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Subject :- Advance engineering  
survey.

Q No: 1: What is transition curve?  
 How super elevation is effected by speed of vehicle and radius of the curve? Prove it with the help of equation and diagram.

Transition curve:-

A curve of varying radius is called a transition curve. It is also called spiral curve or easement curve. It is used on both highway and railway between tangent and



a circular curve in order to have a smooth transition from tangent to the curve from curve to the tangent.

Types:-

There are three common types of transition curves which are given below.

- (i) Cubic parabolic (railways)
- (ii) Clothoid or spiroidal
- (iii) Lemniscate (Highway)

Superelevation <sup>elevation</sup>

It is the amount in which the outer edge of a curve on a road or a railway is banked above the inner

edge of a curve on a road as 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

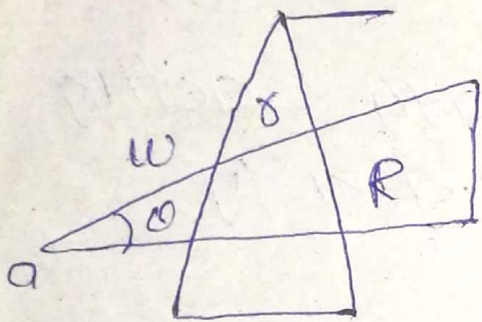
(ii) centrifugal force both acting through centre of gravity of vehicle.

The effect of centrifugal force is to push the vehicle of the track. Now to counteract the action, the plane of the road surface is made perpendicular to resultant of centrifugal force to resultant of centrifugal force



and weight of vehicle. off the track. In outer bank of road is raised above the inner one is known as superelevation.

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.

For equilibrium:-

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

AS we know that

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

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

If  $\theta$  is the inclination of road surface, the inclination of resultant to vertical is also  $\theta$  so we have

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

On roads:-

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

Railways:-

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



# RADIUS $e_7$

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

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

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

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

Speed of vehicles-

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

$$v^2 = b \tan \theta g R$$

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

(for rods)

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

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

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

(for railways)

QNS-20.

ANS-

① Triangulation:-

It is a process in surveying in which tracing and measurements of a series or a network of series or a network of triangles is used for determining distances and relative position of points over an area.

Principle of triangulation:-

- In triangulations all the three angles of each triangles are in the field along with base line.
- The side of first triangle whose length is predetermined is called 'base line', and vertices of ~~the~~



of the individuals triangles  
are known as triangulation  
stations

- To minimize accumulation of errors in lengths, subsidiary bases at suitable intervals are provided.

### b) Trilateration:

The method of surveying in which the lengths of the sides of a triangles are measured and from this information angles are computed.

This method does not involve the measurement of angles.

### Principle of Trilateration:

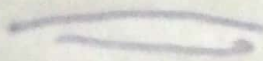
- It is a method of control survey in which a network of triangles is used as in triangulation.

All the three sides of each triangle are measured in the field with the distance measuring instruments.

→ Horizontal angles are measured in the field.

→ Trilateration is adjusted after the computation of the angles and then co-ordinates of the stations are determined.

→ In trilateration, angles are computed indirectly from the lengths of the sides of triangles.





## ② Difference b/w triangulation & trilateration.

- |   |  |
|---|--|
| ① All angles are measured in triangulation.                       | ① All sides are measured in trilateration.                                     |
| ② Distance of baselines are also measured to control scale error. | ② Azimuth of the initial line is measured.                                     |
| ③ Some check base lines are also measured to control scale error. | ③ Some check angle are measured to control azimuth error.                      |
| ④ Intervisibility b/w station is essential.                       | ④ For small areas it is possible to measure distances without intervisibility. |



Q NO 3 :-

part (a)

Hydrographic survey :-

Hydrographic surveying is the survey of physical features under water. It is science of measuring all factors beneath water that affect all the marine activities like design, marine construction and drilling etc.

It is mainly conducted under authority concern. It is mainly carried by means of sensor, sounding or electronic sensor system for shallow water.



Reason for using hydrographic survey:-

In order to get following information we do hydrographic survey.

1. Depth of bed can be determined
2. Shore line can be determined.
3. Locating sewer lines fall by measuring direct current.
4. Locating mean sea level.
5. Tide measurement
6. River and stream discharge measurement.
7. Massive structures like bridges dams are planned.

Factors to be determined while  
conduction the hydrographic  
survey :-

- (a) Survey equipment.
- (b) Preparation of a hydrographic  
survey specification (to include  
a review of existing data).
- (c) Issue to a designated  
unit.
- (d) Programmed planning of that  
unit.
- (e) Assessment of that 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)

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 establish by level.

The object of making sounding in this to determined the configuration of the sub-aqueous source.

Purpose :-

→ Sounding is most important for any water body to improve its negligible properties to be known about

about splitting and scoring  
etc.

⇒ In hydrographics surveying,  
sounding is measurement of  
depth below the water surface.

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

⇒ Equipment:-

- (1) Sounding <sup>boat</sup> ~~rods~~ and poles.
  - (2) Sounding <sup>rods</sup> ~~rods~~ and poles.
  - (3) Lead lines
  - (4) Sounding machines
  - (5) Fathometers
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Q NO 4  
Part (A)

Aerial photogrammetry:-

Aerial photogrammetry is the branch of surveying that deals with the production of maps such as planimetric or topographic maps by compiling number of photographs taken.

Advantages:-

It provides permanent photographic record of conditions that existed at the time the aerial photographs were taken. Since this record has metric characteristics, it is not only a pictorial record but also an accurate measurable record.



## Q4 Part D/ Aerial Photography

It is the branch of surveying that deals with production of maps such as planimetric or topographic maps by compiling number of photographs taken in that area.

### Procedure:-

- establishing control points
- flight planning and photography.
- photo interpretation and stereoscopy.
- parallax and measurement of parallax
- construction of map and cartography.



Types of Aerial Photographs: ⑦

① These are classified to the following types.

(i) Vertical photographs

(ii) Low photographs

(iii) High oblique photographs.

