SURVEYING NOTES AS PER HSBTE

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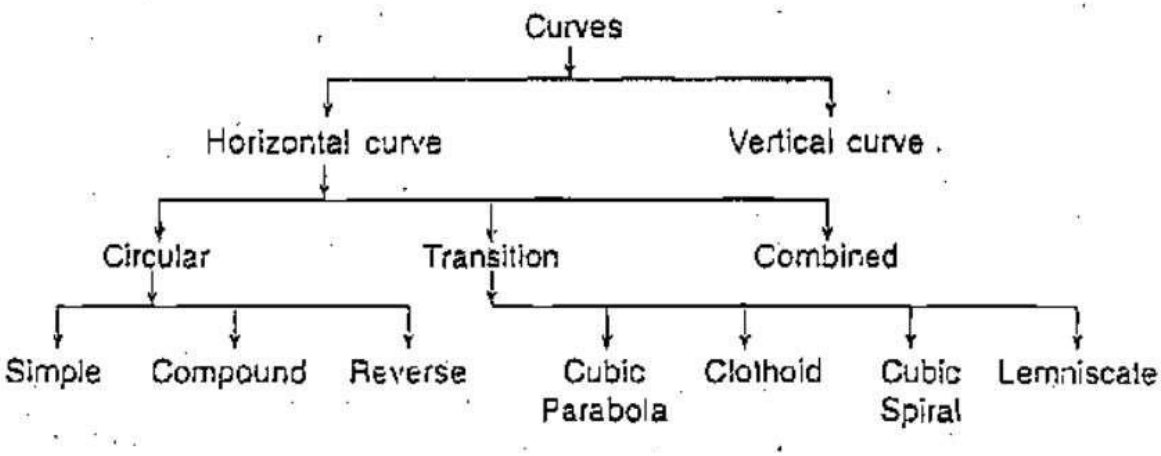
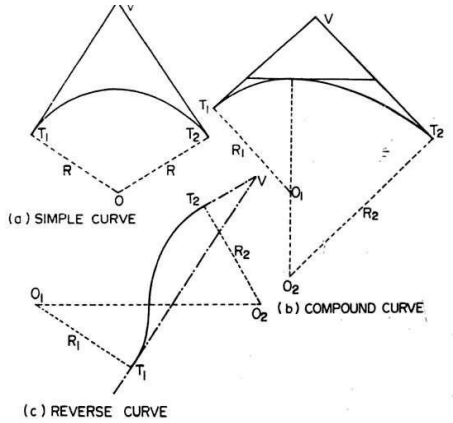
Types of Curves:





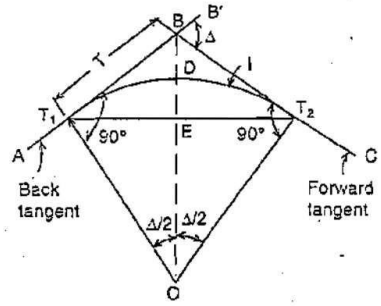
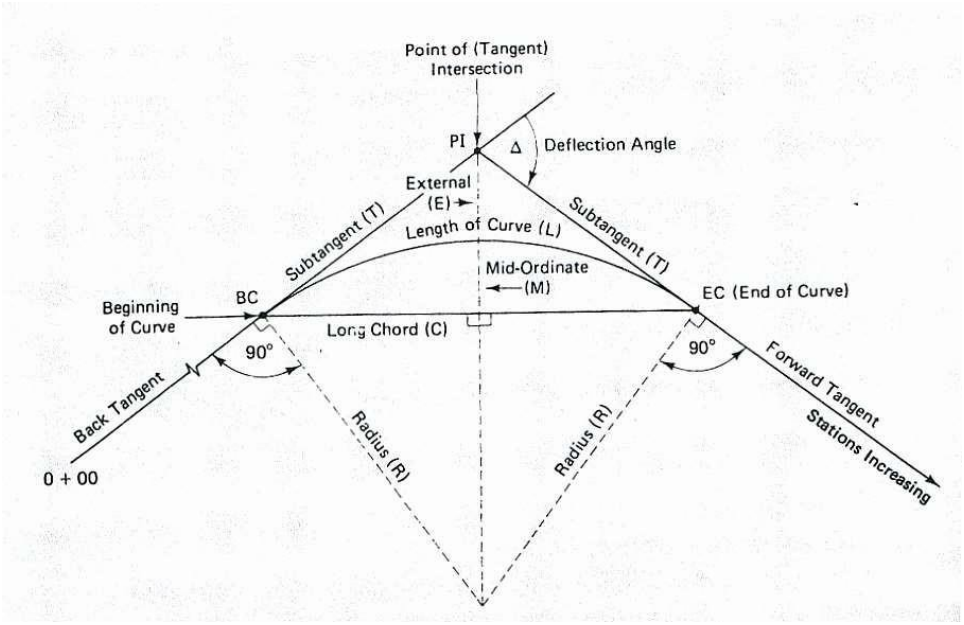


Fig. 12.1 Basic elements of a curve.

Designation of a Curve:

Circular Curve Geometry



Definition:

Curves are provided whenever a road changes its direction from right to S (vice versa) or changes its alignment from up to down (vice versa). Curves are a critical! element in the pavement design. They are provided with a maximum speed limit that should lie followed very strictly. Following the speed limit becomes essential as the exceed in speed may lead to the chances of the vehicle becoming out of control while negotiating a turn and thus increase the odds of fatal accidents

Types of Curves

There are two types of curves provided primarily for the comfort and ease of the motorists in the road namely:

1. HorizontalCurve
2. VerticalCurve

Horizontal Curves

Horizontal curves are provided to change the direction or alignment of a road. Horizontal Curve are circular curves or circular arcs. The sharpness of a curve increases as the radius is decrease which makes it risky and dangerous. The main design criterion of a horizontal curve is the provision of an adequate safe stopping sight distance.

Types of Horizontal Curve:

Simple Curve:

A simple arc provided in the road to impose a curve between the two straight lines.

Compound Curve:

Combination of two simple curves combined together to curve in the same direction.

Reverse Curve:

Combination of two simple curves combined together to curve in the same direction.

Transition or Spiral Curve:

A curve that has a varying radius. Its provided with a simple curve and between the simple curves in a compound curve.

While turning a vehicle is exposed to two forces. The first force which attracts the vehicle towards the ground is gravity. The second is centripetal force, which is an external force required to keep the vehicle on a curved path. At any velocity, the centripetal force would be greater for a tighter turn (smaller radius) than a broader one (larger radius). Thus, the vehicle would have to make a very wide circle in order to negotiate aturn.

Vertical Curves

Vertical curves are provided to change the slope in the road and may or may not. be symmetrical. They are parabolic and not circular like horizontal curves. Identifying the proper grade and the safe passing sight distance is the main design criterion of the vertical curve, iln crest vertical curve the length should be enough to provide safe stopping sight distance and in sag vertical curve the length is important as it influences the factors such as headlight sight distance, rider comfort and drainage requirements.

Types of Vertical Curve:

Sag Curve

Sag Curves are those which change the alignment of the road from uphill to downhill,

Crest Curve/Summit Curve

Crest Curves are those which change the alignment of the road from downhill to uphill. In designing crest vertical curves it is important that the grades be not] too high which makes it difficult for the motorists to travel upon it.

Methods of setting outsimple circularcurve

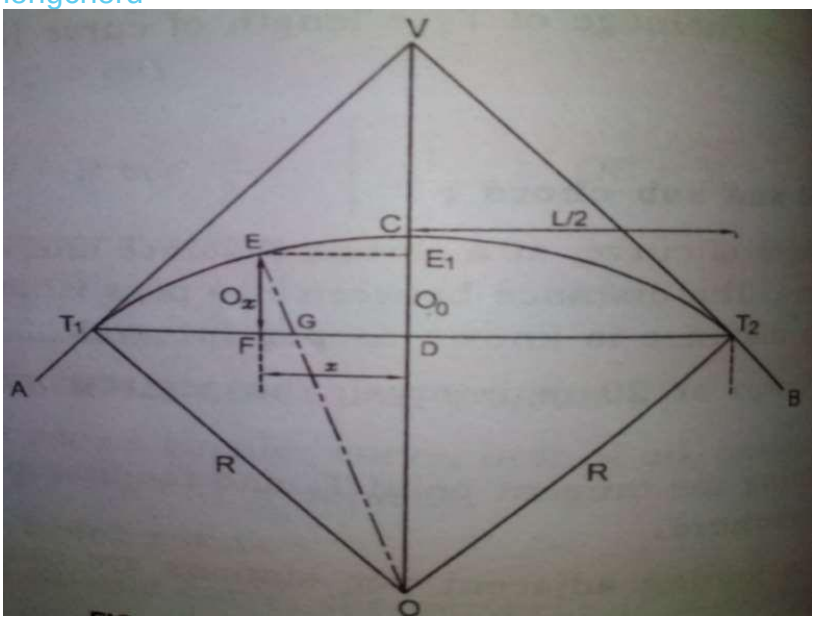
Based on the instruments used in setting out the curves on the ground thereare twomethods:

1) Linearmethod
2) Angular method
3) LinearMethod

- In these methods only tape or chain is used for setting out the curve . Angle measuring instrument are not used.

Main linear methods are

- By offsets from the longchord.
- By successive bisection ofarcs.
- By offsets from thetangent
-
- .By offsets from the longchord



TRANSITION CURVE

is a continuation of the straight lines and curves with a radius of a fixed or variable

PURPOSE

Physical state of hilly land, swampy.
- **Connectingtheexitorentranceastheexitroads'toll‘,**
- **Avoidingthepositionofthedetailsremain,suchasbuildingmosques,cemeteries.**
- **Safetyofroadusersinordertotravelmorecomfortableandsecure.**

SETTING OUT TRANSITION CURVE

Aim:

To set out the transition curve combined with the circular curve by method of deflection angles.

Instruments required:

Theodolite, Ranging rods, Tape or Chain and accessories.

Transition curve:

A transition curve or easement curve is a curve of varying radius introduced between a straight and a circular curve, or between two branches of a compound curve.

Ideal Transition curve:

The fundamental requirement of a transition curve is that its radius of curvature ‘r’ atany point shall vary inversely as the distance (l) from the beginning of the curve. Such a curve is the clothed or the glover’s spiral and is known as the ideal transitioncurve.

Procedure:

In order to make the computations for various quantities of the transition and circular curve the data necessary are

1. The deflection angle (▪) between the originaltangents
2. The Radius of the circular curve (R)
3. The Length of the transition curve(L)
4. The point of intersection(V).

Formulae:

1. Calculate the spiral angle ▪ s by theequation

▪ s = L/2R Radians

2. Calculate the shift S of the circular curve by therelation.

$S = L^2/24R$

3. Calculate total length of the tangentfrom

Tangent length = (R+S) tan ▪ /2 + L/2(l – S/5R) for spiral

Tangent length = (R+S) tan ▪ /2 +L/2 for cubic

4. Calculate the length of the circularcurve.
5. From the chainage of the point of intersection, subtract the length of the tangent to get the chain age of the point of transition curveT.
6. To the chainage of the t add the length of the transition curve to get the chainage of the junction point (d) of the transition curve with the circularcurve.
7. Determine the other junction point (D’) of the circular curve with the transition curve by adding the length of the circular curve to the chainage ofD.
8. Determine the chainage of the point T by adding the length L of the transition curve to

get the chainage ofD'.

9. If it is required to peg the points on through chainage, calculate the length of the sub chords and full chords of the transition curve and circular curve. The peg interval for the transition curve may be 10 metres, while that for the circular curve it may be 20meters.
10. If the curve are to be set out by a theodolite, calculate the deflection angles for transition curve from theexpression.

    ▪ $=5731^2/RL$ Minutes

    and the deflection angles referred to the tangent at D for the circular curve from the expression.

    ▪ = 1719 C/R Minutes

    The total tangent angles ▪ n for the circular curve must be equal to ½(▪ /2▪ s)

11.If however the curves are to be set out linear methods, calculate the offsets from the following formula.

For the true spiral $y = l^3/6\ RL\ (l - ▪^2/14)$ or $l^3/6\ RL\ (1 - L^2/56R^2L^2)$

y being measuring perpendicular to the tangent and l along the curve.

12.For the cubic spiral $y = l^3/6RL$

y being measuring perpendicular to the tangent and l along the curve.

Angular Method

▪ This methods are used when the length of curve is large.

The Angular methods are:

1) Rankine method of tangential angles
2) Two theodolitemethod
3) Tacheometricmethod

EDM

Electronic distance measuring instrument is a surveying instrument for measuring distance electronically between two points through electromagnetic waves.

Electronic distance measurement (EDM) is a method of determining the length between two points, using phase changes, that occur as electromagnetic energy waves travels from one end of the line to the other end. As a background, there are three methods of measuring distance between two points:

DDM or Direct distance measurement – This is mainly done by chaining or taping.
ODM or Optical distance measurement – This measurement is conducted by tacheometry, horizontal subtense method or telemetric method. These are carried out with the help of optical wedge attachments.

EDM or Electromagnetic distance measurement – The method of direct distance measurement cannot be implemented in difficult terrains. When large amount of inconsistency in the terrain or large obstructions exist, this method is avoided

Types of Electronic Distance Measurement Instrument

EDM instruments are classified based on the type of carrier wave as

1. Microwaveinstruments
2. Infrared waveinstruments
3. Light waveinstruments.

1. MicrowaveInstruments

These instruments make use of microwaves. Such instruments were invented as early as 1950 in South Africa by Dr. T.L. Wadley and named them as Tellurometers.

This instrument needs only 12 to 24 V batteries. Hence they are light and highly portable. Tellurometers can be used in day as well as in night.

2. Infrared WaveInstruments

In this instrument amplitude modulated infrared waves are used. Prism reflectors are used at the end of line to be measured. These instruments are light and economical and can be mounted on theodolite. With these instruments accuracy achieved is ± 10 mm. The range of these instruments is up to 3 km.

These instruments are useful for most of the civil engineering works. Theseinstruments are available in the trade names DISTOMAT DI 1000 and DISTOMAT DI55.

3. Visible Light WaveInstruments

These instruments rely on propagation of modulated light waves. This type of instrument was first developed in Sweden and was named as Geodimeter. During night its range is up to 2.5 km while in day its range is up to 3 km. Accuracy of these instruments varies from 0.5 mm to 5 mm/km distance. These instruments are also very useful for civil engineering projects.

- Described by form of electromagneticenergy.
  - First instruments were primarily microwave(1947)
  - Present instruments are some form of light, i.e. laser or near-infrared lights.
- Described by range ofoperation.
  - Generally microwave are 30 - 50 km range.(med)
    - Developed in the early 70’s, and were used for controlsurveys.
  - Light EDM’s generally 3 - 5 km range.(short)
    - Used in engineering andconstruction
- EDM is very useful in measuring distances that are difficult to access or long distances.
- It measures the time required for a wave to sent to a target and reflectback.

EDM CHARECTERSTICs

- 750-1000 metersrange
- Accurate to ±5mm + 5ppm
- Operating temperature between -20 to +50 degreescentigrade
- 1.5 seconds typical for computing a distanc, 1 second whentracking.
- Slope reduction either manual orautomatic.
- Some average repeatedmeasurements.
- Signalattenuation.
- battery operated and can perform between 350 and 1400measurements.

- The measured data can be recorded in the field noteformat
- Can be entered manually into electronic datacollector
- The distance data must be accompanied by all relevant atmos

REMOTE SENSING

Remote sensing is a method for getting information about of different objects on the planet, without any physical contacts with it.

ADVANTAGE

- Provides a view for the largeregion
- Offers Geo-referenced information and digitalinformation
- Most of the remote sensors operate in every season, every day, every time and even in real toughweather

G I S

- **Geographic Information System**
- **Allows the viewing and analysis of multiple layers of spatially related information associated with a geographicregion/location**
- **Both spatial and attribute (tabular) data areintegrated**
- **The widespread collection and integration of imagery into GIS has been made possible through remotesensing**
- **With the increasing technological development of remote sensing, the development of GIS has simultaneously accelerated**

The APPLICATION/IMPORTNACE/USE of RS

- Large amounts of data needed, and Remote Sensing can provideit
- Reduces manual field workdramatically
- Allows retrieval of data for regions difficult or impossible toreach:
  - Openocean
  - Hazardous terrain (high mountains, extreme weather areas,etc.)

        - Ocean depths
        - Atmosphere
    - Allows for the collection of much more data in a shorter amountof time
        - Leads to increased land coverageAND
        - Increase ground resolution of a GIS
    - Digital Imagery greatly enhances aGIS
        - DIRECTLY: Imagery can serve as a visualaid
        - INDIRECTLY: Can serves as a source to derive information suchas…
            - Land use/landcover
            - Atmospheric emissions
            - Vegetation
            - Water bodies
            - Cloud cover
            - Change detection (including sea ice, coastlines, sea levels,etc.)

GPS

GPS systems are extremely versatile and can be found in almost any industry sector. They can be **used** to map forests, help farmers harvest their fields, and navigate airplanes on the ground or in the air. **GPS** systems are **used** in military applications and by emergency crews to locate people in need of assistance

Ghat Tracer

Cylon Ghat Tracer: A reliable instrument for setting out a grade contour, i.e. locating points on a given gradient in the preliminary survey of a hill, road and also for measuring the angle of slope complete in wooden box with target and pole

CLINOMETER

A **clinometer** or inclinometer is an instrument for measuring angles of slope (or tilt), elevation or depression of an object with respect to gravity.

PENTAGRAPH

An instrument for copying plans, maps, and other drawings, on the same, or on a reduced or an enlarged, scale.

What is Total station?

A total station is an electronic/optical instrument used in modernsurveyingandbuilding constructionthat uses electronic transit theodolite in conjunction with electronic distance meter (EDM).It is also integrated with microprocessor, electronic data collector and storage system.

The instrument is used to measure sloping distance of object to the instrument, horizontal angles and vertical angles. This Microprocessor unit enables for computation of data collected to further calculate the horizontal distance, coordinates of a point and reduced level ofpoint.

Data collected from total station can be downloaded into computer/laptops for further processing of information

Abney Levels

An Abney Level is similar to a Hand Level in that it is a telescope with a spirit level attached. The main distinction is

that the spirit level on an Abney level is not set in a static horizontal position. An Abney Level features a graduated arc.
EngineerSupply sells Abney Levels. Once the arc is set at a specific degree it will cause the spirit level to show level at that specific angle. Many Abney levels will feature items such as stadia and will have a feature to focus items at different distances. Some even have a magnification feature. Abney levels are easier to use and inexpensive. They are used to measure degrees, percent of grade and topographic elevation. The user can then determine height, volume and grade through manipulating the readings with trigonometry.

What is a Planimeter?

Planimeter is an instrument used in surveying to compute the area of any given plan. Planimeter only needs plan drawn on the sheet to calculate area. Generally, it is very difficult to determine the area of irregular plot. So, by using planimeter we can easily calculate the area of any shape. The essential parts of planimeter and its working is explained below

Parts of a Planimeter

- Tracingarm
- Tracingpoint
- Anchorarm
- Weight and needlepoint
- Clamp
- Hinge
- Tangentscrew
- Index
- Wheel
- Dial
- Vernier

- ## Howto Use Planimeter inSurveying?
- Planimeter is used to compute the area of given plan of anyshape.

- In the first step anchor point is to be fixed at one point. If the given plan area is small, then anchor point is placed outside the plan. Similarly, if the given plan area is large then it is placed inside theplan.

- After placing the anchor point, place the tracing point on the outline of the given plan using tracing arm. Mark the tracing point and note down the reading on Vernier as initial readingA.
- $$Area = M\,(B - A \pm 10N + C)$$
- Where, A = initialreading
- B = finalreading
- N = no. of completed revolutions of wheel during one complete tracing. N is positive if dial passes index in clockwise, N is negative if dial rotates in anti-clock wisedirection.
- M and C = constants which values are provided on the planimeter. Constant C is used only when theanchor point is placed inside the plan.