LECTURE NOTES:

EARTHWORKS
AREAS & VOLUMES

- Introduction: Areas and Volumes estimation is basic to most engineering schemes/projects such as route alignment, reservoirs, tunnels, etc. Excavation and hauling of materials on projects are always significant and costly. The calculation of areas may be based on data scaled from plans or drawings or data gained directly from survey field data.
- Computation from field notes
- Computation from plotted maps or plan
  - Graphical method
  - Instrumental method
    - Mid-ordinate rule
    - Average ordinate rule
    - Trapezoidal rule: This assumes that the short length of boundary between the ordinates are straight lines.

$$A = d\left({}^{o_1}\!/_{2} + o_2 + o_3 + ... + o_{(n-1)} + {}^{o_n}\!/_{2} \right)$$

    - Simpson's rule: This assumes that the short lengths of boundary between alternate ordinates are parabolic curves. The areas of such a segment will be where p is the mid-ordinate of the segment.

Exercise

- The following offsets were taken from a chain-line to a hedge. Compute the area included between the chain line, the hedge and the end offsets by Simpson's rule

- Prove that on a uniformly sloping ground the X-sectional area of a cutting or an embankment is given by the following equation, where d_1 and d_2 are the horizontal distances from centre line to the limits of the side slopes, b is the formation width of the cutting or embankment and 1 vertical in s horizontal is the gradient of the side slopes.

$$\text{A} = \frac{1}{s}\left(d_1 d_2 - \frac{b^2}{4} \right)$$

Volumes

- Use of Cross-sections: Usually sections are taken at intervals and at points of intersect on the project. The spacing of the section depends on the general characteristics of the ground and the desired accuracy of the earthwork computations.
  - Mean Area

$$V = \frac{(A_1 + A_2 + A_3 + ... + A_n)d}{n}$$

  - Trapezoidal rule

$$V = \frac{d}{2}(A_1 + A_n + 2A_2 + 2A_3 + ... + 2A_{(n-1)})$$

  - Prismoidal Formula

$$V = {}^{d}\!/_{3}(A_1 + 4A_2 + 2A_3 + ... + 2A_{(n-1)} + 4A_{(n-2)} + A_n)$$

  - Prismoidal Correction