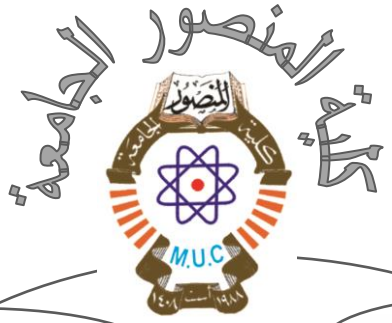


Al-Mansour University College

قسم الهندسة المدنية
المرحلة الثانية

Civil Eng. Dept.
2nd. Stage

Surveying

2022 - 2023

Lec.1

المساحة

3. Measuring Tapes:

Depending on materials used, tapes are classified as:

a. <u>Cloth or linen tapes</u>: Such tape is light and flexible, hence it is easy to handle but:

- It is easily affected by moisture and, thus, gets shrunk.
- It extends due to stretching.
- It is likely to <u>twist and tangle</u>.

a. Linen Tape

Al-Mansour University College
Civil Engineering Department
Second Year/ 2015-2016

SURVEYING

CHAPTER- 1 / GENERAL CONCEPTS

Preface

Surveying is an important subject for all civil engineers engaged in the field work. They are either called to prepare plans and maps or to use them to prepare civil engineering projects on to set out the works using the maps.

All common methods of surveying will have been covered for this year including modern techniques.

Text Books:

1. "Surveying and levelling," by Bhavikatti, S. S. (2008).

2. "Surveying and levelling," by Agor, A. (2012).

General Concepts

Surveying

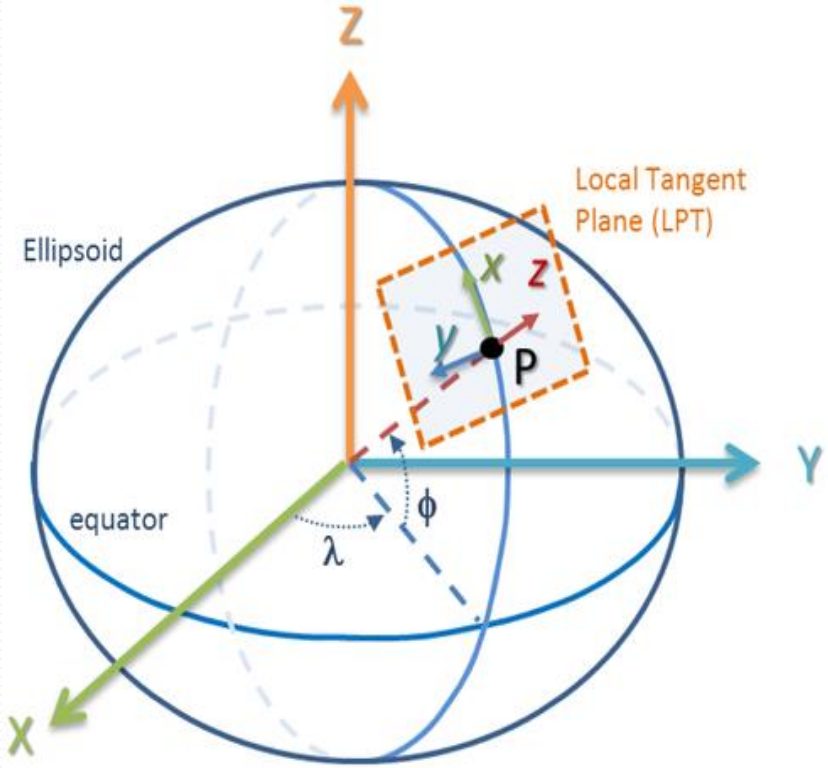
It is the art of measuring horizontal and vertical distances between objects, of measuring angles between lines, of determining the direction of lines, and of establishing points by predetermined angular and linear measurements. Along with the actual survey measurements are the mathematical calculations. Distances, angles, directions, locations, elevations, areas, and volumes are thus determined from the data of the survey.

Survey data is depicted graphically by the construction of maps, profiles, cross sections, and diagrams.

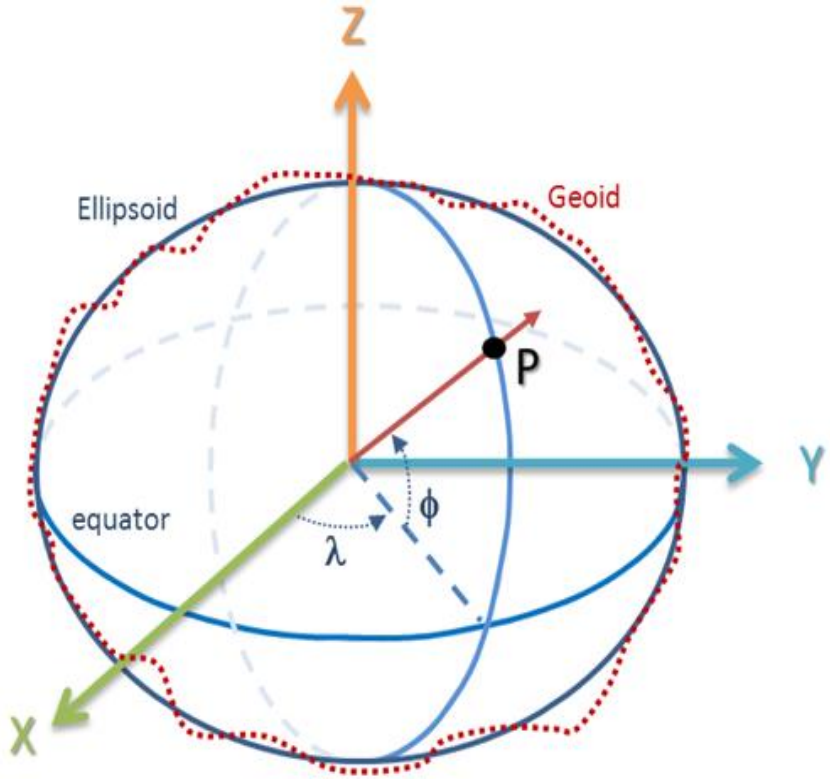
Types of Surveys:

1. Geodetic Surveying: The type of surveying that takes into account the true shape of the earth. These surveys are of high precision and extend over large areas.

2. Plane Surveying: The type of surveying in which the mean surface of the earth is considered as a plane, or in which its spheroidal shape is neglected, with regard to horizontal distances and directions.



Plane Surveying



Geodetic Surveying

An area of less than 250 km2 can be considered as a plane.

Application of Surveying:

- **Boundary Survey:** Made to determine the length and direction of land lines and to establish the position of these lines on the ground.
- **Topographic Survey:** Made to gather data to produce a topographic map showing the configuration of the terrain and the location of natural and man-made objects.
- **Hydrographic Survey:** The survey of bodies of water made for the purpose of navigation, water supply, or subaqueous construction.
- **Mining Survey:** Made to control, locate and map underground and surface works related to mining operations.
- **Construction Survey:** Made to lay out, locate and monitor public and private engineering works.

Types of System Units:

- English Units
- Metric Units

System	Metric	English
Length	meter	inch, foot, mile
Mass	gram	ounce, pound, ton
Volume	liter	pint, quart, gallon
Temperature	degree Celsius	degree Fahrenheit
Time	sec, min, hr	sec, min, hr

1 meter = 3.28 foot

1 liter = 0.26 gallon

1 kilogram = 2.2 pound

$F = (9/5)\ C + 32$

Errors in Surveying

Errors occurred in surveying are due to:

1. Instrument or equipment errors

Such errors are due to manufacturing defects or out of adjusments.

2. Natural errors

Natural errors are because of natural phenomena as variation in temperature, humidity, curvature of the earth, … etc.

3. carelessness

These errors are clearly due to observer's mistakes. They can be avoided by following accurate surveying practice .

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SURVEYING
CHAPTER- 2 / DISTANCE MEASUREMENT

Distance Measurements

There are two main methods of determining the distances between points on a surface earth.

1. Direct Measurement

In this method, distances are actually measured on the surface using measurement instruments.

2. Computative Measurement

Calculations are made to measure distances as in tacheometry and triangulation (or chain) surveying.

Methods of measuring distances

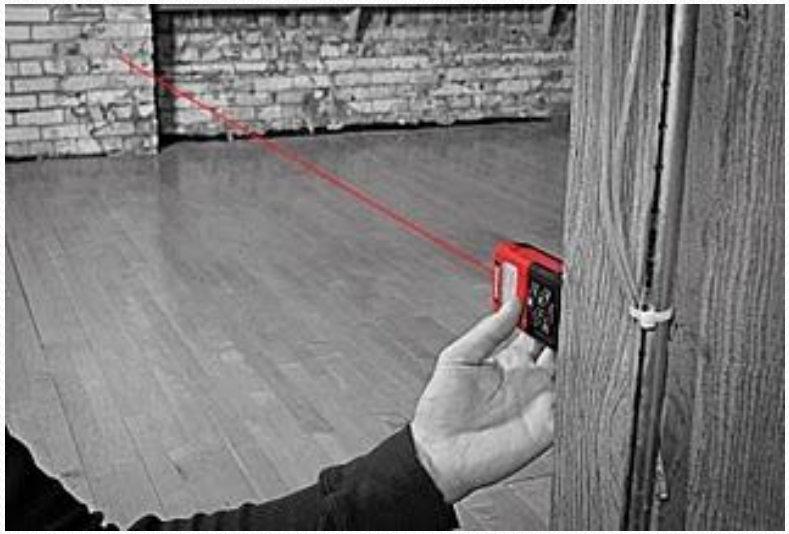
1. Measuring Chain.
2. Measuring Wheel.
3. Measuring Tape.
4. Measuring Laser.
5. Stadia.

4. Measuring Laser:

Work can be done better, faster, and more precise using laser measurements.

It easily measures lines that are difficult of access such as across lakes and rivers, etc.

How does
It work?



Disadvantage of laser measurements is the cost of the equipment.

1. Measuring Chain:

It is easy to read and designed for a rough terrain.

Chains are heavy and, thus, sag is a major error.

2. Measuring Wheel:

It is used for fast measurements and lower accuracy surveys.

Although its accuracy reduced on a rough terrain, it provides good accurate in measurements on a smooth surface such as pavement.

How does It work?

b. <u>Metallic tape</u>: This tape is reinforced with copper wires to prevent stretching or twisting of fibers. It is used for measuring accurate distances.

c. <u>Steel tape</u>: It is used to measure short distances.

b. Metallic Tape

c. Steel Tape

d. <u>Invar tape</u>: It is more expensive and used for high degree of precision in measurements.

5. Stadia:

In stadia, horizontal distances are measured using optical distance measuring (level, theodolite, and total station). Such measurements will be covered in the next chapters.

Chain and Tape Corrections

The length measured by a chain or tape should be corrected for The following:

1. Absolute correction.
2. Slope correction.
3. Temperature correction.
4. Pull or tension correction.
5. Sag correction.

1. Absolute correction:

$$C_a = L\frac{c}{l} \qquad ; \qquad c = l_a - l$$

where,
l: designated tape length, m,
la: absolute or actual tape length, m,
c: correction per tape length, m,
L: total length measured, m, and
C_a: total correction due to absolute length, m.

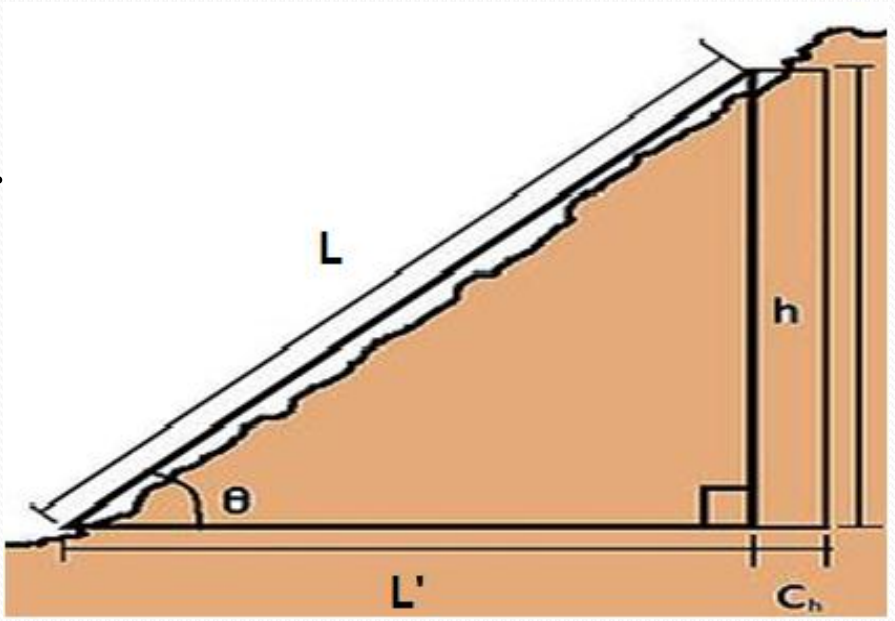
If la > l →→ C_a is positive (+ve)
la < l →→ C_a is negative (-ve)

Corrected length (L′) = L + C_a

2. Slope correction:

$$C_h = \frac{h^2}{2L} \qquad \text{or} \qquad C_h = L(1 - \cos\theta)$$

where,
h: difference in level between the two points, m,
Θ: angle of measured line, degree,
L: total length measured, m, and
C_h: total correction due to slope, m.



This correction is always

negative (-ve). Why?

Therefore;

Corrected length (L') = L - C_h

3. Temperature correction:

$$C_t = L\,\alpha\,(T_m - T_o)$$

where,

α: Coefficient of thermal expansion of the material of tape,/^{0}c,

T_m: Mean temperature during measurement, ^{0}c,

T_o - Temperature at which tape is standardized, ^{0}c,

L: total length measured, m, and

C_t: total correction due to absolute length, m.

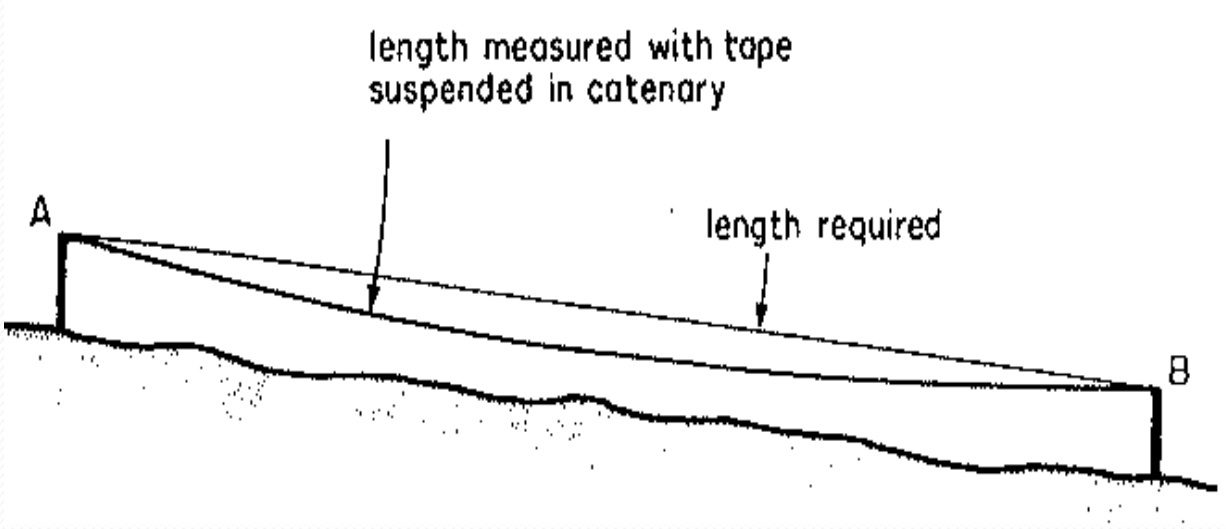
If $T_m > T_o$ → → C_t is positive (+ve)

$T_m < T_o$ → → C_t is negative (-ve)

Corrected length (L′) = L + C_t

5. Sag correction:

$$C_s = \frac{1}{24}\left(\frac{W}{P}\right)^2 L$$



where,

W: weight of tape per span length, N,

P: Pull applied during measurement, N,

L: total length measured, m, and

C_s: total correction due to absolute length, m.

This correction is always negative (-ve). Why?

Therefore;

Corrected length (L′) = L - C_s

Chain and Tape Correction

Summary

Correction for Errors in Taping			
No.	Correction	Sign	Formula
1	Absolute Correction	$\pm$	$C_a = L\frac{c}{l}$ $c = l_a - l$
2	Slope Correction	$-$	$C_h = \frac{h^2}{2L}$ $C_h = L(1 - \cos(\theta))$
3	Temperature Correction	$\pm$	$C_t = L\,\alpha\,(T_m - T_o)$
4	Pull Correction	$\pm$	$C_p = \frac{(P - P_o)L}{AE}$
5	Sag Correction	$-$	$C_s = \frac{1}{24}\left(\frac{W}{P}\right)^2 L$

Note:

All corrections should be done before the correction due to slope.

$$L' = L \pm C_a \pm C_t \pm C_p - C_s$$

$$L'_{for\ slope} = L' - C_h$$

Example (1):

The length of a survey line was 841.5 m measured using a tape of 20 m. When the tape was calibrated, it was found to be 20.1 m. Calculate the corrected length of the line.

Example (2):

The following slope distances were measured with a 50 m tape:

Slope Distance, m	46.2	38.5	42.6
Diff. in elevation Between end points, m	3.2	4.3	5.4

Calculate the total horizontal distance measured.

Example (4):

To measure a base line, a steel tape 30 m long standardized at 15 ºC and 100 N pull was used. Calculate the correction per tape length if the temperature at the time of measurement was 20 ºC and the pull exerted was 160 N. If a length of 250 m is measured on a slope of 1:4, find the horizontal length.

Use: $= 2.1 * 10^5 \frac{N}{mm^2}$; cross-sectional area of tape = 0.08 cm^2 ; and $\alpha = 11.2 * 10^{-6}$ / °C.

Example (5):

Calculate the corrected length of a 50 m base line measured using tape and chain under 100 N pull. Use 6 N weight of linen tape and 50 N weight of chain.