CE 103: Surveying

Lecture 1: Introduction

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Course Outline

- ❑Chain surveying
- ❑Leveling
- ❑Plain table surveying
- ❑Tachometric Surveying
- ❑Cut and fill measurement
- ❑Stadia Surveying
- ❑Astronomical Surveying
- ❑Photogrammetry
- ❑EDM and GIS technology

Reference Books

- Surveying Volume 1,2,3 - Dr. B.C. Punmia, Er. Ashok K Jain, Dr. Arun K. Jain
- Surveying - M.A. Aziz and M. Shahjahan

Contents

- ❑Introduction to surveying
- ❑Plain surveying and Geodetic surveying
- ❑Linear measurements
- ❑Error calculations

Introduction

- Surveying is the art of determining the relative positions of points on, above or beneath the surface of the earth by means of direct or indirect measurements of distance, direction and elevation. It also includes the art of establishing points by predetermined angular and linear measurements.

Primary Divisions of Survey

- Surveying can be divided into two divisions-
- 1. Plane surveying
- 2. Geodetic surveying

- Plane surveying considers earth as a plane and the spherical shape is neglected. All lines are straight and all triangles formed by survey lines are plane triangle.
- Geodetic surveying considers the true shape of the earth. All lines lying in the surface are curved lines and the triangles are spherical triangles.

Primary Divisions of Survey

- **Plane surveying** can be subdivided in following ways:

1. Chain Survey
2. Traverse Survey
3. Plane table survey

- **Geodetic surveying** can be subdivided in following ways:

1. Tacheometric survey
2. Photogrammetric survey
3. Astronomical surveying

Linear measurements

- **Different Methods**
- There are various methods of measuring linear measurements. They can be subdivided into three divisions:

❑**Direct Distance Measurements (DDM):** Distances are actually measured on the ground with the help of tape , chain or any other instrument.

❑**Optical Distance Measurements (ODM)**: Observations are taken through a telescope and calculations are done for the distances.

❑**Electro-magnetic Distance Measurement (EDM) :** Distances are measured with instruments that use propagation, reflection and reception of radio waves, light waves or infrared waves.

2.2 Instruments for Chaining

1) Chain

i) Metric Chains

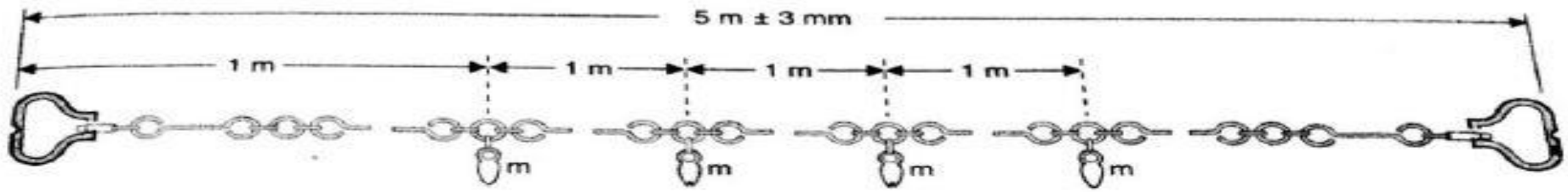


Fig. 3.2 5-Metre Chain

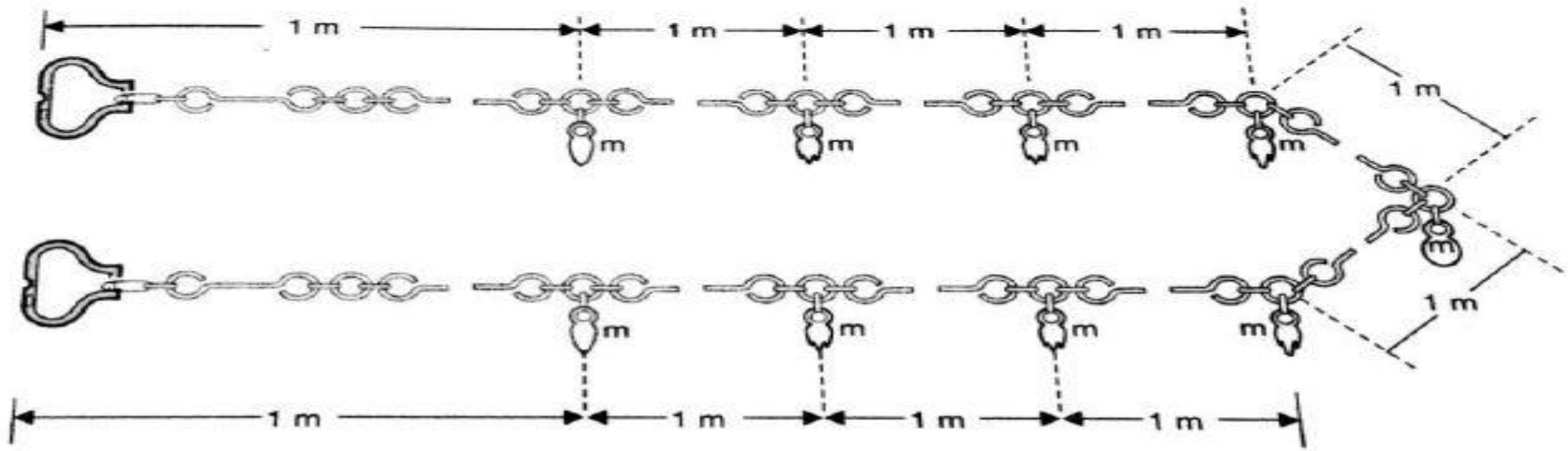


Fig. 3.3 10-Metre Chain

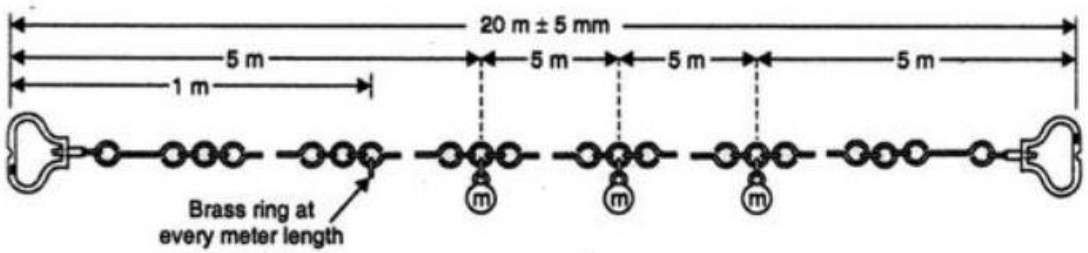


FIG. 3.4. 20-METRE CHAIN

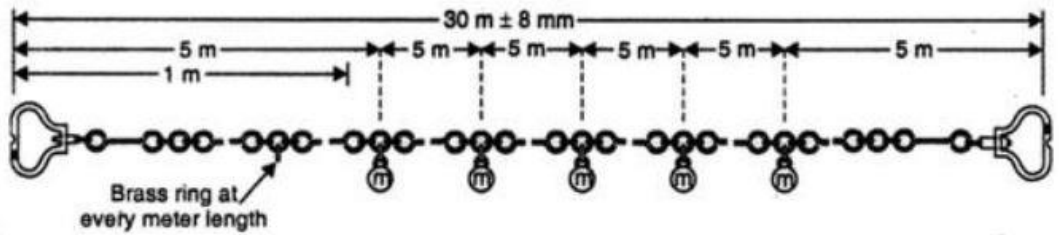


FIG. 3.5. 30-METRE CHAIN

Instruments for Chaining

- **1. Chain**
- i) Metric chain
- ii) Gunter's chain or Surveyor's chain

❑Chain is 66 ft long.

❑Chain consists of 100 links and each link is 0.6 ft or 7.92 inches long.

❑80 Gunter's chain = 1mile

- iii) Engineer's chain

❑Chain is 100 ft

❑Chain consists of 100 links and each link is 1ft long.

- 2) Tape
- 3)Arrows
- Arrows are inserted into ground to mark the end of chain during the process of chaining.
- 4) Pegs
- Wooden pegs are used to mark the positions of the stations or terminal points of a survey lines.

- 5) Ranging Rods and Ranging poles

➢Ranging rods are used to mark areas and to set out straight lines on the field. They are also used to mark points which must be seen from a distance, in which case a flag may be attached to improve the visibility.

➢Length: 2m to 3m

➢They are painted in alternative bands of either black and white or red and white or black, red and white in succession, each band is 20 cm deep.

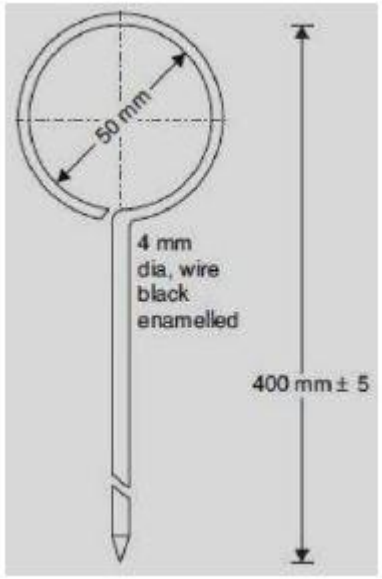
- 6) Plumb Bob

➢While chaining along sloping ground, a plumb bob is required to transfer the points to the ground.

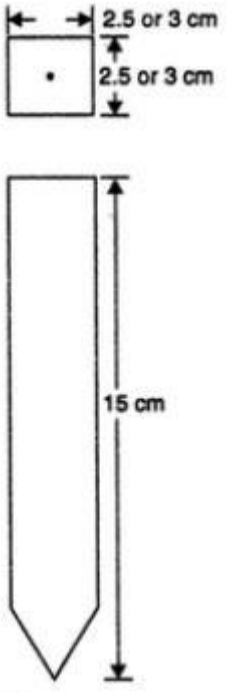
➢Plumb bob is used to make ranging rods vertical and to transfer points from a line ranger to the ground.

➢To aid in centering in theodolites, compass, plane table etc.

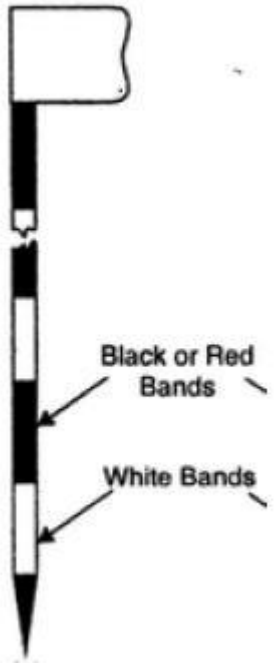
Tape



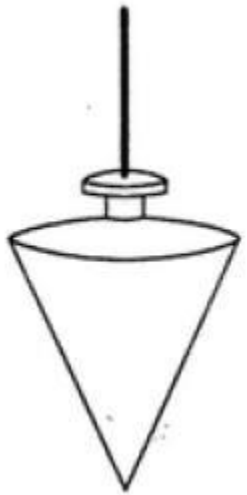
Arrow



Peg



Ranging rod



Plumb bob

Error measurements

2.3 Error due to incorrect chain

Case 1: If the chain is too long, the measured distance will be less . The error will be negative and correction will be positive.

Case 2: If the chain is too short ,the measured distance will be more . The error will be positive and correction will be negative.

Formula:

$$l = \frac{L' \times l'}{L}$$

Where, l = True length of the line

l' = Measured length

L = designated length of the chain

L' = Actual length of the chain

Example 3.1: The length of a line measured with a 20 metre chain was found to be 250 metres. Calculate the true length of the line if the chain was 10 cm too long.

Solution:

Measured Length, l' = 250 m

Actual length of the chain, $L' = 20\text{m} + \frac{10}{100}\text{ m} = 20.1\text{ m}$

Designated length of the chain , L = 20 m

True length of the line, l = ?

$$l = \frac{L'}{L} \times l' = 251.25\,m$$

Example 3.2. *The length of a survey line was measured with a 20 m chain and was found to be equal to 1200 metres. As a check, the length was again measured with a 25 m chain and was found to be 1212 m. On comparing the 20 m chain with the test gauge, it was found to be 1 decimetre too long. Find the actual length of the 25 m chain used.*

Solution.

With 20 m chain : $L' = 20 + 0.10 = 20.10$ m

$$\therefore \quad l = l' \left(\frac{L'}{L} \right) = 1200 \times \frac{20.10}{20} = 1206 \text{ m} = \text{True length of line.}$$

With 25 m chain : $$l = \left(\frac{L'}{L} \right) l'$$

or $$1206 = \left(\frac{L'}{25} \right) 1212$$

$$\therefore \quad L' = \frac{1206 \times 25}{1212} = \mathbf{24.88 \text{ m.}}$$

Thus, the 25 m chain was 12 cm too short.

Example 3.6. *The area of the plan of an old survey plotted to a scale of 10 metres to 1 cm measures now as 100.2 sq. cm as found by planimeter. The plan is found to have shrunk so that a line originally 10 cm long now measures 9.7 cm only. There was also a note on the plan that the 20 m chain used was 8 cm too short. Find the true area of the survey.*

Solution : Present length of 9.7 cm is equivalent of 10 cm original length.

$\therefore$ Present area of 100.2 sq. cm is equivalent to $\left(\frac{10}{9.7}\right)^2 \times 100.2$ sq. cm = 106.49 sq. cm

= original area on plan

Scale of the plan is 1 cm = 10 m

$\therefore$ Original area of survey = $(106.49)\,(10)^2 = 1.0649 \times 10^4$ sq. m

Faulty length of chain used = 20 – 0.08 = 19.92 m

Correct area = $\left(\frac{19.92}{20}\right)^2 \times 1.0649 \times 10^4$ sq.m.= **10564.7** sq. m