37 Determining the Passage Time

DESIGN

PURPOSE

The purpose of this activity is to give you the opportunity to select and justify design values for passage time.

LEARNING OBJECTIVES

○ Compare headway distributions for one lane and two lane data

○ Select passage time values for one lane and two lane approaches

REQUIRED RESOURCE

○ Excel template and results from Activity #36

DELIVERABLE

○ Excel spreadsheet that includes the selected design parameters (passage time), as well as justification for these values. This should be the same Excel file that you used for Activity #36 with the following tabs added:

Tab 8: Headway analysis for two lane data

Tab 9: Phase termination data

Tab 10: Phase termination analysis for two lane data

Tab 11: Performance data from VISSIM

Tab 12: Analysis and summary based on Tasks 6, 7, and 8

CRITICAL THINKING QUESTIONS

1. What are the differences in the headway distributions that you prepared for the one lane approach and two lane approach conditions? Describe them in complete sentences.

2. Would the passage time for a two lane approach be lower or higher than for a one lane approach? Provide justification for your answer.

3. Can you think of a situation in which your answer to question #2 would change? If so, describe that situation.

INFORMATION

In Activity #36, you selected a value for the maximum allowable headway (MAH) that balanced early phase termination with inefficient extension of the phase for a one lane approach. In this activity you will consider the effect of a two lane approach, and how this might change the selection of the MAH.

Figure 129 and Figure 130 compare the headway distributions for one lane and two lane approaches for vehicles that were a part of a queue that existed at the beginning of the green. The headways are lower for the two lane case than for the one lane case since they are measured for consecutive vehicles that sometimes can depart from the approach at nearly the same time. In this latter case, a headway between two vehicles departing from the same approach but from different lanes could be near zero. For the case shown here, the mean headway for the two lane case is 0.8 seconds, while the mean for the one lane case is 1.7 seconds.

A phase termination analysis also shows the differences between the one lane and two lane cases, and why the MAH should be lower for the two lane case. Figure 131 and Figure 132 show the percent phase terminations for Types 1 and 2 terminations for the one lane and two lane data.
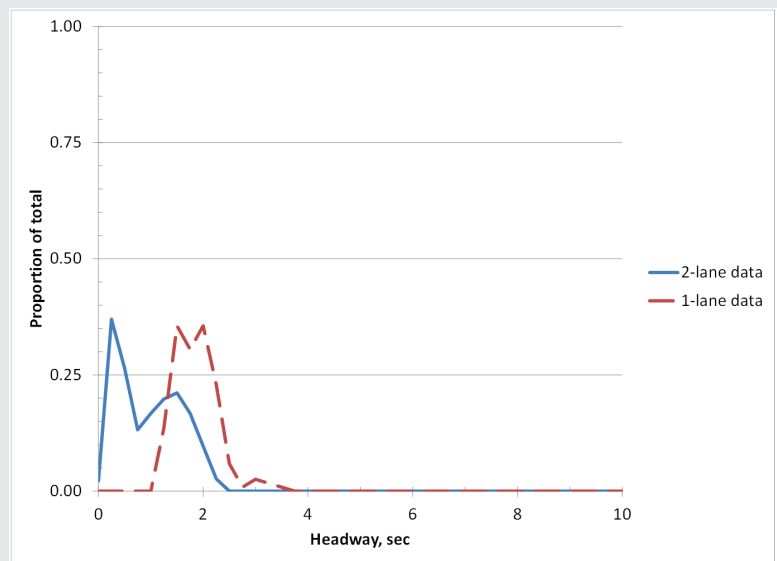
Figure 129. Headway density function, one lane and two lane data
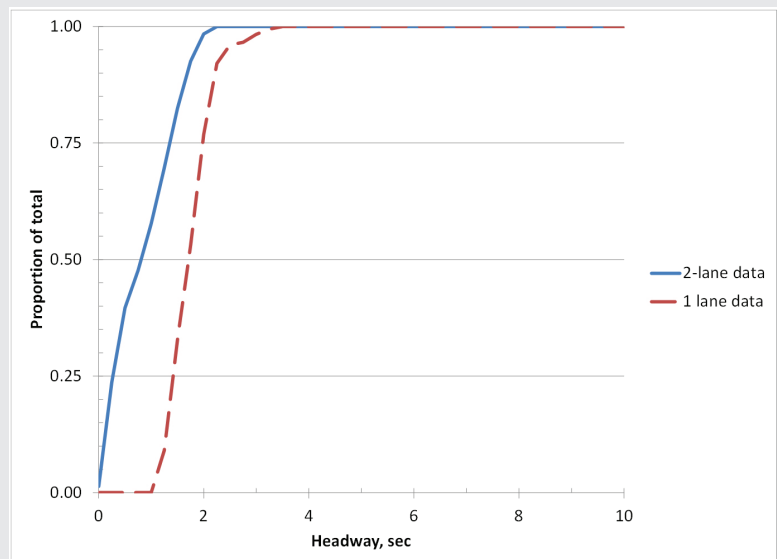
Figure 130. Cumulative headway density function, one lane and two lane data

In Figure 131 for example, the likelihood of a Type 1 termination (the phase terminates before the queue has cleared) for a given MAH is higher for the one lane case than for a two lane case. Stated another way, a smaller MAH can be used for a two lane case than for a one lane case to achieve the same result.
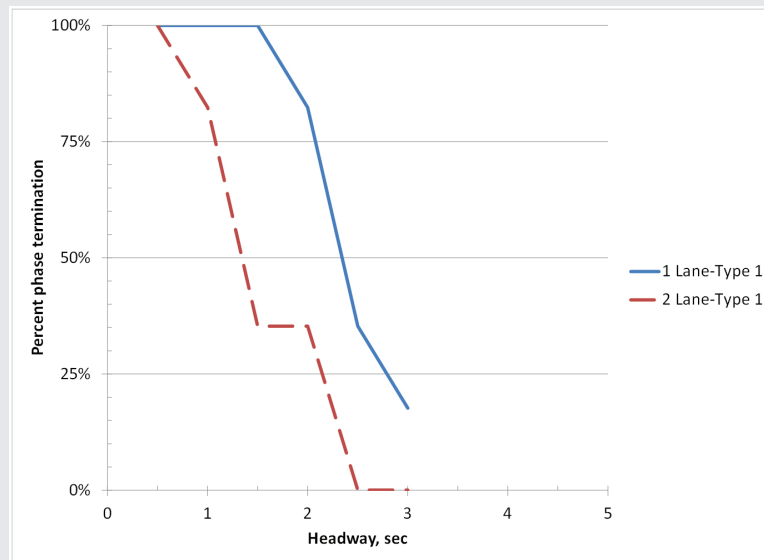

Figure 131. Frequency distribution for Type 1 terminations for the one lane and two lane cases
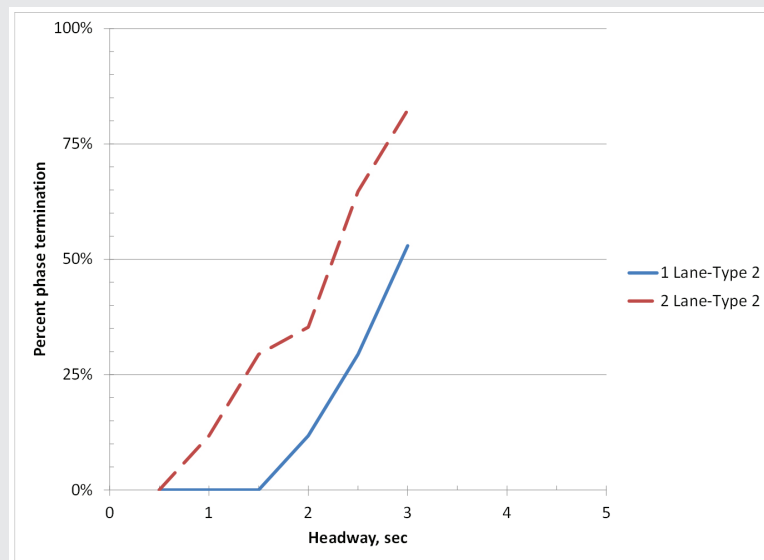

Figure 132. Frequency distribution for Type 2 terminations for the one lane and two lane cases.

TASK 1

Initial steps.

- Open the Excel spreadsheet that you used in Activity #36

- Create new tabs for the following work:

   Tab 8: Headway analysis for two lane data

Tab 9: Phase termination data

Tab 10: Phase termination analysis for two lane data

Tab 11: Performance data from VISSIM

Tab 12: Analysis and summary based on Tasks 6, 7, and 8

TASK 2

Collect speed data.

- Review the speed data collected in the MER file as part of Activity #36

- Prepare a statistical analysis of the data, including a determination of the mean value and a density plot. Identify the speed data that represents vehicles traveling through the intersection after the queue begins to move after the start of green.

- Based on this analysis, select a speed value that you think is appropriate for the calculation of the passage time

TASK 3

Headway distributions for two lane data

- Using the data file created in Activity #36, create frequency (histogram) and cumulative frequency plots using 0.25 second bins based on the data for both lanes combined into one data set. These data should be placed in Tab 8 of your Excel file.

- Figure 133 and Figure 134 show examples of the resulting frequency and cumulative frequency plots for two lane data for both queued and non-queued vehicles
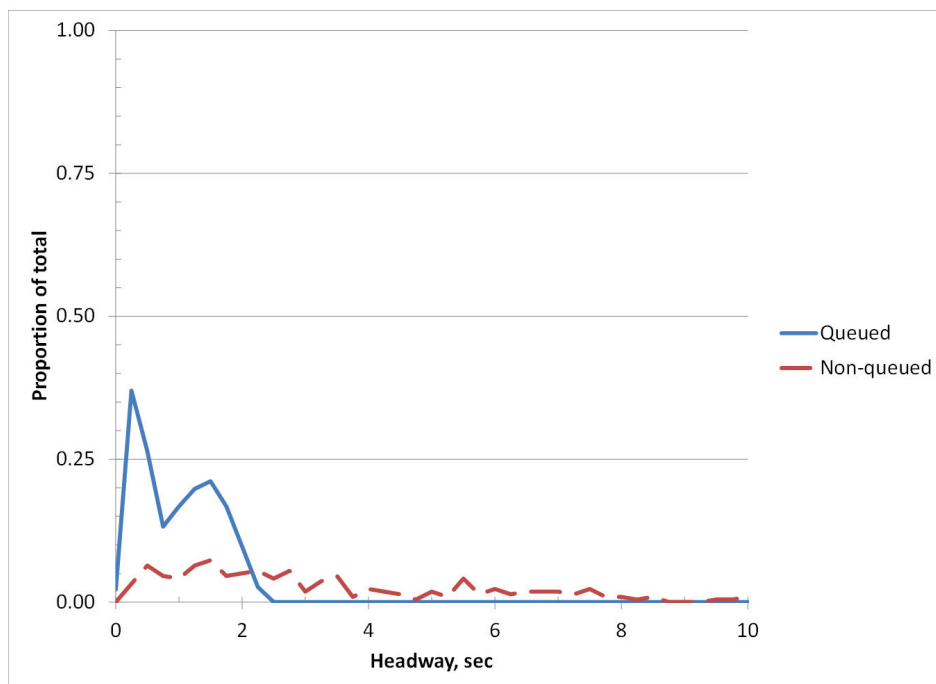
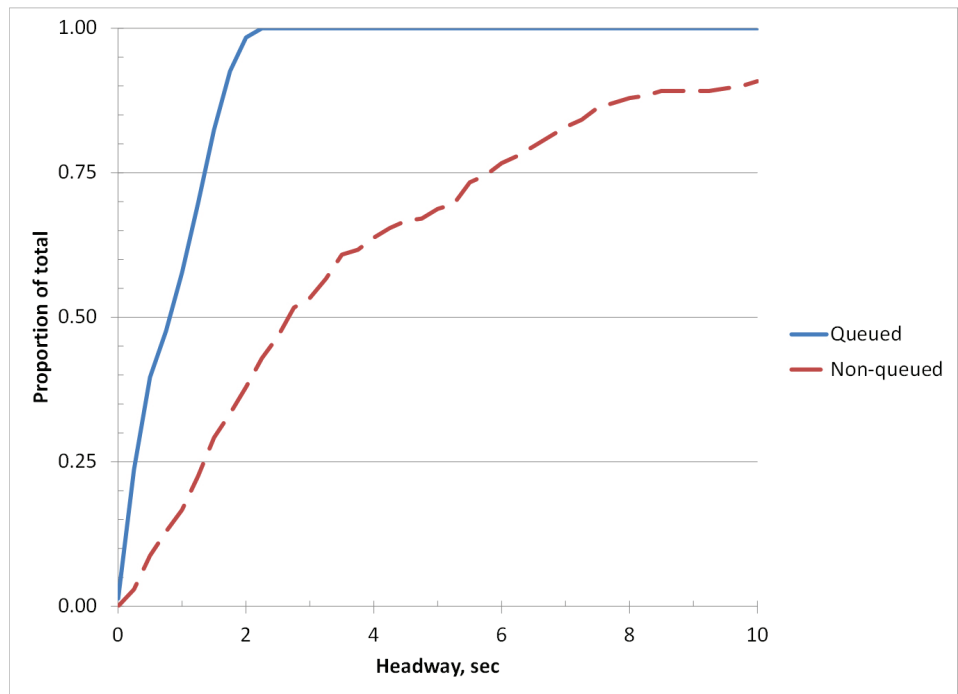**Figure 133.** Headway frequency plot for queue and non-queued vehicles

Figure 134. Headway cumulative frequency plot for queued and non-queued vehicles

TASK 4

Phase termination analysis.

○ Create the data that you will need for the two lane phases termination analysis in tab 9. Figure 135 shows two columns that have been created that place the queued and non-queued headways in the appropriate columns.

Data C.P.	t(leave)	VehNo	tQueue	Q/NQ	Headway		Headway (sec) Queued	Nonqueued
1	300.18	163	9.6	Q				
2	300.42	161	11.8	Q	0.24		0.24	
1	301.33	165	9.1	Q	0.91		0.91	
2	301.41	164	10	Q	0.08		0.08	
2	302.87	167	8.9	Q	1.46		1.46	
1	303.29	169	5	Q	0.42		0.42	
1	304.44	174	0	NQ	1.15			1.15
2	304.76	171	4.5	Q	0.32		0.32	
1	305.74	177	0	NQ	0.98			0.98
2	305.97	176	2	Q	0.23		0.23	
1	307.65	179	0	NQ	1.68			1.68
2	315.15	184	0	NQ	7.5			7.5
1	315.44	186	0	NQ	0.29			0.29
2	318.14	187	0	NQ	2.7			2.7
1	323.47	189	0	NQ	5.33			5.33
2	324.84	190	0	NQ	1.37			1.37
1	328.61	193	0	NQ	3.77			3.77

Figure 135. Creation of input data for phase termination analysis

○ Copy (and paste as "values") the headways for the queued and non-queued vehicles into the two input columns in the phase termination analysis spreadsheet template for the two lane analysis (tab 10 of

Chapter 6: Timing Processes on One Approach

your Excel file). Figure 136 shows the headway data that have been pasted into the first two columns of the spreadsheet. The Signal Information and Termination Outcomes are calculated based these input data.

Headway (sec)		Signal Information		Termination Outcomes		
Queued	NonQueued	Ideal Signal Display	Change Occurs	Type 1	Type 3	Type 2
0.24		Green				
0.91		Green				
0.08		Green				
1.46		Green				
0.42		Green				
	1.15	Green				
0.32		Green				
	0.98	Green				
0.23		Green				
	1.68	Green				
	7.5	Red	Change			1
	0.29	Red				
	2.7	Red				
	5.33	Red				
	1.37	Red				
	3.77	Red				

Figure 136. Outcomes for phase termination analysis showing type 1 termination

○ Use the Phase Termination Analysis template to determine the Termination Outcomes for a range of possible values for the MAH for the two lane case. Enter a value in the MAH cell and record the resulting number of Types 1, 2, and 3 terminations. Figure 137 shows the results of a phase termination analysis for four MAH cases, ranging from 0.5 seconds to 2.0 seconds. When the MAH was set to 0.5 seconds for example, the phase terminated before the queue had cleared for all 17 phases, and only 39 percent of the vehicles would be served. At the other extreme, if the MAH was set to 2.0 seconds, the phase would extend past the time the queue had cleared in 6 of the 17 cases.

MAH	Percentile
3.0	#N/A

Headway (sec)		Signal Information		Termination Outcomes					Outcome Distribution		
Queued	NonQueued	Ideal Signal Display	Change Occurs	Type 1	Type 3	Type 2					
									Type 1 Termination	0	
0.24		Green							Type 3 Termination	3	
0.91		Green							Type 2 Termination	14	
0.08		Green									
1.46		Green							**Results of Phase Termination Analysis**		
0.42		Green						Headway	0.5	1.0	1.5	2.0
	1.15	Green						Percentile	38.9%	57.0%	81.9%	98.1%
0.32		Green						Type 1 Termination	17	14	6	6
	0.98	Green						Type 3 Termination	0	1	6	5
0.23		Green						Type 2 Termination	0	2	5	6
	1.68	Green									
	7.5	Red	Change			1					
	0.29	Red									
	2.7	Red									
	5.33	Red									
	1.37	Red									
	3.77	Red									

Figure 137. Phase termination analysis results for four example maximum allowable headways

TASK 5

Select the MAH.

- o Write a goal statement for the selection of the MAH based on your desired balance of type 1 and type 2 terminations for the two lane case

- o Select the MAH for the two lane case using your goal statement and the analysis that you have completed as the basis for your selection

TASK 6

Compare one lane and two lane data.

- o Compare the mean values of the headway distributions for the queued and non-queued vehicles for the one lane and two lane cases, and the frequency distributions for these two cases

- o Compare the results of the phase termination analyses for both the one lane and two lane cases

TASK 7

Compute passage times.

- o Compute the passage times for the one and two lane cases using the MAH values that you have selected and the speed value that you determined in Task 2. Assume an average vehicle length of 20 feet and a detection zone length of 22 feet.

TASK 8

Observe the VISSIM simulation using new values of passage time.

- o Set the passage times that you selected in Task 7 into your VISSIM network for both the one lane and two lane approaches

- o Set the detection zone lengths to 22 feet and the minimum green time to 5 seconds

- o Gather the performance data (average delay and average queue length) and summarize these data for the individual approaches and for the intersection

- o Observe the operation and make conclusions about what you see, and compare this with your performance data

Student Notes: