**Circular Curve Information: Angles Bearings & Arcs**

- **BEARINGS:** the direction of a line specified by a given angle between the line and an established meridian, usually the north-south axis.

- An angle less than or equal to 90° measured from the North end or South end of a meridian to the east or west (includes quadrant identifier).

- **For Example, N 24° 06’ 15” E**

- **We will measure and note all our tangents with a BEARING & a Length**
What do we do for this Project with Bearings?

- **All tangents** from the starting point on the left side of the sheet and between curves including the ending tangent **need to be labeled with bearings and length.**

- You get the bearings by **measuring the angle with a protractor or in ACAD** from the north south meridian.

- **Label the bearings in degrees and minutes read from your protractor, or degrees,minutes & seconds in ACAD.** Note, protractor measurements are is not very accurate but we must get the practice and familiarity.

- Also **label the length of the tangent in feet and inches using the decimal format.** Approximate the inches as best you can reading from your scale, or give them accurately in ACAD.
Circular Curve Information: Tangents

- **Tangents**: All tangents on our road project need a bearing & a length.
- Measured and Noted along the Center Line of an element ~ our road in this case
- Denotes a direction & distance of travel, from a starting point to an ending point with a bearing and a length.

Gives length of tangent line in feet and decimals of a foot. Here, 461’ 6”

Gives direction of tangent relative to the North South Meridian

N24°06’15”E
461.50
Calculations ~ *The Length of Curve (L)*

- **The Length of Curve (L)** The length of the arc from the PC to the PT.
- **Note,** *a whole station may occur along L* and must be indicated on your plan.
- **Use the following formula:**
  
  \[ L = \left(2\pi R\right) \times \frac{I}{360°} \]

  *Where* \( \pi = 3.14 \) & \( I = \) Included Angle measured with your protractor or in ACAD
What to Measure? What to Calculate

- **(I)** = Included Angle. Measure with a protractor, convert to Degrees and Minutes. Or get in ACAD.
What to Measure? What to Calculate

- **(I)** Measure with a protractor, or in ACAD, convert to Degrees, Minutes, & Seconds.
- **(R)** = Radius You decide based on design speed. We started with 250 ft. This is a minimum.
- You radius will vary depending on your design. **Measure the Radius with your scale or in ACAD.**
- Clearly draft and mark your radii and radius points (0) on trace mockups so you can see them.

Tuesday, April 27, 2010
What to Measure? What to Calculate

- **(I) Included Angel** Measure with a protractor, convert to Degrees and Minutes.

- **(R) Radii** You decide based on design speed. We started with 250 ft. This is a minimum. Vary this.

- **(L) Length of Curve** You must calculate this using the formula.

- **(T) Tangents** Measure with a scale and protractor or in ACAD. Convert to Bearings & length. Label on Tangent.

For each curve provide the following data in a chart:

CURVE NO. 1

R = 
L = 
I =
Want to Measure: Record Stationing

**Where to Station:**

- **Beginning Point** (POB) 0 + 00
- **Every Full Station** 1 + 00, 2 + 00, 3 + 00, etc. (including along Tangents and Curves).
- **At the Ending Point** 4 + 61.50
- **At the PC and PT of each curve.**
- Stations are measured at the scale of the drawing.
Notes on Grading the Road

- Avoid multiple changes in the slope of your road.
- Go for long continuous gradients with as few changes in longitudinal slope of the road as is practical
- Consider the balance of cut and fill when determining the slopes of your road
- Remember when you change the grade of your road, the cross slope contour angles of shoulders and side walk will change
- Drain run off on adjacent land areas away from the road
Area Drain Inlet

- Used for small discreet areas of paved surfaces
- Small overall dimensions of Lid and Pipe it drains into
- Typical of the type we might have specified our earlier residence patio
**Drain Inlets** have only an outlet pipe. They **have no inlet pipe**.

- **Drain Inlets have no Sump** below the outlet pipe
- Note Smaller Diameter than CB’s
- Note Invert Elevation at bottom of pipe
Drainage Structures ~ Catch Basin (CB)

- **Note Sump**: Volume of space below pipes entering & leaving for debris & sediment to settle & Collect

- Catch Basins have a **pipe in & out**

- For our project, the **outlet pipe shall have an invert@ the CB 2″ lower than the invert of the pipe coming into the CB where it enters**
Catch Basin (CB) Required Elevations

- Note the red plus marks. These represent the Invert Elevation of the Pipe.

- The Invert Elevation represents the elevation of the Bottom of the Pipe as it enters or leaves the CB.

- The CB Rim El is the elevation of the top of the grate cover flush with the road/paved surface.
Culvert Basics & Required Information

**Invert Elevation** (INV. IN, INV. OUT.) Invert refers to the Elevation of the **Bottom of the Pipe**.
**Culvert Basics & Required Information**

*Invert Elevation* (INV. IN, INV. OUT.) Invert refers to the Elevation of the **Bottom of the Pipe**

**INV. EL @ CL of road must be 2’-3” above top of pipe directly below it** to achieve a minimum of 2 FT of cover **over the top of the pipe.**
**Invert Elevation** *(INV. IN, INV. OUT.)* Invert refers to the Elevation of the **Bottom of the Pipe**

**INV. EL @ CL of road must be 2’-3” above top of pipe directly below it** to achieve a minimum of 2 FT of cover **over the top of the pipe.**

Note interaction of contours with head wall
Invert Elevation (INV. IN, INV. OUT.) Invert refers to the Elevation of the Bottom of the Pipe

**INV. EL @ CL of road must be 2’-3” above top of pipe directly below it to achieve a minimum of 2 FT of cover over the top of the pipe.**

Note interaction of contours with head wall

Note drafting of head wall beyond in concept section/elevation.

Why is headwall needed?
1. Note longitudinal flow direction on road
2. Note water flow direction of cross slope of crowned road
3. Note DI/CB locations in red against curb
4. Note Contours at Head Wall of Culvert
5. Note Invert Elevations at outlet of culvert pipe & drafting of headwall beyond in section elevation
6. Flow direction through pipe
Notes on Grading the Road

- Avoid excessive changes in the slope of your road.
- Go for long continuous gradients with as few changes in longitudinal slope of the road as is practical. Keep the change between slopes as minimal as you reasonably can.
- Consider the balance of cut and fill when determining the slopes of your road.
- Remember when you change the grade of your road, the cross slope of shoulders and side walk will change.
- Drain run off on adjacent land areas away from the road.
End of Today’s Presentation