Pile Driving Guidelines

Engineers should familiarize themselves with the plans and specification details dealing with piling in the contract. Initially acquire the approved "Welding Procedures" (State approval form) for all welds proposed for the shoes and splices and the "Pile Driving Equipment" (State Form) sheets from the field office. Copies should be made and used for cross-referencing when field verifying these details. List the estimated pile length, bearing capacity, driving criteria and any field verification comments.

Field pile driving details will be recorded on state forms XX & XY. Being "source documents", these forms shall be provided to the field office on a daily basis. Check this detail. Per the forms, recordation is accomplished based on blows-per-centimeter. This should be field verified during the inspection (i.e. pile markings). Check the forms for completeness and note whether final lengths are exceeding the Plan estimated length. If splices are required, the soil borings should be reviewed to obtain an understanding of the possible causes.

Equipment

Contractors shall obtain approval for pile driving equipment. Verify that the type, striking energy per blow, rated speed and serial number are listed on the approved state form, "Pile Driving Equipment" sheet. Note: the usual striking energy per blow is 17.6 Kilo-Joules (13, 000 foot-pounds) for both Cast-in-Place pile casings and Steel Bearing piles.

Hammers shall have continuous compressor capacity to assure that the rated conditions are achieved (single acting: length-of-stroke or blows-per-minute; double acting: bounce chamber pressure). All diesel hammers shall have an acceptable means for measuring hammer energy pressure. When pressure gauges are included, manufacturers charts and graphs, showing calibration to

energy, shall be furnished to the engineer. Check hammer operation and these details.

Materials

Steel bearing piles shall be rolled "HP" sections of standard dimensions. They shall be new and un-used and conform to ASTM A36M materials standards. Cast-in-Place pile casings shall conform with A252-Grade 2 requirements, unless otherwise specified. Review the manufacturer's certification for this conformity along with domestic origin (Buy America provision). Heat numbers should also be listed for each acceptable lot (this number indicates the steel meets Charpy V-notch requirements).

Cast-in-Place pile casings can be either pipe or shell having dimensions no less than 200 mm (8 inches) outside diameter at the toe and 300 mm (12 inches) OD at the cutoff. Wall thicknesses shall be no less than 4.76 mm (3/16 inch) for pipe casings and 2.67 mm (1/8 inch) for shell casings. If driven with a mandrel, shell casings may be thinner. Review the project plans for typical section, thickness and rate-of-taper. Evaluate stockpiles for these details along with "lack of damage" from storage and handling (Per State Construction Manual, any damaged piling will be rejected).

Construction Details

Steel Bearing Piles shall be furnished with a driving shoe, as detailed on the plans or approved by the State. Shoes shall be attached by a state DOT certified welder with a minimum 8mm (3/8 inch) fillet weld along the outside edge of the flanges, or welded in accordance with the plan details. Cast-in-Place pile ends shall be perpendicular to the longitudinal axis. They will be furnished with a 18 mm (3/4 inch) minimum thickness round plate at the end, having a diameter no more than 15 mm larger than the casing. NOTE: If

welding is not detailed on the plans, then an approved "welding procedure" is required. (Spec ref.)

Piles shall not be driven until the excavation has been made to the bottom of footer elevation or tremie per Spec ref. They shall be driven starting from the center of the foundation outwards or starting from an outside row and progressing across the foundation. Piles may be completely driven in one operation or, if directed by the state, be allowed to set for 2 to 24 hours (or as indicated on the plans) before driving is resumed. Evaluate the procedure being followed for this project.

Piles are either plumb (truly vertical) or battered per the plans. Batter is normally measured with a template in the field. Observe and record the method being followed. The pile shall not vary from the planned location by more than 100 mm (4 inches). For abutments, this tolerance is 25 mm (1 inch). Also, piles may not have more than a 20 mm per meter (1/4 inch per foot) variation at their tip from the vertical or batter. Check these details. (Spec ref.)

Splices are a contingent item that is required when the engineer directs the contractor to drive a pile more than 1.5 meters (5 feet) beyond the estimated plan length. All splices are subject to the approval of the DCES. For steel bearing piles, a second splice may used at 8 meters (25 feet) beyond the estimated length subject to approval by the State. Welding will be performed by a State DOT certified welder following an approved Welding Procedure (state form). For Cast-in-Place concrete piles, the state may approve mechanical splices. These splices shall meet the requirements for structural steel (ASTM A36M minimum) and have a seal weld around the entire pile casing. Spec refs. & State Steel Construction Manual).

Pile cutoffs shall be made to the elevation shown on the plans or as established by the EIC. All cavities created by the pile driving shall be backfilled. Any pile sections remaining above ground shall be painted in accordance with the plans. Cast-in-Place pile casings shall be dry before concrete is placed. They shall be filled with a continuous pour of Class A Concrete with a slump that shall not exceed 125 mm (5 inches). Care shall be taken to prevent voids by internal vibration or other means to the maximum depth practicable, to consolidate the concrete. (Spec ref.)

Testing and Rejection Details

Where specified on the plans, the contractor shall provide pile driving equipment, an electrical power source and a suitable test enclosure for pile field testing and pile hammer efficiency evaluation. The contractor will perform all incidental work to make the site accessible. Testing will be performed by State DOT forces and assistance provided by contractor's crews. If a pile requires re-driving within 28 hours after the initial test, this shall be considered as one test. Tests results should be reviewed during the field visit. (Spec ref.)

Defective piles are categorized by the following deficiencies: Location or batter incorrect, pile damaged, piles fails to achieve resistance, tip elevation not within tolerances, EIC determines pile is unserviceable and the Cast-in-Place pile casing is not free of water. The contractor shall remove rejected piles or, at the option of the Engineer, a second pile can be driven adjacent thereto. (Spec ref.)

Measurement and Payment

Furnishing Equipment for Driving Piles is a lump sum item for which 75% of the amount will be paid once pile driving has commenced. The remainder will be paid when the work of driving piles is completed. This payment should correlate to the date of the first pile driving record. Confirm. (Spec ref.)

Pile quantity paid will be the number of meters of driven, acceptable piles measured below cutoff elevation. Pile shoes are included in the unit price. However, partial payment can be made for the invoice cost of the shoes in accordance with Section 109-04. For the piling, progress payment can be made for 80% of the quantity properly installed. The balance will be paid once cutoffs, concrete placement and painting are completed. Daily driving records should be reviewed and correlated to monthly progress payment. (Spec ref.)

Dynamic pile tests are paid on an "each" basis. If re-driving is required after 28 hours, then payment will be made for an additional test. Splices are also paid on an "each" basis. Check daily driving records accordingly.