Per square foot |
| Loose soil/debris removal | 50 | CY | \$ | Per cubic yard |
| Flowable fill placement | 50 | CY | \$ | Per cubic yard |
| Sidewalk repair | 25 | SF | \$ | Per square foot |
| Asphalt repair | 300 | SF | \$ | Per Square foot |

The contract prices for the various specified items of Work shall constitute full compensation for mobilizing, demobilizing, and furnishing all equipment necessary to perform the installation of grout casings and placement of grout in accordance with this Specification.

DRILLING SUMMARY

| LOCATION | TOP OF WEATHERED ROCK DEPTH (FT) | WEATHERED ROCK THICKNESS (FT) | TOP OF SOUND ROCK DEPTH (FT) | TOTAL DEPTH DRILLED (FT) | NOTES |
|----------|----------------------------------|-------------------------------|------------------------------|--------------------------|-----------------------|
| A1 | 50.25 | 0.00 | 50.25 | 60.25 | |
| A2 | 73.80 | 18.00 | 91.80 | 101.80 | VOID 87-91 FEET |
| A3 | 52.50 | 8.50 | 61.00 | 71.00 | |
| B1 | 51.80 | 0.00 | 51.80 | 61.80 | |
| B3 | 51.00 | 7.00 | 58.00 | 68.00 | |
| C1 | 51.50 | 31.00 | 82.50 | 92.50 | HIGHLY WEATHERED ROCK |
| C3 | 62.00 | 9.00 | 71.00 | 81.00 | |
| D1 | 53.00 | 0.00 | 53.00 | 63.00 | |
| D3 | 48.00 | 8.00 | 56.00 | 66.00 | |
| E1 | 32.50 | 20.50 | 53.00 | 63.00 | HIGHLYWEATHERED ROCK |
| E3 | 0.00 | 0.00 | 52.00 | 62.00 | |
| E4 | 14.00 | 0.00 | 14.00 | 24.00 | |
| E6 | 48.00 | 0.00 | 48.00 | 58.00 | |
| F1 | 53.00 | 0.00 | 53.00 | 63.00 | |
| F3 | 14.00 | 2.00 | 16.00 | 26.00 | |
| F4 | 23.00 | 2.00 | 25.00 | 35.00 | |
| F6 | 29.50 | 16.50 | 46.00 | 56.00 | |
| G1 | 46.00 | 0.00 | 46.00 | 56.00 | |
| G3 | 10.00 | 0.00 | 10.00 | 20.00 | |
| G4 | 24.00 | 20.00 | 44.00 | 54.00 | |
| G6 | 50.00 | 0.00 | 50.00 | 60.00 | |
| H1 | 53.50 | 0.00 | 53.50 | 63.50 | |
| H3 | 34.00 | 0.00 | 34.00 | 44.00 | |
| H4 | 45.00 | 0.00 | 45.00 | 55.00 | |
| H6 | 48.50 | 9.50 | 57.00 | 67.00 | |
| I1 | 37.50 | 10.50 | 58.00 | 68.00 | HIGHLY WEATHERED ROCK |
| I3 | 48.50 | 0.00 | 48.50 | 58.50 | |
| I4 | 49.00 | 0.00 | 51.00 | 61.00 | |
| I6 | 60.00 | 22.00 | 82.00 | 92.00 | |
| J1 | 48.00 | 4.00 | 52.00 | 62.00 | |
| J3 | 40.00 | 13.00 | 53.00 | 63.00 | |
| J4 | 0.00 | 0.00 | 49.00 | 59.00 | |
| J6 | 81.00 | 0.00 | 81.00 | 91.00 | |
| K1 | 45.50 | 0.00 | 45.50 | 55.50 | |
| K3 | 45.00 | 3.00 | 48.00 | 58.00 | |
| K4 | 50.00 | 3.00 | 53.00 | 63.00 | |
| K6 | 53.00 | 11.00 | 64.00 | 74.00 | |
| L1 | 53.00 | 0.00 | 53.00 | 63.00 | |
| L3 | 50.00 | 0.00 | 50.00 | 60.00 | |
| L4 | 52.00 | 0.00 | 52.00 | 62.00 | |
| L6 | 45.50 | 3.50 | 49.00 | 59.00 | |
| M4 | 48.00 | 0.00 | 48.00 | 58.00 | |

DRILLING SUMMARY

| LOCATION | TOP OF WEATHERED ROCK DEPTH (FT) | WEATHERED ROCK THICKNESS (FT) | TOP OF SOUND ROCK DEPTH (FT) | TOTAL DEPTH DRILLED (FT) | NOTES |
|----------|----------------------------------|-------------------------------|------------------------------|--------------------------|-------|
| M6 | 48.00 | 0.00 | 48.00 | 58.00 | |
| N4 | 77.00 | 0.00 | 77.00 | 87.00 | |
| N5 | 51.00 | 0.00 | 51.00 | 61.00 | |
| N6 | 50.00 | 0.00 | 50.00 | 60.00 | |
| P10 | 59.00 | 0.00 | 59.00 | 69.00 | |
| P11 | 50.25 | 0.00 | 50.25 | 61.00 | |
| P12 | 17.50 | 0.00 | 17.50 | 27.50 | |
| Q10 | 60.00 | 0.00 | 60.00 | 70.00 | |
| Q12 | 16.00 | 6.00 | 22.00 | 32.00 | |
| R10 | 56.00 | 0.00 | 56.00 | 66.00 | |
| R12 | 29.00 | 0.00 | 29.00 | 39.00 | |
| S7 | 50.00 | 0.00 | 50.00 | 60.00 | |
| S8 | 52.50 | 0.00 | 52.50 | 62.50 | |
| S9 | 78.00 | 0.00 | 78.00 | 88.00 | |
| T7 | 54.00 | 6.00 | 60.00 | 70.00 | |
| T9 | 63.00 | 0.00 | 63.00 | 73.00 | |
| U7 | 56.50 | 0.00 | 56.50 | 66.50 | |
| U8 | 52.00 | 3.00 | 55.00 | 65.00 | |
| U9 | 59.00 | 4.00 | 63.00 | 73.00 | |

| | | | | |
|-----------------|----------------|---------------|----------------|----------------|
| AVERAGE: | 45.96 | 3.95 | 51.75 | 61.76 |
| TOTALS: | 2803.60 | 241.00 | 3156.60 | 3767.35 |

AUSTIN PEAY STATE UNIVERSITY
ITB- 22-020
HENRY STREET SINKHOLD REPAIR AND REMEDIATION

General Comments:

1. The contractor shall visit the site in order to check all conditions, and measurements related to this specification before submitting a bid quotation. The contractor shall contact the Procurement and Contract Services office at Austin Peay State University for access to the site (931-221-7022).
2. The contractor shall provide and incorporate in his bid quotation all charges related to labor, equipment, and material necessary and required for completion of this project as called for under the specifications.
3. The contractor shall provide the Physical Plant office 72 hours' notice for access to the area of work, delivery of materials, use of toilets, etc.
4. All materials shall be delivered to the site at the time of installation. The contractor shall be responsible for all materials left on the site prior to the project's completion. The University cannot accept materials for storage, which are scheduled for installation.
5. The contractor shall provide the Physical Plant office with a comprehensive work schedule for the length of time required from start to the completion of the entire installation. All workers must be either in a company uniform or with proper identification to include nametags noting their name and the name of their company.
6. The contractor shall call the Physical Plant office at the start of each workday when workmen are at the job site. Unless prior arrangements are made, all work shall be done during normal operating times of the facility. The contractor may work after hours for his own convenience if advance notice is given to the Physical Plant Office, and providing there is no extra charge to the University.
7. Before starting work, the contractor shall examine all adjoining work, on which the work of this contract is in any way dependent, for workmanship and fit. The contractor shall do such corrective work to adjoining areas as may be necessary to make the work of this contract watertight.
8. Austin Peay State University shall have the right to inspect all work done at any time. Any work not conforming to specifications and/or drawings shall be removed immediately and/or repaired at no additional charge.
9. The contractor shall provide labor and equipment necessary to remove debris, rubbish, material packages etc. from the premises at Contractor's expense.
10. The contractor shall not block or obstruct means of egress such as public halls, corridors, and fire exits.
11. All work shall be done in a logical sequential order to prevent scattered activities in various places simultaneously. Where possible, the Contractor shall complete the work of one location prior to moving to the next location.
12. The contractor shall guarantee his installations, repairs, and materials against leakage or defects for a period of one (1) year from the time of completion for the repair work.
13. In the event of an emergency, the contractor is obligated to respond within four (4) hours of being notified. Contact phone numbers are to be given to the University prior to the start of the project.
14. Bathroom facilities will not be available on campus unless permitted by the APSU Physical Plant.
15. All vehicles used on campus must have a visitor decal. Vehicles must be parked in valid spots.
16. No harassment of any member of the APSU community will be tolerated.
17. All public areas and outside areas are to be cleaned up at the close of each workday.
18. No change in job scope is valid until approved by the APSU Physical Plant and Procurement and Contract Services office.
19. There is no smoking on campus except in city streets.
20. Any keys for access can be obtained from the Physical Plant.
21. The successful bidder shall provide proof of insurance.
22. The contractor shall not block or obstruct means of egress such as public halls, corridors, and fire exits.
23. The contractor shall provide a list of all equipment bids, to include specifications and cut sheets.
24. The successful bidder shall provide proof of insurance.
25. **THE PROJECT MUST BE COMPLETED** within 30 days of purchase order issuance. Liquidated damages in the amount of \$200.00 per day will be assessed for every day after that time period.