Surveying and Geomatics
Unit-4

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DEFINITION

Curves are regular bends provided in the lines of communication like roads, railways etc. and also in canals to bring about the gradual change of direction. They are also used in the vertical plane at all changes of grade to avoid the abrupt change of grade at the apex.

Classification of Curves:

(i) Simple

(ii) Compound

(iii) Reverse and

(iv) Deviation

(i) Simple Curve:

A simple curve consists of a single arc of a circle connecting two straights. It has radius of the same magnitude throughout. In fig. 11.1 T_1 D T_2 is the simple curve with T_1O as its radius.

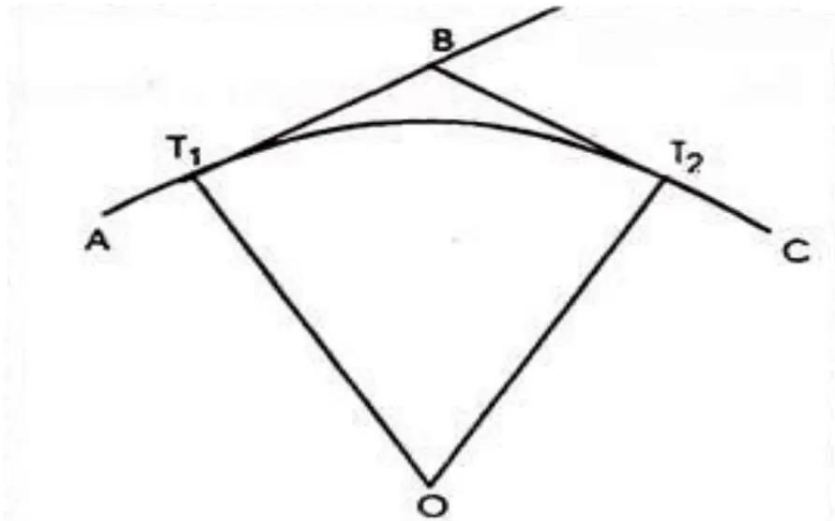


Fig 11.1

(ii) Compound Curve:

A compound curve consists of two or more simple curves having different radii bending in the same direction and lying on the same side of the common tangent. Their centres lie on the same side of the curve. In fig. 11.2, T_1 P T_2 is the compound curve with T_1O_1 and PO_2 as its radii.

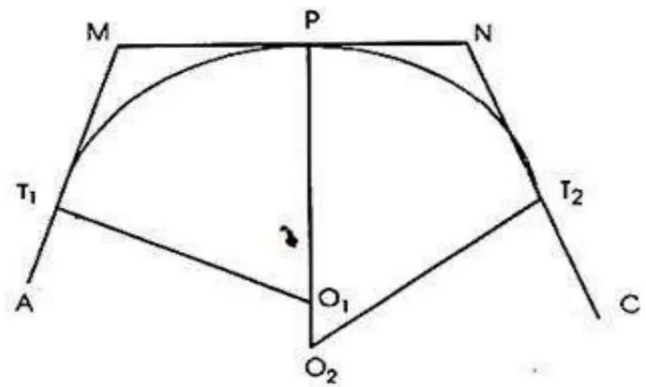


Fig 11.2

(iii) Reverse (or Serpentine) Curve:

A reverse or serpentine curve is made up of two arcs having equal or different radii bending in opposite directions with a common tangent at their junction. Their centres lie of opposite sides of the curve. In fig. 11.3 T_1 P T_2 is the reverse curve with T_1O_1 and PO_2 as its radii.

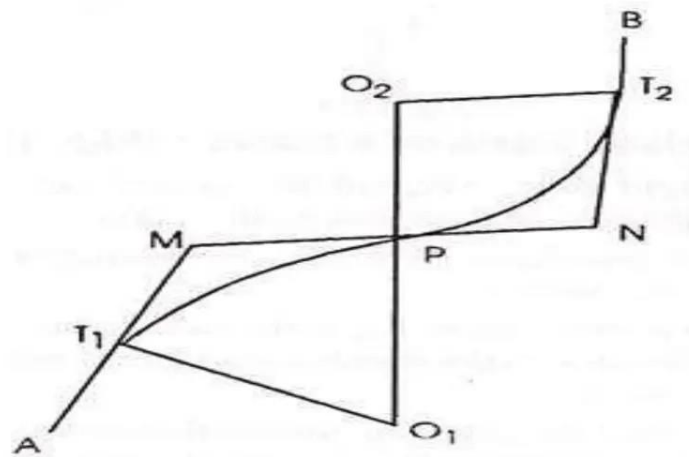


Fig 11 3

(iv) Deviation Curve:

A deviation curve is simply a combination of two reverse curves. It is used when it becomes necessary to deviate from a given straight path in order to avoid intervening obstructions such as a bend of river, a building, etc. In fig. 11.4. T_1 EDFT_2 is the deviation curve with T_1O, EO_2 and FO_3 as its radii.

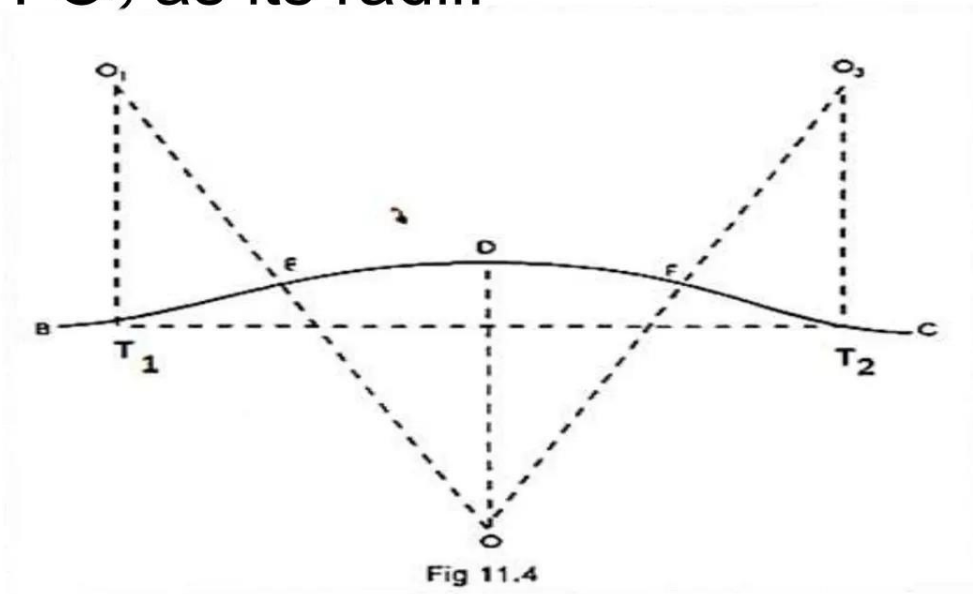


Fig 11.4

TERMINOLOGY USED IN CURVE

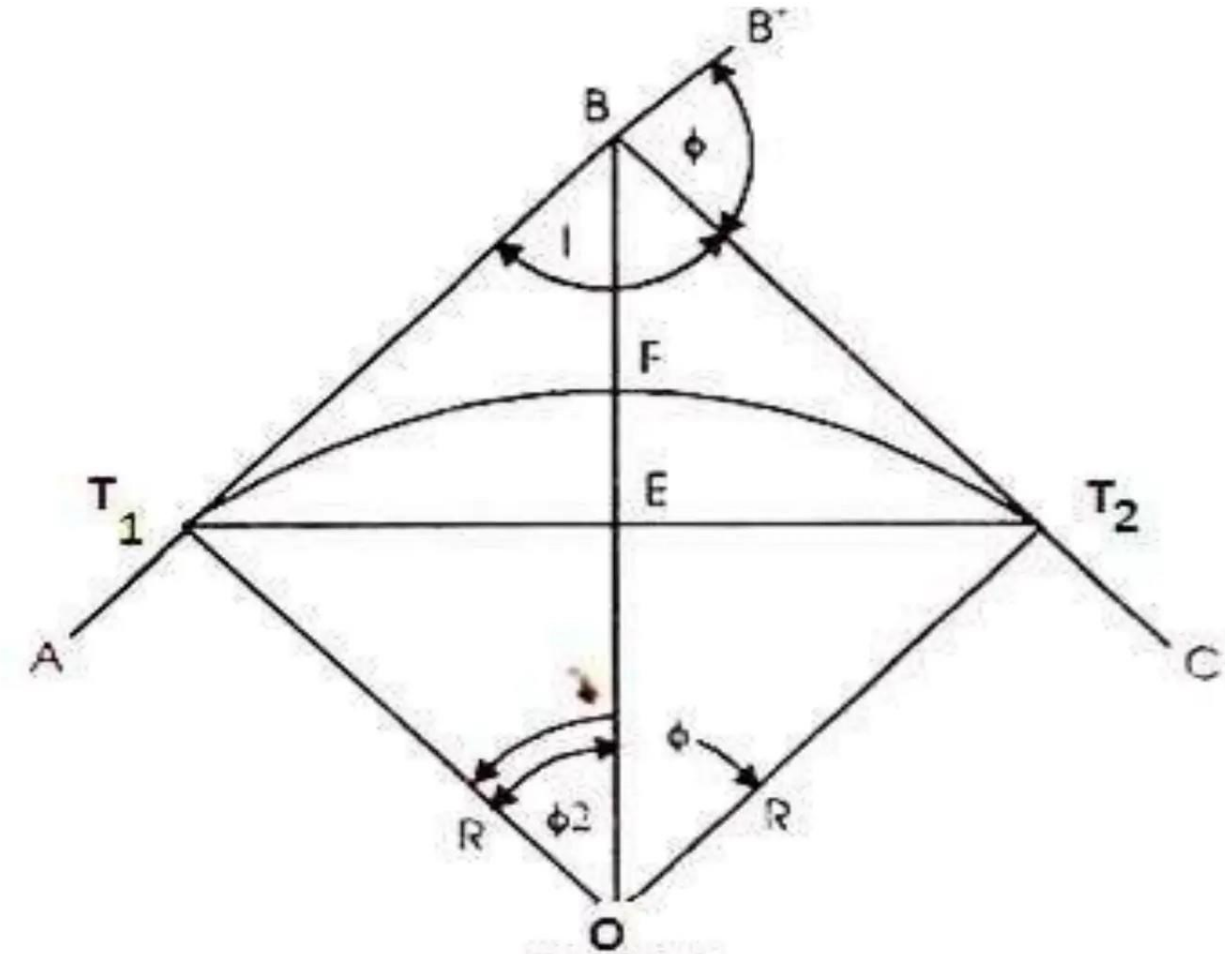


Fig 11.5

- (i) The two straight lines AB and BC, which are connected by the curve are called the tangents or straights to the curve.
- (ii) The points of intersection of the two straights (B) is called the intersection point or the vertex.
- (iii) When the curve deflects to the right side of the progress of survey as in fig. 11.5, it is termed as right handed curve and when to the left, it is termed as left handed curve.
- (iv) The lines AB and BC are tangents to the curves. AB is called the first tangent or the rear tangent BC is called the second tangent or the forward tangent.

- (v) The points (T_1 and T_2) at which the curve touches the tangents are called the tangent points. The beginning of the curve (T_1) is called the tangent curve point and the end of the curve (T2) is called the curve tangent point.
- (vi) The angle between the tangent lines AB and BC (ABC) is called the angle of intersection (I)
- (vii) The angle by which the forward tangent deflects from the rear tangent is called the deflection angle (ϕ) of the curve.
- (viii) The distance the two tangent point of intersection to the tangent point is called the tangent length (BT_1 and BT_2).

- (ix) The line joining the two tangent points (T_1 and T_2) is known as the long-chord
- (x) The arc T_1FT_2 is called the length of the curve.
- (xi) The mid-point (F) of the arc (T_1FT_2) in called summit or apex of the curve.
- (xii) The distance from the point of intersection to the apex of the curve BF is called the apex distance.
- (xiii) The distance between the apex of the curve and the midpoint of the long chord (EF) is called the versed sine of the curve.
- (xiv) The angle subtended at the centre of the curve by the arc T_1FT_2 is known as the Central angle and is equal to the deflection angle (ϕ).

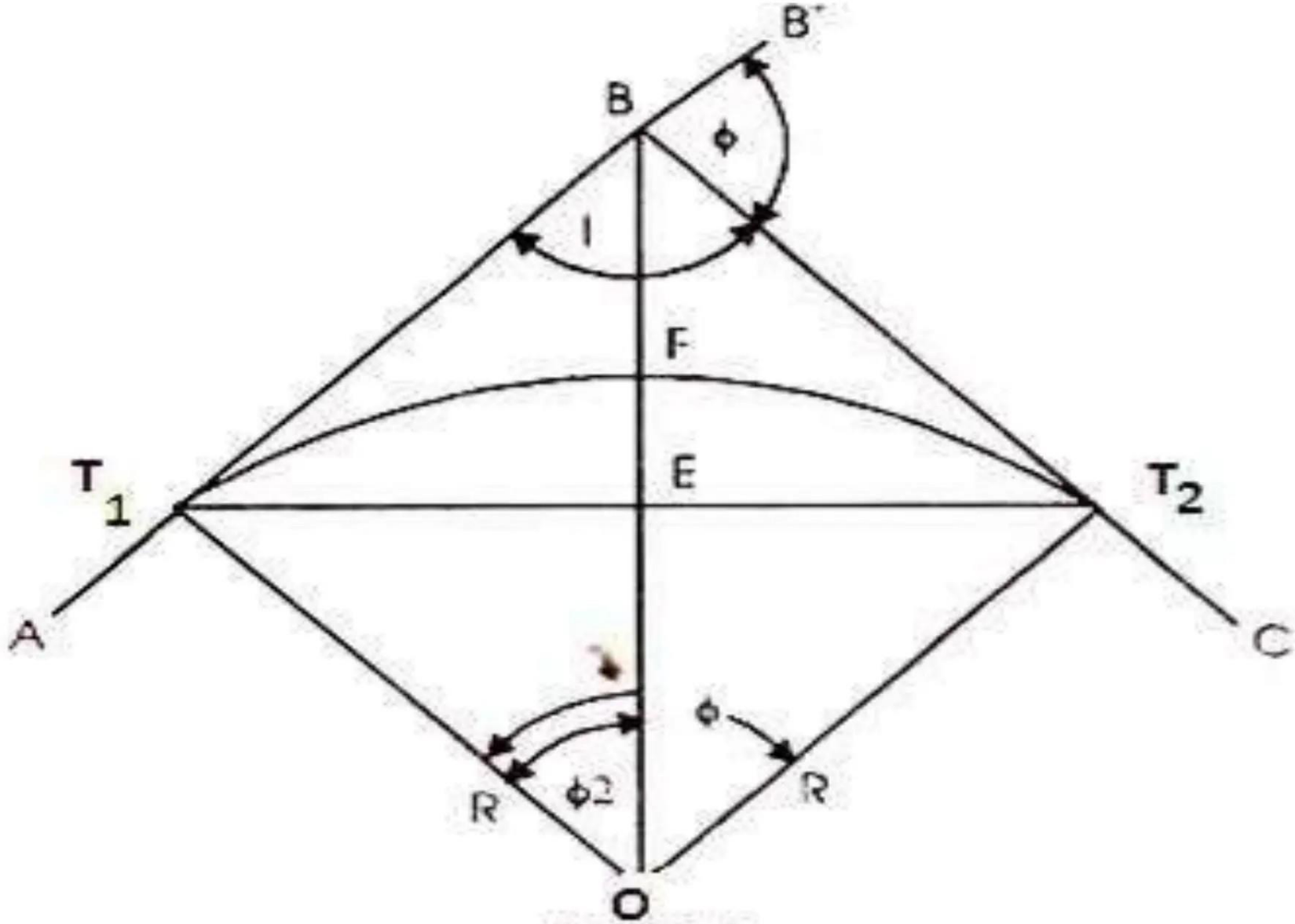


Fig 11.5

(*i*) Angle of intersection + Deflection angle = 180°

or $I + \phi = 180°$ ... ...(Eqn. 11.1)

(*ii*) $\angle T_1OT_2 = 180° - I = \phi$ ... ...(Eqn. 11.2.)

(*i.e.* the central angle = the deflection angle).

(*iii*) Tangent length = $BT_1 = BT_2 = OT_1 \tan \frac{\phi}{2}$

$= R \tan \frac{\phi}{2}$ ... ...(Eqn. 11.3)

(*iv*) Length of Long Chord = $2T_1E = 2 \times OT_1 \sin \frac{\phi}{2}$

$= 2R \sin \frac{\phi}{2}$ ... ... (Eqn. 11.4)

(*v*) Length of the curve = Length of the arc T_1FT_2

$= R\,\phi$ (in radians)

$= \frac{\pi R \phi}{180°}$ ... ... (Eqn. 11.5)

(*vi*) Apex distance = BF = BO — OF

$= R \sec \frac{\phi}{2} - R$

$= R \left(\sec \frac{\phi}{2} - 1 \right)$ ... ...(Eqn. 11.6)

(*vii*) Versed sine of the curve = EF = OF — OE

$= R - R \cos \frac{\phi}{2}$

$= R \left(1 - \cos \frac{\phi}{2} \right) = R \text{ versine } \frac{\phi}{2}$ ... ...(Eqn. 11.7)

Methods of Curve Ranging:

A curve may be set out:

1. By linear methods, where chain and tape are used.
2. By angular or instrumental methods, where a theodolite with or without a chain is used.

LINEAR METHODS OF RANGING

SIMPLE CIRCULAR CURVES

1. **Offsets from the long chord**
2. **Radial offsets from tangents**
3. **Perpendicular offsets from tangents**
4. **Successive bisection of arcs**

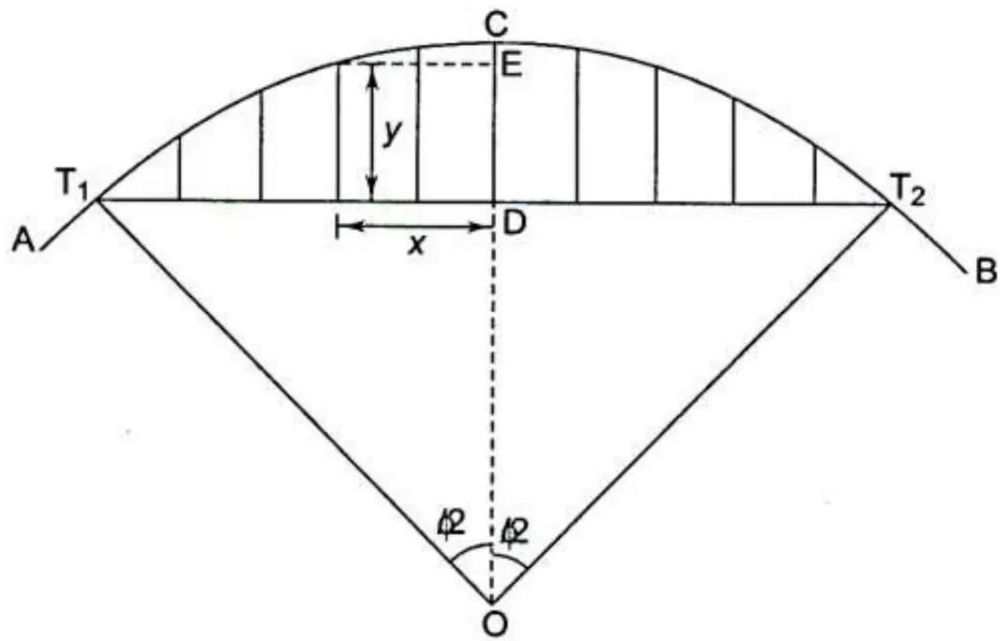
LINEAR METHODS OF RANGING

SIMPLE CIRCULAR CURVES

1. Offsets from the long chord

$$Y = \sqrt{R^2 - x^2} - \sqrt{R^2 - (l/2)^2}$$

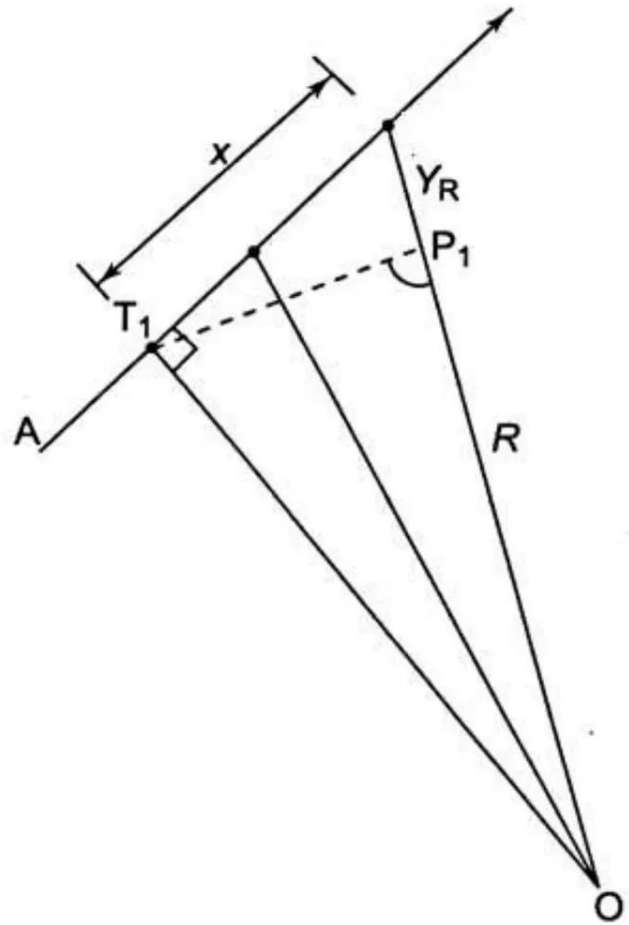
$$\text{Mid-ordinate } Y = R - \sqrt{R^2 - (l/2)^2}$$



LINEAR METHODS OF RANGING

SIMPLE CIRCULAR CURVES

2. Radial offsets from tangents

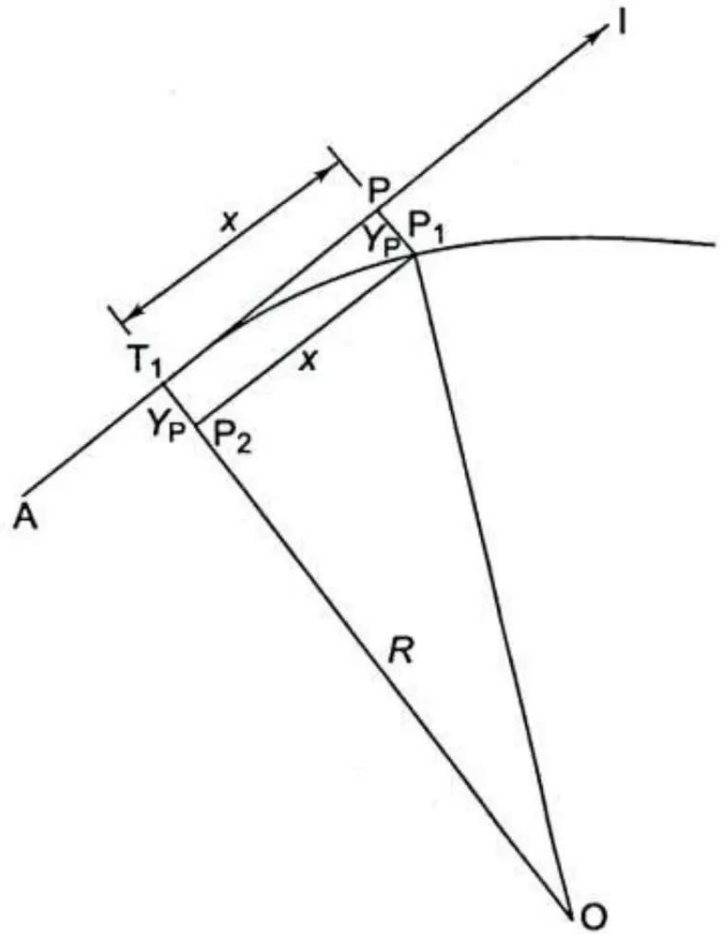


$$Y_R = x^2/2R$$

LINEAR METHODS OF RANGING

SIMPLE CIRCULAR CURVES

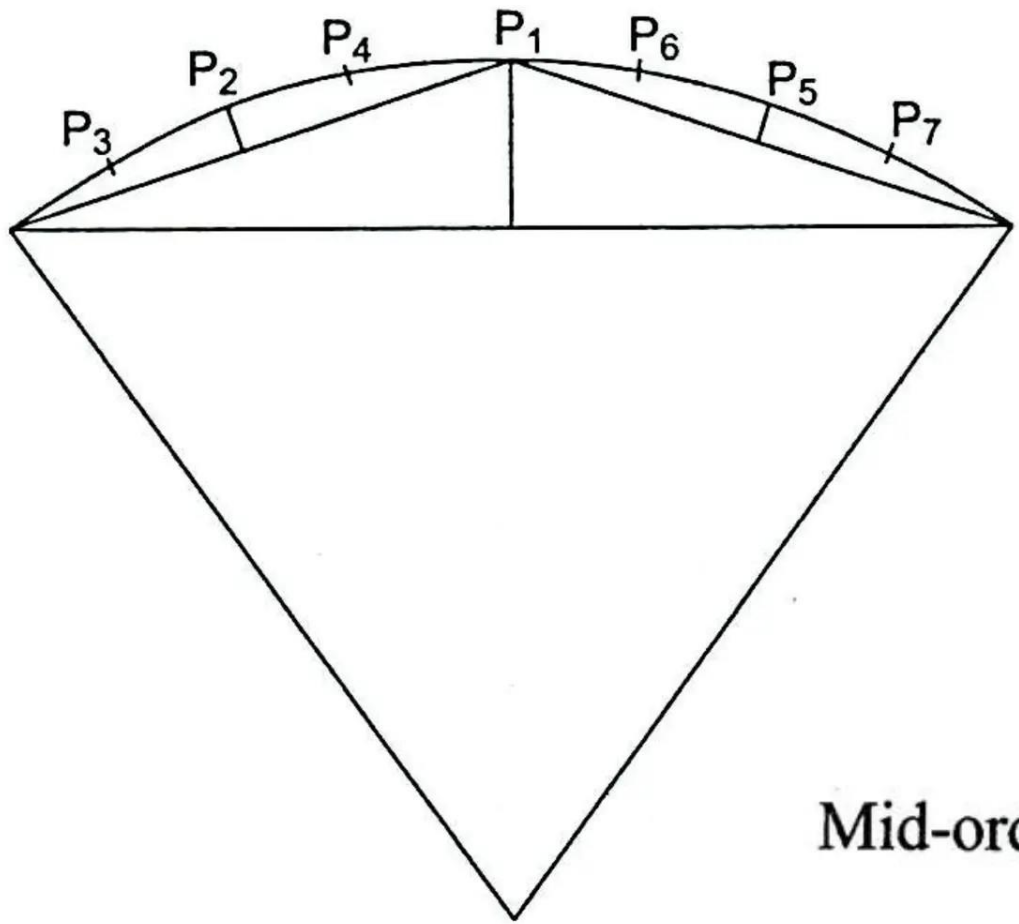
3. Perpendicular offsets from tangents



$$Y_P = x^2/2R$$

LINEAR METHODS OF RANGING SIMPLE CIRCULAR CURVES

4. Successive Bisection of Arcs



Mid-ordinate $Y = R - \sqrt{R^2 - (l/2)^2}$

LINEAR METHODS OF RANGING SIMPLE CIRCULAR CURVES – TUTORIAL

1. **Determine the radius of the curve if it is designated as a 3^0 curve on a 30m arc**

2. **If the radius of the curve is 380m, what is its degree of designation on a 20m arc**

3. **If a curve is designated as a 4^0 curve on a 30m arc, find the tangent distance, length of long chord, length of the arc, apex distance and mid ordinate if the deflection angle is 36^0**

LINEAR METHODS OF RANGING SIMPLE CIRCULAR CURVES – TUTORIAL

4. **If the tangent distance of a curve is 235.6m and the deflection angle is 42^0, calculate the other parameters of the curve, such as length of long chord, length of the curve, apex distance and mid ordinate.**

5. **A simple circular curve has a radius of 800m and a deflection angle of 36^0. Tabulate the ordinates from the chord to set out the curve**

THANK YOU