# Sensitivity analysis of traffic-based influencing factors of travel speeds on urban road segments with fixed-time traffic signal controlled intersections


## Master's Thesis of Umair Hamid Keen

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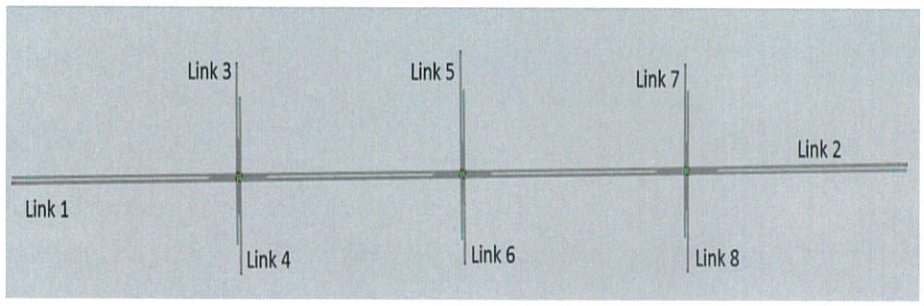
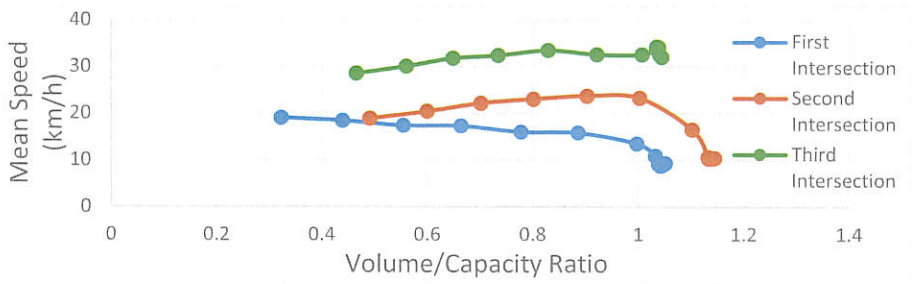
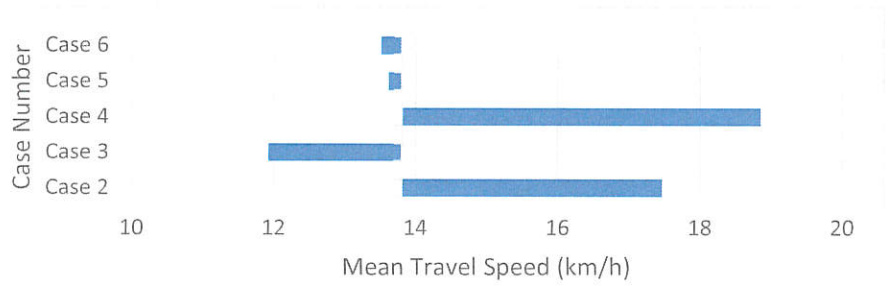


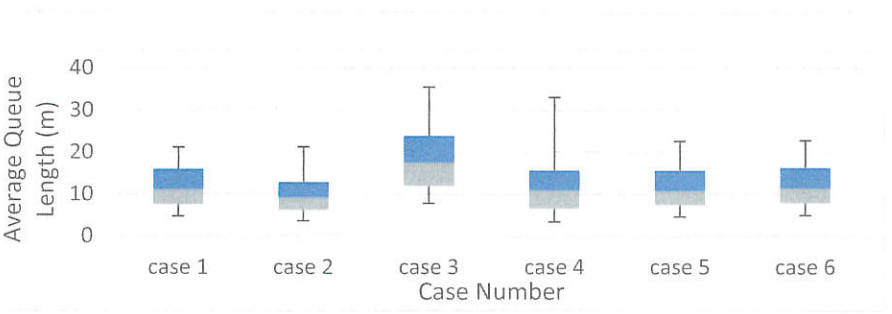




The traffic on urban roads is mainly affected by the traffic flow at signalized intersections. Therefore, detection of the traffic state, particular the knowledge of traffic volumes at the approaches to the intersections, is necessary. In the recent years, Floating Car Data (FCD) with information of the mean travel speed have been used to identify the current traffic state on the road segments. For the usage of the FCD speed information for the purposes of traffic management, the connection to the traffic volume at the different road segments is needed. Moreover analysis of the connection between the traffic signal control and mean travel speed at the road segments is necessary. In order to achieve these objectives, microscopic traffic simulator VISSIM have been used to model a road network consisting of three signalized intersections. Various cases were simulated by modifying the traffic signal timings, the turning ratios and the proportion of heavy duty vehicles. Number of simulations were run with different traffic volumes to replicate the peak and off-peak traffic situation for each case.

The road sections have been divided to into "free traffic area" and "likely to be queued area" to study the effect of urban traffic signal controls on the mean travel speed at the corresponding road segments. As the traffic volume increases in the main direction, the un-coordinated intersection experience gradual decrease in the mean travel speed. On the other hand, the coordinated intersections experiences gradual rise in the mean travel speed with the increase in traffic volume in the main direction. This trend continues until the capacity is achieved which leads to an abrupt fall in the mean travel speed. Six cases have been developed by altering different traffic-based influencing factors. The mean speed results for each case have been compared with the base case. Sensitivity analysis have been carried out by plotting tornado diagrams to determine the factor that causes greatest impact on the mean travel speed. Moreover average queue length results for each case have also been collected to determine the factor that causes the greatest impact.

| | First intersection | | Second intersection | | Third intersection | |
|---|---|---|---|---|---|---|
| Case No. | Mean Speed (km/h) | Percentage Difference | Mean Speed (km/h) | Percentage Difference | Mean Speed (km/h) | Percentage Difference |
| Case 1 | 13.81 | | 16.76 | | 32.46 | |
| Case 2 | 17.47 | 26.5% | 21.15 | 26.2% | 35.43 | 9.1% |
| Case 3 | 11.93 | -13.6% | 14.35 | -14.4% | 29.51 | -9.1% |
| Case 4 | 18.85 | 36.6% | 21.18 | 26.3% | 35.01 | 7.8% |
| Case 5 | 13.62 | -1.4% | 14.95 | -10.8% | 28.59 | -11.9% |
| Case 6 | 13.51 | -2.1% | 16.47 | -1.8% | 32.25 | -0.7% |




The highest increase in the mean speed have been noted when the cycle time is increased and all the additional time is added to the green time of the main direction. However by increasing the cycle time and keeping green time-to-cycle time ratio constant as the base case causes decrease in the mean travel speed. This scenario also experiences the longest average queue lengths.

It can be concluded that by increasing only the green time leads to the shortest queues at all the intersections. Increasing the cycle time but keeping the green time-to-cycle time ratio constant has the longest queue lengths. However if the cycle time is increased and all the additional time is applied to the green time of the main direction leads to the highest gain in the mean travel speed. It can also be concluded that increasing turning ratios leads to the decrease in the mean travel speed of the left turning lanes. Lastly increase in the proportion of the heavy duty vehicles causes minimal decrease in the mean travel speed.