U. S. Department of Agriculture
Soil Conservation Service
National Engineering Staff

April 1981 (Rev. 1)

Design Note No. 18*

Subject: "Unattached" ES drawings

Most Engineering Standard (ES) drawings are contained, because of their subject matter, in either sections of the national engineering handbook, technical releases, design notes, or other similar publications. Thus, such ES drawings are available by procurement of the publications in which they appear.

This design note provides a mechanism by which otherwise "unattached" ES drawings may be obtained.

These "unattached" ES drawings are contained herein. They group naturally into three categories. These are:

Group A: Schedules of National Standard Detail Drawings
- ES- 94 Series "B" Straight Drop Spillways
- ES-169 Standard Covered Risers
- ES-180 Standard Open Risers
- ES-186 Standard Impact Basins (also available in TR-49)
- ES-195 Standard Conduit Details
- ES-231 Standard Baffle Risers

Group B: Drop Inlet Spillway Standards
- ES-150 Covered Top Riser
- ES-151 Rectangular Open Top Riser
- ES-152 Square Open Top Riser
- ES-153 Restricted Flow Riser
- ES-154 Pipe Conduits
- ES-155 Pipe Conduit Outlets
- ES-156 Low Stage Inlets
- ES-232 Baffle Top Riser

Group C: Miscellaneous
- ES- 8 Circular Curve Pipe Layout Information
- ES- 11 Drop Spillway Nappe
- ES-157 Properties of Steel Angles with Equal Legs

*Prepared by Edwin S. Alling, Head, Design Unit, National Engineering Staff, Lanham, Maryland.

STANDARD PLANS: SERIES "B" REINFORCED CONCRETE DROP SPILLWAYS SCHEDULE SHOWING DRAWING NUMBER, CUBIC YARDS OF CONCRETE, AND POUNDS OF REINFORCING STEEL.

F	h \ L	6	8	10	12	14	16	18	20	22	24	26	28	30
5	2-6	2051-6B 19.98 1400.47	2051-8B 21.32 1591.36	2051-10B 22.66 1833.29	2051-12B 24.13 1757.87	2051-14B 25.47 1882.85	2051-16B 26.81 1947.69	2051-18B 28.15 2148.58	2051-20B 29.49 2206.85	2051-22B 30.83 2376.90	2051-24B 32.17 2436.30	2051-26B 33.51 2548.91	2051-28B 34.84 2708.46	2051-30B 36.18 2923.96
	3-0	2052-6B 24.36 1975.81	2052-8B 25.78 2167.93	2052-10B 27.20 2416.75	2052-12B 28.79 2313.39	2052-14B 30.21 2464.78	2052-16B 31.63 2559.55	2052-18B 33.05 2720.18	2052-20B 34.46 2830.36	2052-22B 35.88 2966.63	2052-24B 37.30 3117.16	2052-26B 38.72 3230.65	2052-28B 40.14 3368.08	2052-30B 41.56 3531.59
	3-6										2053-24B 43.06 3457.55	2053-26B 44.56 3635.43	2053-28B 46.05 3812.61	2053-30B 47.55 4023.02
6	2-6	2061-6B 21.08 1601.43	2061-8B 22.50 1767.24	2061-10B 23.92 2034.92	2061-12B 25.49 1973.92	2061-14B 26.91 2092.83	2061-16B 28.33 2206.57	2061-18B 29.75 2433.87	2061-20B 31.17 2532.38	2061-22B 32.59 2734.61	2061-24B 34.01 2830.03	2061-26B 35.43 2986.35	2061-28B 36.85 3167.85	2061-30B 38.27 3405.80
	3-0	2062-6B 25.64 2103.37	2062-8B 27.14 2283.59	2062-10B 28.64 2592.72	2062-12B 30.33 2484.08	2062-14B 31.83 2626.73	2062-16B 33.33 2814.70	2062-18B 34.83 3023.87	2062-20B 36.33 3111.19	2062-22B 37.83 3309.80	2062-24B 39.33 3485.35	2062-26B 40.83 3622.38	2062-28B 42.33 3817.95	2062-30B 43.83 4055.17
	3-6										2063-24B 45.77 3961.17	2063-26B 47.36 4173.51	2063-28B 48.96 4424.57	2063-30B 50.55 4660.84
	4-0	2064-6B* 36.70 3294.86	2064-8B 38.38 3553.83	2064-10B 40.05 3945.15	2064-12B 42.02 3824.54	2064-14B 43.69 4033.21	2064-16B 45.36 4186.48	2064-18B 47.04 4434.64	2064-20B 48.71 4544.86	2064-22B 50.38 4802.44	2064-24B 52.05 4967.94	2064-26B 53.73 5392.81	2064-28B 55.40 5511.74	2064-30B 57.07 5798.13
7	2-6	2071-6B 24.13 1770.40	2071-8B 25.64 1962.20	2071-10B 27.15 2281.97	2071-12B 28.81 2133.03	2071-14B 30.33 2291.06	2071-16B 31.84 2494.10	2071-18B 33.35 2630.02	2071-20B 34.86 2795.37	2071-22B 36.37 2983.80				
	3-0	2072-6B 27.21 2305.84	2072-8B 28.81 2594.80	2072-10B 30.41 2971.44	2072-12B 32.20 2768.75	2072-14B 33.79 2985.86	2072-16B 35.39 3108.27	2072-18B 36.98 3296.11	2072-20B 38.58 3456.31	2072-22B 40.17 3683.76	2072-24B 41.77 3934.24	2072-26B 43.37 4104.64	2072-28B 44.96 4308.07	2072-30B 46.56 4638.52
	3-6										2073-24B 47.94 4606.39	2073-26B 49.62 4881.46	2073-28B 51.29 5103.44	2073-30B 52.97 5389.76
	4-0	2074-6B* 38.72 3517.19	2074-8B 40.49 3818.79	2074-10B 42.26 4322.34	2074-12B 44.34 4060.57	2074-14B 46.11 4324.97	2074-16B 47.88 4435.01	2074-18B 49.65 4679.42	2074-20B 51.41 4941.73	2074-22B 53.18 5356.99	2074-24B 54.95 5614.07	2074-26B 56.72 5842.35	2074-28B 58.49 6158.87	2074-30B 60.25 6465.29
	4-6											2075-26B 64.60 6608.62	2075-28B 66.44 6902.07	2075-30B 68.29 7270.07
	5-0	2076-6B* 51.60 5758.48	2076-8B* 53.52 6063.63	2076-10B 55.45 6506.82	2076-12B 57.83 6374.43	2076-14B 59.76 6630.05	2076-16B 61.69 6866.32	2076-18B 63.61 7137.31	2076-20B 65.54 7383.82	2076-22B 67.47 7891.14	2076-24B 69.39 8221.24	2076-26B 72.01 7986.59	2076-28B 73.93 8195.88	2076-30B 75.86 8441.24
8	2-6	2081-6B 28.52 2286.72	2081-8B 30.11 2580.93	2081-10B 31.70 2894.57										
	3-0	2082-6B 30.00 2606.59	2082-8B 31.67 2933.42	2082-10B 33.35 3393.86	2082-12B 35.22 3166.00	2082-14B 36.90 3418.33	2082-16B 38.57 3621.84	2082-18B 40.24 3842.53	2082-20B 41.92 4035.89	2082-22B 43.59 4296.86	2082-24B 45.26 4796.48	2082-26B 46.93 4846.29	2082-28B 49.45 4547.78	2082-30B 51.12 4800.91
	3-6								2083-20B 46.92 4835.15	2083-22B 48.69 5148.68	2083-24B 50.45 5314.69	2083-26B 52.22 5673.64	2083-28B 54.83 5396.68	2083-30B 56.59 5568.93
	4-0	2084-6B* 40.29 3942.57	2084-8B 42.14 4290.39	2084-10B 43.99 4667.26	2084-12B 46.17 4568.02	2084-14B 48.02 4859.58	2084-16B 49.87 5001.22	2084-18B 51.71 5440.11	2084-20B 53.56 5692.84	2084-22B 55.41 5976.66	2084-24B 57.26 6443.37	2084-26B 59.96 6131.76	2084-28B 61.81 6335.72	2084-30B 63.66 6667.19
	4-6											2085-26B 67.43 7648.31	2085-28B 69.36 8050.62	2085-30B 71.28 8319.20
	5-0	2086-6B* 54.03 6732.94	2086-8B* 56.05 7031.80	2086-10B 58.07 7596.94	2086-12B 60.57 7400.45	2086-14B 62.59 7687.53	2086-16B 64.61 7941.71	2086-18B 66.63 8353.59	2086-20B 68.66 8708.75	2086-22B 71.61 8487.16	2086-24B 73.64 8903.10	2086-26B 75.66 9273.94	2086-28B 77.68 9698.10	2086-30B 79.70 10130.08
9	2-6	2091-6B 33.56 2886.37	2091-8B 35.54 3156.72	2091-10B 37.09 3238.05										
	3-0	2092-6B 35.02 3165.85	2092-8B 36.79 3575.92	2092-10B 38.77 3596.27	2092-12B 40.54 3853.91	2092-14B 42.31 4148.74	2092-16B 44.08 4398.32	2092-18B 45.85 4672.12	2092-20B 47.62 4995.58	2092-22B 50.50 4669.28	2092-24B 52.27 4889.04	2092-26B 54.03 5168.69	2092-28B 55.80 5478.30	2092-30B 57.57 5825.39
	3-6	2093-6B* 36.91 3685.64	2093-8B 38.76 4022.45	2093-10B 40.61 4543.10	2093-12B 42.74 4405.53	2093-14B 44.59 4659.63	2093-16B 46.44 4949.25	2093-18B 48.28 5268.80	2093-20B 50.13 5668.76	2093-22B 53.09 5279.76	2093-24B 54.94 5526.79	2093-26B 56.79 5916.74	2093-28B 58.64 6187.86	2093-30B 60.48 6559.76
	4-0	2094-6B* 41.81 4376.42	2094-8B 43.74 4718.70	2094-10B 45.68 5193.83	2094-12B 47.95 5067.65	2094-14B 49.88 5335.07	2094-16B 51.81 5644.16	2094-18B 53.74 6034.57	2094-20B 56.80 5782.65	2094-22B 58.73 6148.78	2094-24B 60.66 6327.49	2094-26B 62.59 6602.44	2094-28B 64.52 7022.40	2094-30B 66.46 7406.17
	4-6											2095-26B 70.76 8571.17	2095-28B 72.79 8964.40	2095-30B 74.81 9317.86
	5-0	2096-6B* 55.92 7504.69	2096-8B* 58.02 7844.56	2096-10B 60.12 8305.86	2096-12B 62.72 8286.26	2096-14B 64.83 8639.17	2096-16B 66.93 9017.95	2096-18B 69.03 9353.63	2096-20B 72.27 9178.51	2096-22B 74.37 9509.13	2096-24B 76.48 9827.44	2096-26B 78.58 10311.98	2096-28B 80.69 10693.95	2096-30B 82.79 10990.97

(1) Notes: Drawing No., cu. yds of concrete, and lbs.. of reinforcing steel are listed vertically in order for each size. Each drawing number shall be prefixed with the letters E. S.

(2) *The ratio of L + h is less than 2.0 for these values. Correction for hydraulic losses due to end contractions must be considered in the solution of the weir formula, for discharge capacity, before these drop spillways can be applied.

REFERENCE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ENGINEERING DIVISION-DESIGN SECTION

STANDARD DWG. NO.
ES-94
SHEET 1 OF 2
DATE 10-6-54

STANDARD PLANS: SERIES "B" REINFORCED CONCRETE DROP SPILLWAYS SCHEDULE SHOWING DRAWING NUMBER, CUBIC YARDS OF CONCRETE, AND POUNDS OF REINFORCING STEEL.

F	h \ L	6	8	10	12	14	16	18	20	22	24	26	28	30
10	2-6	2101-6B 38.50 3653.89	2101-8B 40.25 4079.57	2101-10B 42.19 4038.44										
	3-0	2102-6B 40.07 4051.02	2102-8B 41.91 4409.92	2102-10B 43.98 4515.45	2102-12B 45.83 4837.60	2102-14B 47.67 5188.38	2102-16B 49.52 5502.04	2102-18B 52.69 5271.26	2102-20B 54.54 5458.22	2102-22B 56.38 5714.65	2102-24B 58.23 6102.21	2102-26B 60.08 6335.89	2102-28B 61.92 6707.70	2102-30B 63.77 7270.23
	3-6			2103-10B 46.81 5104.70	2103-12B 48.75 5398.62	2103-14B 50.69 5790.70	2103-16B 52.64 6181.37							
	4-0	2104-6B* 44.76 4979.57	2104-8B 46.78 5515.76	2104-10B 49.16 5617.58	2104-12B 51.18 5780.68	2104-14B 53.20 6222.16	2104-16B 55.22 6600.50	2104-18B 58.59 6379.79	2104-20B 60.61 6601.14	2104-22B 62.63 6853.84	2104-24B 64.65 7270.83	2104-26B 66.68 7685.13	2104-28B 68.70 8035.65	2104-30B 70.72 8492.21
	4-6											2105-26B 73.48 9288.91	2105-28B 75.58 9723.46	2105-30B 77.79 10324.10
	5-0	2106-6B* 58.26 8337.86	2106-8B* 60.46 8704.38	2106-10B 62.66 9185.84	2106-12B 65.37 9190.06	2106-14B 67.57 9671.24	2106-16B 69.77 10099.38	2106-18B 73.42 9802.47	2106-20B 75.62 10047.62	2106-22B 77.82 10525.47	2106-24B 80.02 10851.85	2106-26B 82.22 11492.03	2106-28B 84.42 11969.87	2106-30B 86.62 12376.95
	6-0	2108-6B* 76.54 12355.69	2108-8B* 78.97 12507.68	2108-10B* 81.40 13199.52	2108-12B 84.53 13268.52	2108-14B 86.96 13950.67	2108-16B 89.39 14502.72	2108-18B 93.18 14030.46	2108-20B 95.62 14338.86	2108-22B 98.05 14889.07	2108-24B 100.48 15265.29	2108-26B 102.91 15559.54	2108-28B 105.53 15803.93	2108-30B 108.45 16180.56

(1) Notes: Drawing No., cu. yds of concrete, and lbs. of reinforcing steel are listed vertically in order for each size. Each drawing number shall be prefixed with the letters E. S.

(2) *The ratio of L + h is less than 2.0 for these values. Correction for hydraulic losses due to end contractions must be considered in the solution of the weir formula, for discharge capacity, before these drop spillways can be applied.

Definition of Symbols:

F = net drop from crest of weir to top of transverse sill in ft
h = total depth of weir in ft
L = length of weir in ft

Load Assumptions:

1. Weight of concrete = 150 lbs/ft^3
2. Weight of earth fill = 100 lbs/ft^3
3. Weight of equivalent fluid against headwall = 62.4 lbs/ft^3
4. Weight of equivalent fluid against sidewalls = 35 lbs/ft^3
5. Weight of equivalent fluid against wingwalls = 35 lbs/ft^3
6. Weight of equivalent fluid against headwall extensions = 5 lbs/ft^3
7. Allowable soil bearing pressure = 2000 lbs/ft^2

Allowable unit working stresses (Class B Concrete):

(1) Ultimate compressive strength f'_c = 3000 lbs/sq in.
(2) Extreme fiber stress in compression f_c = 1200 lbs/sq in.
(3) Working stress for reinforcing steel f_s = 20,000 lbs/sq in.

REFERENCE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ENGINEERING DIVISION-DESIGN SECTION

STANDARD DWG. NO.
ES-94
SHEET 2 OF 2
DATE 10-6-54

STANDARD PLANS: STANDARD COVERED RISERS
SELECTION OF STANDARD DETAIL DRAWINGS

Key to Drawing Numbers

The drawing numbers of the Standard Detail Drawings for Standard Covered Risers are given by:

$$ES\text{-}30DD\text{-}[NN]_{ih}[NN]_{is}[\tfrac{E}{R}]$$

where

DD ≡ D = pipe conduit diameter, inches.

$[NN]_{ih} \equiv N_{ih}$ = vertical distance from pipe invert at the riser to crest of the covered inlet of the riser, ft.

$[NN]_{is} \equiv N_{is}$ = vertical distance from pipe invert at the riser to soil surface, ft. The soil surface is either the sediment or the embankment (berm) surface.

$[\tfrac{E}{R}]$ ≡ riser is designed to be located in the [embankment / reservoir area].

Standard Detail Drawings

Each set of Standard Detail Drawings for a Standard Covered Riser consists of four sheets. Each Standard Covered Riser is designed for a specific combination of N_{ih} and N_{is}.

A set of Standard Detail Drawings may be adapted to a range of riser heights. The height may vary from the full design height given by N_{ih} in the drawing number to five feet less than N_{ih}. The only exception to the preceding statement occurs with risers having D = 36 in. and N_{ih} = 15 ft, for which the height range is four feet.

The design combinations of N_{ih}, N_{is}, and N_{sh} for each pipe conduit diameter together with criteria for selecting the Standard Detail Drawings to be used for a given adaptation, are given on sheet 2 of this drawing.

Adaptation of Standard Detail Drawings

After the particular Standard Detail Drawings to be used have been selected, they must be adapted to the desired riser height. The adaptation is accomplished by completing the fill-ins left blank on sheets 1 and 3 of the drawings. The information required is self-explanatory. It consists of vertical dimensions, reinforcement bar lengths, reinforcement bar quantities, and volumes and weights of materials.

Volumes and Weights of Materials

Quantity schedules for each family of Standard Covered Risers are contained on the following sheets of this drawing:

Pipe Conduit Diameter	Sheet
D = 24 in.	3
30	4
36	5
42	6
48	7

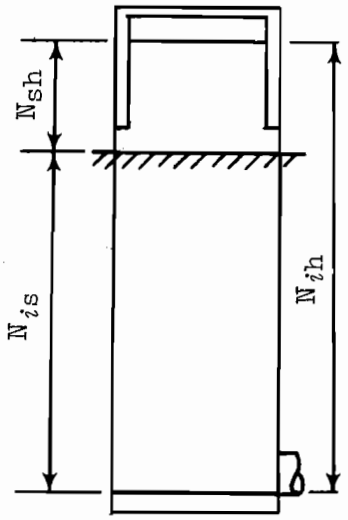
Wind Projections

Risers to be located in the embankment are not designed for wind. An allowable wind projection is tabulated for these risers on the sheets containing the quantity schedules. The tabulated allowable wind projection was computed for the conditions:

(1) No embankment is placed in the vicinity of the riser.
(2) Moist soil condition, allowable earth bearing pressures are:
   $P_{max} \leq 4$ ksf
   $P_{aver} \leq 2$ ksf
   $P_{min} \geq 0$ ksf
(3) Wind acts on the sidewall at 50 psf.
(4) The constructed riser height, above the top of the footing, does not exceed the allowable wind projection.

The assumption is made that the allowable wind projection for other conditions of embankment placement and riser height is not less than that tabulated. Thus, the tabulated allowable wind projection may be considered as the allowable vertical distance between the surface of the embankment and the top of the riser at any stage of construction.

STANDARD PLANS: STANDARD COVERED RISERS
SELECTION OF STANDARD DETAIL DRAWINGS



Selection of Standard Detail Drawings

The selection of the particular Standard Detail Drawings to be adapted to the desired riser height is made as follows:

The N_{ih} of the Standard Detail Drawings to be selected is the smallest value of N_{ih} which is greater than or equal to the N_{ih} desired at the specific site and the N_{sh} of the Standard Detail Drawings to be selected is the greatest value of N_{sh} which is less than or equal to the N_{sh} desired at the specific site.

Thus:

N_{ih} of the standard $\geq$ N_{ih} desired at specific site

N_{sh} of the standard $\leq$ N_{sh} desired at specific site.

Four examples are given. These examples assume a 36 in. pipe conduit diameter and risers will be located in the embankment.

Example 1.
N_{ih} desired = 30.0', N_{sh} desired = 13.0', therefore select ES-3036 - 3020E

Example 2.
N_{ih} desired = 28.5', N_{sh} desired = 13.0', therefore select ES-3036 - 3020E

Example 3.
N_{ih} desired = 27.0', N_{sh} desired = 13.0', therefore select ES-3036 - 3020E

Example 4.
N_{ih} desired = 27.0', N_{sh} desired = 15.0', therefore select ES-3036 - 3015E.

STANDARD PLANS: STANDARD COVERED RISERS SCHEDULE SHOWING DRAWING NUMBERS, VOLUMES OF CONCRETE, AND WEIGHTS OF STEEL.

PIPE CONDUIT DIAMETER = 24 "

STANDARD DETAIL DRAWINGS, ES-3024-$[NN]_{ih}$ $[NN]_{is}[\frac{E}{R}]$

N_{ih} feet	RISERS TO BE LOCATED IN RESERVOIR AREA $N_{sh} = N_{ih} - N_{is}$, feet				RISERS TO BE LOCATED IN EMBANKMENT $N_{sh} = N_{ih} - N_{is}$, feet			
	5	10	15	20	5	10	15	20
40	4035R 41.45 0.97 7848 187	4030R 38.40 0.74 7550 206	4025R 39.00 0.74 7471 206	4020R 40.20 0.74 6588 167	4035E 57.55 0.97 11036 213 25	4030E 44.90 0.74 8434 218 19	4025E 38.00 0.74 7322 206 14	4020E 34.60 0.74 6106 167 9
35	3530R 33.60 0.74 6835 206	3525R 33.60 0.74 5979 167	3520R 33.10 0.74 5977 167	3515R 33.30 0.60 4999 191	3530E 42.40 0.74 8064 218 19	3525E 35.50 0.74 6227 167 16	3520E 32.20 0.74 5667 167 10	3515E 28.20 0.60 6183 191 9
30	3025R 29.20 0.74 5318 167	3020R 27.80 0.60 4957 154	3015R 28.20 0.60 4826 154	3010R 27.90 0.60 4595 118	3025E 32.20 0.74 5841 167 15	3020E 27.80 0.60 4935 154 10	3015E 25.30 0.60 4366 154 8	3010E 24.00 0.60 3980 118 14
25	2520R 22.90 0.60 4298 154	2515R 22.90 0.60 3733 118	2510R 24.10 0.60 3857 116	2505R 24.10 0.60 3725 101	2520E 24.90 0.60 4454 154 11	2515E 21.50 0.60 3625 118 9	2510E 20.70 0.60 3372 116 12	2505E 21.30 0.60 3330 101 17
20	2015R 18.60 0.60 3095 116	2010R 18.60 0.60 2893 98	2005R 18.90 0.60 2817 87	-	2015E 18.70 0.60 3045 116 9	2010E 17.80 0.60 2783 98 12	2005E 18.10 0.60 2622 87 15	-
15	1510R 15.10 0.60 2253 84	1505R 15.00 0.60 2279 78	-	-	1510E 14.80 0.60 2212 84 13	1505E 14.80 0.60 2247 78 13	-	-

Items, listed in vertical order per riser:

(1) Partial drawing number - $[NN]_{ih}[NN]_{is}[\frac{E}{R}]$

(2) Volume of concrete for full height riser, N_{ih} equals tabulated value, cu. yds.

(3) Change in volume of concrete per foot decrease in height of riser, cu. yds.

(4) Weight of steel for full height riser, N_{ih} equals tabulated value, lbs.

(5) Approximate change in weight of steel per foot decrease in height of riser, lbs.

(6) Allowable wind projection, see sheet 1 of this drawing, feet.

REFERENCE

SCS Engineering Memo. - 50
SCS Technical Release - 29
SCS Technical Release - 30

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ENGINEERING DIVISION · DESIGN UNIT

STANDARD DWG. NO.
ES- 169
SHEET 3 OF 7
DATE 8 - 66

STANDARD PLANS: STANDARD COVERED RISERS SCHEDULE SHOWING DRAWING NUMBERS, VOLUMES OF CONCRETE, AND WEIGHTS OF STEEL.

PIPE CONDUIT DIAMETER = 30"

STANDARD DETAIL DRAWINGS, ES-3030-[NN]$_{ih}$ [NN]$_{is}$[$^{E}_{R}$]

N_{ih} feet	RISERS TO BE LOCATED IN RESERVOIR AREA $N_{sh} = N_{ih} - N_{is}$, feet				RISERS TO BE LOCATED IN EMBANKMENT $N_{sh} = N_{ih} - N_{is}$, feet			
	5	10	15	20	5	10	15	20
40	4035R 51.97 1.16 10389 276	4030R 51.48 1.16 10036 276	4025R 51.82 1.16 9420 232	4020R 50.07 1.16 9674 232	4035E 69.37 1.16 13665 303 27	4030E 56.86 1.16 11160 276 22	4025E 53.23 1.16 9433 232 23	4020E 48.12 1.16 8867 232 20
35	3530R 44.51 1.16 8533 232	3525R 44.51 1.16 8116 220	3520R 45.07 1.16 8144 194	3515R 42.38 0.89 7597 198	3530E 51.91 1.16 9908 232 20	3525E 47.22 1.16 8612 220 20	3520E 44.85 1.16 7952 194 21	3515E 38.91 0.89 6871 198 16
30	3025R 36.83 0.89 7106 240	3020R 36.83 0.89 6511 198	3015R 35.43 0.89 6805 198	3010R 33.96 0.72 6319 181	3025E 40.11 0.89 7578 240 21	3020E 38.05 0.89 6600 198 20	3015E 33.12 0.89 6214 198 13	3010E 31.54 0.72 5688 181 17
25	2520R 30.50 0.89 5533 162	2515R 29.03 0.72 5263 181	2510R 29.47 0.72 5118 148	2505R 28.83 0.72 5032 138	2520E 31.82 0.89 5728 162 14	2515E 27.79 0.72 5086 181 15	2510E 27.49 0.72 4767 148 15	2505E 27.63 0.72 4762 138 19
20	2015R 23.49 0.72 4363 148	2010R 23.61 0.72 4049 141	2005R 23.61 0.72 3713 111	–	2015E 23.93 0.72 4480 148 13	2010E 22.65 0.72 3897 141 14	2005E 22.99 0.72 3599 111 18	–
15	1510R 19.04 0.72 3087 111	1505R 19.04 0.72 2880 94	–	–	1510E 19.04 0.72 3087 111 > 17	1505E 19.04 0.72 2845 94 > 17	–	–

Items, listed in vertical order per riser:

(1) Partial drawing number - [NN]$_{ih}$[NN]$_{is}$[$^{E}_{R}$]
(2) Volume of concrete for full height riser, N_{ih} equals tabulated value, cu. yds.
(3) Change in volume of concrete per foot decrease in height of riser, cu. yds.
(4) Weight of steel for full height riser, N_{ih} equals tabulated value, lbs.
(5) Approximate change in weight of steel per foot decrease in height of riser, lbs.
(6) Allowable wind projection, see sheet 1 of this drawing, feet.

REFERENCE

SCS Engineering Memo. - 50
SCS Technical Release - 29
SCS Technical Release - 30

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ENGINEERING DIVISION - DESIGN UNIT

STANDARD DWG. NO.
ES- 169
SHEET 4 OF 7
DATE 1 – 66

REVISED 9-69

STANDARD PLANS: STANDARD COVERED RISERS SCHEDULE SHOWING DRAWING NUMBERS, VOLUMES OF CONCRETE, AND WEIGHTS OF STEEL.

PIPE CONDUIT DIAMETER = 36 "

STANDARD DETAIL DRAWINGS; ES-3036-$[NN]_{ih}$ $[NN]_{is}[\frac{E}{R}]$

N_{ih} feet	RISERS TO BE LOCATED IN RESERVOIR AREA				RISERS TO BE LOCATED IN EMBANKMENT			
	$N_{sh} = N_{ih} - N_{is}$, feet				$N_{sh} = N_{ih} - N_{is}$, feet			
	5	10	15	20	5	10	15	20
40	4035R 69.35 1.67 13288 338	4030R 71.55 1.67 12319 269	4025R 69.35 1.67 11385 269	4020R 64.45 1.35 11981 306	4035E 86.45 1.67 15936 360 30	4030E 80.05 1.67 13131 269 32	4025E 71.15 1.67 11486 269 25	4020E 60.25 1.35 11529 306 22
35	3530R 61.15 1.67 10766 269	3525R 56.25 1.35 10872 306	3520R 57.05 1.35 9635 263	3515R 54.45 1.35 9819 257	3530E 71.45 1.67 11945 269 26	3525E 59.55 1.35 11200 306 25	3520E 56.95 1.35 9693 263 24	3515E 51.85 1.35 9412 257 27
30	3025R 50.55 1.35 8975 263	3020R 48.65 1.35 8710 272	3015R 49.25 1.35 8078 208	3010R 45.50 1.04 8474 231	3025E 54.75 1.35 9432 263 22	3020E 49.75 1.35 8833 272 21	3015E 48.15 1.35 7857 208 20	3010E 42.90 1.04 7896 231 22
25	2520R 39.70 1.04 7263 227	2515R 39.70 1.04 6995 231	2510R 38.10 1.04 6441 178	2505R 36.35 0.85 6263 169	2520E 40.70 1.04 7373 227 17	2515E 40.10 1.04 7030 231 17	2510E 36.10 1.04 6194 178 18	2505E 34.75 0.85 6049 169 20
20	2015R 31.05 0.85 5829 185	2010R 31.05 0.85 5363 169	2005R 30.45 0.85 5038 146	–	2015E 30.55 0.85 5778 185 12	2010E 29.85 0.85 5228 169 18	2005E 28.85 0.85 4842 146 16	–
15	1510R 24.60 0.85 3984 142	1505R 24.60 0.85 3790 123	–	–	1510E 23.90 0.85 3893 142 > 17	1505E 23.90 0.85 3700 123 > 17	–	–

Items, listed in vertical order per riser:
(1) Partial drawing number - $[NN]_{ih}[NN]_{is}[\frac{E}{R}]$
(2) Volume of concrete for full height riser, N_{ih} equals tabulated value, cu. yds.
(3) Change in volume of concrete per foot decrease in height of riser, cu. yds.
(4) Weight of steel for full height riser, N_{ih} equals tabulated value, lbs.
(5) Approximate change in weight of steel per foot decrease in height of riser, lbs.
(6) Allowable wind projection, see sheet 1 of this drawing, feet.

REFERENCE

SCS Engineering Memo. - 50
SCS Technical Release - 29
SCS Technical Release - 30

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ENGINEERING DIVISION - DESIGN UNIT

STANDARD DWG. NO.
ES- 169
SHEET 5 OF 7
DATE 7 – 65

REVISED 9-69

STANDARD PLANS: STANDARD COVERED RISERS SCHEDULE SHOWING DRAWING NUMBERS, VOLUMES OF CONCRETE, AND WEIGHTS OF STEEL.

PIPE CONDUIT DIAMETER = 42"

STANDARD DETAIL DRAWINGS, ES-3042-[NN]$_{ih}$ [NN]$_{is}$[$^{E}_{R}$]

N_{ih} feet	RISERS TO BE LOCATED IN RESERVOIR AREA				RISERS TO BE LOCATED IN EMBANKMENT			
	$N_{sh} = N_{ih} - N_{is}$, feet				$N_{sh} = N_{ih} - N_{is}$, feet			
	5	10	15	20	5	10	15	20
40	4035R 90.75 2.27 16919 368	4030R 91.15 2.27 15054 310	4025R 82.85 1.89 17984 378	4020R 80.45 1.89 15145 308	4035E 104.85 2.27 19698 380 33	4030E 97.25 2.27 15782 310 30	4025E 84.65 1.89 16026 378 29	4020E 77.35 1.89 14492 308 26
35	3530R 74.85 1.89 14754 375	3525R 71.55 1.89 12934 308	3520R 73.75 1.89 12942 301	3515R 67.35 1.53 12709 367	3530E 83.45 1.89 15662 375 30	3525E 75.75 1.89 13398 308 25	3520E 72.45 1.89 12723 301 26	3515E 64.25 1.53 12362 367 22
30	3025R 67.85 1.89 11721 301	3020R 59.85 1.53 11071 313	3015R 57.95 1.53 11033 302	3010R 59.35 1.53 10284 251	3025E 72.45 1.89 12200 301 25	3020E 61.25 1.53 11197 313 23	3015E 55.75 1.53 10733 302 19	3010E 55.75 1.53 9691 251 19
25	2520R 52.55 1.53 9509 251	2515R 53.95 1.53 9028 245	2510R 47.80 1.18 8541 257	2505R 43.05 0.97 8463 249	2520E 54.35 1.53 9705 251 22	2515E 52.25 1.53 8840 245 20	2510E 45.70 1.18 8306 257 21	2505E 41.25 0.97 8174 249 21
20	2015R 40.50 1.18 7583 260	2010R 36.45 0.97 7152 240	2005R 36.35 0.97 6702 192	–	2015E 40.50 1.18 7583 260 > 23	2010E 35.85 0.97 7092 240 > 23	2005E 34.65 0.97 6501 192 18	–
	–	–	–	–	–	–	–	–

Items, listed in vertical order per riser:
(1) Partial drawing number - [NN]$_{ih}$[NN]$_{is}$[$^{E}_{R}$]
(2) Volume of concrete for full height riser, N_{ih} equals tabulated value, cu. yds.
(3) Change in volume of concrete per foot decrease in height of riser, cu. yds.
(4) Weight of steel for full height riser, N_{ih} equals tabulated value, lbs.
(5) Approximate change in weight of steel per foot decrease in height of riser, lbs.
(6) Allowable wind projection, see sheet 1 of this drawing, feet.

REFERENCE

SCS Engineering Memo. - 50
SCS Technical Release - 29
SCS Technical Release - 30

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ENGINEERING DIVISION - DESIGN UNIT

STANDARD DWG. NO.
ES- 169
SHEET 6 OF 7
DATE 9 - 66

Revised 5-67

STANDARD PLANS: STANDARD COVERED RISERS SCHEDULE SHOWING DRAWING NUMBERS, VOLUMES OF CONCRETE, AND WEIGHTS OF STEEL.

PIPE CONDUIT DIAMETER = 48 "

STANDARD DETAIL DRAWINGS, ES-3048-$[NN]_{ih}$ $[NN]_{is}[^{E}_{R}]$

N_{ih} feet	RISERS TO BE LOCATED IN RESERVOIR AREA				RISERS TO BE LOCATED IN EMBANKMENT			
	$N_{sh} = N_{ih} - N_{is}$, feet				$N_{sh} = N_{ih} - N_{is}$, feet			
	5	10	15	20	5	10	15	20
40	4035R 122.90 2.96 20160 374	4030R 106.35 2.53 20404 428	4025R 106.25 2.53 20018 424	4020R 108.55 2.53 18132 362	4035E 134.80 2.96 22278 374 34	4030E 114.65 2.53 20878 428 33	4025E 105.15 2.53 19960 424 28	4020E 102.35 2.53 17941 362 30
35	3530R 97.75 2.53 17087 362	3525R 99.85 2.53 16846 362	3520R 87.05 2.11 16781 356	3515R 87.85 2.11 15872 356	3530E 105.75 2.53 17975 362 31	3525E 101.65 2.53 16834 362 29	3520E 83.95 2.11 16490 356 >38	3515E 83.45 2.11 15415 356 >38
30	3025R 78.25 2.11 14438 356	3020R 78.95 2.11 14419 356	3015R 72.35 1.71 13778 347	3010R 71.85 1.71 13618 344	3025E 82.55 2.11 14928 356 26	3020E 77.95 2.11 14252 356 >33	3015E 68.95 1.71 13461 347 31	3010E 65.85 1.71 13008 344 29
25	2520R 60.95 1.71 11993 347	2515R 62.05 1.71 12070 344	2510R 56.95 1.33 11091 301	2505R 57.05 1.33 10984 298	2520E 63.25 1.71 12293 347 26	2515E 60.35 1.71 11873 344 >28	2510E 54.15 1.33 10779 301 >28	2505E 51.55 1.33 9857 298 >28
20	2015R 49.95 1.33 9599 301	2010R 48.05 1.33 9278 295	2005R 44.25 1.09 9027 278	–	2015E 49.95 1.33 9599 301 >23	2010E 46.95 1.33 9131 295 >23	2005E 42.65 1.09 8795 278 >23	–
	–	–	–	–	–	–	–	–

Items, listed in vertical order per riser:
(1) Partial drawing number - $[NN]_{ih}[NN]_{is}[^{E}_{R}]$
(2) Volume of concrete for full height riser, N_{ih} equals tabulated value, cu. yds.
(3) Change in volume of concrete per foot decrease in height of riser, cu. yds.
(4) Weight of steel for full height riser, N_{ih} equals tabulated value, lbs.
(5) Approximate change in weight of steel per foot decrease in height of riser, lbs.
(6) Allowable wind projection, see sheet 1 of this drawing, feet.

REFERENCE

SCS Engineering Memo. - 50
SCS Technical Release - 29
SCS Technical Release - 30

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ENGINEERING DIVISION - DESIGN UNIT

STANDARD DWG. NO.
ES- 169
SHEET 7 OF 7
DATE 2 - 69

STANDARD PLANS: STANDARD OPEN RISERS
SELECTION OF STANDARD DETAIL DRAWINGS

Key to Drawing Numbers

The drawing numbers of the Standard Detail Drawings for Standard Open Risers are given by:

$$\text{ES-31DD-[NN]}_{ih}\text{[NN]}_{is}\left[\frac{E}{R}\right]$$

where

DD $\equiv$ D = pipe conduit diameter, inches.

$[NN]_{ih} \equiv N_{ih}$ = vertical distance from pipe invert at the riser to crest of the Open Riser Inlet, ft.

$[NN]_{is} \equiv N_{is}$ = vertical distance from pipe invert at the riser to soil surface, ft. The soil surface is either the sediment or the embankment (berm) surface.

$\left[\frac{E}{R}\right]$ $\equiv$ riser is designed to be located in the [embankment / reservoir area].

Standard Detail Drawings

Each set of Standard Detail Drawings for a Standard Open Riser consists of four sheets. The Open Riser Inlet is shown on sheet 4.

The Standard Open Risers tabulated on sheet 2 of this drawing are designed for $N_{ih} = N_{is}$.

A set of Standard Detail Drawings may be adapted to a range of riser heights. The height may vary from the full design height given by N_{ih} in the drawing number to five feet less than N_{ih}. The only exception to the preceding statement occurs with risers having D = 36 in. and N_{ih} = 10 ft, for which the height range is four feet.

Selection of Standard Detail Drawings

The set of Standard Detail Drawings to be selected is that having the smallest N_{ih} which is greater than or equal to the N_{ih} desired at the specific site.

Adaptation of Standard Detail Drawings

After the Standard Detail Drawings have been selected, they must be adapted to the desired riser height. The adaptation is accomplished by completing the fill-ins on sheets 1 and 3 of the drawings. The value to be inserted in a fill-in is either a vertical dimension, a reinforcement bar length, a reinforcement bar quantity, a reinforcement bar weight, or a concrete volume.

Volumes and Weights of Materials

Quantities for Standard Open Risers are given on sheet 2 of this drawing.

Wind Projections

Risers to be located in the embankment are not designed for wind load. An allowable wind projection is tabulated for these risers on sheet 2. The tabulated allowable wind projection was computed for the conditions:

(1) No embankment is placed in the vicinity of the riser.

(2) Moist soil condition, allowable earth bearing pressures are:

$p_{max} \leq 4$ ksf

$p_{av} \leq 2$ ksf

$p_{min} \geq 0$ ksf

(3) Wind load on the sidewall is 50 psf.

(4) The constructed riser height, above the top of the footing, does not exceed the allowable wind projection.

The assumption is made that the allowable wind projection for other conditions of embankment placement and riser height is not less than that tabulated. Thus, the tabulated allowable wind projection may be considered as the allowable vertical distance between the surface of the embankment and the top of the riser at any stage of construction.

STANDARD PLANS: STANDARD OPEN RISERS
SCHEDULE SHOWING DRAWING NUMBERS, VOLUMES OF CONCRETE, AND WEIGHTS OF STEEL.

STANDARD DETAIL DRAWINGS, ES-31DD-$[NN]_{th}$ $[NN]_{ts}[\frac{E}{R}]$

$N_{th} = N_{ts}$	ES-3124-		ES-3130-		ES-3136-		ES-3142-		ES-3148-	
	R	E	R	E	R	E	R	E	R	E
3535	35.55 0.97 7038 187 –	51.55 0.97 10189 213 25	43.94 1.16 9270 276 –	61.16 1.16 12500 303 27	60.25 1.67 11999 338 –	76.90 1.67 14608 360 30	80.05 2.27 15210 368 –	92.83 2.27 17484 380 33	108.50 2.96 18092 374	118.90 2.96 19886 374 34
3030	27.70 0.74 6024 206 –	36.19 0.74 7219 218 19	36.50 1.16 7413 232 –	43.70 1.16 8743 232 20	52.15 1.67 9454 269 –	61.93 1.67 10626 269 26	64.85 1.89 13045 375 –	71.45 1.89 13444 375 30	83.35 2.53 15019 362	89.85 2.53 15583 362 31
2525	23.40 0.74 4511 167 –	26.20 0.74 5011 167 15	28.80 0.89 5986 240 –	31.88 0.89 6414 240 21	41.75 1.35 7662 263 –	45.14 1.35 8113 263 22	55.85 1.89 9929 301 –	59.23 1.89 10226 301 25	63.85 2.11 12370 356	66.65 2.11 12536 356 26
2020	17.00 0.60 3487 154 –	18.90 0.60 3607 154 11	22.48 0.89 4387 162 –	23.62 0.89 4539 162 14	30.60 1.04 5951 227 –	31.20 1.04 6054 227 17	40.41 1.53 7792 251 –	41.22 1.53 7806 251 22	46.55 1.71 9925 347	47.35 1.71 9901 347 >25
1515	12.70 0.60 2288 116 –	12.65 0.60 2215 116 9	15.45 0.72 3242 148 –	15.73 0.72 3316 148 13	21.92 0.85 4539 185 –	21.08 0.85 4450 185 12	28.50 1.18 5865 260 –	27.36 1.18 5684 260 > 19	35.55 1.33 7531 301	34.05 1.33 7207 301 >20
1010	9.32 0.60 1446 84 –	8.76 0.60 1382 84 > 12	11.01 0.72 1966 111 –	10.84 0.72 1924 111 > 13	15.50 0.85 2695 142 –	14.36 0.85 2566 142 > 13	–	–	–	–

Items, listed in vertical order per riser:

(1) Volume of concrete for full height riser, $N_{th} = N_{ts}$, cu. yds.

(2) Change in volume of concrete per foot decrease in height of riser, cu. yds.

(3) Weight of steel for full height riser, $N_{th} = N_{ts}$, lbs.

(4) Approximate change in weight of steel per foot decrease in height of riser, lbs.

(5) Allowable wind projection, ft. (see sheet 1 of this drawing)

REFERENCE

SCS Engineering Memo. - 50

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ENGINEERING DIVISION - DESIGN UNIT

STANDARD DWG. NO.
ES - 180
SHEET 2 OF 2
DATE 3-68

REVISED 9 · 69

STANDARD PLANS: STANDARD IMPACT BASINS SCHEDULE SHOWING DRAWING NUMBERS, VOLUMES OF CONCRETE, AND WEIGHTS OF STEEL.

STANDARD DETAIL DRAWINGS ES-4WWW	QUANTITIES*	
	STEEL - lbs.	CONCRETE - cu. yds.
ES-4050	1500	10
-4060	1900	12.5
-4070	2200	15
-4080	2800	20
-4090	3300	23
-4100	3900	28
-4110	4800	33
-4120	5700	38
-4130	6700	43.5
-4135	7300	46.5
-4140	7900	50.5
-4145	8800	55
-4150	10,000	58.5
-4155	10,600	62
-4160	11,000	65
-4165	12,400	70
-4170	13,300	73.5
-4175	14,100	77

Key to Drawing Numbers

The drawing numbers of the Standard Detail Drawings for Standard Impact Basins are given by:

ES-4WWW

where

WWW ≡ width of basin, WW.W ft

*Quantities of steel and concrete tabulated were obtained from sheet 1 of each ES-drawing. These quantities are approximate since quantities vary with pipe diameter.

REFERENCE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ENGINEERING DIVISION · DESIGN UNIT

STANDARD DWG. NO.
ES- 186
SHEET 1 OF 1
DATE 5 – 70

STANDARD PLANS: STANDARD CONDUIT DETAILS
SCHEDULE SHOWING DRAWING NUMBERS

AVAILABLE STANDARD DETAIL DRAWINGS
FOR
REINFORCED CONCRETE PRESSURE PIPE
PRINCIPAL SPILLWAYS

Class (a) dams more than 50 ft. high, and all class (b) and class (c) dams		Alternate for class (a) dams less than 50 ft. high	
ES-5018-CE	ES-5036-CE	ES-5118-CE	ES-5136-CE
-CR	-CR	-CR	-CR
-BE	-BE	-BE	-BE
-BR	-BR	-BR	-BR
ES-5024-CE	ES-5042-CE	ES-5124-CE	ES-5142-CE
-CR	-CR	-CR	-CR
-BE	-BE	-BE	-BE
-BR	-BR	-BR	-BR
ES-5030-CE	ES-5048-CE	ES-5130-CE	ES-5148-CE
-CR	-CR	-CR	-CR
-BE	-BE	-BE	-BE
-BR	-BR	-BR	-BR

Key to Drawing Numbers

The drawing numbers of the Standard Detail Drawings for Standard Conduit Details are given by:

$$ES\text{-}5\left[\begin{smallmatrix}0\\1\end{smallmatrix}\right]DD\text{-}\left[\begin{smallmatrix}C\\B\end{smallmatrix}\right]\left[\begin{smallmatrix}E\\R\end{smallmatrix}\right]$$

where

DD $\equiv$ D = pipe conduit diameter, inches

$\left[\begin{smallmatrix}C\\B\end{smallmatrix}\right]$ $\equiv$ pipe is supported on cradles or beddings

$\left[\begin{smallmatrix}E\\R\end{smallmatrix}\right]$ $\equiv$ foundation is earth (yielding) or rock (non-yielding)

Completion of Standard Detail Drawings

Various items must be filled in to complete the drawings for inclusion in a set of construction plans. These are: the pipe strength requirements, the pipe joint requirements, the steel schedule, and material quantities. Relations are given from which the volumes of concrete may be obtained.

REFERENCE	U. S. DEPARTMENT OF AGRICULTURE	STANDARD DWG. NO.
SCS Engineering Drawing, ES-154	SOIL CONSERVATION SERVICE	ES- 195
	ENGINEERING DIVISION - DESIGN UNIT	SHEET 1 OF 1
		DATE 10 - 70

STANDARD PLANS: STANDARD BAFFLE RISERS
SELECTION OF STANDARD DETAIL DRAWINGS

Key to Drawing Numbers

The drawing numbers of the Standard Detail Drawings for Standard Baffle Risers are given by:

$$\text{ES-32DD-}[\text{NN}]_{ih}[\text{NN}]_{is}[^{E}_{R}]$$

where

DD $\equiv$ D = pipe conduit diameter, inches

$[\text{NN}]_{ih} \equiv N_{ih}$ = vertical distance from pipe invert at the riser to crest of the Baffle Riser Inlet, ft.

$[\text{NN}]_{is} \equiv N_{is}$ = vertical distance from pipe invert at the riser to soil surface, ft. The soil surface is either the sediment or the embankment (berm) surface.

$[^{E}_{R}] \equiv$ riser is designed to be located in the [embankment / reservoir area].

Standard Detail Drawings

Each set of Standard Detail Drawings for a Standard Baffle Riser consists of four sheets. The Baffle Riser Inlet is shown on sheet 4.

The Standard Baffle Risers tabulated on sheet 2 of this drawing are designed for $N_{ih} = N_{is}$.

A set of Standard Detail Drawings may be adapted to a range of riser heights. The height may vary from the full design height given by N_{ih} in the drawing number to five feet less than N_{ih}. The only exception to the preceding statement occurs with risers having D = 36 in. and N_{ih} = 10 ft, for which the height range is four feet.

Selection of Standard Detail Drawings

The set of Standard Detail Drawings to be selected is that having the smallest N_{ih} which is greater than or equal to the N_{ih} desired at the specific site.

Adaptation of Standard Detail Drawings

After the Standard Detail Drawings have been selected, they must be adapted to the desired riser height. The adaptation is accomplished by completing the fill-ins on sheets 1 and 3 of the drawings. The value to be inserted in a fill-in is either a vertical dimension, a reinforcement bar length, a reinforcement bar quantity, a reinforcement bar weight, or a concrete volume.

Volumes and Weights of Materials

Quantities for Standard Baffle Risers are given on sheet 2 of this drawing.

Wind Projections

Risers to be located in the embankment are not designed for wind load. An allowable wind projection is tabulated for these risers on sheet 2. The tabulated allowable wind projection was computed for the conditions:

(1) No embankment is placed in the vicinity of the riser.

(2) Moist soil condition, allowable earth bearing pressures are:

$P_{max} \leq 4$ ksf

$P_{av} \leq 2$ ksf

$P_{min} \geq 0$ ksf

(3) Wind load on the sidewall is 50 psf.

(4) The constructed riser height, above the top of the footing, does not exceed the allowable wind projection.

The assumption is made that the allowable wind projection for other conditions of embankment placement and riser height is not less than that tabulated. Thus, the tabulated allowable wind projection may be considered as the allowable vertical distance between the surface of the embankment and the top of the riser at any stage of construction.

REFERENCE		STANDARD DWG. NO.
National Engineering Manual Part 536	U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE ENGINEERING DIVISION - DESIGN UNIT	ES-231 SHEET 1 OF 2 DATE 3-80

STANDARD PLANS: STANDARD BAFFLE RISERS

SCHEDULE SHOWING DRAWING NUMBERS, VOLUMES OF CONCRETE, AND WEIGHTS OF STEEL.

STANDARD DETAIL DRAWINGS, ES-32DD-$[NN]_{ih}$ $[NN]_{is}[^{E}_{R}]$

$N_{ih}=N_{is}$	ES-3224-		ES-3230-		ES-3236-		ES-3242-		ES-3248-	
	R	E	R	E	R	E	R	E	R	E
3535	38.55 0.97 7483 187 –	54.65 0.97 10674 213 25	47.90 1.16 9849 276 –	65.30 1.16 13123 303 27	66.85 1.67 12974 338 –	83.95 1.67 15622 360 30	87.05 2.27 15887 368 –	101.15 2.27 18667 380 33	117.00 2.96 19225 374 –	128.90 2.96 21342 374 34
3030	30.70 0.74 6470 206 –	39.50 0.74 7701 218 19	40.50 1.16 7992 232 –	47.90 1.16 9368 232 20	58.65 1.67 10449 269 –	68.95 1.67 11624 269 26	71.15 1.89 13725 375 –	79.75 1.89 14633 375 30	91.85 2.53 16153 362 –	99.85 2.53 17041 362 31
2525	26.30 0.74 4973 167 –	29.50 0.74 5498 167 15	32.75 0.89 6567 240 –	36.05 0.89 7039 240 21	48.05 1.35 8653 263 –	52.25 1.35 9078 263 22	63.15 1.89 10863 301 –	67.75 1.89 11342 301 25	72.35 2.11 13503 356 –	76.65 2.11 13993 356 26
2020	20.00 0.60 3934 154 –	22.00 0.60 4090 154 11	26.45 0.89 4973 162 –	27.75 0.89 5168 162 14	37.20 1.04 6942 227 –	38.20 1.04 7052 227 17	47.85 1.53 8726 251 –	49.65 1.53 8921 251 22	55.05 1.71 11057 347 –	57.35 1.71 11357 347 >25
1515	15.70 0.60 2735 116 –	15.80 0.60 2619 116 9	19.50 0.72 4172 148 –	19.90 0.72 3852 148 13	28.55 0.85 5522 185 –	28.05 0.85 5470 185 12	35.80 1.18 6799 260 –	35.80 1.18 6799 260 >20	44.05 1.33 8664 301 –	44.05 1.33 8664 301 >20
1010	12.20 0.60 1909 84 –	11.90 0.60 1909 84 >13	15.00 0.72 2553 111 –	15.00 0.72 2553 111 >14	22.10 0.85 3677 142 –	21.40 0.85 3587 142 >14	–	–	–	–

Items, listed in vertical order per riser:

(1) Volume of concrete for full height riser, $N_{ih} = N_{is}$, cu. yds.

(2) Change in volume of concrete per foot decrease in height of riser, cu. yds.

(3) Weight of steel for full height riser, $N_{ih} = N_{is}$, lbs.

(4) Approximate change in weight of steel per foot decrease in height of riser, lbs.

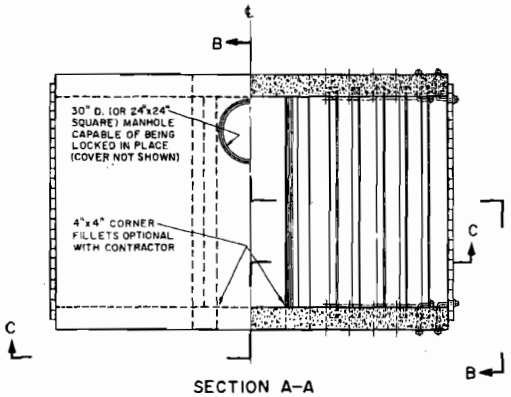
(5) Allowable wind projection, ft. (see sheet 1 of this drawing).

REFERENCE

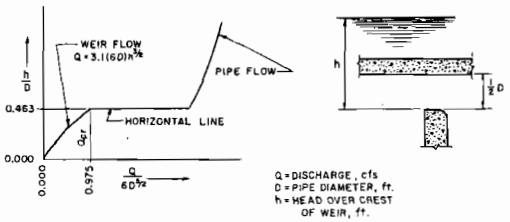
National Engineering Manual
Part 536

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ENGINEERING DIVISION - DESIGN UNIT

STANDARD DWG. NO.
ES-231
SHEET 2 OF 2
DATE 3-80



SECTION A–A
FOOTING AND SPIGOT WALL FITTING NOT SHOWN



Q = DISCHARGE, cfs
D = PIPE DIAMETER, ft.
h = HEAD OVER CREST OF WEIR, ft.

STAGE–DISCHARGE RELATION
FOR COVERED TOP RISER OF PROPORTIONS SHOWN

SCOPE

1. The covered top riser is a standard for two-stage risers, and also for single-stage risers in multi-purpose sites if the maximum sediment elevation is set at least (2D+12") below the crest.
2. Height Ranges of Riser:
   High stage, H_2 = (2D+6") to 20 feet
   Low stage, H_1 = 0 to 30 feet
   Sum, $H = H_2 + H_1 \leq 40$ feet.

CRITERIA

1. Pipe Diameters and Associated Discharges:

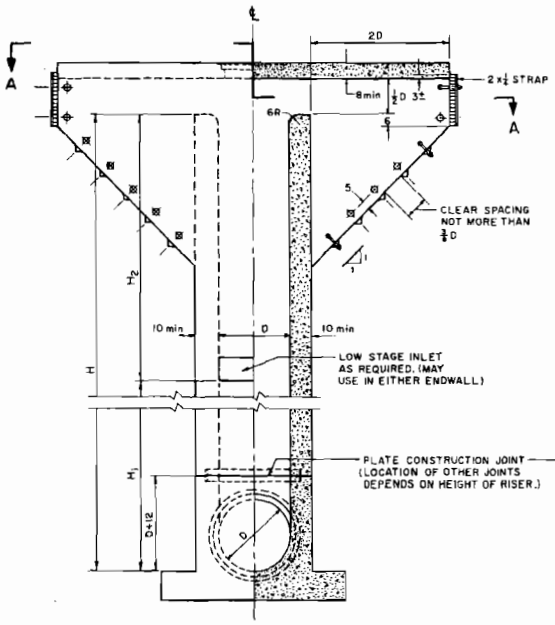
D	$Q_{pr} = 0.975(60D^{5/2})$	$Q_{max} = \frac{30}{4}\pi D^2$
24	33	94
30	58	148
36	92	212
42	135	288
48	188	376

Note: Maximum allowable nominal velocity in pipe = 30 fps.

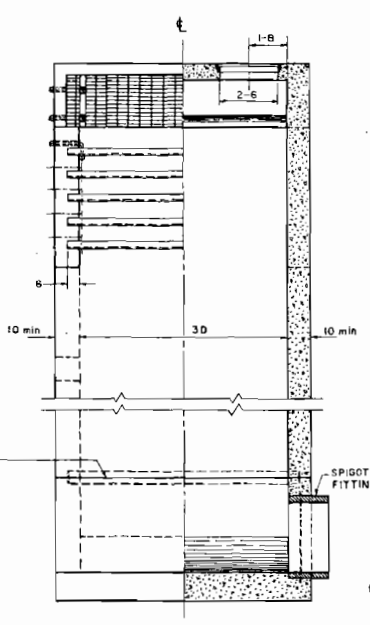
2. Hydraulic Losses (pipe flow):
   Head loss between pool water surface and the projected hydraulic grade line at the pipe entrance = 1.0 times the velocity head in the pipe.
3. Trashracks:
   Required net area for National Standard Detailed Drawings–to be computed from Q_{max} as listed in Criteria (1), and an allowable average velocity of 2.0 fps.
   All bolts, nuts, pipe sleeves, and grating, to be galvanized or otherwise protected by corrosion resistant coating except when made of aluminum.
4. Cover slab live load = 100 psf plus weight of any equipment on the slab.
5. Flotation:
   When riser is in reservoir– the ratio of the weight of riser to the weight of the volume of water displaced by the riser shall not be less than 1.5
   When riser is in the embankment– add to the weight of the riser, the buoyant weight of submerged fill over footing projections.
6. Dry Dams:
   Where sediment is not a problem – set crest of low stage inlet at required elevation.
   Where sediment is a problem – use a series of slotted openings up the longitudinal sides. Trashracks are not required for these openings.
7. Materials:
   Concrete: Class B, f'_c = 4000 psi, f_c = 1600 psi. Reinforcing Steel: Intermediate grade.
   Trashrack: Structural steel or structural aluminum.

NOTES

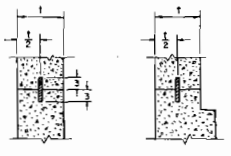
1. Riser Analyses: Standards to be developed for risers located in the embankment (at berm) and for risers located in reservoir area. 2. Round Bottom: May be obtained by use of a pipe cut longitudinally along a diameter, or may be formed by removable semi-circular forms acceptable to the engineer. 3. Drainage of Pool: Provision of means of draining pool to be handled as a modification of these standards by the Field.



SECTION C–C



SECTION B–B



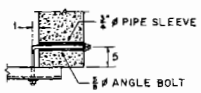
¼ MIN x 6 STEEL PLATE TO BE CONTINUOUS AROUND RISER. TO BE EITHER BUTT WELDED, LAPPED AND FILLET WELDED, OR LAPPED AND BOLTED AT ALL JOINTS (SPLICES)

PLATE CONSTRUCTION JOINT DETAIL

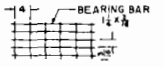
SPIGOT WALL FITTING FOR PIPE AS DESIGNED AND MANUFACTURED UNDER A.W.W.A. SPECIFICATION C-300, C-301, AND C-302, AND A.S.T.M. DESIGNATION C-361.

SPIGOT WALL FITTING FOR PIPE AS DESIGNED AND MANIFACTURED UNDER A.W.W.A. SPECIFICATION C-302 AND A.S.T.M. DESIGNATION C-361.

SPIGOT WALL FITTING DETAIL



BOLT DETAIL



SPACING AND SIZE GIVEN ARE MINIMUMS

GRATING DETAIL– STEEL OR ALUMINUM.

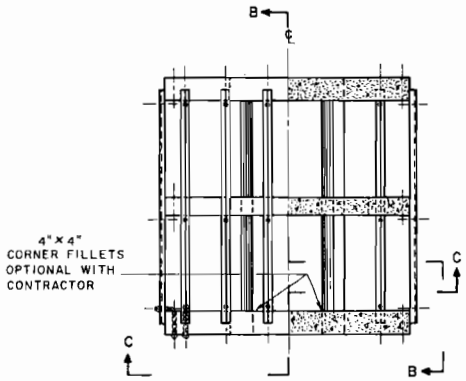
LOW STAGE INLET DETAILS TO BE HANDLED AS A MODIFICATION OF THESE STANDARDS BY THE FIELD

ENGINEERING DIVISION - DESIGN SECTION	
ENGINEERING APPROVAL	CARTOGRAPHIC APPROVAL
DESIGNED BY	DRAWN BY
CHECKED BY	STANDARD DWG. NO.
DATE	SHEET OF

DROP INLET SPILLWAYS
STANDARD FOR
COVERED TOP RISER

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed ENGINEERING DIV.	Date 1-63	Approved by	
Drawn E.S.A.	1-63	Title	
Traced G.B.G	2-63	Sheet	Drawing No.



SECTION A-A

FOOTING AND SPIGOT WALL FITTING NOT SHOWN

SCOPE

1. The rectangular open top riser is a standard for one and two-stage risers.
2. Height Ranges of Riser:
   High stage, H_2 = up to 20 ft.
   Low stage, H_1 = up to 30 ft.
   Sum, $H = H_2 + H_1 \leq 40$ ft.
   If one stage riser: $H \leq 40$ ft.

CRITERIA

1. Pipe Diameters and Associated Discharges:

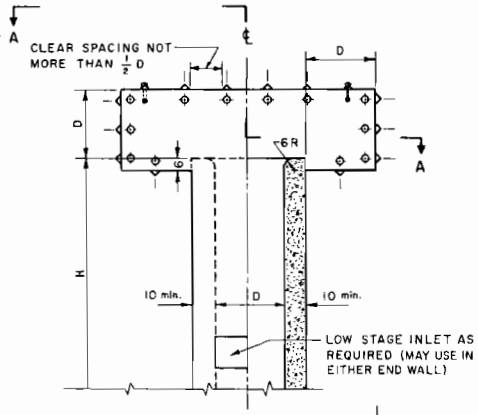
D	$Q_{max.} = \frac{30}{4}\pi D^2$
24	94
30	148
36	212
42	288
48	376

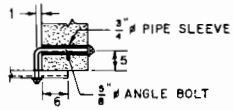
   Note: Maximum allowable nominal velocity in pipe = 30 fps

2. Trashracks:
   Required net area for National Standard Detailed Drawings - to be computed from Q_{max} as listed in Criteria (1) and an allowable average velocity of 2.0 fps.
   All bolts, nuts, pipe sleeves, and grating to be galvanized or otherwise protected by corrosion resistant coating except when made of aluminum.
   Grating may be used in front of weir crest (but not for more than 9" above crest). If grating used, check required net area of trashrack, a revision of the anti-vortex wall dimensions may be necessary.
3. Anti-vortex Walls:
   Omit center anti-vortex wall when D < 36". The bottom of the anti-vortex walls may be formed with a 45° slope when the riser is located in the reservoir.
4. Flotation:
   When riser is in reservoir - the ratio of the weight of riser to the weight of the volume of water displaced by the riser shall not be less than 1.5.
   When riser is in embankment - add to the weight of the riser, the buoyant weight of the submerged fill over the footing projections.
5. Dry Dams:
   Where sediment is not a problem - set crest of single stage riser, or crest of low stage inlet of two-stage riser, at required elevation.
   Where sediment is a problem - use a series of slotted openings up the longitudinal sides. Trashracks are not required for these openings.
6. Materials:
   Concrete : Class B, f'_c = 4000 psi, f_c = 1600 psi.
   Reinforcing Steel : Intermediate grade.
   Trashrack : Structural steel or structural aluminum.

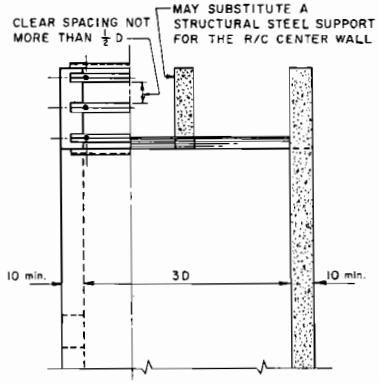
NOTES:

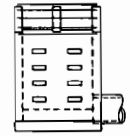
1. Riser Analyses:
   Standards to be developed for risers located in the embankment (at berm) and for risers located in the reservoir area.
2. Round Bottom: May be obtained by use of a pipe cut longitudinally along a diameter, or may be formed by removable semi-circular forms acceptable to the engineer.
3. Drainage of Pool:
   Provision of means of draining pool to be handled as a modification of these standards by the Field.



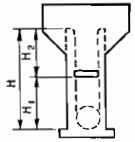


BOLT DETAIL

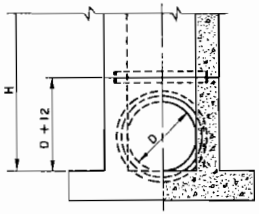




DRY-DAMS
SEE CRITERIA (5)

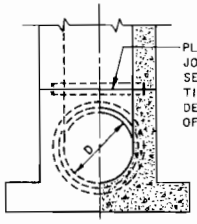


RISER IN RESERVOIR
SEE CRITERIA (3)

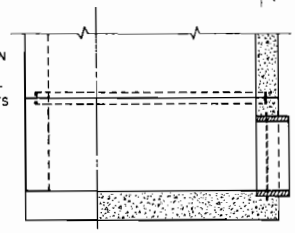


FLAT BOTTOM

SECTION C-C

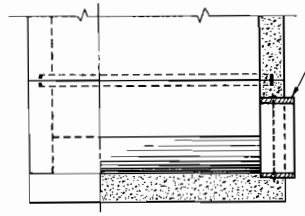


ROUND BOTTOM



FLAT BOTTOM

SECTION B-B



ROUND BOTTOM

LOW STAGE INLET DETAILS TO BE HANDLED AS A

ENGINEERING DIVISION - DESIGN SECTION	
ENGINEERING APPROVAL	CARTOGRAPHIC APPROVAL
DESIGNED BY	DRAWN BY

DROP INLET SPILLWAYS STANDARD FOR RECTANGULAR OPEN TOP RISER

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed ENGINEERING DIV.	Date 1-63	Approved by	
Drawn E.S.A.	1-63	Title	

SCOPE

1. THE BAFFLE TOP RISER IS A STANDARD FOR ONE AND TWO-STAGE RISERS.
2. HEIGHT RANGES OF RISER:
   $N_{sh} \leq 20$ FT.
   $N_{ds} \leq 35$ FT.
   $N_{sh} \leq 40$ FT.

CRITERIA

1. PIPE DIAMETERS AND ASSOCIATED DISCHARGES:

D	$Q_{MAX.} = \frac{30}{4}\pi D^2$
24	94
30	147
36	212
42	289
48	377

NOTE: MAXIMUM ALLOWABLE NOMINAL VELOCITY IN PIPE = 30 FPS

2. HYDRAULICS:
   THE WEIR DISCHARGE COEFFICIENT, C:
   C = 3.1 (CLEAR WATER FLOW)
   C = 2.0 (TRASH LADEN FLOW)
   FOR D x 3D RISERS WITH ROUND BOTTOMS, THE ENTRANCE HEAD LOSS COEFFICIENT, K_e:
   K_e = 0.60 (CLEAR WATER FLOW)
   K_e = 0.65 (TRASH LADEN FLOW)
   DURING PIPE FLOW, THE HEAD LOSS BETWEEN POOL WATER SURFACE AND THE PROJECTED HYDRAULIC GRADE LINE AT THE PIPE ENTRANCE = K_e TIMES THE VELOCITY HEAD IN THE PIPE.

3. BAFFLES:
   REQUIRED NET AREA FOR NATIONAL STANDARD DETAILED DRAWINGS - TO BE COMPUTED FROM Q_{MAX} AS LISTED IN CRITERIA (1) AND AN ALLOWABLE AVERAGE VELOCITY OF 2.5 FPS.
   THE CLEAR HORIZONTAL DISTANCE BETWEEN BAFFLES, s:
   $\frac{D}{3} \leq s \leq \frac{D}{2}$
   THE VERTICAL OVERLAP BETWEEN BAFFLES, f:
   $f \geq 3"$
   THE CLEARANCE BETWEEN THE COVER SLAB AND THE TOP-MOST BAFFLE, u:
   $2" \leq u \leq 3"$
   ALL BOLTS, NUTS, AND PIPE SLEEVES TO BE GALVANIZED OR OTHERWISE PROTECTED BY CORROSION RESISTANT COATING EXCEPT WHEN MADE OF ALUMINUM.

4. COVER SLAB:
   COVER SLAB LIVE LOAD = 100 PSF PLUS WEIGHT OF EQUIPMENT ON THE SLAB.
   $L_o = B(s + b_f)$, ROUNDED UP TO NEXT INCH
   B = NUMBER OF BAFFLES ON ONE SIDE OF INLET
   THE DISTANCE BETWEEN THE WEIR CREST AND THE UNDERSIDE OF THE COVER SLAB, N, IS EQUAL TO OR GREATER THAN THE HEAD OVER THE CREST AT WHICH THE CONDUIT PRIMES AND FULL CONDUIT FLOW BEGINS FOR "WITH TRASH" CONDITIONS, I.E., K_e = 0.65 AND C = 2.0

5. ANTI-VORTEX WALLS:
   OMIT CENTER ANTI-VORTEX WALL WHEN D < 36".

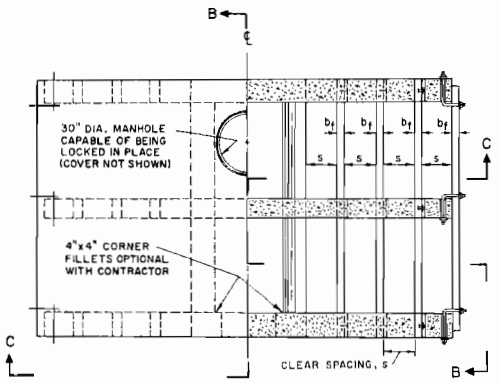
6. FLOTATION:
   WHEN RISER IS IN RESERVOIR - THE RATIO OF THE WEIGHT OF RISER TO THE WEIGHT OF THE VOLUME OF WATER DISPLACED BY THE RISER SHALL NOT BE LESS THAN 1.5.
   WHEN RISER IS IN EMBANKMENT - SAME AS ABOVE, BUT ADD TO THE WEIGHT OF THE RISER, THE BUOYANT WEIGHT OF THE SUBMERGED FILL OVER THE FOOTING PROJECTIONS.

7. DRY DAMS:
   WHEN SEDIMENT IS NOT A PROBLEM - SET CREST OF SINGLE STAGE RISER, OR CREST OF LOW STAGE INLET OF TWO-STAGE RISER, AT REQUIRED ELEVATION.
   WHERE SEDIMENT IS A PROBLEM - USE A SERIES OF SLOTTED OPENINGS UP THE LONGITUDINAL SIDES (SEE ES-151). TRASHRACKS ARE NOT REQUIRED FOR THESE OPENINGS.

8. MATERIALS:
   CONCRETE : CLASS 4000, f_c = 1600 PSI.
   REINFORCING STEEL: GRADE 40
   BAFFLE : AMERICAN STANDARD CHANNELS, MISCELLANEOUS CHANNELS, STRUCTURAL STEEL TUBING OR REINFORCED CONCRETE BEAMS.

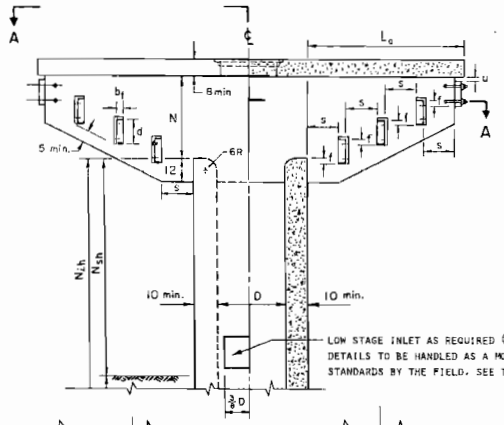
NOTES:

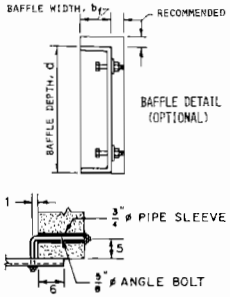
1. RISER ANALYSES:
   STANDARDS TO BE DEVELOPED FOR RISERS LOCATED IN THE EMBANKMENT (AT BERM) AND FOR RISERS LOCATED IN THE RESERVOIR AREA.
2. ROUND BOTTOM:
   MAY BE OBTAINED BY USE OF REMOVABLE SEMI-CIRCULAR FORMS ACCEPTABLE TO THE ENGINEER.
3. DRAINAGE OF POOL:
   PROVIDING FOR MEANS OF DRAINING POOL TO BE HANDLED AS A MODIFICATION OF THESE STANDARDS BY THE FIELD.



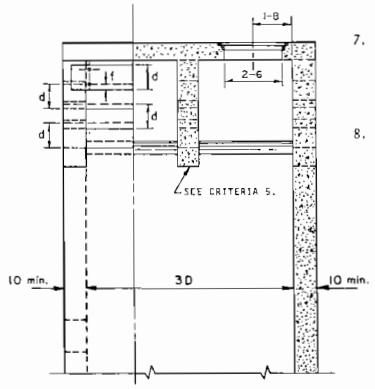
SECTION A-A

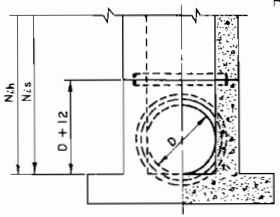
FOOTING AND SPIGOT WALL FITTING NOT SHOWN



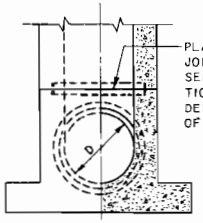


BOLT DETAIL

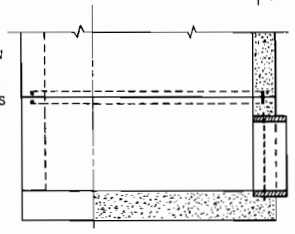




FLAT BOTTOM



ROUND BOTTOM



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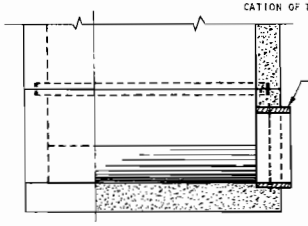


ROUND BOTTOM

SECTION C-C

SECTION B-B

OPENING IN UPSTREAM ENDWALL NEAR BASE OF RISER TO BE HANDLED AS A

DROP INLET SPILLWAYS STANDARD FOR BAFFLE TOP RISER

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	
Designed	NES	3-81	Approved by
Drawn	H.J.G.	3-81	Title
Checked			

SCOPE

1. The square open top riser is a standard for one and two-stage risers.

2. Height Ranges of Riser:
   High stage: H_2 = up to 20 feet. (If one-stage riser, H ≤ 40 feet.)
   Low stage: H_1 = up to 30 feet.
   Sum, $H = H_2 + H_1 \leq 40$

CRITERIA

1. Pipe Diameters and Associated Discharges:

D	$Q_{max} = \frac{30}{4}\pi D^2$
24	94
30	148
36	212
42	288
48	376

Note: Maximum allowable nominal velocity in pipe = 30 fps.

2. Trashracks:
   Fabrication – welded or bolted.
   Required net area for National Standard Detailed Drawings – to be computed from Q_{max}, as listed in Criteria (1) and an allowable average velocity of 2.0 fps.
   All bolts, nuts, pipe sleeves, and grating, to be galvanized or otherwise protected by corrosion resistant coating except when made of aluminum.
   Grating may be used at weir crest level (but not for more than 9" above crest).
   Required net area is exclussive of any grated area.

3. Flotation:
   When riser is in reservoir – the ratio of the weight of riser to the weight of the volume of water displaced by the riser shall not be less than 1.5.
   When the riser is in embankment – add to the weight of the risar, the buoyant weight of the submerged fill over the footing projections.

4. Dry Dams:
   Where sediment is not a problem – set crest of single stage riser or crest of low stage inlet of two-stage riser, at required elevation.
   Where sediment is a problem – use a series of slotted openings up the long longitudinal sides. Trashracks are not required for these openings

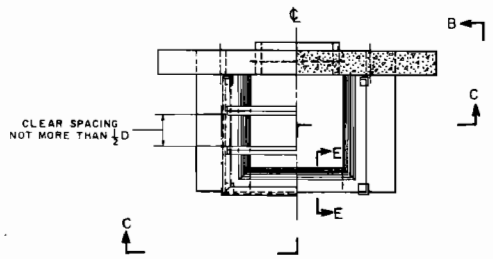
5. Materials:
   Concrete: Class B, f'_c = 4000 psi, f_c = 1600 psi.
   Reinforcing Steel: Intermediate grade.
   Trashrack: Structural steel or structural aluminum.

NOTES

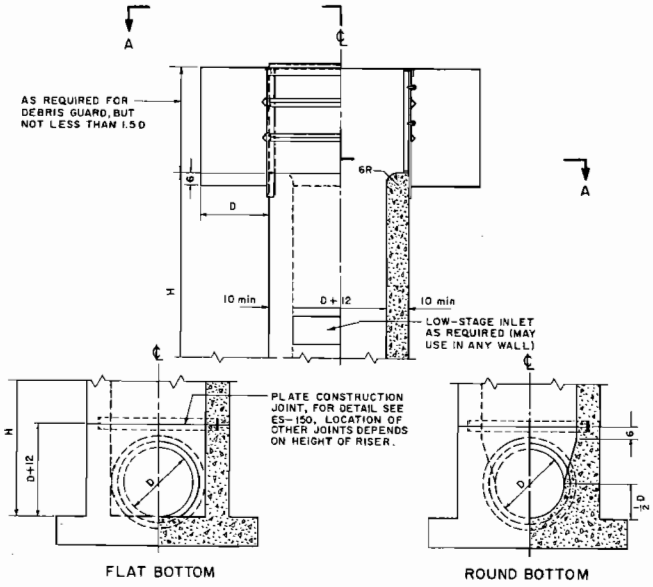
1. Riser Analyses:
   Standards to be developed for risers located in the embankment (at berm) and for risers located in the reservoir area.

2. Round Bottom: May be obtained by use of a pipe cut longitudinally along a diameter, or may be formed by removable semi-circular forms acceptable to the engineer.

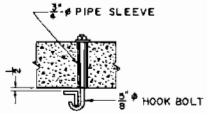
3. Drainage of Pool:
   Provision of means of draining pool to be handled as a modification of these standards by the Field.



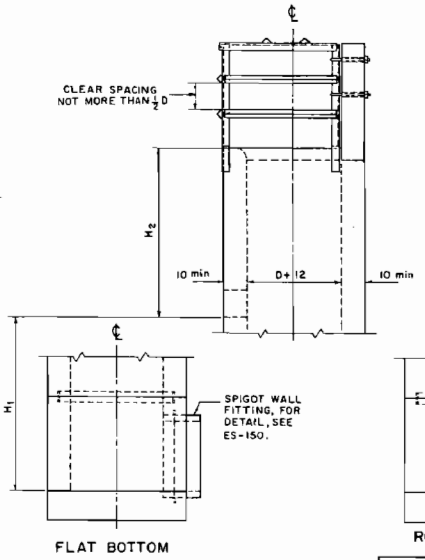
SECTION A–A



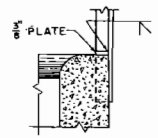
SECTION C–C



BOLT DETAIL



SECTION B–B



SECTION E–E

LOW STAGE INLET DETAIL TO BE HANDLED AS A MODIFICATION OF THESE STANDARDS BY THE FIELD.

ENGINEERING DIVISION - DESIGN SECTION	
ENGINEERING APPROVAL	CARTOGRAPHIC APPROVAL
DESIGNED BY	DRAWN BY
CHECKED BY	STANDARD DWG. NO.

DROP INLET SPILLWAYS
STANDARD FOR
SQUARE OPEN TOP RISER

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date	
Designed ENGINEERING DIV.	1-63	Approved by
Drawn E.S.B.	1-63	Title
Traced C.B.G.	2-63	Title
		Sheet No. / Drawing No.

SCOPE

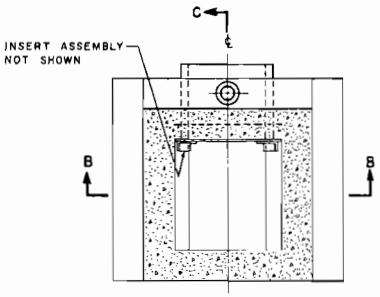
1. Pipe Diameters:
   D= 24" or 30"
2. Maximum Height (H) = 40ft.

CRITERIA

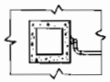
1. Discharge:
   $Q = 0.67a\sqrt{2gh}$ Where the area (a) may be found from ES-97, sheet 1 of 7, and the head (h) is measured from the centroid of the area.
2. Trashrack:
   Fabrication - welded or bolted.
   Required Net Area for National Standard Detailed Drawings – to be computed from Q_{max} and an allowable average velocity of 2.0 fps.
   All bolts, nuts, and pipe sleeves, to be galvanized or otherwise protected by corrosion resistant coating except when made of aluminum.
3. Flotation:
   When riser is in reservoir – the ratio of the weight of the riser to the weight of volume of water displaced by the riser shall not be less than 1.5.
   When riser is in embankment – add to the weight of the riser, the buoyant weight of the submerged fill over the footing projections.
4. Materials:
   Concrete: Class B, f'_c = 4000 psi, f_c=1600 psi.
   Reinforcing Steel: Intermediate grade.
   Trashrack: Structural Steel or structural aluminum.

NOTES:

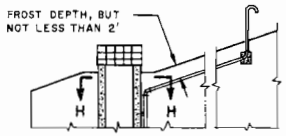
1. Riser Analyses:
   Standards to be developed for risers located in the embankment (at berm) and for risers located in the reservoir area.
2. Round Bottom: May be obtained by use of a pipe cut longitudinally along a diameter, or may be formed by removable semi-circular forms acceptable to the engineer.
3. Drainage of Pool:
   Provision of means of draining pool to be handled as a modification of these standards by the Field.



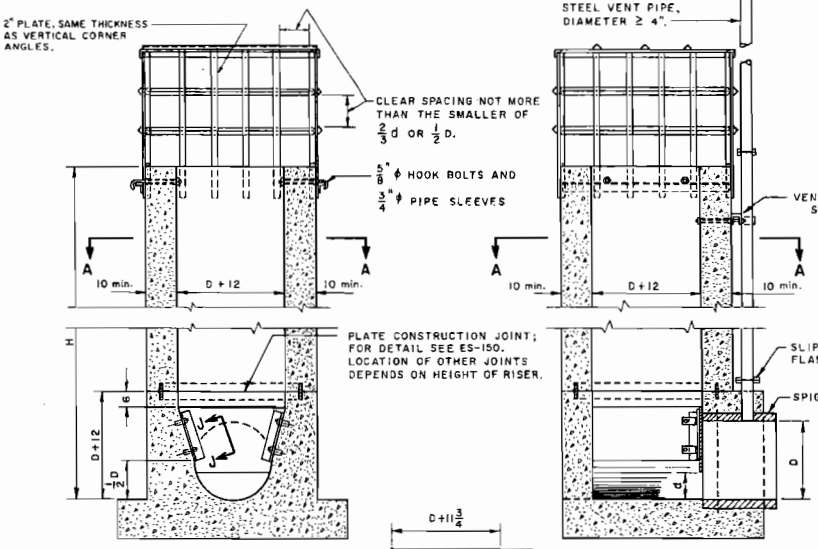
SECTION A-A



SECTION H-H

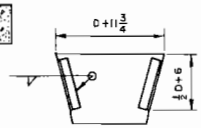


ALTERNATE VENT LAYOUT

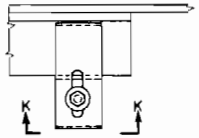


SECTION B-B
VENT PIPE NOT SHOWN

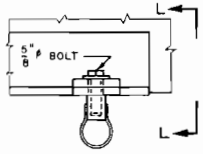
SECTION C-C



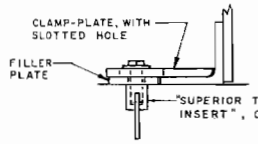
FLOW CONSTRICTION PLATE



SECTION J-J

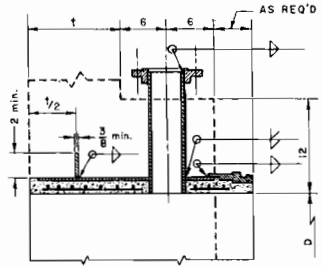


SECTION K-K

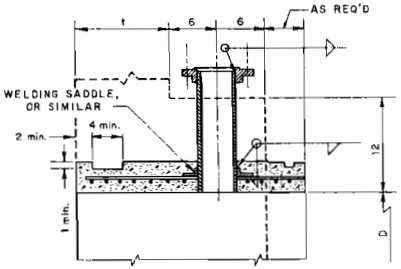


SECTION L-L

CONSTRICTION PLATE CONNECTION DETAIL

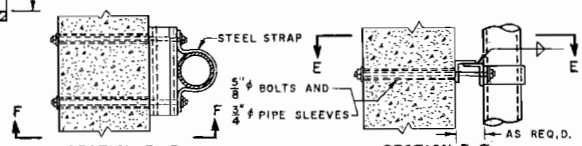


FOR PIPE AS DESIGNED AND MANUFACTURED UNDER A.W.W.A. SPECIFICATIONS C-300, C-301, AND C-302, AND A.S.T.M. DESIGNATION C-361.



FOR PIPE AS DESIGNED AND MANUFACTURED UNDER A.W.W.A. SPECIFICATION C-302 AND A.S.T.M. DESIGNATION C-361.

VENTED SPIGOT WALL FITTING DETAIL



SECTION E-E

SECTION F-F

VENT PIPE SUPPORT DETAIL

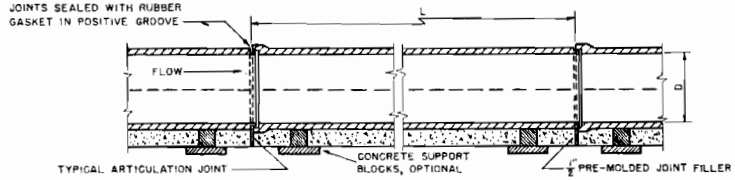
ENGINEERING DIVISION - DESIGN SECTION	
ENGINEERING APPROVAL	CARTOGRAPHIC APPROVAL
DESIGNED BY	DRAWN BY
CHECKED BY	STANDARD DRG. NO.

DROP INLET SPILLWAYS STANDARD FOR RESTRICTED FLOW RISER

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

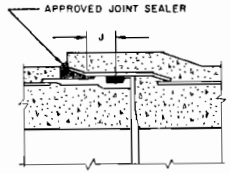
	Date
Designed ENGINEERING DIV.	1-63
Drawn E.S.A.	1-63
Traced I.C.G.	2-63
Checked	

Approved by
Title
Title Sheet
Drawing No. ES-152
No. 1

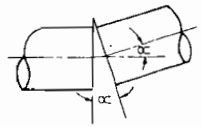


DETAIL OF PIPE CONDUIT
SECTION ON ℄–A2 CRADLE SHOWN

WHEN A1 CRADLE USED:
CUT LONGITUDINAL BARS AT 3" FROM EACH SIDE OF ARTICULATION JOINT. USE NO DOWELS.



JOINT EXTENSIBILITY



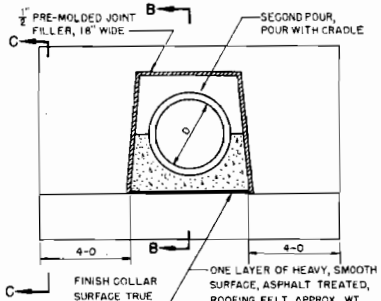
JOINT ROTATION CAPACITY

PIPE JOINT
DISPLACEMENT CHARACTERISTICS

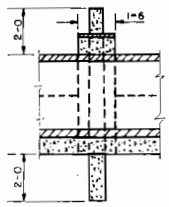
L	J	OC
LENGHT OF PIPE SECTION	REQ'D JOINT EXTENSIBILITY	REQ'D JOINT ROTATION CAPACITY
FEET	INCHES	RADIANS

PRIOR APPROVAL OF PIPE AND PIPE JOINT DETAIL PROPOSED FOR USE, TO BE REQUIRED BY THE SPECIFICATIONS.

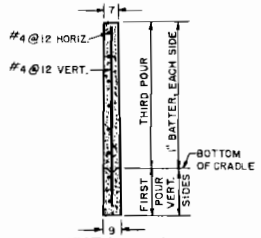
CLASS (a) DAMS MORE THAN 50 FT. HIGH, AND ALL CLASS (b) AND CLASS (c) DAMS



DETAIL SHOWN FOR EARTH FOUNDATION. FOR ROCK FOUNDATION, FOUND BOTTOM OF CRADLE ON ROCK LINE AND KEY COLLAR 6" INTO ROCK.



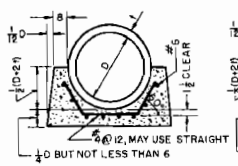
SECTION B-B



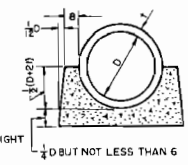
SECTION C-C
(SHOWING STEEL)

SIDES OF ANTI-SEEP COLLARS TO BE FORMED ABOVE BOTTOM OF CRADLE. MAX. SPACING OF COLLARS = 25'.

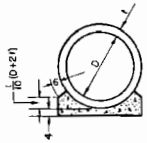
DETAIL OF ANTI-SEEP COLLAR



A1 CRADLE

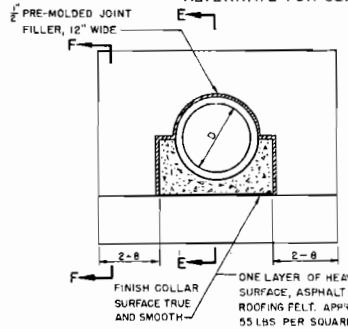


A2 CRADLE

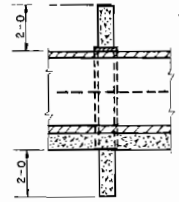


B1 BEDDING

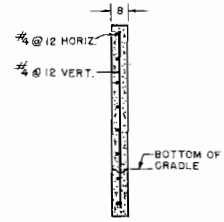
ALTERNATE FOR CLASS (a) DAMS LESS THAN 50 FT. HIGH



DETAIL SHOWN FOR EARTH FOUNDATION. FOR ROCK FOUNDATION, FOUND BOTTOM OF CRADLE ON ROCK LINE AND KEY COLLAR 6" INTO ROCK.



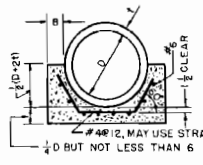
SECTION E-E



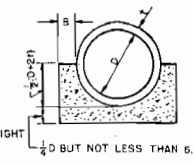
SECTION F-F
(SHOWING STEEL)

MAX. SPACING OF COLLARS = 25'.

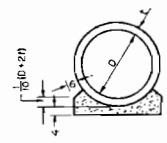
DETAIL OF ANTI-SEEP COLLAR



A1 CRADLE



A2 CRADLE



B1 BEDDING

ENGINEERING DIVISION - DESIGN SECTION	
ENGINEERING APPROVAL	CARTOGRAPHIC APPROVAL
DESIGNED BY	DRAWN BY
CHECKED BY	TRACED BY
QUANTITIES BY	DATE

PIPE AND CRADLE OR BEDDING ALTERNATES

MINIMUM THREE EDGE BEARING TEST STRENGTH LOAD IN POUNDS PER LINEAL FOOT OF PIPE FOR CORRESPONDING PIPE AND CRADLE OR BEDDING

CRADLE OR BEDDING	PIPE SPECIFICATION		LOAD TO PRODUCE NOT MORE THAN 0.01 INCH CRACK	LOAD TO PRODUCE NOT MORE THAN 0.001 INCH CRACK
A1	AWWA	C-300		
		C-301		
		C-302		
	ASTM	C 361		
A2	AWWA	C-300		
		C-301		
		C-302		
	ASTM	C 361		
		C-300		
		C-301		

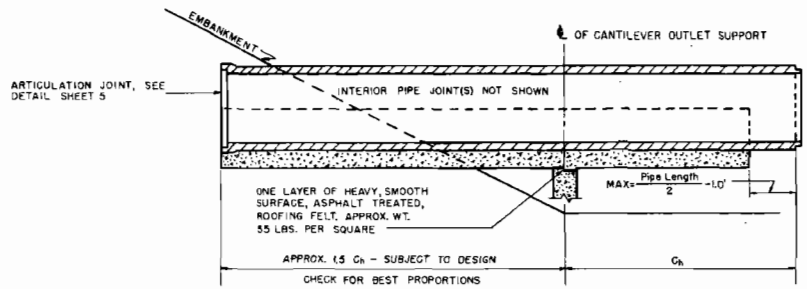
SCOPE:
1. Pipe Diameters:
D=24", 30, 36, 42, and 48

CRITERIA:
1. Materials (except pipe):
Concrete: Class B, fc'=4000 psi, fc=1600 psi
Reinforcing Steel: Intermediate grade
2. Applicable Criteria:
Engineering Memorandum SCS-27
Engineering Memorandum SCS-42 (rev.2)
Technical Release No. 5
Technical Release No. 19

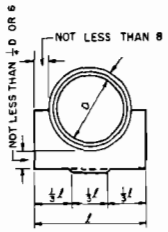
DROP INLET SPILLWAYS
STANDARD FOR
PIPE CONDUITS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed ENGINEERING DIV.	Date 1-63	Approved by
Drawn E.S.A.	Date 1-63	Title



SECTION ON ℄ OF PIPE



ELEVATION

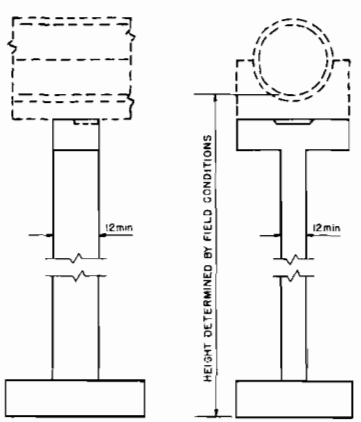
SCOPE:
Pipe Diameters:
D=24", 30, 36, 42, and 48

CRITERIA:
Materials:
Concrete: Class B, f'_c=4000 psi. f_c=1600 psi.
Reinforcing Steel: Intermediate grade

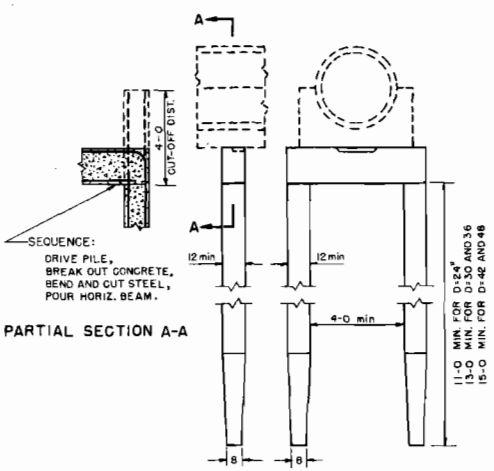
DETAIL OF CANTILEVER OUTLETS

BENTS FOR CANTILEVER OUTLETS

STANDARDS TO BE PREPARED FOR THE THREE TYPES, FIELD TO SELECT BENT DESIRED

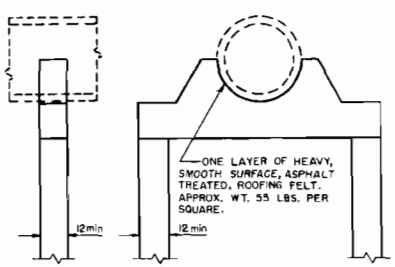


COLUMN BENT



PARTIAL SECTION A-A

PILE BENT



THIS BENT DETAIL FOR USE WITH CONCRETE STEEL CYLINDER PIPE HAVING SUFFICIENT STRENGTH AND LENGTH SUCH THAT A POURED CANTILEVER OUTLET BEAM IS NOT REQUIRED

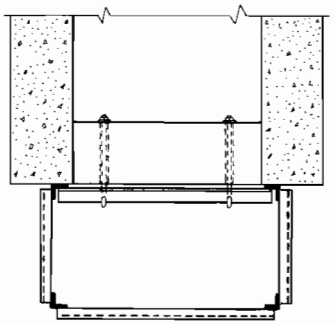
PIPE BEAM BENT

ENGINEERING DIVISION - DESIGN SECTION	
ENGINEERING APPROVAL	CARTOGRAPHIC APPROVAL

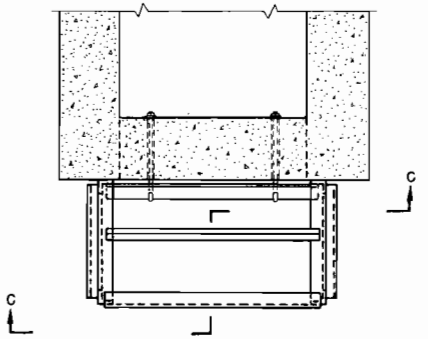
DROP INLET SPILLWAYS
STANDARD FOR
PIPE CONDUIT OUTLETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	
Designed	ENGINEERING DIV.	1-63	Approved by
Drawn	E.S.A.	1-63	Title
Traced			No.



SECTION A—A



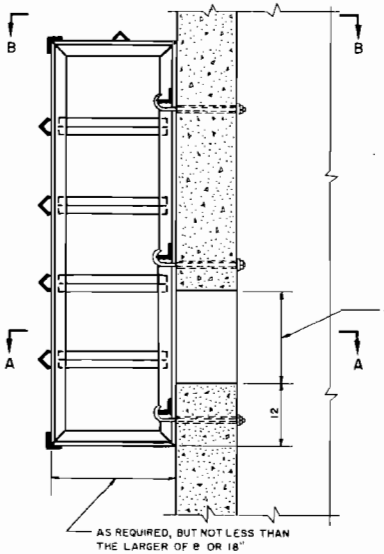
SECTION B—B

SCOPE:

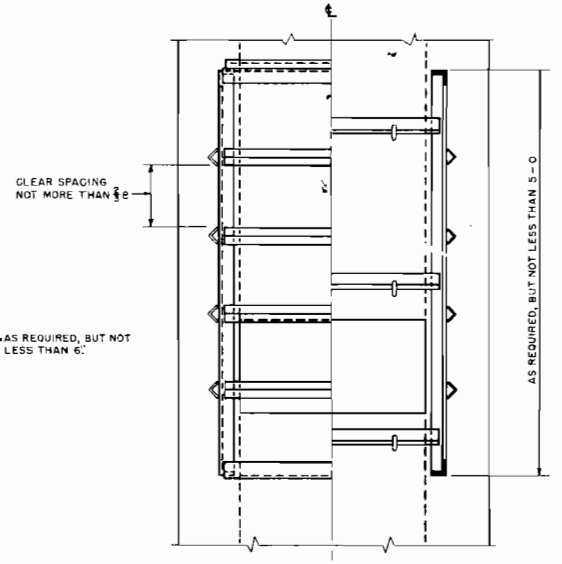
1. These details apply to the standard covered top, rectangular open top, and square open top risers.

CRITERIA:

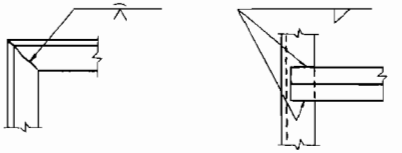
1. Trashracks:
   - Required net area for National Standard Detailed Drawings—to be computed from C_{max} for the low stage inlet and an allowable average velocity of 2.0 fps.
   - Grating may be used at low stage inlet level, but required net area is exclusive of any grated area.
   - Fabrication—may be welded or bolted. Welded shown here.
   - All bolts, nuts, pipe sleeves, and grating to be galvanized or otherwise protected by corrosion resistant coating except when made of aluminum.
   - Number and spacing of $\frac{5}{8}$" bolts $\frac{3}{4}$" pipe sleeves and support angles to be determined as required for strength and rigidity.
2. Materials:
   - Structural steel or structural aluminum.



SECTION ON ℄



SECTION C—C



WELDING DETAILS

GENERAL NOTE:

LOW STAGE INLET DETAILS TO BE HANDLED AS A MODIFICATION OF THE STANDARDS BY THE FIELD.

THIS SHEET CONTAINS DETAILS AND INFORMATION RECOMMENDED FOR USE WITH THE STANDARDS.

ENGINEERING DIVISION - DESIGN SECTION	
ENGINEERING APPROVAL	CARTOGRAPHIC APPROVAL
DESIGNED BY	DRAWN BY
CHECKED BY	STANDARD ENG. NO.

DROP INLET SPILLWAYS
RECOMMENDATIONS FOR
LOW STAGE INLETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date	
Designed ENGINEERING DIV.	1-63	Approved by
Drawn E.S.A.	1-63	Title
Traced J.H.D.	2-63	Title
		Sheet / Drawing No.

STRUCTURAL DESIGN: CIRCULAR CURVE, DIMENSIONING AND LAYOUT FOR REINFORCED CONCRETE SECTIONAL PIPE.

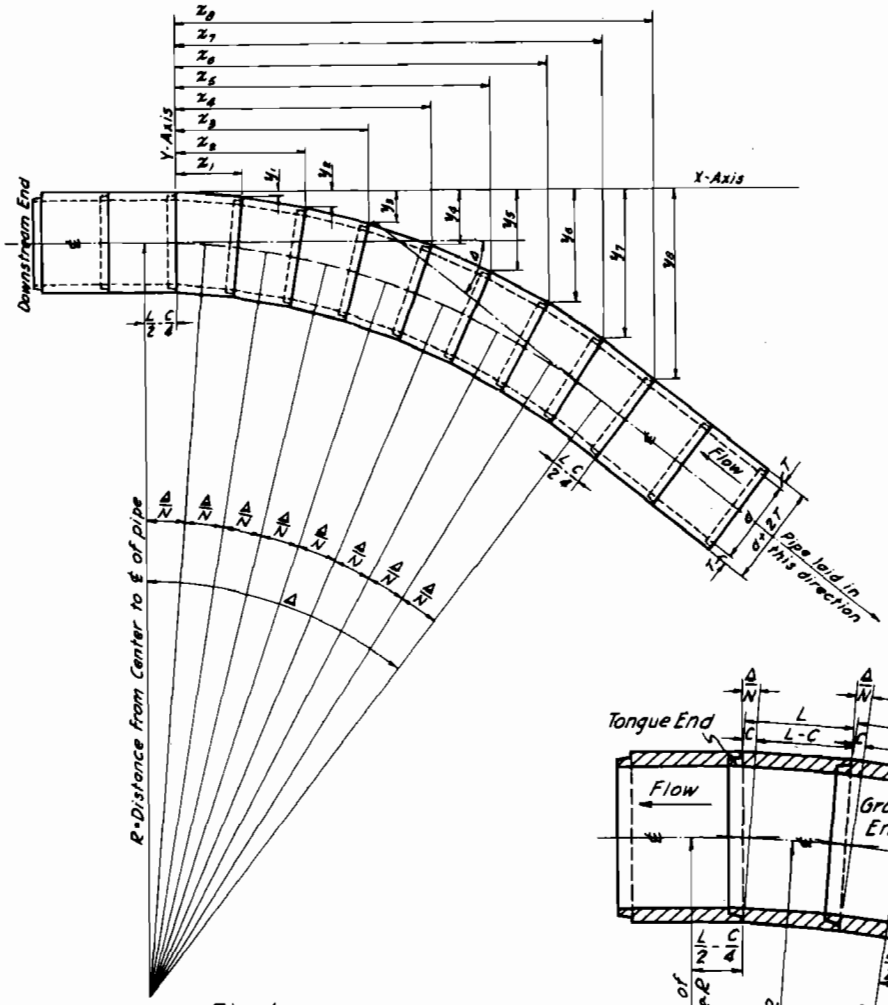


Fig. 1

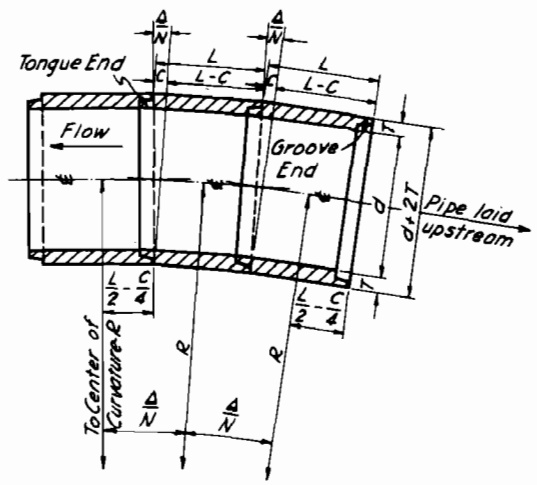


Fig. 2

FORMULAS

1. Tan. $\frac{\Delta}{N} = \frac{C}{d+2T}$; Largest recommended $\frac{\Delta}{N} = 5°$

   $R = \left[\frac{2L-C}{4C}\right]\left\{\sqrt{(d+2T)^2+C^2}+(d+2T)\right\}$ -ft.

   Since C is small compared to (d+2T) when $\frac{\Delta}{N} \leq 5°$, C^2 may be neglected under the radical sign. Then

2. $R = \text{approx.} \frac{(2L-C)(d+2T)}{2C}$ -ft; if $\frac{C}{d+2T} < 0.08$

3.(a) $x_1 = L \cos \Delta/N$ -ft.

   (b) $x_2 = L[\cos \Delta/N + \cos 2(\Delta/N)]$ -ft.

   .....

   $x_n = L[\cos \Delta/N + \cos 2(\Delta/N) + \cos 3(\Delta/N) + \cdots + \cos n(\Delta/N)]$ -ft.

   $x_n = L\left[\frac{\sin(n+\frac{1}{2})(\Delta/N) - \sin \frac{1}{2}(\Delta/N)}{2 \sin \frac{1}{2}(\Delta/N)}\right]$ -ft.

4.(a) $y_1 = L \sin \Delta/N$ -ft.

   (b) $y_2 = L[\sin \Delta/N + \sin 2(\Delta/N)]$ -ft.

   .....

   $y_n = L[\sin \Delta/N + \sin 2(\Delta/N) + \sin 3(\Delta/N) + \cdots + \sin n(\Delta/N)]$ -ft.

   $y_n = L\left[\frac{\cos \frac{1}{2}(\Delta/N) - \cos(n+\frac{1}{2})\Delta/N}{2 \sin \frac{1}{2}(\Delta/N)}\right]$ -ft.

NOMENCLATURE AND SYMBOLS

- R = Radius of curvature - ft.; Distance from center of curve to ℄ of pipe.
- Δ = Central angle of curve = Angle between ℄ tangents.
- N = Number of identically cut sections in curve.
- d = Inside diameter of pipe - ft.
- T = Wall thickness of concrete pipe - ft.
- L = Length of long side of elbow section - ft.
- C = Cut or bevel on tongue end of pipe section - ft. See Fig. 2.
- x_n = Offset dimension of outside edge of n^{th} section from Y-axis - ft.
- y_n = Offset dimension of outside edge of n^{th} section from X-axis - ft.

REFERENCE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ENGINEERING STANDARDS UNIT

STANDARD DWG. NO. ES-8
SHEET 1 OF 3
DATE 1-10-50

STRUCTURAL DESIGN: CIRCULAR CURVE, DIMENSIONING AND LAYOUT FOR REINFORCED CONCRETE SECTIONAL PIPE.

EXAMPLE

Problem: A reinforced concrete pipe with internal diameter of 60 inches and wall thickness of 6" is to be laid on a curve having a central angle (Δ) of 38°-16'. The radius of curvature is to be kept as small as reasonably feasible using standard lengths of pipe and normal fabricating practice. Compute the required cut and coordinates for layout of this pipe curve.

Solution:

The radius of curvature (R) will be smallest for short lengths (L) of pipe and large values of Δ/N. Choose a short standard length L=4' and hold Δ/N as close to, but not over, 5° as possible. Choose number (N) of cut sections of pipe in the curve as 8,

$$\frac{\Delta}{N} = \frac{38°\text{-}16'}{8} = 4°\text{-}47'$$

Solve for the cut (C) as follows:

$$\text{Tan}\,(\Delta/N) = \tan 4°\text{-}47' = 0.08368$$

$$= \frac{C}{d+2T} = \frac{C}{60+12} = \frac{C}{72} \text{ or}$$

$$C = 0.08368 \times 72 = 6.02496 \text{ inches } *$$

This cut, to the closest 1/8" for manufacturing purposes, is C=6.0 inches. Tolerances for pipe cut C=6.0" will allow the use of the value C=6.02496" for calculation purposes thruout the rest of the problem. The radius of curvature (R) of the ℄ of the pipe is

$$R = \frac{(2L-C)(d+2T)}{2C}$$

$$= \frac{[8 - 1/12\,(6.02496)][5+(2\times 1/12\times 6)]}{2\times 1/12\times 6.02496}$$

$$R = 44.31 \text{ ft.}$$

The point of tangency of the curve is located

$$\left(\frac{L}{2} - \frac{C}{4}\right) = \frac{4}{2} - \frac{6.02496}{4\times 12} = 1.87 \text{ ft.}$$

downstream from the first cut section to be placed. The offsets to the outside edge of pipe which will be used in laying the pipe are given on the form Calculation Sheet, sheet 3 of 3.

*Permissible to use inches here if d & T are in inches.

REFERENCE	U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE ENGINEERING STANDARDS UNIT	STANDARD DWG. NO. ES-8 SHEET 2 OF 3 DATE 1-10-50

STRUCTURAL DESIGN: CIRCULAR CURVE, DIMENSIONING AND LAYOUT FOR REINFORCED CONCRETE SECTIONAL PIPE.

CALCULATIONS FOR OFFSETS

$$X_n = L\left[\cos\frac{\Delta}{N} + \cos 2\left(\frac{\Delta}{N}\right) + \cdots + \cos n\left(\frac{\Delta}{N}\right)\right] = L\sum_{j=1}^{n}\cos j\left(\frac{\Delta}{N}\right) - ft.$$

n	$n\frac{\Delta}{N}$	$\cos n\left(\frac{\Delta}{N}\right)$	$\sum_{j=1}^{n}\cos j\frac{\Delta}{N}$	$x_n = L\sum_{j=1}^{n}\cos j\frac{\Delta}{N}$ - ft
1	4°-47'	0.99652	0.99652	3.99
2	9°-34'	0.98609	1.98261	7.93
3	14°-21'	0.96880	2.95141	11.81
4	19°-08'	0.94476	3.89617	15.58
5	23°-55'	0.91414	4.81031	19.24
6	28°-42'	0.87715	5.68746	22.75
7	33°-29'	0.83405	6.52151	26.09
8	38°-16'	0.78514	7.30665	29.23

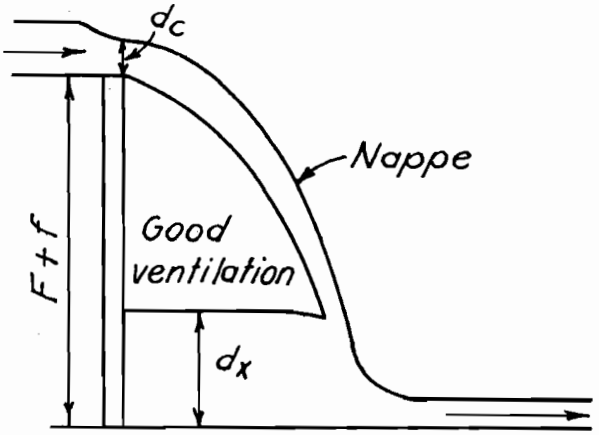
Total (Check) 7.30665

$$y_n = L\left[\sin\frac{\Delta}{N} + \sin 2\left(\frac{\Delta}{N}\right) + \cdots + \sin n\left(\frac{\Delta}{N}\right)\right] = L\sum_{j=1}^{n}\sin j\left(\frac{\Delta}{N}\right) - ft.$$

n	$n\frac{\Delta}{N}$	$\sin n\left(\frac{\Delta}{N}\right)$	$\sum_{j=1}^{n}\sin n\frac{\Delta}{N}$	$y_n = L\sum_{j=1}^{n}\sin j\frac{\Delta}{N}$ - ft
1	4°-47'	0.08339	0.08339	0.33
2	9°-34'	0.16620	0.24959	1.00
3	14°-21'	0.24784	0.49743	1.99
4	19°-08'	0.32777	0.82520	3.30
5	23°-55'	0.40541	1.23061	4.92
6	28°-42'	0.48022	1.71083	6.84
7	33°-29'	0.55169	2.26252	9.05
8	38°-16'	0.61932	2.88184	11.53

Total (Check) 2.88184

DROP SPILLWAYS: DEPTH OF STANDING WATER BEHIND NAPPE OF DROP SPILLWAY



SCHEMATIC DIAGRAM

d_c = Hydrostatic critical depth-ft.
F + f = Height of fall-ft.
d_x = Depth of standing water behind nappe-ft.

REFERENCE

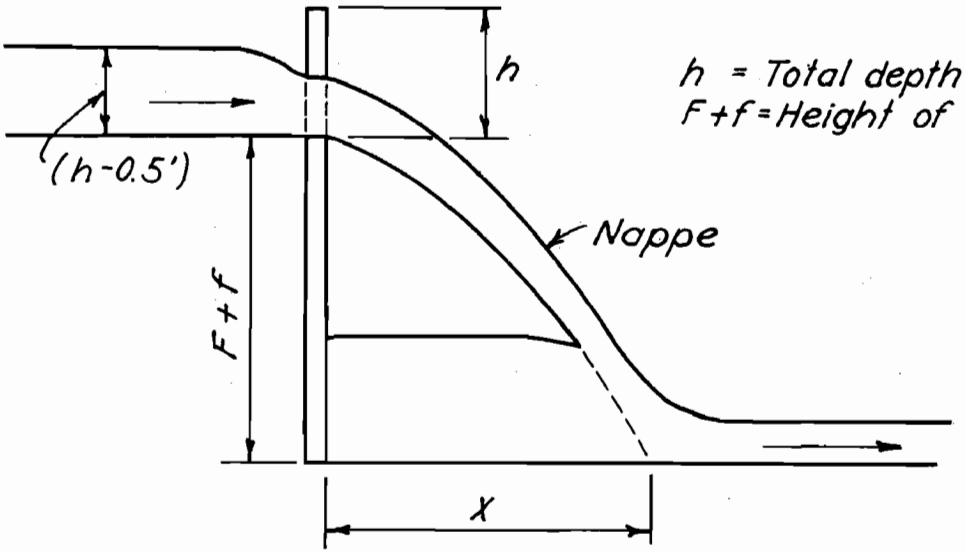
Proceedings - ASCE Transaction No. 108, 1943, Paper No. 2204 by Walter L. Moore, Page 1343

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

ENGINEERING STANDARDS UNIT

STANDARD DWG. NO.
ES - 11
SHEET 1 OF 2
DATE 1 - 27 - 50

DROP SPILLWAYS: APPROXIMATE HORIZONTAL DISTANCE, (X), TRAVELLED BY THE NAPPE OVER A DROP SPILLWAY



h = Total depth of weir-ft.
F+f = Height of fall-ft.

SCHEMATIC DIAGRAM

$$X = 1.185(F+f)^{\frac{1}{2}}(h-0.5)^{\frac{1}{2}}$$

	Value of X in feet								
F+f \ h	2'-0"	2'-6"	3'-0"	3'-6"	4'-0"	4'-6"	5'-0"	5'-6"	6'-6"
4'-0"	2.90	3.35	3.75	4.10	4.43	4.74	5.03	5.30	5.80
5'-0"	3.25	3.75	4.18	4.59	4.96	5.30	5.62	5.92	6.49
6'-0"	3.55	4.10	4.59	5.03	5.43	5.80	6.16	6.49	7.11
7'-0"	3.84	4.44	4.96	5.43	5.87	6.27	6.65	7.01	7.68
8'-0"	4.11	4.74	5.30	5.80	6.27	6.70	7.11	7.49	8.21
9'-0"	4.35	5.03	5.62	6.16	6.65	7.11	7.54	7.95	8.71
10'-0"	4.59	5.30	5.92	6.49	7.01	7.49	7.95	8.38	9.18
11'-0"	4.81	5.56	6.21	6.81	7.35	7.86	8.34	8.79	9.63
12'-0"	5.03	5.80	6.49	7.11	7.68	8.21	8.71	9.18	10.05
13'-0"	5.23	6.04	6.76	7.40	7.99	8.55	9.06	9.55	10.46
14'-0"	5.43	6.27	7.01	7.68	8.30	8.87	9.41	9.91	10.86

Note: Velocity of approach neglected

REFERENCE

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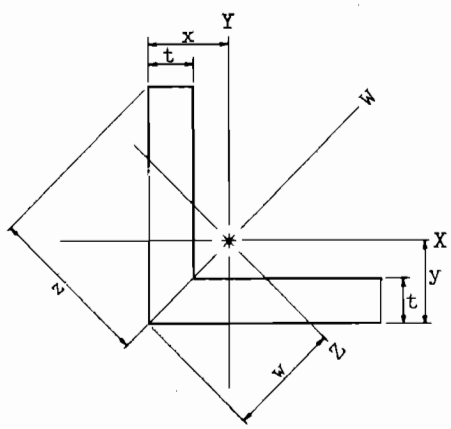
SOIL CONSERVATION SERVICE
ENGINEERING STANDARDS UNIT

STANDARD DWG. NO.
ES-11
SHEET 2 OF 2
DATE 1-27-50

STRUCTURAL DESIGN: STEEL ANGLES WITH EQUAL LEGS



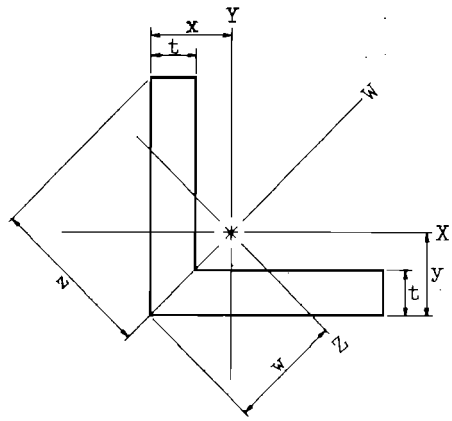
Size in.	t in.	Weight lb/ft	Area in^2	x or y in.	z in.	w in.	Axis Z-Z		
							I in^4	S in^3	r in.
8 x 8	1 1/8	56.9	16.7	2.41	5.66	3.41	40.8	12.0	1.56
	1	51.0	15.0	2.37	5.66	3.35	36.7	11.0	1.56
	7/8	45.0	13.2	2.32	5.66	3.28	32.6	9.93	1.57
	3/4	38.9	11.4	2.28	5.66	3.22	28.4	8.81	1.58
	5/8	32.7	9.61	2.23	5.66	3.16	24.1	7.62	1.58
	9/16	29.5	8.68	2.21	5.66	3.12	21.8	6.99	1.59
	1/2	26.4	7.75	2.19	5.66	3.09	19.6	6.34	1.59
6 x 6	1	37.4	11.0	1.86	4.24	2.64	15.0	5.69	1.17
	7/8	33.1	9.73	1.82	4.24	2.57	13.3	5.18	1.17
	3/4	28.7	8.44	1.78	4.24	2.51	11.6	4.63	1.17
	5/8	24.2	7.11	1.73	4.24	2.45	9.87	4.03	1.18
	9/16	21.9	6.43	1.71	4.24	2.41	8.98	3.72	1.18
	1/2	19.6	5.75	1.68	4.24	2.38	8.07	3.39	1.18
	7/16	17.2	5.06	1.66	4.24	2.35	7.15	3.04	1.19
	3/8	14.8	4.36	1.64	4.24	2.32	6.20	2.67	1.19
	5/16	12.4	3.65	1.62	4.24	2.29	5.23	2.29	1.20
5 x 5	7/8	27.2	7.98	1.57	3.54	2.22	7.56	3.41	0.973
	3/4	23.6	6.94	1.52	3.54	2.15	6.59	3.06	0.975
	5/8	19.9	5.86	1.48	3.54	2.09	5.60	2.68	0.978
	1/2	16.2	4.75	1.43	3.54	2.03	4.59	2.26	0.983
	7/16	14.2	4.18	1.41	3.54	2.00	4.07	2.04	0.986
	3/8	12.3	3.61	1.39	3.54	1.96	3.54	1.80	0.990
	5/16	10.3	3.03	1.37	3.54	1.93	2.99	1.55	0.994
4 x 4	3/4	18.5	5.44	1.27	2.83	1.80	3.29	1.83	0.778
	5/8	15.7	4.61	1.23	2.83	1.74	2.80	1.61	0.779
	1/2	12.8	3.75	1.18	2.83	1.67	2.29	1.37	0.782
	7/16	11.3	3.31	1.16	2.83	1.64	2.04	1.24	0.785
	3/8	9.73	2.86	1.14	2.83	1.61	1.77	1.10	0.788
	5/16	8.17	2.40	1.12	2.83	1.58	1.50	0.953	0.791
	1/4	6.59	1.94	1.09	2.83	1.55	1.22	0.793	0.795
$3\frac{1}{2}$ x $3\frac{1}{2}$	1/2	11.1	3.25	1.06	2.47	1.50	1.51	1.01	0.683
	7/16	9.77	2.87	1.04	2.47	1.46	1.35	0.919	0.684
	3/8	8.45	2.48	1.01	2.47	1.43	1.17	0.818	0.687
	5/16	7.11	2.09	0.990	2.47	1.40	0.995	0.710	0.690
	1/4	5.74	1.69	0.968	2.47	1.37	0.812	0.593	0.694

REFERENCE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ENGINEERING DIVISION - DESIGN SECTION

STANDARD DWG. NO.
ES- 157
SHEET 1 OF 2
DATE 4 - 64

STRUCTURAL DESIGN: STEEL ANGLES WITH EQUAL LEGS



Size in.	t in.	Weight lb/ft	Area in^2	x or y in.	z in.	w in.	Axis Z-Z		
							I in^4	S in^3	r in.
3 x 3	1/2	9.36	2.75	0.932	2.12	1.32	0.938	0.712	0.584
	7/16	8.28	2.43	0.910	2.12	1.29	0.833	0.647	0.585
	3/8	7.18	2.11	0.888	2.12	1.26	0.726	0.578	0.587
	5/16	6.05	1.78	0.865	2.12	1.22	0.617	0.504	0.589
	1/4	4.89	1.44	0.842	2.12	1.19	0.504	0.423	0.592
	3/16	3.71	1.09	0.820	2.12	1.16	0.388	0.334	0.596
2½ x 2½	1/2	7.66	2.25	0.806	1.77	1.14	0.533	0.468	0.487
	3/8	5.90	1.73	0.762	1.77	1.08	0.412	0.382	0.487
	5/16	4.98	1.46	0.740	1.77	1.05	0.350	0.335	0.489
	1/4	4.04	1.19	0.717	1.77	1.01	0.287	0.283	0.491
	3/16	3.07	0.902	0.694	1.77	0.982	0.221	0.225	0.495
2 x 2	3/8	4.63	1.36	0.636	1.41	0.899	0.206	0.229	0.389
	5/16	3.92	1.15	0.614	1.41	0.868	0.175	0.201	0.390
	1/4	3.19	0.938	0.592	1.41	0.837	0.143	0.171	0.391
	3/16	2.43	0.715	0.569	1.41	0.805	0.111	0.138	0.394
	1/8	1.65	0.484	0.546	1.41	0.773	0.0766	0.0991	0.398
1¾ x 1¾	1/4	2.76	0.813	0.529	1.24	0.748	0.0947	0.127	0.341
	3/16	2.11	0.621	0.506	1.24	0.716	0.0733	0.102	0.343
	1/8	1.44	0.422	0.484	1.24	0.684	0.0507	0.0742	0.347
1½ x 1½	1/4	2.34	0.688	0.466	1.06	0.659	0.0586	0.0890	0.292
	3/16	1.79	0.527	0.444	1.06	0.628	0.0454	0.0723	0.293
	1/8	1.22	0.359	0.421	1.06	0.596	0.0315	0.0529	0.296
1¼ x 1¼	1/4	1.91	0.563	0.403	0.884	0.570	0.0333	0.0585	0.243
	3/16	1.48	0.434	0.381	0.884	0.539	0.0257	0.0477	0.244
	1/8	1.01	0.297	0.359	0.884	0.507	0.0179	0.0353	0.246
1 x 1	1/4	1.49	0.438	0.339	0.707	0.480	0.0168	0.0350	0.196
	3/16	1.16	0.340	0.318	0.707	0.450	0.0129	0.0286	0.194
	1/8	0.798	0.234	0.296	0.707	0.418	0.00896	0.0214	0.196