CE 553: Traffic Engineering

Course Description:

Driver, pedestrian, and vehicular characteristics. Traffic characteristics; highway capacity; traffic studies and analyses. Principles of traffic control for improved highway traffic service. Application of appropriate computing software and tools.

Course Outcomes (students should be able to):

1. Explain the impact of reaction time and other user characteristics on the design of traffic control devices.
2. Calculate basic traffic flow quantities and relate them to each other (speed, flow, density, time headway and space headway).
3. Infer quantities to describe speed or travel time distributions from distributions, and draw conclusions about the performance.
4. Determine traffic volumes using classification and axle counts.
5. Explain the limitations of volume measurements, in light of the concept of roadway capacity.
6. Calculate different traffic flow quantities through application of the K-factor and PHF.
7. Describe typical variations in traffic volume by day of week and season.
8. Judge whether a quantity is a low or high amount of traffic by relating it to capacity; estimate the capacity of a facility on general principles (per lane, interrupted flow, uninterrupted flow).
9. Apply a traffic flow model (such as the Greenshields model) to speed-density data and use it to extract the mean free speed, jam density, and capacity.
10. Explain the limitations of the Greenshields model.
11. Identify capacity and critical density in a speed-flow or flow-density diagram.
12. Calculate the speed of a traffic shockwave.
13. Construct a visual representation of a traffic situation involving shockwaves. Extract information such as length of queue and time to clear the queue by using shockwave speeds. Apply this to the problems of stopped traffic and reduced capacity.
14. Predict properties of queuing systems (e.g., time in system, queue length) using information about the service and arrival rates.
15. Construct a queuing diagram. Extract information such as the total delay and time needed to clear the queue by using basic queuing diagram principles. Apply this to the problems of stopped traffic, reduced capacity, and change in arrival rate.
16. Estimate freeway level of service.
17. Explain the goals of ramp metering and how to determine the desirable ramp volume.
18. Identify how to exclude outliers from a set of observations using the Median Absolute Deviation methodology.
19. Estimate travel time given roadway speed information.
20. Identify the critical gap given distributions of rejected and accepted gaps.
21. Apply the formula for the distribution of the number of gaps and explain how gaps can relate to the capacity of a two-way stop controlled movement.
22. Estimate the level of service for a roundabout.
23. Determine if a traffic signal is warranted at a location.

Course Outcomes, continued

24. Describe considerations in locating traffic signal heads.
25. Describe the essential components of physical traffic signal infrastructure.
26. Explain how a detector works and how the information is used by a controller to call and extend.
27. Describe what a phase is and what an overlap is. Explain how eight-phase timing works and why it is used.
28. Explain the difference between protected, permitted, and protected-permitted movements.
29. Design fully-actuated signal timing for an intersection.
30. Explain coordinated signal timing and describe how it is different from fully-actuated / non-coordinated signal timing.
31. Calculate the ideal offset for one-way traffic. Explain how to come up with a good offset for two-way traffic.
32. Explain how two eight-phase signals are coordinated with each other using their offsets, the reference point, and the system reference point.
33. Design coordinated signal timing for an intersection.
34. Estimate the level of service for a signalized intersection.
35. Appraise whether coordinated signal timing is working well or working poorly using information such as a coordination diagram or a flow profile.
36. Explain the goals of traffic signal preemption.
37. Summarize the basic principles behind traffic responsive and adaptive control.
38. Outline the steps in traffic impact analysis.
39. Use a trip generation table or chart to predict the amount of trips that will be generated by a facility.
40. Apply the gravity model to apportion trips to zones. Apply the Logit model to estimate the mode choice for such trips. Explain how to assign trips to different specific routes.

Course Topics

- User characteristics
- Traffic measurements
- Traffic flow models
- Shockwaves
- Queuing theory
- Freeway operation
- Traffic monitoring
- Traffic control devices
- Traffic signals
- Intersection Design
- Signal Timing
- Coordination concepts
- Signal performance measures
- Traffic impact analysis
- Adaptive signal control