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Solution for Reduction of Traffic Congestion: A Case Study of Intersection on Badlapur- Katai Road

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Abstract: ***The increasing vehicular traffic on roads is growing issue in today's life. This leads to the congestion on the streets and degrades safe and efficient movement of traffic. This is becoming an important issue in the urban premises. It is observed that traffic congestions take place majorly at the intersections where the entering and exiting traffic from the towns to the highways creates conflicts due to improper movement. This study intended to examine flow of traffic at an intersection on Badlapur – Katai road in state of Maharashtra. The location is a part suburban areas of Mumbai metropolitan city. The Majority population is of working class also the industrial development in this area is high due to MIDC and thus the road carries huge traffic during peak hours. The study comprises of collection of the current traffic volume data, projection of the traffic for next 20 years and analysing the intersection for its serviceability. The outcomes may show the requirement of improvement of intersection as grade separated intersection.***

Keywords: Badlapur, Katai, traffic, Congestion, Grade separation, Intersection Design, Improvement.

I. INTRODUCTION

Intersection design influences the capacity of the corridor and the safe movement of conflicting directions. The pattern of the traffic movements at the intersection and the volume of traffic on each approach, during on peak period of the day determine the lane widths required including the auxiliary lanes, traffic control devices and channelization, wherever necessary. The arrangement of the islands and shape, length of the auxiliary lanes also differs based upon the type of intersection. The general design principles of intersection design are the approach speeds, restriction on available land, sight distance available and the presence of the larger volume of all the road users in urban areas, although it is necessary that there should be an application of the knowledge about the local conditions while interpreting and arriving at the solution in terms of design. Intersections should have uniform design standards so that even a new comer in the area anticipates what to expect at the intersections.

II. NEED OF STUDY

Badlapur has become rapidly growing place attracting large traffic movement due to both residential and industrial development in its vicinity. The Badlapur – Katai road is the major link carrying huge traffic of light as well as heavy type of vehicles from Mumbai to suburban areas. Additionally, it is also carrying traffic towards Pune generated from central portion of Mumbai suburban. Ghorpade Chowk is the important junction on the road where major merging of traffic from Badlapur Town happens which leads to congestion. So there is need of proper study and upgradation of the intersection.

III.OBJECTIVES

The primary objective is to study the traffic condition at the intersection in the statistical form and to evaluate the performance of the intersection on the basis of the parameters such as Vehicle travel time. This can be done using the VISSIM software. Some necessary improvements at the intersections are also proposed in this thesis considering the future growth of the traffic at the particular locations.

A. To analyses the current traffic flow at the intersection.

The assessment of performance of the existing intersections is a necessary step in view of achieving the congestion free traffic movement at the intersection. Hence the current intersection layout is being analyzed for its performance. This can be done with help of the traffic count surveys and the simulation models.

B. To analyse the intersection for projected traffic conditions.

The traffic congestion issues are going to increase in the coming future. Hence it is necessary to evaluate the intersection for the future traffic conditions. Hence traffic projection becomes essential step. This objective can be achieved with help of suitable traffic growth factors. Further the intersection can be evaluated for future traffic conditions.

C. To reduce the number and severity of potential conflicts between cars, buses, trucks, bicycles and the pedestrians and minimize delay for through traffic.

The primary reason behind the congestion at the intersection is the disturbance to the through traffic due to the local traffic and the pedestrians in the urban areas. Hence this objective can be achieved by proposing improvements such as signalized junction or rotary junction or grade separated intersection. The pedestrian's safety is also a major consideration while designing any intersection in urban areas.

D. To find usefulness of the simulation software VISSIM in designing of roads.

The above mentioned objectives are achieved on the basis of the evaluation of the design with help of the simulation model created using the VISSIM software. Hence to analyze the usefulness of the simulation software in view of cost saving and time saving is the objective of this thesis.

IV. METHODOLOGY

After analyzing the problem statement and going thoroughly through the context and the need, existing literature review has been done to get an essence of the required research. This work was supportive to fix the outline of the work, which is to be carried out. As observed from the brief review of existing literature, many studies have incorporated their work on analyzing the roundabouts or other complex type of intersections for their efficiency or the performance. But there was very petite work observed to be done on the straight sections of roads, especially within the cities.

The intercity roads connecting the major areas of the city are prone to face lots of congestions, not only during peak hours, but also during off-peak hours. The lateral interactions of such straight road sections result into deprived capacity of the system, with unexpected delays experienced by the users which are the failure of the system design. Hence, a proper study is to be done in order to understand the complex behavior of traffic.

A junction location was selected in the present study. The study section was a 3 arm junction carrying traffic from city to the highway. For this video graphic data collection method was used. A wide-lens cameras were placed at junction location on pole for a clear view of the vehicles. This data was analyzed manually. The fundamental traffic parameters such as volume and density data were extracted from the video on a wide screen. The overall traffic was converted into five main types of vehicles for ease in the analysis, namely two-Wheeler (2W), Car, Bus and Heavy Goods Vehicle (HGV). One category of vehicle was extracted at a time, to avoid the possible errors. Further, these parameters of traffic were modelled in to simulation software PTV VISSIM. From this data vehicle travel time was calculated to cross the junction in all directions for current scenario. The proposal showing Solution to the traffic congestion is developed following the guidelines from IRC code. The Proposed improvement is designed so as to accommodate the proposed improvement within available ROW. The proposed improvement is then re verified with vehicle travel time data using VISSIM software.

A. Road Inventory

The project site was visited and details such as road width, adjacent buildings, Type of land use and other connectivity to the road are identified. Existing cross sectional details are taken by measuring with tape. The road components such as median, carriageway, paved shoulder, soft shoulder, Road side drain are measured. The type of approach road is identified and it's graded accordingly. The DP map available at the corresponding Municipal Corporation can be utilized for Identifying the exact ROW.

B. Intersection Volume Count Survey

The Intersection volume count survey is done to understand traffic characteristics of each arm of intersection and to assess the need of signal control, grade separator etc. Intersection volume count survey was carried out junction on the project highway. The traffic on all arms is then checked to satisfy IRC specifications for signalization and for Grade separator if required. If the total peak hour traffic at intersection is more than 10,000 PCU/hr., then grade separator is warranted.

C. Traffic Data Analysis

The one-day traffic count is to be performed at the Intersection collecting the details of all the vehicles coming from each arm. The data is collected for 24 Hrs. at 15 min interval as per the Guidelines of the IRC: SP: 19 – 2001.The collected data is compiled in per Hour format to obtain Average Daily Traffic and Peak Hour Traffic data at the Intersection.

Proforma 1

CLASSIFIED TRAFFIC VOLUME COUNT SURVEY

IRC:SP:19-2001

Road Name :
Section From : To
Location Km. :
Direction Towards :

Road No. :
Station No. :
Date & Day :
Hour :

ADDL. INFORMATION :
WEATHER :

TIME	FAST MOVING VEHICLES											SLOW MOVING VEHICLES				
	Two Wheeler	Three Wheeler/ Auto Rickshaw	Car/Jeep/ Van/Taxi	BUS		LCV	TRUCK			Agri. Tractor		Cycle	Cycle Rickshaw	Animal Drawn		Others (Pl. Specify)
				Mini	Full		2-Axle	Multi-Axle	Artic/ Semi Artic	With Trailer	Without Trailer			Bullock Cart	Horse	
00--15																
15-30																
30-45																
45-60																
TOTAL																

Name &
Signature of Enumerators:_____

Name &
Signature of Supervisor:_____

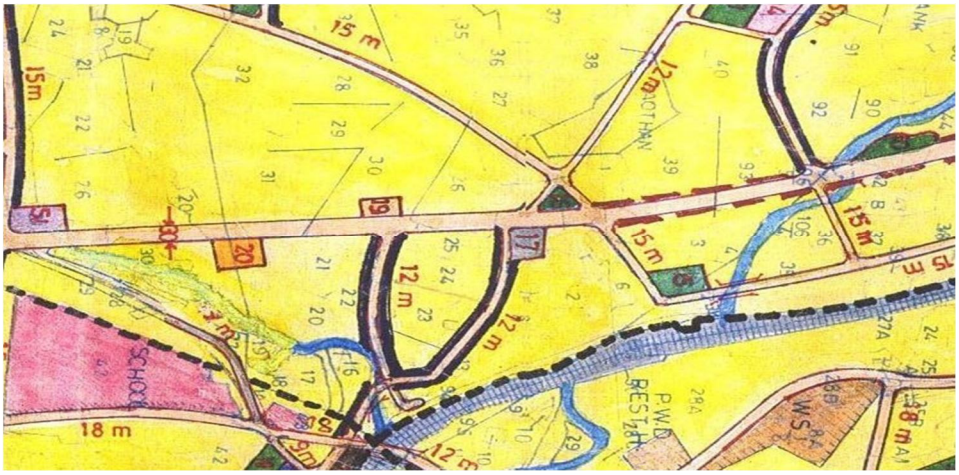
D. Traffic Growth Projection

The traffic data is also projected for assessing the future growth of the traffic. The Growth rates shall be produced on the bases of historical data like vehicle registration data from the local authority. In case of unavailability of the historical data growth rate of 7.5 can be adopted as per the guidelines in IRC: SP: 90-2010. In case of Grade separated structure the design life of 20 years shall be taken in consideration.

V. DATA ANALYSIS

A. Road Inventory Data

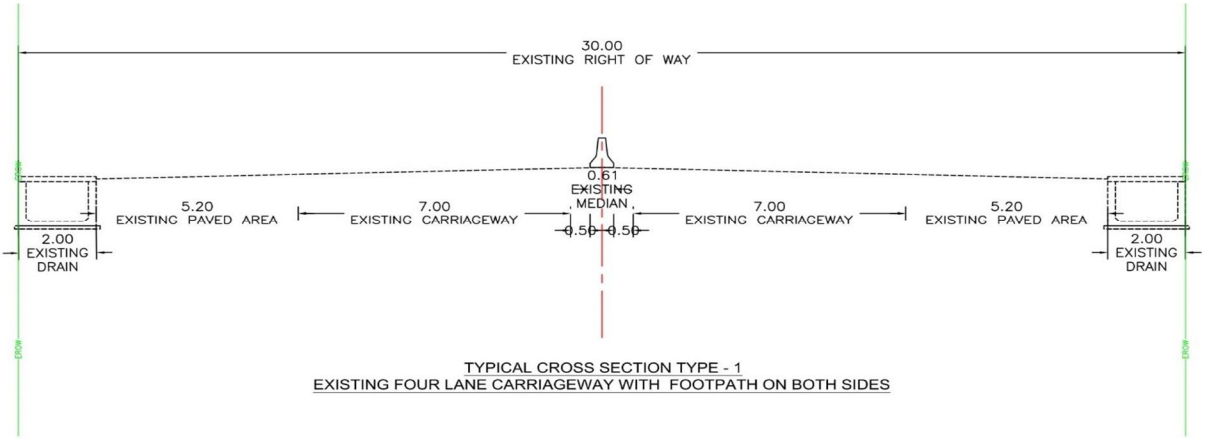
The governing body at the study area is Kulgaon Badlapur Municipal Corporation. The Major road passes through the Town acting as the important 4 lane road. This road carries heavy traffic towards Pune via Karjat Link road. The road improvements are usually done within the existing available ROW i.e. Right of ways. But in case of heavy Traffic conditions for the widening purpose of the road additional land can be acquired by the road development authorities. But that includes huge cost of land acquisition. The ROW details of this major road are derived from the DP map. The DP map obtained from the website of the Kulgaon Badlapur Municipal Corporation shows the DP width of the Badlapur - Katai Road passing through the town to be 30m.



TowardsBadlapur

TowardsKarjat

TowardsAmbernath



TYPICAL CROSS SECTION TYPE - 1
EXISTING FOUR LANE CARRIAGEWAY WITH FOOTPATH ON BOTH SIDES

B. Traffic Volume data Collection using Video Graphic Data

Camera1–Ambernath Direction

Camera2–KarjatDirection

Camera 3 – Badlapur Direction

Camera 4 – Junction Area

C. Traffic Volume Count in terms of PCU/Hr.

Time		Traffic in terms of PCU								
From	To	Karjat - Ambernath	Ambernath- Karjat	Badlapur- Ambernath	Ambernath- Badlapur	Badlapur- Karjat	Karjat - Badlapur	Total	Maximum Traffic	Peak Hour
12.00 PM	1.00 PM	1722	1780	311	407	428	740	5388		
1.00 PM	2.00 PM	1866	2595	312	594	341	750	6458		
2.00 PM	3.00 PM	1858	2802	471	628	550	913	7222		
3.00 PM	4.00 PM	2023	2553	357	390	450	867	6640		
4.00 PM	5.00 PM	1940	3021	521	343	516	785	7126		
5.00 PM	6.00 PM	1750	2801	376	411	463	785	6586		
6.00 PM	7.00 PM	1958	2721	404	631	411	972	7097		
7.00 PM	8.00 PM	1490	2192	305	495	367	522	5371		
8.00 PM	9.00 PM	1085	1092	278	251	245	237	3188		
9.00 PM	10.00 PM	1150	583	218	286	155	279	2671		11.00 AM to 12.00 PM
10.00 PM	11.00 PM	951	220	82	190	132	157	1732	7548	
11.00 PM	12.00 AM	665	228	94	187	110	148	1432		
12.00 AM	1.00 AM	916	542	87	207	271	192	2215		
1.00 AM	2.00 AM	780	610	84	156	168	130	1928		
2.00 AM	3.00 AM	175	337	76	80	133	132	933		

3.00 AM	4.00 AM	405	803	206	118	184	309	2025		
4.00 AM	5.00 AM	570	610	240	199	139	526	2284		
5.00 AM	6.00 AM	770	753	167	231	203	469	2593		
6.00 AM	7.00 AM	1075	872	234	240	566	509	3496		
7.00 AM	8.00 AM	1731	1694	572	437	767	620	5821		
8.00 AM	9.00 AM	1771	2282	585	758	573	1098	7067		
9.00 AM	10.00 AM	2083	1702	710	661	479	1009	6644		
10.00 AM	11.00 AM	1928	1723	939	758	491	973	6812		
11.00 AM	12.00 PM	2114	2261	757	831	680	905	7548		
Total		32776	36777	8386	9489	8822	14027	110277		
%Trafficw.r.t.total Traffic		29.72	33.35	7.60	8.60	8.00	12.72	100.00		

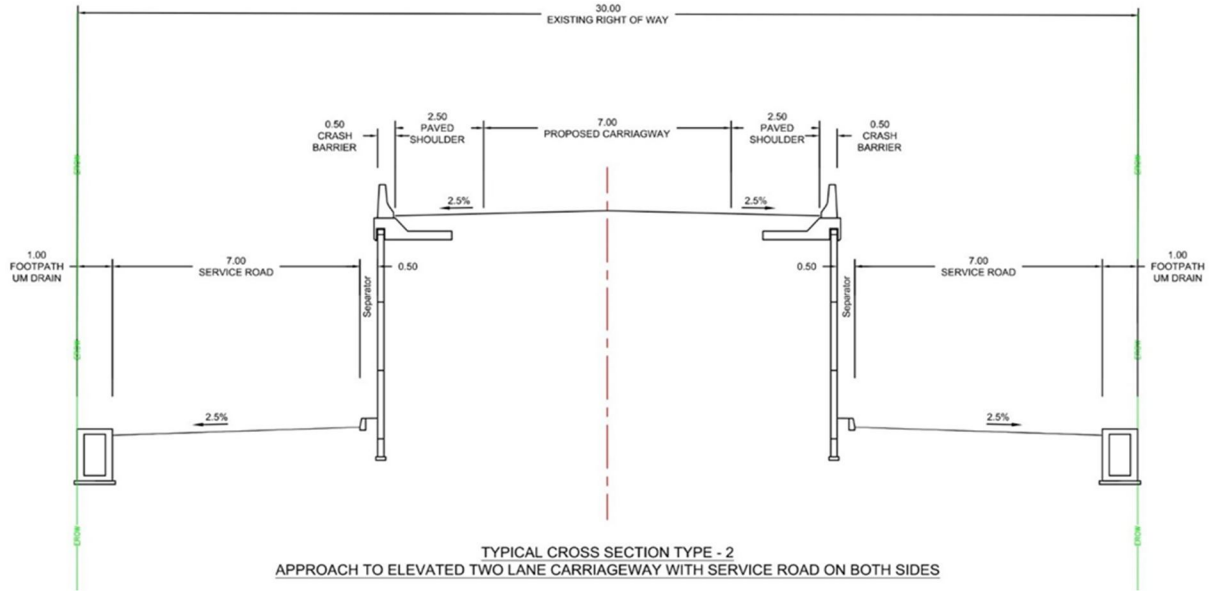
The above table indicates that the total traffic of 110277 PCU/Day crosses across the intersection. The major traffic flow is between Ambernath – Karjat & Karjat – Ambernath, which combined covers 63.07% of the total traffic. Whereas this traffic gets interrupted due to traffic entering and exiting traffic from the Badlapur town which is 36.93%. The traffic required to evaluate the performance of the intersection is in terms of the Peak Hour Traffic. Hence the peak hour has been identified from the collected data. The details of the peak hour taffic are as follows.

Peak Hour Traffic								
Name of Intersection: Ch : Ghorpade Chowk			Peak Hour Time		Peak Hour Traffic		Peak Hour Traffic	
Date of Survey : 03/05/2021-04/05/2021			From	To	7667		7548	
Day : MONDAY			11.00 AM	12.00PM	Veh./ Hr		PCU / Hr	
Traffic Direction			Vehicles per Day	PCUper Day	Peak Hour Traffic	% Peak Hour Trafficin each direction	Peak Hour Traffic	% Peak Hour Trafficin each direction
Arm	From	To						
1 To 3	Karjat	Ambernath	20081	32776	2007	26.18	2114	28.01
3 To 1	Ambernath	Karjat	37306	36777	2085	27.19	2261	29.95
2 To 1	Badlapur	Karjat	6778	8822	807	10.53	680	9.01
1 To 2	Karjat	Badlapur	12851	14027	1095	14.28	905	11.99
2 To 3	Badlapur	Ambernath	6269	8386	947	12.35	757	10.03
3 To 2	Ambernath	Badlapur	7747	9489	726	9.47	831	11.01
Total Traffic in All arms			91032	110277	7667	100.00	7548	100.00

It is found that the peak hour is between 11AM to 12PM in the Day. During the peak Hour the total traffic at junction is 7548 PCU/Hr. Even when the major road is 4 lane road but the Approach road from the town is only 12m wide DP road traffic congestion causes a lot of time for vehicles to cross the junction.

D. Geometric Design of the Intersection

The existing toad is a 4 lane road, hence as per the Manual for 4 Lanning, IRC: SP:84-2019 a 6 lane grade separator (VUP) shall be provided with 2 lane service roads on the both sides. Since the road is crossing through a densely habituated area widening of the right of way is not possible. If the VUP is designed as per the IRC standards the required width of the Road will be higher than the existing DP width of 30m. Hence substandard geometry is proposed. Following is the TCS showing the proposed improvements.



TYPICAL CROSS SECTION TYPE - 2
APPROACH TO ELEVATED TWO LANE CARRIAGEWAY WITH SERVICE ROAD ON BOTH SIDES

The VUP having 2 lanes with paved shoulder is proposed to carry the through traffic betweenKarjat & Ambernath. Also 2 lane service road is proposed on both sides of the VUP along with Footpath cum drain to carry the storm water. This will eliminate the 60% traffic from getting disturbed at the junction as the VUP will offer the free flow to the through traffic. The only movements that will occur at grade are of entering and exiting traffic from the Badlapur Town.

Following are the Plan & Profile diagrams of the proposed VUP at Ghorpade Chowk Intersection of Badlapur Katai road with Old DP road. The Horizontal as well as the vertical geometry is design for a design speed of 80kmph. The Proposed VUP is having width of 20m and the Vertical clearance of the VUP is of 5.5m.

The total length of the separator is of 700m. The service roads will meet the DP road at the junction. Minimum turning radius of 15m is given at the junction to get the clear sight at the junction.

Proper installation of the road signs boards and the road markings is necessary to get the most efficient performance of the VUP. Now to check the efficiency of the intersection the vehicle travel time test shall be performed for this design with projected traffic.

VI. CONCLUSION

The Travel time taken by the vehicle too cross the junction in existing scenario and in case of the proposed improvements scenario has been compared to get the idea about the efficiency of the improvements. Following is chart showing details of vehicle travel time.

Name	From	To	Travel Time for ExistingJunction Design (sec.)	Travel Time for ProposedJunction Design (sec.)	Savingin Time (sec.)
A	Ambernath	Badlapur	59.03	78.55	19.52
B	Ambernath	Karjat	42.87	-	NA
C	Badlapur	Karjat	208.01	126.70	- 81.31
D	Badlapur	Ambernath	241.79	165.09	- 76.70
E	Karjat	Ambernath	96.70	-	NA
F	Karjat	Badlapur	164.04	27.75	-136.29

It is seen that even after increase in the volume the travel time taken by the vehicles on 5 directions out of 6 is reduced. Hence this can be considered as the possible solution for the traffic.

Further the first direction i.e. Ambernath-Badlapur the vehicle travel time is seen to be increasing this problem can be solved by providing dedicated left turning lane as chainage 0+300 Km. as an existing DP road is connecting to major highway and goes parallel to the approach road.

It is found very much helpful to make use of simulation software such as VISSIM for getting the fare idea about the performance of the design on the basis of various parameters.

VII. ACKNOWLEDGEMENT

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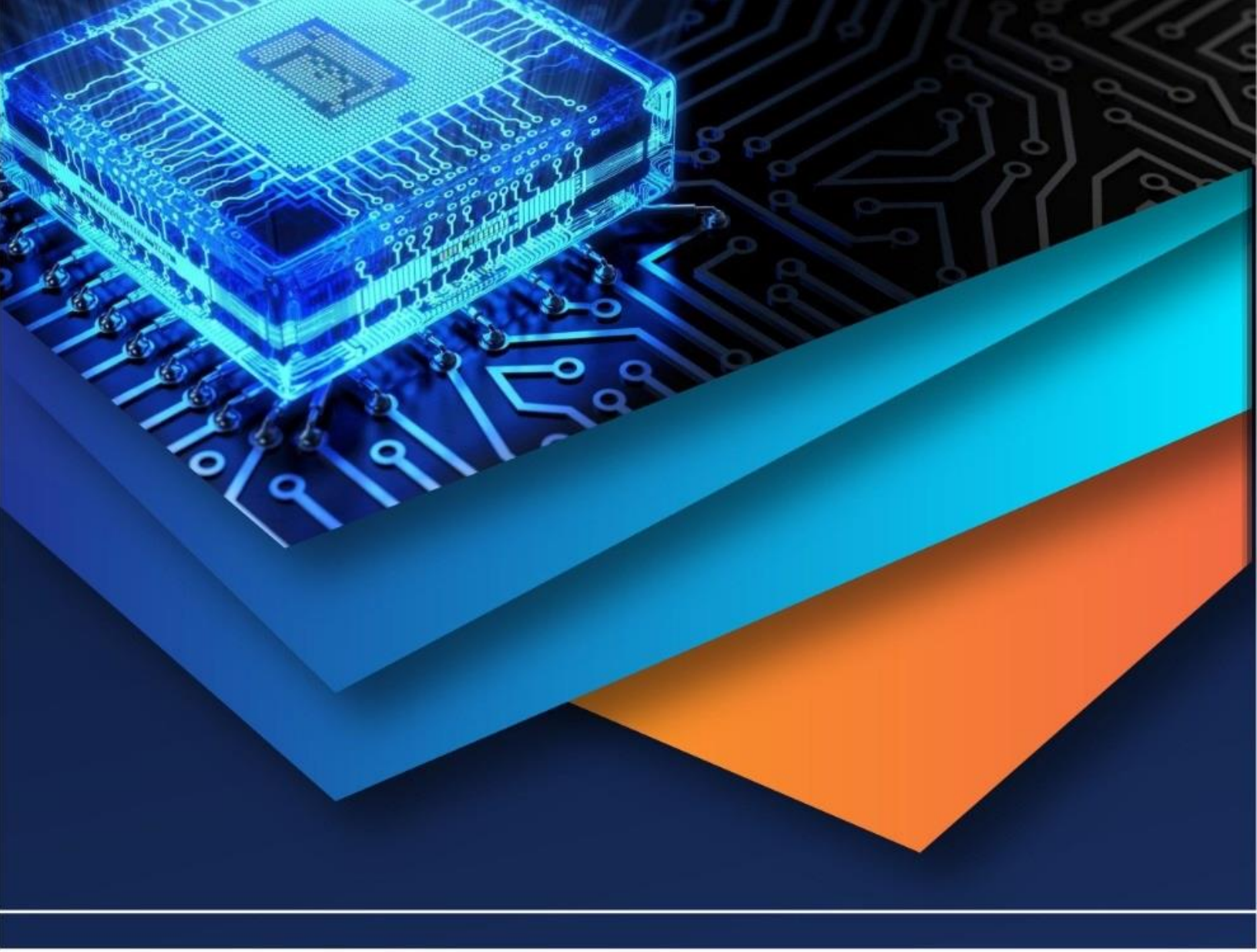

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