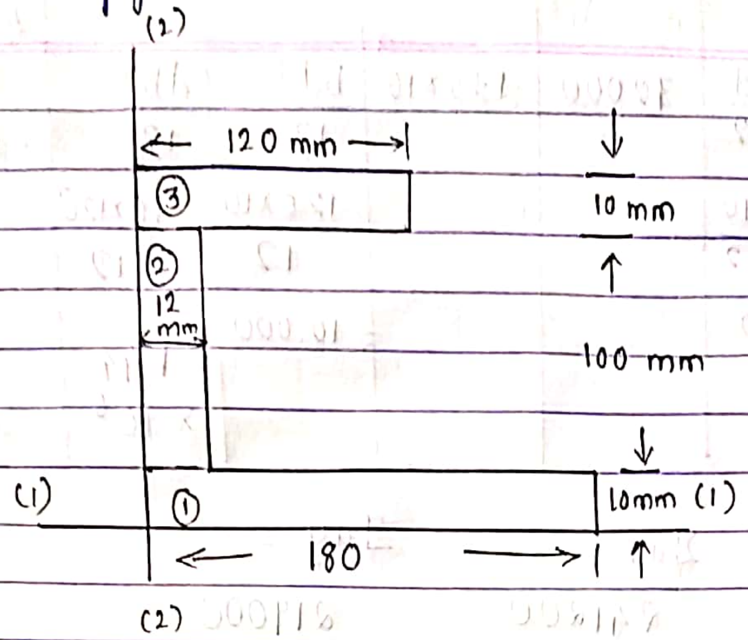
(2) Calculate the least radius of gyration for the section shown in the figure.



To calculate least radius of gyration, calculate Ixx & Iyy compare the values the radius of gyration corresponding to least value of M.I is least radius of gyration.

Comp.	a	$\bar{x}$	$\bar{y}$	$a\bar{x}$	$a\bar{y}$	I_{gx}	I_{gy}	$r_x = \bar{Y} - \bar{y}$	$r_y = \bar{X} - \bar{x}$
1	$180 \times 10 = 1800$	$\frac{b}{2} = \frac{180}{2} = 90$	$\frac{d}{2} = \frac{10}{2} = 5$	162×10^3	9×10^3	$\frac{bd^3}{12} = \frac{(180) \times 10^3}{12} = 15 \times 10^3$	$\frac{db^3}{12} = \frac{10 \times 180^3}{12} = 4.86 \times 10^6$	$52.14 - 5 = 47.14$	$57.43 - 90 = -32.57$
2	$12 \times 100 = 1200$	$\frac{b}{2} = \frac{12}{2} = 6$	$10 + \frac{b}{2}$ $10 + \frac{100}{2} = 60$	7200	72×10^3	$\frac{bd^3}{12} = \frac{12 \times 100^3}{12} = 1 \times 10^6$	$\frac{db^3}{12} = \frac{100 \times 12^3}{12} = 14400$	$52.14 - 60 = -7.86$	$57.43 - 6 = 51.43$

Comp	area 'a'	$\bar{x}$	$\bar{y}$	$a\bar{x}$	$a\bar{y}$	I_{gx}	I_{gy}	$r_x = \bar{Y} - \bar{y}$	$r_y = \bar{X} - \bar{x}$
3	$120 \times 10 = 1200$	$\frac{b}{2} = \frac{120}{2} = 60$	$110 + \frac{d}{2} = 110 + \frac{10}{2} = 115$	72000	138×10^3	$\frac{bd^3}{12} = \frac{120 \times 10^3}{12} = 10{,}000$	$\frac{db^3}{12} = \frac{10 \times 120^3}{12} = 1.44 \times 10^6$	$52.14 - 115 = -62.86$	$57.43 - = -2.57$

$\Sigma a = 4200 \text{ mm}^2$ $\quad \Sigma a\bar{x} = 241200$ $\quad \Sigma a\bar{y} = 219000$

$$\bar{X} = \frac{\Sigma a\bar{x}}{\Sigma a} = \frac{241200}{4200} = 57.43 \text{ mm}$$

$$\bar{Y} = \frac{\Sigma a\bar{y}}{\Sigma a} = \frac{219000}{4200} = 52.14 \text{ mm}$$

Moment of Inertia about the horizontal centroidal axes

$$I_{xx} = \Sigma \left[I_{gx} + a \times r_x^2 \right]$$

$$= \left[I_{gx} + a \times r_x^2 \right]_1 + \left[I_{gx} + a \times r_x^2 \right]_2 + \left[I_{gx} + a \times r_x^2 \right]$$

$$= \left[15 \times 10^3 + 1800 \times 47.14^2 \right] + \left[1 \times 10^6 + 1200 \times (-7.86)^2 \right] + \left[10{,}000 + 1200 \times (-62.86)^2 \right]$$

$$= 4.014 \times 10^6 + 1.074 \times 10^6 + 4.75 \times 10^6$$

$$= 9.838 \times 10^6 \text{ mm}^4$$

$$I_{yy} = \Sigma\left[I_{gy} + a \times r_y^2\right]$$

$$= \left[I_{gy} + a \times r_y^2\right]_1 + \left[I_{gy} + a \times r_y^2\right]_2$$

$$+ \left[I_{gy} + a \times r_y^2\right]_3$$

$$= \left[4.86 \times 10^6 + 1800 \times (-32.57)^2\right] + \left[14400 + 1200 \times (51.43)^2\right]$$

$$+ \left[1.44 \times 10^6 + 1200 \times (-2.57)^2\right]$$

$$= 6.77 \times 10^6 + 3.19 \times 10^6 + 1.44 \times 10^6$$

$$\approx 11.4 \times 10^6 \ mm^4$$

$$I_{xx} < I_{yy}$$

$\therefore$ Least radius of gyration

$$K_{min} = \sqrt{\frac{I_{xx}}{\Sigma a}}$$

$$= \sqrt{\frac{9.838 \times 10^6}{4200}} = 48.40 \ mm.$$

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