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1. Introduction

Aerial Photography is defined as art, science and technology of taking aerial photographs from an air-borne platform. Probably Gasper Felix Tournachon "Nadar" took very first aerial photograph in 1858 of a village of Petit Bicetre (France) from a balloon.

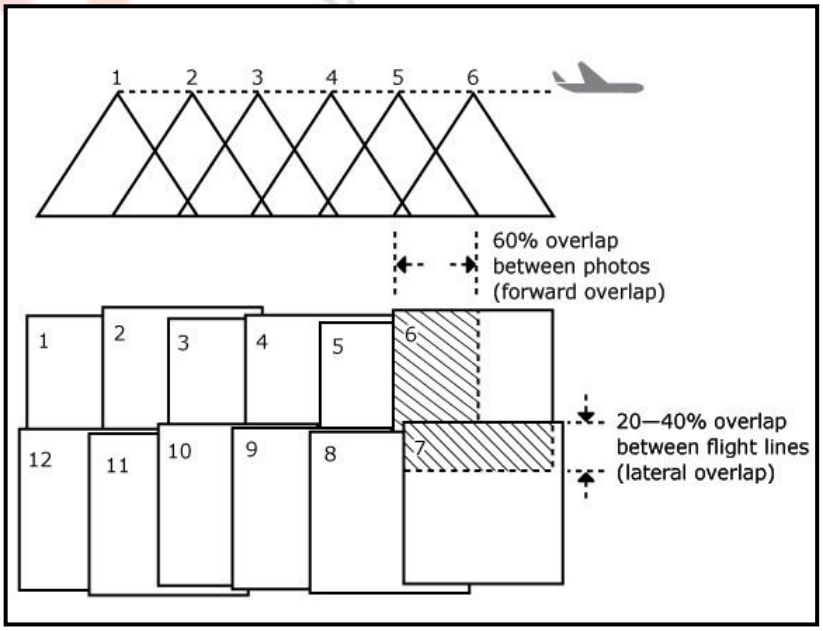
During World War-I aerial photography got major momentum of development. Air photos were taken for reconnaissance from fighter planes and pigeons. Small lightweight cameras were attached to the birds and a timer was set to take pictures every 30 seconds as it flew.

Now, aerial photographs are taken from aircraft to capture series of images using a large roll of special photographic film. The film is processed and cut into negatives. The common sizes of negatives are 23 x 23 cm. The basis of aerial photography is light sensitive chemicals in the film emulsion. These chemicals may react to ultraviolet, visible and near infra-red portions of the spectrum from 0.3 µm to 0.9 µm wavelength.

To plan an aerial photographic mission we must define final product then determine camera system, other material required, determine flight pattern and setting shutter timing for endlap and overlap.

2. Aerial photography in India

Aerial photography in India goes back to 1920 when large-scale aerial photographs of Agra city were obtained. Subsequently, Air Survey Party of the Survey of India took up aerial survey of Irrawaddy Delta forests, which was completed during 1923–24. Subsequently, several similar surveys were carried out and advanced methods of mapping from aerial photographs were used. Today, aerial photography in India is carried out for the entire country under the overall supervision of the Directorate of Air Survey (Survey of India) New Delhi. Three flying agencies, i.e. Indian Air Force, Air Survey Company, Kolkata and National Remote Sensing Centre, Hyderabad have been officially authorised to take aerial photographs in India. The procedure for indenting aerial photographs for educational purposes could be made with APFPS Party No. 73, Directorate of Air Survey, Survey of India, West Block IV, R. K. Puram, New Delhi.



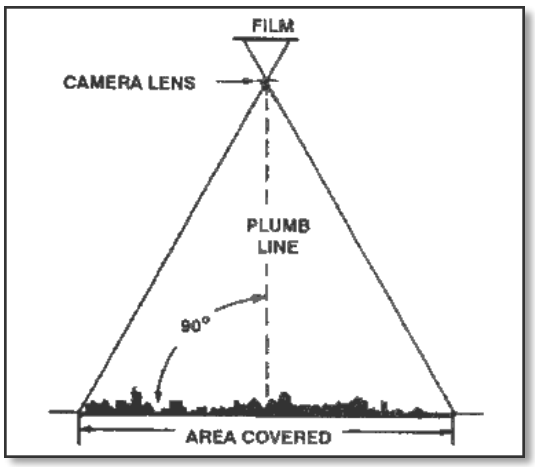
3. Photogrammetry

The term “photogrammetry" is derived from the three Greek words *phot* which means light, *gramma* which means something drawn, and *metrein*, the noun of measurement. Photogrammetry can be defined as the science and art of determining qualitative and quantitative characteristics of objects from the images recorded on photographic emulsions without coming in physical contact with the objects. Here information is obtained through processes of recording patterns of electromagnetic radiant energy, predominantly in the form of photographic images. Objects are identified and qualitatively described by observing photographic image characteristics such as shape, pattern, tone, and texture. Photogrammetry also allows for the extraction of three-dimensional features from remotely sensed data.

4. Types of Aerial Photograph

4.1 Vertical Aerial Photograph

Vertical aerial photography is an aerial photography technique where the shots are taken from directly above the subject of the image. Allowable tolerance is usually + 3° from the perpendicular (plumb) line to the camera axis. This method of aerial photography is also referred as “overhead aerial photography.” In vertical aerial photograph, the lens axis is perpendicular to the surface of the earth. In vertical photograph, we may see flat and map-like image of the rooftops and canopies of the building and structure being photographed. There are three common ways that vertical aerial photography can be conducted: (i) Low Altitude – For this particular shot, the resulting images will show bigger and closer shots of the subject and its surroundings, (ii) Medium Altitude – Here, the resulting images of the subject and the surroundings are smaller than those produced in low

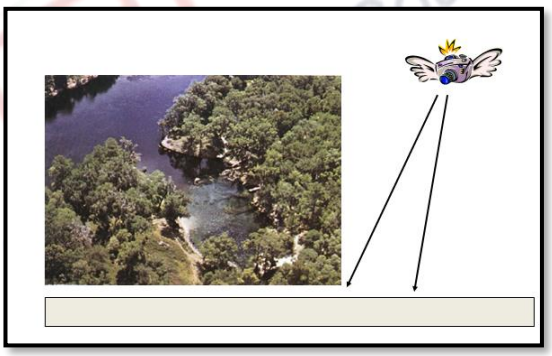


altitude vertical aerial photography, (iii) High Altitude – The images of the subject and its surroundings produced from high altitude vertical aerial photography are way smaller than those produced from low altitude and medium altitude vertical aerial photography. Nonetheless, they are able to cover a wider section of the land.

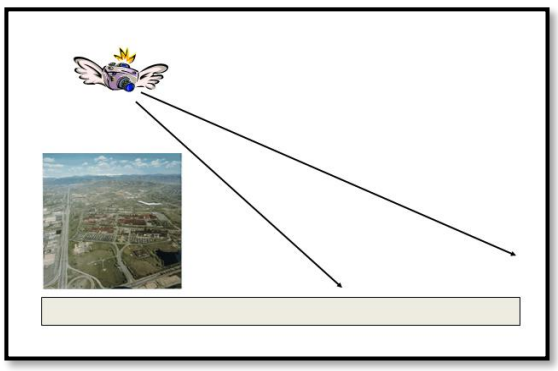
4.2 Oblique Photography

The word oblique means having a sloping direction or angular position. Therefore, Photographs taken at an angle are called *oblique photographs*. Oblique Photography is of two types.

4.2.1 Low Oblique Aerial Photography: Low oblique aerial photograph is a photograph taken with the camera inclined about 30° from the vertical. In this type of photograph horizon is not visible. The ground area covered is a trapezoid, although the photo is square or rectangular. No scale is applicable to the entire photograph, and distance cannot be measured. Parallel lines on the ground are not parallel on this photograph; therefore, direction (azimuth) cannot be measured. Relief is detectable but distorted.



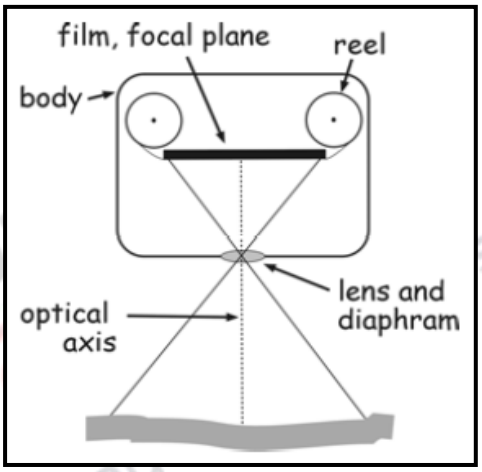
4.2.2 High Oblique Aerial Photography: The high oblique is a photograph taken with the camera inclined about 60° from the vertical. In this type of aerial photograph horizon is visible. It covers a very large area. The ground area covered is a trapezoid, but the photograph



is square or rectangular. Distances and directions are not measured on this photograph for the same reasons that they are not measured on the low oblique. Relief may be quite detectable but distorted as in any oblique view.

5. Basics of Aerial Camera

According to McGraw-Hill Dictionary, an aerial camera is a highly specialized camera, designed for use in aircraft and containing a mechanism to expose the film in continuous sequence at a steady rate. They are referred to as "passive sensors" because they detect and capture the natural light reflected from objects.



An aerial camera is a mechanical optical instrument with automatic and electronic elements. It is designed for obtaining aerial photographs of the earth's surface from an airplane or other type of aircraft. Aero-camera differs from ordinary camera and has specific features like fully automatic operation, shock absorbing support frame, large picture format, and rapid frame advance. Apart from these, aero-camera is accomplished with photographing from great distance, rapid movement and vibration during exposure. The world's first aerial camera for an area photography from an areophane was invented by the Russian army engineer V. F. Potte during World War I.

Aerial cameras may have one or more lenses for plan views, perspectives and panoramic survey. Basic features of aerial cameras are their focal length, negative size, and minimum exposure time, which is as short as 1/1000 sec in Soviet aerial cameras.

Standard Soviet aerial cameras designed for topographical surveys, are having 18 x 18 cm negative size, have focal lengths from 50 to 500 mm and corresponding field-

of-view angles from 150° to 30°. Aerial cameras of either type are used for black and white or color aerial photographic surveying.

Aerial cameras with varying focal lengths, beginning with 88 mm, are also used aboard. With the most popular 23 x 23 cm negative size, this corresponds to field-of-view angles up to 125°. Like other cameras, aerial camera also has basic features of Lens, Shutter and Diaphragm, working as focal plane/focal length, controlling exposure speed and aperture respectively.

5.1 Focal Plane and Focal Length

Focal plane is the flat surface where film is held. Focal length is the distance from the focal plane to approximately the center of the camera lens. Thin lens equation is:

$$\frac{1}{f} = \frac{1}{o} + \frac{1}{i}$$

f = focal length of the camera, o = distance between object and camera and i = distance between lens and image plane.

Most metric aerial cameras have a fixed focal length such as 152 mm and 305mm. Military photoreconnaissance operations commonly employ lenses 3 to 6 feet to obtain detailed photographs from extremely high altitudes.

5.2 Types of Aerial Cameras

5.2.1 Single-lens mapping (metric) cameras: It provides highest geometric and radiometric quality of aerial photography to map the planimetric (x, y) location of features and to derive topographic contour map. Individual exposures are typically 23 x 23 cm.

5.2.2 Multiple-lens cameras: Each of the lenses (camera) simultaneously records photographs of the same area, but using different film and filter combination. This creates multiple band photographs.

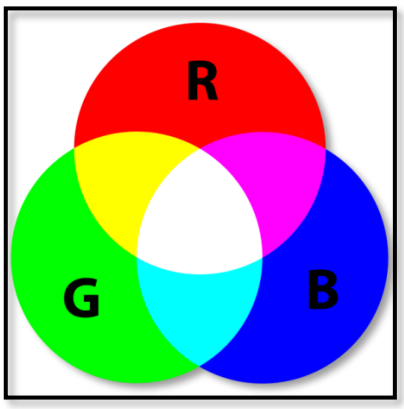
5.2.3 Panoramic camera: This type of camera uses a rotating lens (or prism) to produce a narrow strip of imagery perpendicular to the flight line. It is commonly used by military but much less in civilian applications due to poor geometric integrity.

5.2.4 Digital camera: Digital camera uses "charge-coupled-device (CCD) detectors. These detectors are arranged in a matrix and located at the film plane.

A digital camera takes light and focuses it via the lens onto a sensor made out of silicon. It is made up of a grid of tiny photosites that are sensitive to light. Each photosite is usually called a pixel ("picture element"). There are millions of individual pixels in the sensor of a digital camera. Advantage with digital camera is that it records and store photographic images in digital form. These images can be stored directly in the camera or can be uploaded onto a computer or printer later on. To replicate the spatial resolution of standard 9x9 inches metric aerial photograph, a digital camera would require approximately 20000 x 20000 detectors.

5.3 Aerial Photograph Filtration

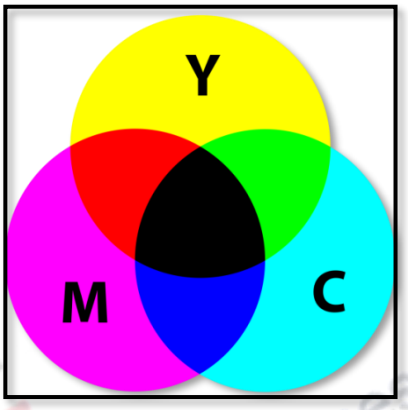
Lens filters are transparent or translucent glass or gelatin elements that attach to the front of a camera lens. They protect the camera lens, alter the characteristics of light passing through the lens or add special effects and colour to an image. Photographic filters are used to achieve image enhancement effects that can change the tone and mood of the photographs. Filters work on the theories of additive colour and subtractive colour.



5.3.1 Additive colour: Blue, green and red are considered to be additive colour

and also known as primary colour. These primary colours can be mixed to create all colour shades.

5.3.2 Subtractive colour: Yellow, cyan and magenta are the subtractive colour. These colour are also known as secondary colour. A *subtractive colour* model explains the mixing of a limited set of dyes, inks, paint pigments or natural colourants to create a wider range of colours, each the result of partially or completely subtracting some wavelengths of light.



Filters filter out certain types of unwanted wavelengths of light before they can reach the film plane and expose the film. A filter will appear the colour of light that is allowed to pass through.

5.3.3 Haze filter: When collecting natural colour aerial photograph, it is desired to eliminate much of the scattering of ultraviolet radiation caused by atmosphere haze. Haze filters were developed to absorb light shorter than 400nm.

5.3.4 Yellow filter (minus blue filter): When collecting colour infrared aerial photography, yellow filter is used, which subtract almost all of the blue light (wavelength < 500nm). This reduces the effect of

atmospheric Rayleigh scattering. It absorbs blue and allows green and red light to be transmitted. A mixture of red and green is yellow.

Yellow Filter

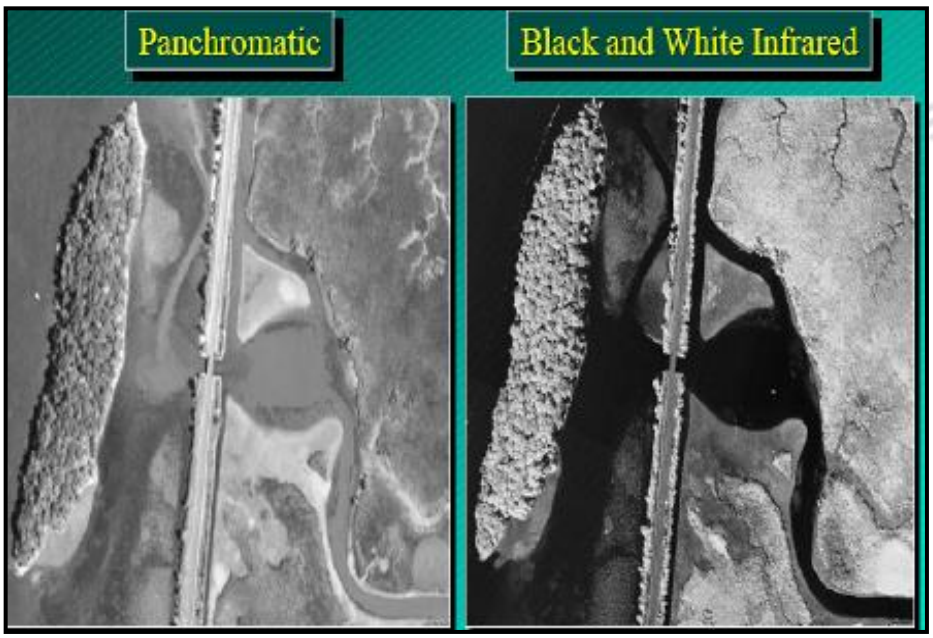
5.3.5 Band pass filter: Band pass filter configure a film and filter combination so that the camera only records a very specific band of reflected EM energy.

Band Pass Filter

5.3.6 Polarization filter: A Polarizing filter reduces atmospheric haze, but also reduces reflected sunlight. The most typical function of a Polarizer is to remove reflections from water and glass. The resulting image is free of reflected light, and transparent objects like glass are free of reflections. It allows the vibration of a light ray in just one plane to be passed.

5.4 Types of Film

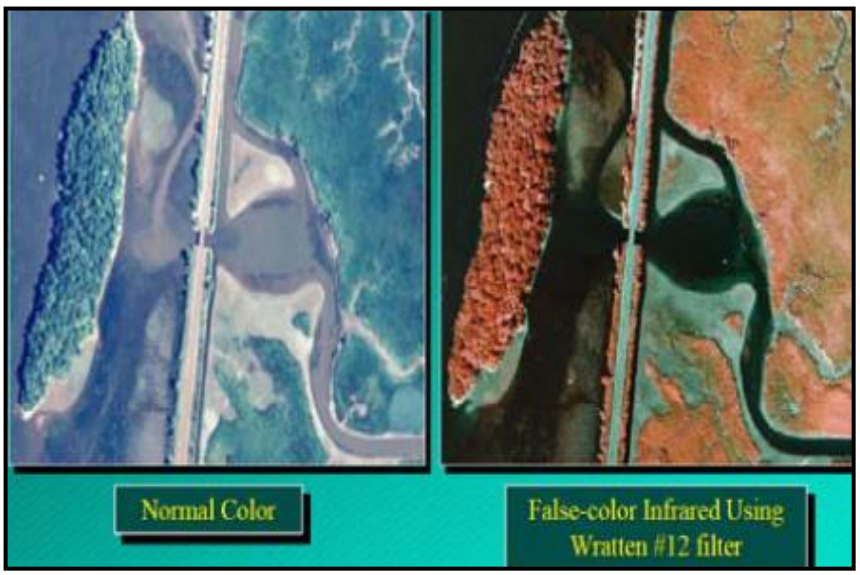
5.4.1 Panchromatic: Panchromatic film is also called as 'black and white' film. It is sensitive to the same range of light wavelength as perceived by the human eye. Panchromatic film is most commonly used for planimetric and topographic map. A yellow filter is normally used for exposure on panchromatic film to reduce the fogging effect caused by atmospheric haze. Unfiltered panchromatic film is used for penetration through clear water.



5.4.2 Black and White Infrared (IR): It is sensitive to a range of wavelength that includes the green, red and near infrared position of the spectrum. It has great ability to differentiate different types of vegetation. Healthy deciduous vegetation is recorded in light tones and coniferous registers in dark tones. It is also useful for differentiating dry and moist soils. In Black IR film moist soil appears in dark tone and dry soil in light tones. The NIR wavelength (0.7-1.0) cannot be perceived by the human eye, so they provide information that beyond the human perception system.

5.4.3 Natural colour: It is often called true colour is sensitive to the same wavelength of light as perceived by the human eye. It is especially useful for identifying soil types, rock types and surficial deposits, water surface patterns and various forms of polluted water. It has good penetration qualities and is therefore valuable for recording underwater features. Its penetration through clear water can exceed 25 m. Colour photography is also useful for detecting forest damage caused by various insects.

5.4.4 Colour Infrared (CIR): It was developed during World War II for detecting camouflaged military targets. It is also called as false colour (or FCC). Like natural colour, they are usually displayed using the RGB colour system to re-create the same colour as on the photo print. Vegetation usually appears red on these images, thus the term false colour. CIR photos are commonly used for agriculture, forestry and wetland studies because the IR band provides valuable information on vegetation health, species and biomass. Deep and clear water absorbs almost all of the NIR energy while reflecting somewhat more green and red light. Deep water free from suspended sediment will appear black. Whereas, water with substantial suspended sediment may appear in relative dark shades of blue and green.



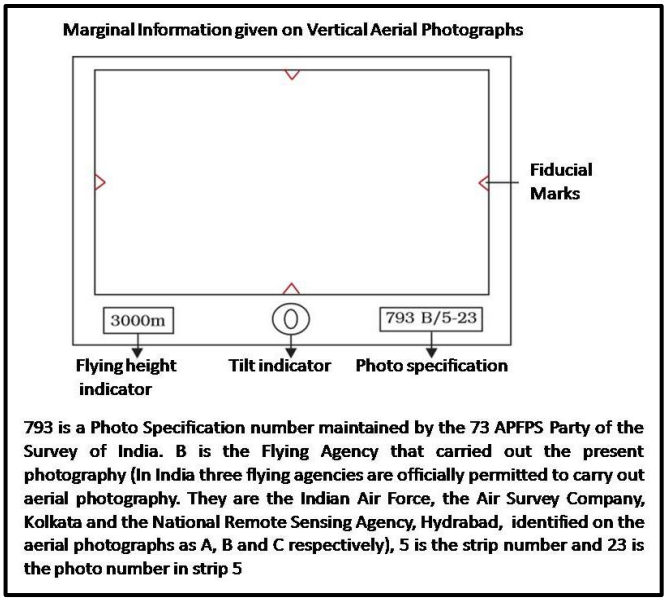
5.4.5 Multiband photography: Aerial camera using multiband photography film takes simultaneous photos in different portions of the spectrum. For example, four bands photography might include separate b/w photographs in blue, green, red and short-infrared bands.

6. Geometric Properties of Aerial Photographs

6.1 Printed Information/Annotation on aerial photograph

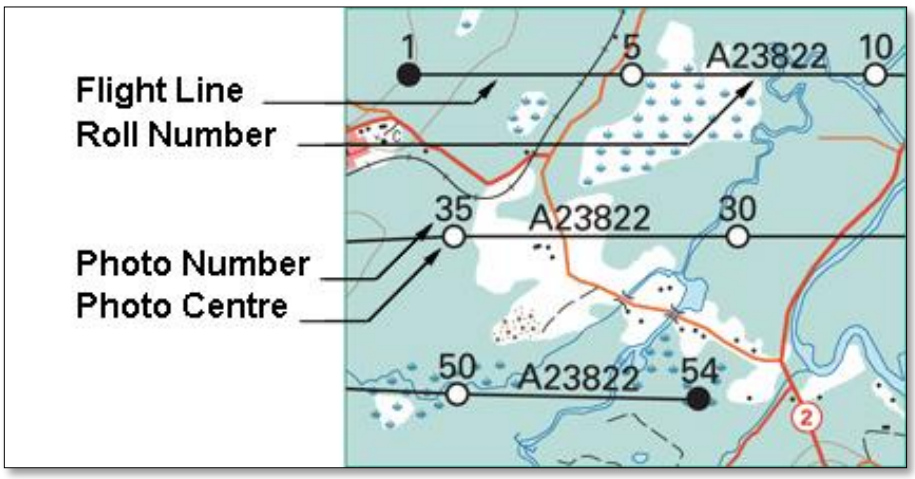
Along the top edge of the aerial photo, we may find: Date of Flight - always top left. Camera focal length in mm (frequently 152.598 mm = 6”), Nominal scale (RF), Vendor/Job #, Roll #, Flight line & Exposure # are always on top right of photographs. Photo Orientation Labels and annotation are generally along northern edge of photo, sometimes-eastern edge is also used.

6.1.1 Roll and Photo Numbers: Each aerial photo is assigned a unique index number according to the photo's roll and frame. For example, photo A23822-35 is the 35th annotated photo on roll A23822. This identifying number allows you to find the photo in NAPL's archive, along with metadata information such as the date it was taken, the plane's altitude (above sea level), the focal length of the camera, and the weather conditions.



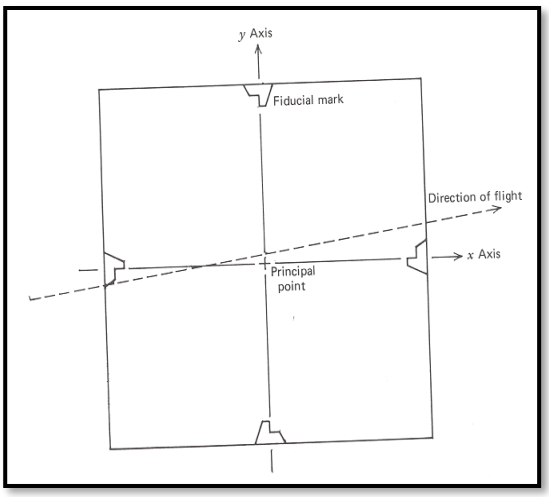
793 is a Photo Specification number maintained by the 73 APFPS Party of the Survey of India. B is the Flying Agency that carried out the present photography (In India three flying agencies are officially permitted to carry out aerial photography. They are the Indian Air Force, the Air Survey Company, Kolkata and the National Remote Sensing Agency, Hydrabad, identified on the aerial photographs as A, B and C respectively), 5 is the strip number and 23 is the photo number in strip 5

6.1.2 Flight Lines and Index Maps: At the end of a photo mission, the aerial survey contractor plots the location of the first, last, and every fifth photo centre, along with its roll and frame number, on a National Topographic System (NTS) map. Photo centres are represented by small circles, and straight lines are drawn connecting the circles to show photos on the same flight line.



This graphical representation is called an air photo index map, and it allows you to relate the photos to their geographical location. Small-scale photographs are indexed on 1:250 000 scale NTS map sheets, and larger-scale photographs are indexed on 1:50 000 scale NTS maps.

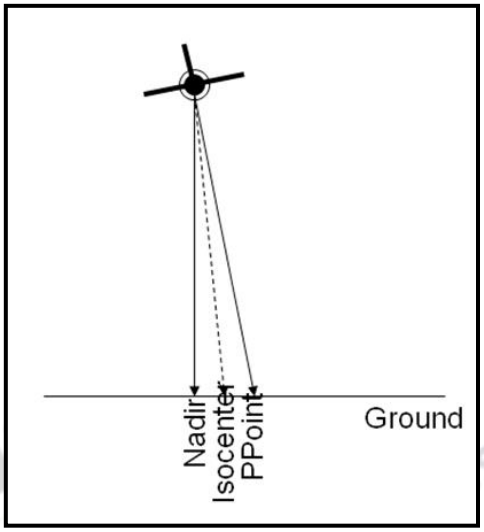
6.1.3 Fiducial marks: Optically projected geometric figures located at either the four corners of a photograph, or on the four sides of a photograph. They define the coordinate axes and geometric center of a single aerial photograph.



The x-axis most nearly defines the direction of

flight. The y-axis most nearly defines the flight line. The intersection of the fiducial marks represents the "principal point" of the photograph.

6.1.4 Principal point: It is geometric center of the photograph, and the intersection of the X and Y axes.



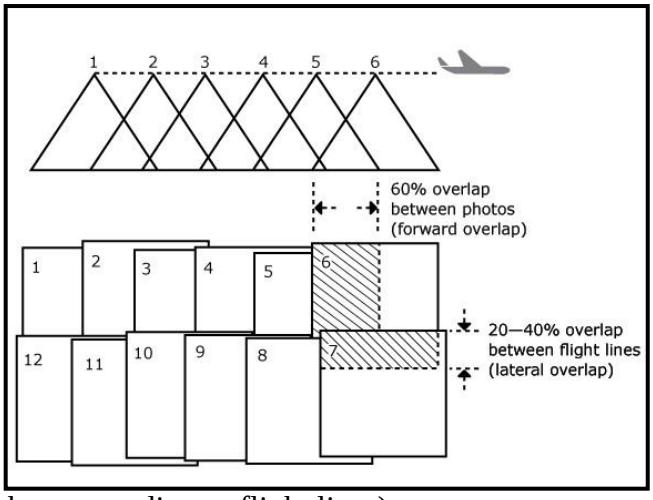
6.1.5 Nadir: The point vertically beneath the camera at the time the photograph was taken.

6.1.6 Isocenter: The point that falls on a line halfway between the 'Principal Point' and the 'Nadir'. On a truly vertical aerial photograph, all three-photo centers will be located in the same place.

6.1.7 Camera axis (C-PP): It is defined by the projection center *C* and the principal point *PP*. The camera axis represents the optical axis. It is perpendicular to the image plane.

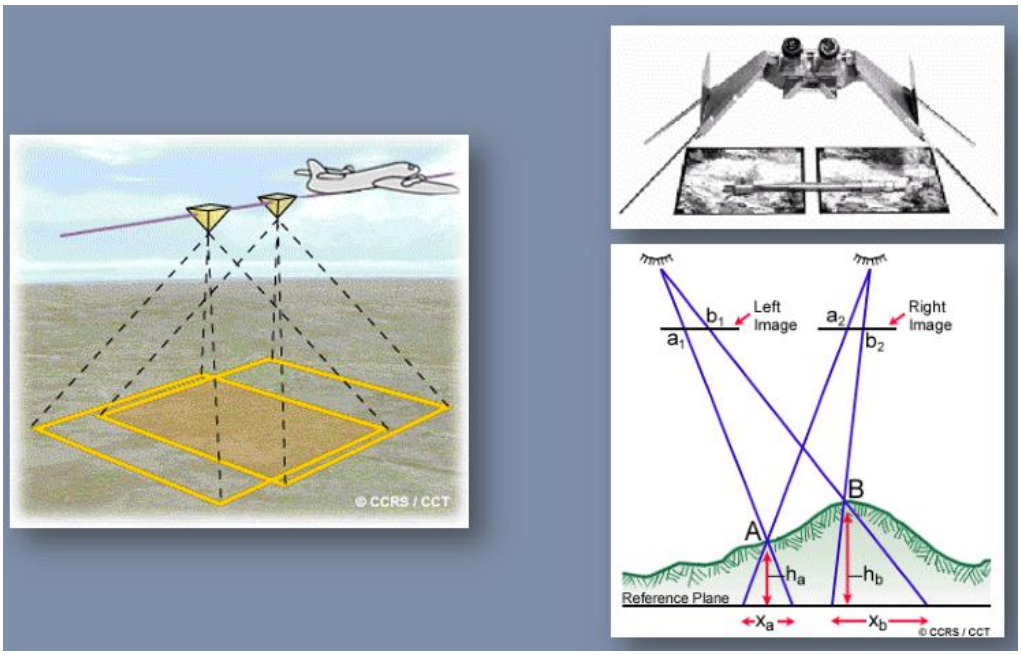
6.1.8 Tilt angle *t:* It is angle between vertical and camera axis.

6.1.9 Overlap: It **is** the amount by which one photograph includes the area covered by another photograph, and is expressed as a percentage. The photo survey is designed to acquire 60% forward overlap (between photos along the same flight line) and 30% lateral overlap (between photos on adjacent flight lines).



7. Stereoscopic Coverage

The three-dimensional view which results when two overlapping photos (called a stereo pair), are viewed using a stereoscope. Each photograph of the stereo pair provides a slightly different view of the same area, which the brain combines and interprets as a 3-D view. Stereoscopic vision determines the distance to an object by intersecting two lines of sight. Stereoscopic vision can be made by using following equipments:



7.1 Lens Stereoscope

A lens or pocket stereoscope is a low-cost instrument that is very useful in the field as well as the office. It offers a fixed magnification, typically 2.5X. The lens stereoscope is useful for photo interpretation, control point design, and verification of mapped planimetric and topographic features.

7.1.1 Mirror Stereoscope: A mirror stereoscope can be used for the same functions as a lens, but is not appropriate for field use. The mirror stereoscope has a wider field of view at the nominal magnification ratio. Since photographs can be held fixed for stereo viewing under a mirror stereoscope, the instrument is useful for simple stereoscopic

measurements. Mirror stereoscopes can be equipped with binocular eyepieces that yield 6X and 9X magnifications. The high magnification helps to identify, interpret, and measure photographed features.

8. Scale of the photograph

The concept of scale for aerial photograph is same as that of a map. Scale is the ratio of a distance on an aerial photograph and the distance between the same two places on the ground in the real world. It can be expressed in unit equivalents like 1 cm= 1,000 km (or 12,000 inches) or as a representative fraction (1:100,000). To determine the dimension during air photo interpretation, it will be necessary to make estimates of lengths and areas, which require knowledge of the photo scale.

8.1 Scale maybe expressed in three ways

8.1.1 Scale ratio: It is also referred to as the proportional scale. 1:20,000 is read as "one to twenty thousand".

8.1.2 Equivalent scale: Equivalent scale is also known as the descriptive scale. For example: one inch equals 5,280 feet (1 inch = 5,280 feet).

8.1.3 Graphic scale: Also called a bar scale, used on maps and drawings to represent length scale on paper with length units.

8.2 Large scale: Larger-scale photos (e.g. 1:25 000) cover small areas in greater detail. A large-scale photo simply means that ground features are at a larger, more detailed size. The area of ground coverage that is seen on the photo is less than at smaller scales.

8.3 Small scale: Smaller-scale photos (e.g. 1:50 000) cover large areas in less detail. A small-scale photo simply means that ground features are at a smaller, less detailed size. The area of ground coverage that is seen on the photo is greater than at larger scales.

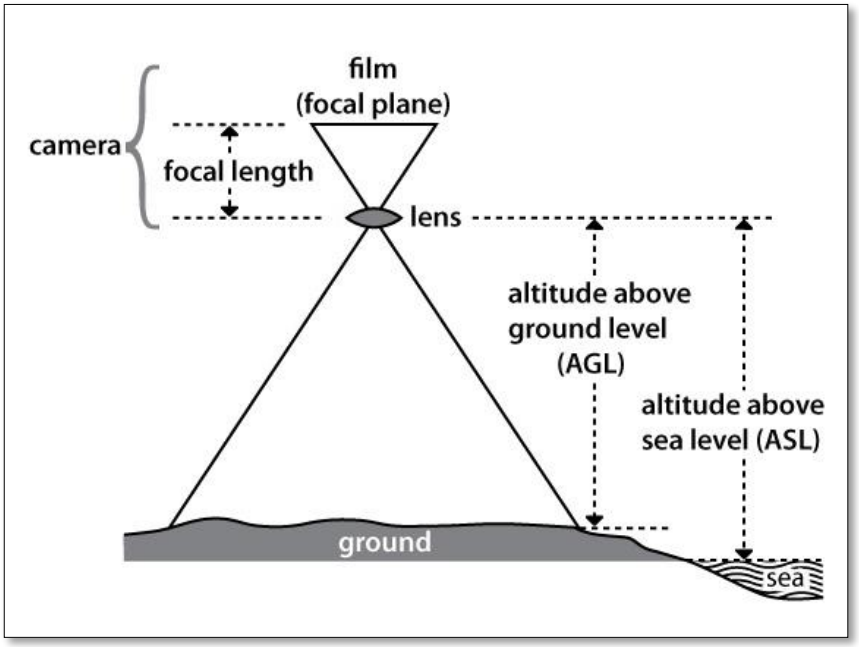
Following methods are used to compute scale of an aerial photograph using different sets of information:

8.3.1 Method 1: Scale is the ratio of the distance between two points on a photo to the actual distance between the same two points on the ground (i.e. 1 unit on the photo equals "x" units on the ground). If a 1 km stretch of highway covers 4 cm on an air photo, the scale is calculated as follows:

$$\frac{Photo\ distane}{Ground\ distance} = \frac{4\ cm}{1\ km} = \frac{4\ cm}{100000\ cm} = \frac{1}{25000}$$

So the scale is: 1/25000

8.3.2 Method 2: Another method used to determine the scale of a photo is to find the ratio between the camera's focal length and the plane's altitude above the ground being photographed.



If a camera's focal length is 152 mm, and the plane's altitude Above Ground Level (AGL) is 7 600 m, using the same equation as above, the scale would be:

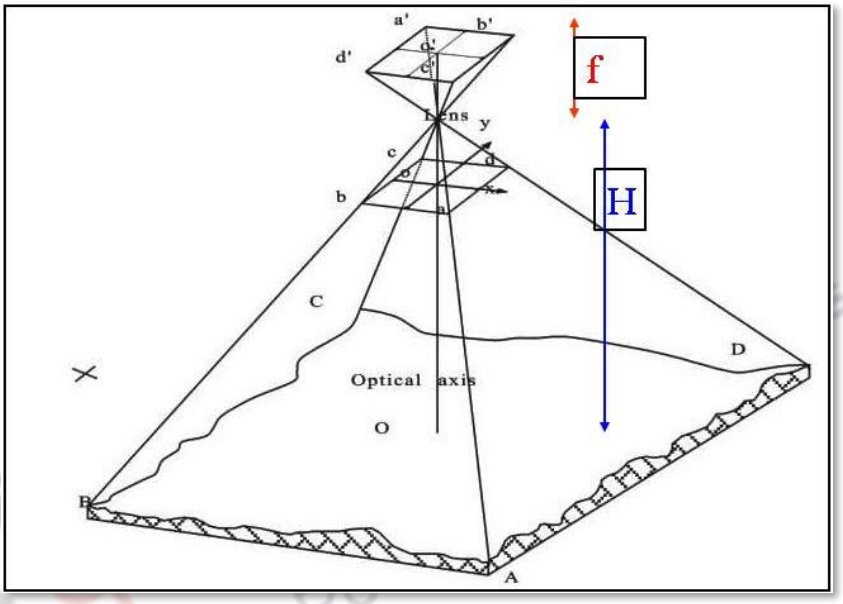
$$\frac{Focal\ length}{Altitude} = \frac{152\ mm}{7600\ m} = \frac{152\ mm}{57600000\ mm} = \frac{1}{50000}$$

So the scale is: 1/50000

8.3.3 Method 3: Scale of the photograph can also be calculated if we know focal length of camera and height of aircraft above the ground level.

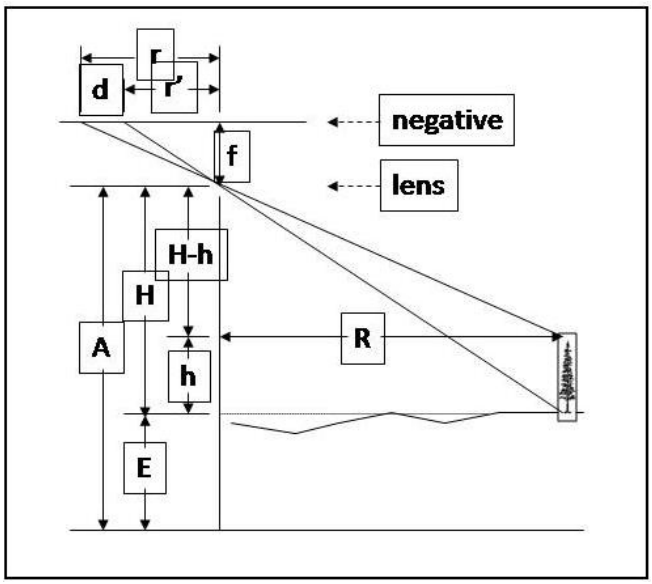
Scale = f/H-h

Where, *H*=flying height of aircraft above sea level, *h* = height of ground above sea level and *f* is focal length.



9. Relief Displacement

Relief displacement is the shift in an object's image position caused by its elevation above a particular datum. A vertical object (such as a building or tree) will appear to be lying along a line radial to the image nadir point. This deformation is called relief displacement.



Here,

r = distance on the photo from the nadir to the displaced landscape feature.

r' = actual place on the photo where the landscape feature should be located.

d = relief (topographic) displacement.

f = focal length.

h = height of the landscape feature.

A = altitude of the aircraft above sea level.

E = elevation of the landscape feature.

H = Flying height above the base of the landscape feature at nadir.

R = distance from the nadir to the landscape feature.

Example: Estimation of Tree Height

Suppose we have the measured displacement of a tree, on flat ground, or d = 2.1 mm.

The distance from the top of the tree to the nadir of the photograph is 79.4 mm, or r = 79.4 mm.

The flying height of the aircraft, A, above sea level is 10,000 feet.

The elevation of the area, E, from a topographic map is 2,000 feet.

Then what is height of the tree?

$$h = \left[\frac{(A-E)d}{r}\right]$$

$$h = \left[\frac{(10000\ feet - 2000\ feet)21.mm}{79.4}\right]$$

$$h = \left[\frac{(8000\ feet)2.1mm}{79.4\ mm}\right]$$

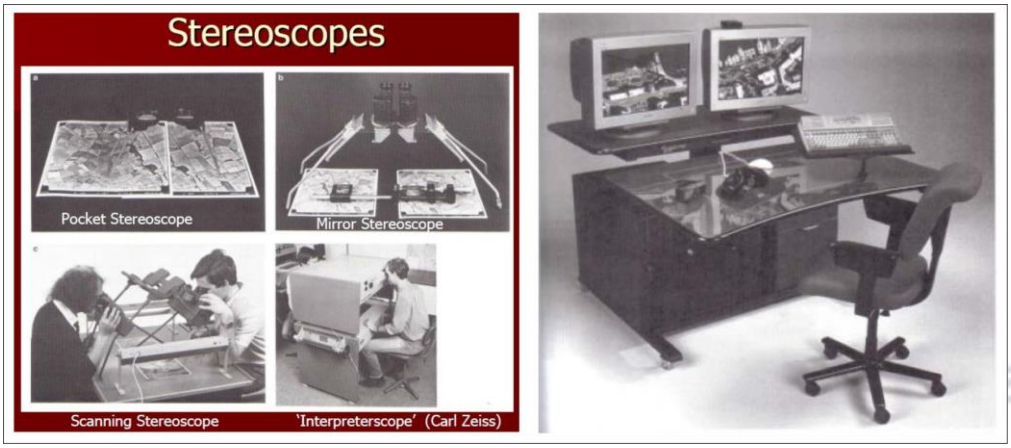
h = 211.6 feet

10. Photo Interpretation

The identification and extraction of meaning of objects from photo is known as photo interpretation. Once corrected, and georeferenced, photos can be used for topographic mapping and as a mapping layer, with map data overlain on top. With

careful interpretation, air photos are an excellent source of spatial data for studying the Earth's environment.

10.1 Photo Interpretation Equipment

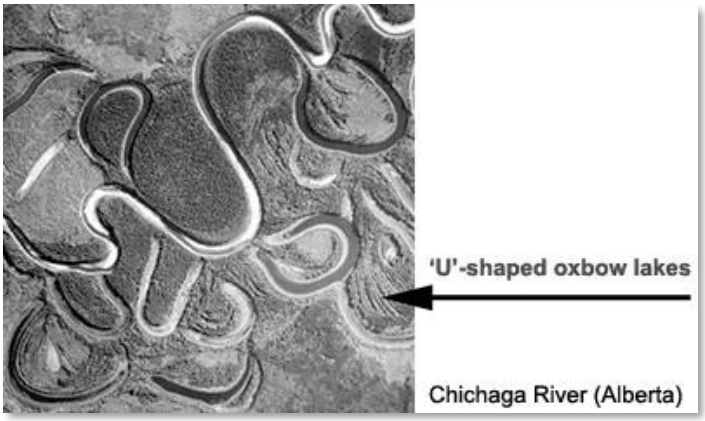


10.1.1 Photogrammetric workstation: Photogrammetric workstation involves integrated hardware and software systems for spatial data capture, manipulation, analysis, storage, display and output of softcopy images. These systems incorporate functionality of analytical stereo plotters, automated generation of DEM, computation of digital ortophotos, preparation of perspective views and capture @D and 3D data for use in a GIS.

11. Elements of Aerial Photo Interpretation

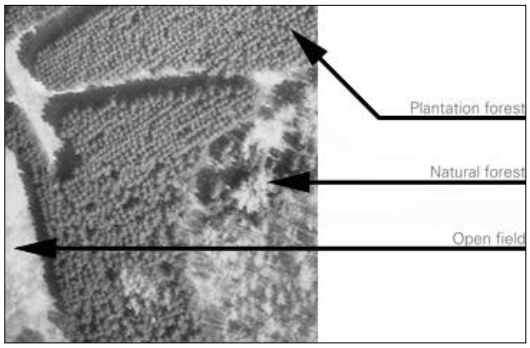
11.1 Shape

The form of an object on an air photo helps to identify the object. Regular uniform shapes often indicate a human involvement.



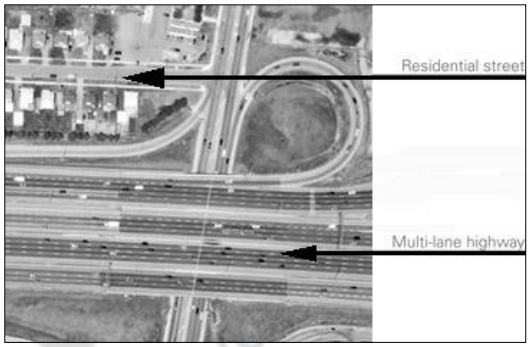
11.2 Pattern

Similar to shape, the spatial arrangement of objects (e.g. row crops vs. pasture) is also useful to identify an object and its usage.



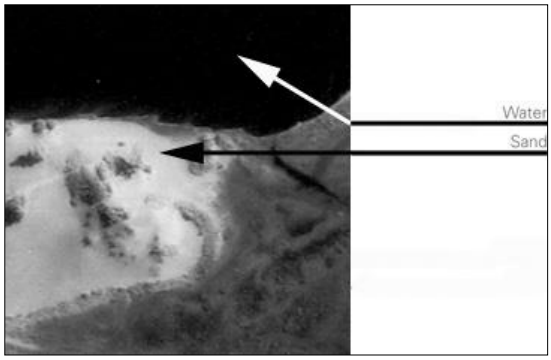
11.3 Size

A measure of the object's surface area (e.g. single-lane vs. multi-lane highways).



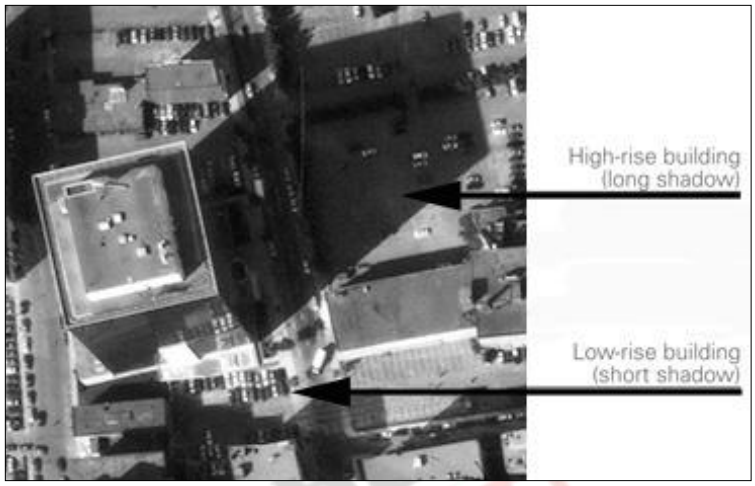
11.4 Tone/Colour

The colour characteristics of an object, relative to other objects in the photo, are used to identify the feature (e.g. sand has a bright tone, while water usually has a dark tone; tree species can be determined by the colour of their leaves at certain times of the year).



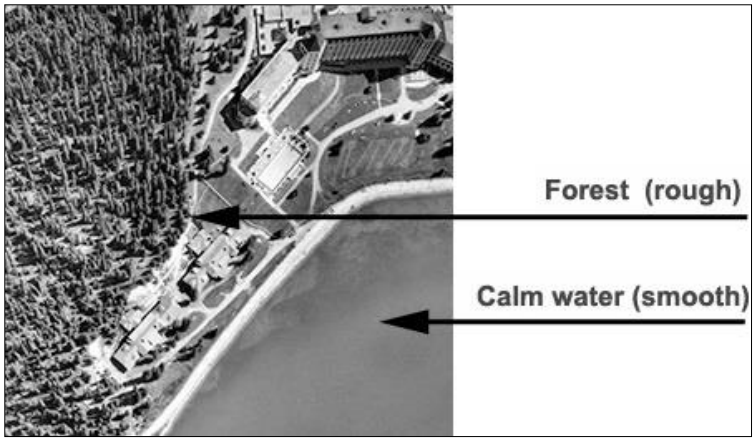
11.5 Shadow

A shadow provides information about the object's height, shape, and orientation (e.g. tree species).



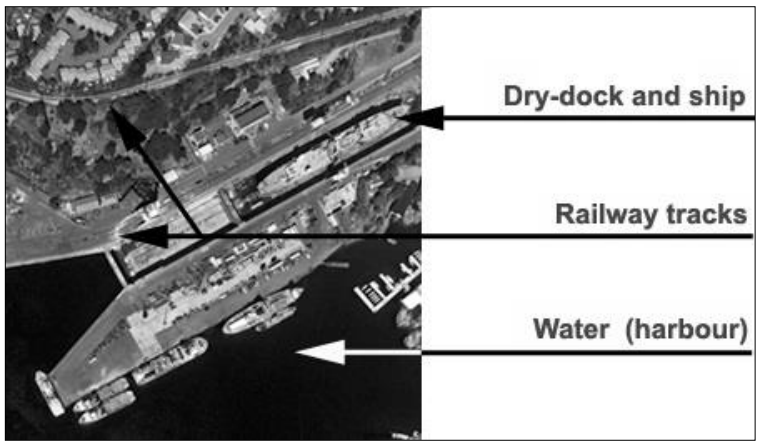
11.6 Texture

The physical characteristics of an object will change the way they appear on a photo (e.g. calm water has a smooth texture; a forest canopy has a rough texture).



11.7 Association/Site

Associating the presence of one object with another, or relating it to its environment, can help identify the object (e.g. industrial buildings often have access to railway sidings; nuclear power plants are often located beside large bodies of water).



11.8 Time

Temporal characteristics of a series of photographs can be helpful in determining the historical change of an area (e.g. looking at a series of photos of a city taken in different years can help determine the growth of suburban neighborhoods.

12. Keys for the identification of objects in aerial photographs

Objects	Panchromatic	Infrared
Snow	White	White
Clouds	White	White
Sky	Medium gray	Black
Clear water	Dark gray	Black
Silty water	Light gray	Medium gray
Deciduous foliage	Dark gray	White
Coniferous foliage	Dark gray	Medium gray
Autumn foliage	Light gray	Light gray
White sand (dry)	Light gray	Light gray
White sand (moist)	Medium gray	Dark gray
Red sand stone (dry)	Medium gray	Light gray
Red sand stone (moist)	Medium gray	Dark gray
Swamp	Dark gray	Black
Asphalt	Dark gray	Black
Concrete	Light gray	Medium gray

Objects	Normal colour	Colour infrared
Snow	White	White
Clouds	White	White
Sky	Blue	Blue
Clear water	Blue or green	Black or dark blue
Silty water	Red or brown	Light blue or green
Deciduous foliage	Green	Bright red
Coniferous foliage	Green	Brownish red
Aquatic vegetation	Green	Pink
Citrus tress Healthy Pre-visual stress Late stage of stress	 Green Green Yellow	 Red Pink White
Defoliated trees	Gray	Blue or green
Artificial turf Dry Wet	 Green Green	 Blue Black
Red sand stone (dry)	Red	Yellow or green
Red sand stone (moist)	Medium gray	Dark gray
Asphalt	Black	Black
Concrete	Gray	Stool gray
Damp ground	Slightly darker	Darker
Shadows	Bluish	Black

13. Importance of Aerial Photographs

13.1 What type of information can be extracted from an air photo?

Unlike a map, features on an aerial photograph are not generalized or symbolized. Air photos record all visible features on the Earth's surface from an overhead perspective. Although the features are visible, they are not always easily identifiable. The process of studying and gathering the information required identifying the various cultural and natural features is called photo interpretation. With careful interpretation, air photos are an excellent source of spatial data for studying the Earth's environment.

Aerial photographs provide a three dimensional overall view of the ground at almost any scale demanded by the user. This property makes aerial photographs to be of great value for the following activities.

a) Topographical mapping
b) Regional geological mapping
c) Regional soil mapping
d) Forestry Resources
e) Land use studies
f) Military intelligence
g) Archaeology and civil engineering studies
h) In Urban Studies
i) In Climate Change

Frequently Asked Questions-

Q1. What are the different aerial platforms used for shooting the aerial photograph?

Ans: Platforms for aerial photography include fixed-wing aircraft, helicopters, unmanned aerial vehicles, balloons, blimps and dirigibles, rockets, pigeons, kites, parachutes, stand-alone telescoping and vehicle-mounted poles. A helicopter is probably one of the best choices and options are a small two seater, like an R-22 is the most economical, but not the most stable and a Jetranger is more stable, but more expensive. They range in price from $250/hr. to over $1,000/hr. A small fixed wing plane is the most economical, like a Cessna, it is limited to higher altitudes and can only orbit in circles. The running cost starts with $50/hr. for a two-seater. Now Drones fitted with camera are also used for Aerial Photography. Flexible camera mounts, image stability in all conditions, professional gimbals and flexible camera options are key features of these drone aerial photography. In India, Director General of Civil Aviation, DGCA Complex, Opposite Safdarjung Airport, New Delhi– 110003 grants permission for aerial photography.

Q2. What types of lenses are required for aerial photography?

Ans: A zoom lens is the most ideal, but it has limitation, as it does not give best image quality. A fixed lens with a focal length of 28mm, 35mm, or 50mm will give the most shooting options, it indented to do landscape aerial photography at altitudes 500 feet or below. If we plan on shooting at altitudes above 500 feet then we may need a lens with a focal length of at least 105mm to as much as 300mm.

Q3. What is Photo Scale?

Ans: Photo scale is the ratio of a distance on the photo to the corresponding distance on the ground. Photo scale may be presented as unit equivalents, unit fractions, dimensionless representative fractions or dimensionless ratio. Photo scale is shown as where one unit on the photograph represents a specific number of the same units on the ground. For example, a photo scale of 1:15000 means 1 mm unit on the photo is represents 15000 mm or 15 metres unit on the ground. There are two

types of common photo scale: (i). Large Scale – means the larger ground features and more detailed in size. However the area of ground coverage on the photo is less than at smaller scales. (ii). Small Scale – means the smaller ground features and less detailed size. However the area of ground coverage on the photo is greater than at larger scales.

Q4. The distance between two points on an aerial photograph is measured as 2 centimetres. The known distance between the same two points on the ground is 1 km. Compute the scale of the aerial photograph (Sp)?

Ans: Scale of aerial photograph = Distance between two points on an aerial photograph: distance between the same two points on the ground

Sp = Dp: Dg

= 2 cm: 1 km

= 2 cm: 1 x 100,000 cm

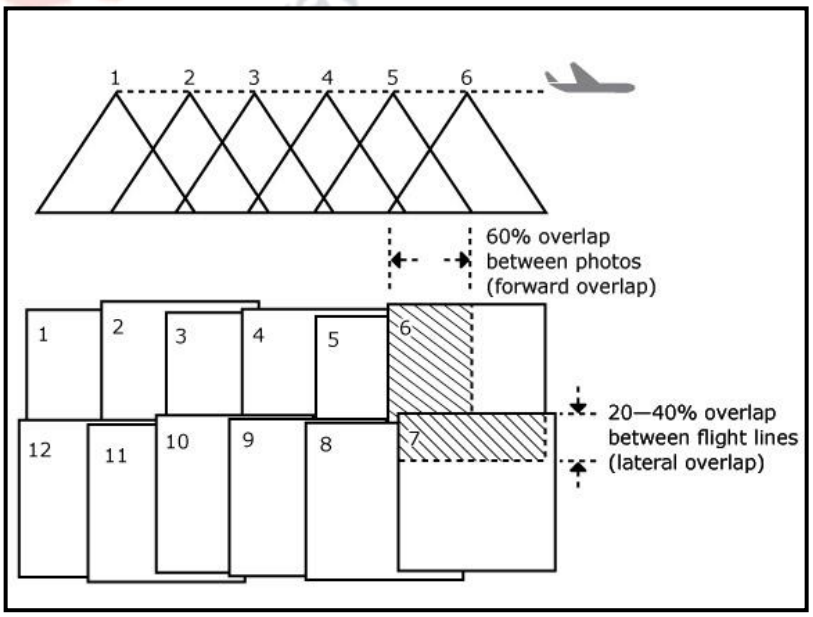
= 1: 100,000/2 = 50,000 cm

= 1 unit represents 50,000 units

Therefore, Sp = 1: 50,000

Q5. What is the average endlap and sidelap for the aerial photography?

Ans: The average endlap and sidelap for aerial photographs in the flight line are 60% and 30% respectively. Figure shows the concept of overlays in an aerial photography.



Multiple Choice Questions-

1. Aerial photography can be accomplished from a

(a) Hot air balloon
(b) Fixed-wing aircraft
(c) Helicopter
(d) All of the above

Ans: d

2. In which of the following aerial photographs the horizon appears

(a) Vertical
(b) Near-vertical
(c) Low-oblique
(d) High-oblique

Ans: d

3. In which of the following aerial photographs the Nadir and the principle points coincide

(a) Vertical
(b) Near-vertical
(c) Low-oblique
(d) High-oblique

Ans: a

4. Kinds of photographs that are used by geographers includes

(a) Satellite images
(b) Landscape photographs
(c) Aerial photographs
(d) All of the above

Ans: d

5. Colour of infrared images that represent little vegetation cover areas is

(a) yellow
(b) pink-red
(c) red-magenta
(d) white-cream

Ans: a

Suggested Readings:

1. Aniello, C., Morgan, K., Busbey, A., & Newland, L. (1995). Mapping micro-urban heat islands using Landsat TM and a GIS. Computers & Geosciences, 21(8), 965-969.
2. Aston, M. (2003). Interpreting the Landscape from the Air, Arcadia Publishing (SC). ISBN: 075242846, 978-0752428468.
3. Paine, David P. and Kiser, James D., 2003. Aerial photography and image interpretation, 3rd Edn. John Wiley & Sons. ISBN: 978-0-470-87938-2.
4. Lloyd, Harvey (1990), Aerial Photography. Amphoto Books, New York. ISBN: 0817432930, 978-0817432935.
5. Lillesand Thomas, Keifer Ralph W. and Chipman Jonathan (2015), Remote sensing and Image Interpretation, 7th Edn., John Wiley & Sons, New York. ISBN : 978-1-118-34328-9.
6. Short, Nicholas. 2010. Elements of Aerial Photography. Remote Sensing Tutorial, NASA.
7. http://www.isprs.org/proceedings/XXVII/congress/part7/196_XXVII-part7-sup.pdf.