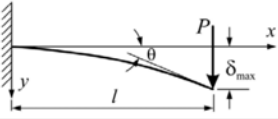
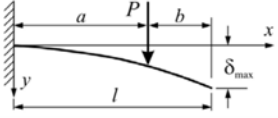
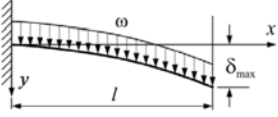
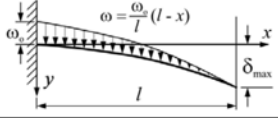
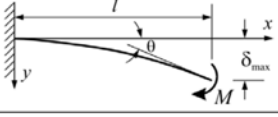


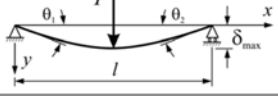
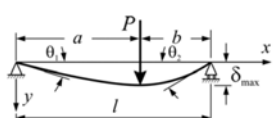
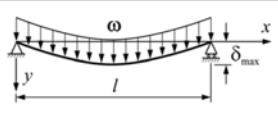
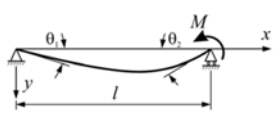
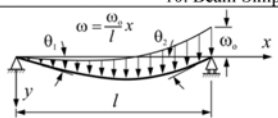
۱. تغییر شکل تیرهای کنسولی

BEAM DEFLECTION FORMULAE

BEAM TYPE	SLOPE AT FREE END	DEFLECTION AT ANY SECTION IN TERMS OF $x$	MAXIMUM DEFLECTION
1. Cantilever Beam – Concentrated load $P$ at the free end		$\theta = \frac{Pl^2}{2EI}$	$y = \frac{Px^2}{6EI}(3l-x)$ $\delta_{\max} = \frac{Pl^3}{3EI}$
2. Cantilever Beam – Concentrated load $P$ at any point		$\theta = \frac{Pa^2}{2EI}$	$y = \frac{Px^2}{6EI}(3a-x)$ for $0 < x < a$ $y = \frac{Pa^2}{6EI}(3x-a)$ for $a < x < l$ $\delta_{\max} = \frac{Pa^2}{6EI}(3l-a)$
3. Cantilever Beam – Uniformly distributed load $\omega$ (N/m)		$\theta = \frac{\omega l^3}{6EI}$	$y = \frac{\omega x^2}{24EI}(x^2 + 6l^2 - 4lx)$ $\delta_{\max} = \frac{\omega l^4}{8EI}$
4. Cantilever Beam – Uniformly varying load: Maximum intensity $\omega_0$ (N/m)		$\theta = \frac{\omega_0 l^3}{24EI}$	$y = \frac{\omega_0 x^2}{120EI}(10l^3 - 10l^2x + 5lx^2 - x^3)$ $\delta_{\max} = \frac{\omega_0 l^4}{30EI}$
5. Cantilever Beam – Couple moment $M$ at the free end		$\theta = \frac{Ml}{EI}$	$y = \frac{Mx^2}{2EI}$ $\delta_{\max} = \frac{Ml^2}{2EI}$

۲. تیر ساده

BEAM DEFLECTION FORMULAS

BEAM TYPE	SLOPE AT ENDS	DEFLECTION AT ANY SECTION IN TERMS OF $x$	MAXIMUM AND CENTER DEFLECTION
6. Beam Simply Supported at Ends – Concentrated load $P$ at the center		$\theta_1 = \theta_2 = \frac{Pl^2}{16EI}$	$y = \frac{Px}{12EI}\left(\frac{3l^2}{4} - x^2\right)$ for $0 < x < \frac{l}{2}$ $\delta_{\max} = \frac{Pl^3}{48EI}$
7. Beam Simply Supported at Ends – Concentrated load $P$ at any point		$\theta_1 = \frac{Pb(l^2 - b^2)}{6EI}$ $\theta_2 = \frac{Pab(2l - b)}{6EI}$	$y = \frac{Pbx}{6EI}(l^2 - x^2 - b^2)$ for $0 < x < a$ $y = \frac{Pb}{6EI}\left[\frac{l}{b}(x-a)^3 + (l^2 - b^2)x - x^3\right]$ for $a < x < l$ $\delta_{\max} = \frac{Pb(l^2 - b^2)^{3/2}}{9\sqrt{3}EI}$ at $x = \sqrt{(l^2 - b^2)}/3$ $\delta = \frac{Pb}{48EI}(3l^2 - 4b^2)$ at the center, if $a > b$
8. Beam Simply Supported at Ends – Uniformly distributed load $\omega$ (N/m)		$\theta_1 = \theta_2 = \frac{\omega l^3}{24EI}$	$y = \frac{\omega x}{24EI}(l^3 - 2lx^2 + x^3)$ $\delta_{\max} = \frac{5\omega l^4}{384EI}$
9. Beam Simply Supported at Ends – Couple moment $M$ at the right end		$\theta_1 = \frac{Ml}{6EI}$ $\theta_2 = \frac{Ml}{3EI}$	$y = \frac{Mlx}{6EI}\left(1 - \frac{x^2}{l^2}\right)$ $\delta_{\max} = \frac{Ml^2}{9\sqrt{3}EI}$ at $x = \frac{l}{\sqrt{3}}$ $\delta = \frac{Ml^2}{16EI}$ at the center
10. Beam Simply Supported at Ends – Uniformly varying load: Maximum intensity $\omega_0$ (N/m)		$\theta_1 = \frac{7\omega_0 l^3}{360EI}$ $\theta_2 = \frac{\omega_0 l^3}{45EI}$	$y = \frac{\omega_0 x}{360EI}(7l^4 - 10l^2x^2 + 3x^4)$ $\delta_{\max} = 0.00652 \frac{\omega_0 l^4}{EI}$ at $x = 0.519l$ $\delta = 0.00651 \frac{\omega_0 l^4}{EI}$ at the center

۳. مرجع

[www.wikipedia.org](http://www.wikipedia.org)