CHAPTER 1
Basics of Surveying

Surveying: The art of measuring distances, angles, and position on or near surface of earth.

Types of Surveys:

1. ***Plane surveying***: earth is plane in x-y and height in Z, where z = 0. at MSL.

   for long surveys such as highway's, correction has to be made. .

2. ***Geodetic survey***: earth is spherical and z is height.

   very accurate
   used for national boundaries and control network

Classes of surveys:

1. *The preliminary survey*: (data gathering)

   Collection of distances,. angles, and difference in elevation data to locate physical .features so' data. can be plotted to scale on a map.

2. *Layout surveys*:

   Making on the ground the features shown on a design plan:

3. *Control surveys*:

   To reference preliminary and layout surveys,

   Horizontal control can be anything but usually roadways or coordinated control stations.

   Vertical controls are a series of benchmarks.

1.4 Definitions:(text page 6)

1. *Topographic survey*: (preliminary) tie in surface features
2. *Hydrographic survey*: (preliminary) tie in surface features near and under sea level
3. *Route survey*: (preliminary, layout and control) narrow but long strips of load
4. *Property survey*: (preliminary, layout and control)
5. *Aerial survey*: preliminary and final (photogrametric)
6. *Construction survey*: (layout)
7. *Final survey*: as built (preliminary)
8. *GPS*: N, E and elevation using. NAVASTAR satellite signal.

1.5 Surveying Instruments:

1. *Steel tape* – Measure horizontal and slope distances
2. *Level and rod* - Measure differences in elevation:
3. *Todolitehe (transit):* Measure horizontal & vertical angles
   Establish straight lines
   Establish curved lines
4. *Total Station Instrument*
   Measure horizontal & vertical angles
   Measure horizontal & vertical distances
   Data stored and processed electronically.
5. *GPS receivers* - Measure position coordinates (N,E, elevation)
6. *Electronic Distance Measuring device (EDM)*

1.7 **Grid Reference:**

One common datum for x-y in-large area
Ease of calculation
Coordinates are referenced to central meridian (0^0 long) and equator (0^0 Lat)

1.8 **Legal Reference**

Various squares (CH 15)

1.9 **Vertical reference**

MSL = 0.000 m.

1.10: **Distance Measurements**.

- *Horizontal & slope distance*:

By: cloth or steel tape or EDM devices
In surveying the horizontal distance is required
Slope distances must be converted to horizontal
(Slope angle and/or difference in Elevation)

- *Vertical distance*:

By tape or by level and rod

1.11 **Units:**
English or Metric

→ All countries will change to metric.

Angles	**Degrees**	**Minutes**	**Seconds**
	1 revolution = 360^o	1 deg. = 60′ min.	1 min = 60″ seconds

See text and table 1.1

1.12 Location Methods:

Determine location of a point relative to reference line AB so that it can draw on scale map.

1. Right angle offset tie (Rectangular Tie)
2. Angle distance tie (Polar Tie)
3. Intersection Technique

See Page 14

1.13: Accuracy & Precision

Accuracy: Relation between measured value and true value.

Precision: Refinement with which the measurement is made.

Ex.	True Dist.	Meas. Dist.	Error
Cloth tape	157.22	157.2	.02
Steel tape	157.22	157.23	0.01

More precise method resulted in more accurate measurement

More precise method can result in less accurate measurement.
exp. Repaired tape.

1.14: Errors

- ***Systematic errors****:* magnitude & sign of the error can be determined
  Should be eliminated

Example: temperature error in steel tape

- ***Random error*** *(accidental error*):
Error due to surveyor Skill.

Tend to cancel each other.

Little significance except for high precision survey.

Unskilled or careless surveyor can make problem.

Large random error doesn't result in accurate work even if they cancel.
If surveyor is skilled and careful - not significance

Example: Plumbing and Marking error

1.15: **Mistakes**

Blunders made by survey personnel

- Example: transposing figures (23 - 32)
- Miscounting tape length, measuring from wrong point.

Mistakes will occur and must be discovered and eliminated by verifying the measurement (Repeat Geometry analysis, etc.).

Every measurement should be repeated to eliminate mistakes and improved precision.-

1.16: **Accuracy Ratio:**

- *Error of closure:* difference between the measured location and the theoretically correct location due to random error -

- Theoretically correct location: from repeated measurement and/or mathematical analysis

Accuracy ratio: Ratio of error of closure to the distance measured

Exp. measured dist. 250.56

known dist. 250.50

Accuracy ratio $\frac{\text{error } 0.06}{0.06} = \frac{0.06}{250.50} = \frac{1}{4175} = \frac{1}{4200}$

- Typical ratio: 1/3000, 1/5000, 1/10,000, 1/20,000

1.17: **Stationing**

- Measurement along baseline - at 'right angles to baseline'
- Distance along baseline:

See Fig. 1.12 Page 16

=> Full station 100 m or 100 ft

=> Half station 50

=> Partial station 20 m

1.18: **Field Notes.**

Should be Complete, Accurate and Neat (CAN)

- Not to be copied
- In the field
- Sketches should be used whenever necessary

=> What you should & should NOT do see and study pages 18-19.

- Field books
  - Bound books
  - Loose-leaf books