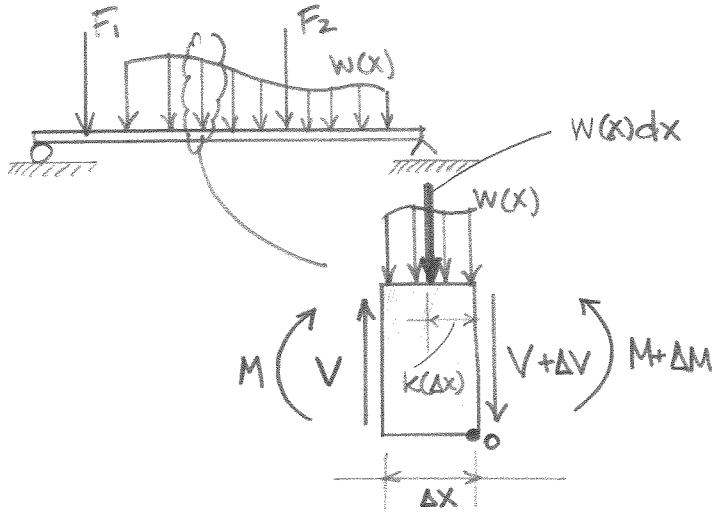
CLASS 15 - DRAWING SHEAR & MOMENT DIAGRAMS

OBJECTIVES: ① GAIN INTUITION of BENDING BEAMS
② V&M DIAGRAM SHORTCUTS

DRAWING SHEAR & MOMENT DIAGRAMS CAN BE CUMBERSOM BASED ON EQUILIBRIUM EQUATIONS. SOME TRICKS & TIPS

① REGIONS of DISTRIBUTED LOADS

CONSIDER DISTRIBUTED BEAM LOAD



INFINTESIMAL ELEMENT MUST BE IN EQUILIBRIUM:

ΣF_y: $V - \Delta V - V - w(x)\Delta x = 0$

$$\Delta V = -w(x)\Delta x$$

$$\lim_{\Delta x \to 0} \quad \boxed{\frac{dV}{dx} = -w(x)}$$

Slope of Shear Diagram $= -w(x)$

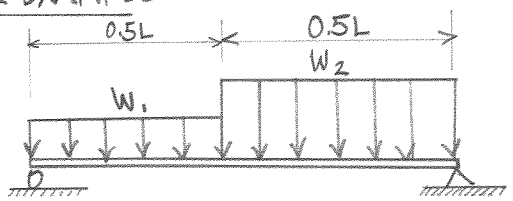
$(+\circlearrowleft \Sigma M_o$: $M + \Delta M - M - V\Delta x + w(x)\Delta x \, k\Delta x = 0$

$$\Delta M = V\Delta x - k\, w(x)\Delta x^2$$

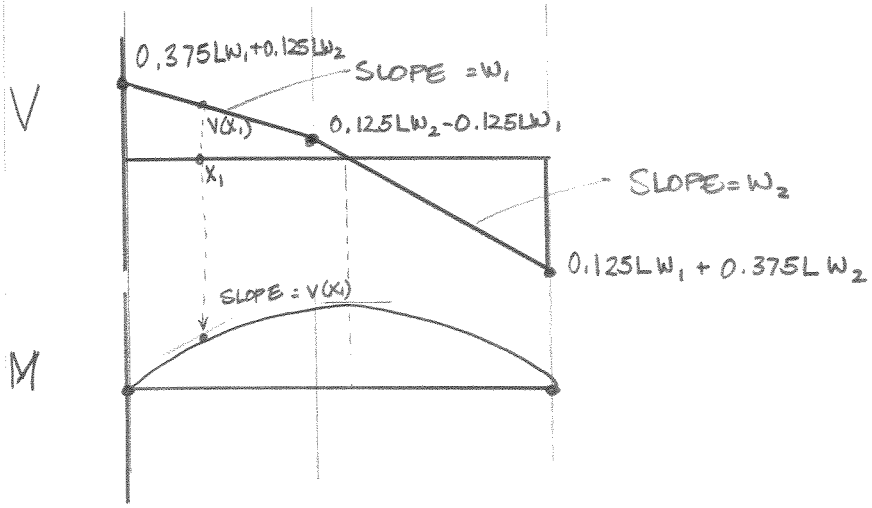
$$\lim_{\Delta x \to 0} \quad \boxed{\frac{dM}{dx} = V}$$

Slope of Moment Diagram $= V$

FOR EXAMPLE:



$0.375LW_1 + 0.125LW_2$ $\qquad$ $0.125LW_1 + 0.375LW_2$



IN A SIMILAR FASHION:

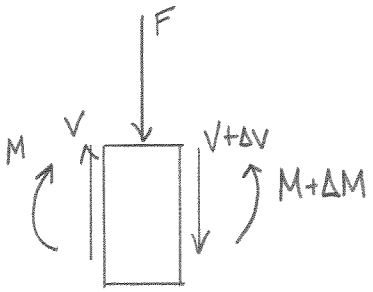
$$\Delta V = -\int W(x)\,dx$$

= AREA UNDER DISTRIBUTED LOADING

$$\Delta M = +\int V(x)\,dx$$

= AREA UNDER SHEAR DIAGRAM

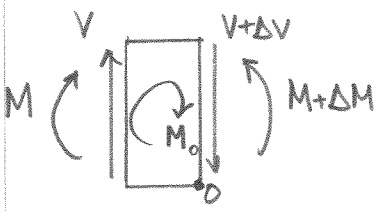
② REGION of CONCENTRATED FORCE & MOMENT:



$\sum F_y$: $V - F - V - \Delta V = 0$

$$\boxed{\Delta V = -F}$$

CONCENTRATED FORCE RESULTS IN A "JUMP" IN THE SHEAR DIAGRAM



$(+\circlearrowleft \sum M_o$: $-M + M + \Delta M - M_o - V\Delta X = 0$

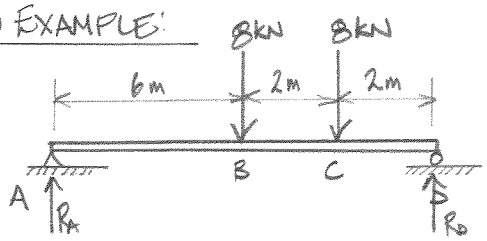
$$\Delta M - M_o - V\Delta X = 0$$

$\lim_{\Delta X \to 0}$

$$\boxed{\Delta M = M_o}$$

CONCENTRATED MOMENT RESULTS IN A "JUMP" IN THE MOMENT DIAGRAM

③ EXAMPLE:



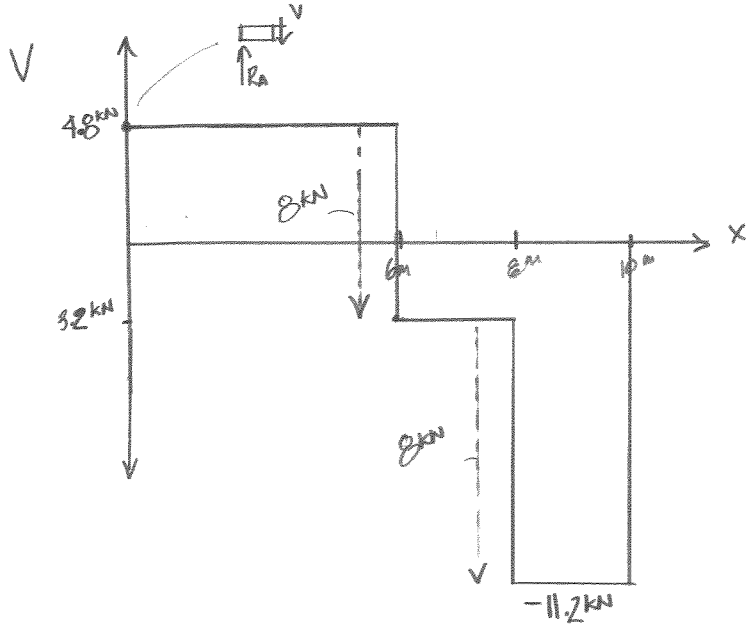
I- FIND SUPPORT REACTIONS:

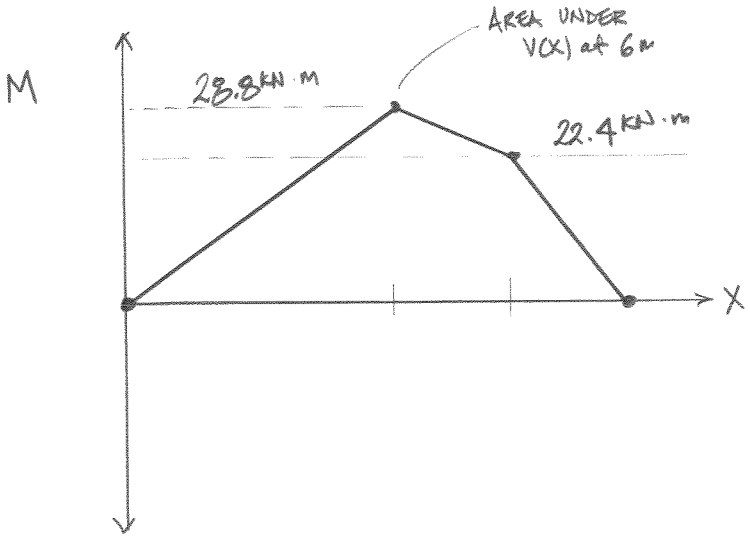
$8^{kN}(6m) + 8^{kN}(8m) - R_D(10m) = 0$

$R_D = 11.2^{kN}$

$\therefore R_A = 16 - 11.2^{kN} = 4.8^{kN}$

II - DRAW SHEAR DIAGRAM:


V
V
R_A
4.8kN
8kN
3.2kN
8kN
−11.2kN
X
6m
8m
10m


M
AREA UNDER V(X) at 6m
28.8kN·m
22.4kN·m
X