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ASSIGNMENT: 07

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Q1: What do you understand by Level of Service A, B, C, and D Differentiate between them?

LEVEL OF SERVICE A.

Level of service A is represent free flow condition (traffic operation at free flow speeds. Individual users are virtually unaffected by the presence of other in the traffic stream. Freedom to select speeds and to maneuver within the traffic stream is extremely high. The general level of comfort and convenience provided to drivers is excellent.

LEVEL OF SERVICE B.

Level of service B. also allow speeds at or near free flow speeds, but the presence of other users in the traffic stream beings to the noticeable. Freedom to select speeds is relatively unaffected but area is a slight decline in the freedom to maneuver within the traffic stream relative to level of service A.

LEVEL OF SERVICE C.

Level of service C has speeds at or near free flow speed, but the freedom to maneuver is noticeable restricted (lane changes require careful attention on the part of drivers).the general level of comfort and convenience declines significantly at this level. Disruption in the traffic stream, such as an incident for example vehicular delay. In contrast the effects of incidents at level of service A or level of service B are minimal with only minor delay in the immediate vicinity of the event.

LEVEL OF SERVICE D.

Level of service D represents the condition where speeds begin to decline slightly with increasing flow. The freedom to maneuver become more restricted and drivers experience reduction in physical and psychological comfort. Incidents can generate lengthy queues because the higher density associated with this level of service provides little space to absorb disruptions in the traffic flow.

Q2: Explain the procedure how free flow speed is determine?

PROCEDURE FREE FLOW SPEED DETERMINE:

For basic freeway segment FFS is the mean speed of passenger cars operating in flow rate up to 1300 passenger car per hours per lane (pc/h/In). If FFS is to be estimate rather than measured the following equation can be used. It accounts for the roadway characteristic of lane width, right shoulder lateral clearance and ramp density.

$FFS=75.4-f_{LW}-f_{LC}-3.22TRD^{0.84}$

FFS= estimated free-flow speed in mi/h,

f_{LW}= adjustment for lane width in mi/h,

f_{LC}= adjustment for lateral clearance in mi/h,

TRD= adjustment for total ramp density in mi/h.

The base free flow speed (BFFS) and applies to freeways in urban and rural area. The HCM, transportation research board recommends that the calculated free flow speed be rounded to the nearest 5 mi/h. the following section describe the procedure for estimating the adjustment factor values.

LANE WIDTH ADJUSTMENT:

When the width are narrower than the base 12 ft, the adjustment factor f_{LW} is used to reflect the impact on free flow speed. Such an adjustment is needed because narrow lanes cause traffic to show as a results of reduce psychological comfort and limits on driver maneuvering and accident avoidance option. Thus FFS under theses condition is less than the value that would be observed if base lane widths were provided.

LATERAL CLEARANCE ADJUSMENT:

When obstruction are closer than 6 ft (at the road side) from the travel pavement the adjustment factor f_{LC} is used to reflect the impact on FFS. Again these condition lead to reduce psychological comfort for the driver and consequently reduced speeds. An obstruction is a right side object that can either be continuous (such as a retaining wall or barrier) or periodic (such as light posts or utility poles).

TOTAL RAMP DENSITY:

Ramp density provides a measure of the impact of merging and diverging traffic on free flow speed. Total ramp density is the number of on and off ramps (in one direction) within a distance of three miles upstream and three miles downstream of the midpoint of the analysis segment divided by six miles.

Q3: Determine the base conditions for a basic freeway segment?

BASIC FREEWAY SEGMENT:

A basic freeway segment is defined as a section of a divided roadway having two or more lanes in each direction, full access control, and traffic that is unaffected by merging or diverging movement near ramps. It is important to note that capacity analysis for divided roadway focuses on the traffic flow in one direction only. This is responsible because the objective is to measure the highest level of congestion.

Due to directional imbalance of traffic flows. For example morning rush hours having higher volume going away from the central city. Consideration of traffic volumes in both direction is likely to seriously understate the true level of traffic congestion.

The provide level of service criteria corresponding to traffic density, speed, volume to capacity ratio, and maximum flow rate. A graphical representation is provided. The maximum service flow rate is simply the maximum flow rate, under base condition that can be sustained for a given level of service. This speed flow density relationship is central to the analysis of basic freeway segments as will be outlined in the remainder of this section.

BASE CONDITION AND CAPACITY:

The base condition for a basic freeway segment are as defined as

- 12-ft minimum lane widths.

- 6-ft minimum right shoulder clearance between the edge of the travel lane and object (utility poles, retaining walls, etc.) that influence driver behavior.
- 2-ft minimum median lateral clearance.
- Only passenger cars in the traffic stream.
- Five or more lanes in each travel direction (urban areas only).
- 2-mi or greater interchange spacing.
- Level terrain (no grades greater than 2%)
- A driver population of mostly familiar roadway users.

These condition represent a high operating level, with a free flow speed of 70 mi/h or higher.

The capacity C for basic freeway segment, in passenger cars per hours per lane (pc/h/In). The upper boundary of LOS E corresponds to the value of capacity and a v/c of 1.0. Other value of v/c for a specific level of service are obtained by simply dividing the maximum flow rate for that level of service by capacity (the maximum flow rate at LOS E).

Q4: How service of a basic freeway segment is measured?

SERVICE OF A BASIC FREEWAY SEGMENT IS MEASURED:

The service measure for basic freeway segment is density. Density as discussed in typically measured in terms of passenger cars per mile per lane (pc/h/In) and therefore provides a good measure of the relative mobility of individual vehicle in the traffic stream. A low traffic stream density gives individual vehicle the ability to change lanes and speeds with relative ease. While the traffic stream thus, traffic density is the primary determinant of freeway level of service.

Where,

q=flow in veh/h,

u=speed in mi/h,

k=density in veh/mi.

Density is therefore calculated as flow divided by speed. The following sections will describe how to arrive at flow and speed values for the given roadway and traffic condition, once the flow and speed values have been determined according to the given condition, to arrive at a level of service for the freeway segment.

Q5: Discuss how lane width affect the free flow speed?

LANE WIDTH AFFECT THE FREE FLOW SPEED:

Lane width reduction makes driver operate vehicles close to the center of the road whereas hard shoulder widening induce a position further away from the road's center. The goal of the present driver simulator study was twofold.

First, it was aimed at further investigation the respective effect of lane and shoulder width on in lane positioning strategies by examining vehicle distance from the center of the lane.

The second aim was to assess the impact on safety of three possible cross sectional reallocation of the width of the road i.e three lane width reductions concomitant shoulder widening at a fixed cross sectional width, as compared to a control road. The result confirmed that lane width reduction made participants drive closer to the road's center. However in lane position was affected differently by lane narrowing, depending on the traffic situation. In the absence of oncoming traffic lane narrowing gave rise to significant shifts in the car's distance from the lane's center toward the edge line, whereas this distance remained similar across lane width during traffic period. When the shoulders were at least

0.50 m wide participants drove farther away from both the road center and the lane center, road reallocation operation resulted in vehicles positioned father away from the edge of the road and less swerving behavior, without generating higher driving speeds.

Finally it is argued that road space reallocation may serve as a good low cost tool for providing a recovery area for steering errors without impairing driver's behavior.

Q6: A six lane urban freeway (three lanes in each direction) is on rolling terrain with 11-ft lanes, obstructions 2 ft. from the right edge of the traveled pavement, and nine ramps within three miles upstream and three miles downstream of the midpoint of the analysis segment. The traffic stream consists primary of commuters. A directional weekday peak hour volume of 2300 vehicle is observed, with 700 vehicle arriving in the most congested 15 min period. If the traffic stream has 15% large truck and buses and no recreational vehicle, determine the level of service?

SOLUTION:

$$FFS = 75.4 - f_{LW} - f_{Lc} - 3.22TRD^{0.84}$$

With

F_{LW}=1.9 mi/h

F_{LC}=1.6 mi/h

TRD=9/6=1.5 ramps/mi

FFS=75.4-1.9-1.6-3.22$(1.5)^{0.84}$=67.4mi/h

Rounding this FFS value to the nearest 5 mi/h gives a FFS of 65 mi/h. Determine the flow rate according to Equation.

V_p=V/PHFxNxf_{HV}xf_p

With

PHF=2300/700x4

N=3(Given)

f_p=1.0(commuters),and

E_T=2.5(rolling terrain)

F_{HV}=1/1+0.15(2.5-1)=0.816

So,

V_p=2300/0.821x3x0.816x1.0

=1144.4 or 1145 pc/h/In

Obtaining average passenger car speed for a flow rate of 1145 and a FFS of 65 mi/h yields an S of 65 mi/h. In this case, the average speed is still the same as the FFS because the flow rate is low enough such that it is still on the linear/flat part of the speed flow curve.

Now density can be calculated with equation,

D=1145/65=17.6 pc/mi/In

It can been seen that this corresponds to LOS-B (11.0(max density for LOS A) greater than 17.6 grater than 18.0 (max density for LOS B). thus this freeway segment operate at level of service B.