

KCS 11 40 15 : 2019

Drainage Pipes

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KC CODE



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	<ul style="list-style-type: none">• Established by the Korean Society of Civil Engineers commissioned by the Ministry of Construction	Enacted (1967.12)
Road Construction Standard Specifications	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Partial, revision including overview, forest and tree protection materials, and general construction works. 	Revised (2016.05)
KCS 11 40 15 : 2016	<ul style="list-style-type: none"> 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 15 : 2018	<ul style="list-style-type: none"> Modified to satisfy the Korean Industrial Standards and Construction Standards. 	Revised (2018.07)
KCS 11 40 15 : 2019	<ul style="list-style-type: none"> 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 specifies overall items concerning the construction of drain pipes in accordance with the linear shape, gradients, and dimension instructed in the design drawings and by the construction supervisor.

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 25 Road surface drainage
- KCS 14 20 10 General Normal weight cConcrete
- KS B 0241 Mechanical properties of corrosion-resistant stainless-steel fasteners
- KS B 0802 Method of tensile test for metallic materials
- KS B 5209 Steel tape measures
- KS B 5246 Metal rules
- KS D 3506 Hot-dip zinc-coated steel sheets and coils
- KS D 3555 Hot-rolled carbon steel strip for pipes and tubes
- KS D 3589 Extruded polyethylene coated steel pipes
- KS D 3698 Cold rolled stainless steel plates, sheets and strip
- KS F 4402 Vibrated and rolled reinforced concrete pipe
- KS F 4403 Reinforced spun concrete pipes
- KS F 4405 Core type prestressed concrete pipes
- KS F 4406 Prestressed concrete-steel cylinder pipe
- KSM 6070 Powder coatings

1.3 Definition of Terms

- Batter board: It refers to a horizontal wood set by placing board piles for excavation predation. It is used to show the outer shape of structures.
- Collar: It refers to a joint pipe that is round and short, which is used in joint section when connecting pipes.

- Spacer: It refers to metal, plastic, concrete, and mortar parts that are used to maintain the reinforcement spacing accurately or have a constant coating thickness in the reinforcing bar or tendon.

1.4 Submission documents

- (1) The contractor shall create a construction plan document in accordance with the construction plan according to the requirements of KCS 10 10 10, and submit it to the construction supervisor.
- (2) The constructor shall submit additional documents that investigate the site conditions such as construction size, location, and gradients.

2. Materials

2.1 Materials

2.1.1 Factory-produced concrete drain pipes

- (1) The reinforced concrete pipes shall pass the standards of KS F 4402, KS F 4403, KS F 4405, and KS F 4406.
- (2) Manufacturing factory name or abbreviation, manufacturing date, nominal diameters and pipe length shall be marked on all pipes.

2.1.2 Site-produced concrete pipes

- (1) The concretes used in the site-produced concrete pipes (RC pipes) shall follow the requirements of KCS 14 20 10.
- (2) The external pressure strength criteria of the site-produced concrete pipes are presented in Table 2.1-1.
- (3) The quality standards of wires used in the site-produced concrete pipes are presented in Table 2.1-2.

Table 2.1-1 Criteria of external pressure strength of site-produced concrete pipes

Category		Nominal diameter (mm)				Note
		600	800	1,000	1,200	
Crack Strength	SI unit (kN/m ²)	29	35	41	45	
Fracture Strength	SI unit (kN/m ²)	59	71	82	94	

Table 2.1–2 Quality standards of wires for site–produced concrete pipes

Category	Specification (mm)	Tensile strength	Permissible tolerance of linear diameter	Test method
		SI unit (kN/mm ²)		
Normal wire	6 9	5.3 or higher 5.3 or higher	±0.13	KS B 0802

2.1.3 Corrugated steel pipes

(1) Materials

- ① Corrugated steel pipes are made of hot-dip zinc-coated steel sheets according to KS D 3506.

Table 2.1–3 Requirements of hot-dip zinc-coated steel sheets

Symbol	Chemical composition		Mechanical property		
	P(%)	S(%)	Yield point	Tensile strength	Elongation percentage (%)
SGHC	—	—	205 (N/mm ²) or higher	270 (N/mm ²) or higher	-

- ② The zinc coating weight of hot-dip zinc-coated steel sheets are as follows:

Table 2.1–4 Zinc coating weight standards

Type of zinc coating weight	Three-point minimum coating weight (based on two sides, gf/m ²)
Z600	600

(2) Shape and dimension (SCP 1RS)

① Shape

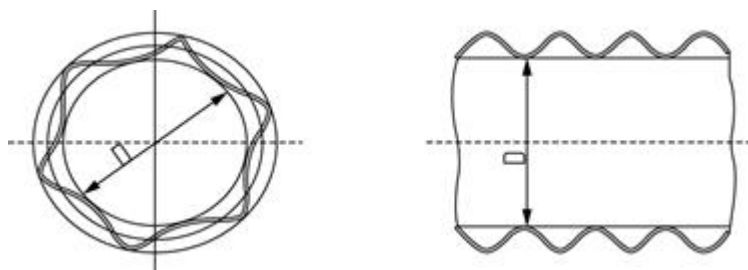


Figure 2.1–1 Specifications of SCP 1RS

② Symbol of section dimension

Table 2.1–5 Plate thickness by nominal diameter of SCP 1RS

Symbol	Nominal diameter D (mm)	Plate thickness (mm)				Length (mm)
		1.6	2.0	2.7	3.2	
SCP 1RS	300	O	O	-	-	Designated length from 4,000 to 6,000
	400	O	O	-	-	
	450	O	O	-	-	
	600	O	O	O	-	
	800	O	O	O	-	
	1,000	O	O	O	O	
	1,200	O	O	O	O	
	1,350	O	O	O	O	
	1,500	O	O	O	O	
	1,650	O	O	O	O	
	1,800	O	O	O	O	

Figure 2.1–2 Shape of SCR 1RS

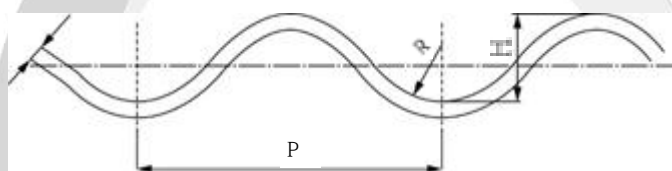


Table 2.1–6 Specifications of SCR 1RS

Symbol	Dimension		
	Corrugation pitch P(mm)	Corrugation depth H(mm)	Corrugation bend radius r(mm)
SCP 1RS	68.0	13.0	17.5

③ Symbol of dimensional tolerance

Table 2.1–7 Allowable tolerance of SCR 1RS (unit: mm)

Symbol	Dimensional tolerance					
	Corrugation pitch P	Corrugation depth H	Steel pipe length L	Nominal diameter D	Axial bending	Coupling band width W
SCP 1RS	±2.0	±2.0	+40 of designated length -10 of designated length	Less than 1000 ±10 More than 1000 ±1%	Less than ±0.3% of length	▽5.0

④ Section shape and dimension of coupling band

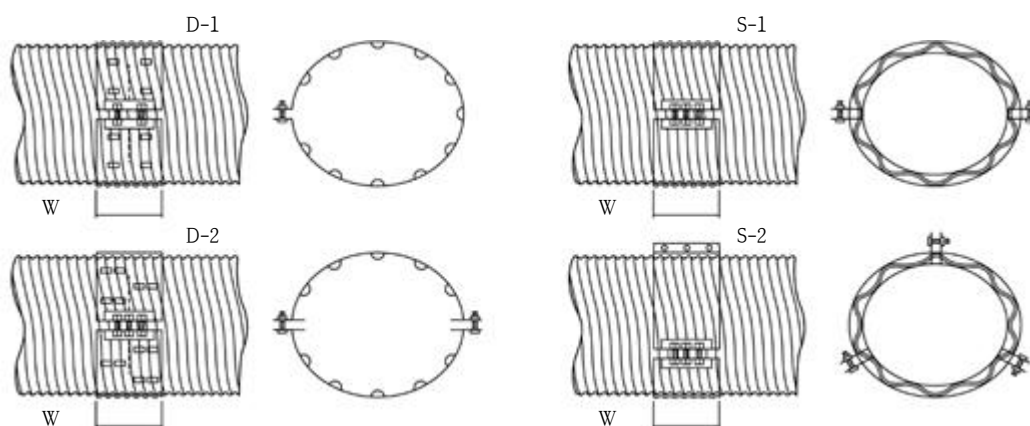


Figure 2.1-3 Coupling band shape

Table 2.1-8 Coupling band specifications

Symbol	Nominal diameter D(mm)	D-1		D-2		S-1		S-2	
		Plate thickness t(mm)	Width W(mm)	Plate thickness t(mm)	Width W(mm)	Plate thickness t(mm)	Width W(mm)	Plate thickness t(mm)	Width W(mm)
SCP 1RS	300 400 450	1.6	270	-	-	1.6, 2.0	410	-	-
	600 800	1.6			-	1.6, 2.0, 2.7	410		
	1000 1200 1350 1500	-	270	2.0	410	1.6, 2.0, 2.7, 3.2	410		
	1650 1800	-	-	2.7	410			3.2	410

2.1.4 Resin corrugated steel pipe (flat type)

(1) Materials

- ① The original pipe of the resin corrugated steel pipe shall be SPHT2, specified in KS D 3555, or an equivalent or higher quality materials.

(2) Coating materials

- ① Polyethylene used as a coating material shall follow Appendix 1 of KS D 3589, and other materials shall be of equivalent or higher quality.

- ② The powder epoxy shall follow KS M 6070, and other materials shall be of equivalent or higher quality.

- ③ Adhesives shall follow Appendix 2 of KS D 3589.

(3) Joint materials

- ① The flange binding band shall follow the chemical composition and mechanical properties of STS304 in KS D 3698.

- ② Bolts shall follow chemical composition and mechanical properties of KS B 0241, and the type and grade shall be austenitic A2.

(4) Shape and dimension

- ① Shape

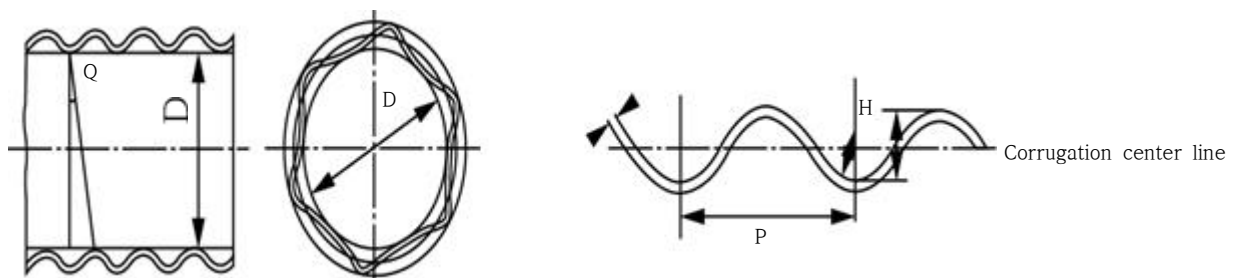


Figure 2.1-4 Cross-sectional shape of the resin corrugated steel pipes

Table 2.1–9 Plate thickness and permissible tolerance of nominal diameter by symbol of resin corrugated steel pipe

(Unit: mm)

Category	Nominal diameter (D)	Plate thickness (T)				Length (L)
		1.6±0.17	2.0±0.17	2.7±0.21	3.2±0.21	
1RS Flat type	300	○				Designated length (1 pipe = 8 m)
	350	○				
	400	○				
	450	○				
	500	○				
	600	○	○			
	700	○	○			
	800		○			
	900		○			
	1000		○			
3RS Flat type	900		○			Designated length (1 pipe = 8 m)
	1000		○			
	1100		○			
	1200		○			
	1350		○	○		
	1500			○		
	1650			○		
	1800			○	○	
	2000				○	
	2200				○	
	2400				○	
	2500				○	
	2600				○	
	2700				○	
	2800				○	
	2900				○	
	3000				○	

Note 1) Plate thickness indicates a thickness of original plate prior to polyethylene coating.

② Dimension and allowable tolerance

Table 2.1–10 Dimension and allowable tolerance of the pipe

(Unit: mm)

Type		Symbol	Allowable tolerance			
			Steel pipe length (L)	Nominal diameter	Corrugation pitch (P)	Corrugation depth (H)
Round shape	1S type	1RS flat type	+40 of designated length -10	Less than 1000 ±10	68.0±2.0	13.0±2.0
	3S type	3RS flat type		More than 1000 ±1%	76.0±2.0	25.0±2.0

Note 1) Since constant thickness of flange is fused in the flange portion, D900 or smaller shall be within the reference inner diameter -20 mm, and D900 or larger shall be within the reference inner diameter -30 mm.

Table 2.1–11 Thickness of pipe wall (H1) and thickness of flat resin in the inner surface (H2) by pipe thickness

(Unit: mm)

Type	Pipe thickness (t) Nominal diameter (D)	1.6	2.0	2.7	3.2
1RS Flat type	300–500	H1: 4.23 or thicker H2: 1.5 or thicker			
	600–700	H1: 4.23 or thicker H2: 1.5 or thicker	H1: 4.73 or thicker H2: 1.5 or thicker		
	800–1000		H1: 4.73 or thicker H2: 1.5 or thicker		
3RS Flat type	900–1200		H1: 4.73 or thicker H2: 1.5 or thicker		
	1350		H1: 4.73 or thicker H2: 1.5 or thicker	H1: 5.29 or thicker H2: 1.5 or thicker	
	1500–1650			H1: 5.29 or thicker H2: 1.5 or thicker	
	1800			H1: 5.29 or thicker H2: 1.5 or thicker	H1: 5.79 or thicker H2: 1.5 or thicker
	2200–3000				H1: 5.79 or thicker H2: 1.5 or thicker

2.2 Assembly allowable tolerance

(1) Sectional shape and dimension of the flange binding band

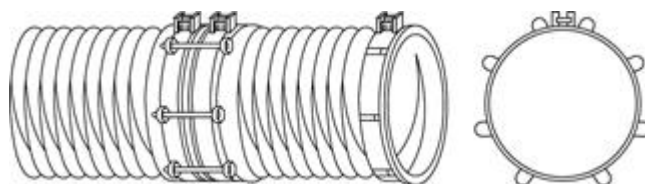


Figure 2.2-1 Sectional shape of the flange binding band

Table 2.2-1 Dimension and allowable tolerance of the flange binding band

(Unit: mm)

Type	Pipe diameter r	Flange binding band		Type	Pipe diameter r	Flange binding band	
		Thickness	Width			Thickness	Width
1RS Flat type	300	2 ± 0.17	50 0 – +5	3RS Flat type	900	2 ± 0.17	50 0 – +5
	350				1000		
	400				1100		
	450				1200		
	500				1350		
	600				1500		
	700				1650		
	800				1800		
	900	3 ± 0.22					
	1000		2000				
	—	2200					
	—	2400					
	—	2500					
		2600					
	—	2700					
	—	2800					
	—	2900					
—	3000						

2.3 Material quality control

(1) Polyethylene coating thickness

The coating thickness and allowable tolerance by resin type for the resin corrugated steel pipe are as follows:

- ① The epoxy thickness coated in the middle of the corrugated steel pipe and polyethylene shall be 30 μm or thicker.
- ② The minimum coating thickness of resin fused in the resin corrugated steel pipe shall be 0.3mm or thicker on the inner surface, and 1 mm or thicker on the outer surface.
- ③ The minimum coating thickness of polyethylene coating that is overlaid in the lock seam portion of the inner and outer surface of the resin corrugated steel pipe shall be 0.5mm or thicker.
- ④ The name of each portion is shown in Figure 2.3-1, and pipe wall thickness (H1) and flat resin thickness (H2) in the inner surface follows in Table 2.1-11.
- ⑤ The sectional shape of the flange binding band, which is joint material of the resin corrugated steel pipe, is shown in Figure 2.2-1, and the dimensions and the allowable tolerance follow in Table 2.2-1. Note that other dimensions may be used if a purchaser and manufacturer agree.

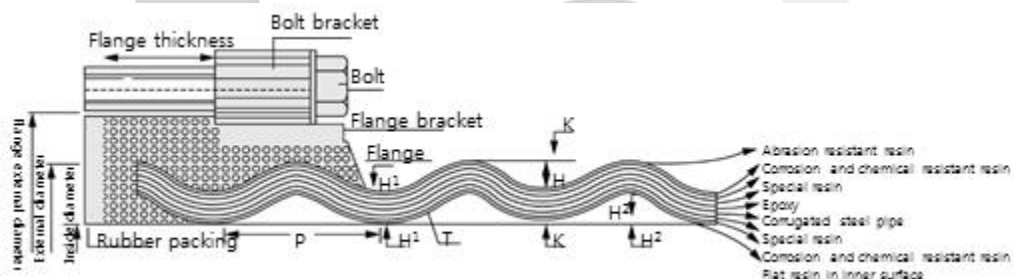


Figure 2.3.-1 Sectional diagram of resin corrugated steel pipe (flat type)

(2) Test method

- ① The outer shape is inspected with bare eyes.
- ② Three specimen pipes are used to measure the dimension as follows:
 - A. The coating thickness is measured by using a thickness gauge. The measurement is conducted at four arbitrary points that are orthogonal to the circumferential direction, which is about 200mm or longer away from the ends of the specimen pipe.
 - B. The pipe's diameter and length are measured by using a steel tape measure or metal straight edge ruler specified in KS B 5209 or KS B 5246, and the measurement precision shall be 1mm or longer.
 - C. The pinhole test shall follow KS D 3589 using a pore detector (holiday detector). The

presence of pinholes is examined for all surfaces of the coating by applying 10,000–12,000 V for the contact type and 20,000–40,000 V for contactless type.

D. The hydrostatic test is conducted to investigate the presence of leakage or other defects by applying and maintaining a pressure of 73.6 kPa with room temperature water inside of the pipe for 10 min.

E. The resistance to cathodic debonding test shall follow Appendix 4 of KS D 3589.

Table 2.3–1 Performance of the resin corrugated steel pipe

Item	Performance value	Items of tests applied
Pinholes	No spark shall be generated.	Refer to ② C.
Hydrostatic test in the joint portion	No leakage or other defects shall be found.	Refer to ② D.
Resistance to cathodic debonding	Mean debonding radius is 8 mm or smaller. Mean debonding radius is 10 mm or smaller.	Refer to ② E.

(3) Quality

- ① The inner and outer surfaces of the pipe shall have a good finish, no defects, cracks, uneven surface, or introduction of foreign matter that may cause harm. In addition, the steel pipes shall be straight, and both ends shall be perpendicular to the pipe axis.
- ② The end portion of the pipe shall be coated with the same polyethylene material that is used in the pipe body, and have no exposure of the steel plate for the prevention of debonding of the PE coating layer at the end portion and corrosion.
- ③ The performance test of the pipe is conducted in accordance with (2), and shall comply with the specifications presented in Table 2.3-1.

3. Construction

3.1 Work preparation

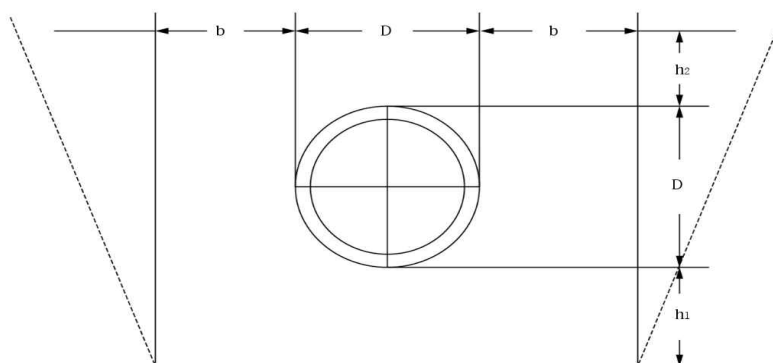
- (1) The excavated ground shall have a certain gradient. If the ground is soft, it shall cope with settlement using a construction method that is suitable to the site circumstance, for example, replacement with proper materials, broken stone laying, or blinding concrete placement etc. The bottom shall be well compacted to prevent unequal settlement after laying the pipe.
- (2) The drain pipes shall be laid precisely according to the gradient instructed by the design drawings or the construction supervisor, and shall be installed from the downstream side.
- (3) The pipe shall be in tight contacted with the foundation and next joint pipes, and shall not be misaligned.

- (4) Once the pipe laying is complete, the construction supervisor shall verify the laying condition followed by refilling.
- (5) For refilling materials, the same material used in banking shall be used, and no concentrated load shall be applied to the drain pipes by mixed stones.

3.2 Construction standards

3.2.1 Excavation

- (1) For excavation, KCS 11 20 15 shall be followed. The width of the bottom for excavation shall be constructed based on the design drawings according to site circumstance, soil conditions, and pipe type.
- (2) The excavated bottom surface shall be sufficiently firm to support the pipes. If the foundation ground is soft, the soft ground shall be replaced with pit run gravel or material approved by the construction supervisor. If rock masses are projected above the ground surface, they shall be trimmed at a certain gradient using a breaker.
- (3) The successive work shall not start after excavation completion until the construction supervisor inspects the work.
- (4) Ideally, the excavation width is narrow, and the wall is vertical to the ground when normal ground or well-compacted ground is excavated and drain pipes are laid.



b: Around 30 cm for normal ground
and around 50 cm for soft ground

h1: Determined depending on softness for soft ground
h2: 33 cm

Figure 3.2–1 Criteria of excavation width

Table 3.2–1 Excavation width by pipe diameter

Pipe diameter (mm)	300	350	400	450	500	600	700	800	900	1000	1100	1200	1300	14M	1500
Excavation width (mm)	700	800	900	1000	1100	1200	14M	1600	1700	1800	2000	2100	2200	2400	2500

3.2.2 Foundation

- (1) If pebbles or broken pebbles are used in the foundation, pebbles or broken pebbles are laid first and then gravels or broken gravels shall be used to fill.
- (2) If pit run gravels is used in the foundation, pit run gravel is laid and compacted according to the required shape and dimension, and the portion that is contacted with the pipe shall be trimmed to match with the pipe wall shape.
- (3) For concrete foundations, required pebbles (or broken pebbles) and gravels (or broken gravels) for filling are laid evenly, and concrete placement shall be done in accordance with KCS 11 40 10.
- (4) For pile foundations, piles indicated in the design drawings are driven and concrete is poured according to the instructions of the construction supervisor.
- (5) The foundation ground shall be firm enough to support the pipes. If the ground is soft or has unsuitable soil, it shall be replaced with higher quality granular materials or approved materials according to the instructions of the construction supervisor. If rock masses are projected above the surface, they shall be trimmed according to the required gradient.
- (6) It is necessary for corrugated steel pipes to have a foundation that can evenly distribute the load of since corrugated steel pipes are flexible. Thus, foundations shall not be constructed with concrete, but high-quality foundation materials (sands or sandy soils) shall be used and compacted evenly according to the ground conditions as much as possible:

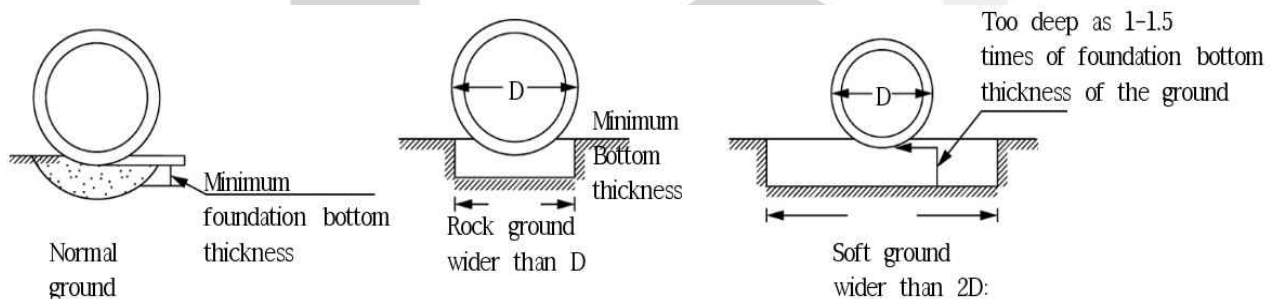


Figure 3.2-2 Foundation width according to ground condition

Table 3.2–2 Minimum thickness of foundation according to ground condition

Thickness and width		Minimum thickness of foundation (H)			Foundation Width (W)
Geological feature of foundation	Pipe diameter	900 mm or shorter	From 900 mm to 2000 mm	2,000 mm or longer	
Normal ground		200 mm	300 mm	0.2D	D
Rock ground		200 mm	200 mm (Note that if banking height exceeds 5 m, The thickness it is increased by 40 mm per 1 m.)		D
Soft ground:		500 mm	Larger value between 0.4D and 500 mm	Up to 1 m	2D–3D

Note 1) Soft ground shall be improved by replacement in principle. However, if soft layer is deep, the value proposed in the above table is used.

- (7) The selection of bottom materials is determined by a ratio of soil grain size to spacing size of the joint portion where soil particles can infiltrate, which is presented in Table 3.2–3.

Table 3.2–3 Selection of bottom materials

Mud Clay	Silt			Sand		
	Fine	Medium	Coarse	Fine	Medium	Coarse
0.002	0.006	0.02	0.06	0.2	0.6	2.0

3.2.3 Transportation and installation (Reinforced concrete pipes V.R pipes)

- (1) Pipe joints, joint method, joint order, and joint materials shall be examined according to pipe types prior to the start of construction.
- (2) Pipes laid in the foundation surface shall be tightly contacted with the ground by workers or chain block.
- (3) When transporting and unloading pipes, machinery such as cranes shall be used, and care should be taken to avoid any sudden impact on the pipes. Pipes shall be stored after laying rectangular lumber on the flat ground to prevent damage to the socket portions.
- (4) When minor transportation of pipes is required, pipes shall be firmly fixed by ropes for to prevent rolling and transported by truck.
- (5) The socket and spigot portions shall be thoroughly cleaned and inspected. When tying and lowering a pipe, two wire ropes are used to tie and lower the pipe.
- (6) For soils used in refilling, sands or high-quality soils are used. A thickness of one layer shall be 200mm or shallower beneath the pipe conduit, and 300mm or shallower above the pipe conduit

during compaction and refilling.

- (7) Construction equipment such as bulldozer shall be run directly over the pipes.

3.2.4 Manufacturing of site-produced concrete pipes

- (1) The concrete is poured and compacted air-tightly, and shall have no uneven surface in the pipe sections.
- (2) If forms are removed early, an automatic temperature recorder shall be attached, and steam curing shall be done.
- (3) The wires shall be accurately processed according to the design drawings.
- (4) When rolling equipment is used for welded wire fabric processing, care should be taken not to damage the weld zone. If the weld zone is not normal, re-assembly shall be done.
- (5) At least eight spacers for a single wire fabric and 16 spacers for double wire fabrics shall be installed to affix the wire fabrics and maintain the coating during concrete placement.
- (6) The pipe type, manufacturing date, and nominal diameter shall be marked in the completed pipes after inspection, and they shall be stored to avoid damage or impact.

3.2.5 Pipe-laying

- (1) All pipes shall be laid precisely according to the gradient instructed by the design drawings or the construction supervisor, and shall be installed from the downstream side. The pipes shall be well contacted with the foundation, and shall not be misaligned.
- (2) If a socket is attached to a pipe, the socket shall be installed directly upstream. If a pipe has no socket, methods such as butt joint using rubber rings or interlock joints using water-tight bands or collars are used to joint pipes. The connecting portion shall be water-tight and filling the gap with cement mortar whose volume mix proportion is 1:2 unless instructed otherwise by the construction supervisor.
- (3) Prior to refilling and backfilling, the suitability of pipe installation, the presence of settlement and damage shall be inspected by the construction supervisor. If there are some abnormal problems found, pipes shall be re-installed or replaced according to the instruction of the construction supervisor.
- (4) The pipe joint portion where mortar is applied shall be well cleaned with water and soaked by water sufficiently before the joint mortar is constructed.
- (5) When the corrugated steel pipes are installed inside the banking section, if severe settlement is expected in the future, the expected settlement shall be added to calculate the height in the design in advance, following the design drawings or instruction of the construction supervisor.

3.2.6 Joint of pipes

- (1) The joint portion of pipes shall be water-tight, filling the gaps with cement mortar whose volume mix proportion is 1:2.
- (2) The inside of the pipe joint portion is filled with mortar and cleansed thoroughly to have a smooth finish.
- (3) For pipe joint portions, caulking compounds or preformed joints can be used as joint materials instead of cement mortar if approved by the construction supervisor.

3.2.7 Refilling, backfilling, and banking

- (1) Once pipe laying is complete, refilling or backfilling shall be constructed after inspecting the laying status by the construction supervisor.
- (2) If abnormal or damage portions are discovered in terms of the pipe arrangement and safety reasons, pipes shall be re-arranged or replaced according to the instruction of the construction supervisor.
- (3) High quality soil is used in refilling for corrugated steel pipes as much as possible. The refilling work shall maintain the horizontally level and the finish thickness of one layer shall not exceed 200mm and the maximum dry density shall be 95% or higher.
- (4) Special care should be taken to have superior compaction in the lower side of the pipes.
- (5) Other refilling work shall follow KCS 11 20 25.
- (6) A thickness of one layer of banking shall be less than 200mm.
- (7) The materials in the banking shall be the same as that of the backfilling.

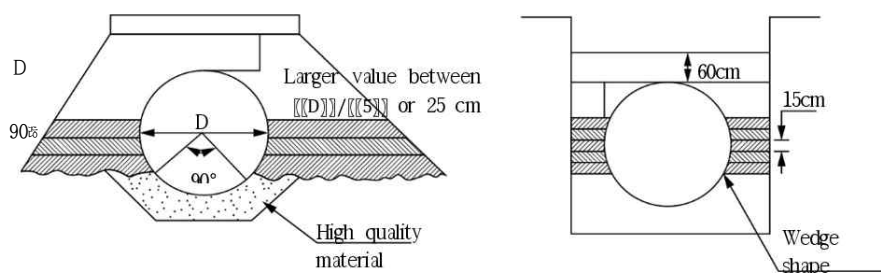


Figure 3.2-3 Criteria of banking and backfill

3.2.8 Wing wall and inlet and outlet

- (1) The wing wall construction shall follow KCS 14 20 10.
- (2) The inlet and outlet shall be structured to induce natural water flow according to the geological conditions before and after the water supply and drain pipes, and suitable scour prevention shall be installed.
- (3) If contacted with side gutters, collecting wells, or drainage wells, it shall be water-tightly using

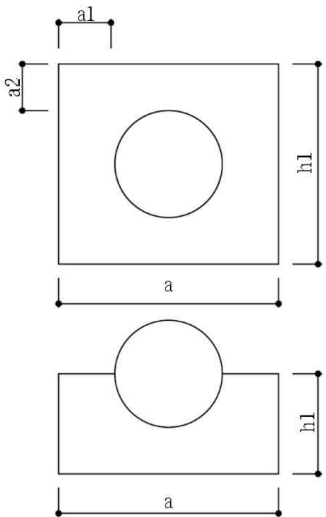
cement mortars whose volume mix proportion is 1:2 unless instructed otherwise by the construction supervisor or other special rules.

- (4) The joint portion between the drainage pipe and wing wall shall be cleansed before the wall is placed.
- (5) A water flow at the inlet and outlet shall be induced to have a gradual change in water flow without sudden fluctuation.

3.2.9 Specification management of drain pipes

- (1) The specification management criteria of drainage pipes are listed in Table 3.2-4.

Table 3.2-4 Specification management criteria of drainage pipes

Item	Specification (mm)	Measurement criteria	Note
Reference level	±30	<ul style="list-style-type: none"> • When construction length is more than 40 m: One location in every 40 m. • When construction length is less than 40 m: Two places/locations 	
Width a	-50		
Height h1	-30		
Thickness a1, a2	-20		
Length L	-200		