International Literature Review on Traffic Congestion Mitigation Methods

Bachelor‘s Thesis of Rai Edú Córdova Vidal

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Figure 1. Construction takes place on I-35 on Tuesday, April 27, 2021. (Source: Compton, 2021, retrieved from https://herald-zeitung.com/community_alert/article_c3dc462c-a942-11eb-acf5-3b3987212749.html)

Traffic Congestion has been a topic of discussion for decades among governments, transportation engineers and travelers. This traffic phenomenon brings with it several terrible consequences that may not be obvious at first glance like hindering business growth and attractiveness, causing more fuel consumption, air pollution and thus lowering the quality of life of citizens.

The strategies to mitigate traffic congestion presented in this thesis address their direct causes like incidents on the road, work zones, dangerous road surface conditions due to heavy weather, variation in traffic demand, special events, poor programmed traffic control devices and inadequate base capacity of a highway.

The first method consists in adding more physical transit capacity to the highway. This includes the opening of shoulders for part-time use as well as the construction of more transportation infrastructure, which apart from being the most expensive of all other strategies, it also discourages commuters from using public transportation and instead encourages them to drive and use the available roads, making traffic flow even worse.

Managing the existing highway capacity more efficiently is another key strategy to alleviate traffic congestion. The appropriate preparation and addressing of events like accidents, construction sites on or near the highway, heavy weather or even sporting events are part of this strategy. Other examples include the implementation of reversible lanes and the restriction left turns (for right-driving countries), which have shown average travel time reductions of up to 20%, even when converting a six-lane highway into a five-lane road with a reversible center lane. Optimizing traffic signal devices to autonomously adapt to current traffic flow in real-time, implementing variable speed limits, installing ramp meters and coordinating their rates as well as agreeing on the timing parameters of traffic signals across adjacent jurisdictions have also shown positive results in increasing average travel speeds, vehicle throughput and in that way alleviating traffic congestion overall.

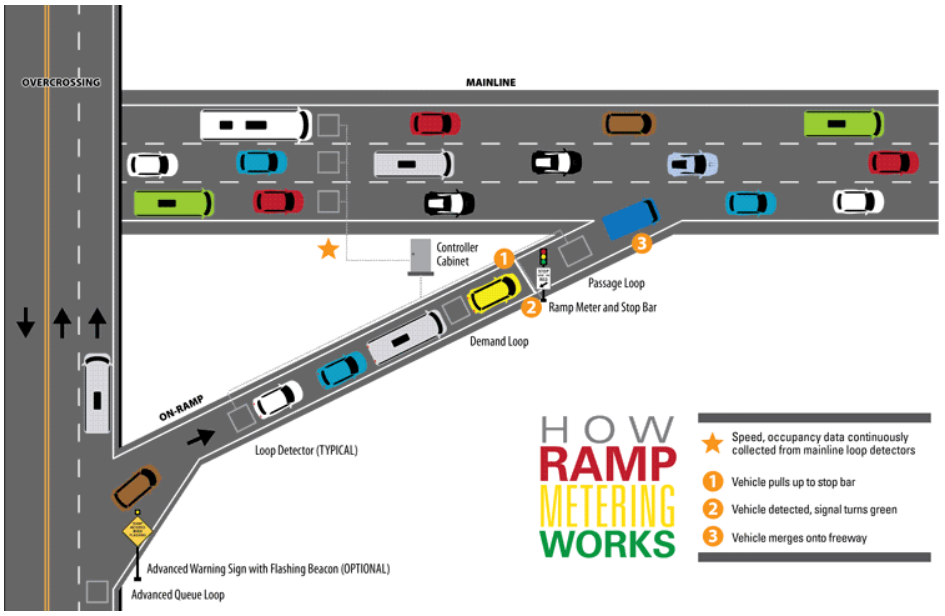

Figure 2. Ramp metering configuration (Source: WSP Global Inc., 2004, retrieved from https://ops.fhwa.dot.gov/publications/fhwahop14020/sec1.htm#:~:text=Ramp%20metering%20reduces%20overall%20freeway,queue%20behind%20the%20stop%20line.)

Figure 3. A HOV lane sign and variable-message sign on Interstate 5 northbound in Seattle, Washington, approaching SR 523 in Shoreline, May 12, 2017, retrieved from https://upload.wikimedia.org/wikipedia/commons/e/e9/Interstate_5_northbound_near_Shoreline%2C_WA_-_HOV_and_VMS.jpg

Furthermore, encouraging people to use alternative routes or sustainable transportation means is another solution to relieve traffic congestion on highways in general. Converting one lane into a high-occupancy lane so only vehicles with one or more passengers can drive in it has achieved time savings of around 35 minutes in some freeways as the it carries more people than the adjacent general-purpose lanes. Other examples include implementing tolls for the use of express lanes without the need to drive by a toll booth. Instead, tolls are charged by using antennas and video cameras. Restricting vehicles on certain highways by their license plate numbers has also demonstrated to increase the average speed on these roads in about 19%.

All in all, these strategies are more viable solutions in terms of capital expenditure, public acceptance and time of implementation. These operational improvements can be seen as a way to magnify the investment made for the construction of the treated highway or even to fund other infrastructure projects or to improve the quality of public transportation without having to increase taxes.