Korean Construction Specification

KCS 11 50 20 : 2019

Sheet Pile

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국토교통부

Foreword

• In accordance with the change to the construction standards code system, the duplications and conflicts between existing construction standards (design standards, standard specifications) were compared and reviewed and then integrated into this standard as a standard code.

• This standard was established by integrating the parts of the existing temporary work standard specification and the harbor and fishing port construction standard specification corresponding to sheet piles. The history of this standard and its revisions is as follows.

Construction Standard	Main Content	Enacted or Revised (Year.Month)
Temporary work standard specification	• Regulations related to temporary work that had been scattered across various specifications and established regulations were organized to fit conditions in Korea in areas such as formwork, staging, scaffolding, safety facilities, and temporary retaining walls.	Enacted (2002.05)
Temporary work standard specification	• Established construction standards for emerging temporary works to reflect changes in construction methods and environment. In particular, systematic construction standards were established for the construction work of subways, ports, tunnels, and bridges.	Revised (2006.12)
Temporary work standard specification	• Reorganized the specifications which were mainly based on construction standards into design and construction sections.	Revised (2014.8)
Temporary work standard specification	• Partially revised to include the separation distance between the construction site boundary and surrounding buildings and the installation standard of temporary fences for traffic safety	Enacted (2016.6)
Port construction standard specification	• Established harbor construction standard specification	Enacted (1976.12)
Port construction standard specification	• Revised Harbor construction standard specification	Revised (1977.12)
Port construction standard specification	• Revised to cover various design conditions for port construction, and include general policies & standards for designs related to water facilities, counter facilities, and other facilities related to port construction.	Revised (1986.12)

Construction Standard	Main Content	Enacted or Revised (Year.Month)
Port construction standard specification	• Added coastal maintenance facilities to the scope of application, upgraded the design wind speed and load factor to enhance the safety of port facilities, and established the application base for re-estimated deep-sea waves.	Revised (1996.12)
Port construction standard specification	• Fully revised to reflect changes in port construction conditions and adopt preemptive measures against climate change, such as global warming.	Revised (2005.11)
Port construction standard specification	• Revised to reflect changes in high-level technical standards and standards in other areas, supplement specifications related to mass concrete and cap concrete and specifications related to filter mats, vessels, quay walls, and other related facilities, and add specifications for marina facilities.	Revised (2012.12)
KCS 11 50 20 : 2016	• Integrated and maintained as code according to the changes to the construction standards code system	Enacted (2016.6)
KCS 11 50 20 : 2016	• Amended according to Korean Industry Standards and Construction Standards	Amended (2018.7)

Table of Contents

1. General

1.1 Scope of application

(1) This standard specifies matters related to the construction of sheet piles (steel sheet pile, steel pipe sheet pile, prefabricated cell-type steel sheet pile, concrete sheet pile) used in temporary work, bridge construction, road and railway construction, port construction, river work, docking facilities, revetments, breakwaters, and cofferdams.

1.2 Reference

1.2.1 Related laws and regulations

No content

1.2.2 Related standards

- KCS 11 50 15 Precast pile
- KS F 4602 Steel pipe piles for foundations
- KS F 4605 Steel pipe sheet pile
- KS D 3003 Corrosion-resistant steel for port and marine structures
- KS D 3300 Corrosion-resistant steel pipes for port and marine structures
- KS D 3503 Rolled steel for general structures
- KS D 3515 Rolled steel for welded structures
- KS D 3858 Cold-formed steel sheet pile
- KS F 4604 Hot rolled steel sheet pile
- KS F 4208 Concrete sheet pile
- KS F 4303 Pre-tensioned centrifugal PC pile
- KS F 4306 Pre-tensioned centrifugal high-strength concrete pile

1.3 Materials to submit

1.3.1 Construction plan

(1) Prepare the construction plan before starting construction. If there are any changes in the construction conditions, modify the construction plan immediately.

(2) The main contents of the construction plan are as follows.

① The personnel and organization chart specifying the main personnel for various works, including a list of people in charge who are mandated by related laws and regulations.

② Prepare a work schedule and attach a floor plan that lists the process, order, and construction methods of the entire construction process including the construction process

and temporary facilities of each stage.

③ Include detailed locations, normal lines and control points, plans to install guide beams, the machine and process used, methods for handling obstacles, and matters related to construction records.

④ Establish equipment operation plans including the types and specifications of the equipment to be used, drilling methods, hammer capacity and pile driving plan, constructible depth, and piling and erecting piles.

⑤ In establishing the construction plan, ensure sufficient stability at each stage of the process considering the soil conditions, retaining wall structure, excavation scale, excavation method, the status of underground utilities, the construction method of the main structure, and adjacent structures.

⑥ In addition to the record of each work day, the construction record shall make it easy to understand the construction status of each individual pile.

⑦ In terms of environmental conservation measures, develop such measures by considering the conditions of the sheet pile construction site and reviewing changes in the surrounding environment.

⑧ Develop safety measures to provide measures, instrumentation plans, and result analysis methods to ensure safety by considering the conditions of the construction site.

⑨ If the design drawings and the site conditions are different, a professional engineer shall develop countermeasures and submit a design review report that includes a signed and sealed modified drawing, calculation sheet, review document, and specifications.

⑩ Develop a plan to handle traffic, including plans to handle traffic in the construction section, plans to deploy traffic safety officers, and matters discussed with the relevant organizations.

⑪ Other matters required by the construction supervisor

1.3.2 Construction drawing

(1) Submit a construction drawing that includes the following information.

① Details such as the dimensions of the sheet pile, weight, joint, edge machining and connection of joints, and pile boundary treatment

② Detailed location of construction, normal lines and control points, and plans to install guide beams

③ Matters related to the transport, storage, and production of sheet piles

1.3.3 Construction report

(1) Prepare a construction report that includes the construction plan and progress, a list of field workers, materials, consultation and adjustment of instructions, and the status of sheet pile construction equipment.

1.3.4 Daily work report (Sheet pile construction work record)

(1) Prepare a daily report on all sheet piles including test sheet piles.

1.3.5 Sheet pile location map

(1) Prepare a location map for the installed sheet piles within 1 week after constructing the sheet piles. The drawing must show the design position and the actual position, and the error of both positions.

1.4 General requirements

1.4.1 Installation tolerance

(1) Keep the vertical degree within 1/100 ~ 1/200 of the pile length.

(2) Do not construct pile joints at the same height.

1.4.2 Pile and filling

(1) For sheet piles made from used steel, materials with structural defects such as severely damaged piles, bent piles, dent piles, cracked piles, and those that do not meet the required dimensions should not be brought into the site.

(2) If boring and installing sheet piles, fill the area around the sheet pile with high-quality materials (sand, crushed stone, soil cement, etc.), after consulting with the construction supervisor on the conditions and filling materials.

2. Materials

2.1 Steel sheet pile

2.1.1 Materials

(1) The materials of steel sheet piles shall comply with the standards of KS D 3003, KS D 3503, KS D 3515, KS D 3858, and KS F 4602.

(2) Steel sheet piles are divided into U-type, Z-type, straight type, and combined type depending on the shape, and the material, shape, and dimensions shall conform to the drawings or construction specifications.

(3) With regard to production errors of the steel sheet pile shape, component analysis of the materials, and strength tests, the manufacturer of the steel sheet piles shall submit the relevant test reports.

2.1.2 The use of used steel

(1) If using used steel, the thickness of the steel sheet piles should be at least 90% of the thickness of new steel, and if the thickness is less than 90%, the approval of the construction supervisor must be obtained.

(2) If the thickness of the product is significantly reduced by local corrosion, consult with the construction supervisor to take proper reinforcement measures or exclude the affected products for safety.

2.1.3 Production

(1) In principle, the main body of the steel sheet piles shall be manufactured in a factory, but length connections or deformed steel sheet piles may be fabricated in the field. Obtain the approval of the construction supervisor to fabricate and produce steel sheet piles in the field.

(2) In principle, steel materials added to fabricate steel sheet piles in the field shall be made of the same materials as the steel sheet piles. If using other materials, the approval of the construction supervisor must be obtained.

2.2 Steel pipe sheet pile

2.2.1 Materials

(1) Steel pipe sheet piles are also called wall steel pipe piles, but they are referred to as steel pipe sheet piles in this standard.

(2) Steel pipe sheet piles are formed by connecting the section formed by welding joint metals to the steel pipe to form a sheet pile wall, producing the characteristics of steel sheet piles, in addition to a greater horizontal resistance due to the larger section modulus compared to steel sheet piles, and the vertical bearing capacity of steel pipe piles.

(3) The materials of steel pipe sheet piles shall comply with the standards of KS F 4602, KS F 4605, KS D 3003, KS D 3300, KS D 3503, and KS D 3515.

(4) The type, material, shape, and dimensions of the steel pipe sheet piles shall conform to the drawings or construction specifications.

2.2.2 Production

(1) Steel pipe sheet piles shall be manufactured in a factory or in the field. If it is inevitably necessary to produce the piles in the field, obtain the approval of the construction supervisor.

(2) Fabricate the shape, dimensions, and materials of the steel pipe sheet piles according to the design documents.

(3) Construct the joints of the steel pipe sheet pile as specified in the drawings. The location and contents of the joints shall be consulted on, adjusted, and approved by the construction

supervisor.

2.3 Cell-type steel sheet pile

2.3.1 Materials

(1) The steel sheet piles shall comply with the standards of KS F 4604, KS D 3003, KS D 3300, KS D 3503, and KS D 3515.

(2) The type, material, shape, and dimensions of the steel sheet piles shall conform to the drawings or construction specifications.

2.3.2 Production

(1) The steel sheet piles shall be manufactured in a factory or in the field. If it is inevitably necessary to produce the piles in the field, obtain the approval of the construction supervisor.

(2) Construct the joints of the steel sheet pile as specified in the drawings. The location and contents of the joints shall be consulted on, adjusted, and approved by the construction supervisor.

2.4 Concrete sheet pile

2.4.1 Material

(1) Concrete sheet piles shall comply with the standards of KS F 4208, KS F 4303, and KS F 4306.

(2) The type, material, shape, and dimensions of the concrete sheet piles shall conform to the drawings or construction specifications.

2.4.2 Production

(1) The shape, dimensions, and steel materials used to produce the concrete sheet piles shall comply with the requirements specified in the design drawing.

(2) Construct the joints of the concrete sheet pile as specified in the drawings. The location and contents of the joints shall be consulted on, adjusted, and approved by the construction supervisor.

3. Construction

3.1 General

3.1.1 Transportation and storage

(1) To prevent impact and deformation, use cranes to load and unload sheet piles. Hang the steel

sheet piles with ropes at 2 points to prevent the pile from falling during transportation. The binding points should be $\ell/5$ from both ends of the pile.

(2) Store the steel sheet piles on a flat surface with sufficient ground bearing capacity. If there are concerns over subsidence, improve the ground. The storage height shall be less than 2m, and store less than 5 sheets on 1 floor by using supports. The supports shall be 100㎜ lumber, and the spacing shall be within 4m.

(3) Prevent damage to the coating surface, joints, and lower end (fore-end) while transporting the steel pipe sheet piles, and avoid distortion or deformation in order to maintain the characteristics of the section. In addition, store the piles on a flat, well-drained surface using supports to pile up the sheet piles.

(4) Prevent damage to the coating surface, joints, and lower end (the end hammered in) while transporting the cell-type steel sheet piles, and avoid distortion or deformation in order to maintain the characteristics of the section. In addition, store the piles on a flat, well-drained surface using supports to pile up the sheet piles.

(5) Concrete sheet piles may have tensile and compressive sides depending on the arrangement of rebars, so check the piles carefully to prevent cracks or damage due to excessive stress during the handling process.

3.1.2 Construction equipment

(1) Select safe and economical construction machinery and equipment considering the type, shape, dimensions, weight, penetration depth, soil, the number of placements, and the surrounding environment.

(2) Sheet pile construction equipment shall be in accordance with KCS 11 50 15.

(3) The pile driving equipment shall be capable of driving piles that are 3m longer than the ones specified in the design. In general, drop hammers or vibro hammers must be used. Select the capacity of the vibro hammer by considering the characteristics of the machine, such as the amplitude, frequency (rotation), vibration acceleration, vibromotive force, and self-weight of the pile driver.

(4) When selecting the hammer, consider the increased resistance of the adjacent steel pipe sheet piles due to the interference of the joints caused by the movement or rotation of the steel pipe sheet piles during the pile driving process.

(5) If penetrating through rocks, prepare drilling equipment that can be also used to pile drive rocks.

(6) If using the water injection method to facilitate pile driving, the number and pressure of the injection nozzles shall be sufficient to erode the materials around the pile. Repair or reinforce the nozzle immediately if it becomes clogged or when it does not work.

3.2 Preparation for construction

3.2.1 Test pile drive

(1) The driving of the sheet pile is determined by the N-value, but this sometimes is not accurate depending on the ground conditions. Perform a test pile drive to determine all of the conditions.

(2) Perform a test pile drive to confirm the specifications, driving method, and equipment specifications for the sheet piles. If there are differences from the design drawing, change the design after obtaining the approval of the construction supervisor.

3.2.2 Normal line

(1) To construct the sheet piles correctly, carry out the following work after confirming the normal line.

(2) For the normal line, install the control point by measuring the exact location based on the design drawing, and check and correct the location of construction frequently in parallel with the progress of pile driving.

3.2.3 Guide beam

(1) The purpose of guide beams is to facilitate the erection and driving of steel sheet piles by installing auxiliary struts and piles of H-beams parallel to the normal line to ensure accurate driving and stability in construction.

(2) Drive auxiliary piles in 2 rows according to the construction normal (10m intervals) and install auxiliary struts inside the auxiliary piles. At this point, the inner spacing of the auxiliary struts should have a margin of 20 ~ 50 ㎜ than when the steel sheet piles are in a tight state.

(3) To prevent the hammer from hitting the guide beam after driving the steel sheet piles, the installation height of the guide beam should be 300 ㎜ ~500 ㎜ lower than the target height of the steel sheet piles.

(4) When driving the steel sheet piles, the striking force shall be greater than the driving resistance of the steel sheet piles. However, you should prevent the striking force from damaging the head of the steel sheet pile or exceeding the permissible long-column buckling load by checking the driving depth before starting construction.

3.2.4 Guide ring

(1) In terms of the cell-type, install an observation platform to frequently inspect the planned normal line and to determine the position to install the guide ring, and conduct preparatory work such as marking the scales on the sheet piles and drilling holes for the erecting work.

(2) To install the cells in the planned locations correctly, install the supports and guide beams to install the guide rings in the form of a #, then place a guide ring on top and form a cell by

erecting and driving steel sheet piles in turn. For the observation of normal lines, installation of supports, and installation of guide rings, consult and obtain the approval of the construction supervisor.

3.3 Test construction

(1) For the construction of steel pipe sheet piles, conduct a test pile drive to obtain the required data for construction management such as verifying the substrate, the penetration at the finishing location of pile driving, the fitness of construction machinery, and the degree of construction, and if the data obtained differs from the design drawing, change the design after obtaining the approval of the construction supervisor.

(2) Perform a pile driving test for each foundation with a steel pipe sheet pile reaching the substrate, and carry out at least 3 tests according to the conditions of the substrate. If the constructability of steel pipe sheet piles at the construction site is already confirmed, the pile driving test may be omitted.

3.4 Steel sheet pile

3.4.1 Erection

(1) Erection refers to the work of adjusting the joint of the next steel sheet pile to the steel sheet pile driven beforehand and lowering it to a depth where it can be independent. If it is not penetrated to a certain depth by self-weight, strike it lightly with a hammer.

(2) Before erecting the piles, tie the piles completely and hoist them up at a speed of 10 m/min. The vertical tolerance after erecting the piles shall be within 1/100 ~ 1/200.

(3) Be careful not to deflect or twist the joints when erecting the steel sheet piles. The steel sheet pile that is driven first becomes the reference for subsequent pile driving, so erect the piles by maintaining the position and inclination in the directions of the normal line and perpendicular direction.

(4) If there is a gap between the steel sheet pile and the auxiliary support, insert a spacer and adjust the direction of driving the steel sheet pile to prevent deviation.

(5) Handle the steel sheet piles carefully by considering various safety precautions from the time of erecting and driving the piles. In particular, collisions or shaking must be avoided.

3.4.2 Steel sheet pile driving

(1) After erecting the steel sheet piles, drive 1 or 2 piles at a time by considering the hammer capacity, field work conditions, and construction period. When driving the steel sheet pile, it will incline in the direction of progress, so perform the work so that it does not spread more than the width of the steel sheet pile. If a slope of about 1 sheet width occurs, it can be corrected

by driving a deformed sheet pile with the approval of the construction supervisor. Do not use deformed sheet piles consecutively.

(2) When it is impossible to penetrate to the predetermined depth due to changes in the ground layer and obstacles, structural problems can be anticipated, so establish countermeasures by consulting with the construction supervisor in advance. When the penetration exceeds the predetermined depth due to soft soil conditions, consult with the construction supervisor on the penetration depth.

(3) If there are inclinations, interlocking penetrations, rotation, head fractures, and joint deviations while driving the steel sheet piles, stop the driving process, identify the cause, and develop proper countermeasures.

(4) If the steel sheet pile is tilted during the driving process, the frictional resistance of the joint increases, which will cause a significant obstacle to driving the next pile. Therefore, correct the slope immediately as follows.

① Pull the head of the steel sheet pile in the opposite direction of the slope using a wire rope.

② Cut the bottom of the steel sheet pile diagonally so that the joint becomes shorter and correct the slope by reducing the ground penetration resistance of the joint.

③ If performing individual driving, change to parallel driving.

④ Strike the head of the steel sheet pile diagonally.

⑤ Apply lubricant to the connections to reduce the frictional resistivity at the connections, and install a shoe in the fore-end to prevent soil in the gaps.

⑥ Fabricate and use deformed steel sheet piles.

(5) When interlocking penetration occurs due to driving steel sheet piles on soft ground or by penetrating adjacent driven steel sheet piles together as a result of low bearing capacity at the fore-end or by inclination, prevent interlocking penetration using one of the following methods.

① If the steel sheet pile is inclined, correct the slope to reduce the frictional resistance of the joint.

② If the ground is soft, stop striking the steel sheet pile slightly higher than the planned position to create a margin equivalent to the interlocking penetration, and at the end, strike the piles again to align the positions.

③ Fix the steel sheet pile to be interpenetrated by welding or bolts to adjacent piles.

④ Put the rope of the crane on the steel sheet pile to be interpenetrated and hit the pile.

⑤ Apply lubricant to the joints to reduce frictional force.

⑥ If interlocking occurs despite applying the methods above, pull out the piles with a vibro hammer and perform the work again.

(6) To prevent the steel sheet pile from rotating, maintain a certain distance between the guide beam and steel sheet pile and insert spacers to facilitate striking on the ground. Note that when striking in the sea, it can be difficult to prevent rotation depending on the guide beam, since the

restraint of the guide beam is reduced by the length of the guide beam supporting piles higher than the sea-bed and the depth of the soft layer below the sea-bed. Therefore, when lowering in the upright position, control the work to prevent rotation by accurately observing in the direction of the normal line and the direction perpendicular to the normal line. In addition, if a gradual rotation occurs after construction, pull it out immediately and perform reconstruction.

(7) Increase and decrease of construction extension

Since there is a certain clearance in the joints, the construction extension may be increased or decreased depending on the conditions of erecting and driving. In this case, adjust the tension, neutral, and compressive conditions in the direction of the normal line, and review the increase and decrease every 20 ~ 30 sheets while performing the construction work.

(8) Pull out any steel sheet piles that deviate while driving the piles. When it is impossible to drive the piles again, consult with the construction supervisor to take proper reinforcement measures.

(9) In areas with firm sand, weathered soil, or weathered rock, use a vibro hammer and a water jet facility in parallel to drive to the required depth, or use rock drilling equipment. Select hard ground driving equipment after consulting with the construction supervisor.

(10) In the construction of steel sheet piles using a water jet, control the final penetration by limiting and adjusting the water jet injection to prevent ground disturbance.

(11) Where there is a risk of damage to nearby buildings and facilities due to groundwater leaks, apply waterproofing agents on the joints to prevent leaks.

(12) Remove soil and rust from the joints of the steel sheet pile and keep it sufficiently dry to apply the waterproofing agent.

(13) The waterproofing material shall have sufficient expansibility. Apply 200 g/m (3~4㎜ thickness) of the waterproofing material on the joint and cure for 12~24 hours during summer and 24~48 hours during winter.

(14) Apply the waterproofing material on one or both sides by consulting with the construction supervisor according to the estimated level of groundwater leakage, and protect the material from water if it rains.

(15) Discuss the connection and cutting of steel sheet piles with the construction supervisor.

(16) Prepare and store records of driving steel sheet piles, and record the details for each steel sheet pile in a certain form according to each step of work.

(17) Confirm whether the piles have been constructed according to the location, direction, height, inclination, and normal line specified in the design drawing. The tolerances are as follows.

① Wall length: (+) Sheet pile 1 sheet width, (−) None

② Curvature to the normal line: (±) 100 ㎜

③ Inclination to the normal line (transverse): Less than 1/75

④ Inclination of normal direction (longitudinal): (During construction) difference between top and

bottom ≤ Sheet pile 1 sheet width, (After completion) less than 1/75

3.4.3 Welding and cutting

(1) For welding, perform arc welding. The order of welding shall be approved by the construction supervisor prior to construction.

(2) Perform welding accurately and minimize the residual stress and deformation due to welding.

(3) Do not use welding rods with defects such as peeling of covering materials, gaps, contamination, and moisture.

(4) Be aware of the risk of electric shock accidents caused by welding machines and wires, and wear proper protective equipment while performing the welding work.

(5) Clean the surface of the piece to be welded before welding. In particular, remove water, rust, paint, slag, and dust from the weld surface and adjacent areas, as they cause cracks.

(6) If performing joint welding, maintain proper space between the ends of the pieces and avoid any significant errors.

(7) If performing lap joint welding, be careful of the adhesion of the pieces and prevent any gaps.

(8) When welding an assembly tool to a member, the weld shall be as small as possible; when removing it, smooth out the weld.

(9) Weld in the flat position, and obtain the approval of the construction supervisor prior to welding in other positions.

3.5 Steel pipe sheet pile (Wall steel pipe pile)

3.5.1 Piling work

(1) Erect the steel pipe sheet piles in accordance with the planned normal line based on the standard frame, and consult with the construction supervisor in advance on the construction method and sequence.

(2) In principle, use a vibro hammer to erect the steel pipe sheet piles, and install the steel pipe sheet piles at the position indicating the induced formwork while confirming the verticality from 2 orthogonal directions. The error with regard to verticality shall be within 1/100 ~ 1/200.

(3) In principle, finish driving the steel pipe sheet piles at the penetration depth according to the design drawing or the result of test construction.

(4) Handle the steel pipe sheet piles carefully by considering the various safety precautions from the time of erecting and driving the piles. In particular, collisions or shaking must be avoided.

(5) When it is impossible to penetrate to the predetermined depth due to changes in the ground layer and obstacles, structural problems can be anticipated, so establish countermeasures by consulting with the construction supervisor in advance. When the penetration exceeds the

predetermined depth due to soft soil conditions, consult with the construction supervisor on the penetration depth.

(6) Pull out any steel pipe sheet piles that deviate while driving the piles. When it is impossible to drive the piles again, consult with the construction supervisor to take proper reinforcement measures.

(7) Drive the steel pipe sheet piles using a method that does not cause rotation or inclination.

(8) Prepare and store records of driving steel pipe sheet piles in a certain format.

(9) Confirm whether the piles have been constructed based on the location, direction, height, inclination, and normal line specified in the design drawing.

① Wall length: (+) Sheet pile 1 sheet width, (−) None

② Curvature to the normal line: (±) 100 ㎜

③ Inclination to the normal line (transverse): Less than 1/75, or in conformance with construction specification

④ Inclination of normal direction (longitudinal): (During construction) difference between top and bottom ≤ Sheet pile 1 sheet width, (After completion) less than 1/75 or conform to construction specification

3.5.2 Field welding joint

(1) Since steel pipe sheet piles have joints and directionality, it is difficult to make an adjustment when the verticality of the upper and lower steel pipe sheet piles is poor, and therefore, field welding also requires construction management for each construction stage.

3.5.3 Sealing concrete and processing joints

(1) For combined use as a cofferdam, place sealing concrete to reinforce the steel pipe sheet piles in the vicinity of the upper slab connections.

(2) To secure the rigidity of the steel pipe sheet pile well, remove soil inside the joints by using a water jet and fill mortar over the entire length of the joints.

3.5.4 Steel pipe sheet pile well construction

(1) For combined use as a cofferdam, construct the cofferdam by excavating inside the cofferdam, installing staging, and placing bottom concrete according to the construction method and order specified in the design drawing and construction plan.

(2) Construct the joint between the steel pipe sheet pile and the upper slab so that the load acting on the upper slab is transferred to the steel pipe sheet pile.

(3) For combined use as a cofferdam, remove the steel pipe sheet piles in the staging and cofferdam after completing the upper slab and sphere according to the construction method and order specified in the design drawing and construction plan.

3.6 Cell-type steel sheet pile

3.6.1 Transportation and storage

(1) Prevent damage to the coating surface, joints, and lower end (the end hammered in) while transporting the cell-type steel sheet piles, and avoid distortion or deformation in order to maintain the characteristics of the section. In addition, store the piles on a flat, well-drained surface using supports to pile up the sheet piles.

(2) When lifting or transporting cell-type steel sheet piles horizontally, hoist the piles at 2 points.

3.6.2 Preparations for construction and guide ring

(1) Install an observation platform to frequently inspect the planned normal line and to determine the position to install the guide ring, and perform preparatory work such as marking the scales on the sheet piles and drilling holes for the erecting work.

(2) To install the cells in the planned locations correctly, install the supports and guide beams to install the guide rings in the form of a #, then place a guide ring on top and form a cell by erecting and driving steel sheet piles in turn. With regard to the observation of normal lines, installation of supports, and installation of guide rings, consult and obtain the approval of the construction supervisor.

3.6.3 Erecting steel sheet piles

(1) Erect the steel sheet piles by erecting the T-shaped steel sheet piles in the arc section first according to the guide ring, then erect the guide steel sheet piles, and erect steel sheet piles on the left and right sides of the guide pile while maintaining even spacing.

(2) After erecting the piles evenly, pull out the guide piles and erect the steel sheet piles to be constructed.

(3) Before erecting the steel sheet piles, consult with the construction supervisor about the erection process in advance after taking weather and marine conditions into consideration.

3.6.4 Driving steel sheet piles

(1) First, drive the T-shaped steel sheet pile, then drive 2~3 steel sheet piles on both sides of the T-shaped steel sheet pile to fix it, and drive the remaining piles.

(2) Consult with the construction supervisor in advance regarding the order and method of pile driving.

3.6.5 Filling

(1) Fill with high-quality sand or gravel. The requirements for selecting the filling material shall be as specified in the construction specification.

(2) To prevent eccentricity from being applied to the cell while filling, conduct filling from the center of the cell to the outer direction and carefully check for any deformation or inclination of the cell or arc.

(3) Remove guide rings and supports after performing filling halfway. Install filling rings to prevent cell deformation and then complete the filling.

(4) Consult with the construction supervisor on the work process until the filling work is complete, and prepare for changes in the weather and sea.

3.6.6 Prefabricated cell-type steel sheet pile

(1) The preparations for construction such as the scope of application, materials, production, transportation, and storage shall follow the requirements for the cell-type steel sheet pile.

(2) The method of erecting steel sheet piles outside the guide ring of the assembly base shall follow the applicable requirements of 3.4 and 3.5 of this standard.

(3) Bundle the assembled steel sheet piles, attach a vibro hammer, and connect to a lifting cable. Since the method requires a floating crane to lift the lifting cable for marine transportation, the processes similar to the method of launching a caisson shall follow the specifications related to caisson transportation.

(4) Arc assembly and marine transportation shall also follow the prefab cell-type construction method.

(5) Consult with the construction supervisor regarding the order of driving the assembled cells at the predetermined locations.

(6) Matters related to field work such as the assembly base facilities, the order of construction work, selecting the vibro hammer, and selecting the floating crane shall be managed by consulting with the construction supervisor.

3.7 Concrete sheet pile

3.7.1 Transportation and storage

(1) Depending on the arrangement of rebars, concrete sheet piles may have tensile and compressive sides, so check the piles carefully to prevent cracking or damage caused by excessive stress during the handling process.

3.7.2 Pile driving

(1) Remove concrete sheet piles that are damaged or short in length and replace the piles with new ones to perform pile driving again.

(2) Check the tensile and compressive sides of the concrete sheet piles and drive the piles by aligning the direction of the piles according to the occurrence of bending stress.

3.7.3 Inspection and tolerance

(1) Confirm that the piles have been constructed according to the location, direction, height, inclination, and normal line specified in the design drawing.

(2) The tolerances are as follows.

① Wall length: (+) Sheet pile 1 sheet width, (−) None

② Curvature to the normal line: (±) 100 ㎜

③ Inclination to the normal line (transverse): Less than 1/75

④ Inclination of normal direction (longitudinal): (During construction) difference between top and bottom ≤ Sheet pile 1 sheet width, (After completion) less than 1/50

⑤ Sheet pile floor height: (±) 50 ㎜