

KCS 11 73 05 : 2019

# Grid Block and Stone (Block) Pitching

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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 a standard by integrating the Construction Work Slope Surface Standard Specification and the corresponding parts of the Road Work Standard Specification and the General Civil Engineering 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 73 05 : 2016	• Integrated and maintained as a code according to changes in the construction standard code system.	Enactment (June 2016)
KCS 11 73 05 : 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 the construction of cast-in-place concrete grid blocks, precast concrete grid blocks, synthetic resin grid blocks, alternative protection blocks, and slope protection blocks.

### 1.2 Reference Standards

- KS F 2530 Stones
- KS D 3504 Steel bars for concrete reinforcement
- KS F 2405 Method of test for compressive strength of concrete
- KS F 2408 Method of test for flexural strength of concrete
- KS L 5201 Portland cement

### 1.3 Supplied Materials

Not applicable.

### 1.4 Definition

Not applicable.

### 1.5 System Description

Not applicable.

### 1.6 Allowable System Error

Not applicable.

### 1.7 Submissions

- (1) The submissions that shall be prepared and submitted include the general details about the material, dimensions, weight, and compressive strength of grid block for the slope protection, the independent production status, technical data, installation guidelines, and product data, including the construction results data.

## 2. Materials

### 2.1 Materials

#### 2.1.1 General Materials

- (1) The blocks for slope protection shall be selected according to the design drawings. A concrete or synthetic resin product having performance and material equal to or better than those of the design product and having excellent appearance, strength, constructability, durability, and economic feasibility may be used after obtaining approval for design change. However, a concrete product must be used for a large-scale slope, a clay ground or a part where the sliding of the surface soil is expected.

### 2.1.2 Concrete Slope Protection Block (Precast Block)

- (1) Flexural strength: 5MPa or higher
- (2) Water-cement ratio (W/C) of concrete: below 40% (in manufacturing)
- (3) Allowable dimensions
  - ① Width and thickness: Design drawing dimension  $\pm 2\text{mm}$
  - ② Length: Design drawing dimension  $\pm 4\text{mm}$
- (4) With regard the outer appearance, the material shall be dense without any hazardous defects, and the surface shall be flat and well-shaped.
- (5) The joint structure shall allow the construction of an anchor steel reinforcement bar at the block joint, and the filling of the pore with mortar to resist sliding of the ground.
- (6) The anchor pin shall be a deformed D16 steel bar that meets the KS D 3504 standards and has a length of 0.4 to 1 m, and the tip shall be processed to make it sharp for easy insertion into the ground.
- (7) For the mortar, the volumetric mixing ratio of Portland cement and fine sand having a particle diameter of less than 1mm shall be 1:3.
- (8) The cement shall a product equal to or better than that of KS L 5201.
- (9) The maximum dimension of coarse aggregates shall be less than 40mm and less than  $\frac{2}{5}$  of the minimum thickness of the manufactured product, and shall not exceed 4.5 of the minimum horizontal interval.
- (10) The steel reinforcement bar shall be a product equal to or better than that of KS D 3504.

### 2.1.3 Concrete Grid Block

- (1) The dimensions, weight, shape, and compressive strength (or flexural strength) of the material shall be in accordance with the specified design drawings and approved by the construction supervisor.
- (2) The cement shall be a product equal to or better than that of KS L 5201.
- (3) The maximum dimension of coarse aggregates shall be less than 40mm and less than  $\frac{2}{5}$  of the minimum thickness of the manufactured product, and shall not exceed 4.5 of the minimum horizontal interval.



- (4) The steel reinforcement bar shall be a product equal to or better than that of KS D 3504.
- (5) The admixture shall be a product of which quality has been tested by sufficiently investigating the application methods and effects.

#### **2.1.4 Synthetic Resin Grid Block**

- (1) The quality standard for a synthetic resin product used for a resin grid block shall be not less than 30MPa in compressive strength and not less than 0.8MPa in flexural strength.
- (2) The block shall have the dimensions and shape that are in accordance with the design drawings and, unless otherwise specified, shall be approved by the construction supervisor.
- (3) A synthetic resin grid block shall be installed in a place with a low risk of fire.

#### **2.1.5 Stone Block**

- (1) The material of the stone block shall be equal to or better than that of KS F 2530. Because the stone block is an unpolished rectangular rubble, the length of 300 to 700mm, the width of 250 to 350mm, and the thickness of 100 to 150mm shall be used.

#### **2.1.6 Basic Materials for Slope Protection Block**

- (1) The concrete strength shall be equal to or higher than the strength required by the design. The air ratio shall be less than  $4.5 \pm 1.5\%$ , the slump less than  $8 \pm 2.5\text{cm}$ , and the maximum aggregate dimension less than 40mm.

### **3. Construction**

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

Not applicable.

#### **3.2 Work Preparation**

Not applicable.

#### **3.3 Construction Standards**

##### **3.3.1 Protection Block Foundation Installation**

- (1) The slope protection block shall be supported by a solid structure such as a banquette drain or a retaining wall in order to prevent settlement or sliding. When such a

structure does not exist at the bottom of the block or when the design does not include a foundation, a concrete foundation shall be installed after obtaining approval for the design change.

### 3.3.2 Slope Protection Block (Precast Concrete Block)

#### (1) Surface leveling

- ① Loose rocks, tree roots, and other unstable soil lumps on the slope surface or near the slope shall be completely removed.
- ② The slope surface shall be neatly arranged according to the lines and slopes specified in the design drawings. A batter board and a reference frame shall be installed in the completely arranged area and kept until the completion of the construction to allow the construction supervisor to inspect.
- ③ In the finishing works of the slope surface, broken rocks shall be completely removed from the exposed rock. For a solid bedrock, a slope protection grid block shall be installed in consultation with the construction supervisor.

#### (2) Trenching and back filling

- ① A slope protection block must be installed after trenching, and shall not be constructed by placing a block on the slope surface and covering it with soil.
- ② After installing a protection block, the area around the trenching work shall be compacted manually. The bottom of the top member shall be carefully compacted to prevent soil settlement.

#### (3) After a banquette drain, a retaining wall, or a separate foundation is completed, the slope protection blocks shall be stacked from the bottom to the top to avoid sliding, not from the top down to the bottom. In addition, a marginal space shall be secured to fill the grid blocks with soil.

#### (4) Assembly and installation

- ① The slope protection blocks shall be carefully installed to ensure that each member interlocks rightly. After fixing an anchor reinforcement bar vertically on the ground at the grid intersection, the pore shall be densely filled with mortar to promote tight attachment to the original ground and prevent sliding.
- ② When the collapse of sliding is expected or when the standing timber on the slope shall be protected, actions shall be employed in consultation with the construction supervisor (or administrator) to install a facility for preventing collapse or to protect the standing timber.
- ③ With regards to the methods of connecting and assembling the protection blocks, the protection blocks shall be coupled according to the design drawings, and an anchor bar shall be fixed to the design depth of the slope.

- ④ After the grid blocks are completely assembled and arranged in the longitudinal and transverse directions, the inside of the protection blocks shall be covered with soil. For the growth of plants, the slope protection blocks shall be filled with fertile mold and uniformly compacted using a wooden stick.
- ⑤ The sod-pitching work shall be performed with block-sod with much soil for the areas of weathered rock and decomposed granite by plating the sod densely on the entire block.
- ⑥ Soil compaction shall be performed when the soil is slightly wet. Pieces of wood, large stones, and other impurities shall be removed during compaction.
- ⑦ The locations and shapes of the protection block can be changed according to the site conditions and shall be approved by the construction supervisor before starting the installation.
- ⑧ If the construction work is found to be inappropriate through the inspection, the contractor shall perform the construction again or take necessary measures at the contractor's own expense according to the instructions from the construction supervisor.

### 3.3.3 Grid Block

- (1) When installing concrete grid blocks, the slope surface shall be leveled according to the design drawings, and the grid blocks shall be stacked to be interlocked with each other rightly to avoid sliding.
- (2) The length of a slope surface to which grid blocks are continuously applied is limited to less than 10m. If the length of a grid block is longer than 10m, a berm having a width of at least 1m shall be installed so that the length of continuous construction can be less than 10m. The maximum length of continuous construction of cast-in-place grid blocks is 20m.
- (3) A flow blockage is installed at the fixing part of the grid, the flow blockage and the grid shall be fixed sufficiently.
- (4) The inside of the grid block shall be filled by spraying, grass planting, and stone filling depending on the conditions of the slope surface.
- (5) When grass is planted in the grid, the soil for the grass shall be sufficiently filled and compacted.
- (6) A synthetic resin product shall be tightly fixed with a pin between two grids and settled on the slope surface.
- (7) When constructing a grid hole in an area with a berm, the finishing block and the end part of the berm shall be combined as one body so that the block may not collapse or become detached by the softening of the block foundation due to the infiltration of

surface water through the joint and the scouring of the end part.

- (8) In areas where the slope surface may become detached or collapse due to scouring caused by surface water or gushout water, a drainage facility shall be installed as specified in the design drawings or according to the instructions given by the construction supervisor.
- (9) The slope shall be constructed in a range of  $\pm 50\text{mm}$  from the finished surface and  $\pm 25\text{mm}$  from the bottom surface.

### 3.3.4 Block Pitching

- (1) Blocks shall be aligned to be attached on a sandy material having a thickness of 0.5m with a masonry joint width of less than 25mm.
- (2) Blocks shall be tightly attached, and the masonry joint shall be filled with mortar to the surface. The depth of mortar masonry joint shall be 50mm.
- (3) The surface shall be covered for at least 5 days after completion to maintain the wet condition.

### 3.4 Allowable Construction Error

- (1) The allowable construction error of the slope protection block shall be less than  $\pm 50\text{mm}$  from the finished surface.

### 3.5 Repair and Reconstruction

Not applicable.

### 3.6 On-site Quality Control

#### 3.6.1 Test Frequency

- (1) The flexural strength test (KS F 2408) for the concrete slope protection blocks shall be performed every 2,500 blocks.

#### 3.6.2 Manufactured Concrete Product (Concrete Bloc, Concrete Grid Block, Etc.)

- (1) The name or code of the manufacturing factory, and the date of manufacturing shall be marked on the product.
- (2) Total inspection shall be performed with regard to the appearance of the product.
- (3) Random sampling inspection shall be performed for the inspection and testing of the product. The result shall be approved by the construction supervisor.
- (4) Broken products and those with cracks, pores, discoloration, or visible defects shall not be used.

- (5) The strength of the concrete products shall be tested every 200 products.
- ① Three specimens shall be prepared by the same compacting and curing conditions as the manufactured product.
  - ② A standard specimen has a diameter of 100mm and a height of 0.2m.
  - ③ The compressive strength test shall be performed according to KS F 2405.
  - ④ If the measurement value of one specimen differs by more than 10% from the average, the measurement value obtained with that specimen shall not be included in the calculation of the compressive strength. If the measurement values of two specimens out of the three differ by more than 10% from the average, the products are not accepted.
- (6) In the strength test, the placing conditions and the reinforcement cover shall be inspected by using broken samples of the manufactured product.
- (7) The compressive strength of the tested specimens shall be higher than the value in the product data provided by the manufacturer.
- (8) In the strength test, the placing conditions and the reinforcement cover shall be inspected by using broken samples of the manufactured product.

### **3.6.3 Test of Synthesis Resin Grid Block**

- (1) The test of synthesis resin grid block shall be performed according to the product data provided by the manufacturer.