

**COURSE CODE:**

CVE 314

**COURSE TITLE:**

ENGINEERING SURVEYING AND PHOTOGRAMMETRY

**NUMBER OF UNITS:**

03

**COURSE DURATION:**

2 hours contact time per week

**COURSE DETAILS:**

Course Coordinator: Engr. Dr. Adedayo A. BADEJO

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Office Location: Civil Engineering Building

Other Lectures:

**COURSE CONTENT:**

Introduction to photogrammetry, elements of photogrammetry equipment, principles and uses. Errors of measurements. Evaluation of single photographs. Further work on contours and contouring, methods of contouring; contour interpolation and uses of contour plans and maps. Areas and volume. Setting out of engineering works. Elementary topographical surveying. Global Positioning System and Geographic Information System (GPS/GIS) Photogrammetry and Hydrographic surveying. Engineering applications to surveying measurements

**COURSE REQUIREMENT:**

This course is a compulsory course for Civil Engineering students. Students are expected to participate in all the course activities and have a minimum of 75% attendance to be able to write the final examination.

**READING LIST:**

1. Surveying, Theory and Practice 7th Edition by Anderson Milkail MacGraw Hill, 1998
2. Surveying and Leveling by Basak N.N Tata McGraw Hill Publishing Company Limited New Delhi
3. Surveying 7th Edition by Bannister Arthur, Stanley Reynold and Raymond Baker, Pearson Prentice Hall London, 1998.

## 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.

$$A = d \left( \frac{o_1}{2} + o_2 + o_3 + \dots + o_{(n-1)} + \frac{o_n}{2} \right)$$

- 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.

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

#### 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
$$V = \frac{(A_1 + A_2 + A_3 + \dots + A_n)d}{n}$$
  - Trapezoidal rule
$$V = \frac{d}{2} (A_1 + A_n + 2A_2 + 2A_3 + \dots + 2A_{(n-1)})$$
  - Prismoidal Formula
$$V = \frac{d}{3} (A_1 + 4A_2 + 2A_3 + \dots + 2A_{(n-1)} + 4A_{(n-2)} + A_n)$$
  - Prismoidal Correction

$$P.C = d/6 \frac{g^2}{(g^2 - s^2)} s(h_1 - h_2)^2$$

▶ Use of Spot heights

Whenever earthwork is required for large excavations, the site is divided into triangles, squares or rectangles of equal areas of convenient sizes.

$$V = \frac{A}{3} \sum_{i=1} (h_i n_i)$$

▶ Use of Contours

The estimation of the capacity of a reservoir may be easily determined with the help of contour map. It is also applicable to volumes of materials stocked while awaiting distribution. The area enclosed by each contour line is normally measured with a planimeter. The trapezoidal or Simpson's formula is applied in getting the volume.

▶ Construction volumes

- ▶ Mass Haul Diagram: In works where large volumes of earthwork have to be handled (such as railways and arterial roads) a mass-haul diagram is of great value both in planning and construction. A mass haul diagram or curve can be drawn subsequent to the calculation of earthwork volumes, its ordinates showing cumulative volumes at specific points along the centre line.

### Exercises

- ▶ At a certain station an embankment formed on level ground has a height at its centre line of 3.10m. If the breadth of formation is 12.50m, find the side widths and the area of X-section given that the side slope is 1 vertical to 2<sup>1</sup>/<sub>2</sub> horizontal.
- ▶ An embankment is formed on ground that is level transverse to the embankment but falling at 1 in 20 longitudinally so that three sections 20m apart have a centre-line heights of 6.0, 7.6 and 9.2 respectively above original ground level. If side slopes of 1 in 1 are used, determine the volume of fill between the outer sections when the formation width is 6.0 m, using trapezoidal rule.
- ▶ Given below are data for a reservoir, the areas are the ones that will be contained by a proposed dam and the corresponding contour lines:

Calculate the volume of water impounded if the water level at peak volume is at elevation 630m.

### Hydrographic Surveying

- ▶ Introduction
- ▶ Mean Sea Level
- ▶ Shore-line surveys
- ▶ Position fixing
  - from observed bearing
  - by resection
  - on ranged lines
  - by intersections
  - cross-rope

- depression angles

## Setting Out

- ▶ Introduction
- ▶ Preliminaries
- ▶ General principles
- ▶ Plans
- ▶ Layout-working drawings
- ▶ Setting out plan
- ▶ As-built drawing
- ▶ Setting out a building
- ▶ Positioning Techniques
  - ▶ From existing details
  - ▶ From Coordinates
- ▶ Setting out by bearing and distance
- ▶ Setting out a pipeline
  - ▶ Horizontal control
  - ▶ Vertical Control

## Photogrammetry

- ▶ Introduction
- ▶ Elements of photogrammetry
- ▶ General principles
- ▶ Uses and application
- ▶ Evaluation of photographs