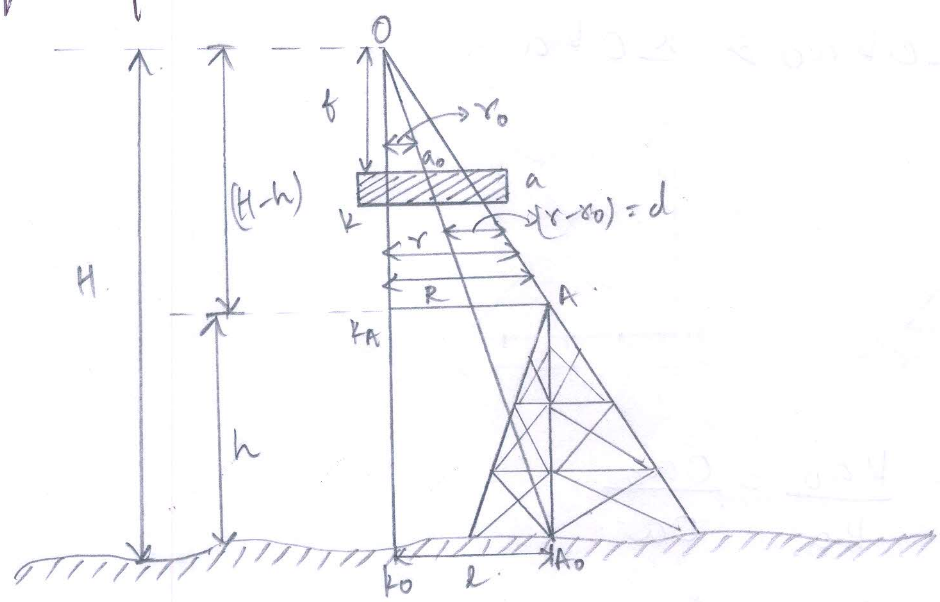
Solution to 2nd IAT. Advanced Survey (17CV46)

1A) Relief displacement on a vertical photograph:-



Relief displacement: It is defined as the small radial displacement 'r' of the object in the photo-image due to ~~or~~ curvature of the Earth. This radial displacement is termed as relief displacement.

As shown in the figure let,

O = exposure station of camera axis.

H = height of exposure station above the given datum.

$AA_0 = h$ = a signal tower standing vertically above the datum.

a = projected of image of object A in the photograph.

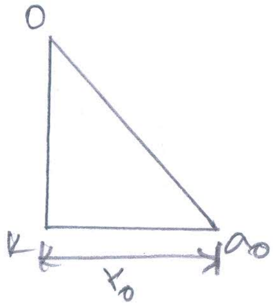
a_0 = projected image of A_0 in the photograph.

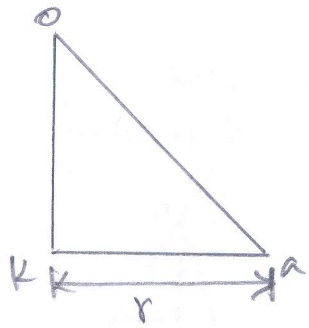
$r = aa_0$ = radial relief displacement of image ~~A_0~~ from the focal point k.

$r_0 = a_0k$ = radial relief displacement of A_0 from the principal point k.

proof:

1. compare $\triangle OKa_0$ & $\triangle OKa$.



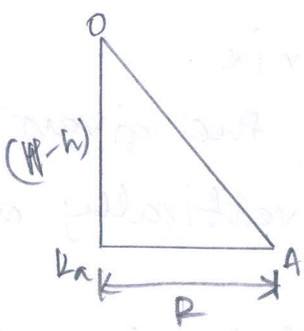


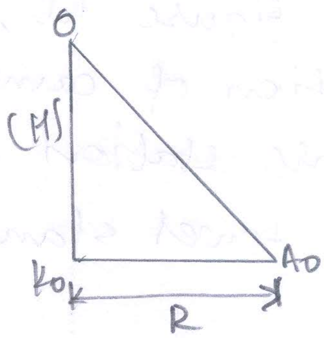
$$\frac{OK}{OK} = \frac{Ka_0}{Ka} = \frac{Oa_0}{Oa}.$$

$$\frac{f}{f} = \frac{r_0}{r} = \frac{Oa_0}{Oa}.$$

$$\frac{f}{r_0} = \frac{f}{r} \quad — \text{(1)}$$

2. compare $\triangle OK_A A$ & $\triangle OK_0 A_0$





$$\frac{OK_A}{OK_0} = \frac{K_A \cdot A}{K_0 A_0} = \frac{OA}{OA_0}$$

$$\frac{(H-h)}{h} = \frac{R}{P} = \frac{OA}{OA_0}.$$

$$\frac{(H-h)}{P} = \frac{H}{P} \quad — \text{(2)}$$

By using relation for equal proportions, comparing eqn (1) & (2) & equating them

$$\frac{f}{r_0} = \frac{f}{r} \;(=)\; \frac{(H-h)}{R} = \frac{H}{R}.$$

$$\frac{f}{r_0} = \frac{H}{R} \Rightarrow r_0 = \frac{fR}{H} \quad -(3)$$

$$\frac{f}{r} = \frac{H-h}{R} \Rightarrow r = \frac{fR}{(H-h)} \quad -(4)$$

3.) equation (4) - (3)

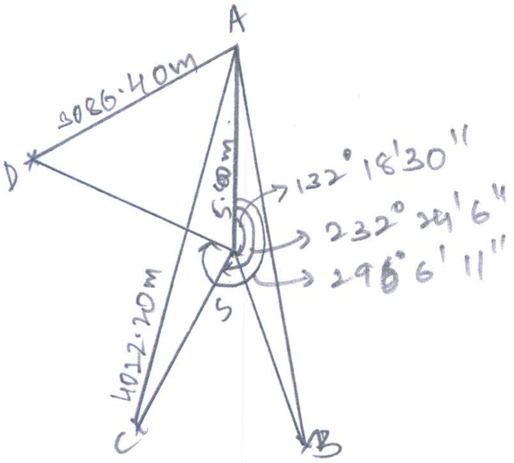
$$d = r - r_0 = \frac{fR}{(H-h)} - \frac{fR}{H}$$

$$= fR\left[\frac{1}{(H-h)} - \frac{1}{H}\right]$$

$$= fR\left[\frac{H-H+h}{H(H-h)}\right] = \frac{fRh}{H(H-h)}$$

$\therefore$ d = relief displacement (or) radial relief displacement $= \dfrac{fRh}{H(H-h)}$.

2A)



Given:

AS = 5·60 m

A(0° 0' 0'')

B(132° 18'30'')

C(232° 24' 6'')

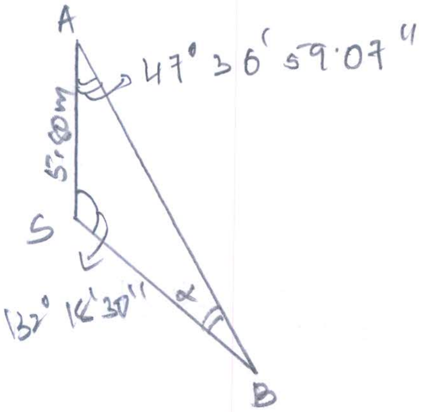
D(296° 6' 11'')

AB = 3265·50 m

AC = 4022·20 m

AD = 3086·40 m.

① To find direction of AB:



$$\frac{5.60}{\sin\alpha} = \frac{3265.50}{\sin(132°\,18'\,30'')}$$

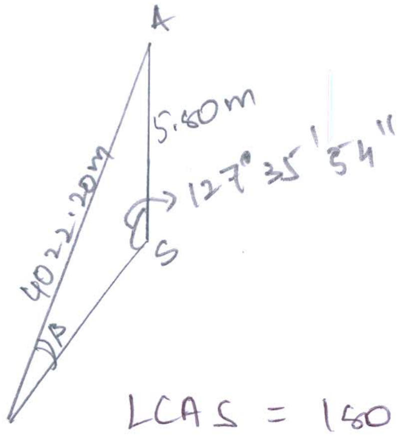
$$\sin\alpha = \frac{5.60 \times \sin(132°\,18'\,30'')}{3265.50}$$

$$\Rightarrow \alpha = 0°\,4'\,30.93''$$

$$\angle SAB = 180 - (132°\,18'\,30'' - 0°\,4'\,30.93'')$$

$$= 47°\,36'\,59.07''$$

② To find direction cosine of line AC:



$$\frac{5.60}{\sin\beta} = \frac{4022.20}{\sin(127°\,35'\,54'')}$$

$$\sin\beta = \frac{5.60 \times \sin(127°\,35'\,54'')}{4022.20}$$

$$\Rightarrow \beta = 0°\,3'\,55.66''$$

$$\angle CAS = 180 - (127°\,35'\,54'' + 0°\,3'\,55.66'')$$

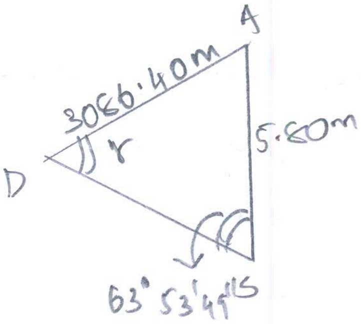
$$= 52°\,20'\,10.34''$$

∴ direction of line AC (direction cosine) =

$$180 + \angle CAS = 180 + 52^\circ 20' 10.34''$$

$$= 232^\circ 20' 10.34''.$$

3.) To find direction cosine of line AD :



$$\frac{5.80}{\sin(r)} = \frac{3080.40}{\sin(63^\circ 53' 44'')}$$

$$\sin(r) = \frac{5.80 \times \sin(63^\circ 53' 49'')}{3080.40}$$

$$\Rightarrow r = 0^\circ 5' 48.08''.$$

$$\angle DAS = 180 - (63^\circ 53' 49'' + 0^\circ 5' 48.08'')$$

$$= 116^\circ 0' 22.92''$$

∴ direction cosine of AD = 180 + ∠DAS

$$= 180 + 116^\circ 0' 22.92''$$

$$= 296^\circ 0' 22.92''.$$

3A) (c) Factors affecting selection of base line :

1) The selected site should be fairly levelled & inter-visible.
2.) The ground should be firm & smooth.
3) The ends of triangulation station nodes must be intervisible.
4) Triangulation stations containing the base line must form well-conditioned triangle, such that minimum length of base line required is available.

(d) Horizantal & vertical control points are developed to create a frame-work around which other surveys can be adjusted for the sake of establishing ground controls for photogrammetry. These control surveys are used for accurate mapping of the ground features.

ground control: It consists of locating the ground position of various stations which should be identified on a aerial photograph. Therefore, the ground control involves two important objectives namely

(i) Basic control

(ii) photo control.

(i) Basic control: It consists of conducting reconaissance survey, helping to establish triangulation stations, traverse stations, calculation of Azimuth & benchmarks of prominent ground control points.

(ii) photo control: It consists of taking out photographic images of ground control points, correlating it to basic control.

Mapping the photograph & collaging them to scale, so as to form a logical translation of ground features is called photo control.

4A) (i) Azimuth: It is the angle formed between a reference direction & a line from the observer to a point of interest projected on the same plane as the reference direction orthogonal to the zenith.

(ii) Laplace station: It is one of the several stations selected at intervals in a large system of geodetic triangulation or traverse, where both astronomic azimuth & longitude observations are made for the purpose of determining the laplace correction.

(iii) Well conditioned triangle: There are various triangulation figures & the accuracy attained in each figure depends upon various factors, but a triangle such that its shape & any error in measurement of angle shall have a minimum effect upon the lengths of the calculated sides, such triangle is called well conditioned triangle.

(iv) Base line: It is the most important part of a triangulation system. It is aligned & measured with greatest accuracy. It forms the basis of interconnecting triangles. The length of base line ~~measurement~~, must ensure the formation of well conditioned triangles.

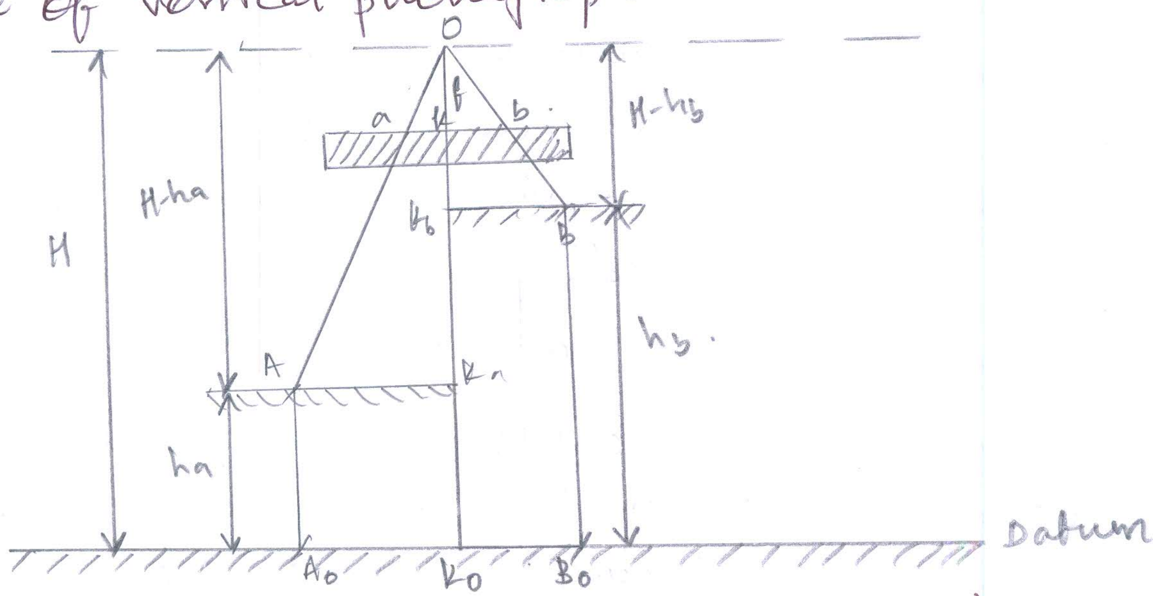
(v) Focal plane: The plane perpendicular to the optical axis of the lens in which images of points in the object field ~~are~~ are focused.

5A) Aerial photogrammetry :- It is the branch of photogrammetry, where in the photographs are taken from a camera, which is placed in a drone or air-craft which flies over the area.

⇒ Uses of photogrammetry:

1) Construction of topographic map of the area.
2) Geological interpretation of ground data.
3) Military intelligence
4) Preparation of composite pictures of the ground.

6A) Scale of vertical photograph:



let O = exposure station of camera axis above ground

H = height of exposure station O above datum.

Ok = f = focal length of camera axis.

ha = height of object A above datum.

hb = height of object B above datum

S = Scale of vertical photograph $= \frac{\text{photo distance}}{\text{Map distance}} = ?$

Ao, ko, Bo are vertically below the points A, k, B

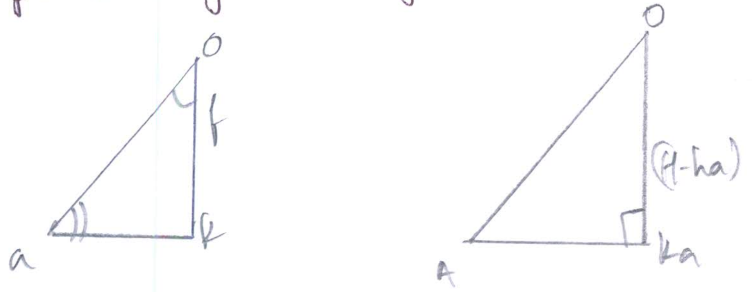
∴ Ao, ko, Bo are in same principal plane.

a; k, b = image of the object AB which is captured from the exposure station O.

Ak_a, Bk_b are orthographic projections of the ground image points A & B respectively.

proof:

1.) compare right angled Δles Oak & ΔOAk_a.

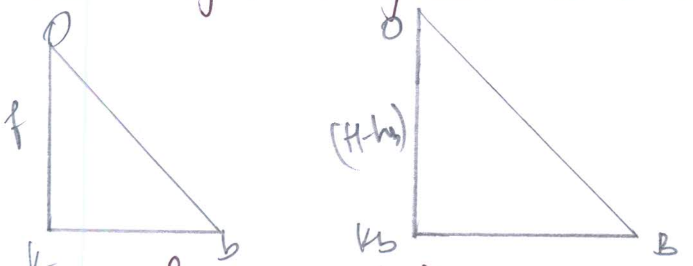


$$\frac{f}{(H-h_a)} = \frac{ak}{Ak_a} = S \quad \text{—} \ (1)$$

ak = photo distance
Ak_a = ground distance.

$$\therefore S = \frac{f}{(H-h_a)} = \frac{\text{photo distance}}{\text{ground distance}}.$$

2.) compare right angled Δles ΔOkb & ΔOBk_b.



$$\frac{f}{(H-h_b)} = \frac{bk}{Bk_b} = S \quad \text{—} \ (2)$$

bk = photo distance
Bk_b = ground distance

$$\therefore \frac{f}{(H-h_b)} = \frac{\text{photo distance}}{\text{ground distance}} = S.$$

$\because$ from eqn (1) & (2)

$$S = \frac{f}{H-h_a} = \frac{f}{H-h_b} = \frac{\text{photo distance}}{\text{Map distance on ground}} = \text{scale of vertical photograph.}$$

7A) Given:

ground distance = 2000m.

photo distance of AB = 5.65cm = 5.65×10^{-2} m.

$f = 20 \text{ cm} = 20 \times 10^{-2}$ m

$h = 400$ m.

(i). $H = ?$

(ii) at $h = 600$ m, $S = ?$

① To find scale (S) & height of exposure station (H) :-

$$S = \frac{\text{photo distance}}{\text{Map/ground distance}} = \frac{5.65 \times 10^{-2}}{2000} = \frac{1}{\cancel{2.825 \times 10^{-5}}\ 35398.23}$$

∴ scale of photograph = 1 in ~~2.825 × 10^-5~~ 35398.23

By formula,

$$S = \frac{f}{H-h}.$$

$$= \frac{1}{35398.23} = \frac{20 \times 10^{-2}}{(H-400)}$$

$$H - 400 = 20 \times 10^{-2} \times 35398.23$$

$$H = 7479.646 \text{ m}.$$

∴ height of exposure station $H = 7479.646$ m.

2) To find scale when $H = 7479.646$ & $h = 600$m

$$S = \frac{f}{(H-h)} = \frac{20 \times 10^{-2}}{7479.64 - 600}$$

$$= 2.907 \times 10^{-5} = 1/34398.2$$

∴ S = 1 in 34398.2 = Scale of photograph.