# CE 5332: Highway Design

## Spring 2020

## Project-1: Making the right move

Submitted by:

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## Introduction

For my project, I chose “**Project 1 - Making the Right Move”**.

Here, a problem is described where at an urban intersection, the northbound right turn (the north to east maneuver, with $\Delta=90^o$) is to be channelized for a large school bus (S-Bus-40) at a 10-mph design speed. The PI is at station 80+00. The channelized section is to include provisions for passing a stalled vehicle of the same type.

According to the project, I have to prepare a plan view centerline drawing and the associated table of deflection angles and chord lengths to stake out the curve from the PC to the PT at 25’ (every 1/4 station) intervals.

## Methodology

At first, I have to find out what things are given through which I can proceed to solve the problem.

Given,

- It is an urban intersection and the northbound right turn is to be channelized for a large school bus **(S-Bus-40)**
- **$\Delta=90^o$** is already given here
- Design speed, **V= 10 mph**
- Station, **PI = 80+00**

## Solution Approach:

Secondly, I have to think what I can derive from the given information.

I have to find out the radius of the curve. So, I need to find the super elevation and the side friction.

As the super elevation is not given, I can assume **super elevation e= 1%.** I assume that as the Professor taught us in the class for **Urban area, super elevation, e = 0 – 0.06**

I also assumed that, **side friction, f= 0.38** (as Professor gave us a table of side friction for different design speed)

We know,

$R_{min}$ **= $v^2$/ 15(.01e+f)**

= $10^2$ / 15(.01*1+0.38)

= 17.09 ft

From **figure 2-17 (AASHTO-2018),**

$R_{max}$ for S-Bus-40 is **42.2 ft**

So, I am considering, **R = 42.2 ft**

**Station of PC= Station of PI -T**

**Station of PT = Station of PC + Larc**

Length of the arc**, Larc = ΔR / 57.3**

**= 90*42.2 / 57.3**

**= 66.28 ft**

Tangent, **T = R x tan(Δ/2)**

**= 42.2 x tan(90/2)**

**= 42.2 ft**

**Station of PC = (80+00) – 42.2'**

**= 79 + 57.8**

**Station of PT = (79 + 57.8) + 66.28'**

**= 80 + 24.08**

External Distance, **E= T*tan(Δ/4)**

=42.2*tan(90/4)= 17.48 ft

Middle ordinate, **M= R*(1-cos(Δ/2))**

=42.2*(1-cos(90/2))= 12.36 ft

Long chord,**C= 2*R*sin(Δ/2)**

=2*42.2*sin(90/2)=59.68 ft

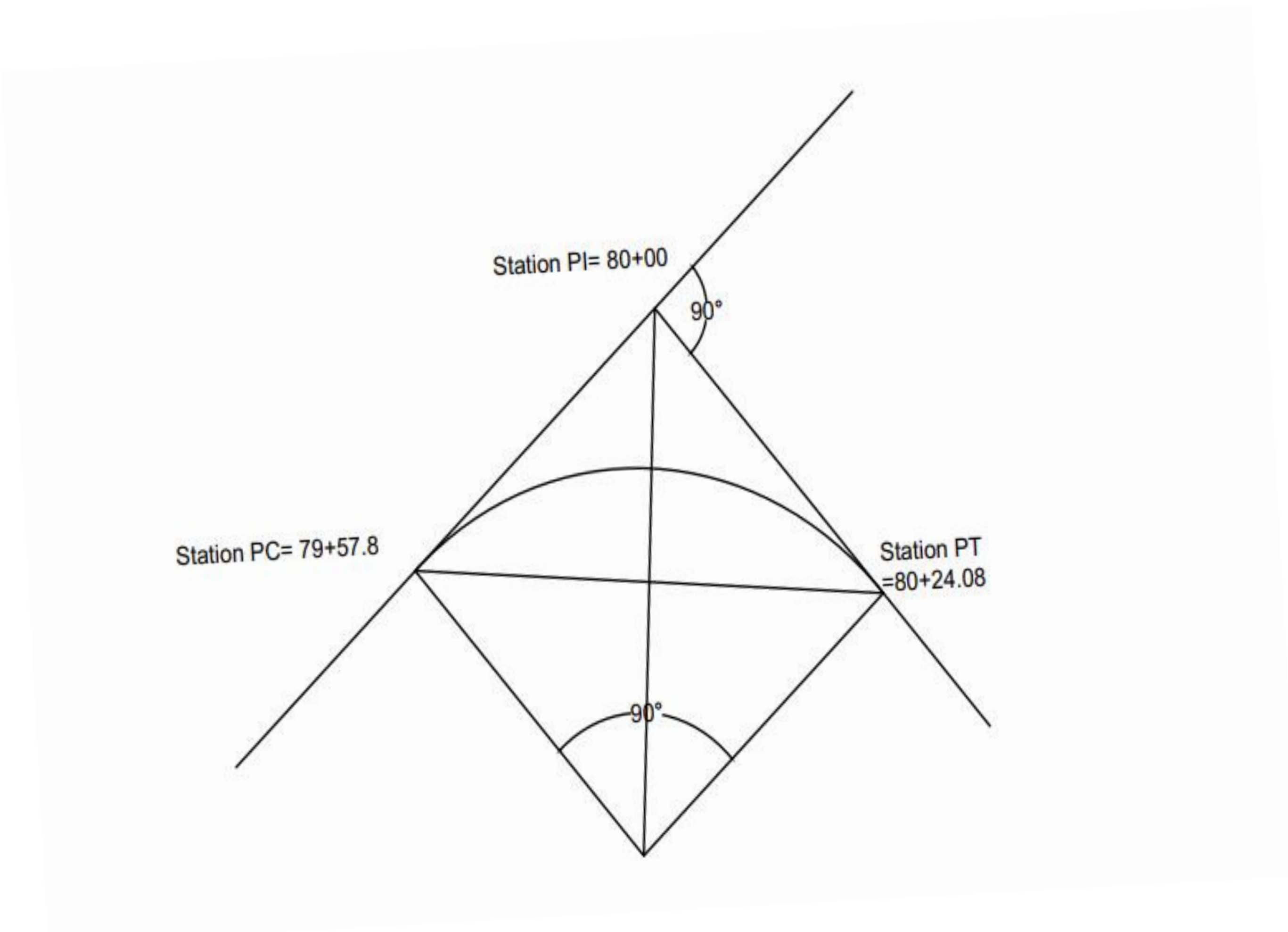


**Figure 1: Horizontal Curve Layout (drawn by AutoCAD)**

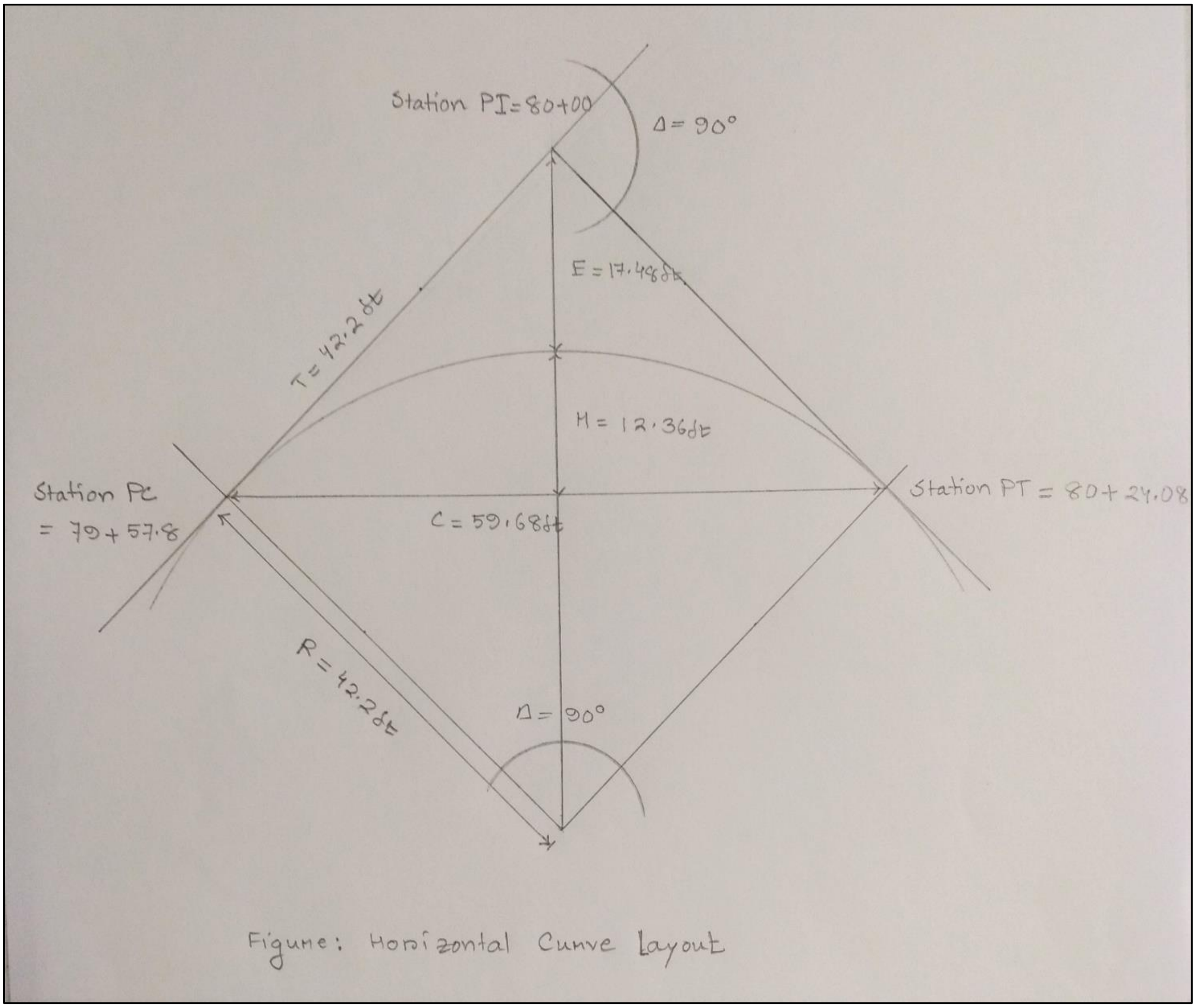


**Figure 2: Horizontal Curve Layout**

## Sample calculation for deflection angle and chord length

79 + 82.8

+ Larc = (79 + 82.8) – (79 + 57.8)

79 + 57.8 = 25 ft

**$\sigma$ = Larc/R x (180/ $\pi$)**

= (25/42.2) x (180/$\pi$)

= $33.92^o$

**Deflection angle, d = $\sigma$/2**

= 33.92/2

= $16.97^o$

**$1^{st}$ chord length**

**C= 2R*sin(**$\sigma$/2)

= 2*42.2*sin(16.97)

= 24.64 ft

**Table:** Deflection angles and Chord lengths to stake out the curve from the PC to PT at 25' intervals

| Stations | Total Deflection Angles from PC | Total chord length |
|---|---|---|
| 79 + 57.8(PC) | - | - |
| 79 + 82.8 | $16.97^o$ | 24.64' |
| 80 + 7.8 | $33.94^o$ | 47.12' |
| 80 + 24.08(PT) | $45^o$ | 59.68' |

I have also drawn the horizontal Curve in AutoCAD which is submitted in canvas.