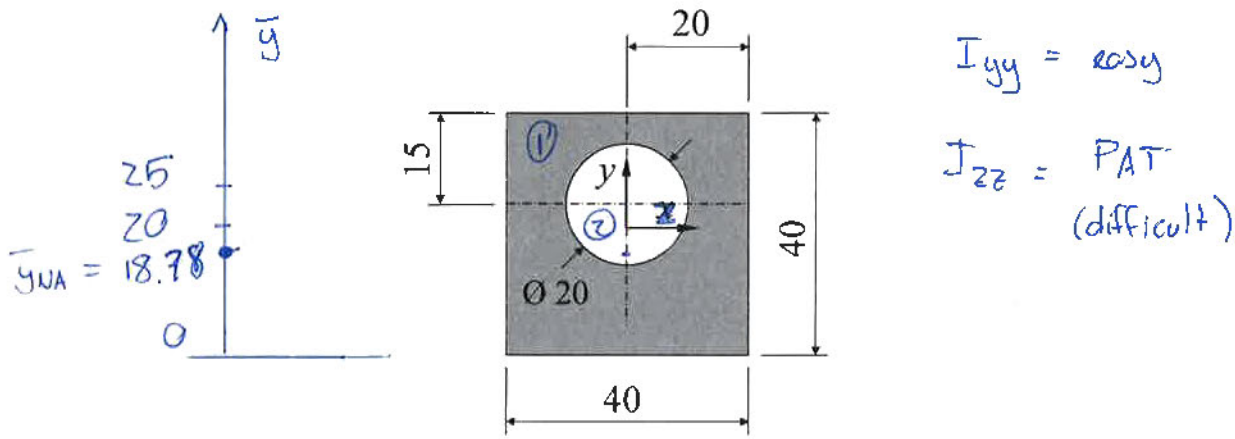
Example 2.2.5

Figure 1 shows the cross-section of an extrusion profile which consists of a square outline and one circular 'cavity' as shown. Note that the cavity is not completely centred with respect to the cross-section. About which of the axes, *x* or *y*, does this cross-section offer the lowest second moment of area? (NB. the origins of *x* and *y* should denote the unknown centroid of the cross-section.)



I_{yy} = easy

I_{zz} = PAT (difficult)

Figure 1: Cross-section of an extruded profile (dimensions in millimetres).

i	1	2	Compound
A_i	40^2	$-\pi(10)^2$	ΣA_i
$[mm^2]$	1600	-314.16	1285.8
I_i	$\frac{bh^3}{12}$	$\frac{\pi R^4}{4}$	
$[mm^4]$	213 333	7854	
$\bar{y}_i$	20	25	
$A_i \bar{y}_i$	32000	-7854	
d_i $[mm]$	1.22	6.22	

$I_{yy} = I_1 - I_2$

205 479.4

$\bar{y}_{NA} = \frac{\Sigma(A_i \bar{y}_i)}{\Sigma A_i}$

$\bar{y}_{NA} = 18.78$ mm

$d_i = \bar{y}_i - \bar{y}_{NA}$

$I_{zz} = \Sigma(I_i + A_i d_i^2)$

$I_{zz} = 195\,706$ mm^4