

# Chain and cross staff survey

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# Measuring Distances and angles

## Measuring horizontal distances

- At every point along that length, the line tangent to the level surface is horizontal. Horizontal distances may be measured by stretching a steel tape between a series of points along a horizontal line.
- Most surveying data are eventually plotted and drawn as a different types of plots like boundary plats or topographic maps.
- The scaled length of any line on the drawing is proportional to the actual horizontal distance between its endpoints on the Earth.

- Depending on the specific application and the required accuracy, one of several methods may be used to determine horizontal distance. The most common methods include pacing, taping, and electronic distance measurement (EDM).
- To this day, the term chaining is often used to describe the taping operation.
- Measuring horizontal distances with a tape is simple in theory, but in actual practice it is not as easy as it appears at first glance.
- It requires skill and experience for a surveyor to be able to tape a distance with a relative accuracy between 1:3000 and 1:5000, which is a generally accepted range for most preliminary surveys, ordinary property surveys, and many types of construction layouts.
- Using good-quality equipment and under normal field conditions, an experienced surveyor can readily achieve a 1:3000 accuracy without having to correct for systematic errors.

## ❖ Different types tape

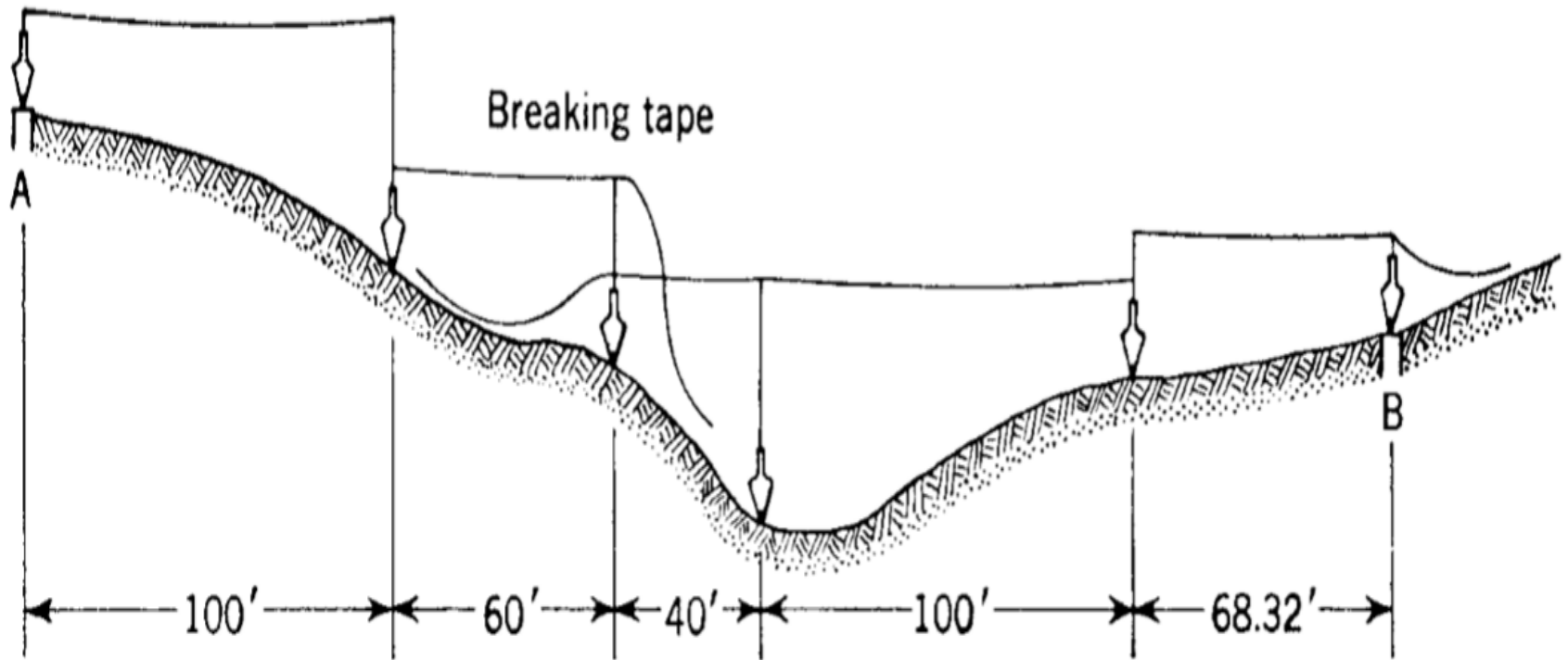
- Cloth tape, Steel Tapes.
- For very precise measurements and for checking or standardizing the length of ordinary steel tapes, special tapes made from a nickel–steel alloy may be used.
- **Accessories for Taping**

- One of the most important accessories for proper horizontal taping is the plumb bob. It is a small metal weight with a sharp, replaceable point.
- Freely suspended from a cord, the plumb bob is used to project the horizontal position of a point on the ground up to the tape, or vice versa.
- When taping horizontal distances, it is necessary to hold the tape as close to a horizontal position as possible. To reduce errors caused by an excessively sloped tape, some surveyors make use of a hand level.

- A **spring-balance tension handle** should be attached to the forward end of the tape to indicate whether or not the correct pull or tension is applied.
- **Taping a Horizontal Distance**
- Clearly, at least two surveyors are needed to tape a distance—a front, or head, chainman to hold the front end of the tape and a rear chainman to hold the back of the tape.
- When the ground slope is excessive, it may be difficult or impossible to hold the full tape in a horizontal position by plumbing one end; when a surveyor tries to hold a plumb bob and tape from shoulder height, or higher, accidental errors tend to increase due to the unsteady position. Over rough terrain, then, a process called **breaking tape** should be employed

# Procedure for breaking tape

- Breaking tape refers to the following procedure: After unreeling the tape out to its full length, the head chainman returns to a point where the tape can be held level in a comfortable and steady position. He or she then selects an integer footmark, say 60 ft, which is announced to the rear chainman. After a temporary mark is set at that distance, the rear chainman comes forward and holds the tape at that exact footmark. The measurement proceeds without moving the tape; using a clamp handle or “chain grip,” the rear chainman holds the 60-ft footmark as if it were zero and the head chainman sets a new mark at the 100-ft end of the tape. The process is repeated as required until the full distance is measured. (For long distances, the use of EDM is preferable to breaking tape.)



**FIGURE 4-14.** Breaking tape over steeply sloping ground.



# Tapping errors

- Random errors – Unknown and unpredictable factors.
- Systematic errors - **Systematic error** is consistent, repeatable **error** associated with faulty equipment or a flawed experiment design.
- Taping errors may be systematic or random. Unavoidable random or accidental errors occur primarily when using the plumb bob; setting chaining pins, tacks, or other marks; and estimating readings to values less than the smallest tape graduation.
- Random errors also occur in tape tension, tape alignment, and temperature readings (when computing corrections).

- Systematic errors due to incorrect tension and sag. Should be corrected by applying normal tension.
- In use, tapes tend to change length. They wear out and thus become thinner and lighter; due to wear, they stretch more and sag less and thus become longer.
- Correction for the temperature due to thermal expansion and contraction.

# Chain survey

- *Chain survey* is the simplest method of surveying.
- In chain survey, only measurements are taken in the field, and the rest work, such as plotting calculation etc. are done in the office.
- Here only linear measurements are made i.e. no angular measurements are made.
- This is most suitably adapted to small plane areas with very few details. If carefully done, it gives quite accurate results.

- ❖ Chain survey is suitable in the following cases:
  - The area to be surveyed is comparatively small
  - The ground is fairly level
  - The area is open and
  - Details to be filled up are simple and less.

# Instrument used

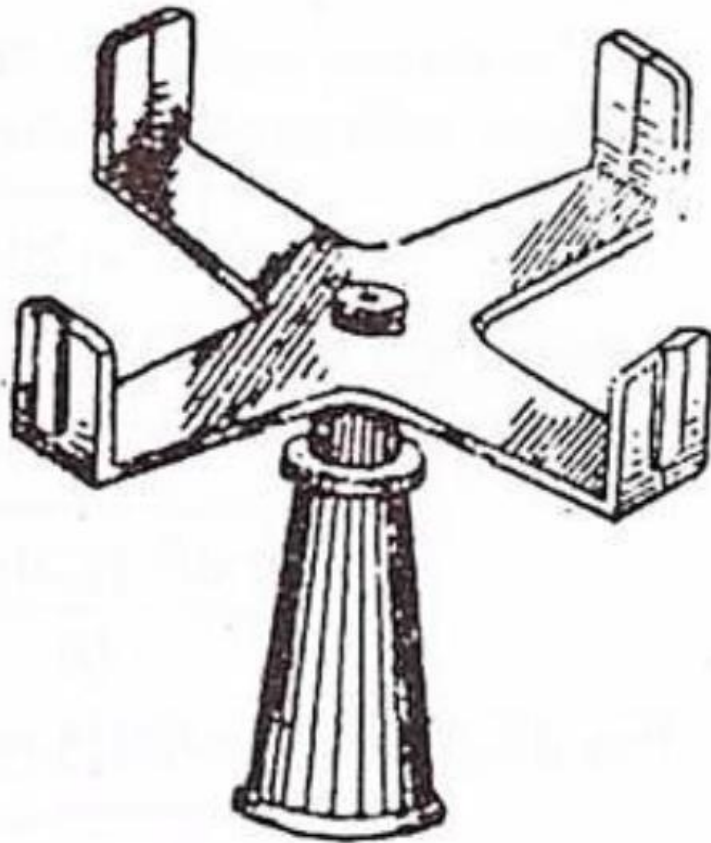


Chain



Ranging rod

- **Cross-Staff:**
- **Open Cross-Staff**
- Four metal arms with vertical slits for sighting through at right angles to each other.
- **French Cross-Staff (Fig. 3.9.):**
- It consists of an octagonal brass tube with slits on all the eight sides. It has an alternate vertical sighting slit and an opposite vertical window with a vertical fine wire or horse hair on each of the four sides. These are used for setting out right angles. On the other sides are vertical slits, which are at  $45^\circ$  to those mentioned above for setting out angles of  $45^\circ$ . The sights are about 8 cm apart.



Metal arm open cross-staff

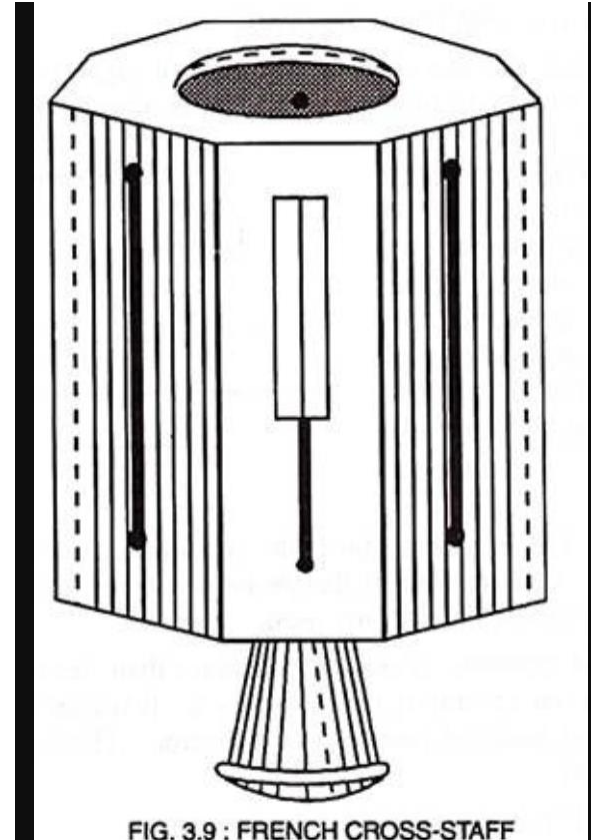


FIG. 3.9 : FRENCH CROSS-STAFF

- **Chain Survey Stations**

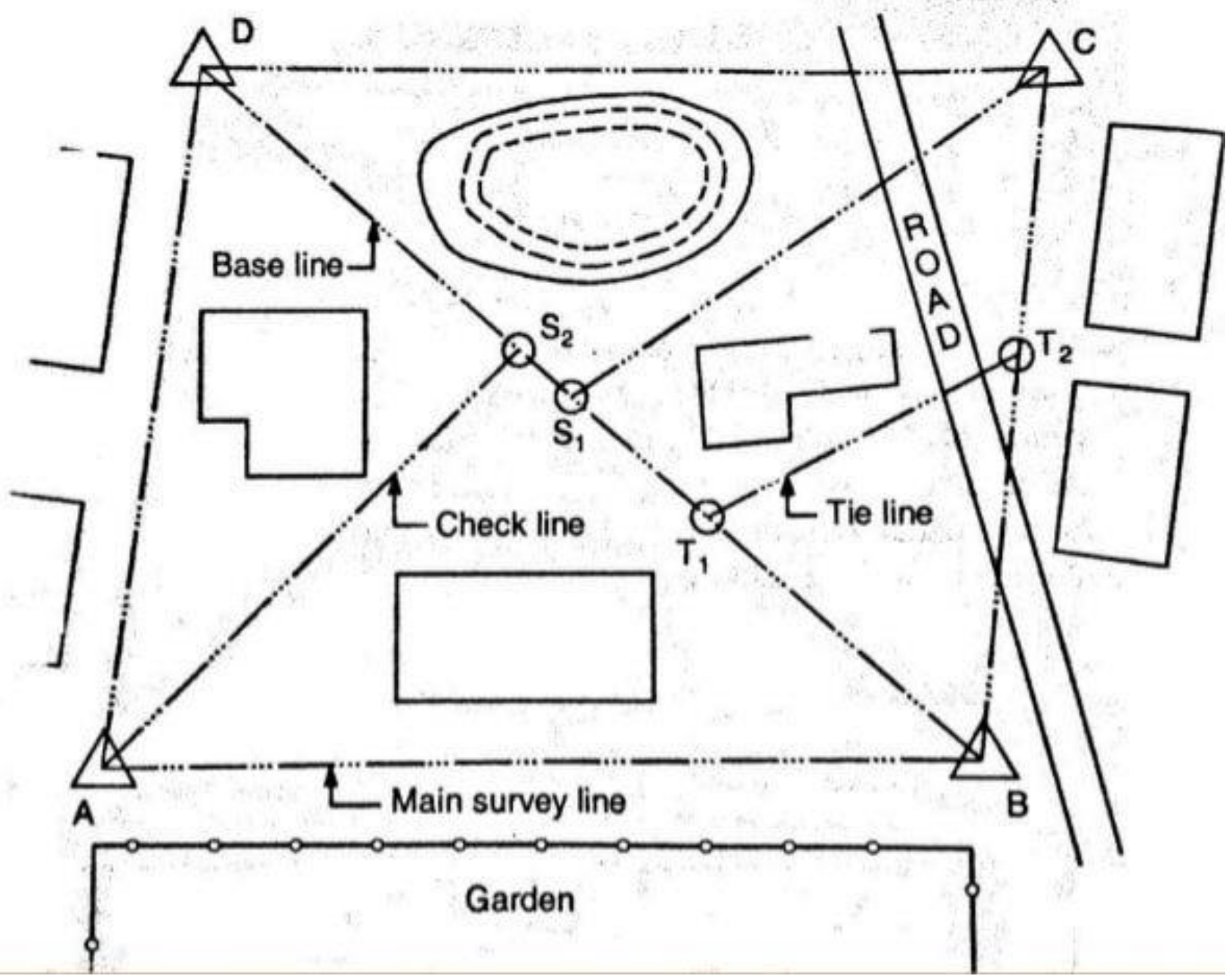
- Survey stations are points of importance at the beginning and end of a chain line. There are two major types of stations in chain surveying:
  - 1. Main stations
  - Main stations are the end of lines that determine the boundary of the surveying.
  - 2. Tie (Subsidiary) Stations
  - Tie stations are points which are specified on the chain line (main survey lines) where it is required to identify interior details like buildings and fences.



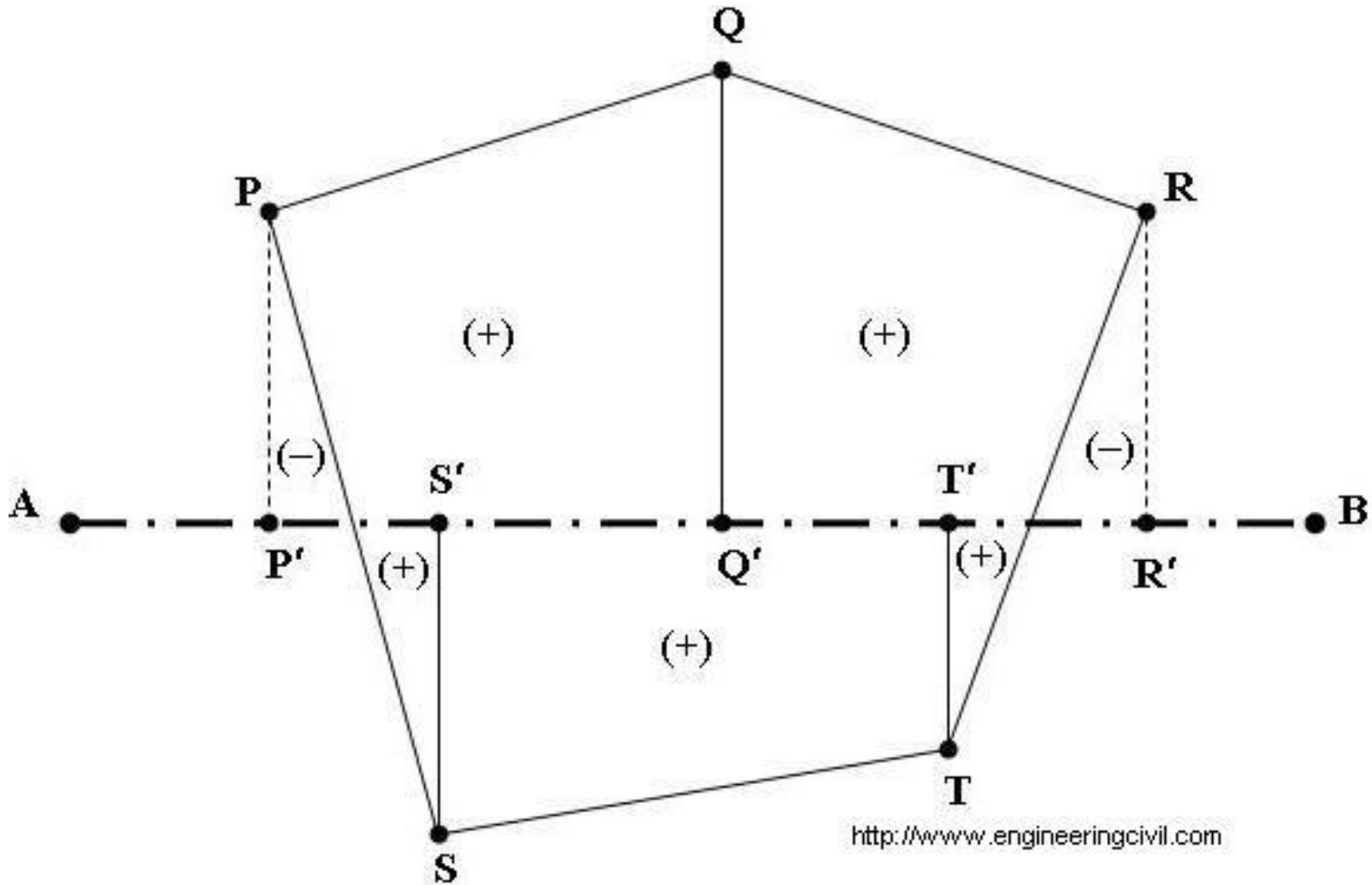
- **Line Types in Chain Survey**
- **1. Base Lines**
- It is the main and longest line from which all measurements to demonstrate details of the work are taken. The base line passes through the center of the field.
- **2. Chain Line (Main Survey) Lines**
- The lines that join main stations are termed as chain line or main survey lines.
- **3. Tie (Subsidiary) Lines**
- It joins two fixed points on the chain line. The advantage of tie line appears while checking surveying accuracy in locating interior details such as buildings and paths.

- **4. Check (Proof) Lines**
- It joins triangle apex to some fixed points on any two sides of a triangle. It is used to examine the accuracy of the framework. The length of check line measured on ground shall be consistent with its length on the plan.

- **Offsets**
- Offsets are the lateral measurements from the baseline to fix the positions of the different objects of the work with respect to the baseline.
- **Perpendicular offsets – taken at right angle**
- **Oblique offsets – other than right angle.**



# Perpendicular offsets



## Chain Survey Procedures

1. Firstly, inspect the area to be surveyed and prepare key plan. This stage is termed as **reconnaissance phase**.
2. Then, mark stations using suitable means such as fixing ranging poles, driving pegs, and digging and fixing a stone.
3. After that, specify the way for passing the main line which should go through the center of the field.
4. Fix ranging rod on stations
5. Then, the chaining can begin.
6. Make ranging wherever necessary.
7. Measure the change and offset and record them.
8. Area calculation in office.