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Dept ≠ Civil

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①

Question No # (1)

Transition curve:



Transition curve is a curve in plan which is provided to change the horizontal alignment from straight to circular curve gradually. The radius of transition curve varies b/w infinity to  $R$ .

Types:

There are three types of transition curve.

(2)

- $\Rightarrow$  cubic Parabola (Railway)
- $\Rightarrow$  Spiral or clothoid (Railway)
- $\Rightarrow$  Lemniscate (Highway)

Super elevation:

It is the amount by which the outer edge of a curve on a road or railway is banked above the inner edge. When a vehicle passes to a curved path, the following forces act on it.

(3)

⇒ weight of vehicle

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

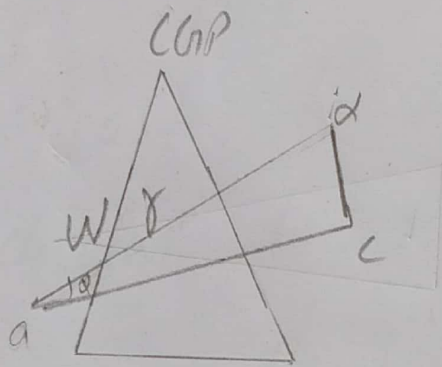
The effect of centrifugal force is to push the vehicle off the track.

The plane of the road surface is made perpendicular to resultant of centrifugal force and weight of vehicle. In otherword the outer bank of road is raised above the inner one.

(4)

This raising of outer bank over the inner one is known as super elevation

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

(5)

$b$  = width of road

$R$  = Distance b/w centre of rails.

For equilibrium

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

As we know that

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

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

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

(6)

So we have

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

on Road:

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

on Railway:

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

Radius:

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

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

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

(7)

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

Speed of vehicle:

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

$$v^2 = b \tan \phi gR$$

④ Taking square root  
on b. side

$$v = \sqrt{b \tan \phi gR}$$

(for road)



(8)

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

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

Square root on b. side

$$v = \sqrt{\frac{b \tan \phi \ gR}{G}}$$

(for railway)

(8) (2)

Question No = (2)

### Triangulation

⇒ All angle are measured in triangulation

⇒ Distance of base line is measured

⇒ Some check base line are also measured to control scale error

### Trilateration

All side are measured in Trilateration

Azimuth of the initial line is measured

Some check angle are measured to control azimuth error

(2)

⇒ Intervisibility b/w station is essential

For small area it is possible to measure distance without intervisibility

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

There are less internal check in comparison with triangulation

⇒ The side length are computed on the basis of measured angle applying sine law

The angle are computed on the basis of measured side length applying cosine law.

(3)

## Principle of triangulation:-

⇒ Entire area to be surveyed is converted into framework of a triangles

⇒ If the length and bearing of one side and three angle of a triangle are measured precisely, the length and direction of other two side can be computed

⇒ If the coordinate of any vertex of the triangle and azimuth of any side are also known. Then co-ordinate of the remaining vertex may computed.

(9)

## Principle of Trilateration:

- => It is a high accurate and Precised method of establishing and expanding horizontal control
- => Method of control survey in which a network of a triangle is used as in triangulation system
- => All the three side of each triangle are measured in the field with the distance measure instrument
- => Horizontal angle are not measured in the field

(5)

Angle in trilateration system are computed indirectly from the length of the side of triangle by Cosin formula.

=> Few Horizontal angle are also sometime measured to provide to a check on computed angle

=> Vertical angle are also measured where deviation have not been establish

Cosin rule

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

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

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

$$A = \cos^{-1} \left( \frac{b^2 + c^2 - a^2}{2bc} \right)$$

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Question No  $\neq$  (3)

Part (a)

Hydrographic Survey :

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Hydrographic Survey is the survey of physical feature present under water. It is science of measuring all factor beneath water that affect all the marine activities like dredging, marine construction, offshore drilling etc.

(2)

Hydrographic survey is mainly conducted under authority concern. It is mainly carried by mean of sensor, sounding or electronics sensor system for shallow under

⇒ Why do we do Hydro-  
-graphic Survey :

In order to get the following information. We do Hydrographic Survey

1) Depth of bed can be determine



(3)

- 2) Shore line can be determine
- 3) Locating : Sewer fall by measuring direct current
- 4) Locating mean sea level
- 5) Tide measurement
- 6) River and Stream discharge measurement
- 7) Massive structure like bridge dams harbors are planned

(4)

⇒ Factor to be determine while conducting hydrographic Survey

Following are the factor which would be done while doing and conducting hydrographic Survey.

⇒ Survey equipment

⇒ Preparation of hydrographic Survey Specification

⇒ Issue to a designated unit

⇒ Programme planning of that unit

(5)

=> Assessment of the task with in that unit

=> Reconance requirement

=> Resource allocation

=> Detailed Survey Planning

=> Plan for compilation and checking of data.

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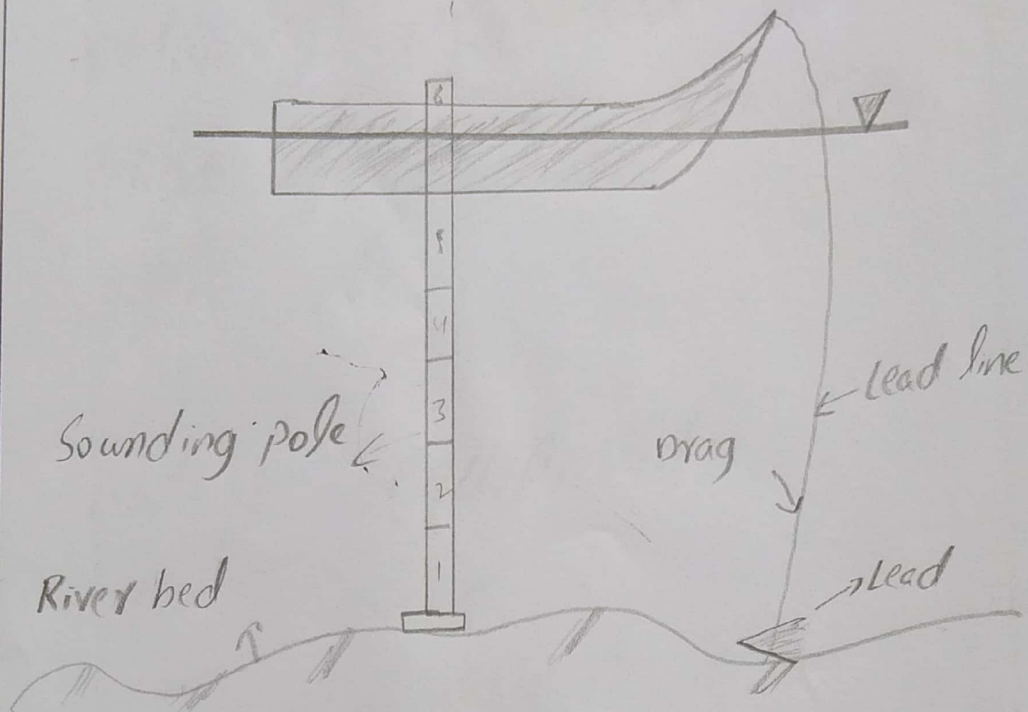
Question No # (3)

Part (b)

Sounding:

In hydrographic surveying, sounding is the measured of depth below the water surface. Sounding is most important for any water body to improve its navigable properties, to know about silting and scouring etc.

(2)



Purpose of Sounding :

⇒ Preparation of accurate chart for navigation

⇒ Determination of the quantities of the material to be filled

(8)

⇒

obtaining information for design of break water, sea walls etc.

Sounding equipment:-

- (1) Sounding boat
- 2) Sounding rods and poles
- 3) Lead line
- 4) Sounding machine
- 5) Fathometer

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Question No # 4

Part (a)

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 point needed in one photograph

Reason for use of Aerial  
Photogrammetry:

Following are some of the  
reason for use of aerial  
Photogrammetry

It is used because it provide  
compute 2D and 3D model.

These model are topographical in  
nature. They represent the  
dimension and physical feature  
of the area of land and  
in stunning accurately. These  
model can be rotated and  
zoomed



(3)

Along with survey may of the  
uses of aerial photogrammetry  
in different field.

(4)

Question No # 4  
Part (b)

## Procedure of Aerial Photogrammetry :

Following are the main steps  
of Aerial Photogrammetry

- 1) Establishing Control Point
- 2) Flight Planning and Photogram-  
-phy
- 3) Photo interpretation and  
Stereoscopy
- 4) Parallax and measurement  
of Parallax

(5)

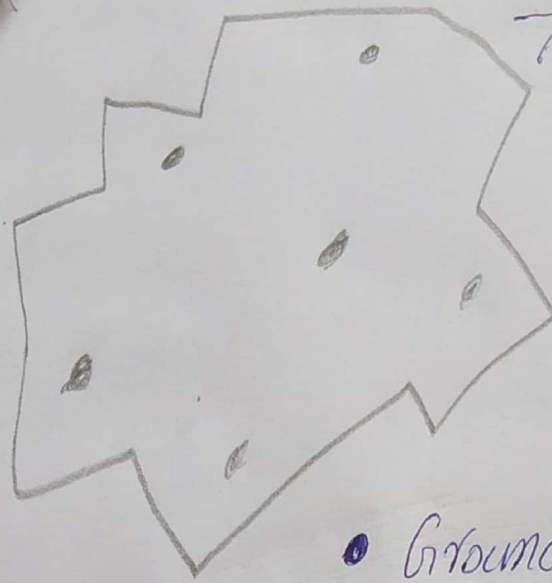
(5) => Construction of map and cartography

Establishing Control Point:

Control point are point establish on ground with known relative position. The photograph captured is observed by setting these control point as boundaries. So the point should be establish in such a way that they should be easily identifiable on photograph.

There should be minimum of 3 to 4 control point are needed in one photograph.

(6)



Aerial Photography  
area

- Ground control point

## Flight Planning and Photography

Flight planning is nothing but knowing the height to be maintained by flight while taking photo, area to be covered in each photograph,

(7)

number of photograph, no of strips and time interval b/w exposed

The planning mainly depend on following factor

- ⇒ Area to be surveyed
- ⇒ Focal length of camera
- ⇒ overlap
- ⇒ Scale of photograph
- ⇒ Ground speed of aircraft in still air.