



Capacity Analysis of Roads Network at Sheraton Area, Cairo, Egypt

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Abstract: This paper aims to evaluate the current traffic volume and level of service (LOS) of roads network at Sheraton area, Cairo. Due to the annual increase in traffic volume on roads, it is very important to measure traffic volume and in turn estimate the level of service (LOS) of roads especially those leading to new developed areas in Cairo. This study concerns with studying traffic flow characteristics of newly developed area in Sheraton, Heliopolis, Cairo. The area is assigned for different human activities as tourism recreation centers, housing area, and malls. Approach roads leading to this area are; Autostrad Road, 6th of October Street and Abdel Hameed Badawy Street. The traffic count study was performed on a week day (Thursday) by ten counting workers. Data collected from the field were used to calculate traffic flow characteristics and to determine level of service according to the Egyptian Code of Practice and the Highway Capacity Manual. The study provides important guidelines for traffic flow characteristics near Autostrad Road. In addition, it emphasizes the importance of conducting traffic studies before any new constructions especially for existed level of service D.

Keywords: Roads, traffic study, traffic characteristics.

1. Introduction

This study was conducted to evaluate the current traffic flow characteristics of roads network leading to the new developed area in Sheraton, Heliopolis, Cairo. The study includes the measurement of actual traffic volumes, peak hour factors, peak hour volumes, and the determination of LOS according to the Egyptian code of practice [1]. Based on this study it will be easy to determine the impact of new human activities generated and attracted by the newly developed area and in turn recommendation will be developed to overcome traffic flow problems on roads network in this area. As shown in Fig. 1, the new assigned area locates on Autostrad Road from north and east sides. From the west side, 6th of October Street is the boundary of the studied area while the south boundary is a local road leading to Abdel Hameed Badawy Street.

Autostrad Road in this location composed of six lanes highway divided by a median of four to six meters width. Traffic carriage lanes width is varied from 11-12 m. also there is a side walk of three to four meters for each side. 6th of October Street is about 700 m long connecting

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Autostrad Road to Abdel Hameed Badawy Street. The road is composed of six lanes of 11-12 m width for each direction. The road is divided by 2-3 m median. Also there are two sidewalks each of 4-6 m width. In addition there is a service road of 10 m width parallel to the main road.

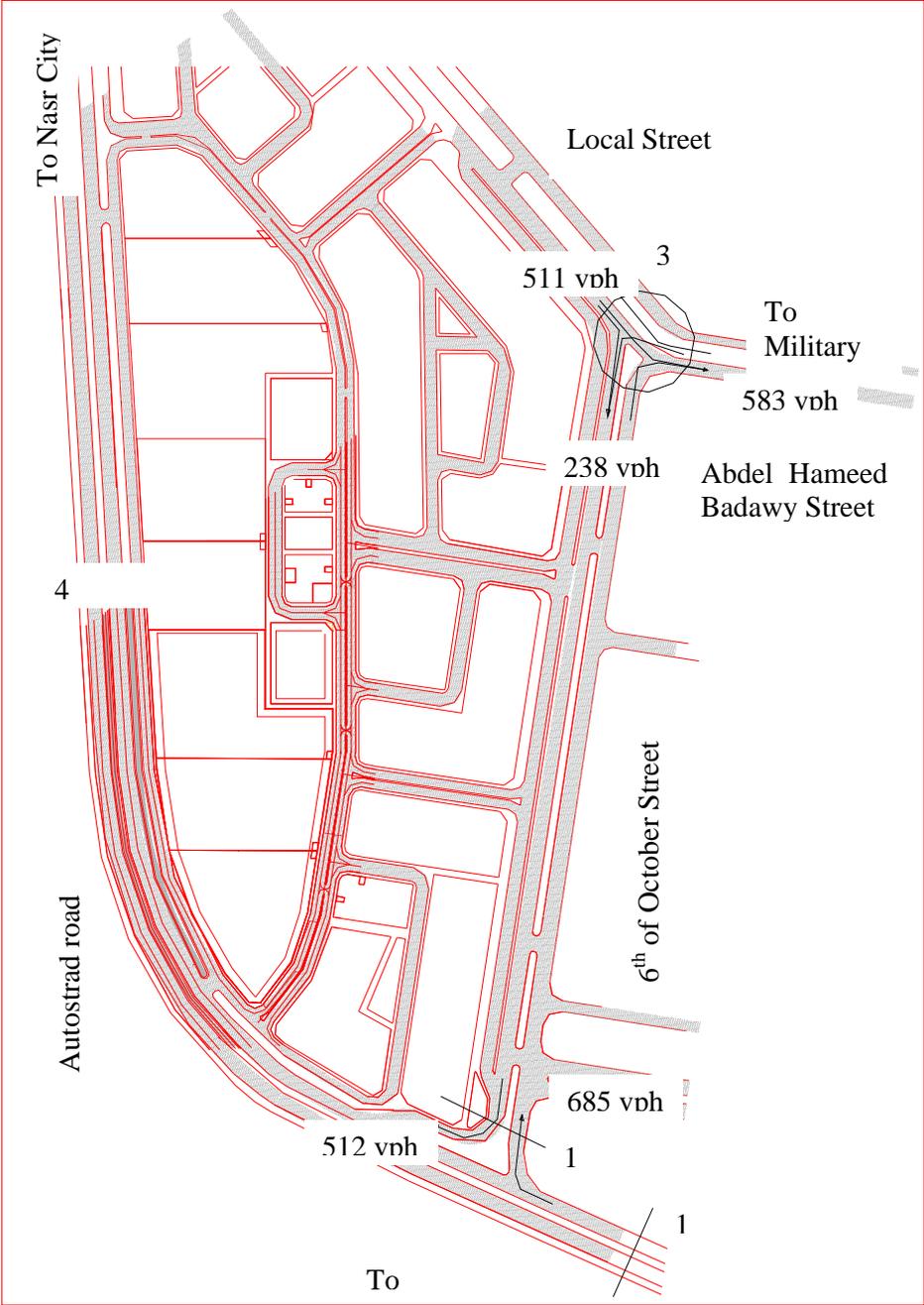


Fig. 1 Site Location, Distribution of Counting Workers, and Traffic Volume at Intersections

Abdel Hameed Badawy Street is composed of 6-lanes divider road. Traffic carriage lanes width is 11 m for each direction and the median width is 9 m serves the Metro line of Heliopolis. Side walk width is varied between 6 to 15 m each side of the road. The Local street connecting Abdel Hameed Badawy Street to the Autostrad Road is composed of 6 lanes of 11-12 m width each direction. The road is divided by 4 m width median. In addition, there are two sidewalks each of 4 m width.

2. Methodology

To study traffic characteristics of roads network, manual counting was conducted. Traffic counting was performed for 16 hours starting at 7:00 am and ending at 11:00 pm in a working day (Tuesday). The counting team consisted of 10 well trained workers as shown in Fig. 1;

Four workers on Autostrad Road (2 / each direction)

One worker at intersection of Autostrad Road and 6th of October Street.

One worker at U-Turn on Autostrad Road.

Three workers at intersection of 6th of October street and Abdel Hameed Badawy Street.

One standby worker.

3. Results of Field Investigation

3.1. Autostrad Road

Fig. 2 illustrates the variation of traffic volume of Autostrad Road in the direction of Sheraton. The peak hour volume (PHV) was found to be 2993 vehicle per hour (vph). This traffic volume was measured from 10:00 am to 11:00 am. Fig. 3 shows the traffic composition at rush hour in Sheraton direction. The figure shows that private cars and taxi represent 83.7% of traffic while all other vehicle types represent 16.3% of traffic. Similarly, Fig. 4 and Fig. 5 illustrate variation of traffic volume and traffic composition at rush hour for Autostrad in Nasr City direction. The PHV was found to be 2471 vph and the rush hour was from 2:00 pm to 3:00 pm. Passenger cars (private and taxi) represent 73.9% while all other vehicles represent 25.1% of traffic volume on that direction.

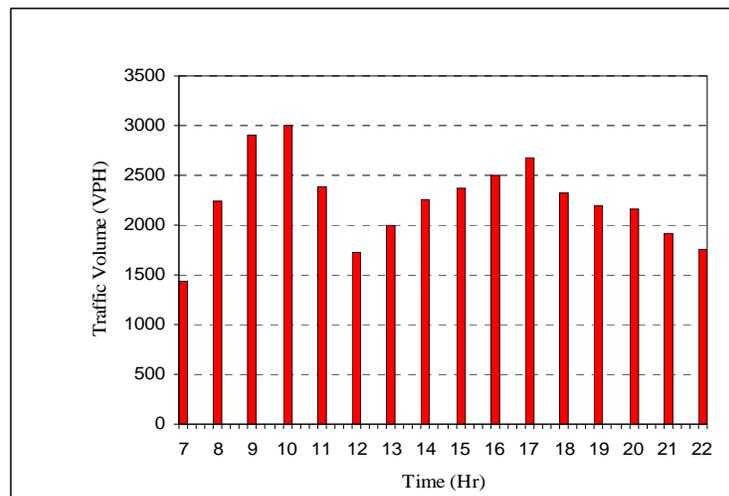


Fig. 2. Hourly variation of Traffic Volume, Autostrad Road, to Sheraton

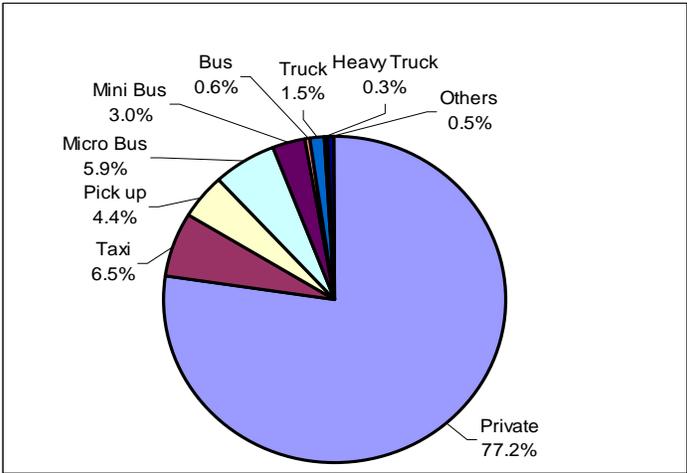


Fig. 3. Traffic composition, Autostrad, to Sheraton

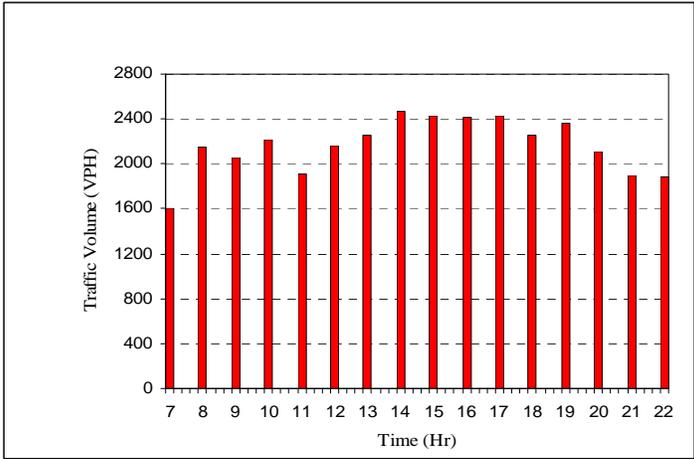


Fig. 4. Hourly variation of traffic volume, Autostrad, to Nasr City

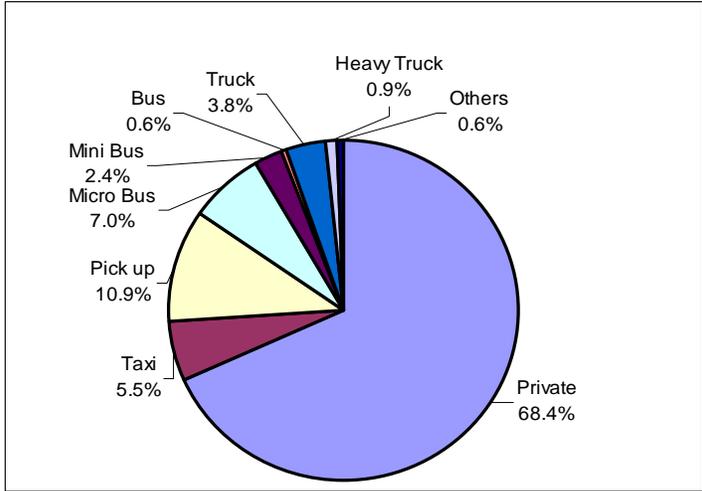


Fig. 5. Traffic composition, Autostrad Road, to Nasr City

3.2. Abdel Hameed Badawy Street

Fig. 6 illustrates the variation of traffic volume on Abdel Hameed Badawy Street in the direction coming from the Military Academy. The PHV was found to be 797 vph. This traffic volume was measured from 9:00 am to 10:00 am. Fig. 7 shows the traffic composition at rush hour in that direction. The figure shows that private cars and taxi represent 85.3% of traffic while all other vehicle types represent 14.7% of traffic. Similarly, Fig. 8 and Fig. 9 illustrate variation of traffic volume and traffic composition at rush hour in Military Academy direction. The PHV was found to be 705 vph and the rush hour was from 2:00 pm to 3:00 pm. Passenger cars (private and taxi) represent 86% while all other vehicles represent 14% of traffic volume on that direction.

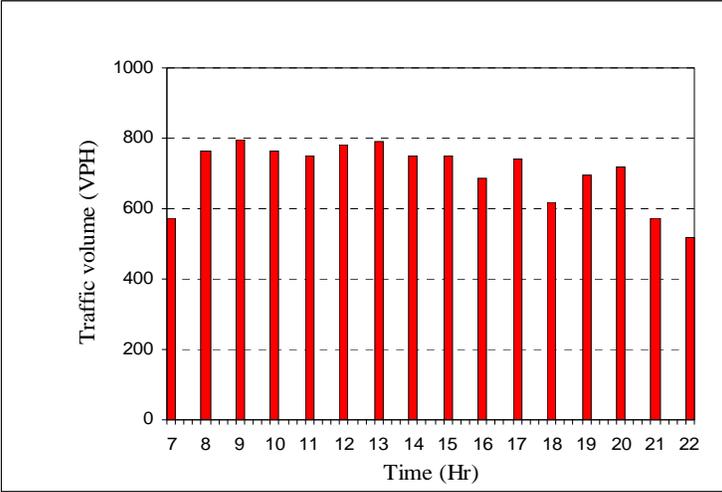


Fig. 6. Hourly Variation of Traffic Volume, Abdel Hameed Badawy Street, from Military Academy

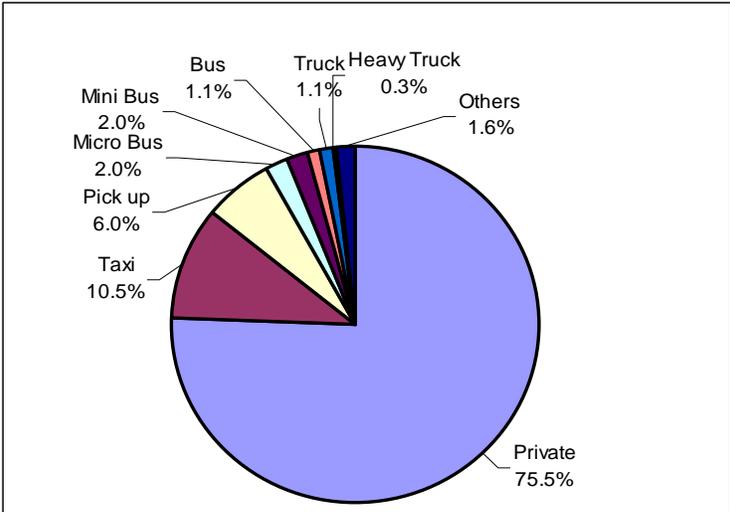


Fig. 7. Traffic composition, Abdel Hameed Badawy Street, from Military Academy

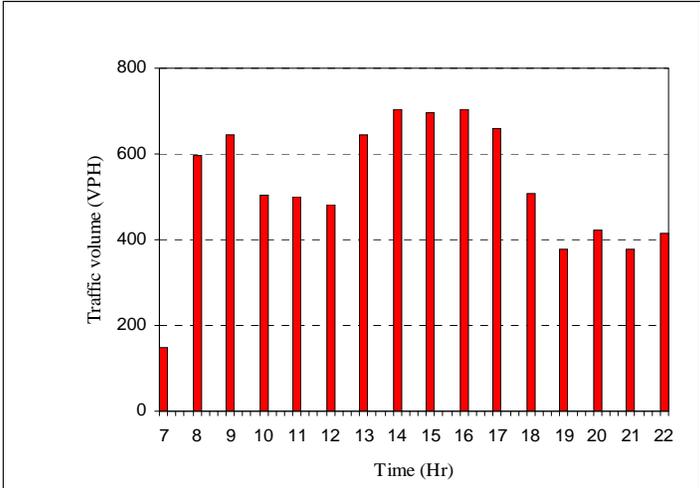


Fig. 8. Hourly Variation of Traffic Volume, Abdel Hameed Badawy Street, to Military Academy

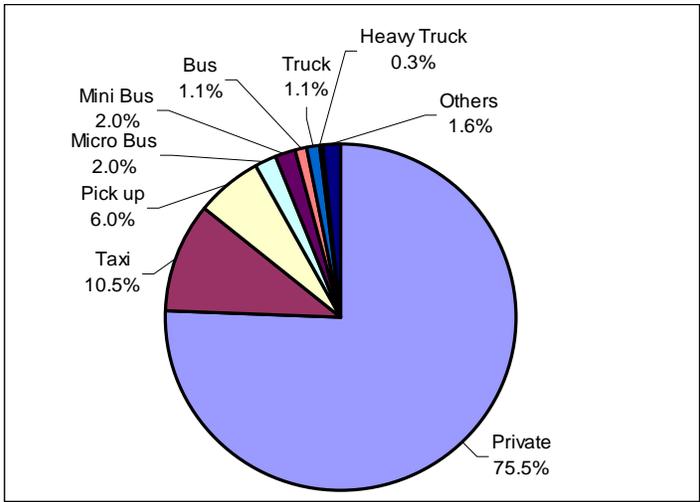


Fig. 9. Traffic Composition, Abdel Hameed Badawy Street, to Military Academy

3.3. 6th of October Street

Fig. 10 shows the hourly variation of traffic volume on 6th of October Street for Autostrad Road direction. It is noticed that the rush hour exists from 3:00 pm to 4:00 pm where PHV was found to be 591 vph. Traffic composition on that direction is illustrated in Fig. 11 where the percent of passenger cars is 82.4% and all other vehicle types represent 17.6% of traffic volume. Fig. 12 and Fig. 13 present the hourly variation of traffic volume and traffic composition for Sheraton direction, respectively. These figures show that PHV was 584 vph and it occurred from 4:00 pm to 5:00 pm. In addition, the percent of passenger cars was 84.6% of traffic volume.

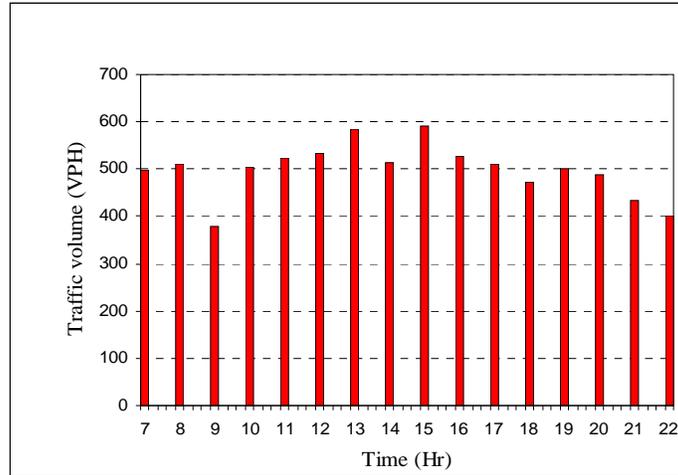


Fig. 10. Hourly Variation of Traffic volume, 6th of October Street, to Autostrad Road

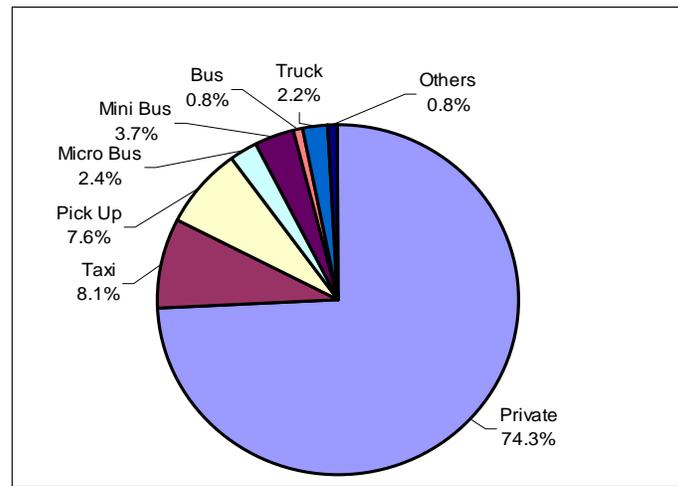


Fig. 11. Traffic Composition, 6th of October Street, to Autostrad Road

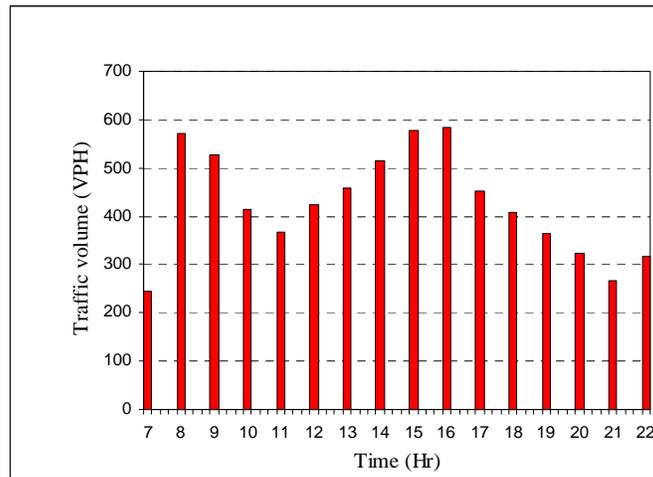


Fig. 12. Hourly variation of traffic volume, 6th of October, to Sheraton

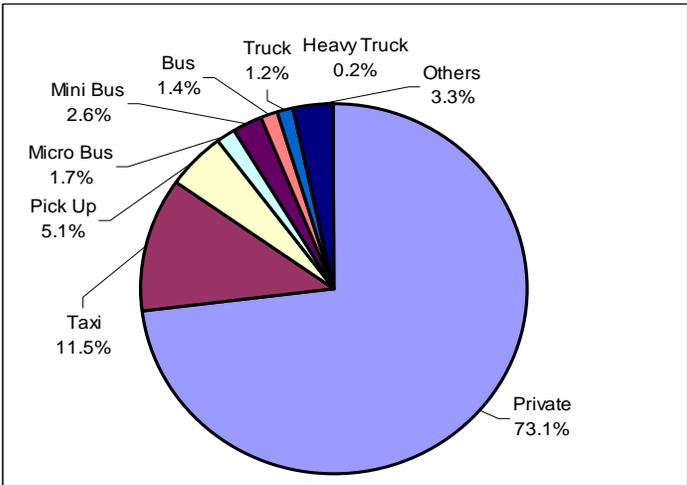


Fig. 13. Traffic Composition, 6th of October Street, to Sheraton

3.4. Local Street Connecting Autostrad to Abdel Hameed Badawy Street

The hourly variations of traffic volume and traffic composition for both directions are illustrated in Fig. 14 to Fig. 17. The PHV were 138 vph and 501 vph for Abdel Hameed Badawy direction and Autostrad direction, respectively. These values of traffic volumes were observed at 2:00-3:00 pm and 8:00-9:00 am. The percent of passenger cars were found to be 86.9% and 84.1% for both directions.

3.5. U-Turn on Autostrad

Fig. 18 and Fig.19 show the variation of traffic volume through the day and traffic composition, respectively. The rush hour was observed at 8:00-9:00 am and the PHV was found to be 1100 vph. It was anticipated that the percent of passenger cars was increased at U-turn as public transportation on Autostrad Road do not enter Sheraton area. The percent of passenger cars was 91.4% on that U-turn.

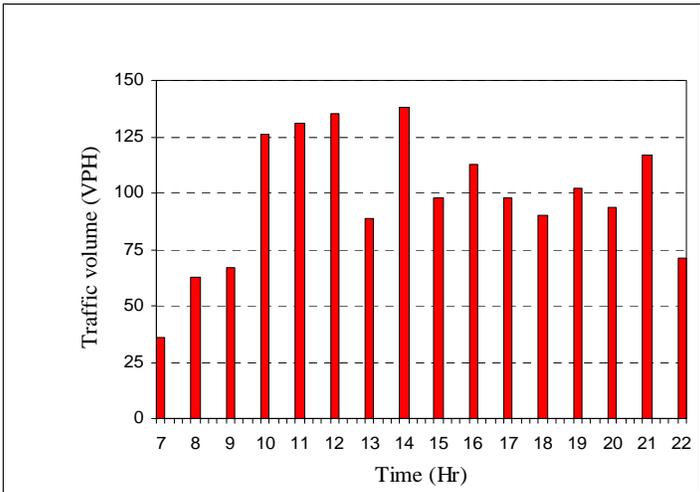


Fig. 14. Hourly variation of Traffic Volume, Local Street, to Abdel Hameed Badawy Street

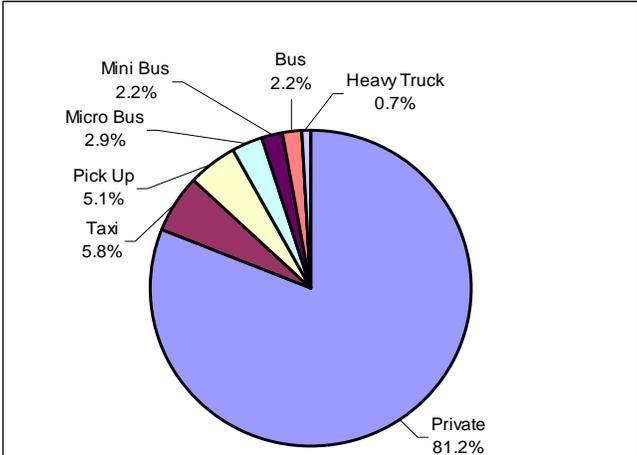


Fig. 15. Traffic composition, Local Street, to Abdel Hameed Badawy Street

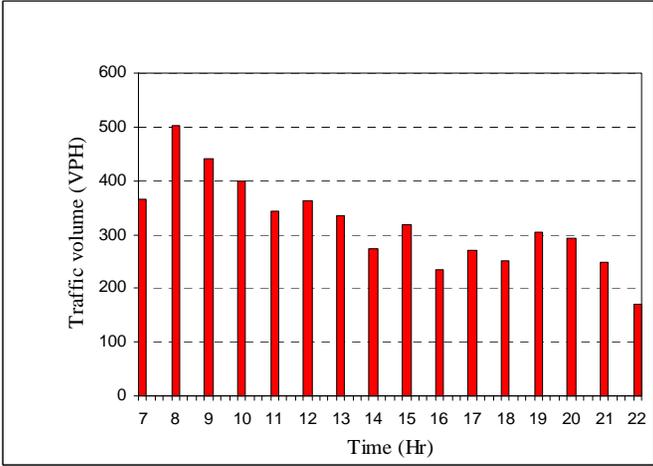


Fig. 16. Hourly Variation of Traffic Volume, Local Street, to Autostrad Road

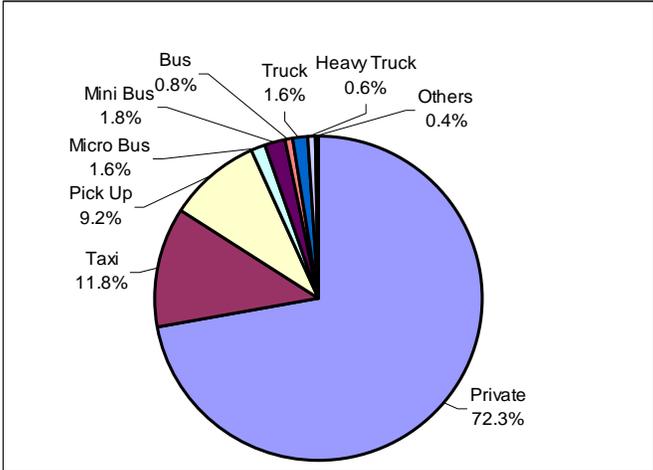


Fig. 17. Traffic Composition, Local Street, to Autostrad Road

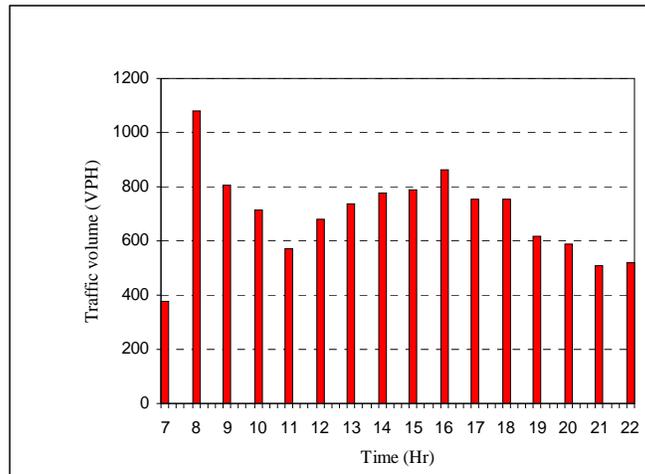


Fig. 18. Hourly Variation of Traffic Volume, U-Turn on Autostrad Road

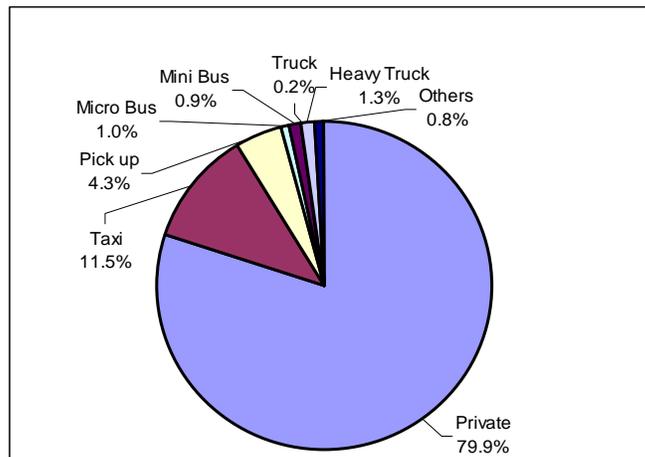


Fig. 19. Traffic Composition, U-Turn on Autostrad Road

Fig. 1 also shows the calculated traffic volumes at intersections of 6th of October Street with Abdel Hameed Badway Street and Autostrad Road, respectively. Maximum hourly volumes were observed 8:00-9:00 am for both intersections.

4. Determination of Level of Service

To evaluate the current quality of traffic flow, level of service (LOS) was determined for each road individually as a function of traffic volume to capacity (V/C) ratio. The following equation was used to determine LOS according to the Egyptian Code of Practice [1, 2, 3].

$$SV_i = C_j \times (V/C) \times N \times W \times T \tag{1}$$

where:

N = number of lanes per direction,
 SV_i = service flow at LOS I,

C_j = capacity of lane (1900 pcplph),
 $(V/C)_i$ = ratio of volume to capacity at LOS I,
 W = correction factor for lane and shoulder width, and
 T = correction factor for heavy vehicles (buses and trucks)

First, peak hour factor (PHF) was calculated as PHV divided by four times the maximum volume during 15 minutes and service flow SV_i was calculated as; $SV_i = PHV/PHF$. Equation (1) was used to obtain (V/C) ratios, and then LOS was determined [1, 2, 3]. Table 1 presents the traffic flow characteristics for all roads under study, the table shows that Abdel Hameed Badawy Street and 6th of October Street have excellent LOS and consequently the intersection of these roads has also an excellent LOS. However, Autostrad Road has LOS (D/C) in both directions which may put some constraints on suggested human activities proposed for the studied area.

Table 1. Traffic Flow Characteristics and Level of Service.

Road	Direction	Heavy Vehicles (%)	PHF (%)	V/C	LOS
Autostrad	to Sheraton	15.7	0.83	0.690	D
	to Nasr City	25.6	0.91	0.554	C
Abdel Hameed Badawy	from Military Academy	14.6	0.93	0.164	A
	to Military Academy	10.7	0.88	0.150	A
6 th of October	from Sheraton	12.1	0.90	0.128	A
	to Sheraton	17.6	0.90	0.123	A
Local Street	from Autostard	13.1	0.72	0.036	A
	to Autostrad	15.6	0.84	0.115	A

5. Conclusions

Based on the field and analytical work conducted in this paper, the observations and results support the following conclusions:

The study provides important guidelines for traffic studies at newly developed areas near Autostrad Road.

The study emphasizes the importance of conducting traffic studies to evaluate the impact of new activities on road network especially for roads of current LOS (D) to avoid future traffic congestion.

Traffic flow is steady as indicated by higher values of PHF ranges for most cases from 0.83% to 0.93%.

The variation of traffic volume during day hours is slight especially for Autostrad Road and Abdel Hameed Badawy Street. It means that there is more than one rush hour on these roads during the day time.

The percent of passenger cars varies between 73.9% and 86.9% of traffic volume. The percent of heavy vehicles varies between 10.7% and 25.6% of traffic volume.

6. References

- [1] Egyptian Code of Practice for Urban and Rural Roads, Part II: Traffic Studies, First Edition, Cairo, Egypt, 1998.
- [2] American Association of State Highway and Transportation Officials, Highway Capacity Manual, Washington, D.C., USA, 1985.
- [3] Garber N. J. and Hoel L. A., "Traffic and Highway Engineering", Third Edition. The Wadsworth Group, Books/Close, Thomson Learning Inc., CA, USA, 2002.