



Part ①: $I_{a-a} = \frac{1}{3} (300)(100)^3 = 10^8 \text{ mm}^4$

Part ②: $I_{a-a} = I_{x_0} + A \left(100 + \frac{4(100)}{3\pi} \right)^2$

where $I_{x_0} = I_x - A\bar{r}^2 = \frac{1}{8} \pi (100)^4 - \pi \frac{100^2}{2} \left(\frac{4 \cdot 100}{3\pi} \right)^2$
 $= 10.98 (10^6) \text{ mm}^4$

So $I_{a-a} = 10.98(10^6) + \frac{\pi (100)^2}{2} (142.4)^2 = 330(10^6) \text{ mm}^4$

Part ③: $I_{a-a} = I_x + A(100)^2 = \frac{1}{4} \pi (50)^4 + \pi (50)^2 (100)^2$
 $= 83.4(10^6) \text{ mm}^4$

Combined: $I_{a-a} = (100 + 330 - 83.4) 10^6 = \underline{346(10^6) \text{ mm}^4}$

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