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TRAFFIC CONGESTION IN MANDALAY CITY

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Abstract

Traffic congestion is a condition on road networks in which demand for road space exceeds supply and is characterized by slower speeds, longer trip times and increased vehicles queuing. Traffic congestion is caused when a volume of traffic generated demand for space greater than the available road capacity. In Mandalay City, there are totally 28 numbers of traffic lights but some are not in properly working condition. Only about 10 out of 28 are the busiest. To study the traffic congestion in Mandalay City, there are many indicators such as traffic intensity, traffic density and the speed of vehicles. Therefore, it is necessary to measure the incoming flow and outgoing flow of the vehicles which pass through the traffic lights. But, we, the researchers are neither motorists nor passengers on bus, so that traffic density or speed or vehicles may not be acquired and cannot be analyzed in this paper.

Key words: traffic congestion, Mandalay City, vehicles, traffic light, saloon, motor cycles, cargo truck, passenger truck.

Introduction

Cities and traffic have developed since the earliest large human settlement. The same forces that draw inhabitants to large urban areas also lead to in tolerable levels of traffic congestion on urban street and thorough fares. The study area is founded in 1859 by King Mindon during Myanmar Last Dynasty. After annexation by the British Government, the Mandalay City has been started developing with urban characters and infrastructures. During Second World War, the British Forces and its alliance forces bombed there, so that some infrastructures were destroyed. After gaining Independence, the Parliament Government has renovated all the characters of the City. Since that time, the government of Myanmar and the authorities from Mandalay City Development Committee also put effort to develop the facilities for City dwellers. Mandalay City lies in the heart of Myanmar and it is the third capital of the country. It lies in the Central Basin with natural boundary of the Ayeyarwady River in the west. Therefore, the city is accessible from any direction of the country with various modes of transportation. Hence, it has become the commercial centre of the entire county not only for inter- and intra- local trade but also for the international one. Along with the increased total population, the city is needed to expand by

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horizontally or vertically. Moreover, the growth of economy of the inhabitants in the city leads to use more number of vehicles in or around the city. Apart from that, more leisure time can be spent by the City people and as a result, moving here and there by the residents has become one of the major causes for traffic congestion in Mandalay City.

Aim and Objectives

The main aim of the paper is focused on that whether there is traffic congestion in Mandalay City and it's environ or not.

- For that main aim of the paper, it is necessary:
- To know how many types and number of vehicles are used by the City dwellers,
- To understand the spatial distribution pattern of transportation routes in the City,
- To account the number and location of traffic lights which are able to control or to manage the traffic flow in/or Mandalay City and around the City,
- To provide the alternative ways for reducing traffic congestion, and
- To know when and where the motor vehicles are mostly congested in the city.

Study Area

Mandalay City lies between North Latitudes (21˚ 53′) and (22˚ 02′), and East Longitudes (96˚ 04′) and (96˚ 09′). It is located on the flat plain which is formed by the river terraces of the Ayeyarwady. It has an average elevation of 250 feet above sea level except Mandalay Hill (776 ft) [Map (1)]. Recently, Mandalay City is composed of 5 townships with (86) wards. In 2012, about 1.2 million people resided in the City. Being located in dry zone of Central Myanmar, it usually experiences hot summer, scanty but double maxima rainfall, cool and dry winter in a year. As the study area is full of urban characters, there is also the urban vegetation cover.

The total number of vehicles according to their types which were registered by the Department of Road Transport Administration within Mandalay Municipal Area up to end of 2012 are shown in the following table.

Sr. No.	Types of Vehicle	Number of Vehicle
1	Private-owned	408358
2	Cargo Truck (small)	3641
3	Cargo Truck (big)	5915
4	Passenger Truck	1407
5	Others	563
6	Two-wheelers	478323
7	Tri-Shaw	10972
8	*Htawlargy*	5912
9	Machines	33

Source: Department of Road Transport Administration, Mandalay Region (2012)

Data Collection and Method

Yatanapon Shwe Myo Daw Gyi (ancient name of Mandalay City) has been started forming as a square shape with an alignment of Moat and Palace since the regime of King Mindon. Yearly increase of population mainly by immigration became the major cause to expand the city. As a result, the present shape of city is in rectangular. Moreover, Mandalay City is a focus of trade and transportation routes. Its location also favours to arrive at the city from other big towns and cities of the country and even from border area. Therefore, the number of vehicles which incoming to / outgoing from the city are especially collected at 6 gates (i.e. entrances of the city). But, there is a great drawback that this study could not cover the intra-urban traffic flow pattern.

Besides, due to less time and less number of researcher, this project has been lacked of data collection for certain time of a day (i.e. 6:00 p.m. to next day 6:00 a.m.). It was assumed that most vehicles have been traveling during the day time. Actually, the data collection was made on the particular day which is not the fast-day and they are gathered with 2 hours time interval between 6:00 a.m. and 6:00 p.m. When collecting the number of vehicles, types of vehicle are also classified as follows:

1. Passenger truck (including public busses)
2. Cargo truck
3. Private owned vehicles (Saloon and pick-up)
4. Others (*Htawlargy*, government and organization owned, ambulance, motor tri-shaw)
5. Motorcycles

Due to flat lowland topography, the people not only from the city but also from the nearby areas can move around the city by using bicycles. Counting on number of such two-wheeler is the greatest difficulty for the researchers, so that two-wheelers without fuel engine are omitted in this paper.

The main roads which serve for inter- and intra- city transportation are shown in map (2). Moreover, the locations of the traffic lights and the selected places of data collection are also integrated on the same map.

The traffic intensity for each entrance (6 gates) is calculated by using the method from "Wikipedia".

The formula is as follow:

$$\text{Traffic Intensity} = \frac{\text{Number of Vehicles}}{\text{Unit of Time}}$$

According to the ratings, the intensity is classified into six classes (i.e. from "A to F"). Their descriptions are:

Class	Description	Intensity (vehicle/lane/hour)
A	Traffic flow at or above posted speed limit	under 700
B	Slightly congested	700-1100
C	Ability to pass or change lanes constrained	1100-1550
D	Speeds somewhat reduced (urban peak period)	1550-1850
E	Flow becomes irregular, speeds vary and rarely reached posted limit.	1850-2000
F	Flow is forced with frequent drops in speed to nearly zero	unstable

Source: Wikipedia

The researchers are neither motorists nor travelers, so that to collect the data for speed of vehicle, road length unit, etc. are not possible. Therefore, only the traffic intensity index is applied to examine the congestion rate of selected places.

Up to December 2012, the Department of Road Transport Administration, Mandalay City had registered totally 547,604 numbers of vehicles by nine categories. Out of which total number of motor cycles were 478,323. It is also attracted that whether the number of vehicles which are only registered for the city are moving or not. For considering the traffics which are from out of municipal area, the selected places are arranged at 6 places: two at eastern, one at southern, two at western and one at northern entrances of Mandalay City.

Out of six, the eastern one is the most accessible and mostly used not only by the city dwellers but also by the outsiders. Therefore, two different sites for the eastern entrance are observed separately. Although there are at least four places to enter the city from the east site, the entrance of 30th main road was renovated while surveying. And, for the entrance of Theikpan Road, the observation was made along with that of southern entrance (junction of Theikpan Road and Yangon-Mandalay Highway). The western entrance was chosen at the junctions of 86th main road and Kandawgyi Circular Road and Sagaing –Mandalay Road and Kandawgyi Circular Road. It was due to the consideration of vehicles from the western part of Ayeyarwady River (Chin State, Sagaing Region, Tamu Border Area). For the last entrance, the northern gate, the junction of Mandalay-Mogok Road and the City Circular Road was selected (Map- 2).

Discussion on Traffic Intensity Rate

From the specific days of data collection, the traffic intensity for east sample place could be calculated and the results are shown in the following table.

Traffic Intensity Rate for Mandalay City (from 6:00 a.m. to 6:00 p.m.)

Sr. No.	Sample Places (Sites)	Traffic Intensity Rate	
		Incoming	Outgoing
1	Junction of 35th & 62nd Streets	1,402.75	1,324.33
2	Junction of 19th & 66th Streets	638.16	645.66
3	Theikpan Road & Yangon-Mandalay Highway	3,972.33	3,935.25
4	Sagaing-Mandalay Road & Kandawgyi Circular Road	1,042.58	906.75
5	86th street & Kandawgyi Circular Road	378.00	472.5
6	Mandalay-Mogok Road & City Circular Road	552.83	539.75

Source: Calculated by the researchers based on surveyed data.

According to the table, for both incoming and outgoing to/ from Mandalay City, the traffic intensity rate was the highest at the junction of Theikpan Road and Yangon-Mandalay Highway. It is mainly due to many reasons. They are that:

1. It is more accessible since earlier days.
2. It is the main entrance from Yangon (former capital) and Nay Pyi Taw (recent capital).
3. New residential areas have been extended towards the southern and southeastern portions of the city.

4. The Highway Bus Station and Wholesales Centres have been operated in the southern part of the city.

The second highest intensity is noticed at the junction of 35th & 62nd Streets. It is also main entrance from the eastern part of the country to the city especially from Northern Shan State and Pyin Oo Lwin which is famous hill resort station of the country. Therefore, the people used to move by passing this junction. Moreover, allocating of Yetaguntaung Golf Course, Yemontaung Residential Area also attracts many people to settle around the City who have to pass this point.

It is followed by the site of the junction at Sagaing-Mandalay Road and Kandawgyi Circular Road. At this point, the site of 86th Street and Kandawgyi Circular Road can also be considered together because both are located as western entrance of the city. This gate mainly used by the vehicles which come from/go to Monywa, Pakokku and Sagaing: western parts of the Ayeyarwady River. After completing Yatanabon Bridge on Ayeyarwady River, it is more convenient to connect east and west of the Ayeyarwady.

The minimum intensity of traffic is found in the northern entrance, i.e., the junction of Mandalay-Mogok Road and City Circular Road. Actually, the road to Mogok, Thabeikyin, Madaya is tarred road, but its width is narrow and is not yet upgraded as highway. Therefore, the number of vehicles which pass through this point is rather less than that of other sites.

Traffic Congestion Rate According to the Time Intervals

As mentioned above, six places are selected to observe and collect the primary data for investigating the traffic flow of Mandalay City. The traffic intensity rates for those sites are shown in the respective tables and figures.

Table (1.a & 1.b) and Figure 1 indicated that the total number of vehicles (including motor cycle) which pass through the junction of 35th & 62nd streets within 12 hours (from 6:00 a.m. to 6:00 p.m.). It can be noted that total number of motorcycle have been found as the highest both for incoming and outgoing to/from the city. The second highest number is saloon cars and the least number is the others. Moreover, the greatest number of motorcycle moved during the peak hours of 8:00 a.m. to 10:00 a.m. for incoming to the city, whereas its outgoing way was highest during 10:00 a.m. to 12:00 noon. It may be due to drop the students or to go for shopping and coming back from the schools or markets, respectively. Again, it has

been raised up at the time of about 4:00 p.m. for both ways. That may be also due to the journeys of going back home from the works or schools or offices. The moving trend of saloon explained that both incoming and outgoing ways were highest during the hours of 10:00 a.m. and 12:00 noon.

The same patterns of moving vehicles are also observed in Figure 2. It is shown the sample site of junction at 19th & 66th streets. In this figure, it can be noticed that the outgoing motorcycle from the City has been remarkably higher than that of incoming to the City. This site is an entrance of Mandalay City from Patheingyi Town, which is about 5 miles away. Therefore, total incoming motor cycles during 8:00 a.m. and 10:00 a.m., might have gone back to home since from 2:00 p.m. up to 6:00 p.m. At this point also, the second highest vehicles are saloon both for incoming and outgoing way. It is no doubt that the least number of moving vehicles was others. (Table 2.a & 2.b)

At the sample place of Theikpan Road & 78th Road (Yangon-Mandalay Highway) junction, both incoming and outgoing numbers of cycles are the highest during 8:00 a.m. to 10:00 a.m. Then, it dropped again up to 2:00 p.m. and it started rising up again since 4:00 p.m. to 6:00 p.m. (Figure-3, Table 3.a & 3.b). It is followed by the number of saloon and the least number is that of others.

At the junction of Kandawgyi Circular Road and Sagaing-Mandalay Road, only the number of motorcycle led as the highest vehicles which passed through this point both for incoming and outgoing ways. But the number of passenger truck was also great along with the number of saloon. All the passenger cars going to Sagaing, Pakokku and Monywa have to pass this point so that its amount has become noticeable. As shown in Figure-4, Table 4.a & 4.b, the peak hours of incoming vehicles were during 8:00 a.m. and 10:00 a.m. and that of going back are after 4:00 p.m.

As another western entrance, the junction of Kandawgyi Circular Road and 86th street, also showed the same pattern of vehicles moving to/from the City. Whereas, the incoming motorcycle has been started going down since 10:00 a.m. up to evening 6:00 p.m. It is reversed that the outgoing motorcycle from the City has been increased since 2:00 p.m. up to 6:00 p.m. In the Figure-5 and Table 5.a & 5.b, comparative less in number of other vehicles (saloon, cargo truck, passenger truck and others) have been found at this point.

The junction of City Circular Road and Mandalay-Mogok Road represents as the northern entrance of the City. Here also, total number of motorcycles influenced passing through this place and while remaining types of vehicle showed very less in amount during the same period. In this figure (Figure-6), it can be assumed that the incoming motorcycles might have been gone back home since the time of about 2:00 p.m. Those motorcycles may be from the nearby City areas. This site is the only gate which is passed through by the passenger truck to-and-fro Mandalay and Mogok, Thabeikyin, etc. so that, the number of passenger buses have been found at 2nd highest level about 10:00 a.m. (Table 6.a & 6.b). From Mogok, many people used to come in and go out to/from the City by using their owned cars. Hence, the number of saloon also showed as the 2nd highest trend in this figure.

Findings and Suggestions

By considering total number of vehicle all together which are collected at 6 places for a day (i.e., 12 hours), it can be noted that all types of vehicles are accounted for 189,731. It is about 34.65 % of total number of registered vehicles in Mandalay Municipal Area. Out of 34.65 % of vehicles, total number of motor cycles are 136,335 (71.86 %) of vehicles on that particular day. Therefore, it can be assumed that motor cycle is the major reason to be traffic congested at all sample places, especially for two sites: junction of Theikpan Road & Yangon-Mandalay Highway and junction and 62nd & 35th streets. To avoid the problem of road congestion by motor cycles in the city, the following measures should be considered.

Regarding Traffic Light

The traffic light should be setup more number around the city. The present situation about traffic light is seemed incapable to control the traffic congestion. Traffic lights should go with the flow, rather than enslaving drivers to the tyranny of timed signals. The bam, bam, bam of greens allow platoons of vehicles to move smoothly through intersection after intersection. By doing so, no drivers have to wait very long and sections of road don't become so filled with cars that there is no room for entering vehicles when the light does go green. In addition, the traffic lights should be upgraded and it possible, time manage met for the motor cycles should be taken into account. For example, it there is a specific traffic regulation (green intersection) for two-wheelers, it can reduce the traffic block at a point. Lights should stay green longer during peak traffic hours and at that time; computers will help prioritize public transit. Moreover, the traffic light should work together by figuring

out how charges at each individual intersection would affect the entire system. Within the entire city, there are only two traffic guidances which help to light for individual lane with separate time signals. Therefore, it can control the passing of many vehicles at a time. Such traffic guidance with proper electricity and technology provision can definitely reduce the vehicle congestion around the city.

Regarding Public Bus Services

To reduce the number of using motor cycle by the City dwellers, more convenient and more reliable bus transport systems should be replaced. The City's current bus system is a cyclical bus route. In such a system, the bus stops frequently to drop off and pick up passengers. The problem with this system is that it takes more time for a passenger to travel long distances when riding a bus than when driving motor cycle or car. It is proposed for developing customized bus routes using computer technology. By creating customized bus routes using commuter information, the public bus services can be promoted in the city. To do that, 3 information of each commuter's originating point, destination point, at time of arrival should be provided. School buses should also be proposed to the parents who used to drop/pick up their children by their own cars or motorcycles. Such school bus system may take much longer time, but safety and less degree of road congestion can be benefited.

Regarding City Planners

Effective land use planning, transport planning and coordinated transport development involving all transport modes are fundamentally important to the high transport modes and to the high quality access needed in large urban areas. Road transport policies, however, should seek to manage congestion on a cost-effective basis with the aim of reducing the excessive congestion that imposes upon travelers and urban dwellers throughout the urban road network. Besides, the congestion management policies should keep track of travel reliability indicators. These may capture the variance in travel times, or alternatively, communicate the amount of time buffers road users have to include in their travel plans to make their trips "on time". In future, demand for use of highly trafficked roads will need to be managed. Transport authorities need to employ a combination of access, parking and road pricing measures from operational and infrastructure measures aimed at mitigating traffic congestion. The authorities have to take necessary actions on motorists who

break down the rules and regulation of traffic laws. The width of the existing lanes should be expanded on both sides.

Regarding Alternative Ways

As shown in map (3), the proposed flyovers may help to lessen the traffic congestion for the city. It can be clearly seen that these flyovers should be bridged between the sub-urban areas and to the CBD of Mandalay City especially from southern and eastern entrances. It is no doubt that construction on such bridge will take longer duration and will be necessary to transform or change the present buildings around the city. But, it may ensure to lessen the traffic congestion especially in the CBD area. According to the collected from 6 places, the number of private saloons has been increased day by day in the city after that of motorcycle. So, it should be considered to have flyovers for the saloon cars.

Conclusion

Cities provide access to a wide range of activities, people, services, goods, markets, opportunities, ideas and networks. These benefits can be delivered either through speed or through greater proximity. Congestion may affect travel speed. Fully eradicating roadway congestion is neither an affordable nor feasible goal in economically dynamic urban areas. In Mandalay City, congestion has been grown as city has expanded as well as economic activities. As the City attracted more people and activities, not only from nearby areas but also from far ones, it has produced more wealth and as a by-product, the roads have become more crowded. Measuring congestion is a necessary step in order to deliver better congestion outcomes. Although, congestion should not be described using a single metric, i.e., traffic intensity, this work may be expected to fill a blank of congestion rates in the different areas. Moreover, much can be done to reduce its occurrence and to lesser its impacts on roadway users within Mandalay City. Besides, more studies can be carried out by the other researchers who interest in urban transport systems. This paper is focused only on the selected sample places. Therefore, other vehicle congested places in the City are missed. Besides, intensive attention should be paid for the remaining crowded places throughout the City.

References

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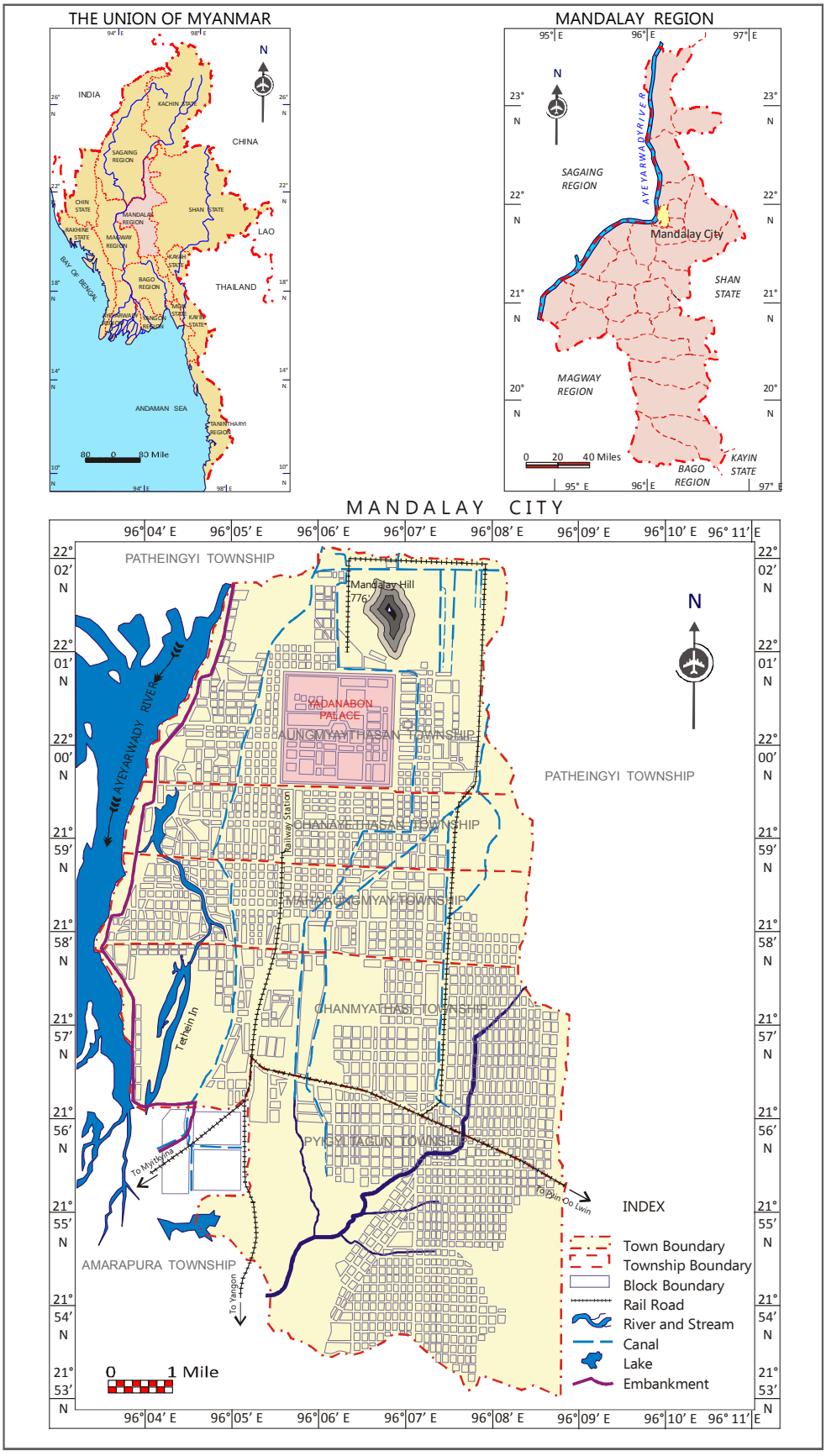
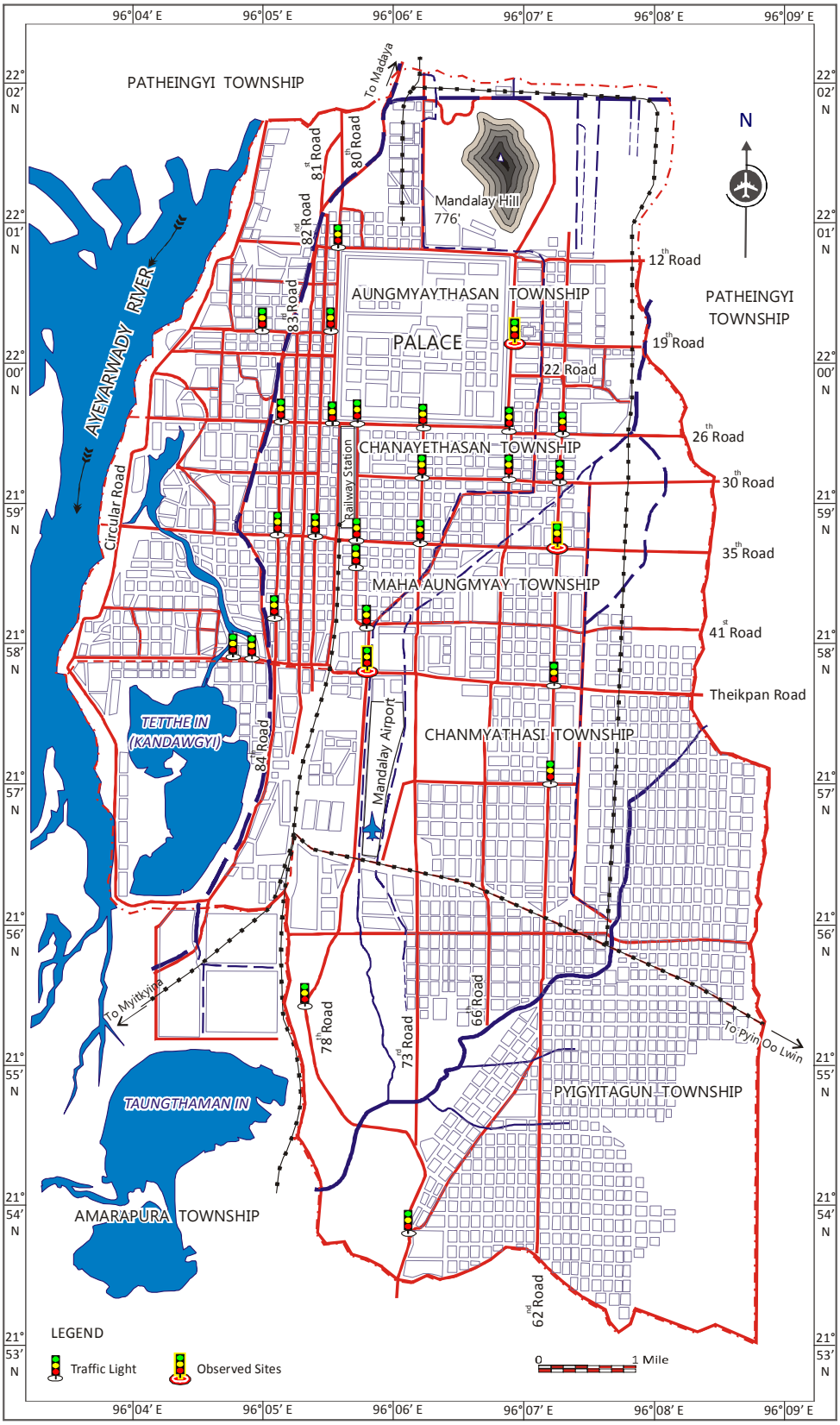
MAP (1) LOCATION OF MANDALAY CITY



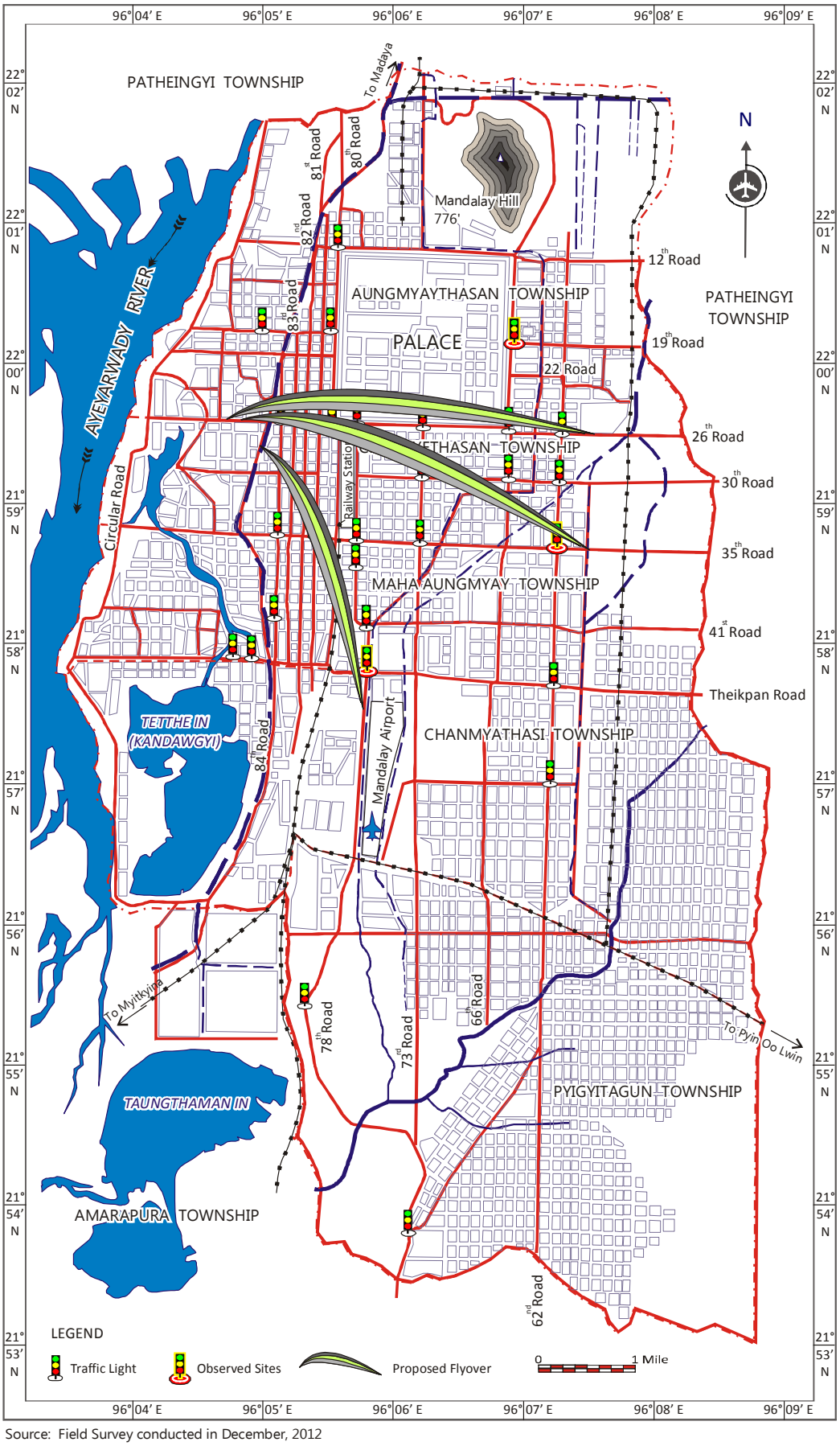
Source: UTM Map No. 2195_13, 2196_01 and 2296_04.

MAP (2) MAIN ROADS AND TRAFFIC LIGHTS IN MANDALAY CITY



Source: Mandalay City Development Committee

MAP (3) PROPOSED FLYOVER IN MANDALAY CITY



Source: Field Survey conducted in December, 2012

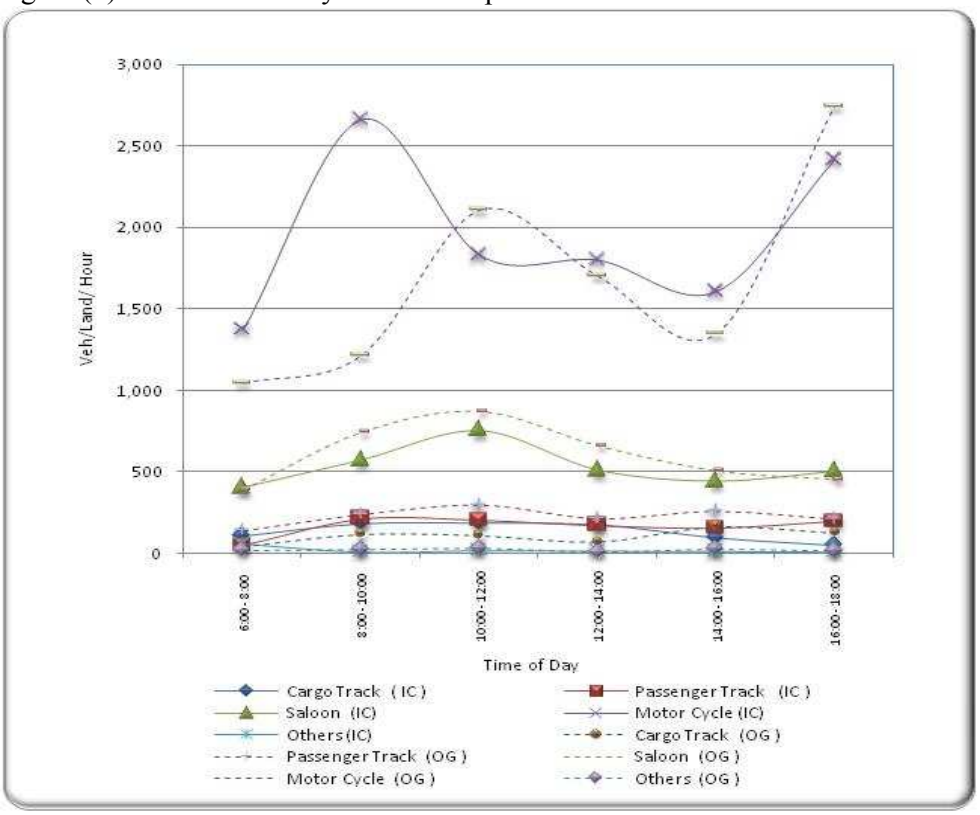
Table 1 (a) Number of Vehicle incoming to Mandalay City at Sample Place: 35thx 62ndStreet

No	Time Interval	Number of Incoming				
		Cargo Track (CT)	Passenger Track (PT)	Saloon (S)	Motor Cycle (MC)	Others (Os)
1	6:00 - 8:00	109	52	406	1,375	60
2	8:00 - 10:00	184	212	576	2,664	10
3	10:00 - 12:00	188	205	756	1,832	19
4	12:00 - 14:00	177	172	512	1,802	16
5	14:00 - 16:00	98	157	444	1,609	14
6	16:00 - 18:00	52	199	505	2,417	11
TOTAL		**808**	**997**	**3,199**	**11,699**	**130**

Table 1 (b) Number of Vehicle Outgoing from Mandalay City at Sample Place: 35thx 62ndStreet

No	Time Interval	Number of Outgoing				
		Cargo Track (CT)	Passenger Track (PT)	Saloon (S)	Motor Cycle (MC)	Others (Os)
1	6:00 - 8:00	38	142	389	1,045	19
2	8:00 - 10:00	116	239	742	1,217	25
3	10:00 - 12:00	108	296	870	2,106	33
4	12:00 - 14:00	69	215	659	1,700	10
5	14:00 - 16:00	164	259	506	1,348	27
6	16:00 - 18:00	125	212	453	2,743	17
TOTAL		**620**	**1,363**	**3,619**	**10,159**	**131**

Figure (1) Traffic Intensity for the Sample Place of 35th x 62nd Street



Source: Field Survey conducted on 15-12-2012.

Note- IC = Incoming Vehicle, OG = Outgoing Vehicle

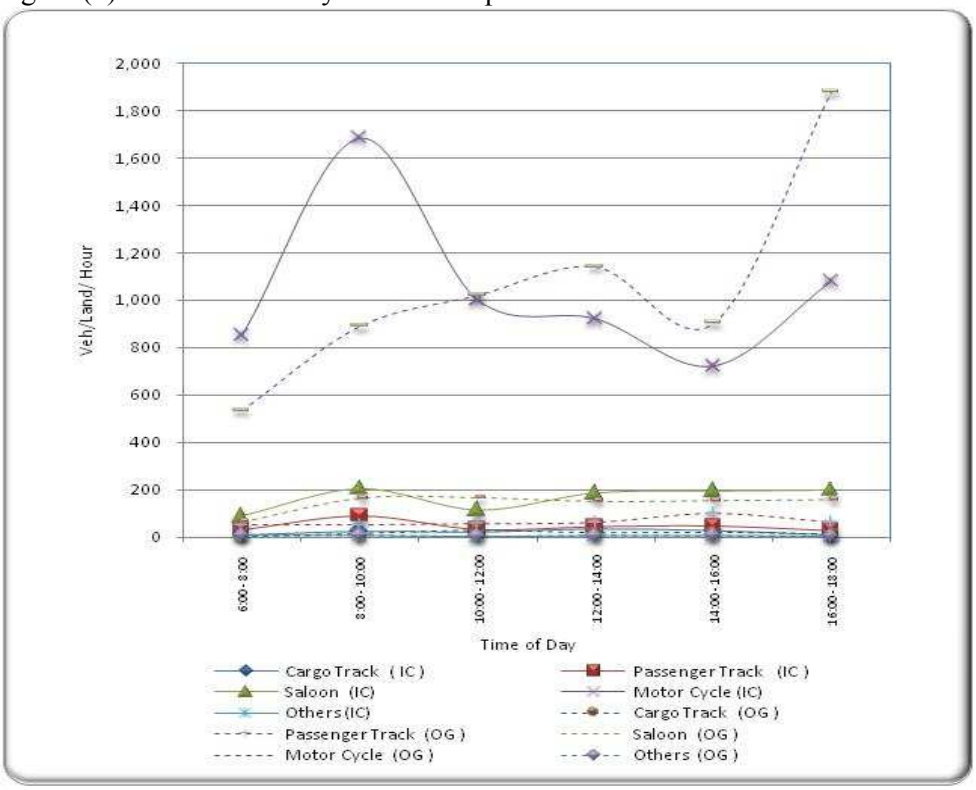
Table 2 (a) Number of Vehicle incoming to Mandalay City at Sample Place: 19th and 66th Street

No	Time Interval	Number of Incoming				
		Cargo Track (CT)	Passenger Track (PT)	Saloon (S)	Motor Cycle (MC)	Others (Os)
1	6:00 - 8:00	10	28	87	850	9
2	8:00 - 10:00	26	88	203	1,686	7
3	10:00 - 12:00	23	30	112	1,000	1
4	12:00 - 14:00	36	42	185	920	6
5	14:00 - 16:00	29	45	193	720	7
6	16:00 - 18:00	11	25	197	1,080	2
TOTAL		**135**	**258**	**977**	**6,256**	**32**

Table 2 (b) Number of Vehicle Outgoing from Mandalay City at Sample Place: 19th and 66th Street

No	Time Interval	Number of Outgoing				
		Cargo Track (CT)	Passenger Track (PT)	Saloon (S)	Motor Cycle (MC)	Others (Os)
1	6:00 - 8:00	4	50	65	534	6
2	8:00 - 10:00	17	51	163	890	8
3	10:00 - 12:00	32	55	165	1,020	5
4	12:00 - 14:00	21	61	150	1,140	7
5	14:00 - 16:00	23	100	153	903	6
6	16:00 - 18:00	15	62	157	1,880	5
TOTAL		**112**	**379**	**853**	**6,367**	**37**

Figure (2) Traffic Intensity for the Sample Place of 19th and 66th Street



Source: Field Survey conducted on 15-12-2012.
Note- IC = Incoming Vehicle, OG = Outgoing Vehicle

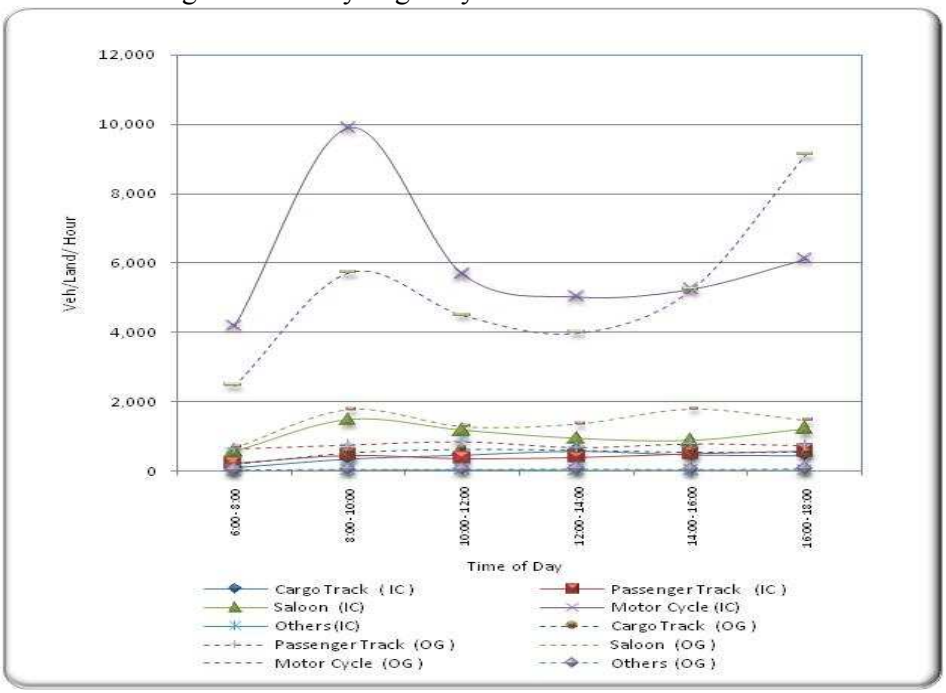
Table 3 (a) Number of Vehicle incoming to Mandalay City at Sample Place: Theikpan Road and 78th Road

No	Time Interval	Number of Incoming				
		Cargo Track (CT)	Passenger Track (PT)	Saloon (S)	Motor Cycle (MC)	Others (Os)
1	6:00 - 8:00	120	228	576	4,184	7
2	8:00 - 10:00	368	458	1,484	9,893	31
3	10:00 - 12:00	481	361	1,175	5,681	41
4	12:00 - 14:00	594	398	945	5,030	32
5	14:00 - 16:00	488	510	885	5,255	30
6	16:00 - 18:00	466	582	1,219	6,120	26
TOTAL		**2,517**	**2,537**	**6,284**	**36,163**	**167**

Table 3 (b) Number of Vehicle Outgoing from Mandalay City at Sample Place: Theikpan Road and 78th Road

No	Time Interval	Number of Outgoing				
		Cargo Track (CT)	Passenger Track (PT)	Saloon (S)	Motor Cycle (MC)	Others (Os)
1	6:00 - 8:00	203	634	687	2,470	40
2	8:00 - 10:00	531	748	1,778	5,725	55
3	10:00 - 12:00	629	844	1,290	4,495	51
4	12:00 - 14:00	600	675	1,365	3,990	63
5	14:00 - 16:00	550	780	1,790	5,243	49
6	16:00 - 18:00	549	730	1,467	9,123	69
TOTAL		**3,062**	**4,411**	**8,377**	**31,046**	**327**

Figure (3) Traffic Intensity for the Sample Place of Theikpan Road and Yangon-Mandalay Highway



Source: Field Survey conducted on 15-12-2012.

Note- IC = Incoming Vehicle, OG = Outgoing Vehicle

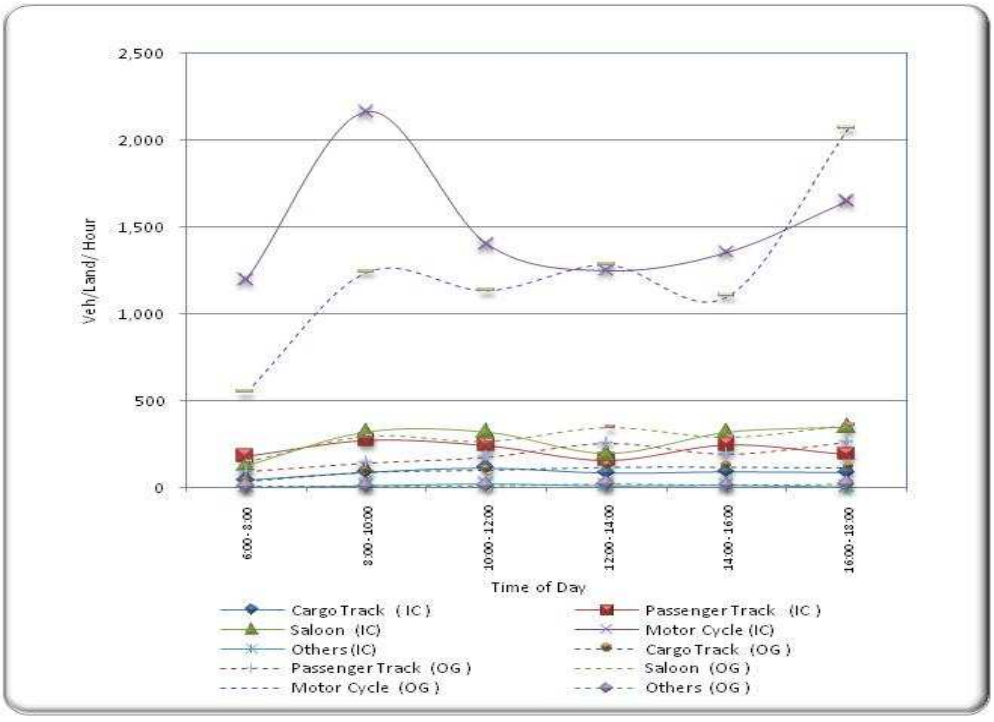
Table 4 (a) Number of Vehicle incoming to Mandalay City at Sample Place: Kandawgyi Circular Road and Sagaing-Mandalay Road

No	Time Interval	Number of Incoming				
		Cargo Track (CT)	Passenger Track (PT)	Saloon (S)	Motor Cycle (MC)	Others (Os)
1	6:00 - 8:00	42	183	127	1,196	2
2	8:00 - 10:00	90	271	321	2,162	11
3	10:00 - 12:00	115	242	320	1,400	21
4	12:00 - 14:00	85	160	197	1,247	11
5	14:00 - 16:00	93	246	320	1,353	14
6	16:00 - 18:00	88	192	349	1,648	5
TOTAL		**513**	**1,294**	**1,634**	**9,006**	**64**

Table 4 (b) Number of Vehicle Outgoing from Mandalay City at Sample Place: Kandawgyi Circular Road and Sagaing-Mandalay Road

No	Time Interval	Number of Outgoing				
		Cargo Track (CT)	Passenger Track (PT)	Saloon (S)	Motor Cycle (MC)	Others (Os)
1	6:00 - 8:00	37	93	147	550	7
2	8:00 - 10:00	91	143	295	1,241	10
3	10:00 - 12:00	104	176	265	1,135	10
4	12:00 - 14:00	121	257	345	1,284	21
5	14:00 - 16:00	122	194	289	1,102	14
6	16:00 - 18:00	118	263	359	2,068	20
TOTAL		**593**	**1,126**	**1,700**	**7,380**	**82**

Figure (4) Traffic Intensity for the Sample Place of Kandawgyi Circular Road and Sagaing-Mandalay Road



Source: Field Survey conducted on 22-12-2012.

Note- IC = Incoming Vehicle, OG = Outgoing Vehicle

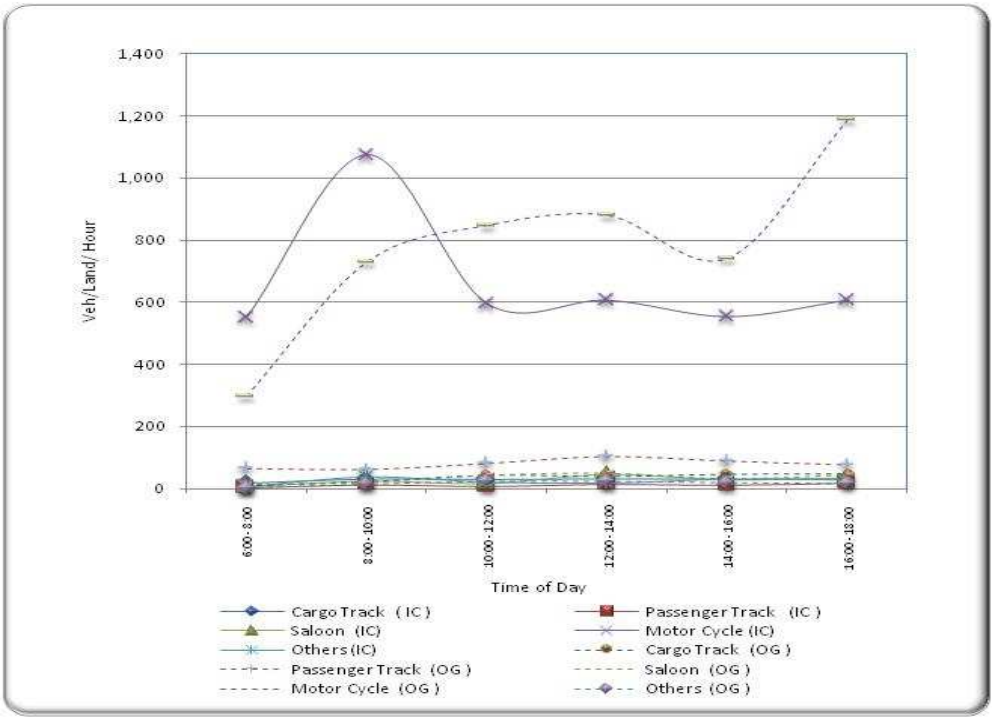
Table 5 (a) Number of Vehicle incoming to Mandalay City at Sample Place: Kandawgyi Circular Road and 86th Street

No	Time Interval	Number of Incoming				
		Cargo Track (CT)	Passenger Track (PT)	Saloon (S)	Motor Cycle (MC)	Others (Os)
1	6:00 - 8:00	19	3	7	550	7
2	8:00 - 10:00	32	13	25	1,073	37
3	10:00 - 12:00	31	8	18	595	21
4	12:00 - 14:00	33	15	47	606	18
5	14:00 - 16:00	32	12	30	553	30
6	16:00 - 18:00	33	19	35	606	28
TOTAL		**180**	**70**	**162**	**3,983**	**141**

Table 5 (b) Number of Vehicle Outgoing from Mandalay City at Sample Place: Kandawgyi Circular Road and 86th Street

No	Time Interval	Number of Outgoing				
		Cargo Track (CT)	Passenger Track (PT)	Saloon (S)	Motor Cycle (MC)	Others (Os)
1	6:00 - 8:00	11	65	13	296	3
2	8:00 - 10:00	23	62	20	728	15
3	10:00 - 12:00	43	82	43	846	24
4	12:00 - 14:00	39	105	50	878	24
5	14:00 - 16:00	46	90	32	740	20
6	16:00 - 18:00	47	77	44	1,187	17
TOTAL		**209**	**481**	**202**	**4,675**	**103**

Figure (5) Traffic Intensity for the Sample Place of Kandawgyi Circular Road and 86th Street



Source: Field Survey conducted on 22-12-2012.

Note- IC = Incoming Vehicle, OG = Outgoing Vehicle

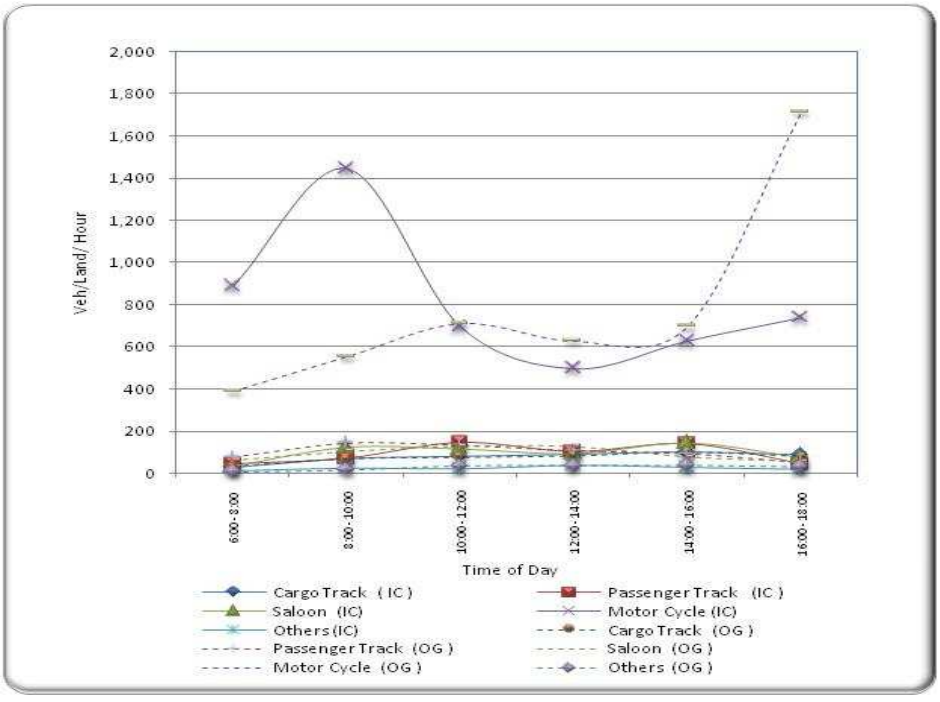
Table 6 (a) Number of Vehicle incoming to Mandalay City at Sample Place: City Circular Road and Mandalay-Mogok Road

No	Time Interval	Number of Incoming				
		Cargo Track (CT)	Passenger Track (PT)	Saloon (S)	Motor Cycle (MC)	Others (Os)
1	6:00 - 8:00	31	43	33	890	13
2	8:00 - 10:00	70	71	123	1,447	25
3	10:00 - 12:00	80	147	115	698	22
4	12:00 - 14:00	89	103	93	498	37
5	14:00 - 16:00	99	141	143	630	28
6	16:00 - 18:00	87	44	74	740	20
TOTAL		**456**	**549**	**581**	**4,903**	**145**

Table 6 (b) Number of Vehicle Outgoing from Mandalay City at Sample Place: City Circular Road and Mandalay-Mogok Road

No	Time Interval	Number of Outgoing				
		Cargo Track (CT)	Passenger Track (PT)	Saloon (S)	Motor Cycle (MC)	Others (Os)
1	6:00 - 8:00	33	79	62	390	9
2	8:00 - 10:00	68	146	104	554	17
3	10:00 - 12:00	75	136	129	712	35
4	12:00 - 14:00	82	110	128	628	36
5	14:00 - 16:00	100	96	78	699	37
6	16:00 - 18:00	79	53	56	1,715	31
TOTAL		**437**	**620**	**557**	**4,698**	**165**

Figure (6) Traffic Intensity for the Sample Place of City Circular Road and Mandalay-Mogok Road



Source: Field Survey conducted on 27-12-2012.
Note- IC = Incoming Vehicle, OG = Outgoing Vehicle