Appendix D
Design Calculations

Hartman Engineering

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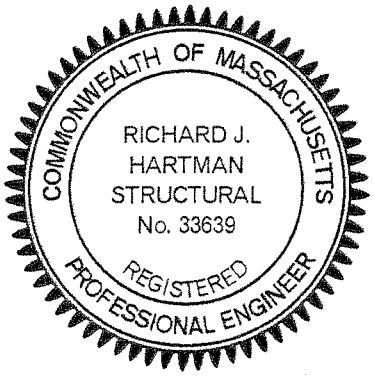
ENGINEERING CALCULATIONS FOR DESIGN OF COFFERDAMS
FOR REMEDIATION OF FORMER RAYTHEON
FACILITY SITE IN WAYLAND, MA

Prepared for
Environmental Resources Management, Inc.



Richard J. Hartman
5/25/06

Project No. 06-602
May 25, 2006

HARTMAN ENGINEERING

BY RJH DATE 5/25/06 SUBJECT _____ SHT. NO. TC-1 OF _____

CHKD. BY _____ DATE _____ _____ JOB NO. 06-602

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HARTMAN ENGINEERING

BY RJH DATE 3/6/06 SUBJECT _____ SHT.NO GI-1 OF _____

CHKD. BY GTB DATE 3/12/06 GENERAL INFORMATION JOB NO. 06-602

This project involves design of excavation protection for remediation of a former Raytheon site in Wayland, MA. The client is Environmental Resources Management (ERM).

The excavation area has been segmented by ERM into "Head" and "Neck" areas. The Head area is approximately 40' x 63'; the Neck area approximately 34' x 69'. Anticipated depth of excavation is 35'.

A meeting was conducted with the client at the site on Feb. 2, 2006. Options were generally discussed. The client requested that options focus upon circular cofferdams versus rectangular cofferdams. It was agreed to formulate preliminary designs and cost estimates for various diameter cofferdams. ERM is continuing subsurface investigations and the preliminary design information, combined with the investigation information, will be used to select an excavation plan.

The site location is situated north of the facility parking lot a sufficient distance that settlement in the vicinity of the cofferdam is not anticipated to be a problem. Some existing utilities, cables, etc, exist at the site; the client advised that they all are abandoned and can be disposed of.

4/20/06

The client advised that the desired cofferdam layout is

1) 40' radius, 25' deep at Center Point X=691447.5020, Y=2958537.1875
2) 30' radius, 35' deep at Center Point X=691392.9312, Y=2958539.5333

The design will proceed on that basis.

5/20/06

Preliminary designs were developed. Meetings on 5/14 & 5/17 indicated that no changes are required. The designs will be finalized.

5/21/06

Designs are finalized.

The client provided soil boring logs and some interpretive cross sections. In general terms the cross sections show strata

(1) coarse to fine sand 5'± thick
(2) fine sand & silt 30'± thick
(3) medium to fine sand 15'± thick
(4) fine sand & silt 15'± thick
(5) gravel 5'± thick
(6) fine sand & silt 10'± thick
(7) till 5'± thick
(8) bedrock.

A generalized profile using MW-552 and MW-262D is shown on Sheet SI-3

Using the descriptions and SPT values from MW-262D, consider

El 127 to El 118
$N_{avg} = 78/4 = 19.5$ → Med dense sand & silt
$\gamma = 120\ ^{\#}/_{ft^3}$ $\phi = 30°$ → $k_a = 0.333 = \frac{1}{3}$
$\gamma' = 65\ ^{\#}/_{ft^3}$ $\delta = 15°$ $k_p = 3.0$

El 118 to El 81
$N_{typical} = 7\pm$ → Loose sand & silt
$\gamma = 110\ ^{\#}/_{ft^3}$ $\phi = 28°$ → $k_a = 0.361$
$\gamma' = 60\ ^{\#}/_{ft^3}$ $\delta = 14°$ $k_p = 2.77$

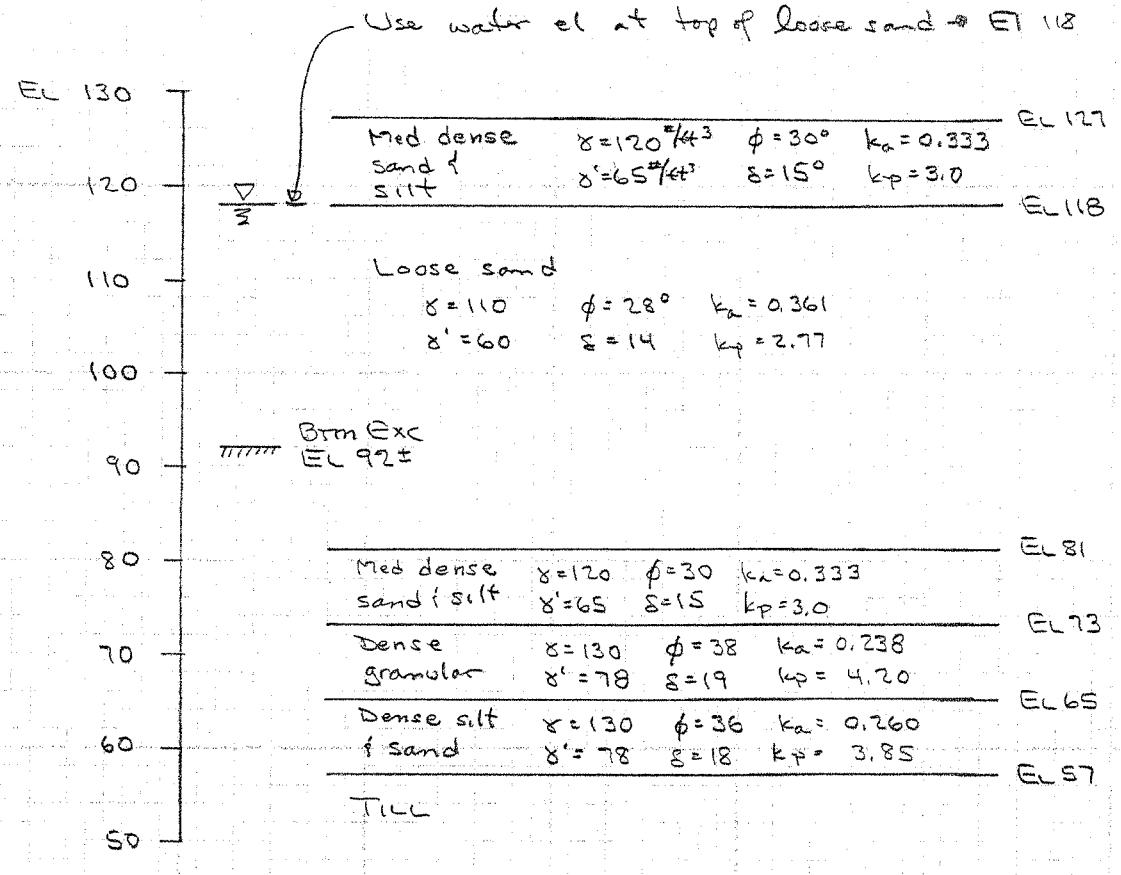
EL 81 to El 73
N range 12 to 63 → Conservatively use - Med dense sand & silt
$\gamma = 120\ ^{\#}/_{ft^3}$ $\phi = 30°$ → $k_a = 0.333 = \frac{1}{3}$
$\gamma' = 65\ ^{\#}/_{ft^3}$ $\delta = 15°$ $k_p = 3.0$

El 73 to El 65
$N_{avg} = 172/4 = 43$ → Dense granular
$\gamma = 130\ ^{\#}/_{ft^3}$ $\phi = 38°$ → $k_a = 0.238$
$\gamma' = 78\ ^{\#}/_{ft^3}$ $\delta = 19°$ $k_p = 4.20$

El 65 to El 57
$N_{avg} = 146/3 = 49$ → Dense silt, sand
$\gamma = 130\ ^{\#}/_{ft^3}$ $\phi = 36°$ → $k_a = 0.260$
$\gamma' = 78\ ^{\#}/_{ft^3}$ $\delta = 18°$ $k_p = 3.85$

BELOW EL 57
TILL

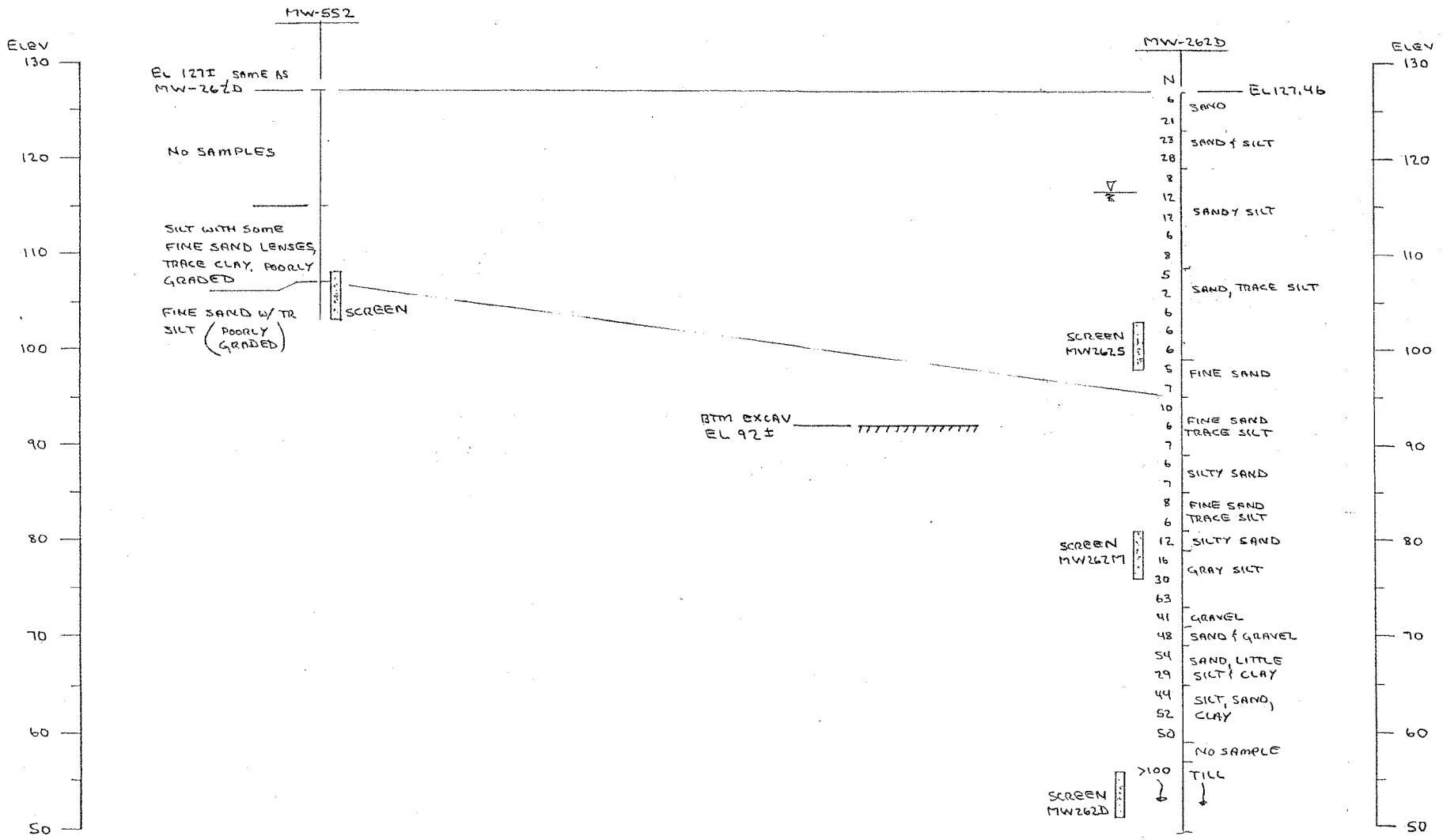
For Design Considerations Use



HARTMAN ENGINEERING

BY RSH DATE 3/6/06 SUBJECT _____ SHT.NO SI-3 OF _____

CHKD. BY GTB DATE 3/12/06 _____ JOB NO. 06-602

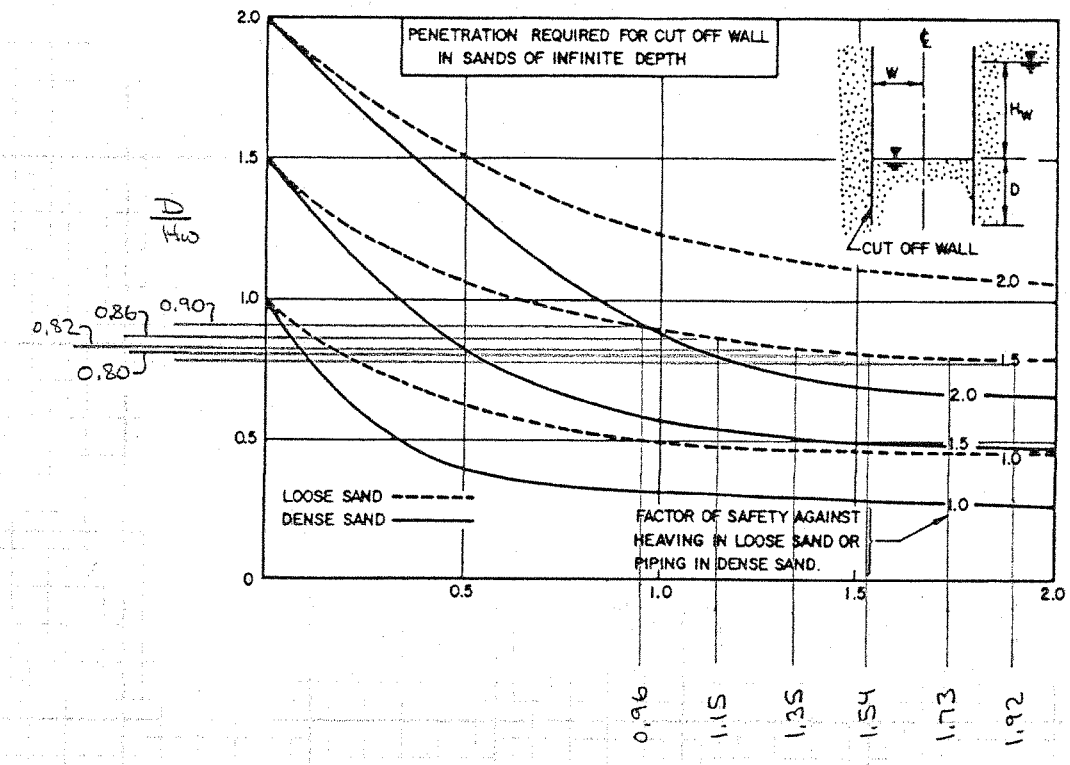


HARTMAN ENGINEERING

BY RJH DATE 3/9/06 SUBJECT STABILITY OF BOTTOM SHT.NO SB-1 OF

CHKD. BY GTB DATE 3/12/06 JOB NO. 06-602

ITEM No. 1- REQ'D TOE USING NAVFAC DM7.1



W/Hw

W = ½ WIDTH

$H_w = 118 - 92 = 26'$ Ref: SI-2

Use W = Radius = ½ Diameter

Use req'd FS = 1.5 for loose sand

HARTMAN ENGINEERING

BY RJH DATE 3/9/06 SUBJECT _____ SHT.NO SB-2 OF _____

CHKD. BY GJB DATE 3/12/06 _____ JOB NO. 06-602

_____ _____

DIA	W=½ DIA	W/Hw	D/Hw	D
50'	25	0.96	0.90	23.4'
60	30	1.15	0.86	22.4'
70	35	1.35	0.82	21.3'
80	40	1.54	0.80	20.8'
90	45	1.73		
100	50	1.92		
110	55	2.12		
120	60	2.31		

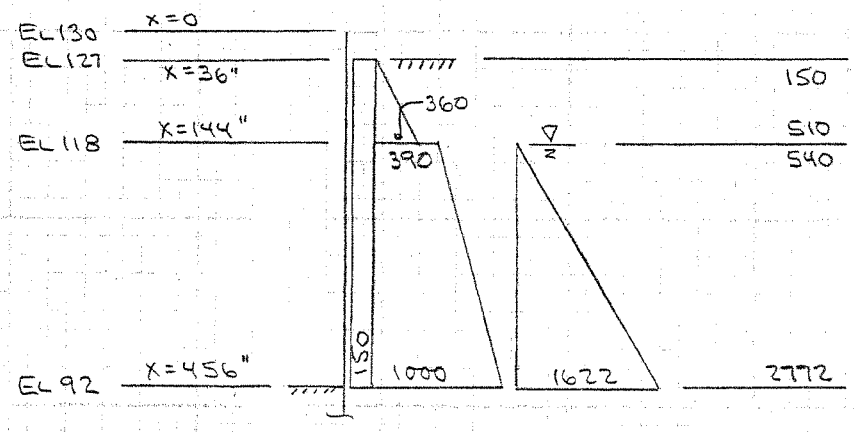
Use 22', anchc 60' ϕ or larger

ITEM NO. 1 – SOIL AT EL 127, BOTTOM EL 92

RANKINE DISTRIBUTION

WATER EL 118

SURCHARGE = 150 psf HOR



AT EL 127

$p_a = 0$

AT EL 118$^+$

$p_a = k_a \gamma z = 0.333(120)(127-118)$

$= 360$ psf

AT EL 118$^-$

$p_a = k_a \Sigma(\gamma H) = 0.361(120)(127-118)$

$= 390$ psf

AT EL 92

$p_a = 390 + k_a \gamma'(\Delta z) = 390 + (0.361)(65)(118-92)$

$= 390 + 610$

$= 1000$ psf

$p_w = \gamma_w H_w = 62.4(118-92) = 1622$ psf

$\Sigma F = 150(36) + \frac{1}{2}(360)(9) + \frac{1}{2}(390+1000)(26) + \frac{1}{2}(1622)(26)$

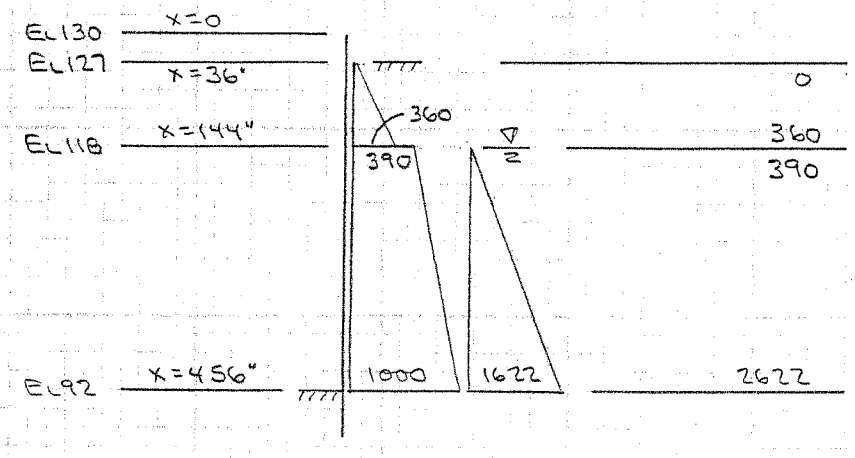
$= 46{,}026$ #/ft

INPUT DATA

LOAD	LOCATION		MAGNITUDE	
	START	STOP	START	STOP
1	36	144	150#/ft = 12.50#/in	510#/ft = 42.50#/in
2	144	456	540#/ft = 45.00#/in	2772#/ft = 231.00#/in

ITEM No. 2 - SOIL AT EL 127 BOTTOM EL 92
- RANKINE DISTRIBUTION
- WATER EL 118
- SURCHARGE = 0

Use the information on PA-2 without the surcharge.



$$\Sigma F = \tfrac{1}{2}(360)(9) + \tfrac{1}{2}(390+1000)(26) + \tfrac{1}{2}(1622)(26)$$
$$= 40{,}776\ ^{\#}/_{ft}$$

Check $40{,}776 + 150(35) \stackrel{?}{=} 46{,}026$ (ref: PA-1)

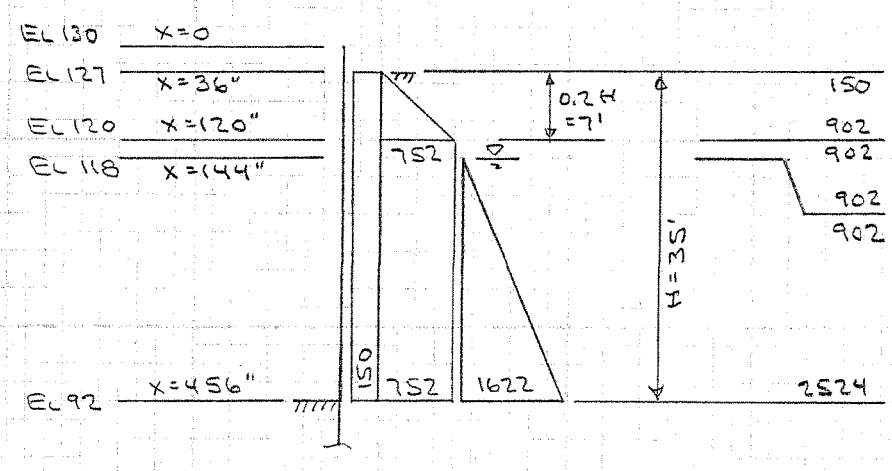
$46{,}026 = 46{,}026$ ok

INPUT DATA

LOAD	LOCATION		MAGNITUDE	
	START	STOP	START	STOP
1	36	144	0	$360\ ^{\#}/_{ft} = 30.00\ ^{\#}/_{in}$
2	144	456	$390\ ^{\#}/_{ft} = 32.50\ ^{\#}/_{in}$	$2622\ ^{\#}/_{ft} = 218.50\ ^{\#}/_{in}$

ITEM No. 3 - SOIL AT EL 127 BOTTOM EL 92
- TRAPAZOIDAL DISTRIBUTION
- WATER EL 118
- SURCHARGE = 150 psf HOR

Ref: Tong, Pg 393



$P_b = 0.8\, k_a \gamma H \cos\delta$

$= 0.8\left[0.333(120)(127-118)(\cos 15^\circ) + 0.361(65)(118-92)(\cos 14^\circ)\right]$

$= 752$ psf

$\Sigma F = 150(35) + 752\left(\frac{7}{2}+28\right) + \frac{1}{2}(1622)(26)$

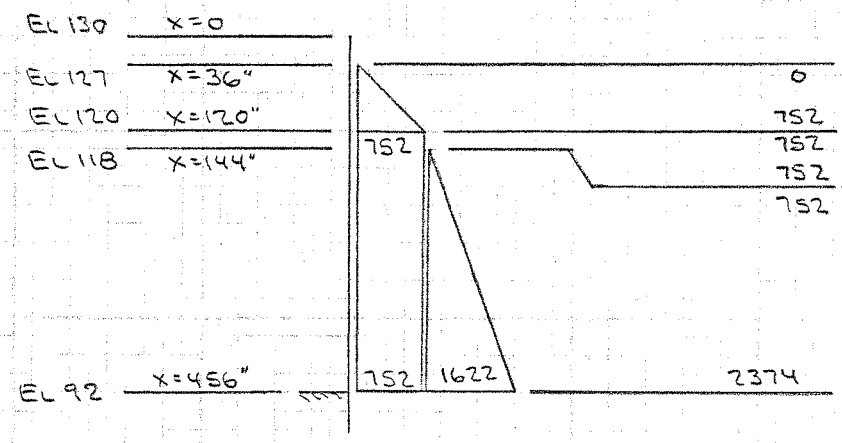
$= 50{,}024$ #/ft

INPUT DATA

LOAD	LOCATION		MAGNITUDE	
	START	STOP	START	STOP
1	36	120	150 #/ft = 12.50 #/in	902 #/ft = 75.17 #/in
2	120	144	75.17	75.17
3	144	456	75.17	2524 #/ft = 210.33 #/in

ITEM No. 4 - SOIL AT EL 127, BOTTOM EL 92
- TRAPAZOIDAL DISTRIBUTION
- WATER EL 118
- SURCHARGE = 0

Use the information on PA-4 without the surcharge.



$$\Sigma F = 752\left(\frac{1}{2} + 28\right) + \frac{1}{2}(1622)(26)$$
$$= 44{,}774\ \#/ft$$

Check $44{,}744 + 150(35) \stackrel{?}{=} 50{,}024$

$50{,}024 \stackrel{?}{=} 50{,}024$ OK

INPUT DATA

LOAD	LOCATION		MAGNITUDE	
	START	STOP	START	STOP
1	36	120	0	752 #/ft = 62.67 #/in
2	120	144	62.67	62.67
3	144	456	62.67	2374 #/ft = 197.83 #/in

ITEM No. 5 - SOIL AT EL 121 BOTTOM EL 92
- RANKINE DISTRIBUTION
- WATER EL 118
- SURCHARGE = 150 psf HOR

For 6' of removed soil use vertical surcharge

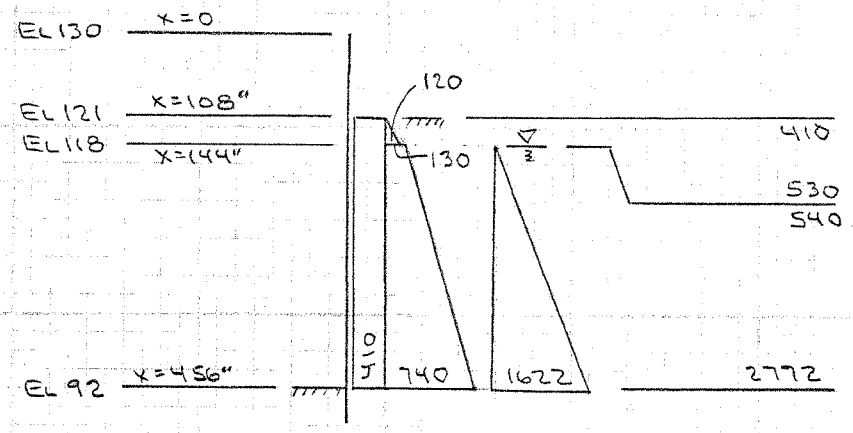
$q = \gamma(\Delta H) = 120(6) = 720$ psf

Use k_a for loose soil

$p_s = k_a q = 0.361(720) = 260$ psf

The p_s adds to equipment, storage surcharge of 150

total = 260 + 150 = 410 psf.



At El 121

$p_a = 0$

At El 118$^+$

$p_a = k_a \gamma z = (0.333)(120)(3) = 120$ psf

At El 118$^-$

$p_a = k_a \Sigma \gamma H = (0.361)[120(3)] = 130$ psf

At El 92

$p_a = 130 + k_a \gamma' (\Delta z) = 130 + (0.361)(65)(118-92)$

$= 740$ psf

$\Sigma F = 410(121-92) + \frac{1}{2}(120)(3) + \frac{1}{2}(130+740)(26) + \frac{1}{2}(1622)(26)$

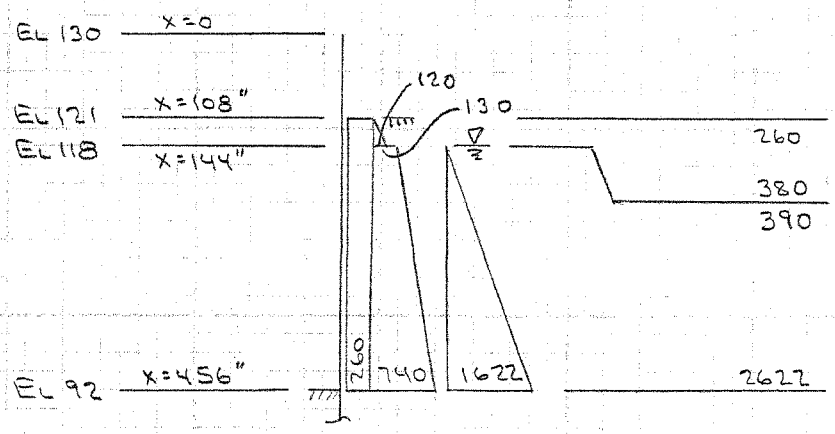
$= 44{,}466$ #/ft

INPUT DATA

LOAD	LOCATION		MAGNITUDE	
	START	STOP	START	STOP
1	108	144	410#/ft = 34.17#/in	530#/ft = 44.17#/in
2	144	456	540#/ft = 45.00#/in	2772#/ft = 231.00#/in

ITEM No. 6 - SOIL AT EL 121, BOTTOM EL 92
- RANKINE DISTRIBUTION
- WATER EL 118
- SURCHARGE = 0 FROM EQPT, ETC

Use the information on PA-6 without the 150 psf horizontal surcharge



$$\Sigma F = 260(29) + \tfrac{1}{2}(120)(3) + \tfrac{1}{2}(130+740)(26) + \tfrac{1}{2}(1622)(26)$$
$$= 40{,}116\ ^{\#}/_{ft}$$

Check

$40{,}116 + 150(29) \stackrel{?}{=} 44{,}466$

$40{,}466 = 40{,}466$ OK

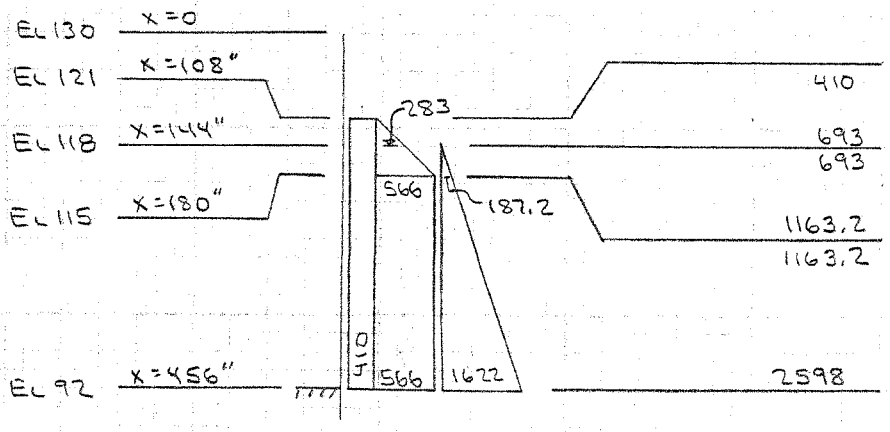
INPUT DATA

LOAD	LOCATION		MAGNITUDE	
	START	STOP	START	STOP
1	108	144	$260\ ^{\#}/_{ft} = 21.67\ ^{\#}/_{in}$	$380\ ^{\#}/_{ft} = 31.67\ ^{\#}/_{in}$
2	144	456	$390\ ^{\#}/_{ft} = 32.50\ ^{\#}/_{in}$	$2622\ ^{\#}/_{ft} = 218.50\ ^{\#}/_{in}$

ITEM No. 7 - SOIL AT EL 121 BOTTOM EL 92

- TRAPAZOIDAL DISTRIBUTION
- WATER EL 118
- EQPT, ETC SURCHARGE = 150 psf HOR

Ref: Teng, Pg 393



$H = 121 - 92 = 29'$

$0.2H = 5.8' \rightarrow$ Use $6'$

$P_b = 0.8 k_a \gamma H (\cos\delta)$

$= 0.8\left[0.333(120)(121-118)(\cos 15°) + 0.361(65)(118-92)(\cos 14°)\right] = 566 psf$

$\Sigma F = 410(121-92) + 566\left(\frac{6}{2}+23\right) + \frac{1}{2}(1622)(26)$

$= 47{,}692 \#/ft$

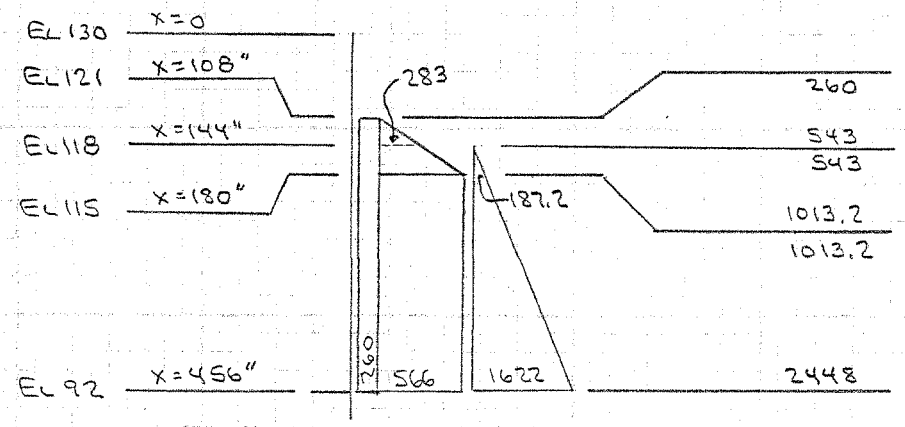
INPUT DATA

LOAD	LOCATION		MAGNITUDE	
	START	STOP	START	STOP
1	108	144	$410 \#/ft = 34.17 \#/in$	$693 \#/ft = 57.75 \#/in$
2	144	180	57.75	$1163.2 \frac{\#}{ft} = 96.93 \#/ft$
3	180	456	96.93	$2598 \#/ft = 216.50 \frac{\#}{in}$

ITEM No. 8 - SOIL AT EL 121, BOTTOM EL 92

- TRAPAZOIDAL DISTRIBUTION
- WATER EL 118
- SURCHARGE = 0 FROM EQPT, ETC

Use the information from PA-9 without the 150 psf horizontal surcharge



$$\Sigma F = 260(29) + 566\left(\frac{6}{2} + 23\right) + \frac{1}{2}(1622)(26)$$
$$= 43{,}342 \text{ \#/ft}$$

Check $43{,}342 + 150(29) \stackrel{?}{=} 47{,}692$

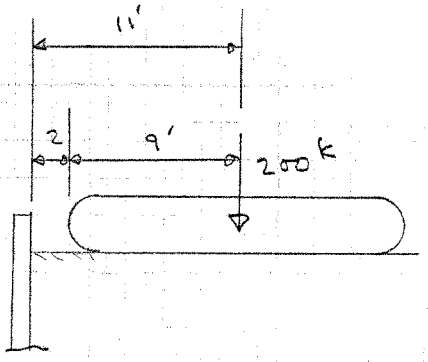
$47{,}692 \stackrel{?}{=} 47{,}692$ OK

INPUT DATA

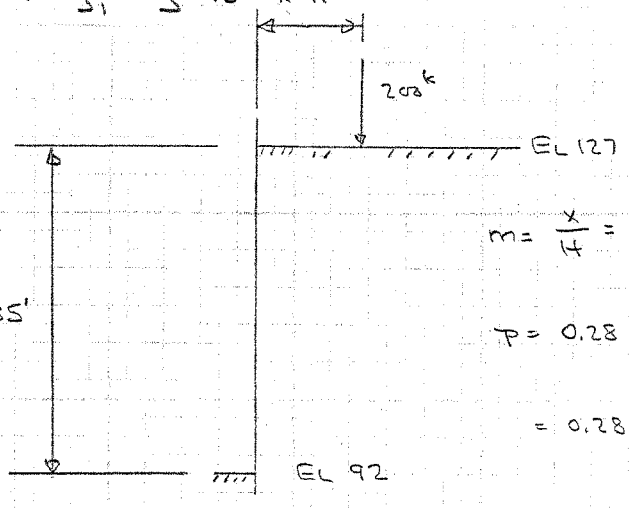
LOAD	LOCATION		MAGNITUDE	
	START	STOP	START	STOP
1	108	144	260 #/ft = 21.67 #/in	543 #/ft = 45.25 #/in
2	144	180	45.25	1013.2 #/ft = 84.43 #/in
3	180	456	84.43	2448 #/ft = 204.00 #/in

ITEM No. 9- SOIL AT EL 127, BOTTOM EL 92

- CRANE SURCHARGE
- CONCENTRATED LOAD = 200 k



Ref: Tang, Pg 90 x=11'



$$m = \frac{x}{H} = \frac{11}{35} = 0.314 < 0.4$$

$$p = 0.28 \frac{Q}{H^2} \frac{n^2}{(0.16+n^2)^3}$$

$$= 0.28 \frac{200{,}000}{35^2} \frac{n^2}{(0.16+n^2)^3}$$

$$= \frac{45.71\, n^2}{(0.16+n^2)^3}$$

Ref: PA-12

INPUT DATA $\Sigma F = 4496\ \#/ft$

LOAD	LOCATION		MAGNITUDE	
	START	STOP	START	STOP
1	36	120	0	$218.5\ \#/ft = 18.21\ \#/in$
2	120	204	18.21	18.21
3	204	336	18.21	$81\ \#/ft = 6.75\ \#/in$
4	336	456	6.75	$30\ \#/ft = 2.50\ \#/in$

HARTMAN ENGINEERING

BY RJH DATE 3/7/06 SUBJECT _____ SHT.NO PA-12 OF _____

CHKD. BY GSB DATE 3/12/06 JOB NO. 06-602

Elev	z	p
126.5	0.5	2
125.5	1.5	20
124.5	2.5	52
123.5	3.5	93
122.5	4.5	137
121.5	5.5	179
120.5	6.5	214
119.5	7.5	240
118.5	8.5	257
117.5	9.5	264
116.5	10.5	263
115.5	11.5	256
114.5	12.5	245
113.5	13.5	231
112.5	14.5	215
111.5	15.5	198
110.5	16.5	182
109.5	17.5	166
108.5	18.5	150
107.5	19.5	136
106.5	20.5	123

Elev	z	p
105.5	21.5	111
104.5	22.5	100
103.5	23.5	90
102.5	24.5	82
101.5	25.5	74
100.5	26.5	66
99.5	27.5	60
98.5	28.5	54
97.5	29.5	49
96.5	30.5	45
95.5	31.5	40
94.5	32.5	37
93.5	33.5	34
92.5	34.5	31
		Σ = 4496 #/ft

Calculate p so that ΣF = 4496

$\frac{1}{2}(p)(7) + 7p + \frac{1}{2}(p+81)(11)$

$+ \frac{1}{2}(81+30)(10) = 4496$

$p[3.5 + 7 + 5.5] + 445.5 + 555 = 4496$

$16p = 4496 - 1000.5 = 3495.5$

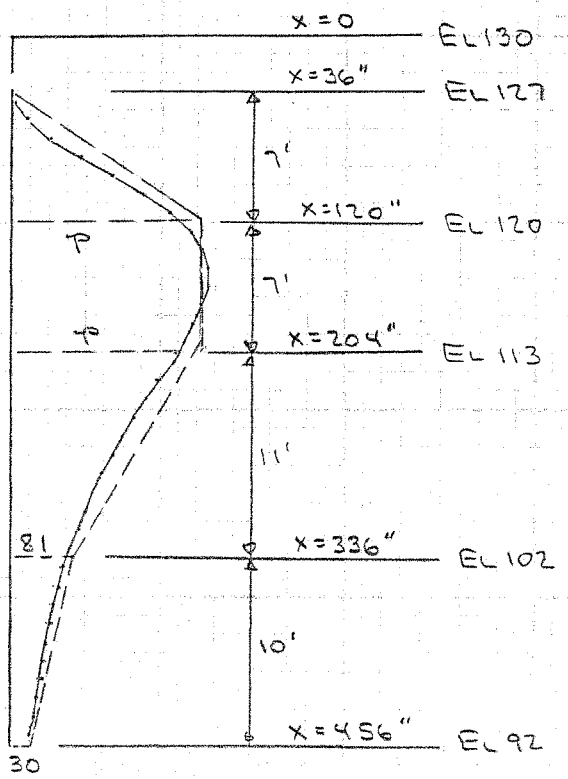
$p = 218.5$ psf

Check

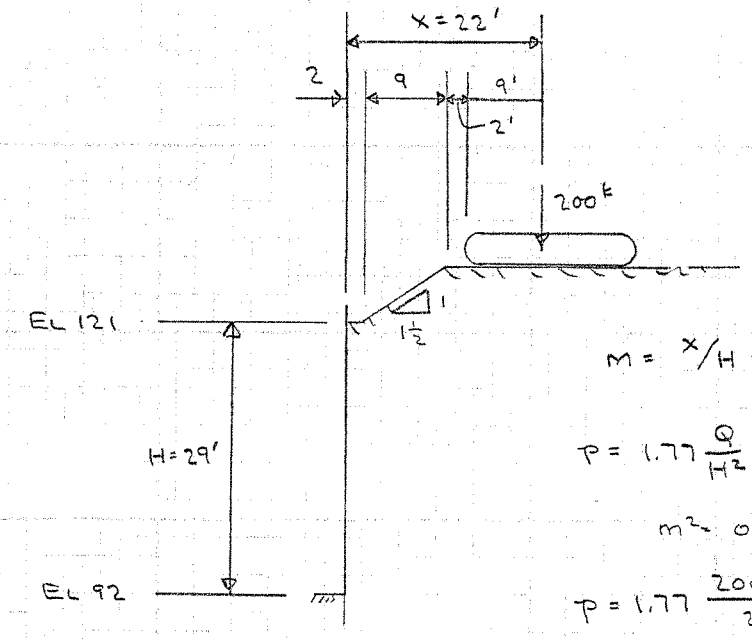
$\frac{1}{2}(218.5)(7) + 7(218.5)$

$+ \frac{1}{2}(218.5 + 81)(11) + \frac{1}{2}(81+30)(10)$

$= 4496$ #/ft OK



ITEM NO. 10 - SOIL AT EL 121, BOTTOM EL 92
- CRANE SURCHARGE
- CONCENTRATED LOAD = 200^k



$m = x/H = 22/29 = 0.759 > 0.4$

$$p = 1.77 \frac{Q}{H^2} \frac{m^2 n^2}{(m^2+n^2)^3}$$

$m^2 = 0.576$

$$p = 1.77 \frac{200{,}000}{29^2} \frac{0.576\, n^2}{(0.576+n^2)^3}$$

$$= \frac{242.45\, n^2}{(0.576+n^2)^3}$$

Ref: PA-14

INPUT DATA $\Sigma F = 2115^{\#}/ft$

LOAD	LOCATION		MAGNITUDE	
	START	STOP	START	STOP
1	108	252	0	$102^{\#}/ft = 8.50^{\#}/in$
2	252	324	8.50	8.50
3	324	456	8.50	$60^{\#}/ft = 5.00^{\#}/in$

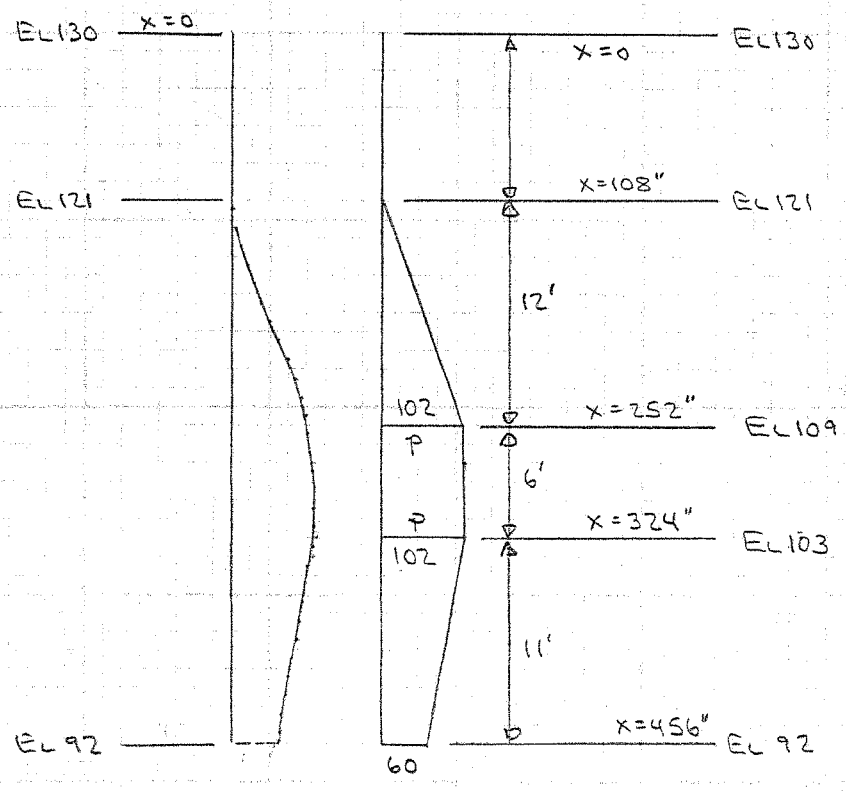
HARTMAN ENGINEERING

BY RJH DATE 3/7/06 SUBJECT _____ SHT.NO PA-14 OF _____

CHKD. BY GTB DATE 3/12/06 JOB NO. 06-602

Elev	z	p
120.5	0.5	0
119.5	1.5	3
118.5	2.5	9
117.5	3.5	17
116.5	4.5	27
115.5	5.5	38
114.5	6.5	50
113.5	7.5	61
112.5	8.5	72
111.5	9.5	82
110.5	10.5	90
109.5	11.5	97
108.5	12.5	102
107.5	13.5	105
106.5	14.5	108

Elev	z	p
105.5	15.5	108
104.5	16.5	108
103.5	17.5	106
102.5	18.5	104
101.5	19.5	101
100.5	20.5	97
99.5	21.5	93
98.5	22.5	89
97.5	23.5	85
96.5	24.5	81
95.5	25.5	76
94.5	26.5	72
93.5	27.5	68
92.5	28.5	64
		$\Sigma = 2113$ #/ft



Find p so that $\Sigma F = 2113$ #/ft

$\frac{1}{2}(p)(12) + 6p + \frac{1}{2}(p+60)(11) = 2113$

$p(6+6+5.5) + 330 = 2113$

$p = (2113 - 330)/17.5$

$= 102$ psf.

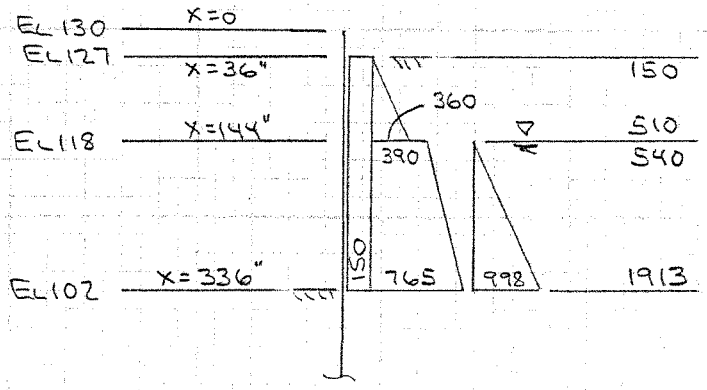
Check

$\Sigma F = \frac{1}{2}(102)(12) + 102(6) + \frac{1}{2}(102+60)(11)$

$= 2115$ #/ft OK

ITEM No. 11 - SOIL AT EL 127 BOTTOM EL 102
RANKINE DISTRIBUTION
WATER EL 118
SURCHARGE = 150 psf HOR

Ref: PA-1 for similar situation



At El 102

$$P_a = 390 + k_a \gamma' (\Delta z) = 390 + (0.361)(65)(118-102) = 390 + 375 = 765 \text{ psf}$$

$$P_w = \gamma_w H_w = 62.4(118-102) = 998 \text{ psf}$$

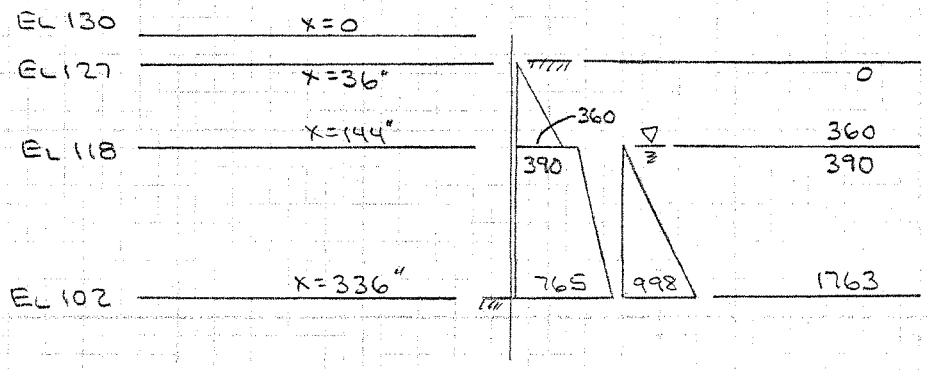
$$\Sigma F = 150(25) + \tfrac{1}{2}(360)(9) + \tfrac{1}{2}(390+765)(16) + \tfrac{1}{2}(998)(16)$$
$$= 22{,}594 \text{ \#/ft}$$

INPUT DATA

LOAD	LOCATION		MAGNITUDE	
	START	STOP	START	STOP
1	36	144	150 #/ft = 12.5 #/in	510 #/ft = 42.5 #/in
2	144	336	540 #/ft = 45 #/in	1913 #/ft = 159.42 #/in

ITEM NO. 12- SOIL AT EL 127, BOTTOM EL 102
- RANKINE DISTRIBUTION
- WATER EL 118
- SURCHARGE = 0

Use the information on PA-15 without the surcharge



$$\Sigma F = \tfrac{1}{2}(360)(9) + \tfrac{1}{2}(390+765)(16) + \tfrac{1}{2}(998)(16)$$
$$= 18{,}844\ \#/ft$$

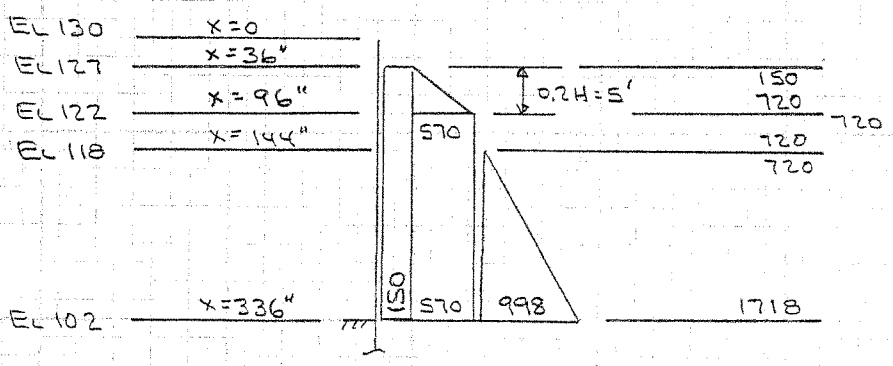
Check
$18{,}844 + 150(25) \stackrel{?}{=} 22{,}594$ (Ref. PA-15)
$22{,}594 \stackrel{?}{=} 22{,}594$ OK

INPUT DATA

LOAD	LOCATION		MAGNITUDE	
	START	STOP	START	STOP
1	36	144	0	360 #/ft = 30 #/in
2	144	336	390 #/ft = 32.5 #/in	1763 #/ft = 146.92 #/in

ITEM No. 13 - SOIL AT EL 127, BOTTOM EL 102

- TRAPAZOIDAL DISTRIBUTION
- WATER EL 118
- SURCHARGE = 150 psf HOR



$$P_b = 0.8\, k_a\, \gamma H (\cos\delta)$$

$$= 0.8\left[0.333(120)(127-118)(\cos 15^\circ) + 0.361(65)(118-102)(\cos 14^\circ)\right]$$

$$= 570 \text{ psf}$$

$$\Sigma F = 150(25) + 570\left(\frac{5}{2}+20\right) + \frac{1}{2}(998)(16)$$

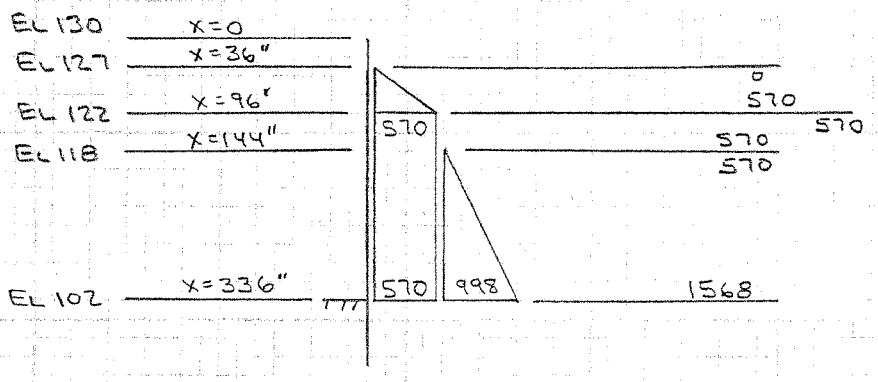
$$= 24{,}559 \text{ \#/ft}$$

INPUT DATA

LOAD	LOCATION		MAGNITUDE	
	START	STOP	START	STOP
1	36	96	150 \#/ft = 12.5 \#/in	720 \#/in = 60 \#/in
2	96	144	60	60
3	144	336	60	1718 \#/ft = 143.17 \#/in

ITEM No. 14 - SOIL AT EL 127, BOTTOM EL 102
- TRAPAZOIDAL DISTRIBUTION
- WATER EL 118
- SURCHARGE = 0

Use the information on PA-17 without the surcharge



$$\Sigma F = 570\left[\frac{5}{2} + 20\right] + \frac{1}{2}(998)(16)$$
$$= 20{,}809 \text{ \#/ft}$$

Check

$20{,}809 + .25(150) \stackrel{?}{=} 24{,}559$

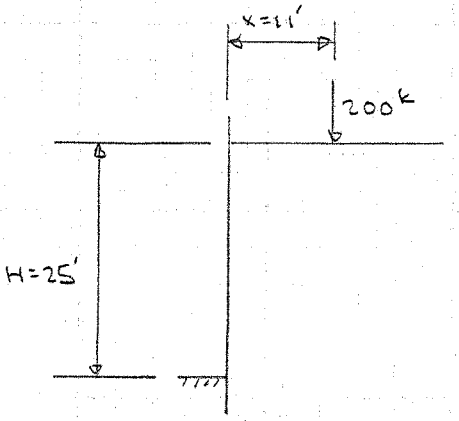
$24{,}559 = 24{,}559$ OK

INPUT DATA

LOAD	LOCATION		MAGNITUDE	
	START	STOP	START	STOP
1	36	96	0	570 #/ft + 47.5 #/in
2	96	144	47.5	47.5
3	144	336	47.5	1568 #/ft + 130.67 #/in

ITEM NO. 15 - SOIL AT EL 127, BOTTOM EL 102
CRANE SURCHARGE
CONCENTRATED LOAD = 200^K

Ref: Sketch on PA-11



$m = \frac{x}{H} = \frac{11}{25} = 0.44 > 0.4$

$p = 1.77 \frac{Q}{H^2} \frac{m^2 n^2}{(m^2+n^2)^3}$

$= 1.77 \frac{200{,}000}{25^2} \left[\frac{(0.44)^2 n^2}{(0.44^2+n^2)^3} \right]$

$= 109.66 \frac{n^2}{(0.1936+n^2)^3}$

Ref: PA-20

$\Sigma F = 5652$ #/ft

INPUT DATA

LOAD	LOCATION		MAGNITUDE	
	START	STOP	START	STOP
1	36	108	0	385#/ft = 32.08#/in
2	108	156	32.08	32.08
3	156	240	32.08	180#/ft = 15#/in
4	240	336	15	65#/ft = 5.42#/in

HARTMAN ENGINEERING

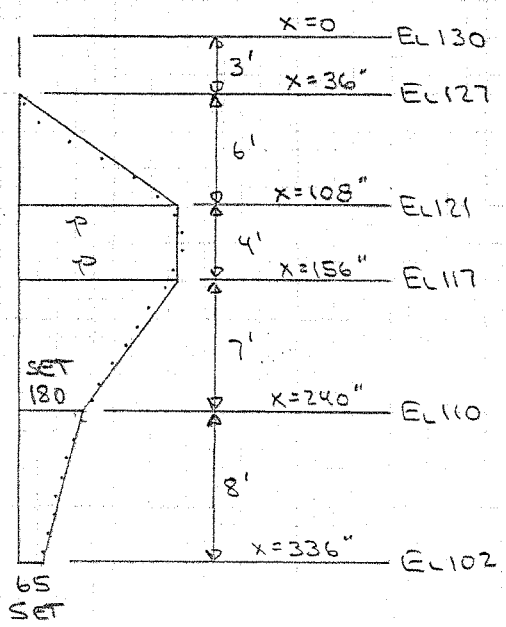
BY RJH DATE 4/21/06 SUBJECT _____ SHT.NO PA-20 OF _____

CHKD. BY GJB DATE 5/23/06 JOB NO. 06-602

ELEV	z	p
126.5	0.5	6
125.5	1.5	51
124.5	2.5	130
123.5	3.5	222
122.5	4.5	308
121.5	5.5	374
120.5	6.5	416
119.5	7.5	433
118.5	8.5	429
117.5	9.5	410
116.5	10.5	382
115.5	11.5	349
114.5	12.5	314
113.5	13.5	280
112.5	14.5	248
111.5	15.5	218

ELEV	z	p
110.5	16.5	192
109.5	17.5	168
108.5	18.5	147
107.5	19.5	129
106.5	20.5	114
105.5	21.5	100
104.5	22.5	88
103.5	23.5	78
102.5	24.5	68

$\Sigma = 5654$ #/ft ✓



Calculate p so that $\Sigma F = 5654$ #/ft

$\frac{1}{2}p(6) + p(4) + \frac{1}{2}(p+180)7$

$+ \frac{1}{2}(180+65)(8) = 5654$

$p[3+4+3.5] + 1610 = 5654$

$p = (5654 - 1610)/10.5$

$= 385$ psf

Check

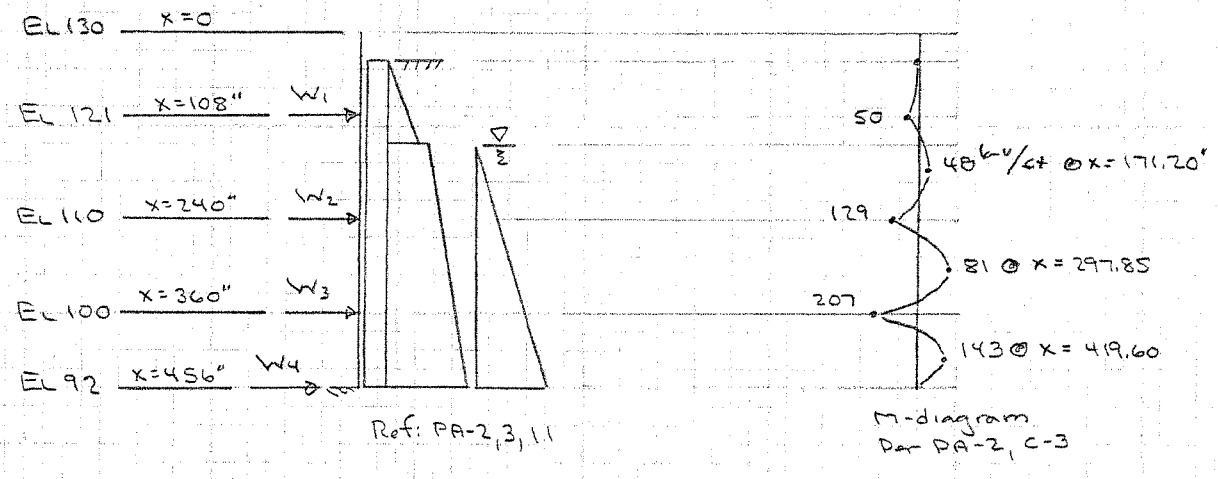
$\frac{1}{2}(385)(6) + 385(4)$

$+ \frac{1}{2}(385+180)(7)$

$+ \frac{1}{2}(180+65)(8) = 5652$ #/ft

OK

ITEM NO. 1 - SOIL AT EL 127, BOTTOM EL 92
RANKINE DISTRIBUTION
WATER EL 118
WALES AT EL 121, 110, 100



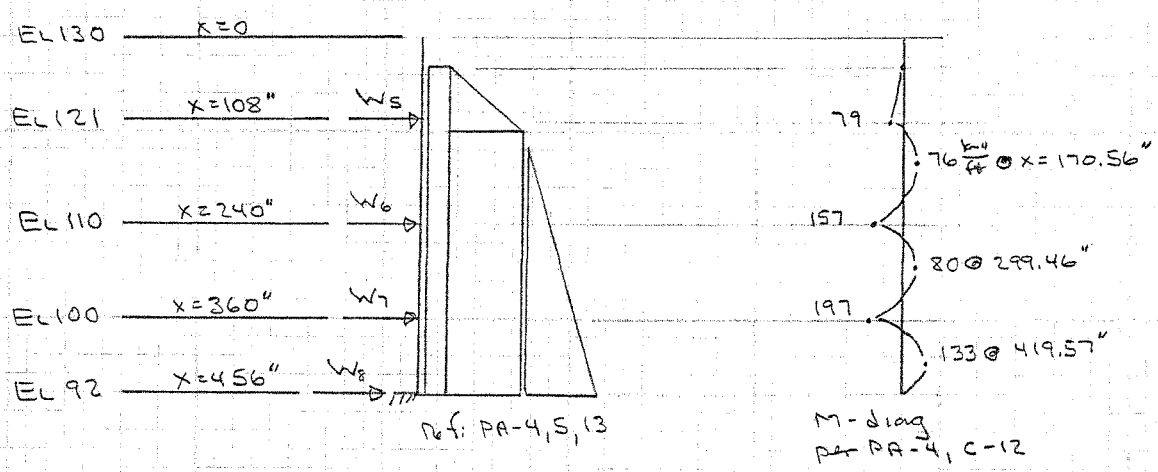
Ref: PA-2, 3, 11

M-diagram
Per PA-2, C-3

ANALYSIS RESULTS

ELEV	WITH SURCH Ref: PA-2 $\Sigma F = 46,026$ #/ft	W/O SURCH Ref: PA-3 $\Sigma F = 40,776$ #/ft	CRANE LOAD Ref: PA-11 $\Sigma F = 4496$ #/ft
	Ref: C-1 to C-3 $\Sigma F = 46,026$ #/ft OK	Ref: C-4 to C-6 $\Sigma F = 40,776$ #/ft OK	Ref: C-7 to C-9 $\Sigma F = 4497$ #/ft OK
121	$W_1 = 4415$ #/ft	$W'_1 = 2542$ #/ft	$W''_1 = 1660$ #/ft
110	$W_2 = 12,534$ #/ft	$W'_2 = 11,128$ #/ft	$W''_2 = 2095$ #/ft
100	$W_3 = 21,064$ #/ft	$W'_3 = 19,533$ #/ft	$W''_3 = 620$ #/ft
92	$W_4 = 8014$ #/ft	$W'_4 = 7573$ #/ft	$W''_4 = 123$ #/ft

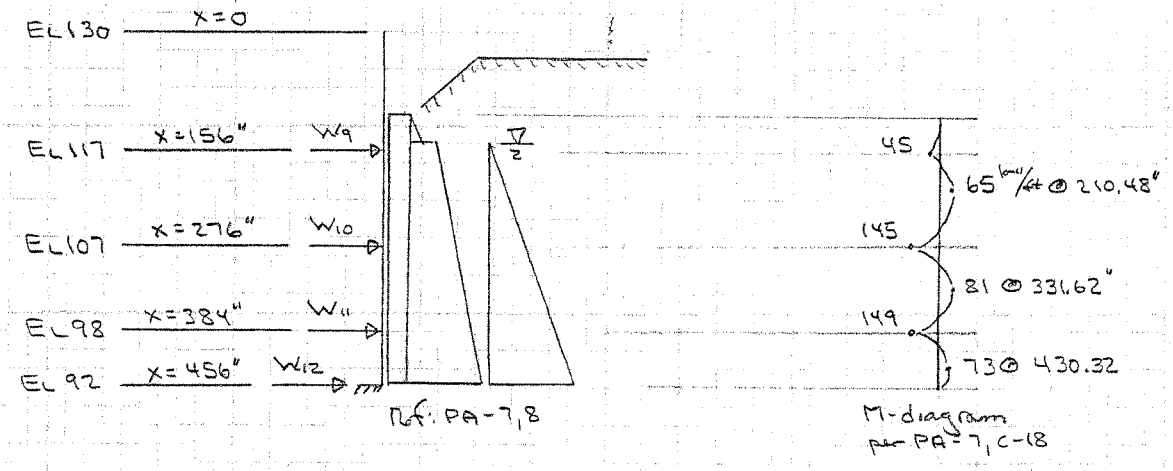
ITEM No. 2 - SOIL AT EL 127 BOTTOM EL 92
- TRAPAZOIDAL DISTRIBUTION
- WATER EL 118
- WALES AT EL 121, 110, 100



ANALYSIS RESULTS

ELEV	WITH SURCH Ref: PA-4 $\Sigma F = 50{,}024$ #/ft	W/O SURCH Ref: PA-5 $\Sigma F = 44{,}744$ #/ft	CRANE LOAD Ref: PA-11 Same as WA-1
	Ref: C-10 to C-12 $\Sigma F = 50{,}024$ #/ft OK	Ref: C-13 to C-15 $\Sigma F = 44{,}774$ #/ft OK	
121	$W_5 = 7636$ #/ft	$W'_5 = 5763$ #/ft	$W_1'' = 1660$ #/ft
110	$W_6 = 14{,}771$ #/ft	$W'_6 = 13{,}365$ #/ft	$W_2'' = 2095$ #/ft
100	$W_7 = 20{,}241$ #/ft	$W'_7 = 18{,}711$ #/ft	$W_3'' = 620$ #/ft
92	$W_8 = 7376$ #/ft	$W'_8 = 6935$ #/ft	$W_4'' = 123$ #/ft

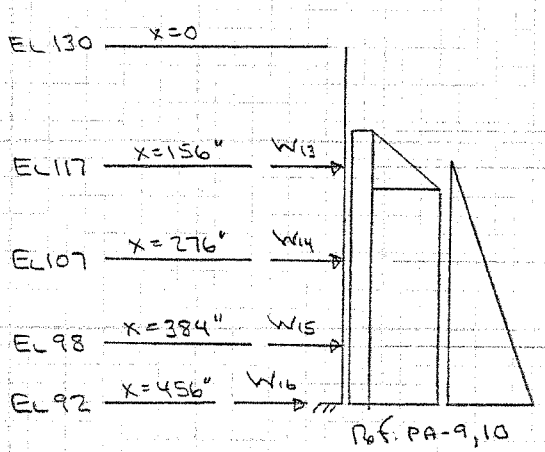
ITEM No. 3 - SOIL AT EL 121 BOTTOM EL 92
- RANKINE DISTRIBUTION
- WATER EL 118
- WALES AT EL 117, 107, 98



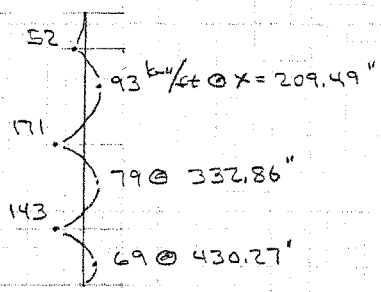
ANALYSIS RESULTS

ELEV	WITH SURCH Ref: PA-6,7 $\Sigma F = 44,466$ #/ft	W/O SURCHARGE Ref: PA-8 $\Sigma F = 40,116$ #/ft	CRANE LOAD Ref: PA-13 $\Sigma F = 2115$ #/ft
	Ref: C-16 to C-18 $\Sigma F = 44,466$ #/ft OK	Ref: C-19 to C-21 $\Sigma F = 40,116$ #/ft OK	Ref: C-22 to C-24 $\Sigma F = 2115$ #/ft OK
117	$W_q = 5719$ #/ft	$W'_q = 4368$ #/ft	$W''_q = 302$ #/ft
107	$W_{10} = 14,626$ #/ft	$W'_{10} = 13,160$ #/ft	$W''_{10} = 1008$ #/ft
98	$W_{11} = 18,386$ #/ft	$W'_{11} = 17,166$ #/ft	$W''_{11} = 679$ #/ft
92	$W_{12} = 5735$ #/ft	$W'_{12} = 5422$ #/ft	$W''_{12} = 126$ #/ft

ITEM No. 4 - SOIL AT EL 121, BOTTOM EL 92
- TRAPAZOIDAL DISTRIBUTION
- WATER EL 118
- WALES AT EL 117, 107, 98



Ref. PA-9, 10

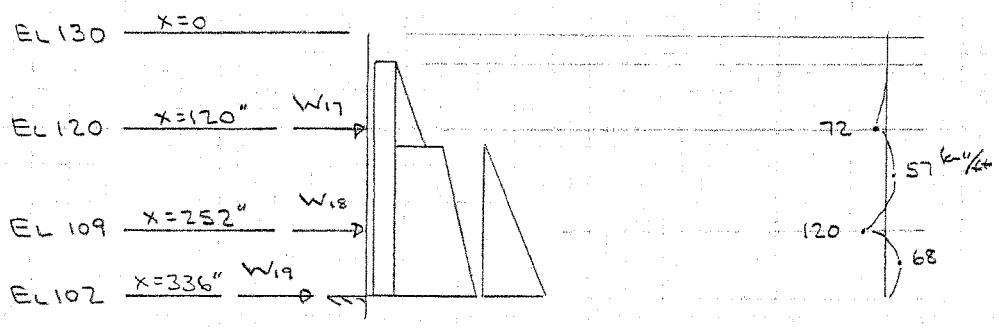


M-diagram
per PA-9, C-27

ANALYSIS RESULTS

ELEV	WITH SURCH Ref: PA-9 ΣF = 47,692 #/ft	W/O SURCH. Ref: PA-10 ΣF = 43,342 #/ft	CRANE LOAD Ref: PA-13 Same as WA-3
	Ref: C-25 to C-27 ΣF = 47,692 #/ft ok	Ref: C-28 to C-30 ΣF = 43,342 #/ft ok	
117	W_{13} = 7486 #/ft	W'_{13} = 6135 #/ft	W''_9 = 302 #/ft
107	W_{14} = 16,832 #/ft	W'_{14} = 15,366 #/ft	W''_{10} = 1008 #/ft
98	W_{15} = 17,948 #/ft	W'_{15} = 16,727 #/ft	W''_{11} = 679 #/ft
92	W_{16} = 5427 #/ft	W'_{16} = 5114 #/ft	W''_{12} = 126 #/ft

ITEM No. 5 - SOIL AT EL 127, BOTTOM EL 102
- RANKINE DISTRIBUTION
- WATER EL 118
- WALES AT EL 120, 109

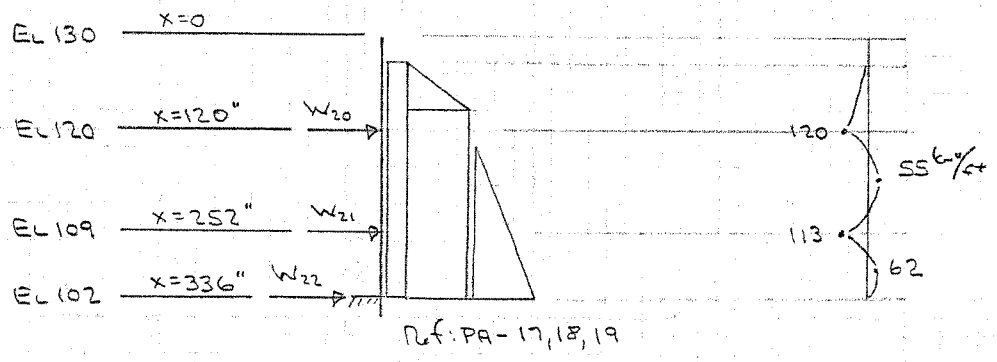


Ref: PA-15, 16, 19

ANALYSIS RESULTS

ELEV	WITH SURCH Ref: PA-15 ΣF = 22,594 #/ft	W/O SURCH Ref: PA-16 ΣF = 18,844 #/ft	CRANE LOAD Ref: PA-19 ΣF = 5652 #/ft
	Ref: C-31 to C-33 ΣF = 22,605 #/ft ✓	Ref: C-34 to C-36 ΣF = 18,844 #/ft ✓	Ref: C-37 to C-39 ΣF = 5652 #/ft ✓
120	W_{17} = 5449 #/ft	W'_{17} = 3296 #/ft	W''_{17} = 3589 #/ft
109	W_{18} = 12,591 #/ft	W'_{18} = 11,423 #/ft	W''_{18} = 1991 #/ft
102	W_{19} = 4565 #/ft	W'_{19} = 4126 #/ft	W''_{19} = 72 #/ft

ITEM No. 6 - SOIL AT EL 127, BOTTOM EL 102
- TRAPAZOIDAL DISTRIBUTION
- WATER EL 118
- WALE EL 120, 109



Ref: PA-17, 18, 19

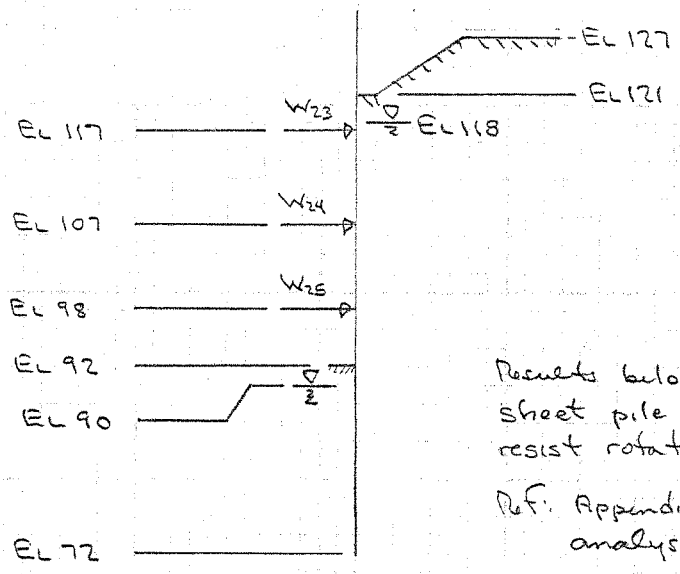
ANALYSIS RESULTS

ELEV	WITH SURCH Ref: PA-17 ΣF = 24,559 #/ft	W/O SURCH Ref: PA-18 ΣF = 20,809 #/ft	CRANE LOAD (Same as WA-5) ΣF = 5652 #/ft
	Ref: C-40 to C-42 ΣF = 24,559 #/ft	Ref: C-43 to C-45 ΣF = 20,809 #/ft	Ref: C-37 to C-39 ΣF = 5652 #/ft
120	W_{20} = 8324 #/ft	W'_{20} = 6171 #/ft	W'_{20} = 3589 #/ft
109	W_{21} = 12,071 #/ft	W'_{21} = 10,910 #/ft	W''_{21} = 1991 #/ft
102	W_{22} = 4164 #/ft	W'_{22} = 3728 #/ft	W''_{22} = 72 #/ft

ITEM No. 7- R=30' COFFERDAM

- SOIL AT EL 121
- EXCAV EL 92
- WATER EL 118
- WALES AT EL 117, 107, 98
- RANKINE DISTRIBUTION
- PROVISION FOR LOAD BELOW SUBGRADE

Use Shoring Suite software for evaluation of sheet pile loads below bottom of excavation Ref: Appendix B



Results below indicate load pattern if sheet pile strength is required to resist rotation about lower wale.

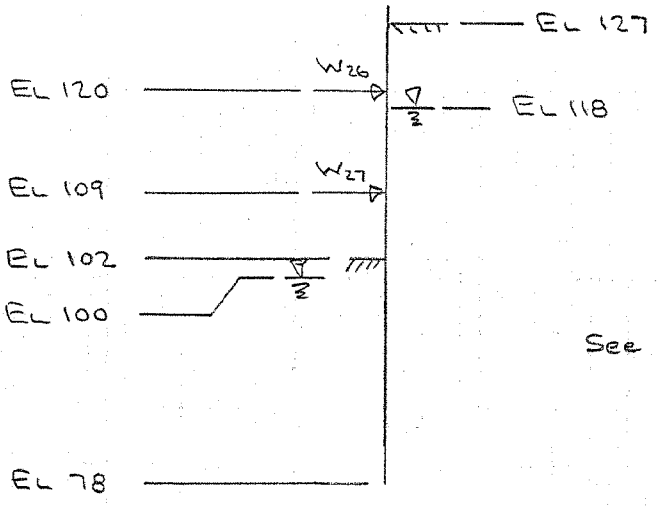
Ref: Appendix B for results of computer analysis

ELEV	WITH SURCH	W/O SURCH	CRANE LOAD
117	3.4 K/ft	2.1 K/ft	302 #/ft
107	2.7	0	1008 #/ft
98	33.6	33.9	679 #/ft

Ref: App. B B-1 to B-9 | Ref: App B B-10 to B-17 | Ref: WA-3

ITEM No. 8 – R = 40' COFFERDAM
- SOIL AT EL 127
- EXCAV EL 102
- WATER EL 118
- WALES AT EL 120, 109
- RANKINE DISTRIBUTION
- PROVISION FOR LOAD BELOW SUBGRADE

Ref: Appendix C



See note on WA-7

ELEV	WITH SURCH	W/O SURCH	CRANE LOAD
120	-2.8 k/ft	-3.5 k/ft	3589 #/ft
109	+23.5	+21.1	1991 #/ft

Ref: App C C-1 to C-8 | Ref App C C-9 to C-15 | Ref: WA-5

HARTMAN ENGINEERING

BY RJH DATE 3/9/06 SUBJECT RING DESIGN SHT.NO RD-1 OF

CHKD. BY GTB DATE 3/12/06 JOB NO. 06-602

ITEM No. 1 - SOIL ELEV 127
- WALES AT EL 121, 110, 100
- DIAMETER RANGE 50' TO 120'

DIA	WALE ELEV	DESIGN LOADS			Ref:	OPTIONS
		RANGE OF P	V_{MAX}	M_{MAX}		
50'	121	185 to 377^{k}	88.89^{k}	10,805^{k-ft}	RA-2	24x30 w/ 12#10
	110	342-597	62.65	7858		24x30 w/ 8#10
	100	531-783	41.91	5054		24x30 w/ 6#10
60	121	223-450	104.88	15,340	RA-2	24x42 w/ 12#10
	110	410-712	72.93	10,946		24x30 w/ 10#10
	100	637-939	49.62	7193		24x30 w/ 6#10
70	121	260-522	120.50	20,575	RA-2	30x42 w/ 6#18
	110	479-827	82.73	14,642		24x36 w/ 12#10
	100	743-1094	57.20	9676		24x36 w/ 8#10
80	121	297-593	111.52	21,966	RA-3	30x42 w/ 6#18
	110	547-942	92.05	18,634		24x42 w/12#10
	100	849-1249	64.63	12,493		24x42 w/ 8#10
90	121	334-664	150.64	33,098	RA-3	36x48 w/ 8#18
	110	616-1055	100.96	23,049		30x42 w/6#18
	100	955-1404	71.94	15,654		30x42 w/6#18
100	121	371-735	165.28	40,417	RA-3	36x54 w/8#18
	110	684-1169	109.51	27,896		36x54 w/ 6#18
	100	1062-1559	79.15	19,160		30x42 w/6#18

CONTINUED ON RD-2

HARTMAN ENGINEERING

BY RJH DATE 3/9/06 SUBJECT _____ SHT.NO RD-2 OF _____

CHKD. BY GTB DATE 3/12/06 _____ JOB NO. 06-602

DIA	WALE ELEV	DESIGN LOADS			Ref:	OPTIONS
		RANGE OF P	V_{MAX}	M_{MAX}		
110	121	409 - 806 k	179.67 k	48,397 k-in	RA-4	36x60 w/8#18
	110	752 - 1282	117.78	33,112	↓	36x54 w/6#18
	100	1168 - 1714	86.27	22,994		30x42 w/6#18
120	121	446 - 876	193.87	57,025	RA-4	36x60 w/10#18
	110	821 - 1395	125.79	38,685	↓	36x48 w/8#18
	100	1274 - 1869	93.31	27,151		30x42 w/6#18

ITEM No. 2 - SOIL ELEV 121
- WALES AT EL 117, 107, 98
- DIAMETER RANGE 50' TO 120'

DIA	WALE ELEV	DESIGN LOADS			Ref:	OPTIONS
		RANGE OF P	V_{MAX}	M_{MAX}		
50'	117	181-317 k	40.06 k	4736 k-ft	RA-6	16x28 w/6#9
	107	394-651	49.93	5998	↓	↓
	98	467-685	37.88	4537		
60'	117	217-380	47.85	6803	RA-6	24x30 w/6#10
	107	472-780	59.18	8584	↓	↓
	98	560-822	44.96	6497		
70'	117	254-443	55.56	9232	RA-6	24x30 w/10#10
	107	551-908	68.16	11,591	↓	24x30 w/10#10
	98	653-958	51.86	8782		24x30 w/6#10
80	117	290-506	63.20	12,019	RA-7	24x36 w/10#10
	107	630-1036	76.89	15,012	↓	24x36 w/10#10
	98	747-1093	58.59	11,380		24x36 w/8#10
90	117	326-569	70.77	15,158	RA-7	24x42 w/10#10
	107	709-1164	85.41	18,830	↓	24x42 w/10#10
	98	840-1229	65.17	14,289		24x42 w/8#10
100	117	363-632	78.33	18,646	RA-7	24x48 w/10#10
	107	788-1292	93.88	23,031	↓	24x48 w/10#10
	98	934-1364	71.73	17,495		24x42 w/10#10

CONTINUED ON RD-4

HARTMAN ENGINEERING

BY RJH DATE 3/9/06 SUBJECT _____ SHT.NO RD-4 OF _____

CHKD. BY GTB DATE 3/12/06 _____ JOB NO. 06-602

DIA.	WALE ELEV	DESIGN LOADS			REF:	OPTIONS
		RANGE OF P	V_{MAX}	M_{MAX}		
110	117	399-695	85.85	22,481	RA-8	30x42 w/6#18
	107	866-1419	102.20	27,603	↓	↓
	98	1027-1499	78.18	20,991		
120	117	435-757	93.31	26,659	RA-8	30x48 w/6#18
	107	945-1546	110.37	32,537	↓	30x48 w/6#18
	98	1120-1634	84.53	24,770		30x42 w/6#18

ITEM No. 3 - 60' DIA.
- WALES AT EL 117, 107, 98

WALE ELEV	ARC	DESIGN LOADS			Ref:	OPTIONS
		RANGE OF P	V	M		
117	110°	168-244	52.70	6796	RA-10	24" x 30" w/ 6#10 ↓
	125°	168-244	61.03	9144		
107	110°	496-725	55.72	7320	RA-10	24"x30" w/ 6#10 ↓
	125°	496-724	63.84	9798		
98	110°	588-843	42.35	5547	RA-10	24"x30" w/ 6#10 ↓
		1026-1456	19.92	2680		
	125°	588-843	48.61	7431		
		1026-1456	22.51	3564		

For prelim design, use 24"x30" w/ 6#10 for all sections

ITEM No. 4 - 80' DIA
- WALES AT EL 120, 109

WALE ELEV	ARC	DESIGN LOADS			Ref:	OPTIONS
		RANGE OF P	V	M		
120	100°	364 - 612^{k}	159.94	25,945$^{k''}$	RA-12	36" x 48" w/ 6#18
	130°	364-603	204.11	44,837		36" x 60" w/ 8#18
109	100°	1059 - 1539	107.36	17,228	RA-10	36" x 42" w/ 6#18
	130°	1059 - 1534	138.68	30,105		36" x 48" w/ 6#18

USE: ELEV 120

ARC = 100° → 36" x 48" w/ 6#18
130° → 36" x 60" w/ 8#18

SUPERCEEDED
SEE RD-7

ELEV 109

ARC = 100° → 36" x 42" w/ 6#18
130° → 36" x 48" w/ 6#18

ITEM No. 5 - 80' DIAMETER

- WALES AT EL 120, 109
- VERIFY USING 48", 60" WALE WIDTH

Ref: RD-6

At EL 109
width = 48" for all

At EL 120
width = 60" for all

} Use constant width versus reducing width in 100° arc, Difficulties in rebar bending outweigh savings in concrete.

$R_o = \frac{1}{2}(80.96) = 40.48'$

At El 109

$R_o/R_\ell = 40.48/(40.48 - 2.00) = 40.48/38.48 = 1.052$

At El 120

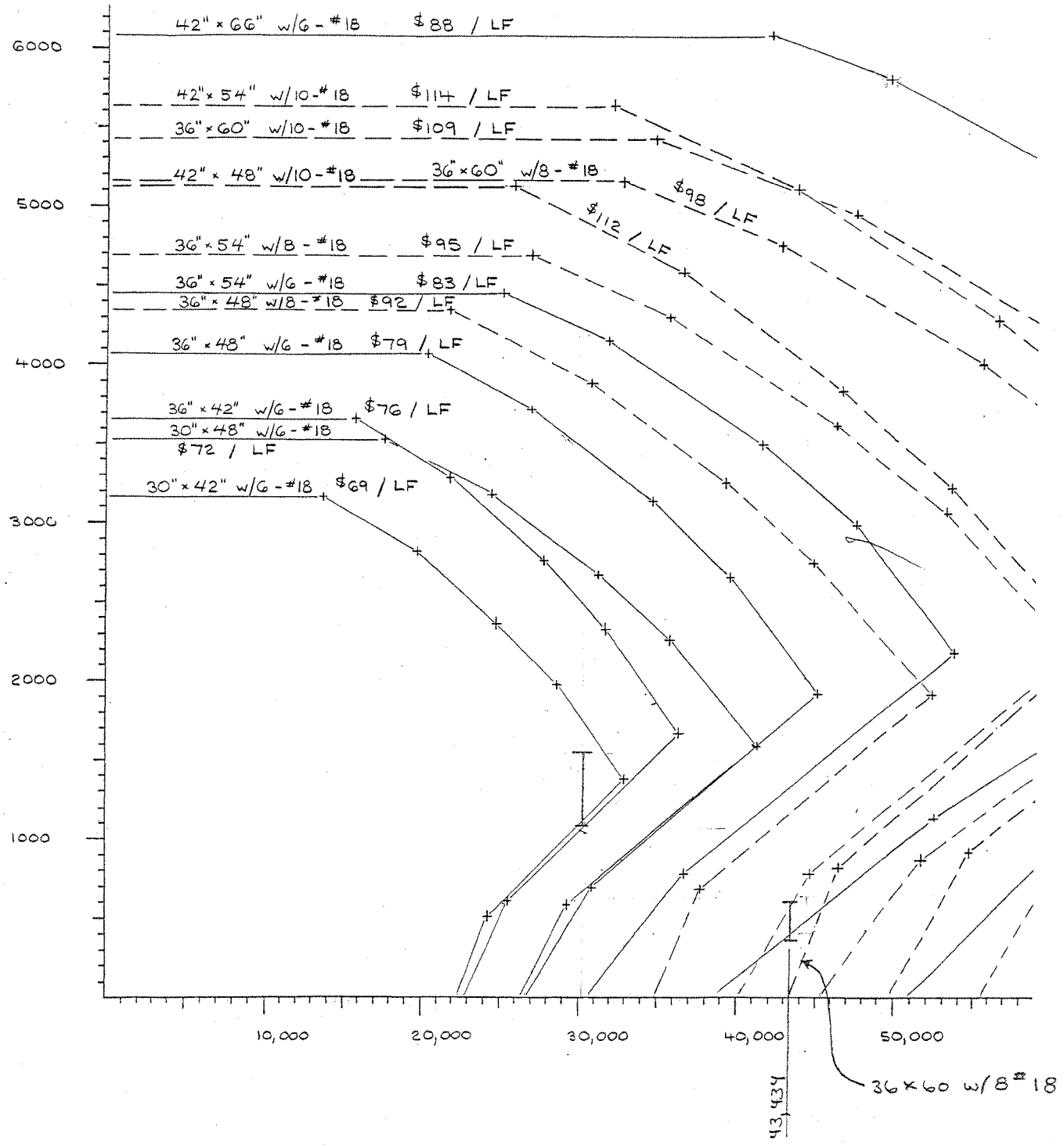
$R_o/R_\ell = 40.48/(40.48 - 2.5) = 40.48/37.98 = 1.066$

WALE ELEV	ARC	DESIGN LOADS			Ref:	OPTIONS Ref: RD-8
		P	V	M		
120	130	359 - 595 k	201.66 k	43,434 k-in	RA-14 ↓	36x60 w/ 8 # 18 ↓
	100	359 - 604	157.99	25,104		
109	130	1073 - 1554	139.84	30,139	RA-14 ↓	30x48 w/ 6 # 18 ↓
	100	1073 - 1559	108.18	17,232		

HARTMAN ENGINEERING

BY RJH DATE 5/20/06 SUBJECT _____ SHT.NO R0-8 OF _____

CHKD. BY _____ DATE _____ JOB NO. 06-602



Column Ties

At EL 120

36×60 w/ 8#18

(a) Min dia ties #4 Per ACI 7.10.5.1

(b) Maximum spacing Per ACI 7.10.5.2

1) 16 longitudinal bar dia = 16(2.25) = 36"
2) 48 tie bar dia = 48(0.5) = 24"
3) least dim of member = 36"

} Use #4@24"

At EL 109

30×48 w/ 6#18

(a) #4 min

(b) Max spacing

1) 16(2.25) = 36"
2) 48(0.5) = 24"
3) 30"

} Use #4@24"

Check Shear Cap'y

At EL 120

36×60 w/ 8#18

$P = 359 - 595^k$

$V = 201.66^k$ max

$V_u = \phi (V_c + V_s)$ (Ref ACI 11.1.1)

$\phi = 0.85$

$V_c = 2\left[1 + \frac{N_u}{2000 A_g}\right]\sqrt{f'_c}\, b_w d$ Ref: ACI 11.3.1.2

$d \approx 60 - 2 \text{ cover} - \frac{1}{2}(2\frac{1}{4}) = 56.75 \rightarrow$ Use 56"

$V_c = 2\left[1 + \frac{359{,}000}{2000(36)(60)}\right]\sqrt{4000}\,(36)(56)$

$= 276{,}198^{\#}$

$\phi V_c = 0.85(276{,}198) = 234{,}768^{\#} = 234.77^k > 201.66$ OK

AT EL 109

30 x 48 w/ 6 # 18

P = 1073 - 1554 k

V = 139.84 k

$d \approx 48 - 2 - 1.25 = 44.75'' \rightarrow$ Use 44"

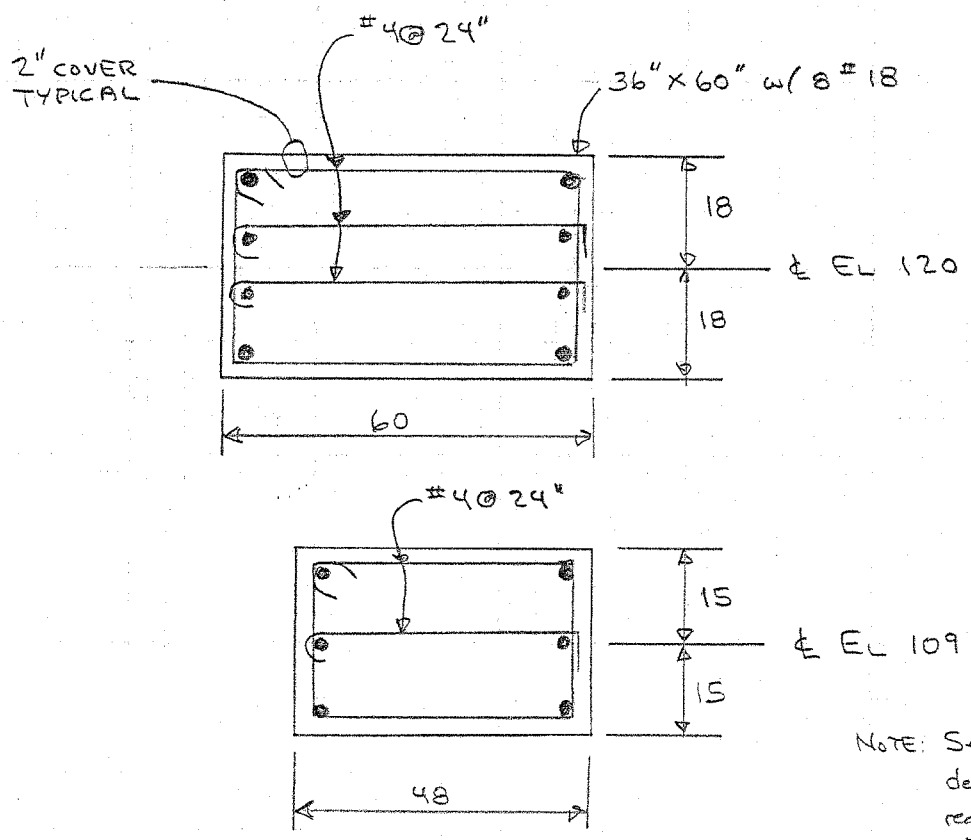
$$V_c = 2\left[1 + \frac{N_u}{2000 A_g}\right]\sqrt{f'_c}\, b_w d$$

$$= 2\left[1 + \frac{1{,}073{,}000}{2000(30)(44)}\right]\sqrt{4000}\,(30)(44)$$

$$= 234{,}831\# = 234.83^k$$

$$\phi V_c = 0.85(234.83) = 199.61^k > 139.84 \text{ OK}$$

SUMMARY FOR 80' DIA COFFERDAM



NOTE: See RD-11 for determination regarding add'l ties

Check clear distance between restrained bars (Ref: ACI 7.10.5.3)

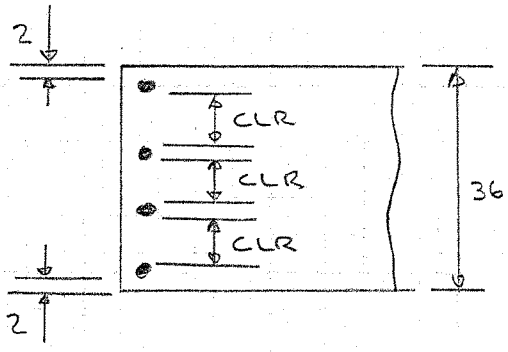
Max clear = 6"

At El 120

$$CLR = \frac{1}{3}\left[36 - 2 - 2 - 4\left(2\tfrac{1}{4}\right)\right]$$

$$= 7.66" > 6$$

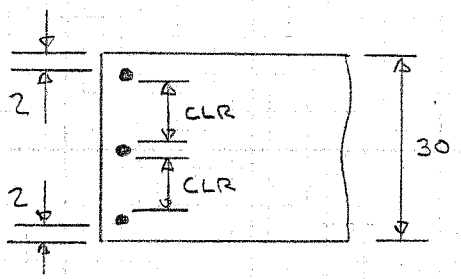
Need tie on all bars



At EL 109

$$CLR = \frac{1}{2}\left[30 - 2 - 2 - 3\left(2\tfrac{1}{4}\right)\right]$$

$$= 9.62" > 6$$



ITEM No. 6 - 60' DIAMETER
- WALES AT EL 117, 107, 98
- VERIFY & SELECT TIES

Wale dimensions used for the analyses on RA-9, RA-10 were 24" x 30" so there is no need to rerun the analyses.

EL 117

Design Loads (Ref: RA-10)

110°
P = 168 to 244 k
M = 6796 k-"

125°
P = 168 to 244 k
M = 9144 k-"

Ref: RD-13

Use 24" x 30" w/ 10 # 10

EL 107

Design Loads (Ref: RA-10)

110°
P = 496 to 725 k
M = 7320 k-"

125°
P = 496 to 724 k
M = 9798 k-"

Ref: RD-13

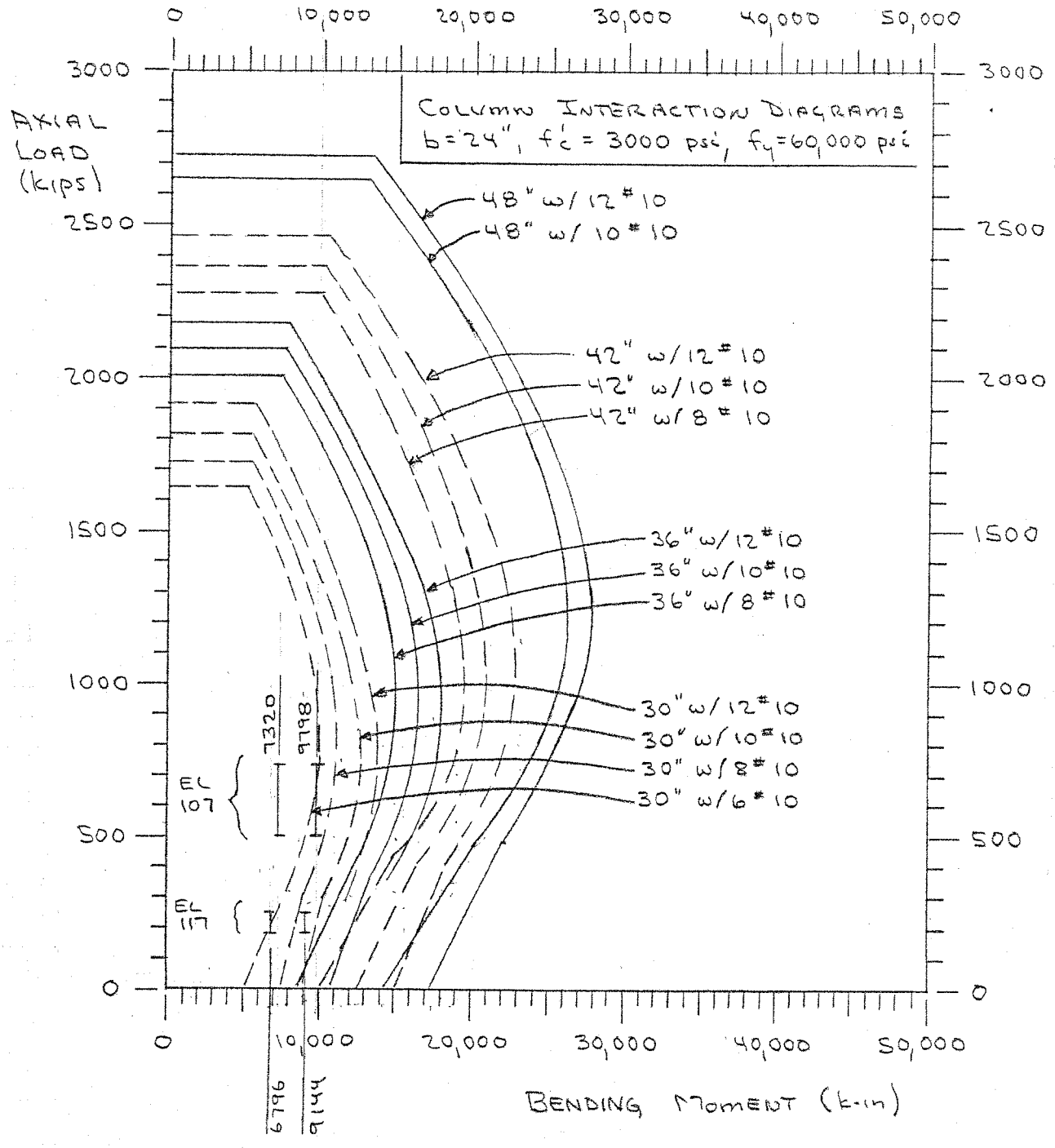
Use 24" x 30" w/ 8 # 10

(CON'T ON RD-14)

HARTMAN ENGINEERING

BY RJH DATE 5/21/06 SUBJECT _____ SHT.NO RD-13 OF _____

CHKD. BY GTB DATE 5/23/06 JOB NO. 06-602



EL 98

Design Loads (Ref: RA-10)

Evaluate two conditions, Trapazoidal & Loads from WA-7

110°

Trapazoidal

P = 588 to 843 k

M = 5547 k-in

From WA-7

P = 1026 to 1456 k

M = 2680 k-in

125°

Trapazoidal

P = 588 to 843 k-in

M = 7431 k-in

From WA-7

P = 1026 to 1456 k

M = 3564 k-in

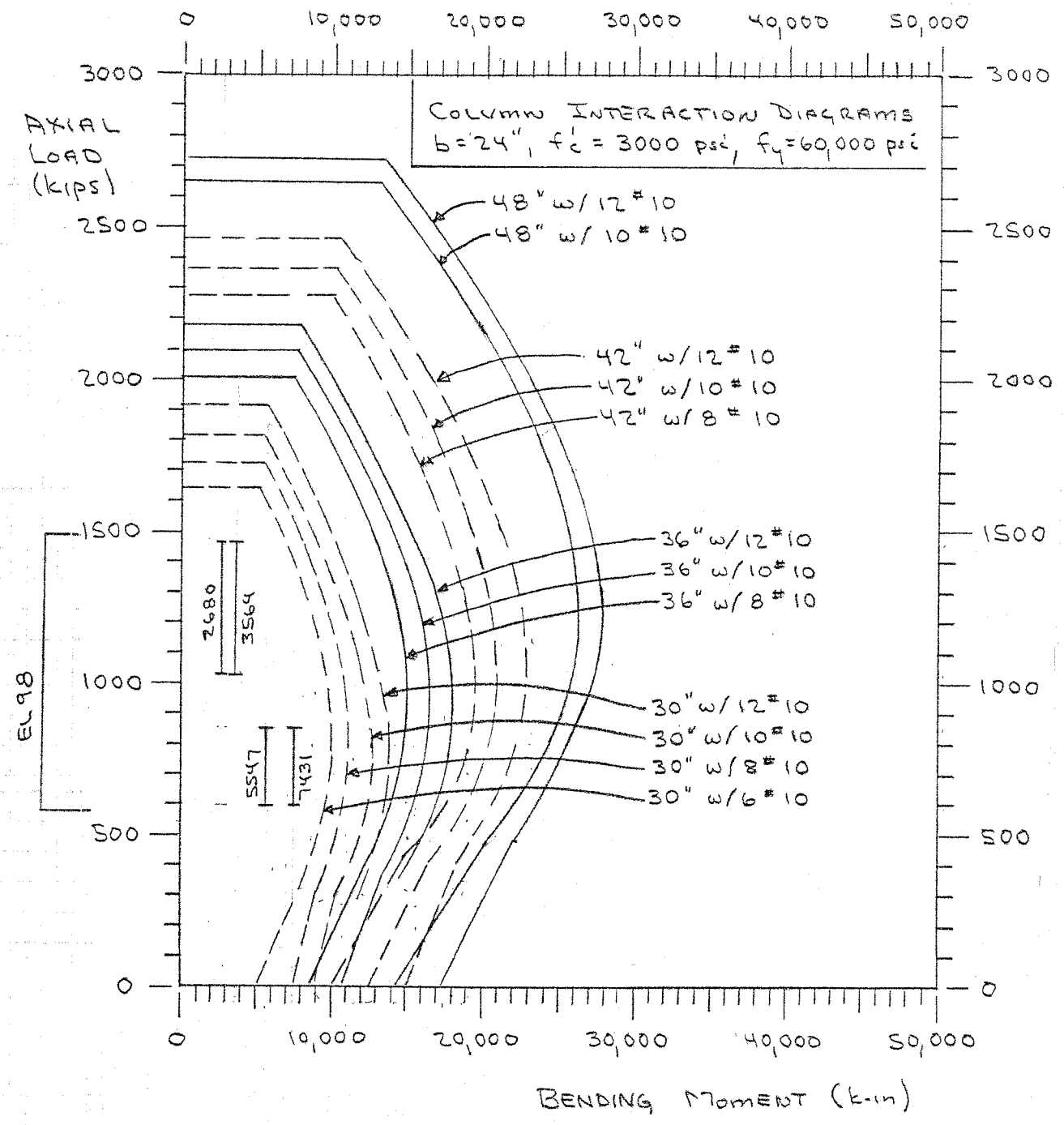
Ref: RD-15

Use 24" x 30" w/ 6 # 10

HARTMAN ENGINEERING

BY RJH DATE 5/21/06 SUBJECT _____ SHT.NO RD-15 OF _____

CHKD. BY GJB DATE 5/23/06 JOB NO. 06-602



Column Ties

Wales are 24" x 30" at all levels. Primary reinf is #10

Ties can be either #3 or #4 Per ACI 7.10.5.1

Maximum spacing Per ACI 7.10.5.2

1) 16 longit bar diameters = 16(1.25) = 20"

2) 48 tie bar diameters

= 48(0.5) = 24" for #4

= 48(0.375) = 18" for #3

3) least dimension of member = 24"

Use #3 @ 18"

CHECK SHEAR CAP'Y

AT EL 117

24" x 30" w/ 10#10

P = 168 to 244^k

V = 61.03^k (Ref: RA-10)

$V_u = \phi(V_c + V_s)$ (Ref: ACI 11.1.1)

$\phi = 0.85$

$V_c = 2\left[1 + \frac{N_u}{2000 A_g}\right] f'_c b_w d$ (Ref: ACI 11.3.1.2)

Use d = 30 - 2 cover - $\frac{1}{2}(1\frac{1}{4})$ = 26.75" → use 26"

$V_c = 2\left[1 + \frac{168{,}000}{2000(24)(30)}\right]\sqrt{4000}(24)(26) = 88{,}139\ \#$

$= 88.14^k$

$\phi V_c = 0.85(88.14) = 74.92^k > 61.03$ OK

AT EL 107

24" x 30" w/ 8#10

P = 496 to 725^k

V = 63.84^k (Ref: RA-10)

$$V_c = 2\left[1 + \frac{496{,}000}{2000(24)(30)}\right]\sqrt{4000}\,(24)(26) = 106{,}118^{\#}$$

$$= 106.12^{k}$$

$$\phi V_c = 0.85(106.12) = 90.20^{k} > 63.84 \text{ OK}$$

At El 98

24" x 30" w/ 6#10

P = 588 to 843^{k}

V = 48.61^{k} (Ref: RA-10)

$$V_c = 2\left[1 + \frac{588{,}000}{2000(24)(30)}\right]\sqrt{4000}\,(24)(26) = 111{,}160^{\#}$$

$$= 111.16^{k}$$

$$\phi V_c = 0.85(111.16) = 94.49^{k} > 48.61 \text{ OK}$$

Check clear distance between restrained bars (Ref ACI 7.10.5.3)

Max clear = 6"

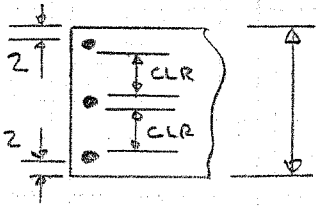
At EL 98

$$CLR = \frac{1}{2}\left[24 - 2 - 2 - 3\left(1\tfrac{1}{4}\right)\right]$$

$$= \frac{1}{2}[16.25]$$

$$= 8.125 > 6$$

∴ Need tie on center bar



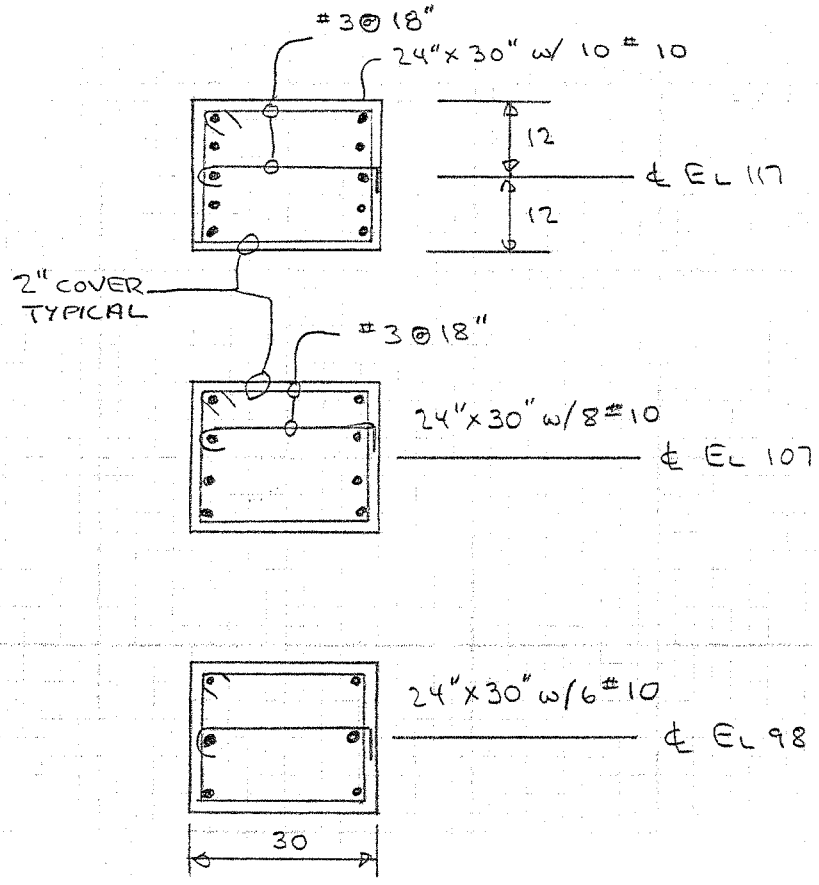
At El 107

$$CLR = \frac{1}{3}\left[24 - 2 - 2 - 4\left(1\tfrac{1}{4}\right)\right] = 5" \text{ OK}$$

At El 117

$$CLR = \frac{1}{4}\left[24 - 2 - 2 - 5\left(1\tfrac{1}{4}\right)\right] = 3.4" \text{ OK}$$

SUMMARY FOR 60' DIA COFFERDAM



HARTMAN ENGINEERING

BY RJH DATE 3/8/06 SUBJECT RING ANALYSIS SHT.NO RA-1 OF

CHKD. BY GJB DATE 3/12/06 JOB NO. 06-602

ITEM No. 1 - SOIL ELEV 127
- WALES AT EL 121, 110, 100
- RADIUS RANGE 25' to 60'

Estimate wale depth = 3% diameter for initial work
= 6% of radius
℄ radius = Outside radius − 3% (outside radius)
= 0.97 (outside radius)

Ref: WA-1

RANKINE DIST

El 121
$W_1 = 4415\ ^{\#}/_{ft}$ $\alpha = 4415/2542 = 1.737$ Crane Ld = $1660\ ^{\#}/_{ft}$

El 110
$W_2 = 12,534\ ^{\#}/_{ft}$ $\alpha = 12,534/11,128 = 1.126$ C.L. = $2095\ ^{\#}/_{ft}$

El 100
$W_3 = 21,064\ ^{\#}/_{ft}$ $\alpha = 21,064/19,533 = 1.078$ C.L. = $620\ ^{\#}/_{ft}$

Ref: WA-2

TRAPEZOIDAL DIST

El 121
$W_5 = 7636\ ^{\#}/_{ft}$ $\alpha = 7636/5763 = 1.325$ C.L. = $1660\ ^{\#}/_{ft}$

El 110
$W_6 = 14,771\ ^{\#}/_{ft}$ $\alpha = 14,771/13,365 = 1.105$ C.L. = $2095\ ^{\#}/_{ft}$

El 100
$W_7 = 20,241$ $\alpha = 20,241/18,711 = 1.082$ C.L. = $620\ ^{\#}/_{ft}$

} same

Distance from wale

$D = 11 + 1.5^{\pm} = 12.5'^{\pm}$ (Ref: PA-11)

HARTMAN ENGINEERING

BY RJH DATE 3/8/06 SUBJECT SHT.NO RA-2 OF

CHKD. BY GTB DATE 3/12/06 JOB NO. 06-602

TABULATION OF DESIGN LOADS

Dia	℄ Rad	Wale Elev	Soil Pr Distr.	Applied Load	Var. Factor	Design Loads			Ref.
						Range of P	Y	M	
50'	24.25'	121	Rank	4415 #/ft	1.737	185^k to 294^k	88.89^k	10,805 k-ft	RAC-1
			Trap	7636	1.325	245 - 377	73.76	9039	-2
		110	R	12,534	1.126	342 - 521	62.65	7858	RAC-3
			T	14,771	1.105	395 - 597	62.10	7793	-4
		100	R	21,064	1.078	550 - 783	41.58	5015	RAC-5
			T	20,241	1.082	531 - 756	41.91	5054	-6
60'	29.10	121	R	4415	1.737	223 - 350	109.88	15,340	RAC-7
			T	7636	1.325	294 - 450	86.72	12,798	-8
		110	R	12,534	1.126	410 - 622	72.93	10,835	RAC-9
			T	14,771	1.105	474 - 712	72.26	10,946	-10
		100	R	21,064	1.078	660 - 939	49.23	7,137	RAC-11
			T	20,241	1.082	637 - 906	49.62	7,193	-12
70'	33.95	121	R	4415	1.737	260 - 405	120.50	20,575	RAC-13
			T	7636	1.325	343 - 522	99.31	17,115	-14
		110	R	12,534	1.126	479 - 722	82.73	14,642	RAC-15
			T	14,771	1.105	554 - 827	81.95	14,515	-16
		100	R	21,064	1.078	770 - 1094	56.74	9601	RAC-17
			T	20,241	1.082	743 - 1056	57.20	9676	-18

HARTMAN ENGINEERING

BY RJH DATE 3/8/06 SUBJECT SHT.NO RA-3 OF

CHKD. BY GTB DATE 3/12/06 JOB NO. 06-602

TABULATION OF DESIGN LOADS - CONTINUED

DIA	℄ RAD	WALE ELEV	SOIL PR DIST	APPLIED LOAD	VAR FACTOR	DESIGN LOADS			Ref:
						RANGE OF P	V	M	
80'	38.80	121	R	4415	1.737	297 to 416^{k}	102.04^{k}	19,113$^{k-"}$	RAC-19
			T	7636	1.325	392 - 593	111.52	21,966	-20
		110	R	12,534	1.126	547 - 822	92.05	18,634	RAC-21
			T	14,771	1.105	633 - 942	91.16	18,468	-22
		100	R	21,064	1.078	881 - 1249	64.11	12,395	RAC-23
			T	20,241	1.082	849 - 1206	64.63	12,493	-24
90'	43.65	121	R	4415	1.737	334 - 514	150.64	33,098	RAC-25
			T	7636	1.325	441 - 664	123.40	27,377	-26
		110	R	12,534	1.126	616 - 920	100.96	23,049	RAC-27
			T	14,771	1.105	712 - 1055	99.96	22,839	-28
		100	R	21,064	1.078	991 - 1404	71.35	15,530	RAC-29
			T	20,241	1.082	955 - 1355	71.94	15,654	-30
100'	48.50	121	R	4415	1.737	371 - 569	165.28	40,417	RAC-31
			T	7636	1.325	490 - 735	135.01	33,356	-32
		110	R	12,534	1.126	684 - 1019	109.51	27,896	RAC-33
			T	14,771	1.105	791 - 1169	108.40	27,637	-34
		100	R	21,064	1.078	1101 - 1559	78.49	19,007	RAC-35
			T	20,241	1.082	1062 - 1505	79.15	19,160	-36

HARTMAN ENGINEERING

BY RJH DATE 3/8/06 SUBJECT SHT.NO RA-4 OF

CHKD. BY GTB DATE 3/12/06 JOB NO. 06-602

TABULATION OF DESIGN LOADS - CONTINUED

DIA	℄ RAD	WALE ELEV	SOIL PR. DIST	APPLIED LOAD	VAR FACTOR	DESIGN LOADS			Ref:
						RANGE OF P	V	M	
110'	53.35	121	R	4415	1.737	409-623^{k}	179.67^{k}	48,397$^{k''}$	RAC-37
			T	7636	1.325	539-806	146.38	39,852	-38
		110	R	12,534	1.126	752-1117	117.78	33,112	RAC-39
			T	14,771	1.105	870-1282	116.56	32,799	-40
		100	R	21,064	1.078	1211-1714	85.55	22,808	RAC-41
			T	20,241	1.082	1168-1654	86.27	22,994	-42
120	58.20	121	R	4415	1.737	446-677	193.87	57,025	RAC-43
			T	7636	1.325	588-876	157.55	46,856	-44
		110	R	12,534	1.126	821-1215	125.79	38,685	RAC-45
			T	14,771	1.105	949-1395	124.45	38,312	-46
		100	R	21,064	1.078	1321-1869	92.53	26,930	RAC-47
			T	20,241	1.082	1274-1803	93.31	27,151	-48

ITEM No. 2 - SOIL ELEV 121
- WALES AT EL 117, 107, 98
- RADIUS RANGE 25' TO 60'

℄ radius = 0.97 (outside radius) Ref: RA-1

Ref: WA-3

RANKINE DIST

EL 117
W_9 = 5719 #/ft α = 5719/4368 = 1.309 C.L. = 302 #/ft

EL 107
W_{10} = 14,626 #/ft α = 14,626/13,160 = 1.111 C.L. = 1008 #/ft

EL 98
W_{11} = 18,386 #/ft α = 18,386/17,166 = 1.071 C.L. = 679 #/ft

Ref: WA-4

TRAPAZOIDAL DIST

EL 117
W_{13} = 7486 #/ft α = 7486/6135 = 1.220 C.L. = 302 #/ft

EL 107
W_{14} = 16,832 #/ft α = 16,832/15,366 = 1.095 C.L. = 1008 #/ft

EL 98
W_{15} = 17,948 #/ft α = 17,948/16,727 = 1.073 C.L. = 679 #/ft

Distance from wall

D = 22 + 1.5± = 23.5' ± (Ref: PA-13)

HARTMAN ENGINEERING

BY RJH DATE 3/8/06 SUBJECT SHT.NO RA-6 OF

CHKD. BY GTJ DATE 3/12/06 JOB NO. 06-602

TABULATION OF DESIGN LOADS

DIA	℄ RAD	WALE ELEV.	SOIL PR DIST	APPLIED LOAD	VAR FACTOR	DESIGN LOADS			Rℓ
						RANGE OF P	V	M	
50'	24.25'	117	R	5719 #/ft	1.309	181 to 261 k	40.06 k	4736 k-ft	RAC-49
			T	7486	1.220	221 - 317	37.70	4460	-50
		107	R	14,626	1.111	394 - 577	49.93	5998	RAC-51
			T	16,832	1.095	446 - 651	49.45	5942	-52
		98	R	18,386	1.071	477 - 685	39.78	4526	RAC-53
			T	17,948	1.073	467 - 670	37.88	4537	-54
60'	29.10	117	R	5719	1.309	217 - 313	47.85	6803	RAC-55
			T	7486	1.220	265 - 380	45.02	6406	-56
		107	R	14,626	1.111	472 - 690	59.18	8584	RAC-57
			T	16,832	1.095	536 - 780	58.60	8503	-58
		100	R	18,386	1.071	573 - 822	44.84	6482	RAC-59
			T	17,948	1.073	560 - 804	44.96	6497	-60
70	33.95	117	R	5719	1.309	254 - 365	55.56	9232	RAC-61
			T	7486	1.220	310 - 443	52.26	8692	-62
		107	R	14,626	1.111	551 - 805	68.16	11,591	RAC-63
			T	16,832	1.095	625 - 908	67.49	11,481	-64
		100	R	18,386	1.071	668 - 958	51.72	8760	RAC-65
			T	17,948	1.073	653 - 937	51.86	8782	-66

HARTMAN ENGINEERING

BY RJH DATE 3/8/06 SUBJECT SHT.NO RA-7 OF

CHKD. BY GTB DATE 3/17/06 JOB NO. 06-602

TABULATION OF DESIGN LOADS - CONTINUED

DIA.	℄ RAD	WALE ELEV.	SOIL PR DIST	APPLIED LOAD	VAR. FACTOR	DESIGN LOADS			Ref:
						RANGE OF P	V	M	
80	38.80	117	R	5719	1.309	290-417	63.20	12,019	RAC-67
			T	7486	1.220	354-506	59.43	11,312	-68
		107	R	14,626	1.111	630-918	76.89	15,012	RAC-69
			T	16,832	1.095	715-1036	76.13	14,869	-70
		98	R	18,386	1.071	764-1093	58.44	11,352	RAC-71
			T	17,948	1.073	747-1070	58.59	11,380	-72
90	43.65	117	R	5719	1.309	326-468	70.77	15,158	RAC-73
			T	7486	1.220	398-569	66.53	14,264	-74
		107	R	14,626	1.111	709-1031	85.41	18,830	RAC-75
			T	16,832	1.095	804-1164	84.55	18,649	-76
		98	R	18,386	1.071	859-1229	65.00	14,253	RAC-77
			T	17,948	1.073	840-1202	65.17	14,289	-78
100	48.50	117	R	5719	1.309	363-520	78.33	18,646	RAC-79
			T	7486	1.220	442-632	73.62	17,542	-80
		107	R	14,626	1.111	788-1143	93.88	23,031	RAC-81
			T	16,832	1.095	893-1292	92.92	22,807	-82
		98	R	18,386	1.071	955-1364	71.54	17,451	RAC-83
			T	17,948	1.073	934-1335	71.73	17,495	-84

HARTMAN ENGINEERING

BY RJH DATE 3/9/06 SUBJECT SHT.NO RA-8 OF

CHKD. BY GTJ DATE 3/12/06 JOB NO. 06-602

TABULATION OF DESIGN LOADS - CONTINUED

DIA.	℄ RAD	WALE ELEV	SOIL PR DIST.	APPLIED LOAD	VAR. FACTOR	DESIGN LOADS			Ref.
						RANGE OF P	V	M	
110'	53.35	117	R	5719	1.309	399-572	85.85	22,481	RAC-85
			T	7486	1.220	487-695	80.66	21,145	-86
		107	R	14,626	1.111	866-1256	102.20	27,603	RAC-87
			T	16,832	1.095	983-1419	101.14	27,333	-88
		98	R	18,386	1.071	1050-1499	77.97	20,938	RAC-89
			T	17,948	1.073	1027-1467	78.18	20,991	-90
120'	58.20	117	R	5719	1.309	435-623	93.31	26,659	RAC-91
			T	7486	1.220	531-757	87.66	25,069	-92
		107	R	14,626	1.111	945-1369	110.37	32,537	RAC-93
			T	16,832	1.095	1072-1546	109.22	32,215	-94
		98	R	18,386	1.071	1146-1634	84.31	24,707	RAC-95
			T	17,948	1.073	1120-1599	84.53	24,770	-96

ITEM No. 3 - R = 30' COFFERDAM
- PZC18 SHEET PILING → $R_{INSIDE\ PILING}$ = 30.53 feet
- SOIL ELEV 121 USING PRE-EXCAVATION
- BOTTOM EL = 92

Estimate wale dimensions: 24"x30" (ref: RD-3 with 60' DIA)

Ratio R_o/R_{ℓ} = $30.53/(30.53-\frac{2.5}{2}) = 30.53/29.28 = 1.043$

Use R_{ℓ} = 29.28

Applied Loads (Ref: RA-5)

EL 117

R:	$1.043\ W_9 = 1.043(5719) = 5965$ #/ft	$\alpha = 1.309$	C.L. = 302 #/ft
T:	$1.043\ W_{13} = 1.043(7486) = 7808$	$\alpha = 1.220$	C.L. = 302
WA-7	$1.043\ W_{23} = 1.043(3400) = 3546$	$\alpha = 1.619$	C.L. = 302

$\alpha = 3.4/2.1 = 1.619$

EL 107

R:	$1.043\ W_{10} = 1.043(14,626) = 15,255$	$\alpha = 1.111$	C.L. = 1008
T	$1.043\ W_{14} = 1.043(16,832) = 17,556$	$\alpha = 1.095$	C.L. = 1008
WA-7	$1.043\ W_{24} = 1.043(-)$ not applicable		~~C.L. = 1008~~

EL 98

R:	$1.043\ W_{11} = 1.043(18,386) = 19,177$	$\alpha = 1.071$	C.L. = 679
T:	$1.043\ W_{15} = 1.043(17,948) = 18,720$	$\alpha = 1.073$	C.L. = 679
WA-7	$1.043\ W_{25} = 1.043(33,600) = 35,045$	$\alpha = 0.991$	C.L. = 679

$\alpha = 33.6/33.9 = 0.991$

TABULATION OF DESIGN LOADS

R = 29.28' FOR ALL Crane dist = 23.5' for all

ARC	WALE ELEV	SOIL PRES TYPE	APPLIED LOAD	VAR FACTOR	DESIGN LOADS			Ref./NOTES
					RANGE OF P	V	M	
110°	117	RANK	5965 #/ft	1.309	228 - 329 k	45.20 k	5837 k-in	RAC-97
		TRAP	7808	1.220	278 - 399	42.52	5495	-98
		WA-7	3546	1.619	168 - 244	52.70	6796	-99
	107	RANK	15,255	1.111	496 - 725	55.72	7320	-100
		TRAP	17,556	1.095	562 - 818	55.18	7251	-101
		WA-7	—	—	—	—	—	—
	98	RANK	19,177	1.071	601 - 862	42.25	5534	RAC-102
		TRAP	18,720	1.073	588 - 843	42.35	5547	-103
		WA-7	35,045	0.991	1026 - 1456	19.92	2680	-104
125°	117	RANK	5965	1.309	228 - 328	52.29	7849	RAC-105
		TRAP	7808	1.220	278 - 399	49.18	7388	-106
		WA-7	3546	1.619	168 - 244	61.03	9144	-107
	107	RANK	15,255	1.111	496 - 724	63.84	9798	-108
		TRAP	17,556	1.095	562 - 817	63.20	9704	-109
		WA-7	—	—	—	—	—	—
	98	RANK	19,177	1.071	601 - 861	48.49	7412	RAC-110
		TRAP	18,720	1.073	588 - 843	48.61	7431	-111
		WA-7	35,045	0.991	1026 - 1456	22.51	3564	-112

HARTMAN ENGINEERING

BY RJH DATE 5/9/06 SUBJECT SHT.NO RA-10 OF

CHKD. BY GTB DATE 5/23/06 JOB NO. 06-602

ITEM No. 4 - R = 40' COFFERDAM

- PZC18 SHEET PILING → R_t = 40.48 feet
- SOIL ELEV 127
- BOTTOM ELEV 102

Estimate wale dimensions 24"x42" (ref. RD-1 w/ 80' Dia)

Ratio $R_o/R_\ell = 40.48/\left(40.48 - \frac{21}{12}\right) = 40.48/38.73 = 1.045$

Use R_ℓ = 38.73'

Applied Loads

RANKINE DIST

EL 120

$w = 1.045\, W_{17} = 1.045(5449) = 5694$ #/ft

$\alpha = W_{17}/W'_{17} = 5449/3296 = 1.653$

EL 109

$w = 1.045\, W_{18} = 1.045(12,591) = 13,158$ #/ft

$\alpha = W_{18}/W'_{18} = 12,591/11,423 = 1.102$

TRAPAZOIDAL DIST

EL 120

$w = 1.045\, W_{20} = 1.045(8324) = 8698$ #/ft

$\alpha = W_{20}/W'_{20} = 8324/6171 = 1.349$

EL 109

$w = 1.045\, W_{21} = 1.045(12,071) = 12,614$ #/ft

$\alpha = W_{21}/W'_{21} = 12,071/10,910 = 1.106$

FROM WA-8

EL 120 → not applicable

EL 109

$w = 1.045\, W_{27} = 1.045(23,500) = 24,558$ #/ft

$\alpha = 23.5/21.1 = 1.114$

TABULATION OF DESIGN LOADS

R = 38.73' FOR ALL CRANE DIST @ 12.5' FOR ALL (REF RA-1)

ARC	WALE ELEV	SOIL PRES TYPE	APPLIED LOAD	VAR FACTOR	DESIGN LOADS			Ref:/ NOTES
					RANGE OF P	V	M	
100°	120	RANK	5694#/ft	1.653	364 - 612^{k}	159.94^{k}	25,945^{k-ft}	RAC-113
		TRAP	8698	1.349	454 - 738	142.68	23,318	-114
		WA-8	—	—	—	—	—	—
	109	RANK	13,158	1.102	561 - 842	70.51	11,620	RAC-115
		TRAP	12,614	1.106	540 - 812	70.38	11,601	-116
		WA-8	24,558	1.114	1059 - 1539	107.36	17,228	-117
130°	120	RANK	5694	1.653	364 - 603	209.11	44,837	RAC-118
		TRAP	8698	1.349	454 - 728	180.53	40,017	-119
		WA-8	—	—	—	—	—	—
	109	RANK	13,158	1.102	561 - 837	88.34	19,794	RAC-120
		TRAP	12,614	1.106	540 - 807	88.16	19,759	-121
		WA-8	24,558	1.114	1059 - 1534	138.68	30,105	-122

HARTMAN ENGINEERING

BY RJH DATE 5/9/06 SUBJECT SHT.NO RA-12 OF

CHKD. BY GJB DATE 5/22/06 JOB NO. 06-602

ITEM No. 5 - R = 40' COFFERDAM

R_I = 40.48'

SOIL EL 127

BOTT EL 102

VERIFY USING 48", 60" WALE WIDTH

Ref: RD-7

Applied Loads

RANKINE DIST

EL 120

$w = 1.052(W_{17}) = 1.052(5449) = 5732$ #/ft (Ref RD-7)

$\alpha = 1.653$ (Ref: RA-11)

EL 109

$w = 1.066(W_{18}) = 1.066(12,591) = 13,422$ #/ft

$\alpha = 1.102$

TRAPAZOIDAL DIST

EL 120

$w = 1.052(W_{20}) = 1.052(8324) = 8757$ #/ft

$\alpha = 1.349$

EL 109

$w = 1.066(W_{21}) = 1.066(12,071) = 12,868$ #/ft

$\alpha = 1.106$

FROM WA-8

EL 120 → not applicable

EL 109

$w = 1.066(W_{27}) = 1.066(23,500) = 25,051$ #/ft

$\alpha = 1.114$

TABULATION OF DESIGN LOADS

Crane distance = 12.5' for all (Ref: RA-1)

At EL 120

W''_{17} = 3589 #/ft

At EL 109

W''_{18} = 1991 #/ft

WALE ELEV/ Rt	ARC	SOIL PRES TYPE	APPLIED LOAD	VAR. FACTOR	DESIGN LOADS			Ref./ NOTES
					RANGE OF P	V	M	
120 R=37.98	100°	RANK	5732 #/ft	1.653	359-604 K	157.99 K	25,104 K-ft	RAC-123
		TRAP	8757	1.349	448-728	140.97	22,563	-124
		WA-8	—	—				
	130°	RANK	5732	1.653	359-595	201.66	43,434	RAC-125
		TRAP	8757	1.349	448-720	178.40	38,769	-126
		WA-8	—	—	—	—	—	
109 R=38.48	100°	RANK	13,422	1.102	569-853	70.83	11,585	RAC-127
		TRAP	12,868	1.106	547-822	70.70	11,565	-128
		WA-8	25,051	1.114	1073-1559	108.18	17,232	-129
	130°	RANK	13,422	1.102	569-848	88.82	19,754	RAC-130
		TRAP	12,868	1.106	547-818	88.64	19,719	-131
		WA-8	25,051	1.114	1073-1554	139.84	30,139	-132

Ref: RA-13

HARTMAN ENGINEERING

BY RJH DATE 5/20/06 SUBJECT SHT.NO RA-14 OF

CHKD. BY GTF DATE 5/23/06 JOB NO. 06-602

ITEM No. 1- OVERLAP OF CIRCULAR COFFERDAMS
DETERMINE ARC OF INTERFERENCE

Specified layout information

1) 40' radius, 25' deep

X = 691,447.5020'
Y = 2,958,537.1875

2) 30' radius, 35' deep

X = 691,392.9312
Y = 2,958 539.5333

The x,y differences between the centers are

$\Delta X = 447.5020 - 392.9312$
$= 54.5708$

$\Delta Y = 537.1875 - 539.5333$
$= -2.3458$

The distance between the centers is

$L = [54.5708^2 + 2.3458^2]^{1/2}$
$= 54.62'$

Ref: LG-2

Scaling the angles with a protractor

$\alpha_1 = 43.5°$

$\alpha_2 = 48.4°$

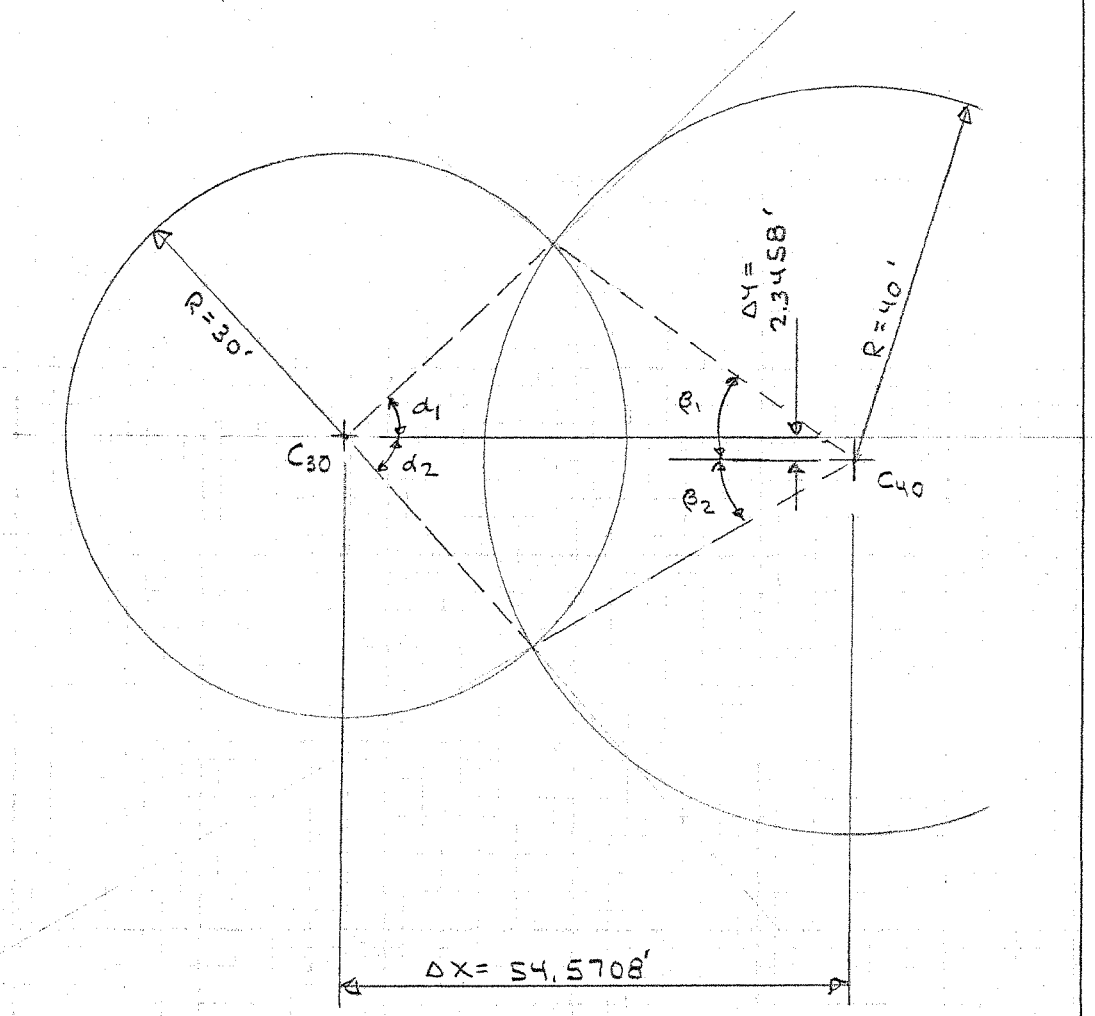
$\beta_1 = 35.7°$

$\beta_2 = 30.1°$

For ring designs consider the theoretical intercepted arcs to be

$\alpha_1 + \alpha_2 = 43.5 + 48.4 = 91.9°$
$\beta_1 + \beta_2 = 35.7 + 30.1 = 65.8°$

} to LG-3



Check reasonableness of scaled angles

In the x direction

$30(\cos\alpha_1) + 40(\cos\beta_1) = 54.24$ vs 54.57 OK

$30(\cos\alpha_2) + 40(\cos\beta_2) = 54.52$ vs 54.57 OK

In the y direction

$30(\sin\alpha_1) - 40(\sin\beta_1) = -2.69$ vs -2.35 OK

$-30(\sin\alpha_2) + 40(\sin\beta_2) = -2.37$ vs -2.35 OK

For practical considerations

(1) circumference may increase by 1 pair of sheet piles, say 4.5'. Radius increase = $4.5/\pi = 1.43'$

(2) sheet pile depth $\approx 18" = 1.5'$

Calculated potential radius increase is $1.43 + 1.5 = 2.93'$

Use 4' potential radius increase

For conservatism consider radii $\perp$ at circle intersections

To gain 4' arc distance in R = 30' circle

$$\Delta S = R\gamma$$

ΔS = arc distance

γ = angle in radians

$$\gamma_{30} = \frac{\Delta S}{R} = \frac{4}{30} = 0.133 \text{ radians} = 7.64°$$

To gain 4' arc distance in R = 40' circle

$$\gamma_{40} = \frac{\Delta S}{R} = \frac{4}{40} = 0.100 \text{ radians} = 5.73°$$

For design purposes

In the R = 30' circle, use

$$(\alpha_1 + \alpha_2) + 2\gamma_{30} = 91.9 + 2(7.64) = 107.2° \rightarrow \text{Use } 110°$$

Design with arcs 110°, 125°, 125°

In the R = 40' circle, use

$$(\beta_1 + \beta_2) + 2\gamma_{40} = 65.8 + 2(5.73) = 77.3°$$

Design with arcs ~~80°, 110°, 110°~~

100°, 130°, 130° Revised to reduce loads on longer wales

CAD Confirmation of calculated angles

The comparisons are:

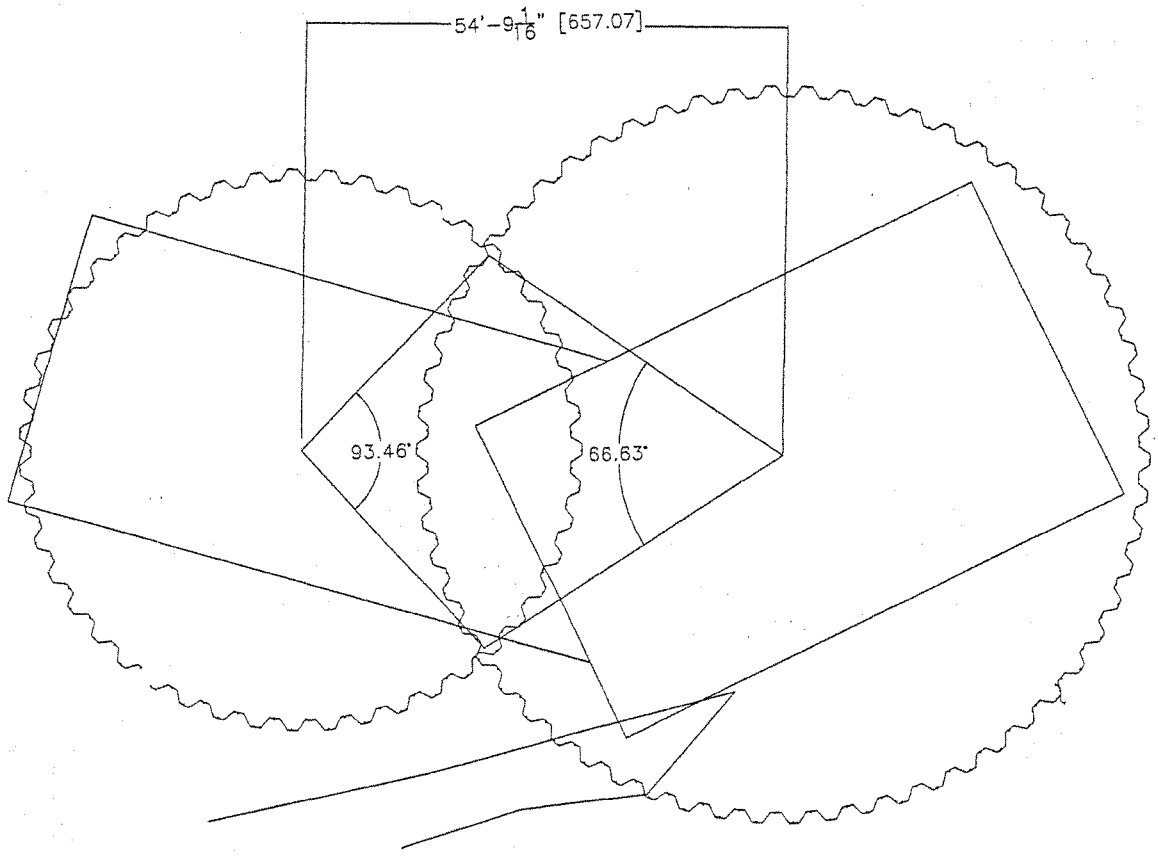
1) $\alpha_1 + \alpha_2 = 43.5 + 48.4 = 91.9°$ vs $93.46°$
2) $\beta_1 + \beta_2 = 35.7 + 30.1 = 65.8°$ vs $66.63°$

} OK

Design values of circular arcs are

1) $110° > 93.46$
2) ~~80°~~ > 66.6
   $100° > 66.6$

} OK



ITEM No. 2 - SHEET PILING LAYOUT
- 80' DIAMETER
- PZC18 SHEET PILING

For 80' Diameter

add sheet pile depth

$D+\Delta D = 80 + 15.25/12 = 81.27'$ for ℄ between flanges

$\text{Circum} = \pi(D+\Delta D) = 255.32' = 3063.84"$

No. sheet piles $= 3063.84/25 = 122.55 \rightarrow$ Use 124 pcs

For 124 Pcs PZC18

℄ circum $= 124(25) = 3100"$

℄ diam $= 3100/\pi = 986.76"$

inside diam $= 986.76 - 15.25 = 971.51" = 80' - 11\frac{1}{2}\pm$ (80.959')

ITEM No. 3 - SHEET PILING LAYOUT
- 60' DIAMETER
- PZC18 SHEET PILING

For 60' diameter

add sheet pile depth

D + AD = 60 + 15.25/12 = 61.27' for ℄ between flanges

Circum = π (D + AD) = 192.49' = 2309.86"

No. sheet piles = 2309.86/25 = 92.39 → Use 94 pcs

For 94 Pcs PCZ18

℄ circum = 94 (25) = 2350"

℄ diam = 2350/π = 748.03"

inside diameter = 748.03 - 15.25" = 732.78" = 61' - 0 3/4 ± (61.065')

ITEM No. 1 - WALE HANGER ASSEMBLY - 80' DIA COFFERDAM

Wales are

(a) 36" x 60" @ El 120

(b) 30" x 48" @ El 109

At El 120

Weight = $150(36 \times 60)/144 = 2250^{\#}/ft$

If use 2 rods at 45°, the tension per rod is

$T = \frac{1}{2}(2250)\sqrt{2} = 1591^{\#}/ft$ of wale

If use standard HE design with #8 rebar the stress is

$f_a = 1591^{\#}/0.79\ in^2 = 2014\ psi/ft$ of wale

If $F_a = 0.6 F_y = 0.6(60) = 36$ ksi

max S = $36{,}000/2014 = 17.9$ ft

Spacing of PZC18 sheet piling is 50" per pair

max no. pairs = $17.9(12)/50 = 4.3$

To provide for impact, etc, use spacing = 3 pairs = 150" = 12.5 ft

Tension load in rod is

$(1591^{\#}/ft)(12.5\ ft) = 19{,}888^{\#} = 19.89^{k}$

check: $f_a = 2014(19.89) = 40{,}058$ psi = 40.06 ksi ok

If use standard HE detail

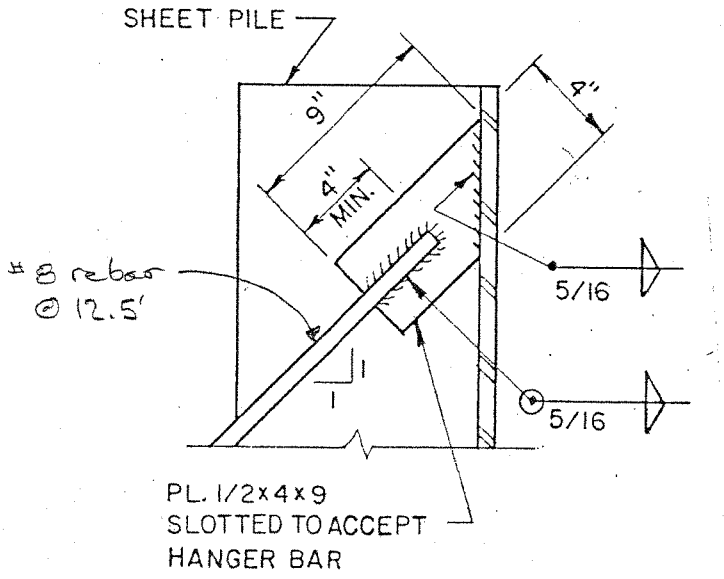
Ref: DE-2

The load in the weld between rebar and PL $\frac{1}{2}$ is

$19.89/16 = 1.24^{k}/in$ OK

The load on the weld between the PL $\frac{1}{2}$ and the sheet pile is

$19.89 / 2(4)\sqrt{2} = 1.76$ k/in OK



Use detail at El 120 & El 109

Space @ 12'-6

ITEM No. 2- WALE HANGER ASSEMBLY
- 60' DIA COFFERDAM

All wales are 24" x 30"

Weight = 150(24)(30)/144 = 750 #/ft

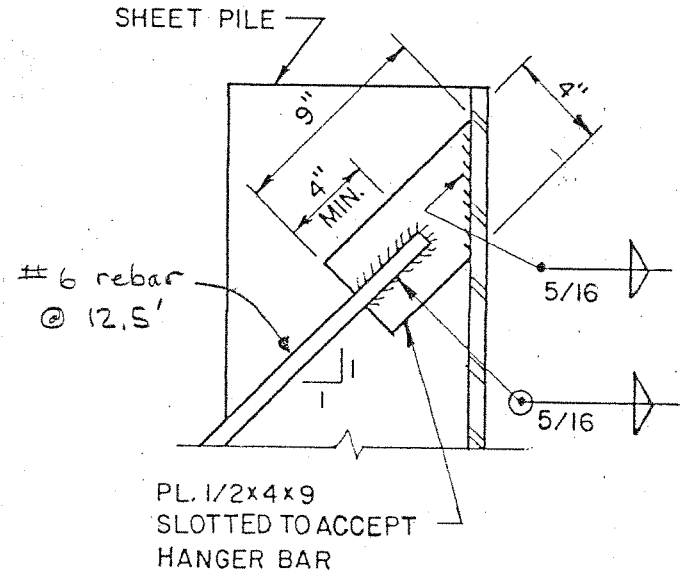
Consider that 3 pairs of sheet piles, or 12.5 ft, is max desirable spacing. The load on each bar is

$$T = \frac{1}{2}\left[750(12.5)\sqrt{2}\right] = 6629^{\#}$$

If use #6 bar w/ Area = 0.44 in²

$$f_a = 6629/0.44 = 15{,}066 \text{ psi} = 15.07 \text{ ksi} \quad \text{ok}$$

Use same connection detail



Use detail at El 117, EL 107, & EL 98

Space @ 12'-6

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 1 OF ____

CHKD. BY: _____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 1

INPUT DATA

Applied Load = 4415 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 1660 lb./ft.

Variation Factor = 1.737
Radius CL = 24.25 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	185	0.00	0	14	0.00	0	185 to 285	0.00	0
5	185	6.52	82	14	2.59	16	185 to 285	13.54	144
10	185	12.25	312	14	4.91	99	185 to 285	25.51	606
15	185	17.13	656	14	6.80	239	185 to 284	35.56	1326
20	185	21.11	1083	14	8.19	426	185 to 284	43.49	2241
25	185	24.16	1595	14	9.17	635	185 to 285	49.42	3314
30	185	26.30	2142	15	9.54	849	185 to 286	53.04	4442
35	185	27.54	2681	16	9.63	1086	185 to 287	54.94	5600
40	185	27.94	3232	17	9.26	1306	185 to 289	54.87	6747
45	185	27.56	3743	17	9.08	1500	185 to 290	54.04	7791
50	185	26.51	4209	18	8.27	1659	185 to 291	51.18	8714
55	185	24.87	4611	19	7.51	1782	185 to 292	47.60	9486
60	185	22.77	4940	19	6.91	1886	185 to 293	43.63	10123
65	185	20.32	5166	19	6.51	1954	185 to 294	39.53	10555
70	185	17.65	5313	20	6.34	1979	185 to 294	35.50	10805
75	185	14.88	5333	20	6.39	1961	185 to 294	31.69	10801
80	185	12.12	5246	20	6.65	1901	185 to 294	28.28	10578
85	185	12.60	5041	19	7.13	1798	185 to 294	29.78	10116
90	185	16.97	4700	19	8.51	1654	185 to 293	38.24	9392
95	185	21.60	4236	18	9.20	1469	185 to 292	45.90	8430
100	185	26.35	3647	18	9.55	1246	185 to 291	53.14	7225
105	185	31.20	2923	17	10.98	985	185 to 290	62.35	5768
110	185	36.09	2069	16	12.33	689	185 to 288	71.49	4069
115	185	40.80	1097	15	13.58	359	185 to 287	80.22	2147
120	185	45.55	0	14	14.77	0	185 to 285	88.89	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 2 OF ____

CHKD. BY: _____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 2

INPUT DATA

Applied Load = 7636 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 1660 lb./ft.

Variation Factor = 1.325
Radius CL = 24.25 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	245	0.00	0	14	0.00	0	245 to 368	0.00	0
5	245	4.97	63	14	2.59	16	245 to 368	11.38	116
10	245	9.34	238	14	4.91	99	245 to 368	21.44	502
15	245	13.07	500	14	6.80	239	245 to 368	29.87	1108
20	245	16.10	826	14	8.19	426	245 to 368	36.47	1881
25	245	18.43	1217	14	9.17	635	245 to 368	41.39	2784
30	245	20.06	1633	15	9.54	849	245 to 369	44.30	3731
35	245	21.00	2044	16	9.63	1086	245 to 371	45.79	4709
40	245	21.31	2465	17	9.26	1306	245 to 372	45.59	5673
45	245	21.02	2855	17	9.08	1500	245 to 373	44.88	6547
50	245	20.22	3210	18	8.27	1659	245 to 375	42.37	7315
55	245	18.97	3517	19	7.51	1782	245 to 376	39.33	7954
60	245	17.37	3767	19	6.91	1886	245 to 376	36.07	8482
65	245	15.50	3940	19	6.51	1954	245 to 377	32.78	8839
70	245	13.46	4052	20	6.34	1979	245 to 377	29.63	9039
75	245	11.35	4067	20	6.39	1961	245 to 377	26.75	9029
80	245	9.24	4001	20	6.65	1901	245 to 377	24.26	8834
85	245	9.61	3845	19	7.13	1798	245 to 377	25.59	8441
90	245	12.94	3584	19	8.51	1654	245 to 376	32.60	7831
95	245	16.47	3231	18	9.20	1469	245 to 375	38.72	7022
100	245	20.10	2782	18	9.55	1246	245 to 374	44.38	6013
105	245	23.79	2229	17	10.98	985	245 to 373	51.98	4796
110	245	27.52	1578	16	12.33	689	245 to 371	59.50	3381
115	245	31.12	836	15	13.58	359	245 to 370	66.66	1783
120	245	34.74	0	14	14.77	0	245 to 368	73.76	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 3 OF ____

CHKD. BY: _____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 3

INPUT DATA

Applied Load = 12534 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 2095 lb./ft.

Variation Factor = 1.126
Radius CL = 24.25 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	342	0.00	0	18	0.00	0	342 to 510	0.00	0
5	342	3.16	40	18	3.27	21	342 to 510	10.00	92
10	342	5.94	151	18	6.20	125	342 to 510	18.87	425
15	342	8.31	318	18	8.59	302	342 to 510	26.25	960
20	342	10.24	525	18	10.34	537	342 to 510	31.92	1650
25	342	11.73	774	18	11.57	802	342 to 510	36.10	2448
30	342	12.76	1039	19	12.04	1071	342 to 512	38.34	3277
35	342	13.36	1301	20	12.16	1371	342 to 513	39.39	4152
40	342	13.56	1568	21	11.69	1649	342 to 515	38.87	5000
45	342	13.38	1817	22	11.46	1893	342 to 517	38.22	5762
50	342	12.86	2042	23	10.43	2094	342 to 518	35.76	6420
55	342	12.07	2238	24	9.48	2249	342 to 520	33.02	6958
60	342	11.05	2397	24	8.72	2381	342 to 521	30.30	7404
65	342	9.86	2507	25	8.22	2466	342 to 521	27.79	7703
70	342	8.57	2579	25	8.00	2498	342 to 522	25.60	7858
75	342	7.22	2588	25	8.06	2476	342 to 522	23.82	7833
80	342	5.88	2546	25	8.40	2399	342 to 522	22.52	7644
85	342	6.11	2447	25	9.00	2270	342 to 521	23.88	7284
90	342	8.23	2281	24	10.74	2087	342 to 520	29.80	6743
95	342	10.48	2056	23	11.62	1854	342 to 519	34.43	6032
100	342	12.79	1770	23	12.05	1572	342 to 518	38.40	5152
105	342	15.14	1419	22	13.86	1243	342 to 516	44.76	4100
110	342	17.51	1004	21	15.56	869	342 to 514	50.98	2884
115	342	19.80	532	19	17.14	454	342 to 512	56.87	1517
120	342	22.11	0	18	18.64	0	342 to 510	62.65	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 4 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 4

INPUT DATA

Applied Load = 14771 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 2095 lb./ft.

Variation Factor = 1.105
Radius CL = 24.25 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	395	0.00	0	18	0.00	0	395 to 585	0.00	0
5	395	3.10	39	18	3.27	21	395 to 585	9.92	91
10	395	5.84	148	18	6.20	125	395 to 585	18.72	422
15	395	8.16	312	18	8.59	302	395 to 585	26.04	952
20	395	10.06	516	18	10.34	537	395 to 585	31.66	1637
25	395	11.52	760	18	11.57	802	395 to 585	35.80	2428
30	395	12.53	1021	19	12.04	1071	395 to 587	38.02	3251
35	395	13.12	1277	20	12.16	1371	395 to 588	39.05	4120
40	395	13.31	1540	21	11.69	1649	395 to 590	38.53	4961
45	395	13.14	1784	22	11.46	1893	395 to 592	37.88	5716
50	395	12.63	2006	23	10.43	2094	395 to 593	35.43	6369
55	395	11.85	2198	24	9.48	2249	395 to 595	32.72	6902
60	395	10.85	2354	24	8.72	2381	395 to 596	30.02	7344
65	395	9.69	2462	25	8.22	2466	395 to 596	27.54	7641
70	395	8.41	2532	25	8.00	2498	395 to 597	25.38	7793
75	395	7.09	2542	25	8.06	2476	395 to 597	23.64	7768
80	395	5.77	2500	25	8.40	2399	395 to 597	22.37	7580
85	395	6.01	2403	25	9.00	2270	395 to 596	23.73	7223
90	395	8.09	2240	24	10.74	2087	395 to 595	29.59	6686
95	395	10.29	2019	23	11.62	1854	395 to 594	34.17	5980
100	395	12.56	1738	23	12.05	1572	395 to 593	38.08	5107
105	395	14.87	1393	22	13.86	1243	395 to 591	44.38	4064
110	395	17.20	986	21	15.56	869	395 to 589	50.54	2859
115	395	19.45	522	19	17.14	454	395 to 587	56.37	1504
120	395	21.71	0	18	18.64	0	395 to 585	62.10	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 5 OF ____

CHKD. BY: _____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 5

INPUT DATA

Applied Load = 21064 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 620 lb./ft.

Variation Factor = 1.078
Radius CL = 24.25 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	550	0.00	0	5	0.00	0	550 to 780	0.00	0
5	550	3.29	41	5	0.97	6	550 to 780	6.26	69
10	550	6.18	157	5	1.83	37	550 to 780	11.78	283
15	550	8.65	331	5	2.54	89	550 to 780	16.43	616
20	550	10.66	547	5	3.06	159	550 to 780	20.12	1036
25	550	12.20	805	5	3.42	237	550 to 780	22.90	1531
30	550	13.28	1081	5	3.56	317	550 to 780	24.65	2053
35	550	13.90	1353	6	3.59	405	550 to 781	25.58	2585
40	550	14.10	1632	6	3.46	488	550 to 781	25.63	3114
45	550	13.92	1890	6	3.39	560	550 to 782	25.25	3599
50	550	13.38	2125	6	3.08	619	550 to 782	23.99	4029
55	550	12.56	2328	7	2.80	665	550 to 783	22.35	4391
60	550	11.50	2494	7	2.58	704	550 to 783	20.49	4690
65	550	10.26	2608	7	2.43	730	550 to 783	18.50	4893
70	550	8.91	2683	7	2.36	739	550 to 783	16.50	5013
75	550	7.51	2692	7	2.38	732	550 to 783	14.57	5015
80	550	6.11	2649	7	2.48	710	550 to 783	12.79	4916
85	550	6.36	2545	7	2.66	671	550 to 783	13.44	4706
90	550	8.57	2373	7	3.18	617	550 to 783	17.40	4373
95	550	10.90	2139	7	3.43	548	550 to 782	21.11	3928
100	550	13.30	1841	6	3.56	465	550 to 782	24.69	3369
105	550	15.75	1476	6	4.10	367	550 to 782	29.03	2692
110	550	18.22	1045	6	4.60	257	550 to 781	33.34	1900
115	550	20.60	554	5	5.07	134	550 to 780	37.47	1004
120	550	23.00	0	5	5.51	0	550 to 780	41.58	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 6 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 6

INPUT DATA

Applied Load = 20241 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 620 lb./ft.

Variation Factor = 1.082
Radius CL = 24.25 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	531	0.00	0	5	0.00	0	531 to 752	0.00	0
5	531	3.32	42	5	0.97	6	531 to 752	6.30	69
10	531	6.25	159	5	1.83	37	531 to 752	11.87	286
15	531	8.74	334	5	2.54	89	531 to 752	16.56	621
20	531	10.77	552	5	3.06	159	531 to 752	20.28	1044
25	531	12.32	814	5	3.42	237	531 to 752	23.08	1543
30	531	13.41	1092	5	3.56	317	531 to 753	24.84	2068
35	531	14.04	1367	6	3.59	405	531 to 753	25.78	2604
40	531	14.25	1648	6	3.46	488	531 to 754	25.83	3138
45	531	14.06	1909	6	3.39	560	531 to 754	25.45	3626
50	531	13.52	2147	6	3.08	619	531 to 755	24.18	4059
55	531	12.69	2352	7	2.80	665	531 to 755	22.53	4425
60	531	11.61	2519	7	2.58	704	531 to 756	20.65	4725
65	531	10.37	2635	7	2.43	730	531 to 756	18.65	4930
70	531	9.00	2710	7	2.36	739	531 to 756	16.63	5051
75	531	7.59	2720	7	2.38	732	531 to 756	14.68	5054
80	531	6.18	2676	7	2.48	710	531 to 756	12.88	4954
85	531	6.43	2571	7	2.66	671	531 to 756	13.53	4742
90	531	8.65	2397	7	3.18	617	531 to 755	17.52	4407
95	531	11.02	2161	7	3.43	548	531 to 755	21.27	3958
100	531	13.44	1860	6	3.56	465	531 to 755	24.88	3396
105	531	15.91	1491	6	4.10	367	531 to 754	29.25	2713
110	531	18.41	1055	6	4.60	257	531 to 754	33.60	1915
115	531	20.81	559	5	5.07	134	531 to 753	37.76	1011
120	531	23.23	0	5	5.51	0	531 to 752	41.91	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 7 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 7

INPUT DATA

Applied Load = 4415 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 1660 lb./ft.

Variation Factor = 1.737
Radius CL = 29.1 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	223	0.00	0	16	0.00	0	223 to 339	0.00	0
5	223	7.82	119	15	2.56	30	223 to 339	15.32	219
10	223	14.71	449	15	6.28	153	223 to 339	31.28	889
15	223	20.56	945	15	7.97	363	223 to 339	42.35	1942
20	223	25.33	1560	15	10.26	633	223 to 339	52.92	3261
25	223	29.00	2298	16	10.84	930	223 to 340	59.03	4799
30	223	31.56	3084	17	11.62	1232	223 to 341	63.95	6414
35	223	33.05	3860	18	11.21	1561	223 to 343	65.34	8059
40	223	33.52	4654	18	10.96	1860	223 to 344	65.59	9679
45	223	33.08	5391	19	9.95	2118	223 to 346	63.23	11149
50	223	31.81	6061	20	9.26	2329	223 to 347	60.29	12445
55	223	29.85	6640	21	8.37	2490	223 to 348	56.03	13530
60	223	27.33	7113	21	7.85	2608	223 to 349	51.62	14394
65	223	24.39	7439	22	7.66	2694	223 to 350	47.19	14994
70	223	21.18	7652	22	7.34	2721	223 to 350	42.14	15340
75	223	17.85	7679	22	7.64	2691	223 to 350	37.99	15327
80	223	14.54	7555	22	7.79	2604	223 to 350	33.61	15005
85	223	15.13	7260	21	8.75	2459	223 to 349	36.06	14346
90	223	20.37	6768	21	9.27	2259	223 to 348	44.27	13317
95	223	25.92	6100	20	10.67	2005	223 to 347	54.44	11950
100	223	31.63	5252	20	11.26	1698	223 to 346	63.42	10241
105	223	37.44	4210	19	12.50	1341	223 to 345	73.67	8174
110	223	43.31	2980	18	14.00	937	223 to 343	84.44	5766
115	223	48.96	1579	17	15.40	489	223 to 341	94.73	3043
120	223	54.66	0	16	16.67	0	223 to 339	104.88	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 8 OF ____

CHKD. BY: _____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 8

INPUT DATA

Applied Load = 7636 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 1660 lb./ft.

Variation Factor = 1.325
Radius CL = 29.1 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	294	0.00	0	16	0.00	0	294 to 439	0.00	0
5	294	5.96	91	15	2.56	30	294 to 439	12.72	179
10	294	11.21	342	15	6.28	153	294 to 439	26.39	740
15	294	15.68	721	15	7.97	363	294 to 438	35.51	1628
20	294	19.32	1189	15	10.26	633	294 to 438	44.50	2743
25	294	22.12	1752	16	10.84	930	294 to 439	49.39	4035
30	294	24.07	2352	17	11.62	1232	294 to 441	53.46	5389
35	294	25.20	2944	18	11.21	1561	294 to 442	54.36	6776
40	294	25.57	3550	18	10.96	1860	294 to 444	54.45	8133
45	294	25.23	4111	19	9.95	2118	294 to 446	52.24	9358
50	294	24.26	4622	20	9.26	2329	294 to 447	49.72	10432
55	294	22.77	5064	21	8.37	2490	294 to 448	46.11	11324
60	294	20.84	5425	21	7.85	2608	294 to 449	42.54	12030
65	294	18.60	5673	22	7.66	2694	294 to 449	39.08	12523
70	294	16.16	5836	22	7.34	2721	294 to 450	35.10	12798
75	294	13.62	5857	22	7.64	2691	294 to 450	32.05	12776
80	294	11.09	5762	22	7.79	2604	294 to 449	28.77	12495
85	294	11.54	5537	21	8.75	2459	294 to 449	31.04	11934
90	294	15.53	5162	21	9.27	2259	294 to 448	37.51	11068
95	294	19.77	4653	20	10.67	2005	294 to 447	45.83	9923
100	294	24.12	4006	20	11.26	1698	294 to 446	52.92	8496
105	294	28.55	3211	19	12.50	1341	294 to 444	61.23	6776
110	294	33.03	2273	18	14.00	937	294 to 443	70.05	4776
115	294	37.34	1205	17	15.40	489	294 to 441	78.46	2518
120	294	41.69	0	16	16.67	0	294 to 439	86.72	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 9 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 9

INPUT DATA

Applied Load = 12534 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 2095 lb./ft.

Variation Factor = 1.126
Radius CL = 29.1 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	410	0.00	0	20	0.00	0	410 to 609	0.00	0
5	410	3.79	57	20	3.24	38	410 to 609	10.82	147
10	410	7.13	218	19	7.93	193	410 to 608	23.48	634
15	410	9.98	458	19	10.06	459	410 to 608	31.08	1423
20	410	12.29	757	19	12.95	799	410 to 608	39.24	2419
25	410	14.07	1115	20	13.68	1174	410 to 609	42.96	3557
30	410	15.31	1497	21	14.67	1555	410 to 611	46.39	4741
35	410	16.04	1873	22	14.15	1970	410 to 613	46.52	5973
40	410	16.27	2259	23	13.84	2348	410 to 615	46.31	7155
45	410	16.05	2616	25	12.55	2674	410 to 617	43.82	8209
50	410	15.44	2941	26	11.69	2939	410 to 619	41.49	9116
55	410	14.49	3223	26	10.57	3142	410 to 620	38.25	9854
60	410	13.26	3452	27	9.91	3292	410 to 621	35.43	10430
65	410	11.84	3610	28	9.67	3400	410 to 622	33.03	10835
70	410	10.28	3714	28	9.26	3435	410 to 622	30.14	11039
75	410	8.66	3727	28	9.64	3397	410 to 622	28.52	10993
80	410	7.05	3667	28	9.83	3286	410 to 622	26.60	10721
85	410	7.34	3523	27	11.05	3104	410 to 621	29.06	10210
90	410	9.88	3285	26	11.69	2851	410 to 620	33.73	9447
95	410	12.58	2961	26	13.47	2530	410 to 619	40.52	8447
100	410	15.35	2549	25	14.21	2143	410 to 618	45.65	7213
105	410	18.17	2043	24	15.77	1693	410 to 616	52.26	5739
110	410	21.02	1446	22	17.67	1183	410 to 614	59.47	4036
115	410	23.76	766	21	19.43	617	410 to 611	66.31	2122
120	410	26.53	0	20	21.04	0	410 to 609	72.93	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 10 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 10

INPUT DATA

Applied Load = 14771 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 2095 lb./ft.

Variation Factor = 1.105
Radius CL = 29.1 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	474	0.00	0	20	0.00	0	474 to 699	0.00	0
5	474	3.73	56	20	3.24	38	474 to 699	10.73	145
10	474	7.01	214	19	7.93	193	474 to 698	23.30	628
15	474	9.80	450	19	10.06	459	474 to 698	30.83	1411
20	474	12.07	743	19	12.95	799	474 to 698	38.93	2400
25	474	13.82	1095	20	13.68	1174	474 to 699	42.61	3529
30	474	15.04	1470	21	14.67	1555	474 to 701	46.01	4703
35	474	15.75	1840	22	14.15	1970	474 to 703	46.12	5926
40	474	15.98	2218	23	13.84	2348	474 to 705	45.90	7098
45	474	15.76	2569	25	12.55	2674	474 to 707	43.42	8143
50	474	15.16	2889	26	11.69	2939	474 to 709	41.10	9042
55	474	14.23	3165	26	10.57	3142	474 to 710	37.89	9773
60	474	13.02	3390	27	9.91	3292	474 to 711	35.10	10344
65	474	11.62	3545	28	9.67	3400	474 to 712	32.73	10744
70	474	10.09	3647	28	9.26	3435	474 to 712	29.89	10946
75	474	8.51	3660	28	9.64	3397	474 to 712	28.31	10900
80	474	6.93	3601	28	9.83	3286	474 to 712	26.42	10629
85	474	7.21	3460	27	11.05	3104	474 to 711	28.88	10122
90	474	9.70	3226	26	11.69	2851	474 to 710	33.48	9364
95	474	12.35	2907	26	13.47	2530	474 to 709	40.20	8373
100	474	15.07	2503	25	14.21	2143	474 to 708	45.27	7149
105	474	17.84	2006	24	15.77	1693	474 to 706	51.80	5687
110	474	20.64	1420	22	17.67	1183	474 to 704	58.94	4000
115	474	23.34	753	21	19.43	617	474 to 701	65.71	2103
120	474	26.05	0	20	21.04	0	474 to 699	72.26	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 11 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 11

INPUT DATA

Applied Load = 21064 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 620 lb./ft.

Variation Factor = 1.078
Radius CL = 29.1 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	660	0.00	0	5	0.00	0	660 to 935	0.00	0
5	660	3.95	60	5	0.95	11	660 to 935	7.16	103
10	660	7.42	226	5	2.34	57	660 to 935	14.39	415
15	660	10.38	477	5	2.97	135	660 to 935	19.60	899
20	660	12.79	787	5	3.83	236	660 to 935	24.42	1505
25	660	14.64	1160	6	4.04	347	660 to 935	27.38	2215
30	660	15.93	1557	6	4.34	460	660 to 935	29.69	2963
35	660	16.68	1949	6	4.19	583	660 to 936	30.48	3720
40	660	16.93	2350	7	4.09	694	660 to 937	30.66	4471
45	660	16.70	2722	7	3.71	791	660 to 937	29.70	5156
50	660	16.06	3060	7	3.46	870	660 to 938	28.37	5763
55	660	15.07	3353	7	3.12	930	660 to 938	26.42	6275
60	660	13.80	3591	8	2.93	974	660 to 938	24.31	6685
65	660	12.31	3756	8	2.86	1006	660 to 939	22.11	6969
70	660	10.69	3863	8	2.74	1016	660 to 939	19.64	7137
75	660	9.01	3877	8	2.85	1005	660 to 939	17.47	7137
80	660	7.34	3815	8	2.91	972	660 to 939	15.23	6994
85	660	7.64	3665	8	3.27	918	660 to 938	16.25	6694
90	660	10.28	3417	7	3.46	843	660 to 938	20.28	6219
95	660	13.09	3080	7	3.98	748	660 to 938	25.10	5585
100	660	15.97	2652	7	4.20	634	660 to 937	29.51	4791
105	660	18.90	2125	7	4.66	501	660 to 937	34.40	3828
110	660	21.87	1505	6	5.23	350	660 to 936	39.51	2702
115	660	24.72	797	6	5.75	182	660 to 935	44.39	1427
120	660	27.60	0	5	6.22	0	660 to 935	49.23	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 12 OF ____

CHKD. BY: _____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 12

INPUT DATA

Applied Load = 20241 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 620 lb./ft.

Variation Factor = 1.082
Radius CL = 29.1 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	637	0.00	0	5	0.00	0	637 to 902	0.00	0
5	637	3.99	60	5	0.95	11	637 to 902	7.21	104
10	637	7.50	229	5	2.34	57	637 to 902	14.49	418
15	637	10.49	482	5	2.97	135	637 to 902	19.75	906
20	637	12.92	795	5	3.83	236	637 to 902	24.61	1516
25	637	14.79	1172	6	4.04	347	637 to 902	27.59	2231
30	637	16.09	1573	6	4.34	460	637 to 903	29.92	2985
35	637	16.85	1969	6	4.19	583	637 to 903	30.72	3748
40	637	17.10	2374	7	4.09	694	637 to 904	30.90	4505
45	637	16.87	2750	7	3.71	791	637 to 904	29.94	5195
50	637	16.22	3091	7	3.46	870	637 to 905	28.60	5807
55	637	15.22	3387	7	3.12	930	637 to 905	26.63	6323
60	637	13.94	3628	8	2.93	974	637 to 906	24.50	6736
65	637	12.44	3794	8	2.86	1006	637 to 906	22.29	7023
70	637	10.80	3903	8	2.74	1016	637 to 906	19.79	7192
75	637	9.10	3917	8	2.85	1005	637 to 906	17.60	7193
80	637	7.41	3854	8	2.91	972	637 to 906	15.33	7049
85	637	7.71	3703	8	3.27	918	637 to 906	16.36	6746
90	637	10.39	3452	7	3.46	843	637 to 905	20.43	6268
95	637	13.22	3112	7	3.98	748	637 to 905	25.29	5629
100	637	16.13	2679	7	4.20	634	637 to 904	29.73	4829
105	637	19.09	2147	7	4.66	501	637 to 904	34.67	3858
110	637	22.09	1520	6	5.23	350	637 to 903	39.82	2723
115	637	24.97	805	6	5.75	182	637 to 903	44.74	1438
120	637	27.88	0	5	6.22	0	637 to 902	49.62	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 13 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 13

INPUT DATA

Applied Load = 4415 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 1660 lb./ft.

Variation Factor = 1.737
Radius CL = 33.95 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	260	0.00	0	17	0.00	0	260 to 393	0.00	0
5	260	9.13	162	17	2.54	44	260 to 393	17.10	303
10	260	17.16	611	16	6.17	218	260 to 393	34.53	1227
15	260	23.99	1286	16	9.12	511	260 to 392	49.10	2671
20	260	29.56	2123	16	11.15	878	260 to 393	60.35	4467
25	260	33.83	3127	17	12.38	1271	260 to 394	68.41	6541
30	260	36.82	4198	18	12.80	1670	260 to 396	73.32	8718
35	260	38.55	5254	19	12.56	2098	260 to 397	75.35	10923
40	260	39.11	6335	20	12.00	2481	260 to 399	75.16	13089
45	260	38.59	7338	21	11.08	2809	260 to 401	72.87	15049
50	260	37.12	8249	22	10.11	3074	260 to 402	69.16	16776
55	260	34.83	9038	23	9.28	3274	260 to 403	64.54	18221
60	260	31.88	9682	23	8.69	3409	260 to 404	59.42	19351
65	260	28.46	10125	24	8.28	3496	260 to 405	53.93	20119
70	260	24.72	10415	24	8.17	3525	260 to 405	48.50	20575
75	260	20.83	10452	24	8.34	3482	260 to 405	43.35	20553
80	260	16.96	10283	24	8.87	3364	260 to 405	38.84	20117
85	260	17.65	9881	23	9.64	3174	260 to 404	41.11	19231
90	260	23.76	9212	23	10.62	2913	260 to 403	51.33	17850
95	260	30.24	8304	22	11.79	2583	260 to 402	62.39	16017
100	260	36.90	7149	21	12.51	2186	260 to 401	72.93	13726
105	260	43.68	5730	20	13.81	1725	260 to 399	84.64	10956
110	260	50.53	4057	19	15.45	1205	260 to 397	97.01	7728
115	260	57.13	2150	18	16.97	628	260 to 395	108.83	4079
120	260	63.77	0	17	18.36	0	260 to 393	120.50	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 14 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 14

INPUT DATA

Applied Load = 7636 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 1660 lb./ft.

Variation Factor = 1.325
Radius CL = 33.95 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	343	0.00	0	17	0.00	0	343 to 509	0.00	0
5	343	6.96	123	17	2.54	44	343 to 509	14.06	249
10	343	13.08	466	16	6.17	218	343 to 509	28.83	1024
15	343	18.30	981	16	9.12	511	343 to 509	41.13	2244
20	343	22.54	1619	16	11.15	878	343 to 509	50.53	3761
25	343	25.80	2385	17	12.38	1271	343 to 510	57.17	5501
30	343	28.08	3202	18	12.80	1670	343 to 512	61.08	7323
35	343	29.40	4007	19	12.56	2098	343 to 514	62.54	9177
40	343	29.83	4832	20	12.00	2481	343 to 516	62.17	10984
45	343	29.43	5596	21	11.08	2809	343 to 517	60.05	12611
50	343	28.31	6292	22	10.11	3074	343 to 519	56.83	14035
55	343	26.56	6893	23	9.28	3274	343 to 520	52.97	15218
60	343	24.32	7384	23	8.69	3409	343 to 521	48.83	16134
65	343	21.70	7722	24	8.28	3496	343 to 521	44.48	16755
70	343	18.85	7943	24	8.17	3525	343 to 522	40.28	17115
75	343	15.89	7972	24	8.34	3482	343 to 522	36.43	17080
80	343	12.94	7843	24	8.87	3364	343 to 521	33.21	16700
85	343	13.46	7536	23	9.64	3174	343 to 521	35.24	15948
90	343	18.12	7026	23	10.62	2913	343 to 520	43.44	14789
95	343	23.06	6333	22	11.79	2583	343 to 518	52.34	13258
100	343	28.14	5453	21	12.51	2186	343 to 517	60.67	11351
105	343	33.31	4370	20	13.81	1725	343 to 515	70.13	9052
110	343	38.54	3094	19	15.45	1205	343 to 514	80.22	6380
115	343	43.57	1640	18	16.97	628	343 to 512	89.85	3364
120	343	48.64	0	17	18.36	0	343 to 509	99.31	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 15 OF ____

CHKD. BY: _____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 15

INPUT DATA

Applied Load = 12534 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 2095 lb./ft.

Variation Factor = 1.126
Radius CL = 33.95 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	479	0.00	0	21	0.00	0	479 to 707	0.00	0
5	479	4.43	78	21	3.20	56	479 to 707	11.65	206
10	479	8.32	296	21	7.79	275	479 to 706	24.91	883
15	479	11.64	624	21	11.51	645	479 to 706	35.88	1972
20	479	14.34	1030	21	14.08	1109	479 to 706	44.02	3328
25	479	16.42	1518	22	15.62	1604	479 to 708	49.55	4853
30	479	17.87	2037	23	16.16	2108	479 to 710	52.49	6437
35	479	18.71	2550	24	15.86	2647	479 to 712	53.16	8072
40	479	18.98	3075	26	15.14	3132	479 to 715	52.33	9629
45	479	18.73	3561	27	13.98	3545	479 to 717	50.00	11013
50	479	18.01	4004	28	12.76	3880	479 to 719	46.92	12201
55	479	16.90	4387	29	11.71	4133	479 to 720	43.58	13168
60	479	15.47	4699	29	10.97	4302	479 to 721	40.32	13893
65	479	13.81	4914	30	10.46	4412	479 to 722	37.12	14381
70	479	11.99	5055	30	10.31	4449	479 to 722	34.32	14642
75	479	10.11	5073	30	10.53	4394	479 to 722	32.06	14573
80	479	8.23	4991	30	11.20	4246	479 to 722	30.57	14206
85	479	8.56	4796	29	12.17	4006	479 to 721	32.69	13525
90	479	11.53	4471	29	13.41	3676	479 to 720	38.94	12510
95	479	14.68	4030	28	14.88	3260	479 to 718	45.85	11184
100	479	17.91	3470	27	15.79	2759	479 to 717	51.92	9549
105	479	21.20	2781	26	17.43	2178	479 to 715	59.32	7596
110	479	24.52	1969	24	19.50	1521	479 to 712	67.48	5342
115	479	27.72	1043	23	21.41	793	479 to 710	75.23	2809
120	479	30.95	0	21	23.17	0	479 to 707	82.73	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 16 OF ____

CHKD. BY: _____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 16

INPUT DATA

Applied Load = 14771 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 2095 lb./ft.

Variation Factor = 1.105
Radius CL = 33.95 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	554	0.00	0	21	0.00	0	554 to 812	0.00	0
5	554	4.35	77	21	3.20	56	554 to 812	11.54	204
10	554	8.18	291	21	7.79	275	554 to 811	24.71	876
15	554	11.43	613	21	11.51	645	554 to 811	35.59	1956
20	554	14.09	1012	21	14.08	1109	554 to 811	43.66	3302
25	554	16.12	1490	22	15.62	1604	554 to 813	49.14	4815
30	554	17.55	2001	23	16.16	2108	554 to 815	52.04	6386
35	554	18.37	2504	24	15.86	2647	554 to 817	52.69	8007
40	554	18.64	3019	26	15.14	3132	554 to 820	51.85	9552
45	554	18.39	3497	27	13.98	3545	554 to 822	49.53	10924
50	554	17.69	3932	28	12.76	3880	554 to 824	46.47	12101
55	554	16.60	4308	29	11.71	4133	554 to 825	43.15	13058
60	554	15.20	4615	29	10.97	4302	554 to 826	39.93	13775
65	554	13.56	4826	30	10.46	4412	554 to 827	36.77	14257
70	554	11.78	4964	30	10.31	4449	554 to 827	34.02	14515
75	554	9.93	4982	30	10.53	4394	554 to 827	31.80	14445
80	554	8.08	4901	30	11.20	4246	554 to 827	30.37	14081
85	554	8.41	4710	29	12.17	4006	554 to 826	32.47	13405
90	554	11.32	4391	29	13.41	3676	554 to 825	38.65	12398
95	554	14.41	3958	28	14.88	3260	554 to 823	45.48	11083
100	554	17.58	3408	27	15.79	2759	554 to 822	51.47	9461
105	554	20.82	2731	26	17.43	2178	554 to 820	58.79	7526
110	554	24.08	1933	24	19.50	1521	554 to 817	66.87	5293
115	554	27.23	1025	23	21.41	793	554 to 815	74.53	2783
120	554	30.40	0	21	23.17	0	554 to 812	81.95	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 17 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 17

INPUT DATA

Applied Load = 21064 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 620 lb./ft.

Variation Factor = 1.078
Radius CL = 33.95 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	770	0.00	0	6	0.00	0	770 to 1090	0.00	0
5	770	4.61	81	6	0.94	16	770 to 1090	8.06	143
10	770	8.66	308	6	2.30	81	770 to 1089	16.05	570
15	770	12.11	649	6	3.40	191	770 to 1089	22.75	1234
20	770	14.92	1072	6	4.16	328	770 to 1089	27.98	2059
25	770	17.08	1579	6	4.62	474	770 to 1090	31.78	3018
30	770	18.59	2120	6	4.78	624	770 to 1091	34.16	4029
35	770	19.47	2653	7	4.69	783	770 to 1091	35.23	5046
40	770	19.75	3199	7	4.48	926	770 to 1092	35.27	6054
45	770	19.48	3705	8	4.13	1049	770 to 1093	34.32	6971
50	770	18.74	4165	8	3.77	1148	770 to 1093	32.66	7783
55	770	17.58	4564	8	3.46	1223	770 to 1093	30.51	8469
60	770	16.10	4889	8	3.24	1273	770 to 1094	28.06	9009
65	770	14.37	5112	8	3.09	1305	770 to 1094	25.38	9377
70	770	12.48	5259	9	3.05	1316	770 to 1094	22.66	9601
75	770	10.52	5277	9	3.11	1300	770 to 1094	20.02	9600
80	770	8.56	5192	8	3.31	1256	770 to 1094	17.63	9406
85	770	8.91	4989	8	3.60	1185	770 to 1094	18.60	9001
90	770	12.00	4651	8	3.96	1088	770 to 1093	23.54	8362
95	770	15.27	4193	8	4.40	964	770 to 1093	28.86	7510
100	770	18.63	3610	8	4.67	816	770 to 1092	34.03	6442
105	770	22.05	2893	7	5.15	644	770 to 1092	39.65	5146
110	770	25.51	2048	7	5.77	450	770 to 1091	45.53	3633
115	770	28.84	1085	6	6.33	234	770 to 1090	51.16	1919
120	770	32.20	0	6	6.85	0	770 to 1090	56.74	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 18 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 18

INPUT DATA

Applied Load = 20241 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 620 lb./ft.

Variation Factor = 1.082
Radius CL = 33.95 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	743	0.00	0	6	0.00	0	743 to 1051	0.00	0
5	743	4.65	82	6	0.94	16	743 to 1051	8.13	144
10	743	8.75	312	6	2.30	81	743 to 1051	16.17	575
15	743	12.23	656	6	3.40	191	743 to 1051	22.92	1243
20	743	15.07	1083	6	4.16	328	743 to 1051	28.19	2074
25	743	17.25	1595	6	4.62	474	743 to 1052	32.02	3041
30	743	18.78	2141	6	4.78	624	743 to 1052	34.42	4059
35	743	19.66	2680	7	4.69	783	743 to 1053	35.51	5084
40	743	19.95	3231	7	4.48	926	743 to 1054	35.55	6100
45	743	19.68	3743	8	4.13	1049	743 to 1054	34.60	7024
50	743	18.93	4208	8	3.77	1148	743 to 1055	32.93	7843
55	743	17.76	4610	8	3.46	1223	743 to 1055	30.76	8534
60	743	16.26	4938	8	3.24	1273	743 to 1056	28.29	9079
65	743	14.51	5164	8	3.09	1305	743 to 1056	25.58	9450
70	743	12.60	5312	9	3.05	1316	743 to 1056	22.84	9676
75	743	10.62	5331	9	3.11	1300	743 to 1056	20.17	9675
80	743	8.65	5245	8	3.31	1256	743 to 1056	17.75	9480
85	743	9.00	5040	8	3.60	1185	743 to 1055	18.73	9072
90	743	12.12	4699	8	3.96	1088	743 to 1055	23.71	8428
95	743	15.42	4235	8	4.40	964	743 to 1055	29.08	7570
100	743	18.82	3647	8	4.67	816	743 to 1054	34.29	6494
105	743	22.28	2923	7	5.15	644	743 to 1054	39.96	5188
110	743	25.77	2069	7	5.77	450	743 to 1053	45.89	3662
115	743	29.14	1096	6	6.33	234	743 to 1052	51.57	1934
120	743	32.53	0	6	6.85	0	743 to 1051	57.20	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 19 OF ____

CHKD. BY: _____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 19

INPUT DATA

Applied Load = 4415 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 1660 lb./ft.

Variation Factor = 1.737
Radius CL = 38.8 feet
Distance to Surcharge = 0 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	297	0.00	0	0	0.00	0	297 to 416	0.00	0
5	297	10.43	212	0	0.00	0	297 to 416	14.61	296
10	297	19.61	798	0	0.00	0	297 to 416	27.45	1118
15	297	27.42	1680	0	0.00	0	297 to 416	38.39	2353
20	297	33.78	2773	0	0.00	0	297 to 416	47.29	3883
25	297	38.67	4085	0	0.00	0	297 to 416	54.13	5719
30	297	42.08	5484	0	0.00	0	297 to 416	58.91	7677
35	297	44.06	6863	0	0.00	0	297 to 416	61.69	9608
40	297	44.70	8275	0	0.00	0	297 to 416	62.58	11585
45	297	44.11	9584	0	0.00	0	297 to 416	61.75	13418
50	297	42.42	10775	0	0.00	0	297 to 416	59.39	15085
55	297	39.80	11805	0	0.00	0	297 to 416	55.73	16528
60	297	36.44	12646	0	0.00	0	297 to 416	51.02	17705
65	297	32.52	13225	0	0.00	0	297 to 416	45.53	18515
70	297	28.25	13603	0	0.00	0	297 to 416	39.55	19045
75	297	23.81	13652	0	0.00	0	297 to 416	33.33	19113
80	297	19.39	13432	0	0.00	0	297 to 416	27.14	18804
85	297	20.17	12906	0	0.00	0	297 to 416	28.24	18069
90	297	27.16	12032	0	0.00	0	297 to 416	38.02	16845
95	297	34.56	10846	0	0.00	0	297 to 416	48.39	15184
100	297	42.17	9338	0	0.00	0	297 to 416	59.04	13074
105	297	49.92	7484	0	0.00	0	297 to 416	69.89	10478
110	297	57.75	5299	0	0.00	0	297 to 416	80.85	7418
115	297	65.29	2808	0	0.00	0	297 to 416	91.40	3932
120	297	72.89	0	0	0.00	0	297 to 416	102.04	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 20 OF ____

CHKD. BY: _____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 20

INPUT DATA

Applied Load = 7636 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 1660 lb./ft.

Variation Factor = 1.325
Radius CL = 38.8 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	392	0.00	0	17	0.00	0	392 to 580	0.00	0
5	392	7.95	161	17	3.98	65	392 to 580	17.92	338
10	392	14.95	609	17	7.55	295	392 to 579	33.79	1355
15	392	20.91	1282	17	11.21	683	392 to 579	48.35	2957
20	392	25.76	2115	17	13.03	1158	392 to 579	58.22	4930
25	392	29.49	3115	18	13.78	1655	392 to 581	64.73	7176
30	392	32.09	4182	19	14.43	2154	392 to 583	69.46	9519
35	392	33.61	5234	21	13.71	2686	392 to 585	70.37	11896
40	392	34.09	6311	22	13.13	3159	392 to 587	70.07	14207
45	392	33.64	7310	23	12.00	3559	392 to 589	67.50	16285
50	392	32.35	8218	24	10.84	3882	392 to 590	63.74	18105
55	392	30.36	9004	24	10.09	4124	392 to 591	59.67	19618
60	392	27.79	9645	25	9.40	4285	392 to 592	54.90	20788
65	392	24.80	10086	25	9.12	4362	392 to 593	50.24	21538
70	392	21.54	10375	25	8.93	4377	392 to 593	45.36	21966
75	392	18.16	10412	25	9.00	4317	392 to 593	40.73	21918
80	392	14.79	10244	25	9.85	4168	392 to 593	37.46	21428
85	392	15.38	9844	25	10.44	3930	392 to 592	39.30	20462
90	392	20.71	9177	24	11.24	3604	392 to 591	48.11	18975
95	392	26.36	8272	23	12.77	3193	392 to 590	58.62	17010
100	392	32.16	7122	22	13.92	2701	392 to 588	68.71	14564
105	392	38.07	5708	21	14.95	2131	392 to 586	78.73	11615
110	392	44.04	4041	20	16.70	1487	392 to 584	90.06	8187
115	392	49.79	2142	19	18.33	775	392 to 582	100.88	4317
120	392	55.59	0	17	19.81	0	392 to 580	111.52	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 21 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 21

INPUT DATA

Applied Load = 12534 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 2095 lb./ft.

Variation Factor = 1.126
Radius CL = 38.8 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	547	0.00	0	22	0.00	0	547 to 805	0.00	0
5	547	5.06	102	22	5.03	83	547 to 805	15.65	285
10	547	9.51	387	22	9.53	373	547 to 804	29.54	1177
15	547	13.30	815	22	14.15	863	547 to 804	42.70	2609
20	547	16.39	1346	22	16.44	1461	547 to 804	50.91	4369
25	547	18.76	1982	23	17.40	2088	547 to 806	55.85	6327
30	547	20.42	2661	25	18.21	2719	547 to 809	59.55	8349
35	547	21.38	3331	26	17.31	3391	547 to 812	59.37	10428
40	547	21.69	4016	28	16.58	3987	547 to 814	58.56	12401
45	547	21.40	4651	29	15.14	4492	547 to 816	55.72	14150
50	547	20.59	5229	30	13.69	4899	547 to 818	52.10	15651
55	547	19.32	5730	31	12.74	5205	547 to 819	48.71	16872
60	547	17.68	6138	31	11.87	5408	547 to 820	44.94	17787
65	547	15.78	6418	32	11.51	5505	547 to 821	41.68	18346
70	547	13.71	6602	32	11.27	5524	547 to 822	38.37	18634
75	547	11.55	6626	32	11.36	5449	547 to 822	35.50	18540
80	547	9.41	6519	32	12.44	5260	547 to 821	34.32	18070
85	547	9.79	6264	31	13.18	4959	547 to 820	36.12	17202
90	547	13.18	5840	31	14.19	4548	547 to 819	42.58	15909
95	547	16.77	5264	30	16.11	4030	547 to 817	50.88	14222
100	547	20.46	4532	28	17.57	3409	547 to 815	58.54	12142
105	547	24.23	3632	27	18.87	2690	547 to 813	66.00	9659
110	547	28.03	2571	26	21.08	1877	547 to 810	75.08	6793
115	547	31.69	1363	24	23.13	978	547 to 807	83.70	3572
120	547	35.37	0	22	25.01	0	547 to 805	92.05	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 22 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 22

INPUT DATA

Applied Load = 14771 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 2095 lb./ft.

Variation Factor = 1.105
Radius CL = 38.8 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	633	0.00	0	22	0.00	0	633 to 925	0.00	0
5	633	4.97	101	22	5.03	83	633 to 925	15.52	282
10	633	9.34	380	22	9.53	373	633 to 924	29.30	1167
15	633	13.07	801	22	14.15	863	633 to 924	42.36	2589
20	633	16.10	1322	22	16.44	1461	633 to 924	50.50	4335
25	633	18.43	1947	23	17.40	2088	633 to 926	55.38	6277
30	633	20.05	2613	25	18.21	2719	633 to 929	59.04	8282
35	633	21.00	3271	26	17.31	3391	633 to 932	58.84	10344
40	633	21.30	3944	28	16.58	3987	633 to 934	58.02	12301
45	633	21.02	4568	29	15.14	4492	633 to 936	55.18	14033
50	633	20.22	5136	30	13.69	4899	633 to 938	51.58	15520
55	633	18.97	5627	31	12.74	5205	633 to 939	48.22	16728
60	633	17.37	6027	31	11.87	5408	633 to 940	44.50	17633
65	633	15.50	6303	32	11.51	5505	633 to 941	41.28	18185
70	633	13.46	6484	32	11.27	5524	633 to 942	38.02	18468
75	633	11.34	6507	32	11.36	5449	633 to 942	35.21	18374
80	633	9.24	6402	32	12.44	5260	633 to 941	34.09	17906
85	633	9.61	6152	31	13.18	4959	633 to 940	35.87	17044
90	633	12.94	5735	31	14.19	4548	633 to 939	42.25	15762
95	633	16.47	5169	30	16.11	4030	633 to 937	50.46	14090
100	633	20.10	4451	28	17.57	3409	633 to 935	58.02	12028
105	633	23.79	3567	27	18.87	2690	633 to 933	65.40	9568
110	633	27.52	2525	26	21.08	1877	633 to 930	74.38	6728
115	633	31.12	1338	24	23.13	978	633 to 927	82.90	3538
120	633	34.74	0	22	25.01	0	633 to 925	91.16	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 23 OF ____

CHKD. BY: _____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 23

INPUT DATA

Applied Load = 21064 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 620 lb./ft.

Variation Factor = 1.078
Radius CL = 38.8 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	881	0.00	0	6	0.00	0	881 to 1244	0.00	0
5	881	5.26	107	6	1.49	24	881 to 1244	9.91	191
10	881	9.90	403	6	2.82	110	881 to 1244	18.66	752
15	881	13.84	848	6	4.19	255	881 to 1244	26.50	1622
20	881	17.05	1400	6	4.86	432	881 to 1244	32.15	2696
25	881	19.52	2062	6	5.14	618	881 to 1245	36.09	3938
30	881	21.24	2769	7	5.38	804	881 to 1246	38.91	5244
35	881	22.25	3465	7	5.12	1003	881 to 1246	39.86	6557
40	881	22.57	4178	8	4.90	1180	881 to 1247	39.94	7856
45	881	22.27	4839	8	4.48	1329	881 to 1248	38.80	9035
50	881	21.42	5440	9	4.05	1450	881 to 1248	36.87	10082
55	881	20.10	5961	9	3.77	1540	881 to 1249	34.55	10964
60	881	18.40	6385	9	3.51	1600	881 to 1249	31.73	11660
65	881	16.42	6677	9	3.40	1629	881 to 1249	28.78	12119
70	881	14.26	6868	9	3.33	1634	881 to 1249	25.64	12395
75	881	12.02	6893	9	3.36	1612	881 to 1249	22.55	12392
80	881	9.79	6782	9	3.68	1556	881 to 1249	19.96	12142
85	881	10.18	6517	9	3.90	1467	881 to 1249	20.89	11619
90	881	13.71	6075	9	4.20	1346	881 to 1249	26.34	10794
95	881	17.45	5476	8	4.77	1192	881 to 1248	32.54	9695
100	881	21.29	4715	8	5.20	1009	881 to 1247	38.65	8317
105	881	25.20	3779	8	5.58	796	881 to 1247	44.78	6644
110	881	29.16	2675	7	6.24	555	881 to 1246	51.43	4690
115	881	32.96	1418	7	6.84	289	881 to 1245	57.79	2477
120	881	36.80	0	6	7.40	0	881 to 1244	64.11	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 24 OF ____

CHKD. BY: _____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 24

INPUT DATA

Applied Load = 20241 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 620 lb./ft.

Variation Factor = 1.082
Radius CL = 38.8 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	849	0.00	0	6	0.00	0	849 to 1201	0.00	0
5	849	5.32	108	6	1.49	24	849 to 1201	9.98	193
10	849	10.00	407	6	2.82	110	849 to 1200	18.80	758
15	849	13.98	857	6	4.19	255	849 to 1200	26.70	1634
20	849	17.23	1414	6	4.86	432	849 to 1200	32.40	2716
25	849	19.72	2083	6	5.14	618	849 to 1201	36.36	3968
30	849	21.46	2797	7	5.38	804	849 to 1202	39.21	5284
35	849	22.47	3500	7	5.12	1003	849 to 1203	40.18	6607
40	849	22.80	4221	8	4.90	1180	849 to 1203	40.26	7915
45	849	22.50	4888	8	4.48	1329	849 to 1204	39.12	9104
50	849	21.63	5496	9	4.05	1450	849 to 1204	37.18	10160
55	849	20.30	6022	9	3.77	1540	849 to 1205	34.83	11050
60	849	18.59	6450	9	3.51	1600	849 to 1205	32.00	11752
65	849	16.59	6746	9	3.40	1629	849 to 1205	29.02	12214
70	849	14.41	6939	9	3.33	1634	849 to 1206	25.85	12493
75	849	12.14	6964	9	3.36	1612	849 to 1206	22.72	12491
80	849	9.89	6851	9	3.68	1556	849 to 1205	20.10	12238
85	849	10.29	6583	9	3.90	1467	849 to 1205	21.04	11712
90	849	13.85	6137	9	4.20	1346	849 to 1205	26.53	10881
95	849	17.63	5532	8	4.77	1192	849 to 1204	32.79	9773
100	849	21.51	4763	8	5.20	1009	849 to 1204	38.96	8384
105	849	25.46	3817	8	5.58	796	849 to 1203	45.14	6698
110	849	29.45	2702	7	6.24	555	849 to 1202	51.85	4728
115	849	33.30	1432	7	6.84	289	849 to 1201	58.26	2498
120	849	37.18	0	6	7.40	0	849 to 1201	64.63	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 25 OF ____

CHKD. BY: _____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 25

INPUT DATA

Applied Load = 4415 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 1660 lb./ft.

Variation Factor = 1.737
Radius CL = 43.65 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	334	0.00	0	18	0.00	0	334 to 500	0.00	0
5	334	11.74	268	18	3.97	87	334 to 500	23.19	524
10	334	22.06	1011	18	8.90	385	334 to 500	46.02	2070
15	334	30.84	2127	18	12.26	878	334 to 499	64.03	4472
20	334	38.00	3510	18	14.72	1468	334 to 500	78.25	7411
25	334	43.50	5170	19	15.50	2077	334 to 502	87.26	10770
30	334	47.34	6940	21	15.37	2677	334 to 504	92.41	14269
35	334	49.57	8686	22	14.69	3319	334 to 506	94.39	17803
40	334	50.29	10473	23	13.87	3884	334 to 508	94.00	21266
45	334	49.62	12130	24	12.75	4360	334 to 510	91.15	24396
50	334	47.72	13637	25	11.65	4743	334 to 512	86.63	27156
55	334	44.78	14941	26	10.57	5029	334 to 513	80.68	29468
60	334	41.00	16005	26	9.99	5216	334 to 514	74.39	31276
65	334	36.59	16738	27	9.61	5304	334 to 514	67.57	32450
70	334	31.78	17217	27	9.69	5290	334 to 514	60.98	33098
75	334	26.78	17279	27	10.05	5188	334 to 514	54.60	33010
80	334	21.81	16999	26	10.26	5005	334 to 514	47.98	32309
85	334	22.69	16335	26	11.16	4716	334 to 513	50.75	30887
90	334	30.55	15228	25	12.30	4323	334 to 512	63.69	28669
95	334	38.88	13727	24	13.63	3829	334 to 511	77.62	25727
100	334	47.44	11819	23	15.12	3237	334 to 509	92.13	22051
105	334	56.16	9473	22	15.94	2553	334 to 507	105.73	17603
110	334	64.97	6706	21	17.79	1781	334 to 505	121.21	12418
115	334	73.45	3554	20	19.51	928	334 to 502	136.01	6555
120	334	82.00	0	18	21.08	0	334 to 500	150.64	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 26 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 26

INPUT DATA

Applied Load = 7636 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 1660 lb./ft.

Variation Factor = 1.325
Radius CL = 43.65 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	441	0.00	0	18	0.00	0	441 to 650	0.00	0
5	441	8.95	204	18	3.97	87	441 to 650	19.29	435
10	441	16.82	771	18	8.90	385	441 to 649	38.69	1734
15	441	23.52	1622	18	12.26	878	441 to 649	53.78	3765
20	441	28.98	2677	18	14.72	1468	441 to 649	65.62	6245
25	441	33.18	3943	19	15.50	2077	441 to 652	72.80	9052
30	441	36.10	5293	21	15.37	2677	441 to 654	76.68	11963
35	441	37.81	6625	22	14.69	3319	441 to 656	77.92	14918
40	441	38.35	7987	23	13.87	3884	441 to 658	77.29	17786
45	441	37.84	9251	24	12.75	4360	441 to 660	74.66	20365
50	441	36.40	10401	25	11.65	4743	441 to 661	70.77	22625
55	441	34.15	11396	26	10.57	5029	441 to 663	65.80	24504
60	441	31.27	12207	26	9.99	5216	441 to 663	60.77	25959
65	441	27.90	12766	27	9.61	5304	441 to 664	55.41	26889
70	441	24.24	13131	27	9.69	5290	441 to 664	50.42	27377
75	441	20.43	13178	27	10.05	5188	441 to 664	45.70	27270
80	441	16.63	12965	26	10.26	5005	441 to 664	40.74	26661
85	441	17.31	12458	26	11.16	4716	441 to 663	43.21	25460
90	441	23.30	11614	25	12.30	4323	441 to 662	53.54	23610
95	441	29.66	10469	24	13.63	3829	441 to 660	64.70	21166
100	441	36.18	9014	23	15.12	3237	441 to 659	76.37	18124
105	441	42.83	7225	22	15.94	2553	441 to 656	87.07	14456
110	441	49.55	5115	21	17.79	1781	441 to 654	99.63	10190
115	441	56.02	2711	20	19.51	928	441 to 652	111.61	5374
120	441	62.54	0	18	21.08	0	441 to 650	123.40	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 27 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 27

INPUT DATA

Applied Load = 12534 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 2095 lb./ft.

Variation Factor = 1.126
Radius CL = 43.65 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	616	0.00	0	23	0.00	0	616 to 902	0.00	0
5	616	5.69	130	23	5.02	110	616 to 902	16.51	370
10	616	10.70	490	23	11.23	485	616 to 902	34.09	1513
15	616	14.97	1032	23	15.47	1108	616 to 901	47.26	3330
20	616	18.44	1703	23	18.58	1853	616 to 902	57.42	5536
25	616	21.11	2509	25	19.56	2621	616 to 905	62.82	7970
30	616	22.97	3368	26	19.39	3379	616 to 907	65.14	10461
35	616	24.06	4216	28	18.54	4189	616 to 910	65.21	13024
40	616	24.41	5083	29	17.51	4902	616 to 913	63.94	15450
45	616	24.08	5887	31	16.09	5503	616 to 915	61.07	17598
50	616	23.16	6619	32	14.71	5986	616 to 917	57.43	19443
55	616	21.73	7252	33	13.35	6347	616 to 918	53.12	20943
60	616	19.90	7768	33	12.61	6584	616 to 919	49.31	22068
65	616	17.76	8124	34	12.13	6694	616 to 920	45.49	22753
70	616	15.42	8356	34	12.23	6676	616 to 920	42.39	23049
75	616	13.00	8386	34	12.69	6547	616 to 920	39.78	22872
80	616	10.58	8251	33	12.95	6317	616 to 920	36.84	22290
85	616	11.01	7928	33	14.09	5952	616 to 919	39.38	21218
90	616	14.83	7391	32	15.52	5456	616 to 917	47.15	19623
95	616	18.87	6662	31	17.20	4832	616 to 916	55.67	17542
100	616	23.02	5736	30	19.08	4086	616 to 913	64.69	14977
105	616	27.26	4597	28	20.12	3222	616 to 911	72.37	11915
110	616	31.53	3255	27	22.46	2248	616 to 908	82.33	8380
115	616	35.65	1725	25	24.63	1171	616 to 905	91.78	4407
120	616	39.79	0	23	26.61	0	616 to 902	100.96	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 28 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 28

INPUT DATA

Applied Load = 14771 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 2095 lb./ft.
Variation Factor = 1.105
Radius CL = 43.65 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	712	0.00	0	23	0.00	0	712 to 1037	0.00	0
5	712	5.59	127	23	5.02	110	712 to 1037	16.36	366
10	712	10.51	481	23	11.23	485	712 to 1037	33.82	1500
15	712	14.70	1014	23	15.47	1108	712 to 1036	46.89	3304
20	712	18.11	1673	23	18.58	1853	712 to 1037	56.96	5493
25	712	20.73	2464	25	19.56	2621	712 to 1040	62.29	7907
30	712	22.56	3308	26	19.39	3379	712 to 1042	64.57	10376
35	712	23.63	4140	28	18.54	4189	712 to 1045	64.61	12918
40	712	23.97	4992	29	17.51	4902	712 to 1048	63.33	15323
45	712	23.65	5781	31	16.09	5503	712 to 1050	60.47	17450
50	712	22.74	6500	32	14.71	5986	712 to 1052	56.85	19277
55	712	21.34	7122	33	13.35	6347	712 to 1053	52.58	20761
60	712	19.54	7629	33	12.61	6584	712 to 1054	48.81	21873
65	712	17.44	7978	34	12.13	6694	712 to 1055	45.04	22549
70	712	15.14	8206	34	12.23	6676	712 to 1055	42.01	22839
75	712	12.76	8236	34	12.69	6547	712 to 1055	39.45	22662
80	712	10.39	8103	33	12.95	6317	712 to 1055	36.57	22083
85	712	10.81	7786	33	14.09	5952	712 to 1054	39.10	21019
90	712	14.56	7258	32	15.52	5456	712 to 1052	46.78	19437
95	712	18.53	6543	31	17.20	4832	712 to 1051	55.20	17375
100	712	22.61	5633	30	19.08	4086	712 to 1048	64.11	14833
105	712	26.77	4515	28	20.12	3222	712 to 1046	71.68	11800
110	712	30.96	3196	27	22.46	2248	712 to 1043	81.54	8298
115	712	35.01	1694	25	24.63	1171	712 to 1040	90.88	4364
120	712	39.08	0	23	26.61	0	712 to 1037	99.96	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 29 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 29

INPUT DATA

Applied Load = 21064 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 620 lb./ft.

Variation Factor = 1.078
Radius CL = 43.65 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	991	0.00	0	6	0.00	0	991 to 1399	0.00	0
5	991	5.92	135	6	1.48	32	991 to 1399	10.82	245
10	991	11.14	510	6	3.32	143	991 to 1399	21.25	959
15	991	15.57	1074	6	4.57	328	991 to 1399	29.59	2061
20	991	19.19	1772	6	5.50	548	991 to 1399	36.22	3413
25	991	21.96	2610	7	5.79	775	991 to 1400	40.59	4974
30	991	23.90	3504	7	5.74	1000	991 to 1401	43.22	6606
35	991	25.03	4386	8	5.48	1239	991 to 1401	44.37	8248
40	991	25.39	5288	8	5.18	1450	991 to 1402	44.36	9870
45	991	25.05	6125	9	4.76	1628	991 to 1403	43.17	11343
50	991	24.09	6886	9	4.35	1771	991 to 1403	41.13	12652
55	991	22.61	7544	9	3.95	1878	991 to 1404	38.37	13756
60	991	20.70	8081	10	3.73	1948	991 to 1404	35.33	14627
65	991	18.47	8451	10	3.59	1981	991 to 1404	31.97	15200
70	991	16.04	8693	10	3.62	1975	991 to 1404	28.62	15530
75	991	13.52	8724	10	3.75	1937	991 to 1404	25.32	15509
80	991	11.01	8583	10	3.83	1869	991 to 1404	21.93	15195
85	991	11.46	8248	9	4.17	1761	991 to 1404	23.13	14542
90	991	15.42	7689	9	4.59	1614	991 to 1404	29.41	13510
95	991	19.63	6931	9	5.09	1430	991 to 1403	36.14	12135
100	991	23.95	5967	8	5.64	1209	991 to 1402	43.14	10410
105	991	28.35	4783	8	5.95	953	991 to 1402	49.82	8318
110	991	32.80	3386	8	6.64	665	991 to 1401	57.22	5872
115	991	37.08	1795	7	7.28	346	991 to 1400	64.31	3102
120	991	41.40	0	6	7.87	0	991 to 1399	71.35	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 30 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 30

INPUT DATA

Applied Load = 20241 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 620 lb./ft.

Variation Factor = 1.082
Radius CL = 43.65 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	955	0.00	0	6	0.00	0	955 to 1350	0.00	0
5	955	5.98	136	6	1.48	32	955 to 1350	10.90	247
10	955	11.25	515	6	3.32	143	955 to 1350	21.41	966
15	955	15.73	1085	6	4.57	328	955 to 1349	29.81	2077
20	955	19.38	1790	6	5.50	548	955 to 1350	36.49	3439
25	955	22.19	2637	7	5.79	775	955 to 1350	40.91	5011
30	955	24.14	3540	7	5.74	1000	955 to 1351	43.56	6656
35	955	25.28	4430	8	5.48	1239	955 to 1352	44.73	8310
40	955	25.65	5342	8	5.18	1450	955 to 1353	44.72	9945
45	955	25.31	6187	9	4.76	1628	955 to 1354	43.53	11431
50	955	24.34	6956	9	4.35	1771	955 to 1354	41.48	12750
55	955	22.84	7621	9	3.95	1878	955 to 1355	38.69	13863
60	955	20.91	8164	10	3.73	1948	955 to 1355	35.62	14742
65	955	18.66	8538	10	3.59	1981	955 to 1355	32.23	15321
70	955	16.21	8782	10	3.62	1975	955 to 1355	28.85	15654
75	955	13.66	8813	10	3.75	1937	955 to 1355	25.51	15633
80	955	11.12	8671	10	3.83	1869	955 to 1355	22.09	15318
85	955	11.57	8332	9	4.17	1761	955 to 1355	23.29	14660
90	955	15.58	7768	9	4.59	1614	955 to 1354	29.63	13620
95	955	19.83	7002	9	5.09	1430	955 to 1354	36.42	12234
100	955	24.20	6028	8	5.64	1209	955 to 1353	43.48	10496
105	955	28.64	4832	8	5.95	953	955 to 1352	50.23	8386
110	955	33.14	3420	8	6.64	665	955 to 1352	57.69	5920
115	955	37.46	1813	7	7.28	346	955 to 1351	64.84	3128
120	955	41.82	0	6	7.87	0	955 to 1350	71.94	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 31 OF ____

CHKD. BY: _____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 31

INPUT DATA

Applied Load = 4415 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 1660 lb./ft.

Variation Factor = 1.737
Radius CL = 48.5 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	371	0.00	0	19	0.00	0	371 to 553	0.00	0
5	371	13.04	331	19	5.34	112	371 to 553	27.34	656
10	371	24.51	1248	19	10.21	484	371 to 553	51.68	2571
15	371	34.27	2626	18	13.26	1093	371 to 552	70.54	5535
20	371	42.23	4333	19	15.48	1808	371 to 553	85.45	9141
25	371	48.33	6383	20	16.59	2534	371 to 556	95.89	13245
30	371	52.60	8568	22	16.61	3232	371 to 558	101.88	17492
35	371	55.08	10724	23	15.58	3987	371 to 560	103.62	21793
40	371	55.88	12929	24	14.51	4648	371 to 563	102.91	26004
45	371	55.13	14975	26	13.36	5203	371 to 565	99.92	29812
50	371	53.02	16836	26	12.16	5648	371 to 566	94.91	33174
55	371	49.75	18446	27	11.16	5979	371 to 567	88.64	35991
60	371	45.55	19760	28	10.66	6194	371 to 568	81.90	38195
65	371	40.65	20664	28	10.43	6291	371 to 569	74.65	39626
70	371	35.31	21255	28	10.35	6270	371 to 569	67.04	40417
75	371	29.76	21332	28	10.56	6130	371 to 568	59.63	40286
80	371	24.24	20987	28	11.05	5872	371 to 568	52.73	39366
85	371	25.21	20167	27	11.81	5525	371 to 567	55.38	37628
90	371	33.95	18800	26	13.17	5063	371 to 566	69.93	34928
95	371	43.20	16946	26	14.39	4483	371 to 564	84.95	31347
100	371	52.71	14591	24	15.76	3789	371 to 563	100.61	26870
105	371	62.40	11695	23	16.80	2988	371 to 560	115.94	21452
110	371	72.19	8279	22	18.74	2084	371 to 558	132.93	15135
115	371	81.61	4388	20	20.54	1085	371 to 556	149.19	7990
120	371	91.11	0	19	22.19	0	371 to 553	165.28	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 32 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 32

INPUT DATA

Applied Load = 7636 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 1660 lb./ft.

Variation Factor = 1.325
Radius CL = 48.5 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	490	0.00	0	19	0.00	0	490 to 719	0.00	0
5	490	9.94	252	19	5.34	112	490 to 719	23.00	545
10	490	18.69	952	19	10.21	484	490 to 719	43.53	2156
15	490	26.14	2003	18	13.26	1093	490 to 719	59.15	4663
20	490	32.20	3305	19	15.48	1808	490 to 720	71.42	7701
25	490	36.86	4868	20	16.59	2534	490 to 722	79.83	11124
30	490	40.12	6535	22	16.61	3232	490 to 724	84.40	14645
35	490	42.01	8179	23	15.58	3987	490 to 727	85.31	18230
40	490	42.62	9861	24	14.51	4648	490 to 729	84.34	21709
45	490	42.05	11421	26	13.36	5203	490 to 731	81.60	24837
50	490	40.44	12841	26	12.16	5648	490 to 732	77.29	27580
55	490	37.95	14069	27	11.16	5979	490 to 734	72.10	29862
60	490	34.74	15070	28	10.66	6194	490 to 734	66.76	31630
65	490	31.01	15760	28	10.43	6291	490 to 735	61.14	32761
70	490	26.93	16211	28	10.35	6270	490 to 735	55.31	33356
75	490	22.70	16269	28	10.56	6130	490 to 735	49.74	33199
80	490	18.48	16007	28	11.05	5872	490 to 734	44.68	32393
85	490	19.23	15381	27	11.81	5525	490 to 733	47.00	30928
90	490	25.89	14339	26	13.17	5063	490 to 732	58.65	28682
95	490	32.95	12925	26	14.39	4483	490 to 731	70.60	25716
100	490	40.20	11128	24	15.76	3789	490 to 729	83.09	22022
105	490	47.59	8919	23	16.80	2988	490 to 727	95.20	17567
110	490	55.05	6314	22	18.74	2084	490 to 724	108.95	12384
115	490	62.24	3347	20	20.54	1085	490 to 722	122.07	6532
120	490	69.49	0	19	22.19	0	490 to 719	135.01	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 33 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 33

INPUT DATA

Applied Load = 12534 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 2095 lb./ft.
Variation Factor = 1.126
Radius CL = 48.5 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	684	0.00	0	24	0.00	0	684 to 999	0.00	0
5	684	6.33	160	24	6.74	142	684 to 999	20.32	467
10	684	11.89	605	24	12.88	611	684 to 999	38.56	1887
15	684	16.63	1274	23	16.74	1379	684 to 998	51.75	4130
20	684	20.49	2103	24	19.54	2281	684 to 1000	61.92	6824
25	684	23.46	3098	26	20.94	3198	684 to 1002	68.45	9774
30	684	25.53	4158	28	20.96	4080	684 to 1006	71.38	12758
35	684	26.73	5204	29	19.67	5032	684 to 1009	70.87	15842
40	684	27.12	6275	31	18.31	5867	684 to 1011	69.11	18759
45	684	26.76	7268	32	16.87	6567	684 to 1014	66.14	21341
50	684	25.73	8171	34	15.34	7129	684 to 1016	62.12	23559
55	684	24.15	8953	34	14.08	7547	684 to 1017	57.76	25364
60	684	22.11	9590	35	13.45	7818	684 to 1018	53.83	26718
65	684	19.73	10029	35	13.16	7940	684 to 1019	50.00	27540
70	684	17.14	10316	35	13.06	7913	684 to 1019	46.21	27896
75	684	14.44	10353	35	13.33	7736	684 to 1019	42.89	27647
80	684	11.76	10186	35	13.95	7411	684 to 1018	40.19	26861
85	684	12.23	9788	34	14.90	6974	684 to 1017	42.47	25559
90	684	16.47	9125	33	16.63	6390	684 to 1016	51.34	23638
95	684	20.97	8225	32	18.16	5657	684 to 1014	60.23	21134
100	684	25.58	7082	31	19.90	4782	684 to 1011	69.65	18045
105	684	30.28	5676	29	21.21	3771	684 to 1009	78.46	14357
110	684	35.03	4018	28	23.66	2630	684 to 1006	89.27	10098
115	684	39.61	2130	26	25.93	1370	684 to 1003	99.54	5312
120	684	44.22	0	24	28.00	0	684 to 999	109.51	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 34 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 34

INPUT DATA

Applied Load = 14771 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 2095 lb./ft.

Variation Factor = 1.105
Radius CL = 48.5 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	791	0.00	0	24	0.00	0	791 to 1149	0.00	0
5	791	6.21	157	24	6.74	142	791 to 1149	20.16	463
10	791	11.68	595	24	12.88	611	791 to 1149	38.26	1872
15	791	16.33	1251	23	16.74	1379	791 to 1148	51.34	4098
20	791	20.12	2065	24	19.54	2281	791 to 1150	61.41	6771
25	791	23.04	3042	26	20.94	3198	791 to 1152	67.86	9696
30	791	25.07	4084	28	20.96	4080	791 to 1156	70.74	12654
35	791	26.25	5111	29	19.67	5032	791 to 1159	70.20	15712
40	791	26.63	6163	31	18.31	5867	791 to 1161	68.43	18602
45	791	26.28	7138	32	16.87	6567	791 to 1164	65.47	21158
50	791	25.27	8025	34	15.34	7129	791 to 1166	61.47	23354
55	791	23.71	8792	34	14.08	7547	791 to 1167	57.15	25139
60	791	21.71	9418	35	13.45	7818	791 to 1168	53.27	26477
65	791	19.38	9849	35	13.16	7940	791 to 1169	49.51	27288
70	791	16.83	10131	35	13.06	7913	791 to 1169	45.78	27637
75	791	14.18	10168	35	13.33	7736	791 to 1169	42.53	27387
80	791	11.55	10003	35	13.95	7411	791 to 1168	39.90	26605
85	791	12.02	9612	34	14.90	6974	791 to 1167	42.17	25313
90	791	16.18	8961	33	16.63	6390	791 to 1165	50.92	23409
95	791	20.59	8077	32	18.16	5657	791 to 1164	59.71	20927
100	791	25.12	6955	31	19.90	4782	791 to 1161	69.01	17867
105	791	29.74	5574	29	21.21	3771	791 to 1159	77.70	14215
110	791	34.40	3946	28	23.66	2630	791 to 1156	88.39	9997
115	791	38.90	2091	26	25.93	1370	791 to 1153	98.54	5258
120	791	43.42	0	24	28.00	0	791 to 1149	108.40	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 35 OF ____

CHKD. BY: _____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 35

INPUT DATA

Applied Load = 21064 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 620 lb./ft.

Variation Factor = 1.078
Radius CL = 48.5 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	1101	0.00	0	7	0.00	0	1101 to 1554	0.00	0
5	1101	6.58	167	7	1.99	42	1101 to 1554	12.61	305
10	1101	12.37	630	7	3.81	180	1101 to 1553	23.81	1190
15	1101	17.30	1326	7	4.95	408	1101 to 1553	32.65	2550
20	1101	21.32	2188	7	5.78	675	1101 to 1554	39.68	4211
25	1101	24.40	3223	7	6.19	946	1101 to 1555	44.70	6121
30	1101	26.56	4326	8	6.20	1207	1101 to 1555	47.73	8110
35	1101	27.81	5414	8	5.82	1489	1101 to 1556	48.83	10112
40	1101	28.21	6528	9	5.42	1736	1101 to 1557	48.72	12092
45	1101	27.84	7561	9	4.99	1943	1101 to 1558	47.46	13890
50	1101	26.77	8501	10	4.54	2109	1101 to 1558	45.20	15488
55	1101	25.12	9314	10	4.16	2233	1101 to 1559	42.26	16837
60	1101	23.00	9977	10	3.98	2313	1101 to 1559	38.97	17902
65	1101	20.53	10434	10	3.89	2349	1101 to 1559	35.36	18602
70	1101	17.83	10732	10	3.86	2341	1101 to 1559	31.53	19007
75	1101	15.02	10771	10	3.94	2289	1101 to 1559	27.74	18972
80	1101	12.23	10597	10	4.13	2193	1101 to 1559	24.15	18565
85	1101	12.73	10183	10	4.41	2063	1101 to 1559	25.32	17765
90	1101	17.14	9493	10	4.92	1891	1101 to 1558	32.36	16505
95	1101	21.81	8557	9	5.37	1674	1101 to 1558	39.68	14826
100	1101	26.61	7367	9	5.88	1415	1101 to 1557	47.27	12721
105	1101	31.51	5905	8	6.27	1116	1101 to 1556	54.78	10164
110	1101	36.45	4180	8	7.00	778	1101 to 1555	62.93	7176
115	1101	41.21	2216	7	7.67	405	1101 to 1555	70.74	3792
120	1101	46.00	0	7	8.28	0	1101 to 1554	78.49	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 36 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 36

INPUT DATA

Applied Load = 20241 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 620 lb./ft.

Variation Factor = 1.082
Radius CL = 48.5 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	1062	0.00	0	7	0.00	0	1062 to 1499	0.00	0
5	1062	6.65	169	7	1.99	42	1062 to 1499	12.70	308
10	1062	12.50	636	7	3.81	180	1062 to 1499	23.99	1199
15	1062	17.48	1339	7	4.95	408	1062 to 1499	32.90	2569
20	1062	21.54	2210	7	5.78	675	1062 to 1499	39.99	4242
25	1062	24.65	3256	7	6.19	946	1062 to 1500	45.05	6167
30	1062	26.83	4370	8	6.20	1207	1062 to 1501	48.11	8171
35	1062	28.09	5470	8	5.82	1489	1062 to 1502	49.23	10190
40	1062	28.50	6595	9	5.42	1736	1062 to 1502	49.12	12185
45	1062	28.12	7638	9	4.99	1943	1062 to 1503	47.86	13998
50	1062	27.04	8588	10	4.54	2109	1062 to 1504	45.59	15610
55	1062	25.38	9409	10	4.16	2233	1062 to 1504	42.62	16970
60	1062	23.23	10079	10	3.98	2313	1062 to 1504	39.30	18044
65	1062	20.74	10540	10	3.89	2349	1062 to 1505	35.65	18752
70	1062	18.01	10842	10	3.86	2341	1062 to 1505	31.79	19160
75	1062	15.18	10881	10	3.94	2289	1062 to 1505	27.96	19126
80	1062	12.36	10705	10	4.13	2193	1062 to 1504	24.33	18716
85	1062	12.86	10287	10	4.41	2063	1062 to 1504	25.50	17910
90	1062	17.31	9590	10	4.92	1891	1062 to 1504	32.61	16641
95	1062	22.04	8644	9	5.37	1674	1062 to 1503	39.99	14948
100	1062	26.89	7443	9	5.88	1415	1062 to 1502	47.65	12826
105	1062	31.83	5965	8	6.27	1116	1062 to 1502	55.23	10249
110	1062	36.82	4223	8	7.00	778	1062 to 1501	63.45	7236
115	1062	41.63	2238	7	7.67	405	1062 to 1500	71.33	3823
120	1062	46.47	0	7	8.28	0	1062 to 1499	79.15	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 37 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 37

INPUT DATA

Applied Load = 4415 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 1660 lb./ft.

Variation Factor = 1.737
Radius CL = 53.35 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	409	0.00	0	19	0.00	0	409 to 606	0.00	0
5	409	14.34	401	19	5.33	141	409 to 606	29.16	802
10	409	26.96	1510	19	11.47	593	409 to 606	57.26	3123
15	409	37.70	3177	19	14.23	1327	409 to 605	76.99	6705
20	409	46.45	5243	20	16.97	2174	409 to 607	93.89	11039
25	409	53.17	7724	21	17.59	3022	409 to 609	104.34	15952
30	409	57.86	10368	23	17.35	3814	409 to 612	110.51	21000
35	409	60.59	12976	24	16.39	4686	409 to 614	112.69	26133
40	409	61.47	15645	26	15.17	5445	409 to 617	111.85	31160
45	409	60.65	18120	27	13.78	6081	409 to 618	108.35	35708
50	409	58.33	20372	28	12.60	6590	409 to 620	103.08	39725
55	409	54.73	22320	28	11.81	6968	409 to 621	96.70	43095
60	409	50.11	23909	29	11.23	7211	409 to 622	89.26	45733
65	409	44.72	25003	29	10.82	7318	409 to 623	81.01	47446
70	409	38.84	25719	29	10.92	7288	409 to 623	72.95	48397
75	409	32.74	25811	29	11.02	7121	409 to 622	64.58	48242
80	409	26.66	25394	29	11.73	6818	409 to 622	57.27	47144
85	409	27.73	24402	28	12.69	6382	409 to 621	60.42	45013
90	409	37.34	22748	27	13.62	5819	409 to 620	75.44	41741
95	409	47.53	20505	26	15.05	5151	409 to 618	92.14	37465
100	409	57.98	17655	25	16.66	4353	409 to 616	109.51	32118
105	409	68.64	14151	24	18.10	3431	409 to 614	126.87	25645
110	409	79.40	10018	22	19.57	2393	409 to 611	144.45	18095
115	409	89.77	5310	21	21.44	1246	409 to 609	162.15	9553
120	409	100.22	0	19	23.15	0	409 to 606	179.67	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 38 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 38

INPUT DATA

Applied Load = 7636 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 1660 lb./ft.

Variation Factor = 1.325
Radius CL = 53.35 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	539	0.00	0	19	0.00	0	539 to 789	0.00	0
5	539	10.94	305	19	5.33	141	539 to 789	24.39	669
10	539	20.56	1152	19	11.47	593	539 to 789	48.30	2621
15	539	28.75	2423	19	14.23	1327	539 to 788	64.46	5649
20	539	35.43	3999	20	16.97	2174	539 to 790	78.45	9296
25	539	40.55	5891	21	17.59	3022	539 to 792	86.67	13386
30	539	44.13	7907	23	17.35	3814	539 to 795	91.28	17556
35	539	46.21	9896	24	16.39	4686	539 to 797	92.56	21821
40	539	46.88	11932	26	15.17	5445	539 to 799	91.43	25962
45	539	46.25	13820	27	13.78	6081	539 to 801	88.20	29688
50	539	44.48	15537	28	12.60	6590	539 to 803	83.70	32957
55	539	41.74	17023	28	11.81	6968	539 to 804	78.52	35679
60	539	38.22	18235	29	11.23	7211	539 to 805	72.61	37789
65	539	34.11	19070	29	10.82	7318	539 to 806	66.15	39139
70	539	29.62	19616	29	10.92	7288	539 to 806	60.05	39852
75	539	24.97	19686	29	11.02	7121	539 to 805	53.71	39667
80	539	20.33	19368	29	11.73	6818	539 to 805	48.41	38707
85	539	21.15	18611	28	12.69	6382	539 to 804	51.20	36906
90	539	28.48	17350	27	13.62	5819	539 to 803	63.03	34183
95	539	36.25	15639	26	15.05	5151	539 to 801	76.35	30652
100	539	44.22	13465	25	16.66	4353	539 to 799	90.24	26252
105	539	52.35	10793	24	18.10	3431	539 to 797	104.07	20944
110	539	60.56	7641	22	19.57	2393	539 to 794	118.07	14766
115	539	68.47	4050	21	21.44	1246	539 to 792	132.32	7789
120	539	76.44	0	19	23.15	0	539 to 789	146.38	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 39 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 39

INPUT DATA

Applied Load = 12534 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 2095 lb./ft.
Variation Factor = 1.126
Radius CL = 53.35 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	752	0.00	0	25	0.00	0	752 to 1096	0.00	0
5	752	6.96	194	25	6.73	178	752 to 1096	21.20	576
10	752	13.08	733	24	14.48	748	752 to 1096	42.95	2299
15	752	18.30	1542	24	17.97	1674	752 to 1095	56.17	5006
20	752	22.54	2545	25	21.42	2744	752 to 1097	67.98	8229
25	752	25.80	3748	27	22.19	3814	752 to 1100	73.86	11733
30	752	28.08	5032	29	21.90	4814	752 to 1103	76.55	15229
35	752	29.40	6298	31	20.68	5914	752 to 1107	76.34	18871
40	752	29.83	7593	32	19.15	6872	752 to 1109	74.32	22314
45	752	29.43	8794	34	17.40	7675	752 to 1112	70.79	25361
50	752	28.31	9887	35	15.90	8318	752 to 1114	66.67	27983
55	752	26.56	10833	36	14.90	8794	752 to 1115	62.53	30117
60	752	24.32	11604	37	14.18	9101	752 to 1117	58.16	31718
65	752	21.70	12135	37	13.66	9235	752 to 1117	53.61	32691
70	752	18.85	12483	37	13.78	9197	752 to 1117	49.83	33112
75	752	15.89	12527	37	13.92	8987	752 to 1117	45.91	32817
80	752	12.94	12325	36	14.80	8605	752 to 1116	43.28	31884
85	752	13.46	11843	36	16.02	8055	752 to 1115	46.09	30275
90	752	18.12	11041	35	17.19	7344	752 to 1113	54.60	27943
95	752	23.06	9952	33	19.00	6501	752 to 1111	64.60	24985
100	752	28.14	8569	32	21.02	5494	752 to 1109	75.15	21336
105	752	33.31	6868	30	22.84	4331	752 to 1106	85.48	16978
110	752	38.54	4862	29	24.71	3020	752 to 1103	95.96	11942
115	752	43.57	2577	27	27.06	1573	752 to 1100	107.02	6283
120	752	48.64	0	25	29.22	0	752 to 1096	117.78	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 40 OF ____

CHKD. BY: _____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 40

INPUT DATA

Applied Load = 14771 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 2095 lb./ft.

Variation Factor = 1.105
Radius CL = 53.35 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	870	0.00	0	25	0.00	0	870 to 1261	0.00	0
5	870	6.83	191	25	6.73	178	870 to 1261	21.03	571
10	870	12.85	720	24	14.48	748	870 to 1261	42.62	2281
15	870	17.97	1514	24	17.97	1674	870 to 1260	55.71	4967
20	870	22.14	2499	25	21.42	2744	870 to 1262	67.41	8165
25	870	25.34	3681	27	22.19	3814	870 to 1265	73.22	11639
30	870	27.58	4942	29	21.90	4814	870 to 1268	75.84	15103
35	870	28.88	6185	31	20.68	5914	870 to 1272	75.60	18713
40	870	29.30	7457	32	19.15	6872	870 to 1274	73.58	22123
45	870	28.91	8637	34	17.40	7675	870 to 1277	70.05	25140
50	870	27.80	9710	35	15.90	8318	870 to 1279	65.96	27735
55	870	26.08	10639	36	14.90	8794	870 to 1280	61.86	29845
60	870	23.88	11396	37	14.18	9101	870 to 1282	57.55	31427
65	870	21.31	11918	37	13.66	9235	870 to 1282	53.07	32386
70	870	18.51	12259	37	13.78	9197	870 to 1282	49.36	32799
75	870	15.60	12303	37	13.92	8987	870 to 1282	45.51	32502
80	870	12.70	12104	36	14.80	8605	870 to 1281	42.96	31575
85	870	13.22	11631	36	16.02	8055	870 to 1280	45.75	29977
90	870	17.80	10843	35	17.19	7344	870 to 1278	54.14	27666
95	870	22.65	9774	33	19.00	6501	870 to 1276	64.02	24735
100	870	27.64	8415	32	21.02	5494	870 to 1274	74.44	21121
105	870	32.72	6745	30	22.84	4331	870 to 1271	84.64	16805
110	870	37.85	4775	29	24.71	3020	870 to 1268	94.99	11820
115	870	42.79	2531	27	27.06	1573	870 to 1265	105.92	6218
120	870	47.77	0	25	29.22	0	870 to 1261	116.56	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 41 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 41

INPUT DATA

Applied Load = 21064 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 620 lb./ft.

Variation Factor = 1.078
Radius CL = 53.35 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	1211	0.00	0	7	0.00	0	1211 to 1708	0.00	0
5	1211	7.24	202	7	1.99	52	1211 to 1708	13.53	373
10	1211	13.61	762	7	4.28	221	1211 to 1708	26.35	1444
15	1211	19.03	1604	7	5.31	495	1211 to 1708	35.69	3089
20	1211	23.45	2647	7	6.33	812	1211 to 1708	43.61	5087
25	1211	26.84	3900	8	6.56	1128	1211 to 1709	48.75	7379
30	1211	29.21	5235	8	6.48	1424	1211 to 1710	51.92	9751
35	1211	30.59	6552	9	6.12	1750	1211 to 1711	53.24	12148
40	1211	31.03	7899	9	5.66	2033	1211 to 1712	53.09	14517
45	1211	30.62	9149	10	5.15	2271	1211 to 1713	51.63	16671
50	1211	29.45	10286	10	4.70	2461	1211 to 1713	49.23	18586
55	1211	27.63	11270	10	4.41	2602	1211 to 1714	46.19	20203
60	1211	25.30	12072	10	4.19	2693	1211 to 1714	42.56	21480
65	1211	22.58	12625	11	4.04	2733	1211 to 1714	38.49	22322
70	1211	19.61	12986	11	4.08	2722	1211 to 1714	34.39	22808
75	1211	16.53	13033	11	4.11	2659	1211 to 1714	30.14	22768
80	1211	13.46	12822	10	4.38	2546	1211 to 1714	26.29	22281
85	1211	14.00	12321	10	4.74	2383	1211 to 1714	27.67	21302
90	1211	18.85	11486	10	5.08	2173	1211 to 1713	35.04	19776
95	1211	23.99	10354	10	5.62	1923	1211 to 1713	43.16	17766
100	1211	29.28	8915	9	6.22	1625	1211 to 1712	51.57	15245
105	1211	34.66	7145	9	6.76	1281	1211 to 1711	60.02	12182
110	1211	40.09	5058	8	7.31	893	1211 to 1710	68.56	8601
115	1211	45.33	2681	8	8.01	465	1211 to 1709	77.08	4545
120	1211	50.60	0	7	8.64	0	1211 to 1708	85.55	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 42 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 42

INPUT DATA

Applied Load = 20241 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 620 lb./ft.

Variation Factor = 1.082
Radius CL = 53.35 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	1168	0.00	0	7	0.00	0	1168 to 1648	0.00	0
5	1168	7.31	204	7	1.99	52	1168 to 1648	13.63	376
10	1168	13.75	770	7	4.28	221	1168 to 1648	26.54	1455
15	1168	19.23	1621	7	5.31	495	1168 to 1648	35.96	3112
20	1168	23.69	2674	7	6.33	812	1168 to 1648	43.95	5125
25	1168	27.12	3939	8	6.56	1128	1168 to 1649	49.14	7435
30	1168	29.51	5288	8	6.48	1424	1168 to 1650	52.34	9826
35	1168	30.90	6618	9	6.12	1750	1168 to 1651	53.67	12241
40	1168	31.35	7980	9	5.66	2033	1168 to 1652	53.53	14630
45	1168	30.93	9243	10	5.15	2271	1168 to 1653	52.06	16802
50	1168	29.75	10391	10	4.70	2461	1168 to 1653	49.65	18733
55	1168	27.92	11385	10	4.41	2602	1168 to 1654	46.58	20364
60	1168	25.56	12196	10	4.19	2693	1168 to 1654	42.92	21653
65	1168	22.81	12754	11	4.04	2733	1168 to 1654	38.81	22502
70	1168	19.81	13119	11	4.08	2722	1168 to 1654	34.67	22994
75	1168	16.70	13166	11	4.11	2659	1168 to 1654	30.38	22954
80	1168	13.60	12953	10	4.38	2546	1168 to 1654	26.49	22464
85	1168	14.14	12447	10	4.74	2383	1168 to 1653	27.87	21479
90	1168	19.05	11604	10	5.08	2173	1168 to 1653	35.31	19940
95	1168	24.24	10459	10	5.62	1923	1168 to 1652	43.50	17914
100	1168	29.57	9006	9	6.22	1625	1168 to 1652	51.99	15372
105	1168	35.01	7218	9	6.76	1281	1168 to 1651	60.51	12284
110	1168	40.50	5110	8	7.31	893	1168 to 1650	69.14	8674
115	1168	45.79	2708	8	8.01	465	1168 to 1649	77.73	4584
120	1168	51.12	0	7	8.64	0	1168 to 1648	86.27	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 43 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 43

INPUT DATA

Applied Load = 4415 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 1660 lb./ft.

Variation Factor = 1.737
Radius CL = 58.2 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	446	0.00	0	20	0.00	0	446 to 659	0.00	0
5	446	15.65	477	20	6.60	171	446 to 659	33.14	960
10	446	29.42	1797	20	12.70	711	446 to 659	62.78	3726
15	446	41.13	3782	19	15.83	1580	446 to 658	84.50	7981
20	446	50.67	6240	20	18.30	2565	446 to 660	102.06	13099
25	446	58.00	9192	22	18.48	3540	446 to 663	112.63	18887
30	446	63.12	12339	24	18.29	4437	446 to 665	119.48	24819
35	446	66.10	15442	25	17.08	5408	446 to 668	121.59	30814
40	446	67.05	18619	26	15.64	6268	446 to 670	120.48	36723
45	446	66.16	21565	28	14.25	6988	446 to 672	116.85	42072
50	446	63.63	24244	29	13.06	7563	446 to 674	111.29	46800
55	446	59.71	26563	29	12.14	7988	446 to 675	104.25	50768
60	446	54.66	28454	30	11.74	8259	446 to 676	96.49	53878
65	446	48.79	29756	30	11.43	8376	446 to 676	87.75	55899
70	446	42.37	30608	30	11.41	8337	446 to 677	78.74	57025
75	446	35.71	30718	30	11.71	8142	446 to 676	69.91	56847
80	446	29.08	30222	30	12.30	7793	446 to 676	61.63	55559
85	446	30.26	29040	29	13.17	7292	446 to 674	64.76	53053
90	446	40.74	27073	28	14.30	6643	446 to 673	81.35	49196
95	446	51.85	24403	27	15.64	5852	446 to 671	99.19	44114
100	446	63.26	21011	26	17.17	4925	446 to 669	117.75	37790
105	446	74.88	16841	25	18.82	3882	446 to 667	136.84	30177
110	446	86.62	11922	23	20.30	2707	446 to 665	155.80	21294
115	446	97.93	6319	22	22.24	1410	446 to 662	174.92	11244
120	446	109.33	0	20	24.00	0	446 to 659	193.87	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 44 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 44

INPUT DATA

Applied Load = 7636 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 1660 lb./ft.

Variation Factor = 1.325
Radius CL = 58.2 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	588	0.00	0	20	0.00	0	588 to 859	0.00	0
5	588	11.93	364	20	6.60	171	588 to 859	27.94	801
10	588	22.43	1371	20	12.70	711	588 to 858	53.00	3129
15	588	31.37	2884	19	15.83	1580	588 to 858	70.84	6724
20	588	38.65	4759	20	18.30	2565	588 to 860	85.22	11025
25	588	44.24	7010	22	18.48	3540	588 to 862	93.36	15833
30	588	48.14	9411	24	18.29	4437	588 to 865	98.51	20719
35	588	50.41	11777	25	17.08	5408	588 to 867	99.62	25684
40	588	51.14	14200	26	15.64	6268	588 to 870	98.20	30537
45	588	50.46	16447	28	14.25	6988	588 to 872	94.87	34907
50	588	48.53	18491	29	13.06	7563	588 to 873	90.15	38745
55	588	45.54	20259	29	12.14	7988	588 to 875	84.41	41943
60	588	41.69	21702	30	11.74	8259	588 to 876	78.33	44424
65	588	37.21	22695	30	11.43	8376	588 to 876	71.54	46013
70	588	32.32	23344	30	11.41	8337	588 to 876	64.66	46856
75	588	27.24	23428	30	11.71	8142	588 to 876	58.04	46641
80	588	22.18	23050	30	12.30	7793	588 to 875	51.97	45518
85	588	23.08	22149	29	13.17	7292	588 to 874	54.70	43405
90	588	31.07	20648	28	14.30	6643	588 to 873	67.81	40202
95	588	39.54	18612	27	15.64	5852	588 to 871	81.96	36006
100	588	48.24	16025	26	17.17	4925	588 to 869	96.74	30809
105	588	57.11	12844	25	18.82	3882	588 to 867	111.96	24582
110	588	66.07	9093	23	20.30	2707	588 to 864	127.02	17333
115	588	74.69	4820	22	22.24	1410	588 to 861	142.38	9145
120	588	83.38	0	20	24.00	0	588 to 859	157.55	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 45 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 45

INPUT DATA

Applied Load = 12534 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 2095 lb./ft.

Variation Factor = 1.126
Radius CL = 58.2 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	821	0.00	0	25	0.00	0	821 to 1193	0.00	0
5	821	7.59	231	25	8.33	216	821 to 1193	24.81	692
10	821	14.27	872	25	16.02	898	821 to 1193	47.24	2748
15	821	19.96	1835	25	19.98	1994	821 to 1192	61.92	5960
20	821	24.59	3028	26	23.09	3238	821 to 1194	73.70	9745
25	821	28.15	4461	28	23.33	4468	821 to 1198	79.08	13841
30	821	30.63	5988	30	23.09	5600	821 to 1201	82.15	17905
35	821	32.08	7495	32	21.56	6826	821 to 1204	81.57	22097
40	821	32.54	9036	34	19.74	7911	821 to 1207	79.13	26101
45	821	32.11	10466	35	17.98	8820	821 to 1210	75.53	29647
50	821	30.88	11767	36	16.48	9545	821 to 1212	71.26	32701
55	821	28.98	12892	37	15.33	10081	821 to 1214	66.64	35188
60	821	26.53	13810	38	14.81	10424	821 to 1215	62.33	37056
65	821	23.68	14442	38	14.43	10571	821 to 1215	57.69	38191
70	821	20.56	14856	38	14.41	10522	821 to 1215	53.29	38685
75	821	17.33	14909	38	14.78	10275	821 to 1215	49.39	38342
80	821	14.11	14668	38	15.52	9835	821 to 1214	46.15	37255
85	821	14.68	14095	37	16.62	9203	821 to 1213	48.82	35378
90	821	19.77	13140	36	18.04	8384	821 to 1211	58.36	32650
95	821	25.16	11844	34	19.74	7386	821 to 1209	68.80	29138
100	821	30.70	10198	33	21.67	6216	821 to 1206	79.82	24845
105	821	36.34	8173	31	23.75	4899	821 to 1204	91.27	19773
110	821	42.04	5786	29	25.62	3417	821 to 1200	102.43	13910
115	821	47.53	3067	27	28.06	1779	821 to 1197	114.26	7319
120	821	53.06	0	25	30.29	0	821 to 1193	125.79	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 46 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 46

INPUT DATA

Applied Load = 14771 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 2095 lb./ft.
Variation Factor = 1.105
Radius CL = 58.2 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	949	0.00	0	25	0.00	0	949 to 1373	0.00	0
5	949	7.46	227	25	8.33	216	949 to 1373	24.62	687
10	949	14.02	856	25	16.02	898	949 to 1373	46.88	2726
15	949	19.60	1802	25	19.98	1994	949 to 1372	61.42	5914
20	949	24.15	2974	26	23.09	3238	949 to 1374	73.08	9669
25	949	27.64	4381	28	23.33	4468	949 to 1378	78.37	13729
30	949	30.08	5881	30	23.09	5600	949 to 1381	81.38	17755
35	949	31.50	7360	32	21.56	6826	949 to 1384	80.77	21909
40	949	31.96	8874	34	19.74	7911	949 to 1387	78.31	25874
45	949	31.53	10278	35	17.98	8820	949 to 1390	74.72	29384
50	949	30.33	11556	36	16.48	9545	949 to 1392	70.48	32405
55	949	28.46	12661	37	15.33	10081	949 to 1393	65.91	34864
60	949	26.05	13562	38	14.81	10424	949 to 1395	61.67	36709
65	949	23.25	14183	38	14.43	10571	949 to 1395	57.09	37828
70	949	20.19	14589	38	14.41	10522	949 to 1395	52.78	38312
75	949	17.02	14641	38	14.78	10275	949 to 1395	48.96	37967
80	949	13.86	14405	38	15.52	9835	949 to 1394	45.80	36887
85	949	14.42	13842	37	16.62	9203	949 to 1393	48.46	35024
90	949	19.41	12904	36	18.04	8384	949 to 1391	57.87	32320
95	949	24.71	11631	34	19.74	7386	949 to 1389	68.17	28841
100	949	30.15	10015	33	21.67	6216	949 to 1386	79.05	24589
105	949	35.69	8027	31	23.75	4899	949 to 1383	90.36	19567
110	949	41.29	5682	29	25.62	3417	949 to 1380	101.37	13765
115	949	46.68	3012	27	28.06	1779	949 to 1377	113.07	7242
120	949	52.11	0	25	30.29	0	949 to 1373	124.45	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 47 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 47

INPUT DATA

Applied Load = 21064 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 620 lb./ft.

Variation Factor = 1.078
Radius CL = 58.2 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	1321	0.00	0	7	0.00	0	1321 to 1863	0.00	0
5	1321	7.90	241	7	2.46	64	1321 to 1863	15.26	446
10	1321	14.85	907	7	4.74	265	1321 to 1862	28.86	1722
15	1321	20.76	1909	7	5.91	590	1321 to 1862	39.13	3676
20	1321	25.58	3151	7	6.83	958	1321 to 1863	47.44	6040
25	1321	29.28	4641	8	6.90	1322	1321 to 1864	52.74	8745
30	1321	31.87	6230	8	6.83	1657	1321 to 1865	56.24	11540
35	1321	33.37	7797	9	6.38	2020	1321 to 1866	57.57	14350
40	1321	33.86	9401	10	5.84	2341	1321 to 1867	57.33	17142
45	1321	33.41	10889	10	5.32	2610	1321 to 1868	55.82	19682
50	1321	32.13	12241	10	4.87	2824	1321 to 1868	53.27	21940
55	1321	30.15	13412	11	4.53	2983	1321 to 1869	49.92	23849
60	1321	27.60	14367	11	4.38	3085	1321 to 1869	46.10	25359
65	1321	24.63	15025	11	4.27	3128	1321 to 1869	41.75	26354
70	1321	21.39	15455	11	4.26	3113	1321 to 1869	37.20	26930
75	1321	18.03	15510	11	4.37	3041	1321 to 1869	32.68	26884
80	1321	14.68	15260	11	4.59	2910	1321 to 1869	28.37	26312
85	1321	15.28	14663	11	4.92	2723	1321 to 1868	29.75	25159
90	1321	20.57	13670	10	5.34	2481	1321 to 1868	37.88	23356
95	1321	26.18	12322	10	5.84	2185	1321 to 1867	46.58	20967
100	1321	31.94	10609	9	6.41	1839	1321 to 1867	55.62	17980
105	1321	37.81	8503	9	7.03	1450	1321 to 1866	64.89	14370
110	1321	43.74	6020	8	7.58	1011	1321 to 1865	74.13	10147
115	1321	49.45	3191	8	8.30	526	1321 to 1864	83.35	5362
120	1321	55.20	0	7	8.96	0	1321 to 1863	92.53	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 48 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 48

INPUT DATA

Applied Load = 20241 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 620 lb./ft.

Variation Factor = 1.082
Radius CL = 58.2 feet
Distance to Surcharge = 12.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	1274	0.00	0	7	0.00	0	1274 to 1797	0.00	0
5	1274	7.98	243	7	2.46	64	1274 to 1797	15.37	449
10	1274	15.00	916	7	4.74	265	1274 to 1797	29.07	1735
15	1274	20.98	1929	7	5.91	590	1274 to 1797	39.42	3704
20	1274	25.85	3183	7	6.83	958	1274 to 1797	47.81	6085
25	1274	29.58	4688	8	6.90	1322	1274 to 1798	53.16	8812
30	1274	32.19	6294	8	6.83	1657	1274 to 1799	56.69	11629
35	1274	33.71	7877	9	6.38	2020	1274 to 1800	58.05	14462
40	1274	34.20	9497	10	5.84	2341	1274 to 1801	57.82	17276
45	1274	33.75	11000	10	5.32	2610	1274 to 1802	56.29	19837
50	1274	32.45	12366	10	4.87	2824	1274 to 1802	53.73	22115
55	1274	30.45	13549	11	4.53	2983	1274 to 1803	50.35	24041
60	1274	27.88	14514	11	4.38	3085	1274 to 1803	46.49	25564
65	1274	24.88	15178	11	4.27	3128	1274 to 1803	42.10	26568
70	1274	21.61	15612	11	4.26	3113	1274 to 1803	37.51	27151
75	1274	18.21	15669	11	4.37	3041	1274 to 1803	32.94	27106
80	1274	14.83	15416	11	4.59	2910	1274 to 1803	28.58	26530
85	1274	15.43	14813	11	4.92	2723	1274 to 1803	29.97	25368
90	1274	20.78	13809	10	5.34	2481	1274 to 1802	38.17	23552
95	1274	26.44	12448	10	5.84	2185	1274 to 1802	46.96	21143
100	1274	32.26	10718	9	6.41	1839	1274 to 1801	56.07	18132
105	1274	38.19	8590	9	7.03	1450	1274 to 1800	65.43	14491
110	1274	44.18	6081	8	7.58	1011	1274 to 1799	74.75	10233
115	1274	49.95	3223	8	8.30	526	1274 to 1798	84.06	5408
120	1274	55.77	0	7	8.96	0	1274 to 1797	93.31	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 49 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 49

INPUT DATA

Applied Load = 5719 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 302 lb./ft.

Variation Factor = 1.309
Radius CL = 24.25 feet
Distance to Surcharge = 23.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	181	0.00	0	3	0.00	0	181 to 260	0.00	0
5	181	3.54	45	3	0.44	3	181 to 260	5.71	69
10	181	6.65	169	3	0.83	16	181 to 260	10.73	265
15	181	9.30	356	3	1.17	40	181 to 260	15.02	568
20	181	11.46	588	3	1.44	72	181 to 260	18.51	946
25	181	13.12	866	3	1.64	111	181 to 260	21.16	1403
30	181	14.28	1163	3	1.77	154	181 to 260	23.00	1890
35	181	14.95	1456	3	1.81	196	181 to 260	24.02	2373
40	181	15.17	1755	3	1.80	240	181 to 260	24.31	2866
45	181	14.97	2033	3	1.84	282	181 to 260	24.10	3327
50	181	14.40	2285	4	1.71	320	181 to 261	23.07	3744
55	181	13.51	2504	4	1.55	350	181 to 261	21.55	4101
60	181	12.37	2682	4	1.39	372	181 to 261	19.69	4389
65	181	11.04	2805	4	1.27	391	181 to 261	17.63	4593
70	181	9.58	2886	4	1.20	400	181 to 261	15.47	4721
75	181	8.08	2896	4	1.19	400	181 to 261	13.34	4736
80	181	6.58	2849	4	1.24	391	181 to 261	11.33	4654
85	181	6.84	2738	4	1.36	372	181 to 261	11.90	4466
90	181	9.21	2552	4	1.58	344	181 to 261	15.60	4159
95	181	11.73	2300	4	1.62	307	181 to 261	19.19	3743
100	181	14.31	1981	4	1.96	262	181 to 261	23.38	3219
105	181	16.94	1587	4	2.28	209	181 to 261	27.61	2578
110	181	19.60	1124	3	2.59	147	181 to 260	31.85	1824
115	181	22.16	595	3	2.90	77	181 to 260	35.96	965
120	181	24.74	0	3	3.19	0	181 to 260	40.06	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 50 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 50

INPUT DATA

Applied Load = 7486 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 302 lb./ft.

Variation Factor = 1.22
Radius CL = 24.25 feet
Distance to Surcharge = 23.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	221	0.00	0	3	0.00	0	221 to 316	0.00	0
5	221	3.30	41	3	0.44	3	221 to 316	5.37	65
10	221	6.20	157	3	0.83	16	221 to 316	10.10	249
15	221	8.67	332	3	1.17	40	221 to 316	14.14	534
20	221	10.68	548	3	1.44	72	221 to 315	17.41	890
25	221	12.23	807	3	1.64	111	221 to 315	19.91	1320
30	221	13.31	1084	3	1.77	154	221 to 316	21.64	1779
35	221	13.94	1356	3	1.81	196	221 to 316	22.60	2234
40	221	14.14	1636	3	1.80	240	221 to 316	22.86	2699
45	221	13.95	1894	3	1.84	282	221 to 316	22.67	3133
50	221	13.42	2130	4	1.71	320	221 to 317	21.69	3526
55	221	12.59	2334	4	1.55	350	221 to 317	20.26	3863
60	221	11.52	2500	4	1.39	372	221 to 317	18.52	4134
65	221	10.28	2614	4	1.27	391	221 to 317	16.58	4326
70	221	8.93	2689	4	1.20	400	221 to 317	14.56	4446
75	221	7.53	2699	4	1.19	400	221 to 317	12.57	4460
80	221	6.13	2655	4	1.24	391	221 to 317	10.70	4382
85	221	6.38	2551	4	1.36	372	221 to 317	11.24	4205
90	221	8.59	2378	4	1.58	344	221 to 317	14.72	3915
95	221	10.93	2144	4	1.62	307	221 to 317	18.07	3524
100	221	13.34	1846	4	1.96	262	221 to 317	22.01	3030
105	221	15.79	1479	4	2.28	209	221 to 317	25.99	2427
110	221	18.26	1047	3	2.59	147	221 to 316	29.99	1717
115	221	20.65	555	3	2.90	77	221 to 316	33.85	909
120	221	23.05	0	3	3.19	0	221 to 316	37.70	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 51 OF ____

CHKD. BY: _____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 51

INPUT DATA

Applied Load = 14626 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 1008 lb./ft.
Variation Factor = 1.111
Radius CL = 24.25 feet
Distance to Surcharge = 23.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	394	0.00	0	11	0.00	0	394 to 571	0.00	0
5	394	3.25	41	11	1.47	12	394 to 571	7.06	79
10	394	6.11	155	11	2.78	55	394 to 571	13.29	312
15	394	8.55	327	11	3.92	136	394 to 571	18.63	690
20	394	10.53	540	11	4.82	241	394 to 571	22.95	1167
25	394	12.05	796	11	5.47	372	394 to 571	26.19	1747
30	394	13.12	1068	11	5.91	514	394 to 571	28.42	2370
35	394	13.74	1337	12	6.05	657	394 to 572	29.53	2990
40	394	13.94	1612	12	6.02	802	394 to 573	29.75	3622
45	394	13.75	1868	13	6.16	944	394 to 574	29.73	4220
50	394	13.22	2100	13	5.71	1068	394 to 574	28.23	4756
55	394	12.41	2300	14	5.18	1168	394 to 575	26.18	5208
60	394	11.36	2464	14	4.67	1244	394 to 576	23.85	5566
65	394	10.14	2577	14	4.27	1306	394 to 577	21.46	5829
70	394	8.81	2651	15	4.02	1337	394 to 577	19.18	5985
75	394	7.42	2660	15	3.97	1337	394 to 577	17.15	5998
80	394	6.04	2617	15	4.16	1305	394 to 577	15.54	5884
85	394	6.29	2515	15	4.54	1242	394 to 577	16.53	5634
90	394	8.47	2345	14	5.30	1149	394 to 576	20.87	5236
95	394	10.77	2113	14	5.43	1025	394 to 576	24.33	4703
100	394	13.15	1820	14	6.55	875	394 to 575	29.56	4036
105	394	15.56	1458	13	7.62	698	394 to 575	34.76	3229
110	394	18.00	1032	13	8.66	491	394 to 574	39.94	2281
115	394	20.36	547	12	9.69	258	394 to 573	44.98	1205
120	394	22.72	0	11	10.65	0	394 to 571	49.93	0

HARTMAN ENGINEERING

BY: RJH DATE: 03-08-2006 SUBJECT _____ SHT. NO.: RAC - 52 OF ____

CHKD. BY: ____ DATE: _____ _____ JOB NO.: 06-602

ANALYSIS AND DESIGN LOADS FOR WALE NO. 52

INPUT DATA

Applied Load = 16832 lb./ft.
Arc Subtended = 120 degrees
Surcharge Load = 1008 lb./ft.
Variation Factor = 1.095
Radius CL = 24.25 feet
Distance to Surcharge = 23.5 feet

TABULATION OF INTERNAL LOADS

Point	Analysis Loads						Design Loads		
	Soil & Water			Surcharge			Range of P	V	M
	P (kips)	V (kips)	M (k-in)	P (kips)	V (kips)	M (k-in)	(kips)	(kips)	(k-in)
0	446	0.00	0	11	0.00	0	446 to 645	0.00	0
5	446	3.20	40	11	1.47	12	446 to 645	6.99	78
10	446	6.02	153	11	2.78	55	446 to 645	13.16	309
15	446	8.42	322	11	3.92	136	446 to 645	18.45	683
20	446	10.37	532	11	4.82	241	446 to 645	22.72	1156
25	446	11.87	784	11	5.47	372	446 to 645	25.93	1731
30	446	12.92	1052	11	5.91	514	446 to 645	28.14	2347
35	446	13.53	1317	12	6.05	657	446 to 646	29.24	2962
40	446	13.73	1588	12	6.02	802	446 to 647	29.46	3588
45	446	13.54	1839	13	6.16	944	446 to 648	29.44	4181
50	446	13.03	2068	13	5.71	1068	446 to 649	27.95	4711
55	446	12.22	2266	14	5.18	1168	446 to 649	25.92	5160
60	446	11.19	2427	14	4.67	1244	446 to 650	23.61	5514
65	446	9.99	2538	14	4.27	1306	446 to 651	21.24	5775
70	446	8.67	2611	15	4.02	1337	446 to 651	18.99	5929
75	446	7.31	2620	15	3.97	1337	446 to 651	16.99	5942
80	446	5.95	2578	15	4.16	1305	446 to 651	15.41	5829
85	446	6.19	2477	15	4.54	1242	446 to 651	16.39	5581
90	446	8.34	2309	14	5.30	1149	446 to 651	20.69	5187
95	446	10.61	2082	14	5.43	1025	446 to 650	24.10	4658
100	446	12.95	1792	14	6.55	875	446 to 649	29.28	3998
105	446	15.33	1436	13	7.62	698	446 to 649	34.43	3198
110	446	17.73	1017	13	8.66	491	446 to 648	39.56	2260
115	446	20.05	539	12	9.69	258	446 to 647	44.55	1194
120	446	22.38	0	11	10.65	0	446 to 645	49.45	0