Module 3-2 tutorial
Solutions

Austroads

Traffic analysis concepts

Question 1. Determine the spare capacity at a signalised intersection with a intersection flow ratio of 0.65 under the following scenarios:

i. Intersection lost time per cycle = 0.167 minute
ii. Intersection lost time per cycle = 0.25 minute
iii. Intersection lost time per cycle = 0.333 minute

Answer the following:

a) Are the calculated spare capacity values similar to the ones obtained from the graph shown on slide 12 of the webinar?
b) Observe the trend in the calculated spare capacity values, as the intersection lost time per cycle increases. Comment whether the trend makes sense or not.

Solution to Question 1.

The formula for spare capacity, as shown on slide 12 of the webinar is:

$$Spare\ Capacity = \frac{X_m - X_p}{X_p}\ .\ 100\ \% \qquad \textbf{Equation 1}$$

$$X_p = \frac{Y}{1 - {}^{L}/_{120}} \qquad \textbf{Equation 2}$$

Where: X_m = *maximum acceptable degree of saturation, recommended value is 0.9*

X_p = *practical minimum degree of saturation for an intersection*

c_{max} = *maximum cycle time, recommended value is 120 seconds*

Y = intersection flow ratio

L = total intersection lost time per cycle

The intersection flow ratio $Y =\ 0.65$

The maximum acceptable degree of saturation $X_m = 0.9$

The total intersection lost time per cycle (L) should be in seconds.

Using the above formulae, the spare capacity for the three scenarios is as follows:

i. $X_p = \frac{0.65}{1 - {0.167*60}/{120}} = 0.7092$ $\quad Spare\ Capacity = \frac{0.9 - 0.7092}{0.7092} \,.\, 100\ \% = 26.9\%$

ii. $X_p = \frac{0.65}{1 - {0.25*60}/{120}} = 0.7428$ $\quad Spare\ Capacity = \frac{0.9 - 0.7428}{0.7428} \,.\, 100\ \% = 21.1\%$

iii. $X_p = \frac{0.65}{1 - {0.333*60}/{120}} = 0.7798$ $\quad Spare\ Capacity = \frac{0.9 - 0.7798}{0.7798} \,.\, 100\ \% = 15.4\%$

a) *The calculated values closely match the values from the plot. Thus, the graph can be alternatively used to determine spare capacity instead of using the formulae*

b) *The calculations indicate that the spare capacity decreases as the lost time increases. This trend makes sense as increase in the traffic (demand) at the intersection leads to longer queues which increase the lost time per cycle. Thus, an increased traffic demand leads to a lower spare capacity.*

Question 2. A 3-lane highway with an FFS of 25 m/s is observed to have a VCR of 0.75. Determine its LOS. Assume the LOS which is closer to the observed VCR value.

<u>Solution to Question 2</u>.

The formula for spare capacity, as shown on slide 12 of the webinar is:

A 3-lane highway is considered as a multi-lane highway for analysis.

*Convert FFS into km/h = 25 * 3.6 = 90 km/h*

Refer to Table 4.4 (pg. 45) of AGTM Part 3: Traffic Studies and Analysis which gives the LOS criteria for multi-lane highway.

For an FFS of 90 km/h:

LOS	Maximum volume to capacity ratio (VCR)
C	0.68
D	0.89

Observed VCR = 0.75

*Since the observed VCR is closer to 0.68, the LOS is **C**.*

Question 3. Select the right answer:

An urban arterial in Adelaide (with an BFFS of 60 km/h) suffers from poor traffic flow stability during AM peak.

Answer the following:

The arterial has an LOS ____ with prevailing speed in the range ____ and ____ km/h (rounded to the nearest whole number).

i. C, 30, 40 ii. D, 24, 30

iii. E, 18, 24 iv. None of these

Solution to Question 3.

Refer to Section 5.2.2 (pg. 60) of AGTM Part 3: Traffic Studies and Analysis which gives the LOS criteria for arterial roads.

The calculations have been tabulated below:

LOS	Travel Speed Range	Traffic Flow Condition	Speed Range (rounded) for the Given Arterial
A	> 80% of BFFS	Free-flow	> 48 km/h (i.e. 0.8*60)
B	67% – 85% of BFFS	Reasonably Unimpeded	40 km/h – 51 km/h (i.e. from 0.67*60 to 0.85*60)
C	50% – 67% of BFFS	Stable	30 km/h – 40 km/h (i.e. from 0.50*60 to 0.67*60)
D	40% – 50% of BFFS	Less Stable	24 km/h – 30 km/h (i.e. from 0.40*60 to 0.50*60)
E	30% – 40% of BFFS	Unstable	18 km/h – 24 km/h (i.e. from 0.30*60 to 0.40*60)
F	< 30% of BFFS	Forced Flow	< 18 km/h (i.e. 0.3*60)

It is given that the arterial road has poor traffic flow stability. Thus, the LOS should be D in this instance.

Hence, the statement is:

*The arterial has an LOS _**D**_ with prevailing speed in the range _**24**_ and _**30**_ km/h (rounded to the nearest whole number).*