533372 Highway Engineering

Traffic Characteristics

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Traffic Flow Characteristics

1. Speed and Travel Time
   - Spot speed
   - Overall speed
   - Running speed

Spot Speed

- Time-mean speed $\bar{u}_t = \frac{\sum_{i=1}^{n} u_i}{n}$
- Space-mean speed $\bar{u}_s = \frac{nd}{\sum_{i=1}^{n} t_i}$

Overall Speed

$$Overall\ speed = \frac{Total\ distance\ traveled}{Total\ time\ required}$$

Running Speed

$$Running\ speed = \frac{Total\ distance\ traveled}{Running\ time}$$

2. Traffic Volume and Rate of Flow

The number of vehicles that pass a point along a roadway or traffic lane per unit of time

Average daily traffic (ADT)

The number of vehicles that pass a particular point on a roadway during a period of 24 consecutive hours averaged over a period of 365 days, vehicle-kilometers or vehicle-miles

Rate of flow

The value accounts for the variability or the peaking that may occur during periods of less than 1 hr. This term is used to express an equivalent hourly rate for vehicles passing a point along a roadway or for traffic during an interval less than 1 hr, usually 15 min.

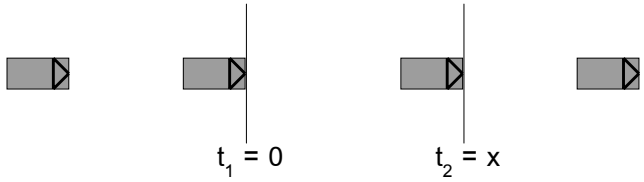
3. Traffic Density or Traffic Concentration

The average number of vehicles occupying a unit length of roadway at a given instant

4. Spacing and Headway

Space headway or spacing

Time headway or headway



5. Speed-Volume-Density Relationships

$$q = k\bar{u}_s$$

q = average volume of flow (vehicles/hr)
k = average density or concentration (vehicles/mile)
u_s = space-mean speed (mph)

6. Highway Capacity

- Highway Capacity Manual
- Factors Affecting Capacity, Service Flow Rate, and Level of Service
- General Methodology for Capacity Analysis for Freeway Segments

Ideal conditions for uninterrupted flow facilities includes:

- 3.6-m (12-ft) lane widths
- 1.8-m (6-ft) clearance between the edge of travel lanes and the nearest roadside obstructions
- all passenger cars in the traffic stream
- a driver population comprised predominantly of regular and familiar users of the facility

An ideal signalized intersection approach has

- 3.6-m (12-ft) lane widths
- level grade
- no curb parking allowed on the intersection approaches
- all passenger cars in the traffic stream
- no turning movements at the intersection
- intersection located outside the central business district
- green signal available at all times

Roadway factors include

- the types of facility and its development environment
- lane widths
- shoulder widths and/or lateral clearance
- design speed
- horizontal and vertical alignments

General Methodology for Capacity Analysis for Freeway Segments

$$SF_i = MSF_i \times N \times f_W \times f_{HV} \times f_P$$

SF_i = service flow rate for level of service *i* under prevailing roadway and traffic conditions for N lanes in one direction (vehicle/hr)

N = number of lanes in one direction of the freeway

f_W = factor to adjust for the effects of restricted lane widths and/or lateral clearances

f_{HV} = factor to adjust for the effect of heavy vehicles (trucks, buses and recreational vehicles) in the traffic stream

f_P = factor to adjust for the effect of driver population

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Geometric Design of Highways

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Design criteria

- **Factor influencing to the elements of design**
  1. Design control
  2. Engineering criteria
  3. Project-specific objectives
- **The Summary of Factors**
  1. Functional classification of the roadway
  2. Projected traffic volume and composition
  3. Required design speed
  4. Topography of the surrounding land
  5. Capital costs for construction
  6. Agency funding mechanisms
  7. Human sensory capacities of roadway users
  8. Vehicle size and performance characteristics
  9. Traffic safety considerations

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- **The Summary of Factors (Cont.)**
  10. Public involvement, review, and comment
  11. Environmental considerations
  12. Right-of-way impacts and costs

- **The Principal Design Criteria**
  1. Traffic volume
  2. Design speed
  3. Vehicle size
  4. Vehicle mix

Relationship of Traffic to Highway Design

- **The major traffic elements that influence highway design:**
  1. Average daily traffic (ADT)
  2. Design hour volume (DHV)
  3. Directional distribution (D)
  4. Percentage of trucks (T)
  5. Design speed (V)

- **Design hour volume:**

$$DHV = ADT \times K$$

K = the percentage representative of the amount of traffic occurring during the peak hour during an average weekday

= 8 to 12 percent for urban facilities

= 12 to 18 percent for rural facilities

- **Directional distribution:**

  The one-way volume in the predominant direction of travel, expressed a percentage of the volume in the two-way design hour volume

  D = 55 to 80 percent for rural roads (typically is about 67 percent)

- **Percentage of trucks:**

  Expressed as the percentage of trucks (exclusive of light delivery trucks) present in the traffic flow during the design hour. That percentage typically varies from about 5 to 10 percent.

- **Roadway capacity**

  Service volume: The traffic volumes that can be served at each level of service

- **Design speed**
  - The maximum safe speed that can be maintained over a specified section of highway when conditions are so favorable that the design features govern
  - The choice of design speed will depend primarily on the surrounding terrain and the functional class of the highway

  Other factors determining the selection of design speed:

  - traffic volume and composition
  - costs of right-of-way and construction
  - aesthetic considerations

  Design speed: 30 to 120 km/hr (20 to 75 mph)