Evaluation of Traffic Congestion and Level of Service at Major Intersections in Lefkoşa, Northern Cyprus

Hüseyin Gökçekuş, Youssef Kassem, Gazi Tallawi

Abstract: ***Among the problems, facing urban areas at the level of arterial roads is the high volume of traffic volumes, which lead to difficulties in operating traffic and thus the emergence of so-called congestion or traffic congestion. Through this study, we have collected spatial data on traffic volumes using the peak hour imaging method, and by applying the service level scale, which is a real indicator of congestion, as well as the SIDRA software as a tool for accurate assessment of road intersections, Roads and intersections are the mirrors of civilization in any country. The quality, the number of roads, and the flow of traffic at intersections measure the development in countries. The intersection is defined as the area resulting from the confluence of two or more roads with each other used to facilitate changes in traffic direction. In this study, Level of Service (LOS) and Measures of Effectiveness (MOEs) of the three major intersections in Lefkoşa, Northern Cyprus was evaluated using SIDRA software. The proposed intersections could be used as a viable alternative to cut down vehicular emissions, making intersections more environmentally friendly and reducing traffic issues. It is found that It is observed that Çangar roundabout has the highest number of vehicles passing it compared to other roundabout and intersection. Moreover, the results indicate that It is noticed that the fuel consumptions have reduced rapidly with an average percentage of about 75% for all roundabouts. Overall, it can be concluded that the possible solutions can be used to solve the traffic congestion in Lefkoşa, Northern Cyprus*.*

Keywords: Level of Service (LOS); Measures of Effectiveness (MOEs), SIDRA Software, Traffic Congestion.

I. INTRODUCTION

The activities and functions that the city provides to its inhabitants are as the container carrying these activities in the form of the uses of different lands with all the types of patterns and the focus of urban studies at all levels on the achievement of the structure of urban integrated aspects and dimensions, both in terms of housing and places of entertainment in addition to different areas of work [1, 2]. The city's road network represents the arteries that link these functions and activities to each other in a way that achieves the highest traffic efficiency, record time for trips, and the highest energy of comfort and security in motion and in an economical manner, that suits the characteristics of the city's population.

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From the common expression that the city is a living organism that grows and develops, the roads represent the arteries in that object. Traffic represents the flowing blood [3-6]. To ensure the safety of road traffic, standard specifications must be available for the elements of the integrated group, the road, the vehicle, and the human element [7-9]. Moreover, the development of the network of roads and traffic imposed on the sector could be improved the levels of service and comfort for the users of the road [10-12]. Workings on the development of urban roads are among the challenges faced by cities in the world because of its important role in linking the various urban areas [13]. In addition, the volumes of traffic in different locations on the road network is important for the planning and operation of traffic as each road has a specific capacity to absorb a certain traffic volume [14,15].
The importance of this study comes because the city of Lefkoşa is the link between the major cities in Northern Cyprus so it has become of cultural and economic importance and civilization that the importance of increased the number of trips through the roads and intersection. Therefore, the study decided to analyze these three intersections in order to upgrade the level of service and thus provide the necessary flow in the passage of users. A flowchart is given in Figure 1 to illustrate the analysis procedure of this study.

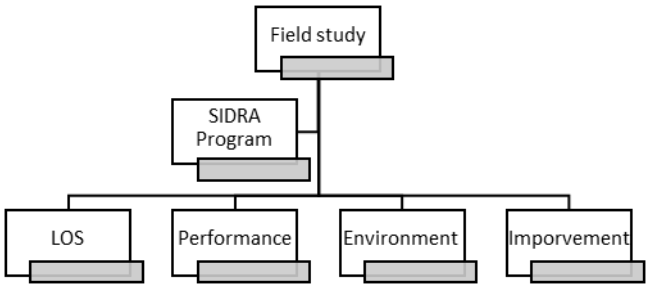

Figure 1. Analysis procedure of this study.

II. STUDY AREA

Figure 2 presents the major intersections; namely, Çangar and Terminal and YeniŞehir intersections in Lefkoşa in Northern Cyprus .In this study, video camera with high stage capacity an long-life battery was used to collect the data .Groups of people distributed in the selected areas were recorded in the field data. The time of recording started from off-peak (7:30 am – 8:30 am) until another off-peak(4:30 pm - 5:30 pm) and is evaluated every 15 minutes. Moreover, Figure 3 shows the major intersection in the capital

city in Northern Cyprus. The data collection is the primary and most important step for research. Therefore, the following steps describes the procedure for collected the data from each roundabout.

1). Recording the geometric of the connected roads such as width, road length, roundabout diameter for each intersection.
2). Calculating the volume of the traffic during the peak periods in the morning and in the evening.
3). Monitoring the flow for each line connected with the roundabout.

Figure 2. Locations of the major intersections

III. DATA ANALYSIS

The SIDRA program is specialized in the analysis of the road intersections, the program deals with the road sections individually and analyzes it as the given data.the input data for each intersection are

1). Movement definition
2). Lane geometry
3). Lane movements
4). Roundabout if any
5). Pedestrians
6). Volumes
7). Vehicle movement data

3.1 Intersection

The intersection is the site of a network to be analyzed. In this stage we define:

a). The road names
b). The section direction
c). Lane geometry
d). Lane length as an approach distance

Figure 3. Roundabout; (a) Çangar) ,b (Terminal and (c) YeniŞehir intersection

3.2 Movement definition

The type of vehicle can be selected or a compound as the user defines it. In this project, we will consider the light vehicle as our relative. In this work, all vehicles have been changed into the light vehicle bymultiplying the

1). car with factor 1
2). van with factor 2.5
3). bus and truck with factor 3
4). motorcycle with factor 1.25

In addition, the allowed movement for each lane should be defined.

3.3 Lane geometry and Lane movement

The geometric properties for the roads are assigned in lane geometry. The lane width, median width, the type of lane, and the movement of the lane as giveaway can be assigned.The movement of the vehicle throws the intersection from the entry lane to the intersection and the lane which the vehicle goes throw it after it leaves the section is defined in lane.

3.4 Roundabout, volume and vehicle movement data

The parameter for the roundabout is shown in Figure 4. generally, the volume of the traffic is changed to be in means of light vehicle firstly, by using the factors. The volume of the traffic after factorizing is assigned in each lane and for each movement whether the direction to left, straight, right or U-turn. In this study, the data for volume is selected to be during the peak flow period, which is 15 min. For vehicle movement data, the most important data in this

phase are the vehicles speed at the moment of entering the intersection and the speed of vehicles when they leave the intersection.

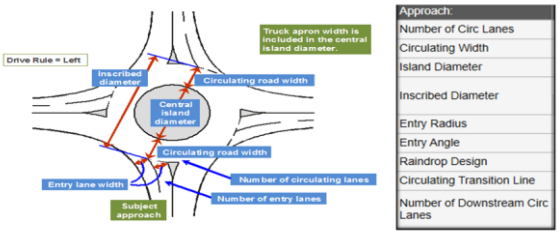

Figure 4. Parameter for the roundabout.

IV. RESULT AND DISCUSSION

The output results of SIDRA for the most congested intersections are discussed in this section. Figure 2 shows the layout of the most three congested intersections in Lefkoşa obtained by SIDRA computer program. The geometries of each roundabout before improvement using SIDRA program are shown in Figures 5-7.

Figure 5. The geometry of the Çangar roundabout.

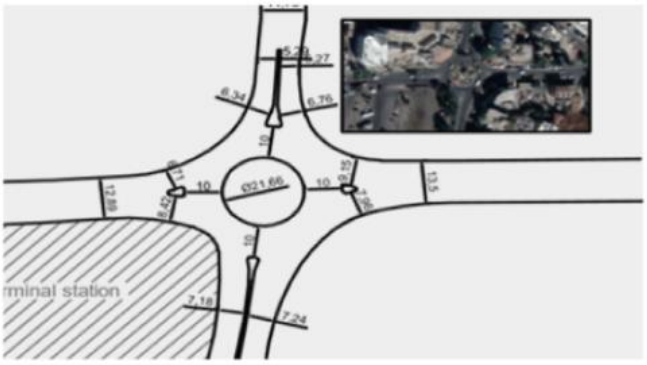

Figure 6. The geometry of the Terminal roundabout.

Figure 7. The geometry of the YeniŞehir intersection.

As mention previously, the data were collected in the morning and evening period. Tables 1-3 summarize the number of the vehicle for each roundabout. It is observed that Çangar roundabout has the highest number of vehicles passing it compared to other roundabout and intersection. Furthermore, it found that the highest number of vehicles occurred in the morning time at Çangar roundabout expects in Şahit Mustafa Ahmet Resa Caddasi lane. Furthermore, it is noticed that the maximum vehicles number of 1422 vehicles occurred in the morning time at Terminal roundabout as shown in Table 2. While, at Yeni Şehir intersection, the maximum vehicles number occurred in the evening time.

Table 1. Number of veichles in Çangar roundabout.

Morning Period					Evening Period				
NORTH: ŞAHIT MUSTAFA AHMET RESA CADDASI									
Phase	Cars	Van	Motorcycles	Bus & Truck	Phase	Cars	Van	Motorcycles	Bus & Truck
Left	14	5	0	1	Left	25	4	0	8
Right	93	11	0	6	Right	32	7	0	3
Straight	154	22	1	10	Straight	93	19	6	16
U-Turn	8	2	0	1	U-Turn	12	2	0	3
% Total	82.01%	12.20%	0.30%	5.49%	% Total	70.43%	13.91%	2.62%	13.04%
EAST: OZKER OZGUR CADDASI									
Phase	Cars	Van	Motorcycles	Bus & Truck	Phase	Cars	Van	Motorcycles	Bus & Truck
Left	50	7	1	4	Left	34	3	1	0
Right	21	10	0	5	Right	20	4	1	3
Straight	86	19	2	11	Straight	70	10	2	7
U-Turn	0	0	0	0	U-Turn	1	0	0	0
% Total	72.69%	16.67%	1.39%	9.26%	% Total	80.13%	10.90%	2.56%	6.41%
SOUTH: ŞAHIT MUSTAFA AHMET RESA CADDASI									
Phase	Cars	Van	Motorcycles	Bus & Truck	Phase	Cars	Van	Motorcycles	Bus & Truck
Left	17	5	0	4	Left	12	4	0	2
Right	44	12	1	2	Right	27	7	3	2
Straight	73	20	6	6	Straight	101	12	3	8
U-Turn	1	2	1	1	U-Turn	17	2	1	0
% Total	69.23%	20.00%	4.10%	6.67%	% Total	78.11%	12.44%	3.48%	5.97%
WEST: OZKER OZGUR CADDASI									
Phase	Cars	Van	Motorcycles	Bus & Truck	Phase	Cars	Van	Motorcycles	Bus & Truck
Left	45	1	1	2	Left	35	5	1	2
Right	38	2	2	2	Right	18	5	0	1
Straight	68	1	1	7	Straight	45	7	2	7
U-Turn	1	0	0	0	U-Turn	0	0	0	1
% Total	88.9%	0.023	0.023	0.064	% Total	0.760	0.132	0.023	0.085

Table 2. Number of veichles in Terminal roundabout.

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Morning Period					Evening Period				
NORTH: ŞAHIT MUSTAFA AHMET RESA CADDASI									
Phase	Cars	Van	Motorcycles	Bus & Truck	Phase	Cars	Van	Motorcycles	Bus & Truck
Left	3	2	1	1	Left	14	1	0	2
Right	127	3	2	5	Right	62	3	5	1
Straight	158	8	1	7	Straight	84	5	3	9
U-Turn	5	0	0	0	U-Turn	19	2	0	0
% Total	90.71%	4.02%	1.24%	4.02%	% Total	85.24%	5.24%	3.81%	5.71%
EAST: ATATURK CADDESI.									
Phase	Cars	Van	Motorcycles	Bus & Truck	Phase	Cars	Van	Motorcycles	Bus & Truck
Left	48	0	7	1	Left	56	4	3	1
Right	73	5	0	2	Right	38	1	2	2
Straight	46	1	3	2	Straight	43	4	3	0
U-Turn	0	0	0	0	U-Turn	4	1	0	0
% Total	88.83%	3.19%	5.32%	2.66%	% Total	87.04%	6.17%	4.94%	1.85%
SOUTH: CAZETCI KAMAL ASIK CADDESI.									
Phase	Cars	Van	Motorcycles	Bus & Truck	Phase	Cars	Van	Motorcycles	Bus & Truck
Left	45	9	1	4	Left	33	4	1	0
Right	22	1	0	0	Right	23	1	4	0
Straight	103	11	3	14	Straight	115	2	8	4
U-Turn	5	2	0	0	U-Turn	0	0	0	1
% Total	79.55%	10.45%	1.82%	8.18%	% Total	87.24%	3.57%	6.63%	2.55%
WEST: ATATURK CADDESI.									
Phase	Cars	Van	Motorcycles	Bus & Truck	Phase	Cars	Van	Motorcycles	Bus & Truck
Left	16	0	0	1	Left	10	1	3	0
Right	17	0	0	1	Right	21	1	2	3
Straight	21	2	0	3	Straight	18	0	2	1
U-Turn	0	0	0	0	U-Turn	0	0	0	0
% Total	88.52%	3.28%	0	8.20%	% Total	79.03%	3.23%	11.29%	6.45%

Table 3. Number of veichles in YeniŞehir intersection.

Morning Period					Evening Period				
NORTH: ŞEHIT ECVET YUSUF CADDESI.									
Phase	Cars	Van	Motorcycles	Bus & Truck	Phase	Cars	Van	Motorcycles	Bus & Truck
Left	49	5	7	2	Left	20	7	4	0
Right	7	0	0	1	Right	11	1	1	0
Straight	84	13	5	2	Straight	53	4	7	7
U-Turn	0	0	0	0	U-Turn	0	0	0	0
% Total	80.00%	10.29%	6.86%	2.86%	% Total	73.04%	10.43%	10.43%	6.09%
EAST: ATATURK CADDESI.									
Phase	Cars	Van	Motorcycles	Bus & Truck	Phase	Cars	Van	Motorcycles	Bus & Truck
Left	33	4	2	1	Left	13	2	1	1
Right	26	2	2	1	Right	52	3	4	4
Straight	46	7	0	2	Straight	44	3	1	7
U-Turn	0	0	0	0	U-Turn	0	0	0	0
% Total	83.33%	10.32%	3.17%	3.17%	% Total	80.74%	5.93%	4.44%	8.89%
SOUTH: ŞEHIT ECVET YUSUF CADDESI.									
Phase	Cars	Van	Motorcycles	Bus & Truck	Phase	Cars	Van	Motorcycles	Bus & Truck
Left	9	0	1	0	Left	7	0	2	0
Right	31	1	2	1	Right	32	1	2	2
Straight	94	6	7	6	Straight	93	6	7	6
U-Turn	0	0	0	0	U-Turn	0	0	0	0
% Total	84.81%	4.43%	6.33%	4.43%	% Total	83.54%	4.43%	6.96%	5.06%
WEST: ATATURK CADDESI.									
Phase	Cars	Van	Motorcycles	Bus & Truck	Phase	Cars	Van	Motorcycles	Bus & Truck
Left	8	2	0	0	Left	13	0	2	2
Right	6	0	1	1	Right	14	14	3	0
Straight	72	5	3	6	Straight	65	7	2	8
U-Turn	0	0	0	0	U-Turn	0	0	0	0
% Total	82.69%	6.73%	3.85%	6.73%	% Total	70.77%	16.15%	5.38%	7.69%

Level of Service (LOS) Method is described based on US highway capacity manual (HCM) a subjective measure used to relate the efficiency of traffic flow. LOS is utilized to dissect highway by sorting traffic flow and doling out quality levels of movement in view of execution measure like speed, density (Highway Capacity Manual HCM, 2010). LOS definitions based on delay HCM (for vehicles) is indicated in Figure 8. Existing LOS was investigated in this study using SIDRA.

Results illustrated that in the morning period, the east and north lanes of Çangar roundaboutwere F and C grades, respectively. For evening period, there were no traffic issues for Çangar roundabout. After applying the possible solution (adding a slip in high angle for north and east lanes, change in the movement of vehicles, in order not to avoid the conflicting of vehicle movements and adding one extra lane to both for north and east), the result of analysis was satisfactory after improvement for LOS as shown in Figure 9.

For Terminal roundabout, it is noticed that the north lane has a level of service F grade and D because it is the nearest road leads to city center. While the LOS for the right lane from the west movement was D in the morning period. In addition, it is found that LOS in evening period is much better compared to morning period and the LOS of north lane was C grade. The possible solution for Terminal roundabout were adding one more circulating lane to roundabout, which increase the capacity for the roundabout, constructing a bypass lane from west to north with short lane entry and improving the north lane capacity by adding a short lane from the left. Consequently, LOS is improved from grade F to B and A in north lane. LOS is also improved from grade D to B and A in west lane.

For YeniŞehir intersection, LOS of traffic signal is almost F. This may be due to geometry of the intersection, which could be considered as un-uniform geometry and the movement of vehicle which is not smooth. After applying the suitable solution that was increased the number of lane from north lane where the all movement should not have conflicted, the results is shown in Figure 9.

The four measures of effectiveness (MOEs) (CO, CO_2, NO_X and HC) used to evaluate the performance of the roundabouts and intersections are shown in Table 4. In addition, economic analysis in terms of total fuel consumptions and total cost for all the roundabouts after applying the possible solution is tabulated in Table 4.

It is noticed that the fuel consumptions have reduced rapidly with average percentage of about 75% for all roundabouts. Overall, it can be concluded that the possible solutions can be used to solve the traffic congestion in Lefkoşa, Northern Cyprus.

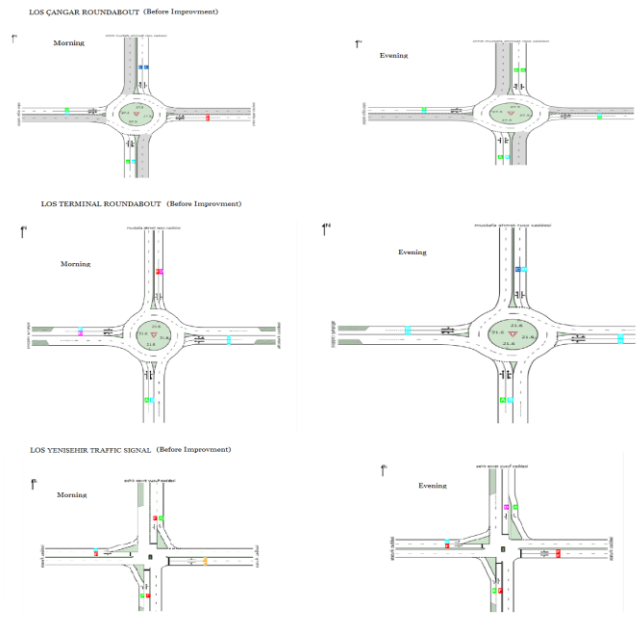
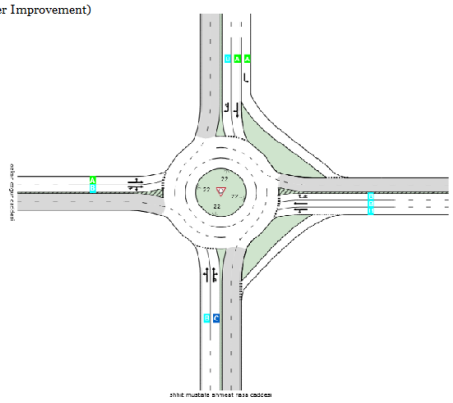
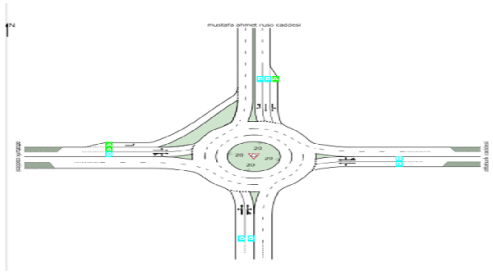


Figure 8. Details of LOS for all roundabouts before applying the possible solutions.

LOS Çangar Roundabout (After Improvement)



LOS Terminal Roundabout (After Improvement)



LOS Yenişehir Traffic Signal (After Improvement)

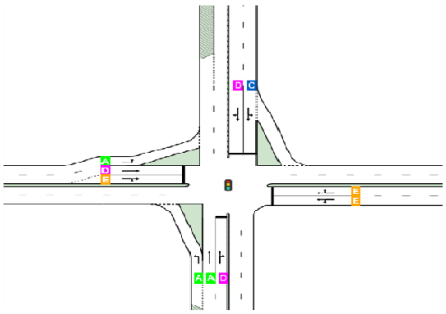


Figure 9. Details of LOS for all roundabouts after applying the possible solutions.

Table 4.MOEs and economic analysis for Çangar roundabout.

MOV ID	TURN	COST TOTAL TL/H	FUEL TOTAL L/H	CO2 TOTAL KG/H	CO TOTAL KG/H	HC TOTAL KG/H	NOX TOTAL KG/H
SOUTH: ŞAHİT MUSTAFA AHMET RESA CADDASI							
3U	U	110.2	11.5	27.1	0.03	0.002	0.006
1	L2	422.08	52.7	123.8	0.13	0.01	0.042
2	T1	1487.08	129.9	305.2	0.29	0.021	0.069
3	R2	863.55	72.5	170.3	0.16	0.012	0.04
		2882.9	266.6	626.5	0.61	0.046	0.157
EAST:OZKER OZGUR CADDESI							
6U	U	19.45	1.1	2.5	0	0	0.001
4	L2	1541.75	105.4	247.8	0.23	0.023	0.055
5	T1	3282.92	252	592.2	0.57	0.059	0.192
6	R2	1188.34	67.2	157.8	0.13	0.015	0.035
		6032.46	425.7	1000.3	0.94	0.097	0.283
NORTH: SHHIT MUSTAFA AHMEAT RASA CADDESI							
9U	U	134.53	12.9	30.4	0.03	0.002	0.009
7	L2	189.31	18.4	43.3	0.04	0.003	0.011
8	T1	1679.01	216.2	508	0.56	0.039	0.122
9	R2	1125.02	160.1	376.2	0.41	0.034	0.148
		3127.87	407.6	957.9	1.04	0.079	0.29
WEST: OZKER OZGUR CADDESI							
12U	U	8.36	1.2	2.7	0	0	0.001
10	L2	423.36	40.8	96	0.1	0.007	0.025
11	T1	700.55	65.1	152.9	0.15	0.011	0.037
12	R2	432.32	51.2	120.2	0.13	0.009	0.028
		1564.59	158.2	371.9	0.38	0.027	0.088
INTERSECTIOIN:		13607.82	1258.1	2956.5	2.97	0.249	0.819

Table 6.MOEs and economic analysis for Terminal roundabout.

MOV ID	TURN	COST TOTAL TL/H	FUEL TOTAL L/H	CO2 TOTAL KG/H	CO TOTAL KG/H	HC TOTAL KG/H	NOX TOTAL KG/H
SOUTH: CAZETTCI KAMAL ASIK							
4	U	7.82	0.8	1.8	0	0	0.001
1	L2	111.66	15.9	37.3	0.04	0.003	0.011
2	T1	440.89	95.1	223.5	0.27	0.017	0.056
3	R2	80.22	8.2	19.2	0.02	0.002	0.007
		640.6	119.9	281.8	0.33	0.022	0.075
EAST: ATTATURK CADDESI							
8	U	3.51	0.3	0.8	0	0	0
5	L2	42.07	4	9.5	0.01	0.001	0.003
6	T1	63.85	8.6	20.2	0.02	0.002	0.006
7	R2	144.47	25.7	60.3	0.07	0.005	0.16
		253.89	38.7	90.9	0.1	0.007	0.025
NORTH: MUSTAFA AHMET RUSO CADDESI							
12	U	271.48	28	65.9	0.07	0.005	0.015
9	L2	217.42	15.6	36.6	0.03	0.003	0.008
10	T1	1239.83	86.9	204.1	0.17	0.014	0.047
11	R2	849.91	67.8	159.3	0.15	0.011	0.038
		2578.65	198.3	465.9	0.42	0.033	0.109
WEST: ATTATURK CADDESI							
15	U	15.44	1.6	3.6	0	0	0.001
13	L2	232.14	35.3	83	0.09	0.006	0.02
14	T1	680.75	56.3	132.3	0.12	0.01	0.038
15	R2	151.23	12	28.1	0.03	0.002	0.008
		1079.57	105.1	247	0.25	0.019	0.067
INTERSECTIOIN:		4552.71	462	1085.6	1.1	0.082	0.276

Table 7.MOEs and economic analysis for YeniŞehir intersection.

MOV ID	TURN	COST TOTAL TL/H	FUEL TOTAL L/H	CO2 TOTAL KG/H	CO TOTAL KG/H	HC TOTAL KG/H	NOX TOTAL KG/H
SOUTH: SEHIT ECVET YUSUF CADDESI							
1	L2	18.98	3.1	7.3	0.01	0.001	0.002
2	T1	1493.01	103.3	242.7	0.22	0.025	0.057
3	R2	428028	29.7	69.9	0.06	0.007	0.016
		1940.27	136.1	319.9	0.29	0.032	0.076
EAST: ATTATURK CADDESI							
4	L2	60.12	5.7	13.3	0.01	0.001	0.003
5	T1	491.22	47.2	110.8	0.11	0.009	0.026
6	R2	51.97	5.7	13.5	0.01	0.001	0.003
		603.31	58.6	137.6	0.13	0.012	0.032
NORTH: SEHIT ECVET YUSUF CADDESI							
7	L2	214.47	33.9	79.6	0.08	0.006	0.016
8	T1	779.23	64.4	151.4	14	0.014	0.036
9	R2	60.52	5.1	12	0.01	0.001	0.003
		1054.22	103.4	243	0.23	0.02	0.058
WEST: ATATURK CADDESI							
10	L2	104.77	18.3	42.9	0.04	0.003	0.01
11	T1	464.96	33.3	18.3	0.06	0.007	0.016
12	R2	153.16	9.6	22.5	0.02	0.002	0.005
		722.9	61.2	143.7	0.12	0.013	0.031
INTERSECTIOIN:		4320.7	359.2	844.2	0.77	0.077	0.197

V. CONCLUSION

In the past, the approach to solving the congestion problem was to build or expand more roads in order to increase its capacity while maintaining the same pattern along these roads. This approach was desired goal in the short period. While for long period, this approach is burdened of financial, operational, and environmental especially for long portion of congestion. Traffic congestion has significant social, economic, and environmental costs associated with it. Efficiency of intersections contributes significantly towards the efficiency of urban road networks, as they are the main bottlenecks in the system. Computer simulation is a vital means for the examination of expressways and urban lanes and streets. In the present study, the data collected was used for designing the volume, geometric and phase movement in program software.The statistical analysis of the MOEs helps determine if and how the stop-controlled intersections and the roundabout- controlled intersections differed in cutting down vehicular emissions. The analysis provides information to assess characteristics of the stop controls and the roundabout. It is concluded that at the intersections studied the modern roundabouts significantly reduced the vehicular emissions of the intersections studied by making the traffic flow orderly.

REFERENCES

1. Carmona, M. (2010). Public places, urban spaces: The dimensions of urban design. Oxford: Architectural Press.

2. Hayden, D. (2006). The power of place: Urban landscapes as public history. Cambridge, MA: The Mit Press.
3. Fernández-Ares, A., Mora, A. M., Arenas, M. G., García-Sánchez, P., Romero, G., Rivas, V., ...&Merelo, J. J. (2017). Studying real traffic and mobility scenarios for a Smart City using a new monitoring and tracking system. Future Generation Computer Systems, 76, 163-179
4. Deng, T., & Nelson, J. D. (2011). Recent Developments in Bus Rapid Transit: A Review of the Literature. Transport Reviews, 31(1), 69-96. doi:10.1080/01441647.2010.492455
5. Cocks, G. V. (2017). Transportation For Livable Cities. Place of publication not identified: Routledge.
6. Whitelegg, J. (1997). Critical mass: Transport, environment and society in the twenty-first century. London: Pluto.
7. Cobbinah, P. B., &Amoako, C. (2012). Urban sprawl and the loss of peri-urban land in Kumasi, Ghana. International Journal of Social and Human Sciences, 6(388), e397
8. Kockelman, K., & Zhou, B. B. (2003). Handbook of transportation engineering (Vol. 12). Chapter
9. Rao, A. M., & Rao, K. R. (2012). Measuring urban traffic congestion-a review. International Journal for Traffic & Transport Engineering, 2(4)
10. Talvitie, A. (2000). Evaluation of road projects and programs in developing countries. Transport Policy, 7(1), 61-72
11. Haque, M. M., Chin, H. C., &Debnath, A. K. (2013). Sustainable, safe, smart—three key elements of Singapore's evolving transport policies. Transport Policy, 27, 20-31
12. Maibach, M., Schreyer, C., Sutter, D., Van Essen, H. P., Boon, B. H., Smokers, R., ...&Bak, M. (2008). Handbook on estimation of external costs in the transport sector. Ce Delft
13. Smith, N. (2005). The new urban frontier: Gentrification and the revanchist city. Routledge
14. Taylor, M. A., Woolley, J. E., &Zito, R. (2000). Integration of the global positioning system and geographical information systems for traffic congestion studies. Transportation Research Part C: Emerging Technologies, 8(1-6), 257-285
15. Buchanan, C. (2015). Traffic in Towns: A study of the long term problems of traffic in urban areas. Routledge.

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Prof. Dr. Hüseyin Gökçekuş completed his undergraduate education at the Department of Geological Engineering of Faculty of Sciences in Ankara University in 1982. During his years of postgraduate study, he started to work as a Research Assistant at METU in 1983 and in June1990, he completed his PhD at the Department of Geological Engineering. Professor Dr. Hüseyin Gökçekuş has more than 80 publications on significant issues of the country such as water, environment, earthquakes, tourism and education. Professor Gökçekuş has made more than 140 presentations at scientific meetings mainly in Turkey and in the Turkish Republic of Northern Cyprus, alongside with South Cyprus, Sweden, France, Greece, United States, Italy, Austria, Morocco, Azerbaijan, England, Norway, Indonesia, Russia, Malta, Germany, Croatia, Kirghizstan and Brazil. As the Head of Higher Education Board of TRNC (YÖDAK), Professor Gökçekuş had been elected as a Member of Managing Board of Association of Quality Assurance Agencies of the Islamic World in Bahrain, in February 2014. On the other hand, in 2015, he presided the "IQA Workshop" hosted by NEU through cooperation with the Higher Education Board of TRNC. As part of the Turkey-TRNC Economical Cooperation Agreement, he has contributed to the preparation of the Report on "The Preparation and Realisation of the TRNC Higher-Education Strategy Document and Action Plan" in June 2015, by the Higher Education Board of the TRNC (YÖDAK).

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