SETTING PILES

CRITERIA

- Use 3 setting Pads as recommended by Board
- Add sufficient ballast to assure Dead loads exceed bouyancy by 5% with water stage @ EL 3.0
- Setting piles resist wt of partially ballasted structure with water @ EL 1.0.

GATE BAY MODULE

Partial Ballasting

Reqd D.L. = 1.05 x (57 x 0.0625 x 180 x 434) = 278,300 K

WT. OF SHELL = 188,000 K

Ballast WT REQ.D = 278,300 - 188,000 = 90,300 K < 146,100 K AVAIL BALLAST WT.

NOTE: FOR INITIAL SETTING, BALLAST D-Frame to 95% needed ~~ballast~~ when water Stage @ EL 1.0 with concrete. The remaining setting ballast wt. shall be water in lock wall voids. This will permit refloating in case of poor alignment.

Setting Load = 5% EXCESS OF Bouyancy + 2' Head Drop

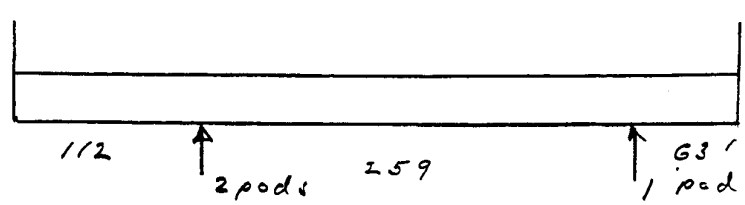
$= (57 \times 0.0625 \times 180 \times 434)\,0.05 + 2(0.0625 \times 180 \times 434)$

$= 13{,}900 + 9{,}765$

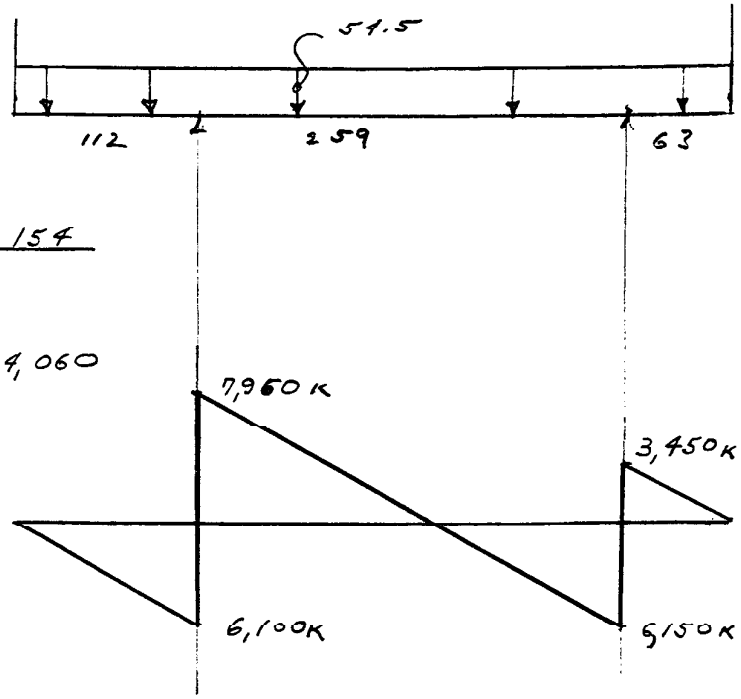
$= 23{,}670$ K

$\text{Load}/_{LF} = 23{,}670 / 434 = 54.5\ K/_{LF}$

Through iterative process, pad location with lowest moment and number of piles is shown below.



LONGITUDINAL AXIS



$R_L = \frac{434 \times 54.5 \times 154}{259}$

$= 14,060\ K$

$R_R = 23,670 - 14,060$

$= 9,610$

V

M_{max} U-FRAME $= 6100K \times 112/2 = 341,600\ ^{L}K$

$= 4,099,200\ ^{''}K$

DETERMINE STRESS ON FULL U-FRAME (USE WSD FOR PRELIMINARY REPORT)

$\sigma_{TENSION\ MAX} = \frac{341,600}{26,280} = 13.0\ KSF$

$= 90\ psi$ negligible $< 6\sqrt{f_c'}$

requires minimal reinforcement $= 6\sqrt{4,000}$

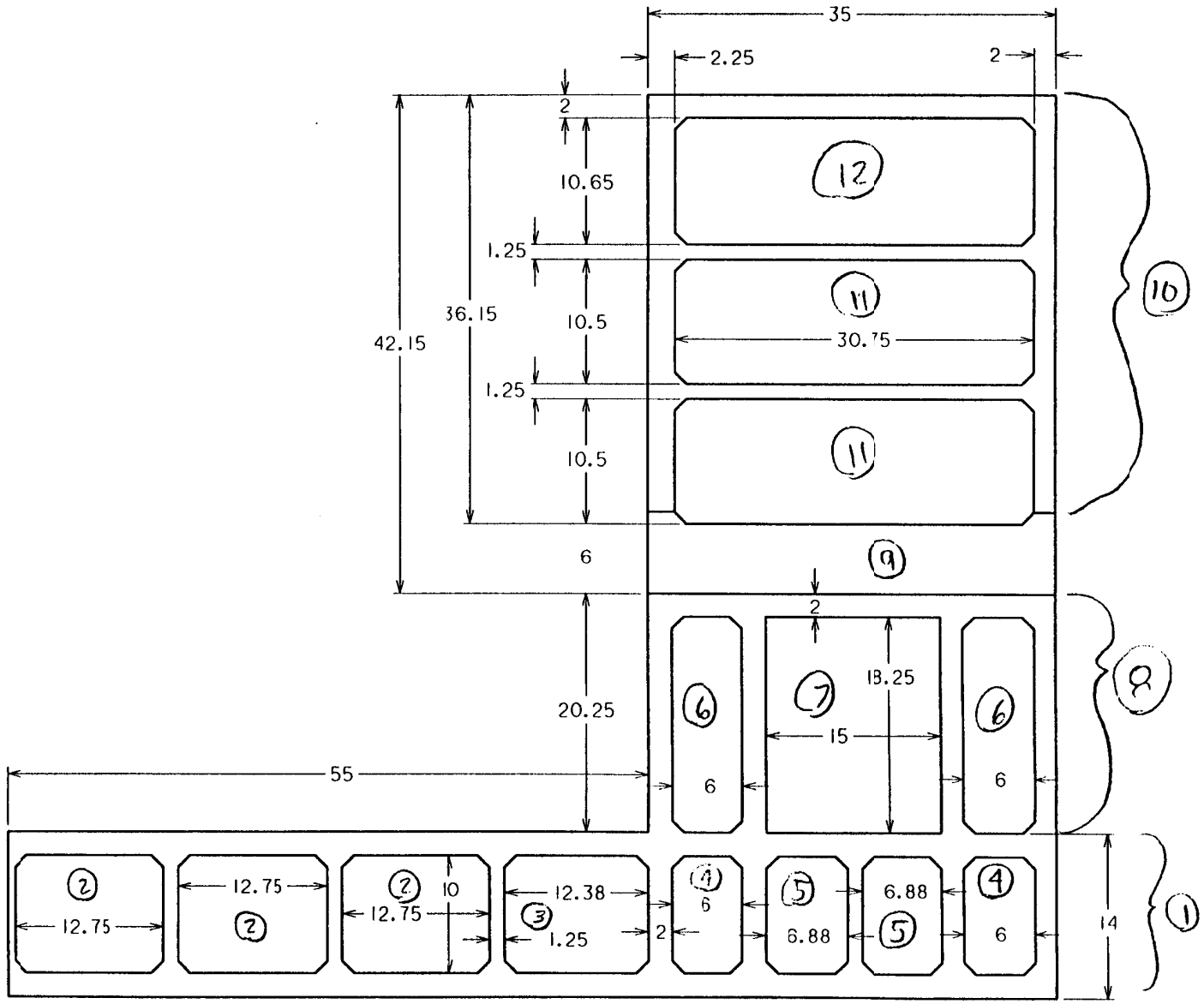
$= 380\ psi$

$\sigma_{compression\ max} = \frac{341,600}{43,360} = 7.9\ KSF$

$= 54.7\ psi < 0.45 f_c' = 0.45 \times 6000$

$= 2700\ psi$

∴ U-FRAME Adequate in Long. Direction


35
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36.15
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12.75
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12.38
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6
6.88
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30 of 10

IHNC Lock Replacement

Setting Conditions - determination of Neutral Axis & Moment of Inertia - Gate Bay Monolith (1/2 SECTION)

Determine Neutral Axis

Area No.	# of Areas	'b' (ft)	'h' (ft)	A (sf)	y (ft)	y*A (cf)
1	1	90	14	1260	7.000	8820.00
2	-3	12.75	10	-382.5	7.000	-2677.50
3	-1	12.38	10	-123.8	7.000	-866.60
4	-2	6	10	-120	7.000	-840.00
5	-2	6.88	10	-137.6	7.000	-963.20
6	-2	6	18.25	-219	23.125	-5064.38
7	-1	15	18.25	-273.75	23.125	-6330.47
8	1	35	20.25	708.75	24.125	17098.59
9	1	35	6	210	37.250	7822.50
10	1	35	36.15	1265.25	58.325	73795.71
11	-1	30.75	10.5	-322.875	45.500	-14690.81
12	-1	30.75	10.5	-322.875	57.250	-18484.59
13	-1	30.75	10.65	-327.488	69.075	-22621.20
		Sum (A) =		1214.113	Sum (y*A) =	34998.05

Centroid = $\frac{34998.05}{1214.113}$ = 28.83 ft from bottom of slab

Determine Moment of Inertia

Ix=Sum(I+Ad^2) = Sum(bh^3/12+Ad^2) for a rectangular shape

= Sum(bh^3/36+Ad^2) for a triangular shape

Area No.	# of Areas	'b' (ft)	'B' (in)	'h' (ft)	'H' (in)	'd' (ft)	'D' (in)	'a' (sf)	'A' (sq. in)	I
1	1	90	1080	14	168	21.826	261.912	1260.00	181440.00	1.29E+10
2	-3	12.75	153	10	120	21.826	261.912	127.50	18360.00	-3.84E+09
3	-1	12.38	148.56	10	120	21.826	261.912	123.80	17827.20	-1.24E+09
4	-2	6	72	10	120	21.826	261.912	60.00	8640.00	-1.21E+09
5	-2	6.88	82.56	10	120	21.826	261.912	68.80	9907.20	-1.38E+09
6	-2	6	72	18.25	219	5.701	68.412	109.50	15768.00	-2.74E+08
7	-1	15	180	18.25	219	5.701	68.412	273.75	39420.00	-3.42E+08
8	1	35	420	20.25	243	4.701	56.412	708.75	102060.00	8.27E+08
9	1	35	420	6	72	8.424	101.088	210.00	30240.00	3.22E+08
10	1	35	420	36.15	433.8	29.499	353.988	1265.25	182196.00	2.57E+10
11	-1	30.75	369	10.5	126	16.674	200.088	322.88	46494.00	-1.92E+09
11	-1	30.75	369	10.5	126	28.424	341.088	322.88	46494.00	-5.47E+09
12	-1	30.75	369	10.65	127.8	40.249	482.988	327.49	47158.20	-1.11E+10
									Ix =	1.30E+10 in^4
									=	6.25E+05 ft^4

I_x Full Section = 12.5E+05 ft^4

$$S_{x_{BOT}} = \frac{I_x}{28.83} = 43,360\ ft^3$$

$$S_{x_{TOP}} = \frac{I_x}{(76.4 - 28.83)} = 26,280\ ft^3$$

SETTING PILES

TRANSVERSE AXIS (see Diagram on PG 6)
(14' WIDTH)

$M_{max} = 4.24 \times \frac{(90-21)^2}{2} = 10{,}093$ '-K

COMPARE w/ USD DESIGN - REFER TO BASE DESIGN

$M_u = 1.7 \times 10{,}093 = 17{,}160$ '-K

$M_N = 93{,}000$ '-K $> M_u$ ∴ I-BEAM REINFORCEMENT IS ADEQUATE

$V_{max} = 4.24 \times (90-21) = 293$ K

$V_u = 293 \times 1.7 = 497$ K

$V_N = V_{N_{18'' \text{ WEB w/2\#8 @ 12''}}} = 1353(0.85) = 1150_K > V_u$

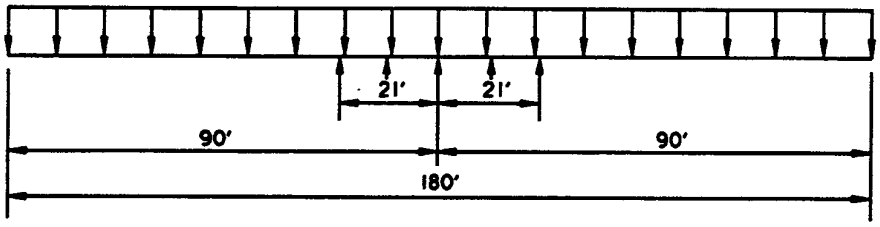
PILE REACTION @ PAD

PILE CAPACITY F.S. = 1.5 $= \frac{860 \text{ TN} \times 2 \text{ K/TN}}{1.5} = 1{,}150$ Kips
USE 1,100 K

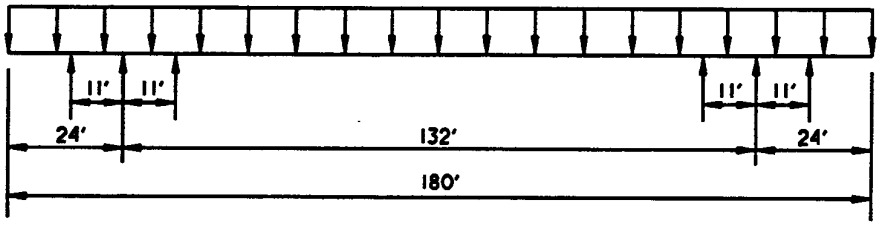
#Piles @ Twin Pads $= \frac{14{,}100 \text{ K}}{1100 \text{ K} \times 2} = 6.4$ USE 8 Piles

Piles @ Single Pad $= \frac{9610 \text{ K}}{1100 \text{ K}} = 8.7$ USE 9 PILES

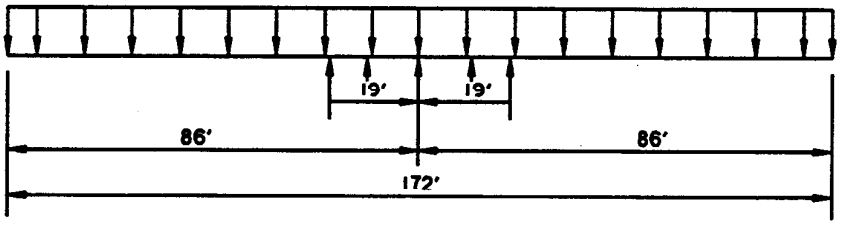
GATEBAY TRANSVERSE
4.24 K/LF FOR 14' WIDTH



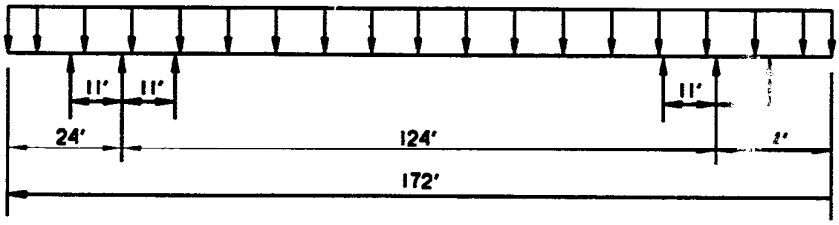
GATEBAY TRANSVERSE
4.24 K/LF FOR 14' WIDTH



CHAMBER TRANSVERSE
4.24 K/LF FOR 14' WIDTH



CHAMBER TRANSVERSE
4.24 K/LF FOR 14' WIDTH



SETTING PILES

CHAMBER MODULE

Req'd DL = 1.05 × (57 × 0.0625 × 172 × 446) = 286,950

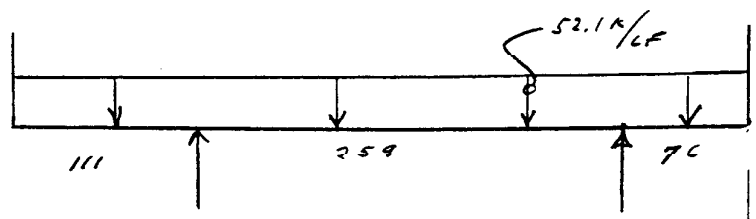
WT. OF Shell = 174,500 K + 2(0.0625 × 14.75 × $\frac{6.5}{2}$ × 446) = 177,200 K
PLUS WATER WT
ON OUTER WALL

Ballast WT. REQ'D = 286,950 − 177,200 = 109,750 K < 116,130 K
AVAIL BALLAST WT OK

SETTING LOAD = (57 × 0.0625 × 172 × 446) 0.05
+ (2 × 0.0625 × 172 × 446)
= 23,253

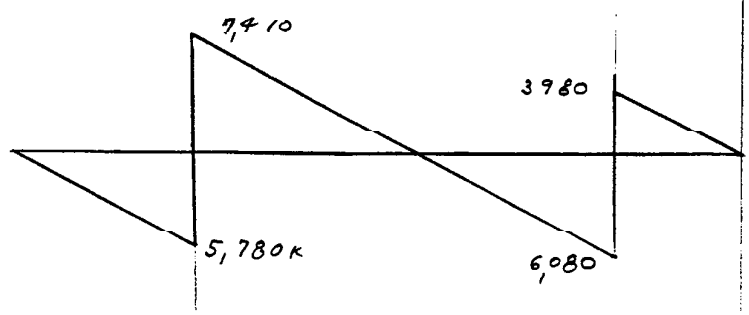
LOAD/LF = 23,250/446 = 52.1 K/LF

PAD FINAL LOCATION



$R_L = \frac{446 \times 52.1 \times 147}{259}$
= 13,190 K

R_R = 23,250 − 13,190
= 10,060

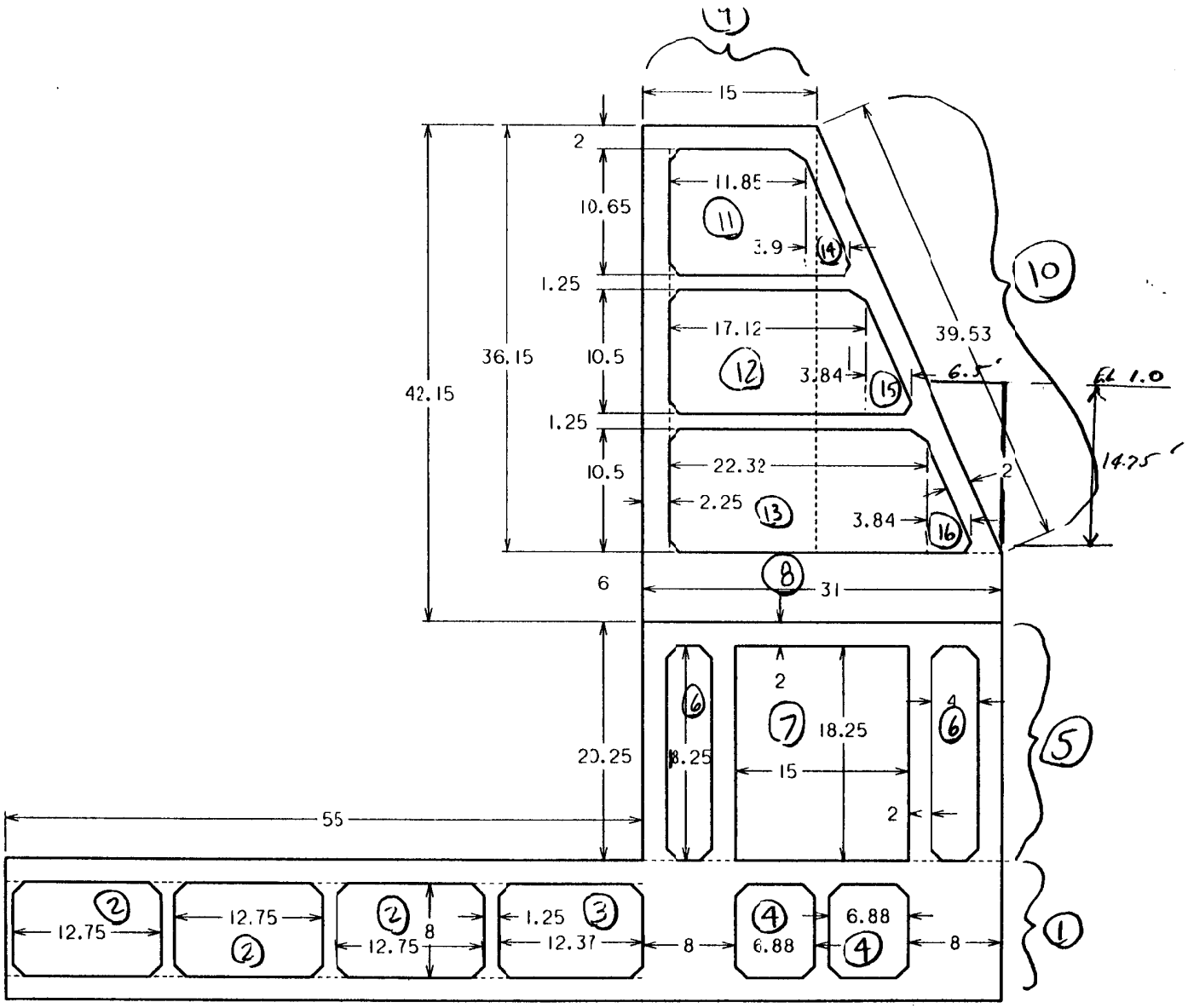


M_{max} = 5780 × $\frac{111}{2}$ = 320,790 '-K

DETERMINE STRESS ON FULL U-FRAME

$\sigma_{Tension\ MAX} = \frac{320,790}{19,740}$ = 16.25 KSF
= 113 psi negligible < $6\sqrt{4000}$
= 380 psi

$\sigma_{compression\ Max} = \frac{320,790}{40,330}$ = 7.95 KSF
= 55.2 psi < 0.45 fc' = 2700 psi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IHNC Lock Replacement
Setting Conditions - determination of Neutral Axis & Moment of Inertia – CHAMBER

Determine Neutral Axis

Area No.	# of Areas	'b' (ft)	'h' (ft)	A (sf)	y (ft)	y*A (cf)
1	1	86	12	1032	6.000	6192.00
2	-3	12.75	8	-306	6.000	-1836.00
3	-1	12.37	8	-98.96	6.000	-593.76
4	-2	6.88	8	-110.08	6.000	-660.48
5	1	31	20.25	627.75	22.125	13888.97
6	-2	4	18.25	-146	21.125	-3084.25
7	-1	15	18.25	-273.75	21.125	-5782.97
8	1	31	6	186	35.250	6556.50
9	1	15	36.15	542.25	56.325	30542.23
10	1	16	36.15	289.2	50.300	14546.76
11	-1	11.85	10.65	-126.203	67.075	-8465.03
12	-1	17.12	10.5	-179.76	55.250	-9931.74
13	-1	22.32	10.5	-234.36	43.500	-10194.66
14	-1	3.9	10.65	-20.7075	65.300	-1356.12
15	-1	3.84	10.5	-20.16	53.500	-1078.56
16	-1	3.84	10.5	-20.16	41.750	-841.68
		Sum (A) =		1141	Sum (y*A) =	27901.21

Centroid = 27901.21 / 1141 = 24.45 ft from bottom of slab

Determine Moment of Inertia
Ix=Sum(I+Ad^2) = Sum(bh^3/12+Ad^2) for a rectangular shape
= Sum(bh^3/36+Ad^2) for a triangular shape

Area No.	# of Areas	'b' (ft)	'B' (in)	'h' (ft)	'H' (in)	'd' (ft)	'D' (in)	'a' (sf)	'A' (sq. in)	I
1	1	86	1032	12	144	18.453	221.440	1032.00	148608.00	7.54E+09
2	-3	12.75	153	8	96	18.453	221.440	102.00	14688.00	-2.19E+09
3	-1	12.37	148.44	8	96	18.453	221.440	98.96	14250.24	-7.10E+08
4	-2	6.88	82.56	8	96	18.453	221.440	55.04	7925.76	-7.89E+08
5	1	31	372	20.25	243	2.328	27.940	627.75	90396.00	5.15E+08
6	-2	4	48	18.25	219	3.328	39.940	73.00	10512.00	-1.18E+08
7	-1	15	180	18.25	219	3.328	39.940	273.75	39420.00	-2.20E+08
8	1	31	372	6	72	10.797	129.560	186.00	26784.00	4.61E+08
9	1	15	180	36.15	433.8	31.872	382.460	542.25	78084.00	1.26E+10
10	1	16	192	36.15	433.8	25.847	310.160	289.20	41644.80	4.44E+09
11	-1	11.85	142.2	10.65	127.8	42.622	511.460	126.20	18173.16	-4.78E+09
12	-1	17.12	205.44	10.5	126	30.797	369.560	179.76	25885.44	-3.57E+09
13	-1	22.32	267.84	10.5	126	19.047	228.560	234.36	33747.84	-1.81E+09
14	-1	3.9	46.8	10.65	127.8	40.847	490.160	20.77	2990.52	-7.21E+08
15	-1	3.84	46.08	10.5	126	29.047	348.560	20.16	2903.04	-3.55E+08
16	-1	3.84	46.08	10.5	126	17.297	207.560	20.16	2903.04	-1.28E+08
									Ix =	1.02E+10 in^4
									=	4.93E+05 ft^4

I_x FULL SECTION = 9.86 E+05 ft^4

$$S_{x_{BOT}} = \frac{I_x}{24.45} = 40{,}330\ ft^3$$

$$S_{x_{TOP}} = \frac{I_x}{(74.4 - 24.45)} = 19{,}740\ ft^3$$

SETTING PILES

TRANSVERSE AXIS (see Diagram on PG 6)
(14' WIDTH)

$w_{14'} = \frac{52.1 \times 14}{12} = 4.24^{k}$

$M_{max} = \frac{4.24 \times (86-19)^2}{2} = 9{,}517^{'-k}$

$M_u = 9{,}517 \times 1.7 = 16{,}180^{'-k} < M_N = 93{,}000$ (see I-BEAM Transverse Design)

$V_{max} = 4.24 \times (86-19) = 284^{k}$

$V_u = 284 \times 1.7 = 483^{k} < V_N = 1200^{k}$
18" w × 6
2-#8 @ 12"

PILE REACTION @ PAD

PILE CAPACITY = 1100 K

PILES @ TWIN PADS $= \frac{13190}{2 \times 1100} = 6$ piles / PAD
USED 8

PILES @ SINGLE PAD $= \frac{10{,}060}{1100} = 9$ piles