United States
Department of
Agriculture

Soil
Conservation
Service

693 Federal Building
210 Walnut Street
Des Moines, Iowa 50309

February 28, 1983

ENGINEERING FIELD MANUAL
IA210-EFM - AMENDMENT IA11, CHAPTERS 6 AND 17

Purpose. This notice transmits pages IA6-46(1) through IA6-46(5), IA6-54(1) through IA6-54(4) and IA17-24(1) through IA17-24(12). This adds sections on design criteria for hood inlets, drop inlets, and hot and cold weather concreting.

Effective Date. This amendment is effective upon receipt.

Filing Instructions. Pages IA6-46(1) through IA6-46(5) should be filed immediately following page 6-46. Pages IA6-54(1) through IA6-54(4) should be filed immediately following page 6-54. Pages IA17-24(1) through IA17-24(12) should be filed immediately following page 17-24. This amendment should be noted on the EFM Tabulation Sheet.

This material was formerly contained in Engineering Technical Notes. Engineering Technical Notes #5 (Rev 1) June 12, 1973, and (Rev 1) (Suppl 1), August 14, 1979; #17, June 19, 1973; and #18, June 20, 1973, are cancelled and should be removed from the file.

Each copy of the EFM should have these new pages. Additional copies may be ordered from the State Office. This transmittal should be destroyed when the material has been filed.

Gilbert L Landtiser
William J. Brune
State Conservationist

Attachments

IA6-54(1) through IA6-54(4)
is superceded by
Amendment IA30

AC
DC + Anthon
EN2
MNTC (5)
SCE Midwest States
SO

The Soil Conservation Service
is an agency of the
Department of Agriculture

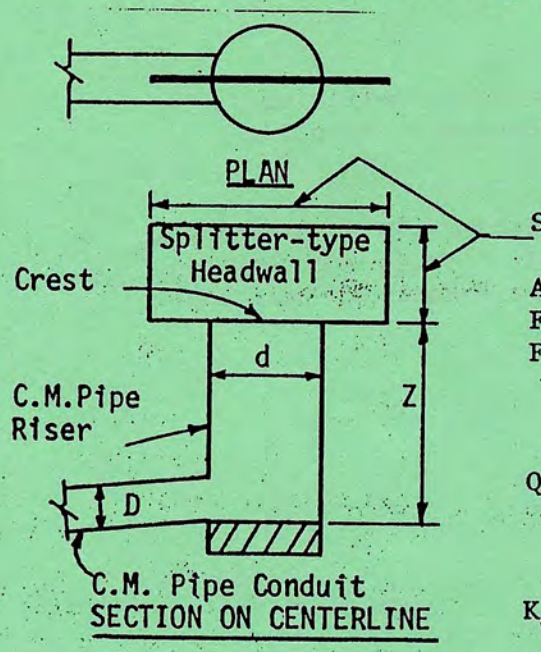
DROP INLET DESIGN CRITERIA

The attached sheets show formulas, nomenclature, criteria, coefficients, dimensions, and other information to be used in the design of drop inlet spillways.

When using the weir flow formulas, care should be exercised in determining the amount of obstruction to be deducted. If the weir flow is suppressed by fill slopes, posts, or other obstructions, suitable deductions will be made in the weir length.

CORRUGATED METAL PIPE RISER

Weir flow, $Q = 3.1\ (\Pi d - \text{any obstructions})\ h^{3/2}$



See Table Below

Area of riser $\geq$ 1.5 x area of conduit
For conduit slope > friction slope, Z = 5D
For conduit slope $\leq$ friction slope, Z = 2D

PIPE FLOW FORMULA

$$Q = a\sqrt{\frac{2gH}{1 + K_e + K_m + \Sigma K_p L}}$$

$K_e = 1.0$

$K_m = \frac{n\ \alpha}{3}$ (for $\alpha \leq 30^0$)

(When entire length of conduit is on the same slope, $K_m = 0$)

SYMBOLS

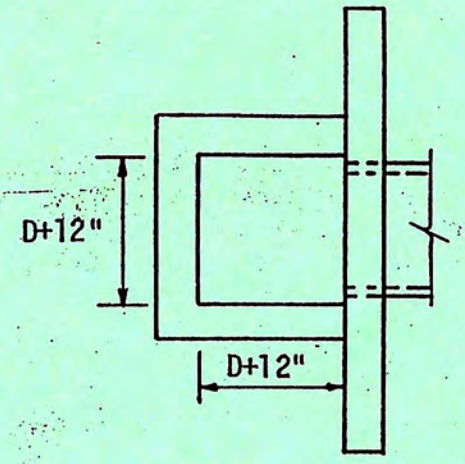
Q = Discharge in c.f.s.
h = Height of water over weir crest in feet
d = Inside diameter of riser in feet
D = Inside diameter of conduit in feet
Z = Riser height in feet
a = Area of conduit in square feet
g = Acceleration due to gravity = 32.2 ft/sec^2
H = Total available head in feet
K = Entrance loss coefficient
K = Head loss coefficient (circular pipe)
L = Length of conduit in feet

Manning's roughness coefficient
n = 0.027 for CMP (1" x 3" corrugations)
n = 0.025 for CMP (½" x 2½" corrugations)
n = 0.023 for HCMP
n = 0.010 for Welded Steel Pipe

INLET PROPORTIONS		ANTI-VORTEX DEVICE		
Pipe (D) Conduit-in.	Pipe (d) Riser-in.	Length ft.	Height ft.	Gage
8 & 10	18	5	2	16
12	18	5	2	16
15	24	6	2	16
18	30	7	2	16
21	30	7	2	16
24	36	8	2	14
30	42	9	2.5	14
36	48	10	3	12
42	54	11	3.5	12
48	60	12	4	10

SQUARE OPEN TOP RISER - PIPE DROP INLET

REINFORCED CONCRETE PIPE CONDUIT



PLAN

Weir flow, $Q = 3.1\ (L+4R - \text{Any Obstructions})h^{3/2}$

Pipe flow, $Q = a\sqrt{\dfrac{2gH}{1+K_e+K_m+\Sigma K_p L}}$

$K_e = 1.20$ (min. clear water)

$K_e = 2.00$ (max. with debris)

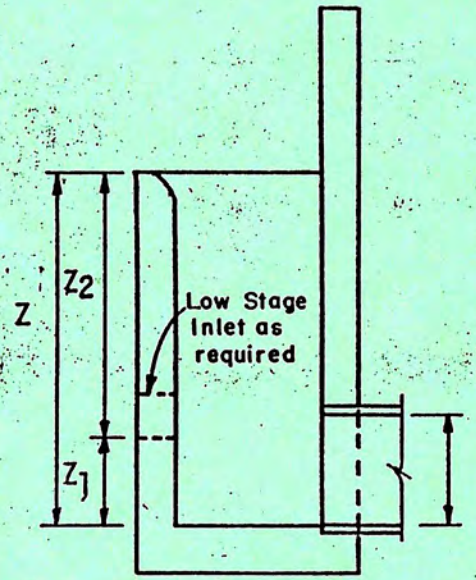
$K_m = \dfrac{n\ \alpha}{3}$ (for $\alpha \leq 30^0$)

(When entire length of conduit is on same slope, $K_m = 0$)

For conduit slope > friction slope,
Minimum Z = 5D

For conduit slope ≤ friction slope:

D	Q_{max}	Min. Z
24	94	5.0
30	148	5.5
36	212	6.0
42	288	6.5
48	376	7.0



SECTION ON CENTERLINE

Maximum allowable velocity in pipe = 30 fps.

Symbols

Q = Discharge in c.f.s.
L (Weir flow formula) = 3D+3 = Weir length in feet.
L (Pipe flow formula) = Length of conduit in feet.
R = Radius of crest rounding in feet.
h = Height of water over weir crest in feet.
D = Inside diameter of conduit in feet.
Z_1 = Low stage inlet (0 to 30 feet).
Z_2 = High stage inlet (Up to 20 feet).
$Z = Z_1+Z_2$ (Not to exceed 40 ft.).
a = Area of conduit in square feet.
g = Acceleration of gravity = 32.2 ft./sec.^{2}
H = Total available head in feet.
K_e = Entrance loss coefficient.
K_m = Bend loss coefficient.
K_p = Head loss coefficient (circular pipe).

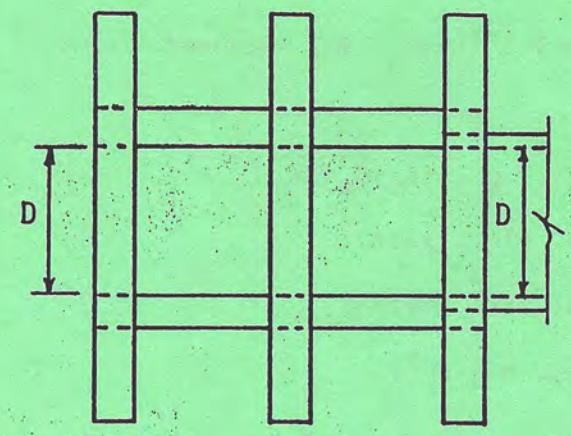
Manning's roughness coefficient "n" = 0.013

Reference:

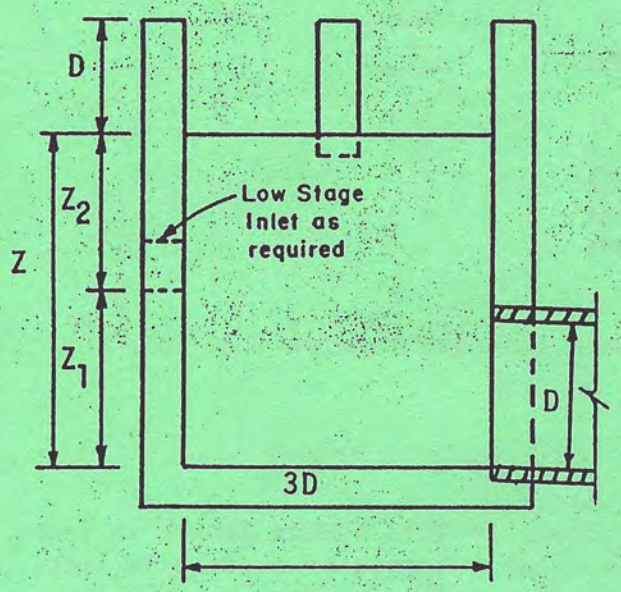
Washington Design Note 8
Washington Design Note 18

STANDARD RECTANGULAR OPEN TOP RISER - PIPE DROP INLET

REINFORCED CONCRETE PIPE CONDUIT



PLAN



SECTION ON CENTERLINE

Weir flow, $Q = 3.1\ (L+4R - \text{Any Obstructions})h^{3/2}$

Pipe Flow, $Q = a\sqrt{\dfrac{2gH}{1+K_e+K_m+\Sigma K_p L}}$

K_e = 0.50 (for round bottom riser)(min. clear water)
0.90 (for round bottom riser)(max. with debris)
0.60 (for square bottom riser)(min. clear water)
1.10 (for square bottom riser)(max. with debris)

$K_m = \dfrac{n\ \alpha}{3}$ (for $\alpha \leq 30^0$)

(When entire length of conduit is on same slope, $K_m = 0$)

For conduit slope > friction slope,
Minimum Z = 5D

For conduit slope ≤ friction slope:

D	Qmax	Min. Z
24	94	5.0
30	148	5.5
36	212	6.0
42	288	6.5
48	376	7.0

Maximum allowable velocity in pipe = 30 fps.

Symbols

Q = Discharge in c.f.s
L (Weir flow formula) = 6D = Weir length in feet.
L (Pipe flow formula) = Length of conduit in feet.
R = Radius of crest rounding in feet.
h = Height of water over weir crest in feet.
D = Inside diameter of conduit in feet.
Z_1 = Low Stage inlet (0 to 30 feet).
Z_2 = High Stage inlet (Up to 20 feet).
$Z = Z_1+Z_2$ (Not to exceed 40 ft.)
a = Area of conduit in square feet.
g = Acceleration of gravity = 32.2 ft./sec.^{2}
H = Total available head in feet.
K_e = Entrance loss coefficient.
K_m = Bend loss coefficient.
K_p = Head loss coefficient (circular pipe).

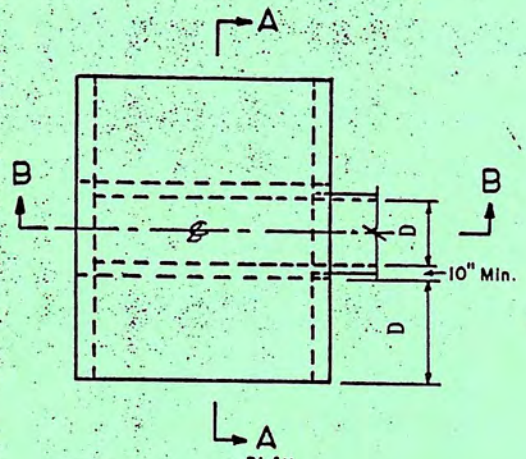
Manning's roughness coefficient "n" = 0.013

Reference:

Washington Design Note 8
Washington Design Note 18

STANDARD RECTANGULAR COVERED TOP RISER - PIPE DROP INLET

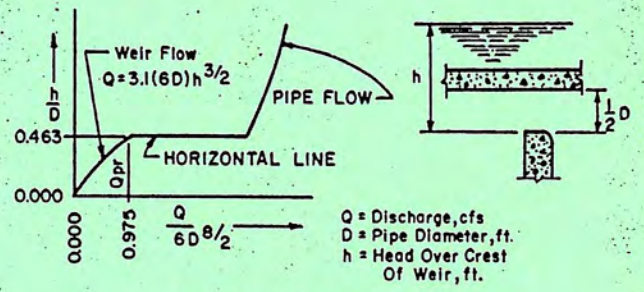
REINFORCED CONCRETE PIPE CONDUIT



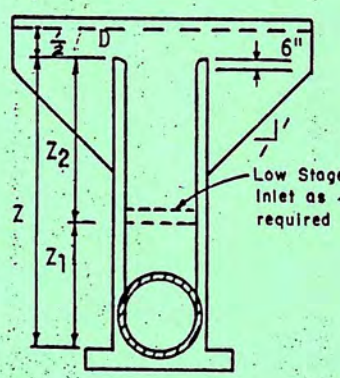
PLAN

References:

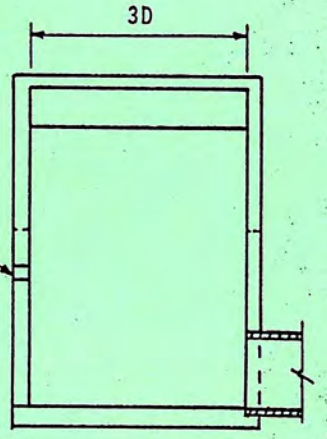
Washington Design Note 8
Washington Design Note 18



STAGE-DISCHARGE RELATION
FOR COVERED TOP RISER OF PROPORTIONS SHOWN



SECTION A-A



SECTION B-B

For conduit slope > friction slope, Minimum Z = 5D

For conduit slope ≤ friction slope:

D	Q_{max}	Min. Z
24	94	7.5
30	148	9.0
36	212	10.5
42	288	12.0
48	376	13.5

Maximum allowable velocity in pipe = 30 fps.

Weir flow, $Q = 3.1\ Lh^{3/2}$

Pipe Flow, $Q = a\sqrt{\dfrac{2gH}{1 + K_e + K_m + \Sigma K_p L}}$

K_e = 0.70 (for round bottom riser)(max. with debris)

K_e = 0.60 (for round bottom riser)(min. clear water)

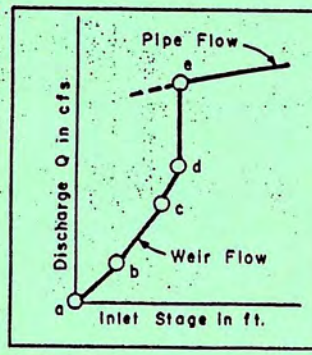
$K_m = \dfrac{n\ \alpha}{3}$ (for $\alpha \leq 30^0$)

(When entire length of conduit is on same slope, K_m = 0)

Manning's roughness coefficient "n" = 0.013

Symbols

Q = Discharge in c.f.s.
L (Weir flow formula) = 6D = Weir length in feet.
L (Pipe flow formula) = Length of conduit in feet.
R = Radius of crest rounding in feet.
h = Height of water over weir crest in feet.
D = Inside diameter of conduit in feet.
Z_1 = Low stage inlet (0 to 30 feet)
Z_2 = High stage inlet (2D+6" to 20 feet)
Z = Z_1+Z_2 (Not to exceed 40 ft.)
a = Area of conduit in square feet.
g = Acceleration of gravity = 32.2 ft./sec.^{2}
H = Total available head in feet.
K_e = Entrance loss coefficient.
K_m = Bend loss coefficient.
K_p = Head loss coefficient (circular pipe)



Pipe Dia. (in.)	PLOTTING COORDINATES							
	b		c		d		e	
	h	Q	h	Q	h	Q	h	
24	0.5	13.2	0.7	21.8	0.93	33	0.93	
30	0.6	21.6	0.9	39.7	1.16	58	1.16	
36	0.7	32.7	1.1	64.4	1.39	91	1.39	*
42	0.8	46.6	1.3	96.5	1.62	134	1.62	
48	0.9	63.5	1.5	136.7	1.85	187	1.85	

* From Pipe Flow Formula