KCS 11 40 25 : 2019

Road Surface Drainage

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국토교통부

Foreword

- This standard was organized and integrated as the code by comparing and reviewing duplicate or contradictory content within the existing construction standards (design standards, standard specifications) due to the transition of the construction standards code system.

- This standard is established by integrating and organizing the parts that are related to reinforced concrete culverts in each standard based on the existing Road Construction Standard Specifications. The history of the standards are as follows:

Construction Standard	Main Content	Enacted or Revised (Year.Month)
Road Construction Standard Specifications	• Established by the Korean Society of Civil Engineers commissioned by the Ministry of Construction	Enacted (1967.12)
Road Construction Standard Specifications	• The specifications were improved and revised to become general specifications of overall road work by reviewing the related existing specifications and guidelines that were used and being developed.	Revised (1985.12)
Road Construction Standard Specifications	• The specifications were improved and revised to be better specifications by advancing and complying with the currently used specifications and guidelines, along with the introduction of new theories	Revised (1990.05)
Road Construction Standard Specifications	• The specifications were revised to enhance the international competitiveness and to promote quality improvements of road works by reorganizing the system to cope with the openness of the construction market as a result of the launch of the World Trade Organization (WTO)..	Revised (1996.07)
Road Construction Standard Specifications	• The specifications were re-organized to establish a system of national standards and to reflect the revision of contents and other standards, such as the Korean Industrial Standard (KS) and the Standard Specification of Concrete according to the Construction Standard Organization Guideline, and to improved and revise standards to address the problems.	Revised (2003.11)

Construction Standard	Main Content	Enacted or Revised (Year.Month)
Road Construction Standard Specifications	• The specifications were revised to improve the problems produced during the road construction and to induce reliable constructions through consistency with other standards such as the KS, Standard Specification of Concretes , and Standard Specifications of Tunnels, ensuring the prevention of shoddy and faulty construction thorough quality control.	Revised (2009.03)
Road Construction Standard Specifications	• The specifications were revised to reflect the recommendations from the Central Construction Technology Deliberation Committee and changed the standard specifications, specialized specifications, and design drawings.	Revised (2015.09)
Road Construction Standard Specifications	• Partial, revision including overview, forest and tree protection materials, and general construction works.	Revised (2016.05)
KCS 11 40 25 : 2016	• Integrated and organized to accommodate the code system due to the transition to the code system of construction standards.	Enacted (2016.06)
KCS 11 40 25 : 2018	• Modified to satisfy the Korean Industrial Standards and Construction Standards.	Revised (2018.07)
KCS 11 40 25 : 2019	• Modified to satisfy the Korean Industrial Standards and Construction Standards.	Revised (2019.11)

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1. Generals

1.1 Scope of Application

(1) This standard is applied to constructions of small concrete structures for side gutters related to roads, such as L-shape, U-shape, V-shape and collecting gutters, constructions of embankment dikes and collecting gutter installation that collects flowing water through dikes and discharges the water to the outside of the road through longitudinal drain openings through embankments (road waterway), constructions of cast-in place concrete rainwater catcher and collecting well spheres and covers, and constructions of asphalt concrete curbs, precast concrete curbs, cast-in place concrete curbs, and stone curbs, and constructions of installation of cast-in place concrete manhole spheres and covers.

1.2 Reference standards

1.2.1 Related laws

No contents.

1.2.2 Related standards

- KCS 10 10 10 Public administration requirements
- KCS 11 20 15 Excavation
- KCS 11 20 25 Refilling and backfill
- KCS 11 40 20 Underground drainage
- KCS 14 20 10 General concrete
- KCS 14 20 11 Reinforcement construction
- KCS 21 50 05 General items of forms and temporary shore construction
- KCS 44 50 05 Anti-freeze layer, subbase and base construction
- KCS 44 50 10 Pavement construction of asphalt concrete
- KCS 44 50 15 Pavement construction of cement concrete
- KS D 0201 Test method of hot dip galvanizing
- KS D 3706 Stainless steel bar
- KS D 4040 equirements for cast iron(steel) manhole cover and frame
- KS F 4005 Concrete and reinforced concrete L-shape
- KS F 4006 Concrete boundary block
- KS F 4010 Reinforced concrete plume and bench plume
- KS F 4016 Reinforced concrete U-shape

1.3 Submission documents

(1) The requirements and procedure of document submission follow the corresponding requirements in KCS 10 10 10.

(2) The documents that investigate site conditions such as construction size, location, and detailed construction diagrams shall be additionally submitted at the time of manhole and cover installation construction.

2. Materials

2.1 Materials of side gutter

2.1.1 Cast-in place concrete side gutter

(1) The materials used in cast-in place concrete shall follow KCS 14 20 10.

2.1.2 Factory-produced concrete side gutter

(1) For factory-produced concrete side gutters, products that pass the specifications of KS F 4005, KS F 4010, and KS F 4016 shall be employed.

(2) The factory products marked in the design drawings shall be used after the approval from construction supervisor.

2.2 Materials of dike and collection gutter

2.2.1 Aggregates

(1) KCS 14 20 10 shall be followed.

2.2.2 Cements

(1) KCS 14 20 10 shall be followed.

2.2.3 Mix standards

(1) KCS 14 20 10 shall be followed.

2.2.4 Joint sealing compound

(1) For joint sealing compounds, products that comply with the corresponding specifications shall be employed.

2.2.5 Form

(1) Approved steel forms attached to machine placing equipment shall be used in principle, and wooden forms may be used after obtaining the approval of the construction supervisor for very short sections or sharply curved line.

2.3 Materials of rainwater catcher and collecting well

2.3.1 Steel grating

(1) Steel grating is a galvanized steel product that shall comply with the standards presented in Table 2.3-1.

Table 2.3-1 Material standards of steel grating

Item	Test specification	Test method	Criteria
Zinc deposition amount	KS D 0201	4.1 (Direct method), 4.2 (antimony chloride method)	550 g/㎡ or more
Copper sulphate	KS D 0201	5.0 (Copper sulfate test)	Shall not reach the end point.
Adhesion	KS D 0201	6.1 (Bare eyes), 6.5 (hammer test)	Abnormal phenomena such as crack, peeling, swelling etc. should not be found.

(2) The shape and dimension of steel grating cover that is installed in L-shape side gutter and median strip collecting wells shall follow the specified drawings, and bearing bar spacing shall be within 50 mm.

(3) The cover of steel grating for L-shape side gutter and median strip collecting wells shall be a product that satisfies the T-20 condition (112 kN of rear wheel uniaxial load considering impact load) as presented in Table 2.3-2.

Table 2.3-2 Steel grating standard by class

Class	Gross weight (t)	Rear wheel uniaxial load (kN)	Load considering impact (kN)	Vehicle contact area A ㎜ × B ㎜
T = 20	20	80	112	200 × 500
T = 14	14	56	78.4	200 × 500
T = 6	6	24	33.6	200 × 240
T = 2	2	8	11.2	200 × 160

(4) The cover of the steel grating for U-shape side gutter (Type-1) shall follow the specified design drawings, and the bearing bar spacing shall be within 50 mm.
(5) The cover of the steel grating for U-shape side gutter shall exceed 134 N/plate.
(6) The comb spacing of tee steel grating installed on the sidewalk, pedestrian crossing, and bike road shall be within 20 mm to prevent safety-related accidents, and if necessary, it may be covered with wire meshes or other mesh-type products may be used.

2.3.2 Concretes and reinforcement

(1) Concretes and reinforcement shall be products that comply with the corresponding requirement in KCS 14 20 10 and KCS 14 20 11 or equivalent or higher standard products

2.3.3 Materials delivered to the site

The manufacturer shall conduct the following tests on the materials delivered to the site in the presence of the construction supervisor, and submit the test results.
(1) The cover and frame of steel grating shall have no harmful flaws, and shapes and dimensions shall be accurate according to the specified drawings as well as good outer shapes. The products delivered to the site shall be tested to determine whether they match with the test result reported from the quality test agency.
(2) The test method of hot dip galvanizing shall be conducted in accordance with KS D 0201.

2.4 Materials of curbs

2.4.1 Precast concrete curbs

(1) The curbs shall be manufactured using Portland cement concrete in accordance with the length, shape, and specifications indicated in the design drawings.
(2) The quality standards of the factory-produced precast concrete curbs are presented in Table 2.4-1.

Table 2.4-1 Quality standards of precast concrete curbs

Category	L=600 ㎜	L=1,000 ㎜	Note
Breaking load (kgf)	1,600 or higher	1,000 or higher	
Absorption ratio (%)	Within 5%		
Test method	KS F 4006		

(3) The materials shall follow KCS 44 50 15.
(4) For foundation material of precast concrete curbs, and concretes for floor leveling are used.

(5) The volume mix (cement : fine aggregate) of cement mortars is 1:2 for joint mortar and 1:3 for floor mortar.

2.4.2 Cast-in place concrete curbs

(1) The materials shall follow KCS 44 50 15.

(2) The grading range of fine aggregates shall follow KCS 14 20 10.

(3) The grading range of coarse aggregates shall follow KCS 14 20 10.

(4) The mix standards are as follows.

① Design flexural strength f28 = 3 MPa(35 ㎏f/㎠)

② Pouring concrete slump is 50㎜ or smaller.

③ Maximum dimension of aggregates is 25㎜ (19 ㎜ for machine construction)

④ Air volume of fresh concrete is 4.5% ± 1%.

(5) For joint sealing compounds, products that comply with the corresponding specifications shall be employed.

(6) Approved steel forms shall be used in principle, and wooden forms may be used after obtaining the approval of the construction supervisor for very short sections or sharply curved lines.

2.4.3 Asphalt concrete curbs

(1) The aggregates used in asphalt curbs shall be materials specified in KCS 14 20 10, and the grading ranges presented in Table 2.4-2 are standard ranges.

Table 2.4-2 Grading range of the materials

Sieve size	4.75 ㎜	2.36 ㎜	600 ㎛	300 ㎛	150 ㎛	75 ㎛
Percent passing Weight (%)	70 – 100	55 – 100	30 – 70	20 – 55	7 – 35	4 – 20

(2) Bitumen materials used in mixtures and tack coats of asphalt concrete curbs shall follow KCS 44 50 10 pavement construction of asphalt concretes.

(3) Mixtures of asphalt concrete curbs

① The mixtures used in asphalt concrete shall follow KCS 44 50 05.

② The mix standard of the mixture of asphalt concrete curbs are presented in Table 2.4-3, but it may be modified according to the instruction of the supervisor if necessary.

Table 2.4-3 Mix standards of mixture of asphalt concrete curbs

Type	Aggregates	Stone powder	Asphalt
Mix ratio (%)	93	7	8

2.4.4 Stone curbs

(1) Stones used in stone curbs shall be certified limestones, sandstones, or granite materials. The material shall be specified in the contract. If the material is not specified, only one of the three types above shall be used in the construction.

(2) The straight portion of the stone curb shall have no drill holes in the surface of the curb, and the upper surface shall have no unevenness of more than 6mm. The front side shall maintain the plane surface specified in the contract, and the rear side shall have no unevenness of 25mm or longer horizontally, and 75mm or longer vertically. The bottom surface shall have no unevenness of 25mm more than the unevenness of the surface described above. The edge lines in the front and rear sides shall be linearly straight and comply with the design. The lateral side of the stone curb shall be flat rectangular and space between adjacent stone curbs shall not exceed 13.1mm from the front and upper sides of the joint sealing compound. The stone curb installed in the last section shall not be cut more than 100mm from the end, otherwise special length shapes shall be used.

(3) The stone curb in the curved part shall be the same conditions as the straight part except for the following items. The allowable unevenness of the stone curb in the curved part is 13mm for rear side, and other exposed sides shall be less than 25mm, and 75mm or smaller for unexposed sides.

(4) The space between adjacent stone curbs shall not exceed 20mm from the front and upper sides of the joint sealing compound.

2.5 Materials of manhole and cover installation

2.5.1 Manhole cover and ladder

(1) Manhole covers shall comply with the specification of KS D 4040 or equivalent or higher quality products.

(2) The test of color manhole shall be conducted according to the product material of the manufacturer at the quality inspection specialized organization.

(3) The stainless-steel bar shall be products that satisfy the specification of KS D 3706 or equivalent or higher quality products.

3. Construction

3.1 Construction standards

3.1.1 Side gutter

(1) Excavation

① The excavation shall follow KCS 11 20 15.

② If the excavation place of the drain structure is on the road or slope, the excavation size shall be the required minimum section area, and much care should be taken not to damage the already-completed part.

③ The excavation of the drain structure can be done by machine or workers. The excavation shall be to the determined depth and inclination.

(2) Foundation

① The materials for foundation shall be natural stones or crushed stone of 100㎜ to 150㎜ in diameter, and shall not contain biased length stones or soft stones.

② The sands for foundation are river sand, sea sands, or crushed sands, and shall not contain clay, silt, and other harmful substances. All sands shall pass a 10 mm sieve, with a passing percentage of 0.08㎜,(No.200) sieve shall be less than 10%.

③ The gaps shall be filled with rubble stones when the foundation material is laid followed by compaction according to the specifications using a small roller or rammer and finishing with the design thickness.

④ If underground drain holes are installed at the lower side of the side gutter, KCS 11 40 20 shall be followed.

(3) For forms, KCS 21 50 05 shall be followed.

(4) Concrete placement

① It shall follow KCS 14 20 10. In particular, much care should be taken for concrete not to have material segregation, and structural integrity shall be ensured.

② The foundation bottom of the drain facility shall have the same gradient specified in the design.

③ The concretes inside the form shall have no voids inside the concrete, ensured by the use of a vibrator, and vibrating compaction shall not be focused at a single place for a long time to prevent material segregation or laitance occurring in the surface.

④ Slip prevention shall be installed at steep places, and concrete shall be placed to see the effects of the slip prevention.

⑤ The area in the manhole and collecting gutter where the cover is placed shall be finished flatly without unevenness and the joint part of the drain pipes shall be water tight, sealed with cement mortar whose volume mix proportion is 1:2 unless otherwise specified.

⑥ If the bottom and wall are constructed separately according to the instruction of the design drawings and the construction supervisor, 16 mm-diameter or longer reinforcing bars shall be installed at every 300mm to play the role of a dowel in the joint area.

⑦ The pipes used in the inlet, manhole, and end walls shall not be projected inside the manhole.

(5) Concrete curing: The exposed surface after concrete placement shall be covered with wet or

water-sprayed non-woven fabric or straw bags for curing to protect the concrete under wet conditions for five days or longer, and curing management shall be done for at least 14 days. Note that the curing period may be shortened if the required strength is proven based on the concrete strength test result.

(6) The refilling and backfilling shall follow KCS 11 20 25.

(7) L-shape side gutter construction

① The L-shape side gutter foundation shall have the same compaction with that of the main line, thereby preventing cracks or failures due to settlement after construction.

② The construction shall start after the installation locations and gradients specified in the design drawings are verified.

③ The location of the longitudinal drain openings (road waterway) shall be determined after verifying the flow rate of the catchment area. In particular, water in the elevated section shall not flow to the surface.

④ When the construction is done by workers, the dimension, joints, and the solid state shall be verified. In particular, curved parts of the road shall be constructed in line with the alignment of the road.

⑤ Water shall be sprayed or vinyl shall be laid on the foundation bottom not to dry the surface sufficiently in order to prevent the moisture loss when pouring the concretes.

⑥ If vinyl is laid as a segregation film, vinyl shall be overlapped 100mm or longer in the height direction and 300mm or longer in the width direction, and shall be fixed.

⑦ In the concrete placement by workers, expansion joints are installed first, and concretes shall be poured spacing one span at a time. In case of consequent placements, joints that are capable of complete insulation shall be installed to prevent concrete from touching the boundaries of the spans. joints shall be after designing a detailed plan for joints and permission from the construction . In addition, the joints shall be firmly fixed to prevent the distortion during concrete placements.

⑧ A waterstop shall be installed in the expansion joint, and spacing of the joints shall be no more than 20m. The front side of the expansion joint is sealed and filled, and the spacing, width, and depth of the contraction joint shall be 6m, 6㎜, and 50㎜ respectively.

⑨ The location of the expansion joint in the foundation and wall shall be matched.

⑩ The rainwater collected at the L-shape side gutter shall be drained through drainage facilities, collecting wells, and longitudinal and lateral drain pipes at the boundary of the soil cut and filling.

⑪ Machine construction

A. Since the linearity and gradient of the L-shape side gutter are highly important, the tension of the height measurement guide line (sensor line) shall be firmly fixed to maintain 250 N or larger and the sensor line shall be installed in accordance with the

designed gradient.

B. The form shape of the L-shape side gutter and ground condition and height measurement guide line shall be inspected by the construction supervisor prior to the start of construction.

C. The coating curing agent shall be evenly sprayed by sprayers immediately after moisture disappears from the surface.

D. A construction joint shall be installed at the position of work suspension or the daily pouring end position.

E. For the L-shape side gutter start portion, drainage plans shall be established not to introduce rainwater collected along the embankment dike into the L-shape side gutter prior to the start of construction.

F. The spacing, width, and depth of the contraction joint shall be 6m, 6mm, and 50mm respectively.

G. The contraction joint shall be cut in the orthogonal and perpendicular directions of the driving direction, and foreign substances shall be cleansed thoroughly and dried.

H. The expansion joints shall be installed with the spacing specified in the design drawings.

I. The grout in the joint shall be mixed well, as to not produce bubbles after applying the primer inside the groove before grouting.

(8) V-shape side gutter construction

① The foundation bottom shall be leveled to have the same gradient with that in the design drawings and construction shall be done from the lower gradient first.

② The linear shape specified in the design drawings shall be constructed.

③ If the bottom and wall are constructed separately according to the instruction of the design drawings and the construction supervisor, reinforcing bars shall be installed at a regular spacing to play the role of a dowel in the joint areas.

④ Since the boundary between public and private lands is distinguished by the side gutter facility installed on the site, the road's nodes or curve sections shall be verified by the reference points prior to the start of construction.

⑤ The joint shall be installed first for the concrete placement of side gutter, and then concretes shall be poured in every other section. In case of consequent placements, joints that are capable of complete insulation shall be installed in order to prevent concrete from touching the boundaries of the spans. Installation of joints shall be followed after detailed design for joints and receving permission from the construction supervisior. In addition, the joints shall be firmly fixed to prevent the distortion during concrete placements.

⑥ When refilling after the completion of side gutter, compaction shall be thoroughly done not to have settlement of the side gutter due to the infiltration of surface water. The ground level after the compaction shall be higher than the side gutter to enable smooth flow of surface

water.

⑦ Construction shall be done to introduce and drain the surface water through the side gutter by lowering the construction ground as compared to the surrounding ground.

⑧ When V-shape side gutters are installed in the sections where small animals (small ammals, amphibians, reptiles) frequently travel, slopes(exit routes) for animals shall be installed outwards the V-shape side gutters and the slopes should be uneven/irregular to prevent the animals from slipping.

(9) U-shape side gutter construction

① The foundation bottom shall be leveled to have the same gradient with that in the design drawings and construction shall be done from the lower gradient first.

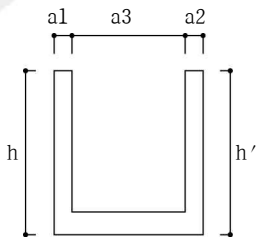
② The construction shall be done after verifying the linear shape specified in the design drawings and the surrounding drainage plan.

③ When a collecting well is installed, accurate gradients of inlet and outlet of the drainage pipe and connecting joints shall be kept to match the design level specified in the design drawings.

④ When a drain pan is installed, its design location, structure, and dimension, as well as connecting joints with side gutters and pipe lines shall be verified as suitable for the design drawings.

(10) The specifications of the concrete side gutters shall be managed according to the standards in Table 3.1-1.

Table 3.1-1 Standards of specification management of concrete side gutters

Item	Specification (mm)	Measurement standard	Note
Reference level	± 30	· When construction length is more than 40 m : One in every 40 m. · When construction length is less than 40 m : Two places	
Width a3	- 50		
Height h, h′	- 30		
Length L	- 20		

3.1.2 Dike and reinforcement

(1) Embankment dike

① Concrete placement by machine shall be done in principle considering the road linear shape and aesthetics.

② The compaction in a place where concrete placing equipment track passes shall be

thoroughly done at the same level with that of the main line without unevenness so that cracks or fractures shall not occur due to settlement after dike construction.

③ The detailed construction diagram shall be created considering the thickness and elevation of the road shoulder pavement specified in the design drawings prior to the installation of the height measurement guide line to ensure the accuracy of the linear shape and installation height of the dike and this shall be submitted to the construction supervisor.

④ When the height measurement guide line is installed, steel sticks shall be installed every 10m in the straight section and every 5m in the curved section to secure the location firmly without deflection, and shall be fixed strongly to maintain the tension over 250 N. The verification survey on the installation location and linear shape shall be conducted after installation to verify they follow the design drawings.

⑤ For short sections or portions that must be built by workers, concrete placement shall be done after confirming the linear shape, form dimension, joints, and fixed condition by the construction supervisor. In particular, the curved section shall be constructed to match the main line's linear shape.

⑥ The coating curing agent shall be evenly sprayed by sprayers immediately after moisture disappears from the surface.

⑦ A construction joint shall be installed at the position of work suspension or the daily pouring end position.

⑧ Once the initial hardening is complete, contraction joints are installed at 6m of width, 6mm of spacing, and 50mm of depth to prevent contraction cracks, and the contraction joints shall be matched with the joints of the concrete pavement.

⑨ After curing is complete, refilling shall be conducted at the rear side of the dike prior to the construction of the road shoulder pavement.

⑩ Inspection of finished surface evenness: The finished surface shall have no more than 3mm of the unevenness when measuring with a 3m-long straightedge.

⑪ The masking tape or vinyl shall be attached in advance to the front side of the dike not to be stained with asphalt emulsion on the exposed surface of the dike when the road shoulder is paved, and much care should be taken to prevent damage to the dike due to compaction equipment.

(2) collection gutter (L-Type, T-Type)

① A collection gutter is divided into two types: L-Type and T-Type. For general embankment sections, L-Type is installed, and for the lowest spot (where the water is gathered from both directions) of a concave section, T-Type is installed. The location is determined after reviewing the match between the scheduled installation location in the drawing and geographical features of the site, as well as the suitability.

② Installation of collection gutter concretes

A. The laitance of the surface in the dike that is connected with the collection gutter shall be removed and chipped to increase the adhesion.

B. The base plate of the collection gutter shall be placed in advance to be joined to the base plate of the longitudinal drain openings (road waterway), and reinforcing bars (D16 ㎜) shall be inserted in line with the linear shape of the collection gutter wall for the connection with the wall before the hardening of the concrete.

C. Once the bottom plate is cured, a wall form is installed. A form support and its adhesion shall be firmly attached without moving or deformation when pouring the concrete.

D. The concretes must be placed and finished at once without the occurrence of construction joints during the concrete placement of the collection gutter.

E. The road shoulder pavement in front of the collection gutter in the straight section shall have 4% larger gradient than the standard elevation and about 1m of width for rapid drainage. The curved section shall be constructed after approval or verification from the construction supervisor if necessary.

3.1.3 Installation of rainwater catcher and collecting well

(1) Verification of construction conditions

① The contractor shall verify whether the foundation bottom surface is suitable before the rainwater catcher and the collecting well are installed.

② The forms, earth pressure support surface, reinforcement, and underground utilities shall be inspected prior to concrete placement, and then approved by the construction supervisor.

(2) Construction preparation

① The reinforcement shall be checked whether it was processed and assembled in accordance with the specified drawings prior to the placement of concrete.

(3) Construction standards

① The concrete placement shall follow the corresponding requirements of KCS 14 20 10.

② Waterproofing work

A. For the rainwater catcher and collecting wells, a form may be installed according to the precise dimension, as concrete is poured, or ready-made products may be used. The top end of the collecting well shall be built 5mm to 10㎜ lower than the road surface design l considering the traffic load to facilitate drainage.

B. A sleeve shall be cut and inserted according to the size of pipe and drain.

C. To make the size, shape, and locations of the work accurately, it is necessary to adjust other work.

③ Installation of steel grating

A. The cover and support frame shall be installed firmly as not to be moved according to the specified drawings.

B. During installation, traffic passage shall be reviewed, and the lateral horizontal degree of the steel grating, the match between connecting portion of support frame and the connecting portion of grating, leveling of the connecting portion, and evenness of the grade and road surface shall be maintained. In addition, noise generation or damage to concretes of support frame shall not occur due to the poor construction quality.

④ The structure refilling shall follow KCS 11 20 25, and refilling shall not be conducted until the concrete is fully cured.

⑤ The pipes connected to the rainwater catcher and collecting well shall not be extruded inside of the structure.

3.1.4 Curbs

(1) Precast concrete curbs

① The curb block shall be cleansed thoroughly prior to installation and blocks damaged during transportation or handling shall not be used.

② The bottom mortar shall be spread evenly, and installed to be leveled with the height of the required linear shape. A width of the block joint shall follow the dimension specified in the design drawings, and cement mortar whose volume mix proportion is 1:1 shall be filled in the joint and finished.

③ The refilling soil shall not be spread if the strength of joint and bottom mortars are fully secured. The initiation time of refilling shall be instructed by the construction supervisor, and refilling shall be compacted sufficiently until the required compaction level is achieved.

(2) Cast-in-place concrete curbs

① Excavation

A. If excavation is needed, it shall be done to have a certain depth and width indicated in the design drawings to make the curb's finished surface to be level with the required gradient and height, and the specified foundation materials are laid and compacted well to make them level and broad.

B. If the curb is placed over the subbase or base course, the foundation shall be arranged to have the longitudinal and cross-sectional shapes indicated in the design drawings, and shall be compacted with the compaction specified in KCS 44 50 05.

② For forms, KCS 21 50 05 shall be followed.

③ Concrete placement

A. All materials used in cast-in place concrete curbs shall be measured and mixed according to the specifications of KCS 44 50 15.

B. The surface of subbase or base course shall be sprayed with water prior to concrete placement to make it wet. A placement depth of one layer shall not exceed 100mm, and concrete shall be poured in the horizontal layer, and a vibrator or other approved machines shall be used to consolidate the concrete, eliminating voids.

④ Machine construction

A. The cast-in place concrete curbs may be constructed using self-propelled machines if the construction supervisor approves. Here, care should be taken to supply concretes continuously and uniformly to the machine, and the required cross-section shall be maintained without deformation after molding and a smooth surface shall be obtained. If additional finish is needed, it shall be done immediately after machine construction.

⑤ Joint

A. Expansion joint

(A) The expansion joint shall abut the joint structure, and the installation location shall be instructed by the design drawings and the construction supervisor. It shall be cut at a right angle and a perpendicular direction to the curb line, and the width of the joint shall be precisely constructed as indicated in the design drawings.

(B) The joint sealing compound (chamfer strip) shall be constructed when curb concrete is poured, and care should be taken not to damage the joint sealing compound during finishing work.

B. Contraction joint

(A) The contraction joint shall be placed in every 6m in principle, and precisely constructed according to the required dimensions indicated in the design drawings. The joint of the curb installed in contact with the concrete pavement shall match the joint of the concrete pavement.

(B) The contraction joint shall be constructed with a concrete cutter approved by the construction supervisor, and a width of the joint shall be 6mm, unless otherwise instructed.

(C) When the joint is cut, care should be taken not to damage the already-made curb surface. The joint material does not need to be filled in the contraction joint.

⑥ Finish surface

A. The range of the allowable construction tolerance of the concrete curb's finish surface is ± 15㎜, and the depth of the maximum unevenness shall not exceed 3mm when measured with a 3m-long straightedge.

⑦ Curing and protection

A. The cast-in place concrete curbs shall be cured using the method specified in KCS 44 50 15 (3.2.16). When wet curing, the curing period may be three days, and curbs shall be protected not to be damaged during the curing period.

⑧ Refilling and backfilling

A. If the excavated part still remains after the required curing is complete, it shall be filled and well compacted not to exceed 200mm of thickness for a single layer using the approved materials.

(3) Asphalt concrete curbs

① Foundation preparation

A. If the foundation where the asphalt concrete curb will be installed is already cured, or if the foundation is above the old cement concrete base course or asphalt stabilization base course, or asphalt concrete base course surface, the foundation surface shall be blown by compressed air and cleansed thoroughly and shall be dried to the condition absent of water.

B. Once the surface is well dried, a tack coat shall be applied according to the materials and methods specified in KCS 44 50 10 just before the installation of curbs. Care should be taken not to spray the tack coat materials outside of the contact surface of the curb.

② Placement

A. The asphalt concrete curb shall be constructed with machines approved by the construction supervisor. The machine shall be manufactured and adjustable to obtain the required shapes indicated in the design drawings.

B. When placing, the temperature of the mixture shall not exceed ±10 ℃ from the specified temperature, depending on the work and weather conditions. The mixture discharged from the machine shall have no material segregation with a proper compaction level and surface shape.

C. The machine shall be properly supported while operating along the edge of the pavement surface, and the linear shape shall be accurately maintained after drawing a line based on pulling a thread placed beforehand.

D. If the completed asphalt concrete curve is severely cracked, bent, and satisfied compaction is not achieved, or the required linear shape and gradient, and cross section are not matched, the curb shall be removed and re-constructed.

③ Joint

A. The asphalt concrete curb shall avoid joints as much as possible.

B. If the mixture placement is suspended for a long period of time, the end part of the curb is cut vertically, and heated asphalt is thinly applied to the cut surface to have a continuous connection.

④ Curing and protection

A. The completed asphalt concrete curb shall be protected for at least 12 hours after placement using proper methods.

(4) Stone curbs

① Foundation preparation

The material sofs to necurb foundation shall be compacted to have ahardand flat surface, and weak and unsuitable materials shall be remove dandreplaced with higher quality materials.

② The stone curb shall be installed to be matched with the line and height required by the front side edge, and all spaces under the curb shall be filled and compacted with materials required for the foundation.

③ Joint

A. The joint spacing of the stone curb shall be constructed accurately according to the dimension set in the design drawings, and the joint shall be finished by filling it with joint mortar whose volume mix proportion is 1:2 (cement : sand). The space between the joint sealing compound and stone curb shall be filled with mortar that have the same mix proportion.

B. When the curb is in contact with the cement concrete pavement in construction, the joint of the curb shall be leveled with the expansion joint of the pavement, and the space shall be filled with the expansion joint filling material with the same thickness of that the of the pavement joint.

④ Refilling

A. The refilling soil of the curb shall not be laid if the strength of the joint mortar is not sufficiently acquired, and the initiation time of refilling shall also be instructed by the construction supervisor.

3.1.5 Installation of manhole and cover

(1) Verification of construction conditions

① The contractor shall ensure that the foundation bottom surface shall be tightly contacted prior to the installation of manholes.

② The forms, earth pressure support surface, reinforcement, and underground utilities shall be inspected prior to concrete placement, and then approved by the construction supervisor.

(2) Construction preparation

① The reinforcing bars shall be verified whether they are processed and assembled according to the design drawings specified in KCS 14 20 11 before concrete is poured.

(3) Construction standards

① The concrete placement shall follow KCS 14 20 10.

② Manhole waterproofing construction

A. Concrete is placed in the bottom of the foundation surface, and the surface shall be finished with trowels.

B. The form of the manhole shall be accurately installed vertically and horizontally according to the dimension and elevation, and concrete shall be placed.

C. A sleeve shall be cut and inserted according to the size of pipe and drain.

D. The bottom in the upper part shall be filled with grout to be level with the gradient of the outflow tube, and finished with trowels to have smooth curves.

E. To make the size, shape, and locations of the work accurate, it is necessary to adjust other works.

③ The cover and cover frame shall be leveled with the elevation precisely and fixed horizontally as to have the same gradient of the road surface without tilting.

④ The footsteps shall be installed according to the specified design drawings and zinc-plated deformed or stainless-steel bars shall be used.

⑤ The structure refilling shall follow KCS 11 20 25, and refilling shall not be conducted until the concrete is fully cured.

⑥ The pipes connected to manholes shall not be extruded inside of the manhole.

(4) Allowable construction tolerance

① The allowable tolerance of manholes shall follow KCS 14 20 10 and KCS 14 20 11.

(5) Quality management at the site

① The concrete tests shall follow KCS 14 20 01.

② The reinforcement tests shall follow KCS 14 20 11.

③ If construction supervisor demands re-tests at the site, the contractor shall accept the re-test demands even if the material tests are complete