CHAIN SURVEYING

By

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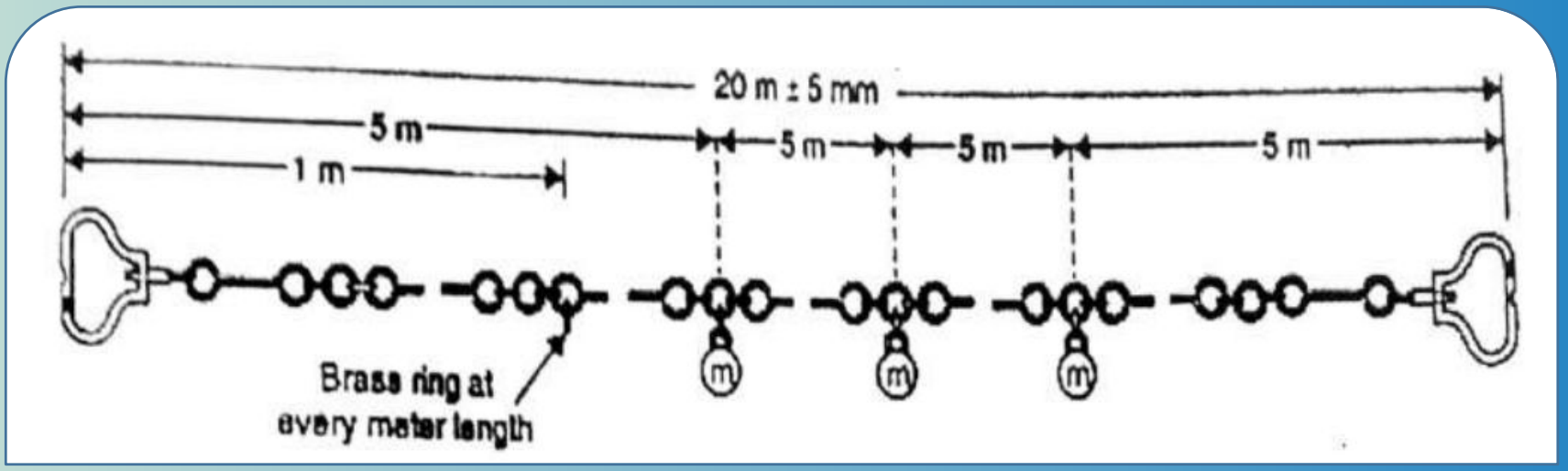
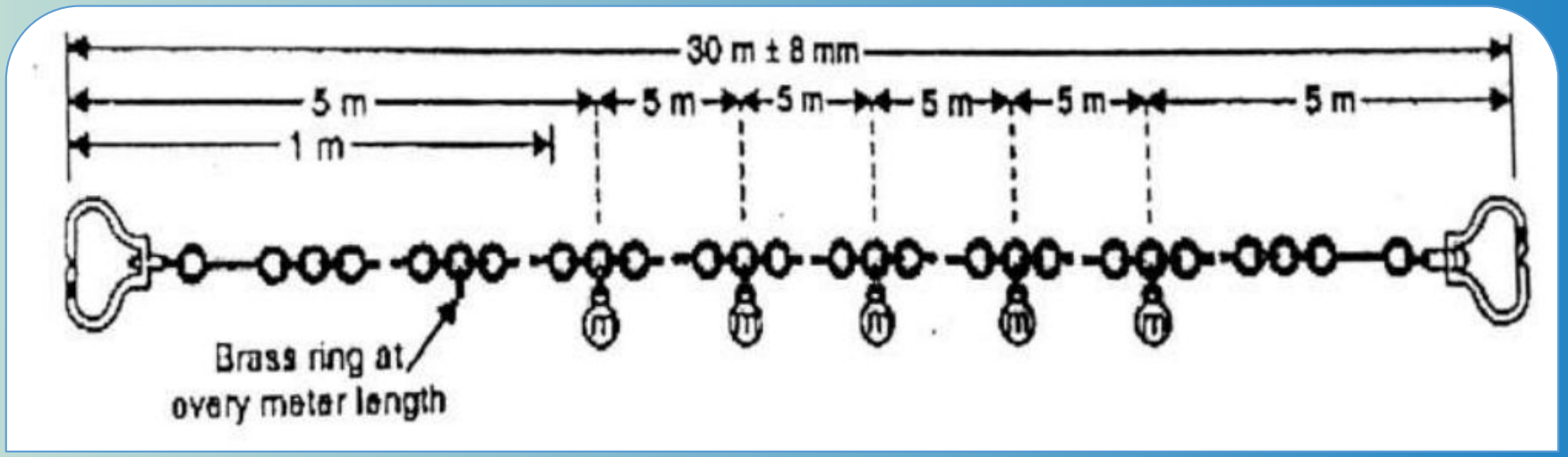
Introduction

- Chain surveying is the type of surveying in which only linear measurements are taken in the field.
- Chain (Tape) surveying is the simplest form of detail surveying. In this method the lengths of lines marked on the field are measured, while the details are measured by offsets from these line.
- This type of surveying is done for surveys of small extent to describe the boundaries of plot of land to locate the existing features on them.
- It is the method the area is divided into network of triangles and the sides of the various triangles are measured directly in the field with a chain or a tape and no angular measurements are taken.



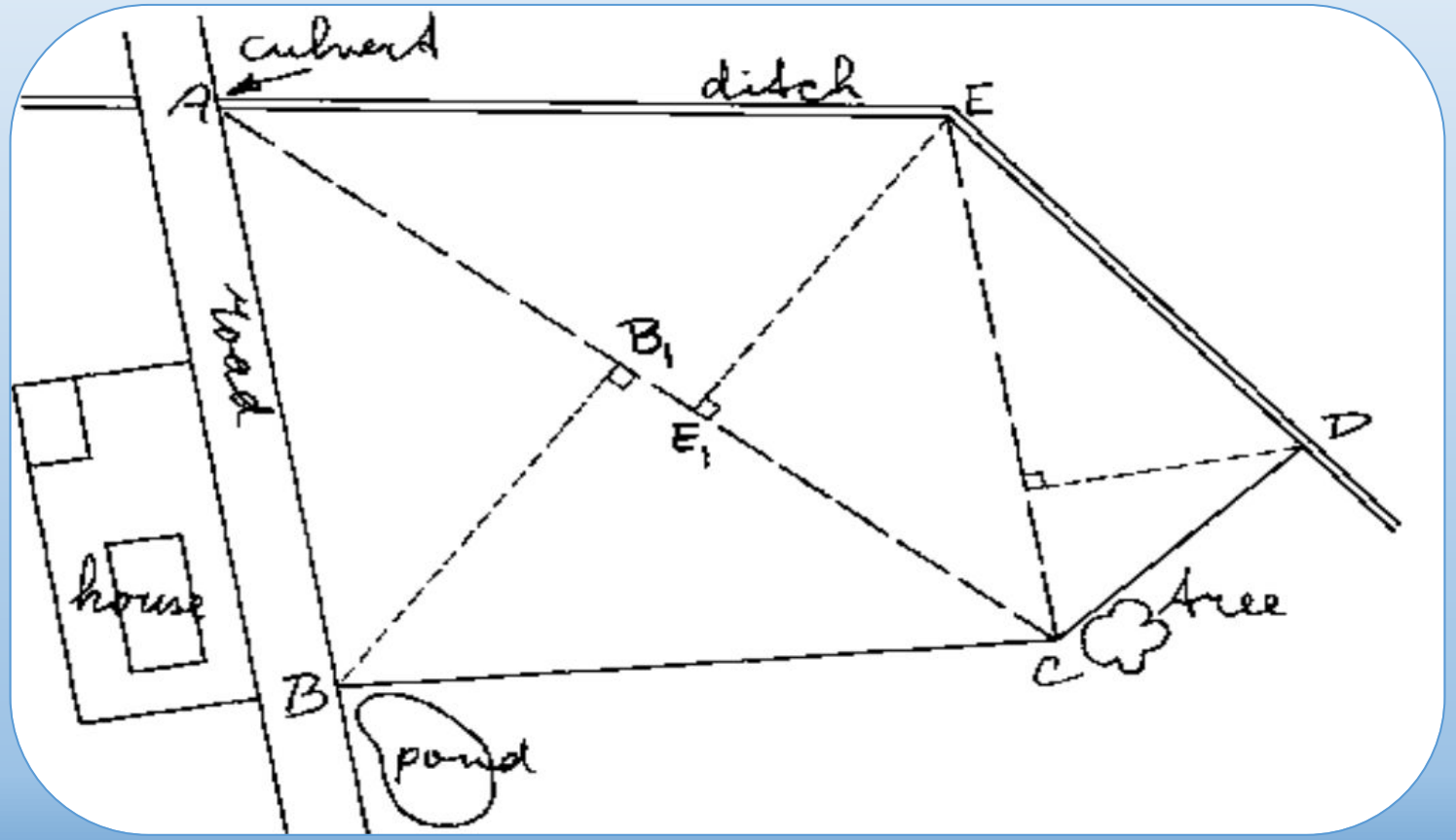
20 Meter Chain

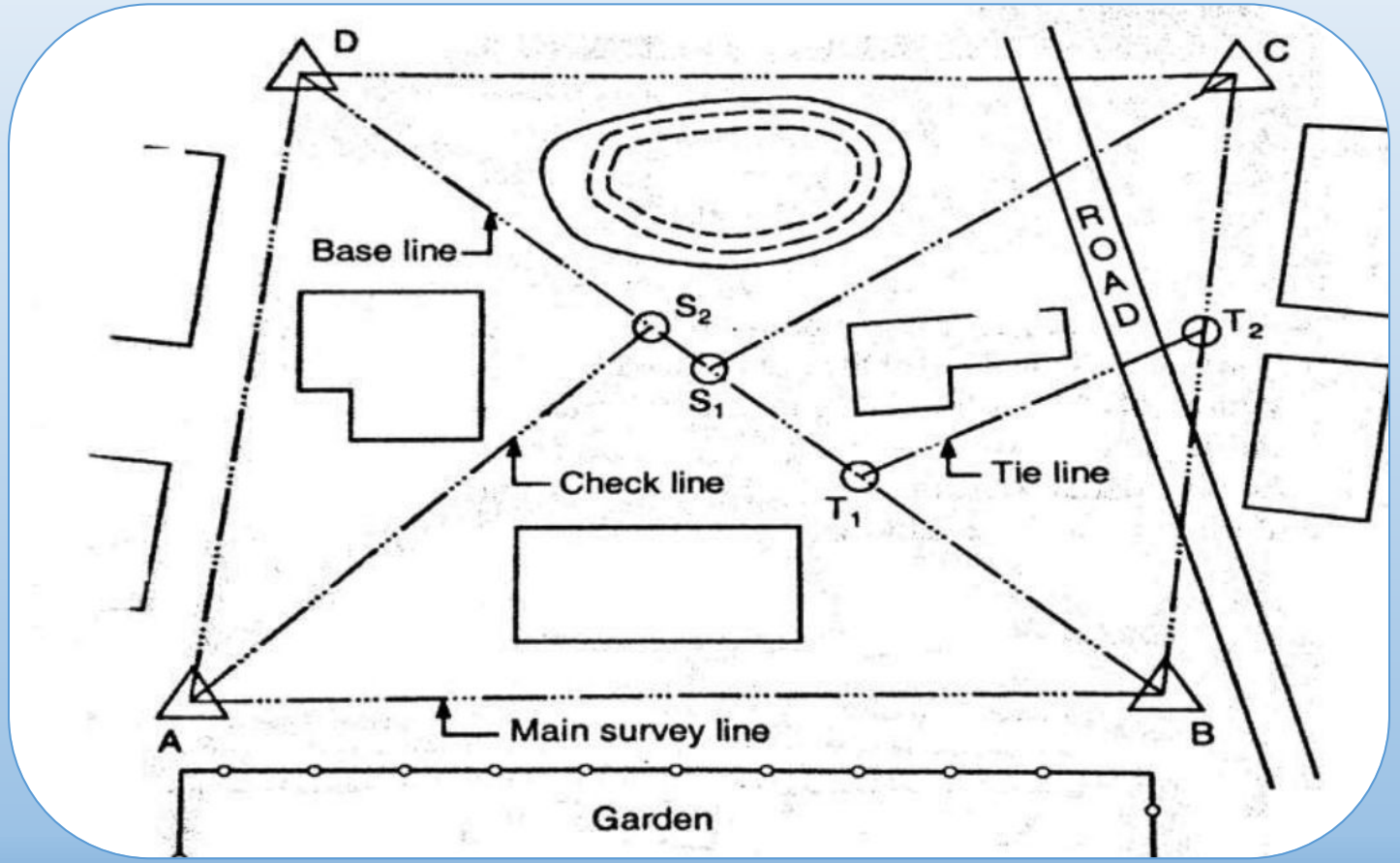


30 Meter Chain

PRINCIPAL OF CHAIN SURVEYING

- The principal of chain surveying is to divide the area into a number of triangles of suitable sides.
- As a triangles is the only simple plane of geometrical figure which can be plotted from the lengths of the three sides even if the angels are not known.
- A network of triangles (triangulation) is preferred to in chain surveying .
- If the area to be surveyed is triangular in shape and if the lengths and sequence of its three sides are recorded the plane of area can be easily drawn.


culvert
ditch
A
E
road
B_1
E_1
D
house
tree
C
B
pond


D
C
Base line
ROAD
S_2
T_2
S_1
Check line
Tie line
T_1
A
Main survey line
B
Garden

Suitability of chain surveying

- Ground surface is more or less level.
- Area is small.
- Small-scale map is required to prepare.
- Formation of well conditioned triangle is easy

Chain surveying is not recommended

- Area is crowded with many details.
- Area consists of too many undulations.
- Area is very large.
- Formation of well conditioned triangle is not easy

well conditioned triangle

- A triangle is said to be well conditioned triangle when no angle in it is neither less than 30 nor greater than 120.
- If in a triangle an angle is less than 30 or greater than 120 is called ill conditioned triangle.
- An equilateral triangle having each angle of 60 is an ideal triangle.

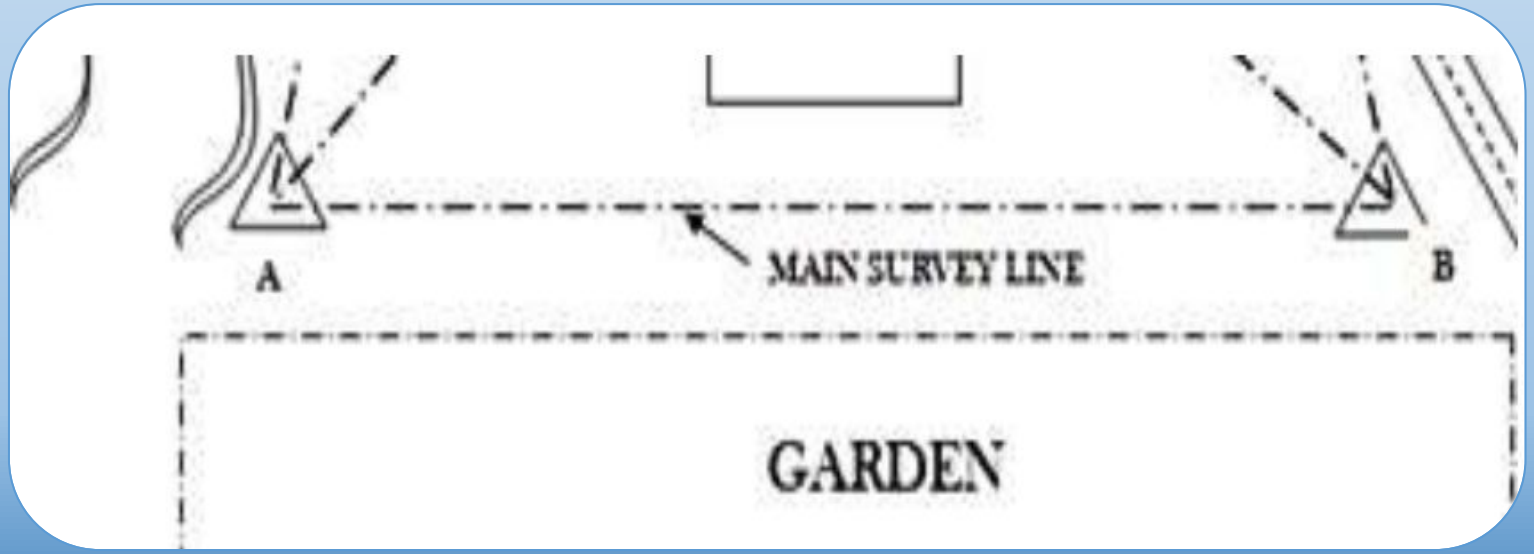
SURVEY STATIONS

Survey stations are the points at the beginning and at the end of the chain line. They may also occur at any convenient position on the chain line.

- Main stations
- Subsidiary stations
- Tie stations

Main stations

- Main Station Stations along the boundary of an area as controlling points are known as ‘Main Stations’ The lines joining the main station are called ‘ Main Survey Lines’. The main survey lines should cover the whole area to be surveyed. The main stations are denoted by Δ.



Subsidiary Stations:

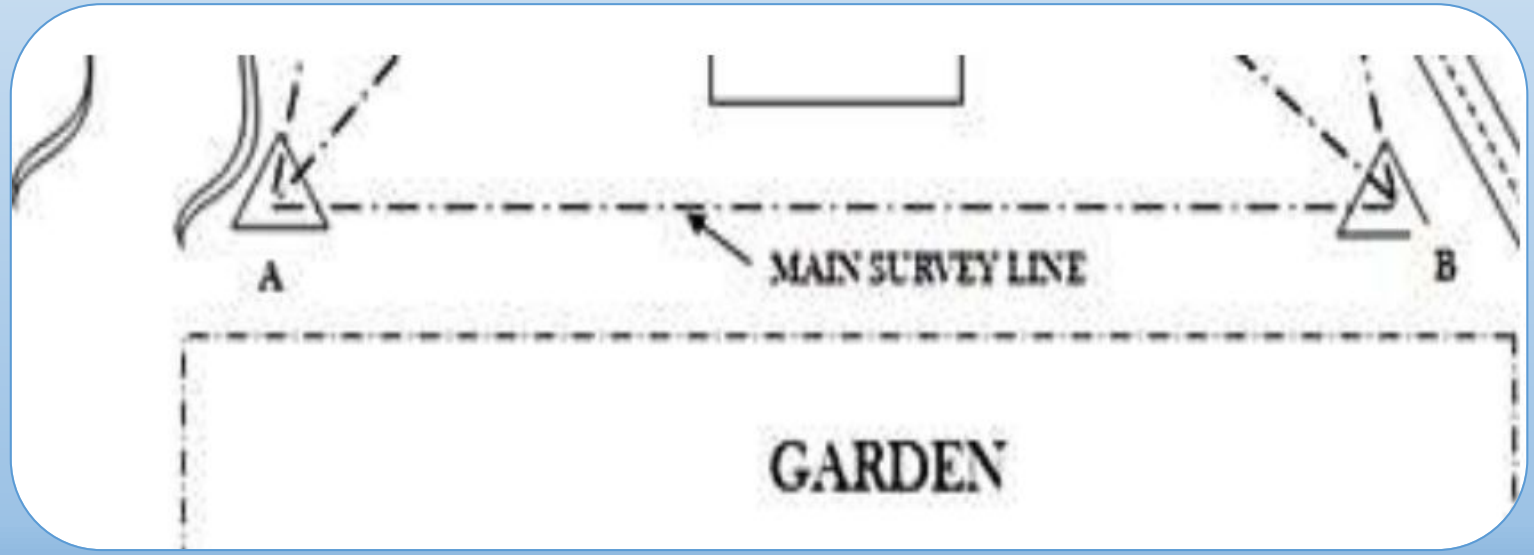
Stations which are on the main survey lines or any other survey lines are known as ‘ Subsidiary Stations’ these stations are taken to run subsidiary lines for dividing the area into triangles, for checking the accuracy of triangles and for locating interior details.

Tie Stations

These stations are also subsidiary stations taken on the main survey lines. Lines joining the stations are known as ‘ Tie lines’ Tie lines are taken to locate interior details.

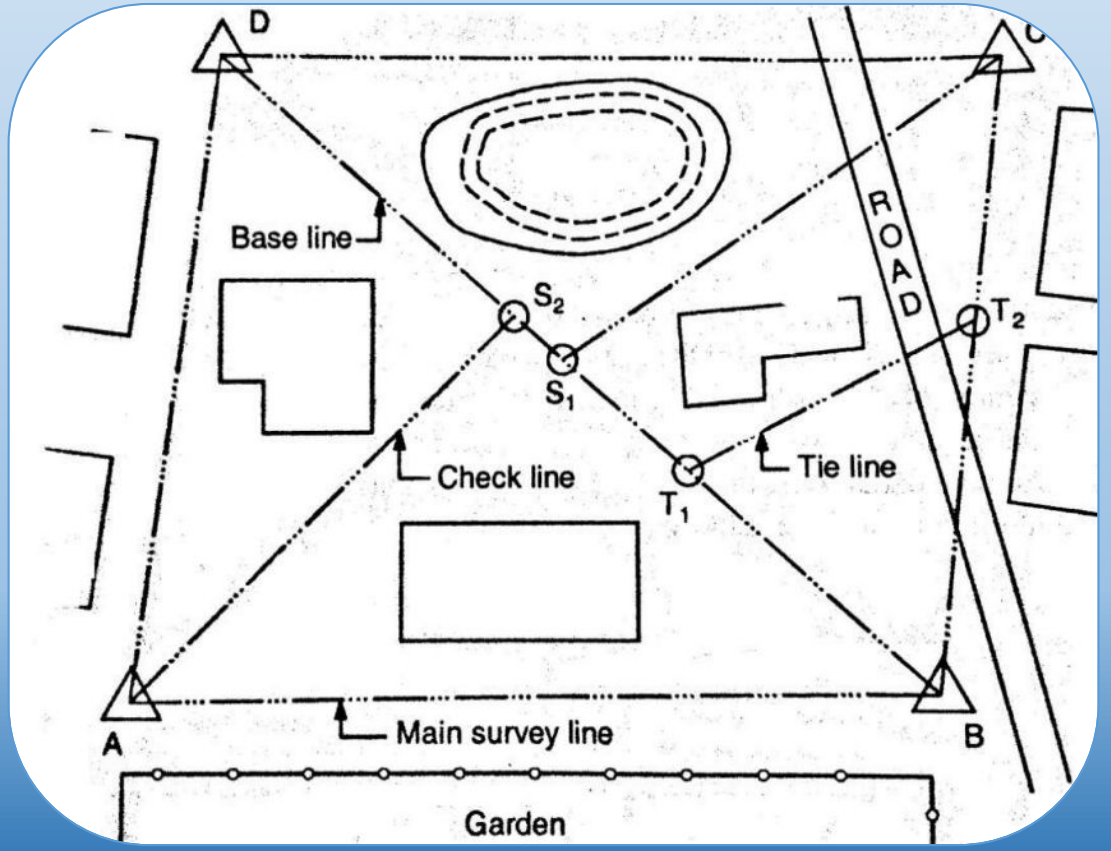
Main Survey line

The lines joining the main stations are called ‘main survey lines’ or chain lines



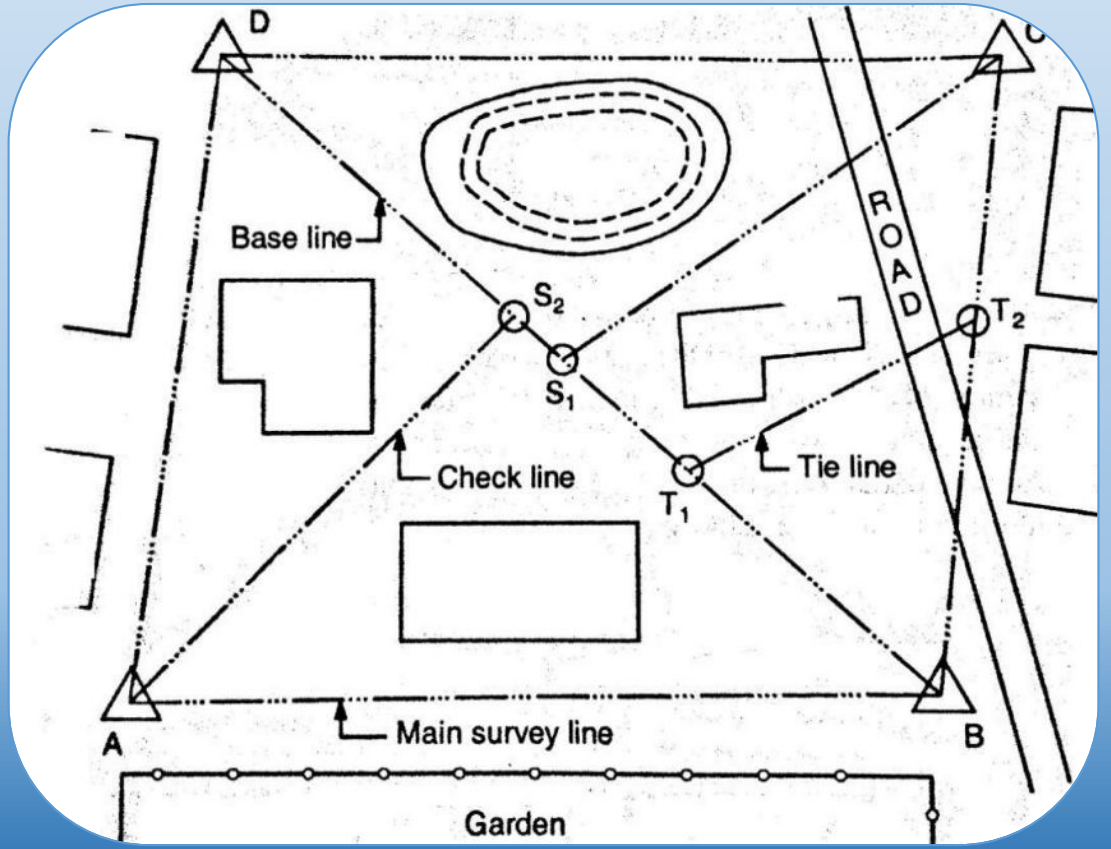
BASE LINE

The line on which the framework of the survey is built is known as the ‘base line’ . It is the most important line of the survey . Generally , the longest of the main survey line is considered as the base line. This line should be measured very carefully and accurately. In fig. BD is the base line.



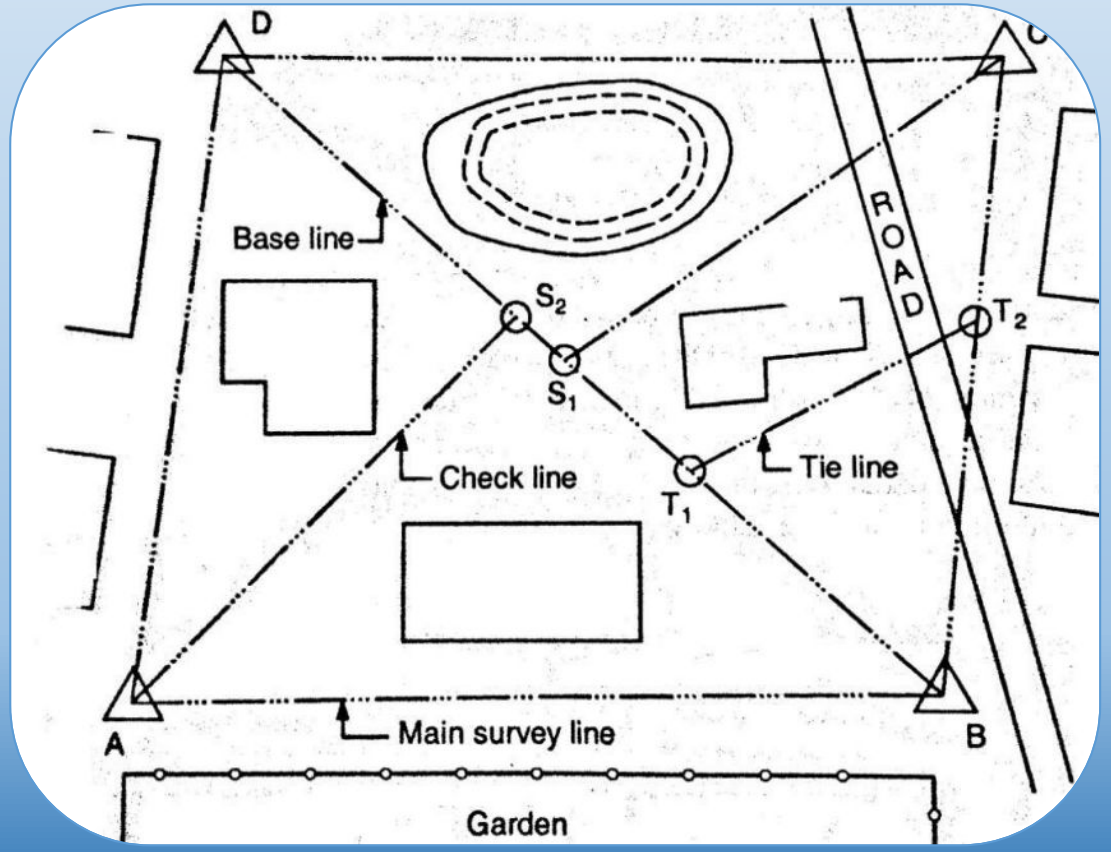
Check line

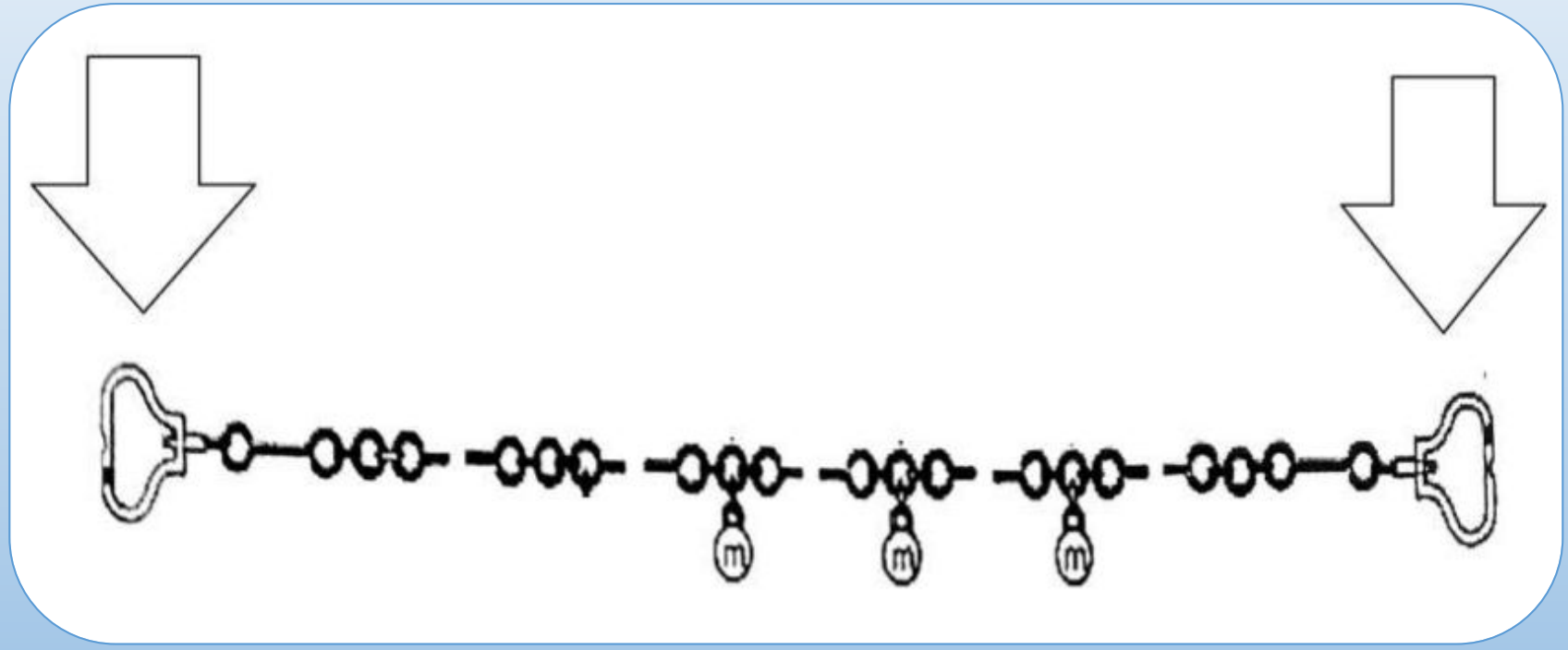
- The line joining the apex point of a triangle to some fixed points on its base is known as the ‘check line’. It is taken to check the accuracy of the triangle . Sometimes this line is helps to locate interior details . In fig. CS1 , AS2 are the check lines.



TIE – LINE

A line joining tie stations is termed as a tie line. It is run to take the interior details which are far away from the main lines and also to avoid long offsets. It can also serve as check line. In Fig. T1 T2 is the tie line.




m
m
m

Procedure

- Fix station A and B at some distance by fixing wooden peg to determine horizontal distance between them.
- Position of station A and B is fixed by measuring their position from at least three permanent objects and location sketch of station A and B are drawn.
- The follower holds one handle of the chain in contact with peg at station A.
- The leader takes the other handle of the chain, arrows and ranging rod & walks in the forward direction dragging chain with him
- After the chain is stretched completely along the line the follower steps on one side of the line with the ranging rod touching the handle.

ERRORS IN CHAIN SURVEYING

- Every measurement made with a mechanical device is subject to any error that could possibly be caused by the condition of the **device or by the procedure** used in taking the measurement.
- Some of the more common sources of errors are

  Personal errors

  Compensating errors, and

  Cumulating errors.
- With proper care of the chain and reasonable effort made with each use, the effects of these errors can be kept within acceptable tolerances for all but the most precise measurements.
- When necessary, each of these conditions can be compensated for mathematically if they are monitored and compared to a known standard.

Errors in chaining may be classified as:

Personal Errors

Wrong reading, wrong recording, reading from wrong end of chain etc., are personal errors. These errors are serious errors and cannot be detected easily. Care should be taken to avoid such errors.

Cumulative Errors

The errors that occur always in the same direction are called cumulative errors. In each reading the error may be small, but when large number of measurements are made they may be considerable, since the error is always on one side. Examples of such errors are:

- Bad ranging
- Bad straightening
- Erroneous length of chain
- Temperature variation
- Variation in applied pull
- Non-horizontality
- Sag in the chain, if suspended for measuring horizontal distance on a sloping ground.

Compensating Errors

These errors may be sometimes positive and sometimes negative. Hence They are likely to get compensated when large number of readings are taken. The magnitude of such errors can be estimated by theory of probability. The following are the examples of such errors:

- Incorrect marking of the end of a chain.
- Fractional part of chain may not be correct though total length is corrected.
- Graduations in tape may not be exactly same throughout.
- In the method of stepping while measuring sloping ground, plumbing may be crude.
- Errors (i), (ii), (vi) and (vii) are always +ve since they make measured length more than actual.

PROPORTIONAL ERRORS

- When a chain is manufactured, it is intended to be a specific length, plus or minus some tolerance. It may or may not actually meet those specifications. When a field measurement is taken, the acceptable error may be more or less than what the chain was designed for.

- For high precision work, we need to measure several known distances and determine if this chain is the proper length. If not, we need next to determine if the error is in one or more specific locations along the chain or if the error is proportional along the length.

- If a known 50 foot distance is measured to be 49.995 feet and a known 100 foot distance to be 99.99 feet, all measurements made with that chain should be multiplied by a factor of 100/ 99.99 (known distance over measured distance).

CONSTANT ERRORS

- If a chain has been kinked or broken and spliced back together, there is a good chance that there will be a consistent error for any distances measured using that portion of the chain.

- This error needs to be added or subtracted as appropriate each time.

SAG CORRECTION

- When a chain is suspended from each end and not supported along its length, the weight of the chain causes it to sag and pulls the two ends toward each other. It is impossible to exert enough outward force to fully overcome the sag.
- For all measurements, adequate tension should be applied to minimize the effective shortening of the chain. For precise measurements, a correction should be applied using the formula given below.

$$C_s = \frac{w^2 L^2}{24 P^2}$$

where:

Cs = Sag Correction between points of support

w = Weight of tape

L = Distance between supports

P = Applied Tension

TENSION CORRECTION

- While a certain amount of tension is desirable to help offset the sag effect, it will also stretch the chain. Steel is generally thought of as not being very easily stretched and indeed it is not. That is one of the reasons it is used for making chains. But steel will still stretch to some degree if tension is applied.
- When a chain is checked against a known distance, the applied tension should be controlled. Subsequent precise measurements should be made using the same tension, or if not, a correction should be applied. The formula for this is also mentioned below.

$$C_P = \frac{(P - P_0)L}{aE}$$

where:

C_p = Correction per distance L

P = Applied Tension

P_0 = Tension for which the tape was standardized.

L = Length

a = Cross-Sectional Area of the Chain.

E = Modulus of Elasticity of Steel.

TEMPERATURE CORRECTION

- Whatever material is used to make a chain, that material will expand and contract with any change in temperature. Some materials are more affected than others, but every chain will change length somewhat if warmed or cooled.
- If precise measurements are needed, an adjustment needs to be made for the change in temperature between the current temperature and the temperature at the time the chain was checked against a known distance. This formula is also given below.

$$C_t = \alpha L(T - T_0)$$

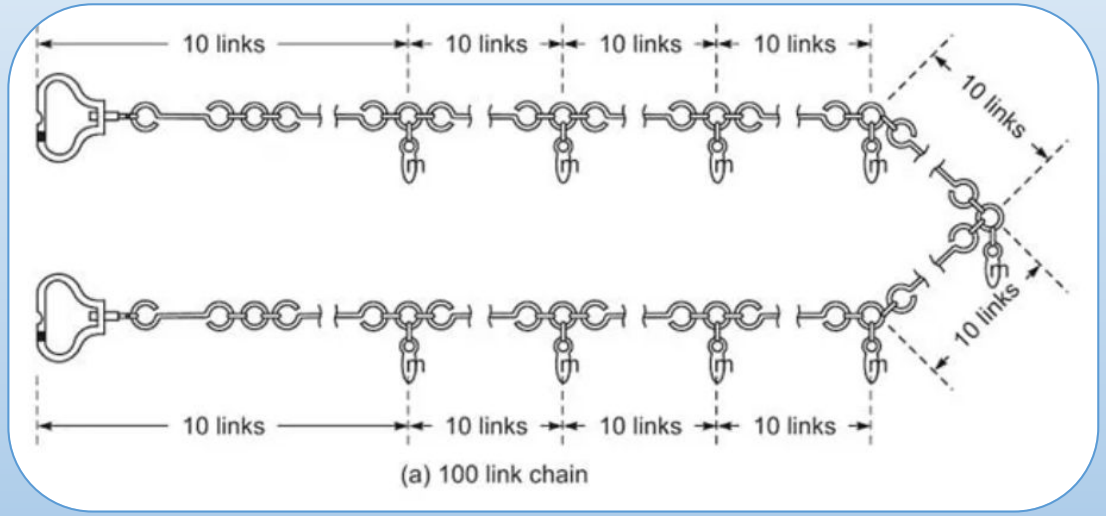
where:

α = Coefficient of thermal expansion

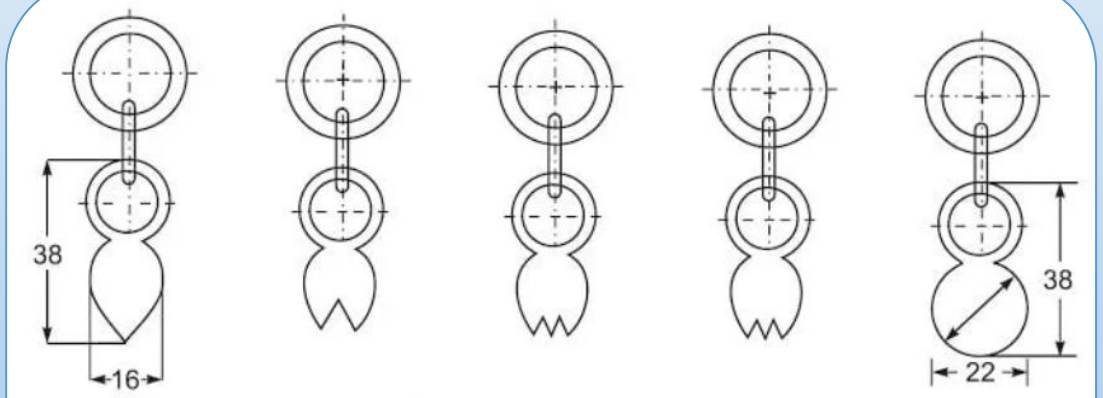
L = Measured Length

T_0 = Temperature of Chain

T = Standard Temperature



(a) 100 link chain



10/90 links 20/80 links 30/70 links 40/60 links 50 links

(b) Talleys

Types of Chains used in Surveying

Depending upon the length of the chain, these are divide into following types,

- Metric chains
- Steel band or Band chain
- Gunter’s chain or surveyor’s chain
- Engineer’s chain
- Revenue chain

Metric chains

Metric chains are the most commonly used chain in India.

These types of chains comes in many lengths such as 5, 10, 20 and 30 meters.

Most commonly used is 20m chain. Tallies are provided at every 2m of the chain for quick reading.

Every link of this type of chain is 0.2m.

The total length of the chain is marked on the brass handle at the ends.

Steel band or Band chain

- These types of chain consist of a long narrow strip of steel of uniform width of 12 to 16 mm and thickness of 0.3 to 0.6 mm.
- This chain is divides by brass studs at every 20cm or instead of brass studs, band chain may have graduated engraving as centimeter.
- For easy use and workability band chains are wound on steel crosses or metal reels from which they can be easily unrolled.
- These steel bands are available in 20m and 30m length and the width of about 12-16mm

Gunter's chain or **surveyor's chain**

- Gunter chain comes in standard 66ft.
- These chain consists of 100links, each link being 0.66ft or 7.92inches.
- The length 66ft is selected because it is convenient in land measurements.

- 10 square Gunter's chains = 1 Acre
- 10 Gunter chains = 1 Furlong
- 80 Gunter chains = 1 mile

Revenue Chain

The standard size of this type of chain is 33ft. The number of links are 16, each link being 2 ft. This chain is commonly used in cadastral survey.

Engineer’s chain

- This chain comes in 100ft length.
- Its consist of 100 links each link being 1ft long.
- At every 10 links a brass ring or tags are provided for indication of 10 links.
- Readings are taken in feet and decimal.

Measuring Tapes in Surveying

Cloth or linen tape

- Used for subsidiary measurements
- Very light, easy to handle
- May effect by moisture

Metric steel tape

- Made of steel
- Outer end is provided with a ring for holding

Invar tape

- Used for high precision work
- Made of alloy steel
- Coefficient of thermal expansion of invar alloy is very low

Synthetic tape

- Made of glass fiber with PVC coating
- These are used for short measurements

Testing and Adjustment of Chain

As the chain is a metal made, it may undergo many changes due to temperature effect or human error and etc. So for all lengths of chain a tolerance is given

- 5m chain = + or – 3mm
- 10m chain = + or – 3mm
- 20m chain = + or – 5mm
- 30m chain = + or – 8mm

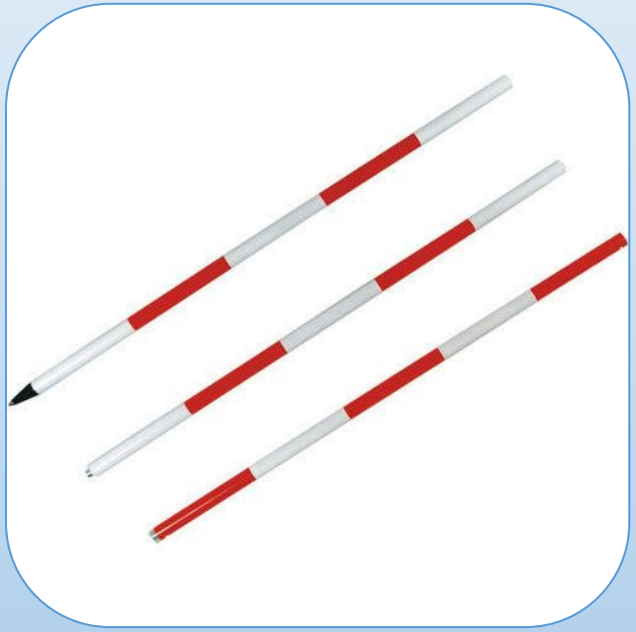
Chain length shorten due to

- Bending of links.
- Sticking of mud in the rings
- Chain length increases due to
- Opening of small rings.
- Wearing of surfaces.

Chains may be tested with respect to

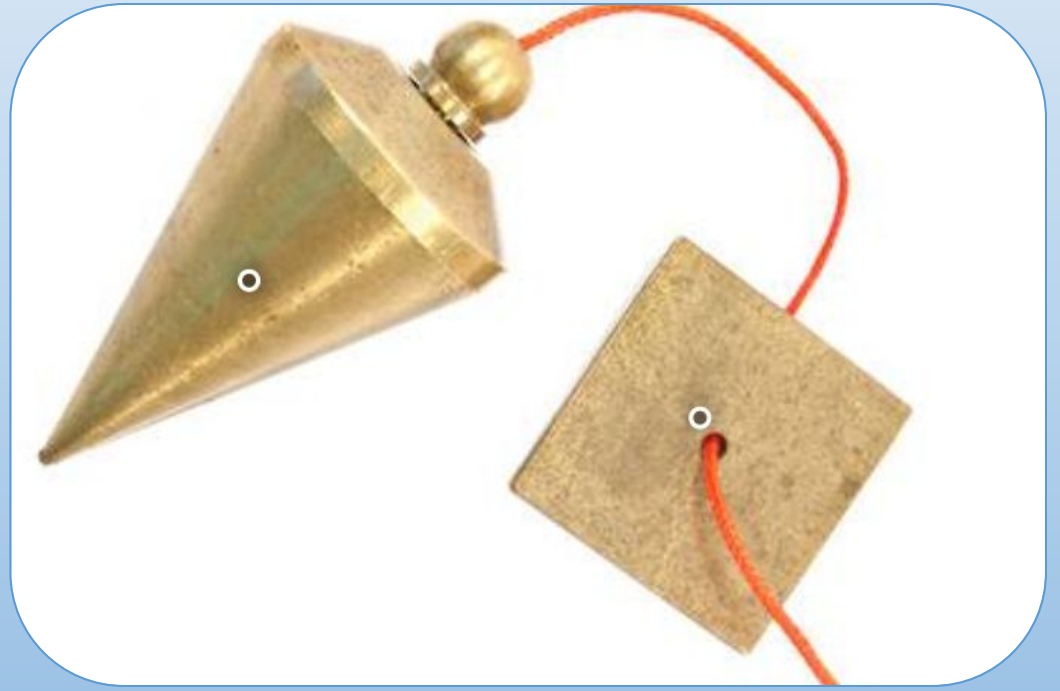
- Steel tape
- Permanent test gauge
- Pegs driven in the field at required distances
- Permanent test gauge made with dressed stones

Ranging Rod & Peg



Cross Staff

Plumb bob



Thank you

https://www.youtube.com/watch?v=E8JFAVUQ31A