

## LECTURE 13

### **General procedure:**

- (1) Reconnaissance of the area, to ensure the best possible positions for stations and base lines.
- (2) Construction of the stations.
- (3) Consideration of the type of target and instrument to be used and also the method of observation.  
All of these depend on the precision required and the length of sights involved.
- (4) Observation of angles and base-line measurements.
- (5) Computation: base line reduction, station and figural adjustment, coordinates of stations by direct methods.

A general introduction to triangulation has been presented, aspects of which will now be dealt with in detail.

(1) Reconnaissance is the most important aspect of any well-designed surveying project. Its main function is to ensure the best positions for the survey stations commensurate with well-conditioned figures, ease of access to the stations and economy of observation. A careful study of all existing maps or plans of the area is essential. The best position for the survey stations can be drawn on the plan and the overall shape of the network studied. While chains of single triangles are the most economic to observe, braced quadrilaterals provide many more conditions of adjustment and are at their strongest when square shaped. Using the contours of the plan, profiles between stations can be plotted to ensure intervisibility. Stereo-pairs of aerial photographs, giving a three-dimensional view of the terrain, are useful in this respect. Whilst every attempt should be made to ensure that there are no angles less than  $25^\circ$ , if a small angle cannot be avoided it should be situated opposite a side which does not enter into the scale computation. When the paper triangulation is complete, the area should then be visited and the site of every station carefully investigated. With the aid of binoculars, intervisibility between stations should be checked and ground-grazing rays avoided. Since the advent of EDM, base-line sitting is not so critical. Soil conditions should be studied to ensure that the ground is satisfactory for the construction of long-term survey stations. Finally, whilst the strength of the network is a function of its shape, the purpose of the survey stations should not be forgotten and their position located accordingly.

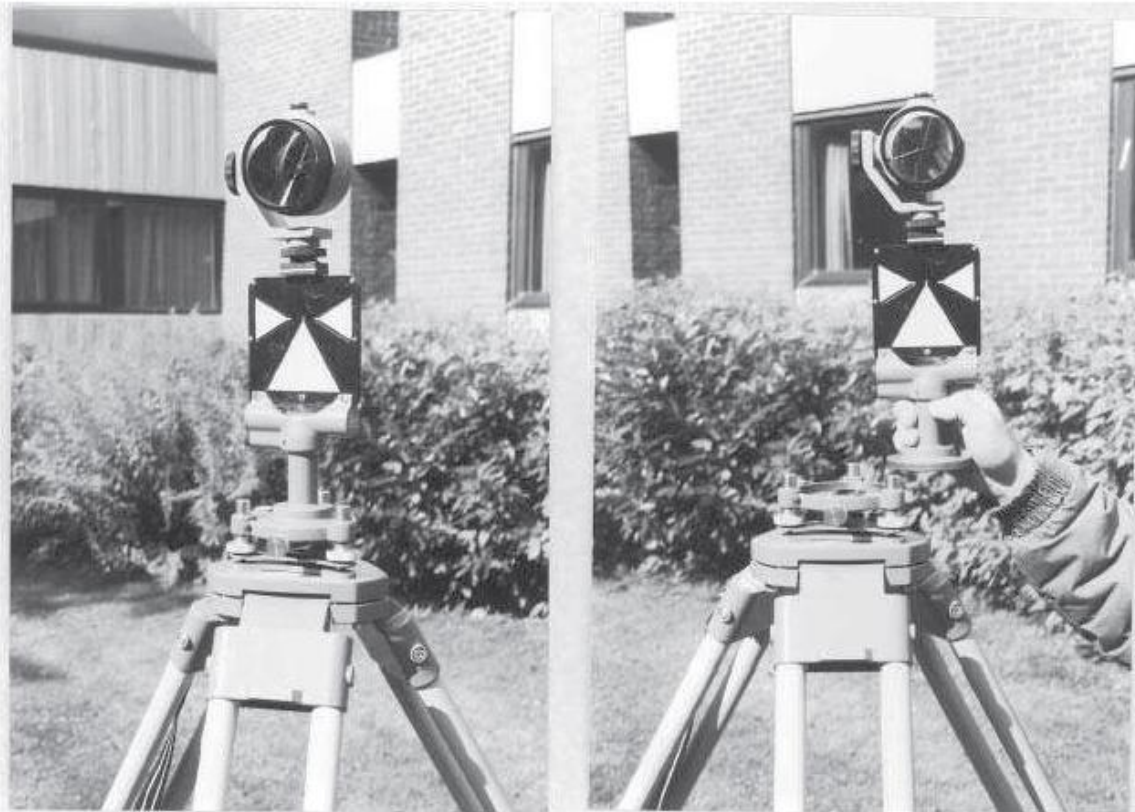
(2) Stations must be constructed for long-term stability. A complete referencing of the station should then be carried out in order to ensure its location at a future date.

(3) As already stated, the type of target used will depend on the length of sight involved and the accuracy required for highly precise networks, the observations may be carried out at night when refraction is minimal. In such a case, signal lamps would be the only type of target to use. For short sights it may be possible to use the precise targets shown in *Figure 13.1*. Whatever form the target takes, the essential considerations are that it should be capable of being accurately centred over the survey point and afford the necessary size and shape for accurate bisection at the observation distances used.

(4) In triangulation the method of directions would inevitably be used and the horizon closed. An appropriate number of sets would be taken on each face. The base line and

check base would most certainly be measured by EDM, with all the necessary corrections made to ensure high accuracy.

(5) Since the use of computers is now well established, there is no reason why a least squares adjustment using the standard variation of coordinates method should not be carried out. Alternatively the angles may be balanced by simpler, less rigorous methods known as 'equal shifts'. On completion, the sides may be computed using the sine rule and finally the coordinates of each survey point obtained. If the survey is to be connected to the national mapping system of the country, then all the baseline measurements must be reduced to MSL and multiplied by the local scale factor. As many of the national survey points as possible should be included in the scheme.



*Figure 13.1.* Interchangeable target and tribrach