PART 1 - GENERAL

1.01 DESCRIPTION
   A. Work Included
      This section covers requirements for the manufacture, delivery, and instal-
      lation of precast prestressed concrete piling as indicated on the plans and
      as specified herein.
   B. Related Work Specified Elsewhere
      (Optional section - to be supplied by specification writer, if needed.)

1.02 QUALITY ASSURANCE

   A. Driving
      It is the Contractor's responsibility to install in an undamaged condition all
      the piles to the tip elevations on the drawings or to refusal as defined by the
      Engineer. The Contractor shall select, subject to the approval of the Engi-
      neer, the hammer size and cushion type and thickness, and the frequency
      of replacement of cushions so that piles can be installed without damage. If
      piles are hollow (voided) or if they contain internal jet pipe, the Contractor
      shall submit, subject to the approval of the Engineer, the methods and
      procedures to be used during driving or jetting to ensure that the piles are not
      damaged by bursting forces from "water hammer" or jetting/driving opera-
      tions.
   B. Manufacturer's Qualifications
      The precast concrete manufacturing plant shall be certified by the Precast/
      Prestressed Concrete Institute (PCI) Plant Certification Program. Manufacturer
      shall be certified at the time of bidding. Certification shall be in the
      following product groups and categories: C3 or C4. Written evidence may
      be required listing experience, plant facilities, quality control procedures,
      staff, and any other documentation needed to establish adequate qualifica-
      tions for manufacture of the piles. A Manufacturer which meets these
      qualifications is: CONCRETE TECHNOLOGY CORPORATION, Tacoma,
      Washington.
C. **Testing and Manufacturing Procedures**
Fabrication and in-plant testing shall be in general compliance with the applicable provisions of PCI MNL-116, “Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products,” latest edition.

D. **In-Plant Inspection**
In-plant inspection of materials and finished products shall be under the supervision of the Manufacturer’s Quality Assurance Manager and shall comply with the provisions of PCI MNL-116 and the Manufacturer’s documented quality assurance program.

1.03 CODES AND STANDARDS
In addition to all applicable codes, the following codes and standards shall apply, except as may be modified herein:

C. ACI 214, “Recommended Practice for Evaluation of Strength Test Results of Concrete,” latest edition.

1.04 SUBMITTALS
A. Pile order lists, details of equipment and methods proposed for handling and driving piles, and the sequence of construction. Driving of piles shall not commence until the Engineer’s review of proposed equipment is complete and an authorization to proceed is given.
B. Manufacturer qualifications, as specified in 1.02-B.
C. Shop drawings showing the number and size of prestressing strands, prestress force, reinforcing, mark numbers, pick point locations, and all other details necessary for manufacturing and handling the prestressed concrete piles. Casting of piles shall not commence until shop drawings are approved by the Engineer.
1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

Piles shall be lifted and supported during manufacturing, storage, transportation and driving operations only at the lifting and supporting locations shown on the shop drawings. All lifting devices shall have a minimum safety factor of three. If stacked in multiple layers during storage and shipment, suitable bunks shall be used between each pile at the support locations, with lifting devices accessible and undamaged.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Portland Cement: ASTM C 150, “Standard Specification for Portland Cement.” Types I, II, or III cement may be used, provided the $C_{3}A$ content does not exceed 8 percent.


C. Water: Clean, potable and free from injurious amounts of oils, acids, alkalis, organic materials, or other substances that may be deleterious to concrete or steel.


H. Corrugated Metal Duct: Galvanized, corrugated steel interlocked duct, mortar tight, and free from grease, paint, or other substances which could interfere with proper bond of concrete or grout.

I. Jet Pipes: As shown on the drawings or as detailed by the pile manufacturer. Details and material shall be shown on the shop drawings and approved by the Engineer.


2.02 CONCRETE MIXES
Mix designs shall be developed by the pile Manufacturer using the materials as specified herein. The designs shall comply with the requirements of ACI 318 and shall have been prepared in accordance with ACI 211.1, for the concrete strengths shown on the contract drawings. The mix designs shall be based on materials previously evaluated by the pile Manufacturer using established methods of statistical quality control that conform to ACI 214.

2.03 FORMWORK
Provide exterior forms of steel on concrete founded casting beds. Side forms for square piles may have minimum draft adequate for stripping. Interior forms shall be of steel and either the fixed-collapsible or moving-mandrel type capable of maintaining specified dimensional tolerances. Forms must be cleaned and oiled prior to placement of reinforcing.

2.04 PLACEMENT OF REINFORCING
Place prestressing strands symmetrically in the piles and jack simultaneously to specified force. Space spiral wire to specified pitch and tie adequately to maintain position during placement of concrete.

2.05 PLACEMENT OF CONCRETE
Place concrete continuously and consolidate with high frequency vibration. Strike-off unformed surfaces and apply good float finish.

2.06 CURING
Cover forms with moisture-retaining cover and apply heat in uniform manner. Embed thermocouples in piles and connect through central computer to electrically heated test cylinders for constant monitoring of curing temperatures and to insure that test cylinders and piles are heated equally.

2.07 STRIPPING AND HANDLING
When a test cylinder made from the concrete pour for the piles involved reaches the minimum release strength specified, detension strands gradually and simultaneously so as to maintain internal stresses uniform across the pile cross sections. Burn strands flush with ends of piles. Handle and transport piles as described in paragraph 1.05 above. Do not drive piles until they have reached both their required 28 day strength and a minimum age of 10 days.
2.08 FINISHES
Piles with minor imperfections which do not impair the structural integrity of the pile, such as small surface holes caused by air bubbles, color variations, form joint marks, and minor chips and spalls will be accepted as is. Marina guide piles shall be sacked to five feet below extreme low water. Piles with defects such as honeycomb which could reduce the structural capacity of the pile will be accepted only if repaired to the Engineer’s satisfaction.

2.09 PATCHING OF LIFT LOOPS
Prior to driving piles in a marine or fresh water location, cut off and patch embedded lifting loops at elevations higher than 10 feet below the mudline using materials and methods as recommended by the Manufacturer.

2.10 MANUFACTURING TOLERANCES
A. Length ................................................................. +6 in., -2 in.
B. Width or diameter .................................................. ±3/8 in.
C. Sweep (variation from straight line parallel to centerline of pile) 
   (considered to be a form tolerance) .................. ±1/8 in. per 10 ft.
D. Position of tendons .................................................. ±1/4 in.
E. Wall thickness .......................................................... -1/4 in., +1/2 in.
F. Position of handling devices ....................................... ±6 in.
G. Position of steel driving tips ...................................... ±1/2 in.
H. Variation from specified end squareness or skew .............. 
   .................................................................................. ±1/4 in. per 12 in., ±1/2 in. max.
I. Local straightness any surface ................................. ±1/4 in. per 10 ft.
J. Longitudinal spacing of spiral reinforcement.............. ±3/4 in.

PART 3 - EXECUTION

For recommendations and precautions for preventing damage to piles during driving, please refer to Chapter 5 - Installation of Prestressed Concrete Piles in the PCI Committee Report entitled “Recommended Practice for Design, Manufacture and Installation of Prestressed Concrete Piling,” PCI JOURNAL, V. 38, No. 2, March-April 1993, pp 36-41.

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