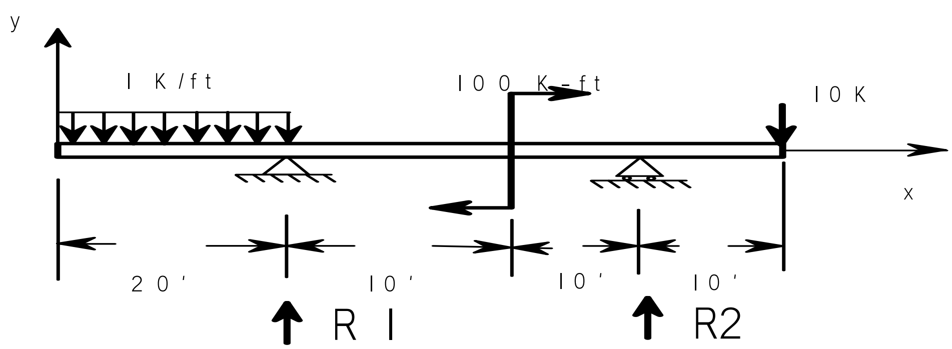
Shames (13.10 Text) Problem 10.34. repeated here for info: Find the supporting forces for the simply supported beam in figure. Then sketch the shear-force and bending moment diagrams, labeling key points. 1K = 1000 lbs



initial estimates: $R_1 := 10$ $R_2 := 5$

equilibrium ...

Given

forces $-1\cdot 20 + R_1 + R_2 - 10 = 0$

moments wrt RA $1\cdot 20\cdot\frac{20}{2} - 100 + R_2\cdot 20 - 10\cdot 30 = 0$

$\mathrm{Find}(R_1, R_2) = \begin{pmatrix} 20 \\ 10 \end{pmatrix}$ $R_1 := 20$ $R_2 := 10$

starting from the notes combining various elements and adding an expression for a concentrated moment:

distributed ....

$$\mathrm{shear}(x) = \sum_{i=ll}^{ul} \left[w_i\cdot(x - \xi_{i,0})\cdot(\xi_{i,0} < x \le \xi_{i,1}) + w_i\cdot(\xi_{i,1} - \xi_{i,0})\cdot(x > \xi_{i,1}) \right]$$

$$\mathrm{bending\_moment}(x) = \sum_{i=ll}^{ul} \left[w_i\cdot\left[\frac{1}{2}\cdot(x - \xi_{i,0})^2\right]\cdot(\xi_{i,0} < x \le \xi_{i,1}) \ldots + w_i\cdot\left[\left[(\xi_{i,1} - \xi_{i,0})\cdot(x - \xi_{i,1}) + \frac{1}{2}\cdot(\xi_{i,1} - \xi_{i,0})\cdot(\xi_{i,1} - \xi_{i,0})\right]\right]\cdot(x > \xi_{i,1}) \right]$$

concentrated force: $\text{shear}(x) = \sum_{i=ll}^{ul} f_i \cdot (x \ge xx_i)$ $\quad$ $\text{bending\_moment}(x) = \sum_{i=ll}^{ul} f_i \cdot (x - xx_i) \cdot (x \ge xx_i)$

concentrated moment ... (new) $\quad$ $\text{bending\_moment}(x) = \sum_{i=ll}^{ul} m_i \cdot (x \ge xm_i)$

now set up problem values:

distributed ... $\quad w_0 := -1 \quad \xi := (0 \;\; 20) \quad ul := 0 \quad ll := 0$

$$\text{shear\_distr}(x) := \left[\sum_{i=ll}^{ul} \left[w_i \cdot (x - \xi_{i,0}) \cdot (\xi_{i,0} < x \le \xi_{i,1}) + w_i \cdot (\xi_{i,1} - \xi_{i,0}) \cdot (x > \xi_{i,1})\right]\right]$$

$$\text{bend\_mmt\_dist}(x) := \left[\sum_{i=ll}^{ul} \left[w_i \cdot \left[\frac{1}{2} \cdot (x - \xi_{i,0})^2\right] \cdot (\xi_{i,0} < x \le \xi_{i,1}) \ldots + w_i \cdot \left[\left[(\xi_{i,1} - \xi_{i,0}) \cdot (x - \xi_{i,1}) + \frac{1}{2} \cdot (\xi_{i,1} - \xi_{i,0}) \cdot (\xi_{i,1} - \xi_{i,0})\right] \cdot (x > \xi_{i,1})\right]\right]\right]$$

concentrated force: $\quad f := \begin{pmatrix} R_1 \\ R_2 \\ -10 \end{pmatrix} \quad xx := \begin{pmatrix} 20 \\ 40 \\ 50 \end{pmatrix} \quad ul := 2 \quad ll := 0$

$\text{shear\_conc\_f}(x) := \left[\sum_{i=ll}^{ul} f_i \cdot (x \ge xx_i)\right]$ $\quad$ $\text{bend\_mmt\_conc\_f}(x) := \left[\sum_{i=ll}^{ul} f_i \cdot (x - xx_i) \cdot (x \ge xx_i)\right]$

concentrated moment ... (new)

$m_0 := 100 \quad xm_0 := 30 \quad ul := 0 \quad ll := 0$

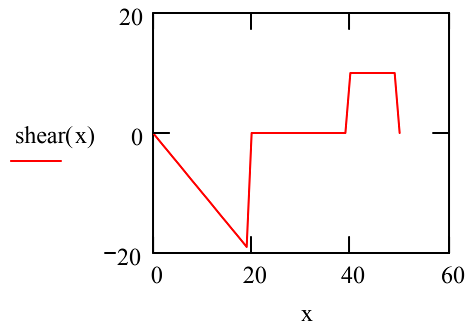
$$\text{bend\_mmt\_conc\_m}(x) := \sum_{i=ll}^{ul} m_i \cdot (x \ge xm_i)$$

sign was reversed in equilibrium (arbitrary direction) but is positive here consistent with our "structural" sign convention now superpose all the above ...

$x := 0 .. 20 + 10 + 10 + 10$

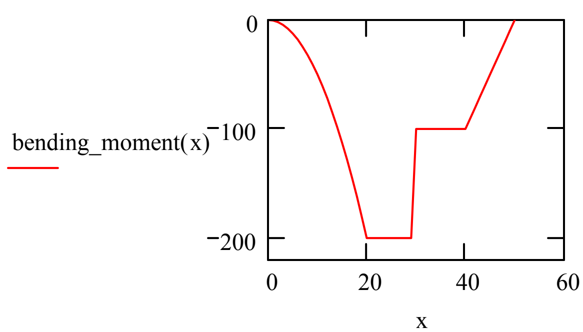
$shear(x) := shear\_distr(x) + shear\_conc\_f(x)$

$bending\_moment(x) := bend\_mmt\_dist(x) + bend\_mmt\_conc\_f(x) + bend\_mmt\_conc\_m(x)$



$shear(50) = 0$

checks ....



$bending\_moment(50) = 0$

also checks ....