MODJESKI & MASTERS
ENGINEERS

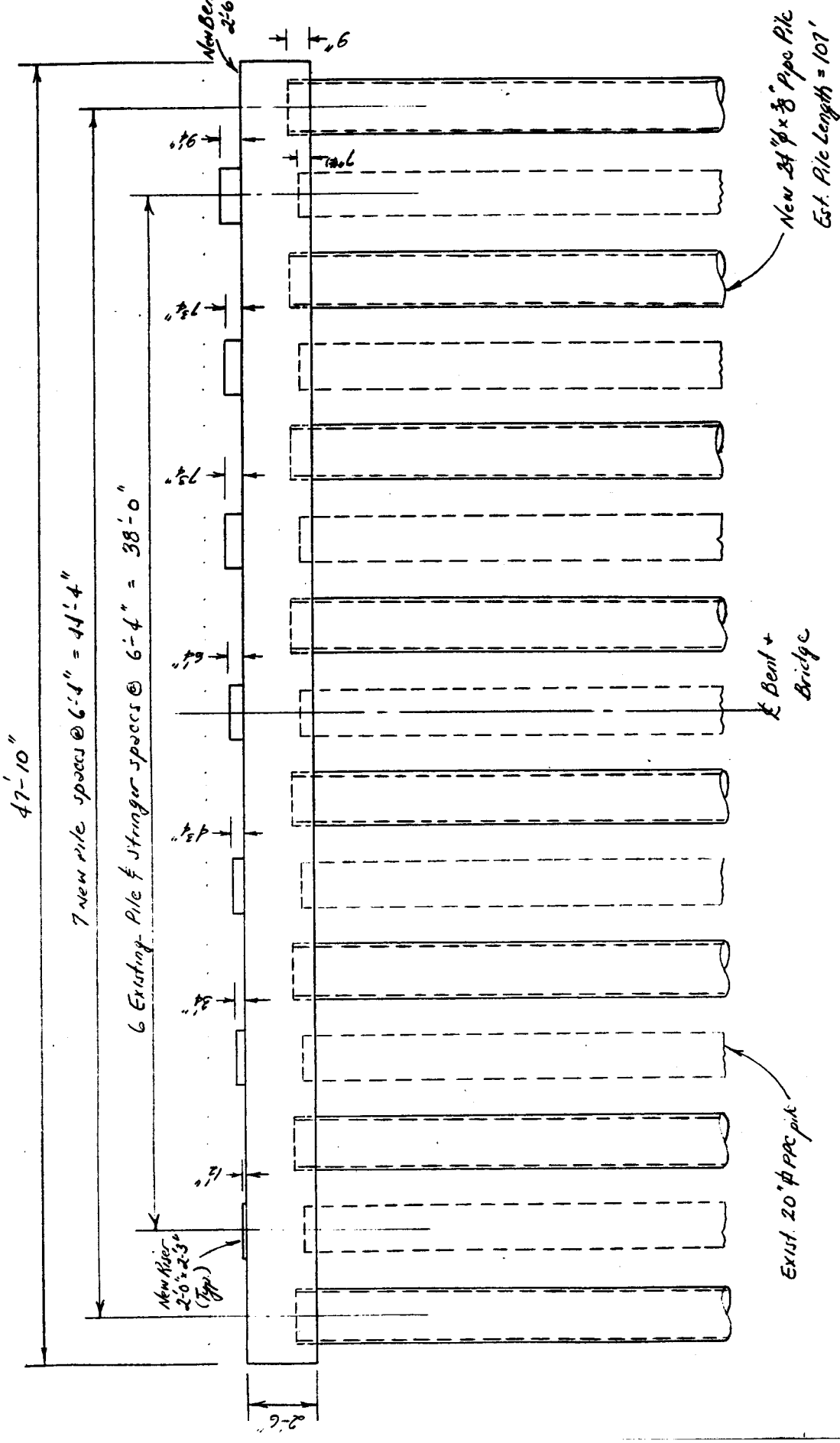
Project 17th St. Canal (A000677)

Subject Veterans Hwy Bridge
Deck & Substructure Replacement

Made by GPT 25 JUL 86 Date

Checked by _____ Date

Sheet No. _____ of _____



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Project 17th St. Canal
Subject Veterans Hwy Bridge
Deck & Sub Structure Replacement

Made by GPT 25JUL06 Date
Checked by _____ Date
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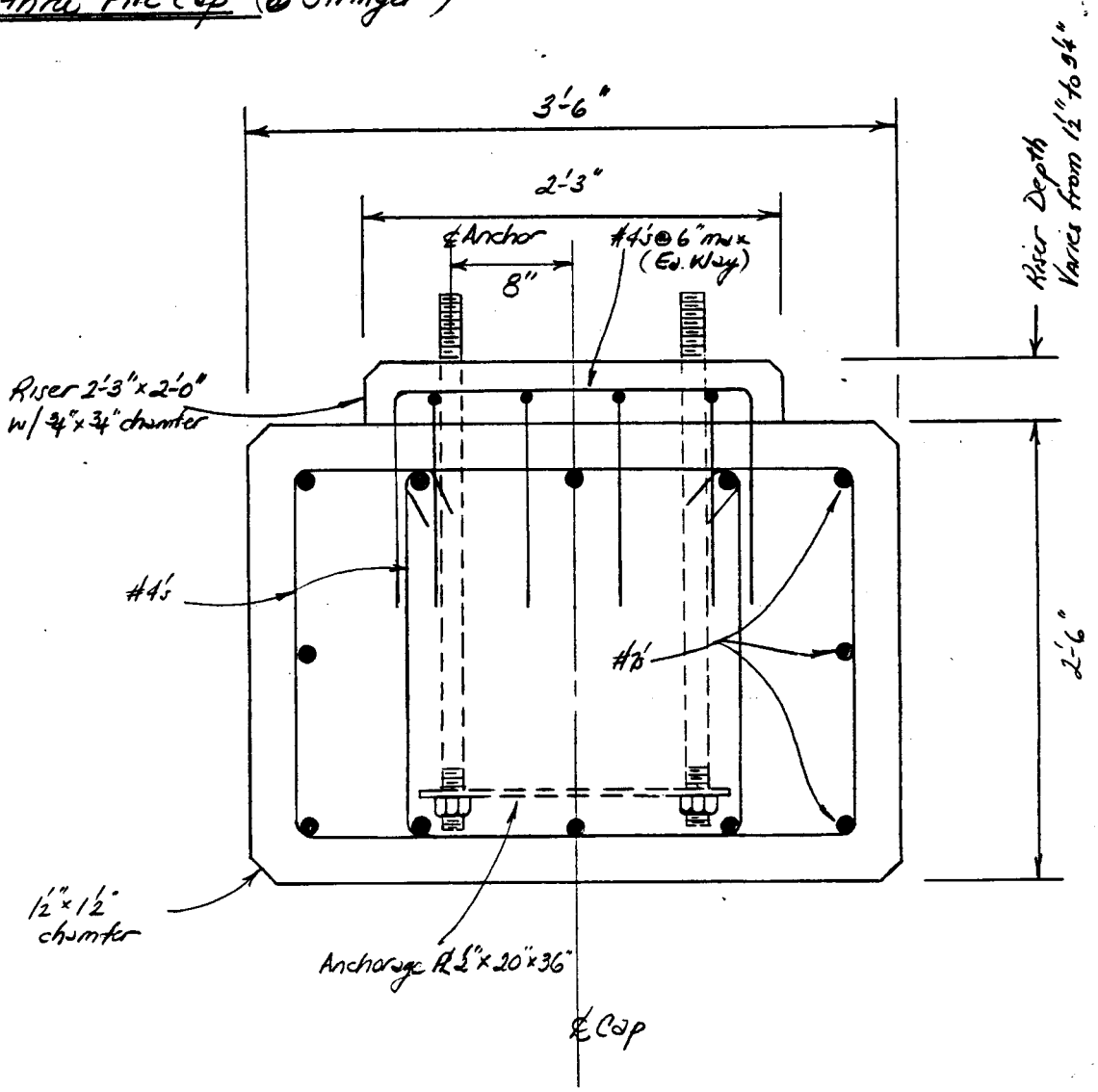
Section Thru Pile Cap (@ Stringer)



(Scale 1"=1'-0")

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Project 17th St. Canal
Subject Veterans Hwy Bridge
Deck & Substructure Replacement

Made by GPT 25/14/86 Date
Checked by _____ Date
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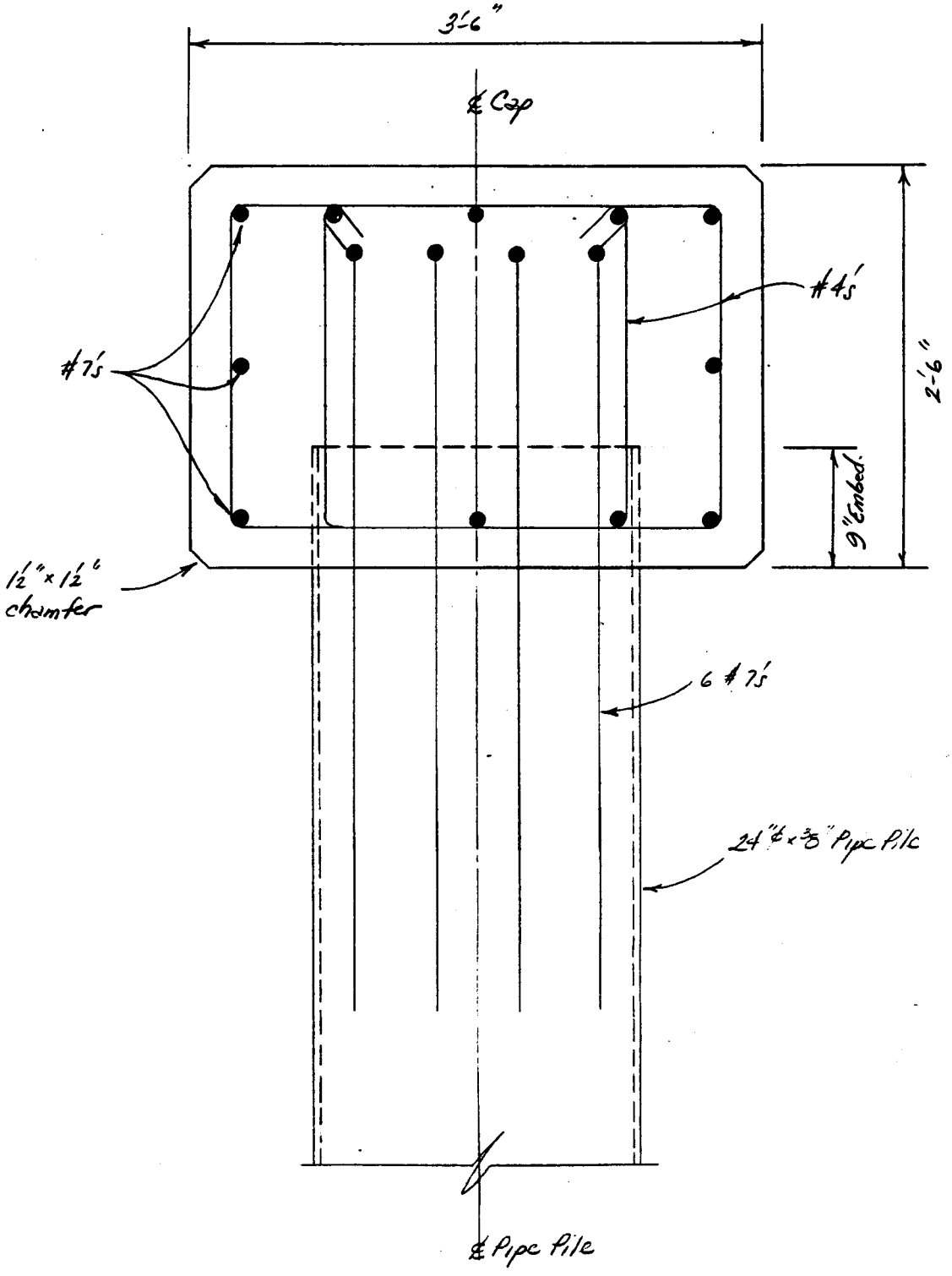
Section thru Pile Cap (6 Pile)



(Scale 1" = 1'-0")

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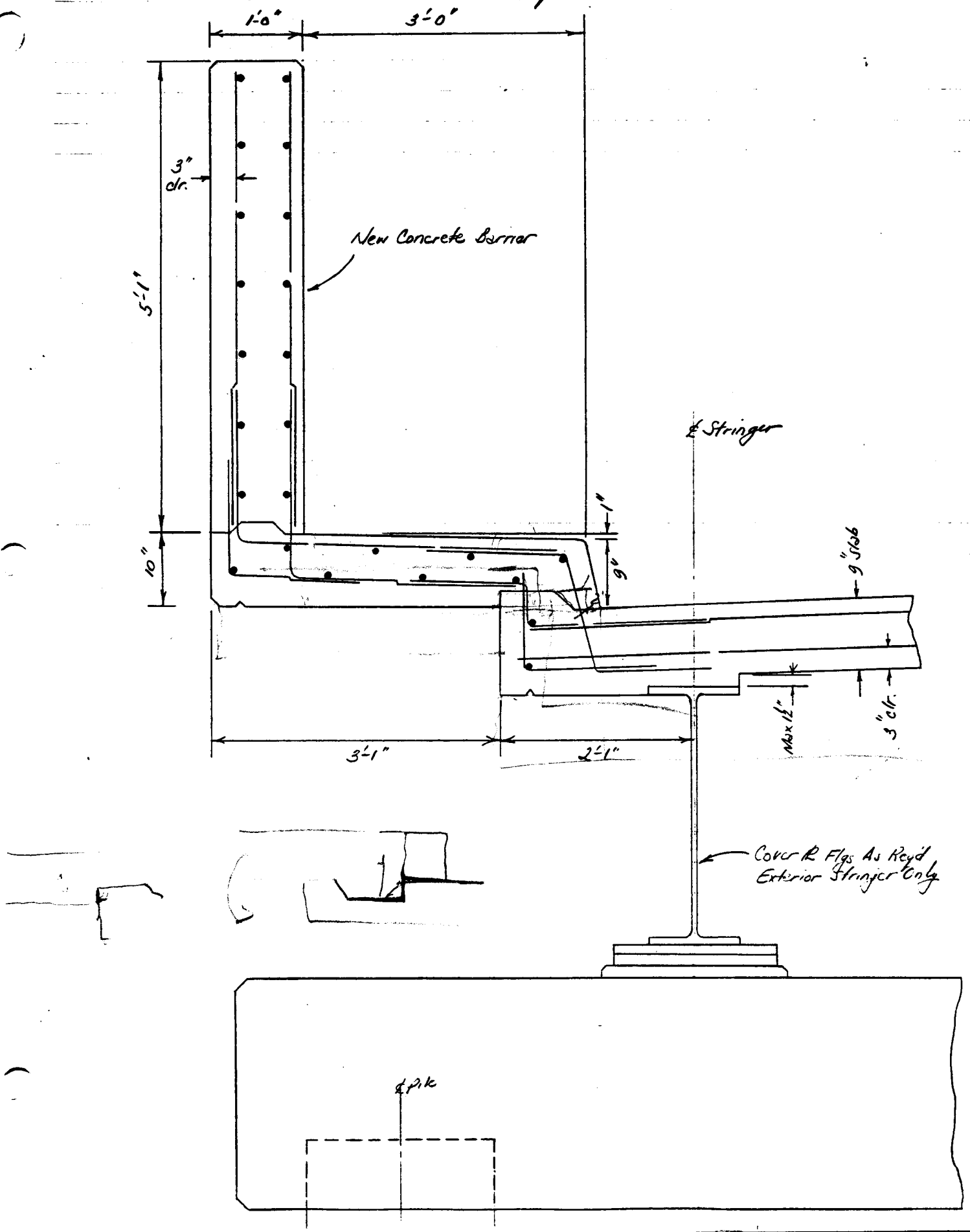
Project 17th St. Canal

Subject Veterans Hwy Bridge
Deck & Substructure Replacement

Made by GPT 25JUL86 Date

Checked by _____ Date

Sheet No. _____ of _____



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Project Veterans Hwy. Bridge Replacement
Subject 17th St. Canal
Cost Estimate

Made by GPT 24JUL86 (Date)
Checked by _____ (Date)
Sheet No. _____ of _____

	UNIT	QUANTITY	UNIT COST	COST
Superstructure Concrete	CY	680	300.00	$ 204,000.00
Substructure Concrete	CY	298	250.00	74,500.00
Reinforcing Bars	LB	207,060	0.40	82,824.00
Structural Steel (A36)	LB	25,561	3.00	76,683.00
Steel Pipe Pile (24"ϕ)	LF	10,272	125.00	1,284,000.00
Waterstop	LF	708	7.00	4,956.00
Compression Jt. Seal	LF	568	15.00	8,520.00
Remove Old Barrier & Slab	SYD	2,679	175.00	468,825.00
Remove & Re-install Exist. Stringers Modify Exist. Sole Pls	EA.	1	65,000.00	$ 65,000.00
				$ 2,269,308.00
			15% Contingencies	340,396.00
				$ 2,609,704.00

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Project Veterans Bridge Replacement
Subject 17th St. Canal
Quantities

Made by GPT 23 JUL 86 (Date)
Checked by _____ (Date)
Sheet No. _____ of _____

Concrete,

Slab, $9/12\,(47.33')(226.0')(2\text{ bridges}) = 16{,}045.9\text{ ft}^3 = 594.3\text{ cy}$
Barrier, $(5.08')(1')(226.0')(2\text{ bridges}) = 2{,}296.1 = 85.0$
Pile Cap, $2.5'(3.5')(48.0')(6)(2\text{ bridges}) = 5{,}040.0 = 186.7$
Pile Fill, $\pi/4\,(23.25''/12)^2(10.0')(8)(6)(2) = 2{,}830.4 = 104.8$
Risers, $(2.0' \times 3.0')(7.625''/2)(7)(6)(2)/12 = 160.1 = 5.9$
$976.7 \approx 977\text{ cy}$

revised in calcs - difference should be less than 10%

Rebar,

Slab #6 @ 6½ / #4 @ 6½: $(75+84+107+75+84)(47')(1.502\#/')(2)(2) = 120{,}010\#$
$88\,(226')(0.668\#/')(2)(2) = 53{,}141$
Pile Cap long.: $12(6)(2)(47.67')(2.044\#/') = 14{,}031$
stirrups: $2(2.0'+3.0')(2)(7\times7+2\times2)(6)(2)(0.668\#/') = 8{,}497$
Pile Anchors: $5(8)(6)(2)(6.0')(2.044) = 5{,}887$
Risers: $7(6)(2)(4')(2)(0.668\#/') = 449$
Spirals in piles: $(25\text{ turns})(\pi/4)(1.6')^2(0.167\#/')(8)(6)(2) = 806$
Barrier Rail: $[(8.0')(227) + 6(226')](2)(0.668) = 4{,}238$
$207{,}059\#$

Structural Steel

Anchor Bolts: $(27'' + 7.625''/2 + 1.06''\text{ (Hg)} + 0.5''\text{ (pad)} + 3'')(1.77\text{in}^2)(2)(10)(490/1728) = 355\#$ (490 lb/cy grout)
Anchorage R: $(36'' \times 36' \times 0.5'')(7)(6)(2)(490/1728) = 15435$
(Joint Armor) Comp. Dams: $[(5''\times2'')(40') + 0.31\text{in}^2(0.67')(41)](6)(2)(2)(3.4028) = 8{,}862$
$(0.25''\times0.25'')(40')(6)(2)(2)(3.4028) = 204$
shear studs: $0.44\text{in}^2(6'')(3)[(28\times4)+(31\times4)_{3rd}+(39\times2)](490/1728) = 705$
$25{,}561\#$

Steel Pipe Pile (24" ϕ x ⅜")

8 piles (6 bents)(2 bridges)(85.5 + 29.17' − 0.75' − 2.75' − 2.5' + 0.75' − 2.43') = 10,272 lin ft
(penetration; top of slab; slab; stringer; pile cap; pile cap embed; ground el. conv. datum; 107')

Waterstop

Perimeter = [40.0' + 0.75'(2) + 4.17' + 3.17' + 5.08'(2)](6)(2) = 708 lin ft

Compression H. Seal

Perimeter = 47.33'(6)(2) = 568.0 lin. ft

MODJESKI & MASTERS
-ENGINEERS

Project Veterans Bridge Replacement
Subject Design of Slab System using existing Stringers

Made by GPT 21JUL86 Date
Checked by _____ Date
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Exist. stringer spacing 6'-3" ← actual stringer spacing is 6'-4" - say o.k. W33x130 & 152 have 11½" Flg widths

Spacing for slab design (AASHTO 3.24.1.2) = 6.25'(12") - 11.5"/2 = 69.25" = 5.77'

From Bridge Design Manual 7" slab is min. t use 9" slab to have 3" min cover on bottom steel

Case I - (DC + LL + I)

DC

Slab, (9/12)(0.15 kcf) = 0.1125 k/l.
F.W.S., 12 psf = 0.012 k/l.
0.125 k/l. ✓

DLM $+M_{DC} = \frac{1}{12}wl^2 = \frac{1}{12}(0.125^{k/l})(5.77')^2$
$= 0.347^{k/l}$
$-M_{DC} = \frac{1}{9}wl^2 = \frac{1}{9}(0.125^{k/l})(5.77')^2$
$= 0.462^{k/l}$ ✓

LL (HS20-44)

$\pm M_{LL} = [(S+2)(P_{20})/32](0.9)(0.8)$ ← 3 lanes, ← continuity

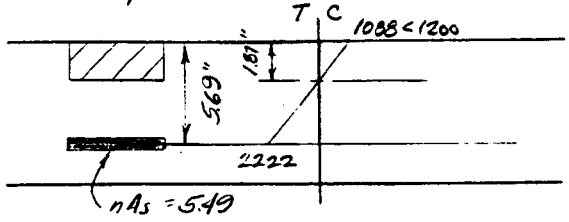
$= [(5.77+2)(16)/32](0.72) = 2.8^{k/l}$ ✓

$\pm M_{LL+I} = 2.8^{k/l}[1 + 50/(5.77+125)] = 2.8(1.30\ max) = 3.64^{k/l}$ ✓

$+M_{TL} = 3.64^{k/l} + 0.35^{k/l} = 3.99^{k/l}$
$-M_{TL} = 3.64 + 0.46^{k/l} = 4.10^{k/l}$
} use $4.10^{k/l}$ for neg & pos moment ←

Try 9" slab #5 @ 6" ← ⊥ to traffic top + bottom $\pm A_s = 0.61\ in^2$ $\pm d = 9" - 3" - \frac{1}{2}(0.625) = 5.69"$

$f'_c = 3200$ psi $n = 9.0$ $f_c = 1.2$ ksi (LADOTD)



compression block
$12x^2/2 = 5.49(5.69" - x)$
$6x^2 - 5.49x + 31.24$
$x^2 + 0.915x - 5.21 = 0$

$x = 1.87"$

$C_1 = \frac{1}{2}(1.088)(12)(1.87) = 12.27^k$
$T = 20 ksi(0.61 in^2) = 12.20^k$

allow $M = 12.26^k(5.69" - 1.87"/3) = 61.8^{"k} = 5.15^{'k} > 4.10^{'k}$ ok ✓

Case II - DC + Uplift

Head difference at bottom of 9" slab = 35.0' - 29.17' + 0.75' = 6.58' of water

pressure = 6.58'(0.0624 pcf) = 411 psf

net pressure = Uplift - DC slab = (411 - 125) psf = 286 #/'

$+M = \frac{1}{12}wl^2 = \frac{1}{12}(0.286)(5.77')^2 = 0.79^{k/'}$
$-M = \frac{1}{9}wl^2 = \frac{1}{9}(0.286)(5.77')^2 = 1.06^{k/'}$
} both < 4.10 k/' 9" slab ok

Use 9" slab w/ #5 bars @ 6" trussed & straight as per LADOTD

Distribution Steel, (parallel to traffic) % of main rebar = $220/\sqrt{S} = 220/\sqrt{5.77} = 91.6\% > 67\%$

$0.61 in^2(0.67) = 0.41 in^2/ft$ #4's @ 5½" $A_s = 0.43 in^2$

Use #4 bars @ 5½" top & bottom as distribution steel
(reduce distribution by 50% in outer quarter of span)

Shear studs (Slab to stringer) AASHTO 10.38.5 (pgs 147-149)

Water displaced under rdwy = (35 - 29.17 + 0.75)(47.33')(0.0624) = 19.43 k/' of length

Uplift Force per stringer 19.43 k/'(8.292'/47.33') = 3.40 k/'

DC of Barrier + Slab/stringer = (0.765 k/' + 0.25 k/') = 0.95 k/'

Net Uplift = 3.4 - 0.95 = 2.45 k/'

Max V from Beam = 68 k (W33x152 - 57' span)
from stringer rating

Statical Moment of Slab, $Q = Ay = 75.0 in^2\left(4.5" + \frac{33.49"}{2} - 30.06\right) = 595 in^3$
$I_{COMPOSITE} = 21,300 in^4$

Horizontal Shear Range, $S_R = VQ/I = 68^k(595 in^3)/21,300 in^4 = 1.9^{k/"}$

Allowable range of horizontal shear for studs $Z_r = \alpha d^2$ $\alpha = 7,860$ $d = 0.75" = \text{stud } \phi$

Stress category B cycles 500,000, (ADTT) < 2500 $= 10,600(0.75")^2 = 5,963\# \approx 5.96^k/\text{stud}$

Max $V_{cc} = 35.16^k$ at $L = 0$

Max range of horizontal shear $= 1.9^{k/in}(35.16^k/68") = 0.98^{k/in}$

Req'd pitch $= 5.96^k(2 \text{ studs})/0.98^{k/in} = 12.2"$ 3 studs yield pitch of 18.24"

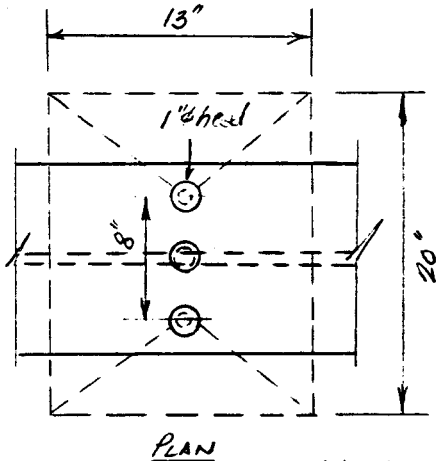
at $L = 0.25$ of span $V_{cc} = 25.62^k$ Max Range of horz. shear $= 1.9(25.62^k/68") = 0.716^{k/in}$

Req'd pitch $= 5.96(3 \text{ studs})/0.716^{k/in} = 24.97"$

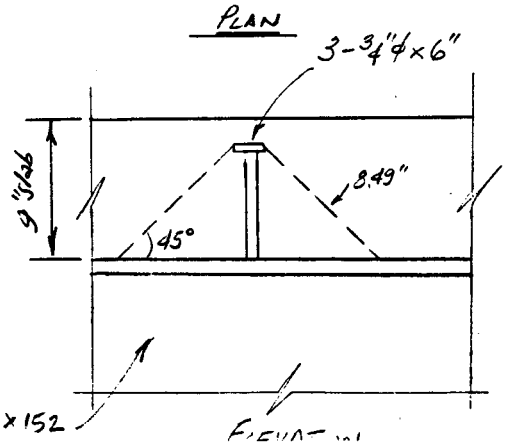
Use 3-$\frac{3}{4}$"ϕ Studs @ 18" (6" long)

Check the studs for the uplift case.

Net Uplift $= 2.45^{k/ft}$



PLAN



Surface area of shear failure (pullout)

$A = 2[(20"+8")(8.49")/2 + (13"+1")(8.49")/2]$

$A = 356.6 \text{ in}^2$

Allowable $v_c = 0.95\sqrt{f'_c} = 0.95\sqrt{3200 \text{ psi}} = 53.74 \text{ psi}$

Shear capacity $= 53.74 \text{ psi}(356.6 \text{ in}^2)/1000 = 19.16^k$

Net uplift over 18" $= 2.45(1.5') = 3.68^k$

Check the studs for ultimate strength

$N = P/\phi S_u$

$S_u = 0.4d^2\sqrt{f'_c E_c}$

$0.4(0.75")^2(3200)^{\frac{1}{2}}(3{,}429{,}461\ psi)^{\frac{1}{2}}$

$E_c = w^{1.5}(33)\sqrt{f'_c}$

$= (150)^{1.5}(33)\sqrt{3200}$

$E_c = 3{,}429{,}461\ psi$

$S_u = 23{,}570.6\ \#/stud = 23.57\ ^k/stud$

$P = A_s f_y$ or $0.85 f'_c b_c$

W33×152 $A_s = 44.7\ in^2$ $\quad P = 44.7\ in^2(36.0\ ksi) = 1{,}609.2^k$

$P = 0.85(3.2\ ksi)(6.25" \times 12)(9") = 1{,}836.0^k$

use the smaller P

$N = 1{,}609.2^k / 0.85(23.57^k/stud) = 80.3$ studs

$80.3/3 = 26.8 \approx 27$ spaces

$27 @ 18" = 40.5' < 57.0'$ o.k. Use 18" spacing

Check shear on pin of suspended span

DL	33.62^k	
LL	35.16(0.9)	= 31.64^k
I	35.16(0.2208)(0.9)	= 6.99^k
TL	72.25^k	

$f_v = 72.25^k / (\pi/4)(3")^2 = 10.22\ ksi < 13.0\ ksi$ (Rating A

Uplift from water at el 35.0 $\quad$ DL per girder = $0.703^{k/'} + 0.25^{k/'} + 0.152^{k/'} = 1.105^{k/'}$

$= 3.40^{k/'}$/stringer (exterior only); interior $= 2.57^{k/'}$

Net Uplift $= 3.40^{k/'} - 1.105^{k/'} = 2.295^{k/'}$

(ext.) Max Net Uplift on Pin $= 2.295^{k/'}(57/2) = 65.41^k/pin < 72.25^k$

(int.) " " " " " $= (2.57^{k/'} - 1.105^{k/'})(57/2) = 41.75^k/pin < 72.25^k$

MODJESKI & MASTERS
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Project Veterans Bridge Replacement
Subject Rating of Existing Stringers

Made by GPT 22JUL86 Date
Checked by _____ Date
Sheet No. _____ of _____

Case I DL+LL+I (input for beam x continuous girder program)

DL (44'-6" Span) — actual stringer bearing is 6'-4" say O.K. (48'-4" Span)

Slab,	$(9"/12")(0.15 kcf)(6.25')$ =	0.703 k/l.		0.703 k/l.
F.W.S.	$12 psf (6.25')$ =	0.075		0.075
Barrier	$[5.833' \times 1' \times 0.15 kcf](2/7)$	0.250		0.250
Stringer	W33×130	0.130	W33×152	0.152
		1.16 k/l.		1.18 k/l.

Non-Composite Section Properties

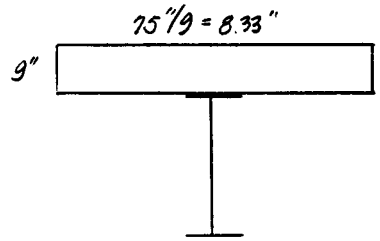
	W33×130	W33×152
A	38.3 in²	44.7 in²
I	6,710 in⁴	8,160 in⁴
S	406 in³	487 in³
d	33.09"	33.49"

Composite Properties

Effective Flg Width

$\frac{1}{4}(44.5') = 11.125'$	$\frac{1}{4}(48.33') = 12.08'$
6.25' ←	6.25' ←
$12(9") = 9'$	9'

$n = 9"$



W33×130

	A (in²)	y (in)	Ay (in³)	Ay² (in⁴)	I_o (in⁴)
8.33"×9"	75.0	37.59	2,819.3	105,975.6	506.3
W33×130	38.3	16.55	633.9	10,490.5	6,710.0
	113.3		3,453.2	116,466.1	7,216.3

$\bar{y} = 3453.2/113.3 = 30.48"$

$I = 7,216.3 + 116,466.1 - 30.48(3453.2) = \underline{18,434 in^4}$

W33×152

	A	y	Ay	Ay²	I_o
8.33×9	75.0	37.99	2,849.3	108,243.0	506.3
W33×152	44.7	16.75	748.7	12,541.1	8,160.0
	119.7		3,598.0	120,784.0	8,666.3

$\bar{y} = 3598.0/119.7 = 30.06"$

$I = 8,666.3 + 120,784.0 - 30.06(3598) = \underline{21,300 in^4}$

$n = 30$

W33×130 $\bar{y} = 1479.7/60.8 = 24.34"$

$I = 42,283.2 + 6861.9 - 24.34(1479.7) = \underline{13,133 in^4}$

W33×152 $\bar{y} = 1603.5/67.2 = 23.86"$

$I = 45,014.0 + 8311.9 - 23.86(1603.5) = \underline{15,064 in^4}$

LL

Wheel load = $S/5.5 = 6.25/5.5 = 1.14$ wheels $= 0.57$ lanes

17TH STREET CANAL - VETERANS HIGHWAY BRIDGE FILENAME: VETNEW
RATING OF AS BUILT STRINGERS W/ NEW 9" SLAB
52'-57.67-44.5' CONTINUOUS SPAN W/ HINGES 4.33' INTO 57.67' SPAN

NUMBER OF SPANS - 2 HS20TRUCK SPECIFIED

	LENGTH FT	DEAD LOADS (KIPS/LF) DL 1 LEFT	DL 1 RIGHT	DL 2 LEFT	DL 2 RIGHT	LANE FACTOR LEFT	LANE FACTOR RIGHT
1	44.5000	.1300	.1300	.7030	.7030	.5700	.5700
2	52.6700	.1520	.1520	.7030	.7030	.5700	.5700

	DL3 LEFT	DL3 RIGHT	DL4 LEFT	DL4 RIGHT
1	.2500	.2500	.0750	.0750
2	.2500	.2500	.0750	.0750

DEAD LOAD CONTINUITY FACTORS 0. 0. 0. 0.

INERTIA DATA FOR SPAN 1 OF 2
NO HINGE IN SPAN 1

I(L)	DIST	I(R)
.00	.000	6710.00
6710.00	44.500	8160.00

INERTIA DATA FOR SPAN 2 OF 2
HINGE DIST FROM LEFT END 4.3300

I(L)	DIST	I(R)
6710.00	.000	8160.00
8160.00	52.670	.00

INERTIA DATA FOR SPAN 1 OF 2
NO HINGE IN SPAN 1

I(L)	DIST	I(R)
.00	.000	13133.00
13133.00	44.500	15064.00

INERTIA DATA FOR SPAN 2 OF 2
HINGE DIST FROM LEFT END 4.3300

I(L)	DIST	I(R)
13133.00	.000	15064.00
15064.00	52.670	.00

INERTIA DATA FOR SPAN 1 OF 2
NO HINGE IN SPAN 1

I(L)	DIST	I(R)
.00	.000	16434.00
16434.00	44.500	21300.00

INERTIA DATA FOR SPAN 2 OF 2
HINGE DIST FROM LEFT END 4.3300

I(L)	DIST	I(R)

21300.00 32.870 .00

07-22-86
14:03:53

MODJESKI AND MASTERS, ENGINEERS
HARRISBURG, PENNSYLVANIA 17105

17TH STREET CANAL - VETERANS HIGHWAY BRIDGE
RATING OF AS BUILT STRINGERS W/ NEW 9" SLAB
44.5'-57.0'-44.5' CONTINUOUS SPAN W/ HINGES 4.33' INTO 57.0' SPAN

C O N T I N U O U S B E A M S T R E S S E S
S P A N 1 O F 2 (BEAMX)

M O M E N T S

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0
DL1 steel	0	10	17	22	24	24	21	15	7	-4	-17
DL2 slab	0	55	95	122	135	134	119	90	47	-9	-80
DL3 Barrier	0	19	34	43	48	48	42	32	17	-3	-28
DL4 Fwds	0	6	10	13	14	14	13	10	5	-1	-9
L-MAX	0	126	218	269	298	297	298	269	218	126	0
L-MIN	0	-14	-28	-42	-56	-70	-84	-98	-112	-126	-140
TRUCK	0	126	218	269	298	297	298	269	218	126	0
TRUCK	0	-14	-28	-42	-56	-70	-84	-98	-112	-126	-140
LANE	0	74	131	172	198	204	198	172	131	74	0
LANE	0	-9	-17	-26	-34	-43	-51	-60	-68	-77	-85

S H E A R

	.0	.2	.4	.6	.8	1.0
DL1	2.50	1.35	.19	-.97	-2.12	-3.28
DL2	13.85	7.59	1.33	-4.92	-11.18	-17.44
DL3	4.92	2.70	.47	-1.75	-3.98	-6.20
DL4	1.48	.81	.14	-.53	-1.19	-1.86
L-MAX	32.43	24.22	16.00	8.46	3.29	.00
L-MIN	-3.14	-4.22	-8.97	-16.15	-24.22	-32.43
TRUCK	32.43	24.22	16.00	8.46	2.33	.00
TRUCK	-3.14	-3.65	-8.97	-16.15	-24.22	-32.43
LANE	22.94	17.00	11.81	7.23	3.29	.00
LANE	-2.35	-4.22	-8.16	-12.75	-17.98	-23.87

R E A C T I O N S

	LEFT	RIGHT
DL1	2.50	7.61
DL2	13.85	37.47
DL3	4.92	13.32
DL4	1.48	4.00
L-MAX	32.43	37.74
L-MIN	-3.14	.00
TRUCK	32.43	37.74
TRUCK	-3.14	.00
LANE	22.94	30.39
LANE	-2.35	.00

SPAN 1 DATA

LENGTH OF SPAN = 44.0000 FT
DL1 = .1300 TO .1300 KIPS/LF
DL2 = .7030 TO .7030 KIPS/LF
DL3 = .2500 TO .2500 KIPS/LF
DL4 = .0750 TO .0750 KIPS/LF
LIVE LOAD = .0700 TO .0700
LANES OF HS20
NO HINGE IN SPAN

SHEAR IN KIPS, MOMENT IN KIP-FT

07-22-86
:03:33

MODJESKI AND MASTERS, ENGINEERS
HARRISBURG, PENNSYLVANIA 17105

17TH STREET CANAL - VETERANS HIGHWAY BRIDGE
RATING OF AS BUILT STRINGERS W/ NEW 9" SLAB
44.5'-57.0'-44.5' CONTINUOUS SPAN W/ HINGES 4.33' INTO 57.0' SPAN

C O N T I N U O U S B E A M S T R E S S E S
S P A N 2 O F 2 (BEAMX)

M O M E N T S

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0
DL1	-17	3	20	32	40	44	44	39	30	17	0
DL2	-80	16	92	149	186	204	202	181	140	80	0
DL3	-28	6	33	53	66	72	72	64	50	28	0
DL4	-9	2	10	16	20	22	22	19	15	9	0
L-MAX	0	30	173	268	319	341	340	311	255	151	0
L-MIN	-140	-2	-2	-2	-1	-1	-1	-1	0	0	0
TRUCK	0	30	173	268	319	341	340	311	255	151	0
TRUCK	-140	-2	-2	-2	-1	-1	-1	-1	0	0	0
LANE	0	18	103	167	209	223	227	203	157	90	0
LANE	-85	0	0	0	0	0	0	0	0	0	0

S H E A R

	.0	.2	.25	.4	.6	.8	1.0
DL1	4.33	2.73	2.33	1.13	-.47	-2.07	-3.68
DL2	20.03	12.62	10.77	5.22	-2.19	-9.59	-17.00
DL3	7.12	4.48	3.83	1.86	-.78	-3.41	-6.04
DL4	2.14	1.35	1.15	.56	-.23	-1.02	-1.81
L-MAX	35.16	27.80	25.42	18.31	10.82	3.37	.04
L-MIN	.00	-2.34	-3.59	-7.35	-15.32	-24.17	-33.12
TRUCK	35.16	27.80		18.31	10.82	3.37	.04
TRUCK	.00	-2.34		-7.35	-15.32	-24.17	-33.12
LANE	20.21	13.62		13.48	8.13	3.80	.00
LANE	.00	-2.05		-6.19	-11.17	-18.99	-23.64

R E A C T I O N S

	LEFT	RIGHT
DL1	7.81	3.88
DL2	37.47	17.00
DL3	13.32	6.04
DL4	4.00	1.81
L-MAX	37.74	33.12
L-MIN	.00	-.04
TRUCK	37.74	33.12
TRUCK	.00	-.04
LANE	30.39	23.84
LANE	.00	.00

SPAN 2 DATA

LENGTH OF SPAN - 52.8700 FT
DL1 - .1020 TO .1020 KIPS/LF
DL2 - .7030 TO .7030 KIPS/LF
DL3 - .2000 TO .2000 KIPS/LF
DL4 - .0700 TO .0700 KIPS/LF
LIVE LOAD - .0700 TO .0700
LANES OF HS20
HINGE DIST - 4.3300 FT

SHEAR IN KIPS, MOMENT IN KIP-FT

Case I - DC+CC+I

From Beamx,

44'-6" Span (W33x130)

DCM = 221 "k
CCM = 298 "k (0.9) = 268 "k ← 3 lane continuity factor
Impact % = 50/(145' + 125) = 29.5%
IM = 268(0.295) = 79 "k

57'-0" Span (W33x152)

DCM = 342 "k
CCM = 341 "k (0.9) = 307 "k
Impact % = 50/(52.67' + 125) = 28.14%
IM = 307 "k (0.2814) = 86 "k

Capacity (Composite)

$M = \sigma I/c$ ← Inventory

$M = 18\,ksi\,(18{,}434\,in^4)/30.48" = 907\,"k$

(24.5/18)(907 "k) = 1,234 "k ← Operating

$M = 18\,ksi\,(21{,}300\,in^4)/30.06" = 1{,}063\,"k$

(24.5/18)(1,063 "k) = 1,447 "k

Inventory Rating

44'-6" span

$[(907 - 221)/(268 + 79)](20) =$ **HS39.5**

57'-0" Span

$[(1{,}063 - 342)/(307 + 86)](20) =$ **HS36.7**

Operating Rating

44'-6" Span

$[(1234 - 221)/347](20) =$ **HS58.4**

57'-0" Span

$[(1{,}447 - 342)/393](20) =$ **HS56.4**

MODJESKI & MASTERS, ENGINEERS
HARRISBURG, PENNSYLVANIA 17055
DATE= 01-01-80 TIME= 00:01:10

17th Street Canal - Veterans Highway Bridge
Pile Length Determination for 24" pipe pile
Input File Name : VetPile2.prn

PILE TYPE = STEEL OR TIMBER
CIRCULAR PILE CROSS-SECTION
LIMITING ADHESION CURVE USED IN ANALYSIS

WEIGHT OF PILE INCLUDED IN ANALYSIS

PILE CROSS SECTIONAL AREA = 3.14 PILE WEIGHT/FOOT (NO BUOYANCY) = .05

PILE K = .50 FACTOR OF SAFETY = 3.00

PILE DESIGN LOAD = 55.00

NO GROUP EFFICIENCY APPLIED

GROUND ELEVATION = -18.00 +2.43 WATER TABLE ELEVATION = -3.00

STRATA ELEV	THK	GAMMA	ADJGAM	OVBURD	STRA PRES	QU	COH	CA	TAN PHEANG	FRIC	SURF-AREA	P LOAD - ULT INC	P LOAD - ULT SUM	P LOAD - DES INC	P LOAD - DES SUM
-18.0															
	5.0	.0525	.0213	.00	.11	.00	.00	.00	.577350	.02	6.28	.72	.72	.24	.24
-23.0															
	3.0	.0525	.0213	.11	.06	.00	.00	.00	.577350	.05	6.28	.90	1.62	.30	.54
-26.0															
	2.0	.0525	.0213	.17	.04	.00	.00	.00	.577350	.06	6.28	.79	2.41	.26	.80
-28.0															
	3.0	.0525	.0213	.21	.06	.00	.00	.00	.577350	.08	6.28	1.48	3.89	.49	1.30
-31.0															
	2.0	.0525	.0213	.28	.04	.00	.00	.00	.577350	.09	6.28	1.18	5.07	.39	1.69
-33.0															
	3.0	.0525	.0213	.32	.06	.00	.00	.00	.577350	.11	6.28	2.06	7.12	.69	2.37
-36.0															
	2.0	.0525	.0213	.38	.04	.00	.00	.00	.577350	.12	6.28	1.56	8.69	.52	2.90
-38.0															
	3.0	.0525	.0213	.43	.06	.00	.00	.00	.577350	.14	6.28	2.64	11.32	.88	3.77
-41.0															
	2.0	.0525	.0213	.49	.04	.00	.00	.00	.577350	.16	6.28	1.95	13.27	.65	4.42
-43.0															

STRATA ELEV	THK	GAMMA	ADJGAM	OVBURD	STRA PRES	QU	COH	CA	TAN PHEANG	FRIC	SURF-AREA	P LOAD - ULT INC	P LOAD - ULT SUM	P LOAD - DES INC	P LOAD - DES SUM
-43.0															
	3.0	.0525	.0213	.53	.06	.00	.00	.00	.577350	.17	6.28	3.22	16.49	1.07	5.50
-46.0															
	2.0	.0525	.0213	.60	.04	.00	.00	.00	.577350	.19	6.28	2.34	18.82	.78	6.27
-48.0															
	5.0	.0600	.0288	.64	.14	.69	.35	.29	.000000	.00	6.28	9.24	28.06	3.08	9.35
-53.0															
	5.0	.0600	.0288	.78	.14	.89	.45	.32	.000000	.00	6.28	10.31	38.37	3.44	12.79
-58.0															
	5.0	.0600	.0288	.93	.14	.77	.39	.32	.000000	.00	6.28	10.28	48.64	3.43	16.21
-63.0															
	5.0	.0600	.0288	1.07	.14	1.15	.58	.36	.000000	.00	6.28	11.62	60.26	3.87	20.09
-68.0															
	5.0	.0600	.0288	1.22	.14	1.74	.87	.35	.000000	.00	6.28	11.17	71.44	3.72	23.81
-73.0															
	3.0	.0600	.0288	1.36	.09	2.97	1.49	.37	.000000	.00	6.28	7.14	78.58	2.38	26.19
-76.0															
	2.0	.0525	.0213	1.45	.04	.00	.00	.00	.577350	.43	6.28	5.42	84.00	1.81	28.00
-78.0															
	3.0	.0525	.0213	1.49	.06	.00	.00	.00	.577350	.45	6.28	8.41	92.41	2.80	30.80
-81.0															
	2.0	.0525	.0213	1.55	.04	.00	.00	.00	.577350	.46	6.28	5.80	98.21	1.93	32.74
-83.0															
	5.0	.0525	.0213	1.59	.11	.00	.00	.00	.577350	.48	6.28	15.18	113.40	5.06	37.80
-88.0															
	5.0	.0525	.0213	1.70	.11	.00	.00	.00	.577350	.51	6.28	16.15	129.55	5.38	43.18
-93.0															
	57.0	.0525	.0213	1.81	1.21	.00	.00	.00	.577350	.70	6.28	252.37	381.91	84.12	127.30
-150.0															

*** END OF BORING ***

PILE DESIGN LOAD = 55.00 TONS

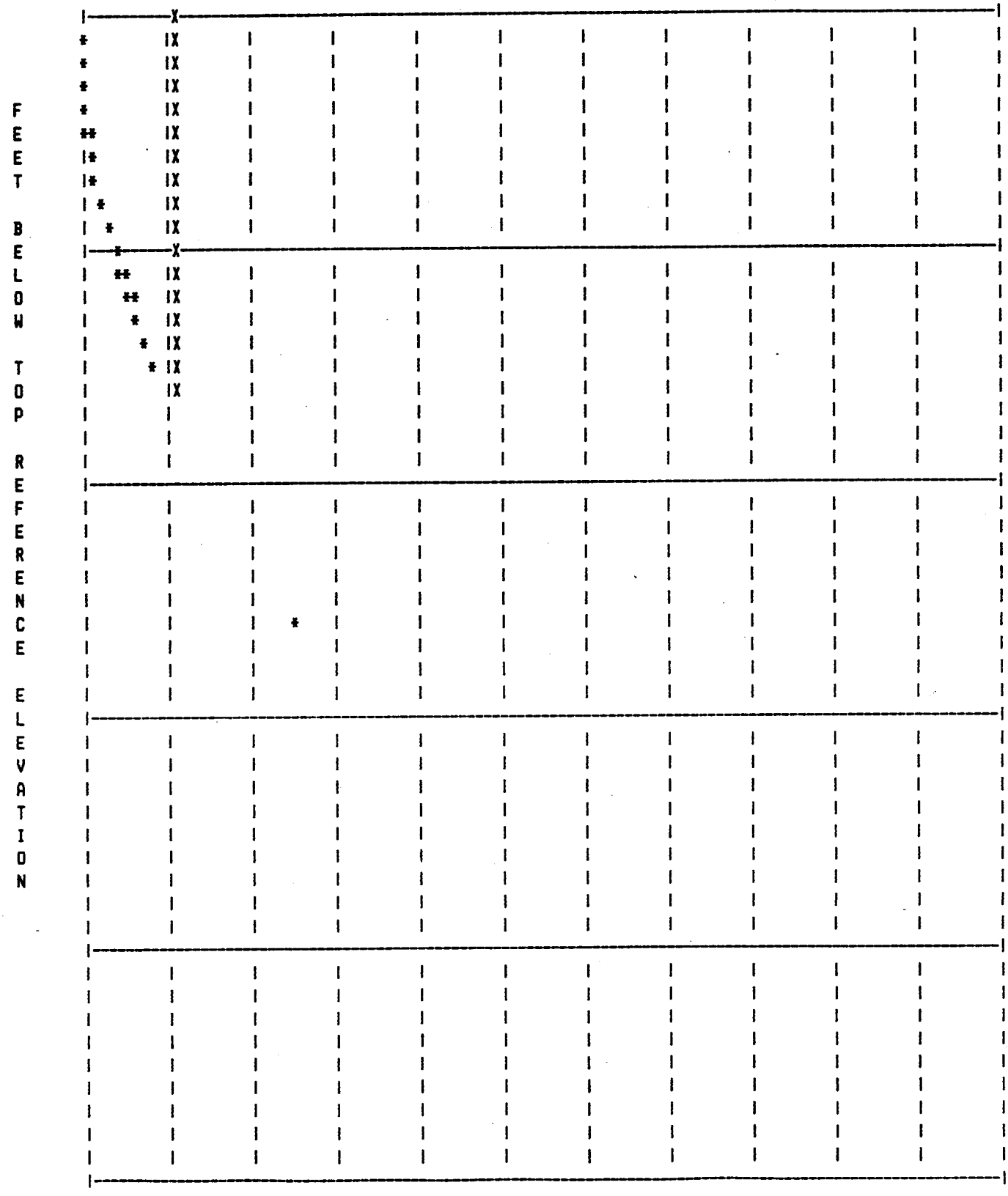
PILE DESIGN LENGTH = 85.50 FEET

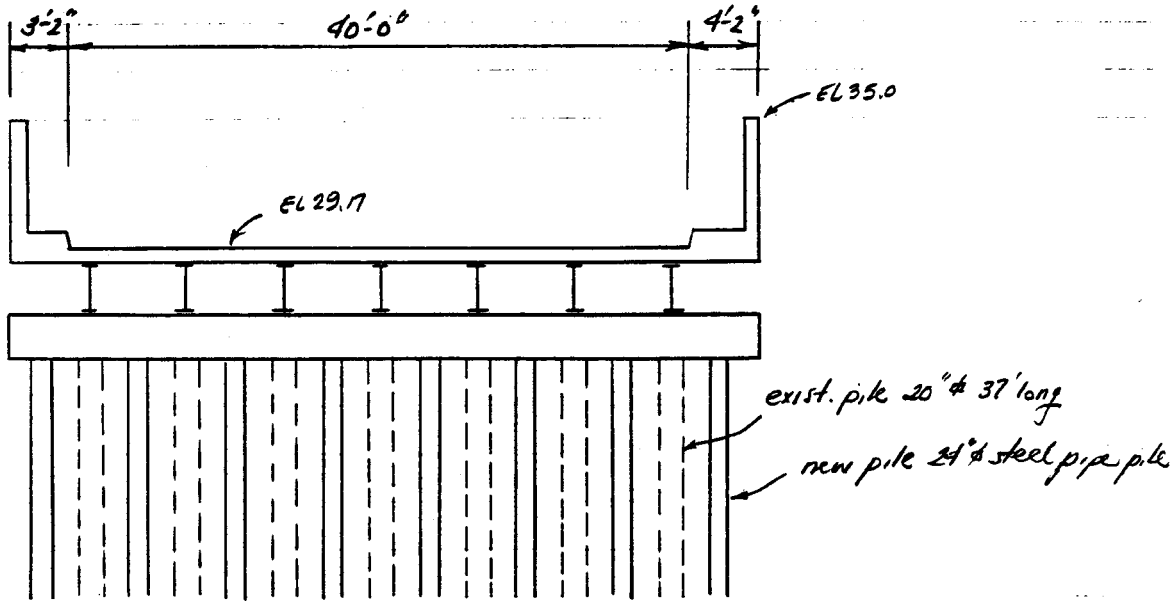
PILE TIP ELEVATION = -103.50 FEET

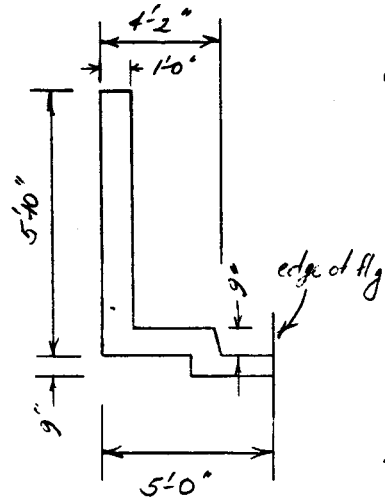
PILE DESIGN LOAD CURVE F.S. = 3.00

HORIZ. AXIS = 5.0 TONS / SPACE
VERT. AXIS = 5.0 FEET / LINE

PILE DESIGN CAPACITY (P LOAD - DES) - TONS







Check slab @ ext. stringer

DL	Barrier	(5.0' x 1.0')(0.15kcf) =	750 #/.
	Slab	0.75'(0.15kcf) =	113 #/.
			60 #/.
LL			

$M_{DL+LL} = 0.75^{k/.}(4.5') + 0.113^{k/.}(4.0')^2/2 + 3.17'(2.42')(0.06\,k/.)$

$M = 4.74^{'k/.} < 6.59^{'k}$ capacity of slab.

Design pile cap assuming exist. piles do not exist.

Max. Stringer Reaction from 41'-6" & 57'-0" span together = $62.4^{k}_{DL} + 37.74^{k}_{LL}(1.2208)_{I}(0.9)_{\text{continuity}} = 103.9^{k}$ $\left|1+\frac{50}{(125+37+45)}\right|$

Use DL of cap (2'-6" x 3'-0") = 2.5(3.0)(0.15) = 1.125 k/.

Create Stress Model of Cap using 18"ϕ steel pipe piles & new superstructure DL + LL + I

LOADING 3 - UPLIFT AND TRANSVERSE LOAD (WATER @ EL 14.5)

MEMBER FORCES

MBR	JOINT	AXIAL FORCE	SHEAR FORCE	BENDING MOMENT
1	1 S	-58.7977	3.9737	92.3889
1	2	58.7977	-3.9737	.0000
2	2	27.7363	-58.7977	.0000
2	4	-27.7363	-64.8023	18.7646
3	3 S	-116.8448	3.9697	92.2962
3	4	116.8448	-3.9697	.0000
4	4	23.7666	-52.0424	-18.7646
4	6	-23.7666	-71.5576	79.7495
5	5 S	-129.5113	3.9663	92.2167
5	6	129.5113	-3.9663	.0000
6	6	19.8002	-57.9537	-79.7495
6	8	-19.8002	-65.6463	103.7889
7	7 S	-127.4463	3.9635	92.1505
7	8	127.4463	-3.9635	.0000
8	8	15.8368	-61.8000	-103.7889
8	10	-15.8368	-61.8000	103.7889
9	9 S	-127.4463	3.9612	92.0976
9	10	127.4463	-3.9612	.0000
10	10	11.8756	-65.6463	-103.7889
10	12	-11.8756	-57.9537	79.7495
11	11 S	-129.5113	3.9595	92.0579
11	12	129.5113	-3.9595	.0000
12	12	7.9161	-71.5576	-79.7495
12	14	-7.9161	-52.0424	18.7646
13	13 S	-116.8448	3.9583	92.0314
13	14	116.8448	-3.9583	.0000
14	14	3.9578	-64.8023	-18.7646
14	16	-3.9578	-58.7977	.0000
15	15 S	-58.7977	3.9578	92.0182
15	16	58.7977	-3.9578	.0000

LOADING 3 - UPLIFT AND TRANSVERSE LOAD (WATER @ EL 14.5)

APPLIED JOINT LOADS, ALL JOINTS

JOINT	FORCE-X	FORCE-Y	MOMENT-Z
1 S	.0000	.0000	.0000
2	31.7100	.0000	.0000
3 S	.0000	.0000	.0000
4	.0000	.0000	.0000
5 S	.0000	.0000	.0000
6	.0000	.0000	.0000
7 S	.0000	.0000	.0000
8	.0000	.0000	.0000
9 S	.0000	.0000	.0000
10	.0000	.0000	.0000
11 S	.0000	.0000	.0000
12	.0000	.0000	.0000
13 S	.0000	.0000	.0000
14	.0000	.0000	.0000
15 S	.0000	.0000	.0000
16	.0000	.0000	.0000

LOADING 3 - UPLIFT AND TRANSVERSE LOAD (WATER @ EL 14.5)

REACTIONS ON SUPPORT JOINTS DUE TO INTERNAL AND EXTERNAL LOADS

JOINT	FORCE-X	FORCE-Y	MOMENT-Z
1 S	-3.9737	-58.7977	92.3889
3 S	-3.9697	-116.8448	92.2962
5 S	-3.9663	-129.5113	92.2167
7 S	-3.9635	-127.4463	92.1505
9 S	-3.9612	-127.4463	92.0976
11 S	-3.9595	-129.5113	92.0579
13 S	-3.9583	-116.8448	92.0314
15 S	-3.9578	-58.7977	92.0182

LOADING 3 - UPLIFT AND TRANSVERSE LOAD (WATER @ EL 14.5)

JOINT DISPLACEMENTS

JOINT	DISPL. X	DISPL. Y	ROTATION
1 S	.00000000	.00000000	.00000000
2	.04254460	.00169352	.00040096
3 S	.00000000	.00000000	.00000000
4	.04250190	.00336542	.00014330
5 S	.00000000	.00000000	.00000000
6	.04246531	.00373025	.00000349
7 S	.00000000	.00000000	.00000000
8	.04243483	.00367078	-.00001068
9 S	.00000000	.00000000	.00000000
10	.04241045	.00367078	.00001068
11 S	.00000000	.00000000	.00000000
12	.04239217	.00373025	-.00000349
13 S	.00000000	.00000000	.00000000
14	.04237998	.00336542	-.00014330
15 S	.00000000	.00000000	.00000000
16	.04237389	.00169352	-.00040096

LOADING 4 - (DL + LL + I) (HS20-44)

MEMBER FORCES

MBR	JOINT		AXIAL FORCE	SHEAR FORCE	BENDING MOMENT
1	1	S	53.5815	.0000	.0000
1	2		-53.5815	.0000	.0000
2	2		.0000	53.5815	.0000
2	4		.0000	58.5247	-15.4476
3	3	S	105.8285	.0000	.0000
3	4		-105.8285	.0000	.0000
4	4		.0000	47.3038	15.4476
4	6		.0000	64.8025	-70.1310
5	5	S	117.3780	.0000	.0000
5	6		-117.3780	.0000	.0000
6	6		.0000	52.5755	70.1310
6	8		.0000	59.5307	-91.8660
7	7	S	115.5839	.0000	.0000
7	8		-115.5839	.0000	.0000
8	8		.0000	56.0531	91.8660
8	10		.0000	56.0531	-91.8660
9	9	S	115.5839	.0000	.0000
9	10		-115.5839	.0000	.0000
10	10		.0000	59.5307	91.8660
10	12		.0000	52.5755	-70.1310
11	11	S	117.3780	.0000	.0000
11	12		-117.3780	.0000	.0000
12	12		.0000	64.8025	70.1310
12	14		.0000	47.3038	-15.4476
13	13	S	105.8285	.0000	.0000
13	14		-105.8285	.0000	.0000
14	14		.0000	58.5247	15.4476
14	16		.0000	53.5815	.0000
15	15	S	53.5815	.0000	.0000
15	16		-53.5815	.0000	.0000

LOADING 4 - (DL + LL + I) (HS20-44)

APPLIED JOINT LOADS, ALL JOINTS

JOINT	FORCE-X	FORCE-Y	MOMENT-Z
1 S	.0000	.0000	.0000
2	.0000	.0000	.0000
3 S	.0000	.0000	.0000
4	.0000	.0000	.0000
5 S	.0000	.0000	.0000
6	.0000	.0000	.0000
7 S	.0000	.0000	.0000
8	.0000	.0000	.0000
9 S	.0000	.0000	.0000
10	.0000	.0000	.0000
11 S	.0000	.0000	.0000
12	.0000	.0000	.0000
13 S	.0000	.0000	.0000
14	.0000	.0000	.0000
15 S	.0000	.0000	.0000
16	.0000	.0000	.0000

LOADING 4 - (DL + LL + I) (HS20-44)

REACTIONS ON SUPPORT JOINTS DUE TO INTERNAL AND EXTERNAL LOADS

JOINT	FORCE-X	FORCE-Y	MOMENT-Z
1 S	.0000	53.5815	.0000
3 S	.0000	105.8285	.0000
5 S	.0000	117.3780	.0000
7 S	.0000	115.5839	.0000
9 S	.0000	115.5839	.0000
11 S	.0000	117.3780	.0000
13 S	.0000	105.8285	.0000
15 S	.0000	53.5815	.0000

LOADING 4 - (DL + LL + I) (HS20-44)

JOINT DISPLACEMENTS

JOINT	DISPL. X	DISPL. Y	ROTATION
1 S	.00000000	.00000000	.00000000
2	.00000000	-.00154328	-.00035943
3 S	.00000000	.00000000	.00000000
4	.00000000	-.00304813	-.00012973
5 S	.00000000	.00000000	.00000000
6	.00000000	-.00338078	-.00000366
7 S	.00000000	.00000000	.00000000
8	.00000000	-.00332911	.00000949
9 S	.00000000	.00000000	.00000000
10	.00000000	-.00332911	-.00000949
11 S	.00000000	.00000000	.00000000
12	.00000000	-.00338078	.00000366
13 S	.00000000	.00000000	.00000000
14	.00000000	-.00304813	.00012973
15 S	.00000000	.00000000	.00000000
16	.00000000	-.00154328	.00035943

LOADING 5 - (DL + UPLIFT AND TRANSVERSE LOAD) (WATER @ EL 14.5)

MEMBER FORCES

MBR	JOINT	AXIAL FORCE	SHEAR FORCE	BENDING MOMENT
1	1 S	-24.9581	3.9737	92.3889
1	2	24.9581	-3.9737	.0000
2	2	27.7363	-24.9581	.0000
2	4	-27.7363	-28.0357	9.6174
3	3 S	-50.2481	3.9697	92.2962
3	4	50.2481	-3.9697	.0000
4	4	23.7666	-22.2124	-9.6174
4	6	-23.7666	-30.7813	36.3953
5	5 S	-55.6181	3.9663	92.2167
5	6	55.6181	-3.9663	.0000
6	6	19.8002	-24.8367	-36.3953
6	8	-19.8002	-28.1570	46.7712
7	7 S	-54.6539	3.9635	92.1505
7	8	54.6539	-3.9635	.0000
8	8	15.8368	-26.4969	-46.7712
8	10	-15.8368	-26.4969	46.7712
9	9 S	-54.6539	3.9612	92.0976
9	10	54.6539	-3.9612	.0000
10	10	11.8756	-28.1570	-46.7712
10	12	-11.8756	-24.8367	36.3953
11	11 S	-55.6181	3.9595	92.0579
11	12	55.6181	-3.9595	.0000
12	12	7.9161	-30.7813	-36.3953
12	14	-7.9161	-22.2124	9.6174
13	13 S	-50.2481	3.9583	92.0314
13	14	50.2481	-3.9583	.0000
14	14	3.9578	-28.0357	-9.6174
14	16	-3.9578	-24.9581	.0000
15	15 S	-24.9581	3.9578	92.0182
15	16	24.9581	-3.9578	.0000

LOADING 5 - (DL + UPLIFT AND TRANSVERSE LOAD) (WATER @ EL 14.5)

APPLIED JOINT LOADS, ALL JOINTS

JOINT	FORCE-X	FORCE-Y	MOMENT-Z
1 S	.0000	.0000	.0000
2	31.7100	.0000	.0000
3 S	.0000	.0000	.0000
4	.0000	.0000	.0000
5 S	.0000	.0000	.0000
6	.0000	.0000	.0000
7 S	.0000	.0000	.0000
8	.0000	.0000	.0000
9 S	.0000	.0000	.0000
10	.0000	.0000	.0000
11 S	.0000	.0000	.0000
12	.0000	.0000	.0000
13 S	.0000	.0000	.0000
14	.0000	.0000	.0000
15 S	.0000	.0000	.0000
16	.0000	.0000	.0000

LOADING 5 - (DL + UPLIFT AND TRANSVERSE LOAD) (WATER @ EL 14.5)

REACTIONS ON SUPPORT JOINTS DUE TO INTERNAL AND EXTERNAL LOADS

JOINT	FORCE-X	FORCE-Y	MOMENT-Z
1 S	-3.9737	-24.9581	92.3889
3 S	-3.9697	-50.2481	92.2962
5 S	-3.9663	-55.6181	92.2167
7 S	-3.9635	-54.6539	92.1505
9 S	-3.9612	-54.6539	92.0976
11 S	-3.9595	-55.6181	92.0579
13 S	-3.9583	-50.2481	92.0314
15 S	-3.9578	-24.9581	92.0182

LOADING 5 - (DL + UPLIFT AND TRANSVERSE LOAD) (WATER @ EL 14.5)

JOINT DISPLACEMENTS

JOINT	DISPL. X	DISPL. Y	ROTATION
1 S	.00000000	.00000000	.00000000
2	.04254460	.00071886	.00017615
3 S	.00000000	.00000000	.00000000
4	.04250190	.00144727	.00006168
5 S	.00000000	.00000000	.00000000
6	.04246531	.00160194	.00000100
7 S	.00000000	.00000000	.00000000
8	.04243483	.00157417	-.00000478
9 S	.00000000	.00000000	.00000000
10	.04241045	.00157417	.00000478
11 S	.00000000	.00000000	.00000000
12	.04239217	.00160194	-.00000100
13 S	.00000000	.00000000	.00000000
14	.04237998	.00144727	-.00006168
15 S	.00000000	.00000000	.00000000
16	.04237389	.00071886	-.00017615

MODJESKI & MASTERS
· ENGINEERS

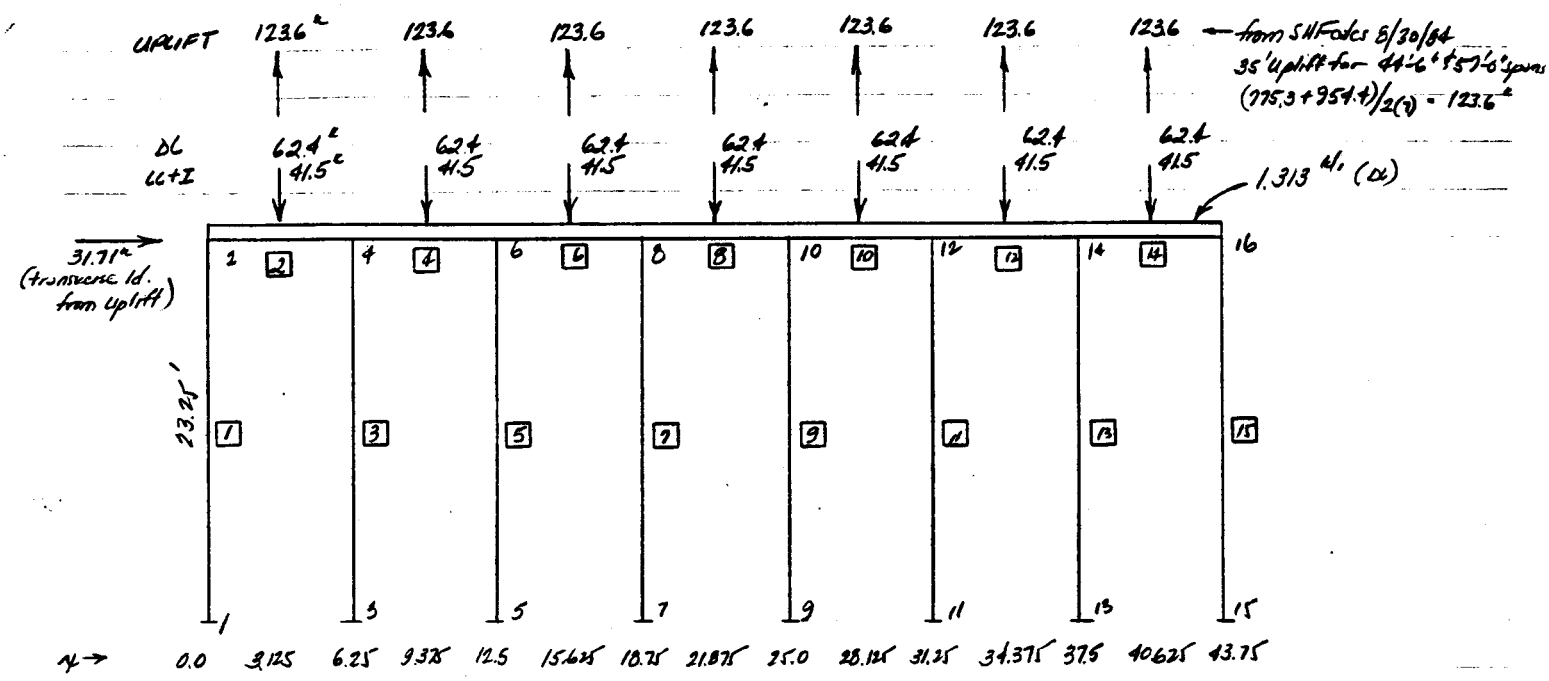
Project Veterans Bridge Replacement

Subject

Made by GPT 23 JUL 96 Date

Checked by Date

Sheet No. of



from SHFactcs 8/30/94
35' uplift for 44'-6" & 57'-6" spans
(775.3 + 954.4)/2(7) = 123.6 k

24" ϕ A = 27.83 in² = 0.1933 ft² I = 1942.28 in⁴ = 0.0937 ft⁴

cap A = 2'-6" × 3'-6" = 8.75 ft² I = 4.5573 ft²

equiv A & I for n = 9

A = 2.5 × 3.5/3 = 2.5 × 0.388 = 0.972 ft²

I = bh³/12 = 0.388 (2.5)³/12 = 0.5064 ft⁴

From Stress: VETNEW1

Max Cap Moment DL+LL+I = 92 ft-k Shear = 65 k

Max Cap Moment DL+UPLIFT = 92 ft-k Shear = 31 k

Pile embedment = 9" cover = 3" ᵗd = 30" - 5.5" = 26.5"

k = allow fc / (allow fs/n + allow fc) = 0.4(3.2 ksi) / [24/9 + 1.28 ksi] = 0.3243

j = 1 - k/3 = 1 - 0.3243/3 = 0.8919

Reqd As = M/fs j d = 92'(12) / 20(0.8919)(26.5") = 2.37 in² ← T+B w/ 1 on each side = 12

5 # 7s' = 300 in²

check stresses, n.a. 42x²/2 = 5(0.6 in²)(26.5 - x)

x² + 0.143x - 3.79 x = 1.88" arm = 26.5 - 1.88/3 = 25.87"

C = T = Mw/Arm = 92(12)/25.87" = 42.67 k

actual fs = T/As = 42.67 k/3.0 = 14.22 ksi < 20 ksi

actual fc = C/bx = 42.67 k/0.5(12)(1.88) = 1.89 ksi < 1.28 ksi

$V = 65^k$ $V_{c\ allow} = 0.9\sqrt{f'_c} = 51 psi$

$v_c = 65^k/(42" \times 26.5") = 0.0584 = 58 psi > 51 psi$ use double #4 stirrups (min)

Max pile tension (uplift) = -55^k

Anchor req'd $55^k/20 ksi = 2.75 in^2$ $5\ \#7's\ A_s = 3.00 in^2$

$l_d = 0.04(0.6)(60{,}000)/\sqrt{3200} = 25.5"$ Use 48" embed into pile and 36" into cap

Max stringer uplift = 61.2^k

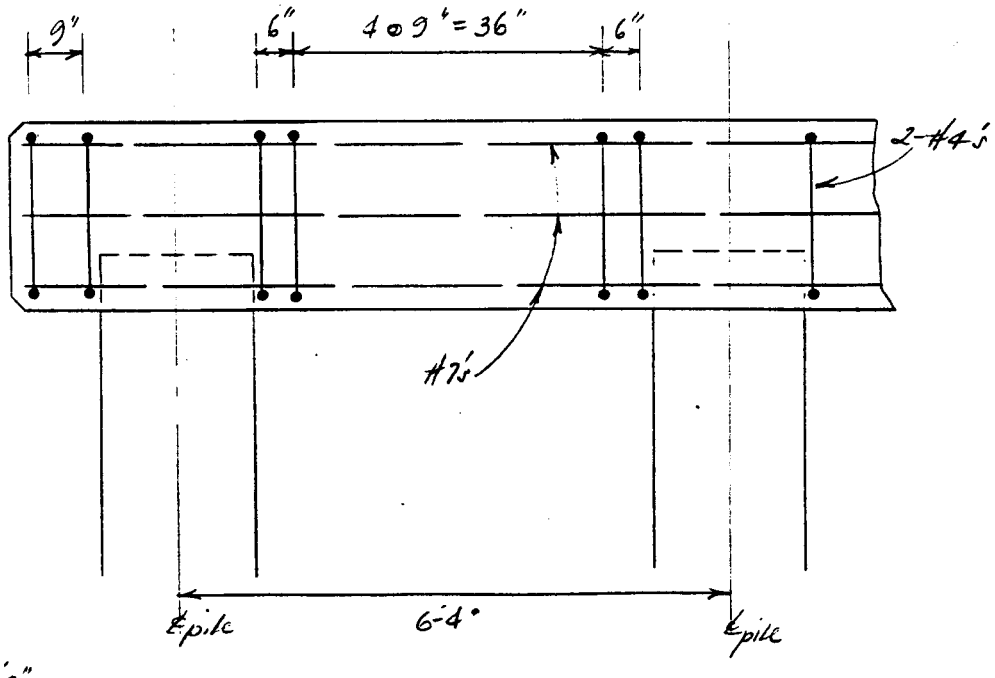
Anchor req'd = $61.2^k/20 ksi = 3.06 in^2$ $2-12"\phi$ $A_s = 2(1.77) = 3.54 in^2$

$l_d = 0.04(1.77)(36{,}000)/\sqrt{3200} = 45.06"$ Use anchorage in cap

$1.67' \times 3' \times 0.5"$ ← at d = 27", 45% of conc. engaged.

↑ penetration

Piles from VETPILE2, 8-24"ϕ pipe piles will have to be $21.5' + 85.5' = 107.0'$ in length



riser req'd min $1'-3" \times 2'-0"$

use $2'-0" \times 2'-3"$

STRUCTURE - VETERANS HIGHWAY BRIDGE - BENT DESIGN

```
    FILENAMES:  INPUT DATA     (FILE5)=B:VETNEW1.PRN
                PUNCH FILE     (FILE7)=NONE
                MEMBER FORCES  (FILE4)=NONE
                MEMBER LOADS  (FILE10)=F10.SRT
                JOINT LOADS   (FILE11)=F11.SRT
```

```
*NEW 8 - 24" PIPE PILE BENT SUPPORTING EXISTING STRINGERS AND NEW SLAB
*WATER AT ELEVATION 14.5                                  FILENAME: VETNEW1
TYPE PLANE FRAME
NUMBER OF JOINTS 16
NUMBER OF MEMBERS 15
NUMBER OF SUPPORTS 8
NUMBER OF LOADINGS 5
TABULATE ALL
JOINT COORDINATES
       1     0.00     0.00 S
       2     0.00    23.25
       3     6.25     0.00 S
       4     6.25    23.25
       5    12.50     0.00 S
       6    12.50    23.25
       7    18.75     0.00 S
       8    18.75    23.25
       9    25.00     0.00 S
      10    25.00    23.25
      11    31.25     0.00 S
      12    31.25    23.25
      13    37.50     0.00 S
      14    37.50    23.25
      15    43.75     0.00 S
      16    43.75    23.25
MEMBER INCIDENCES
       1         1         2
       2         2         4
       3         3         4
       4         4         6
       5         5         6
       6         6         8
       7         7         8
       8         8        10
       9         9        10
      10        10        12
      11        11        12
      12        12        14
      13        13        14
      14        14        16
      15        15        16
MEMBER RELEASES
       1 END MOMENT Z
       3 END MOMENT Z
       5 END MOMENT Z
       7 END MOMENT Z
       9 END MOMENT Z
      11 END MOMENT Z
      13 END MOMENT Z
      15 END MOMENT Z
MEMBER PROPERTIES PRISMATIC
```

```
       2 AX  0.9722 IZ  0.5064
       3 AX  0.1933 IZ  0.0937
       4 AX  0.9722 IZ  0.5064
       5 AX  0.1933 IZ  0.0937
       6 AX  0.9722 IZ  0.5064
       7 AX  0.1933 IZ  0.0937
       8 AX  0.9722 IZ  0.5064
       9 AX  0.1933 IZ  0.0937
      10 AX  0.9722 IZ  0.5064
      11 AX  0.1933 IZ  0.0937
      12 AX  0.9722 IZ  0.5064
      13 AX  0.1933 IZ  0.0937
      14 AX  0.9722 IZ  0.5064
      15 AX  0.1933 IZ  0.0937
CONSTANTS E 4176000.0 ALL
LOADING 1 - (DL) ONLY
MEMBER LOADS
 2 FORCE Y UNIFORM W -1.313
 4 FORCE Y UNIFORM W -1.313
 6 FORCE Y UNIFORM W -1.313
 8 FORCE Y UNIFORM W -1.313
10 FORCE Y UNIFORM W -1.313
12 FORCE Y UNIFORM W -1.313
14 FORCE Y UNIFORM W -1.313
   FORCE Y CONCENTRATED P -62.4 L 3.125
 4 FORCE Y CONCENTRATED P -62.4 L 3.125
 6 FORCE Y CONCENTRATED P -62.4 L 3.125
 8 FORCE Y CONCENTRATED P -62.4 L 3.125
10 FORCE Y CONCENTRATED P -62.4 L 3.125
12 FORCE Y CONCENTRATED P -62.4 L 3.125
14 FORCE Y CONCENTRATED P -62.4 L 3.125
LOADING 2 - (LL + I)      (HS20-44)
MEMBER LOADS
 2 FORCE Y CONCENTRATED P -41.5 L 3.125
 4 FORCE Y CONCENTRATED P -41.5 L 3.125
 6 FORCE Y CONCENTRATED P -41.5 L 3.125
 8 FORCE Y CONCENTRATED P -41.5 L 3.125
10 FORCE Y CONCENTRATED P -41.5 L 3.125
12 FORCE Y CONCENTRATED P -41.5 L 3.125
14 FORCE Y CONCENTRATED P -41.5 L 3.125
LOADING 3 - UPLIFT AND TRANSVERSE LOAD    (WATER @ EL 14.5)
JOINT LOADS
       2 FORCE X     31.71
MEMBER LOADS
 2 FORCE Y CONCENTRATED P 123.6 L 3.125
 4 FORCE Y CONCENTRATED P 123.6 L 3.125
 6 FORCE Y CONCENTRATED P 123.6 L 3.125
 8 FORCE Y CONCENTRATED P 123.6 L 3.125
10 FORCE Y CONCENTRATED P 123.6 L 3.125
   FORCE Y CONCENTRATED P 123.6 L 3.125
   FORCE Y CONCENTRATED P 123.6 L 3.125
LOADING 4 - (DL + LL + I)    (HS20-44)
COMBINE 1    1.00        2     1.00
LOADING 5 - (DL + UPLIFT AND TRANSVERSE LOAD)    (WATER @ EL 14.5)
COMBINE 1    1.00        3     1.00
SOLVE
```

* * * MEMBER GEOMETRY LISTING * * *

MEMBER NUMBER	START JOINT	END JOINT	MEMBER LENGTH	MEMBER PROJECTIONS X-AXIS	Y-AXIS	Z-AXIS
1	1	2	23.2500	.0000	23.2500	.0000
2	2	4	6.2500	6.2500	.0000	.0000
3	3	4	23.2500	.0000	23.2500	.0000
4	4	6	6.2500	6.2500	.0000	.0000
5	5	6	23.2500	.0000	23.2500	.0000
6	6	8	6.2500	6.2500	.0000	.0000
7	7	8	23.2500	.0000	23.2500	.0000
8	8	10	6.2500	6.2500	.0000	.0000
9	9	10	23.2500	.0000	23.2500	.0000
10	10	12	6.2500	6.2500	.0000	.0000
11	11	12	23.2500	.0000	23.2500	.0000
12	12	14	6.2500	6.2500	.0000	.0000
13	13	14	23.2500	.0000	23.2500	.0000
14	14	16	6.2500	6.2500	.0000	.0000
15	15	16	23.2500	.0000	23.2500	.0000

LOADING 1 - (DL) ONLY

MEMBER FORCES

MBR	JOINT		AXIAL FORCE	SHEAR FORCE	BENDING MOMENT
1	1	S	33.8396	.0000	.0000
1	2		-33.8396	.0000	.0000
2	2		.0000	33.8396	.0000
2	4		.0000	36.7667	-9.1472
3	3	S	66.5967	.0000	.0000
3	4		-66.5967	.0000	.0000
4	4		.0000	29.8300	9.1472
4	6		.0000	40.7762	-43.3542
5	5	S	73.8932	.0000	.0000
5	6		-73.8932	.0000	.0000
6	6		.0000	33.1170	43.3542
6	8		.0000	37.4893	-57.0178
7	7	S	72.7924	.0000	.0000
7	8		-72.7924	.0000	.0000
8	8		.0000	35.3031	57.0178
8	10		.0000	35.3031	-57.0178
9	9	S	72.7924	.0000	.0000
9	10		-72.7924	.0000	.0000
10	10		.0000	37.4893	57.0178
10	12		.0000	33.1170	-43.3542
11	11	S	73.8932	.0000	.0000
11	12		-73.8932	.0000	.0000
12	12		.0000	40.7762	43.3542
12	14		.0000	29.8300	-9.1472
13	13	S	66.5967	.0000	.0000
13	14		-66.5967	.0000	.0000
14	14		.0000	36.7667	9.1472
14	16		.0000	33.8396	.0000
15	15	S	33.8396	.0000	.0000
15	16		-33.8396	.0000	.0000

LOADING 1 - (DL) ONLY

APPLIED JOINT LOADS, ALL JOINTS

JOINT	FORCE-X	FORCE-Y	MOMENT-Z
1 S	.0000	.0000	.0000
2	.0000	.0000	.0000
3 S	.0000	.0000	.0000
4	.0000	.0000	.0000
5 S	.0000	.0000	.0000
6	.0000	.0000	.0000
7 S	.0000	.0000	.0000
8	.0000	.0000	.0000
9 S	.0000	.0000	.0000
10	.0000	.0000	.0000
11 S	.0000	.0000	.0000
12	.0000	.0000	.0000
13 S	.0000	.0000	.0000
14	.0000	.0000	.0000
15 S	.0000	.0000	.0000
16	.0000	.0000	.0000

LOADING 1 - (DL) ONLY

REACTIONS ON SUPPORT JOINTS DUE TO INTERNAL AND EXTERNAL LOADS

JOINT	FORCE-X	FORCE-Y	MOMENT-Z
1 S	.0000	33.8396	.0000
3 S	.0000	66.5967	.0000
5 S	.0000	73.8932	.0000
7 S	.0000	72.7924	.0000
9 S	.0000	72.7924	.0000
11 S	.0000	73.8932	.0000
13 S	.0000	66.5967	.0000
15 S	.0000	33.8396	.0000

LOADING 1 - (DL) ONLY

JOINT DISPLACEMENTS

JOINT	DISPL. X	DISPL. Y	ROTATION
1 S	.00000000	.00000000	.00000000
2	.00000000	-.00097467	-.00022481
3 S	.00000000	.00000000	.00000000
4	.00000000	-.00191815	-.00008161
5 S	.00000000	.00000000	.00000000
6	.00000000	-.00212831	-.00000249
7 S	.00000000	.00000000	.00000000
8	.00000000	-.00209661	.00000590
9 S	.00000000	.00000000	.00000000
10	.00000000	-.00209661	-.00000590
11 S	.00000000	.00000000	.00000000
12	.00000000	-.00212831	.00000249
13 S	.00000000	.00000000	.00000000
14	.00000000	-.00191815	.00008161
15 S	.00000000	.00000000	.00000000
16	.00000000	-.00097467	.00022481

LOADING 2 - (LL + I) (HS20-44)

MEMBER FORCES

MBR	JOINT		AXIAL FORCE	SHEAR FORCE	BENDING MOMENT
1	1	S	19.7419	.0000	.0000
1	2		-19.7419	.0000	.0000
2	2		.0000	19.7419	.0000
2	4		.0000	21.7581	-6.3004
3	3	S	39.2319	.0000	.0000
3	4		-39.2319	.0000	.0000
4	4		.0000	17.4738	6.3004
4	6		.0000	24.0262	-26.7767
5	5	S	43.4848	.0000	.0000
5	6		-43.4848	.0000	.0000
6	6		.0000	19.4586	26.7767
6	8		.0000	22.0414	-34.8482
7	7	S	42.7914	.0000	.0000
7	8		-42.7914	.0000	.0000
8	8		.0000	20.7500	34.8482
8	10		.0000	20.7500	-34.8482
9	9	S	42.7914	.0000	.0000
9	10		-42.7914	.0000	.0000
10	10		.0000	22.0414	34.8482
10	12		.0000	19.4586	-26.7767
11	11	S	43.4848	.0000	.0000
11	12		-43.4848	.0000	.0000
12	12		.0000	24.0262	26.7767
12	14		.0000	17.4738	-6.3004
13	13	S	39.2319	.0000	.0000
13	14		-39.2319	.0000	.0000
14	14		.0000	21.7581	6.3004
14	16		.0000	19.7419	.0000
15	15	S	19.7419	.0000	.0000
15	16		-19.7419	.0000	.0000

LOADING 2 - (LL + I) (HS20-44)

APPLIED JOINT LOADS, ALL JOINTS

JOINT	FORCE-X	FORCE-Y	MOMENT-Z
1 S	.0000	.0000	.0000
2	.0000	.0000	.0000
3 S	.0000	.0000	.0000
4	.0000	.0000	.0000
5 S	.0000	.0000	.0000
6	.0000	.0000	.0000
7 S	.0000	.0000	.0000
8	.0000	.0000	.0000
9 S	.0000	.0000	.0000
10	.0000	.0000	.0000
11 S	.0000	.0000	.0000
12	.0000	.0000	.0000
13 S	.0000	.0000	.0000
14	.0000	.0000	.0000
15 S	.0000	.0000	.0000
16	.0000	.0000	.0000

LOADING 2 - (LL + I) (HS20-44)

REACTIONS ON SUPPORT JOINTS DUE TO INTERNAL AND EXTERNAL LOADS

JOINT	FORCE-X	FORCE-Y	MOMENT-Z
1 S	.0000	19.7419	.0000
3 S	.0000	39.2319	.0000
5 S	.0000	43.4848	.0000
7 S	.0000	42.7914	.0000
9 S	.0000	42.7914	.0000
11 S	.0000	43.4848	.0000
13 S	.0000	39.2319	.0000
15 S	.0000	19.7419	.0000

LOADING 2 - (LL + I) (HS20-44)

JOINT DISPLACEMENTS

JOINT		DISPL. X	DISPL. Y	ROTATION
1	S	.00000000	.00000000	.00000000
2		.00000000	-.00056862	-.00013462
3	S	.00000000	.00000000	.00000000
4		.00000000	-.00112998	-.00004811
5	S	.00000000	.00000000	.00000000
6		.00000000	-.00125247	-.00000117
7	S	.00000000	.00000000	.00000000
8		.00000000	-.00123250	.00000359
9	S	.00000000	.00000000	.00000000
10		.00000000	-.00123250	-.00000359
11	S	.00000000	.00000000	.00000000
12		.00000000	-.00125247	.00000117
13	S	.00000000	.00000000	.00000000
14		.00000000	-.00112998	.00004811
15	S	.00000000	.00000000	.00000000
16		.00000000	-.00056862	.00013462