



Lecture 1.1  
August 7, 2007



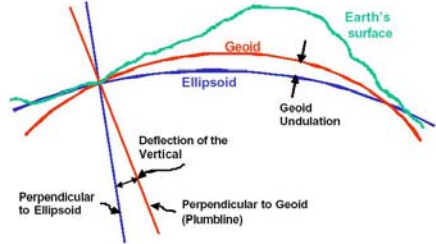
# CE200 SURVEYING

## WHAT IS SURVEYING?

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**Geodesy** is the discipline that deals with measurements and representation of the earth, including its gravity field, in a three dimensional time varying space.



**Surveying** is the science of measuring and representing natural and artificial features on the ground in a limited area, regarding the earth as flat.

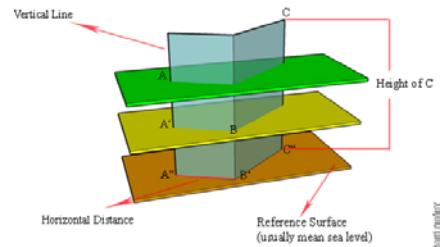


If the area that you are interested in is small enough, the techniques of **surveying** are used. That is to say you have horizontal planes and straight vertical lines parallel to each other.

If the area you are interested in is larger or if you are interested in the shape, size, and the gravity field of the earth, recognizing their time variant aspects. Then measuring techniques and mathematical models of **geodesy** are used.



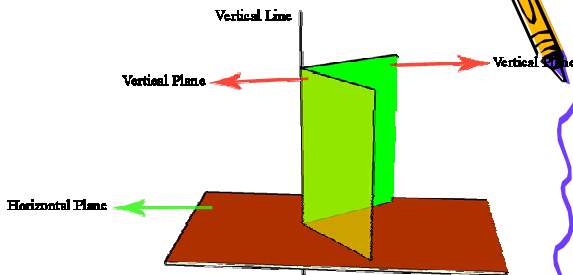
## HORIZONTAL PLANES, REFERENCE SURFACE



Vertical line is perpendicular to the horizontal plane.



## VERTICAL PLANES



## VERTICAL PLANES

Vertical line is perpendicular to the horizontal plane.



## Parts of Surveyor's work

- ❖ Decision making (selecting techniques, equipments, etc.)
- ❖ Fieldwork (data acquisition)
- ❖ Data processing (calculations to give locations, areas, volumes, etc.)
- ❖ Mapping (maps, plans, charts)
- ❖ Reporting (conclusion of the task)

## Why should I study surveying?

You may be required to perform simple surveying operations (particularly if you're employed in Local Govt), or you will need to discuss your needs with surveyors.



### What is measured?

- ❖ Distances
  - to calculate areas, volumes, etc.
  - to draw plans, maps, etc.
- ❖ Angles
  - both horizontal and vertical
- ❖ Heights
  - levels or elevations (the third dimension)

How are these measured and Which instrument should I use?

- ❖ Distances
  - taping (steel tape), tacheometry (theodolite), electronic (EDM, GPS)
- ❖ Angles
  - tacheometry (theodolite)
- ❖ Heights
  - leveling (level, theodolite)

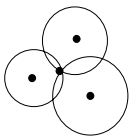


Techniques in surveying are mainly divided into two categories

- ❖ Operations of horizontal position fixing, i.e. measurements in plan (as a professional term we call it **planimetric position fixing**)
- ❖ Operations of vertical position fixing, i.e. measurements for fixing heights or relative differences in level (as a professional term we call it **leveling**)

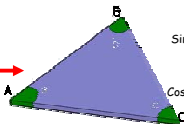


### HORIZONTAL POSITION FIXING



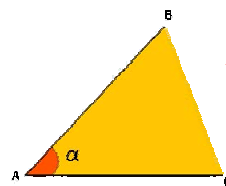
Hyperbolic Trilateration

Triangulation



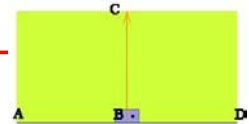
Sines Rule  $\frac{A}{\sin a} = \frac{B}{\sin b} = \frac{C}{\sin c}$

Cosines Rule  $C^2 = A^2 + B^2 + 2AB \cos(c)$   
 $B^2 = A^2 + C^2 - 2AC \cos(b)$   
 $C^2 = B^2 + C^2 - 2BC \cos(a)$



Radiation/Polar Coordinates

Offset/Rectangular Coordinates



### WHAT IS ACCURACY?

Accuracy is the nearness of your measurements to the true value.

### WHAT IS PRECISION?

Precision is the amount by which a measurement deviates from its mean.

Suppose that you measure the same line five times.

The first party reports the following measurements: 736.80, 736.70, 736.75, 736.85, and 736.65 m. → more accurate

The second party reports the following measurements: 736.42, 736.40, 736.40, 736.42, and 736.41 m. → more precise

The true length of the line is 736.72 m



### ERRORS ☹

No measurement is exact!

#### Gross Errors and Mistakes

These are serious mistakes made by surveyor, such as reading 15.45 instead of 5.45 or writing 9.64 instead of 6.94.

#### Systematic Errors

These are due to instruments or operations, and have cumulative effect. As an example, you have a meter to measure distance with a production error. It shows 1 meter but in reality the distance is 99.5 cm. Then you measure always longer than the real distance.

#### Accidental Errors

These are unavoidable errors arising from weather condition, change in temperature, humidity, mood of observer, etc.

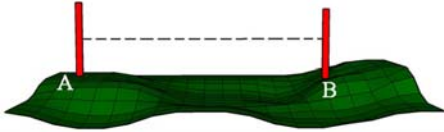
Golden rule of surveying: CHECK IT!



## DISTANCE MEASUREMENTS

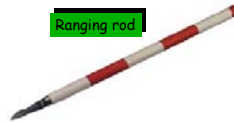
### Methods:

- Taping (will be practised)
- Tacheometry (will be practised)
- Electronic (will be demonstrated)

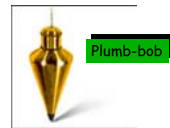


Taping is the linear measurement of the **HORIZONTAL** distance between two points using a surveyor's tape.

## EQUIPMENT USED FOR TAPING



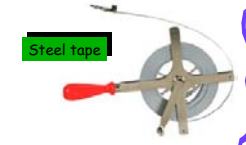
Ranging rod



Plumb-bob



Tripod



Steel tape



Pegs

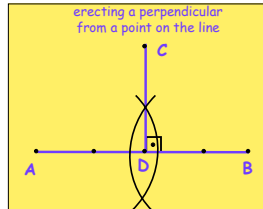
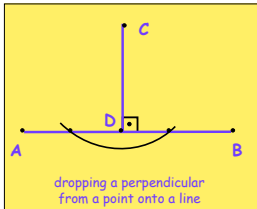


Chalk



## FIELDWORK 1

- Set up a rod at a point in vertical position (to make the rod plumb)
- Ranging a line (to locate a rod at an intermediate point on a line)
- Hand signals in ranging
- Measuring the horizontal distance between two points



AB > 20m.

**Warning:**  
Write a report what you have done and difficulties you encountered while you are working.  
Each member of subgroup should measure individually and check the measurements.