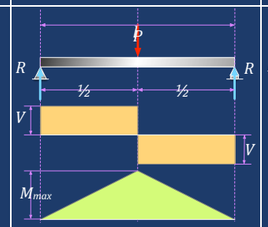
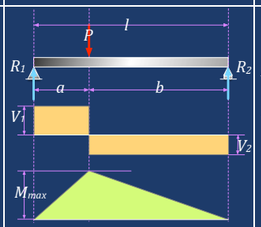
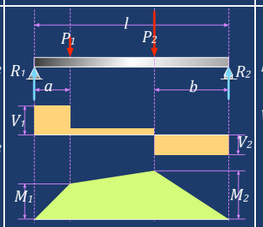
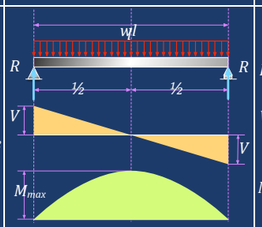
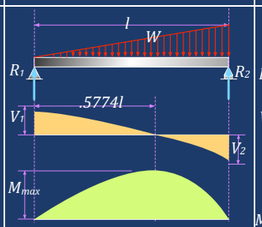
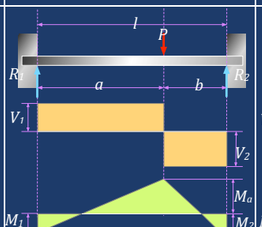
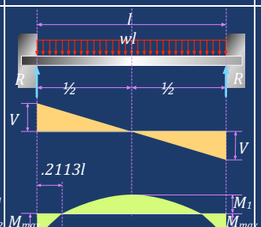
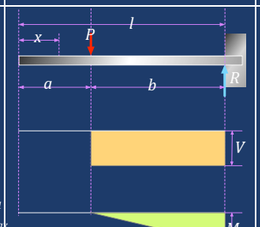
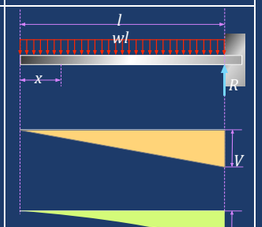
RAIC Centre for Architecture at Athabasca University

Common Vertical Force and Bending Moment Diagrams

Beam Type	Simple	Simple	Simple	Simple	Simple	Fixed at Both Ends	Fixed at Both Ends	Cantilever	Cantilever
Free Body Diagram **Vertical Force (V) or Shear Diagram** **Bending Moment (M) Diagram**									
Load	*Concentrated Load at Centre*	*Concentrated Load at Any Point*	*2 Unequal Concentrated Loads Unsymmetrically Placed*	*Uniformly Distributed Load*	*Load Increasing Uniformly Towards One End*	*Concentrated Load at any Point*	*Uniformly Distributed Loads*	*Concentrated Load at any Point*	*Uniformly Distributed Loads*
Connectors	*Pin and Roller*	*Pin and Roller*	*Pin and Roller*	*Pin and Roller*	*Pin and Roller*	*Fixed*	*Fixed*	*Cantilever*	*Cantilever*
Reactions	$R = V$	$R_1 = V_1$ $R_2 = V_2$	$R_1 = V_1$ $R_2 = V_2$	$R = V$	$R_1 = V_1$ $R_2 = V_2$	$R_1 = V_1$ $R_2 = V_2$	$R = V$	$R = V$	$R = V$
Vertical Force	$V = \frac{P}{2}$	$V_1 = \frac{Pb}{l}$ $V_2 = \frac{Pa}{l}$	$V_1 = \frac{P_1(l-a)+P_2b}{l}$ $V_2 = \frac{P_2(l-b)+P_1a}{l}$	$V = \frac{wl}{2}$	$V_1 = \frac{W}{3}$ $V_2 = \frac{2W}{3}$ *where* $W = \frac{wl}{2}$	$V_1 = \frac{Pb^2(3a+b)}{l^3}$ $V_2 = \frac{Pa^2(3b+a)}{l^3}$	$V = \frac{wl}{2}$	$V = P$	$V = wl$ $V_x = wx$
Bending Moment	$M_{max} = \frac{Pl}{4}$ *(at point of load)*	$M_{max} = \frac{Pab}{l}$ *(at point of load)*	$M_1 = R_1a$ *(max. if* $R_1 > P_1$*)* $M_2 = R_2b$ *(max. if* $R_2 > P_2$*)*	$M_{max} = \frac{wl^2}{8}$ *(at centre)*	$M_{max} = \frac{2Wl}{9\sqrt{3}}$ $= .1283Wl$	$M_1 = \frac{Pab^2}{l^2}$ *(max. if* $a < b$*)* $M_2 = \frac{Pba^2}{l^2}$ *(max. if* $a > b$*)* $M_a = \frac{2Pb^2a^2}{l^3}$ *(at point of load)*	$M_{max} = \frac{wl^2}{12}$ *(at ends)* $M_1 = \frac{wl^2}{24}$ *(at centre)*	$M_{max} = Pb$ *(at fixed end)* $M_x = P(x-a)$ *(when* $x > a$*)*	$M_{max} = \frac{wl^2}{2}$ *(at fixed end)* $M_x = \frac{wx^2}{2}$