COSNTRUCTION SURVEYING

Setting out (dimensional control)

In engineering the production of an accurate large-scale plan is usually the first step in the planning and design of a construction project. Thereafter the project, as designed on the plan, must be set out on the ground in the correct absolute and relative position and to its correct dimensions. Thus, surveys made in connection with a specific project should be planned with the setting-out process in mind and a system of three-dimensional control stations conveniently sited and adequate in number should be provided to facilitate easy, economical setting out.

It is of prime importance that the establishment and referencing of survey control stations should be carried out at such places and in such a manner that they will survive the construction processes.

This entails careful choice of the locations of the control stations and their construction relative to their importance and long- or short-term requirements. For instance, those stations required for the total duration of the project may be established in concrete or masonry pillars with metal plates or bolts set in on which is punched the station position. Less durable are stout wooden pegs set in concrete or driven directly into the ground. A system of numbering the stations is essential, and frequently pegs are painted different colours to denote the particular functions for which they are to be used.

1 - PROTECTION AND REFERENCING

Most site operatives have little concept of the time, effort and expertise involved in establishing setting-out pegs. For this reason the pegs are frequently treated with disdain and casually destroyed in the construction process. A typical example of this is the centre-line pegs for route location which are the first to be destroyed when earth-moving commences. It is important, therefore, that control stations and BMs should be protected in some way (usually as shown in Figure(1) and site operatives, particularly earthwork personnel, impressed with the importance of maintaining this protection.

Where destruction of the pegs is inevitable, then referencing procedures should be adopted to relocate their positions to the original accuracy of fixation. Various configurations of reference pegs are used and the one thing that they have in common is that they must be set well outside the area of construction and have some form of protection, as in Figure(1).

A commonly-used method of referencing is from four pegs (A, B, C, D) established such that two strings stretched between them intersect to locate the required position (Figure (2). Distances AB, BC, CD, AD, AC, BD should all be measured as checks on the possible movement of the reference pegs, whilst distances from the reference pegs to the setting-out peg will afford a check on positioning.

Intersecting lines of sight from theodolites at, say, A and B may be used where ground conditions make string lining difficult.

Where ground conditions preclude taping, the setting-out peg may be referenced by trisection.

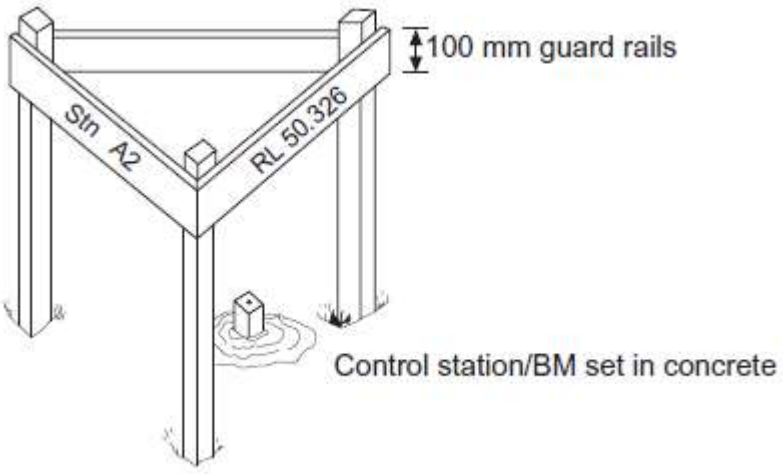
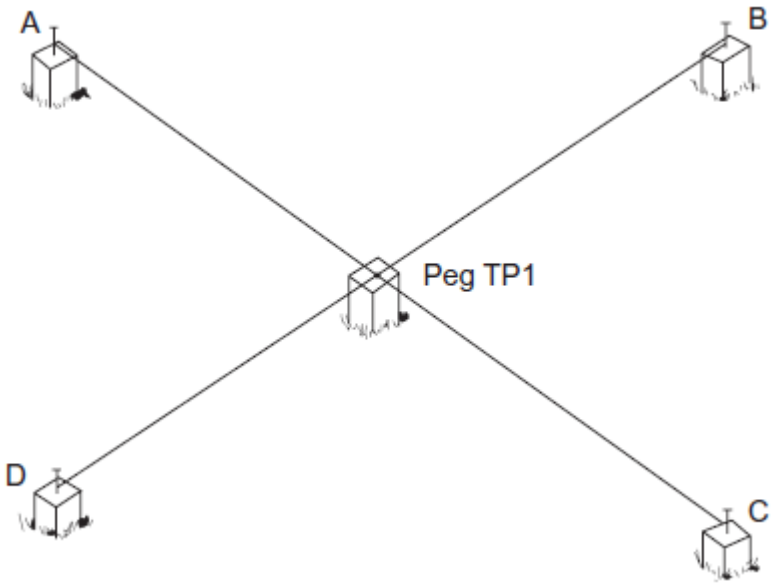


Fig (1)



Fig(2)

From three reference pegs. The pegs should be established to form well-conditioned triangles of intersection (Figure 10.3), the angles being measured and set out on both faces of a 1″theodolite.

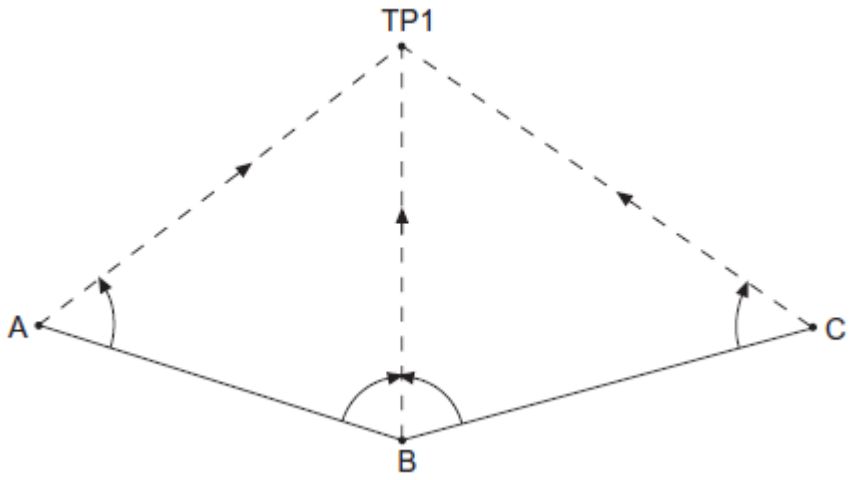
All information relating to the referencing of a point should be recorded on a diagram of the layout involved.

2 -BASIC SETTING-OUT PROCEDURES USING COORDINATES

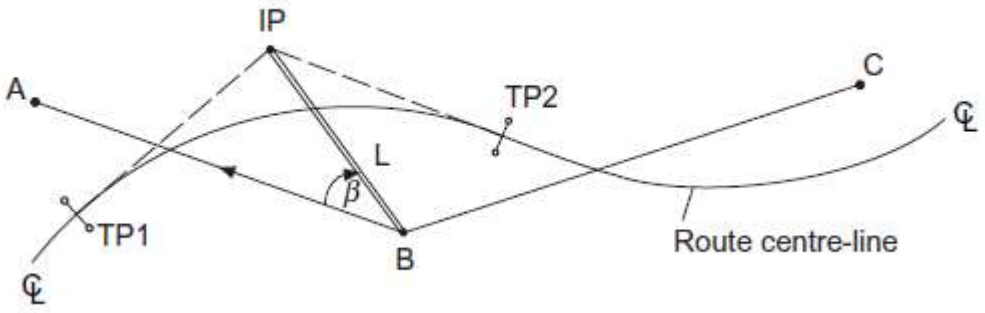
Plans are generally produced on a plane rectangular coordinate system, and hence salient points of the design may also be defined in terms of rectangular coordinates on the same system. For instance, the centre-line of a proposed road may be defined in terms of coordinates at, say, 30-m intervals, or alternatively, only the tangent and intersection points may be so defined. The basic methods of locating position when using coordinates is by either polar coordinates or intersection.

i- By polar coordinates

In *Figure (4)*, *A*, *B* and *C* are control stations whose coordinates are known. It is required to locate point *IP* whose design coordinates are also known. The computation involved is as follows:



Fig(3)



Fig(4)

(1) From coordinates compute the bearing BA (this bearing may already be known from the initial control survey computations).

(2) From coordinates compute the horizontal length and bearing of B – IP.

(3) From the two bearings compute the setting-out angle AB(IP), i.e. $.

(4) Before proceeding into the field, draw a neat sketch of the situation showing all the setting-out data. Check the data from the plan or by independent computation.

The field work involved is as follows:

(1) Set up theodolite at B and backsight to A, note the horizontal circle reading.

(2) Add the angle $ to the circle reading BA to obtain the circle reading B – IP. Set this reading on the theodolite to establish direction B – IP and measure out the horizontal distance L.

3- By intersection

This technique, illustrated in Figure (6), does not require linear measurement; hence, adverse ground conditions are immaterial and one does not have to consider tape corrections.

The computation involved is as follows:

(1) From the coordinates of A, B and IP compute the bearings AB, A – IP and B – IP.

(2) From the bearings compute the angles α and β

The relevant field work, assuming two theodolites are available, is as follows:

(1) Set up a theodolite at A, backsight to B and turn off the angle α.

(2) Set up a theodolite at B, backsight to A and turn off the angle β.

The intersection of the sight lines A – IP and B – IP locates the position of IP. The angle ծ is measured as a check on the setting out.

If only one theodolite is available then two pegs per sight line are established, as in Figure (5),

and then string lines connecting each opposite pair of pegs locate position IP, as in Figure (2).