

KCS 11 60 00 : 2019

Anchor

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KC CODE



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 relevant sections of the road construction standard specification, highway bridge standard specification, and the building construction standard specification, based on the existing construction slope standard specification. The history of the standard and its revisions is as follows.

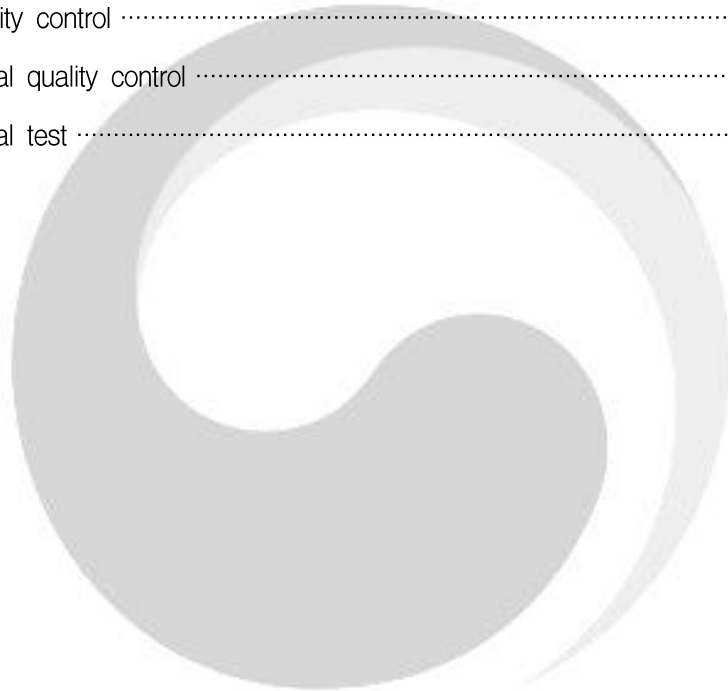
Construction Standard	Main Content	Enacted or Revised (Year. Month)
Construction slope standard specification	• Established construction slope design standard	Enacted (2006.05)
Construction slope standard specification	• Revised construction slope design standard	Revised (2011.12)
KCS 11 60 00 : 2016	• Integrated and maintained as code in accordance with the changes to the construction standards code system	Enacted (2016.06)
KCS 11 60 00 : 2016	• Amended according to Korean Industry Standards and Construction Standards	Amended (2018.7)



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1. General

1.1 Scope of application

(1) This standard applies to the anchor work performed to reinforce ground structures.

1.2 Reference standards

No content

1.2.1 Related regulations

- KS D 1161
- KS D 1162
- KS D 1163
- KS F 4101
- KS F 4102
- KS F 4103
- KS F 4104
- KS F 4105
- KS L 5060
- KS F 4106

1.2.2 Related standards

No content

1.3 Definitions

(1) Definition

1.4 Materials

1.4.1 Construction

- (1) The construction shall be performed in accordance with the construction plan and start construction after obtaining confirmation from the construction supervisor.
- (2) The contractor shall prepare a construction plan that includes the following.
- ① Construction overview
 - ② Detailed construction schedule (including materials, manpower, and equipment plans)
 - ③ Construction schedule by type of construction
 - ④ Quality control plan (quality control organization, management goals, measures to satisfy said goals, measures to meet unachieved goals, etc.)
 - ⑤ Safety management plan and environmental management plan

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- ⑥ Matters requiring consultation with other construction projects, and other types of construction
- ⑦ Matters that require changes in the design drawing
- ⑧ Other matters required by the construction supervisor

1.4.2 Test plan

- (1) The contractor shall submit an anchor test plan (tension test, confirmation test, pull-out test, tensile test, verification test, pull-out, and creep test if necessary, etc.) required on-site, testing presented in the design manual in consultation with the designer and construction supervisor before the construction.
- (2) The anchor shall be installed in the design.
- (3) A confirmation test shall be performed for one or more types of anchorages installed in the ground. The number of anchorages shall be determined by the construction supervisor.

1.5 Construction

- (1) Drilling
- (2) Test

2. Materials

2.1 Materials

2.1.1 Tensile

- (1) For the tensile test, the quality of the anchor shall be confirmed with the construction supervisor. The test shall be performed in accordance with KS C 1501.
- (2) Use a tensile test.

2.1.2 Grout

- (1) Use Portland cement or high-early-strength cement as specified in KS L 5201 as the grout, and obtain approval from the construction supervisor for other types of cement.
- (2) Use admixtures specified in the design drawing, and obtain approval from the construction supervisor for other admixtures.
- (3) The water used in the grout shall not contain more than 0.1% of harmful substances, such as oil, acid, saline, organic substances, and other materials that adversely affect the anchor body.

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and tendons.

- (4) The aggregate used in the grout shall be clean, hard, durable and of an adequate grade. In addition, the aggregate shall not contain dust, clay or organic materials.
- (5) The grout shall be of chemically stable materials that do not decrease in volume, do not erode, and are free from organic materials, and shall be filled by gravity or pressure.
- (6) The compressive strength of the grout at 28 days shall be pre-tested using samples taken before tensioning or during construction, and the reference strength must be satisfied even if accelerators are used to advance the curing period, and the water-cement ratio (W/C) shall follow the test method.
- (7) The b 24 hours.
- (8) Other

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- (1) The s ess.
- (2) The pressure gauge of the stressing jack shall be tested and calibrated by a certified testing institute.
- (3) The anchorage wedge of the tension cylinder and its fastener shall be tensioned in good engaged condition. It is also desirable to use a stressing jack equipped with a self-gripping assembly.
- (4) Cylinder with jack chair or tensile cylinder supports shall be used for preventing the tilt to the lower part when installing a tensile cylinder.

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2.3.2 Grout mixer and pump

- (1) The grout mixer shall consist of a mixing tank, grouting tank, storage tank, and water tank in order to check the mixture according to the mixing design at all times.
- (2) The mixer shall be capable of mixing and grouting at the same time, capable of continuous injection until the grouting is completed, and equipped with a pressure gauge.
- (3) The grout pump shall have a minimum injection pressure of at least 0.5 MPa, and the grout hose and connection shall be made of materials capable of withstanding pressures up to 2 MPa.
- (4) The water meter shall be capable of measuring up to 2 ℓ/m^3 of water used to mix the grout.
- (5) The shut-off valve installed at the injection connection shall be capable of maintaining the required pressure.
- (6) Pump: When using anchor

2.4 Other

2.4.1 Non

- (1) Permanent anchors shall be sealed since the wedge anchor the
- (2) Skip c
- (3) The non-adhesive without any strain elastic

2.4.2 Wa

- (1) Permanent anchor since the wedge (or squeezed from the wedges due to corrosion of the tensile materials, and the anchor forces shall be significantly reduced.
- (2) In the case of permanent anchors, adhering watertight materials shall be inserted into the contact surface between concrete grids, iron plates, anchorage, and steel plate in order to prevent corrosion of the anchor steel and anchorage by rain or moisture, and shall be completely filled with grease for corrosion method inside the anchor head cap.

2.5 Materials quality management

2.5.1 Storing the materials

- (1) Store the materials in a manner that will prevent any damages. Take particular care to keep the steel, cement, and admixtures away from moisture.

3. Construction

3.1 Checking the construction conditions

- (1) For construction, first check the construction plan and site conditions from the construction design.
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geote
- (2) Perform the construction according to the construction plan and site conditions.
ence and
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- (3) If it is necessary, check the construction plan and site conditions.
ction plan
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- (4) Do not start construction until the necessary conditions are met.
to ins necessary
drilling and before
- (5) Make a borehole and install the anchor.
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anchc ect of the
- (6) The anchor should be installed deeper than the drawing.
d deeper
than r drawing
throug of the site
differ ng to the
groun instruction
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- (7) Check the construction conditions and take necessary measures.
sary, take
meas
- (8) Take measures to cut off or block water to prevent excessive discharge of groundwater at the anchor.

3.2 Preparatory work

3.2.1 Processing and assembly of anchors

- (1) Before starting construction, test drill and check the ground conditions of the site with the ground conditions of the design in order to process and assemble the anchors according to the design

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drawing.

- (2) Factory assembly shall be performed in principle, but field assembly is also possible for cases with the equivalent field facilities because waterproofing and anti-corrosion without foreign substances entering the anchor body are important,
- (3) Install spacers in a suitable location to maintain the spacing between tension members and to prevent bending of the anchor body so that the covering depth of the grout is maintained.
- (4) Cut the tension members with a cutter instead of a oxygen cutting machines, in case of tensile type anchors, rust-proof the tension members except the bonded zone, and cover them with a sheath to prevent rust. For the cutting length, take into account the length of the sheath.
- (5) For the hose as specified in the drawing, the hose shall be used.
- (6) For the zone shall be used.
- (7) In prior to the obtaining of the radius of the curve, the radius of the curve shall be used.
- (8) To prevent the radius of the curve, the radius of the curve shall be used.
- (9) Be careful of the instruction for inserting the anchor into the hole.
- (10) If the anchor is not round and take



3.3 Cons

3.3.1 Drill

- (1) Drilling shall be conducted at the site after the construction of the slope. On the slope, compressed air drills are used to prevent increase of saturation of the surface during the drilling. For general excavation, compressed air shall be used effectively, but for clayey soils or loose landfills, hydraulic drills or anchor-specific drilling equipment shall be used.
- (2) The diameter and depth of drilling shall follow the design drawing.
- (3) The drilling diameter shall be based on the drawing and at least 40 mm larger than the diameter of the anchor in case of difficulties in the construction of an anchor insertion and its ability to exhibit the anchor force. In areas where there is concern of soil collapse, prevent any disturbance and collapse of soil by inserting a casing within a certain period of time after drilling

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(time required to insert and inject the anchor).

- (4) The drilling work shall satisfy the location, direction, and length specified in the design drawing by considering presence of the stratum and water (leakage) by the slime and circulating water to prevent damage to the borehole.
- (5) When groundwater flows out after drilling, pre-inject with high-pressure injection and repeat drilling to prevent the outflow of groundwater.
- (6) Prepare a drilling report for every hole to check the soil layer, drilling length, drilling diameter, and drilling time, and to confirm the reliability of the anchor body and tensile force by comparison with the design value.
- (7) Set the head of the anchor to the head of the casing.
- (8) For drilling in soft soil, prevent soil leakage during drilling.
- (9) During drilling, prevent soil leakage.
- (10) The anchor shall pass through the space from the surface to the bottom of the hole.
- (11) When the anchor is inserted, it shall pass through the space between the adjacent casing and the borehole.
- (12) Borehole diameter shall be checked at the following points:
 - ① At the top of the borehole.
 - ② At the bottom of the borehole.
 - ③ At the middle of the borehole.



3.3.2 Inserting the anchor

- (1) In case of difficult insertion by manpower, the anchor is inserted by using an insertion bench or a crane.
- (2) When inserting the anchor, attach centralizers at intervals of 1 m ~ 3 m to the anchor so that the anchor is located at the center of the drilling hole.
- (3) If there are concerns that the borehole will collapse, pre-inject the grout into the part of the bonded zone before inserting the anchor without the pulling out of the casing. After pulling out of

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the casing, inject the grout into the rest.

(4) Insert supports to fix the anchor in the hole after inserting it to the required length.

(5) If there is a leak in the hole, block the opening with non-woven fabric or sealed packs to prevent the leakage of soil and grout.

3.3.3 Grout mixing and grouting

(1) Mix the grout as specified in the design drawing. However, if the grout is mortar, correct the plant discharge according to the surface moisture of sand.

(2) Perform test grouting before grouting and start grouting after confirming the detection pressure, gel time, and the amount of grout.

(3) Use a pump to inject grout into the hole from the bottom and fill the hole with grout. When the grout is injected, the next

(4) Inject

(5) Prior to grouting, the

(6) Use a

(7) Install unbonded

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(11) The

curing step.

(12) Record and store data such as the mixing, quantity, and pressure of grouting.

3.3.4 Prestressing and anchorage work

(1) Install the head and anchorage according to the order of construction to prevent being buried by foreign substances due to the grout.

(2) Perform prestressing with a proper jack according to the tendons with the prestressing force specified in the design drawing.

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- (3) Tension members shall be tensioned after completing the grout and confirming the strength specified in the design drawing.
- (4) Keep the anchor head and tension members vertical to prevent fractures caused by eccentricity.
- (5) Have instruments such as the load gauge of the stressing jack tested and calibrated by a certified testing institute to accurately measure the load.
- (6) Record the pressure and elongation of the tension meter in the anchor prestressing report.
- (7) Fix the anchor head correctly to maintain the anchorage prestressing force in the manner specified in the design drawing.
- (8) During the grouting process, record the elongation according to the prestressing force on the prestressing jack and the elongation of the grout.
- (9) Perform the anchorage strength test for the anchorage k suitable.
- (10) On the site, adjust the prestressing force of the anchor.
- (11) Disassemble the anchor suddenly.
- (12) Consistent
- (13) Consistent

3.4 Consistent

No counter

3.5 Repair

- (1) If the surrounding concrete is damaged, the repair of the concrete shall be verified, if necessary.

3.6 On-site quality control

3.6.1 General quality control

- (1) Quality control of anchors shall be performed for the following.
 - ① Grouting work management
 - A. Grout mixing management
 - B. Consistency management

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- C. Injection rate management
- D. Types of mixing materials and mixing ratio management
- ② Testing
 - A. Tensile test
 - B. Verification test
 - C. Pull-out test
 - D. Creep test
 - E. Lift-off test
- (2) Record test results and subject the results to the acceptance standard of the test results of the construction.
- (3) Tensile test
 - ① Perform the test according to the instruction, and the test results should be recorded. The test results show that the test results are round will be recorded.
- (4) Grout test
 - ① Verify the test results, if the test results are not as expected, the test should be repeated once.
 - ② Perform the test.
 - ③ Test results.
 - ④ Record the test results.
- (5) Performance test
 - ① Test results.
 - ② Test results.
 - ③ Test results.
 - ④ Test results.

3.6.2 General tests

- (1) Tensile test
 - ① Specify anchors subject to tensile tests in the work process of the construction plan, and develop plans to obtain the acceptance standard of the verification test.
 - ② Use a pressurizing device with a nominal capacity of at least 1.2 times the maximum planned test load that is capable of increasing and decreasing the load according to the planned loads. Activate the load gauge of the stressing jack before measuring the loads in

order to measure the loads accurately.

- ③ Except in special cases, the general test method shall be as follows.
 - A. Set the planned maximum test load to at least 1.2 times the design load and less than 0.9 times the yield load of the tendons. To verify the stability of the anchor for the design, conduct tensile tests on at least 3 anchors and 5% of the total ground anchor, and test the remaining anchors according to the verification test process.
 - B. Set the initial load to 0.1 times the planned maximum test load, but maintain an initial load of at least 50kN because it is difficult to measure small loads when the test load is

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Table 3

Load	
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- ④ If the results of the tensile test show that there is something wrong with the anchor, report it immediately to the construction supervisor and take the proper measures.
- ⑤ The test results show the load-displacement curve, the load-elastic displacement curve, the load-plastic displacement curve, and the time-load curve. Record any significant findings of the test.
- ⑥ If the results of the tensile test show that there is something wrong with the anchor, report it immediately to the construction supervisor and take the proper measures.
- ⑦ Perform the tensile test before prestressing the anchor and performing anchorage work.

(2) Verification test

- ① Conduct the verification test on all anchors other than those subject to the tensile test.
- ② For the pressurizing device, refer to 3.6.2(1)②.
- ③ Except in special cases, the general test method shall be as follows.
 - A. Set the planned maximum test load to 1.2 times the design load.
 - B. Perform the test by loading from the initial load to the planned maximum load and unloading to the initial load; count this as 1 cycle.
 - C. During the loading process, stop unloading at 0.4 times, 0.6 times, and 1.0 times the planned maximum load, and record the load value when the load becomes

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(3) Pull-out

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⑤ The test method shall be as follows, except as specifically specified.

A. The planned maximum test load shall be the largest one 1.2 times the design load, or the expected pull-out resistance.

B. Initial load shall be 0.1 times the maximum planned test load.

C. Multi-step method by load control for 5 to 10 steps shall be employed through the load stage from the initial load to the planned maximum test load.

D. If the maximum planned test load is not reached, the maximum test load considering the strength characteristics of the tensile materials shall be re-injected after the initial load shall

E. The type of ground on which the anchorages are installed, the time specified according to the loading step, and whether the loads can be maintained shall be checked at each cycle of the loading.

G. The measurement item shall be the load, displacement and duration of the load. The displacement shall be based on the average of the two dial gauges.

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stability.

③ E)

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load until the displacement becomes stable. When the stability cannot be maintained, maintain the load according to Table 3.6-2 below.

Table 3.6-2 Creep test: Minimum loading time

Loads \ Layer	Minimum observation time	
	Sand	Clay
0.2T _d		
0.4T _d	More than 15 minutes	More than 30 minutes
0.8T _d	More than 15 minutes	More than 30 minutes
1.0T _d	More than 1 hour	More than 2 hours

- D
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- F. semi-log
- ④ If , report it
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- (5) Lift-off
- ① Ti in tension
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- ② Ir placement
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- ③ T terials for
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- anchors.

- (6) A uniaxial compressive strength test for grout quality control shall be conducted in accordance with KS F 2426.