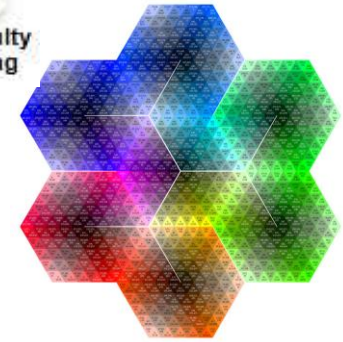
Benha University

Shoubra Faculty of Engineering



Surveying Engineering
Lecture 6:
Computation of Areas

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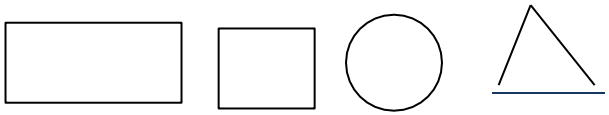
Methods for Area Determination

1. Areas directly from field data.
2. Area from coordinates.
3. Area of regular shapes.
4. Area of irregular shapes.
5. Sub-dividing areas

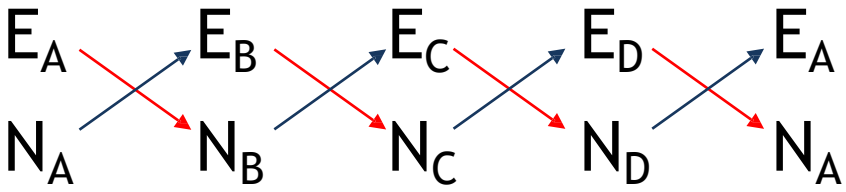
Analytical Method

1- Uniform shape method:



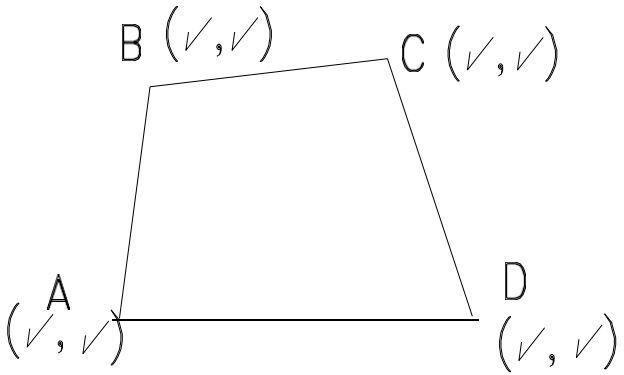
through uniform geometric figures

2- Coordinate Method:



$$U = E_A*N_B + E_B*N_C + E_C*N_D + E_D*N_A \quad L = N_A*E_B + N_B*E_C + N_C*E_D + N_D*E_A$$

$$A = \frac{1}{2}|U - L|$$

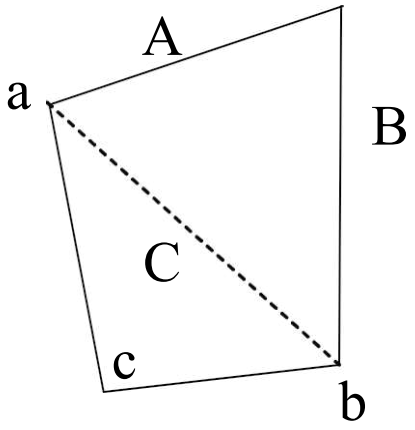


Uniform shape method

We require 3 pieces of data to fix a triangle.

Area of a triangle from lengths of sides is given by using distances, all sides of a triangle must be measured to determine the area.

The figure is reduced to a number of triangles with sides of each being measured, and the sum of areas of triangles used to find the area of the polygon



$$area = \sqrt{s(s-a)(s-b)(s-c)}$$

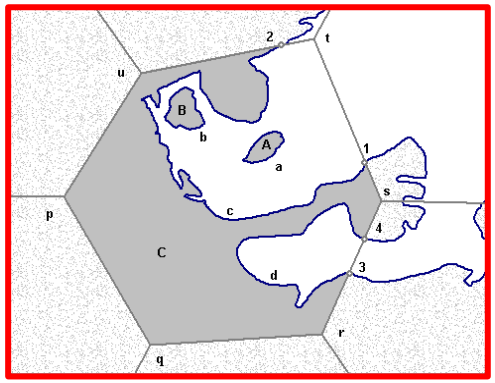
where $s = \frac{1}{2}(a+b+c)$

$$area = \frac{1}{2}ab\sin C$$

Analytical Method

b) Semi-computational Method

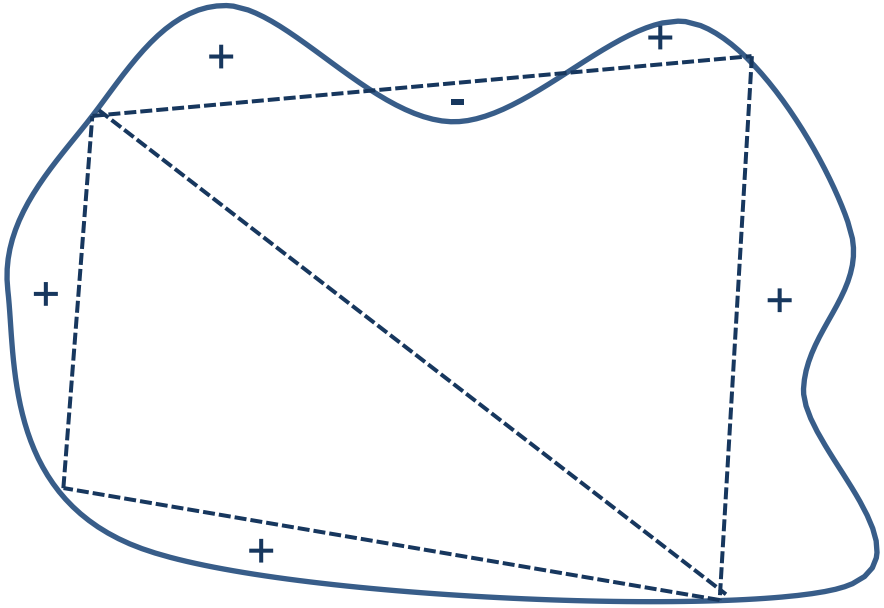
Irregular boundaries are divided into uniform geometric shapes and irregular parts



i) Average Height Method

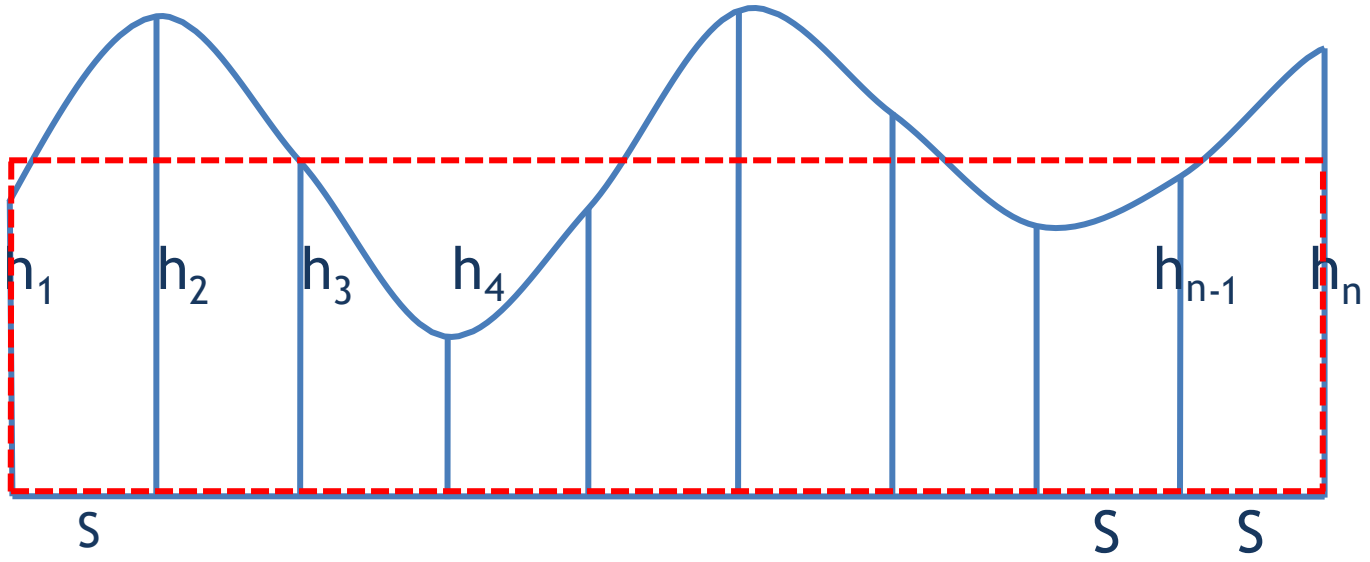
ii) Trapezoidal Method

iii) Simpson Method



Average Height Method

Irregular shape is approximated to a rectangle

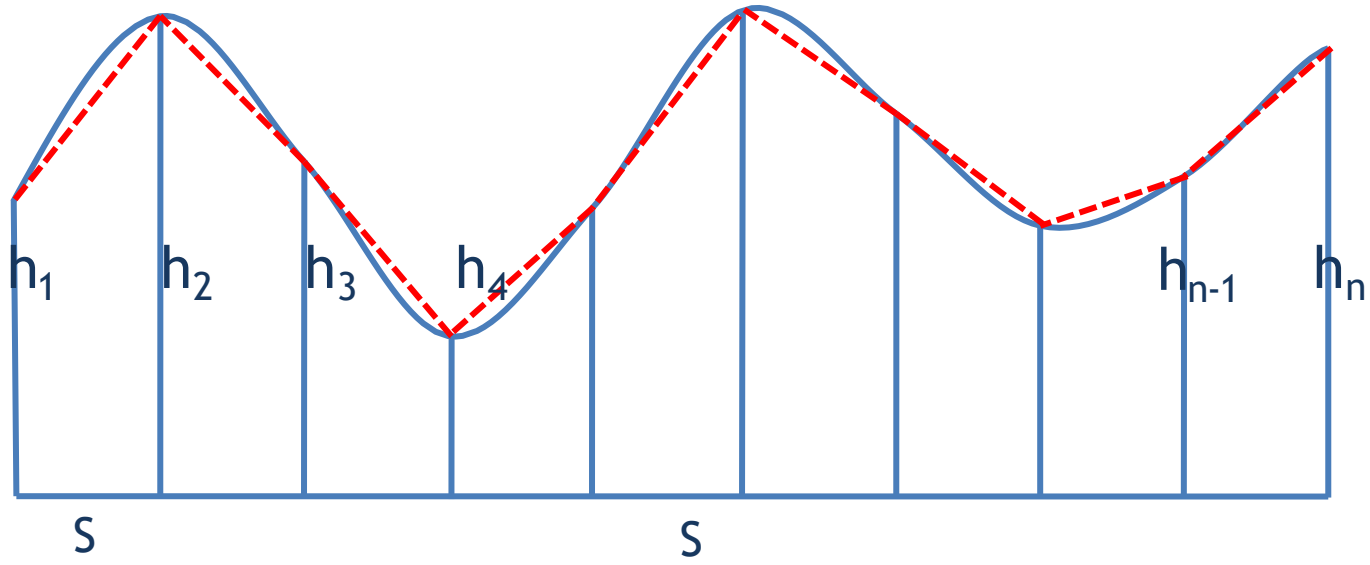


$$h_{avg.} = \frac{h_1 + h_2 + h_3 + \ldots\ldots + h_n}{n}$$

$$\text{Area} = (n - 1) * S * h_{avg.}$$

Trapezoidal Method

Irregular shape is approximated to trapeziums



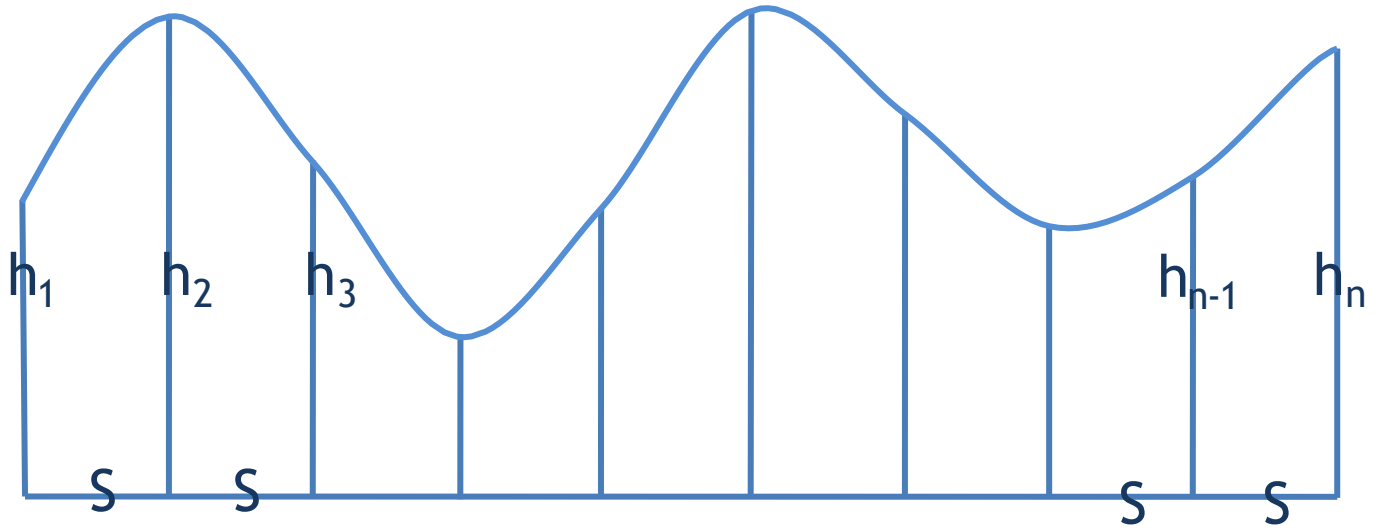
$$\text{Area} = \frac{(h_1 + h_2)}{2} * S + \frac{(h_2 + h_3)}{2} * S + \ldots\ldots\ldots\ldots$$

$$+\ldots\ldots\ldots\ldots\ldots + \frac{(h_{n-1} + h_n)}{2} * S$$

$$\text{Area} = \frac{S}{2}\left[h_1 + h_n + 2(h_2 + h_3 + h_4 + \ldots\ldots\ldots h_{n-1})\right]$$

Simpson Method

Irregular shape is approximated to part of parabola



$$\text{Area} = \frac{S}{3}[h_1+h_n+2(h_3+h_5+\ldots..+h_{n-2})+4(h_2+h_4+\ldots..+h_{n-1})]$$

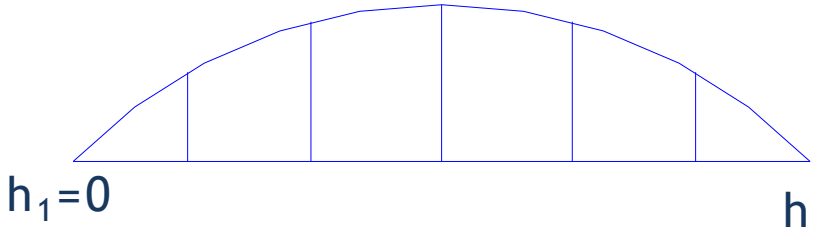
-n odd offsets or even spacings

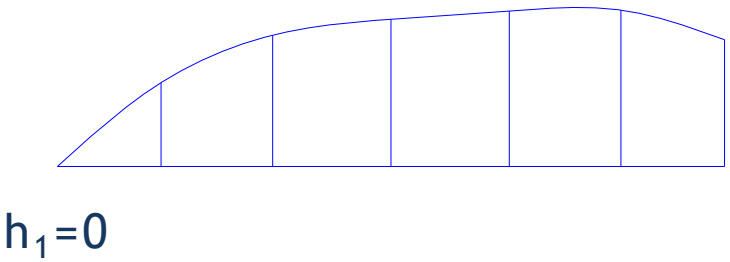
-Most precise for irregular boundaries

If n even offsets, then remove smaller offset from start or end & calculate using Simpson

Area of irregular shapes

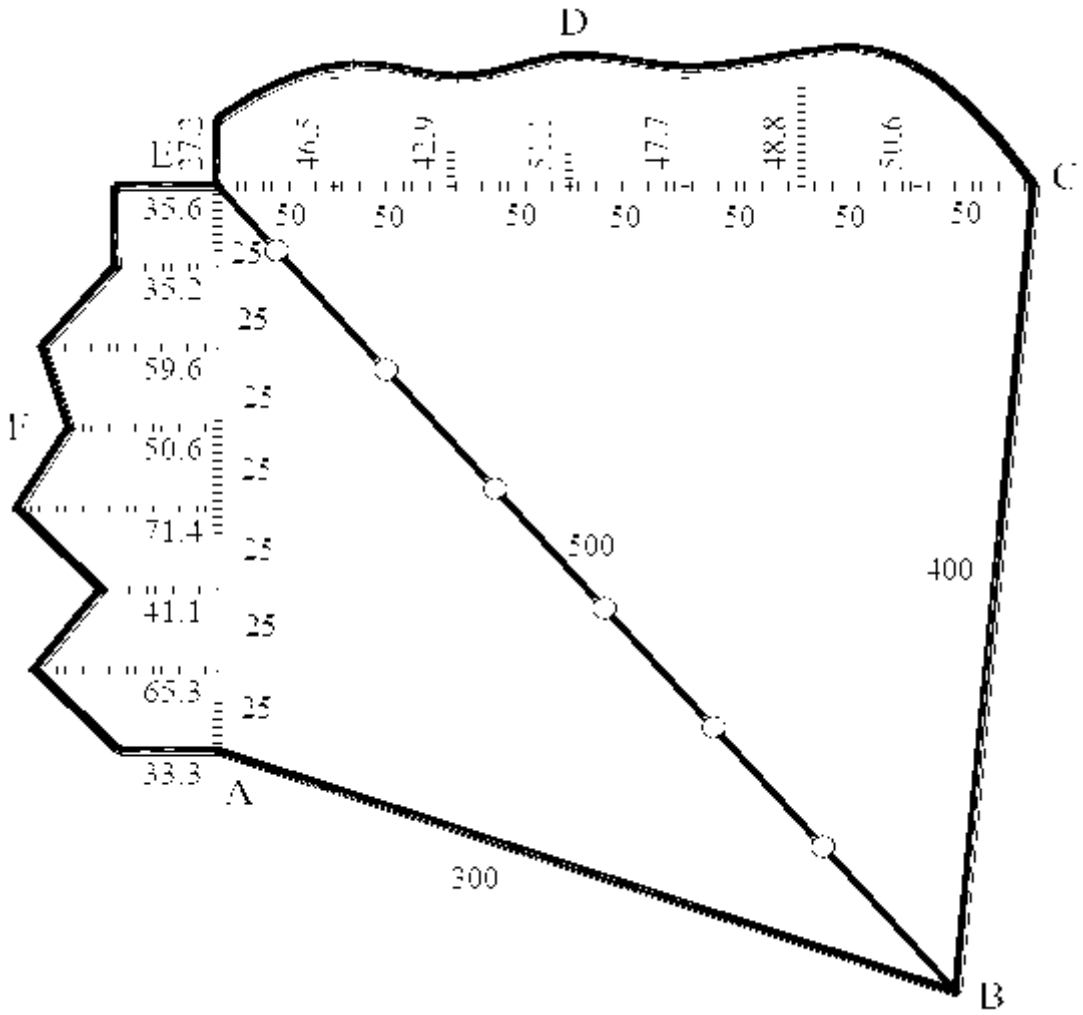
- If Spacing S differs from one part to another then divide into several parts with similar spacing
- For subtracted areas, offsets could be inserted -ve values
- Reference line could be irregular
- Zero offsets are counted





Solved Example

Calculate the ABEFA area ?



Solved Example

$S_{EBC} = \frac{350+500+400}{2} = 600$

$A_{EBC} = 54772.26\ m^2$ Similarly $A_{ABE} =$ m^2

$A_{EDC} = \frac{50}{3}(27.2 + 50.6 + 2(42.9+47.7) + 4\ (46.5 + 51.1 + 48.8)) + \frac{1}{2}x50.6\times50 =$ m^2

$A_{AFE} = \frac{25}{2}\times(33.3 + 35.6 + 2\ (65.3+41.1+71.4 +50.6+59.6+35.2)) =$ m^2

$A_{BCDEB} = A_{EBC} + A_{EDC} =$ m^2

$A_{ABEFA} = A_{ABE} + A_{AFE} =$ m^2

Supplementary files:

- https://www.youtube.com/watch?v=rOLWL-rVIHs
- https://www.youtube.com/watch?v=CcLPJP1Ebbg
- https://www.youtube.com/watch?v=JnLDmw3bbuw

Thanks

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