GPSC - CIVIL

Surveying

EXAM ACHARYA
EDUCATION REDEFINED

The best Brains of the Nation may be found on the last Benches of the Classroom.

A.P.J. Abdul Kalam

The content of this book covers all PSC exam syllabus such as MPSC, RPSC, UPPSC, MPPSC, OPSC etc.

PREFACE

Surveying, a comprehensive refresher for GPSC, is designed for aspirants who are targeting GPSC and definitely useful for other job oriented technical exams such as RPSC, MPSC, MPPSC, UPSC, RRB JE, SSC JE etc by Exam Acharya. This book provides knowledge of the field and also helpful hints to make the study and understanding easier to the aspirants. Each chapter in this book has been meticulously designed by the state PSC's toppers and experienced faculties with the idea of maximizing the potential of an individual in a limited time. Every chapter in the book is logically divided to various sections while ensuring that the content in the book is self-sufficient and requires no cross referencing. Extra efforts have been made to simplify and summarize the theoretical aspects of the subject. Over all the whole content of the book furnishes the students with the knowledge of the subject and paves a confident path for the aspirants to accomplish success in state PSC's.

Key Features:

- Conforms to the latest syllabus prescribed by GPSC.
- Presents each topic in a lucid manner for a quick recap.
- Facilitates quick revision of concepts.

Prepared by

Mukesh Rai

Guidelines for the Aspirants

How to use this book?

- While preparing a subject, first cover all the theoretical topics of each chapter so that you will get a basic idea about particular topic.
- After covering the theoretical portion, solve the questions under “CLEAR YOUR CONCEPT” title.
- After covering the questions under “CLEAR YOUR CONCEPT” move towards the next set of questions under “TEST YOUR SELF” title.
- After finishing the theory and numerical portion of this book for each chapter, solve previous year GPSC questions which is provided in GPSC – CIVIL ENGINEERING book.
- After solving the previous year GPSC questions, for getting best results give the weekly, mid subject and full-length test prepared by Exam Acharya.

SURVEYING

Classification of surveys, various methodologies, instruments & analysis of measurement of distances, elevation and directions, Field astronomy, Global Positioning System, Map preparation, Photogrammetry, Remote sensing concepts, Survey Layout for culverts, canals, bridges, road/railway alignment and buildings, Setting out of Curves.

INDEX

CHAPTER – 1

INTRODUCTION OF SURVEYING

Surveying is the art of determining the relative positions of points on, above or beneath the surface of earth by means of direct or indirect measurements of distance, direction end elevations.

OBJECT OF SURVEYING

The aim of surveying is to prepare a map to show the relative positions of the objects on the surface of the earth.

CLASSIFICATION OF SURVEYING

1. On the Basis of Curvature of the Earth

A) Plane Surveying

It is that type of surveying in which curvature of the earth surface is not included in the measurements (i.e. spheroidal shape is neglected). This is because plane surveying is carried out over a small area where average degree of accuracy is required. In such surveying is a line joining any two points is considered as straight. The triangle formed by any three points is considered as a plane triangle and the angles of the triangle are assumed to be plane angles. Plane surveying is conducted by state agencies like the irrigation department, Railway department etc. Plane surveying is done on an area of less than 250 km^2.

b) Geodetic surveying:

The surveying in which curvature of earth is included in the measurements is known as geodetic surveying. It is carried out over larger area and where higher degree of accuracy is required. The line joining any two points is considered as curved line. The triangle formed by any three points is

iii. City surveying

The surveying in which design and drawing of any project related to citizen welfare is prepared, known as city surveying. The project like water supply, sewage treatment and park development etc. comes under city surveying.

b) Marine Surveying or Hydrographic Surveying

The surveying of area inside the large water bodies is known as hydrographic surveying. It includes determination of discharge through a stream, capacity of reservoir and determination of MSL etc. It is also used to determine the depth of water through sounding and observing the fluctuations of the ocean tide.

C) Astronomical Surveying

When the absolute location of a point or line is determined with respect to the heavenly bodies like sun or any fixed star, is defined as astronomical surveying.

3. On the Basis of Object of Surveying

a) Engineering Surveying

The surveying related to any engineering project like construction of highway, railway track, dam etc, is known as engineering surveying. It includes Preliminary study, design and drawing, estimation of cost and quantities etc.

b) Defence Surveying

In this surveying the points of strategic importance are located.

c) Archeological Surveying

It includes unearthing of relics from antiquity.

d) Geological Surveying

It includes exploring the mineral wealth of earth and its geological features.

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Building Material and Construction

Dream is not that which you see while sleeping it is something that does not let you sleep.

A.P.J. Abdul Kalam

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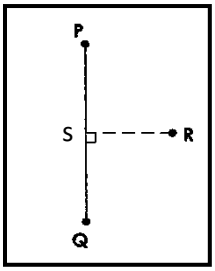
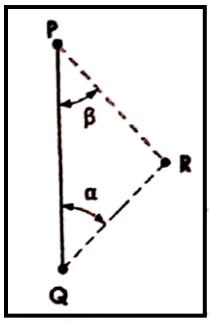
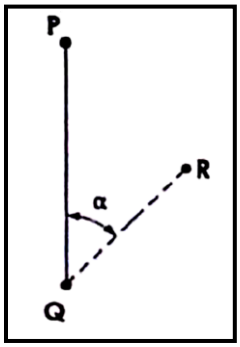


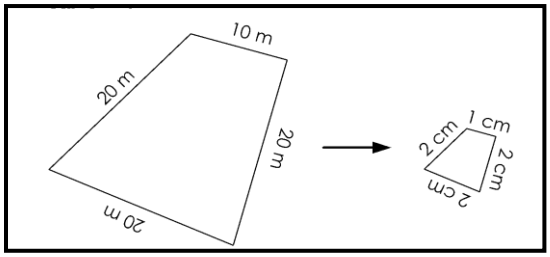
c) In this method the distance PR and QR are not measured but angle RPQ and angle RQP are measured with an angle measuring instrument knowing the distance PQ and R is plotted either by means of a protractor or by solution of triangle PQR. This principle is very much used in triangulation. This is known as compass surveying.



d) The distance QR and the angle PQR can be measured and point R is plotted either by means of a protractor or trigonometrically. This principle is used in traversing.



e) Angle RQP and distance PR are measured and point R is plotted either by protracting an angle or swinging an arc from P or plotted trigonometrically. This principle used in traversing.



$$scale = \frac{map\ or\ plan\ distance}{ground\ distance}$$

If the scale of the map is 1 cm = 10m, it means that 1 cm on paper will represents 10m on ground.

Note
- On assuming a scale for drawing of map only size of actual appearance can be changed (shape can't be changed),
- As the size of scale is reduced the accuracy of the map is increased.
- Scale is also defined as the fixed ratio of the distance marked on plan to the actual measurement on the field.

REPRESENTATIVE FRACTION

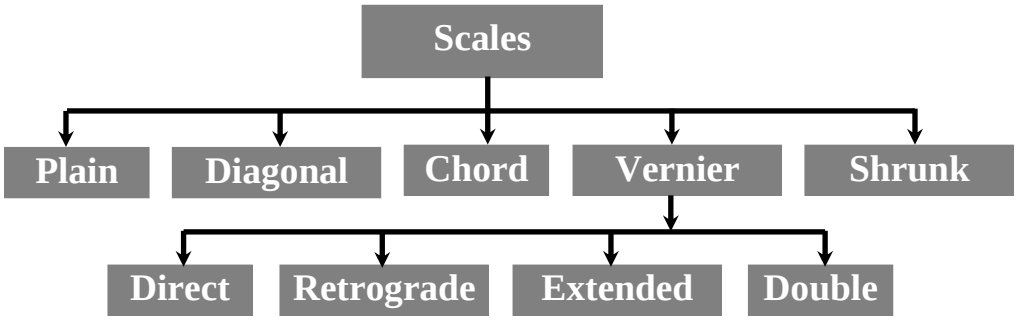
The ration of map or plan distance to the corresponding ground distance is independent of unit of measurement and is called representative fraction.

E.g. If the scale is 1 cm = 10m

$$RF = \frac{1\ cm}{10\ m} = \frac{1\ cm}{1000\ cm} = \frac{1}{1000}$$

NOTE
- In R.F both numerator and denominator must be taken in same unit.

TYPE OF SCALES



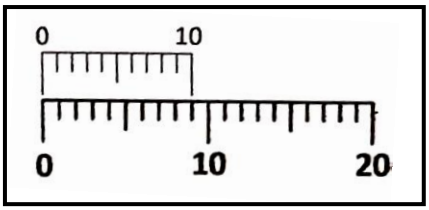
Vernier Scale

It is a device for measuring accurately the fractional part of the smallest division on a graduated scale.

Principle of vernier is based on the fact that the eye can perceive without strain and with considerable precision when two graduation coincide two from one continuous straight line.

There are four types of vernier scale:

1. *Direct Vernier*



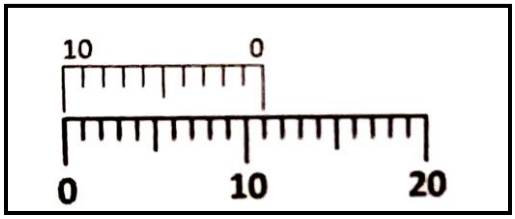
The direct Vernier has divisions which are slightly shorter than those of the main scale. Let us assume that "n" divisions on the Vernier scale are equal in length to (n-1) divisions on the main scale. Thus,

nv= (n -1)s

The least count (LC) is therefore given by, L.C. = s – v = s – $\frac{(n-1)}{n}s = \frac{s}{n}$

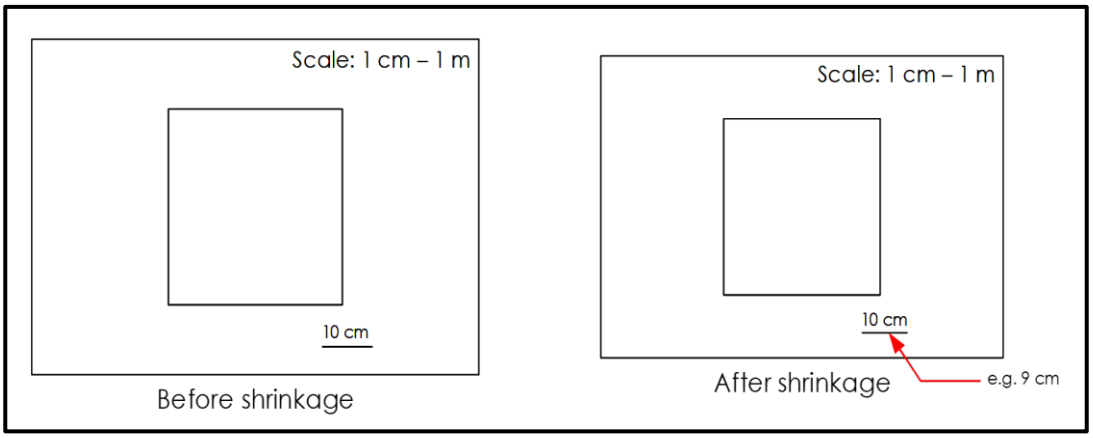
LC of the Vernier is the equal to the value of smallest division on the main scale divided by the total number of division on the Vernier.

2. *Retrograde Vernier*



Shrunk Scale

Shrunk scale is used to eliminate the effect of shrinkage in paper oof map or calculation of actual dimenscions from plotted dimensions.



shrunk scale = shrinkage factor x original scale

Shrinkage factor = $\frac{shrunk\ length}{original\ length}$

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Total weekly test : 35

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TEST YOUR SELF :

Qu6) The plan of a map was photo copied to a reduced size such that a fine originally 100 mm, measures 90 mm. The original scale of the plan was 1:1000. The revised scale is

a) 1 : 900
b) 1 : 1111
c) 1 : 1121
d) 1 : 1221

Qu7) The shrinkage factor of an old map is found to be 15/16 and the representative fraction of the map is 1/1600. The corrected scale for the map is

a) 1/1600
b) 1/1500
c) 1/1706.6
d) None of the above

Answer

1-(c), 2-(b), 3-(a), 4-(c), 5-(c), 6-(b), 7-(c)

iii) Odometer or speedometer

The odometer or speedometer is an instrument for registering the no. of revolution of a wheel. The odometer is fitted to a wheel which is rolled along the line whose length is required. The number of revolution registered by the odometer can then be multiplied by circumference of the wheel to get the distance.

iv) Pacing

Measurements of distance by pacing is chiefly confirmed to the preliminary surveys, where a surveyor is called upon to make a rough survey as quickly as possible.

v) Chaining

Chain is a term which is used to denote measuring distance either with the help of a chain or a tape and is the most accurate method of making direct measurements. For work of ordinary precision, a chain can be used. For higher precision a tape can, be used.

TYPES OF CHAIN

a) Metric chain (IS 1492: 1970):

- It comes in lengths of 5, 10, 20 and 30 m.
- Chain consist of galvanised mild steel wire of 4mm diameter known as link.
- The 20 m chain is divided into 100 links each of 0.2 m.
- The 30 m chain is dived in 150 links, so each link is of 0.2 m.
- Tallies are fixed on every meter length in 5 m and 10 m chains, whereas they are fixed on every 5m length in 20 m and 30 m chain.
- Brass rings are fixed on every meter length in 20 m and 30 m chain but except the locations where tallies are provided.

e) Steel Band

Steel band or band chain consists of a long narrow strip of blue steel of uniform width of 12 to 16 mm and thickness of 0.3 to 0.6m. Metric steel bands are available in length of 20 or 30 m.

TAPES

Tapes can be classified in following forms.

1. Cloth tape
2. Steel tape
3. Metallic tape
4. Invar tape

Invar Tape

Mostly preferred tape, because invar is the alloy of nickel (36%) and steel (64%)and has very low coefficient of thermal expansion.

CHAINING INSTRUMENTS

1. Arrows

- These are also called marketing or chaining pins.
- These are used to mark the end of the chain during the process of chaining.
- Length of arrow is 400mm.
- Arrows are made of good quality steel wire of 4 mm diameter.

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Construction, Planning and Management

"All Birds find shelter during a rain.
But Eagle avoids rain by flying above
the Clouds."

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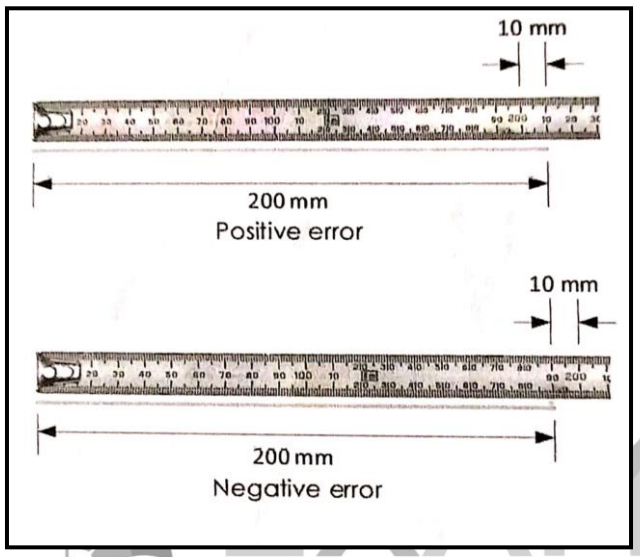
NATURE OF ERROR

The error shown the two types of nature i.e. positive and negative.

If the designation length of tape is shorter than original length of tape than always, the measure length will always be greater than actual value and error will be positive and vice versa.



NATURE OF CORRECTION

Two types of corrections are possible:

1. Additive
2. Subtractive

Note
- The nature of error always remains opposite to the nature of correction.
- The magnitude of error and correction remains same for one measurement.

1. Correction Due to Pull or Tension

If the pull applied during measurement is more than the pull in which tape was standardized the length of the tape increases. Measured distances becomes less and correction applied is positive and vice versa.

The distance measured along the slope is always greater than the horizontal distance and hence the correction is always subtractive.

Let,

AB = L =inclined length measured,

AB_1 = Horizontal length = AB_2

h = Difference in elevation between the length

c_s = Slope correction

c_s =AB - AB_1

= L - $\sqrt{L^2 - h^2}$

From Binominal theorem we get, $c_s = L - L[1 - \frac{h^2}{2L^2} - \frac{h^4}{8L^4}]$

Since h < L hence neglecting the terms containing $(\frac{h}{L})^4$ and so on.

$$c_s = L - L[1 - \frac{h^2}{2L^2}]$$

$$\therefore \boldsymbol{c_s = \frac{h^2}{2L}}$$

$$AB_1 = AB\cos\theta = L\cos\theta$$

$$c_s = AB - AB_1$$

$$= L - L\cos\theta$$

$$\therefore \boldsymbol{c_s = L\,(1 - \cos\theta)}$$

Where

l = Actual distance between A and B,

l' = length of chain (under sag)

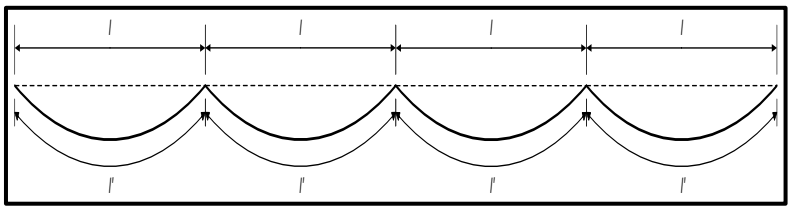
P = force applied on both ends of chain

h = central dip

w = self weight per unit length of chain

W = Total self weight of chain

Now sag correction for "n" sags,



If total "n" sags are taking place,

Total sag correction = n (correction for one sag)

$$= n[\frac{l'(wl')^2}{24P^2}]$$

$$= \frac{(nl')(wl')^2}{24P^2}$$

$$= \frac{L'(wl')^2}{24P^2}$$

$$= \frac{L'(wl')^2}{24P^2} X (\frac{n}{n})^2$$

$$= \frac{L'w^2n^2l^2}{24P^2n^2}$$

$$= \frac{L'w^2L'^2}{24P^2n^2}$$

$$= \frac{L'W^2}{24P^2n^2}$$

$$\therefore C_{sag_n} = \frac{L'W^2}{24P^2n^2}$$

Where, L' = Total length of chain in all sags.

CALCULATION OF MEASURED QUANTITY DUE TO FAULTY TAPE OR CHAIN

If,

l = correct length of tape

l'= faulty length of tape = l + Δl

1. Length

L= Actual length or true length of the measurement,

L= Faulty measured length.

l x L = l' x L'

$$\mathbf{L = \frac{l'}{l} x\ L'}$$

2. Area

A = Actual area or true area of the measurement

A'= Faulty measured area.

$l^2XA = l'^2XA'$

$$\mathbf{A = (\frac{l'}{l})^2 \times A'}$$

A $= [\frac{(l+\Delta l)}{l}]^2 \times A'$

A $= (1+\frac{\Delta l}{l})^2 \times A'$

A $= (1+e)^2 \times A', \quad [\frac{\Delta l}{l} = e]$

$$\mathbf{A = (1+2e)\ x\ A'}$$

[∴ e is very small]

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Survey Station

A control point on the field from where information about the area under survey is collected in the form of linear distances, known as survey stations.

Major control points or major survey stations are marked on the outer boundary of area i.e. main stations and subsidiary stations, whereas minor control points are marked inside the survey area i.e. tie stations.

Survey Line

A line joining the two control points or a control point with base line is known as survey line.

a) Base Line

It is the reference line of survey which connects two far distance major control points. The base line should be selected in such a way that, it can cover most of the survey area.

The end points of a base line are known as main stations.

b) Main Line

The survey line which connects the two major control points along the external boundary of survey area is known as main line. The control points on external boundary except main stations are known as subsidiary stations.

c) Tie Line

The line which joins a subsidiary station with a base line is known a tie line.

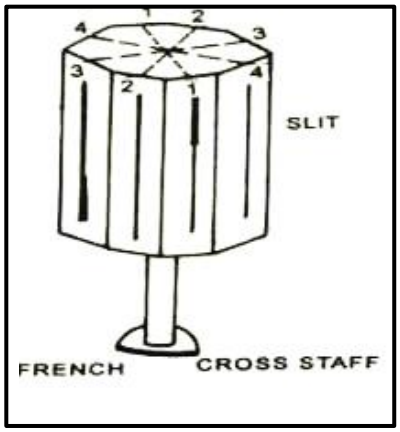
The point or stations on base line where tie line meets known as tie stations.

d) Offset

The lateral distance of a point or any ground feature from a survey line is known as offset.

survey line. If the object is not seen then the cross staff is move backward or forward till the line of sight also passes through the point.

ii) French cross staff



It contains of a hollow octagonal box. Vertical sighting sites are cut in the middle of each face. It is possible to set out angles of either 45˚ or 90˚ with the instrument.

iii) Adjustable cross staff

It consists of two cylinders of equal diameter placed one on top of each other. It is possible to set out any angle offset with the help of this instrument.

CLEAR YOUR CONCEPT :

Qu1) The book in which chain measurements are entered is called:

a) Field book
b) Record book
c) Study book
d) Chain book

Qu2) Which of the following is not a method of measuring the distances directly?

a) Pacing
b) Measurement with passometer
c) Measurement with pedometer
d) Measurement with theodolite

Qu3) In which method measurements of distances are chiefly confined to the preliminary surveys and explorations where a surveyor is called upon to make a rough survey as quickly as possible?

a) Chaining
b) Pacing
c) Measurements with passometer
d) Measurements with theodolite

Qu4) Instrument shaped like a watch and is carried in pocket or attached to one leg is _____

a) Pedometer
b) Odometer
c) Passometer
d) Speedometer

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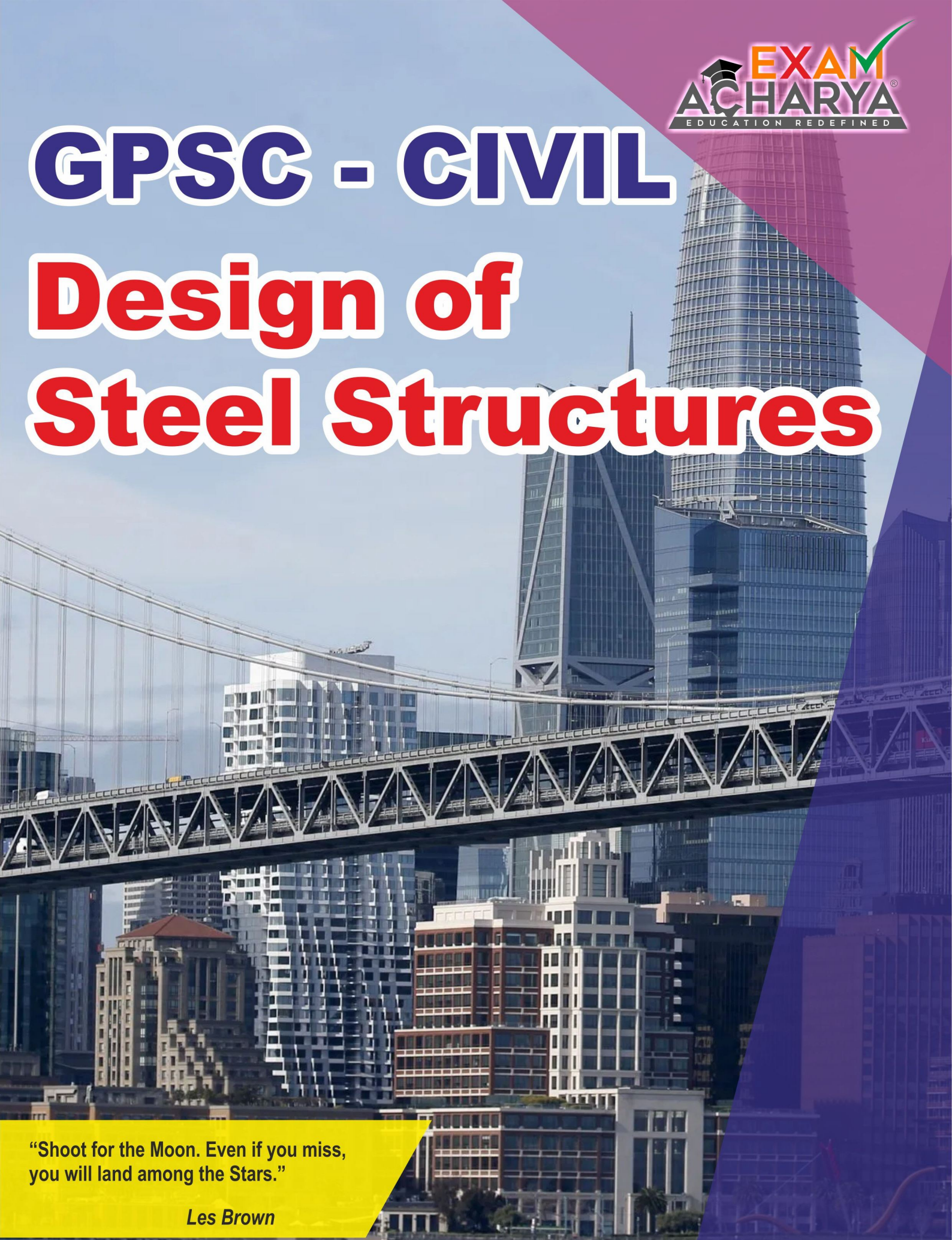
Design of Steel Structures



"Shoot for the Moon. Even if you miss, you will land among the Stars."

Les Brown

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CHAPTER – 3

COMPASS SURVEYING

Chain surveying is used where area under survey is relatively small and plane and sufficient information about the field can be collected by linear measurement and perpendicular offsets only.

But where area under survey is large and is not plane then chain surveying alone is not sufficient. In this case the angles between survey lines are also calculated with some angle measuring instruments and the method is known as compass surveying.

The angular measurement in surveying is done by two types.

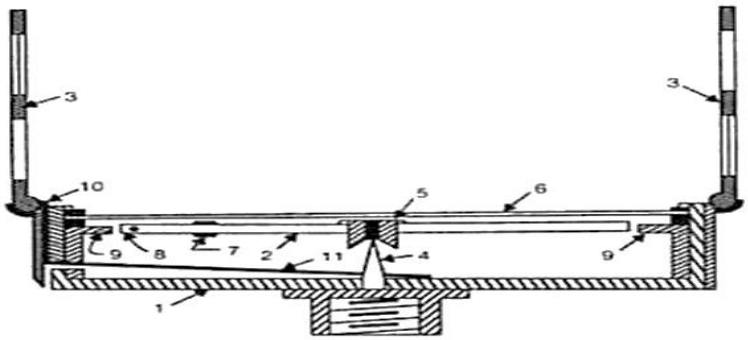
1. **Determination of angle between two lines**

   a. Theodolite

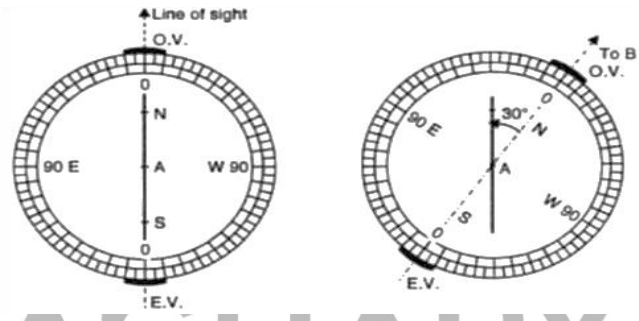
   b. Sextant

SURVEYOR'S COMPASS

It gives the magnetic bearing of line in quadrant bearing system.



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



Note

- Graduated circular ring is not attached with magnetic needle and remains stable along the line of sight.
- In this method sighting of compass and reading of bearing can't be done simultaneously.
- The graduations are marked is quadrantal bearing system heaving 0˚ at north and south and 90˚ at east and west.
- The position of east and west are interchanged.
- The instrument can't be used without a tripod.

ERROR'S IN COMPASS SURVEY

1. Instrumental Error

This type of error arises due to faulty adjustment of instrument because of following reasons,

i. The needle is not perfectly straight.
ii. Sluggish needle
iii. Plane of sight is not perfectly horizontal

IMPORTANT DEFINITION

Magnetic Meridian

The line joining the magnetic north and magnetic south pole is known as magnetic meridian (along the earth surface).

True Meridian

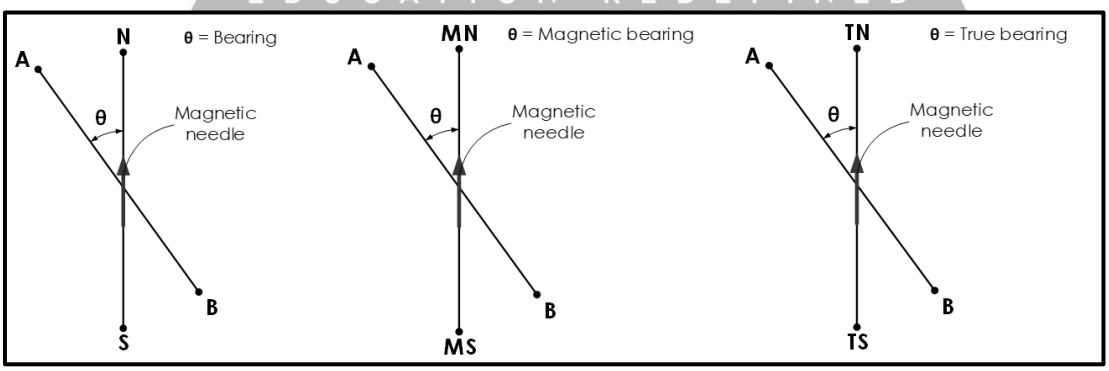
The line joining the true north and true south along the earth surface is known as true meridian.

Note

- Since the true north and true south are imaginary poles hence, true meridian is also an imaginary line.
- The position of magnetic north and magnetic south depends on the revolution of earth. As the earth tilts about its polar axis the position of magnetic north and south is also changed and due to which the direction of magnetic meridian changes.

BEARING OF A LINE

Angle of any line measured from a meridian is defined as the bearing of line. If the angle is measured from magnetic meridian then it is known as magnetic bearing and if angle is measured from true meridian then it is known as true bearing.



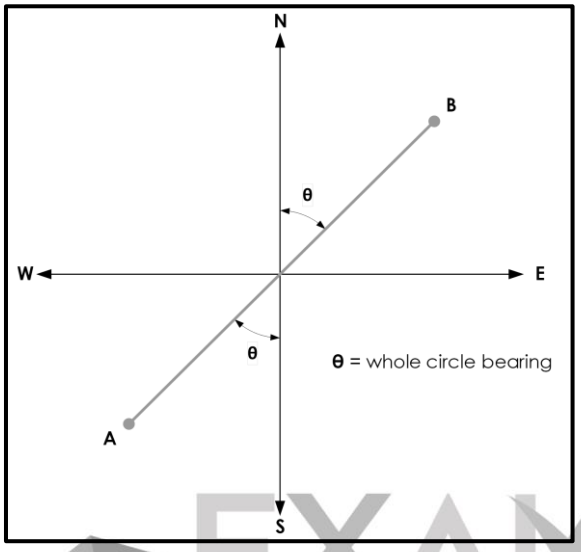
Grid Bearing

Horizontal angle which the line makes with grid meridian is called grid bearing.

DESIGNATION OF BEARING

1. Whole Circle Bearing (WCB) or Azimuth System

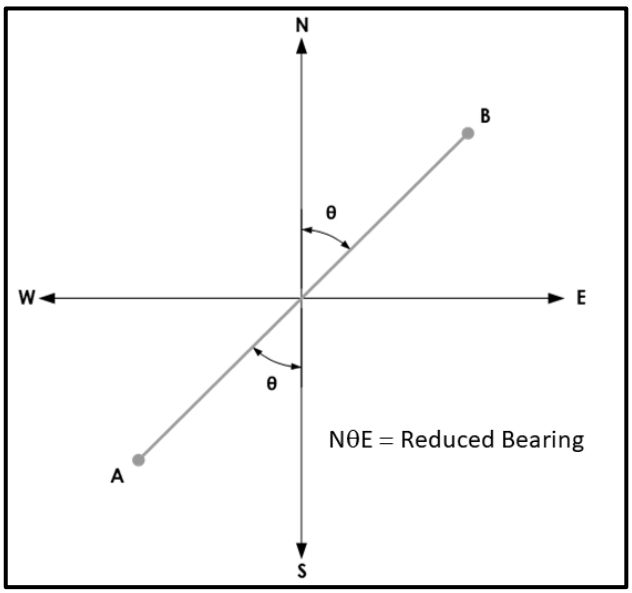
In this system bearing are measured in clockwise direction either from north axis or south axis.



Note

- Generally, measurement of WCB is preferred from north axis only due to uniformity of drawing sheet.

2. Quadrantal Bearing (QB) System or Reduced Bearing System



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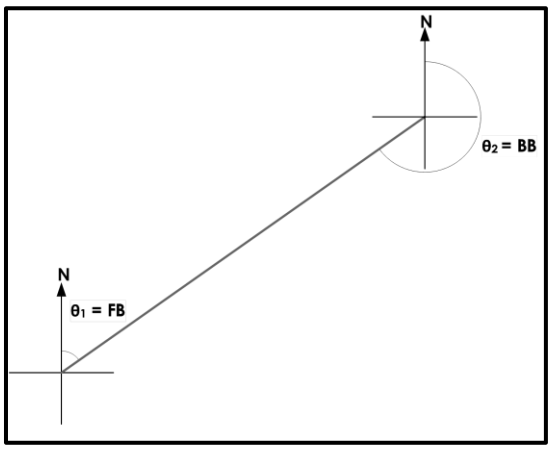
back bearing. Generally it is considered at end point of line.



$$\mathbf{BB = FB \pm 180^\circ}$$

If, FB >180°, use –ve sign

If, FB <180°, use +ve sign

LOCAL ATTRACTION

A magnitude meridian is established by a freely suspended compass needle, uninfluenced by other attraction forces. However due to presence of local magnetic field the compass needle can be slightly deviated from actual magnetic north direction.

Local attraction is the term which shows the influence of local attraction forces on compass needle due to various reasons like presence of magnetic (iron ore) in ground, electric wires carrying high voltage current, nearby steel structure or railway track or steel bridge etc. If difference between fore bearing and back bearing of a line is other than 180˚, than it can due to local attraction at one or both the ends of line.

CLEAR YOUR CONCEPT:

Qu1) The difference between magnetic north and geographic north is:

a) Dip
b) Strike
c) Declination
d) Bearing

Qu2) The direction of a line relative to a given meridian is called:

a) Bearing
b) Declination
c) Angle
d) Dip

Qu3) How many types of a compass are used in surveying?

a) 4
b) 2
c) 3
d) 5

Qu4) _____ bearing is measured in the direction of survey.

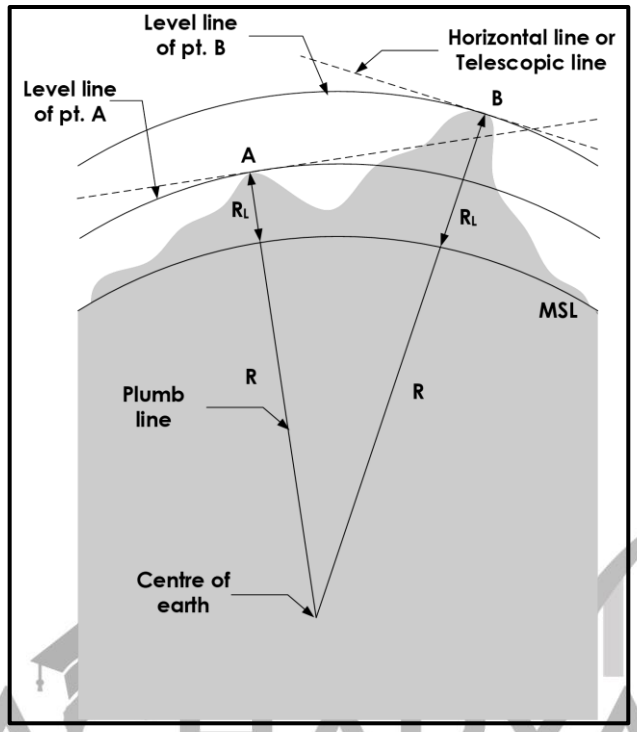
a) Primary
b) First
c) Fore
d) Front

Qu5) In a reduced bearing system, bearing is measured from:

a) Nearest one (North or South)
b) South
c) West
d) North

CHAPTER – 4

LEVELLING



It is the branch of surveying in which elevation of a point with respect to a datum is measured.

Level Line

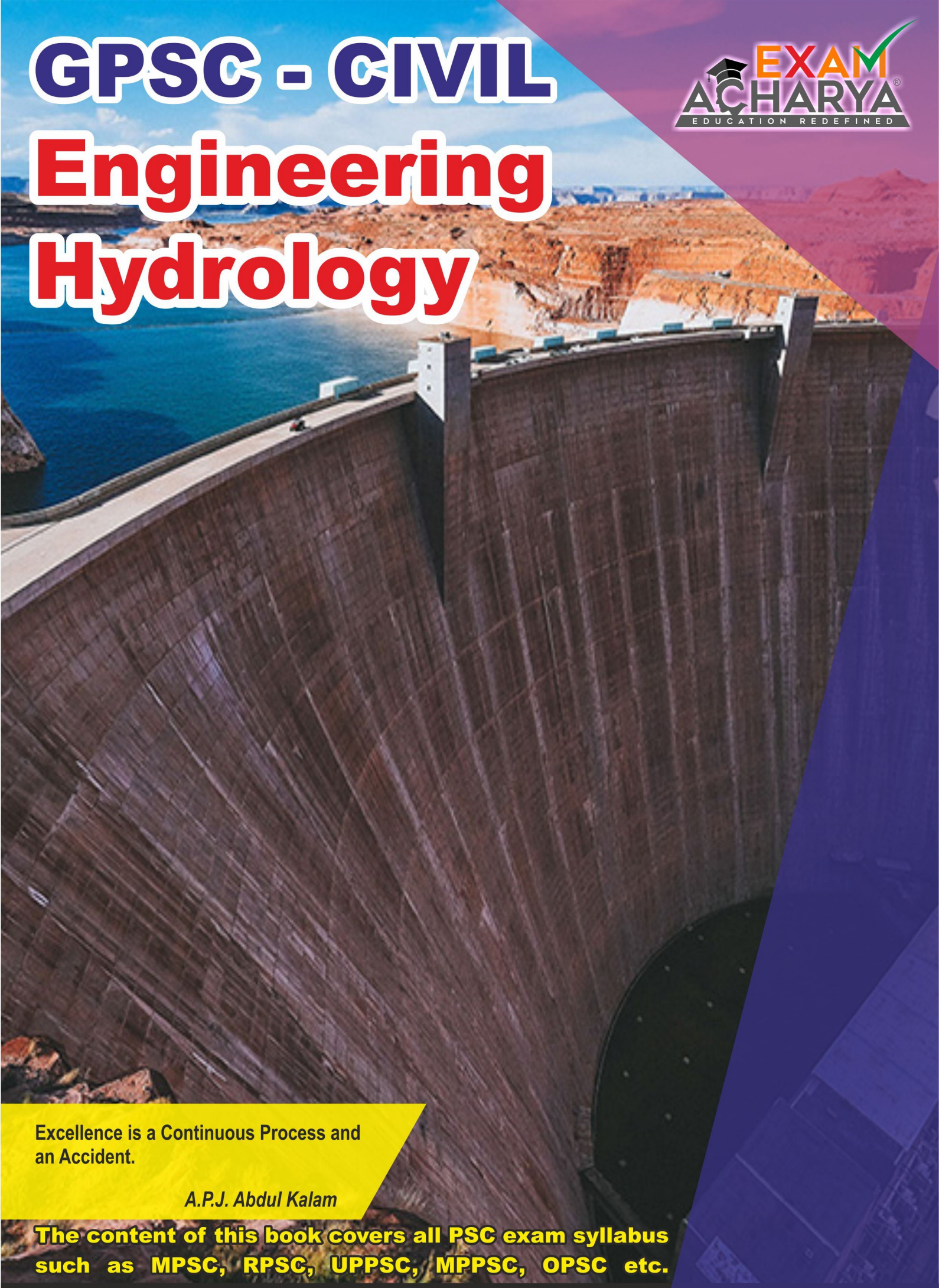
It is the line at any point of earth surface which remains parallel to its curvature or MSL.

It is the line which remains perpendicular to the direction of gravity at each and every point.

Plumb Line

It is the line which joins any point of earth surface to the centre of earth. It shows the direction of gravity at any point on the earth surface. It remains perpendicular to level line.

GPSC - CIVIL Engineering Hydrology



EXAM ACHARYA
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Excellence is a Continuous Process and an Accident.

A.P.J. Abdul Kalam

The content of this book covers all PSC exam syllabus such as MPSC, RPSC, UPPSC, MPPSC, OPSC etc.

1) ***Great Trigonometric Survey Bench Marks (G.T.S.B.M)***

They are established by the survey of India department with very high precision at large intervals (about 100 km) all over the country with respect to the standard datum. They are also shown on G.T.S. maps.

2) ***Permanent Bench Marks***

They are the fixed points of reference established between G.T.S. B.M by the government agencies like P.W.D., Railways, Irrigation etc. They are established on permanent points like parapet of bridge or culvert, plinth of a building, kilometer stone, platform etc.

3) ***Arbitrary Bench Marks***

They are reference points, the elevations of which are arbitrarily assumed (not with reference to any fixed datum) for small levelling operations.

4) ***Temporary Bench Marks***

They are reference points established when there is a break in the work or at the end of day's work. They are established on definite and permanent objects.

LEVELLING INSTRUMENT

1. Level

A level is the instrument which provides a horizontal line of sight.

It is of following types,

1) Dumpy level

2) Wyle or 'v' level

3) Tilting level

4) Reversible level

5) Auto level

Note
- If type of staff is not mentioned in question then choose the answer as 5 mm.

b. Targeted staff

A targeted staff contains a blank rod which is painted by white colour and the target point is obtained through a moving finger against which the reading is taken by a staff man.

IMPORTANT TERMS RELATED TO LEVELLING

Station

It is the point where levelling staff is placed.

Note
- Station is not the point where instrument is held.

Height of Instrument (HI)

The vertical elevation of line of sight from a standard datum (MSL) is known as Hl.

Back Sight

It is the first observation which is taken after the setting of the instrument in backward direction.

The back sight is always measured on a point whose RL is already known.

Note
The purpose of the BS is to find the Hl. It is also known as positive sight because it is always added in the elevation of the point on which is taken. The very first back sight of a levelling project is taken on BM or any other reference point.

Fore Sight

It is the last sight taken from the location of the instrument.

Note
- It is considered as negative sight as it is always subtracted from the Hl to get the elevation or RL of the station.

Difference Between

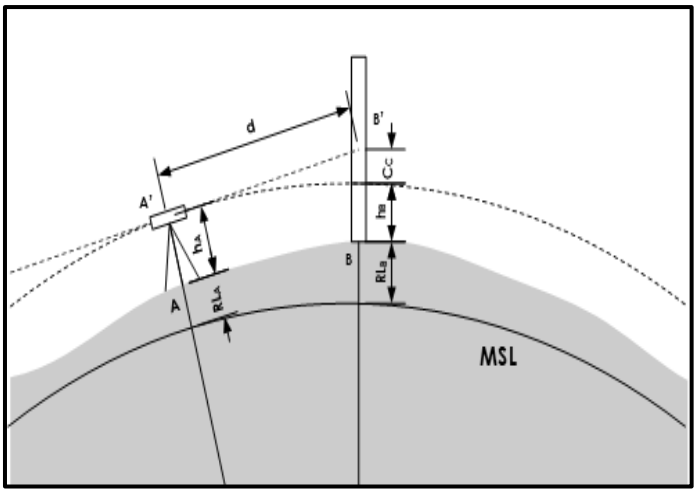
(H.I. Method) Collimation method	Rise and fall method
1. It is more rapid and less tedious	1. It is laborious and more tedious
2. Less number of calculations are required.	2. More calculations are required.
3. Less accurate.	3. More accurate.
4. There is no check on R.L. of intermediate points. Hence, there are chances of mistakes.	4. There is a cross check on R.L. of intermediate points. Hence, there are less chances of mistakes.
5. There are two checks on the calculations of RLs ΣBS – Σ FS = Last R.L. – First R.L	5. There are three checks on the calculations of RLs ΣBS – Σ FS = Σ Rise – Σ Fall =Last R.L. – First R.L
6. This method is suitable for profile levelling where there are number of intermediate sights.	6. This method is suitable for Fly levelling, precise levelling where there are number of intermediate sights.

CORRECTION IN DIFFERENTIAL LEVELLING

1. Correction Due to Curvature of Earth

When the curvature of earth comes into account then the observed reading of staff on a faraway point is apparently increased, because a horizontal line lies above the level line.

Hence, a correction of subtractive nature is required for correct reading of staff.

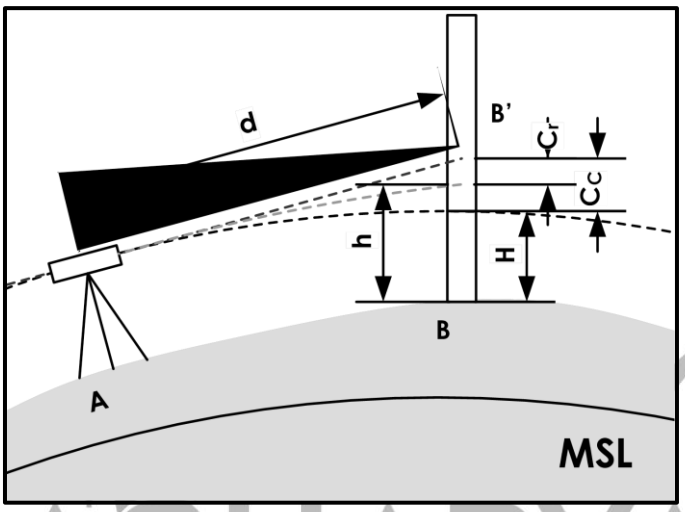


From practical observation it is seen that C_r remains 1/7 of C_c. It is always of additive nature.

$$\therefore C_r = \frac{1}{7} C_c = 0.01121d^2$$

where R & d is in 'km' and C_r is in 'm'

3. Combine Correction for Refraction and Curvature of Earth



Where,

h = Observed reading at B.

H = Correct reading at B.

$$H = h - (C_c - C_r)$$

$$\mathbf{H = h - 0.06727d^2}$$

Note:

- Curvature correction and combined correction are always of subtractive nature whereas refraction correction is always of positive nature.

New Batches are going to start.....

Contact:

7622050066

Test Series Available..

Total weekly test : 35

Total mid subject test : 16

Total full length test : 13

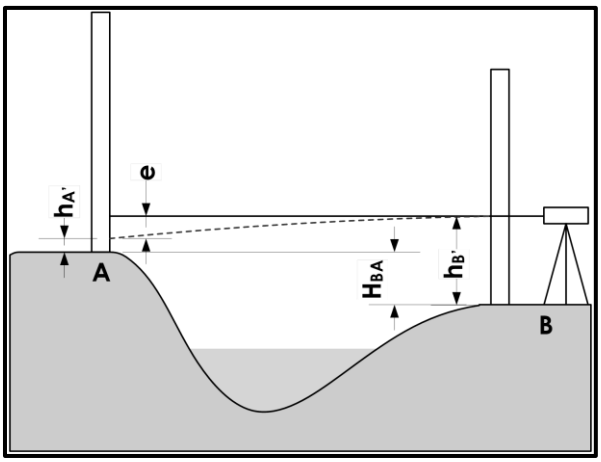
Mock test : 16

Total test : 80

Differential level between A and B is,

$$H_{AB} = (h_B + e) - h_A$$

When instrument is at "B"



Differential level between A and B is

$$H_{AB} = (h_{B'} - (h_{A'} + e)$$

Correction differential level between A and B = Average of both the cases.

$$H = \frac{H_{AB} + H_{BA}}{2}$$

$$H = \frac{(h_B - h_A) + (h_{B'} - h_{A'})}{2}, \text{ (when A is above B)}$$

$$H = \frac{(h_A - h_B) + (h_{A'} - h_{B'})}{2}, \text{ (when B is above A)}$$

Reciprocal levelling is independent of type and value of error. By the counter levelling error is balanced and the correct differential level between two points can be calculated as following.

$$H_{differential} = \frac{\left(\begin{matrix}\text{Difference of observation} \\ \text{from one point}\end{matrix}\right) + \left(\begin{matrix}\text{Difference of observation} \\ \text{from second point}\end{matrix}\right)}{2}$$

CLEAR YOUR CONCEPT:

Qu1) A levelling staff is used to establish:

a) Horizontal line of sight
b) Vertical line of sight
c) Location of points
d) Distance of points

Qu2) Which of the below cannot be used to measure vertical heights?

a) Self level
b) Aneroid barometer
c) Transit
d) Hypsometer

Qu3) How many types of self-reading staffs are available?

a) 5
b) 2
c) 3
d) 4

Qu4) How many methods are used in levelling?

a) 3
b) 2
c) 4
d) 5

Qu5) In _____ levelling, the first and last point are at a far distance.

a) Fly
b) Differential
c) Profile
d) Reciprocal

CHAPTER – 5

THEODOLITE SURVEY

1. Vertical Axis

The vertical axis is the axis about which the instrument can be rotated in a horizontal plane. It is also known as the azimuth axis.

This is the axis about which the lower and upper plates rotate.

2. Horizontal Axis (Trunnion Axis)

It is the axis about which the telescope and the vertical circle rotate in vertical plane.

3. Line of Sight or Line of Collimation

It is the imaginary line passing through the intersection of the crosshairs of the diaphragm and the optical centre of the objective.

4. Axis of Telescope

It is the line joining the optical centre of the object glass to the centre of the eye piece.

5. Face Left

When the vertical circle of the theodolite is on the left of the observer, the position of the theodolite is called face left.

6. Face Right

When the vertical circle of the theodolite is on the right of the observer, the position of the theodolite is called face right.

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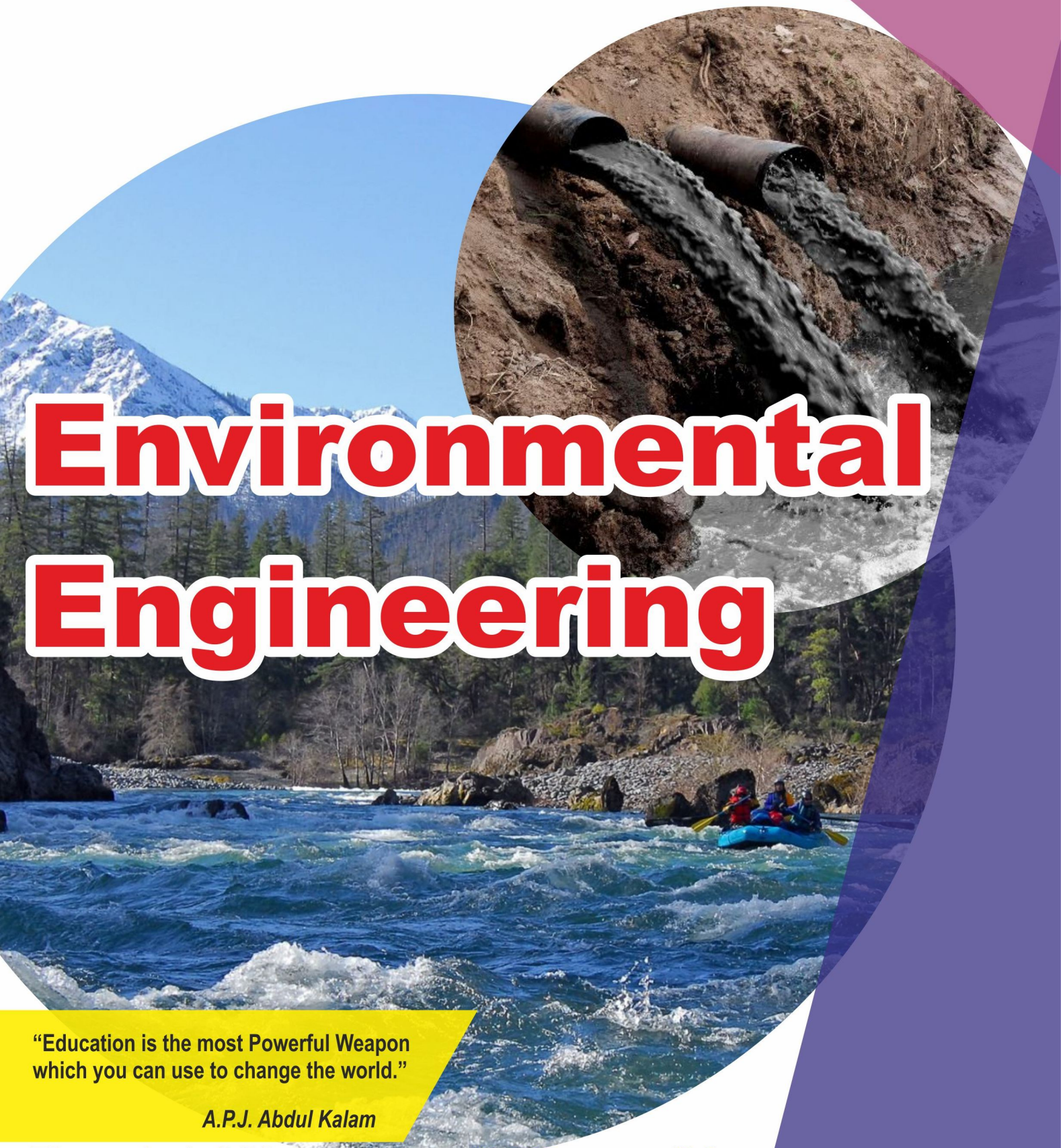


Environmental Engineering

"Education is the most Powerful Weapon which you can use to change the world."

A.P.J. Abdul Kalam

The content of this book covers all PSC exam syllabus such as MPSC, RPSC, UPPSC, MPPSC, OPSC etc.

14. Axis of Level Tube

The axis of the level tube or the bubble line is a straight line tangential to the longitudinal curve of the level tube at its centre. The axis of the level tube is horizontal when the bubble is at centre.

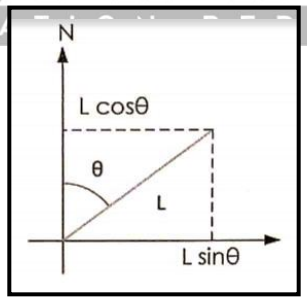
LATITUDES AND DEPARTURE

The projection of survey line on the reference meridian in the north south axis, is known as latitude.

If the projection of line is measured on north direction then it is known as north latitude or positive latitude or northing. If it is on south direction, known as south latitude or negative latitude or southing.

On the other hand the projection of a line on reference meridian in east west direction is known as departure.

If the projection of line is measured on east direction then it is known as positive departure or east departure or easting and If it is measured in west direction then it is known as west departure, negative departure or westing.



WCB	Latitude	Departure
0° - 90°	+ L cosθ	+ L sinθ
90° - 180°	- L cosθ	+ L sinθ
180° - 270°	- L cosθ	- L sinθ
270° - 360°	+ L cosθ	- L sinθ

Note
- For closed traverse sum of latitude and sum of departure is zero.

Where,

C_L = Correction to the latitude of any side.

C_D = Correction to the departure of any side.

l_i= Length of any side.

2. Transit Method

This method is used when angular measurement is more precise as compared to linear measurements. Error in latitude and departure are distributed in proportion of latitude and departure.

$$C_L = \Sigma L \; X \; \frac{L}{L_m} \qquad\qquad C_D = \Sigma D \; X \; \frac{L}{L_m}$$

Where,

ΣD = Net sum of departure (with considering sign)

ΣL = Net sum of latitude (with considering sign)

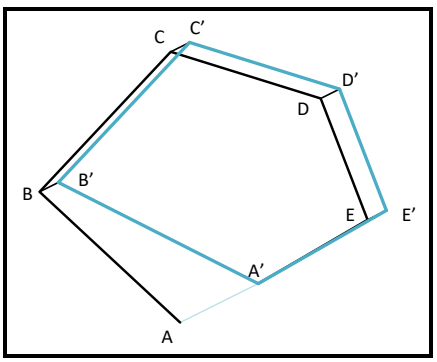
L = Latitude of any line

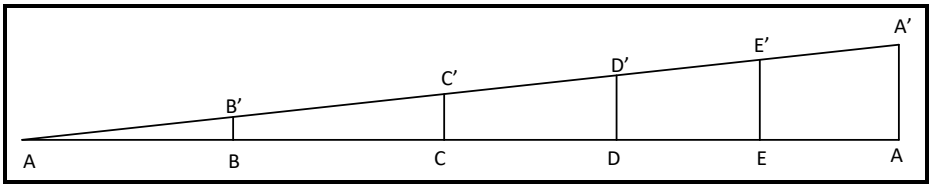
D = Departure of any line

L_m = Total sum of latitude (without considering sign)

D_m = Total sum of departure (without considering sign)

3. Graphical Method

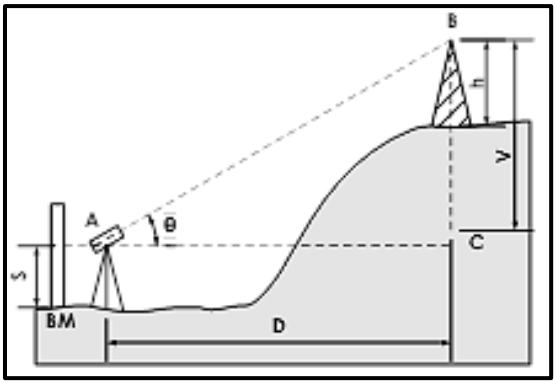




TRIGONOMETRIC LEVELLING

It involves the calculation of vertical angles and horizontal distance using the basic relationship of trigonometry.

Case – I : When distance between object and station is known



V = D tan θ

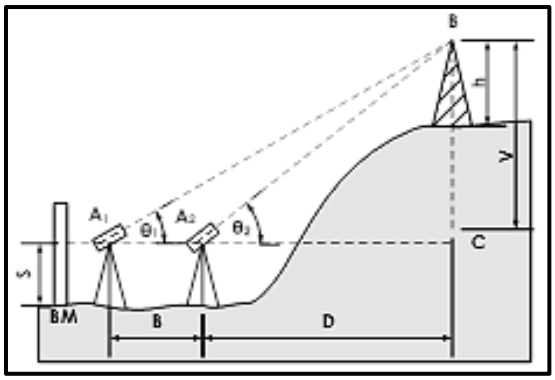
R.L. of tower's top= R.L. of B.M. + S + V + C

R.L. of tower's bottom = R.L. of B.M. + S + V – h + C

Where, C= correction due to curvature or refraction or both.

Case – II: When distance between object and station can't measure and instruments are at same RL.

In this case two instruments are used and their angle to the top of tower is calculated.



$$D = \frac{B \tan \theta_1 - s}{\tan \theta_2 - \tan \theta_1}$$

From equation (ii),

$$V = \frac{(B \tan \theta_1 - s) \tan \theta_2}{\tan \theta_2 - \tan \theta_1}$$

R.L. of tower's top = R.L of B.M. + S_1+ S + V + C

= R.L. of B.M + S_2 + V +C

R.L. of tower's bottom = R.L of B.M. + S_2 + V - h + C

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Test Series Available..

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Total mid subject test : 16

Total full length test : 13

Mock test : 16

Total test : 80

The closing error for the traverse PQRS (in degrees) is

a) 3°
b) 7°
c) 5°
d) 4°

TEST YOUR SELF:

Qu6) In a closed loop traverse of 1 Km total length, the closing errors in departure and latitude are 0.4 m and 0.5 m, respectively. The relative precision of this traverse will be

a) 1/1563
b) 1/2000
c) 1/2563
d) 1/1000

Qu7) The following details refer to a closed traverse

Line	Consecutive coordinate			
	Northing (m)	Southing (m)	Easting (m)	Westing (m)
PQ	-	437	173	-
QR	101	-	558	-
RS	419	-	-	96
SP	-	83	-	634

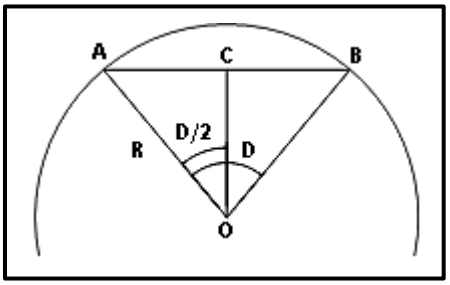
The length and direction (WCB) of closure, respectively are:

a) 1 m and 90°
b) 2 m and 90°
c) 1 m and 270°
d) 2 m and 270°

Answer:

1-(d), 2-(c), 3-(d), 4-(a), 5-(b), 6-(a), 7-(a)

RELATION BETWEEN RADIUS AND DEGREE OF CURVE



Let AB be the unit chord of 30m, O is the centre, R is the radius and D is the degree of the curve.

Here, OA = R

AB = 30m

AC = 15m

$\angle AOC = \frac{D}{2}$

From triangle OAC

$\sin\frac{D}{2} = \frac{AC}{OA} = \frac{15}{R}$

$R = \frac{15}{\sin\frac{D}{2}}$

When D is very small,

$R = \frac{15}{\sin\frac{D}{2}} = \frac{15X360}{\pi D} = \frac{1718.9}{D}$ (radian)

$$\mathbf{R = \frac{1{,}719}{D}\ (radian)}$$

TYPES OF HORIZONTAL CURVES

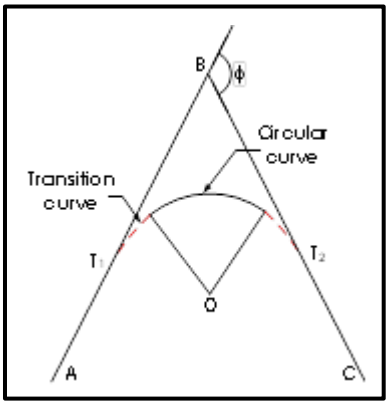
The following are the different types of curves,

1. Simple Circular Curve

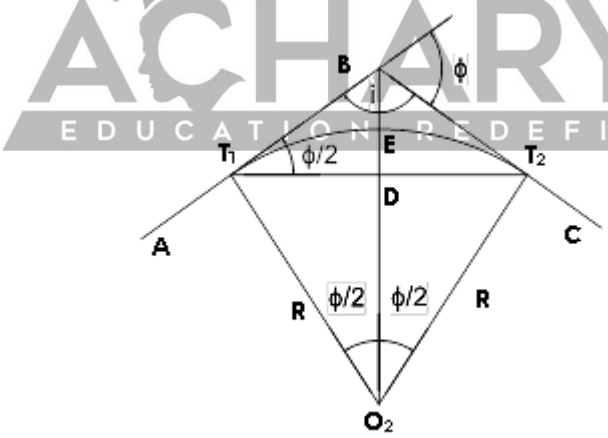
When a curve consists of a single arc with a constant radius connecting the two tangents, it is said to be a circular curve.

4. Transition Curve

A curve of variable radius is known as a transition curve. It is also called a spiral curve or easement curve. In railways such a curve is provided on both sides of a circular curve to minimize super elevation. Excessive super elevation may cause wear and tear of the rail section and discomfort to passengers.



Properties of Circular Curves



1. If the angle of intersection is given then, $\emptyset = 180° - i$
2. If radius is not given then, $R = \frac{1719}{D}$
3. Tangent length BT_1 or $BT_2 = R \tan \frac{\emptyset}{2}$
4. Length of curve = $\frac{\pi R \emptyset°}{180°} m$

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Fluid Mechanics and Hydraulic Machines

"Success Consists of going from Failure without Loss of Enthusiasm."

Winston Churchill

The content of this book covers all PSC exam syllabus such as MPSC, RPSC, UPPSC, MPPSC, OPSC etc.

(4) Simpson's Rule

$$\mathbf{A} = \frac{d}{3}[(h_0 + h_n) + 4(h_1 + h_3 + h_5 + \ldots\ldots) + 2(h_2 + h_4 + h_6 + \ldots)]$$

Note:

- Simpson's rule is applicable only when number of ordinates are odd.

Trapezoidal Rule	Simpson's Rule
Boundary between ordinates straight	Boundary between ordinates is parabolic
Can be applied for any number of ordinates.	Can be applied when number of ordinates are odd.
Gives approximate area	Gives accurate area

2. Planimeter

A planimeter is a precise instrument which measures the area of plan of any shape with more accuracy. There are two types of planimeter

(a) Amsler Polar Planimeter

(b) Roller planimeter

The most commonly used type is the polar planimeter.

The Various Component Parts of a Polar Planimeter is as Follows

(1) Tracing arm & Tracing point

(2) Anchor arm

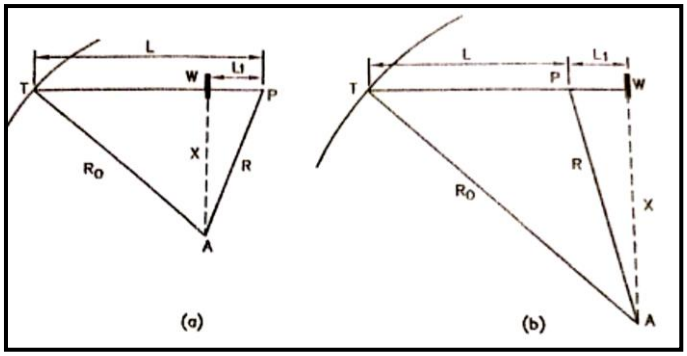
(3) Anchor point

(4) Rotating wheel

(5) Graduated drum

(6) Disc

(7) Magnifier



➢ **By Using Formula:**

(a) **Area of zero circle = M x C**

Where, M = multiplier

C = the constant

(b) **Area of zero circle =** $\pi(L^2 \pm 2LL_1 + R^2)$

Where, L = the length of the tracing arm (from hinge to the tracing point)

L_1 = the distance between the hinge (pivot)and the wheel

R = the length of anchor arm (from hinge to the anchor point)

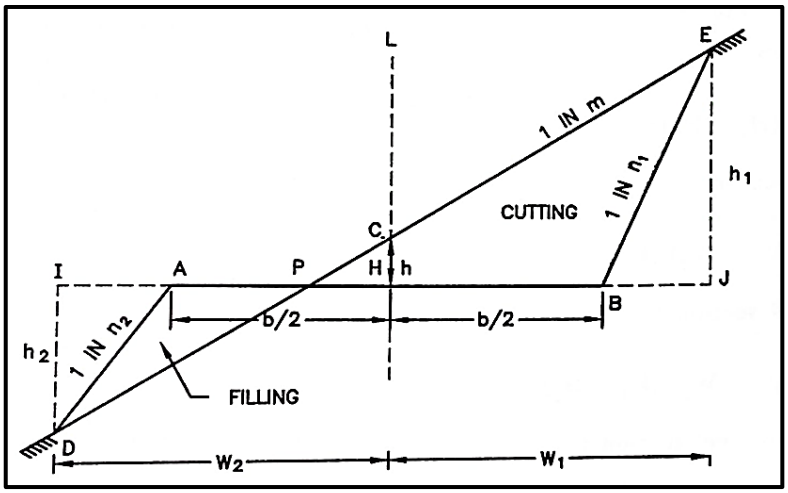
use + sign when the wheel is placed beyond the hinge and away from tracing point and - sign when it is placed between the hinge and the tracing point.

3. Computation of Volumes

(A) Level Section

$$A = (b + nh)\, h$$

n : l = H : V



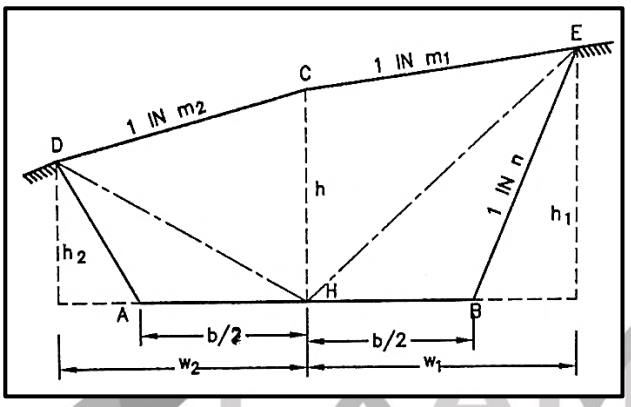
(C) Three Level Section

$$C_p = \frac{d}{12}(w_1 - w_2)(H_1 - H_2)$$

(D) Side Hill Two Level Section

$$\text{For cutting } C_{P1} = \frac{d}{12(m - n_1)}\, m^2\, (H_1 - H_2)^2$$

$$\text{For filling } C_{P2} = \frac{d}{12(m - n_2)}\, m^2\, (H_1 - H_2)^2$$



Instrument	Use
1. Box sextant	- Measure angular distance
2. Tangent clinometer	- difference in elevation between the points
3. Subtense bar	- to determine horizontal distance
4. Heliotrope	- to mark position of participants in land survey

TEST YOUR SELF:

Qu6) The length of the long chord of a simple circular curve is approximately

a) Twice the apex distance

b) Twice the mid ordinate twice

c) Twice the tangent length

d) Twice the radius of the curve

Qu7) Which one of the following is not used for setting out circular curve

a) Rankine method of tangential angle

b) Two theodolite method

c) Three theodolite method

d) Tachometric method

Answer:

1-(b), 2-(a), 3-(c), 4-(d), 5-(a), 6-(c), 7-(c)

EXAM ACHARYA
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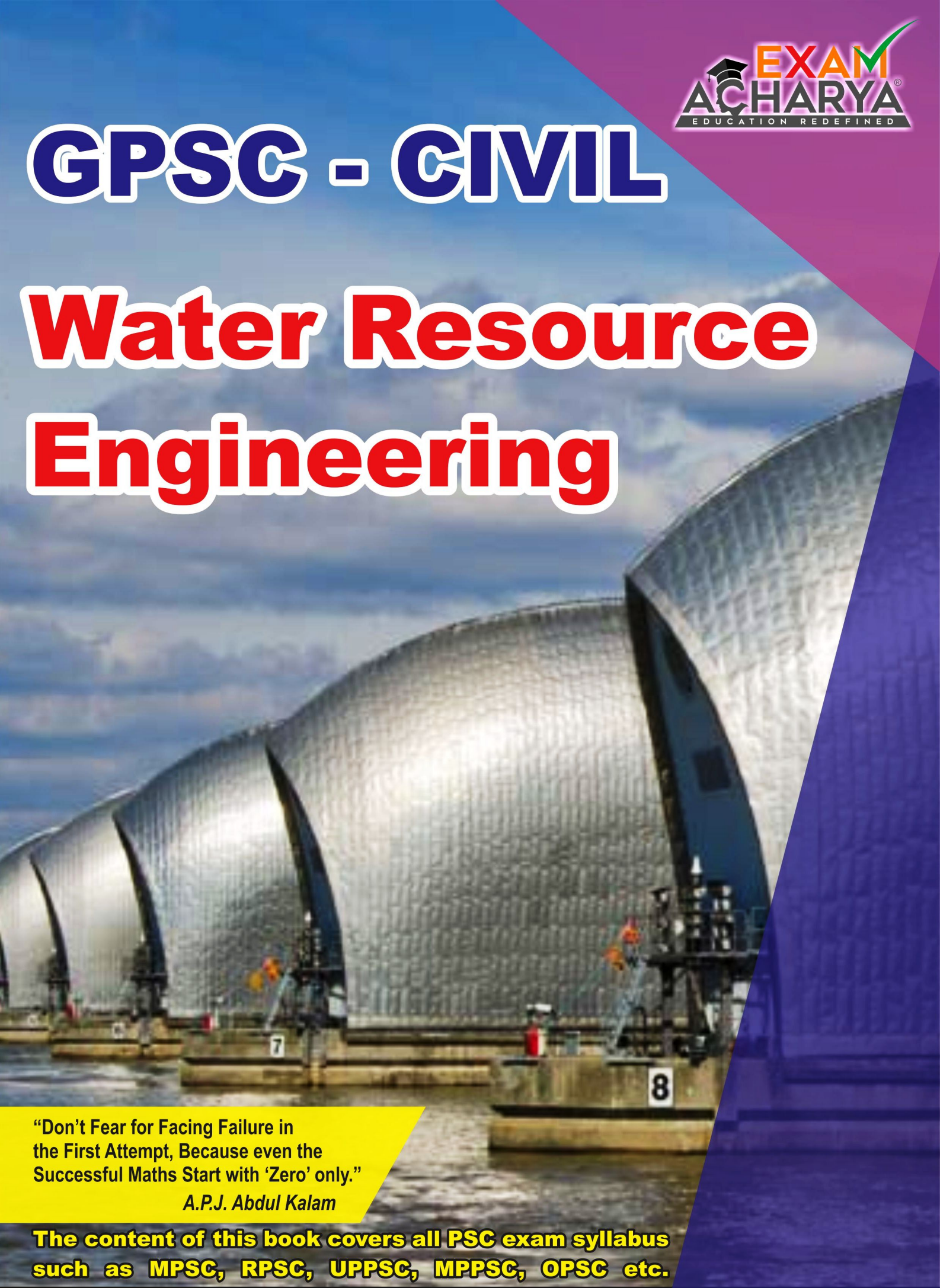
Water Resource Engineering

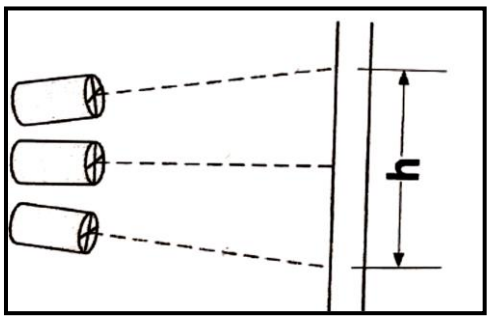


"Don't Fear for Facing Failure in the First Attempt, Because even the Successful Maths Start with 'Zero' only."

A.P.J. Abdul Kalam

The content of this book covers all PSC exam syllabus such as MPSC, RPSC, UPPSC, MPPSC, OPSC etc.

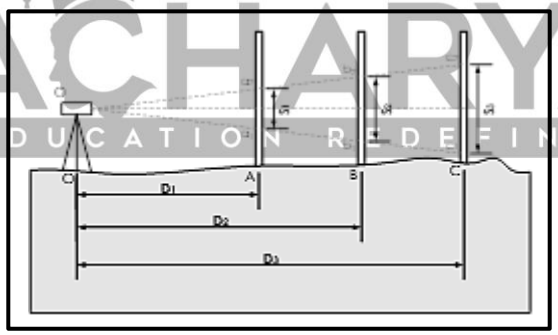
2. Tangential System



In this method, the stadia hairs are not used. The reading being taken against the horizontal crosshair. To measure the staff intercept, two pointing of the instruments are therefore necessary.

PRINCIPAL OF THE STADIA METHOD

The principal of tachometry is based on the property of isosceles triangles, where the ratio of the distance of the base from apex and the length of the base is always constant.



So according to the stated principal,

$$\frac{D_1}{S_1} = \frac{D_2}{S_2} = \frac{D_3}{S_3} = \frac{f}{i}$$

The constant $\frac{f}{i}$ is known as the multiplying constant,

Where,

f = Focal length of objective

i = Stadia intercept.

$$u = \left(\frac{s}{i} + 1\right) f$$

We can see from the diagram,

$$D = u + d$$

$$= \left(\frac{s}{i} + 1\right) f + d$$

$$= \left(\frac{f}{i}\right) s + (f + d)$$

$$\mathbf{D = ks + c}$$

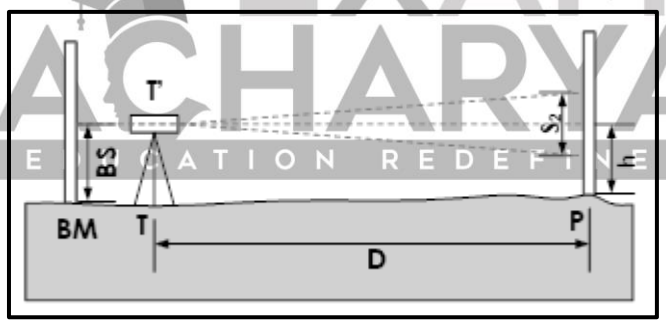
Where , k = multiplying constant $= \frac{f}{i}$

c = Additive constant = f + d

when k = 100 and c = 0, then the telescope is called as anallatic telescope.

FIXED HAIR METHOD

Case – 1: Line of Sight is Horizontal and Staff is Held Vertically



When the line of sight is horizontal, the general tachometric equation for distance is given by,

$$\mathbf{D = \left(\frac{f}{i}\right) s + (f + d) = ks + c}$$

RL of staff station P = HI – h

Where HI = RL of BM + BS

h = central hair reading

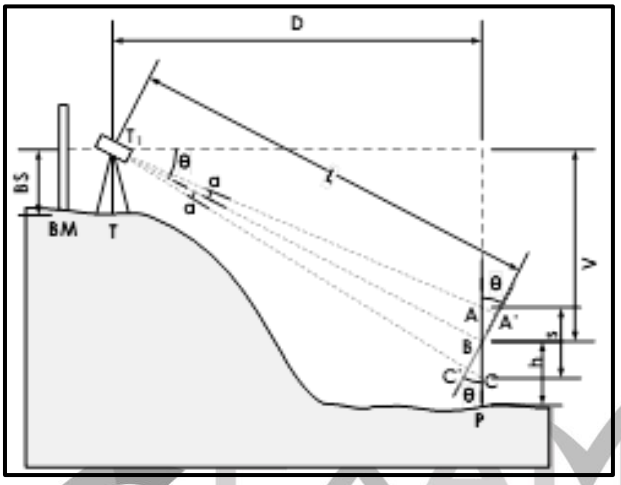
∴ V = L sin θ

= kS cos θ sin θ + c sin θ

$$V = kS\frac{\sin 2\theta}{2} + c \sin \theta$$

∴ RL of P = RL of instrument axis + V – h.

b. Considering Angle of Depression (Negative)



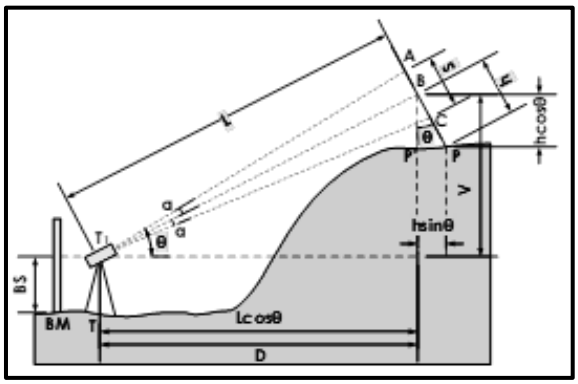
$$D = kScos^2\theta + C\cos\theta$$

$$V = kS\frac{\sin 2\theta}{2} + c \sin \theta$$

∴ RL of P = RL of instrument axis - V – h.

Case – 3: Line of Sight Inclined, but Staff Normal to it.

a. Considering Angle of Elevation (Positive)



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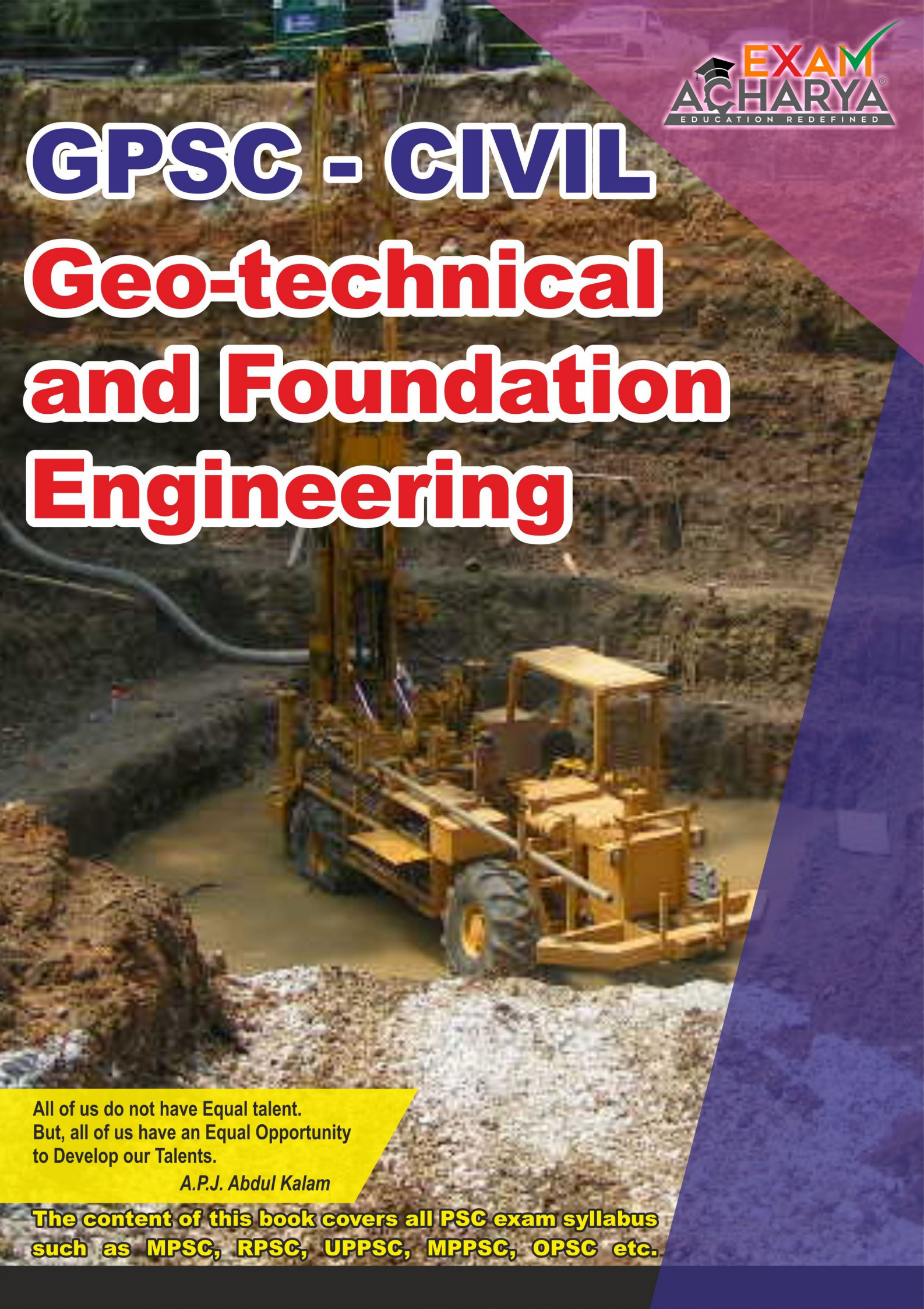

All of us do not have Equal talent.
But, all of us have an Equal Opportunity
to Develop our Talents.

A.P.J. Abdul Kalam

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∴ Horizontal distance D = L cos $\theta - h \sin \theta$

$$\mathbf{D = kS \cos \theta + c \cos \theta - h \sin \theta}$$

∴ vertical distance, V = L sin θ

$$\mathbf{V = kS \sin \theta + c \sin \theta}$$

∴ RL of P = RL of instrument axis - V – h cos θ

MOVABLE HAIR METHOD

D = kS + c

$$\mathbf{D = (\frac{f}{i})\ s + (f + d)}$$

Where,

i = m x p

m = no. Of revolutions

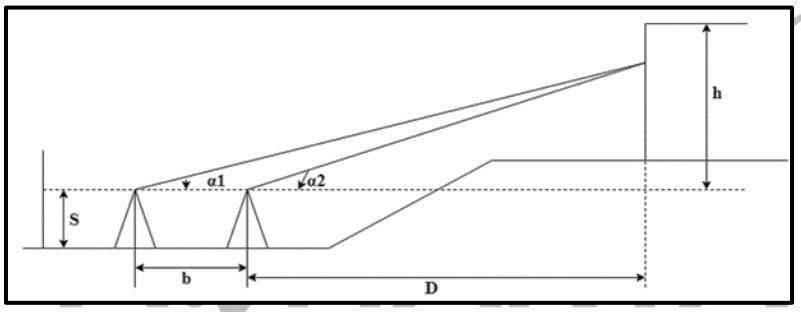
P = pitch of micrometer screws.

Qu5) The multiplying constant in the distance formula by tacheometry is given by

a) Focal length of the objective lens divided by the distance between the stadia wires
b) Focal length of the objective lens multiplied by the distance between the stadia wires
c) Stadia intercept divided by the focal length of the objective lens
d) Stadia intercept multiplied by the focal length of the objective lens

TEST YOUR SELF :

Qu6) From the figure, find the horizontal distance between the station and staff and consider distance between stations will be 2 m.



a) 1.6 m
b) 1.4 m
c) 1.2 m
d) 1.8 m

CHAPTER – 8

PHOTOGRAMMETRY

Photogrammetry is the science of obtaining information about physical objects through process of recording measuring and interpreting of photographs of the area.

Aerial photogrammetry is the branch of photogrammetry in which photographs of the area are taken with a camera mounted on an aircraft.

Terrestrial photogrammetry is the branch of the photogrammetry in which photographs are taken with a camera fixed on or near the ground. It is also known as ground photogrammetry, in this phototheodolite is used as the instrument.

Use of terrestrial photogrammetry is limited to the plotting of special features e.g. vertical cliff, mountainous terrain etc. However aerial photographs are used for topographical surveys, preliminary route surveys, i.e. highways, railways, pipelines etc. The main advantages of aerial photogrammetry are the speed with which an area is covered, the ease with which topography of inaccessible areas can detailed, there is no possibility of omitting any field data, and the tremendous amount of details shown. Aerial are classified into two types,

1. VERTICAL PHOTOGRAPHS

Vertical photographs are taken when the camera axis is vertical i.e. it coincides with line of the gravity of camera. When the camera axis is perfectly vertical, the photo plane is parallel to the datum plane and the resulting photograph is truly vertical photograph. When the camera axis is titled slightly from vertical, the resulting photographs is known as tilted photograph. The tilt is generally less than 1˚ and rarely exceeds 3˚. This tilt is unintentional.

2. OBLIQUE PHOTOGRAPHS

Oblique aerial photographs are taken with a camera axis considerably inclined to the vertical. The camera axis is intentionally kept oblique from the vertical.

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END is not the end if fact E.N.D. means
" Effort Never dies"

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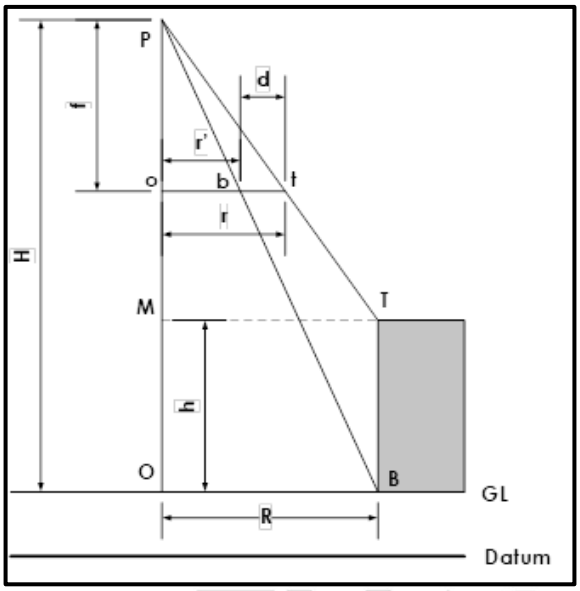
RELIEF DISPLACEMENT

Relief displacement is the shift in an object's image position caused by its elevation above a particular datum.



As, $\Delta POB \sim \Delta Pob$

$$\therefore \frac{Po}{PO} = \frac{ob}{OB}$$

$$\frac{f}{H} = \frac{r'}{R} = \frac{r-d}{R}$$

$$f = \frac{H(r-d)}{R}$$

As, $\Delta POT \sim \Delta Pot$

$$\therefore \frac{Po}{PM} = \frac{ot}{MT}$$

$$\frac{f}{H-h} = \frac{r}{R}$$

$$\frac{H(r-d)}{R} = \frac{r(H-h)}{R}$$

$Hr - Hd = Hr - hr$

$Hd = hr$

$$d = \frac{rh}{H}$$

Relief displacement, d = $\frac{rh}{H}$

Where

N = No. Of photographs required,

A = total area to be covered,

a = Area covered by one photograph

P_l = longitudinal overlap (0.6)

P_s = Side overlap (0.3)

l = Length of photograph in the direction of flight

w = Width of photograph normal to the direction of flight

S = Scale of photograph

Method – 2: When Length(L_1) and Width(W_1) of the Ground to be Covered is Given

$$(1 - P_l)X \frac{l}{S}(N_1 - 1) = L_1$$

$$(1 - P_l)X \frac{w}{S}(N_2 - 1) = W_1$$

Where,

l = Length of photograph is the direction of flight

w = Width of photograph normal to the direction of flight

S = Scale of photograph

L_1 = length of ground to be covered

W_1 = Width of ground to be covered

N_1 = No. of photo in the direction of flight,

N_2 = No. of photo perpendicular to the direction of flight

P_l = Overlap in the direction of flight (0.6)

P_w = Overlap in the direction perpendicular to the direction of flight (0.3)

∴ Total no. of photos required,

$$\mathbf{N = \left[\frac{L_1}{\frac{(1-P_1)l}{s}}+1\right]\ \left[\frac{w_1}{\frac{(1-P_w)w}{s}}+1\right]}$$

Qu5) A road section of length 1km scales 8cm on a vertical photograph. The focal length of the camera is 160mm. If the terrain is fairly level, then the flying height will be

a) 20m
b) 2000m
c) 20km
d) 200km

TEST YOUR SELF:

Qu6) A map of the area plotted at the scale of 1 in 30,000 is available. If the length of a runway on the map is 160mm and the photo distance of the runway is 200mm then the scale of photograph will be

a) 1 in 22000
b) 1 in 24000
c) 1 in 32000
d) 1 in 34000

Qu7) A map of the area plotted at the scale of 1 in 30,000 is available. If the length of a runway on the map is 160mm and the photo distance of the runway is 200mm then the scale of photograph will be

a) 1 in 22000
b) 1 in 24000
c) 1 in 32000
d) 1 in 34000

Answer

1-(a), 2-(b), 3-(c), 4-(c), 5-(b), 6-(b), 7-(b)

The choice of contour intervals depends on the various reasons.

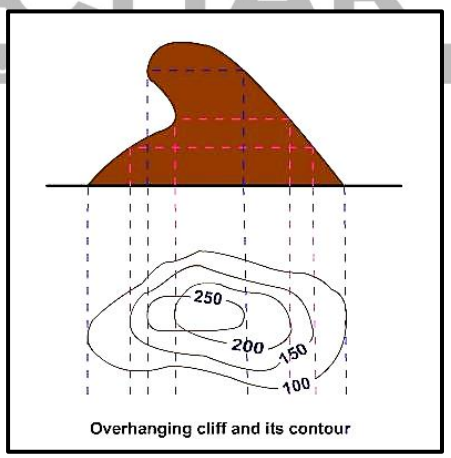
i. Topography of ground
ii. Scale of map
iii. Extent of survey
iv. Time and expenses allotted etc

GUIDELINES FOR CONTOUR INTERVALS

Type of Survey	Scale of Map	Contour Interval
Building work	1 cm = 10 m or less	0.2 – 0.5 m
Town planning or Reservoir scheme	1 cm = 50 – 100 m	0.5 – 2 m
Location survey	1 cm = 50 – 200 m	2 – 3 m

CHARACTERISTICS OF CONTOUR LINES

1. Two contour line of different elevations can't cross each other on a toposheet excluding the case of overhanging cliff or cave.



Overhanging cliff and its contour

2. Contour lines of different elevation can unite at a point in case of overhanging cliff only. Contour line of different elevation can unite at a line in case of vertical cliff only.

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Reinforced Cement Concrete

Education's purpose is to
replace an empty mind with an open one.

Malcolm Forbes

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MATHEMATICAL CRITERIA FOR CONTOUR INTERVAL

1. Contour interval = $\frac{25}{cm\ per\ km\ length}$ in m

2. Contour interval = $\frac{50}{inches\ per\ mile\ length}$ in foot

cm in km length represents total vertical undulations in one km length.

METHODS OF CONTOURING

1. Direct Method

In the direct method the contour to be plotted is actually traced on the ground and only those points are surveyed which are to be drawn on the sheet.

Note
- This method is tedious and lime consuming but gives the great accuracy.
- Method is suitable for small area only.

2. Indirect Method

In indirect method, some suitable guide points are selected and surveyed. The guide points need not necessarily to be on the contours. This method is suitable for large area under survey.

Note
- It is a quick method and gives the average degree of accuracy.
- Method is most widely accepted.

TEST YOUR SELF:

Qu6) In which of the following cases contour lines of different elevations can intersect?

1) Caves, 2) Vertical cliffs, 3) Hills, 4) Overhanging Cliff

a) 1) and 2)
b) Only 1)
c) 1), 2) and 4)
d) 1) and 4)

Qu7) The difference between contouring and levelling is that

a) Contouring focuses on distance measurements while levelling focuses on elevation
b) Contouring is an angle measuring operation while levelling is for measuring heights
c) Contouring focuses on finding points having a given elevation while levelling is to find the elevation of given points
d) Contouring focuses on finding points having a given elevation while levelling is to find the elevation of points having same contour interval

Answer:

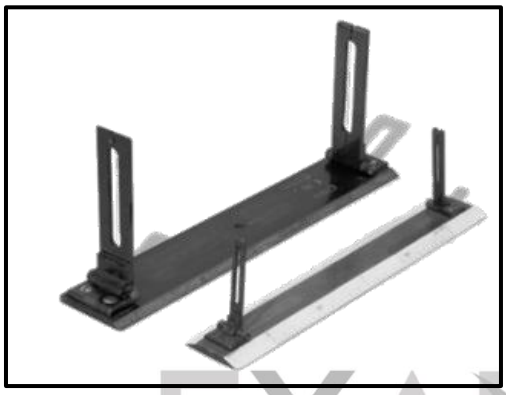
1-(c), 2-(a), 3-(c), 4-(b), 5-(d), 6-(d), 7-(c)

The plumbing fork is used for centering of table over the station in the field from which survey is to be done.

3. *Spirit Level*

Spirit level is used for levelling of table along the horizontal plane. The spirit level used may be of tabular or circular type.

4. *Alidade*



It generally consists of metal or wooden rule (scale) with two vertical vanes at the ends. One of the vane is provided with a narrow vertical slit (eye piece) while the other remains open and carries a thin vertical thread.

Both the vanes provided a definite line of sight which can be made to pass through the object (station), and the point located over the sheet.

Alidade is of two types,

1. Plain alidade
2. Telescopic alidade

WORKING OPERATION

i. Fixing of table

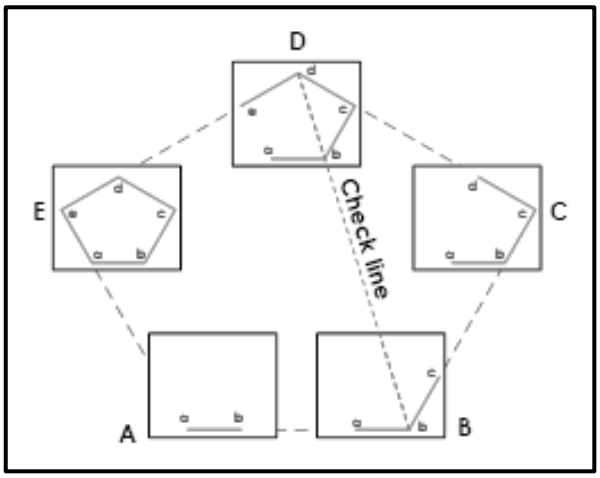
ii. Levelling of table

iii. Orientation of table

iv. Sighting and plotting of stations

3. Traversing

In traversing, table is set on (n-1) main stations where "n" is the total number of stations, a fore sight is taken to the next station and its location is plotted by the method described in radiation. Similarly, by consecutive fore sights all the main stations can be plotted on the drawing sheet.



Note

- The method of traversing provides additional benefit of checks during the plotting of area.
- To draw the check line the table should be moved at least to the (n – 2) main station

4. Resection

Resection is the process of determining the plotted position of station occupied by the plain table by means of sight taken towards known points location of which have been already plotted.

Resection is done through four methods,

i. Resection Through Compass

This method is used only for small scales and rough mapping of the unknown points.

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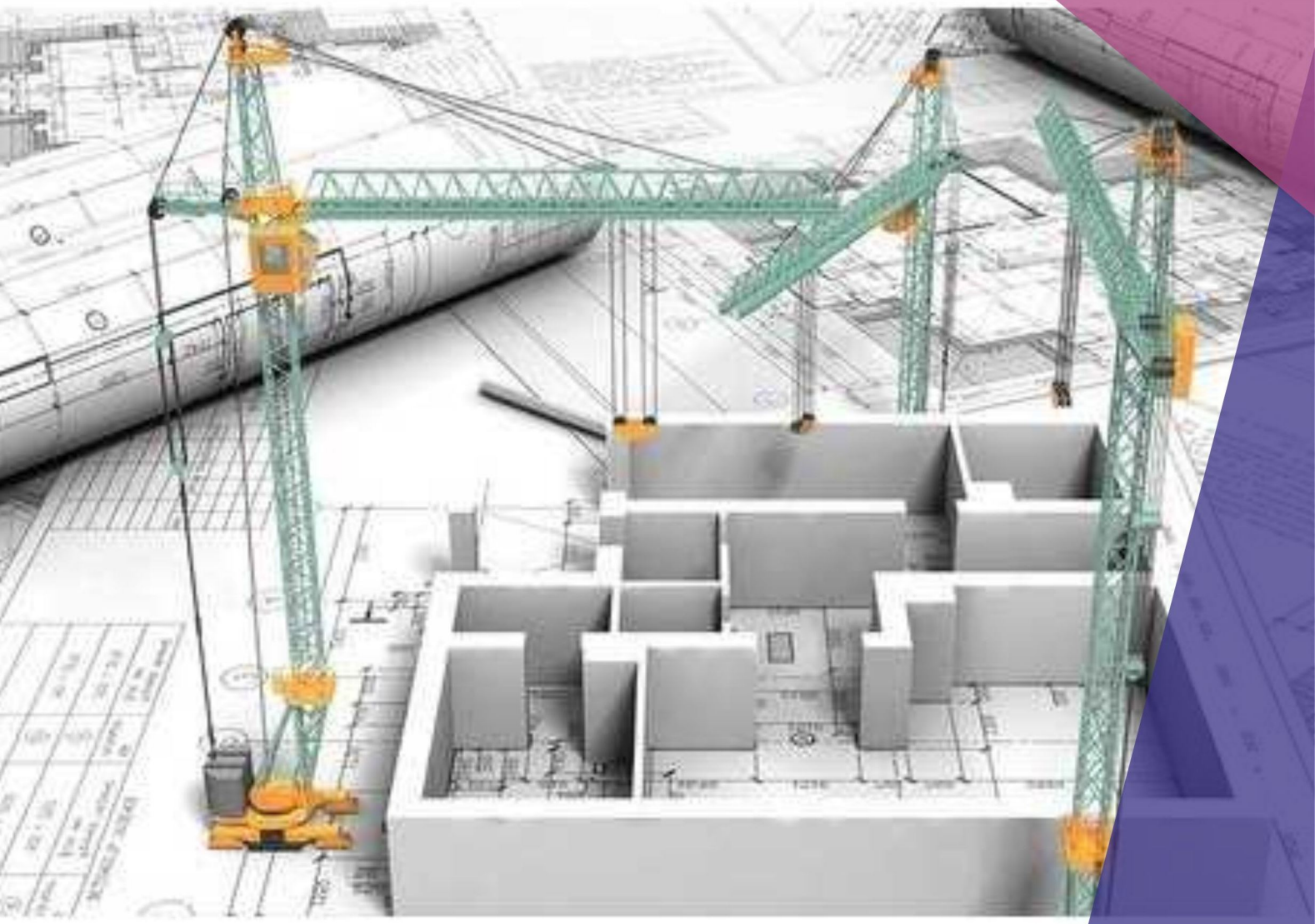

Structural Analysis

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But, all of us have an Equal Opportunity
to Develop our Talents."
A.P.J. Abdul Kalam

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Let "O" be the unknown instrument station which is to be marked on the sheet and ABC are the points which are already drawn in the sheet.

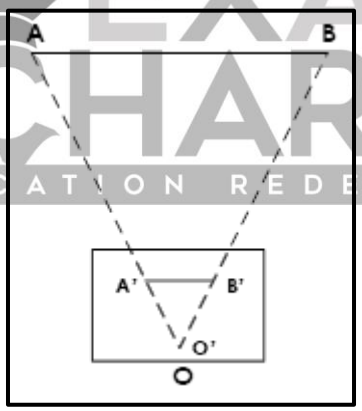
In three-point problem the table is oriented at point O in such a way that three resector from A, B, C from point O intersects at O' through A', B', and C' on the sheet.

Note
- If more than three stations are available then three known main stations are selected which are nearer to point "O".

iv. *Resection Through Two Point Problem*

Location of the position on the plan of the station occupied by plane table by means of observations from two well defined points whose position have been previously plotted on the plan.

In this method the table is oriented in such a way that two resector to A and B from point O intersected at point O' through A' and B'.



Note
- In three-point problem and two-point problem resector can be drawn by following three methods,
  1. Tracing paper method
  2. Graphical method
  3. Lehmann's method
- The first two methods are generally employed for plotting the details of survey area from reference point while the last two methods are used to locate the details of survey area by placing the table on main station.

GIS AND GPS

GIS (Geographic Information System)

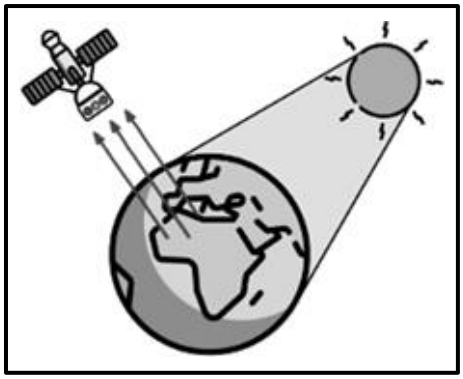
A geographic information system is a computer system for capturing, storing checking and displaying data related to positions on earth's surface.

GPS (Global Positioning System)

GPS is a satellite navigation system used to determine the ground position of an object. Today GPS receivers are included in many commercial products such as automobiles, smart phones, exercise watches and GIS devices. The GPS system includes 24 satellites deployed in space about 12,000 miles(19,300 kilometers) above the earth's surface. They orbit the earth once every 12 hours at an extremely fast pace of roughly 7,000 miles per hour (11,200 kilometers per hour). The satellites are evenly spread out so that four satellites are accessible via direct line of sight from anywhere on the globe. Each GPS satellite broadcasts a message that includes the satellite's current position, orbit, and exact time. A GPS receiver combines the broadcasts from multiple satellites to calculate its exact position using a process called triangulation. Three satellites are required in order to determine a receiver's location, though a connection to four satellites is ideal since it provides clock deviation from satellite time. Hence, minimum 4 satellites are required for a GPS to determine the position precisely.

Remote Sensing

Remote sensing is the acquisition of information about an object or phenomenon without making physical contact with the object and thus in contrast to on-site observation, especially the earth. Remote sensing is used in numerous fields, including geography, land surveying and most Earth science disciplines (e.g. hydrology, ecology, meteorology, oceanography, glaciology, geology). It also has military, intelligence, commercial, economic, planning applications. It can be divided into following categories.



i. Photography

ii. Infrared

iii. Charge coupled devices

iv. Radiometers

Enhanced Thematic Mapper Sensor Remote Sensing Satellite LANDSAT -7

The Landsat Enhanced Thematic Mapper Sensor on board the Landsat 7 satellite has acquired images of the Earth nearly continuously since July 1999, with a 16- day repeat cycle.

Total number of spectral band in enhanced thematic mapper sensor is 8:

Band 1 – Blue

Band 2 – Green

Band 3 – Red

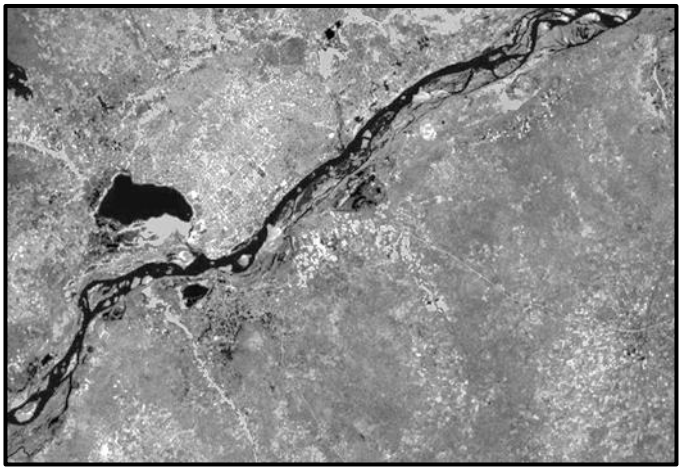
Band 4 – Near infrared (NIR)

Band 5 – Short wave infrared (SWIR 1)

Band 6 – Thermal

Band 7 – Short wave infrared (SWIR -2)

Band 8 - Panchromatic



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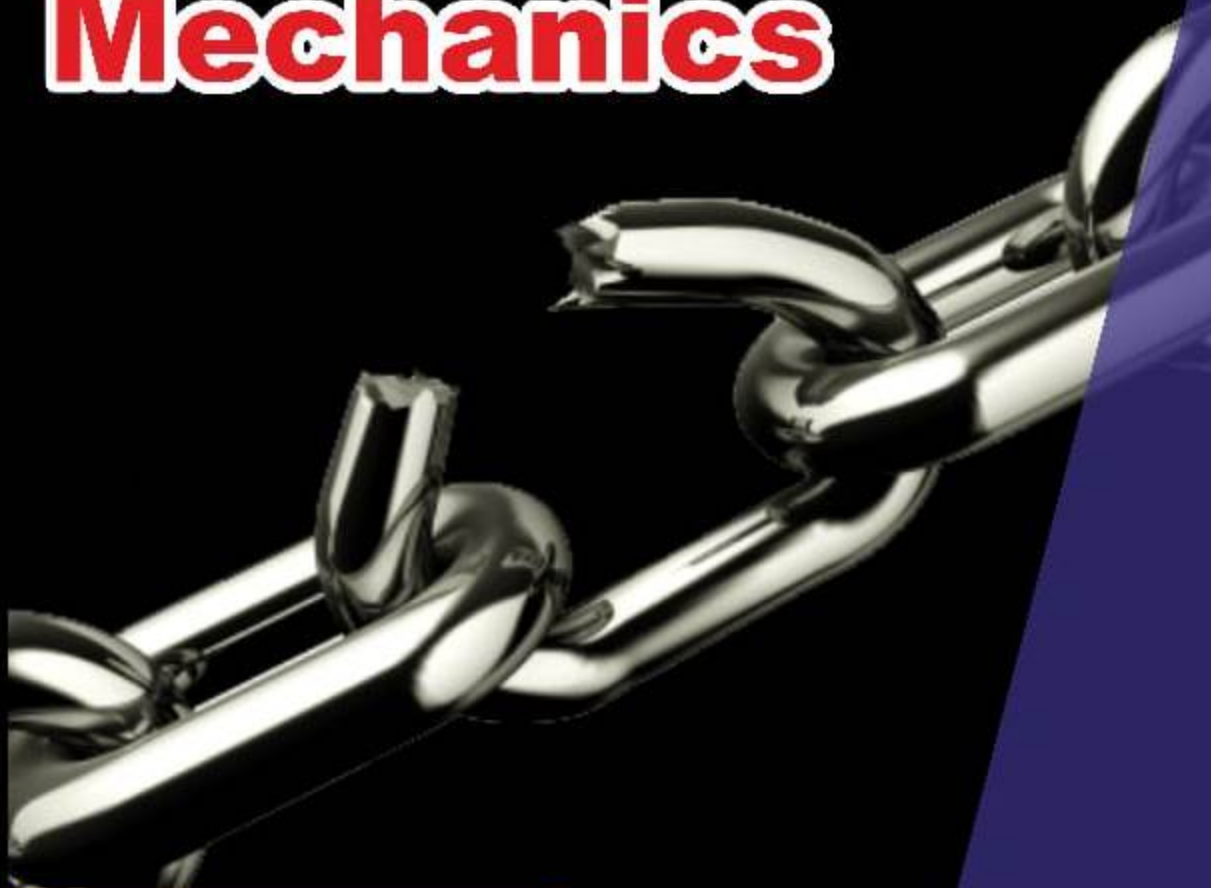
Solid Mechanics



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A.P.J. Abdul Kalam

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Solid Mechanics

Qu5) The three-point problem in plane tabling involves

a) Determining the position of three points
b) Locating the station occupied by plane table given the position of the three points
c) Locating the position of two points given the position of the third point
d) Surveying a triangular area

TEST YOUR SELF:

Qu6) Spectral resolution means:

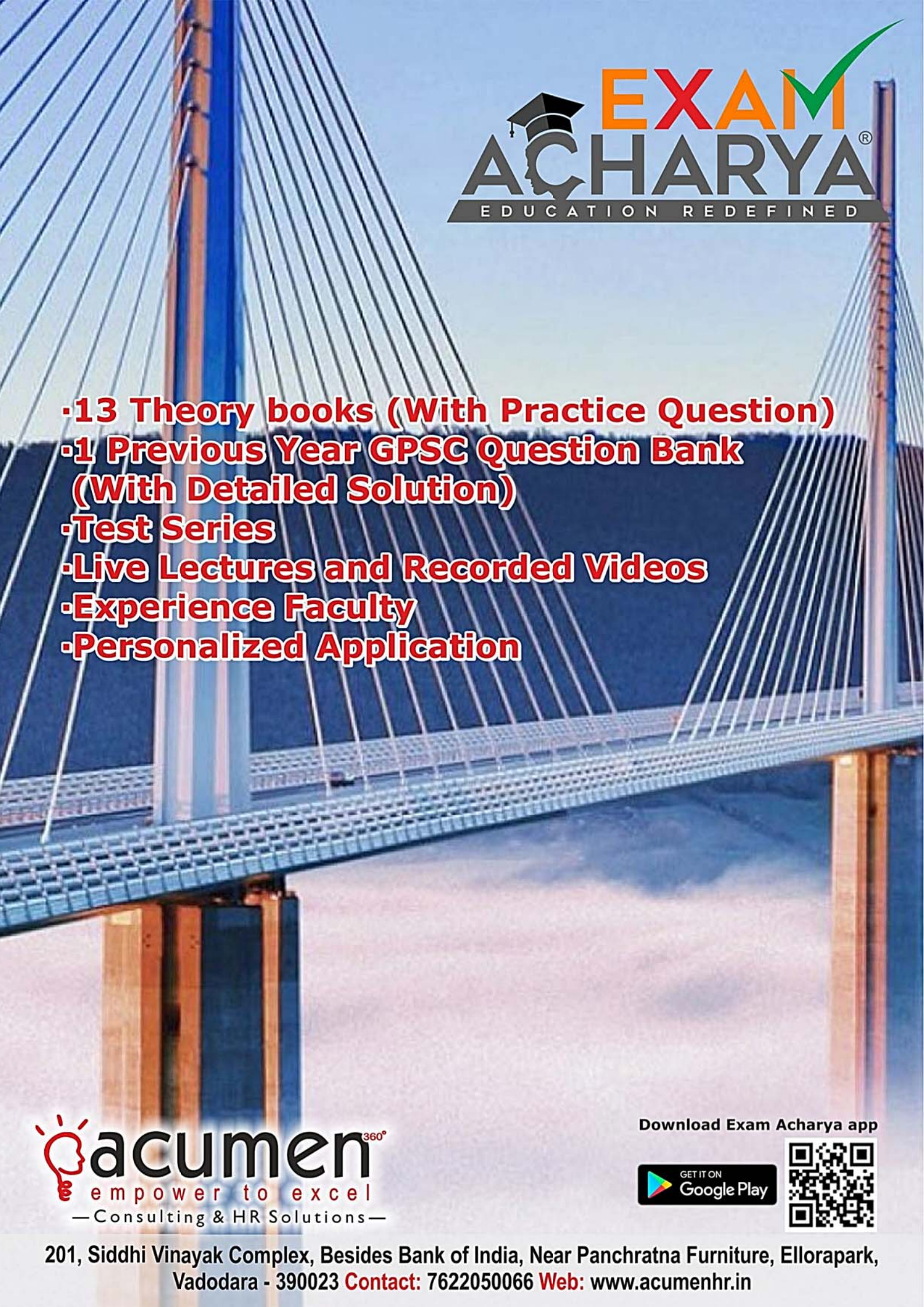
a) The frequency of receiving radiations
b) Sensitivity of the system to small changes in radiation
c) The ability of the system to distinguish the details in the images
d) The wavelengths to which the remote sensing system is sensitive

Qu7) The position of a point can be located in GPS on receiving signals from at least

a) 1 satellite
b) 2 satellite
c) 3 satellite
d) 4 satellite

Answer :

1-(a), 2-(d), 3-(c), 4-(a), 5-(b), 6-(d), 7-(d)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