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January 17, 2015
Job No. 14-167

BES Design/Build, LLC
766 Middle Street
Fairhope, Alabama 36532

Attn: Ms. Allison Chang, LEED GA, Associate IIDA
Project Manager

**REF: MICROPILE RECOMMENDATIONS
EMERGENCY DEPARTMENT MENTAL HEALTH ADDITION
JOHN L. McCLELLAN MEMORIAL VETERANS HOSPITAL
LITTLE ROCK, ARKANSAS**

Dear Ms. Chang,

Submitted herewith are supplemental foundation recommendations for the proposed Emergency Department Mental Health (EDMH) addition to the John L. McClellan Memorial Veterans Hospital in Little Rock, Arkansas. These supplemental recommendations are for micropile foundations. It is understood that the micropiles will be installed in relatively confined areas in the existing building basement, about 16 ft below existing grade. The results of the geotechnical investigation performed for this project were provided in our report of November 15, 2014. We have utilized the results of the borings performed for the geotechnical investigation to develop micropile recommendations.

Micropiles

Support of addition foundation loads may be developed using micropile-supported footings. Micropiles are small-diameter (i.e., less than about 12-in. diameter) deep foundation elements comprised of grouted columns with a central reinforcing bar. With appropriate connections, micropiles can be used to support new footings (i.e., pile caps). Conceptual sketches showing typical micropile to footing connections are provided in Attachment 1.

We recommend that micropiles extend from footing/pile cap in the basement through the low hardness to moderately hard weathered shale to develop capacity in the moderately hard to hard shale or sandstone. A plot of preliminary allowable micropile capacity versus penetration for micropiles is provided in Attachment 2. These capacities have been developed utilizing a minimum factor of safety of 2.5 for compression and 3.0 for uplift. The preliminary capacity curves have been developed assuming that micropiles are advanced with a minimum 3-in.-diameter rock bit and develop a nominal micropile diameter of 3 in. in the rock bearing strata. Other micropile sizes can be evaluated, if desired. A minimum micropile spacing of three (3) diameters is recommended.

Final design capacity of production micropiles should be based on a specific plan provided by the Specialty Contractor. Post-construction settlement of properly installed

micropiles should be less than 0.5 inch. We recommend that the bearing capacity of a micropile-supported footing system be based on the capacities of the micropiles alone with no contribution from the footing/pile cap.

We strongly recommend that a minimum of 10 percent of production micropiles or at least two (2) production micropiles, whichever number is greater, be proof-tested to at least 1.3 times the design load. Proof-testing results should be reviewed by the Engineer and Geotechnical Engineer.

The Micropile Contractor should select the most suitable micropile type and installation method for the particular system being utilized. The Micropile Contractor's micropile design, including the proposed micropile layout, corrosion protection details, connection to footings, verification load test (if utilized), proof-testing plans, and the work plan should be reviewed by the design team and approved by the Engineer prior to the start of work. Example micropile specifications are provided in Attachment 3. Consideration may also be given to allowing the Micropile Contractor to provide micropile specifications for approval by the Engineer.

Closing

Specific micropile design should be developed by a qualified contractor. The specific micropile design and work plan for micropile installation should be approved by the Engineer prior to the start of work. Depending on foundation conditions encountered during micropile installation, modification of the recommendations provided herein could be warranted.

The following attachments are included and complete this submittal.

Attachment 1	Concepts for Micropile-Footing Connections
Attachment 2	Preliminary Allowable Micropile Capacity
Attachment 3	Example Micropile Specifications

* * * * *

We appreciate the opportunity to be of continued service to you on this project. Should you have any questions regarding this supplemental information or if we may be of additional assistance, please call on us.

Sincerely,

**GRUBBS, HOSKYN,
BARTON & WYATT, INC.**



Mark E. Wyatt, P.E.
President

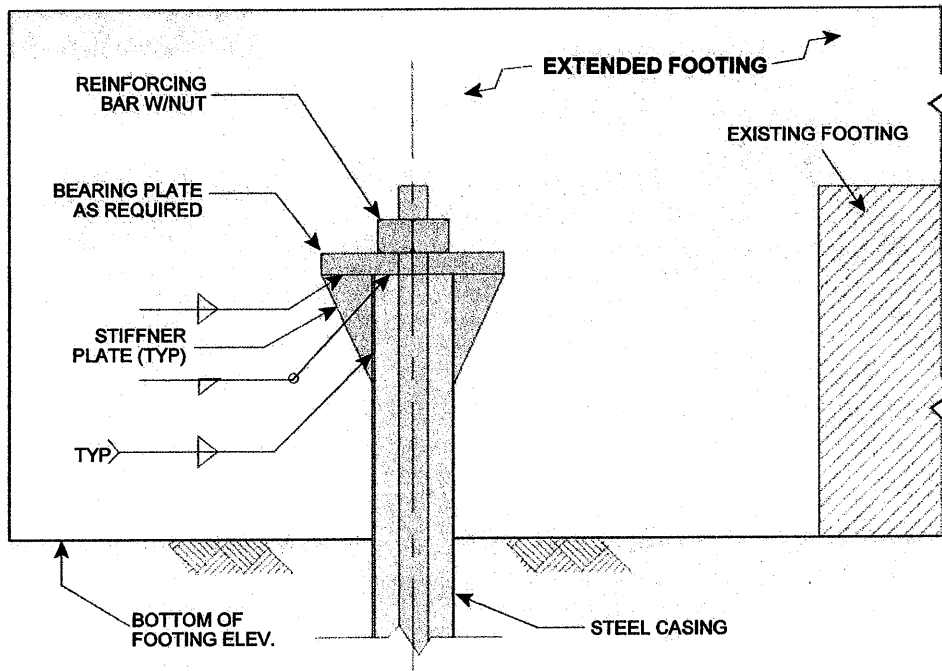


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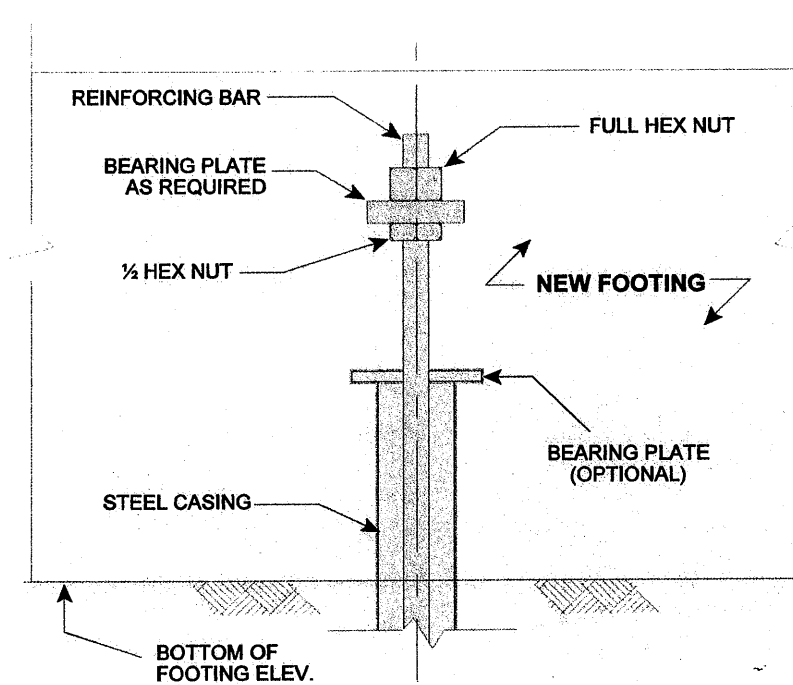
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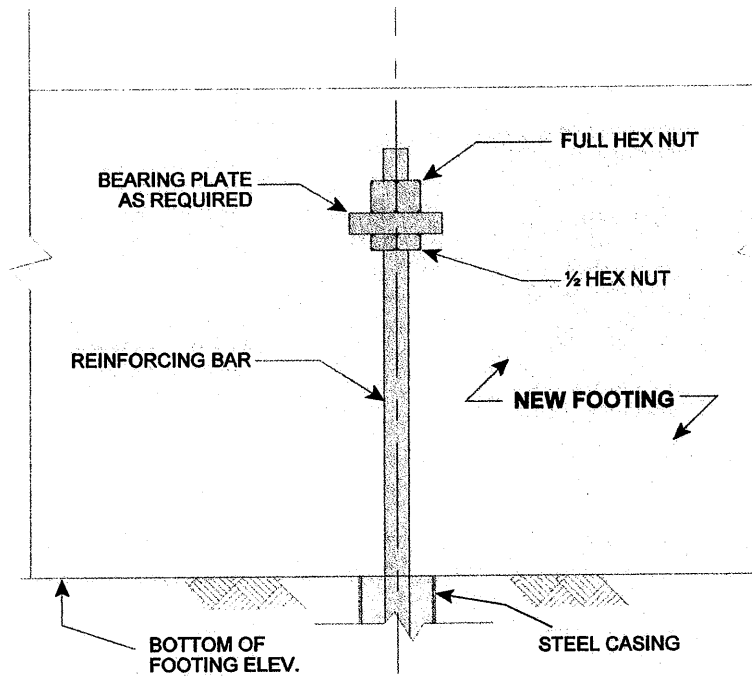
ATTACHMENT 1



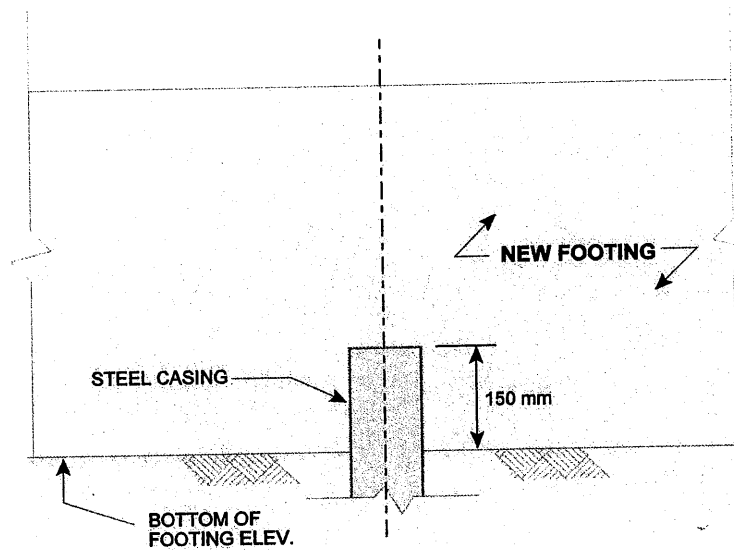
Micropile to New Footing Connection Detail – Alternative 1 (Compression and Uplift)



Micropile to New Footing Connection Detail – Alternative 2 (Compression and Uplift)



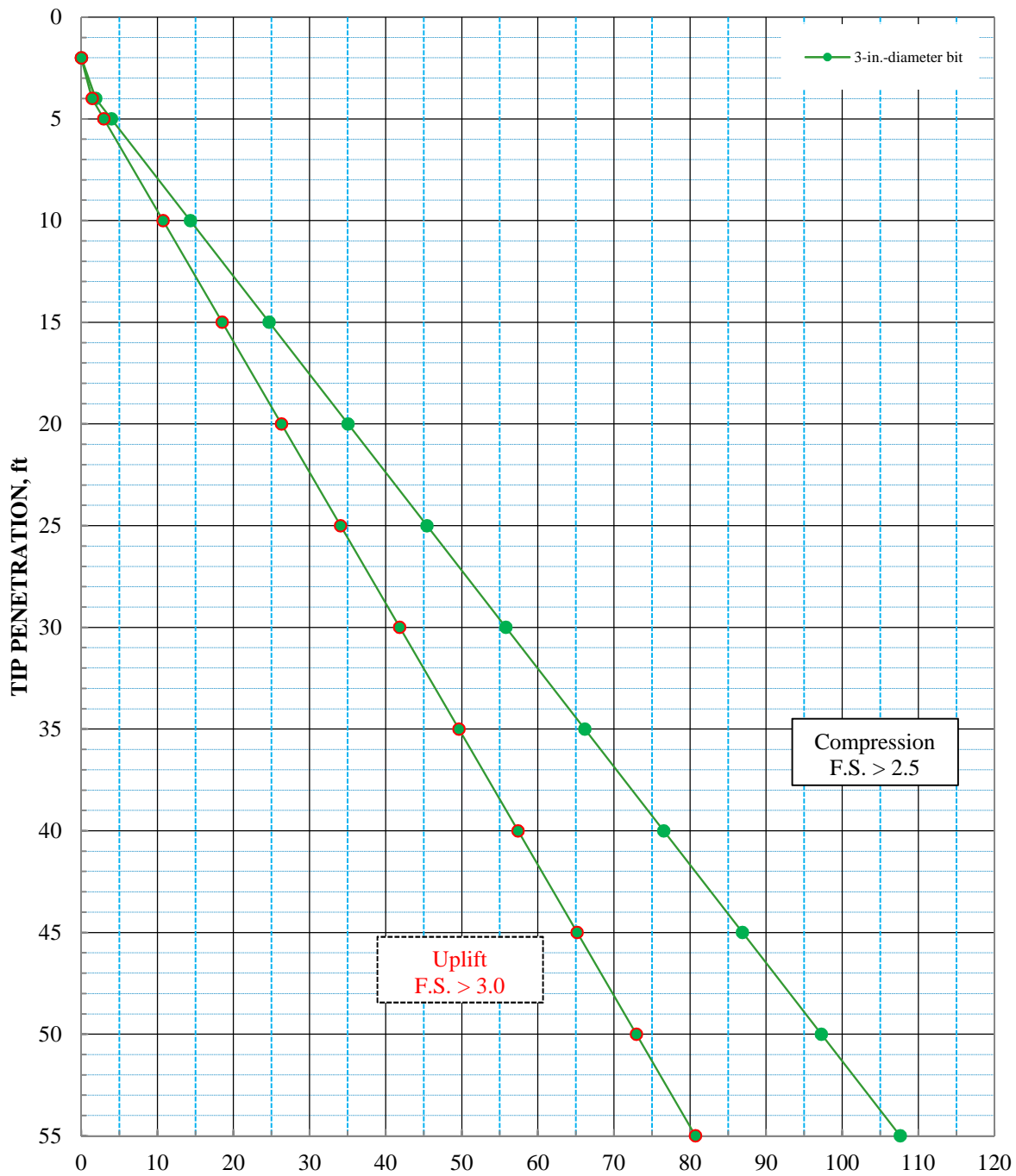
Micropile to New Footing Connection Detail – Alternative 3 (Compression and Uplift)



Micropile to New Footing Connection Detail – Alternative 4 (Compression Only)

ATTACHMENT 2

ALLOWABLE SINGLE MICROPILE CAPACITY, kips



PRELIMINARY ALLOWABLE SINGLE MICROPILE CAPACITY, kips

VA EDMH Addition
Little Rock, Arkansas
GHBW Job No. 14-167

Note: Pile cap/footing bottom assumed to be
at minimum 1 ft below basement-level finish floor

ATTACHMENT 3

MICROPILES

1.0 GENERAL

The Contractor shall supply, install and test micropiles shown on the drawings or specified herein in accordance with the specification

The Contractor shall allow for all necessary operations including cutting through concrete slabs, scaffolding, platforms, handling equipment, tools machinery etc necessary for the expeditions handling of the work.

1.1 Setting Out

The Contractor shall be required to employ an approved Licensed Surveyor who will set up the positions of the piles as shown in the pile layout plans of the detailed design. The Contractor will be responsible for the accuracy of location and positioning of each pile. Any errors in setting out and any consequential loss to the Owner will be made good by the Contractor to the satisfaction of the Engineer.

The Contractor shall preserve the pegs set out by the Surveyor. Should any peg be displaced or lost it must be replaced by a Licensed Surveyor to the approval of the Engineer. Upon completion of all piling works, the Contractor shall produce as-built Drawings showing the positions of all piles as installed. The positions of piles shall be verified by a Licensed Surveyor.

1.2 Tolerances

Position

The pile heads shall be positioned as shown on the Drawings within a maximum deviation of 1.5 in. in either direction from correct center point.

Verticality

For micropiles, the maximum permitted deviation of the finished pile from the vertical at any level is 1 in 150. The contractor shall demonstrate to the satisfaction of Engineer the pile verticality is within the allowable tolerance.

Correction

Should piles be installed outside these tolerances affecting the design and appearance of the structure, the Contractor shall propose and carry out immediate remedial measure to the approval of the Engineer.

1.3 Person in Charge

The piling work is to be carried out by full-time operators and supervisory staff who must be experienced in the installation of the proposed type of piles.

The Contractor shall submit to the Engineer for approval, written evidence to show that the persons who will be engaged in the works have had such experience.

1.4 Piling Equipment and Accessories

The equipment and accessories must be capable of safely, speedily and efficiently installing piles to the design requirements at the project site.

Sufficient units of equipment and accessories must be provided to keep to the agreed construction schedule.

1.5 Sequence of Installation of Production Piles

The Engineer reserves the absolute right and the Contractor shall recognize such right to direct the installation of working piles in any sequence the Engineer deems necessary for the satisfactory completion of the works.

2.0 SCOPE OF WORK

The contract comprises the provision of all labour, materials, tools, plant, etc. necessary for the following work:

- a. Supply and installation of pile foundations to carry the loads as specified in the drawings.
- b. Stripping and cutting the piles to cut off levels specified and preparation of the pile head as shown on the drawings.
- c. Carrying out standard proof tests as specified.

3.0 MATERIALS

3.1 Reinforcement

The type of reinforcement to be used, the diameter and/or thickness, grade, yield strength and stress shall be as specified or as shown on the Approved Design.

3.2 Grout

Unless otherwise specified, the grout shall be non-shrink cement grout. The grout mix design such as the water-cement ratio, the minimum cement and grout strength at 7 and 28 days shall be as specified and shown on the Drawings. Grout at placement shall have a specific gravity (G_s) within the range of 1.65 to 1.85. All grout shall have a minimum compressive strength of 4000 psi at 28 days. Grout shall be tested in accordance with ASTM C109 at a frequency of no less than one set of three (3) grout cubes or cylinders from each grout plant each day of operation.

If admixtures are used, details of admixtures shall be submitted to the Engineer for approval before commencement of works. The use of the admixture shall fully comply with the manufacturer's instructions.

If the grout as tested fails to satisfy the criteria as prescribed in Specification and drawings, the piles constructed using this batch of grout shall be rejected. The Contractor shall undertake all necessary additional and consequential remedial/compensatory work to the approval of the Engineer.

4.0 SITE AND ADJACENT PROPERTIES

4.1 Subsurface Information

The subsurface information is provided only for information and guidance to the Contractor and shows the approximate nature of the strata as known to the Engineer. The Owner and Engineer shall not be liable for the accuracy of the data given and the Contractor may carry out his own subsurface investigation to obtain additional information.

4.2 Site Visit

The Contractor is advised to visit the site to acquaint himself with the site conditions and no claims for inadequate information regarding site conditions will be entertained at a later date. The system or systems put forward by the contractor shall be well known. The adequacy of any system and its approval shall be at the discretion of the Engineers.

4.3 Underground Services And Adjacent Property

The Contractor shall take care to ensure the safety of underground services and adjacent properties during the installation of micropiles. The contractor will be liable to any claims of damage due to the piling operations.

5.0 DRILLING OPERATIONS

5.1 Diameter of Piles

The diameter of piles shall not be less than the specified/designed diameter at any level throughout its length.

5.2 Drilling

The Contractor shall submit to the Engineer details of drilling equipment and drilling procedure for approval before commencement of works. Drilling operations shall be carried out in accordance with the relevant requirements as follows:

(a) Boring near recently Cast Piles

Piles shall not be bored within three (3) diameters of other piles which have recently been cast less than 24 hours or contain unset grout, whichever longer to avoid damage to any of these piles.

(b) Stability of Drill holes

It is held that the Contractor has allowed in the unit rate of the pile for the implementation of all necessary measures, including the provision of all materials, labour and plant, for maintaining the stability of the sides of boreholes during micropile installation and successful completion of the piles. The Contractor shall submit his proposed methods for agreement prior to commencement of boring operations.

Irrespective of the presence of groundwater, the sides of all boreholes shall be kept intact and no loose material shall be permitted to fall into the bottom of the boreholes. The Contractor's boring equipment shall be able to advance a steel casing to support the sides of all boring.

If the sides of boreholes are found to be not stable, temporary steel casing shall be driven into stable stratum. The borehole shall be filled with drilling fluid to a level sufficiently to stabilize the boreholes.

If groundwater is found in any hole in sufficient quantity or gushing out as to affect boring operations or excavations and removal of soil from the boreholes, or the sides of boreholes collapse, then a steel casing of appropriate size and length in conjunction with stabilizing fluid or other alternatives of sufficient strength shall be used to support the sides of the borehole and permit boring operations to proceed smoothly and safely. The proposed drilling fluid mix must be submitted to the Engineer for approval.

Excavations shall not be exposed to the atmosphere longer than is necessary and shall be covered at all times when work is not in progress. Piles excavated shall be cast that same work day unless otherwise agreed by the Engineer.

In the event of a rapid loss of drilling fluid from the borehole excavation and caused instability of bore, the excavation shall be backfilled without delay or other appropriate and approved remedial measures taken by the Contractor like installing temporary casing prior to resuming boring at that location. The cost of redrilling of the hole shall be borne by the Contractor.

(c) Stability of bore by Temporary Casing Method

Where the use of a temporary casing is required to maintain the stability of a bore, the bottom of casing shall be kept a minimum of 3 ft or more below the unstable strata to prevent the inflow of soil and the formation of cavities in the surrounding ground.

Temporary casings shall be thin walled mild steel cylindrical casing. The dimensions and quality of the casing shall be adequate to withstand without damage or distortion all handling, construction and ground stresses to which they will be subjected. The casings shall have an internal diameter not less than the specified pile diameter. They shall be free of significant distortion, of uniform cross-section throughout each continuous length and free from internal projections and encrusted grout which might prevent the proper formation of piles. The joints of casings shall be watertight.

If temporary casings are damaged during installation in a manner which prevents the proper formation of the pile, such casings shall be withdrawn from the bore before grout is placed, repaired if necessary, or other action taken as may be approved to continue the construction of the pile.

(d) Rock Coring

Rock drilling will be required and will be a part of the work. There will be no additional compensation for drilling in hard rock. Coring of inclined rock surface, limestone pinnacles, cavities and soil below boulder/floater shall be considered as boring in soils.

(e) Inspection of Pile Excavation

Where practicable, all pile excavations shall be inspected for their full length before grouting. The Contractor shall provide all the apparatus necessary for the inspection. In the course of inspection any loose or soft material in the borehole which is likely to affect the performance of the pile shall be removed to the satisfaction of the Engineer.

6.0 GROUTING OPERATIONS

6.1 Mixing and Placing Grout

The Contractor shall provide details of the method and equipment used in grout mixing. Further information such as grouting pressure, grouting procedure, grouting equipment and technique employed in grouting underwater shall also be furnished for approval.

Grout shall be mixed on site and shall be free from segregation, clumping and bleeding. Grout shall be pumped into its final position in one continuous operation as soon as possible and in no case more than half an hour after mixing.

Micropile shall be grouted in one continuous process. If there is significant loss of grout, the Contractor may choose to carry out pre-grouting in stages as necessary to prevent further loss of grout for the construction of micropile. Method statement of pre-grouting including details of equipment, materials and procedures have to be reviewed and approved by the Engineer. If after the process of pre-grouting and re-drilling of the hole is required. The Contractor has to bear the cost and time of the pre-grouting and re-drilling.

6.2 Grout Falls

The loss of flushing mediums of either water or drilling mud drilling will demonstrate potential for excessive grout loss or falls. Depending on its seriousness, the Contractor can decide to carry out a water tightness test to decide whether pregrouting is required. The cost and time of the test will be borne by the Contractor. Pregrouting and re-drilling shall be carried out if results of the test shown that leakage exceeds 1.3 gal per min at an excess head of 14.5 psi, measured over a period of 10 minutes.

7.0 CONSTRUCTION OF PILE HEADS

7.1 Lengthening of Piles

Where lengthening is required, the pile reinforcement unit shall be connected on Site to the details shown on the Drawings.

Other means of jointing reinforcement shall be to the approval of the Engineer.

7.2 Cutting and Preparation of Pile Heads

Pile heads shall be constructed to the details as shown on the Drawings.

8.0 STANDARDS

All materials shall be of the best quality and new. All piling work shall be executed in accordance with the approved designs prepared by the Contractor and to the approval of the Engineer.

8.1 Standard Verification Test

A verification test of two-and-one-half (2.5) times the working load shall be carried out on piles designated by the Engineers and in accordance with ASTM D 1143-81, Testing of Piles under Axial Compressive Load (Quick Procedure). The number and location of test piles shall be at the discretion of the Engineer. The Contractor shall submit a detailed proposal of the load tests to the Engineer and shall obtain his approval in writing before carrying them out. On completion of the test, the Contractor shall submit to the engineer the results including graphs showing load and settlement versus time and settlement versus load.

The test procedure shall be as specified in Specification.

Failure to standard load test shall be as specified in Specification.

8.2 Proof-Testing

Production proof-tests will be performed on at least 5 percent of the production piles or no less than two (2) production piles. The maximum test load for production micropile proof-testing is (DL x 1.3). Proof tests shall be made by incrementally loading the micropile in accordance with the following schedule, to be used for both compression and tension loading.

AL = Alignment Load, DL = Design Load		
	LOAD	HOLD TIME (MIN)
1	AL	1
2	0.25 DL	1
3	0.50 DL	1
4	0.75 DL	1
5	1.00 DL	1
6	1.33 DL	10 or 60 min creep test
7	1.33 DL (maximum test load)	1
8	AL	1

The acceptance criteria for micropile verification load tests are:

- a. The pile shall sustain the compression and tension design loads (1.0 DL) with no more than 0.50 in. total vertical movement at the top of the pile as measured relative to the top of the pile prior to the start of testing. If an Alignment Load is used, then the allowable movement shall be reduced by multiplying by a factor of $(DL-AL)/DL$. (This conservatively accounts for the movement in reaching AL).
- b. At the end of the 1.33DL creep test load increment, test piles shall have a creep rate not exceeding 1mm per log cycle time (1 to 10 minutes) or 2mm per log cycle time (6 to 60 minutes). This creep rate shall be linear or decreasing throughout the creep load hold period.
- c. Failure does not occur at the 1.67DL maximum compression and tension loads. Failure is defined as the load at which attempts to further increase the test load simply result in continued pile movement.

9.0 TEST REPORT

The report shall contain the following: -

- A. Pile designation, date completed, weather condition, pile length, pile size, volume of
- B. grout intake, time of drilling at intervals not greater than 4m and time to grout the
- C. pile.
- D. Description of the apparatus used for testing, loading system and procedure for
- E. measuring settlement.
- F. Field data
- G. Time/Settlement Curve
- H. Load/Settlement Curve
- I. Remarks explaining unusual events or data and movement of piles.
- J. Calibration certificates of dial gauges and pressure gauges.
- K. The format of record shall be approved by the Engineer.

10.0 DAMAGED OR DISPLACED PILES

Should the deviation exceed the tolerance provided in this specification, the contractor shall submit this remedial proposal for the approval for the Engineer. Failing this, the faulty pile shall be replaced by additional piles as necessary in positions as determined by the Engineer at no cost to

the Owner. The cost of modification to pile cap etc., if any, shall be borne by the Contractor. The same will also apply to any piling work rejected by the Engineer for not truly constructed and installed in accordance with the specification.

Where a pile has been damaged during installation, testing or by other causes, the damaged pile shall be considered and treated as a faulty pile and should be replaced by additional piles as approved by the Engineer at the Contractor's expense.

10.1 Forcible Correction Not Permitted

Where piles have not been positioned within the specified limits no method of forcible correction will be permitted.

11.0 PAYMENT

11.1 Unconcreted (Empty) Bore

The unit rate of the pile shall be deemed to include whatever empty bore above the cut-off level of the pile and re-drilling after pre-grouting. No claims will be considered for any empty bore and re-drilling, and the Contractor shall allow in Contract for the cost of these processes due to the sequence of construction.

11.2 PAY LENGTH

For all proposed pile, the Contractor shall be paid only for the length of installed pile measured from toe of the pile to the cut-off level. The same applies for the grout. Pregrout, grout loss, over drill, re-drilling will have to be borne by the Contractor and shall be deemed to have included in the rate.

12.0 PILING RECORDS

Complete piling records shall be kept by the Contractor during pile installation. The Contractor shall submit the following in duplicate to the Engineer:

- a. Records of all piles as the work proceeds.
- b. Upon completion, a record of the work as carried out and as-built drawing.

The format of the record shall be approved by the Engineer.

The record shall contain all information required by the Engineer which includes the following where applicable:

- reference number and position of pile
- type and dimension
- date of boring and nature of strata where each pile is bored
- details of equipment used
- ground level and base of excavation level
- total penetration
- length and position of cavity/cavities in each pile
- penetration in rock
- time of drilling at intervals not exceeding 5m
- details of all splicing or jointing operations, locations of sleeves, etc.
- details of grouting operation for tremie grouting and time tables
- weather
- top level of pile immediately after completion
- errors in position and inclination
- amount of grout and the pressure used
- size and position of boulder/boulders in each pile

- detailed drilling speed (m/min)
- description of drilled material

12.1 As-Built Drawings

After completion of the piling, the Contractor shall submit an as-built drawing. This drawing shall be prepared by Registered Licensed Surveyor. It should include the following:

- a. Size and type of piles
- b. Eccentricities in both directions
- c. Depth of penetration of each pile or reduced level of tip of each pile and cut-off level of each pile.