PART I - GENERAL

1.01 SUMMARY

A. Section Includes: Fundex Tubex Grout Injection Piles (TGI Piles)

B. Related Sections: Reinforcing: Section 03200
Welding: Section 05500
Cast in Place Concrete: Section 03300
Structural Steel: Section 05120

1.02 SUBMITTALS

A. Product Data: Contractor shall submit a description of the equipment proposed for installing Tubex Grout-Injection (TGI) Piles.

B. Shop Drawings: Contractor shall submit shop drawings of TGI piles proposed for use on the project showing details of piles, reinforcing, concrete mix design, calculations, and other information required to describe proposed materials and construction methods.

C. Pile Installation, Layout and Records: Contractor shall submit piling layout drawing indicating location and numbering system to correspond to installation record. At the completion of work, Contractor shall submit installation records, which shall note TGI pile depth, crowd and torque pressures, grout pressures and grout quantity and any notable occurrences experienced during installation.

1.03 DELIVERY, STORAGE AND HANDLING

A. Protect pipe from damage during transportation, storage and handling. Protect cement and other material from effects of weather.

1.04 PROJECT CONDITIONS

A. Field Measurements:
1. Pile Installation record to show
a) Date installed
b) Tip elevation/butt elevation
c) Torque and crowd pressures of installation
d) Quantity and pressure of injected grout
e) Locations of splices, if any
f) Results of grout tests, if any
g) Unusual occurrences encountered in drilling operation

1.05 SEQUENCING AND SCHEDULING

A. Fabrication and Installation: Do not fabricate or install piles until shop drawings have been reviewed and approved by Engineer.

B. Pile Installation Tolerances:

1. Do not deviate from design location by more than 76 mm [3”] in any direction.
2. Elevation of pile top shall be not more than 51 mm [2”] higher or lower than design elevation
3. Deviation from Vertical: Not more than 2%

PART II MATERIALS

A. Pipe: The pile tube shall be pipe of carbon steel conforming to ASTM A252 grades 2 or 3 or API 5L, grade B, seamless, longitudinal fusion, spiral-welded or electric-resistant welding.

Pipe shall be 305 mm [12-inch] to 508 mm [20-inch] in diameter. Minimum wall thickness shall be 8 mm [0.312 inches]. Used pipe meeting the above requirements, with or without reconditioning, may be used subject to Contractor’s/Engineer’s prior inspection and approval.

B. Pile Tips: Tips shall be weldable castings with grout outlets at the bottom and be supplied by Fundex B.V. The tip will have teeth as necessary for cutting through the soil, and helical fins for mixing the grout with native soil. Tips shall be 457 mm [18 inches], 560 mm [22 inches], or 660 mm [26 inches] in diameter.

C. Concrete:

Concrete in Tubex piles shall have a minimum compressive strength of 21 MPa [3000 psi] at 28 days and shall conform to the requirements of Caltrans standard specifications Section 90.

D. Reinforcing: Reinforcing steel shall have a minimum yield strength of 345 MPa [60 ksi].

E. Cement Grout: Grout for soil/cement mixture shall conform to the provisions of Caltrans Specification Section 50-1.09, “Bonding and Grouting”, except as follows:

1.) The grout shall contain 42 *liters* [11 gallons] of water per 42.6 kg [94 pounds] of cement. (Unit weight = 1842 -1986 kg/cm2 [115-124 pcf]).
2.) California Test 541 will not be required.
3.) Grout shall not be required to pass through a screen with a 1.7-mm [0.07-inch] maximum clear opening prior to being introduced into the grout pump.

Admixtures shall conform to the provisions of Caltrans Specifications Section 90-4, "Admixtures", and must be on Caltrans NMT&R list of approved admixtures.

Field grout-mixing specifications as follows:

SI:
Small Batch: Hany Grout mixer: 5 sacks*, 213 kg total type II cement, 216 liters water, 2.3 kg Interplast-N, (optional retarder: 295 ml Plastiment).
Large Batch: Hany Grout mixer: 8 sacks*, 341 kg total type II cement, 322 liters water, 3.17 kg Interplast-N, (optional retarder: 473 ml Plastiment).

[English:
Small Batch 9.8 C.F: Hany Grout mixer: 5 sacks* type II cement, 57 gallons water, 5 pounds Interplast-N, (optional retarder: 10 oz Plastiment).
Large Batch 15.6 CF: Hany Grout mixer: 8 sacks* type II cement, 85 gallons water, 7 pounds Interplast-N, (optional retarder: 16 oz Plastiment).]

* 94 lb. Sack cement

PART III EXECUTION

3.01 EXAMINATION

A. Verify that the completed pile is clear of water and debris. Clean before placing concrete or reinforcing steel

3.02 INSTALLATION

A. Pile Installation:

1. Where headroom and/or material availability permits, install piles in one piece. Piles shall be installed using a Fundex F-12 or Tubex machine using torque and down pressure “crowd” to push pile into ground. Splice piles per AWS D1.1 as required for low-overhead conditions, or as dictated by material availability.

2. Water, bentonite, or 1-sack cement-water solution injected through the tip shall be employed as necessary to facilitate the installation. In difficult driving conditions, employ “post-grouting techniques”; begin grouting nearer specified tip elevation. Where soil profile permits, grout pile during driving over its full length

3. After achieving a minimum designed tension tip elevation the pile can be stopped if it experiences refusal above design compression tip elevation. The contractor will have the option of performing additional soil investigations or providing Engineer with geotechnical engineer’s review of pile to verify the minimum tip elevation required. Refusal will be defined as when the pile installation rate becomes less than one foot of penetration in five minutes at maximum crowd pressure, or when the torque required to install the pile exceeds 203,370 N-m [150,000 foot-pounds].

4. Noise: F-12 or Tubex machine shall operate at less than 85 dB at full torque, when measured at a distance of 6 m [20 ft.] in unconfined areas.

5. Vibration: Vibration shall not exceed background vibration levels recorded at a distance of 3 m [10 ft.] from the pile location.

B. Grouting:

1. Mixing/Mixing Equipment: Water shall be first added to the mixer. The grout shall be mixed with mechanical mixing equipment of a type that will produce uniform and thoroughly mixed grout. Retempering of grout shall not be allowed. Grout shall be continuously agitated until it is pumped. Grouting equipment shall be capable of operating at pressures of 40 Bars (4054 kPa) [(588 psi)].

2. Injection of grout: Grout Injection Pressure shall be recorded by reading the pressure gauge on the grout pump. Gauge pressure shall be at least 15 bars when grouting. An average pressure reading shall be taken every 1.5 to 3 m [5 to 10 ft.] of pile penetration. Grout shall be continuously or semi-continuously pumped. Pile shall be examined for grout blockage should gauge pressure above 55 Bars be observed. Grout blockages shall be hydraulically cleared. Should it not be possible to clear blockage, the pile shall be extracted and replaced.

Unless retarder is used, grout shall be pumped within 90 minutes of batching. Retarded grout shall be pumped within the time parameters of the type and amount of retarder used.

3. Sequence of Grout Installation: In generalized soil conditions, grouting shall start at a depth not higher than 8D above specified tip elevation, nor less than 3 feet above tip elevation. Specific variances are as follows:

a.] For spliced pipe installations, grouting shall not start until the last splice has been completed.

b.] Where ground water is to be sealed while driving, pile shall be grouted from the surface elevation

c.] Where rock socketing is required, grouting shall start after rock is penetrated

4. Grout Volumes: The theoretical volume of grout required shall be initially established as 20% of the tip cross sectional area less the pipe cross sectional area, times the required grouted height on the pile.

Note: Injected grout volumes are deduced per empirical results from completed projects, and account for injected grout mixing with in situ soils and soil rebound around pipe above the tip. In clayey soils grout take may be on the order of 40% theoretical volume; in very soft clays (e.g. bay mud) grout take would likely be 15%. In sandy profiles, grout take may be 15%-25% of theoretical

Subsequent pile grout volumes may be reduced if the presence of excess grout is seen on the ground surface, to conform to actual soil mixing proportions and reductions in the annular space volume experienced on site. No further reduction shall be made in the theoretical grout volume if grout is not seen on the surface.

Where full pile length grouting is required, sufficient grout shall be pumped to force grout to the surface. If piles are to be end bearing only, grout injection volume shall be calculated and/or as approved by the engineer.

C. Welding: All welding shall be in accordance with Structural Welding Code AWS D1.1-94. The abutting ends of pipe to be spliced shall be trimmed true and square to the axis of the pile. Commercial back-up rings shall be used to ensure alignment for welding. Splices shall be single-bevel full penetration welds.

D. Concrete Placement:

1. Water Infiltration: Surface water shall not be permitted to enter the Tubex piling. Water that has infiltrated the Tubex piling shall be removed before placing concrete therein. Residual water in the cone of the tip itself need not be removed.

2. Concrete Placement: The concrete to be placed in Tubex piles shall be permitted to free-fall provided that flow of concrete is directed at the center of the pile using a hopper or pump. Concrete in the top 4.5 m [15 ft.] of the pile shall be vibrated if reinforcing steel is present. Concrete shall not be tremmied or pumped to the pile bottom.

PART IV PAYMENT

A. A Bid Base lump sum bid price for Tubex pile work based on the number of piles and lengths. Price shall include all costs associated with Tubex pile installation, including pipe material, tips, accessories, concrete, reinforcing steel and labor and equipment necessary for the work.

B. Payment shall be based on the pile footage and number, as established between Contractor and Engineer prior to the bid.

C. A unit add and a unit deduct price shall apply for additional or deleted footage.

D. Unit prices for load tests shall apply.

E. Unit prices for mobilization shall apply.