

CHAPTER 8

CONSTRUCTION SURVEYS

8.1 Introduction

A construction survey, also called a layout or location survey is performed in order to mark the position of new points on the ground. These new points represent the location of building corners, road center lines, and other facilities that are to be built. These positions are shown on a site plan, which is essentially a combination of the property survey and topo survey, along with the newly designed facilities. This also may be called a plot plan.

A site plan shows the location dimensions which are to be measured with reference to boundaries or other control points. Vertical heights are given by elevations. Some times horizontal positions may be given by coordinates. Wooden stakes are used by the surveyors to mark the positions of the building, roads, and other structures. An example of a drawing which includes location dimensions is shown below figure 8.1 below.

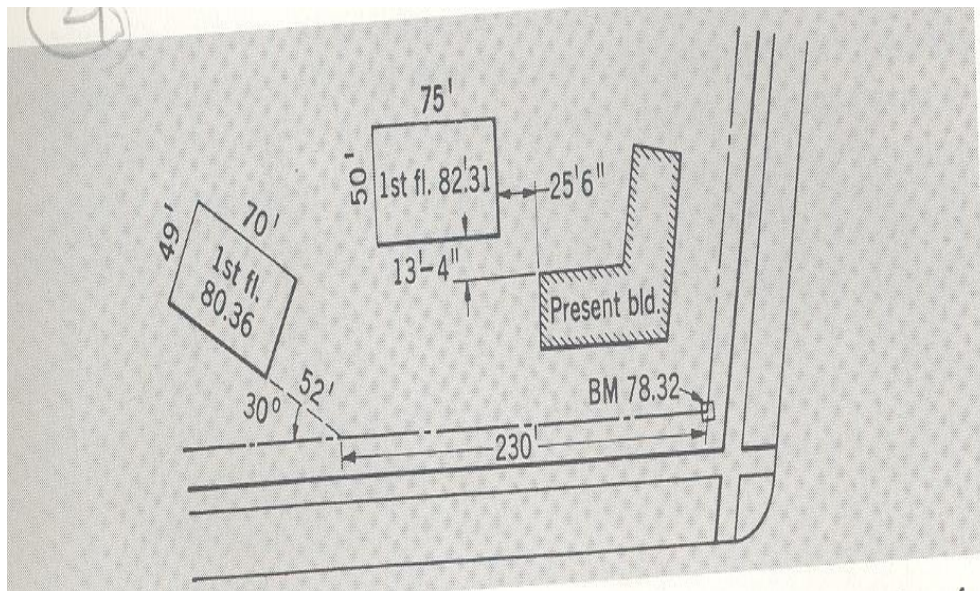


Fig-8.1- Typical location dimension found on engineering or architectural plans, for use during a stake out survey.

The wooden stakes serve as reference points for the construction contractor who actually builds the project. They may be centerline stakes, offset stakes, or grade stakes.

Carpenters, masons, and other skilled professionals transfer measurements directly from the survey points. The procedure of placing the markers is called staking out. Another term used, especially for pipelines and roads, is giving line and grade.

- ✓ Construction surveys provide the horizontal and vertical layout for every key component of a construction project. This provision of line and grade can only be accomplished by experienced surveyors familiar with both the related project design and the appropriate construction techniques.

A knowledge of related design is essential to interpret the design drawings effectively for layout purposes, and a knowledge of construction techniques is required to ensure that the layout is optimal for both line and grade transfer and construction schedule.

On any construction site, it is general practice to construct firstly the roadways and sewers, in order to provide

- ✓ Access to the site and
- ✓ Main drainage to all buildings.

All roads, buildings, drains and sewers are set out using standard surveying equipment comprising:

1. Steel tapes: it must always be used for setting out purposes as they are not subject to the same degree of stretching as are Fibre tapes.

The accuracy of setting out work is largely dependent up on the condition of the tape and or course, the expertise of the user.

2. Levels: automatic levels are used on most sites. They compare favorably in price with optical levels and produce much more reliable results.

3. Theodolites: a wide variety of theodolite is now available but, as with levels, the more automation that can be provided, the greater will be the accuracy of the setting out. Thus, it is a good practice to use theodolite with optical plumbing, automatic vertical circle indexing, electronic readout and electronic two axis leveling.

4. Total station: most setting out work, particularly road ways, can be readily and accurately accomplished by the method of coordinates. An EDM instrument is required to set the distances and total stations can set out horizontal distances with ease.

5. Auto plumb instruments: These instruments are used to set a vertical line in high-rise buildings. They are much more convenient to use this purpose than theodolites. They save much time and greatly increase accuracy.

6. Pegs: these are either wooden 50mm X 50mm X 500mm stakes for use in soft ground or 25mm X 25mm X 300mm angle irons for hard standing.

7. Profiles: is a wooden stake to which a cross-piece, painted in contrasting coloured stripes, is nailed. For sewer work, goalpost-type profiles, called sight rails, are preferable. The profiles are elected over the offset pegs in order to remain clear of the excavation.

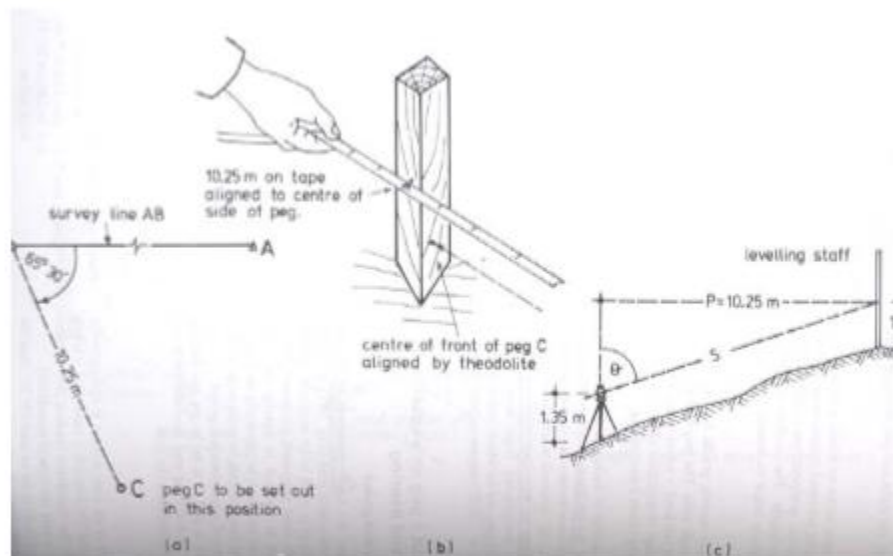
8. Travelers: are really mobile profile boards used in conjunction with sight rails. The length of the traveler equals the sight rail level- sewer invert level. The length of 0.25 meters and travelers are usually about 2 meters long.

9. Corner profiles: during the construction of buildings, the pegs denoting the corners of the buildings are always removed during the construction work. The corner positions have, therefore, to be removed some distance back from the excavations on to corner profiles. Setting out a Peg on a Specified Distance and Bearing

A. Setting Out On Level Ground

- ✓ In order to set out the roads, buildings and sewers shown on the development plan, a total of some forty to fifty pegs need to be accurately placed on the ground in their proposed positions. Opportunely, every peg is set out in exactly the same manner. It is not an easy task to physically set a peg in its exact proposed location and, in order

to do so, the following sequence of operations is required.



- Procedure

1. The theodolite is set over station B and correctly leveled and centered. On face left, a back sight is taken to station A with the type theodolite reading zero degrees (the method varies with the type of theodolite).
2. The horizontal circle is set to read 65030'; thus the theodolite is pointing along line BC
3. The end of the tape is held against the nail in peg B and laid out approximately along the line BC by the assistants.
4. The 10.25 m reading on the tape is held against the SIDE of the proposed peg C the tape is tightened and slowly swing in an arc, until the surveyor sees it clearly through the telescope of the theodolite.
5. The peg is carefully moved, on the observer's instructions, until the bottom, front edge of the peg is accurately bisected. The peg is then hammered home.
6. The tape is again held at peg B, by assistant 1, while assistant 2 tightens it and marks a pencil line across the peg C at distance 10.25 m.

7. A pencil is held vertically on this line by an assistant and is moved slowly along the line until the surveyor sees it bisected by the line of sight through the theodolite. The assistant marks this point on the peg.

8. The distance of 10.25 m is checked and the operation is repeated on face right. If all is well, the two positions of point C should coincide or differ by a very few millimeters. The mean is accepted and a nail hammered into the peg to denote point C.

B. Setting Out On Sloping Ground

- In all setting out operations, the horizontal distance is required, but frequently, because of ground undulations, it will be necessary to set out the slope distance. The setting-out procedure is very similar to that of setting out on a level ground.

1. The theodolite is set up at station B, back sighted to A reading zero and foresighted along the line BC reading 65030'. The instrument height is measured and noted. Let the height be 1.35 m.

2. The tape is stretched out in the proposed direction of line BC and a leveling staff held vertically at distance 10.25 m.

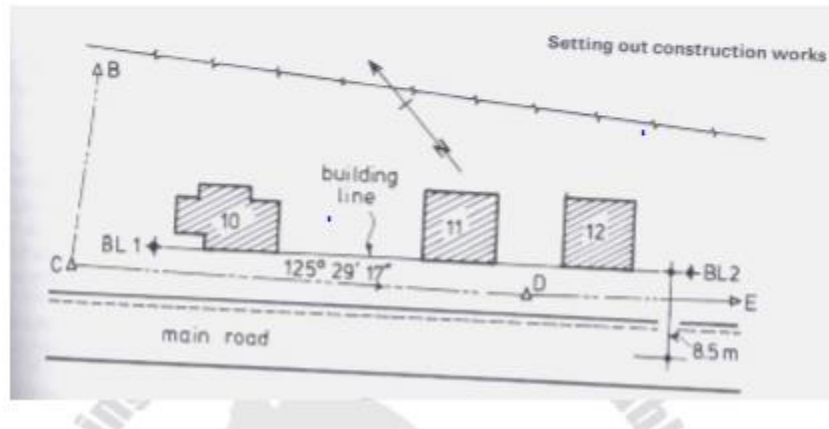
3. The instrument height (1.35 m) is read on the staff and the angle of inclination (vertical or zenith angle) is noted. Let the zenith angle be 84° 15'.

4. The distance to be set out on the slope will have to be increased to be the equivalent of 10.25 m of plan length

1. Setting Out Small Buildings

- Dwelling houses are still largely traditionally built and small inaccuracies in the setting out can usually be tolerated. Large factory buildings, multi-store buildings, schools, etc., are nowadays largely prefabricated and little, if any, inaccuracy can be tolerated in the setting out. Consequently the methods of setting out vary considerably.

- The exact position that the building is to occupy on the ground is governed by the building line as defined by the local authority.



✓ Sewer and Tunnel Construction

Sewer construction

Sewers can be categorized in to two broad categories:

1. Sanitary sewers collect residential and industrial liquid waste and convey these wastes (sewage) to a treatment plant.
2. Storm sewers are designed to collect runoff from rainfall and to transport this water (sewage) to the nearest natural receiving body (e.g. River, lake). The rain water enters the storm sewer system through ditch inlets or through catch basins located at the curb line on paved roads.

The design and construction of sanitary and storm sewers are similar in the respect that the flow of sewage is usually governed by gravity. Since the sewer grade lines (flow lines

Tunnel construction

Tunnels are used in road, sewer and pipeline construction when the cost of working at or near the ground surface becomes prohibitive. For example, sewers are tunneled when they must be at a depth that would make open cut too expensive or (operationally unfeasible) , or sewer may be tunneled to avoid disruption of services on the surface such as would occur if an open cut was put through a busy expressway. Roads and railroads are tunneled through large hills and mountains in order to maintain optimal grade lines.

Building construction

All buildings must be located with reference to the property limits. Accordingly, the initial stage of the building construction survey involves the careful retracing and verification of the property lines. Once the property lines established, the building is located according to plan, with all corners marked in the field. At the same time, original cross sections will be taken, perhaps using one of the longer wall lines as a base line.