Module 2 Lecture 1

# Basic Concepts of Surveying

- ✓ Survey: What, why, how, its use in Geological mapping…..Mining (civil, land use, urban)
- ✓ Branch of Surveying
- ✓ Type of Survey (General Discussion)
- ✓ Type of Survey (In Details): Plan Table, Level, Theodolite, Triangulation
- ✓

# Survey: What

Survey is the act to quantify any feature to view in detail, especially to inspect, examine, or appraise formally or officially in order to ascertain condition, value, etc.

It's the action to conduct one, or more, of the following activities:-

i. To determine, measure and represent land, three-dimensional objects, point-fields and trajectories;

ii. To assemble and interpret land and geographically related information;

iii. To use that information for the planning and efficient administration of the land, the sea and any structures thereon; and

iv. To conduct research into the above practices and to develop them.

# Survey: Why

Surveying and land surveying is the measurement and mapping of our surrounding environment using mathematics, specialized technology and equipment.

- ✓ It helps to prepare topographical maps which show natural and manmade features.
- ✓ It helps to prepare cadastral maps showing the boundaries of the properties, servitudes and other land rights.
- ✓ It helps to prepare an engineering map which shows the details of engineering works such as roads, railways, reservoirs etc.
- ✓ It helps to prepare a contour map to determine the steepness or gentleness of slopes.
- ✓ It helps with control surveys to establish horizontal and vertical positions of control points.
- ✓ It helps with construction survey, surveys which are required for establishment of points, lines, grades and for staking out engineering work.

# Why Surveying?

- Surveying is collection of data or information
- We are concerned with surveying of geoinformation
  - For engineering projects
  - For geographical mapping

# Examples: Construction of a building

- Site Selection
- Knowledge of topography (Map)
- Planning building on it
- Transfer building onto the site
- Where surveying needed?

# Examples: Town planning

- Site Selection
- Knowledge of topography (Map)
- Planning town on it
- Transfer the town onto the ground
- Where surveying needed?

# Examples: Many more…..

- Deformation of dam
- Bridge planning
- Tilt of a tower (Qutub Minar)
- Artillery bombing
- Missile
- Mine Design

# Survey: How

The survey work is carried out based on different-

- Techniques,
- Methods,
- Principles
- Instrument used
- Accessibility

# Survey: Uses (Various uses……)

- ✓ To prepare contour map that determine the best possible route & amount of required earthwork.
- ✓ Preparing maps showing various features on the earth.
- ✓ Maps prepared for marking boundaries of countries, states, districts etc., avoid disputes.
- ✓ For preparing the topographical map showing hills, rivers, forests, valleys, etc.
- ✓ For planning and estimating project works like roads, bridges, railways, airports, water supply and waste water disposal surveying is required.
- ✓ Marine and hydro-graphic survey helps in planning navigation routes and harbours.
- ✓ For preparing a military map showing different strategic points important for the defence of a country.
- ✓ Mine surveys are required for exploring mineral wealth.
- ✓ For preparing archaeological map showing the places where ancient relics may have lied.

# Branches of Surveying

i. **Aerial Surveying:** Aerial surveys are undertaken using special cameras mounted in an aircraft. The photographs produce three-dimensional images of ground features from which maps or numerical data can be produced usually with the aid of stereo plotting machines and computer.

## ii. Hydrographic Surveying (Hydro-Survey):

Hydro survey is undertaken to gather information in the marine environment such as mapping out the coast lines and sea bed in order to produce navigational charts.

It is also used for off-shore oil-gas exploration and production, design, construction and maintenance of harbours, inland water routes, river and sea defence, pollution control and ocean studies

iii. **Geodetic Survey:** In geodetic survey, large areas of the earth surface are involved usually on national basis where survey stations are located large distances (>250km$^2$) apart.

Entire continent….

Account is taken of the curvature of the earth

Mathematical theory and precise measurements are required.

Measure the size, shape of the earth or

Carrying out scientific studies

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-Determination of earth magnetic field

-Direction of continental drifts

**iv. Plane Survey:** In plane survey, relatively small (<250km$^2$) areas are involved and the area under consideration is taken to be a horizontal plane.

- ***Cadastral Surveying***-Define and record the boundary of properties, legislative area…
- ***Topographical Surveying***-Physical features on the earth are measured (both horizontal & vertical), and maps/plans to show their relative positions
- ***Engineering Surveying***-Undertaken to provide special information for construction of civil engineering and building projects.

# Surveying

Art and science of obtaining quantified and qualified measurements, the interpretation of these measurements and a meaningful presentation of result.

The process of surveying is in three stages namely-

1. **Taking a general view** –This part of definition is important as it indicates the need to obtain an overall picture of what is required before any type of survey work is undertaken. In land surveying, this is achieved during reconnaissance study.

2. **Observation and Measurement** –This part of the definition denotes the next stage of any survey, which in land surveying constitutes the measurement to determine the relative position and sizes of natural and artificial features on the land.
3. **Presentation of Data** –The data collected in any survey must be presented in a form which allows the information to be clearly interpreted and understood by others. This presentation may take the form of written report, bills of quantities, datasheets, drawings and in land surveying maps and plan showing the features on the land.

# Types of Surveying

In term of action, surveying is two categories

- ***Surveying***-Bringing the ground/terrain in laboratory/office for working.
- ***Laying out***-Taking the work onto the ground as per design specifications.

On the basis of whether the curvature of earth is taken into account or not, surveying can be divided into two main categories again:-

- **Plane Surveying**: is the type of surveying where the mean surface of earth is considered as a plane.
- **Geodetic Surveying**: is that branch of surveying, which takes into account the true shape of the earth (spheroid).

# Classification

Surveying is classified based on various criteria including--

A. The instruments used

B. Purpose

C. The area surveyed and

D. The method used

# A. Classification on the basis of Instruments used

Based on the instrument used, surveys can be classified into:

1. Chain tape surveys
2. Compass surveys
3. Plane table surveys
4. Leveling surveys
5. Theodolite surveys

1. **Chain/Tape Survey**—This is the simple method of taking the linear measurement using a chain or tape with no angular measurements made.
2. **Compass Survey**—Here horizontal angular measurements are made using magnetic compass with the linear measurements made using a plane table.
3. **Plane table Survey**—This is a quick survey carried out in the field with measurements and drawings made at the same time using a plane table.

4. **Leveling Survey**—This is the measurement and mapping of the relative heights of points on the earth's surface showing them in maps, plane and charts as vertical sections or with conventional symbols.

5. **Theodolite Survey**—Theodolite survey takes vertical and horizontal angles in order to establish controls.

**THEODOLITE**

**The Theodolite is a most accurate surveying instrument mainly used for :**

- **Measuring horizontal and vertical angles.**
- **Locating points on a line.**
- **Prolonging survey lines.**
- **Finding difference of level.**
- **Setting out grades**
- **Ranging curves**
- **Tacheometric Survey**

**THEODOLITE SURVEYING**



# B. Classification on the basis of purpose:

1. **Engineering Survey**
2. **Control Survey**—Control survey uses geodetic methods to establish widely spaced vertical and horizontal control points.
3. **Geological Survey**—Geological survey is used to determine the structure and arrangement of rock strata. Generally, it enables to know the composition of the earth.
4. **Military or Defence Survey**—The survey is carried out to map places of military and strategic importance.
5. **Archeological Survey**—It is carried out to discover and map ancient/relies of antiquity.

## C. Based on the surface and the area surveyed:

1. **Land Survey**—The survey is done for objects on the surface of the earth. It can be subdivided into-
   - i. **Topographic Survey**: This is for depicting the (hills, valleys, mountains, rivers etc.) and manmade features (roads, houses, settlements..) on the surface of the earth
   - ii. **Cadastral Survey**: This survey is used to determining property boundaries including those of fields, houses, plots of land etc.
   - iii. **Engineering Survey**: Is used to acquire the required data for planning, design and execution of engineering projects like roads, bridges, canals, dams, railways, buildings etc.
   - iv. **City Survey**: The surveys involving the construction and development of towns including roads, drainage, water supply, sewerage network etc. are generally referred to as city survey.

2. **Marine or Hydrographic Survey**—Those are surveys of large water bodies for navigation, tidal monitoring, the construction of harbours etc.
3. **Astronomical Survey**—Astronomical survey uses the observations of the heavenly bodies (sun, moon, stars etc.) to fix the absolute locations of places on the surface of the earth.

## D. Classification based on the Method used:

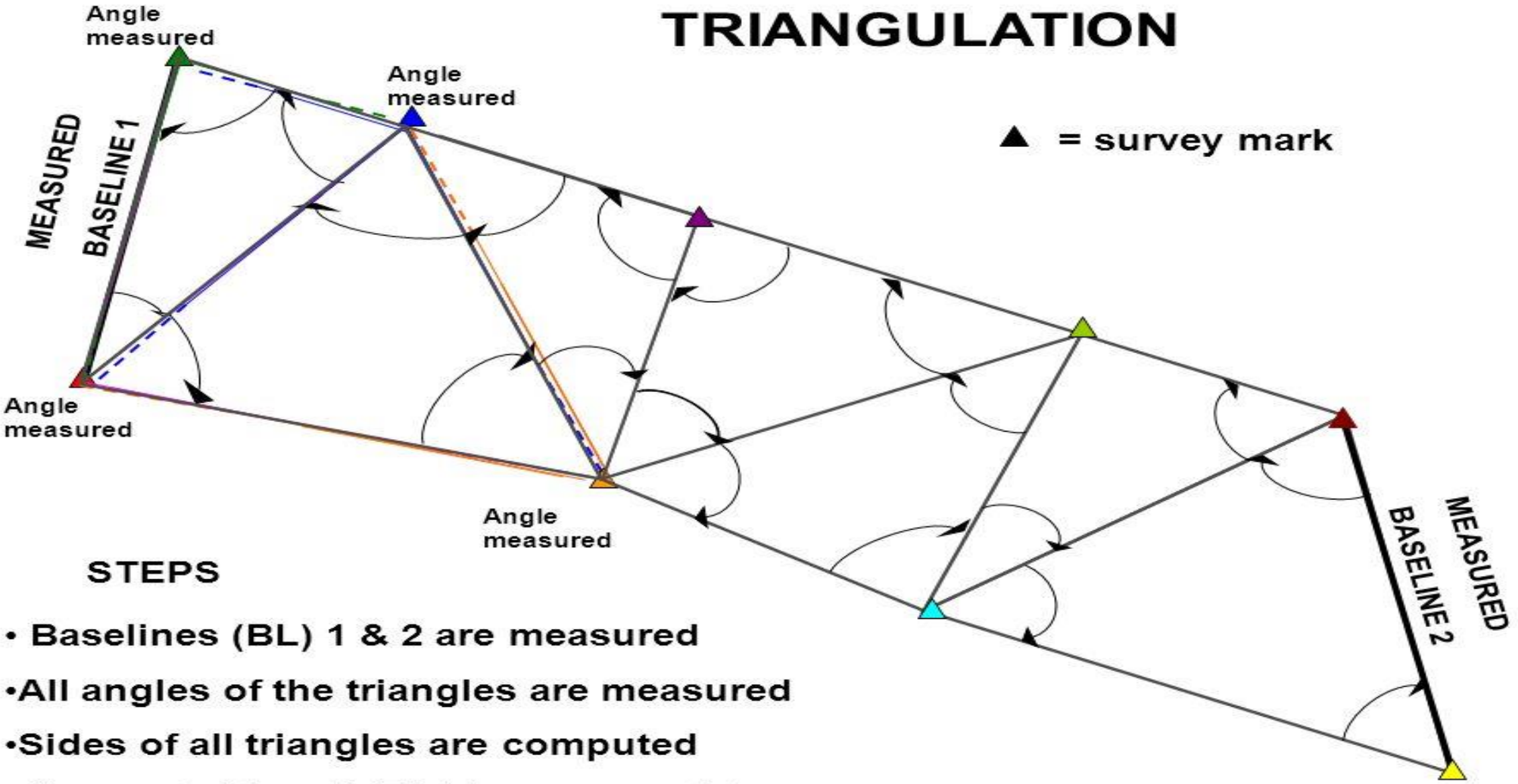
1. **Triangulation Survey**—In order to make the survey, manageable, the area to be surveyed is first covered with series of triangles.

Lines are first run round the perimeter of the plot, then the details fixed in relation to the established lines.

This process is called triangulation.

The triangle is preferred as it is the only shape that can completely over an irregularly sharped area with minimum space left.

# TRIANGULATION




## STEPS

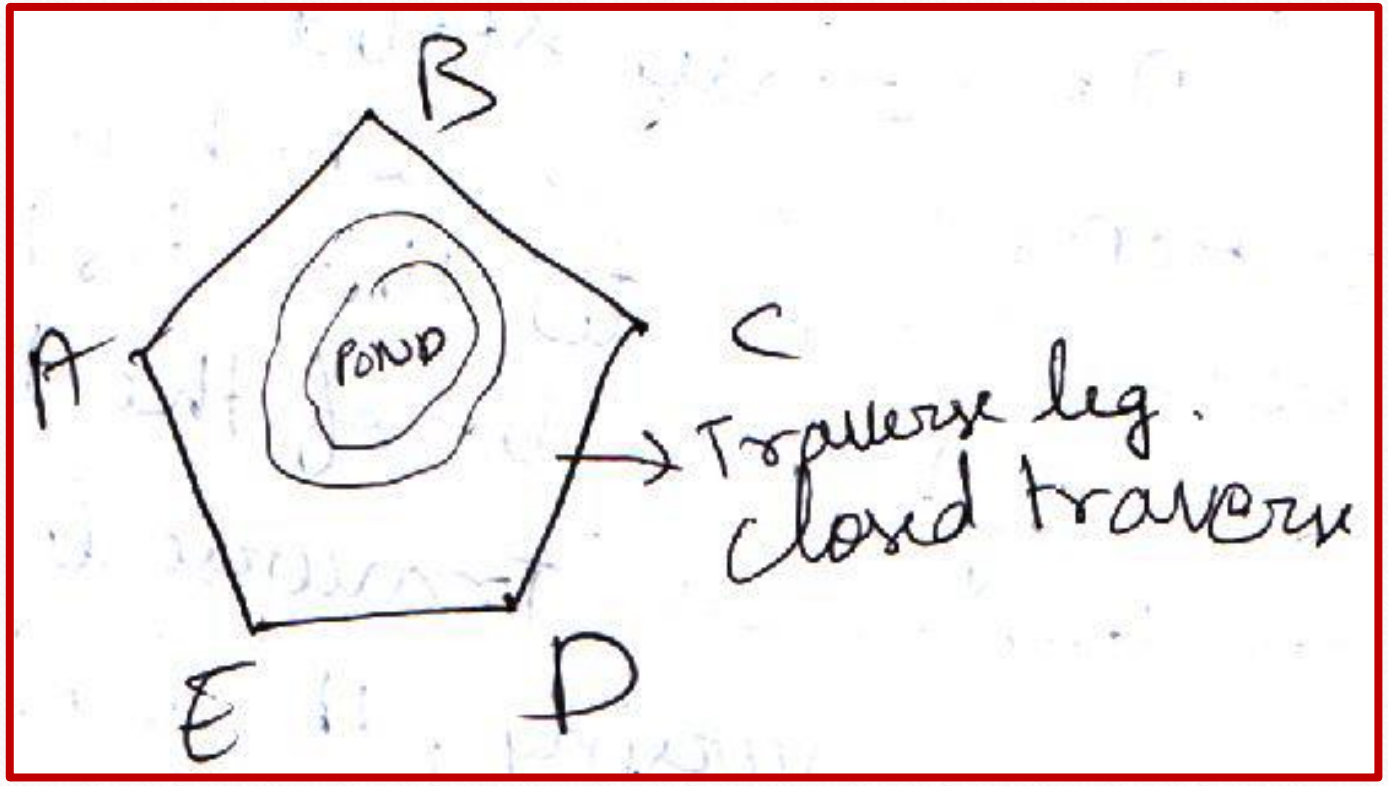
- Baselines (BL) 1 & 2 are measured
- All angles of the triangles are measured
- Sides of all triangles are computed
- Computed length BL2 is compared to measured length of BL2

2. **Traverse Survey**—If the bearing and distance of a place of known point is known: it is possible to establish the position of that point on the ground. From this point, the bearing and distances of other surrounding points may be established. In the process, positions of points linked with lines, is called traversing, while the connecting lines joining two points on the ground.

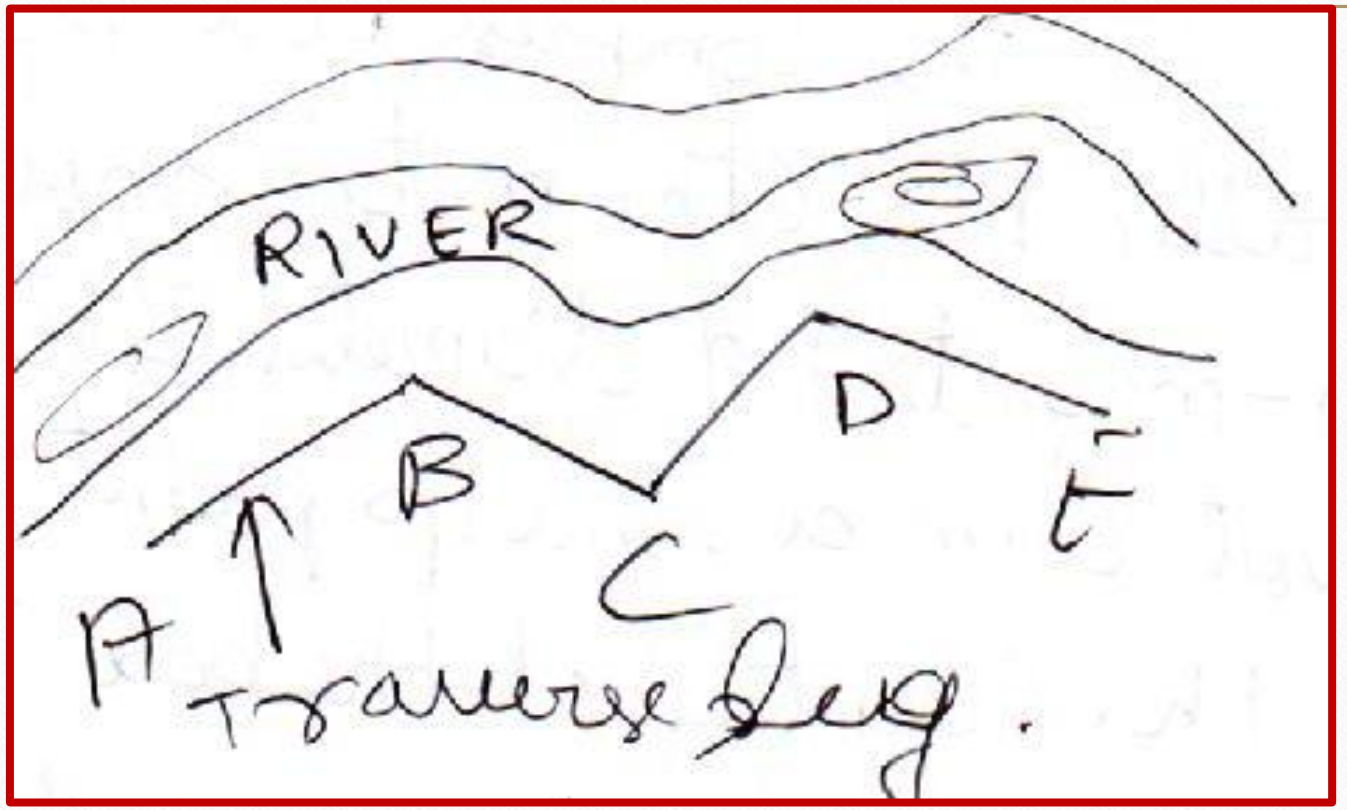
Joining two while bearing and distance is known as traverse.

Traverses may either be **closed** or **open**.

i. **Closed Traverse Survey**—When a series of connected lines forms a closed circuit, i.e. when the finishing point coincides with the starting point of a survey, it is called as a ‘closed traverse’, here ABCDEA represents a closed traverse.



ii. **Open Traverse Survey**—When a sequence of connected lines extends along a general direction and does not return to the starting point, it is known as ‘open traverse’ or (unclosed traverse). Here ABCDE represents an open traverse.



# Basic measurement

- Surveying is about measurement….
- Need of a **reference system** for fixing relative positions of points
- Examples…….

# Reference System for geoinformation

## Coordinate Reference Systems

- A coordinate reference system will consist of one coordinate system that is related to an object through one datum.
- The object for our work and operations will be Earth.
- However:
  - Only certain coordinate system types can be associated with specific types of coordinate reference system.
  - And, only certain datum types can be associated with specific types of coordinate reference system.