Aerial Photography

lecture 3

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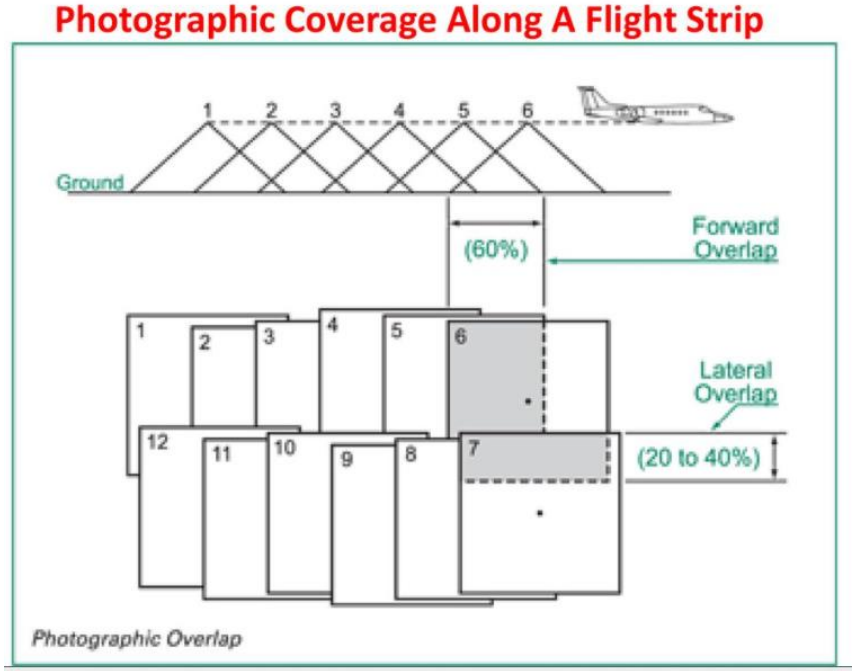
Outline

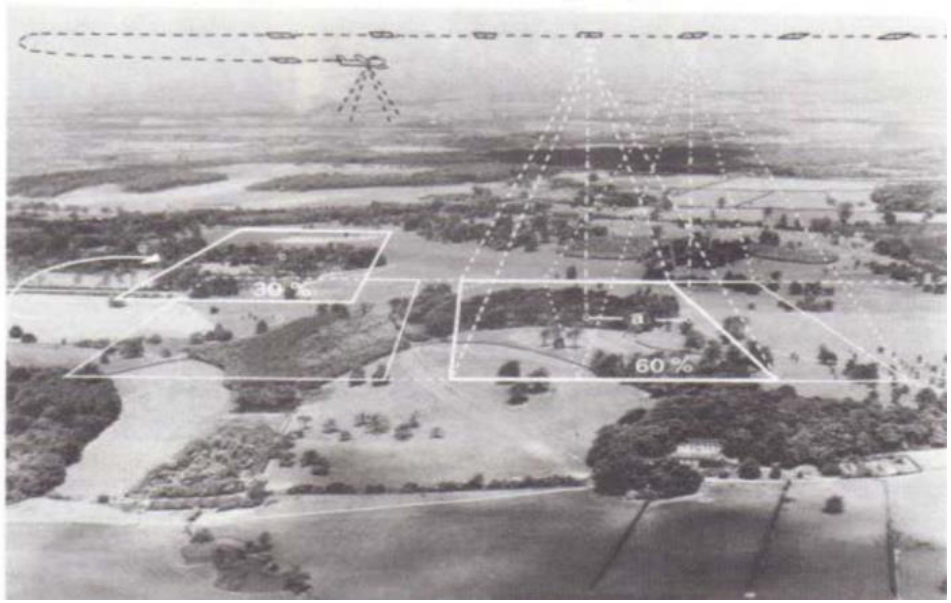
- Aerial photography (Definition)
- Flight pattern
- Aerial Photographs classification
- Grid properties on various types of aerial photographs
- Characteristics information on aerial photograph
- Basic Geometric elements (Vertical A.F.)

Defining Aerial Photography

- The term "photography" is derived from two Greek words meaning "light" (phos) and "writing" (graphien). From Greek phōt- , the stem of phōs 'light', which is a unit of illumination.
- Photography means the art, hobby, or profession of taking photographs, and developing and printing the film or processing the digitized array image.
- Photography is production of permanent images by means of the action of light on sensitized surfaces (film or array inside a camera), which finally giving rise to a new form of visual art.
- Aerial Photography means photography from the air.
- The word 'aerial' originated in early 17th century. [Formed from Latin aerius , from Greek aerios , from aēr 'air'.]

Flying Pattern





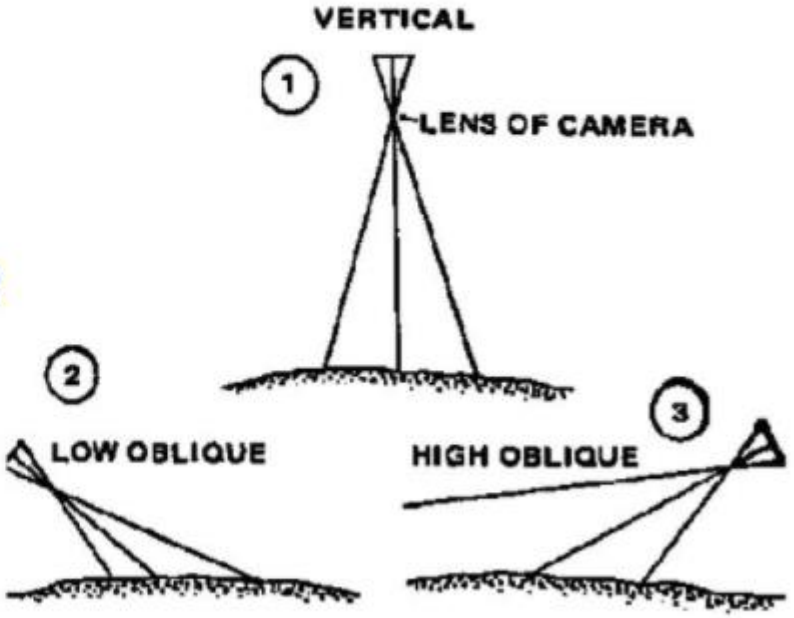
- In aerial photography, the flying pattern refers to the pre-planned path an aircraft or drone follows while capturing images from the air. This pattern is critical for ensuring that the images collected cover the desired area efficiently, with the necessary overlap and accuracy for tasks like mapping, surveying, or creating 3D models.
- The aircraft flies in straight, parallel lines (called flight lines), with images taken at regular intervals.
- **Overlap**: The images have significant forward overlap (60-80%) between consecutive photos along the same flight line and side overlap (20-30%) between adjacent flight lines. This overlap is crucial for stitching images together in post-processing.

Aerial Photographs classification

1. Based on Angles
2. Based on Film

A) TYPES OF AERIAL PHOTOGRAPHS ON ANGELS

1. Vertical
2. Low oblique
3. High oblique

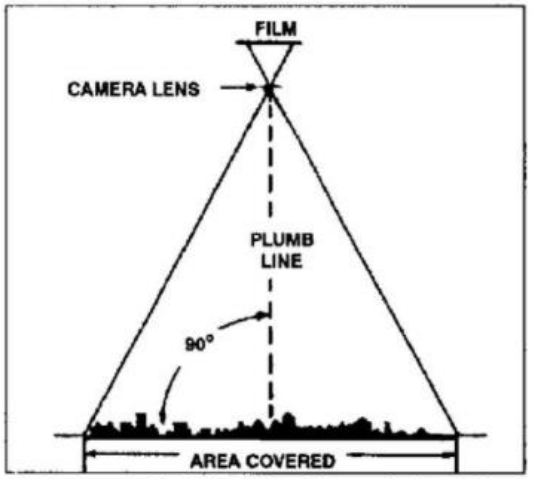


Types of aerial photograph

- Vertical

1. VERTICAL AERIAL PHOTO

"where the camera lens **axis is truly vertical** or perpendicular at the moment of exposure to the surface of the earth."



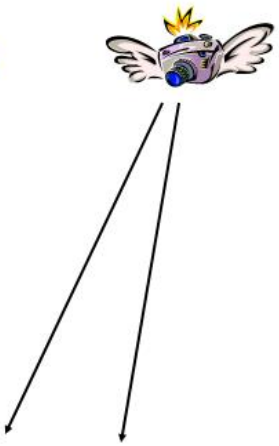
Relationship of the vertical aerial photograph with the ground.

A vertical photograph has the following characteristics:

- The scale is constant and directions are accurate.
- It covers a small area.
- The shape of the ground area a square or rectangle.
- it gives an unfamiliar view of the ground.
- accuracy of maps if taken over flat terrain.
- Relief is not readily apparent.

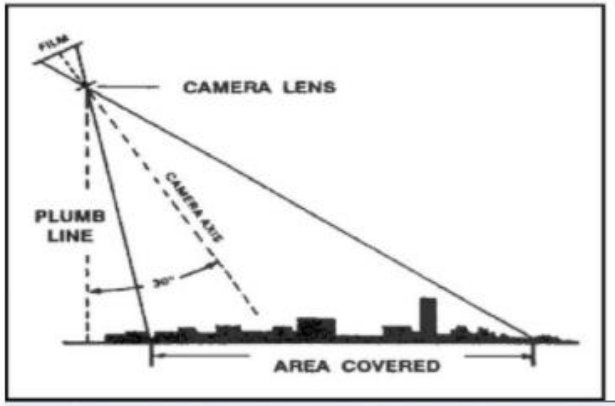
Types of aerial photograph

•Low oblique (no horizon)



2. LOW OBLIQUE

"This is a photograph taken with the camera inclined about 30° from the vertical". 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.

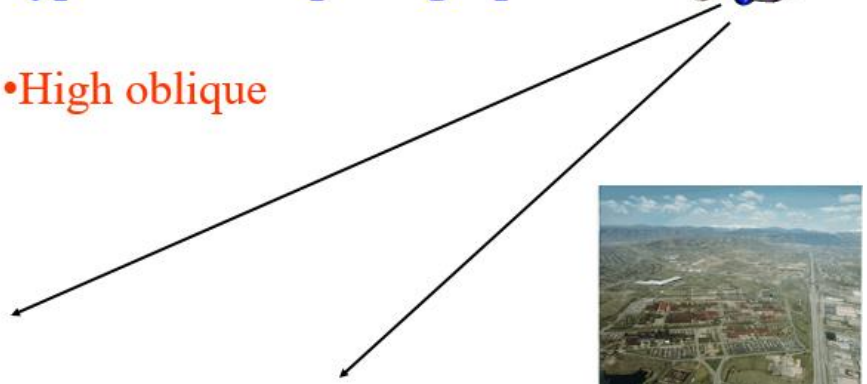


A low oblique has the following characteristics:

- It covers a relatively small area.
- The ground area covered is a trapezoid, & photo is square or rectangular.
- familiar view, comparable to viewing from the top of a high hill or tall building.
- No scale is applicable and direction, distance cannot be measured.
- Relief is distorted.
- It does not show the horizon.

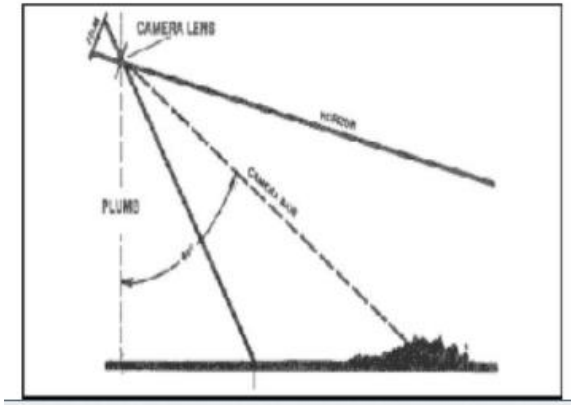
Types of aerial photograph

- High oblique



3. HIGH OBLIQUE.

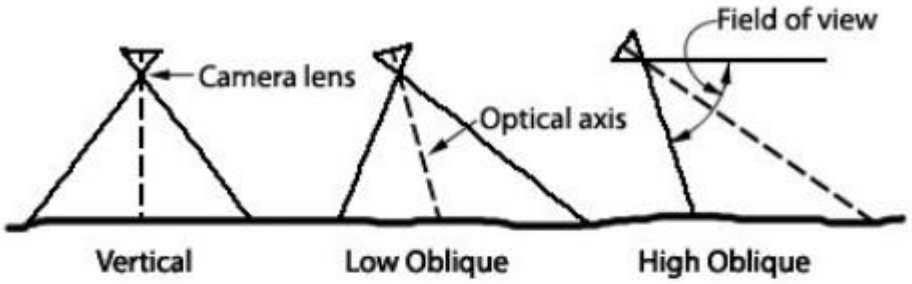
"The high oblique is a photograph taken with the camera inclined about 60° from the vertical". It has a limited military application; it is used primarily in the making of aeronautical charts.



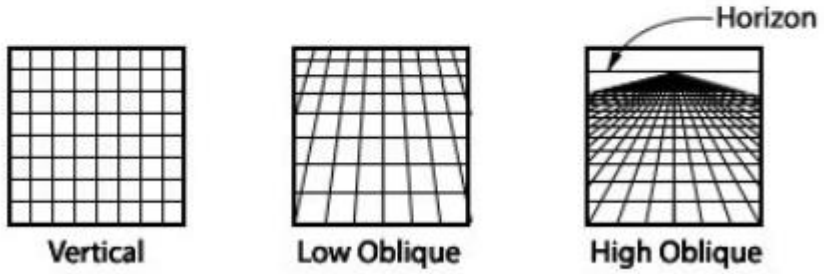
A high oblique has the following characteristics:

- It covers a very large area (not all usable).
- The ground area covered is a trapezoid, but the photograph is square or rectangular.
- The view varies from the very familiar to unfamiliar, depending on the height at which the photograph is taken.
- Distances and directions are not measured .
- Relief is distorted.
- The horizon is always visible.

Grid properties on various types of aerial photographs



Camera orientation for various types of aerial photographs



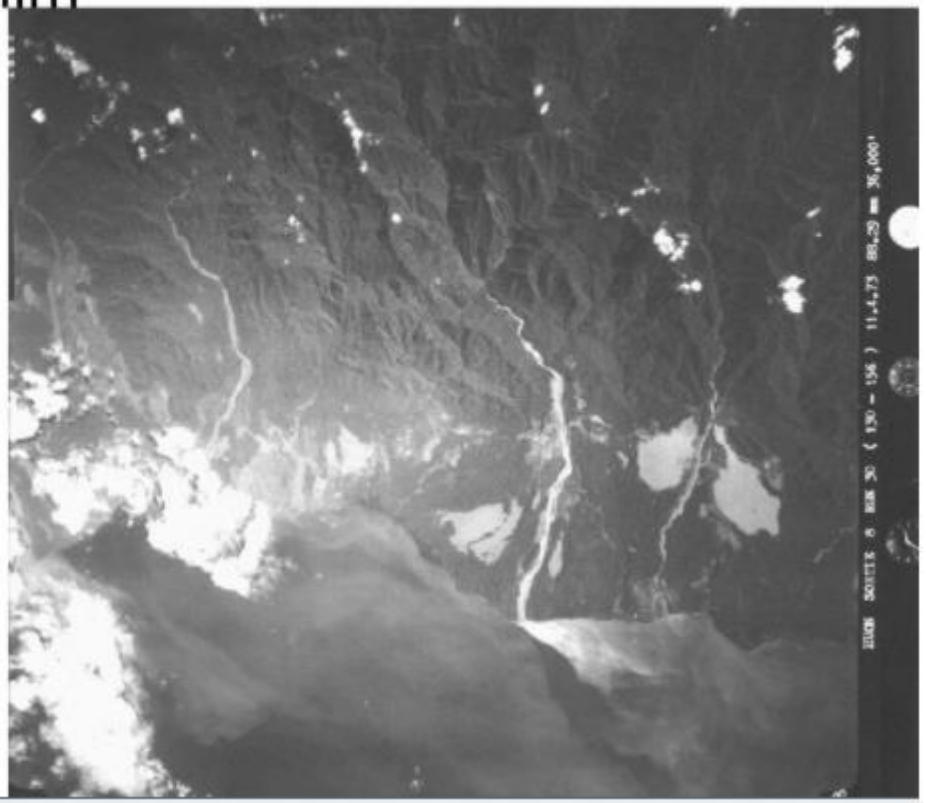
How a grid of section lines appears on various types of photos.

B) TYPES OF AERIAL PHOTOGRAPHS ON FILM

1. **Panchromatic** (B& W)
2. **Colour**
3. **Infrared**

1. **Panchromatic** (B & W) :-

- Most often used in photogrammetry & cheap
- Most aerial photography is taken with panchromatic film



2. Colour:-

- **Easy to interpret** due to atmospheric scattering
- It is limited in its use because of the time required to process it and its **need for clear, sunny weather.**

4. Infrared:-

- This is a **black-and-white** film that is sensitive to infrared waves.
- It can be used to detect artificial **camouflage materials.**

- **Types of Infrared film**

a) Black & White Infrared:-

- Flood mapping (water appears very dark)
- Vegetation mapping
- Soils - dry vs. Moist

b) False Color Infrared (CIR, Standard False Color):-

- Vegetation studies
- Water turbidity

Characteristics information on aerial photograph

- Bubble Level
- Altimeter
- Clock
- Camera (Film) Model, Flight Line and image number, Focal length

Characteristics information on aerial photograph

Camera Model, Flight Line and image number and focal length

Altimeter

Clock

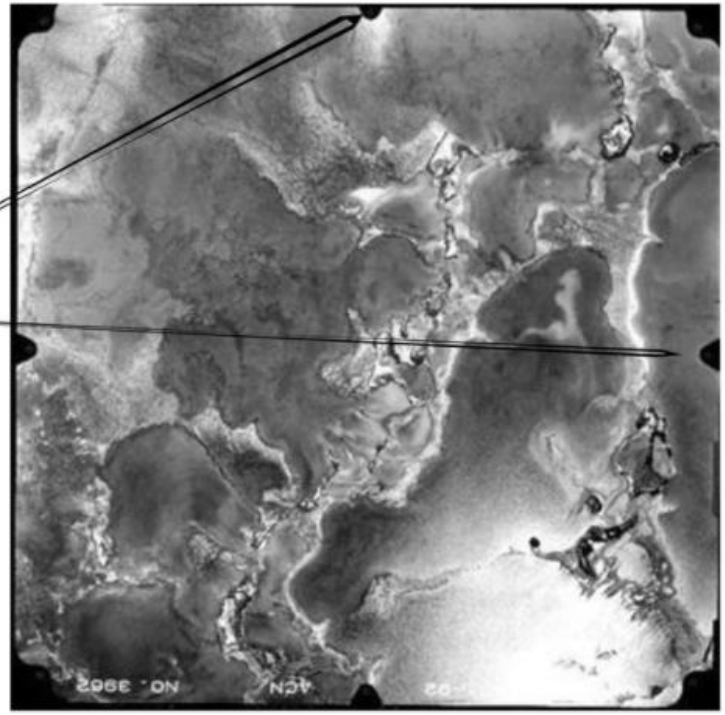
Bubble level

Basic Geometric Elements of Vertical Photograph

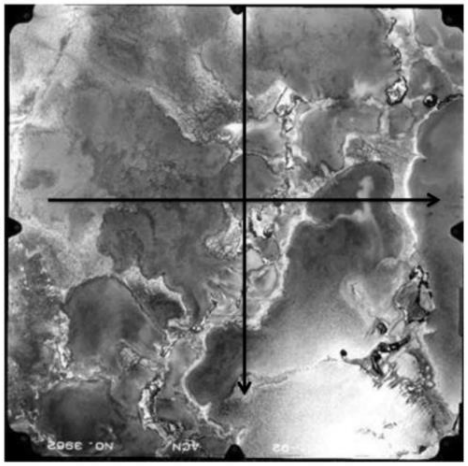
1. Fiducial mark

- Marks on the photograph margins used to locate principal point in photo.

Fiducial marks

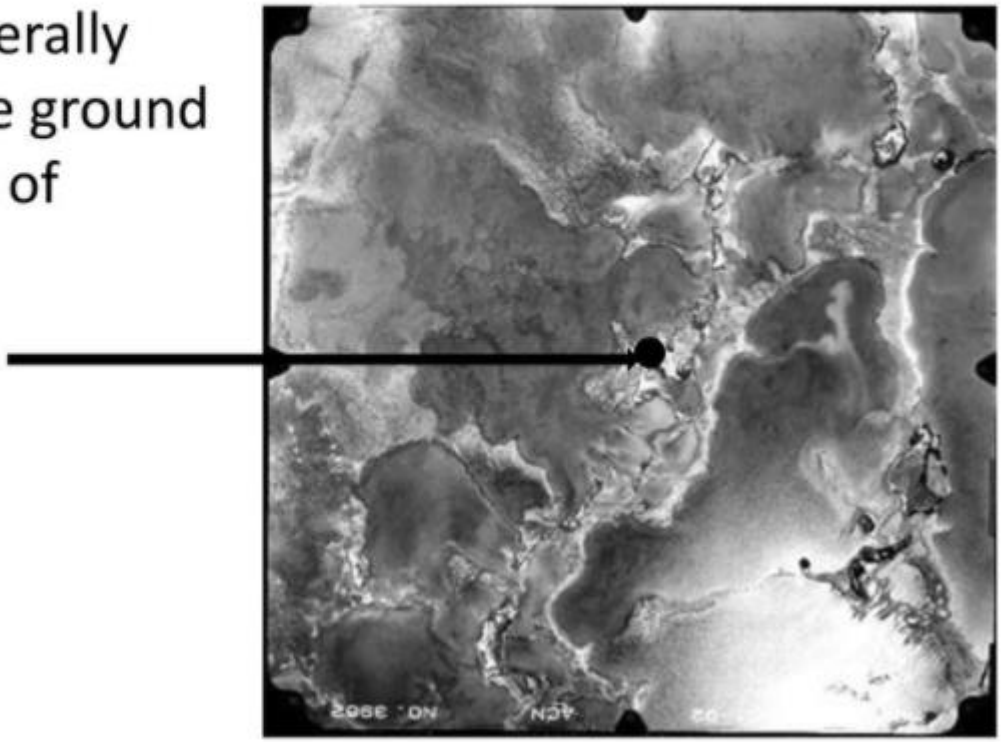


Fiducial axes

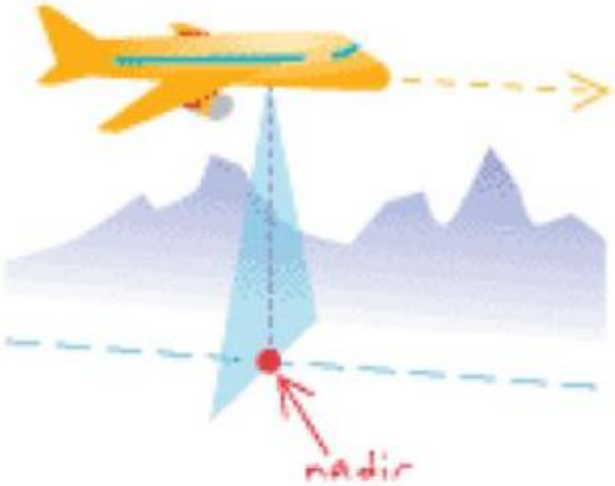


2. Principal Point

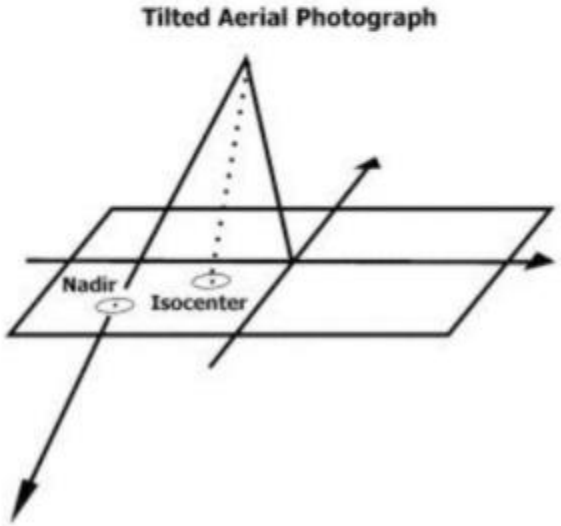
- Geometric center of photograph. Literally the point on the ground in line with axis of camera lens.



3. Nadir - The Nadir is the point vertically beneath the camera center at the time of exposure.



4. Isocenter - The point on the photo that falls on a line half- way between the principal point and the Nadir point.



Outlines

- **Visual Interpretation(Definition)**
- **Elements of image or photo interpretation**
- **Principle of stereoscope**

Visual interpretation

In it simplest definition, Image interpretation is define as the act of examining images for the purpose of identifying objects and judging their significance

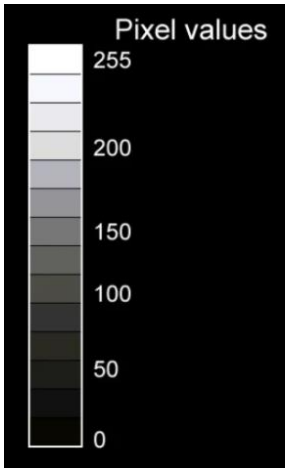
Image interpretation is a process of identifying what we see on the images and communicate the information obtained from these images to others for evaluating this significance. This process, however, is not restricted to making decisions concerning what objects appear in images, but it also usually includes a determination of their relative locations and extents.

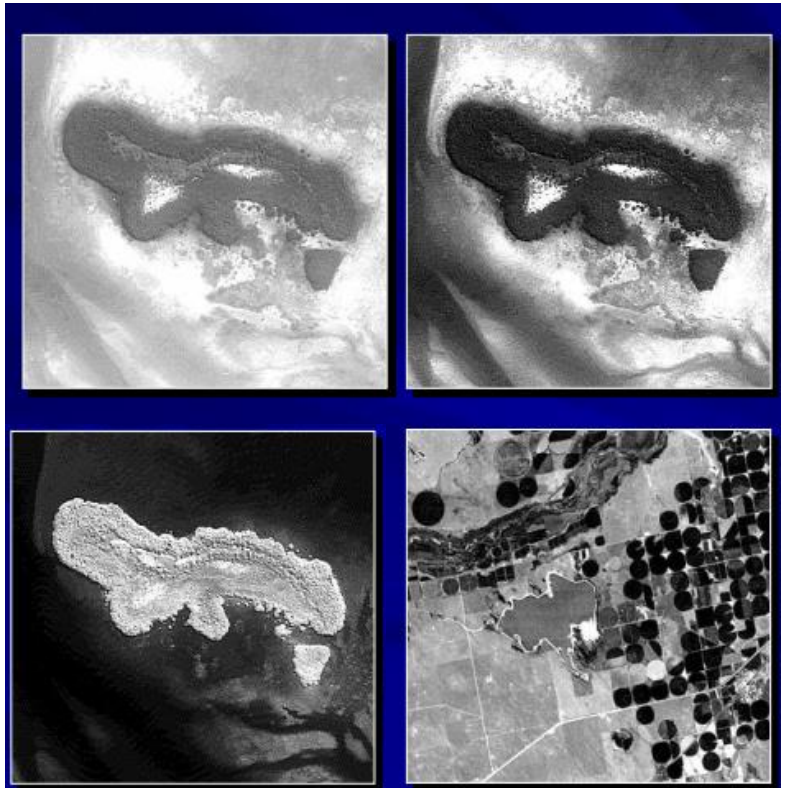
Elements of image or photo interpretation

- **Tone**
- **Texture**
- **Pattern**
- **Size**
- **Shadow**
- **Shape**
- **Association**
- **Site**

1- TONE

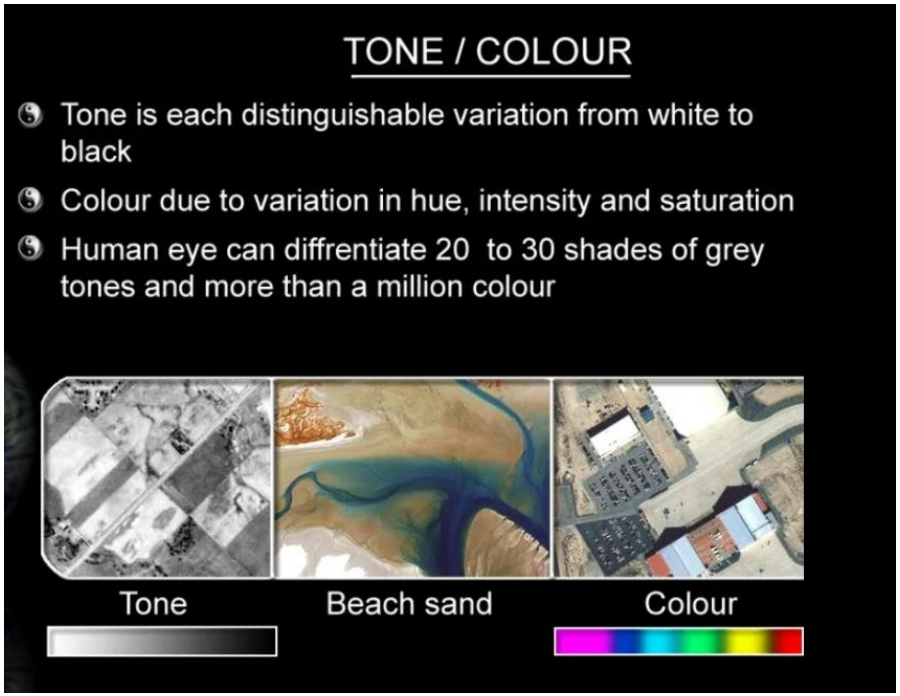
- **Tone** or hue refers to the relative brightness or colour of objects on an image. It is the most important characteristics of the photo. It represents a record of the radiation that has been reflected from the Earth's surface onto the film.
- Light tone represents areas with a high reflectance/radiance and dark tone represents areas with low radiance. The nature of the materials on the Earth's surface affects the amount of light reflected.





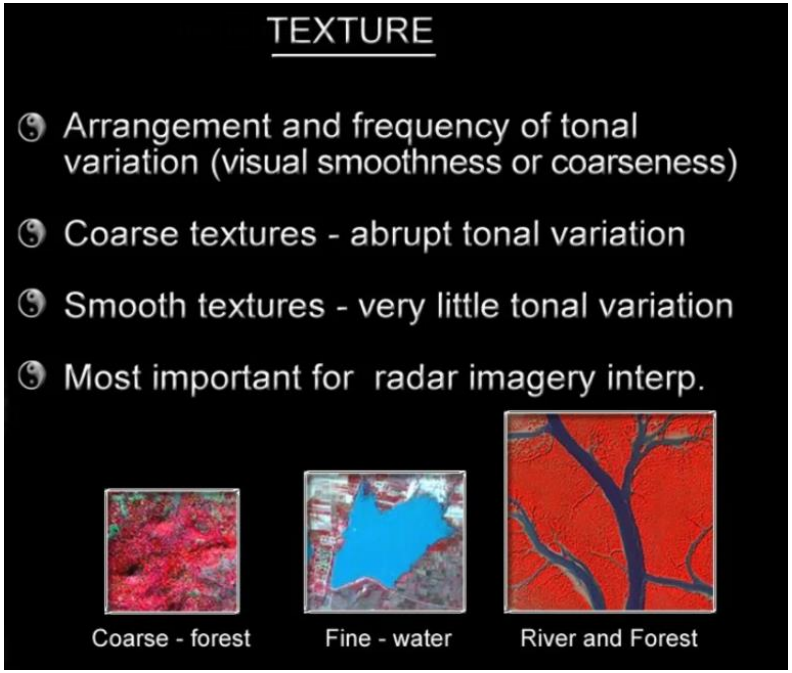
TONE / COLOUR

- Tone is each distinguishable variation from white to black
- Colour due to variation in hue, intensity and saturation
- Human eye can diffrentiate 20 to 30 shades of grey tones and more than a million colour



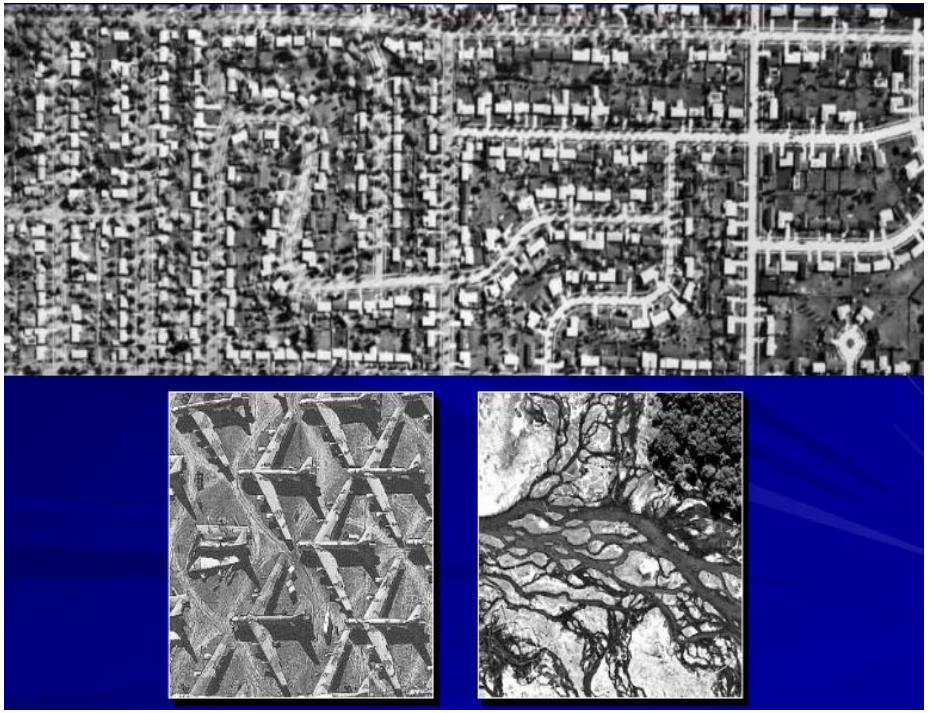
2- TEXTURE

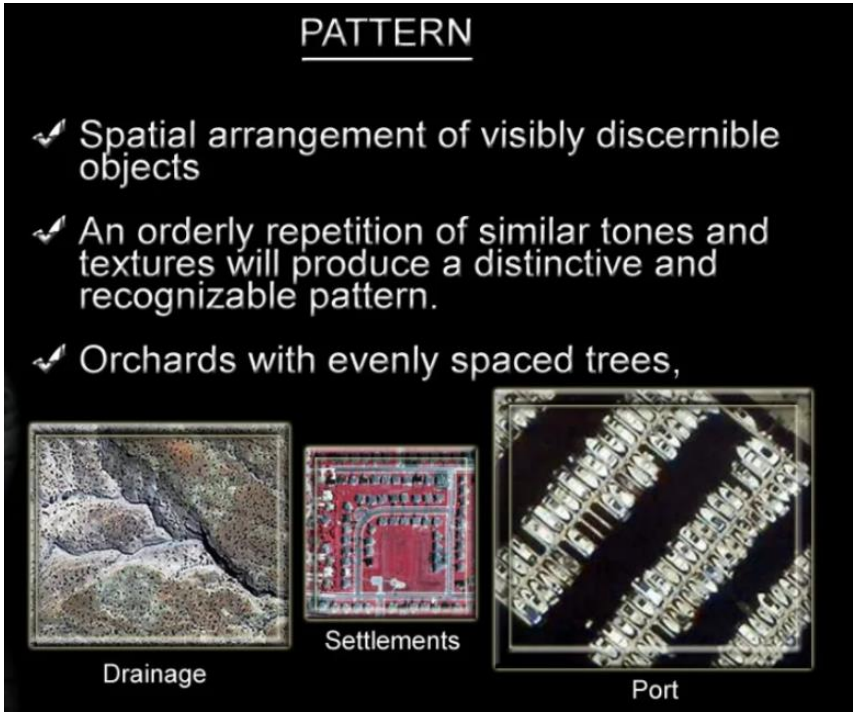
- **Texture** is the frequency of tonal changes within an aerial photo that arises when a number of features are viewed together. Texture is produced by an aggregation of unit features that may be too small may be discerned individually on the image such as the tree leaves and leaf shadows. It determines the overall visual "smoothness" or "coarseness" of image features.
- Texture is dependent on the scale of aerial photograph. As the scale is reduced the texture progressively becomes finer and ultimately disappears.



3- PATTERN

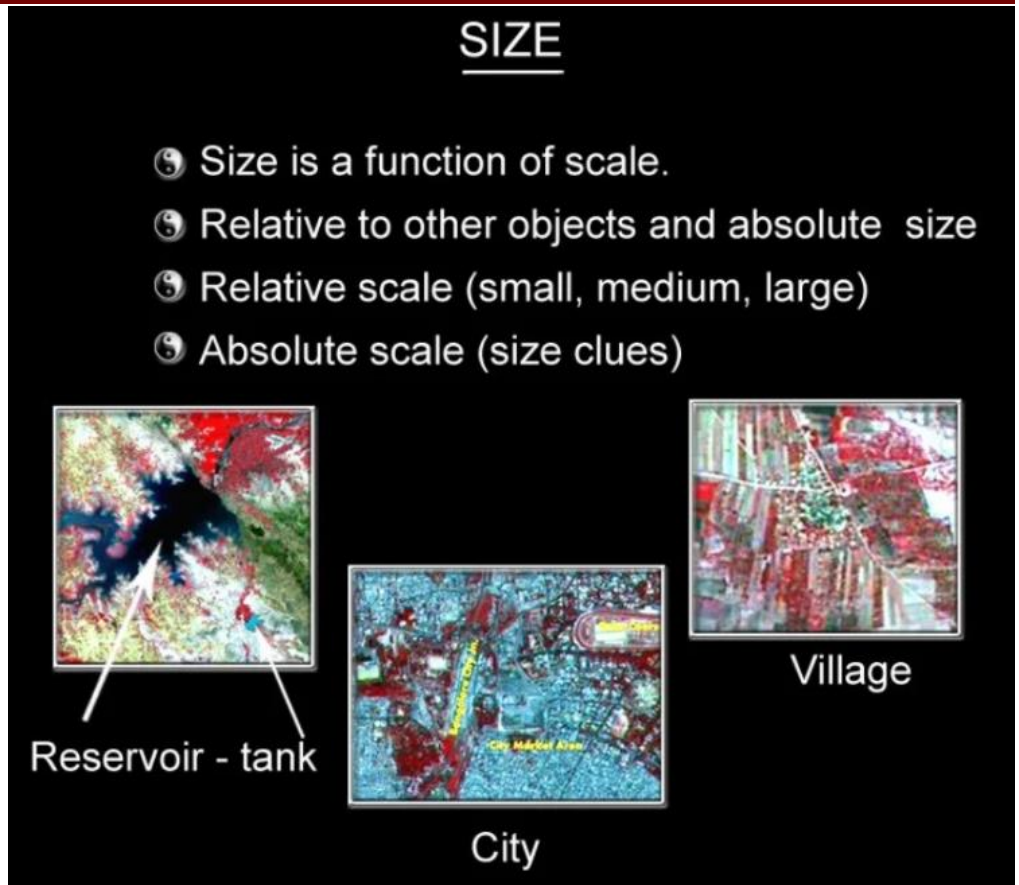
- **Pattern** is the spatial arrangement of objects. The repetition of certain general forms or relationships is characteristic of many objects. For examples road patterns or drainage pattern, crop disease pattern and lithological pattern.





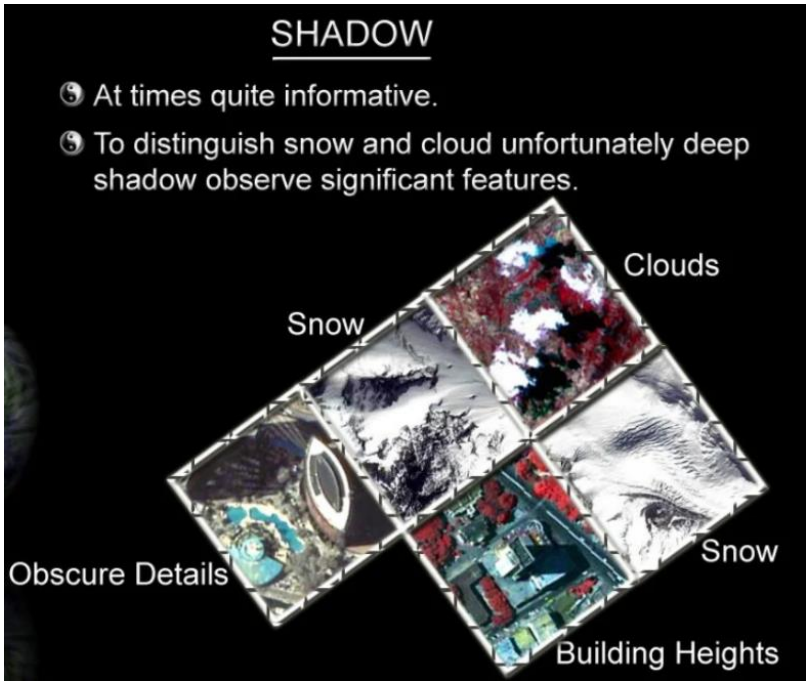
4- SIZE

- **Size** of an object is a function of photo scale. The sizes of objects can be estimated by comparing them with objects whose sizes are known.
- Sizes of objects must be considered while interpreting features and some features may be misinterpreted if sizes were not considered (e.g., a small storage shed might be misinterpreted as a barn if size was not considered).



5- SHADOW

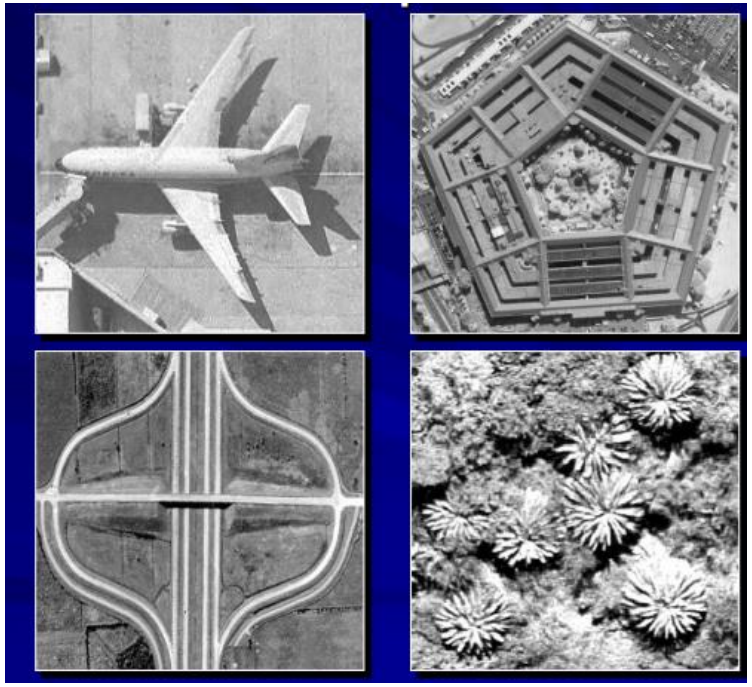
- **Shadows** of objects aid in their identification. Shadows are important in two opposing respects: (1) the shape or outline of shadow affords an impression of the profile view of objects (which aids in interpretation) and (2) objects with shadows reflect little light and are difficult to discern on a photo.

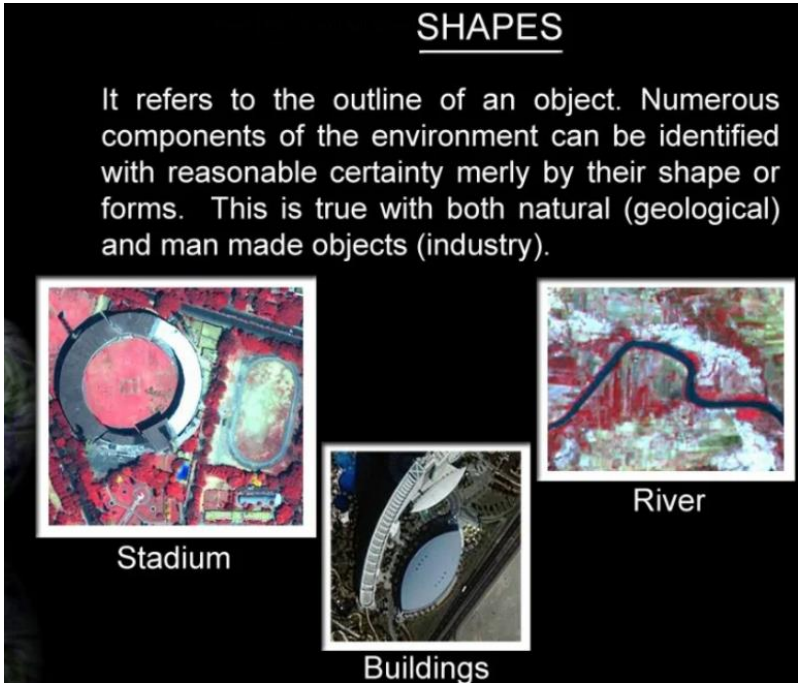


6- SHAPE

Shape refers to the general form, structure, or outline of individual objects. Shape can be a very distinctive clue for interpretation. Straight edge shapes typically represent urban or agricultural (field) targets, while natural features, such as forest edges, are generally more irregular in shape, except where man has created a road or clear cuts. Farm or crop land irrigated by rotating sprinkler systems would appear as circular shapes.

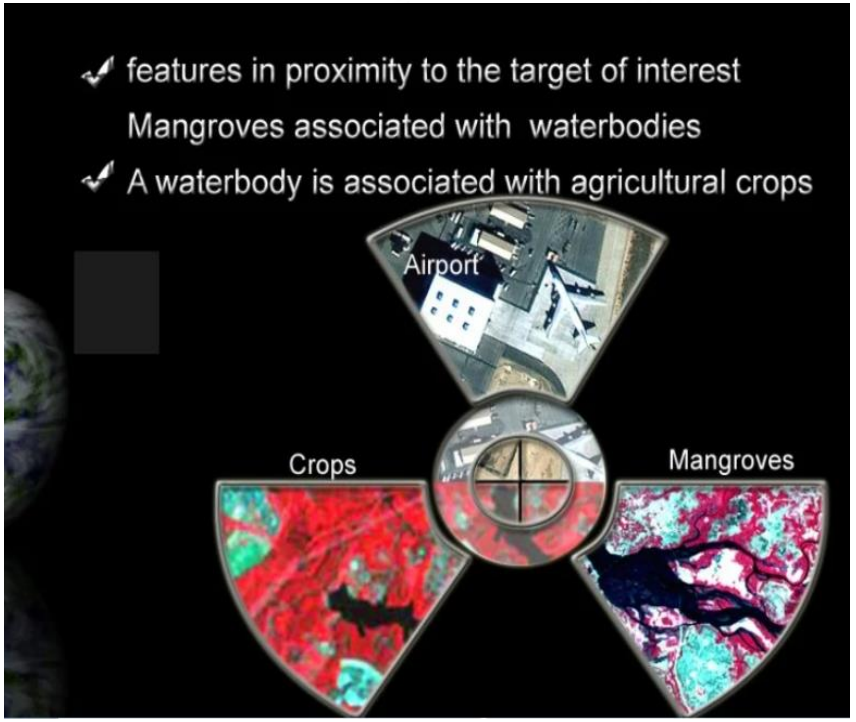
- **Shape** is a qualitative statement referring to the general form, configuration or outline of an object (e.g. 'V' shaped valleys indicative of deeply incised river).





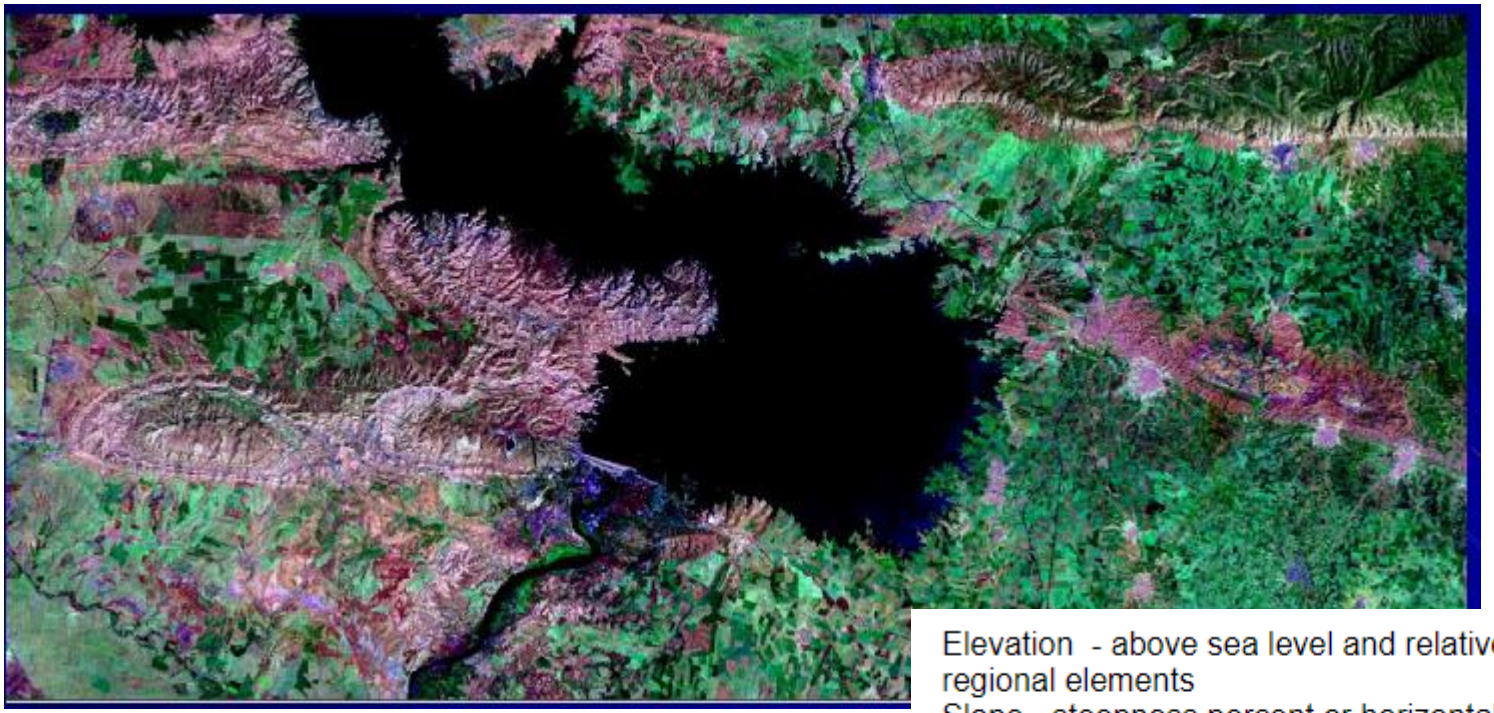
7- ASSOCIATION

Association:- takes into account the relationship between other recognizable objects or features in proximity to the target of interest. The identification of features that one would expect to associate with other features may provide information to facilitate identification. In the example given above, commercial properties may be associated with proximity to major transportation routes, whereas residential areas would be associated with schools, playgrounds, and sports fields. In our example, a lake is associated with boats, a marina, and adjacent recreational land.



7- Site (Topographic, Geographic)

Site refers to topographic or geographic location. It is also an important element in image interpretation when objects are not clearly identified using the previous the elements.

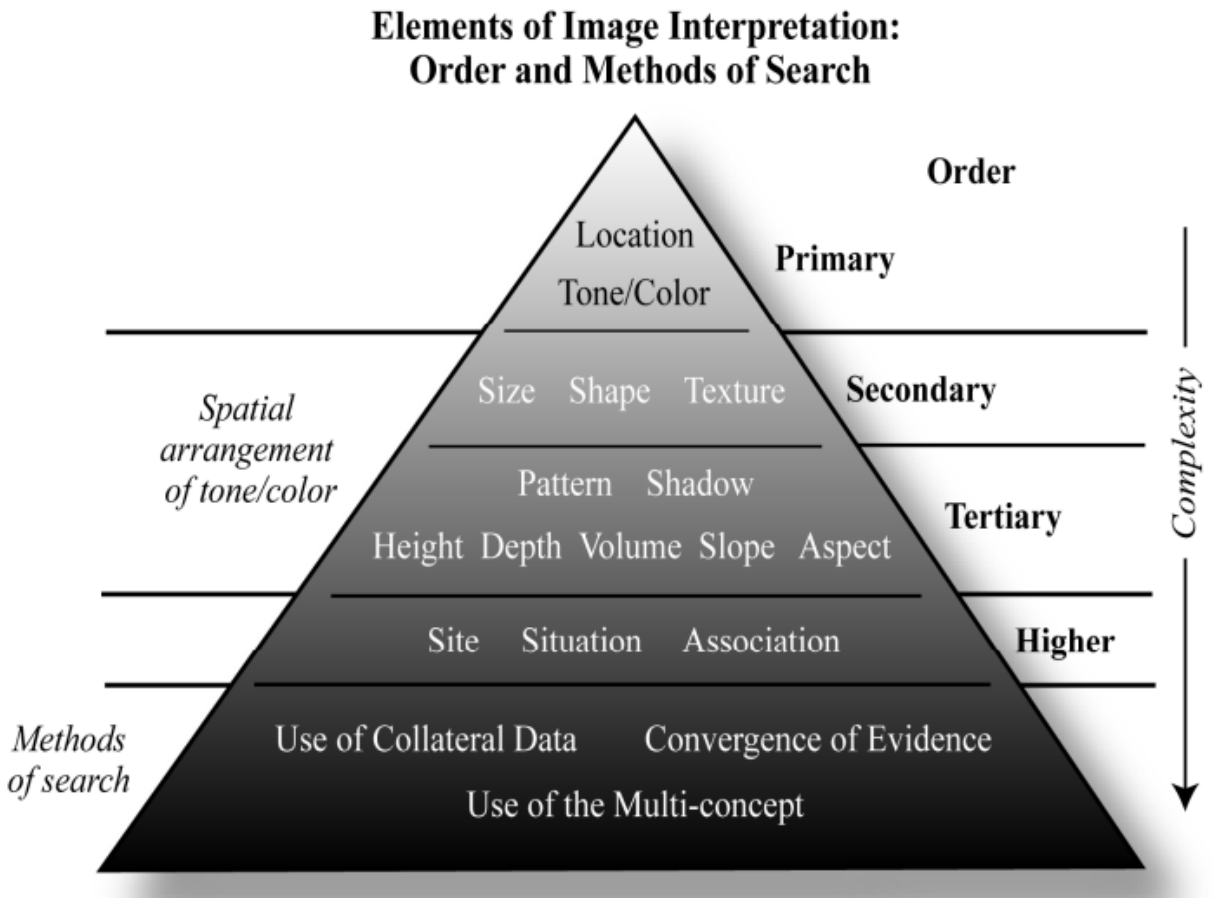


Elevation - above sea level and relative to other regional elements
Slope - steepness percent or horizontal to vertical ratio
Aspect - orientation of the face of the slope
Landform - shape, profile, mass, volume

Element	Common adjectives (quantitative and qualitative)
Location	x,y coordinates: longitude and latitude or meters, easting and northing in a map grid
Size	Length, width, perimeters, area: small, medium (intermediate) and large
Shape	An object's geometric characteristics: linear, curvilinear, circular, elliptical, radial, square, rectangular, triangular, hexagonal, pentagonal, amorphous, etc
Shadow	A silhouette caused by solar illumination from the side
Tone/colour	Gray tone: light (bright), intermediate (gray), dark (black) colour = intensity, hue, saturation
Texture	Characteristics placement and arrangement of repetition of tone or colour; smooth, intermediate (medium), rough (coarse), mottled, stippled
Pattern	The spatial arrangement of objects on the ground; systematic, unsystematic or random, linear, curvilinear, rectangular, circular, elliptical, parallel, centripetal, serrated, striated, braided
Height/depth/ volume/aspect	Z-elevation (height), depth (bathymetry), volume, slope, aspect
Site/situation/ association	Site: elevation, slope, aspect, exposure, adjacency to water, transportation, utilities Situation: objects are placed in a particular order or orientation relative to one another association: related phenomena are usually present

Degree of complexity

Aerial photo interpretation based on the key elements which are give meaningful insights of the surface features. These elements have been arranged on the basis of their spatial arrangement and degree of complexity.



The role of aerial photography in petroleum engineering

- Aerial photography plays an important role in petroleum engineering by providing critical data for exploration, infrastructure development, and environmental monitoring. Here's how aerial photography is applied across various stages of petroleum engineering:
- **1. Exploration and Surveying**
- **Site Selection**: Aerial photography helps in identifying geological formations, fault lines, and surface features like folds and anticlines, which are often associated with oil and gas deposits.
- **Mapping**: High-resolution aerial photographs assist in creating detailed topographical maps. These maps are crucial for understanding surface features, planning seismic surveys, and guiding drilling operations.
- **2. Infrastructure Planning and Development**
- **Pipeline and Facility Layout**: Aerial photography helps in planning the most efficient routes for pipelines, roads, and access points for drilling sites. This reduces environmental impact and optimizes the construction process.
- **Monitoring Construction**: During the construction of refineries, pipelines, and other facilities, aerial images provide an overview of progress and help in managing logistics and site development.
- **Environmental Impact Assessment**: Before development begins, aerial photography is used to assess the environmental conditions of an area. This helps engineers design mitigation measures and avoid environmentally sensitive zones.

- **3. Environmental Monitoring and Compliance**
- **Spill Detection**: In the event of oil spills or gas leaks, aerial photography provides a rapid means of assessing the scope and location of the spill, enabling quicker response measures.
- **Land Use Monitoring**: Periodic aerial surveys are conducted to monitor changes in land use, deforestation, or impacts on water bodies near oil and gas extraction sites. This ensures compliance with environmental regulations.
- **Wildlife and Vegetation Monitoring**: Aerial photos also help track the health of ecosystems around petroleum extraction sites, providing data for managing potential disruptions to wildlife or plant life.
- **4. Monitoring and Maintenance of Infrastructure**
- **Pipeline Monitoring**: Aerial surveys are used to monitor the condition of pipelines and detect potential leaks, corrosion, or structural failures. This helps maintain the integrity of pipelines over vast areas.
- **Asset Management**: Aerial imagery provides a clear view of oil rigs, well sites, storage facilities, and other assets, allowing engineers to monitor and manage the infrastructure more efficiently.
- **5. Risk Management and Emergency Response**
- **Disaster Response**: In case of natural disasters or accidents, aerial photography provides an immediate overview of the situation, helping engineers and emergency responders to assess damage, locate hazards, and plan rescue operations.
- **Hazard Identification**: It helps identify potential hazards such as landslides, subsidence, or flooding near extraction sites, allowing petroleum engineers to take preemptive measures.

References

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Thank You!
Rayan