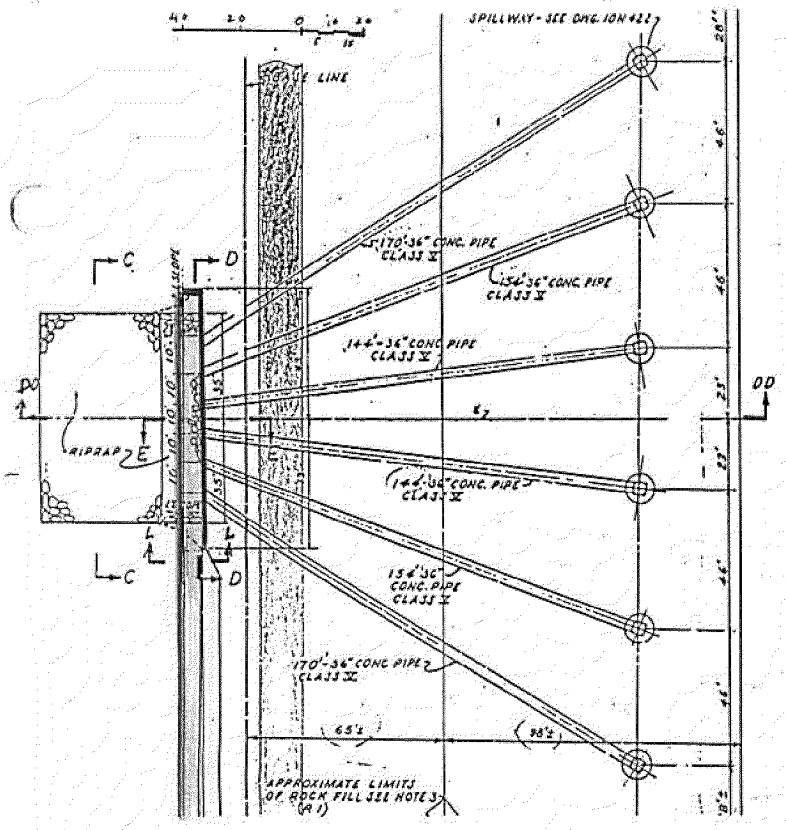
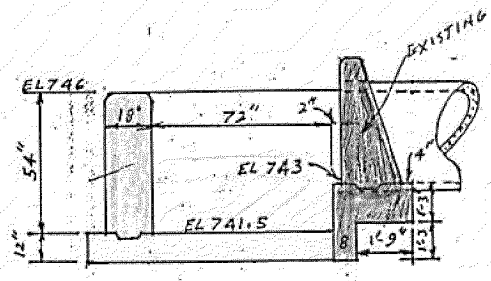
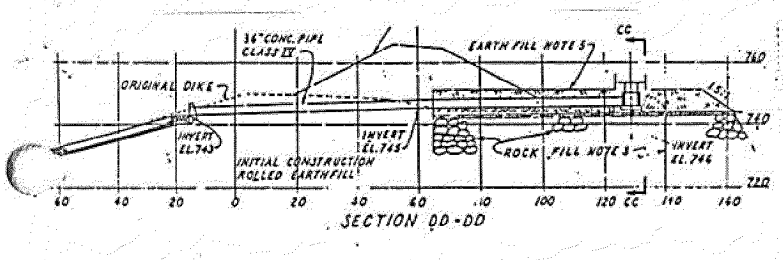
KINGSTON - FLUME TO EMERY RIVER

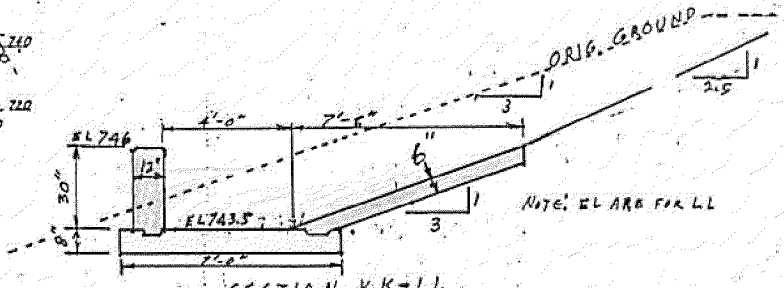




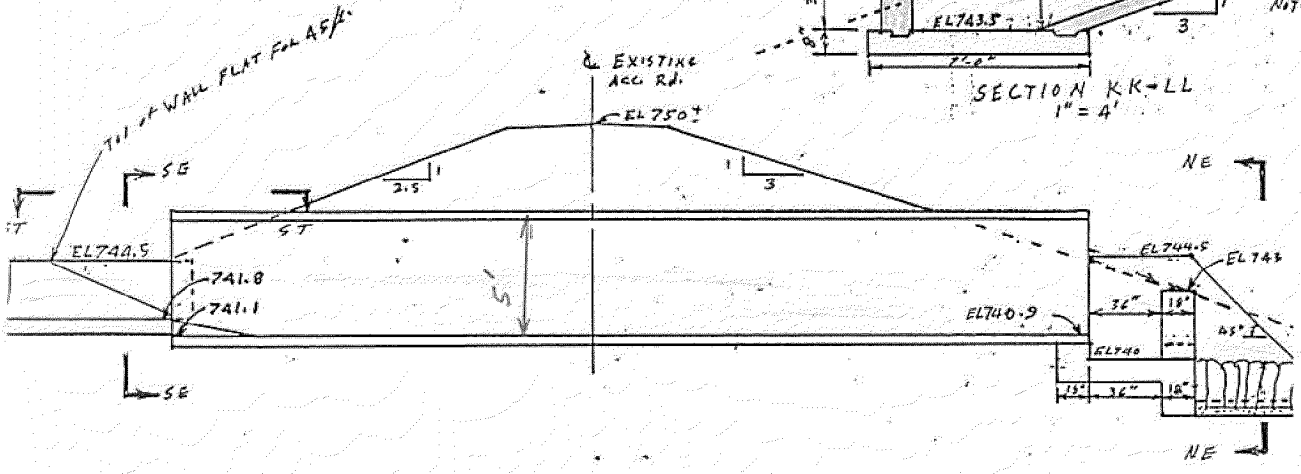
FLUME AT DD-DD

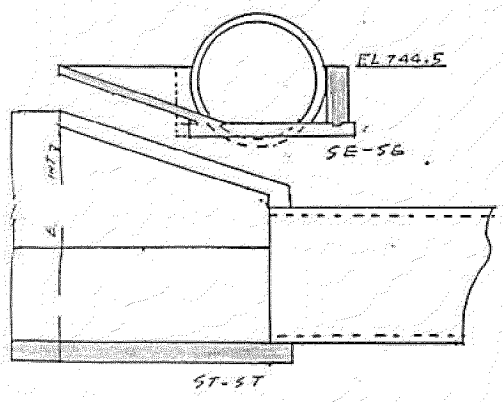


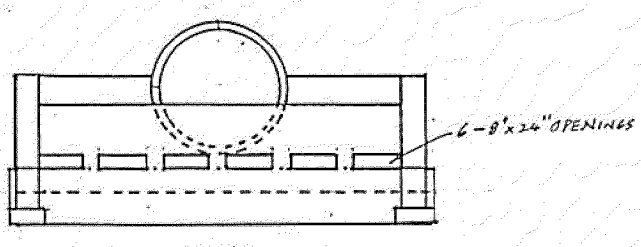
SECTION DD-DD



SECTION KK-LL
1" = 4'







EC 900322 002

FC

Estimate No: PEC 90055
CER No : FHEKIF89-1207

TENNESSEE VALLEY AUTHORITY
POWER ENGINEERING AND CONSTRUCTION
SCOPE OF WORK/COST ESTIMATE

TO : Those listed
FROM: Ronald W. Clevenger, Supervisor, Power Engineering & Construction
Estimating Section, SP 3S54F-C

Date: MAR 22 1990

Project: Kingston Fossil Plant

Feature: Relocate Ash Pond Discharge

Requesting Organization: Fossil & Hydro Engineering (J. A Benedict)

Purpose: Project Authorization

Description of Work to be Performed: Relocate the ash pond discharge from the intake to the Emory River side of the ash pond. Alternate No. 1 consists of building three new discharge structures six inches lower than the existing structures and leaving the existing structures in place. Alternate No. 2 consists of building a collection basin with a diversion channel to the Emory River. For Scope of Work, see Attachment 2. Based on data furnished by F&HE.

Schedule:

Design:
Start : FY 1990
Complete: FY 1990

Construction:
Start : FY 1991
Complete: FY 1991

Type of Estimate: Authorization

Total TVA Cost: $365,000 - Alternate 1
$200,000 - Alternate 2

Comments: Reference the following attachments:
Attachment 1 - Cost Estimate
Attachment 2 - Scope of Work
Attachment 3 - Bill of Materials
Attachment 4 - Cash Flow

APPROVALS:

Original signed by:
Donald Cardwell 3/16/90
F&H Construction (Date)

KWB JAB
3/20/90
F&H Engineering (Date)

for PE&C Estimating 3/12/90 (Date)

RIMS, MR 4N 35A-C
D. Cardwell, SMW-K
D. J. Cowser, LP 2S 125E-C
S. W. Eslinger, BR 4N 44A-C
J. L. Golden, BR 4N 52A-C
F. D. McKeehan, SP 3S 48D-C
J. S. Sims, LP 1S 128E-C
S. Simms, F&HC-KIF

0855D

PEC 90055-01 CER NO: FHEKIF89-1207 ATTACHMENT 1

Kingston Fossil Plant
Ash Pond Discharge Relocation--Alternate 1

ESTIMATE OF COST

WBS#	Description	Qty	Unit	MATERIAL Unit Price	MATERIAL $Amount	LABOR MH/ Unit	LABOR Man-Hours	LABOR $/MH	LABOR $Amount	Equip Usage/ Other $	SITE-TARGETED UNIT RATE & COST Excl Contingency Unit Price	SITE-TARGETED UNIT RATE & COST Excl Contingency Total $ Cost	BID AMOUNT INCLUDING CONTINGENCY Contingency %	Contingency $ Amount	Total $ Cost
10030.1	Coffer Dam	15,000.0	CY			0.1	1,080	15.93	17,200	35,660	3.52	52,860	10	5,290	58,150
1013.1	Riprap	3,050.0	Ton	10.00	30,500	0.1	229	15.78	3,610	1,430	11.65	35,540	10	3,560	39,100
1012.1	Filter Blanket	505.0	Ton	8.20	4,140	0.1	30	17.35	510	340	9.88	4,990	10	510	5,500
10031.1	Fill for Dischg Strs	5,000.0	CY	0.08	400	0.1	440	15.39	6,770	12,440	3.92	19,610	25	4,890	24,500
1230.1	Std Skimmer & Spillway	3.0	Assy	2450.00	7,350	161.0	483	16.37	7,910	3,560	6273.33	18,820	10	1,880	20,70
1230.2	Pipe, Conc,36" Cl 4	344.0	LF	46.25	15,910	1.2	400	14.86	5,940	3,510	73.72	25,360	10	2,540	27,900
10031	Dike Fill	6,700.0	CY			0.0	272	16.38	4,460	4,900	1.40	9,360	10	940	10,300
1230.4	Seepage Collar	3.0	Ea	125.00	380	16.0	48	16.21	780	200	453.33	1,360	10	140	1,500
1230.5	Concrete Headwall	1.0	Ea	3770.00	3,770	177.0	177	15.32	2,710	2,160	8640.00	8,640	10	860	9,500
1230.6	Remove Coffer Dam	15,000.0	CY			0.1	1,320	16.06	21,200	39,450	4.04	60,650	10	6,100	66,750
1014.1	Seed & Mulch	800.0	SY	0.15	120	0.1	40	15.07	600	280	1.25	1,000	10	100	1,100
1026.1	Crushed Stone	105.0	Ton	8.20	860	0.1	10	16.67	170	150	11.24	1,180	10	120	1,300
	Ttl Direct Const				63,430		4,528	15.87	71,860	104,080		239,370	10	26,930	266,300
1898	Construction Facilities						770	15.87	12,200	9,200		21,400	10	2,100	23,500
1886	Field General Expense						265	31.25	8,300	1,700		10,000	10	1,000	11,000
1884	Construction Overhead									8,100		8,100	10	800	8,900
	Total Field Construction				63,430		5,563	16.60	92,360	123,080		278,870	10	30,830	309,700
	Fossil & Hydro Engineering														10,000
	Civil Design											8,800			
	Project Management											1,200			
	Power Overheads														20,000
	Corporate Overheads														25,300
	Total TVA (Excluding AFUDC)														365,000

PEC90055-01

PEC 90055-02 CER NO: FHEKIF89-1207 ATTACHMENT 1

Kingston Fossil Plant
Ash Pond Discharge Relocation--Alternate 2

ESTIMATE OF COST

WBS#	Description	Qty	Unit	MATERIAL Unit Price	MATERIAL $Amount	LABOR MH/ Unit	LABOR Man-Hours	LABOR $/MH	LABOR $Amount	Equip Usage/ Other $	SITE-TARGETED UNIT RATE & COST Excl Contingency Unit Price	SITE-TARGETED UNIT RATE & COST Excl Contingency Total $ Cost	BID AMOUNT INCLUDING CONTINGENCY Contingency %	Contingency $ Amount	Total $ Cost
1028-Road Crossing Culvert															
1028.1-Culvert Pipe		40.0	LF	91.25	3,650	3.9	156	15.51	2,420	2,200	206.75	8,270	10	830	9,100
1028.2-Discharge Structure		1.0	Ea	1980.00	1,980	500.0	500	16.54	8,270	1,550	********	11,800	10	1,180	12,980
1033-Dischg Into Emeory River															
1033.1-Open Trench		420.0	LF	37.26	15,650	5.5	2,320	16.32	37,870	12,420	157.00	65,940	10	6,590	72,53
1033.2-Collection Chamber		1.0	Ea	5440.00	5,440	660.0	660	16.15	10,660	5,610	********	21,710	10	2,170	23,880
1033.3-Temporary Plugs		6.0	Ea			28.0	168	17.36	2,920	810	621.67	3,730	10	370	4,100
1033.4-Temporary Bulkhead		2.0	Ea			30.0	60	14.92	900	740	820.00	1,640	10	160	1,800
1014-Seeding & Mulching		640.0	SY	0.15	100	0.1	44	15.53	680	310	1.70	1,090	10	110	1,200
Ttl Direct Const					26,820		3,908	16.31	63,720	23,640		114,180	10	11,410	125,590
1898-Construction Facilities							664	16.31	10,800	8,100		18,900	10	2,100	21,000
1886-Field General Expense							300	31.25	9,400	1,900		11,300	10	1,100	12,400
1884-Construction Overhead										4,300		4,300	10	410	4,710
Total Field Construction					26,820		4,872	17.22	83,920	37,940		148,680	10	15,020	163,700
Fossil & Hydro Engineering															10,000
Civil Design												8,800			
Project Management												1,200			
Power Overheads															11,00
Corporate Overheads															15,300
Total TVA (Excluding AFUDC)															200,000

KINGSTON FOSSIL PLANT
RELOCATE ASH POND DISCHARGE

1.0 SCOPE OF WORK

Relocate the ash pond discharge from the intake to the Emory River side of the ash pond.

2.0 WORK BREAKDOWN STRUCTURE

2.1 ALTERNATIVE #1

This alternative consists of building three new discharge structures six inches lower than the existing structures and leaving the existing ones in place.

2.1.1 Riprap

Dump 1,500 tons of riprap down the bank and spread to the dimensions of the rock foundation using a dozer.

2.1.2 Coffer Dam

Build a 15,000 cubic yard coffer dam out of bottom ash and pump out the water. (This type of dam must be built with the ash dumped then pushed for fifty feet with a dozer).

Eighteen tons of clay is to be added to the coffer dam and compacted. The clay will come from a borrow site with a haul distance of 2,800 feet one way.

2.1.3 Dike Material

Twenty-five hundred cubic yards of compacted dike material is to be removed and the riprap leveled to the designed elevation. Approximately 500 tons of additional riprap will be needed at this point with 300 tons of 1032 stone for filter blanket material.

Replace approximately 2,000 yards of the twenty five hundred yards of dike material. The remaining amount will be removed.

During this process the top of the dike is not to be below elevation 760 (5 feet below the existing dike and 5 feet above the coffer dam).

2.1.4 Pipes

The three concrete collars are to be put around the pipe in the center of the dike. The pipes are then placed and the clay back-filled to two feet above the discharge pipes.

2.1.5 Retaining Wall

The discharge retaining wall, thirty-six cubic yards of riprap and material replaced before the ash coffer dam, is to be removed by clamshell and returned to the ash disposal area.

2.2 ALTERNATIVE #2

This alternative consists of a collection basin, a road crossing, and a discharge structure.

2.2.1 Road Crossing

Construct a 40-foot road crossing using 5-foot Class IV concrete pipe.

2.2.2 Concrete Canal

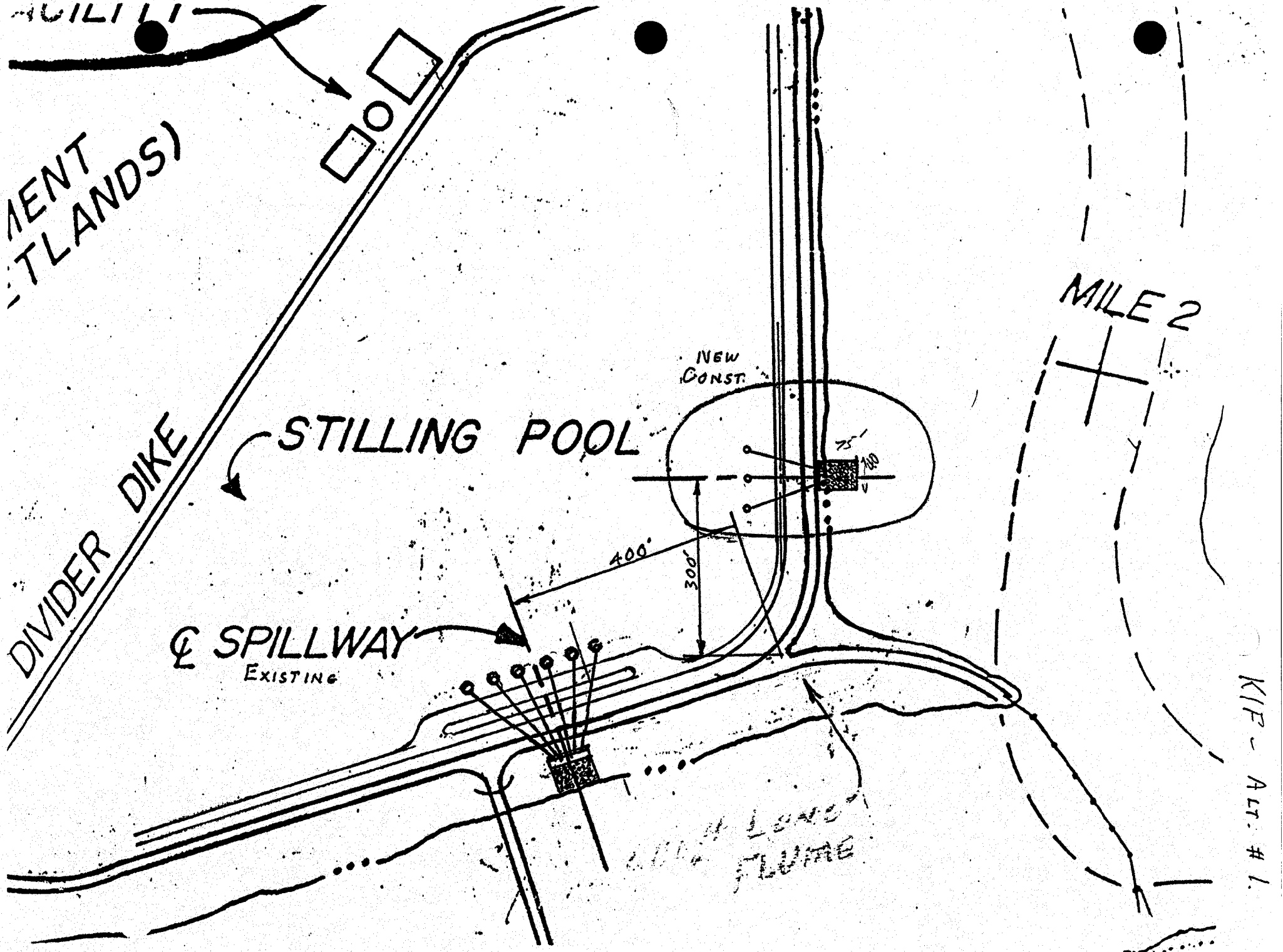
Construct a 420-foot long concrete canal.

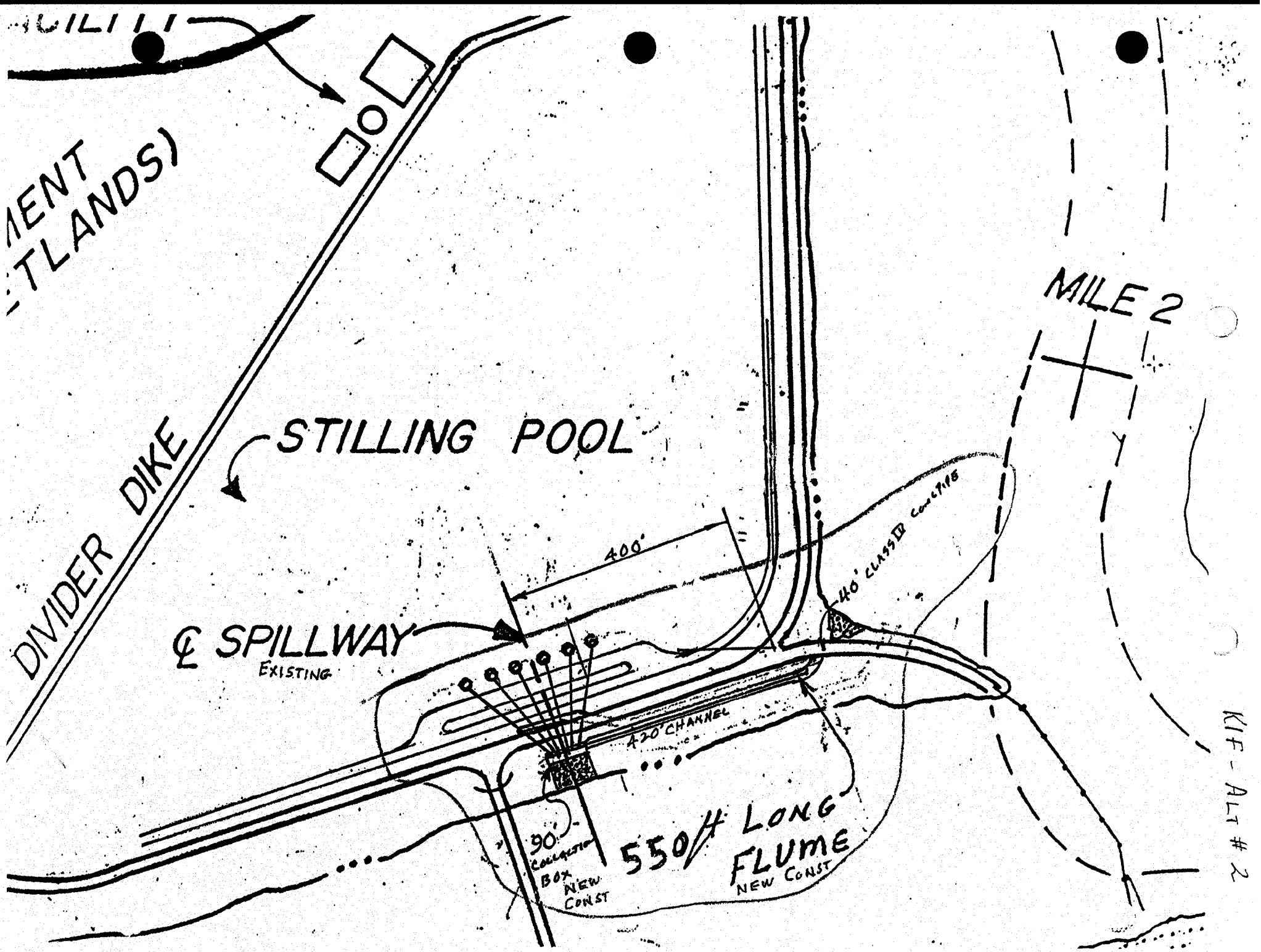
2.2.3 Discharge Structure

Construct a discharge structure and riprap apron (This must be built when the water is below elevation 738).

Block off the three discharges closest to Emory River and construct one half of the collection basin.

Open up the three discharges and close the other three discharges and complete the discharge structure.





P[illegible]0055-02 CER NO: FHEKIF89-1207 ATTACHMENT 3

Kingston Fossil Plant
Ash Pond Discharge Relocation--Alternate 2

List of Quantities & Materials

WBS# Description	Quantity	Unit
1028-Road Crossing Culvert		
1028.1-Culvert Pipe	40.0	LF
Pipe,Conc,Cl IV,60"	40.0	LF
Crushed Stone	30.0	Ton
Excavation	190.0	CY
Backfill	137.0	CY
1028.2-Discharge Structure	1.0	Ea
Filter Blanket	17.0	Ton
Riprap	60.0	Ton
Excavation/Backfill	75.0	CY
Concrete	15.0	CY
Reinforcing Bar	1.0	Ton
Formwork	540.0	SFCA
1033-Dischg Into Emeory River		
1033.1-Open Trench	420.0	LF
Excavation/Backfill	850.0	CY
Concrete	171.0	CY
Reinforcing Bar	11.0	Ton
Wire Mesh	3360.0	SF
Formwork	2870.0	SFCA
Water Stop	475.0	LF
1033.2-Collection Chamber	1.0	Ea
Excavation/Backfill	68.0	CY
Formwork	820.0	SFCA
Concrete	54.0	CY
Reinforcing	5.2	Ton
Drill Holes-1 1/2x8"	96.0	Ea
1033.3-Temporary Plugs	6.0	Ea
1033.4-Temporary Bulkhead	2.0	Ea
1014-Seeding & Mulching	640.0	SY

PER 90055-01 CER NO: FHEKIF89-1207 ATTACHMENT 3

Kingston Fossil Plant
Ash Pond Discharge Relocation--Alternate 1

List of Quantities & Materials

WBS#	Description	Quantity	Unit
1030.1	Coffer Dam	15,000.0	CY
1013.1	Riprap	3,050.0	Ton
1012.1	Filter Blanket	505.0	Ton
10031.1	Fill for Discharge Structures	5,000.0	CY
	Crushed Stone Fill	53.3	Ton
1230.1	Standard Skimmer & Spillway	3.0	Assy
	Formwork	600.0	SFCA
	Reinforced Concrete	15.0	CY
	CMP,12Ga x 120",Coated	15.0	LF
	Misc Steel Shapes	2.2	Ton
	Pipe, Concrete, 48",Cl 4	42.0	LF
1230.2	Pipe, Conrete,36" Cl 4	344.0	LF
10031	Dike Fill	6,700.0	CY
1230.4	Seepage Collar	3.0	Ea
	Reinforced Concrete	6.0	CY
1230.5	Concrete Headwall	1.0	Ea
	Formwork	860.0	SFCA
	Reinforcing Bar	3.0	Ton
	Concrete	32.0	CY
1230.6	Remove Coffer Dam	15,000.0	CY
1014.1	Seed & Mulch	800.0	SY
1026.1	Crushed Stone	105.0	Ton

Kingston Fossil Plant
Relocate Ash Pond Discharge-Alternate 2
Cash Flow

	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	Total
ssil & Hydro Construction						
Material		$26,820				$26,820
Labor		83,920				83,920
Eqpt Usage/Other/Indirects		52,960				52,960
Total Fossil & Hydro Construction	0	163,700	0	0	0	163,700
ocurement Quality Assurance Branch						0
ssil & Hydro Engineering						
Civil Design	8,800					8,800
Project Management	800	400				1,200
her						
ONRED						0
Non-Power Direct Costs						0
Power Direct Costs						0
wer Overheads	600	10,400	0	0	0	11,000
rporate Overheads	800	14,500	0	0	0	15,300
tal TVA (excluding AFUDC)	$11,000	$189,000	$0	$0	$0	$200,000

Assumptions:
Engineering start: FY 90 complete: FY 91
Construction start: FY 91 complete: FY 91

Material constraints: None

Other:

KINGSTON FOSSIL PLANT
RELOCATE ASH POND DISCHARGE-ALTERNATE 1
Cash Flow

	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	Total
ossil & Hydro Construction						
Material		$63,430				$63,430
Labor		92,360				92,360
Eqpt Usage/Other/Indirects		153,910				153,910
Total Fossil & Hydro Construction	0	309,700	0	0	0	309,700
rocurement Quality Assurance Branch						0
ossil & Hydro Engineering						
Civil Design	8800					8,800
Project Management	800	400				1,200
ther						
ONRED						0
Non-Power Direct Costs						0
Power Direct Costs						0
ower Overheads	600	19,400	0	0	0	20,000
orporate Overheads	800	24,500	0	0	0	25,300
otal TVA (excluding AFUDC)	$11,000	$354,000	$0	$0	$0	$365,000

Assumptions:
Engineering start: FY 90 complete: FY 91
Construction start: Fy 91 complete: Fy 91

Material constraints: None

Other:

TVA 489H (EN DES-2-78) **TENNESSEE VALLEY AUTHORITY** SHEET 5 OF 6

SUBJECT _____ PROJECT KFP

COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____

LEFT (ROD READING DIST) RIGHT

BM = 747.00
TOP/WALL
BS 8.37 ∴ HI = 755.37

1+50 ✓	12	0.00	3.0	7.0	13.0	31.0	36.0
	4.28	4.65	4.77	6.09	8.82	11.24	14.53
	751.09	750.72	750.60	749.28	746.55	744.13	740.84
	PUMP						
1+75	11.5	0.00	6.0	17.0	28.0		
	4.23	4.46	4.74	7.80	14.53		
	751.14	750.91	750.63	747.57	740.84		
2+00	10.8	0.0	8.0	16.0	24.0		
	4.26	4.40	4.37	8.62	14.53		
	751.11	750.97	751.00	746.75	740.84		
2+25	8.8	0.00	10.0	28.0			
	4.49	4.48	4.77	14.53			
	750.88	750.89	750.60	740.84			
2+50	9.0	0.0	7.7	28.0			
	4.66	4.73	4.98	14.53			
	750.71	750.64	750.39	740.84			
2+75	9.5	0.0	8.2	26.0			
	4.89	5.14	5.06	14.53			
	750.48	750.23	749.71	740.84			
3+00	10.4	0.0	7.5	20.0	30.0		
	5.01	5.44	5.71	10.72	14.53		
	750.36	749.93	749.66	744.65	740.84		
3+25	11.2	0.0	6.0	16.0	27.5		
	5.07	5.60	6.13	9.76	14.53		
	750.30	749.77	749.24	745.61	740.84		
3+50	11.0	0.0	8.8	28.0			
	5.34	5.82	6.14	14.53			
	750.03	749.55	749.23	740.84			
3+75	9.6	0.0	8.0	28.0			
	5.64	5.98	5.61	14.53			
	749.73	749.39	749.76	740.84			

SUBJECT _____ PROJECT _____

COMPUTED BY DATE CHECKED BY DATE

HI 755.37

4+00

9.0
5.59
749.78

0.0 8.5 25.00
5.66 5.81 14.53
749.71 749.56 740.84

4+25

11.4
5.26
750.11

0.0 4.0 15.0 26.0
5.81 6.05 9.76 14.53
749.56 749.32 745.61 740.84

4+50

14.0 18.0
5.59 5.03
749.78 750.34

0.0 4.0 22 27
6.05 6.43 13.03 14.53
749.32 748.94 742.34 740.84

T.P. (TOP/ROCK)
9.93
750.44

B.M
8.35
747.02 Δ=0.02

TVA 488 (EN DES-3-77)

SHEET 1 OF

KINGSTON - FLUME

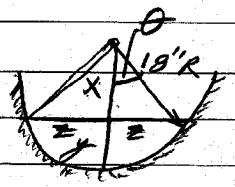
COMPUTED DATE 5/21/90

CHECKED DATE

MIN LAKE EL 735
NORMAL LAKE EL 741

EACH PIPE (5 DISCHARGING) WILL DISCHARGE 15.47 CFS @ 50 MGD
NORMAL OPERATION (5 PIPES) DISCHARGE 9.28 CFS @ 30 MGD
50 MGD = 77.35 CFS 30 MGD = 46.4 CFS
@ 50 MILLIONS GALLONS A DAY THE NORMAL CROSS SECTIONAL AREA of THE WATER IN THE 36" PIPE IS:
15.47 ft^3/sec ÷ 9.5 ft/sec = 1.628 ft^2
FLOW RATE FROM CHART

@ 30 MGD - THE CROSS SECTION AREA IS:
9.28 ft^3/sec ÷ 8.3 ft/sec = 1.118 ft^2



TRY $\theta = 45°$
$\cos 45° = \frac{X}{18}$ ⇒ X = 12.728" @ 45° X = Z
TRIANGLE AREA = 12.728 X 12.728 ÷ 2 X 2 = 162 in^2 or 1.125 ft^2
SEGMENT AREA = $18^2 \times \pi \times \frac{1}{360} \times 90$ = 254.46 in^2 or 1.767 ft^2
WATER AREA IS 1.767 ft^2 - 1.125 ft^2 = 0.624 ft^2 < 1.628 N.G.

TRY $\theta = 55°$
X = Cos 55° * 18" = 10.32"
Z = Sin 55° · 18" = 14.745
AREA of 2 Δ's = 10.32 in X 14.742 in ÷ 2 X 2 = 152.23 in^2 or 1.057 ft^2
SEGMENT AREA = 2.82743 X (55+55) = 311.02 or 2.160 ft^2
2.160 ft^2 - 1.057 ft^2 = 1.103 ft^2 ≈ 1.118 ft^2
WATER DEPTH @ 30 MGD (5 PIPE) = 18" - X = 7.68 in

TRY $\theta = 80°$
X = Cos 80° X 18" = 3.126 in
Z = Sin 80° X 18 = 17.727 in
AREA of 2 Δ's = 3.126" X 17.727" = 55.41 in^2 or 0.385 ft^2
(CONTINUE P-2)

COMPUTED DATE 5/21/90

CHECKED DATE

SEGMENT AREA = 2.82743 x 80 x 2 = 452.39 in² or 3.14 ft²

3.14 ft² - 0.138 ft² = 2.76 ft² > 1.628 ft² TRY AGAIN

TRY θ = 70°

X = Cos 70° x 18" = 6.156 in

Z = sin 70° x 18" = 16.914 in

area of 2Δ's = 6.156 x 16.914 ÷ 2 x 2 = 104.13 in² or 0.723 ft²

SEGMENT AREA = 2.82743 x (70+70) = 395.84 in² or 2.749 ft²

2.749 - 0.723 ft² = 2.03 ft² > 1.628 ft² TRY AGAIN

TRY θ = 65°

X = Cos 65° x 18" = 7.607 in

Z = sin 65° x 18" = 16.314 in

AREA of 2Δ's = 7.607 x 16.314 = 124.10 in²

AREA of SEGMENT = 2.82743 in²/° x 65° x 2 = 367.566

WATER AREA 367.566 - 124.10 = 243.467 or 1.69 ft²

WATER DEPTH IN PIPE @ 50 MGD (5 PIPES) = 18" - X = 10.139 in

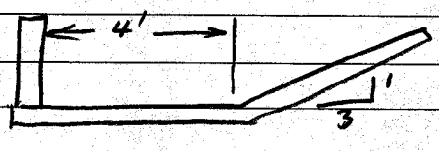
DISCHARGE INVERT ELEV - (PLAN) - 473 (ION 421-R1)

TOP of WATER DESIGN ELEV - 50 MGD 473 + 0.866 = 473.87 EL

30 MGD 473 + 0.64 = 473.64 EL

PRELIMINARY FLUME SIZE:

EL 746



WATER DEPTH @ 50 MGD = 77.37 CFS

MANNING EQ $V = \frac{1.486}{n} R^{2/3} S^{1/2}$ OR $Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$

$R = a/p$

$n = 0.015$

(CONTINUED ON P-3)

KINGSTON FLUME

COMPUTED DATE 5/21/80

CHECKED DATE

$Q = 1.486 \div n \times A \times R^{2/3} \times S^{1/2}$

$77.37 = 1.486 \div 0.015 \times A \times \left(\frac{A}{P}\right)^{2/3} \times (1.2 \div 420)^{1/2}$

FIND A IN TERMS of P

$A\,(A \div P)^{2/3} = 14.61$

TRY DEPTH of 2'

$P = 2 + 4 + \sqrt{2^2 + (2 \times 3)^2} = 12.32$ ft.

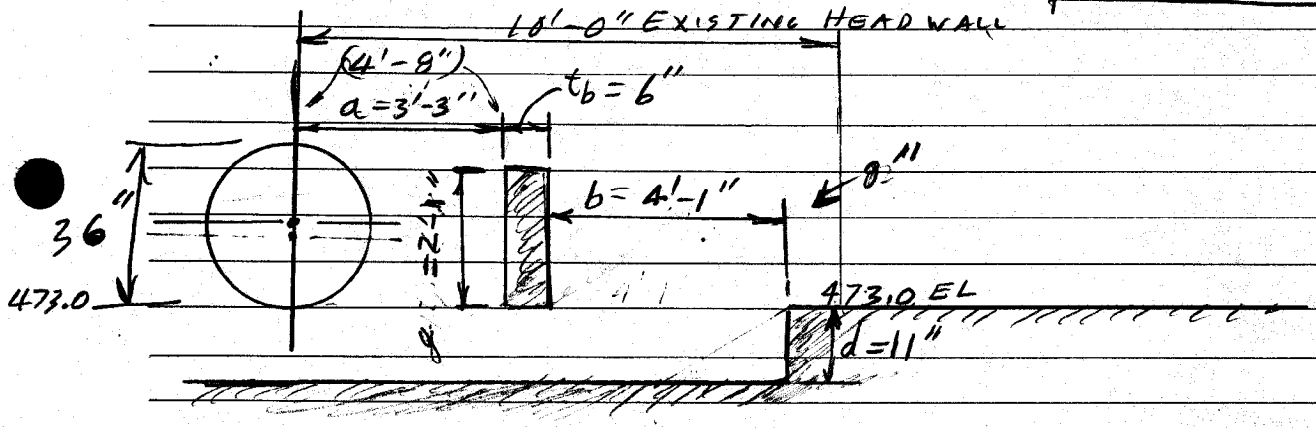
$A = (2 \times 4) + (2 \times 6 \div 2) = 14$

$14\,(14 \div 12.32)^{2/3} = 14.61$

$14.61 = 14.61$

PRELIMINARY DESIGN SET AT 2'

$V = \frac{1.486}{0.015}\,(14 \div 12.32)^{2/3}\,(1.2 \div 420)^{1/2} = 5.766$ ft/sec



DISTANCES WITH ACCUM. LETTERS ARE FROM THE CHART.

TVA 488 (EN DES-3-77)

SHEET 4 OF

KINGSTON – FLUME

COMPUTED DATE 5/23/90

CHECKED DATE

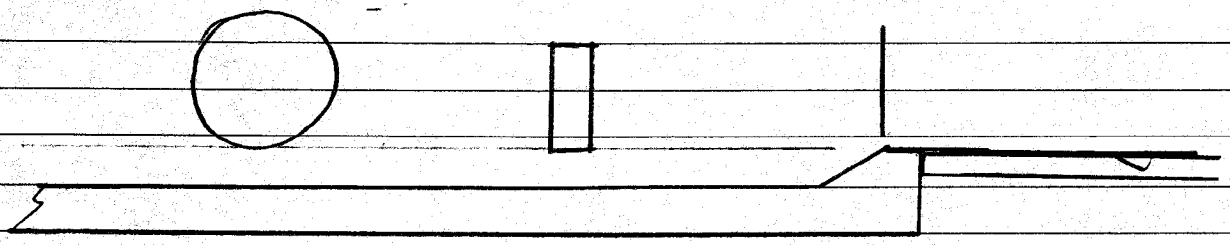
DISCHARGE 15.47 CFS

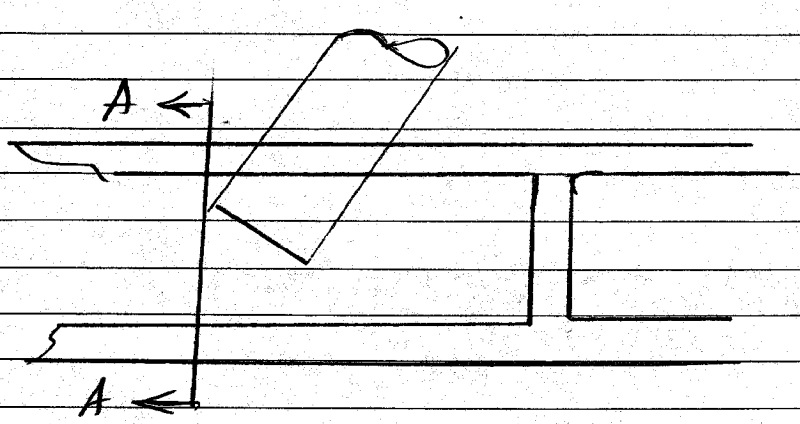
FROM CHART WIDTH 4'-9"

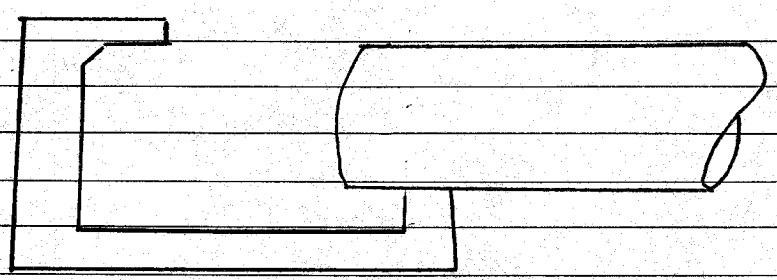
$H = \frac{3W}{4} = \frac{3 \cdot 4.75}{4} = 3.56$ ft or 3'-6 3/4"

$L = 4W \div 3 = (4 \times 4.75) \div 3 = 6.33$ ft or 6'-4"

$d = W \div 6 = 4.75 \div 6 = 0.79$ ft or 9 1/2"







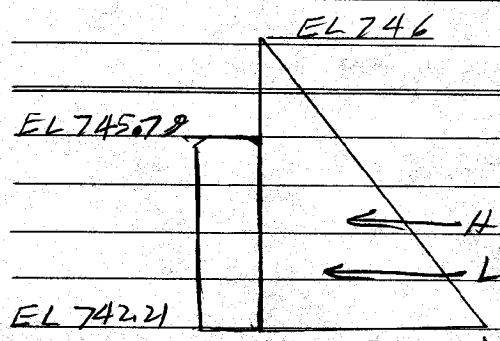
A – A

TVA 488 (EN DES-3-77)

KINGSTON - FLUME SHEET 5 OF

COMPUTED DATE

CHECKED DATE



L = MAX WEIR LENGTH = 61'

Q = 50 MGD = 15.47 CFS

$Q = 3.33(L - 0.2H)H^{1.5}$

WATER = 62.4 lb/ft³

$Q = 3.33(L - 0.2H)H^{1.5}$

$15.47\ CFS = 3.33(61ft - 0.2H)H^{1.5}$

$15.47\ CFS = 203.13H^{1.5} - 0.666H^{2.5}$

TRY H = 0.5 ft

$203.13(0.5)^{1.5} - 0.666(0.5)^{2.5} = 72\ CFS > 15.47$ NG

TRY H = 0.2 ft.

$203.13(0.2)^{1.5} - 0.666(0.2)^{2.5} = 18.16\ CFS > 15.47$ NG

TRY H = 0.15 ft.

$203.13(0.15)^{1.5} - 0.666(0.15)^{2.5} = 11.18 < 15.47$ NG

TRY H = 0.18 ft.

$203.13(0.18)^{1.5} - 0.666(0.18)^{2.5} = 15.50 \approx 15.47$ OK

MAX WATER HEIGHT EL 745.79 + 0.18' = 745.97

BOTTOM − EL 742.21

3.76 ft.

$62.4\ lb/ft^3 \times 1ft \times 3.76\ ft \times 1.7 = 398.86 \approx 400\ lb/ft$

$H_1 = 400\ lb/ft \times 3.76ft \div 2 = 752$

$M_u = 752\ lb \times 3.76ft \div 3 = 942.5\ lb\text{-}ft.$

$M = M_u \div .9 = 1047\ lb\text{-}ft.$

FIND VARIABLES IN TERMS of b AND d

1% DESIGN $N_t = 60{,}000 \times 0.01\ bd = 600bd$

$a = \frac{N_t}{0.85 f'_c b} = \frac{600\ bd}{0.85 \times 6{,}000\ b} = .235d$

$z = d - a/2 = d - \frac{.235d}{2} = .882d$

ASSUMPTION - FORCES ACTING ON ONE FOOT WIDE STRIP THEREFORE b = 12

$M = 530\ bd^2 \Rightarrow 1047\ lb\text{-}ft = 530(12)d^2 \Rightarrow d^2 = \frac{1047}{530 \times 12} = 1.946$

$d = 1.39 \approx 1.5$

(CONTINUED ON P-6)

KINGSTON - FLUME

COMPUTED DATE

CHECKED DATE

WALL THICKNESS h - ASSUM #4

$h = d + 2"$ COVER $+ \frac{1}{2}$ BAR $= 1.4 + 2 + .5 = 3.9"$

ASSUM 4" WALL $4 - 2"$ COVER $- .5 = 1.5" \approx 1.4"$

NOTE TO ANYONE CHECKING THESE COMPUTATIONS.
THIS ENGINEER DOESNOT LIKE A 4" WALL AS AN IMPACT WALL FOR THE PIPE OUT LET. SMALL DAM STUDIES RECOMMEND A 6" MIN. FOR 21 CFS UP TO 33 FT/SEC

ADDITIONAL CK.

50 MGD THROUGH 3 PIPES = 25.79 CFS
30 MGD THROUGH 3 PIPES = 15.47 CFS

25.79 ACTING ON A 3' WIDTH SECTION
$25.79 \div 3 \times 62.4 \times 1.7 = 911.9$ lb - $\rightarrow$ 752 -

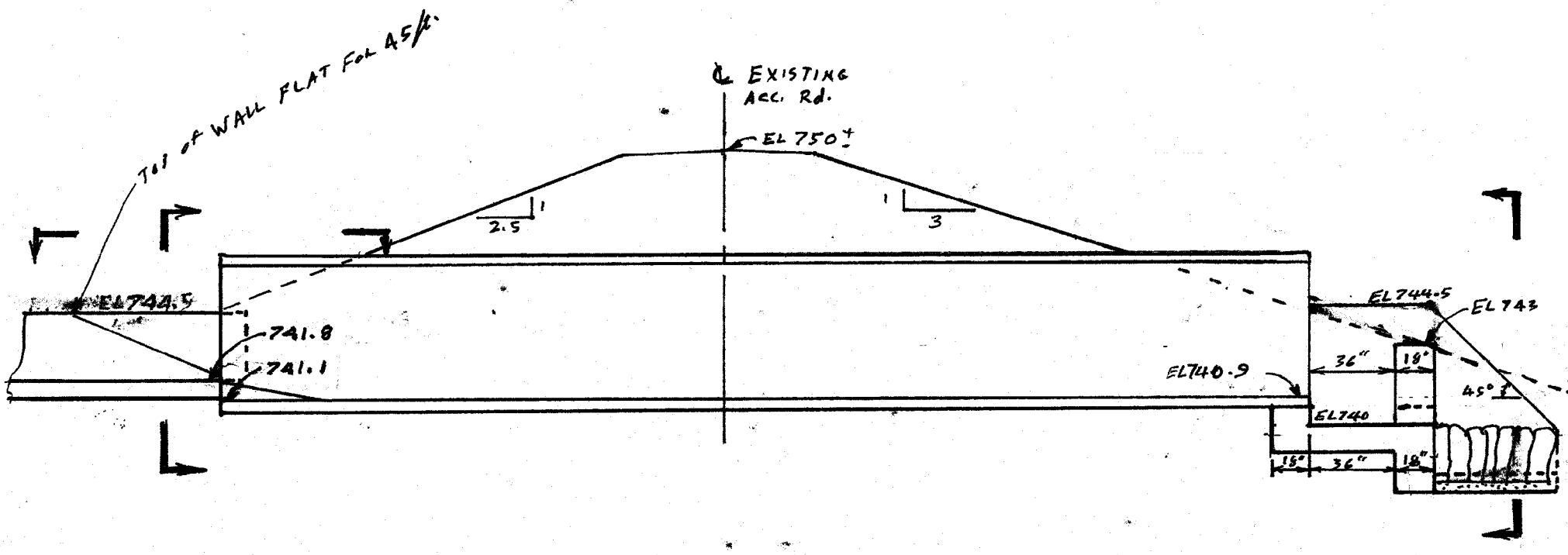
$M_4 = 912 \text{ lb} \times 3.76 \text{ ft} \div 3 = 1143$ lb-ft
$M = 1143$ lb-FT $\div 0.9 = 1270$ lb-FT

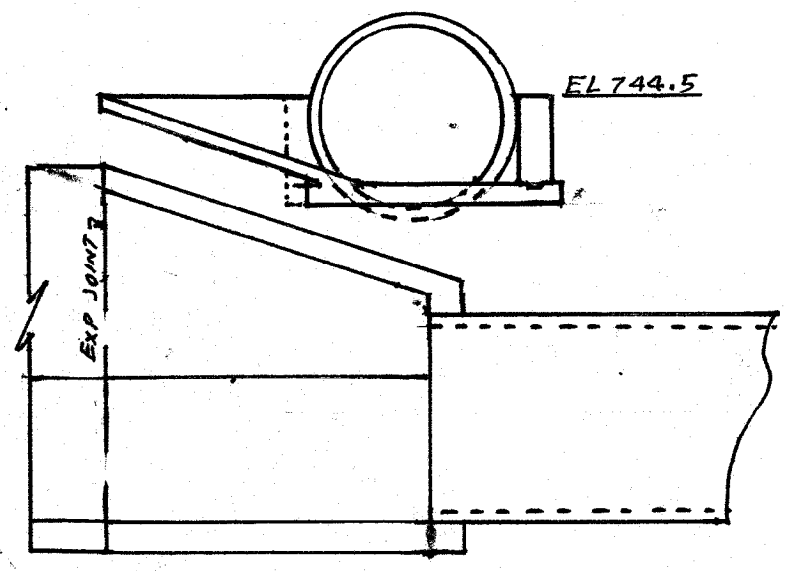
$M = 530\, bd^2 \Rightarrow d^2 = 1270$ lb-FT $\times 12 \text{ in/ft} = 530 \times 12^* d^2$
$d^2 = \frac{1270}{530} = 2.396$
$d = 1.54"$
$h = 1.54 +$ COVER $+ \frac{1}{2}$ BAR $= 1.54 + 2" + 0.5 = 4.048"$
4" WALL REMAINS GOOD
BUT GOING TO 8" WALL ANYWAY

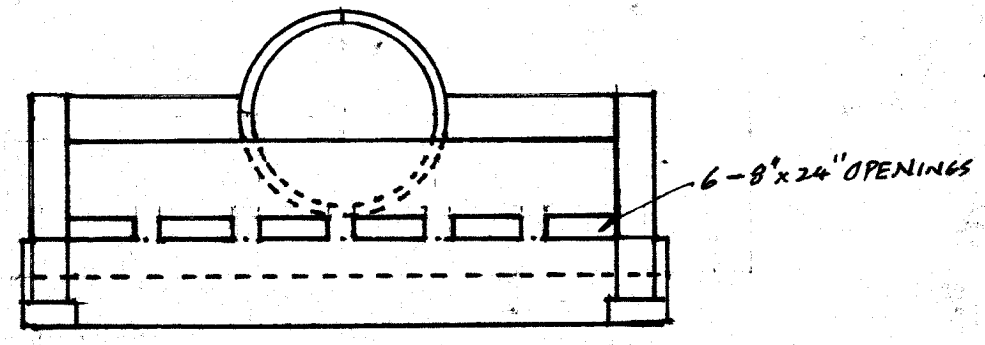
HORIZONTAL STEEL TEMP
8" WALL TEMP - $8 \times 12 \times .0020 = 0.191 \text{ in}^2/\text{ft}$ or $0.016 \text{ in}^2/\text{in}$
#4 $.20/0.016 = 12.5"$ SPACING MAX

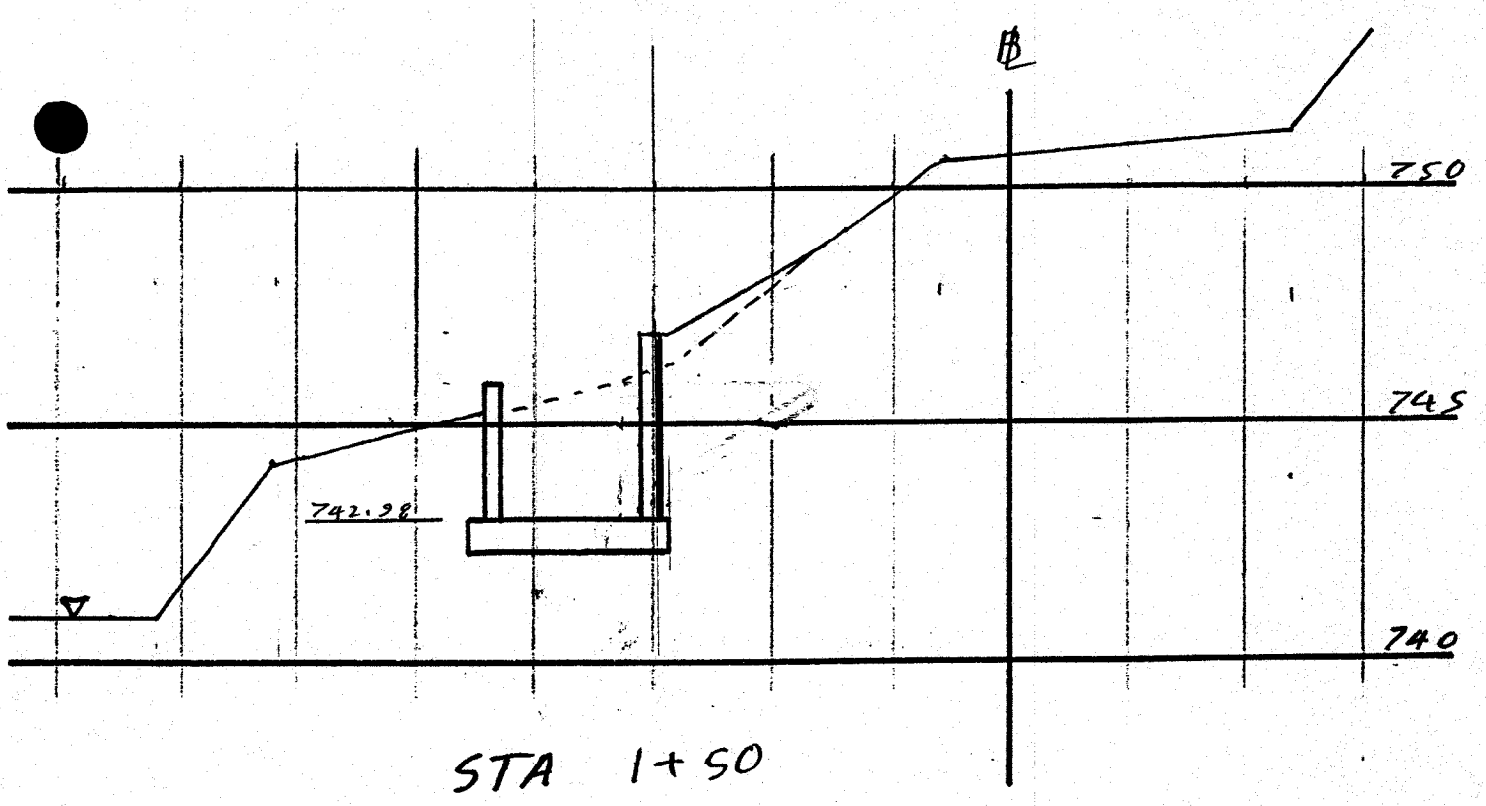
6" WALL $6" \times 12 \times .0020 = 0.144 \text{ in}^2/\text{ft}$ or $0.012 \text{ in}^2/\text{in}$
#4 $.20/0.012 = 16.6"$ SPACE MAX

VERTICAL TEMP - STEEL
6" WALL $6 \times 12 \times .0012 = 0.086 \text{ in}^2/\text{ft}$ or $0.0072 \text{ in}^2/\text{in}$ #4 $.24/0.0072 = 27.8"$ SPACE
8" WALL $8 \times 12 \times .0012 = 0.115 \text{ in}^2/\text{ft}$ or $0.0096 \text{ in}^2/\text{in}$ #4 $.20/0.0096 = 20"$

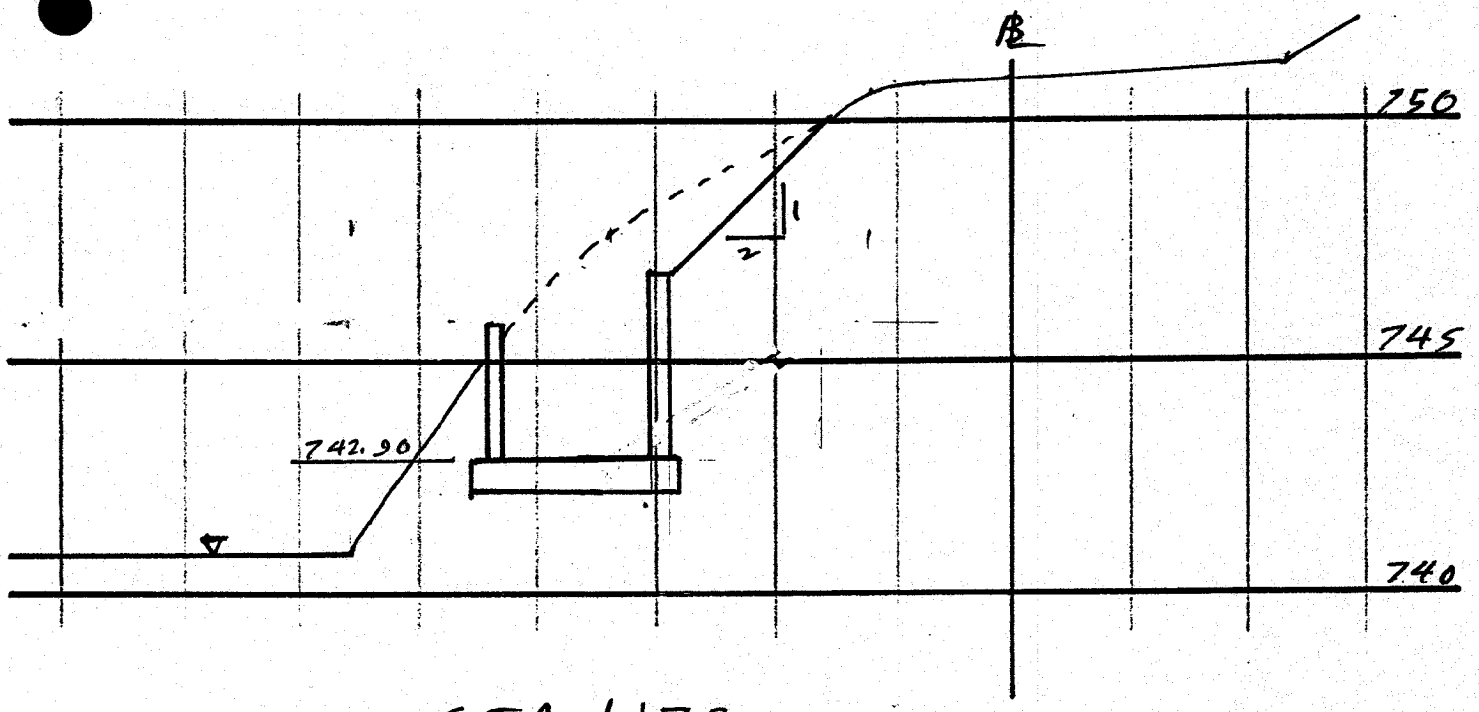








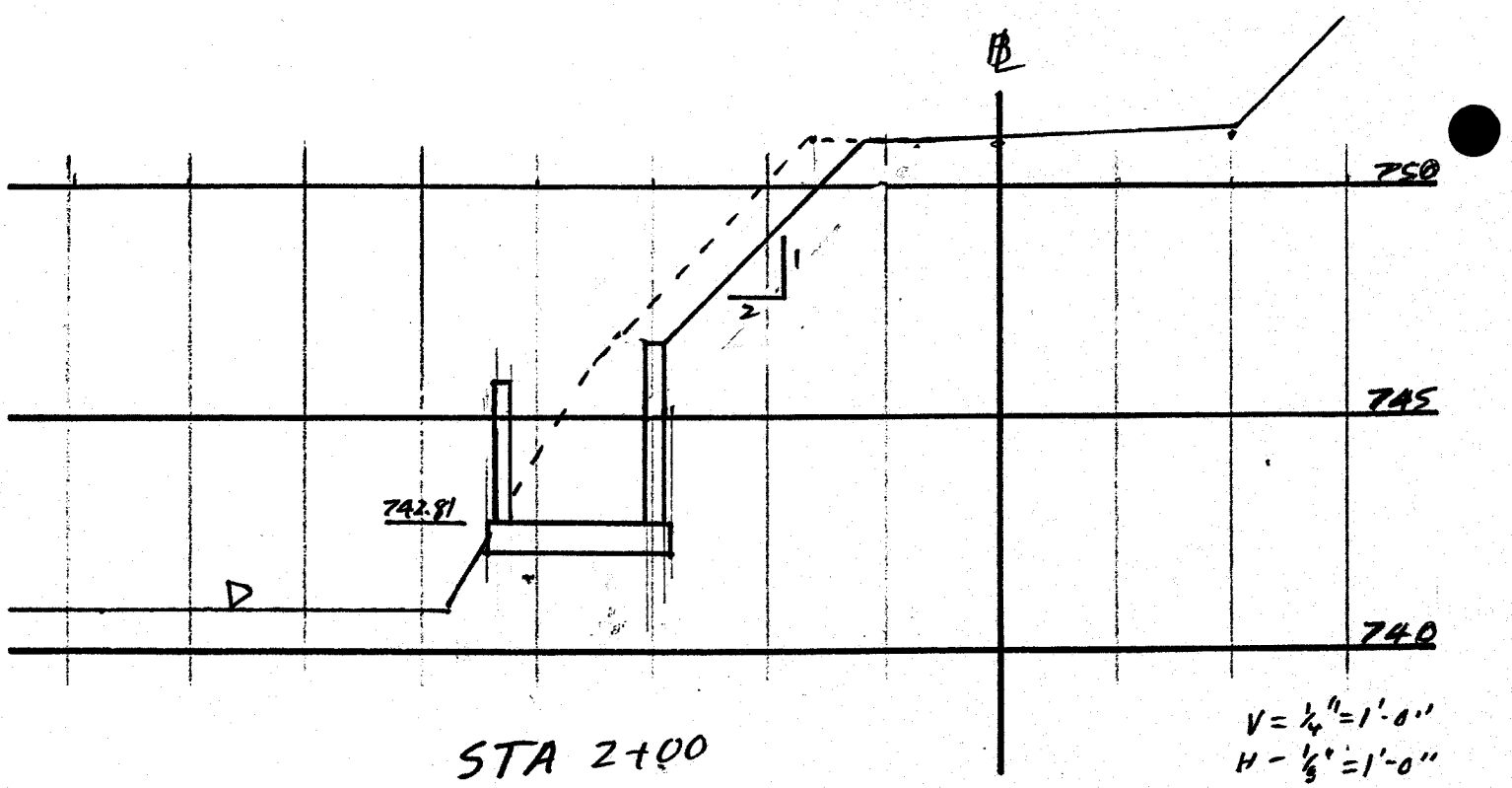
STA 1+50



STA 1+75

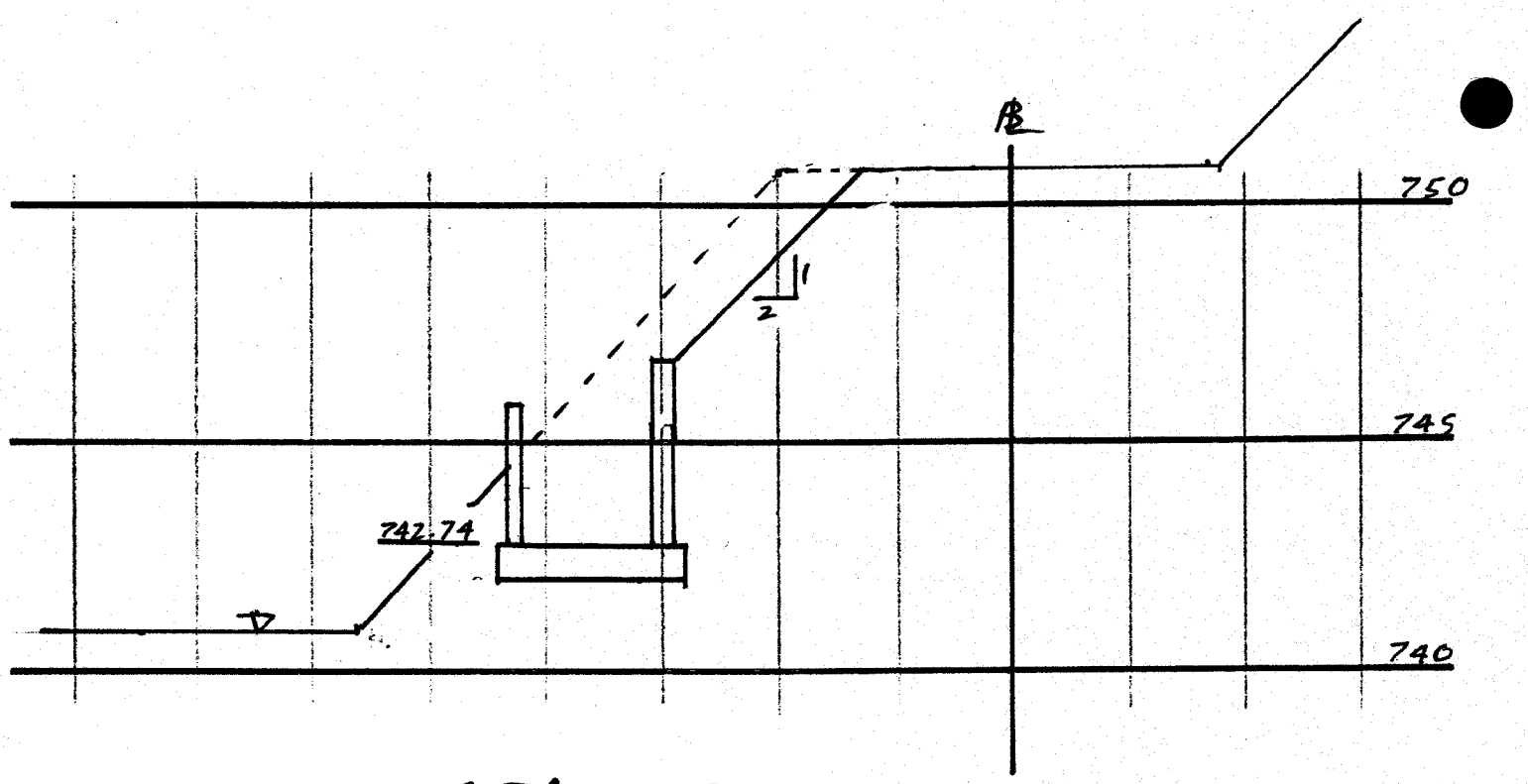
H - 1/8" = 1'-0"

V - 1/4" = 1'-0"



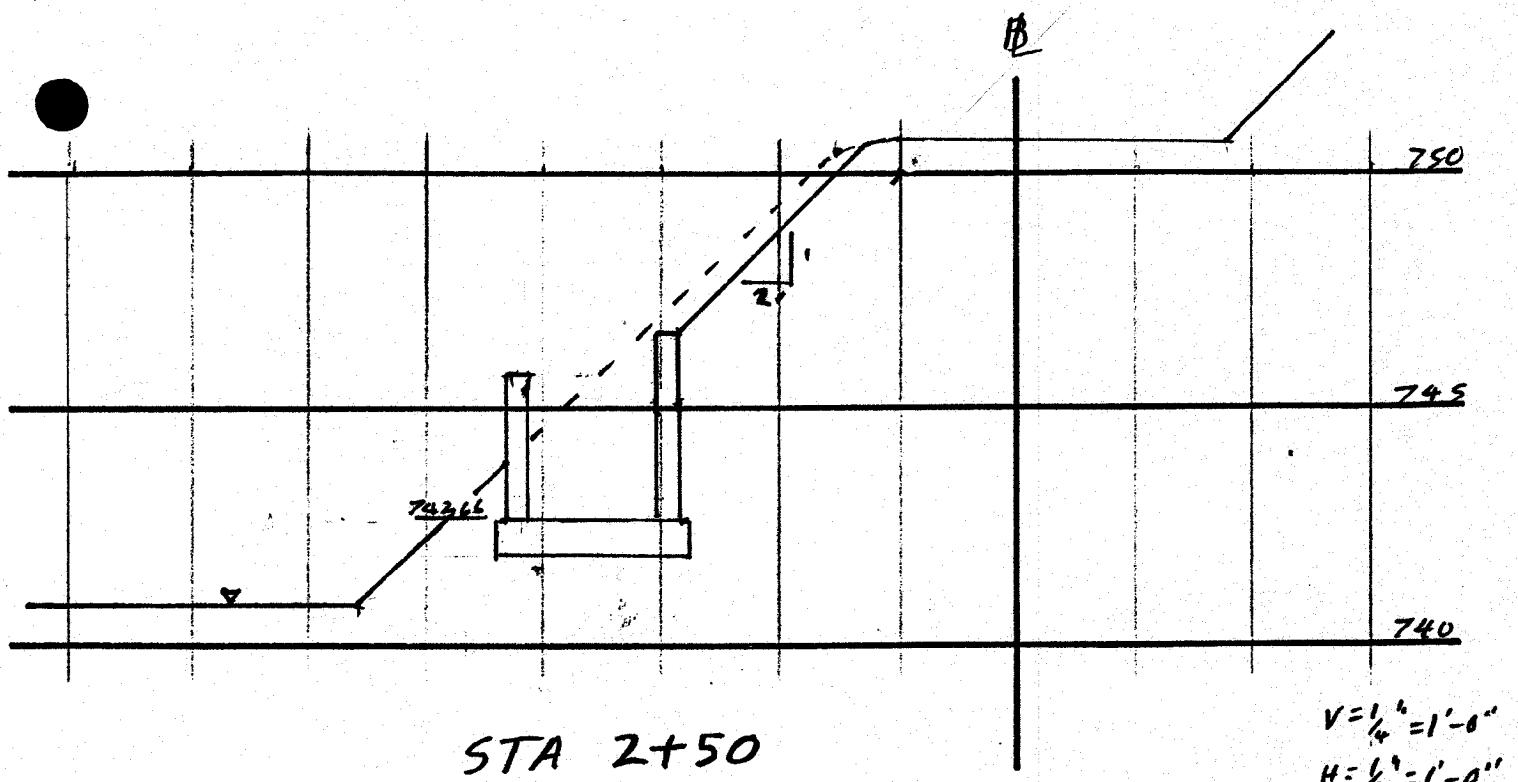
STA 2+00

V = 1/4" = 1'-0"
H - 1/8" = 1'-0"



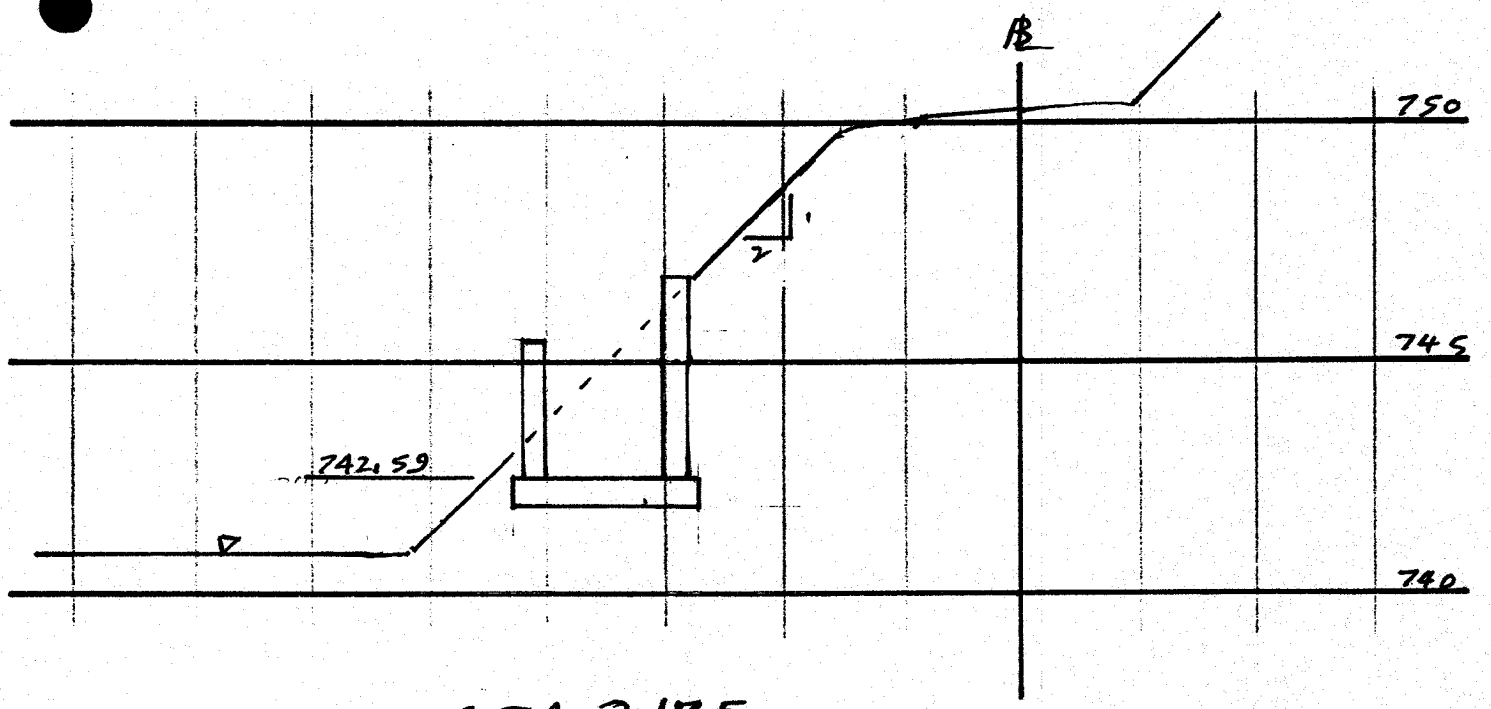
STA 2+25

H - 1/8" = 1'-0"
V - 1/4" = 1'-0"



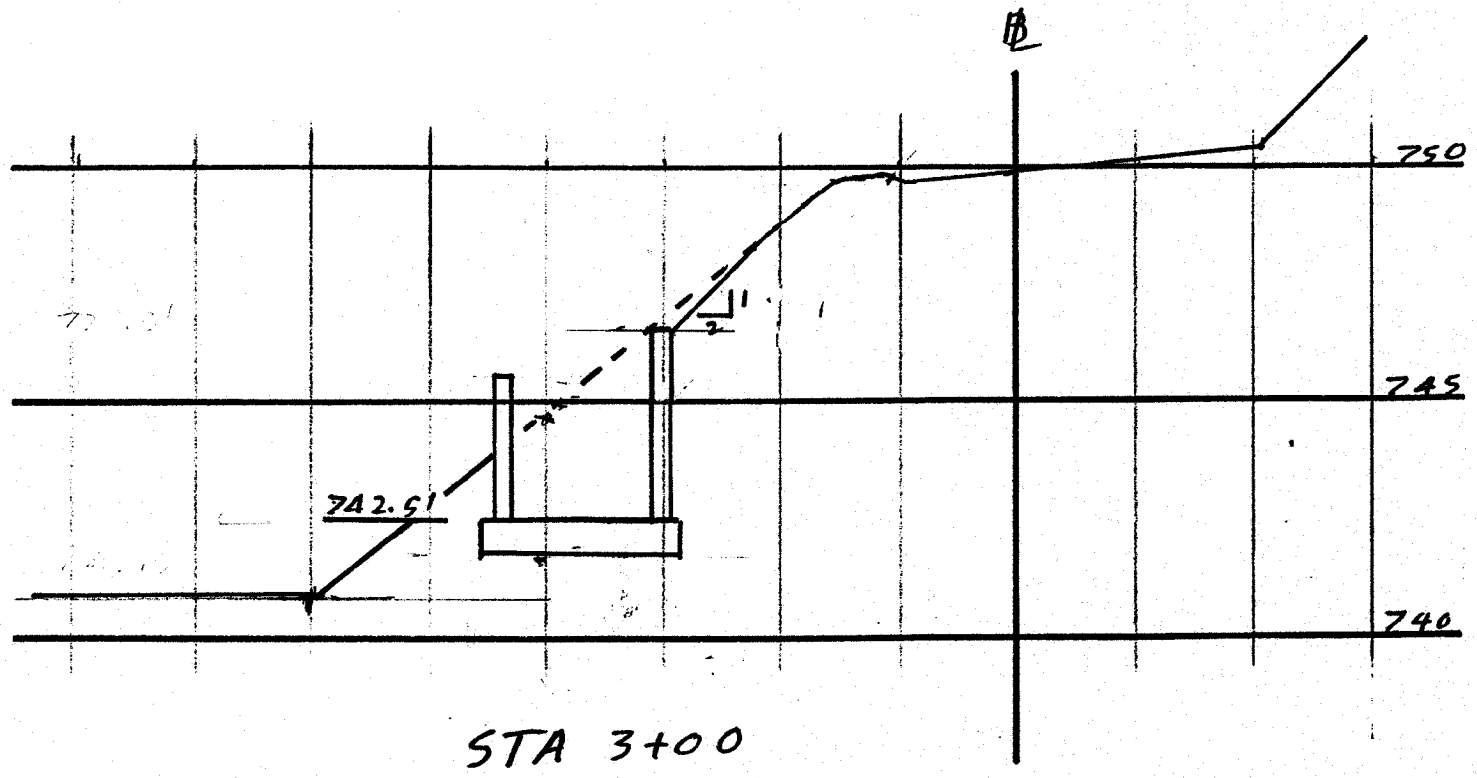
STA 2+50

V = 1/4" = 1'-0"
H = 1/8" = 1'-0"

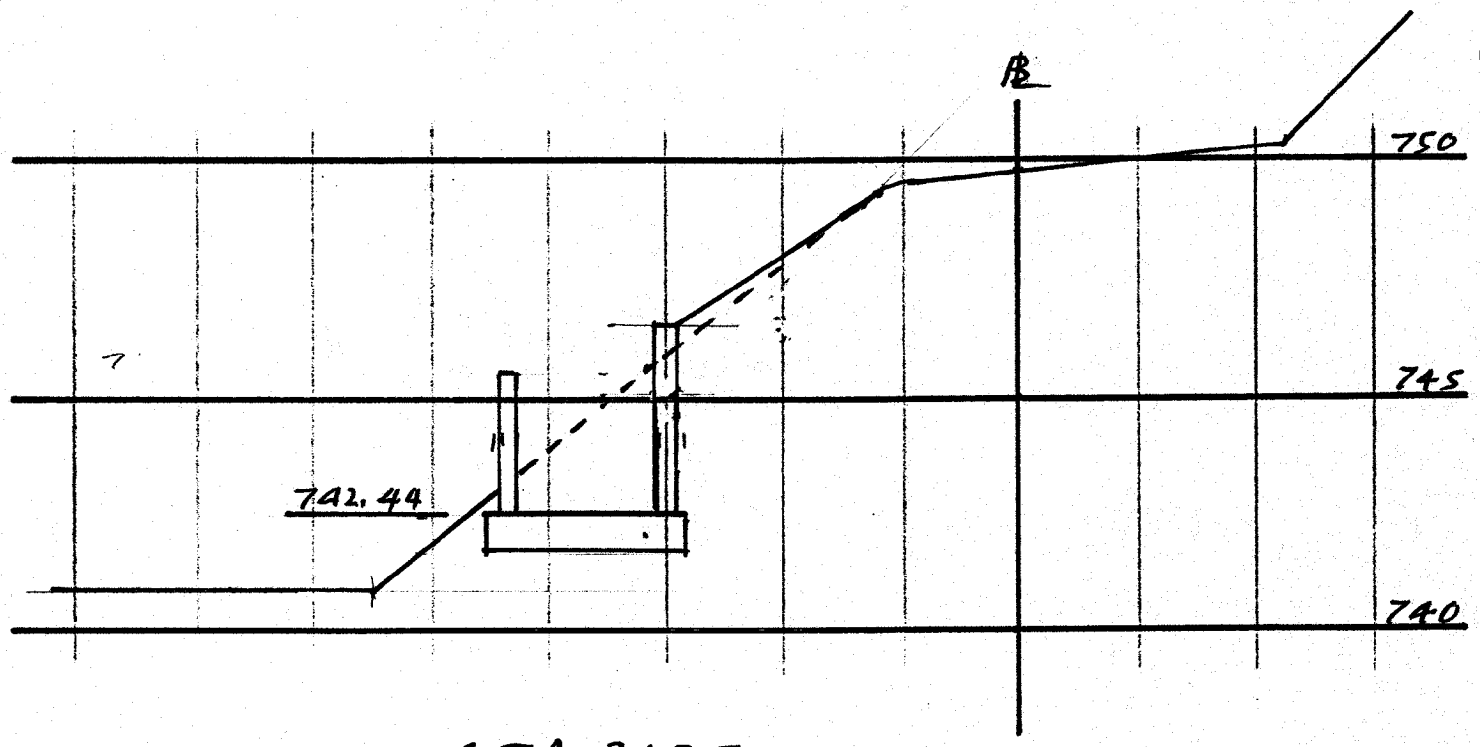


STA 2+75

H - 1/8" = 1'-0"
V - 1/4" = 1'-0"



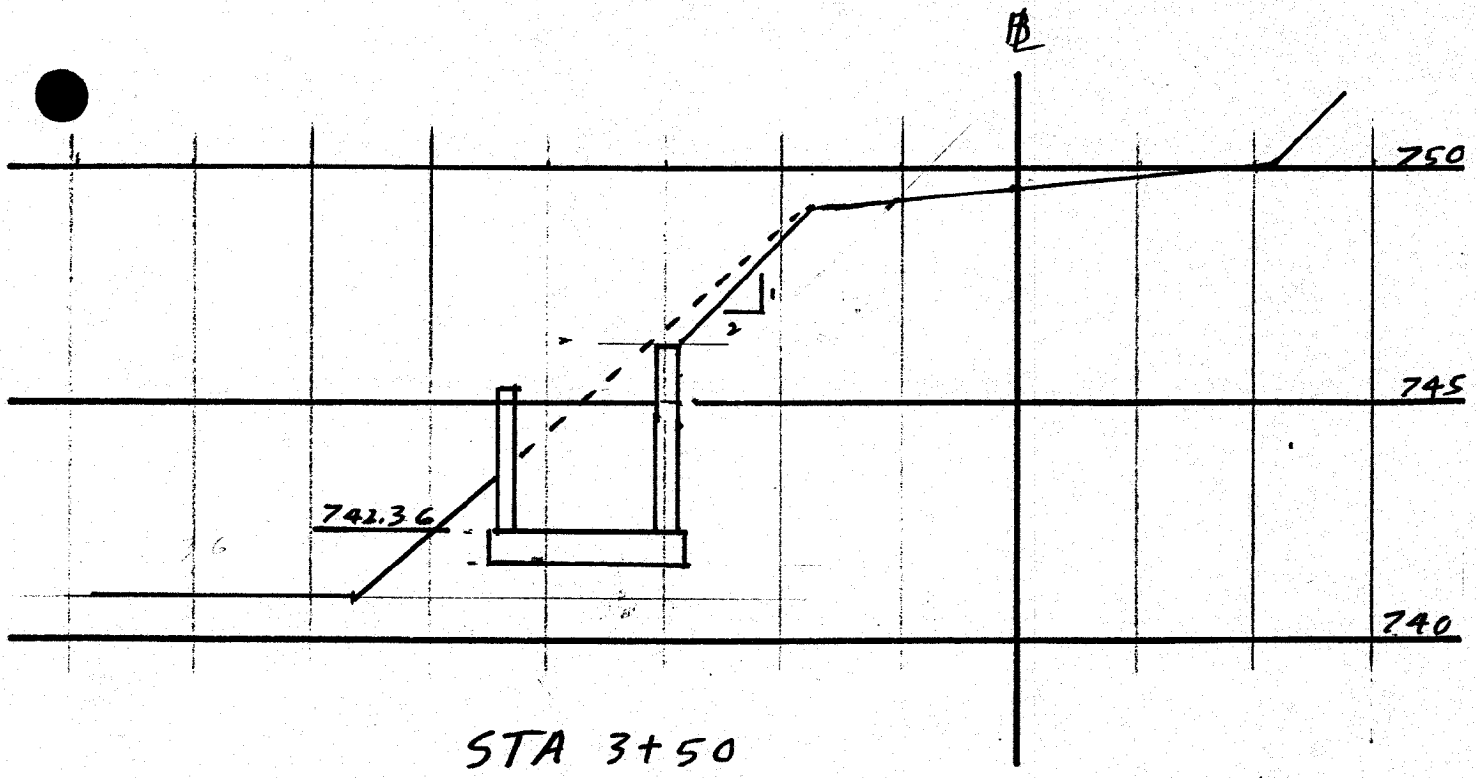
STA 3+00



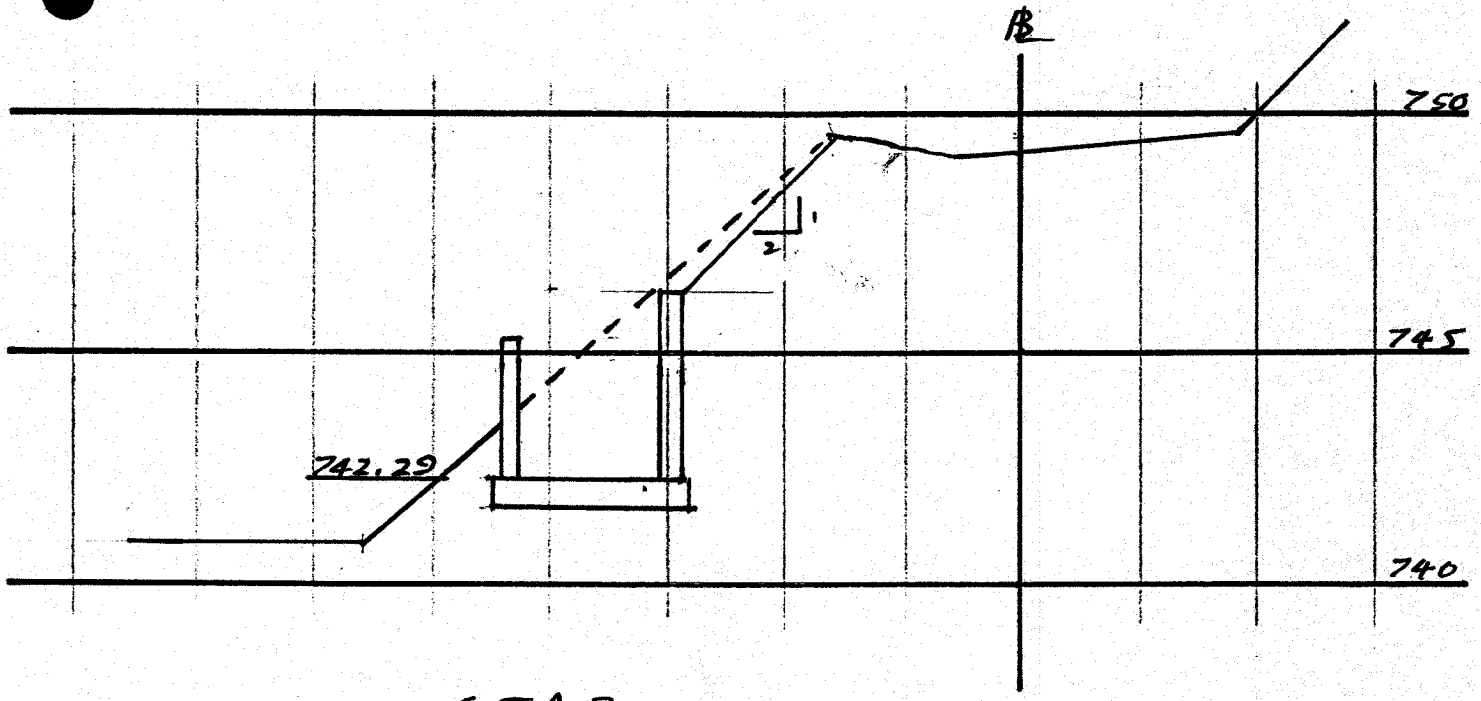
STA 3+25

H - 1/8" = 1'-0"

V - 1/4" = 1'-0"



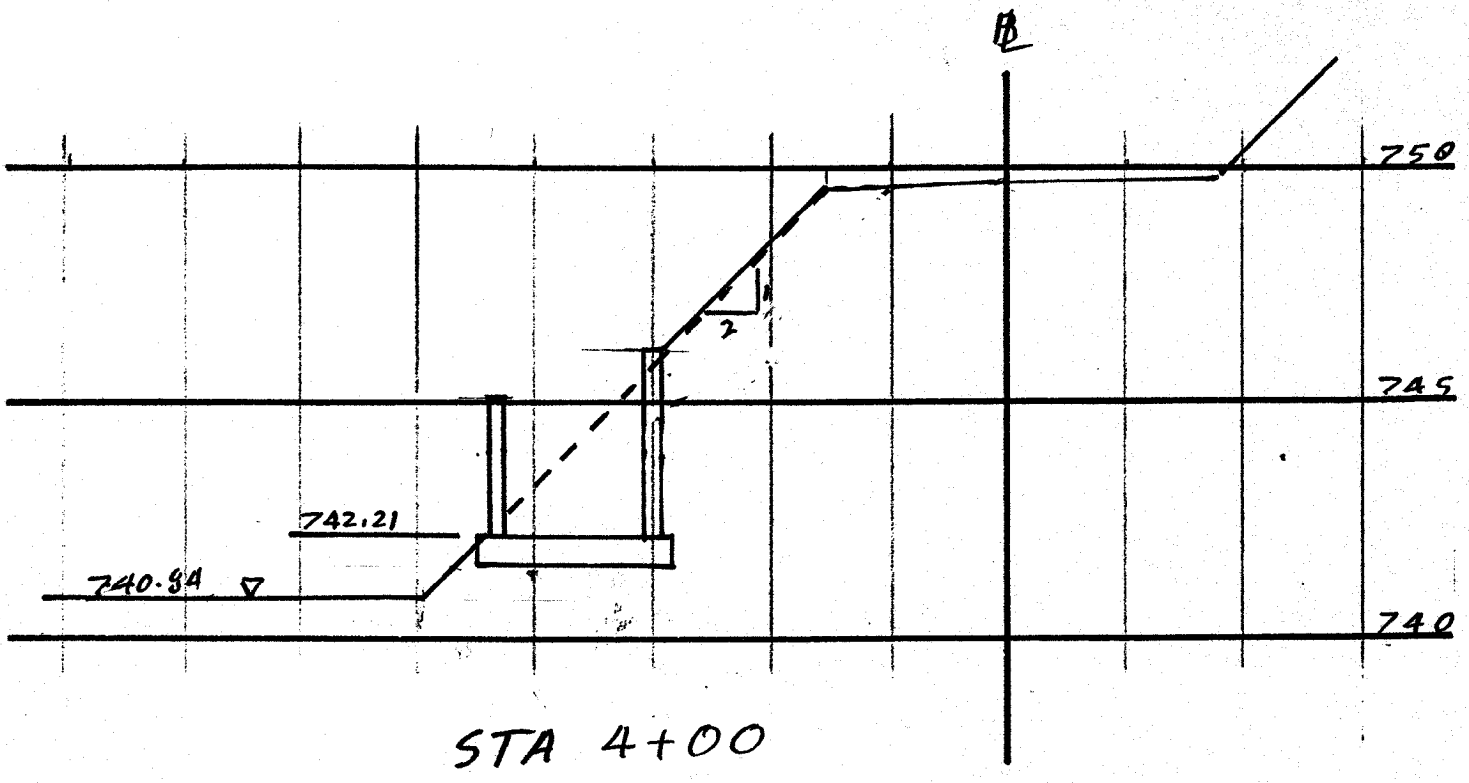
STA 3+50



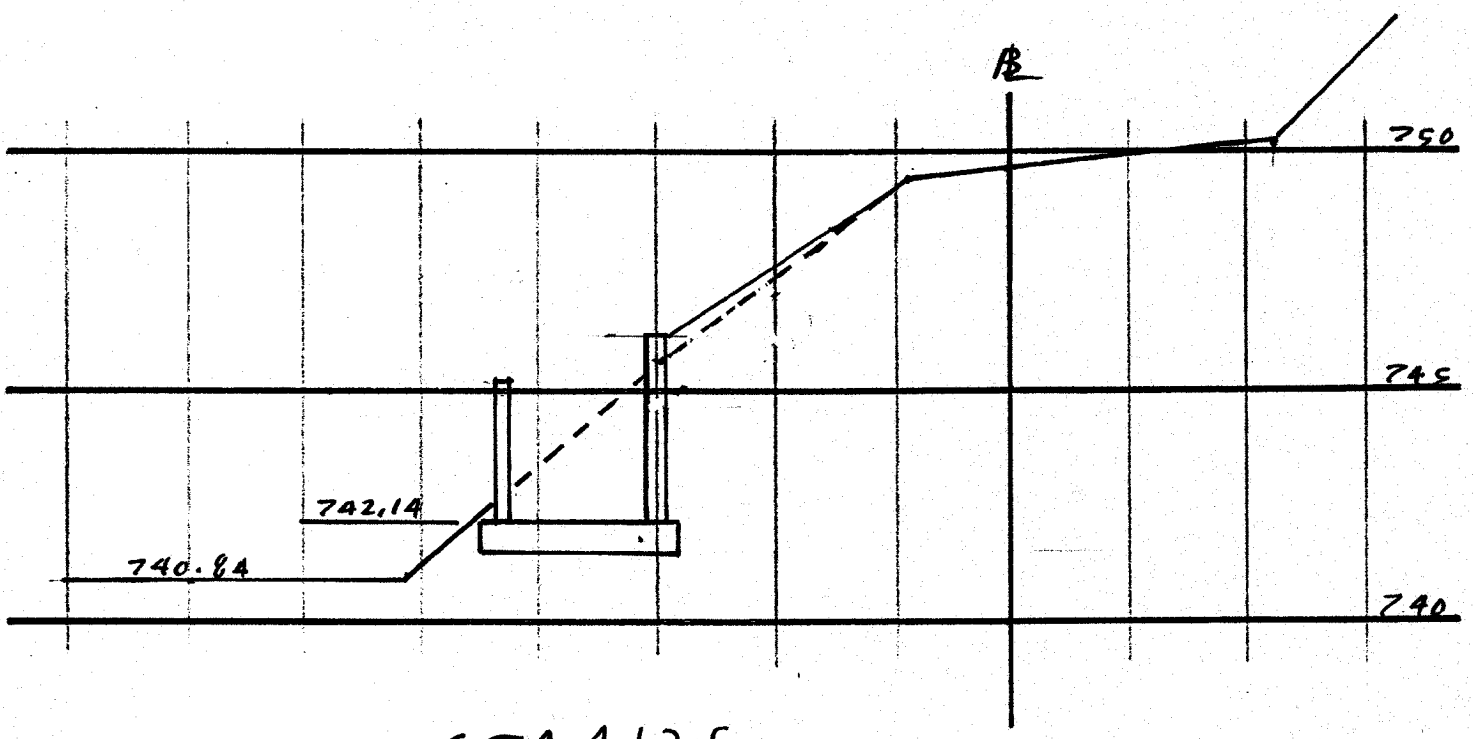
STA 3+75

H - 1/8" = 1'-0"

V - 1/4" = 1'-0"



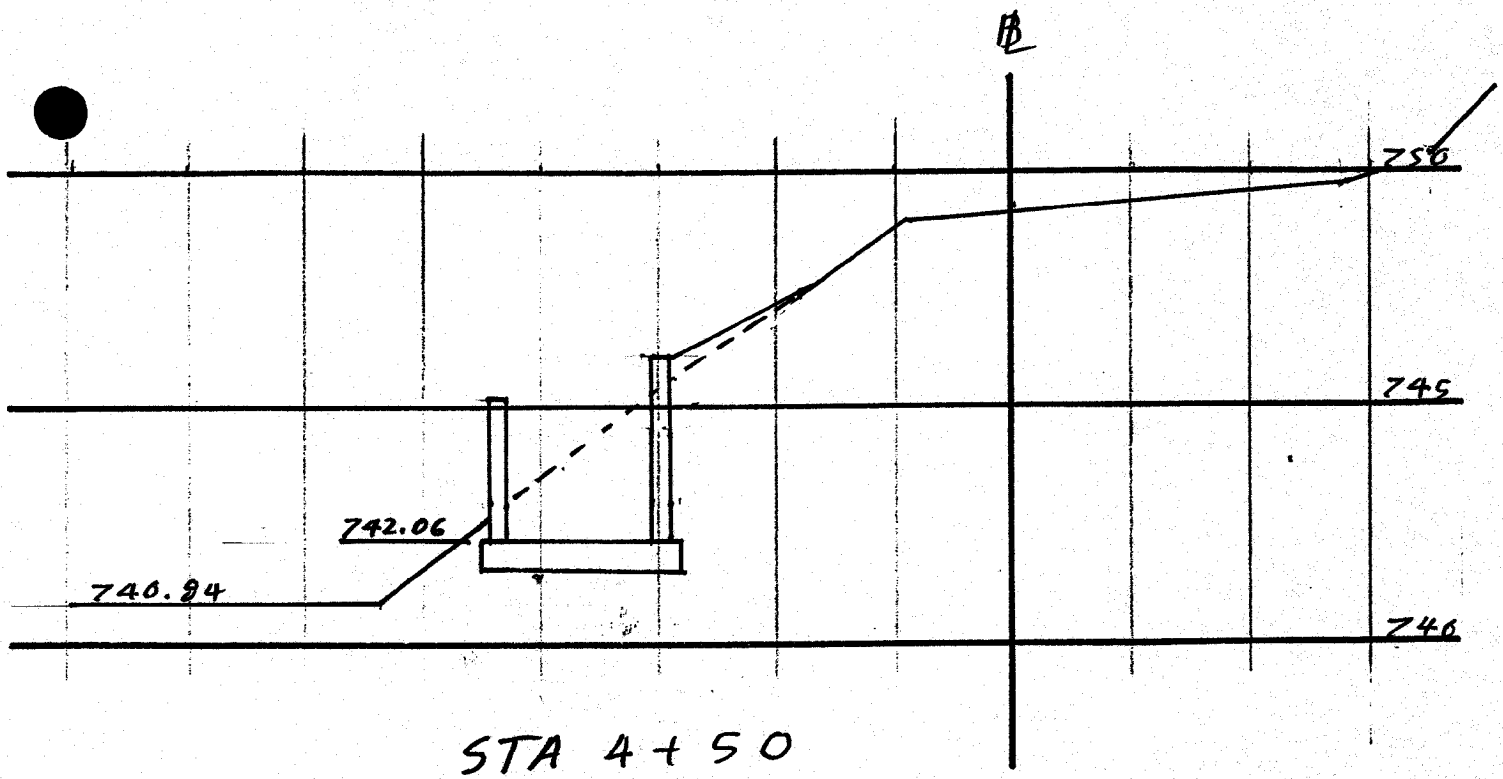
STA 4+00



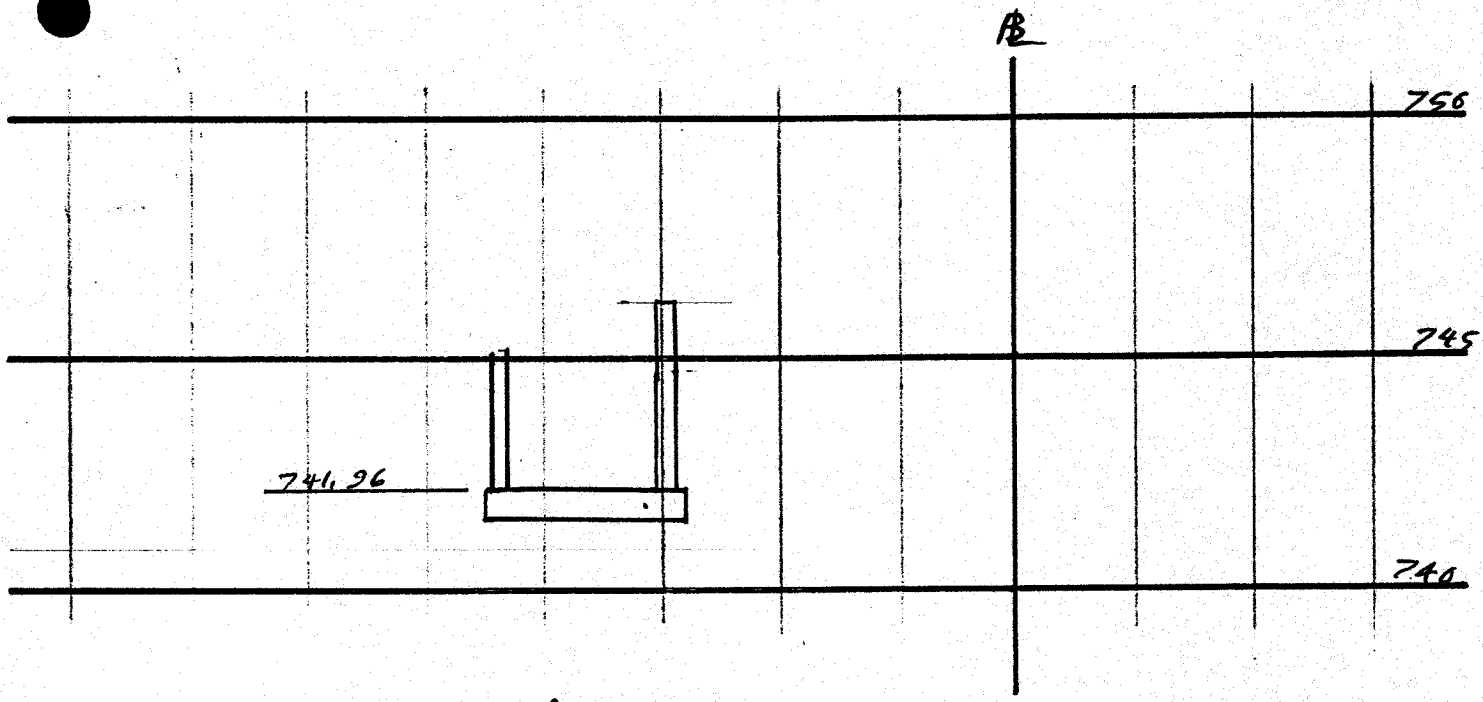
STA 4+25

H - 1/8" = 1'-0"

V - 1/4" = 1'-0"



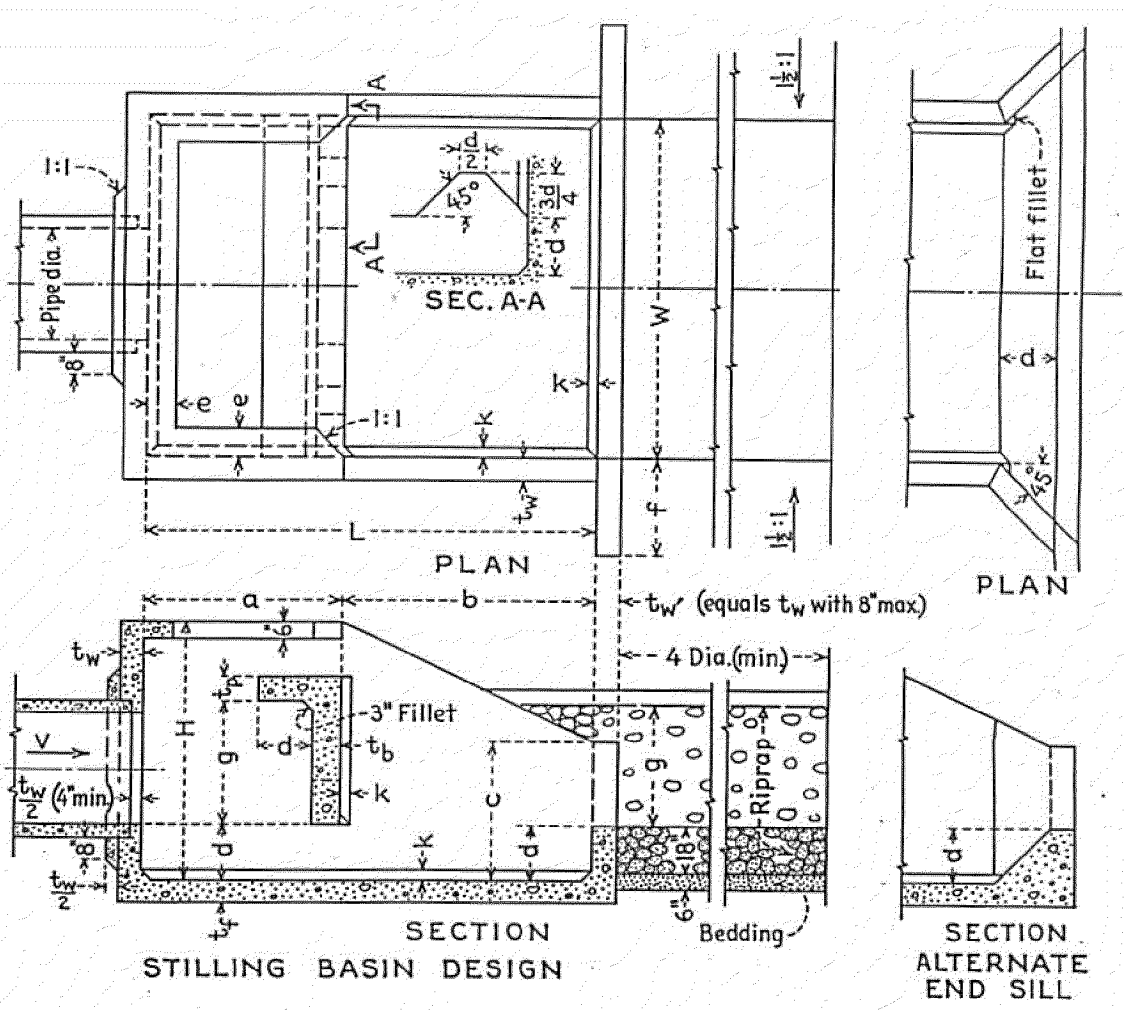
STA 4+50



STA 4+75

H - 1/8" = 1'-0"

V - 1/4" = 1'-0"



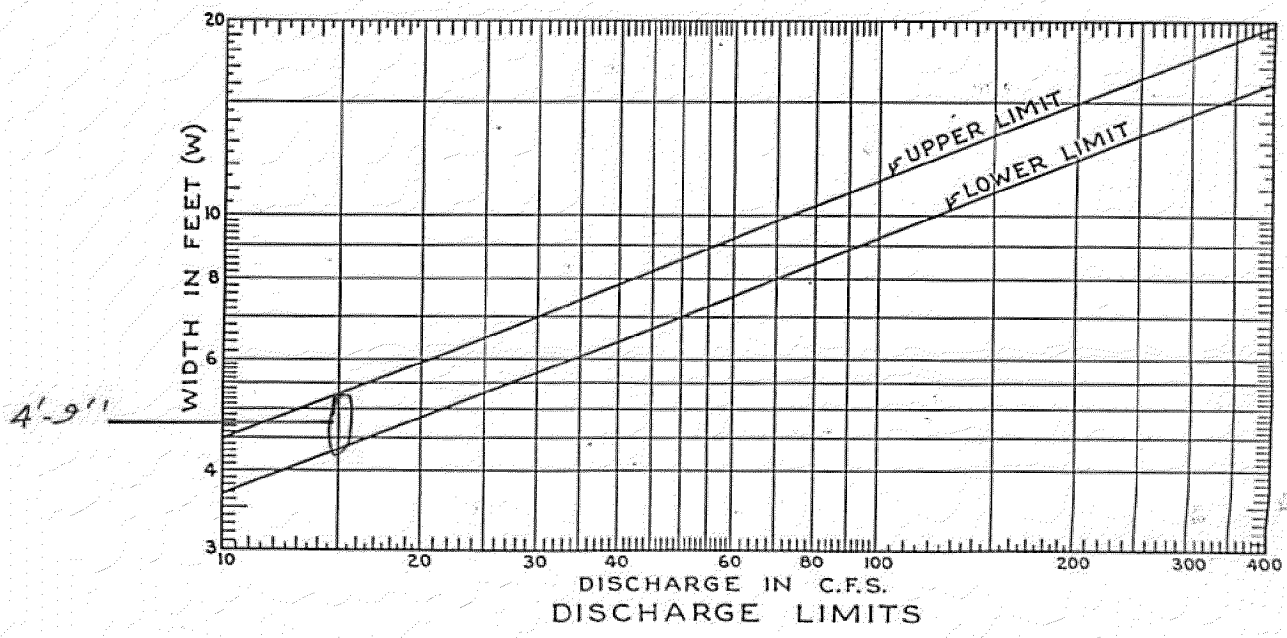


FIGURE 42.—*Impact-type energy dissipator (Basin VI).*

697-831 O—63——7

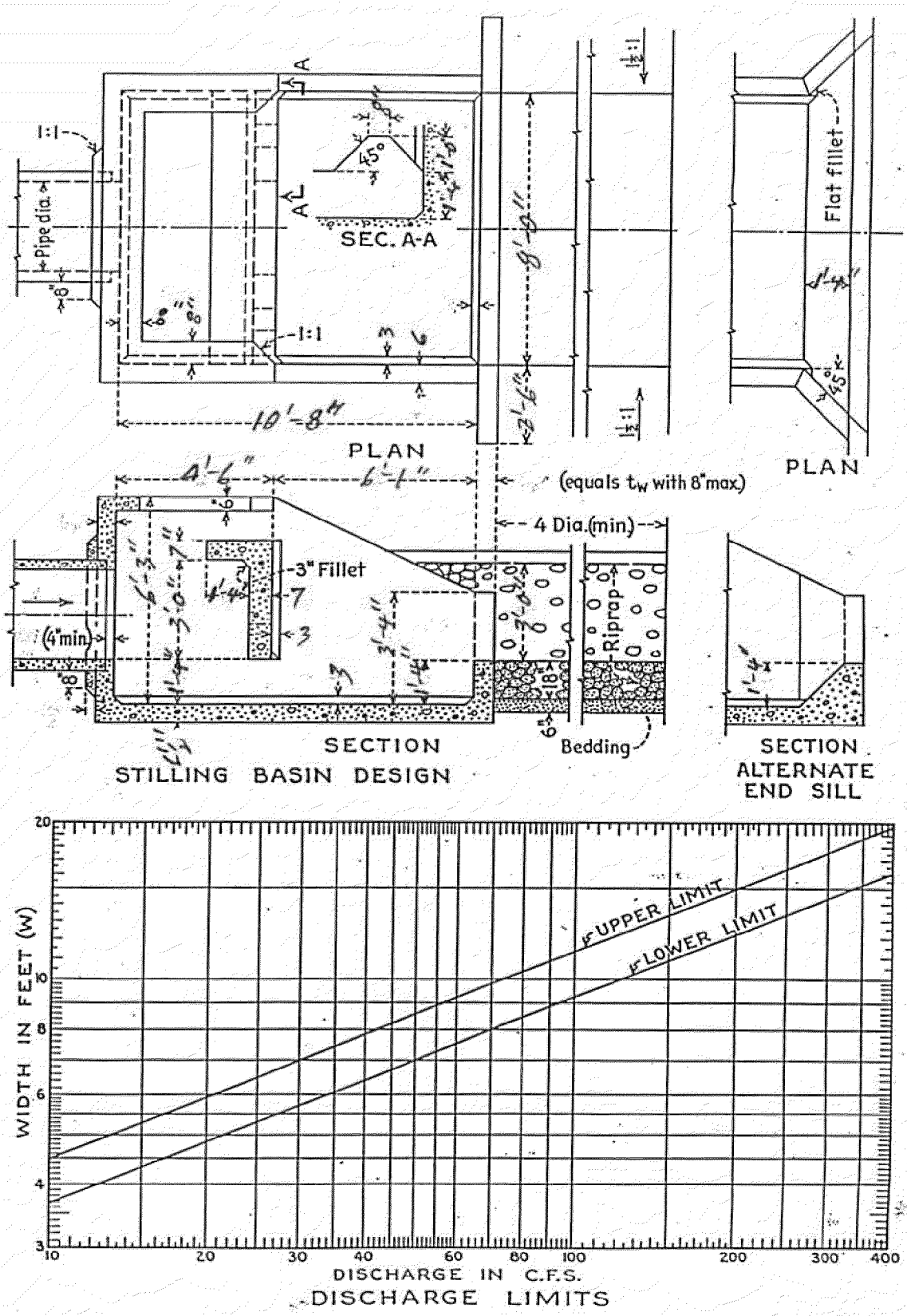


FIGURE 42.—*Impact-type energy dissipator (Basin VI).*

R-1

697-831 O—63——7

TABLE 11.—*Stilling basin dimensions (Basin VI). Impact-type energy dissipator.*

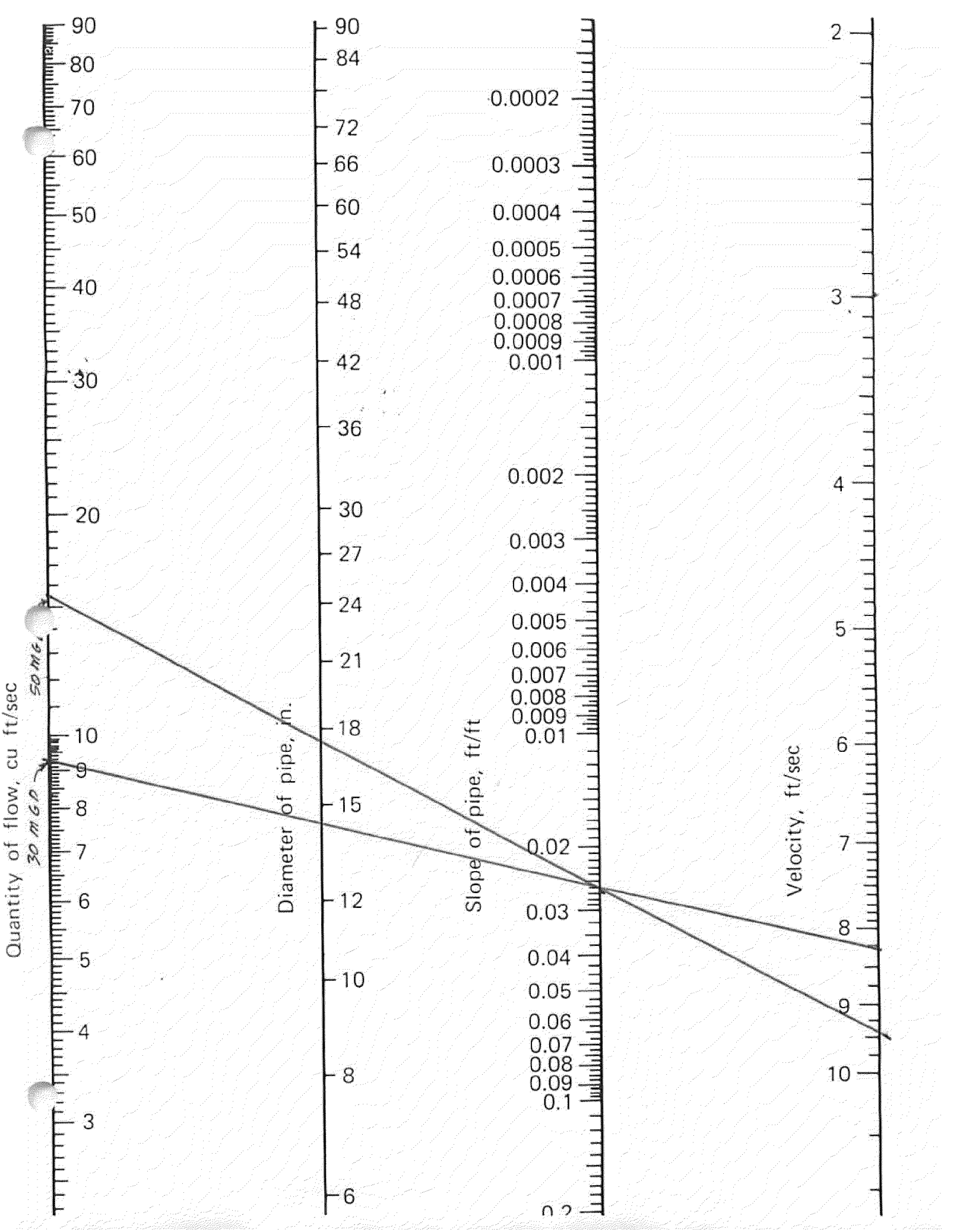
Suggested pipe size [1]		Max discharge Q	Feet and inches										Inches					
Dia in.	Area (sq ft)		W	H	L	a	b	c	d	e	f	g	t_w	t_f	t_b	t_p	K	Suggested riprap size [3]
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
	1.52	16	4-9	3-8	6-4	2-9 11/16	3-6	2-0	0-9 1/2	0-5 3/16	1-3 1/2	1-9 1/2	6					
18	1.77	[2] 21	5–6	4–3	7–4	3–3	4–1	2–4	0–11	0–6	1–6	2–1	6	6½	6	6	3	4.0
24	3.14	38	6–9	5–3	9–0	3–11	5–1	2–10	1–2	0–6	2–0	2–6	6	6½	6	6	3	7.0
30	4.91	59	8–0	6–3	10–8	4–7	6–1	3–4	1–4	0–8	2–6	3–0	6	6½	7	7	3	8.5
36	7.07	85	9–3	7–3	12–4	5–3	7–1	3–10	1–7	0–8	3–0	3–6	7	7½	8	8	3	9.0
42	9.62	115	10–6	8–0	14–0	6–0	8–0	4–5	1–9	0–10	3–0	3–11	8	8½	9	8	4	9.5
48	12.57	151	11–9	9–0	15–8	6–9	8–11	4–11	2–0	0–10	3–0	4–5	9	9½	10	8	4	10.5
54	15.90	191	13–0	9–9	17–4	7–4	10–0	5–5	2–2	1–0	3–0	4–11	10	10½	10	8	4	12.0
60	19.63	236	14–3	10–9	19–0	8–0	11–0	5–11	2–5	1–0	3–0	5–4	11	11½	11	8	6	13.0
72	28.27	339	16–6	12–3	22–0	9–3	12–9	6–11	2–9	1–3	3–0	6–2	12	12½	12	8	6	14.0

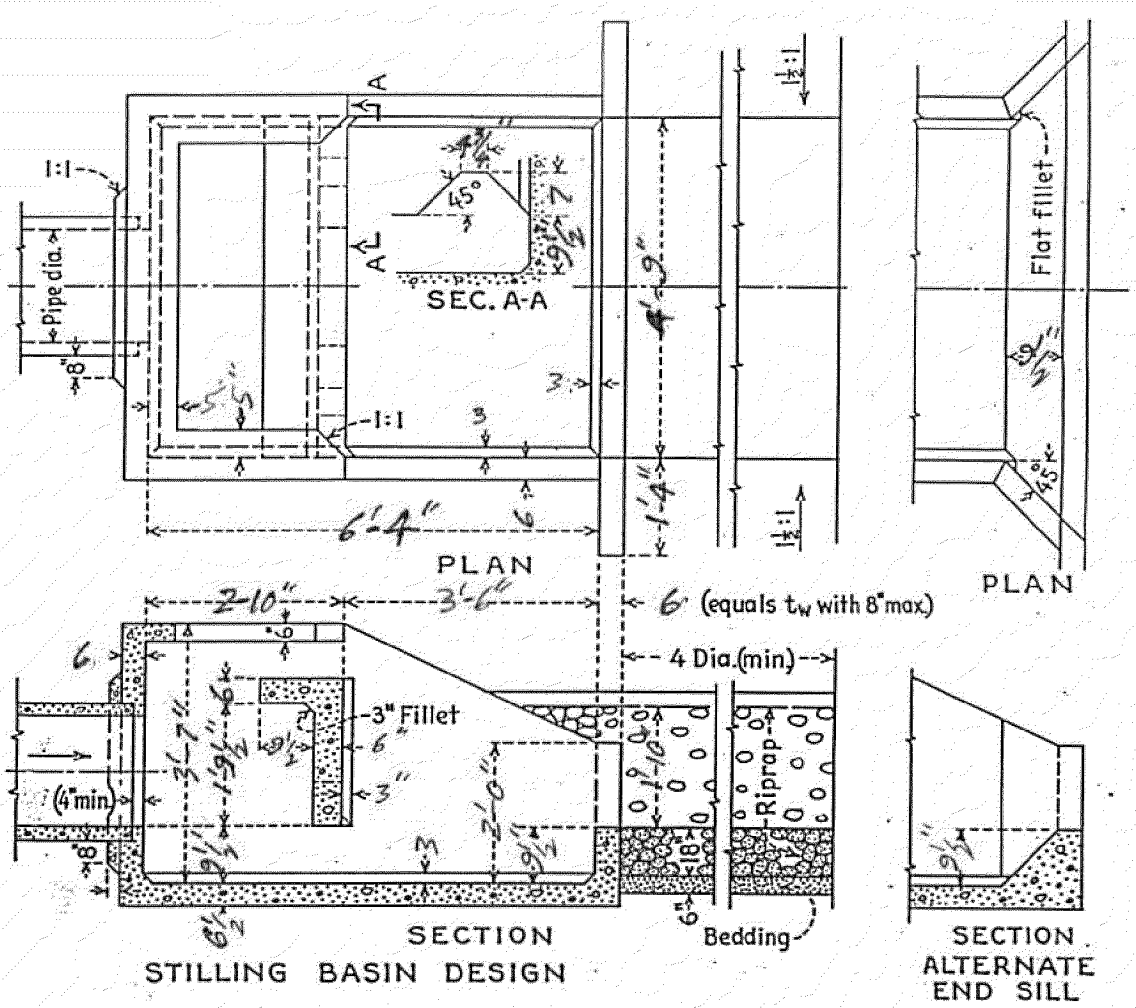
[1] Suggested pipe will run full when velocity is 12 feet per second or half full when velocity is 24 feet per second. Size may be modified for other velocities by Q=AV, but relation between Q and basin dimensions shown must be maintained.

[2] For discharges less than 21 second-feet, obtain basin width from curve of Fig. 42. Other dimensions proportional to W; $H=\frac{3W}{4}$, $L=\frac{4W}{3}$, $d=\frac{W}{6}$, etc.

[3] Determination of riprap size explained in Sec. 10.

MULTIPLICATION FACTOR 0.863636....


Quantity of flow, cu ft/sec
90
80
70
60
50
40
30
20
10
9
8
7
6
5
4
3
SOMEWHERE
30 MGD
Diameter of pipe, in.
90
84
72
66
60
54
48
42
36
30
27
24
21
18
15
12
10
8
6
Slope of pipe, ft/ft
0.0002
0.0003
0.0004
0.0005
0.0006
0.0007
0.0008
0.0009
0.001
0.002
0.003
0.004
0.005
0.006
0.007
0.008
0.009
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.1
0.2
Velocity, ft/sec
2
3
4
5
6
7
8
9
10



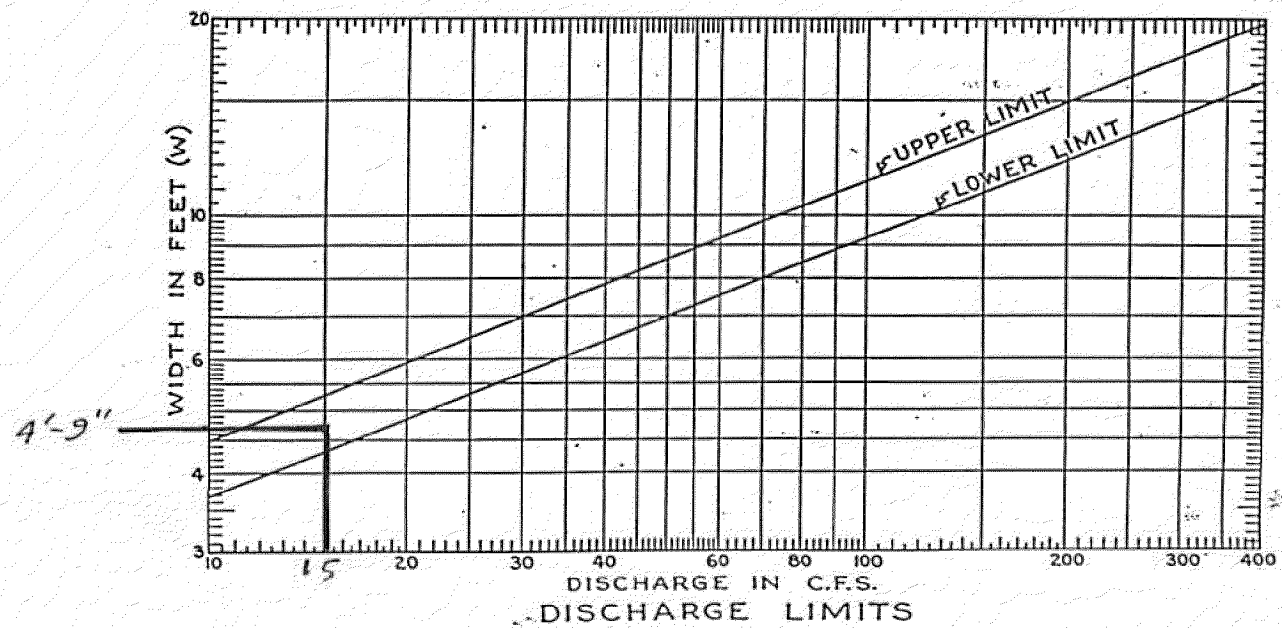


FIGURE 42.—*Impact-type energy dissipator (Basin VI).*

R-0

697-831 O—63——7

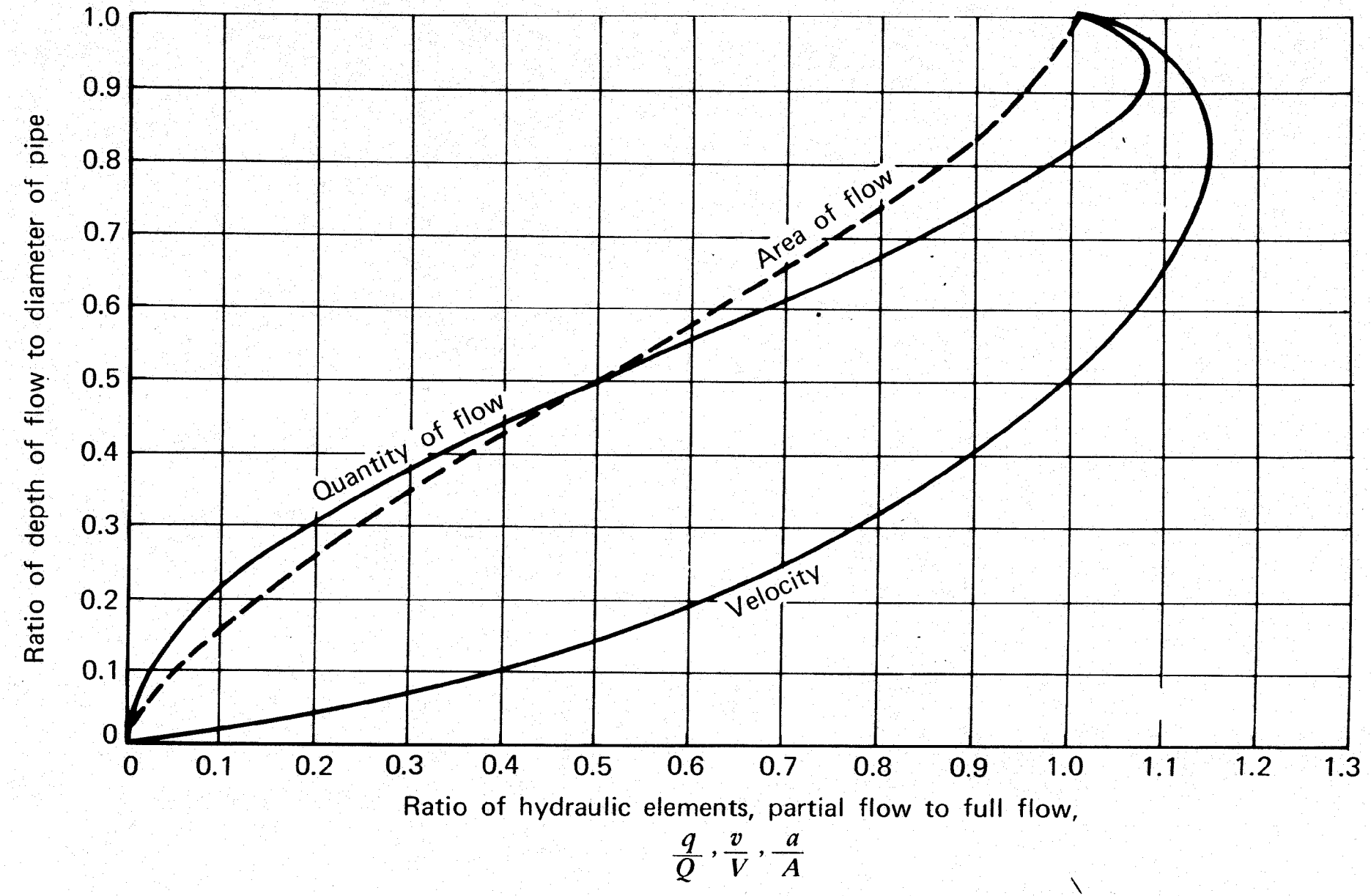
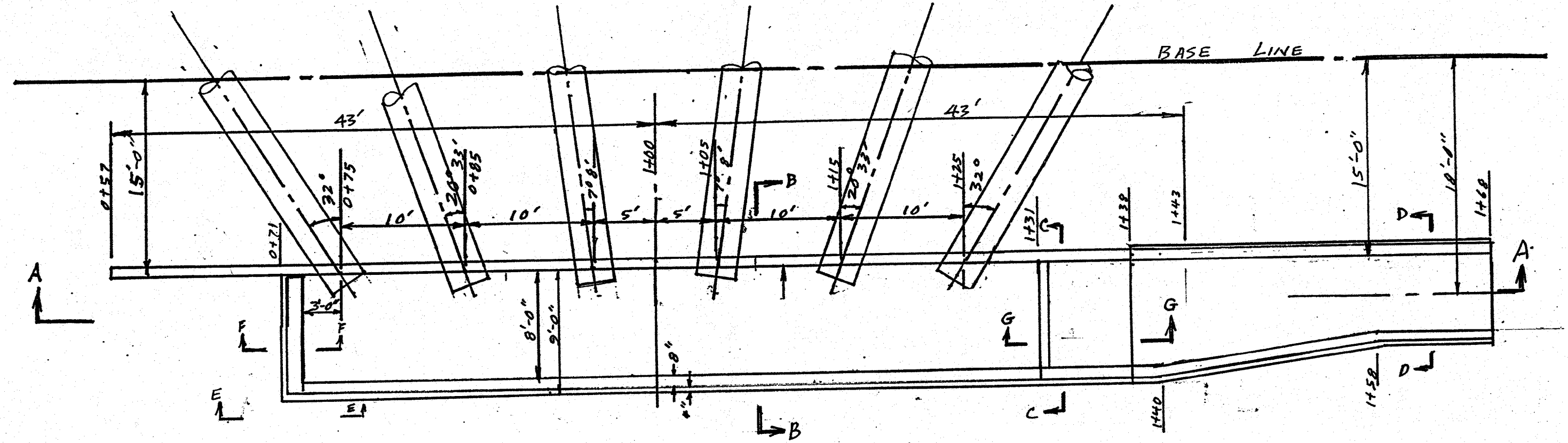
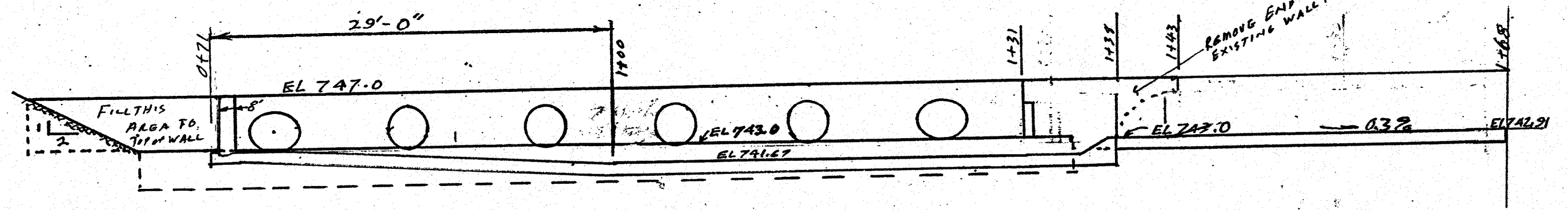


Figure 4-13 Relative quantity, velocity, and cross-sectional area of flow in a circular pipe for any depth of flow.



PLAN

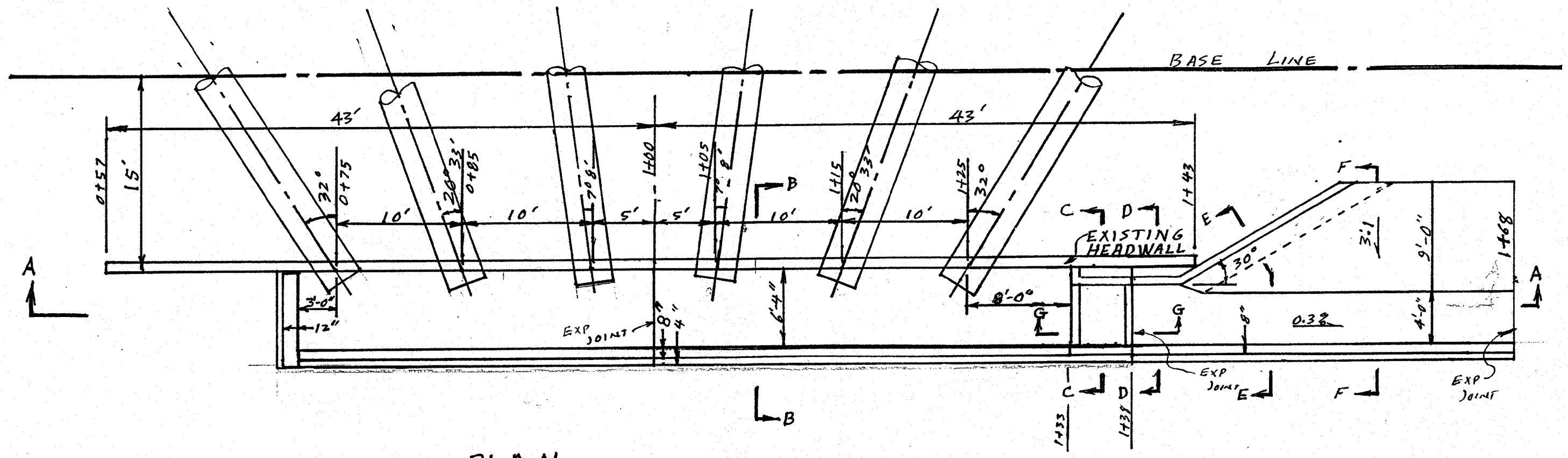
1/8" = 1'-0"



SECTION AA

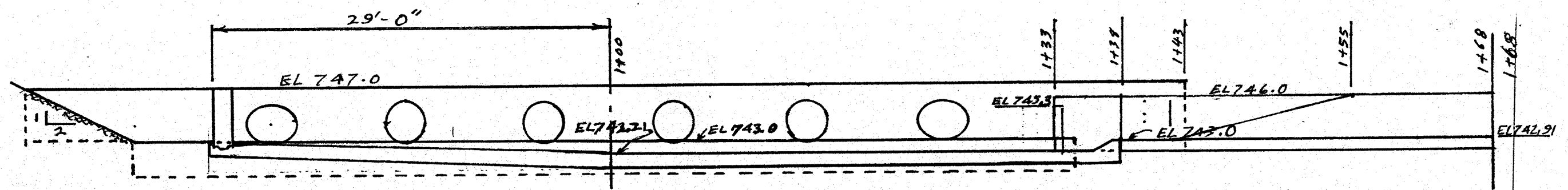
1/8" = 1'-0"

R-1



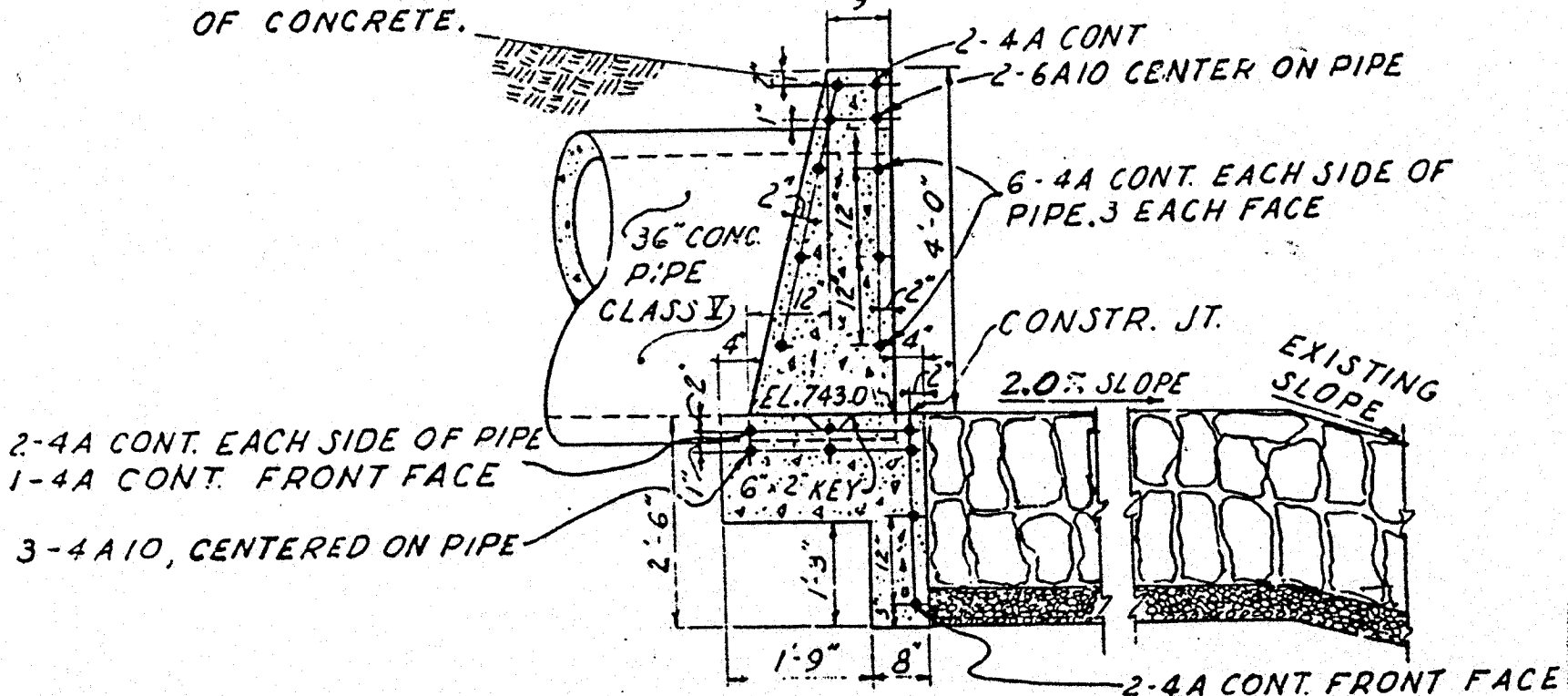
PLAN

$\frac{1}{8}$" = 1'-0"



SECTION A-A

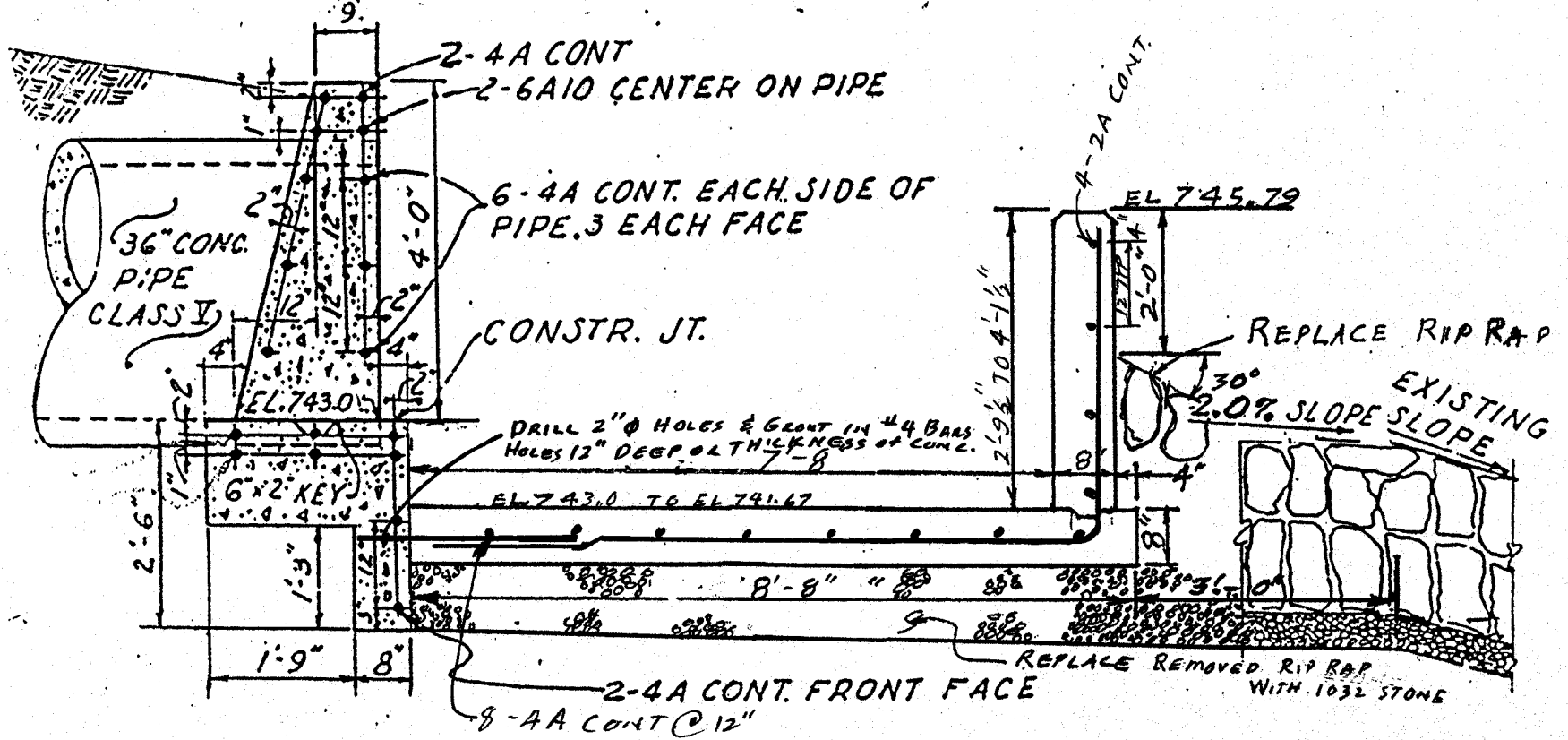
NOTE:
SPACER BARS BY FIELD
NOTE:
USE VERTICAL CONSTRUCTION JOINTS AT THIRD POINTS OF THE LENGTH WITH 6"x2" KEY. CHAMFER EXPOSED EDGES 3/4". LAP REINFORCING BARS A MINIMUM DISTANCE OF 36" DIAMETERS. DIMENSIONS TO REINFORCING ARE CLEAR DISTANCES TO FACE OF CONCRETE.



SECTION B_1-B_1 EXISTING

SCALE: 1/2" = 1'-0"

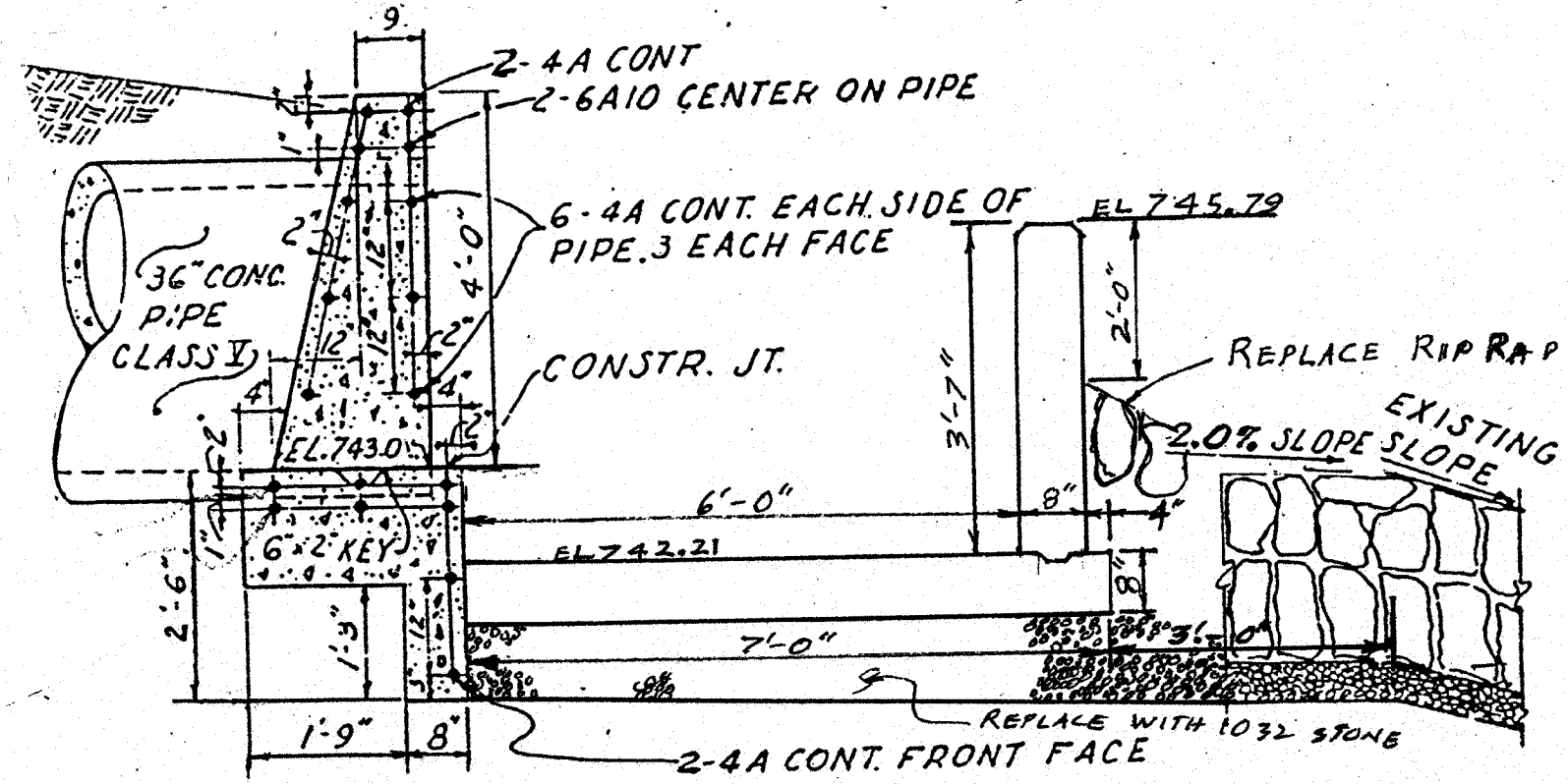
NC
2



SECTION B-B

SCALE: 1/2" = 1'-0"

R-1

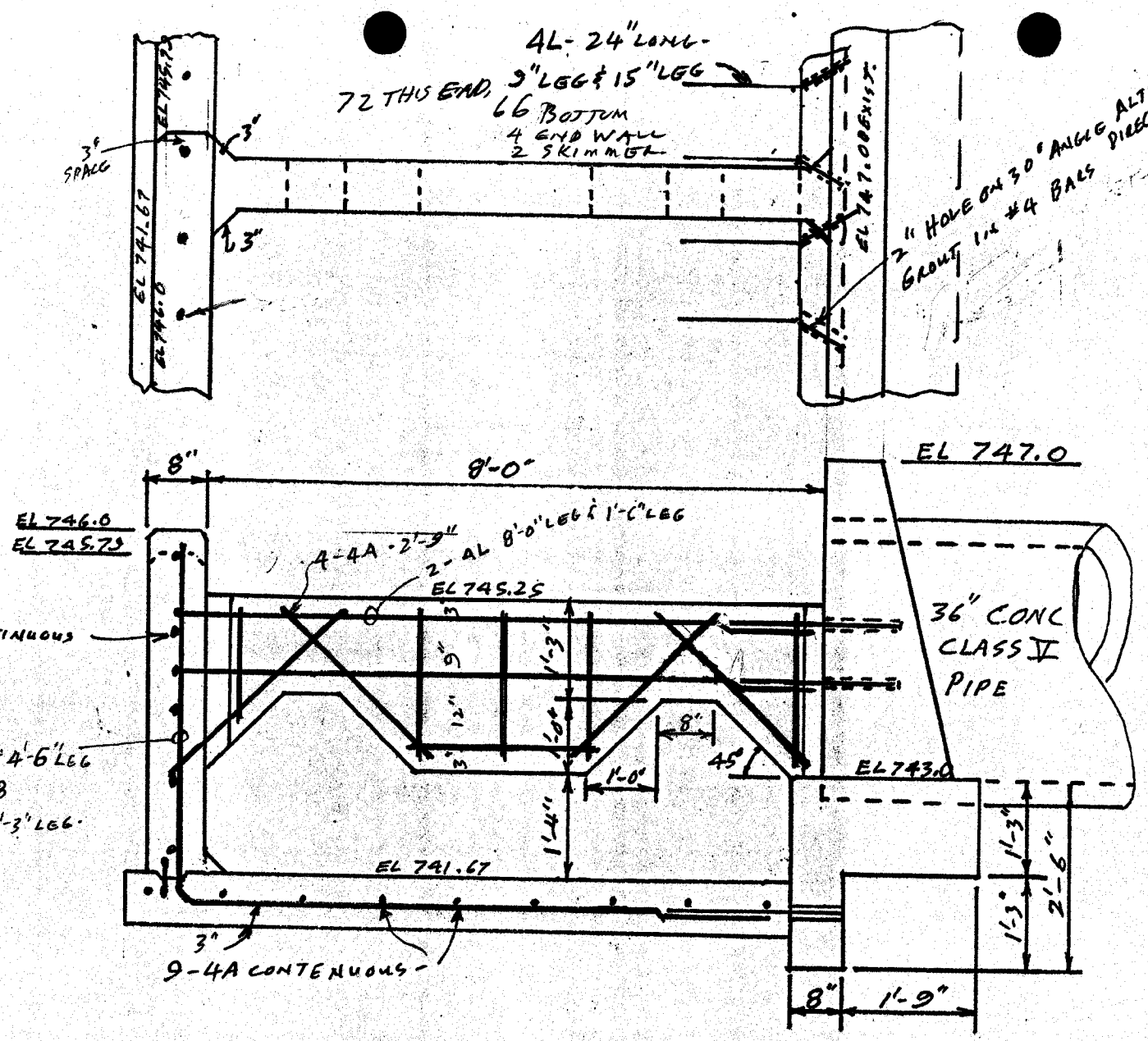


SECTION B_2-B_2 MODIFIED

SCALE: 1/2" = 1'-0"

R-0

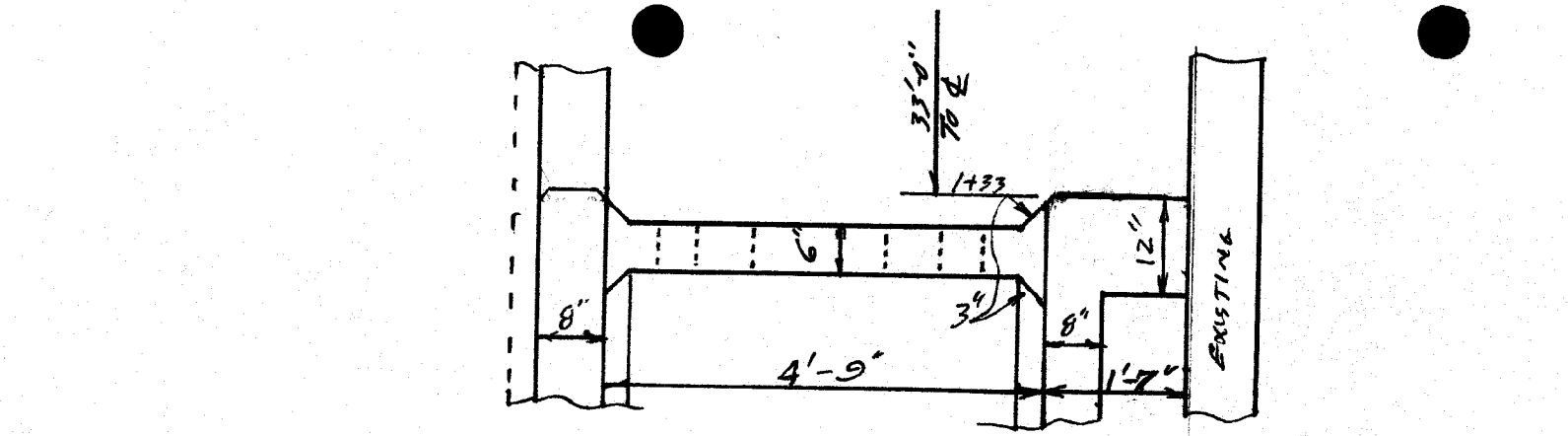
7 - 4L	12'-6	4'-6"	REQ'D
31 - 4L	12'-3"	4'-3"	REQ'D
2 - 4L	12'-0"	4'-2"	REQ'D
2 - 4L	12'-0"	4'-1"	REQ'D
1 - 4L	12'-0"	4'-0"	REQ'D
2 - 4L	11'-9"	3'-11"	REQ'D
2 - 4L	11'-9"	3'-10"	REQ'D
1 - 4L	11'-9"	3'-9"	REQ'D
2 - 4L	11'-8"	3'-8"	REQ'D
2 - 4L	11'-6"	3'-7"	REQ'D
1 - 4L	11'-6"	3'-6"	REQ'D
2 - 4L	11'-6"	3'-5"	
2 - 4L	11'-3"	3'-4"	
1 - 4L	11'-3"	3'-3"	
2 - 4L	11'-0"	3'-2"	
2 - 4L	11'-0"	3'-1"	
1 - 4L	11'-0"	3'-0"	
2 - 4L	10'-9"	2'-11"	
2 - 4L	10'-9"	2'-10"	
1 - 4L	10'-9"	2'-9"	



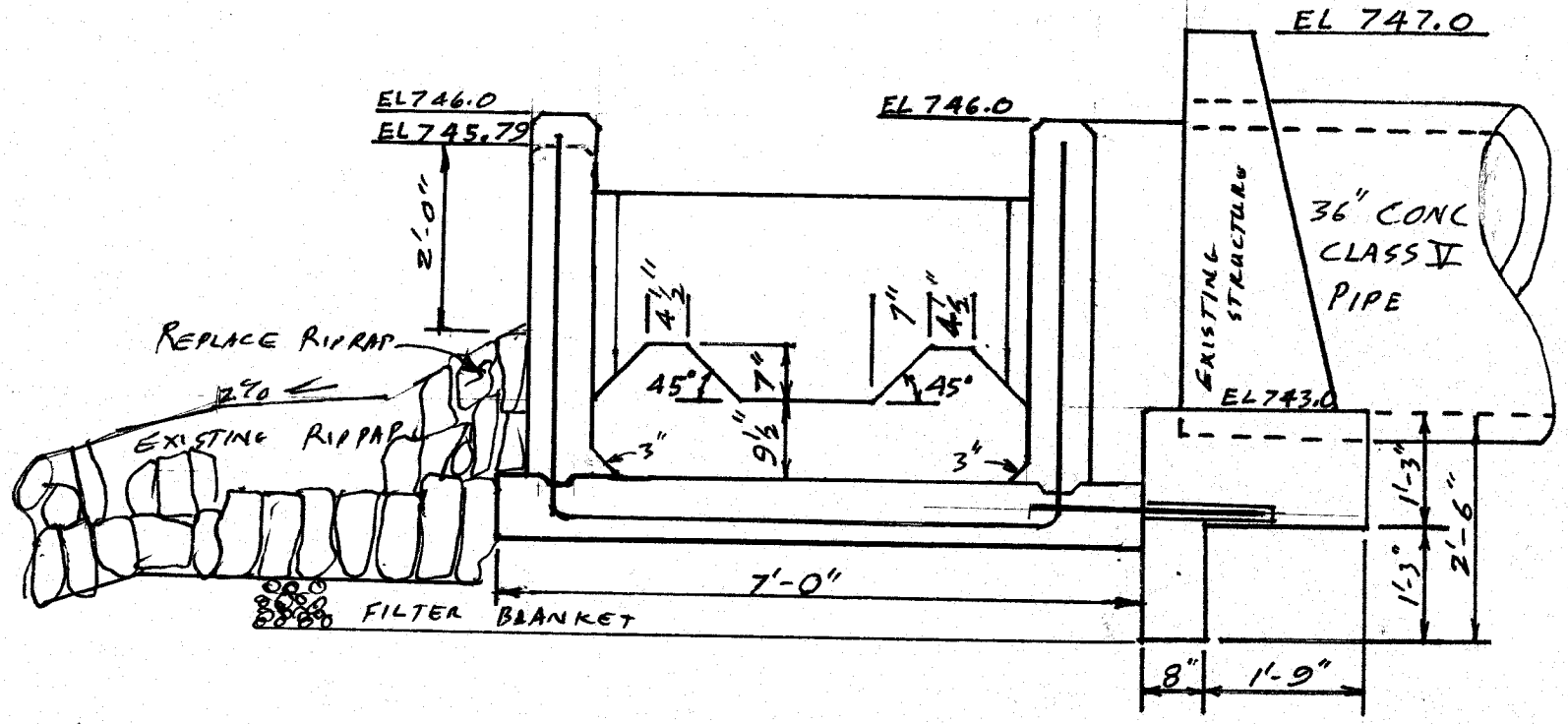
SECTION CC

1/2" = 1'-0"

R-1

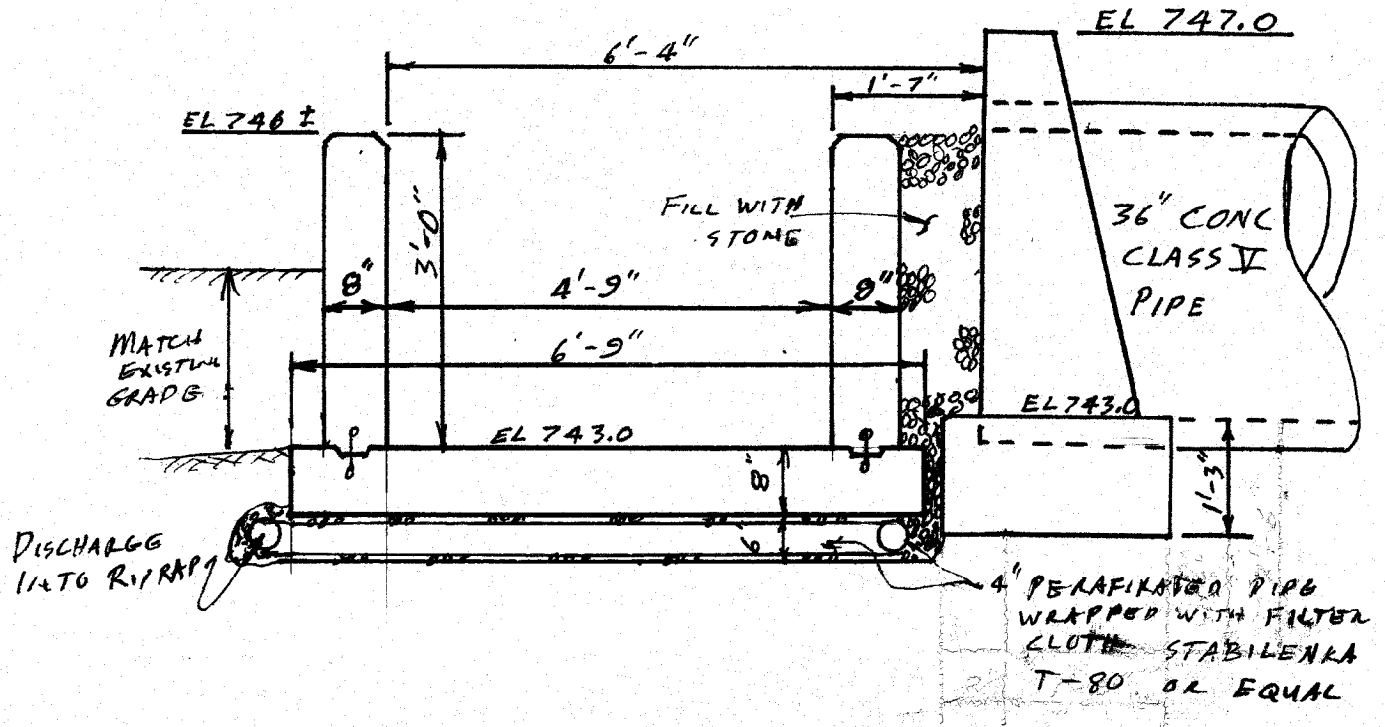


TOP



SECTION C-C
½"=1'-0"

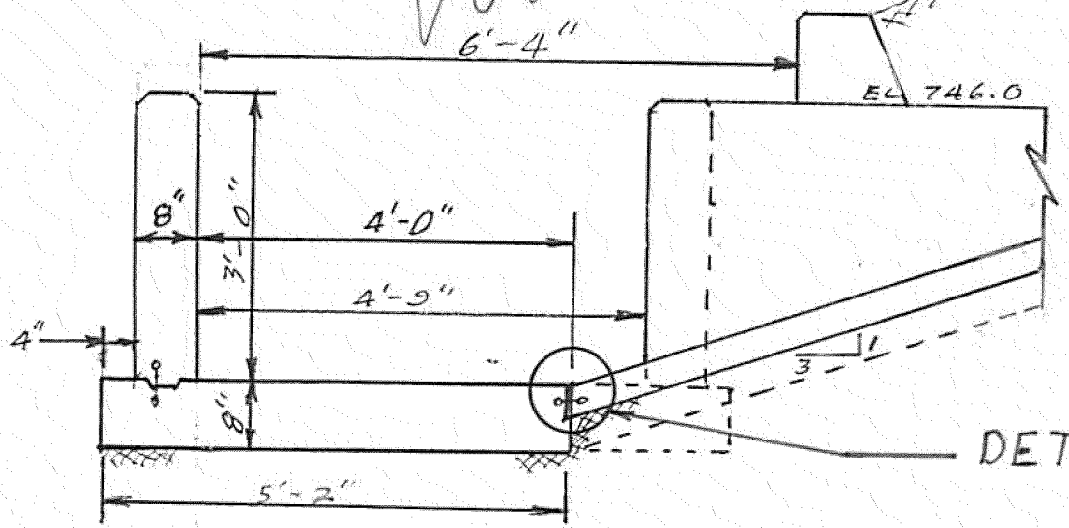
R-0



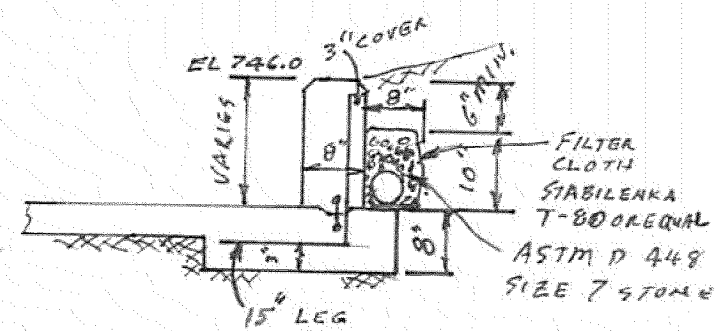
SECTION D D

½"=1'-0"

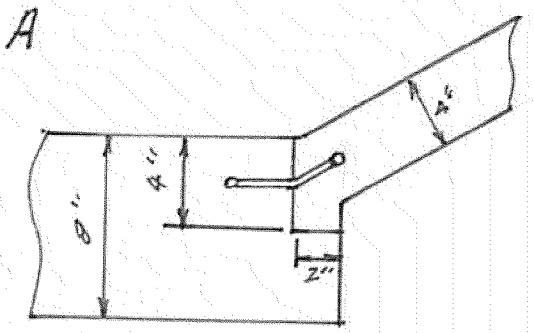
VOID DESIGN DUG TO UPDATED FIELD DATA



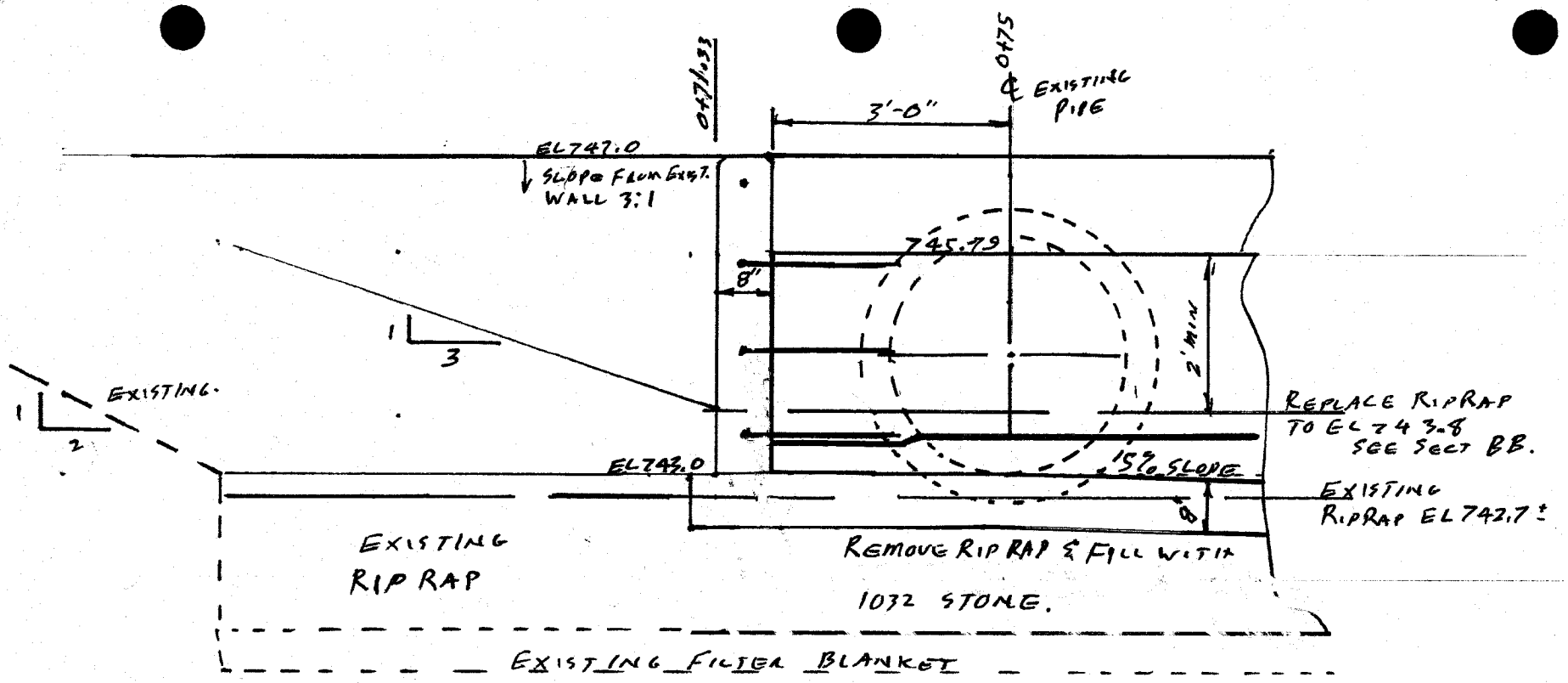
SECTION E E
1/2" = 1'-0"



DETAIL A

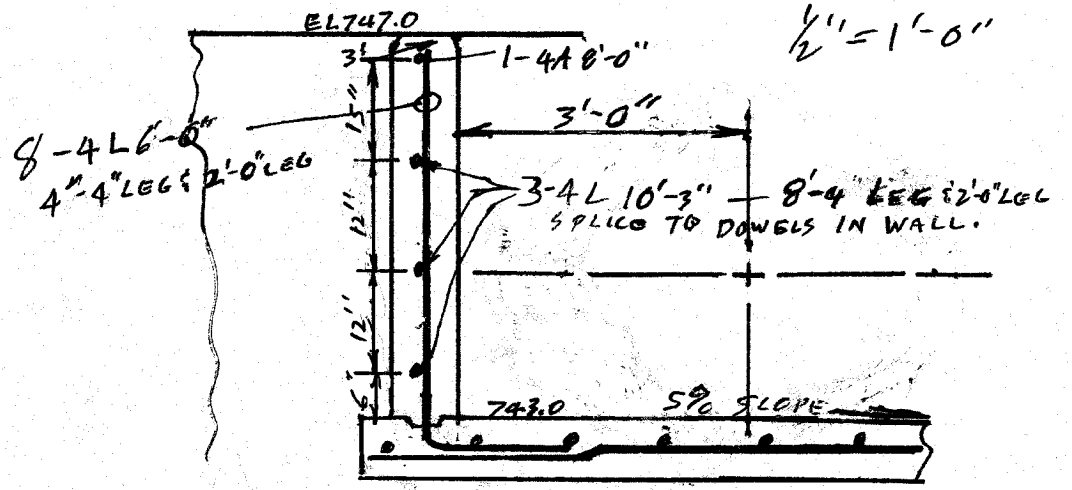


DETAIL A
1 1/2" = 1'-0"



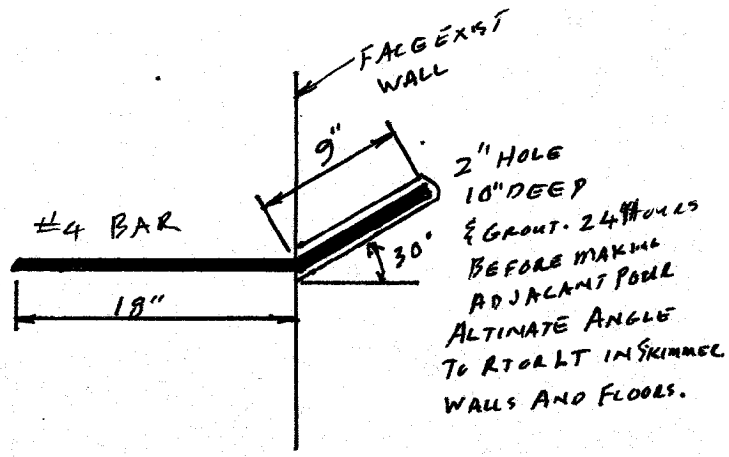
SECTION EE

1/2"=1'-0"



SECTION FF

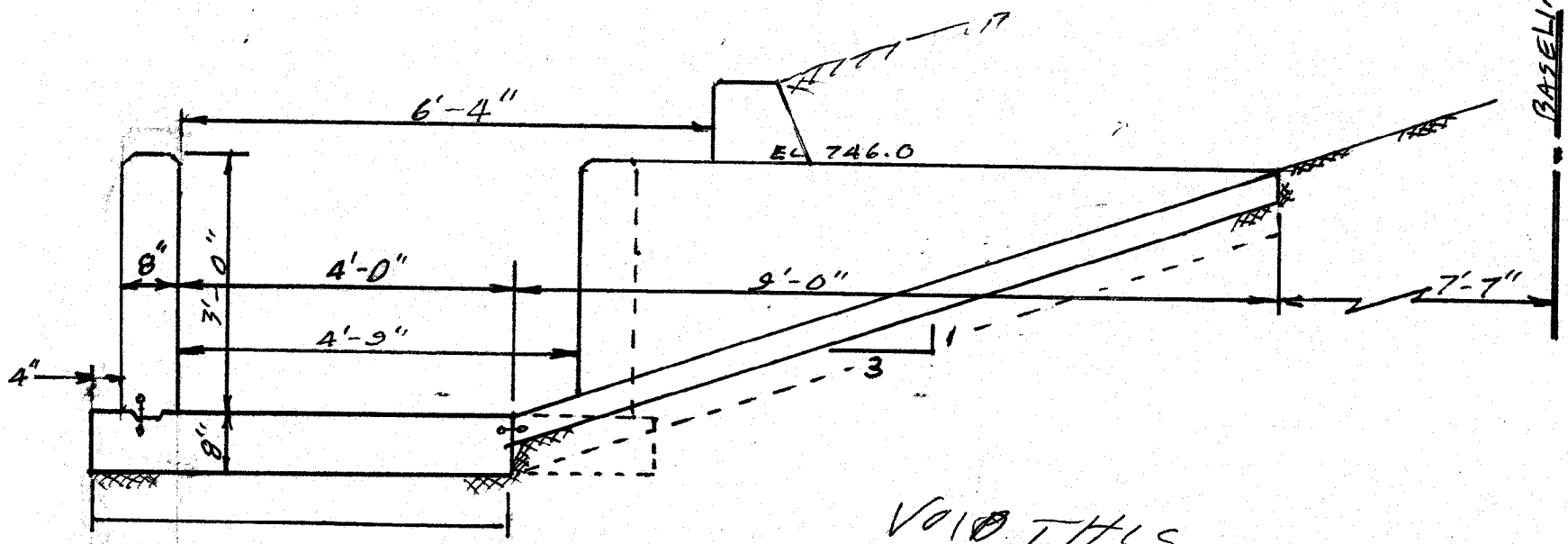
1/2"=1'-0"



TYP. DOWEL

1"=1'-0"

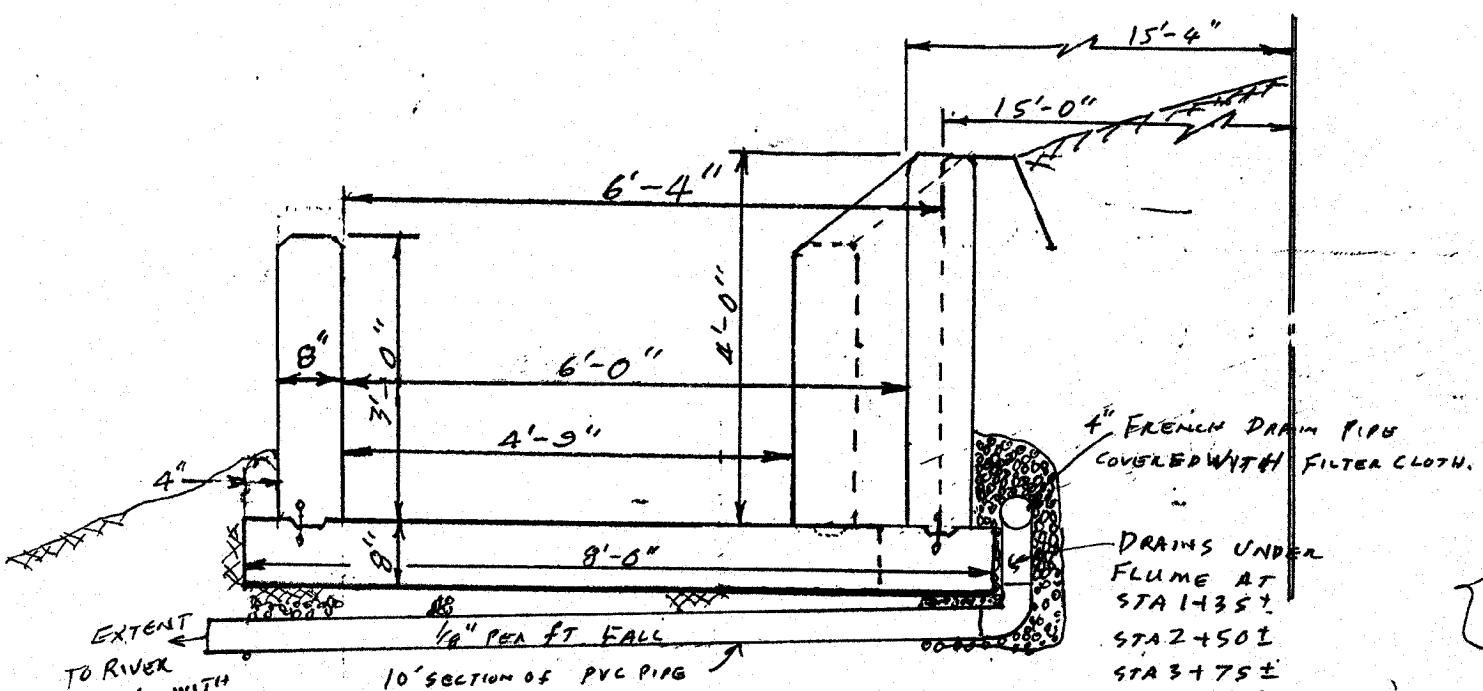
R-1

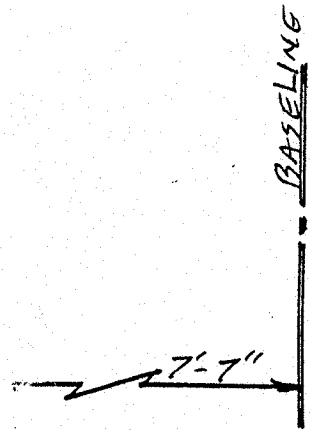


VOID THIS

SECTION F F

½" = 1'-0"





FOR BILL OF MATERIAL

4" PVC PIPE

5 — 10' SECTION (CUT DNG UP)

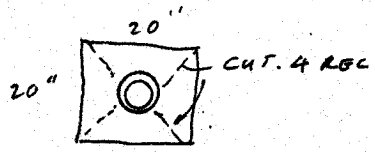
4 — 90° ELBO

~~4 — SHORT SECTION~~

SCREEN. 4 - 20" X 20"

SECTION F F STA 1+60 TO 5+

1/2" = 1'-0"



STATION	ELEV
1+58	742.97
1+75	742.90
2+00	742.81
2+25	742.74
2+50	742.66
2+75	742.59
3+00	742.51
3+25	742.44
3+50	742.36
3+75	742.29
4+00	742.21
4+25	742.14
4+50	742.06
4+75	741.96
4+98	741.87
5+02	741.86
5+10	741.77
5+60	741.00
5+60	740.50
5+70	740.40

4 - 20"x20" COPPER SCREEN WITH 1/4" OPENINGS.

16 - 1" METAL SCREWS - BRASS

16 - BRASS WASHERS FOR 1" METAL SCREWS

Bill of MATERIAL

4 - 4" PVC ELBO - 90°

~~350'~~ - 4" PERFORATED PIPE

4 - 4" "T" FOR PERFORATED PIPE

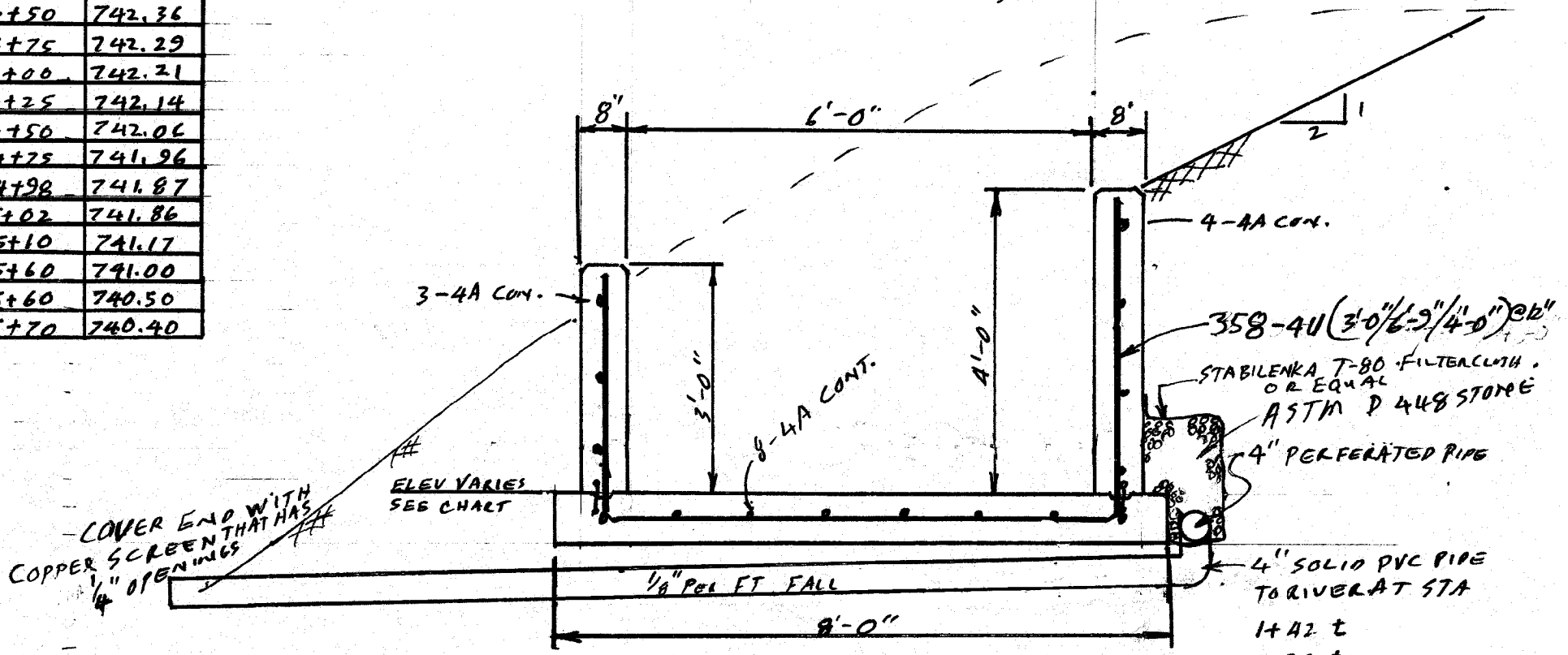
4 - 4" COUPLES

~~60~~ - 4" PVC PIPE

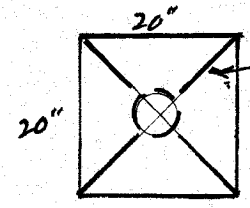
1 CAN CLEANER 4 OZ

1 CAN CEMENT 4 OZ

350' - 4' WIDE FILTER CLOTH - STABILENKA T-80 OR EQUAL



SECTION D D
TYPICAL FROM 1+58 TO 4+98
1/2" = 1'-0"



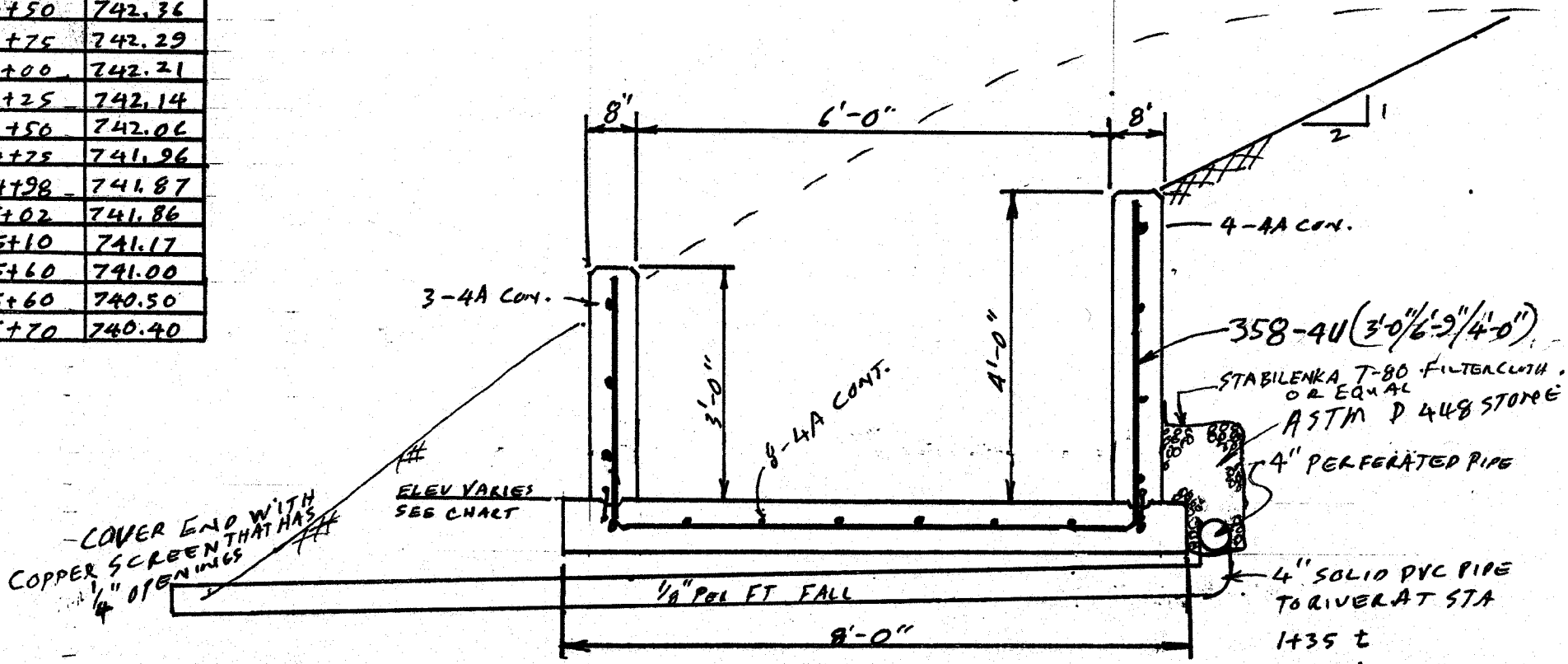
R-1

STATION	ELEV
1+58	742.97
1+75	742.90
2+00	742.81
2+25	742.74
2+50	742.66
2+75	742.59
3+00	742.51
3+25	742.44
3+50	742.36
3+75	742.29
4+00	742.21
4+25	742.14
4+50	742.06
4+75	741.96
4+98	741.87
5+02	741.86
5+10	741.77
5+60	741.00
5+60	740.50
5+70	740.40

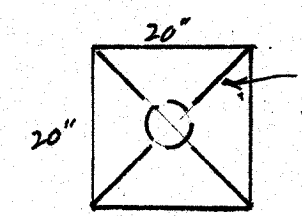
Bill of MATERIAL

4 – 4" PVC ELBO
350' – 4" PERFORATED PIPE
4 – 4" "T" FOR PERFERATED PIPE
4 – 4" COUPLES
60 – 4" PVC PIPE
1 CAN CLEANER
1 CAN CEMENT
4' WIDE FILTER CLOTH-STABILENKA T-80 OR EQUAL

350' –

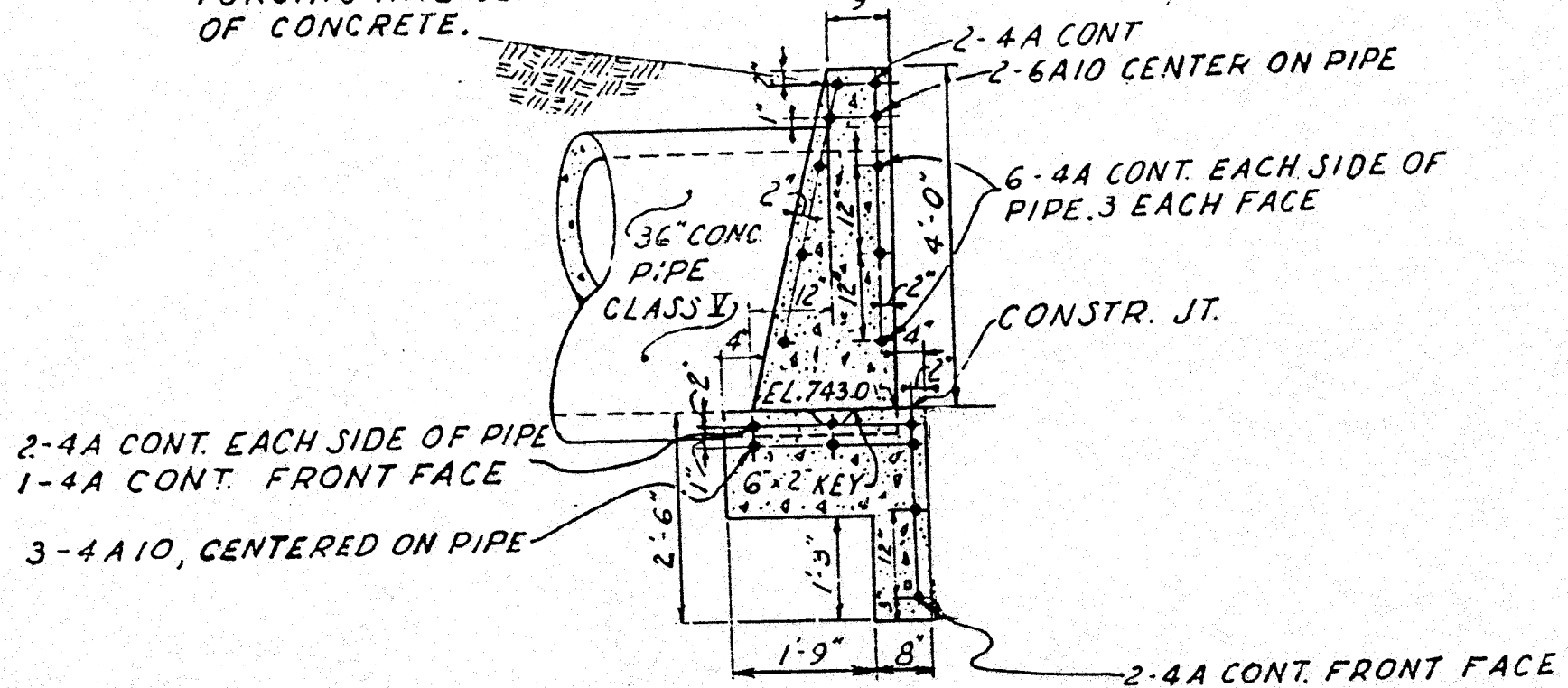


SECTION D D
TYPICAL FROM 1+58 TO 4+98
1/2" = 1'-0"



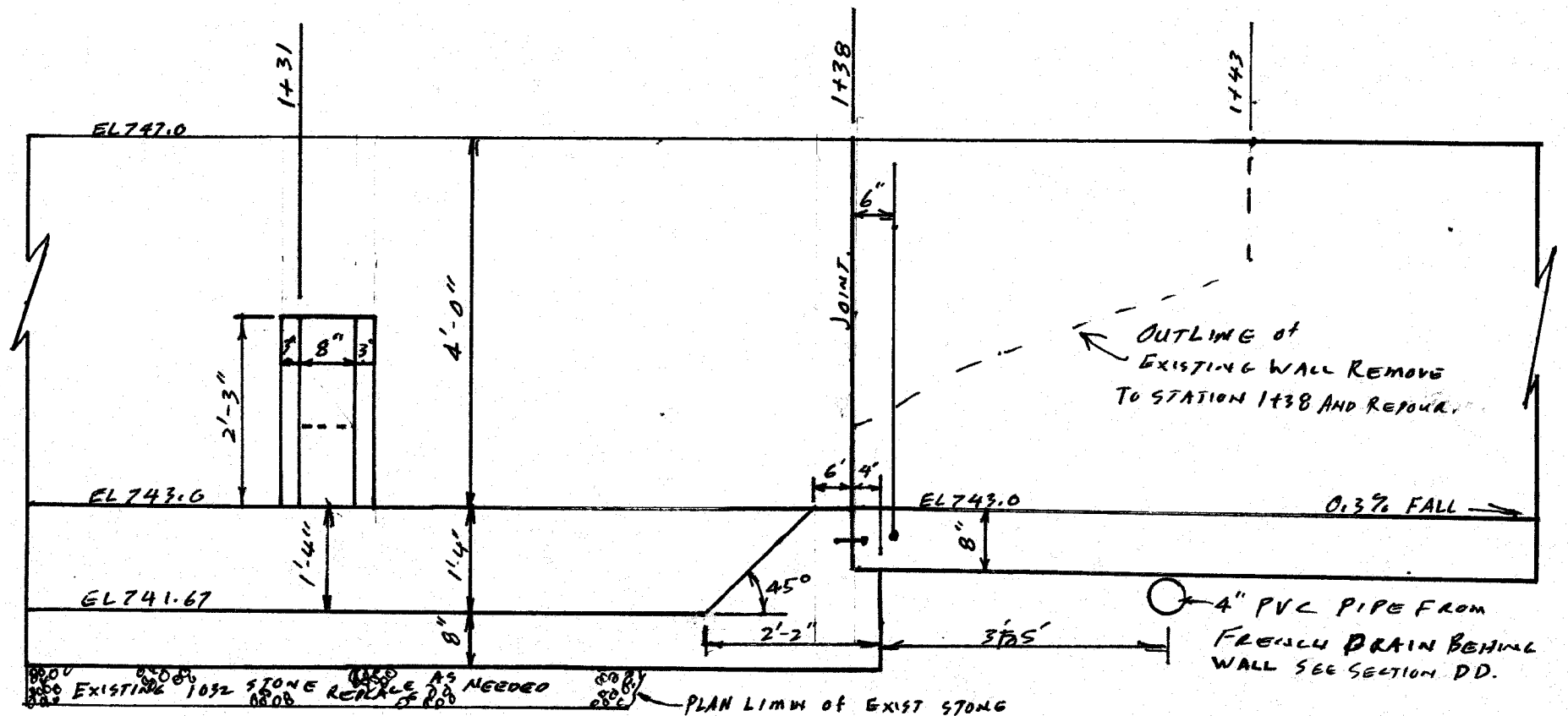
R-1

NOTE:
SPACER BARS BY FIELD
NOTE:
USE VERTICAL CONSTRUCTION JOINTS AT THIRD POINTS OF THE LENGTH WITH 6"x2" KEY. CHAMFER EXPOSED EDGES 3/4". LAP REINFORCING BARS A MINIMUM DISTANCE OF 36" DIAMETERS. DIMENSIONS TO REINFORCING ARE CLEAR DISTANCES TO FACE OF CONCRETE.



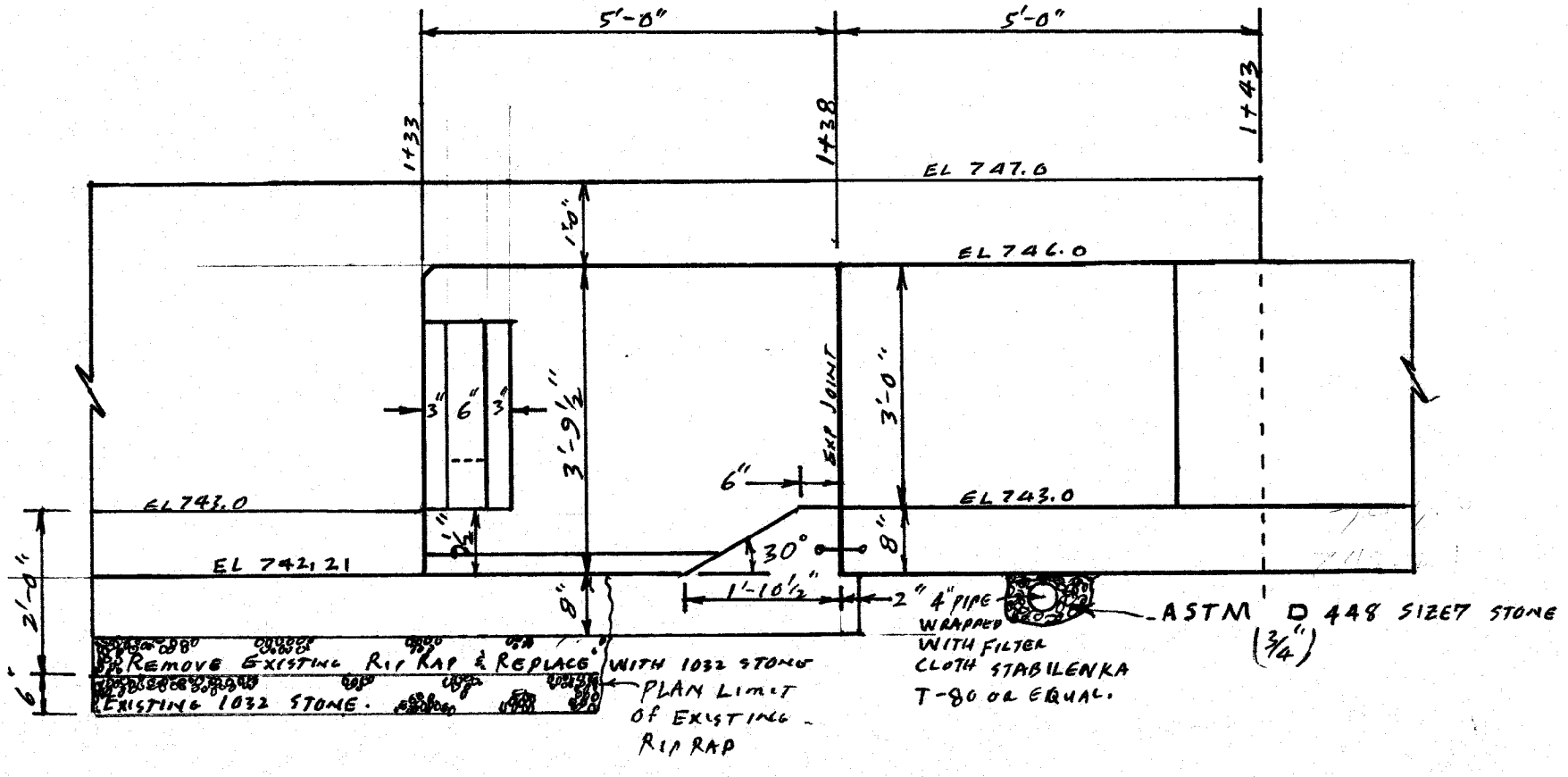
SECTION E-E

SCALE: 1/2" = 1'-0"



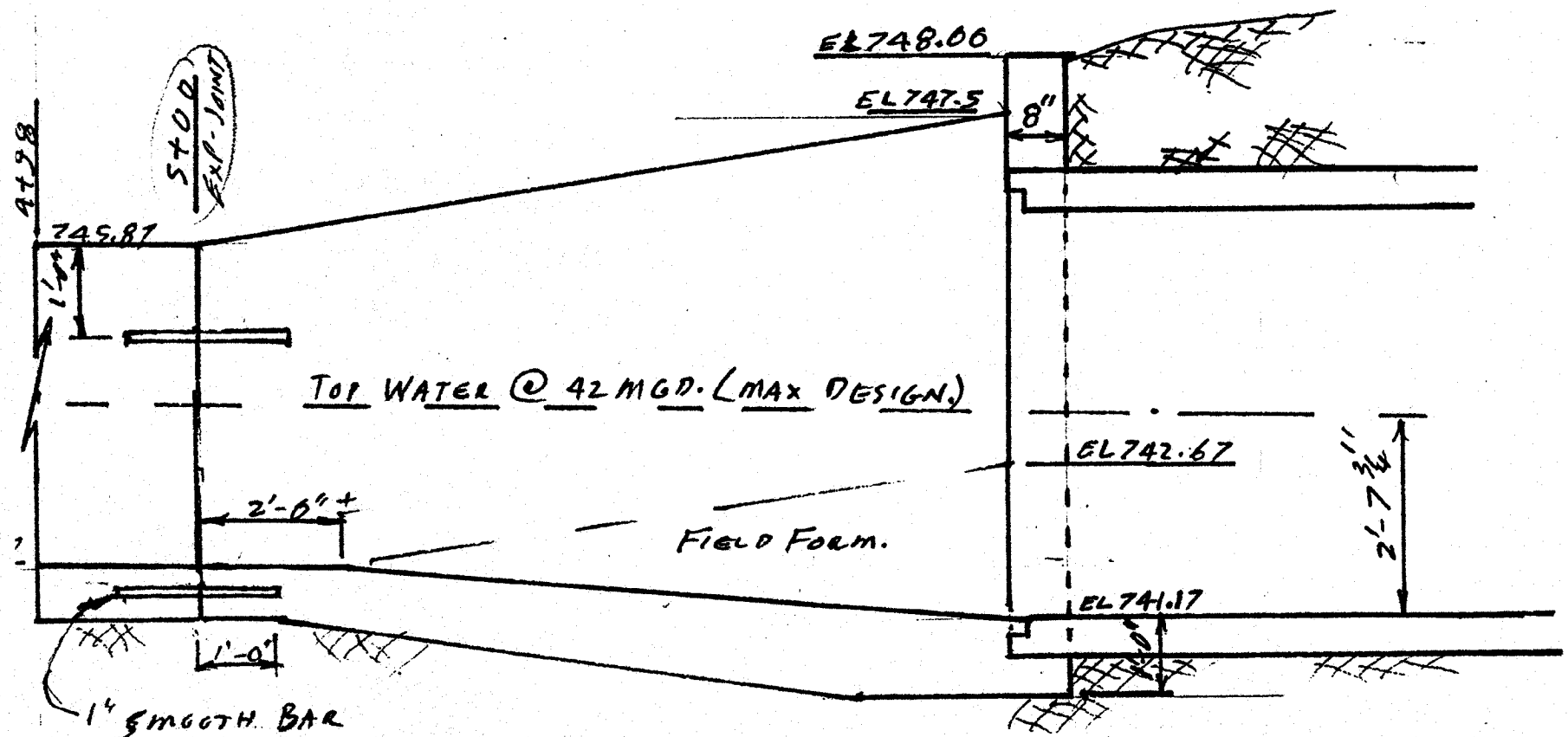
SECTION GG
1/2"=1'-0"

R-1

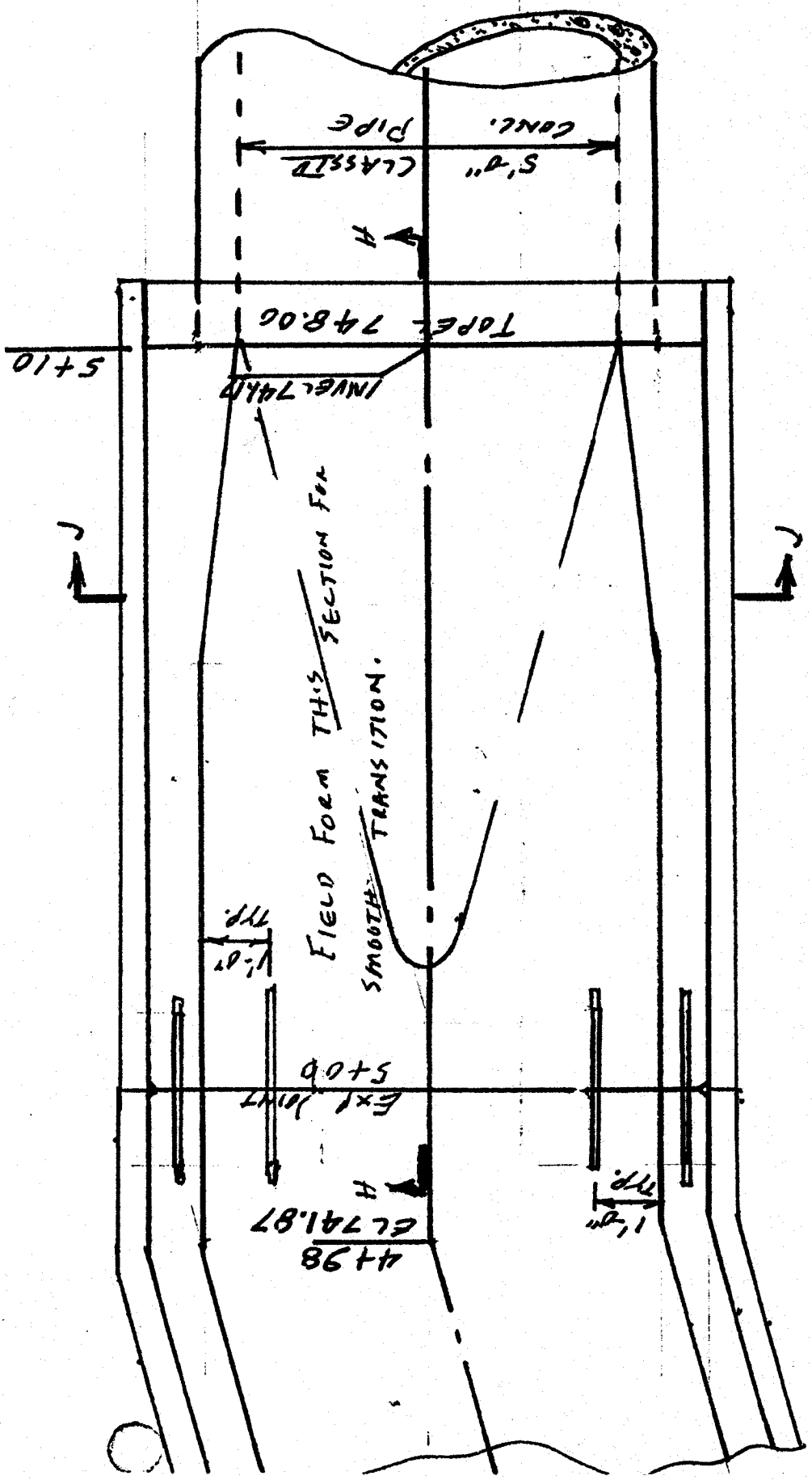


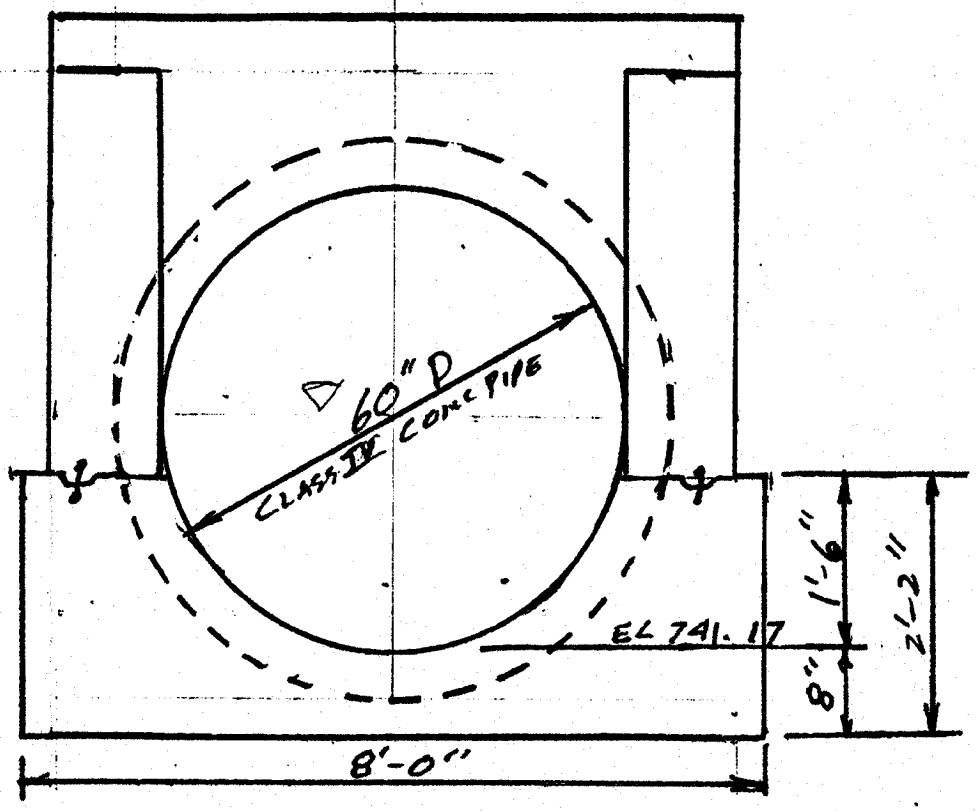
SECTION G G

½" = 1'-0"

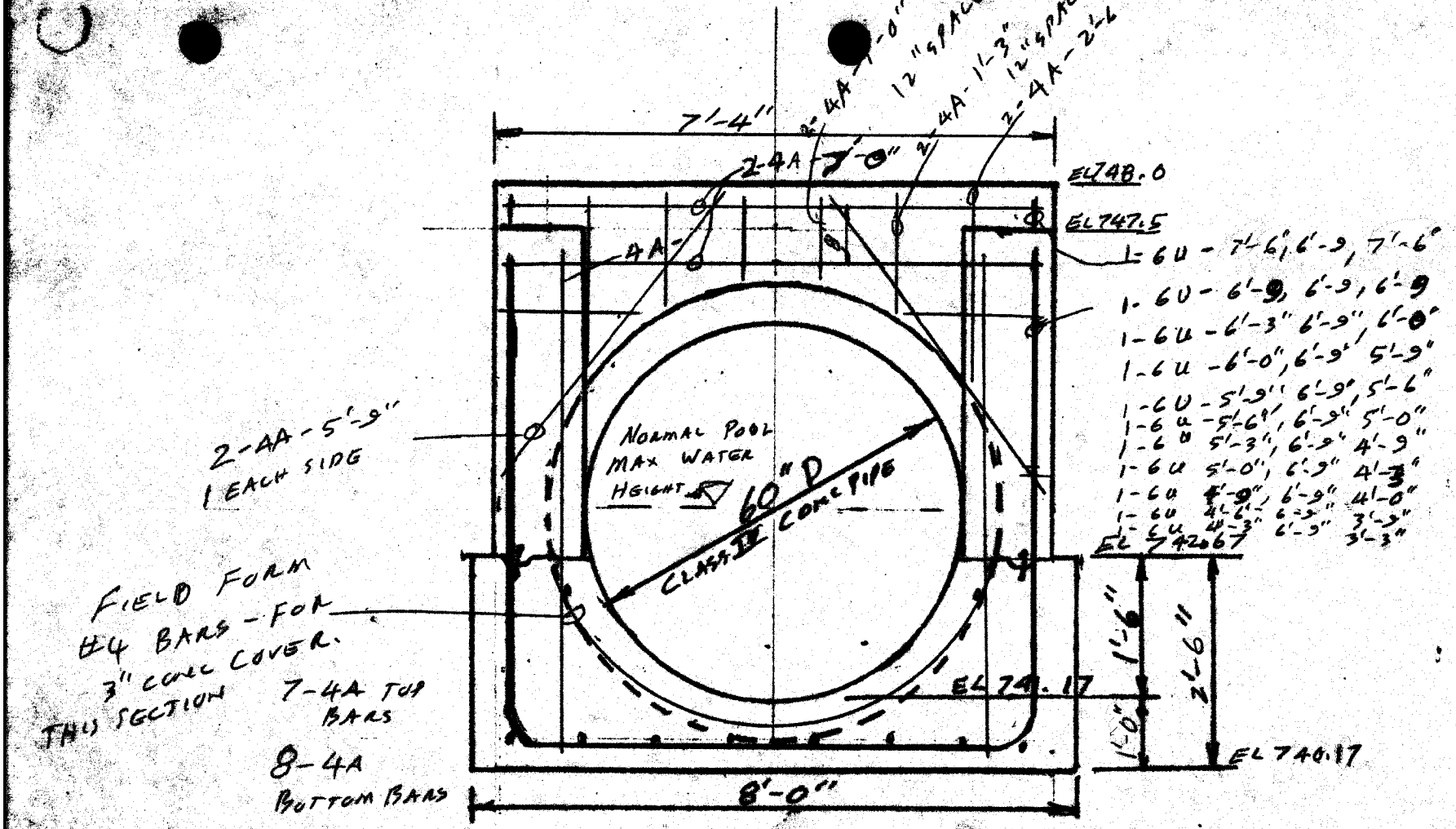


SECTION H H



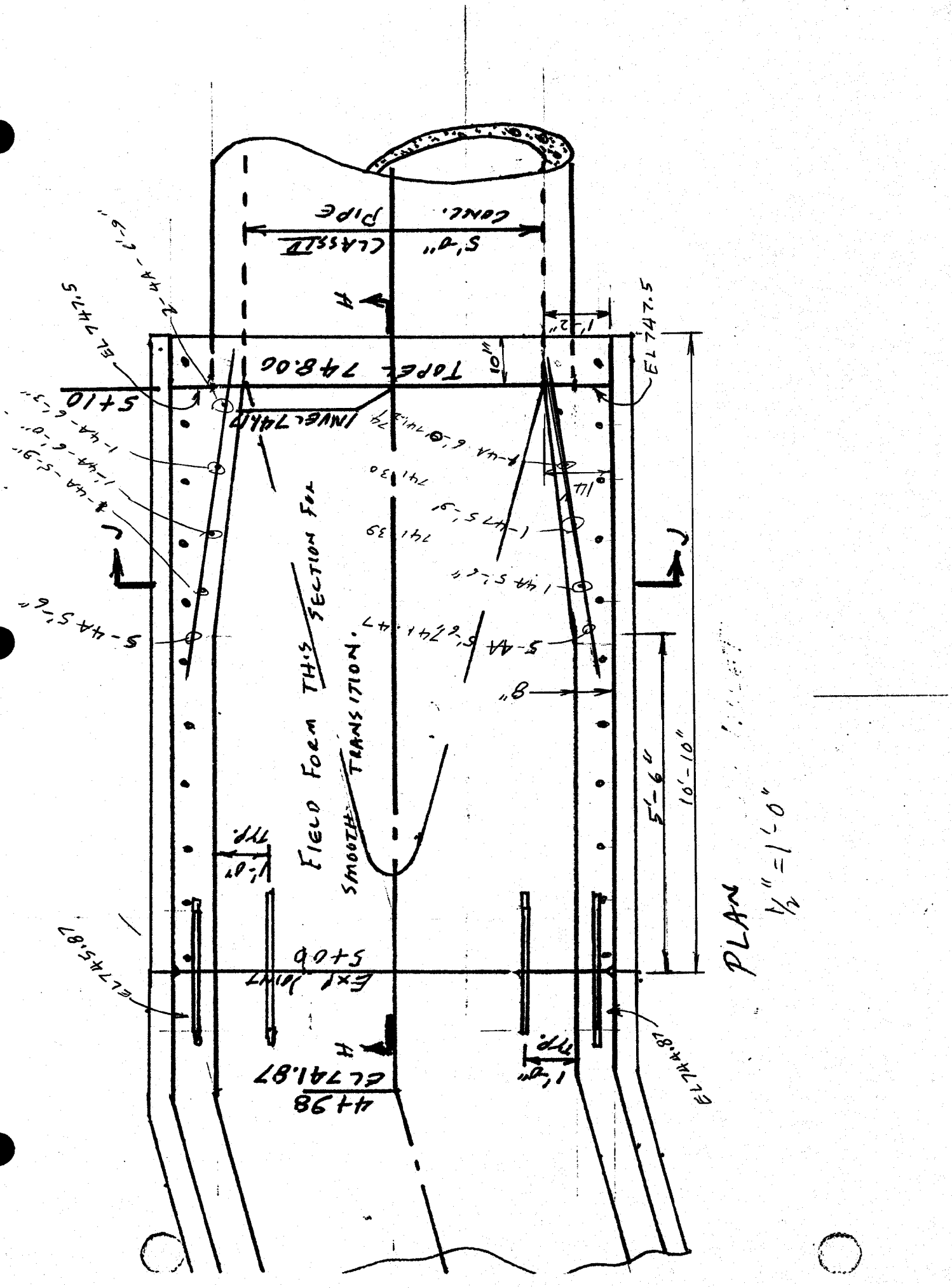


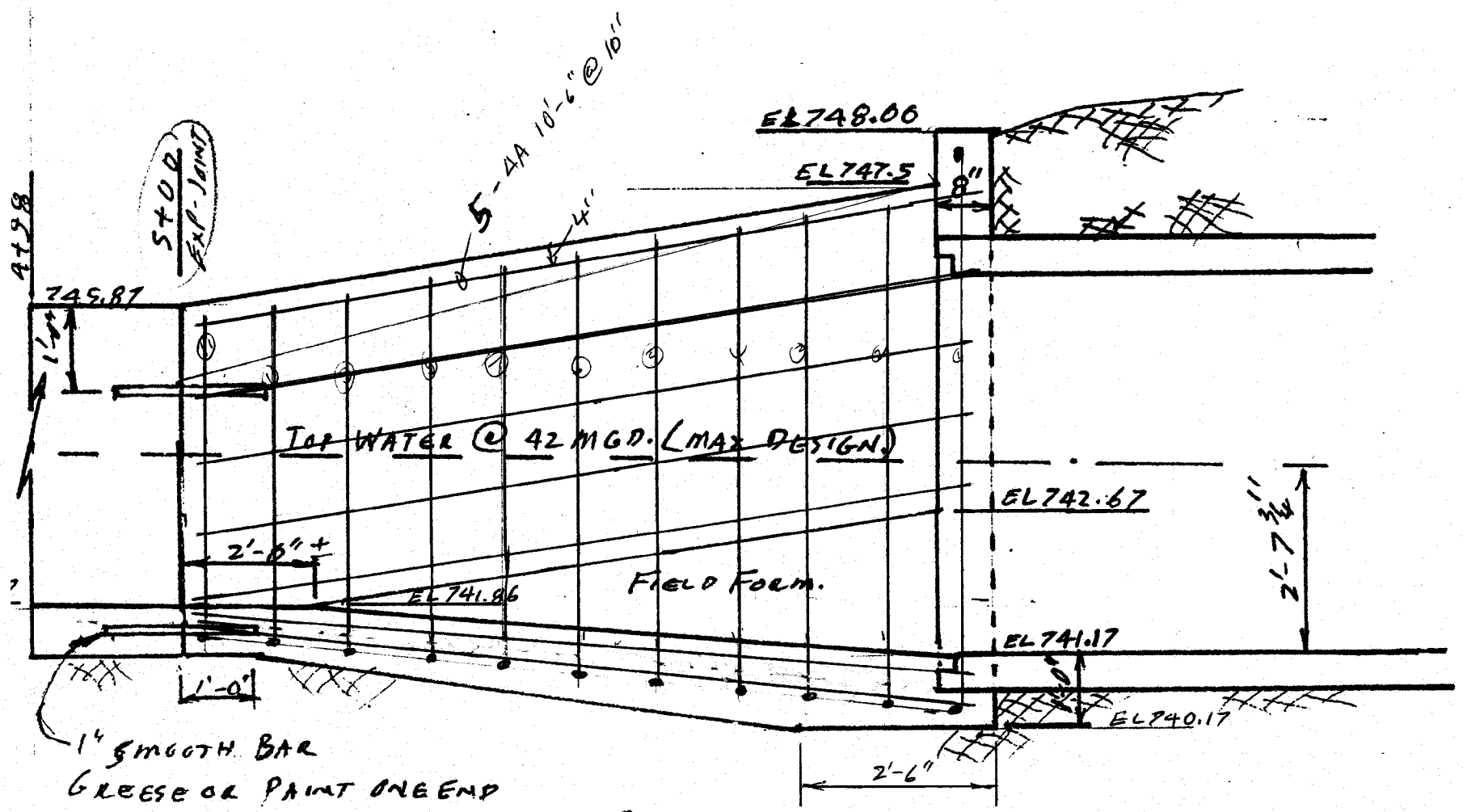
SECTION JJ



SECTION JJ

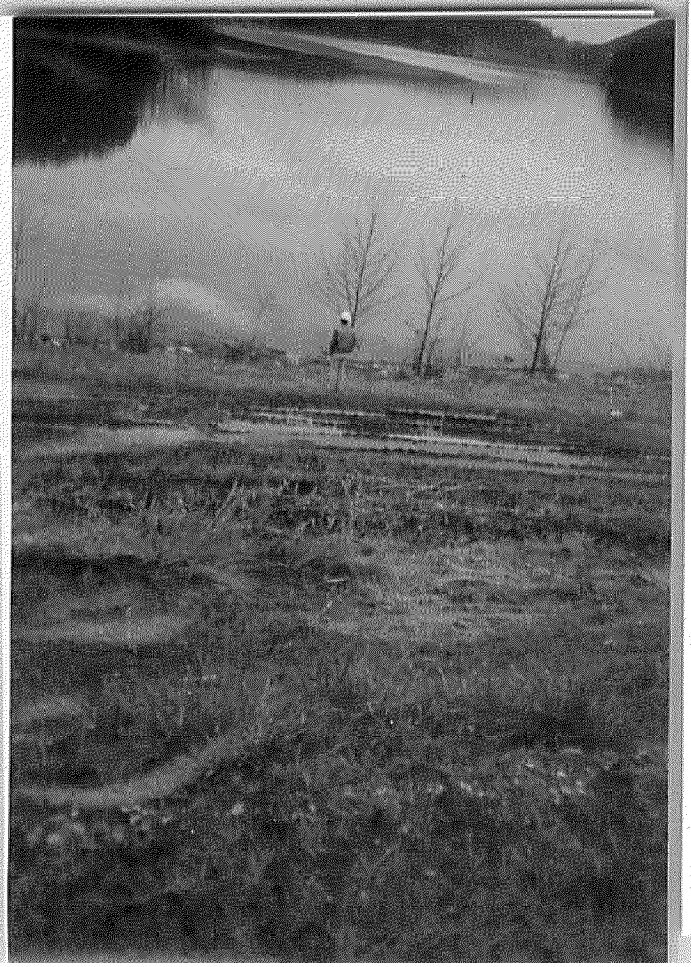
$\frac{1}{2}$" = 1'-0"


CONC. PIPE
5'-0" CLASS III
TOP ± 748.00
INVERT 744.17
EL 747.5
EL 747.13
5+10
5+06
4+98
EL 745.87
EL 744.87
EL 744.87
1'-2"
10"
8"
5'-6"
10'-10"
1'-0"
TYP.
FIELD FORM THIS SECTION FOR SMOOTH TRANSITION.
EXP JOINT
PLAN
1/2" = 1'-0"



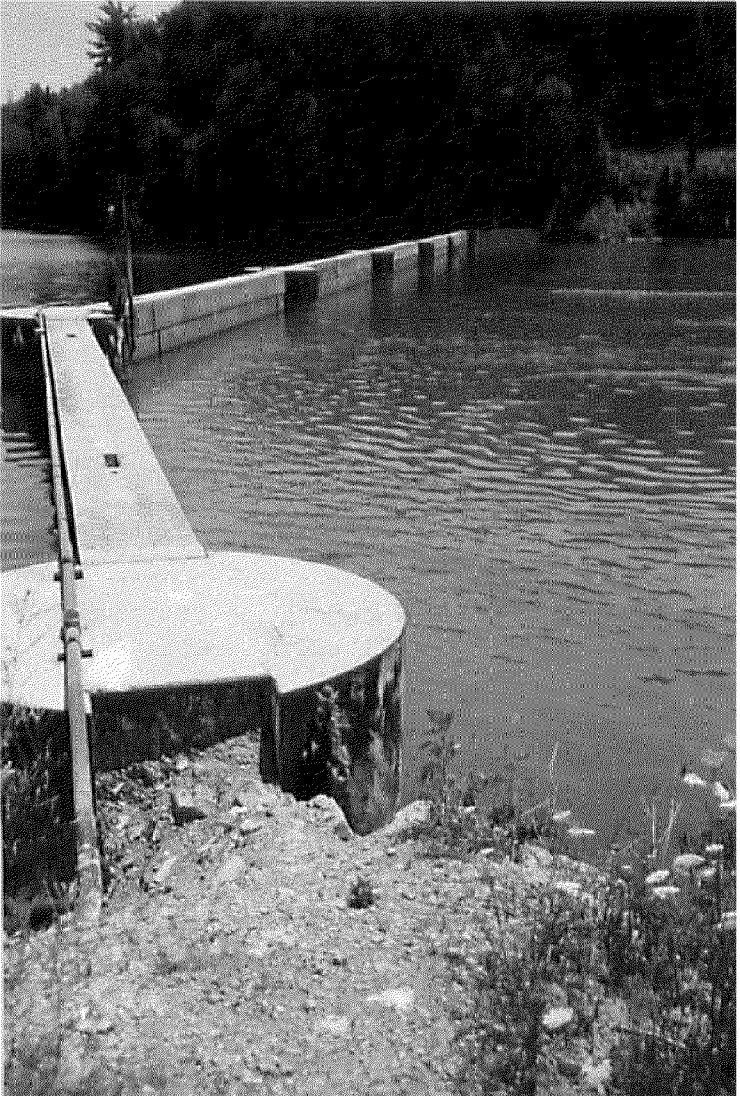
1" SMOOTH BAR
GREESE OR PAINT ONE END
1" X 30' 4 PER EXP JOINT TYP.

SECTION H H
1/2" = 1'-0"



TVA-00013948

TVA-00013949



TVA-00013950