Introduction

Date ___/___/___

★ Surveying-

→ Surveying is the art of determining the relative positions of different objects on the surface of the earth by measuring the horizontal ~~angles~~ distances between them, and by preparing a map to any suitable scale. Thus, in this discipline the measurements are taken only in the horizontal ~~angles~~ plane.

★ Levelling-

→ Levelling is the art of determining the relative vertical distances of different points on the surface of the earth. Therefore, in levelling the measurements are taken only in the vertical plane.

★ Classification of Surveying

- There are two main classification of Surveying

(1) Primary Classification
- (i) Plane Surveying
- (ii) Geodatic Surveying

(2) Secondary Classification
- (i) Based on Instruments
  - (a) Chain Surveying
  - (b) Compass Surveying
  - (c) Plane Table Surveying
  - (d) Theodolite Surveying
  - (e) Tacheometric Surveying
  - (f) Photographic Surveying

2 (ii) Based on Methods
(a) Triangulation Surveying
(b) Traverse Surveying

(iii) Based on Objects
(a) Geological Surveying
(b) Mine Surveying
(c) Archaeological Surveying
(d) Military Surveying

(iv) Based on nature of field
(a) Land Surveying
(b) Marine Surveying
(c) Astronomical Surveying

- $RF = \dfrac{\text{Drawing length}}{\text{Actual length}}$

- Types of scale map according RF value

① Large Scale Map → $RF \leq 1:500$

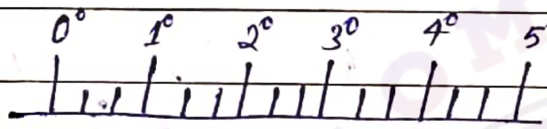
② Small Scale Map → $RF > 1:500$

Date ___ /___ /______

★ Theodolite Surveying

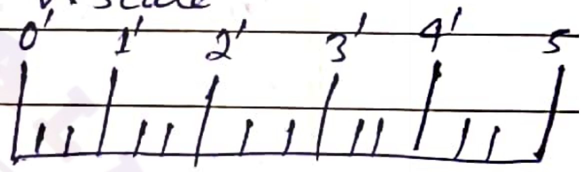
- Transit Theodolite
  - Types of transit theodolite according to scale
    - (i) Vernier Theodolite
    - (ii) Micrometer Theodolite
- Non-Transit Theodolite

M. Scale



Least Count = 20'

V. Scale



L.C = 20''

- Main scale can measure degree & minutes.
- Vernier Scale can measure minutes & seconds.

- We can measure following things using theodolite –

(a) The horizontal angles
(b) The Vertical angles
(c) Distance betn two points
(d) Deflection angle
(e) Magnetic Bearing
(f) Ranging a line
(g) Find the difference of elevation betn the points.
(h) Measure the vertical height of an object.

- The angle betn magnetic direction and object is called magnetic Bearing.

- The angle betn true direction and object is called true direction.

- <u>Centering</u>
The setting of a theodolite exactly over a station mark by means of a plumb bob is suspended from a hook fixed below the ~~verticale~~ vertical axis.

- <u>Transiting</u>
The method of turning the telescope about at horizontal axis in the vertical plane, it is termed as transiting of theodolite.

- <u>Swinging:-</u>
This indicates turning of the telescope in a horizontal plane, if the telescope is turned clockwise then it is called right swing and when the telescope is turned anticlockwise then it is called left swinging

Date ___ / ___ / ______

- **Changing Face**

The operation of bringing the ~~telescope~~ vertical circle from one side of the observer to the other side is known as changing face.

- **Face left**

Face left means that the vertical circle of the theodolite is on the left side of the observer at the time when reading is taking. The observation taken in the face left position is called face left observation.

- **Face Right**

This refers to the situation when the vertical circle of the instruments is on the right of the observer when the reading is taken. The observation taken in the face right position is known as face right ~~opo~~ observation.

- **Telescope Normal**

The face left position is known as telescope normal or telescope direct.

Date

- **Telescope Inverted**
  The face right position is known as telescope inverted or telescope reverse.

★ **Axis of Theodolite**

① Line of Collimation
② Axis of bubble tube
③ Axis of telescope
④ Horizontal axis
⑤ Vertical axis

① **Line of Collimation**

It is an imaginary line passing through the intersection of the crosshair at the diaphragm ~~frame~~ and optical center of the object glass and its continuation.

② **Axis of bubble tube**

It is also an imaginary line tangential to the longitudinal curve of the bubble tube at its middle point.

④ **Horizontal Axis**

It is the axis of rotation of the telescope in the ~~telescope~~ vertical plane, it is also known as ~~hari~~ ~~tarnnion~~ trunnion plane.

Date ___ / ___ / ___

③ <u>Axis of the Telescope</u>

This axis is an imaginary line passing through the optical center of the object glass and optical center of the eye piece.

⑤ <u>Vertical Axis</u>

It is the axis of rotation of the telescope in the horizontal plane.

★ <u>Least count of the Theodolite</u>

This is difference between the value of the smallest division of the main scale and the smallest division of the vernier scale.

⇒ Let,

n smallest division of the vernier scale.

(n-1) smallest division of the main scale.

d = Value of the smallest division of main scale

v = Value of the smallest division of vernier scale

$$(n-1)\,d = n \times v$$

$$v = \frac{(n-1)d}{n}$$

$$LC = d - v$$

$$= d - \frac{(n-1)d}{n}$$

$$= dn - dn + d \qquad \boxed{LC = \frac{d}{n}}$$

Page No. ____

★ Sensitiveness of bubble tube

- The ability of a bubble tube to show a very small deviation of the bubble from its horizontal position is termed as sensitiveness of the bubble tube.

- It depends on the various factor like —

(a) The diameter of the bubble tube
(b) Length of the bubble tube
(c) The radius of curvature of the internal surface of the tube.
(d) The viscocity ~~of~~ of the liquid used inside the tube.

$$\alpha' = \frac{S}{Dn} \text{ radian}$$

$$= \frac{S}{Dn} \times 206265$$

1 radian = 57.296°

S = Staff Intercept
D = Distance betn stand & angle
n = no. of division

★ Measure the horizontal angle by using Theodolite —

Methods are used —

1. Direct Method
2. Repeatation Method
3. Re-itearation Method

Page No.

Date ___ / ___ / ___

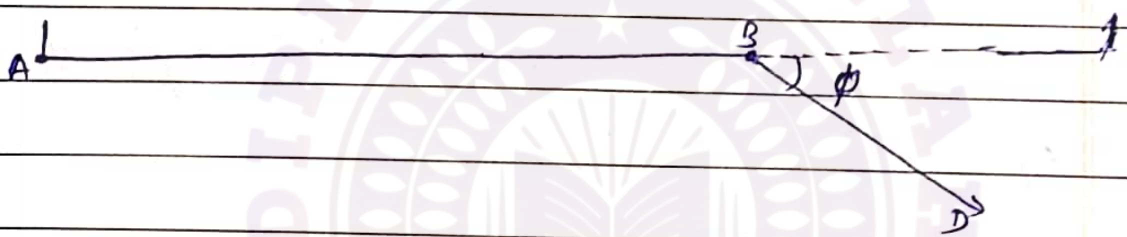
① Direct Method

Left face		Right face	
Right Swing		Right Swing	
V→A	V→B	V→A	V→B
x	y	m	n

Mean $= \frac{x+y}{2}$ Mean $= \frac{m+n}{2}$

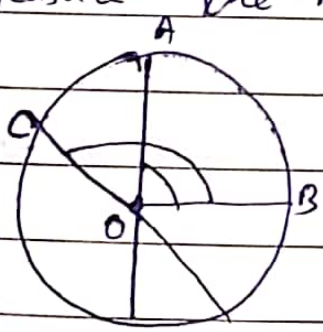
Final angle $= \frac{\text{Left face mean} + \text{Right face mean}}{2}$

★ Deflection Angle



- Methods of measuring deflection angle
  - (i) Included Angle Method
  - (ii) Deflection Angle Method
  - (iii) Fast Angle Method

★ Measure the magnetic bearing by using theodolite —



∠AOB – True Bearing
∠COB – Magnetic Bearing

Page No.

Date / /

★ **Magnetic Bearing**

- Whole Circle Bearing
- ~~Magnetic~~ Quardant Bearing or Reduced Bearing

• **Check in closed Traverse**

(i) The sum of the measured interior angle or include angle should be equal to $(2N-4)90^\circ$. (where N = No. of side)

(ii) The sum of the measured exterior angle should be equal to $(2N+4)90^\circ$

(iii) The algebric sum of the deflection angle should be equal to 360° considering right hand deflection to be positive and left hand deflection to be negative

(iv) The fore bearing and back bearing of the finishing line should different by 180°.

(v) The chaining of each line should be done twice along opposite direction.

- Checked after computation—

→ The sum of northing should be equal to southing & the sum of easting should be equal that of westing

Q Convert the following whole circle bearing to quardant bearing.

(i) 45°30′ (ii) 125°45′ (iii) 222°15′ (iv) 320°15′

⇒ N 45°30′E ⇒ S 54°15′E ⇒ S 42°15′W ⇒ N 39°45′W

★ **Check in open traverse**

① Tie line or cut off line
② Auxiliary point

★ **Sources of error in Theodolite**

① Non- adjustment of plate bubble.
② Line of collimation is not being perpendicular to horizontal axis.
③ Horizontal axis is not being perpendicular to vertical axis.
④ Line of collimation is not being parallel to axis of telescope.
⑤ Eccentricity of outer and inner axis.
⑥ Graduation circle is not being uniformaly.
⑦ Verniers are eccentric.

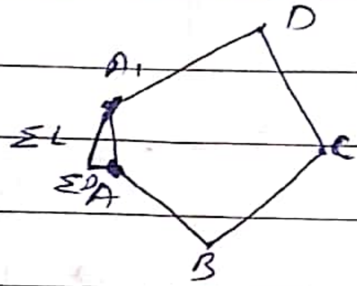
- Personal use error
- Natural error

★ Closing error and its limitation

- Sum of all latitude $= 0$
  Sum of all departure $= 0$

- **Closing Error** – The distance by which a traverse ~~a~~ fails to close is known as closing error or error of closure.

Date ___ / ___ / ___



AA_1 = Closing error

$$AA_1 = \sqrt{(\Sigma L)^2 + (\Sigma D)^2}$$

$$\boxed{\tan\theta = \frac{\Sigma L}{\Sigma D} = \frac{\text{Latitude}}{\text{Departure}}}$$ Sir

- $\tan\theta$ is depend on the θ.

$$\boxed{\tan\theta = \frac{\Sigma D}{\Sigma L} = \frac{\text{Departure}}{\text{Latitude}}}$$ Book

- Relative closing error = $\dfrac{\text{Closing error}}{\text{Perimeter of traverse}}$

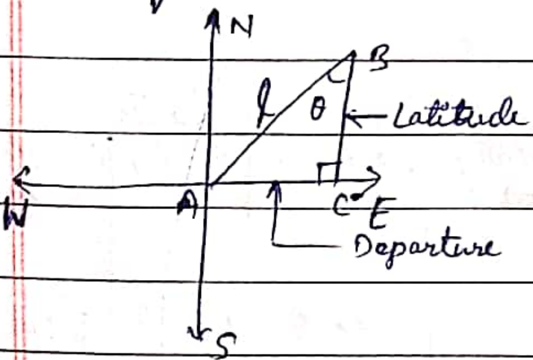
- Permissible angular error = $LC \times \sqrt{N}$ (N = No. of sides)

① Land, Road & Railway = $1' \times \sqrt{N}$ = 1 in 3000

② City Survey, Important boundary survey = $30'' \times \sqrt{N}$ = 1 in 5000

③ Very Important Survey = $15'' \times \sqrt{N}$ = 1 in 10000

★ **Computation of Latitude & Departure**

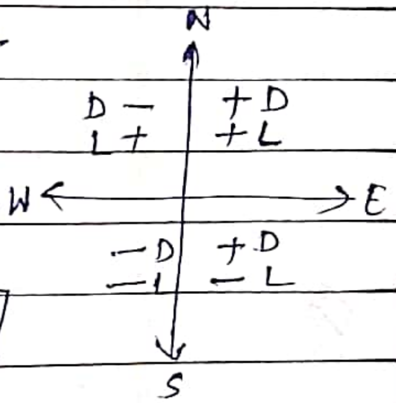


$\sin\theta = \dfrac{AC}{AB} = \dfrac{\text{Departure}}{l}$

$\boxed{\text{Departure} = l\sin\theta}$

$\cos\theta = \dfrac{BC}{AB} = \dfrac{\text{Latitude}}{l}$

$\boxed{\text{Latitude} = l\cos\theta}$



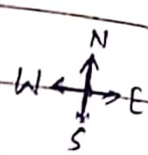
Northing = + Latitude
Southing = − L
Easting = + D
Westing = − D

Date ___ / ___ / ___

★ Conversion of WCB to RB

WCB between	Corresponding RB	Quadrant
0° to 90°	RB = WCB	NE
90° to 180°	RB = 180° - WCB	SE
180° to 270°	RB = WCB - 180°	SW
270° to 360°	RB = 360° - WCB	NW

★ Computing Latitude & Departure



Line	Length	RB	Latitude	Departure
AB	L	N θ E	$+L\cos\theta$	$+L\sin\theta$
BC	L	S θ E	$-L\cos\theta$	$+L\sin\theta$
CD	L	S θ W	$-L\cos\theta$	$-L\sin\theta$
DA	L	N θ W	$+L\cos\theta$	$-L\sin\theta$

• Check for closed traverse

(i) The algebric sum of latitude = 0

(ii) The algebric sum of departure = 0

★ Computing the traverse by using consecutive coordinates.

Line	Length (L)	R.B. (θ)	Consecutive Coordinates Northing (+)	Southing (−)	Easting (+)	Westing (−)
AB	L	N θ E	$L\cos\theta$		$L\cos\theta$	
BC	L	S θ E		$L\cos\theta$	$L\cos\theta$	$L\cos\theta$
CD	L	S θ W		$L\cos\theta$		$L\cos\theta$
DA	L	N θ W	$L\cos\theta$			

- Check for closed traverse —

(i) Sum of Northing = Sum of Southing

(ii) Sum of Easting = Sum of Westing

★ Consecutive Coordinates – The latitude and departure of a point calculated with reference to the preceding point for what are called consecutive coordinates.

2. Independent ~~Coordinates~~ Coordinates – The Coordinates of any point with respect to a common origin are said to be the independent coordinates of that point. The origin may be a station of the survey or a point entirely outside the traverse.

- ~~Coordinates~~ Consecutive coordinates may be positive or negative, depending upon the quardant in which they lie.

- According to Gale's Table the independent coordinates of all the points are made positive by suitably selecting the coordinates of the starting station of the traverse.

- The coordinates of the origin ~~~~ points are assumed to be some positive values slightly greater than the maximum negative values of the latitudes and departures of the concerned traverse.

★ Independent coordinates of points of a traverse —

Point	Line	Consecutive Coordinates N(+)	S(-)	E(+)	W(-)	Independent coordinates N	E
A	-	-	-	-	-	150	50
B	AB	-	115	-	40	35	10
C	BC	5	-	50	-	40	60
D	CD	80	-	25	-	120	85
A	DA	30	-	-	35	150	50
		115	-115	75	-75		

Here, IC = A(50, 150) — Max. negative latitude = −115

B(10, 35) — Max. ~~positive~~ negative departure = −40

C(60, 40)

D(85, 120)

★ Types of error eliminating table error

(1) Bowditch's Rule

(a) Correction to latitude at any side

$$= \frac{\text{Length of that side}}{\text{Perimeter of traverse}} \times \text{total error in latitude}$$

(b) Correction to departure at any side

$$= \frac{\text{Length of that side}}{\text{Perimeter of traverse}} \times \text{total error in departure.}$$

② ~~Third Rule~~ Third Rule

ⓐ Correction to Northing at any side

$$= \frac{\text{Northing of the that side}}{\text{Sum of Northing}} \times \frac{1}{2}(\text{total error in latitude})$$

ⓑ Correction to Southing at any side

$$= \frac{\text{Southing of the that side}}{\text{Sum of Southing}} \times \frac{1}{2}(\text{total error in latitude})$$

ⓒ Correction to Easting at any side

$$= \frac{\text{Easting of the } \cancel{\text{total}} \text{ that side}}{\text{Sum of Easting}} \times \frac{1}{2}(\text{total error in departure})$$

ⓓ Correction to Westing at any side

$$= \frac{\text{Westing of the that side}}{\text{Sum of Westing}} \times \frac{1}{2}(\text{total error in departure})$$

③ Transit Rule

ⓐ Correction to latitude at any side

$$= \frac{\text{Latitude of that side}}{\text{Arithmatical sum of all latitude}} \times \text{total error in latitude}$$

Date

(B) Correction to departure at any side

$$= \frac{\text{Departure of that side}}{\text{Arithmatical sum of all departure}} \times \text{total error in departure}$$

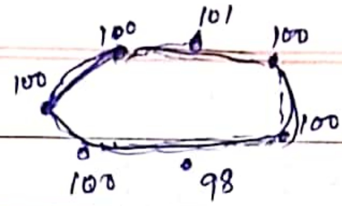
- Example of adjustment

→ Adjustment by Bowditch's Rule —

Line	Length	Consecutive Coordinate L	Consecutive Coordinate D	Correction L (+)	Correction D (−)	Corrected C.C. L	Corrected C.C. D
AB	70	21.05	−65.45	0.072	−0.064	+21.572	−65.51
BC	80	−80.755	−5.25	0.083	−0.073	−80.672	−5.32
CD	43	−41.00	13.55	0.044	−0.039	−40.956	+13.511
DE	38	−14.25	35.15	0.038	−0.034	−14.212	+35.116
DA	115	114.15	22.315	0.118	−0.105	+114.268	+22.21
Total →	346	−0.355	+0.315	0.355	−0.355	0	0
		Error		Correction		Adjusted	

Contours, Importance of Contour Maps, and Charatoristics

Date 02 / 03 / 2025



★ Contours (Isohypes lines)

- Definition – Contours are imaginary lines on the ground surface that connect points of equal elevation above a reference datum (like mean sea level).

BM – BS – 1st
Dump IS – Middle
Point x FS – Last

- Representation – On a map, contours show the three-dimensional features of a terrain in two dimensions.

★ Importance of Contour Maps

- Topographical Representation – Contour maps depict the shape and elevation of the land surface.

- Applications
  - → Engineering – Useful in planning roads, railways, and irrigation projects.
  - → Environmental Studies – Aid in flood control and watershed management.
  - → Military – Assist in strategic planning by understanding terrain.
  - → Construction – Help determine suitable locations for structures.

→ Recreational Activities – Useful in hiking and adventur[e] sports for terrain visualization.

★ Characteristics of Contours

(1) Spacing –
- Close spacing indicates steep slopes.
- Wide spacing indicates gentle slopes.

(2) Elevation – Contours never intersect (except in vertical cliffs or overhangs).

(3) Shape
- Concentric closed contours represent hills.
- Contours with depressions represent basins and vall[eys]

(4) ~~Sha~~ Direction
→ Contours form a "V" shape when crossing stream[s] or rivers, with the open of the "V" pointing upstrea[m]

(5) Uniformity
→ Smooth contours suggest uniform slopes, while irregular ones indicate uneven terrain.

Methods of Plotting Contours and Factors Affecting Contour Interval

Date ___ / ___ / ___

★ Methods of Plotting Contours

(1) Direct Method

- The elevation of the ground is measured at specific points.
- Contour lines are drawn directly by connecting points of equal elevation.

- Use - Suitable for small areas where high accuracy is required.

(2) Indirect Method (Grid Method)

- A grid is established over the survey area.
- Elevations (Reduced levels) are noted at each grid points.
- Contours are interpolated between the grid points.
- Use - Practical for large areas.

★ Factors Affecting Contour Interval

(1) Purpose of the Map

- Detailed maps required smaller intervals.
- General maps can have larger intervals.

(2) Scale of the Map

- Larger scales use smaller contour intervals.

(3) Terrain Characteristics

- Flat terrain - small contour intervals for clarity.
- Steep terrain - Larger intervals are acceptable.

(4) Survey Accuracy - Higher precision allows smaller intervals.

(5) Available Resources - Time, labour, and equipment can influence the interval choice.

★ Methods of Preparing a Contour Map from RLs of Grid Points with examples

★ Steps for Preparing a Contour Map

(1) Grid Establishment

- Lay out a grid over the area (e.g., 10m x 10m)
- Mark the grid points and note their coordinates.

(2) Recording RLs

→ Use instruments like levelling staff and theodo-lite to determine the RLs at each grid point.

Page No.

Remote Sensing

Remote sensing enables the collection of data on various phenomena from a distance, utilizing technologies such as satellites and drones.

Processes in Remote Sensing

Data acquisition - Collecting raw data from remote sensing instruments.

Pre-processing - Cleaning and preparing data for analysis.

Analysis - Applying algorithms and models to extract inside.

Interpretation - Converting analyzed data into meaningful information for decision making.

There are two of Remote Sensing

Passive ~~Active~~ Remote Sensing

~~Active remote sensing~~ Passive ~~Active~~ Remote Sensing is a technique where sensors detect natural radiation (usually from the sun) that is reflected or emitted by objects on Earth's surface. It does not produce its ... relies on external

Remote Sensing

Date ___ / ___ / _____

★ Remote Sensing

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★ There are two of Remote Sensing

① ~~Active~~ Passive Remote Sensing

~~Active remote sensing~~ ~~Active~~ Passive Remote Sensing is a technique where sensors detect natural radiation (usually from the sun) that is reflected or emitted by objects on Earth's surface. It does not produce its own energy but relies on external sou

Page No.

Date __ / __ / __

Example - Optical cameras, thermal sensors and multispectral imaging.

② ~~Passiv~~ Active Remote Sensing

Active Remote sensing is a technique where sensors emit their own energy (such as radio, waves, lasers, or sound waves) towards a target and measure the reflected or scattered signal. It works even in darkness or cloudy conditions.

Example - RADAR, LIDAR, and SONAR

★ Applications of Remote Sensing

① Environmental Monitoring

- Deforestation tracking
- Air and water quality monitoring
- Climate change studies

② Agriculture

- Crop health monitoring
- Soil moisture estimation
- Precision farming

Date ___ / ___ / ___

③ Disaster Management

- Flood and earthquake damage assessment
- Cyclone and storm prediction
- Forest fire detection.

④ Urban Planning & Infrastructure

- Smart city planning
- Traffic management
- Land use mapping

⑤ Military & Defense

- Surveillance and reconnaissance
- Border security monitoring
- Missile detection

⑥ Development and Construction

- Land development
- Engineering and constructions

★ Interpolation method of Contour

- By Estimation Method
  - → Accuracy – Low
  - → Scale – Small Scale Map
  - → Inaccurate/Imperfect
- By arithmatical Calculation method
  - → Accuracy – High
  - → Scale – Large Scale Map
  - → Accurate/Perfect
- By graphical Method

- **Formula**

$$\text{Distance bet}^n \text{ two contour points} \times \frac{\text{Level difference bet}^n \text{ starting point and required contour}}{\text{Level difference bet}^n \text{ two contour points}}$$

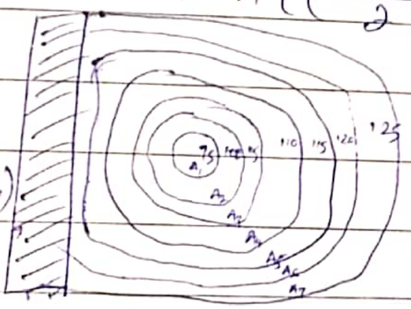
- **Use of Contour map/Application of Contour map**
  - → Determination of Intervisibility
  - → Route Location
  - → Capacity of Resorvior
  - → Drainage area
  - → Earth work estimate
  - → Site of structure

Note – A_1, A_2, A_3, A_4 —— area

- Trapezoidal formula

$$\text{Volume} = \frac{h}{2}\left[(A_1 + A_7) + 2A_2 + 2A_3 + \dots + 2A_7\right]$$

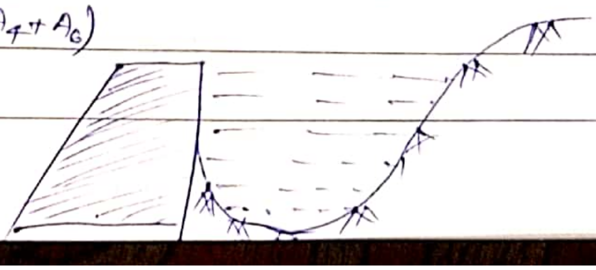
$$= h\left[\left(\frac{A_1 + A_7}{2}\right) + A_2 + A_3 + A_4 + \dots A_7\right]$$



- **Prismoidal Formula**

$$\text{Volume} = \frac{h}{3}(A_1 + A_n) + 2\,\text{Odd} + 4\,\text{Ev})$$

$$= \frac{h}{3}(A_1 + A_2 \dots A_7) + 2(A_3 + A_5 + A_7) + 2(A_2 + A_4 + A_6)$$



Total Station - Working Principle

①

★ Working Principle of Total Station

Total station is a combination of an Electronic Theodolite and an Electronic Distance Measurement (EDM) unit. It based on following principles —

① Distance Measurement (EDM) Unit

→ A laser or infrared beam is emitted from the Total Station.

→ The beam reflects back from a prism reflector,

→ The time taken for the beam to return is used to calculate the distance.

② Angle Measurement (Theodolite Unit)

→ The telescope of the Total station is aimed at the target object.

→ The devices measures horizontal and vertical angles using electronic sensors.

③ Data Processing & Storage

→ A microprocessor processes the collected distance and angle data.

→ The data is displayed on a digital screen and can be stored in memory.

→ It can be tranferred to exteral devices using USB, Bluetooth, or Wi-Fi.

★ Advantages & Disadvantages of Total Station

- **Advantages**

@ High Accuracy - Provides millimeter-level accuracy in measurements.

@ Time Saving - Faster data collection compared to traditional surveying.

@ Less Manpower Required - A single operator can handle it efficiently.

@ Multi-Purpose Use - Useful in construction, mining, land surveying and GIS mapping.

@ Digital Data Collection - Data can ~~collect~~ be stored and transferred easily.

Date

@ 3-D Mapping Capability - Compatible with GIS and other mapping software.

✿ Disadvantages

@ Expensive - Higher cost compared to traditional surveying instruments.

@ Requires Skilled Operators - Training is needed for accurate operation.

@ Battery Dependency - Requires a continuous power supply; battery drain can cause delays.

@ Weather Sensitivity - Fog, dust and heavy rain can affect laser accurracy.

@ Prism Dependence - Some operations require a properly positioned reflector for accurate results.

★ Use of Function Keys in Total Station

Total Stations have function keys that help in data entry, measurement, and configuration. The key functions may vary based on the model and manufacturer, but the general uses are —

Date ___ /___ /______

① Power Button - Turns the Total Station 'ON' or 'OFF.'

② ESC (Escape) Key - Cancels the current operation and return to the previous menu.

③ FUNC (Function) Key - Used to access different measure-ment and setting options.

④ ENT (Enter) Key - Confirms a selected option or entered values.

⑤ Arrow Keys (▲▼◀▶) - Used for menu navigation and adjusting values.

⑥ DIST (Distance Measurement) Key - Initiates the distance mea-surement process.

⑦ ANG (Angle Measurement) Key - Measures horizontal and vertical angles.

⑧ REC (Record) Key - Saves the measured data into internal memory or an external device.

⑨ COORD (Coordinate) Key - Displays the calculated coordina-tes of a surveyed point.

Date

⑩ SET (Setting) Key- Opens configuration settings for calibration and system adjustments.

⑪ SHIFT Key- Allows secondary functions of other keys to be accessed.

⑫ MODE Key- Switches between different operating mode like angle measurement, coordinate measurement and stake-out mode.

★ Precautions while using a Total Station

① Handling & Setup Precautions

- Set up on a stable tripod

→ Ensure the Total Station is securly mounted on a leveled tripod to avoid measurements errors.

- Check battery levels

→ A fully charged battery should be used to prevent power loss during surveying.

- Protect from vibrations

→ Avoid using the Total Station near heavy machinery or vibrating surfaces.

- Ensure Proper calibration
→ Regularly check and calibrate the instrument for accurate readings.

② Environmental Precautions
- Avoid Direct sunlight on the display
→ To prevent visibility issues while reading data.

- Use in favorable weather
→ Rain, fog and dust can affect laser readings; use covers or shields if necessary.

- Avoid reflective surface near the target
→ Unwanted reflections can lead to incorrect distance measurements.

③ Operational Precautions
- Use the correct prism and target settings
→ Incorrect reflector settings can cause inaccurate distance measurements.

- Verify reference points
→ Always check and confirm control points before starting the survey.

- Recheck measurements
→ Take multiple readings for critical measurements to reduce errors.

④ Data & Storage Precautions

- Save data frequently.
→ Avoid loss of important survey data by regularly saving progress.

- Use proper file formats
→ Ensure the Total Station is set to store data in a compatible format for later use in CAD or GIS software.

- Keep communication ports clean
→ Prevent dust from entering USB or Bluetooth to avoid connectivity issues.

Date ___ / ___ / ___

★ Integral parts of Total Station

① Electronic Distance Measurement (EDM) Unit

→ Measures distances accurately using laser or infrared technology

② Telescope

→ Used for sighting and targeting the objects.

③ Electronic Theodolite

→ Measures horizontal and vertical angles.

④ Microprocessor and Storage Unit

→ Processes and stores collected data.

⑤ Display & Control Panel

→ Used for data input and output, featuring a digital screen and keypad.

⑥ Levelling Base & Tribach

→ Ensures stability and precise positioning.

⑦ Battery and Power Supply.

Provides energy for field operation.

Date ___/___/___

⑧ Prism and Target System
→ Reflects signals for distance measurement.

⑨ Communication Ports (USB/Bluetooth/Wi-Fi)
→ Transfer data to external devices.

★ Applications of Total Station

① Land Surveying
→ Used for topographic surveys, boundary making and land mapping.

② Construction
→ Helps in site layout, levelling and alignments of structures.

③ Road & Highway Engineering
→ Used for road alignment, slope measurement and curve setting.

④ Mining Surveys
→ Helps in excavation planning and volumetric calculations.

Date __ / __ / ____

⑤ Bridge & Tunnel Construction
Ensure precision in alignment and structural positioning.

⑥ GIS & Mapping
→ Used for geospatial data collection and digital mapping.

⑦ Archaeological Surveys
→ Helps in documenting historical sites and artifacts.

⑧ Railway & Pipeline Projects
→ Projects assists in route planning and installation.

⑨ Agricultural & Irrigation
Used for land grading, drainage planning, and precision farming.