(b) Indirect Ranging

Indirect ranging is adopted when the ends of the line are not mutually visible due to high intervening ground or the distance is too long. The process is also known as reciprocal ranging.

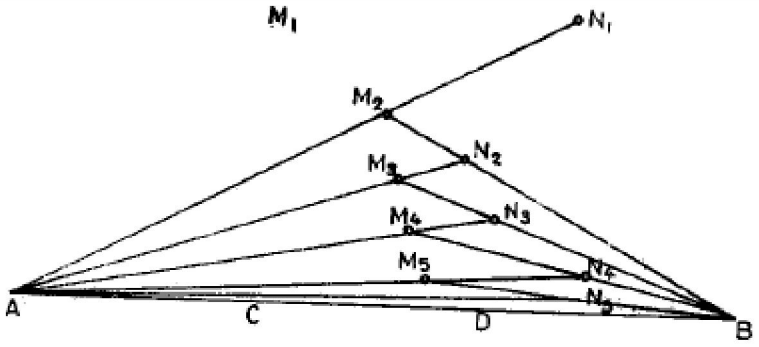

Fig. 2.8

Let A and B are the ends of a chain line which has a rising ground intervening between them. Two chainmen with ranging rods take the position M_1 and N_1 such that they are as nearly is line with A and B as they could judge and such that the chainman at M_1 could see N_1 and B and chainman at N_1 can see M_1 and A. First chainmen at N_1 direct M_1 to M_2 so that he comes in line with A and N_1. Then the chainman at M_2 directs N_1 to N_2 such that he comes in line with B and M_1. This process is repeated so that they align each other successively directing each other until they are in the line AB.

2.9.2. Chaining a Survey Line

To chain a survey line the follower holds the chain in contact with the peg at the beginning of the line and then leader moves forward in line with the ranging rod fixed at the end of the chain line. The follower gives necessary directions in this regard so that leader moves in correct alignment. The leader takes ten arrows in one hand and the handle in the other hand along with a ranging rod. At the end of the chain the leader holds the ranging rod vertically in contact and the instructions are given by the follower to move left or right using the code of signals. The leader then holds the handle in both the hands keeping him self in a straight line and straightens the chain by jerking it and stretches over the mark. He then fixes an arrow at the end of the chain. The leader then moves forward with the remaining nine arrows in hand. The follower holding the rear handle of the chain comes up to the arrow fixed by the leader and calls chain so that the leader stops moving forward. The process is repeated till all the arrows are

fixed by the leader. The follower who collected all these arrows hands over to leader. The number of arrows in the hand of the follower shows number of chain lengths measured. In this way the whole length of a survey line is measured.

2.9.3. Setting out Right Angles

The easiest way of setting out a right angle to the chain line is by the 3, 4, 5 rule. Triangles with sides in proportion 3:4:5 will be right angled.

1) Let PQ is chain line and B is a point on chain line at which a perpendicular is to be erected.

2) By measuring 9m from B the point A is located.

3) Keeping zero end of the tape at A and 12m at B.

4) Stretch the tape laterally and put an arrow at 15m mark i.e. at point C.

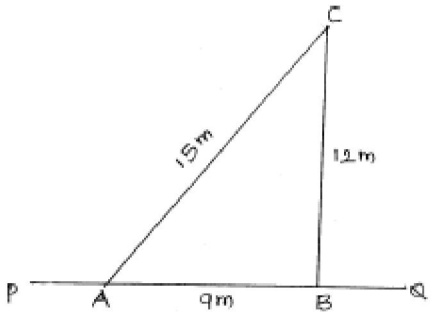

Fig. 2.9

5) Now CB will be perpendicular to the chain line PQ.

The instruments commonly used for setting out right angles are

1) Cross staff 2) Optical square.

2.9.4 Chaining Along a sloped Ground

Since the distances required for plotting purposes are horizontal distances however, as a matter of convenience, they are sometimes made on sloping ground, but they are afterwards reduced to their horizontal equivalents. There are two methods of determining horizontal distances when chaining on sloping ground .(1) Direct method and (2) Indirect method.

Direct method: By stepping; in the stepping method, horizontal distances are directly measured on the ground by the process of stepping which consists in measuring the line in short horizontal lengths, for this purpose, the chain is

stretched horizontally with one end resting on the ground at a convenient height less than 1.8m and the point vertically below this end is then accurately found on the ground by suspending a plumb bob and then marked. The next step is then commenced from this point and the process is continued in correct alignment until the end of the line is reached.

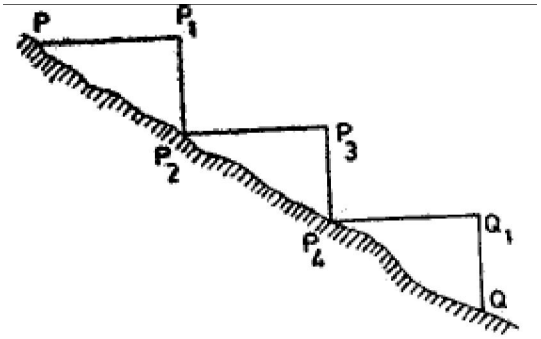

Fig. 2.10

The total horizontal distance $PQ = PP_1 + P_2P_3 + P_4Q_1$

Indirect Method: First Method : This method of stepping is not a very accurate method. The best way is to determine the land slope from the horizontal by using a Clinometer.

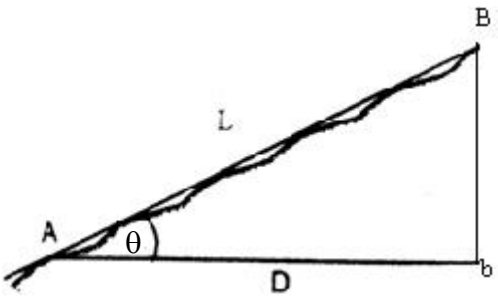

Fig. 2.11

Knowing the sloping distance say L and angle of slope say θ the horizontal distance $D = L \cos\theta$.

Second Method : The distance along with the slope is measured with chain and the difference in the elevation between the first and the end stations is found with the help of a levelling instrument (Fig. 2.12) knowing the sloping distance l and the difference in the elevation h, the horizontal distance can be found from the relation, $D = \sqrt{l^2 - h^2}$

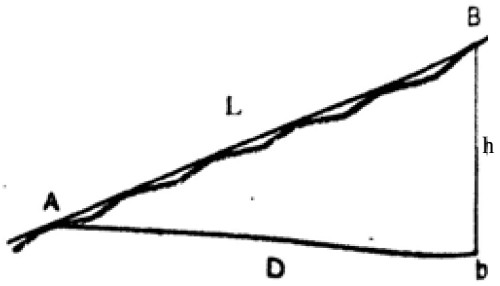

Fig. 2.12

Hypotenusal Allowance Method : Another method is to measure the distance along the slope and apply a correction to get the horizontal distance. Let θ be the angle of the slope. Let AC be the distance measured along the slope and AC_1 horizontal distance, 1chain or 100 links.

AC =100 Secθ links. Therefore
Correction BC = AC -AB = 100(sec θ -1) links per 100 link chain.

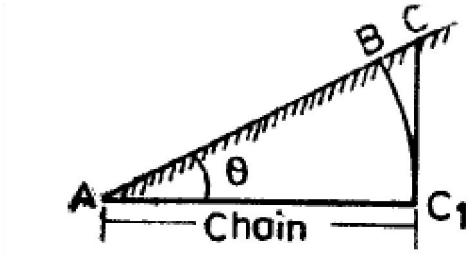

Fig. 2.13

This correction is known as the hypotenusal allowance. The leader must place the arrow ahead of his end of the chain on slopping ground by this amount so that the horizontal distance would be 1 chain.

Example 2.7 : The distance between two points A and B measured along a slope is 504 m. Find the horizontal distance between A and B when (a) the angle of slope is 12^o, (b) the slope is 1 in 4.5, and (c) the difference in elevation of A and B is 65m.

Solution : Let l = the distance measured along the slope between A and B.

D = the horizontal distance between A and B.

θ = the angle of slope.

(a) $l = 504$ m, $\theta = 12^o$

then $D = l \cos \theta = 504 \cos 12^o = 504 \times 0.9781$

$= 492.96$ m (Ans.).

(b) The slope being 1 in 4.5 (i.e. 1 vertical to 4.5 horizontal)

$\text{Tan } \theta = 1/4.5 = 0.222 \quad \therefore \theta = 12^o 32'$

Hence $D = l \cos \theta = 504 \times \cos 12^o 32'$

$= 504 \times 0.9762 = 492$ m (Ans).

(c) $l = 504$, $h = 65$.

$D = \sqrt{l^2 - h^2} = \sqrt{(504)^2 - (65)^2} = 499.80$m (Ans).

Example 2.8 : Find the hypotenusal allowance per chain of 20 m length, the angle of slope of the ground is 10^o.

Solution : Hypotenusal allowance $= 100 (\text{Sec } \theta - 1)$

$= 100 (\text{Sec } 10^o - 1) = 1.54$ links

$= 0.31$ m. (Ans).

2.10 Principles Used in Chain Triangulation

The principle of the chain triangulation is to divide the area into a network of well conditioned triangles. The error will be least when plotting a triangle when no angle of the triangle is less than 300 and more than 1200.Such triangles are called well conditioned triangles. Chain surveying is also called as chain triangulation.

2.11 Recording Field Notes

Field book: It is a book in which the field measurements and relevant notes are recorded. It is about 200mm x 120mm in size and opens length wise. Each page is ruled with a single line or central column about 15mm wide running up the long length of the pages. The pages of the field book are machine numbered.

A specimen page of a field book is shown in the fig 2.14.

At the commencement of the line in the book is written (1) The name and number of the survey line.(2) The name, number of the station, and (3)The symbol denoting the station.