Majmaah University **College of Engineering**

Civil and Environmental Engineering Department **2018/2019-1**

Sheet (6)

Contour maps

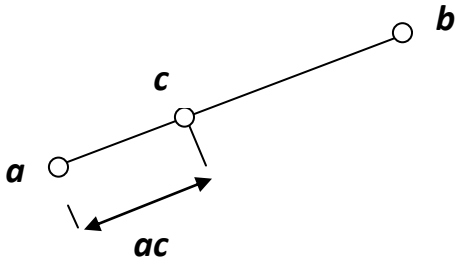
Methods of interpolating contours

Method (1): Estimation (by guessing a value between the two contour lines. This method is not accurate and depends on the experience of the surveyor).

Method (2): Measurement and calculate

Measure the distance between points, and then locate the contour by proportion.

Example:



If ab is the map distance (cm) between points a and b,
If **Elevation$_A$ < Elevation$_B$**

Then, the map distance ac from point a to the point of intersection c of the contour will be:

$$\mathbf{ac = ab\ (Elevation_C - Elevation_A) / (Elevation_B - Elevation_A)}$$

Where the Elevation$_C$ is the elevation of the required contour

Interpolating elevation of points:

In a contour map, elevation of points can be determined by estimation or by scaling between the two neighboring contours.

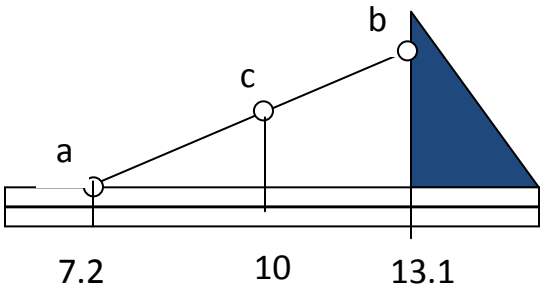
- Let $\mathbf{h_l}$ be the elevation of the lower contour
- $\mathbf{h_h}$ be the elevation of the higher contour
- **lh** is the shortest line between the two contours passing through point **p** whose elevation $\mathbf{Elev_p}$ is required, then:

$$\mathbf{Elevation_p = h_l + (lp/lh)\ (h_h - h_l)}$$

Where **lp** is the distance between point **p** and the lowest contour.

Method (3): triangle scale

We can use a triangle and a scale to mechanically determine the point of intersection of the contour with the line between two points.

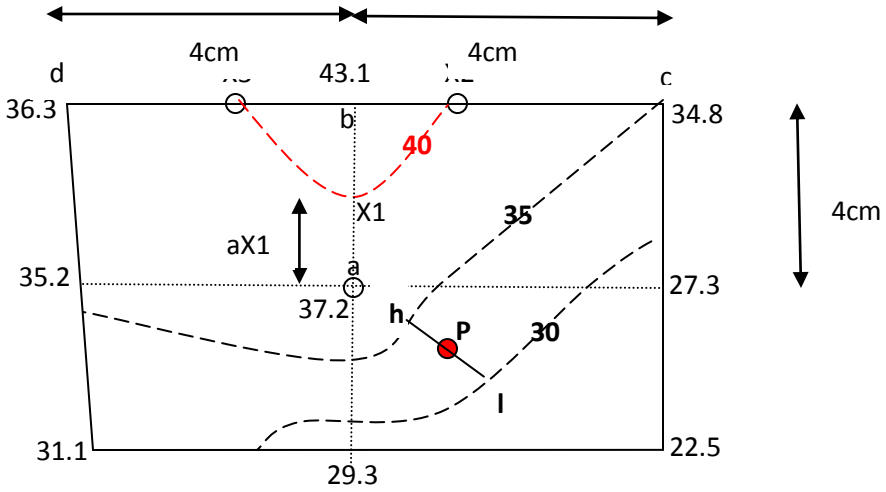


Method (4): transparent sheet

One can use transparent sheets having parallel lines at different line spacing.

Problems:

1) Elevation of points a, b, c, and d are shown in the figure. Map distance *ab* = *bc* = *bd* = *4.0m*. A contour line of elevation *h* = *40 m* is to be drawn. Use the scaling method to find its intersections with lines *ab*, *bc*, and *bd*.



Solution:

Map distance ax_1 = 4.0 (40.0 – 37.2) / (43.1 – 37.2) = …….cm

Map distance cx_2 = 4.0 (40.0 – 34.8.) / (43.1 – 34.8) = …….cm

Map distance dx3 = 4.0 (40.0 – 36.3) / (43.1 – 36.3.) = …….cm

2) Determine the elevation of point p shown in the figure above, if measured distance lh = 2.2 cm, and lp = 1.8 cm

Solution:

$Elevation_p = h_1 + (lp/lh)\ (h_h - h_1)$

$Elevation_p = 30.0 + (…./….)\ (…-…)$ = ….m

Map Scale from Coordinates

Horizontal ground coordinates can be calculated by dividing each photo-coordinate by the true photographic scale at the image point. In equation form, the horizontal ground coordinates of any point are given by:

$$X_g = \frac{x_p(H - h_p)}{f}$$

$$Y_g = \frac{y_p(H - h_p)}{f}$$

Where:

X_g, Y_g= ground coordinates of point p
x_p, y_p = photo-coordinates of point p
h_p = ground elevation of point p

1) The equations for horizontal ground coordinates are exact for truly vertical photographs and typically used for near vertical photographs.

   The same relation can be used for any other point such as B.

   The horizontal distance H_{AB} and the inclined distance (Slop distance) S_{AB} from A to B are:

$$H_{AB} = \sqrt{(X_B - X_A)^2 + (Y_B - Y_B)^2}$$

$$S_{AB} = \sqrt{(X_B - X_A)^2 + (Y_B - Y_B)^2 + (h_B - h_A)^2}$$

Problem (3)

Three points (a,b,c) appear on a vertical photograph. Focal length is 6 in, flaying height is 5000 ft above MSL. If the photo coordinates are: (x_a = 2.5 in, y_a = 3.7 in), (x_b = 1.8 in, y_b = -2.5 in), and (x_c = 1.5 in, y_c = -2.1 in). Elevations of points are: h_A = 250 ft, h_B = 380 ft, and h_C = 320 ft.

(1) Calculate the ground slope distance of line AB
(2) Compute the area of the triangle ABC

Solution: