KCS 11 73 10 : 2019

Concrete Spraying

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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, 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 10 : 2016	• Integrated and maintained as a code according to changes in the construction standard code system.	Enactment (June 2016)
KCS 11 73 10 : 2016	• Revised to harmonize Korean Standards with Construction Standards.	Revision (July 2018)

Table of Contents

1. General Matters

1.1 Scope of Application

(1) This standard applies to spraying works performed for the stabilization of slope surfaces.

1.2 Reference Standard

- KS D 7017 Welded steel wire and bar fabrics
- KS M 3404 Unplasticized poly(vinyl chloride) (PVC-U) pipes for general service
- KS F 2405 Standard test method for compressive strength of concrete
- KS D 3504 Steel bars for concrete reinforcement
- KS L 5201 Portland cement

1.3 Supplied Materials

Not applicable.

1.4 Definition

Not applicable.

2. Materials

2.1 Materials

2.1.1 Concrete Spraying Materials

(1) Ordinary Portland cement is generally used for concrete spraying, but an admixture may be used to obtain a desired strength rapidly.

2.1.2 Mortar Spraying Materials

(1) The mortar shall use Portland cement and aggregates satisfying KS L 5201. Lime shall not be added, and the strength shall be higher than the required design strength.

2.1.3 Drainage Pipe

(1) The drainage pipe shall be a product which satisfies or even being better than the specification stated on KS M 3404.

2.1.4 Reinforcing Wire Netting

(1) The reinforcing wire netting shall be a product which satisfies or even being better than

the specifications stated on KS D 7017.

2.1.5 Material Quality Control

(1) The spraying material shall have the necessary strength, durability, and water-tightness as well as the characteristics to protect steel materials with little quality variation.

(2) The spraying material mixture strength shall be determined by considering the required structural strength, the standard design strength, and the on-site concrete quality variation.

(3) The compressive strength test of concrete shall be performed according to KS F 2405.

(4) Design specifications of reinforcement steel bars and anchoring pins used for mortar spraying shall be in accordance with KS D 3504. The testing frequency shall be determined depending on the requirements of the manufacturers and product specifications.

3. Construction

3.1 Verification of Construction Conditions

(1) Before construction, the site surveying shall be performed to verify if the survey control points, formation level, and batter boards are the same as specified in the design drawing & specification.

(2) The specified boundaries, altitude, contours, and reference plane shall be verified.

3.2 Work Preparation

3.2.1 Preliminary treatment of spraying surface

(1) Loose stones, grass, and trees that may fall during the work shall be removed in advance.

(2) If water exists on the spraying surface, appropriate drainage practices shall be performed, including drainage pipes or drainage filter installation.

(3) If the spraying surface is absorptive, the spraying surface shall be pre-treated appropriately, for example, by spraying water before concrete spraying, to prevent excessive water absorption from the sprayed concrete material.

(4) If the slope surface is frozen or has ice or snow on it, the surface moisture shall be removed before spraying.

3.3 Construction Standards

3.3.1 General Construction

(1) Before starting the construction work, the contractor shall submit a construction work plan to the construction supervisor for consultation , regarding the mixing methods, machines to be used, construction methods, and curing condition.

(2) Before starting the spraying work onto a slope surface, impurities that hinder the attachment of concrete, such as dust, mire, and pumice, shall be removed using compressed water or air.

(3) After the curing of the sprayed material, the air temperature shall be kept over 10℃ for at least three days (only during the curing period). Construction work shall be prohibited under unfavorable weather conditions, including strong wind and rainfall. If water exists on the drilling surface or the spraying surface on which concrete has already been placed, spraying shall be performed after taking appropriate drainage action, including drainage through drainage pipes, increasing the amount of cement or hardening agent, and decrease of added water.

(4) The pipe diameter, material, and number of installed weep holes shall be in accordance with the design drawing & specificiation. Rigid PVC pipes having an internal diameter over 50mm shall be installed in an appropriate number depending on the slope water conditions. The pipes shall be installed more than 0.25m behind cracked bedrock or earth slope surfaces. Only surface drainage may be performed if water is not discharged from the original ground.

(5) The anchoring pin installation depth and interval are specified in the design drawing & specification. Generally, steel reinforcement bars of D16 to D22mm are installed in intervals from 0.4 to 0.6m with an overall density of 0.3 to 2ea/m^2, but not restircted. In areas where sufficient anchoring is difficult to accomplish due to the unevenness of the slope surface, additional anchoring pins may be installed. Steel reinforcement bars of D9 to D13mm are installed in intervals from 0.15 to 0.3m with an overall density of 1 to 3ea/m^2. If the slope surface is relatively flat and wide, contraction joints may be installed and filled with a joint filler as necessary.

(6) In the case of a steep poor rock slope with with a slope inclination equal to or lower than 1:0.5, reinforcing wire nets shall be installed to structurally support the role of the surface protection concrete. The reinforcing wire nets may be installed according to the slope surface conditions by arranging in a grid shape reinforcing bars of D16 to D22mm in intervals from 0.5 to 1m.

(7) Bars for measuring the sprayed thickness shall be installed in intervals of 5m transversely and longitudinally. After the spraying work, inspection holes shall be drilled

at random positions to inspect the thickness. The minimum sprayed thickness shall be more than 75% of the design thickness, and the average thickness shall be equal to or higher than the design thickness. The acceptance rate shall be equal to or higher than 80%.

(8) The concrete spraying shall be performed by placing the nozzle about 1m away from the slope surface in an angle perpendicular to the slope surface, starting from the top of the slope surface and then downward. Spraying shall never be performed from the bottom to the top of the slope surface.

(9) When spraying is performed for two or more layers, the work for the second layer shall be carried out at least one hour after the first layer installation. If the spraying thickness is high, the concrete spraying shall be devided into several layers of an appropriate thickness. Immediately after the spraying is attached to the ground, the individual spraying layers shall also be attached with each other. The mixing of the repulsing spray shall be carefully avoided during the construction work. In particular, spraying that has fallen to the ground during the work on the upper area shall be thoroughly removed.

(10) The final sprayed thickness shall be constructed within a range of ±50mm for the slope and ±25mm for the bottom surface.

3.4 Allowable Construction Error

Not applicable.

3.5 Repair and Reconstruction

Not applicable.

3.6 On-site Quality Control

(1) If the construction work is found to be inappropriate through inspection according to the requirements of quality control, the contractor shall perform the construction again or take necessary countermeasures at the contractor's own expense according to the instructions from the construction supervisor.