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Coastal Engineering Technical Note

SURVEILLANCE CHECKLIST FOR LOAD-BEARING PILE CONSTRUCTION

PROGRAM PURPOSE: Load-bearing piles, in the context of coastal and waterfront structures, are typically used in pile foundations supporting seawalls and to support deck structures of open piers and wharves. In addition, steel H-piles (welded to sheet piles) are used as king piles in bulkheads and round timber piles are used in groins and bulkheads. The following guidelines, in the form of a checklist, may be attached to a clipboard and taken to the field by the Quality Assurance Personnel (QAP). This is not meant to be a comprehensive checklist for the Contractor Quality Control Inspector (CQCI) but is meant to summarize the more important points that the QAP should make time to surveil when looking over the shoulder of Contractor Quality Control Personnel.

A. BEFORE CONSTRUCTION COMMENCES

1. Review reports, manufacturer's data, certificates of compliance, and applicable specifications sections related to piles. For steel piles review Mill Test Report of steel testing and certificate of compliance for steel composition. For concrete piles review applicable ACI provisions. Review ASTM standards (ASTM D25 for treated timber piles, ASTM A36 for H piles, and ASTM A252 for pipe piles). Review standard specifications of the American Wood-Preservers Association for permissible defects in round timber piles. For untreated timber piles review Mil Spec MM-P-371.

2. Conduct coordination meeting on QC/QA program as required by ER 1180-1-6. The purpose of this meeting is to reach a mutual understanding of the system details including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of contractor's management and control with the Government's inspection. Inform CQCI of the following:

a. Timber piling may not be handled with pointed equipment (i.e., hooks or spike poles).

b. Cutting of treated timber wales and piles may not be done to permit fitting, unless approved by the Contracting Officer. If cutting is approved, all cut areas will be treated with creosote.

c. Nails may not be driven, nor holes bored, into creosoted timber piles to support scaffolding.

d. Splicing wood piles will not be done without approval of Contracting Officer

3. Review submittal on pile driver to see how well contractor has matched pile driver to pile.

B. PREPARATORY INSPECTION

1. For H-piles: Is contractor prohibited by job specifications from splicing H-piles at job site? If not, has QAP or his supervisor required a shop drawing be submitted to Resident Office for approval to show splicing details? Will the splices be staggered? Has a maximum number of splices per pile been established by specifications or Contracting Officer? Has welding procedure been submitted to Contracting Officer for approval? Are welders certified for the type of work they are required to perform and have certifications of welders been submitted to Contracting Officer?

2. Have locations of load-bearing piles been staked by survey?

3. Are CQCI and yourself satisfied that that contractor is satisfactorily handling and storing piles in accordance with the following criteria?

a. All piles should be stored on level ground on timber blocking so that the axis of each pile is maintained in a straight line.

b. Timber (round) piles should be stacked alternately butt to tip, with blocking between layers.

c. Steel H piles should be stacked flange to flange, with a 2-inch space between flanges and with blocking between layers. (The 2-inch space facilitates the use of slings for handling as does the blocking.)

d. Pipe piles in single and double random lengths can be stored in one of 2 ways.

(1.) In the first method, the stack is built in layers with the pipe in each layer touching the next pipe and with blocking between layers. (The blocking is not for handling; rather it keeps the lowest outside pipe from being pushed out under the weight of the stacked pipe, which would lead to the collapse of the entire stack.

(2.) In the second method, the stack is built in layers, with each successive layer containing one less length of pipe and with no blocking between the layers. The end pipe on the bottom layer must then be blocked or welded to the adjacent pipe to prevent collapse of the stack.

e. Precast concrete piles must be stored so that their pickup points rest on level blocking, or else the piles will crack. It is also necessary to locate the blocking of successive tiers exactly over the blocking below or the weight of the upper layers of piling will break the lower piles.

4. Assure that CQCI is checking piles stored at job site for damage and defects.

a. Is CQCI checking that prestressed precast concrete piles are of uniform shape and straight? Are broken precast concrete piles being rejected by CQCI?

b. Is CQCI checking H-piles, and pipe piles received from supplier or manufacturer for defective welds or rivets and for fit at splices? Double-check a few. Is CQCI checking H-piles for bends in flanges and for flange injuries that occurred in shipment or during handling?

c. Is CQCI checking dimensions and the following criteria regarding straightness and quality of round timber piles?

(1.) Crooks should not exceed half the diameter of the pile at the middle of the bend.

(2.) In short bends, the distance from the center line of the pile to a line stretched from the centers above and below the bend should not exceed 4% of the bend length, or 2.5 inches (6.3 cm).

(3.) A straight line between centers of butt and tip should fall within the pile.

(4.) The taper should be uniform from butt to tip.

(5.) Wood piles should not have large or loose knots, shakes, splits, decay or reverse bends.

(6.) Piles should be debarked.

5. Assure that CQCI is making certain that pile measuring crew is making measurements from tip of pile upwards. Has CQCI banned use of cloth tapes, due to their tendency to stretch, and is crew using exclusively steel tapes? Is total length being indicated on each pile near top? Measure a few piles yourself to double-check. Is CQCI checking other pile requirements such as butt and tip diameter? (Beware of tip and butt diameters of timber piles being smaller than the minimums set forth in ASTM D25).

C. INITIAL AND FOLLOWUP INSPECTIONS

1. Are all cuts and breaks in timber piles being treated with creosote? Are holes in timber piles being filled with hot creosote after being bored? Are any unused holes being tightly closed by a treated plug? Are all areas of coated H-piles, where the coating has been rubbed or scraped off during handling, being retouched with coal tar epoxy coating?

2. Check whether piles are to be driven to refusal, a specified bearing, or depth. Check the minimum penetration, bearing values, and required pile lengths, if applicable. Also, if applicable, see which pile driving formula will be required to calculate the bearing values.

3. Is the operation of the pile driver satisfactory? Is ram operating at full stroke? Is it operating at rated speed and fully recommended operating pressure that is shown in the manufacturer's brochure? Slowing of hammer during its travel? Continuous driving until penetration is attained? (The

main reason for this concern over proper operation of equipment when driving load-bearing piles is that driving is usually terminated when the resistance exceeds a certain number of blows per inch. In order for driving resistance to be meaningful, it is necessary that the equipment be operated consistently.

4. What method of measuring penetration for calculating bearing during driving is being used by CQCI? Does method exclude introduction of deliberate error by the operator? Contractors have found it to their advantage to underdrive load-bearing piles. One means of deception used by a pile driver operator to underdrive load-bearing piles is manipulation of hammer controls. Carefully watch for proper hammer operation.

A second method of subterfuge is manipulation of cushion block materials. According to the pile formulas, a small penetration corresponds to a high bearing capacity. Thus, an inadequate pile can, by manipulation of cushion block materials, be made to appear acceptable to the unwary CQCI or QAP. Research the specifications carefully. If the applicable specification section does not address control over cushions, establish control over hammer cushions. Only cushions of known characteristics should be used.

(Aluminum and micarta discs are recommended as hammer cushions since the discs both work well and usually last throughout the entire job.) Either specify the cushion block size and material or require the cushion block size and material for hammer cushions be submitted to the Contracting Officer for approval using authority of General Provision 9, the " Material and Workmanship" clause. Require that the approved cushion block be held constant throughout all pile driving.

A third method of deception, used to deliberately underdrive piles, is mechanical modification. This is very difficult to detect. The QAP would have to check all hammer parts against the manufacturer's machine drawings, which is generally infeasible unless QAP is extremely familiar with structure and moving parts of a pile driver.

5. Is the CQCI checking template for sturdiness?

6. Assure that CQCI checks that penetration of pile is sufficient to determine its course before template is moved.

7. Assure that CQCI checks inside of pipe pile or casing of cast-in-place pile for loose soil and water with mirror or drop light. Do not let concrete be dumped in pipe piles or casings through water; loose soil must be cleaned out and the water must be drawn down to an acceptable depth before placing concrete. Have you satisfied yourself that the CQCI is automatically rejecting piles containing water, soil or debris? If the specs do not state an acceptable depth of water, it is recommended that 2-6 inches be the maximum depth of water allowed in the bottom of the pile.

8. Is CQCI insuring that concrete is being placed in bucket and tremie to avoid segregation? Is the concrete at the top of the pile consolidated by mechanical vibrator?

E. FOLLOWUP INSPECTION

1. Is CQCI reporting concrete mix slump and cubic yards placed in cast-in-place or pipe piles in daily CQC report?

2. Is CQCI checking for deviation from proper location of load-bearing pile?

3. Assure that CQCI controls accuracy of line and plumbness for load-bearing piles? Assure that CQCI checks that piles are set vertically or that batter piles are set on the axis which they are to follow. Be certain that CQCI checks that the hammer is centered over the pile. For pipe piles and cast-in-place piles the QAP can make a quick check as follows to see if the pile is within the plumbness allowance: Let the weight on pile measuring tape act as a plumb bob, and determine the location of the top of the tape when the bob is resting against the side of the pile at some known depth.

4. Is CQCI checking for adherence to sequence of driving of load-bearing piles?

5. Check for damage (fraying and battering) to pile heads during driving. Report excessive pile head damage immediately to your supervisor. Observe the fit of drive head and pile, as a poorly fitting drive head contributes substantially to pile head damage. Damage from a poorly fitting drive head is strictly the problem of the contractor and forms no basis for a claim; take copious photographs.

"Brooming" of the tops of timber piles occurs when the driving is not easy. Wrought-iron straps placed around the pile heads will usually prevent brooming. If replacement piles are required (because the straps were not used in the first place), this is exclusively the problem of the contractor and forms no basis for a claim. Take photographs.

6. Is the hammer bouncing? Are piles bending? This is overdriving, because of an obstruction (usually rock) at pile tip, which can result in excessive damage to butts and/or tips of piles due to overstress.

What instructions has CQCI given to piling crew on prevention of destruction of bottoms of end-bearing piles after the piles have hit rock? Were his instructions in consonance with what the specifications state? If the specifications do not cover this subject, check with your supervisor in order to establish the blows per inch that will signify that the pile has been driven to refusal. If the pile is crushed against the rock by too much driving, the full value of the end bearing is destroyed, and the seawall or deck structure being supported could fail.

It is recommended to talk to your supervisor to explore the possibility of pulling an occasional pile if overdriving occurs to check for damage of tip.

7. Assure that CQCI is maintaining a record of driving as required by specifications. Record of driving resistance, pile number, butt and tip elevation; notes regarding delays during driving, extent of jetting if permitted. Are records kept current throughout operations? Assure CQCI

checks that piles are driven continuously. If driving is suspended, insure that he records the tip elevation at the time of the shutdown and the duration of the delay.

8. Have you satisfied yourself that CQCI is watching for proper handling of pre-cast prestressed concrete piles? Are proper pile cushions being used?

9. Is CQCI checking diameters and depth of cased cast-in-place piles?

10. Is CQCI insuring that reinforcing steel is rigidly assembled and centered in hole of casing of cast-in-place pile or pipe pile? Oriented vertically and adequately secured? Has CQCI prohibited loose bars?

11. Is CQCI insuring that computed volume of concrete needed to fill the pile is equal to the amount actually placed?

12. Is CQCI reporting concrete mix slump and cubic yards placed in daily CQC report?

For further information, contact Gordon E. Staab, Coastal Design Branch, Coastal Engineering Research Center, at (601) 634-2139

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