Study on Technical Parameters of Two-Wheel Traffic on the Intersection in Hochiminh City, Vietnam

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Abstract

Ho Chi Minh City, a City of 10 million people, is the largest city of Vietnam, which is the important educational, cultural and economic center of Vietnam. The city is facing to the serious problems of the traffic. Hence, two-wheeler explosion has become a big challenge for traffic sustainable development in Ho Chi Minh City. Everybody has started to realize two-wheeler's challenges for the traffic sustainable development, for the situation of private transport and public transport in Ho Chi Minh City. The purpose of this article is to describe the real stage and reason of two-wheeler explosion from these following viewpoints of: habits, psychology, awareness of people, real condition, urban renewal, land use planning and the development of public transportation ... Analysis results will clarify some problems which are related to two-wheeler traffic, for example reducing the number of two-wheeler, what do we do to reduce the number of two-wheeler. By using VISSIM software, the technical parameter of two-wheeler traffic will be studied. On the other hand, the purpose of this article is to propose solutions for two-wheeler crossing through intersection depending on some researched technical parameters. The author establish relationship between percentage of motorcycles and total number of vehicle, between percentage of motorcycles and capacity or delay time base on simulation results. At last, the author will use the researched results on real case for Hoang HoaTham–Cong Hoa Intersection in Ho Chi Minh City, Vietnam.

Keywords: Two-wheeler traffic flow, Traffic modeling, Reduce the number of two-wheeler, Traffic's sustainable development, VISSIM software.

1. Introduction

Ho Chi Minh City is the largest city of Vietnam, which is facing to the serious problems of the traffic. Among them, two-wheeler explosion has become a big challenge for traffic sustainable development in Ho Chi Minh City. The purpose of this article is to analyze the cause of two-wheeler explosion from the viewpoint of: real condition, habits, psychology, awareness of people, urban renewal, land use planning and the development of public transportation…Analysis results will clarify some problems which are related to two-wheeler traffic, for example reducing the number of two-wheeler, what we do to reduce the number of two-wheeler. With current two-wheeler explosion, government needs solution to help ordinary vehicle traffic, for example, use the overpass at the intersection. By using VISSIM software, the technical parameters of two-wheeler traffic will be studied for two cases: a) existing intersection without overpass and b) intersection with overpass. On the other hand, depending on some researched technical parameters, the purpose of this article is to propose solutions for two-wheeler crossing through intersection. The author establish relation scheme between percentage of motorcycles and total number of vehicle, between percentage of motorcycles andcapacity or delay time base on simulation results. At last, the author will use the researched results on real case for Hoang Hoa Tham–Cong Hoa Intersection in Ho Chi Minh City, Vietnam.

2. Situation of motorcycle in city

2.1. Real stage and reason of explosion of motorcycle number

According to the approval urban planning, the city will be developed and become a mega city with about 10 million citizens in the year 2020 and farther [1]. The today transportation situation of this city is very difficult. There are many problems which are needed to resolve, especially the explosion of the number of private transportation means asmotorcycles and cars. In which, the motorcycle is the main transportation mean and it is the hot problemof the city transportation development in this city.

The main characteristics of the two-wheeler traffic flow of this city are bellows:

- The capacity to satisfy the transportation demand of people: The two-wheeler gains the upper hand and become the main transportation means, which can satisfy more than 80% of transportation demand of city inhabitants.
- Rapidly increasing number and kind of motorcycle: Depend on yearly reports of Ministry of Industry, the whole country consumed approximately 3.6 million units of motorcycle in 2007, about 25 million units put into circulation in 2010, nearly 31 million units in 2015 and 35 million ones in 2020 [2]. The average scale is about 2 people per one unit. The motorcycle market is coming to saturated stage [2]. Fig. 1

Fig.1 Motorcycles in Hochiminh city

- Using of motorcycle: There is various level of inhabitant with different awareness of transportation problems.
- The main harmful effect of two-wheeler traffic: Many streets are over loaded so lead to the traffic jams. The velocity of two wheeler is about 5 ~ 10 km/h in the rush time. The real stage of motorcycle traffic is become chaotic, complicated, and easy to break the law. The motorcycle traffic has very negative effect to environment condition and to humanity as life, time, health and mind of people who live in the city.
- The development and the sustainability of the two-wheeler: it depends on the orientation of the town planning for socio-economic development, the master planning for transportation of the city, especially the policy for development and arrangement of public transportation of the city.

There are many reasons which lead to the above mentioned situation of motorcycle traffic in theHochiminh City. It may be the situation of inhabitant development,effects of various strategy and policy on development approval by the government, the topographical conditions, problem of the townplanning and land use planning, development of the public transportation by various transportation means like metro, monorail and bus; the habit, mentality and awareness of people who live and work in Hochiminh City. The main reasons are as following:

- The increasing rate of inhabitant: naturally about 1, 07 % and mechanical about 1, 9 % [3].The inhabitant growth is rapidly so the transportation demand is increasing. The capacity of public transportation is not satisfy in time, the price of motorcycle is convenient and in accordance with people income. So that, people buy and use the two-wheeler for their transportation means and livelihood.
- Cause of the policy and strategy of the city government: they are approval for short period and local only, with limited vision, not hard line and consistent.
- Cause of town planning and land use planning, the topographical condition.
- Cause of urban planning and public transportation system: The public transportation system with buses has taken interest from the year 2003. There are 151 lines up today, among them there are 117 lines with financial support and 34 lines without financial support from the city government. The total exploitation range is about 3,400 km with the line network density 1.62 km/km^2. Every year, It satisfies approximately 6.2% transportation demand of this city. There are only bus lines but they are not created the bus network for transportation system in this city. In the opinion of inhabitant, the buses have many weak

points and inconvenient. So that, the using of motorcycle gains the upper hand.

▪ Cause of habit, mind and awareness of city inhabitant: A few people like walking by foot, though the traffic range is short. Many people do not like to live in apartment building. With characteristic of private business, it is difficult to concentrate the business in one place, so that the business can do in the living house and along the streets. The level of inhabitant awareness and mind about the transportation is different, with many limits and non-compliance with laws. Fig. 2

Fig. 2 Market on the sidewalk

▪ Cause on benefit and policiesof companies which trade motorcycle [4]: they are ready to increase invested capital, to build more factories, to raise the capacity of production or assemble system for motorcycle. They execute various programs with promotions like giving valuable presents, raising time and condition for service, installment sale for motorcycles …

2.2 Reducing the number of motorcycle: can or can not

Today, the motorcycles gain the upper hand in transportation means in Hochiminh city. Reducing the number of two-wheeler will take strong positive effect to transportation situation, especially in decreasing the traffic jams. By the aim is the transportation by motorcycle will not challenge for sustainable development of this City. The local government and authorities have discussed many policies for reducing the private transportation but the result is not as government expectation. Some researches on this private transportation in near areas are shown that the motorcycle is the economical and most effective transportation means. With the today living standard of Vietnamese, buying and using the motorcycle for transportation demand is able. The motorcycle is the most dynamic transportation means in the hot weather countries. Many inhabitants don't accept many short term solution related to reducing of motorcycle from the local government. Many governments in near areas allow motorcycle joining to the traffic system but not prohibit. So that, the society must accept motorcycle as the today transportation mean, do not prohibit but must deal with the motorcycle as the best effective means today.

Therefore, the research on solution for arrangement of two-wheeler traffic must be taken into duty, especially at intersection for limiting the traffic jams.

3. Methodology

As above mention, the two-wheeler traffic must be researched in advance. So that, the aims of this study is in orderto clarifythe main parameters of two-wheeled traffic flow at the intersection. This study was carried out by the following specific steps:

▪ Step 1: Choosing the main characteristics of suggested intersection: The distance between the intersections is 200m. The plan of typical intersection is shown in Fig.3. The traffic flow is available for two directions.

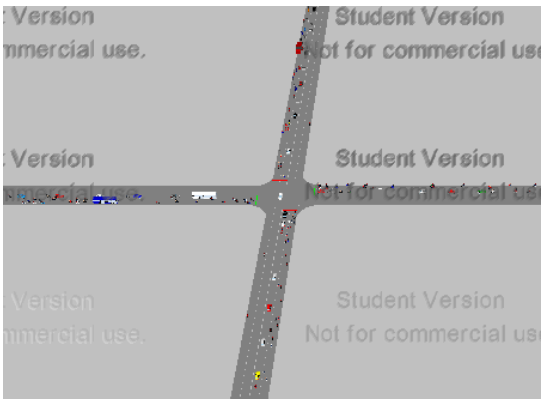

Fig.3 Typical intersection

▪ Step 2: Choosing the geometric elements of the route, which are considered in this study, are pavement width, number of lanes, length of simulation route, lane width. The arrangement of

▪ cross section of road is 4 lanes for motor vehicle. Each lane is 3.5m wide, Fig.4.

▪ Step 3: Assumption of traffic conditionsat the typical intersection: Input dataincludesthe total

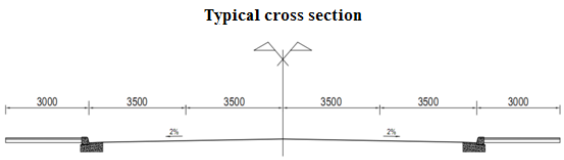

Fig.4 Typical cross section of road

traffic volume, traffic volume on the direction, and a percentage of various types of vehicles in each direction.

+ Total traffic volume in the intersection: Traffic number is based on maximum traffic number allowing capacity of lane is 1600pcu/hour/lane. So that, traffic number of simulation road is considered about 6400 motorbike/hour/lane or 1600 car/hour/lane.
+ Traffic condition for every direction at this intersection is assumed that: 70% vehicle go straight, 15% turn right and 15% turn left 15%. This input data is assumed on the researched data of several intersections in this city.
+ In this study, authors consider three conditions on the scale of number of motorcycles on the total number of transportation means. Today, the motorcycles satisfy up to 80% of the traffic demand. Therefore we consider three cases with different conditions. The condition 1 for the situation if we can reduce the number of motorcycle in the future by various policies. The condition 2 refers to the normal situation and the case, in which the inhabitant can use more and more the public transportation system for their traffic demand. The third condition for the bad situation, if the number of motorcycle will increased in the near future.
  - ✓ Condition 1: 50% motorbikes+50% cars
  - ✓ Condition 2: 70% motorbikes+30% cars
  - ✓ Condition 3: 90% motorbikes+10% cars
+ For arrangement of two wheeler traffic at the intersection, authors study option with overpass for two directions on one road.

▪ VISSIM is the leading microscopic simulation program for multi-modal traffic flow modeling. With its unique high level of detail it accurately simulates urban and highway traffic, including pedestrians, cyclists and motorized vehicles. The program can analyze private and public transport operations under constraints such as lane configuration, vehicle composition, traffic signals, PT stops, etc. Thus making it a useful tool for the evaluation of various alternatives based on transportation engineering and planning measures of effectiveness. However, The author need calibrate and optimize parameters modeling in Hochiminh condition [6]

▪ Using VISSIM software [7], the technical parameter of two-wheeler traffic will be studied. For the typical intersection, the two output position will be shown in this article as Fig. 5. At each position, the following value will be calculated:

Fig. 5 Output positions on Cong Hoa Street at the intersection

+ P – Output position
+ T_S – Simulation time, unit in second
+ V – Average speed of motorbike, in m/s
+ T_D – Delay time, unit in second
+ N – The number of vehicle crossing the output position, unit in vehicle/hour

▪ Step 4: establishment the complementary relationship of traffic flow and capacity base on Simulation results. Proposed solutions for two-wheeler go through intersection depending on some researched technical parameters.

▪ Step 5: Application the results of studies for the real case Hoang Hoa Tham–Cong Hoa Intersection in Hochiminh city, Vietnam.

▪ Step 6: re-simulation for Hoang HoaTham–Cong Hoa intersection and verify the results of study.

4. Results

4.1 Results for the for typical intersection

With the simulation time 600 seconds, the main researched values for each output position contain: P – Output position, V – Average speed of motorbike in m/s, T_D – Delay timein second and N – The number of vehicle crossing the output positionin vehicle/hour, which are calculated by simulation model in VISSIM software, are shown in table 1 for the case of assumed investigated

typical intersection with various scale of motorcycle on total vehicle number. The same results for the case with overpass at the intersection are shown in table 2.

Table 1 Output data of the existing intersection

P	V (m/s)	T_D (s)	N (ve/h)
Condition 1: 50% motorbikes+50% cars			
1	26.2	176.3	1632
2	13.2	140.9	1704
Condition 2: 70% motorbikes+30% cars			
1	26.5	171.3	1506
2	11.8	123.8	1716
Condition 3: 90% motorbikes+10% cars			
1	26.8	152.5	1650
2	14	118.6	1860

Table 2 Output data with overpass

P	V (m/s)	T_D (s)	N (ve/h)
Condition 1: 50% motorbikes+50% cars			
1	23.4	20.6	6228
2	23.4	0.1	5568
Condition 2: 70% motorbikes+30% cars			
1	23.5	19.6	6120
2	23.4	0.1	5502
Condition 3: 90% motorbikes+10% cars			
1	23.4	26.4	6198
2	23.4	0.1	5508

For under mentioned graph, the symbols are represented for following data:

- In the case of the typical investigated intersection with natural traffic and without any special solution for motorcycle
  - At the position 1, which is after going out intersection.
  - At the position 2, which is before going in intersection.
- In the case of the investigated intersection, which arranged overpass for motorcycle
  - At position 1, which is after going out intersection
  - At position 2, which is before going in intersection

Base on simulation results, authors build graph showing following relationship for the number of vehicle, the capacity, and the delay time.

- The relationship between the percentage of motorcycle over the maximum traffic number and the total number of vehicle which can go through the intersection Fig. 6

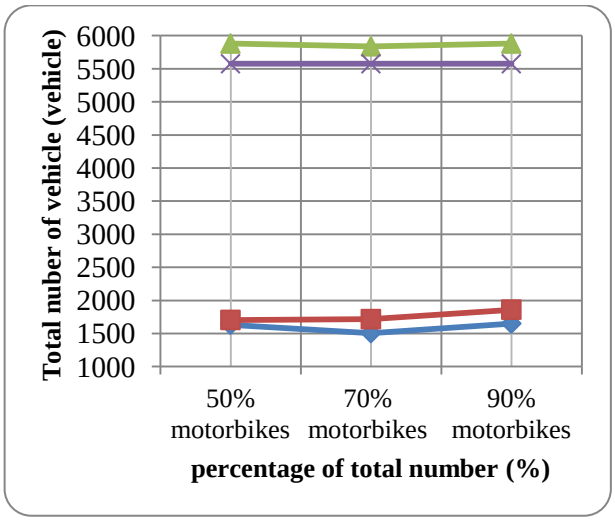

Fig.6 Relationship between percentage of motorcycles and Total number of vehicle

- The relationship between the percentage of motorcycle and capacity of vehicle which go through the intersection, is shown on Fig. 7

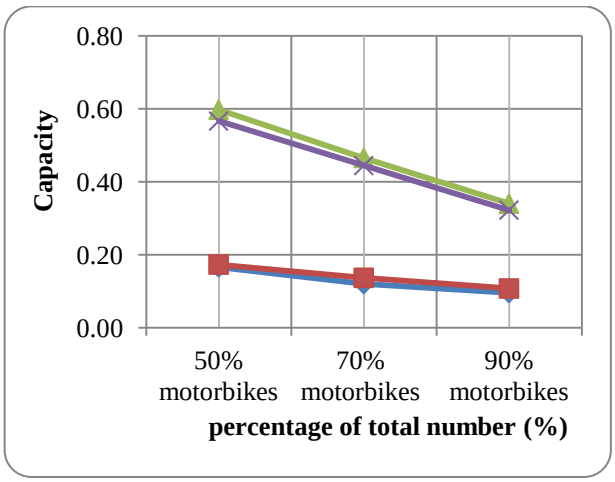

Fig.7 Relationship between percentage of motorcycle and capacity

▪ The relationship between the percentage of motorcycle and the delay time of vehicle which go through the intersection, is shown on Fig. 8

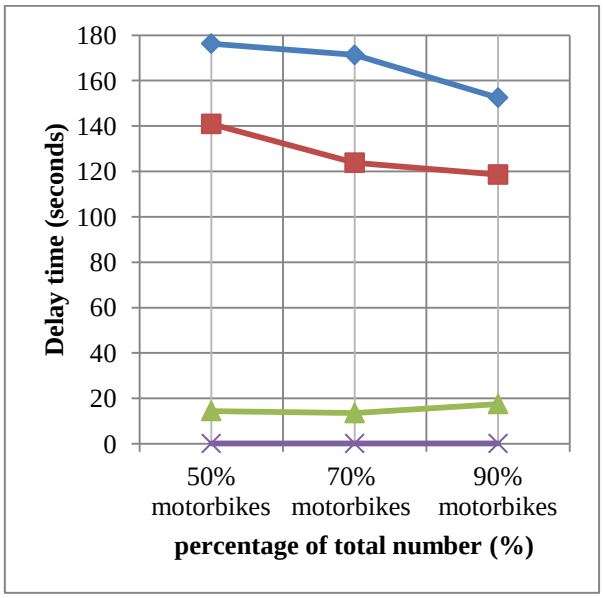

Fig.8 Relationship between percentage of motorcycle and delay time

The data in table 1, table 2 and on graph in Fig.6 ~ 8 show that there is traffic jam at this intersection because the delay time is more than 80 second. In the other hand, the total number of vehicle be able pass through the intersection is only about 1650 vehicles, although the total number ofvehicles in input is 1600pcu/hour/lane. So that, the capacity of the intersection is less than 0.2. If the percentage of motorcycle increases, the delay time will decrease and the total number of vehicle be able pass through intersection will increase.

4.2. The real case, Hoang HoaTham–Cong Hoa intersection

For the verify results of study, The Hoang HoaTham-Cong Hoa intersection in Tan BinhDistrict is chosen. The traffic congestion regular occurs at this intersection. The Cong Hoa Street is main road, which connects Tan Binh District with Central District (CBD). The Cong Hoa Street is two directions with 4 lanes. The width of lane is 3.5m.

The position of the Hoang HoaTham-Cong Hoa intersection is shown on the Google Earth (web page link http://earth.google.com). Fig. 9

Fig. 9 The position of Cong Hoa–Hoang HoaTham intersection

The number of vehicle data is counted at Hoang HoaTham-Cong Hoa intersection in 1/3/2013[5] with survey points as shown in Fig.10 and table 3

Table 3 The number of vehicle data (vehicle/hour)

D	Car	C	Tr	Mo	B	Total
1	10	1	4	211	3	228
2	659	239	222	9398	54	10571
3	6	1	3	837	14	861
4	99	15	44	2991	48	3196
5	27	5	17	1434	91	1574
6	61	1	18	507	5	593
7	22	0	5	1174	10	1211
8	837	148	193	10613	0	11792
9	32	1	17	911	10	971
10	38	1	11	1774	29	1853
11	12	1	2	1076	67	1157
12	6	1	1	171	18	197

There is:

- ▪ D: Directions,
- ▪ C: Coach
- ▪ Tr: Truck
- ▪ Mo: Motorbike
- ▪ B: Bike

Base on the number of vehicle data is counted Hoang HoaTham-Cong Hoa intersection, the maximum total number of vehicle for straight direction which need to go through this intersection is 11792vehicle/hour, among that is 90% of motorcycle. According to the graph on Fig. 6 ~ 8 the traffic jam occur at this intersection. So that, the overpass for the direction from the airport to Hoang

Van Thu park and reverse must be built at this intersection for motorcycle. With this option the total number of vehicles be able pass through this intersection will increase up to 5508vehicle/hour, the delay time will decrease down to 0.1 second and the speed of vehicle will not be change.

By the simulation in VISSIM with the traffic data at this intersection, the results for this intersection are shown on table 4.

Table 4 Result for the investigated intersection

P	V (m/s)	T_D (s)	N (ve/h)
1	24.9	25.5	8162
2	25.1	0.5	9780

5. Conclusion/Discussion

Two-wheeler explosion has become a big challenge for traffic's sustainable development in Ho Chi Minh City. For the special characteristic of Ho Chi MinhCity, the local government has many plans to reduce the number of this traffic means. The society must accept motorcycles as the effective transportation mean. So that the research on motorcycle traffic must be taken out, special at intersections.

By using VISSIM software, the technical parameters of two-wheeler traffic have been studied.

The authors have established the relationship between the number of vehicle, the capacity and the delay time for solutions with and without overpass for motorcycles at intersection. By using the results of study, the traffic at the Cong Hoa–Hoang HoaTham intersection shown that it is necessary invest the overpass for motorcycle at this intersection.

6. Acknowledgement (If preferred)

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