'Surveying-2'
Lecture-7
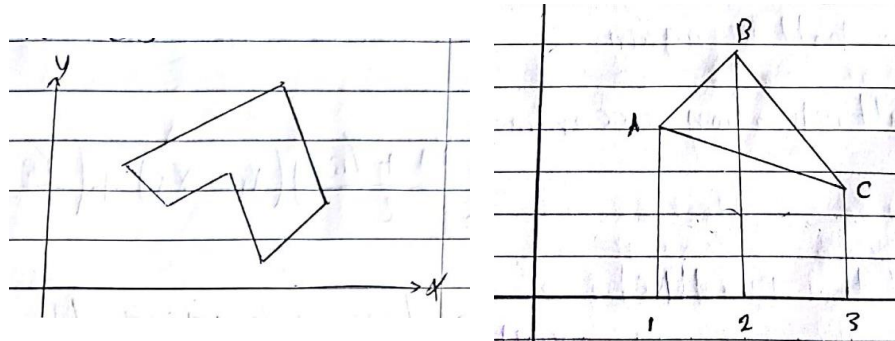## "Area"

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Outline

✓ **Area By Coordinates**

Area By Coordinates

A closed polygon with (n-sides). It is possible to determine the area of the polygon using coordinates of the corner points (i.e. x, y).

A solution may be found out by projecting the corners on x or y axis, then forming trapezoid to obtain the net area.

$$A_{ABCA} = A_{1AB2} + A_{2BC3} - A_{1AC3}$$

$$= \left(\frac{Y_A + Y_B}{2}\right)(X_B - X_A) + \left(\frac{Y_B + Y_C}{2}\right)(X_C - X_B)$$

$$- \left(\frac{Y_A + Y_C}{2}\right)(X_C - X_A)$$

After arranging the formula

$$2A = (X_B Y_B + X_B Y_C + X_C Y_A) - (Y_A X_B + Y_B X_C + Y_C X_A)$$
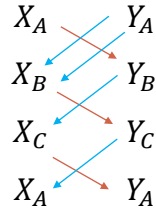
To apply the procedure

1. Write the coordinate of the points in sequence (clockwise or anticlockwise).

2. Repeat the coordinate of the point you started from at the bottom again.

3. Carry out the multiplication according to the arrows indicated

4. Take the sum of the products of left and right side.

5. Subtract sums and divide by (2) to obtain the area.

$$X_A \qquad Y_A$$
$$X_B \qquad Y_B$$
$$X_C \qquad Y_C$$
$$X_A \qquad Y_A$$

$$Sum1 = \qquad\qquad Sum2 =$$

$$A = \frac{Sum1 - sum2}{2} \quad or \quad A = \frac{sum2 - sum1}{2}$$

Important note: first plot the polygon then apply the method.

Ex: calculate the area of the triangle from the following coordinates.

Point	X	Y
A	30	60
B	90	100
C	120	20

Sum = 60 * 90 + 100 * 120 + 20 * 30 = 18000

Sum = 30 * 100 + 90 * 20 + 120 * 60 = 12000

$$A = \frac{Sum1 - sum2}{2} = \frac{18000 - 12000}{2} = 3000 \ m^2$$

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Area from cross-sections

Types of cross sections

Depending upon the type of the natural ground cross-sections may be divided to four types:

1. One level section.

2. Two level section

3. Three level section

4. Multi-level section

Area of multi-level section by coordinate

Procedure;

1. Create coordinate system for the section (a; conceder the center line as the y-axis of the system, and the x-axis will be considered with the design level)

2. Split the section to two halves (left side of y-axis, and right side of y-axis).

3. Determine the coordinate of all points ignoring the signs
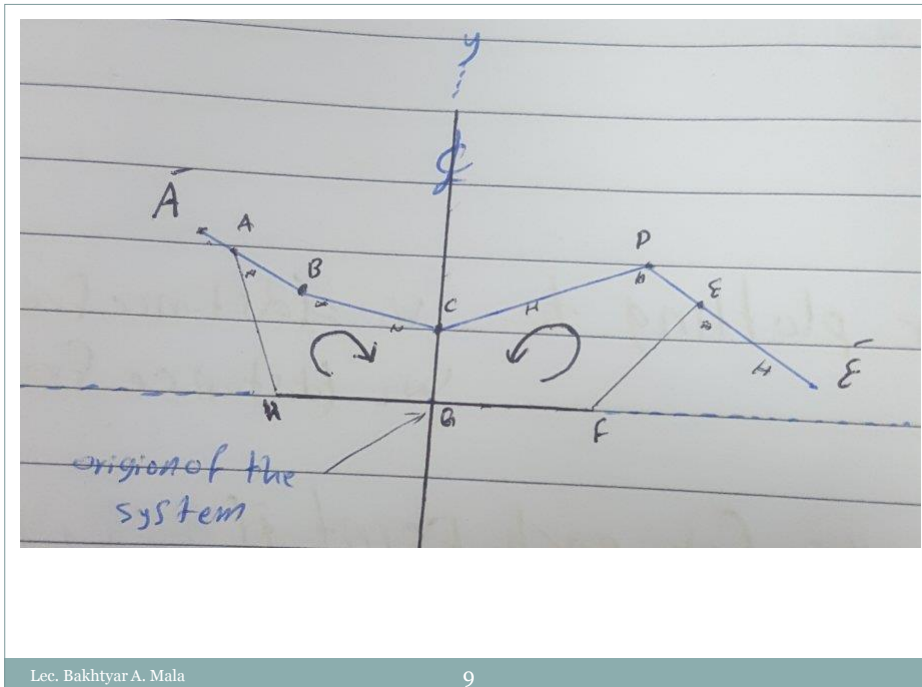
Calculate the area of the following section using coordinates

$$\frac{c\ 5.2}{19.8} \quad \frac{c6.8}{10.0} \quad \frac{c\ 7.2}{0.00} \quad \frac{c6.1}{15.0} \quad \frac{c7.4}{20.0} \quad \frac{c9.6}{26.4}$$

And 2b0 = 24.0m

$$\frac{0.0}{0.0} \searrow \frac{0.0}{12.0} \searrow \frac{5.2}{19.8} \searrow \frac{6.8}{10.0} \searrow \frac{7.2}{0.0} \quad \frac{0.0}{0.0}$$

$$Al = \frac{E1 - E2}{2} = \frac{62.4 + 134.64 + 72 - 52}{2} = 108.52$$

$$\frac{0.0}{0.0} \quad \frac{0.0}{12.0} \quad \frac{9.6}{26.4} \quad \frac{7.4}{20.0} \quad \frac{6.1}{15.0} \quad \frac{7.2}{0.0} \quad \frac{0.0}{0.0}$$

$$AR = \frac{115.2 + 195.36 + 122 + 108 - (192 + 111)}{2} = 118.78$$

A = AL + AR = 108.52 + 118.78 = 227.3m^2

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