OPERATIONAL AN) NON-MOTORIZED VEHICLE FLOW AT INTERSECTION OF ...ING AND WANSHOU ROADS

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ABSTRACT

With the rapid development of society, the transportation is more and more important in our country. That's why more and more traffic problems need to solve. Speed limit in the urban area at Xi'an city is already quite low at 40km/h, and this posses major problem at intersection where the traffic has to slow down at least by 50% of the speed limit as to allow vehicle from other directions to pass through; worst still having mixed mode of motorized and non- motorized vehicles at the same time The better to solve these problems are improving the road network and the traffic system. For this project, to determine the limit of capacity for the intersection based on three scenarios (mixed mode, bus and other motorized vehicles and bicycle only) as to analysis the severity of the problem According to these conditions the project will show the best intersection for the case. This research can apply the modern road network and improve the traffic system by analysis and design the new intersection, the suitable design can save cost, increase the speed through the intersection, and fully utilize space area. some common traffic problems can be relieved.

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CHAPTER 1

INTRODUCTION

1.1 Background

Transportation is playing an important role in the political, economic and social development of any society and whether in rural or urban societies, transportation constitutes the main avenue through which different parts of the society are linked together. Because of the emergence of transportation, we need to build or improve our road system. The road includes "bridges, tunnels, supporting structures, junctions, crossings, interchanges, and toll roads." In urban areas roads may diverge through a city or village and be named as streets, serving a dual function as urban space easement and route. Modern roads are normally smoothed, paved, or otherwise prepared to allow easy travel. Traffic congestion, often bad enough to require drastic control measures, was a feature of city life at least as early as Roman times. For the road traffic, Road traffic control involves directing vehicular and pedestrian traffic around a construction zone, accident or other road disruption, thus ensuring the safety of emergency response teams, construction workers and the general public. Traffic control also includes the use of CCTV and other means of monitoring traffic by local or State roadways authorities to manage traffic flows and providing advice concerning traffic congestion. Nowadays, traffic jam has become a big and familiar problem in our life. As car ownership rates and traffic volume increase over the last 10 years, our road infrastructure is not enough. Then more and more authorities are trying to optimize our traffic system, to

control our traffic system. So one of the methods is design and built the suitable interchange to relieve traffic. What is called interchange is a location where two things meet, usually perform some kind of exchange, and possibly go on their ways again. It is used in a number of different contexts. It is a road junction that typically uses grade separation, and one or more ramps, to permit traffic on at least one highway to pass through the junction without directly crossing any other traffic stream. For this project, it will be determining many kinds of interchange, and also give some suggestion about the interchange design and the selection for the different road intersection. Figure 1.1 and 1.2 shows the difference between traditional and modern roads.

Figure 1.1 Traditional Road

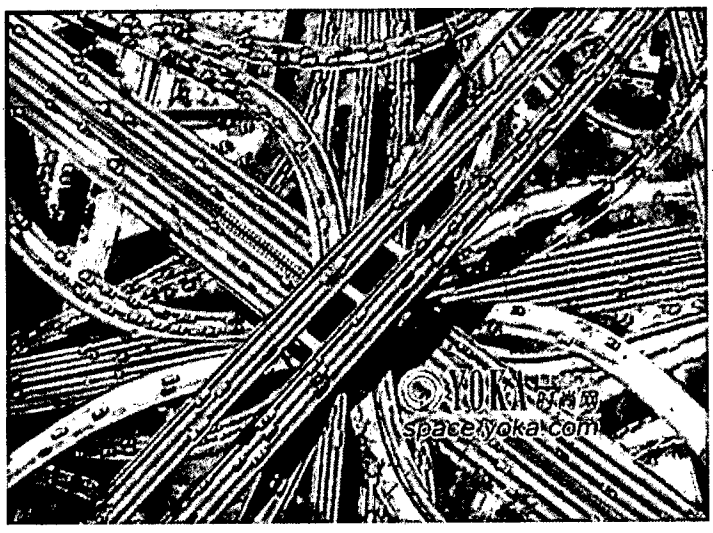


Figure 1.2 Modern Road

1.2 Problem Statements

Nowadays transportation required fast mobility however the traffic jam is one of the major problems since more and more cars running on the road, as they come from different directions, and need to be controlled.

For the study area the main problem is speed limit in the urban area at Xi'an city is already quite low at 40km/h, and this posses major problem at intersection where the traffic has to slow down at least by 50% of the operating speed limit as to allow vehicle form other directions to pass through; worst still having mixed mode of motorized and non-motorized vehicles at the same time. Figure 1.3 shows a traffic congestion problem that may lead to traffic accident.

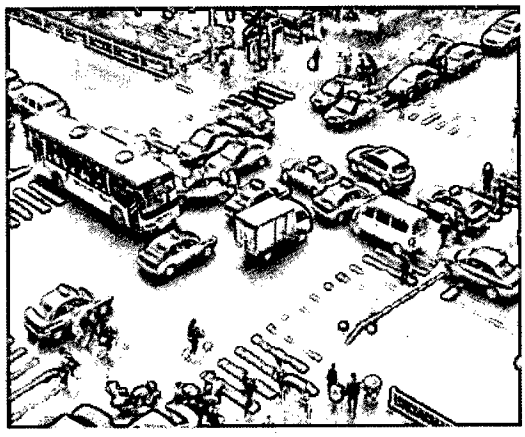


Figure 1.3 Traffic congestion problem

1.3 Definition of Terms

Road:

A road is an identifiable route, way or path between two or more places. Roads are typically smoothed, paved, or otherwise prepared to allow easy trável though they need not be, and historically many roads were simply recognizable routes without and formal construction or maintenance (City of road design 2010).

Cycle:

A signal cycle is one complete rotation trough all of the indications provided. In general, every legal vehicular movement receives a green indication during each cycle, trough there are some expectations to this rule (City of road design 2010).

Area:

Area is a physical quantity expressing the size of a part of surface. Usually the area is used for the habitat of the places (City of road design 2010).

1.4 Terminology and Key Definitions

The following table shows the terms that were usually used to describe traffic signal operation. All the terms were very important to used in interchange design and build. This is the key to connecting the road.

Table 1.1 Terminology and key definitions

Term	Definition
Cycle	One complete sequence of signal indications
Cycle length (C)	Total time for the signal to complete one Cycle
Phase	Part of cycle allocated to any combination of traffic movements receiving the right of way simultaneously during one or more interval
Interval	Period of time during which all signal indications remain constant
Change interval (Y)	The "yellow" and /or "all-red" intervals, which occur at the end of a phase to provide for clearance of the intersection before conflicting movement are released.
Green time (G)	Time within a given phase during which the "green" indication is shown
Lost time	Time which is during the intersection is not effectively used by any movement.
Effective green time (gs)	Time during which a given phase is effectively available for stable moving platoons of vehicles in the permitted.

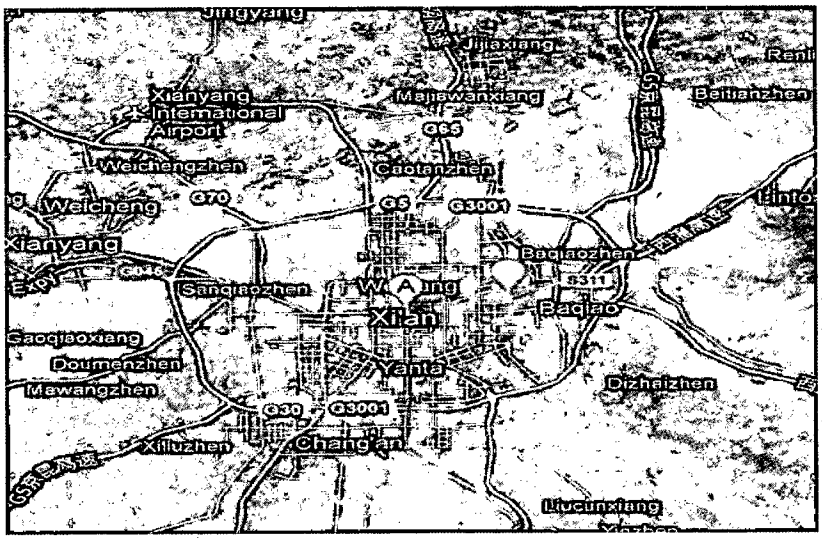
Source from (Traffic Division of the Superior Court of California, County of San Mate)

1.5 Objective

To determine the limit of capacity for the intersection based on three scenario(mixed mode, bus and other motorized vehicles and bicycle only) as to analysis severity of the problem.

1.6 Scope and study area

The project will be analysis the road traffic system, like how does it work, the function of the design. Then it will show how they solve the traffic problem. Specially, it will focus on the intersection, and the project will example which kind of design is suitable for the road or highway, then to explain the function, and adapt to the conditions. The study area is in China, Xi'an city as shown below.



(a) Xi'an city

1.7 Significant of Study

The project will be analysis the function of the different kinds of intersection. It is apply to all kinds of road, such as street, highway. It can improve the road network, especially in urban network. Because this study analysised the function of each intersection. Then it can help you to select the best suitable situation for each kind of intersection, and the suitable design can save the cost, and the use area. Secondly, it can increase the speed through the intersection. The people can drive fast, and safety. They no need to stop and wait the car through the section which from the other lane.

1.8 Summary

This chapter shows that the background of traffic, which include traffic congestion, traffic accident, and the road safety. Then we discuss about some common problems like traffic jam, and road infrastructure in our society. The object of research is discuss the road traffic control system can avoid traffic jam, reduce traffic accident, and ensure convenient and quick. The scope of study is to discuss about this project functioning.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

An intersection is the area where two or more streets join or cross at-grade. The intersection includes the areas needed for all modes of travel: pedestrian, bicycle, motor vehicle, and transit. Thus, the intersection includes not only the pavement area, but typically the adjacent sidewalks and pedestrian curb cut ramps. The intersection is defined as encompassing all alterations (for example, turning lanes) to the otherwise typical cross-sections of the intersecting streets. Intersections are a key feature of street design in four respects:

Focus of activity - The land near intersections often contains a concentration of travel destinations (Traffic Division of the Superior Court of California, County of San Mate).

Conflicting movements - Pedestrian crossings and motor vehicle and bicycle turning and crossing movements are typically concentrated at intersections (Traffic Division of the Superior Court of California, County of San Mate).

Traffic control - At intersections, movement of users is assigned by traffic control devices such as yield signs, stop signs, and traffic signals. Traffic control often results in delay to users traveling along the intersecting roadways, but helps to organize traffic and decrease the potential for conflict (Traffic Division of the Superior Court of California, County of San Mate).

Capacity - In many cases, traffic control at intersections limits the capacity of the intersecting roadways, defined as the number of users that can be accommodated within a given time period (Traffic Division of the Superior Court of California, County of San Mate).

2.2 Intersection Users

All roadway users are affected by intersection design as described below:

Pedestrians:

Key elements affecting intersection performance for pedestrians are: (1) amount of right-of-way provided for the pedestrian including both sidewalk and crosswalk width, accuracy of slopes and cross slopes on curb cut ramps and walkways, audible and/or tactile cues for people with limited sight, and absence of obstacles in accessible path; (2) crossing distance and resulting duration of exposure to conflicts with motor vehicle and bicycle traffic; (3) volume of conflicting traffic; and (4) speed and visibility of approaching traffic. (Mass highway 2006).

Bicyclists:

Key elements affecting intersection performance for bicycles are: (1) degree to which pavement is shared or used exclusively by bicycles; (2) relationship between turning and through movements for motor vehicles and bicycles; (3) traffic control for bicycles; (4) differential in speed between motor vehicle and bicycle traffic; and (5) visibility of the bicyclist (Mass highway 2006).

Motor vehicles:

Key elements affecting intersection performance for motor vehicles are: (1) type of traffic control; (2) vehicular capacity of the intersection, determined primarily from the number of lanes and traffic control (although there are other factors); (3) ability to make turning movements; (4) visibility of approaching and crossing pedestrians and bicycles; and (5) speed and visibility of approaching and crossing motor vehicles (Mass highway 2006).

Transit:

When transit operations involve buses, they share the same key characteristics as vehicles. In addition, transit operations may involve a transit stop at an intersection area, and influence pedestrian, bicycle, and motor vehicle flow and safety. In some cases, the unique characteristics of light-rail transit must be taken into account (Mass highway 2006).

2.3 Capacity

The 2006 Highway Capacity manual defines the capacity of facility as "the maximum hourly rate at which persons or vehicles can reasonably be expected to traverse point or uniform section of a lane or roadway during a given time period under prevailing roadway, traffic and control conditions (MHCM, 2010).

The capacity of highway facility is an important characteristic. Few facilities were designed to operate at or near capacity because of poor operating characteristics and the difficulty in maintaining capacity operations without breakdown. Capacity may be defined in terms of person per hour, passenger cars per hour, or vehicles per hour depending upon the type of facility and type of analysis (Patil, 2002).

2.3.1 Malaysia Highway Capacity Manual (MHCM)

The capacity of signalized intersection, unsignalized intersection and urban & suburban arterial indicates the ability of the facilities to accommodate a moving stream of people or vehicles. It is a measure of the supply side of any transportation facilities.
MHCM provides transportation practitioner and researchers with a consistent and maintained system of techniques for the evaluation of the quality of service on highway and street (road) facilities in urban and suburban area specific to Malaysia road condition.
The facilities being considered are signalized intersection, unsignalized intersections and urban and suburban arterials.

Developed which may materially affect design, should be obtained prior to interchange design (MHCM 2010). There are some factor have to be available:

1) The location and standards of existing and proposed local streets including types of traffic control.

2) Existing and proposed land use including such developments as shopping centers, recreational facilities, housing developments, schools, and other institutions.

3) A traffic flow diagram showing average daily traffic and design hourly volumes, as well as time of day, anticipated on the freeway ramps and affected local streets or roads.

4) The relationship with adjacent interchanges.

5) The location of major utilities, railroads, or airports.

2.3.2 Highway Capacity Manual defines level of service (LoS)

Density – Density is described the proximity of vehicles to each other in the traffic stream and reflect ease of maneuverability in the traffic stream, as well as psychological comfort of drivers.

Delay - Delay represents excess or additional travel time due to travel time of controls. It can be described in many ways.

Speed and travel time – Speed is very evident measure of quality, while on surface streets systems; the drive is very sensitive to total time. This is one of the most easily perceived measure of service quality is speed, or travel time.

DHV - Demonstration of Higher Value (HCM David Levinson).

Peak hour -- a part of the day during which traffic congestion on roads and crowding on public transport is at its highest (HCM David Levinson).

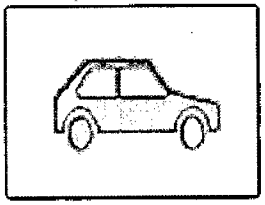
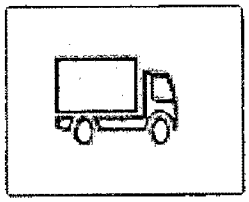
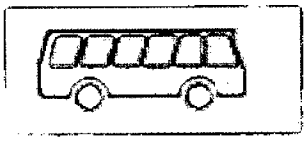
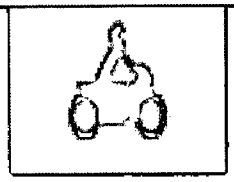
JSD -- The degree of saturation (%) is a ratio of demand to capacity on each approach to the junction, with a value of 100% meaning that demand and capacity are equal and no further traffic is able to progress through the junction. Values over 85% are typically regarded as suffering from traffic congestion, with queues of vehicles beginning to form. The term practical reserve capacity (PRC) is often used to refer to the available spare capacity at a junction. A negative PRC indicates that the junction is over capacity (HCM David Levinson).

Other measure – A variety of other measures are used to describe service quality. But sometimes it is not directly discernible to drives or passengers (HCM David Levinson).

2.3.3 Vehicle Classification

In China, there is a special case the government is not allowed the motorcycle driving in the city. The Government believes that the motorcycle driving is very dangerous, so instead of bicycles and electric bicycles to avoid traffic congestion and reduce the rate of traffic accidents. Full classification of vehicle is provided in table 2.1

Table 2.1 Vehicle Classification

CLASS	Symbol	Description
1		Vehicles with 2 axles and 3 or 4 wheels excluding taxis
2		Vehicles with 2 axles and 5 or 6 wheels excluding buses.
3		Vehicles with 3 or more axles.
4		Buses
5		Motorcycles (bicycles or vehicles with 2 or less wheels)

2.3.4 Primary Measures Of Effectiveness

Primary measures of effectiveness in Malaysia Highway Capacity Manual is provide as in Table 2.2.

Table 2.2 Type of facility and measure of effectiveness

Type of facility	Measure of effectiveness
Signalized intersections	Average controlled delay (sec/veh)
Un-signalized intersections	Average controlled delay (sec/veh)
Urban and suburban arterials	Average running speed (km/h)

2.3.5 Traffic signal setting formulas

Traffic signal formulas in MCHM is provided as this following Table 2.3

Table 2.3 Setting formulas for traffic signal

Junction saturation degree	JSD
Cycle length	1.5∑Lost time/(1-JSD)
∑Available green time	Cycle length - ∑Y+AR
Effective green for every Φ	∑Available green x Critical v/c for the Φ /JSD

Important formulas are as follows:

(a) The peak hour traffic volume $v_p = V/PHF$,

Where, V = volume

PHF = peak hour factor

(b) The capacity of every lane group at the junction $c_{LG} = BC \times N \times f_w \times f_g \times f_a \times f_{LT\ or\ RT} \times (1/f_c)$, where,

S: saturation flow rate under prevailing conditions (veh per hour of effective green time)

S_0: Ideal saturation flow rate (veh per hour of green time per lane)

N: Number of lanes in the lane group

f_w: adjustment factor for lane width ($\geq$ 3.66 meters)

f_g: approach grade adjustment factor

f_a: area type adjustment factor

f_{RT}: right turning in the lane group adjustment factor

f_{LT}: left turning in the lane group for adjustment factor

f_c: vehicle composition correction factor ($f_{car} + f_{HV} + f_{motor}$)

f_{HV}: adjustment factor for heavy vehicles

f_{car}: adjustment factor for passenger cars

f_{motor}: adjustment factor for motorcycles

(c) The v/c of every lane group at the junction

Where,

v = peak hour traffic volume

c = the capacity of every lane group at junction

(d) Junction Saturation Degree (JSD) of the junction JSD = critical v_p/c_{LG} of Φ_1 + critical v_p/c_{LG} of Φ_2 + critical v_p/c_{LG} of Φ_3 + critical v_p/c_{LG} of Φ_4