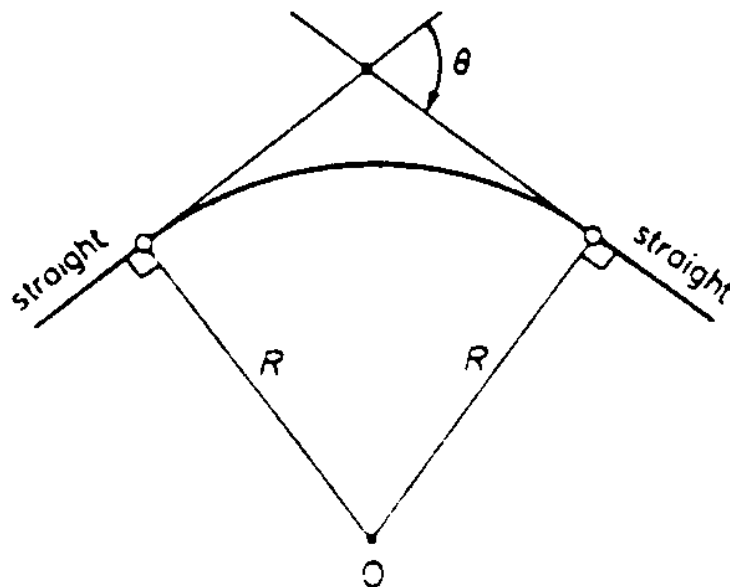


Surveying II

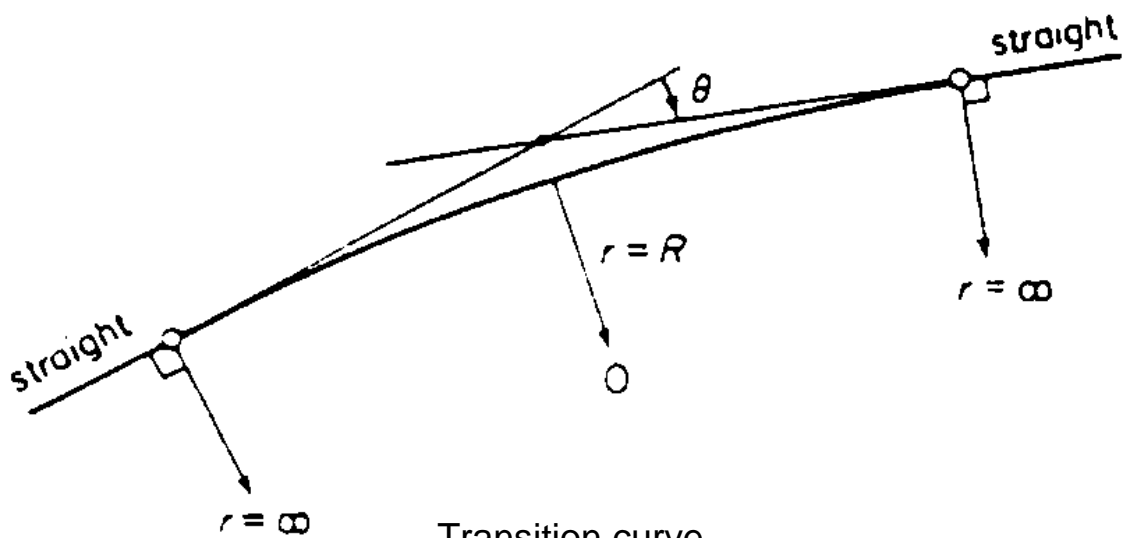
Horizontal Curves

Introduction

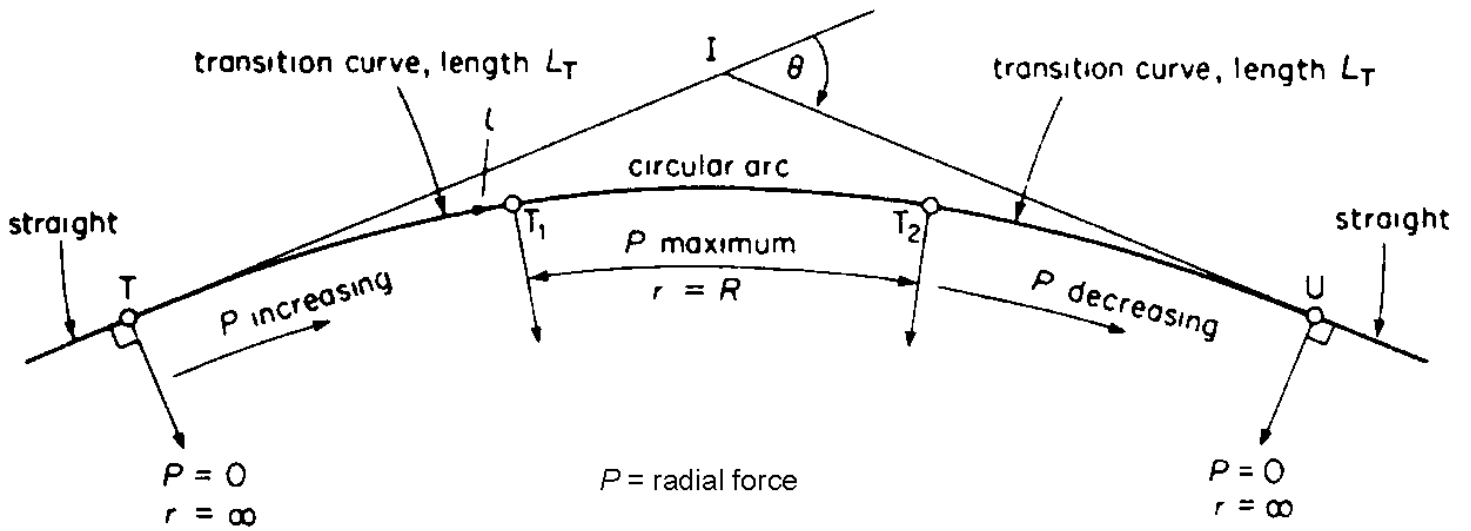
- Straight sections of road or track are connected by curves
- Horizontal and vertical alignments must be considered
- Horizontal curves are used to join two horizontal straights
- Vertical curves are used to join two vertical straights
- These notes concern horizontal curves, we are therefore concerned with horizontal distances, horizontal angles, and plan co-ordinates



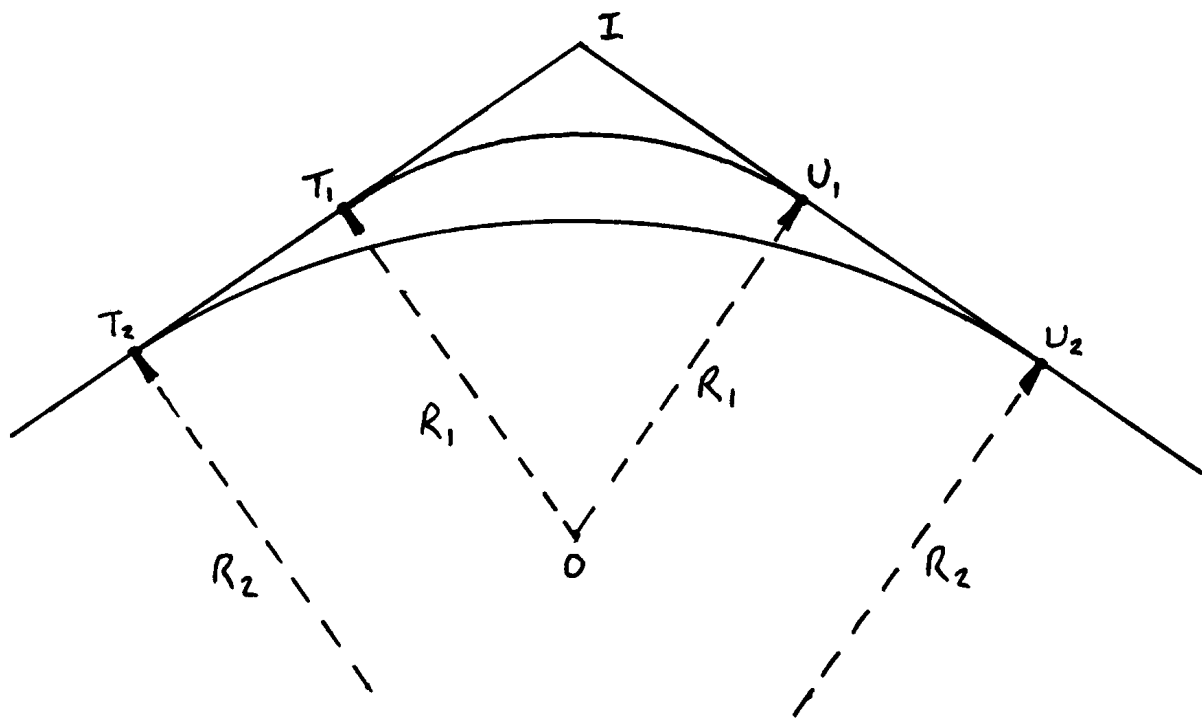
Circular curve – constant radius



Transition curve – decreasing radius then increasing radius



Composite curve – decreasing radius (entry transition),
 constant radius (circular arc),
 increasing radius (exit transition)

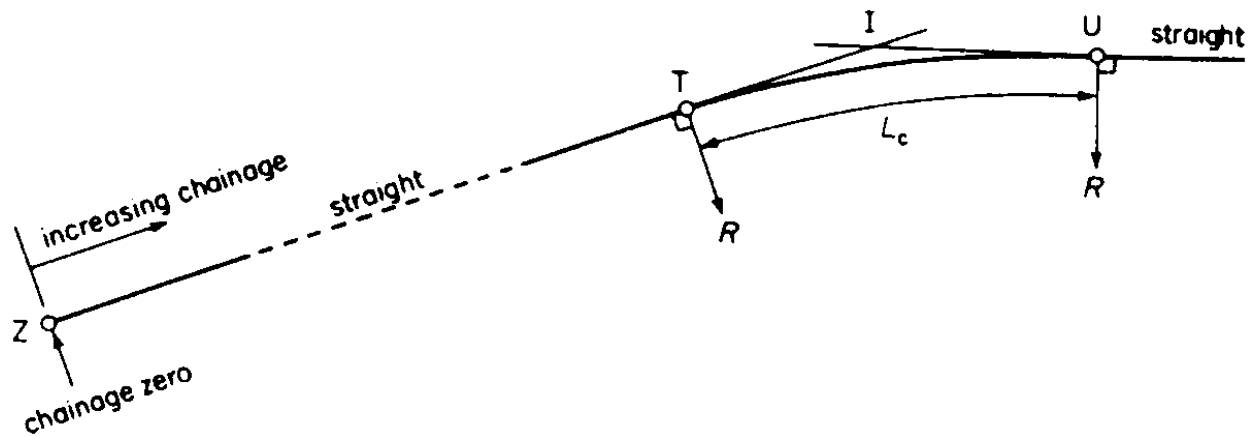


R_1 – small radius, tight curve, short tangent lengths, short curve length
 R_2 – large radius, shallow curve, long tangent lengths, long curve length

Question

- An entry straight has a bearing of 57 degrees 22 minutes and 53 seconds
- The exit straight has a bearing of 112 degrees 19 minutes and 38 seconds
- What is the deflection angle, θ ? (draw a diagram)

Through Chainage



- 'Through Chainage' or 'Chainage' is a distance, usually in metres, measured from the start of the scheme, to a particular point on the centre-line.
- Often, we will know the Chainage of I. In this case:
Chainage of T = Chainage of I – Tangent Length TI
Chainage of U = Chainage of T + Curve Length

Question

- The Intersection Point, I, between two straights has the co-ordinates 624.64mE, 1143.08mN, and its Through Chainage is 2472.34m
- A point, A, on the entry straight has the co-ordinates 541.23mE, 1092.77mN
- A point, B, on the exit straight has the co-ordinates 730.21mE, 1105.50mN
- A circular curve of radius 200m is to connect the two straights
- Calculate the Through Chainage of the Tangent Points, T and U.

- Hints:

Draw a diagram

You need to know the deflection angle, so you need to know the bearings of the straights

Rect to Pol co-ordinate conversion from point A to point I will give the bearing of the entry straight

The same for point I to point B will give the bearing of the exit straight

The difference in the bearings is the deflection angle

You know the formula for the Tangent Length

You know the formula for the Curve Length

You know how to work out the Through Chainage of the Tangent Points from the Chainage of I, the Tangent Length and the Curve Length

Easy

Horizontal Curve Design

- As with most Engineering Design problems, there are usually many acceptable solutions
- There is usually a 'band of interest' within which our road alignment must fall – to avoid certain areas of land, and existing features
- The designer might have some control over the bearings of the entry and exit straights (and hence the deflection angle)
- In a new road scheme, the band of interest may be quite large, giving the designer a lot of flexibility
- In the re-alignment of an existing road, the band of interest may be very narrow, giving the designer little choice
- The designer may also choose the radius for the curve, though this must ensure that the road alignment stays within the band of interest
- Obviously a tight bend (small radius) on a fast road is not a good design, so the design speed for the road is another design variable
- In the UK, the Department of Transport specify minimum radii for horizontal curves on roads of different design speeds
- The road designer therefore has to adjust deflection angle and radius to ensure that the alignment fits within the band of interest, making sure that the radius is above the published minimum for the given road design speed
- More flexibility is given by using composite curves rather than circular curves, and by using 'superelevation' (banking)
- There are other factors to consider such as sight distance
- All these variables make road design an ideal application for a computer. The computer program would normally produce co-ordinates for the centre-line of the road at regular intervals of through chainage (e.g. every 10m).

Setting Out

- Surveying textbooks (e.g. Surveying for Engineers, by Uren and Price) describe several methods of setting out horizontal curves using one or more theodolites and tapes, based on setting out data produced by hand calculation. These methods are quite slow, though they do allow checks on the setting out to be easily made.
- Setting out is more commonly done from co-ordinates produced by a road design computer package. You will do this during your residential field course later in the Semester.
- For small curves (such as kerb lines on minor roads) a quicker, simpler and cheaper method is often used, such as by 'Offsets from the Long Chord'. (See example).