RAMA UNIVERSITY

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# TRANSPORTATION ENGINEERING – I

## DEPARTMENT OF CIVIL ENGINEERING

## FACULTY OF ENGINEERING & TECHNOLOGY

# SURVEYING UNIT-1 LECTURE - 4

**Topics to be covered:**

- Meridian
- Bearings
- Methods of leveling

# MERIDIAN

## Meridian

Meridian is a reference direction with respect to which the direction of lines are mentioned. There are three types of meridian – True Meridian, Magnetic Meridian & Arbitrary Meridian.



### 1 – True Meridian

It is the reference direction of north pole of earth from a given station point. It is also called geographic meridian.

### 2 – Magnetic Meridian

It is the direction of north pole indicated by magnetic needle.

### 3 – Arbitrary Meridian

This is any assume direction to a well defined object. It may be useful for small areas. e.g A mosque is taken as reference and location of road will be mentioned with respect to this mosque. Direction of magnetic north with respect to true north is called magnetic direction.

# BEARINGS

## Bearings

Bearing is the angle which a certain line make with a certain a certain meridian. Bearing with respect to true meridian is called true bearings while magnetic bearing is the angle which a line makes with respect to magnetic meridian. There are two ways to represent the bearings,

- Whole circle bearing (W.C.B)
- Reduced Bearing (R.B)

### 1) Whole Circle Bearing (W.C.B)

It can be taken 0° to 360°. Quadrants are taken clock-wisely and angles are also determined in clockwise direction.

### 2) Reduced Bearing

Reduced bearing or Quadrantal bearing is the angle which a line makes from North or South Pole whichever may be near. It is value is from 0° to 90°.

# MERIDIAN

Using the above figures you can easily convert the Whole Circle Bearing into Reduced Bearing. Some Examples are given are below.

| Whole Circle Bearing (W.C.B) | (R.B.)Reduced Bearing |
|---|---|
| 135 | °S45E |
| 37 | °N37E |
| 65 | °N65E |
| 125 | °S55E |
| 215 | °S35W |
| 300 | °N60W |

## Leveling

Levelling is the most widely used method of obtaining the elevations of ground points relative to a reference datum and is usually carried out as a separate procedure to those used in fixing planimetric position. The basic concept of leveling involves the measurement of vertical distance relative to a horizontal line of sight. Hence it requires a graduated staff for the vertical measurements & an instrument that provides a horizontal line of sight.



Types of Levelling Survey are:

- Precise or Geodetic Levelling
- Ordinary or Simple Levelling

**Methods of Levelling**

The different types of Levelling are:

1 Differential Levelling
2 Precise Levelling
3 Reciprocal Levelling
4 Longitudinal Levelling or Longitudinal Sectioning
5 Cross Levelling
6 Levelling for Giving Levels for Works
7. Barometric Levelling
8 . Hypsometry
9. Trigonometrical Levelling.



**Differential Levelling:**

It is carried out with the object of determining the reduced levels of points some distance apart or to establish bench marks. The process has already been described in Continuous or compounds levelling and is also known as running flying levels from one point to the other.

In flying levelling, only the back and fore sights are necessary and the shortest convenient route between the points is selected. The length of a sight is kept as long as the power of the telescope and local obstacles permit.

**Check Levelling:**

It is conducted for the purpose of checking a series of levels, which have previously been fixed. At the end of each day's work a line of levels starting from the point and returning to the starting point of that day is run with the object of checking the work done on that day.
Since the circuit is completed i.e., the levelling work ends at the starting point, therefore, for the work to be correct the difference between the sum of all the back sights and that of all therefore sights on that day should be zero.

**Precise Levelling:**
It is special method of levelling used for establishing bench marks with high precision at widely distant points, it is conducted by some govt., agency such as Great Trignometrical Survey of India department for establishing G.T.S. bench marks.

**Precautions while Levelling:**

(i) The adjustment of the level are carefully tested.
(ii) (ii) The parallax should be entirely eliminated by correct focussing.
(iii) The staff should be exactly vertical. It may be plumbed with the staff-level or plumb-bob.
(iv) The bubble should be exactly in the centre of its run at the time of taking readings.
(v) Lengths of sights are limiting to about 100 m.
(vi) The back sight and fore sight distances should be exactly equal. Stadia readings may be taken for this purpose.
(vii) Ground for level and staff should be stable. To avoid error due to settlement of tripod and staff, the back sights and the following fore sights should be taken in quick successions and the order of taking readings is interchanged at alternate set up i.e. at first setting, the back sight is observed first and then the fore sight while at the 2nd setting, the foresight is taken first and then the back sight and so on.
(viii) Levelling work should be suspended in rainy and windy days and also at noon in hot summer days. If work is necessarily to be done under such conditions, level should be protected from the sun or wind by a screen or umbrella.
(ix) Check levelling should be performed by a different surveyor on different days with different change points. And if the closing error exceeds the permissible value, the work should be repeated.

**Reciprocal Levelling:**

It is a method of levelling adopted to determine the difference of levels between two points when it is, not possible to set up the level midway between them as in the case of a river, a deep valley etc.

**This method also eliminates:**
(i) The error due to curvature and refraction, and
(ii) The error due to line of collimation not being parallel to the bubble line which may otherwise occur due to non —equality of back and fore sight distances.
The operation involves two sets of observations giving two incorrect differences of levels, the mean of which is the true difference. Let A and B be two points [Fig- 7.3 (a) and (b)] on opposite banks of a wide river.

**Then to find the true difference of level between A and B, proceed as follows:**
(i) Set up and level the instrument very near to A or over A [fig. 7.31. (a)].
(ii) Read the staff held at A and B and let the staff readings be ($a_1$) and ($b_1$) respectively.
(iii) Transfer the instrument to B and set it up and level very near to B or over B [fig. 7.31 (b)].
(iv) Observe the readings on the staff held at A and B and denote them as ($a_2$) and ($b_2$) respectively.

# LEVELING

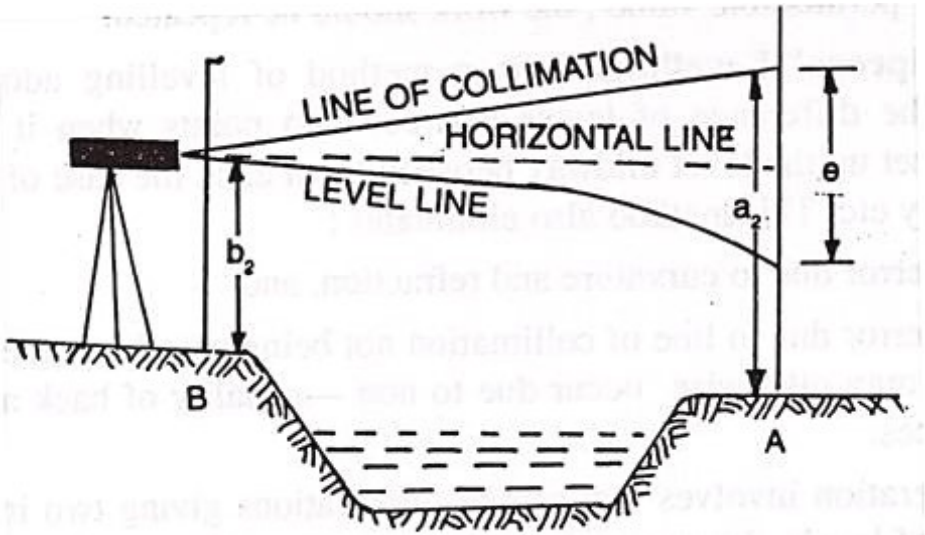


Fig. 7.31. (b)

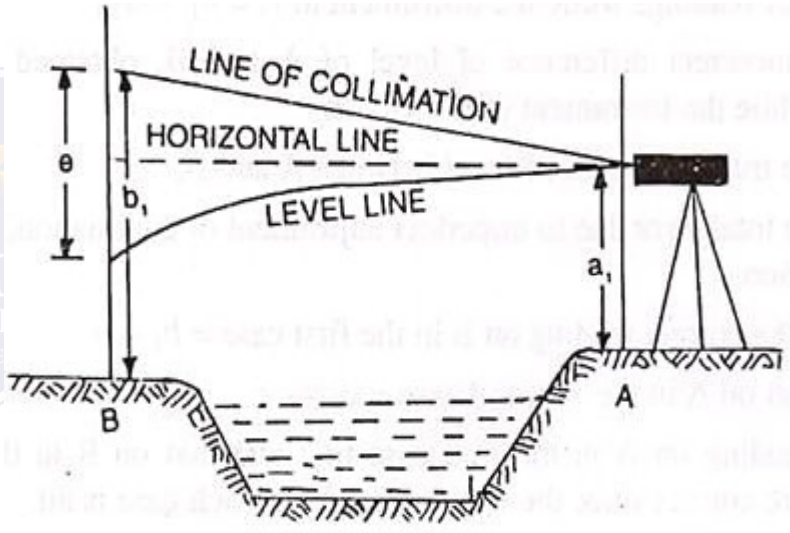


Fig. 7.31. (a)

# LEVELING

If the staff is near to the level, then the reading on it should be taken through the object-glass or the height of the centre of the eye-piece above that point should be measured directly with the staff and be considered as staff reading on that point.

Since the combined effect of collimation error, curvature and refraction in the readings is proportional to the distance of the staff from the instrument, the error in reading in both the cases are equal as the lengths of sight in each case is same.

Let in each case the reading at B be greater than that at A i.e., $b_1 > a_1 > b_2 > a_2$.

and let, $d_1$ = incorrect difference of level of A and B., obtained from the observed readings while the instrument at A = $b_1$ —$a_1$.

$d_2$ = incorrect difference of level of A and B, obtained from the readings while the instrument at B = $b_2 – a_2$.

d = the true difference of level between A and B.

e = the total error due to imperfect adjustment of collimation, curvature and refraction.

Then the correct reading on B in the first case = $b_1$ —e

and that on A in the second case = $a_2$ — e

The reading on A in the first case ($a_1$) and that on B in the second case ($b_2$) are correct since the length of sight in each case is nil.

In the first case, the true difference, d = correct reading at B —correct reading at A ($b_1$ — e) $a_1$

$= (b_1 - a_1) - e$ .....(i)

Similarly, in the second case, the true difference, d = correct reading at B —correct reading at A:

$= b_2 - (a_2 - e)$

$= (b_2 - a_2) + e$ .....(ii)

Adding .(i) and (ii) to eliminate $e$, we get

$$2d = (b_1 - a_1) + (b_2 - a_2)$$

$$d = \frac{(b_1 - a_1) + (b_2 - a_2)}{2}$$

$$\mathbf{d} = \frac{d_1 + d_2}{2} \quad \ldots \quad \ldots \quad \ldots \text{ (Eqn. 7.7)}$$

.e., the true difference of level between two points equals the mean of the two incorrect differences of level obtained in the two settings of the instruments.

Equating (i) and (ii), we have

$$(b_1 - a_1) - e = (b_2 - a_2) + e$$

or $$2e = (b_1 - a_1) - (b_2 - a_2)$$

$$e = \frac{(b_1 - a_1) - (b_2 - a_2)}{2}$$

*i.e.*, The total error, $e = \frac{d_1 - d_2}{2}$ ... ... (Eqn . 7.8)


“Thank you”