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Traffic Noise Pollution Studies of Gwalior, M.P.

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Abstract: ***sound is basically generated through vibrations. The sound generated through unsystematic and unorganised vibrations is termed as noise. Noise pollution is an often-overlooked source of environmental stress that can raise hearing loss, stress, sleep disturbances, heart disease, and more. Change in life style in developing cities like gwalior, leads to rapid increase in use of automobile, owing to long distance location of work place and lack of availability of public transport. People prefer to use their personal vehicle (two/four wheeler) rather than to wait for the public transport. Excessive use of automobiles in addition to uncontrolled traffic movements leads to severe noise pollution. Noise pollution is one of the major component of pollution. It has become major concern for health hazards and quality of life.***

The present study focuses on noise pollution in gwalior city through traffic network of roads. Gwalior is one of the main cities in madhya pradesh, located 319 kms in south of delhi. This is main education and commercial centre of northern madhya pradesh. Students from surrounding towns and villages come to gwalior for better education opportunities. Certainly this contributes to increase in traffic in the city. Being a major commercial centre, farmers and traders from surrounding areas visit the city frequently. The commercial commodity flow is through automobiles, which adds to noise and air pollution. Major parameters for analysis in this paper are: l_{10}, l_{50}, l_{90}, equivalent sound level (l_{eq}), traffic noise index (tni) and noise pollution level (l_{np}).

Key words: - traffic noise pollution, equivalent sound level, traffic noise index.

I. INTRODUCTION

Sound is the vibrating molecules in the air that reach our ear, when this sound becomes unwanted and displeasing it is termed as noise. A developing country like India is facing several environmental problems like air, water and noise pollution. Noise pollution is one of the major component of pollution in urban areas. Population growth leads to increase in traffic which results in increase in noise pollution. Sounds made by traffic, mainly automobiles are major causes of noise pollution.

Loudness of sound is measured in decibels (dB). Normal conversation sound level is about 60 dB. As per the rules, the prescribed highest limit of noise levels for residential localities is 55 dB during day time, and 45 dB during night time. Permissible limits for silence zones like hospitals and education centres is between 40 to 50 decibels. For the industrial area, the permissible noise level is 70 to 75 decibels, and for commercial areas between 55 and 65 decibels. For human beings 55 dB (A) noise level is sufficient for creating disturbance and 65 dB (A) noise level is deemed intolerable causing severe sleep disturbance. In general, sounds above 85 dB (A) are harmful depending on how long and how often one is exposed to them. According to Environmental protection rules 1986 some standards are laid down these are as follows:-

Table2: [AMBIENT AIR QUALITY STANDARDS IN RESPECT OF NOISE]

Category of zones	Day time limits in dB(A)	Night time limits in dB(A)
Industrial area	75	70
Commercial area	65	55
Residential area	55	45
Silence zone	50	40

Day time is reckoned between 6 a.m. and 9 p.m.

Night time is reckoned between 9 p.m. and 6 a.m.

Silence zone is defined as areas upto 100m around such premises as hospitals, educational institutions and courts. Silence zones are to be declared by the competent authority. Loud noisy applications are banned in these areas.

The vehicular noise is major source of noise pollution then industrial and commercial noise sources. Vehicle noise contributes 2/3rd of total noise pollution in urban areas. More noise cause due to public carrying commercial vehicles run by lower class owners unable to maintain the vehicle property and uses roughly for increasing their income level to carryout their lively hood.

A. The noise is generated from following sources

1) Engines
2) Exhausts systems
3) Tyres interacting with roads
4) Honking of horns
5) Sounds of brakes
6) Slamming of car doors
7) Shattering of vehicle bodies

II. PARAMETERS USED IN THIS STUDY

A. There are various parameters which are used in this study these are discussed below

1) Unit: - 'Decibel' is the unit of sound (noise) also denoted by dB. It also measure sound intensity. If 'P' is the pressure fluctuation then sound level is given by

$$L = 10 \log [P/P_0] \text{ dB}$$

$P_0 = 2x10^{-5}$ N/m^2 (amplitude of audible pressure wave)

2) L_n: - For n percent of time the exceeded sound pressure level is L_n. In other words, for n percent of time, fluctuating sound pressure levels are higher than the L_n level.
3) L_{10}:- It is level exceeded for 10 percent of time. It indicates peak level of intruding noise.
4) L_{50}:- It is level exceeded for 50 percent of time. Statistically it is the midpoint of noise readings. It also represents the median of fluctuating noise levels.
5) L_{90}:- It is the level exceeded for 90 percent of time. It represents the ambient or background level of a noise environment.
6) Equivalent Noise Level (L_{eq}):-It is also describe as Average Sound Level over the period of measurement. Usually measured in A-weighted but there is no time constant applied. The method to describe the noise levels that vary over the time period results from value of noise in decibel, which takes into account the total acoustic energy over the period of time of interest.

$$L_{eq} = L_{50} + (L_{10} - L_{90})^2/56 \text{ dB}$$

7) Traffic Noise Index (TNI):- Basically it is used to evaluate aircraft noisiness. The TNI takes into account the amount of variability in observed sound level, in an attempt to improve the correlation between traffic noise measurements and subjective response to noise. In other words it takes into account the noisy vehicles weighted against the general traffic noise.

$$TNI = 4 (L_{10} - L_{90}) + L_{90} - 30 \text{ dB}$$

8) Noise Pollution Level (L_{np}):- Noise pollution level is some time used to describe community noise which employs the equivalent continuous (A-weighted) sound level and the magnitude of the time fluctuation in levels. L_{np} is based on the fact that annoyance due to noise is dependent on the mean acoustic energy L_{eq} and the range of its variation.

$$L_{np} = L_{eq} + (L_{10} - L_{90})$$

OR

$$L_{np} = L_{50} + (L_{10} - L_{90})^2 /56 + (L_{10} - L_{90})$$

III. OBJECTIVE OF STUDY

The overall objective of the study is to assess Traffic noise level in Gwalior city owing to vehicles/automobiles. Specific objectives are:

A. Assess the traffic volume on busy roads/intersections in Gwalior city.
B. Assess the noise level on busy road intersections during peak traffic hours.
C. To what extend noise level in Gwalior city is more than the permissible level in India.

IV. METHODOLOGY OF THE STUDY

A. Sample Selection

Through random sample method five busy traffic road intersections from different locations for selected for the purpose of the study. The sample intersections are given below:

1) Gole ka mandir

2) Jayendraganj
3) Maharaj bada
4) Padav, Lashkar
5) Baradari Chauraha Morar

B. Data Collection

Traffic volume study is carried out and noise pollution levels are measured in Gwalior city at some important and highly loaded traffic/crowded areas. Firstly, for finding out the peak hour a traffic volume survey is conducted from 8:00 a.m. – 11:00 a.m. and 6:00 p.m. to 9:00 p.m., after analysing this study, it is noted that the peak hour at Gole ka Mandir i.e. 9:00 a.m. to 10:00 a.m., and this traffic volume study was carried out at every station. Now, noise levels dB (A) were carried out by sound pressure level meter in those peak hours. Noise related parameters such as L_{eq}, L_{10}, L_{50}, L_{90}, TNI and L_{NP} have been estimated from field observations of noise levels**.** The variation in noise levels are studied and showed in graphical form. The graph takes a shape of a bell which is symmetrical about the mean.

The sound level data were taken by CIRRUS SOUND LEVEL METER at edge of road, and the reading for every 15 seconds interval was recorded. 'A' weighted noise level dB (A) was measured, and 120 readings in 30 minutes at each station during peak hours were observed. Firstly, traffic volume survey was carried out then with the help of sound level meter the sound levels are carried out from Gole Ka Mandir square, which is the busiest intersection of the Gwalior and contains large amount of traffic volume at peak hours. Though the complete survey had been carried out for five intersections, but, the observations of "Gole Ka Mandir" are considered here for explaining the methodology and calculations are stated below:

Table no. 3

TRAFFIC VOLUME SURVEY OF GOLE KA MANDIR

Date: - 20/3/2017-22/3/2017 Peak hour: - 9:00 a.m. - 10:00 a.m.

Time 9 am to 10 am	Number of vehicles					
	Car	Bus	Truck	Three wheeler	Two wheeler	P.C.U.*
9:00-9:15	278	11	_	163	314	518.1
9:15-9:30	270	9	8	159	432	573.3
9:30-9:45	227	16	12	174	473	587.2
9:45-10:00	191	8	5	171	464	501.1
Total	966	44	25	667	1683	2179.7

The above traffic volume study was conducted according to the norms of Indian Road Congress (I.R.C.)

Table no. 4

SOUND LEVELS dB (A)

Station- Gole ka Mandir Date- 6/5/2017
Measuring Time- 30 minutes Day- Saturday
Timing- 9:25 a.m.-9:55 a.m.

120 readings of noise in db taken at Gola Ka Mandir with interval of 15 seconds between 9am-10am

86.9	73.2	75.6	80.4	82.0
80.4	75.0	92.2	79.2	79.9
83.8	88.5	88.9	81.1	84.5
77.6	79.5	87.8	96.5	78.5
84.8	80.2	95.0	95.3	74.7
97.3	80.8	79.3	83.2	79.1
83.2	86.0	77.1	78.8	79.3

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90.0	66.6	78.9	80.0	79.6
72.3	72.8	85.5	74.4	83.3
76.7	92.8	81.1	76.9	91.0
72.5	74.9	74.5	82.3	86.7
81.8	76.1	77.1	76.7	84.6
80.4	83.1	84.6	81.2	87.3
85.5	74.4	79.6	79.2	71.0
88.7	80.7	82.5	84.6	77.8
88.9	90.0	81.9	76.2	79.4
75.8	97.6	82.4	82.1	72.4
76.5	82.2	77.6	88.2	77.2
76.1	91.6	74.8	86.2	86.8
82.0	67.5	84.0	70.5	81.6
77.0	74.9	93.2	77.8	90.2
78.0	76.0	76.1	75.4	82.1
69.3	75.1	74.4	73.2	77.1
79.6	72.1	87.7	90.4	88.1

Table no. 5
CALCULATIONS

Noise level interval in dB(A)	Lowest noise level dB(A)	Highest noise level dB(A)	Average noise level dB(A)	Number of Occurrence of levels between intervals dB(A)	Percentage of occurrence dB(A)	Cumulative percentage dB(A)
66-69	66.6	67.5	67.05	2	1.66	100.00
69-72	69.3	71.0	70.15	3	2.50	98.34
72-75	72.1	75.0	73.55	16	13.33	95.84
75-78	75.1	78.0	76.55	23	19.16	82.51
78-81	78.5	80.8	79.65	21	17.50	63.35
81-84	81.1	84.0	82.55	20	16.66	46.15
84-87	84.5	86.9	85.70	12	10.00	29.49
87-90	87.3	90.0	88.65	11	9.16	19.45
90-93	90.2	92.8	91.50	6	5.00	10.33
93-96	93.2	95.3	94.25	3	2.50	5.33
96-99	96.5	97.6	97.05	3	2.50	2.83

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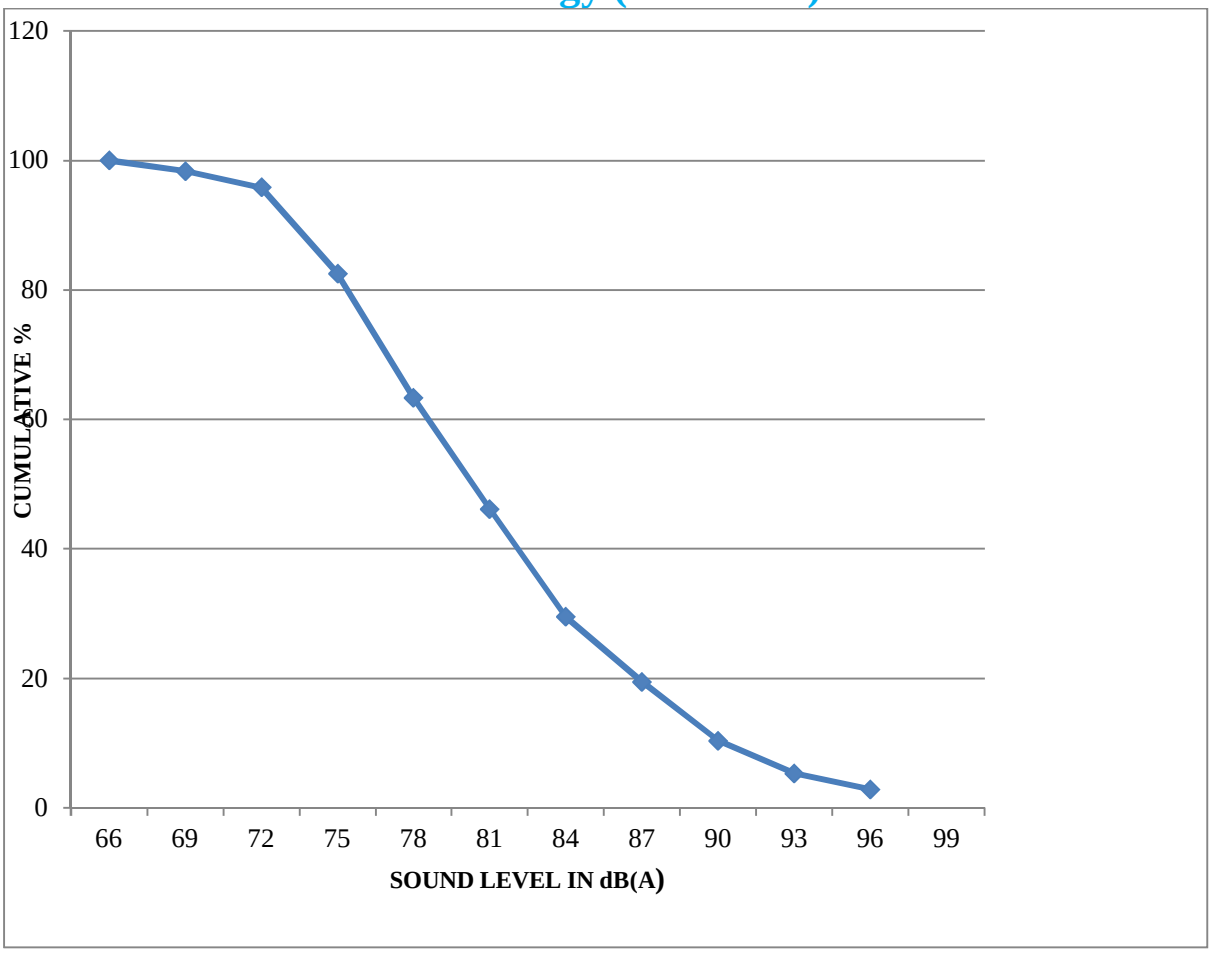

Fig: - CUMMULATIVE PERCENTAGE V/s SOUND LEVEL dB (A)

L_{10} = 88.1 dB (A)
L_{50} = 79.3 dB (A)
L_{90} = 72.1 dB (A)

L_{eq} = 79.3 + (88.1 - 72.1)2 /56 = 83.87dB (A)
TNI = 4 (88.1 - 72.1) +72.1 - 30 = 106.1dB (A)
L_{NP} = 83.87 + (88.1 – 72.1) = 99.87 dB (A)

Table no. 6 - SOUND LEVEL PARAMETERS

Site No.	Station	L_{10} dB(A)	L_{50} dB(A)	L_{90} dB(A)	L_{eq} dB(A)	TNI dB(A)	L_{np} dB(A)
1	Gole ka mandir	88.1	79.3	72.1	83.87	106.1	99.87
2	Jayendraganj	82.0	75.9	70.8	78.14	85.6	89.34
3	Maharaj bada	85.5	76.9	71.8	80.25	96.6	93.95
4	Padav	86.9	77.8	71.9	81.81	101.9	96.81
5	Baradari	85.1	80.3	76.0	81.77	82.4	90.87

V. RESULTS AND DISCUSSION

Noise level measurements were carried out at five different busy stations with average P.C.U of 1675 per hour at peak hour. The minimum, maximum and average noise levels are found to be very high in comparison to standard acceptable limits. The following table shows the maximum and minimum sound levels of the five consecutive stations.

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Table no. 7

Site	Stations	Peak hours	Maximum sound level in dB(A)	Minimum sound level in dB(A)
1.	Gole ka mandir	9:00-10:00 a.m.	97.6	66.6
2.	Jayendraganj	5:15-6:15 p.m.	93.2	68.4
3.	Maharaj bada	7:00-8:00 p.m.	97.2	68.9
4.	Padav	10:00-11:00 a.m.	97.3	68.2
5.	Baradari	4:30-5:30 p.m.	92.2	75.7

A. Gole ka Mandir intersection

This is very busiest intersection in Gwalior. This intersection connects the industrial areas of Gwalior where sound level parameters were judged from the table stated above. The value of L_{10} came to be 88.1 dB (A) and is peak value due to irregular speeds.TNI and L_{np} were 106.1 dB (A) and 99.87 dB (A) respectively were also high.

B. Jayendraganj

This area is commercial cum residential area. The High Court of Gwalior is situated at this intersection, so there is a large number of traffic flows on the roads which connect this intersection.

C. Maharaj Bada

This area is totally a commercial area. Large number of markets are there, which makes this area more crowded. TNI and L_{np} are so high in this area because of heavy traffic volume.

D. Padav, Lashkar

This intersection connects the educational centre of Gwalior and also connects the Gwalior Railway Station. After analysing Table no. 6 all sound parameters found to be very high because of large number of traffic volume.

E. Baradari Churaha, Morar

This intersection connects the army cantt, commercial area and some major hospitals. So, army trucks, ambulance, tempo and auto rickshaw passes through this intersection. The TNI and L_{np} are at the alarming stages.

VI. CONCLUSION

A. The noise parameters at all five intersections after study found to be exceeded the acceptable limits as per Central Pollution Control Board.

B. After this study we found that maximum and minimum sound levels are 95.5 dB (A) and 69.5 dB (A) respectively at peak hours which is very alarming situation.

C. Value of L_{10}, L_{50} and L_{90} varies with speed of traffic stream.

D. Heavy loaded vehicles, poor condition vehicles, tempo, auto- rickshaw, tractor- trolley, road- rollers; excavating machines are mainly responsible for highly irritating, displeasing and intolerating noise pollution.

E. The main problem on the road of Gwalior is encroachment of roads by shopkeepers and hawkers. This leads to reduction in road width and create vehicular traffic congestion and results in large number of noise pollution.

F. Excessive sound will create physiological and psychological damages to human beings like mental stress, poor-concentration, cardiovascular diseases etc.

G. Road dividers with small plants, road side trees, making of flyovers for continuous flow of vehicles, road bifurcations are necessary for different types of vehicles, road side parking of vehicles and un-notified stoppages of commercial vehicles to be stopped. These steps will reduce some amount of vehicular noise pollution.

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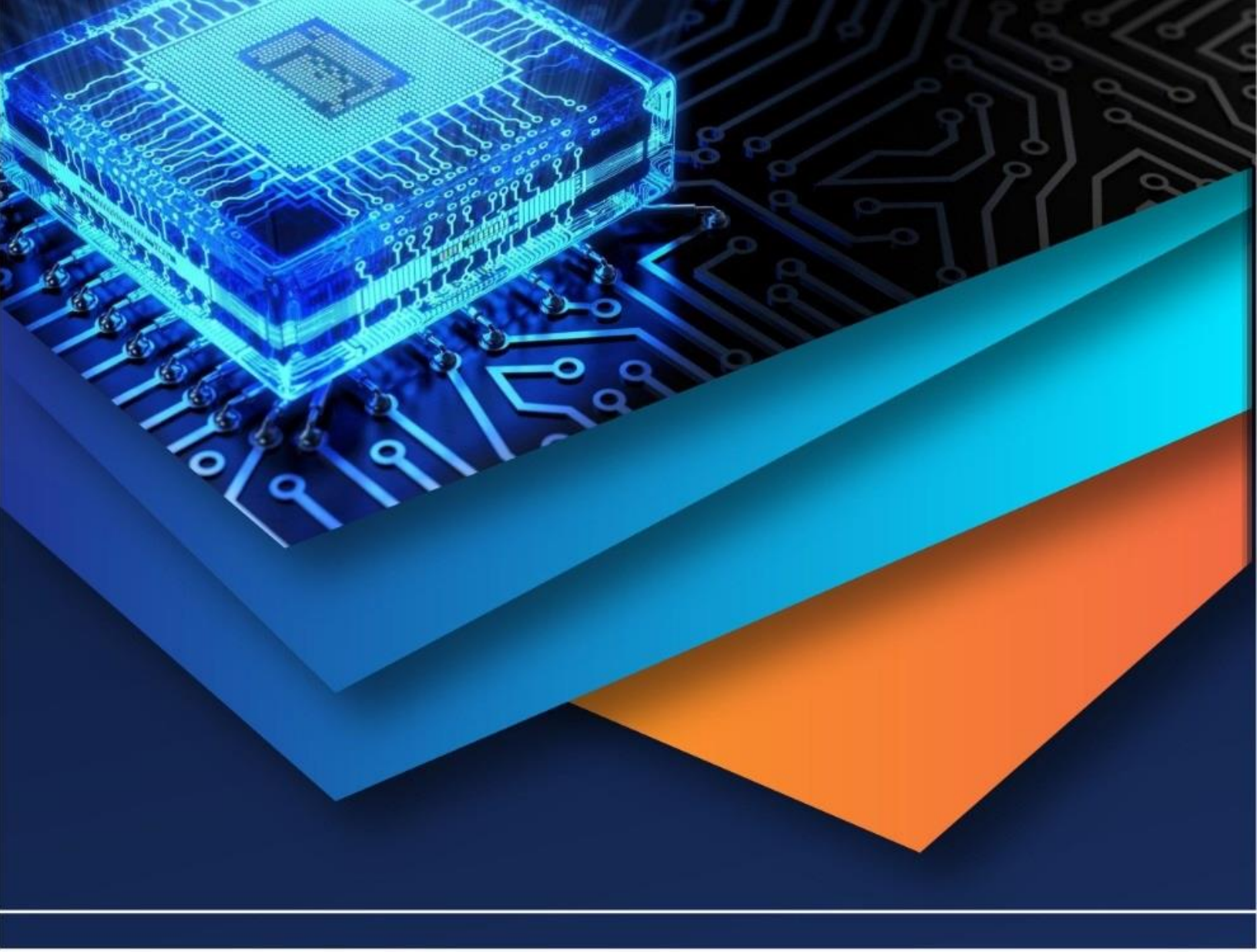

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