Photographic surveying

Photogrammetry is defined as the science of obtaining reliable measurements by the use of photographs in order to determine characteristics such as size, shape and position of photographed objects.

Techniques used in photogrammetric surveying

(a) Aerial: Photographs used are taken from the air or from space with the camera usually pointing vertical downwards.

(b) Terrestrial: Photographs used are taken on the ground with the camera usually pointing in a horizontal direction.

(c) In industrial and scientific purpose, terrestrial technique can be adapted to small distances, by setting camera at any suitable angle.

Aerial photogrammetry is that branch of photogrammetry wherein the photographs are taken by a camera mounted in an aircraft flying over the area.

Air survey is used to describe survey techniques using photographs taken from the air or from the space.

Types of photogrammetric surveying

Photogrammetry can be divided into classes

(i) Terrestrial or ground photogrammetry

(ii) Aerial photogrammetry.

17 **Terrestrial or Ground photogrammetry:**

In terrestrial photogrammetry maps are prepared from terrestrial (or ground) photographs which are taken from points on earth surface.

The terrestrial photographic surveying is considered as the further development of plane table surveying.

Aerial photogrammetry

In aerial photogrammetry maps are produced from air photograph's which are taken from the air.

Photogrammetry can be compared two major areas of specialization.

(i) Metrical
(ii) Interpretive

The first area is of principal interest to surveyor's since it is applied to determined distances, elevations, areas, volumes, cross-sections and to compile topographic maps from measurements made on photographs.

Interpretive photogrammetry involves objects from their photographic images and judging their significances. Critical factors considered in identifying objects of shape, sizes, patterns, shadow.

Uses of photogrammetry:

(I) Photogrammetry is wed in preparing topographic maps

(II) It is used to make shore line in hydrographic surveying.

(III) It is used to preside ground co-ordinates of pts in control surveying.

(IV) It is wed to develop maps and cross-section route (road or railways) and survey.

(V) Photogrammetry is also used successfully in many non-engineering fields eg. geology, archeology, forestry, agriculture, conservation, military intelligence, traffic management accident investigation.

(VI) It is particularly suitable for inaccessible regions, forbidden properties (restricted areas) etc.

Advantages of using photogrammetry in preparing topographic maps.

(I) Speed of coverage of an area

(II) Relatively low cost

(III) Ease of obtaining topographic details.

(IV) It is used in land surveying to compute co-ordinates of section corner, body corner or pts.

1. **Vertical photograph:** A vertical photograph is an aerial photograph made with the camera axis coinciding with the direction of gravity.

2. **Tilted photograph:** A tilted photograph is an aerial photograph made with the camera axis unintentionally tilted from the vertical by a small amount, usually less than 3°.

3. **Oblique photograph:** An oblique photograph is an aerial photograph taken with the camera axis directed intentionally between the horizontal and vertical. If the apparent horizon is shown in the photograph, it is said to be high oblique. If the apparent horizon is not shown, it is said to be low oblique.

4. **Perspective projection:** A perspective projection is the one produced by straight lines radiating from a common point and passing through points on the sphere to the plane of projection. A photograph is a perspective projection.

5. **Flying height:** Flying height is the elevation of the exposure station above sea level or any other selected datum.

6. **Flight line:** It is a line drawn on a map to represent the track of the aircraft.

① when the scale of a

Scale of a vertical photograph

① When the ground is horizontal or ground points have the same elevation.

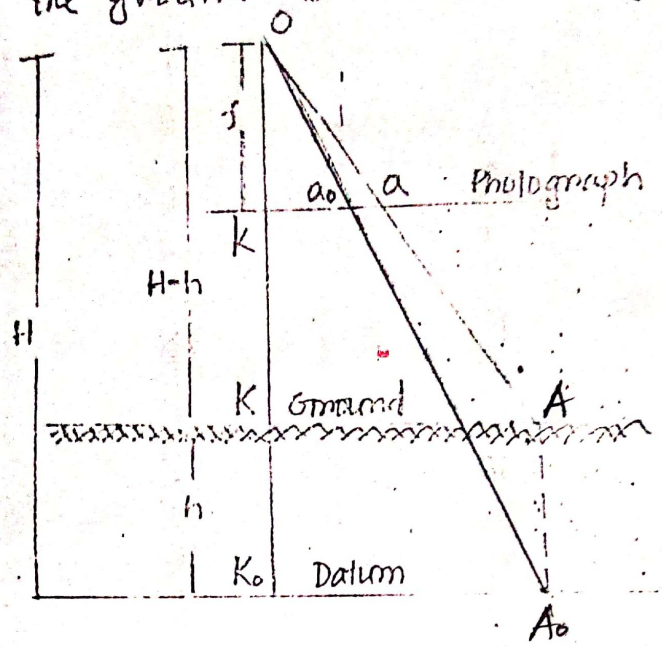

Fig: Scale of a vertical photograph

In above figure, the image of two points A and A_o, vertically above each other, are displaced on a vertical photograph and are represented by a and a_o respectively.

When the ground is horizontal i.e all the points are having the same elevation,

Let, S = scale = $\frac{\text{map distance}}{\text{ground distance}}$

$$S = \frac{ka}{KA} = \frac{OK}{OK} = \frac{f}{H-h}$$

When $h = 0$

$$S = \frac{f}{H}$$

where, H = height of the exposure station above the mean sea level.

f = focal length of the camera

h = height of the ground above mean sea level.

(ii) when the ground is not horizontal.

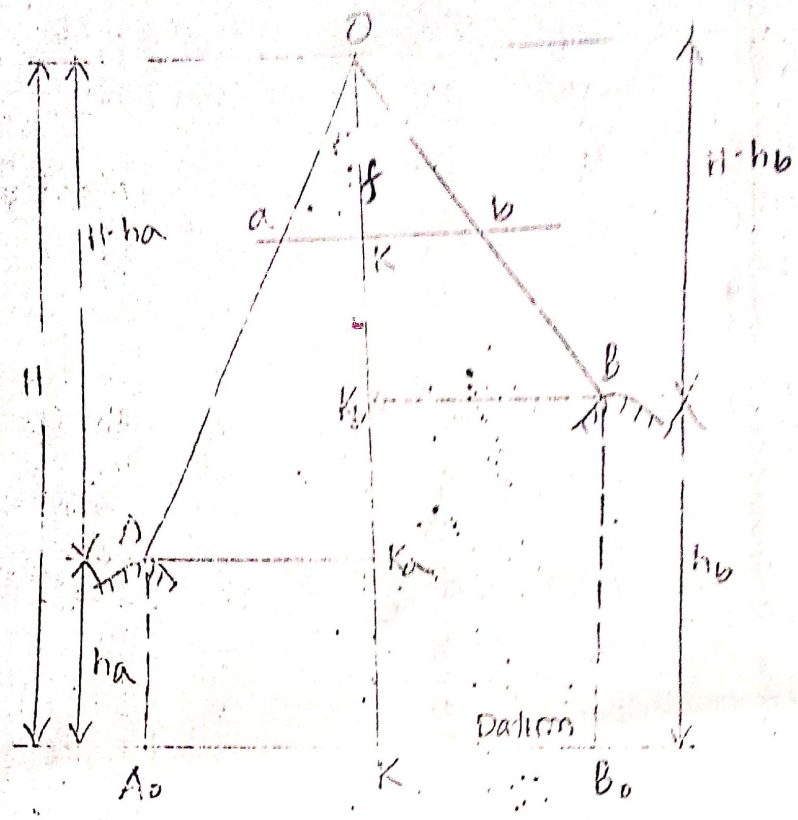

Fig: scale of a vertical photograph

Let A and B be two points having elevations h_a and h_b respectively above mean sea level. They are represented by a and b respectively on the map. K is the principal point of the vertical photograph taken at height H above mean sea level.

The scale of the photograph at the elevation h_a is equal to

$$\text{scale, } S = \frac{ak}{AKa} = \frac{OK}{OKa} = \frac{f}{H-h_a}$$

The scale of the photograph at the elevation h_b is equal to

$$\text{i.e. } \frac{bk}{BKb} = \frac{OK}{OKb} = \frac{f}{H-h_b}$$

In general, the scale of the photograph is given by,

$$S_h = \frac{f}{H-h}$$

S_h = scale at the elevation h

Representative fraction,

$$R_h = \frac{1}{\left(\frac{H-h}{f}\right)}$$

where, (H-h) and f in metres

Datum scale: (S_d)

The datum scale of a photograph is that scale which would be effective over the entire photograph if all the ground points were projected vertically downward on the mean sea level before being photographed. From fig ①

Datum scale, $S_d = \frac{Ka}{KA_0} = \frac{OK}{OK} = \frac{f}{H}$

where, K and A_0 are the projections of K and A on the datum line.

Average scale (S_{av})

The average scale of a vertical photograph is that which would be effective over the entire photograph if all the ground points were projected vertically downward or upward on a plane representing the average elevation of the

terrain before being photographed.

Thus, $S_{av} = \frac{f}{H - h_{av}}$

h_{av} = average elevation of the terrain.

II. Computation of length of line between points of different elevations from measurements on a vertical photograph

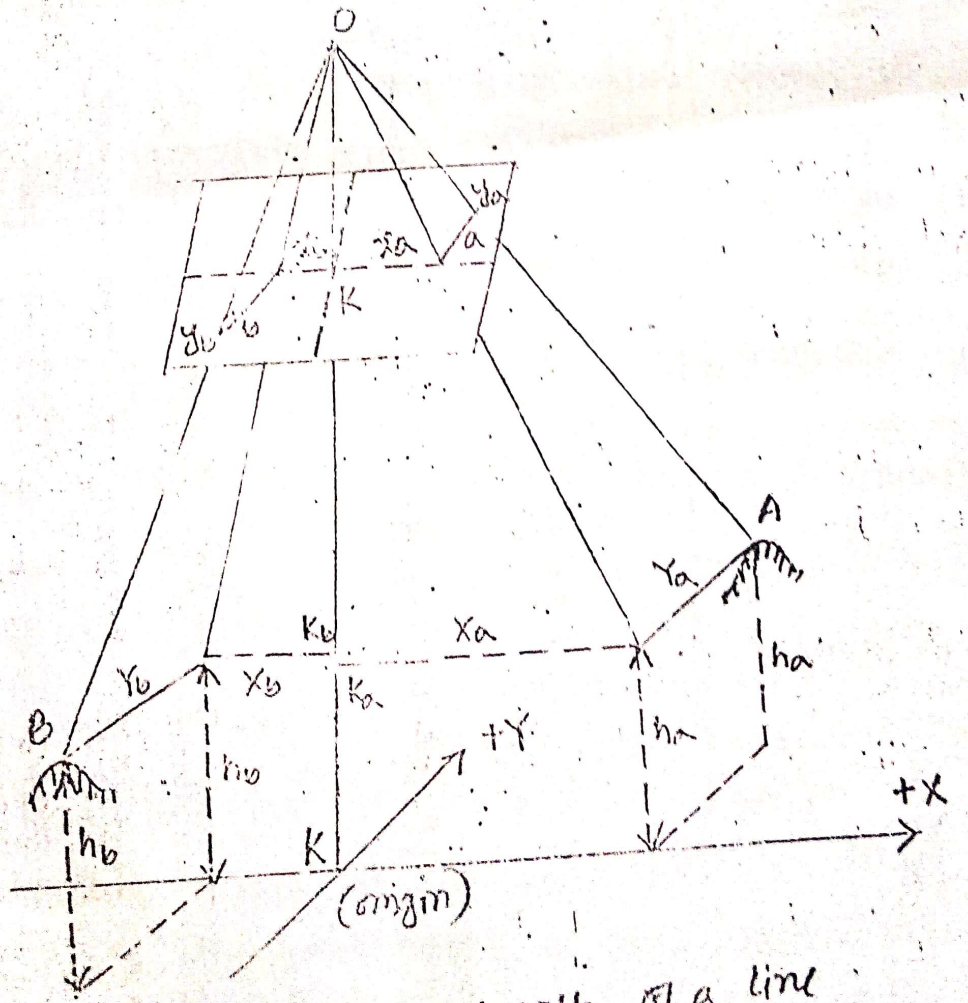

Fig: Computation of length of a line

Let A and B be two ground points having elevations h_a and h_b above datum and the co-ordinates (X_a, Y_a) and (X_b, Y_b) respectively. Let a and b be the corresponding points of the photograph, and (x_a, y_a), (x_b, y_b) be the corresponding co-ordinates. From similar triangles

$$\frac{Ok}{OKa} = \frac{x_a}{X_a} = \frac{y_a}{Y_a} = \boxed{\frac{f}{H-h_a}} \quad \text{--- (1)}$$

Also, $$\frac{Ok}{OK_b} = \frac{x_b}{X_b} = \frac{y_b}{Y_b} = \boxed{\frac{f}{H-h_b}} \quad \text{--- (2)}$$

Hence, we have,

$$X_a = \frac{H-h_a}{f} \cdot x_a$$

$$Y_a = \frac{H-h_a}{f} \cdot y_a$$

$$X_b = \frac{H-h_b}{f} \cdot x_b$$

$$Y_b = \frac{H-h_b}{f} \cdot y_b$$

And in general, the co-ordinates X and Y of any point at an elevation are,

$$X = \frac{H-h}{f} x \; ; \quad Y = \frac{H-h}{f} y$$

The length L between the two points A and B is then given by,

$$\boxed{L = \sqrt{(X_a - X_b)^2 + (Y_a - Y_b)^2}}$$

The value of X_a, X_b, Y_a, Y_b must be substituted with their proper signs.