Highway Capacity

Highway Capacity & Level of Service

- One of the most critical needs in traffic engineering is a clear understanding of **how much traffic** a given facility can accommodate, and under what **prevailing conditions.**

- These are the issues addressed in highway capacity analysis.

Highway Capacity & Level of Service

- In the United States, the standard reference for capacity analysis procedures is the Highway Capacity Manual (HCM) published by the Transportation research Board (TRB).

- They have been developed from a wide range of research studies conducted during the past 55 years.

- They reflect North American operating experience and may not be representative of traffic, transit, and pedestrian operations in other parts of the world.

Highway Capacity & Level of Service

• Several major types of transportation facilities and road user categories are described in the HCM:

- Uninterrupted Flow facilities:

• Freeways
• Multilane Highways
• Two-lane Highways

- Interrupted Flow Facilities:

• Signalized Intersections
• Unsignalized Intersections
• Urban Streets

- Other Road Users

• Transit
• Pedestrians
• Bicyclists

Highway Capacity & Level of Service

The HCM defines the capacity of a facility as

"the maximum hourly rate at which persons or vehicles can be reasonably expected to traverse a point or uniform segment of a lane or roadway during a given time period under prevailing roadway, traffic, and control conditions."

Ideal Capacity

- Freeways: Capacity (Free-Flow Speed)

  2,400 pcphpl (70 mph)

  2,350 pcphpl (65 mph)

  2,300 pcphpl (60 mph)

  2,250 pcphpl (55 mph)

- Multilane Suburban/Rural

  2,200 pcphpl (60 mph)

  2,100 (55 mph)

  2,000 (50 mph)

  1,900 (45 mph)

- 2-lane rural – 2,800 pcph
- Signal – 1,900 pcphgpl

Highway Capacity & Level of Service

Roadway Conditions:

- Lane widths
- Shoulder widths and lateral clearances
- Horizontal curvature
- Vertical curvature (grades)
- Design speed
- Street parking allowed
- Queuing storage for turn lanes

Highway Capacity & Level of Service

Traffic Conditions:

- Vehicle type (i.e., pc, truck, RV, bus)
- Directional distribution
- Lane distribution
- Driver familiarity with route
- Number of pedestrian crossings

Highway Capacity & Level of Service

Control Conditions

- Signals
- Signs
- Marking

Highway Capacity & Level of Service

Level of Service is a qualitative measure describing operational conditions within a traffic stream and their perception by motorists and passengers.

Factors affecting LOS are:

- Speed and Travel Time
- Freedom to maneuver
- Traffic interruptions
- Comfort and Convenience

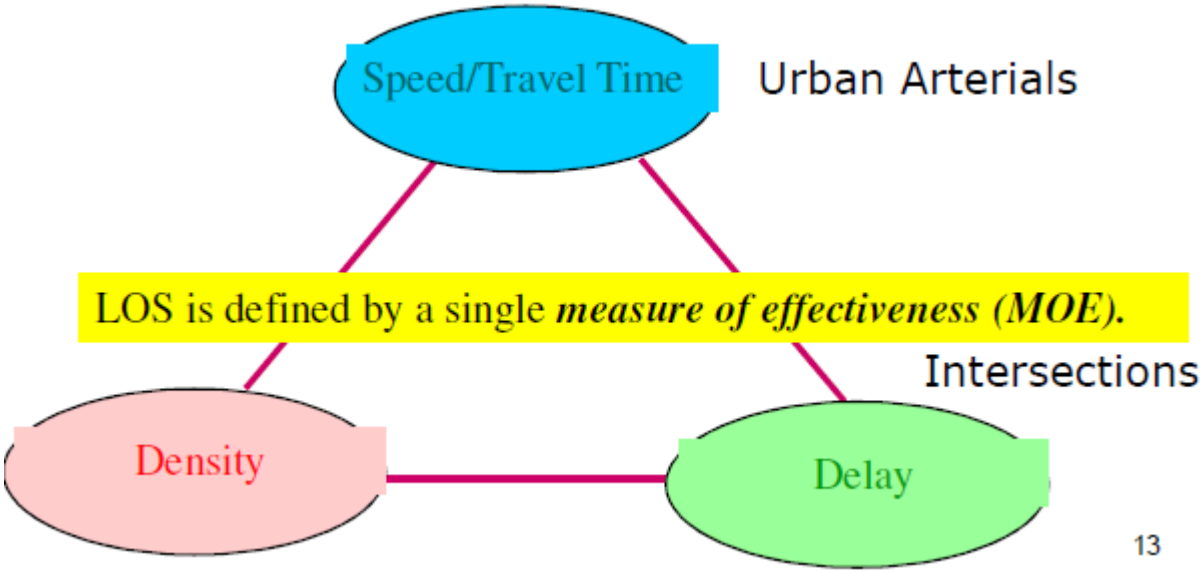
Highway Capacity & Level of Service

- Six levels of service are defined for each type of facility for which analysis procedures are available in the HCM.

- They are given letter designations, from A to F, with LOS A representing the best operating conditions and LOS F the worst.

- Each level of service represents a range of
- operating conditions.

"A *level of service is a letter designation that describes a* **range of operating** conditions on a particular type of facility."



Freeway and rural arterials

Highway Capacity & Level of Service

• The maximum rate of flow that can be accommodated by a facility at each LOS (except LOS F) is described as the service flow rate.

• The service flow rate for a designated LOS is the maximum hourly rate at which persons or vehicles can reasonably be expected to traverse a point or uniform section of a lane or roadway during a given period under prevailing roadway, traffic, and control conditions.

•The service flow rates are generally based on a15-min period. Typically, the hourly flow rate is defined as four times the peak 15-min volume.

Highway Capacity & Level of Service

The capacity analysis procedures attempt to establish or predict the maximum rate of flow that can be accommodated by various facilities at each level of service, except LOS F, for which flows are unstable. Thus each facility has five service flow rates, one for each level of service (A through E).

The service flow rate for LOS E is the value that corresponds to the capacity of the facility.

Highway Capacity & Level of Service

Note that service flow rates are **discrete values**, whereas levels of service represent a **range** of conditions.

Because the service flow rates are defined as maximums for each level of service, they effectively define flow boundaries between the various levels of service

LOS A (Freeway)

- Free flow conditions
- Vehicles are unimpeded in their ability to maneuver within the traffic stream
- Incidents and breakdowns are easily absorbed

LOS B

- Flow reasonably free
- Ability to maneuver is slightly restricted
- General level of comfort provided to drivers is high
- Effects of incidents and breakdowns are easily absorbed

LOS C

- Flow at or near FFS
- Freedom to maneuver is noticeably restricted
- Lane changes more difficult
- Minor incidents will be absorbed, but will cause deterioration in service
- Queues may form behind significant blockage

LOS D

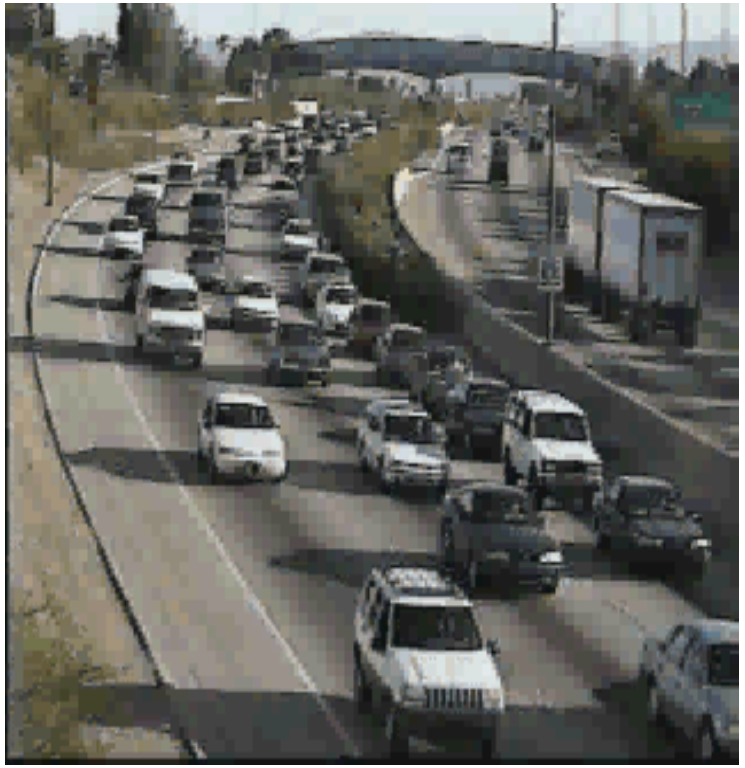
- Speeds begin to decline with increasing flow
- Freedom to maneuver is noticeably limited
- Drivers experience discomfort
- Even minor incidents cause queuing, traffic stream cannot absorb disruptions

LOS E

- Capacity
- Operations are volatile, virtually no usable gaps
- Vehicles are closely spaced
- Disruptions such as lane changes can cause a disruption wave that propagates throughout the upstream traffic flow
- Cannot dissipate even minor disruptions, incidents will cause breakdown

LOS F

- Breakdown or forced flow
- Occurs when:
  - Traffic incidents cause a temporary reduction in capacity
  - At points of recurring congestion, such as merge or weaving segments
  - In forecast situations, projected flow (demand) exceeds estimated capacity



Design Level of Service (LOS)

	Type of Area and Appropriate Level of Service			
Highway Type	**Rural Level**	**Rural Rolling**	**Rural Mountainous**	**Urban and Suburban**
Freeway	B	B	C	C
Arterial	B	B	C	C
Collector	C	C	D	D
Local	D	D	D	D

Source: Adapted from the AASHTO Green Book