UNIT 1 : PHOTOGRAMMETRY

1.1 INTRODUCTION

'Photo' - light' Gram' – drawing'Metry' – measurement

Simply stated, Photogrammetry is the art and science of making measurements fromimagery. Historically, this meant using photographs, but today, digital images are becoming themedium of choice for many photogrammetric applications. In fact, the distinction betweenremote sensing and Photogrammetry has gradually become blurred as conventionalPhotogrammetrist employs "non-conventional" imagery for mapping purposes. One of the mainadvantages of Photogrammetry is that the photograph/image forms a permanent record of thesituation at that instant in time. This is ideal when change detection is important in a project.

Imagery is generally collected from an airplane. The advantage is that the camera cancapture a very wide image from which the mapping can be performed. For example, most aerialphotography uses a film size of 9" x 9" (23 cm x 23 cm). If the scale of the photograph was 1" = 500' then each photograph would image approximately 4,500' x 4,500' on the ground. Thus,with one click of the shutter, the image captures approximately 465 acres of land1. Anotheradvantage of Photogrammetry there is no line of sight problems that surveyors may encounter on the ground since we are looking at the land from above.

1.2 Objective

After going through this unit the learner will able to learn:

- *Understand Meaning of 3DGIS*
- *How to Prepare GIS Model and How Web GIS work*
- *Capable To Work on Advance Gis Formats*

1.3History

From earliest times mankind has held a fascination with the view from above. The "bird's eye" view of mythology and dreams Therefore it's not surprising that, not long after the discovery of photography, photographic pioneers began to turn their attention to the aerial view.

However, it was not an easy task for these dedicated souls. At that time most photographers used a Collodion or "wet plate" process where the plate must be developed while still moist. This required all steps, from sensitizing the plate, to exposure and development be accomplished within 20 minutes. When used for aerial photography a darkroom and all gear, including a supply of water, had to be fitted into the basket of a balloon.

The first to successfully accomplish this feat was Gaspar Felix Tournachon or "Nadar" in 1858 when he photographed the houses of the French village of Petit-Becetre from a balloon tethered at a height of 80 meters. That first image has unfortunately been lost, but Nadar went on with his experiments becoming the first to photograph Paris from a balloon in 1868.

In 1860, not long after Nadir's first attempts, James Wallace Black is successful in photographing Boston from a balloon. This is the oldest aerial photograph know to still exist.

Figure -1.1 First to Photograph Paris from a Balloon in 1868, James Wallace 'S Boston City Photograph

Figure -1.2one of the smaller models of aerial camera, dated 1907, kept in DuetschesMuseum, Germany. (Source: Curran, 1988)

Soon the advent of dry plate techniques and camera improvements allowed photographs to be taken with relative ease and the camera moved from balloons to kites and other platforms. In 1903 Julius Neubronne patents a breast-mounted camera for pigeons and in 1906(Fig-1.2) Albert Maul uses a rocket powered by compressed air to loft a camera which then parachutes back to earth

Also in 1906 a famous photograph depicting the aftermath of the San Francisco Earthquake is taken by George Lawrence using a string of kites to lift a handmade panoramic camera aloft

Figure -1.3San Francisco in Ruins

The first use of a motion picture camera mounted to a heavier-than-air aircraft took place on April 24, 1909 over Rome in the 3:28 silent film short, Wilbur Wright und seine Flugmaschine.
The first special semiautomatic aerial camera was designed in 1911 by Russian military engineer — Colonel Potte V. F. This aerial camera was used during World War I.
The use of aerial photography for military purposes was expanded during World War I by many other aviators such as Fred Zinn. One of the first notable battles was that of Neuve Chapelle.

One of the most successful pioneers of the commercial use of aerial photography was by Sherman Fairchild who started his own aircraft firm Fairchild Aircraft to develop and build specialized aircraft for high altitude aerial survey missions. One Fairchild aerial survey aircraft in 1935 carried unit that combined two synchronized cameras, and each camera having five six inch lenses with a ten inch lenses and took photos from 23,000 feet. Each photo covers two hundred and twenty five square miles. One of its first government contracts was an aerial survey of New Mexico to study soil erosion. A year later, Fairchild introduced a better high altitude camera with nine-lens in one unit that could take a photo of 600 square miles with each exposure from 30,000 feet.

1.4Aerial Photography

An aerial photograph is any photograph taken from an airborne vehicle (aircraft, drones, balloons, satellites, and so forth). The aerial photograph has many uses in military operations andas well ascommercial purpose

1.4.1Vertical Aerial Photography

A vertical photograph is taken with the camera pointed as straight down as possible (Figures 1.4, 1.7and 1.6). Allowable tolerance is usually + 3° from the perpendicular (plumb) line to the camera axis. The result is coincident with the camera axis. A vertical photograph has the following characteristics

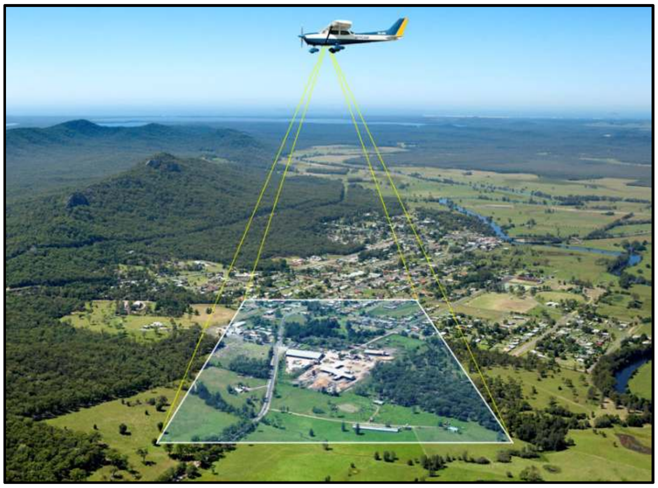


Figure -1.4 Vertical PhotosTaken by Aircraft

(1) The lens axis is perpendicular to the surface of the earth.

(2) It covers a relatively small area.

(3) The shape of the ground area covered on a single vertical photo closely approximates a square or rectangle.

(4) Being a view from above, it gives an unfamiliar view of the ground.

(5) Distance and directions may approach the accuracy of maps if taken over flat terrain.

(6) Relief is not readily apparent.

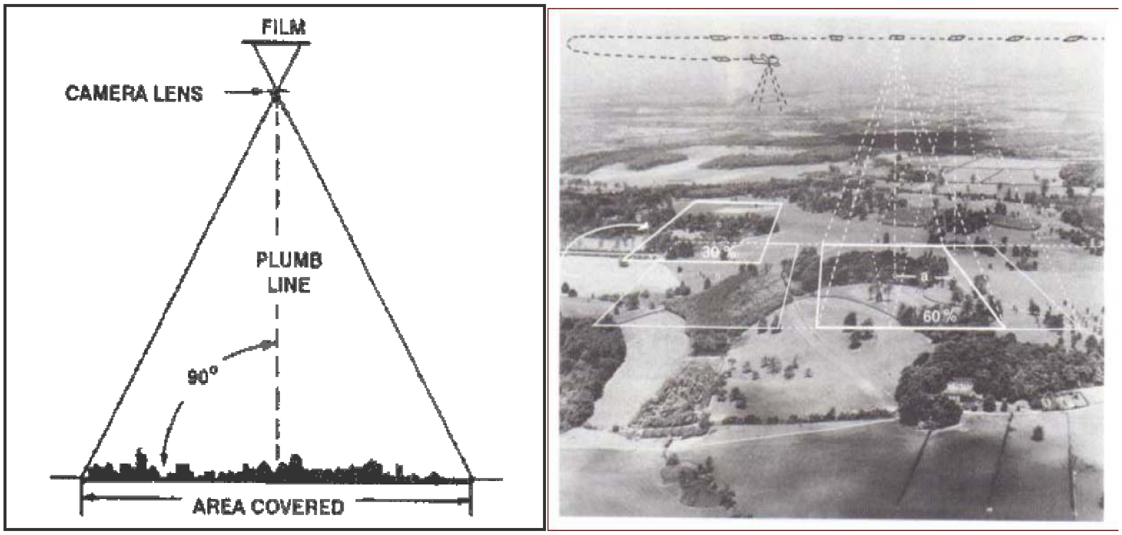


Figure-1.5Relationship of the vertical aerial photograph with the ground

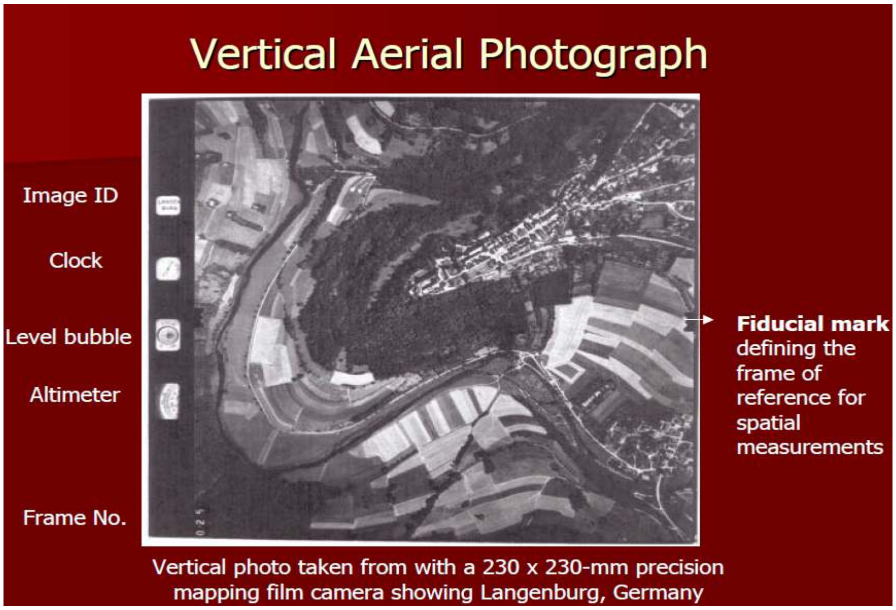


Figure-1.6.Vertical photograph

1.4.2Oblique Aerial Photography

Photographs taken at an angle are called oblique photographs. And it's taken from some kind of aircraft whether this is a fixed wing aero plane, helicopter or "lighter than air" craft (balloon). There are two basic types of oblique aerial photography. These two types are:

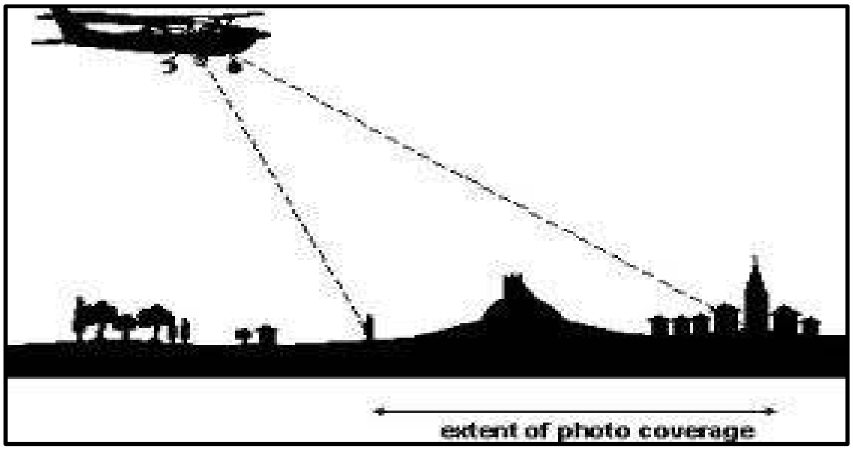


Figure-1.7Oblique Photographs Taken by Aircraft

1.4.2.1Low Oblique

This is a photograph taken with the camera inclined about 30° from the vertical (Figure 7 and Figure-8). It is used to study an area before an attack, to substitute for a reconnaissance, to substitute for a map, or to supplement a map. A low oblique has the following characteristics:

1) It covers a relatively small area ground.

(2) The ground area covered is a trapezoid, although the photo is square or rectangular.

(3) The objects have a more familiar view, comparable to viewing from the top of a high hill or tall building.

(4) 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.

(5) Relief is discernible but distorted.

(6) It does not show the horizon

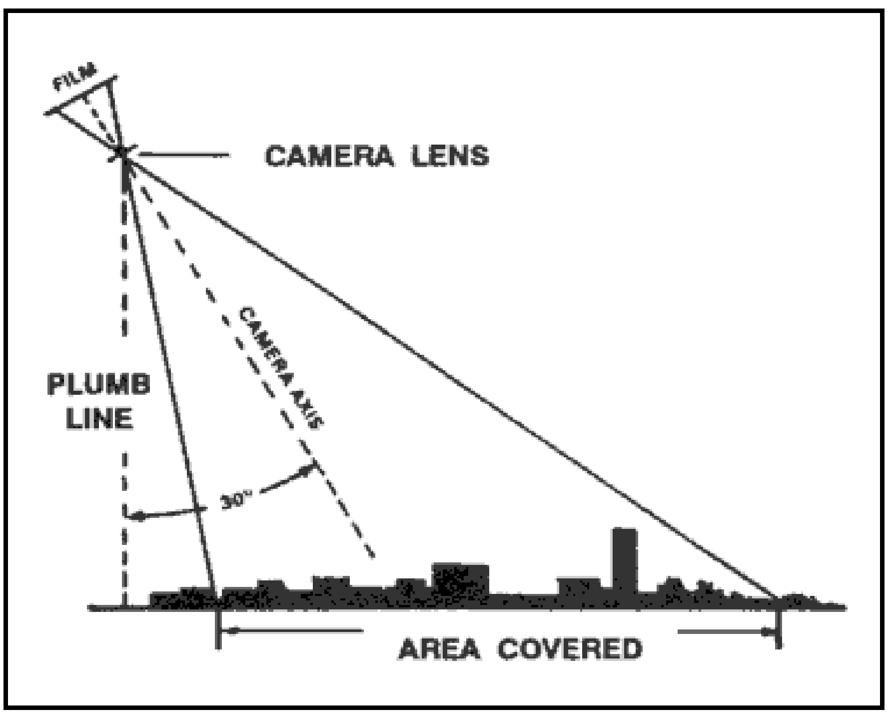


Figure-1.8 Relationshipof Low Oblique Photograph to the Ground

Figure -1.9 Low oblique photograph.

1.4.2.2 High Oblique

The high oblique is a photograph taken with the camera inclined about 60° from the vertical (Figures 1.10 and 1.11). It has a limited military application; it is used primarily in the making of aeronautical charts. However, it may be the only photography available. A high oblique has the following characteristics:

(1) It covers a very large area (not all usable).

(2) The ground area covered is a trapezoid, but the photograph is square or rectangular.

(3) The view varies from the very familiar to unfamiliar, depending on the height at which the photograph is taken.

(4) Distances and directions are not measured on this photograph for the same reasons that they are not measured on the low oblique.

(5) Relief may be quite discernible but distorted as in any oblique view. The relief is not apparent in a high altitude, high oblique.

(6) The horizon is always visible.

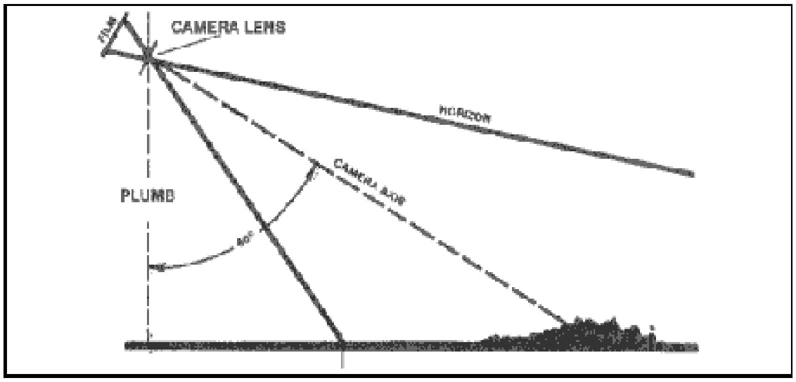


Figure-1.10Relationship of high oblique photograph to the ground.

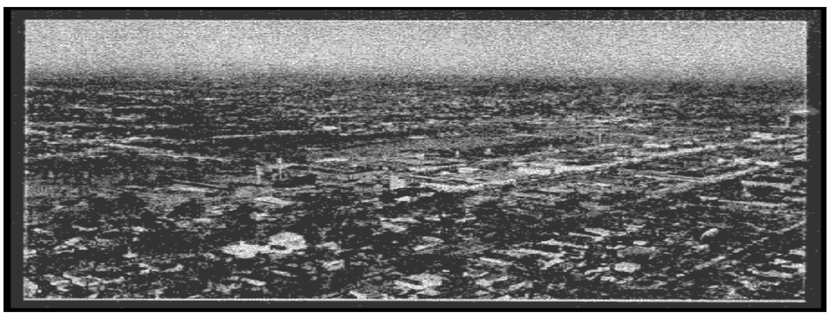


Figure 1.11View of High oblique Aerial photos

1.4.3Trim Trogon

This is an assemblage of three photographs taken at the same time, one vertical and two highoblique, in a direction at right angle to the line of flight. The oblique's, taken at an angle of 60° from the vertical, side lap the vertical photography, producing composites from horizon to horizon (Figure -1.12)

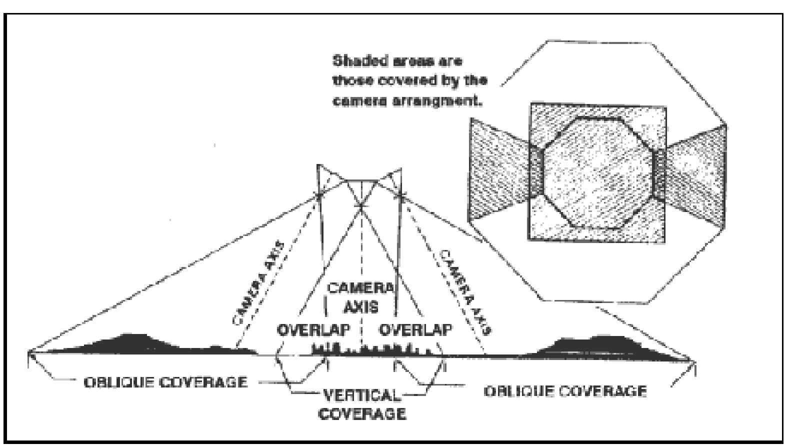


Figure-1.12 Relationship of Cameras to Ground for Trim Trogon Photography (Three Cameras)

1.4.4Multiple Lens Photography

These are composite photographs taken with one camera having two or more lenses, or by two or more cameras. The photographs are combinations of two, four, or eight oblique's around a vertical. The obliques are rectified to permit assembly as verticals on a common plane.

1.4.5Convergent Photography

These are done with a single twin-lens, wide-angle camera, or with two single-lens, wide-angle cameras coupled rigidly in the same mount so that each camera axis converges when intentionally tilted a prescribed amount (usually 15 or 20°) from the vertical. Again, the cameras are exposed at the same time. For precision mapping, the optical axes of the cameras are parallel to the line of flight, and for reconnaissance photography, the camera axes are at high angles to the line of flight.

1.4.6Panoramic

The development and increasing use of panoramic photography in aerial reconnaissance has resulted from the need to cover in greater detail more and more areas of the world.

(1) To cover the large areas involved, and to resolve the desired ground detail, present-day reconnaissance systems must operate at extremely high-resolution levels. Unfortunately, high-resolution levels and wide-angular coverage are basically contradicting requirements.

(2) A panoramic camera is a scanning type of camera that sweeps the terrain of interest from side to side across the direction of flight. This permits the panoramic camera to record a much wider area of ground than either frame or strip cameras. As in the case of the frame cameras, continuous cover is obtained by properly spaced exposures timed to give sufficient overlap between frames. Panoramic cameras are most advantageous for applications requiring the resolution of small ground detail from high altitudes.

1.5. Types of Film

Types of film generally used in aerial photography include panchromatic, infrared, and color. Camouflage detection film is also available.

1.5.1Panchromatic

This is the same type of film that is used in the average hand-held small camera. It records the amount of light reflected from objects in tones of gray running from white to black. Most aerial photography is taken with panchromatic film.

1.5.2Infrared

This is a black-and-white film that is sensitive to infrared waves. It can be used to detect artificial camouflage materials and to take photographs at night if there is a source of infrared radiation.

1.5.3Color

This film is the same as that used in the average hand-held camera. It is limited in its use because of the time required to process it and its need for clear, sunny weather.

1.5.4 Camouflage

This film is a special type that records natural vegetation in a reddish color. When artificial camouflage materials are photographed, they appear bluish or purplish. The name of this film indicates its primary use.

1.6. Numbering and Titling Information

Each aerial photograph contains in its margin important information for the photo user. The arrangement, type, and amount of this information is standardized; however, the rapid development of cameras, film, and aeronautical technology since World War II has caused numerous changes in the numbering and titling of aerial photographs. As a result, the photo user may find that the marginal information on older photographs varies somewhat from the standard current practice. With certain camera systems, some of the data are automatically recorded on each exposure, while other systems require that all titling data be added to the film after processing.

1.6.1 Standard Titling

Data for aerial photography prepared for the use of the Department of Defense are as follows. For reconnaissance and charting photography, items 2 through 14 and item 19 are lettered on the beginning and end of each roll of film. Items 1 through 9 and item 19 are lettered on each exposure. For surveying and mapping photography, items 2 through 19 are lettered on the beginning and end of each roll of film, and items 1, 2, 3, 5, 6, 7, 8, 9, 13, and 19 are lettered on each exposure.

(1) Negative number (2) Camera position (3) Taking unit(4) Service.(5) Sortie/mission number. (6)Date (7) Time group and zone letter (GMT) (8) Focallength (9) Altitude.

(10) Kind of photography or imagery (11) Geographic coordinates (12) Descriptive title.

(13) Project number and or name (14) Camera type and serial number(19) Security classification.(15) Cone serial number (if any) (16) Lens type and serial number (17) Magazine type and serial number (18) Type of photographic filter used

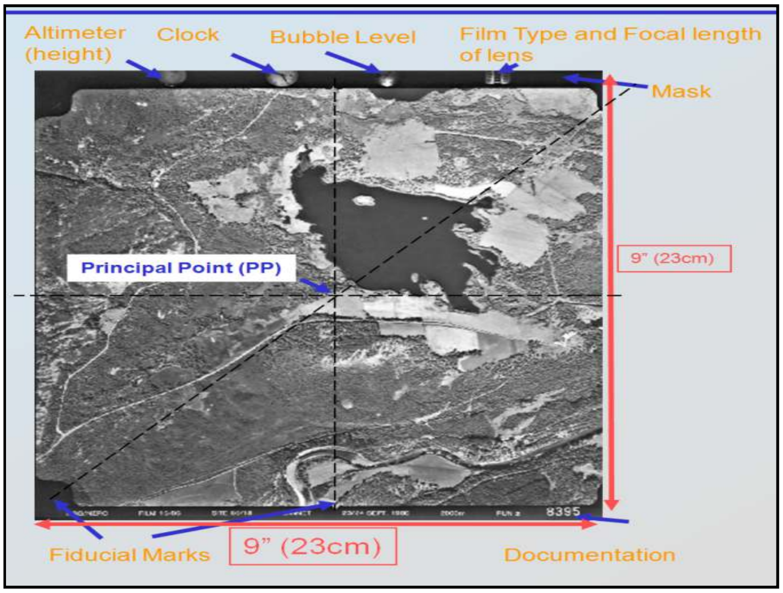


Figure-1.13 Characteristic of Aerial Photograph

1.6.2. Automatically recorded

Data may differ somewhat in arrangement from the sequence listed above, but the same information is available to the photo user. A detailed explanation of the Titling items and the codes used to indicate them is found in TM 5-243

1.7. Scale Determination

Before a photograph can be used as a map supplement or substitute, it is necessary to know its scale. On a map, the scale is printed as a representative fraction that expresses the ratio of map distance to ground distance, For example:

RF
—— *= MD*
GD

On a photograph, the scale is also expressed as a ratio, but is the ratio of the photo distance (PD) to ground distance. For example:

RF
—— *= PD*
GD

The approximate scale or average scale (RF) of a vertical aerial photograph is determined by either of two methods; the comparison method or the focal length-flight altitude method.

1.7.1Comparison Method

The scale of a vertical aerial photograph is determined by comparing the measured distance between two points on the photograph with the measured ground distance between the same two points.

SCALE (RF)
—————— *= Photo Distance*
Ground Distance

The ground distance is determined by actual measurement on the ground or by the use of the scale on a map of the same area. The points selected on the photograph must be identifiable on the ground or map of the same area and should be spaced in such a manner that a line connecting them will pass through or nearly through the center of the photograph (Figure -1.14)

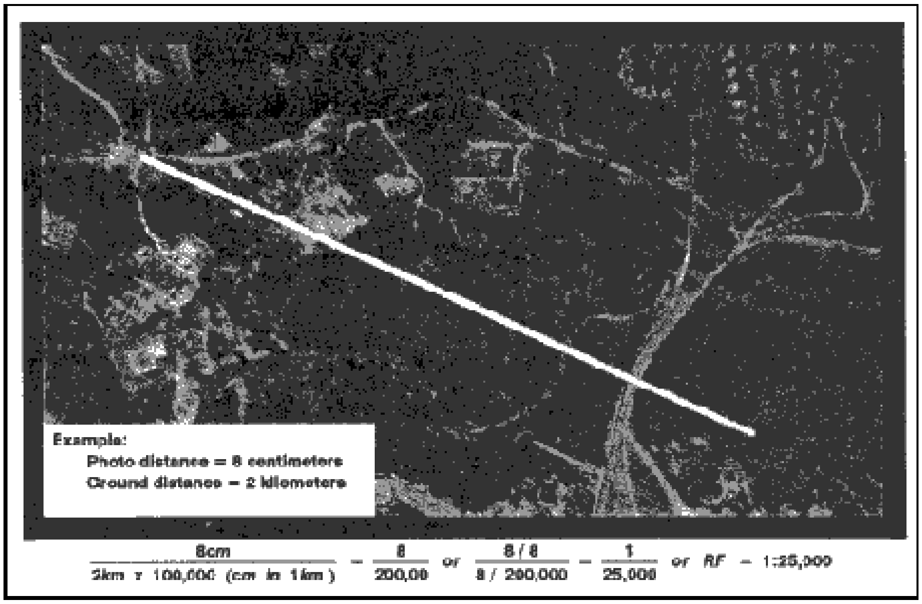


Figure -1.14Selections of points for scale determination

1.7.2. Focal Length

Flight Altitude Method When the marginal information of a photograph includes the focal length and the flight altitude, the scale of the photo is determined using the following formula (Figure 1.15)

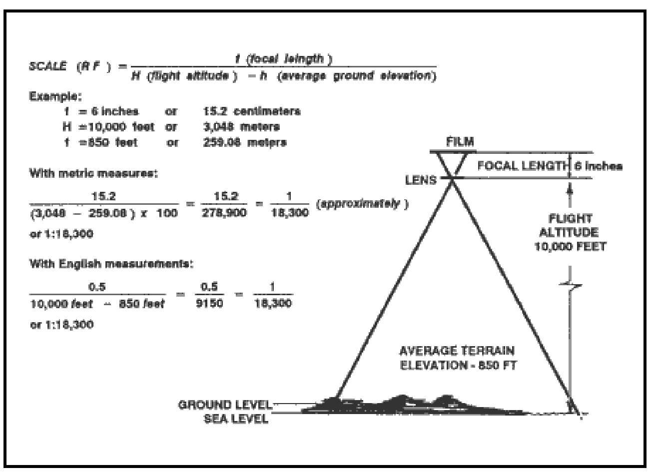


Figure-1.15 Computation of scale from terrain level

When the ground elevation is at sea level, H becomes zero, and the formula is as shown in Figure-1.16

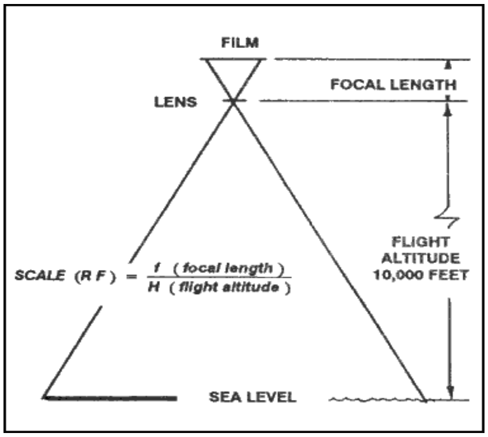


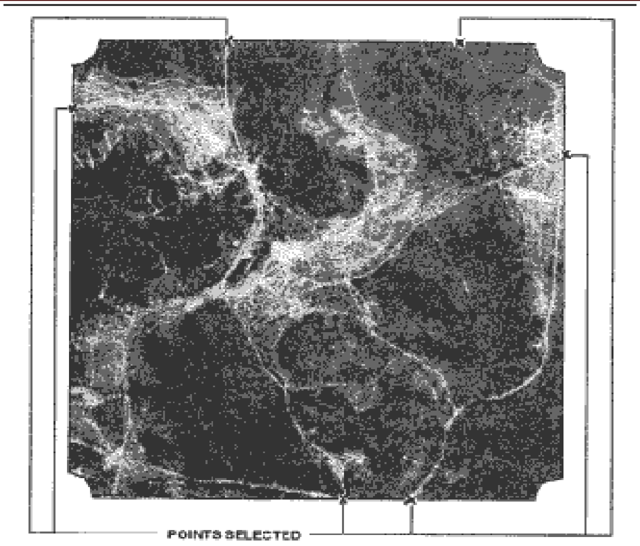
Figure-1.16 Basic computation of scale from sea level

1.8. Indexing

When aerial photos are taken of an area, it is convenient to have a record of the extent of coverage of each photo. A map on which the area covered by each photo is outlined and numbered or indexed to correspond to the photo is called an index map. There are two methods of preparing index maps.

1.8.1 The Four-Corner Method

This method requires location on the map of the exact point corresponding to each corner of the photo (Figures -1.17 and 1.18). If a recognizable object such as a house or road junction can be found exactly at one of the corners, this point may be used on the map as the corner of the photo. If recognizable objects cannot be found at the corners, then the edges of the photo should be outlined on the map by lining up two or more identifiable objects along each edge; the points where the edges intersect should be the exact corners of the photo. If the photo is not a perfect vertical, the area outlined on the map will not be a perfect square or rectangle. After the four sides are drawn on the map, the number of the photograph is written in the enclosed area for identification. This number should be placed in the same corner as it is on the photo.



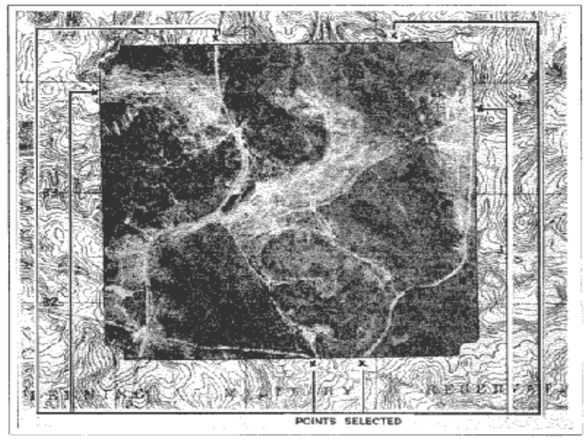


Figure -1.17 Four-corner methods (selection of points)Figure 1.18 Plotting, using the four-corner method

1.8.2. The Template Method

This Method is used when a large number of photos are to be indexed, and the exact area covered by each is not as important as approximate area and location. In this case, a template (cardboard pattern or guide) is cut to fit the average area the photos cover on the index map. It is used to outline the individual area covered by each photo. To construct a template, find the average map dimensions covered by the photos to be indexed as follows. Multiply the average length of the photos by the denominator of the average scale of the photos; multiply this by the scale of the map. Do the same for the width of the photos. This gives the average length and width of the area each photo covers on the map--or the size to which the template should be cut

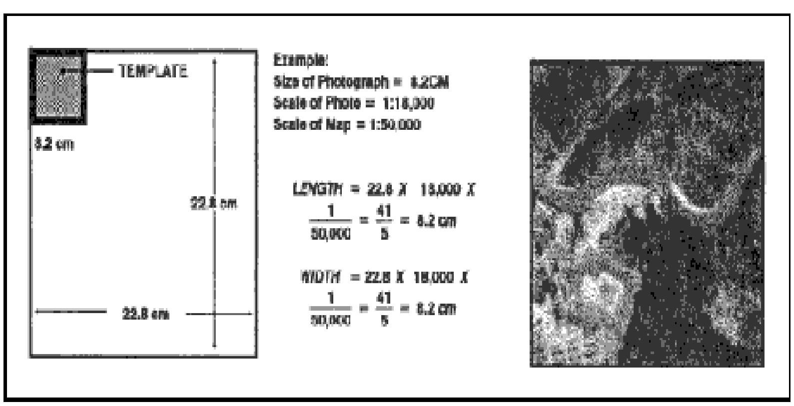


Figure-1.19Constructing a Template

1.8.3 Index the Map

To Index the map select the general area covered by the first photo and orient the photo to the map. Place the template over the area on the map and adjust it until it covers the area as completely and accurately as possible. Draw lines around the edges of the template. Remove the rectangle and proceed to the next photo (Figure 1.20).

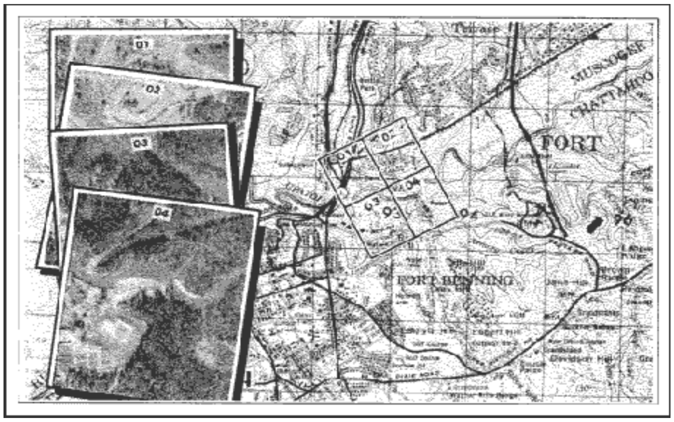


Figure-1.20IndexingWith a Template s

After all photos have been plotted, write on the map sufficient information to identify the mission or sortie. If more than one sortie is plotted on one map or overlay, use a different color for each sortie.

In most cases, when a unit orders aerial photography, an index is included to give the basic information. Instead of being annotated on a map of the area, it appears on an overlay and is keyed to a map.

Check your Progress

Q.1 *What is Photogrammetry?*

Q.2 *What is Scale?*

Q.3 *Fill in the blank.*

a)*Most aerial photography uses a film size of …………………..*

b) *Photograph taken with the camera inclined about 30° from the vertical is …………*

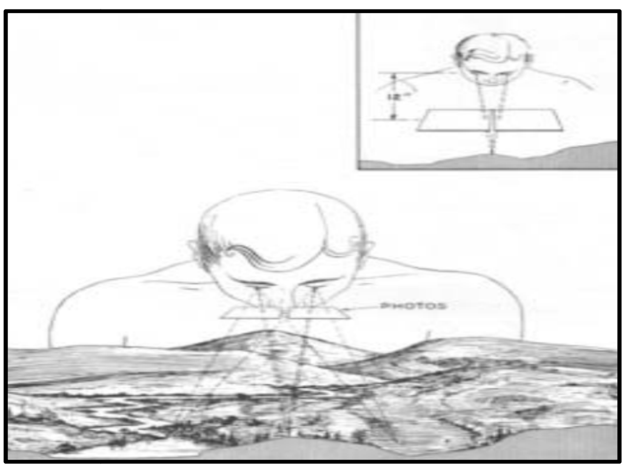
Q. 4 *True false against the following:*

- ***a)***Each aerial photograph contains in its margin important information for the photo user*

- ***b)***When aerial photos are taken of an area, it is convenient to have a record of the extent of coverage of each photo*

1.9. Stereovision

One of the limitations of the vertical aerial photograph is the lack of apparent relief. Stereoscopic vision (or as it is more commonly known, stereovision or depth perception) is the ability to see three-dimensionally or to see length, width, and depth (distance) at the same time. This requires two views of a single object from two slightly different positions. Most people have the ability to see three-dimensionally. Whenever an object is viewed, it is seen twice--once with the left eye and once with the right eye. The fusion or blending together of these two images in the brain permits the judgment of depth or distance.



(a) In taking aerial photographsit is rare for only a single picture to be taken. Generally, the aircraft flies over the area to be photographed taking a series of pictures, each of which overlaps the photograph preceding it and the photograph following it so that an unbroken coverage of the area is obtained (Figure-1.21). The amount of overlap is usually 56 percent, which means that 56 percent of the ground detail appearing on one photo also appears on the next photograph.

When a single flight does not give the necessary coverage of an area, additional flights must be made. These additional flights are parallel to the first and must have an overlap between them. This overlap between flights is known as side lap and usually is between 15 and 20 percent (Figure1.22).

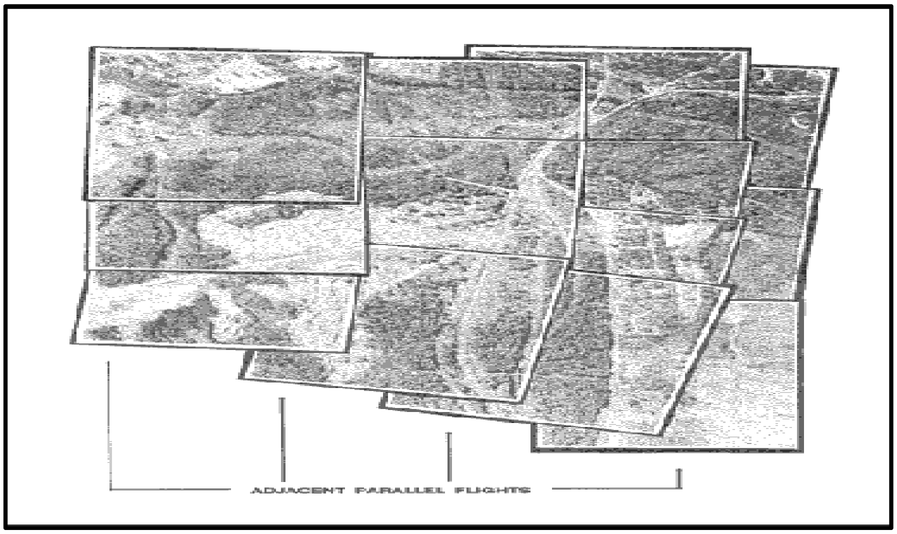


Figure -1.21 Photographic overlap

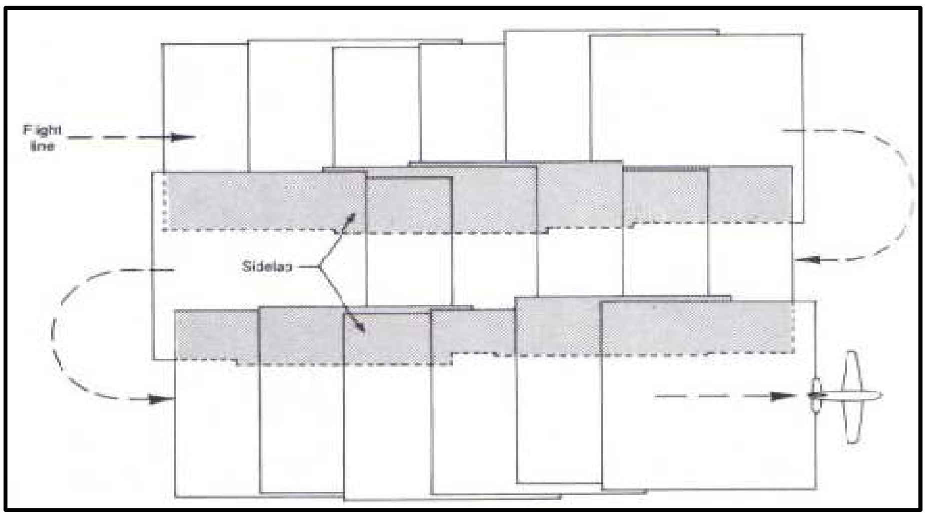


Figure-1.22 Side lap

(b). The requirement for stereovision can be satisfied by overlapping photographs if one eye sees the object on one photograph and the other eye sees the same object on another photograph. While this can be done after practice with the eyes alone, it is much easier if an optical aid is used. These optical aids are known as stereoscopes. There are many types of stereoscopes, but only the two most commonly used are discussed.

1.9.1 Pocket Stereoscope

The pocket stereoscope (Figure-1.23), sometimes known as a lens stereoscope consists of two magnifying lenses mounted in a metal frame. Because of its simplicity and ease of carrying, it is the type used most frequently by military personnel.

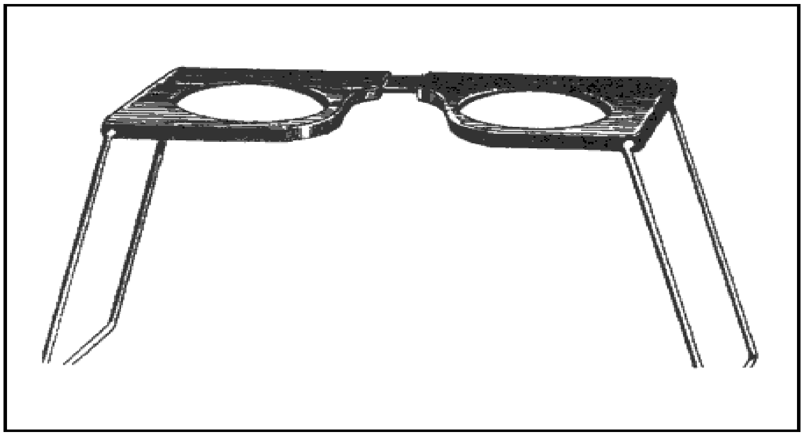


Figure-1.23 PocketStereoscope

1.9.2Mirror Stereoscope

The mirror stereoscope (Figure-1.24) is larger, heavier, and more subject to damage than the pocket stereoscope. It consists of four mirrors mounted in a metal frame.

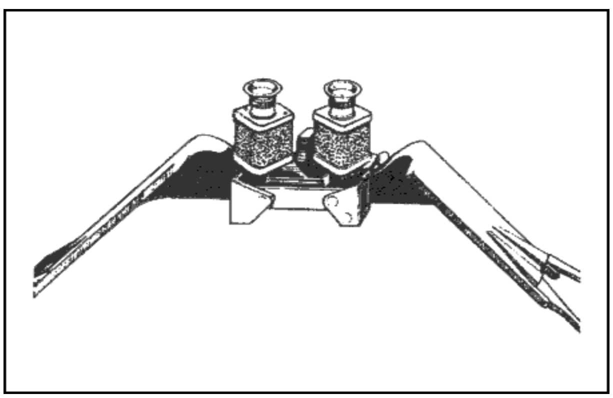


Figure -1.24 Mirror Stereoscopes

A method to orient a pair of aerial photographs for best three-dimensional viewing is outlined below:

(1) Arrange the selected pair of photos in such a way that the shadows on them generally appear to fall toward the viewer. It is also desirable that the light source enters the side away from the observer during the study of the photographs (Figure -1.25).

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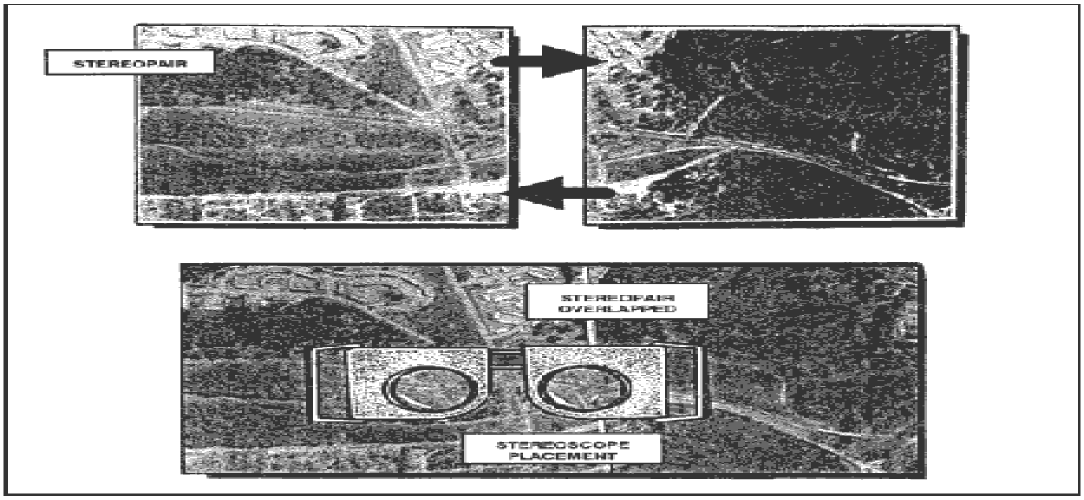

Figure -1.25Placement of stereoscope over stereo pair

(2) Place the pair of photographs on a flat surface so that the detail on one photograph is directly over the same detail on the other photograph

(3) Place the stereoscope over the photographs so that the left lens is over the left photograph and the right lens is over the right photograph

(4) Separate the photographs along the line of flight until a piece of detail appearing in the overlap area of the left photograph is directly under the left lens and the same piece of detail on the right photo is directly under the right lens.

(5) With the photograph and stereoscope in this position, a three-dimensional image should be seen. A few minor adjustments may be necessary, such as adjusting the aerial photographs of the stereoscope to obtain the correct position for your eyes. The hills appear to rise and the valleys sink so that there is the impression of being in an aircraft looking down at the ground.

(6) The identification of features on photographs is much easier and more accurate with this three-dimensional view (Figure-1.26). The same five factors of recognition (size, shape, shadow,

tone, and surrounding objects) must still be applied; but now, with the addition of relief, a more natural view is seen.

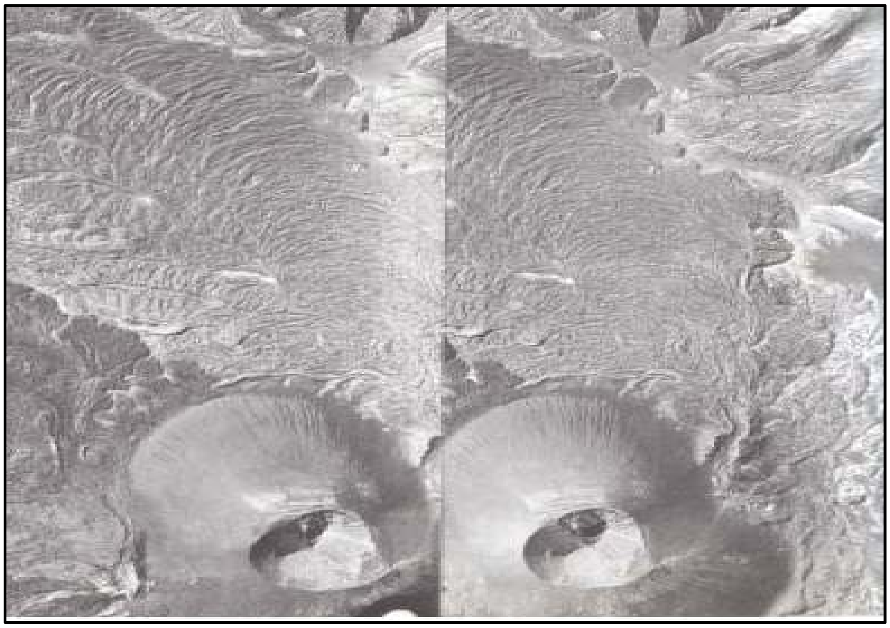

Figure-1.26Stereoscopic view

1.10. Identification ofPhotograph Features

The identification of features on a photograph is not difficult if the following facts are remembered. The view that is presented by the aerial photograph is from above and, as a result, objects do not look familiar. Objects that are greatly reduced in size appear distorted. Most aerial photography is black and white, and all colors appear on the photograph in shades of gray. Generally speaking, the darker the natural color, the darker it will appear on the photograph.

1.10.1Tone

Tone can be defined as each distinguishable variation from white to black. Color may be defined as each distinguishable variation on an image produced by a multitude of combinations of hue, value and chroma. Many factors influence the tone or color of objects or features recorded on *photographic emulsions. But, if there is not sufficient contrast between an object and its background to permit, at least, detection there can be no identification. While a human interpreter may only be able to distinguish between ten and twenty shades of gray; interpreters can distinguish many more colors. Some authors state that interpreters can distinguish at least 100 times more variations of color on color photography than shades of gray on black and white photography.*

1.10.2 Resolution

Resolution can be defined as the ability of the entire photographic system, including lens, exposure, processing, and other factors, to render a sharply defined image. An object or feature must be resolved in order to be detected and/or identified. Resolution is one of the most difficult concepts to address in image analysis because it can be described for systems in terms of modulation transfer (or point spread) functions, or it can be discussed for camera lenses in terms of being able to resolve so many line pairs per millimeter. There are resolution targets that help to determine this when testing camera lenses for metric quality. Photo interpreters often talk about resolution in terms of ground resolved distance which is the smallest normal contrast object that can be identified and measured

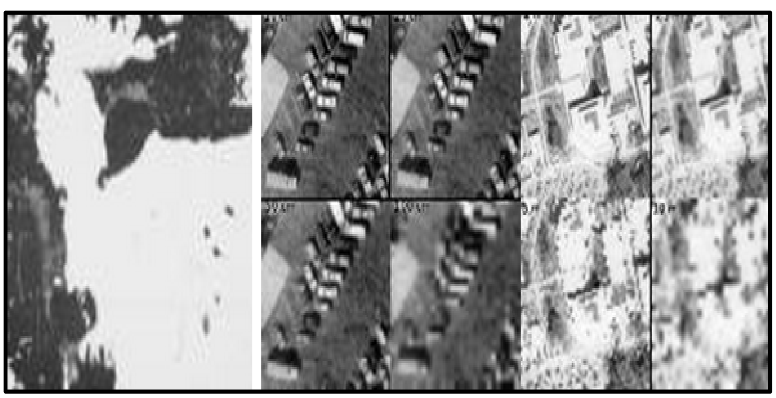

Figure-1.27 Tone, Centimeter VS. Meter Resolution

1.10.3 Size

Size can be important in discriminating objects and features (cars vs. trucks or buses, single family vs. multifamily residences, brush vs. trees, etc.). In the use of size as a diagnostic characteristic both the relative and absolute sizes of objects can be important. Size can also be *used in judging the significance of objects and features. The size of the crowns of trees can be related to board feet that may be cut for specific species in managed forests. The size of agricultural fields can be related to water use in arid areas, or the amount of fertilizers used. The size of runways gives an indication of the types of aircraft that can be accommodated.*

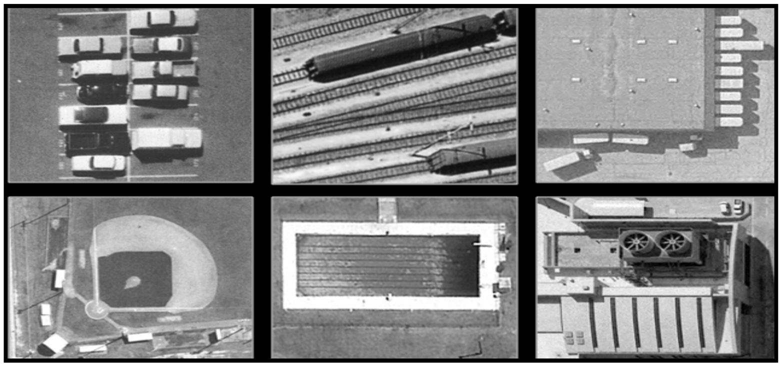

Figure-1.28 Size variation indifferent Objects or Features

1.10.4 The shape

Shape of objects/features can provide diagnostic clues that aid identification. The Pentagon building in Washington is a diagnostic shape. Man-made features have straight edges, natural features tend not to. Roads can have right angle (90°) turns, railroads can't. Other examples include freeway interchanges, old fortifications (European cities), military installations (surface to air missile sites).

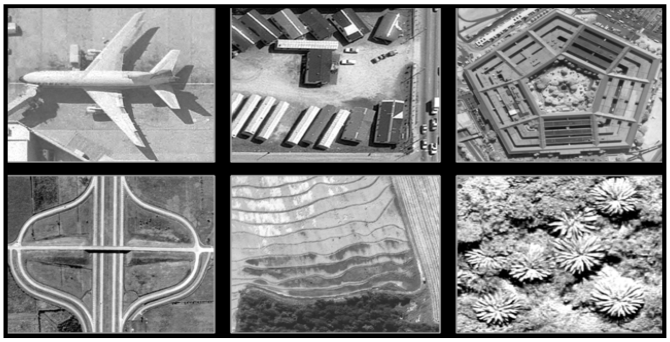

Figure-1.29 Shape variation in different Objects or Features

1.10.5Texture

Textureis the frequency of change and arrangement of tones. This is a micro image characteristic. The visual impression of smoothness or roughness of an area can often be a valuable clue in image interpretation. Still water bodies are typically fine textured, grass *medium, brush rough. There are always exceptions though and scale can and does play a role; grass could be smooth, brush medium and forest rough on higher altitude aerial photograph of the same area.*

1.10.6 Pattern

Patternis the spatial arrangement of objects. Patterns can be either man-made or natural. Pattern is a macro image characteristic. It is the regular arrangement of objects that can be diagnostic of features on the landscape. An orchard has a particular pattern. Pattern can also be important in geologic or geomorphologic analysis; drainage pattern can reveal a great deal about the lithology and geologic structural patterns of the underlying strata. Dendridic drainage patterns develop on flat bedded sediments, radial on domes, linear or trellis in areas with faults etc. It must be noted here that pattern is highly scale dependent.

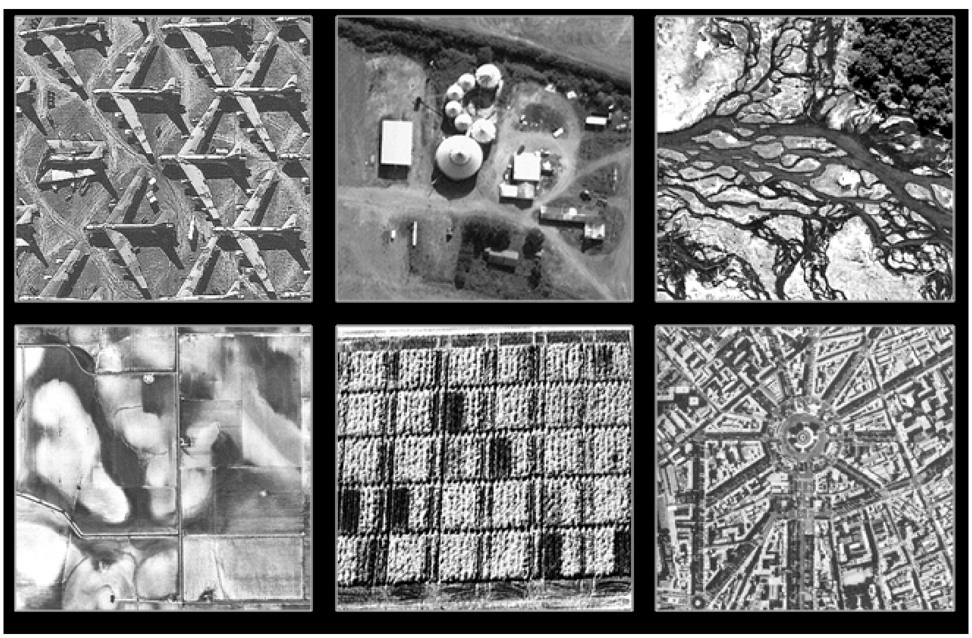

Figure-1.30Variation differences Between Texture and Patterns

1.10.7 Height

For some types of analysis e.g. land forms, forestry and some intelligence applications, some interpreters believe that after tone/color height is the most important element for identification. This is a point of debate, but height can add significant information in many types of *interpretation tasks, particularly those that deal with the analysis of man-made features and vegetation. How tall a tree is can tell something about the expected amount of board feet. How deep an excavation is can tell something about the amount of material that was removed (in some mining operations excavators are paid on the basis of material removed as determined by photogrammetric measurement of volume).*

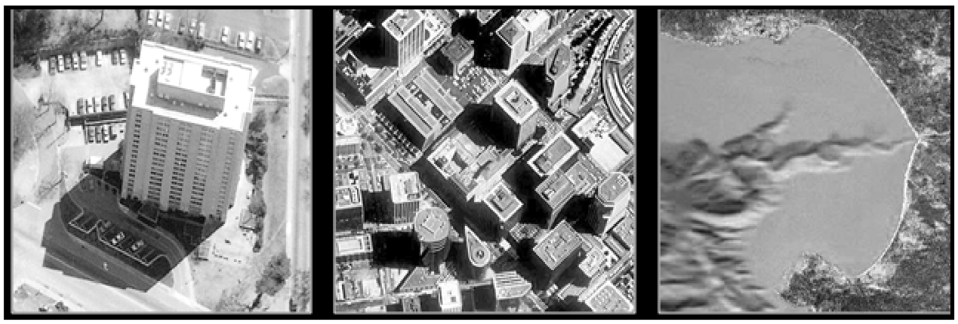

Figure-1.31 Heights

1.10.8 Shadow

Geologists like low sun angle photography because of the features that shadow patterns can help identify (e.g. fault lines and fracture patterns). Church steeples and smokestacks can cast shadows that can facilitate their identification. Tree identification can be aided by an examination of the shadows thrown. Shadows can also inhibit interpretation. On infrared aerial photography shadows are typically very black and can render targets in shadows uninterpretable.

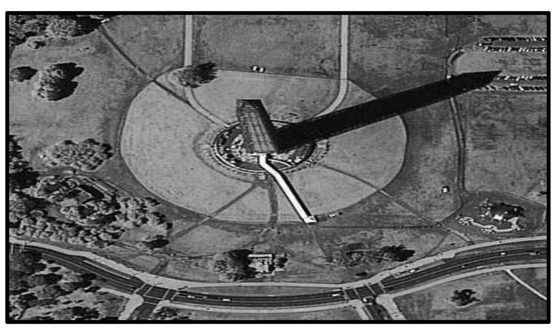

Figure-1.32 Washington Monument (height-shadow)

1.10.9Site

Site Refers to how objects are arranged with respect to one another, or with respect to terrain features. Aspect, topography, geology, soil, vegetation and cultural features on the landscape are distinctive factors that the interpreter should be aware of when examining a site. The relative *importance of each of these factors will vary with local conditions, but all are important. Just as some vegetation grows in swamps others grow on sandy ridges or on the sunny side vs. the shaded sides of hills. Crop types may prefer certain conditions (e.g. orchards on hillsides). Man made features may also be found on rivers (e.g. power plant) or on hilltops (e.g. observatory or radar facility).*

1.10.10Association

Some objects are so commonly associated with one another that identification of one tends to indicate or confirm the existence of another. Smoke stacks, cooling ponds, transformer yards, coal piles, railroad tracks = coal fired power plant. Arid terrain, basin bottom location, highly reflective surface, sparse vegetation = playa, which typically have halophytic vegetation e.g. saltbush. Association is one of the most helpful interpretation clues in identifying man made installations. Aluminum manufacture requires large amounts of electrical energy. Schools of different grade levels typically have characteristic playing fields, parking lots and clusters of buildings. Nuclear power plants are associated with a source of cooling water, weather patterns can be associated with pollution sources etc.

Figure-1.33 View of Different Sites

Check your Progress

Q.5*whatis Stereoscopic vision?*

Q.6 *whatis pocket stereoscope?*

Q. 7 *True false against the following:*

a)*The mirror stereoscope is not larger, heavier, and more subject to damage than the pocket stereoscope.*

b)*Shape of objects/features can provide diagnostic clues that aid identification.*

1.11. Applications

Aerial photographs enhance the value of many GIS, mapping, engineering and telecommunications applications. Here are a few examples:

- ***Telecommunications Network Planning****:-Engineers can see exact detail around resources such as cell towers and fiber optic cable to improve site/asset management and streamline new site selection and antenna placement.*
- ***Site Selection****:-The area around a proposed site can be viewed and analyzed in terms of parking/traffic access, adjacent buildings, land types and street networks to improve decision-making regarding site selection.*
- ***Real Estate****:-Using aerial photographs to present visually appealing advertising materials that illustrate the exact design, nature and characteristics of the property in question. This helps in increasing the value of the property.*
- ***Public Sector****:-Real-world pictures of an area help planners and administrators make better decisions regarding land use planning, zoning, growth administration and resource deployment.*
- ***Cartography****:-A process that is used in photogrammetric surveys, the basis for topographic maps*

- ***Land-use planning:-*** *A method by which the ideal usage of a piece of land is determined*
- ***Archaeology****:-Studying a given area for potential archaeological sites, Movie production: Evaluating a potential area for filming*

- ***Environmental studies:-*** *Charting the environmental changes that have occurred in a given area, Examining a particular area and evaluating the environmental status and/or damage that has taken place over a set period of time.*
- ***Surveillance:*** *Making sure that an area has not been compromised or occupied by hostile forces*

1.11.1Limitations/ Comparison with Maps

A topographic map may be obsolete because it was compiled many years ago. A recent aerial photograph shows any changes that have taken place since the map was made. For this reason, maps and aerial photographs complement each other. More information can be gained by using the two together than by using either alone.

- ***Advantages:****An aerial photograph has the following advantages over a map:*

(1) It provides a current pictorial view of the ground that no map can equal.

(2) It is more readily obtained. The photograph may be in the hands of the user within a few hours after it is taken; a map may take months to prepare.

(3) It may be made for places that are inaccessible to ground soldiers.

(4) It shows military features that do not appear on maps.

(5) It can provide a day-to-day comparison of selected areas, permitting evaluations to be made of enemy activity.

(6) It provides a permanent and objective record of the day-to-day changes with the area.

- ***Disadvantages:****The aerial photograph has the following disadvantages as compared to a map*

(1) Ground features are difficult to identify or interpret without symbols and are often obscured by other ground detail as, for example, buildings in wooded areas.

(2) Position location and scale are only approximate.

(3) Detailed variations in the terrain features are not readily apparent without overlapping photography and a stereoscopic viewing instrument.

(4) Because of a lack of contrasting colors and tone, a photograph is difficult to use in poor light.

(5) It lacks marginal data.

1.12 Summary

In this unit we have discussed the technology of Photogrammetry. What is the exact meaning of Photogrammetry, how it done through Aerial photography then discussed on techquine of aerial photo, it types and it application. We also learned about the Image Stereoscopic image used for 3D image and further discuss on Image interpretation.

1.13 Glossary

Image: *Two dimensional representation of a real object, produced by focusing rays of light.*

Camera angles: *Various positions of the camera with respect to the subject being photographed, each giving a different viewpoint and perspective*

Angle of view: *The amount of a scene that can be recorded by a particular lens; determined by the focal length of the lens.*

Focal point: *Point of light on the optical axis where all rays of light from a given subject meet at a common point of sharp focus*

Infrared: *Rays that occur beyond the red end of the electro-magnetic spectrum and are invisible to the human eye. They can be recorded on specially sensitized films, producing images in black & white or color.*

Nadir: *The point on the celestial sphere directly beneath a given position or observer and diametrically opposite the zenith.*

Altimeter : *A sensitive aneroid barometer that is graduated and calibrated, used chiefly in aircraft for finding distance above sea level, terrain, or some other reference point by a comparison of air pressure*

1.14. Answer to check your progress/Possible Answers to SAQ

Ans.1 *'Photo' - light' Gram' – drawing'Metry' – measurement*

Simply stated, Photogrammetry is the art and science of making measurements fromimagery

Ans.2The *scale of a vertical aerial photograph is determined by comparing the measured distance between two points on the photograph with the measured ground distance between the same two points.*

Scale (Rf)

——————— = Photo Distance

Ground Distance

Ans.3 *Fill in the blank.*

(a)*9" x 9" (23 cm x 23 cm)****(b)*** *Low Oblique*

Ans. 4 *True false against the following:*

(a) *True* ***(b)*** *True*

Ans.5*One of the limitations of the vertical aerial photograph is the lack of apparent relief. Stereoscopic vision (or as it is more commonly known, stereovision or depth perception) is the ability to see three-dimensionally or to see length, width, and depth (distance) at the same time.*

Ans.6*The pocket stereoscope sometimes known as a lens stereoscope consists of two magnifying lenses mounted in a metal frame. Because of its simplicity and ease of carrying, it is the type used most frequently by military personnel.*

Ans. 7 *True false against the following:*

(a) *False* ***(b)*** *True*

1.15 References

1. http://www.aerialarts.com/History/history.htm

2. http://en.wikipedia.org/wiki/Aerial_photography#History

3. http://143.210.25.138/index.php/A_Brief_History_of_Photogrammetry

4. http://www.map-reading.com/aptypes.php

5. http://rscc.umn.edu/rscc/v1m2.html

1.16 Suggested Readings

1. Lillesand, Thomas M., Ralph W. Kiefer, and Jonathan W. Chipman. 2004

2. Small-Format Aerial Photography: Principles, techniques and geosciences applicationsby James S. Aber(Jun 22, 2010)

3. Aerial Photography and Image Interpretationby David P. Paine(Feb 14, 2012)

1.17 Terminal Questions

Q.1- What is Vertical Aerial photography?

Q.2-Define Types of Aerial Films

Q.3- Discuss on Map Scale

Q.4- What is Pocket Stereoscope?

Q.5- What is the limitation of areial Photography?

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