

SCHEDA TECNICA

Il momento d'inerzia di una figura piana rispetto ad un suo generico punto, con assi Cartesiani avente origine sempre in tale punto, è uguale alla somma dei momenti d'inerzia di ogni singolo quadrante (sempre positivo in x e y), scomposto ipoteticamente dal sistema cartesiano originario.

Quindi, nel metodo della "Scomposizione cartesiana", il momento d'inerzia totale è pari alla somma dei momenti d'inerzia di ogni quadrante. Vedi "Dimostrazione del metodo.ITA" sul sito Web.

$$I_{x1} = \sum_{j,i=1}^n m_{j,i} d_{y,j,i}^2 = m_{1,1} d_{y1,1}^2$$

$$I_{x2} = \sum_{j,i=1}^n m_{j,i} d_{y,j,i}^2 = m_{2,2} d_{y2,2}^2$$

$$I_{x3} = \sum_{j,i=1}^n m_{j,i} d_{y,j,i}^2 = m_{3,3} d_{y3,3}^2$$

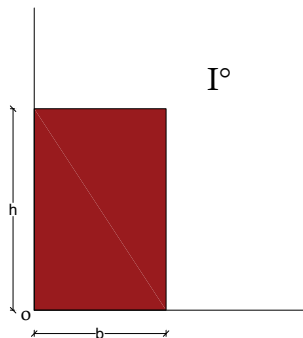
$$I_{x4} = \sum_{j,i=1}^n m_{j,i} d_{y,j,i}^2 = m_{4,4} d_{y4,4}^2$$

$$I_x = \sum_{j,i=1}^n I_{xj} = I_{x1} + I_{x2} + I_{x3} + I_{x4} = \sum_{j,i=1}^n m_{j,i} d_{y,j,i}^2$$

$$I_x = m_{1,1} d_{y1,1}^2 + m_{2,2} d_{y2,2}^2 + m_{3,3} d_{y3,3}^2 + m_{4,4} d_{y4,4}^2 = m_1 d_{y1}^2 + m_2 d_{y2}^2 + m_3 d_{y3}^2 + m_4 d_{y4}^2$$

$$I_y = \sum_{j,i=1}^n I_{yj} = I_{y1} + I_{y2} + I_{y3} + I_{y4} = \sum_{j,i=1}^n m_{j,i} d_{x,j,i}^2$$

$$I_y = m_{1,1} d_{x1,1}^2 + m_{2,2} d_{x2,2}^2 + m_{3,3} d_{x3,3}^2 + m_{4,4} d_{x4,4}^2 = m_1 d_{x1}^2 + m_2 d_{x2}^2 + m_3 d_{x3}^2 + m_4 d_{x4}^2$$



$$A = b \cdot h$$

$$x_g = b/2 \quad y_g = h/2$$

$$S_x = A/2 \cdot y_g/2 \quad S_y = A/2 \cdot x_g/2$$

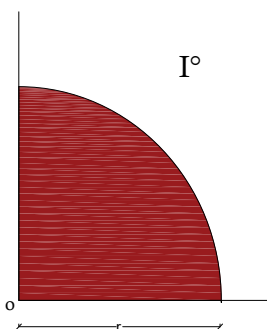
$$I_{o,x} = b \cdot h^3/3 \quad I_{o,y} = b^3 \cdot h/3$$

$$w_{pl,x} = S_x \cdot 2 \quad w_{pl,y} = S_y \cdot 2$$

$$I_{x,g} = b \cdot h^3/12 \quad I_{y,g} = h \cdot b^3/12$$

$$w_{el,x} = I_{x,g} / y_g \quad w_{el,y} = I_{y,g} / x_g$$

$$r_{x,g} = I_{x,g} / A \quad r_{y,g} = I_{y,g} / A$$



$$A = \pi \cdot r^2$$

$$y_g, x_g = \frac{2 \cdot r \cdot \sin(\alpha^\circ)}{3\alpha} \frac{180}{\pi} \cdot \cos(\vartheta)$$

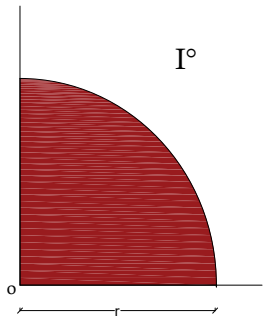
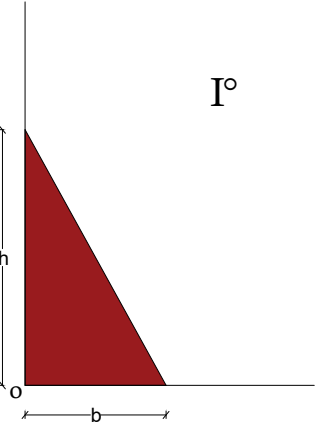
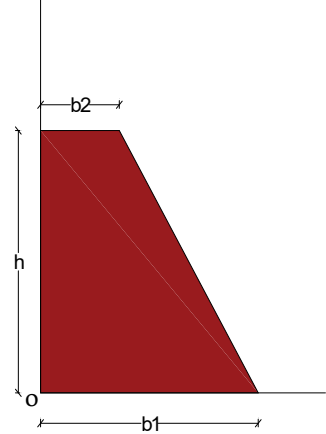
$$S_x = A(y)/2 \cdot y_g/2 \quad S_y = A(x)/2 \cdot x_g/2$$

$$A(x) = A(y) = \left[\frac{R^2 \cdot \text{Arcsen}(x/r)}{2} + \frac{r \cdot x \cdot \sqrt{r^2 - x^2}}{2 \cdot r} \right]_0^r$$

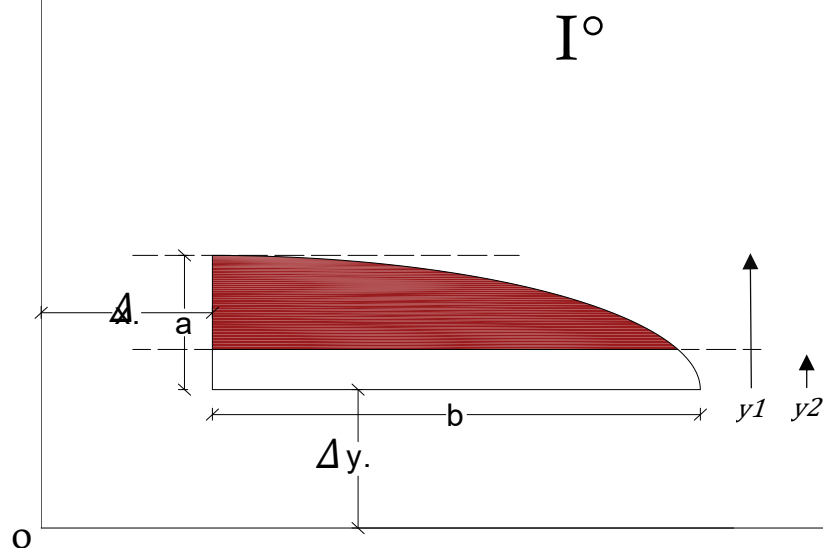
$$x_g = \frac{1}{A(x)} \int \left(\int_0^{\sqrt{r^2 - x^2}} x \cdot dx \right) dy$$



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	$I_{o,x} = \pi \cdot D^4 / 256 \quad I_{o,y} = \pi \cdot D^4 / 256$ $w_{pl,x} = S_x \cdot 2 \quad w_{pl,y} = S_y \cdot 2$ $[I_{x,g}; I_{y,g}] = [Steiner - hyugens(I_{o,x}; I_{o,y})]$ $w_{el,x} = I_{x,g} / y_g \quad w_{el,y} = I_{y,g} / x_g$ $r_{x,g} = I_{x,g} / A \quad r_{y,g} = I_{y,g} / A$
	$A = b \cdot h / 2$ $x_g = b / 3 \quad y_g = h / 3$ $S_x = b_i \cdot h_i \cdot h_i / 3 \quad S_y = b_i \cdot h_i \cdot b_i / 3$ $I_{o,x} = b \cdot h^3 / 12 \quad I_{o,y} = b^3 \cdot h / 12$ $w_{pl,x} = S_x \cdot 2 \quad w_{pl,y} = S_y \cdot 2$ $I_{x,g} = b \cdot h^3 / 36 \quad I_{y,g} = h \cdot b^3 / 36$ $w_{el,x} = I_{x,g} / y_g \quad w_{el,y} = I_{y,g} / x_g$ $r_{x,g} = I_{x,g} / A \quad r_{y,g} = I_{y,g} / A$
	$A = (b_1 + b_2) \cdot h / 2$ $x_g = \frac{(b_1^2 + b_2^2 + b_1 \cdot b_2)}{3 \cdot (b_1 + b_2)} \quad y_g = \frac{h \cdot (2 \cdot b_2 + b_1)}{3 \cdot (b_1 + b_2)}$ $S_x = (b_{1,i} + b_{2,i}) \cdot h_i / 2 \cdot \frac{h_i \cdot (2 \cdot b_{2,i} + b_{1,i})}{3 \cdot (b_{1,i} + b_{2,i})} \quad S_y = (b_{1,i} + b_{2,i}) \cdot h_i / 2 \cdot \frac{(b_{1,i}^2 + b_{2,i}^2 + b_{1,i} \cdot b_{2,i})}{3 \cdot (b_{1,i} + b_{2,i})}$ $I_{o,x} = (b_1 - b_2) \cdot h^3 / 12 + b_2 \cdot h^3 / 3 \quad b_1 > b_2$ $I_{o,x} = (b_2 - b_1) \cdot h^3 / 12 + b_1 \cdot h^3 / 3 \quad b_1 < b_2$ $I_{o,y} = b_2 \cdot h^3 / 3 + h \cdot (b_1 - b_2)^3 / 36 + \left\{ \left[(b_1 - b_2) \cdot h / 2 \cdot \left[b_2 + (b_1 - b_2) / 3 \right]^2 \right] \right\} \quad b_1 > b_2$ $I_{o,y} = b_1 \cdot h^3 / 3 + h \cdot (b_2 - b_1)^3 / 36 + \left\{ \left[(b_2 - b_1) \cdot h / 2 \cdot \left[b_1 + (b_2 - b_1) / 3 \right]^2 \right] \right\} \quad b_1 < b_2$ $w_{pl,x} = S_x \cdot 2 \quad w_{pl,y} = S_y \cdot 2$ $[I_{x,g}; I_{y,g}] = [Steiner - hyugens(I_{o,x}; I_{o,y})]$ $w_{el,x} = I_{x,g} / y_g \quad w_{el,y} = I_{y,g} / x_g$ $r_{x,g} = I_{x,g} / A \quad r_{y,g} = I_{y,g} / A$





$$\Delta A(y) = \frac{4b}{a} \int_0^a \sqrt{a^2 - y_1^2} dy - \frac{4b}{a} \int_0^a \sqrt{a^2 - y_2^2} dy$$

$$y_g = \frac{1}{A(y)} \iint y dy dx \quad y_g = \frac{b}{A(y)} \int_0^{y_i} \sqrt{y_i^2 \left(1 - \frac{y_i^2}{a^2}\right)} dy$$

$$x_g = \frac{1}{A(y)} \iint y dy dx \quad x_g = \frac{1}{2 \cdot A(y)} \int_0^{y_i} b^2 \left(1 - \frac{y_i^2}{a^2} \right) dy$$

$$\Delta y_g = \frac{A(y)_1 \cdot y_{g,1} - A(y)_2 \cdot y_{g,2}}{A(y)_1 - A(y)_2} \quad \Delta x_g = \frac{1}{2 \cdot \Delta A(y)} \cdot \left[\int_0^{y_2} b^2 \left(1 - \frac{y_2^2}{a^2} \right) dy - \int_0^{y_1} b^2 \left(1 - \frac{y_1^2}{a^2} \right) dy \right]$$

$$\Delta I_y(x) = \iint x_1^2 dA - \iint x_2^2 dA = \iint x_1^2 dx dy - \iint x_2^2 dx dy \quad \Delta I_y = \int_0^{y_1} dy \int_0^{b/a\sqrt{a^2-y_1^2}} x_1^2 dx - \int_0^{y_2} dy \int_0^{b/a\sqrt{a^2-y_2^2}} x_2^2 dx$$

$$\Delta I_y(x) = \frac{b^3}{3 \cdot a^3} \int_0^{y_1} \sqrt{a^2 - y_1^2} dy - \frac{b^3}{3 \cdot a^3} \int_0^{y_2} \sqrt{b^2 - y_2^2} dy$$

$$\Delta I_x(x) = \iint y_1^2 dA - \iint y_2^2 dA = \iint y_1^2 dx dy - \iint y_2^2 dx dy \quad \Delta I_x = \int_0^{y_1} y_1^2 dy \int_0^{\sqrt{\left(1 - \frac{y_1^2}{a^2}\right) b^2}} dx - \int_0^{y_2} y_2^2 dy \int_0^{\sqrt{\left(1 - \frac{y_2^2}{a^2}\right) b^2}} dx$$

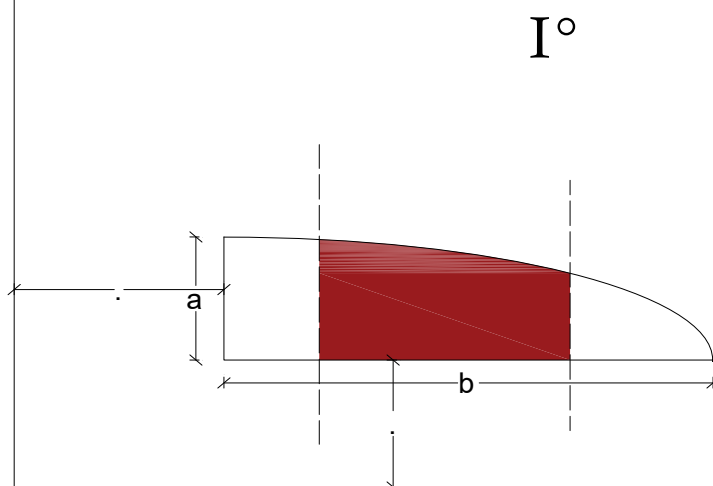
$$\Delta I_x(x) = \frac{b}{a} \int_0^{y_1} y_1^2 \sqrt{a^2 - y_1^2} dy - \frac{b}{a} \int_0^{y_2} y_2^2 \sqrt{a^2 - y_2^2} dy$$

$$[I_{x,g}; I_{y,g}] = [Steiner-hyugens(I_{o,x}; I_{o,y})]$$

$$w_{el,x} = I_{x,g} / y_g \quad w_{el,y} = I_{y,g} / x_g$$

$$r_{x,g} = I_{x,g} / A \quad r_{y,g} = I_{y,g} / A$$





$$\Delta A(x) = \frac{4a}{b} \int_0^b \sqrt{b^2 - x_1^2} dx - \frac{4a}{b} \int_0^b \sqrt{b^2 - x_2^2} dx$$

$$x_g = \frac{1}{A(x)} \iint x dy dx \quad x_g = \frac{a}{A(x)} \int_0^{x_i} \sqrt{x_i^2 \left(1 - \frac{x_i^2}{b^2}\right)} dx$$

$$y_g = \frac{1}{A(x)} \iint y dy dx \quad y_g = \frac{1}{2 \cdot A(x)} \int_0^{x_i} a^2 \left(1 - \frac{x_i^2}{b^2}\right) dx$$

$$\Delta x_g = \frac{A(x)_2 \cdot x_{g,2} - A(x)_1 \cdot x_{g,1}}{A(x)_2 - A(x)_1} \quad \Delta y_g = \frac{1}{2 \cdot \Delta A(x)} \cdot \left[\int_0^{x_2} a^2 \left(1 - \frac{x_2^2}{b^2}\right) dx - \int_0^{x_1} a^2 \left(1 - \frac{x_1^2}{b^2}\right) dx \right]$$

$$\Delta I_x(x) = \iint y_1^2 dA - \iint y_2^2 dA = \iint y_1^2 dx dy - \iint y_2^2 dx dy \quad \Delta I_x = \int_0^{x_1} dx \int_0^{a/b\sqrt{b^2-x_1^2}} y_1^2 dy - \int_0^{x_1} dx \int_0^{a/b\sqrt{b^2-x_2^2}} y_2^2 dy$$

$$\Delta I_x(x) = \frac{a^3}{3 \cdot b^3} \int_0^{x_1} \sqrt{b^2 - x_1^2} dx - \frac{a^3}{3 \cdot b^3} \int_0^{x_2} \sqrt{b^2 - x_2^2} dx$$

$$\Delta I_y(x) = \iint x_1^2 dA - \iint x_2^2 dA = \iint x_1^2 dx dy - \iint x_2^2 dx dy \quad \Delta I_y = \int_0^{x_1} x_1^2 dx \int_0^{\sqrt{\left(1 - \frac{x_1^2}{b^2}\right)} \cdot a^2} dy - \int_0^{x_2} x_2^2 dx \int_0^{\sqrt{\left(1 - \frac{x_2^2}{b^2}\right)} \cdot a^2} dy$$

$$\Delta I_y(x) = \frac{a}{b} \int_0^{x_1} x_1^2 \sqrt{b^2 - x_1^2} dx - \frac{a}{b} \int_0^{x_2} x_2^2 \sqrt{b^2 - x_2^2} dx$$

$$[I_{x,g}; I_{y,g}] = [\text{Steiner-huygens}(I_{o,x}; I_{o,y})]$$

$$w_{el,x} = I_{x,g} / y_g \quad w_{el,y} = I_{y,g} / x_g$$

$$r_{x,g} = I_{x,g} / A \quad r_{y,g} = I_{y,g} / A$$

