

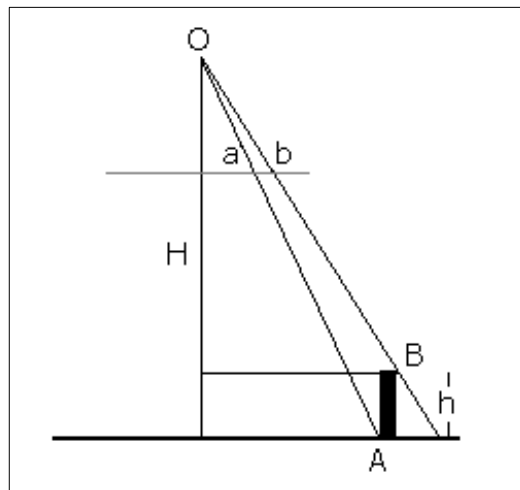
IMAGE DISPLACEMENT

In aerial photographs the relief variations of the terrain cause shifting of image from their correct planimetric position. In map all the planimetric features are shown in their correct horizontal position, because the map is the orthogonal projection of the terrain. But an aerial photograph is a central projection. The images are displaced from their orthogonal position due to the various factors, the important ones are:

- 1) Lens aberration
- 2) Relief of the terrain
- 3) Tilt of the camera axis.

Relief displacement: -

On aerial photographs the displacement of image due to variation in relief of the terrain is known as relief displacement or height distortion.



In the above diagram the relief displacement due to height of the object **AB** is shown. The bottom (**A**) of the object has no elevation and appears at '**a**' on the photo but the top (**B**) of the object having elevation '**h**' above the ground is imaged at '**b**'. The image of **B** is thus displaced by distance **ab**. This is called relief displacement. It can be proved geometrically that the magnitude of this displacement is given by:

$$d = rh / H$$

If relief displacement of an object is measured from the photograph, the height of the object can be calculated using the following formula:

$$h = dH / r$$

Where **d** is relief displacement, **H** is the flying height, **h** is height of the object and **r** is the radial distance on the photo from the principal point to the displaced image point.

The relief displacement depends on following factors:

- i) **Distance from the principal point** – It increases as the distance of the object increases from the principal point.
- ii) **Height of the object** – It increases as the elevation of the points increases.

iii) **Flying height** – It decreases with the increase in flying height.
Tilt displacement: -

The tilt of the camera axis at the instant of photography causes displacement of images on the photograph. A square ground on the terrain is deformed to a trapezium. The displacements are smaller in magnitude than the relief displacement but are far more difficult to detect, to calculate and correct.

Mathematically, the amount of tilt varies approximately as the square of the distance of the image from the isocentre of the photograph and is radial from it.

If the terrain is flat, the effect of tilt on photo scale is very regular. It increases regularly towards the nadir point side of the isocentre and decreases regularly towards the principal point side.

The tilt distortions can, however be corrected by a process known as rectification. The negative is projected in such a way that some of the selected image points fall at their correct planimetric positions on projection table and recorded on a sensitive film/plate, which after development gives rectified photo.

Since relief and tilt displacement are radial from different points, the combination of the two displacement in a single photograph will result in a lateral displacement of images. In vertical photographs the three points, plumb point (Nadir), principal point and isocentre coincide. However if the tilt is less than 3° the 3 points are quite close to each other.