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

▶ 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 formular 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 $2\frac{1}{2}$ 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