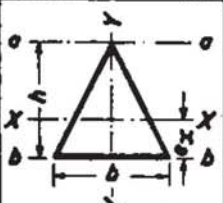
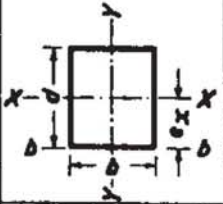
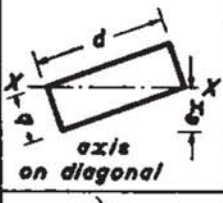
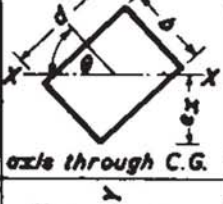
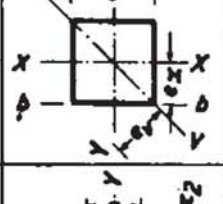
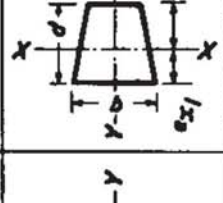
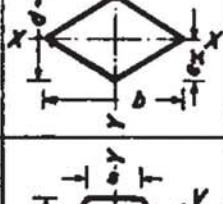

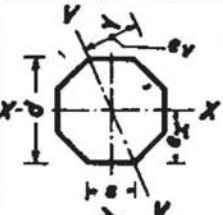
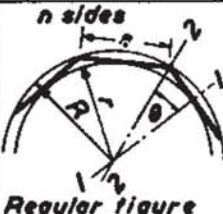
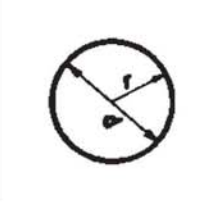
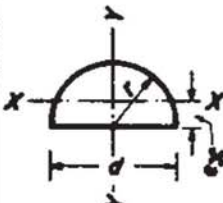
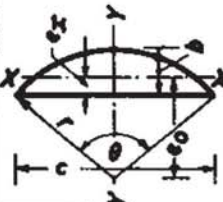
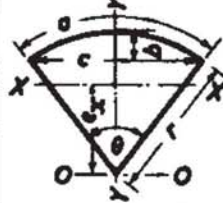
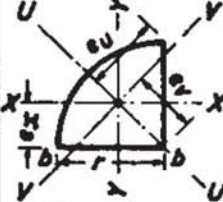
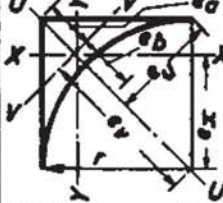
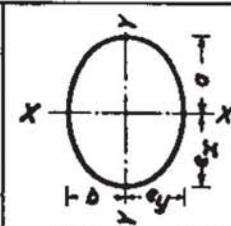
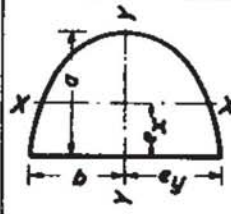
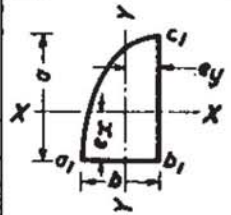
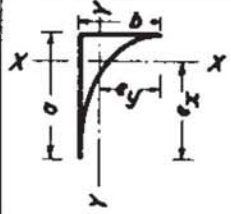
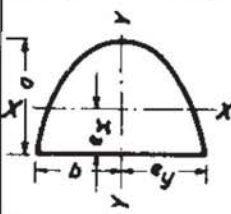
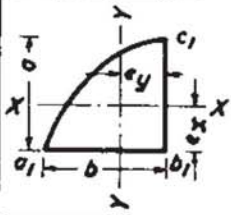
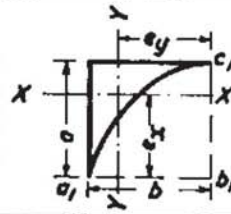
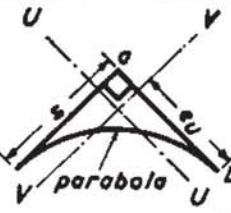


۱. جدول مشخصات هندسی شکلهای مختلف

GEOMETRICAL PROPERTIES OF PLANE SECTIONS					
	Section	Area	Position of Centroid	Moments of Inertia	Section Moduli
TRIANGLE		$A = \frac{bh}{2}$	$e_x = \frac{h}{3}$	$I_{XX} = bh^3/36$ $I_{YY} = hb^3/48$ $I_{OO} = bh^3/4$ $I_{bb} = bh^3/12$	Z_{XX} base = $bh^2/12$ apex = $bh^2/24$ $Z_{YY} = bh^2/24$
RECTANGLE		$A = bd$	$e_x = \frac{d}{2}$	$I_{XX} = bd^3/12$ $I_{YY} = db^3/12$ $I_{bb} = bd^3/3$	$Z_{XX} = bd^2/6$ $Z_{YY} = db^2/6$
RECTANGLE		$A = bd$	$e_x = \frac{bd}{\sqrt{b^2+d^2}}$	$I_{XX} = \frac{b^3d^3}{6(b^2+d^2)}$	$Z_{XX} = \frac{b^2d^2}{6\sqrt{b^2+d^2}}$
RECTANGLE		$A = bd$	$e_x = \frac{b \sin \theta + d \cos \theta}{2}$	$I_{XX} = \frac{bd(b^2 \sin^2 \theta + d^2 \cos^2 \theta)}{12}$	$Z_{XX} = \frac{bd(b^2 \sin^2 \theta + d^2 \cos^2 \theta)}{6(b \sin \theta + d \cos \theta)}$
SQUARE		$A = s^2$	$e_x = \frac{s}{2}$ $e_y = \frac{s}{\sqrt{2}}$	$I_{XX} = I_{YY} = s^4/12$ $I_{bb} = s^4/3$ $I_{VV} = s^4/12$	$Z_{XX} = Z_{YY} = \frac{s^3}{6}$ $Z_{VV} = \frac{s^3}{6\sqrt{2}}$
TRAPEZIUM		$A = \frac{d(a+b)}{2}$	$e_x = \frac{d(2a+b)}{3(a+b)}$	$I_{XX} = \frac{d^3(a^2+4ab+b^2)}{36(a+b)}$ $I_{YY} = \frac{d(a^3+a^2b+ab^2+b^3)}{48}$	$Z_{XX} = \frac{I_{XX}}{d-e_x}$ (two values) $Z_{YY} = \frac{2I_{YY}}{b}$
DIAMOND		$A = \frac{bd}{2}$	$e_x = \frac{d}{2}$	$I_{XX} = \frac{bd^3}{48}$ $I_{YY} = \frac{db^3}{48}$	$Z_{XX} = \frac{bd^2}{24}$ $Z_{YY} = \frac{db^2}{24}$
HEXAGON		$A = 0.866d^2$	$e_x = 0.866s = d/2$	$I_{XX} = I_{YY} = I_{VV} = 0.0601d^4$	$Z_{XX} = 0.1203d^3$ $Z_{YY} = Z_{VV} = 0.1042d^3$

GEOMETRICAL PROPERTIES OF PLANE SECTIONS				
Section	Area	Position of Centroid	Moments of Inertia	Section Moduli
 <p>OCTAGON</p>	$A = 0.8284d^2$ $s = 0.4142d$	$e_x = \frac{d}{2}$ $e_y = 0.541d$	$I_{XX} = I_{YY} = I_{VV}$ $= 0.0547d^4$	$Z_{XX} = Z_{YY}$ $= 0.1095d^3$ $Z_{VV} = 0.1011d^3$
 <p>POLYGON Regular figure</p>	$A = \frac{ns^2 \cot \theta}{4}$ $A = nr^2 \tan \theta$ $A = \frac{nR^2 \sin 2\theta}{2}$	$e = r$ or R depending on the axis and value of n	$I_1 = I_2$ $= \frac{A(6R^2 - s^2)}{24}$ $= \frac{A(12r^2 + s^2)}{48}$	$Z = \frac{I}{e}$
 <p>CIRCLE</p>	$A = \pi r^2$ $A = 0.7854d^2$	$e = r = \frac{d}{2}$	$I = \frac{\pi d^4}{64}$ $I = 0.7854r^4$	$Z = \frac{\pi d^3}{32}$ $Z = 0.7854r^3$
 <p>SEMI-CIRCLE</p>	$A = 1.5708r^2$	$e_x = 0.424r$	$I_{XX} = 0.1098r^4$ $I_{YY} = 0.3927r^4$	Z_{XX} base = $0.2587r^3$ crown = $0.1907r^3$ $Z_{YY} = 0.3927r^3$
 <p>SEGMENT</p>	$A = \frac{r^2(\pi\theta - \sin\theta)}{2}$	$e_o = \frac{c^3}{12A}$ $e_x = e_o - r \cos \frac{\theta}{2}$	$I_{XX} = \frac{r^4}{16} \left(\frac{\pi\theta}{90} - \sin 2\theta \right) - \frac{20r^4(1 - \cos \theta)^3}{\pi\theta - 180\sin \theta}$ $I_{YY} = \frac{r^4}{48} \left(\frac{\pi\theta}{30} - \theta \sin \theta + \sin 2\theta \right)$	Z_{XX} base = $\frac{I_{XX}}{e_x}$ crown = $\frac{I_{XX}}{b - e_x}$ $Z_{YY} = \frac{2I_{YY}}{c}$
 <p>SECTOR</p>	$A = \frac{\theta}{360} \pi r^2$	$e_x = \frac{2}{3} r \frac{c}{a}$ $e_x = \frac{r^2 c}{3A}$	$I_{XX} = I_o - \frac{360}{\theta} \sin^2 \frac{\theta}{2} \cdot \frac{4r^4}{5}$ $I_{YY} = \frac{r^4}{8} (\pi\theta - \sin \theta)$ $I_o = \frac{r^4}{8} (\pi\theta + \sin \theta)$	Z_{XX} centre = $\frac{I_{XX}}{e_x}$ crown = $\frac{I_{XX}}{r - e_x}$ $Z_{YY} = \frac{2I_{YY}}{c}$
 <p>QUADRANT</p>	$A = \frac{\pi r^2}{4}$	$e_x = 0.424r$ $e_y = 0.6r$ $e_u = 0.707r$	$I_{XX} = I_{YY} = 0.0549r^4$ $I_{bb} = 0.1963r^4$ $I_{UU} = 0.0714r^4$ $I_{VV} = 0.0384r^4$	Minimum Values $Z_{XX} = Z_{YY}$ $= 0.0953r^3$ $Z_{UU} = 0.1009r^3$ $Z_{VV} = 0.064r^3$
 <p>COMPLEMENT</p>	$A = 0.2146r^2$	$e_x = 0.777r$ $e_y = 1.098r$ $e_u = 0.707r$ $e_o = 0.316r$ $e_b = 0.391r$	$I_{XX} = I_{YY} = 0.0076r^4$ $I_{UU} = 0.012r^4$ $I_{VV} = 0.0031r^4$	Minimum Values $Z_{XX} = Z_{YY}$ $= 0.0097r^3$ $Z_{UU} = 0.017r^3$ $Z_{VV} = 0.0079r^3$

GEOMETRICAL PROPERTIES OF PLANE SECTIONS				
Section	Area	Position of Centroid	Moments of Inertia	Section Moduli
ELLIPSE 	$A = \pi ab$	$e_x = 0$ $e_y = 0$	$I_{XX} = 0.7854ba^3$ $I_{YY} = 0.7854ab^3$	$Z_{XX} = 0.7854bd^2$ $Z_{YY} = 0.7854ab^2$
SEMI-ELLIPSE 	$A = \frac{\pi ab}{2}$	$e_x = 0.424a$ $e_y = b$	$I_{XX} = 0.1098ba^3$ $I_{YY} = 0.3927ab^3$ $I_{base} = 0.3927ba^3$	$Z_{XX} - base = 0.2587ba^2$ $Z_{XX} - crown = 0.1907ba^2$ $Z_{YY} = 0.3927ab^2$
1/4 ELLIPSE 	$A = 0.7854ab$	$e_x = 0.424a$ $e_y = 0.424b$	$I_{XX} = 0.0549ba^3$ $I_{YY} = 0.0549ab^3$ $I_{b_1, a_1} = 0.1963ba^3$ $I_{b_1, c_1} = 0.1963ab^3$	$Z_{XX} - base = 0.1293ba^2$ $Z_{XX} - crown = 0.0953ba^2$ $Z_{YY} - base = 0.1293ab^2$ $Z_{YY} - crown = 0.0953ab^2$
COMPLEMENT 	$A = 0.2146ab$	$e_x = 0.777a$ $e_y = 0.777b$	$I_{XX} = 0.0076ba^3$ $I_{YY} = 0.0076ab^3$	$Z_{XX} - base = 0.0338ba^2$ $Z_{XX} - apex = 0.0097ba^2$ $Z_{YY} - base = 0.0338ab^2$ $Z_{YY} - apex = 0.0097ab^2$
FULL PARABOLA 	$A = \frac{4ab}{3}$	$e_x = \frac{2a}{5}$ $e_y = b$	$I_{XX} = 0.0914ba^3$ $I_{YY} = 0.2666ab^3$ $I_{base} = 0.3048ba^3$	$Z_{XX} - base = 0.2286ba^2$ $Z_{XX} - crown = 0.1524ba^2$ $Z_{YY} = 0.2666ab^2$
SEMI-PARABOLA 	$A = \frac{2ab}{3}$	$e_x = \frac{2a}{5}$ $e_y = \frac{3b}{8}$	$I_{XX} = 0.0457ba^3$ $I_{YY} = 0.0396ab^3$ $I_{b_1, a_1} = 0.1524ba^3$ $I_{b_1, c_1} = 0.1333ab^3$	$Z_{XX} - base = 0.1143ba^2$ $Z_{XX} - crown = 0.076ba^2$ $Z_{YY} - base = 0.1055ab^2$ $Z_{YY} - crown = 0.0633ab^2$
COMPLEMENT 	$A = \frac{ab}{3}$	$e_x = \frac{7a}{10}$ $e_y = \frac{3b}{4}$	$I_{XX} = 0.0176ba^3$ $I_{YY} = 0.0125ab^3$ $I_{a_1, b_1} = 0.181ba^3$ $I_{b_1, c_1} = 0.2ab^3$	$Z_{XX} - base = 0.0587ba^2$ $Z_{XX} - apex = 0.0252ba^2$ $Z_{YY} - base = 0.05ab^2$ $Z_{YY} - apex = 0.0167ab^2$
FILLET 	$A = \frac{r^2}{6}$	$e_u = e_v = \frac{4r}{5}$	$I_{UU} = I_{VV} = 0.00524r^4$ $I_{ab} = 0.1119r^4$	$Z_{UU} = Z_{VV}$ $base = 0.0262r^3$ $apex = 0.0066r^3$

۲. مرجع

Steel Designers Manual, Construction Steel Research and Development Organization, Fourth Edition, 1972.