P.S.R. ENGINEERING COLLEGE

An Autonomous Institution, Affiliated to Anna University
Approved by AICTE, New Delhi, Accredited by NBA & NAAC
Recognized Under 12 (B) of the UGC Act, 1956 & ISO 9001:2015
Sivakasi-626 140, Virudhunagar Dt., Tamil Nadu

Department of Civil Engineering

191CE38 SURVEY PRACTICAL

Regulation 2019

G.BASKAR SINGH

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01.09.2021

G.BASKAR SINGH

1/9/21

Dr. M.SHAHUL HAMEED, M.E.,Ph.D.,M.B.A.,Ph.D.,
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SIVAKASI-626140

P.S.R. ENGINEERING COLLEGE
DEPT OF CIVIL ENGG
SIVAKASI

INSTITUTION VISION AND MISSION

VISION

- To contribute to the society through excellence in technical education with societal values and thus a valuable resource for industry and the humanity.

MISSION

- To create an ambience for quality learning experience by providing sustained care and facilities.
- To offer higher level training encompassing both theory and practices with human and social values.
- To provide knowledge based services and professional skills to adapt tomorrow's technology and embedded global changes.

DEPARTMENT OF CIVIL ENGINEERING

VISION

- The vision of the Civil Engineering Department is to produce the Civil Engineers to meet the dynamic problems in the society with human values.

MISSION

- To provide high-class engineering education.
- To join hands with organizations to provide training and internship.
- To facilitate the students for research and development.
- To deliver good Civil Engineering graduates with human values

PROGRAM OUTCOMES (PO's)

The Program Outcomes of B.E in Civil Engineering are:

1. **Engineering Knowledge:** Apply knowledge of mathematics, physical sciences and Civil Engineering fundamentals.
2. **Problem Analysis:** Able to identify, formulate, analyze and solve for Civil Engineering problems.
3. **Design/Development of Solution:** Able to design and realize civil structures to meet desired needs within practical constraints such as economical, environmental, social, political, ethical, health and safety, manufacturability and sustainability.
4. **Conduct Investigations of Complex Problem**: Able to investigate and conduct experiments, as well as to analyze and interpret data.
5. **Modern Tool Usage:** Use of techniques, skills and modern engineering tools necessary for engineering practice
6. **The Engineering and Society:** Contextual knowledge to assess societal, health, safety, legal and cultural issues related to Engineering.
7. **Environment and Sustainability:** Realize the impact of Civil Engineering solutions in a global, economic and environmental context.
8. **Ethics:** Apply ethical principles and commitment to professional ethics and responsibility.
9. **Individual and Team Work:** Function as an individual and as a member or leader in multidisciplinary teams.
10. **Communications:** Communicate effectively with the engineering community and society at large.
11. **Project Management and Finance:** Knowledge and understanding of management and business practices and their limitations.
12. **Lifelong Learning:** Recognize the need and have the ability to engage in life-long learning.

PROGRAMME SPECIFIC OUTCOMES (PSO'S)

1. Proficiency in Civil Engineering problem identification, formulation, analysis, design, execution and safety using appropriate tools.
2. Solve problems in the hydraulics, transportation geotechnical and Surveying disciplines of Civil Engineering with competence in modern tool usage.
3. Apply modern construction techniques, equipment and management tools so as to complete the project within specified time and funds.
4. Graduates will have a broad understanding of economical, environmental, societal and health involved in infrastructural development and ability to function within multidisciplinary teams.

PREFACE

For any Civil Engineering project like building a house, constructing a dam, laying out a road, railway, setting up of an industry etc., the first requirement is to have a plan/map of the area. To have a plan/map of any area, it is required to collect information and data about the terrain as well as the objects present in the area by taking necessary measurements using different types of instruments. Data thus collected are being subsequently used to prepare the plan/map of the area. The domain of engineering which involves the collection of field data and subsequently preparation of plan/map of the area is termed as 'Surveying'. ***Surveying is defined as the art and science of making measurements of the earth specifically the surface of the earth***. This is being carried out by finding the spatial location (relative/absolute) of points on or near the surface of the earth. Different methods and instruments are being used to facilitate the work of surveying.

Surveying is primarily utilised to fix the national and state boundaries, chart coastlines, navigable streams and lakes, establishing control points, execute hydrographical and oceanographically charting and mapping, prepare topographic map of land surface of the earth, prepare plan or map of the area surveyed, collect field data, analyze and to calculate the field parameters for setting out operation of actual engineering works. Moreover, during execution, project of any magnitude is constructed along the lines and points established by surveying. Thus, surveying is a basic requirement for all Civil Engineering projects.

Based upon the consideration of the shape of the earth, surveying is broadly classified as geodetic surveying and plane surveying. Most of the civil engineering works, concern only with a small portion of the earth which seems to be a plane surface. Based on the purpose for which surveying is being conducted, surveying has been classified into: control surveying, land surveying, topographic surveys, engineering surveys, route surveys, construction surveys, astronomic surveys and mine surveys. Engineering survey is of prime importance consisting of three broad steps: reconnaissance survey, preliminary survey, location survey; which helps in collecting requisite data for planning, design and execution of engineering projects such as construction of highways, bridges, tunnels, dams etc. The primary aims of field surveying are to measure horizontal distance, vertical elevation and relative direction of lines by measuring horizontal angles. In the present day scenario, it has become mandatory for every civil engineer to have the basic awareness of surveying.

Identifying this need, the **P. S. R. Engineering College, Sivakasi** has introduced this practice based course for core branch of Civil Engineering at the second year level for undergraduate students.

The main objective of this study is to help students in gaining the practical experience by exposing them to various techniques of field surveying. The students will have an understanding of the concepts involved in the preparation of layouts, plans, maps etc.

In this semester, the present course on Surveying Lab plays a vital role for enhancing the knowledge of an aspiring civil engineer. This lab course comprises of seven major experiments which are intended to make the students to understand and gain familiarity with latest surveying techniques. ***The study consists of Principles of Survey, chain surveying, compass survey, Theodolite Survey, Tacheometric Survey, GPS and Total Station Survey.***

At the end of this course, a student should be able to appreciate the role of the surveyor in the civil engineering industry: to plan and execute a topographical survey for engineering development; plan, design and set out engineering works; manage, organize execute a given task to meet specifications within a strict deadline and with team work.

Evaluation of Laboratory Marks

	Mark Split up	Marks
Mark Split up (100)	Observation Work	25
	Record Word	25
	Lab Model Exam	40
	Attendance	10
	Total	100

SYLLABUS :

191CE38	**SURVEY PRACTICAL**			**L-T-P**	**C**
				0-0-4	**2**
Programme:	B.E., Civil Engineering	**Sem:**	**III**	**Category**	**PCC**
Pre-requisites:	Nil				
AIM:	The aim of this course is to make the student familiar with geometric principles of surveying.				

LIST OF EXPERIMENTS

1. Chain traversing.
2. Compass Traversing-open and closed Traversing.
3. Determination of reduced level Fly levelling using Dumpy level.
4. Check levelling.
5. Plotting LS and CS.
6. Contouring.
7. Measurement of horizontal angles by reiteration and repetition and vertical angles.
8. Theodolite survey traverse.
9. Trilateration.
10. Setting out works - Foundation marking
11. Field observation for and Calculation of azimuth, Latitude and Longitude.
12. Determination of angles and height measurement using total station.
13. Determination of area of a given plot using total station

TOTALPERIODS: 45

Course Outcomes:

At end of this course, the students will be able to

CO1: Use conventional surveying tools such as chain/tape, compass, plane table, level in the field of Civil Engineering applications such as structural plotting and highway profiling.

CO2: Apply the procedures involved in field work and to work as a surveying team.

CO3: Plan a survey appropriately with the skill to understand the surroundings.

CO4: Take accurate measurements, field booking, plotting and adjustment of errors can be understood.

CO5: Plot traverses / sides of building

CO6: Determine the location of points present on field on a piece of Paper.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	2	2						2		3	3	3		2	1
CO2	1	2	1	3	2			1	2	2		3	3	1	2	1
CO3	1	3	1	2	2				2			3	1	3		
CO4	3	2	1		2				2	1		3		3		3
CO5	3	2	1	1	2				2	2		3	1	2	2	1
CO6	2	1	1	1	2			1	2	1		3	1	2	1	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

MANDATORY INSTRUCTIONS

1. Students should report to the labs concerned as per the timetable.

2. Record should be updated from time to time and the previous experiment must be signed by the faculty in charge concerned before attending the lab.

3. Students who turn up late to the labs will in no case be permitted to perform the experiment scheduled for the day.

4. After completion of the experiment, certification of the staff in-charge concerned in the observation book is necessary.

5. Students should bring a notebook of about 100 pages and should enter the readings/observations/results into the notebook while performing the experiment.

6. The record of observations along with the detailed experimental procedure of the experiment performed in the immediate previous session should be submitted and certified by the staff member in-charge.

7. Not more than FIVE students in a group are permitted to perform the experiment on a set up.

8. The group-wise division made in the beginning should be adhered to, and no mix up of student among different groups will be permitted later.

9. The components required pertaining to the experiment should be collected from Lab- in-charge after duly filling in the requisition form.

10. When the experiment is completed, students should disconnect the setup made by them, and should return all the components/instruments taken for the purpose.

11. Any damage of the equipment or burnout of components will be viewed seriously either by putting penalty or by dismissing the total group of students from the lab for the semester/year.

12. Students should be present in the labs for the total scheduled duration.

13. Students are expected to prepare thoroughly to perform the experiment before comingto Laboratory.

14. Procedure sheets/data sheets provided to the students groups should be maintained neatly andare to be returned after the experiment.

15. DRESS CODE:
    a. Boys – College uniform with tuck in and safety shoes.
    b. Girls – College uniform (Lab Coat) with safety shoes.

PRINCIPLES OF SURVEYING

The fundamental principles upon which the surveying is being carried out are

- ***Working from whole to part.***
- After deciding the position of any point, its reference must be kept from at least two permanent objects or stations whose position has already been well defined.

The purpose of working from whole to part is

- To localize the errors and
- To control the accumulation of errors.

This is being achieved by establishing a hierarchy of networks of control points (Stations having known position). The less precise networks are established within the higher precise network and thus restrict the errors. To minimize the error limit, highest precise network (primary network) Fig.1 of control points are established using the most accurate / precise instruments for collection of data and rigorous methods of analysis are employed to find network parameters. This also involves most skilled manpower and costly resources which are rare and cost intensive.

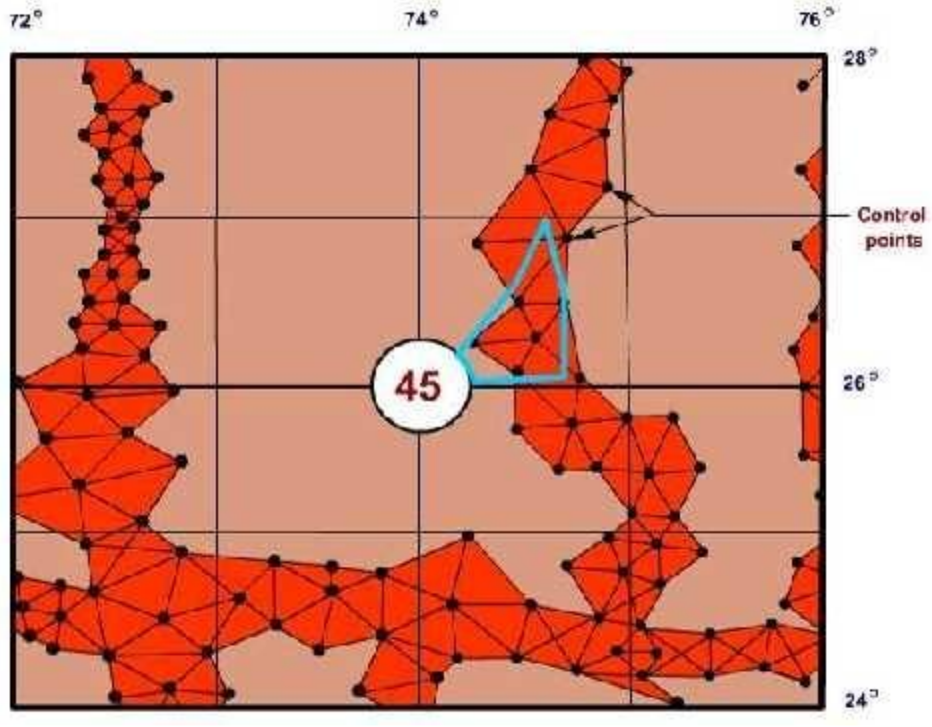


FIG.1 NETWORK OF CONTROL POINTS

EX.NO:1 **CHAIN SURVEYING**

DATE: **(INTRODUCTION)**

This method of surveying derives its name from the fact that the principal item of equipment used in is the measuring chain. The equipment used in this type of survey are simple in construction. However work of a sufficiently high order of accuracy to cover the requirements of much ordinary engineering work is possible, especially when large-scale plans of relatively small area are required. In addition to being a complete method of surveying, some operations of chain surveying occur in other methods of surveying. A good knowledge of chain surveying is therefore essential to a proper knowledge of surveying as a whole.

1) EQUIPMENT AND ACCESSORIES:

Chain

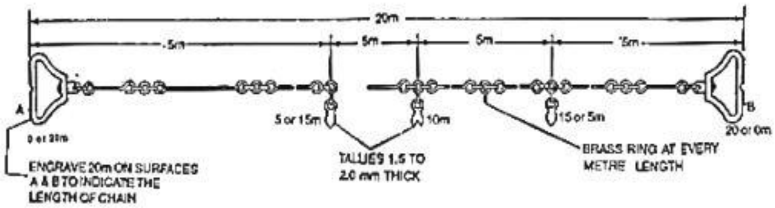


fig 2.1:20 Metre Chain

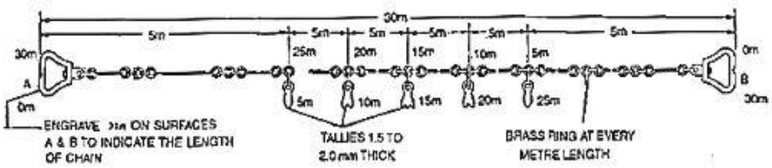


fig 2.2:30 Metre chain

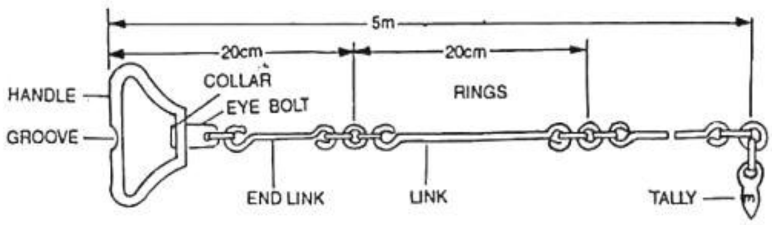
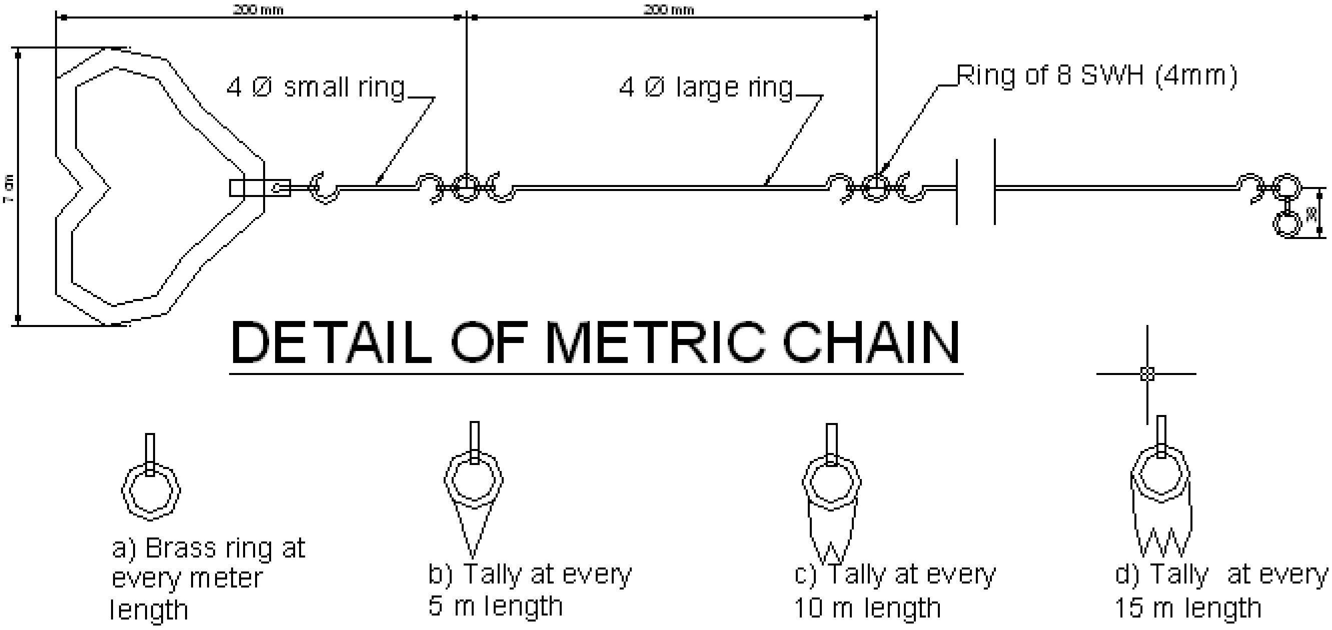


Fig 2 Chain

A chain is mainly used in chain surveying to measure the distances. A chain may be metric or non-metric. Generally a chain consists of 100 or 150 links each 300 mm or 200 mm length. The link is made of galvanized mild steel wire 4 mm to 6mm diameter. The ends of each link are bent into a loop and connected together by means of three oval rings. The ends of the chain are provided with handles for dragging the chain on the ground, each wire with a swivel joint so that the chain can be turned without twisting. The length of the chain is measured from the outside of one handle to the outside of another handle.

Types of chains



Metric chains

Metric chains of length 20m, 30m, 50m and 100m are used now-a-days for measuring the distances in metres and its fractions.

i. **Non-metric chains**

The following are the non metric chains in which the unit of measurement is foot.

a) Engineers chain

It is 100 feet long and consists of 100 links, each of 1 foot length.

b) Gunter's chain or surveyor's chain

It is 66 feet in length, consists of 100 links each being 0.66 foot long

c) Revenue chain

It is 33 feet long and consists of 16 links. It is used in cadastral survey.

ii. **Steel band or Band chain**

It is made of steel ribbon 16 mm wide and is available in 20 and 30m lengths. It is wound on an open steel cross in a closed case.

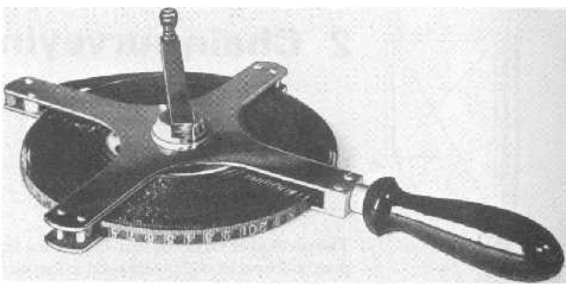


Fig.3. Steel band or band chain

Tapes

Tapes are used for measuring the distances in precise work. Following are the various types of tapes

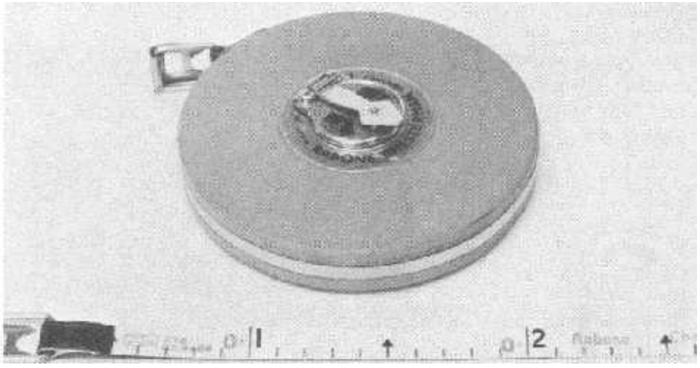


Fig.4 Tape

i) Cloth or linen tape
ii) Metallic tape
iii) Steel tape
iv) Invar tape

a) Cloth or linen tape

It is made of woven linen strip 5 mm to 15 mm wide and varnished. It is easily affected by damp.

b) Metallic tape

It is made of linen strip inserted with metallic wires.

c) Steel tape

It is made of thin steel strip and is available in 10, 20, 30 and 50 metre lengths. It is widely used for measurements.

d) Invar tape

It is made of an alloy of steel and nickel. It is used for the work of highest precision.

Arrows

Arrows are made of good quality hardened steel wire of 4 mm diameter. The arrows are made 400 mm in length, are pointed at one and the other end is bent into a loop or circle.

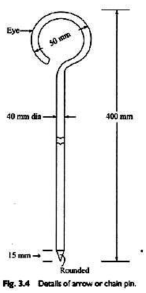


Fig.5 Arrow

Ranging rods

Ranging rods are used to range some intermediate points in the survey line. The length of the ranging rod is either 2m or 3m. They are shod at bottom with a heavy iron point. Ranging rods are divided into equal parts 0.2m long and they are painted alternately black and white or red and white or red, white and black. When they are at considerable distance, red and white or white and yellow flags about 25 cm square should be fastened at the top.

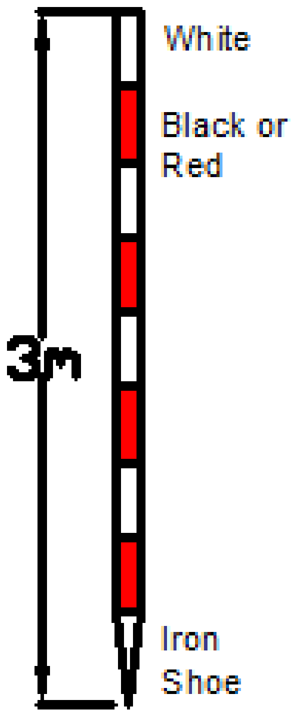


Fig.6 Ranging rod and offset rod

Offset Rod

An offset rod is similar to ranging rod, but it is provided with a hook at the top for pulling or pushing the chain through a hedge. It is divided into metres and decimeters with alternate bonds of paints. Offset rods are mainly used for measuring offsets.

Cross staff

The simplest instrument used for setting out a right angle. The common forms of cross staff are: Open cross staff, French cross staff, Adjustable cross staff.

Pegs

These are rods made from hard timber and tapered at one end, generally 25mm or 30mm square and 150mm long wooden pegs are used to mark the position of the stations on the ground.

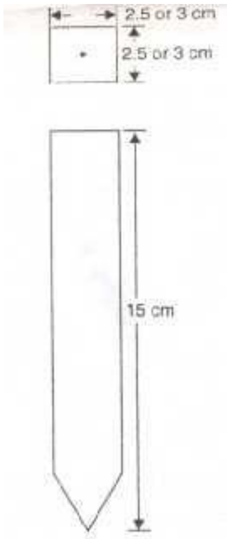
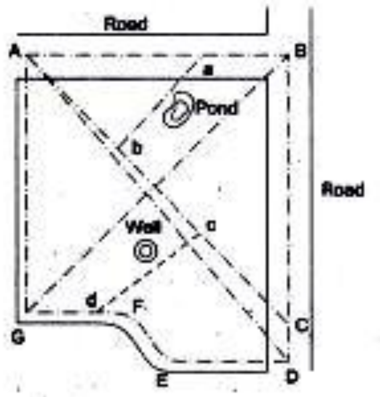


Fig.7 Peg

Plumb Bob

It is a solid cone attached to a thread. It is used when measuring distances along slopes to transfer points to the ground.

2) TERMINOLOGY:



Main Station

Main station is a point in chain survey where the two sides of a traverse or triangle meet. These stations command the boundaries of the survey and are designated by capital letters such as A, B, C etc.

Tie Station or Subsidiary Station

Tie station is a station on a survey line joining two main stations. These are helpful in locating the interior details of the area to be surveyed and are designated by small letters such as a, b, c etc.

Main Survey Line

The chain line joining two main survey stations is called main survey line. AB, BC are examples of main survey lines.

Tie Line or Subsidiary Line

A chain line joining two tie stations is called tie line such as ab or cd. It is also called auxiliary line. These are provided to locate the interior details which are far away from the main lines.

Base Line

It is the longest main survey line on a fairly level ground and passing through centre of the area. It is most important line as the direction of all other survey lines are fixed with respect to this line.

Check Line

Check line or proof line is a line which is provided to check the accuracy of the field work. The measured length of the check line and computed (scaled off the plan) must be the same. AD is an example of check line.

Offset

It is the distance of the object from the survey line. It may be perpendicular or oblique.

Chainage

It is the distance of a well defined point from the starting point. In chain surveying it is normally referred to as the distance of the foot of the offset from the starting point on the chain line.

3) ERRORS IN CHAINING:

Errors in chaining are classified as follows

a) Compensating errors

b) Cumulative errors

c) Gross errors

Compensating errors

These errors are liable to occur in both the directions and tend to compensate. These errors occur due to:

1) Incorrect holding and marking of the arrows.
2) Fractional parts of the chain may not be correct, that is, the chain may not be calibrated uniformly.
3) Plumbing may be incorrect while chaining by stepping on slopes.
4) In setting chain angles with a chain.

Cumulative errors

These errors are liable to occur in the same direction and tend to accumulate. The error thus considerably increases or decreases the actual measurements. The cumulative errors are proportional to the length of line and may be positive or negative.

Positive cumulative errors:

These are the errors which make the measured lengths more than the actual. Therefore, the actual length can be found by subtracting the error from the measured length.

1) The length of the chain is shorter than the standard length.
2) Bending of links, knots in links, removal of rings during adjustment of the chain, clogging of rings with mud etc.
3) Not applying slope correction to the length measured along slopes.
4) Not applying sag correction.
5) Not applying temperature correction when temperature during measurements is less than the standard temperature.
6) Bad ranging, bad straightening and wrong alignment.

Negative cumulative errors:

These are the errors which make the measured length less than the actual. Therefore the actual length can be found by adding the error to the measured length.

1) Length of chain is more than the standard length, which may be due to flattening of rings, opening of joints etc.
2) Not applying the temperature correction when temperature during measurements is more than the standard temperature.

Gross errors

The four sources of mistakes are the following

1) Displacements of arrows or station marks.
2) Miscounting tape lengths
3) Misreading the tape
4) Wrong booking

4) PRECAUTIONS:

In every fieldwork exercise relevant precautions have to be taken to minimize the errors that are mentioned in the previous paragraphs.

5) APPLICATIONS:

This surveying method can be used to measure distances between two survey stations and also to prepare topographic maps of small parcel of land.

RESULT:

Thus the study about the Temporary and Permanent adjustments of a Chain Survey is practiced.

Faculty Signature **----------------- out of 25.**

EX.NO:2 **DETERMINATION OF PACE**

CALCULATION:

TRIAL	20 m	40 m	60 m
1.			
2.			
3.			
AVERAGE			

PACE = TOTAL LENGTH / AVERAGE VALUE OF PACE

PACE FOR 2O m =

PACE FOR 40 m =

PACE FOR 60 m=

AVERAGE PACE =_____________ m / pace.

EX.NO:2 **DETERMINATION OF PACE**

DATE:

OBJECTIVE

To determine the average length of own pace.

EQUIPMENTS REQUIRED

Steel/Fiber tape, chaining pins.

INSTRUCTIONS

1. The location for this lab shall be determined by your instructor.
2. Place chaining pins in the ground at 0m, 20m, 40m, and 60m stations.
3. Use ranging rods to insure that all 4 pins are in a straight line.
4. Use your normal walk to pace off each distance (i.e.: 0 to 20, 0 to 40 and 0 to 60) a total of 3 times each.
5. Record the number of paces for each trial in your field / observation book.
6. Calculate the average number of paces for each distance.
7. Calculate the average length of your pace.
8. Write up the lab in your field book and calculate the own pace.

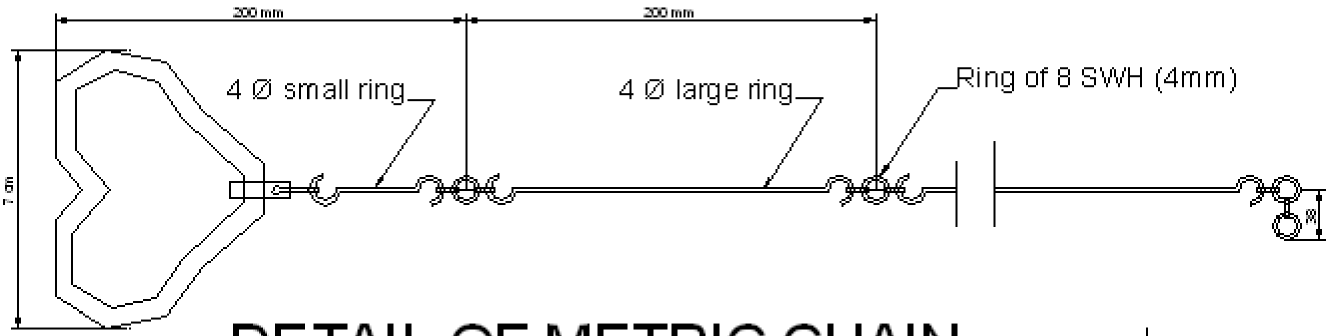
RESULT

Average Value of own pace= ____________________ m /pace.

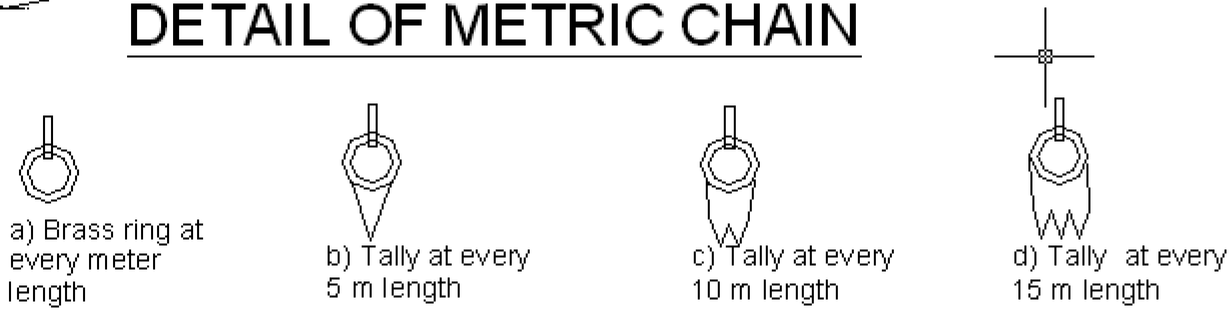
25

Faculty Signature

EX.NO:3 **MEASUREMENT OF DISTANCE BY RANGING AND CHAINING**



DETAIL OF METRIC CHAIN



RANGING ROD (3m)

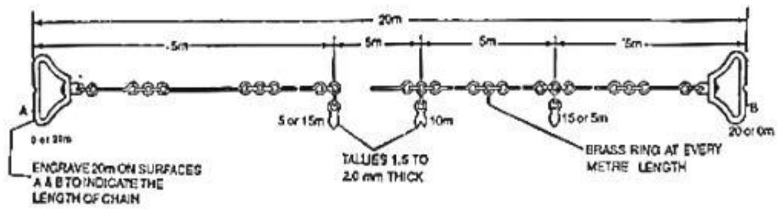


fig 2.1:20 Metre Chain

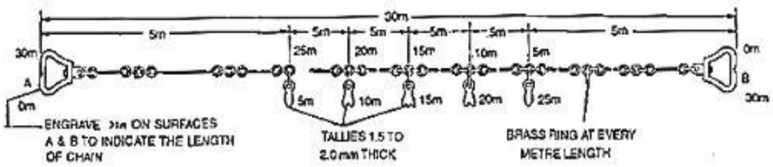
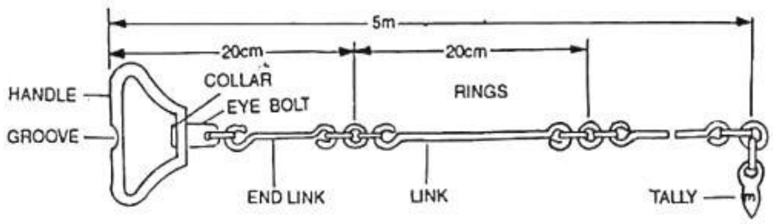
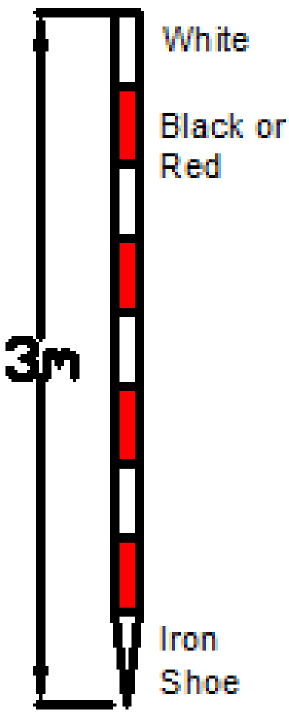


fig 2.2:30 Metre chain





EX.NO:3 **MEASUREMENT OF DISTANCE BY RANGING AND CHAINING**

DATE:

OBJECTIVE

To determine the measurement of Distance by Ranging and Chaining.

EQUIPMENTS REQUIRED

Chain, Arrows, Tapes, Ranging Rods, Offset Rods, Cross staff or optical square, Plumb bob, wooden mallet, pegs.

INSTRUCTIONS

Two men are required for chaining operation; The chain man at the forward end of chain is called the leader while the other man at the rear end is known as the follower. Duties of leader &follower

Leader:-
1) To put the chain forward
2) To fix arrows at the end of chain
3) To follow the instruction of the followers.

Follower:-
1) To direct the leader to the line with the ranging rod.
2) To carry the rear end of the chain.
3) To pick up the arrows inserted by the leader.

Chaining
1) The follower holds the zero handle of the chain against the peg &directs the leader to be in line of the ranging rod.
2) The leader usually with to arrows drags the chain alone the line.
3) Using code of signals the follower directs the leader as required to the exactly in the line.
4) The leader then fixes the arrows at the end of chain the process is repeated.

Ranging
1) Place ranging rods or poles vertically behind each point
2) Stand about 2m behind the ranging rod at the beginning of the line.
3) Direct the person to move the rod to right or left until the three ranging rods appear exactly in the straight line.
4) Sight only the lower portion of rod in order to avoid error in non-vertically.
5) After ascertaining that three rods are in a straight line, ask the person to fix up the rod.

RESULT

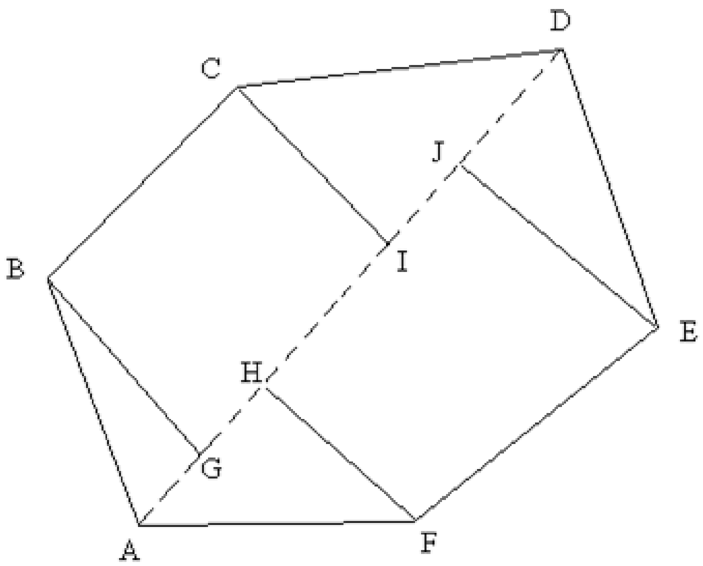
By Chaining and ranging the total distance is found to be_____________

Faculty Signature

25

EX.NO:4

CHAIN TRAVERSING



Survey of an Open Field (Closed Traverse)

S.NO	Figure	Chainage in (meter)	Base in (meter)	Offset in (meter)	Area in sq.meter	Remarks
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

EX.NO:4 **CHAIN TRAVERSING**

DATE:

OBJECTIVE

To survey an open field by chain survey in order to calculate the area of the open field.

EQUIPMENTS REQUIRED

Chain, Tape, Ranging Rods, Arrows, Cross Staff.

INSTRUCTIONS

1. ABCDEF is the required closed traverse open field to be surveyed for calculating the area as shown in Fig .
2. From the station A the length of all the opposite corners such as AC, AD and AE are measured with a chain and the longest distance is considered for laying off the main chain line. In this case AD is the longest and a chain line running from A to D is laid.
3. Offsets to corner points B, C, E and F are now laid from the chain line AD either by tape or cross-staff and their foot of offsets are G, I, J, H respectively.
4. All the offset lengths GB, HF, IC and JE are measured either by chain or tape depending on the length of offsets.
5. The distances between all the points AG, GH, HI, IJ and JD are also measured along the chain line.
6. Area Calculations: ***(Note: Areas of all triangles and trapeziums are calculated and added together to calculate the total area of open field (Closed Traverse) as described in class).***

FORMULA

Area of the triangle Δ = $\sqrt{S\,(S-a)\,(S-b)(S-c)}$

S= { (a+b+c) / 2 }

RESULT

The enclosed area is ____________________ Acres.

Faculty Signature

25

EX.NO:5 **PLANE TABLE SURVEYING**

DATE:

INTRODUCTION

In plane table surveying, a plane table is used for taking the measurements and for plotting the plan in the field. A plane table consists of a drawing board mounted on a tripod. Plane table surveying is a method in which the field observations and plotting of the plan proceed simultaneously. Thus the plan is plotted as the survey progresses. It is unlike other methods of surveying, such as compass surveying and chain surveying, in which the plan is plotted in the office after taking the measurements in the field.

The main feature of plane table surveying is that the plotting is done in the field where all the stations and other features are in the view of the surveyor, and he can compare the plan and plotted details with actual features on the ground. Thus, the mistakes are easily detected.

1) EQUIPMENT AND ACCESSORIES:

The following instruments are used in plane table survey

- The plane table with levelling head having arrangements for *(a)* levelling, *(b)* rotation about vertical axis, and *(c)* clamping in any required position.
- Alidade for sighting
- Plumbing fork and plumb bob.
- Spirit level.
- Compass.
- Drawing paper with a rainproof cover.

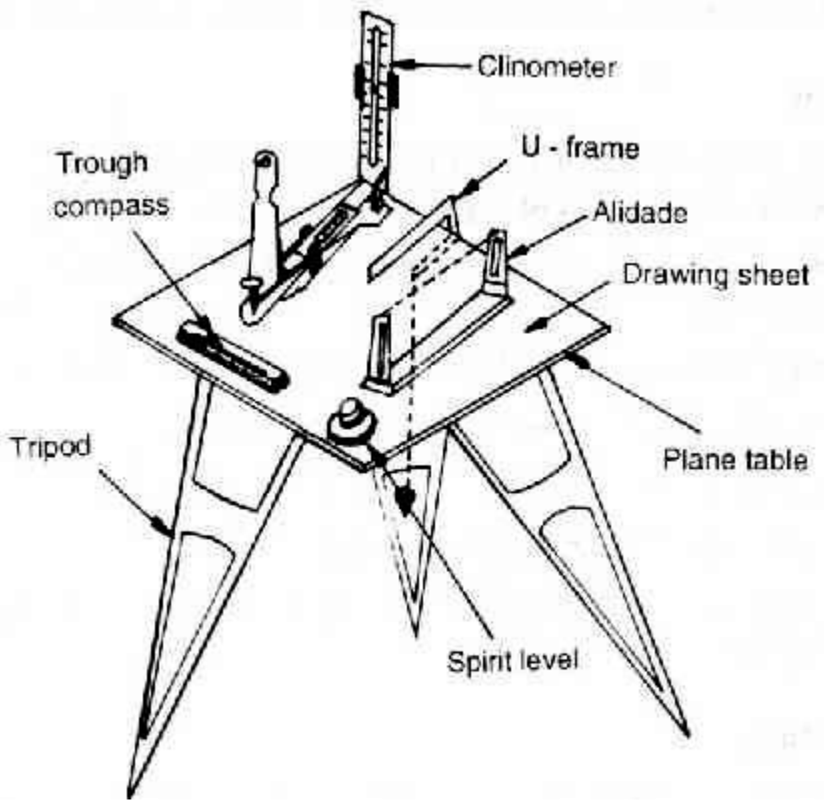


Fig.5.1 Plane table and its accessories

The Plane Table

Three distinct types of tables (board and tripod) having devices for levelling the plane table and controlling its orientation are in common use

(i) The *Traverse* Table, *(ii)* The *Johnson* Table and *(iii)* The *Coast Survey* Table.

The Traverse Table:

The traverse table consists of a small drawing board mounted on a light tripod in such a way that the board can be rotated about the vertical axis and can be clamped in any position. The table is levelled by adjusting tripod legs, usually by eye-estimation.

Johnson Table:

This consists of a drawing board usually 45 x 60 cm or 60 x 75 cm. The head consists of a ball-and-socket joint and a vertical spindle with two thumb screws on the underside. The ball-and-socket joint is operated by the upper thumb screw. When the upper screw is free, the table may be tilted about the ball-and-socket for levelling. The clamp is then tightened to fix the board in a horizontal position. When the lower screw is loosened, the table may be rotated about the vertical axis and can thus be oriented.

The Coast Survey Table:

This table is superior to the above, two types, and is generally used for work of high precision. The levelling of the table is done very accurately with the help of the three foot screws. The table can be turned about the vertical axis and can be fixed in any direction very accurately with the help of a clamp and tangent screw.

Alidade

A plane table alidade is a straight edge with some form of sighting device. Two types are used :

(i) Plain alidade and (ii) telescopic alidade.

Plain Alidade:

It is generally consist of a metal or wooden rule with two vanes at the ends. The two vanes or sights are hinged to fold down on the rule when the alidade is not in use. One of the vanes is provided with a narrow slit while the other is open and carries a hair or thin wire. Both the slits thus provide a definite line of sight which can be made to pass through the object to be sighted. The alidade can be rotated about the point representing the instrument station on the sheet so that the line of sight passes through the object to be sighted. A line is then drawn against the working edge (known as the *fiducial edge)* of the alidade.

Telescopic Alidade:

The telescopic alidade is used when it is required to take inclined sights. Also the accuracy and range of sights are increased by its use. It essentially consists of a small telescope with a level tube and graduated arc mounted on horizontal axis.

Plumbing Fork

The plumbing fork, used in large scale work, is meant for centering the table over the point or station occupied by the plane table when the plotted position of that point is already known on the sheet. Also, in the beginning of the work, it is meant for transferring the ground point on to the sheet so that the plotted point and the ground station are in the same vertical line.

The fork consists of a hair pin-shaped light metal frame having arms of equal length, in which a plumb-bob is suspended from the end of the lower-arm. The fitting can be placed with the upper arm lying on the top of the table and the lower arm below it, the table being centered when the plumb-bob hangs freely over the ground mark and the pointed end of the upper arm coincides with the equivalent point on the plan.

Spirit Level

A small spirit level may be used for ascertaining if the table is properly level. The level may be either of the tubular variety or of the circular type, essentially with a flat base so that it can be laid on. The table and is truly level when the bubble is central. The table is levelled by placing the level on the board in two positions at right angles and getting the bubble central in both positions.

Compass

The compass is used for orienting the plane table to magnetic north. The compass used with a plane table is a trough compass in which the longer sides of the trough are parallel and flat so that either side can be used as a ruler or laid down to coincide with a straight line drawn on the paper.

Drawing Paper

The drawing paper used for plane tabling must be of superior quality so that it may have minimum effect of changes in the humidity of the atmosphere. The changes in the humidity of the atmosphere produce expansion and contraction in different directions and thus alter the scale and distort the map. To overcome this difficulty, sometimes two sheets are mounted with their grains at right angles and with a sheet of muslin between them. Single sheet must be seasoned previous of the use by exposing it alternatively to a damp and a dry atmosphere. For work of high precision, fiber glass sheets or paper backed with sheet aluminum are often used.

The other equipment and accessories used are chain, tape, ranging rods, pegs and hammer.

2) TERMINOLOGY:

Radiation

In this method the instrument is setup at a station and rays are drawn to various stations which are to be plotted. The distances are cut to a suitable scale after actual linear measurements on the ground are taken.

Traversing

In this method the table is set at each of the stations in succession. A foresight is taken to the next station and the distance is cut to a suitably chosen scale.

Intersection

In this method two stations are so selected that all the other stations to be plotted are visible from these. The line joining these two stations is called *base line.* The length of this line is measured very accurately. Rays are drawn from these stations to the stations to be plotted. The intersection of the rays from the two stations gives the positions of the stations to be plotted on the drawing sheet. Sometimes, this method is also termed as *graphical triangulation*.

Resection

It is a method of orientation employed when the table occupies a position not yet located on the drawing sheet. Therefore, it can be defined as the process of locating the instrument station occupied by the plane table by drawing rays from the stations whose positions have already been plotted on the drawing sheet. The resection of two rays will be the point repre- senting the station to be located, provided the orientation at the station to be plotted is correct, which is seldom achieved. The problem can be solved by any of the methods such as resection after orientation by back ray, by two points, or by three points.

3) TEMPORARY ADUSTMENTS:

Three *operations* are needed

Fixing

Fixing the table to the tripod.

Setting

(i) Levelling the table *(ii)* Centering *(iii)* Orientation.

Levelling

For small-scale work, levelling is done by estimation. For work of accuracy, an ordinary spirit level may be used. The table is levelled by placing the level on the board in two positions at right angles and getting the bubble central in both directions. For more precise work, a Johnson Table or Coast Survey Table may be used.

Centering

The table should be so placed over the station on the ground that the point plotted on the sheet corresponding to the station occupied should be exactly over the station on the ground. The operation is known as *centering* the plane table. As already described this is done by using a plumbing fork.

Orientation

Orientation is the process of putting the, plane-table into some fixed direction so that line representing a certain direction on the plan is parallel to that direction on the ground. *This is essential, condition to be fulfilled when more than one instrument station is to be used.* If orientation is not done, the table will not be parallel to itself at different positions RESULTing in an overall distortion of the map. The processes of centering and orientation are dependent on each other. For orientation, the table will have to be rotated about its vertical axis, thus disturbing the centering. If precise work requires that the plotted point should be exactly over the ground point, repeated orientation and shifting of the whole table are necessary.

There are two main methods of orienting the plane table:

(i) Orientation by means of trough compass.

(ii) Orientation by means of back sighting.

Sighting the points

Points are sighted using alidade

4) ERRORS IN PLANE TABLING:

The degree of precision to be attained in plane tabling depends upon the character of the survey, the quality of the instrument, the system adopted and upon the degree to which accuracy is deliberately sacrificed for speed. The various sources of errors may be classified as:

1. **Instrumental Errors:** Errors due to bad quality of the instrument.
2. Errors due to manipulation and sighting: These include

a) Non-horizontality of board: The effect of non-horizontality of board is more severe when the difference in elevation between the points sighted is more.

b) Defective sighting: The accuracy of plane table mapping depends largely upon the precision with which points are sighted. The plain alidade with open sight is much inferior to the telescopic alidade in the definition of the line of sight.

c) Defective orientation: Orientation done with compass is unreliable, as there is every possibility of local attraction. Erroneous orientation contribute towards distortion of the survey. This orientation should be checked at as many stations as possible by sighting distant prominent objects already plotted.

d) Movement of board between sights: Due to carelessness of the observer, the table may be disturbed between any two sights RESULTing in the disturbance of orientation. To reduce the possibility of such movement the clamp should be firmly applied. It is always advisable to check the orientation at the end of the observation from a station.

e) It is very essential to have a proper conception of the extent of error introduced by inaccurate centring, as it avoids unnecessary waste of time in setting up the table by repeated trials.

5) PRECAUTIONS:

In every fieldwork exercise relevant precautions have to be taken to minimize the errors that are mentioned in the previous paragraphs.

6) APPLICATIONS:

Maps can be produced directly with the plane table with complete networks of control points fixed with it and the whole of the detail filled in. This method can be used for the filling in of detail or the revision of plans when the control points have already been fixed by traversing or triangulation. This method can also be used for location of contour-lines.

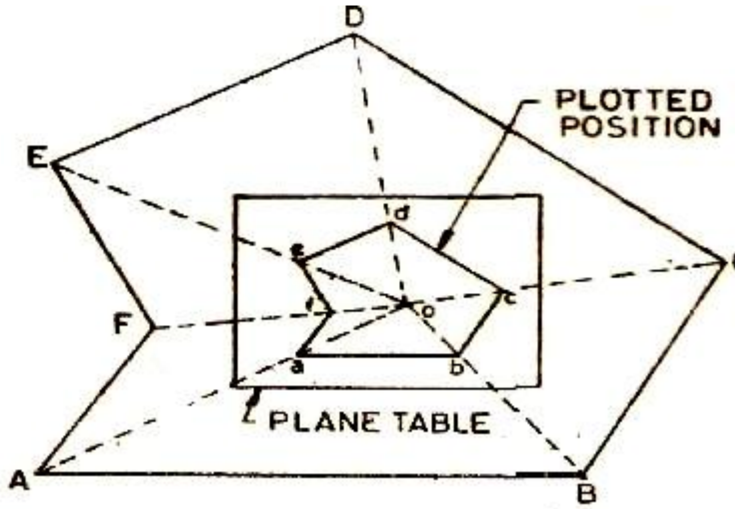
RESULT:

Thus the study about the Temporary and Permanent adjustments of a Plane Table Surveying is practiced.

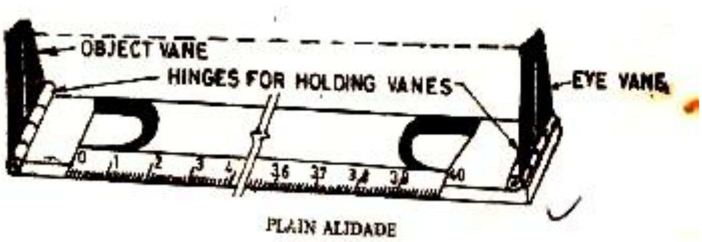
25

Faculty Signature

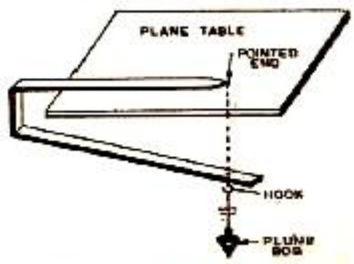
EX.NO:6 **RADIATION METHOD BY USING PLANE TABLE SURVEY**



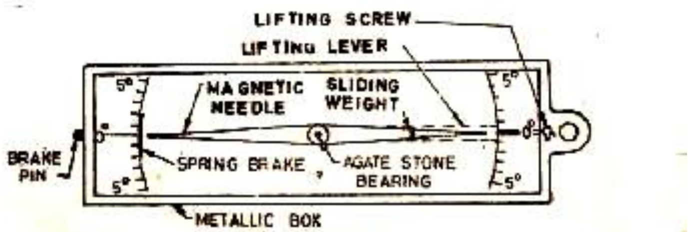
RADIATION METHOD



PLAIN ALIDADE



PLUMBING FORK
Fig. 4.3



TROUGH COMPASS

EX.NO:6 **RADIATION METHOD BY USING PLANE TABLE SURVEY**

DATE:

OBJECTIVE

To determine the enclosed area radiation method by using plane table survey.

EQUIPMENTS REQUIRED

1) The Plane table with tripod, 2) Alidade, 3) Trough compass, 4) Sprit level

5) Plumbing fork or U-frame, 6) Plumb bob, 7) Tape, chain, pegs, ranging rods, wooden mallet etc.

INSTRUCTIONS

Radiation Method:-

When from a single set of plane table on instrument station different details are located on the sheet, the method is known as radiation method

1. Select the position of the table where it is be set so that all the points to be located are visible from it. Let 'O' be the position of such a point on the ground.
2. Set the plane table over this point and level it. Draw the North line in the top corner of sheet by means of trough compass at the table.
3. Now transfer the position of the point 'O' on the ground to the sheet by means of the a plumbing fork. The point 'O' will represent point 'o' will represent point 'O'on the ground.
4. With the alidade touching the point 'o' (may be represented by fixing a pin), sight the point A in the field. Draw the ray along the fiducially edge. Measure the distance of this point from the instrument station by means of tape and plot the point 'a' corresponding to point 'A' in the field to scale in the sheet.
5. Similarly sight other points such as B,C,D,E etc. and measure their distances from the instrument station. Plot them to scale to get their position on the sheet such as b,c,d etc. on the sheet.

FORMULA

Area of the triangle Δ = $\sqrt{S(S-a)(S-b)(S-c)}$ S= { (a+b+c) / 2 }

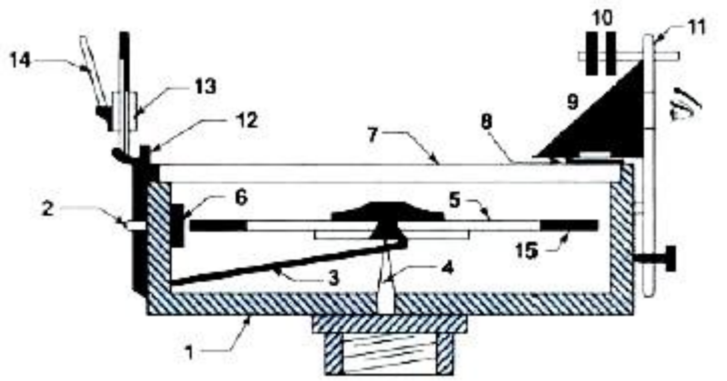
RESULT

The enclosed area is ____________________ Acres.

25

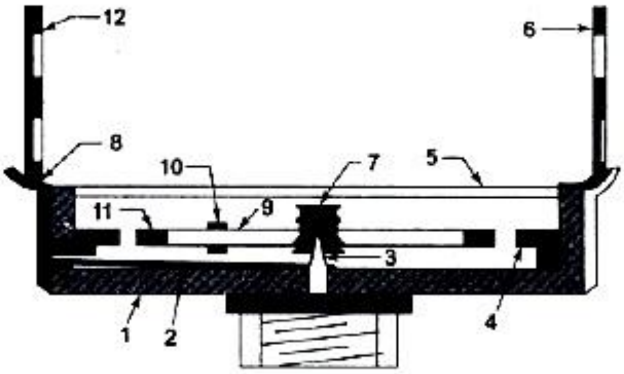
Faculty Signature

EX.NO:7 **COMPASS SURVEYING**



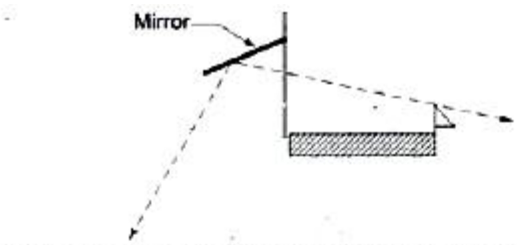
1. Box 2. Brake pin 3. Lifting lever 4. Pivot
5. Needle 6. Spring 7. Glass cover 8. Prism cap
9. Prism 10. Sun glass 11. Eye vane 12. Lifting pin
13. Object vane 14. Mirror 15. Graduated ring

Fig. 3.2 Prismatic compass

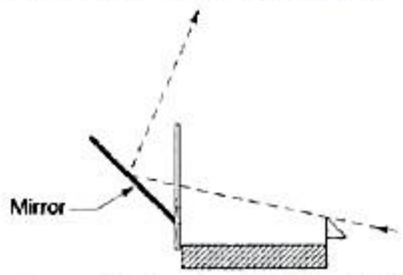


1. Box 2. Lifting lever 3. Pivot
4. Circular graduated arc 5. Glass top 6. Sight vane
7. Jewel bearing 8. Lifting pin 9. Magnetic needle
10. Rider 11. Metal pin 12. Object vane

Fig. 3.4 Surveyor compass



Mirror lowered downwards for bearings of objects in depressions



Mirror raised upwards for bearings of objects at higher altitudes

Fig. 3.3 Use of sliding mirror

EX.NO:7 **COMPASS SURVEYING**

DATE: **INTRODUCTION**

If two lines are required to be plotted in chain surveying, the third line to form the triangle must also be measured. However, if the bearings of the two lines are known they can be plotted by scaling the angle they make with a reference direction without the need for making further linear measurements.

By setting up a compass at the intersection of the lines and by observing their magnetic bearings their directions may be plotted. This process may be extended through successive lines, forming a compass traverse, which enables a complete network of survey lines to be plotted without the need for a base line or check lines.

If the series of lines closes back on to the starting point, the work may be checked because the plotted figure must also close back on to its starting point.

Compass surveys are mainly used for rapid filling in of detail in larger surveys and for exploratory work and not for accurate, large-scale plans. Compasses do not provide a very accurate determination of the bearing of a line as the compass needle aligns itself to the earth's magnetic field, which does not provide a constant reference direction.

1) EQUIPMENT AND ACCESSORIES:

The magnetic compasses used in surveying may be classified as:

- Prismatic compass
- Surveyor's compass
- Trough compass
- Tubular compass

The general principle on which the compasses work is same for all types of compass. If a long and narrow magnetized iron or steel strip suspended on a pivot at its centre, is allowed to oscillate freely about its vertical axis passing through the pivot, it will always tend to assume a direction of the magnetic meridian at the place.

In our fieldwork exercises we will use the prismatic compass

Prismatic compass

It is the most suitable portable form of compass used for surveying. Main parts of a prismatic compass are shown in figure given previous page

A prismatic compass consists of a circular box of about 100 mm diameter. A magnetic needle is attached to a light circular aluminum ring balanced on a hard steel pointed pivot. The ring is graduated to degree and half degree with 0° mark at the south end of the needle and 180° mark at its north end. The graduations run clockwise, therefore, 90° mark is towards west and 270° mark is towards east as shown in figure.

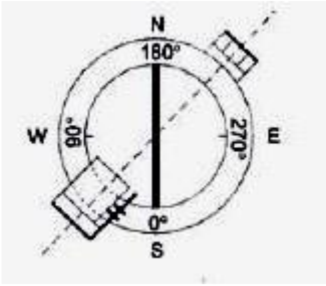
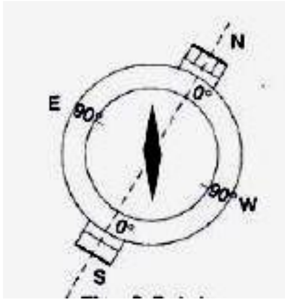


Fig.12 Graduations in prismatic compass



Graduations in Surveyor compass

The figures on the ring are written inverted. When these are read using a prism, they are erected and magnified. The object vane carries a vertical hair attached to a suitable frame. Sight vane or eye slit consists of a vertical slit cut into the upper assembly of the prism. The object vane and sight vane are hinged to the box, diagonally opposite at the top.

To sight an object, the sight vane is rotated with respect to N-S ends of the ring through an angle which the line makes with the magnetic meridian. The angle read is the whole-circle bearing of the line at the compass station. Brake pin may be used to dampen the oscillations of the needle by pressing it. The sun glasses provided at the eye vane may be used to sight the bright objects. When the instrument is not in use, the object vane frame may be folded on the glass lid. It automatically presses against a bent lever, which lifts the needle off the pivot and holds it against the glass lid.

The other equipment and accessories used in this type of surveying are tripod stand, chain, tape, ranging rods, pegs, plumb bob, hammer, field-book, pencils, eraser.

2) TERMINOLOGY:

Bearing

Bearing of a line is its direction relative to a given meridian. A meridian in any direction such as (1) True Meridian (2) Magnetic Meridian (3) Arbitrary Meridian

True Meridian

True meridian through a point i.e., the line in which a plane, passing that point and the north and south poles, intersects with surface of the earth. It thus, passes through the true north and south. The direction of true meridian through point can be established by astronomical observations.

True Bearing

True bearing of a line is the horizontal angle which it makes with l the true meridian through one of the extremities of the line. Since the direction of the meridian through a point remains fixed, the true bearing of a line is a constant quantity.

Magnetic Meridian

Magnetic meridian through a point is the direction shown by a freely floating and balanced magnetic needle free from all other attractive forces. The direction of magnetic meridian can be established with the help of a magnetic compass.

Magnetic Bearing

The magnetic bearing of a line is the horizontal angle which it makes with the magnetic meridian passing through one of the extremities of the line. A magnetic compass is used to measure, it.

Arbitrary Meridian

Arbitrary meridian is any convenient direction towards a permanent and prominent mark or signal, such as a church spire or top of a chimney. Such meridians are used to determine the relative positions of lines in a small area.

Arbitrary Bearing

Arbitrary bearing of a line is the horizontal angle which it makes with any arbitrary meridian passing through one of the extremities. A theodolite or sextant is used to measure it.

3) TEMPORARY ADJUSTMENTS:

Temporary adjustments are those adjustments which have to be made at every set up of the instrument. They comprise the following:

Centering

Centering is the process of keeping the instrument exactly over the station. Ordinary prismatic compass is not provided with fine centering device as is generally fitted to engineer's theodolite. The centering is invariably done by adjusting or manipulating the legs of the tripod. A plumb-bob may be used to judge the centering and if it is not available, it may be judged by dropping a pebble from the centre of the bottom of the instrument.

Levelling

If the instrument is a hand instrument, it must be held in hand in such a way that graduated disc is swinging freely and appears to be level as judged from the top edge of the case. Generally, a tripod is provided with ball and socket arrangement with the help of which the top of the box can be levelled.

Focusing the Prism

The prism attachment is slide up or down for focusing till the readings are seen to be sharp and clear.

4) ERRORS IN COMPASS SURVEY:

The error may be classified as:

a) Instrumental errors
b) Personal errors
c) Errors due to natural causes

Instrumental error

These errors arise due to the faulty adjustments of the instruments. They may be due to the following reasons.

1) The needle not being perfectly straight.
2) Pivot being bent.
3) Sluggish needle.
4) Blunt pivot point.
5) Improper balancing weight
6) Plane of sight not being vertical

Personal errors

These errors arise due to the following reasons

1) Inaccurate Levelling of the compass box.
2) Inaccurate centering.
3) Inaccurate bisection of target.
4) Carelessness in reading and recording.

Natural errors

These errors arise due to the following reasons

1) Variation in declination.
2) Local attraction due to proximity of local attraction forces.
3) Magnetic changes in the atmosphere due to clouds and storms.
4) Irregular variations due to magnetic storms etc.

5) Precautions:

In every fieldwork exercise relevant precautions have to be taken to minimize the errors that are mentioned in the previous paragraphs.

6) APPLICATIONS

Compass surveys are mainly used for rapid filling in of detail in larger surveys and for exploratory work. It is also used for tracing of streams and plotting irregular shore lines.

RESULT:

Thus the study about the Temporary and Permanent adjustments of a Compass Survey is practiced.

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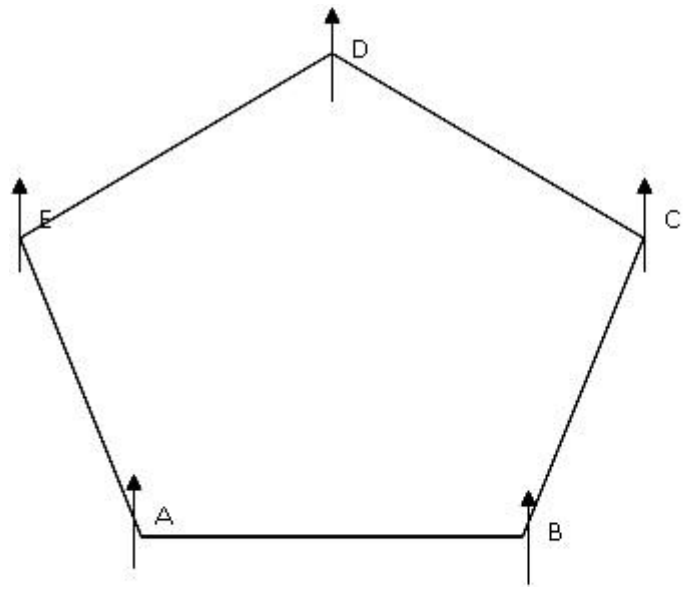
Faculty Signature

EX.NO:8 **MEASURING THE AREA OF A PLOT BY COMPASS**

(CLOSED TRAVERSE)



OBSERVATION :

Line	Distance in m	F.B.	B.B.	F.B. ~ B.B.	Local attraction
AB					
BC					
CD					
DE					
EA					

EX.NO:8 **MEASURING THE AREA OF A PLOT BY COMPASS**

DATE: **(CLOSED TRAVERSE)**

OBJECTIVE

To find the area of the given plot by traversing.

EQUIPMENTS REQUIRED

30m chain, prismatic compass with tripod stand, ranging rods and arrows.

INSTRUCTIONS

1. The boundary of the area was marked by fixing the ranging rods at the vertices.
2. The prismatic compass was mounted on a tripod and the whole setup was centered on the station **A**.
3. The compass was carefully adjusted so that it assumed a horizontal position.
4. The slit of the prism was focused towards the point **B**, properly bisected and the bearing of the line **AB** was noted as forebearing of the line **AB.**
5. Similarly the slit line was then focused towards the point E and bearing of the line **AE** was noted as back bearing of the line **AE**
6. The compass was then transferred to the point B and the PROCEDURE was repeated.
7. Using the 30m chains the length of the traverse lines **AB, BC, CD, DE**, and **EA** were measured.
8. Thus the closed traverse was conducted and plotted.
9. The included angles were found out and closing error was calculated.
10. The traverse was drawn in proper scale and then the closing error was eliminated using **Bowditch rule.**
11. ***The whole area was split into triangles. The area of a single triangle was calculated first and then added to get the area of the whole plot.***

RESULT

Area of the given Plot = ____________ Sq.m

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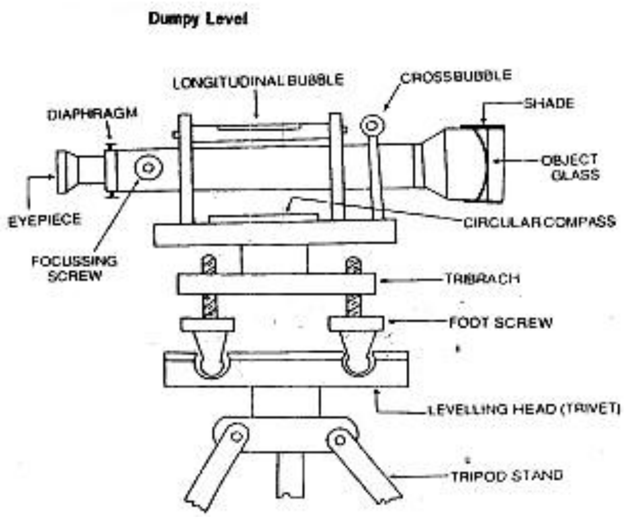
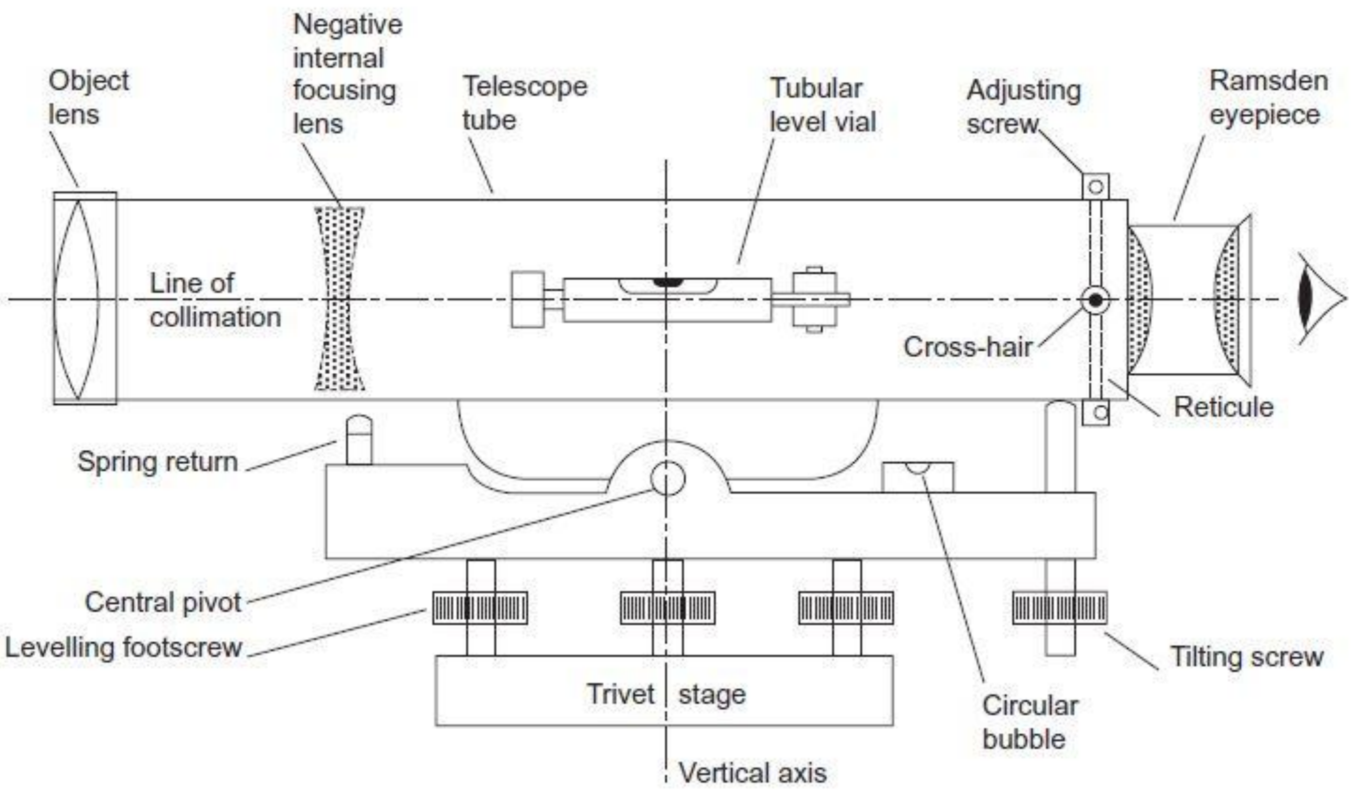
Faculty Signature

EX.NO:9 **LEVELLING**

INTRODUCTION





Tilting level

EX.NO:9 **LEVELLING**

DATE: **INTRODUCTION**

Levelling is a method of surveying used for determination of the difference of elevations or levels of various points on the surface of the earth. The elevation of a point is its' vertical distance above or below a reference level, called datum. The most commonly used datum is the mean sea level (M.S.L.). The levelling deals with distances in a vertical plane.

Levelling is an important method of surveying for many engineering works and construction projects. Levelling is required to determine the undulations of the earth's surface for topographic mapping. Levelling is needed for the design of highways, railways, canals, sewers, etc., and for locating the gradient lines. Levelling is essential for the layout of construction projects, for locating the excavation levels, and for the control of various elevations in buildings, bridges, dams, etc.

The drainage characteristics of the area can be obtained by levelling, The RESULTs of the levelling can be used to determine the catchment area, volume of the reservoir and the area submerged by a reservoir. The RESULTs of levelling can also be used to determine the volume of earthwork for roads, railways, etc.

Levelling is required in almost all engineering work of importance in one form or the other.

1) EQUIPMENT AND ACCESSORIES:

The instrument used in levelling is level. Its basic purpose is to establish a horizontal line of sight. It consists essentially of the following parts:

- a telescope which provides a line of sight.
- a level tube for making the line of sight horizontal.
- a levelling head for bringing the bubble of the level tube at the centre of its run.
- a tripod for providing support to the level.

Of the various types of levels the following are the most common:

1) Dumpy level
2) Tilting level
3) Automatic level

Now a days automatic level is the most widely used Levelling instrument.

Dumpy level

The dumpy level shown in figure consists of a telescope, generally the internal focussing type, fixed on a vertical spindle. The telescope tube and the vertical spindle are cast as one piece. The spindle revolves in the socket of the levelling head. The levelling head consists of two parallel plates held apart by three (or four) levelling screws. The upper plate is called tribrach and the lower one is called trivet stage. The telescope can be rotated in the horizontal plane about its vertical axis.

A sensitive level tube is fitted on the top of the telescope or on its side. An inclined mirror is attached to the level tube to enable the observer to view the bubble from the eye end of the telescope without moving round the instrument. The cross hairs of the diaphragm normally have a vertical line and a horizontal line. When instrument is in adjustment, the line of sight of the instrument is perpendicular to the vertical and parallel to the bubble tube axis as shown in figure.

The modern dumpy levels are provided with a clamp for clamping the telescope to the tribrach in any desired position. Also a graduated horizontal circle is provided to determine the direction of the telescope. The dumpy level is simple in construction and requires fewer permanent adjustments.

Tilting level

The telescope of a tilting level is not rigidly fixed to the vertical spindle as in the case of dumpy level. The telescope can be tilted on a pivot about a horizontal axis in the vertical plane upwards or downward through a small angle by means of a tilting screw as shown in figure.

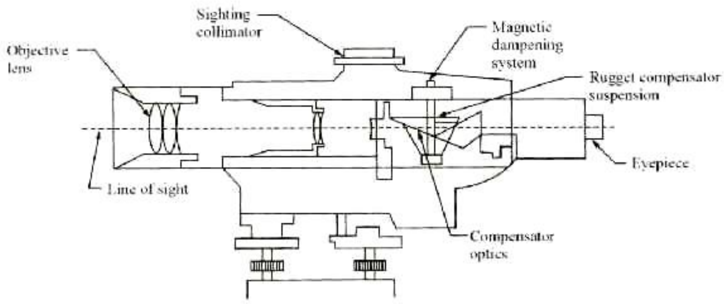
The bull's eye or circular level is fixed to the upper plate of levelling head for approximate levelling by foot screws. The exact levelling of the instrument is done using the tilting screw before taking every reading. The tilting screw is usually graduated to set out gradient lines.

Tilting levels are more robust, compact and accurate than dumpy levels. These have shorter telescope and are lighter. The tilting arrangement saves time required for temporary adjustments. A tilting level is most useful when only a few readings are to be taken from one setting of the instrument.

Automatic level

The automatic level employs a gravity referenced prism or mirror compensator to automatically orient the line of sight (line of collimation). The instrument is quickly levelled when a circular spirit level is used. When the bubble has been centered or nearly so, the compensator takes over and maintains the horizontal line of sight, even if the telescope is slightly tilted.

Automatic levels are extremely popular in present-day surveying operations. They are quick to set up, easy to use, and can be obtained for use at almost any required precision.



Section through Automatic level

Automatic Level

Levelling Staff

Staffs used for levelling work are sectional and are assembled either telescopically or by slotting onto one another vertically. Most modern designs are manufactured in an aluminum alloy. Staff lengths are either 3m, 4 m or 5 m on extension. The graduations are 10 mm deep spaced at 10 mm intervals, the lower three graduations in each 100 mm interval being connected by a vertical band to form an E shape, natural or reversed. The 50 mm or 100 mm intervals are therefore located by these shapes. The graduations of the first meter length are colored black on a white background, with the next meter length showing red graduations and so on alternately.

2) TERMINOLOGY:

Level Surface

A surface parallel to the mean spherical surface of the earth is called level surface, e.g., a still lake. A level surface is a curved surface, every point on which is equidistant from the centre of the earth. It is normal to the plumb line at all the points.

Vertical line

It is a line from any point on the earth's surface to the centre of the earth. It is commonly considered to be the line defined by a plumb line.

Levelline

It is a line lying on a level surface. It is normal to the plumb line at all the points.

Horizontal plane

It is a plane tangential to the level surface at the point under consideration. It is perpendicular to the plumb line.

Horizontal line

It is a line lying in the horizontal plane. It is a straight line tangential to the level line.

Axis of telescope

It is a line joining the optical centre of the objective to the centre of the eyepiece.

Line of collimation

It is a line joining the intersection of the cross-hairs to the optical centre of the objective and its continuation. It is also called the line of sight.

Axis of level tube or bubble tube

It is an imaginary line tangential to the longitudinal curve of the tube at its mid-point.

Height of instrument (H.I.)

It is the elevation of the plane of collimation when the instrument is leveled. It should be noted that the height of instrument does not mean the height of the centre of the telescope above the ground, where the level is set up.

Back sight (B.S.)

It is a staff reading taken on a point of known elevation, e.g., a sight on a bench mark or on a change point. It is the first staff reading taken after the level is set up. It is also called plus sight.

Fore sight (F.S.)

It is a staff reading taken on a point whose elevation is to be determined, e.g., a sight on a change point. It is also cal!ed a minus sight. It is the last staff reading and denotes the shifting of the instrument.

Intermediate sight (I.S)

It is a staff reading taken on a point of unknown elevation between backsight and foresight.

Change point (C.P.) or turning point (T.P.)

It is a point, denoting the shifting of the level. Both F.S. and B.S. are taken on this point.

Station

A point, whose elevation is to be determined is called station.

Parallax

It is the apparent movement of the image relative to the cross-hairs when the image formed by the objective does not fall in the plane of the diaphragm.

Bench Mark

It is a fixed reference point of known elevation. Depending upon the permanency and precision, bench marks may be of the following types:

Great trigonometric survey (G. T.S.) bench marks (B.M.)

These are established by the Survey of India at an interval of about of 100 km all over the country with respect to the mean sea level at Karachi as datum. Their elevations are shown on a G.T.S. map.

Permanent bench marks

These are established between the G.T.S. bench marks by the government agencies like P.W.D. on clearly defined and permanent points such as the top of a parapet wall of a bridge or culvert, kilometer stone, railway platform etc.

Arbitrary bench marks

These are reference points whose elevations are arbitrarily assumed for small levelling operations. Their elevations do not refer to any fixed datum.

Temporary bench marks

These are the reference points on which a day's work is closed and from where levelling is continued the next day. Such a B.M. is carefully established on permanent objects like km stones, parapets, etc.

3) TEMPORARY ADJUSTMENTS:

These consist of setting up, levelling, and elimination of parallax.

Setting Up

Since the level is not to be set at any fixed point. the setting up of a level is much simple as compared to other instruments. While locating the level the ground point should be so chosen that

(a) the instrument is not too low or too high to facilitate reading on a bench mark

(b) the length of the backsight should preferably not be more than 98.0 m

(c) the backsight distance and foresight distance should be equal, and the foresight should be so located that it advances the line of levels. Setting up includes fixing the instrument and approximate levelling by leg adjustment.

Fixing the instrument over tripod

The clamp screw of the instrument is released. The level is held in the right hand. It is fixed on the tripod by turning round the lower part with the left hand and is firmly screwed over the tripod.

Leg adjustment

The instrument is placed at a convenient height with the tripod legs spread well apart and so adjusted that the tripod head is as nearly horizontal as can be judged by the eye.

Levelling Up

1. The telescope is held parallel to two foot screws, the two foot screws are turned uniformly towards each other or away from each other until the circular bubble is central.
2. Turn the telescope through 90° and bring the circular bubble in centre by turning the third foot screw.
3. Now the circular bubble should be central for any orientation of telescope.

Elimination of Parallax

Focusing the eyepiece

This operation is done to make the cross-hairs appear distinct and clearly visible. The following steps are involved:

1. The telescope is directed skywards or a sheet of white paper is held in front of the objective.
2. The eyepiece is moved in or out till the cross-hairs appear distinct.

Focusing the objective

This operation is done to bring the image of the object in the plane of the cross-hairs. The following steps are involved:

1. The telescope is directed towards the staff.
2. The focusing screw is turned until the image appears clear and sharp.

4) ERRORS IN LEVELLING:

There are five sources of error in ordinary Levelling.

a) Instrumental errors

b) Errors in handling the instruments

c) Errors due to displacement of equipment

d) Errors in reading and booking

e) Errors due to natural clauses

Instrumental errors

1) The line of sight should be horizontal. If it is not the error is proportional to the length of the line of sight.
2) The bubble may be unstable.
3) The level must be stable. Examine the tripod for any looseness in the joints or damage to the screw threads caused by over tightening.
4) Staff graduations may be in error or the staff may not be properly extended.

Errors in handling the instruments

1) Ensure the bubble is always centered.
2) The staff should be held vertically or readings will be too great.

Errors due to displacement of the equipment

1) Set up the instrument on stable ground. On soft ground the instrument may settle and alter the

height of line of collimation.

2) Change points must be chosen so that when turning the staff round or when replacing it after removal no alteration of height take place.

3) Never move the staff until a backsight has been taken. Never move the level until a foresight has been taken.

Errors in reading and booking

1) Reading against a stadia hair instead of the horizontal cross hair.

2) Concentrating on the decimal reading and noting the metres wrongly.

3) Omitting a zero for example recording 3.09 instead of 3.009

4) Entering a reading in the wrong column.

5) Forgetting to book an entry.

6) Noting a reading with the numbers interchanged for example 1.501 instead of 1.105.

7) Noting a wrong distance or point description in the remarks column.

Errors due to natural causes

1) Errors arise due to curvature of the earth's surface and atmospheric refraction. For sights up to 272.5 m this error is 0.005 m which is the usual least count of the staff being used. Therefore, sights longer than 272.5 m should be avoided. However for precise work sights longer than 98 m are not permitted. The error can be eliminated by equalizing B.S and F.S distances.

2) The wind causes vibration of the level, tripod and the staff and can make accurate sighting impossible.

3) The sun can cause an apparent vibration of the staff owing to irregular refraction. Sighting is difficult when sun shines into object glass.

5) PRECAUTIONS:

In every fieldwork exercise relevant precautions have to be taken to minimize the errors that are mentioned in the previous paragraphs.

6) APPLICATIONS

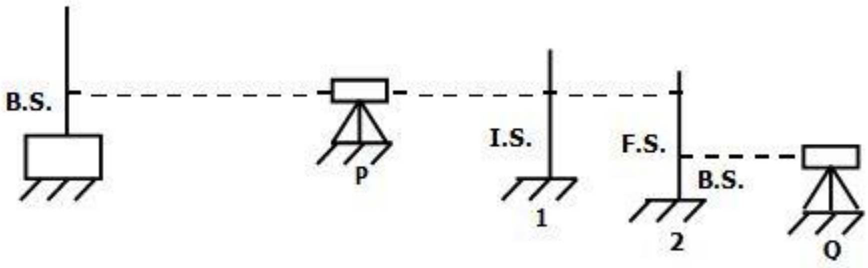
Apart from the general problem of determining the difference in level between two points, the main application of Levelling are: taking longitudinal sections, cross-sections, contouring and setting out levels.

RESULT

Thus the study about the Temporary and Permanent adjustments of a Levelling instrument is practiced.

Faculty signature

EX.NO:10 **FLY LEVELLING**



Fly levelling

Observations and Calculations:

TABLE - Height of Instrument Method

S. No.	Station	Sight to	B.S. (m)	I.S. (m)	F.S. (m)	H.I. (m)	R.L. (m)	Remarks

TABLE - Rise and Fall Method :

S. No.	Station	Sight to	B.S. (m)	I.S. (m)	F.S. (m)	Rise (m)	Fall (m)	R.L. (m)	Remarks

a) Height of Instrument Method:

Height of Instrument (H.I.) = R.L. of A.B.M. + B.S.
R.L. of a station = H.I. – I.S. or F.S.
Height of Instrument at C.P. (H.I.) = R.L. of C.P. + B.S.
R.L. of a station = R.L. of C.P. – I.S. or F.S.
CHECK : Sum of B.S. – Sum of F.S. = First R.L. – Last R.L.

b) Rise and Fall Method:

If the difference of successive observations is +ve, it indicates fall, otherwise it indicate rise

R.L. of a station = R.L. of B.M. + Rise or (– Fall)
CHECK : Sum of B.S. – Sum of F.S. = Sum of Rise – Sum of Fall
= First R.L. – Last R.L.

EX.NO:10 **FLY LEVELLING**

DATE:

OBJECTIVE

To find the reduced levels of the given stations by differential levelling.

EQUIPMENT AND ACCESSORIES

Automatic Level/ Dumpy Level, levelling staff, Levelling book, pencil and eraser.

PRINCIPLE

In order to find difference of level between two points on the ground, it is necessary to establish a level surface above the two points and measure the vertical distance from it to the points. The difference between these measurements will give the difference in level between the points. It is possible to get a horizontal surface from the line of sight of a telescope adjusted into the horizontal position. This is done by any Levelling instrument.

Therefore by setting up a Levelling instrument at a suitable location on the ground it is possible to obtain difference between levels of two points. Automatic level is a very convenient Levelling instrument. When the difference in level between two points cannot be obtained by one set-up of Levelling instrument, it is necessary to repeat the process. This process of using a series of several set-ups of Levelling instrument to find the level difference between two distantly placed points is called fly Levelling.

INSTRUCTIONS

1. Set-up the automatic level at point ‘P’ near to the Bench Mark (BM) (the R.L of BM is 100.000 m) as shown in figure and level the instrument.
2. Focus the telescope towards BM and bisect the staff correctly and take the back sight (BS) on it and record the reading in the Levelling book.
3. Keep the levelling staff at a convenient intermediate point(s) and take the intermediate sight (IS) and enter the reading.
4. Before shifting the instrument to the next station enter the last staff reading in the FS column.
5. Shift the instrument to the next station ‘Q’ and follow the steps from 3 to 4.
6. Calculate the Reduced levels by Height of Instrument Method and also by Rise and Fall Method which can be shown in Table 6 & 7 respectively.

RESULT

Thus the R.L. of a station = ____________________ m

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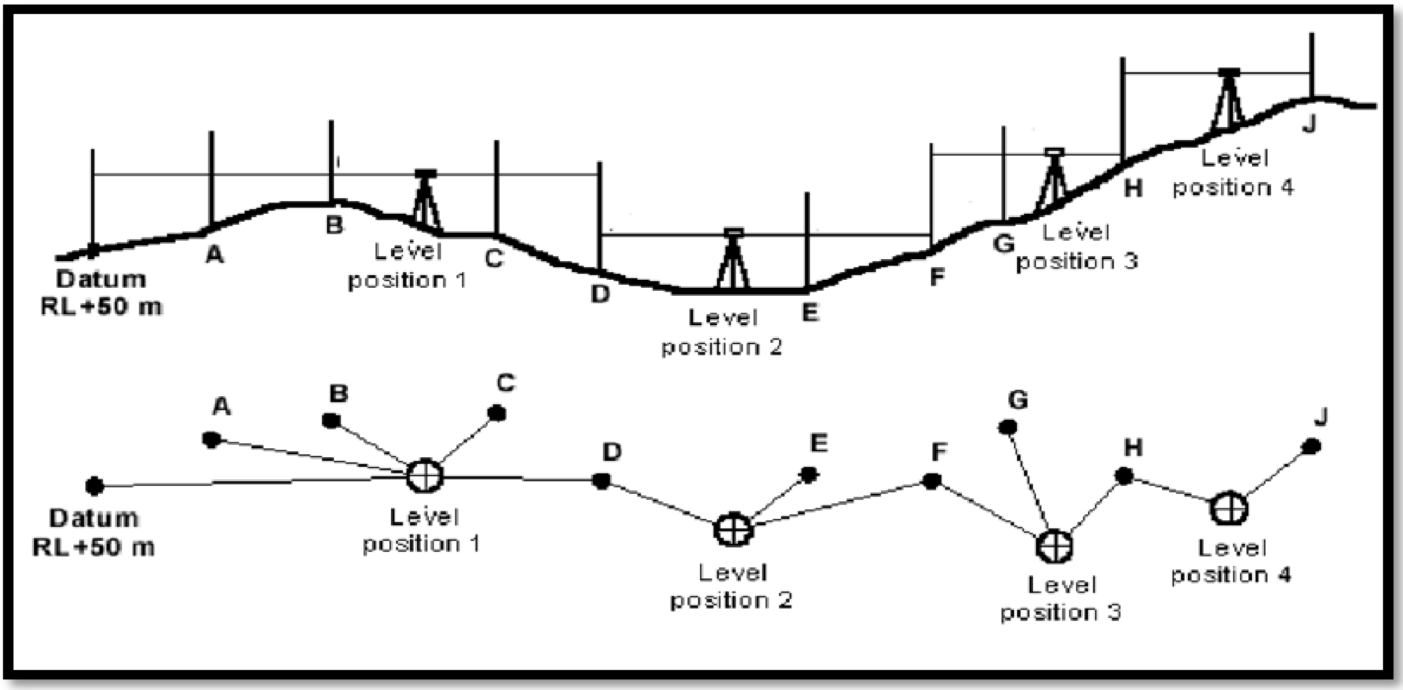
EX.NO:11 **CHECK LEVELLING**



Height of instrument method

Instrument at	Sight to	BS (m)	IS (m)	FS (m)	Height of instrument (m)	RL (m)	Remarks

Check : B.S – F.S = Last R.L – R.L of B.M

EX.NO:11 **CHECK LEVELLING**

DATE:

OBJECTIVE

To run check levels connecting the given points, reduce and check their levels.

Check leveling- Definition

It is the operation of running levels to check a series of levels, which are already taken. It is also done to accurately establish a B.M. near the site of work from a known B.M. check levels are carried out at the end of each days work, starting from the last to the first point. If the leveling work is correct, the R.L. of the first point assumed at the beginning will be equal to that obtained from the check levels.

Generally check leveling is done using a single leveling instrument with a single staff or two leveling instruments with a single staff.

EQUIPMENTS REQUIRED

1. A level with tripod
2. A leveling staff

FIELD WORK INSTRUCTIONS

The following is the procedure of levellling work in the field (refer fig)

1. Instrument level is setup at a convenient position near first point (say A).
2. Temporary adjustments should be done,(setting up, leveling up, elimination of a parallax) are performed.
3. First sight of B.M (point of known elevation) is taken and reading is entered in back Sight column.
4. Intermediate sight column.
5. If distance is large instrument is shifted, the instrument becomes turning point (or) changing point.
6. After setting up instrument at new position, performing temporary adjustment and Take back sight as turning point.
7. Thus turning point will have both back sight and fore sight readings.
8. Link wise the process is repeated till last point (say B) is reached.
9. The above procedure is shown in fig. Readings are entered in a tabular form is given below and Reduced levels are calculate either by height of instrument method (or) Rise and fall method.

RESULT:

Thus the reduced levels of the given points are determined and they are checked by Check levelling.

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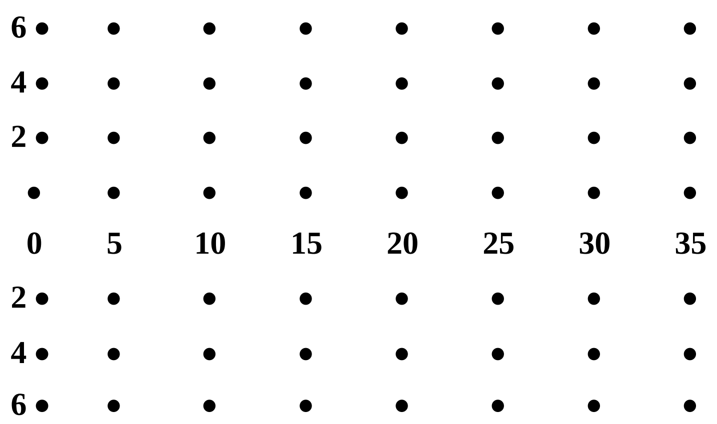
EX.NO:12 **LONGITUDINAL – SECTIONING AND CROSS SECTIONING**

(L.S AND C.S) FOR ROAD ALIGNMENT



Longitudinal and cross sectioning

Observations and Calculations:

TABLE

S.No.	Chainage of centre line	Chainage Left C.S.	Chainage Right C.S.	B.S. (m)	I.S. (m)	F.S. (m)	H.I. (m)	R.L. (m)	Remarks

Height of Instrument = R.L. of B.M. + B.S.

R.L. of each arrow point = H.I. – I.S. or F.S.

EX.NO:12 **LONGITUDINAL – SECTIONING AND CROSS SECTIONING**

DATE: **(L.S AND C.S) FOR ROAD ALIGNMENT**

OBJECTIVE

To conduct the survey, L.S and C.S for a road alignment and plotting the profile.

Longitudinal sectioning (profile leveling)

In this method also called profile leveling the object of the leveling operation is to determine the undulations of the ground surface along the center-line of a road, railway, canal or pipe line. The levels are taken at the peg station points which marked at a distance 20 to 30 m on the ground.

Cross sectioning

Cross-sections are taken usually along a line, perpendicular to the center line and the interval between successive stations is 30 to 50m. the length of cross- sections on either side will be varies with the nature of the proposed work at the site. For a road the length may be 30m on either side; for a railway line it may be 45m on either side.

EQUIPMENTS REQUIRED

Level, leveling staff, ranging rods, cross staff, chain, tape, pegs, arrows, etc.

INSTRUCTIONS (longitudinal section)

Profile leveling is similar to fly leveling but it is run along a predetermined line at measured intervals. Let AB and BC be the proposed alignment along which profile leveling is to be done. Refer to figure, following is the field procedure.

1. Establish the bench marks near the starting and ending points of the proposed profile by running check levels from a bench mark of known R.L.(B.M.1 and B.M.2).
2. Fix the profile line AB and BC on the ground by fixing ranging rods at A,B,and C.
3. Measure and record the magnetic bearings of the lines AB and BC using a compass.
4. Align the line and mark number of points at equal intervals on the proposed alignment. Let A,1,2,3,…… B,9,10,……….. C be the marked points on alignment.
5. Setup the leveling instrument on the side of the alignment on firm ground at some suitable place, P1, So as to cover a large number of points on the lines.
6. Take B.S. on B.M.1 to determine the height of the instrument.

Back Sight	Inter Sight	Fore Sight	Height of Collimation	Reduced Level	Distance	Total Distance			Remarks
						Left	Center	Right	

7. Hold the leveling staff at successive stations A,1,2,3,4 etc. and take I.S. to determine the levels of these points.
8. Select a change point (C.P.1). if the I.S. distance exceed 100m. in the figure it is after taking I.S. on point 5. Take F.S. reading on the C.P.1.
9. Shift the instrument and setup at P2. So that it covers large number of forward points.
10. Take B.S. reading on the C.P.1 to determine the new height of instrument.
11. Hold the leveling staff on 6,7,8,9,10,11,12 and take intermediate sights.
12. Select a second change point C.P.2 after taking I.S. reading on point 12, when the sight distance exceeds 100m. Take a F.S. on C.P.2.
13. Shift the instrument to P3 and proceed as in steps 8,9,10 till the last point 'C'is covered.
14. Finally close the work by taking F.S. reading on B.M.2 from the last instrument setup.

INSTRUCTIONS (Cross – Sectioning)

1. Mark the cross-section points and number them continuously (say 1,2,3,….. etc) on the proposed center line alignment.
2. Setout perpendiculars at those points on both sides on the centre line, using a cross staff or optical square.
3. Mark representative points along these perpendicular lines depending upon the nature of the ground and the type of the project (usually at intervals of 1m, 2m or 3m).
4. Take staff readings on each cross – section on marked points, from the same instrument station as set up for the longitudinal sectioning.
5. Enter the staff readings accordingly. (let the marked points be L1,L2,L3,etc. to the left of the center line and R1,R2,R3,etc. to the right of the center line)
6. Reduced the levels and apply usual checks.

Plotting the profile

After the levels are reduced, it is ready for plotting. A datum line is drawn and the changes of points to be plotted are marked along the datum line. Perpendiculars are drawn at each of these points and appropriated reduced levels are set off along these perpendicular lines. A continuous line joining the above points represents the profile of the ground.

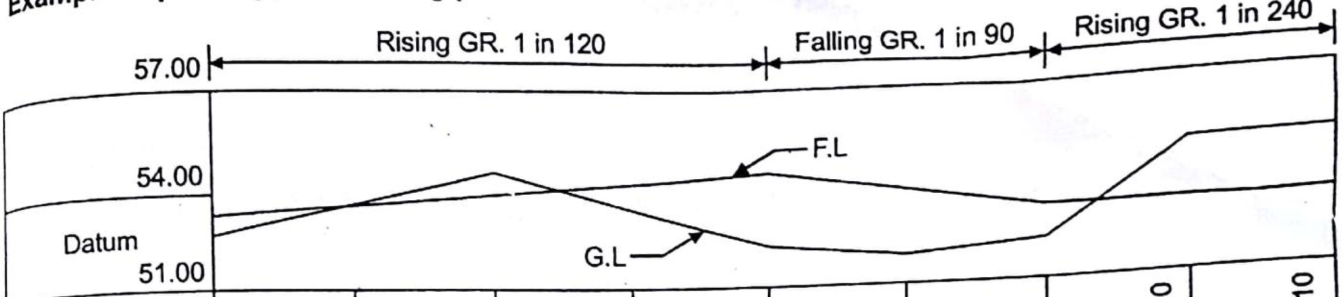
Scale for plotting the longitudinal section

As the horizontal distances involved in sectioning are much greater than the variation of levels, the scale for vertical distances is generally 10 times larger than the horizontal scale.

Plotting of cross- section

15. The plotting of cross-section is similar to that of plotting the profile except that the horizontal and vertical scales are the same.

Example of plotting the working profile



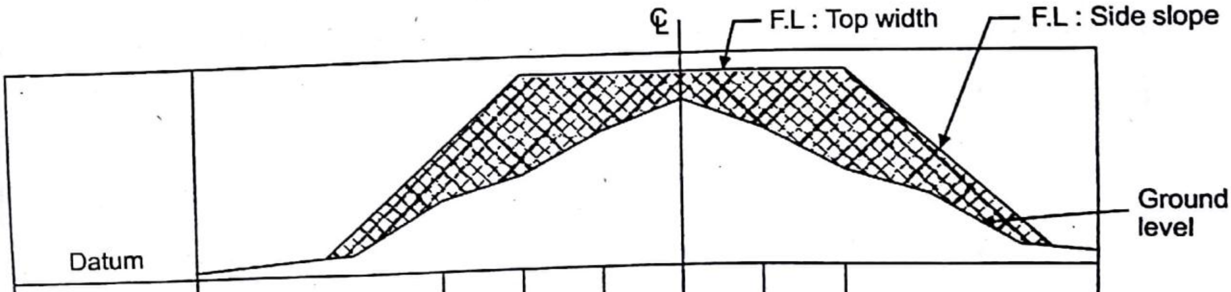
Depth of cutting		0.005	0.265					0.390	0.410
Depth of filling	0.230			0.150	1.875	1.910	0.940		
Formation level (FL)	53.350	53.600	53.850	54.100	54.350	54.020	53.690	53.815	53.940
Ground level (GL)	53.100	53.405	54.115	53.950	52.675	52.110	52.750	54.205	54.350
Distance	30	30	30	30	30	30	30	30	30
Chainage	0	30	60	90	120	150	180	210	240

Scale H = 1 : 3000
V = 1 : 300

Fig. 4.3 Working profile

Bearing of L.S from chainage 0 m to ________ m = ________.

Bearing of L.S from chainage ________ m to ________ = ________.



Formation level							
Reduced level							
Distance		1	1	1	1	1	
Chainage	30 3	2	1	0	1	2	30

℄

Fig. 4.4 Cross section number ________ at ________ m. Chainage on L.S

Scale = 1 : 100

PLOTTING THE WORKING PROFILE

OBJECTIVE

To plot the working profile.

Working profile

After the engineering work has been finally located and designed, a working section is prepared for used by the engineer-in –charge of the work. This is called the working profile and it includes the factors of the ground surface, the level of the new work, finished surface levels, depths of cutting and filling, etc. as required for the construction. The colours used for showing the different lines are as follows.

1. Red : Formation line, formation levels, depth of cutting, gradient, dimensions and arrows.
2. Blue : Finished surface line, heights of bank.
3. Black : Original ground levels.

Calculation of formation levels (F.L)

To calculate the F.L. find the rise or fall per unit length from the given gradient. The starting with the F.L at the starting point, calculate the formation levels at the other points by adding rise or subtracting fall repeatedly.

Scale for plotting the longitudinal section

As the horizontal distance involved in sectioning are much greater than the variation of levels, the scales of vertical distances is generally 10 times larger than the horizontal scale.

Plotting the cross-section

The plotting of cross-section is similar to that of plotting of the profile except that the horizontal and vertical scales are the same.

RESULT:

The longitudinal sectioning & cross sectioning is carried out and the profile and cross sections are plotted on Graph sheet.

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EX.NO:13 **CONTOURING – GRID METHOD**

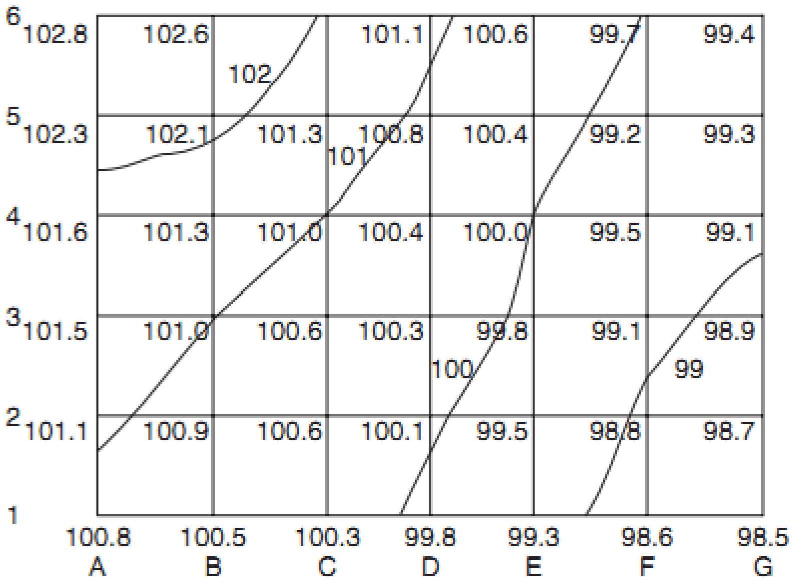

Figure 1: Grid Contouring

EX.NO:13 **CONTOURING – GRID METHOD**

DATE:

OBJECTIVE

To plot the contour map for a given land by direct method.

EQUIPMENTS REQUIRED

Dumpy Level, Levelling Staff, Tripod, Staff bubble, Chain or Tape.

INSTRUCTIONS

1. First, ensure that an appropriate bench mark (BM) is available near the site of the survey. If a B.M is not available, then one should be located near the site by fly leveling.
2. Once a benchmark is available, set up the instrument (level) at a suitable position covering a large part of the area to be surveyed.
3. The area is divided into a number of squares and all grid points are marked **(Ref. Fig. 1).** Commonly used size of square varies from 5 m × 5 m to 20 m × 20 m.
4. Levels of all grid points are established by leveling.
5. Then grid square is plotted on the drawing sheet. Reduced levels of grid points marked and contour lines are drawn by interpolation **[Ref. Fig. 1].**

RESULT:

Thus the Grid Contouring are plotted on Graph sheet.

Faculty Signature

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EX.NO:14 STUDY OF THEODOLITE

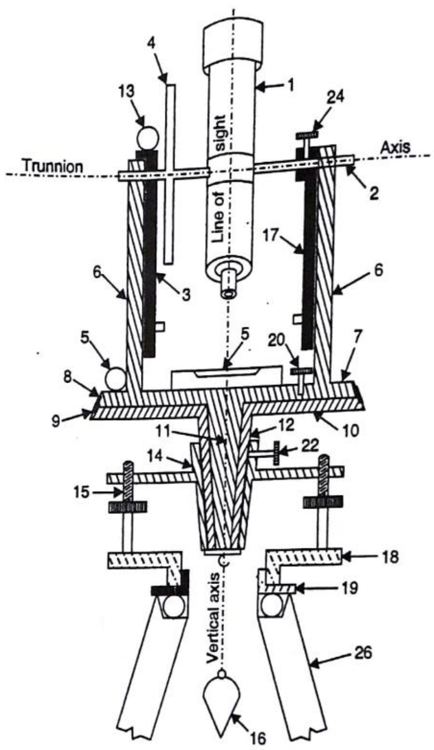


FIG. 6.1. THE ESSENTIALS OF A TRANSIT.

1. TELESCOPE
2. TRUNNION AXIS
3. VERNIER FRAME
4. VERTICAL CIRCLE
5. PLATE LEVELS
6. STANDARDS (A-FRAME)
7. UPPER PLATE
8. HORIZONTAL PLATE VERNIER
9. HORIZONTAL CIRCLE
10. LOWER PLATE
11. INNER AXIS
12. OUTER AXIS
13. ALTITUDE LEVEL
14. LEVELLING HEAD
15. LEVELLING SCREW
16. PLUMB BOB
17. ARM OF VERTICAL CIRCLE CLAMP.
18. FOOT PLATE
19. TRIPOD HEAD
20. UPPER CLAMP
22. LOWER CLAMP
24. VERTICAL CIRCLE CLAMP
26. TRIPOD

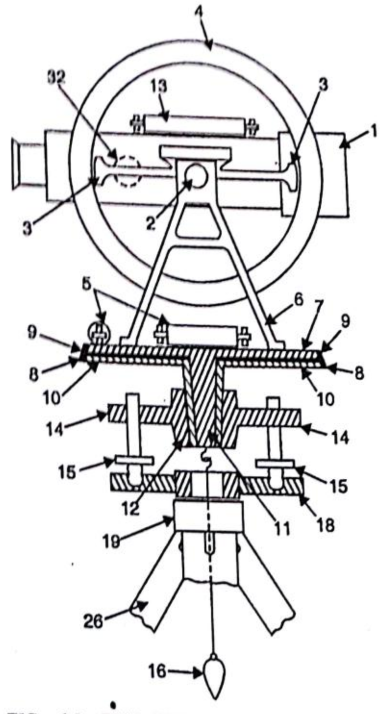
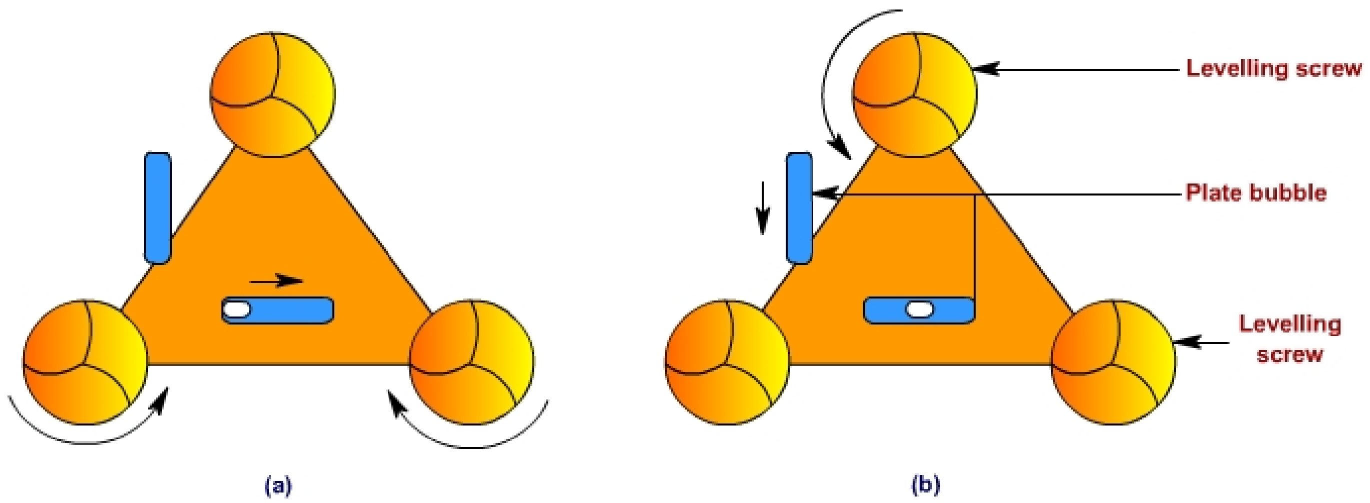


FIG. 6.2. THE ESSENTIALS OF A TRANSIT.

1. TELESCOPE
2. TRUNNION AXIS
3. VERNIER FRAME
4. VERNIER CIRCLE
5. PLATE LEVELS
6. STANDARDS (A-FRAME)
7. UPPER PLATE
8. HORIZONTAL PLATE VERNIER
9. HORIZONTAL CIRCLE
10. LOWER PLATE
11. INNER AXIS
12. OUTER AXIS
13. ALTITUDE LEVEL
14. LEVELLING HEAD
15. LEVELLING SCREW
16. PLUMB BOB
18. FOOT PLATE
19. TRIPOD HEAD
26. TRIPOD
32. FOCUSING SCREW



EX.NO:14 **STUDY OF THEODOLITE**

DATE:

OBJECTIVE

To study about the Temporary and Permanent adjustments of a Theodolite.

EQUIPMENT REQUIRED

Theodolite

INSTRUCTIONS

ADJUSTMENTS OF THEODOLITE

The Theodolite should be properly adjusted to obtain accurate observations. The adjustments are mainly of two types. They are as follows:

1. Permanent adjustments and
2. Temporary adjustments.

1. Permanent adjustments

The permanent adjustments are to be done to maintain the required standard relationship between the fundamental lines (axes) of a Theodolite. The fundamental lines are as follows:

a. Vertical axis
b. Horizontal axis or trunnion axis
c. Line of collimation or line of sight
d. Axis of plate level
e. Axis of altitude level.

Required relations between the fundamental lines (axes)

i) The axis of plate level must be perpendicular to the vertical axis.

ii) The line of collimation must be perpendicular to the horizontal axis

iii) The horizontal axis must be perpendicular to the vertical axis.

iv) The axis of the altitude level must be parallel to the line of collimation.

v) The vernier reading of vertical circle must read zero when the line of collimation is horizontal.

The permanent adjustments of a Theodolite are:

- Adjustment of plate level.
- Adjustment of line of sight.
- Adjustment of horizontal axis.
- Adjustment of altitude bubble and vertical index frame.

2. Temporary adjustments

The adjustments which are carried out at every setting of the instrument before the observations are referred as temporary adjustments. There are three types of temporary adjustments as follows.

a. Setting up
b. Levelling up
c. Elimination of parallax.

a**) Setting up**

This adjustment includes the following two operations.
i. Centering the Theodolite over the instrument station.
ii. Approximate leveling of Theodolite with the help of the tripod legs only.

Centering

It is the operation by which the vertical axis of the theodolite represented by a plumb line is made to pass through the mark of instrument station on the ground.

Approximate levelling

The approximate leveling may be done with the reference to a small circular bubble provided on the tribrach or by eye judgements.

b) Leveling up

The operation of making the vertical axis truly vertical is known as leveling of the Theodolite. After the centering and approximate leveling an accurate leveling is to be done with the help of foot screws.

i) First the telescope is to be kept parallel to any of the two foot screws as in the figure.
ii) The bubble of plate level is to be brought to the centre of its run by turning the foot screws either inwards or outwards simultaneously.
iii) Then the telescope is to be turned through 90°, so that it lies over the third foot screw (i.e perpendicular to the first position)
iv) The bubble is to be brought to the centre of its run by turning the third foot screw either clockwise or anticlockwise.
v) Then the telescope is brought back to its original position (position at (i)) and the position of bubble is checked whether it remains in the center or not.
vi) If the bubble is not in centre the above operations are repeated till the bubble retain at centre in both the positions.

c) Elimination of parallax.

An apparent change in the position of an object caused by the change in position of the observer's eye is known as **parallax.** This can be eliminated in two steps.
i) Focusing the eye piece for distinct vision of the cross hairs.
ii) Focusing the objective to bring the image of the object in the plane of cross hairs.

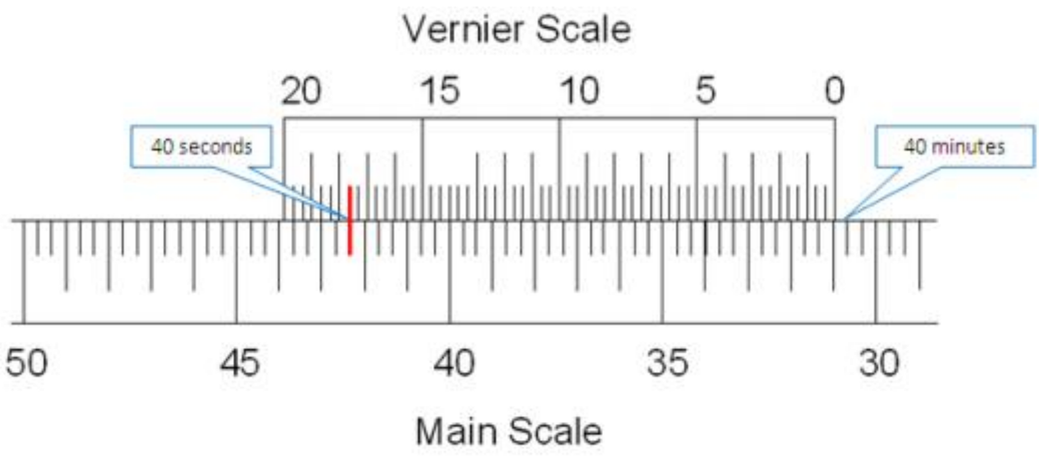
i) Focusing the eye piece

The telescope is to be pointed towards the sky or a sheet of white paper is to be hold in front of the objective.

The eye piece is to be moved in or out by rotating it gradually until the appearance of cross hairs becomes sharp and distinct.

ii) Focusing the objective

Telescope is to be directed towards the object. Focusing screw is to be turned until the appearance of the object becomes sharp and clear.



	°	'	"
Main Scale	30	40	
Vernier Scale		17	40
Reading	30	57	40

.

RESULT:

Thus the study about the Temporary and Permanent adjustments of a Theodolite is practiced

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25

EX.NO:15 MEASUREMENT OF HORIZONTAL ANGLE – REPETITION METHOD

Inst at	Sight to	Face : Left Swing : Right												Face : Right Swing: Right												Average Horizontal Angle $\frac{(1)+(2)}{2}$		
		Vernier					Mean			No of Rep	Horizontal Angle (1)			Vernier					Mean			No of Rep	Horizontal Angle (2)					
		A			B									A			B											
		°	'	"	'	"	°	'	"		°	'	"	°	'	"	'	"	°	'	"		°	'	"	°	'	"
Average														Average														

EX.NO:15 **MEASUREMENT OF HORIZONTAL ANGLE**

DATE: **REPETITION METHOD**

OBJECTIVE

To find the horizontal angle by method of repetition and to calculate the horizontal distance between two accessible points.

Repetition- Definition

To measure an angle by repetition means to measure it two or more times allowing the vernier to remain clamped each time at the end of each measurement instead of setting it back at 0° when sighting at the back sight. Thus, an angle reading is mechanically multiplied by the number of repetitions. The value of the angle observed is obtained by dividing the accumulated reading by the number of repetitions. Generally six repetitions are done, three with the telescope normal and three with the telescope inverted.

EQUIPMENTS REQUIRED

Theodolite with stand, Arrow, Tape, etc.

INSTRUCTIONS

1. Setup the instrument over the station 'Q' and do all the temporary adjustments. Keep the vertical circle to the left.
2. Set the vernier A to zero with the help of upper clamp and tangent screws. Notes the readings of vernier A and B.
3. Loosen the lower clamp and turn the telescope towards the object P. Clamp the lower clamp and bisect the point exactly using lower tangent screw.
4. Loosen the upper clamp and turn the telescope clockwise to bisect the object R; clamp the upper clamp and bisect R exactly using upper tangent screw.
5. Read both verniers to get approximate value of the angle PQR. Let this angle be θ.
6. Unclamp the lower plate and turn the telescope clockwise to sight the point P again. Clamp the lower clamp and bisect P exactly using lower tangent screw. Check that the vernier A and B readings have not changed.
7. Loosen the upper plate and turn the telescope clockwise and again bisect R. clamp the upper plate bisect R exactly using upper tangent screw. The vernier will now read twice the value of angle PQR.
8. Repeat the steps (6) and (7) once again. The final readings of the vernier A will be thrice the angle PQR.

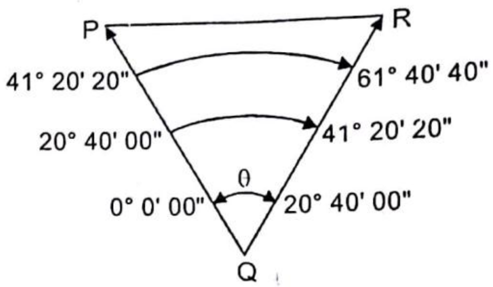

Fig. 1.3 Repetition method

CALCULATION

Angle PQR = Total Angle / Number of Repetitions.

Angle PQR= average of face left and face right observations.

RESULT:

Angle PQR= ___________ .

25

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EX.NO:16 MEASUREMENT OF HORIZONTAL ANGLE – REITERATION METHOD

Inst at	Sight to	Face : Left Swing : Right											Face :Right Swing : Left													
		Vernier					Mean			Included Angle			Vernier					Mean			Included Angle			Average Included Angle		
		A			B								A			B										
		°	'	"	'	"	°	'	"	°	'	"	°	'	"	'	"	°	'	"	°	'	"	°	'	"

EX.NO:16 **MEASUREMENT OF HORIZONTAL ANGLE**

DATE: **REITERATION METHOD**

OBJECTIVE

To measure the horizontal angles with Theodolite by reiteration method.

Reiteration – Definition

This method of measuring horizontal angle is preferred when several angular measurements are to be made at a station. All the angles are measured successively and finally the horizon is closed. The final reading on vernier A should be same as the initial zero. If not, the discrepancy is equally distributed among all the angles.

EQUIPMENTS REQUIRED

Theodolite with stand, arrow etc.

INSTRUCTIONS

Figure 1.2 shows the instrument station 'O', where the angles PQR,QOR,ROS and SOP have to be measured by reiteration; following procedure is used.

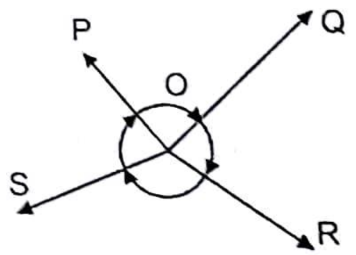

Fig. 1.2 Reiteration method

1. Setup the instrument over the station 'O' and do all the temporary adjustments; keep the vertical circle to the left.
2. Set the vernier A to zero using upper clamp and its tangent screw.
3. Loosen the lower clamp and direct the telescope to signal at 'P'; clamp the lower clamp and bisect P accurately using lower tangent screw; read both verniers.
4. Loosen the upper clamp and turn the telescope clockwise until the signal at Q is bisected; clamp the upper clamp and bisect Q exactly using upper tangent screw. Read both verniers. Mean of the vernier readings gives the horizontal angles POQ.
5. Loosen the upper clamp again and turn the telescope clockwise until the signal at R is bisected. Use the upper tangent screw for exact bisection. Read both verniers and determine the angle QOR. The angle QOR is obtained by finding the difference between the readings to R and Q.
6. Similarly, determine the angle ROS.
7. Finally, sight the signal P and read both the verniers. Vernier A should now read 0° or (360°), if not note the reading and find the error due to slip etc. if the error is small, distribute it equally to all angles. If the error is large, respect the above procedure and take fresh set of readings.
8. Change the face of the instrument to right face. Repeat the process in step 2.

9. Loosen the upper clamp screw, rotate the telescope counter-clockwise (i.e. swing left) and sight station ‘S’ clamp the upper and bisect the signal S exactly using upper tangent screw. Read both the verniers and determine the angle POS.

10. Similarly, determine the angles SOR,ROQ and QOP by rotating the telescope in the counter-clockwise direction, distribute the error, if any equally among all angles.

11. Determine the average value of each angle obtained with the face left and the face right.

CALCULATION

RESULT:

Included angles, POQ=

QOR=

ROS=

SOP=

Total=

25

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EX.NO:17 CLOSED THEODOLITE TRAVERSE MEASUREING INCLUDED ANGLES

	Sight to	Face : Left Swing Right											Face : Right Swing : Right											Average horizontal angle			Side and length	Bearing
		A			B		Mean			Horizontal angle			A			B		Mean			Horizontal angle							
		°	'	"	'	"	°	'	"	°	'	"	°	'	"	'	"	°	'	"	°	'	"	°	'	"		

EX.NO:17 **CLOSED THEODOLITE TRAVERSE MEASUREING**

DATE: **INCLUDED ANGLES**

OBJECTIVE

To determine the lengths and included angles between the lines of closed traverse with the use of Theodolite.

EQUIPMENTS REQUIRED

1.Theodolite, 2.Ranging rods,3.Pegs or Arrows.

General

This method is normally provided for closed traverse. In this method included angle between two successive lines is measured.

INSTRUCTIONS

1. The instrument is set up over the station "P" and all the temporary adjustments are made. Telescope is oriented along the magnetic meridian and the magnetic meridian of PQ is measured.
2. The reading of 0°0'0"is set at vernier A by using upper clamp and tangent screw and the face of Theodolite is kept as left.
3. The telescope is brought back in the line of PT with the help of lower clamp and tangent screw, the reading in vernier A is kept as 0°0'0" and the reading in vernier B is kept as 180°0'0".
4. Upper clamp is loosened and the telescope is turned clockwise and "Q" is bisected. Upper clamp is clamped and "Q" is bisected exactly using tangent screws.
5. Both the verniers of A and B are read and noted. Mean of the two verniers is determined as an included angle QPT.
6. Face is changed and all the above steps are repeated to determine one more included angle QPT. The average of the two included angle QPT is measured.
7. The Theodolite is shifted to second station Q. The station P is bisected and the whole process is repeated to get an included angle of RQP.
8. Similarly included angles at R,S and T are measured.
9. Lengths of traverse lines PQ,QR,RS,ST and TP are measured using a tape or chain.

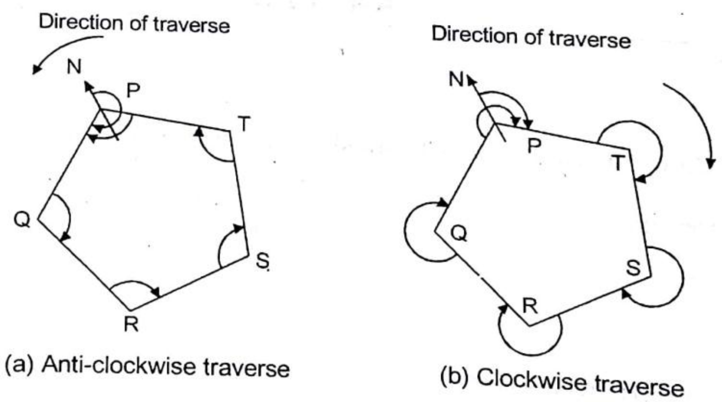

Fig. 1.4

CALCULATION

RESULT:

1. The included angle between the lines

(i) Face Left		**(ii) Face Right**	
∠ QPT	=	∠ QPT	=
∠RQP	=	∠RQP	=
∠SRQ	=	∠SRQ	=
∠TSR	=	∠TSR	=
∠PTS	=	∠PTS	=

2. Length of lines

i) PT =

ii) TS =

iii) SR =

iv) RQ =

v) QP =

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25

EX.NO:18 **DETERMINATION OF AREA BY TRILATERATION METHOD.**

Instrument @	Sight to	Vertical angle	Staff Reading			S (m)	Distance (m)
			TOP	MIDDLE	BOTTOM		
O	A						
	B						
	C						
	D						
	E						
	F						
	G						
A	G						
	B						
C	B						
	D						
E	D						
	F						
G	F						
	A						

EX.NO:18 **DETERMINATION OF AREA BY TRILATERATION METHOD**

DATE:

OBJECTIVE

To determine the distance between the given station points using the method of trilateration and area enclosed by the station points.

INSTRUMENTS REQUIRED

1. Theodolite
2. Ranging rod
3. Leveling staff
4. Cross staff
5. Arrows
6. Pegs

FORMULA USED

1. **Horizontal Distance:**

$D=KS\ Cos^2\ \theta + C\ Cos\ \theta.$

K= Multiplicative constants = 100

S= Staff intercepts (Top hair – Bottom hair)

C= Additive Constants=0

2. **Area of Triangle:**

$A= S*(S-a) * (S-b) * (S-c)$

$S= \{ (a+b+c) / 2 \}$

INSTRUCTIONS

1. Mark the given points A, B, C, D, and E … by using peg or arrows in such a way that it is possible to see those points from any point.
2. Then the instrument is placed in such a way that it is center to all the points and also visible from the selected point.
3. The initial adjustment are done for accuracy in the survey.
4. Then the point A is focused, and then the vertical angle and the top, middle and top hair reading are taken by placing the leveling staff at point A.
5. The vertical angle and the top, middle and top hair reading are taken for all the given points
6. Then the instrument is set any point and the point and the distance and vertical angle between the adjacent points are taken.

7. Thus we get a polygon whose sides are known or multiple triangles whose sides are known.
8. By using the given dimensions and by using the triangle formulas the area can be calculated.

CALCULATION

Consider ΔOAG;

OA = ______________ m (a)

OG = _____________ m (b)

AG = _________ m (c)

S= { (a+b+c) / 2 }

S= ______________ m.

Area of triangle OAG

$$\sqrt{S\,(S-a)\,(S-b)(S-c)}$$

=

=_______________ m^2.

Similarly for other triangles;

AOB =_______________ m^2.

BOC=_______________ m^2.

COD=_______________ m^2.

DOE=_______________ m^2.

EOF=_______________ m^2.

GOF=_______________ m^2.

Total Area of the Triangles =_______________ m^2.

RESULT

Thus the area of the given land is found out as________________ m^2 by using Trilateration method.

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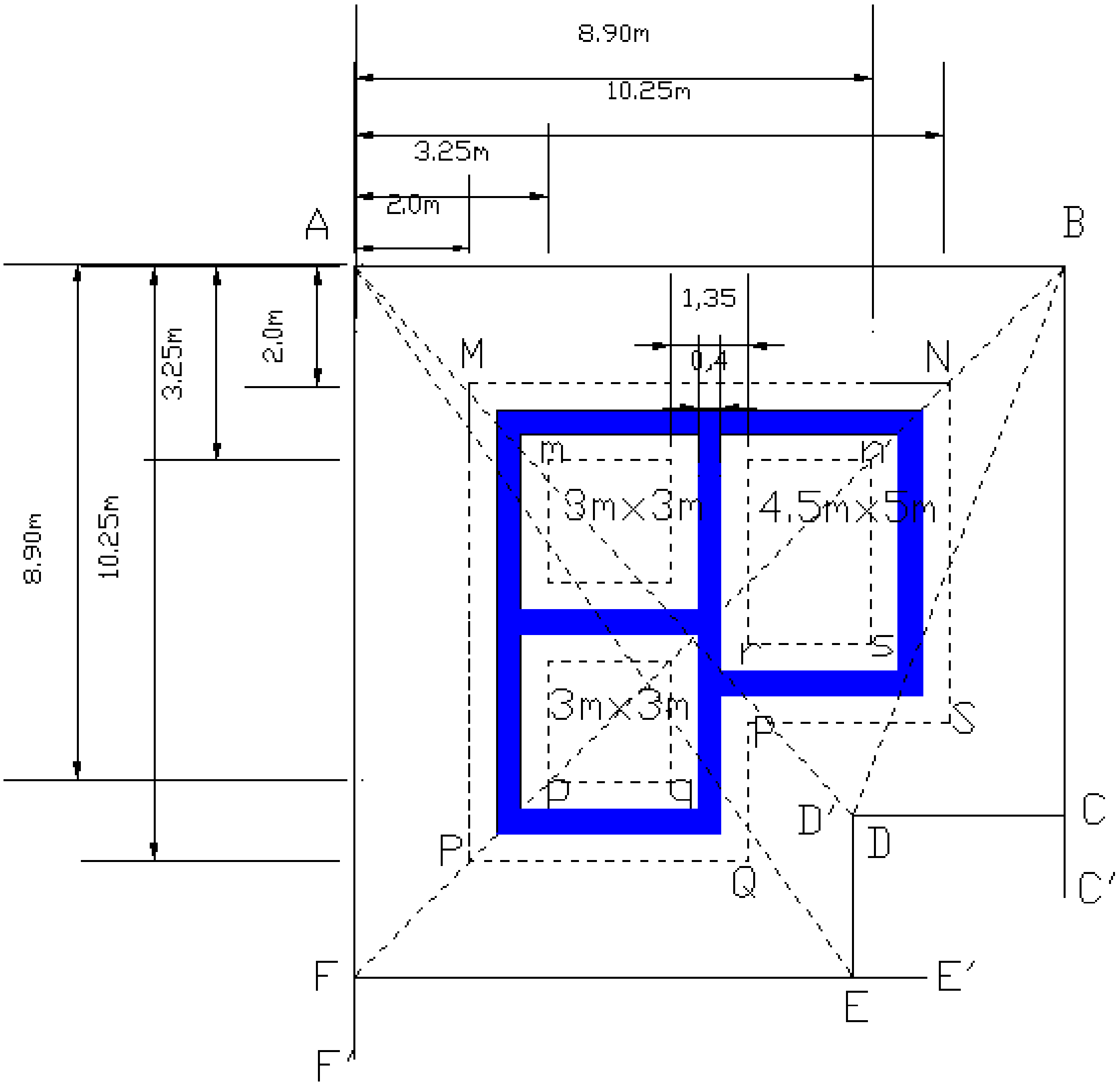
EX.NO:19 **SETTING OUT WORKS - FOUNDATION MARKING**



EX.NO:19 **SETTING OUT WORKS - FOUNDATION MARKING**

DATE:

OBJECTIVE

To give layout for given plan of building.

EQUIPMENTS REQUIRED

Pegs, Nails, Lime, Wooden Mallet.

SKETCH:

Plan figure.

Theory:

When plans are ready for the works, the works are to be executed .To start with any structure first of all; trenches for the foundation are to be excavated. To excavate these trenches, the outline of excavation are defined on the ground, the process of defining the outlines of the excavation on the ground is known as setting out of works or lining out of works.

To set any structure or work whether it may be building, culvert, pipeline or sewer line, the plan showing the width of the foundation trench, for various walls, distance of the corners from some definite line etc. is required. This plan called foundation plan (Fig).The distances and they are with reference to lines AB and AF.

INSTRUCTIONS

1. To start with the setting out of building, first of all a point A is fixed and then line AB is oriented in the required direction .Thus having fixed the direction of the line AB, two pegs A and B are driven at distance of 12.25m apart (This distance calculated from the plan).
2. Wire nails are driven at the centers of the pegs. Again the distance between the wire nails is checked and which should be equal to12.25m. And a cord is stretched along AB and ends are secured to the wire nails at A and B.
3. Perpendiculars AF' and BC' are set out. Perpendicular may be set with a tape by 3-4-5 method or by swinging method. (Theodolite may be used to set a perpendicular if the work is important).
4. Along AF' and BC'', points F and C are fixed at a calculated distance from A & Brespectively.
5. The perpendicular are then set at C and F and point D and E are fixed along CD'' and FE' at a calculated distance from C and F respectively.
6. The stakes are driven at these points C, D, E, and F and wire nails are driven at the centers of these stakes. A cord is stretched all along ABCDEF.
7. To check up the work, the diagonal AE, AD, BF, and BD are actually measured and these measured values should agree with their corresponding calculated lengths.

Otherwise the setting out work should be repeated and stakes should be refixed at their correct positions.

8. After fixing up all the pegs and stretching the cords, the corners M, N, P etc and m, n, p etc. are to be located. The point A is considered as the origin and the lines AB and AF as the axes of the coordinates. The coordinates of all the corners M, N, P etc., and m, n, p, etc. are calculated with reference to A as origin. For example Co-ordinates of M.N.P are (2 , 2) , (2 , 10.25) and (10.25 , 2) respectively and those for m, n, p are (3.35 , 3.35) , (3.35 , 8.90) and (8.90 , 3.35) respectively.
9. With these coordinates, point M, N, P, m, n, p etc., are set and pegs are driven at these points. The cord are stretched around the wire nails at M,N,P,Q,R,S and m, n, p, r, s indicating peripheries. The outlines of the peripheries are marked with lime spread.
10. Now the lime lines on the ground indicate the trenches for the various walls and the excavation may be started. During the progress of the work if the marked lines are disturbed, they may be checked or reset with help of reference line ABCDEF.

RESULT:

Thus setting out of building is laid on the ground as shown in the figure.

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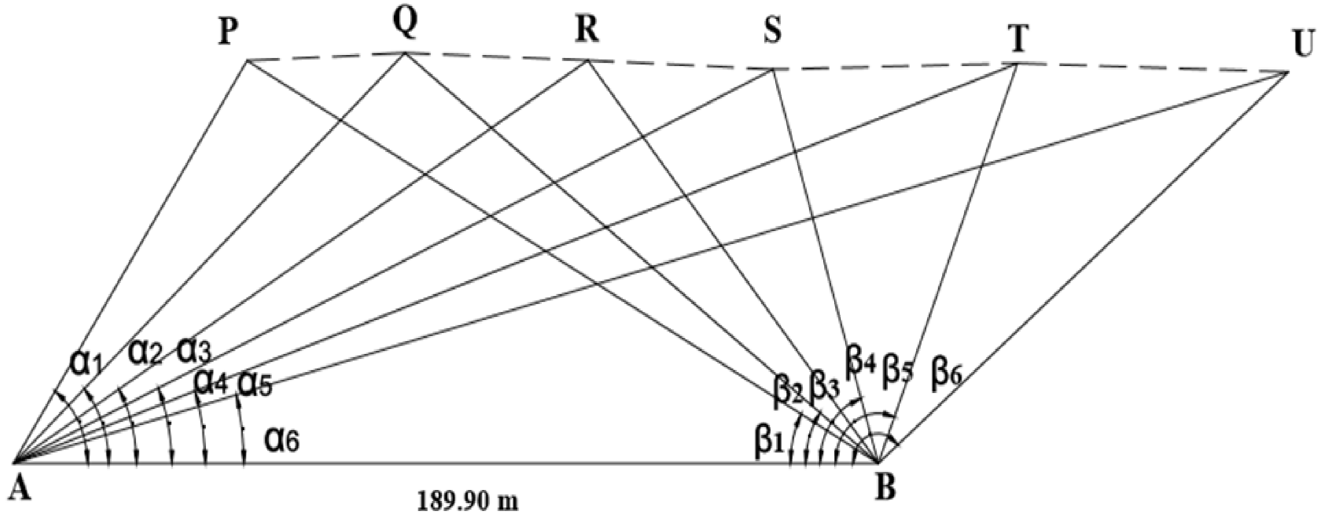
EX.NO:20 FIELD OBSERVATION FOR AND CALCULATION OF AZIMUTH, LATITUDE AND LONGITUDE



EX.NO:20 FIELD OBSERVATION FOR AND CALCULATION OF AZIMUTH, LATITUDE AND LONGITUDE

OBJECTIVE

The aim of geodetic survey is to establish a certain number of points on the surface whose relative positions and elevations are determined. The positions of these points are determined relatively in terms of length and zenith of line joining them absolutely in terms of the co ordinate latitudes and elevation of sea level. These points serve as control points with reference to which other ordinary topographic survey may be carried out. Hence it is more accurate the control points wherein primarily angles are measured and the sides connecting the points are computed with reference to choose accurate base line.

EQUIPMENTS REQUIRED

Forms of base measuring apparatus:

There are two forms:

1. Rigid bars
2. Flexible apparatus

Rigid bars:

1. Contact apparatus
2. Optical apparatus

Flexible apparatus

The flexible apparatus consists of,

1. Steel invar tape
2. Steel and brass wires

Other Instruments Used

1. Theodolite
2. Invar steel
3. Small tripods
4. Weights – 5,8,10kgs

OBSERVATION & TABULATION:

TABLE – LATITUDE OF THE PLACE OF OBSERVATION READINGS:

STATION	POINT	STADIA READING	HORIZONTAL ANGLE			VERTICAL ANGLE			REMARK
			0º	0’	0”	0º	0’	0”	
A	P								
	Q								
	R								
	S								
	T								
	U								
	B								
B	A								
	P								
	Q								
	R								
	S								
	T								
	U								

5. Dumpy level
6. Staff

INSTRUCTIONS

- To start with the theodolite is set on any one of the stations say A. The work is carried towards B.
- The station B is sighted through the telescope of the theodolite.
- The tripods are ranged along the line of the theodolite at approximately equidistant between them such that the invar tape is divided into segments.
- The invar tape is stretched on the knife edge of the tripods and the end is connected to straining rods. To the other end of the tape weights are put to eliminate sagging of tape to certain extent.
- One thing is too kept in mind that means the main divisions of the tape should rest over the knife edge of the tripod which helps to read the length directly.

CALCULATION

RESULT

LENGTH OF SIDES		R.L. OF POINTS	LATITUDE	LONGITUDE
AB =	BA =	A =	P =	P =
AP =	BP =	B =	Q =	Q =
AQ =	BQ =	P =	R =	R =
AR =	BR =	Q =	S =	S =
AS =	BS =	R =	T =	T =
AT =	BT =	S =	U =	U =
AU =	BU =	T =		
		U =		

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25

EX.NO:21 **STUDY OF TOTAL STATION**

EX.NO:21 **STUDY OF TOTAL STATION**

DATE:

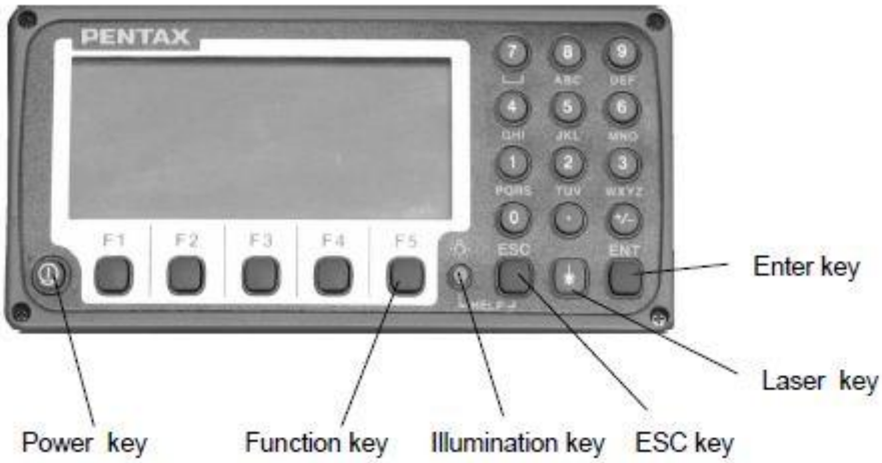
OBJECTIVE

To study of Total Station and their operational components.

APPARATUS REQUIRED:

Pentax 1505N with tripod

Display and Keyboard:



Operation Keys:

Key	Description
[POWER]	ON/OFF of power supply.
[ESC]	Returns to previous screen or cancels an operation.
[ILLU]	Turns the illumination of the LCD display and telescope reticle on and off.
[ENT]	Accepts the selected (highlighted) choice or the displayed screen value.
[LASER]	Displays the laser plummet and the LD point screen when you push the Laser key. (Refer to "2.5 LD POINT, Laser pointer", "3.2 Laser plummet").
[Alphanumeric]	At the numerical value screen, the numerical value and the sign "." displayed are input. The English characters printed right under numeric of each key are input.
[HELP]	Pressing [ILLU]+[ESC] key causes a help menu to appear in MODE A or MODE B or causes a help message to appear.

Function Keys

Display	F. Key	Description
MODE A		
[MEAS]	F1	Pressing this key one time measures the distance in normal mode. Another measurement type can be selected by InitialSetting 2. Pressing this key twice measures the distance in coarse mode. Another measurement type can be selected by initial setting 2.
[TARGET]	F2	Switches the target. REFLECTORLESS / SHEET / PRISM
[0 SET]	F3	Resets the horizontal angle to 0° 0' 0" by pressing twice.
[S.FUNC]	F4	PowerTopoExpress 2 Special Functions.
[MODE]	F5	Switches the screen between MODE A and MODE B.
MODE B		
[DISP]	F1	Switches the display composition in the order "H.angle/H.dst./V.dst.", "H.angle/V.angle/S.dst." and "H.angle/V.angle/H.dst./S.dst./V.dst."
[ANG SET]	F2	Brings up the angle setting screen for setting angle-related parameters. (H.ANGLE /%GRADE, H.ANGLE INPUT and L/R REVERSE)
[HOLD]	F3	Pressing this key twice retains (holds) the horizontal angle shown on the display.
[CORR]	F4	Brings up the screen for changing the target constant, temperature, pressure setting.
[MODE]	F5	Switches the screen between MODE A and MODE B.

[Other functions]

[⇦]	F1	Moves the cursor to the left.
[⇨]	F2	Moves the cursor to the right.
[⇧]	F3	Moves the cursor up.
[⇩]	F4	Moves the cursor down.
[△]	F1	Goes back five items on the screen.
[▽]	F2	Gose forward five items on the screen.
[RETICLE]	F3	Changing the reticle illumination when pressing illumination key.
[LCD]	F4	Changing the LCD contrast when pressing illumination key.
[ILLU]	F5	Changing the LCD illumination when pressing illumination key.
[CLEAR]	F5	Clear the figure.
[SELECT]	F5	Open the selection window.

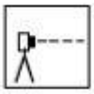
Menu:


1. **PRO:** Program (RDM, REM, VPM)


2. **I/O:** Communication (Text read/write, USB, DATA Transfer)


3. **PREF:** Preference (Setup)


4. **CALC:** Calculations (COGO, 2D Surface, Road Design)


5. **MEAS:** Measurement


6. **STAK:** Stake out


7. **FILE:** File manager


8. **DATA:** Data


9. **STATION:** Free Station (Backward Intersection)

- **Relations between the Memory and each Function**

Function data	Read from the stored data	Write to the stored
Measure	SP, BSP	SP, BSP, FP (SD)
Stake Out	SP, BSP, SOP	SP, BSP, SOP, OP
Point to Line	SP, BSP, KP1, KP2	SP, BSP, KP1, KP2, OP
Free Stationing	Each KP	Each KP, SP (CD)
Traverse	SP, BSP	SP, FP (SD)
VPM	SP, BSP, Each KP	SP, BSP, Each KP, CP (CD)

Station point:	SP	Foresight point:	FP	Backsight point:	BSP	Stake Out point:	SOP
Known point:	KP	End point:	EP	Observation point:	OP	Conversion data:	CD
Conversion point:	CP	Crossing point:	CRP	Surveyed data:	SD		

Key:

KEY	Description
PAGE	Views another function combination.
SELECT	Selects the Character and moves to next input at PN input etc.
ACCEPT	Enters the displayed values without new Coordinates value input etc.
INPUT	Inputs your desired Horizontal angle.
BSP	Views the BSP SETUP screen to input its Coordinates.
SAVE	Saves input data.
ME/SAVE	Measures and then saves input data.
EDIT	Changes the Point Name or Prism Height.
REMOTE	Views your aiming point Coordinates.
OFFSET	Views the Target Coordinates adding the offset values.
STATION	Returns to the STATION POINT SETUP screen.
H. ANGLE	Returns to the STATION POINT H.ANGLE SETUP screen.
LIST	Views the POINT SELECTION FROM THE LIST screen.
OTHER	Views the JOB LIST SEARCH screen.
ZOOM ALL	Returns to the original size.
ZOOM IN	Magnifies the graphics size.
ZOOM OUT	Reduces the graphics size.
DISP	Views point or point & graphic or point & point name or all.
DELETE	Views the POINT DELETION screen.
FIND PN	Views the PN search screen by inputting the point name.
ADD	Allows you to add more points for free stationing.
CALC	Starts the calculation of free stationing.
NEXT	Views the next known point Coordinates setup screen.
DATA	Views the TARGET POINT screen.
TARGET	Selects the Target type.
EDM	Selects the EDM settings.
ALL	Selects all points of the current job.
ORDER	The order of selected points.

Mode:

Display combination of MODE A or MODE B

Function	MODE A	MODE B
F1	MEAS	DISP
F2	TARGET	ANG SET
F3	0 SET	HOLD
F4	S.FUNC	CORR
F5	MODE	MODE

- Mode A or Mode B is switched by pressing [F5] [MODE].

LEVELLING WITH THE PLATE VIAL

(A) Align the plate vial in parallel with a line joining any two of the levelling screws.

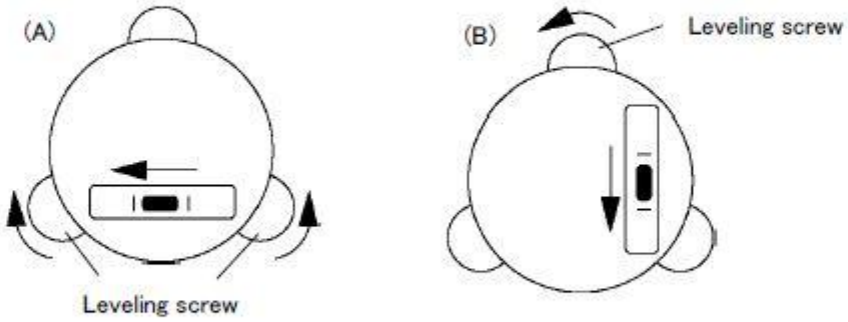
Then, adjust the two screws to centre the bubble in the plate vial.

- Turn two levelling screws in an opposite direction mutually in a way that the bubble moves from the side of the plate vial to the centre.

(B) Rotate the total station 90°.

- Use the remaining screw to centre the bubble in the plate vial.
- Rotate the instrument by 90° and 180° and confirm the position of the bubble in the plate vial.

At this time, it is not necessary to adjust it if the bubble of the plate vial is in the vicinity of the centre.



RESULT:

Thus the study of Total station and their operational components.

Faculty Signature

25

EX.NO:22 **DETERMINATION OF ANGLES AND HEIGHT MEASUREMENT BY USING TOTAL STATION.**

DATE:

OBJECTIVE

To determine the angles and height measurement by using Total station.

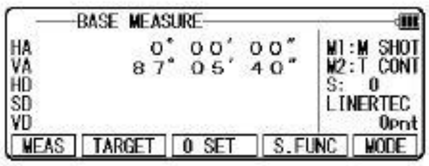
APPARATUS REQUIRED

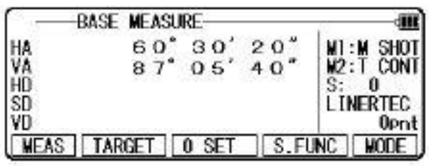
Pentax 1505N with tripod.

INSTRUCTIONS

Measuring an angle

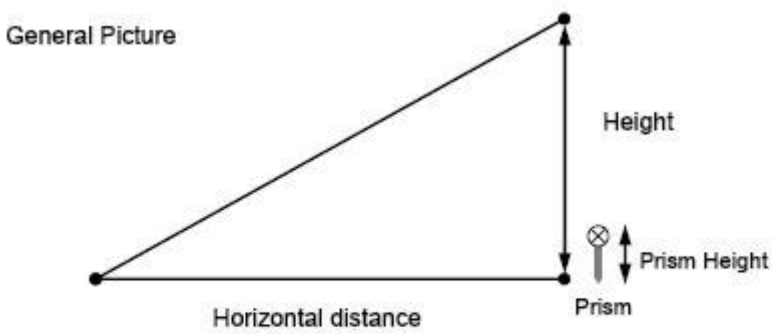
1. At first, Centering the total station.
2. Aim at the first target, then press [F3] [0 SET] twice in succession to reset the horizontal angle to 0.
3. Aim at the second target, then read the horizontal angle and vertical angle.
4. Note it the Base Measurement.





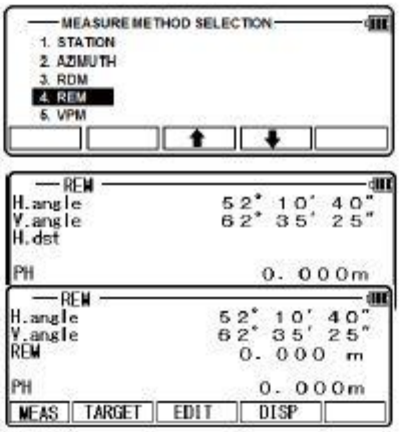
REM (Remote Elevation Measurement)

General Pictures of Measurement



1. From the PowerTopoExpress 2 screen, Select [F2] [REM] and press [ENT] to view MEASURE screen.

2. Please press [ENT] after measuring distance.



RESULT:

1. Horizontal angle HA=____________________
2. Vertical Angle VA=______________________
3. Horizontal Distance =____________________
4. Vertical Distance = __________________

25

Faculty Signature

EX.NO:23

DATE:

DETERMINATION OF AREA OF A GIVEN PLOT USING TOTAL STATION

OBJECTIVE

To find the area of a closed rraverse using total station.

APPARATUS REQUIRED

Pentax 1505N

INSTRUCTIONS:

1. Fix the total station over a station and level it

2. Press the power button to switch on the instrument.

3. Select MODE B -------> S function------->file management------>create(enter a name)------->accept

4. Then press ESC to go to the starting page

5. Then set zero by double clicking on 0 set(F3)

6. Then go to S function ------> measure-----> rectangular co-ordinate---->station --- >press enter.

7. Here enter the point number or name, instrument height and prism code.

PN ....

E...

N...

IH...

PC..

8. Then press accept(Fs)

9. Keep the reflecting prism on the first point and turn the total station to the prism ,focus it and bisect it exactly using a horizontal and vertical clamps.

10. Then select MEAS and the display panel will show the point specification

11. Now select edit and re-enter the point number or name point code and enter the prism height that we have set. 12. Then press MEAS/SAVE (F3) so that the measurement to the first point will automatically be saved and the display panel will show the second point.

13. Then turn the total station to second point and do the same procedure.

14. Repeat the steps to the rest of the stations and close the traverse

15. Now go to S function----> view/edit----graphical view.

16. It will show the graphical view of the traverse.

17. Select S function---> calculation---> 2D surface----> All------> accept

18. This will give the area of the closed traverse.

RESULT:

Area of the closed traverse is calculated.

25

Faculty Signature

EX.NO:24 **CALCULATING AND PLOTTING THE GIVEN AREA USING GPS**

DATE:

OBJECTIVE

To calculate and plotting the given area using GPS

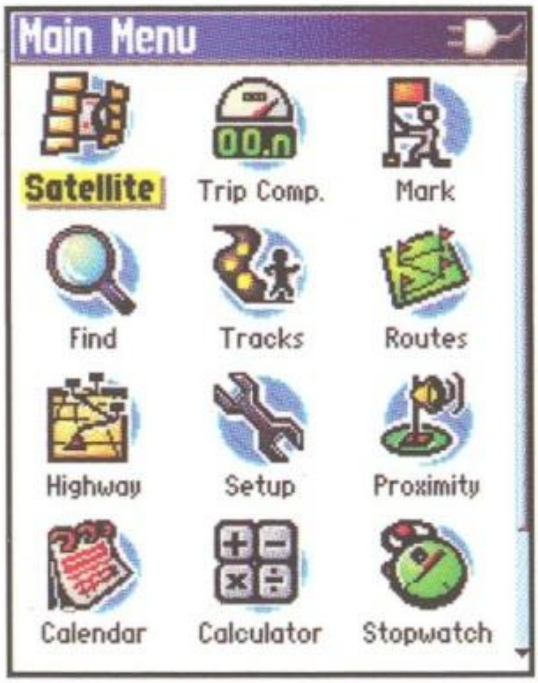
EQUIPMENTS REQUIRED

1. Hand held GPS

INSTRUCTIONS

Measuring area

1. From the main menu, use the thumb stick to choose Tracks.
2. Tap the menu button on the left side of the unit and choose "Area Calculation".
3. When you are ready to begin, click the Start button with the thumb stick and walk in a square, circle or irregular path, returning to my original position. As we move, the area enclosed by your path is displayed on the screen.
4. We can change the unit for the area enclosed using the dropdown menu.



Main Menu

RESULT

The given area using GPS = …… …………m^2

25

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