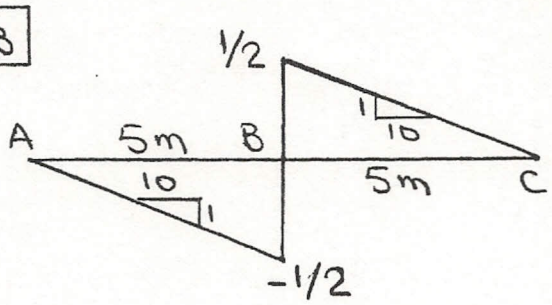
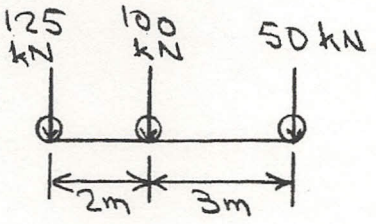
9.13





Influence Line for S_B

Loading position 1:

$$S_B = 125\left(\frac{1}{2}\right) + 100\left(\frac{3}{10}\right) = 92.5 \text{ kN}$$

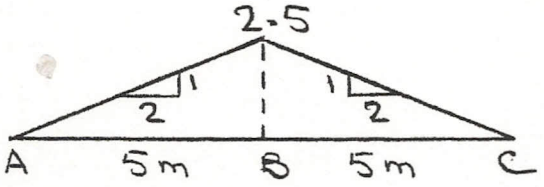
Loading position 2:

$$S_B = 125\left(-\frac{3}{10}\right) + 100\left(\frac{1}{2}\right) + 50\left(\frac{2}{10}\right) = 22.5 \text{ kN}$$

Loading position 3:

$$S_B = 100\left(-\frac{2}{10}\right) + 50\left(\frac{1}{2}\right) = 5 \text{ kN}$$

Max. Positive $S_B = \underline{92.5 \text{ kN}}$



Influence Line for M_B

Loading position 1:

$$M_B = 125(2.5) + 100(1.5) = 462.5 \text{ kN.m}$$

Loading position 2:

$$M_B = 125(1.5) + 100(2.5) + 50(1) = 487.5 \text{ kN.m}$$

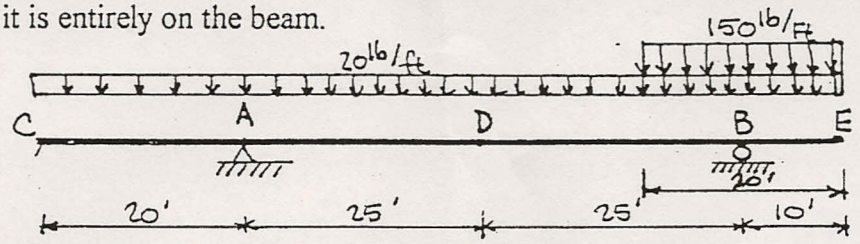
Loading position 3:

$$M_B = 100(1) + 50(2.5) = 225 \text{ kN.m}$$

Max. Positive $M_B = \underline{487.5 \text{ kN.m}}$

HOMEWORK #11 HANDOUT (In addition to Problem 9.6)

GIVEN: The beam loaded as shown. The 150 lb/ft load can be moved anywhere along the beam's length as long as it is entirely on the beam.



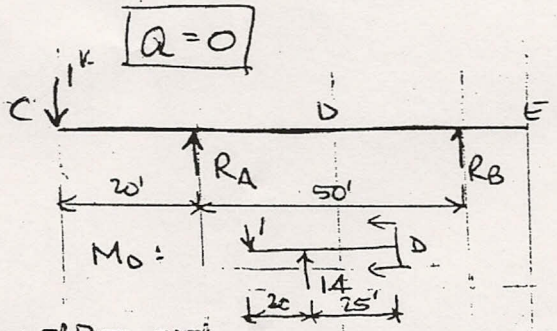
REQUIRED: Using the Influence Line Method, find the maximum reaction at Support A and the maximum positive or negative moment at Point D.

CALCULATIONS :

STEP 1 DEVELOP INFLUENCE DIAGRAM FOR R_A & INFLUENCE DIAGRAM FOR M_D

a	R_A	M_D
0	1.4	-10
20	1	0
45	0.5	+12.5
70	0	0
80	-0.2	-5

a = 0



$\sum M_B = 0$

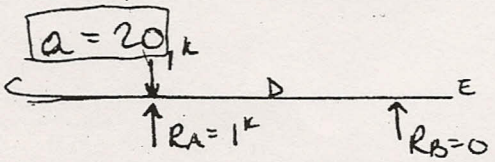
$-1(70) + R_A(50) = 0$

$R_A = \frac{70}{50} = 1.4$

$R_B = 1 - 1.4 = -.4$

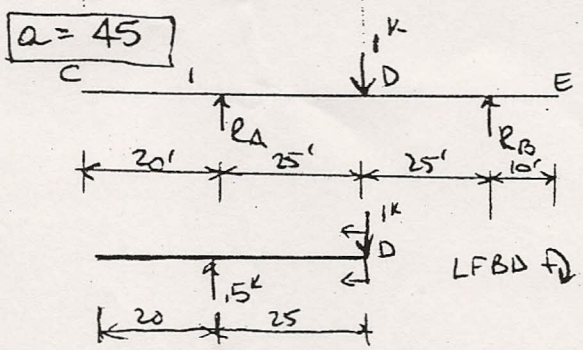
LFBD +↻ $M_D = -1[45] + 1.4[25] = -10^{1K}$

a = 20



$M_D = 0$

a = 45



$\sum M_B = 0$

$R_A[50] - 1^K[25] = 0$

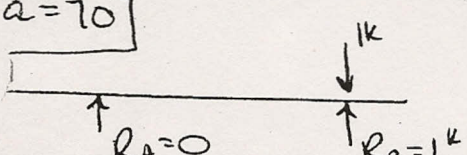
$R_A = 1/2^K$

$R_B = 1 - 1/2 = 1/2$

LFBD +↻

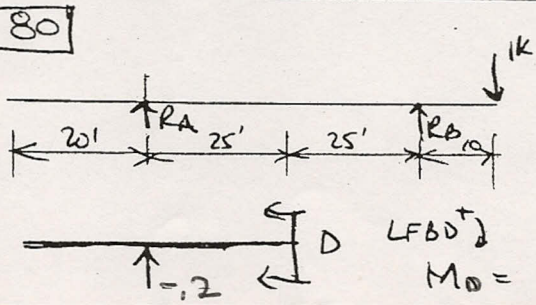
$M_D = 1.5^K[25] = +12.5^{1K}$

a = 70



$M_D = 0$

a = 80



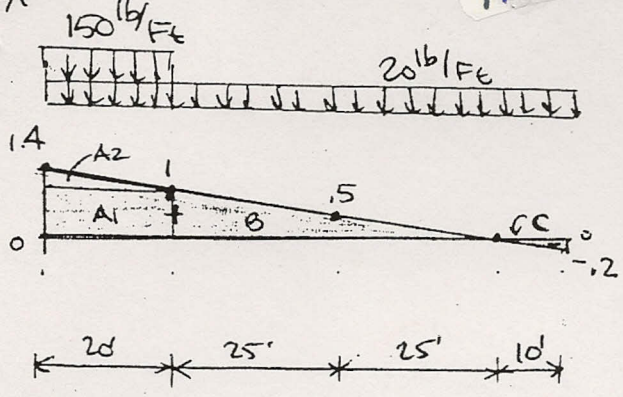
$\sum M_B = 0$

$R_A[50] + 1^K[10] = 0$

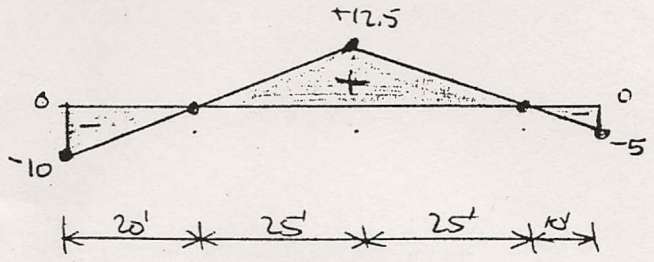
$R_A = -\frac{1}{5} = -.2$

LFBD +↻

$M_D = -.2^K[25] = -5^{1K}$



INFLUENCE DIAGRAM FOR R_A



INFLUENCE DIAGRAM FOR M_D

STEP 2 USE I.D.'s TO GET R_A & M_A

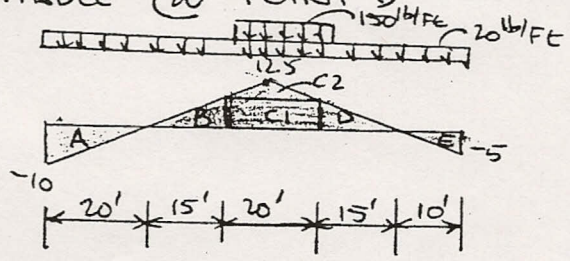
PART A MAXIMIZE R_A → MOST + AREA FOR A 20' LENGTH IS PLACING 20' BEGINNING @ C & ENDING AT A (150 lb/Ft) SEE * ABOVE

$$\text{MAX } R_A = (150+20)^{lb/Ft}\underbrace{\left(\tfrac{1}{2}(.4)(20)\right)}_{A2} + \underbrace{(1)(20)}_{A1} + 20^{lb/Ft}\underbrace{\left(\tfrac{1}{2}(50)(1)\right)}_{B} + 20^{lb/Ft}\underbrace{\left(\tfrac{1}{2}(10)(\cdot\right)}_{C}$$

$$= 4080^{lb} + 500^{lb} - 20^{lb} = 4560^{lb}$$

$R_{A\,MAX} = 4560^{lb}$

PART B_1 MAXIMIZE $+M_D$ → PLACE 20' LENGTH OF 150 lb/Ft LOAD W/ MIDDLE @ POINT D



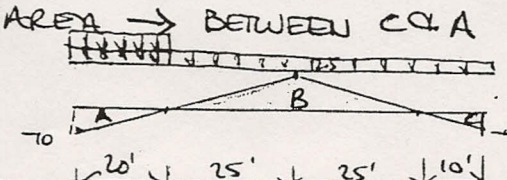
$$\text{MAX } {}^{+}M_D = 20^{lb/Ft}\underbrace{\left(\tfrac{1}{2}(20)(-10)\right)}_{A} + 20^{lb/Ft}\underbrace{\left(\tfrac{1}{2}(15)\left(\tfrac{15}{25}(12.5)\right)\right)}_{B} + (150+20)^{lb/Ft} \times$$

$$\left(\underbrace{\left(\tfrac{1}{2}(20)\left(12.5-\tfrac{15}{25}(12.5)\right)\right)}_{C2} + \underbrace{20'\left(\tfrac{15}{25}(12.5)\right)}_{C1}\right)$$

$$+ 20^{lb/Ft}\underbrace{\left(\tfrac{1}{2}(15)\left(\tfrac{15}{25}(12.5)\right)\right)}_{D} + 20^{lb/Ft}\underbrace{\left(\tfrac{1}{2}(10)(-5)\right)}_{E} = -2000^{1K} + 1125^{1K} + \overset{34000}{+2550} + 1125^{1K} - 500^{1K} = \overset{33750}{25250}{}^{1K}$$

$\text{MAX } {}^{+}M_D = \overset{33750}{25250}{}^{1K}$

PART B_2 MAXIMIZE $-M_D$ → PLACE 20' LENGTH OF 150 lb/Ft WHERE MOST NEGATIVE AREA → BETWEEN C & A



$$\text{MAX } {}^{-}M_D = 170^{lb/Ft}\left(\tfrac{1}{2}(20)(10)\right) + 20^{lb/Ft}\left(\tfrac{1}{2}(12.5)(50)\right) + 20^{lb/Ft}\left(\tfrac{1}{2}(10)(-5)\right)$$

$$= -17000^{1K} + 6250^{1K} - 500^{1K} = -11250^{1K}$$

${}^{-}M_{A\,MAX} = -11250^{1K}$