

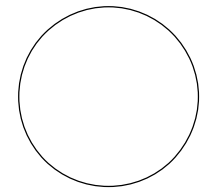
Typical Roadway Section - Center Crown

Note:

Normal sections shown may be appropriately modified for areas specifically designated by the Engineer.

STATION	TO	STATION	LOCATION	WIDTH
0+00		85+63	HEADING NORTH	16'

CONSULTANT:



IOWA DEPARTMENT OF  
NATURAL RESOURCES

ENGINEERING SERVICES - WALLACE BUILDING  
502 E. 9TH ST., DES MOINES, IA 50319-0034



TYPICAL CROSS SECTIONS AND DETAILS

ROAD MAINTENANCE FOR:

KLUM LAKE ACCESS

LOUISA COUNTY

NO. BY DATE REVISION


DRAWN BY: PROJECT NUMBER:

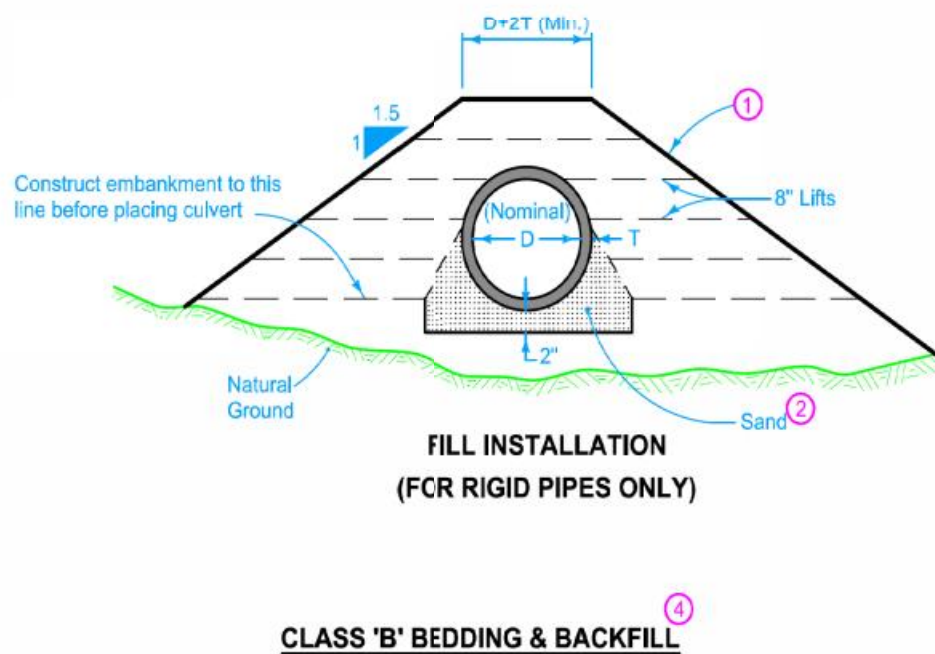
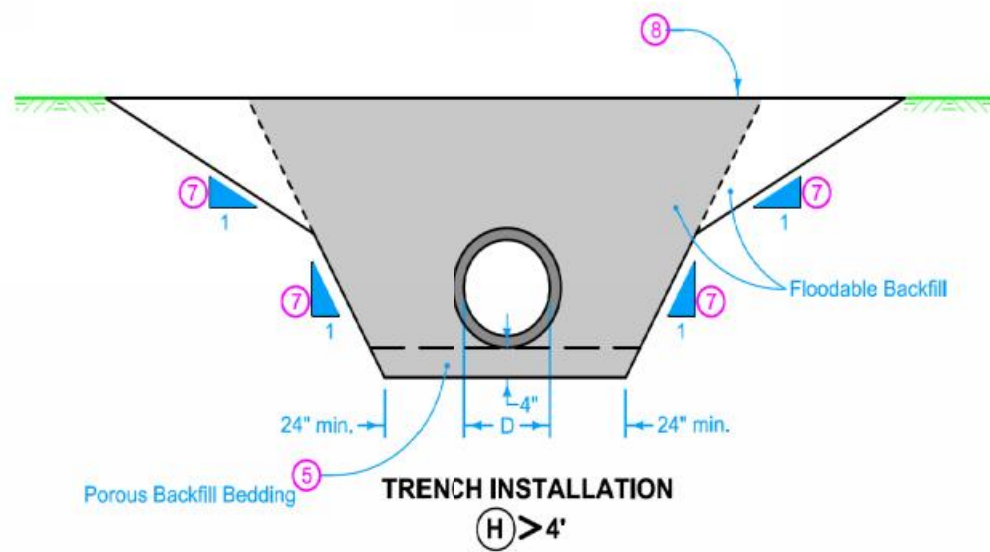
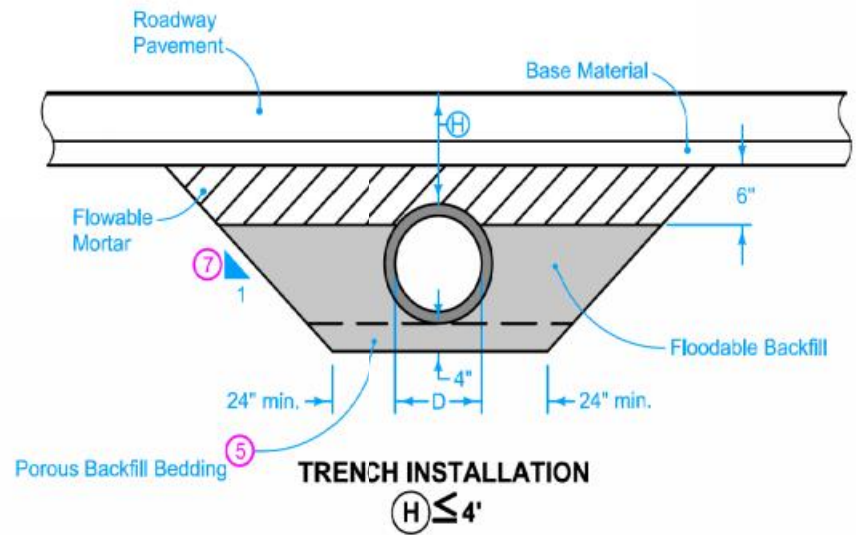
BLF 20-06-58-01

CHK'D BY: DATE:

DEC 2020

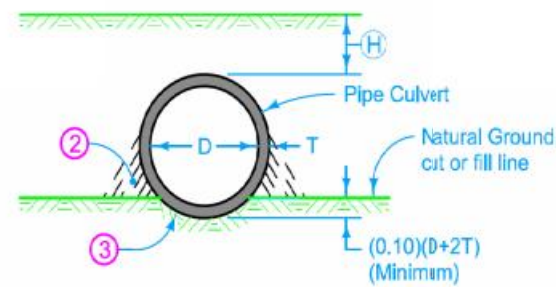
SHEET No:

**B.01**

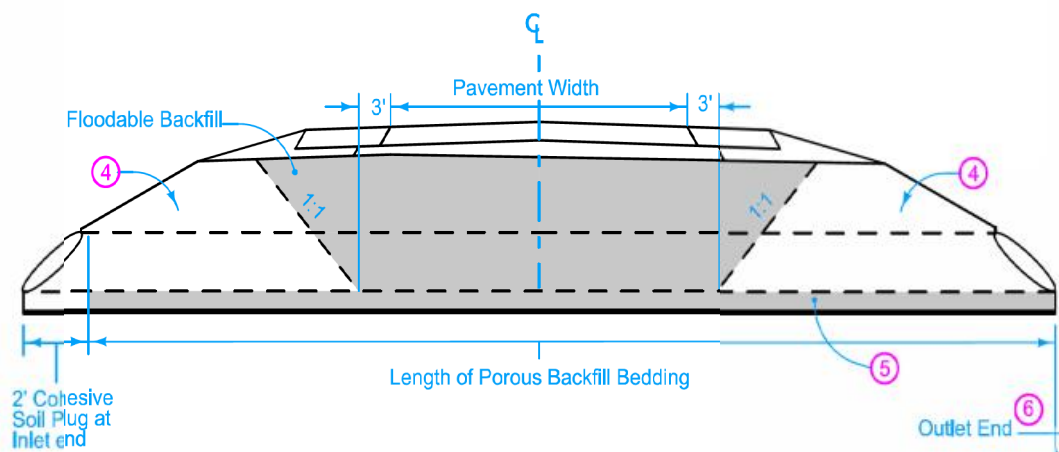
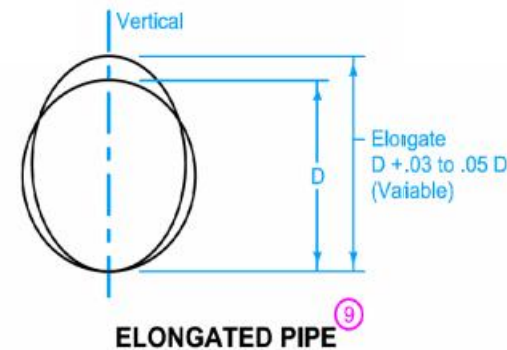


**CLASS 'B' BEDDING & BACKFILL**

Denotes pay limits for flooded backfill



**CLASS 'C' BEDDING & BACKFILL**



**TYPICAL SECTION - SOIL PLUG**

Refer to DR-104 for minimum and maximum allowable cover (H) for the particular kind of pipe culvert.

- 1 The backfill adjacent to and above the pipe culvert may be placed in conjunction with normal embankment construction. Thoroughly tamp the embankment within the limits shown.
- 2 Take extra care to ensure complete and satisfactory tamping of backfill material in the area immediately adjacent to the lower portion of pipe.
- 3 Carefully shape excavation below groundline either using a template conforming to actual dimension and shape of the pipe or using other means. If using other means, check with a template conforming to the actual dimension and shape of the pipe.
- 4 For culverts backfilled by flooding, place a cohesive soil plug at the inlet, outlet, and, when necessary, sides, prior to flooding.
- 5 4-inch Porous Backfill bedding. 2-inch Floodable Backfill bedding may be used under unsealed rigid pipe.
- 6 Extend Porous Backfill through the outlet end soil plug when used for bedding.
- 7 Quantity calculations are based upon a 1:1 slope and minimum trench dimension. Actual slope of trench may vary based upon Contractor's operations.
- 8 Ground Line at time of pipe installation. When existing ground exceeds 5 feet depth over pipe, backfill and compaction by flooding is not required more than 5 feet above the pipe.
- 9 Where a corrugated metal pipe culvert requiring elongation is to be installed (to counteract deformation caused by backfill), complete elongation using a means approved by the Engineer. Elongation may be developed either as part of shop fabrication or field installation. Install with elongated axis vertical.

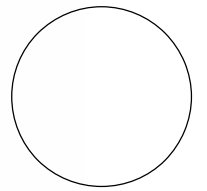
Possible Contract Items:  
Flowable Mortar  
Flooded Backfill  
Excavation, Class 20

Possible Tabulations:  
104-3  
104-4

	REVISION	
	2	04-18-17
<b>STANDARD ROAD PLAN</b>		<b>DR-101</b>
SHEET 1 of 1		REVISIONS: Changed "Porous Backfill" to "Porous Backfill Bedding" for clarity. Modified trench installation detail for H>4' to clarify pay limits.
APPROVED BY DESIGN METHODS ENGINEER 		

**PIPE CULVERT  
(BEDDING AND BACKFILL)**

CONSULTANT:



**IOWA DEPARTMENT OF  
NATURAL RESOURCES**

ENGINEERING SERVICES - WALLACE BUILDING  
502 E. 9TH ST., DES MOINES, IA 50319-0034



TYPICAL CROSS SECTIONS AND DETAILS

ROAD MAINTENANCE FOR:

KLUM LAKE ACCESS

LOUISA COUNTY

NO.	BY	REVISION

DRAWN BY: PROJECT NUMBER:

BLF 20-06-58-01

CHK'D BY: DATE:

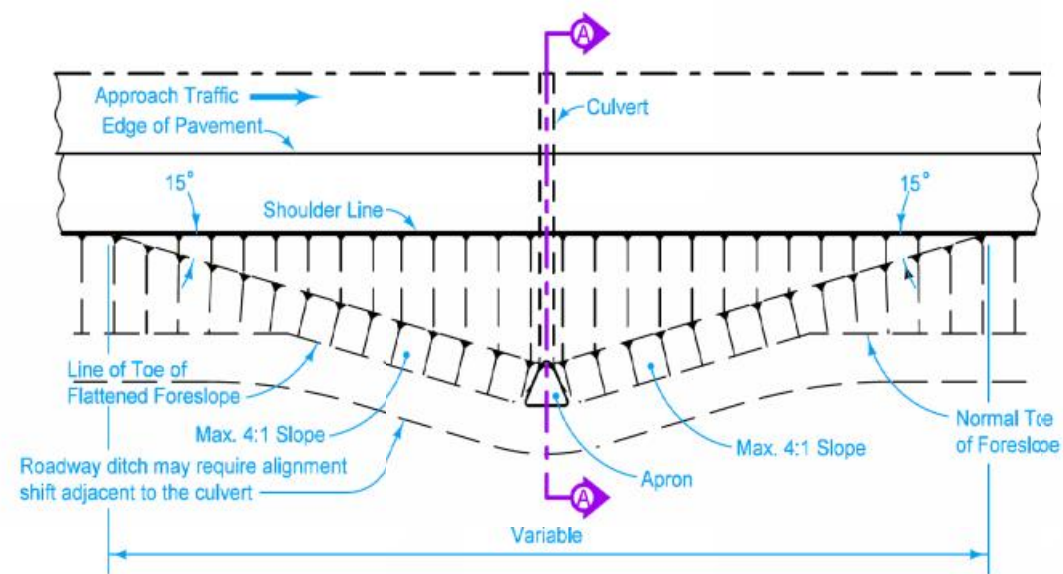
DEC 2020

SHEET NO.:

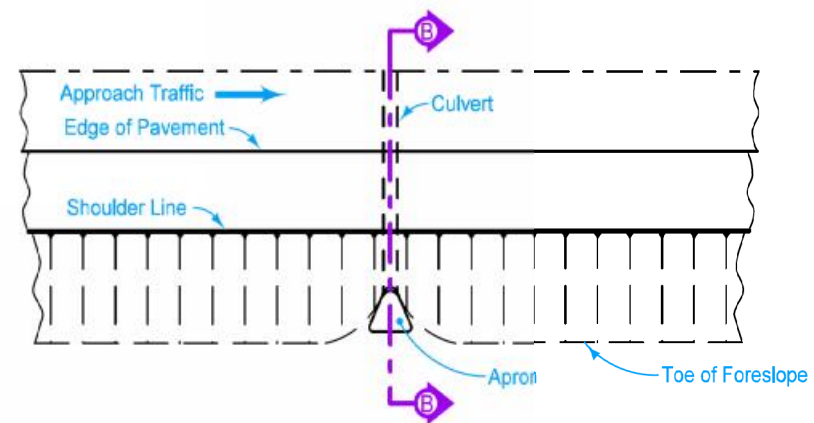
**B.02**



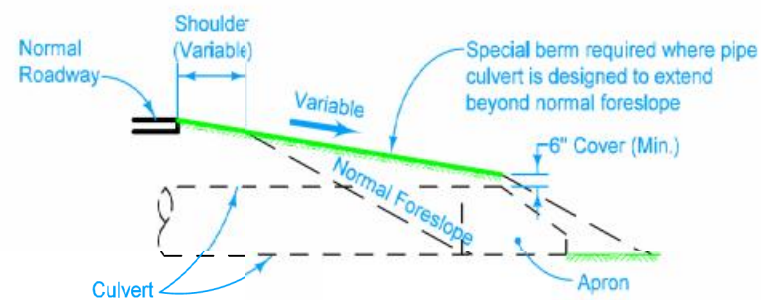




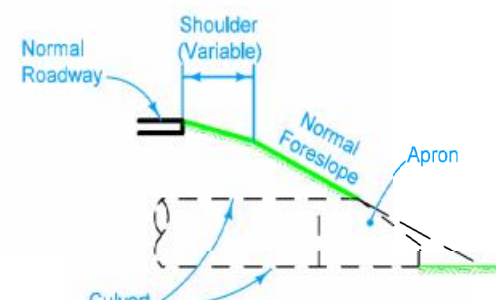
TYPICAL INSTALLATION PLAN  
WHERE SPECIAL BERM IS REQUIRED



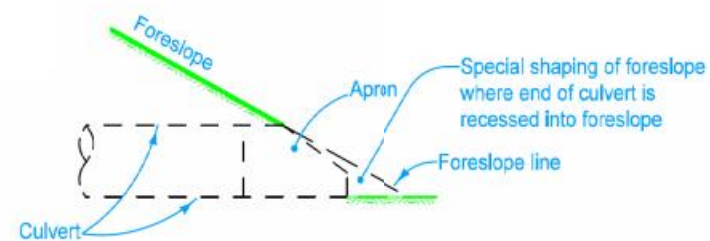
TYPICAL INSTALLATION PLAN  
WHERE CULVERT MATCHES NORMAL FORESLOPE



SECTION A-A



SECTION B-B

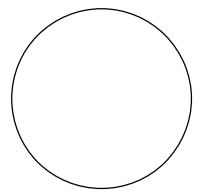


DETAIL OF SHAPING EARTH FORESLOPE  
AT CULVERT END

	REVISION	
	New	04-21-15
STANDARD ROAD PLAN	DR-103	
	SHEET 1 of 1	
REVISIONS: New. Replaces RF-30C.		
APPROVED BY DESIGN METHODS ENGINEER		

PIPE CULVERT  
(INSTALLATION DETAILS)

CONSULTANT:



IOWA DEPARTMENT OF  
NATURAL RESOURCES

ENGINEERING SERVICES - WALLACE BUILDING  
502 E. 9TH ST., DES MOINES, IA 50319-0034



TYPICAL CROSS SECTIONS AND DETAILS

ROAD MAINTENANCE FOR:

KLUM LAKE ACCESS

LOUISA COUNTY

NO.	DATE	REVISION

DRAWN BY: PROJECT NUMBER:  
BLF 20-06-58-01

CHK'D BY: DATE:  
DEC 2020

SHEET NO:

B.04



CONCRETE CULVERT PIPE CLASS "B" BEDDING				
DIAMETER OF PIPE 'D' Inches	(H) MAXIMUM ALLOWABLE COVER IN FEET			
	1500D (Class II)	2000D (Class III)	3000D (Class IV)	3750D (Class V)
18	11	13	20	25
24	12	14	21	26
36	13	16	23	28
48	14	16	24	29
60	14	17	24	29
72	14	17	24	30
84	15	17	25	30
96	15	18	25	31
108	15	18	26	32

CONCRETE CULVERT PIPE CLASS "C" BEDDING				
DIAMETER OF PIPE 'D' Inches	(H) MAXIMUM ALLOWABLE COVER IN FEET			
	1500D (Class II)	2000D (Class III)	3000D (Class IV)	3750D (Class V)
18	9	12	18	22
24	10	13	19	23
36	11	14	20	24
48	11	15	21	25
60	12	15	21	26
72	12	16	22	26
84	13	16	22	27
96	13	16	23	27
108	13	17	23	28

CONCRETE CULVERT PIPE

DESIGN CRITERIA FOR CONCRETE PIPE

The height of cover tables have been prepared from data in the "Concrete Pipe Design Manual" published by the American Concrete Pipe Association using the values listed below.

FOR EMBANKMENT CONDITIONS

Fill Material Density =  $w = 120$  lbs. per cu. ft.  
 Settlement Ratio =  $rsd = +0.5$   
 $\ast$  =  $ku = 0.13$   
 Projection Ratio =  $p = 0.9$  (Class "C" bedding)  
 =  $p = 0.7$  (Class "B" bedding)  
 Factor of Safety =  $F.S. = 1.33$  on Ultimate Strength

$\ast$  Using a ratio of lateral to vertical earth pressure (k) of 0.37 (saturated yellow clay) and a coefficient of internal friction (u) of 0.34.

The values shown for concrete pipe were calculated for concrete pipe placed under embankment conditions. These values do not apply to design and installation of sanitary sewer except where sanitary sewer would be placed under embankment conditions.

When unclassified pipe is specified, furnish and install a class of pipe meeting the requirements on the chart.

For Steel Round Pipe, the Contractor may choose the type of corrugated pipe and installation to furnish as long as the selection conforms to the limits indicated for the type specified.

When furnishing Steel Arch Pipe, furnish pipe with corrugations as specified in plans.

Minimum allowable cover for concrete and metal pipe is 2 feet for roadway culverts and 1 foot for entrance culverts.

Maximum cover for all sizes and installations of concrete arch pipe is 12 feet.


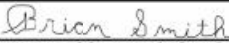
For all sizes and installations of polyethylene pipe:  
 minimum cover = 2 feet  
 maximum cover = 24 feet for 12 to 24 inch pipes  
 20 feet for 30 to 48 inch pipes

Where a pipe size not listed in the table is required, the 'H' indicated for the next smaller size will apply.

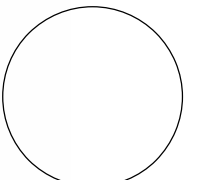
Special installations may be designed to exceed indicated maximum allowable cover by specific modification of one or more of the following conditions:

1. Bedding Class
2. Pipe Strength (including special design pipe)
3. Type of backfill or cover material
4. Compaction requirements for backfill or cover material
5. Controlled trench width

Where site conditions favor such modifications, significant economy may result from special design installations and these should be considered. Special designs will specify particular modification of construction requirements or design criteria as applicable. Necessary modifications of normal requirements will not ordinarily be paid for separately but will be included in the price bid for culvert pipe.

 <b>STANDARD ROAD PLAN</b>	REVISION	
	1	04-19-16
<b>DR-104</b> SHEET 1 of 3		
REVISIONS: Added general note regarding maximum cover on concrete arch pipes.		
 APPROVED BY DESIGN METHODS ENGINEER		
<b>DEPTH OF COVER TABLES FOR CONCRETE AND CORRUGATED PIPE</b>		

CONSULTANT:



IOWA DEPARTMENT OF  
NATURAL RESOURCES

ENGINEERING SERVICES - WALLACE BUILDING  
502 E. 9TH ST., DES MOINES, IA 50319-0034



TYPICAL CROSS SECTIONS AND DETAILS

ROAD MAINTENANCE FOR:

KLUM LAKE ACCESS

LOUISA COUNTY

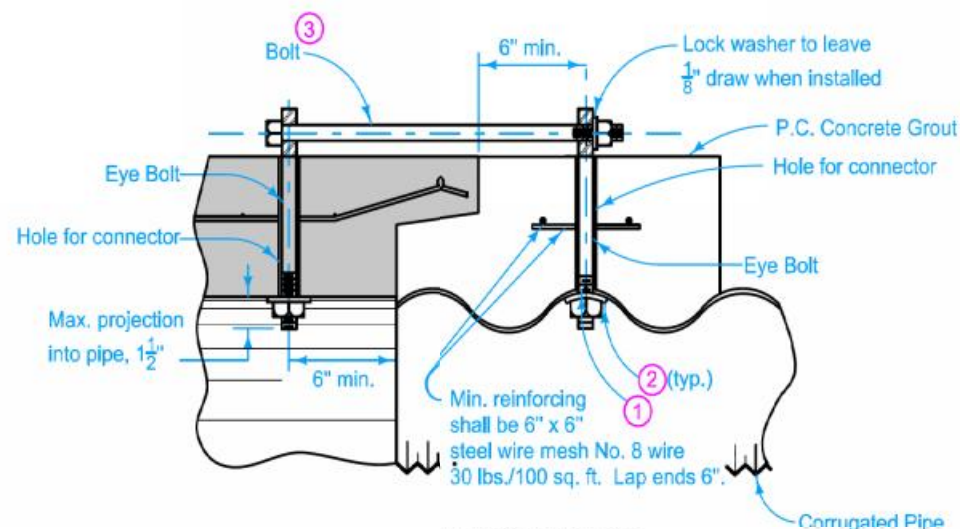
NO.	BY	REVISION

DRAWN BY: BLF PROJECT NUMBER: 20-06-58-01

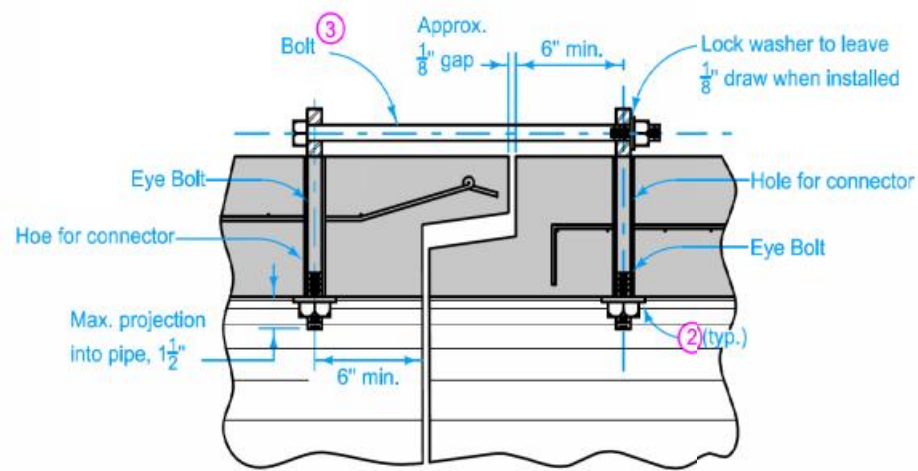
CHK'D BY: DATE: DEC 2020

SHEET NO:

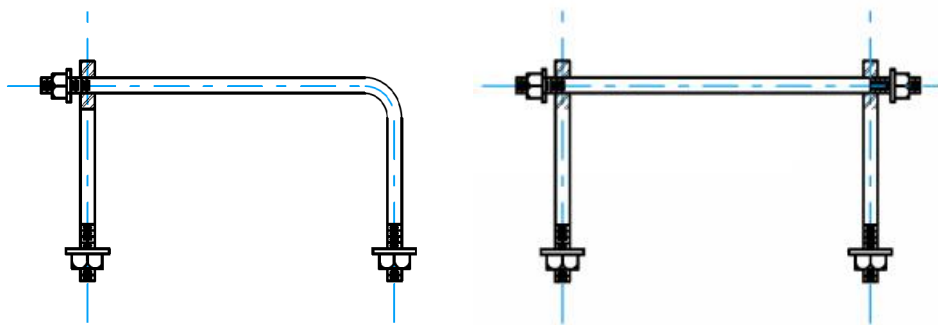
**B.05**



**SECTION OF PIPE CONNECTOR  
(Concrete Pipe to Corrugated Pipe)**



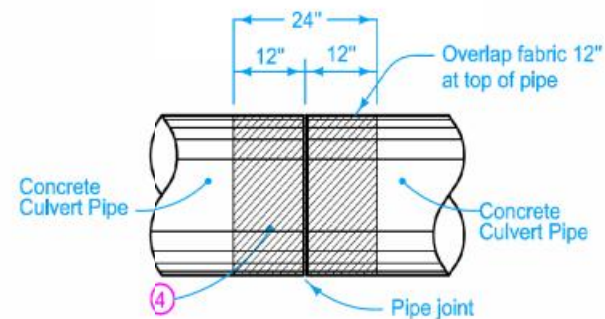
**SECTION OF PIPE CONNECTOR  
(Concrete Pipe to Concrete Pipe)**



**ONE BEND END**

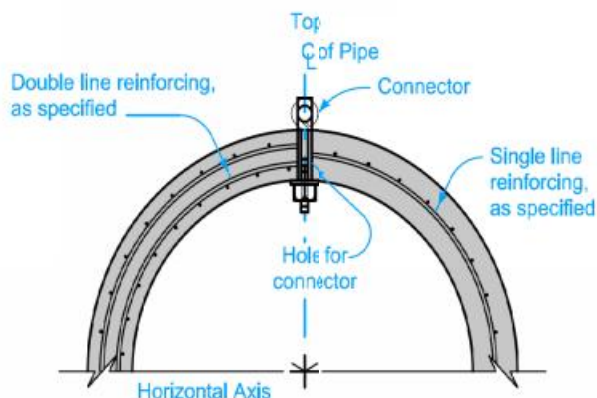
**THREADED AT BOTH ENDS**

**OPTIONAL BOLTS/CONNECTORS**

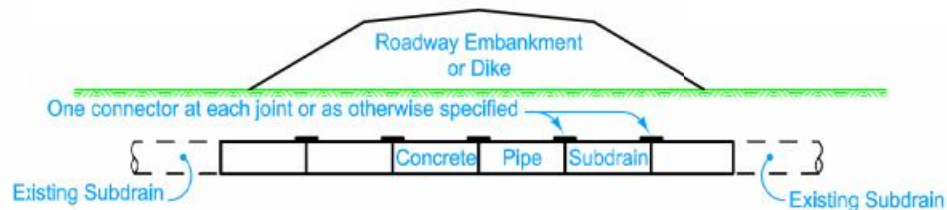


**PIPE JOINT WRAPPING**

PIPE SIZE (in.)	CONNECTOR AND BOLT SIZE (in.)	HOLE FOR CONNECTOR (in.)
12 to 27	5/8	7/8
30 to 60	3/4	1.0
66 to 132	1.0	1 1/4



**TYPICAL SECTION  
(Non-Sealed Joint)**



**TYPICAL INSTALLATION**

**TYPE 1 CONNECTION**

Wrap all joints on concrete roadway pipe culverts.

Use Type 3 Connections on all culvert pipes, unless specified otherwise. Refer to Materials I.M. 445.01 for Connector requirements.

Minimum 2 threads showing at all threaded ends.

Connections not required on pipe sections installed by trenchless methods.

For belled concrete pipe joints, connectors may be installed on the inside of the pipe.

**TYPE 1**

One connector at the top of the pipe section.

**TYPE 2 (Sealed Joint)**

Two connectors near the top of the pipe section. For details of reinforcement, refer to AASHTO M 170 for the class of pipe required. Refer to Materials I.M. 491.09 for seal requirements.

**TYPE 3 (Non - Sealed Joint)**

Two connectors near the top of the pipe section. For details of reinforcement, refer to AASHTO M 170 for the class of pipe required.

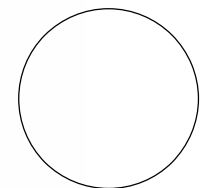
- 1 If holes are field drilled, place a ribbon of butyl sealant around bolts before placing 3 in. x 3 in. x 1/4 in. plate on bolts through corrugated metal pipe and tightening nuts.
- 2 1 1/4 inch round x 5/64 inch thick washer or 3 in. x 3 in. x 1/4 in. square plate (shaped to pipe radius).
- 3 Connectors with One Bend End and Bell End spacers allowed per Materials I.M. 451 Refer to Optional Bolts detail.
- 4 Engineering fabric for embankment erosion control.

Possible Tabulations:  
104-3  
104-5B

	REVISION
	3 10-17-17
STANDARD ROAD PLAN	DR-121
	SHEET 1 of 2
REVISIONS: Added 104-5B to Possible Tabulations. Added Type 3 connection to storm sewer outlet.	
DRAWN BY: <i>Brian Smith</i> APPROVED BY DESIGN METHODS ENGINEER	

**CONNECTED PIPE JOINTS**

CONSULTANT:



**IOWA DEPARTMENT OF  
NATURAL RESOURCES**

ENGINEERING SERVICES - WALLACE BUILDING  
502 E. 9TH ST., DES MOINES, IA 50319-0034



TYPICAL CROSS SECTIONS AND DETAILS

ROAD MAINTENANCE FOR:

KLUM LAKE ACCESS

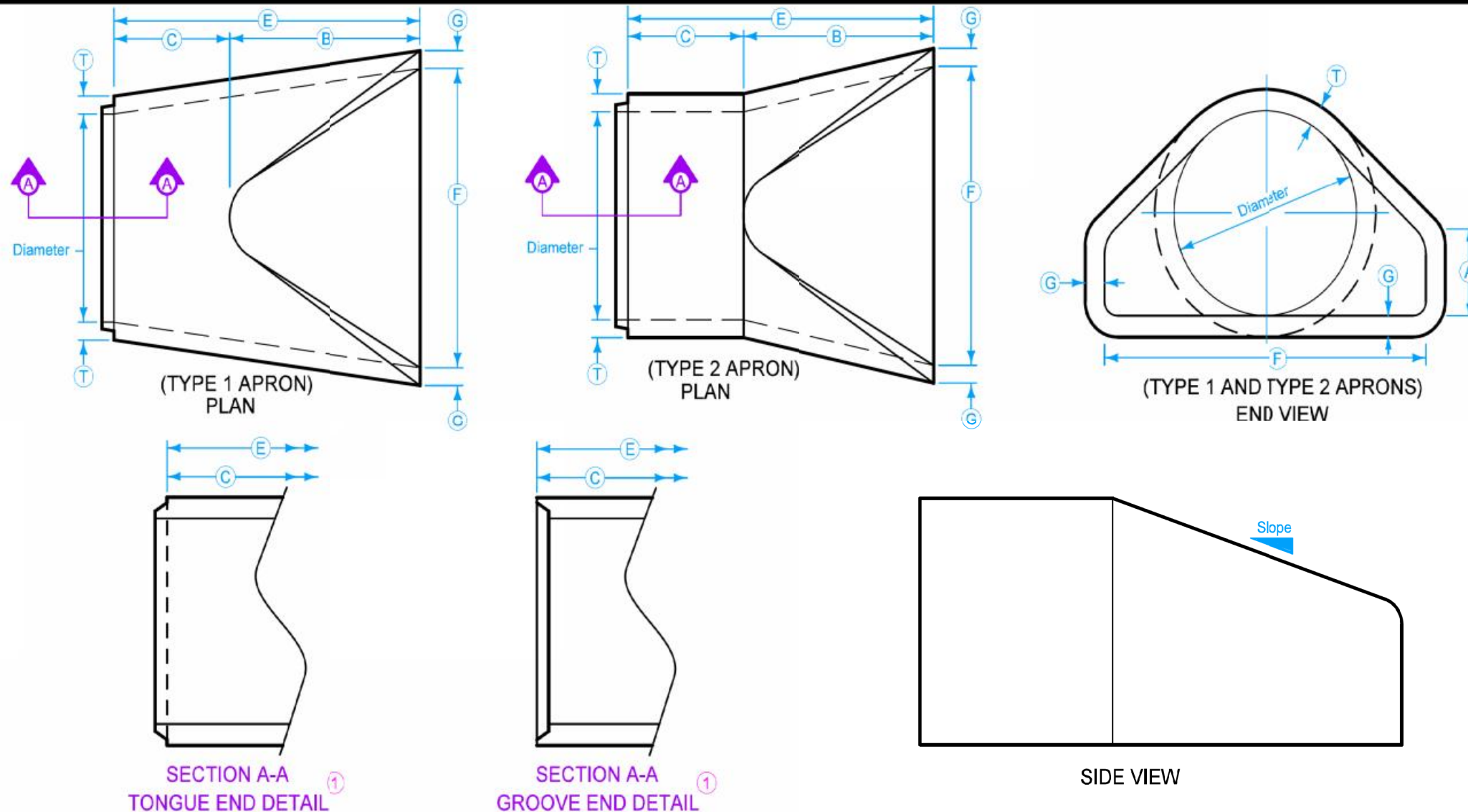
LOUISA COUNTY

NO.	DATE	REVISION

SHEET NO:

**B.06**





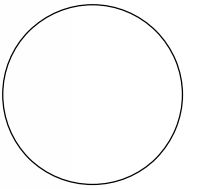
Dimension 'E' shown is the minimum and is considered the design length. Adjust for any difference between the actual length of concrete apron installed and the length indicated hereon within the length of concrete culvert pipe furnished.

Install connected pipe joints as shown on DR-121.

When specified in the contract documents, install pipe apron guards as shown on DR-213. Pipe apron guards are incidental to "Concrete Aprons".

① Tongue end used on inlet end section. Groove end used on outlet end section.

CONSULTANT:



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ENGINEERING SERVICES - WALLACE BUILDING  
502 E. 9TH ST., DES MOINES, IA 50319-0034



TYPICAL CROSS SECTIONS AND DETAILS

ROAD MAINTENANCE FOR:  
**KLUM LAKE ACCESS**  
LOUISA COUNTY

TYPE 1 APRONS								
DIAM.	SLOPE	A	B	MINIMUM		F	G	T
				C	E			
12"	2.4:1	4"	2'-0"	4'- <sup>7</sup> / <sub>8</sub> "	6'- <sup>7</sup> / <sub>8</sub> "	2'-0"	2"	2"
15"	2.4:1	6"	2'-3"	3'-10"	6'-1"	2'-6"	2 <sup>1</sup> / <sub>4</sub> "	2 <sup>1</sup> / <sub>4</sub> "
18"	2.3:1	9"	2'-3"	3'-10"	6'-1"	3'-0"	2 <sup>1</sup> / <sub>2</sub> "	2 <sup>1</sup> / <sub>2</sub> "
21"	2.4:1	9"	3'-0"	3'-1 <sup>1</sup> / <sub>2</sub> "	6'-1 <sup>1</sup> / <sub>2</sub> "	3'-5"	3"	3"
24"	2.5:1	9 <sup>1</sup> / <sub>2</sub> "	3'-7 <sup>1</sup> / <sub>2</sub> "	2'-6"	6'-1 <sup>1</sup> / <sub>2</sub> "	4'-0"	3"	3"
27"	2.5:1	10 <sup>1</sup> / <sub>2</sub> "	4'-1"	2'-0"	6'-1 <sup>1</sup> / <sub>2</sub> "	4'-4"	3 <sup>1</sup> / <sub>2</sub> "	3 <sup>1</sup> / <sub>2</sub> "
30"	2.5:1	12"	4'-6"	1'-7 <sup>3</sup> / <sub>4</sub> "	6'-1 <sup>3</sup> / <sub>4</sub> "	5'-0"	3 <sup>1</sup> / <sub>2</sub> "	3 <sup>1</sup> / <sub>2</sub> "
36"	2.5:1	15"	5'-3"	2'-9"	8'-0"	6'-0"	4"	4"
42"	2.5:1	21"	5'-3"	2'-9"	8'-0"	6'-6"	4 <sup>1</sup> / <sub>2</sub> "	4 <sup>1</sup> / <sub>2</sub> "
48"	2.5:1	24"	6'-0"	2'-0"	8'-0"	7'-0"	5"	5"
54"	1.8:1	27"	5'-0"	3'-0"	8'-0"	7'-6"	5 <sup>1</sup> / <sub>2</sub> "	5 <sup>1</sup> / <sub>2</sub> "
60"	1.6:1	29 <sup>1</sup> / <sub>2</sub> "	5'-0"	3'-0"	8'-0"	8'-0"	5 <sup>1</sup> / <sub>2</sub> "	6"
66"	1.7:1	30"	6'-0"	2'-3"	8'-3"	8'-0"	5 <sup>1</sup> / <sub>2</sub> "	6"
72"	1.6:1	30"	6'-6"	1'-9"	8'-3"	9'-0"	6"	7"
78"	1.8:1	36"	7'-6"	1'-9"	9'-3"	9'-6"	6 <sup>1</sup> / <sub>2</sub> "	7 <sup>1</sup> / <sub>2</sub> "
84"	1.3:1	29 <sup>1</sup> / <sub>2</sub> "	6'-9"	2'-6 <sup>1</sup> / <sub>2</sub> "	9'-3 <sup>1</sup> / <sub>2</sub> "	10'-0"	6 <sup>1</sup> / <sub>2</sub> "	8"

TYPE 2 APRONS								
DIAM.	SLOPE	A	B	MINIMUM		F	G	T
				C	E			
12"	2.4:1	4'	2'-0"	4'- <sup>7</sup> / <sub>8</sub> "	6'- <sup>7</sup> / <sub>8</sub> "	2'-0"	2"	2"
15"	2.4:1	6'	2'-3"	3'-10"	6'-1"	2'-6"	2 <sup>1</sup> / <sub>4</sub> "	2 <sup>1</sup> / <sub>4</sub> "
18"	2.3:1	9'	2'-3"	3'-10"	6'-1"	3'-0"	2 <sup>1</sup> / <sub>2</sub> "	2 <sup>1</sup> / <sub>2</sub> "
21"	2.4:1	9'	3'-0"	3'-1 <sup>1</sup> / <sub>2</sub> "	6'-1 <sup>1</sup> / <sub>2</sub> "	3'-5"	3"	3"
24"	2.5:1	9 <sup>1</sup> / <sub>2</sub> "	3'-7 <sup>1</sup> / <sub>2</sub> "	2'-6"	6'-1 <sup>1</sup> / <sub>2</sub> "	4'-0"	3"	3"
27"	2.5:1	10 <sup>1</sup> / <sub>2</sub> "	4'-1"	2'-0"	6'-1 <sup>1</sup> / <sub>2</sub> "	4'-4"	3 <sup>1</sup> / <sub>2</sub> "	3 <sup>1</sup> / <sub>2</sub> "
30"	2.5:1	12"	4'-6"	1'-7 <sup>3</sup> / <sub>4</sub> "	6'-1 <sup>3</sup> / <sub>4</sub> "	5'-0"	3 <sup>1</sup> / <sub>2</sub> "	3 <sup>1</sup> / <sub>2</sub> "
36"	2.5:1	15"	5'-3"	2'-9"	8'-0"	6'-0"	4"	4"
42"	2.5:1	21"	5'-3"	2'-9"	8'-0"	6'-6"	4 <sup>1</sup> / <sub>2</sub> "	4 <sup>1</sup> / <sub>2</sub> "
48"	2.5:1	24"	6'-0"	2'-0"	8'-0"	7'-0"	5"	5"
54"	1.9:1	24 <sup>1</sup> / <sub>2</sub> "	5'-5"	2'-7"	8'-0"	7'-6"	5 <sup>1</sup> / <sub>2</sub> "	5 <sup>1</sup> / <sub>2</sub> "
60"	1.4:1	24 <sup>1</sup> / <sub>2</sub> "	5'-0"	3'-0"	8'-0"	8'-0"	5 <sup>1</sup> / <sub>2</sub> "	6"
66"	1.7:1	30"	6'-0"	2'-3"	8'-3"	8'-0"	5 <sup>1</sup> / <sub>2</sub> "	6"
72"	1.4:1	24"	6'-6"	1'-9"	8'-3"	9'-0"	6"	7"
78"	1.8:1	36"	7'-6"	1'-9"	9'-3"	9'-6"	6 <sup>1</sup> / <sub>2</sub> "	7 <sup>1</sup> / <sub>2</sub> "
84"	1.5:1	23 <sup>1</sup> / <sub>2</sub> "	7'-6 <sup>1</sup> / <sub>2</sub> "	1'-9"	9'-3 <sup>1</sup> / <sub>2</sub> "	10'-0"	6 <sup>1</sup> / <sub>2</sub> "	8"

Contract Item:  
Apron, Concrete

Tabulations:  
104-3  
104-5C

	REVISION	
	2	4-21-20
<b>STANDARD ROAD PLAN</b>	<b>DR-201</b>	
	SHEET 1 of 1	
REVISIONS: Added Designer Info button.		
APPROVED BY DESIGN METHODS ENGINEER		
<b>CONCRETE APRONS</b>		

NO.	BY	REVISION

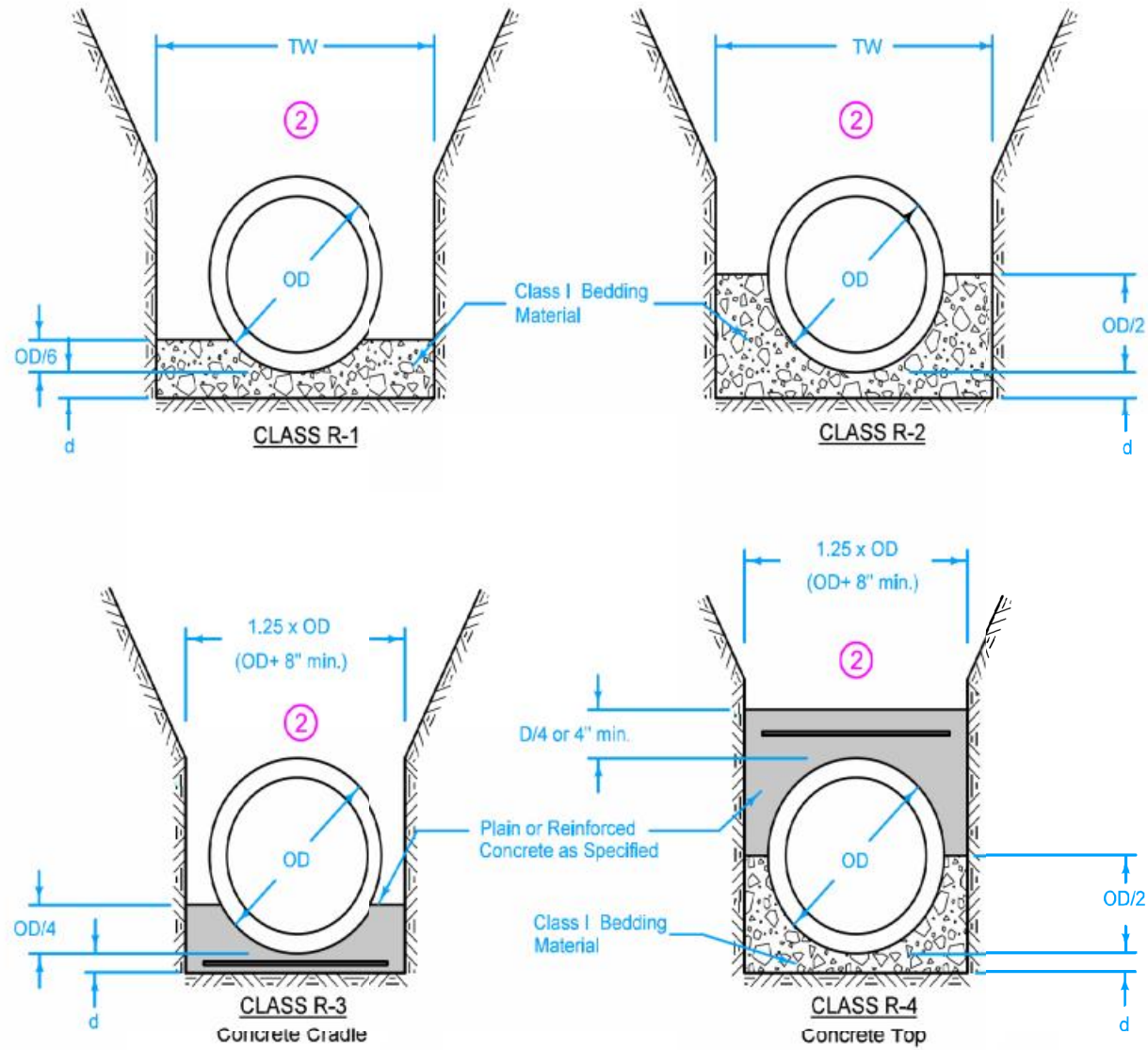
DRAWN BY: PROJECT NUMBER:  
BLF 20-06-58-01

CHK'D BY: DATE:  
  DEC 2020

SHEET NO:

**B.07**

RCP AND VCP CIRCULAR PIPE BEDDING <sup>①</sup>



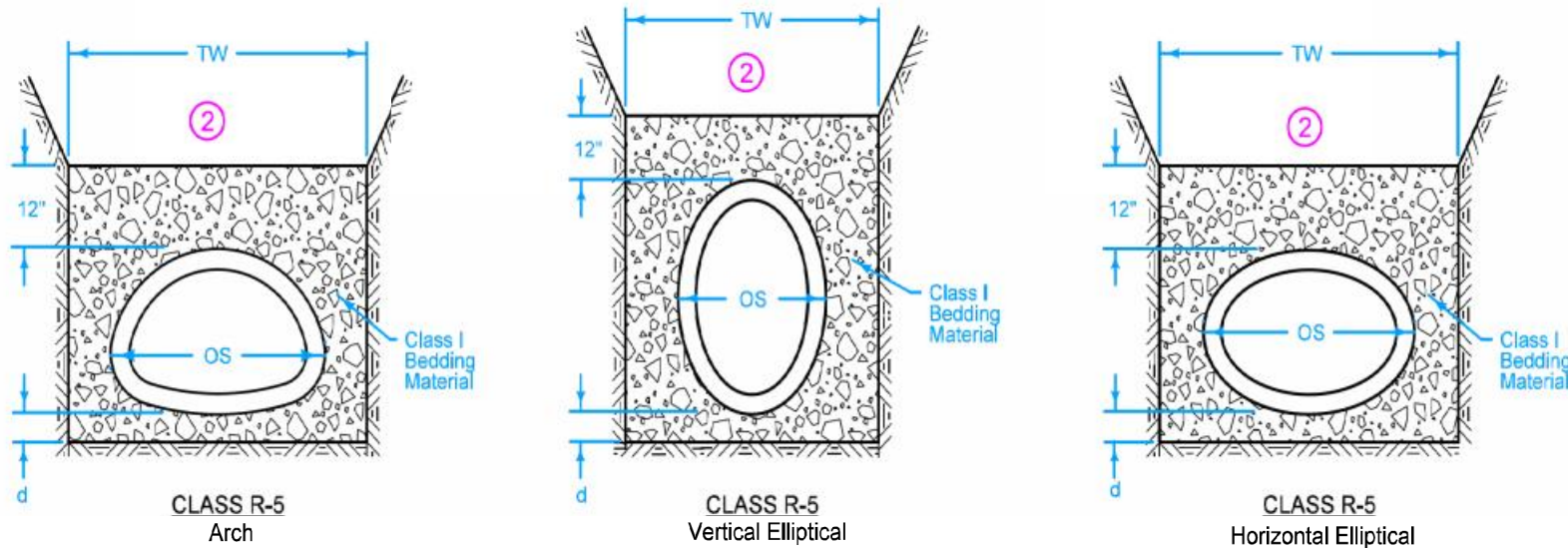
Refer to sheet 2 for bury depth restrictions.

- ① Use Bedding Class R-1 or R-2 unless specified otherwise.
- ② Place remainder of bedding and backfill materials as specified in the contract documents.

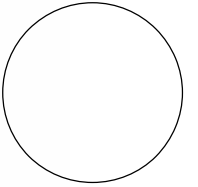
Key

- OD = Outside diameter of pipe
- OS = Outside span of pipe
- TW = Trench width at top of pipe:  
Min. =  $OD + 18$  inches  
Max. =  $1.25 \times OD + 12$  inches OR  
54 inches (whichever is greater)
- d = Depth of bedding material below pipe:  
 $OD/8$  or  $OS/8$ , OR 4 inches  
(whichever is greater)

REINFORCED CONCRETE ARCH AND ELLIPTICAL PIPE BEDDING



CONSULTANT:



IOWA DEPARTMENT OF  
NATURAL RESOURCES

ENGINEERING SERVICES - WALLACE BUILDING  
502 E. 9TH ST., DES MOINES, IA 50319-0034



TYPICAL CROSS SECTIONS AND DETAILS

ROAD MAINTENANCE FOR:  
KLUM LAKE ACCESS  
LOUISA COUNTY

SUDAS	IOWA DOT	REVISION	
		3	04-16-19
FIGURE 3010.102	STANDARD ROAD PLAN	<b>SW-102</b>	
		SHEET 1 of 2	
REVISIONS: Changed Class 1 to Class I in CLASS R-5 Vertical Elliptical detail.			
<i>Paul D. Wiegand</i> SUDAS DIRECTOR		<i>Shawn Nicks</i> DESIGN METHODS ENGINEER	

RIGID GRAVITY PIPE  
TRENCH BEDDING

NO.	BY	REVISION

DRAWN BY: PROJECT NUMBER:  
BLF 20-06-58-01

CHK'D BY: DATE:  
DEC 2020

SHEET NO:

**B.08**











