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Section :- A

PAPER :- Advance  
Surveying  
Engineering.

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Q No (1)

Answer :- Transition Curve :-

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

Types :- These are three types of transition curves which are given below.

- (i) Cubic parabola (railways)
- (ii) clothed or spiral (railways)
- (iii) Lemniscate (Highways)

Superelevation :- It is the amount by which the outer edge of a curve on a road or

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railway is banked above the inner edge when a vehicle passes to a curved path.

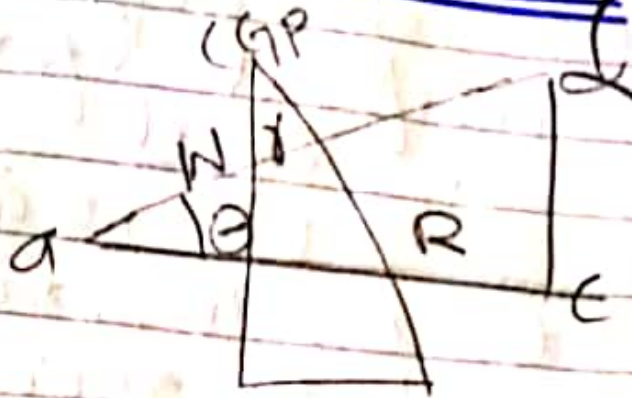
The following forces act on it.

- (i) weight of vehicle
- (ii) centrifugal force both acting centre of gravity of vehicle.

The effects of centrifugal force is to push the vehicle off the track. Now to construct the action the plain of the road surface is made perpendicular to resultant of centrifugal force and weight of vehicle. In other words the outer bank of road is raised above the inner one is known as super elevation.

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## Mathematically :-



$W$  = weight of vehicle  
 $P$  = centrifugal force

$V$  = Speed of vehicle (m/sec)  
 $g$  = acceleration due to gravity

$R$  = radius of curve

$h$  = Super elevation in  
m

$b$  = width of road in  
m

$G$  = Distance between  
centre of rails

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For equilibrium :-

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

As we know that:

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

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

it is the inclination of road surface inclination of resultant to vertical is also  $\theta$

So we have

$$\tan \theta = \frac{dc}{ac} = \frac{P}{W} = \frac{v^2}{gR}$$

On roads :-

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

On Railways :-

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

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Radius :-

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

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

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

$$R = \frac{Gv^2}{b \tan \theta} \quad (\text{for railways})$$

\* Speed of vehicle :-

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

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

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

(For roads)

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

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

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

(For railways)

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Q No 2:-

⇒ What is the difference b/w triangulation & trilateration?

Answer:- Triangulation:-

(1) All angles are measured in triangulation

(2) Distance of baseline is measured.

(3) Some check base line are also measured to control scale error

(4) Intervisibility between stations is essential.

(5) There are more internal checks in comparison with trilateration in the same geometric figure.

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(6) The side lengths are computed on the basis of measured angles applying sine law.

Trilateration:- (1) All sides are measured in trilateration.

(2) Azimuth of the initial line is measured.

(3) Some check angles are measured to control azimuth error.

(4) For small areas it is possible to measure distance without intervisibility.

(5) There are less internal checks in comparison with triangulation in the same geometric figure.



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(6) The angles are computed on the basis of measured sides lengths applying cosine law.

★ Also explain trilateration and its Principles:-

• Trilateration 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 triangle are measured in the field with the distance measuring instruments (EDMS, tapes other apparatus)

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- Horizontal angles are not measured in the field.
- Angles in a trilateration system are computed indirectly from the lengths of the sides of triangle by cosine formula.
- Few horizontal angles are also sometimes measured to provide a check on computed angles.
- Trilateration is adjusted after the computation of the angles and then coordinates of the stations are determined.
- Astronomical observations for azimuth are also made at selected stations.
- Vertical angles are also measured where elevations have

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not been established.

Cosine rule:-  $a^2 = b^2 + c^2 - 2bc \cos A$

## \*Triangulation and its Principle

- it is the process of measuring the angles of a chain or network of triangles formed by stations marked on the surface of the earth.
- The system consists of a number of interconnected of vertices of triangles in which the length of only one base line and the angles of the triangles are measured very precisely which are used to calculate the coordinate of vertices.

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- if all the three angles and the length of one side of triangle are known, then by trigonometry the length of the remaining sides of the triangle can be calculated.
- Again, if the coordinates of any vertex of the triangle and azimuth of any side are also known, then coordinates of the remaining vertices may be computed.



Q No 3 :- (part a)

Answer :- Hydrographic Survey :-

Hydrographic Surveying or both metric Surveying is the survey

of physical features present under water. it is science of measuring all factors beneath water that affects all the marine activities like dredging marine construction of shore drilling etc.

Hydrographic surveying is mainly conducted under authority concern. it is mainly carried by means of sensor, sounding or electronic sensor system for shallow under.

⇒ Why we do Hydrographic Surveying:

In order to get following information we do hydrographic surveying.

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(1) Depth of bed can be determined.

(2) Shore lines can be determined.

(3) Locating sewer fall by measuring direct current.

(4) Locating mean sea level.

(5) Tide measurement.

(6) ~~Tide~~ River and stream discharge measurement.

(7) Massive structures like bridges, dams, harbours are planned.

⇒ Factor to be determined while conducting Hydrographic Survey.

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Following are the factors which would be done while doing and conducting Hydrographic Surveying.

(a) Survey Equipment

(b) Preparation of a hydrographic Survey Specification (to include a review of existing data)

(c) Issue to a designated unit

(d) programme planning of that unit

(e) assessment of the task with in that unit

(f) Reconnaissance requirement

(g) Resource allocation.

(h) Detailed survey planning

(i) Plans for compilation

and checking of data.

### Q No 3 (part b)

#### Answer:- Sounding:-

The measurement of depth below the water surface is called sounding. This corresponds to the ordinary spirit leveling in land surveying where depth are measured below horizontal line established by level. The object of making sounding is thus to determine the configuration of the subaqueous source.

#### ⇒ Purpose of Sounding:-

⇒ Sounding is most important for any water body to improve its



negligible Properties. to know about silt and scouring etc.

→ In Hydrographic Surveying Sounding is the measurement of depth below the water surface.

→ In short the main purpose and objective of sounding to measure finding the depth below the water surface.

### ⇒ Equipment:-

- (1) Sounding boat
- (2) Sounding rods and poles
- (3) Load line
- (4) Sounding Machine
- (5) Fathometer.

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Q No 04 (a)

Answer:- Aerial photogrammetry

Aerial photogrammetry is a process in which an aircraft with camera is used to take photograph from certain height in the air. A minimum 3 to 4 control

Reason for use of Aerial Photogrammetry:-

Following are some of the reasons for uses of Aerial photogrammetry.

it is used because it provides computer 2D and 3D models. These models are topographical in nature. They represent

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the dimension and physical features of the area of land and in stanning accurately then model can be rotated and zoomed along with surveying may of the uses of Aerial photogrammetry in different fields.

Q No 4 (Part b)

Answer:- Procedure of Aerial Photography

Following are the main steps of Aerial photography.

- Establishing control points
- Flight planing and photography.

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→ photo interpretation and stereoscopy

→ Parallax and measurement of parallax

~~→ Construction~~

→ Construction of map and costography

### Establishing Control points

Control points are points established on ground with known relative position

The photograph captured is observed by setting control as boundaries.

there should be minimum 3 to 4 points (intopints) in a photograph

### Flight planing and photogra- phy :-

Flight planing in actully knowing the height to be maintain while taking photo no SJ stivips and time interval between exposures.