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Unconventional Intersection Design for Improving Traffic

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Abstract
In today's economic growth the vehicular traffic is increasing day by day, which leads to failure of intersections before their time period. To increase the efficiency of these failed intersections the engineers added lanes to the existing major and minor roads, but this method do not give results which it used to deliver in the past, hence other methods were adopted. So to increase the efficiency and fulfil the criteria for successful intersection ,to cape with it several intersection are designed which are unconventional in nature like jug handle, bow tie, continuous flow intersection and median u turn which are very effective in increasing green time on highway and minor roads. The software used in this study is autocad for planning and drawing purpose which can be used in simtraffic software which will be used for simulation purpose of the traffic flow on different designs of intersections. The factors which are considered in this study are -location of town centre, population of the zone and driver expectancy. The final conclusion of this study is that continuous flow intersection provides the best results when the traffic is increased. The construction cost is least in median u turn and giving maximum result than all other intersections.
Keywords: *Traffic, Intersection Design, economic growth.*

1. Introduction

Travel by mode trends indicates the use of personal automobiles is increasing as more households are able to afford an automobile. As a result, roadways have become more congested and traffic flow has suffered. Delay time at intersections has increased while average speeds have decreased. Many of the intersections that are in place today were designed several years ago and cannot accommodate the volume of traffic that passes through in an efficient manner. An addition of vehicles to the roadway has resulted in an increase in delay time for through traffic because the traffic signal must remain green longer for the exclusive left turn lanes. Engineers have attempted to alleviate the congestion at high-volume intersections using conventional improvements such as actuated signal systems, multiple left turn lanes, additional through lanes, and right turn lanes.

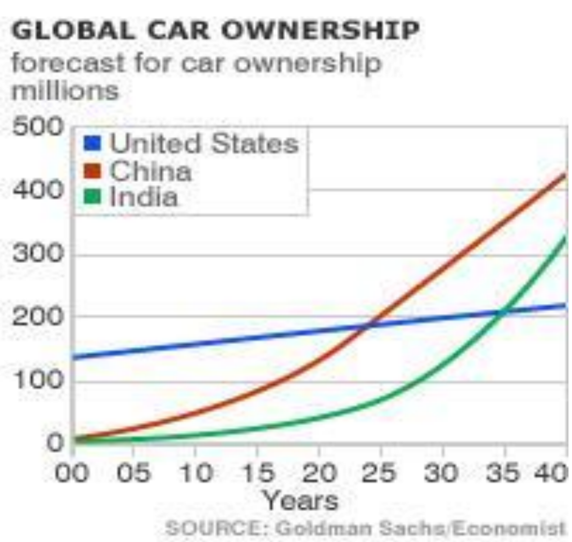

Figure 1: Future Car Ownership

A recent study has shown that conventional methods of adding capacity to an intersection have diminishing returns. For example, if the addition of a second through Lane adds 15 years to the life of the intersection before it reaches capacity, the addition of a third through Lane adds only 10 years, and a fourth through Lane adds only six years. Intersections and roadways in general, follow the transportation and lane use cycle as shown in Figure 1.2 below. After an intersection has undergone improvement, the value of the land surrounding the intersection increases which may lead to changes in the development of the land. The land may be developed commercially, which will result in increased traffic generation through the intersection. As the traffic generation through the intersection increases, and the level of service provided by the intersection will decrease. In order to improve the level of service of the intersection, improvements must be made.

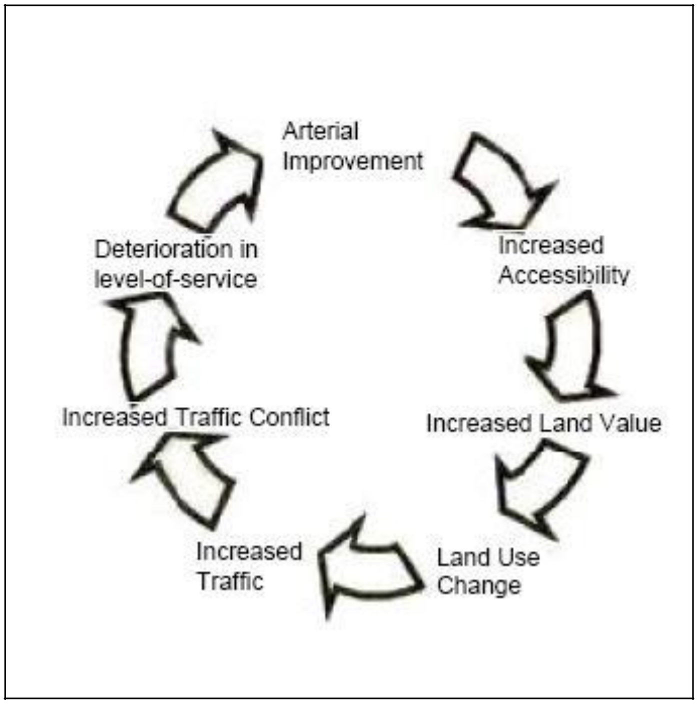

Figure 2: The Transportation-Land Use Cycle

Larger intersections increase lost time due to longer clearance intervals, protected left turn phasing, longer pedestrian clearance time, greater imbalances in lane utilization, and potential queue blockage (caused by the resulting longer cycle lengths).

2. Research Work

Performance data for each type of intersection design was unavailable. Therefore, the performance of each intersection had to be simulated. The simulation was conducted using Synchro Studio 7 and SimTraffic developed by Trafficware. Synchro Studio 7 allows an AutoCAD DXF drawing to be used as a background. This allows the user to design the intersection in Synchro with the desired dimensions.

Synchro implements the Intersection Capacity Utilization (ICU) 2003 method for determining intersection capacity. This method compares the current volume to the intersections ultimate capacity. Synchro also implements the methods of the 2000 Highway Capacity Manual, Chapters 15, 16, and 17; Urban Streets, Signalized

Intersections, and Unsignalized Intersections. In addition to calculating capacity, Synchro can optimize cycle lengths, splits and offsets, eliminating the need to try multiple timing plans in search of the optimum. The use of the optimization functions allows the level of service of the intersection or network to be maximized. Synchro reports the level of service for each lane of traffic and for the intersection or network as a whole.

SimTraffic is designed to model networks of signalized and unsignalized intersections. SimTraffic is especially useful for analyzing complex situations that are not easily modeled macroscopically including the operation of intersections under heavy congestion. SimTraffic analyzes and displays measures of effectiveness (MOEs) such as slowing delay, stopped delay, stops, queue lengths, speeds, travel time and distance, fuel consumption and efficiency, exhaust emissions, and observed actuated green times.

The measures of effectiveness that will be analyzed for this study include level of service, average speed, and delay per vehicle. In particular, the measures of effectiveness will be analyzed for the east bound through lanes of the major road at the main intersection between the major and minor road. The examination of one movement will help keep the study consistent. The performance of the intersection and the flow of traffic will be influenced by the simulation parameters. The simulation parameters include driver characteristics, traffic volume, and signalization.

3. Simulation Parameters (Driver Characteristics)

SimTraffic attempts to simulate driver characteristics such as deceleration rates, reaction times for both yellow and green light recognition, headway at various speeds, and gap acceptance. The deceleration rate is not only influenced by the type of vehicle, it can be influenced by the driver's response to roadway conditions. For example, if a driver recognizes a yellow light within a short distance to the intersection, the driver may feel the need to press the brake pedal with more force than normal. SimTraffic defines yellow deceleration as the maximum deceleration rate a driver is willing to use when faced with a yellow light. If the driver is unable to stop using the yellow deceleration rate, they will continue, even if it means entering the intersection on red.

A driver's reaction time to a yellow or green light will have an effect on the traffic flow. As a vehicle slows down or speeds up the following vehicles will react and the reactions maybe very different from one vehicle to the next. More aggressive drivers will have a longer reaction time to yellow lights and a shorter reaction time to green lights as they are trying to pass through the intersection as soon as possible. Spacing between vehicles also has an effect on the flow of traffic. The spacing between vehicles is known as headway and is measured in time, usually seconds. A more aggressive driver will maintain a shorter headway with the leading vehicle, which means there will be less time and distance for the aggressive driver to react to the movements of the leading vehicle. The movement of the turning vehicles will be controlled by the gap acceptance factor. The gap acceptance factor is an adjustment to the approach gap times.

4. Conclusion

Intersections are an integral part of our daily lives. The performance of an intersection can have a great influence on our travels. An intersection that has reached or is beyond capacity can be unsafe and significantly delay travel time. When an intersection can no longer provide a reasonable level of service, an improvement must be made. The traditional or conventional treatment to increase capacity to an intersection is to add another through lane along the major road in both directions. However, research has shown that the rate of new vehicles entering the roadways is increasing. Therefore, the conventional intersections are failing before originally expected.

To increase the life of an intersection, several unconventional intersections have been designed. The unconventional intersection designs examined during this study include the bowtie, continuous flow intersection, jug handle, median U-turn, and superstreet. Each design eliminates exclusive left turn lanes from the major road at the intersection between the major and minor road. The purpose of eliminating the exclusive left turn lanes from the major road at the intersection is to increase the green phase for through traffic. The bowtie, median U-turn, and superstreet designs require left turning vehicles from the major road to pass through the intersection twice whereas the CFI and jug handle re-route the left turning vehicles.

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