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22. SHEET PILING

22.1 GENERAL

This work shall consist of performing all operations in connection with furnishing driving, cutting off complete in place and strictly in accordance with these Specifications and as shown on the Drawings.

A detailed proposal for the piling shall be delivered by the Contractor to the Engineer-in-Charge well in advance of the start of work. The proposal shall include full details of materials, equipment and method to be used in the construction of piles. Work on piling shall not commence until the Contractor's proposals have been approved by the Engineer-in-Charge and communicated to him.

The kind and type of piles shall be as shown on the Drawings and/or as specified and shall not be changed, except with the approval of the Engineer-in-Charge.

22.2 MATERIAL REQUIREMENTS (STRUCTURAL PILES)

Structural steel piles shall be rolled steel sections of the type, weight and shape called for on the Drawings. The piles shall be structural steel conforming to the requirements of ASTM A-36, except that steel produced by the Acid Bessemer process shall not be used.

The steel piles shall be coated with red lead paint conforming to AASHTO M-72, unless otherwise specified or as directed by the Engineer-in-Charge.

22.3 HANDLING OF PILES

All piles shall be lifted by means of suitable bridle or sling attached to pile at marked pick up points to avoid damage to piles. They shall be properly loaded and carted to the specified place and unloaded in workman like manner and sorted at specified place(s) for further use. Piles which may have been injured during handling, loading or unloading or carriage by the contractor will be rejected and replaced by the contractor at no cost to the employer.

22.4 CONSTRUCTION REQUIREMENTS

a) Location and Site Preparation

Piles shall be used where indicated on the Drawings or as directed by the Engineer-in-Charge.

All excavations for the foundation in which the piles are to be driven shall be completed before the driving is begun, unless otherwise specified or approved by the Engineer-in-Charge. After driving is completed, all loose and displaced materials shall be removed from around the piles by hand excavation, leaving clean solid surfaces to receive the concrete for foundations.

b) Determination of Pile Length

The criteria for pile length and bearing capacity will be determined by the Engineer-in-Charge according to the results from test piles and load tests. The piles shall be driven to such depths, that the bearing loads indicated on the Drawings are obtained.

The criterion for pile length may be one of the following:

- 1) Piles in sand and gravel shall be driven to a bearing value determined by use of the pile driving formula or as decided by the Engineer-in-Charge.
- 2) Piles in clay shall be driven to the depth ordered by the Engineer-in-Charge. However, the bearing value shall be controlled by the appropriate pile driving formula if called for by the Engineer-in-Charge.

- 3) Piles shall be driven to refusal on rock or hard layer when so ordered by the Engineer-in-Charge.

The Contractor shall be responsible for correct pile lengths and bearing capacities according to the criteria given by the Engineer-in-Charge.

c) Pile Driving

All piles shall be driven accurately to the vertical or the batter as shown on the Drawings. Each pile shall, after driving, be within fifteen (15) cm from the theoretical location underneath the pile cap or underneath the super-structure in the case of pile bents. All piles pushed up by the driving of adjacent piles or by any other cause shall be driven down again. Piles shall be used only in places where a minimum penetration of three (3) meters in firm materials; or five (5) meters in soft materials can be obtained. Where a soft stratum overlies a hard stratum, the piles shall penetrate to hard material upto a sufficient distance to fix the ends rigidly.

All pile driving equipment shall be subject to the Engineer-in-Charge's approval. The Contractor shall be responsible for sufficient weight and efficiency of the hammers to drive the piles down to the required depth and bearing capacity. Hammers shall be gravity hammers, single acting steam or pneumatic hammers or diesel hammers. Gravity hammers shall not weigh less than sixty (60) percent of the combined weight of the pile and driving head and not less than 2,000 Kg. The fall shall be adjusted so as to avoid injury to the pile and shall in no case exceed one (1) m unless otherwise specified or approved by the Engineer-in-Charge. The plant and equipment furnished for steam hammers shall have sufficient capacity to maintain, under working conditions, the pressure at the hammer specified by the manufacturer. The boiler or pressure tank shall be equipped with an accurate pressure gauge and another gauge shall be supplied at the hammer intake to determine the drop in pressure between the tank and the hammer. When diesel hammers are used, they shall be calibrated with test piling and/or test loads.

Water jets shall be used only when permitted in writing by the Engineer-in-Charge. When water jets are used, the number of jets and the nozzle volume and pressure shall be sufficient to erode the material adjacent to the pile freely. The jets shall be shut-off at a depth not less than three (3) M before final tip elevation is reached, and the piles driven solely by hammer to final penetration as required by the Engineer-in-Charge.

Piles shall be supported in line and position with leads while being driven. Pile driving leads shall be constructed in such a manner as to afford freedom of movement of the hammer, and shall be held in position by guys or steel braces to ensure rigid lateral support to the pile during driving. The leads shall be of sufficient length to make the use of a follower unnecessary, and shall be so designed as to permit proper placing of batter piles. The driving of piles with followers shall be avoided if practicable and shall be done only under written permission from the Engineer-in-Charge.

The method used in driving piles shall not subject them to excessive and undue stresses producing deformation of the steel. Manipulation of piles to force them into proper position, if considered by the Engineer-in-Charge to be excessive, will not be permitted.

The doll-eying of the piles shall be done by protecting top with driving heads, caps or cushions in accordance with the recommendations from the manufacturer of the pile hammer and to the satisfaction of the Engineer-in-Charge. The driving head shall be provided to maintain the axis of the pile in line with the axis of the hammer and provide a driving surface normal to the pile.

Full-length piles shall be used where practicable. Splicing of piles when permitted shall be done as shown on Drawings or approved by the Engineer-in-Charge. All piles shall be continuously driven unless otherwise allowed by the Engineer-in-Charge.

22.5 PILE RECORDS

The contractor shall keep records of piles driven or installed. A copy of the record shall be given to the Engineer-in-Charge within two (2 days) after each pile is driven;

- Pile Type & Dimension
- Driving Equipment type, weight and efficiency of hammer etc.
- Depth Driven and tip elevation.
- For gravity and single acting hammers the height of drop.
- For double acting the frequency of blows.
- Final set for last 20 blows for every ten piles and when the Engineer-in-Charge so requires the penetration along the whole driven depth shall be recorded.
- Details of any interruption during driving.
- Level of top of pile immediately after driving and the level when all piles in the group are driven.
- Details of Re-driving.
- Any other relevant information.

22.6 DAMAGED OR MISPLACED PILES

Any pile which is cracked or broken because of internal defects or by improper handling or driving or which is otherwise injured so as to impair it for intended use, or any pile driven out of proper location shall be removed and replaced.

The Engineer-in-charge may require the contractor to pull certain selected piles after driving for test and inspection to determine to conditions of the piles. Any pile so pulled and found to be damaged to such extent in the opinion of the Engineer-in-charge, would impair its usefulness in the completed structure, shall be removed from the site of the work and contractor shall furnish, drive a new pile to replace the damaged pile. Piles pulled and found to be sound and in a satisfactory conditions be re-driven.

22.7 MEASUREMENT AND PAYMENT

22.7.1 COMPOSITE RATE

The measurement and payment for the items of the work of Sheet Piling hereof shall be made corresponding to the applicable CSR item as provided in Contract Agreement and shall constitute full compensation, for procurements, transportations, performance in all respect and completion of work as specified including the site clearance as approved by the Engineer-in-Charge.

22.7.2 LABOUR RATE

The measurement and payment for the items of the work of Sheet Piling hereof shall be made corresponding to applicable CSR item as provided in Contract Agreement and shall constitute full compensation for procurements transportations, performance in all respect and at designated location as defined in the Contract Agreement.

22.7.3 QUANTIFICATION

The unit of measurement shall be measured as mentioned below in accordance with corresponding CSR items.

1. For surface area items, the quantity of work shall be measured by surface area. The unit of measurement shall be Square meter or Square foot. Following items of CSR are measured according to this criteria;

Item No.: 22-3 to 22-5

2. Following items of CSR shall be measured as each Job;
Item No.: 22-9, 22-10, 22-11, 22-11, 22-14 and 22-15
3. For linear items, the quantity of work shall be measured linearly along centre line of structure. The unit of measurement shall be running meter or running foot. Following item of CSR are measured according to this criteria;
Item No.: 22-8
4. For bulk items, the quantity of work shall be measured in units of weight i.e. Tonne or Tons. Following item of CSR are measured according to this criteria;
Item No.: 22-13
5. The following items of CSR shall be measured as Per Cut;
Item No.: 22-1 and 22-2
6. The following item of CSR shall be measured as Per Day;
Item No.: 22-17
7. The following items of CSR shall be measured per 30 meter;
Item No.: 22-12 and 22-16
8. The following items of CSR shall be measured as Each;
Item No.: 22-6 and 22-7