SIR C.R. REDDY COLLEGE OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

ACADEMIC YEAR: 2017-18, I-SEMESTER

II-INTERNAL EXAMINATIONS

Absentees 5-18, 58 → (2)

Subject with Code: surveying-I	CE 2104	Dt: 21 -11-2017.
Class: II/IV B.E-Civil	Max. Marks: 30	Time: 9:00 to 10:40 AM

Answer the following

Each question carries 6 marks **5X6=30M**

1. a) Explain about different types of errors in leveling.

   (OR)

   b) Explain the classification of direct leveling method.

2. a) List out the characteristics of contours.

   (OR)

   b) List out the uses of contours.

3. a) What are the errors in plane table surveying?

   (OR)

   b) Write the advantages and disadvantages of plane table survey.

4. a) What is Gale's traverse table. Explain?

   (OR)

   b) Explain the traversing by fast needle method?

5. a) Write about a) abney level b) clinometers

   (OR)

   b) Write about a) Ceylon Ghat tracer b) pentagraph

***

1(a) Errors in Levelling

Instrumental errors:

Error in permanent adjustment of level: For any major surveying work, instrument needs to be tested and if required, gets to be adjusted. For small works, bubble of the level tube should be brought to the center before each reading and balancing of sights are to be maintained.

Staff defective and/or of non-standard quality: The graduation in staff may lack standard distance and thus may cause error in reading. In an ordinary leveling, the error may be negligible but in the case of precise leveling, the graduations are to be standardized with invar tape.

Error due to defective level tube: The bubble of the level tube may remain central even though the bubble axis is not horizontal due to its sluggishness or it may take considerable time to occupy central position, if it is very sensitive. Also, there may be irregularity in the curvature of the tube causing delirious effect.

Error due to defective tripod: The tripod stand should be strong and stable otherwise it causes setting of the instrument unstable and considerable time is required to make it level. The nuts provided at the joints of the legs to the tripod head should be well-tightened before mounting the instrument. The tripod should be set up on a stable, firm ground.

Personal errors:

Due to imperfection in temporary adjustment of the instrument

These errors are caused due to careless setting up of the level, improper leveling of the instrument, lack in focus of eyepiece or/and objective and error in sighting of the staff.

- **Careless set-up of the instrument:** If the instrument is not set up firmly, it gets disturbed easily. If the ground is not firm, it may have settled down and on hard ground, it may get slipped.

- **Imperfect leveling of the instrument:** Due to improper leveling of the instrument, bubble does not remain at the center when the sights are taken resulting error in reading. To avoid the error, the bubble should be brought to the center before each reading.

- **Imperfect focusing.** If either the eye-piece or the objective or both are not properly focused, parallax and thus error in the staff readings occur. Due to movement of eyes if there is any apparent change in the staff reading the eye-piece and objective need proper focusing.

Errors in sighting: This occurs when the horizontal cross-hair does not exactly coincide with the staff graduation or it is difficult to see the exact coincidence of the cross hairs and the staff graduations. The error can be minimized by keeping the sight distance small.

Error due to staff held Non-vertical. If the staff is not held vertical, the staff reading obtained is greater than the correct reading. To reduce the error, the staff should be held exactly vertical or the staff man should be asked to waive the staff towards the instrument and then away from the instrument and the lowest reading should be taken.

Errors in reading the staff: These errors occur if staff is read upward, instead of downwards, read against the top or bottom hair instead of the central hair, mistakes in reading the decimal part and reading the whole meter wrongly.

Errors in recording: The common errors are entering a wrong reading (with digits interchanged or mistaking the numerical value of a reading called by the level man), recording in wrong column, e.g., B.S. as I.S., omitting an entry, entering the inverted staff reading without a minus sign etc.

Errors in computing: adding the fore sight reading instead of subtracting it and or subtracting a back sight reading instead of adding.

Natural errors:

Error due to curvature: In case of small sight distance error due to the curvature are negligible, but if the sight distances are large, the error should be estimated and accounted for, as discussed below. However, the error can be minimized through balancing of sight or reciprocal observation.

Errors due to wind: Strong wind disturbs leveling of an instrument and verticality of staff. Thus, it is advisable to suspend the work in this condition.

Errors due to sun: Due to bright sunshine on the objective, staff reading cannot be taken properly. To avoid such error, it is recommended to maintain a shed to the objective.

Errors due to temperature: Temperature of the atmosphere disturbs setting of parts of instrument as well as causes fluctuation in the refraction of the intervening medium. These lead to error in staff reading. Disturbance caused to instrument may be minimized by placing the instrument under shed.

1(b) Classification of direct levelling

Direct Leveling

It is the most commonly used method of leveling. In this method, measurements are observed directly from leveling instrument.

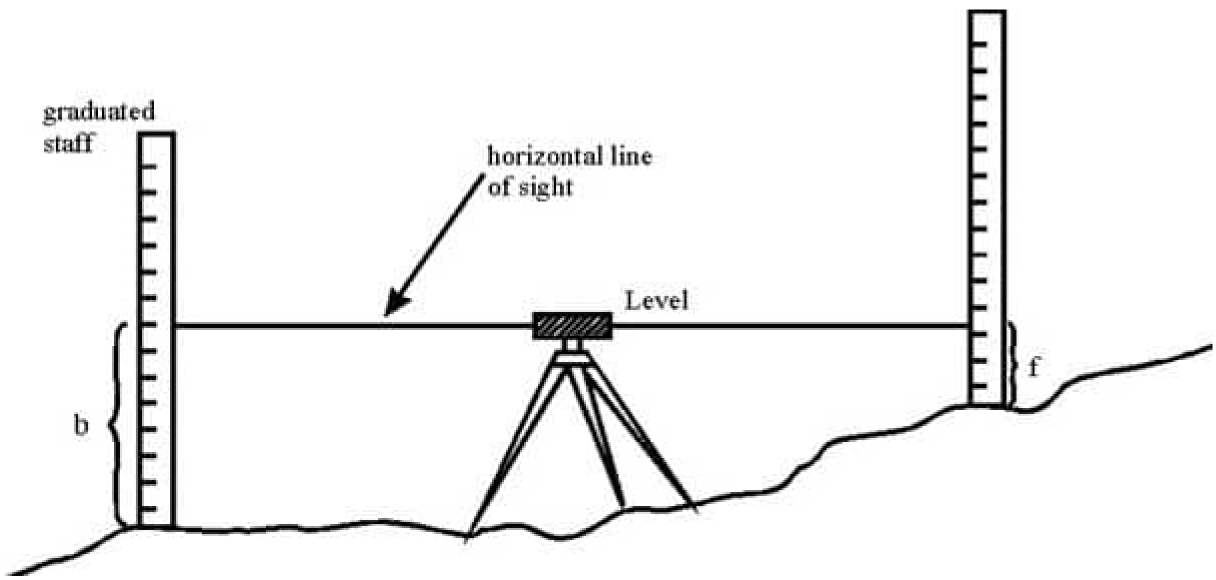
Based on the observation points and instrument positions direct leveling is divided into different types as follows:

- Simple leveling

- Differential leveling
- Fly leveling
- Profile leveling
- Precise leveling
- Reciprocal leveling

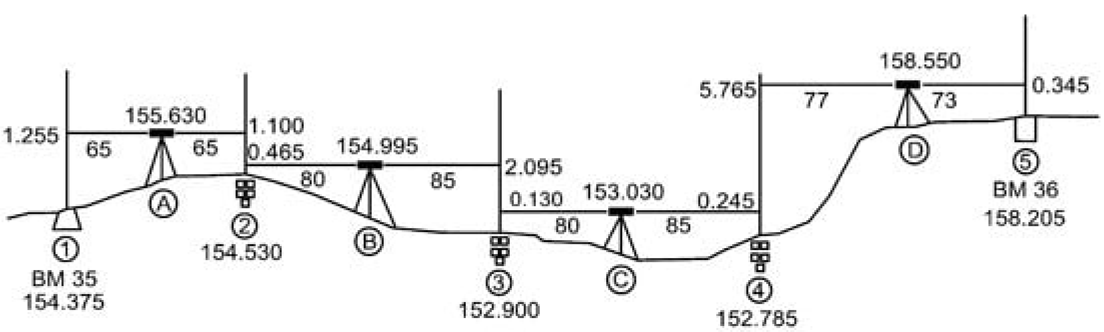
Simple Leveling

It is a simple and basic form of leveling in which the leveling instrument is placed between the points which elevation is to be find. Leveling rods are placed at that points and sighted them through leveling instrument. It is performed only when the points are nearer to each other without any obstacles.



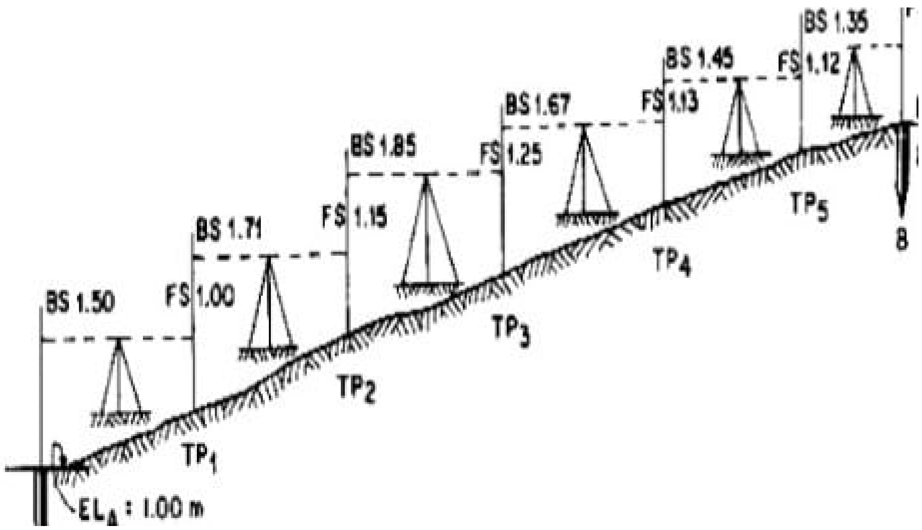
Differential Leveling

Differential leveling is performed when the distance between two points is more. In this process, number of inter stations are located and instrument is shifted to each station and observed the elevation of inter station points. Finally difference between original two points is determined.



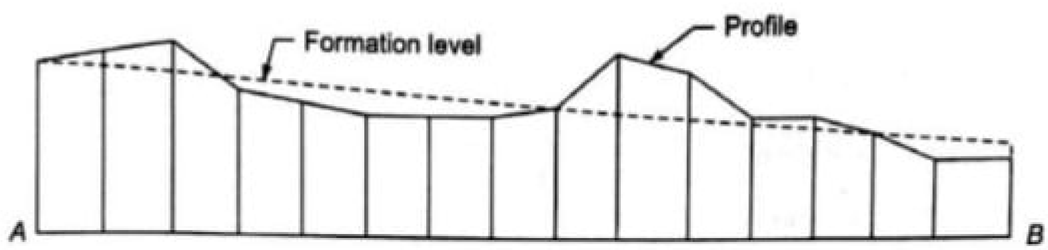
Fly Leveling

Fly leveling is conducted when the benchmark is very far from the work station. In such case, a temporary bench mark is located at the work station which is located based on the original benchmark. Even it is not highly precise it is used for determining approximate level.



Profile Leveling

Profile leveling is generally adopted to find elevation of points along a line such as for road, rails or rivers etc. In this case, readings of intermediate stations are taken and reduced level of each station is found. From this cross section of the alignment is drawn.

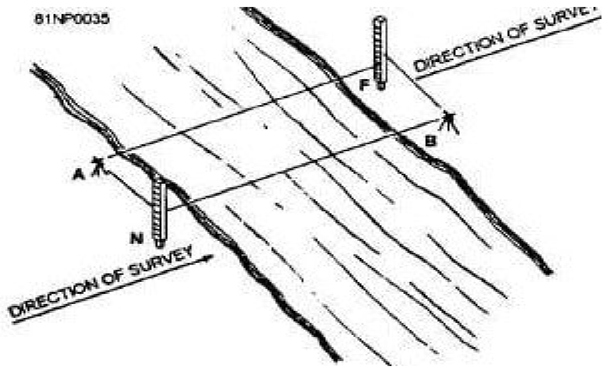


Precise Leveling

Precise leveling is similar to differential leveling but in this case higher precise is wanted. To achieve high precise, serious observation procedure is performed. The accuracy of 1 mm per 1 km is achieved.

Reciprocal Leveling

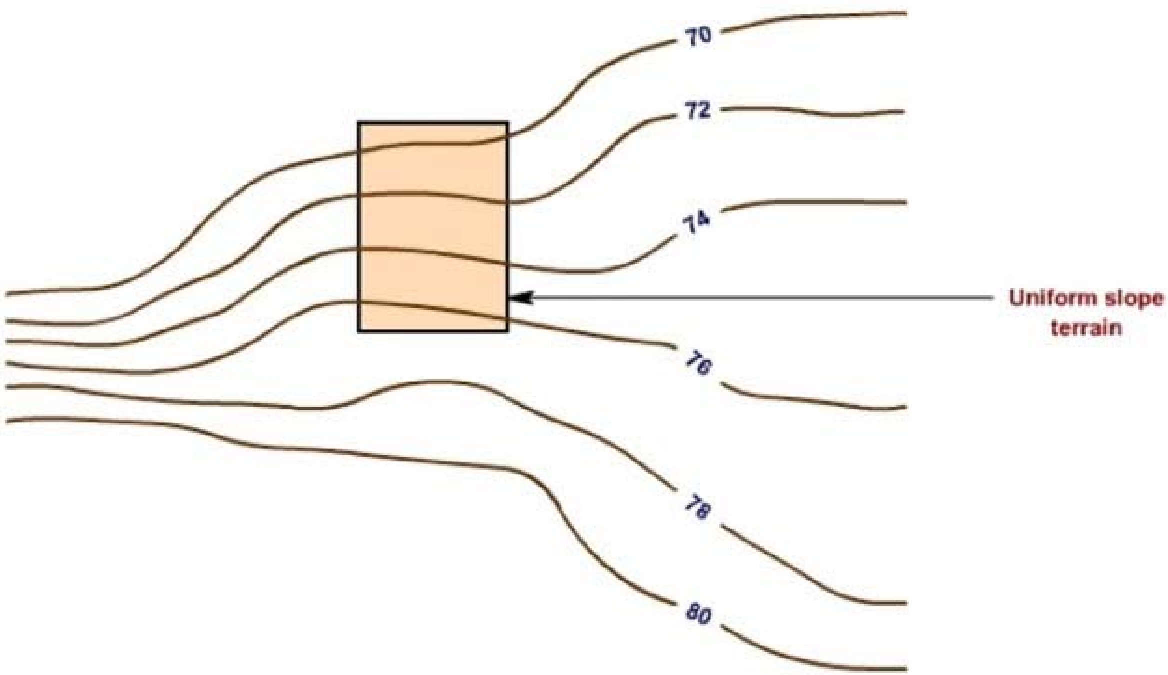
When it is not possible to locate the leveling instrument in between the inter visible points, reciprocal leveling is performed. This case appears in case of ponds or rivers etc. in case of reciprocal leveling, instrument is set nearer to 1st station and sighted towards 2nd station.



2(a) characteristics of contours:

The principal characteristics of contour lines which help in plotting or reading a contour map are as follows:

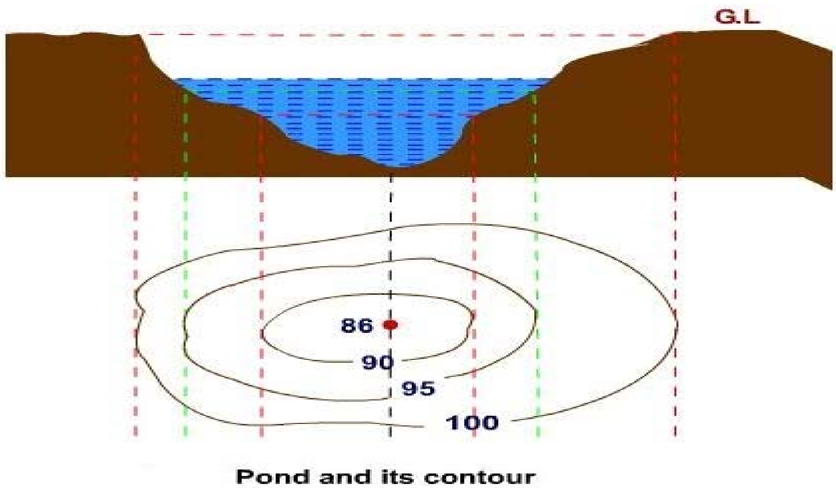
1. Contour lines must close, not necessarily in the limits of the plan.
2. The horizontal distance between any two contour lines indicates the amount of slope and varies inversely on the amount of slope.
3. Widely spaced contour indicates flat surface.
4. Closely spaced contour indicates steep slope ground.
5. Equally spaced contour indicates uniform slope.



Contours of Terrain having different types of slope

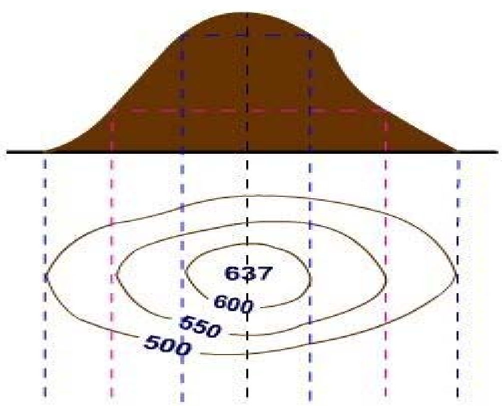
contour showing uniform slope terrain

6. Irregular contours indicate uneven surface.
7. Approximately concentric closed contours with decreasing values towards Centre indicate a pond.



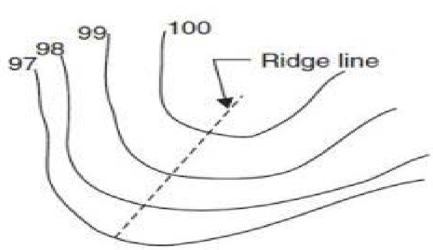
Pond and its contour

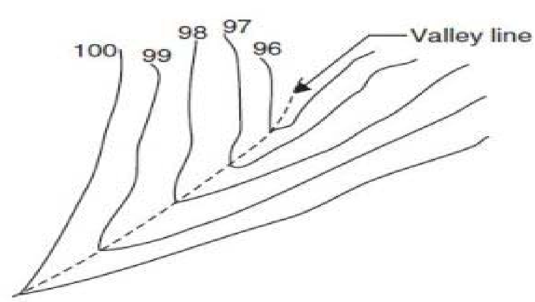
8. Approximately concentric closed contours with increasing values towards Centre indicate hills.



Hill and its contour

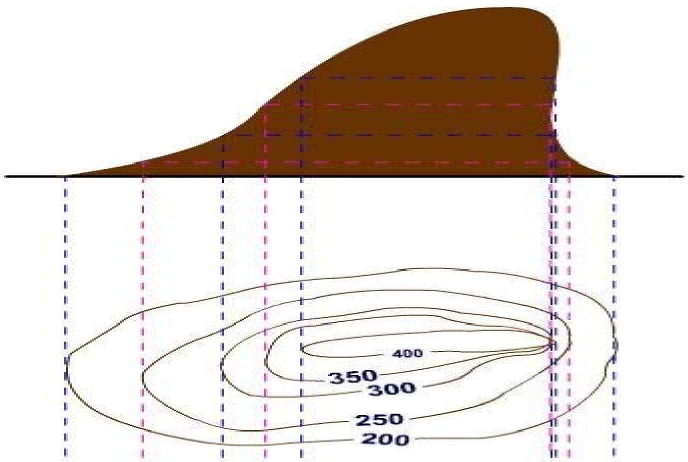
9. Contour lines with U-shape with convexity towards lower ground indicate ridge.
10. Contour lines with V-shaped with convexity towards higher ground indicate valley.





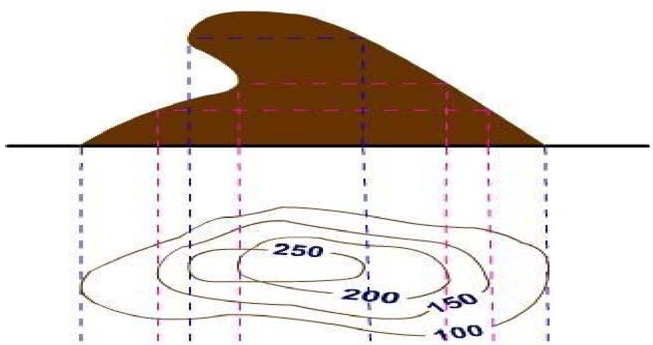
contour showing ridge line and valley line

11. Contour lines generally do not meet or intersect each other. If contour lines are meeting in some portion, it shows existence of a vertical cliff.



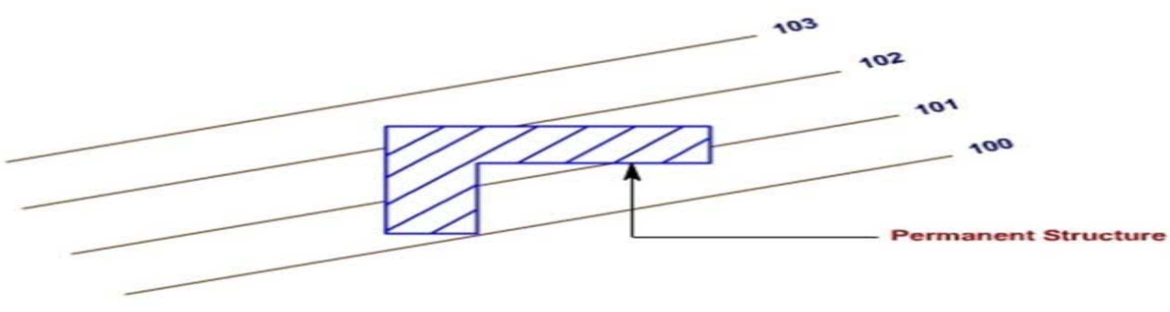
Vertical cliff and its contours

12. Contours of different elevations cannot cross each other. If contour lines cross each other, it shows existence of overhanging cliffs or a cave.



Overhanging cliff and its contour

13. The steepest slope of terrain at any point on a contour is represented along the normal of the contour at that point.
14. Contours do not pass through permanent structures such as buildings.



Contours across permanent structure

contour across a permanent structure

15. A contour line must close itself but need not be necessarily within the limits of the map.

2(b) Uses of Contours

Contour maps are extremely useful for various engineering works:

1. A civil engineer studies the contours and finds out the nature of the ground to identify. Suitable site for the project works to be taken up.
2. By drawing the section in the plan, it is possible to find out profile of the ground along that line. It helps in finding out depth of cutting and filling, if formation level of road/railway is decided.
3. Inter visibility of any two points can be found by drawing profile of the ground along that line.
4. The routes of the railway, road, canal or sewer lines can be decided so as to minimize and balance earthworks.
5. Catchment area and hence quantity of water flow at any point of nalla or river can be found. This study is very important in locating bunds, dams and also to find out flood levels.
6. From the contours, it is possible to determine the capacity of a reservoir.

3(a) Errors in plane table surveying:

Instrumental Errors

The primary source of instrumental errors in plane table surveying arise from the lack in temporary adjustment. Thus, the causes for instrumental errors are as follows:

(i) Undulated plane table surface: Error in observation as well as plotting will occur if the top surface of the plane table is not perfectly plane.

(ii) Curved or inclined fiducial edge: If the fiducial edge of the alidade is not straight, the rays drawn would not be straight and an error in relative location of object will occur.

(iii) Loose fittings in plane table: If the fittings of the plane table and that of tripod are loose, the plane table will not remain stable and error in surveying will occur.

(iv) Improper magnetic compass: If the magnetic compass is sluggish or does not represent proper magnetic direction, an error in orientation of the plane table will occur, (if it is done with the magnetic compass) and thus basic principle of plane table surveying will get violated.

(v) Non-perpendicularity of the sight vanes: If the sight vanes are not perpendicular to the base of the alidade, there would be an error in sighting.

(vi) Defect in level tube: If the level tube is defective, the plane table will not be horizontal when the bubble is central. The plot thus obtained will be inaccurate.

(vii) Unseasoned, poor quality drawing paper: Poor quality drawing paper gets affected by the weather changes and thus it may expand or contract and changes the scale of plotting. The plot thus obtained will be incorrect.

Personal errors:

(i) Improper leveling of plane table: If the plane table is not properly leveled and made horizontal, the sight vanes will be inclined to the vertical. There would be an error and the points located will not be correct.

(ii) Inaccurate Centering: If the plane table is not accurately centered, the error in plotted position of station will cause error in plotting of all other details from that station.

(iii) Improper orientation: If the plane table is not oriented properly, the fundamental principle of plane table surveying will get violated and thus plotting in general will be inaccurate.

(iv) Improper clamping of plane table: Improperly clamped plane table will disturb its orientation, and thus error due improper orientation will creep into.

(v) Inexact bisection of object: If the object is not sighted accurately or not bisected properly, error in direction of object will occur and thus its plotted position.

(vi) Improper plotting: This may be caused due to any error in measurement of distance or direction of ray, due to error in instruments or error in manipulation or sighting. This will lead to inaccurate map of the survey and thus the objective of surveying will be poorly achieved.

(vii) Instability of tripod stand: If the tripod stand is not set in stable, the whole of surveying and plotting will get disturbed and thus error in surveying and making map.

Errors due to inaccurate centering:

Centering is very important for plotting detail through plane table surveying. Error in centering leads to error in plotting of location of objects. So, the operations involved in centering need careful consideration. On the other hand, plotting accuracy (Lesson 2) provides a limit within which no error gets perceptible in plotting. Thus, accuracy with which centering should be done depends on the scale of plotting and accordingly care in centering of plane table should be taken.

Thus, if S is the scale of plotting and 0.25mm is the minimum dimension of plotting, then 0.25 X S is the amount of error in field distance which may be allowed during centering without any effect on actual plotting.

For example, if the plotting scale is 1: 1000, then centering within 0.25-meter distance on ground can be permitted without any error in plotting.

3(b) Advantages and Disadvantage of plane table:

Advantages of plane table survey

- It is suitable for location of details as well as contouring for large scale maps directly in the field.
- As surveying and plotting are done simultaneously in the field, chances of getting omission of any detail get less.
- The plotting details can immediately get compared with the actual objects present in the field. Thus, errors as well as accuracy of the plot can be ascertained as the work progresses in the field.
- Contours and specific features can be represented and checked conveniently as the whole area is in view at the time of plotting.
- Only relevant details are located because the map is drawn as the survey progresses. Irrelevant details get omitted in the field itself.
- The plane table survey is generally more rapid and less costly than most other types of survey.
- As the instruments used are simple, not much skill for operation of instruments is required. This method of survey requires no field book.

Disadvantages of plane table survey

- The plane table survey is not possible in unfavorable climates such as rain, fog etc.
- This method of survey is not very accurate and thus unsuitable for large scale or precise work.
- As no field book is maintained, plotting at different scale require full exercise.
- The method requires large amount of time to be spent in the field.
- Quality of the final map depends largely on the drafting capability of the surveyor.
- This method is effective in relatively open country where stations can be sighted easily.

4(a) Gales traverse table:

The columns of Gale's table are filled as illustrated below:

Column 1: Enter the names of the stations at which the instrument is set up, say P, Q, R, etc

Column 2: Enter the names of traverse sides in between an instrument station and its forward station such as PQ, QR, RS etc.

Column 3: Enter the observed length of the traverse sides.

Column 4: Enter the angles observed at the stations. These may be included / interior angles or deflection angles. Sum of all the angles are entered in the end of this column. Check if there is any error of closure of the observed angles (The type of checking depends on the on the type of angles observed and the type of traverse).

Column 5: If there is any error of closure, necessary corrections are to computed and the same is to be presented in this column. Thus, column 5 provides the correction for error of closure.

Column 6: After making necessary correction to the observed angles, adjusted angles are computed and thus adjusted angles are represented in column 6.

Column 7: From the known azimuth (from previous surveying or determined before the starting of traversing) of a line present in the site and/ or from known angle between the line of known azimuth and that of a traverse side, compute the WCB of the all the traverse sides using the adjusted angles of column 6. The WCB of traverse sides are represented in column 7.

Column 8: Compute the consecutive coordinates of the stations in terms of departure and latitude with appropriate algebraic sign from the observed length (Column 3) and the WCB (Column 7) of the sides. The same are represented in column 8 along proper row and under proper sub-heading. Check the error of closure of the traverse. If any error is present, adjustment and balancing of traverse is to be done. The algebraic sum of the departures and latitudes are to be represented at the end of the appropriate columns.

Column 9: The error associated with the traverse is to be distributed to all the stations in such a way that there is no error of closure. Thus, corrections are to be computed for different stations. Usually Bowditch's Analytical method is usually adopted to find the correction for each individual consecutive coordinate and the same is represented in column 9 under appropriate sub-heading. At the end of the column, sum of the corrections is also represented. It is to be checked that the total correction should be same as the amount of error but opposite in nature

Column 10: The adjusted consecutive coordinates of the stations are computed making due corrections (column 9) to the consecutive coordinates (column 8). The adjusted consecutive coordinates of the stations are thus represented in column 10.

Column 11: From the known coordinates of at least one of the stations the Independent coordinates of all the other stations are computed and the same is represented in column 11.

Station	Sides	Length	Included angle	Correction	Corrected angle	WCB	Consecutive coordinates		Bowditch correction		Corrected conscutive coordinates		Corrected independent coordintes	
							D	L	D	L	D	L	D	L

4(b) Traversing by fast needle method

In this method, the angle between two adjacent lines is measured directly. this method is adopted during the theodolite survey of a big region. In this method survey is conducted accurately. in this method, the bearing of only first line is measured while the angles are measured for the other lines. from the bearing of the first line and the angles of the other lines we can find out the bearing of the other lines. following methods are used to read angles in this method

1) Traversing by included angles
2) Traversing by direct angles
3) Traversing by defection angles

Traverse Method by Included Angles.

This method is used for the area whose survey is to be done by making closed traverse. in this method, the angle is read accurately by repetition method. only the bearing of the first line is read while the included angles of the consecutive lines are read. if the arrangement of the lines of traverse is clock wise then the external angles of the traverse are found out while if it is counter - clock wise, the included angles are find out. Generally, the survey of a closed traverse is carried out in counter-clockwise direction.

Traverse Method by direct method.

This method is used for and open traverse. This method is also called the angles to the right method the angle measurement in this method ranges from 0 to 3600

Method. -

Following procedure is adopted according to this method of theodolite survey.

First of all theodolite is set at the first point of the traverse. by the setting of the theodolite is meant its centering leveling and focusing etc. then the bearing of the first line AB is read. for reading the angle at B, theodolite is set at the point B, by turning the face of telescope toward A, the back site at the pint B is taken after this the theodolite is turned clockwise and faced toward the point C and fore – site taken. the difference between these two readings gives the measurement of the angle ABC. The process is repeated by changing the face of the theodolite the average of these is taken. all angles of the traverse are read by this method.

5(a) Abney level

An Abney Level is similar to a Hand Level in that it is a telescope with a spirit level attached. The main distinction is that the spirit level on an Abney level is not set in a static horizontal position. An Abney Level features a graduated arc. Once the arc is set at a specific degree it will cause the spirit level to show level at that specific angle. Many Abney levels will feature items such as stadia and will have a feature to focus items at different distances. Some even have a magnification feature. Abney levels are easier to use and inexpensive. They are used to measure degrees, percent of grade and topographic elevation. The user can then determine height, volume and grade through manipulating the readings with trigonometry. Land Surveyors, Builders, Contractors, Agriculture Professionals, Foresters, and many other Professionals use Abney levels. One unique use of an Abney level is to indirectly measure the height of a tree.

(b)Clinometer

The clinometer is an optical device for measuring elevation angles above horizontal. The most common instruments of this type currently used are compass-clinometers. Compass clinometers are fundamentally just magnetic compasses held with their plane vertical so that a plummet or its equivalent can point to the elevation of the sight line. A better clinometer is the Abney hand spirit level or clinometer, where the object sighted and the level bubble can be seen simultaneously, so that the index can be set accurately. An Abney clinometer is shown in the photograph. A spirit level is so-called because it contains alcohol in a tube of large radius, in which the bubble moves to the highest point. Spirit levels are used for accurate surveying, although automatic levels that go back to the principle of the plummet are now frequently found, and are easy to use.

A fairly common use of a clinometer is to measure the height of trees, which is easily done. A point should be marked with a stake as far from the Centre of the trunk of the tree as its estimated height, so that the elevation angle is about 45°, which gives the best "geometry." This distance D is measured with a tape. The observer then stands over the stake and sights the top of the tree, finding its elevation angle θ. The height H of the tree is then $H = D \tan \theta + HI$, where HI, the *height of instrument*, is the height of the observer's eye.