Basic Road Design

“If you don't know where you are going, any road will get you there.”
Lewis Carroll
Road Design

- Horizontal alignment of a road defines its location and orientation in plan view.
- Vertical alignment of a road addresses its shape in profile.
• Examine the existing topographical data.
Road Design

- Decide on the type of road and road characteristics.
  - Freeway
  - Expressway
  - Arterial
  - Collector
  - Local
  - Cul-de-sac
Freeway

- Road designed for high speeds
- Possesses no at-grade intersections
  - Intersections are separated by grade or connected by interchanges
Expressway

- Divided highway designed for high volumes of traffic
- Partial control access

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Arterial Road

- Road designed for moderate or high volumes
- Lower speeds than highways and expressways
- Intersections with collector and local streets
- Commercial areas often located on arterial roads
Collector Street

- Low or moderate capacity road
- Leads traffic to activity areas within a community
- Intersects with arterial roads and local roads
Local Road

- Side road
- Low capacity
- Low speed
- Typically located in residential neighborhoods

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Cul-de-sac

- Dead end street with only one ingress/egress
- Created to limit through traffic
Intersections

- Streets shall be designed to intersect at right angles whenever possible.
- Many road codes will not allow streets to intersect at angles less than 75 degrees.
- A school bus has a difficult time turning and swings out over the other lane when the radius is less than 90 degrees.
Intersections

• Modern roundabouts are becoming more common.
• Roundabouts can reduce delay and increase safety.
• Roundabouts are designed to slow entering traffic and allow all traffic to flow through the junction freely and safely.

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Point of Intersection (PI)

- The point at which two or more roads intersect
Sight Distance

• The distance from which an object at eye level remains visible
• Road codes require different sight distances at intersections depending upon the design speed
• Takes into account average perception and reaction times, braking distance, and condition of pavement
Horizontal Curves

• Horizontal curves connect intersecting straight sections of roads
• Point where the straight sections intersect is also called a PI
• The larger the radius, the flatter the curve
• Most municipalities require a radius greater than 125 feet for a 20 mph street
Elements of a Simple Circular Curve
Length of a Curve

The distance from PC to PT is the length of the curve, which is calculated using the formula below.

\[ L = \frac{\pi R \Delta}{180^\circ} \]
Degree of Curvature, $D$

• Like the radius, the degree of curvature is a measure of the sharpness of a curve.

• The degree of curvature is the angle formed by two radii drawn from the center of the circle to the ends of a chord 100 feet in length for a given radius.

$$D = \frac{5729.65}{R}$$
Curve Data

- Complete curve data must be calculated for every curve on the road.
Station Numbers

• In order to define the location of a road, stations numbers are used.
• Station 1+50 would be 150 feet from the beginning of the road.
• Station 3+25 would be 325 feet from the beginning of the road.
• The distance from Sta. 1+07.84 to Sta. 6+75.26 is 567.41 feet.
Station Numbers

• All significant points (PI, PC, and PT) must be identified on the road plan.
• The curve length is used to find the station number of each PC and PT.
Vertical Road Alignment

• Roads must be aligned to the topography of the site for smooth, safe driving.
• To prevent abrupt changes in grade, vertical curves are used.
• Unlike horizontal curves, vertical curves are parabolic arcs.
Crest Vertical Curves

- A crest vertical curve is used at the top of a summit.
- The length of the curve is determined by two factors: stopping sight distance and rider comfort.
- If the curve is too short, then cars approaching the summit could become airborne.
- Drivers also need enough time to stop in case of debris on the road.
Sag Vertical Curves

• A sag vertical curve is used at the bottom of a curve.
• Sag curves are also designed for sight distance and rider comfort.
• The sight distance is determined by the illuminated area from the average car headlight beam.
• If the curve is too short, then a car will bottom out.
Elements of a Vertical Curve

- A vertical curve has two slopes or grade lines.
- The two grade lines are called the back tangent (g1) and forward tangent (g2).
- The intersection point is the point of vertical intersection (PVI).
- The beginning of the curve is the point of vertical curve (PVC).
- The end of the curve is the point of vertical tangent (PVT).
Road Design

To create the vertical profile of the road, lines are projected from the station points and an exaggerated vertical scale is created. Elevation data from existing station points are plotted to a graph.
A straight line is plotted through the points. Vertical curves are added between slopes. The station numbers for PVC and PVT are computed.
Road Charts

• Important data for the construction of the road is contained in a road chart.
• Stations every 100 feet as well as all important points are included on the chart.
## Road Chart

<table>
<thead>
<tr>
<th>Station</th>
<th>Transit line for Project Road from Lead The Way Boulevard (N 90º W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0+00 Begin Project</td>
<td>78.68’ N3º37’W FROM BM to centerline of Project Road</td>
</tr>
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</table>

Setting up a chart for survey data and control points
Road Chart

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<td>78.68’ N3°37’W FROM BM to centerline of Project Road</td>
</tr>
<tr>
<td>STA 0+90.00</td>
<td>P.C to the left Curve Data</td>
</tr>
<tr>
<td></td>
<td>R = 125’</td>
</tr>
<tr>
<td></td>
<td>=59°</td>
</tr>
<tr>
<td></td>
<td>L = 128.72</td>
</tr>
<tr>
<td></td>
<td>D = 45.83°</td>
</tr>
</tbody>
</table>
### Transit line for Short Cut Drive from Project Road (Bearing N 25°3' E) to Lead The Way Boulevard (N 0°4' W)

<table>
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<tr>
<th>Station</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0+00</td>
<td>Begin Project&lt;br&gt;78.68’ N3º37’W FROM BM to centerline of Project Road</td>
</tr>
<tr>
<td>STA 0+90.00</td>
<td>P.C to the left&lt;br&gt;Curve Data&lt;br&gt;R = 125’&lt;br&gt;_ = 59°&lt;br&gt;L = 128.72&lt;br&gt;D = 45.83°</td>
</tr>
<tr>
<td>STA 2+18.72</td>
<td>P.T.</td>
</tr>
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## Road Chart

Continue adding information in this manner until you arrive at the end of the road.

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| STA 0+90.00 | P.C to the left  
Curve Data  
R = 125'  
_=59°  
L = 128.72  
D=45.83° |
| STA 2+18.72 | P.T. |
| STA 3+01.95 | P.C. to the right  
Curve Data  
R = 200'  
_=42°  
L = 146.61  
D = 26.65 |
| STA 4+48.56 | P.T. |
| STA 5+19.79 | P.I. at Big Road |
Resources