

ID

# 7964

Section

# B

Paper

# Advanced  
Surveying

Submitted To

#  
Engr Javhan

Date

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Question :- 02

Triangulation:-

Triangulation consist of a number of interconnected triangles in which the length only one base line and the angles of the triangles are measured very precisely which are used to calculate the co-ordinates of vertices.

~~Principle~~

Principle of triangulation:-  
If all the three angles and the length of one side of a triangle are known then by trigonometry the length of the remaining sides of the triangle can be calculated.

⇒ Again if the co-ordinates of any vertex of the triangle and azimuth of any side are also known then co-ordinates of the remaining vertices may be computed.

## Triangulation:-

Method in which the lengths of all sides of chain of triangles polygons or quadrilaterals are measured with an electronic instrument whereas the angle may be computed from these field measurements.  $\Rightarrow$  uses in the construction of a chain or network of ~~route~~ interconnected triangles in a given area and the measurement of all three sides of each triangle.

Principle of Triangulation  
Triangulation is a highly accurate and precise method of establishing and extending horizontal control method of control survey in which a network of triangles is used as in triangulation system. All the three sides of each triangles are measured in the field.

with the distance measuring instrument.

Horizontal angles are not measured in the field vertical angles are also measured where elevations have not been established.

Difference b/w triangulation & trilateration :-

Triangulation :-

⇒ All angles are measured in triangulation.

⇒ Distance of baseline is measured.

⇒ Some check box lines are also measured to control scale error.

⇒ Intervisibility b/w stations is essential.

⇒ There are more internal check in comparison with trilateration in the same geometric figure.

## Trilateration

- ⇒ All sides are measured in trilateration.
- ⇒ Azimuth of the initial line is measured.
- ⇒ Some check angles are measured to control azimuth error.
- ⇒ For small areas it is possible to measure distance without intervisibility.
- ⇒ The angles are computed on the basis of measured side lengths applying cosine law.



## Question 03 part B

### Sounding

The process of determining depths below water surface is called sounding. Sounding is analogous to levelling on land.

The reduced level of any point on the bottom of water body obtained by subtracting the sounding from the mean sea level.

Purpose for sounding:-

- ⇒ Preparation of accurate charts for navigation
- ⇒ Determination of the quantities of the material to be filled.
- ⇒ obtaining information for design of breakwaters sea wall etc.

Name for equipment of sounding:-

- ⇒ Shore signals and buoys.
- ⇒ sounding equipment
- ⇒ Angle measuring instruments.

(i) Shore signal & buoys:-

- ⇒ Shore signal are required to mark range lines.
- ⇒ The signals are usually wooden tripods with a white and coloured flag on the top.

⇒ In deep waters the range lines are marked by a signal at shore and buoys in water.

### (ii) Sounding Equipment

⇒ The motor should have adequate control both for low speed and for rough waters.

⇒ The boats are generally provided with opening called wells through which soundings are taken.

⇒ The sounding operation is carried out from a flat bottom boat of low draft.

### Sounding Pole or Rod

⇒ The graduations on the rod are marked from bottom upward.

⇒ Thus the reading corresponding to the water surface is directly the depth of water.

## Lead line

⇒ It consists of a graduated line or chain to which a lead is attached.

⇒ Under ordinary tension when wet line should not change its length.

⇒ Due to drag the measured length will be greater than the true depth.

## Weddell's Sounding machine

⇒ When there is a lot of sounding work some form of sounding machine attached to sounding lines is used.

⇒ Weddell's hand driven machine consists of a cast iron casing carrying on a spindle a gun metal barrel.

## Echo sounding machine / fathometer

⇒ Where the depth of water is too much, an echo sounding machine known as fathometer is used.



⇒ it works on the property  
echo property.

it consist of a transmitter  
and a receiving oscillators  
recorder unit and a  
power unit.

⇒ Since the velocity of  
a sound waves in  
water is known the  
distance travelled by  
sound waves can be  
calculated

$$\Rightarrow D = \frac{1}{2}vt.$$

Advantages of Fathometer

it is more accurate  
than the lead line  
it can be used in  
strong currents or  
streams.

it is much more  
rapid in use than the  
ordinary method.

## Angle measuring Equipments

⇒ Theodolite

⇒ Prismatic Compass

⇒ Sextant

⇒ The sextant used in hydrographic surveying is known as the sounding sextant.

⇒ It slightly differs in construction from the astronomical sextant.

## Question 01

### Transition Curve :-

A curve of varying radius is called transition curve between tangent and a circle curve. It is also known as spiral curve. It can be inserted in between the two branches of a compound or reverse curve.

### Types :-

There are three types of transition curves which are given below

Types :-

⇒ Cubic Parabolas

⇒ Clothoid or Spirals

⇒ Lemniscate

Superelevation :-

It is the amount by which the outer edge of a curve on a road or roadway is banked above the inner edge when a vehicle passes to a curved path the following force acts on it.

Weight of vehicle  
Centrifugal force both acting through centre of gravity of vehicle.

Effects :-

The effects of centrifugal force is to push vehicle off the track the plane of the road surface is more perpendicular to resultant of centrifugal force & weight of vehicle. In other words

The inner one this raising of outer bank over the inner one is known as super elevation.

Mathematically



$w$  = weight vehicle

$P$  = Centrifugal force

$v$  = speed of vehicle

$g$  = acceleration due to gravity.

$R$  = radius of curve.

$w$  = width of road

$C$  = distance b/w centre of road.

For equilibrium

The resultant of weight and centrifugal force must be equal and opposite to the reaction perpendicular to road.

As we know that

$$P = \frac{wv^2}{gR}$$

$$\Rightarrow P/w = \frac{v^2}{gR}$$

if  $\theta$  is inclination of road surface the inclination of resultant to vertical is also we have

$$\tan \theta = \frac{dv}{dc}$$

on Road

$$\tan \theta = \frac{v^2}{gR}$$

on Railways

$$\tan \theta = \frac{Gv^2}{gR}$$

Radius  $r$

$$\tan \theta = \frac{v^2}{gR}$$

$$R = \frac{v^2}{\tan \theta g} \quad (\text{for road})$$

$$\tan \theta = \frac{Gv^2}{gR}$$

$$R = \frac{Gv^2}{\tan \theta g} = (\text{for Railway})$$

Speed of vehicle

$$b \tan \theta = \frac{v^2}{gR}$$

$$v^2 = \frac{b \tan \theta g R}{g}$$

$$v = \sqrt{b \tan \theta g R}$$

(For road)

$$b \tan \theta = \frac{C v^2}{g R}$$

$$v^2 = \frac{b \tan \theta g R}{C}$$

$$v = \sqrt{\frac{b \tan \theta g R}{C}}$$

$$v = \sqrt{\frac{b \tan \theta g R}{C}}$$

For railways,

★ Question 03 part (A) ★

Hydrographic Survey

Hydrographic Surveying is the survey of physical features present under water. It is science of measuring all factors beneath water that affect all the marine activities.

like dredging marine construction offshore drilling.

Hydrographic Surveying is mainly conducted under authority concern it is mainly carried by ~~some~~ means of sensor sounding or electronic sensor system for shallow water.

Why we do hydrographic surveying  
In order to get following information we do hydrographic surveying

- ⇒ Depth of bed can be determined.
- ⇒ Shore lines, can be determined.
- ⇒ Tide measurement
- ⇒ Locations: mean sea level.
- ⇒ Locating better fast by measuring direct current.

Factor to be determined while conducting hydrographic survey.

- Survey equipment
- Issue to a designated unit.
- assessment of the task with in that unit.
- Resource allocation.
- Detailed Survey planning.
- plans Job compilation and checking of data.





## Question 04 Part A

Aerial photogrammetry or photogrammetry is the science & technology of obtaining reliable information physical objects and the environment through processes of recording measuring and interpreting photographic images and patterns of recorded and other

phenomena-

In terrestrial photogrammetry photographs are taken from a fixed position on ground while in the aerial photogrammetry, an aircraft with camera setup is used to take photographic from the air flying over the ground.

(17)

Reason for use of aerial photogrammetry:

Following are some of the reason for uses of aerial photogrammetry. It is used because it provides computer generated 2D & 3D models. These models are topographical in nature. They represent the dimension and physical features in staminy accuracy. These model can be rotated & zoomed.

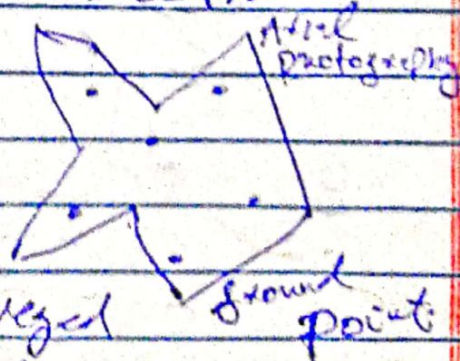
Along with surveying many of the uses of aerial photogrammetry is different fields.

## Question of part B

### Procedure of aerial photography

- Establishing central points
- Light geometry and photography
- Photo interpretation and stereoscopy
- Parallel and measurement of parallel
- Construction of map and cartography

These should be minimum of 3 to 4 central points as need in one photography. The establishment of central points depend upon the scale its map height central and cartographical method of mapping



### Ground factors

- Area to be surveyed
- Focal length of camera
- Overlap