KCS 11 75 10 : 2019

Rockfall Prevention Fence

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국토교통부

Foreword

- To address needs that were caused by changes in the construction standard 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 Road Work 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 75 10 : 2016	• Integrated and maintained as a code according to changes in the construction standard code system.	Enactment (June 2016)
KCS 11 75 10 : 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 installing rockfall prevention fences for preventing accidents due to rockfall from a slope.

1.2 Reference Standard

- KS B 1002 Hexagon head bolts and hexagon head screws
- KS B 1012 Hexagon nut and hexagon thin nuts
- KS D 2330 Aluminium alloy ingots for castings
- KS D 3503 Rolled steels for general structure
- KS D 3514 Wire ropes
- KS D 7018 Chain link wire netting
- KS D 7036 Polyvinyl chloride coated color steel wires
- KS D 3552 Low carbon steel wires

2. Materials

2.1 Materials

2.1.1 Wire Rope

(1) The wire rope has a circumscribed circle diameter of at least 18mm, and a cutting load of at least 157kN. The amount of zinc plating attachment to the strand shall be at least 2.254N/㎡(2230gf/㎡), and other specifications shall satisfy KS D 3514.

(2) Type G wire rope shall tolerate at least 183kN, and Type A shall tolerate at least 197kN.

(3) The amount of zinc plating attachment to the strand shall be at least 0.833N/㎡(85gf/㎡) for Type G, and at least 0.686N/㎡(70gf/㎡) for Type A.

2.1.2 Wire Net

(1) The wire net shall satisfy KS D 7036 and KS D 7018.

(2) The diameter of the core wire of the net shall be 3.2 to 4mm, the diameter of the zinc-plated and PVC-coated core wire shall be 4 to 5mm, and the mesh size shall be at least 50mm × 50mm.

(3) With reference to the SWMV-GS2 type, the amount of zinc attachment shall be at least 0.297N/㎡(30gf/㎡) for a core wire diameter of 3.2mm and at least 0.343N/㎡(35gf/㎡) for a core wire diameter of 4.0mm.

(4) The PVC-coated net shall be a wire net product coated with soft PVC (0.3 mm) satisfying KS D 3552 and shall satisfy V-G1 of KS D 7018.

2.1.3 Anchor Bolts and Nuts

(1) Anchor bolts and nuts shall satisfy KS B 1002 and KS B 1012.

2.1.4 Binding Wire

(1) The material for binding wire shall have a strength equal to or higher than that of the wire net.

2.1.5 Pillars

(1) Steel pipes, shaped steel, and other materials used for pillars shall have specifications equal to or higher than SS400 provided in KS D 3503. The material shall have a tensile strength of 400 to 510MPa, a yield strength of at least 245MPa, and an elongation percentage of at least 17%.

(2) The amount of zinc attachment to one side shall be at least 5.88N/㎡(600gf/㎡).

2.1.6 Auxiliary Pillar

(1) Auxiliary pillars are installed at the central points between an end pillar and a middle pillar or between middle pillars.

(2) The materials used for an auxiliary pillar may be a rectangular pipe with a width of at least 50mm, a breadth of 20 to 50 mm, and a thickness of at least 1.6mm, or a flat iron with a width of at least 50mm and a thickness of at least 4.5mm. An auxiliary pillar shall be fixed to a wire rope using U-shaped bolts.

2.1.7 Anchor Block

(1) Anchor blocks, consisting of U-shaped bolts and nuts, are the devices for anchoring a middle pillar with a wire rope or an auxiliary pillar with a wire rope. The anchor block shall be M20 × 45 in size, and shall be zinc-plated.

(2) The material for an anchor block shall be aluminium alloy for casting of AC4C.2 specified in KS D 2330 and have a tensional load of at least 132.6kN(1,300㎏f) and a compressive load of at least 479.6kN(4,700㎏f).

2.1.8 Splices and Sockets

(1) Splices and sockets are the devices for anchoring a wire rope to an end-pillar. A splice bar shall have a diameter of 25mm and a length of 1 to 2m, and shall be zinc-plated. A socket shall be of zinc-plated cast-iron and be of a material that do

not allow failure even when the wire rope is fractured in a tension test. A splice and a socket that are connected with each other shall have a structure allowing for connection with a nut.

2.1.9 Material Quality Management

(1) When a rockfall prevention fence is formed by using materials that are not used for a general rockfall prevention fence, the used materials of each component shall have sufficient strength and allowable strain values in order to make the rockfall prevention fence be of sufficient performance. Individual materials shall be defined in accordance with the standards.

3. Construction

3.1 Verification of Construction Conditions

3.1.1 Items for Review Before Construction

(1) A construction plan shall be prepared and submitted in accordance with the construction work schedule and the present standards.

(2) Material product data

① Product data and installation instructions provided by the manufacturer

② Statement of delivery and quality test report showing the materials and specifications of the used materials

(3) Detailed drawings for construction

① Floor plans and construction development drawings specifying the installation location and pillar interval, etc. of the rockfall prevention fence

② Cross-sectional view specifying the slope and the installation height of the fence

③ Detailed drawings for pillar installation

(4) Verification of absorption energy

Appropriate height and separation distance shall be determined to prevent falling rocks from jumping over the rockfall prevention fences. The absorption energy within the allowable range of the fence shall be determined and compared with the rockfall energy to review basic stability in the design. The present specifications describe the installation of standard rockfall prevention fences having an absorption energy of 48kJ and 61kJ. Therefore, before construction, the rockfall energy shall be investigated in accordance with the scale of the rockfall (weight and shape of rockfall, falling height, inclination of slope, rock quality, conditions of slope, etc.) in order to install a rockfall prevention fence that may safely absorb the rockfall energy. If the required absorption

energy is too high to prevent the rockfall using a standard type of rockfall prevention fence, a structure that can absorb additional energy, a high-energy absorption rockfall prevention fence or a rockfall prevention retaining wall shall be installed. When a rockfall prevention fence of new specifications or a new shape is to be designed or installed, the maximum energy that may be absorbed by the new rockfall prevention fence shall be verified in advance.

(5) To ensure the quality of a rockfall prevention fence, the contractor shall use for construction products whose suppliers have been approved in advance for each accessary material. If necessary, the contractor shall verify the performance.

3.2 Work Preparation

(1) Before constructing a rockfall prevention fence, the earth works and slope protection works specified in the design drawings shall be completed on the cutting slope in order to prevent safety accidents caused by rockfall or collapse of the slope during the construction works.

3.3 Construction Standards

3.3.1 General Matters of Construction

(1) For construction of ground concrete for fence pillars, steel reinforcements shall be exposed at certain intervals on the back face of the L-type retaining wall on which the fence is installed. After backfilling of the L-type retaining wall, the wire rope shall be tightly anchored to the pillars using anchoring blocks so that the rope may not be moved.

(2) The wire rope shall be stretched tightly for firm installation. The initial tension after construction shall be maintained at 53.9kN(5500kg/rope).

(3) The contractor shall determine the positions and areas of installation of the rockfall prevention fence in accordance with the site conditions and consult with the construction supervisor before installing the rockfall prevention fence.

(4) The surrounding ground shall not be relaxed or moved when constructing the foundation of the pillar.

(5) The standard wire rope is a cable with a diameter of 18 mm. The wire rope shall be basically installed at intervals of 0.3 m in the straight line of the fence pillars. The interval may be reduced to 0.2 m for the purpose of increasing the performance of the rockfall prevention fence.

(6) A wire rope may be anchored to pillars by passing a wire rope through a hole made on each pillar and providing tension at the end-pillars; by using a standard wire

anchor block; or by using bolts with a size of at least M1 2 mm. Since bolts may not be installed in the middle parts of H-beams, they are installed alternately on the left and right sides.

(7) When installing a PVC-coated net, excessive force shall not be applied to the wire rope. The pillars, anchor blocks, and wire rope shall be completely aligned and tightly stretched for firm installation without slack.

(8) If the total height of blasted rock and weathered rock is over 6 m, a rockfall prevention net shall be installed. Even at a section where the total height is less than 6 m, if rockfall is of concern, the rockfall prevention net may be installed after obtaining approval from the construction supervisor.

(9) The foundation concrete shall be constructed by installing the mold in order to prevent separation of materials.

(10) The gap between the end-pillars shall be less than 100 m for maintenance works and maintaining wire rope tension.

(11) The net and wire rope shall be connected at least 20% of the span length.

3.3.2 Pillar Preparation

(1) The straight part of the pillar shall be without joints.

(2) The upper part of the pillars shall be curved in the longitudinal direction for the length specified in the design drawings in order to prevent rockfalls.

3.3.3 Pillar Installation

The gap between pillars shall be kept constant as long as the gap does not exceed the span length specified in the drawing design. Pillars must be installed at the starting points, end points, inflection points, and slope-changing points.

(1) Installation on soil (single foundation)

① Rubbles shall be spread out and leveled on the bottom of the foundation to prevent settlement of the pillars.

② The bottom of the buried pillars shall be welded to be overlapped with each other so that the pillars may be firmly anchored to the foundation.

③ The foundation concrete shall be placed after installing the mold as specified. The concrete shall be exposed over the ground surface by 50mm. The exposed surface shall have an inclination of about 2% from the center to the ends to prevent water infiltration, and shall be finished smoothly.

④ Backfilling shall be performed after the concrete of the foundation is completely cured. The backfilling and compacting shall be performed sufficiently to ensure that the thickness of one layer does not exceed 0.2m.

(2) Installation on a structure such as a retaining wall (continuous foundation)
① In principle, the pillars shall be buried during concrete placement.
② If the site conditions and work conditions do not allow installation using the method specified in ①, installation may be performed by applying foundation bolts or by making pillar holes before concrete placement and then piling the pillars during the main construction works.

(3) The middle pillars applied to the rockfall prevention fence shall be H-beams with section modulus of at least H150×75×5×7㎜ unit dimensions, a straight length of at least 2.5m, and a curved length of at least 0.5m at the top. The gap between the pillars shall be 2 to 3m, and end-pillars shall be installed at every 60 to 100m.

(4) The end-pillars shall be H-beams with at least H150×150×7×10㎜ unit dimensions or □-beams with at least □150×150×4.5㎜ unit dimensions. If necessary, pillars of different dimensions may also be used.

(5) Middle pillars shall be H-beams with section modulus of at least H150×75×5×7㎜ unit dimensions, a straight length of at least 2.5m, and a curved length of at least 0.5m at the top.

(6) In the case it is necessary to increase the absorption energy to 61kJ to enhance the performance of the rockfall prevention fence, H-beams with at least H200×100×8×12㎜ unit dimensions shall be used as middle pillars, and H-beams with at least H200×200×8×12㎜ unit dimensions or □-beams having at least □ 175×175×5.0㎜ or □ 200×200×4.5㎜ unit dimensions shall be used as end-pillars.

3.3.4 Fence Installation

(1) The installation works shall be performed carefully to prevent damage the coating on the wire mesh or the plating surface of the accessories.

(2) When a rockfall prevention net and a rockfall prevention fence are installed together, the bottom height of the net must be equal to the top height of the fence.

(3) In the case where the fences may not be installed over a long distance continuously due to the geographical features or where the fences need to be installed over 100m, the rockfall prevention fences shall be installed separately. In this case, a separation length between the end part of a newly started fence and the previous one shall be less than 0.3m. The gap between the end parts of the fences shall be blocked with a wire net to prevent the release of falling rocks.

(4) In the case where an isolated foundation shall be unavoidably used for the rockfall prevention fence, a continuous foundation over two spans shall be applied to the end parts.

(5) When a rockfall prevention fence of new specifications or a new shape is to be designed

or installed, the maximum energy that may be absorbed by the new rockfall prevention fence shall be evaluated.

(6) In the case where falling rocks with sharp or drill shape may be released through the gap between the wire ropes, auxiliary pillars shall be installed and integrated with the ropes to increase the absorption energy of the fences. The auxiliary pillars shall be rectangular pipes with a width of at least 50m, a breadth of 20 to 50mm, and a thickness of 1.6mm, and shall be anchored to the wire rope using bolts, etc.