ENGINEERING MECHANICS - STATICS

Rashmi B A

Department of Civil Engineering

ENGINEERING MECHANICS - STATICS

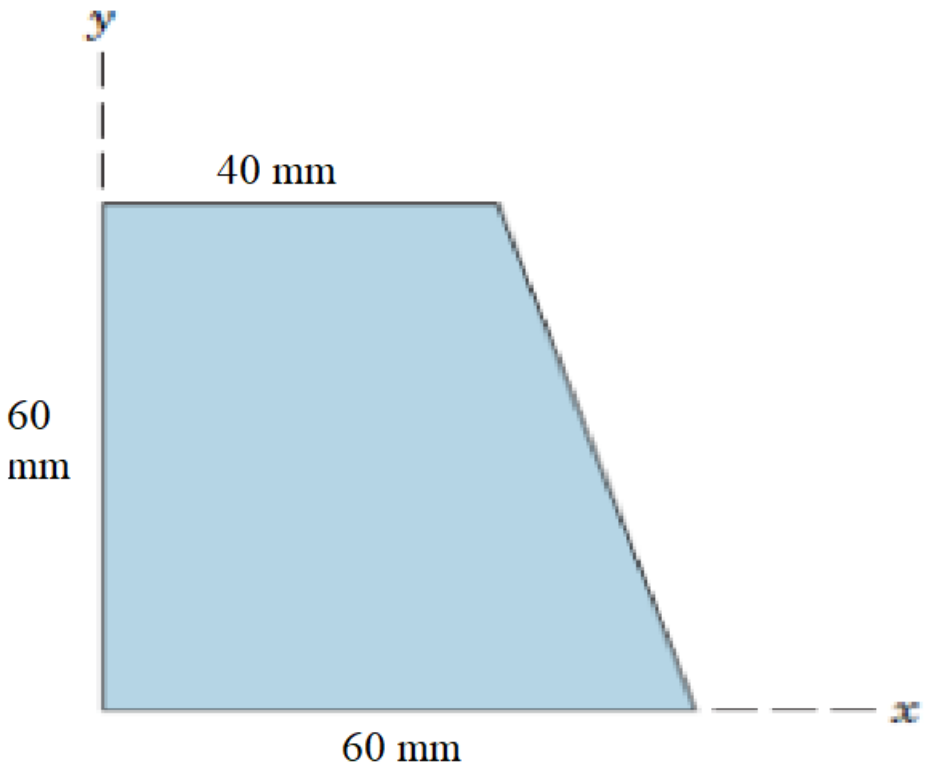
DISTRIBUTED FORCES

Session- 3

Rashmi B A
Department of Civil Engineering

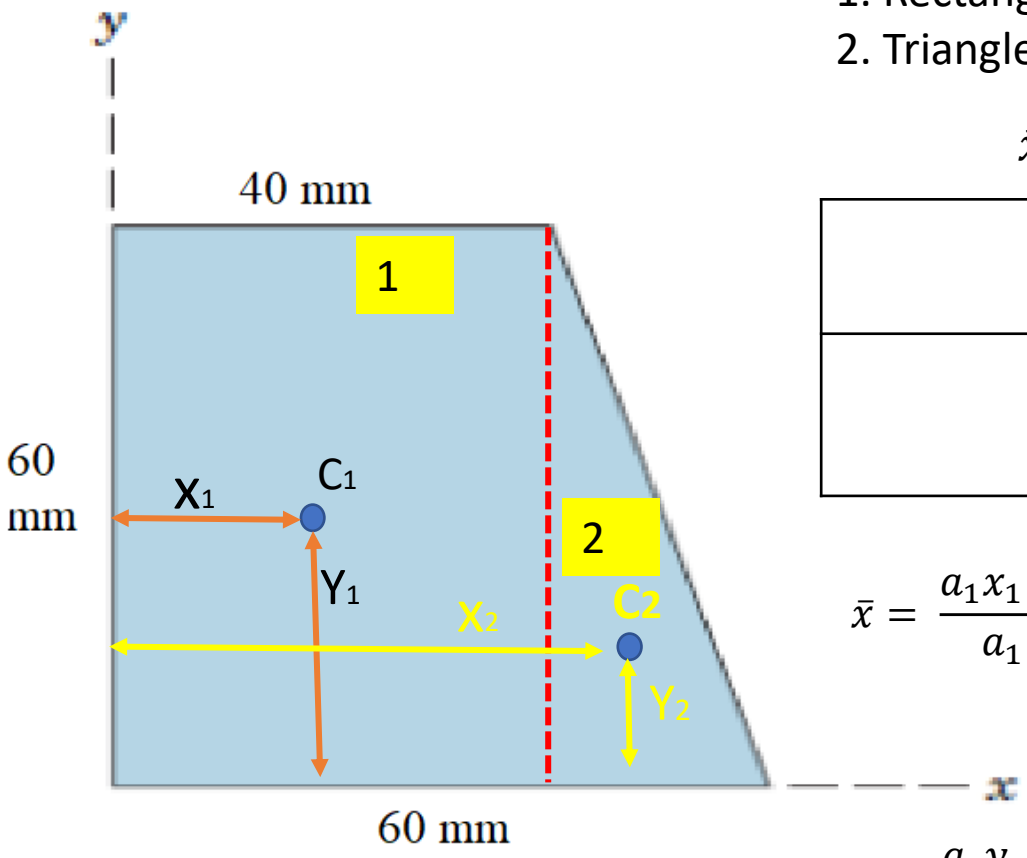
Centroid - Numerical

Problem: 5/47 Determine the coordinates of the centroid of the trapezoidal area shown.



ENGINEERING MECHANICS - STATICS

Centroid - Numerical



1. Rectangle (b= 40mm, h= 60mm)
2. Triangle (b= 20mm, h= 60mm)

$$\bar{x} = \frac{\sum a_i x_i}{A} \quad \bar{y} = \frac{\sum a_i y_i}{A}$$

$a_1 = (bh) = (40\ X\ 60) = 2400mm^2$	$x_1 = \frac{b}{2} = 20mm$	$y_1 = \frac{h}{2} = 30mm$
$a_2 = \frac{(bh)}{2} = \frac{(20\ X\ 60)}{2} = 600mm^2$	$x_2 = 40 + \frac{b}{3} = 46.667mm$	$y_2 = \frac{h}{3} = \frac{60}{3} = 20mm$

$$\bar{x} = \frac{a_1 x_1 + a_2 x_2}{a_1 + a_2} = \frac{(2400\ X\ 20) + (600\ X\ 46.67)}{2400 + 600} = \frac{76000}{3000} = 25.33mm$$

$$\bar{y} = \frac{a_1 y_1 + a_2 y_2}{A} = \frac{(2400\ X\ 30) + (600\ X\ 20)}{2400 + 600}$$

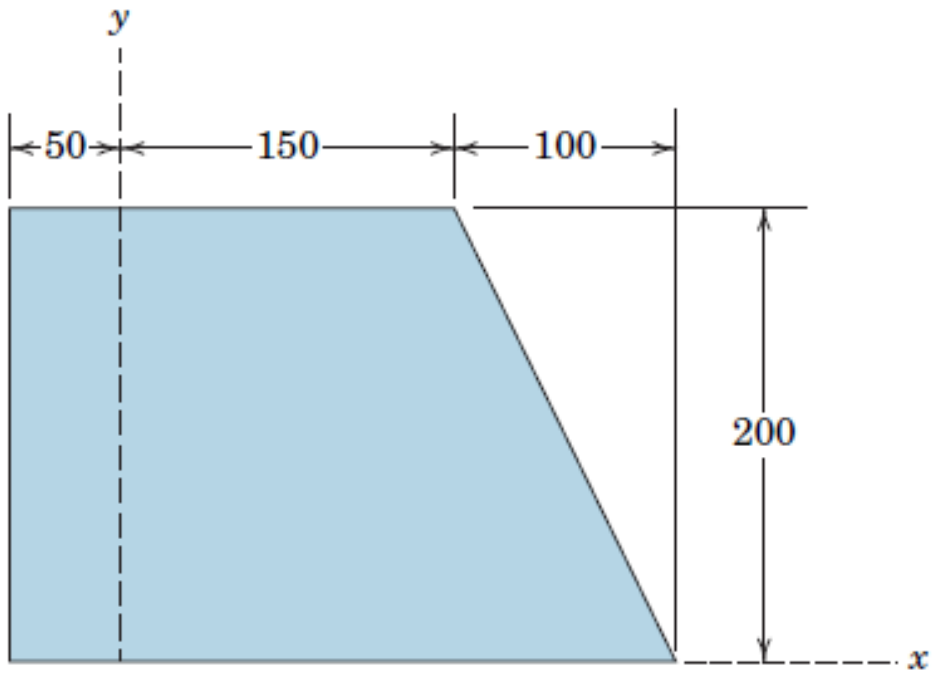
$$= \frac{84000}{3000} = 28.0mm$$

$(\bar{x}, \bar{y})$= (25.33mm, 28.0mm)

ENGINEERING MECHANICS - STATICS

Centroid - Numerical

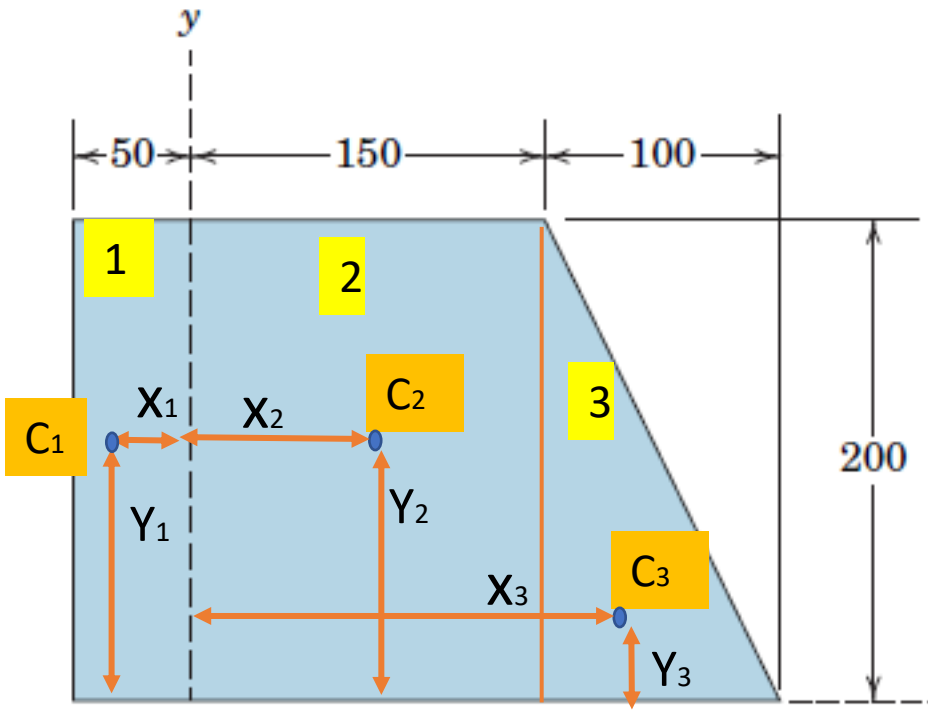
Problem: 5/49 Determine the x- and y-coordinates of the centroid of the shaded area.



Dimensions in millimeters

ENGINEERING MECHANICS - STATICS

Centroid - Numerical



1. Rectangle (b= 50mm, h= 200mm)
2. Rectangle (b= 150mm, h= 200mm)
3. Triangle (b= 100mm, h= 200mm)

$$\bar{x} = \frac{\sum a_i x_i}{A} \quad \bar{y} = \frac{\sum a_i y_i}{A}$$

$a_1 = (bh) = (50\ X\ 200) = 10000mm^2$	$x_1 = \frac{-b}{2} = -25mm$	$y_1 = \frac{h}{2} = 100mm$
$a_2 = (bh) = (150\ X\ 200) = 30000mm^2$	$x_2 = \frac{b}{2} = 75mm$	$y_2 = \frac{h}{2} = 100mm$
$a_3 = \frac{(bh)}{2} = \frac{(100\ X\ 200)}{2} = 10000mm^2$	$x_3 = 150 + \frac{b}{3} = 183.33\ mm$	$y_3 = \frac{h}{3} = \frac{200}{3} = 66.67$

$$\bar{x} = \frac{a_1x_1 + a_2x_2 + a_3x_3}{A} = \frac{(10000\ X\ -25) + (30000\ X\ 75) + (100000X\ 183.33)}{(10000 + 30000 + 10000)} = \frac{3833300}{50000} = 76.67 \text{ mm}$$

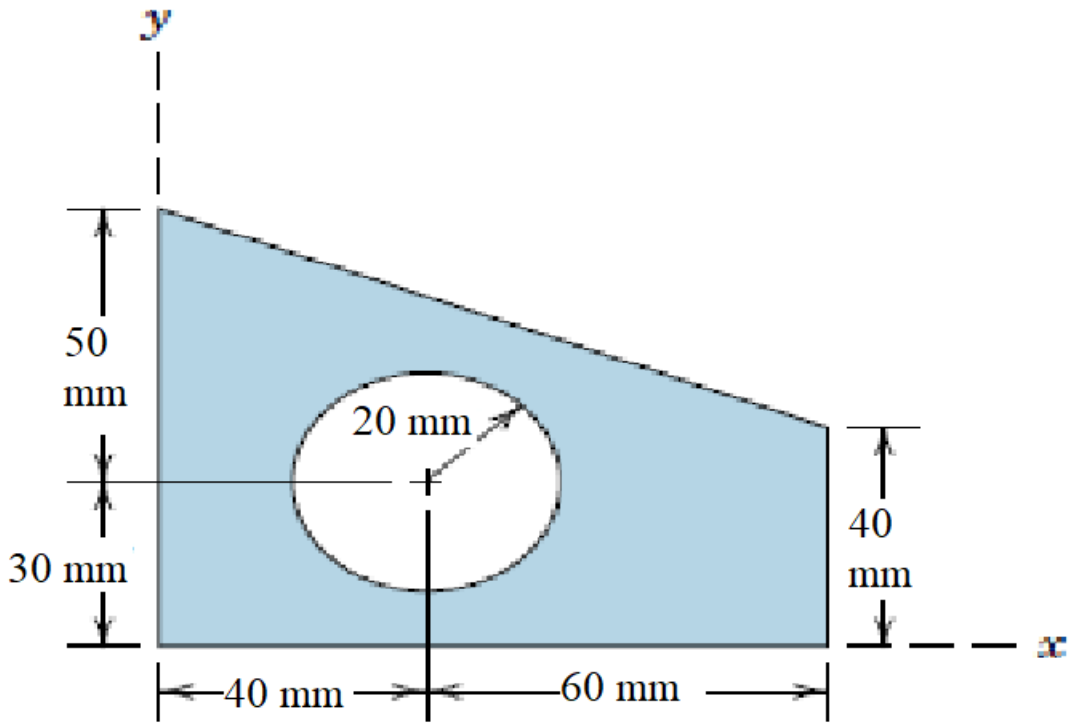
$$\bar{y} = \frac{a_1y_1 + a_2y_2 + a_3y_3}{A} = \frac{(10000\ X\ 100) + (30000\ X\ 100) + (100000X\ 66.67)}{(10000 + 30000 + 10000)} = \frac{46666700}{50000} = 93.34 \text{ mm}$$

$\bar{x} = 76.67$ mm
$\bar{y} = 93.34$ mm

ENGINEERING MECHANICS - STATICS

Centroid - Numerical

Problem: 5/51 Determine the x- and y-coordinates of the centroid of the shaded area.

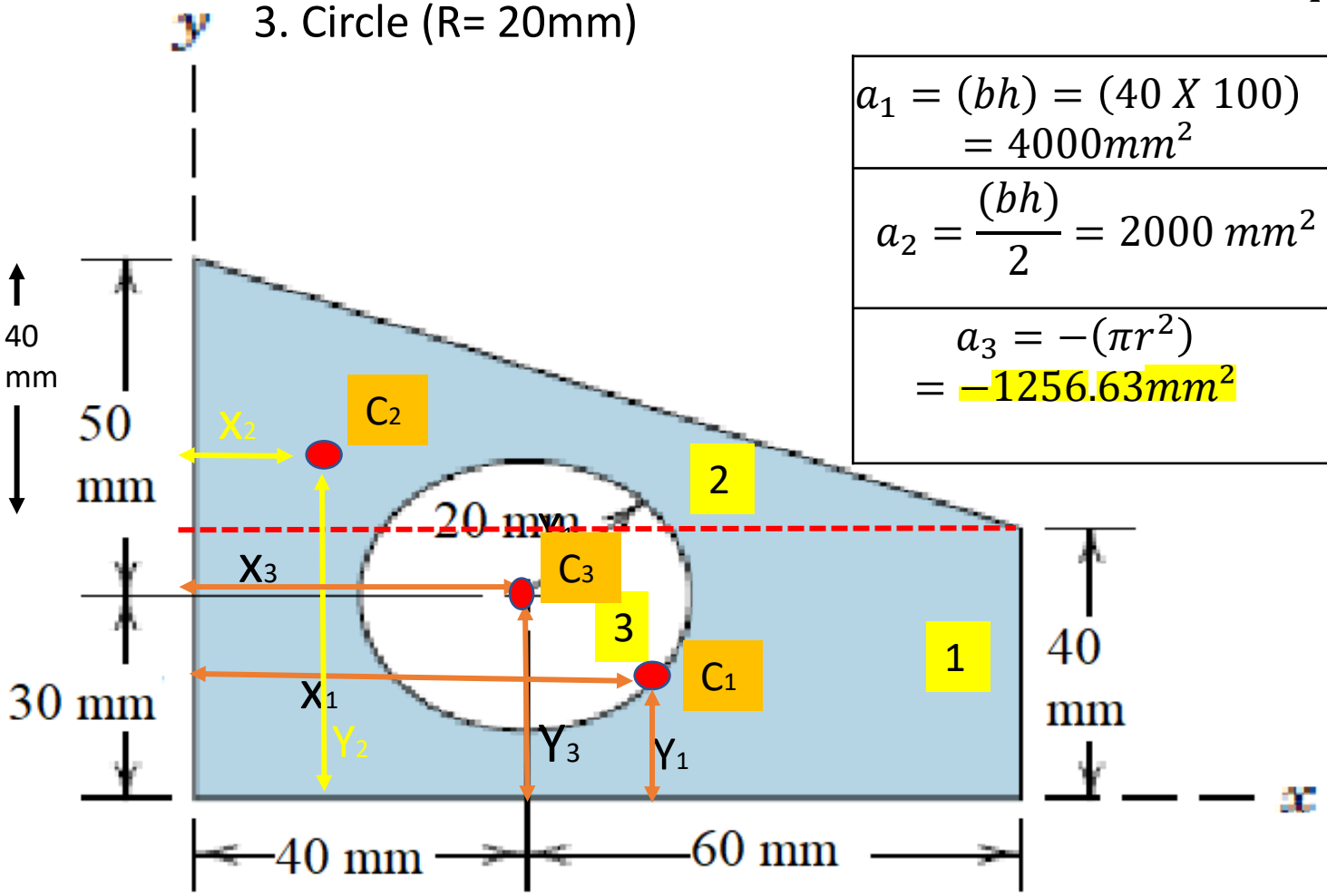


ENGINEERING MECHANICS - STATICS

Centroid - Numerical

1. Rectangle (b= 100mm, h= 40mm)
2. Triangle (b= 100mm, h=(80-40)= 40mm)
3. Circle (R= 20mm)

$$\bar{x} = \frac{\sum a_i x_i}{A} \qquad \bar{y} = \frac{\sum a_i y_i}{A}$$



$a_1 = (bh) = (40\ X\ 100)$ $= 4000mm^2$	$x_1 = \frac{100}{2} = 50mm$	$y_1 = \frac{h}{2} = 20mm$
$a_2 = \frac{(bh)}{2} = 2000\ mm^2$	$x_2 = \frac{b}{3} = 33.33mm$	$y_2 = 40 + \frac{h}{3} = 53.33mm$
$a_3 = -(\pi r^2)$ $= -1256.63mm^2$	$x_3 = 40\ mm$	$y_3 = 30mm$

Centroid - Numerical

$$\bar{x} = \frac{\sum a_i x_i}{A} \quad \bar{y} = \frac{\sum a_i y_i}{A}$$

$x_1 = \frac{100}{2} = 50mm$	$y_1 = \frac{h}{2} = 20mm$	$a_1 = (bh) = (40\ X\ 100) = 4000mm^2$
$x_2 = \frac{b}{3} = 33.33mm$	$y_2 = 40 + \frac{h}{3} = 53.33mm$	$a_2 = \frac{(bh)}{2} = 2000\ mm^2$
$x_3 = 40\ mm$	$y_3 = 30mm$	$a_3 = -(\pi r^2) = -1256.63mm^2$

$$\bar{x} = \frac{\sum a_i x_i}{A} = \frac{(4000\ X\ 50) + (2000\ X\ 33.33) + (-1256.63\ X\ 40)}{(4000 + 2000 - 1256.63)} = \frac{216394.8}{4743.37} = 45.62\ mm$$

$$\bar{y} = \frac{\sum a_i y_i}{A} = \frac{(4000\ X\ 200) + (2000\ X\ 53.33) + (-1256.63\ X\ 30)}{(4000 + 2000 - 1256.63)} = \frac{148961.1}{4748.37} = 31.37\ mm$$

$\bar{x} = 45.62$ mm
$\bar{y} = 31.37$ mm

THANK YOU

Rashmi B A
Department of Civil Engineering

rashmiba@pes.edu