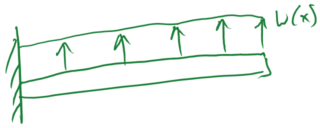
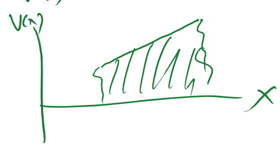
Relations between w, V(x), & M(x)

w = distributed load [force/length]

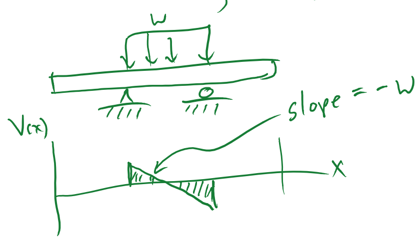


$$\boxed{\frac{dV}{dx} = w(x)}$$

if $w(x) > 0$, $V(x)$ will have positive slope

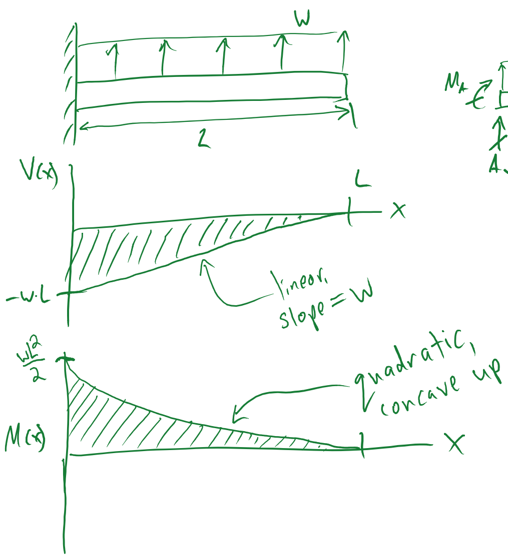


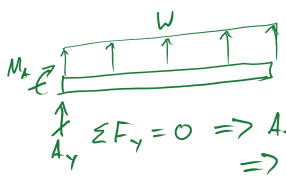
if $w(x) < 0$, $V(x)$ will have negative slope



Between shear force & bending moment:

$$\boxed{\frac{dM}{dx} = V(x)}$$





$\Sigma F_y = 0 \Rightarrow A_y + w \cdot L = 0$

$\Rightarrow A_y = -w \cdot L$

$\Sigma M = 0 \Rightarrow -M_A + \frac{w \cdot L^2}{2} = 0$

$\Rightarrow M_A = \frac{w \cdot L^2}{2}$

If w(x) is constant (non-zero),

M(x) should be:

A) zero

B) const. ($\neq 0$)

C) linear

D) quadratic

E) 3^{rd}-order

If $V(x)$ is linear, not constant,

$w(x)$ is:

A) zero

B) const. $\neq 0$

C) linear

D quadratic.

If $M(x)$ is const, $V(x)$ is:

A) zero

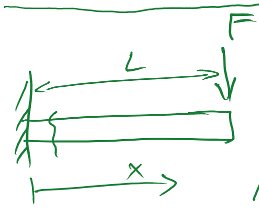
B) const. $\neq 0$

C) linear

D) quadratic

$$\frac{dM}{dx} = 0$$

$$\Rightarrow V(x) = 0$$



$M(x=0) = ?$

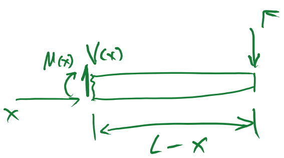
A) $F \cdot L$

B) $-F \cdot L$

C) 0

D) $2FL$

E) $-2FL$



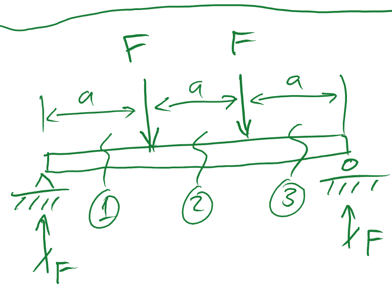
$$(\Sigma M)_x = 0$$

$$-M(x) - F \cdot (L - x) = 0$$

$$M(x) = -F \cdot L + F \cdot x$$

$$M(x) = F \cdot (x - L)$$

at $x = 0$, $M(x=0) = -F \cdot L$



In region 1

$V(x) = ?$

A) F

B) $-F$

C) 0

$M(x) = ?$

A) const $\neq 0$

B) zero

C) linear (pos. slope)

$$\frac{dM}{dx} = F$$

B) $-F$

c) 0

B) zero

C) linear (pos. slope)

D) " (neg. slope)

$$\frac{dM}{dx} = F$$

In region 2

$V(x) = ?$

A) F

B) 0

C) $-F$

$M(x) = ?$

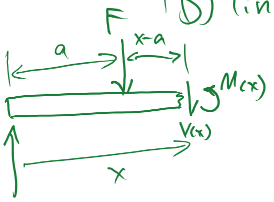
A) const $\neq 0$

B) 0

C) linear pos. slope

D) linear neg. slope

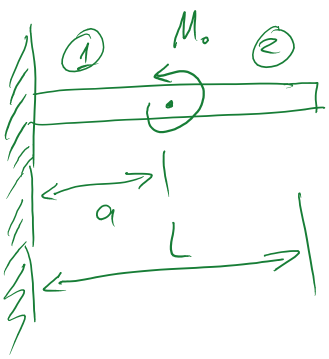
$$\frac{dM}{dx} = V(x) = 0$$



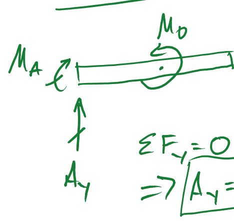
$$(\Sigma M)_x = 0$$

$$M(x) + F\cdot(\cancel{x}-a) - F\cdot\cancel{x} = 0$$

$$\boxed{M(x) = F\cdot a}$$



FBD



$\Sigma F_y = 0$

$\Rightarrow \boxed{A_y = 0}$

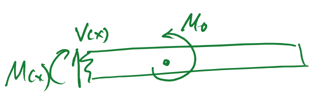
$(\Sigma M)_A = 0$

$\Rightarrow -M_A + M_o = 0$

$\Rightarrow \boxed{M_A = M_o}$

$V_1 =$
A) 0
B) M_o/a
C) $-M_o/a$
D) M_o/L
E) $-M_o/L$

$M_1 = ?$
A) 0
B) M_o
C) $-M_o$



$(\Sigma M)_x = 0$

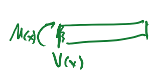
$\Rightarrow M_o - M(x) = 0$

$\Rightarrow \boxed{M(x) = M_o}$

$V_2 = ?$
A) 0
B) M_o/a
C) $-M_o/a$
D) M_o/L
E) $-M_o/L$

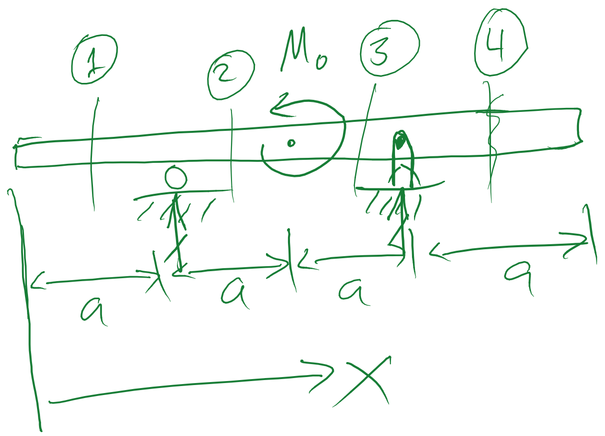
$M_2 = ?$
A) 0
B) M_o
C) $-M_o$

FBD @ 2



$\Sigma M = 0$

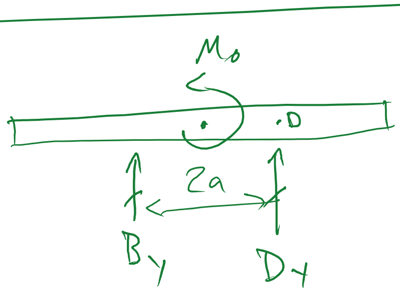
$\Rightarrow M(x) = 0$



$V(x=0) = ?$ $\begin{cases} A)\ 0 \\ B)\ \neq 0 \end{cases}$

$M(x=0) = ?$ $\begin{cases} A)\ 0 \\ B)\ \neq 0 \end{cases}$

Solve for reactions



$(\Sigma M)_D = 0$

$\Rightarrow M_0 - 2 \cdot a \cdot B_y = 0$

$\Rightarrow B_y = \dfrac{M_0}{2a}$

$\Sigma F_y = 0 \Rightarrow D_y = -\dfrac{M_0}{2a}$

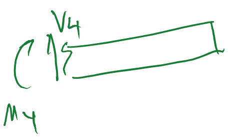
$V_2 = ?$ $\quad = \begin{cases} A)\ 0 \\ B)\ M_0/2a \\ C)\ -M_0/2a \end{cases}$

$(a < x < 2a)$

$V_3 = ?$ $\quad = \begin{cases} A)\ 0 \\ B)\ M_0/2a \\ C)\ -M_0/2a \end{cases}$

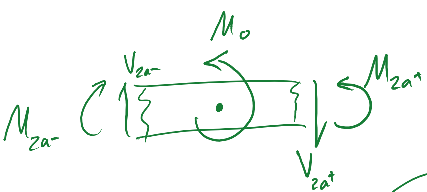
$2a < x < 3a$

$V_4 = \begin{cases} A)\ 0 \\ B)\ M_0/2a \\ C)\ -M_0/2a \end{cases}$



Jump at $x = 2a$ in $M(x)$

$\Delta M = \underline{M_{2a^+} - M_{2a^-}} = ?$ $\quad \begin{cases} A)\ 0 \\ B)\ M_0 \\ C)\ -M_0 \end{cases}$



$$\Sigma M = 0 \Rightarrow \overbrace{M_{2a^+} - M_{2a^-} + M_0}^{\Sigma M} = 0$$

$$\boxed{\underbrace{M_{2a^+} - M_{2a^-}}_{\Delta M} = -M_0}$$