Principles of Levelling

Principles of Simple Levelling: It is the simplest operation in leveling when it is required to find the difference in elevation between two points, both of which are visible from a single position of the level. Suppose A and B are two such points and the level is set up at O, approximately midway between A and B. It is immaterial where the level is set up, however, to eliminate the effect of instrumental error, it is always advisable to place it approximately midway between two points, but not necessarily on the line joining them. After the instrument is correctly leveled, the telescope is directed towards the staff held vertically on A, and focused. The reading at which the horizontal hair of the diaphragm appears to cut the staff is then taken, care being taken to ensure that the bubble is central while the staff is being read. The staff is then held vertically on B. The telescope is then directed on the staff and focused. Before sighting, the bubble should be examined to see if it is central; if not, it must be brought back to the centre of its run by turning the foot screw most nearly in the line with the telescope. The staff reading is then taken. Let the respective readings on A and B be 2.340m and 3.315m. The difference between these readings gives the difference of level between A and B, which is equal to 3.135-2.340=0.795m. If the RL of A is 100, the RL of B may be found thus:

H.I. at O= 100+2.340= 102.340m

R.L. of B= 102.340-3.135= 99.205m

In Simple Levelling the points should be remembered that-

1. When the point is lower, the staff reading is greater, while when it is higher, the staff reading is smaller.
2. The bubble must traverse, i.e. keep its mid position while readings are being taken. If relevelling of the instrument is required for the second reading, the two horizontal planes will not coincide; the difference between them is, however, negligible.
3. If the true difference of level between two points is required, the level must be set up exactly midway between them.

Principles of Differential Levelling: This method is used in order to find the difference in elevation between two points: a) If they are too far apart, b) If the difference in elevation between them is too great c) If there are obstacles intervening. In such a case, it is necessary to set up the level in several positions and to work in a series of stages. The method of simple leveling is employed in each of the successive stages. The process is also known as Compound or Continuous Levelling.

Suppose it is desired to find the difference of level between two points A and B, which are too far apart. Set up the level at O1 and correctly level it. With the bubble central take the reading on the staff held vertically at A. Select a firm point C so that its distance from O1 is approximately equal to that of A from (the distance being measured by pacing), and with the bubble in the

centre of the tube, take the reading on the staff held vertically at C. This forms the first stage in the series. Now shift the instrument to O2 and set up and level it carefully. With the bubble in the centre of its run, take the reading on the staff at C. Choose a firm point D as before so that the instrument station O2 is approximately midway between C and D, and with bubble central, take the reading on the staff at D. Repeat the process until the point B is reached.

The points should be remembered that:

1. Each of the successive points C, D etc is called a Change Point (C.P.) and is read twice, once before and the second time after the instrument is shifted.
2. The level must remain stationary while the staff is being carried forward.
3. The staff at the change point must not be moved but kept on the same spot while the level is carried forward. It should be turned round to face the telescope when a second reading is to be taken.
4. A change point must be taken on a stable and definite object. The distance of the change point from the level should not exceed 100m.
5. The level must be set up on firm ground.
6. The bubble must be brought to the centre of its run each time staff a reading is taken.

The staff reading (a) taken at A from the instrument station O1 is the backsight and the staff reading (c1) at C the foresight. The staff reading (C2) taken at C from the instrument station O2 is the backsight, and the staff reading (d1) at D the foresight, and so on.

Therefore the difference of level between A and C= a - c1

Therefore the difference of level between C and D = c2 – d1 and so on.

The difference of level between A and B is equal to the algebraic sum of these differences or equals the difference between the sum of the backsights and the sum of the foresight. If the difference is positive, it indicates that the point B is higher than the point A; while if the negative, the point B is lower than the point A. If the R.L. of A is known, the R.L. of B may be found the relation,

R. L. of B= R. L. of A + Summation of B.S. – Summation of F.S.

The reduced evels of the intermediate points, if required, may be found by the relation,

R. L. of a point= R. L. of B. M. + Backsight – Intermediate sight

References:

1. Kanetkar, T. P., Kulkatni, S. V. 1988. Surveying and Levelling, Part I, Pune Vidyarthi Griha Prakashan.

2. Basak, N. N. 2017. Surveying and Levelling, 2nd ed, McGraw Hill Education