JOB

SHEET NO. 1 OF 4

CALCULATED BY DATE 10/31/09

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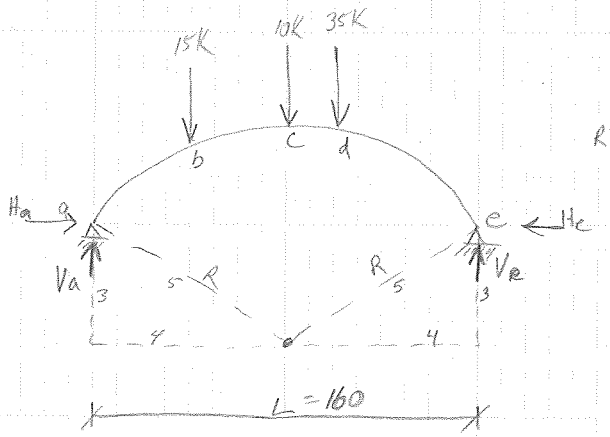
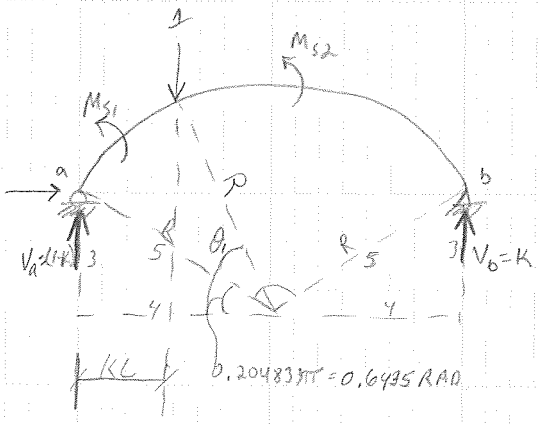
SCALE

(1)



R = 100', EI = CONSTANT



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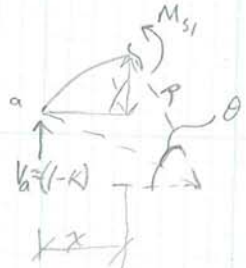
M_{S1} FOR $0 \le \theta \le \theta_1$



$$M_{S1} = V_a x$$
$$= (1-K)[R(1-\cos(\theta)) - 20] \quad \text{(A)}$$

$$y = R\sin\theta - 60$$

NUMERATOR OF EQ(9) BECOMES

$$\int_{0.6435}^{\theta_1} M_{S1}\, y R\, d\theta = \int_{0.6435}^{\theta_1} (1-K)[R(1-\cos\theta) - 20](R\sin\theta - 60)\, R\, d\theta$$

$$= (1-K)R\int_{0.6435}^{\theta_1} [R^2(1-\cos\theta)\sin\theta - 60R(1-\cos\theta) - 20R\sin\theta + 1200]\, d\theta$$

$$= (1-K)\int_{0.6435}^{\theta_1} [R^2\sin\theta - R^2\sin\theta\cos\theta - 60R + 60R\cos\theta - 20R\sin\theta + 1200]\, d\theta$$

CALL A

$$= (1-K)R[R^2(-\cos\theta_1 + 0.8) - 0.5R^2(\sin^2\theta_1 - 0.36) - 60R(\theta_1 - 0.6435) + 60R(\sin\theta_1 - 0.6)$$
$$+ 20R(\cos\theta_1 - 0.8) + 1200(\theta_1 - 0.6435)] \Rightarrow \text{SEE APP A (1)}$$

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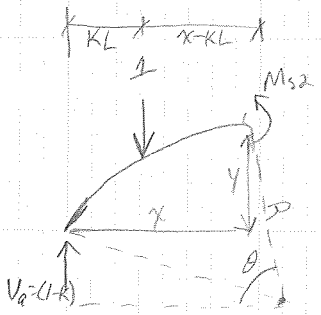
M_{s2} FOR $\theta_1 \geq \theta \leq 2.499$



$2 - KR - 40K$

$M_{s2} = V_a(x) - 1(x-KL)$

$= x(1-K) - x + KL$

$= x - Kx - x + KL$

$= KL - Kx \Rightarrow L = 2R - 40 = 160$

$= 160K - K(R(1-\cos\theta) - 20)$

$= 160K - KR + KR\cos\theta + 20K$

$= K(180 + R\cos\theta - R)$

$y = R\sin\theta - 60$

THE NUMERATOR PART OF EQ(9) BECOMES:

$$\int_{\theta_1}^{2.499} M_{s2}\, y\, R\,d\theta = (180K + KR\cos\theta - KR)(R\sin\theta - 60)\,R\,d\theta$$

$$= KR\int_{\theta_1}^{2.499} (180K/R\sin\theta - 10800K + KR^2\cos\theta\sin\theta - 60KR\cos\theta - KR^2\sin\theta + 60KR)\,R\,d\theta$$

$$= KR\int_{\theta_1}^{2.499} (180R\sin\theta - 10800 + R^2\cos\theta\sin\theta - 60R\cos\theta - R^2\sin\theta + 60R)\,d\theta$$

$$= KR\int (180R\sin\theta - 10800 + R^2\cos\theta\sin\theta - 60R\cos\theta - R^2\sin\theta + 60R)\,d\theta$$

$$= KR\left[180R(-\cos\theta) - 10800\theta + R^2\left(\tfrac{1}{2}\sin^2\theta\right) - 60R(\sin\theta) - R^2(-\cos\theta) + 60R\theta\right]_{\theta_1}^{2.499}$$

CALLB

$$= KR\{-7399.2 + 8000\cos\theta_1 + 4800\theta_1 + 6000\sin\theta_1 - 5000\sin^2\theta_1\} \Rightarrow \text{SEE APP. A(6)}$$

DENOMINATOR OF EQ(9) IS

$$\int_a^e y^2\,ds = \int_{0.6435}^{2.499} (R\sin\theta - 60)(R\sin\theta - 60)R\,d\theta$$

$$= \int_{0.6435}^{2.499} (R^2\sin^2\theta - 120R\sin\theta + 3600)\,R\,d\theta$$

$$= R\left[R^2\left(\tfrac{1}{2}(\theta - \tfrac{1}{2}\sin 2\theta)\right) - 120R(-\cos\theta) + 3600\theta\right]_{0.6435}^{2.499}$$

$$= R\left[\tfrac{1}{2}R^2(\theta - \tfrac{1}{2}\sin 2\theta) + 120R\cos\theta + 3600\theta\right]_{0.6435}^{2.499}$$

$$= 154948$$

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$h_a = \frac{A+B}{154948} \Rightarrow$ h FOR INFLUENCE LINE → SEE ATTACHED EXCEL PRINTOUT FOR INFLUNCE LINE & DATA

$H_a = 38.8K = H_e \Rightarrow$ SEE ATTACHED EXCEL PRINTOUT FOR MOMENT DIAGRAM & DATA

↳ $h_1P_1 + h_2P_2 + h_3P_3 = 0.54041(15) + 0.73883(10) + 0.66568(35) = 38.8K$

$V_A = 15(1-K) + 10(1-K) + 35(1-K) = 15(0.75) + 10(0.5) + 35(0.35) = 28.5K$

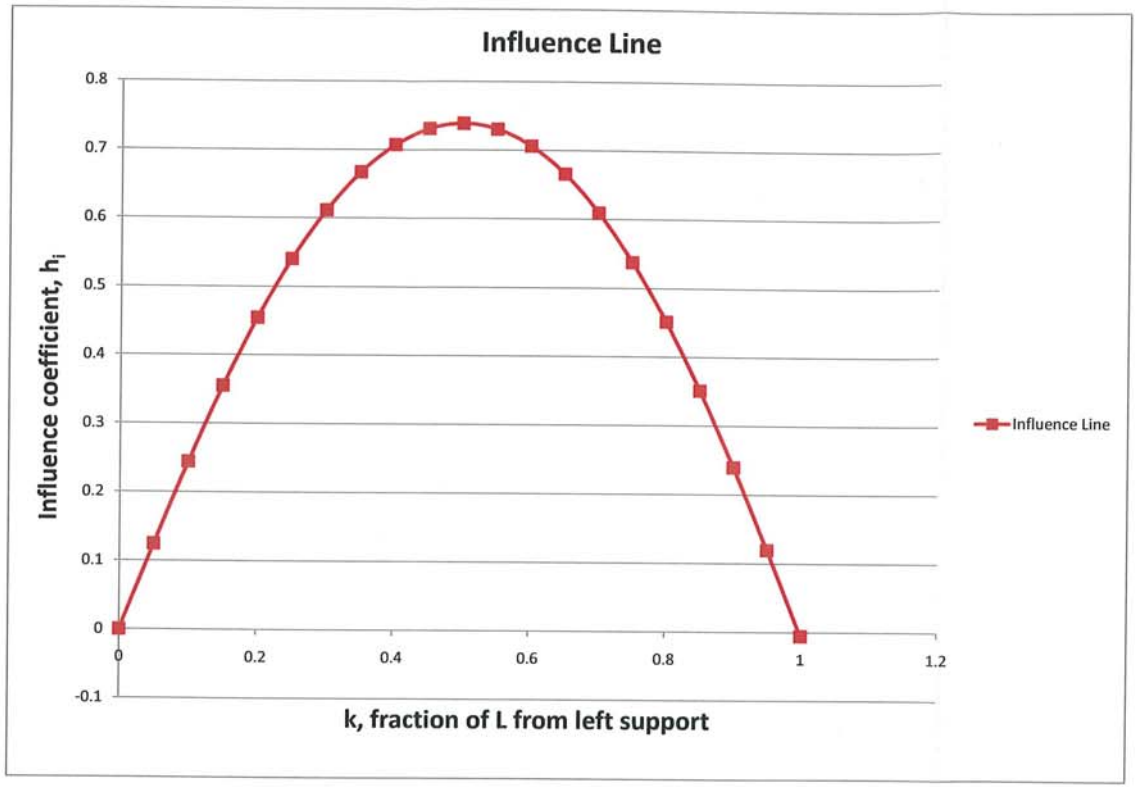
$V_e = 35+10+15-28.5 = 31.5K$

$H_a = 38.8K \rightarrow$	$H_e = 38.8K \leftarrow$
$V_a = 28.5K \uparrow$	$V_e = 31.5K \uparrow$

INFLUENCE LINE ⇒ SEE EXCEL PRINTOUT

MOMENT DIAGRAM ⇒ SEE EXCEL PRINTOUT

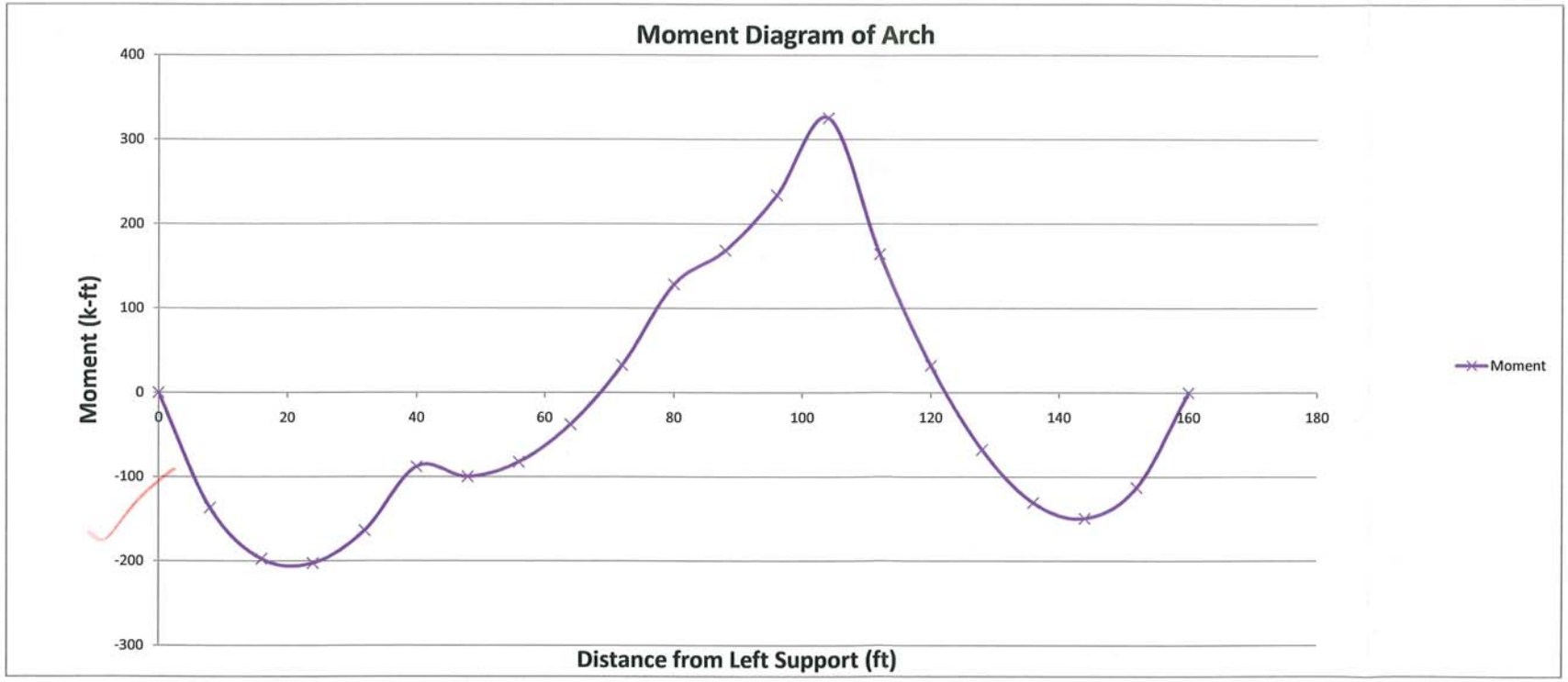
		0.643501				
	k	θ	h_i	R	A	B
0	0	0.643501	0	100	0	0
1	0.05	0.736231	0.124617	100	123.2891	19185.93
2	0.1	0.82896	0.244292	100	944.5921	36907.91
3	0.15	0.92169	0.355191	100	3025.131	52011.08
4	0.2	1.014419	0.454536	100	6739.925	63689.59
5	0.25	1.107149	0.540411	100	12250.94	71484.64
6	0.3	1.199878	0.611577	100	19496.16	75266.47
7	0.35	1.292608	0.667299	100	28194.76	75201.82
8	0.4	1.385337	0.707183	100	37867.64	71708.94
9	0.45	1.478067	0.731049	100	47872.22	65402.42
10	0.5	1.570796	0.73883	100	57449.15	57031.12
11	0.55	1.663526	0.73051	100	65778.64	47412.39
12	0.6	1.756255	0.706104	100	72043.37	37366.01
13	0.65	1.848985	0.66568	100	75494.45	27651.32
14	0.7	1.941714	0.609419	100	75517.28	18910.92
15	0.75	2.034444	0.537713	100	71693.66	11623.9
16	0.8	2.127173	0.451299	100	63856.8	6071.078
17	0.85	2.219903	0.351414	100	52136.49	2314.481
18	0.9	2.312633	0.239975	100	36991.52	192.1395
19	0.95	2.405362	0.119761	100	19227.73	-670.966
20	1	2.498092	-0.0054	100	0	-836.058



Ha	P_1	k_1	h_1	P2	k2	h2	P3	k3	h3
38.7933	15	0.25	0.540411	10	0.5	0.73883023	35	0.65	0.66568

0.643501

Va		k	θ	R	x	y	$M_{Applied\ Loads}$	M_{Ha}	M_{total}
28.5	0	0	0.643501	100	0	0	0	0	0
28.5	1	0.05	0.766994	100	8	9.397406	228	364.556	-136.556
28.5	2	0.1	0.876298	100	16	16.83749	456	653.1812	-197.181
28.5	3	0.15	0.976411	100	24	22.84926	684	886.3973	-202.397
28.5	4	0.2	1.070142	100	32	27.72685	912	1075.615	-163.615
28.5	5	0.25	1.159279	100	40	31.65151	1140	1227.865	-87.8654
28.5	6	0.3	1.245067	100	48	34.74175	1248	1347.746	-99.7459
28.5	7	0.35	1.32843	100	56	37.07729	1356	1438.349	-82.3489
28.5	8	0.4	1.410106	100	64	38.7117	1464	1501.753	-37.7531
28.5	9	0.45	1.490711	100	72	39.67949	1572	1539.297	32.70335
28.5	10	0.5	1.570796	100	80	40	1680	1551.73	128.2696
28.5	11	0.55	1.650882	100	88	39.67949	1708	1539.297	168.7034
28.5	12	0.6	1.731487	100	96	38.7117	1736	1501.753	234.2469
28.5	13	0.65	1.813162	100	104	37.07729	1764	1438.349	325.6511
28.5	14	0.7	1.896526	100	112	34.74175	1512	1347.746	164.2541
28.5	15	0.75	1.982313	100	120	31.65151	1260	1227.865	32.13458
28.5	16	0.8	2.071451	100	128	27.72685	1008	1075.615	-67.6149
28.5	17	0.85	2.165182	100	136	22.84926	756	886.3973	-130.397
28.5	18	0.9	2.265295	100	144	16.83749	504	653.1812	-149.181
28.5	19	0.95	2.374599	100	152	9.397406	252	364.556	-112.556
28.5	20	1	2.498092	100	160	0	0	0	0



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$$(1-K)\int R^2\sin\theta - R^2\cos\theta\sin\theta - 60R + 60R\cos\theta - 20R\sin\theta + 1200\,]R\,d\theta$$

$$(1-K)R\int(R^2\sin\theta - R^2\cos\theta\sin\theta - 60R + 60R\cos\theta - 20R\sin\theta + 1200)\,d\theta$$

$$(1-K)R\left[R^2(-\cos\theta) - R^2\left(\tfrac{1}{2}\sin^2\theta\right) - 60R\,\theta + 60R\sin\theta - 20R(-\cos\theta) + 1200\,\theta\right]_{0.6435}^{\theta_1}$$

$$(1-K)R\left[R^2(-\cos\theta_1 + 0.8) - 0.5R^2(\sin^2\theta_1 - \sin^2 0.6435) - 60R(\theta_1 - 0.6435) + 60R(\sin\theta_1 - 0.6)\right.$$
$$\left. + 20R(\cos\theta_1 - 0.8) + 1200(\theta_1 - 0.6435)\right]$$

$$57448.6 \rightarrow P$$

M52

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$-(10800\theta - \theta_1$

$$KR\left[180R(-\cos\theta) - 10800\theta + R^2\left(\tfrac{1}{2}\sin^2\theta\right) - 60R(\sin\theta) + R^2\cos\theta + 60\theta\right]_{\theta_1}^{2.499}$$

$$= KR\left[180R(0.8 + \cos\theta_1) - 26989.2 + 10800\theta_1 + R^2(0.1796 - 0.5\sin^2\theta_1) - 60R(0.6 - \sin\theta_1)\right.$$

$$\left. + R^2(-0.8 - \cos\theta_1) + 60(2.499 - \theta_1)\right]$$

$$= KR\left[14400 + 18000\cos\theta_1 - 26989.2 + 10800\theta_1 + 0.1796R^2 - 0.5R^2\sin^2\theta_1 - 3600 + 6000\sin\theta_1\right.$$

$$\left. - 8000 - 10000\cos\theta_1 + 14994 - 60\theta_1\right]$$

$$= KR\left[-7399.2 + 8000\cos\theta_1 + 4800\theta_1 + 6000\sin\theta_1 - 5000\sin^2\theta_1\right] \Rightarrow Q$$

$57031.12 \Rightarrow Q$