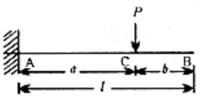
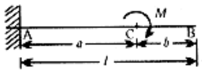
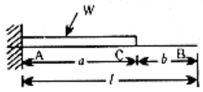
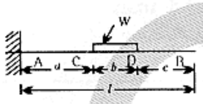
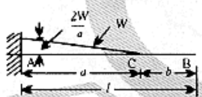
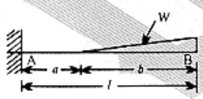
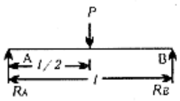
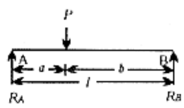
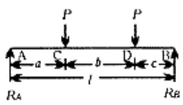
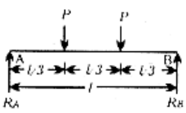
STRESS AND DEFLECTION OF BEAMS

No.	Load condition	Bending moment	Reaction force and shear stress	Deflection
1		$M_x = Px$ $M_{max} = Pa$	$R_A = P$	Curve / Straight Line $d_c = \frac{Pa^3}{3EI}$ $d_{max} = \frac{Pa^3}{3EI}\left(1+\frac{3b}{2a}\right)$
2		$M_{max} = M_x = M_c$	$R_A = 0$	Curve / Straight Line $d_c = \frac{Ma^2}{2EI}$ $d_{max} = \frac{Ma^2}{2EI}\left(1+\frac{2b}{a}\right)$
3		$M_x = \frac{Wx^2}{2a}$ $M_{max} = \frac{Wa}{2}$	$R_A = W$	Curve / Straight Line $d_c = \frac{Wa^3}{8EI}$ $d_{max} = \frac{Wa^3}{8EI}\left(1+\frac{4b}{3a}\right)$
4		$M_{max} = W\left(a+\frac{b}{2}\right)$	$R_A = W$	カーブ / Straight Line $d_{max} = \frac{W}{24EI} \times (8a^3+18a^2b+12ab^2+3b^3+12a^2c+12abc+4b^2c)$
5		$M_x = \frac{Wx^3}{3a^2}$ $M_A = \frac{Wa}{3}$	$R_A = W$	Curve / Straight Line $d_c = \frac{Wa^3}{15EI}$ $d_{max} = \frac{Wa^3}{15EI}\left(1+\frac{5b}{4a}\right)$
6		$M_{max} = W\left(a+\frac{2b}{3}\right)$	$R_A = W$	$d_{max} = \frac{W(20a^3+50a^2b+40ab^2+11b^3)}{60EI}$
7		$M_{max} = \frac{Pl}{4}$	$R_A = R_B = \frac{P}{2}$	$d_{max} = \frac{Pl^3}{48EI}$
8		$M_{max} = \frac{Pab}{l}$	$R_A = Pb/l \quad R_B = Pa/l$	d_{max} takes place in the range of $0.0774l$ from the span center. $d\ center = \frac{Pl^3}{48EI}\left[\frac{3a}{l}-4\left(\frac{a}{l}\right)^3\right]$
9	 a>c	$M_C = \frac{Pa(b+2c)}{l}$ $M_D = \frac{Pc(b+2a)}{l}$	$R_A = \frac{P(b+2c)}{l}$ $R_B = \frac{P(b+2a)}{l}$	Deflection of span center is calculated by applying formula given in No.8 to each load.
10		$M_{max} = \frac{Pl}{3}$	$R_A = R_B = P$	$d_{max} = \frac{23Pl^3}{648EI}$

In case of beam subject to distributed loads, load symbol, W, indicates the total load of the beam. For example, in case of a beam subject to uniformly distributed load, w, W equals wℓ, where ℓ is span length.

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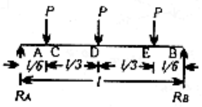
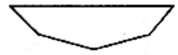
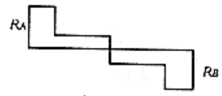
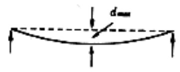
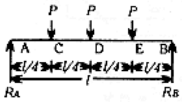
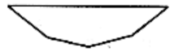
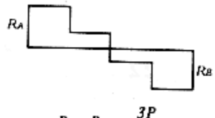
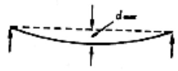
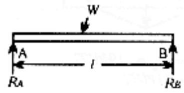
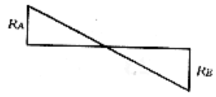
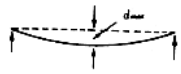
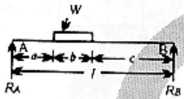
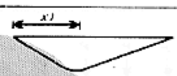
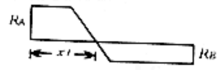
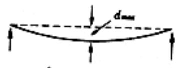
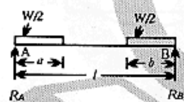
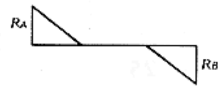
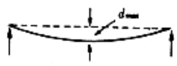
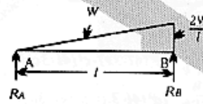
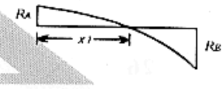
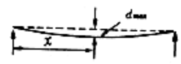
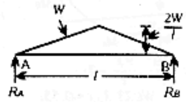
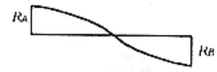
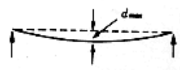
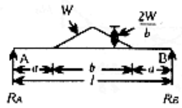
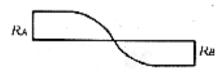
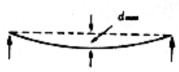
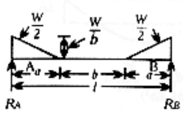
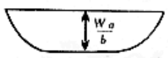
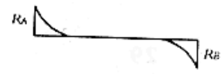
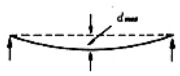
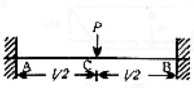
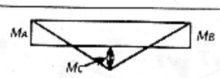
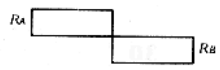
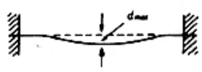
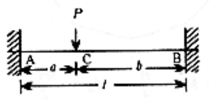
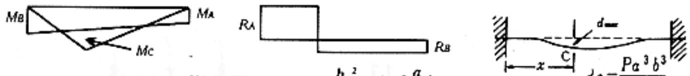
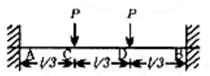
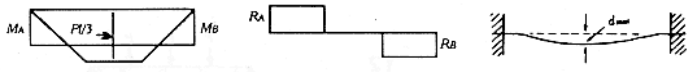
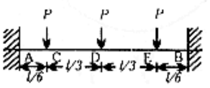
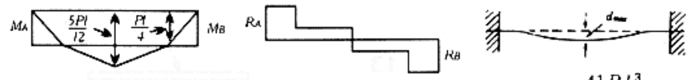
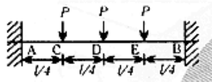
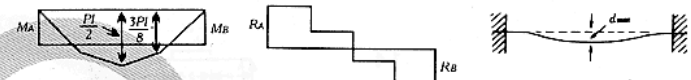
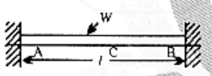
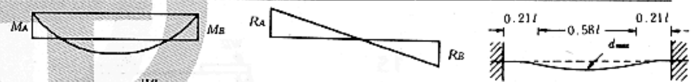
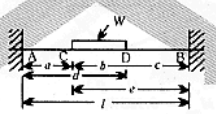
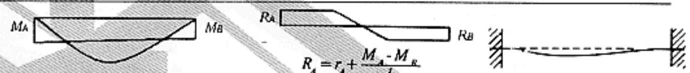
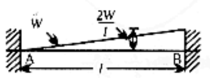
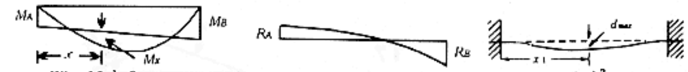
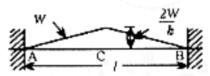
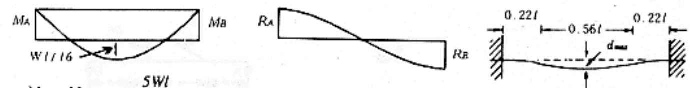
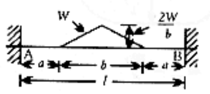
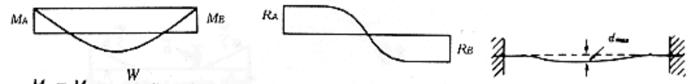
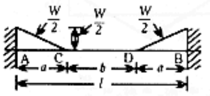
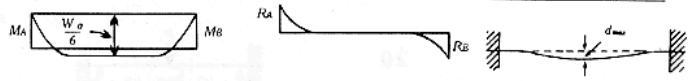
Tel : (065) 861 8801 (10 Lines) • Fax : (065) 861 8860

No.	Load condition	Bending moment	Reaction force and shear stress	Deflection
11		 $M_C = M_E = \frac{Pl}{4}$ $M_D = \frac{5Pl}{12}$	 $R_A = R_B = \frac{3P}{2}$	 $d_{max} = \frac{53Pl^3}{1296EI}$
12		 $M_C = M_E = \frac{3Pl}{8}$ $M_D = \frac{Pl}{2}$	 $R_A = R_B = \frac{3P}{2}$	 $d_{max} = \frac{19Pl^3}{384EI}$
13		 $M_x = \frac{Wx}{2}(1-\frac{x}{l})$ $M_{max} = \frac{Wl}{8}$	 $R_A = R_B = \frac{W}{2}$	 $d_{max} = \frac{5}{384}\cdot\frac{Wl^3}{EI}$
14		 $M_{max} = \frac{W}{b}(\frac{x_1^2 - a^2}{2})$ where $x_1 = a + \frac{Rab}{W}$	 $R_A = \frac{W}{l}(\frac{b}{2}+c)$ $R_B = \frac{W}{l}(\frac{b}{2}+a)$	 where $a=c$ $d_{max} = \frac{W}{384EI}(8l^3-4lb^2-b^3)$
15		 $M_{max} = \frac{Wa}{4}$	 $R_A = R_B = \frac{W}{2}$	 $d_{max} = \frac{Wa(3l^2-2a^2)}{96EI}$
16		 $M_x = \frac{Wx}{3}(1-\frac{x^2}{l^2})$ $M_{max} = 0.128Wl$ where $x_1 = 0.5774l$	 $R_A = \frac{W}{3}$ $R_B = \frac{2W}{3}$	 $d_{max} = \frac{0.01304Wl^3}{EI}$ where $x = 0.5193l$
17		 $M_x = Wx(\frac{1}{2}-\frac{2x^2}{3l^2})$ $M_{max} = Wl/6$	 $R_A = R_B = \frac{W}{2}$	 $d_{max} = \frac{Wl^3}{60EI}$
18		 $M_{max} = \frac{W}{4}(l-\frac{b}{3})$	 $R_A = R_B = \frac{W}{2}$	 $d_{max} = \frac{W}{480EI}(8l^3+7al^2-4a^2l-4a^3)$
19		 $M_{max} = \frac{Wa}{6}$	 $R_A = R_B = \frac{W}{2}$	 $d_{max} = \frac{Wa}{240EI}(18a^2+20ab+5b^2)$
20		 $-M_A = -M_B = M_C = \frac{Pl}{8}$	 $R_A = R_B = \frac{P}{2}$	 $d_{max} = \frac{Pl^3}{192EI}$

In case of beam subject to distributed loads, load symbol, W, indicates the total load of the beam. For example, in case of a beam subject to uniformly distributed load, w, W equals wℓ, where ℓ is span length.

No.	Load condition	Bending moment	Reaction force and shear stress	Deflection
21		 $M_A = -\frac{Pab^2}{l^2}$ $M_B = -\frac{Pa^2b}{l^2}$ $M_C = \frac{2Pa^2b^2}{l^3}$	$R_A = P(\frac{b}{l})^2 (1+2\frac{a}{l})$ $R_B = P(\frac{a}{l})^2 (1+2\frac{b}{l})$	$d_C = \frac{Pa^3b^3}{3EIl^3}$ $d_{max} = \frac{2Pa^2b^3}{3EI(3l-2a)^2} \times \frac{l^2}{3l-2a}$
22		 $M_A = M_B = -2Pl/9$ $M_C = M_D = Pl/9$	$R_A = R_B = P$	$d_{max} = \frac{5Pl^3}{648EI}$
23		 $M_A = M_B = -19Pl/72$ $M_D = 11Pl/72$	$R_A = R_B = 3P/2$	$d_{max} = \frac{41Pl^3}{5184EI}$
24		 $M_A = M_B = -5Pl/16$ $M_D = 3Pl/16$	$R_A = R_B = 3P/2$	$d_{max} = \frac{Pl^3}{96EI}$
25		 $M_A = M_B = -\frac{Wl}{12}$ $M_C = \frac{Wl}{24}$	$R_A = R_B = W/2$	$d_{max} = \frac{Wl^3}{384EI}$
26		 $M_A = \frac{-W}{12l^2b} \{e^3(4l-3e)-c^3(4l-3c)\}$ $M_B = \frac{-W}{12l^2b} \{d^3(4l-3d)-a^3(4l-3a)\}$	$R_A = r_A + \frac{M_A - M_B}{l}$ $R_B = r_B + \frac{M_B - M_A}{l}$ r indicates the reaction force of the single span.	where $a = c$ $d_{max} = \frac{W}{384EI}(l^3 + 2l^2a + 4la^2 - 8a^3)$
27		 $M_x = -\frac{Wl}{30}(\frac{10x^3}{l^3} - \frac{9x}{l} + 2)$ where $+M_{max} = Wl/23.3$, $x = 0.55l$ $M_A = -Wl/15$ $M_B = -Wl/10$	$R_A = 0.3W$ $R_B = 0.7W$	$d_{max} = \frac{Wl^3}{382EI}$ where $x_1 = 0.525\,l$
28		 $M_A = M_B = -\frac{5Wl}{48}$ $M_C = Wl/16$	$R_A = R_B = W/2$	$d_{max} = \frac{1.4Wl^3}{384EI}$
29		 $M_A = M_B = -\frac{W}{48l} \times (5l^2+4al-4a^2)$	$R_A = R_B = W/2$	$d_{max} = \frac{W}{1920EI}(7l^3 + 8al^2 + 4a^2l - 16a^3)$
30		 $M_A = M_B = -\frac{Wa}{12l}(2l-a)$	$R_A = R_B = W/2$	$d_{max} = \frac{wa^2}{480EI}(5l - 4a)$

In case of beam subject to distributed loads, load symbol, W, indicates the total load of the beam. For example, in case of a beam subject to uniformly distributed load, w, W equals wℓ, where ℓ is span length.