

Solution

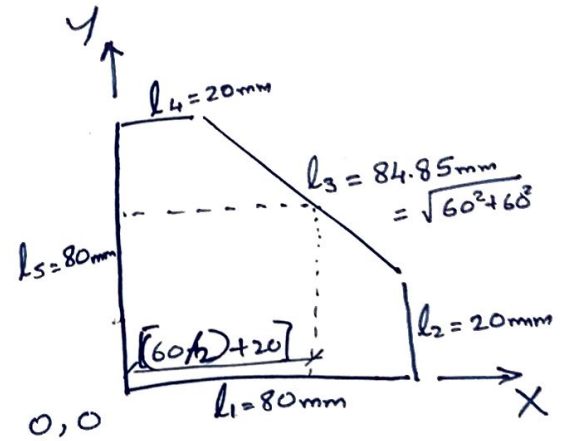
2(a) Center of Pressure = ?

Design scrap strip layout

find L for 60,000 blanks

Assume, thickness of sheet metal

$t = 1 \text{ mm}$



For $\bar{X} = \frac{\sum l_i x_i}{\sum l_i}$ $\bar{Y} = \frac{\sum l_i y_i}{\sum l_i}$

Assume coordinate axis XY as shown in figure.

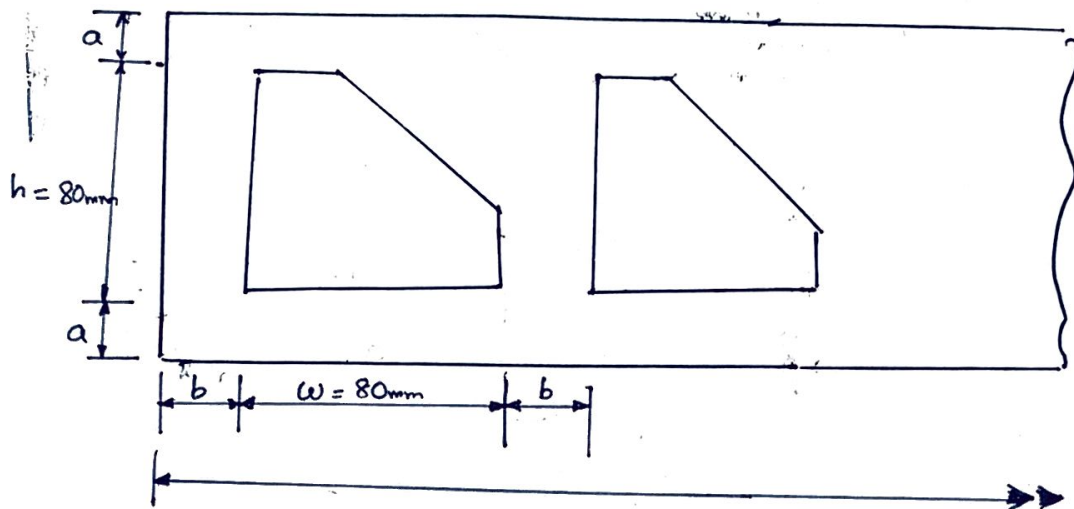
Sr. No.	l_i	x_i	$l_i x_i$	y_i	$l_i y_i$
1	80	40	3200	0	0
2	20	80	1600	10	200
3	84.85	$\frac{(60/2)+20}{2}$ 50	4242.5	50	4242.5
4	20	10	200	80	1600
5	80	0	0	40	3200
Σ	284.85		9242.5		9242.5

$\bar{X} = \frac{9242.5}{284.85}$

$\bar{Y} = \frac{9242.5}{284.85}$

$\bar{X} = \underline{\underline{32.45 \text{ mm}}}$

$\bar{Y} = \underline{\underline{32.45 \text{ mm}}}$

Scrap Strip Layout

Assume $t = 1 \text{ mm}$

No. of blanks = 60,000

$w = 80 \text{ mm}$, $h = 80 \text{ mm}$

for $t = 0.8 - 3.2 \text{ mm}$,

$$b = t = 1$$

$$\begin{aligned} a &= 0.015h + t \\ &= 0.015 \times 80 + 1 \\ &= 2.2 \text{ mm} \end{aligned}$$

$$\text{feed} = w + b = 80 + 1 = 81 \text{ mm}$$

$$\text{Height, } H = h + 2a = 80 + 2(2.2) = 84.4 \text{ mm}$$

$$\text{No. of blanks} = \frac{L - b}{\text{feed}}$$

$$\begin{aligned} L &= 60,000(81) + 1 \\ &= \underline{\underline{4860001 \text{ mm}}} \\ &= \underline{\underline{4.86 \text{ km}}} \end{aligned}$$

Assuming $t = 2 \text{ mm}$

No. of blanks = 60,000

$w = 80 \text{ mm}$, $h = 80 \text{ mm}$

for $t = (0.8 - 3.2) \text{ mm}$

$$b = t = 2 \text{ mm}$$

$$\begin{aligned} a &= 0.015h + t \\ &= 0.015 \times 80 + 2 \\ &= 3.2 \text{ mm} \end{aligned}$$

$$\text{feed} = w + b = 80 + 2 = 82 \text{ mm}$$

$$\begin{aligned} \text{Height, } H &= h + 2a = 80 + 2(3.2) \\ &= 86.4 \text{ mm} \end{aligned}$$

$$\text{No. of blanks} = \frac{L - b}{\text{feed}}$$

$$\begin{aligned} L &= 60,000(82) + 2 \\ &= \underline{\underline{4920002 \text{ mm}}} \\ &= \underline{\underline{4.92 \text{ km}}} \end{aligned}$$

3(b) $d = 75 \text{ mm}$, $H = 65 \text{ mm}$, $r = 1.6 \text{ mm}$, $t = 1.7 \text{ mm}$

Find: D , % redn, N , Punch Radius, Die Radius

Corner radius for punch & Die, C , P

$UTS = 400 \text{ N/mm}^2$, $C = 0.67$

Solution : (i) For finding blank diameter

$$\frac{d}{r} = \frac{75}{1.6} = 46.875 > 20$$

$$\text{Hence } D = \sqrt{d^2 + 4dh}$$

$$D = \sqrt{75^2 + 4(75)(65)}$$

$$D = \underline{\underline{158.51 \text{ mm}}}$$

Adding clearance for every 25 mm of Diameter, 3.2 mm

$$D = 158.51 + 3(3.2)$$

$$D = \underline{\underline{168.11 \text{ mm}}}$$

$$(ii) \% \text{ reduction} = \left(1 - \frac{d}{D}\right) \times 100$$

$$= \left(1 - \frac{75}{168.11}\right) \times 100$$

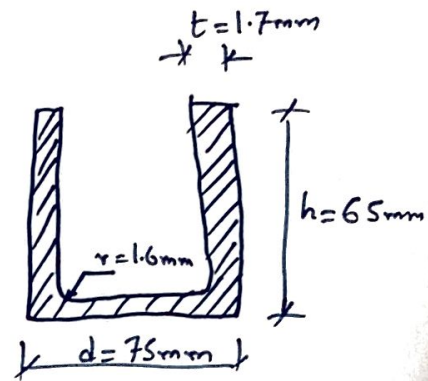
$$= \underline{\underline{55.39\%}}$$

(iii) No. of draws.

$$\frac{h}{d} = \frac{65}{75} = 0.8667 \text{ which lies between } (0.7 - 1.5)$$

$$\text{hence no. of draws} = \underline{\underline{2}}$$

Hence 2 stages are required to make given component.



for stage 1: % reduction = 45%

$$0.45 = \left(1 - \frac{d_1}{D}\right) = 1 - \frac{d_1}{168.11}$$

$$d_1 = \underline{92.46 \text{ mm}}$$

$$\begin{aligned} \text{For stage 2: \% reduction} &= \left(1 - \frac{d_1}{d_2}\right) = \left(1 - \frac{75}{92.46}\right) \\ &= 18.88\% \text{ which is less than } 30\% \end{aligned}$$

(iv) For finding Punch radius & die radius with clearance

Stage 1:

$$\begin{aligned} \text{Punch radius} &= (d_1 - 2t)/2 \\ &= [92.46 - 2(1.7)]/2 \end{aligned}$$

$$= \underline{44.53 \text{ mm}}$$

$$\text{Clearance, } C_1 = (1.08 - 1.1)t$$

$$\text{Assuming } C_1 = 1.1t$$

$$C_1 = 1.87 \text{ mm}$$

$$\begin{aligned} \text{Die Radius} &= (d_1 + 2C_1)/2 \\ &= [92.46 + 2(1.87)]/2 \\ &= \underline{48.1 \text{ mm}} \end{aligned}$$

Stage 2

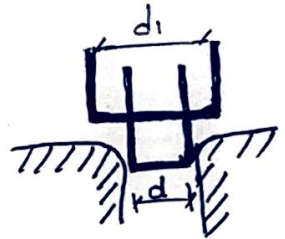
$$\begin{aligned} \text{Punch radius} &= (d - 2t)/2 \\ &= [75 - 2(1.7)]/2 \\ &= \underline{35.8 \text{ mm}} \end{aligned}$$

$$\text{Clearance, } C_2 = (1.09 - 1.12)t$$

$$\text{Assuming, } C_2 = 1.12t$$

$$C_2 = 1.9 \text{ mm}$$

$$\begin{aligned} \text{Die Radius} &= (d + 2C_2)/2 \\ &= [75 + 2(1.9)]/2 \\ &= \underline{39.4 \text{ mm}} \end{aligned}$$



(v) Corner Radius for Punch & Die

$$\text{Punch} = 4t = 4 \times 1.7 = \underline{6.8 \text{ mm}}$$

$$\text{Stage 1: Die} = (4 - \cancel{10})t = \text{Assuming } 6t = 6 \times 1.7 = \underline{10.2 \text{ mm}}$$

$$\text{Stage 2: Punch} = r = \underline{1.6 \text{ mm}} \text{ (Given in problem)}$$

$$\text{Die} = \underline{12 \text{ mm}} \quad \left[\begin{array}{l} \text{In order to place the centre point of the} \\ \text{second draw radius, } 3.2 \text{ mm outside the previous} \\ \text{cup, the draw radius for the second cup is } 12 \text{ mm} \end{array} \right]$$

$$\text{(vi) Drawing Pressure} = \pi d t \sigma_y \left(\frac{D}{d} - C \right)$$

$$= \pi \times 75 \times 1.7 \times 400 \left(\frac{168.11}{75} - 0.67 \right)$$

$$= \underline{251.78 \text{ KN}}$$