

Class Term Project Data and Description

Goal: To give CE students the opportunity to be involved in a real-world roadway design.

Project Data:**Traffic Volume**

Assume that the design capacity of the road is 5000 vehicles/day/lane and the expected traffic volume (or AADT) to travel on the road is 19,200 vehicle/day (both directions).

Soil Ground Surface Specifics

The stations and ground surface elevations are shown in the table below.

<u>Station (ft)</u>	<u>Ground Surface Elevation (ft)</u>
0	350
200	335
400	320
600	310
800	305
1000	305
1200	310
1400	320
1600	340
1800	350
2000	380
2200	395
2400	400
2600	420
2800	410
3000	410
3200	400
3400	410
3600	425
3800	440
4000	435
4200	420
4400	425
4600	410
4800	405
5000	420
5200	435
5400	440
5600	450
5800	440
6000	435
6200	430
6400	415
6600	400

Station (ft)	Ground Surface Elevation (ft)
6800	360
7000	350
7200	340
7400	330
7600	315
7800	310
8000	315
8200	320
8400	325
8600	330
8800	345
9000	350
9200	375
9400	400
9600	410
9800	400
10000	380
10200	370
10400	360
10600	355
10800	340
11000	320
11200	315
11400	310
11600	305
11800	310
12000	315
12200	310
12400	305
12600	310
12800	320
13000	340
13200	355
13400	360
13600	355
13800	345
14000	350
14200	340
14400	330
14600	320
14800	310
15000	300

Roadway Specifics

The roadway elevation at station (0+00) is to be designed at 340 ft. The design speed is 55 mi/hr. Design a vertical curve profile for the roadway to connect station (0+00) to station (150+00). The intended roadway slopes are as follows:

- -1% between stations (0+00) and (10+00).
- +2% between stations (10+00) and (20+00).
- -1.5% between stations (20+00) and (28+00).
- +2.5% between stations (28+00) and (38+00).
- -1% between stations (38+00) and (48+00).
- Level between (48+00) and (138+00).
- -1% between stations (138+00) and (150+00).

Roadway Cross-Section

Lane width is 12 feet, right shoulder width is 8 feet, and undivided median (i.e., no physical median). Also, assume 4 feet on each direction that will be dedicated for roadside guardrails (beyond the right shoulders) and for future road widening.

Cost Matter

Earthwork cost:

- Cut (or excavation) is \$0.15/cubic foot.
- Fill (or borrow) is \$0.45/cubic foot.

Requirements:

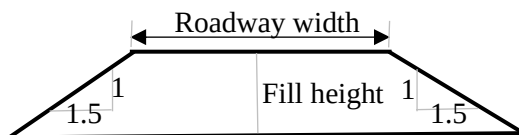
1. How many lanes are to be designed? Also, what is the total roadway width (or right-of-way)?
2. Ground surface: Provide a graph showing both roadway and ground surface elevations (from station (0+00) until station (150+00)).
3. Vertical curves: Use the grades provided from the elevation survey to design the necessary vertical curves. For each crest vertical curve, provide the following calculations in your design:
 - a. Minimum designed curve length (L_{min}) to accommodate the stopping sight distance (SSD) and passing sight distance (PSD);
 - b. Entering and exiting grades; and
 - c. Stations and elevations of *PVC*, *PVI*, and *PVT*.

For each sag vertical curve, provide the following calculations as part of your design:

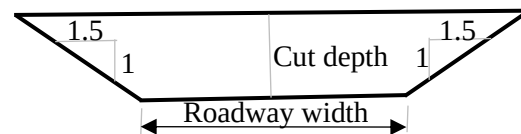
- a. Minimum designed curve length (L_{min}) to accommodate the stopping sight distance (SSD);
 - b. Entering and exiting grades; and
 - c. Stations and elevations of *PVC*, *PVI*, and *PVT*.
4. Horizontal curve: Design a horizontal curvature section of the roadway, given the following:
 - Horizontal curve *PI* is at station (60+00).
 - Maximum roadway superelevation is 6%.
 - Central angle (Δ) is 35° .

For the horizontal curvature design, provide the following calculations as part of your design:

- a. Curve radius until the roadway centerline (R);
 - b. Tangent length (T);
 - c. Curve length (L);
 - d. External distance (E);
 - e. Middle ordinate (M);
 - f. Station of PC ; and
 - g. Station of PT .
5. **Earthwork:** Provide table and calculations for the different cut and fill (borrow) earthwork between each two stations (i.e., every 200 feet). Also, determine the final total volume of cut and fill for the project. Assume that the cut and fill cross-section at each station is trapezoidal in shape, as shown below.



Fill cross-section



Cut cross-section

6. **Cost:** Identify the total cost/budget for each of the cut and fill earthwork required to construct the roadway.
7. **Level-of-service “extra-credit points”:** Identify the level-of-service (LOS) on the designed roadway section between stations (10+00) and (20+00) during the afternoon peak hour, given the following:
- Peak hour factor is 0.90.
 - Directional afternoon peak-hour traffic flow is 2000 vehicles/hr.
 - Percentage of heavy vehicles (i.e., trucks and buses) is 18%.
 - Speed limit on that roadway section is 50 mi/hr.
 - Existence of 15 access points per mile.

Deliverables:

- Submit a final report hard copy by the end of the semester (by **Friday, May 8th, 2020**). This report is intended to demonstrate your understanding of the concepts and principles covered in this course. The report should be typed in MS Word and should be professional, organized, and neat. Provide all the project description, information, and detailed calculations in the report (detailing the seven above requirements). There are no specific guidelines for the report submission and I will leave it up to you to organize the report in the best way that you can think of. There is no specific page limit requirement, but from experience, the full report can

be around 12 to 15 pages long (single-spaced). The final report submission is worth 80% of the total project grade.

- Students also need to submit an initial draft (outlining their understanding of the project and sample design calculations) by the end of March and start of April. Detailed schedule will be announced later. Each student will meet with Dr. Haleem during the announced schedule for 6 minutes. During the meeting, each student will:
 1. explain his/her understanding of the project;
 2. present sample design calculations (e.g., for vertical curve design, horizontal curve design, earthwork calculations, LOS identification, etc.); and
 3. propose a detailed plan to complete the remaining project tasks on time.

The intended objective of this initial project outline submission is to make sure that each student is on the right track to complete the entire roadway design and to also give initial feedback before the final due date. Four dates (outside class meeting times) will be devoted to meet with each student (10 students per day and the meeting time is around 6 minutes). The initial project outline submission is worth 20% of the total project grade.