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Speed and Crash Analysis: A Case Study of Bangalore-Mysore Expressway

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Abstract: ***Aim: Speed is a significant risk factor for traffic safety. The study aimed to identify the most frequent predictors the explanatory variables and measurements used to study the contribution of the airspeed factorto the risk of injury in the event of a collision. Collision Risk Analysis takes into consideration the cause- effect relationships between three major factors: the human being, the vehicle, and the environment (which include the circumstances of the accident and the highway). This study focuses primarily on the analysis ofaccident risk factors, with an emphasis on the contribution of speed to injury risk.***
The proposed route is the NH 275 expressway from Bangalore to Mysore (toll from Bangalore to Nidaghatta– State of Karnataka) which is 50.5 km long. This study deals with the inventory of roads, the inventory ofsignaling, the inventory of traffic volumes, the study of point speed, the study of speed and delays, and other investigations. Accident data has been collected for the 2017-2022 stretch period and analysis is beingconducted. The goal of the study is to evaluate the road safety audit of a section of the Six-Lane National Highway (NH)-275 and the speed analysis and focus on assessing the benefits of proposed actions as a result of deficiencies identified through the audit process. Missing and medium marks must be made and speed readings should match the speed. Speed restriction and control of speed in curves and straight portionsare also deficient, requiring immediate action.
Keywords: crash risk analysis, speed, road safety audit, spot speed analysis, black spot

I. INTRODUCTION

Every year, about 1.3 million people die in road accidents worldwide, and 20 to 50 million people have non-fatal injuries. More than half of road traffic deaths and injuries affect vulnerable road users, including pedestrians, cyclists, motorcyclists, and their passengers. Young people are particularly vulnerable on roads around the world, and road traffic injuries are the leading cause of death for children and young people aged 5 to 29. Young men under the age of 25 are more likely than women to be involved in road accidents.

His 73% of all traffic fatalities occur in young men of this age. Developing countries have the highest roadaccident rates, with 93% of fatalities occurring in low- and middle-income countries. In addition to the human suffering caused by traffic accidents, traffic accidents impose a heavy economic burden on victims and their families, including medical expenses for injured people and decreased productivity for the dead and disabled. More broadly, road accidents have a severe economic impact, with countries suffering a lossof 3% of annual gross domestic product. Proven measures are in place to reduce the risk of injury and deathfrom road accidents, and the 2030 Agenda for Sustainable Development sets ambitious targets to reduce road accidents. Speed is one of the fundamental risk factors in road traffic. Higher driving speeds result infaster collision speeds and more serious injuries. Higher driving speeds mean less time to process and implement information and longer braking distances. Therefore, it is less likely that collisions can be avoided. In other words, higher driving speeds lead to higher accident rates and more serious consequences. However, not all is known about the exact relationship between speed and road safety, and the conditions that influence this relationship. This makes it difficult, for example, to calculate the exact impact of a particular spending measure.

A. What Connection Exists Between crash Severity and Speed?

Two pillars support the relationship between speed and safety. The relationship between collision speed and accident severity is the first pillar, and the relationship between speed and crash risk is the second pillar.The severity of the repercussions in terms of injury and property damage increases with the crash speed. This physical law deals with the amount of kinetic energy that is instantly transformed into things like heatand matter distortion. In addition, compared to the powerful forces unleashed after a collision, the human body is physically quite weak. Vehicles have improved their safety features during the previous few decades(crush zones, airbags, and and seatbelts) to deflect the force of a collision and cushion the occupants' injuries. But the speed of the accident still matters a lot for how the incident turns out.

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B. What Factors Determine a High Crash Location?

1) Undesignated Bus Stops
2) Curves with poor Sight Distance
3) Narrow Bridges
4) Straight long Sections
5) Miscellaneous Problems

C. Indian Road Accident Scenario

The greatest cause of death worldwide and the main cause of death for people between the ages of 15 and 49 are traffic-related injuries. Around 1.3 million people worldwide have their lives cut short as a result of a road traffic accident each year. Although people from more affluent families are more likely to be engagedin traffic accidents in high-income countries, more than 90% of road traffic fatalities, unfortunately, happen in low- and middle-income countries. With an 11% global share, India tops the list of countries with the most fatalities. 2. Given that India has one of the greatest road networks in the world, the issue of road safety becomes even more crucial. The hitherto unheard-of rates of motorization.

D. Geography of the Project

Part of the Bangalore-Mangalore Economic Corridor (EC-34), National Highway 275 (NH-275), also known as the Bengaluru-Mysuru Motorway, is a national highway that begins in Bengaluru, travels throughMysuru as a 10-lane motorway for 119 km (74 mi), then continues as a 4-lane road until Bilikere (towards Madikeri), and finally ends in Bantwal. The seaside city of Mangaluru is connected to Bengaluru by this roadway. Additionally, it serves as the National Highway 75 (NH-75) bypass. This highway's Bengaluru to Mysuru stretch was expanded from 4 to 10 lanes, with the main elevated access-controlled roadway being a 6-lane segment, and service roads on either end of the other 2-lane sections. It promises to shorten the amount of time between Bangalore and Mysore.

E. Area for Study

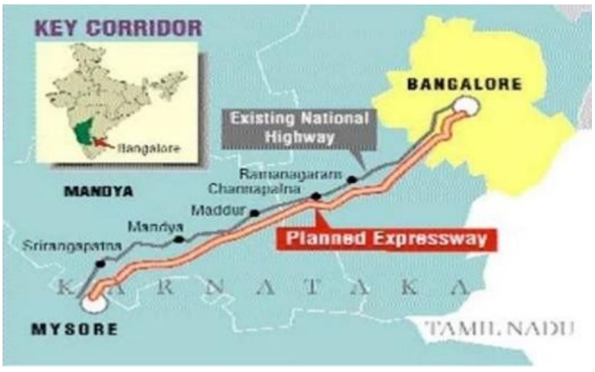
The project is divided into two parts, with Phase 1 between Bengaluru and Nidaghatta measuring 58 km and Phase 2 between Nidaghatta and Mysore measuring 61 km. It features 50 underpasses for cars and pedestrians, 19 big bridges, 44 small bridges, and 4 railway overbridges (ROBs). It also includes greenfieldsections that constitute bypasses around the cities of Bidadi (7 km), Mandya (10 km), Srirangapatna (7 km),Ramanagara-Channapatna (22 km), and Maddur (7 km with 3.5 km of elevated roadway).

F. Speed Limit on the Bangalore-Mysore Expressway

The Bangalore-Mysore expressway's current speed restriction is 100 kph. However, the speed restriction isset at 80 kmph throughout some sections. The NHAI has placed signs specifying the top speed restriction on the designated medians.

II. OBJECTIVES

Map 1



1) The project is divided into two phases, with a 58 km-long Phase 1 between Bengaluru and Nidaghatta and a 61 km-long Phase 2, which increases the risk of accidents and endangers the safety of other road users.
2) To perform an RSA in accordance with the IRC's SP: 88:2010 specifications

III. METHODOLOGY

The overview of the procedure and workflow for the study is briefly described in the methodology. The planning and study statistics that were used to carry out the analysis of road infrastructure audits are depicted in Figures 1 and 2. Observations, questionnaires, and interviews were employed as data-gatheringtechniques for the study. The average index analysis and statistical techniques are the analyses used in thisstudy.

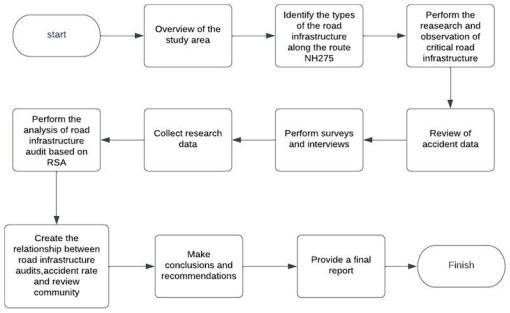


Figure 1

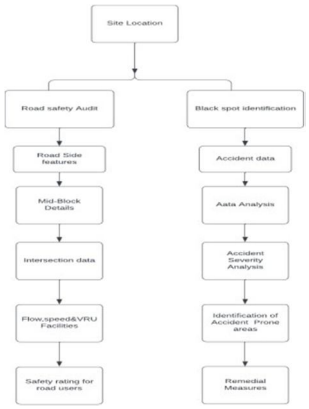


Figure 2

Road design, layout, and roadside furniture are reviewed for potential risks and/or safety flaws. The officereview, the field review, and the final report are the three stages of the road safety evaluation process.

IV. RESULT AND DISCUSSION

A. Examining the Accident Information

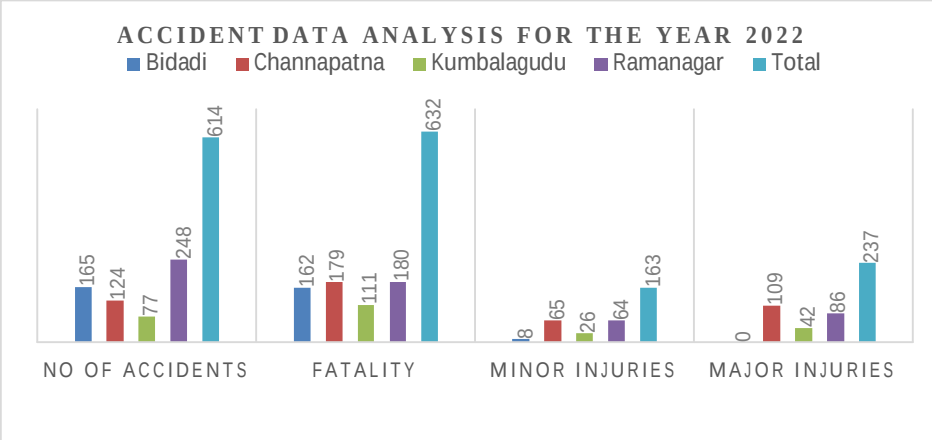
To identify the unintentional black spot on the length of NH-275, various techniques have been used in thispart for analyzing the inadvertent data that has been gathered.

B. Accidents Statistics on Collisions

The police stations at Kumbalagudu, Bidadi, Ramanagar, and Channa Patna Traffic Police Station provideddata for a maximum of five years, from 2017 to 2022.

Table 1: Road Accident Statistics of Selected Stretch

Police Station	No of accidents	Fatality	Minor injuries	Major injuries
Bidadi	165	162	8	0
Channapatna	124	179	65	109
Kumbalagudu	77	111	26	42
Ramanagar	248	180	64	86
Total	614	632	163	237



C. *Spot Speed Study*

The spot speed is the current speed at a specific area or point. Various techniques are employed. The first approach calculates how long it takes the car to travel a short distance. The instantaneous speed is then calculated. After that, pre-calibrated radar equipment that records or displays the speed in the desired units, like kmph, measures the instantaneous speed. This projectmakes use of a radar gun.

Table: Frequency Distribution of Spot Speed Data

1) Speed Statistics

Speedstat-1451 Site: NH-275.2.3NS
Description: MYSORE - BANGALORE
Filter Time: 11:33 Tuesday, February 28, 2023, => 13:39 Monday, April 10, 2023
Scheme: Vehicle classification (India Scheme 6)
Filter: Cls(1-13) Dir(NESW) Sp(10,160) Headway(>0) Span(0 - 100) Lane(0-16)Vehicles = 267065
Posted speed limit = 60 km/h, Exceeding = 213962 (30.12%). Mean Exceeding = 89.67 km/hMaximum = 159.9 km/h, Minimum = 10.1 km/h, Mean = 81.1 km/h
85% Speed = 105.84 km/h, 95% Speed = 119.70 km/h, Median =81.72km/h
20km/h Pace = 76 - 96, Number in Pace = 85951 (32.18%)

2) Speed Bins (Partial days)

Speed	Bin	Below	Above	Energy	vault	n vault
0 -10	0 0.000%	0 0.000	267065 100.0%	0.00	0.00	0.00
10 -20	1222 0.458%	1222 0.458%	265843 99.54%	0.00	0.00	0.00
20 -30	4097 1.5348	5319 1.992%	261746 98.01%	0.00	0.00	0.00
30- 40	8063 3.019%	13382 5.011%	253683 94.99%	0.00	0.00	0.00
40 -50	15184 5.686%	28566 10.70%	238499 89.30%	0.00	0.00	0.00
50- 60	24537 9.188%	53103 19.88	213962 80.12%	0.00	0.00	0.00
60 -70	32427 12.14%	85530 32.03%	181535 67.97%	0.00	0.00	0.00
70 -80	39643 14.84%	125173 46.87%	141892 53.13%	0.00	0.00	0.00
80- 90	43666 16.35%	168839 63.22%	98226 36.78%	0.00	0.00	0.00
90 -100	39618 14.83%	208457 78.05%	58608 21.95%	0.00	0.00	0.00
100 -110	28759 10.77%	237216 88.82	29849 11.18%	0.00	0.00	0.00
110- 120	16918 6.335%	254134 95.16%	12931 4.842%	0.00	0.00	0.00

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120 -130	7830 2.932%	261964 98.09%	5101 1.910%	0.00	0.00	0.00
130- 140	3349 1.254%	265313 99.34	1752 0.656%	0.00	0.00	0.00
140 -150	1263 0.473%	266576 99.821	489 0.183%	0.00	0.00	0.00
150 -160	489 0.183%	267065 100.0%	0 0.000%	0.00	0.00	0.00
160- 170	0 0.000%	267065 100.0%	0 0.000%	0.00	0.00	0.00
170 -180	0 0.000%	267065 100.0%	0 0.000%	0.00	0.00	0.00
180- 190	0 0.000%	267065 100.0%	0 0.000%	0.00	0.00	0.00
190- 200	0 0.000%	267065 100.0%	0 0.000%	0.00	0.00	0.00

SOURCE: 3E Consultancy

Variance = 585.28, Standard Deviation = 24.19 km/hTotal Speed Rating = 0.00
Total Moving Energy (Estimated) = 0.00

Speed limit fields (Partial days)

	Limit	Below	Above
0	60 (PSL)	53103 19.9%	213962 80.1%

Speed limit fields (Partial days)

	Limit	Below	Above
0	60 (PSL)	113544 33.3%	227011 66.7%

From the above tables speed of the vehicle was found to be higher as per IRC standards.

D. Road Inventory

In the chosen stretch, a road inventory survey was carried out to determine the current conditions, includingthe width of the road and the footpath, the width of the shoulder, the type of paving, the condition of the paving, the shoulder, the footpath, and information about the crossroads.

The cross-section shows details such as the width of the carriageway, shoulders, median, and drains. To learn more about the current state of the route, a road inventory survey is carried out. In RSA, the cross-section is examined to see if its performance and dimensions meet IRC requirements.

Highway Accident A black spot is a section of the national highway that is around 500 meters long and where either 5 accidents (in all three years combined) resulted in fatalities or grave injuries, or 10 accidents resulted in fatalities or grave injuries during the previous three calendar years.

E. Analysis Using Visual Survey

Many parameters can result in accidents but the most predominant parameters areselected which are as follows:

1) Visibility at junctions
2) Improper shoulders
3) Small subsidiary road meeting at a junction or unauthorized junction
4) Improper transition of roads
5) Absence of side rails
6) Unguarded bus stops, roadside vendors, or road encroachment
7) Absence of sign boards, reflectors, or road markings
8) Drainage facility
9) Road surface condition
10) Improper median or divider

No End Treatment



No Slope Protection



No Dip Sign Board/No Advance Warning



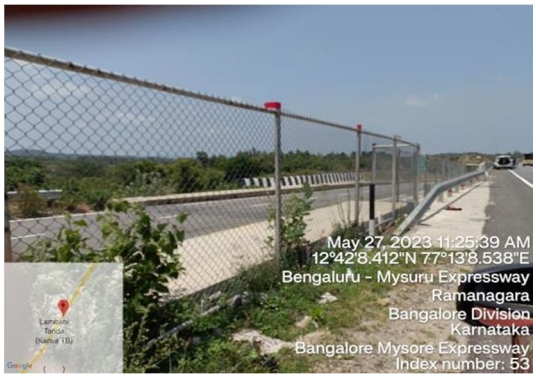
No Merging /Diverging AdvanceWarning Sign Boards



Illegal Approach From Service Road To Nh



No Hazarder Marker



No Advance Warning About Curve/Cheron Marker/Delinataor



Sos Not Working



V. CONCLUSION

The following findings and recommendations were made during a road safety audit:

1) Road markings, which are required by IRC-35, were not present on the primary legs of the intersection.
2) The NH has no infrastructure that allows pedestrians to cross safely from one side to the other. Dueto a VILLAGE being right there at the interface, a pedestrian subway is required.
3) Guardrails were missing and medians were not adequately maintained; as a result, IRC-119 must benotified that guardrails are present.
4) Proper signage that should be posted in accordance with IRC-67 is missing.
5) Shoulders are not provided in accordance with IRC Manual IRC SP 87 and SP 73 requirements**.**
6) Setting speed limits for entering and exiting traffic at the crossroads in accordance with IRC 67 to ensure safe movement.
7) To improve visibility at the crossroads during inconvenient hours and bad weather, proper lighting facilities must be installed.
8) Cut Provide a Hazard and Maintain the Left Sign at the median.
9) At the Service Road Diversion, post a Hazard Marker and a Pass on either Side Sign.
10) In addition to EMERGENCY, the Warning Signs for the cut in the median must be visible at 180-245 meters from the Hazard. turn with caution while maintaining a reasonable distance
11) The requirement to post speed limit signs at regular intervals is number 6. Offer Transverse BarMarking (TM 08) for a psychological speed reduction
12) Provide a convergent and divergent Chevron marking sign in accordance with the appendix IRC Table A.3 for 2015 8. For the full longitudinal Stretch, provide Edge Line Marking LM24/25 and LaneMarking LM18/19.
13) Install W-Beam Crash Barriers on the raised median and across deep drainage ditches (with a roughsurface).
14) The modern solution is to provide the crash cushion or impact attenuators at the end of the W-beamguard rail, which must be flared away.
15) Supply road studs in accordance with IRC specifications IRC 84-2012 Table 9.1 (Warrants for Road Studs) and IRC 35-2015
16) Offer trucks a truck layby. In IRC-84-2012, a typical diagram is shown.

VI. RECOMMENDATION

In the curves, the following suggestion was made:

1) The influence of a warning sign before a sharp bend on approaching and navigating cars will varydepending on where it is placed.
2) The location of warning signs affects how drivers lane-position their cars before sharp turns. In comparison to warning signs placed at 0 m or 50 m, drivers would drive more closely to the centerline in tangents if they were placed at 100 m, 200 m, or 400 m before acute curves.
3) The positioning of a warning sign before a sharp bend affects how drivers behave there. When driving through the severe bends, particularly in the middle of the curve, the car is closer to the inner boundary. A driver's adjustment amplitude of the lane position of a vehicle in a sharp curve is also influenced by the position of the warning sign. Meanwhile, a warning sign placed in a sensible location before a severe bend can significantly lower run-off-the-road collisions.
4) Widening shoulders and lanes on curves.
5) Increasing the clear roadside recovery distance by moving utility poles and trees, 5) Increasing theamount of superelevation (up to permissible maximums of 0.80 and1.0 in urban and rural locations,respectively).
6) Enhancing vertical and horizontal alignment by avoiding abrupt downgrades and left-hand turns.
7) Ensuring adequate pavement surface drainage on bends with large radii and in places wherecross drainage extends beyond the width of a lane.
8) Giving downgrade curve places increased surface anti-skid resistance.

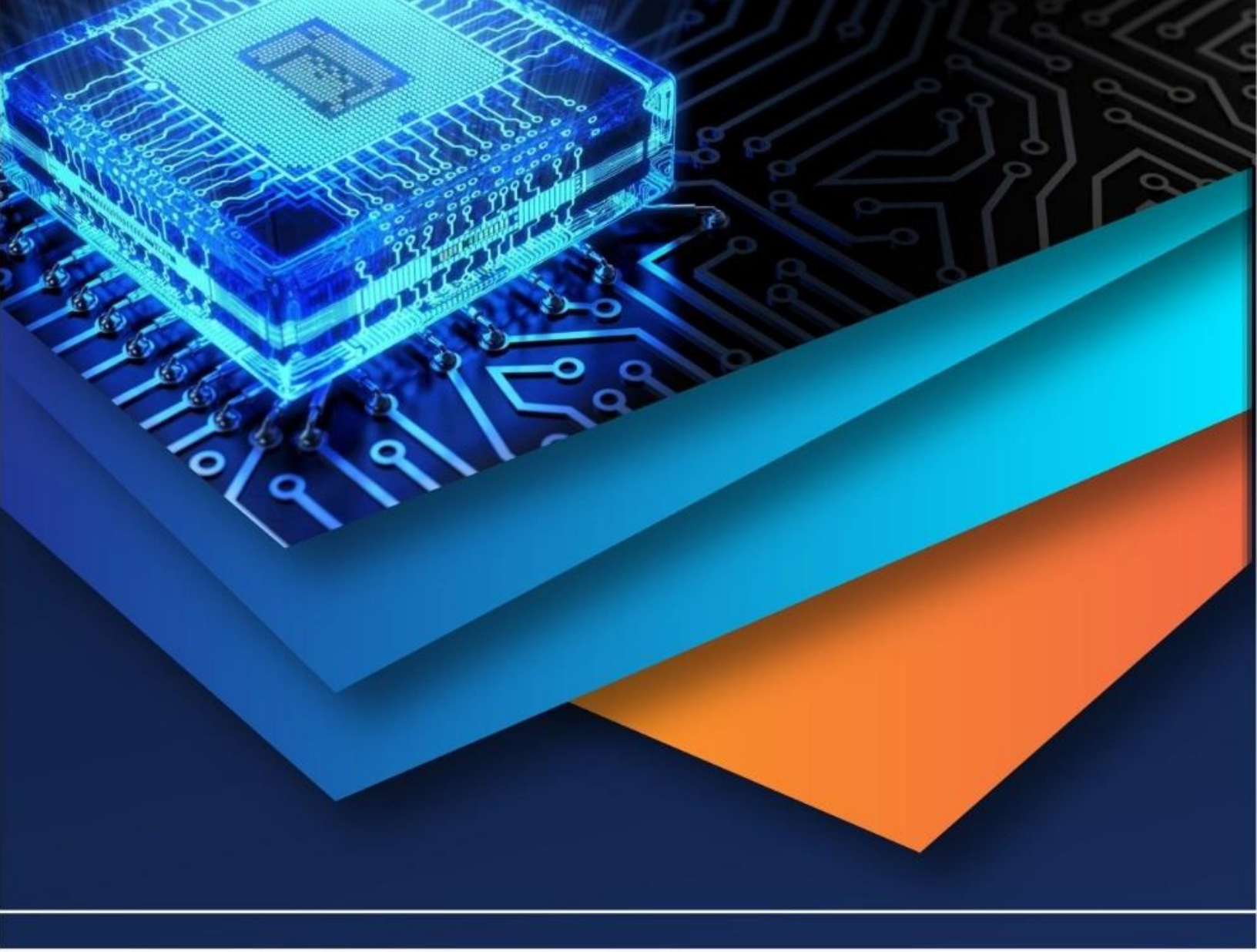
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2. IRC:67CodeofPracticeforRoadSigns
3. IRC: 88 Road safety manual
4. IRC:79Recommended Practices for Road Delineators
5. IRC: SP:73ManualofSpecificationsandStandardsforTwoLaningofHighwayswithPavedShoulders
6. IRC: SP:84Manualof Specifications and Standards for Four Lanes of Highways
7. IRC: SP:87Manualof Specifications and Standards for Six Lanes of Highways
8. IRC: SP:99ManualofSpecificationsandStandardsforExpressways
9. IRC:65GuidelinesforPlanningandDesignofRoundabouts
10. IRC:99GuidelinesforTrafficCalmingMeasuresinUrbanandRuralAreas
11. IRC: SP: 55 Guidelines for Traffic Management in Work ZonesIRC:119 Guidelines for Traffic Safety Barriers



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