

KCS 11 70 15 : 2019

# Stabilizing Pile

December 06, 2019  
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KC CODE



# Foreword

- To address needs that were caused by changes in the construction standards code system, the overlaps and conflicts between existing construction standards (design standards, standard specification) were compared and reviewed and then integrated into a new document that can be maintained as a standard code.
- These standards were revised and enacted as standards by integrating the Construction Work Slope Surface Standard Specification and the corresponding parts of the Temporary Construction Standard Specification, Highway Bridge Standard Specification, and Road Construction Standard Specification. Major matters related to the enactment and revision of these standards are as follows:

Construction Standard	Major Contents	Enactment · Revision (Month, Year)
Construction Work Slope Surface Standard Specification	• Construction Work Slope Surface Design Standards enacted.	Enactment (May 2006)
Construction Work Slope Surface Standard Specification	• Construction Work Slope Surface Design Standards revised.	Revision (Dec 2011)
KCS 11 70 15 : 2016	• Integrated and maintained as a code according to changes in the construction standard code system.	Enactment (June 2016)
KCS 11 70 15 : 2016	• Revised to harmonize Korean Standards with Construction Standards.	Revision (July 2018)



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## 1. General Matters

### 1.1 Scope of Application

(1) These standards are applied to stabilizing piles for reinforcing slope surfaces.

### 1.2 Reference Standards

- KS B 0885 Standard qualification procedure for manual welding technique
- KS B 0896 Method for ultrasonic examination for welds of ferritic steel
- KS F 4009 Ready-mixed concrete
- KS F 4602 Steel pipe piles
- KS F 4603 Steel H piles
- KS L 5201 Portland cement

### 1.3 Supplied Materials

Not applicable.

### 1.4 Definition

Not applicable.

## 2. Materials

### 2.1 Materials

(1) The stabilizing piles include steel pipe piles, H-beam piles, micro-piles, and cast-in-place concrete piles, or combinations of them. In addition, the stabilizing pile shall consist of materials and structures with high flexural stiffness, long-term durability and resistance to corrosion because the pile resists the large-scale activities of slopes by the moment and shear force.

#### 2.1.1 Steel Pipe Pile

(1) Steel pipe piles shall be the standard products specified in KS F 4602 or products that are equivalent to or better than the standard product.

#### 2.1.2 H-Pile

(1) H-piles shall be the standard products specified in KS F 4603 or products that are equivalent to or better than the standard product.

#### 2.1.3 Concrete

- (1) The product specified in KS F 4009 shall be applied. The strength shall meet the requirements specified in the design drawing. If a separate strength standard is not provided, the strength shall be equal to or higher than 24MPa.

#### **2.1.4 Grout**

- (1) The cement shall meet the requirements for Type 1 normal Portland cement specified in KS L 5201. If necessary, an admixture may be added after undergoing objective validation.

### **2.2 Components**

Not applicable.

### **2.3 Equipment**

#### **2.3.1 Boring Equipment**

- (1) Casing shoes shall be attached at the steel pipe head for rotational pushing of the steel pipe to prevent the relaxation of the surrounding ground. The equipment shall allow for performance of double-pipe boring with the steel pipe in the inside by using a hammer bit.

#### **2.3.2 Concrete and Mortar Placement**

- (1) In the placement of concrete or mortar inside a steel pipe, a tremi pipe shall be used to prevent the separation of materials by the inflow of groundwater. The tremi pipe shall have an internal diameter of 150 to 300mm to allow for free falling of concrete.

## **3. Construction**

### **3.1 Verification of Construction Conditions**

- (1) Stability review report of stabilizing pile considering actual site conditions
- (2) Grout mixing design and test injection report
- (3) Construction plan including the equipment specifications of pile construction, head cutting plan, and test construction plan, etc.

### **3.2 Work Preparation**

#### **3.2.1 Work Ground**

- (1) Before the construction, the original ground shall be arranged to tolerate the contact



pressure of the equipment. If the original ground is soft, special actions shall be employed to secure safety.

### **3.2.2 Temporary Pile Stacking**

- (1) Temporary stacking of piles on the construction site shall not cause hazardous deformation on the piles. The stacking height shall be determined by considering the bearing capacity of the ground and the surrounding circumstances.

### **3.2.3 Measurement**

- (1) A batter board for measuring the positions of the pile centers and the height of the pile heads shall be solidly installed to prevent displacement due to the site circumstances.

### **3.2.4 Checkup and Maintenance of Machines and Tools**

- (1) The machines, tools, and accessories shall be checked and maintained according to the manuals before starting the works to display optimal functionality.

### **3.2.5 Removal of Obstacles**

- (1) Obstructing utilities shall be removed, and the underground utilities within the affected area shall be protected or moved.

### **3.2.6 Transportation and Storage**

- (1) In the handling of piles, including pile transportation, stacking, and storage, damage to piles shall be carefully avoided. At the time of transporting piles to the construction site, the appearance, shapes, and dimensions of the piles shall be tested according to KS F 4602 and KS F 4603.

## **3.3 Construction Standards**

- (1) Since stabilizing piles are permanent structures maintaining long-term effectiveness, the entire length of the piles shall be coated after pile insertion with concrete or cement grouting to avoid the corrosion.

### **3.3.1 Ground Boring**

- (1) The construction machine shall be installed at the accurate position on the solid ground to install the piles accurately at the predetermined positions.
- (2) A service hole shall be installed to stand a welded steel pipe.
- (3) The boring depth shall be the design depth.

- (4) With regard to the boring method, a boring machine specified in the design drawing shall be used to prevent the collapse of the hole wall and to minimize the relaxation of the surrounding ground.
- (5) Since muddy water may be used according to the site conditions, appropriate actions shall be employed to prevent the discharged sandy soil from contaminating a third party or the environment. The waste disposal place shall be established before starting the construction work to prevent any problems that may be caused by the discharged sandy soil.
- (6) Information on the work at each step for construction of the individual piles shall be recorded in the predetermined format.

### 3.3.2 Construction of Steel Pipe Piles

- (1) Piles shall be installed accurately and safely according to the design drawings and the construction plan.
- (2) The maximum allowable error of the pile position is the greater value of 100mm from the measurement center and  $D/4$  ( $D$ : pile diameter). The maximum allowable slope is  $1/25$  of the pile length. If the construction error is greater than the maximum allowable error, the load applied to the pile shall be reviewed by considering the actual construction error, and appropriate action shall be employed, including reinforcement.
- (3) In the presence of deformation in pile construction works, the directions of an executive senior engineer in the field of ground construction shall be followed.
- (4) When a pile is constructed while boring the inside of the pile hollow, the change of the ground or the settlement of the pile shall be sufficiently observed to prevent the disturbance of the ground at the pile head and around the pile. Construction shall be performed to the predetermined depth.
- (5) If the change of the ground layer is different from the design drawings after reaching the predetermined depth, appropriate actions shall be employed by considering the design conditions and the construction conditions.
- (6) Information on the work at each step for construction of the individual piles shall be recorded in the predetermined format.

### 3.3.3 Construction of Cast-in-Place Pile

- (1) The slime around the pile head shall be removed before placing concrete.
- (2) Manufacture, assembly, and storage of steel reinforcing bars
  - ① The steel reinforcing network shall be assembled with the main reinforcement, intermediate hoops, reinforcements, reinforcing steel materials, spacers, and others. They shall be solid enough not to be deformed by the material storage, transport,

and erection.

- ② The steel reinforcing bars shall be accurately manufactured and placed according to the design drawings, and the main reinforcement shall be bound with intermediate hoops for assembly.
  - ③ The intermediate hoops shall be processed according to the predetermined shapes, and the joint shall be connected by flare welding in a size over 10D (D: diameter of reinforcing bar) on one side.
  - ④ If the pile length is different from the design drawings, the length of the steel reinforcing bar network shall be adjusted at the lowest part.
- (3) Filling of the remaining part of the borehole (lower than the ground surface) after the concrete placement shall be performed in accordance with the separate guidelines.
- (4) The concrete shall be protected from vibration, impact, and load during curing.
- (5) The horizontal and vertical errors of the cast-in-place piles are the same as those specified in 3.3.2 Construction Steel Pipe Piles.

### 3.3.4 Welding Joint

- (1) The joint of a pile shall have a structure equal to or better than the main body. The part from the joint to the end shall be perpendicular to the pile axis.
- (2) The welding joint shall be prepared and constructed accurately under the appropriate conditions to prevent any hazardous defects in the pile functions.
- (3) The welding workers shall be selected from those who have passed the technical test of KS B 0885 or higher.
- (4) The structures and variation of tolerance of the joints of steel pipe piles and H-beam piles shall conform to KS F 4602 and 4603. When reinforcing or processing is required, the provisions in the agreement between the client and the manufacturer shall be observed.
- (5) Before and after the welding work, the following items shall be visually inspected (Table 3.3-1). If a severe defect is found, the joint shall be completely removed by using a grinder, and it shall be welded again.

**Table 3.3-1 Visual Inspection Items for On-Site Welding.**

Section	Inspection Items
Welding shape	Bead surface unevenness, welding dimensions, weld reinforcement, welding length
Welding defect	Cracks, undercuts, overlaps, pits
Finishing	Slag, spatter removal, grinder finishing, welding dropout

(6) Non-destructive Inspection

- ① A non-destructive inspection shall be performed with welded joints by an intermediate engineer or an engineer of a higher grade as specified in the Construction Technology Management Act and who has a license in the field. The inspection result and the pile-driving record shall be managed after obtaining approval from the construction supervisor.
- ② After welding is completed, inspection shall be performed using the methods specified in the design drawings at the indicated number of positions for individual welded joints. A ultrasonic test shall be performed according to KS B 0896 at least one time per 10 welded pile joints. The test result shall be of the third M detection level (below 18mm) or higher according to the defect level classification specified in KS B 0896.

(7) Weld Repair and Re-test

- ① Weld defects that have not been accepted through the visual inspection and the non-destructive test shall be reported to the construction supervisor, and the method of repairing the defects shall be approved by the construction supervisor.
- ② After repairing the defects using the approved method, a re-test shall be performed, and appropriate actions shall be employed according to the acceptance criteria.

### 3.3.5 Bolted Joint

- (1) A bolt hole for joints shall be perpendicular to the pile surface, and shall be bored 2mm larger than the bolt diameter.
- (2) The bolt used for a pile joint shall be a high tension countersunk bolt for bearing joints, and the bolt shall be inserted to the lower pile to a length longer than the bolt diameter.
- (3) The bolt holes on the upper pile and the lower pile shall be aligned.
- (4) The bolt shall be tightened sufficiently to obtain the specified axial force.

### 3.3.6 Stiffening Member Installation

- (1) After boring the stiffening member for H-beam or steel reinforcing network shall be installed inside a steel pipe pile or cast-in-place pile to the design depth.
- (2) Before the installation of a stiffening member, the slime in the hole shall be removed, and the removal shall be approved by the construction supervisor.
- (3) When installing the H-beam or steel reinforcing network, a spacer shall be used at the top of the steel pipe pile or cast-in-place pile to adjust the vertical and horizontal positions for the installation.
- (4) Before installing a stiffening member, the deformation and welding conditions of the

materials shall be inspected, and approval from the construction supervisor shall be obtained.

- (5) An H-beam shall be placed at the center of a steel pipe pile, and the flange surface shall be perpendicular to the sliding direction of the slope.
- (6) Deformation shall be avoided during reinforcement installation. In addition, during construction work, the reinforcement shall be aligned to the center of the pile and inserted vertically and slowly, while avoiding the collapse of the borehole wall due to the reinforcement.

### 3.3.7 Pile Head Cutting

- (1) After the piles and reinforcements are completely installed, the pile head shall be cut according to the design drawings.
- (2) The damage of the main body of the pile shall be carefully avoided while cutting the pile head.
- (3) The scrap caused by the cutting of steel pipe piles shall be completely cut off and transported to a designated place. If the remaining pile length is over 5m, the scrap may be reused for pile joining after undergoing proper processing.