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An Efficient Scheduling of Flyover at Grade Intersection under Mixed Traffic Environment

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Abstract: A flyover is a bridge constructed along an intersecting highway over an at-grade intersection. It allows two –direction traffic to flow at free flow speed on the bridge. The flyover is one of the methods for solving traffic problems at at-grade junctions on highways including capacity, congestion, long delay and queue length. Traffic signalization at the upgraded intersection often uses the same fixed time control plans, even after the installation of a flyover over the intersection. Most of the flyovers in India are constructed at the junctions on highway bypasses of big cities. The present work deals with a efficient scheduling of flyover at the grade intersection under the mixed traffic environment. From the results and the modeling carried out in the "SIDRA Intersection" software different points are observed. The present work consists of the Proposed Intersection at Rajkamal Square, Amravati.
Keywords: Flyover, Intersection, SIDRA and traffic performance

I. INTRODUCTION

The flyover is a bridge constructed along an intersecting highway over an at-grade intersection. It allows two –direction traffic to flow at free flow speed on the bridge. The flyover is one of the methods for solving traffic problems at at-grade junctions on highways including capacity, congestion, long delay and queue length. Traffic signalization at the upgraded intersection often uses the same fixed time control plans, even after the installation of a flyover over the intersection. Most of the flyovers in Thailand are constructed at the junctions on highway bypasses of big cities. There are 52 flyovers in Thailand, excluding the ones in Bangkok and its vaciniy. Twenty nine of these flyovers are bridges constructed on one of the main highway over existing at-grade fixed-time control signalized intersections To assess the benefits of a flyover, a study case was chosen. It was an at-grade signalized intersection where two 4-lane highways intersect. The flyover was built along the intercity highway over the highway to the Hatyai airport (Fig. 1).

Fig.1: Case study location (near Hat Yai airport, Songkhla)

II. LITERATURE REVIEW

A. General

In the present work there are different research papers related to the efficient scheduling of the flyover at the grade intersection under the mixed traffic environment is studied. The research papers studied are properly observed and the work carried out by the authors are mentioned.

B. Literature Review

Murali Sambasivan and Yau Wen Soon in a research paper entitled "Causes and effect of delay in the Malaysian construction industry," reviewed an integrated approach and attempted to analyze the impact of specific causes and specific effects of project delays.

Abd El-Razek. et al., in their research entitled "Causes of delay in Building Construction Projects in Egypt, a questionnaire survey was conducted and identified the most important causes of delay in a construction project.

Indhu, P. Ajai, in the case study entitled "Study of delay management in a construction project - A case study," identified the most important factors causing delay and the effect of delay on the project duration.

Keval J. Shah, Prof. M. R. Apte in the case study entitled "Causes of Delay in Construction of Bridge Girders," Frequent site visits were carried out in an ongoing bridge girders construction project and collected the data from the site for each activity of construction of bridge girder and compared with its planned duration and actual duration.

N. D. Chhatbar, Pa. Shinkar, "Economic Assessment of Flyoer – A case study of Rajkot city"In these papers the author has research in extensive studies that was undertaken to determine effects of fly over construction to the way of life of the motorists and commuters and general travelling public.

The above research papers are studied related to the scheduling of flyover, delay in the traffic, economic evaluation of the traffic. The different survey is also carried out related to the different places and the results are worked out. The software is also used by the authors for the different conditions of the flyover. From the above research papers it is observed that the proper and efficient scheduling is very much necessary at the grade intersection under the mixed traffic environment.

III. METHODOLOGY

The modeling is completed in the SIDRA Intersection software tool. SIDRA NETWORK model provides a lane-based congestion modelling tool. It determines the backward spread of congestion as queues on downstream lanes block upstream lanes, and applies capacity constraint to oversaturated upstream lanes; thus limiting the flows entering downstream lanes. These two elements are highly interactive with opposite effects. A network-wide iterative process is used to find a solution that balances these opposite effects.

The modeling of the present work involves the following:

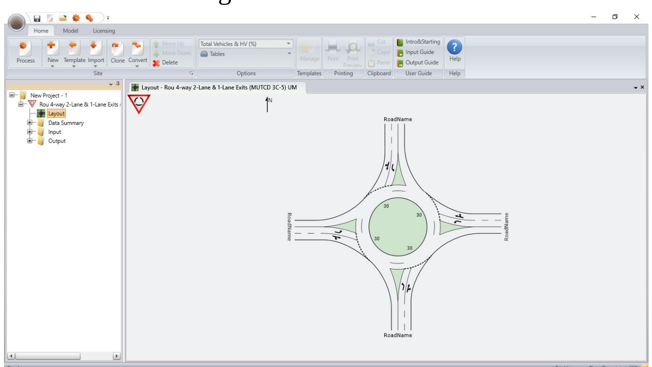

Fig. 2: Layout of the intersection (SIDRA software)

The above figure shows the layout of the intersection which is modeled in the software.

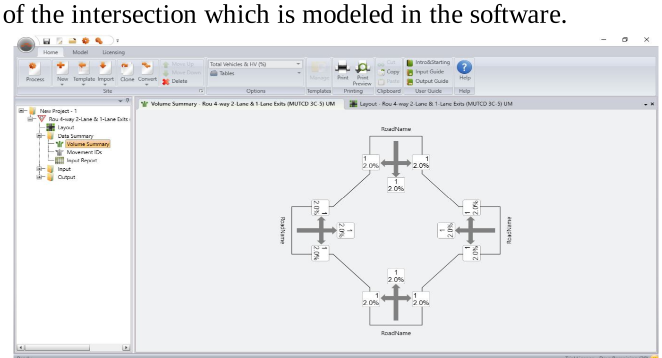

Fig.3: Volume Summary (SIDRA software)

The above figure shows the data of volume which is considered for the modeling in the SIDRA software.

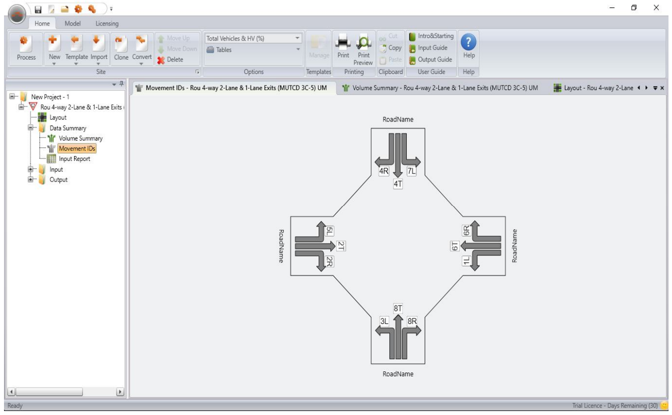

Fig.4: Movement ID of the model (SIDRA software)

The above figure shows the movement ID of the model which is considered for the modeling in the SIDRA software.

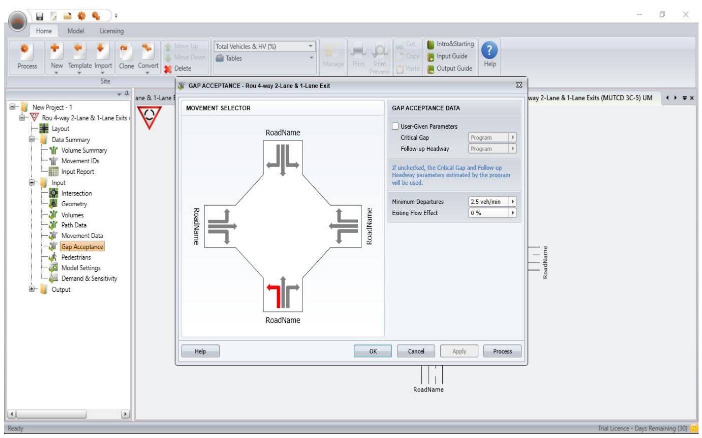

Fig.5: Gap Acceptance data (SIDRA software)

The above figure shows the gap acceptance data of the model which is considered for the modeling in the SIDRA software.

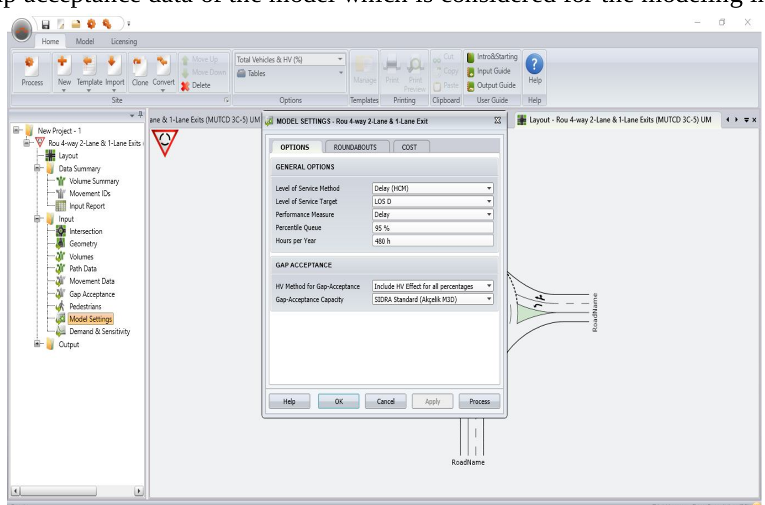

Fig.6: General model data (SIDRA software)

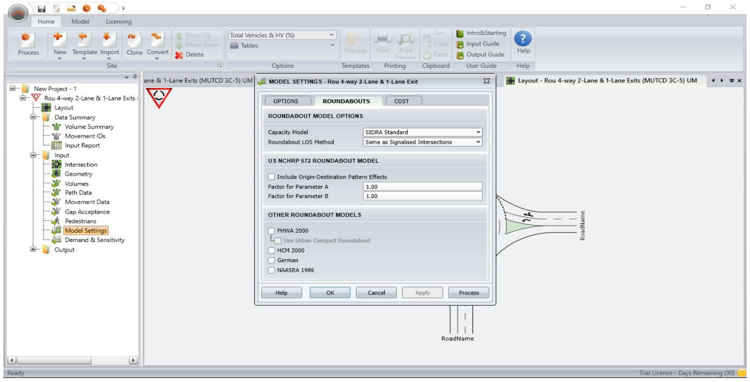

Fig.7: Roundabout Model options (SIDRA software)

The above figure shows the Roundabout Model options of the model which is considered for the modeling in the SIDRA software.

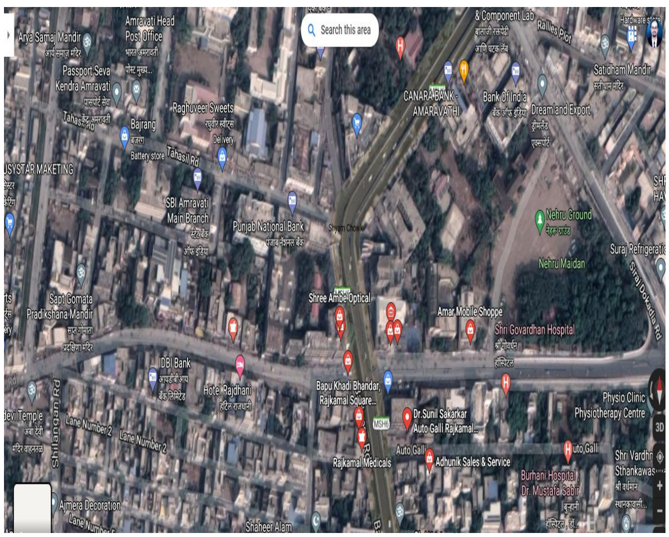

Fig.8: Proposed Intersection at Rajkamal Square, Amravati

The above figure shows the Google Image of the Proposed Intersection at Rajkamal Square, Amravati. The square is highly populated and the need of the good quality intersection is proposed at this location.

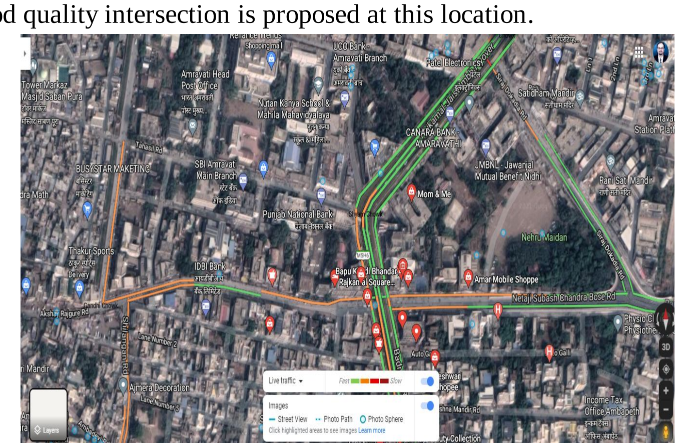

Fig.9: Traffic view at Proposed Intersection at Rajkamal Square, Amravati

The above figure shows the Traffic view at Proposed Intersection at Rajkamal Square, Amravati.

IV. RESULTS

The inputs were given to the SIDRA software in terms of the geometry data, Intersection Details , Volume data, Movement path data, Movement Selector data , Gap Acceptance data, General model data, Roundabout Model options, Cost Details, Demand and sensitivity details of the model. The results obtained in terms of the delay, queue time stop rate and performance index. The results for the model are as follows:

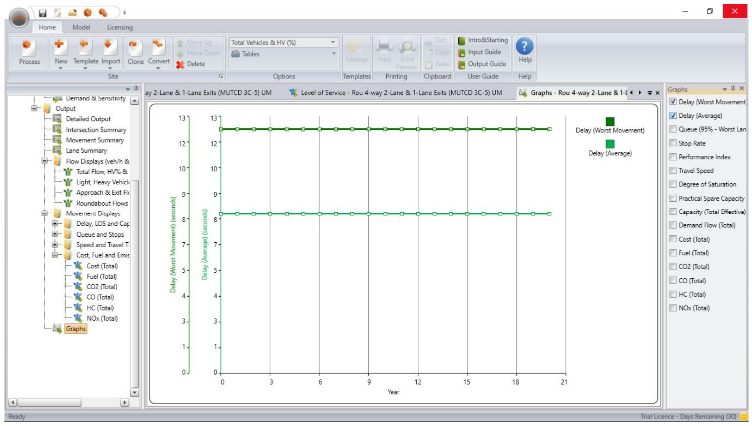

Fig. 10: Delay (Worst movement and average) per year

From the above figure it is observed that the delay (Worst movement and average) per year is constant and would be avoided if proper traffic movement is observed.

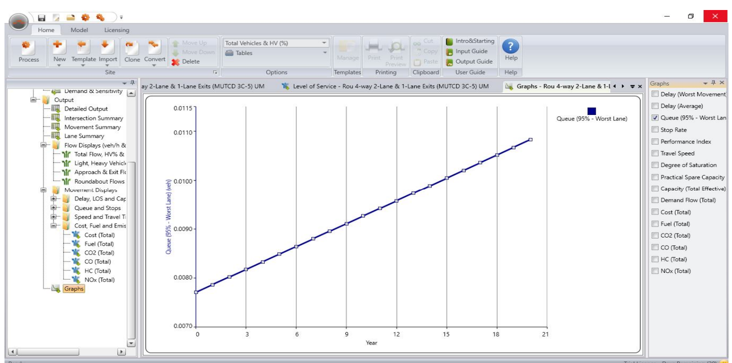

Fig.11: Queue for 95% worst lane of vehicle per year

From the graph it is observed that the Queue for 95% worst lane of vehicle per year is found to be increasing as the year goes on increasing. The maximum value is found to be 0.011.

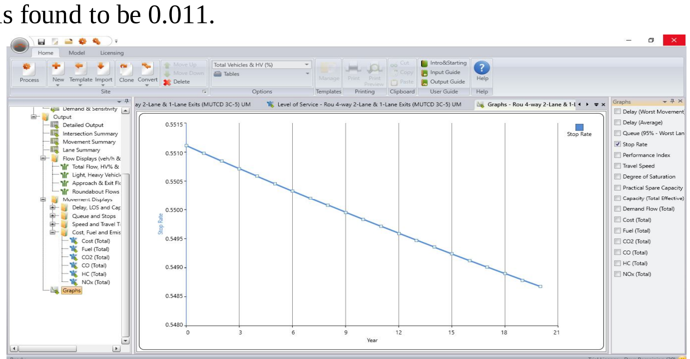

Fig.12:Stop rate per year

From the above graph it is observed that the stop rate found to be decreasing as the year goes on increasing. The minimum value of the stop rate is found to be 0.5485.

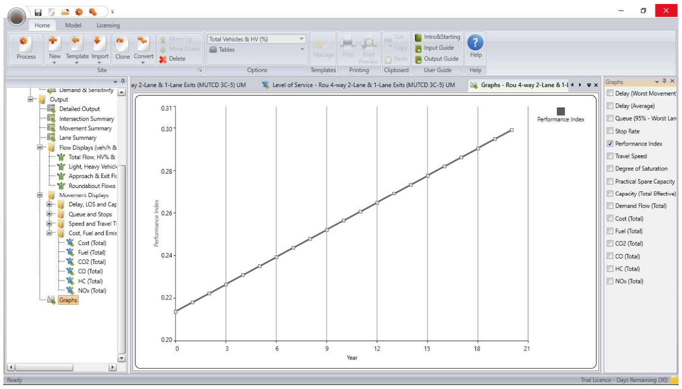

Fig.13: Performance index per year

From the above graph it can be observed that the performance index goes on increasing as the year goes on increasing. The maximum value of Performance index is 0.30.

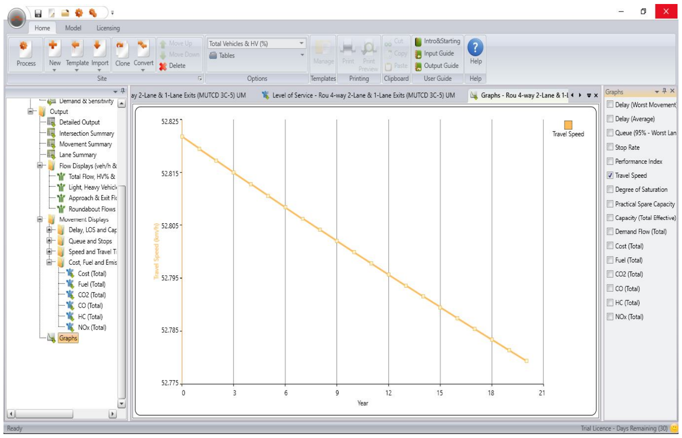

Fig.14: Travel speed (kMph) per year

From the graph it is observed that the travel speed (kmph) found to be decreasing as the year goes on increasing. The minimum value is found to be 52.78 kmph.

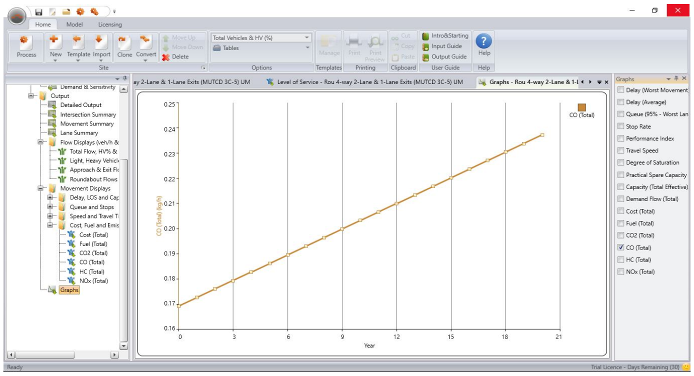

Figure IV.1: Total CO (kg/h) yearwise

From the above graph it is observed that total CO (kg/h) is found to increasing as the year increases and the maximum value is found to be 0.24 kg/h.

Table I
Movement Capacity Parameters

Mov ID	Demand Flow	HV	Opposing Movement Adjust. Flow	HV	Flow	Total Cap.	Prac. Deg. Satn	Prac. Spare Cap.	Lane Util	Deg. Satn
	Veh/h	%	veh/h	%	pcu/h	veh/h	xp	%	%	x
South: Road1										
3L L	2	2.0	5	2.0	5	1078	0.85	****	100	0.001
8T T	2	2.0	5	2.0	5	631	0.85	****	100	0.002*
8R R	2	2.0	5	2.0	5	631	0.85	****	100	0.002*
East: Road2										
1L L	2	2.0	5	2.0	5	1078	0.85	****	100	0.001
6T T	2	2.0	5	2.0	5	631	0.85	****	100	0.002*
6R R	2	2.0	5	2.0	5	631	0.85	****	100	0.002*
North: Road3										
7L L	2	2.0	5	2.0	5	1078	0.85	****	100	0.001
4T T	2	2.0	5	2.0	5	631	0.85	****	100	0.002*
4R R	2	2.0	5	2.0	5	631	0.85	****	100	0.002*
West: Road4										
5L L	2	2.0	5	2.0	5	1078	0.85	****	100	0.001
2T T	2	2.0	5	2.0	5	631	0.85	****	100	0.002*
2R R	2	2.0	5	2.0	5	631	0.85	****	100	0.002*

The above tables gives the result in terms of the movement capacity for the different direction in terms of the lanes and the vehicles for the intersection. After the optimization the LOS of each intersection was improved, which directly have a positive impact on mobility and driving comfort, likewise, it reduces the travel delay. The capacity of a particular approach of the signal control intersection is principally a function of a total of lanes and their respective movement flow, the direction of flow circulation, basic saturation flow and signal green time proportion. Therefore with the addition of number lanes during the optimization, the average capacity of all the intersections increased.

Table II
Movement Performance

Mov ID		Total Delay (veh-h/h)	Total Delay (pers-h/h)	Aver. Delay (sec)	Eff. Stop Rate	Total Stops	Perf. Index	Tot.Trav. Distance (veh-km/h)	Tot.Trav. Time (veh-h/h)	Aver. Speed (km/h)
South: RoadName										
3L	L	0.01	0.01	12.3	0.69	1.1	0.03	1.0	0.0	48.7
8T	T	0.00	0.00	5.3	0.41	0.6	0.02	1.0	0.0	56.1
8R	R	0.00	0.00	6.5	0.54	0.8	0.02	0.9	0.0	54.5
East: RoadName										
1L	L	0.01	0.01	12.3	0.69	1.1	0.03	1.0	0.0	48.7
6T	T	0.00	0.00	5.3	0.41	0.6	0.02	1.0	0.0	56.1
6R	R	0.00	0.00	6.5	0.54	0.8	0.02	0.9	0.0	54.5
North: RoadName										
7L	L	0.01	0.01	12.3	0.69	1.1	0.03	1.0	0.0	48.7
4T	T	0.00	0.00	5.3	0.41	0.6	0.02	1.0	0.0	56.1
4R	R	0.00	0.00	6.5	0.54	0.8	0.02	0.9	0.0	54.5
West: RoadName										
5L	L	0.01	0.01	12.3	0.69	1.1	0.03	1.0	0.0	48.7
2T	T	0.00	0.00	5.3	0.41	0.6	0.02	1.0	0.0	56.1
2R	R	0.00	0.00	6.5	0.54	0.8	0.02	0.9	0.0	54.5

The above table gives results in terms of the vehicle movement performance, delay for the vehicles and the speed for the intersection. The results of the total effective stops presented in this section present the only the total vehicle stop excluding the pedestrian stops measured in ped/h. In the table, the effective stops for a vehicle at the three intersections were also evaluated within the Sidra Intersection. The results show that with the addition of one lane to each leg of the intersection have a significant effect of increasing the capacity of the intersection and likewise reducing the number vehicle that might stop at the intersection. The reduction in the number of vehicular stops would enhance the performance of the intersection and reduce delay.

V. CONCLUSIONS

The present work consists of the Proposed Intersection at Rajkamal Square, Amravati. The square is highly populated and the need of the good quality intersection is proposed at this location. From the above results and the modeling carried out in the "SIDRA Intersection" software following points are concluded:

A. From the graph it is observed that the Queue for 95% worst lane of vehicle per year is found to be increasing as the year goes on increasing. The maximum value is found to be 0.011.

B. From the graph it is observed that the stop rate found to be decreasing as the year goes on increasing. The minimum value of the stop rate is found to be 0.5485.

C. From the graph it can be observed that the performance index goes on increasing as the year goes on increasing. The maximum value of Performance index is 0.30

D. From the graph it is observed that the travel speed (kmph) found to be decreasing as the year goes on increasing. The minimum value is found to be 52.78 kmph.

E. From the graph it is observed that the degree of saturation goes on increasing as the year goes on increasing. The maximum value is found to be 0.024

F. From the graph it is observed that the total effective capacity (vehicle per hour) is fluctuating over the years and the maximum value is found to be 7572 (vehicle per hour).

G. From the graph it is observed that the total demand flow (vehicle per hour) goes on increasing as the year increases and the maximum value is found to be 18.5 vehicle per hour.

H. From the graph it is observed that the total fuel (l/h) goes on increasing as the year increases and the maximum value is found to be 1.25 l/h.

I. From the graph it is observed that the total CO2 (kg/h) goes on increasing as the year increases and the maximum value is observed to be 3.1 kg/h.

J. From the graph it is observed that total CO (kg/h) is found to increasing as the year increases and the maximum value is found to be 0.24 kg/h.

K. From the graph it is observed that total HC (kh/h) is found to be increasing as the year goes on increases and the maximum value is found to be 0.0052 kg/h.

L. From the graph it is observed that the NOx (kg/h) value is found to be increasing as the year goes on increases and the maximum value is found to be 0.0076.

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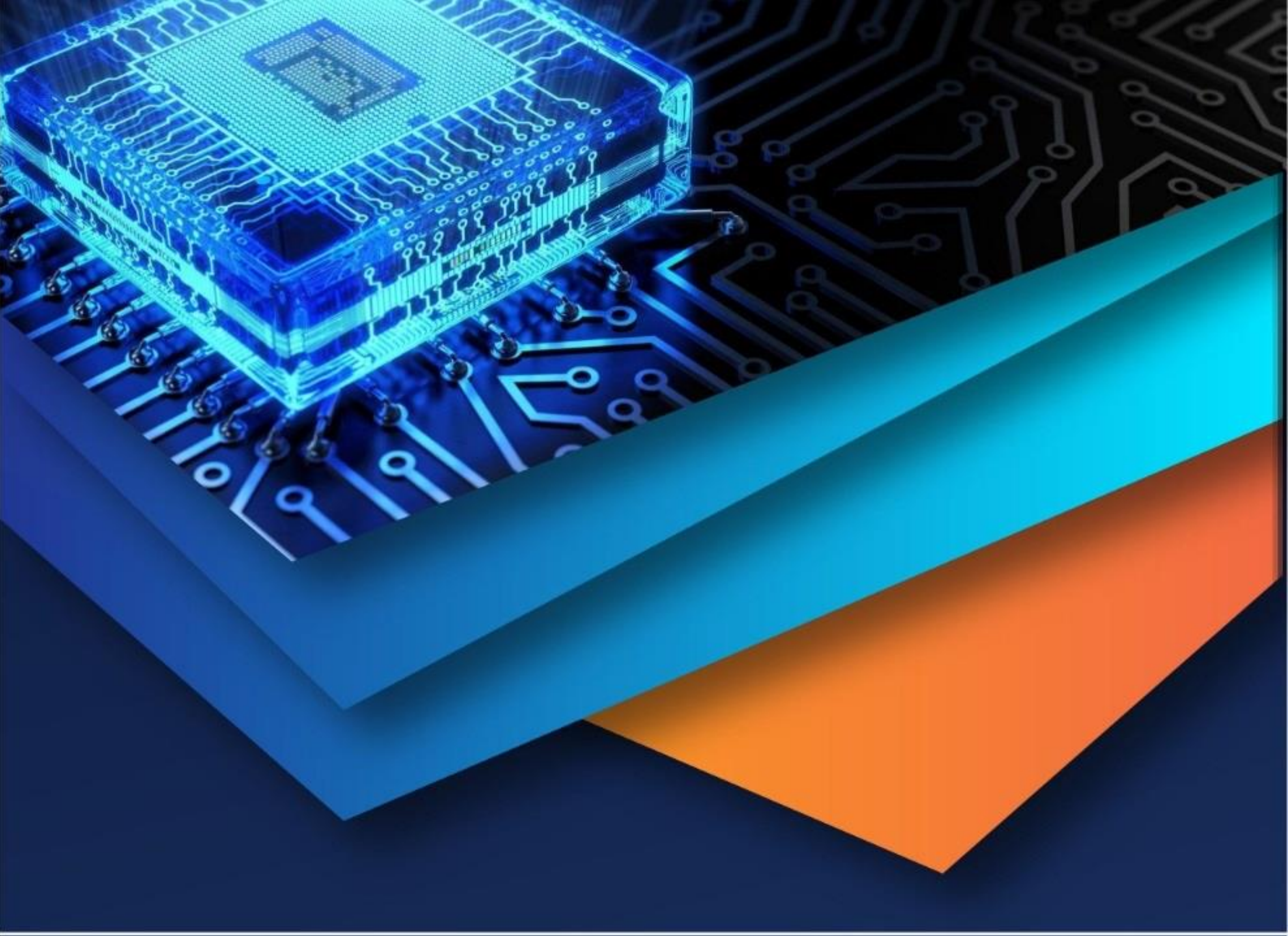

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