POWERLINE CHANNEL DESIGN

SOIL CONSERVATION SERVICE

1964

Arizona Powerline Channel
Watt 1-4-64
Inflow on Powerline Channel
Uncontrolled Area

Channel At Sta 72

	1%	2%	4%	10%
Conc	170	125	90	55
Rock	154	120	90	55
Earth	148	110	83	50

At Sta 205

Conc	770	600	452	300
Rock	690	530	393	250
Earth	460	350	264	170

At Sta 260

Conc	945	740	550	360
Rock	812	640	490	320
Earth	618	475	368	235

Actually these figures are for many inlets to the main channel and give a low T_c & a little higher peak than would result with the 110.9 inlets designed.

178

80
60

Arizona Powerline Channel
Watt 1-4-65
Estimated Discharge From Dams on
10% Frequency Discharge

Powerline Dam 24 hr Precip Drainage Area 49.6
Curve No. 83

	Point Rain	Area Corr	Rainfall	Runoff	Trans Loss	Net Runoff
1%	6.27	.66	4.15	2.41	.66	1.59
10%	4.00	.66	2.64	1.16	.66	0.77

10% AcFt = 77 × 49.6 × 53.3 = 2036 Acft

10 day release
1% discharge Prime Spillway 386 CFS
@ 19' head

10% Head = 14' 10% Dis = $386\left(\frac{14}{19}\right)^{1/2}$ = 330 CFS

30 day release 21' head 225 CFS 1% Dis

10% discharge $225 \times \left(\frac{14}{21}\right)^{1/2}$ = 185 CFS

Vinyard Road Dam

10% Runoff = 53.4 × 0.77 × 53.3 = 2190 AcFt

10 Day release 709 CFS @ 15' head 1% Event

10% release = $709 \times \left(\frac{12}{15}\right)^{1/2}$ = 634

30 Day release 1% = 327

327
386
713

283
185
468

327
225
552

10% = $327 \times \left(\frac{12}{16}\right)^{1/2}$ = 283

225
327
552

Total 10 day release 10% = 964
30 day release 10% = 468

468

Arizona Powerline Channel

Watt 1/4/64

Design Flow For Powerline Channel

At 72+00 10 day release

	Release 1%	Uncont. 10%	Total	Release 10%	Uncont. 2%	Total
Conc.	1095	50	1145	964	110	1074
Rock	1095	50	1145	964	110	1074
Earth	1095	50	1145	964	110	1074

38
327

At 72+00 30 day Release

Conc	552	50	602	468	110	578
Rock	552	50	602	468	110	578
Earth	552	50	602	468	110	578

At 205 10 day Release

Conc	1095	300	1395	964	600	1564
Rock	1095	250	1345	964	530	1494
Earth	1095	170	1265	964	350	1314

At 205 30 day Release

Conc	552	300	852	468	600	1068
Rock	552	250	802	468	530	990
Earth	552	170	722	468	350	818

At 260 10 day Release

Conc	1095	360	1455	964	740	1704
Rock	1095	320	1415	964	640	1604
Earth	1095	235	1325	964	475	1539

At 260 30 day Release

Conc	552	360	912	468	740	1208
Rock	552	250	802	468	640	1108
Earth	552	235	787	468	475	943

552

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Channel
BY Watt | DATE 5-13-65 | CHECKED BY | DATE | JOB NO. C
SUBJECT Rock Rip Rap Channel @ Sta 375± | SHEET | OF

Width of Channel for $Q = 1200$ CFS $n = 0.04$

$d = 6.2$ ft $S = .0043$ $SS = 2:1$

$$K = \frac{Qn}{D^{8/3} S^{1/2}} = \frac{1200 \times .04}{273 \times .04557} = 2.6814$$

$D/b = 1.31$ $D = 1.31 \times 6.2 = 8.1$ ft (Too narrow)

Use width to make 6.5 ft/sec at 3.2' dep

$$A = \frac{1200}{6.5} = 184.6 \text{ sq ft}$$

$bd + 2d^2 = 184.6$

$3.2d = 184.6 - 2 \times 3.2^2 = 51.2'$ Use 50'

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT | C

BY Watt | DATE 2-17-65 | CHECKED BY | DATE | JOB NO.

SUBJECT Most Economical Trap. Channel | SHEET 1 OF 4

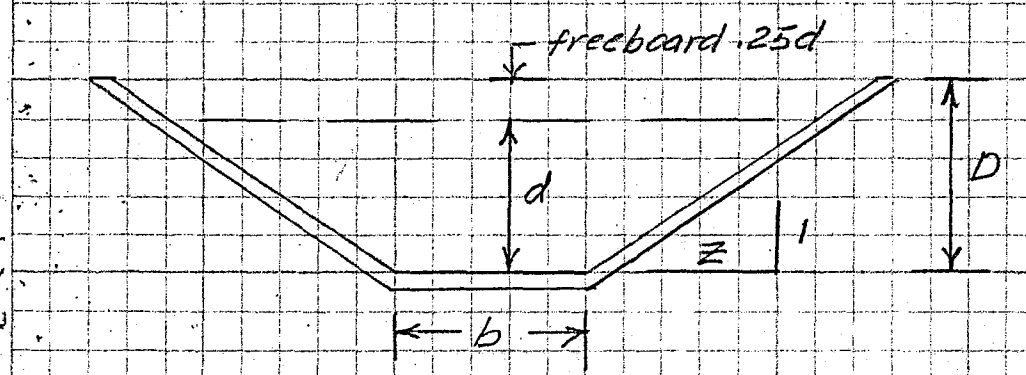
To find the most economical section of trapizoidal channel freeboard = 0.25d

(1.) Find $Q_f = KQ$ — Q_F = Total Freeboard Capacity.

(2) Find D — $D^{8/3} = \frac{1}{C} \frac{Qn}{1.486 S^{1/2}}$ — Q = Design Capacity

(3) Find b — $b = C'D$

Z	K	C	C'
1	1.60	1.159	.828
1.25	1.64	1.237	.702
1.5	1.67	1.334	.605
1.75	1.70	1.446	.531
2	1.72	1.566	.472
2.5	1.75	1.828	.385



COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO 1955 O—407927

STATE Arizona | PROJECT
BY Watt | DATE 2-17-65 | CHECKED BY | DATE | JOB NO. C
SUBJECT For Most economical Trap. Channel | SHEET 2 OF 4

$$A = bd + Zd^2$$

$$P = b + 2\sqrt{1+Z^2}\,d$$

$$P = \frac{A - Zd^2}{d} + 2d\sqrt{1+Z^2}$$

For depth to give min P for Const. A.

$$\frac{dP}{dd} = \frac{-2Zd^2 - A + Zd^2}{d^2} + 2\sqrt{1+Z^2} = 0$$

$$2\sqrt{1+Z^2} = \frac{Zd^2 + A}{d^2}$$

$$Z = \frac{A - bd}{d^2}$$

$$\therefore \quad 2\sqrt{1+Z^2} = \frac{A - bd + A}{d^2}$$

$$bd + 2d^2\sqrt{1+Z^2} = 2A$$

$$d = \frac{2A}{b + 2d\sqrt{1+Z^2}} = 2R$$

$$R = d/2$$

COMPUTATION SHEET
SCS-S23A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO 1958 O—497927

STATE Arizona | PROJECT | JOB NO C
BY Watt | DATE 2-17-65 | CHECKED BY | DATE
SUBJECT Most Economical Dimensions of | SHEET 3 OF 4

Trapizoidal Channel

For most economical dimensions $r = \frac{d}{2}$

$$R = \frac{A}{P} = \frac{bd + zd^2}{b + 2d\sqrt{1+z^2}} = \frac{d}{2}$$

R = Hyd Rad.
P = Wetted Per.
A = Area.

$$bd + zd^2\sqrt{1+z^2} = 2bd + 2zd^2$$

$$2d(\sqrt{1+z^2} - z) = b \qquad b = c'd$$

where $c' = 2(\sqrt{1+z^2} - z)$

$$AR^{2/3} = \frac{Qn}{1.486 S^{1/2}}$$

For most Econ. Dimensions

$$A = bd + zd^2 = 2d^2(\sqrt{1+z^2} - z) + zd^2$$

$$= d^2(2\sqrt{1+z^2} - z)$$

$$AR^{2/3} = d^2(2\sqrt{1+z^2} - z)\left(\frac{d}{2}\right)^{2/3}$$

$$AR^{2/3} = .6337(2\sqrt{1+z^2} - z)\, d^{8/3} = \frac{Qn}{1.486 S^{1/2}}$$

$$C d^{8/3} = \frac{Qn}{1.486 S^{1/2}} \qquad C = .6337(2\sqrt{1+z^2} - z)$$

z	C	$b = c'd$ c'
1	1.159	.828
1.25	1.237	.702
1.5	1.334	.605
1.75	1.446	.531
2	1.566	.472
2.5	1.828	.385

COMPUTATION SHEET
SCS-503A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO 1959 O-497927

STATE Arizona | PROJECT | | JOB NO C

BY Watt | DATE 2-17-61 | CHECKED BY | DATE

SUBJECT To Correct For Freeboard | SHEET 4 OF 4

Make Q_F equal Total Capacity of Channel

A_F = Freeboard Area
P_F = Freeboard Wetted perimeter

If Freeboard = 0.25d

$$\frac{Q_F}{Q} = \frac{\frac{1.486\, A_1 R_1^{2/3} S^{1/2}}{n}}{\frac{1.486\, A R^{2/3} S^{1/2}}{n}} = \frac{A_F R_F^{2/3}}{A R^{2/3}} = \left(\frac{A_F}{A}\right)^{5/3}\left(\frac{P}{P_F}\right)^{2/3}$$

$$\left(\frac{A_F}{A}\right)^{5/3} = \left(\frac{1.25bd + 1.25^2 z d^2}{bd + zd^2}\right)^{5/3} = 1.25^{5/3}\left(\frac{b + 1.25zd}{b + zd}\right)$$

$$\left(\frac{P}{P_1}\right)^{2/3} = \left(\frac{b + 2\sqrt{1+z^2}\,d}{b + 2.50\sqrt{1+z^2}\,d}\right)^{2/3}$$

$$Q_F = Q\ 1.45\left(\frac{b+1.25zd}{b+zd}\right)^{5/3}\left(\frac{b+2\sqrt{1+z^2}\,d}{b+2.5d\sqrt{1+z^2}}\right)^{2/3}$$

If $b = c'd$

$$Q_F = 1.45Q\left(\frac{c'+1.25z}{c'+z}\right)^{5/3}\left(\frac{c'+2\sqrt{1+z^2}}{c'+2.5\sqrt{1+z^2}}\right)^{2/3}$$

$$Q_F = KQ$$

$$\text{Where } K = 1.45\left(\frac{c'+1.25z}{c'+z}\right)^{5/3}\left(\frac{c'+2\sqrt{1+z^2}}{c'+2.5\sqrt{1+z^2}}\right)^{2/3}$$

COMPUTATION SHEET
SCS-523A REV 5-59

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT | JOB NO C

BY Watt | DATE | CHECKED BY | DATE

SUBJECT

SHEET ___ OF ___

For Lower Section

$Q_F = 1210 \times 1.67 = 2020$

$Cd^{8/3} = \frac{Qn}{1.486 S^{1/2}} = \frac{2020 \times .014}{1.486 \times .06083} = 312.85$

$d^{8/3} = \frac{312.85}{1.334} = 234.5 \qquad d = 7.74$

$b = .605 \times 7.74 = 4.68'$

Perimiter $= 4.68 + 2 \times 1.8 \times 7.74$

$= 32.5$ perimeter for Min Sec

$6.75 \times 3.6 + 8 = 32.30$ perimeter Used

This is less because the Q_F is a little less.

For Upper Section

$Q_F = 1.67 \times 600 = 1000 \qquad S = .006$

$D^{8/3} = \frac{1}{1.334} \times \frac{1000 \times .014}{1.486 \times .07746} = 91.1$

$D = 5.43 \qquad b = .605 \times 5.43 = 3.29$

$P = 22.84$ For Most Ec.

Used $4.64 = d \qquad b = 6$

$P = 22.70$ OK

COMPUTATION SHEET

SCS-523A REV 5-60

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

GPO 858 0 - 497927

STATE | PROJECT

BY | DATE | CHECKED BY | DATE | JOB NO.

SUBJECT | SHEET | OF

(1) Z	(2) $\sqrt{1+Z^2}$	(3) $\left(\frac{C'+1.25Z}{C'+Z}\right)$	(4) $(3)^{5/3}$	(5) $\frac{C'+2\sqrt{1+Z^2}}{C'+2.5\sqrt{1+Z^2}}$	(6 $5^{2/3}$	K
1	1.414	1.137	1.239	.838	.889	1.60
1.25	1.60	1.160	1.281	.830	.883	1.64
1.5	1.80	1.178	1.314	.824	.879	1.67
1.75	2.02 (.531)	1.192	1.340	.819	.875	1.70
2.0	2.24 (.472)	1.202	1.359	.816	.873	1.72
2.5	2.69 (.385)	1.217	1.387	.810	.869	1.75

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE | PROJECT

BY | DATE | CHECKED BY | DATE | JOB NO.

SUBJECT | SHEET OF

Check of System

$Q = 600 \quad S = .006 \quad n = .014 \quad Z = 1\frac{1}{2}$

$b = 3.29$

$K' = \frac{600 \times .014}{23.9 \times .07746} = 4.53$

$D/b = 1.32 \quad Q = 3.29 \times 1.32 = 4.34$

$.25q = 1.09$

Total 5.43 Check

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Channel
BY Watt | DATE 4-23-65 | CHECKED BY | DATE | JOB NO.
SUBJECT Hydrology of Inlets For individual inlet capacity. | SHEET ___ OF ___

Area 1 = 1.05"² Length = 2" × 2640 =
168 ac 5280

Sta. 89±

T_c @ 3'/sec = .5 hr $T_p = T_c^{1/2} + .6T_c = 1.0$ hr Curve No 80

	30m P	Runoff in	Runoff Peak CFS
50yr	1.9	.49	62 ←
25yr	1.7	.38	48

Area 2 = 1.75"² Length 4" = 10560 Curve No 80
280 Ac

Sta 215±

T_c = 1.0 hr T_p = 1.6 hr $q = \frac{484\ AQ}{T_p \times 640} = \frac{756\ AQ}{T_p}$

	P in 1 hr		
50yr	2.4	.81	108 ←
25yr	2.1	.61	81

Area 3 = 1.07"² Length 2¼" = 5940 Curve No 80
171 ac

T_c = 0.5 hr T_p = 1.0 hr

	30' P	Runoff in	
50yr	1.9	.49	63 ←
25yr	1.7	.38	49

Area 4 = 2.97"² Length = 6" = 15840 Curve No 80
475

Sta @ 261

T_c = 1.5 hr T_p = 2.1 hr

	P/1.5 hr	Runoff in	
50yr	2.7	1.02	175 CFS ←
25yr	2.4	0.81	140 CFS

C

Arizona
Watt 4-23-65
Capacity Conc. Channel Revised

Discharge From Powerline Dam	188 CFS
" " Vineyard Rd	358
Total	546
Emg Sp Area	54 C.F.S.
At 15+00 ±	600 CFS
Inlet @ Sta 89+00	62
Sub Total	662
Inlets @ 215	108
	63
Sub total	833 850
Inlet @ 260	175
Sub total	1008

From Previous Hydrology @
Elsworth Rd ± use 1200 C.F.S.

Water may be diverted to channel at later date

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Channel C
BY Watt | DATE | CHECKED BY | DATE | JOB NO.

SUBJECT Capacity of pipes for inlets | SHEET | OF

Pipe Size 0.5' Vel head = $V = \sqrt{2gh}$ = $V = 8.02\sqrt{.5}$

$V = 5.67$

Pipe	Area	Q h=.5	Q h=1.0
36	7.07	40	57
42	9.62	55	77
48	12.57	71	101
54	15.90	90	127
60	19.63	111	157

wier

Pipe Inlets are not big Enough

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO 1954 O—497927

STATE Arizona | PROJECT Powerline Channel U
BY Watt | DATE 4-29-65 | CHECKED BY | DATE | JOB NO
SUBJECT Inlet @ 89+00 | SHEET | OF

$Q_1 = 600$ $S_1 = .00538$ $V_1 = 13.43$ $h_{v_1} = 2.80$ $d_1 = 3.82$

$Q_2 = 60$ $V = 0$

$Q_3 = 660$ $S = .00592$ $V = 14.3$ $h_{v_3} = 3.12$ $d = 3.90$

$$h_1 - h_3 = \frac{660 \times 3.12 - 2.80 \times 600}{600} + \left(h_f = \frac{.554 + .60}{2} \times 20\right)$$

$$= .57 + .10 = .67$$

Total drop in grade $= .67 + 3.90 - 3.82 = \underline{0.75}$

If we use same velocity for V_3 as V_1 & let flow accelerate after inlet

$d_3 = 4.08$

$$h_1 - h_3 = \frac{60 \times 2.80}{660} + .11 = 0.36$$

Drop in grade $= .36 + 4.08 - 3.82 = \underline{0.62}$

Use 0.7' Drop

Make Channel 5'6" deep for 50' below inlet.

Length of Weir $\frac{60}{3.3} = 20'$ I

Make 20'

If $Q = 500$ CFS $d_1 = 3.48$

Make Crest of inlet 3.5 from btm @ 89+60

COMPUTATION SHEET

SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

GPO 1958 O - 497927

STATE Arizona | PROJECT Powerline Channel

BY Watt | DATE 4-30-65 | CHECKED BY | DATE | JOB NO. C

SUBJECT Inlet @ 89+00 | SHEET | OF

Length Weir = 20'

$S_1 = .00538$ $Q_1 = 600$ $V_1 = 13.43$ $h_{v_1} = 2.80$ $d_1 = 3.82$ $A = 44.81$

$S_2 = .00538$ $Q_2 = 660$ $V_2 = 13.43$ $h_{v_2} = 2.80$ $d_2 = 4.08$ $A = 49.45$

$Q_3 = 60$ $V_3 = V_c = 4.62$ @ 45° L

$M_1 = \frac{600 \times 13.43}{32.2} = 250.25$ $M_2 = \frac{660 \times 13.43}{32.2} = 275.27$ $M_3 = \frac{60 \times 4.62 \times .707}{32.2} = 6.09$

$P_1 = \frac{3.82^2}{6}(3 \times 6 + 3 \times 3.82) = 71.65$

$P_2 = \frac{4.08^2}{6}(3 \times 6 + 3 \times 4.08) = 83.90$

$P_f = h\,6\left(\frac{3.82}{2} + \frac{.26 \times 18}{36}\right) = 23.64\,h$

$P_w = \frac{3.82 + 4.08}{4}\left[6 \times .26 + (h - .26)\,1.5\,(3.82 + 4.08) + 49.45 - 44.81\right]$ (3.08)

$1.98\,(+11.85h + 3.12)$

$23.40h + 6.16$

$P_f = \frac{20 \times .00538}{2}(49.45 + 44.81) = 5.07$

$275.27 + 83.90 = 250.25 + 71.65 + 6.16 - 5.07 + 23.40h + 23.64h + 6.09$

$47.04h = 30.09$

$h = .64$ OK

COMPUTATION SHEET
SCS-523A REV 5-56

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Channel C

BY Watt | DATE 4-23-65 | CHECKED BY | DATE | JOB NO.

SUBJECT Inlets at 215±

SHEET ___ OF ___

Q = 108 CFS — N Side

Length = 108/3.3 = 32.7 ft — Call 35 — for 1' on wick

Q = 63 CFS — S Side

Length = 63/3.3 = 19.09

Call 20

Total Inlet Q = 108 + 63 = 171

Length of water = 108/3.3 = 32.7 Call 35'

$Q_1 = 660$ $S_1 = .0056$ $V_1 = 13.9$ $d_1 = 3.96$ $h_{v_1} = 3.01$

$Q_2 = 171$ $V_2 = 0$

$Q_3 = 830$ $S = .0035$ $V_3 = 12.4$ $d_3 = 4.6$ $h_{v_3} = 2.4$

$$h_1 - h_3 = \frac{830 \times 2.4 - 660 \times 3.01}{830} + (h_f = .16) = 0.17$$

\+ 4.60

\− 3.96

0.81 ft

$h_f = .2(h_{v_2} - h_{v_3})$

$= .2(3.01 - 2.4)$

$= .2(.61)$

$= .12$

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Channel
BY Watt | DATE 4-28-64 | CHECKED BY | DATE | JOB NO.
SUBJECT Inlet at 215± | SHEET | OF

If we put water in at 45°

$V_{3_1} = V_c =$ $\quad Q/ft = \frac{108}{35} = 3.08\ CFS/ft \quad d_c = .66 \quad V_c = 4.67$

$V_3 \cos 45° = 4.67 \times .707 = 3.32$

$V_{3_2} = \frac{63}{35} = 1.80\ CFS/ft \quad d_c = .46 \quad V_c = 3.91$

$3.91 \cos\theta = 3.91 \times .707 = 2.76$

$M_3 = \frac{108 \times 3.32}{g} + \frac{63 \times 2.76}{g} = 16.53$

$133.31 + 319.62 = 16.53 + 78.09 + 284.91 + 30.1h + 27.48h + 18.32 - 9.22$

$57.58h = 64.30$

$h = 1.12$

Make Drop 1.1 feet

COMPUTATION SHEET

SCS-533A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO 1957 O-497927

STATE Arizona | PROJECT Powerline Channel

BY Watt | DATE 4-28-64 | CHECKED BY | DATE | JOB NO. ✓

SUBJECT Drop in grade for inlets @ 215±

SHEET | OF

By Momentum Equation:-

$b_1 = 6'$ $5.5:1 = 1\frac{1}{2}:1$ $d = 3.96$ $V_1 = 13.9$ $Q_1 = 660$

$b_2 = 8'$ $5:5 = 1\frac{1}{2}:1$ $d = 4.60$ $V = 12.4$ $Q = 830$

Q_3 at right is effective V_3 Momentum $= 0$

$$M_1 = \frac{660 \times 13.9}{g} = 284.91 \qquad M_2 = \frac{830 \times 12.4}{g} = 319.62$$

$$M_3 = 0$$

$$P_1 = \frac{D_1^2}{6}(3b_1 + 2zD_1) = \frac{3.96^2}{6}(3\times 6 + 3\times 3.96) = 78.09 \checkmark$$

$$P_2 = \frac{D_2^2}{6}(3b_2 + 2zD_1) = \frac{4.60^2}{6}(3\times 8 + 3\times 4.60) = 133.31 \checkmark$$

$$P_i = h\left(\frac{6+8}{2}\right)\left(3.96 + \frac{(4.60-3.96)(6+2\times 8)}{3(6+8)}\right) = 30.1\,h \checkmark$$

(.64)

$$P_w = \frac{3.96+4.60}{4}\left[\frac{6+8}{2}(3.96-4.60) + (h-.64)1.5(4.60+3.96) - (6+1.5\times 3.96)3.96 + (8+1.5\times 4.6)4.6\right]$$

$$= 2.14\,(-4.48 + 12.84\,h - 8.22 + 68.54 - 47.28)$$

$$P_w = 27.48h + 18.32$$

$$P_f = \frac{35(.0035+.0056)}{4}(68.54+47.28) = 9.22$$

$$133.31 + 319.62 = 78.09 + 284.91 + 0 + 30.1\,h + 27.48h + 18.32 - 9.22$$

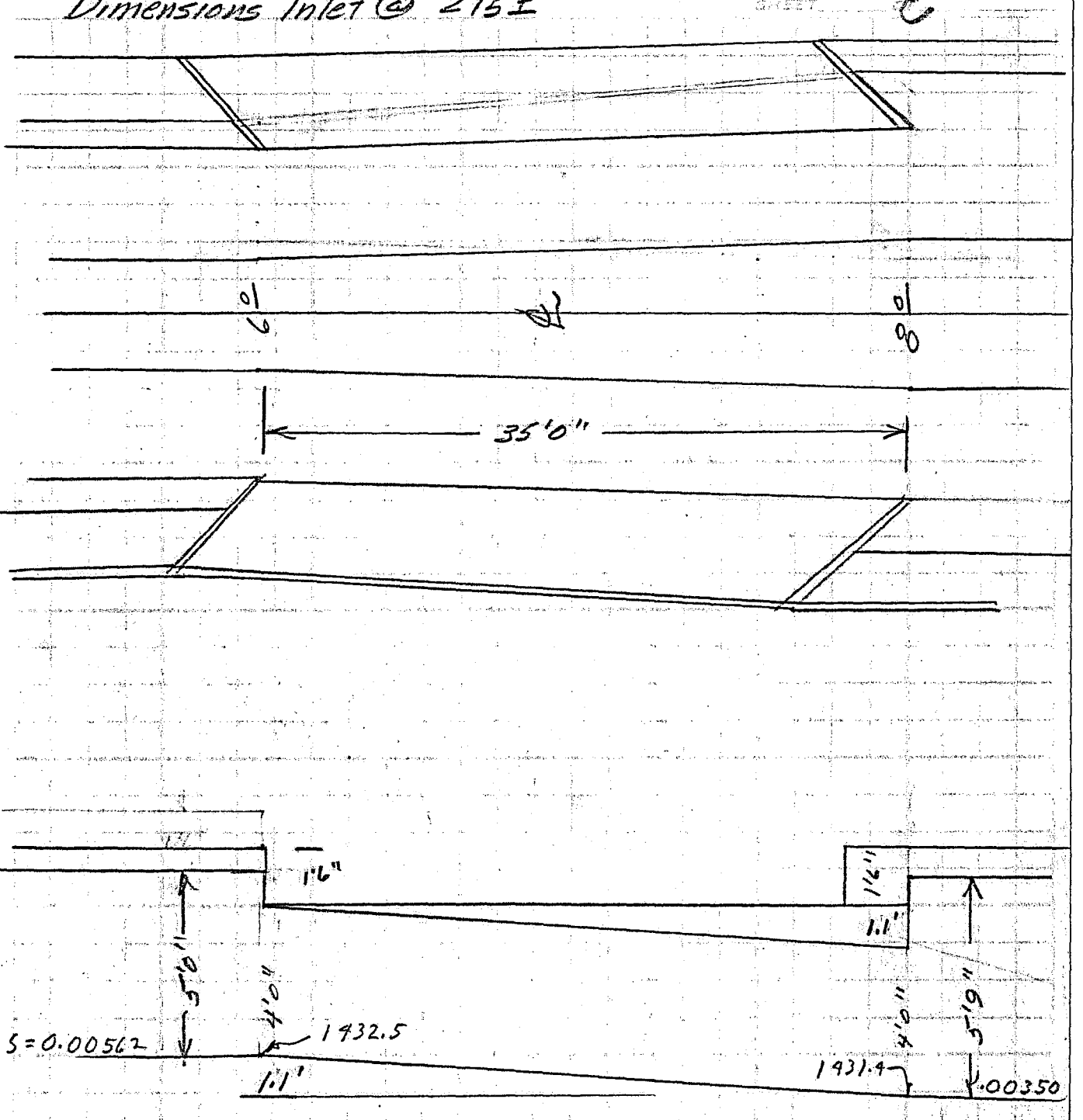
$$57.58h = 80.83$$

$h = 1.40$ ... against 0.81 By energy

Arizona — Powerline Channel

Watt 6-1-65

Dimensions Inlet @ 215±



Both Sides Same

COMPUTATION SHEET

SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

GPO 1958 O—497922

STATE Arizona | PROJECT

BY Watt | DATE 4-28-64 | CHECKED BY | DATE | JOB NO. 3

SUBJECT Inlet @ 261 Required drop in grade | SHEET | OF

$Q = 175$ CFS Length of weir $= \frac{175}{3.3} = 53$ ft

Make 60' long

Q_1 850 $V_1 = 12.4$ $h_{v_1} = 2.4$ $d_1 = 4.60$

Q_2 175 $V_2 = 0$

$Q_3 = 1025$ $V_3 = 13.15$ $h_{v_3} = 2.69$ $d_3 = 5.17$

$$h_1 - h_3 = \frac{1025 \times 2.69 - 850 \times 2.4}{1025} + \left(h_c = \frac{.35}{2}\right) = 0.87$$

0.87

\+ 5.17

− 4.60

Required drop in grade Total = 1.44 feet

COMPUTATION SHEET
SCS-523A REV 5-50

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Laveen Channel

BY Watt | DATE 4-23-65 | CHECKED BY | DATE | JOB NO. C

SUBJECT Grade Determination | SHEET | OF

Sta	Grade	Elev	Q	D	B	t	Use
12+10		1558.7					
			600	4.67	L	4½	4'9"
45+00	.00588	1539.28					
50+00		1536.4					
	.00746		600	4.4'	L	4½	4'9"
76+00		1517.0					
85+00	.00538	1512.15	600	4.77	L	4½	4'9"
89+00		1510					
			Inlet	Detail	L	4½	
89+20		1509.3					
	.005843		660	4.89	L	4½	5'0"
113+00		1495.40					
125+00	.005843	1488.38	660	4.89	L	4½	
132+50		1484.0					
	.00774		660	4.6	L	4½	
148		1472					
165		1461.87					
	.00596		660	4.86	L	4½	
195		1444					
205	0.005552	1438.45	660	4.93	L	4½	5.05 ground cover
215+~~43~~ 71 Bk.							
215+00 Fwd		1432.5					
			Inlet			4½	
215+35		1431.4					

3250
1080
4330

COMPUTATION SHEET
SCS-523A REV 5-56

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Channel
BY Watt | DATE 4-28-65 | CHECKED BY | DATE | JOB NO C
SUBJECT Grade Determination | SHEET | OF

Sta	Grade	Elev	Q	D	b	t	USE D
215+35		1431.40					
245+00	.00350	1421.00	850	5.75	8	5"	5'9"
261+00		1415.40					
			Inlet				
261+60		1413.9					
	.00385		1025	6.25	8	5"	6'3"
276+00		1408.36					
285	.00605	1402.92	1025	5.62	8	5"	
308+00		1389.00					
325+00	.00560	1379.48	1200	6.10	8	5"	6'3"
333+00		1375.00					

COMPUTATION SHEET

SCS-SBSA NEV 6-58

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Channel

BY Watt DATE 3-21-66 CHECKED BY DATE JOB NO.

SUBJECT Elev - Grade SHEET C OF

Sta	Grade	Elev	Q	D	b	Use D
333+00		1375.00				
			1210	6.42	8.0	6'6"
365+00	.00450	1360.60				
373+00		1357.00				
	SAF					
373+42		1354.00				
	.00414		3140	6.9	8.0	7'6"
400+00		1343.00				
405		1341.49				
	.00305		3140	7.45	6.0	7'6"
445		1329.28				
465+50		1323.00				

COMPUTATION SHEET
SCS-522A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Channel
BY Watt DATE 2-3-65 CHECKED BY DATE JOB NO
SUBJECT Outlet Channel SHEET OF

Powerline Dam 188 C.F.S.
Vineyard 358 ←
Total 546
Uncontrolled Area 54 Emg Sp Area ✓
Total 600 CFS

Weir at Transition
$b = 20$ $SS = 1\frac{1}{2}:1$ $d_c = 2.82$ $Q = 600$
$n = .035$
for $(l-0)n^2 = 25 \times .035^2 = .031$ $U = 2.7 \times 10^{-4}$
$\frac{Q^2}{2g} \times U = \frac{600^2}{64.4} \times \frac{2.7}{10000} = 1.51'$ $d_c + U = 0 = 2.82 + 1.51$
$= 4.33$

Channel $b = 50$ $SS = 2:1$ $n = .035$

0+00	2.82 = d_c
0+25	4.23
0+50	
1+00	4.28
2+00	4.34
4+00	4.42

Arizona Powerline Channel C

Watt 5-13-65

Approx Dimensions Earth Channel From Inlet to Concreted Channel

For $d = 3' \pm$ For 600 CFS

Width of weir = $\frac{600}{17} = 35' \pm$

Channel width $A = \frac{600}{2.5} = 240'$

$b = \frac{240 - 2 \times 3^2}{3} = 73'$ wide

Try 4' deep $Q = 600$ CFS

$L = \frac{600}{27} = 22'$

Channel = Area = $\frac{600}{2.5} = 240$

$b = \frac{240 - 2 \times 4^2}{4} = 52'$

50' wide Channel 4' deep

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Dam
BY Watt | DATE | CHECKED BY | DATE | JOB NO.
SUBJECT Approx Width Transition Wier. | SHEET | OF

Depth of flow at Transition

d_c = 2.82
+ 1.41
Total 4.23 feet

If we use 30' Transition

Q = 600 $\quad Q/b$ = 20

d_c = 2.24
1.12
Total 3.36 Better

For 190 CFS @ 2.0'/sec (Power line Dam Prim Sp)

$A = \frac{190}{2.0} = 95$ Sq ft

$3.36 \times b + 2 \times 3.36^2 = 95$

$b = \frac{95 - 2 \times 3.36^2}{3.36} = 21.5$ feet

Call 24'

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Outlet Channel
BY | DATE | CHECKED BY | DATE | JOB NO.

SUBJECT Hydraulics of Channel from dam to Sta 15+00 SHEET ___ OF ___

For Channel 50' wide Wier Crest 30' wide
500' Earth channel with rock rip rap
sides $Q = 600$ $S = 0.00$ $n = 0.035$
Side Slopes = 2:1

Wier Crest 30' S.S. = 1½:1
For $Q = 600$' $d_c = 2.23$ U_1 for $b_1 - b = 25$'
$n^2(50) = .61$ $n^2(100) = 1.22$ $n^2(25) = .031$
$U_1 = 2.14 \times 10^{-4}$

D for $U = 0 = 2.23 + 2.14 \times 10^{-4} \times \frac{600^2}{25} = 3.43$

Sta	depth	A	V
Wier = 0+00	$d_c = 2.23$		
0+25	3.28'	185.5	3.23
0+50	3.30	186.8	3.21
1+00	3.38'	191.8	3.17
2+00	3.50	199.5	3.01
5+00	3.78'	217.6	2.75
6+00	3.83'	220.6	2.71

From 6+00 to 8+50 $Q = 190$
Channel $b = 24'$ S.S. = 2:1 $n = .035$ $S = 0.00$

Sta	D	A	V
6+00	3.83	121.2	1.57
8+00	3.88	123.2	
9+00	3.90	124.0	1.53

COMPUTATION SHEET

SCS-CB3A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Power line Channel

BY Watt | DATE | CHECKED BY | DATE | JOB NO.

SUBJECT Width for Vineyard Road Outlet Channel for Inlet Design. | SHEET | OF

Earth Channel from Vineyard Rd Dam

$Q = 360$ CFS $V = 2'/sec \pm$

$$A = \frac{360}{2} = 180 \text{ Sq ft}$$

$$b \times 3.4 + 3.4^2 \times 2 = 180$$

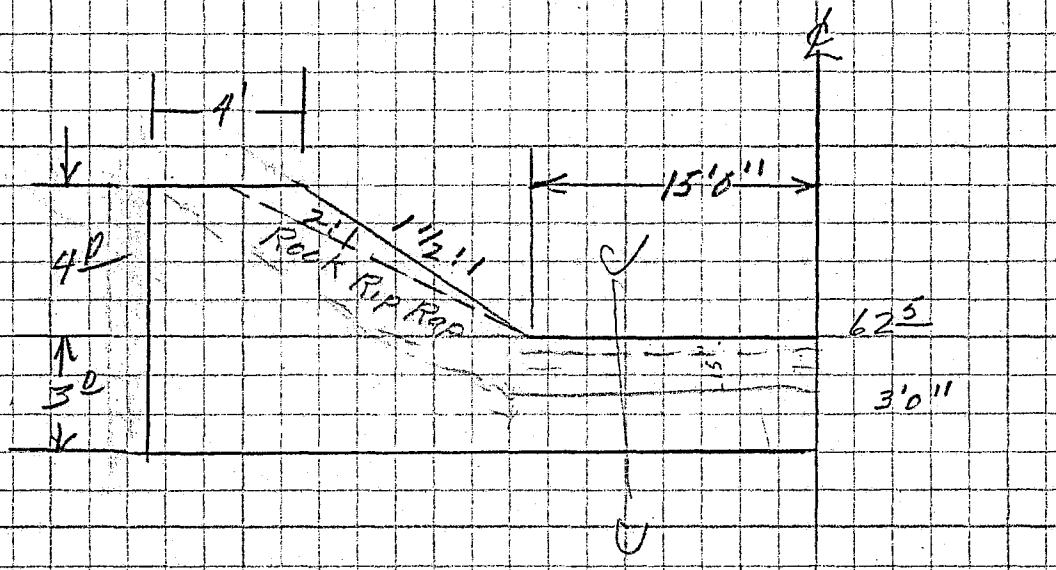
$$b = \frac{-2 \times 3.4^2 + 180}{3.4} = 46.14$$

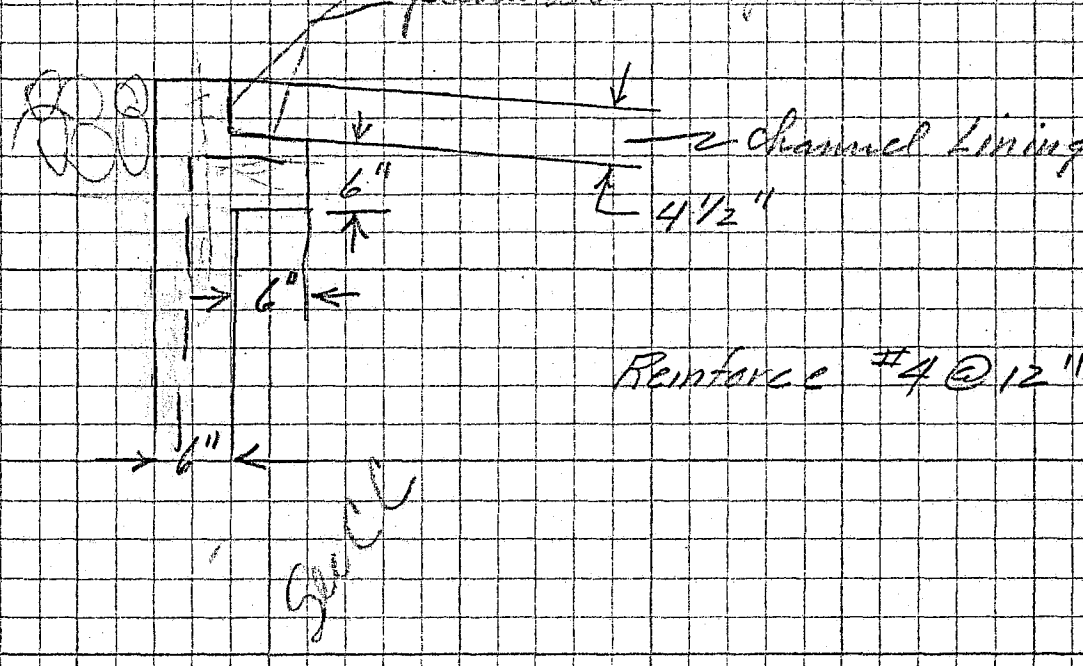
Call 50'

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO 1958 O—497927

STATE Arizona | PROJECT Powerline Channel
BY Watt | DATE | CHECKED BY | DATE | JOB NO. C
SUBJECT Inlet Transition Headwall | SHEET | OF





COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO 1959 O—497852

STATE Arizona | PROJECT Powerline Channel
BY PMW | DATE 3-12-65 | CHECKED BY | DATE | JOB NO C
SUBJECT Transition @ ~~45+00±~~ 11+50 | SHEET 1 OF

Flow in channel
$b = 6.0$ $d_1 = 3.64'$ $V_1 = 14.4$ ′/sec $S = 0.00645$
$SS. = 1\frac{1}{2}:1$ $h_v = 3.22'$

Flow over wier $b = 30$ $SS = 1\frac{1}{2}:1$

$Q = 600$ $dc = 2.24$ 3.36

$\frac{Q}{b} = \frac{600}{30} = 20$ 67 7.5²

$A = 30(2.24) + 1.5(2.24)^2 = 74.72$

$V_c = \frac{600}{74.72} = 8.02$ ′/sec $h_v = 1.00$

Crest of Wier	= 62.00	
dc	= 2.24	
Elev. W.S. @ Wier	= 64.24	
+ Vel. head d_c	= 1.00	
− Vel. head Channel	= −3.22	
− Est. Friction loss	= −0.20	— use higher value
W.S. in Channel	= 61.82	
Depth of flow in Channel	= 3.64	
Bottom of Channel	= 58.18	

Length of Transition

$\frac{30-6}{2 \times \tan 12°} = 56.5$ Call 60'

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Channel C
BY PMW | DATE 3-12-65 | CHECKED BY | DATE | JOB NO
SUBJECT Transition @ 15+00 ± | SHEET 3 OF

From 0 to 0+05

Available head = 62.0 + 2.24 − 61.68 − 2.36 = 0.20'
assume h_f = 0.015 Δh_v = 0.185

@ 0+05: h_v = 1.00 + 0.19 = 1.19

$V = (1.19 \times 64.3)^{1/2} = 8.75$ '/sec (76.517)

$A = \frac{60.0}{8.75} = 68.6$ ft² (8.57)

$b = \frac{68.6 - 1.5(2.36)^2}{2.36} = 25.53'$ ← Ans.

$R_0 = \frac{7.4.7.2}{30 + 3.6(2.24)} = 1.96$ (8.06)

$R_5 = \frac{68.6}{25.53 + 3.6(2.36)} = 2.01$ (8.5)

V_0 = 8.02 '/sec
n = 0.014
$S_0 = 0.185\,(.014 \times 8.02)^2 = 0.00233$

V_5 = 8.75
n = 0.014
$S_5 = 0.179\,(.014 \times 8.75)^2 = 0.00268$

$h_f = \left(\frac{.00233 + 0.00268}{2}\right) 5 = 0.0125$

From 0+05 to 0+10

Available head = 61.68 + 2.36 − 61.36 − 2.48 = 0.20'
assume h_f = 0.015 Δh_v = 0.185

@ 0+10: h_v = 1.19 + 0.18 = 1.37

$V = (1.37 \times 64.3)^{1/2} = 9.38$ '/sec (8.8)

$A = \frac{60.0}{9.38} = 64.$ ft² (9.22)

$b = \frac{64 - 1.5(2.48)^2}{2.48} = 22.1'$ ← Ans.

$R_{10} = \frac{64.0}{22.1 + 3.6(2.48)} = 2.06$ (8.93)

V_{10} = 9.38 '/sec

n = 0.014

$S_{10} = 0.173\,(0.014 \times 9.38)^2 = 0.00298$

$h_f = \left(\frac{0.00298 + 0.00268}{2}\right) 5 = 0.014$ ok.

COMPUTATION SHEET
SCS-S23A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Channel | JOB NO. C

BY PMW | DATE 3-12-65 | CHECKED BY | DATE

SUBJECT Transition @ 15+00 ±

SHEET 4 OF

From 0+10 to 0+15

Available head = 61.36 + 2.48 − 61.05 − 2.59 = 0.20'
assume $h_f = 0.016$ $\Delta h_v = 0.184$

@ 0+15: $h_v = 1.37 + 0.18 = 1.55$

$V = (1.55 \times 64.3)^{\frac{1}{2}} = 9.98$ '/sec

$A = \frac{600}{9.98} = 60.2$ ft²

$b = \frac{60.2 - 1.5\overset{9.65}{(2.59)}^2}{2.59} = 19.5'$ ← Ans.

$R_{15} = \frac{60.2}{19.5 + 3.6\underset{9.31}{(2.59)}} = 2.09$

$V_{15} = 9.98$
$n = 0.014$
$S_{15} = 0.169\,(0.014 \times 9.98)^2 = 0.00331$

$h_f = \left(\frac{0.00298 + 0.00331}{2}\right) 5 = 0.0157$ say 0.016 O.K.

From 0+15 to 0+20

Available head = 61.05 + 2.59 − 60.73 − 2.71 = 0.20'
assume $h_f = 0.018$ $\Delta h_v = 0.182$

@ 0+20: $h_v = 1.55 + 0.18 = 1.73$

$V = (1.73 \times 64.3)^{\frac{1}{2}} = 10.52$ '/sec

$A = \frac{600}{10.52} = 57.0$ ft²

$b = \frac{57.0 - 1.5\overset{11.0}{(2.71)}^2}{2.71} = 17.00'$ ← Ans.

$R_{20} = \frac{57.0}{17.00 + 3.6\underset{9.75}{(2.71)}} = 2.13$

$V_{20} = 10.52$
$n = 0.014$
$S_{20} = 0.165\,(0.014 \times 10.52)^2 = 0.00359$

$h_f = \frac{(0.00359 + 0.00331)}{2} 5 = 0.0172$ O.K.

COMPUTATION SHEET
SCS-533A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Channel
BY PMW | DATE 3-15-65 | CHECKED BY | DATE | JOB NO 6
SUBJECT Transition @ 15+00 ± | SHEET 5 OF

From 0+20 to 0+25

Available head = 60.73 + 2.71 − 60.41 − 2.83 = 0.20'
assume h_f = 0.019 Δh_v = 0.181

@ 0+25: h_v = 1.73 + 0.18 = 1.91

$V = (1.91 \times 64.3)^{1/2} = 11.08$ ft/sec

$A = \frac{600}{11.08} = 54.2$ ft²

$b = \frac{54.2 - 1.5(2.83)^2}{2.83} = 14.92'$ ← Ans.
(12.0)

$R_{25} = \frac{54.2}{14.92 + 3.6(2.83)} = 2.16$
(10.2)

$V_{25} = 11.08$
$n = 0.014$
$S_{25} = 0.162\,(0.014 \times 11.08)^2 = 0.00389$

$h_f = \left(\frac{0.00389 + 0.00359}{2}\right) 5 = 0.0187$ o.k.

From 0+25 to 0+30

Available head = 60.41 + 2.83 − 60.09 − 2.94 = 0.21'
assume h_f = 0.021 Δh_v = 0.189

@ 0+30: h_v = 1.91 + 0.19 = 2.10

$V = (2.10 \times 64.3)^{1/2} = 11.6$ ft/sec

$A = \frac{600}{11.6} = 51.7$ ft²

$b = \frac{51.7 - 1.5(2.94)^2}{2.94} = 13.15'$ ← Ans.
(13.0)

$R_{30} = \frac{51.7}{13.15 + 3.6(2.94)} = 2.18$
(10.6)

$V_{30} = 11.6$ ft/sec
$n = 0.014$
$S_{30} = 0.160\,(0.014 \times 11.6)^2 = 0.00422$

$h_f = \left(\frac{0.00422 + 0.00389}{2}\right) 5 = 0.0203$ OK.

COMPUTATION SHEET
SCS-533A REV 5-56

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO 1959 O—487227

STATE Arizona | PROJECT Power line Channel C
BY PMW | DATE 3-15-65 | CHECKED BY | DATE | JOB NO.
SUBJECT Transition @ 15+00 ± | SHEET 6 OF

From 0+30 to 0+35

Available head = 60.09 + 2.94 − 59.77 − 3.06 = 0.20'
assume h_f = 0.022 Δh_v = 0.178

@ 0+35: h_v = 2.10 + 0.18 = 2.28

$V = (2.28 \times 64.3)^{1/2} = 12.09$ '/sec

$A = \frac{600}{12.09} = 49.6$ ft^2 (14.03)

$b = \frac{49.6 - 1.5(3.06)^2}{3.06} = 11.6'$ ← Ans

$R_{35} = \frac{49.6}{11.6 + 3.6(3.06)} = 2.19$ (11)

V_{35} = 12.09 '/sec
n = 0.014
$S_{35} = 0.159(0.014 \times 12.09)^2 = 0.00455$
$h_f = \left(\frac{0.00455 + 0.00422}{2}\right) 5 = 0.022$ o.k.

From 0+35 to 0+40

Available head = 59.77 + 3.06 − 59.46 − 3.17 = 0.20'
assume h_f = 0.024 Δh_v = 0.176

@ 0+40: h_v = 2.28 + 0.18 = 2.46

$V = (2.46 \times 64.3)^{1/2} = 12.56$ '/sec

$A = \frac{600}{12.56} = 47.8$ ft^2

$b = \frac{47.8 - 1.5(3.17)^2}{3.17} = 10.32'$ (15.1) ← Ans.

$R_{40} = \frac{47.8}{10.32 + 3.6(3.17)} = 2.20$ (11.42)

V_{40} = 12.56 '/sec
n = 0.014
$S_{40} = 0.158(0.014 \times 12.56)^2 = 0.00487$

$h_f = \left(\frac{0.00487 + 0.00455}{2}\right) 5 = 0.0236$ o.k.

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE: Arizona | PROJECT: Powerline Channel
BY: PMW | DATE: 3-15-65 | CHECKED BY: | DATE: | JOB NO. C
SUBJECT: Transition @ 15+00 ± | SHEET 7 OF

From 0+40 to 0+45

Available head = 59.46 + 3.17 − 59.14 − 3.29 = 0.20'
assume $h_f = 0.026$ $\Delta h_v = 0.174$

@ 0+45: $h_v = 2.46 + 0.17 = 2.63$

$V = (2.63 \times 64.3)^{1/2} = 13.0$ '/sec

$A = \frac{6.00}{13.0} = 46.1$ ft² (14.25)

$b = \frac{46.1 - 1.5(3.29)^2}{3.29} = 9.08'$ ← Ans. (11.84)

$R_{45} = \frac{46.1}{9.08 + 3.6(3.29)} = 2.20$

$V_{45} = 13.0$ '/sec.
$n = 0.014$
$S_{45} = 0.158\ (0.014 \times 13.0)^2 = 0.00523$
$h_f = \left(\frac{0.00523 + 0.00487}{2}\right) 5 = 0.0252$

From 0+45 to 0+50

Available head = 59.14 + 3.29 − 58.82 − 3.41 = 0.20'
assume $h_f = 0.027$ $\Delta h_v = 0.173$

@ 0+50: $h_v = 2.63 + 0.17 = 2.80$

$V = (2.80 \times 64.3)^{1/2} = 13.4$ '/sec

$A = \frac{6.00}{13.4} = 44.8$ ft²

$b = \frac{44.8 - 1.5(3.41)^2}{3.41} = 8.0'$ ← Ans. (17.44)

$R_{50} = \frac{44.8}{8.0 + 3.6(3.41)} = 2.21$ (12.29)

$V_{50} = 13.4$ '/sec
$n = 0.014$
$S_{50} = 0.157(0.014 \times 13.4)^2 = 0.00553$
$h_f = \left(\frac{0.00553 + 0.00523}{2}\right) 5 = 0.0269$ ok.

COMPUTATION SHEET
SCS-523A REV 5-56

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO 1959 O—497927

STATE Arizona | PROJECT Powerline Channel
BY PMW | DATE 3-15-65 | CHECKED BY | DATE | JOB NO. C
SUBJECT Transition @ 15+00± | SHEET 8 OF

From 0+50 to 0+55

Available head = 58.82 + 3.41 − 58.50 − 3.53 = 0.20'
assume h_f = 0.029 Δh_v = 0.171

@ 0+55: h_v = 2.80 + 0.17 = 2.97

$V = (2.97 \times 64.3)^{1/2} = 13.8$ '/sec

$A = \frac{600}{13.8} = \frac{43.5}{15.7}$ sf

$b = \frac{43.5 - 1.5(3.53)^2}{3.53} = 7.02'$ ← Ans.

$R_{55} = \frac{43.5}{7.02 + 3.6(3.53)} = \frac{43.5}{13.72} = 2.20$

V_{55} = 13.8'/sec
n = 0.014
$S_{55} = 0.158\,(0.014 \times 13.8)^2 = 0.00590$

$h_f = 0.00571\,(5) = 0.0286$

From 0+55 to 0+60

$h_f = \left(\frac{.00590 + .00643}{2}\right) 5 = 0.031$

Vel. head = 3.22 − 2.97 = 0.25
(0.281)

Available = 0.21

Sta.	b	
0	30.0	30'-0"
5	25.53	25'-6"
10	22.1	22'-1"
15	19.5	19'-6"
20	17.0	17'-0"
25	14.92	14'-11"
30	13.15	13'-2"
35	11.6	11'-7"
40	10.32	10'-4"
45	9.08	9'-1"
50	8.0	8'-0"
55	7.02	7'-0"
60	6.0	6'-0"

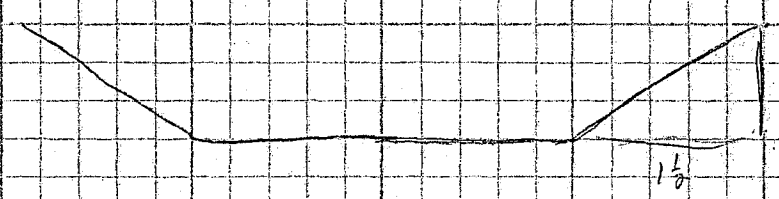
COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona
BY D.H.H.
DATE 5-2-65
SUBJECT

PROJECT Powerline Channel
CHECKED BY
DATE
JOB NO.
SHEET OF

Sta.	Bottom Width	Bottom Elev.	Top Width	Top El.	Height		
11+50	30'	62.5	42	66.5	4	4	6
11+55	25'-6"	62.18	37.6875	66.24	.0625	4' 3/4"	6.09375
11+60	22'-1"	61.86	34.4583	65.99	.1250	4' 1 1/2"	6.1875
11+65	19'-6"	61.55	32.0625	65.74	.1875	2 1/4	6.28125
11+70	17-0	61.23	29.75	65.48	.25	3"	6.375
11+75	14-11	60.91	27.8542	65.22	.3125	3 3/4	6.46875
11+80	13-2	60.59	26.2917	64.97	.375	4 1/2	6.5625
11+85	11-7	60.27	24.8958	64.71	.4375	5 1/4	6.65625
11+90	10-4	59.96	23.833	64.46	.500	6"	6.75
11+95	9-1	59.64	22.7708 9 1/4	64.20	.5625	6 3/4	6.84375
12+00	8-0	59.32	21.875 10 1/2	63.95	.625	7 1/2	6.9375
12+05	7-0	59.00	21.0625 3/4	63.69	4' 6875	8 1/4	7.03125
12+10	6-0	58.68	20.25 3	63.43	4' 75	9	7.125



Transition details at Sta 11+50

214+37.77
41.51
214+79.28

904.38
41.51
945.89

52 39
51 28
53 67
54 07

POWERLINE CHANNEL
TRANSITION @ STA. 15+00 ±
3-15-05 PMW

Top of Channel

Bottom intersection of Channel

65

60

55

0 5 10 15 20 25 30 35 40 45 50 55 60

20 X 20 TO THE INCH 359-10½G
KEUFFEL & ESSER CO. MADE IN U.S.A.

C

Arizona
Watt 1-25-65
Capacity of Concrete Lined Channel

$n = .014$ $Q = 600$ $b = 6'$ $SS = 1\frac{1}{2}:1$

$$K' = \frac{Qn}{b^{8/3} S^{1/2}} = \frac{600 \times .014}{119 \times S^{1/2}} = \frac{.070 c}{S^{1/2}}$$

$d_c = 4.67$ $S_c^{1/2} = \frac{600 \times .014}{164} = .0512$ $S_c = .00263$

S	$S^{1/2}$	K'	d/b	d	A	V	hv	F	D
.005	.07071	.998	.647	3.88	45.9	13.07		0.97	4.85
.006	.07746	.911	.619	3.71	42.9	14.0		0.93	4.64
.007	.08367	.844	.595	3.57	40.5	14.8		0.89	4.46
.008	.08944	.789	.575	3.45	38.6	15.5		0.86	4.31
.004	.06325	1.116	.684	4.10	49.8	12.10		1.03	5.13

$Q = 1070$ $n = .014$ $b = 6'$ $SS = 1\frac{1}{2}:1$

$$K_1' = \frac{1070 \times .014}{119 \times S^{1/2}} = \frac{.12588}{S^{1/2}}$$

S	$S^{1/2}$	K'	d/b	d	A	V	hv	F	D
.004	.06325	1.990	.903	5.42	76.6	14.0		1.35	6.77
.005	.07071	1.780	.857	5.14	70.5	15.17		1.28	6.42
.006	.07746	1.625	.82	4.92	65.8	16.26	29.17	1.23	6.15
.007	.08367	1.504	.79	4.74	62.1	17.23		1.18	5.92
.008	.08944	1.407	.764	4.58	58.9	18.16		1.14	5.72
.003	.05477	2.298	.966						

$Q = 1210$ n .014 $b = 6$ $SS = 1\frac{1}{2}:1$

$$K' = \frac{1210 \times .014}{119 \times S^{1/2}} = \frac{.14235}{S^{1/2}}$$ $d_c = 6.35$ $S_c^{1/2} = \frac{1210 \times .014}{332} =$

$S_c = .00266$

S	$S^{1/2}$	K'	d/b	d	A	V	hv	F	D
.005	.07071	2.013	.908	5.44	77.0	15.71		1.36	6.80
.006	.07746	1.838	.87	5.22	72.2	16.75	29.51	1.30	6.52
.007	.08367	1.701	.838	5.02	67.9	17.82		1.26	6.28
.008	.08944	1.592	.813	4.88	65.0	18.61		1.22	6.10

Arizona

Watt 1-25-65

Capacity of Concrete Lined Channel

$Q = 1070$ $n = .014$ $b = 8'$ $SS = 1\frac{1}{2}:1$

$K' = \frac{1070 \times .014}{256 \times S^{1/2}} = \frac{.0585}{S^{1/2}}$ $d_c = 5.7$ $S_c = \left(\frac{1070 \times .014}{311}\right)^2 = .0023$

$S_c = .00232$

S	$S^{1/2}$	K'	d/b	d	A	V	VF	F	D
.005	.07071	.827	.589	4.71	71.0	15.07		1.18	5.89
.006	.07746	.755	.563	4.50	66.4	16.11	28.30	1.13	5.63
.007	.08367	.699	.541	4.33	62.8	17.03		1.08	5.41
.008	.08944	.654	.523	4.18	59.6	17.95		1.05	5.23
.004	.06325	.925	.623	4.98	77.0	13.9		1.25	6.23
.003	.05477	1.068	.67	5.36	86.0	12.4		1.34	6.70

$Q = 1210$ $n = .014$ $b = 8'$ $SS = 1\frac{1}{2}:1$

$K' = \frac{1210 \times .014}{256 \times S^{1/2}} = \frac{.0661}{S^{1/2}}$ $d_c = 6.17$ $S_c^{1/2} = \frac{1210 \times .014}{366} = .0463$

$S_c = .00214$

S	$S^{1/2}$	K'	d/b	d	A	V	VF	F	D
.005	.07071	.934	.626	5.01	77.7	15.57	3.77	1.25	6.26
.006	.07746	.853	.598	4.78	72.5	16.68	4.32	1.20	5.98
.007	.08367	.790	.576	4.61	68.8	17.6	4.82	1.15	5.76
.008	.08944	.739	.556	4.45	65.3	18.52	5.33	1.11	5.56
.004	.06325	1.045	.661	5.29	84.3	14.4	3.22	1.32	6.61
.003	.05477	1.205	.709	5.67	93.6	12.9		1.42	7.09

COMPUTATION SHEET
SCS-522A REV 5-58

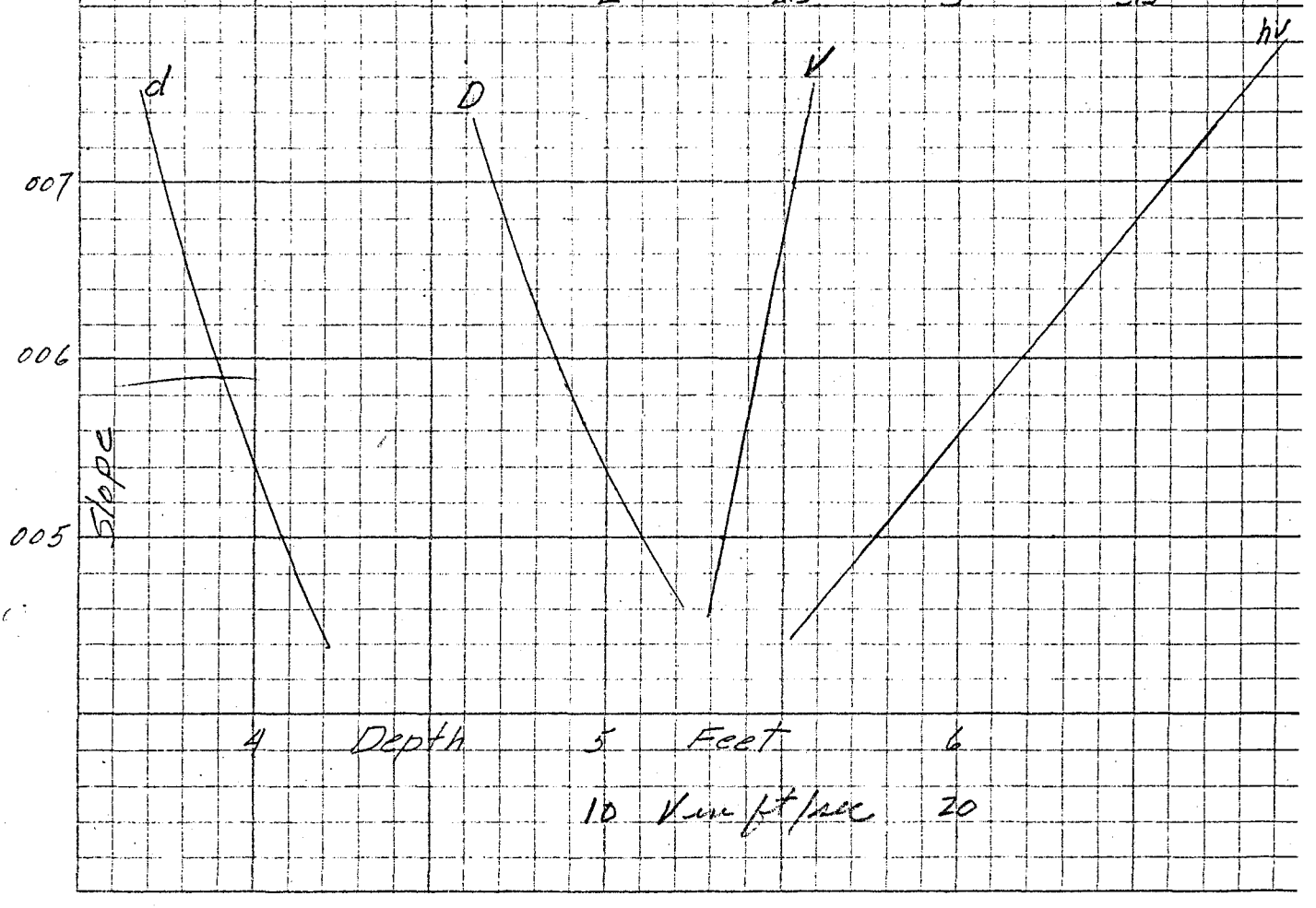
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona
BY Watt DATE
PROJECT Powerline Channel
COMPUTED BY DATE
SUBJECT Capacity Conc. lined Channel
SHEET OF

For Q = 660 b = 6.0 n = .014 S.S. = 1½:1

S	S½	K'	D/b	D	#	V	hv	Total D = 1.25D
.005	.07071	1.10	.680	4.08	49.44	13.35	2.77	5.10
.006	.07746	1.003	.649	3.89	46.04	14.33	3.19	4.86
.007	.08367	.928	.624	3.74	43.42	15.20	3.59	4.67

$K' = \frac{660 \times .014}{11.9 \times 5\frac{1}{2}} = \frac{.0776}{5\frac{1}{2}}$



COMPUTATION SHEET
SCS-ERA REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

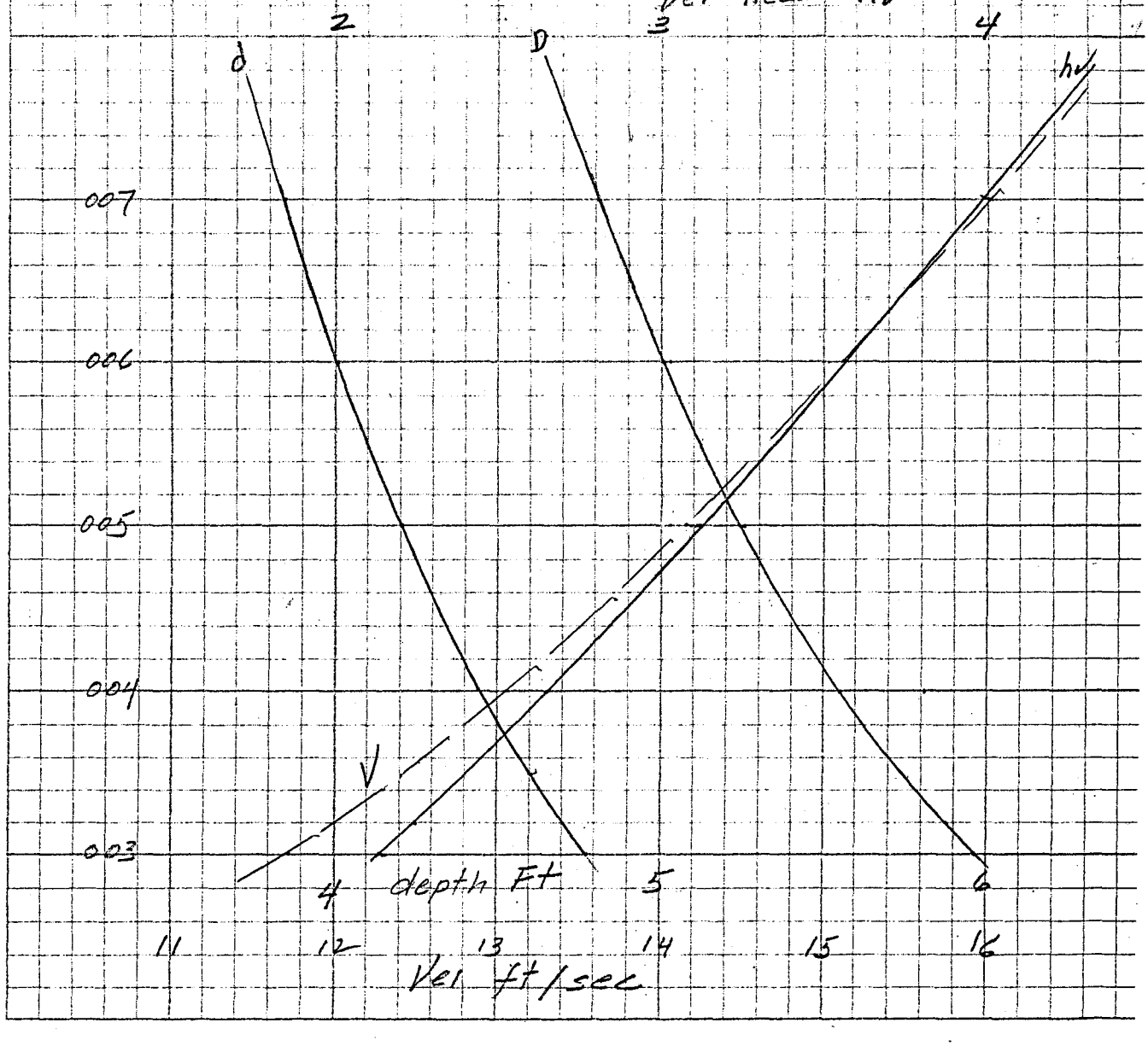
STATE Arizona PROJECT Powerline Channel
BY Watt DATE 4-23-65 COMPUTED BY DATE CHECKED BY
SUBJECT Capacity of Channel SHEET OF

For Q = 850 C.F.S. b = 8 SS = 1½:1 n = .014

$K' = \frac{850 \times .014}{256 \times 5^{1}/_{2}} = \frac{.0465}{5^{1}/_{2}}$

d+F=.25D

Slope	$5^{1}/_{2}$	K'	D/b	d	A	V	hv	D
.004	.06325	.735	.555	4.44	65.09	13.06	2.65	5.55
.005	.07071	.658	.525	4.20	60.06	14.15	3.11	5.25
.006	.07746	.600	.501	4.01	56.20	15.13	3.56	5.01
.007	.08367	.556	.481	3.85	53.03	16.03	3.99	4.81
.003	.05477	.849	.597	4.78	72.51	11.72	2.14	5.97



COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE

PROJECT

BY Watt DATE CHECKED BY DATE

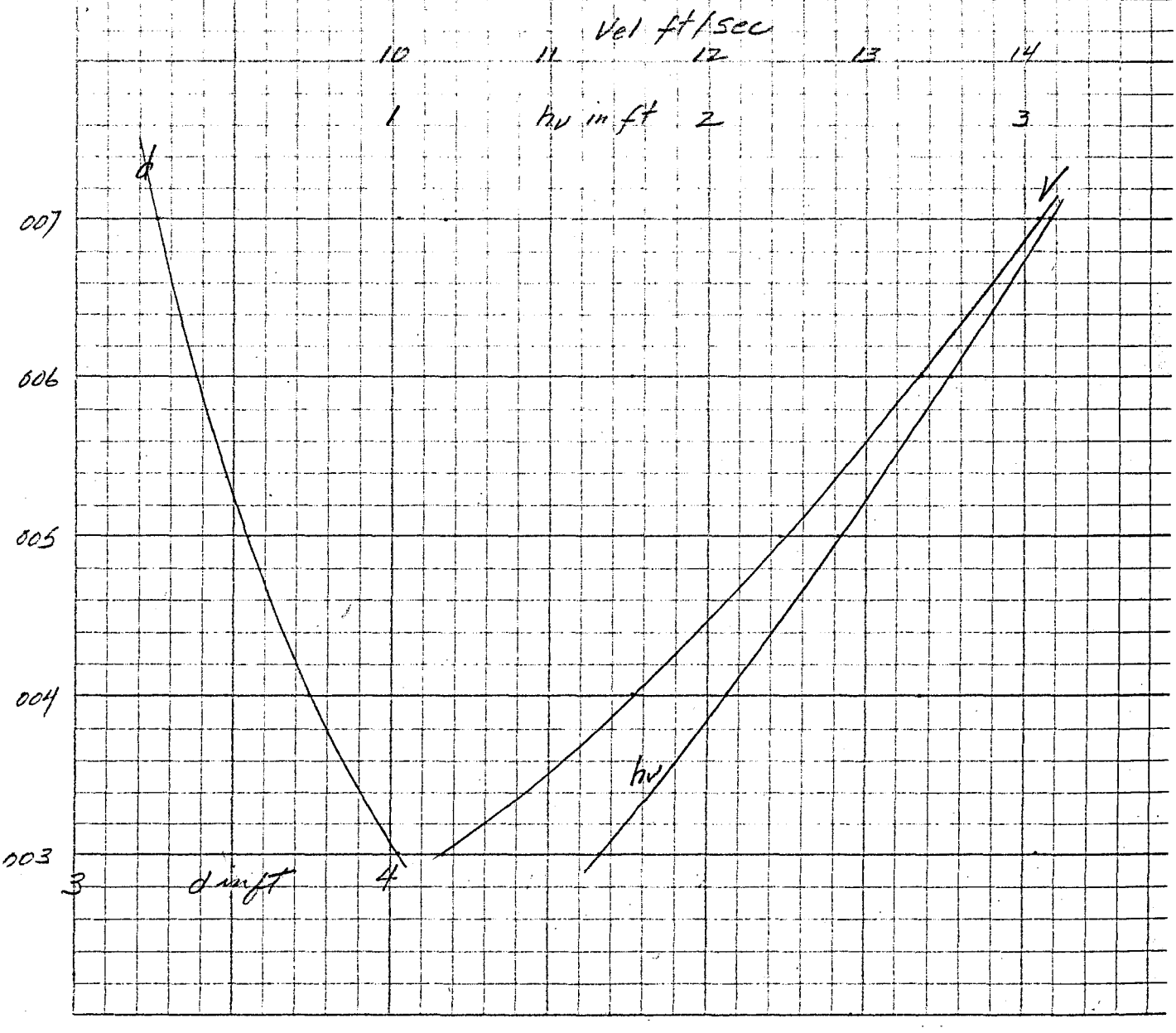
SUBJECT

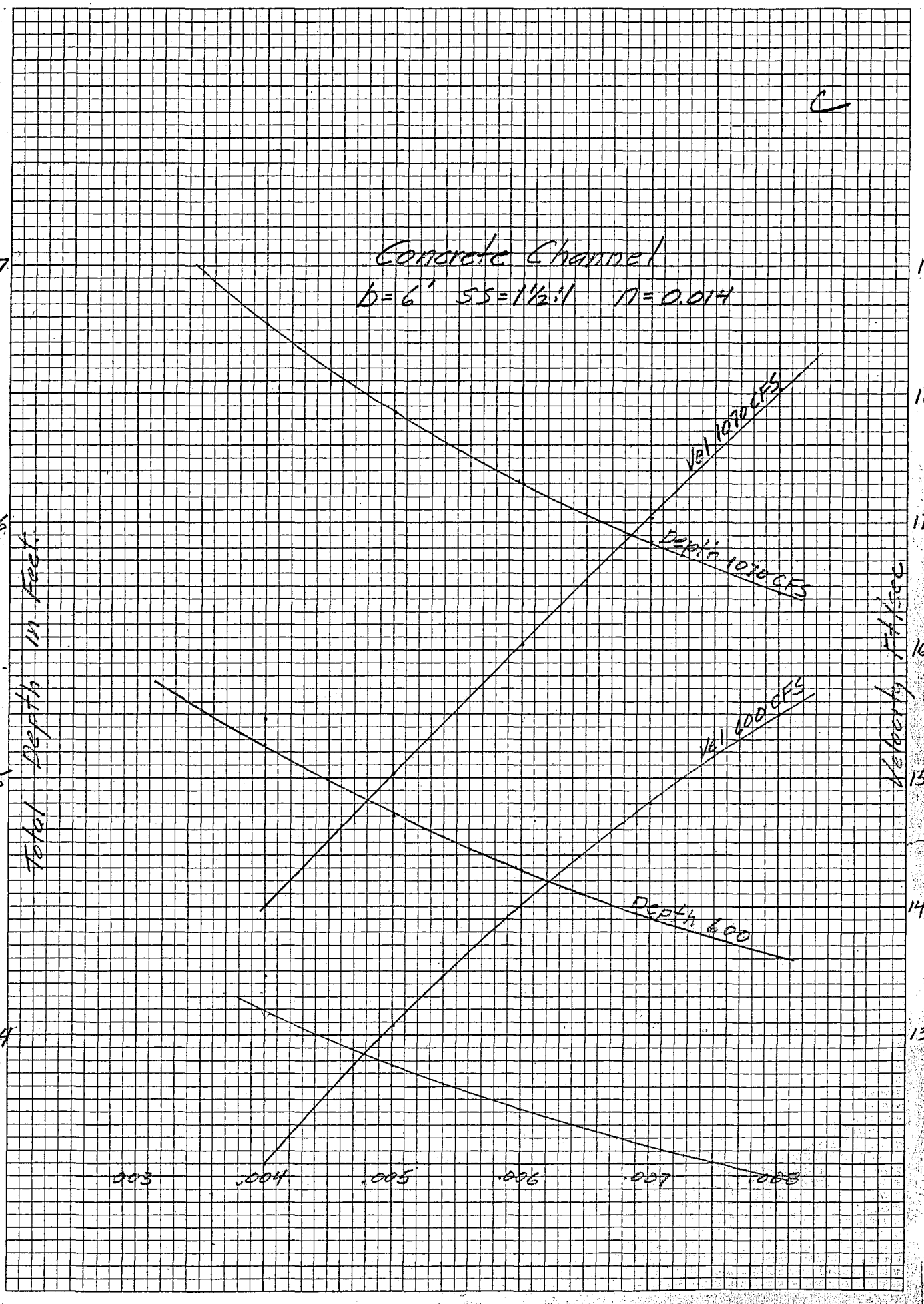
SHEET OF

$b=6$ $SS=1\frac{1}{2}:1$ $n=.014$ $K'=\frac{500\times.014}{119\times S^{1/2}}=\frac{.05882}{S^{1/2}}$

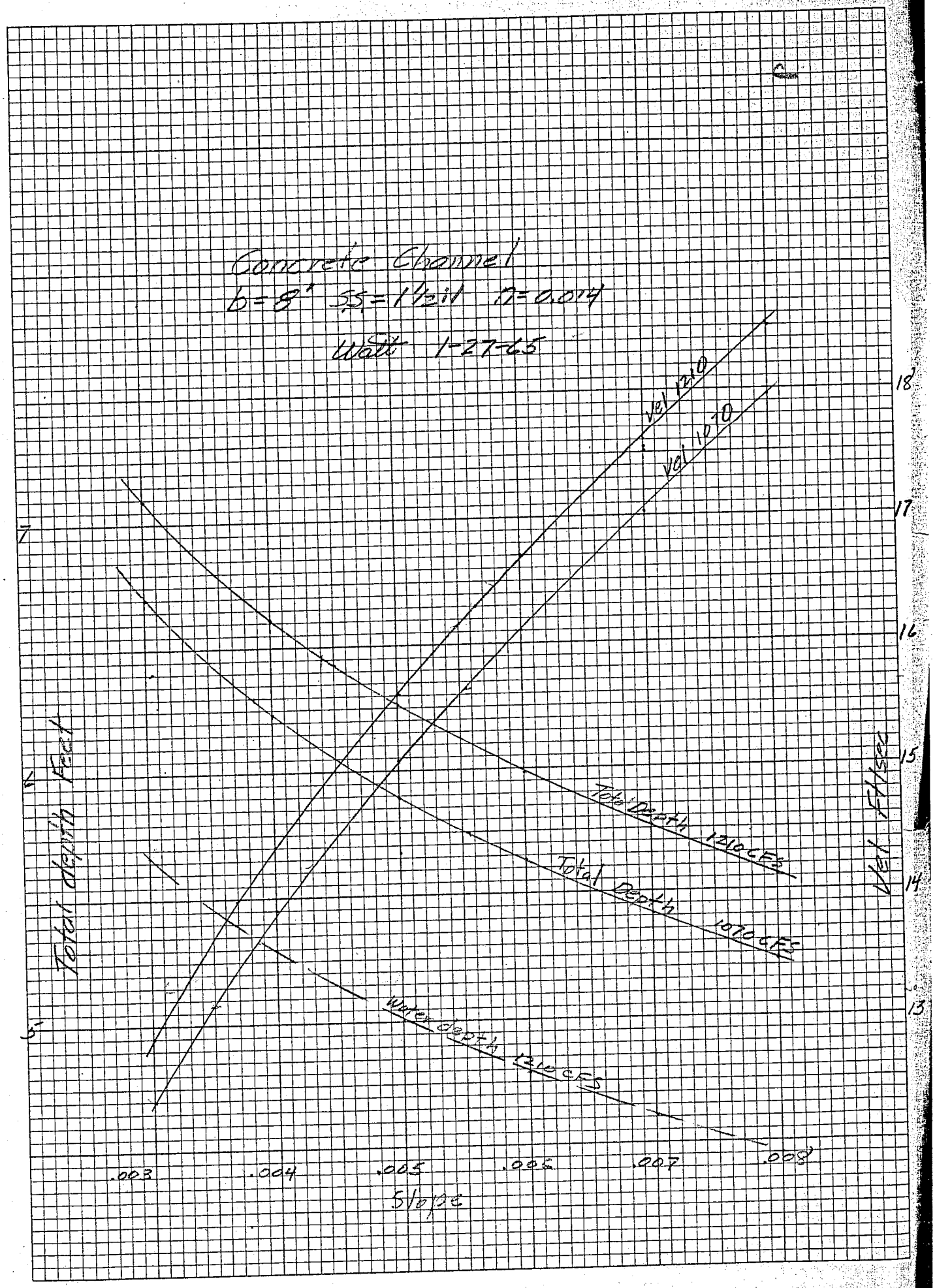
$Q=500$ C.F.S.

S	$S^{1/2}$	K'	D/b	d	A	V	h_v	1.25 d D
.003	.05477	1.074	.670	4.02	48.36	10.33	1.66	5.02
.004	.06325	.928	.624	3.74	43.42	11.52	2.06	4.67
.005	.07071	.832	.591	3.55	40.20	12.44	2.41	4.44
.006	.07746	.759	.564	3.38	37.42	13.36	2.78	4.23
.007	.08367	.703	.543	3.26	35.50	14.08	3.08	4.07





EUGENE DIETZGEN CO.
MADE IN U.S.A.
NO. 340R-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH



EUGENE DIETZGEN CO.
MADE IN U. S. A.
NO. 340R-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona
BY Watt DATE 4-23-65
SUBJECT

PROJECT Powerline Channel

Extra Freeboard for Curve @ 195

$R = 954'$ $b = 6$ $d = 3.9$ $V = 14.3$ $SS = 1\frac{1}{2}:1 = Z$

$$S = \frac{V^2(b+2Zd)}{gR - 2ZV^2} = \frac{14.3^2(17.7)}{32.2 \times 954 - 3 \times 14.3^2} = \frac{3619}{30{,}718 - 613} = .12$$

Should not make radius less.

C

Arizona Powerline Channel
Watt 3-17-66
Hydraulics for Curve @ 321

Min Radius for Curve on Conc Channel

$V = 16.3'/sec \quad d = 4.87 \quad b = 8 + 2 \times 4.87 = 17.8'$

$$S = .1 = \frac{V^2(b + 2zd)}{gR + 2zV^2} = \frac{16.3^2(17.8 + 3 \times 4.87)}{32.2R + 3 \times 16.3^2}$$

$$0.1 = \frac{8611}{32.2R + 797}$$

$$32.2R = 8611 - 79.7 = 2650$$

If we use 0.15' for max raise in W.S.

$$4.83R = 8611 - 120$$

$$R = 1758 \text{ ft}$$

Max $D = 3° 15'$

Use $D = 3° \quad R = 1909.8'$

COMPUTATION SHEET

SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Pouring Channel

BY Watt DATE 4-23-65 CHECKED BY DATE FOR NO

SUBJECT

SHEET OF

Extra Freeboard for Curve @ 195

$R = 954'$ $b = 6$ $d = 3.9$ $V = 14.3$ $55 = 1\frac{1}{2}:1 = Z$

$$S = \frac{V^2(b+2Zd)}{gR-2ZV^2} = \frac{14.3^2(17.7)}{32.2\times954-3\times14.3^2} = \frac{3619}{30,718-613} = .12$$

Should not make radius less.

COMPUTATION SHEET
SCS-522A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

C

STATE Arizona PROJECT Powerline Floodway

GDH 2-28-66

Curve Data Sta 210+33

$\Delta = 36°53' = 36.8375$, $\frac{1}{2}\Delta = 18°26'46''$

$\tan \frac{1}{2}\Delta = 0.33355$

$D = 6°00'$
$R = 954.93'$

$T. = 318.52$
$L. = 613.96$

$T = 954.93 \times .33355 = 318.52$

$L = \frac{\pi\ 954.93 \times 36.83.75}{180} = 613.96'$

	Back		Ahead
PI =	211+27.68		210+33.39
PC =	208+09.16		
Lc	613.96	T	318.52
PT	214+23.12		213+51.91
	148.09		148.09
	215+71.21		215+00

COMPUTATION SHEET
SCS-523A REV. 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO: 1959 O—437927

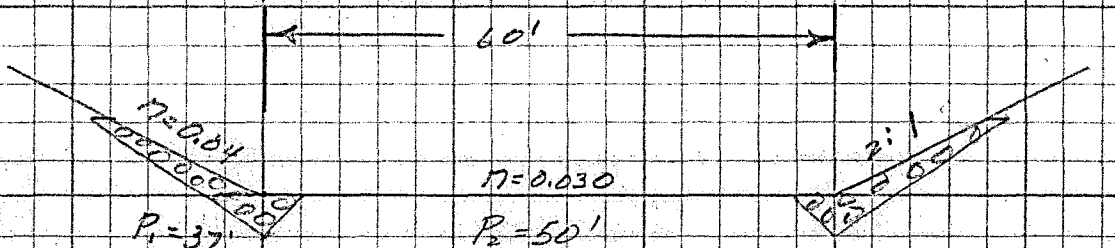
C 71

STATE	PROJECT		
Arizona	Powerline Channel		
BY	DATE	CHECKED BY	DATE	JOB NO.
Watt	5-13-65			

SUBJECT
Capacity of Channel 375 ft.

SHEET OF

Channel $b = 60$ $Q = 3250 + 580 = 3830$ C.F.S. = 1% Storm



$$n = \left(\frac{37 \times .04^{3/2} + 50 \times .03^{3/2}}{87} \right)^{2/3}$$

$$= (.00639)^{2/3} = .034$$

For $b = 60'$ $\quad K' = \frac{Qn}{b^{8/3} S^{1/2}} = \frac{3830 \times .034}{55{,}300\ S^{1/2}} = \frac{.00236}{S^{1/2}}$

S	$S^{1/2}$	K'	D/b	D	A	V	He	D+F
.002	.04472	.0528	.129	7.74	584	6.56	8.41	9.4
.003	.05477	.0431	.115	6.90	509	7.52	7.78	8.8
.004	.06325	.0373	.106	6.36	462	8.28	7.42	7.9
.005	.07071	.0334	.099	5.94	427	8.96	7.18	7.2

For Q of 1200 C.F.S. $\quad K' = \frac{.000739}{S^{1/2}}$

.002	.04472	.0165	.066	3.96	269	4.46
.003	.05477	.0135	.058	3.48	233	5.15
.004	.06325	.0117	.054	3.24	215	5.58
.005	.07071	.010495	.0503	3.02	199	6.03

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO: 1958 O—470868

18
39

STATE		PROJECT		
Arizona		Powerline Channel		✓
BY	DATE	CHECKED BY	DATE	JOB NO.
Watt	5-13-65			

SUBJECT Capacity of Lower Channel — SHEET ____ OF ____

For 2% Uncontrolled $Q = 2560 + 580 = 3140$ $n = .034$
+1% from Dams $b = 60$ $S = 2:1$

$$K' = \frac{3140 \times .034}{55{,}190 \times S^{1/2}} = \frac{.001934}{S^{1/2}}$$

6.62

S	$S^{1/2}$	K'	D/b	D	A	V	H_E	D+F
.001	.0316	.0612	.140	8.4	6950	4.9		
.002	.04472	.0432	.115	6.90	509.2	6.16	7.49	8.40
.003	.05477	.0353	.102	6.12	442.1	7.10	6.90	7.50
.004	.06325	.0306	.094	5.64	402.0	7.81	6.59	6.96
.005	.07071	.0274	.088	5.28	372.6	8.43	6.39	6.56

For 4% Storm $Q = 2060 + 580 = 2640$
$K' = .001626 / S^{1/2}$

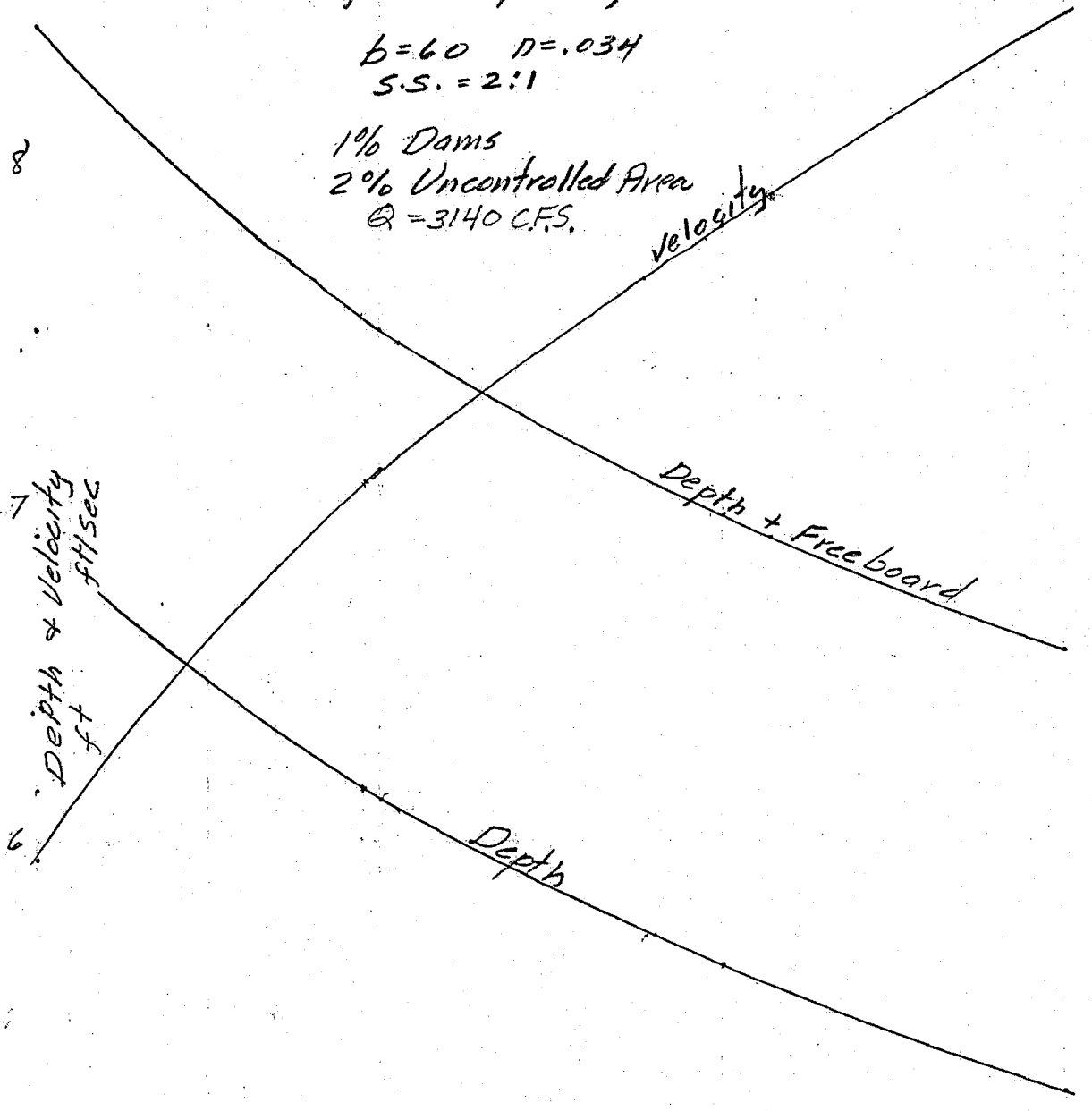
S	$S^{1/2}$	K'	D/b	D	A	V
.002	.04472	.0364	.104	6.23	451.4	5.95
.003	.05477	.0297	.093	5.67	404.5	6.53
.004	.06325	.0257	.085	5.10	359.2	7.35
.005	.07071	.0230	.080	4.80	334.0	7.90

Use W.S. for top Rip Rap for Q=3140
or 6° + Top Dike to 7.50 for S = .00305

Arizona
Watt 5-13-65
Channel Depth Capacity Relations

b = 60 n = .034
S.S. = 2:1

1% Dams
2% Uncontrolled Area
Q = 3140 C.F.S.



COMPUTATION SHEET
SCS-523A REV 5-58

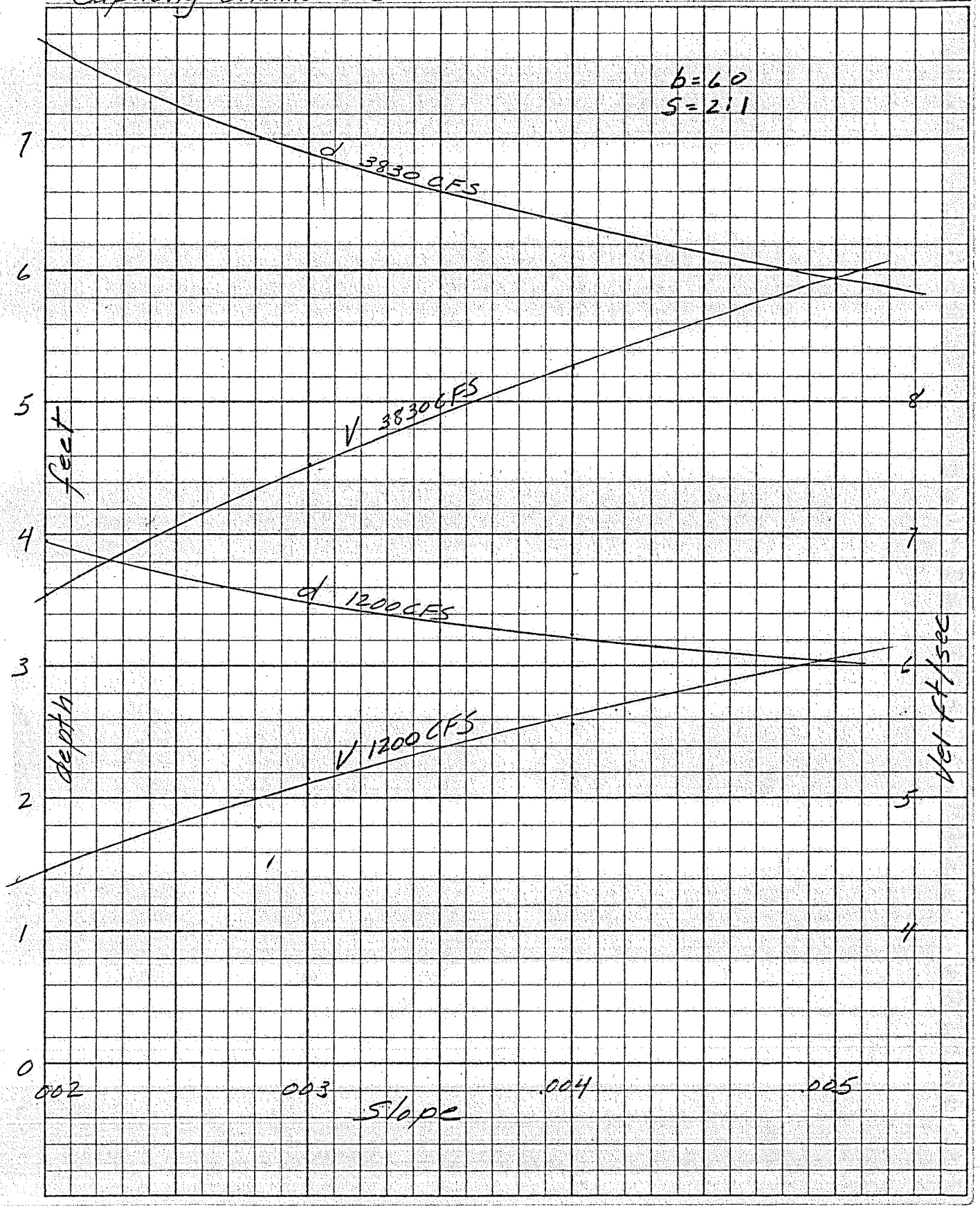
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO 1959 O—497927

STATE	PROJECT	
Arizona	Powerline Channel	V

BY	DATE	CHECKED BY	DATE	JOB NO.
Watt	5-13-65			

SUBJECT: Capacity Channel 375 to

SHEET ____ OF ____



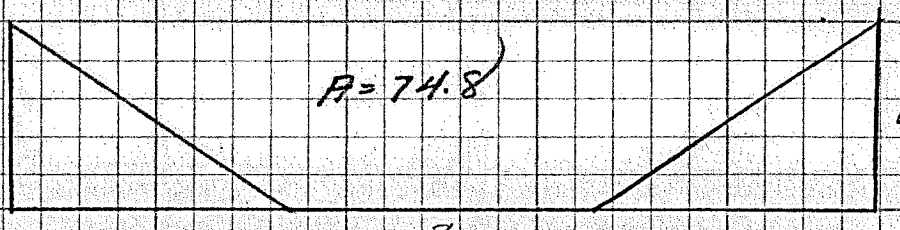
COMPUTATION SHEET
SCS-523A REV 5-58

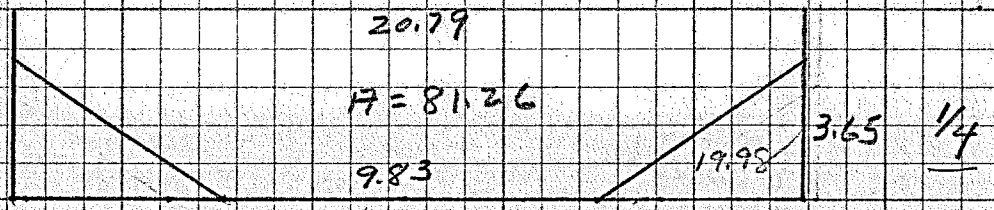
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO : 1959 O—497927

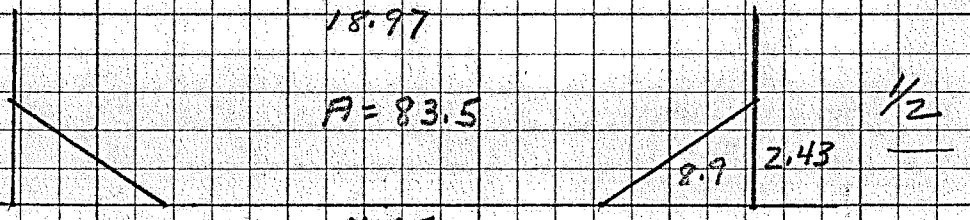
STATE	PROJECT		
Arizona	Powerline Channel		
BY	DATE	CHECKED BY	DATE	JOB NO.
Watt	5-14-65			

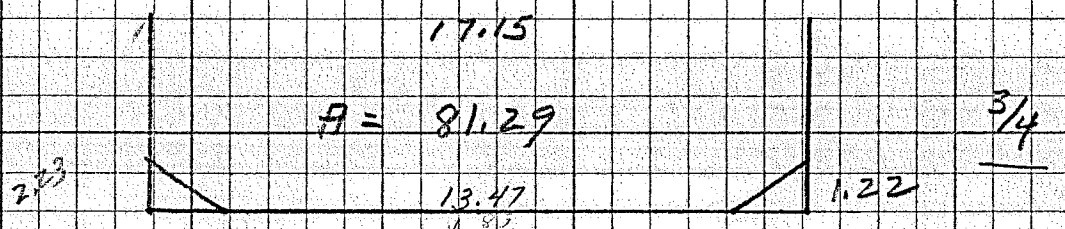
SUBJECT Checking Various Transitions — SHEET C OF

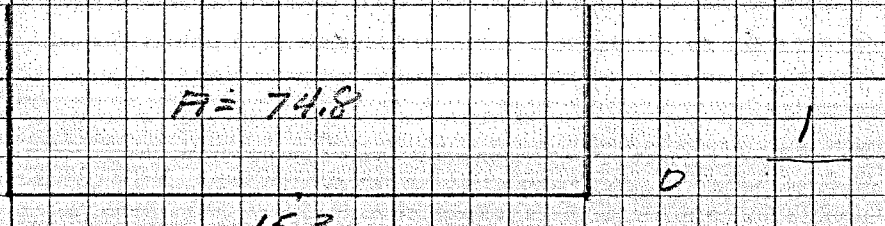
Straight Transition











COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO : 1959 O—497927

STATE Arizona | PROJECT Powerline Channel

BY Watt | DATE 5-14-65 | CHECKED BY | DATE | JOB NO. C

SUBJECT Checking Various Transitions | SHEET | OF

Computations for Constant Area Variable bottom width

$$A = Th - \frac{(T-b)^2}{3^2} \times 1.5$$

$$Th - .1667(T^2 - 2Tb + b^2) = A$$

$$+.1667T^2 - T(.333b + h) + .1667b^2 + A = 0$$

For $b = 11.65$ & $h = 4.87$ $A = 74.8$

$$.1667T^2 - 8.75T + 91.42 = 0$$

$$T^2 - 52.50T + 584.5 = 0$$

$$T = \frac{+52.50 \pm \sqrt{52.50^2 - 4 \times 584.6}}{2} = \frac{52.50 + 20.72}{2} = 15.89'$$

For $b = 9.83$ $h = 4.87$ $A = 74.8$

$$.1667T^2 - 8.14T + 90.90$$

$$T^2 - 48.84T + 545.39 = 0$$

$$T = \frac{+48.84 \pm 14.27}{2} = 17.29$$

For $b = 13.47$ $h = 4.87$ $A = 74.8$

$$.1667T^2 - 9.36T + 105.04$$

$$T^2 - 56.16T + 630.22$$

$$T = \frac{+56.16 \pm 25.16}{2} = 15.50$$

Solving for b

$$-.1667b^2 + .333bT - .1667T^2 - A + Th = 0$$

$$b^2 - 2bT + T^2 + \frac{(A - Th)}{.1667} = 0$$

STATE Arizona PROJECT Powerline Channel

BY Watt DATE 5-14-65 CHECKED BY DATE JOB NO.

SUBJECT Checking Various Trans. Cont. SHEET OF

$$b^2 + 2bT + T^2 + \frac{A - Tb}{.1667} = 0$$

When $b = 4.87$ $T = 20.79$ $A = 74.8$

$$b^2 - 41.58b + (432.22 - 273.54 - 158.68)$$

$$b = \frac{+41.58 \pm 25.19}{2} = 8.20$$

When $b = 4.87$ $T = 18.97$ $A = 74.8$

$$b^2 - 37.94b + 359.86 - 254.36 - 105.50$$

$$b = \frac{37.94 \pm 20.54}{2} = 8.70$$

When $b = 4.87$ $T = 17.15$ $A = 74.8$

$$b^2 - 34.30b + 241.80 = 0$$

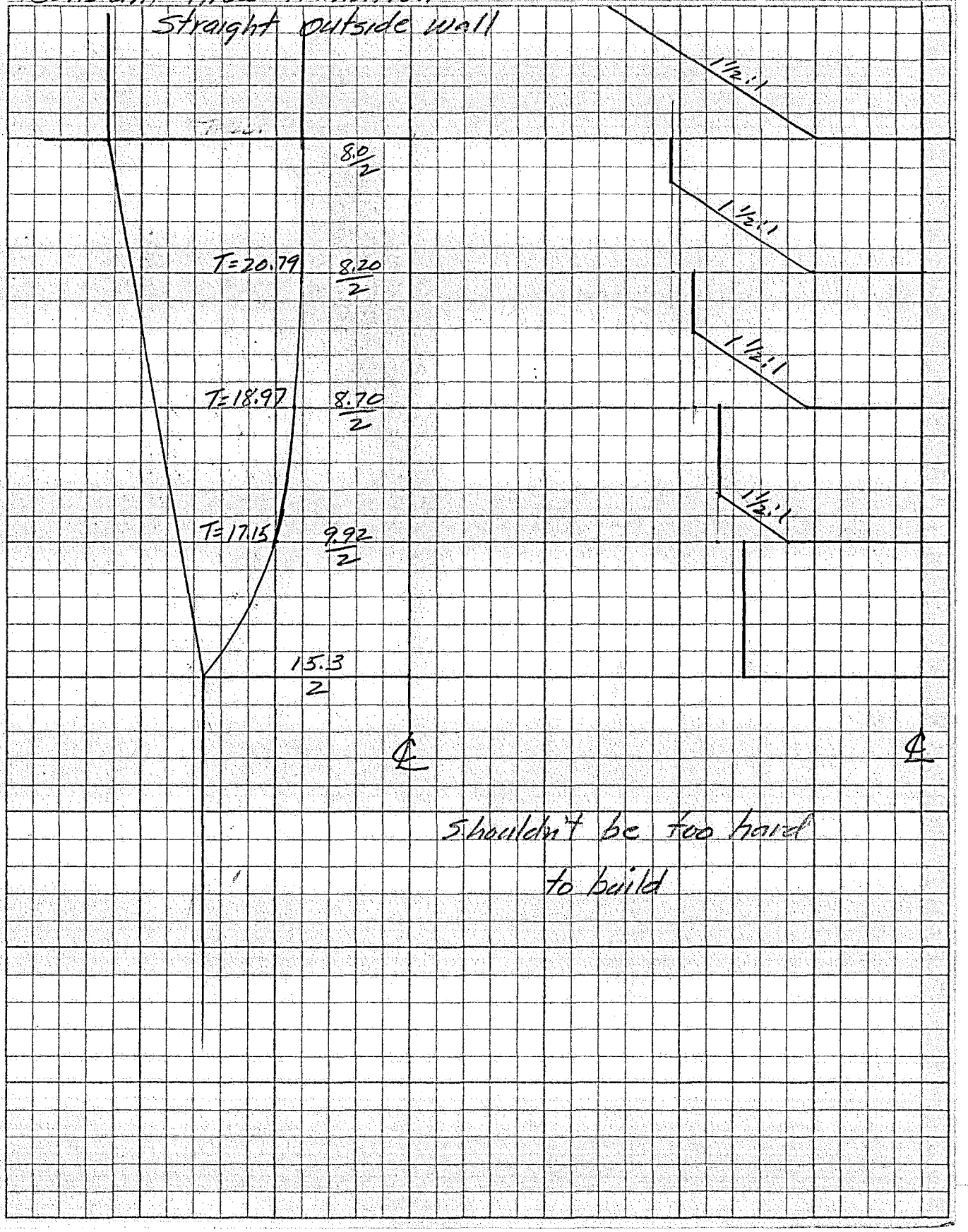
$$b = \frac{34.3 - 14.46}{2} = 9.92$$

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO 1958 O—497927

STATE	PROJECT	
Arizona	Powerline Dam	
BY	DATE	CHECKED BY	DATE	JOB NO.
Watt	5-14-65			

SUBJECT: Constant Area Transition — SHEET 6 OF



Shouldn't be too hard to build

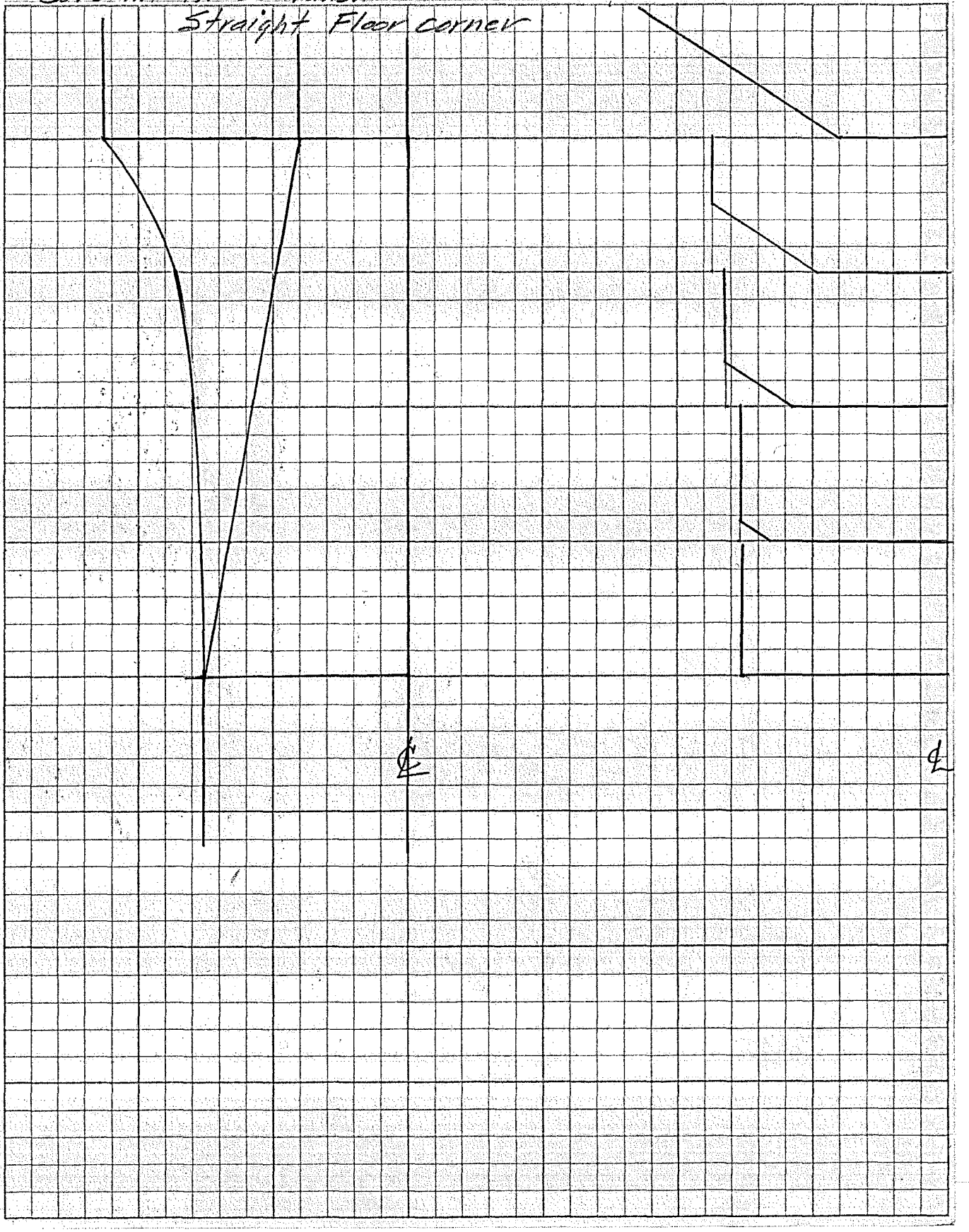
COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO 1959 O—497827

STATE	PROJECT		
Arizona	Powerline Dam		
BY	DATE	CHECKED BY	DATE	JOB NO.
Watt	5-14-65			

SUBJECT
Constant Area Transition
Straight Floor corner

SHEET OF

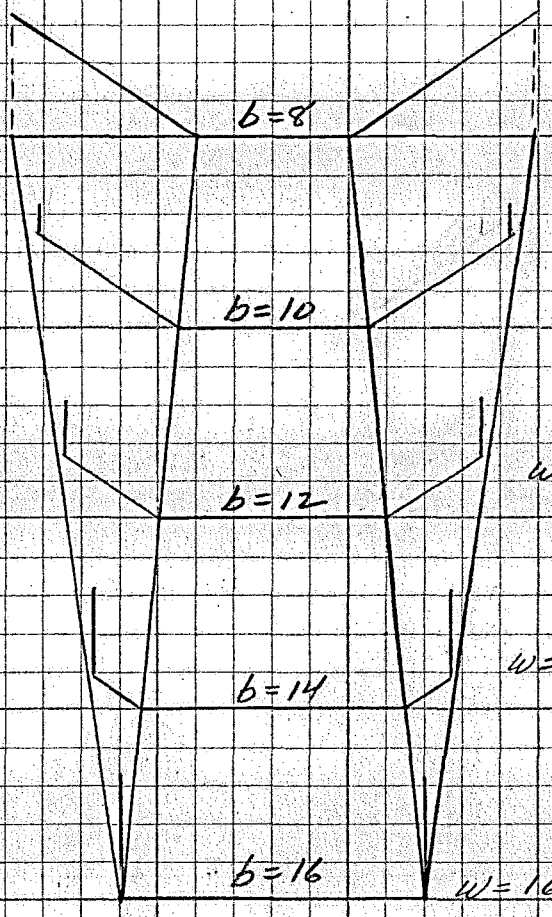


COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO : 1959 O—497927

STATE Arizona | PROJECT Powerline Channel C
BY Watt | DATE | CHECKED BY | DATE | JOB NO.
SUBJECT Transition to SAF S.T.R. | SHEET | OF

Length = 20' Depth = 6.5'



W = 27.5 A_1 = 82.16

W = 24.63' A_2 $24.63 \times 5.2 - \frac{(24.63-10)^2}{6} = 92.40$

W = 21.75' A_3 $21.75 \times 5.2 - 158.5 = 97.27$

W = 18.88' A_4 $18.88 \times 5.2 - 396 = 94.22$

W = 16.00 A_5 $16 \times 5.2 = 83.2$

V_1 = 14.6'/sec h_{v_1} = 3.31 h_f = .0056 × 10 = .05 = slope of ch.

$d_1 + h_v$ = 5.2 + 3.31 = 8.51 Assume slope = friction loss

For	A_3	V_3	h_v	E_3	
D_3 = 5.2	97.2	12.37	2.37	7.57	
D_3 = 4.2	75.5	15.9	3.92	8.12	
D_3 = 3.8	66.82	17.6	4.82	8.62	
D_3 = 4.0	71.17	16.85	4.42	8.42	Approx 3.95 = d
D_3 = 3.9	69.00	17.4	4.71	8.61	

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO : 1959 O—497927

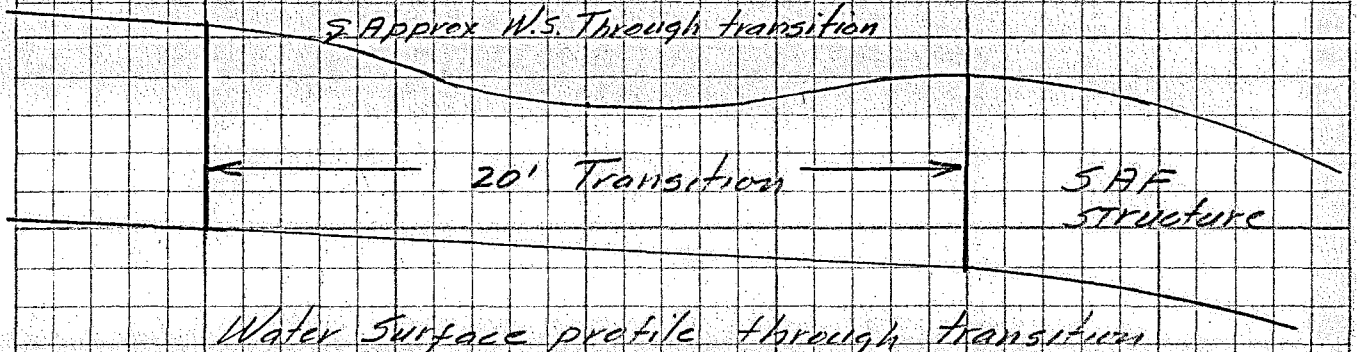
STATE		PROJECT		
Arizona		Powerline Channel		
BY	DATE	CHECKED BY	DATE	JOB NO.
Watt	65			C

SUBJECT Water Profile Transition to SAF STR — SHEET ____ OF ____

E = 8.5

@ A_3

D = 5.0 A = 80 V = 15 h_v = 3.5 E = 8.5



Water Surface profile through transition

Not too good but just before S.A.F. Structure o.k.

Make Slope of 0.2 drop in 20'
= S = .01
Should be plenty to take care of h_f.

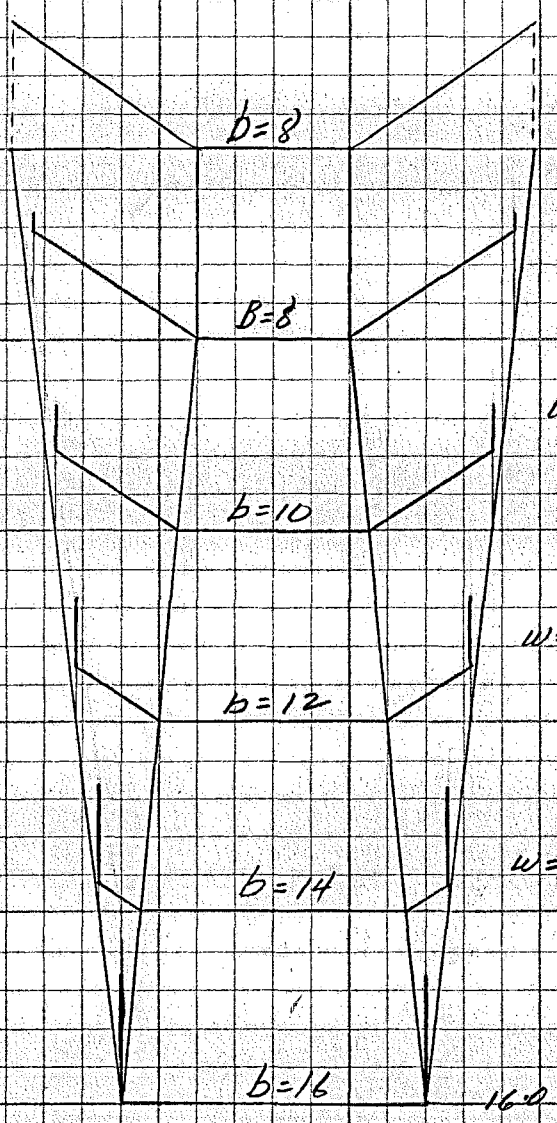
COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO : 1958 O—497927

STATE	PROJECT	
Arizona	Powerline Channel	
BY: Watt	DATE: 5-26-65	CHECKED BY: DATE: JOB NO. ✓

SUBJECT: Transition to SAF

SHEET OF



Area @ d = 5.2

A = 1.5 × 5.2² + 8 × 5.2 = 82.16

W = 25.2 — $\frac{(25.2-8)^2}{6}$ + 5.2 × 25.2 = 81.74

W = 22.9 — 5.2 × 22.9 − $\frac{(22.9-10)^2}{6}$ = 91.35

W = 20.6 — 5.2 × 20.6 − $\frac{(20.6-12)^2}{6}$ = 94.80

W = 18.3 — 5.2 × 18.3 − $\frac{(18.3-14)^2}{6}$ = 92.08

16.0 — 16 × 5.2 = 83.2

Might be a little better but not too much.

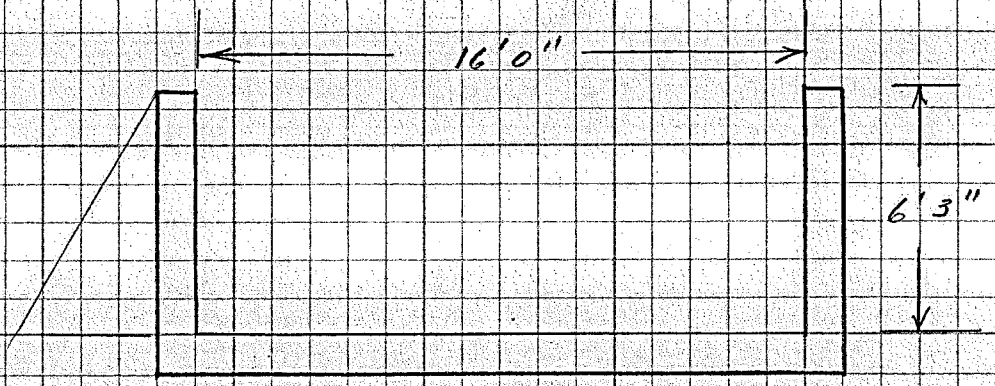
Don't Use

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO : 1959 O—497937

STATE	PROJECT	
Arizona	Powerline Channel	C
BY Watt	DATE 5-27-65	CHECKED BY / DATE / JOB NO.

SUBJECT Transition to SAF — SHEET / OF



Equivalent Earth pressure = $40^{\#}/ft^2$

Weight of Earth = $110^{\#}/ft^3$

Wt of Concrete = $150^{\#}/ft^3$

Channel Empty Backfilled

$$M_E = \frac{WH^3}{6} = \frac{40 \times 6.25^3}{6} = 1632 \text{ ft lbs}$$

Assume Walls 7"

Wt of Walls $= \frac{7}{12} \times 6.25 \times 150 \times 2 = 1094^{\#}$

Active Unit pressure on floor $= \frac{1094}{16} = 68.4^{\#}/ft$

Simple moment

$$M_S = 547\ell - \frac{68.4\ell^2}{2} = 547\ell - 34.2\ell^2$$

ℓ	M
2	957
4	1640
6	2050
8	2188

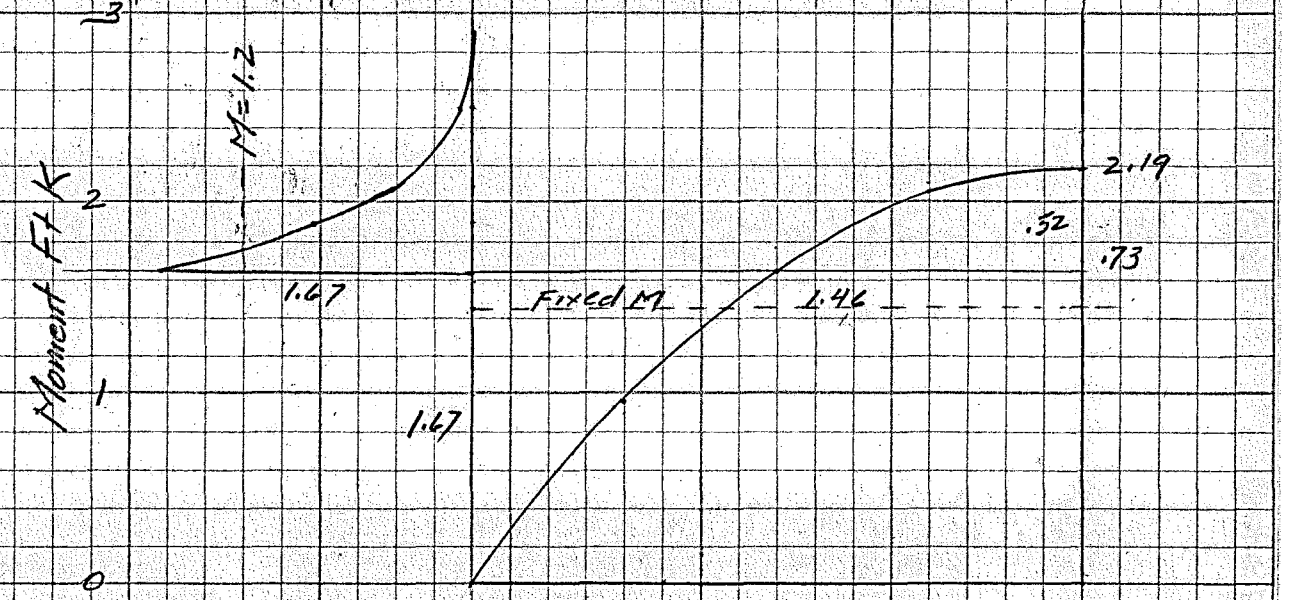
Fixed End $\frac{68.4 \times 16^2}{12} = 1459$

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO 1959 O—497927

STATE	PROJECT		
Arizona	Powerline Channel C		
BY	DATE	CHECKED BY	DATE	JOB NO.
Watt	5-27-65			

SUBJECT Transition to SAF Structure — SHEET ___ OF ___



Side Wall Moment $= \frac{40b^3}{6} =$

b	M
2	53
4	427
6.3	1667

Allowable M No steel $= \frac{100 \times 12 \times 7^2}{6 \times 12} = 820$ ft lbs

OK for reversable M.

Use 4#@ 5"

4#@ 10" For M = 1.2 or bring up side 1'0"

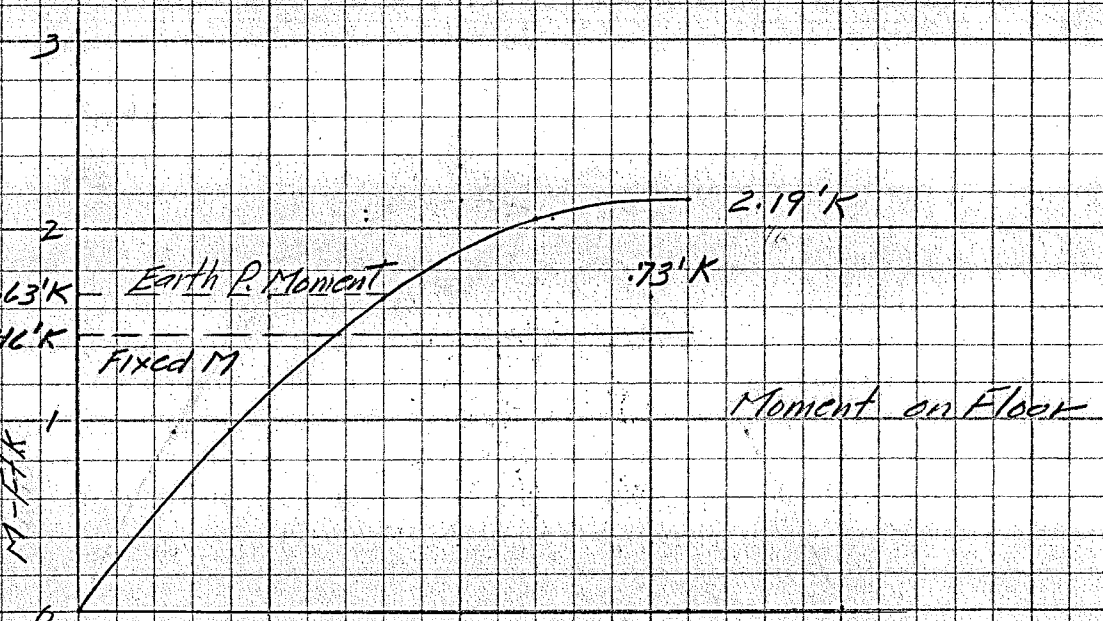
Shear $\frac{40 \times 6.25^2}{2} = 781^{\#}$ $\quad S = \frac{781 \times 1.2}{12 \times 3.5} = 20^{\#}/in^2$

OK

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO 1959 O—497927

STATE	PROJECT		
Arizona	Powerline Channel		
BY: Watt	DATE: 5-27-65	CHECKED BY	DATE	JOB NO.
SUBJECT: Transition to SAF Structure			SHEET ___ OF ___



Filled with water No backfill

$$M = \frac{wl^3}{6} = \frac{62.5 \times 6.25^3}{6} = 2543$$

$S = \frac{6M}{bd^2}$

Allowable M No steel

$$M = \frac{Sbd^2}{6} = \frac{100 \times 12 \times 7^2}{6 \times 12} = 820 \text{ ft lbs}$$

$M = \frac{Sbd^2}{6}$

ok for reverseable Moment

Use 1½" steel @ 5" & 7" Wall

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO : 1959 O—497927

STATE	PROJECT	
Arizona	Powerline Channel	
BY Watt	DATE 5-27-65	CHECKED BY / DATE / JOB NO.
SUBJECT Transition to SAF Structure		SHEET C OF

Center floor Moment
No Backfill

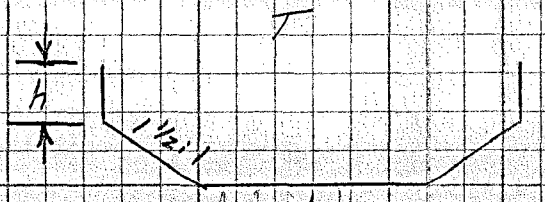
ℓ = dist. up from rec. end

$T = 16 + .575\ell$

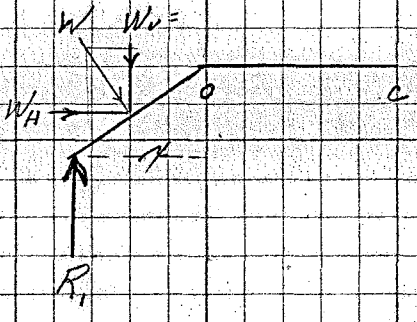
$b = 16 - .4\ell$

$h = 6.25 - .31\ell$

$x = .469\ell$



Assume load of vertical load is distributed through width T $W_v = 1.5 W_H$



$$M_o = R_1 x - \frac{W_v x}{1.5} \times \frac{x}{3} - \frac{W_v x^2}{2}$$

$$= \left(\frac{T x}{2} - .722 x^2\right) W_v$$

$$M_c = \frac{W_v b^2}{8} + M_o$$

$$= W_v \left(\frac{b^2}{8} + \frac{T x}{2} - .722 x^2\right)$$

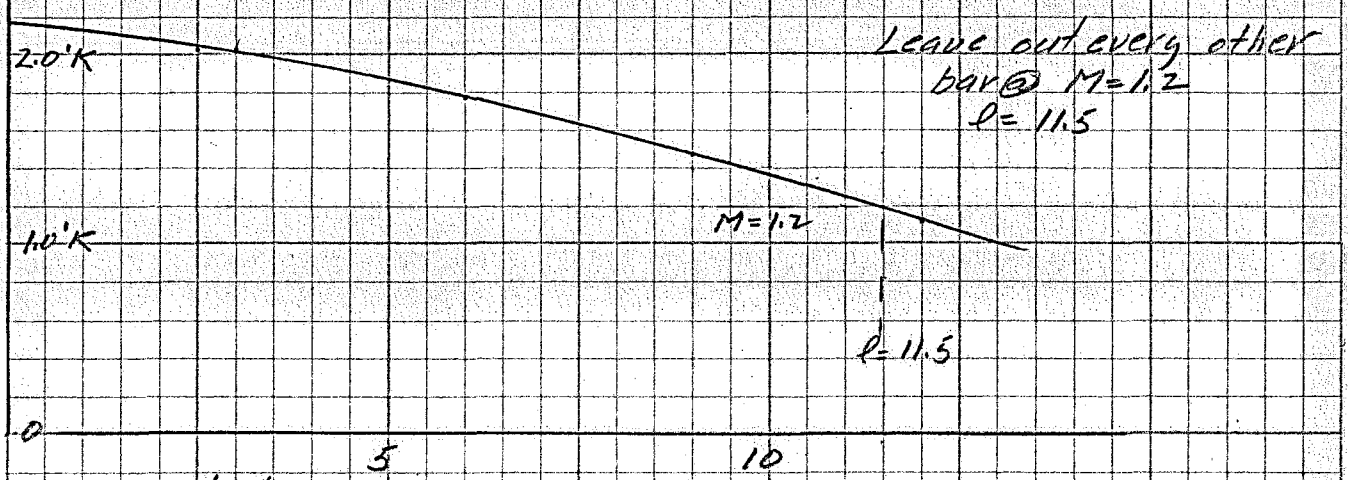
$(.5T - .72x)x$

ℓ	T	h	W_v	b	x	$(.5T-.72x)x$	$\frac{b^2}{8}$	M_c
3	17.73	5.32	52.5	14.8	1.4	10.99	27.38	2014
6	19.45	4.39	39.5	13.6	2.81	22.33	23.12	1795
9	21.17	3.46	28.6	12.4	4.22	31.81	19.22	1459
12	22.90	2.53	19.3	11.2	5.63	41.61	15.60	11.04

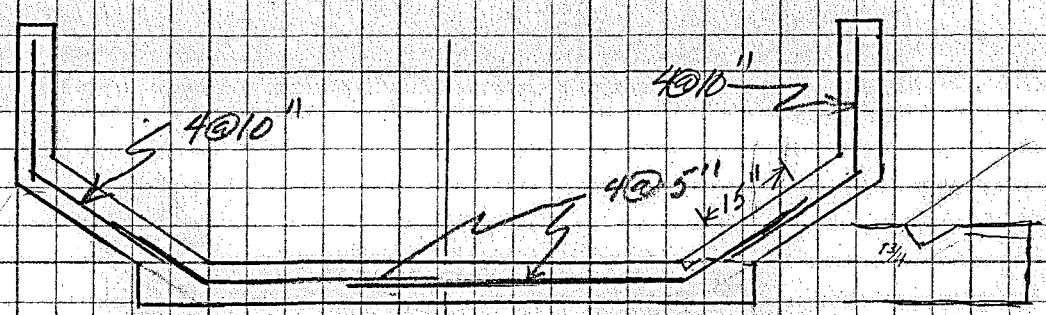
COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO 1959 O—497927

STATE	PROJECT		
Arizona	Powerline Channel		
BY Watt	DATE 5-27-65	CHECKED BY	DATE	JOB NO.
SUBJECT Transition to SAF Str.			SHEET ___ OF ___

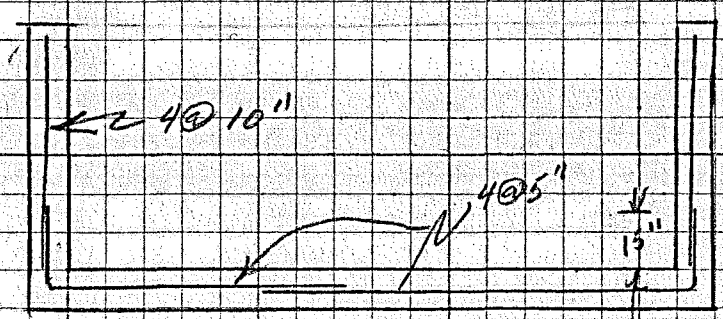


dist. from square end



Sec @ ℓ=9

Horiz. bars 4# @ 12"



Sec @ L=

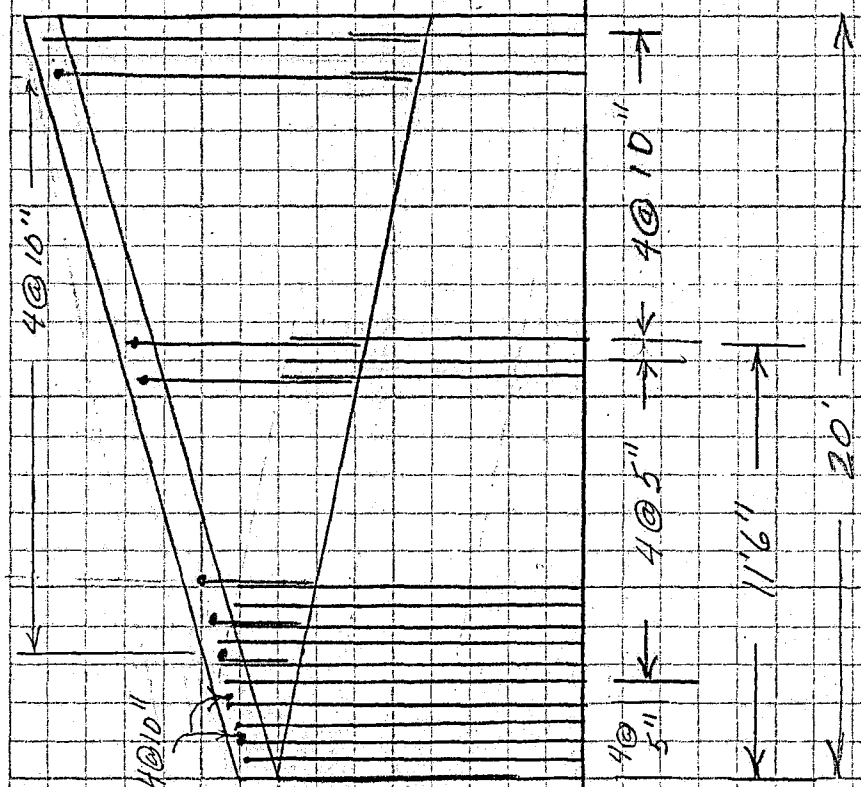
SCS-523A REV 5-58 SOIL CONSERVATION SERV

STATE Arizona PROJECT Powerline Channel

BY Watt DATE 5-27-65 CHECKED BY DATE JOB NO.

SUBJECT Transition to S.A.F.S.T.R. SHEET C OF

Plan View steel



COMPUTATION SHEET
SCS 523A REV 8-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline JOB NO.

BY EWatt DATE 5-14-65 CHECKED BY DATE SHEET OF

SUBJECT Try W = 30'

Total Drop from W.S. in Channel to W.S. in SAF

Depth of water in Channel	+5.0
Drop in grade	3.0
Floor Blk Below Grade	3.0 ±
Depth WS in SAF	-2.0

Total = 9.0'

$V_{ch} = 16.35$ $Q = 1200$

$\frac{V_1^2}{2g} = 9 + \frac{16.35^2}{29} =$

$V_2 = 29$ ft/sec

Length of Saf Str = $\frac{30-16}{2} \times 8 = 56'$ Call 60'

Width at $L_B = 30 - \frac{14 \times 16}{60} = 23.6$

$A = \frac{1200}{29} = 41.4$ $d_1 = 1.75$

$L_B = 14'$ $J = 11.0$ Total depth = 11.0 + 6.3 - 3.2 = 14.1 ft

$F = \frac{29.0^2}{32.2 \times 1.75} = 14.92$ Too damn high

$d_2' = \frac{1.4 \times 1.75 \times 14.92^{.475}}{.45} = 8.52$ = Tail water

3.2 = Depth in channel

5.3 = Hole depth

Too damn deep

$Z = 3\sqrt{14.92} = 11.6 = 12:1$

Length = $12 \times \frac{(30-16)}{2} = 84$ ft Too damn long

COMPUTATION SHEET
SCS-523A REV 5-56

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT | JOB NO C

BY Watt | DATE | CHECKED BY | DATE

SUBJECT

SHEET | OF

Try $W = 24'$ $L = 40'$

Width at top blocks

$$24 - 8\frac{22}{40} = 19.60$$

$$d_1 = \frac{1200}{29 \times 19.60} = 2.11$$

$$F = \frac{29^2}{32.2 \times 2.11} = 12.38$$

$$d_2 = \frac{2.11}{2}\left(\sqrt{12.38 \times 8 + 1} - 1\right) = 9.5$$

$$d_2' = 2.11 \times 1.4 \times 12.38^{.45} = 9.2$$

$$L_B = \frac{9.5 \times 4.5}{12.38^{.38}} = 16.45$$

3.16

$$J = \frac{9.5}{3} + 9.2 = 12.3$$

$$S = .07 d_2 = .07 \times 9.5 = .67$$

$$Z = 3\sqrt{12.38} = 10.56$$

$$L = \frac{24-16}{2} \times 10.56 = 42.2'$$

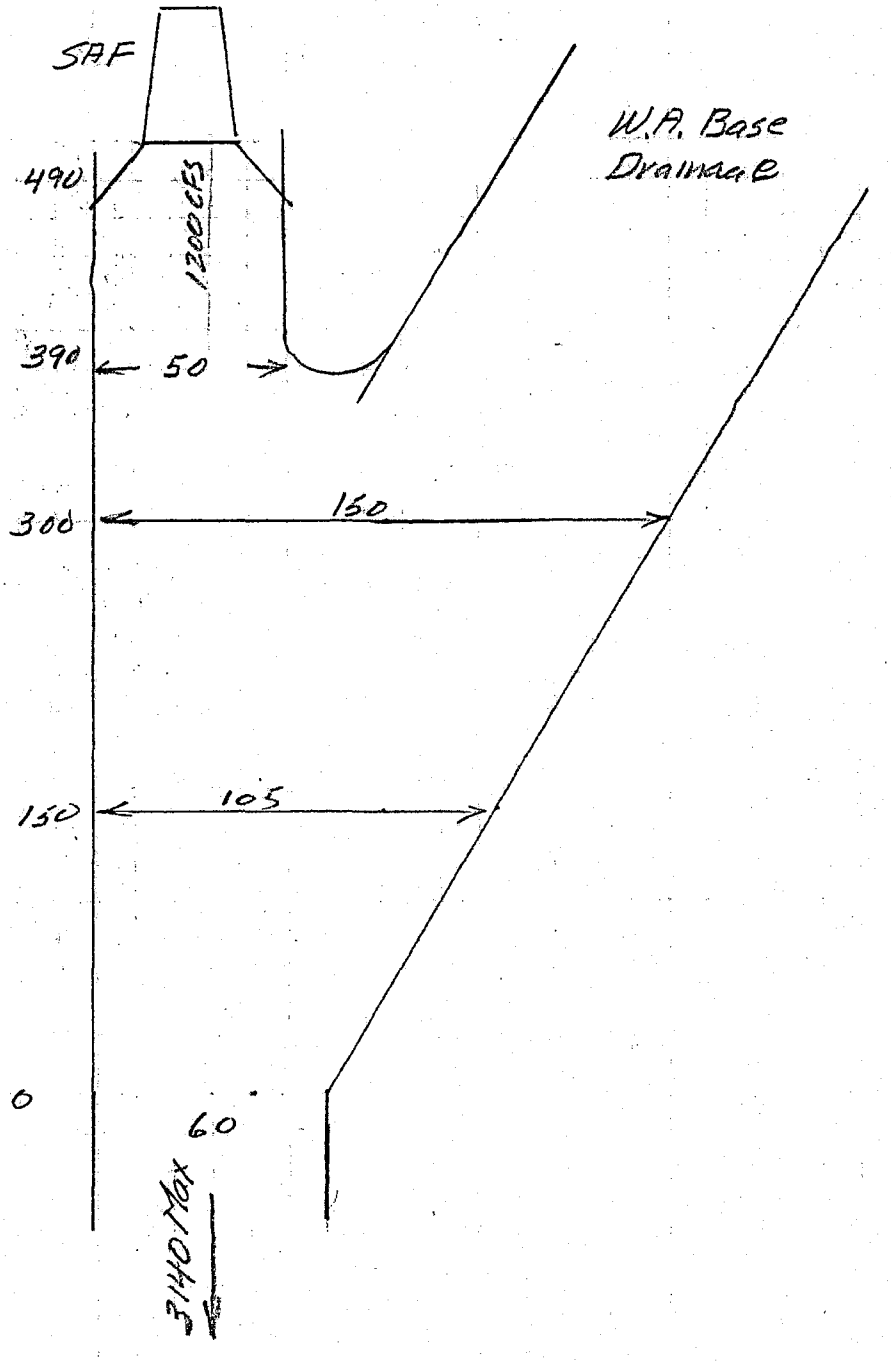
Blocks $= 3/4 \times 2.11 = \frac{6.33}{4} = 18''$

J + Extra Tail Water $12.3 + 6.3 - 3.2 = 16.4$

Use 16' Close enough for infrequent chance of occurance of short duration

$9.2 - 3.2 = 6.0$

Arizona Powerline Channel
Watt 5-14-65
Tail Water SAF Str



COMPUTATION SHEET — U.S. DEPARTMENT OF AGRICULTURE — SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Channel

BY Wath DATE 5-16-65 CHECKED BY DATE JOB NO.

SUBJECT Check Tail Water SAF Str SHEET OF

Min Tail Water 1200 CFS in SAF Str
0 CFS From W.A. Base.

Dist	b	n	Q/b	.5
0	60	.035		0041
150	105	.03	11.5	0041
300	150	.03	8.0	0041
390	50	.04		0041
490	50	.04		0041

From 0 – 150

@ 0 $Q=1200$ $S_f=.0041$ $V=5.7$ $d=3.2$ $h_v=.51$

Try $d=3.0$ @ 150

$V=\frac{11.5}{3}=3.8$ $h_v=0.22$ $S_f=0014$

$h_f=(.0041+.0014)\frac{150}{2}=$ +.41
$h_v=.51-.22=$ +.29
$S=-150\times.41$ −.61
Depth @ 0 3.2
Depth @ 150 3.29

Try $d=3.3$ $V=3.5$ $h_v=0.19$ $S_f=0010$

$h_f=(.0041+0010)\frac{150}{2}=$ +.38
$h_v=.51-.19$ +.32
$S=-150\times.41$ −.61
Depth @ 0 3.2
Depth @ 150 3.29 Call 3.30K

From 150 to 300 Try $d=3.0$

@ 300 $V=8/3=2.7$ $h_v=.11$ $S_f=0007$

$h_f=(.0007+0010)\frac{150}{2}=$ +.13
$h_v=.19-.11$ +.08
$S=150\times.41$ −.61 Depth = 2.9

COMPUTATION SHEET — U. S. DEPARTMENT OF AGRICULTURE — SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Channel

BY Watt | DATE 5-16-65 | CHECKED BY | DATE | JOB NO.

SUBJECT Check Tail Water SAF Str | SHEET | OF

From 150 to 300 Try $d = 2.9$

@ 300 $V = 2.8$ $h_v = .12$ $S_f = .0007$

$h_f = (.0007 + .0010)\frac{150}{2}$ $= +.13$

$h_v = .19 - .12$	$+.07$
$S = 150 \times .41$	$-.61$
Depth @ 150	3.3
Depth at 300	2.89 Call 2.9

From 300 to 390

at 390 try $d = 3.0$

$h_f = \frac{(.014 + .0007)90}{2} =$ $+.64$ } too big

$h_v = -.84 + .12$ $-.72$ } Jump.

$S = .0041 \times 90 =$ $-.37$ }

D_c for 50' channel 1200 CFS 2:1 side slopes $= 2.53$

If depth was at critical @ 390

From ES-129 $n^2 \ell = .16$ for 100'

.08 for 50

.04 for 25

Pist	D
390	2.53
415	3.20
440	3.37
465	3.46 = Min tail Water for 1200 C.F.S. from Conc. Channel (Used 3.2) OK

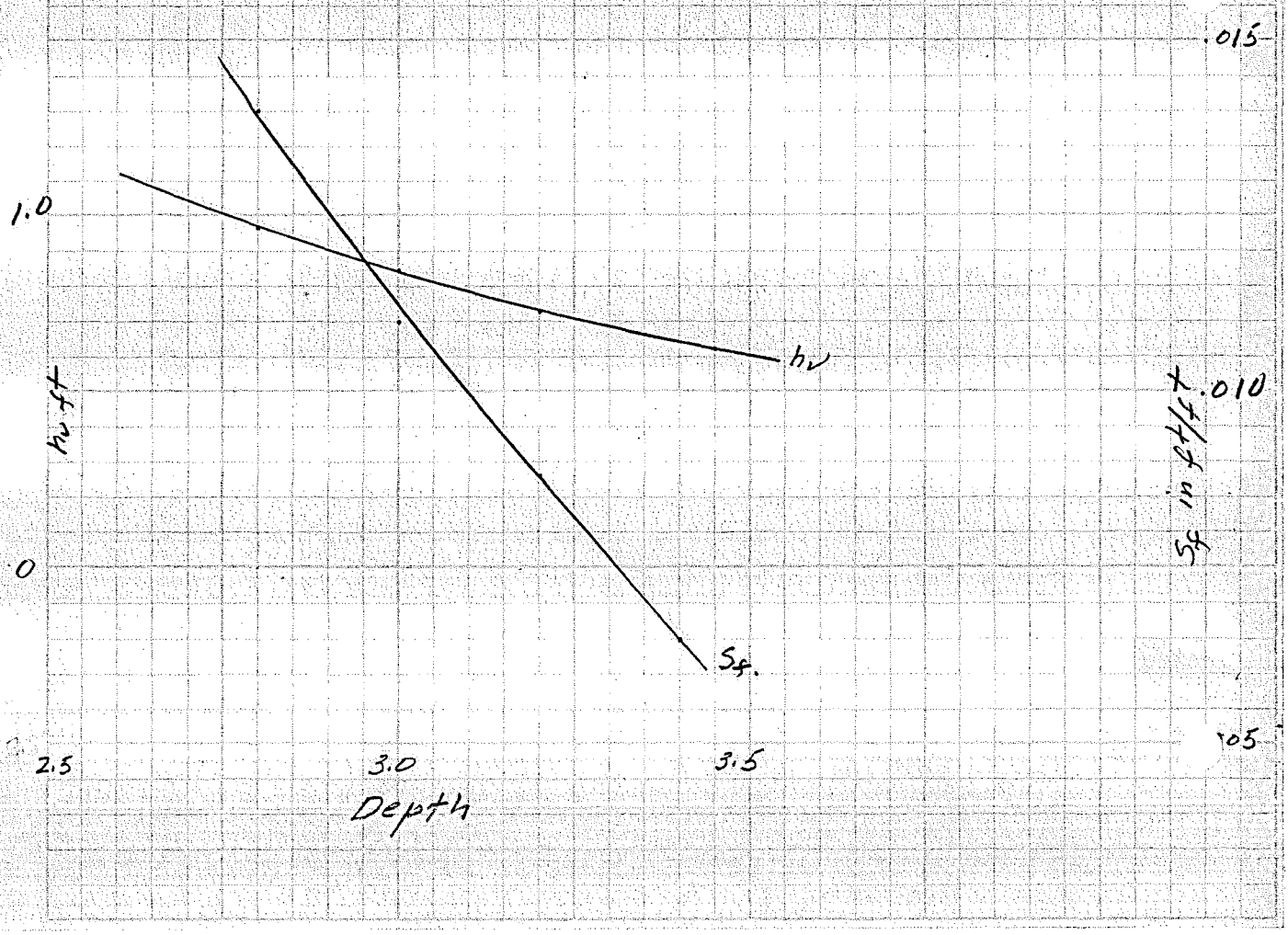
Max tail water would be approx 6' or max water surface in full channel. with W.A. Base Drainage at max Discharge.

Note 1200 CFS in Conc. Channel with no flow in W.A. Base Drainage is almost impossible. because approx 650 C.F.S. would come from below dams into conc channel & none from same area into W.A. Base drainage. However it does give figure for min tail water for S.A.F.

Arizona Powerline Channel
Wath 5-16-65

Elements Hydraulics for 50' Channel - 1200 CFS

	A	V	hv	P	R	S_f
2.8	151.8	7.90	.97	62.5	2.4	.014
3.0	163.5	7.33	.84	63.4	2.6	.011
3.2	175.4	6.84	.72	64.3	2.7	.0088
3.4	187.3	6.40	.62	65.2	2.9	.0070
6.0	354	3.38	.18	76.8	4.6	.0011
2.6	140.1	8.50	1.11	61.5	2.3	.0017

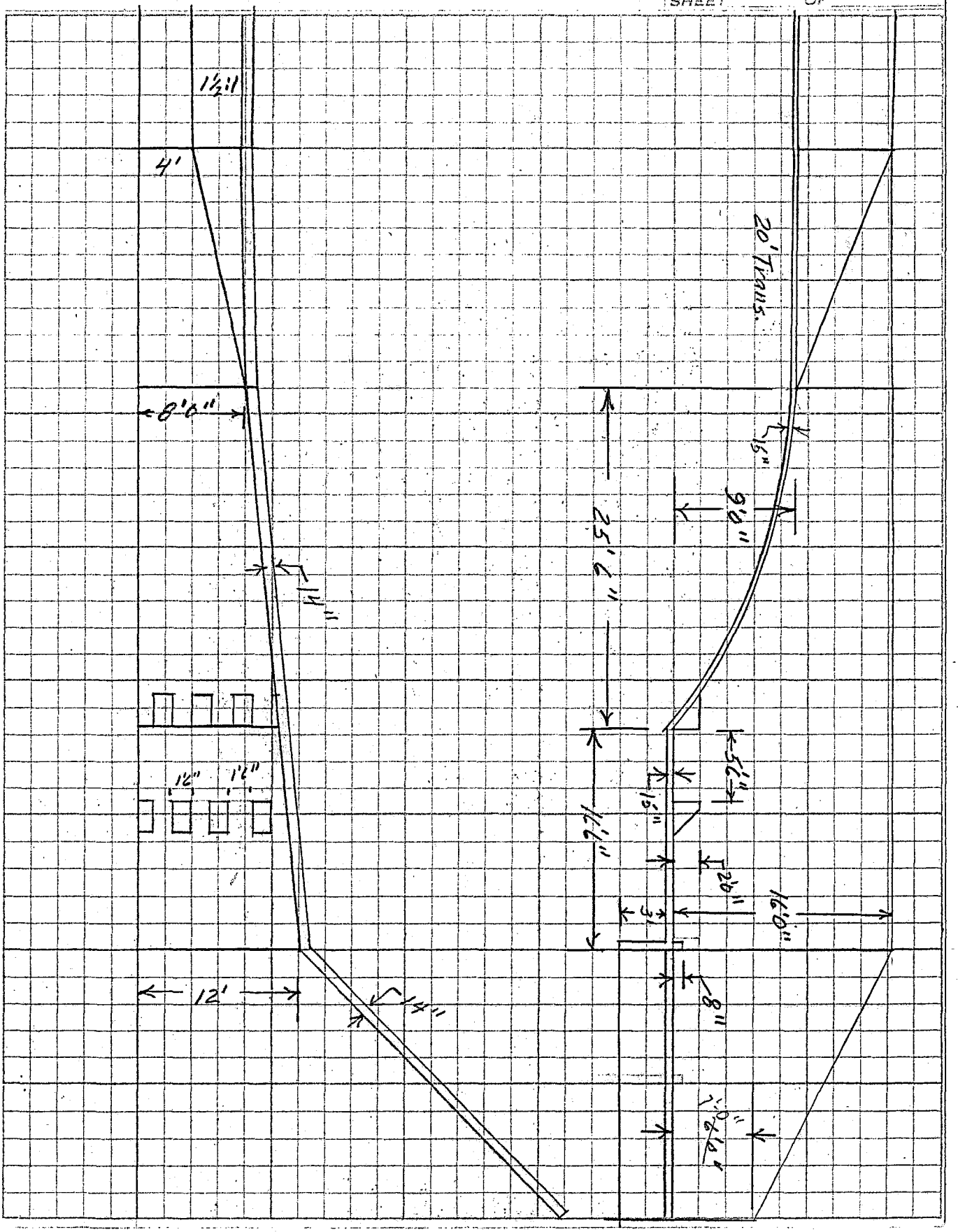


COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO 1951 O—497527

STATE		PROJECT		
BY	DATE	CHECKED BY	DATE	JOB NO. C
SUBJECT				SHEET OF



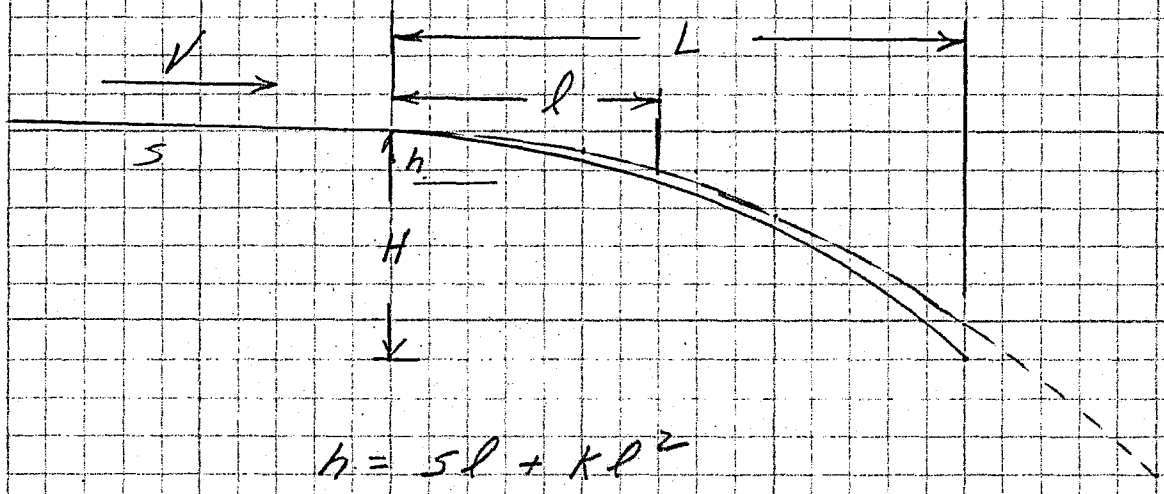
COMPUTATION SHEET
SCS-523A REV 5-56

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE | PROJECT

BY | DATE | CHECKED BY | DATE | JOB NO C

SUBJECT | SHEET OF



$$h = Sl + Kl^2$$

$$K = \frac{H - SL}{L^2}$$

$$V_a = \sqrt{\frac{g}{2K}}$$

V_a should be greater than V

For $H = 9$ $L = 25.5$ $S = .0044$

$$K = \frac{9 - 25.5 \times .0044}{25.5^2} = .0137 \qquad V_a = \sqrt{\frac{16.1}{.0137}} = 34.2 \text{ ok}$$

$$h = .0044l + .0137l^2$$

l	Sl	Kl^2	h	h Inches
5.5	.02	.41	.43	5"
10.5	.05	1.51	1.56	1'6½"
15.5	.07	3.29	3.36	3'4¼"
20.5	.09	5.75	5.84	5'7"
25.5	.11	8.90	9.0	9'0"

When deep $H = 7'0$

$$.0137l^2 + .0044l - 7.0 = 0$$

$$l^2 + .321l - 510.95 = 0$$

$$l = \frac{-.321 \pm 45.21}{2} = 22.44$$

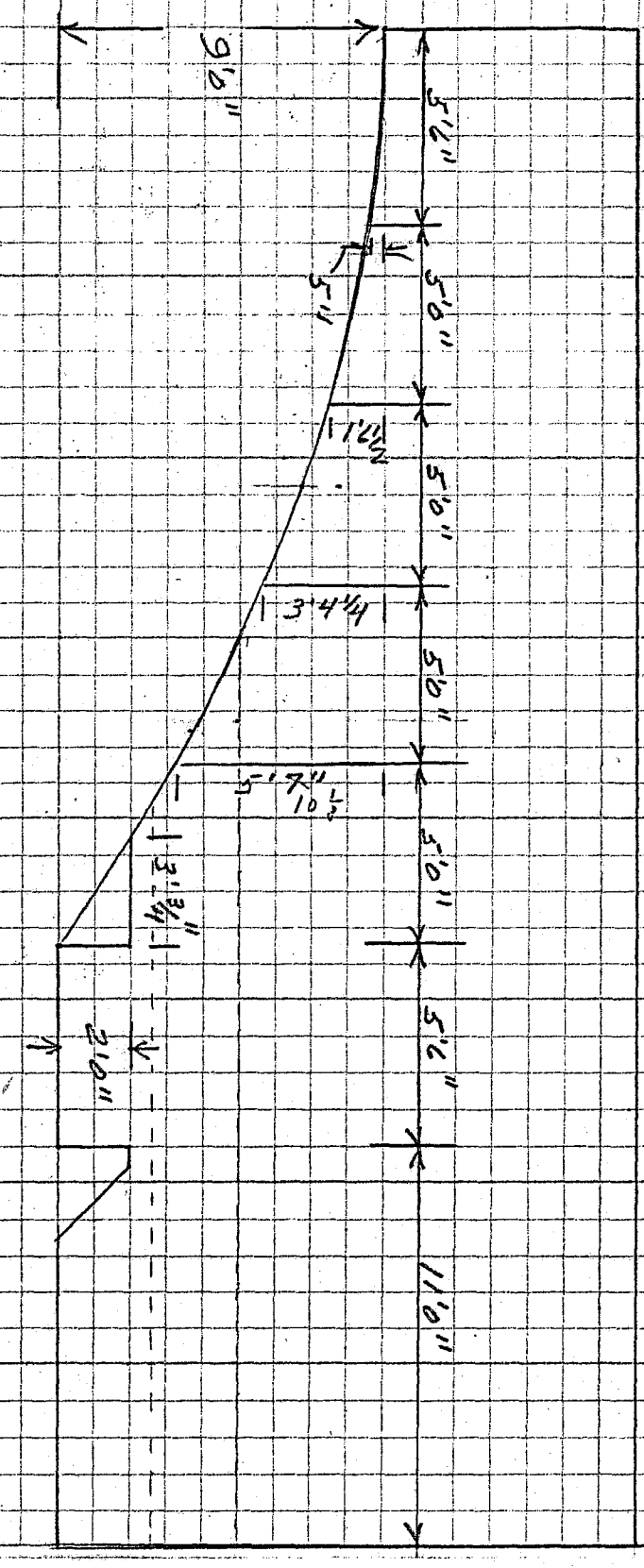
$$25.5 - 22.44 = 3.06$$

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO : 1959 O—487927

STATE		PROJECT		
BY	DATE	CHECKED BY	DATE	JOB NO.
SUBJECT				SHEET C OF



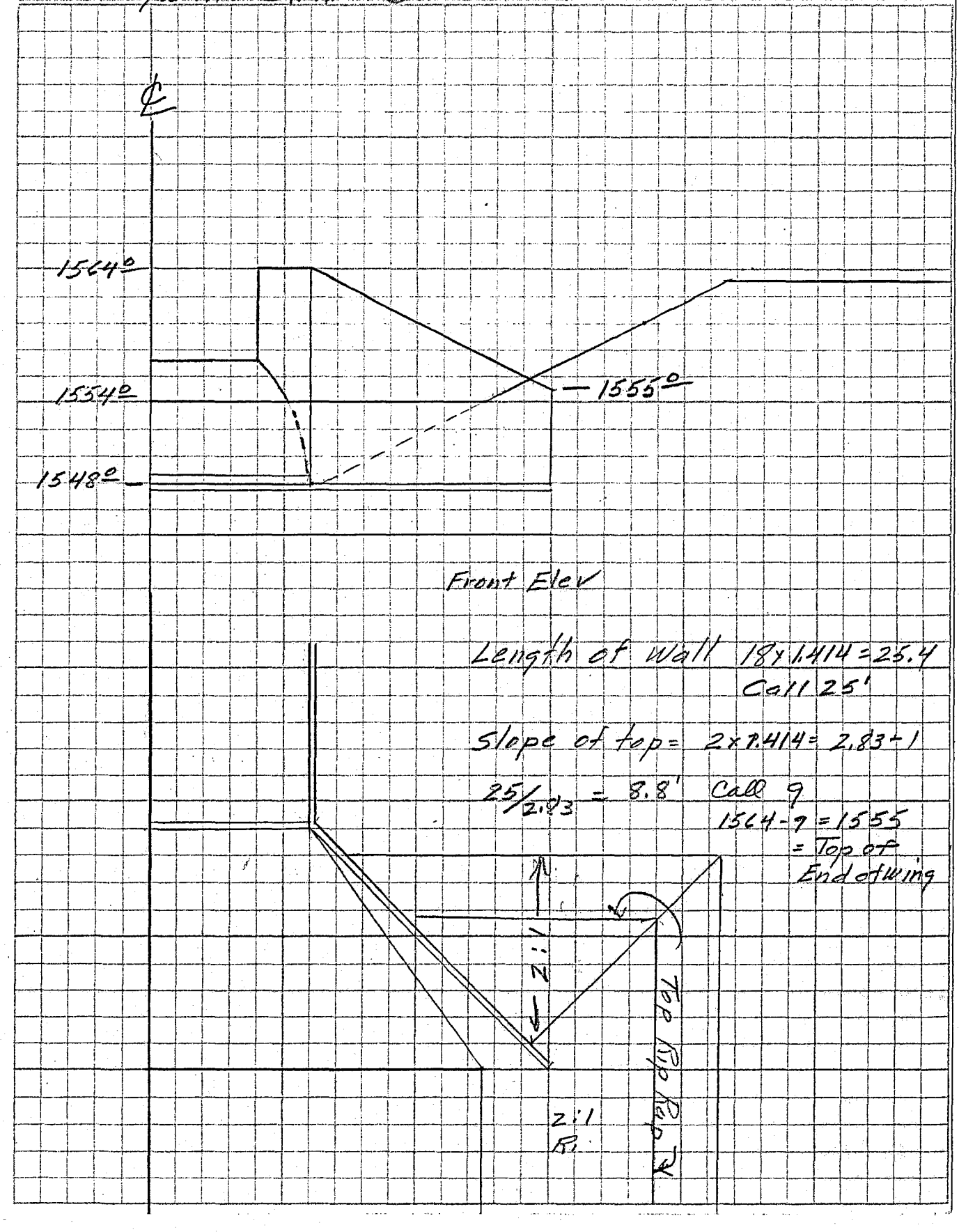
COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE | PROJECT

BY | DATE | CHECKED BY | DATE | JOB NO. C

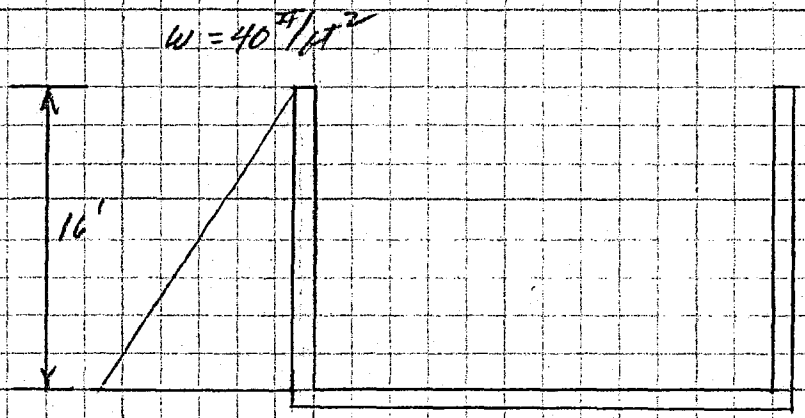
SUBJECT Wing Wall S.A.F Structure | SHEET | OF



COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Channel C
BY Watt | DATE 5-19-65 | CHECKED BY | DATE | JOB NO.
SUBJECT Side Walls S.A.F. Structure | SHEET | OF



$M = \frac{wl^3}{6} = \frac{40 \times 16^3}{6} = 27{,}306$ ft-lbs

$d = 10.7''$ $A_s = 1.75$

Use 14" walls No 7 # @ 4"

$\text{Shear} = \frac{40 \times 16}{2} = 5120\#$

$v = \frac{5120 \times 8}{7 \times 11.5 \times 12} = 42\ \#/in^2$ OK

$\frac{wl^2}{12}$

$\text{Bond} = \frac{5120 \times 8}{7 \times 8.25 \times 11.5} = 62\ \#/in^2$ OK

M for #7 @ 8" =

$A_s = 9^0$ $d = 11.5$

$M = 15$ ft K $= \frac{40l^3}{6} = 15{,}000$

$l^3 = 2{,}250$ $l = 13.1$ ft Stop even

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Channel
BY Watt | DATE 5-19-65 | CHECKED BY | DATE | JOB NO C
SUBJECT Side Wall Steel SAF Str | SHEET ____ OF ____

Use No 8 @ 5½" $A_s = 1.71$

Splice to No 6 @ 5½" $A_s = .96$

$M = 16{,}000$ ft-lbs $= \frac{40}{6} \ell^3$

$\ell = 13.4'$ $16 - 13.4 = \underline{2.6 \text{ from Floor}}$

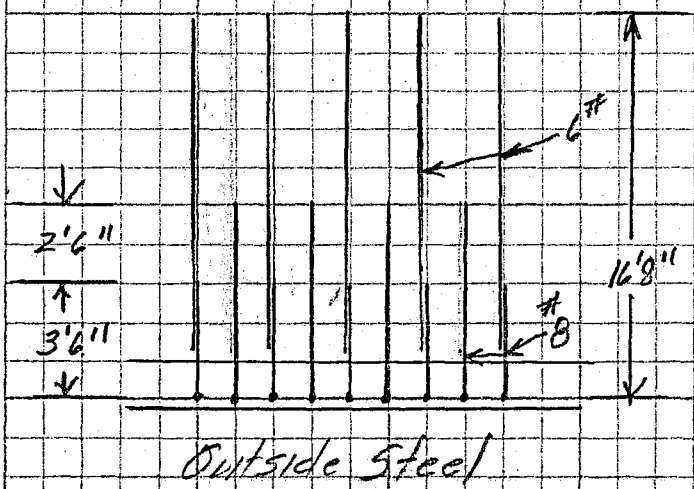
Cut off ½ of No 6 @

$A_s = 0.48$ $M = 8500$ ft-lbs

$\ell^3 = \frac{8500 \times 6}{40} = 10.9'$

$16 - 10.9 = \underline{5.1 \text{ from Floor.}}$

Might as well make every other bar 6' long



Outside Steel

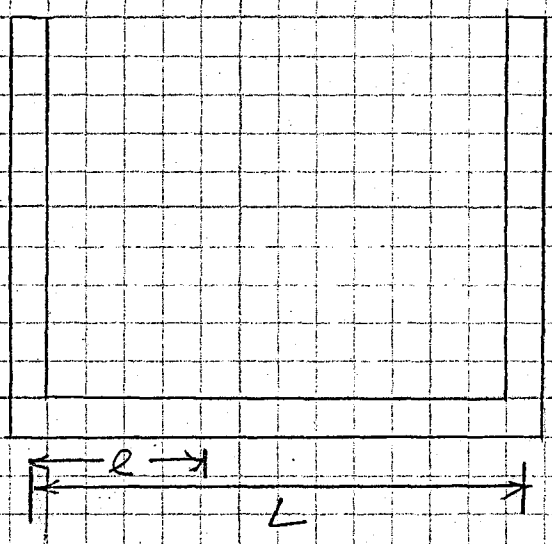
COMPUTATION SHEET
SCS-523A REV 5-56

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE: Arizona | PROJECT: Powerline Channel C

BY: Watt | DATE: 5-20-65 | CHECKED BY: | DATE: | JOB NO.:

SUBJECT: Moments on Floor | SHEET ___ OF ___



Wt of walls

$16 \times 1.167 \times 150 \times 2 = 5600^{\#}$

$M_s = 2800\ell - \frac{5600\ell^2}{L\ 2}$

$= 28\ell - \frac{28\ell^2}{L}$

M_o Fixed $= \frac{560L}{12} =$

ℓ	L = 25	L = 21
0	0	0
1/8 ℓ	7.66	6.44
1/4 ℓ	13.13	11.03
3/8 ℓ	16.41	13.79
1/2 ℓ	17.50	14.70
0 Fixed	11.65	9.78

Min $L = -(24-16)\frac{16.5}{42} + 24 = 20.85$

Span Length = 20.85 + 1 = 21.85

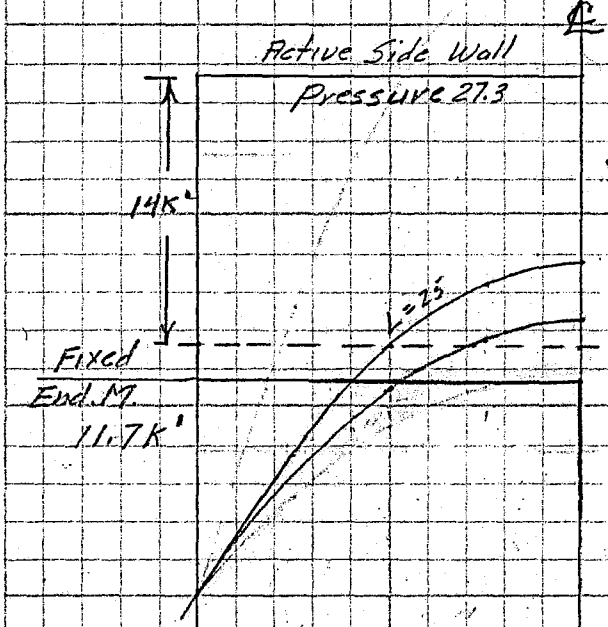
27.50
17.5

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO 1959 O-487827

STATE Arizona | PROJECT Powerline Channel
BY Watt | DATE 5-20-65 | CHECKED BY | DATE | JOB NO. C
SUBJECT Moments on Basin Floor | SHEET | OF

No Backfill



M for No 8 bars @ 11" A_s = .185 d = 11.5

M = 14 ft K

M for No 6 @ 5½" = 16.000 ft K

OK @ 3/8 of 17 = = 6.4 12.8

Pre-Backfill M = 17.5 d = 11½

Inside steel A_s = 1.00

Use 6#@12" + 7#@12"

Cut off 7@ M = 7.8 @ ⅛ of 25 + 3'8

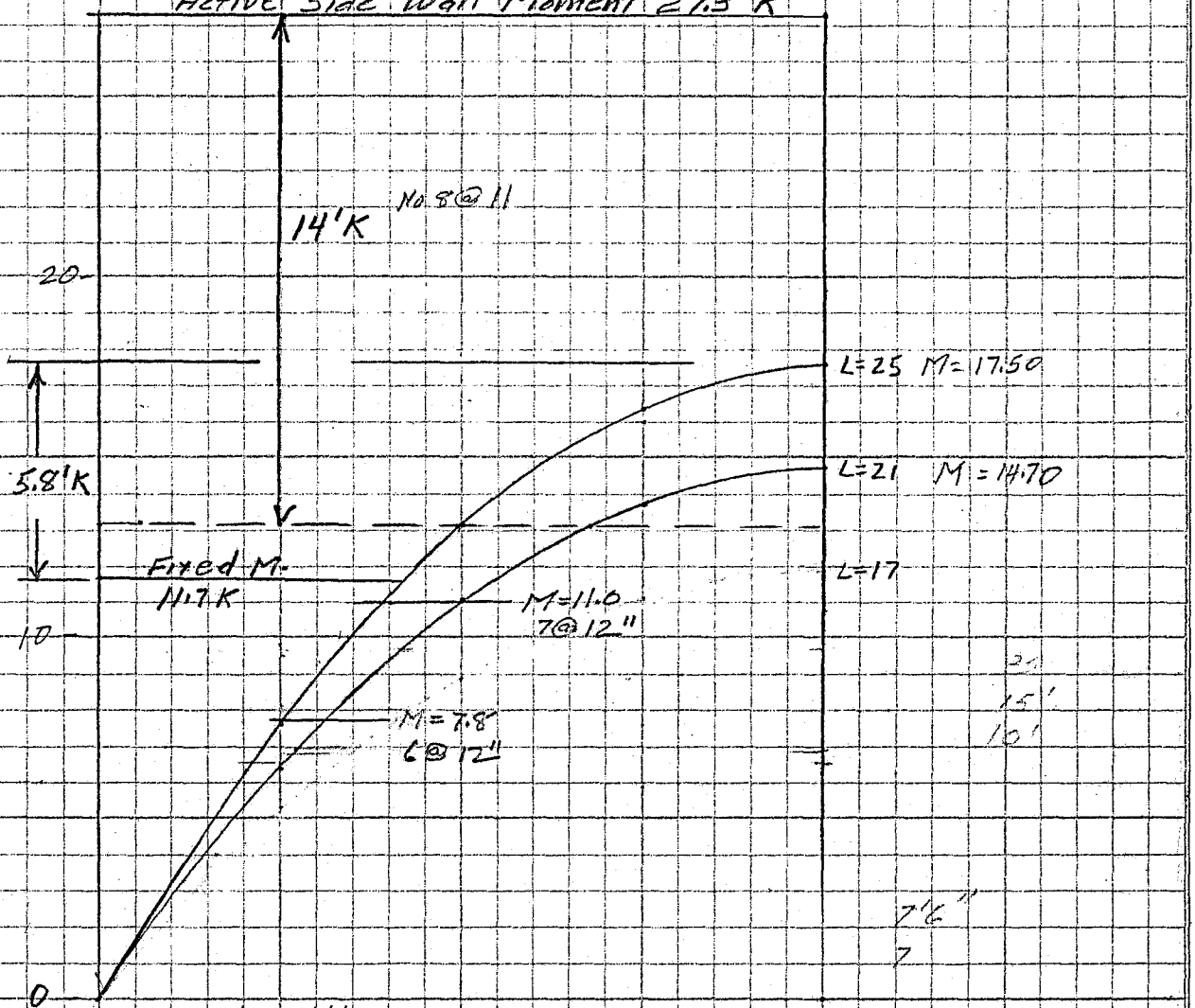
or 6@ M = 11 @ 5/40 of 25 = 5'0" Saves more

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Channel
BY Watt | DATE 5-20-65 | CHECKED BY | DATE | JOB NO
SUBJECT SAF Structural Design | SHEET | OF

Moment on Basin Floor



For 21' Width
$\frac{13.5}{20} \times 10.5 = 7.10$

For 25' Width
$\frac{10}{20} \times 12.5 = 6.25$

Cut every other bar @ 7'6" long

Outside Steel

COMPUTATION SHEET

SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE

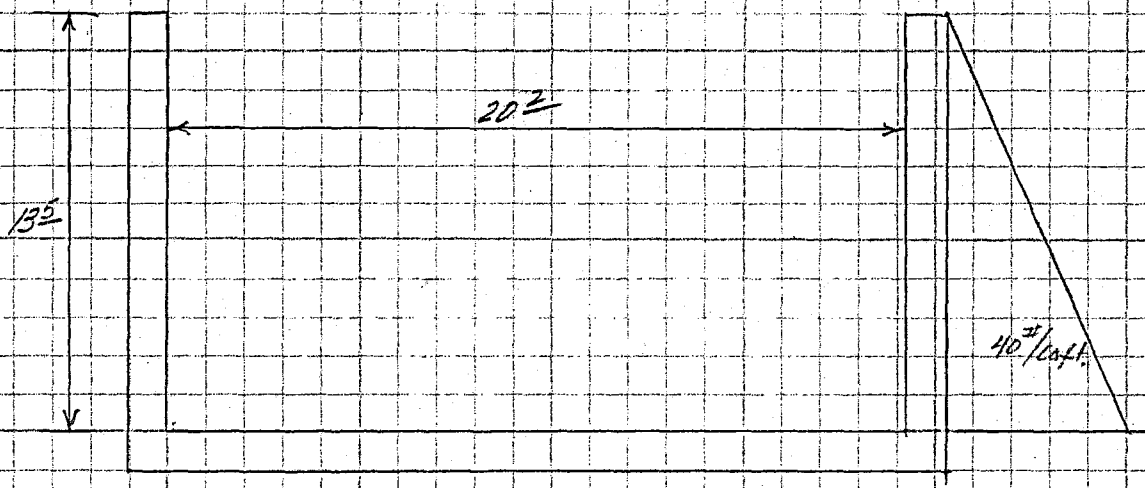
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Channel

BY Watt | DATE 5-24-65 | CHECKED BY | DATE | JOB NO

SUBJECT SAF Str. | SHEET C

Floor Moments @ H = 13.5 W = $24 - \frac{20}{42} \times 8 = 20.2$



$M_1 = \frac{40 \times 13.5^2}{6} = 16{,}400$ ft lbs

Wt of walls = $13.5 \times 1.167 \times 150 \times 2 = 4726$

$M_s = 2.363\,\ell - \frac{2.363\,\ell^2}{L}$

L = 21.2

ℓ	
1/8 L	5.48 ft K
1/4 L	9.39
3/8 L	11.74
1/2 L	12.53

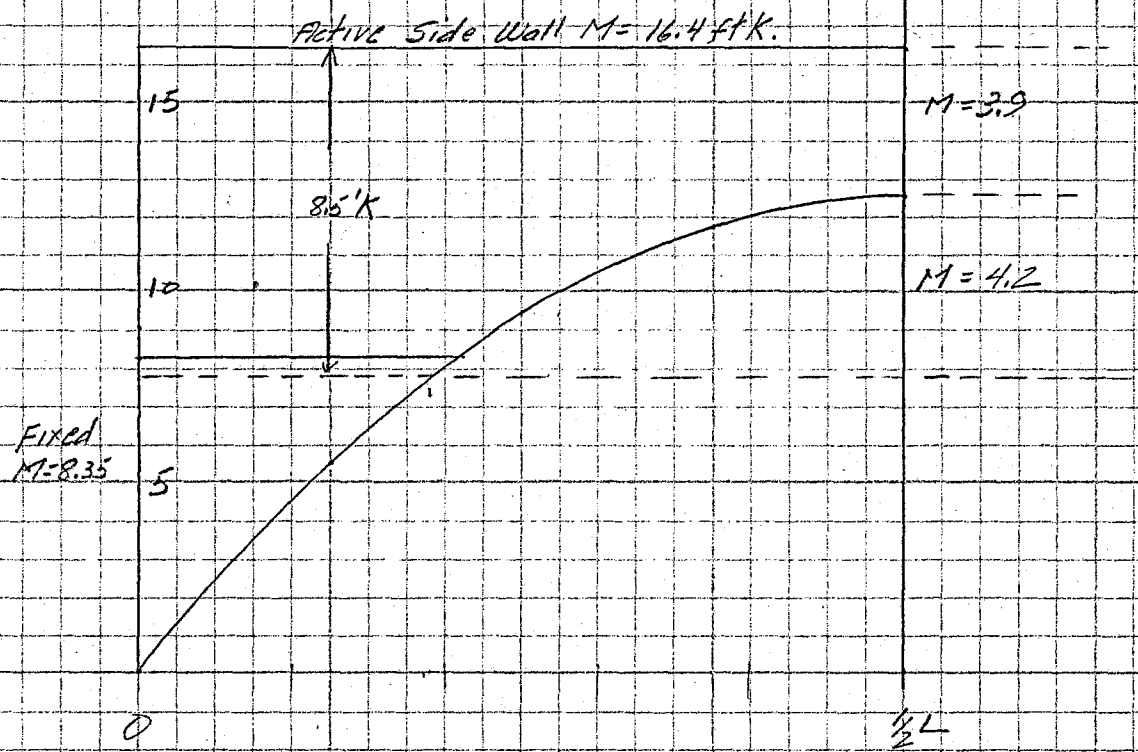
Fixed end = $\frac{4.726 \times 21.2}{12} = 8.35$ ft K.

COMPUTATION SHEET
SCS-523A REV 5-58

U. S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Channel
BY Watt | DATE 5-24-65 | CHECKED BY | DATE | JOB NO C
SUBJECT SAF Str | SHEET | OF

Floor Moments @ H = 13.5 W = 20.2



For No 6 @ 11 M = 8500

Length to carry 6 @ 5½ = .2 × 20.2 = 4.04
+.5
Make 4½'

Pre Backfill

Inside Floor steel = M = 12.5 d = 11.5 As = 0.72

Use 5# @ 12" & 6 @ 12" redand

Cutoff 5# @ M = 7.7 = $\frac{7.5}{40}$ × 20.2 = 3.8'

Horizontal Steel Inside No 5 @ 11"

Outside No 4 @ 12"

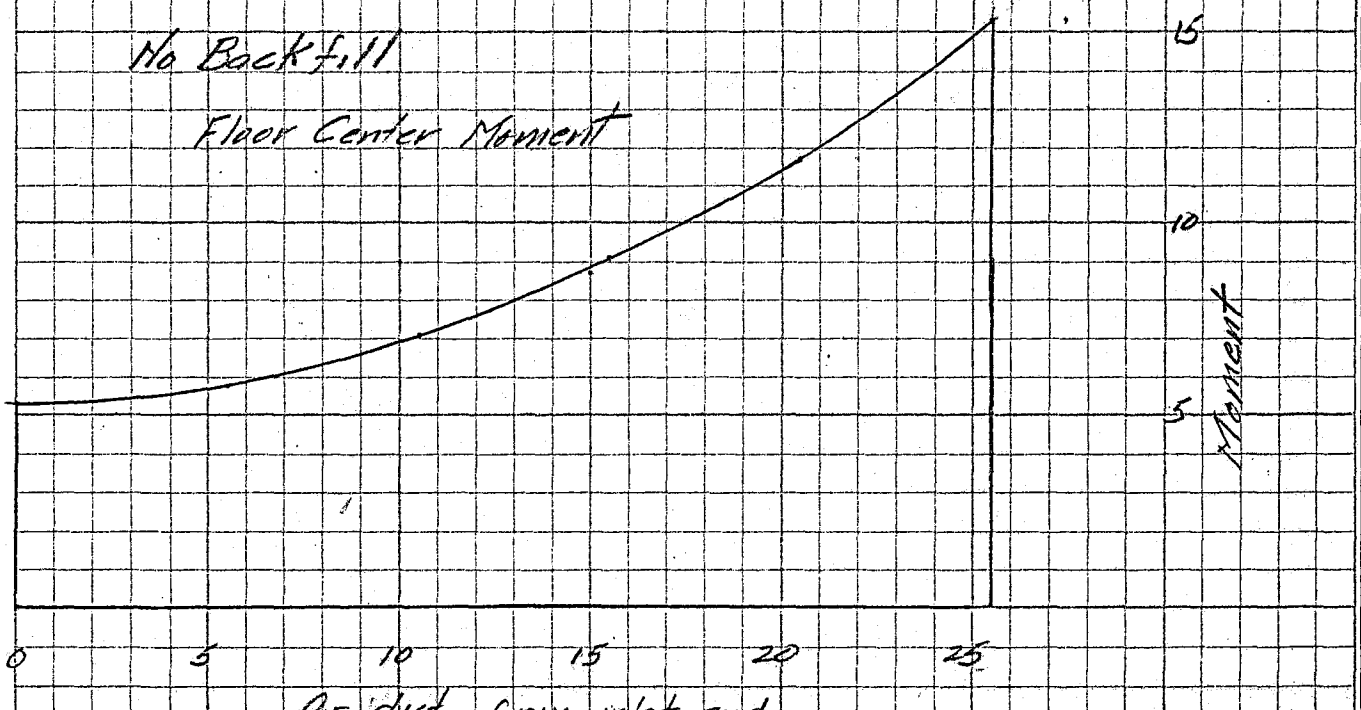
Temp Steel = 5 @ 11"

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Channel
BY Watt | DATE 5-25-65 | CHECKED BY | DATE | JOB NO.
SUBJECT Center Moment Floor SAF Str | SHEET | OF

ℓ	h	wt Walls	Span .1905ℓ+17	Wt per Ft	M center Simple Span
0	7.0	2.457	17	144.5	5220
5.5	7.43	2608	18.0	144.9	5868
10.5	8.56	3005	19.0	158.2	7139
15.5	10.36	3636	20.0	181.8	9090
20.5	12.84	4507	20.9	215.6	11,772
25.5	16.00	5616	21.9	256.4	15,371



COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline
BY Watt | DATE 5-25-65 | CHECKED BY | DATE | JOB NO.
SUBJECT Steel SAF Str. Inside Face | SHEET C OF

Steel $d = 11.5$

Size	Spacing	Area	M
6	6"	.88	15.0
6	12"	.44	7.7

Position $M = \frac{1}{2} M_c$

$$\frac{\cancel{W}L\ell}{\cancel{2}} - \frac{\cancel{W}\ell^2}{\cancel{2}} = \frac{\cancel{W}L^2}{\cancel{8}_4} \times \frac{1}{2}$$

$$\ell^2 - L\ell + \frac{L^2}{8} = 0$$

$$\ell = \frac{L \pm \sqrt{L^2 - \frac{L^2}{2}}}{2} = \frac{L}{2} \pm \frac{L}{2}\sqrt{\frac{1}{2}} = \frac{2L \pm L\sqrt{2}}{4}$$

$$= .146L$$

500
.354
46

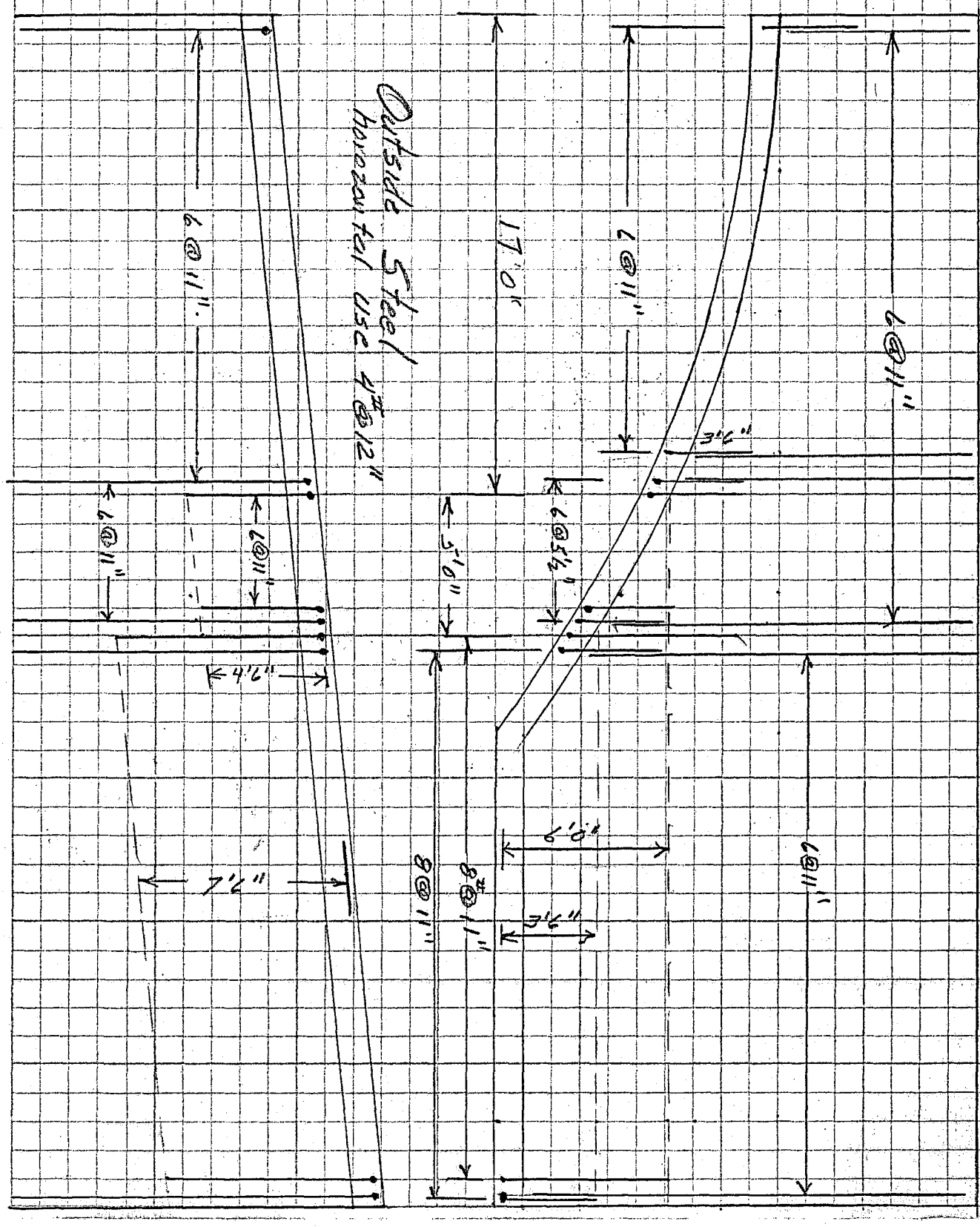
Cut half steel @ 21.9 x .146 = 2.16 from ℄ of Wall

@ 1½' ft from inside Face of Wall

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT Powerline Channel		
BY Watt	DATE 5-24-65	CHECKED BY	DATE	JOB NO. C
SUBJECT Outside Steel SAF Structure				SHEET ___ OF ___



COMPUTATION SHEET

SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE

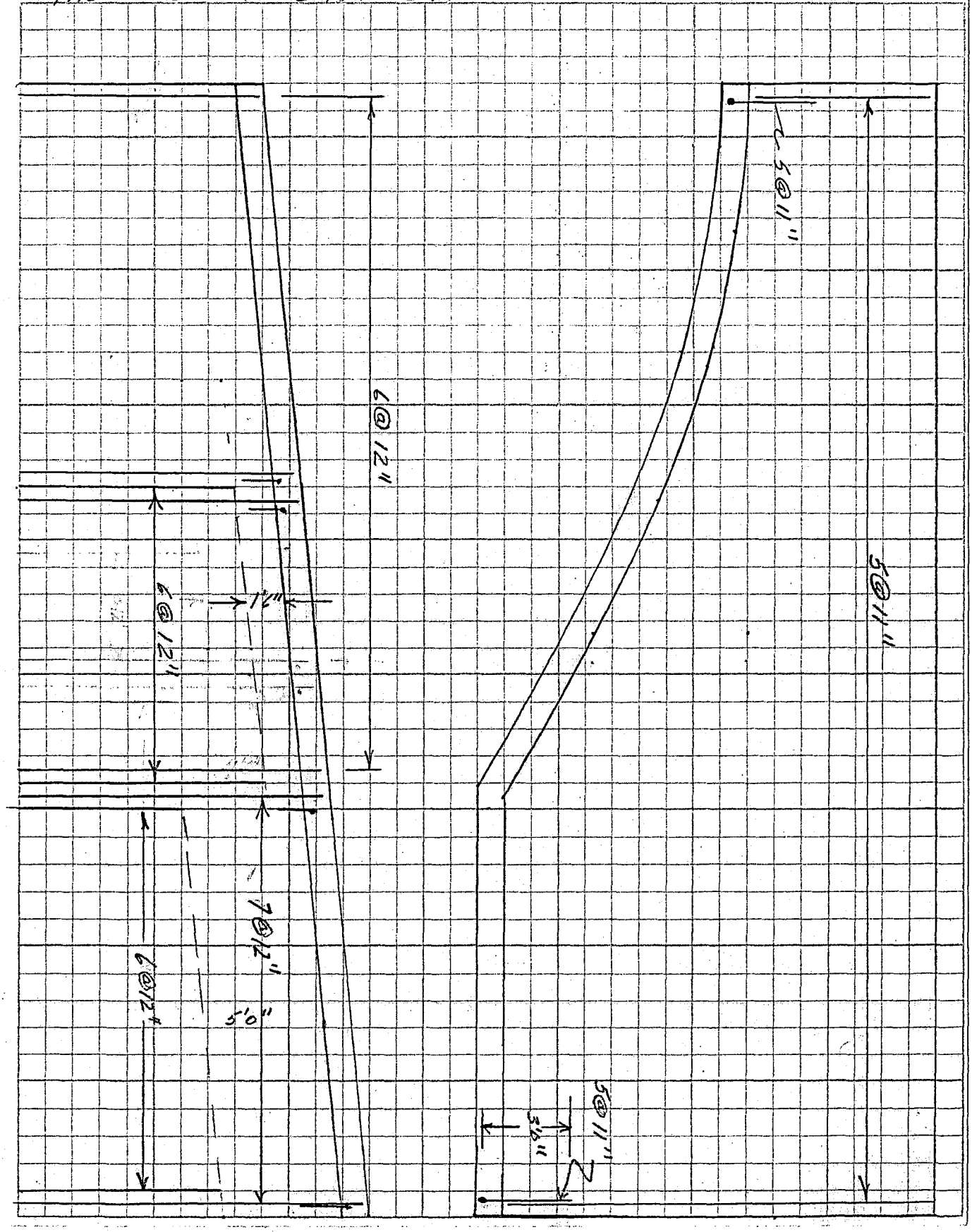
SOIL CONSERVATION SERVICE

STATE	PROJECT	
Arizona	Powerline Channel	
BY: Watt	DATE: 5-25-65	CHECKED BY:
DATE:	JOB NO:	

SUBJECT: Inside Steel SAF Str

C

SHEET ____ OF ____



COMPUTATION SHEET

SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE

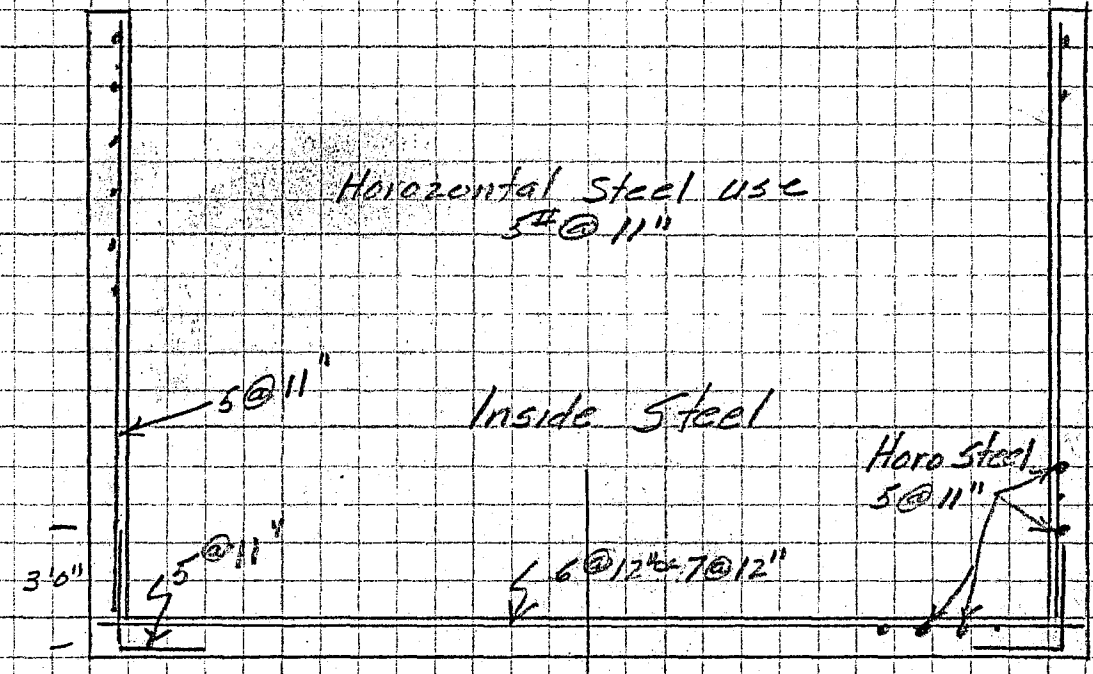
SOIL CONSERVATION SERVICE

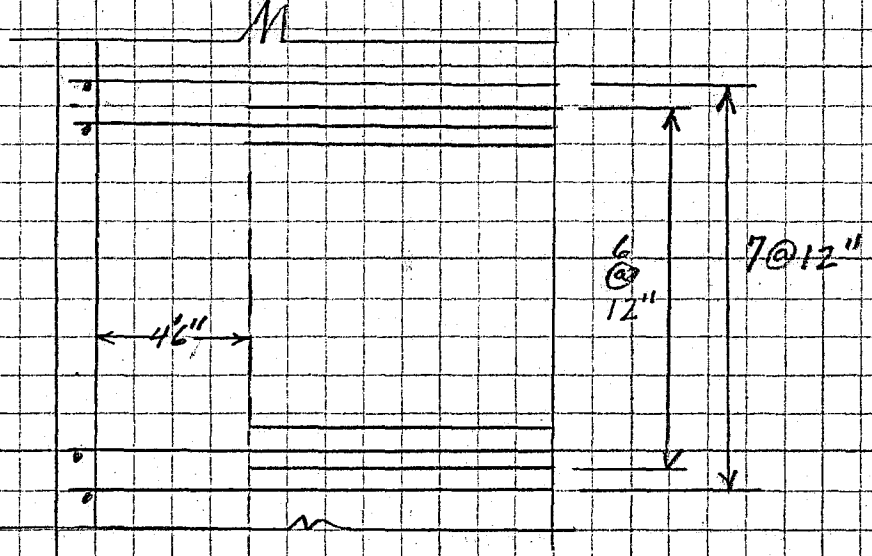
GPO 1958 O—487923

STATE Arizona | PROJECT Powerline Channel C

BY Watt | DATE 5-24-65 | CHECKED BY | DATE | JOB NO

SUBJECT Inside Steel SAF Str | SHEET | OF





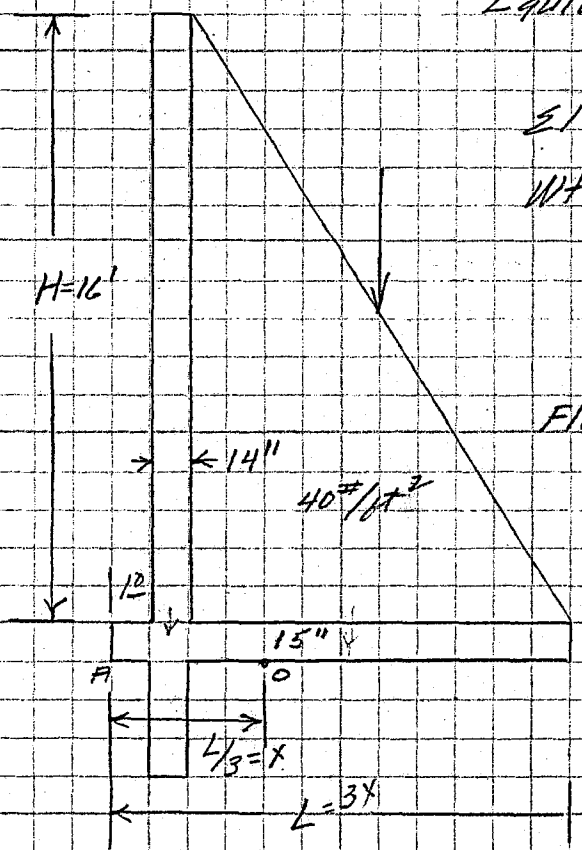
COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Channel
BY Watt | DATE 5-25-65 | CHECKED BY | DATE | JOB NO
SUBJECT Wing Wall SAF Structure | SHEET C OF

Wt of earth = 110 #/ft

Equiv Fluid pressure = 40 #/ft²



ΣM_o @ 1/3 Pt.

Wt of Earth = $(3X-2.17)\times 110\times 16\left[\frac{(3X-2.17)}{2}-(X-2.17)\right]$

$= 1760(3X-2.17)\left(\frac{X+2.17}{2}\right)$

$= 830(3X^2+4.34X-4.71)$

Floor Slab = $3X\cdot 1.25\times 150\left(\frac{3X}{2}-X\right)$

$= 281.25X^2$

− Wall = $16\times 1.167\times 150\,(X-1.58)$

$= -2800.8X + 4425.3$

Fluid pressure

$-\frac{40\times 16^2}{2}\left(\frac{16+1.25}{3}\right) = 33690$

$2490X^2+3602.20X-3909.30+281.25X^2-2800.8X+4425.3-27,306.7$

$2771.25X^2+801.32X-33,690 = 0$

$X^2+.289X-12.157=0$

$X = \frac{-.289 \pm \sqrt{1.0835+\quad}}{2} = 3.47$

$3X = 3.47\times 3 = 10.4$ Use 10½'

Check

$\frac{1760\times(10.5-2.17)(6.34)+2801\times 1.58+1969\times 5.25-33,690}{1760\,(10.5-2.17)+2801+1969} = \frac{74,023}{19,430}$

$X = 3.81$ ok within middle 1/3

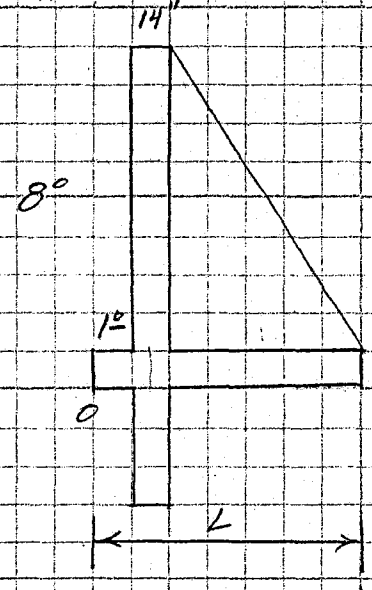
COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Channel
BY Watt | DATE 5-25-65 | CHECKED BY | DATE | JOB NO.
SUBJECT Width of Footing when Wing 8° high | SHEET | OF

Wt of Earth = 110 #/ft³

Equiv Fluid Pressure = 40 #/ft²



ΣM_o

Earth $110 \times 8 (L-2.17)\left[\frac{(L-2.17)}{2} + 2.17\right]$

$= 440 (L-2.17)(L+2.17)$

$= 440L^2 - 2072$

Floor Slab $= \frac{1.25 \times 150 L^2}{2} = 93.75L^2$

Wall $= 8 \times 1.17 \times 150 \times 1.58 = 2218$

Equiv Earth Pressure

$\frac{40 \times 64}{2} \times \left(\frac{8}{3} + 1.25\right) = 5012$

$$\frac{\Sigma M_o}{\Sigma F_v} = \frac{440L^2 - 2072 + 93.75L^2 + 2218 - 5012}{880(L-2.17) + 187.5L + 1404} = \frac{L}{3}$$

$$440L^2 - 2072 + 93.75L^2 + 2218 - 5012 = \frac{880L^2 - 1910 + 187.5L + 1404}{3}$$

$$440L^2 - 187.5L - 14092 = 0$$

$$L^2 - .426L - 32.03$$

$$L = \frac{.426 \pm 11.327}{2} = 5.87$$

COMPUTATION SHEET
SCS-523A REV 5-58

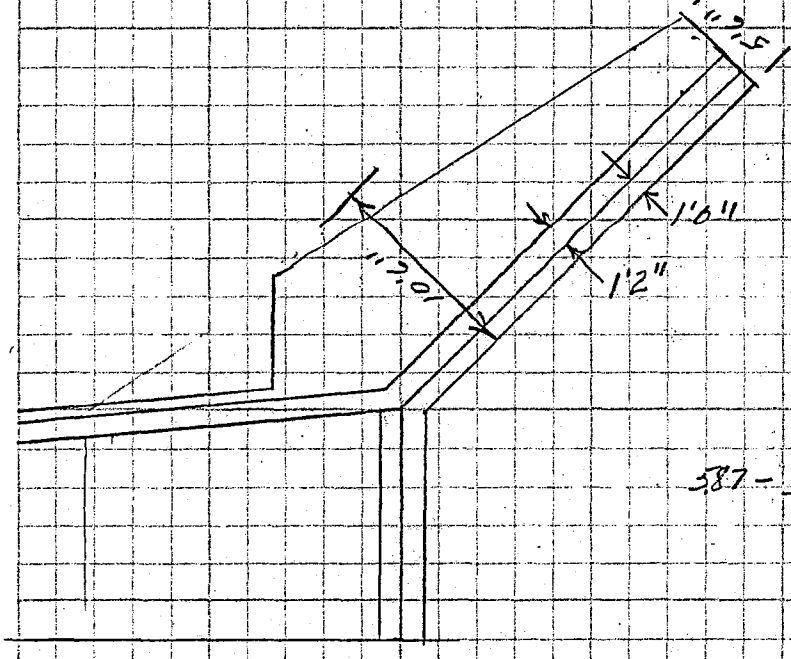
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT	
Arizona	Powerline Channel	
BY Watt	DATE 5-25-65	CHECKED BY / DATE / JOB NO.

SUBJECT SAF Structure

SHEET C-8

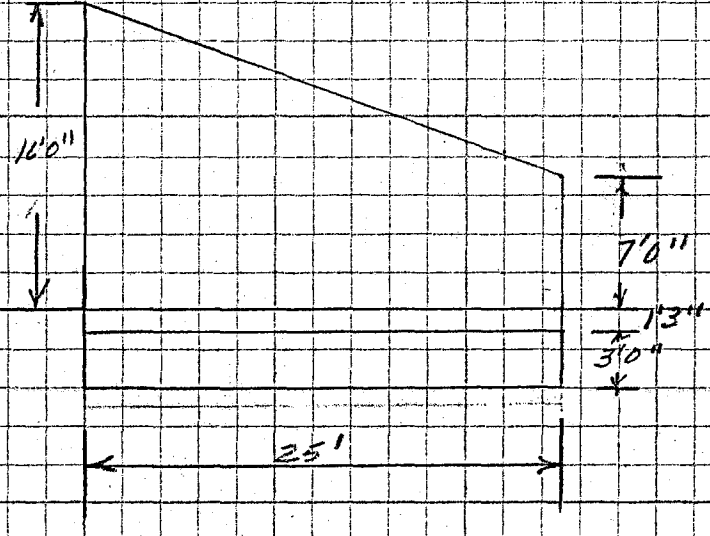
Dimensions of Wing Foundation



End width of footing

$$5.87 - \frac{10.5 - 5.87}{22} \times 1.5 = 5.5$$

Call 5'6"



COMPUTATION SHEET

SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

GPO . 1958 O—497927

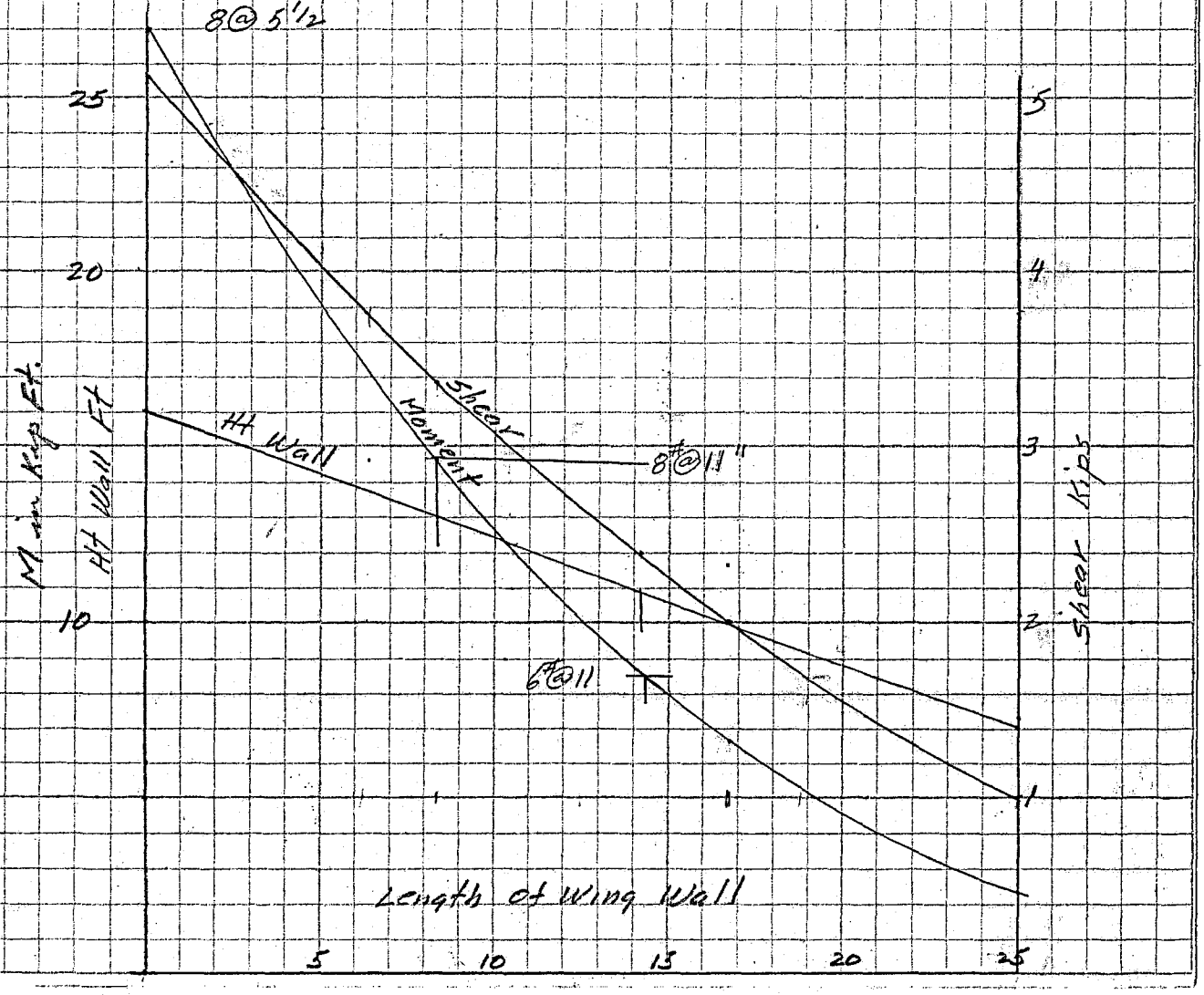
STATE Arizona | PROJECT

BY Watt | DATE 5-25-65 | CHECKED BY | DATE | JOB NO.

SUBJECT Moments on Wing Wall | SHEET 6 OF

Equiv. Fluid Pressure = 40 #/ft²

Ht of Wall	Shear $S = \frac{wh^2}{2}$	Moment $S = \frac{wh^3}{6}$	d = 11.5 Unit Shear
16	5120 lbs	27,306 ft lbs	42 #/in²
13	3380	14,646	30 #/in²
10	2000	6667	16
7	980	2286	8



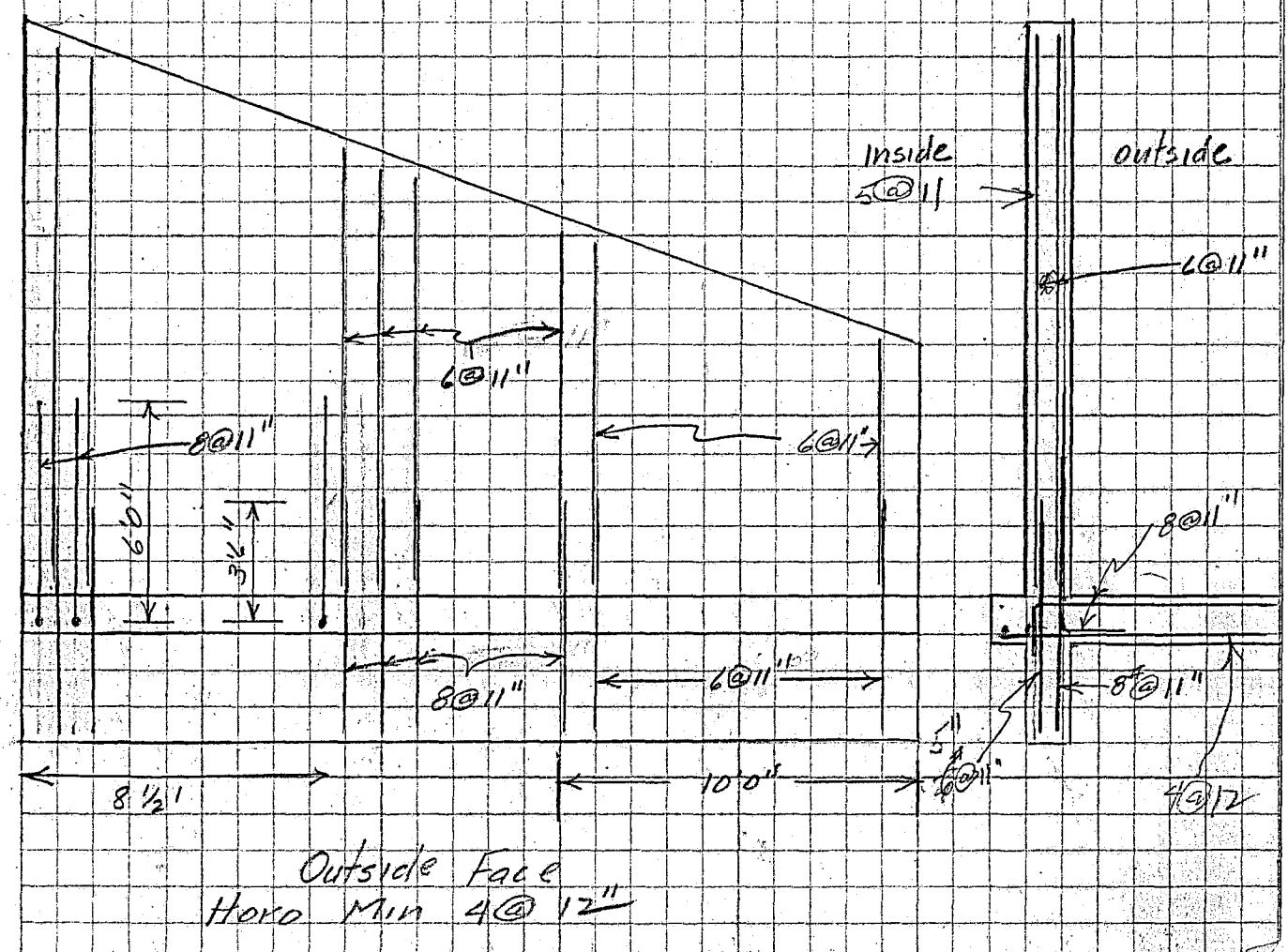
COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Channel
BY Watt | DATE 5-25-65 | CHECKED BY | DATE | JOB NO. C
SUBJECT SAF Str Wing Wall Steel | SHEET | OF

Resting Moment d = 11.5"

	A_s	M	Bond
No 8 @ 5½"	1.71	28'K	ΣP 6.85	83 #/in²
No 8 @ 11"	.86	15'K	3.43	109
No 6 @ 5½	.96	17'K	5.14	80
No 6 @ 11"	.48	8.5'K	2.57	103
No 5 @ 11"	.33	6'K	2.14	



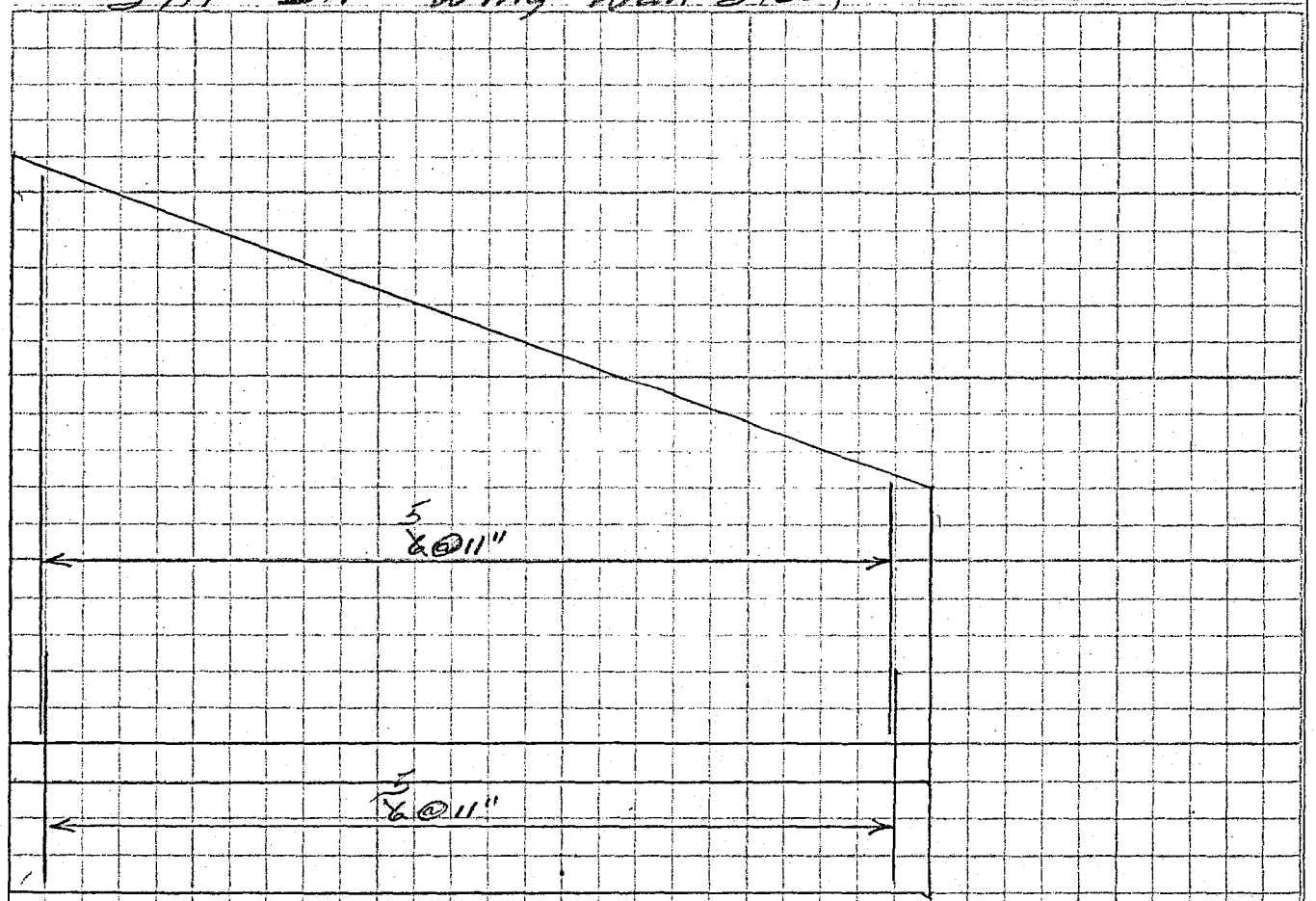
Outside Face
Horo Min 4@12"

COMPUTATION SHEET
SCS-533A REV 5-58

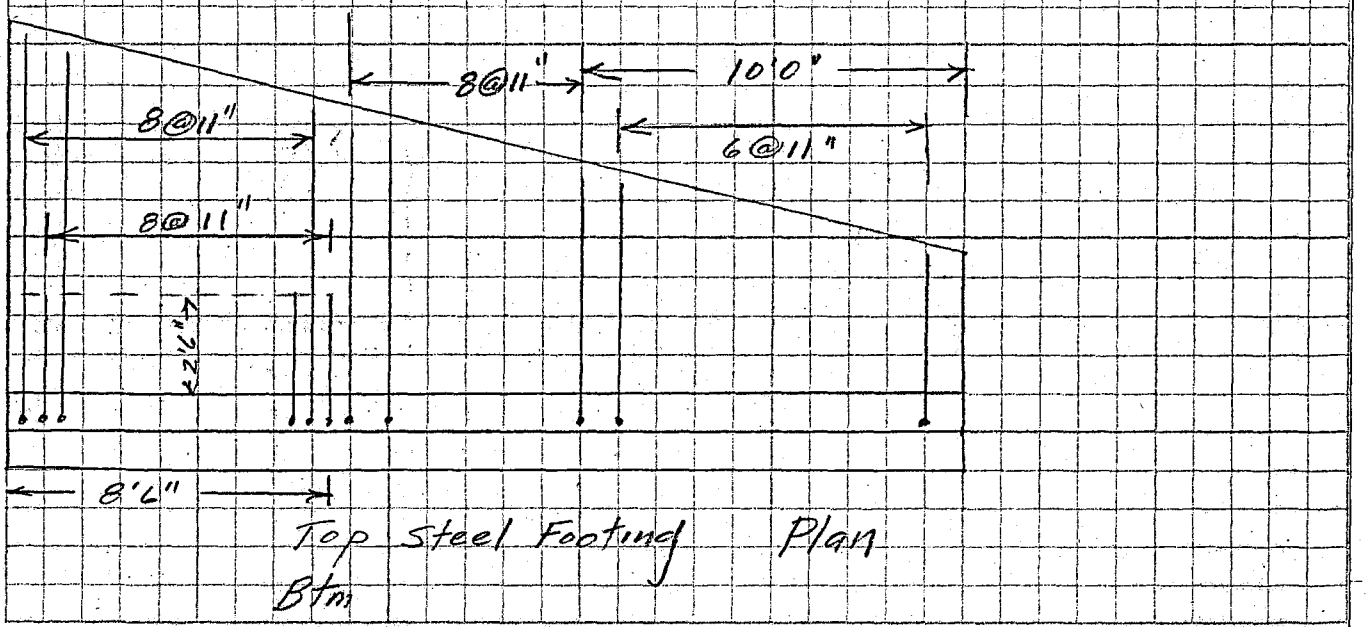
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO 1959 O—497927

STATE Arizona | PROJECT Powerline Channel
BY Watt | DATE 5-25-65 | CHECKED BY | DATE | JOB NO. 2

SUBJECT SAF Str Wing Wall Steel | SHEET | OF



Inside Face Horz Steel 5@11"



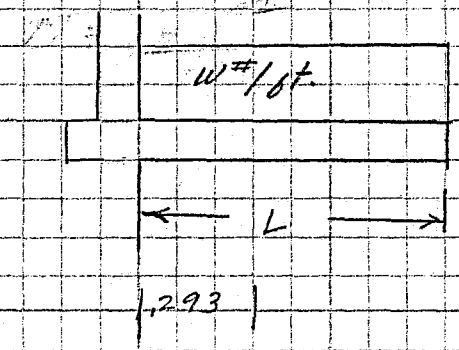
Top Steel Footing Plan
Btm

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Channel
BY Watt | DATE 3-25-65 | CHECKED BY | DATE | JOB NO
SUBJECT Footing Steel SAF Str | SHEET | OF

C



$M = \frac{WL^2}{2}$

When $m = \frac{M}{2}$

$\frac{Wl^2}{8} = \frac{WL^2}{8 \times 2}$

$l = \frac{L}{1.414} = .707L$

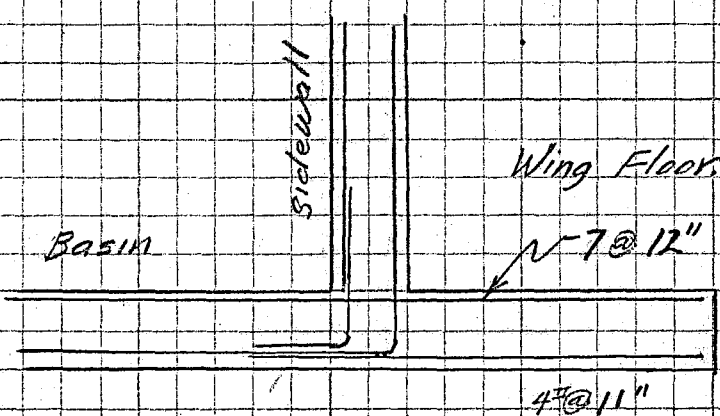
Cut of 1/2 of Steel @ .293 l

$8.5 \times .293 = 2\frac{1}{2}$ ft

10.5
2.2
8

Shear on toe Wall $M = 27.2 = \frac{W \times 8.3}{2}$

$W = 6550$ $\quad \frac{6550 \times 8}{7 \times 11.5} = 65\#/in^2$ OK



COMPUTATION SHEET
SCS-ES3A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Vineyard Road Dam
BY GOH | DATE 9-7-65 | CHECKED BY | DATE | JOB NO.

SUBJECT Computing size of pipe to drain area of emergency spillways into powerline channel. | SHEET | OF

Drainage area = Planimeter 1st = 38.91" 2nd 39.0"

Scale = 1" = 300' 1□" = 300 x 300 = 90,000 □'

Acres = $\frac{90,000 \times 39}{43,560}$ = 80.6 acres Length = 2800'

Av. slope = 0.004 For Hyd Rad 0.5 V = 2.0'/sec

T_L $\frac{2800}{3600 \times 2}$ = .38 call .4 hrs

	10	25	50	100
Precip	1.3	1.6	1.8	2.2
Runoff CM80	.20	.32	.43	.68
Runoff CFS	15	24	32	51

$T_p = \sqrt{.4} + .6 \times .4 = .63 + .24 = .87$ call .8

Runoff = $\frac{484 A Q}{T_p} = \frac{484 \times 80 \, Q}{.8 \times 640}$

$75 Q$

Use 42" pipe thru bank Q = 50 CFS
1' drop - in U.S.

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT

BY Watt | DATE 4-19-64 | CHECKED BY | DATE | JOB NO. C

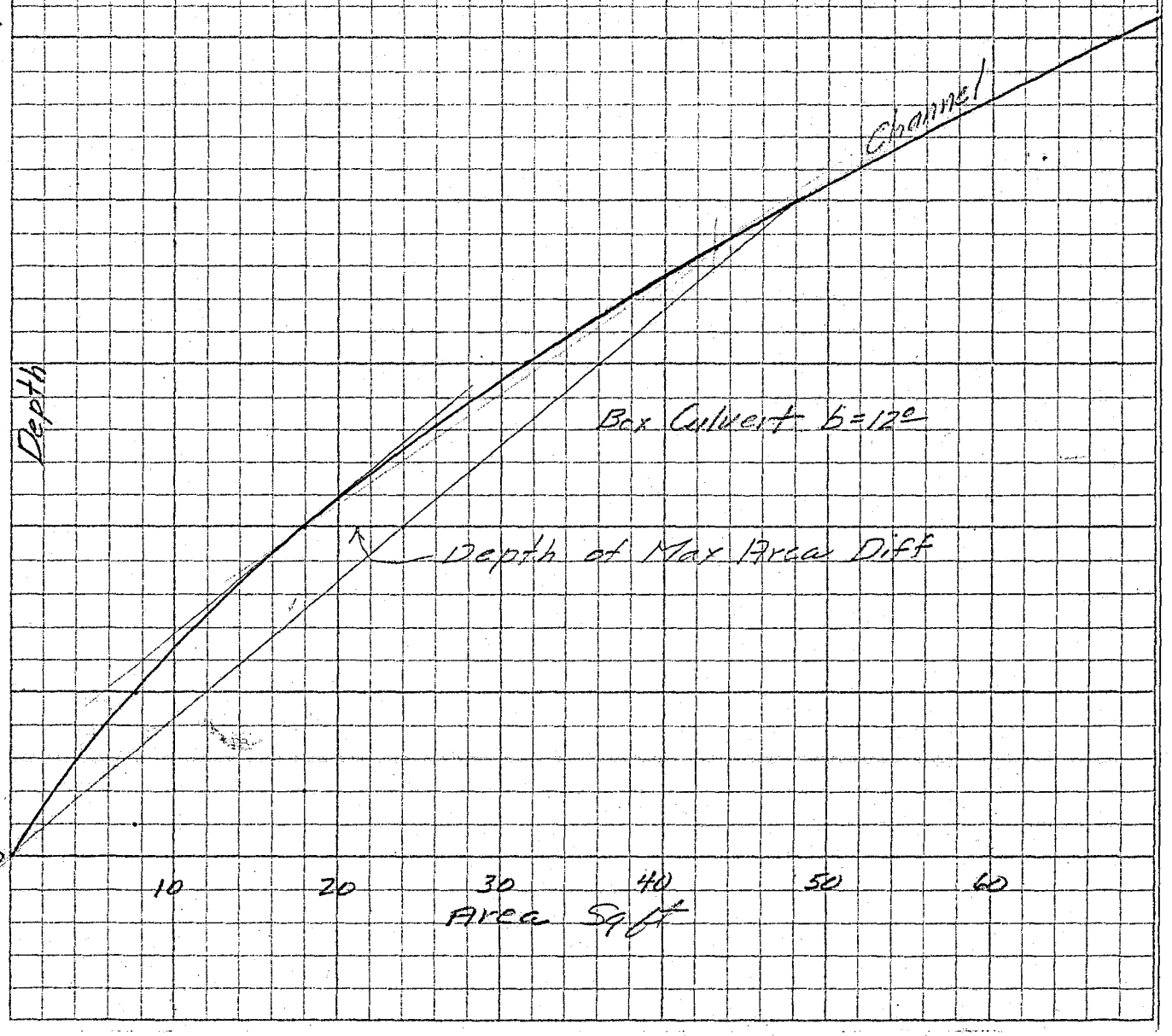
SUBJECT Bridge at Vineyard Road | SHEET | OF

Depth area Curve of Channel

$A = 1.5d^2 + 6d$

d	
1	7.5
2	18
3	31.5
4	48.0
5	67.5

$\frac{43}{3.7}$ 12



COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Channel | JOB NO. C
BY Watt | DATE 4-19-64 | CHECKED BY | DATE
SUBJECT Hydraulics of Box Culvert | SHEET | OF

Water-surface profile through box culvert
2' of water in channel.

Channel $d=2.0$ $S=.0062$ $SS=1\frac{1}{2}:1$ $n=.014$

$b=6'$ $A=2\times6+1.5\times2^2=18$

$P=6+2\times3.6=13.2$

$R=1.36$

$V=\frac{1.486\times.0787\times1.227}{.014}=10.25$

$Hv=$

$Q=18\times10.25=184.5$

Lengths of Transitions 20'

Length of 12'x5' Box Culvert 50'

Un channel $n^2l=.014^2\times20=.004$

For $b=2'$ $=3.2\times10^{-3}$ (ES 128 sheet 6

$f=$ Box Culvert $n^2l=.014^2\times50=.0098$

Sta	Depth		
0+00	2.0'		down St. Channel
0+20	3.22'	ES 125-59	outlet box (Sub Crit
0+70		" "	Inlet box $V=$
0+90		ES 12	Inlet Channel

Flow would be sub critical in box so at end of transition in channel flow would be at critical depth. or $d=2.49$

$V=1.9\times10^{-3}$

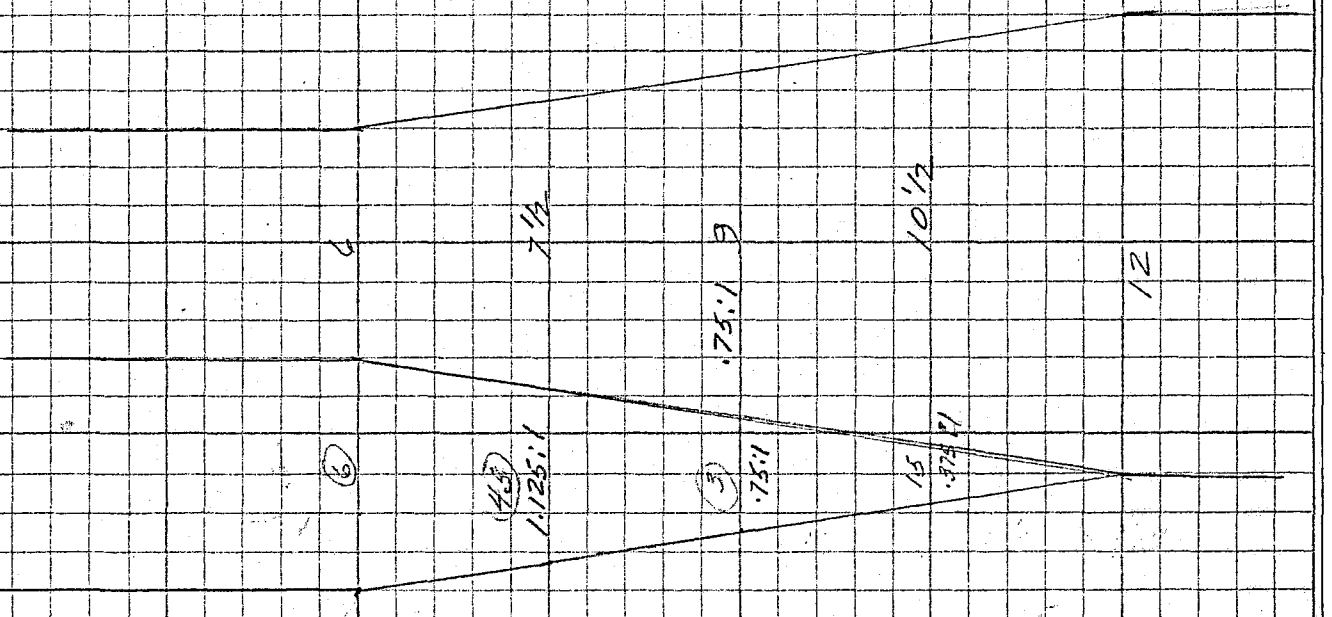
COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO 1951 O—491927

STATE Arizona | PROJECT Powerline Channel
BY Watt | DATE 4-19-64 | CHECKED BY | DATE | JOB NO C
SUBJECT Hydraulics of Box Culvert. | SHEET | OF

Sta	Depth		
0+00	2.49	Critical	Ditch
0+20	2.97	Sub-Critical	outlet Culvert
0+70	2.55	Sub-Critical	Inlet Culvert
0+90	2.00	Super. Crit	Ditch

At this stage have 2' on freeboard
So should be OK



To Keep area = 48 Throughout Transition

@ 6' $SS = 1\frac{1}{2}:1$

@ 7½' $SS = \frac{(48 - 7.5 \times 4)}{16} =$

@ 9' $SS = \frac{48 - 9 \times 4}{16} =$

@ 10½' $SS = \frac{48 - 4 \times 10.5}{16}$

COMPUTATION SHEET

SCS-533A REV 5-58

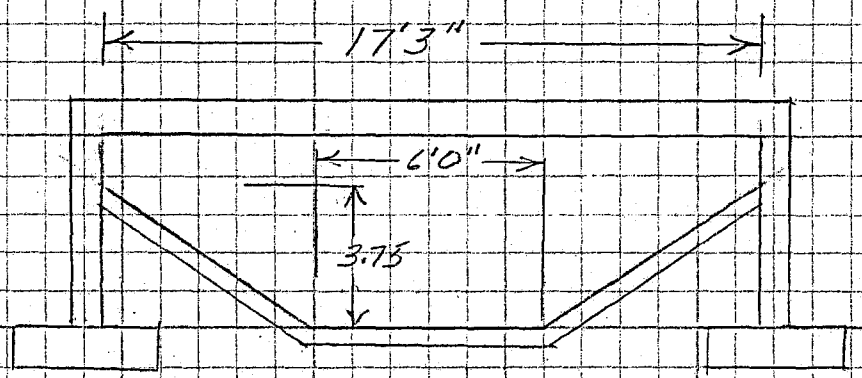
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Channel

BY Watt | DATE 4-19-64 | CHECKED BY | DATE | JOB NO.

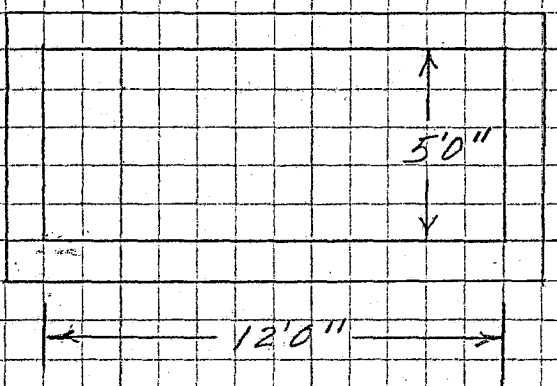
SUBJECT Bridge @ Vineyard Rd | SHEET C OF

Bridge Dimensions



Span = 6 + 2×1.5×3.75 = 17.25
= 18.0 C-C

Box Culvert Dimensions



Bridge

Better Hydraucally

No Transition required

Box Culvert

Probably cheaper

COMPUTATION SHEET
SCS-523A REV 5-56

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Channel
BY Watt DATE 5-24-66 CHECKED BY DATE JOB NO.
SUBJECT Box Culvert Ellsworth Road SHEET OF

$Q = 1210$ CFS

Channel $b = 8.0$ $s = .0056$ $d = 4.88$ $SS = 1\frac{1}{2}:1$

Total Depth = 6'3"

$A = 4.88 \times 8 + 1.5 \times 4.88^2 = 74.76$

d for 12' Box $\frac{74.76}{12} = 6.23$

6.23 − 4.88 1.45 ft drop
Too Much

d for 14' Box $\frac{74.76}{14} = 5.34$

5.34 − 4.88 = 0.46'
OK

Depth Required $4.9 + 0.5 + 1.0 = 6.4'$

Make Box 14' x 6½'

Transition length

$$\frac{6.25 \times 3 + 8 - 14}{2 \times .2} = 31.87 \text{ ft}$$

Make Transition 32' long

Conc. in Transition

$$\left(\frac{(6.25 \times 3.6 + 8.2)\frac{7}{12}}{2 \times 27} + \frac{15.16 \times 7.08 - 14 \times 6.5}{2 \times 27} \right) 32 = 20.29 \text{ cuyd}$$

For 2 40.6 cuyd

COMPUTATION SHEET

STATE Arizona PROJECT Powerline Channel

BY Watt DATE 5-24-66 CHECKED BY DATE

SUBJECT Box Culvert @ Ellsworth - Cost Est SHEET OF

Box Culvert 14'x6½' - 68' long

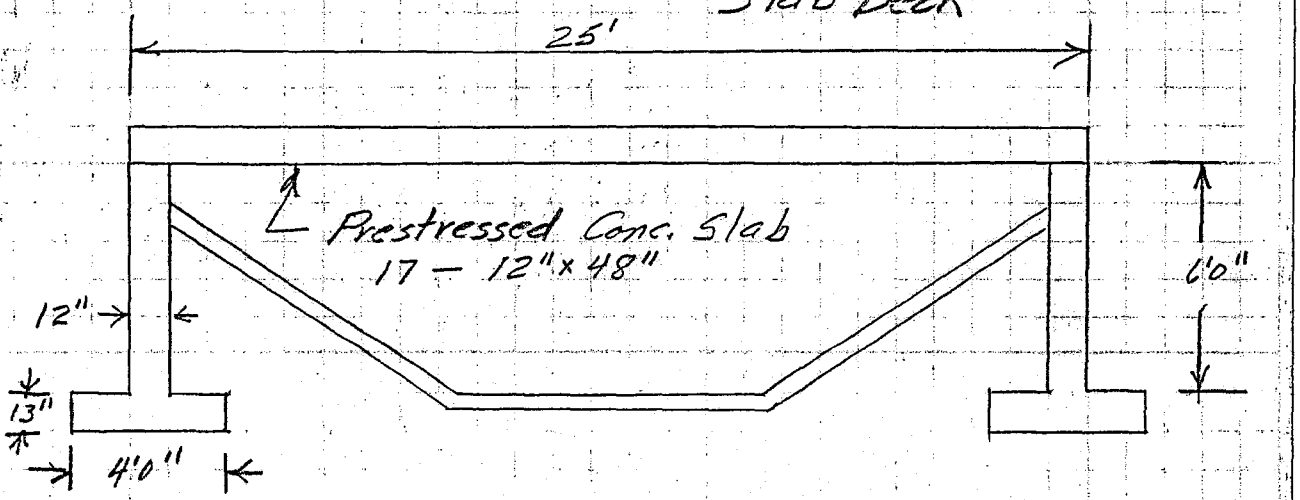
$$\text{Conc} = \frac{(16 \times 8.5 - 14 \times 6.5)\,68}{27} = 113.3 \text{ cuyd}$$

Concrete Bridge	113.3 @ $65 =	$ 9230
" Transitions	40.6 @ $75 =	3045
Excavation	$\frac{7.5 \times 19 \times 132}{27}$ = 697 cuyd @ $2	1394
Backfill	$\frac{3 \times 2 \times 68 \times 7.5}{27}$ = 113 @ $5	$ 567
	Total Est Cost	14,636
Less Cost 132' Channel @ $29/ft		− 3,828
	Total Est Cost	$ 10,808

COMPUTATION SHEET
SCS-523A REV 5-68

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona
PROJECT Powerline Channel
BY Watt DATE
CHECKED BY DATE JOB NO.
SUBJECT Ellsworth Road Bridge-Prestressed Slab Deck
SHEET OF



$$\text{Conc} = \frac{68 \times 2 \times 6 + 4 \times 2 \times 1.1 \times 68}{27} = 52.3 \text{ cuyd}$$

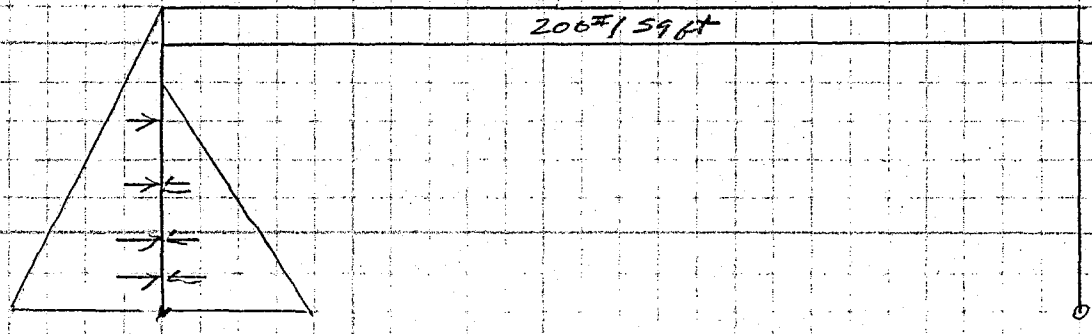
52.3 × $75 $3922

Prestressed Slabs

17×25 @ $17/lin ft = $7225

Excavation & Backfill $1900

Estimated Cost Prestressed Conc Decked bridge = $13,047



Live load H-20S

Max Wheel load 32.0 K

Using Single axle load $24 \times [1 + .016(24-18)]$

$= 26.3\,K$ AASHO 60 Pg 25

Impact $I = \frac{50}{24+125} = .336$

Total live load = $26.3 \times 1.336 = \underline{35.1\ K}$

Distribution Per Wheel

$E = \frac{10+12}{4} = 5.5$ ft

Live load per Unit width of Bridge

$\frac{35.1}{2} \times \frac{1}{5.5} = 3.2\ K/lin\,ft.$

Dead load Use $200\#/ft^2$

Earth Equivalent fluid pressure $50\#/cu\,ft$

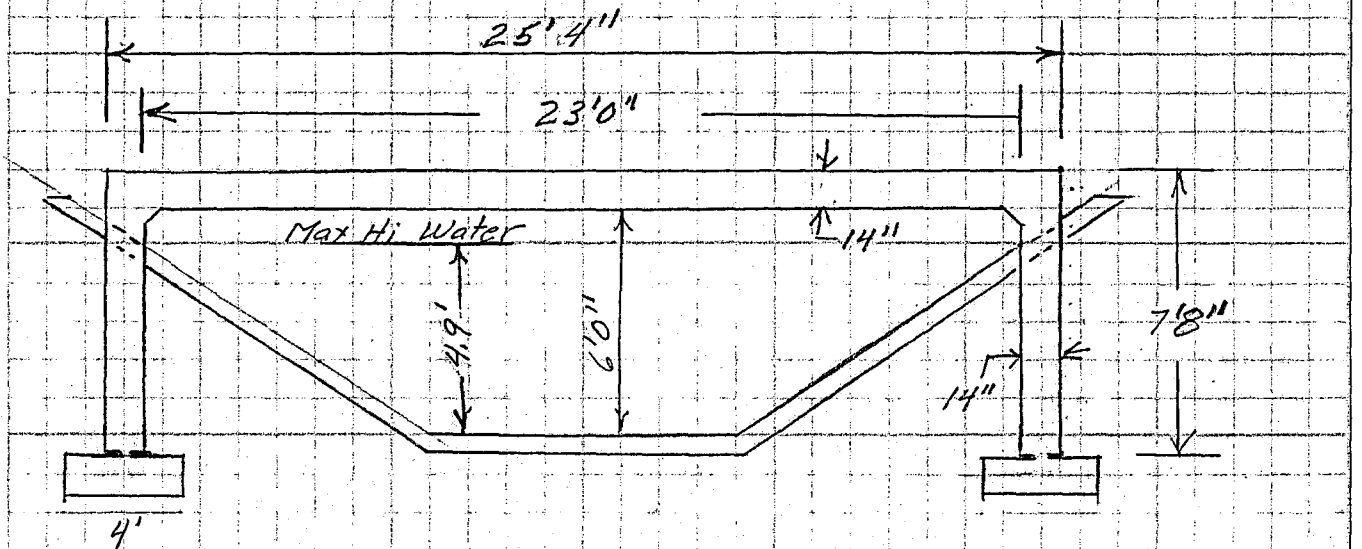
COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Channel

BY Watt DATE 5-19-66 CHECKED BY DATE JOB NO.

SUBJECT Ellsworth Rd Bridge. SHEET 1 OF 15



Width 68' ? ?

Concrete 130.8 Cuyd @ $85 = 11,118

Conc $50/cuyd
Steel $35/cuyd
Total $85/cuyd

Excavation $\frac{7 \times 2 \times 72 \times 8}{27} = 300$ @ $3 900

Backfill $\frac{6 \times 2 \times 72 \times 6}{27} = 200$ @ $5 1,000

Total $13,210

COMPUTATION SHEET
SCS-ESSA REV 5-56

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Channel
BY Watt DATE 5-19-66 CHECKED BY DATE JOB NO
SUBJECT Ellsworth Rd Br SHEET 3 OF 15

Distribution factors

Thickness of deck & abutment equal

For Fixed Ends

Deck $\frac{1}{24} = .04167$ = 23%

Abt $\frac{1}{7} = .1428$ = 77%

For Abt. Hinged at footing

Deck .04167 = 28%

Abt = .75 × .1428 = .1071 = 72%

For Symetrical Loading Hinged Footing

Deck = .5 × .04167 = .02084 = 16%

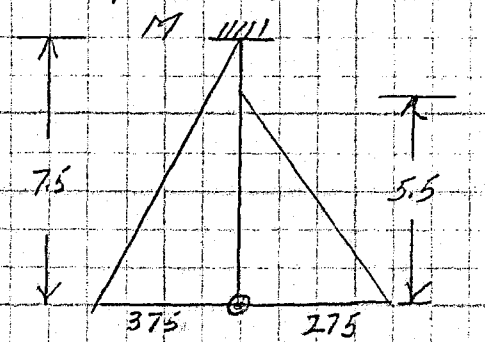
Abt .1071 = 84%

Fixed End Moments:

Dead Load

Deck $M = \frac{wl^2}{12} = \frac{0.2 \times 24^2}{12} = 9.6$ ft K

Earth load Abt



Earth Equ fluid Pres = 50 #/cu ft

$$M = .058 \times 50 \times 7.5^3 - \frac{275 \times 5.5^3}{60 \times 7.5^2}(5 \times 7.5 - 3 \times 5.5) + \frac{275 \times 5.5^2}{120 \times 7.5^2}(10 \times 7.5^2 - 10 \times 5.5 \times 7.5 + 3 \times 5.5^2)$$

(1223) (284) (297)

M = 642 ft lbs = .64 ft K

Distribution Dead Load

16%

+0.64 −9.60
+7.53 +1.43
84% +8.17 −8.17 ft K

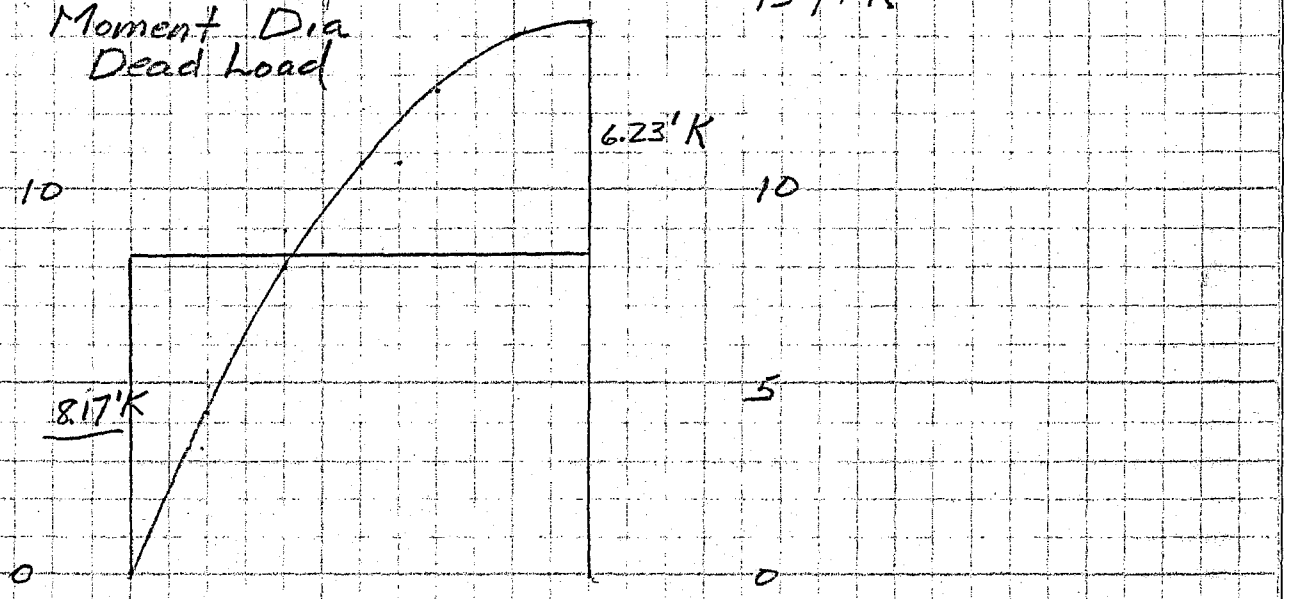
$$M = \frac{wlx}{2} - \frac{wx^2}{2} = \frac{.2 \times 24}{2}X - \frac{.2X^2}{2} = 2.4X - .1X^2$$

X	M
2	4.4
4	8.0
6	10.8
8	12.8
10	14.0
12	14.4

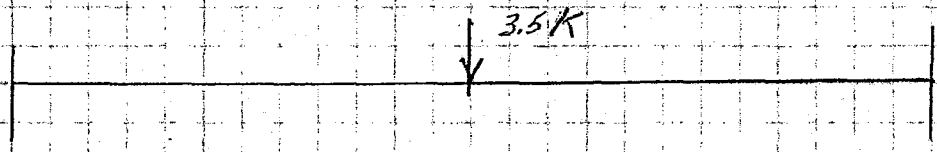
14.4
8.17
6.23

15 ft K

Moment Dia
Dead Load



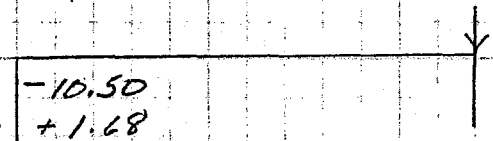
Fixed End Live load Moments



$$M = \frac{3.5 \times 12}{4} = 10.5' K$$

Distribution

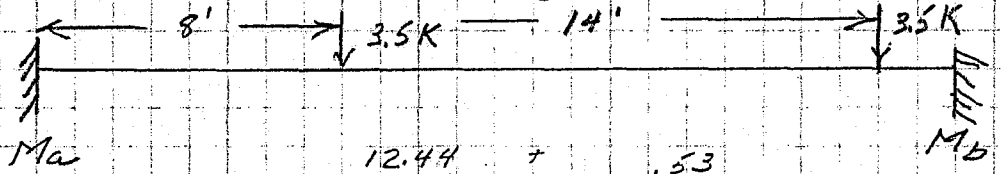
16%



84%

0	-10.50
+8.82	+1.68
+8.82	+8.82

Fixed End Live Load @ 1/3 pt



$$M_a = 3.5 \times 8\left(1-\frac{8}{24}\right)^2 + 3.5 \times 22\left(1-\frac{22}{24}\right)^2 = 12.44 + .53 = 12.97$$

$$M_b = 3.5 \times 2\left(1-\frac{2}{24}\right)^2 + 3.5 \times 16\left(1-\frac{16}{24}\right)^2 = 5.88 + 6.22 = 12.10$$

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Channel

BY Watt DATE 5-19-66 CHECKED BY DATE JOB NO

SUBJECT Ellsworth Rd Br. SHEET 6 OF 15

Distribution Live load @ 8'

28%

	M_a			M_b	
	0	-12.97	+12.10	0	
	+9.34	+ 3.63	-3.39	-8.71	
	0	-1.70	+1.82	-.96	
72%	+1.22	+ .48	-.51	-1.31	72%
	0	-.25	+.24	0	
	+.18	+ .07	-.07	-.17	
	0	-.04	+.04	0	
	+.03	+ .01	-.01	-.03	
	+10.77	-10.77 ft K	+10.22	-10.22	

Correct for Sway $M_a = -M_b$

$-10.77 + .27 = -10.50$

$+10.22 + .28 = +10.50$

14

For Live load @ 5'

5' 3.5 K 14 3.5

2
14

$$M_a = M_b = 3.5 \times 5 \times \left(\frac{19}{24}\right)^2 + 3.5 \times 19 \times \left(\frac{5}{24}\right)^2 = 13.85$$

(10.97 and 2.88)

Distribution

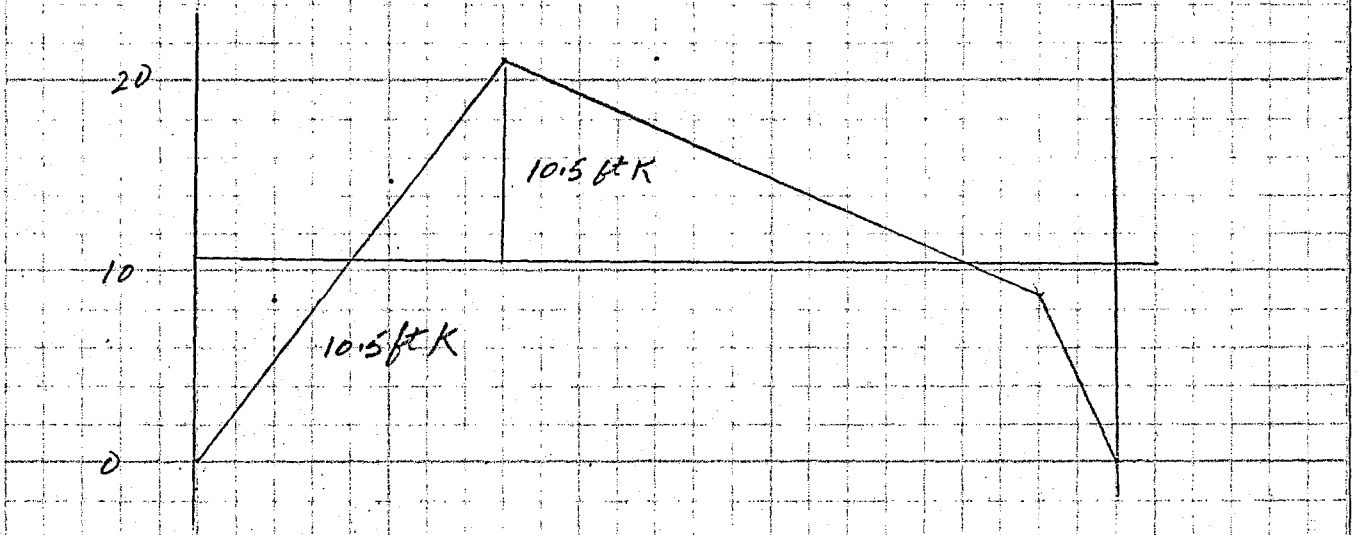
16%

84%	0	-13.85
	-11.63	+ 2.22
	+11.63	-11.63 ft K

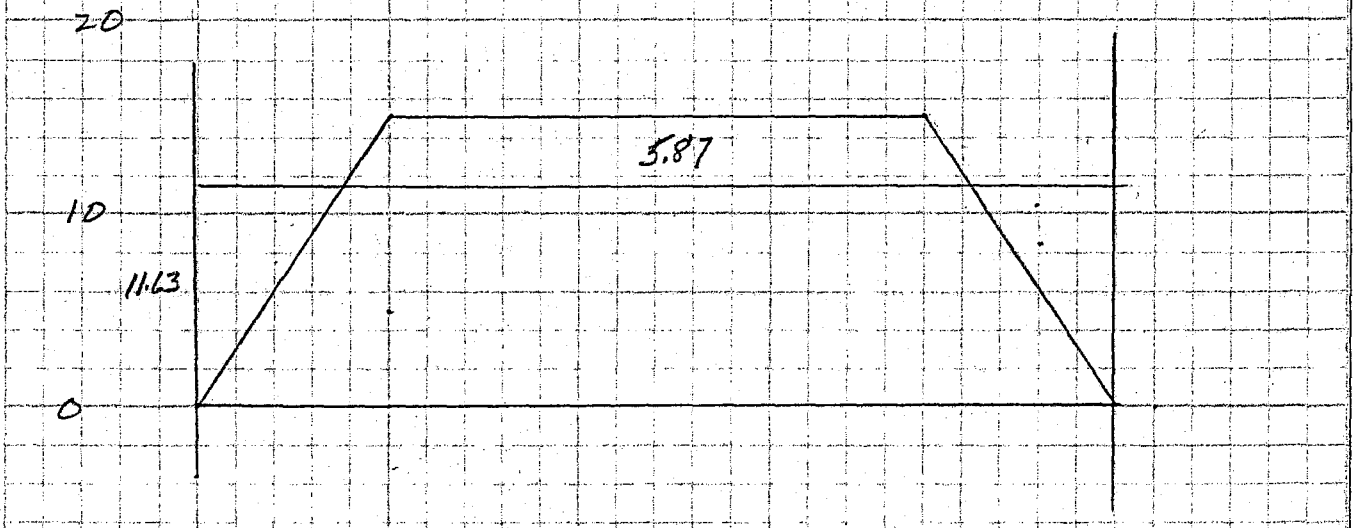
Moment Dia. load @ 8'

$$M_8 = 8 \times \left(3.5 \times \frac{16}{24} + 3.5 \times \frac{2}{24}\right) = 21$$

$$M_{22} = 2 \times 3.5 \left(\frac{22}{24} + \frac{8}{24}\right) = 8.75$$



M for load @ 5' M = 3.5 x 5 = 17.5



SCS-3224 REV 5-58 SOIL CONSERVATION SERV

STATE Arizona PROJECT Powerline Channel

BY Watt DATE 5-19-66 CHECKED BY DATE JOB NO.

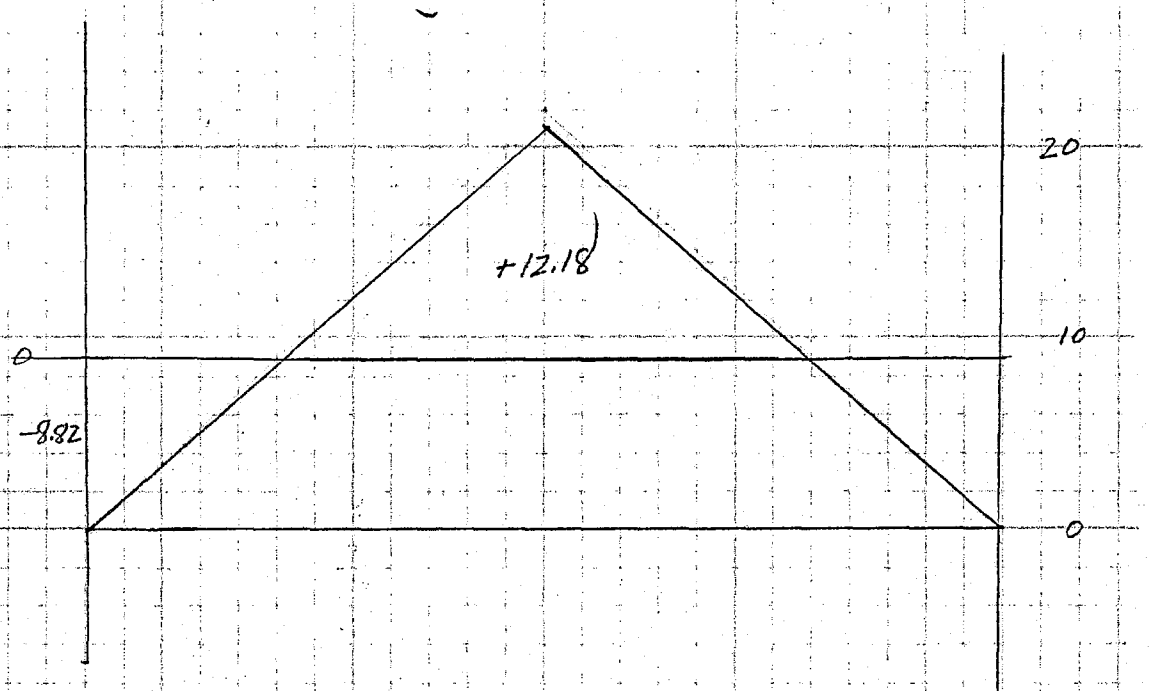
SUBJECT Ellsworth Rd Bridge SHEET 8 OF

Moment Diagrams Live load

Load @ Center

Simple Moment @ Center = $\frac{3.5 \times 24}{4} = 21.0$

21 - 8.82 12.18



Arizona Powerline Channel
Watt 5-19-66
Ellsworth Rd Bridge 9 15

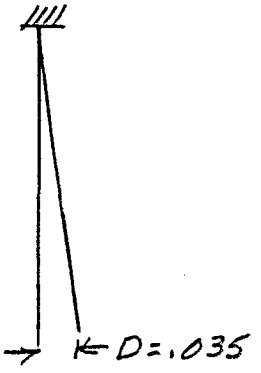
Temperature Stresses.

For 40° Rise & 40° Fall AASHO 1966 Pg 20

$n = 8$ $E = 3{,}600{,}000$ lbs/in²/in

Coef Thermal Exp = .000006

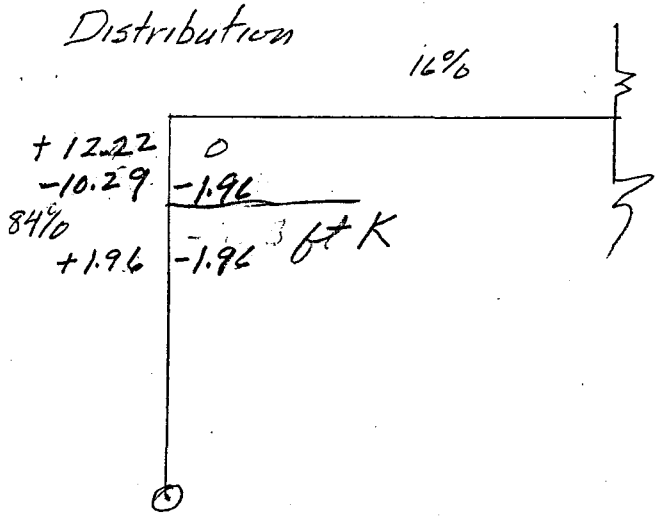
Expansion of deck = .000006 × 40 × 24 × 12 = .0691"



$$D = \frac{M\ell^2}{3EI} \qquad M = \frac{3EID}{\ell^2}$$

$$M = \frac{3 \times 3{,}600{,}000 \times \frac{12 \times 14^3}{12} \times .035}{7^2 \times 12^2 \times 12} = 12{,}225 \text{ ft lbs}$$

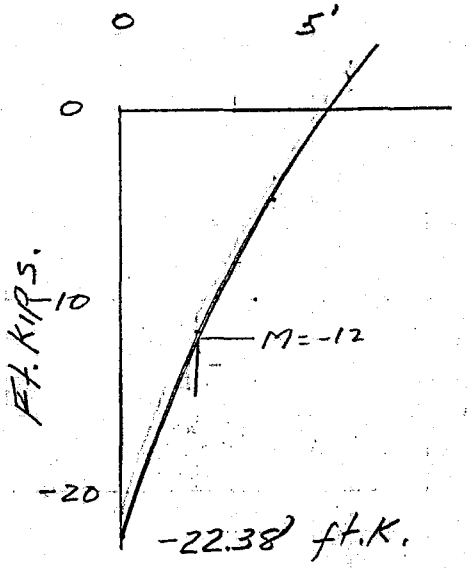
Distribution



Arizona Powerline Channel
Watt 5-19-66
Ellsworth Rd Bridge

Max Neg Moment

at	Dead Load	Temp	Live Load	Total
0	- 8.82	- 1.93	- 11.63	- 22.38
2	- 4.00	- 1.93	- 5.80	- 11.73
4	- 0.30	- 1.93	- 2.10	- 4.43
6	+ 2.30	- 1.93	+ 1.50	+ 1.87



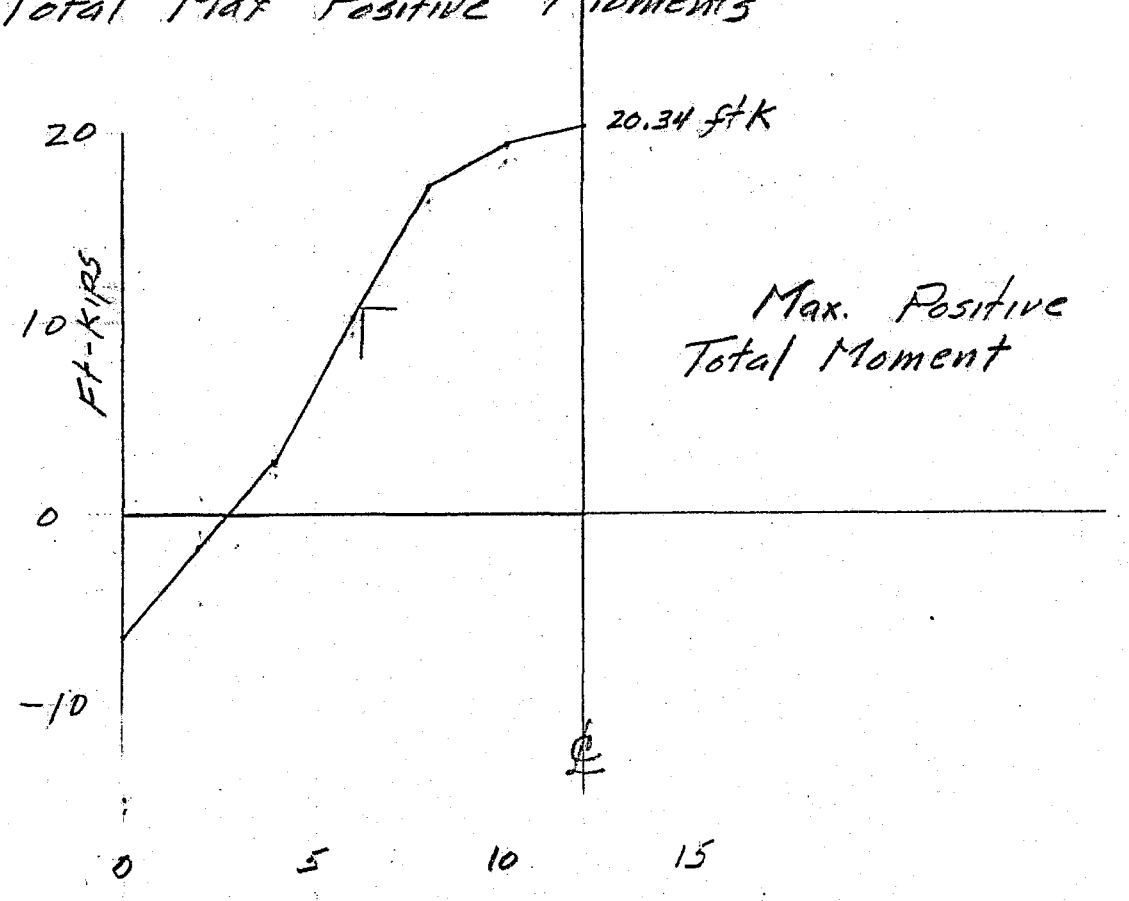
Total
Max Neg Moment

Max Positive Moment

at	Dead Load	Temp		
0	- 8.17	+ 1.93	0.0 } No Live Load	- 6.24
2	- 3.77	+ 1.93	0.0 } No Live Load	- 1.84
4	- 0.17	+ 1.93	+ 1.0	+ 2.76
6	+ 2.63	+ 1.93	+ 5.5	+ 10.06
8	+ 4.63	+ 1.93	+ 10.5	+ 17.06
10	+ 5.83	+ 1.93	+ 11.3	+ 19.06
12	+ 6.23	+ 1.93	+ 12.18	+ 20.34 ft K

Arizona Powerline Channel
Watt 5-19-66
Ellsworth Rd Bridge 11 of 15

Total Max Positive Moments



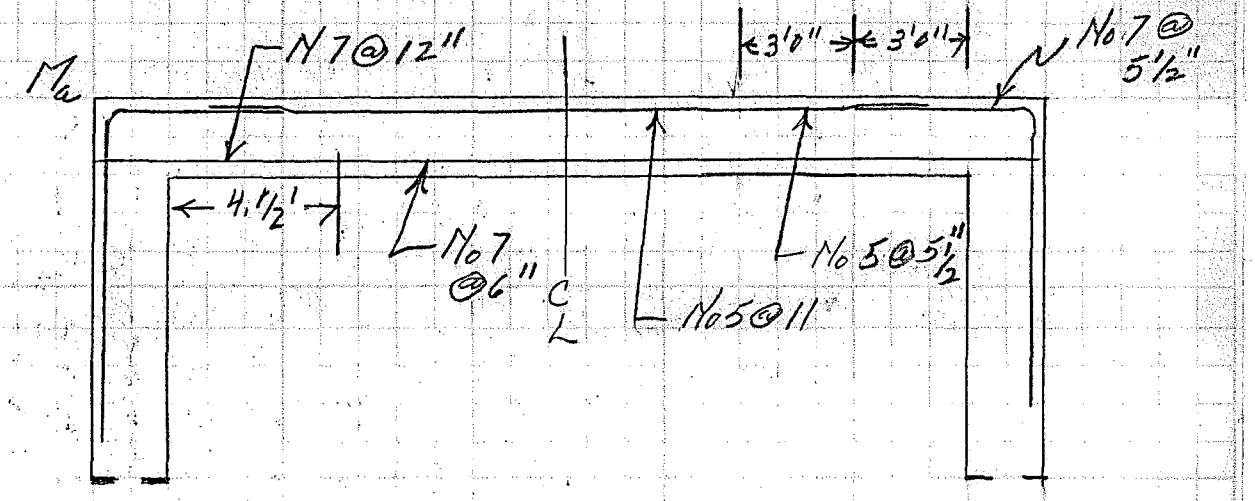
COMPUTATION SHEET — U. S. DEPARTMENT OF AGRICULTURE
SCS-ECS-A REV. 5-58 — SOIL CONSERVATION SERVICE

STATE: Arizona — PROJECT:

Watt 5-20-66

Ellsworth Rd Bridge 12 15

Steel & Conc Thickness



Max. Neg M_a = 22.38

d = 11.5 A_s = 1.30 sq.in

No 7 @ 5½" A_s = 1.31 sq.in.

For No 5 @ 5½ A_s = 0.67 sq.in

M = 12.0 ft. K.

@ 2' from ℄ support + 15" cut of No 7 bars
splice with No 6
= 3.0' from inside face Abt

@ 6" from Abt face
use No 6 @ 13"

Positive Moments

Max = 20.34

For d = 11.5 A_s = 1.20 sq in

Use No 7 @ 6"

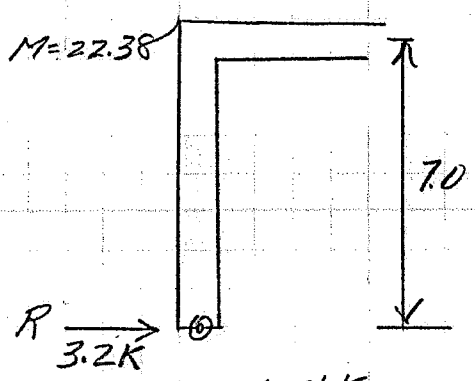
15 x 7/8

M for No 7 @ 12" M = 10.5

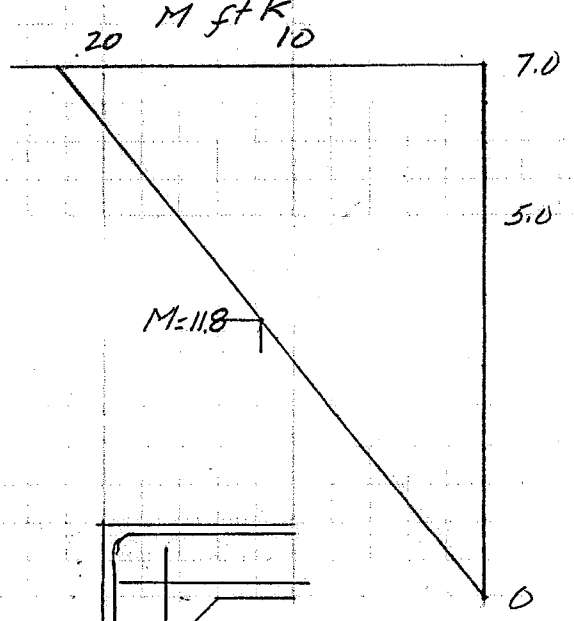
Use No 7 @ 12" 4½' from Abt

COMPUTATION SHEET
SCS-ESS-1 REV 5-58
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Arizona Powerline Channel
Watt 5-20-64
Ellsworth Rd Bridge 13 15
Abutment Design



$R = \frac{22.38}{7.0} = 3.2K$

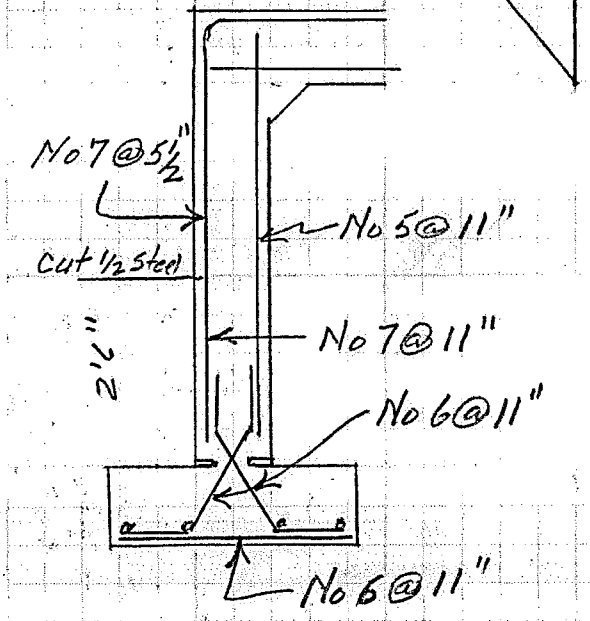


M for No 7 @ 11" d=11.5
$A_s = 0.66$ sq in M = 11.8

Area for Abt Support
Steel take all of Max total load

$\frac{10,670}{16,000} = 0.67$ sq in Required

Use No 6 @ 11
Both Sides
Steel = .96 sq in



Arizona Powerline Channel
Watt 5-20-66
Ellsworth Rd Bridge 14 15

Concrete

Deck	$\frac{1.17 \times 68 \times 24.33}{27}$	=	71.7 Cu yd
Abt	$\frac{2 \times 1.17 \times 68 \times 6.5}{27}$	=	32.7
Footing	$\frac{2 \times 4 \times 1.25 \times 68}{27}$	=	25.2
Curb	$\frac{.75 \times .75 \times 25 \times 2}{27}$		1.0
Fillets	$\frac{.5 \times .5 \times 25}{27}$		.2
		Total	130.8 Cu yd

Wt of Bridge $\frac{130.8 \times 150 \times 27}{68} = 7.790$ lbs/lin ft

Load on footing

Dead Load = $\frac{7.79}{2} = 3.9$ K/lin ft

Live Load

$\frac{26.3}{5.5}\left(1 + \frac{10}{24}\right) = 6.77$ K/lin ft

Total = 10.67 K/lin ft

For 4' Footing $\frac{10.67}{4} = 2.67$ K/sq ft

COMPUTATION SHEET
SCS-525A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

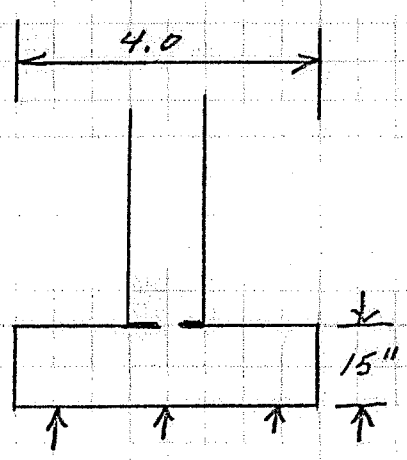
STATE Arizona PROJECT Powerline Channel

BY Watt DATE 5-20-66

SUBJECT Ellsworth Road Br

15 15

Foundation Slab Design



2.67 K/ft²

Shear = 1.5' × 2.67 = 4.0 K

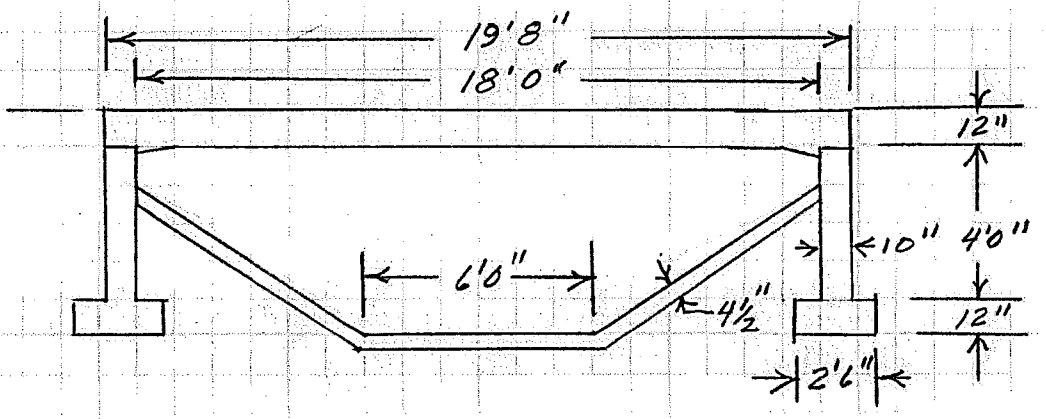
Unit Sheer

$$4000 \times \frac{8}{7} \times \frac{1}{12 \times 11.5} = 33.\ \#/in^2$$

$$M = \frac{2.67 \times 2}{2} = 2.67\ ft\,K$$

COMPUTATION SHEET
SCS-ENGR. REV. 5-50
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Arizona Powerline Channel
Watt 5-17-66
Bridge Private Desert Roads 1 8



2-2
11x20
x5

Bridge H-10 Loading
at Rt Angle to Channel
Width 16' Wide

Estimated Cost.

Concrete	20 cuyd @ $50	1000
Steel	2860 # @ 18¢	515
Excavation	50 cuyd @ 3	150
Backfill	33 cuyd @ $6	198
	Estimated Cost	$1863

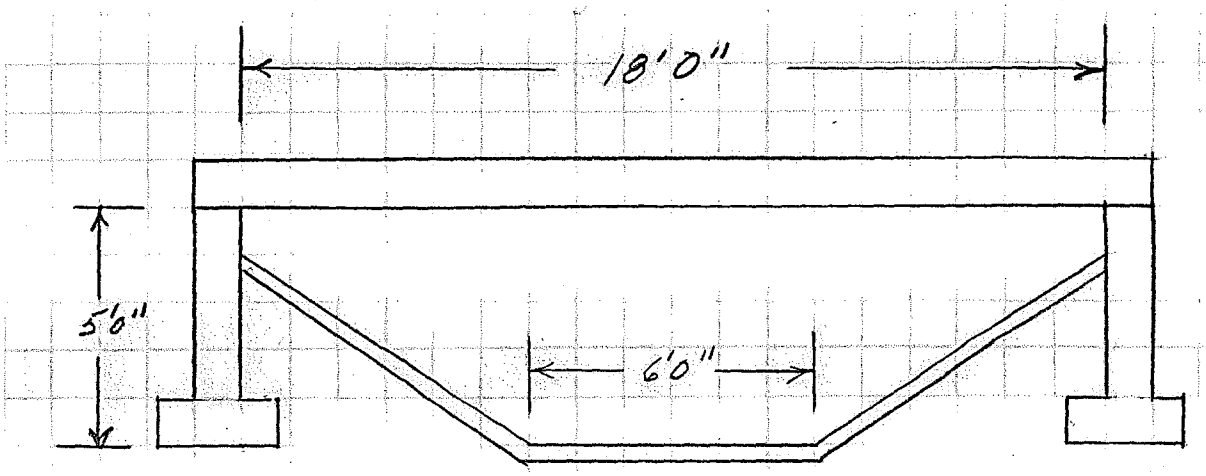
COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO : 1958 O—470868

STATE		PROJECT		
Arizona				
BY	DATE	CHECKED BY	DATE	JOB NO.
Watt	5-17-66			

SUBJECT Bridge Xing Private Desert Roads — SHEET 2 OF 8



Bridge Width 16'
For H-10 Loading
Wheel Load 16,000#
Impact 30% Total live load 20.8K

Load distribution = $E = \frac{10+12}{4} = 5.5$ ft/wheel

Live Load per ft width = $\frac{20.8}{2 \times 5.5} = 1.9$ K/ft width

Dead Load = 150 #/sq ft.

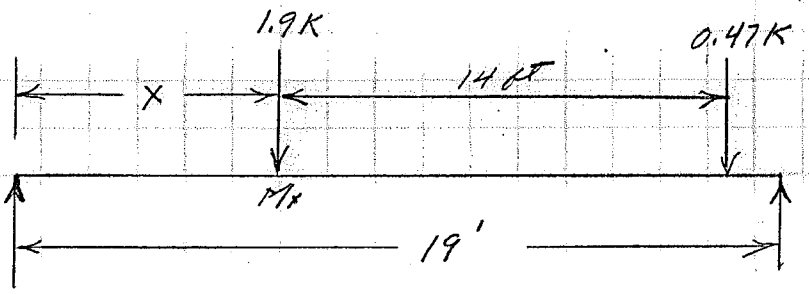
Earth Load Abt
Equivalent Fluid Pressure 45 #/cu ft.

$f_c' = 1350$ #/in²
$f_s = 20{,}000$ #/in²

Front Wheel Load $\frac{4.0 \times 1.30}{11} = 0.47$ K/ft Width

STATE		PROJECT		
Arizona				
BY	DATE	CHECKED BY	DATE	JOB NO.
Watt	5-17-66			

SUBJECT Private Bridge Live Load Moments — SHEET 3 OF 8



$$M = \frac{W x (l-x)}{l} = \frac{1.9x(19-x)}{19} = 1.9x - .1x^2$$

X	1.9K Mx	0.47 Mx	Total
2	3.4 ft k	0.1	3.5 ft k
4	6.0	0.1	6.1
6	7.8		7.8
8	8.8		8.8
9.5	9.0		9.0

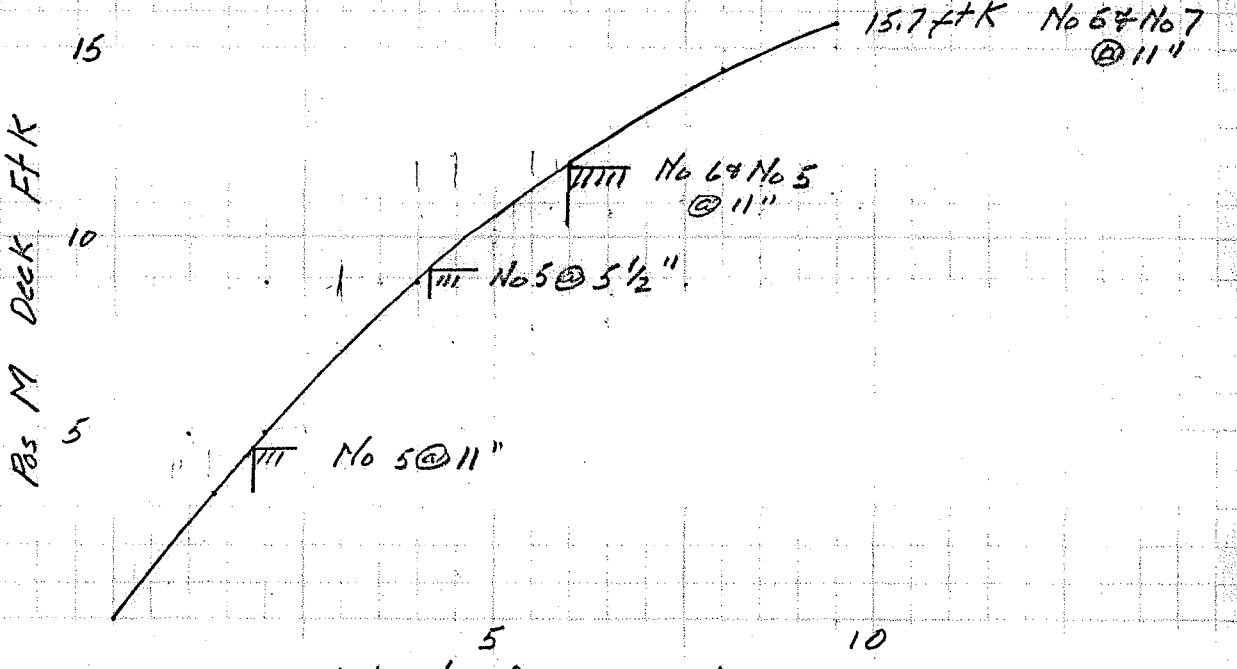
Dead Load Moment = $\frac{Wl}{2}\frac{x}{2} = \frac{wlx}{4} = \frac{.15 \times 19}{4} X = .71X$

X	Dead L. Mx	M-Live	Total
2	1.4 Ft K	3.5	4.9
4	2.8	6.1	8.9
6	4.3	7.8	12.1
8	5.7	8.8	14.5
9.5	6.7	9.0	15.7

1

Bridge Private Rd 4 8

Simple Moment
Dead + Live Load



For $M = 15.7$ $d = 8.3$

Use $t = 12"$ $d = 9.5$ $A_s = 1.13$

Use No 6 @ 11" & No 7 @ 11"

For No 6 @ 11" + No 5 @ 11"
$A_s = 0.81$ $M = 12.0$

For No 5 @ 11"
$A_s = .33$ $M = 4.5$

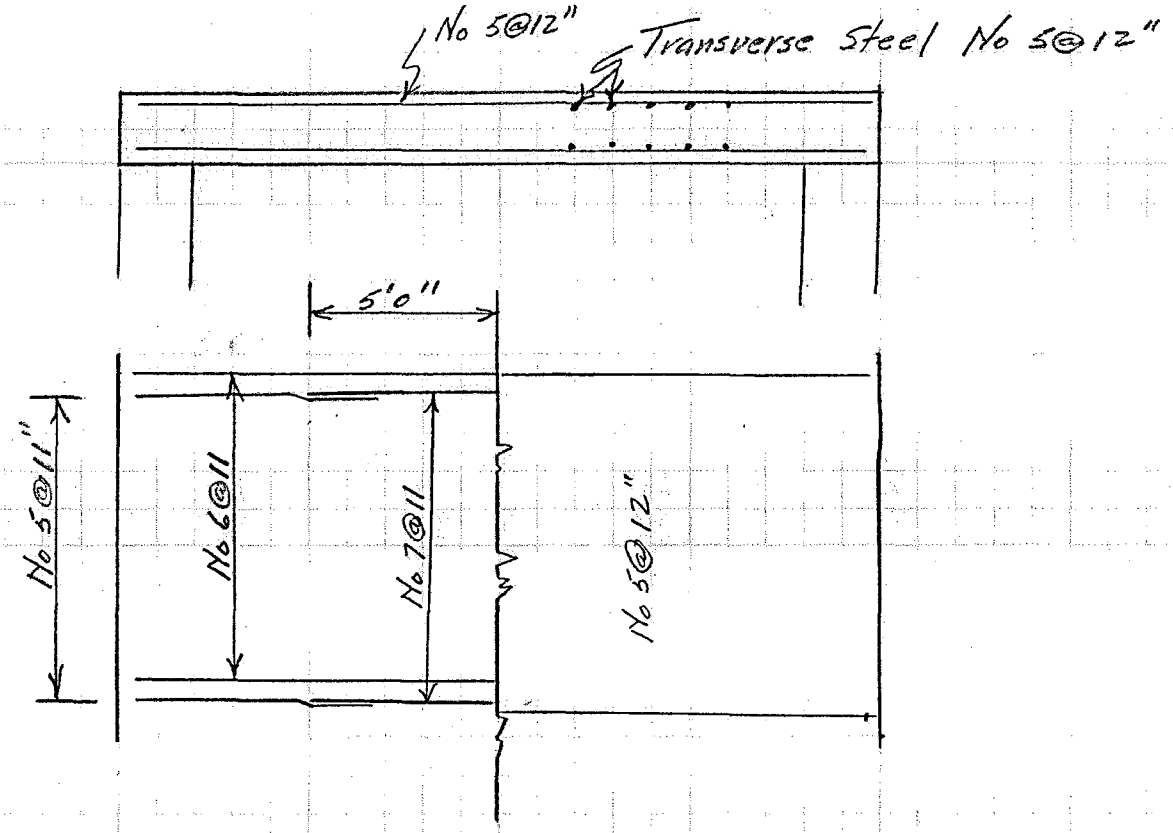
For N 5 @ 5½" =
$A_s = .66$ $M = 9.2$

COMPUTATION SHEET — U.S. DEPARTMENT OF AGRICULTURE
SCS-ENGR-REV 6-80 — SOIL CONSERVATION SERVICE

STATE: Arizona — PROJECT: Powerline Channel

Watt 5-17-LL

Bridge Private Rd — 5 8



Transverse Steel temp No 5@12" = @.31 = A_s

% Req = $\frac{100}{119}$ = 23%

A_s = 23 × 1.14 ~ 0.26 in²/ft OK

COMPUTATION SHEET
SCS-523A REV 5-58

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE PROJECT

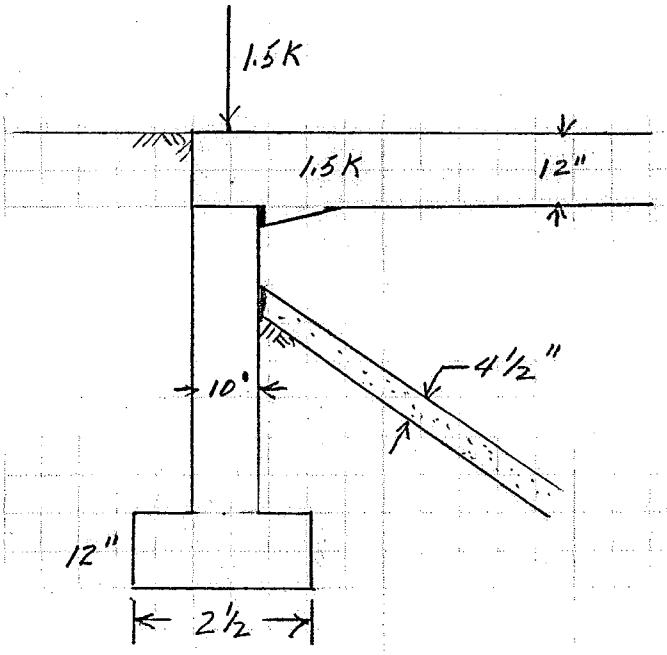
Arizona
Watt 5-17-66
Bridge Xing Private Desert Roads 6 8

Foundation Pressure

Live load $\frac{16}{2 \times 5.5} = 1.5$
Dead Load
Deck = .15×10 1.5 "
Abt - 4×.15×.83 0.5
Foundation 2.5×.15 .3

Total 3.8 K/lin ft

For 2½' wide footing = 1.5 K/lin ft
= .75 tons/sq ft



16

Shear = $1.5 \times \frac{11}{12} = 1.38$ K/lin ft

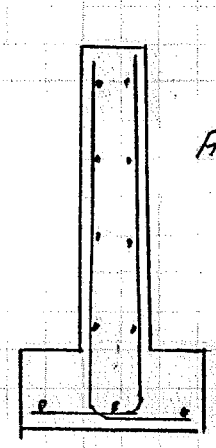
Unit Shear

$v = \frac{1.38 \times 8}{12 \times 8.5 \times 7} \times 1000 = 15.4$ #□" OK

$M = \frac{wl}{2} = \frac{1.5 \times 1.25}{2} = .93$

Negligible

15



All steel No 5
@ 12"

Horo Steel 11 ft
Vert 11.7 ft
Total 22.7 ft No 5 #/lin ft
= 23.7 #/lin ft

15 11'

15
3' 34
5' 10"

1 1/2 / 4 1/2

COMPUTATION SHEET — U. S. DEPARTMENT OF AGRICULTURE
SCS-ENGR-REV.5-20 — SOIL CONSERVATION SERVICE
STATE — PROJECT

Arizona — Powerline Channel
Watt 5-17-66
Deck Steel · Private Rd Br — 7 · 8

System No 1 — Splice No 7 bar with No 5

No. 7	10' long	=	2.044	20.4
No. 5	2-6' long	=	1.043	12.5
No 6	20' long	=	1.502	30.0
				62.9 #

System No 2 — Splice both No 5

No. 7	10' long	2.044	20.4
No. 6	13' long	1.502	19.5
No 5	2 x 4 1/2 long	1.043	9.4
No 5	2 x 6' long	1.043	12.5
			61.8 #

Extra 11 lbs

Extra lbs/cuyd

$\frac{27}{20 \times \frac{11}{12}} \times 11 = 1.62 \cdot$ lbs/cuyd =

Per 16' wide br = $\frac{\#}{ft} \times 16 \times 12 = 192\#$

Extra Cost = 192 x .18 = #3.50
one splice

COMPUTATION SHEET
SCS-SSSA REV 5-65
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
STATE PROJECT

Arizona Powerline Channel
Watt 5-17-66
Private Rd Bridge

Concrete per ft Width

1 × 20		= 20.
Fillet 4" × 12½ × 2		1.33
Footing	2 × 2.5 × 1	5.0
Abt.	$\frac{2 \times \frac{1}{2} \times 10}{3}$	6.67

Total 32.00 cuft

For 16' br Conc.

$\frac{32 \times 16}{27}$ = 19 cuyd

Rails $\frac{\frac{3}{4} \times \frac{3}{4} \times 20 \times 2}{27}$ = 0.83

Total 19.83

Call 20 cu yd

Approx Steel

Deck

Transvers & Tem St

3 × 1.043 × 27 = 84.5 #/cu yd

Main

$\frac{62.9 \times 27}{20 \times \frac{11}{12}}$ = 92.6 lbs/cuyd

Total 177.1 /cuyd

Abt Steel = $\frac{23.7 \times 2 \times 27}{11.67}$ = 109.7 #/cuyd

Total Steel Deck $\frac{20 \times 16}{27} \times 177.1$ = 2100 #

Abt = $\frac{11.67 \times 16}{27} \times 109.7$ = 760

Total 2860

COMPUTATION SHEET
SCS-522A REV 5-59

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

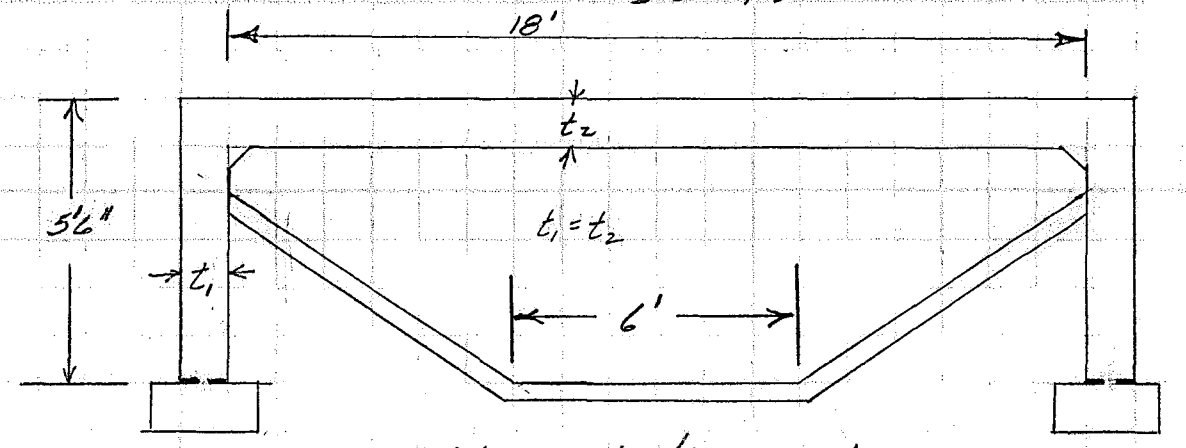
STATE Arizona PROJECT Powerline Channel

BY Watt DATE 5-13-66

Bridge Xing Private Roads

Channel $S = .0059$ $Q = 660$ $d = 3.9$ Design $D = 5.0$ $b = 6.0$

$S:S = 1\frac{1}{2}:1$



Bridge. Width. -16'

For H-10 Load

Wheel load 16,000#

Impact = 30% total Live load 20.8 Kips

$$E = \frac{10 \times 1 + 12}{4} = 5.5 \text{ ft width/wheel}$$

$$\text{Load per ft width} = \frac{20.8}{2 \times 5.5} = 1.9 \text{ K/ft. width}$$

Dead Load 150#/sq ft

Earth Load

Equivalent fluid pressure 45#/sq ft

Stiffness factors I on deck & abutment same

$K_{deck} = \frac{1}{19} = .053$

$K_{abt} = \frac{1}{5} = .20$ For hinged btm $= .2 \times \frac{3}{4} = .15$

COMPUTATION SHEET
SCS-ES-22A REV 9-65
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Channel

Watt 5-13-66

Private Bridge - Dead load Moments

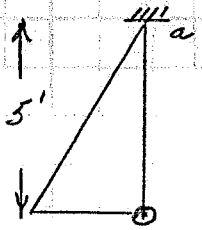
Dead Load

Fixed Moment Bridge deck slab 150#/ft²

Span = 19'

$M = \frac{Wl^2}{12} = \frac{.150 \times 19^2}{12} = 4.51$ ft K

Earth Load on abutment



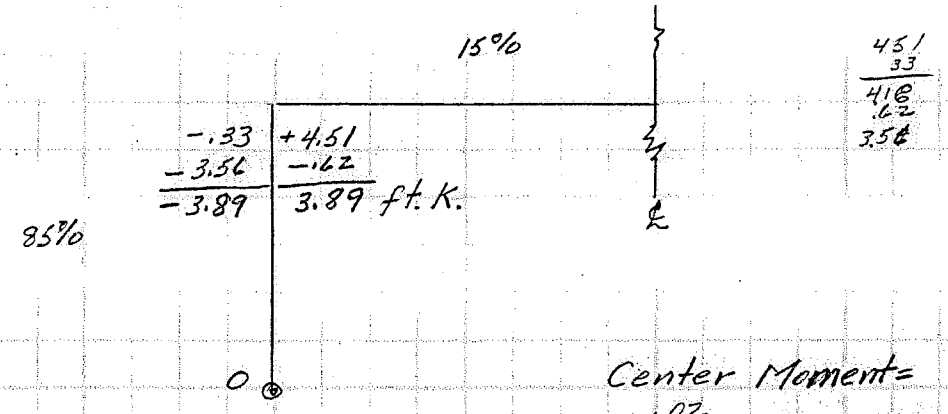
$M_a = .058\,Wl^3 = .058 \times 45 \times 5^3 = 326$ 'lbs

$= .33$ ft K

Distribution of Moments.

For Sem. Str Deck = $\frac{.053}{2} = .027 = 15\%$

abt $.015 = 85\%$



Center Moment =

$\frac{Wl^2}{8} - 3.89 = \frac{.150 \times 19^2}{8} - 3.89 =$

$M_c = 2.87$

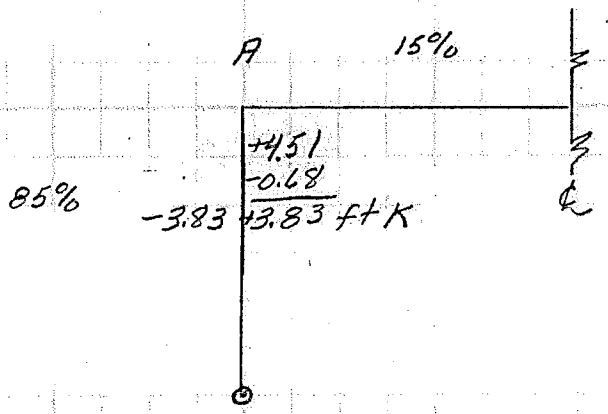
STATE Arizona PROJECT Powerline Channel

Watt 5-13-cc

Private Bridge Corner Moments

Live load at Center

Fixed End $M = \frac{Wl}{8} = \frac{1.9 \times 19}{8} = 4.51$ ft K

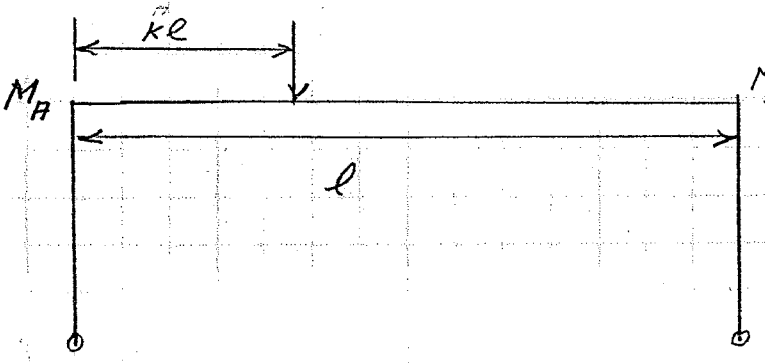


Center Moment

$M_c = \frac{Wl}{4} - 3.83 = \frac{1.9 \times 19}{4} - 3.83$

$M_c = 5.19$

Live load position for Max Moment at A



$M_A = WKl(1-K)^2$

$= Wl(K - 2K^2 + K^3)$

$\frac{dM_A}{dK} = 1 - 4K + 3K^2 = 0$

$(K-1)(3K-1) = 0$

$K = 1/3$

Fixed M.

$M_a = \frac{Wl}{3} \times \frac{4}{9} = \frac{4}{27} Wl$

$M_A = \frac{4}{27} \times 1.9 \times 19 = 5.34$ ft K

$M_B = \frac{2}{3} \times \frac{1}{9} \times 1.9 \times 19 = 2.67$ ft K

STATE: Arizona
PROJECT: Watt 5-13-CC

Private Bridge Dist Live load @ 1/3 point

Dist Factor Deck .053 26%
Abt. .150 74%

A		B	
0	+5.34	-2.67	+0
-3.95	-1.39	+0.69	+1.98
0	+.34	-.70	0
-.25	-.09	+.18	+.52
0	+.09	-.04	0
-.07	-.02	+.01	+.03
0	0	-.01	0
0	0	0	+.01
-4.27	+4.27 ft K For No Sway.	-2.54	+2.54

If Bridge sways from eccentric loading

427
254
173

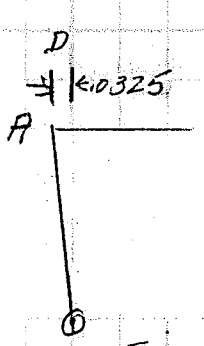
$M_a = -M_b$	+4.27	-2.54
	-0.86	-0.87
	$M_a = +3.41$	$M_b = -3.41$

Arizona Powerline Channel
Watt 5-13-66
Private Bridge
Temperature Moments:

Use 50°F departure From median

Total Expansion of deck = .000006 × 18 × 12 × 50 = .065

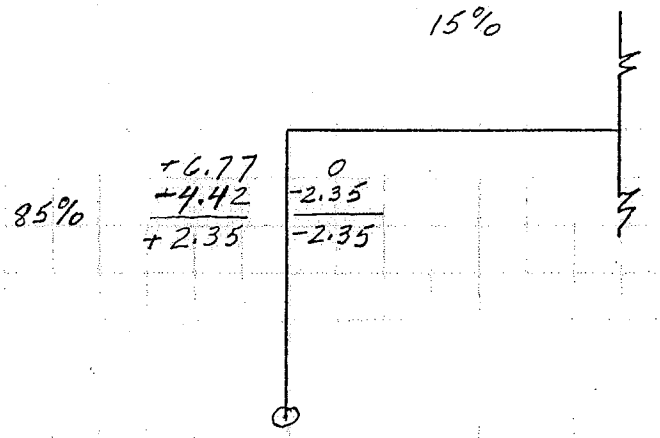
Deflection of one abutment = .6325



$$D = \frac{MQ^2}{3EI}$$

$$.0325 = \frac{M \times 5^2 \times 144}{3 \times 3{,}000{,}000 \times \frac{12 \times 10^3}{12}}$$

Fixed End 81250 in lbs = 6.77 ft-lbs



COMPUTATION SHEET
SCS-232A REVISED
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
STATE PROJECT

Arizona Powerline Channel
Watt 5-16-66
Private Bridge Max Moments & Foundation Pressures

Max Moment in Corner

Dead Load =	3.89
Live Load	3.83
Temp load	2.35
	10.07

For 10" wall $d = 7.5$ $A_s = 0.90$
No 6 @ 5½"

Max Moment at Center Span.

Dead Load =	2.87 ft.K.
Live Load =	5.19
Temp	2.35
	10.41

For 10" Wall $d = 7.5$ $A_s = 0.92$
No 6 @ 5½"

Temp Steel = No 4 @ 10"
Sec (f) Page 25 A.A.S.P. 1960 Shear & Bond O.K.
Transverse Steel = $.96 \times \frac{100}{\sqrt{19}} = 0.23$ = No 4 @ 10"

Foundation Pressure

Live Load		1.9K per lin ft
Dead Load		
Deck .150 x 10		1.5K
Abt 4.5 x .150 x .83		0.56 K
Found		0.15 K
	Total	4.1K

Use Base 2'6" Wide
= 1.6K/ft
0.8 Tons/ft

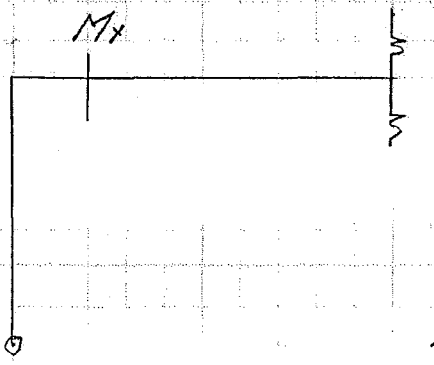
COMPUTATION SHEET
SCS-325A REV. 6-58
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Dam.

Watt 5-16-CC

Private Bridge

Cut off point top steel



M_x = Temp 2.35 ft K

M_x Dead

$M_x = -3.89 + \frac{.15x^2}{2}$

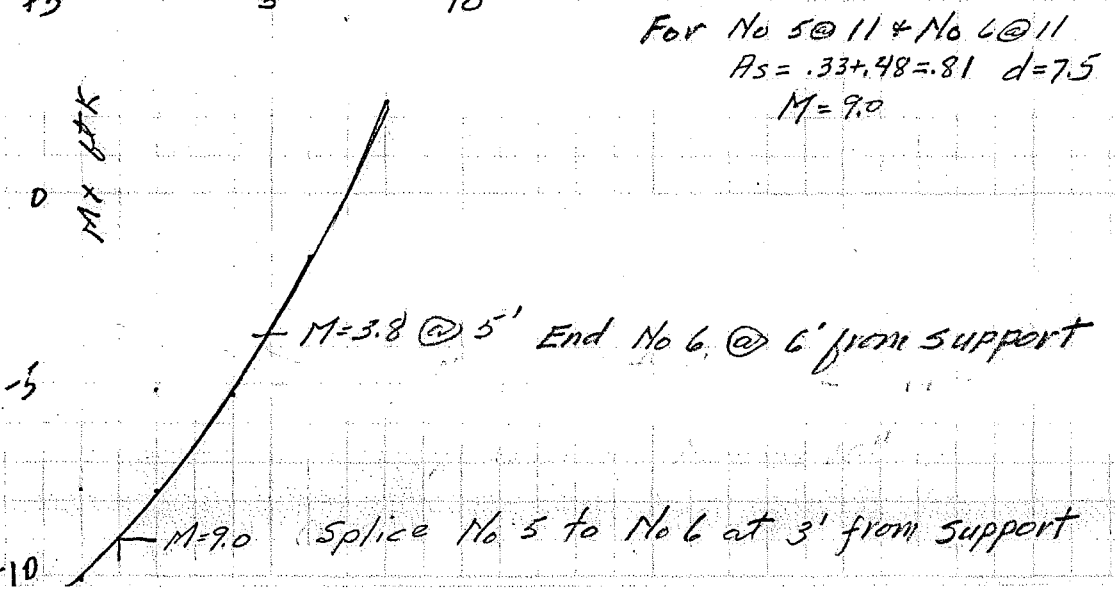
Live load load @ center

$M = -3.83 + \frac{1.9x}{2} =$

x	Dead Load	Temp Load	Live Load	Total
2	- 3.58	- 2.35	- 1.93	- 7.86
4	- 2.69	- 2.35	- 0.03	- 5.07
6	- 1.19	- 2.35	+ 1.87	- 1.67
8	+ .91	- 2.35	+ 3.77	+ 2.33

Allowable M for No 5 @ 11"
$A_s = 0.33$ $d = 7.5$
$M = 3.8$

For No 5 @ 11 + No 6 @ 11
$A_s = .33 + .48 = .81$ $d = 7.5$
$M = 9.0$

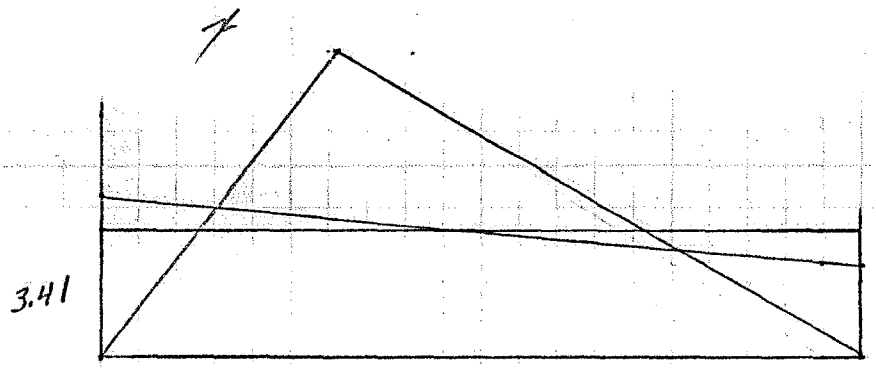


COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona
PROJECT Powerline Channel
BY Watt DATE 5-16-66
SUBJECT Private Bridge

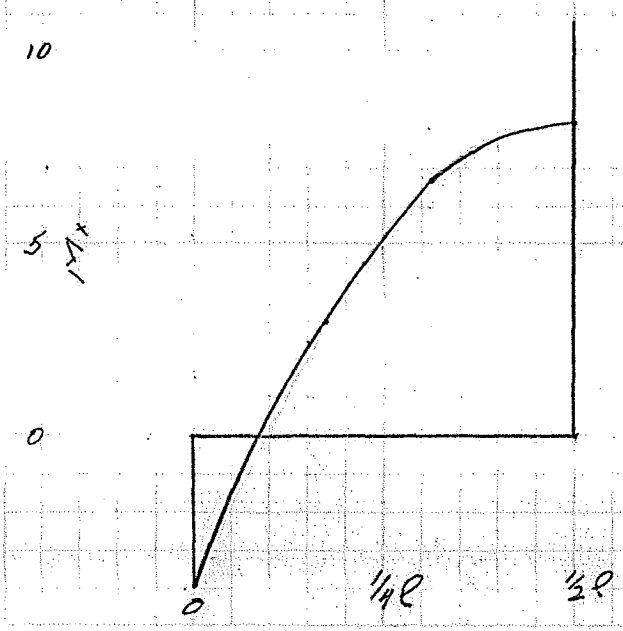
Cutoff point Btm steel



8.02
− 3.41
4.61

9.02
− 3.83
5.19

Dist	Dead Load M	Live load M under Load	@	Total
0	−3.89	0	0	−3.89
1/3	2.12	4.61	1/3 l	+6.73
1/2	2.87	5.19	1/2 l	+8.06



M = 5.0 @ 1/4

1/4 × 19 =

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

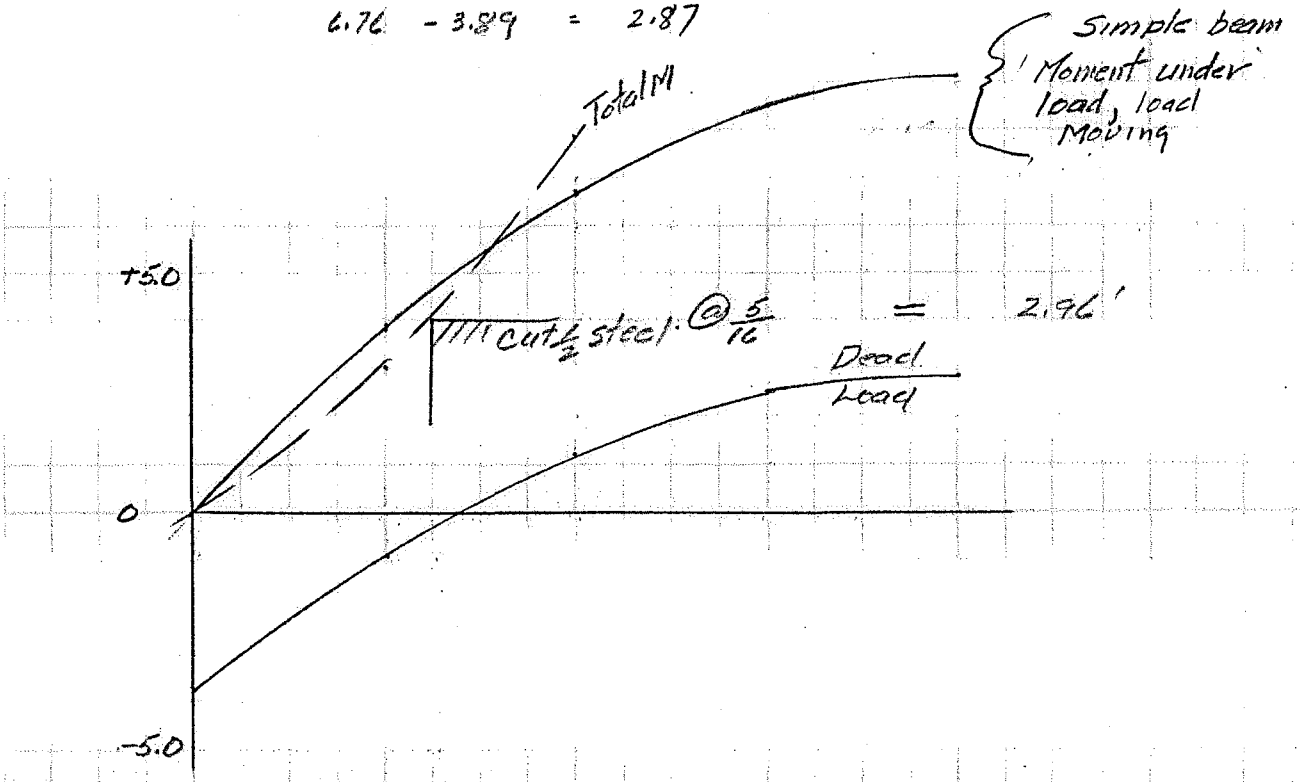
GPO : 1958 O—470868

STATE		PROJECT		
Arizona		Powerline Channel		
BY	DATE	CHECKED BY	DATE	JOB NO.
Watt	5-16-66			

SUBJECT Private Bridge Cutoff Point Btm. Steel SHEET ____ OF ____

	Dead Load $M = \frac{wlx}{2} - \frac{wx^2}{2}$ $w = 150$	Live Load @ x $M = \frac{wx(l-x)}{l}$ =
x		
1/8 l	2.96	3.94
1/11 l	5.08	6.72
1/3 l	6.01	8.02
3/8 l	6.35	8.42
1/2 l	6.76	9.02

6.01 − 3.89 = 2.12
2.96 − 3.89 = −0.93
5.08 − 3.89 = 1.19
6.35 − 3.89 = 2.46
6.76 − 3.89 = 2.87



COMPUTATION SHEET
FCS-232A REV 2-58
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
STATE
PROJECT

Arizona Powerline Channel
Watt 5-16-66
Footing Design Private Bridge

Shear in footing

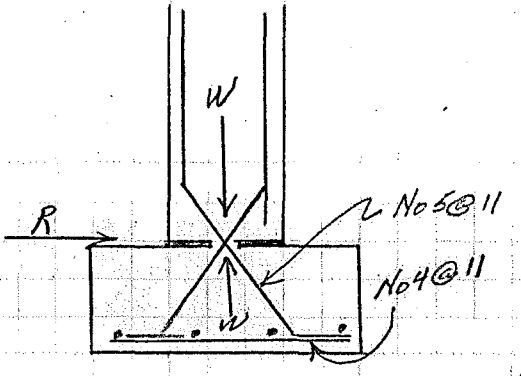
$$S = \frac{4100}{2} \times \frac{8}{7} \times \frac{1}{12 \times 9.5} = 20.5 \#/in^2$$

Moment in footing

$$M = \frac{4.1}{2} \times 1.25 = 2.6 \text{ ft K}$$

Min Steel No 4 @ 11"

Area Steel to Support Bridge

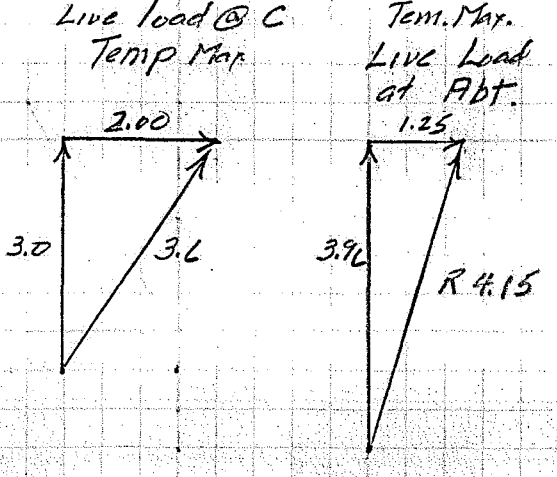


W - per ft br Live load near Abt.

Live load	1.9 K
Dead load	2.0 C
Total	3.9 C

$$R = \frac{2.35 + 3.89}{5} = 1.25 \text{ K}$$

W per ft br. Live load @ center



Live Load =	.95
Dead Load	2.0 C
Total	3.01

$$R = \frac{10.07}{5} = 2.0$$

$$\text{Max } A_s \text{ Required} = \frac{4,150}{16000} = 0.2C$$

No 5 @ 11"

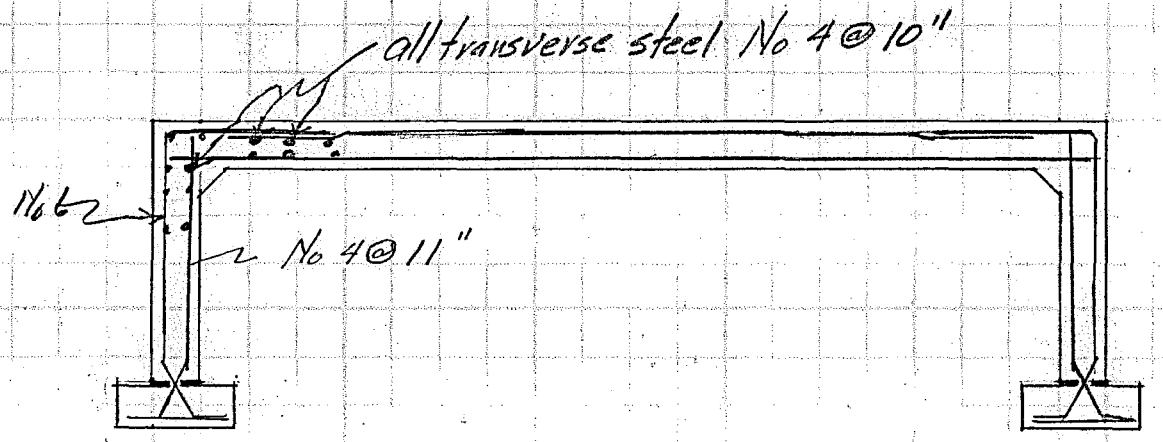
COMPUTATION SHEET
SCS-522A REV 5-58

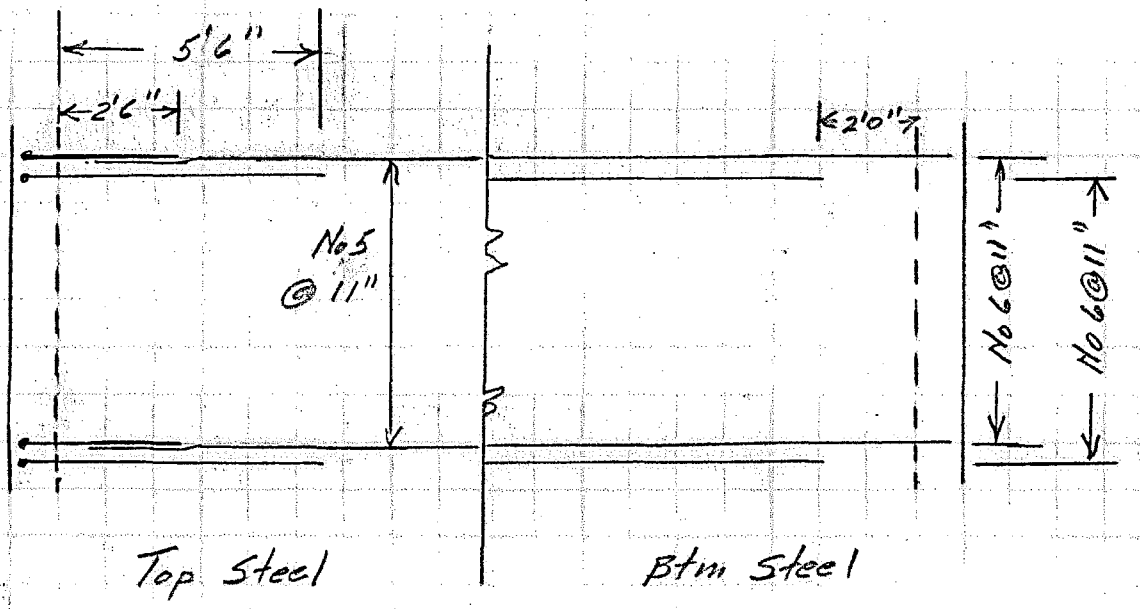
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

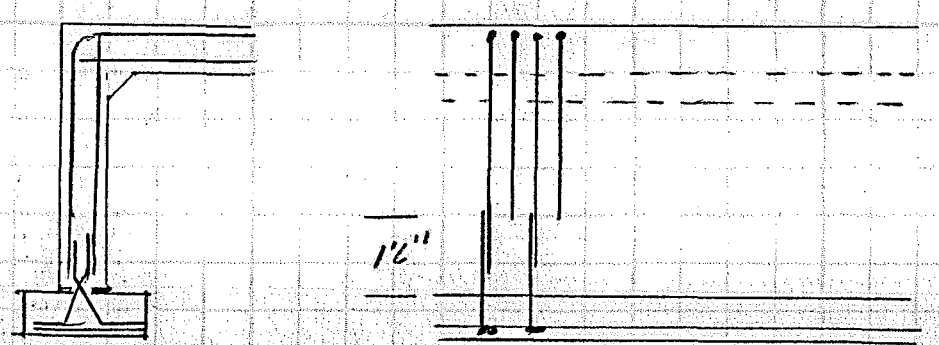
STATE | PROJECT

5-16-66

Private Bridge
Steel Layout







COMPUTATION SHEET
SCS-522A REV 5-58

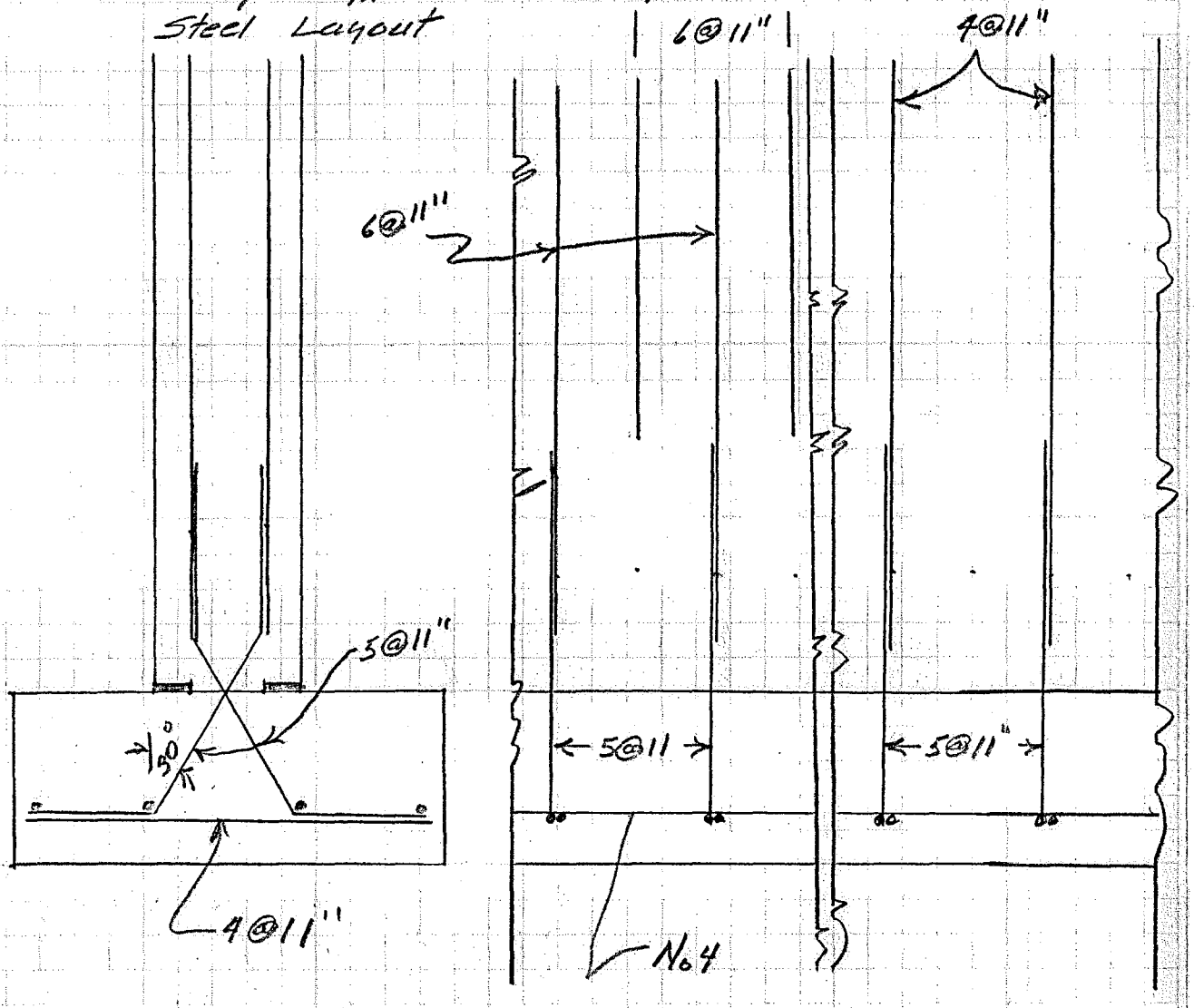
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Channel

Watt 5-16-66

Footing Design Private Bridge

Steel Layout



CONSULTATION SHEET
SCS-ECS-A, REV. 5-58
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
STATE
PROJECT
BY
DATE
SUBJECT

Concrete per ft

Deck.	$18 \times \frac{10}{12}$ =	15.0
Abt.	$5\frac{1}{2} \times \frac{10}{12} \times 2$	9.2
Footing	$2\frac{1}{2} \times 2 \times 1$ =	5.0
		29.2 cuft

Cuyd/ft = 1.08 cuyd/ft width

1.08 × 16 = 17.28 cuyd

@ $100 = $1728

Call $2000

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona
PROJECT
BY Watt
DATE 5-23-66
CHECKED BY
DATE
JOB NO
SUBJECT Box Culvert - Vinyard Rd
SHEET 1 OF 2

Size of Box Culvert Required for Vinyard Rd

Water cross section of max channel flow
$Q = 600 \quad b = 6 \quad s = 1\frac{1}{2}:1 \quad d = 3.52$

$A = 3.52 \times 6 + 1.5 \times 3.5^2 = 39.71$

Required width for equal Area & depth

$39.71 / 3.52 = 11.28'$

For 10' Width Culvert

$d = \frac{39.71}{10} = 3.97$ ft

Drop in grade for 10' Box = $3.97 - 3.52 = .47$

Make Box 5'×10' drop Channel grade 0.5'

Transitions $\frac{10-6}{2 \times .2}$ 10' btm

$\frac{4.75 \times 3 + 6 - 10}{2 \times .2} = 25.6$ ft

Make Transitions 25' long
Equal Area for Max flow.

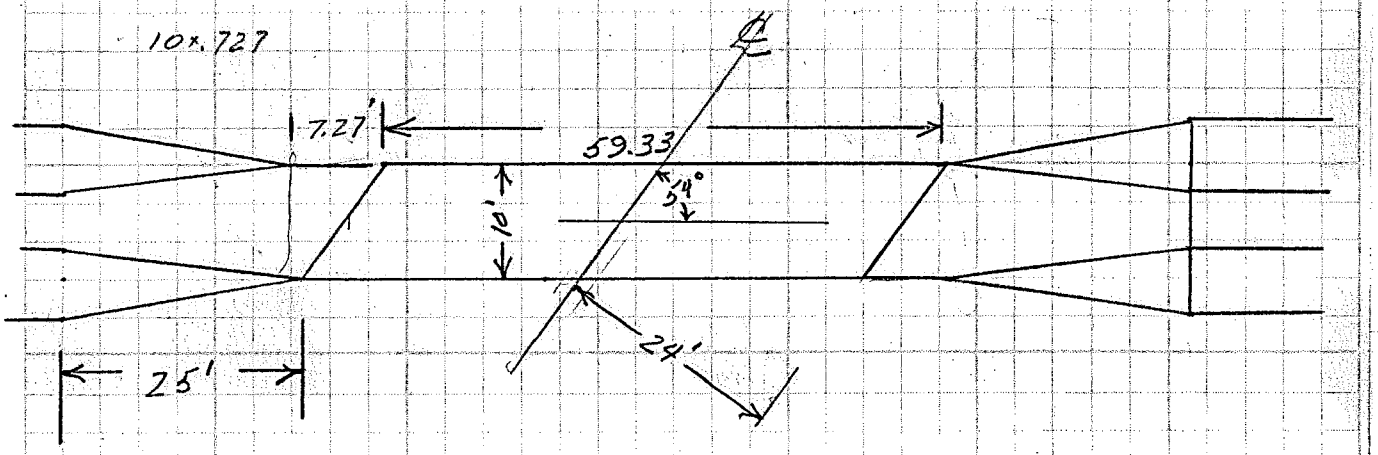
COMPUTATION SHEET
SCS-ECOA REV 5-56

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT

BY Watt DATE 5-23-66 | CHECKED BY | DATE | JOB NO.

SUBJECT Vineyard Rd Box Culvert | SHEET | OF



Conc in box 10" walls

$$\left(11.67 \times 6.67 - 10 \times 5\right)\frac{59.33}{27} = 61.17 \text{ cuyd}$$

Conc in transition 6" walls

$$\frac{(4.75 \times 3.6 + C)}{2}\tfrac{1}{2} + \frac{(11.0 \times 5.5 - 10 \times 5)}{2} = 11.025 \text{ cuft/ft}$$

$$\frac{11.025 \times 25}{27} = 10.2 \text{ cuyd / Trans.}$$

2-Corners $\frac{7.27}{27}\left(\frac{11 \times 5.5 - 50}{}\right) = 2.82$ cuyd.

Concrete Box $61.17 \times \$85 = \$5200.$

Transitions $2 \times 10.2 + 2.82 = 23.22 @ \$75 \quad 1742$

Excav. $\frac{116.6 \times 14 \times 6}{27} = 362 @ \$2^{00} \quad 724$

Backfill $\frac{3 \times 60 \times 6}{27} = 40 @ \$5^{00} \quad 200$

$\$7866$

Less Cost of Channel $\$23 \times 116 \quad 2668$ Flood Con.

$\$5198$ Rts of Way

COMPUTATION SHEET
SCS-SCSA REV 1-50

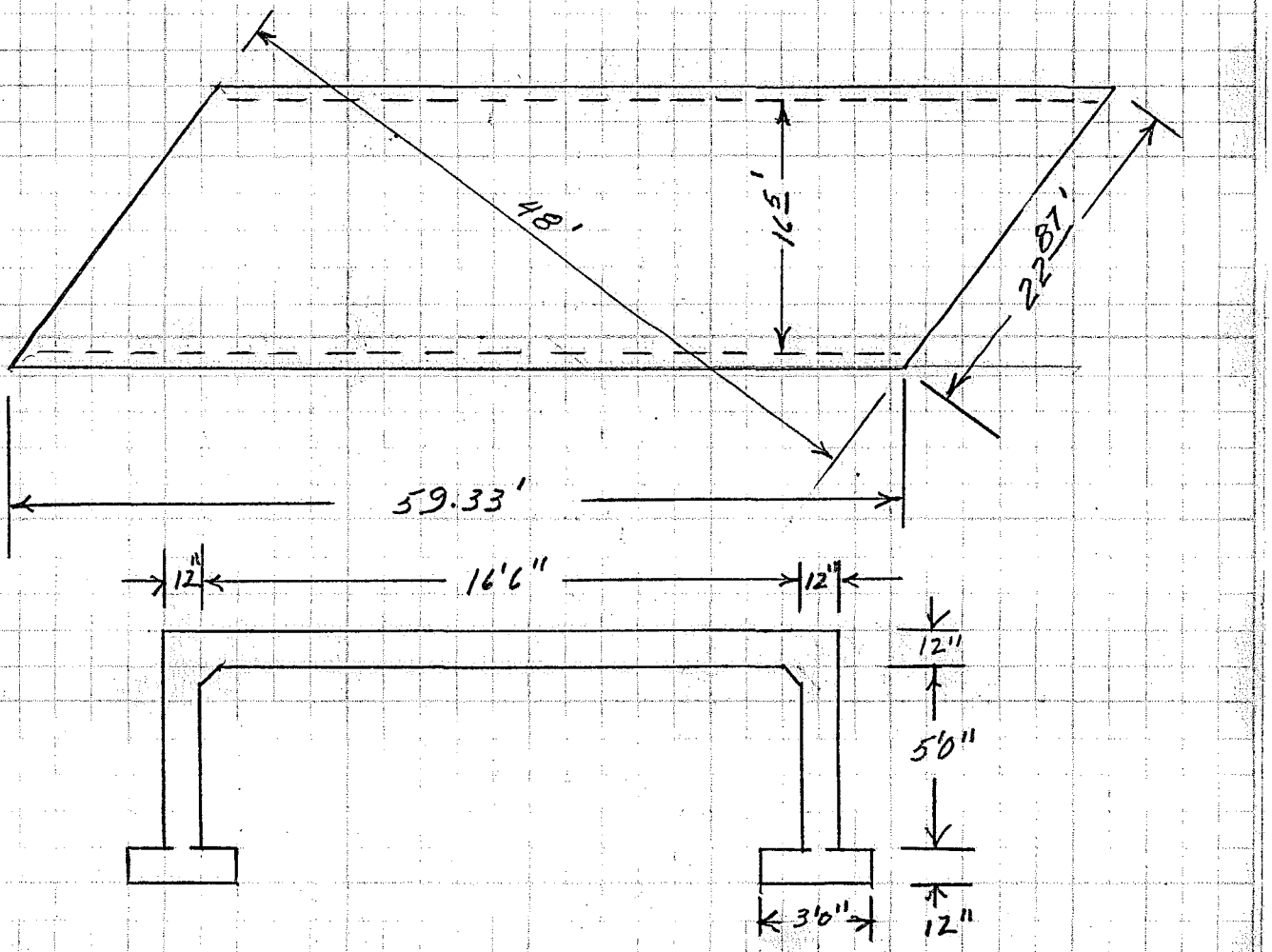
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Channel

BY Watt DATE 5-23-66 CHECKED BY DATE JOB NO.

SUBJECT Vineyard Rd Bridge

SHEET 1 OF 14



Estimated Cost

Conc $50/cuyd Steel $35/cuyd		81 cuyd @ 85 =	$6885
Excav	$\frac{63\times6\times6\times2}{27}$	168 @ $3	504
Backfill	$\frac{63\times5\times5\times2}{27}$	117 @ $5	585
		Total	$7974

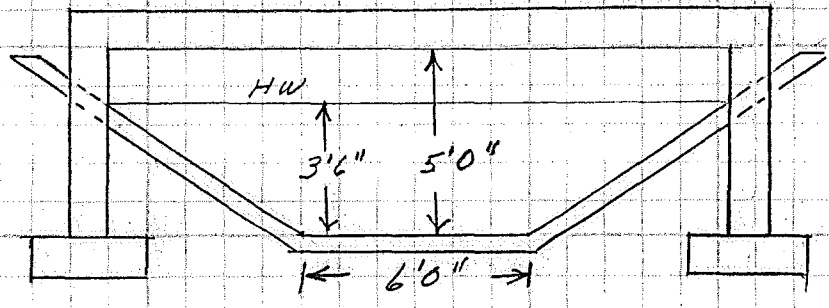
Est Cost

STATE Arizona PROJECT Powerline Channel

BY Watt DATE 5-23-66 CHECKED BY DATE JOB NO.

SUBJECT Vineyard Road Dam

Bridge Skewed @ 54°

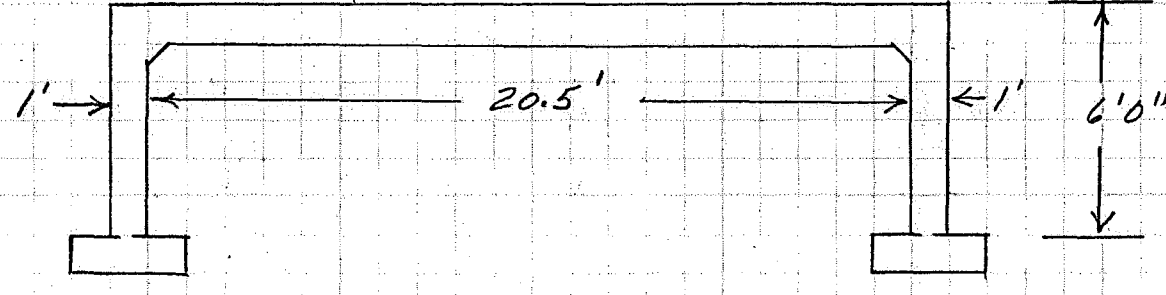


Perpendicular Clearance

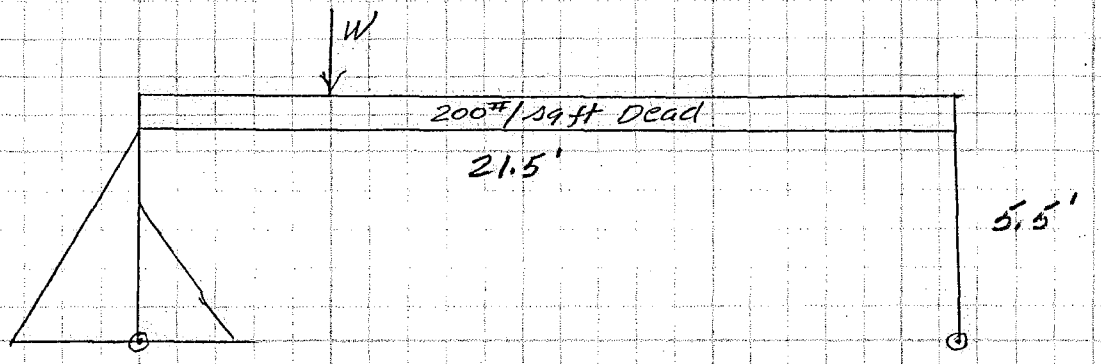
$3.5 \times 2 \times 1.5 + 6 = 16.5$ ft

Skewed Distance $= 16.5 / \underset{.80902}{\sin 54°} = 20.4$ ft

Make Clearance 20.5 ft



STATE Arizona PROJECT Powerline Channel
BY Watt DATE 5-19-66 CHECKED BY DATE JOB NO
SUBJECT Vineyard Rd Br - Bridge loads SHEET 3 OF 14



Live load H-20-S

Max Wheel Load 32.0K

Using Single axle load $24(1+.016(21.5-18) = 25.3K$

$$\text{Impact} = \frac{50}{21+125} = .34$$

Total Live Load $= 1.34 \times 25.3 = 33.9K$

Distribution Per Wheel

$$E = \frac{10+12}{4} = 5.5 ft$$

Live load per Unit width of bridge

$$\frac{33.8}{2} \times \frac{1}{5.5} = 3.2 K/lin ft$$

Dead load Use $200\#/ft^2$

Earth Equiv fluid pressure $50\#/cuft$

STATE Arizona PROJECT Powerline Channel
BY Watt DATE 5-19-66 CHECKED BY DATE JOB NO
SUBJECT Vinyard Rd Bridge SHEET 4 OF 14

Distribution Factors

Thickness of deck & abutment equal

For Fixed Ends

Deck $\frac{1}{21.5} = .0465$ 20%

Abt $\frac{1}{5.5} = .1818$ 80%

For Abt Hinged at Footing

Deck $= .0465$ 25.4 %

Abt $= .75 \times .1818 = .1364$ 74.6 %

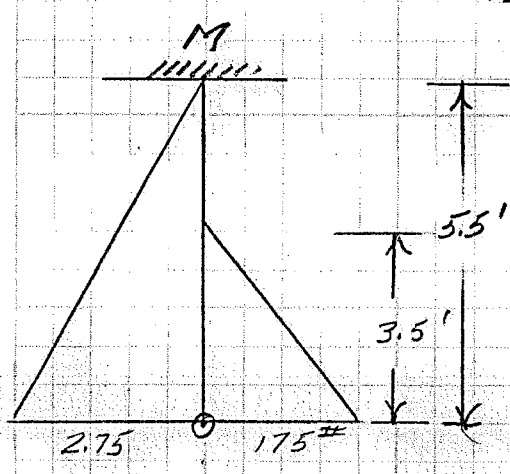
For Hinged Footing - Symetrical Loading

Deck $.5 \times .0465 = .0233 = 14.6\%$

Abt. $= .1364 = 85.4\%$

Fixed End Moments - Dead Load

$$M = \frac{Wl^2}{12} = \frac{0.2 \times 21.5^2}{12} = 7.7 \text{ ft.K.}$$



$$M = \overset{482}{.058 \times 50 \times 5.5^3} - \overset{-70}{\frac{175 \times 3.5^3}{60 \times 5.5^2}(5 \times 5.5 - 3 \times 3.5)}$$

$$- \underset{-118}{\frac{175 \times 3.5^2}{120 \times 5.5^2}(10 \times 5.5^2 - 10 \times 3.5 \times 5.5 + 3 \times 5.5^2)}$$

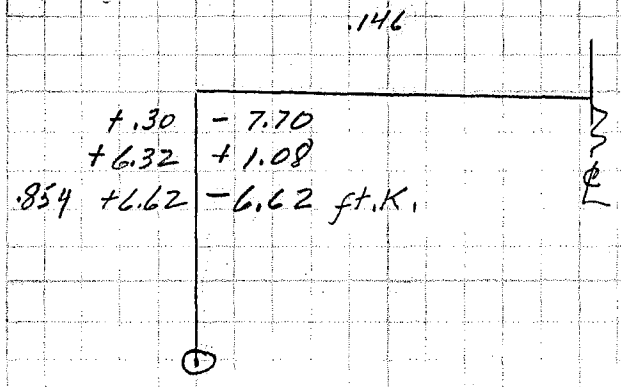
$= 2.94$ ft lbs $= .30$ ft K

COMPUTATION SHEET
SCS-523A REV 5-60

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO : 1959 O - 487927

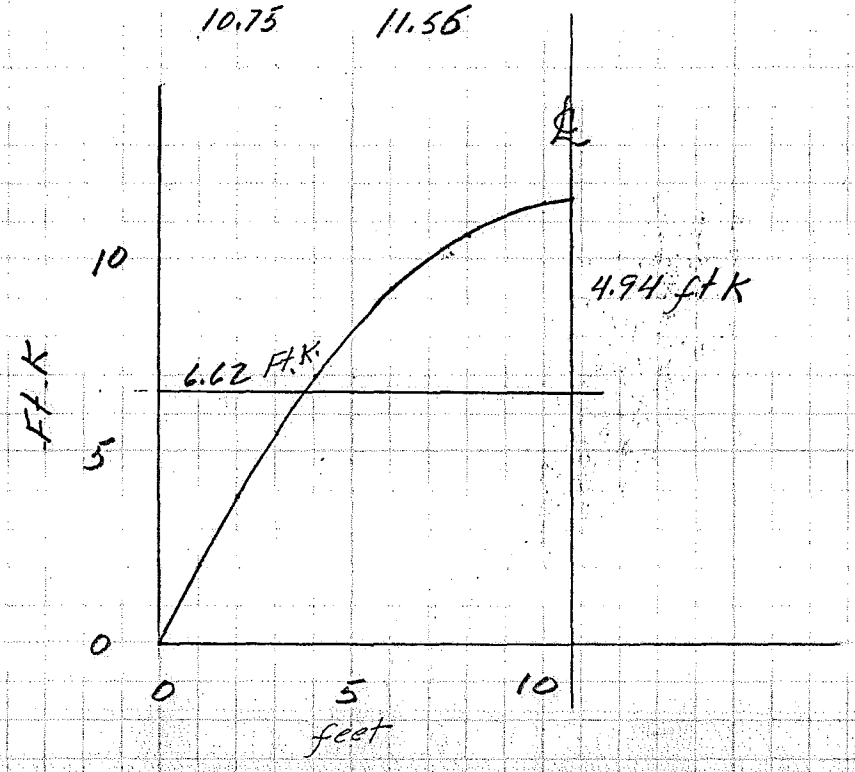
STATE Arizona PROJECT Powerline Channel
BY Watt DATE 5-19-66 CHECKED BY DATE JOB NO
SUBJECT Vinyard Rd Bridge SHEET 5 OF 14

Distribution Dead Load Moments



$$M = \frac{wlx}{2} - \frac{wx^2}{2} = \frac{.2 \times 21.5}{2}x - \frac{.2x^2}{.2} = 2.15x - .1x^2$$

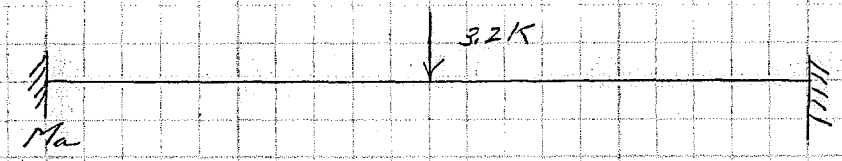
X	M
2	3.9 - ftK
4	7.0
6	9.3
8	10.8
10	11.5
10.75	11.56



STATE Arizona PROJECT Powerline Dam

BY Watt DATE 5-19-66 CHECKED BY DATE JOB NO

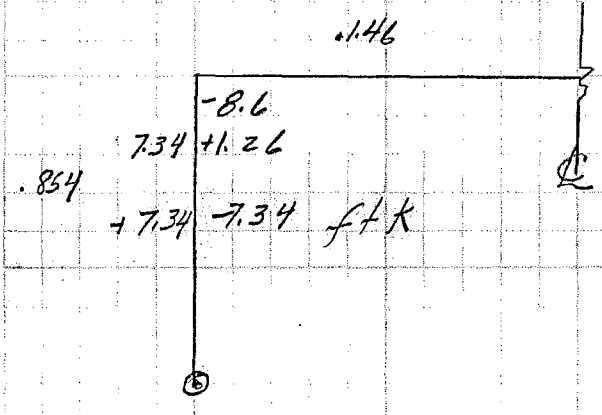
SUBJECT Vineyard Rd Bridge - Live load Moments SHEET 6 OF 14



Fixed End Moment

$$M_a = \frac{Wl}{8} = \frac{3.2 \times 21.5}{8} = 8.6 \text{ ft K}$$

Distribution

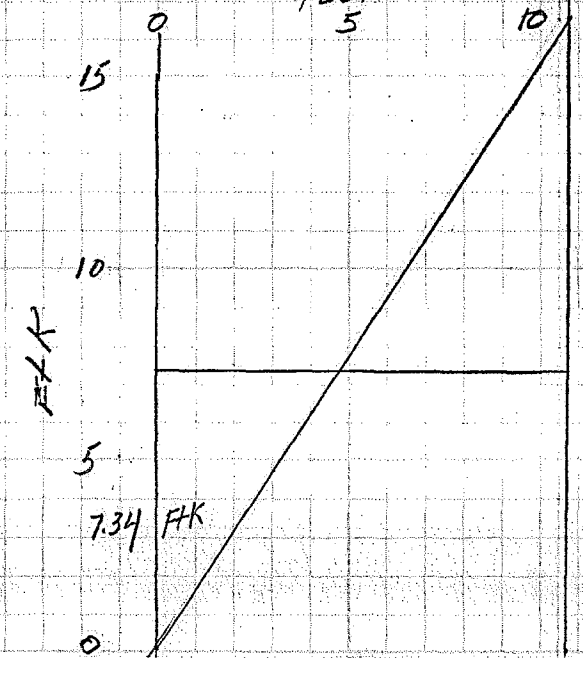


Positive M_{simple}

$$M = \frac{Wl}{4} = \frac{3.2 \times 20.6}{4} = 16.5 \text{ ft K}$$

16.5 - 7.34 = 9.16

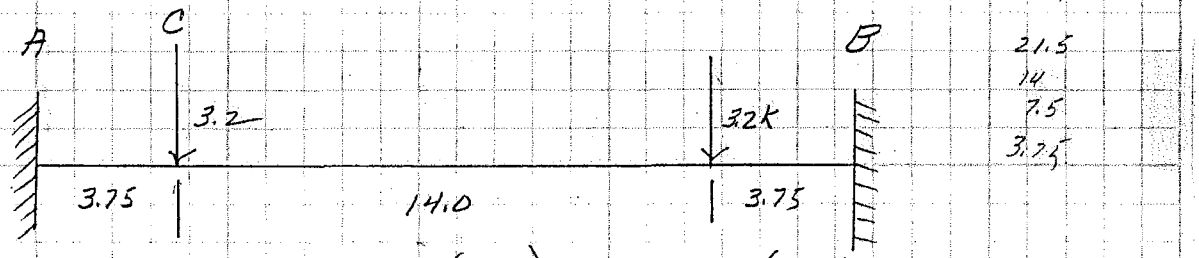
Moment Dia. Live load at Center



STATE Arizona PROJECT Powerline Dam

BY Watt DATE 5-19-86 CHECKED BY DATE JOB NO

SUBJECT Vineyard Rd Bridge - Live Load Moments SHEET 7 OF 14

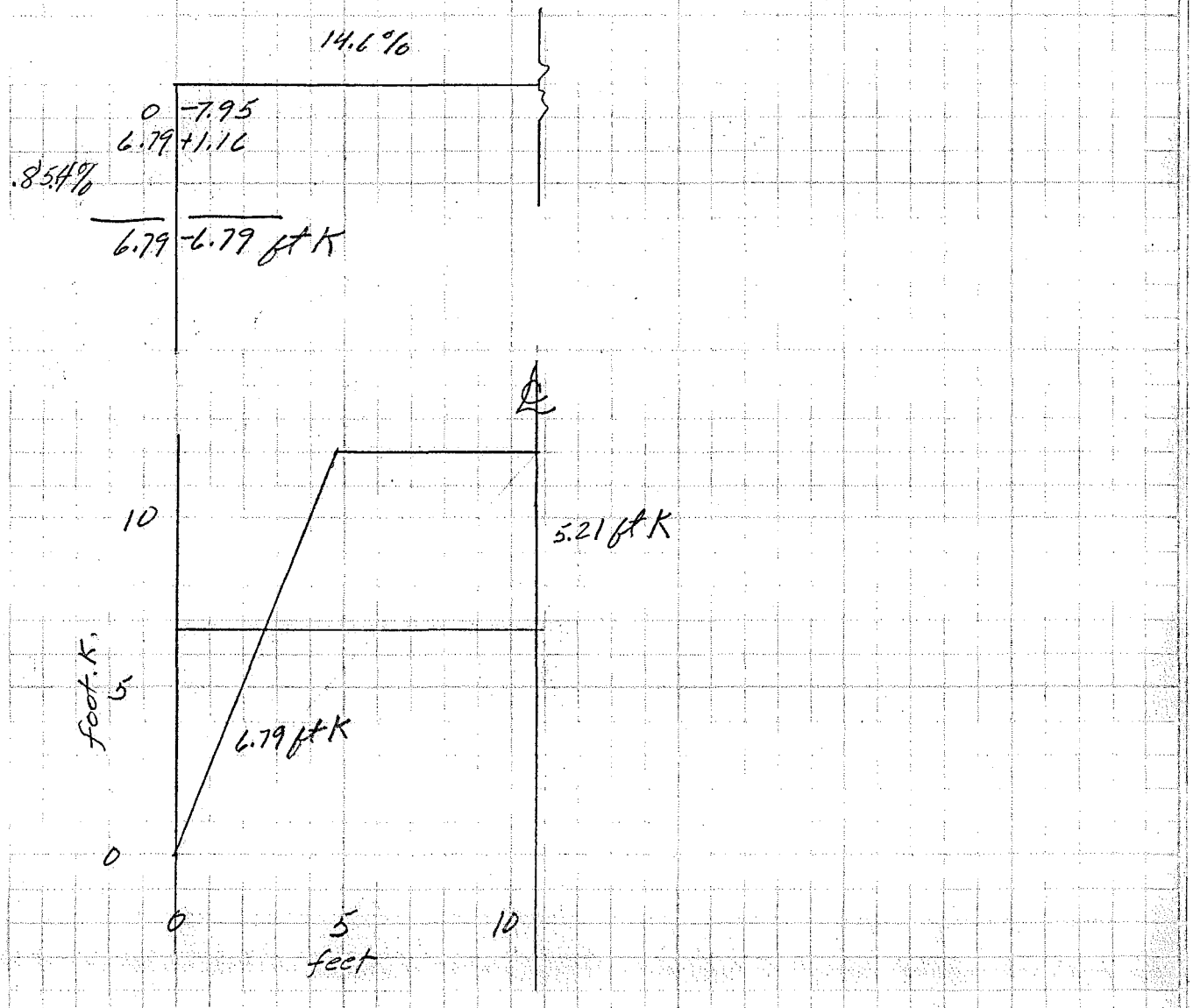


$$M_a = M_b = 3.2 \times 3.75 \left(\frac{17.75}{24}\right)^2 + 3.2 \times 17.75 \left(\frac{3.75}{24}\right)^2 = 7.95 \text{ ft.k.}$$

(6.56) (1.38)

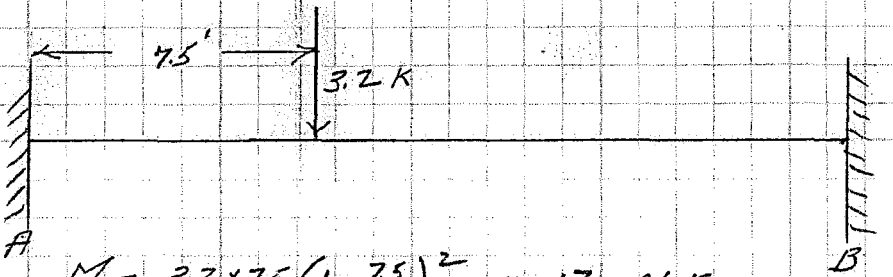
$$M_c = 3.2 \times 3.75 = 12.00 \text{ ft.k.}$$

Distribution



STATE Arizona PROJECT Powerline Channel
BY Watt DATE 5-23-66 CHECKED BY DATE JOB NO
SUBJECT Vineyard Rd Bridge
SHEET 8 OF 14

Live load Moment Live load @ 1/3 pt ±



$M_a = 3.2 \times 7.5 \left(1 - \frac{7.5}{21.5}\right)^2 = 10.17$ ft.K.

$M_b = 3.2 \times 14 \left(1 - \frac{14}{21.5}\right)^2 = 5.45$ ft.K.

$M_{simple} = 3.2 \times \frac{14}{21.5} \times 7.5 = 15.63$ ft.K.

25.4

0	-10.17	
+7.59	+2.58	
0	-0.69	
+0.51	+0.18	
0	-.17	
+.13	+.04	
0	-.01	
+.01	0	
+8.24	-8.24 ft K	

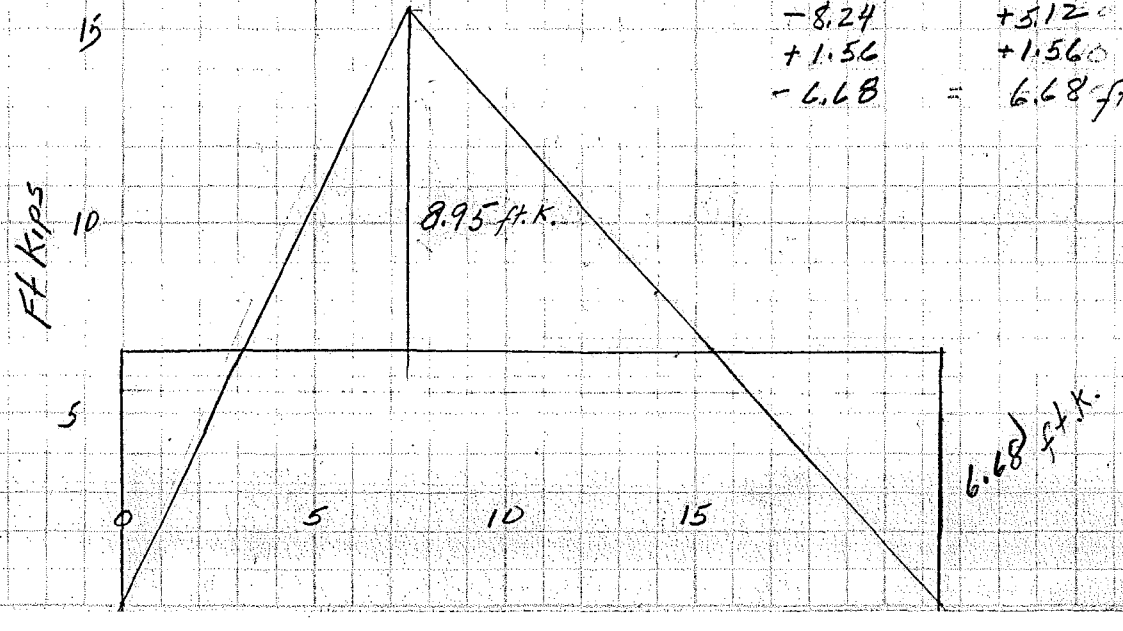
74.6

+5.45	0.00	
-1.38	-4.07	
+11.29	0	
-0.33	-.96	
+.09	0	
-.02	-.07	
+.02	0	
0	-.02	
+5.12	-5.12 ft K.	

74.6

Sway Correction

-8.24	+5.12
+1.56	+1.56
-6.68	= 6.68 ft K



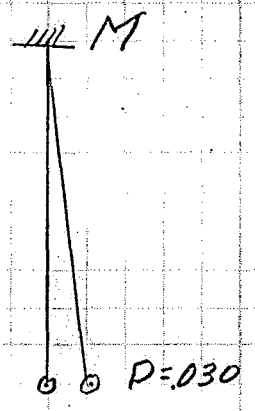
STATE Arizona PROJECT Powerline Channel
BY Watt DATE 5-23-66 CHECKED BY DATE JOB NO
SUBJECT Vinyard Rd Bridge SHEET 9 OF 14

Temperature Stresses

For 40° Rise & 40° Fall

$n = 8$ $E = 3{,}600{,}000$
Coef. Thermal Expansion $= .000006$ "/deg. F

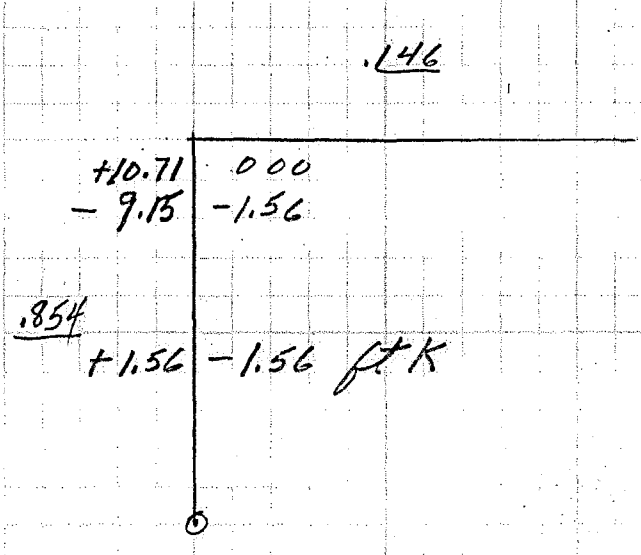
Expansion of Deck $= .000006 \times 40 \times 20.5 \times 12 = .059$ in.



$$D = \frac{Ml^2}{3EI} \qquad M = \frac{3DEI}{l^2}$$

$$M = 3 \times 3{,}600{,}000 \times .030 \times \frac{\cancel{12} \times \cancel{12^3}}{\cancel{12}} = \underline{10{,}710} \text{ ft lbs}$$
$$5.5^2 \times \cancel{12^2} \times \cancel{12}$$

Distribution



COMPUTATION SHEET
SCS-523A REV 5-58

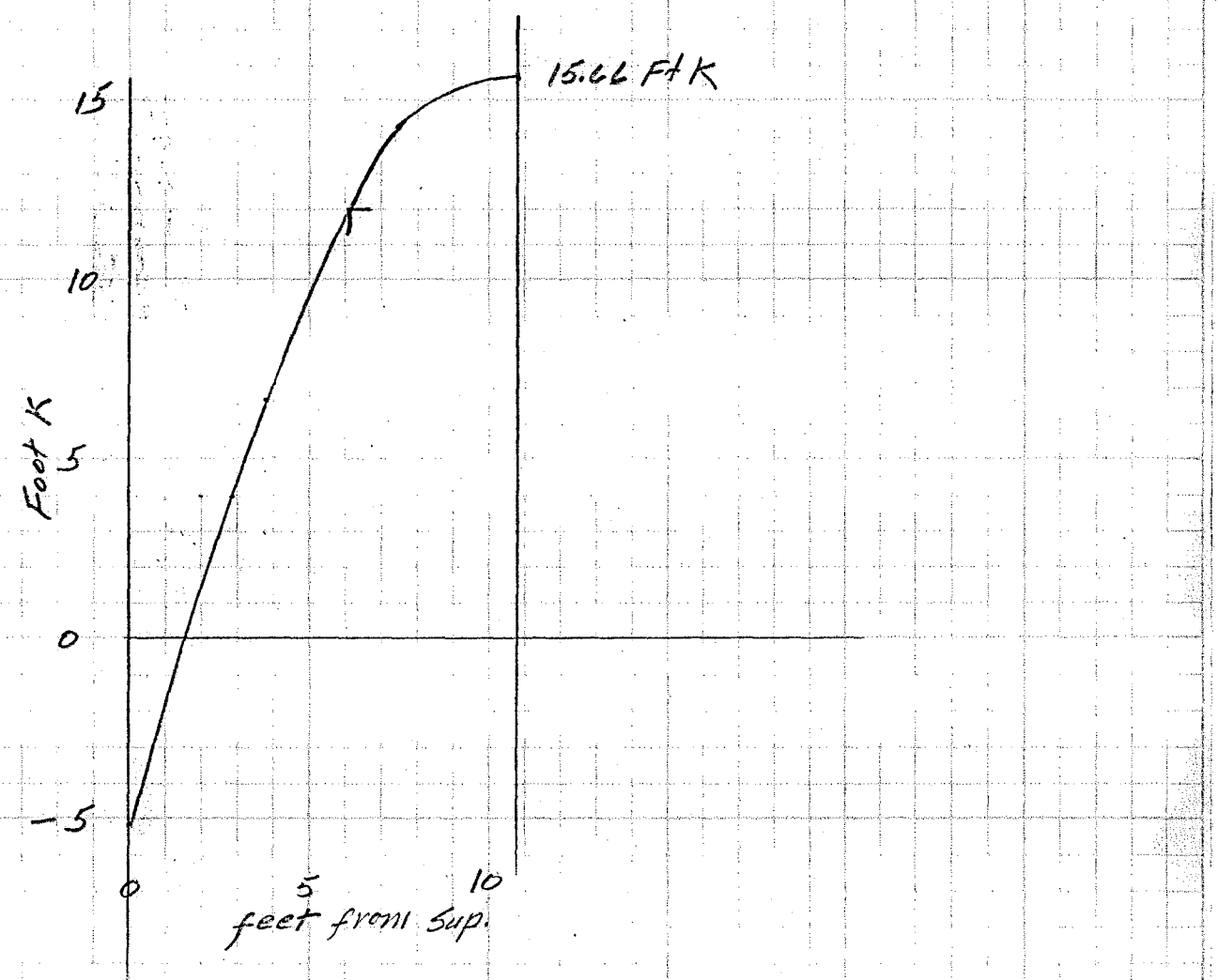
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Channel
BY Watt | DATE 5-23-66 | CHECKED BY | DATE | JOB NO
SUBJECT Vinyard Rd Bridge

SHEET 10 OF 14

Max Positive Moment

x	Dead Load	Max Live Load	Temp	Total	
0	-6.62	0	1.56	-5.06	ft. K.
3.75	0	5.21	1.56	6.77	"
7.5	3.8	8.95	1.56	14.31	"
10.75	4.94	9.16	1.56	15.66	"



COMPUTATION SHEET
SCS-SESA REV 5-59

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Channel

BY Watt DATE 5-23-66 | CHECKED BY | DATE | JOB NO.

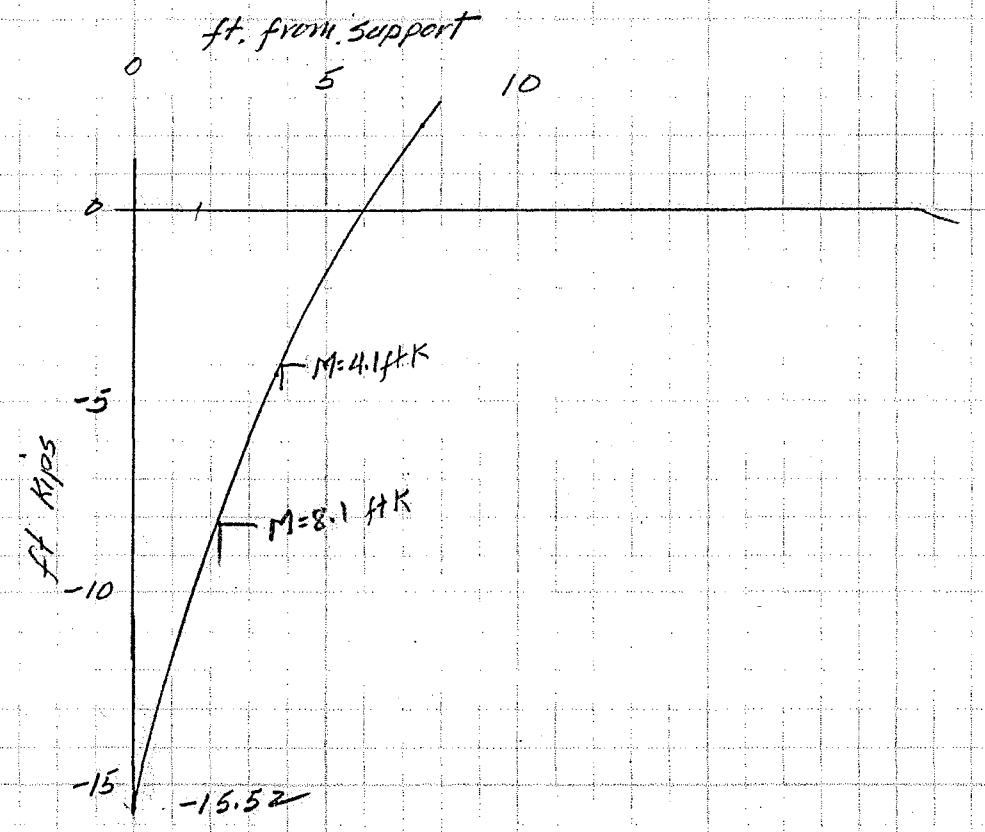
SUBJECT Vinyard Rd Bridge

SHEET 11 OF 14

10.4
6.6
5

Max Neg Moment at Support

X	Dead Load	Temp	Max Live Load M		
0	-6.62	-1.56	-7.34	-15.52	ft. K.
3.75	00	-1.56	-2.70	-4.26	"
7.5	+3.8	-1.56	+0.00	+2.24	"
10.75		-1.56			

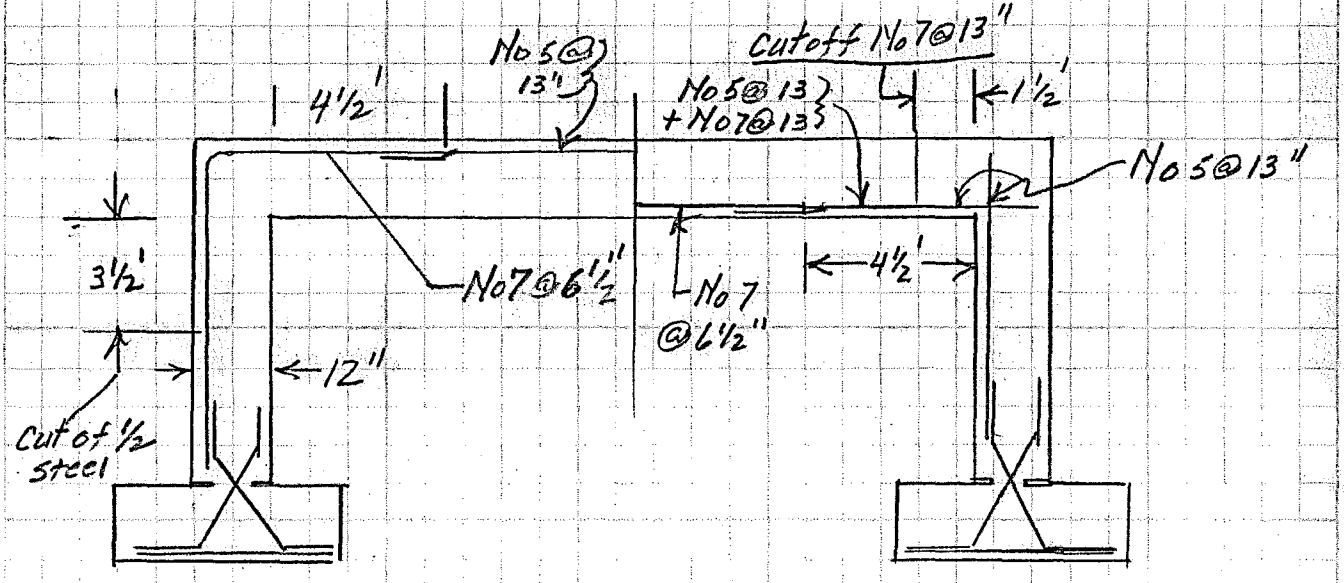


COMPUTATION SHEET
CCS-SCS-A REV. 5-59
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Channel

BY Watt DATE 5-23-66 CHECKED BY DATE JOB NO.

SUBJECT Vinyard Rd Bridge SHEET 12 OF 14



Max Positive M = 15.66 d = 9.5 A_s = 1.1

No 7@ 6½"

For No 5@13" + No 7@ 13"

A_s = 0.28+0.56 = 0.84

M = 12.0

For No 5@13" A_s = 0.28

M = 4.3 ft K

Max Neg Steel M_{max} = 15.52 Use No 7@6½"

For No 7@13" A_s = 0.56 M = 8.1

For No 5@6½" A_s = 57 M = 8.1

Splice With No 5@6½" at 3'0' from abt

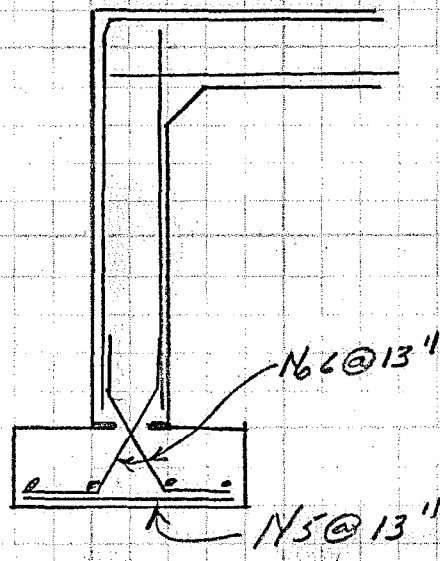
Cut off ½ No 5@ 5' from abt.

or carry out 7 to 4½' from abt

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO : 1959 O—437927

STATE Arizona
PROJECT Powerline Channel
BY Watt
DATE 5-23-66
CHECKED BY
DATE
JOB NO
SUBJECT Vinyard Road Bridge
Footing Design



$R = \frac{15.52}{5.5} = 2.82\ K$

Total Wt of Bridge

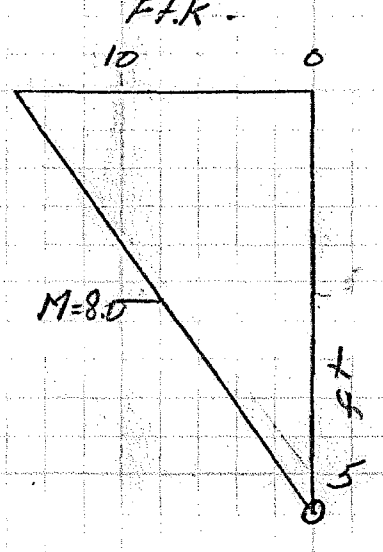
$80.4 \times 150 \times 27 = 325{,}620$

Unit Pressure on Found/ft width

$\frac{325{,}620}{2 \times 59.3} = 2745^{\#}$ 2.75 K

Live load $= \frac{25.3}{5.5}\left(1 + \frac{7.5}{21.5}\right) = 6.20\ K$

Total 8.95 K



Pressure $= \frac{8.95}{3} = 3\ K/sq\,ft$

Unit Shear

$3000 \times \frac{8}{7} \frac{1}{12 \times 9.5} = 30^{\#}/in^2$

Moment $= \frac{3.0 \times 1.5}{2} = 2.25'K$

Steel to Support Bridge

$\frac{8{,}950}{16{,}000} = 0.56$ No 6 @ 13" Both Sides $= 0.82\ sq\,in/ft$

COMPUTATION SHEET
SCS-523A REV 5-52

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona
PROJECT Powerline Channel
BY Watt DATE 5-23-66
CHECKED BY DATE JOB NO.
SUBJECT Vinyard Rd Bridge
SHEET 14 OF 14

Concrete Quantities

Deck $\frac{48 \times 22.5}{27}$ = 40.0 cuyd

Abt $\frac{48 \times}{.809} \times \frac{5.5 \times 2}{27}$ = 24.2

Footing $\frac{48}{.809} \times \frac{2 \times 3}{27}$ = 13.18

Curb $\frac{3/4 \times 3/4 \times 59.3 \times 2}{27}$ = 2.5

Fillet $\frac{1/2 \times 1/2 \times 59.3}{27}$ = .5

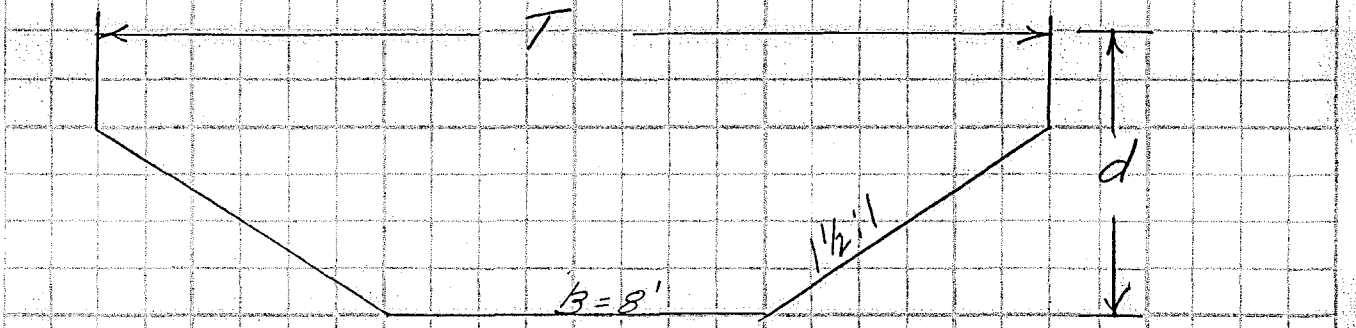
Total = 80.4 cuyd

81 cuyd

COMPUTATION SHEET
SCS-522A REV 5-53

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Channel
BY Watt | DATE 6-8-66 | CHECKED BY | DATE | JOB NO
SUBJECT Ellsworth Road Bridge Transition | SHEET | OF



From Trap Ch to 94 × 6½' Box Culvert 68' long.

Transition based on equal X section Area

$$d = \frac{A}{T} + \frac{(T+b)^2}{6T} = \frac{6A+(T-b)^2}{6T}$$

Channel $S = .0056$ $d = 4.88$ $b = 8$

$A = 4.88 \times 8 + 1.5 \times 4.88^2 = 74.76$

$T = 6.25 \times 3 + 8 = 26.75$

Transition 32' long $4.88 \times 3 + 8 = T' = 22.64$ @ 10.3 ft.

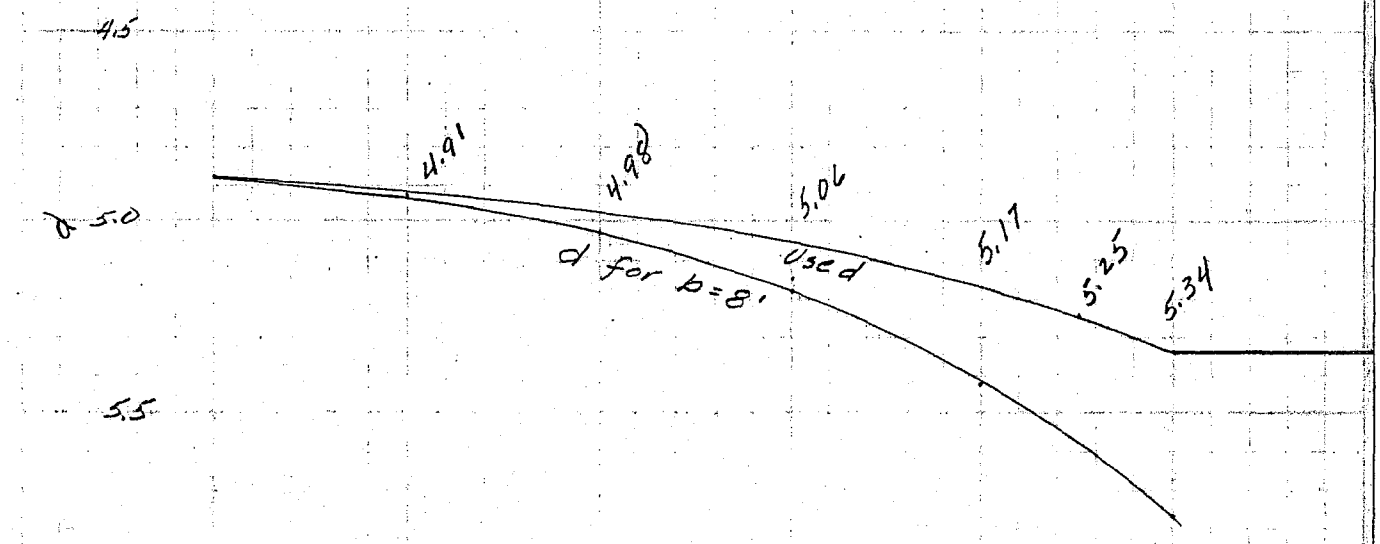
	T	b	d	Use d	b use	Ht slope
0	26.75	8		4.88	8	
4	25.16	8		4.88	8	
8	23.56	8		4.88	8	
12	21.97	8	4.88	4.88	8.01	4.62
16	20.37	8	4.92	4.91	8.06	4.10
20	18.78	8	5.03	4.98	8.17	3.54
24	17.19	8	5.17	5.06	8.63	2.85
28	15.60	8	5.41	5.17	9.65	1.98
32	14.00		5.77	5.34	14.00	0
30	14.80			5.25	10.60	1.40

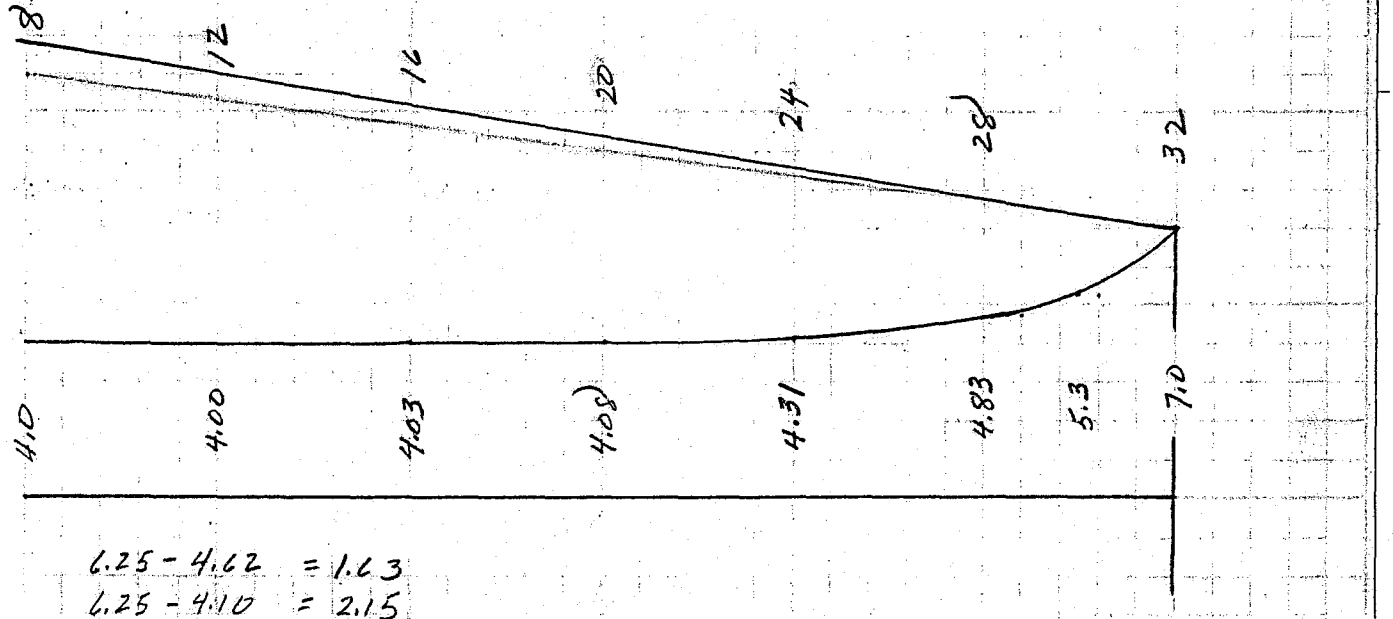
$b = T - 2.45\sqrt{Td - A}$

COMPUTATION SHEET
SCS-522 A REV 5-58

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Channel
BY Watt DATE 6-8-66 CHKD BY DATE
SUBJECT Ellsworth Rd Bridge Transition SHEET OF





6.25 - 4.62 = 1.63
6.25 - 4.10 = 2.15
6.25 - 3.54 = 2.71
6.25 - 2.85 = 3.40
6.25 - 1.98 = 4.27
6.25 - 1.40 = 4.85
6.25 - 0 = 6.25

COMPUTATION SHEET
SCS-523A REV 5-58

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona
BY Watt DATE 6-9-66
PROJECT Powerline Channel
CHECKED BY DATE JOB NO
SUBJECT Ellsworth Rd Br Transition
SHEET OF

Sto		Depth from WS	Total D 1.37 F.B.	Inlet → Ver Ht of Slope	Ht of Ver Wall	Outlet Total Ht	Ht Ver Wall
0	97+90	4.88	6.25	6.25	0.00	6.25	0.00
4	51+90	4.88	6.25	5.71	0.54	6.31	0.60
8	55+90	4.88	6.25	5.16	1.09	6.37	1.21
12	59+90	4.88	6.25	4.62	1.63	6.44	1.82
16	63+90	4.91	6.28	4.10	2.18	6.50	2.40
20	67+90	4.98	6.35 6	3.54	2.81	6.56	3.02
24	71+90	5.06	6.48 5	2.85	3.60	6.62	3.77
28	75+90	5.17	6.54 6	1.98	4.58	6.69	4.71
30	77+90	5.25	6.62 5	1.40	5.25	6.72	5.32
32	79+90	5.34	6.75	0	6.75	6.75	6.75

Btm St. Gr
.0056

Friction loss Rect Channel 5.34' = d b = 14
n = .0014 Q = 1210 A = 74.76 R = 3.03

V = 16.2 $S/(nv)^2$ = .103 S = .0053

Friction loss in box almost

same as Channel = .0056

At full flow W.S. will be even at inlet & culvert because they will have equal Areas

At outlet the depth will drop about 0.2' less than inlet because excess of .46 ft head

COMPUTATION SHEET
SCS-SSSA REV 5-58

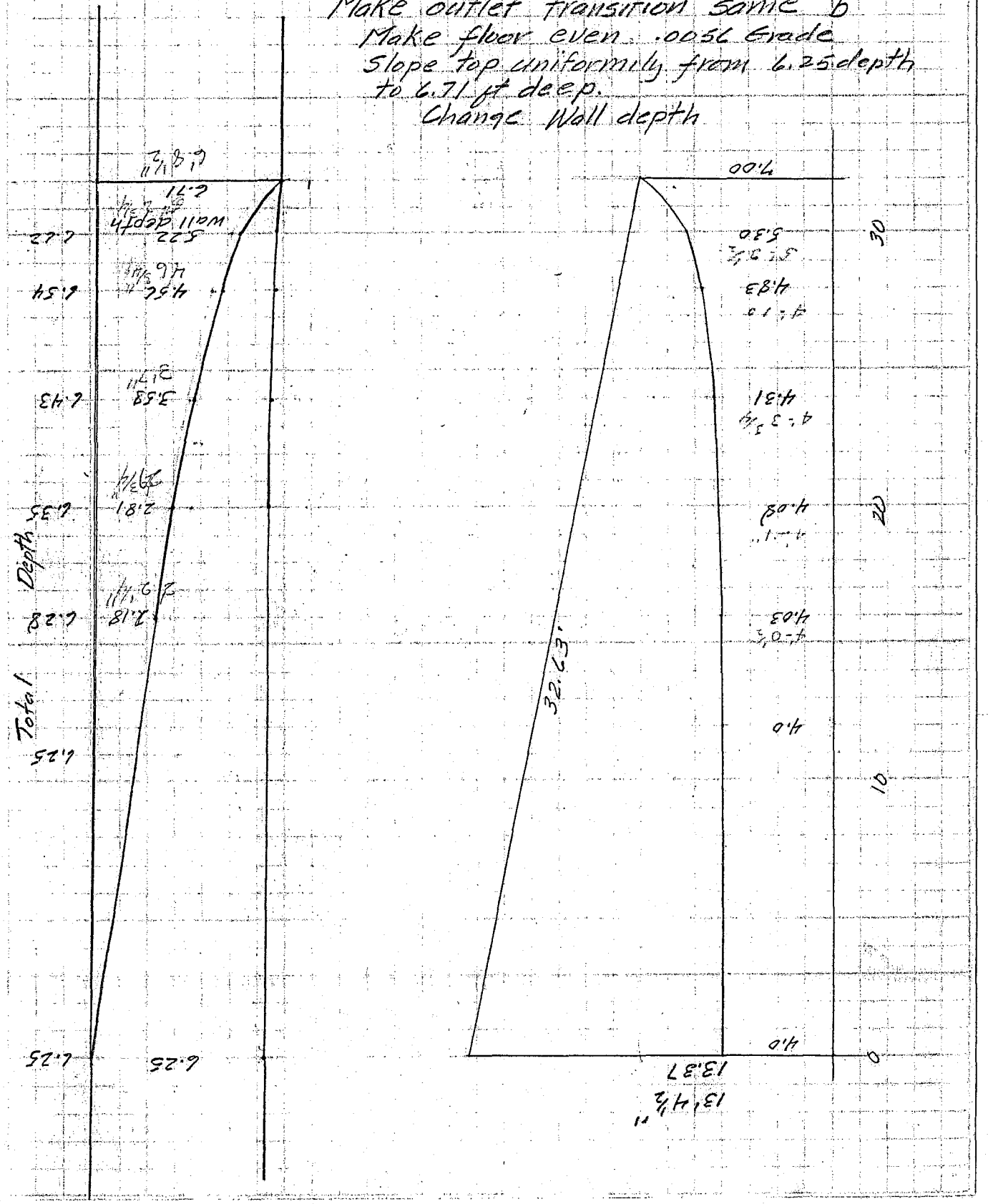
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Channel

BY Watt DATE 6-9-66 CHECKED BY DATE JOB NO.

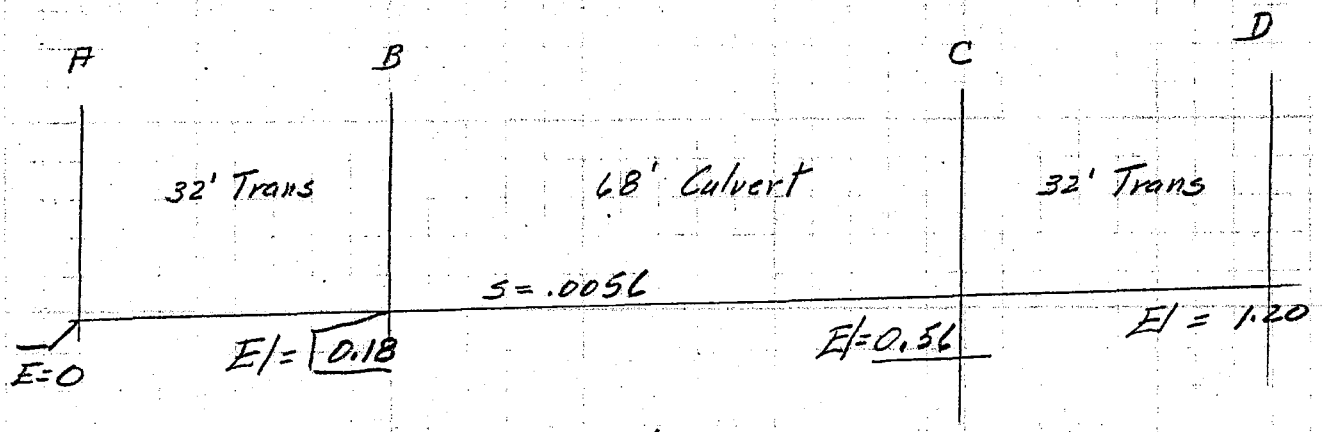
SUBJECT Ellsworth Rd Bridge Transition SHEET OF

Make outlet transition same "b"
Make floor even .0056 Grade
Slope top uniformly from 6.25 depth
to 6.71 ft deep.
Change Wall depth



COMPUTATION SHEET — DEPARTMENT OF AGRICULTURE
SCS-SEDA REV 5-65 — SOIL CONSERVATION SERVICE

STATE Ariz. PROJECT Powerline Channel
BY Watt DATE 6-9-66 CHECKED BY DATE JOB NO.
SUBJECT Ellsworth Rd Bridge Transition SHEET ___ OF ___



For 600 CFS W.S. d @ A = 3.43 h_v = 2.81

From D to C

Try $d_{@C}$ = 3.0

$h_f = \frac{.0056+.0058}{2} \times 32 = .19$

Δh_v = 3.17 − 2.81 = .36

Head Req = .57

Head Avail = 1.20 − .56 + 3.43 − 3.00
= 1.07

Try 2.75 $h_f = \frac{.0056+.0087}{2} \times 32 = 0.23$

h_v = 3.81 − 2.81 = 1.0
= 1.23

Available .64 + 3.43 − 2.75 = 1.32

At 2.7 Δh_v = 3.91 − 2.81 = 1.10

$h_f = \frac{.0056+.0092}{2} \times 32$ .24

Total 1.34 Avail 1.37
OK

COMPUTATION SHEET

SCS-523A REV 5-68

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

STATE Arizona

BY DATE PROJECT

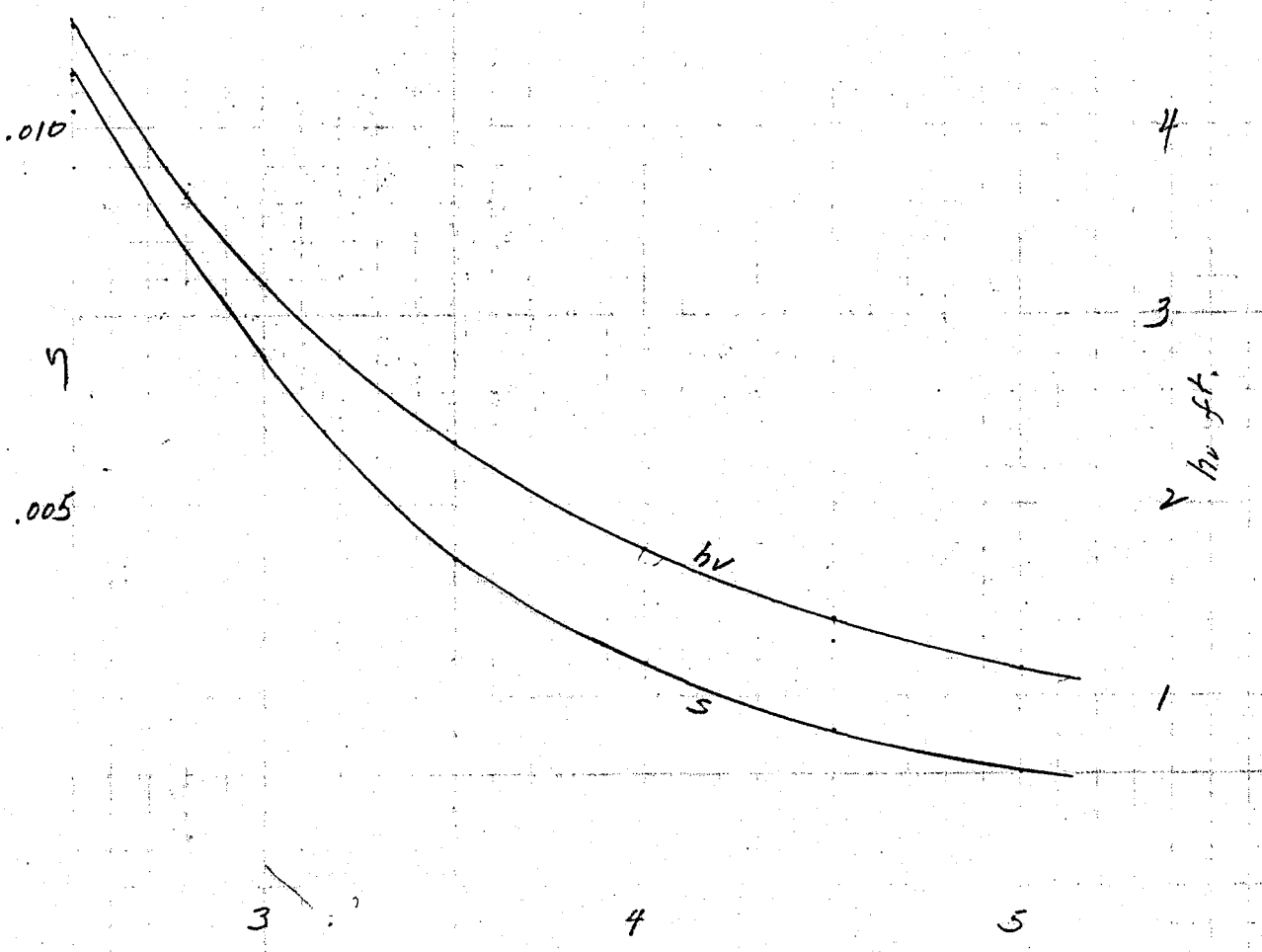
SUBJECT Watt

Rect. Channel

SHEET OF

Q=600 b=14' n=.014 Rect Channel

D	A	V	hv	R	$S(nv)^2$	S
2.5	35	17.14	4.57	1.94	.187	.0107
3	42	14.3	3.17	2.10	.168	.00669
3.5	49	12.24	2.33	2.33	.147	.00432
4	56	10.71	1.78	2.54	.131	.00295
4.5	63	9.52	1.41	2.74	.118	.00209
5	70	8.57	1.14	2.92	.108	.00155



COMPUTATION SHEET
SCS-523A REV 5-58

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

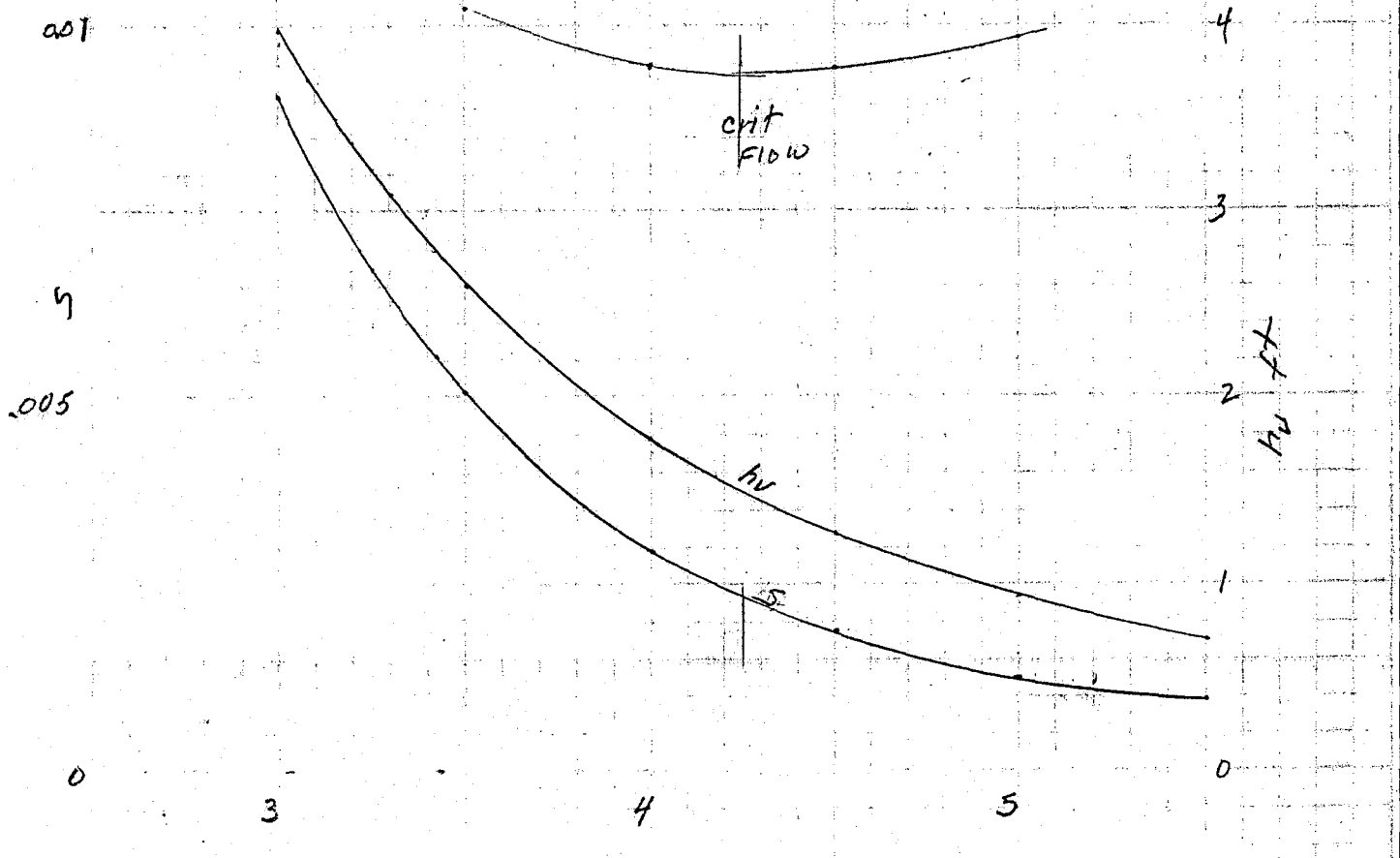
STATE PROJECT

BY DATE CHECKED BY DATE JOB NO.

SUBJECT Trap Channel SHEET OF

For 600 C.F.S. b=8' S:S=1½:1 n=.014

D	A	V	hv	R	$\frac{S}{(nv)^2}$	S
3.5	46.37	12.93	2.60	2.25	.154	.00504
4.0 crit I	56.0	10.71	1.78	2.50	.133	.00299
4.5	66.37	9.04	1.27	2.74	.118	.00189
5.0	77.50	7.74	0.93	2.98	.106	.00124
5.5	89.37	6.71	0.70	3.21	.0956	.00084
3.0	37.50	16.00	3.98	1.99	.181	.00908



COMPUTATION SHEET
SCS-523A REV 5-58

DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE PROJECT

BY DATE CHECKED BY DATE FOR

SUBJECT

SHEET OF

From C to B

Try $D_B = 2.8$

$\Delta h_v = 3.91 - 3.65 = +.26$

$h_f = \frac{.0092 + .0083}{2} \times 68 = -0.59$

Net $-.33$ req

$0.38 - 2.8 + 2.7 = .28$ OK

From B to A

Try $D_A = 3.1$

$\Delta h_v = 3.65 - 3.65 = +0.00$

$\Delta h_f = \frac{.0083 + .0080}{2} \times 32 = +0.26$

Net $= 0.26$

Available $-0.18 + 2.8 + 3.1 = +.12$

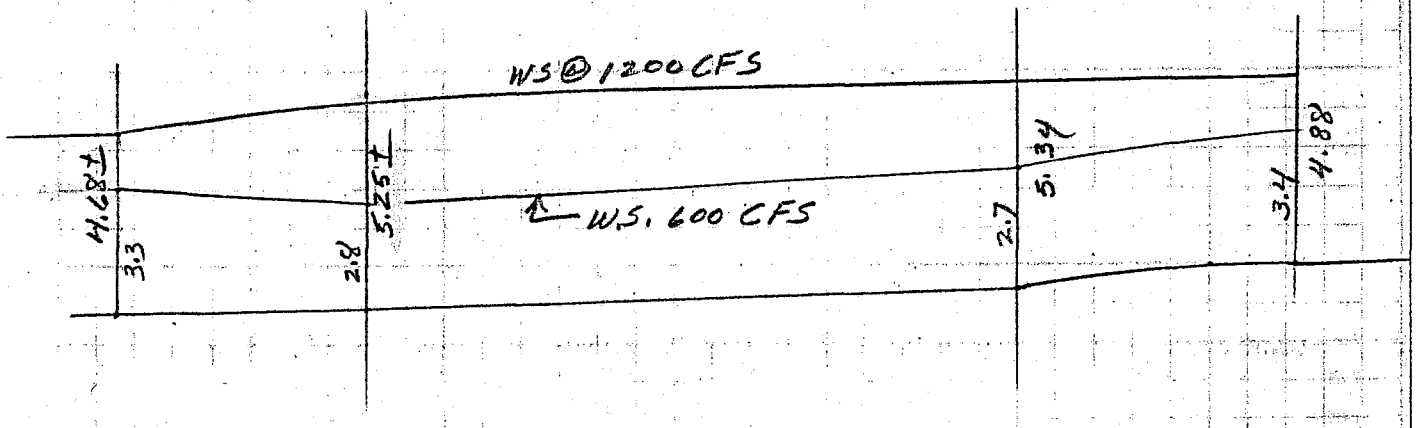
Try $D_A = 3.3$

$\Delta h_f = 3.65 - 3.1 = +0.55$

$\frac{.0083 + .0063}{2} \times 32 = -0.23$

$+.32$ up

$3.3 - 2.8 - .18 = 0.32$ up

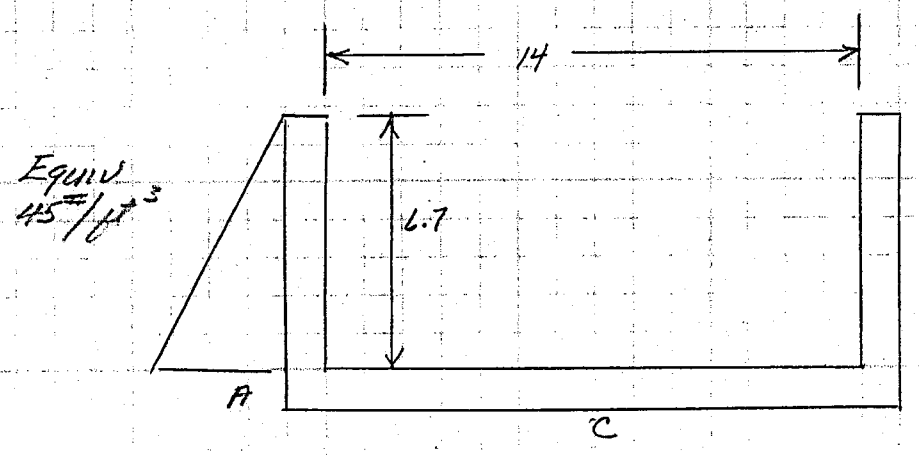


COMPUTATION SHEET
SCS-523A REV 5-58

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Ariz
BY Watt DATE 6-10-66
SUBJECT Ellsworth Br Trans

PROJECT Powerline Channel
CHECKED BY DATE JOB NO.
SHEET OF



$$M_B = \frac{wl^3}{6} = \frac{45 \times 6.7^3}{6} = 2{,}256$$

$D = 3.5$ $A_s = 0.43$
No 4 @ 5½
Use 7" Walls

For No Backfill

Upward load on btm =

$$\frac{2 \times 7/12 \times 6.7 \times 150}{15.0} = 78.2^{\#}$$

$$M = \frac{wl^2}{8} = \frac{78.2 \times 14.5^2}{8} = 2055 \text{ ft lbs}$$

7" walls ok

bars No 4 @ 5½" ok

For Backfill Channel empty

$M = -2{,}256 + 2{,}055 = -200$ ft lbs OK

$$\text{Shear} = \frac{wl^2}{2} \times \frac{8}{7} \frac{1}{12 \times 3.5} = 27.5^{\#}/\text{in}^2$$

COMPUTATION SHEET
SCS-232A REV 5-56

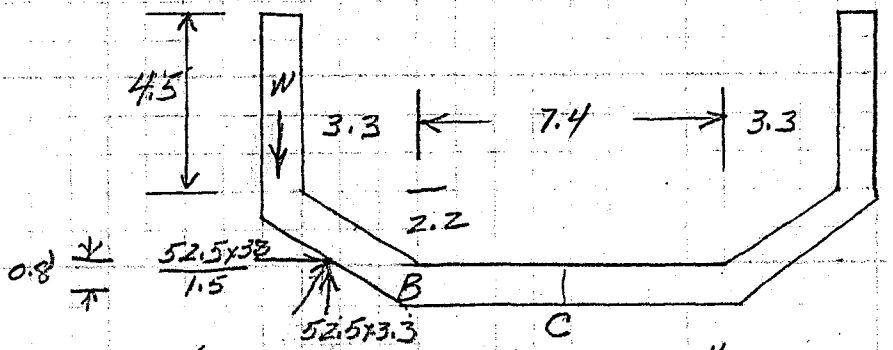
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Ariz PROJECT Powerline Channel

BY Watt DATE 6-10-66 CHECKED BY DATE JOB NO.

SUBJECT Ellsworth Rd Bridge Transition SHEET OF

14.0
6.6
7.4



Max M for No 4 @ 11" = 1200 ft lbs

$M = \frac{Wl^3}{6} = \frac{45}{6} l^3 = 1200 \qquad l = 5.4$

M_B - After Backfill $M = 45 \times \frac{4.5^2}{2} \times \left(\frac{4.5}{3} + 2.12\right) - 4.5 \times 75 \times 3.7 + \frac{52.5 \times 3.3}{2}$ (1686, −1249, 86)

$= 523'lbs$ OK

Cut off 1/2 of Ver Steel 4'6" from top Wall

Center Moment when Wall Ht = 4.5
No Backfill Wt of Ver Walls dist evenly across hor & sloping floor

$W = \frac{4.5 \times \frac{7}{12} \times 2 \times 150}{15} = 52.5^{\#}$

$M_C = \frac{52.5 \times 14^2}{8} - \frac{52.5 \times 3.8 \times 0.8}{1.5} = 1,180$

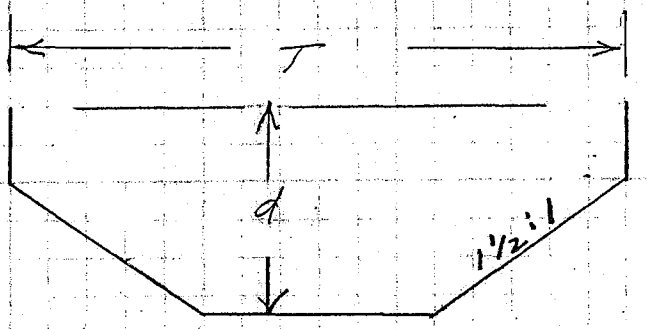
OK for No 4@11"

Use No 4 @ 5½" for 5' from 27 to 32'
Remainder use No 4@11"

COMPUTATION SHEET
SCS-529A REV 5-66

DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona
PROJECT Powerline Channel
BY Watt DATE 5-25-66
CHECKED BY DATE
JOB NO
SUBJECT Vinyard Rd Bridge Transition
SHEET OF



Box 5'x10'

4.75x

Transition Based on Equal Cross Sec Area

$$A = Td - \frac{(T-b)}{3}\frac{(T-b)}{2} = Td - \frac{T^2 - 2Tb + b^2}{6}$$

$$6A = 6Td - T^2 + 2Tb - b^2$$

$$b^2 - 2Tb + (T^2 - 6Td + 6A) = 0$$

$$b = T - 2.45\sqrt{Td - A}$$

x	T	d	A	b
25	10	3.97	39.70	10.00
22	11.23	3.89	39.70	6.33
19	12.46	3.80	39.70	5.68
16	13.69	3.72	39.71	5.48
13	14.92	3.63	39.71	5.61
10	16.15	3.55	39.71	5.87
9	16.56	3.52	39.71	6.00
7	17.38	3.52		
4	18.61	3.52		
0	20.25	3.52		

To much change in & out

$$A = 3.52 \times 6 + 3.52^2 \times 1.5 = 38.05$$

$$T = 3.52 \times 3 + 6 = 16.56$$

COMPUTATION SHEET
SCS-523A REV 5-56

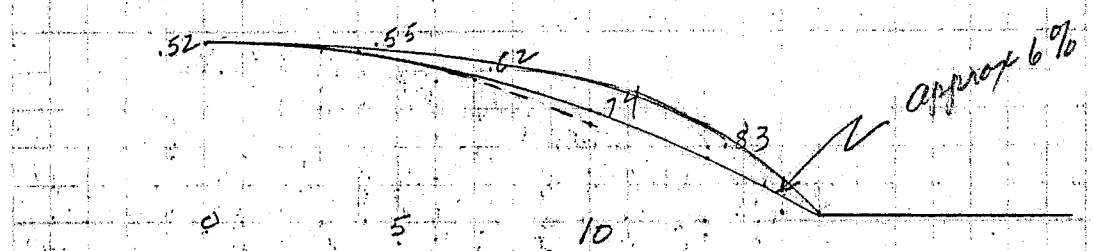
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

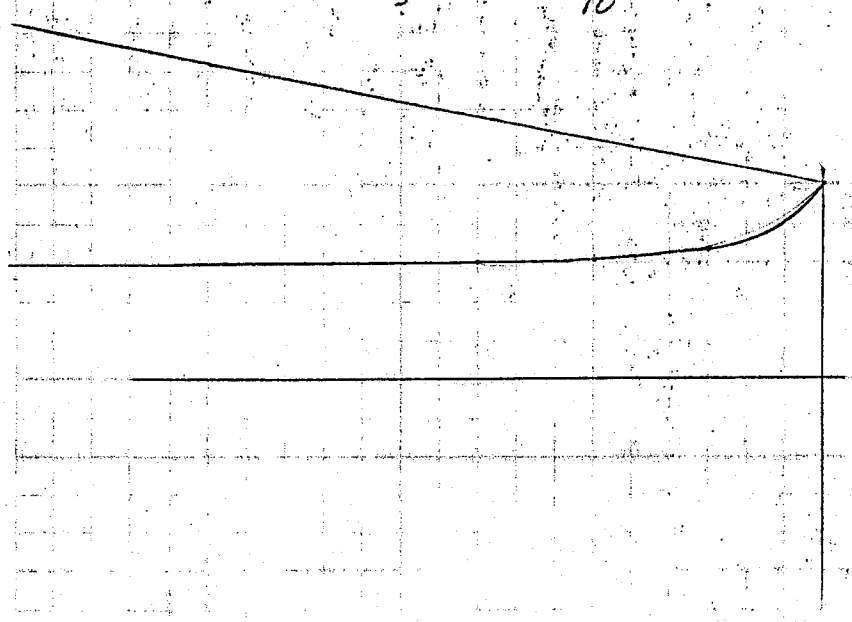
STATE Arizona PROJECT Powerline Channel
BY Watt DATE 5-25-66 CHECKED BY DATE ARI NO.
SUBJECT Vinyard Rd Br Transition SHEET OF

Holding b at 6' & changing d

$$d = \frac{6A + (T-b)^2}{6T} = \frac{A}{T} + \frac{(T-b)^2}{6T}$$

X		A	T	b	d	Use (from Curve)	Use b= (Calculated)
16	25	39.70	10	10.0	3.97	3.97	10
13	22	39.70	11.23			3.76	7.34
10	19	39.70	12.46	6	3.74	3.65	6.57
7	16	39.70	13.69	6	3.62	3.58	6.21
4	13	39.70	14.92	6	3.55	3.55	6.0
0	9	39.70	16.56	6	3.52	3.52	6.0
14.5	19	39.70	10.615			3.85	7.97





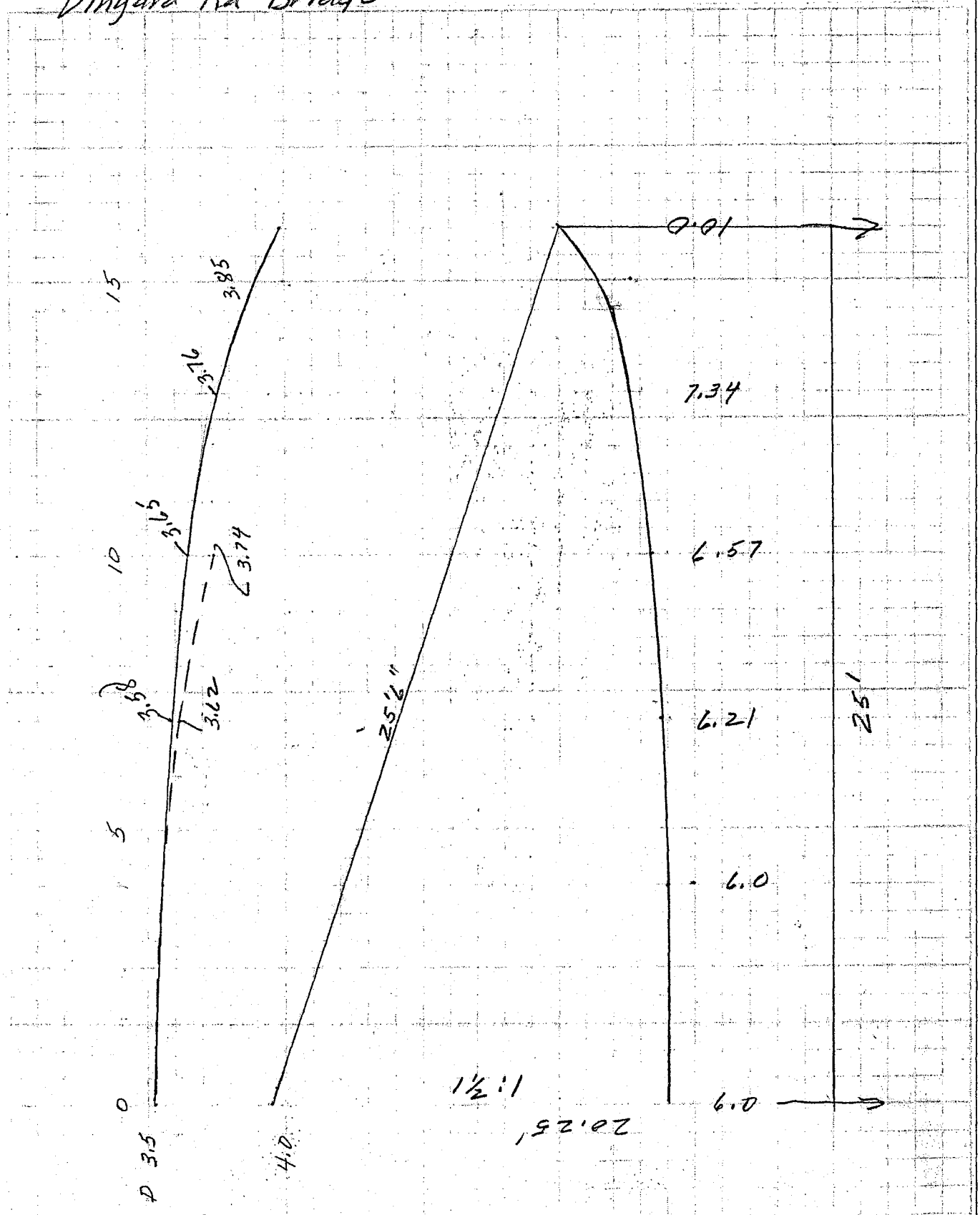
COMPUTATION SHEET
SCS-522A REV 5-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Channel

BY Watt DATE 5-25-66 CHECKED BY DATE JOB NO.

SUBJECT Vinyard Rd Bridge SHEET OF



COMPUTATION SHEET
SCS-SEA REV 5-80

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Channel

BY Watt DATE 5-25-LL CHECKED BY DATE JOB NO

SUBJECT Vinyard Rd Transition SHEET OF

Sta	T	Depth of Flow	Depth + F.B. = 1.23	b	$\frac{T-b}{3}$	Ht Ver Wall
	1	4.75				
0	20.25	3.52	4.75	6.0	4.75	0.0
5	18.20	3.52	4.75	6.0	4.07	0.68
10	16.15	3.52	4.75	6.0	3.38	1.37
13	14.92	3.53	4.76	6.0	2.97	1.79
16	13.69	3.58	4.81	6.21	2.49	2.32
19	12.46	3.65	4.88	6.57	1.96	2.92
22	11.23	3.76	4.99	7.34	1.30	3.69
23.5	10.61	3.85	5.08	7.97	0.88	5.08
25	1.0	3.97	5.20	10	0.0	0.00

Downstream Use Same b

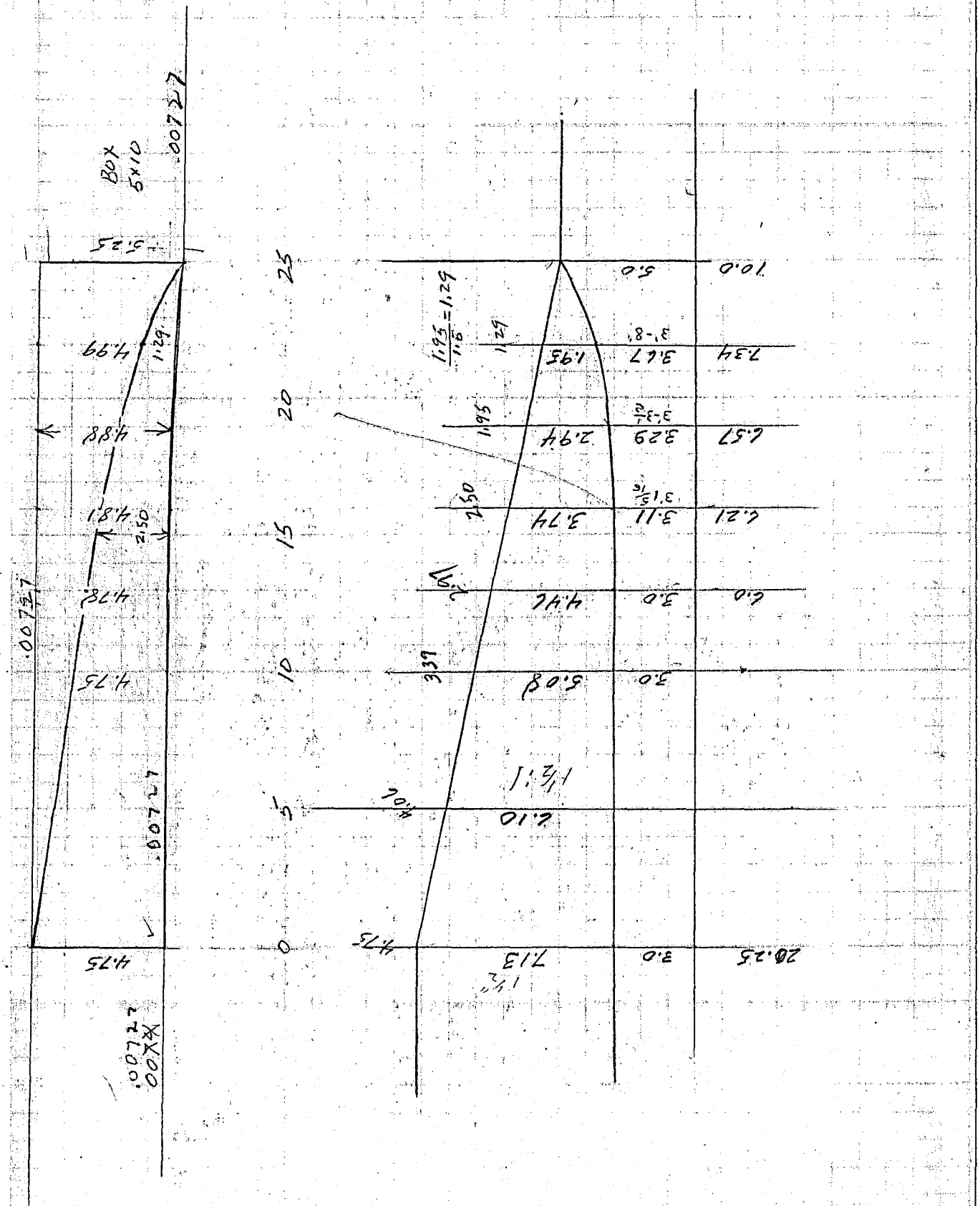
Straight btm on floor at grade of Channel

Use Top of Ver Wall even Grade from depth of 5.25 to 4.75.

Arizona Powerline Channel

Watt 5-25-66

Vineyard Rd Bridge - Trans. Dimensions



COMPUTATION SHEET
SCS-522A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Ariz. PROJECT Powerline Channel
BY Watt DATE 5-23-66 CHECKED BY DATE JOB NO.
SUBJECT Transition Vinyard Road Culvert SHEET OF

Friction loss in 5'x10' Box

$d = 3.97$ $b = 10'$ $n = .014$ $Q = 600$

$A = 39.70$ $R = 2.21$ $V = 15.11$

$S/(nV)^2 = .157$ $S = 0.0070$

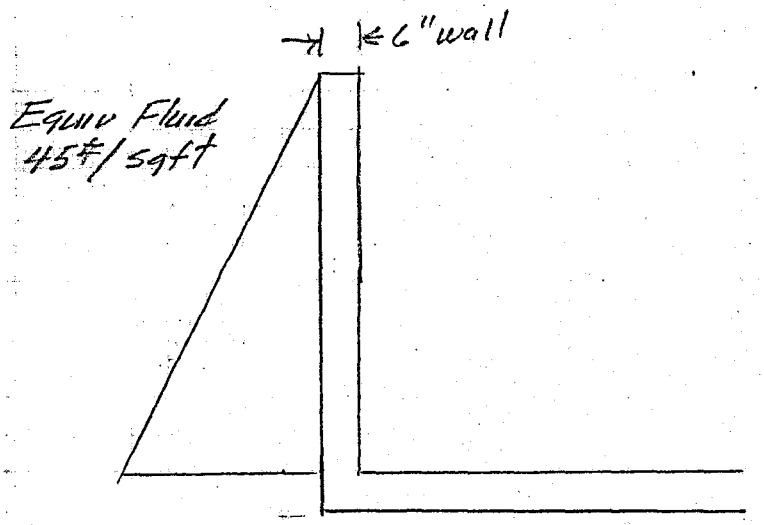
for 60' Culvert $h_f = 0.42'$ Required

$60 \times .0072 = 0.43$ Designed

For full flow Water Cross sectional areas on inlet transition & box Culvert are equal at friction W.S. slope. At outlet there is an excess of head of .5 from flow depth change but that won't hurt anything.

All flow super critical

Arizona Powerline Channel
Watt 5-25-66
Vinyard Rd Br. Transition



$$M @ \frac{45 \times 5.25^3}{6} = 1.085 \text{ ft-K}$$

$A_s = 0.23$ No 4 @ 10" first 3'

Center Steel $W = \frac{5.25 \times 150}{11} = 71\#/\text{ft}$

$$M = \frac{wl^2}{8} = \frac{71 \times 10.75^2}{8}$$ 978 ft-lbs ok

No 4 @ 10"

$$\text{Shear} = \frac{45 \times 5.25^2}{2} \times \frac{8}{7} \frac{1}{12 \times 3} = 20\#/\text{sq in ok}$$

COMPUTATION SHEET

SCS-652a REV 5-80

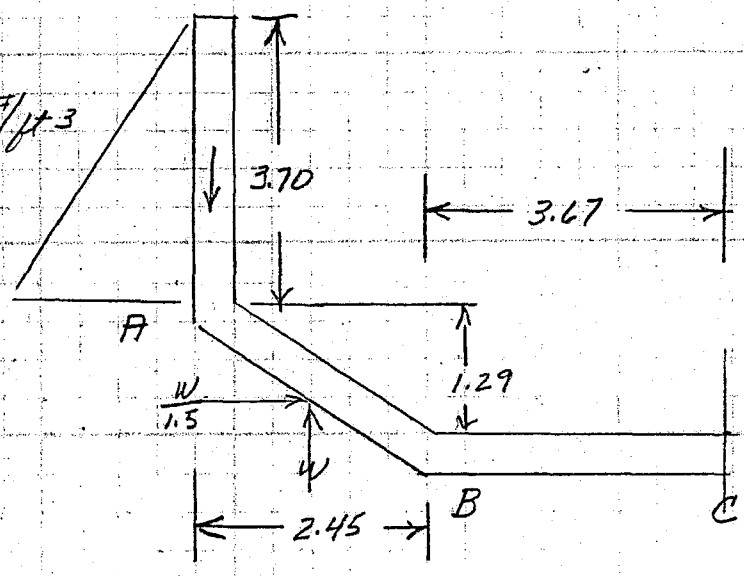
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Channel

BY Watt DATE 5-25-66 CHECKED BY DATE JOB NO

SUBJECT Trans Vineyard Rd Culvert. SHEET OF

Moments @ 3' from Culvert



For No Backfill Ver Wall dis over btm.

$$\frac{3.7\times}{2}\frac{\times 150}{3.67+2.45} = 18\#/ft^2$$

After Backfill

$$M_A = \frac{wl^3}{6} = \frac{45\times 3.70^3}{6} = 380'lbs$$

$$M_B = \frac{45\times 3.7^2}{2}\left(\frac{3.7}{3}+1.5\right) - \frac{3.7}{2}\times 150\times 2.2 + 18\times 2.45\times(1.2+0.8$$

$$841 - 610 + 88 = 319\ ft\ lbs$$

Before Backfill

$$M_C = \frac{18\times 12^2}{8} = 18\times 2.45\times 0.8' = 324$$

At 3' No 4 @ 12" OK

COST ESTIMATE OF ENGINEERING SERVICES REQUIRED TO LAY OUT AND INSPECT LAND RIGHTS ITEMS TO BE INCLUDED IN THE CONTRACT FOR POWERLINE CHANNEL

	FEDERAL COSTS TO BE REIMBURSED
Concrete Structures Design of Box Culverts and Bridges done by County	0.00
Survey layout 5 structures, 3-man crew - 5 days @ $90	450.00
Inspection GS7 - 10 days @ $37.50	375.00
Total.....	$825.00

Signed

Date

COST ESTIMATE OF LAND RIGHTS TO BE
INCLUDED IN THE CONTRACT FOR
POWERLINE FLOODWAY

Vinyard Rd. Box Culvert	$5,700
Ellsworth Rd. Box Culvert	12,280
Bridge @ Sta 184+20	2,085
Bridge @ Sta 347+50	2,900
Channel Crossing 378+50	1,350
427+95	1,350
451+00	1,350
Total	$27,015

Signed

Date 12/7/66

COMPUTATION SHEET
SCS-522A REV 5-58

DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO 1960 O-543350

STATE Arizona | PROJECT Powerline Channel
BY Watt | DATE 7-26-6 | CHECKED BY | DATE | JOB NO.
SUBJECT Vinyard Road Box Culvert & Trans. | SHEET 4 OF 6

Box Culvert 60' long 5x10 box

Conc.
60 x 1.171 = 70.26 @ 65 = 4567
Steel 60 x 122.0 = 732# @ 18¢ = 132
Cement 105 bbls @ 5.00 = 525
Excavation
$\frac{15 \times 6 \times 60}{27}$ = 200 @ 50¢ = 100

Backfill
$\frac{\frac{1}{2} \times 60 \times 7}{27}$ = 47 @ 5.00 = 235

Transitions
Conc 20.62 cuyd @ $65 = 1340
Steel 1614 # @ 18¢ = 290
Cement 31 bbls @ 5.00 = 155
Excav
$\frac{50 \times (6 \times 6 + 1.5 \times 6^2)}{27}$ = 167 cuyd @ 50¢ = 83
Backfill $\frac{50 \times 3 \times 2.7}{27}$ = 15 cuyd @ $5.00 = 75

Total $1750

Cost of Equiv Channel

Conc 36.5 x 32.50 = $1186
Cement 55 x 5.00 = 275
Steel 1120 x 0.18 = 202
Excav 275 x 0.50 = 138
$1801

Extra Cost Culvert $ 51

COMPUTATION SHEET
SCS-520A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Channel

BY Watt DATE 7-26-66 CHECKED BY DATE JOB NO.

SUBJECT Est Cost 110' Channel at Vinyard Rd SHEET 5 OF 6

Conc Channel

$.6056 \times \frac{4\frac{1}{2}}{12} = .227$

4.75
375
5.125

$5.125 \times 6.227 + 1.5 \times 5.125^2 = 71.312$

$- \; 4.75 \times 6 + 1.5 \times 4.75^2 \quad 62.344$

$8.97 = .332$ cuyd/ft

Conc. $110 \times .332 =$ 36.5 cuyd

Cement 55 bbls

Steel $23.1 \times 110 \times 1.05 = 2668$ sqft

$6 \times 6 - 6/6 = 42 \times 2668 = 1120$ #

Excav. $= \frac{5 \times 6 + 5^2 \times 1.5}{27} \times 110 = 275$ cuyd

COMPUTATION SHEET
SCS-522A REV 5-58

DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

4.5
216
8.21

STATE Arizona PROJECT Powerline Channel

BY Watt DATE 7-26-66 CHECKED BY DATE JOB NO

SUBJECT Extra Cost Ellsworth Rd Xing SHEET 2 OF 6

Cost Ellsworth Bridge

Culvert

Concrete	135 Cu yd	@	65.00	8,775
Steel	10,900 Cu yd	@	0.18	1,962
Excavation				
$\frac{74 \times 19.67 \times 8.5}{27} = 458$		@	0.50	229
Backfill $\frac{9.6 \times 3 \times 74}{27} = 74$		@	5.00	370
Cement bbls	112.5	@	5.00	563

Transitions

Conc.	42.44	@	65.00	2759
Steel	2978#	@	0.18	536
Excavation				
$64 \times \left(\frac{8 \times 7 + 7^2 \times 1.5}{27}\right) = 307$		@	0.50	154
Backfill				
$\frac{64 \times 3 \times 3}{27} =$	22	@	5.00	110
Cement bbls	63.7	@	5.00	318
			Total	15,776

Cost of Channel 138'

Concrete	69	@	32.50 =	2243
Cement	103.5	@	5.00	518
Steel	2238#	@	0.18	403
Excav	670	@	0.50	335
				3499

Diff = 15,776 - 3,499 = 12,277

COMPUTATION SHEET 118

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

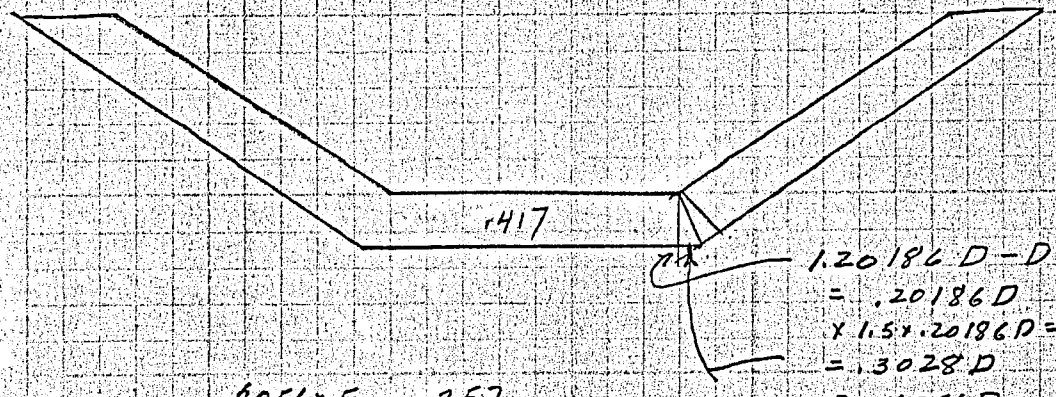
STATE Arizona PROJECT Powerline Channel

BY Watt DATE 7-26-66 CHECKED BY DATE JOB NO

SUBJECT Cost 138' Channel @ Ellsworth Rd SHEET 3 OF 26

74
64
138

2242



1.20186 D - D
= .20186 D
x 1.5 x .20186 D =
= .3028 D
x2 = .6056 D

.6056 x 5/12 = .252

$$-\left(6.5\times 8+1.5\times 6.5^{2}\right)+\left(6.917\times 8.252+1.5\times 6.917^{2}\right)=13.471 \text{ cuft}$$

115.375 128.846

0.50

138 x .5 = = 69.0 Cuyd

Steel 6x6-5x5

1.8 x 6.5 + 8 = 31.5 Lin ft
+5% 1.6
33.1 x 49 = 16.22

16.22 x 138 = 2238#

$$\text{Excav} = \frac{7.0\times 8.25+1.5\times 7.0^{2}}{27} = 4.86$$

4.86 x 138 = 670

COMPUTATION SHEET
SCS-522A REV. 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Channel
BY Watt | DATE 7-26-66 | CHECKED BY | DATE | JOB NO.
SUBJECT Cost Private Bridges @ Sta 184+20 & 151+90 | SHEET | OF

2/

Concrete	19 cuyd	@ $65		1235
Cement	29 bbls	@ 5.00		145
Steel	2680 lbs	@ 18¢		515
Excavation	50 Cuyd	@ 50¢		25.00
Backfill	33 " "	@ 5.00		$165.00
		Total		$2085

Bridge @ Sta 347+50 ±
Span = 23'

Concrete	27.1 Cuyd	@ $65	1762
Cement	41 bbls	@ 5.00	205
Steel	3800	@ 18¢	690
Excavation	70 Cuyd	@ 50¢	35
Backfill	40 Cuyd	@ 5.00	200
		Total	2892

XERO COPY XERO COPY XERO COPY

COMPUTATION SHEET
SCS-ECS-A REV 5-56

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Dam
BY Watt DATE CHECKED DATE
SUBJECT Cost Sharing Channel Crossing & Stabilizers. SHEET OF

Flood Control Costs Extra Rip Rap

Rts. of Way Costs Concrete Xing.

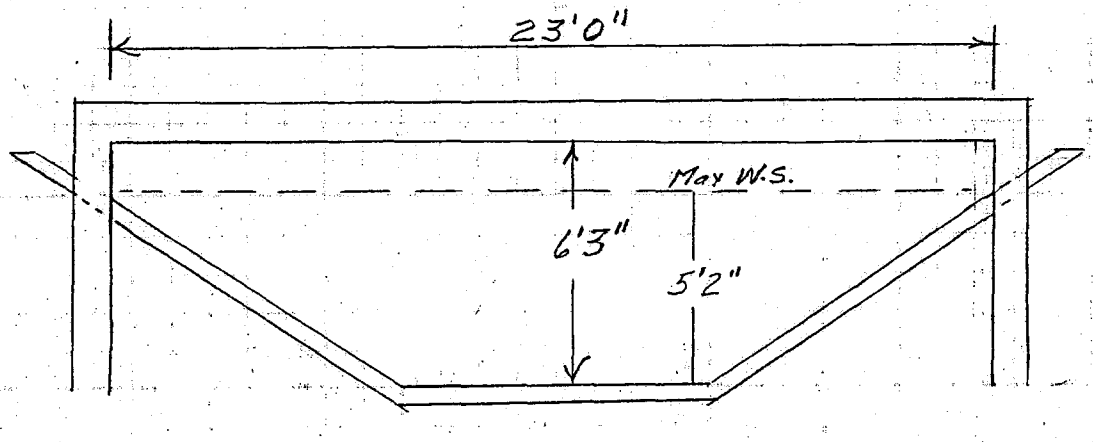
Conc. per Xing = 33.7 cuyd

@ $40 = $1348.

3 = $4044

Arizona Powerline Channel
Watt 10-21-66
Required Bridge Dimensions

Required Span Bridge Between Sta 330 & 373



Concrete

Deck,	$25 \times 16 \times \frac{14}{12}$	=	467 cu ft,
Abt,	$16 \times 9 \times \frac{14}{12}$	=	168 " "
Found.	$6 \times 1 \times 16$		96

= 27.1 cu yd

Steel @ 140 #/cu yd = 3800 lbs

COST ESTIMATE OF LAND RIGHTS TO BE INCLUDED IN THE CONTRACT FOR POWERLINE FLOODWAY

Vinyard Rd. Box Culvert	$5,700
Ellsworth Rd. Box Culvert	12,280
Bridge @ Sta 184+20	2,085
Bridge @ Sta 347+50	2,900
Channel Crossing 378+50	1,350
427+95	1,350
451+00	1,350
Total	$27,015

Signed

Date 12/7/64

COMPUTATION SHEET
SCS-522A REV. 5-58

DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO: 1969 O-343250

STATE Arizona | PROJECT Powerline Channel
BY Watt | DATE 7-26-6[illegible] | CHECKED BY | DATE | JOB NO.
SUBJECT Vineyard Road Box Culvert & Trans | SHEET 4 OF 6

Box Culvert 60' long 5x10 box

Conc.
60 x 1.171 = 70.26 cu yds @ $65 = 4567
Steel 60 x 122.0 = 7320# @ 18¢ = 132
Cement 105 bbls @ 5.00 = 525
Excavation
$\frac{15 \times 6 \times 60}{27}$ = 200 @ .50¢ = 100
Backfill
$\frac{2 \times 8 \times 20 \times 7}{27 \times 3}$ = 47 @ 5.00 = 235

Transitions
Conc 20.62 cuyd @ $65 = 1340
Steel 1614# @ 18¢ = 290
Cement 3.1 bbls @ 5.00 = 155
Excav
$\frac{50 \times (6 \times 6 + 1.5 \times 6^2)}{27}$ = 167 cuyd @ 50¢ = 83
Backfill $\frac{50 \times 3 \times 2.7}{27}$ = 15 cuyd @ $5.00 = 75

Total $7502

Cost of Equiv Channel

Conc 36.5 x 32.50 = $1186
Cement 55 x 5.00 = 275
Steel 1120 x 0.18 = 202
Excav 275 x 0.50 = 138
$1801

Extra Cost Culvert $5701

COMPUTATION SHEET
SCS-ENG. REV. 5-30

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Channel

BY Watt DATE 7-26-66 CHECKED BY DATE JOB NO.

SUBJECT Est Cost 110' Channel at Vineyard Rd SHEET 5 OF 6

Conc Channel

$.6056 \times \frac{4\frac{1}{2}}{12} = .227$

4.75
375
5.125

$5.125 \times 6.227 + 1.5 \times 6.125^2 = 71.312$

$- \quad 4.75 \times 6 + 1.5 \times 4.75^2 \quad 62.344$

$8.97 = .332$ cuyd/ft

Conc. $110 \times .332 =$ 36.5 cuyd

Cement 55 bbls

Steel $23.1 \times 110 \times 1.05 = 2668$ sqft

$6 \times 6 - 6/6 \quad = 42 \times 2668 = 1120$ #

Excav. $= \frac{5 \times 6 + 5^2 \times 1.5}{27} \times 110 = 275$ cuyd

COMPUTATION SHEET
SCS-522A REV 5-58

DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

6.5
2.6
8.7

STATE Arizona | PROJECT Powerline Channel
BY Watt | DATE 7-26-66 | CHECKED BY | DATE | JOB NO.
SUBJECT Extra Cost Ellsworth Rd Xing | SHEET 2 OF 6

Cost Ellsworth Bridge

Culvert

Concrete 135 Cu Yd @ 65.00 8,775
Steel 10900 Cu Yd @ 0.18 1,962
Excavation
$\frac{74 \times 19.67 \times 8.5}{27} = 458$ @ 0.50 229

14
16.67

Backfill $\frac{9.0 \times 3 \times 74}{27} = 74$ @ 5.00 370

Cement bbls 112.5 @ 5.00 563

Transitions
Conc. 42.44 @ 65.00 2759
Steel 2978# @ 0.18 536
Excavation
$64 \times \left(\frac{8 \times 7 + 7^2 \times 1.5}{27}\right) = 307$ @ 0.50 154

Backfill
$\frac{64 \times 3 \times 3}{27} = 22$ @ 5.00 110

Cement bbls 63.7 @ 5.00 318

Total 15,776

Cost of Channel 138'

Concrete 69 @ 32.50 = 2243
Cement 103.5 @ 5.00 518
Steel 2238# @ 0.18 403
Excav 670 @ 0.50 335
3499

Diff = 15,776 − 3,499 = 12,277

COMPUTATION SHEET 118

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

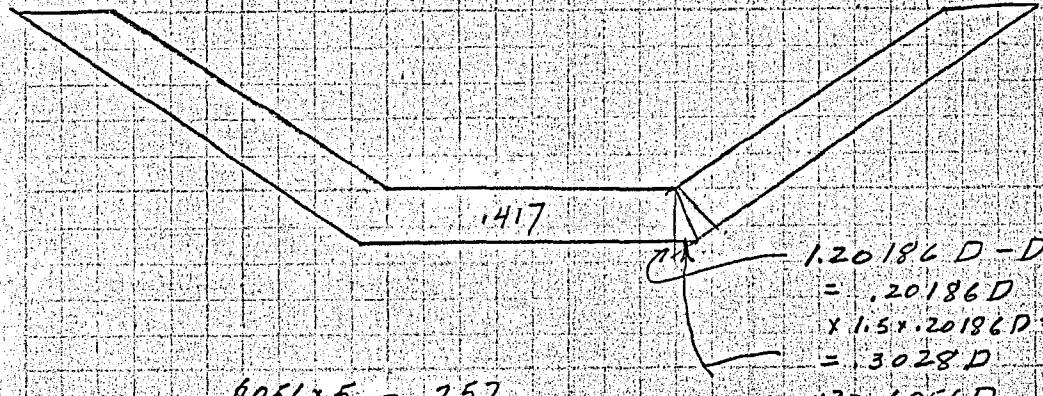
STATE Arizona PROJECT Powerline Channel

BY Watt DATE 7-26-66 CHECKED DATE JOB NO.

SUBJECT Cost 138' Channel @ Ellsworth Rd SHEET 3 OF 26

74
64
138

2242



1.20186 D − D
= .20186 D
× 1.5 × .20186 D =
= .3028 D
×2 = .6056 D

$.6056 \times \frac{5}{12} = .252$

$$-\left(\overset{115.375}{6.5\times 8 + 1.5\times 6.5^2}\right) + \left(\overset{128.846}{6.917\times 8.252 + 1.5\times 6.917^2}\right) = 13.471' \text{ cuft}$$

= 0.50

138 × .5 = = 69.0 Cuyd

Steel 6×6 − 5×5

1.8 × 6.5 + 8 = 31.5 sqft
+5% 1.6
33.1 × .49 = 16.22

16.22 × 138 = 2238#

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4.86 × 138 = 670

COMPUTATION SHEET
SCS-522A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Channel
BY Watt DATE 7-26-66 CHECKED BY DATE JOB NO.
SUBJECT Cost Private Bridges @ Sta 184+20 SHEET OF

2/ & 151+90

Concrete	19 Cuyd	@ $65		1235
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Bridge @ Sta 347+50 ±
Span = 23'

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Steel	3800	@ 18¢	690
Excavation	70 Cuyd	@ 50¢	35
Backfill	40 Cuyd	@ 5.00	200
		Total	2892

COMPUTATION SHEET
SCS-523A REV 3-56

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona
PROJECT Powerline Dam
BY Watt
DATE
CHECKED BY
DATE
JOB NO.
SUBJECT Cost Sharing Channel Crossing & Stabilizers.
SHEET OF

Flood Control Costs Extra Rip Rap

Rts. of Way Costs Concrete Xing.

42.7 Changed
Conc per Xing = 33.7 Cuyd
@ $40 = $1348. ✓
3 = $4044 ✓

POWERLINE CHANNEL

Location Extending from a point approximately 4 1/4 miles south of Apache Junction to the N.W. Corner of Williams A.F.B.

Trapizoidal Reinforced Concrete Channel

Capacity	600 to 1200 C.F.S.
Length	6.8 miles
Bottom Width	6 and 8 feet
Depth	4'9" to 6'6"
Side Slopes	1 1/2: 1
Thickness	4 1/2 and 5 inches
Cubic Yds Concrete	15,215 cu.yd.
Excavation	142,500 cu.yd.

Other Concrete Structures - 641 Cu.Yd. Concrete

Earth and Rock Riprap Channel

Capacity	3800 C.F.S.
Length	1.8 miles
Bottom width	60 feet
Depth	7.5 feet
Side Slopes	2:1
Excavation	137,200 cu.yd.
Fill	54,500 cu.yd.
Rock Riprap	20,600 Cu.Yd.

POWERLINE CHANNEL

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Excavation	137,200 cu.yd.
Fill	54,500 cu.yd.
Rock Riprap	20,600 Cu.Yd.

OPTIONAL FORM NO. 10
5010-103

UNITED STATES GOVERNMENT

Memorandum

TO : John Geter S.C.S. Phoenix

DATE: Nov. 17, 1964

FROM : Dick Wenberg S.C.S. Coolidge

SUBJECT: Apache Junction - Gilbert W.P.P. — Channel alignment

As per your request the south section line of Sect's 19 & 20 of T1S & R7E. was rechained & confirmed our original work. Do not confuse the P.I. between Sect 19 & 20 as being a section corner — the actual corner was not located.

The south line of Sect 23 of T1S & R7E was also rechained. From the S.E. corner of Sect 23 going west all stations are 1.6' long. Sta. 116+00 should be 115+98.4 etc. The large errors that you were looking for must have been in the early Lyng Survey

STANDARD FORM NO. 64

Office Memorandum • UNITED STATES GOVERNMENT

TO : George Watt, Design Engineer
SCS, Phoenix, Arizona

DATE: November 30, 1964

FROM : Dick Wenberg, Project Engineer
SCS, Coolidge, Arizona

SUBJECT: APACHE JUNCTION-GILBERT WATERSHED - Field notes

Am enclosing notes from Roosevelt Water Conservation District Floodway. I discussed the contents of same with Paul Wright at your office last Friday. The X-section notes are not reduced, but the levels are O.K.

Encl.

COMPUTATION SHEET
SCS-5144 REV. 5-55

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE PROJECT

BY DATE CHECKED BY DATE JOB NO

SUBJECT R.W. for Lower End of Channel SHEET OF

Beginning at point from which the common Corner of Sections 19, 20, 29 & 30 T. 1 S., R. 1 E., G & S.R. B & M bears S 0°35' W 23.0 feet and S 89°25' E 2716.2 feet thence from said point of begining 947.6 feet along a circular curve whose center bears S 0°35' W 1357.4 feet, thence S 50°35' W 460 feet, thence N 17°34' E 238.5 feet; thence N 50°35' E 260 feet, thence 1038.4 feet along a circular curve whose center bears S 39°25' E 1487.4 feet Thence S 0°35' W to the point of beginning.

COMPUTATION SHEET
SCS-522A REV 5-58

94
75

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Channel
BY Watt DATE CHECKED BY DATE JOB NO
SUBJECT Location Lower End of Channel SHEET OF

From Survey Sec $\frac{20|21}{29|28}$ @ Sta 373+81.74

From Plat Sheet Sec Line 5283.3 ft

Sta @ $\frac{19|20}{30|29}$ 426+65.04 Survey Sta
5.59

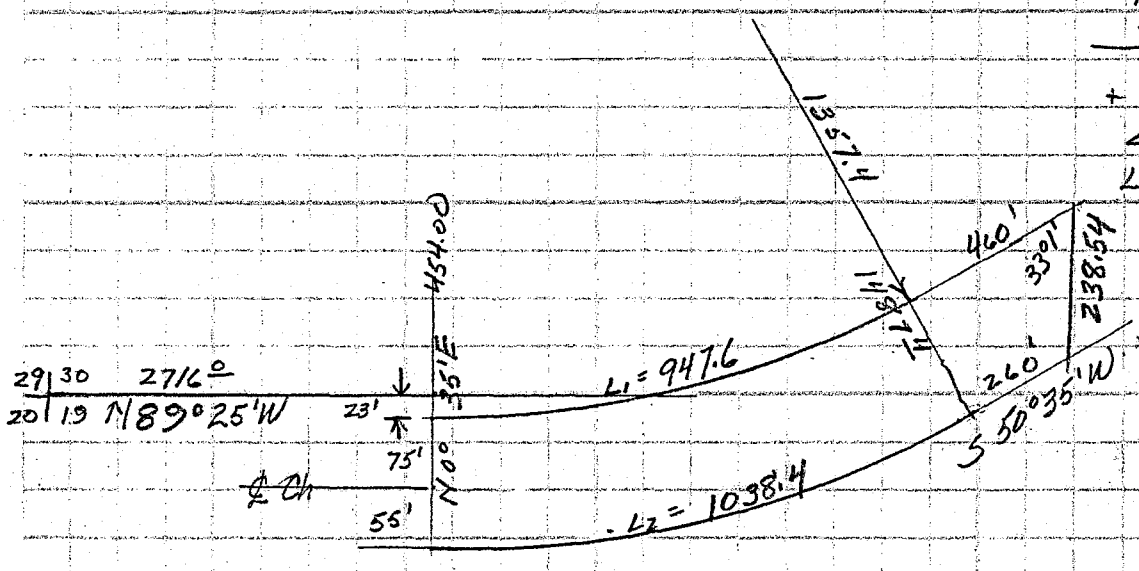
Design Sta = 426+70.63 (on tan of curve)

Sta of Curve PC = 454+00
426+70.63

Corr. for Rev. Curve — Corr 13.35

Dist from P.C. to Sec Cor $\frac{19|20}{30|29}$ = 2716.02

1432.4
− 75
+ 130
Δ = 40°
L = 1000'



50
40°

$L_1 = 1000 \times \frac{1357.4}{1432.4} = 947.6$

$L_2 = 1000 \times \frac{1487.4}{1432.4} = 1038.4$

$(200^2 + 130^2)^{1/2} = 238.54$

$\tan\alpha = \frac{130}{200} = .65 \quad \alpha = 33°01'$

A.V. 4/13/67

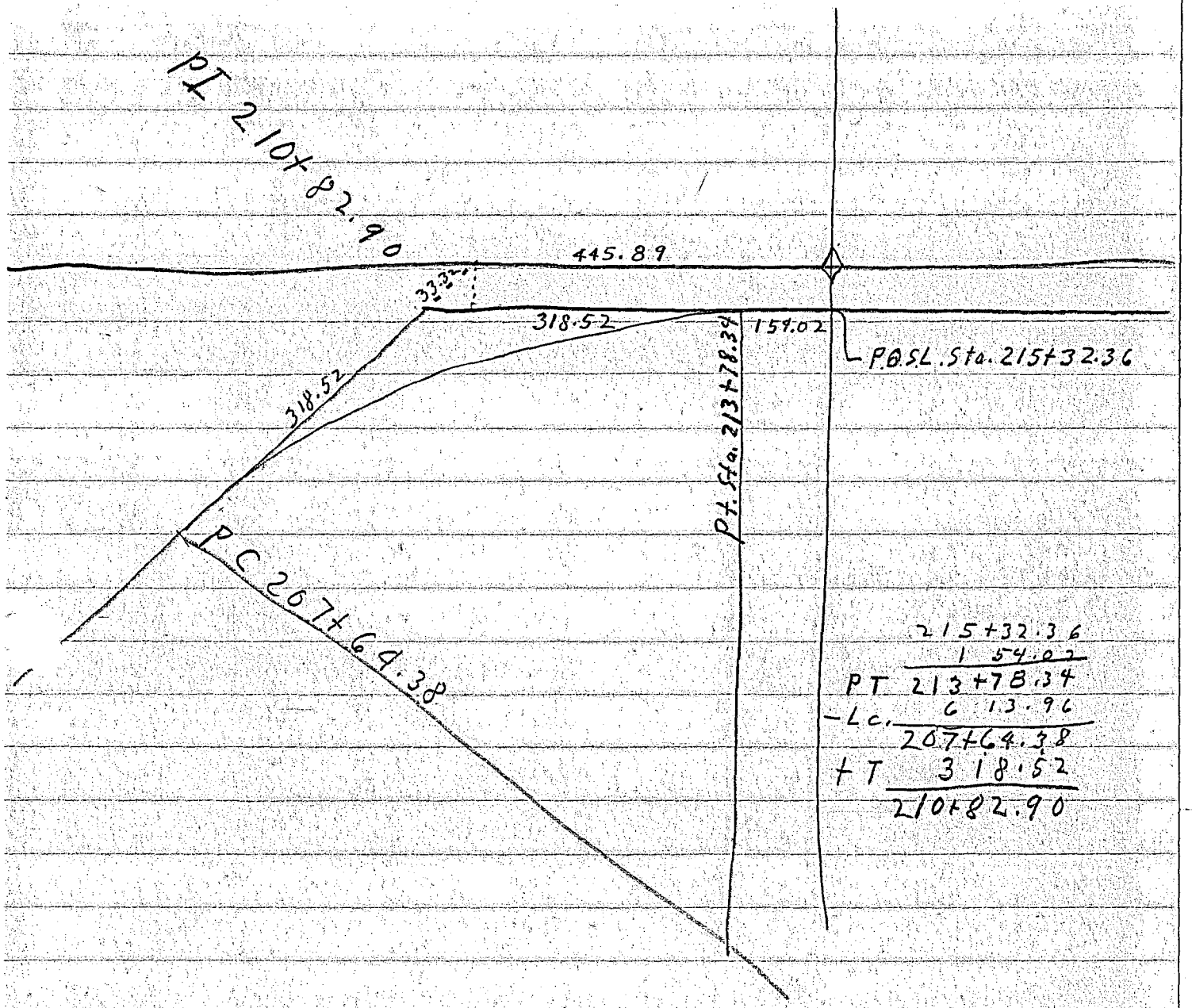
Ralph Arrington
S.C.S. Phoenix

This is the Correction in Stationing on Powerline Floodway Channel.

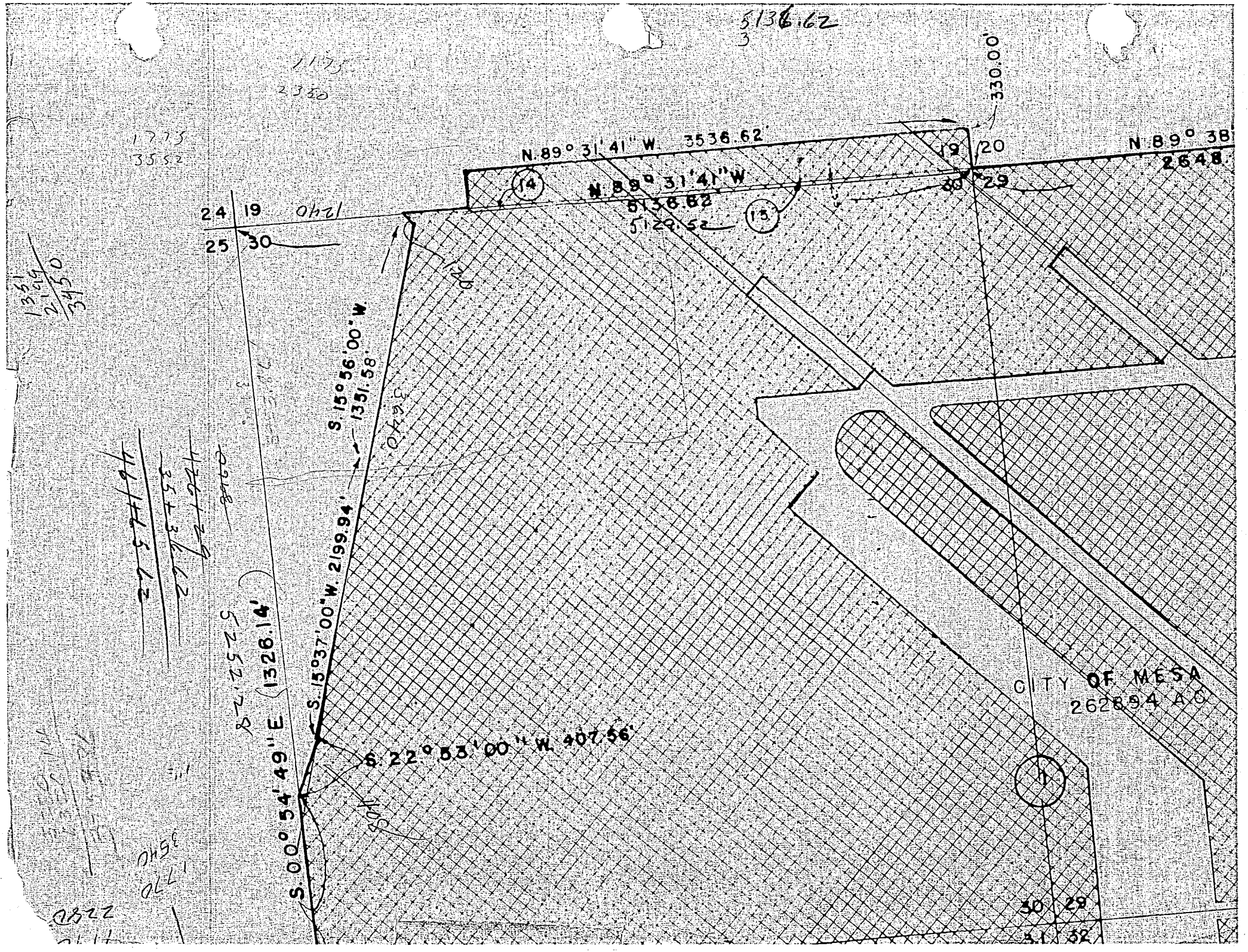
	Field		Plans	
Sta.	7+77	=	7+87	P.I. (intersection)
Sta.	12+00	=	12+10	start Concrete Channel
Sta.	215+32.36	=	215+44.58	G.M. S.E. Corner Section Line Corner 23, 24, 25 & 26
Sta.	321+67.66	=	321+13.90	Ellsworth Road Section Line Corner 21, 22, 27 & 28

Note; no equation in Line exists in field stationing —

[signature]



215+32.36
1 54.02
PT 213+78.34
-Lc. 6 13.96
207+64.38
+T 318.52
210+82.90



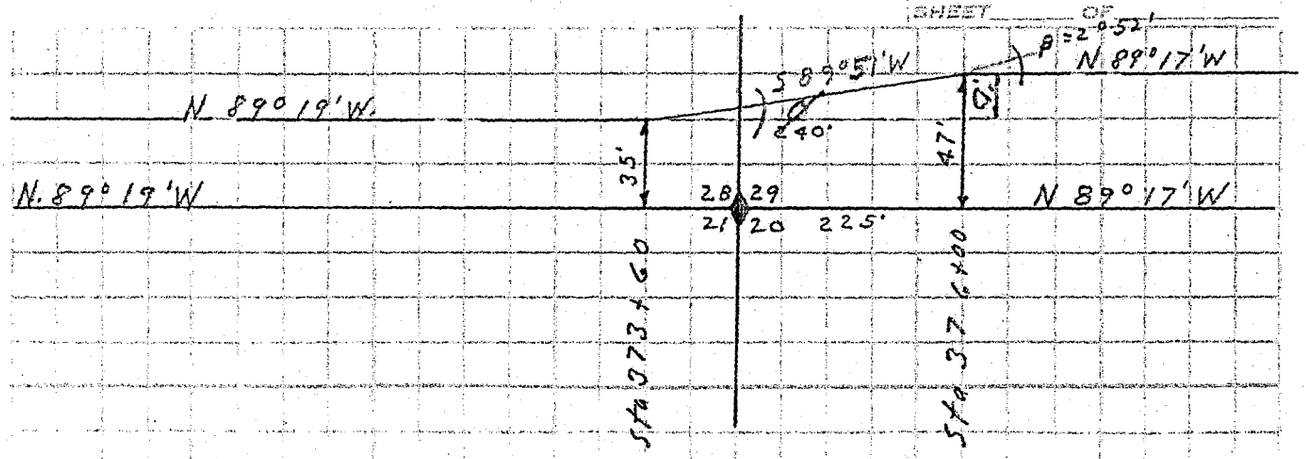
5136.62
330.00'
N.89° 31' 41" W. 3536.62'
N.89° 31' 41" W
5136.62
5129.52
N.89° 38'
2648.
19
20
30
29
14
15
24
19
25
30
S.15° 56' 00" W.
1351.58'
S.15° 37' 00" W. 2199.94'
S.00° 54' 49" E (1326.14'
S.22° 53' 00" W. 407.56'
CITY OF MESA
262894 A.C.
30
29
31
32

COMPUTATION SHEET
SCS-SDAA REV 6-68

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE: Arizona | PROJECT: Powerline Floodway
BY: GDH | DATE: 9- | CHECKED BY | DATE | JOB NO.
SUBJECT

SHEET ___ OF ___



$$q = 47 - 35 - (225 \tan 0°02')$$

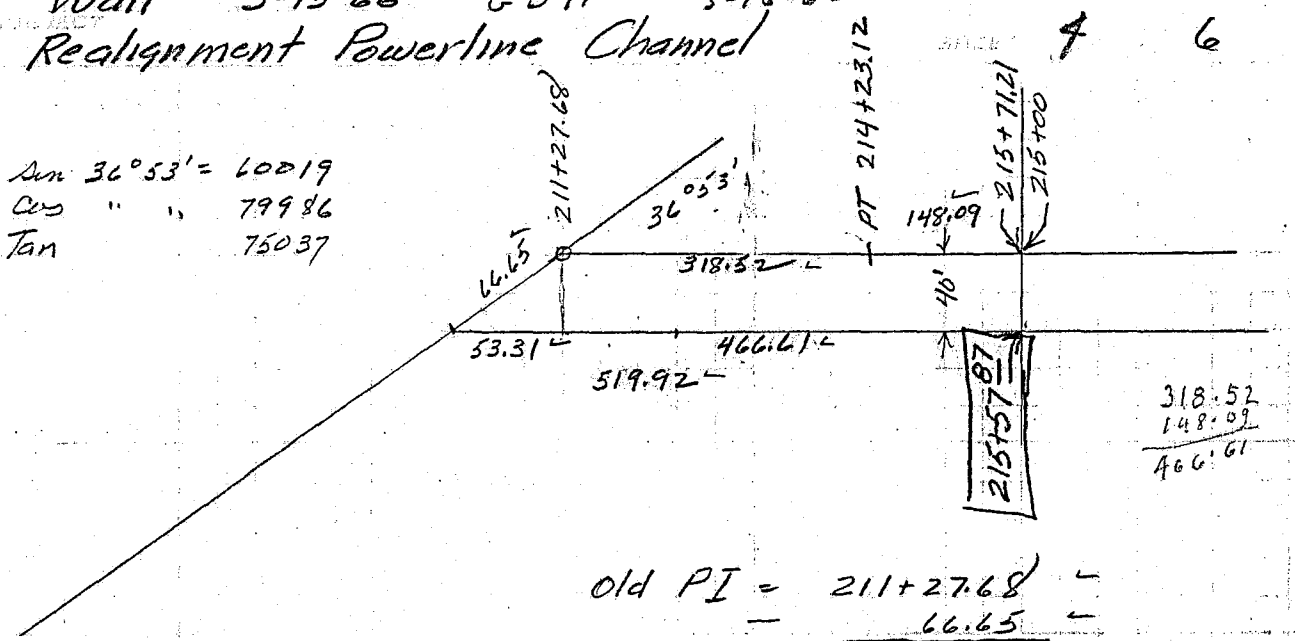
$$q = 12 - 0.13 = 11.87$$

$$\tan \phi = \frac{11.87}{240} = 0.049495 = 2°50'$$

Arizona Powerline Channel

Watt 3-15-66 GDH 3-16-66

Realignment Powerline Channel 4 6



Sin 36°53' = 60019
Cos " " = 79986
Tan " = 75037

Curve
Δ = 36°53'
D = 6°00'
R = 954.93
T = 318.52
L = 613.96

Old PI = 211+27.68
66.65
New PI = 210+61.03
tan 318.52
New PC = 207+42.51
Lc 613.96
New PT 213+56.47
519.92
-tan -318.52
New Equ = 215+57.87 = 215+00

VOID

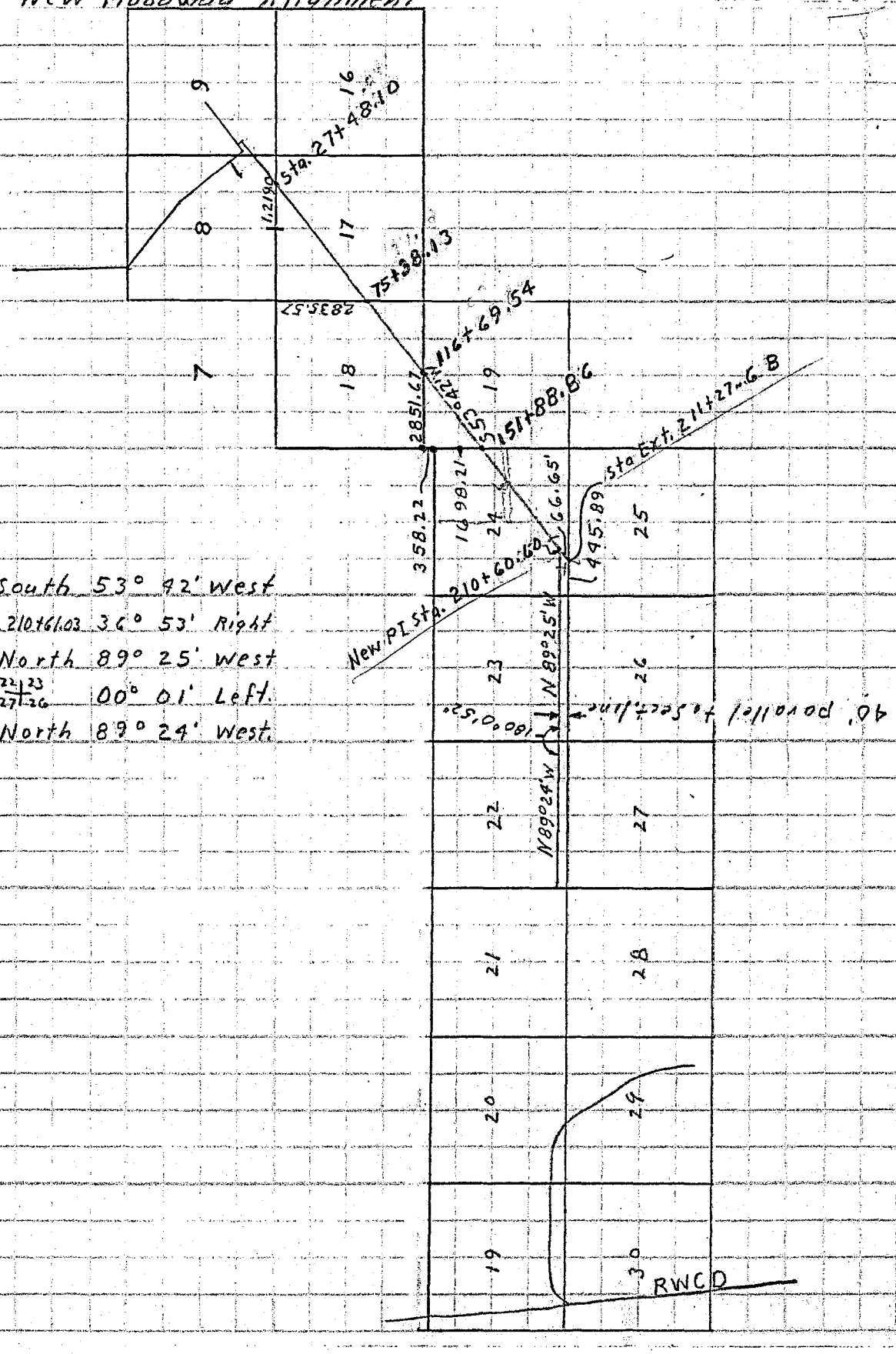
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PROJECT Arizona Powerline Channel

DATE 3-18-65 CHECKED BY DATE

SUBJECT New Floodway Alignment

SHEET ___ OF ___

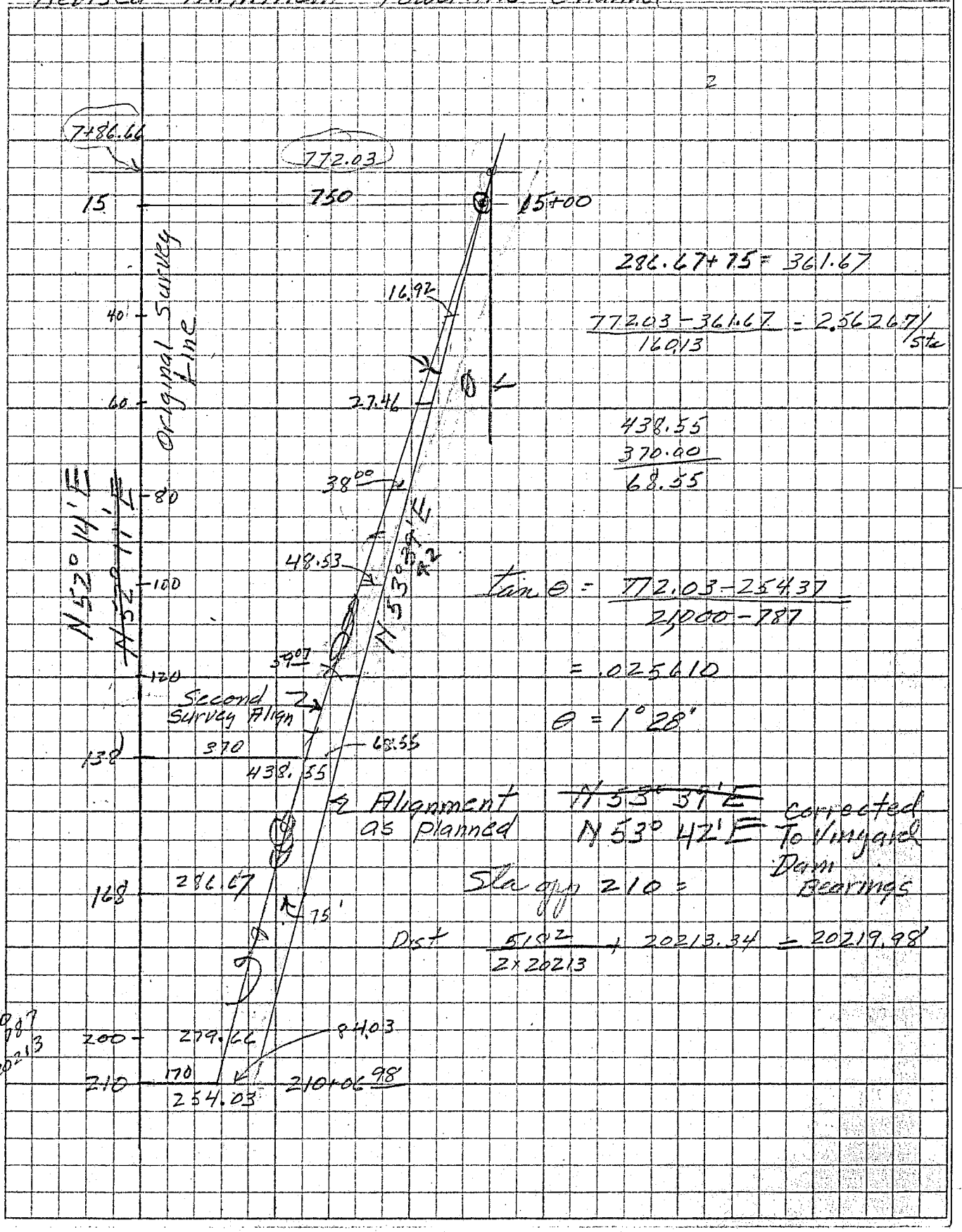


South 53° 42' West
∡ 210+61.03 36° 53' Right
North 89° 25' West
∡ 22/27 | 23/26 00° 01' Left.
North 89° 24' West.

COMPUTATION SHEET
SCS-523A REV 5-56

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE: Arizona | PROJECT: Powerline Channel
BY: Watt | DATE: 4-27-65 | CHECKED BY: | DATE: | JOB NO.
SUBJECT: Revised Alignment Powerline Channel | SHEET | OF



286.67 + 75 = 361.67

$$\frac{772.03 - 361.67}{16013} = 2.562671/\text{sta}$$

438.55
370.00
68.55

$$\tan\theta = \frac{772.03 - 254.37}{21000 - 787}$$

$$= .025610$$

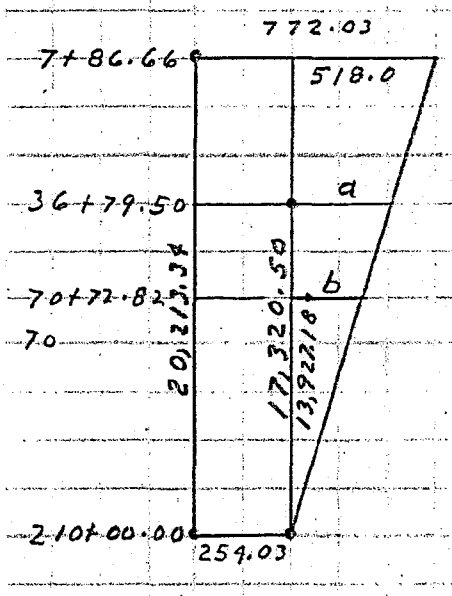
$\theta = 1°28''$

Arizona Powerline Floodway

GDH 3-17-66

Section line ties to new alignment 1/4 cor. 8/17

SHEET 1 OF 2-6



210+00.00 − 36+79.50 = 17,320.50

210+00.00 − 70 72.82 = 13,927.18

$\frac{a}{17{,}320.50} = \frac{518.0}{20{,}213.34}$, $a = 443.87 + 254.03$ (697.90)

$\frac{b}{13{,}927.18} = \frac{518.0}{20{,}213.34}$, $b = 356.917 + 254.03$ (610.94)

179 59 60 − 142 14 30 = 37°45'30"

90 − 37°45'30" = 52°14'30"

179 59 60 − 127 45 30 = 52 14 30

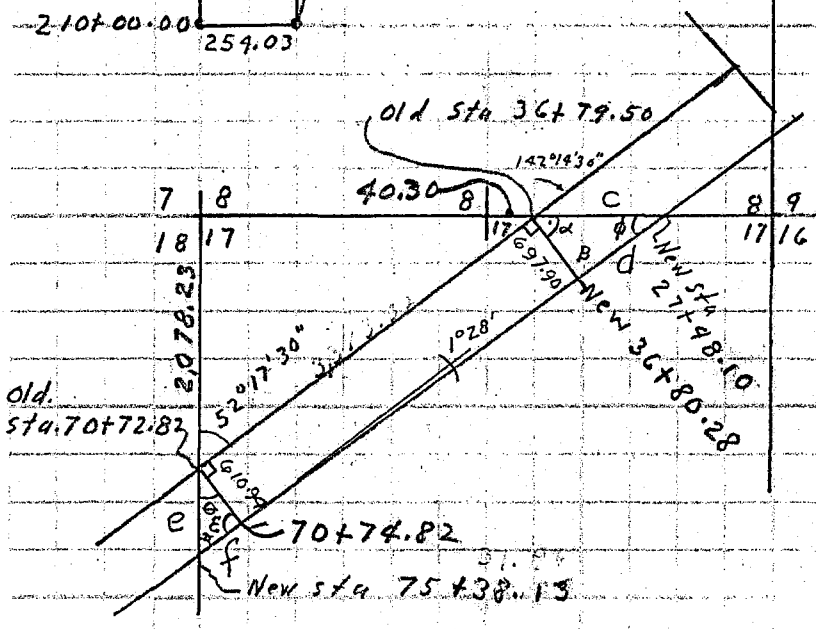
$\beta = 91°28'$

$\phi = 37°45'30" - 1°28' = 36°17'30"$

$\theta = 180 - 142°17'30" = 37°42'30"$

$\pi = 52°17'30" + 1°28' = 53°45'30"$

$\varepsilon = 90° - 1°28' = 88°32'$



$\frac{c}{\sin 91°28'} = \frac{697.90}{\sin 36°17'30"}$, $c = \frac{697.90 \times 0.99967}{0.59190} = 1{,}178.70'$

$\frac{d}{\sin 52°17'30"} = \frac{697.90}{\sin 36°17'30"}$, $d = \frac{697.90 \times .79060}{0.59190} = 932.18$

$\frac{e}{\sin 88°32'} = \frac{610.94}{\sin 53°45'30"}$, $e = \frac{610.94 \times 0.99967}{0.80653} = 757.24$

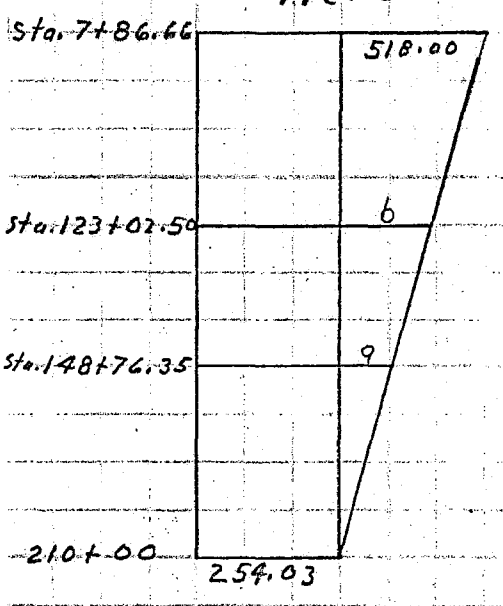
$\frac{f}{\sin 37°42'30"} = \frac{610.94}{\sin 53°45'30"}$, $f = \frac{610.94 \times 0.61164}{0.80653} = 463.31$

Arizona Powerline Floodway

GDH 3-17-66

Section line ties to new alignment $\frac{13|18}{24|19}$ SHEET 2 OF 36

772.03



772.03	210+00.00	210+00.00	210+00.00
254.03	7 86.66	123+02.50	148+76.35
518.00	202 13.34	86 97.50	61 23.65

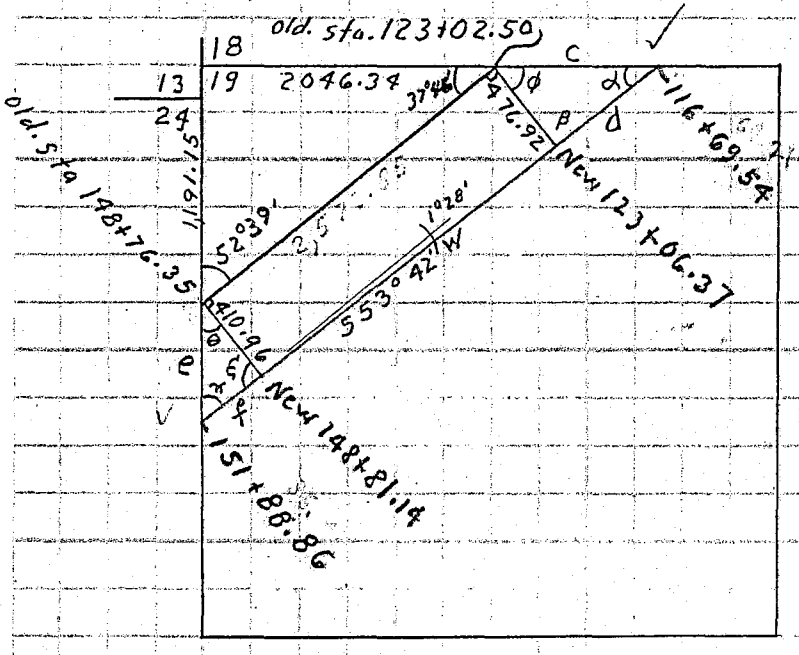
$\frac{a}{6123.65} = \frac{518.00}{20213.34}$, $a = 156.93 + 254.03$

$\frac{b}{8697.50} = \frac{518.00}{20,213.34}$, $b = 222.89 + 254.03$

$\alpha = 37°46' - 1°28' = 36°18'$

$\phi = 180 - 37°46' - 90° = 52°14'$

$\beta = 180 - 36°18' - 52°14' = 91°28'$



$\theta = 180 - 90 - 52°39' = 37°21'$

$\pi = 52°39' + 1°28' = 59°07'$

$\xi = 180 - 37°21' - 59°07' = 88°32'$

$\frac{c}{\sin 91°28'} = \frac{476.92}{\sin 36°18'}$ $\quad c = \frac{476.92 \times .99967}{0.59201} = 805.33'$

$\frac{d}{\sin 52°14'} = \frac{476.92}{\sin 36°18'}$ $\quad d = \frac{476.92 \times 0.79051}{0.59201} = 636.83'$

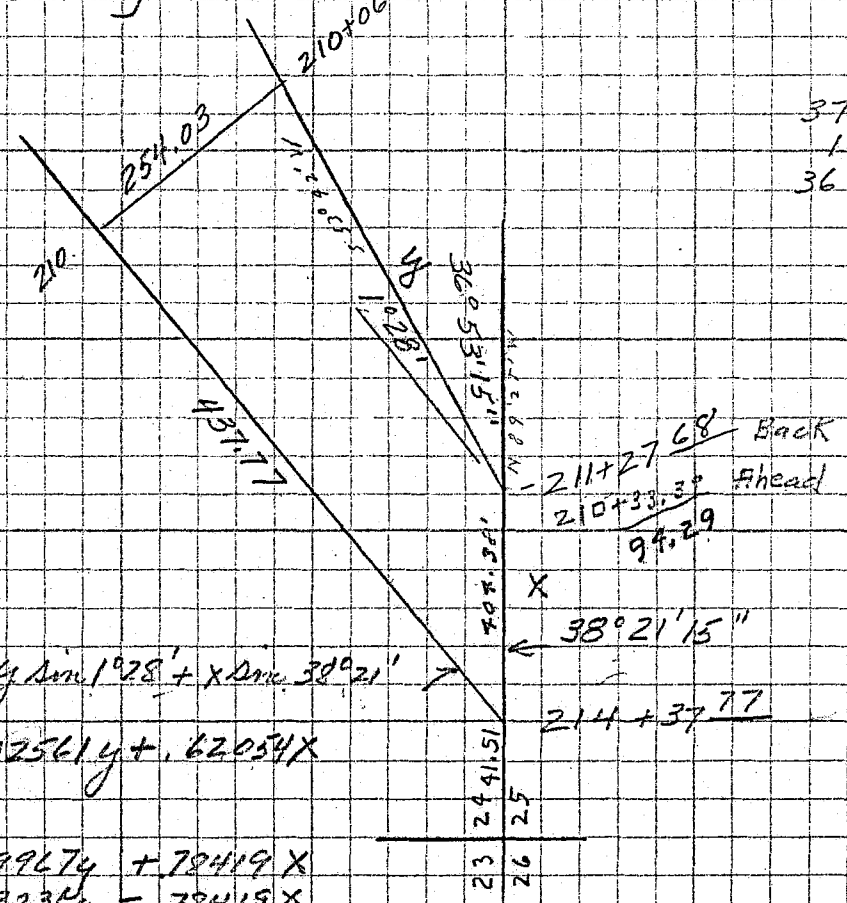
$\frac{e}{\sin 88°32'} = \frac{410.96}{\sin 59°07'}$ $\quad e = \frac{410.96 \times .99967}{0.81021} = 507.06'$

$\frac{f}{\sin 37°21'} = \frac{410.96}{\sin 59°07'}$ $\quad f = \frac{410.96 \times 0.60668}{0.81021} = 307.72'$

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Channel
BY Watt | DATE 4-27-65 | CHECKED BY | DATE | JOB NO
SUBJECT Tie from revised alignment to original survey | SHEET 3 OF 6



37 81 13
1 28 00
36 53 15

$254.03 = y \sin 1°28' + x \sin 38°21'$

$254.03 = .02561y + .62054X$

94.29
23.00
71.21

$437.77 = .99967y + .78419X$
$-321.02 = -.03236y - .78419X$
$116.75 = .96731y$
$y = 120.70$
$x = 404.38$

Back PI = 210+06.98 + 1+20.70 = 211+27.68

Ahead PI = 214 + 37.77 − 404.38 = 210+33.39

New sta 211+27.68 to 23/24 26/25 = 404.38 + 41.51 = 445.89'
Extended line

COMPUTATION SHEET
SCS-523A REV 5-58

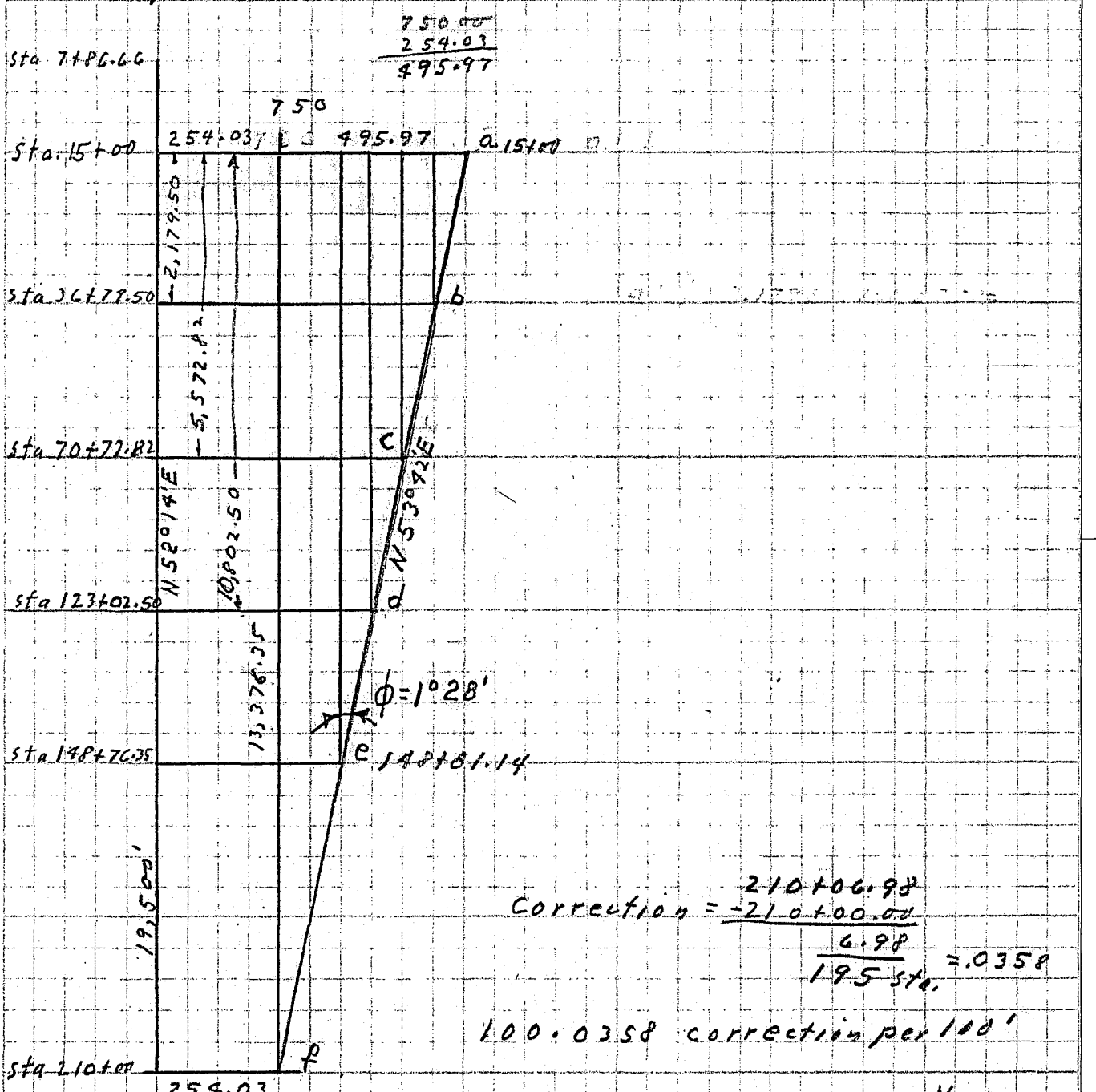
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Ariz. PROJECT Powerline Floodway

BY COH DATE 5-23-66 CHECKED BY DATE JOB NO

SUBJECT Alignment.

SHEET 6 OF 6



Correction = $\frac{210+06.98}{-210+00.00}$

$\frac{6.98}{195 \text{ sta.}} = .0358$

100.0358 correction per 100'

				New Sta
a to b =	100.0358	X 2.1795 = 2,180.28	+ 1,500	= 36+80.28
a to c =	"	X 5,572.82 = 5,574.82	+ "	= 70+74.82
a to d =	"	X 10,802.5 = 10,806.37	+ "	= 123+06.37
a to e =	"	X 13,376.35 = 13,381.14	+ "	= 148+81.14
a to f =	"	X 19,500 = 19,506.55	+ "	= 210+06.98

COMPUTATION SHEET
SCS-523A REV. 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE | PROJECT

BY | DATE | CHECKED BY | DATE | JOB NO.

SUBJECT Check

SHEET 5a OF

$\cos 1°28' = 0.99967238$

$$a \text{ to } b = \frac{2,179.50}{0.99967238} = 2,180.21 + 1,500 = \text{Sta. } 36+80.21$$

$$a \text{ to } c = \frac{5,572.82}{0.99967238} = 5,574.65 + 1,500 = 70+74.65$$

$$a \text{ to } d = \frac{10,802.50}{0.99967238} = 10,806.04 + 1,500 = 123+06.04$$

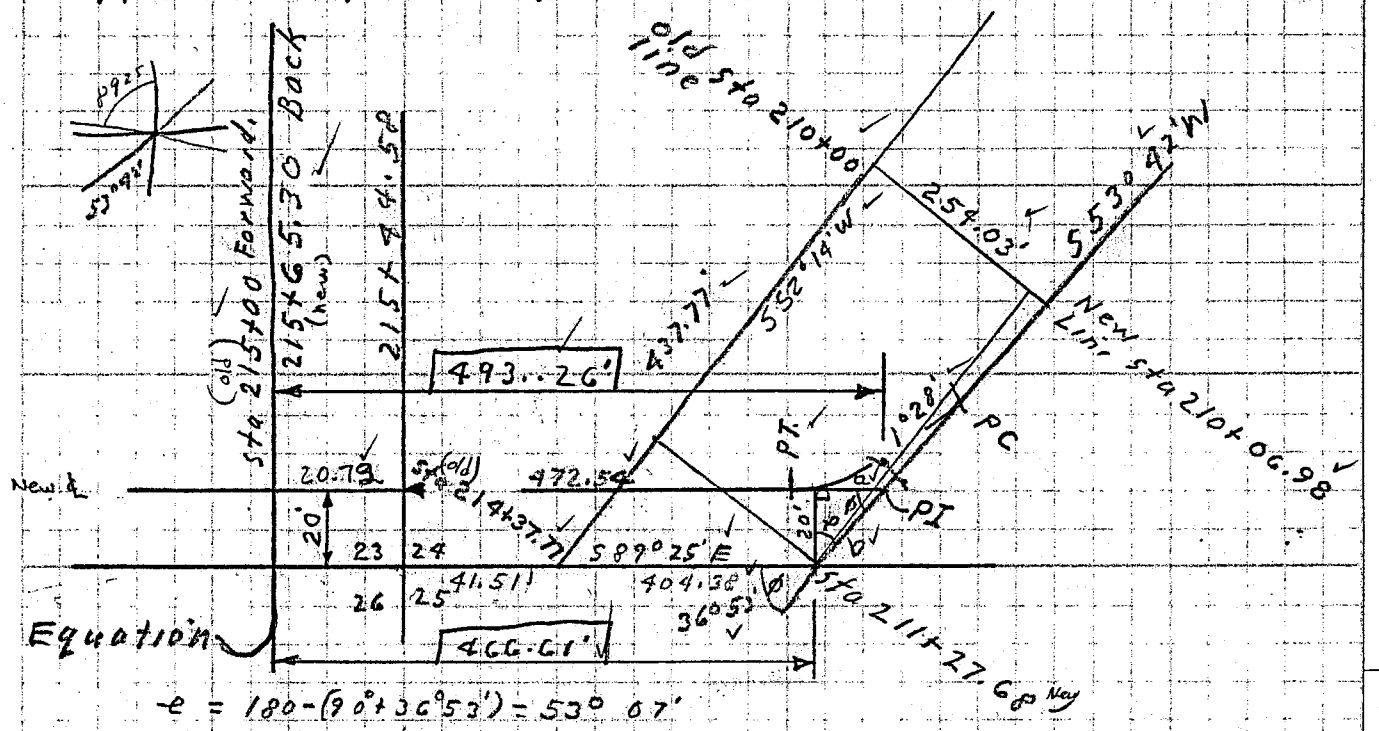
$$a \text{ to } e = \frac{13,376.35}{0.99967238} = 13,380.73 + 1,500 = 148+80.73$$

$$a \text{ to } f = \frac{19,500}{0.99967238} = 19,506.39 + 1,500 = 210+06.39$$

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Ariz. PROJECT Powerline Floodway
BY GDH DATE 5-20-66 CHECKED BY DATE JOB NO.
SUBJECT New Alignment SHEET 5 OF 6



$e = 180 - (90° + 36°53') = 53° 07'$

$$\frac{a}{\sin 53°07'} = \frac{20}{\sin 36°53'} = 26.65$$

0.7998593 0.6001876

$$\frac{b}{\sin 90°} = \frac{20}{\sin 36°53'} = 33.32'$$

0.6001876

New PI = 211+27.68 − 33.32 = Sta 210+94.36
− Tan. 3 18.52
New PC = 207+75.84
+ Lc 6 14.72
New PT 213+90.56
+ 4 93.26
− tan 3 18.52
New Equ. Back = 215+65.30

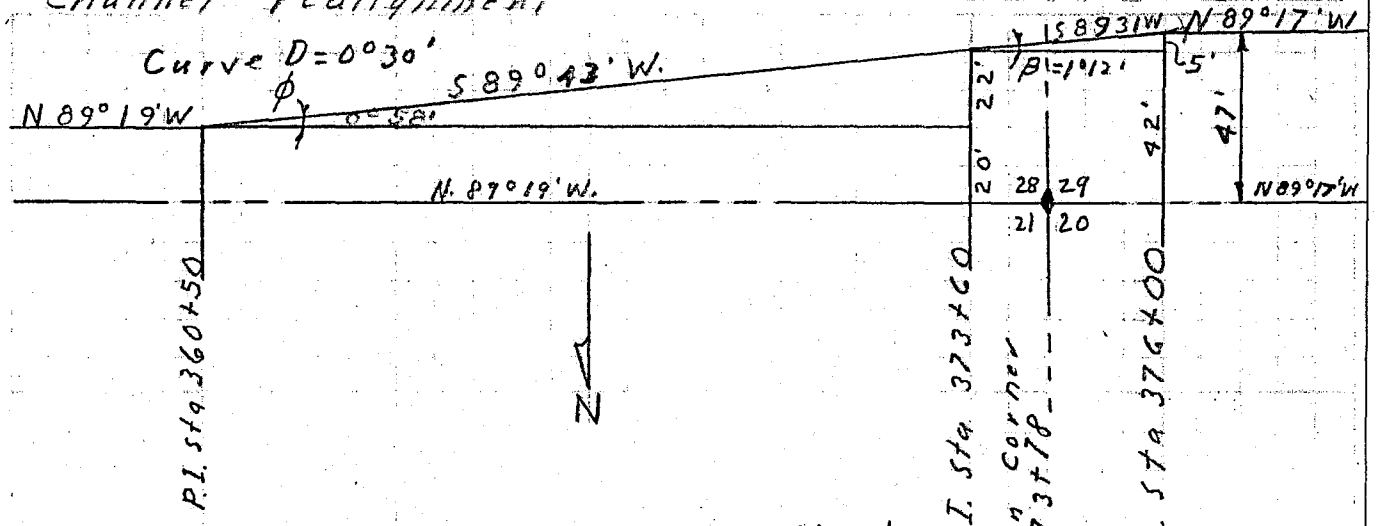
Curve Data
Δ = 36°53'
D = 6°00'
R = 954.93'
T = 318.52'
L = ~~613.96'~~ 614.72

New PT 213+90.56
+ 4 72.54
− 3 18.52
sta @ Sect. Line 215+44.58

Arizona Powerline Floodway

GDH 7-11-66

Channel realignment

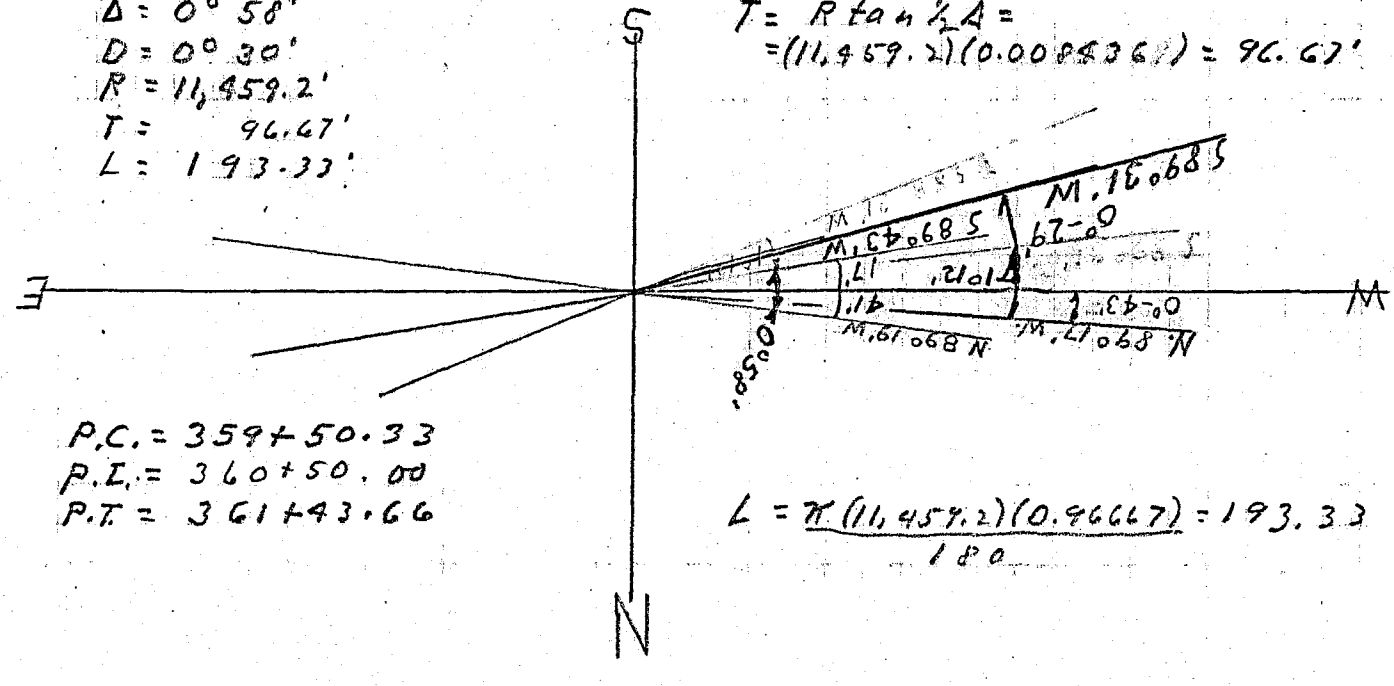


$$\begin{array}{r} 373+60 \\ 360+50 \\ \hline 1310 \end{array} \qquad \tan\phi = \frac{22}{1310} = 0.016794 = \cancel{0°57'44''}\ 0°58'$$

$$\begin{array}{r} 376+00 \\ 373+60 \\ \hline 240 \end{array} \qquad \tan\beta = \frac{5}{240} = 0.02083 = \cancel{1°11'30''}\ 1°12'$$

$\Delta = 0°58'$
$D = 0°30'$
$R = 11{,}459.2'$
$T = 96.67'$
$L = 193.33'$

$T = R\tan\frac{1}{2}\Delta =$
$= (11{,}459.2)(0.008436) = 96.67'$



P.C. = 359+50.33
P.I. = 360+50.00
P.T. = 361+43.66

$$L = \frac{\pi(11{,}459.2)(0.96667)}{180} = 193.33$$

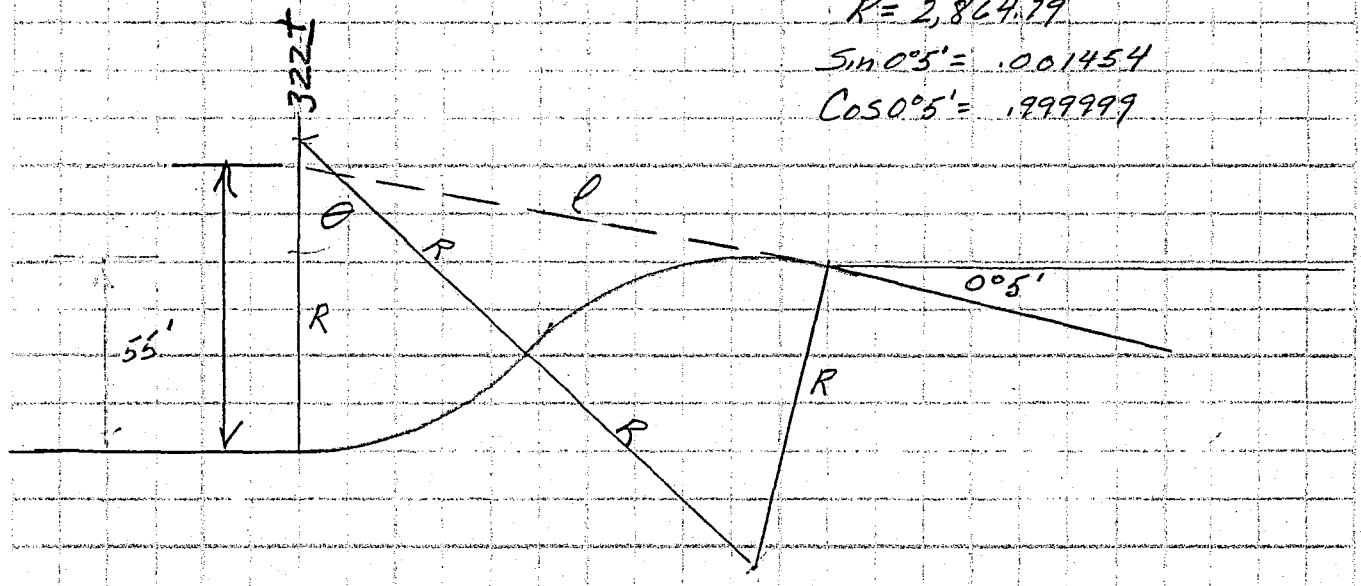
COMPUTATION SHEET
SCS-523A REV 5-56

805.79

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona
PROJECT Powerline Channel
BY Watt DATE 7-2
CHECKED BY DATE JOB NO.
SUBJECT Alignment Ellsworth Rd
SHEET OF

$R = 2,864.79$
$\sin 0°5' = .001454$
$\cos 0°5' = .999999$



$I \; \Sigma x - l \cos 0°5' = R \sin 0°5' + 2R \sin\theta$

$II \; \Sigma y - R - 2R\cos\theta + R\cos 0°5' = 55 - l \sin 0°5'$

$II \times 687.757 - 1375.514R - 1375.514R\cos\theta = 37,826.6 - .99999l$
$.001R + 2R\sin\theta = .99999l$

$I + II \quad 1376.514R - 1375.514R\cos\theta + 2R\sin\theta = 37,826.6$
$\div R \quad 1375.515 - 1375.514\cos\theta + 2\sin\theta = 13.20398$

$\cos\theta = .990398 + .001453\sin\theta$
$\theta = 7°51'48''$ $\quad \cos = .990597$
$\sin = .136811$
$l = 788.04$

Check Equ II
$2864.79 - 5675.70 + 2864.79 = 55 - 1.15$
$53.88 = 53.85$ OK

l is too long =
Use $D = 2°30'$
$R = 2291.83$

STATE Arizona PROJECT Powerline Channel

BY Watt DATE 7-27-66 CHECKED BY DATE JOB NO.

SUBJECT Revision Alignment @ Ellsworth Rd SHEET OF

$R = 2291.83$

$\ell \cos 0°5' = R \sin 0°5' + 2R \sin\theta$

$R - 2R\cos\theta + R\cos 0°5' = 55 - \ell \sin 0°5'$

$1375.514\,R - 1375.514\,R\cos\theta = 37{,}826.635 - .999999\,\ell$

$.001\,R + 2R\sin\theta = + .999999\,\ell$

$1375.515\,R - 1375.514\,R\cos\theta + 2R\sin\theta = 37{,}826.635$

$1375.514\cos\theta - 2\sin\theta = 1376.514 - 16.505$

$\cos\theta = .988001 + .001454\sin\theta$

$\cos\theta = .988222$

$\sin\theta = .152024$

$\theta = 8°48'9''$

$\ell = 2R\sin\theta + R\sin 0°5' = 696.83 + 3.33 = 700.16$

$4583.66 - 4529.67 = 55 - 1.02$

$53.99 = 53.98$

COMPUTATION SHEET
SCS-523A REV 5-66

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Channel
BY Watt DATE 7-27-66 CHECKED BY DATE JOB NO.
SUBJECT Revised Alignment Powerline Ch. SHEET OF

Curves $D = 2°30'$ $R = 2291.83$

$\Delta_1 = 8°48'$

$\Delta_2 = 8°53'$

Curve No 1

$\Delta = 8°32'$
$T = 2291.83 \times .076946 = 176.35$
$L = 352.00$

PC	322+00
+t	176.35
PI	223 76.35
PC+L	352.00
PRC	325+52.00
+#2t	178.02
PI	327+30.02
PRC+#2L	355.33
PT	329+07.33

Curve No 2

$\Delta = 8°37'$
$T = 2291.83 \times .077677 = 178.02$
$L = 355.33$

$(176.35 + 178.02) \times 1.98822 = 704.56$
$352.00 + 355.33 = 707.33$

2.77 Correction

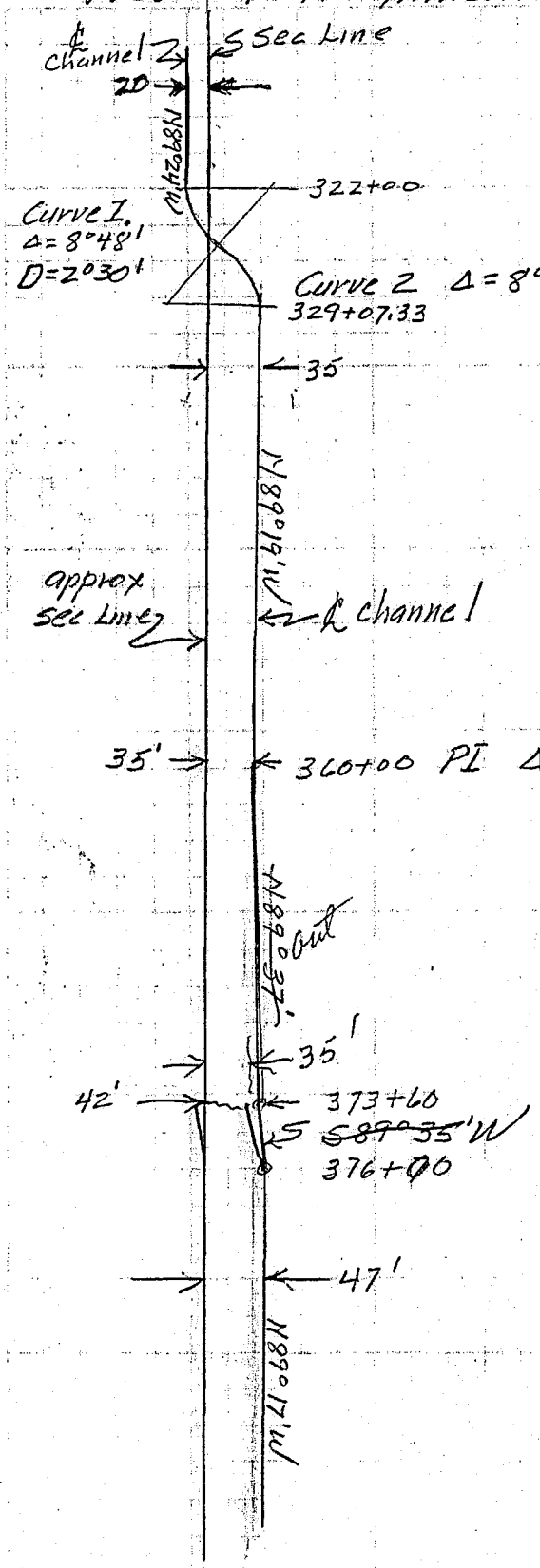
Check $(176.35 + 178.02) \times .152024 = 53.87$

$\times .154423 = 54.65$
$176 \times .001454$ .26
54.91 OK

Arizona — Powerline Channel

Watt 8-11-66

Revised Alignment Powerline Channel



$\frac{7.00}{1360} = .0005147 = \sin\Delta$

$\Delta = 17'45''$

$\frac{5.00}{260} = .0192308 = \sin\Delta$

$1°06' = 66'$

$-\ 18'$

$48'$

$89°37'$

$48'$

$N\ 90°25'W$

$S\ 89°35'W$

COMPUTATION SHEET

STATE Arizona PROJECT Powerline Floodway

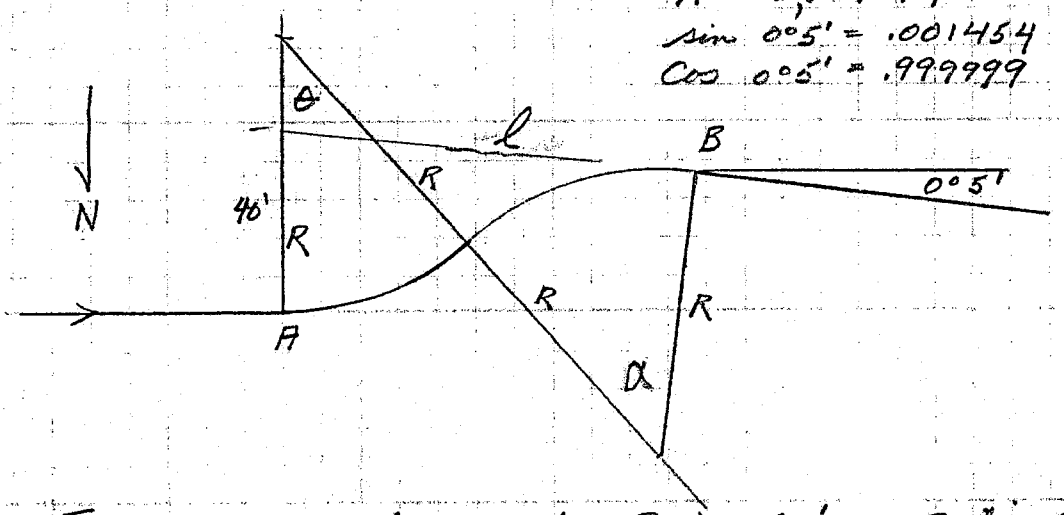
BY G. Watt DATE 7-1-66 CHECKED BY DATE JOB NO

SUBJECT Channel Realignment Revision SHEET 1 OF 2

$R = 2,864.79$

$\sin 0°5' = .0014454$

$\cos 0°5' = .999999$



I $\quad \Sigma X_{AB} \quad \ell \cos 0°5' = R \sin 0°5' + 2R \sin\theta$

II $\quad \Sigma Y_{AB} \quad R - 2R\cos\theta + R\cos 0°5' = 40 - \ell \sin 0°5'$

II × 687.757 $\quad 1375.514R - 1375.514R\cos\theta = 27510.29 - .999999\ell$

I $\quad .001R + 2R\sin\theta = +.999999\ell$

II + I $\quad 1375.514R - 1375.514R\cos\theta + 2R\sin\theta = 27510.29$

÷R $\quad 1375.515 - 1375.514\cos\theta + 2\sin\theta = 9.6028989$

$687.757\cos\theta - \sin\theta = 682.956$

for $6°46' = \theta$

$682.963 - .118 = 682.956$

$682.845 = 682.956$

For $\theta = 6°42' \quad 682.943 = 682.956 - 13$

For $\theta = 6°41' \quad 682.964 = 682.956 + 8$

$\theta = 6°41'30'' \quad \cos\theta = .993188$

$\sin\theta = .116522$

$\alpha = 6°46'30''$

Eq I $\quad \ell = 671.79$

Check Eq II $\quad 5729.57 - 5690.55 = 40 - .977$

$39.02 = 39.02$ OK

COMPUTATION SHEET
SCS-523A REV 6-65

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona
PROJECT Powerline Floodway
BY Watt DATE 7-6-66
CHECKED BY DATE JOB NO.
SUBJECT Channel Realignment Revision
SHEET OF

Curve I P.C. = 322+00

R = 2,864.79
Δ = 6°41'30"
T = 2,864.79 × .058462 = 167.48
L = 334.58

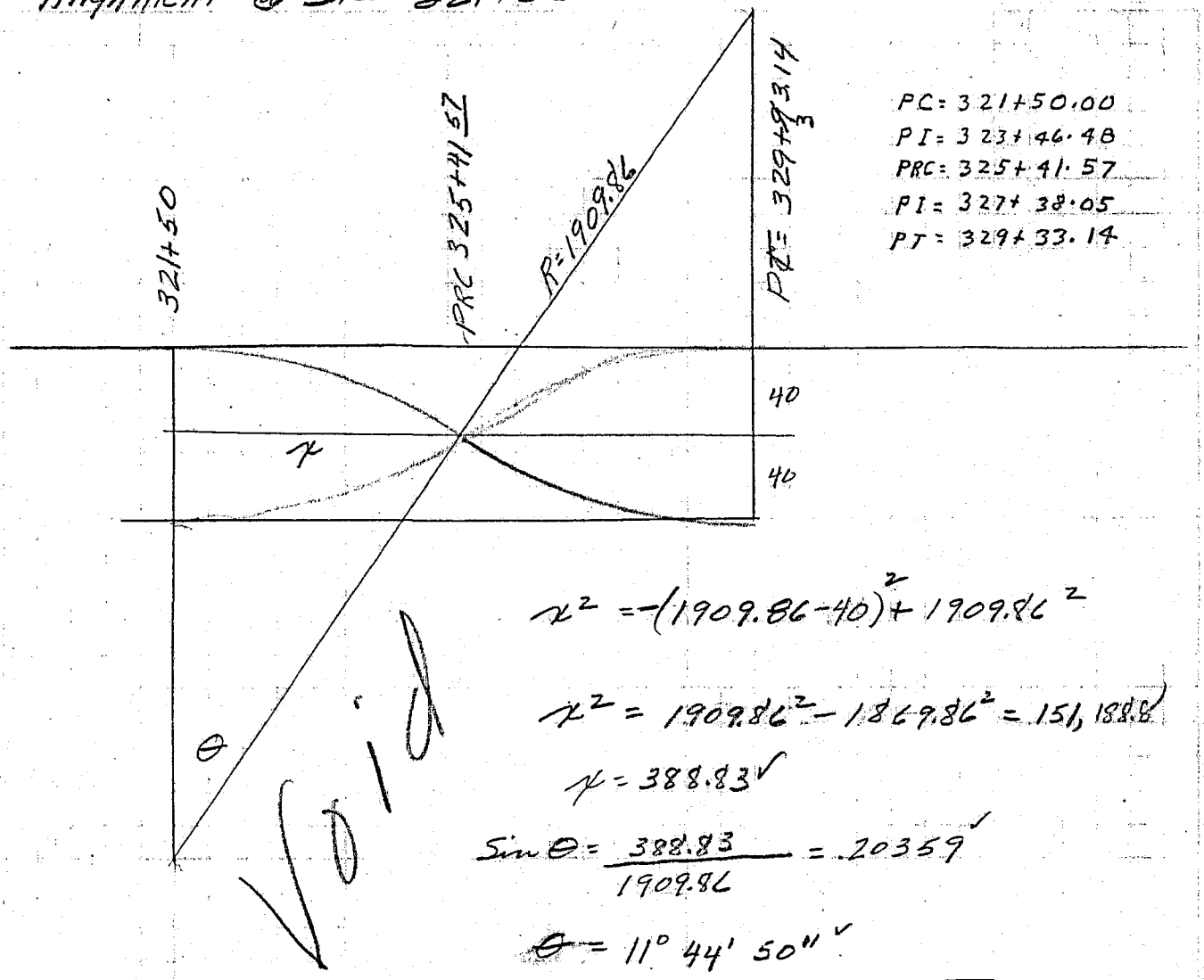
Curve II

R = 2,864.79
Δ = 6°46'30"
T = .059192 × 2,864.79 = 169.57
L = 338.75

PC = 322+00
PI = 323+67.48
PRC = 325+34.58
PI = 327+04.15
P.T. = 328+73.33

Correction 334.58 + 338.75 = 673.33
(167.48 + 169.57) 1.993188 = 671.80
Corr 1.53

Arizona Power line Channel
Watt
Alignment @ Sta 321+50



PC: 321+50.00
PI: 323+46.48
PRC: 325+41.57
PI: 327+38.05
PT: 329+33.14

Void

$x^2 = -(1909.86-40)^2 + 1909.86^2$

$x^2 = 1909.86^2 - 1869.86^2 = 151,188.8$

$x = 388.83$ ✓

$\sin\theta = \frac{388.83}{1909.86} = .20359$ ✓

$\theta = 11° 44' 50''$ ✓

Curve
$\Delta = 11° 44' 50''$
$T = 1909.86 \times .10300 = 196.72$
$L_c = 391.57$
$D = 3°$

Sta Correction

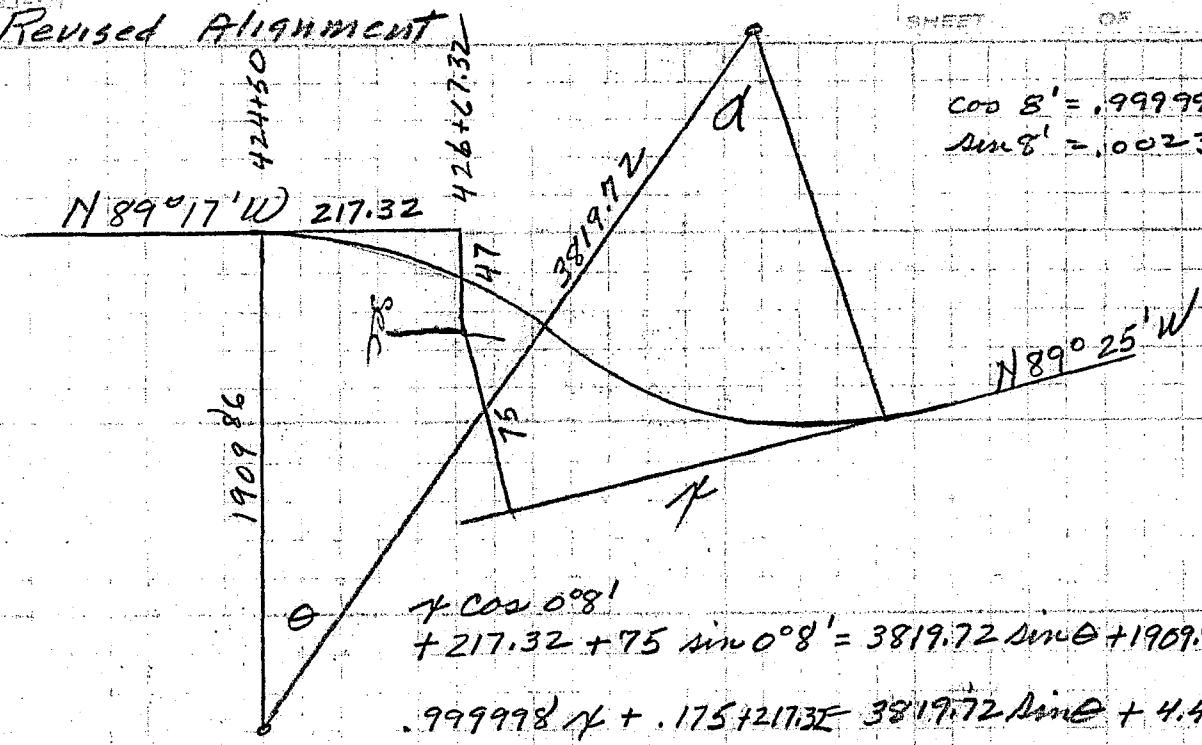
2 x 388.83 =	777.66
2 x 391.57	783.14
Diff	5.48

329+93.14 opp 329+87.66 survey line

COMPUTATION SHEET
SCS-523A REV 5-66

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona
PROJECT Powerline Channel
BY Watt
DATE 7-6-66
CHECKED BY
DATE
JOB NO.
SUBJECT Revised Alignment
SHEET OF



$\cos 8' = .999998$
$\sin 8' = .002327$

$x \cos 0°8'$
$+ 217.32 + 75 \sin 0°8' = 3819.72 \sin\theta + 1909.86 \sin 8'$

$.999998x + .175 + 217.32 = 3819.72 \sin\theta + 4.444$

$.999998x = 3819.72 \sin\theta - 213.050$

$47 + 75 \cos 0°8' - x \sin 0°8' - 1909.86 \cos 0°8' +$

$3819.72 \cos\theta - 19.09.86 = 0$

$-.002327x - 3697.716 + 3819.72 \cos\theta = 0$
$-.999998x - 213.050 + 3819.72 \sin\theta = 0$

$-.002327x - .496 + 8.898 \sin\theta = 0$
$-.002327x - 3697.716 + 3819.72 \cos\theta = 0$

$3819.72 \cos\theta - 8.898 \sin\theta = 3697.22$

$\cos\theta = .967930 + .00233 \sin\theta$

For 14°25'

$.96851 = .967930 + .000579 = .968509$

$\theta = 14°22'$ $x = 737.70$
$a = 14°30'$

COMPUTATION SHEET
SCS-5234 REV 5-62

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Channel
BY Watt DATE 7-6-66 CHECKED BY DATE JOB NO.
SUBJECT Revised Alignment SHEET OF

Curve No 1

$\Delta = 14°25'$

$D = 3°00'$

$R = 1909.86$

$T = 1909.86 \times .126477 = 241.55$

$L = 480.56$

Curve No 2

$\Delta = 14°33$

$D = 3°00'$

$R = 1909.86$

$T = 1909.86 \times .127632 = 243.76$

$L = 485.00$

P.C. = 424+50

P.I. = 426+91.55

P.R.C. = 429+30.56

P.I. = 431+74.32

P.T. = 434+15.56

Sta Corr = 480.56+485.00 − (241.55+243.76) 1.96851

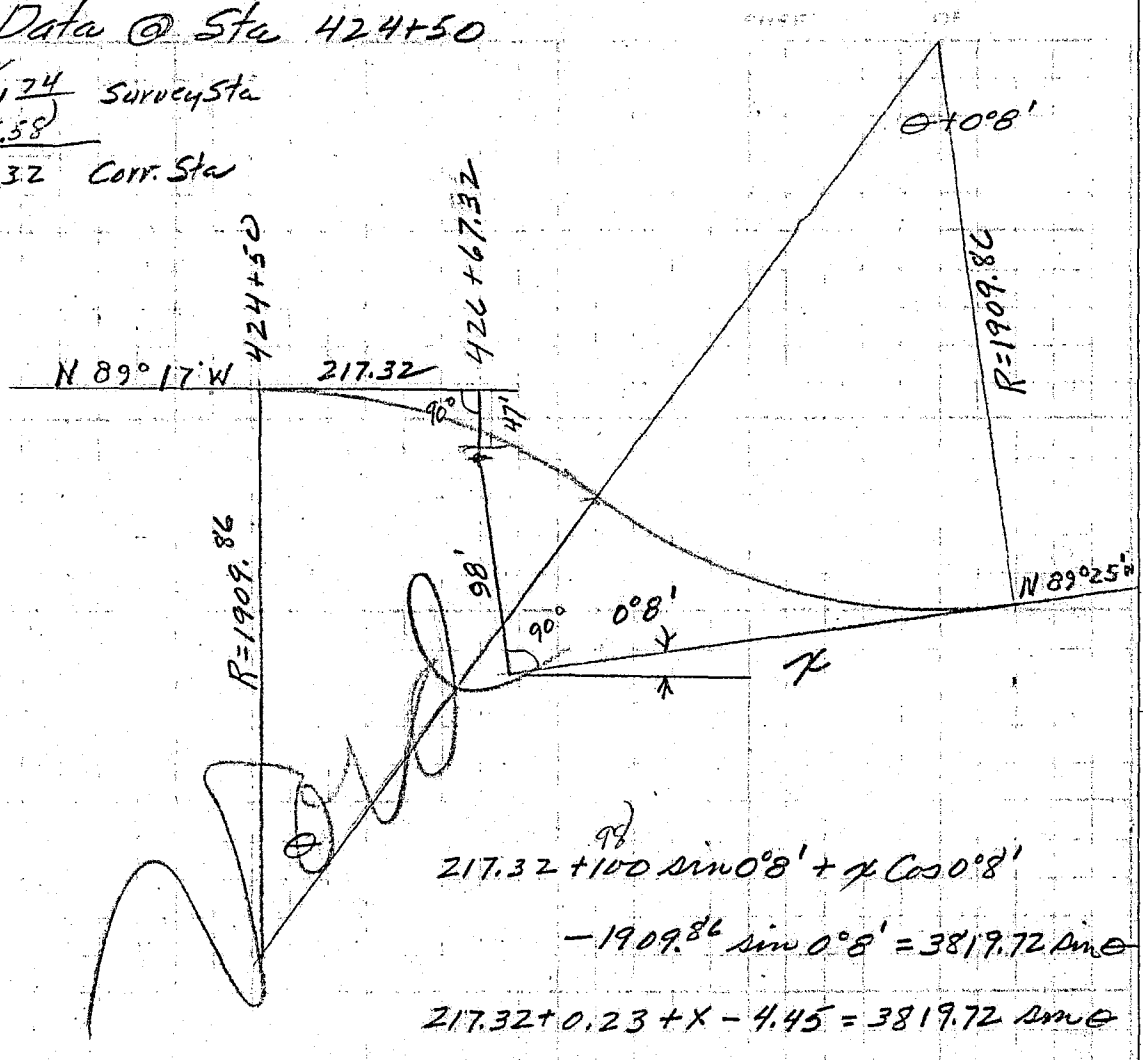
= 10.22 Corr

Arizona Powerline Channel

Watt 3-21-66

Curve Data @ Sta 424+50

426+61.74 Survey Sta
5.58
426+67.32 Corr. Sta



$217.32 + 100 \sin 0°8' + x \cos 0°8' - 1909.86 \sin 0°8' = 3819.72 \sin\theta$

$217.32 + 0.23 + x - 4.45 = 3819.72 \sin\theta$

$x = 3819.72 \sin\theta - 213.10$

$.00233x + 3819.72 - 145 = 3819.72 \cos\theta$

$.00233x + 3674.72 = 3819.72 \cos\theta$

$.00233x + .50 = +8.90 \sin\theta$

$3819.72 \cos\theta - 8.90 \sin\theta = 3674.22$

For $\theta = 15°44'$ $\quad 3676.60 - 241 = 3674.22$

$3674.19 = 3674.22$ OK

$\sin 15°44' = .27116$

$\cos 15°44' = .96253$ $\quad x = 3819.72 \times .27116 - 213.10 = 822.66$

96253

Arizona Power Inc Channel
Watt 3-21-66 ASK 3-25-66
Curve Data @ 424+50

Check

217.32+98 x .00233 + 822.66 = 1909.86 x .00233 = 3819.72 x .27116
217.32 + .23 + 822.66 − 4.45 = 1035.76
1035.76 = 1035.76 OK

.00233 x 822.66 + 3819.72 − 145 = 3819.72 x .96253
3676.64 = 3676.60 OK

Curve 1

Δ = 15° 44' ✓
D = 3° ✓
R = 1909.86 ✓
T = 263.89 ✓
Lc = 524.44 ✓

Curve 2

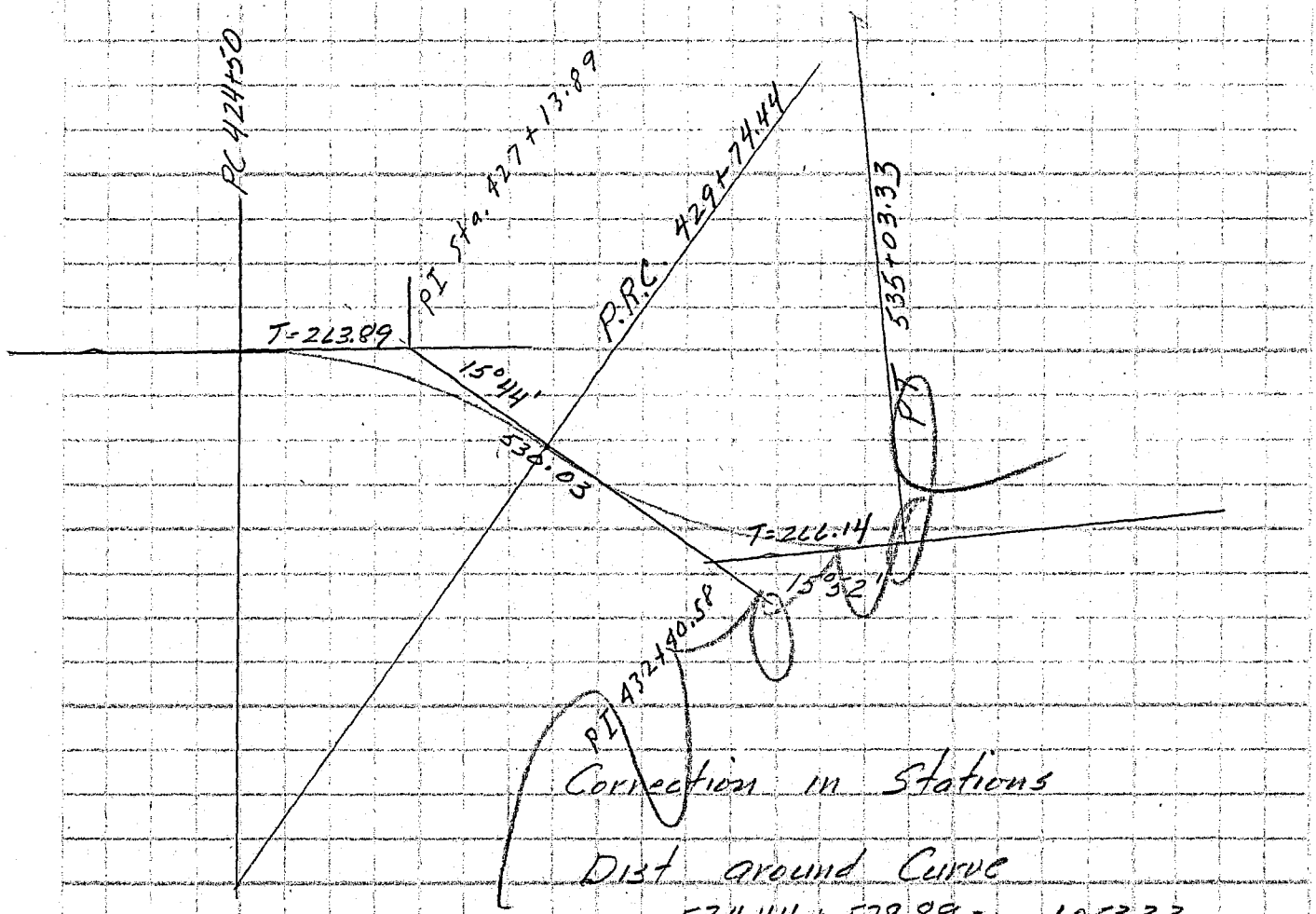
Δ = 15° 52' ✓
D = 3° ✓
R = 1909.86 ✓
T = 266.14 ✓
Lc = 528.89 ✓

P.C.	424+50.00
	+ 2+63.89
P.I.	427+13.89
P.C. +	5 24.44
P.R.C.	429+74.44
	+ 2 66.14
P.I.	432+40.58
P.R.C +	5 28.89
	435+03.33

COMPUTATION SHEET
SCS-529A REV. 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Channel
BY Watt DATE 3-21-66 CHECKED BY DATE JOB NO
SUBJECT Curve Data @ 424+50 SHEET ___ OF ___



Correction in Stations

Dist around Curve
524.44 + 528.89 = 1053.33

Dist along survey Sta.
217.32 + 822.66 = 1039.98

Diff = 13.35 ft
+ Corr @ 321.E 373 5.59
Total 18.94

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO 1958 O - 497927

STATE Arizona
PROJECT Powerline Channel
BY Watt
DATE 4-27-65
CHECKED BY
DATE
JOB NO.
SUBJECT Stationing of revised Channel
SHEET ___ OF ___

15,6141

Orig. Survey Sta		New Sta		Offset	
7+86.66	opposite	7+87		772+03	
15+00		15+00.57		753.75	
27+60		27+60.99		721.46	
70+72.82	.032837 ft/sta	70+75.22	25	610.94	608 580
100+00		100			
123+02.50		123+06 62	2.56267 ft/sta	476.92	
138+00		138+04 61		438.54	
148+76.35		148+81.32		410.96	
168+00		168+05 60		361.66	
200+00		200+06 65		279.66	
210+00		210+06 98		254.03	
210+33.39		211+27.68	PI	Equation	

COMPUTATION SHEET
SCS-[illegible], REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE: Arizona
PROJECT: Powerline Channel
BY: Watt
DATE: 4-23-65
CHECKED BY:
DATE:
JOB NO.:
SUBJECT: Grade Determination
SHEET ___ OF ___

Sta	Grade	Elev.	Q	D	B	Use
12+10 ✓		1558.68				
			600	4.67	6	4'9"
45+00 ✓	.00588 ✓	1539.28 ✓				
50+00 ✓		1536.4 ✓				
	.00746 ✓		600	4.4'	6	4'9"
76+00 ✓		1517.0 ✓				
85+00 ✓	.00538 ✓	1512.15 ✓	600	4.77	6	4'9"
89+00 ✓		1510 ✓				
			Inlet	Detail	6	
89+20 ✓		1509.3 ✓				
	.005843 ✓		660	4.89	6	5'0"
113+00		1495.40				
125+00 ✓	.005843 ✓	1488.38 ✓	660	4.89	6	
132+50 ✓		1484.0 ✓				
	~~.00774~~ ✓		660	4.6	6	
148 ✓		1472 ✓				
165 ✓		1461.87 ✓				
	.00596 ✓		660	4.86	6	
195		1444				
205	00555 ~~00562~~	1436.45	660	4.93	6	5.05 around curve
214+50 ~~215+45~~		1433.18 ~~1432.5~~				
215+00						
214+85		1432.13	Inlet			

3250
1080
4330

COMPUTATION SHEET

SCS-ECJA REV 5-65

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Channel

BY Watt | DATE 4-28-65 | CHECKED BY | DATE | JOB NO.

SUBJECT Grade Determination | SHEET NO. | OF

Sta	Grade	Elev	Q	D	b
~~214+85~~ ~~215+35~~		1432.13 ~~1431.80~~			
245+00	.00363	1421.13 ~~1421.00~~	850	5.75	8
261+00		1415.40			
			Inlet		
261+60		1413.9			
	.00385		1025	6.25	8
276+00		1408.36			
285	.00605	1402.92	1025	5.62	8
308+00		1389.00			
325+00	.00560	1379.48	1200	6.10	8
333+00		1375.00			

COMPUTATION SHEET
SCS-522A REV 5-58

DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Channel
BY Watt DATE 3-21-66 CHECKED BY DATE JOB NO.
SUBJECT Elev - Grade SHEET OF

Sta	Grade	Elev	Q	D	b	Use D
333+00 ✓		1375.00 ✓				
			1210	6.42	8.0	6'6"
365+00 ✓	.00450 ✓	1360.60 ✓				
373+00		1357.00				
	SAF					
373+42		1354.00				
	.00414		3140	6.9	8.0	7'6"
400+00		1343.00				
405		1341.~~49~~ 52				
	~~.00305~~ .00296		3140	7.45	60	7'6"
445		1329.~~28~~ 68				
467+50 ~~465+50~~		1323.00				

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Channel
BY Watt | DATE 4-27-65 | CHECKED BY | DATE | JOB NO.
SUBJECT | SHEET OF

To get curve a inlet before line reaches section cor.

Tan for 6° Curve = 318 ft
Length of Inlet Weir = 35'
Total 353 ft
Dist From PI to Sec 305
Diff = 48'
48 sin A = 48 x .60 = 28.8'

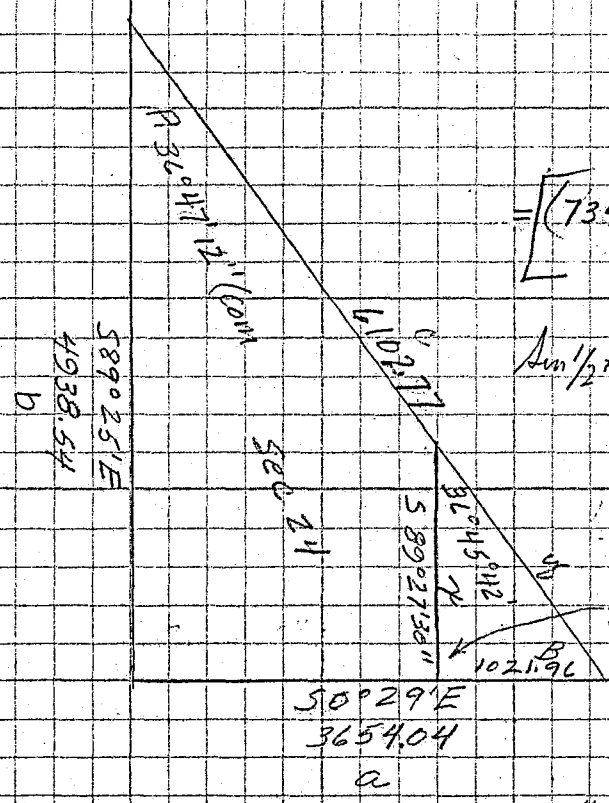
The purpose of revising the alignment are threefold.

1. To miss the SW 1/4 of NE 1/4 of Sec 24
2. To make the 1000' radius curve fit in before the inlet & provide bridge @ 215+00
3. To fit the ridge of the drainage area better.

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO 1955 O—457927

STATE Arizona | PROJECT Powerline Channel
BY Watt | DATE 4-27-65 | CHECKED BY | DATE | JOB NO.
SUBJECT Offset required to miss SW 1/4 of NE 1/4 of Sec 24 | SHEET ___ OF ___



$$\sin \tfrac{1}{2}A = \sqrt{\frac{(S-b)(S-c)}{bc}}$$

$$= \left[\frac{(7347.67-6102.77)(7347.67-4938.54)}{6102.77 \times 4938.54}\right]^{1/2}$$

1244.90 2409.13

$\sin \tfrac{1}{2}A = .31545$ $\tfrac{1}{2}A = 18°23'36'$

$A = 36°47'12''$

check $36°45\ 31''$

$$\frac{\sin B}{4938.54} = \frac{\sin 36°47'12''}{3654.04}$$

$$\sin B = \frac{.59884 \times 4938.54}{3654.04} = .80935$$

$B = 54°02'$

$$y = \frac{1021.96 \times .99990}{.59850}$$

$y = 1707.4$

$$\frac{.80935}{x} = \frac{.59850}{1021.96} \qquad x = 1381.99$$

$$\text{Q Sec Dist} = \frac{5264.82 + 5243.70}{8} = 1313.56$$

Dist ℄ in Sec = 1381.99
1313.56
68.43 ft

at rt ∠s = 67.43 × .59850 = 40.35'
33

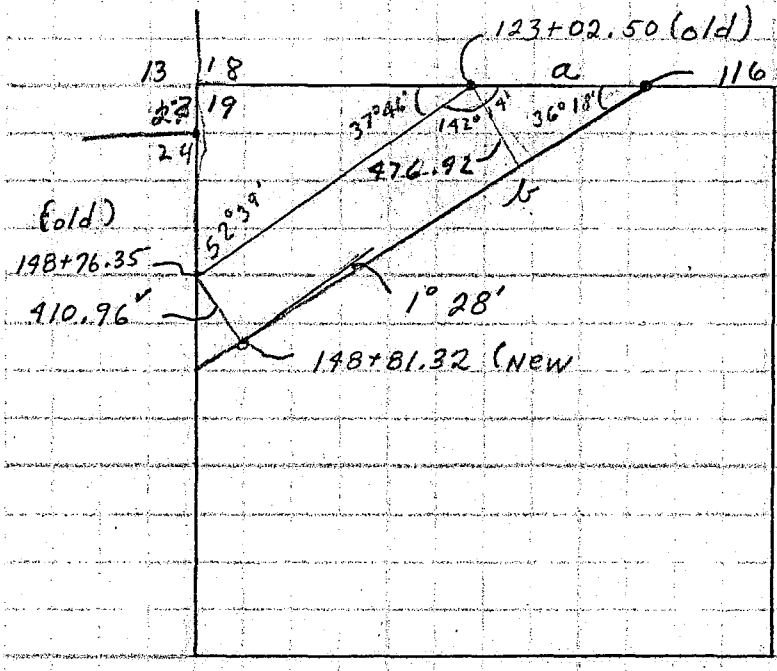
To Move out of SW 1/4 NE 1/4 = 73.35' Call 75'
at Sta 167+85±

4672
130
45 42
9951
17

COMPUTATION SHEET — U. S. DEPARTMENT OF AGRICULTURE
SCS-ENGR. REV. 5-58 — SOIL CONSERVATION SERVICE

STATE Arizona — PROJECT Powerline Floodway
BY D.H.H. — DATE 4-29-65 — CHECKED BY — DATE — JOB NO. 2006
SUBJECT Ties of new alignment with section conner 13|18 / 24|19 — SHEET — OF

129 60
37 96
142° 14'
179 60



distance from section 13|18 / 24|19 to new sta. 116+69.85
= 2,851.59'

b sin 1°28' + 410.96 = a sin 142° 14'
b cos 1°28 + a cos 142° 14 = old line

b .02560' + 410.96' = a .61245'
b .99967' − a .79051' = 2,573.85'

.02560'b − a .61245' + 410.96' = 0
.99967b' − a .79051' − 2,573.85' = 0

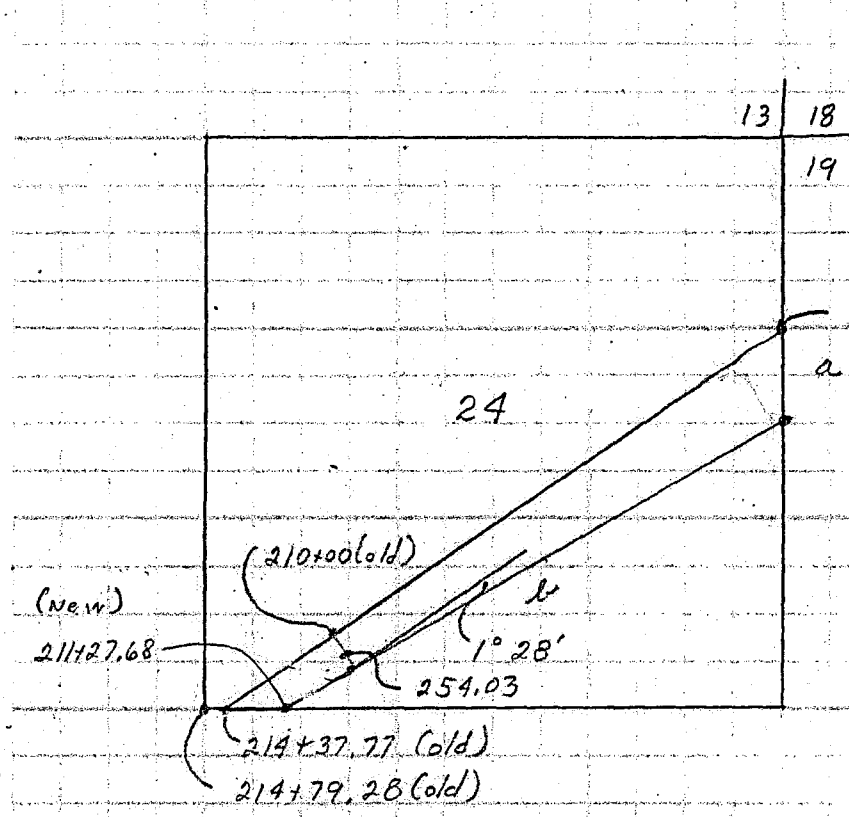
−.020246 + .494156 − 324.86799 = 0
+.612256 − .494156 − 1,576.35443

.592016 = 1,901.22242
b = 3,211.47
a = 805.25

Arizona Powerline Floodway

D.H.H. 4-2965 2006

Ties of new alignment with section 24



$b \sin 1°28' + 254.03 = a \sin 52°39'$

$b \cos 1°28' + a \cos 52°39' = \text{old line}$

$b\ .02560 + 254.03 = a\ .79494$

$b\ .99967 + a\ .60668 = 6,123.65$

$.025606 - .79494a + 254.03 = 0$

$.999676 + .60668a - 6,123.65 = 0$

$.015536 - .48227 + 154.11492 = 0$

$+.799686 + 48227 - 4,867.93433 = 0$

$.81021\ b = +4,713.819411 = 0$

$b = 5,818.02$

$a = 506.94$

5,818.100043

COMPUTATION SHEET

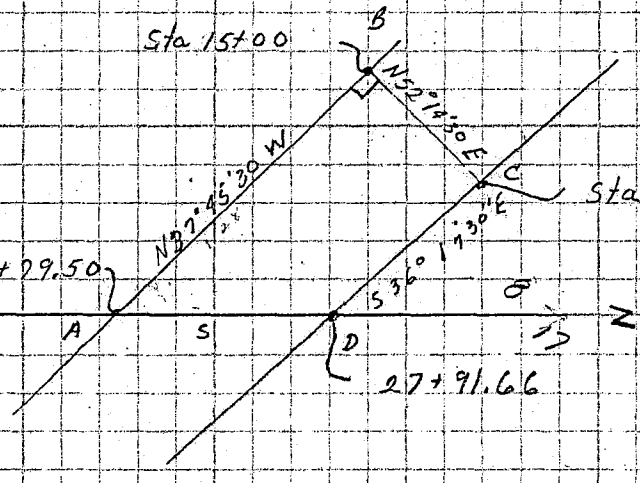
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE: Arizona | PROJECT: Powerline Floodway

BY: D.H.H. | DATE: 5-4-65 | CHECKED BY: | DATE: | JOB NO: 2006

SUBJECT: Location of section line 8/17 | SHEET 1 OF 2



179 59 60 — 89 59 60

142 14 30 — 37 45 30

37 45 30 — 52 14 30

Project Powerline Floodway By D.H.H. Date 9-5-65 Checked _____ Date _____

Location of Section line 8/17

Stations	Deflections	Bearings	Length In Feet	Cos	Sin	Latitudes		Departures	
						North	South	East	West
A to B		N 37°45'30"W	2,179.50	.79060	.61233	1,723.11			1,334.57
B to C		N 52°14'30" E	721.46	.61233	.79060	441.77		570.39	
C to D		S 36°17'30 E	1,291.09	.80619	.59189		1,040.86	764.18	
D to A		S	1,124.02			1.	1,124.02		

XERO COPY
XERO COPY
XERO COPY

C O P Y - R. Arrington

Room 6029 Federal Bldg.
230 North First Avenue
Phoenix, Arizona 85025

AApril 16, 1968

Colonel John C. Lowry
Contracting Officer
Flood Control District of Maricopa County
3325 West Durango Street
Phoenix, Arizona 85009

Ref: FCD#2, Low Drop Structures Powerline Channel
FCD#3, Outlet Vineyard Road Dam

Dear Colonel Lowry:

As per our telephone conversation of this date the following is submitted for your approval:

Powerline Channel - FCD#2

Due to the restriction for equipment height near the Williams Field runways, during daylight working hours, the contractors request to place concrete by pumping methods on the low drop structures is granted.

We suggest an increase in cement content to seven bags to offset the increase in slump required for the pumping operation unless concrete strength tests show otherwise.

The smaller aggregate will be necessary for pumping operation, so, we suggest that the design mix used on the concrete channel be specified.

Vineyard Road Dam - FCD#3

The Outlet Sta. 251+00 as constructed, may require submerged flow for short periods due to the possible high water level within the stock tank immediately below the outlet. Additional rock placed to level of the top of the outlet pipe and extended downstream fifteen feet will be necessary to offset the effects of the submergence.

Yours very truly,

Robert J. Cavallo
State Administrative Officer

cc: J. J. Turner
R. A. Arrington
Geo. England

RA:jh

JUSTIFICATION STATEMENT
Contract Modification #5

By: George M. England
Government Representative

Contract FCD#2
Modification No. 5

Flood flows occurring during construction operations have shown the need for further stabilization of the earthen channel between Station 375+00 and Station 450+00. Erosion that has occurred in the bottom of the channel is in excess of that which was anticipated. Concrete low drop grade stabilizers have been determined to be the most suitable in controlling the accelerated erosion. Grouted rock riprap sections will be required at each structure to provide protection to the channel banks and to the grade stabilizers.

An estimated cost of doing the additional work is as follows:

EXCAVATION - EARTH CHANNEL

Due to the many variables concerning extent of removal and disposal of channel excavation, it is determined that the contract price of 30 cents per cubic yard is a fair and equitable price for the small amount of work involved.

EXCAVATION - STRUCTURAL

Superintendency			
Superintendent	½ time @	$ 8.00	$ 4.00
Pick-up Truck	½ time @	1.50	.75
Equipment			
Backhoe and Operator	1 hour @	16.50	16.50
Front End Loader and Operator	1 hour @	18.50	18.50
Air Compressor	1 hour @	4.50	4.50
Jack Hammer	1 hour @	.80	.80
2 Pick-up Trucks	1 hour @	1.50	3.00
Labor			
Foreman	1 hour @	7.20	7.20
4 Laborers	1 hour @	5.00	20.00
TOTAL (No profit shown except in equipment rental)			$ 75.25 per hour

Estimated time required - 10 hours for job.

Estimated cost $\frac{\$\ 752.50}{142\ \text{cu.yds.}}$ = $ 5.30 per cubic yard

CONCRETE - LOW DROP STRUCTURE

It is estimated four days time will be required to do the concrete work for each structure; two days installing forms, screeds, etc.; one day placing the concrete and one day stripping forms, finishing concrete and clean-up. Costs based on this estimate are as follows: Wage rates reflect 25 percent above scale for Social Security, insurance, etc.

Superintendency			
Superintendent	12 hours @	$ 8.00	$ 96.00
Pick-up Truck	12 hours @	1.50	18.00
Installing forms, screeds, etc.			
Foreman	16 hours @	7.20	115.20
2 Carpenters	32 hours @	6.56	209.92
2 Laborers	32 hours @	5.00	160.00
Truck, flat bed	16 hours @	4.00	64.00
2 Pick-up Trucks	32 hours @	1.50	48.00
Power Plant	16 hours @	2.50	40.00
Concrete			
50 Cubic Yards (less cement)	@	10.00	500.00
10 Cubic Yards Overage (including cement)	@	15.00	150.00
Placing concrete			
Foreman	10 hours @	7.20	72.00
Carpenter	8 hours @	6.56	52.48
4 Laborers	32 hours @	5.00	160.00
2 Finishers	20 hours @	6.56	131.20
3 Pick-up Trucks	28 hours @	1.50	42.00
Power Plant	8 hours @	2.50	20.00
Crane (cost to Contractor)	8 hours @	100.00	800.00
Stripping forms			
Foreman	8 hours @	7.20	57.60
Carpenter	8 hours @	6.56	52.48
Labor	8 hours @	5.00	40.00
2 Finishers	16 hours @	6.56	104.96
2 Pick-up Trucks	16 hours @	1.50	24.00
Truck, flat bed	8 hours @	4.00	32.00
Sub-Total			$ 2989.84

Sub-Total	$ 2989.84
10% profit, overhead, insurance, etc.	299.00
Total estimated cost	$ 3288.84

Estimated cost per cubic yard $\frac{\$ 3288.84}{50 \text{ cu.yd.}} = \$ 65.78$

CEMENT

The current price of cement is $1.35 per bag or $5.40 per bbl.

REINFORCING STEEL

Reinforcing steel is available at ten cents per pound. Estimated placement cost is ten cents per pound. Price estimate for steel in place is twenty cents per pound.

ROCK RIPRAP

Rock suitable for rock riprapping is available at a price of $3.00 per yard delivered to the job site. Placement cost is estimated at $3.00 per cubic yard. The total estimated cost is $6.00 per cubic yard.

GROUTED ROCK RIPRAP

Removal of existing in place rock from channel banks	$ 1.00	Cu. Yd.
Replacement of rock on banks and around grade stabilizer (Major placement by hand labor)	15.00	Cu. Yd.
Grouting of rock riprapping (Estimate of 40% voids in rock) Cost Grout at job site - $6.12 Placing Grout in rocks - $6.12	12.24	Cu. Yd.
	$ 28.24	
10% for profit, overhead and insurance	2.82	
Estimated cost per cubic yard	$ 31.06	

It is estimated that fifty-six days will be required to perform the additional work (one week for each of the six structures, one week move-in time and one week for clean-up). The contract is presently approximately 98% completed. Contract time should be extended from the original completion date of May 5, 1968, to June 30, 1968, to provide for the additional work.

COMPUTATION SHEET
SCS-523A REV 5-58

DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE PROJECT

BY DATE CHECKED BY DATE TOC

SUBJECT

SHEET OF

FINAL QUANTITIES

Item	STRUCTURE 2x85 I	2x60 II	1.5x60 III	1.5x60 IV	1.5x60 V	2x60 VI	TOTALS
Struct Exc.	110	180	150	106	127	129	702
Struct. Backfill	39	39	39	39	39	39	234
Concrete	64.4	48.0	48.0	46.4	46.4	48.0	301.2
Cement							451.8
Reinf. Steel	5,926	4163	4163	4094	4094	4163	26,603
Channel Exc.	—	83	558	296	653	346	1936
Grouted Riprap 50' incl rock	103	120	120	116	116	120	695
Loose Rock Riprap 80' section	0	~~78.5~~ 62.7	~~78.5~~ 62.7	78.5 62.7	78.5 62.7	78.5 62.7	~~392.6~~ 314

110

STATE Ariz PROJECT Powerline Channel

SUBJECT RA 3-68 SHEET OF

Quantities - Concrete

Structure No. 1

Slab - From Comp by Hanley 3-1-C &

A+B+C = 16.917 (incl. bothsides)
98.343
2.449
117.71 — 117.71

75 x 19.33 x .6667 = 966.65

Head wall

$2\left(\frac{9+5}{2}\right) \times 2 \times .0667 = 18.67$

$\frac{101+89}{2} \times 3 \times .8333 = 237.5$

101 x 2.667 x .1667 = 179.56
101 x .1667 x .5 = 33.66

Toe Wall

95 x .167 x .1667 = 42.22
$\frac{95+89}{2} \times 2 \times .1667 = 122.67$
$2\left(\frac{10+6}{2}\right) .2 \times .1667 = 21.33$

655.61 — 655.61

1739.97 CF

64.44 cy.

COMPUTATION SHEET
SCS 523A REV 5-58

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Ariz
PROJECT
BY RA DATE 3-68
CHECKED BY
SUBJECT
SHEET OF

Quantities

Channel Excavation -

will begin at end of apron + extend 100 ft downstream @ grade. From there will transition to existing grade.

Structure No I

no channel Exc. required.

Str. No II

End Apron sta 380+44

Sta	End Area ft^2	Sum Areas	Distances	Volume	
380+44	24				
		53	56	55	
381+00	29				
		34	44	27.7	
381+44	4.8			82.7	1,936.0

Str. No III - End Apron sta 390+70

390+70	75				
		150	30	83.3	
391+00	75				
		150	70	194	
391+70	75				
		105	130	252.8	
393+00	30				
		30	50	27.8	
393+50	0			557.9	1853.3

RA

SHEET OF

CHANNEL Etc.

Structure No. IV - End Apron sta 403+20

sta.	Area	sum	Dist	Volume
403+20	46			
		79	80	117
404+00	33			
		66	20	24.4
404+20	33			
		48	80	71.1
405+00	15			
		15	300	83.3
408+00	0			295.8

1295.4

Structure No. V - End Apron Sta. 416+20

416+20	70.5			
		153	80	226.6
417+00	82.5			
		153	20	56.6
417+20	70			
		100	80	148.1
418+00	30			
		30	400	222
422+00	0			653.3

999.8

Structure No. VI - End Apron sta, 428+90

428+90	61			
		118	10	21.8
429+00	57			
		88	90	146.6
429+90	31			
		31	310	177.9
434+00	0			346.3

COMPUTATION SHEET
SCS-CS2A REV 8-58

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Ariz PROJECT Powerline Channel
BY RA DATE 3-68 CHECKED DATE JOB NO.
SUBJECT SHEET OF

Quantities

STRUCTURAL Etc.

Str. No. 1 Assume Grd Surface 6" above apron.

cutoffs to slab level

$83(3.5)\ .833 = 241$
$83(2.0)\ .67 = 110$
$2\left(\frac{3+9}{2}\right) 3.6 \times .83 = 135$
$2\left(\frac{3+6}{2}\right) 2\ .67 = 12$

slab & walls
$1.16 \times 7.5 \times 21.5 = 1870$
20.8 $2\left(\frac{2.67+1}{2}\right) 4 \cdot 21.5 = 229$
3 $2(1.5 \times 1)\ 21.5 = 64$

Headwalls
$83 \times 1.16 \times 2.16 = 207$
$2\left(\frac{7+2.67}{2}\right) 10.5 \cdot 3.67 = 372$

Endwall
$2\left(\frac{5.5+2.67}{2}\right) 7.5 \times 3.67 = 225$

$2\left(\frac{1.67+3}{2}\right) \times 2.16 = 11$

3476

$\frac{3476}{27} = 129$ cy.

Minus Rock Section removed for grouting

$2\left(\frac{1.5+2.5}{2}\right)\frac{(7.5+10.5)(3.67+3.67)}{27} = 19.57$

$\Sigma = 110$ cy.

QUANTITIES

Str. Excavation - Structure No. 2.

Assume Grd. level 6" above apron.

cutoff to Slab level

$60(3.5)(.83)$	=	175
$2\frac{(9+3)}{2}3.25(.83)$	=	33
$2\frac{(3+6)}{2}2(.67)$	=	12
$60(-2).67$	=	80

Slabs & Walls

$2.16 \times 5.2 \times 21.5$	=	1300
$2(2.67+1)4 \cdot 21.5$	=	229
$2(1.15 \times 1)21.5$	=	64

Headwall

$60 \times 1.16 \times 2.16$	=	151
$2\frac{(7+2.67)}{2}10.5 \cdot 3.67$	=	372

Endwall

$2\frac{(5.5+2.67)}{2}(7.5 \times 3.67$	=	225
$2\left(\frac{1.67 \times 3}{2}\right) * 2.16$	=	11
		2652

98 cy.

Minus Rock Scale — 19

79 cy.

COMPUTATION SHEET
SCS-[illegible]
STATE
BY DATE
SUBJECT
DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
PROJECT
CHECKED BY DATE JOB NO.
SHEET OF

Structural Exc.

Stop No. III

Leaves as is – 150 cy.

Structure No VI – 18" drop

Assume Grd level 1' above apron –

slab = 1.67 × 54 × 21.5 = 1938.9

Previous Σ = 3951
– slab Exc. 2519
1432 1432
3371

$\frac{3371}{27}$ = 125 cy.
Rocksection – 19
106

Structure V
Assume Grd level @ crest ∴ 127 cy.

Structure VI 24" drop

Assume Grd level 6" below crest

Slab + sidewall –
2.16 × 52 × 21.5 = 2415
Previous Σ = 4578
– Slab Exc. 2985
1593 ... 1593
4008 = 148.4

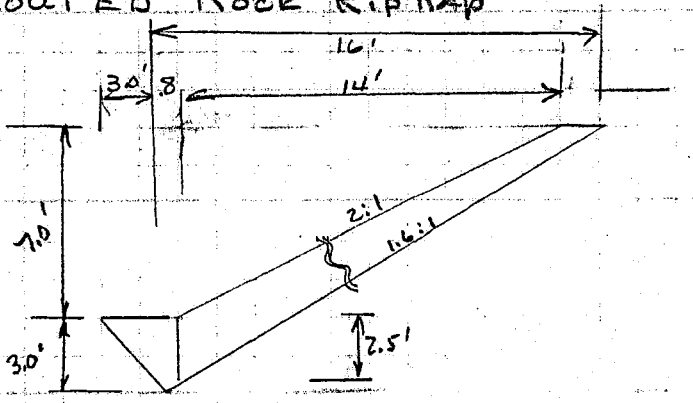
Minus Rocksection 19 cy = 129 cy.

COMPUTATION SHEET
SCS-523A REV 5-68

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Ariz
PROJECT Powerline Channel
BY RA DATE 3-68
CHECKED BY DATE JOB NO.
SUBJECT MODIFICATION
SHEET OF

GROUTED ROCK RIP RAP



Upstream Section

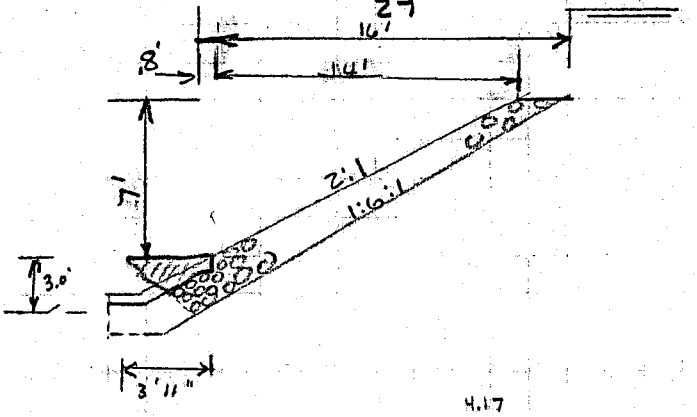
$$Vol/ft = \left[16 \times \frac{10}{2} + 3.0 \times \frac{3.0}{2}\right] = 84.5$$

80 4.5

$$- \left[14 \times \frac{7}{2} + (7 \times .8)\right] = 54.6$$

$$30.0 \text{ ft}^3$$

Section for 9.33' $Vol = \frac{30 \times 18.66}{27} = 20.7$ c.y.



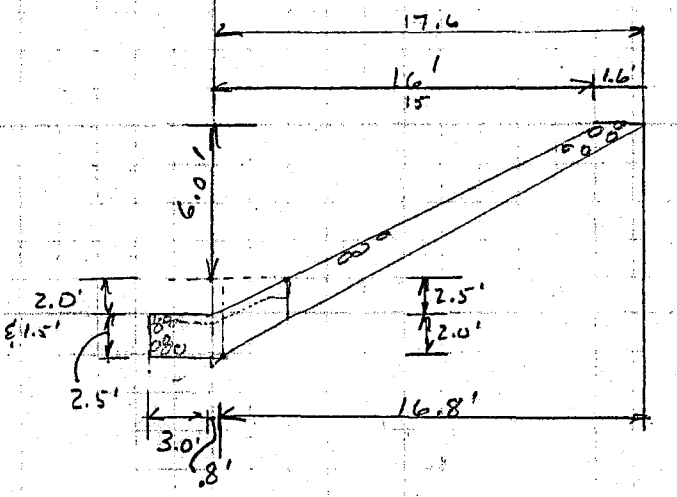
4.17

$$Vol/ft = 30.0 - (3.92 - .5)1 + \frac{2.0(.75)}{2} = 25.83$$

3.42 .75

Section for 20.67' $Vol = \frac{20.67\,(25.83)}{27}\,2 = 39.5$ c.y.

GROUTED ROCK



For 2'- drop -

$$\text{Vol}/\text{ft} = \overset{96.8}{\frac{17.6(11.0)}{2}} + \overset{7.5}{3.0(2.5)} = 104.3$$

$$- \frac{16.0(8)}{2} \qquad - \quad 64$$

$$40.3 \text{ ft}^3$$

20' Section - $\text{Vol} = \frac{40(40.3)}{27} = 59.7$ c.y.

For 18" drop -

$$\text{Vol}/\text{ft} = \overset{86.11}{\frac{16.6(10.37)}{2}} + \overset{7.5}{3.0(2.5)} = 93.6$$

$$- \frac{15(7.5)}{2} \qquad 56.2$$

$$37.4$$

Str. No. I $\qquad \text{Vol} = \frac{40(37.4)}{27} = 55.4$ c.y.

6' section $\qquad \text{Vol}/\text{ft} = 28.5 \text{ ft}^2$

$$\text{Volume} = \frac{28.5(40)}{27} = 42.2 \text{ c.y.}$$

COMPUTATION SHEET
SCS-SESA REV 6-80

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE | PROJECT

BY | DATE | CHECKED BY | DATE | JOB

SUBJECT

SHEET | OF

GROUTED ROCK

Structure	Upstream	@ Str.	Downstream	Total
I	20.7	39.5	42.2	102.4
2' drop	20.7	39.5	59.7	119.9
1.5' drop	20.7	39.5	55.4	115.6

COMPUTATION SHEET
SCS-CESA REV 5-56

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Ariz. PROJECT Powerline Floodway

BY G. Hanlen DATE 3-1-68 CHECKED BY DATE JOB NO.

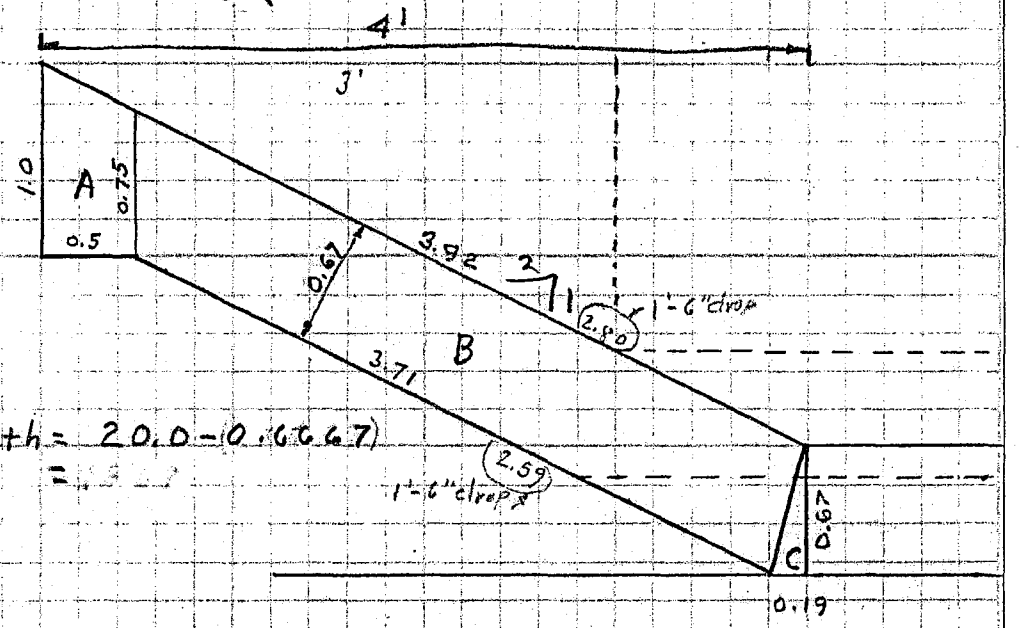
SUBJECT

SHEET 1A OF 2

Final Quantities

Concrete For 2' drop.

2:1 sections



Length = 20.0 - 0.6667

= ...

$A = 2(19.3333)\left(\frac{1.0+0.75}{2}\right)(0.5) = 16.917$

$B = 2(19.3333)\left(\frac{3.92+3.71}{2}\right)(0.67) = 98.343$

$C = 2(19.3333)\left(\frac{0.19}{2}\right)(0.67) = 2.449$

Center Slab. 60 - 8' = 52'

52 x 19.3333 x 0.6667 --- = 670.225

Total concrete for 1, 2' str = 1,296.20 ft³

x 1/27 = 48.02 yd³

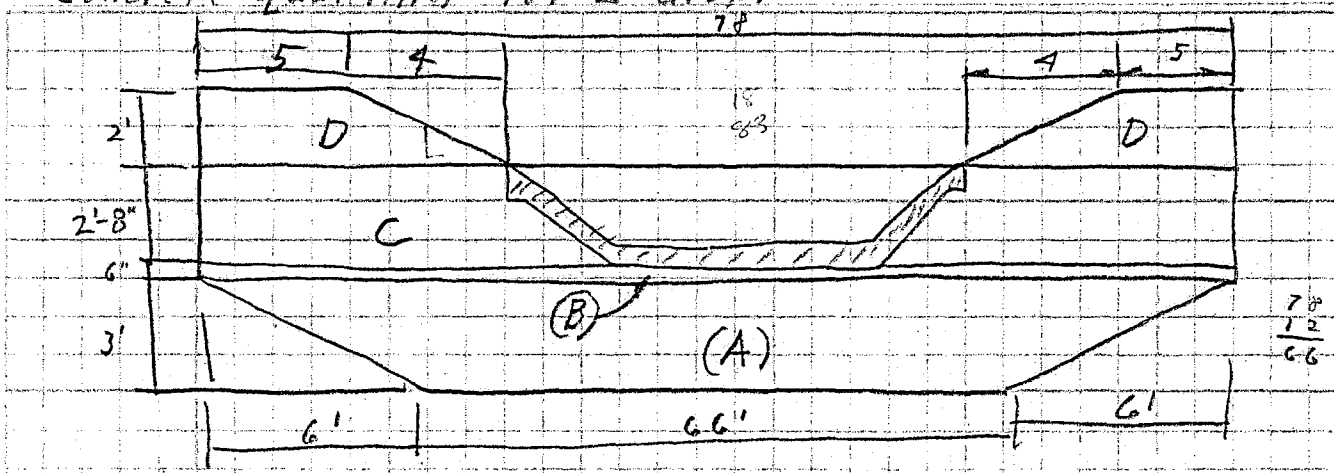
COMPUTATION SHEET
SCS-652A REV 5-60

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Floodway

BY G. Hanley DATE 3-8-68 CHECKED BY DATE JOB NO.

SUBJECT Concrete quantities for 2' drop. SHEET 1 OF 2

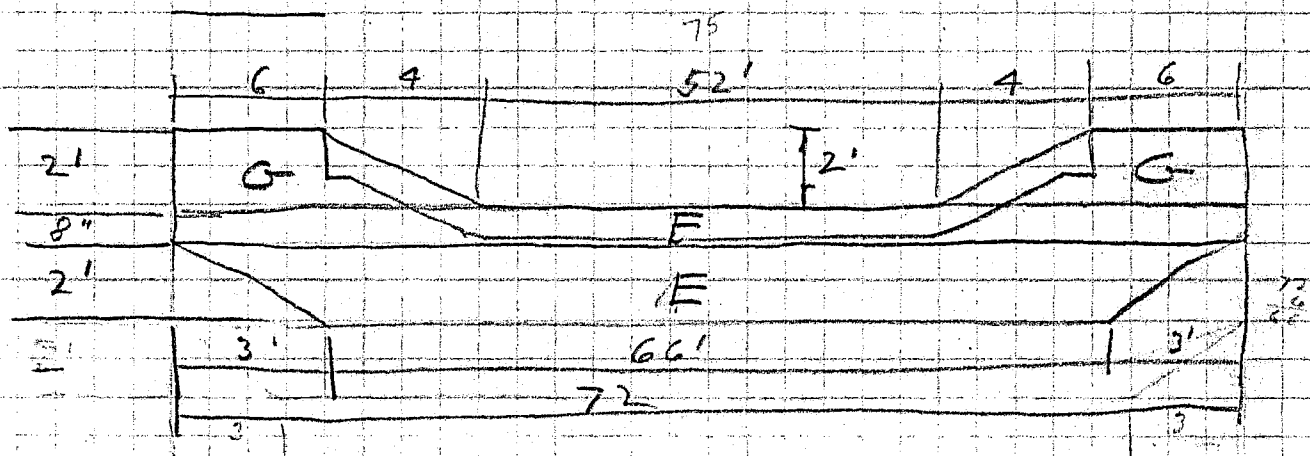


Headwall $A = \frac{78+66}{2} \times 3 \times 0.8333 = 180.000$

32.5000 B $78 \times 0.6667 \times 0.5 = 26.000$

C $78 \times 2.6667 \times 0.6667 = 138.668$

17.333 D $\frac{2 \times 9 + 5}{2} \times 2 \times 0.6667 = 18.667$



Toe Wall: $E = \frac{72+66}{2} \times 2' \times 0.667 = 92.000$

$F = 72 \times 0.6667 \times 0.6667 = 32.000$

$G = 2 \times \frac{10+6}{2} \times 2 \times 0.6667 = 21.333$

COMPUTATION SHEET
SCS-SESA REV 6-58.

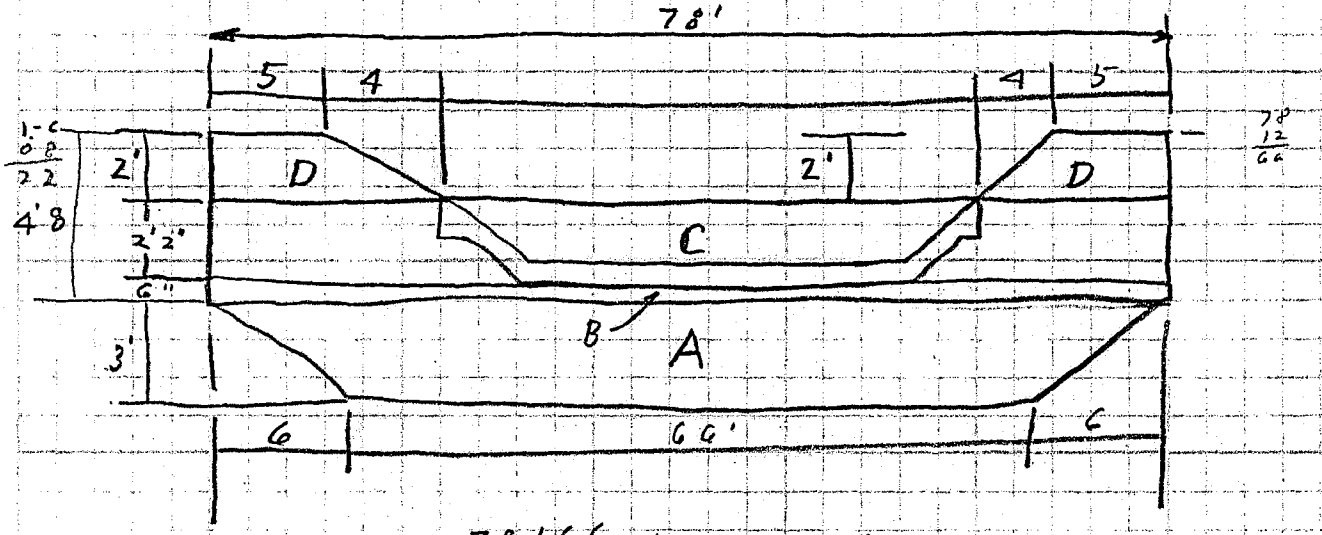
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Ariz | PROJECT Powerline Floodway

BY G. Hanley | DATE 3-8-68 | CHECKED BY | DATE | JOB NO.

SUBJECT Concrete quantities for 1'-6" drop | SHEET 1 OF 2

Headwall



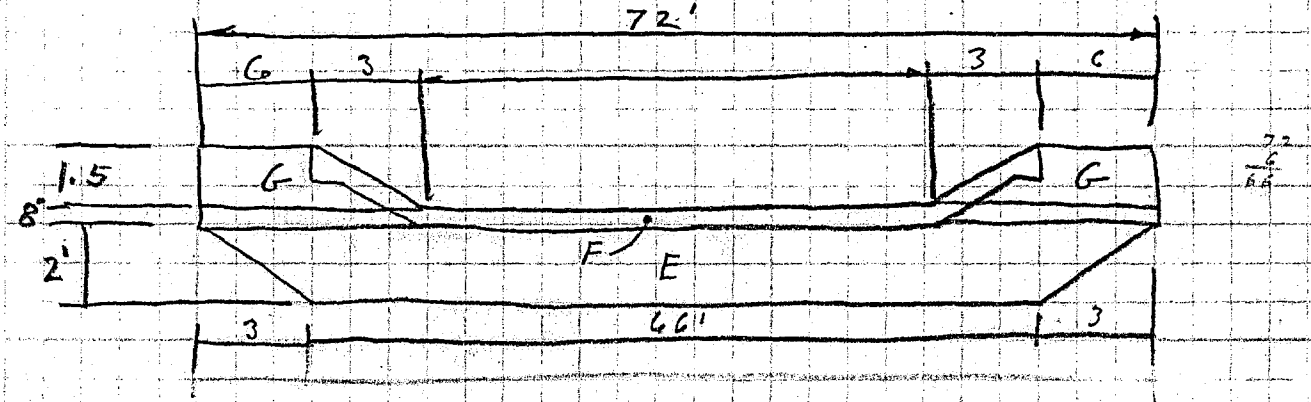
$A = \frac{78+66}{2} \times 3 \times 0.83333 - - - - = 180.000$

$B = 78 \times 0.66667 \times 0.5 - - - = 26.000$

$C = 78 \times 2.16667 \times 0.66667 = = 112.667$

$D = 2 \times \frac{9+5}{2} \times 2 \times 0.66667 - - - = 18.667$

Toe Wall



$E = \frac{72+66}{2} \times 2 \times 0.66667 - - - = 92.000$

$F = 72 \times 0.66667 \times 0.5 - - - = 24.000$

$G = 2 \times \frac{9+6}{2} \times 1.5 \times 0.66667 = 15.000$

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Ariz. PROJECT Powerline Floodway

BY G. Hanley DATE 3-8-68 CHECKED BY DATE JOB NO

SUBJECT Concrete quantities for 1'-6" drop SHEET 2 OF 2

2:1 end sections of slab., (see drawing for 2' drop sheet 2 of 2.)

A = same as for 2' drop --- = 16.917

B = 2 (19.33333) $\left(\frac{2.80+2.59}{2}\right)$ (0.66667 = 69.661

C = same as for 2' drop ---- = 2.449

Center slab. 60 - 6' = 54'

= 54 X 19.33333 X 0.66667 - = 696.003

Total concrete for 1. str = 1,253.364

X 1/27 = 46.42 Yd³

11. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details therefor are:

A. Bid Item 15A, Grouted Rock Riprap

1. This item consists of the removal of existing in-place rock riprap from the channel banks, subsequent replacement of the rock riprap and the furnishing and placing of concrete grout within the rock riprap section at the site of the low drop structures and adjacent to the structures as shown on the drawings.

2. The gradation and tolerances of the rock riprap shall conform to the gradation and tolerances included under bid item 15, Loose Rock Riprap.

3. All work shall conform to this specification except Sec.7 which is changed to read "The Engineer shall be responsible for proportioning the mix." Subsequent paragraphs under Sec.7 are to be deleted.

4. Measurement and payment will be made in accordance with Method 1. The Contract Unit Price will include removal, replacement and preparation of the rock riprap, and the furnishing and placing of the concrete grout.

Arizona — Powerline Channel

C. Ware 3-28/6.3 — FCD #2 MOD #3

Check of Grade Elevation, Ramp and Drop Structures — sheet 1 of 1

Item	Station From	Station to	Slope	Dist	Elevation
Ramp Xing	379+92		–		50.7
Drop Str #2		380+24	–	32.0	50.7
Drop Str #3		390+50	.00383	1058	46.6
Grade Change		400+00	.00383	200.8	43.0
Drop Str #4	400+00	403+00	.00296	300	42.1
Drop Str #5		416+00	.00296	1600	38.3
Ramp Xing		428+28	.00296	2828	34.6 (21") 34.2
Drop Str #5		428+70	.00296	2870	34.5

EWP-8
2-57
PORTLAND, ORL

WATER SURFACE PROFIL CALCULATION SHEET

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSER SERVICE

Project: Powerline Channel Location Apache Junction Arizona

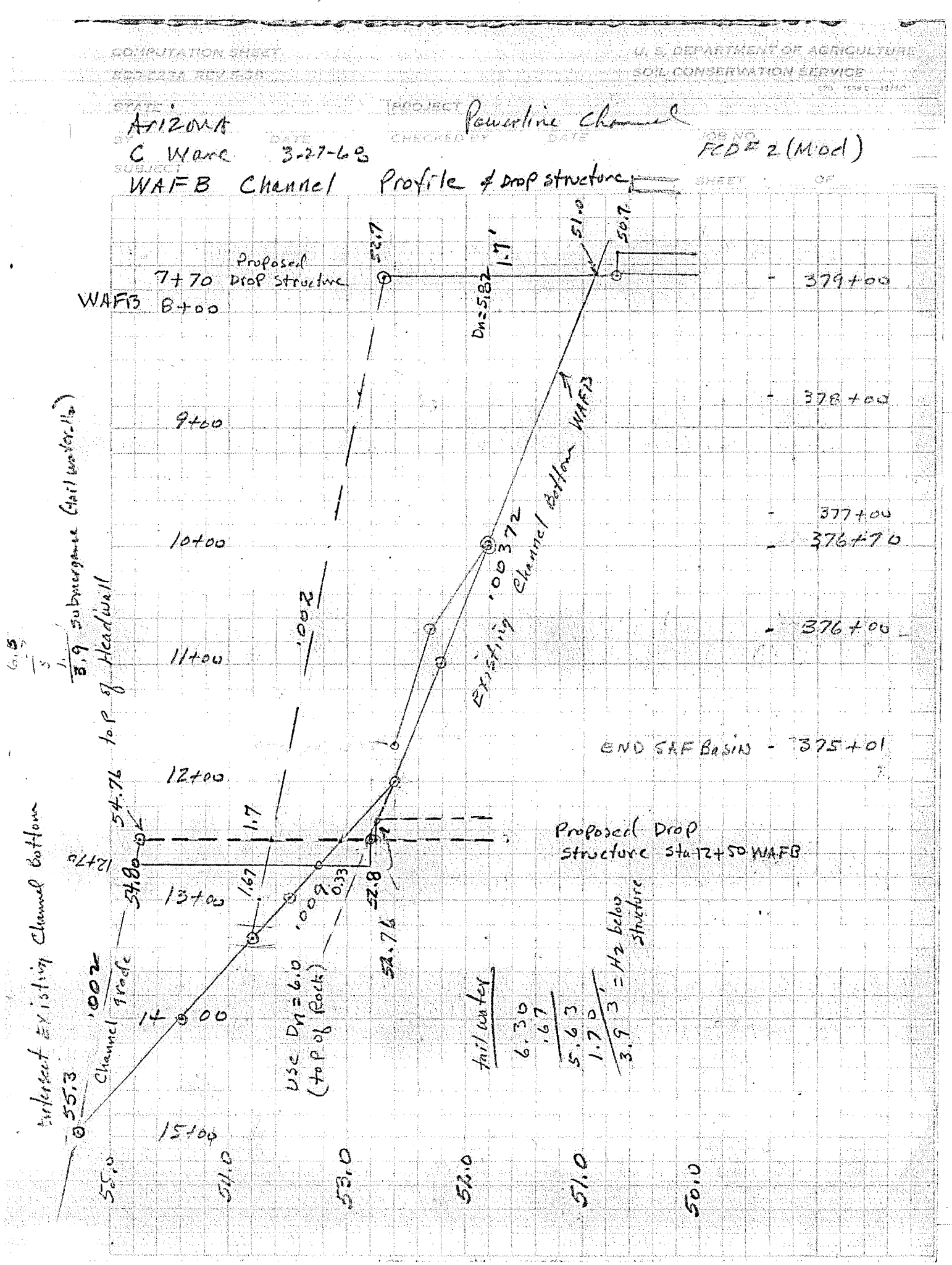
Date: 3-27-68 By: C Ware Sheet 3 of 3 Appropriation:

Q = 1930 b = 75 z = 2:1 n = .032 n^2 =

Station	Depth, D	Bottom Width, b	Area, A	Velocity, $V=\frac{Q}{A}$	Velocity Head $h_v=V^2/2g$	D/b	ctable 97 King)	Hydraulic Radius R = cD	$\frac{1}{2.2083R^{4/3}}$ (table 107, King)	V^2	n^2v^2	Friction Slope $\frac{n^2v^2}{2.2083R^{4/3}}$	Invert Slope S_i ft./ft.	Energy Head $H_e = D+h_v$	$H_e''-H_e'$	S_f-S_i	$I=\frac{H_e''-H_e'}{S_f-S_i}$	Remarks
							.906											
12+70	3.9	75	322.9	6.0	.559	.052	~~3.53~~	3.53						4.46				Rip Rap in 6.0 from channel bottom.
				5.7			.897	3.64	.0809		.0336	.00269	.002		0.20	.00069	289.8	
15+60	4.2	75	355.3	5.4	.455	.056	~~3.75~~	3.75						4.66				
	SCS Contract Ends at Station 15+60 therefore No													No				
	Profile is Considered above this station.																	
			Dn for b = 7.5'															
				Q = 1930 cfs						$\frac{nQ}{b^{8/3}s^{1/2}}$		$= \frac{.032(1930)}{(75)^{8/3}.0447}$		$=$	61.76	61.76		
				n = .032											$\frac{61.76}{b^{8/3}(.0447)}$	$\frac{61.76}{100,251.65\times(.0447)}$		
				s = .002											$=$	.00061	= .0138	
																.0447		
				for slope			.0055		$s^{1/2}$ = .0745							$\frac{d}{b}$ = .0592		
				$\frac{b}{d}$ = .0437					= .00061 / .0745			= .00805						
				d = 75 × .0437			= 3.28									$\frac{d}{n}$ = 75 X .0592 = 4.44		

USDA-SCS-PORTLAND, ORE. 1967 M-1231

COMPUTATION SHEET — U. S. DEPARTMENT OF AGRICULTURE
FEDERAL REVISED — SOIL CONSERVATION SERVICE
STATE Arizona — PROJECT Powerline Channel — JOB NO FCD 2 (Mod)
BY C Ware — DATE 3-27-69 — CHECKED BY — DATE
SUBJECT WAFB Channel Profile & drop structure — SHEET — OF



EWP-8
2-57
PORTLAND, OR

WATER SURFACE PROFI) CALCULATION SHEET

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSE SERVICE

Project: Powell Location

Date: By: Sheet 1 of 3 Appropriation:

Q = 3140 b = 60 z = 2:1 n = .032 n^2 =

Station	Depth, D	Bottom Width, b	Area, A	Velocity, V = Q/A	Velocity Head $h_v = V^2/2g$	D/b	d(table 97 King)	Hydraulic Radius R = cD	$\frac{1}{2.2083R^{4/3}}$ (table 107, King)	V^2	$(NV)^2$ n^2v^2	Friction Slope $\frac{n^2v^2}{2.2083R^{4/3}} = S_f$	Invert Slope S_i ft./ft.	Energy Head $H_e = D + h_v$	$H_e'' - H_e'$	$S_f - S_i$	$l = \frac{H_e'' - H_e'}{S_f - S_i}$	Remarks
434+00	6.30	60	457.4	6.86		.105		5.18						7.02				
				6.80				5.22	.0509		.0473	.00224	.00220		0.10	.00004	2500	
431+50	6.40	60	465.9	6.74	.718	.107		5.25						7.12				
				6.77				5.24	.0498		.0469	.00223	.002		0.14	.0003	466.7	
429+33	6.45	60	470.2	6.68	.712	.108		5.29						7.16				
				6.74				5.26	.0495		.0465	.00228	.002		0.18	.0003	600.0	
428+00	6.50	60	474.5	6.62	.705	.108		5.33						7.20				
428+70		Drop structure					2.0'	Drop										
428+70	6.30	60	457.4	6.86		.105		5.18						7.02				
				6.80				5.22	.0500		.0473	.00224	.00157		0.10	.00008	125.0	
427+45	6.40	60	465.9	6.74	.718	.107		5.25						7.12				
				6.74				5.26	.0495		.0465	.0023	.00157		0.18	.00007	257.1	
426+13	6.50	60	474.5	6.62	.705	.108		5.33						7.20				
				6.56				5.36	.0483		.0441	.00212	.00157		0.45	.00006	748.3	
420+22	6.80	60	500.5	6.27	.669	.113		5.54						7.47				
				6.46				5.42	.0476		.0427	.00200	.00157		0.63	.00005	1260.0	
416+10	7.0	60	518.0	6.06	.648	.117		5.67						7.65				
416+00			1.5'	Drop	structure													
416+00	6.30	60	457.4	6.86		.105		5.18						7.02				
				6.68				5.29	.005		.0473	.0024	.0020		.10	.0004	250	
4+75	6.6	60	483.1	6.50	.693	.110		5.40	.0491		.0457	.0022	.0020	7.29	.27	.00024	1125	

PORTLAND, ORE. 1957 M-1231

EWP-8
2-57
PORTLAND, ORE

WATER SURFACE PROFILE CALCULATION SHEET

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Project: _____ Location _____

Date: _____ By: _____ Sheet 2 of 3 Appropriation: _____

Q = 3140 b = 60 z = 2:1 n = .032 n^2 = _____

Station	Depth, D	Bottom Width, b	Area, A	Velocity, $V=\frac{Q}{A}$	Velocity Head $h_v = V^2/2g$	$\frac{D}{b}$	c(table 97 King)	Hydraulic Radius $R = cD$	$\frac{1}{2.2083R^{4/3}}$ (table 107, King)	V^2	n^2v^2	Friction Slope $S_f^2 = \frac{n^2v^2}{2.2083R^{4/3}}$	Invert Slope S_i ft./ft.	Energy Head $H_e = D + h_v$	$H_e'' - H_e'$	$S_f - S_i$	$l = \frac{H_e'' - H_e'}{S_f - S_i}$	Remarks
				6.86				5.18						7.02				
				6.65				5.30	.0490		.0453	.00227	.0020		.32	.00022	1454.5	
401+45	6.65	60	487.4	6.44	.687	.111		5.43						7.34				
403+00	Drop	structure				2'	Drop											
403+00	6.30	60	457.4	6.86				.578						7.02				
				6.71				5.27	.0494		.0461	.00228	.0020		.23	.00028	821.4	
394+79	6.55	60	478.8	6.56	.699	.109		5.36						7.25				
				6.68				5.29	.0491		.0457	.0022	.0020		.27	.00024	1125.0	
391+75	6.60	60	483.1	6.50	.693	.110		5.40						7.29				
393+00	Drop	structure				2'	Drop											
393+00	6.30	60	457.4	6.86				5.18						7.02				
				6.68				5.29	.0491		.0457	.0022	.0020		.27	.00024	1125.0	
381+75	6.6	60	483.1	6.50	.693	.110		5.40						7.29				
				6.65				5.30	.0490		.0453	.00227	.0020		.32	.00022	1454.5	
378+46	6.65	60	487.4	6.44	.687	.111		5.43						7.34				
380+24			Drop	structure				2' Drop										
380+24	6.30	60	457.4	6.86				5.18						7.02				
				6.83				5.20	.0503		.0478	.00240	.002		.105	.0004	125.0	
378+99	6.35	60	461.6	6.80	.724	.106		5.22						7.07				
				6.80				5.22	.0500		.0473	.0024	.002		.10	.0004	250.0	Drop #1 2' Drop
377+74	6.40	60	465.9	6.74	.718	.107		5.25						7.12				378+44,

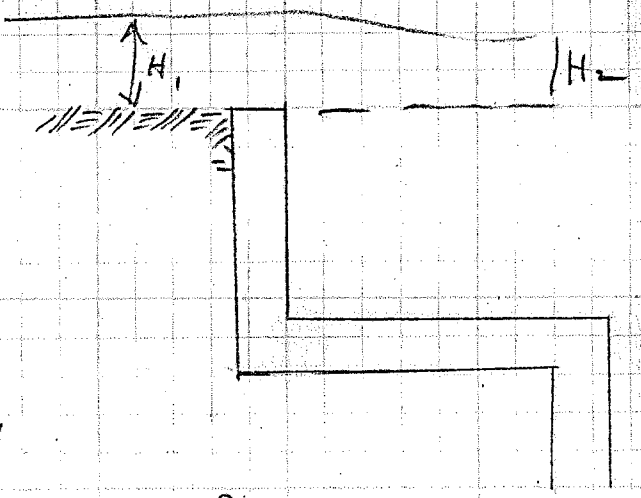
COMPUTATION SHEET
FORM SCS-213A REV. 5-57
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona. PROJECT Powerline Channel

BY C Ware DATE 3-27-68 CHECKED BY DATE JOB NO.

SUBJECT Drop structure, Flow Determinations SHEET 3 OF 4

2' Drop station 12+30 WAFB



Design Data

Q = 1930 cfs

2.0' Drop
H_2 = 3.9'

C = 3.1 discharge coefficient

From Engr Handbook, section 11, Curve Page 3.17
and Table Page 3.19
f = 1.5

1	2	3	4	5	6	7	8	9
h	$H_1 - h - f$	$H_1 = ^{3/2}$	$q_f = 3.1 H_1^{3/2}$	$\frac{H_2}{H_1}$	R (From Chart)	$q_s = R q_f$	1930 cfs $L = \frac{Q}{q_s}$	L
5.5	4.0	8.00	24.8	0.98	0.12	2.97	105.7	106
6.0	4.5	9.55	29.6	0.87	0.71	21.01	91.8	92
6.5	5.0	11.18	34.7	0.78	0.85	29.49	65.4	65
7.0	5.5	12.90	40.0	0.71	0.90	36.00	53.6	54
	4.8		34.8	Interpolated for 75' and 2.75				

$Q = 34.8 \times 75 = 2610$

$A = 4.8 \times 60 + 9.6 \times 4.8 = 334.1$

$V = \frac{2610}{334.1} = 7.78$

$D_n = 4.8 - \frac{(7.78)^2}{64.4} = 4.8 - .94 = 3.86$

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO : 1958 O—470868

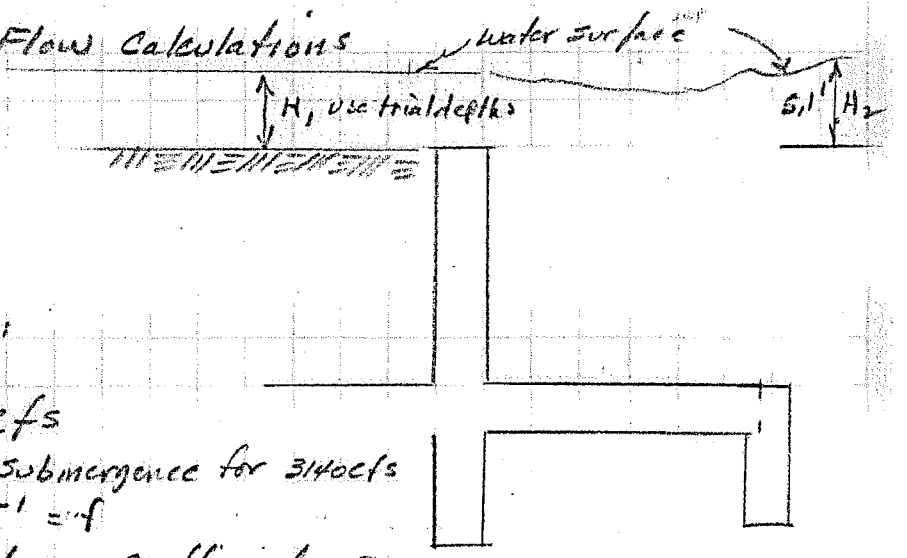
STATE		PROJECT		
Arizona		Powerline Channel		
BY	DATE	CHECKED BY	DATE	JOB NO.
C Ware	3/26/67			FCD #2 Modified

SUBJECT
Drop structures Flow Determination

SHEET 1 OF 4

1.5' Drop

Submerged Flow Calculations



Design Data:

Q = 3140 cfs
1.5 Drop H_2 = 5.1' submergence for 3140 cfs
freeboard = 1.5' = f
C = 3.1 discharge coefficient Engr

From Engr Hand book, Section 11, Curve Page 3.17 and table Page 3.19

1	2	3	4	5	6	7	8	9
h	$H_1 = h - f$	$H_1^{3/2}$	$q_f = 3.1 H_1^{3/2}$	H_2/H_1	R (from chart)	$q_s = R q_f$	$L = \frac{Q}{3140/q_s}$	L
7.0	5.5	12.90	40.0	0.92	0.45	18.0	174.4	174
7.5	6.0	14.70	45.6	0.85	0.75	34.2	91.8	92
8.0	6.5	16.57	51.4	0.78	0.85	43.7	71.85	72
8.5	7.0	18.52	57.4	0.73	0.89	51.1	61.45	61
9.0	7.5	20.54	63.7	0.68	0.91	58.0	54.14	54

60' given width Required H_1 = 7.06' Less velocity head $q = 57.5$

$Q = 57.4 \times 60 = 3440.0$

$A = 7.00 \times 60 + 14.12 \times 7.06 = 518.0$

$V = \frac{3450}{523.3} = 6.65$

$H = H_1 - \frac{V^2}{2g} = 7.06 - \frac{44.22}{64.4} = 7.06 - 0.687 = 6.31'$

Area for D = 6.31 = $6.31 \times 60 + 12.62 \times 6.31 = 458.2$ sq ft

C. Ware

Drop structures, Flow Determination

2.0' Drop

Design Data

Q = 3140 cfs
2.0' Drop $H_2 = 6.6 - 2.0 = 4.6$
Freeboard = 1.5
C = 3.1 discharge coefficient

From Engr Handbook, section 11, Curve Page 3.17 and Table Page 3.19

1	2	3	4	5	6	7	8	9	
h	H_1	$H_1^{3/2}$	g_s	H_2/H_1	R	g_s	L	L	Remarks
7.0	5.5	12.90	40.0	.84	.78	31.2	100.6	101	
7.5	6.0	14.70	45.6	.77	.86	39.2	80.1	80	
8.0	6.5	16.57	51.4	.71	.90	46.3	67.8	68	
8.5	7.0	18.52	57.4	.66	.92	52.8	59.5	60	use this
9.0	7.5	20.54	63.7	.61	.94	59.9	52.4	52	

$Q = 57.4 \times 60 = 3444$ cfs

$A = 7.0 \times 60 + 14 \times 7.0 = 518.0$

$V = \frac{3444}{518} = 6.65$

$H = H_1 - \frac{V^2}{2g} = H_1 - \frac{44.22}{64.4} = 7.0 - .687 = 6.31$

Area for $D = 6.31 = 6.31 \times 60 + 12.62 \times 6.31 = 458.2$ sq ft

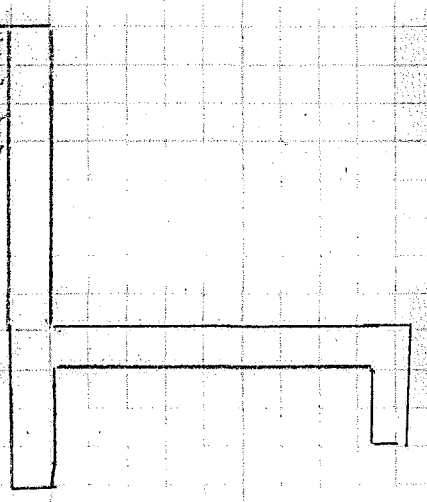
COMPUTATION SHEET
SCS-ENGR. REV. 5-58
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Cware

BY DATE CHECKED BY DATE JOB NO.

SUBJECT Drop Structures, Flow Determination SHEET 4 OF 4

2.0' Drop
Station 377+00



Submerged Flow Calculation

Design Data:

Q = 3140 cfs

2.0' Drop

$H_2 = 6.35 - 2.0 = 4.35$

C = 3.1 Coefficient of Discharge

From Engr Hand book Section 11, Curve Page 3.17

1	2	3	4	5	6	7	8	9
H	$H_1 = H - f$	$H_1^{3/2}$	$Q_f = 3.1 H_1^{3/2}$	$\frac{H_2}{H_1}$	R from Chart	$Q_s = R Q_f$	$L = \frac{3140 - Q_d}{Q_s}$	L
6.5	5.0	11.18	34.66	.87	0.77	24.6	127.6	128
7.0	5.5	12.90	40.0	.79	0.85	31.6	99.4	99
7.5	6.0	14.70	45.6	.72	0.89	40.6	77.3	77
8.0	6.5	16.57	51.4	.67	0.92	47.3	66.4	66
8.5	7.0	18.52	57.7	.62	0.94	54.2	57.9	58
9.0	7.5	20.54	63.7	.58	0.95	60.5	51.9	52
9.5	8.0	22.28	90.8	.54	0.96	87.2	36.0	36

Crest of structure is 1.7 feet above present grade line

∴ bottom width on 2:1 slope = $60 + (1.7 \times 2)2 = 66.8'$

b = 66.8 from table, for b = 66.4' d = 6.5

$Q = 66.4 \times 51.4 = 3412.96$

$A = 6.5 \times 66.4 + 13.0 \times 6.5 = 431.6 + 84.5 = 516.1$

$V = \frac{3413}{516} = 6.61$, $H = 6.5 - \frac{(6.61)^2}{64.4} = 6.5 - .68 = 5.82$

Area for D = 5.82 = $5.82 \times 66.4 + 11.64 \times 5.82$

= $386.4 + 67.7 = 454.1 \approx 0'$

Arrington

E. J. Core

March 1, 1968

H. M. Flaxman

Trip Report - Powerline Channel; Magma Channel, Arizona - February 14, 1968

Powerline Channel

Reference is made to the report of Ralph Arrington dated February 14, 1968 on the trip made by Bill Mildner, Kenneth Kaneshiro, Ralph and me. Ralph's report well covers the results of our observations.

One aspect of specific interest at Powerline channel is whether or not the criteria for predicting the stability of cohesive soils was exceeded. The greatest scour occurred immediately downstream from the transition section at the junction of the lined channel from the dam and the earth channel entering from the east side of the air base. Scour of 2 feet or more in this limited reach was not a test of the criteria for several reasons. These are -

1. The added energy of flow over the transition slope of more than .008 ft/ft. had not been dissipated.

2. Scour was in the vicinity of a pit dug below constructed grade and then backfilled with rubble, and

3. Added turbulence was created by gtavels eroded from the upper end of the transition.

Apparent scour of in-place soil up to about 1 foot at other locations may be partially attributed to disturbances of other backfilled pits whose exposed rubble added local roughness to the south side of the bed, accelerating velocity over the smoother in-place materials. Some other indications of scour as exhibited by exposed grade stakes were emphasized as such by the fact that the bed was top dressed with disturbed soil in some places. George England, who met us at the site, pointed out locations where pits were excavated and scour associated with soil replacement occurred.

As pointed out by Ralph in his item 5, erosion of the "siltstone" was slightly excessive for the conditions that existed. Shear tests as related to tractive power (Fig. 6.1-1 in TR-25) indicates that the Powerline channel would be stable even using lower n values as experienced during the December flood. However, the samples were less than 80% saturated at the time of the test, apparently being allowed to drain first in order to insure their successful extrusion from the tubes.

In view of the amount of channel bed disturbances at the time of construction and the probably greater strength of the unsaturated samples, it is not believed that the experience at Powerline channel is a valid test of the criteria for cohesive soils. It does indicate that the soils were able to take considerable stress without massive failure.

The lower portion of Powerline channel is covered with a layer of sand believed to have been transported chiefly from the channel above the recently improved reach. In addition to a decline in grade, there is a backwater influence from the low gradient RWCD Floodway. In a less frequent flood than that experienced in December, the amount of bedload brought in will be greater as will be the backwater influences. Bad stabilization where deposition has occurred over little or no scour in this reach will be of doubtful value and could induce an undesirable amount of aggradation.

Magma Channel

This channel was seen at several locations. Below the second drop structure the channel has become incised several feet in resistant material, apparently during the reservoir release of about 8 days in December. The channel boundary material is resistant to erosion, and the process of enlargement will be slow unless weaker material is exposed.

At Felix Road crossing, which has a concrete drop under the bridge, a new small channel has developed in the brush on the east side.

Upstream from Hunt Highway the headcut mentioned as item 1 in Ralph's report has moved upstream about 1,000 feet during the December discharge. This compares with a total of roughly half that amount for the preceding several years. The apparent place of natural stabilization is nearly a miles and a half upstream where exposed rock dips toward the east under the valley fill. The accelerated rate of headcut recession is related to the extended flow from Magma Dam. The Magma watershed work plan contained headcut control structures as a part of the structural program for lower Magma channel. These were deleted in design of lower Magma channel with the exception of a drop structure near Hunt Highway and another downstream. These would have no effect on the headcut recession upstream.

The present lower channel shows some evidence of recent aggradation. Confirmation of this and of the amount would need to be determined from repeat surveys of a few of the original cross sections.

I agree that an evaluation of the effect of accelerated erosion in lower Magma Wash should be made. This should include consideration of on-site damage to land and to the lower Magma channel to be constructed.

Reviewed and approved.
By RJC Date 3/1/68

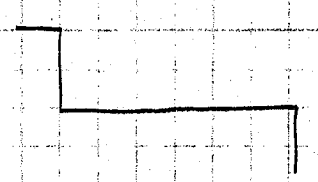
cc - M. D. Burdick, Phoenix
J. J. Turner, Phoenix
Ralph Arrington, Phoenix
Wm. Mildner, Phoenix

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona
PROJECT Powerline
BY G. Hanley DATE 3-12-68
CHECKED BY DATE
JOB NO.
SUBJECT New trib Grade
SHEET ___ OF ___

Drop No	Hdwall Sta.	Toe Wall Sta.	Crest El.	Slab El.	Dist.	Drop	Slope
I	379+00	379+20	1352.7	1350.7		2	
					124	0	0
II	380+24	380+44	1350.7	1348.7		2	
					1256	2.5	.002
III	393+00	393+20	1346.2	1344.7		1.5	
					980	2.0	.002
IV	403+00	403+20	1342.7	1341.2		1.5	
					1680	3.9	.002
V	420+00	420+20	1337.8	1336.3		1.5	
					828	1.6	.00193
Ramp	428+28		1334.7				
VI	428+70	428+90	1334.7	1332.7			



Arizona Powerline Channel
C Ware 3/21/67
Preliminary Cost Estimate

original Plan —
Proposed Alternate —

Item	Quantity		Unit Cost		Cost
Structural EX	1294.0	1370.0	~~3.00~~ 4.00	~~3.0~~ 4.00	5176.0 5480.0
Concrete	284.9	310.7	65.00	65.00	18,518.50 20,195.50
Reinf. Steel	15910.0	17343.0	0.16	0.16	2545.60 2774.88
Channel EX	3289.3	3775.4	0.~~30~~ 4	0.~~30~~ 4	1315.72 1510.16
Grouted Rock Rip Rap	660.0	662.2	~~45.00~~ 30.00	~~45.00~~ 30.00	19,800.00 19,866.00
Rock Rip Rap	1037.0	470.2	~~12~~ 10.00	6.00	10,370.00 2,821.20
Str. Back fill	234.0	—	4.00	—	936.00 —
Dike Fill	3257.2	—	~~0.70~~ 1.30	—	4234.36 —
		total			$62,896.18 52,647.7

Arizona Powerline Channel

C Ware 3/21/68

Quantities of Concrete and Steel 80' bottom Drop #1
Width Structure at 378+20 with
2' Drop, Alternate

From original structure with 2' drop
each foot of $L = \frac{48.02}{52}$ cu yds = 0.92 cu yds, L = Bottom width

Additional Length for Drop #1 = 80 - 52 = 28'

Additional Concrete for additional width = 28 x .92 = 25.8 cu yds

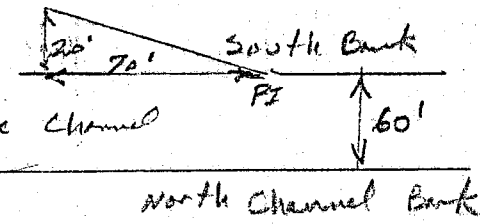
Total Concrete structure #1 Revised = 48.02 + 25.8 = 73.8 cu yds
total Steel Str #1 = $\frac{2661}{52} \times 28 + 2661 = 1433 + 2661 = 4094$ #

Total Concrete for Revised Plan

Structure No	Concrete 1 str. cu yd	Total Conc cu yd	steel 1 str lbs	Total steel lbs
Drop #1	73.8	73.8	4094	4094
Drops II, III & IV	48.02	144.1	2661	7983
Drop IV & V	46.42	92.8	2633	5266
Total all structures		310.7 cu yds		17,343 #

Arizona
C Wasc 3-20-68
Location of Drop #1, Revised

for 88' channel Bottom width based on 6'/sec velocity on .002 grade. to Con



1st trial : D = 4.3
Q = 3140

$\frac{20}{70} = \frac{88-60}{x}$

$20x = 28 \times 70$

$x = \frac{28 \times 70}{20} = 98.0'$ D at this station = 4.5

2d trial. D = 4.5 Q = 3140

$Q = C L H^{3/2}$

$3140 = 3.32 \times L \times \left(4.5 + \frac{(6)^2}{64.4}\right)^{3/2}$

$3140 = 3.32 \times L \times (5.03)^{3/2}$

$L = \frac{3140}{3.32 \times (5.03)^{3/2}} = \frac{3140}{5.32 \times 11.28} = 83.84'$

37.95

2d trial Location

$\frac{20}{70} = \frac{83.8 - 60 \times 70}{x}$

$20x = 23.8 \times 70$

$x = \frac{1666}{20} = 83.3'$

Use 84' width up stream 80' from original Plan Location; Revised station on Powerline channel = 378+20

Arizona — Powerline Channel

C Ware 5/20/68

Determination of Channel requirement for Q

For Maximum Flow over weir, designated crest width

$Q = CLH^{3/2}$ $C = 3.32$ table 51 Page 164, King's

$D = 6'$ $(6)^{3/2} = 14.7$

$Q = 3.32 \times 60 \times 14.7 = 2928$ cfs Weir capacity

Design $Q = 3140$

Width for Design $Q = \frac{3140}{3.32 \times 14.7} = 64.34'$

Drop #1

For 6' total depth, depth from crest $= 6.0 - 1.7 = 4.3'$

Approach velocity correction $= \left(H + \frac{v^2}{2g}\right)$

$V = 6.0$ f/sec

$= \left(4.3 + \frac{[6]^2}{64.4}\right) = 4.86$

$Q = CLH^{3/2}$ $(4.86)^{3/2} = 10.71$

$3140 = 3.32 \times L \times 10.71$

$L = \frac{3140}{3.32 \times 10.71} = \frac{3140}{35.56} = 88.3'$ use 88'

to obtain the sectional area required move structure upstream to station where a 88.0' bottom exists. the additional width required equals $88.0 - 52 = 36.0'$

For Drops II, III IV V VI

velocity = 6.0 fps on 0.2 slope

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

using 60' bottom width

$Q = 3.32 \times 60 \times \left(6 + \frac{36}{64.4}\right)^{3/2} = 3.32 \times 60 \times 16.8 = 3346.6$ cfs

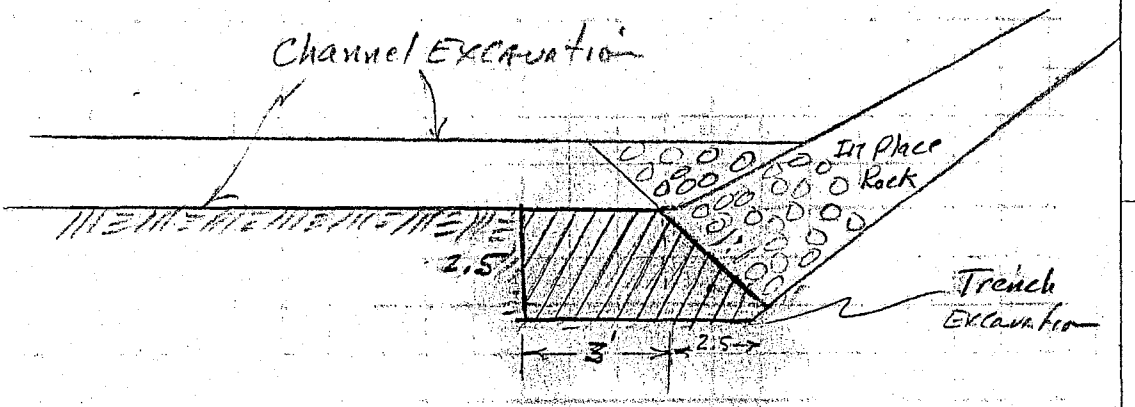
Which exceeds Design $Q = \underline{3140}$ cfs.

Arizona
C Ware 3-19-68

Additional Rock toe extend 100' below each structure
Both Sides.

END AREAS (Excavation & Rock Back Fill)

Same Quantities for original and Alternate Plan



7.5 3.08

END Area = $2.5 \times 3 + \frac{2.5 \times 2.5}{2} = 10.58 \times 2 \text{ sides} = 21.16$

Distance 5 structures x 100' each structure = 500'
+ 5 structure x 64' = 64'
Total D = 564'

Volume = $\frac{21.16 \times 564}{27} = 442.00$ cu yds

Trench Excavation = 442.00 both sides
Rock Back fill = 442.00 both sides

Proposed Alternate

6 structures @ 100' = 600

Volume = $\frac{21.16 \times 600}{27} = 470.22$ cu yds (both sides)

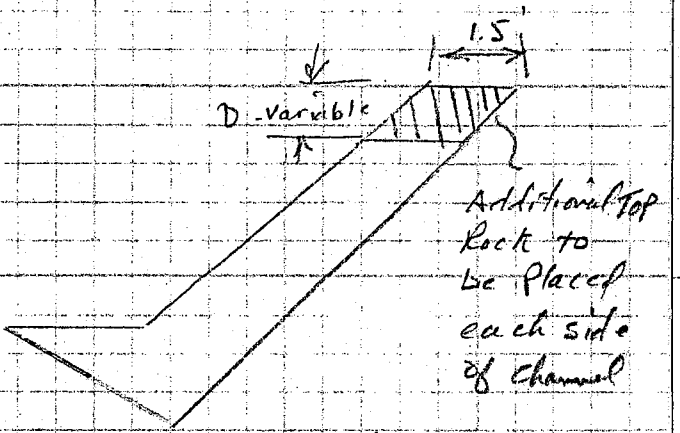
5 Str - $\frac{500}{27} + 21.2 = 393$

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE: ARIZONA
PROJECT: Powerline Channel
BY: C Ware
DATE: 3-16-68
CHECKED BY: D. Marlow
DATE: 3-16-68
JOB NO:
SUBJECT:
SHEET OF

Quantities Rock Rip Rap (top Addition)



typical for each side of channel

From profile

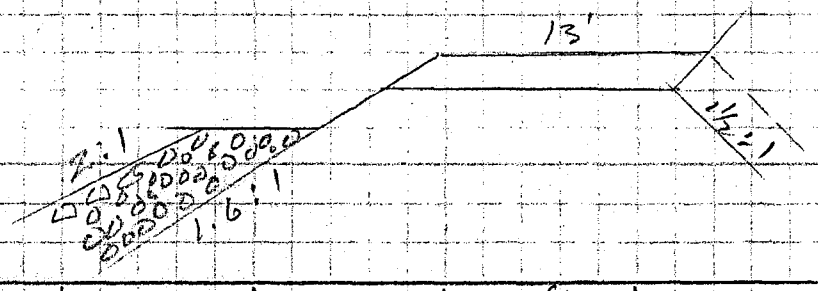
Begin Fill	End Fill	Depth of Fill @ end	Length	Cu ft Vol = ½ D.L x 1.5	
371+60	379+00	2.5	740	1387.5	
385+00	393+00	2.0	800	1200.0	
393+00	403+00	1.6	1000	1200.0	
403+00	420+00	1.6	1700	2040.0	
420+00	428+70	1.0	870	652.5	
438+00	450+40	1.5	1240	1395.0	
Feed	crossing				
450+60	452+00	1.5	140	157.5	
				8032.5	297.5 Cu yds each side

Total Rock = 297.5 x 2 = 595.0 both sides

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE: Arizona
PROJECT: Powerline Channel
BY: C WARE
DATE: 3-16-68
CHECKED BY: D. Marlow
DATE: 3-16-68
JOB NO.
SUBJECT: Quantities of Earth Fill, top addition
SHEET ___ OF ___



Earth Fill

South side

Begin Fill	End Fill	Depth of Fill @ End	Length	Cu ft Vol = ½ DL x 13	Cu yds
371+60	379+00	2.8	740	13,468	
385+00	393+00	1.5	800	7800	
393+00	403+00	1.6	1000	10,400	
403+00	420+00	1.8	1700	19,890	
420+00	428+70	1.0	870	5655	
438+00	450+40	1.5	1240	12,090	
450+60	452+00	1.5	140	1,365	
				70,668	2617.33

North Side

424+00	428+70	1.2	470	3666	
428+70	428+90	1.2	20	156	
438+00	450+40	1.5	1240	12090	
450+60	452+00	1.5	140	1365	
				17,277	639.9

total earth fill 3257.2

COMPUTATION SHEET
SCS-ES3A REV 5-68

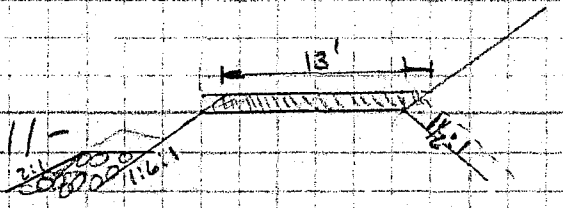
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Ariz | PROJECT Powerline Channel
BY RA | DATE 2-68 | CHECKED BY | DATE | JOB NO
SUBJECT

SHEET OF

Quantities:

Dike earth fill -



Begin Fill	End Fill	Depth at Fill @ End	Length	Vol = ½ DL·13
South Side -				
387+00	393+20	1.4	620	5642
393+20	393+40	1.4	20	182
397+00	401+40	1.0	440	2860
401+40	401+60	1.0	20	130
408+00	416+20	1.0	820	5330
416+20	416+40	1.0	20	130
420+00	425+00	0.6	500	1950
443+00	450+40	1.0	740	4810
450+40	452+00	1.0	160	1040
				22,064 = 817 cy.
North Side				
424+00	428+70	1.2	470	3666
428+70	428+90	1.2	20	156
443+00	450+40	1.0	740	4810
450+40	452+00	1.0	160	1040
				9,672 = 358 cy.

TOTAL = 1175 cy.

COMPUTATION SHEET
SCS-ESBA REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Floodway

BY G. Hanley DATE 3-12-68 CHECKED BY DATE JOB NO

SUBJECT Solving for flows, 52' bottom 2:1 SS SHEET OF

Width = 52', SS = 2:1, slope = 0.002, n = 0.032

Q = 3140 cfs $0.002^{1/2} = 0.04472$

Try D = 4, 4.5, 5, 5.5, 6, 6.5 & 7

$$r = \frac{1 + zx}{1 + 2x\sqrt{1 + x^2}} D = cD \qquad A = (52 + 2D)D$$

D	b	D/b	c	cD = r	$r^{2/3}$	A	V	Q = AV
4.0	52	0.07692	.854	3.41	2.265	240	4.70	1128
4.5	"	.08653	.841	3.78	2.427	279.5	5.04	1383
5.0	"	.09615	.829	4.15	2.583	310.0	5.36	1662
5.5	"	.10576	.818	4.50	2.726	346.5	5.66	1961
6.0	"	.11538	.807	4.84	2.862	384.0	5.94	2281
6.5	"	.125	.797	5.18	2.994	422.5	6.22	2628
7.0	"	.13461	.792	5.54	3.131	462.0	6.50	3003
7.1	"	.13653	.790	5.61	3.157	470.0	6.56	3083
7.2	"	.13846	.787	5.67	3.180	478.1	6.60	3155
7.6	"	.14615	.778	5.91	3.269	510.7	6.79	3468

$$V = \frac{1.486}{0.032} \times 0.04472\, r^{2/3} = 2.077\, r^{2/3}$$

COMPUTATION SHEET
SCS-333A REV 6-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Floodway

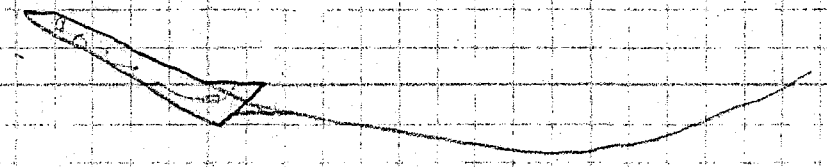
BY G. Hanley DATE 3-11-68 CHECKED BY DATE JOB NO

SUBJECT Solving for flows with parabolic bottom SHEET OF

$S = 0.002$, $n = 0.032$ c from King's 7-43 Table 89

	D	T	A	D/T	c	$c\sqrt{D}$	$r^{2/3}$	V	$\frac{Q}{AV}$
	1.0	42	27	.023	.666	.67	.765	1.16	35
	2.0	60	67	.030	.665	1.33	1.209	2.51	168
	3.0	64.0	129	.047	.622	1.87	1.518	3.15	406
	4.0	68.0	195	.059	.620	2.69	1.91	3.97	774
	5.0	72.0	265	.069	.658	3.29	2.212	4.59	1312
	6.0	76.0	339	.079	.656	3.99	2.495	5.18	1756
	7.0	80.0	417	.089	.653	4.57	2.754	5.72	2385
5.6	7.6	82.4	466	.092	.652	4.96	2.908	6.04	2815
6.6	8.6	84.0	499	.102	.650	5.59	3.15	6.54	3263

$$V = \frac{1.486}{0.032} \times 0.002^{1/2} r^{2/3} = 2.077\, r^{2/3}$$



COMPUTATION SHEET
SCS-523A REV 5-66

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Powerline Floodway

BY G. Hanley | DATE 4-6-68 | CHECKED BY | DATE | JOB NO

SUBJECT

SHEET ___ OF ___

TABLE OF DIMENSIONS & ELEVATIONS

Drop No	Sta.	El. M.	El. N.	A	B	C	D	E
I	379+00	1352.7	1350.7	2.0	4.0	4'-8"	7'-8"	
II	380+24	1350.7	1348.7	2.0	4.0	4'-8"	7'-8"	
III	393+00	1346.2	1344.2	2.0	4.0	4'8"	7'-8"	
IV	403+00	1342.2	1340.7	1.5	3.0	4'-2"	7'-2"	
V	416+00	1338.1	1336.6	1.5	3.0	4'-2"	7'-2"	
VI	428+70	1334.7	1332.7	2.0	4.0	4'-8"	7'-8"	

COMPUTATION SHEET
SCS-ECOA REV 5-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Power line Floodway

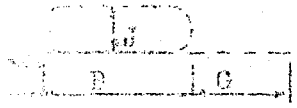
BY G. Hanley DATE 3-8-68 CHECKED BY DATE JOB NO

SUBJECT Summary Table of Quantities for Concrete and Steel. SHEET OF

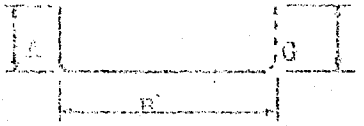
Structure	concrete for one Structure Cu.Yd.	Total concrete Cu.Yd.	steel for one structure Lbs	Total steel Lbs
Drops I, II, III & VI	48.02	192.1	2,661	10694
Drops IV & V	46.42	92.8	2,633	5,266
Total all Structures		284.9		15,910
	2 1/4	2"	1 1/4	1 1/4	1 1/4

8"

1:-6 [illegible]



Type 1



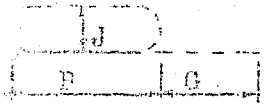
Type 2

Sl[illegible]ght

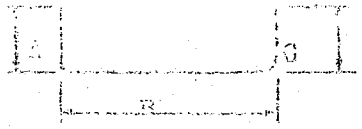
Str.

BAR SCHEDULE

Location	Mark	Size	Quantity	Length	Total Length	Type							
	1	4	60	5-3"	315-0	Str							
	2		2	5-6	11-0								
	3		2	5-9	11-6								
	4		2	5-3	10-6								
	5		2	6-6	13-0								
	6		2	6-6	13-0								
	7		2	6-0	12-0								
	8		2	5-3	10-6								
	9		2	4-9	9-6								
	10		2	4-6	8-0								
	11		2	18-3	36-6								
	12		2	20-3	40-6								
	13		2	22-0	44-0								
	14		28	29-6	826-0	Str							
	15		62	12-9	790-6	2	2-2	10-7					
	16		62	11-8	728-6	2	1-0	10-9					
	17		40	14-9	590-0	19	3-2	11-7	1-5				
	18		2	2-6	5-0								
	19		2	2-9	5-6								
20 left out	21		2	3-3	6-6								
	22		6	3-9	22-6								
	23		2	3-6	7-0								
	24		2	2-9	5-6								
	25		2	2-0	4-0								
	26		2	18-0	36-0								
	27		2	19-6	39-0								
	28		2	8-9	17-6								
	29		2	7-6	15-0								
	30	4	2	5-6	11-0								



Type 1



Type 2

Sh. Light

Str.

4-2
1-6
5 8

BAR SCHEDULE

Location	Mark	Size	Quantity	Length	Total Length	Type
	31	4	6	23-6	141-0	
	32	4	2	6-9	13-6	
	33	4	2	4-9	9-6	
	34	4	2	5-0	10-0	
*	35	6	36	1-6	54-0	

Smooth dowel Bars

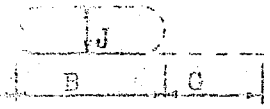
Total Length of No 4 bars for 1 str = 3819.5 = 2552
2 81
2633

~~[illegible]~~ lbs

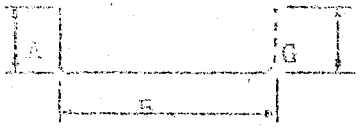
Total length of No 6 bars for 1 str = 54'
2
108 x 1.502 = 163 lbs

2796

L drop [illegible]



Type 1



Type 2

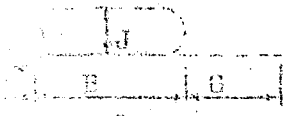
St. ight

Str.

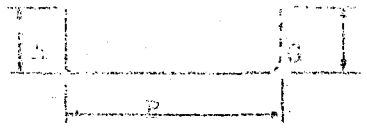
BAR SCHEDULE

Location	Mark	Size	Quantity	Length	Total Length	Type	A	G					
	1	4	60	5'-9	345-0	str							
	2		2	6-0	12-0								
	3		2	6-3	12-6								
	4		2	6-9	13-6								
	5		2	7-0	14-0								
	6		2	7-0	14-0								
	7		2	6-6	13-0								
	8		2	5-9	11-6								
	9		2	5-3	10-6								
	10		2	5-0	10-0								
	11		2	19-0	38-0								
	12		2	21-0	42-0								
	13		2	23-0	46-0								
	14		28	29'-6	826-0	str							
	15		62	12-9	790-6	2	2-2	10-7					
	16		62	12-0	744-0	2	1-3	10-9					
	17		40	14-0	560-0	19	4-2	10-10	10 1/4				
let-foot	18		2	3-0	6-0	str							
20	19		2	3-3	6-6								
	21		2	3-9	7-6								
	22		6	4-3	25-6								
	23		2	3-9	7-6								
	24		2	3-3	6-6								
	25		2	2-6	5-0								
	26		2	18-0	36-0								
	27		2	19-6	39-0								
	28		2	9-6	19-0								
	29		2	7-6	15-0								
	30	4	2	5-6	11-0								

2' drop



Type 1



Type 2

St. Eight

Str.

SAR SCHEDULE

Location	Mark	Size	Quantity	Length	Total Length	Type
	31	~~4~~	6	23-6	141-0	
	32		2	6-9	13-5	
	33		2	4-9	9-6	
	34	4	2	5-0	10-0	
	35	6	36	1-6	54-0	

Total length of No 4 bars for 1 str = 3861

$$\begin{array}{r} 3861 \\ +\quad 4 \\ \hline 15444 \\ \times .668 \\ \hline 10,317 \text{ lbs} \end{array}$$

$$\begin{array}{r} 25,80 \\ 81 \\ \hline 2661 \end{array}$$

Total length of No 6 bars for 1 str = 54

$$\begin{array}{r} 54 \\ 4 \\ \hline 216 \end{array} \times 1.562 = 325 \text{ lbs.}$$

$$\begin{array}{r} 10,317 \\ 325 \\ \hline 10,642 \\ 2796 \\ \hline 13438 \end{array}$$

~~total~~

$$\begin{array}{r} 6)\,13438\,(2706 \\ 12 \\ \hline 14 \\ 14 \\ \hline 38 \\ 36 \end{array}$$

COMPUTATION SHEET
SCS-652A REV 5-60

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE: Ariz | PROJECT: Powerline Floodway
BY: G. Hanley | DATE: 4-6-68 | CHECKED BY: | DATE: | JOB NO:
SUBJECT: Earth channel modification | SHEET | OF

Location of drop Structures

	Headwall Sta.	Toewall Sta.	Crest El. M	Slab El. N	Dist.	Drop. A	Slope
I	379+00	379+20	1352.7	1350.7		2'	
					124		0.00
II	380+24	380+44	1350.7	1348.7		2'	
					1256		.002
III	393+00	393+20	1346.2	1344.2		2'	
					980		0.002
IV	403+00	403+20	1342.2	1340.7		1.5	
					1280		0.002
V	416+00	416+20	1338.1	1336.6		1.5	
					1208		0.00157
	428+28	[illegible]	1334.7				
					42'		0.00
VI	428+70	428+90	1334.7	1332.7		2'	

COMPUTATION SHEET
SCS-523A REV 5-68

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Ariz. PROJECT Powerline Floodway
BY G. Hanley DATE 3-4-68 CHECKED BY DATE JOB NO.
SUBJECT SHEET OF

Low Drop Channel Stabilizer
5

COST ESTIMATE

One Typical Structure

Item No.	Item	Units Average	Unit Cost	Total Cost
1	Exca. Structural	142	5.00	710
2	Exc. Channel	700	.60	420
3	Earth fill Dike	215	.60	129
4	Earth fill - structural	40	4.00	160
5	Concrete Reinforced	47.4	80.00	3792
6	Reinforcing Steel	2710	.20	542
7	Rock Rip Rap loose	110	10.00	1100
	Rock Rip Rap - Grouted	110	20.00	2200
				$ 9,053

COMPUTATION SHEET
SCS-ECSA REV 5-68

U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE | PROJECT

BY | DATE | CHECKED BY | DATE | JOB NO

SUBJECT

6 | SHEET | OF

Summary of Quantities, One Str.

Item No.	Item	Units	Quantity
1	Str. Excavation	Cu. Yd.	192
2	" Backfill	" "	~~55~~ 39
3	Concrete	" "	47.4
4	Reinforcing Steel	Lbs.	2710
5.	Channel Excavation		700 cy Avg.
6.	Dike Fill		215 cy. Avg.
7.	Grouted Rock Rip Rap		110 cy Avg.
8.	Rock Rip Rap 50+60		180 cy Avg.

COMPUTATION SHEET
SCS-ENG-A REV 6-60

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Ariz. PROJECT Power Line Floodway

BY C. H. DATE 3-1-68 CHECKED BY DATE JOB NO.

SUBJECT

SHEET 4 OF

Final Quantities

Reinforcing Steel. Apron area.

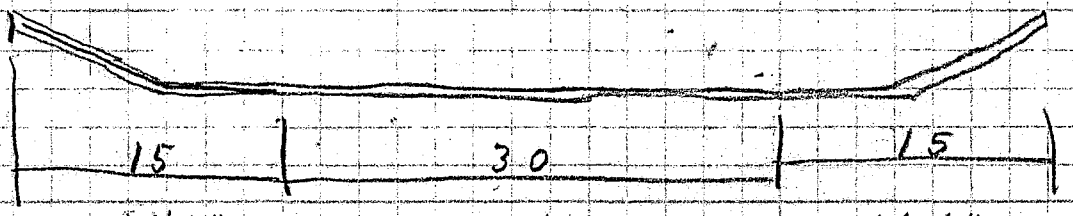
20-8" Transverse 60 each

(1) 19'-9" x 1½ = 9'-8" + 8" for lap. = 10'-4" + bend down 2'-2"
total = 12'-6"

(2) 10'-4" + 1'-2" = 11'-6"

(3) 6'-2" - 5" = 5'-9"

Longitudinal



18 each

(4) 14'-6" 36 bars

(5) 29'-6 18 bars

Upstr headwall (Horizontal)

(5) Center span 29'-6" 6 bars
(6) Outside ends 14'-9 + 4'-9" = 19'6" 16 bars
(7) " " 8'-6" 6 bars
(8) " " 7'-6" 2 bars

Upstr. headwall Vertical

(9)	Outer ends	5'-0"	2	bars
(10)		5'-6"	2	"
(11)		5'-9"	2	"
(12)		6'-3"	2	"
(13)		7'-0"	6	"
(14)		6'-6"	2	"
(15)		6'-0"	2	"

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Ariz. PROJECT Powerline Fldwy

BY G.H. DATE 3-1-68 CHECKED BY DATE JOB NO.

SUBJECT

SHEET 5 OF

Downstr Headwall.

Horizontal

(5) center span. 29'-6" 3 bars

(16)	outer bars	15-9" + 4-6 = 19'-3"	3 bars
(17)	" "	6-6	2 bars
(18)	" "	8-6	2 "

Vertical

(19)	outer bar	2'-6"	2 bars
(20)		3'-0"	2 "
(21)		4'-0"	2 "
(22))		4'-3"	8 "

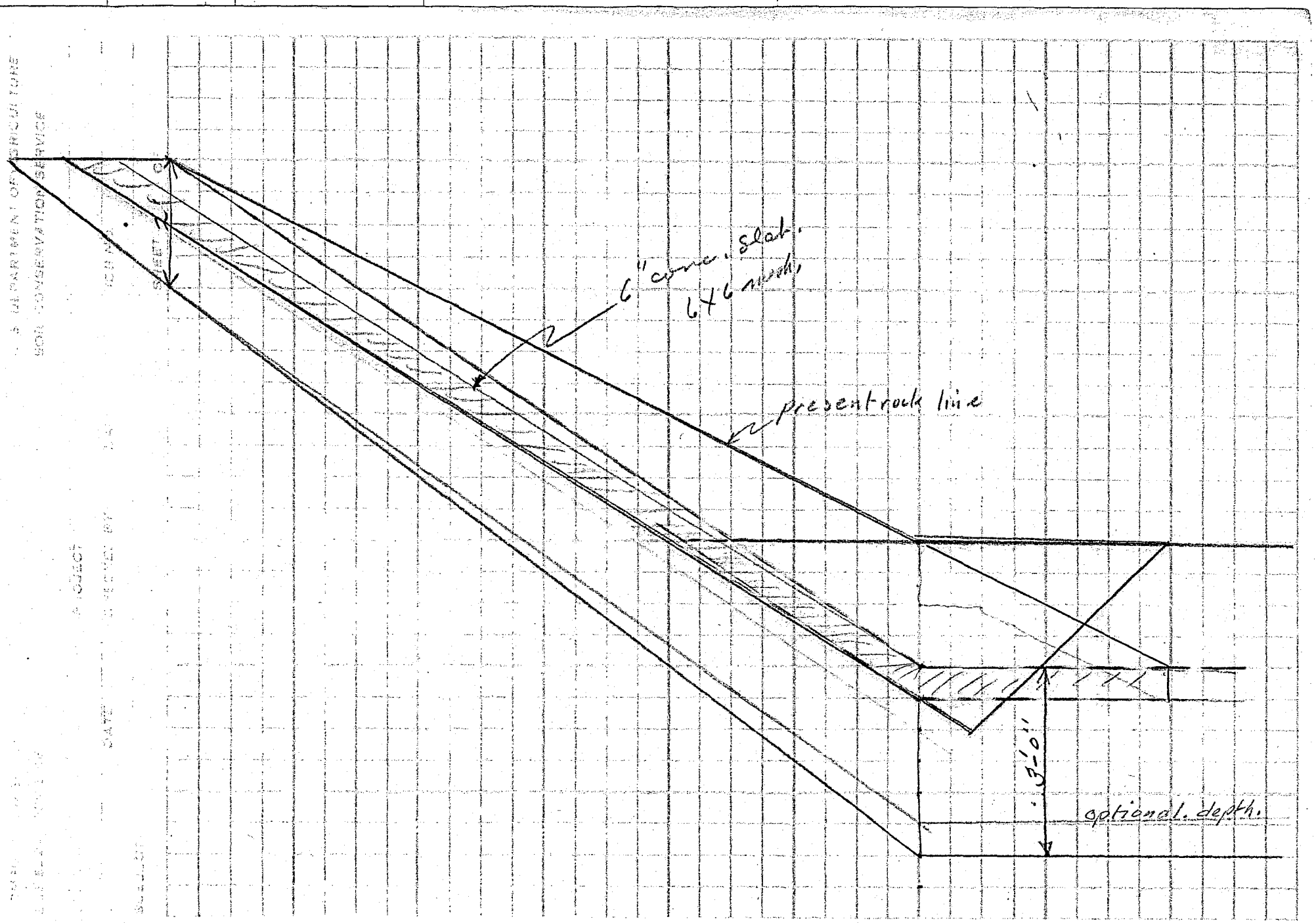
Summary

Mark	No.	Length	Total Length
1	60	12.5'	750.0
2	60	11.5'	690.0
3	60	5.75'	345.0
4	36	14.5	522.0
5	27	29.5	796.5
6	6	19.5	117.0
7	6	8.5	51.0
8	2	7.5	15.0
9	2	5.0	10.0
10	2	5.5	11.0
11	2	5.75	11.5
12	2	6.25	12.5
13	6	7.0	42.0
14	2	6.5	13.0
15	2	6.0	12.0
16	3	19.25	57.75
17	2	6.5	13.0
18	2	8.5	17.0
19	2	2.5	5.0
20	2	3.0	6.0
21	2	4.0	8.0
22	8	4.25	34.0
			3539.25 x.668 = 2622 lbs.

Total

No. 6 dowels 18" long 38 required 57 x 1.502 = 86 lbs

Total 2708


6" conc. slab
6+6 mesh
present rock line
3'-0"
optional depth

COMPUTATION SHEET
SCS-ES-3A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Ariz | PROJECT

BY RA | DATE | CHECKED BY | DATE | JOB NO.

SUBJECT

SHEET OF

Time Reqd for Plans

Design = 3 days

Drafting = 10 days

Quantities = 3 days.

Estimate March 15, 1968

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Ariz
PROJECT Powerline Channel
BY RA
DATE 2-68
CHECKED BY
DATE
JOB NO.
SUBJECT
SHEET 1 OF

FINAL QUANTITIES - Concrete

Headwall:
Footing $\left(\frac{78+66}{2}\right)(3)(0.83) = 179.28$
" $((78))(0.83(0.5) = 32.37$
Headwall $(78)(2.67)(0.67) = 139.53$
" $2\left(\frac{5.0+9.0}{2}\right)(1.83)(0.67 = 17.17$

side 2:1 slabs

see attached drawing. 114.16

slab
$(52 \times 18.67).67 = 650.46$

cutoff
& Wingwall
$\left(\frac{72+66}{2}\right)(2.0)(0.67) = 92.46$
$(72)(0.67)(0.67) = 32.32$
$2\left(\frac{10+6}{2}\right)(2.0)(0.67) = 21.44$

46.6 1279.19 y.

$= 47.4\ yd^3$

COMPUTATION SHEET
SCS-533A REV 5-68

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Ariz | PROJECT Powerline Channel
BY RA | DATE 2-68 | CHECKED BY | DATE | JOB NO
SUBJECT Structural Excavation | SHEET 2 OF

Final Quantities

Structural Exc.

		2'-0	1-6"
cutoffs to slab level formed in Cvd.			
$60(\frac{3.5}{3.33}+2.0).167$	=	~~221~~ 213	221
$2(\frac{3+6}{2})2 \times .167$	=	12	12
$2(\frac{9+3}{2})3.25 .167$	=	26	26
Slab & Sidewalls			
$\frac{2.67}{2} \times 52 \times 21.5$	=	~~2985~~ ~~2236~~	2519
$2(2.67+1)4 \cdot 21.5$	=	315	186
$2(1.5^2 \times 1)\ 21.5$	=	65	65
Headwalls			
$60.0 \times 2.67 \times 2.16$	=	346	314
$2(\frac{7+2.67}{2})\ 10.5 \times 3.67$	=	372	372
End wall above slab btm.			
$2(\frac{5.5+2.67}{2})\ 7.5 \times 3.67$	=	225	225
$2(\frac{1.67 \times 3}{2}) \times 2.16$	=	11	11
		~~3821~~ 4578 + 43	3951
		169.5	146.3 cy.
		-19	19
		150	127

Minus Rock Section @ Bank = 19 cy.

Proposed alternate

Additional excavation for Drop #1
cut-offs to slab level
Bottom width = 52'
Added bottom width = 80 - 52 = 28'
Excavation per ft bottom width = $\frac{142}{52} = 2.73$
Excavation for 80' width = 142 + 2.73 x 28 = 218.44 Cu yds
5 structures @ 142 = 710
1 Structure @ 218 = 218 total EXC = 928 Cu yds

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE | PROJECT
BY | DATE | CHECKED BY | DATE | JOB NO.
SUBJECT

SHEET 3 OF

Quantaties – final

Structural Backfill

Headwall above slab bottom

60 x 2.67 x 1.5 = 240.3
$2\left(\frac{7+2.67}{2}\right)$ 10.5 x 3.0 = 304.6
544.9 =
Side wall 2(1.5 x 1.5) 21.5 97.0

Down Str. toe wall

52 x 2.67 x 1.5 – – = 208.3

$2 \times \frac{4.67+2.67}{2} \times 4.0 \times 1.5 = 44.0$

2 x 3.0 x 4.67 x 3.0 – – = 84.0

$2 \times \frac{4.67+2.67}{2} \times 3.0 \times 3.0 = 66.$

947.2
Total. 97
1044.2

$\frac{1044}{27} = 39$ cy.

Alternate – Eliminate

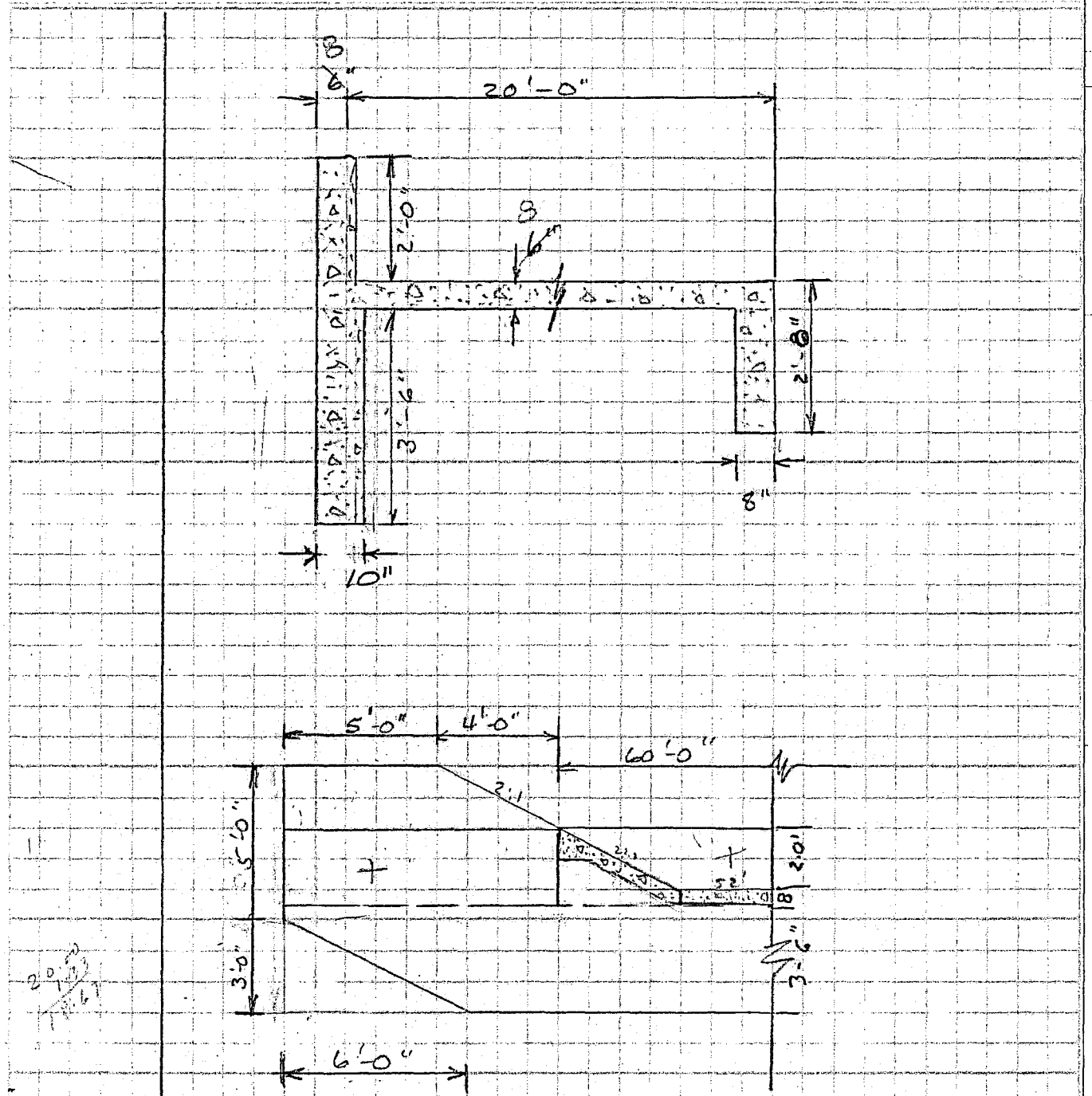
COMPUTATION SHEET
SCS-ENGR. REV 2-68

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE | PROJECT

BY | DATE | CHECKED BY | DATE | JOB NO

SUBJECT | SHEET OF



COMPUTATION SHEET
SCS-523A REV 5-58

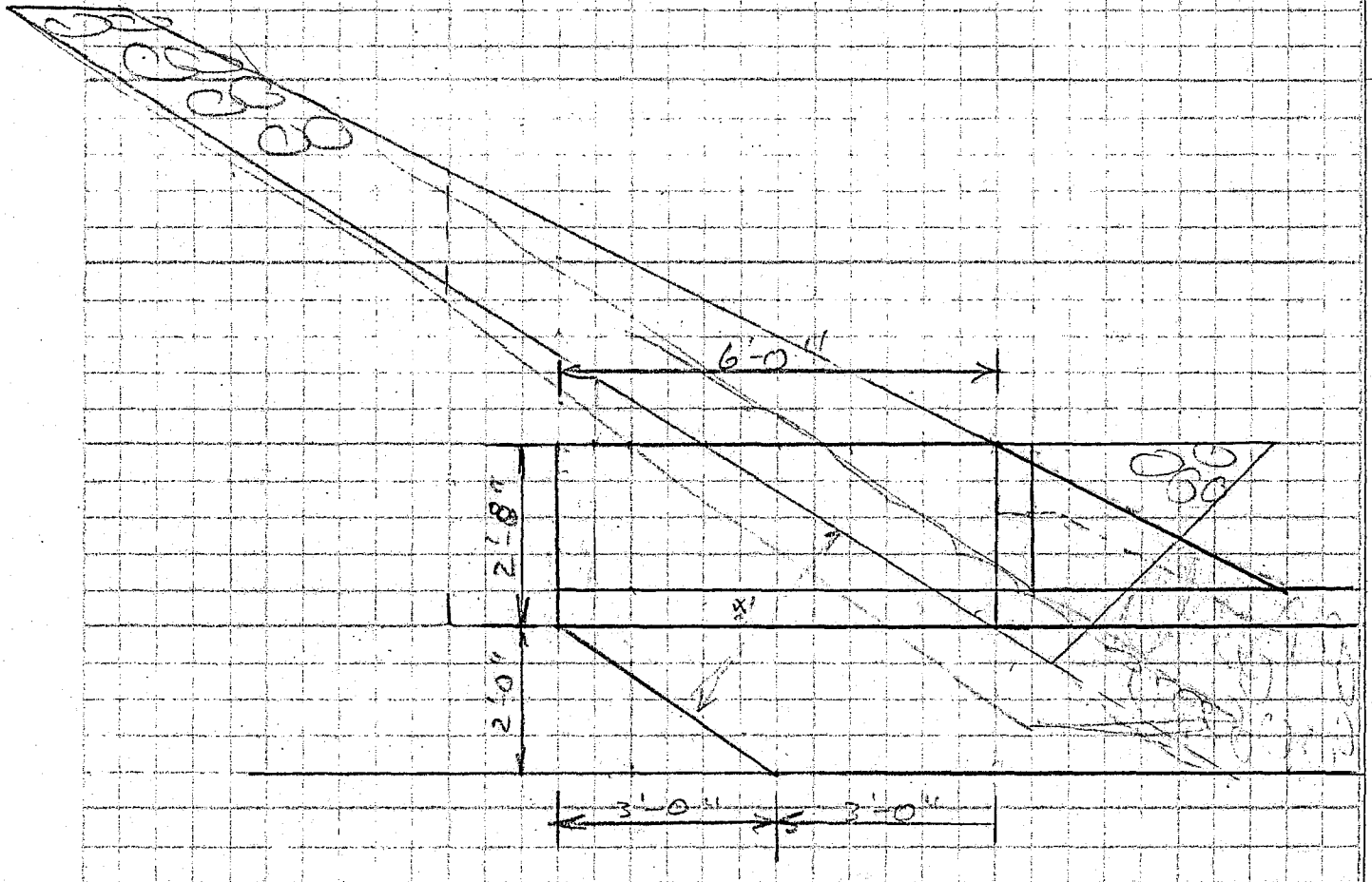
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE | PROJECT

BY | DATE | CHECKED BY | DATE | JOB NO.

SUBJECT ROCK & WINGWALL D.S. SHEET ___ OF ___

LOW DROP GRADE STABILIZER



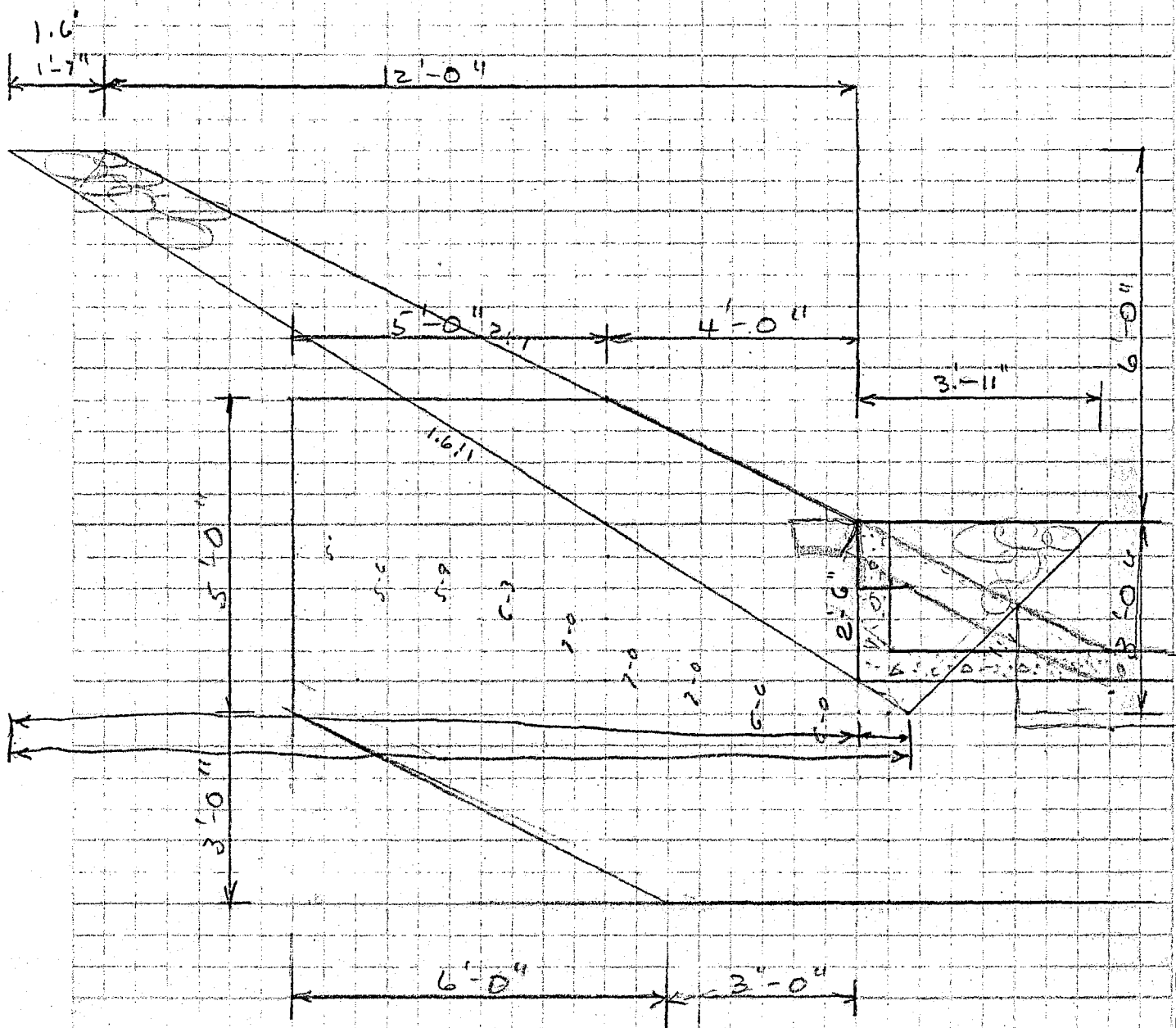
COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE | PROJECT

BY | DATE | CHECKED BY | DATE | JOB NO

SUBJECT Rock & HEADWALL | SHEET | OF



COMPUTATION SHEET
SCS-523A REV 5-66

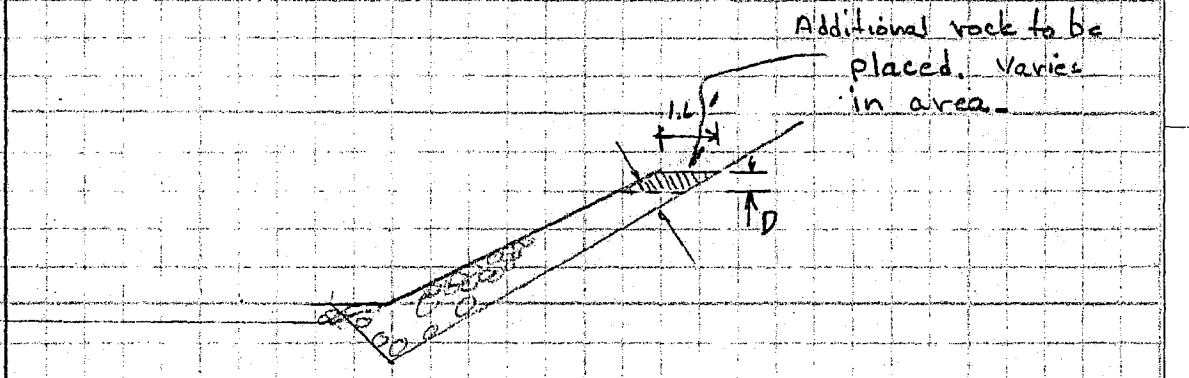
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Ariz PROJECT Powerline Channel -
BY RA DATE 2-68 CHECKED BY DATE JOB NO
SUBJECT

SHEET 19 OF

Quantities

Rock Rip Rap -



From Profile:

Begin Rock	End Rock	Depth @ End		Length	Vol = 1/2 DL·1.6	
		53°				
387+00	393+20		1.4	620	694	
397+00	401+40	49½°	1.0	440	352	
408+00	416+20	45°	1.0	820	656	
420+00	428+70		1.2	870	835	
443+00	450+40		1.0	740	592	
450+40	452+00		1.0	160	128	
					3257	
					$\frac{3257}{27}$ =	120.6 cy. each side

Rock Rip Rap = 242 cy.

Alternate - Eliminate

CS-529
IEV 8-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

EARTHWORK COMPUTATION SHEET

Revised Quantities

LOCATION: Powerline Channel	OWNER		
AIED: Apache Junction - Gilbert	SUB-WATERSHED	SITE NO.	
CONTRACTOR	COMPUTED BY	DATE	
ITEM: Channel Bottom Evaluation	CHECKED BY	DATE	
CONTRACT NO.	ESTIMATE _____ CU. YDS.	ACTUAL _____ CU. YDS.	

Ware 3-14-68

STATION	END AREA SQ. IN.		END AREA SQ. FT.		SUM OF END AREAS SQ. FT.		DISTANCE IN FEET		SECTION PRODUCTS CU. FT.		VOLUME CU. YD.		REMARKS	
380+25	.48	.48	2.40	2.40										
					53.0	53.0	75	75			73.6	73.6	73.6	73.6
381+00	.58	.58	2.90	2.90										
					33.8	33.8	100	100			61.1	61.1	134.7	134.7
382+00	.095	.095	0.48	0.48										
					4.8	4.8	100	100			8.9	8.9	143.6	143.6
383+00	0	0	0	0										
393+20	.77	.18	3.85	0.90										
					55.5	10.5	80	80			82.2	15.6	225.8	159.2
394+00	.34	.03	1.70	0.15										
					24.0	1.5	100	100			44.4	2.8	270.2	162.0
395+00	.14	0	0.70	0										
					14.5	0	100	100			26.8	0	297.0	162.0
396+00	.15	0	0.75	0										
					7.5	0	100	100			13.9	0	310.9	162.0
397+00	0	0	0	0										
403+00	.92	.40	4.60	2.00										
					79.0	31.0	100	100			146.3	57.4	457.2	219.4
404+00	.66	.22	3.30	1.10										
					66.0	19.5	100	100			122.2	36.1	579.4	255.5
405+00	.66	.17	3.30	0.85										
					65.0	16.0	100	100			120.4	29.6	699.8	285.1
406+00	.64	.15	3.20	0.75										
					59.5	14.0	100	100			110.2	25.9	810.0	311.0
407+00	.57	.13	2.75	0.65										
					51.0	10.0	100	100			94.4	18.5	904.4	329.5
408+00	.47	.07	2.35	0.35										
					47.5	6.0	100	100			88.0	11.1	992.4	340.6
409+00	.28	.05	1.40	0.25										
					41.0	4.0	100	100			75.9	7.4	1068.3	348.0
410+00	.34	.03	1.70	0.15										
					30.0	1.5	100	100			55.6	2.8	1173.9	350.8
411+00	.26	0	1.30	0										
					20.5	0	100	100			38.0	0	1161.9	350.8
412+00	.15	0	0.75	0										
					21.5	0	100	100			39.8	0	1201.7	350.8
413+00	.28	0	1.40	0										
					14.0	0	100	100			25.9	0	1227.6	350.8
414+00	0	0	0	0										
416+20	1.41	0	7.05	0										
					153.0	0	80	80			226.7	0	1454.3	350.8
417+00	1.65	0	8.25	0										
					143.5	0	100	100			265.7	0	1720.0	350.8
418+00	1.22	0	6.10	0										
					121.0	0	100	100			224.1	0	1944.1	350.8
419+00	1.20	0	6.00	0										

_____ Original Proposal
_____ Alternate Proposal

SHEET 1 OF 2 SHEETS

SCS-629
REV 8-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

EARTHWORK COMPUTATION SHEET

Revised Quantities

LOCATION Powerline Channel	OWNER		
HED Apache Junction - Gilbert	SUB-WATERSHED	SITE NO.	
CONTRACTOR	COMPUTED BY	DATE	
ITEM Channel Bottom Excavation	CHECKED BY	DATE	
CONTRACT NO.	ESTIMATE _____ CU. YDS.	ACTUAL _____ CU. YDS.	

Wayne - 3-14-68

STATION	END AREA SQ. IN.		END AREA SQ. FT.		SUM OF END AREAS SQ. FT.		DISTANCE IN FEET		SECTION PRODUCTS CU. FT.		VOLUME CU. YD.		REMARKS Accumulative Total	
419+00	1.20	0	60.0	0										
					107.5	30.0	100	100			199.1	55.6	2143.2	406.4
420+00	.95	.60	47.5	30.0										
					82.0	51.0	100	100			151.8	94.4	2295.0	500.9
421+00	.69	.42	34.5	21.0										
					72.5	52.0	100	100			134.3	96.3	2429.3	597.1
422+00	.76	.62	38.0	31.0										
					64.0	48.5	100	100			118.5	89.8	2547.8	686.9
423+00	.52	.37	26.0	17.5										
					49.5	34.5	100	100			91.7	63.9	2639.5	750.8
424+00	.47	.34	23.5	17.0										
					42.5	27.0	100	100			78.7	50.0	2718.2	800.8
425+00	.38	.20	19.0	10.0										
					27.0	18.0	100	100			50.0	33.3	2768.2	834.1
426+00	.16	.16	8.0	8.0										
					8.0	8.0	100	100			14.8	14.8	2783.0	848.9
427+00	0	0	0	0										
428+70	1.22	1.22	61.0	61.0										
					118.0	118.0	30	30			65.6	65.6	2848.6	914.5
429+00	1.14	1.14	57.0	57.0										
					88.0	88.0	100	100			163.0	163.0	3011.6	1077.5
430+00	.62	.62	31.0	31.0										
					56.5	56.5	100	100			104.6	104.6	3116.2	1182.1
431+00	.51	.51	25.5	25.5										
					41.5	41.5	100	100			76.8	76.8	3193.0	1258.9
432+00	.32	.32	16.0	16.0										
					34.0	34.0	100	100			63.0	63.0	3256.0	1321.9
433+00	.36	.36	18.0	18.0										
					18.0	18.0	100	100			33.3	33.3	3289.3	1355.2
434+00	0	0	0	0										
			Proposed Alternate No 2											
			original Plan		Excavation = 3289.3 cu yds									
			Additional Exc from 3+70 to 390+50 to 393+00										total Channel Exc =	
													3289.3 + 486.1 =	
390+50	1.32		66.0											
					105		250				486.1			3775.4
393+00	.78		39.0											

Net Volume saved by Alternate 1934.1 cu yds

SHEET 2 OF 2 SHEETS

— Original Proposal
— Alternate Proposal
— 2nd Alternate

SCS-529
REV 8-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

EARTHWORK COMPUTATION SHEET

SHEET 1

LOCATION Power line Channel		OWNER	
W[illegible]HED Apache Junction		SUB-WATERSHED	SITE NO.
C[illegible]TRACTOR		COMPUTED BY	DATE
ITEM Channel bottom Excavation		CHECKED BY	DATE
CONTRACT NO.		ESTIMATE ——— CU. YDS.	ACTUAL ——— CU. YDS.

STATION	END AREA SQ. IN.	END AREA SQ. FT.	SUM OF END AREAS SQ. FT.	DISTANCE IN FEET	SECTION PRODUCTS CU. FT.	VOLUME CU. YD.	REMARKS
380+25	.31	31					
			60	75		83	83
381+00	.29	29					
			39	100		72	155
382+00	.10	10					
			10	100		18	174
383+00	0	0					
393+20	.42	42					
			59	80		87	261
394+00	.17	17					
			29	100		53	315
395+00	.12	12					
			12	100		22	337
396+00	0	0					
401+40	.60	60					
			117	66		130	467
402+00	.57	57					
			107	100		198	665
403+00	.50	50					
			97	100		179	845
404+00	.47	47					
			79	100		146	991
405+00	.32	32					
			54	100		100	1091
406+00	.22	22					
			44	100		81	1172
407+00	.22	22					
			65	100		120	1293
408+00	.43	43					
			55	100		101	1394
409+00	.12	12					
			24	100		44	1439
410+00	.12	12					
			17	100		31	1470
411+00	0.05	5					
			16	100		29	1500
412+00	[illegible].11	11					
			11	100		20	1520
413+00	0	0					
416+20	.66	66					
			137	80		202	1723
417+00	.71	71					
			121	100		224	1947
418+00	.50	50					
			109	106		201	2149
419+00	.59	59					
			95	100		175	2325
420+00	.36	36					

SHEET ____ OF ____

SCS-529
REV 8-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

EARTHWORK COMPUTATION SHEET

SHEET 2

LOCATION Powerline Channel	OWNER		
HED Apache Junction	SUB-WATERSHED		SITE NO.
CONTRACTOR	COMPUTED BY		DATE
ITEM Channel Bottom Exc.	CHECKED BY		DATE
CONTRACT NO.	ESTIMATE _____ CU. YDS.	ACTUAL _____ CU. YDS.	

STATION	END AREA SQ. IN.	END AREA SQ. FT.	SUM OF END AREAS SQ. FT.	DISTANCE IN FEET	SECTION PRODUCTS CU. FT.	VOLUME CU. YD.	REMARKS
420+00	.36	36					
			59	100	1[illegible]7	109	2434
421+00	.23	23					
			71	100		131	2566
422+00	.48	48					
			83	100		153	2719
423+00	.35	35					
			58	100		107	2826
424+00	.23	23					
			39	100		72	2898
425+00	.16	16					
			16	100		29	2928
426+00	0	0					
428+70	1.04	104					
			159	30		88	3016
429+00	.55	55					
			96	100		177	3194
430+00	.41	41					
			71	100		131	3326
431+00	.30	30					
			50	100		92	3418
432+00	.20	20					
			30	100		55	3474
433+00	.1	10					
			10	100		18	3493
434+00	0	0					

SHEET _____ OF _____ SHEETS

COMPUTATION SHEET
SCS-ECOA REV 5-61

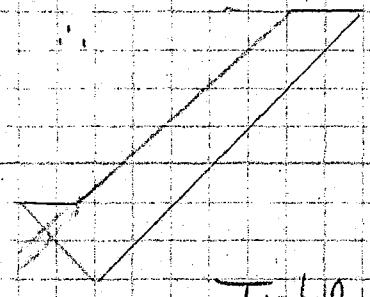
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Ariz | PROJECT Powerline Channel
BY RA | DATE 2-68 | CHECKED BY | DATE | JOB NO.
SUBJECT Channel Stabilization | SHEET 17 OF

Quantities Cont'd

Grouted Rock -

Grout 4' rock section for a distance of 50' - i.e. 10 ft upstream 20' along drop and 20 ft downstream



6' section A = 28.8 ft³
7' section Add 1.6
30.1 ft³/ft

Total Grouting 2(30.1 x 50)
= 3000 ft³
= 3000/27 = 110 c.y./str.

Alternate - structure #1

$\frac{110}{2} \times \frac{72.81}{70} = 57.2$

$C = \sqrt{(20)^2 + (70)^2} = 72.81$

Structure #1 = 55 + 57.2 = 112.2
Structures 2-6 = 110 x 5 = 550.0
662.2

Ariz
RA 2-68

Powerline Channel

Revised Cost Summary

ITEM	No. UNITS	UNIT COST	COST
Low Drops			
Drop Structures	5	$6500	$32,500
Head structure	1	$7500	7500
Excavation - channel	3500	.60	2100
Rock Rip Rap			
channel Banks	310	10.00	3100
Junction	210	6.00	1260
Earth Fill Dikes	1200	.60	720
			$47,180
		SAY	$50,000

COMPUTATION SHEET
SCS-SCS-A REV 5-55

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Ariz PROJECT Powerline Channel
BY RA DATE 2-68 CHECKED BY DATE JOB NO.
SUBJECT

SHEET ... OF ...

Cost Summary

ITEM	No Units	Unit Cost	Cost
LOW DROPS -			
Drop Structures	5	$6500	32,500
channel Bottom Exc. - 60' bottom	3500	.30 60	1,050
@ Junction	1900	.30 66	570
Rock rip rap			
channel banks.	242	10 00	2420
Junction	3900	6 00	23,400
Earth fill dikes	1175	.60	705
			$60,645
			+ 1,500
ROCK RIP RAP SECTION Entire Channel			
12" rock - 15" section			
channel	17,403	6 00	104,418
Junction	2410	6 00	14,460
			$ 118,878
8" rock 12" section			
channel	13,860	6 00	83,160
Junction 15"	2410	6 00	14,460
			$97,620

COMPUTATION SHEET
SCS-523A REV 5-66

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Ariz. PROJECT Powerline Channel
BY RA DATE 2-68 CHECKED BY DATE JOB NO.
SUBJECT SHEET ___ OF ___

Quantities

Consider a 2'-0" drop sta. ~~378+33~~ 379+00

Width of channel = 66±

Conservative estimate results if we proportion the cost of the larger width structure to the smaller width.

Cost of 60 ft str = $6500

cost per ft = say $110

∴ 66 × $110 = $7260 SAY $7300

Rock riprap - extra in bottom -

sta 379+20 to 379+84 = 64 ft.

$\frac{60 \times 1.25}{27} \times 64 = \cancel{177}$ 208 cy.

177 × 6.00 = 1062.00

Extra Backfill Rock

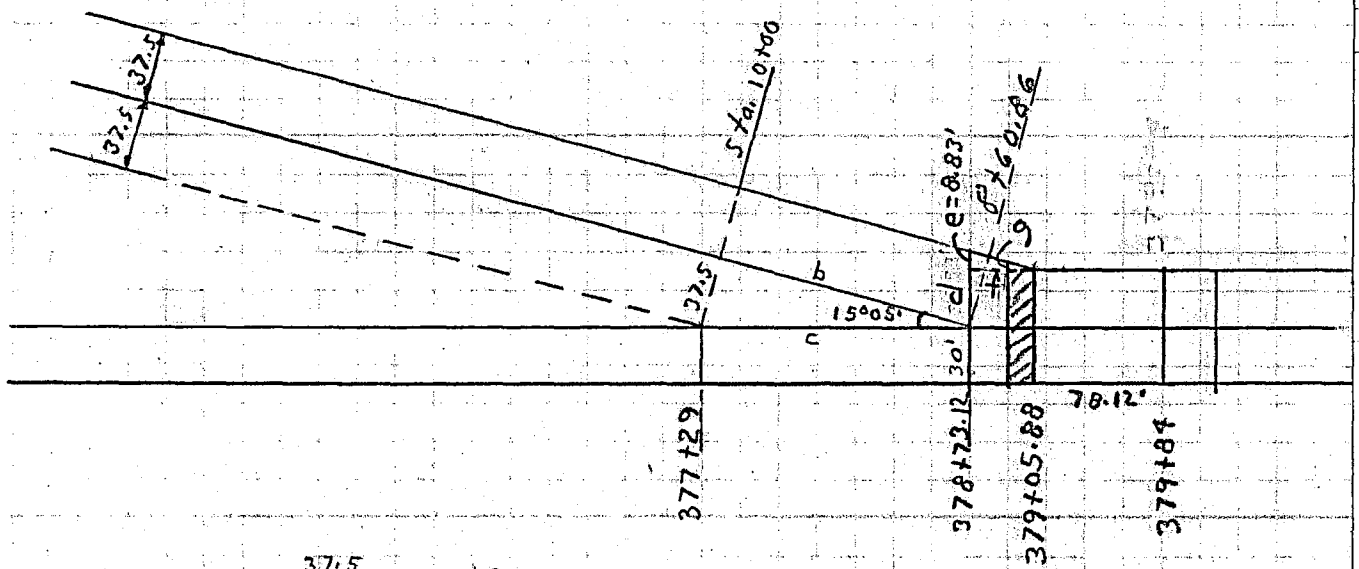
$\frac{2\left(\frac{500 \times 2}{2} \times 1.6\right)}{27} = 60$ cy

$\frac{1600}{27}$

Arizona Powerline Floodway

G. Hanley 2-21-67

Alternate: Place drop @ intersection of channels



$b = \frac{37.5}{\tan 15°05'} = \frac{37.5}{.26951} = 139.14$

$c = \frac{37.5}{\sin 15°05'} = \frac{37.5}{.26022} = 144.11$

$d = \frac{37.5}{\cos 15°05'} = \frac{37.5}{.96555} = 38.83$

$e = 38.83 - 30 = 8.83'$

$f = \frac{8.83'}{\tan 15°05'} = \frac{8.83'}{.26951} = 32.76$

$g = 20 \tan 15°05' = 20 \times .26951 = 5.39'$

Sta	377+29
	1 94.21
	378+73.12
	32.76
	379+05.88

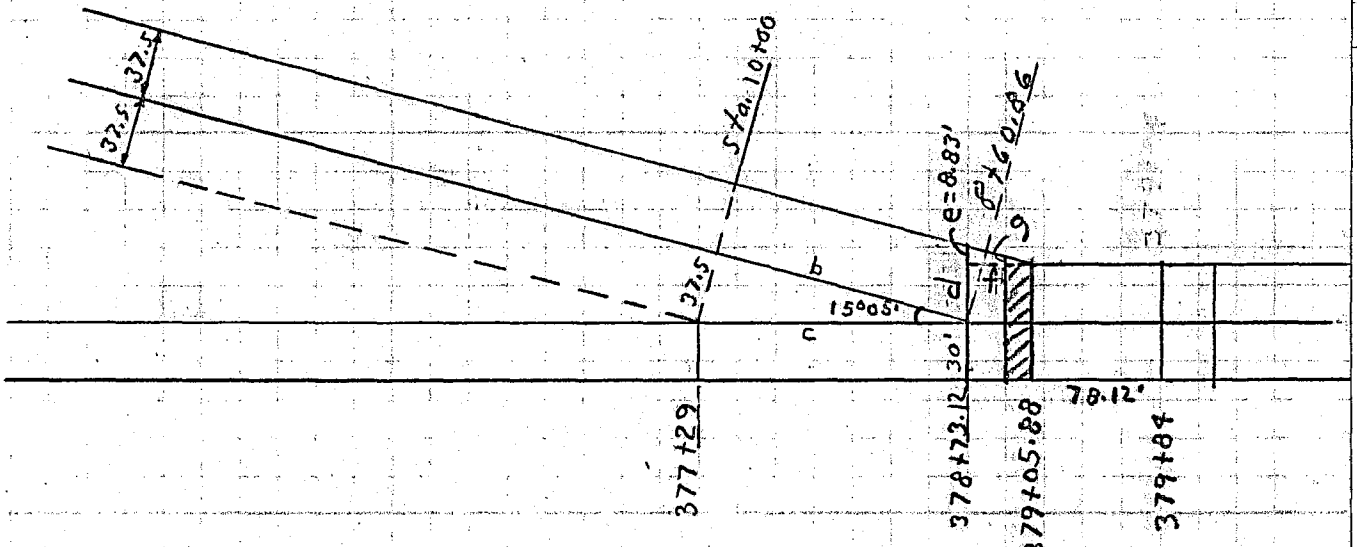
10+00.00	
1 39.14	
8+60.86	

For each foot you moove up stream from Sta 379+05.88 add 0.27'

Arizona Powerline Floodway

G. Hanley 2-21-67

Alternate: Place drop @ intersection of channels



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$d = \frac{37.5}{\cos 15°05'} = \frac{37.5}{.96555} = 38.83$

$e = 38.83 - 30 = 8.83'$

$f = \frac{8.83}{\tan 15°05'} = \frac{8.83}{.26951} = 32.76$

$g = 20 \tan 15°05' = 20 \times .26951 = 5.39'$

Sta 377+29
1 44.21
378+73.12
32.76
379+05.88

10+00.00
1 39.14
8+60.86

For each foot you moove up stream from Sta 379+05.88 add 0.27'

Arizona Powerline Floodway

G. Hanley 2-1-68

Computing volume of riprap for earth channel bottom for cost comparison.

1. Area at intersection of Air Base channel and Powerline Channel, to upstream edge of AF Base crossing

Planimetered area: $5.4^{a"} \times 100^2 = 54{,}000\ ft^2$

Minus area of existing riprap in AF Base channel

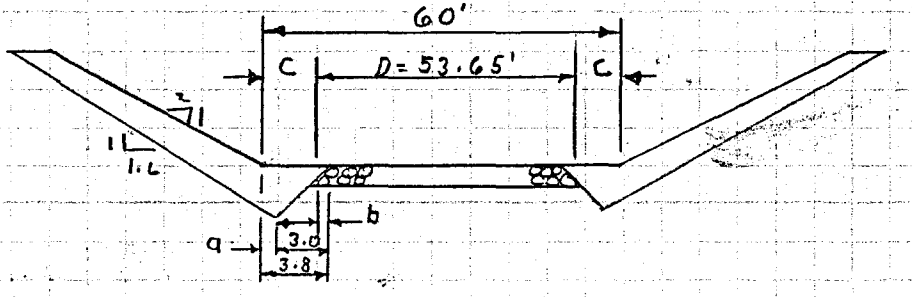
$\frac{85+75}{2} \times 25 = 2{,}000\ ft^2$

Total = $52{,}000\ ft^2$

$52{,}000 \times 1.25 \times 1/27 = 2{,}410\ Yd^3$

$52{,}000 \times 1.0 \times 1/27 = 1{,}926\ Yd^3$

2.



$a = 0.5 \times 1.6 = 0.8$

$b = \frac{1.25}{2} = 0.625$ for 1.25 thick 0.5 for 1' thick

$C = 3.8 - 0.625 = 3.175$ $C = 3.8 - 0.5 = 3.3$

$D = 60 - (2 \times 3.175) = 53.65$ $= 60 - (2 \times 3.3) = 53.4$

Volume of riprap per foot of length.

For 1.25' thick $= 53.65 \times 1.25 = 67.0625\ ft^3$

For 1.0' thick $= 53.4 \times 1.0 = 53.40\ ft^3$

Arizona Powerline Floodway

G. Hanley 2-1-68

Solving for rock riprap size (D_s) using Far West standards, Criteria for rock riprap size page G-13b & c

equation (5) = $D_s = \frac{1.4}{0.4K} W D S = \frac{3.5}{K} W D S$

For the Williams Air Force diversion channel

$S = 0.00864$, $D = 2.8'$ $W = 62.4$ $K = 0.72$

$$D_s = \left(\frac{3.5}{0.72}\right)^{3\,03.33} (62.4)(2.8)(0.00864) = \underline{7.34''}$$

For Powerline floodway with $S = 0.00381$

$D = 5.75$ $K = 0.72$ $W = 62.4$

$$D_s = \left(\frac{3.5}{0.72}\right)(62.4)(5.75)(0.00381) = \underline{6.65''}$$

For Powerline floodway with $S = 0.00296$

$D = 6.16$, $K = 0.72$ $W = 62.4$

$$D_s = \left(\frac{3.5}{0.72}\right)(62.4)(6.16)(0.00296) = \underline{5.53''}$$

use riprap 1.0' thick

Arizona Powerline Floodway

G. Hanley 2-1-68

Solving for Volume of Rock riprap

Area of intersection of floodway and Williams AFBase from 25' upstream from existing riprap in AFB channel to upstream edge of ford crossing.

from page one (1) = 1,926 yd3

For Floodway sta. ~~450+90~~ 450+17 to ~~378+40~~ 380+10
a distance of 7,250'

~~7250~~ 7007 x 53.4 x 1/27 = ~~14,337~~ 13,860 yd3

Total = 15,786 + 1,926 = 16,265 yd3

Cost @ $5.20 = $84,578.00

For riprap 1.25' thick

7007 x 67.06 x 1/27 = 2,410 + 17,403 = 19,813 yd3

Arizona Powerline Floodway

G. Hanlen 2-21-68

Volume of rock riprap at intersection of A.B. channel and Powerline Floodway

$52{,}000 \times 2.0 \times 1/27 = 3852\ Yd^3$

USE $3900\ Yd^3$

Excavation

$52{,}000 \times 1 \times 1/27 = 1930\ Yd^3$

Arizona Powerline Floodway

G. Hanley 2-21-68

Solving for riprap size for junction of Powerline floodway with W. A. F B diversion channel.

$S = 0.00853$ $n = 0.02$ $W = 62.4$ $K = 0.72$

$D = 2.8'$

$$D_s = \frac{3.5}{K} w D S = \left(\frac{3.5}{0.72}\right)(62.4)(0.00853) D^{2.59}$$

$$D_s = 2.59\ D$$

D	2.59	D_s
2		= 5.17"
2.5		= 6.5"
3.0		= 7.8"
3.5		= 9.1"
4.0		= 10.3"
4.5		= 11.6"
5.0		= 12.9"
5.5		= 14.2"
6.0		= 15.5"

Q = 1930 cfs. Width 75'

critical depth normal depth

Arizona — Powerline Floodway

G. Hanley 2-21-68

Solving for normal depth & critical depth of flow where:

$Q = 1930$ cfs $b = 75'$ $S = .00853$

$\frac{Q}{b} = \frac{1930}{75} = 25.73$ $\frac{z}{b} : \frac{2}{75} = 0.0267$

using ES-24 Chart $d_c = 2.65$

Depth	T	A	v	V	Q cfs	Q/b
2.0	68	128	1.86	10.87	1391	
2.2	68.8	191.68	2.03	11.59	1642	
2.4	69.6	155.52	2.20	12.28	1910	25.5
2.6	70.4	169.52	2.37	12.95	2195	29.3
2.8	71.2	183.68	2.53	13.61	2500	33.3
3.0	72.0	198.00	2.70	14.25	2822	37.6
3.4	73.6	227.12	3.02	15.49	3518	46.9
3.6	74.4	241.92	3.18	16.09	3892	52
3.8	75.2	256.88	3.34	16.68	4285	57
4.0	76.0	272.00	3.49	17.26	4695	62.6
4.2	76.8	287.28	3.65	17.83	5122	68
4.4	77.6	302.72	3.80	18.39		
4.6	78.4	318.32	3.95	18.95		
4.8	79.2	334.08	4.10	19.49		
5.0	80.0	350.00	4.25	20.03		

Q/b	d_c ES 24
26	2.75
33	3.15
38	3.42
47	3.95
52	4.25
57	4.45
63	4.75
68	5.0

sta 424 stop waste

So. 425 to 428 is higher So. side — the rest on grade —

rock	10.00
concrete	80.00
excav —	5.00
Back	4.00
channel Exc.	30
dike Fill	60
bottom Rock Rip	6.00

~~X~~ sand starts 472+00

Clark
Robt.

1056
.002
48.7 1 2
2.1
46.6

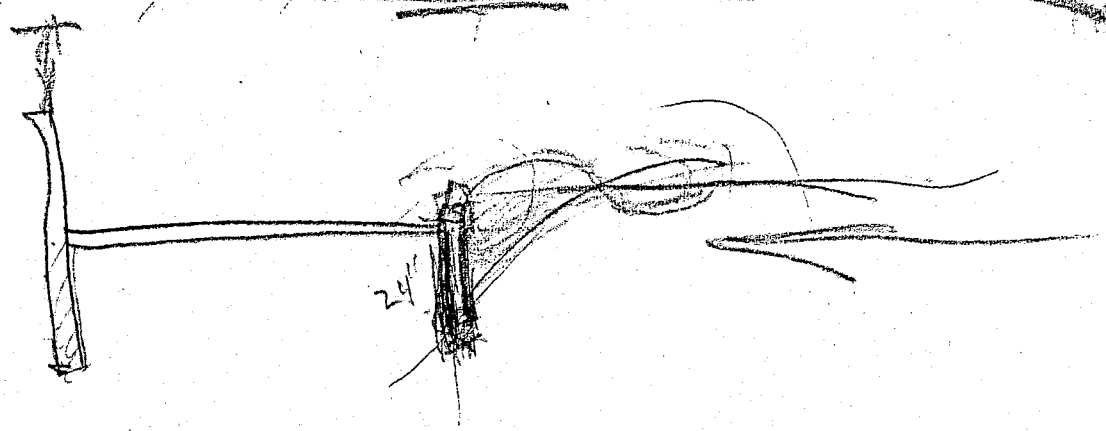
8'

E. Coal
Ramps
Back -

Top		℄	Slope
34.2	400 sta	428+28 - ~~4~~	.00296
27.8		450 + ~~25~~ 50 ℄	℄
50.7		379+92 - 400	.00387

See Turner about photos —

State off Photos ←→



SCS-529
REV 8-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

EARTHWORK COMPUTATION SHEET

LOCATION	OWNER	
WATERSHED Powerline Floodway	SUB-WATERSHED	SITE NO.
CONTRACTOR	COMPUTED BY G. Hanley	DATE 2-21-68
ITEM Silt deposit (excavation)	CHECKED BY	DATE
CONTRACT NO. from Dec. 1967 rainfall	ESTIMATE _____ CU. YDS.	ACTUAL _____ CU. YDS.

Scale = 10"x10" = 100'/in

STATION	END AREA SQ. IN.	END AREA SQ. FT.	SUM OF END AREAS SQ. FT.	DISTANCE IN FEET	SECTION PRODUCTS CU. FT.	VOLUME CU. YD. (Accum.)	REMARKS
455+00	0	0					
456	0.15	15	15	100		28	
457	0.21	21	36			94	
458	0.24	24	45			178	
459	0.30	30	54			278	
460	0.27	27	57			383	
461	0.42	42	69			511	
462	0.41	41	83			665	
463	0.58	58	99			848	
465	0.88	88	146			1119	
466	0.78	79	167			1428	
467	1.20	120	199	100		1796	
467+50	0	0	120	50		1907	Yds^3

SHEET _____ OF _____ SHEETS

Quantities:

STEEL

36 cy concrete = 972 ft³

@ 6" thickness = 1944 ft²

2' steel per ft² = 3888 ft steel

allow 20% increase 4666 ft

#4 bar = .668 lbs

TOTAL = 3117 lbs

4.0
30
1200

Cost:

Item	Units yd³	Unit Cost	Total Cost
Exc.	202	5.00	1010
Backfill	75	4.00	300
Concrete	36	80.00	2880
Steel	3117	0.20	630
Grouted Rock	110	15.00	1650
			$6,470

for 2' drop

Assume 1'-6" drop and 1'-0" drop @ same cost.

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO : 1959 O—487227

STATE Ariz | PROJECT Powerline Channel
BY EA | DATE | CHECKED BY | DATE | JOB NO.
SUBJECT Channel Stabilization | SHEET 16 OF

Quantities

Structural Backfill

Excav. − Vol Concrete Str.

Vol -

headwalls		180
		28
		40
box	(2.5×61×20.5)	3120
cutoff.		75
endwall		20
		3463 ft³

Exc. − Vol

5501 − 3463 = 2038 ft³

Backfill: $\frac{2038}{27} = \underline{\underline{75}}$ c.y.

COMPUTATION SHEET
SCS-523A REV 5-59

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO : 1959 O—497527

STATE Ariz. | PROJECT Powerline Channel
BY RA | DATE 2-68 | CHECKED BY | DATE | JOB NO.
SUBJECT Channel Stabilization | SHEET 15 OF

Quantities

Concrete:

headwall –	$6(6.0).5$	=	180 ft³
	$2\left(\frac{6+8}{2}\right)(4).5$	=	28
	$2(5(8).5)$	=	40
sidewall	$2(1.5\times20).5$	=	30
slab	$20\times60\times.5$	=	600
cutoff	$2.5\times60\times.5$	=	75
endwall	$2(5\times4\times.5)$	=	20
			973 ft³

$\frac{973}{27}$ = 36 cy

EXCAVATION (Assum Channel grade @ creek.)
18" vertical plane incl. cutoffs.

box =	$2.5(6\frac{1}{3})\times20.5$	=	3230
Headwalls =	$2(10.5\times6\times3.5)$	=	442
	$2\left(\frac{10.5\times5.5}{2}\times3.5\right)$	=	202
Cutoffs up	$4\times60\times3.5$	=	840
down	$2.5\times60\times3.5$	=	525
endwalls	$2(5.5\times4\times3.5$	=	1154
	$2\left(\frac{5.5\times3}{2}\times3.5\right)$	=	57
			5450

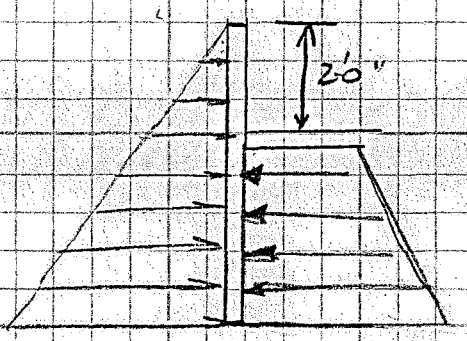
$\frac{5500}{27}$ = 202 cy.

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO : 1959 O—497927

STATE Ariz	PROJECT			
BY RA	DATE 2-68	CHECKED BY	DATE	JOB NO.
SUBJECT				SHEET 14 OF

HEAD WALL



Ignore footing

Overturning Moment - $\Sigma FP = 65$ psf

$$M = \frac{wl^3}{6} = \frac{65(2)^3}{6}$$

$$= 86 \text{ ft lbs}$$

Temp Steel Governs-

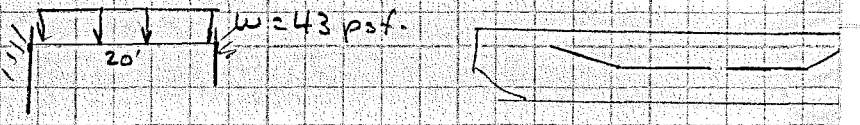
COMPUTATION SHEET
SCS-533A (REV. 5-58)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Ariz. | PROJECT Powerline Channel
BY RA | DATE 3-27-68 | CHECKED BY | DATE | JOB NO.
SUBJECT Modification | SHEET 13A OF

Redesign Steel:

Assume slab fixed on 2 sides only.



Using 8" wall

$M_{pos} = \frac{1}{24} 43 \cdot 20^2 = 716'^{\#}$

$M_{neg} = \frac{1}{12} 43 \cdot 20^2 = -1432'^{\#}$

Steel –

Neg. $d = 4''$ $A_{s\,neg} = .23\ in^2$

Pos. $d = 4''$ $A_{s\,pos} = .14\ in^2$

Temp. $.0025 (8)(12) = .24$

∴ Temperature steel controls –

Use #4 @ 10"

AND Single grid of concrete –

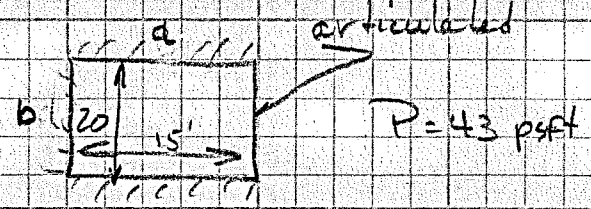
COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO : 1957 O—497927

STATE Ariz	PROJECT Powerline Channel		
BY RA	DATE 2-68	CHECKED BY	DATE	JOB NO.
SUBJECT			SHEET 13 OF

Assume - due to concal. or uneven settlement Load of 43psf does exist -
Assume slab fixed on three sides

Size



$b/a = \frac{20}{15} = 1.33$

Mom. Coeff

x = 0	y = .5	-.15	← max
.2a		-.13	
.4a		-.11	
.6a			

y = 0	x = a	-.1	← max
.1b		-.085	
		-.075	

$M_x = M_x \, pa^2$

$= .15(.43)\,15^2$

$= 1451$ ft lbs. SAY $1.5^{'k}$

$f_c' = 3000'$ $d_{eff} = 3''$

∴ Use 6" slab. chart ES162

$A_s = .37$ in #4@6" : $.39 \text{ in}^2$

Temp steel single grid $.0025(12)6 = .018 \text{ in}^2$

#4@12"

COMPUTATION SHEET
SCS-523A REV 5-59

U. S. DEPARTMENT OF AGRICULTURE
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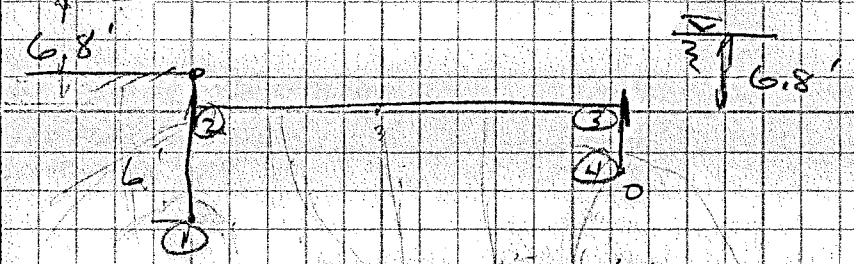
STATE		PROJECT		
BY	DATE	CHECKED BY	DATE	JOB NO.
SUBJECT				SHEET 12 OF

Modification

LOADS:

Slab Thickness



Assume 6" slab,

Press (1) 1278/62.4 = 798

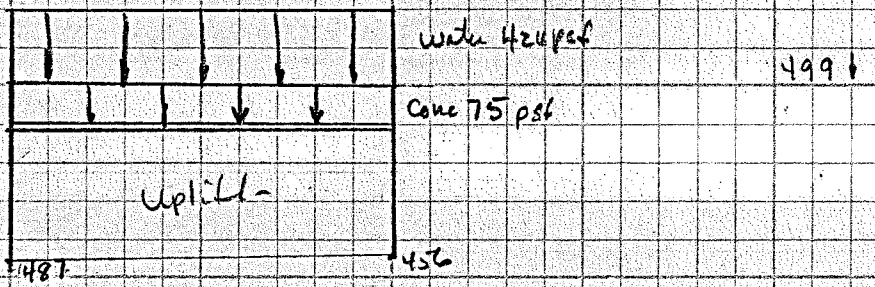
(2) 8.8(62.4) − 62.4) = 549 − 62 = 487

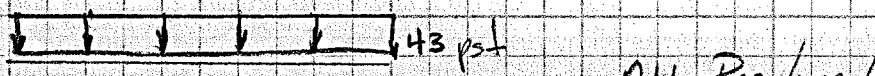
(3) 8.8(62.4 − 1.5(62.4)) = 549 − 93 = 456

(4) 9.3(62.4) − 2.0(62.4) = 580 − 125 = 455

Wt. slab .5(150) = 75 psf

Tailwater = 6.8(62.4) = 424 psf





All Positive!!

DESIGN LOAD

COMPUTATION SHEET
SCS-523A REV 5-60

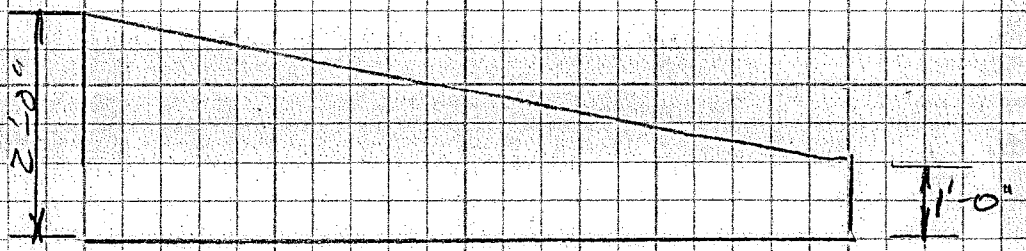
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO : 1959 O-497927

STATE		PROJECT		
BY	DATE	CHECKED BY	DATE	JOB NO.

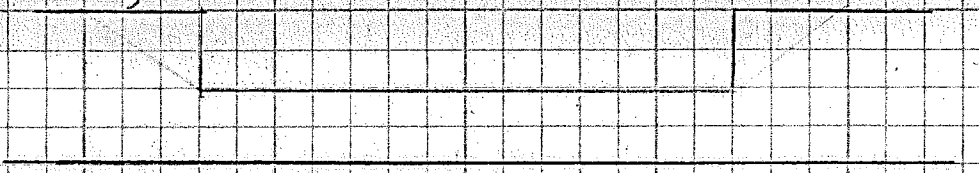
SUBJECT

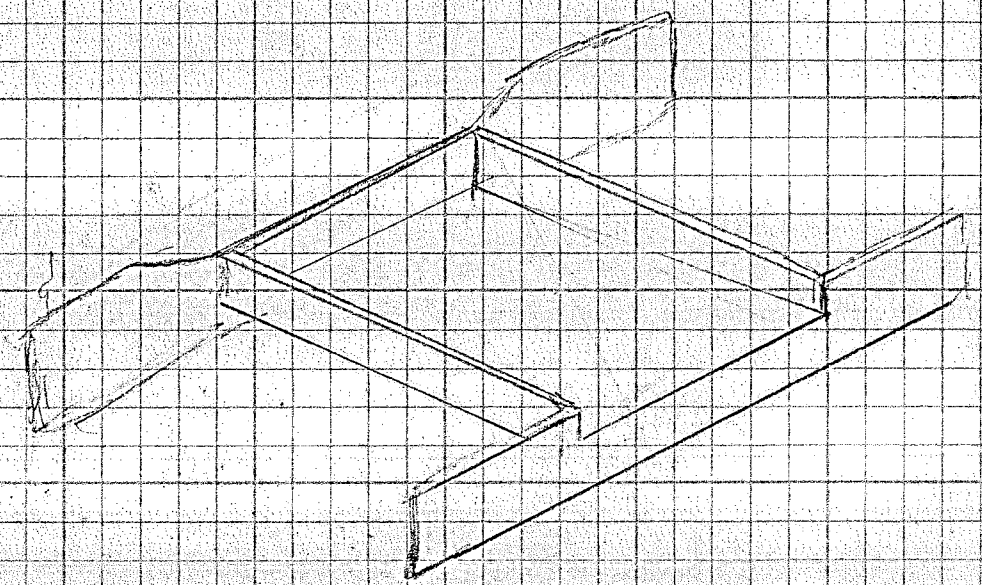
SHEET 11 OF

SIDEWALL



End wall





Isometric

COMPUTATION SHEET
SCS-ES3A REV. 5-58

U. S. DEPARTMENT OF AGRICULTURE
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GPO : 1959 O—497827

STATE		PROJECT		
Ariz		Powerline Channel		
BY	DATE	CHECKED BY	DATE	JOB NO.
RA	2-68			

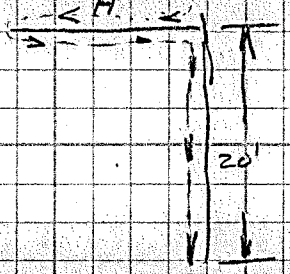
SUBJECT

SHEET 10 OF

Headwall length -

Wake Head difference - 2'-0"

$C_w = 8.5$

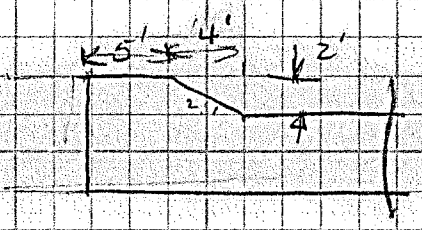


$$C_w = \frac{L + 3(H-2)}{3H}$$

$$8.5 = \frac{20 + 6H}{6}$$

$$6H = 51.0 - 20$$

$$H = \frac{31}{6} = 5.1 \text{ ft.} \quad \text{make } 5'-0"$$



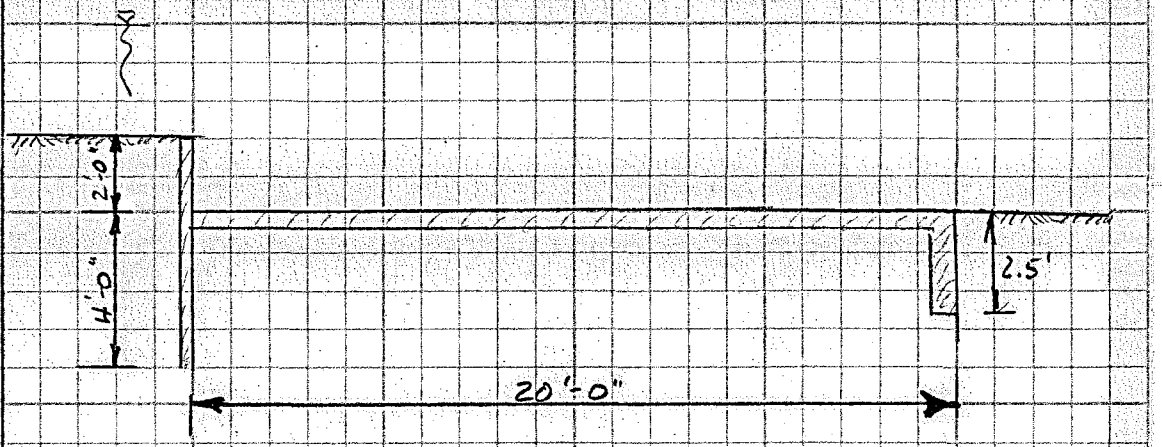
COMPUTATION SHEET
SCS-323A REV 5-59

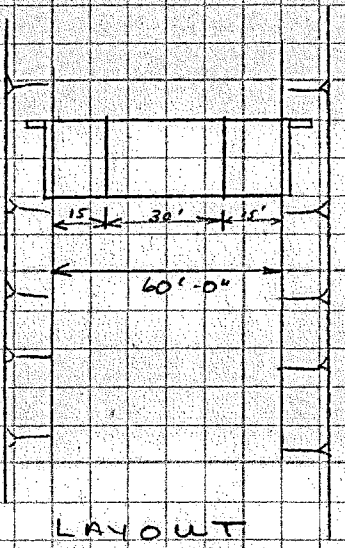
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO 1959 O—457927

STATE		PROJECT		
Ariz		Powerline Channel		
BY	DATE	CHECKED BY	DATE	JOB NO.
RA	2-68			

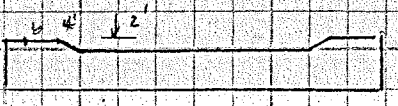
SUBJECT: Channel Stabilization — SHEET 9 OF

Drop Design





LAYOUT



COMPUTATION SHEET
SCS-ECSA REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO : 1959 O—497927

STATE Ariz | PROJECT Powerline Channel
BY RA | DATE 2-68 | CHECKED BY | DATE | JOB NO.
SUBJECT Channel Stabilization - | SHEET 8 OF

416+17 to 428+50 = 1233 ft.

.002(1233) = 2.466

Begin 1' drop sta 428+58 see below

Crest elev - 1334.5
Sill Elev 1333.54

sta 428+70 to sta 450+25 = 215.5'

.002(215.5) = 4.310'

working back ramp elev = 27.8'

grade @ sta place @ 1328.3

∴ 1328.3 + 4.3 = 1332.6

∴ Drop would be 1334.5
− 1332.6
1.9 ft say 2.0'

Provide 2.0' Drop sta 428.5

Crest 1334.5
Sill 1332.5 ft.

COMPUTATION SHEET
SCS-523A REV 5-59

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO : 1959 O—497527

STATE Ariz | PROJECT Powerline Channel
BY RA | DATE 2-68 | CHECKED BY | DATE | JOB NO.
SUBJECT

SHEET 7 OF

RE DESIGN USING 1'-6" drops

on Slope = 0.002 %

Begin Drop sta 380+24 (Use 2'-0" here)

Crest Elev. 1350.7
Sill Elev. 1348.7 end sta 380+44

8100
40
56
1002
112

391+00 to 380+44 = 1056 ft.
.002 x 1056 =

Make 392+00

Move to Sta. 393+00 to avoid excavation

Begin Drop sta 391+00 (Use 2'-0" Drop)

Crest Elev. 1346.6
Sill Elev 1344.6 sta 391+20

sta 391+20 to 401+20 = 1000'
.002(1000) = 2.0'

Begin Drop sta 401+20

Crest Elev. 1342.6
Sill Elev. 1341.1 sta 401+39

416+00 to 401+40 = 1460'
.002 x 1460 = 2.92 ft.

Begin Drop sta 416+00 Use 1'-2" Drop.

Crest Elev - 1338.2
Sill Elev 1337.0 sta 416+17'

416+17 to sta 428+28 = 1211'
.002 x 1211 = 2.42'
ch. grade @ Ramp: 34.6 ok.

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO : 1959 O—497927

STATE Ariz	PROJECT Powerline Channel		
BY RM	DATE 2-68	CHECKED BY	DATE	JOB NO.
SUBJECT			SHEET 6 OF

3. Provide 2 ft Drop Sta 410+00

Crest Elev = 1340.4
Sill Elev 1338.4

Sta. 410+20 to Sta 428+20 = 1800 ft.

.002 × 1800 = 3.6' drop.

4. Provide 2 ft Drop Sta. 428+20

Crest Elev 1334.8
Sill Elev 1332.8

428+40 to 445+00 = 1660
.002 × (1660) = 3.32 ft.
5. Sta 445+00 to Sta 451+00 = 600'

.002(600) = 1.20 ft

5. Provide 1 ft drop Sta 445+00

Crest Elev. 1329.5 ft.
Sill Elev 1328.5 ft.

@ Sta 451+00 Elev 1327.3 (= crest of Ramp
∴ okay —

COMPUTATION SHEET
SCS-523A REV 5-50

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO 1959 O—457527

STATE Ariz | PROJECT Powerline Channel
BY RA | DATE 2-68 | CHECKED BY | DATE | JOB NO.
SUBJECT

SHEET 5 OF

The previous locations for the drops require excessive additional earth fill at the banks and additional rock rip rap to increase the protected area of the banks. Therefore relocate the drops to minimize these requirements -

1. Provide 2 ft drop @ Sta. 378+80

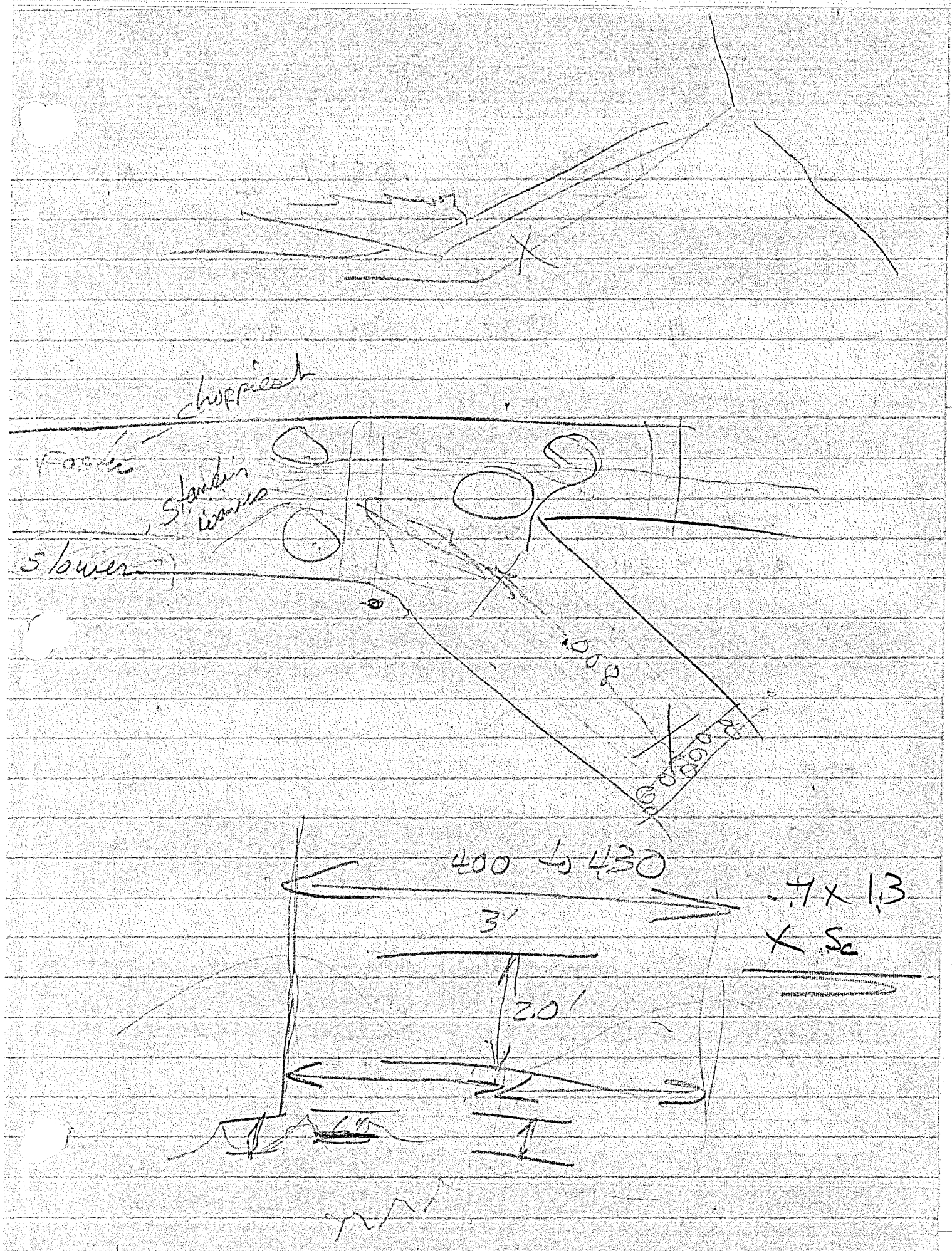
Crest Elev. 1350.60
Sill Elev. 1348.60 Sta 379+00
Length Sill 20'

395+00 to 379+00 = 1600 ft
.002 x 1600 = 3.2' drop
Grade Elev 1348.6 − 3.2 = 1345.4

2. Provide 2 ft drop @ Sta 395+00

Crest Elev. 1345.4
Sill El. 1343.4

395+20 to 410+00 = 1480 ft
.002 x 1480 = 2.96 ft Say 3.0'


choppiest
Faster
standing waves
slower
400 to 430
3'
.7 x 1.3
x Sc
20'

COMPUTATION SHEET
SCS-ENGR. REV. 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO : 1959 O—487927

STATE: Arizona | PROJECT: Powerline Channel
BY: C. Ware | DATE: 2/16/68 | CHECKED BY: | DATE: | JOB NO.: FCD No 2
SUBJECT: Drop structures | SHEET ___ OF ___

(1) Design for Creep
use $C_W = 8.5$ (Maximum)

$$3\Sigma L_V = C_W \times 3H - \Sigma L_H$$
$$L_V = \frac{C_W \times 3H - \Sigma L_H}{3}$$

For $H = 2.0$ $\quad \Sigma H = 20'$

$$L_V = \frac{(8.5 \times 6) - 20}{3} = 10.33$$

(2) For $H = 1.6$ $\quad \Sigma H = 19.3'$

$$\Sigma L_V = \frac{8.5(3)(1.6) - 19.3}{3} = 7.17$$

(3) For $H = 1.0$ $\quad \Sigma H = 17.4$

$$\Sigma L_V = \frac{8.5(3)(1.0) - 17.4}{3} = 2.7$$

Trials for Solving t_1

(1) use $t_2 = 2.0'$, $t_1 = \frac{10.33 - 2}{2} = 4.2'$

use $t_2 = 2.5$, $t_1 = \frac{10.33 - 2.5}{2} = 3.92$

use $t_2 = \underline{2.5}$ and $t_1 = \underline{4.0}'$

(2) use $t_2 = 1.5$, $t_1 = \frac{7.17 - 1.5}{2} = 2.84$

use $t_2 = 1.75$, $t_1 = \frac{7.17 - 1.75}{2} = 2.71$

use $t_2 = 1.25$, $t_1 = \frac{7.17 - 1.25}{2} = 2.96$

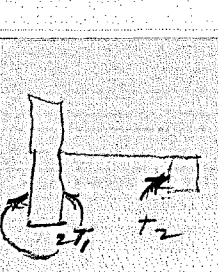
use $t_2 = \underline{1.5}$ and $t_1 = \underline{3.0}$

(3) use $t_2 = 0.5$, $t_1 = \frac{2.7 - .5}{2} = \frac{2.2}{2} = 1.1$

use $t_2 = .75$, $t_1 = \frac{2.7 - .75}{2} = 0.975$

use $t_2 = \underline{1.0}$ and $t_1 = \underline{1.5}$ as Minimum design

2' Head
1.6 Head
1' Head



FOR 2' head

use 8.5 for creep ratio

2/16/68
Ware

$CW \times 3H = \Sigma LH = 3\Sigma LV$

$3\Sigma LV = CW \times 3H - \Sigma LH$

$3\Sigma LV = 8.5 \times 3(2\alpha) - 20$

$\Sigma LV = \frac{8.5 \times 6 - 20}{3} = 10.33$

① use $t_2 = 2.0'$

$t_1 = \frac{10.33 - 2}{2} = 4.2'$

① use $t_2 = 2.5'$

$T_1 = \frac{10.33 - 2.5}{2} = 3.92'$ use 4'

use $t_2 = 2.5$ & $t_1 = 4.0'$

(2) For 1.6' head

$\Sigma LV = \frac{8.5(3)(1.6) - 19.3}{3} = \frac{21.5}{3} = 7.17$

② use $t_2 = 1.5'$

$T_1 = \frac{7.17 - 1.5}{2} = 2.84$

use 2.85'

use $t_2 = 1.5$ & $t_1 = 3.0$

② use $t_2 = 1.75$

$t_1 = \frac{7.17 - 1.75}{2} = 2.71$

② use $t_2 = 1.25$

$t_1 = \frac{7.17 - 1.25}{2} = 2.96$

(3) For 1.0' head

$\Sigma LV = \frac{8.5(3)(1.0) - 17.4}{3}$

$\Sigma LV = \frac{8.1}{3} = 2.7$

use $t_2 = 0.5$

$t_1 = \frac{2.7 - .5}{2} = \frac{2.2}{2} = 1.1$

use $t_2 = .75$

$t_1 = \frac{2.7 - .75}{2} = 0.975$

use as Minimum - $t_2 = 1.0$ & $t_1 = 1.5$

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO : 1959 O-497027

STATE	Ariz	PROJECT	Powerline Channel	
BY RA	DATE 2-68	CHECKED BY	DATE	JOB NO.
SUBJECT				SHEET 2 OF

Assume 2'-0" Drops to be installed.

$d_n > d_c$ ∴ MILD SLOPE Method Applies

$F = 2.0$, $F/d_c = 2/4.2 = 0.476$

SLOPE	d_n/d_c	F/d_c	S/d_c	C_L	$\sqrt{F d_c}$	Apron Length	Remarks
.001	1.957	.476	no sill required	6.9	2.9	20.01'	Use 20' Apron no sill
.0015	1.757	.476	"	"	"	"	
.002	1.614	.476	"	"	"	"	
.0025	1.521	.476	"	"	"	"	

For 1'6" Drops

$F/d_c = \frac{1.5}{4.2} = 0.357$

$C_L = 7.7$

$L = C_L \sqrt{F d_c} = 7.7 (1.5 \cdot 4.2)^{1/2}$

$= 19.3$ ft. ⟵

For 1'-0" Drops

$F/d_c = \frac{1}{4.2} = .238$

$C_L = 8.5$

$L = 8.5 \sqrt{1 \times 4.2}$

$= 17.4$ ft. ⟵

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO : 1959 O—497927

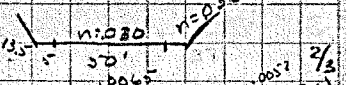
STATE Ariz | PROJECT Powerline Channel
BY RA | DATE 1-68 | CHECKED BY | DATE | JOB NO.
SUBJECT STABILIZER DESIGN | SHEET 1 OF

Low Drops or Stabilizers

Reference - Low Drop Design - B. Ochibani Oct 1962

Given: $n = .031$ $Q = 3140$ cfs $S_{o_1} = .003847$ $S_{o_2} = .00296$

$z = 2$ $b = 60$ ft



$$n = \frac{(37 \times .035^{3/2} + 50 \times .03^{3/2})^{2/3}}{87}$$

$$= (.005747)^{2/3}$$

$$= .032$$

Determine d_c

$$\frac{Q_c}{b} = \frac{3140}{60} = 52.33$$

$$\frac{Tz}{b} = \frac{2}{60} = .033$$

$d_c = 4.20$ ft.

Determine d_n

$$\frac{nQ}{b^{8/3} S^{1/2}} = \frac{.032(3140)}{55,174\,(S^{1/2})} = \frac{.002003}{S^{1/2}} = .03682$$

Area	Vel	slope	$S^{1/2}$	$\frac{.002003}{S^{1/2}}$	D/b	d
628	5.0	0.001	.03162	.0633	.137	8.22
551.7	5.69	.0015	.03873	.0517	.123	7.38
498.7	6.29	.002	.04472	.0447	.113	6.78
465	6.75	.0025	.050	.0400	.1065	6.39
457.4	6.86	.00296		.0368	.1050	6.30

HWF

(Rough Draft)
B.B. Ochitani

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ENGINEERING AND WATERSHED PLANNING UNIT
PORTLAND, OREGON

LOW DROP DESIGN
(GRADE STABILIZERS)

Prepared By
Boon B. Ochitani
and the E&WP Unit Staff

Under the Supervision of
Francis K. Mucous

DESIGN SECTION
October 1962

This design procedure is an abstract of "Experimental Design of Low Rectangular Drops for Alluvial Flood Channels" by V. A. Vanoni and M. E. Pollak, Report No. E.62 and "Hydraulic Model Studies of Modifications of Existing Grade-Control Structures in Arroyo Simi" by V. A. Vanoni, Tech. Memo No. 61-9.

Definitions. The low drop structure is a control across unstable streams and channels. The structure consists of a headwall, cutoff wall and apron, with protected channel sides of the drop.

Uses. The structure is used to stabilize grade.

Layout. The low drop structure is constructed perpendicular to the direction of flow and the lined crest section extends across the full width of the channel. The proportioned apron is placed below the crest. The cutoff walls anchor the structure in the stream bed.

CONCLUSIONS AND RECOMMENDATIONS (From Report No. E.62)

1. For a drop structure in a channel with a steep slope, and a given flow rate and drop height, the depth of the basin required for satisfactory performance tends to increase as the Froude number increases.

2. For structures on mild slopes with a given discharge and drop height, the basin length and depth required for satisfactory performance tends to increase as the depth of the water downstream increases. Stated in other words, as the backwater on the structure is increased, the depth of basin required for satisfactory performance diminishes. When the ratio of tailwater or downstream depth to critical depth is greater than 1.27, the transverse sill is not included in the design.

The rigid basin length is then a function of the critical depth and drop height.

If there is a highly variable stage in the channel and the minimum downstream depth can not be maintained, the need for the transverse sill becomes a critical design factor.

3. The experiments in the laboratory were conducted in a two-dimensional flow system and hence do not truly represent the conditions that occur in a field structure, especially near the banks. Field experience and experiments by others indicate that there would be an attack on the banks by the overfalling water. This condition must be taken care of by reinforcing the bank revetment at the structure and for short distances upstream and downstream from it.

The limits of application for this condensed analysis are as follows:

(1) Steep channel slopes with Froude numbers less than 1.5 ($Fn < 1.5$)

(2) Fall to critical depth ratio between 0.25 and 0.65 (F/d_c range = 0.25 to 0.65)

(3) Depth of water downstream to critical depth ratio between 1.06 and 1.27 (d_d/d_c range = 1.06 to 1.27) for transverse sill and greater than 1.27 for no transverse sill ($d_d/d_c > 1.27$).

(4) The low drops are designed only for unstable stream beds and are not considered for heavily cobbled or rock-based stream channels.

The side slopes at the approach and exit of all design drops shall be protected with rock riprap for a minimum reach of 20'-0". It is well to point out here that the width of the stream does not appear in the list of variables, which means that it has been assumed that the stream is wide compared to its depth and may be considered two-dimensional.

The Froude number is defined by the following $F_R = V/\sqrt{gd}$ where V is the mean velocity of the water obtained by dividing flow rate by cross-sectional area, d is average depth of flow, and g is the gravitational acceleration. Unless otherwise stated, the Froude number is the one upstream of the drop.

Figures 1 and 2 clearly define the terms used in the following solution.

d_u is average depth upstream and

d_d is average depth downstream.

Mild slope - Compute d_d by theory of steady non-uniform flow in open channels, d_d maximum cannot exceed normal depth for a given channel. d_d minimum will occur when the structures are very close together and it is an improbable value since it is uneconomical to place structures very close together. Because the distance between drops may vary from job to job, one must anticipate that the depth d_d may take on a range of values between d_c and normal depth.

Steep slope - d_d is not considered.

The curves for the solution of proportioning low drops are limited by experimental data collected from the model studies conducted, and only values falling within these limits are considered.

PROCEDURE FOR DESIGN OF LOW DROPS

CASE I. MILD SLOPE ($d_n > d_c$ and $d_d/d_c < 1.27$), TRANSVERSE SILL.

1. Use Figures 1, 2 and 3.
2. Given F, n, Q, So, Z, b, compute d_c and d_d.
3. Evaluate d_d/d_c F/d_c. Enter chart on Figure 3. Select S/d_c value within computed range. Solve for S (height of sill).
4. Using F/d_c, enter Figure 3 and select C_L value, at intercept with 1.2 C_L min. line.
5. Compute L.

$$L \text{ (Length of Basin)} = C_L\sqrt{Fd_c}$$

CASE II. MILD SLOPE ($d_n > d_c$ and $d_d/d_c > 1.27$), NO TRANSVERSE SILL.

1. Use Figures 1, 2, and 3.
2. Given F, n, Q, So, Z, b, compute d_c and d_n.
3. Evaluate F/d_c and d_d/d_c. Enter chart on Figure 3, and select C_L value at the minimum value line.
4. Compute L.

$$L \text{ (Length of rigid apron)} = C_L\sqrt{Fd_c}.$$

CASE III. STEEP SLOPE ($d_n < d_c$)

Use Figures 1, 2 and 3.

1. Evaluate $F_n = V/\sqrt{gd}$.
2. Given: F, n, Q, So, Z and b, compute d_c.
3. Evaluate F/d_c and enter chart on Figure 3.
4. Select S/d_c value and solve for S.
5. Enter Figure 3 and select C_L value and solve for L (Length of basin) $= C_L\sqrt{Fd_c}$.

TYPICAL DESIGN PROBLEMS

EXAMPLE X:

GIVEN: TRAPEZOIDAL CHANNEL.

NOTE: Use Warp Approach and outlet sections to rectangular drops.

$Z = 3$; $n = 0.04$; $Q = 300$; $S_o = 0.01$; $b = 30$; $b^{8/3} = 8690$;

$S^{1/2} = 0.1$

DETERMINE: Proportions for 1'-0" low drop S and L.

SOLUTION:

(1) Compute d_c by HS-24, National Engineering Handbook Section 5.

$Q/b = 300/30 = 10$

$Z/b = 0.1$

$d_c = 1.39$

(2) Compute d_n (normal depth).

$$K = \frac{n\,Q}{b^{8/3}\,S^{1/2}} = \frac{0.04 \times 300}{8690 \times 0.1} = 0.0138$$

$d/b = 0.0582$ $d = 1.75$ feet.

$d > d_c$, Mild Slope Condition.

Proportion drop by Mild Slope Method:

$F = 1'\text{-}0"$, $d_d/d_c = 1.75/1.39 = 1.26$,

$d_c = 1.39'$, $F/d_c = 1/1.39 = 0.72$,

$d_d = 1.75$ feet.

By Figure 3:

$d/d_c = 1.26$.

$\frac{S}{d_c}$ range = 0.19 to 0.35

$S = d_c \times$ range

0.26' to 0.49'

Use still 3" to 6" OK.

$C_L = 5.2$

$L = C_L \sqrt{F\, d_c} = 5.2\sqrt{1 \times 1.39} = 5.2 \times 1.18 = 6.14$ feet.

Use (L) = 6' - 2"

EXAMPLE II:

GIVEN: Change S, other Given data constant.

SOLUTION: Use S = 0.05, $S^{1/2} = 0.2236$, $\frac{n\,Q}{b^{8/3}\, s^{1/2}} = 0.06$

$d/b = 0.037$, $d = 1.11'$, $d_c = 1.39$

$d_n < d_c$ Slope is steep.

∴ Use Steep Slope Analysis.

$A = d\,(b + 2d) = 1.11 \times 33.33 = 37$ sq. ft.

$V = Q/Z = 300/37 = 8.1$ ft./sec.

$Fn = V/\sqrt{gd} = 8.1/\sqrt{32.2 \times 1.11}$

$Fn = 1.33$ Use $F = 0.5$

$F/d_c = 0.5/1.39 = 0.36$

$C_L = 9.2$ (Figure 3)

$L = 9.2\sqrt{\frac{1.39}{2}} = 9.2\sqrt{0.7} = 7.7'$

Use 7' - 10"

S/d_c range 0.35 to 0.37 Use 5" Sill (Figure 3)

EXAMPLE III:

GIVEN: $F = 2.0'$; $b = 64'$; $Q = 3500$ cfs; $Z = 2$; $d_c = 4.33'$;

$n = 0.04$; $S^{1/2} = 0.057$

DETERMINE: L and d_n

SOLUTION:

$$K = \frac{n\,Q}{S^{1/2}\,b^{8/3}} = \frac{(.04)\,(3500)}{(.057)(65,340)} = 0.0376$$

From King's Handbook, $\frac{D}{b} = 0.106$ $\quad d_n = 6.8$

$d_n > d_c$ Mild Slope

$d_n/d_c = 6.8/4.33 = 1.57 > 1.27$ no sill required.

From Figure 3 and $F/d_c = 2/4.33 = 0.46$ $\quad C_L = 6.95$

$$L = C_L\sqrt{Fd_c} = (6.95)\sqrt{(2)(4.33)} = 20'$$

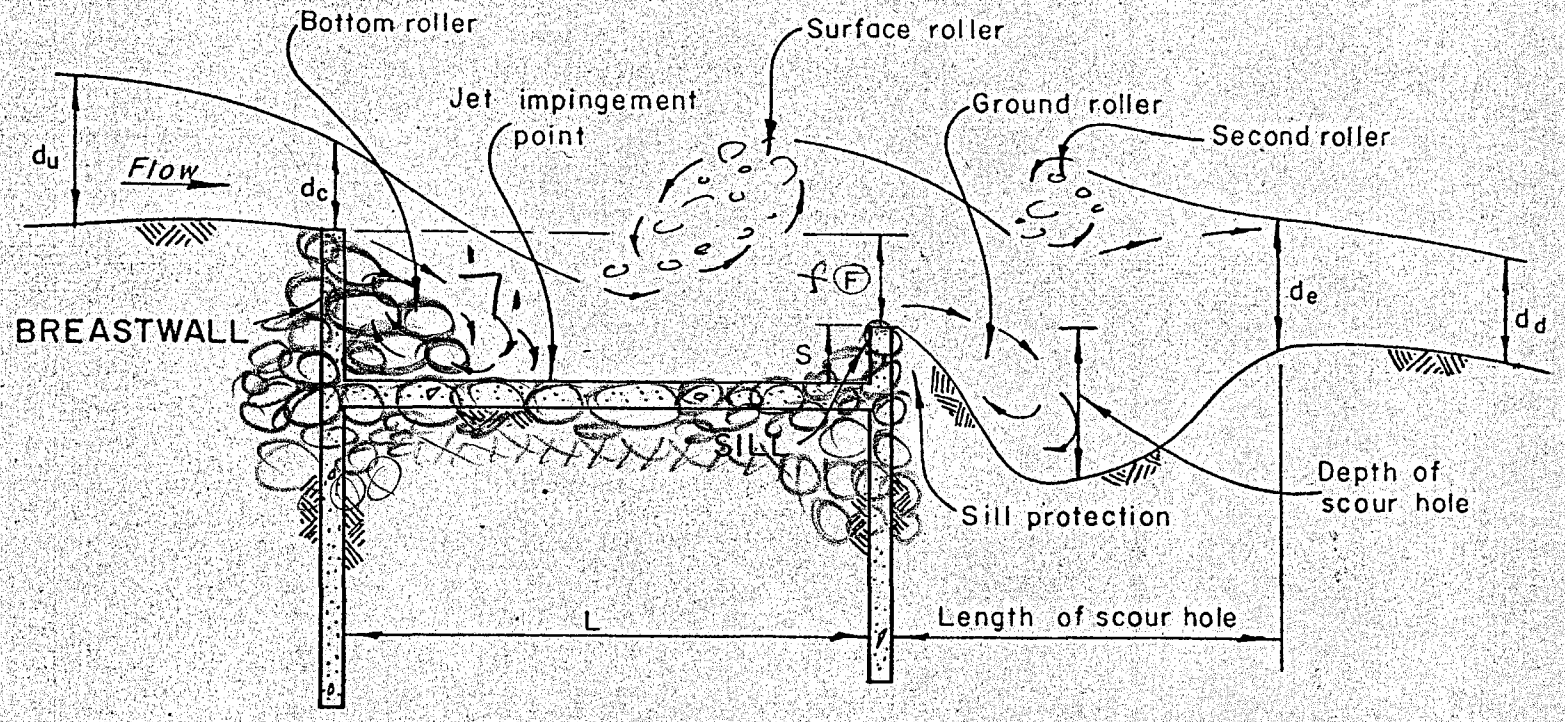
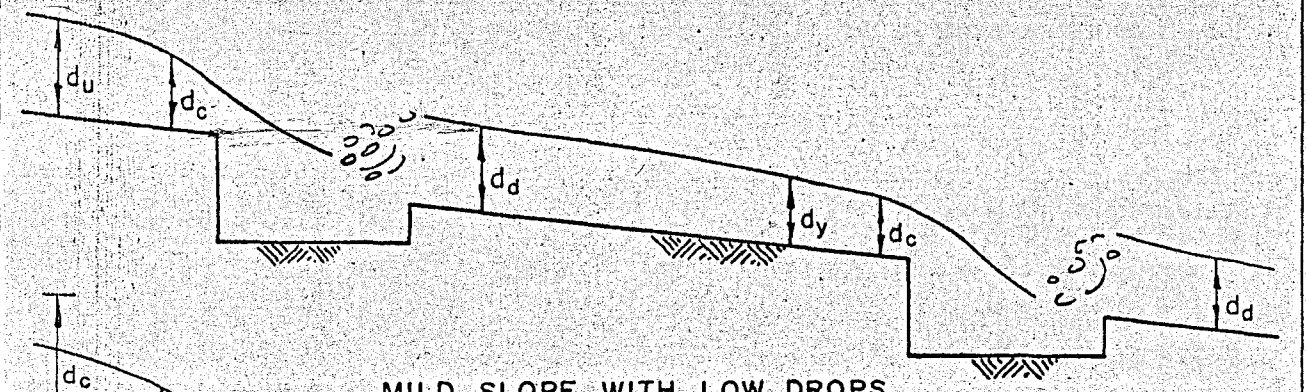
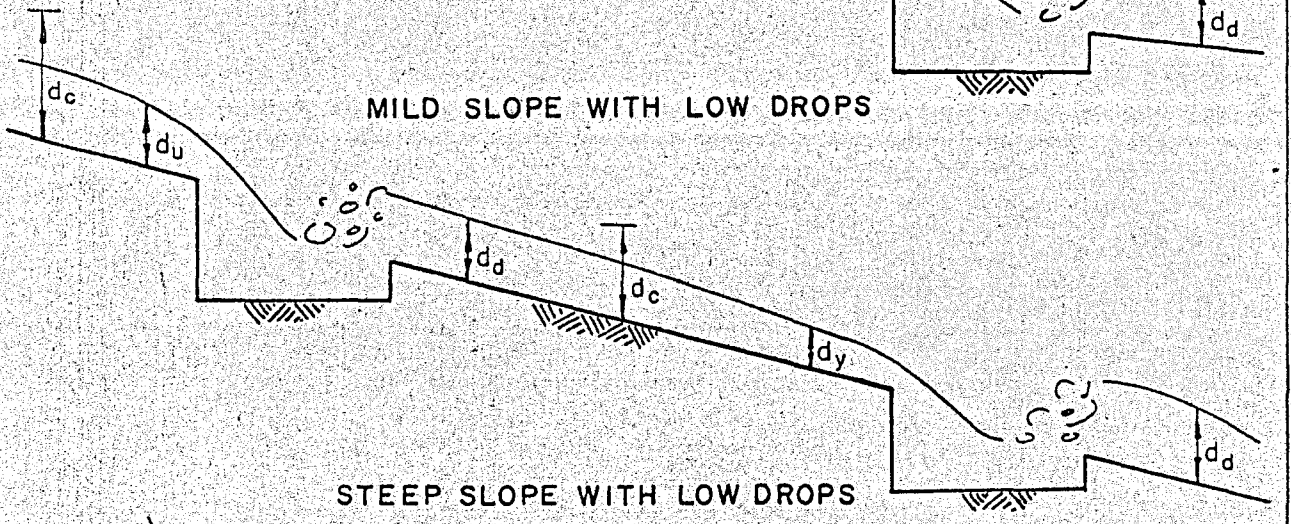

Bottom roller
Surface roller
Jet impingement point
Ground roller
Second roller
d_u
Flow
d_c
f Ⓕ
d_e
d_d
BREASTWALL
S
SILL
Depth of scour hole
Sill protection
L
Length of scour hole

FIG. 1

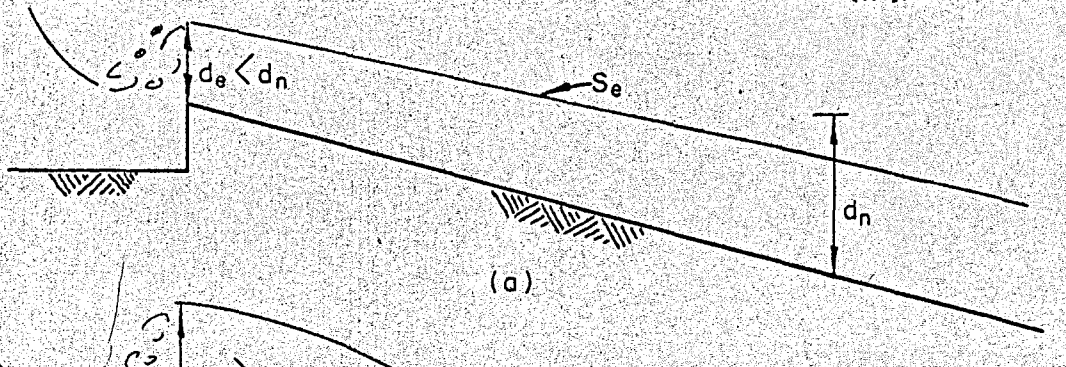
HYDRAULICS: Stabilizers on mild and steep slope. Water surface profile between structures and water surface profiles downstream from drop on steep slope.



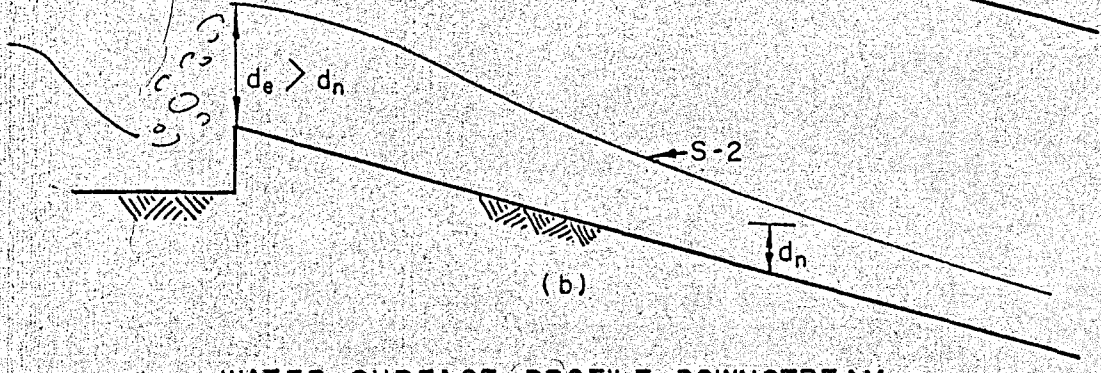
MILD SLOPE WITH LOW DROPS



STEEP SLOPE WITH LOW DROPS



(a)



(b)

WATER SURFACE PROFILE DOWNSTREAM FROM A DROP IN A STEEP SLOPE

FIG. 2

HYDRAULICS: Design curves for low drops.

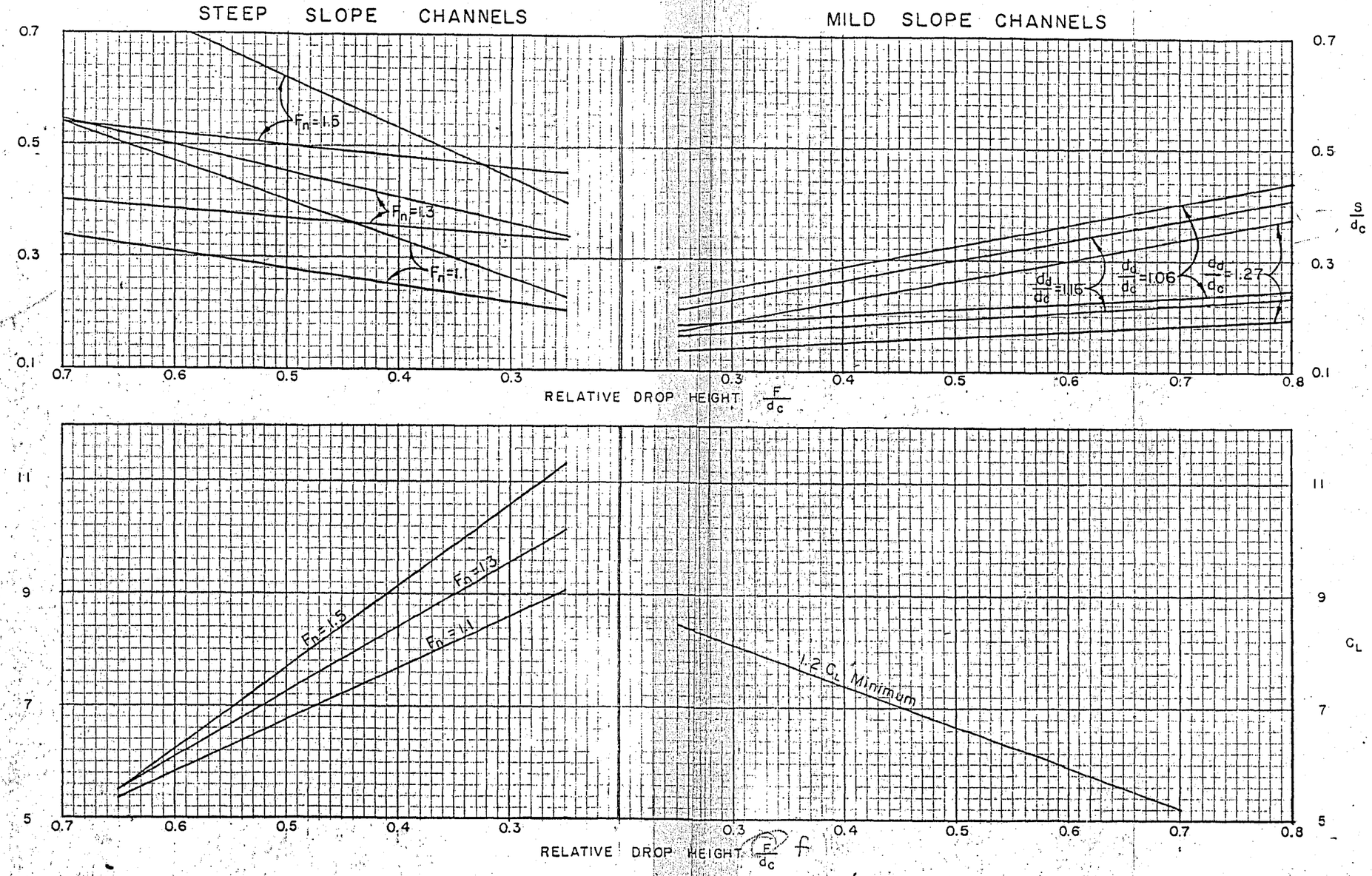


FIG. 3

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO 1959 O—497927

STATE Ariz | PROJECT Powerline Channel
BY RA | DATE 2-68 | CHECKED BY | DATE | JOB NO.
SUBJECT Grade Layouts | SHEET 3 OF

Try slope = 0.002

End Sta 467+50 Elev. 1323.0
Ramp Sta 451+00 Elev. 1327.88
Dist = 1650' Fall 4.88'
@ S = 0.002 drop = 3.30'
∴ Midway place A Drop 1.58'

Elev. Crest $\frac{27.88}{}$ − .002(825) = 1.650 = 26.23

Sill 1323 + .002(825) = 1.65 = 24.65

Place @ sta 459+25

Ramp Sta 427+95 Elev. 1334.71
" Sta 451+00 Elev. 1327.88

Dist 2305' Fall = 6.83'

.002(2305) = 4.61 Allow 6.83
− 4.61
2.22' Drop

Crest Elev. 1334.71 − .002(1152) = 1332.41

Sill 1327.88 + .002(1152) = 1330.18

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO : 1959 O—497927

STATE	Ariz	PROJECT	Powerline Channel	
BY RA	DATE 2-68	CHECKED BY	DATE	JOB NO.

SUBJECT Grade SHEET 4 OF

RAMP Sta 378+50 Elev. 1350.7

RAM Sta 427+95 Elev. 1334.71

Distance 4945 FALL = 16.0

@ S=0.002 Fall= 9.89 ft.

Using 2' drops $\frac{16.0-9.89}{2}$ = 3 drops

Place @ $\frac{4945}{4}$ = 1236 ft intervals

427+95 − 1236 = Sta 415+59

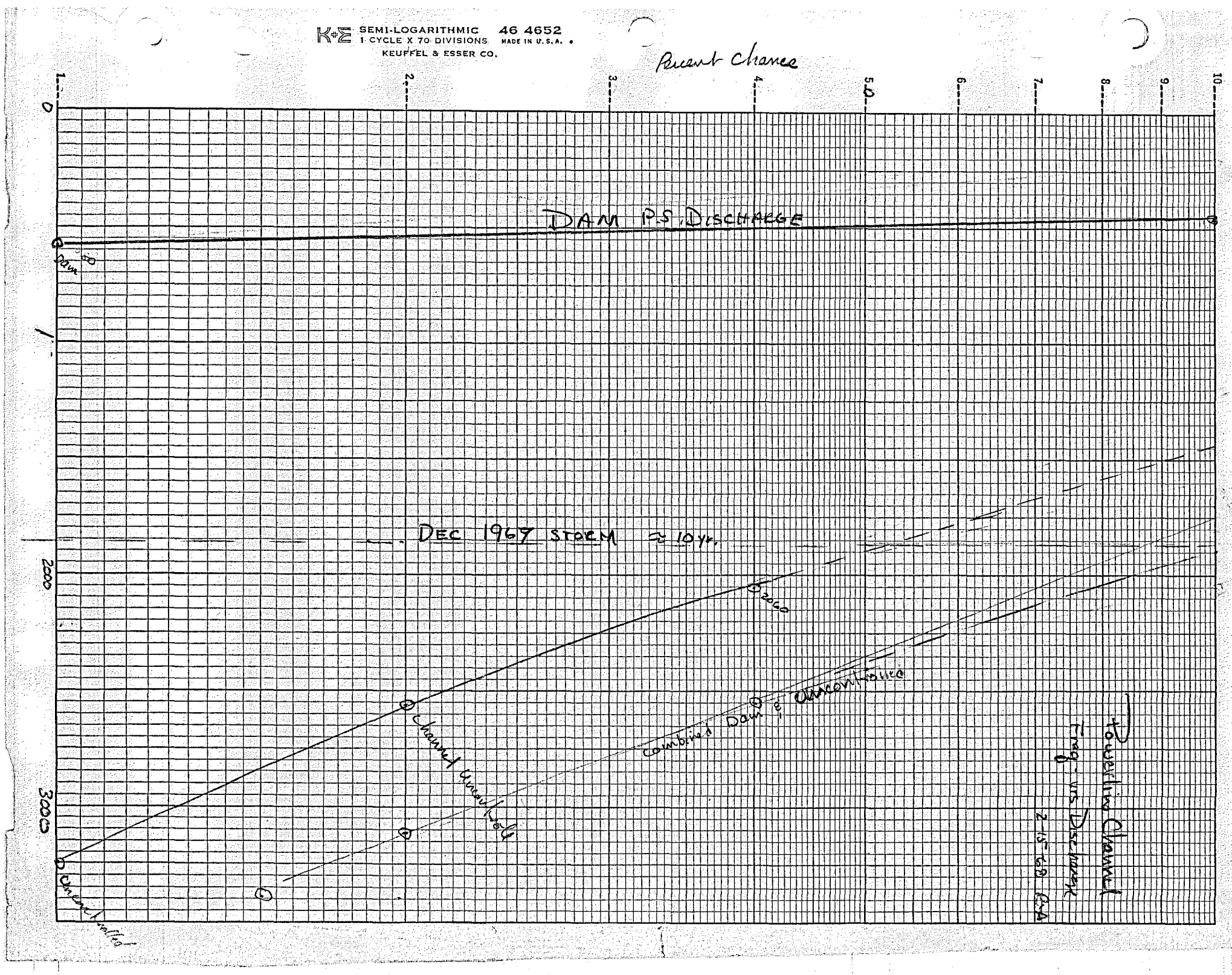
1236 (.002) = 2.472 ft.

STATION	415+59
Crest	1339.18
Sill	1337.18

Sta.	403+23
Crest	1343.65
Sill	1341.65

Sta.	390+87
Crest	1348.12
Sill	1346.12

	Sta.	378+51	
RAMP	Crest	1350.6	close Enough


K+E SEMI-LOGARITHMIC 46 4652
1 CYCLE X 70 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO.
Percent Chance
1
2
3
4
5
6
7
8
9
10
0
1
2000
3000
DAM P.S. DISCHARGE
Dam
DEC 1967 STORM ≈ 10 yr.
2060
Channel Uncontrolled
Combined Dam & Uncontrolled
Uncontrolled
Powerline Channel
Freq. vs Discharge
2-15-68 RA

COMPUTATION SHEET
SCS-523A REV 6-62

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

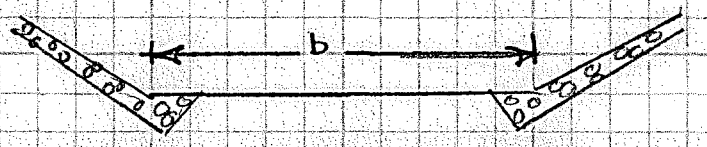
STATE Ariz | PROJECT Powerline Channel
BY RA | DATE 1-68 | CHECKED BY | DATE | JOB NO.
SUBJECT

SHEET 1 OF

Study: stabilization Requirements for the Powerline Channel.

Q = 3140 cfs b = 60' n = .00381 & .00296

Z = 2:1 Use n = .034



$$V = \frac{1.486\, r^{2/3} s^{1/2}}{n}$$

$$= \frac{1.486 (r)^{2/3} (.00381)^{1/2}}{0.034}$$ (.0617)

$$= 2.69\, r^{2/3}$$

S = .0081

Depth	Area	Hydr. Rad		Vel.	Q
2	128	1.86	1.513	4.08	522
4	272	3.49	2.301	6.2	1686
6	432	4.98	2.916	7.84	3386
8	608	6.35	3.429	9.2	5593

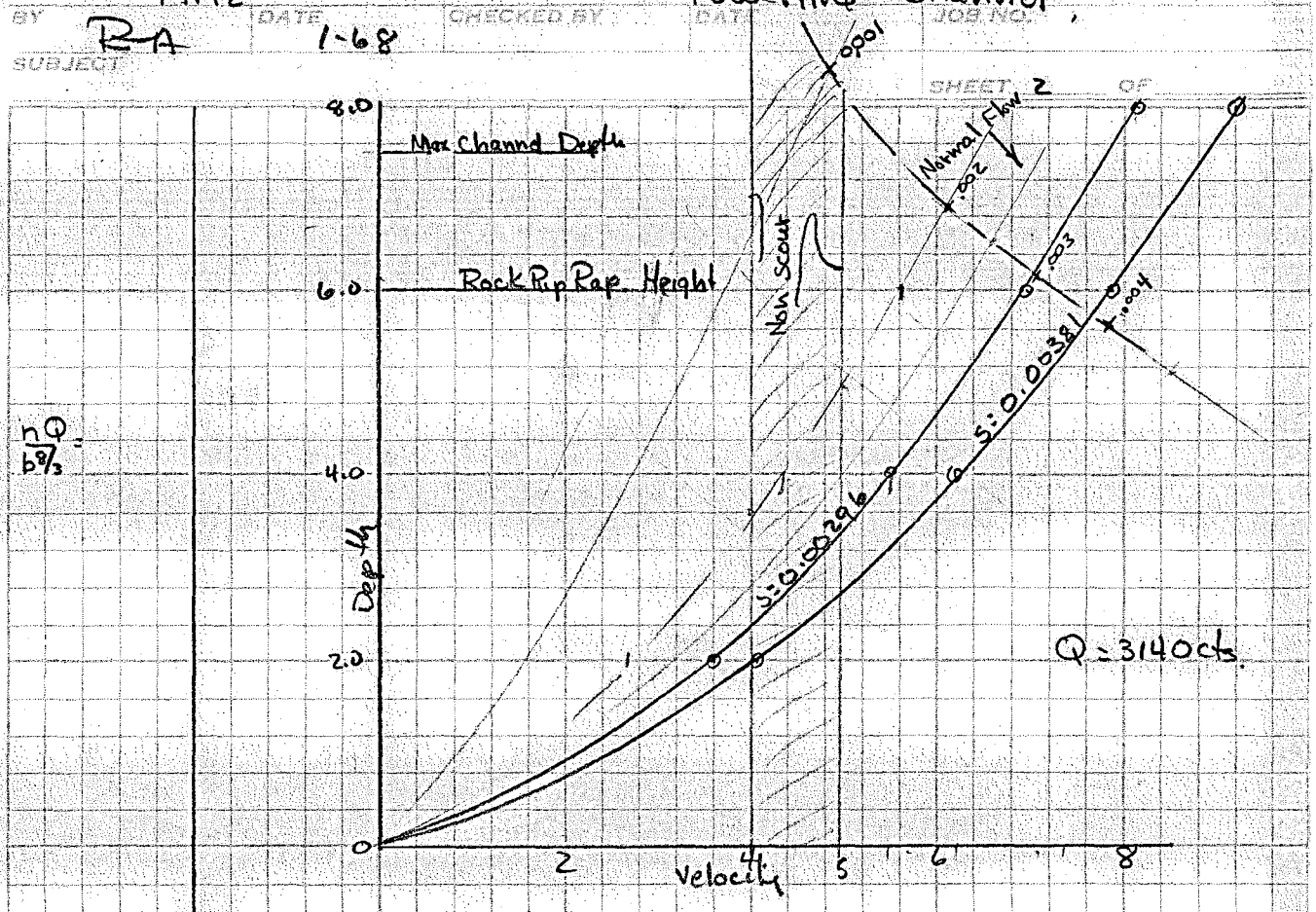
S = 0.00296 $2.38\, r^{2/3}$

2	128	1.513	3.60	461
4	272	2.301	5.47	1487
6	432	2.916	6.94	2998
8	608	3.43	8.16	4961

COMPUTATION SHEET
SCS-503A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Ariz | PROJECT Powerline Channel,
BY RA | DATE 1-68 | CHECKED BY | DAT | JOB NO.
SUBJECT | SHEET 2 OF



$\frac{nQ}{b^{8/3}}$ =

COMPUTATION SHEET
SCS-523A REV 5-53

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Channel.
BY RA DATE 1-68 CHECKED BY DATE JOB NO.
SUBJECT

SHEET 3 OF

For Drop Structure:

Consider Use of 2' Conc. drops

Evaluate type "C"

Type C suggested for high tailwater and values of h/F greater than .5.

Approx $h \cong 7.0'$ $\frac{h}{F} = 3.5$
$F = 2.0'$

Therefore both conditions apply -

Limitations type "C"

$\frac{h}{F} \leq 1.43$ Actual $\frac{h}{F} = 3.5$

∴ Model study guidelines may not apply.

$L \geq 1.5 d_c$ $q = \frac{3140}{60} = 52.3$

$d_c = 4.4$

$L \geq 4.4(1.5) = 6.6' < 60'$

∴ okay

$t \geq 1.75 d_c$

$1.75 d_c = 1.75(4.4) = 7.7' > 7.0'$

∴ may not apply - unless t made greater.

Min F for type C = $1.05 d_c$

$1.05(4.4) = 4.62' > 2.0'$ desired

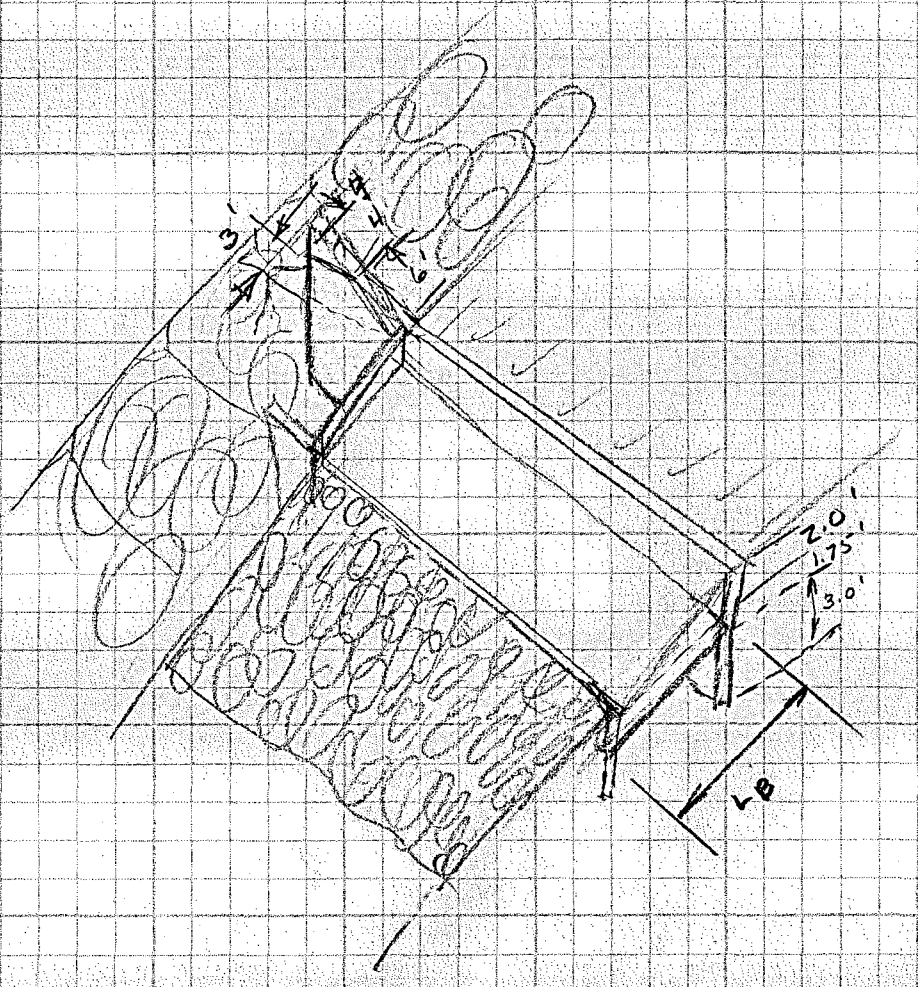
∴ Type C not applicable

STATE | PROJECT

BY | DATE | CHECKED BY | DATE | JOB NO.

SUBJECT

SHEET 4 OF



It appears in order to use type C dimensions and add extra rip rap downstream to resist the roller-currents that will be carried downstream since h_1 value is larger than allowable according to model Study.

$L_B = L_{B\,max} = 20$ ft.

COMPUTATION SHEET
SCS-523A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE | PROJECT
BY | DATE | CHECKED BY | DATE | JOB NO.
SUBJECT

SHEET 5 OF

Conc Volume approx

Headwall	= 6.75 × 60 × .75	=	300
	2(9.75 × 4 × .75	=	58.5
	2(8.25 × 6 × .75	=	74.2
Floor	(20 × 61.5 × .75	=	922
sidewall	2($\frac{4.5 + 2.5}{2}$ × 20 × .75	=	105
sill	4.0 × 68 × .75	=	204
		Σ =	16639

61.6 cy.

Say 62 cy.

cost = @ $110 = $6,820 each.

50 ft @ 2 cy./ft = 100 cy.

@ $5.50 $550

total $7370 each.

Exc. and/or backfill
for rock at 1'-0" Avg. = 2cy/ft @ 60¢

$1.20 × 50 ft = $60.00

Total = $7430

SAY $7500

COMPUTATION SHEET
SCS-523A REV 6-62

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE: Arizona | PROJECT: Powerline Floodway

BY: G. Hanley | DATE: 2-2-68 | CHECKED BY | DATE | JOB NO.

SUBJECT: Solve for Velocity & Q

SHEET 1 OF 4

D = 2', 4', 6', 8'

S = 0.0005, 0.001, 0.002, 0.003 & 0.004

W = 60'

SS = 2:1

n = 0.035

Slope = 0.0005

Depth	Area	r	V	Q cfs.
2.0	128.0	1.86	1.43	183
4.0	272.0	3.49	2.19	596
6.0	432.0	4.98	2.77	1,197
8.0	608.0	6.35	3.25	1,976

Slope = 0.001

Depth	Area	r	V	Q
2.0	128	1.86	2.03	260
4.0	272	3.49	3.09	840
6.0	432	4.98	3.92	1,693
8.0	608	6.35	4.61	2,803

Slope = 0.002

Depth	Area	r	V	Q
2.0	128	1.86	2.87	367
4.0	272	3.49	4.37	1,189
6.0	432	4.98	5.54	2,393
7.0	518	5.67	6.04	3,129
8.0	608	6.35	6.52	3,964

COMPUTATION SHEET
SCS-523A REV. 5-55

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE: Arizona
PROJECT: Powerline Floodway
BY: G. Hanley
DATE: 2-2-68
CHECKED BY:
DATE:
JOB NO.:
SUBJECT: Solving for V & Q continued
SHEET 2 OF 4

Slope = 0.003

Depth	Area	r	V	Q
2.0	128	1.86	3.52	451
4.0	272	3.49	5.35	1455
6.0	432	4.98	6.78	2929
7.0	518	5.67	7.39	3828
8.0	608	6.35	7.98	4852

S = 0.004

Depth	Area	r	V	Q
2.0	128	1.86	4.06	520
4.0	272	3.49	6.18	1681
6.0	432	4.98	7.83	3383
7.0	518	5.67	8.54	4424
8.0	608	6.35	9.21	5600

COMPUTATION SHEET
SCS-523A REV 5-66

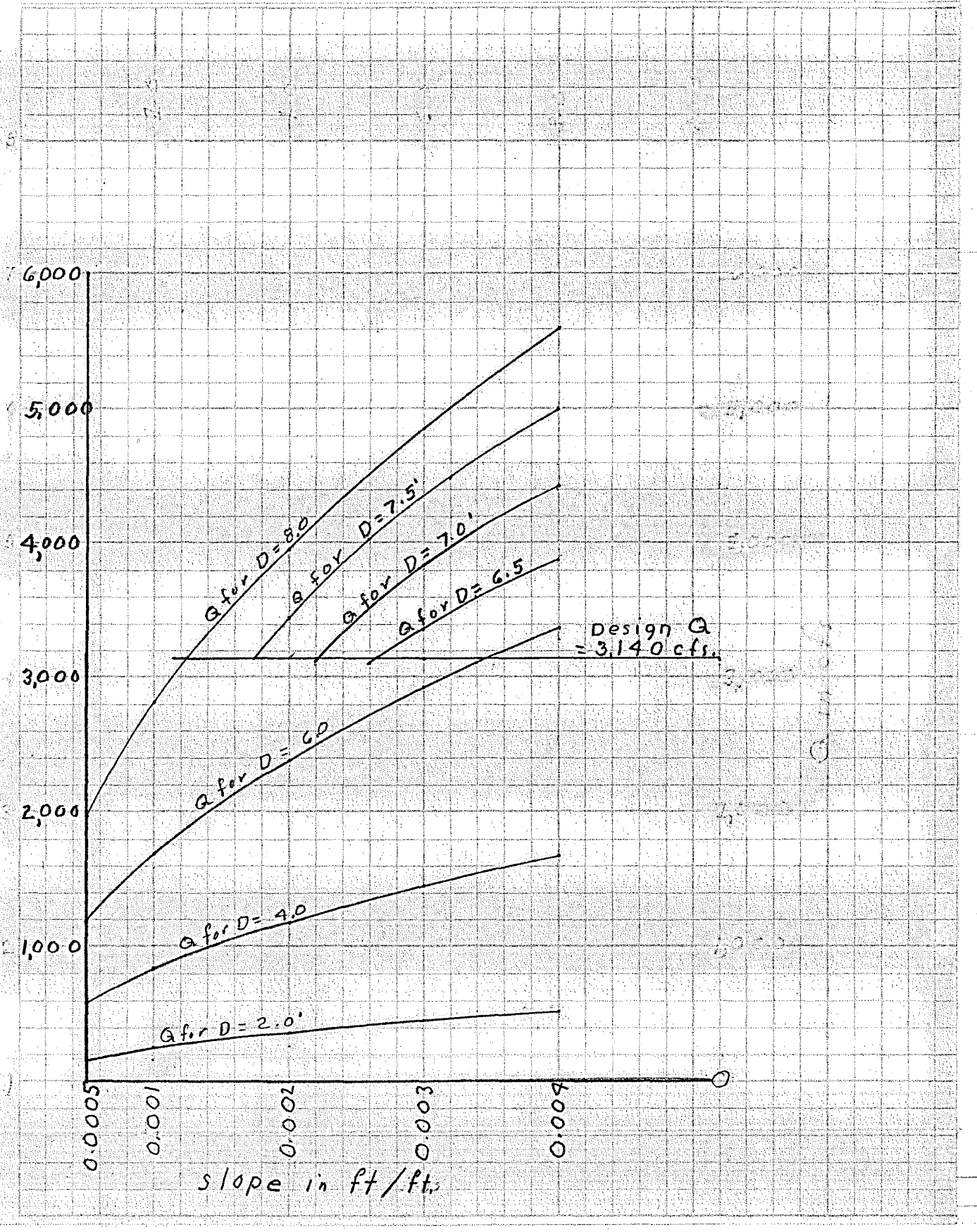
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE: Arizona | PROJECT: Powerline Floodway

BY: G. Hanley | DATE: 2-2-68 | CHECKED BY: | DATE: | JOB NO.

SUBJECT:

SHEET 3 OF 4

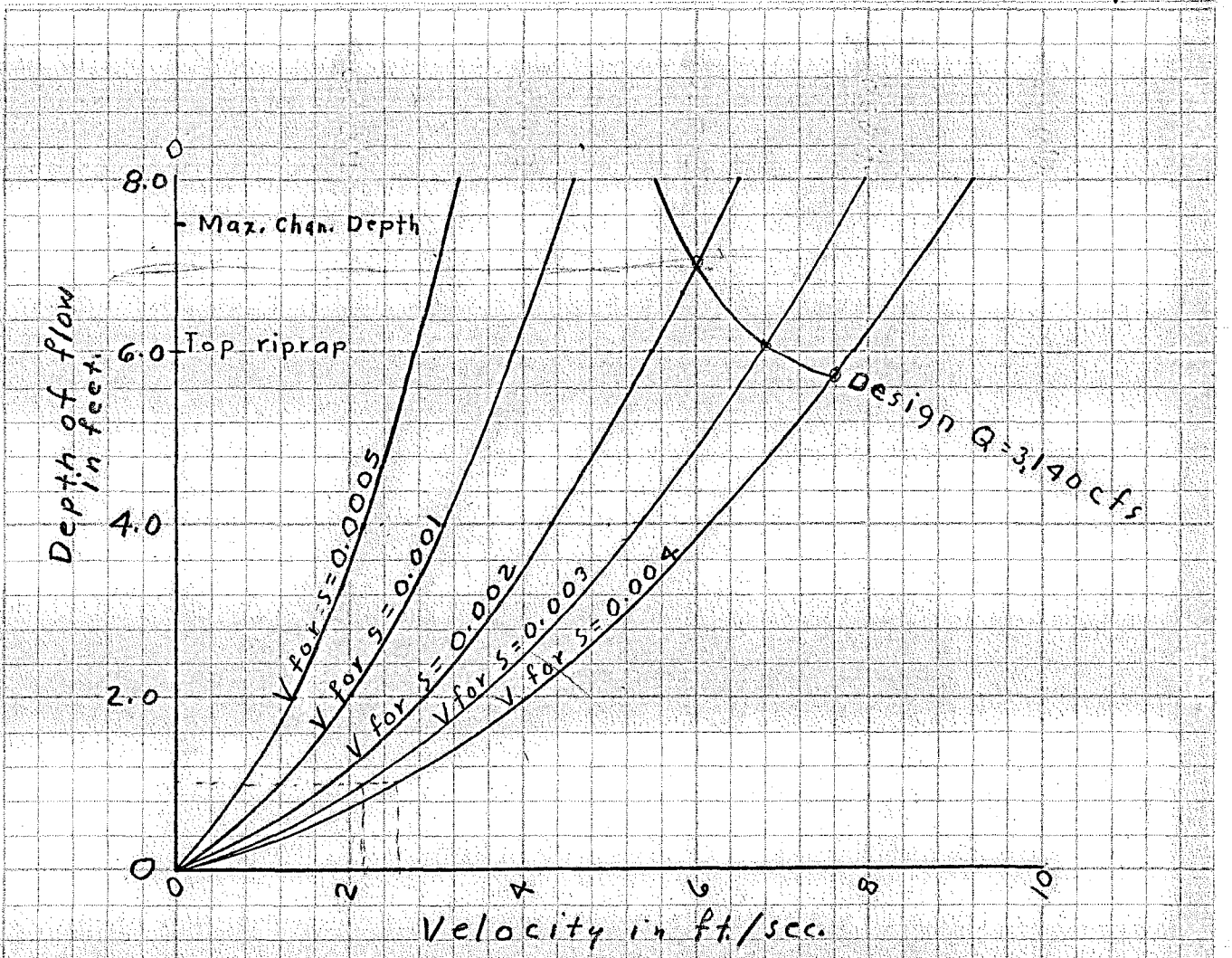


COMPUTATION SHEET
SCS-523A REV 5-50

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE: Arizona | PROJECT: Powerline Floodway
BY: G. Hanley | DATE: 2-2-68 | CHECKED BY: | DATE: | JOB NO.:
SUBJECT:

SHEET 4 OF 4



AD-311 (7-61) U. S. DEPARTMENT OF AGRICULTURE

SPEED-MEMO

DATE: February 2, 1968

1

TO: Ralph M. Arrington

SUBJECT: ENG - Low Drop Grade Stabilizer

FROM: H. W. Firman

MESSAGE *(Write concise message. Sign and forward parts 1 and 2 to addressee. Retain part 3)*

Attached is a copy of a paper on hydraulically proportioning a low drop grade stabilizer. I have redlined Figure 1 to show a rock riprap structure in place of the R/C concrete.

Critical item in the application of these drops is determining grade between successive drops to prevent undermining or burying the upstream structure. This portion of the design is lacking in the paper and requires judicious application of judgment.

Enc.

SIGNATURE Harry W. Firman

REPLY *(Use this space for reply. Sign and date. Return part 2 to sender. Retain part 1)*

SIGNATURE

DATE

AD-311 (7-61)

SCS-803 (3-66)

UNITED STATES GOVERNMENT

Memorandum

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

TO : Ralph M. Arrington, SCS, Phoenix, Arizona February 2, 1968

FROM : J. C. Stevenson, E&WP Unit, SCS, Portland, Ore.

SUBJECT : SOILS MECHANICS - Soil Testing on Powerline Channel

Please find enclosed 2 copies each of 22 laboratory reports of completed testing on subject project, as requested by telephone per this date.

Encs.

cc: J. J. Turner

Greg Cunningham

SCS-803 (3-66)

UNITED STATES GOVERNMENT

Memorandum

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

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cc: J. J. Turner

Greg Cunningham

R Arrington

M. D. Burdick, State Conservationist
SCS, Phoenix, Arizona

February 2, 1968

J. J. Turner, State Conservation Engineer
SCS, Phoenix, Arizona

ENG - Trip Report - PL-566 Operations - Powerline Channel

On January 31, 1968 I visited the office and construction sites of the subject projects in company of State Design Engineer Arrington. Project Engineer England was on sick leave and Mr. Don Riddle was in charge.

IT WAS AGREED that entries in both the JOB DIARY, SCS-310, and the DAILY NARRATIVES, SCS-252, should be more specific. Hypothetical examples of good and unsatisfactory entries are as follows:

Good: "Inspected and approved wooden forms and steel placement in bridge deck at sta. 1068+35 at 3:30 p.m."

"Wooden forms for bridge deck at sta. 1078+36 were inspected at 3:00 p.m. and found to be 6" below the level shown on the plans. The contractor's superintendent was informed that all forms and steel must be raised to provide 5'-1 1/2" clearance between surface of bottom of concrete channel and under side of concrete bridge deck."

Unsatisfactory:

"Inspection activities including falsework on bridge at sta. 1068+35."

"Inspection activities and supervision of laboratory and testing activities."

The key to the "good" examples is that they show <u>results</u> of inspections and <u>actions taken</u> by inspectors.

The above agreed-to item was discussed by telephone with George England on February 1, 1968. He understands what is desired and advised that corrective action would be taken regarding keeping of <u>all diaries</u>, specifically SCS-310 and SCS-252.

The deck of the concrete bridge at sta. 184+20 that was reported 6" too low in the Riddle entry of Book #4 of the JOB DIARY under date of January 24, 1968 was inspected and the clearance between the surface of the bottom of the channel and the bottom of the slab was found to be 54". The plans (page 38) indicate 5' 1-1/2" of clearance is specified.

IT WAS AGREED that the slab as placed did not meet specifications.

The bridge deck at sta. 116+69.5 was measured and the clearance found to be 5' 0", indicating that the contractor had made the corrections indicated by Mr. Riddle's Job Diary entry of January 24, 1968.

No record of form inspection or approval could be found in the diaries for the bridge deck at sta. 184+20 that was placed on January 18, 1968.

Extenuating circumstances are that England was on sick leave on January 17 and 18 and Mr. Riddle would have been at home with a cold had England not been ill.

The rock revetted earth channel sta. 374+00 to sta. 467+00 was inspected. The erosion in the upper part of the channel and the deposition in the lower part of the channel resulting from the December storm that caused flow depth of approximately 3' was considered serious enough to justify design modifications to stabilize the channel bottom.

IT WAS AGREED that the State office would advise Mr. England regarding further prosecution of the channel construction by the contractor.

On February 1, 1968, after consultation with Messrs. Strong, Cavallo, and Arrington, I advised Mr. England to permit the contractor to proceed with the placing of the fords located at 427+95 and 451+00 together with the 10' of 1'-3" thick rock riprap downstream from the crossings. The concrete crossing at sta. 378+68 was in place at time of visit.

I advised Mr. England to suggest to the contractor that he not attempt to repair the flood damage to the earth bottom of the channel until after engineering cross-sections had been run and the extent of erosion and deposition determined. Mr. England agreed to have the necessary survey work done on February 6 and 7, 1968.

cc to:
Ralph Arrington
George England

Form SCS 353
9-64

LABORATORY NO. 650427

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SOIL CLASSIFICATION

PROJECT and STATE: Apache Junction-Gilbert, Powerline channel, Arizona

SAMPLE LOCATION: Channel Sta. 432+00

FIELD SAMPLE NO.	DEPTH	GEOLOGIC ORIGIN
608 A.1	2.6 to 3.2'	-

TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
Undisturbed	Portland, Oregon	Gilbert L. Sullivan	4/9/65

SYMBOL: CL-2

DESCRIPTION: Yellowish red calcareous sandy silty clay

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c
-	0.0018	0.015	0.054	0.11	0.4	4.76	-	-

FINES | SANDS | GRAVELS | COBBLES

SIEVE OPENING, (mm)

U.S. STANDARD SIEVE SIZE

GRAIN SIZE IN MILLIMETERS

PERCENT FINER BY DRY WEIGHT

UNDISTURBED CONDITION

MOISTURE	DRY UNIT WEIGHT
%	g/cc / pcf
9.64	- / 104.3

SOLUBLE SALTS	SHRINKAGE LIMIT
2.0 %	- %

ATTERBERG LIMITS

	NATURAL MOISTURE		AIR DRY		OVEN DRY	
	LL	PI	LL	PI	LL	PI
	-	-	40	16	-	-

SPECIFIC GRAVITY (G_s)

(-) #4	(+) #4
2.71	-

REMARKS: Positive reaction to HCL.
Slight reaction to benzidine.

Form SCS 127
9-64

LABORATORY NO. 650427

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SOIL PERMEABILITY

PROJECT and STATE: Apache Junction-Gilbert, Powerline Channel, Arizona

SAMPLE LOCATION: Channel Sta. 432+00

FIELD SAMPLE NO.	DEPTH	GEOLOGIC ORIGIN
608 A.1	2.6 to 3.2 ft.	-

TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
Undisturbed	Portland, Oregon	Gilbert C. Sullivan	4/9/65

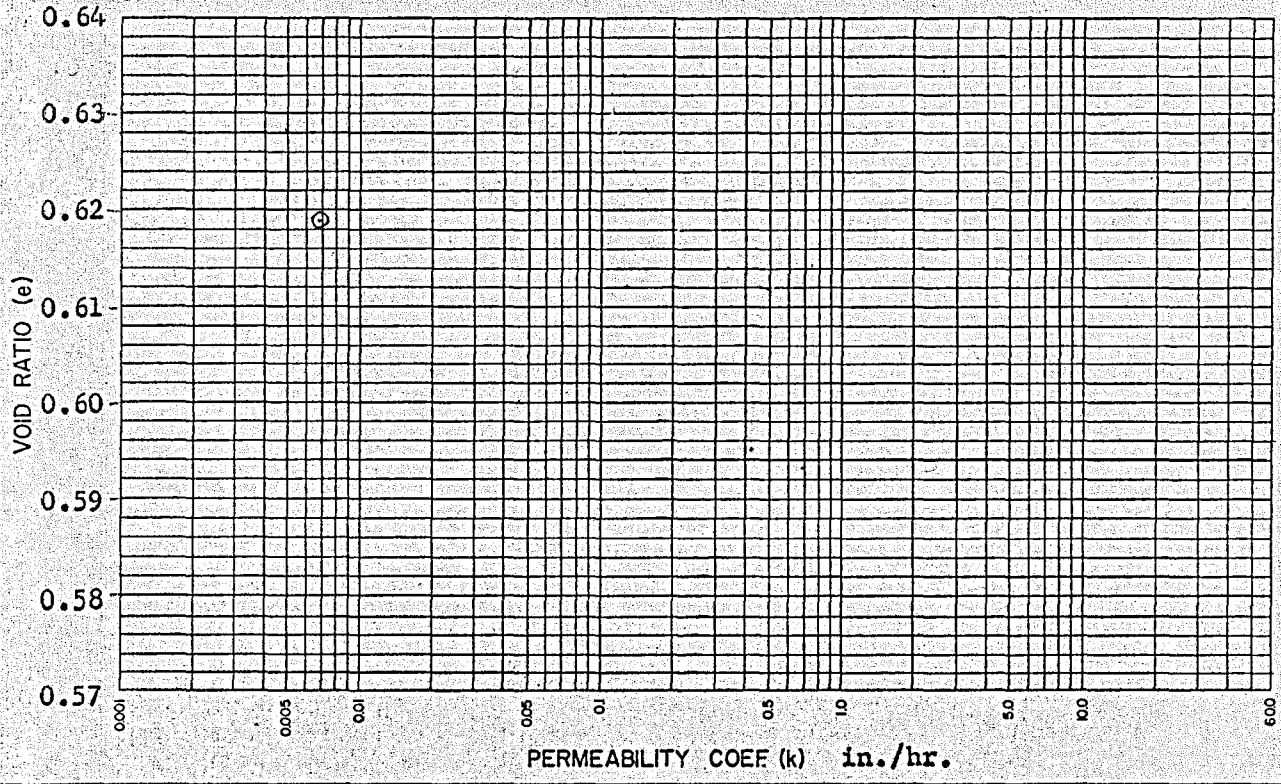
CLASSIFICATION: CL-2; Yellowish red calcareous sandy silty clay. LL 40 PI 16

SPECIFIC GRAVITY

TEST NO.	1	2	3	4
INITIAL MOISTURE %	9.6	-	-	-
DRY DENSITY □ g/cc ▪ pcf	104.3	-	-	-
VOID RATIO	0.619	-	-	-
PERMEABILITY COEF	0.00693	-	-	-
PERCOLATION COEF	0.0181	-	-	-
H/L DURING TEST	6.84:1	-	-	-

G_s (-) #4	2.71
G_s (+) #4	-
G_m(Bulk)(+) #4	-

TEST SPECIFICATIONS
Specimen trimmed to size from larger "block" sample. Flow was perpendicular to natural bedding planes.



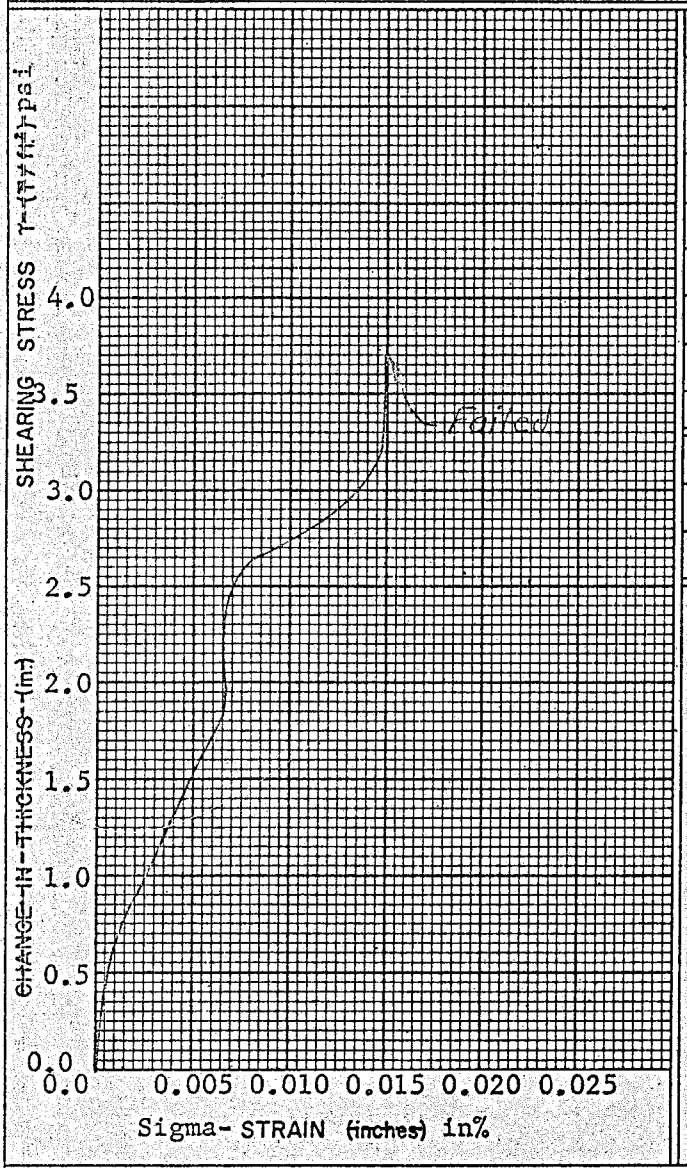
REMARKS

MATERIALS TESTING SECTION REPORT	E.W P-20 (4-24-58) Portland, Oregon	SHEAR TEST

PROJECT	LOCATION
Apache Junction-Gilbert, Powerline channel Arizona	Channel Sta. 432+00

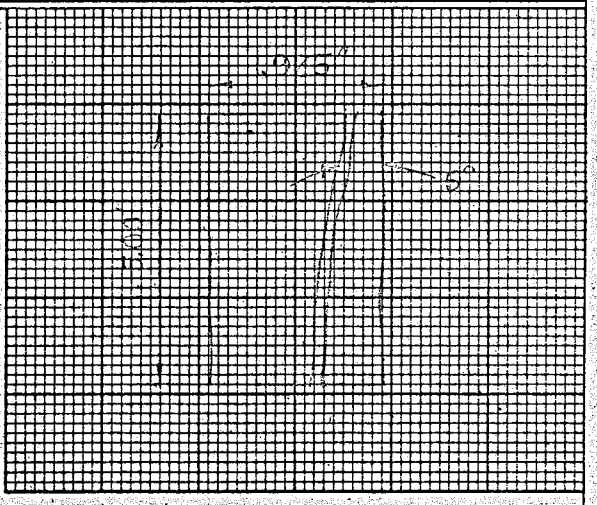
FIELD SAMPLE No.	TYPE of SAMPLE	ORIGIN
608 A.1	Undisturbed	Depth 2.6 to 3.2 ft.
PROPOSED USE	**TESTING SECTION SAMPLE No.**	**SUBMITTED BY**
-	650427	W.F. Mildner

TYPE OF TEST	CONTROL
Unconfined compression	- stress
RATE OF LOADING 0.0243	**MOISTURE CONDITION** 77.4 % sat.
TYPE OF SPECIMEN Undisturbed	**AREA (sq in)** - **THICKNESS (in)** -



TEST NO	1	2	3	4
INIT. MOISTURE, %	17.79	-	-	-
DRY DENSITY, lb/ft³	104.0	-	-	-
INIT VOID RATIO	0.624	-	-	-
TEST DURATION, MIN.	11	-	-	-
FINAL MOISTURE, %	17.79	-	-	-
NORMAL STRESS, T/ft²	-	-	-	-
MAX. SHEAR STRESS, T/ft²	0.267	-	-	-
MAX RATIO T/6	-	-	-	-

SHEAR VALUES	ϕ	C
AT MAXIMUM STRESS T/ft.²	-	0.138
AT ULTIMATE STRESS	-	-



TYPE OF FAILURE

REMARKS Note: Sample partially failed under its own weight when placed in unconfined compression machine. Numerous fracture planes appeared in sample at this time.

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE
ENGINEERING and WATERSHED PLANNING UNIT
PORTLAND, OREGON

SIGNATURE Gilbert C. Sullivan
TITLE Civil Engineer
DATE 4/9/65

M-2055

7-0-14316-L

Form SCS 353
9-64

LABORATORY NO. 650428

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SOIL CLASSIFICATION

PROJECT and STATE: Apache Junction-Gilbert, Powerline channel, Arizona

SAMPLE LOCATION: Channel Sta. 432+00

FIELD SAMPLE NO.: 608 A.2

DEPTH: 4.9 to 5.5'

GEOLOGIC ORIGIN: -

TYPE OF SAMPLE: Undisturbed

TESTED AT: Portland, Oregon

APPROVED BY: Gilbert L. Sullivan

DATE: 4/9/65

SYMBOL: ML

DESCRIPTION: Light brown calcareous sandy clayey silt

GRAIN SIZE DISTRIBUTION

C_c	C_u	$D_{MAX.}$	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}
-	-	12.7	0.42	0.063	0.035	0.0061	0.0014	-

COBBLES | GRAVELS | SANDS | FINES

SIEVE OPENING, (mm)

U.S. STANDARD SIEVE SIZE

PERCENT FINER BY DRY WEIGHT

GRAIN SIZE IN MILLIMETERS

UNDISTURBED CONDITION

MOISTURE	DRY UNIT WEIGHT
14.52 %	102.9 pcf

SOLUBLE SALTS	SHRINKAGE LIMIT
3.0%	- %

ATTERBERG LIMITS

	NATURAL MOISTURE		AIR DRY		OVEN DRY	
	LL	PI	LL	PI	LL	PI
	-	-	40	14	-	-

SPECIFIC GRAVITY (G_s)

(-) #4	(+) #4
2.70	-

REMARKS: Positive reaction to HCL.
Slight reaction to benzidine.

MATERIALS TESTING SECTION REPORT	E.W.P-20 (4-24-58) Portland, Oregon	SHEAR TEST

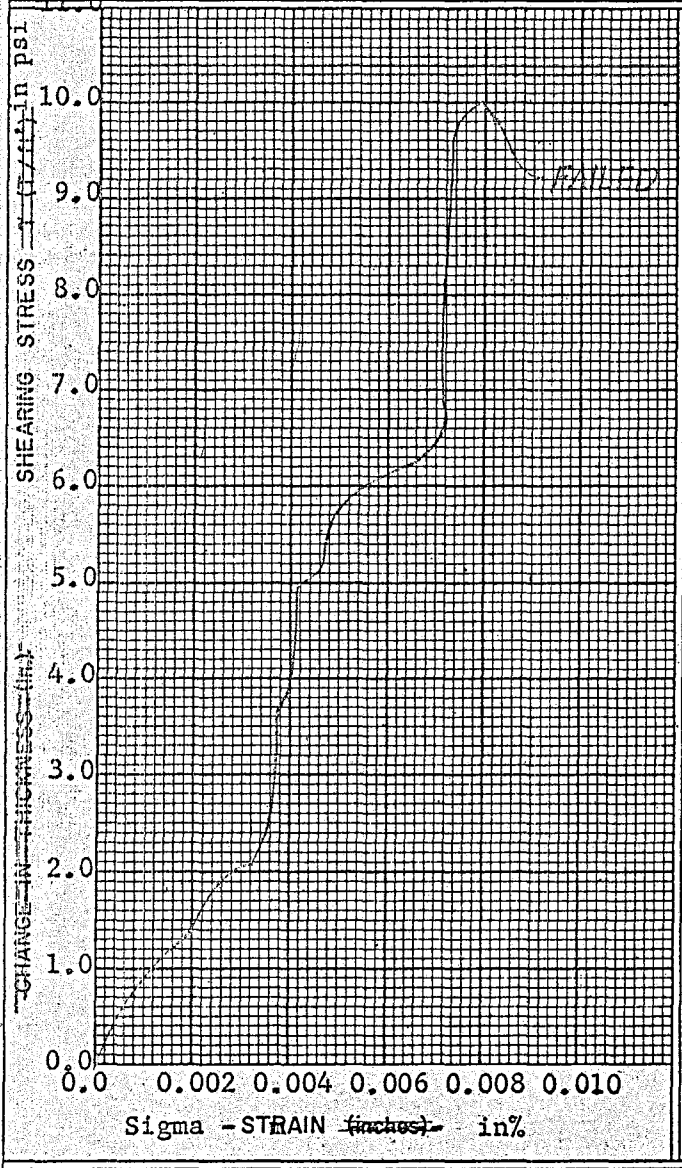
PROJECT	LOCATION
Arizona Apache Junction-Gilbert, Powerline channel	Channel Sta. 432+00

FIELD SAMPLE No.	TYPE of SAMPLE	ORIGIN
608 A.2	Undisturbed	Depth 4.9 to 5.5 ft.
PROPOSED USE	**TESTING SECTION SAMPLE No.**	**SUBMITTED BY**
-	650428	W.F. Mildner

TYPE OF TEST	CONTROL
Unconfined Compression	stress

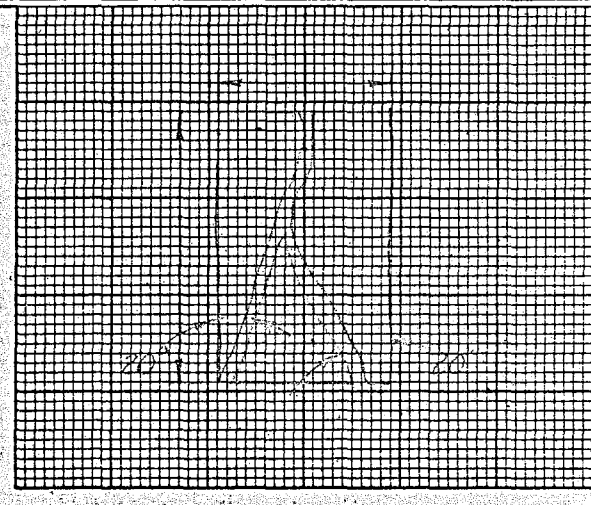
RATE OF LOADING	MOISTURE CONDITION
0.025 T/ft^2/min.	78.0% sat.

TYPE OF SPECIMEN	AREA (sq. in.)	THICKNESS (in.)
Undisturbed	-	-



TEST NO	1	2	3	4
INIT. MOISTURE, %	16.93	-	-	-
DRY DENSITY, lb/ft^3	106.2	-	-	-
INIT. VOID RATIO	0.588	-	-	-
TEST DURATION, MIN.	29	-	-	-
FINAL MOISTURE, %	16.93	-	-	-
NORMAL STRESS, T/ft^2	-	-	-	-
MAX. SHEAR STRESS, T/ft^2	0.72	-	-	-
MAX. RATIO T/6	-	-	-	-

SHEAR VALUES	ϕ	C
AT MAXIMUM STRESS T/ft.^{2}	-	0.36
AT ULTIMATE STRESS	-	-



TYPE OF FAILURE

REMARKS

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE
ENGINEERING and WATERSHED PLANNING UNIT
PORTLAND, OREGON

SIGNATURE Gilbert C. Sullivan

TITLE Civil Engineer

DATE 4/9/65

M-2055

7-0-14316-L

Form SCS 127
9-64

LABORATORY NO. 650428

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SOIL PERMEABILITY

PROJECT and STATE: Apache Junction-Gilbert, Powerline Channel, Arizona

SAMPLE LOCATION: Channel Sta. 432+00

FIELD SAMPLE NO.	DEPTH	GEOLOGIC ORIGIN
608 A.2	4.9 to 5.5 ft.	-

TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
Undisturbed	Portland, Oregon	Gilbert A. Sullivan	4/9/65

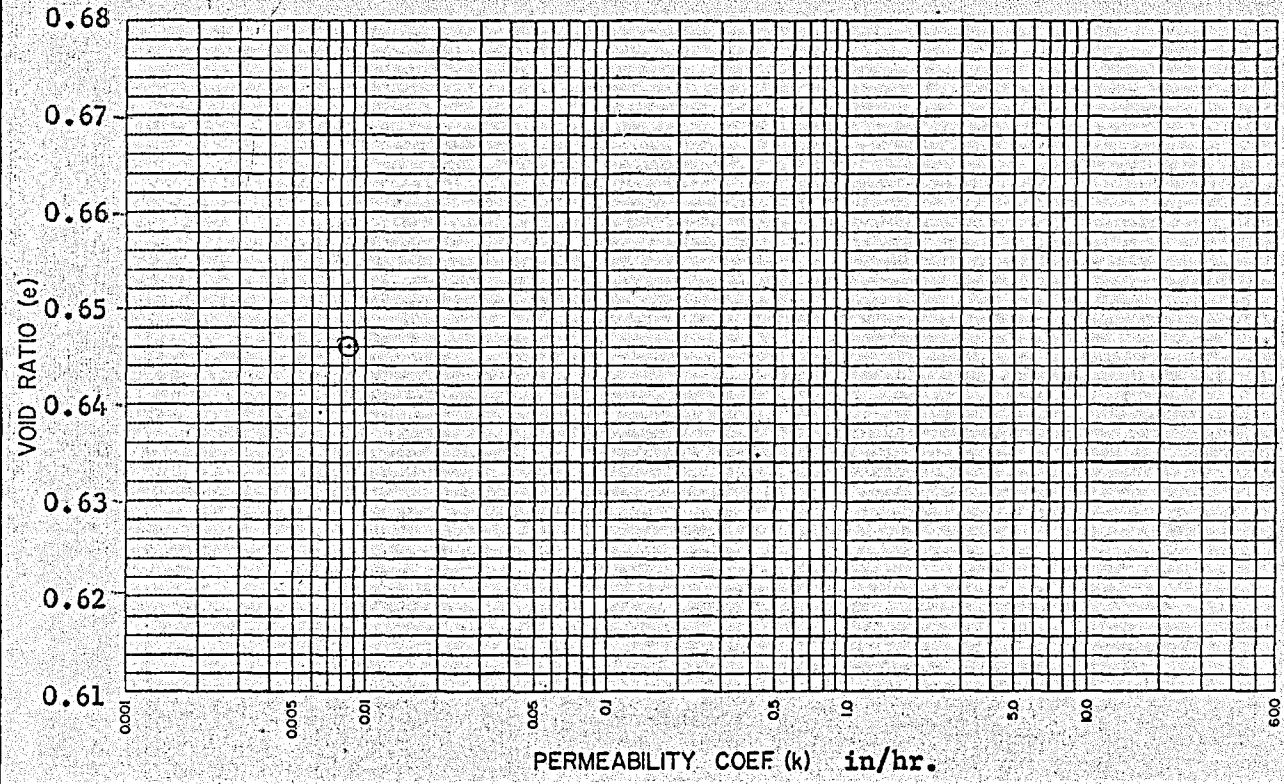
CLASSIFICATION: ML-Light brown calcareous sandy clayey silt. LL 40 PI 14

SPECIFIC GRAVITY

TEST NO.	1	2	3	4
INITIAL MOISTURE %	14.5	-	-	-
DRY DENSITY □ g/cc ☒ pcf	102.9	-	-	-
VOID RATIO	0.646	-	-	-
PERMEABILITY COEF	0.00865	-	-	-
PERCOLATION COEF	0.0220	-	-	-
$H/_L$ DURING TEST	6.64:1	-	-	-

G_s (-) #4	2.70
G_s (+) #4	2.70
G_m(Bulk)(+) #4	-

TEST SPECIFICATIONS
Specimen trimmed to size from larger "block" sample. Flow was perpendicular to natural bedding planes.



REMARKS

Form SCS 353
9-64

LABORATORY NO. 650429(A)

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SOIL CLASSIFICATION

PROJECT and STATE: Apache Junction-Gilbert, Powerline Channel, Arizona

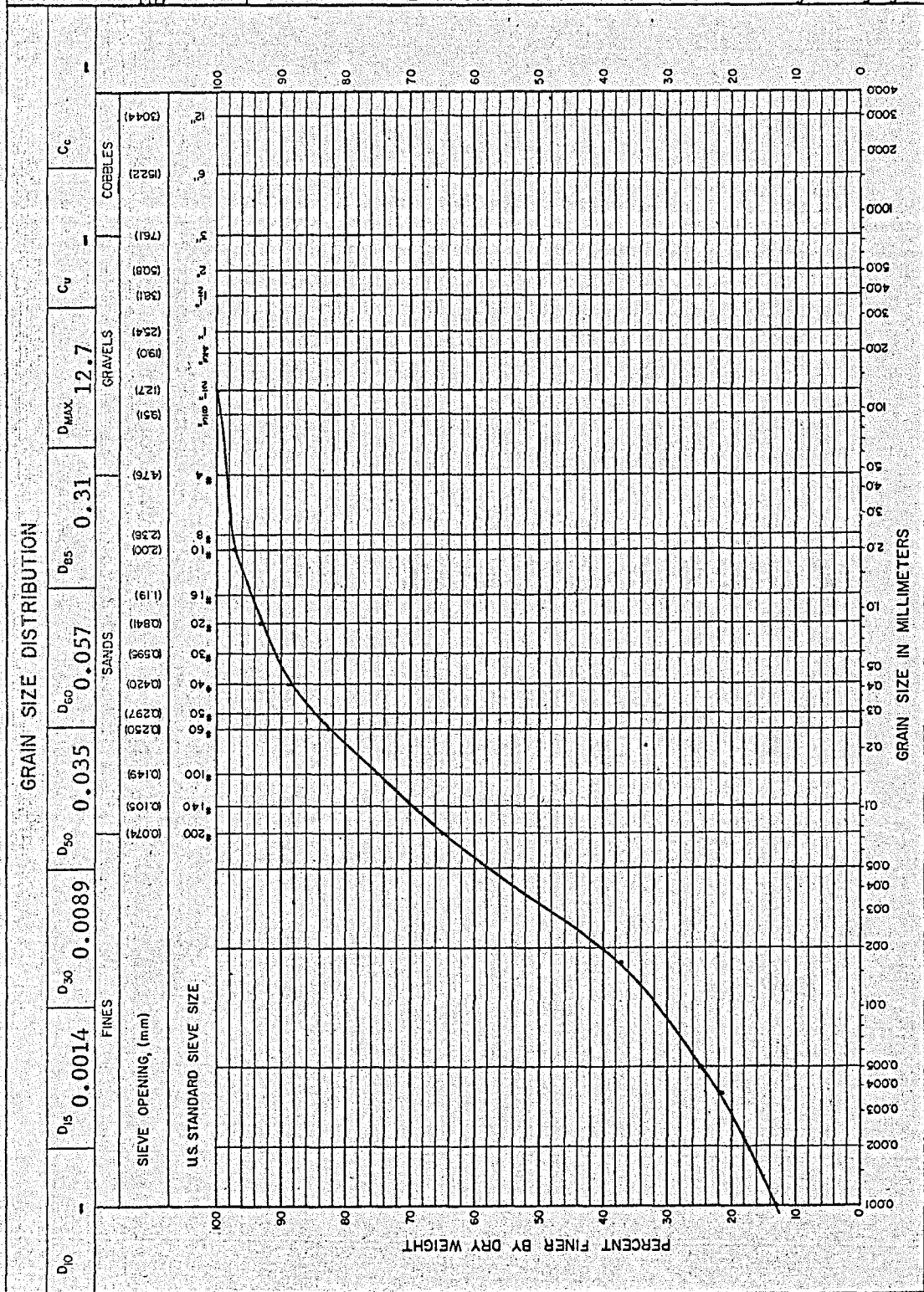
SAMPLE LOCATION: Channel Sta. 396+00

FIELD SAMPLE NO.	DEPTH	GEOLOGIC ORIGIN
614 A.1	2.7 to 3.3	-

TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
Undisturbed	Portland, Oregon	Gilbert C. Sullivan	4/9/65

SYMBOL: ML

DESCRIPTION: Yellowish red calcareous sandy clayey silt



ATTERBERG LIMITS

	NATURAL MOISTURE		AIR DRY		OVEN DRY	
	LL	PI	LL	PI	LL	PI
	-	-	44	16	-	-

SOLUBLE SALTS: 0.5 %

SHRINKAGE LIMIT: - %

UNDISTURBED CONDITION

MOISTURE	DRY UNIT WEIGHT	
	-	g/cc
12.9 %	99.6	pcf

SPECIFIC GRAVITY (G_s)

(-) #4	(+) #4
2.68	-

REMARKS: Positive reaction to HCL.
Slight reaction to benzidine.

Form SCS 127
9-64

LABORATORY NO. 650429(A)

MATERIALS TESTING REPORT	U.S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SOIL PERMEABILITY

PROJECT and STATE: Apache Junction-Gilbert, Powerline Channel, Arizona

SAMPLE LOCATION: Channel Sta. 396+00

FIELD SAMPLE NO.: 614 A.1

DEPTH: 2.7 to 3.3 ft.

GEOLOGIC ORIGIN: -

TYPE OF SAMPLE: Undisturbed

TESTED AT: Portland, Oregon

APPROVED BY: Gilbert C. Sullivan

DATE: 4/9/65

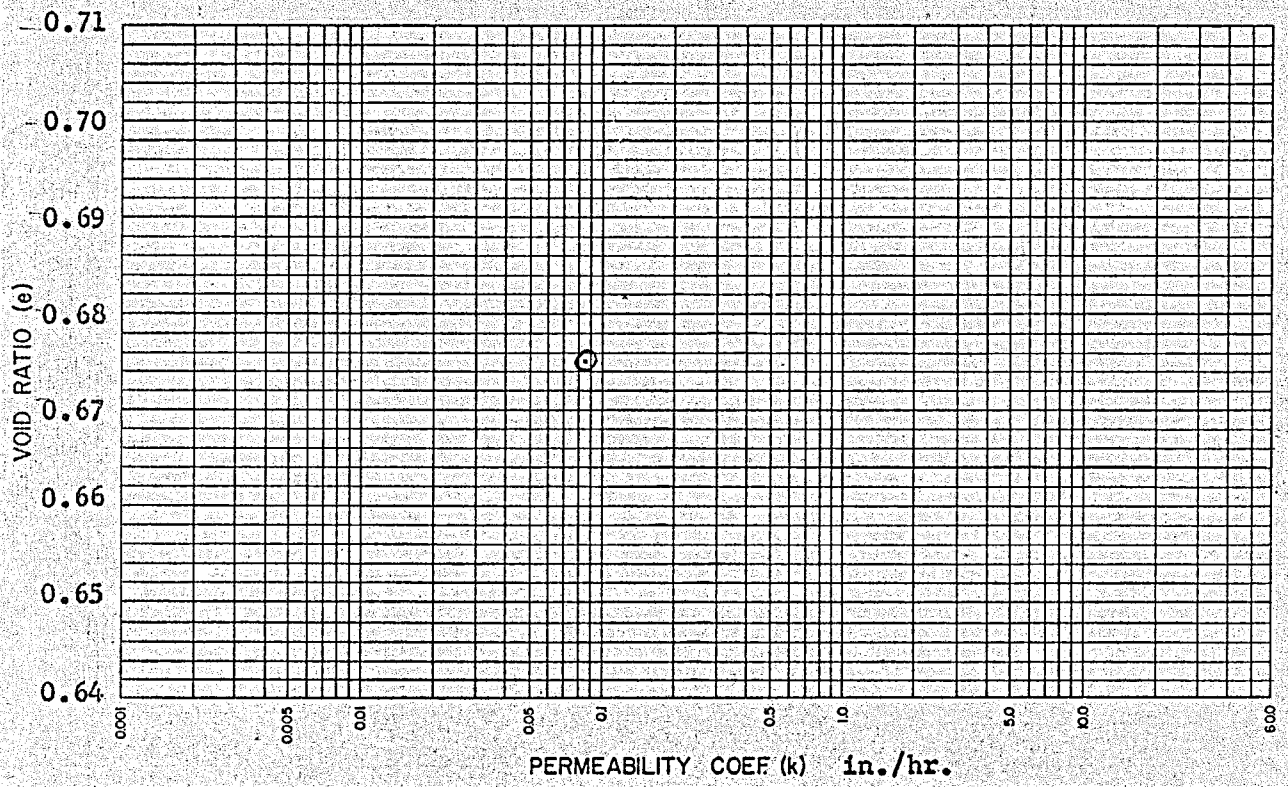
CLASSIFICATION: ML-Yellowish red calcareous sandy clayey silt. LL 44 PI 16

SPECIFIC GRAVITY

TEST NO.	1	2	3	4
INITIAL MOISTURE %	12.9	-	-	-
DRY DENSITY □ g/cc ⊠ pcf	99.6	-	-	-
VOID RATIO	0.675	-	-	-
PERMEABILITY COEF	0.0879	-	-	-
PERCOLATION COEF	0.218	-	-	-
H/L DURING TEST	6.85:1	-	-	-

G_s (-) #4	2.68
G_s (+) #4	-
G_m(Bulk)(+) #4	-

TEST SPECIFICATIONS
Specimen trimmed to size from larger "block" sample. Flow was perpendicular to natural bedding planes.



REMARKS

MATERIALS TESTING SECTION REPORT	E.W.P-20 (4-24-58) Portland, Oregon	SHEAR TEST

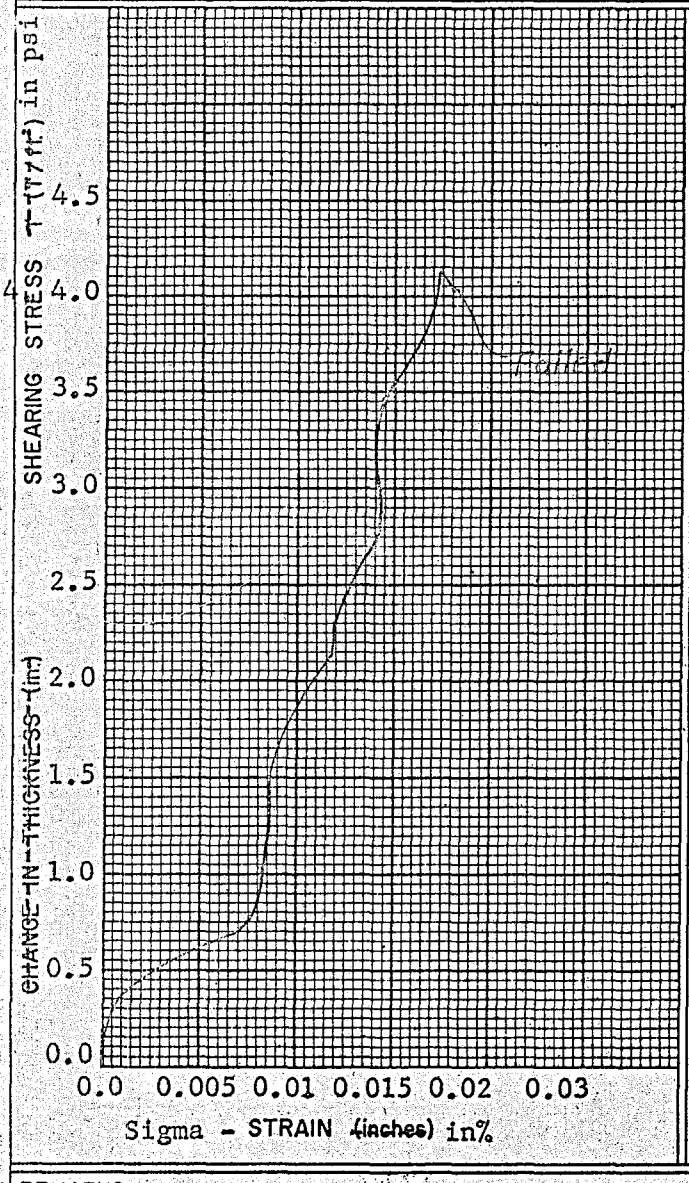
PROJECT	LOCATION
Apache Junction-Gilbert, Powerline channel Arizona	Channel Sta. 396+00

FIELD SAMPLE No.	TYPE of SAMPLE	ORIGIN
614 A.1	Undisturbed	Depth 2.7 to 3.3'
PROPOSED USE	**TESTING SECTION SAMPLE No.**	**SUBMITTED BY**
-	650429(A)	W.F. Mildner

TYPE OF TEST	CONTROL
Unconfined compression	stress

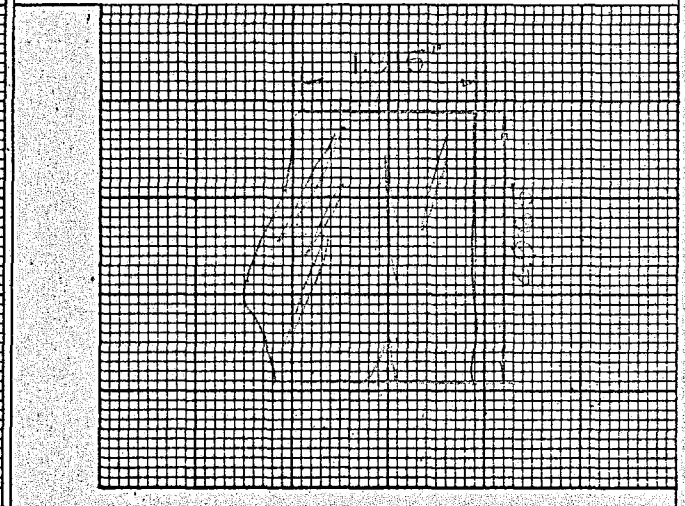
RATE OF LOADING	MOISTURE CONDITION
0.025 T/ft.^{2}/min.	84.4% sat.

TYPE OF SPECIMEN	AREA (sq. in.)	THICKNESS (in)
Undisturbed	-	-



TEST NO	1	2	3	4
INIT. MOISTURE, %	21.83	-	-	-
DRY DENSITY, lb/ft³	98.7	-	-	-
INIT. VOID RATIO	0.695	-	-	-
TEST DURATION, MIN.	12	-	-	-
FINAL MOISTURE, %	21.83	-	-	-
NORMAL STRESS, T/ft²	-	-	-	-
MAX. SHEAR STRESS, T/ft²	0.295	-	-	-
MAX RATIO T/σ	-	-	-	-

SHEAR VALUES		ϕ	C
AT MAXIMUM STRESS	T/ft.^{2}	-	0.15
AT ULTIMATE STRESS		-	-



REMARKS

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE
ENGINEERING and WATERSHED PLANNING UNIT
PORTLAND, OREGON

SIGNATURE Gilbert A Sullivan
TITLE Civil Engineer
DATE 4/9/65

M-2055

7-0-14316-L

Form SCS 353
9-64

LABORATORY NO. 650429 (B)

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SOIL CLASSIFICATION

PROJECT and STATE: Apache Junction-Gilbert, Powerline channel, Arizona

SAMPLE LOCATION: Channel Sta. 396+00

FIELD SAMPLE NO.	DEPTH	GEOLOGIC ORIGIN
614 A.1	2.7 to 3.3	-

TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
Disturbed	Portland, Oregon	Gilbert C. Sullivan	4/9/65

SYMBOL: CL-2

DESCRIPTION: Yellowish red calcareous sandy silty clay

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c
0.002	0.005	0.022	0.068	0.15	0.9	12.7	-	-

COBBLES | GRAVELS | SANDS | FINES

SIEVE OPENING, (mm)

US STANDARD SIEVE SIZE

12"	6"	3"	2"	1½"	1"	¾"	½"	⅜"	#4	#8	#10	#16	#20	#30	#40	#50	#60	#100	#140	#200
(304)	(152)	(76.1)	(50.8)	(38.1)	(25.4)	(19.0)	(12.7)	(9.51)	(4.76)	(2.38)	(2.00)	(1.19)	(0.841)	(0.595)	(0.420)	(0.297)	(0.250)	(0.149)	(0.105)	(0.074)

GRAIN SIZE IN MILLIMETERS

PERCENT FINER BY DRY WEIGHT

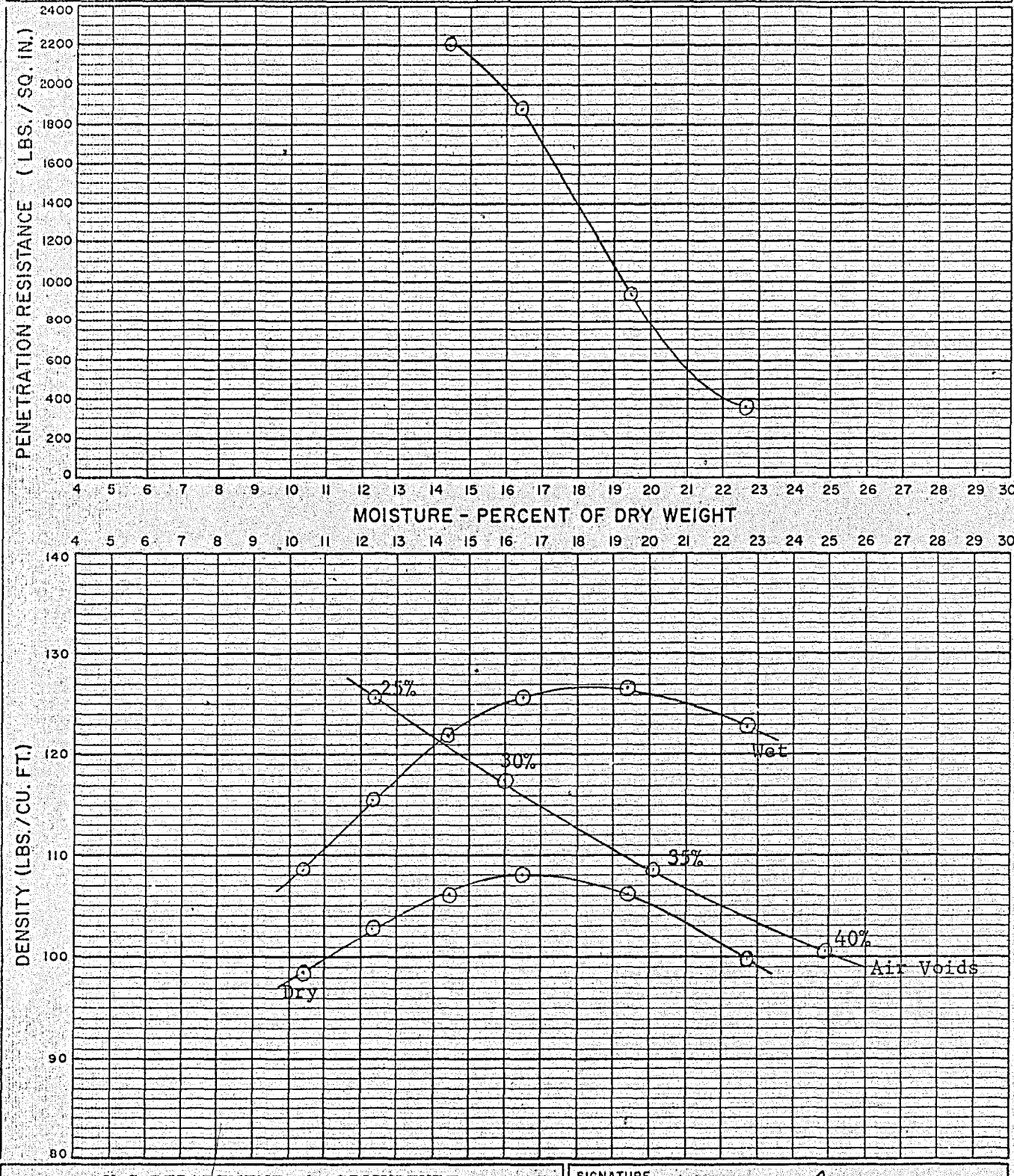
SPECIFIC GRAVITY (G_s)		ATTERBERG LIMITS								SOLUBLE SALTS	SHRINKAGE LIMIT	UNDISTURBED CONDITION		
		NATURAL MOISTURE		AIR DRY		OVEN DRY						MOISTURE	DRY UNIT WEIGHT	
(-) #4	(+) #4	LL	PI	LL	PI	LL	PI						g/cc	pcf
2.68	-	-	-	42	20	-	-			0.5%	-	-	-	-

REMARKS: Positive reaction to HCL.
Slight reaction to benzidine.

MATERIALS TESTING SECTION REPORT	EWP-23 1-21-59 PORTLAND, OREGON	SOIL COMPACTION CURVES

PROJECT	LOCATION
Powerline channel, Ariz. Apache Junction-Gilbert	Channel Sta. 396+00

FIELD SAMPLE No.	TESTING SECTION SAMPLE No.	% LARGER THAN TESTED	COMPACTIVE EFFORT
614 A.1	650429(B)	Trace	ASTM STD.



U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE
ENGINEERING and WATERSHED PLANNING UNIT
PORTLAND, OREGON

SIGNATURE: Gilbert C. Sullivan

TITLE: Civil Engineer

DATE: 4/9/65

M-1554

7-0-14821-L

Form SCS 353
9-64

LABORATORY NO. 650430(A)

MATERIALS TESTING REPORT | U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE | SOIL CLASSIFICATION

PROJECT and STATE: Apache Junction-Gilbert, Powerline Channel, Arizona

SAMPLE LOCATION: Channel Sta. 396+00

FIELD SAMPLE NO.	DEPTH	GEOLOGIC ORIGIN	
614 A.2	7.6 to 8.2 ft.	-	
TYPE OF SAMPLE: Undisturbed	TESTED AT: Portland, Oregon	APPROVED BY: Gilbert C. Sullivan	DATE: 4/9/65

SYMBOL: ML

DESCRIPTION: Light brown calcareous sandy clayey silt

GRAIN SIZE DISTRIBUTION

D_{90}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c
0.0014	0.0033	0.018	0.05	0.085	0.34	12.7	-	-

COBBLES | GRAVELS | SANDS | FINES

SIEVE OPENING, (mm)

U.S. STANDARD SIEVE SIZE

GRAIN SIZE IN MILLIMETERS

PERCENT FINER BY DRY WEIGHT

SPECIFIC GRAVITY (G_s)		ATTERBERG LIMITS						SOLUBLE SALTS	SHRINKAGE LIMIT	UNDISTURBED CONDITION		
		NATURAL MOISTURE		AIR DRY		OVEN DRY				MOISTURE	DRY UNIT WEIGHT	
(-) #4	(+) #4	LL	PI	LL	PI	LL	PI					
2.71	-	-	-	34	9	-	-	1.5%	- %	11.7 %	- g/cc	101.5 pcf

REMARKS: Positive reaction to HCL
Slight reaction to benzidine.

MATERIALS TESTING SECTION REPORT	E.W.P-20 (4-24-58) Portland, Oregon	SHEAR TEST

PROJECT	LOCATION
Apache Junction-Gilbert, Powerline channel Arizona	Channel Sta. 396+00

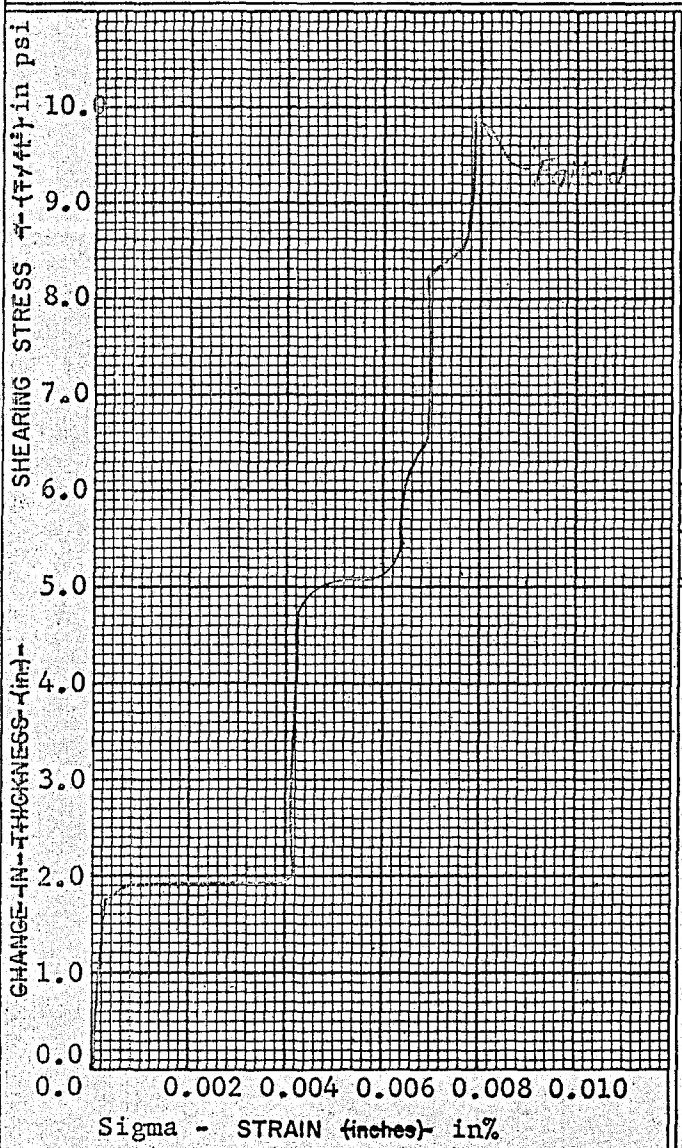
FIELD SAMPLE No.	TYPE of SAMPLE	ORIGIN
614 A.2	Undisturbed	depth 7.6 to 8.2 ft.

PROPOSED USE	TESTING SECTION SAMPLE No.	SUBMITTED BY
- -	650430 (A)	W.F. Mildner

TYPE OF TEST	CONTROL
Unconfined compression	stress

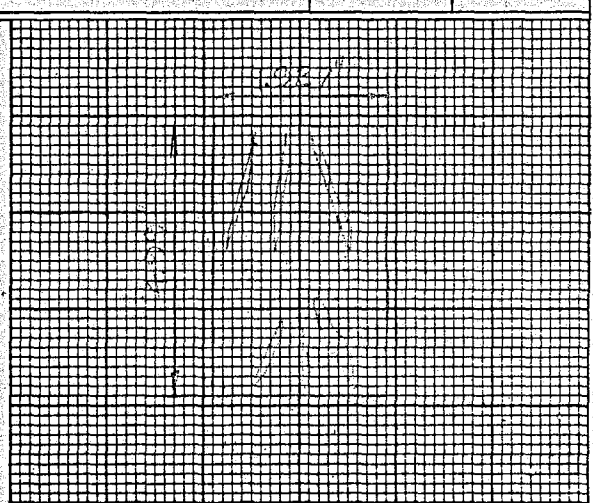
RATE OF LOADING	MOISTURE CONDITION
0.025 T/ft.^{2}/min.	75.0% sat.

TYPE OF SPECIMEN	AREA (sq. in)	THICKNESS (in)
Undisturbed	-	-



TEST NO	1	2	3	4
INIT. MOISTURE, %	18.9	-	-	-
DRY DENSITY, lb/ft³	100.7	-	-	-
INIT. VOID RATIO	0.684	-	-	-
TEST DURATION, MIN.	29	-	-	-
FINAL MOISTURE, %	18.9	-	-	-
NORMAL STRESS, T/ft²	-	-	-	-
MAX. SHEAR STRESS, T/ft²	0.71	-	-	-
MAX RATIO T/σ	-	-	-	-

SHEAR VALUES	ϕ	C
AT MAXIMUM STRESS T/ft^2	-	0.36
AT ULTIMATE STRESS	-	-



TYPE OF FAILURE

REMARKS

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE
ENGINEERING and WATERSHED PLANNING UNIT
PORTLAND, OREGON

SIGNATURE Gilbert C. Sullivan

TITLE Civil Engineer

DATE 4/9/65

M-2055

7-0-14316-L

Form SCS MT 5-64

LABORATORY NO. 650430(A)

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SOIL PERMEABILITY

PROJECT and STATE: Apache Junction-Gilbert, Powerline Channel, Arizona

SAMPLE LOCATION: Channel Sta. 396+00

FIELD SAMPLE NO.	DEPTH	GEOLOGIC ORIGIN
614 A.2	7.6 to 8.2 ft.	-

TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
Undisturbed	Portland, Oregon	Gilbert C. Sullivan	4/9/65

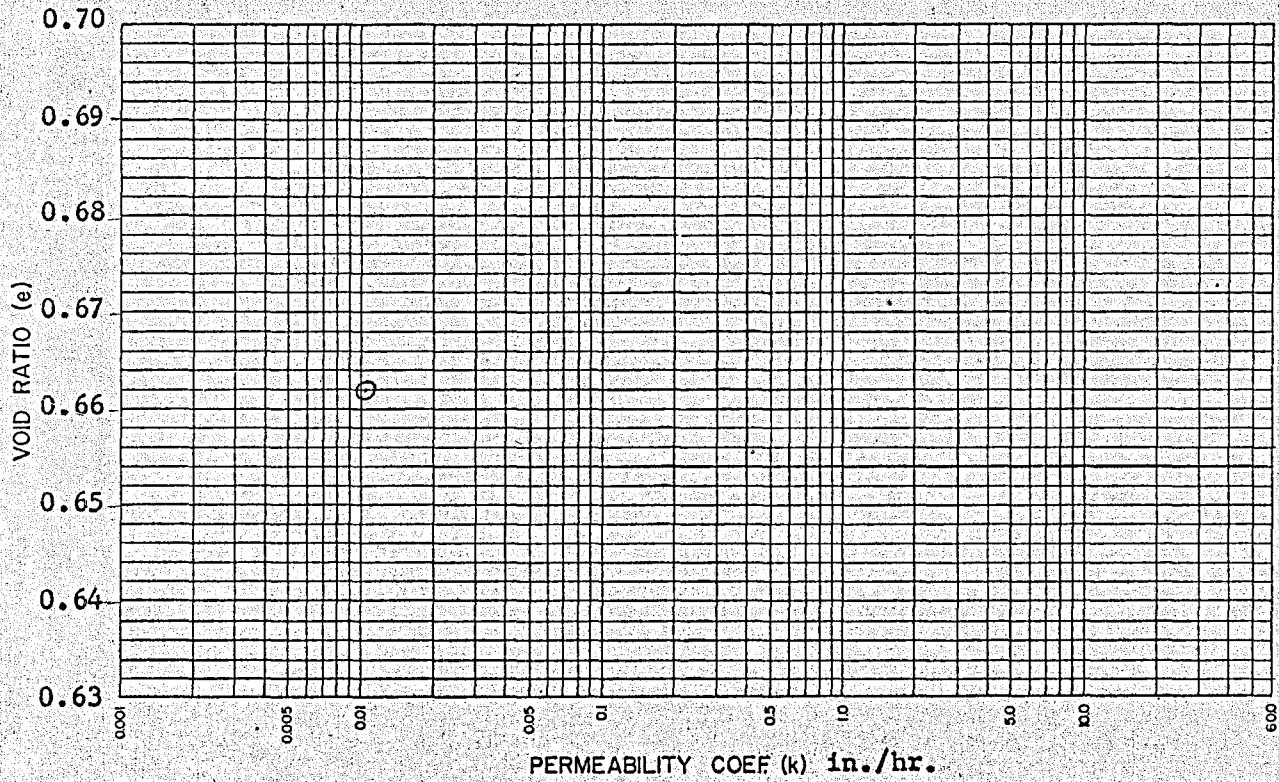
CLASSIFICATION ML, Light brown calcareous sandy clayey silt. LL 34 PI 9

SPECIFIC GRAVITY

TEST NO.	1	2	3	4
INITIAL MOISTURE %	10.9	-	-	-
DRY DENSITY ☐ g/cc ☒ pcf	101.5	-	-	-
VOID RATIO	0.662	-	-	-
PERMEABILITY COEF	0.0102	-	-	-
PERCOLATION COEF	0.0256	-	-	-
H/L DURING TEST	06.9:1	-	-	-

G_s (-) #4	2.71
G_s (+) #4	-
G_m(Bulk)(+) #4	-

TEST SPECIFICATIONS
Specimen trimmed to size from larger "block" sample. Flow was perpendicular to natural bedding planes.



REMARKS

Form SCS 353
9-64

LABORATORY NO. 650430(B)

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SOIL CLASSIFICATION

PROJECT and STATE: Apache Junction-Gilbert, Powerline Channel, Arizona

SAMPLE LOCATION: Channel Sta. 396+00

FIELD SAMPLE NO.: 614 A.2

DEPTH: 7.6 to 8.2 ft.

GEOLOGIC ORIGIN: -

TYPE OF SAMPLE: Disturbed

TESTED AT: Portland, Oregon

APPROVED BY: Gilbert C. Sullivan

DATE: 4/9/65

SYMBOL: ML

DESCRIPTION: Light brown calcareous sandy clayey silt

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c
0.0013	0.0032	0.018	0.045	0.070	0.26	12.7	-	-

COBBLES | GRAVELS | SANDS | FINES

SIEVE OPENING, (mm)

U.S. STANDARD SIEVE SIZE

GRAIN SIZE IN MILLIMETERS

PERCENT FINER BY DRY WEIGHT

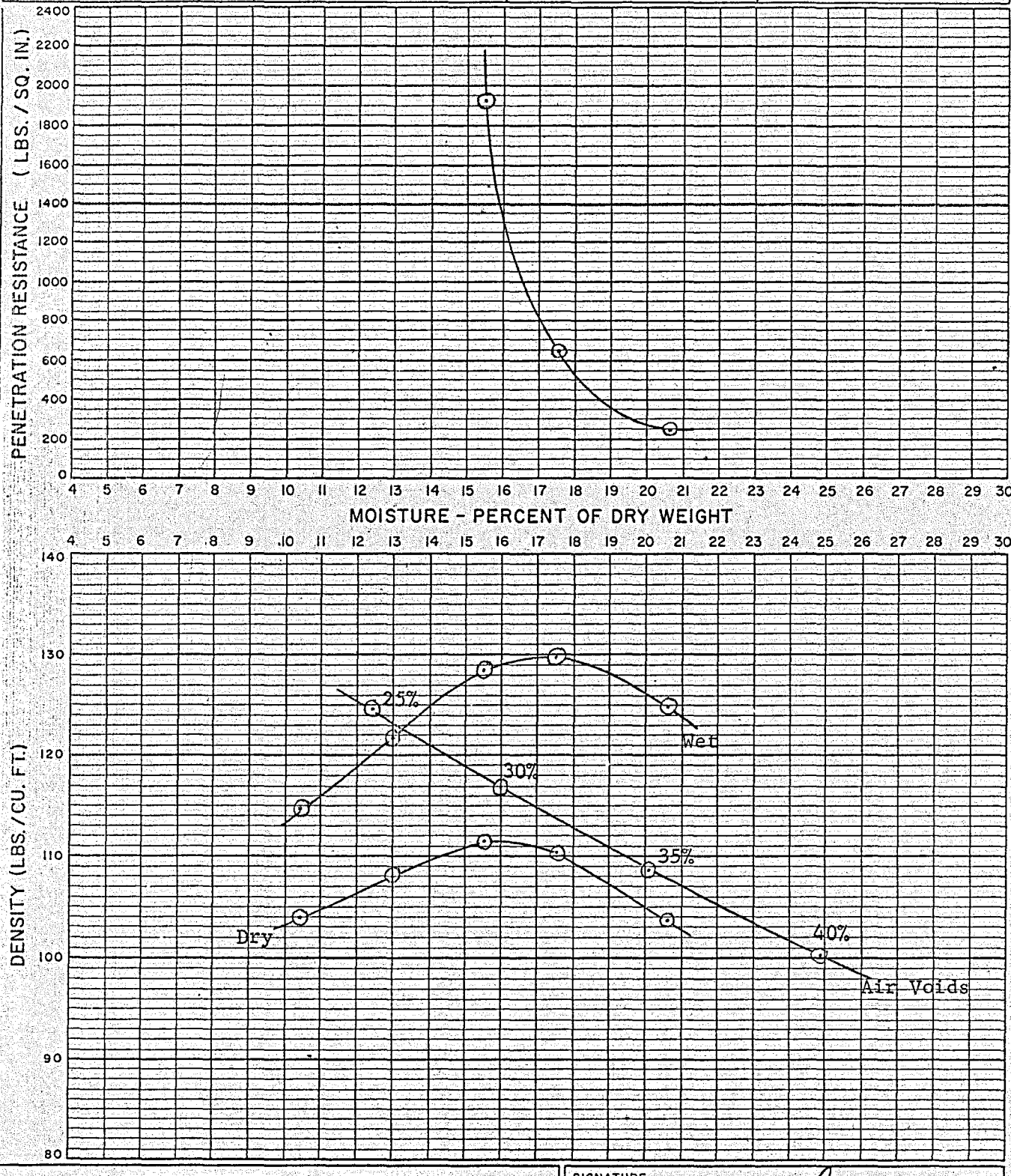
SPECIFIC GRAVITY (G_s)		ATTERBERG LIMITS								SOLUBLE SALTS	SHRINKAGE LIMIT	UNDISTURBED CONDITION		
		NATURAL MOISTURE			AIR DRY			OVEN DRY				MOISTURE	DRY UNIT WEIGHT	
(-) #4	(+) #4	LL	PI	-	LL	PI	9	LL	PI	1.0%	- %	%	- g/cc	- pcf
2.68	-	-	-		34			-	-			-	-	

REMARKS: Positive reaction to HCl.
Slight reaction to benzidine.

MATERIALS TESTING SECTION REPORT	EWP-23 1-21-59 PORTLAND, OREGON	SOIL COMPACTION CURVES

PROJECT	LOCATION
Apache Junction-Gilbert, Powerline channel Arizona	Channel Sta. 396+00

FIELD SAMPLE No.	TESTING SECTION SAMPLE No.	% LARGER THAN TESTED	COMPACTIVE EFFORT
614 A.2	650430(B)	Trace	ASTM STD.



U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE ENGINEERING and WATERSHED PLANNING UNIT PORTLAND, OREGON	SIGNATURE Gilbert C. Sullivan TITLE Civil Engineer DATE 4/9/65

M-1554

7-0-14821-L

Form SCS 353
9-64

LABORATORY NO. 650431

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SOIL CLASSIFICATION

PROJECT and STATE: Apache Junction-Gilbert, Powerline Channel, Arizona

SAMPLE LOCATION: Channel Sta. 378+00

FIELD SAMPLE NO.: 617 A.1

DEPTH: 4.0 to 4.6 ft.

GEOLOGIC ORIGIN: -

TYPE OF SAMPLE: Undisturbed

TESTED AT: Portland, Oregon

APPROVED BY: Gilbert C. Sullivan

DATE: 4/9/65

SYMBOL: CL-ML

DESCRIPTION: Light brown calcareous sandy silty clay.

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c
-	0.0023	0.012	0.038	0.060	0.24	12.7	-	-

COBBLES | GRAVELS | SANDS | FINES

SIEVE OPENING, (mm)

U.S. STANDARD SIEVE SIZE

GRAIN SIZE IN MILLIMETERS

PERCENT FINER BY DRY WEIGHT

SPECIFIC GRAVITY (G_s)		ATTERBERG LIMITS						SOLUBLE SALTS	SHRINKAGE LIMIT	UNDISTURBED CONDITION		
		NATURAL MOISTURE		AIR DRY		OVEN DRY				MOISTURE	DRY UNIT WEIGHT	
(-) #4	(+) #4	LL	PI	LL	PI	LL	PI				g/cc	pcf
2.70	-	-	-	43	17	-	-	0.0 %	- %	14.52 %	-	95.6

REMARKS: Positive reaction to HCL. Slight reaction to benzidine.

MATERIALS TESTING SECTION REPORT	E.W.P-20 (4-24-58) Portland, Oregon	SHEAR TEST

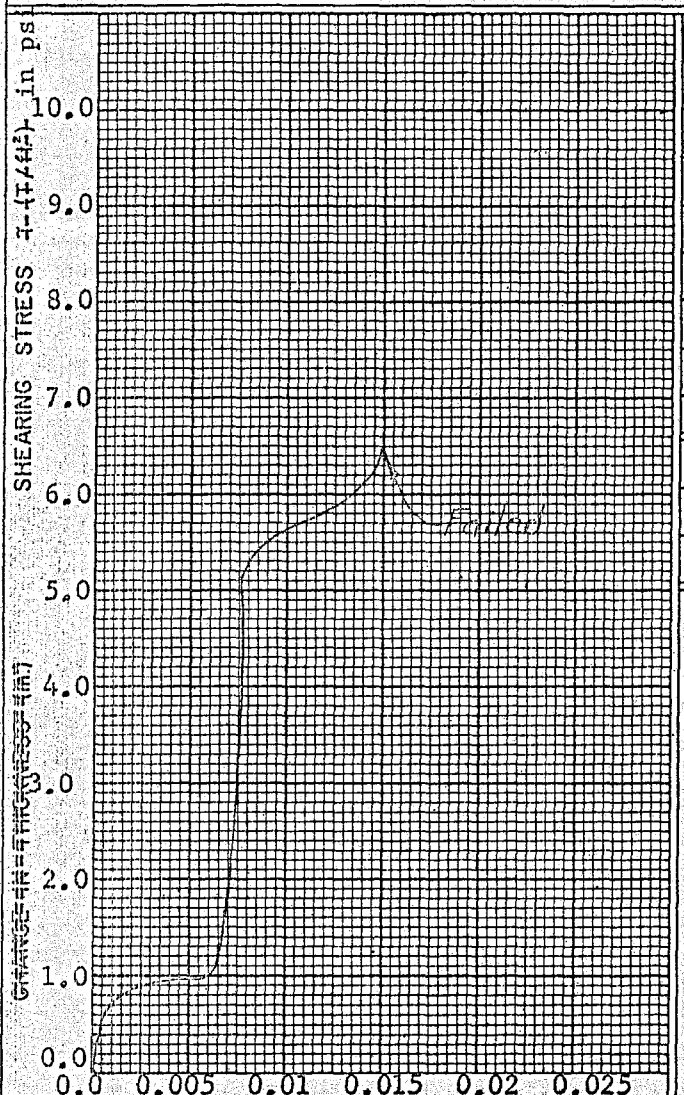
PROJECT	LOCATION
Arizona Apache Junction-Gilbert, Powerline Channel	Channel Sta. 378+00

FIELD SAMPLE No.	TYPE of SAMPLE	ORIGIN
617 A.1	Undisturbed	Depth 4.0 to 4.6'
PROPOSED USE	**TESTING SECTION SAMPLE No.**	**SUBMITTED BY**
-	650431	W.F. Mildner

TYPE OF TEST	CONTROL
Unconfined Compression	Stress

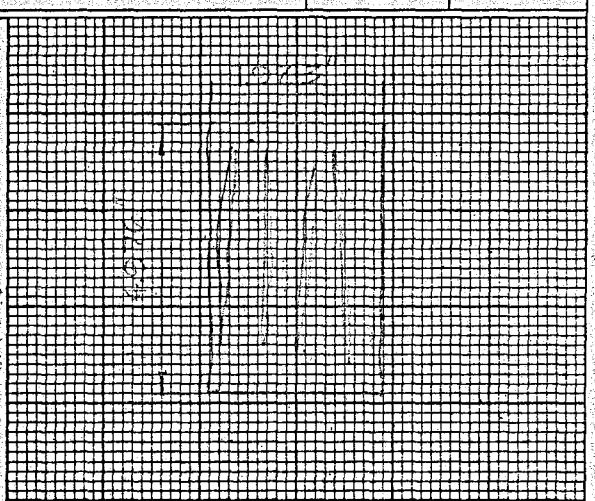
RATE OF LOADING	MOISTURE CONDITION
0.0246 T/ft.^{2}/min.	79.0% sat.

TYPE OF SPECIMEN	AREA (sq. in)	THICKNESS (in)
Undisturbed	-	-



TEST NO	1	2	3	4
INIT. MOISTURE, %	21.0	-	-	-
DRY DENSITY, lb/ft³	98.1	-	-	-
INIT. VOID RATIO	0.720	-	-	-
TEST DURATION, MIN.	19	-	-	-
FINAL MOISTURE, %	21.0	-	-	-
NORMAL STRESS, T/ft²	-	-	-	-
MAX. SHEAR STRESS, T/ft²	0.462	-	-	-
MAX RATIO T/6	-	-	-	-

SHEAR VALUES	∅	C
AT MAXIMUM STRESS T/ft.^{2}	-	0.231
AT ULTIMATE STRESS	-	-



TYPE OF FAILURE

REMARKS

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE
ENGINEERING and WATERSHED PLANNING UNIT
PORTLAND, OREGON

SIGNATURE Gilbert E. Sullivan

TITLE Civil Engineer | DATE 4/9/65

M-2055

7-0-14316-L

Form SCS 127
9-64

LABORATORY NO. 650431

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SOIL PERMEABILITY

PROJECT and STATE	SAMPLE LOCATION
Apache Junction-Gilbert, Powerline channel, Arizona	Channel Sta. 378+00

FIELD SAMPLE NO.	DEPTH	GEOLOGIC ORIGIN
617 A.1	4.0 to 4.6'	-

TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
Undisturbed	Portland, Oregon	Gilbert C. Sullivan	4/9/65

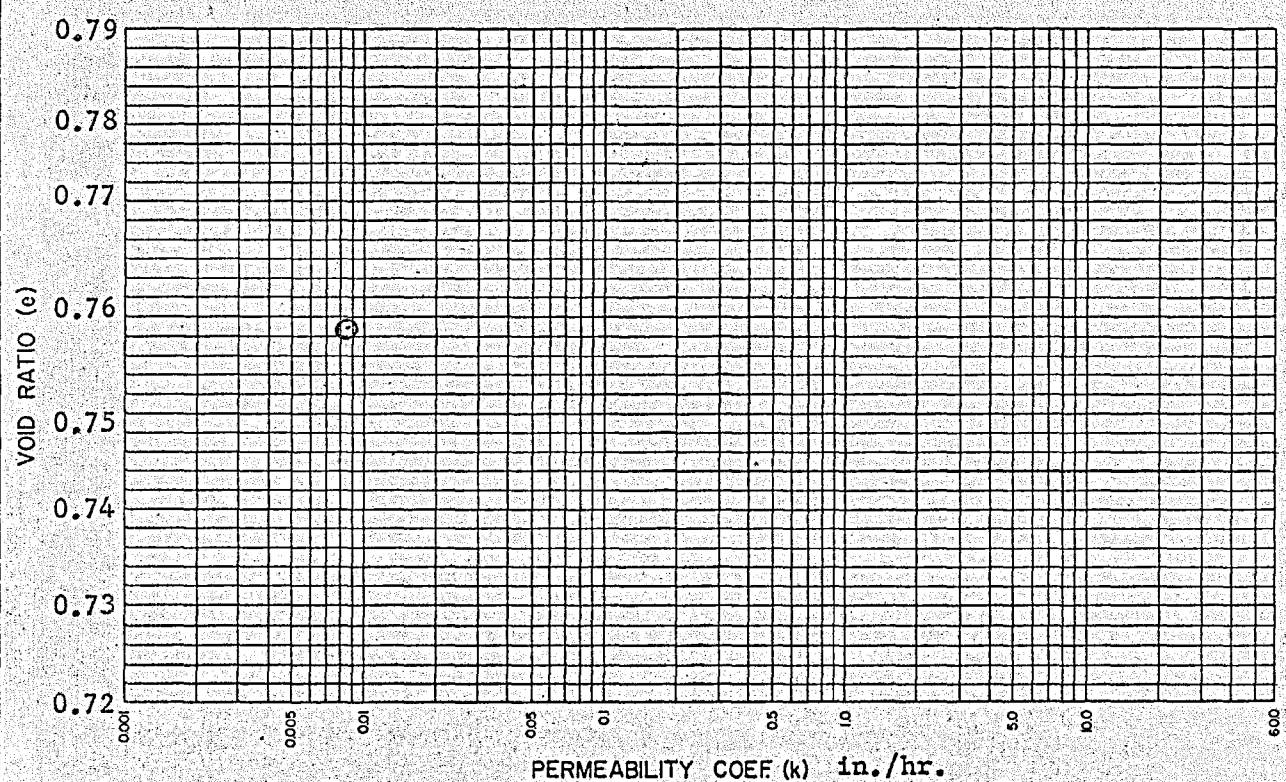
CLASSIFICATION
CL-ML; Light brown calcareous sandy silty clay. LL 43 PI 17

TEST NO.	1	2	3	4
INITIAL MOISTURE %	17.7	-	-	-
DRY DENSITY ☐ g/cc ☒ pcf	95.6	-	-	-
VOID RATIO	0.759	-	-	-
PERMEABILITY COEF	0.00868		-	-
PERCOLATION COEF	0.0202	-	-	-
$H/_L$ DURING TEST	6.76:1	-	-	-

SPECIFIC GRAVITY

G_s (-) #4	2.70
G_s (+) #4	-
G_m(Bulk)(+) #4	-

TEST SPECIFICATIONS
Specimen trimmed to size from larger "block" sample. Flow was perpendicular to natural bedding planes.



REMARKS

Form SCS 353
9-64

LABORATORY NO. 650432

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SOIL CLASSIFICATION

PROJECT and STATE: Apache Junction-Gilbert, Powerline channel, Arizona

SAMPLE LOCATION: Channel Sta. 378+00

FIELD SAMPLE NO.: 617 A-2

DEPTH: 6.9 to 7.5'

GEOLOGIC ORIGIN: -

TYPE OF SAMPLE: Undisturbed

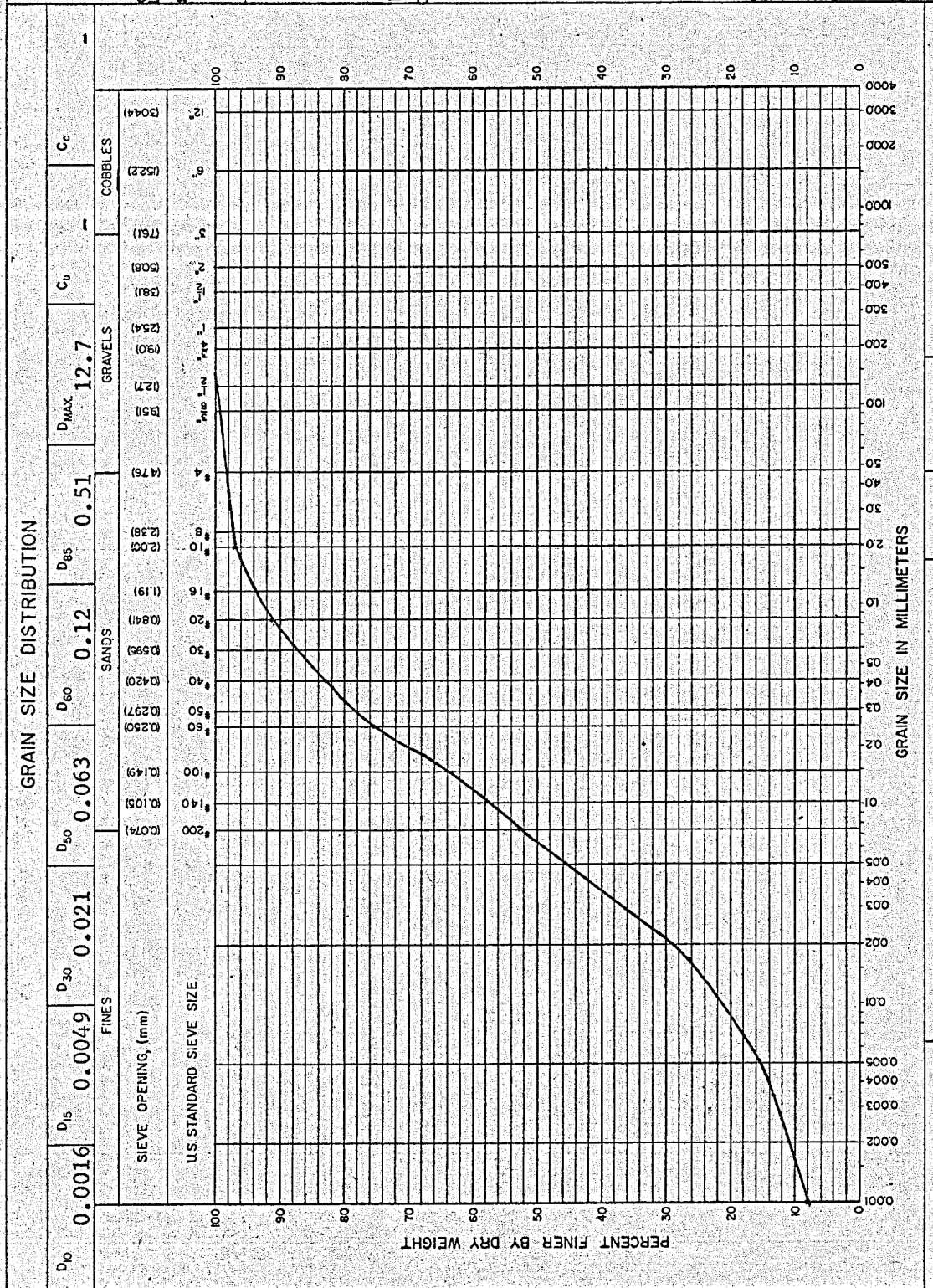
TESTED AT: Portland, Oregon

APPROVED BY: Gilbert C. Sullivan

DATE: 4/9/65

SYMBOL: CL-1

DESCRIPTION: Light brown calcareous sandy silty clay



UNDISTURBED CONDITION: MOISTURE 11.68 %; DRY UNIT WEIGHT - g/cc, 101.0 pcf

SHRINKAGE LIMIT: - %

SOLUBLE SALTS: 0.0 %

ATTERBERG LIMITS

	NATURAL MOISTURE		AIR DRY		OVEN DRY	
	LL	PI	LL	PI	LL	PI
	-	-	36	14	-	-

SPECIFIC GRAVITY (G_s): (-)#4 2.72; (+)#4 -

REMARKS: Positive reaction to HCL.
Slight reaction to benzidine.

MATERIALS TESTING SECTION REPORT	E.W.P-20 (4-24-58) Portland, Oregon	SHEAR TEST

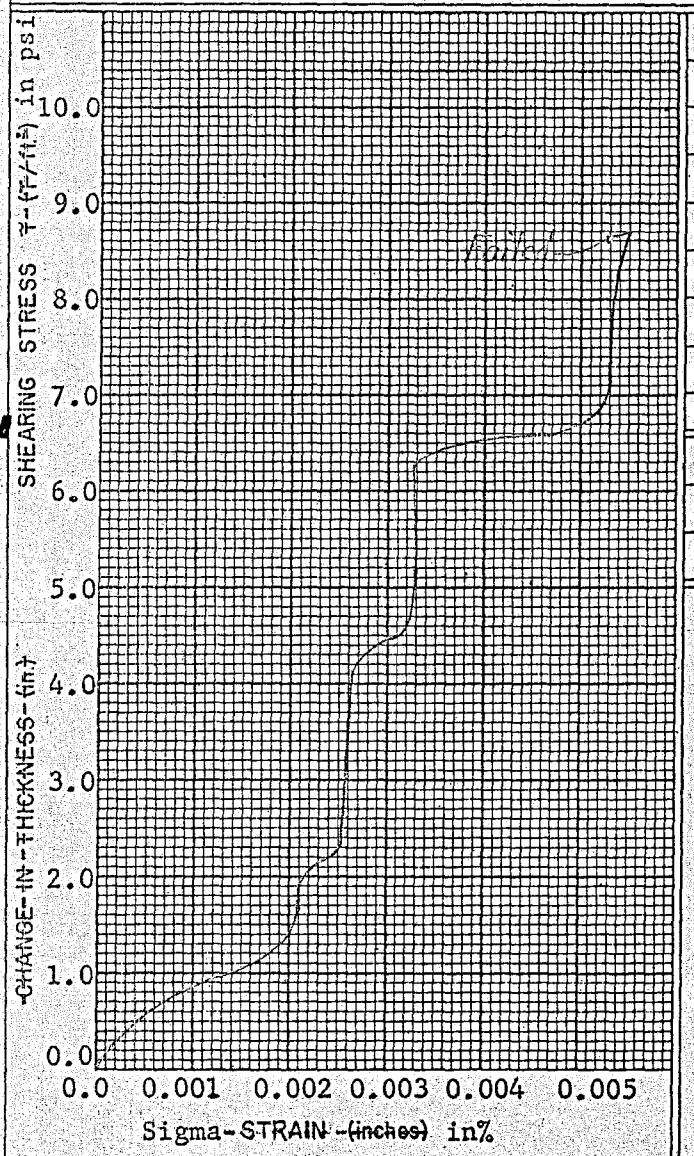
PROJECT	LOCATION
Apache Junction-Gilbert, Powerline channel Arizona	Channel Sta. 378+00

FIELD SAMPLE No.	TYPE of SAMPLE	ORIGIN
617 A-2	Undisturbed	Depth 6.9 to 7.5 '
PROPOSED USE	**TESTING SECTION SAMPLE No.**	**SUBMITTED BY**
-	650432	W.F. Mildner

TYPE OF TEST	CONTROL
Unconfined compression	Stress

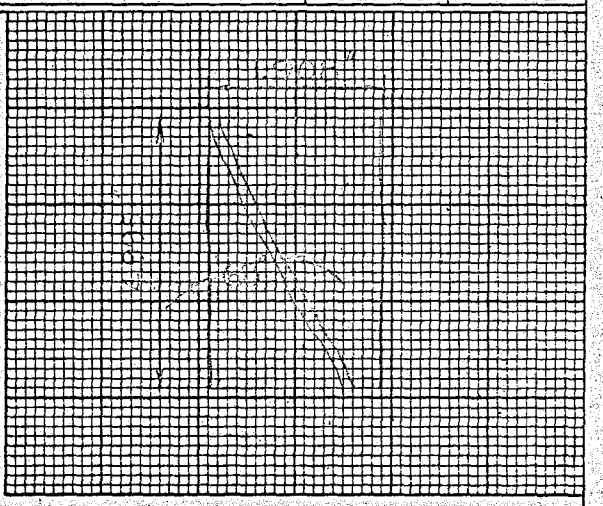
RATE OF LOADING	MOISTURE CONDITION
0.0252 T/ft^2/min.	73.2% saturation

TYPE OF SPECIMEN	AREA (sq. in)	THICKNESS (in)
Undisturbed	-	-



TEST NO	1	2	3	4
INIT. MOISTURE, %	17.4	-	-	-
DRY DENSITY, lb/ft³	102.9	-	-	-
INIT. VOID RATIO	0.648	-	-	-
TEST DURATION, MIN.	25	-	-	-
FINAL MOISTURE, %	17.4	=	-	-
NORMAL STRESS, T/ft²	-	-	-	-
MAX. SHEAR STRESS, T/ft²	0.625	-	-	-
MAX. RATIO τ/σ	-	-	-	-

SHEAR VALUES	ϕ	C
AT MAXIMUM STRESS T/ft.^{2}	-	0.312
AT ULTIMATE STRESS	-	-



TYPE OF FAILURE

REMARKS

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE
ENGINEERING and WATERSHED PLANNING UNIT
PORTLAND, OREGON

SIGNATURE Gilbert G. Sullivan

TITLE Civil Engineer

DATE 4/9/65

M-2055

7-0-14316-L

Form SCS 127
9-64

LABORATORY NO. 650432

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SOIL PERMEABILITY

PROJECT and STATE: Apache Junction-Gilbert, Powerline Channel, Arizona
SAMPLE LOCATION: Channel Sta. 378+00

FIELD SAMPLE NO.	DEPTH	GEOLOGIC ORIGIN
617 A.2	6.9 to 7.5 ft.	-

TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
Undisturbed	Portland, Oregon	Gilbert E. Sullivan	4/9/65

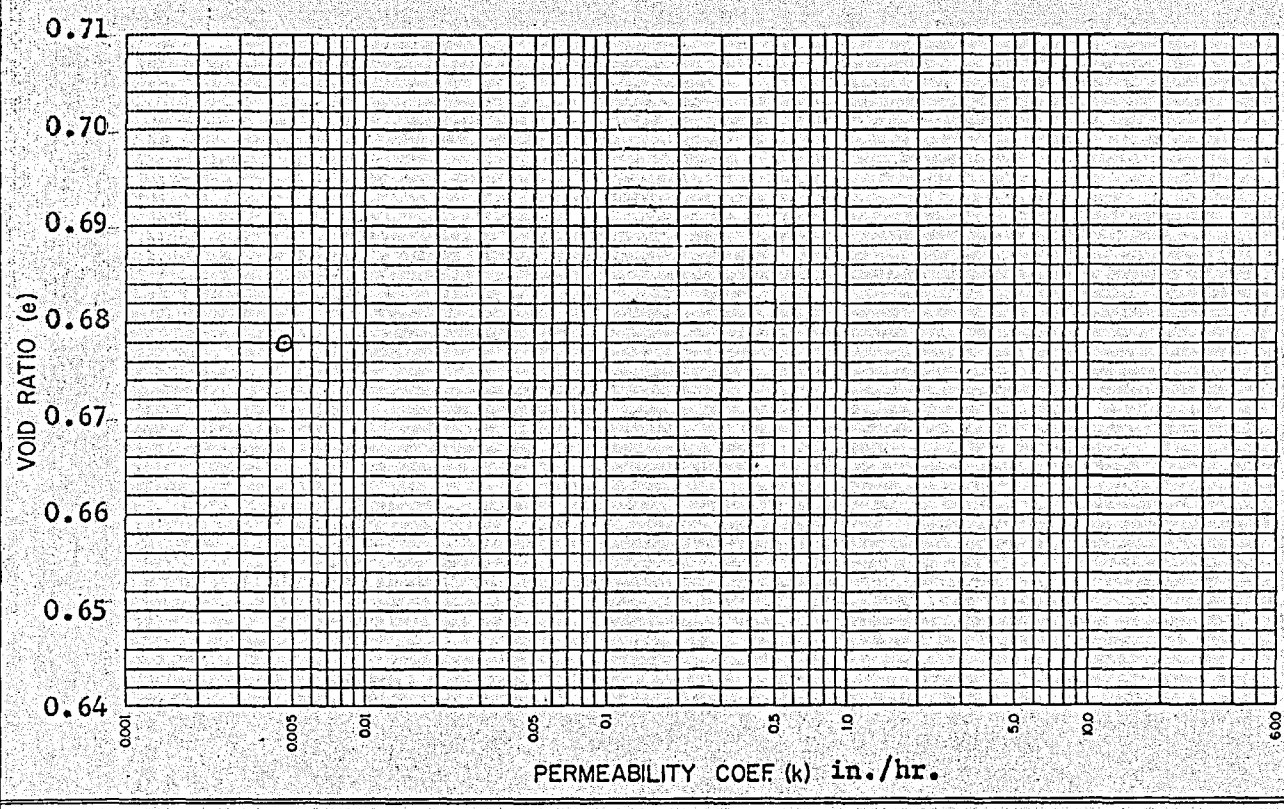
CLASSIFICATION CL-1; Light brown calcareous sandy silty clay. LL 36 PI 14

SPECIFIC GRAVITY

TEST NO.	1	2	3	4
INITIAL MOISTURE %	11.0	-	-	-
DRY DENSITY γ_b ☐ g/cc ☒ pcf	101.0	-	-	-
VOID RATIO	0.678	-	-	-
PERMEABILITY COEF	0.00489	-	-	-
PERCOLATION COEF	0.0120	-	-	-
H/L DURING TEST	6.9:1	-	-	-

G_s (-) #4	2.72
G_s (+) #4	-
G_m(Bulk)(+) #4	-

TEST SPECIFICATIONS
Speciment trimmed to size from larger "block" sample. Flow was perpendicular to natural bedding planes.



REMARKS