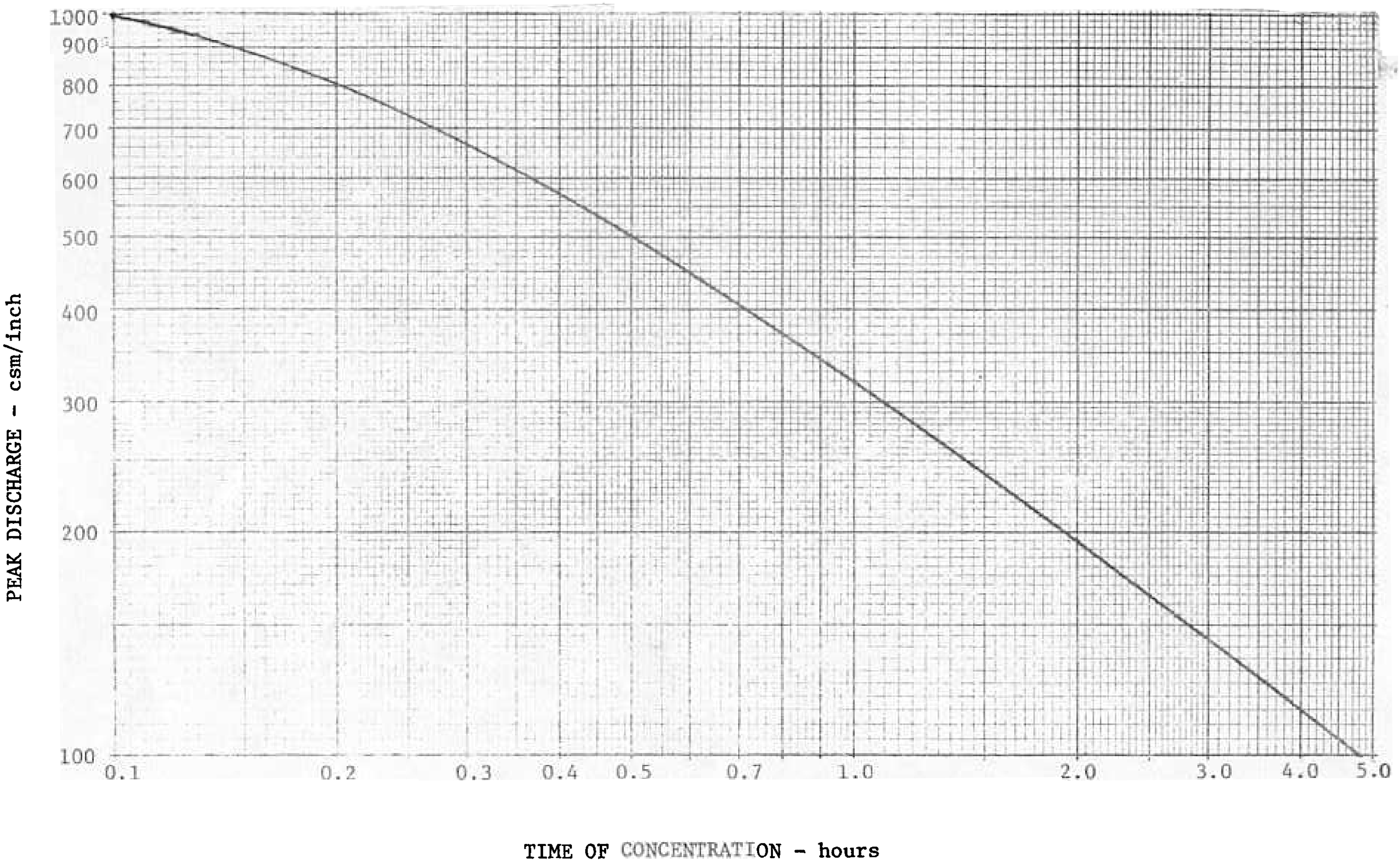
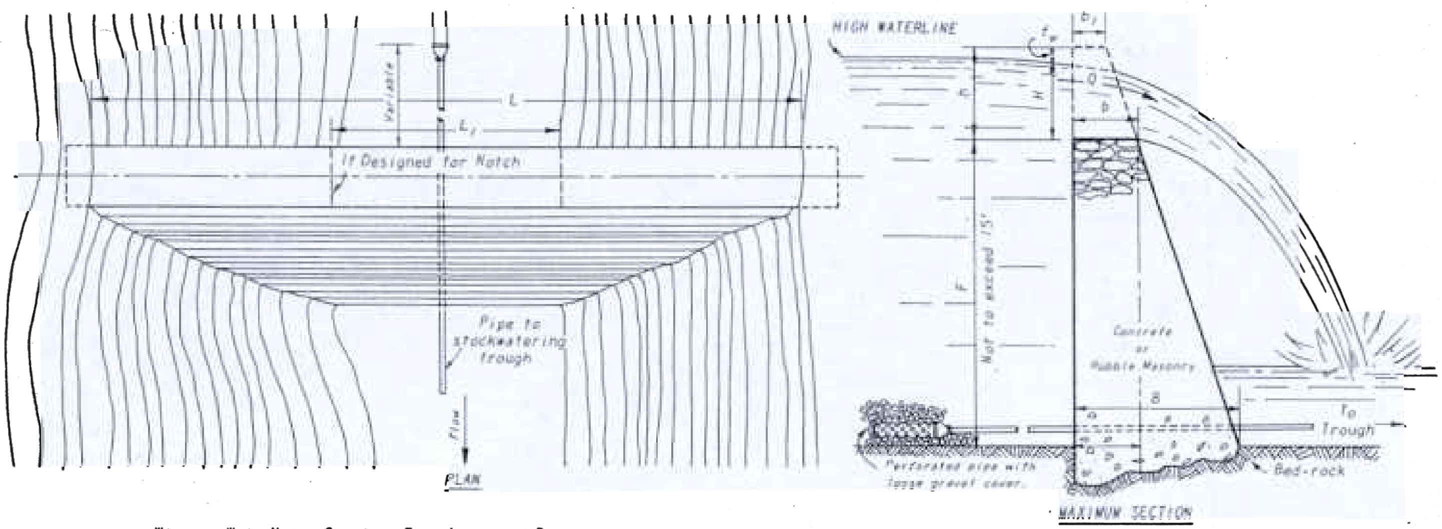


Figure 1-6 -- Peak discharge in csm per inch of runoff versus time of concentration (T_c) for 24-hour type-II storm distribution.



__Without Weir Notch Overflow Full Length of Dam__

- F — Height of Dam or Headwall
- Q — Discharge Over Crest in C.F.S.
- B — Width of Dam at Base 0.65 (F + H)
- b — 0.65 H (To be not less than 12" for concrete and 18" for masonry)
- H — Head on crest (Does not include velocity head)
- L — Length of Dam at Crest

__With Weir Notch and Headwall Extensions__

- B — 0.65 (F + h)
- b — 0.65 h (To be not less than 12" concrete and 18" masonry)
- F — Height of Dam or Headwall
- Q — Discharge Through Weir Notch in C.F.S.
- b_1 — Minimum width of Headwall Extension (12" for concrete and 15" for Masonry)
- h — Depth of Weir Notch = $H + f_w$
- f_w — Freeboard
- L_1 — Length of Weir Notch

__Note:__ This type of dam is best adapted to low wide sites where foundations can be carried into solid rock.

$Q = CL\left(H + \frac{v^2}{2g}\right)^{3/2}$ with velocity of approach

$Q = CLH^{3/2}$ without velocity of approach

$Q = \frac{CLh^{3/2}}{1.10 + 0.01F}$ for values of h

or $h = \left[\frac{Q\,(1.10 + 0.01F)}{CL}\right]^{2/3}$

c = 3.1 for all cases

Note: If F exceeds 15 feet special design should be prepared.

Figure 1-6A

SMALL MASONRY GRAVITY DAM FOR ROCK FOUNDATIONS

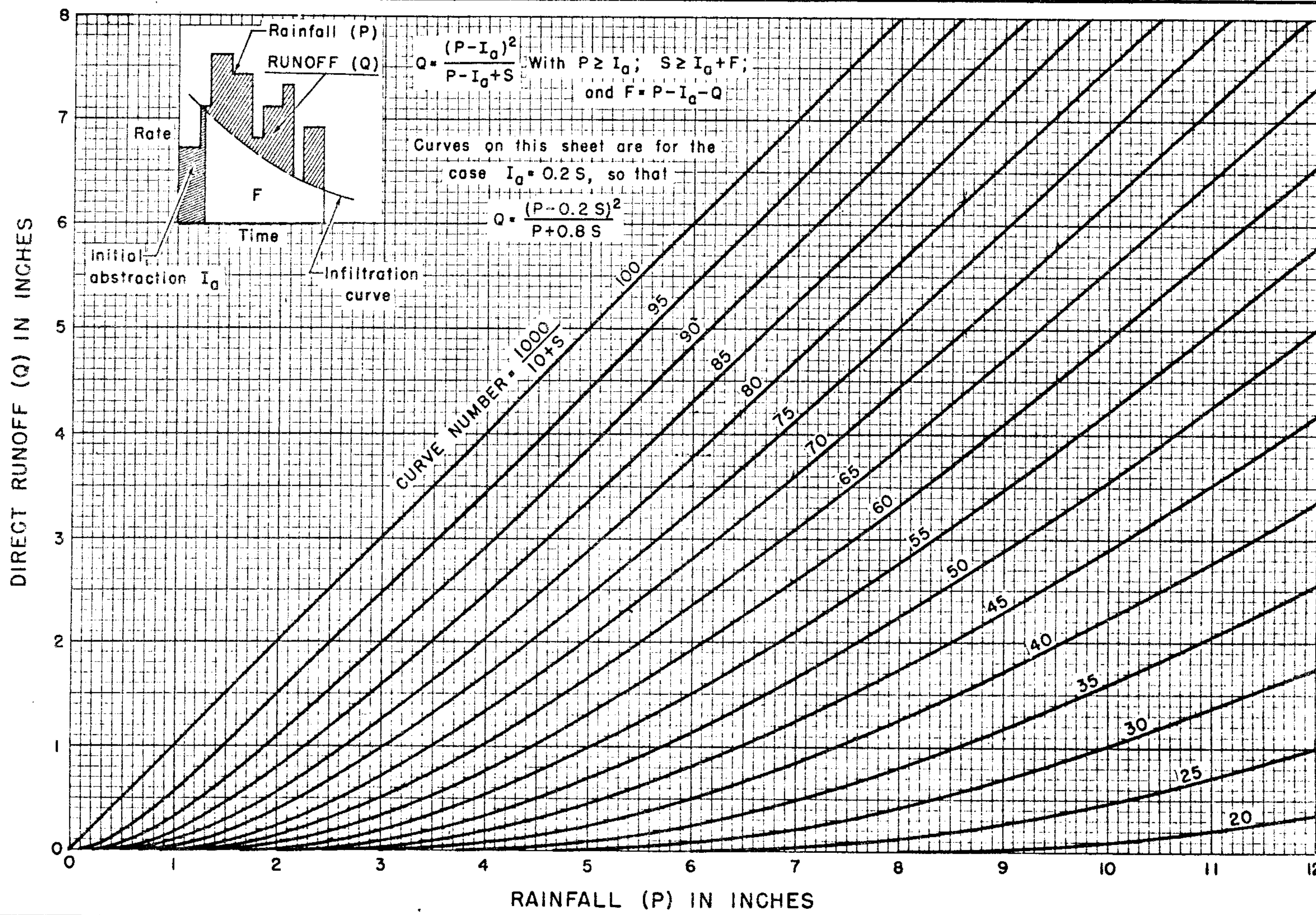
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	H.E.N.-L.W.M.	6-57	Approved by: Howard Matson
Drawn	C.F.L.	7-57	Head, E.&W.M.S. / E.M. Price
Traced			State Cons. Eng'r.
Checked	H.E.N.-C.M.M.		Sheet 1 of 1 — Drawing No. 4-N-11739

Reference: 6-N-12103-1 New Mexico, Old Regional Handbook, Section III.

HYDROLOGY: SOLUTION OF RUNOFF EQUATION $Q = \frac{(P-0.2S)^2}{P+0.8S}$

P = 0 to 12 inches
Q = 0 to 8 inches



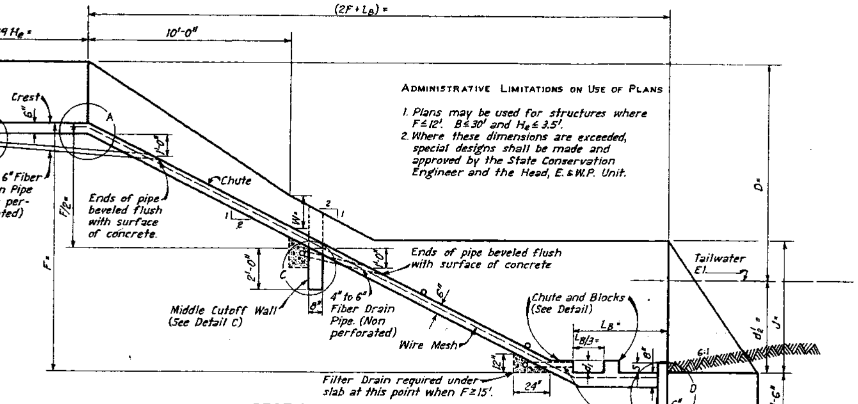
REFERENCE

Mockus, Victor; Estimating direct runoff amounts from storm rainfall: Central Technical Unit, October 1955

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ENGINEERING DIVISION – HYDROLOGY BRANCH

STANDARD DWG. NO. ES-1001
SHEET 1 OF 2
DATE 6-29-56
REVISED 10-1-64

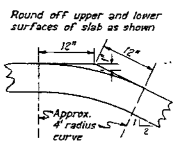
Figure – 1-7



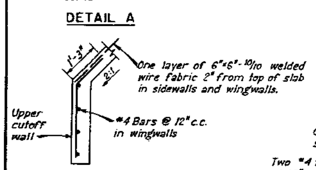
SECTION ALONG ℄

ADMINISTRATIVE LIMITATIONS ON USE OF PLANS

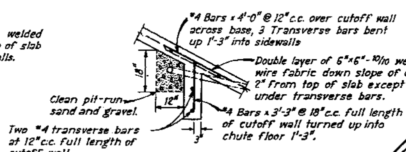
1. Plans may be used for structures where F ≤ 12'. B ≤ 30' and H_e ≤ 3.5'.
2. Where these dimensions are exceeded, special designs shall be made and approved by the State Conservation Engineer and the Head, E. & W.P. Unit.



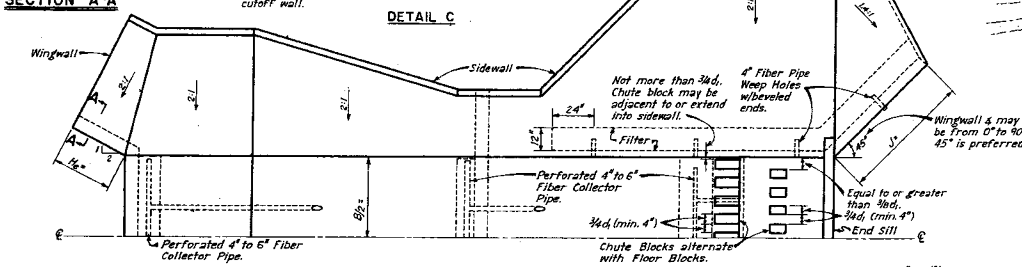
DETAIL A



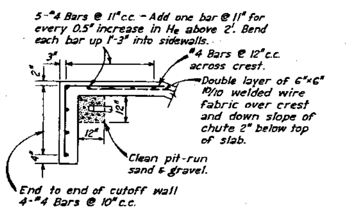
SECTION A-A



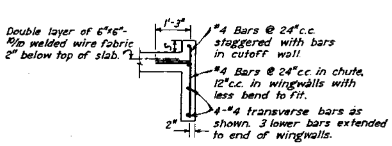
DETAIL C



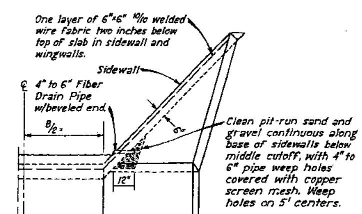
HALF PLAN



DETAIL B



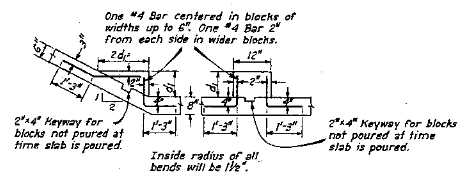
DETAIL D



LOWER END VIEW

SYMBOLS

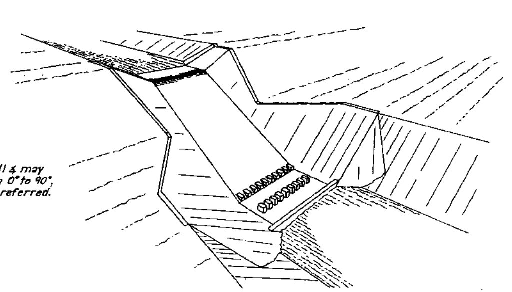
B - Bottom width of chute, in feet.
D - Difference in elevation from energy gradient at crest section to tailwater surface below stilling basin, in feet.
d_1 - Entrance depth of water at stilling basin immediately above chute blocks. Also height of blocks, in feet. Depth measured normal to chute floor.
d_2' - Elevation of tailwater surface above stilling basin floor, in feet.
F - Difference in elevation between crest of chute and stilling basin, in feet.
H_e - Energy head at crest = depth of water + velocity head ($V^2/2g$), in feet.
J - Height of sidewalls of stilling basin, in feet.
L_B - Length of stilling basin, in feet.
Q - Designed capacity of chute spillway, in c.f.s.
s - Height of transverse end sill, in feet.
w - Height of walls of chute 10' downstream from crest, in feet.
v_1 - Velocity in chute section immediately above chute blocks, in feet/second.



CHUTE BLOCK DETAIL   FLOOR BLOCK DETAIL

NOTES

1. Floor and chute blocks should be poured at time slab is poured.
2. Floor blocks must occupy from 40% to 55% of the stilling basin width at the location of the floor blocks.
3. An ALTERNATE procedure may be used as follows:
   a. Blocks to be formed and poured after the slab is poured.
   b. Steel from the slab to be turned up for use in the floor and chute blocks prior to forming for the blocks.



PERSPECTIVE VIEW

Design based on Engineering Handbook, Section 14, Chute Spillways, except sidewalls are laid back on a 2:1 slope.

FORMLESS CONCRETE CHUTE SPILLWAY
STRUCTURE DETAILS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	
Designed	B.H.B. & C.M.M.	3-61	Approved by
Drawn	E.C.B. & N.J.P.	6-62	
Traced	N.J.P.	6-62	Sheet 1 of 2
Checked	E.C.B. & C.M.M.	7-62	Drawing No. 4-E-15,030

Design Procedure

Step 1:
Determine the following items from field investigations:
a. Q
b. Tailwater elevation
c. Crest elevation

Step 2:
Choose "H_p" and "B" from the following chart based on $Q = 2.21\,B\,H_p^{3/2} + 2.17\,H_p^{5/2}\,z$.

Q, c.f.s. for Z = 2:1

B \ H_p	2.0	2.5	3.0	3.5	4.0	4.5	5.0
10	1123	1653	2269	3025	3864	4853	5942
15	1562	2266	3095	4040	5104	6303	7633
20	2000	2878	3901	5055	6349	7763	9253
25		3490	4707	6071	7585	9265	11091
30			5513	7088	8824	10748	12862
35				8101	10064	12226	14556
40					11305	13706	16084

Step 3:
Find D from the following formula:
D = (Crest elevation + H_p) − Water surface elevation below stilling basin.

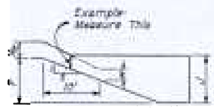
Step 4:
Solve for the following dimensions using the chart of formula constants as needed.
Note: 1. "F" must be between 5' and 20'.
2. All negative signs must be observed in using the formulas.

$F = aD + b$ $\quad d_1 = -iD + k$
$L_B = -cD + f$ $\quad d_2 = H_p + (F - D)$
$J = gD + h$ $\quad w = 0.3 + 0.4\,H_p$
$\quad s = 0.10\,d_2$

Chart of Formula Constants

Dimensions		F		L_B		J		d_1	
Constants		a	b	c	f	g	h	i	k
H_p	2.0	1.027	0.22	.0486	2.98	.0394	3.13	.01002	.484
	2.5	1.041	0.83	.0710	5.38	.0650	4.53	.01468	.646
	3.0	1.047	1.03	.0933	6.14	.0872	5.29	.01866	.801
	3.5	1.052	1.09	.1066	8.08	.0987	6.13	.02341	1.000
	4.0	1.069	1.10	.1399	9.51	.1160	6.84	.02679	1.178
	4.5	1.074	1.15	.1493	10.86	.1190	7.77	.02941	1.414
	5.0	1.096	1.29	.1855	10.46	.1528	8.35	.02847	1.820

Step 5:
If $H_p + (9 - w) \geq H_p + (F - J)$, draw a scale section to find height of sidewall at beginning of stilling basin wall. Otherwise use formula in step 4 above.



Quantities of Materials**

Steel Bars

H_p	F = 5 Sides	F = 5 Per Ft B	F = 10 Sides	F = 10 Per Ft B	F = 15 Sides	F = 15 Per Ft B	F = 20 Sides	F = 20 Per Ft B
	Linear Feet of #4 Bars							
2.0	106.40	46.90	108.59	45.13	111.28	44.83	112.48	53.68
2.5	137.83	48.13	140.07	47.13	146.01	48.57	149.93	50.50
3.0	165.84	55.13	168.27	47.18	171.19	48.24	176.44	49.04
3.5	184.46	55.86	189.96	56.98	192.58	58.77	201.26	49.86
4.0	207.15	56.30	214.69	57.84	220.78	58.80	227.63	60.81
4.5	231.76	56.81	238.51	57.74	245.51	59.61	252.26	60.76
5.0	249.87	57.38	262.90	58.10	270.75	59.88	279.50	61.58

Example:
H_p = 3.5', F = 20', B = 18'.
Total length required = 201.26 + (49.86 × 18) = 1098.74'

Notes Concerning Steel Bars:
1. All bars are #4, Wt = Length (Ft) × 0.668 (lbs/ft)
2. Lengths above heavy line include one bar each per chute block and floor block. Lengths below heavy line include two bars each per chute block and floor block.
3. Bars should be cut and bent as they are placed.

Wire Mesh

H_p	F = 5 Sides	F = 5 Per Ft B	F = 10 Sides	F = 10 Per Ft B	F = 15 Sides	F = 15 Per Ft B	F = 20 Sides	F = 20 Per Ft B
	Square Yards of 6"×6"-10/10 Wire Mesh							
2.0	35.58	3.77	38.67	6.27	34.48	8.84	40.28	11.07
2.5	44.45	4.37	48.22	6.71	56.34	9.11	64.46	11.32
3.0	61.30	4.79	65.56	7.18	75.64	9.36	85.70	11.55
3.5	81.70	5.29	86.12	7.66	97.40	10.06	109.04	12.41
4.0	103.78	5.79	109.38	8.13	122.12	10.47	136.14	12.81
4.5	130.90	6.30	137.34	8.63	149.82	10.48	165.32	13.29
5.0	157.72	6.58	162.68	9.13	180.74	11.45	208.88	13.72

Example:
H_p = 3.5', F = 20', B = 18'.
Total area of mesh required = 109.04 + (12.41 × 18) = 332.42 Sq. Yds.

Notes Concerning Wire Mesh:
1. These numbers indicate the actual area to be covered by wire mesh, including a double thickness on the channel bottom. Consult with contractor or supplier to estimate the additional amount that is ordinarily wasted.
2. Experience indicates that the first layer of mesh should be placed in strips running across the channel.
3. If practical, get rolls 5'-6" wide for second layer in bottom and lay lengthways.

Concrete

H_p	F = 5 Sides	F = 5 Per Ft B	F = 10 Sides	F = 10 Per Ft B	F = 15 Sides	F = 15 Per Ft B	F = 20 Sides	F = 20 Per Ft B
	Cubic Yards of Concrete							
2.0	4.36	0.517	4.98	0.734	6.02	0.940	7.04	1.140
2.5	7.62	0.586	8.08	0.786	9.69	0.981	11.10	1.185
3.0	10.46	0.624	11.18	0.833	12.92	1.032	14.66	1.228
3.5	13.90	0.698	14.64	0.883	16.58	1.078	18.58	1.273
4.0	17.80	0.738	18.60	0.930	20.73	1.120	23.12	1.319
4.5	22.16	0.768	23.28	0.976	25.38	1.169	28.00	1.359
5.0	26.56	0.841	28.16	1.028	30.54	1.213	33.80	1.401

Example:
H_p = 3.5', F = 20', B = 18'.
Vol. of Concrete = 18.58 + (18 × 1.273) = 18.58 + 22.91 = 41.49 Cu. Yds.

Notes Concerning Concrete:
Volumes shown above are to line and grades and do not include over-run due to rough grading, over-cutting, etc. Volumes should be adjusted depending on accuracy of grading operations.

** Tables used for computing quantities apply only to 2:1 bottom slope of chute and 2:1 side slopes.

Complete Examples

Design:
Step 1: Q = 500 c.f.s., Tailwater Elev. = 760.0', Crest Elev. = 767.5'
Step 2: H_p = 3.5', B = 20'
Step 3: D = (767.5 + 3.5) − 760.0 = 11.0'
Step 4: F = (1.052 × 11.0) + 1.09 = 11.57 + 1.09 = 12.66'
L_B = [−0.1066 × (11.0)] + 8.08 = −1.17 + 8.08 = 6.91'
J = (0.0987 × 11.0) + 6.13 = 1.02 + 6.13 = 7.15'
d_1 = [−0.02341 × (11.0)] + 1.000 = −0.258 + 1.000 = .74'
d_2 = 3.5 + (12.66 − 11.0) = 5.16'
w = 0.3 + 0.4 × 3.5 = 0.3 + 1.40 = 1.70'
s = 0.10 × 5.16 = 0.52'
Step 5: 3.5 + (9 − 1.70) = 6.8'
3.5 + (12.66 − 7.15) = 9.01'
6.8' < 9.01'
∴ w = 1.70' is correct

Quantities: When F is not equal to 5', 10', 15' or 20', quantities must be interpolated.
Steel Bars (Let F = 12.7', B = 20', H_p = 3.5')
Total Length = "Sides" + "Per Ft. B"
(1) Find "Sides" for F of 12.7' (Interpolate between F = 10 and F = 15).
Subtract: 195.58' − 189.96' = 5.62'
Construct the ratio as constant: $\frac{12.7 - 10}{15 - 10} = \frac{2.7}{5} = .54$; 5.62 × .54 = 3.03'
Add: 189.96' + 3.03' = 192.99'
(2) Find "Per Ft. B" for F of 12.7' (Interpolate between F = 10 and F = 15).
Subtract: 58.72' − 56.98' = 1.74'
Using the constant derived in step (1) above: 1.74' × .54 = 0.94'
Add: 56.98' + 0.94' = 57.92'
Total Length = 192.99' + 20 (57.92) = 1351.39'
Weight = 1352 Ft. × 0.668 lbs./Ft. = 903 lbs.

Wire Mesh (Let F = 12.7', B = 20', H_p = 3.5')
Total Area = "Sides" + "Per Ft. B"
(1) Find "Sides" for F of 12.7' (Interpolate between F = 10 and F = 15 as above, using table of Wire Mesh Quantities).
Area = 92.20 sq. yds.
(2) Find "Per Ft. B" for F of 12.7' (Interpolate between F = 10 and F = 15 as above, using table of Wire Mesh Quantities).
Area = 20 (8.96) = 179.20 sq. yds.
Total Area = 92.20 sq. yds. + 179.20 sq. yds. = 271.20 sq. yds.

Concrete (Let F = 12.7', B = 20', H_p = 3.5')
Total Volume = "Sides" + "Per Ft. B"
(1) Find "Sides" for F of 12.7' (Interpolate between F = 10 and F = 15 as above, using table of Concrete Quantities).
Volume = 15.69 cu. yds.
(2) Find "Per Ft. B" for F = 12.7' (Interpolate between F = 10 and F = 15 as above, using table of Concrete Quantities).
Volume = 20 (0.988) = 19.76 cu. yds.
Total Volume = 15.69 cu. yds. + 19.76 cu. yds. = 35.45 cu. yds.
Increase estimate of concrete by approximately 5% to compensate for overcutting, waste, etc.

General Construction Notes

1. Concrete will be Class "C". Strength at 28 day test to be not less than 2500 #/in².
2. Wire mesh will be:
   a. 6"×6"-10/10 welded wire fabric or equivalent.
   b. Single layer in wingwalls and sidewalls.
   c. Double layer in floor of chute and apron.
   d. Lapped one square.
   e. Placed on brick or concrete blocks for support.
3. All splices of reinforcing bars to be 15" min.
4. Fiber pipe will conform to Standard Material Specification 509-58.
5. All steel reinforcement will conform to Standard Material Specification 508-58.
6. Construction joints shall be no closer than 10' horizontally and steel shall be continuous through the joints.

Range of Application of This Design

H_p = 2.0' to 5.0'
B = 10.0' to 40'
F = 5.0' to 20'

Notes:
Administrative approval limited to F ≤ 12', B ≤ 30' and H_p ≤ 3.5'. Special design required where these limitations are exceeded.

Tailwater depth must be accurately determined in all cases.

Revised 2-14-63
Revised 9-26-62

FORMLESS CONCRETE CHUTE SPILLWAY
DESIGN DATA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date
Designed	E.N.B. & C.M.N.	2-61
Drawn	E.C.B. & N.J.R.	6-62
Traced	N.J.R.	6-62
Checked	E.C.B. & C.M.N.	7-62

Sheet No. 2 of 2 — Drawing No. 4-E-15,030

CHAPTER 2. WORKING TOOLS AND SHORT-CUT TECHNIQUES

INTRODUCTION

There have been some indications that the mass routing procedures presented in Chapter 1 require considerable time in structure planning. This is especially true where the procedure is used infrequently and formats for recording must be developed. As a result, Form TX-204 has been prepared to record data for each step of the principal spillway design procedure.

FORMS TO RECORD DATA

The following forms were developed for recording data for each step of the structure design:

1 TX-204-1 - Low Head Drop Inlet Design

2 TX-204-1a - Drop Inlet Structure Design Work Sheet

3 TX-204-1b - Table 1-1, Mass Rainfa and Runoff

4 TX-204-1c - Table 1-2, Storage-Indication Routing

5 TX-204-1d - Table 1-2A or B, Storage-Indication Routing

6 TX-204-1e - Table -2C, Storage-Indication Routing Curve Tabulation

STEP PROCEDURE

Each step, as presented in the technical note and provided for on Form TX-204-1a, is discussed.

Step 1: The desired level of emergency spillway protection must be determined. Emergency spillway capacity should be provided to carry the outflow from the 25-year frequency flood at the safe velocity for the site. Thus, detention storage capacity will vary depending upon emergency spillway conditions and the need for downstream flood protection. Conditions at each site should be studied to determine the detention capacity needed to protect downstream areas or to keep frequency and depth of emergency spillway flow within limits which will not cause significant damage. The detention capacity may vary from a small amount to that required to detain a 25-year frequency flood.

Step 2: Space is provided on Form TX-204-1a to compute hydrologic soil cover complex curve number.