SURVEYING-I

Distance Measurement

1. **PACING:**
2. **ODOMETER:**
3. **SPEEDO METER:**
4. **PERAMBULATOR:**
5. **TIME MEASUREMENTS:**
6. **CHAINING:**

1. PACING:

Where approximate results are required, distance may be determined by pacing. It may be used for approximate checking more accurate measurements of distance. The method consists of walking over a line and counting the number of paces. Knowing the average length of pace, the required distance may be obtained by multiplying the number of paces by the average length of the pace.

In order to obtain satisfactory results, the average length of one pace or step should be known by pacing over a line of known length on the level as well as rough ground. The length of the pace varies with the individual and also with:

- Age, height & physical condition.
- Nature of ground (pace being shortened when going up hill and lengthened when going down hill).
- The slope of the country (means site) &
- Speed of the pacing.

STANDARDIZING THE PACE-LENGTH:

- Total distance from A to B = 100 ft
- No. of steps/paces from point A to B = N1 = x1
- No. of steps/paces from point B to A = N2 = x2
- Now; average of number of paces = n = (N1+N2) / 2 = y

Hence;

- The measure of one pace will be = 100/y = z

2. ODOMETER:

Distance may be approximately determined by means of simple device called as “Odometer”.

It can be attached to the wheel of vehicle or a bicycle etc, and it registers the no. of revolutions of the wheel. The distance traveled may be obtained by multiplying the no. of revolutions by the circumference of the wheel (i.e. circumference of circle = $2\pi r$).

3. SPEEDO METER:

The Speedo meter of an automobile may be used to measure distance approximately. It gives better results than pacing, provided the route is smooth as long a highway or motorway.

4. PERAMBULATOR:

It is a rapid determination of distance measurement. This instrument resembles a single bicycle wheel provided with forks and a handle. It is wheeled along a line whose length is desired. The distance traversed is automatically registered in terms of miles, furlongs and yards. The registered readings are too approximate on rough ground.

Unit Conversion

- 1/8th of mile = 1 furlong
- 1 yard = 3 feet
- 1 furlong = 220 yards
- 1 mile = 8 furlongs
- 1 Marla = 272 sq.ft
- 1 Kanal = 20 Marla
- 1 Acre = 8 Kanal or 160 Marla
- 1 square = 25 Acre

Difference between yard & meter

- 1 yard = 36 inches.
- 1 meter = 39 inches.

5. TIME MEASUREMENTS

Distances are roughly determined by time interval of travel. Knowing the average time per mile of a person at walk, the distance traveled may be readily obtained.

6. CHAINING:

The most common & accurate method of measuring distance with a chain or a tape is called chaining.

For work of ordinary precision, a chain is used but where great accuracy is required, a steel tape is used.

DIFFERENT TYPES OF CHAINS:

1. Gunter's chain
2. Engineer's chain
3. Revinue chain
4. Meteric chain

GUNTER'S CHAIN:

Gunter's chain, named after its inventor, is 66 ft long and it is divided into 100 links; each of 0.66 ft long. It is very convenient for measuring distance in miles, furlong and for measuring land when the unit of the area is an acre on account of its simple relation to the mile and acre.

- 10 Gunter's chains = 1 furlong
- 80 Gunter's chains = 1 mile
- 10 Square Gunter's chain = 1 Acre

Distance measured with the Gunter's chain is recorded in chains and decimals e.g., 9.37 chains/chain and links. i.e.,9 chains & 37 links.

REVINUE CHAIN:

It is 33 ft long and divided into 16 links each 2 $^{1/16}$ ft long.

ENGINEER'S CHAIN:

It is 100 ft long and divided into 100 links; each link equals to 1 ft. It is used in all engineering surveys when long lines are to be measured. It is most accurate than the Gunter's chain because of the greater length. The distance measured with engineer's chain is recorded in feet & decimals.

METERIC CHAIN:

It consists of 20 meter or 30 meter length divided into 100 or 150 links respectively. Length of each link is 20 cm.

TESTING OF CHAIN

When the chain is new, it is very nearly of the standard length. During its first use the links become bent and consequently the chain is shortened. It is also shortened by mud clogging the links when working over muddy ground. On the other hand, it gets elongated due to stretching of links and joints and opening out of small rings. It is therefore necessary to check its length, otherwise the measurements becomes unreliable. Before testing the chain, the surveyor should see that the links & rings are free from mud and there are no bent links.

The chain is tested by the comparison with the steel tape, which should be kept in the surveyor's office for this purpose.

- The chain is tested at the start & end of the job.
- Suppose;
- The error at the start = e1
- The error at the end = e2
- Mean of two errors = e = (e1+e2) / 2

Actually length (with error) of the chain = $L^{/} = L + e$

Where;

- L = Normal length of the chain.
- = 100 ft for Engineer's chain.
- = 100 links for Gunter's chain.
- = 20 or 30 meter for Meteric chain.

ERRORS IN CHAINS:

Suppose;

- Error in chain = e = (e1+e2) / 2
- If normal length of the chain = L
- Incorrect length of the chain = L + e = L

ERRORS IN CHAINS:

True length measured with an incorrect chain.

True length = (L/L) x measured length.

$$L = L \pm e$$

L will be:

- Positive, when chain is too long.
- Negative, when chain is too short.

ERRORS IN CHAINS:

True area measures with an incorrect chain.

- True area = (L/L) 2 x measured area

True volume measured with an incorrect chain.

- True volume = (L/L) 3 x measured volume

Problem No. 01

Length of a line measured with an Engineer's chain was found to be 820 ft. it was afterwards found that the chain was 3 inches long. Find the true length of the line?

Solution

True length = (L/L) x measured length.

- L = 100 ft
- e = + 3 inches = 0.25 ft

- Thus
  - L = L + e = 100.25 ft

- Measured length = 820 ft

So,

True length = (100.25/100) x 820 = 822.05 ft. (Answer)

Problem No. 02

Length of a line measured with an Engineer's chain was found to be 820 ft. it was found that the error in chain at start was 3 inches long & 9 inches long at the end. Find the true length of the line?

Solution

True length = (L/L) x measured length.

- L = 100 ft
- e1 = +3 inches = +0.25 ft
- e2 = +9 inches = +0.75 ft

Mean = (e1+e2) / 2 = (0.25+0.75)/2 = 0.50 ft

- L = L + e = 100.5 ft

- True length = (L/L) x measured length
  = (100.5/100) x 820 = 824.10 ft
  (Answer)

Problem No. 03

Stations are measured by means of a Günter's chain which was 0.4 links too short and the result was 1248 links. What was the true distance between the stations?

Solution

- L = 100 ft
- e = -0.4 links
- L = L + e = 100 – 0.4 = 99.6

True length = (L/L) x measured length

= (99.6/100) x 1248

= 1243.008 links

[Since 1 link = 0.33 ft]

Therefore; True length = 410.192 ft (Answer)

Problem No. 04

Length of line measured by means of a 100 ft chain was found to be 224. ft and the true length of the line was 2245 ft. what was the actual length of the chain?

Solution

- True length = 2245 ft
- L = 100 ft
- Measured length = 2240 ft

Since;

L = (True length/ measured length) x L

L = 100.223 ft.

(Answer)

Problem No. 05

Length of line measured by means of a 100 ft chain was found to be 224. ft and the true length of the line was 2245 ft. what was the actual error in the chain?

Solution

True length = 2245 ft

L = 100 ft

Measured length = 2240 ft

Since;

L = (True length/ measured length) x L

L = 100.223 ft.

Error in the chain = (100.223 – 100)ft

= 0.223 ft

Thus, Error = e = 0.223 ft (Answer)

Problem No. 06

A survey line was measured by means of a Gunter's chain and found to be 3400 links. It was also measured with a 100 ft chain and the result was 2258 ft. if the error in the Gunter's chain is +0.3 links. Find the error in 100 ft chain?

Solution

Gunter's chain:

True length = (L/L) x measured length

= (100.3/100) x 3400

= 3410.2 links

Now,

True length of Gunter's chain = 3410.2 x 0.66

= 2250.73 ft

(since 1 link = 0.66 ft)

Engineer's Chain:

Measured length = 2258 ft

L =?

True length = 2250.73 ft

True length = (L/L) x measured length

Therefore; L = (True length/ measured length) x L

L = (2250.73/2258) x 100

L = 99.67 ft

So, L = L + e

e = L – L

= 99.67 – 100 = -0.33 ft (Answer)

Problem No. 07

An area was measured with a 100 ft chain and found to contain 38 acres (or 1647680 ft).It was afterward found that the chain was 6 inches too short. What was the true area of the field?

Solution

True area = (L/L) 2 x measured area _____ (i)

Since;

L = 99.5 ft

L = 100 ft

Therefore from (i) we get

True Area = 37.62 acres

or 1631244.39 sq.ft (Answer)

Problem No. 08

A chain was tested before starting the survey of a field and was found to be exactly 100 ft, at the end of survey; it was tested again and was found to be 100 ft & 6 inches. Area of a plan drawn a scale of one inch = 66 ft was 18.50 inch2.Find the true area of the field?

Solution

True area = (L/L) 2 x measured area

= (100.25/100)2 x 18.50 inch2

True area = 18.593 or 18.6 inch2

Given;

1 inch = 66 ft or 1 sq.inch = 4356 sq.ft

True area = 81021.6 ft2

OR True area = 81021.6/5440 = 14.89 kanals.

OR True area = 14.89/8 = 1.86 acres.

Problem No. 09

Length of a line measured with a 20 meter chain was found to be 635.4 m. when the chain was compared with a standard chain, it was found to be 0.2m too long. Find the true length of the line?

Solution

L = 20 m

e = 0.2 m

Measured length = 635.4 m

Since; L = L + e

L = 20 + 0.2 = 20.2 m

True length = (LL) x M.L

True length = (20.2/20) x 635.4

= 641.754 m (Answer)

Problem No. 10

A 20 meter chain was found to be 2 cm too long after chaining a distance of 1200 m. After chaining a total distance of 2500 m. it was tested again and was found to be 5 cm too long. If the chain was corrected at the commencement of work, find the correct distance measured?

Solution

Step I.

L = 20 m

M.L = 1200 m

e = (e1 + e2) / 2

= (0 + 2) / 2 = 1 cm or 0.01 m

Therefore;

L = L + e = 20 + 0.01 = 20.01 m

Now; (True length) 1 = (L/L) x M.L

= 1200.6 m

Step II.

M.L = 2500 – 1200 = 1300

L = 20

e = (e1 + e2) / 2 = (2 + 5)/2 = 3.5 cm or 0.035 m

So, L = L + e = 20 + 0.035 = 20.035 m

(True length) 2 = (L/L) x M.L

= (20.035/20) x 1300

= 1302.275 m

True length = (True length) 1 + (True length) 2

= 1200.6 + 1302.275

= 2502.375 m

Problem No. 11

Chain was tested before starting a survey and was found to be exactly 30m. After measuring the area it was tested again and was found to be 30.20m. Area of the plan of the field was found to be 50.5 sq.cm.

Which was plotted to a scale of 1 cm = 10 m. Find the true area?

Solution

e = (e1 + e2) / 2 = (0 + 0.20) / 2 = 0.1 m

M.A = 50.5 sq.cm or 5050 sq.m (given 1 cm = 10 m)

L = 30 m

Therefore; L = L + e

L = 30 + 0.1 = 30.1 m

Now;

True area = (L /L) x M.A

= (30.1/30)2 x 5050 sq.m

True Area = 5083.722 sq.m

Thanks