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Road Safety Audit: A Detailed Analysis of Dhandhuka to Dholera (SH-20) in Gujrat State

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Abstract: ***In country like India road accident result in loss of lakhs of human as well as animals lives and severe injuries to crores of people. In India itself more than eighty thousand people are killed in road accidents every year. The present transport system has reduced the distances but it has on the other hand increased the life threat. In most of the cases accident arises either due to negligence or due to lack of road safety attentiveness of the road user. Our ambition is to provide road safety information for road users to inspire safer road user behavior among current and approaching road users and minimize the number of people killed and injured on roads each year. In this study, the section of road from "(Dhandhuka to Dholera road state highway 20)" near Ahmedabad in the state of Gujrat. Road having considerable traffic during day time and some black spots on the road where accidents takes place continuously. A detailed analysis of road is carried out on the basis of data collection like classified traffic volume study, accidental data collection, potholes on road data collection, road safety signs and symbols, crust details of existing road etc.***

I. INTRODUCTION

A. *General*

Accord to the NCRB data, around 1.50 lakhs human deaths were observed in road accident in India in the year 2021 that is the highest among previous years. The reduction in accident crashes were observed in the year 2020 due to lockdowns and travel restrictions. According to report the no. of accidents were less than before pandemic period but the no. of deaths have raised after pandemic. States of Tamil Nadu (56,975), Madhya Pradesh (49,312), Uttar Pradesh (35,998), Kerala (33,217) and Maharashtra (30,333) reported high number of accidents. Deaths per 100 km of National Highways have come down from 44 in 2018 to 40 in 2021. According to World Bank report (‘*Traffic Crash Injuries And Disabilities: The Burden on India Society*‘) India accounts for 11% of the global death in road accidents despite having just 1% of the world’s vehicles. The road accidents costs INR 6 lakh crore or 3.14% of Gross Domestic Product (GDP).

Key map of selected study stretch (Source :- Google maps)

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II. OBJECTIVE OF THE STUDY

The main purpose of the study was to recognize the safety deficit and accident prone spots on SH-20 section from Dhandhuka to Dholera (approx. 27Kms). Based on which recommendations for appropriate safety measures that need to be provided at accident prone locations where being made as per the Guidelines for the existing road network as per IRC SP:88-2019 and various risk factors and priorities of their therapies were suggested. The aim of this study is to avoid the happening of any type of accident or to mitigate the harshness of possible crash on Dhandhuka to Dholera Section of SH-20, thus to making the road journey safe and ease for all road users and surroundings.

III. LITERATURE REVIEW

1) *Omkar Gholap 2018* In this study, Road taken having considerable traffic during day time and some black spots on the road where accidents takes place continuously. They have collected peak hours & normal hours traffic volume, real time potholes, accident analysis data etc. From the above study they concluded that continues contact with potholes present on the road leads to major health issues. By cumulative study of various conditions The aim of study is the inspecting the road in the terms of the safety measures, road scenario, any type of flaws and to suggest the mitigative and preventive measures for the selected section of road for audit.
2) *Yuha Huvarinen 2016* They have concluded that the need of safety auditing the roads they found the audit may prevent about 27% of the road accidents. Prevention of such significance cost of community justifies the cost required for safety audit performance and implementation of audit proposals. According to study safety audit can be implemented at any stage from planning to completion
3) *Sudipa Chatterji* 2019 In their study they identified the risk factors and given countermeasures for that. By analyzing they found the most of the road users suffers about the concept of road safety. By education and awareness about the road safety one can influence and change their behavior towards road safety. According to him school based education about the road safety can still safe attitudes of young people early which leads to reduction in number of road accidents.
4) *Dr. S. S. Jain 2011* The study aims to evaluate Road Safety Audit of a section of four-lane National Highway NH- 58 they raised the issue of road standards such as high speeds. From data simulation process they found that, Road Markings, Condition of Shoulder, Traffic Volume, Spot Speed, Median Opening and Carriageway condition were main parameters for causing accidents they also observed the slow moving traffic creating hazards for fast moving traffic as it always occupied the innermost lane of highway. They also mentioned unauthorized median openings, adequate provisions for crossing local peoples, undeveloped major and minor intersections, adequate lighting provisions etc.

IV. DATA COLLECTION

A. *Traffic Survey*

Traffic volume count survey has been done at ch. 7+250 for 4hr day & night pick hour time (8AM to 12PM) and (4PM to 8PM) for 7 days of week including sunday. Avg. traffic volume has been converted into PCU as per IRC guidelines. Summary of ADT and AADT in terms of total vehicles and equivalent PCU is given.

Table 4.1 Summary of ADT and AADT at Ch. 7+250

Type of vehicle	ADT		AADT	
	Number	PCU	Number	PCU
Two wheeler	1824	912	1459	730
Three Wheeler	297	297	237	237
Car/Jeep	580	580	464	464
Bus Mini	10	15	8	12
Bus standard	63	189	50	151
LCV	208	312	166	249
Truck 2A	104	313	83	250
Truck 3A	252	757	202	605
MAV 4-6 A	160	720	128	576
MAV >6A	6	25	5	20
Tractor trailer	46	208	37	167
Tractor	20	30	16	24
Cycle	7	4	6	3
Cycle Rickshaw	1	2	1	2
Animal Cart	1	7	1	5
Other	4	17	3	13
Total	3582	4386	2866	3509

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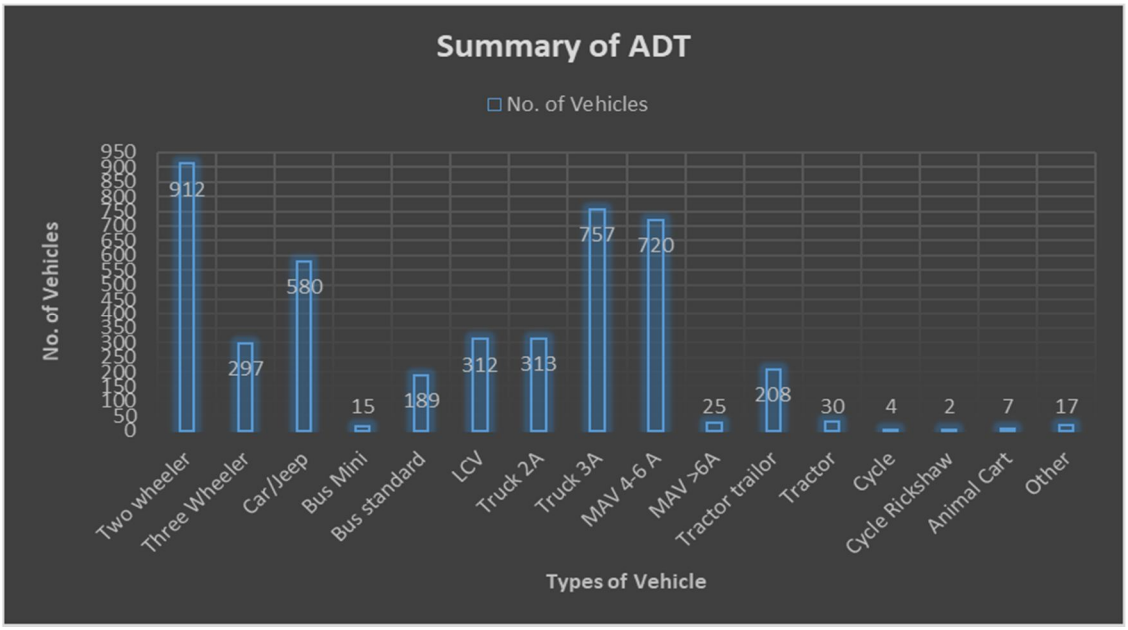
Chart 4.1 Bar Chart for various types of vehicles running on the stretch in PCU



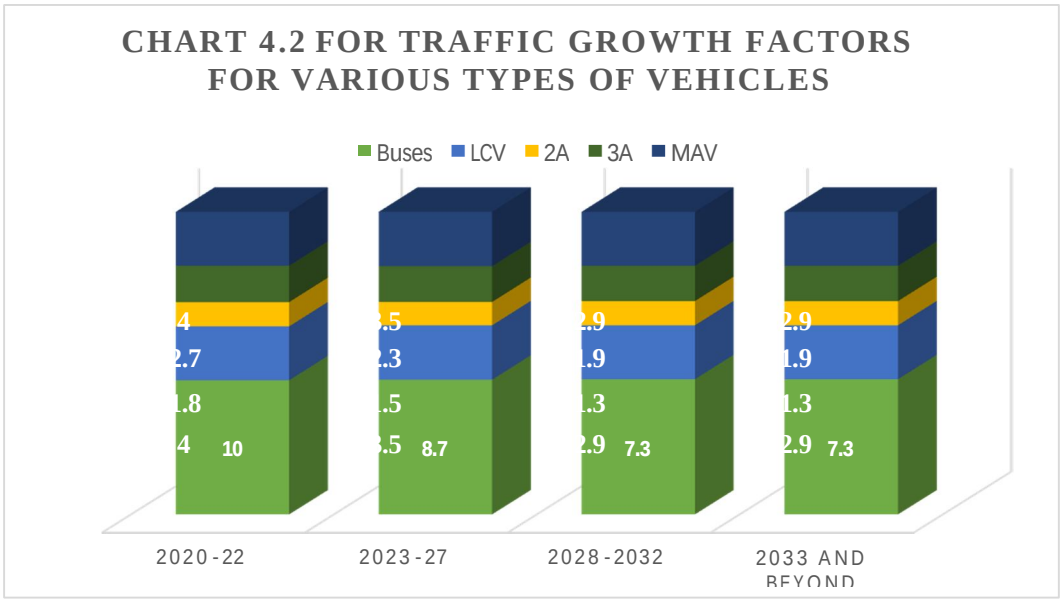
B. Traffic Growth Rates

Traffic growth rates has been assessed as per economic indicators and registration of vehicles. For reference the growth rates adopted in DPR have also been considered.

The summary growth factors for various types of vehicles from analysis are given.

Table 4.2 Summary of Growth Rates

Vehicles	Buses	LCV	2A	3A	MAV
2020-22	10.0	4.0	1.8	2.7	4.0
2023-27	8.7	3.5	1.5	2.3	3.5
2028-2032	7.3	2.9	1.3	1.9	2.9
2033 and Beyond	7.3	2.9	1.3	1.9	2.9



Design Traffic

For assessing the design traffic the following parameters have been adopted:

1) *Design Life:* Design life of 15 years has been adopted as stage construction is not permitted.
2) *Traffic Growth Rates:* Traffic growth rates have been taken as per analysis. The MSA has also been assessed considering minimum 5% growth rate of all commercial vehicles. The maximum of two values has been taken as design traffic for pavement design.

C. Assessment of Design Traffic as per Analyzed Growth rates is Given.

No. of Vehicles in the Year	Bus	LCV	2 Axle	3 Axle	MAV	Total	ESAL (MSA)	
							Yearly	Cumulative
2020 (In the year of completion)	64	173	84	207	138	667		
2021	70	180	86	213	144	693	1.18	1.18
2022	77	187	88	219	150	720	1.22	2.40
2023	84	193	89	224	155	745	1.26	3.66
2024	91	200	90	229	160	771	1.29	4.95
2025	99	207	92	234	166	798	1.33	6.28
2026	108	214	93	240	172	826	1.37	7.65
2027	117	222	94	245	178	856	1.41	9.05
2028	126	228	96	250	183	882	1.44	10.49
2029	135	235	97	255	188	909	1.48	11.97
2030	145	242	98	259	194	937	1.51	13.48
2031	155	249	99	264	199	967	1.55	15.03
2032	167	256	101	269	205	997	1.59	16.62
2033	179	263	102	274	211	1029	1.62	18.24
2034	192	271	103	280	217	1063	1.66	19.91
2035	206	279	105	285	223	1098	1.71	21.61

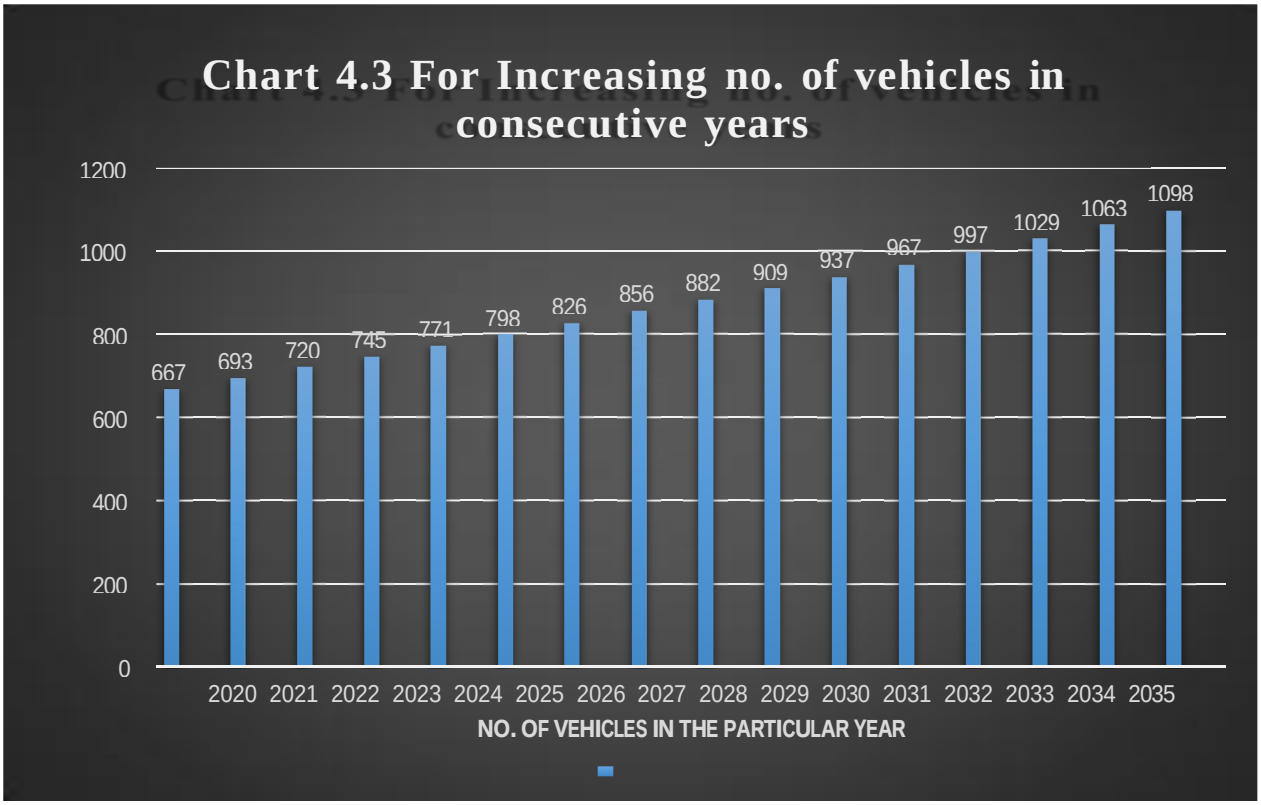


Table 4.6 Summary Pavement Condition Dhandhuka-Dholera

S. N0.	Over all condition	Chainage		Length	Total length	Percentage of length
		From	To			
1	Good	15.000	18.000	3.000	3.000	11.11
2	Fair	0.000	15.000	15.000	24.000	88.89
		18.000	27.000	9.000		
3	Poor	-	-	-	0.000	0.00
Total				27.000	27.000	100.00

Table 4.10 Accident Report of selected stretch from year 2016 to 2022

Year	Minor	Grievous	Fatal	Total
2016	1	0	1	2
2017	2	2	0	4
2018	1	1	1	3
2019	0	0	2	2
2020	0	0	2	2
2021	0	0	1	1
2022	0	1	0	1

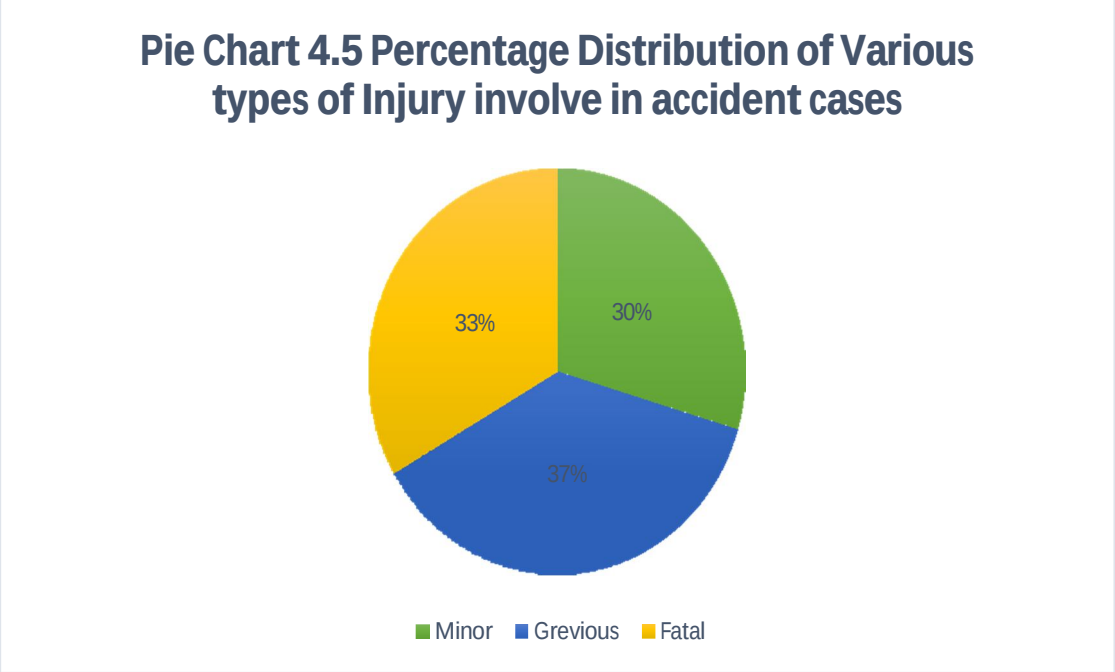


Figure 5.1 Layout plan of 2-lane Black Spot Junction

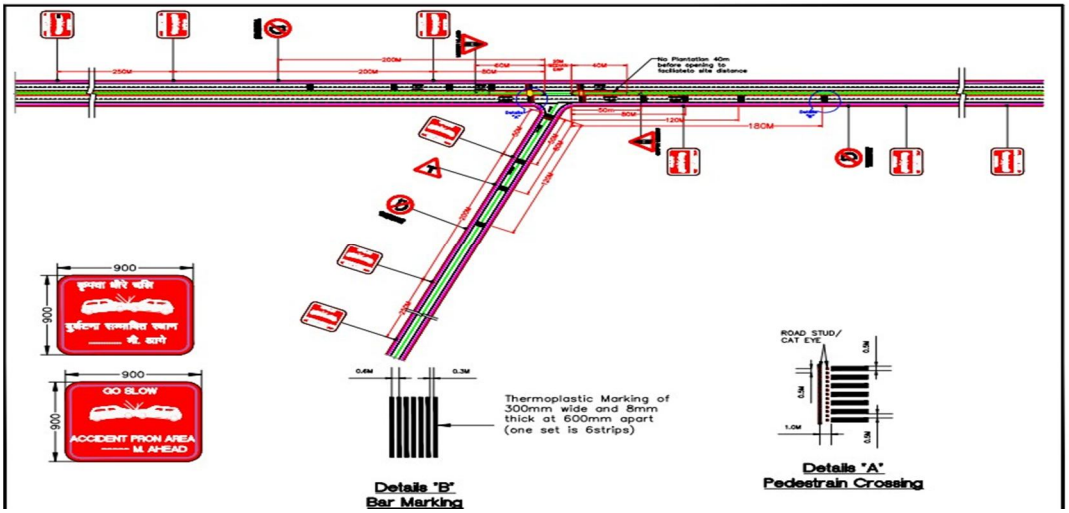


Table 5.1 General Observations

S. No.	Chainage (Meter)	Existing Road Features (Dhandhukato Dholera)	Suggestions
1	0+000	Major Junction Black spot identified	Speed breaker must be provided with proper warning signs
2	0+010	Damaged metal road delineator sign board	Damaged delineator should be changed & median side kerb should be repaired.
3	0+000 to 1+500	RCC Cover Drain installed	Elevated drain above FRL should be re-erected at suitable level.
4	0+170	Cross Road culvert	Head wall should be repaired
5	0+310	Tilted Double Chevron right direction sign board	Sign board must be realigned
6	0+600	Faded in colored Stone HM	HM Stone must be painted
7	0+750	Speed Breaker installed	Thermoplastic material painted on should be breakers
8	1+050	Minor Junction	improper wing approach
9	1+450	Solar Traffic Blinker	Damaged must be repaired
10	1+800	Damaged HM Stone	Damaged must be repaired
11	2+167	Metal Beam Crush Barrier	Damaged must be repaired
12	2+170	Hazard Marking	Sign board must be repaired
13	2+720	HPC Pipe Culvert	Sign board must be repaired
14	3+355	Speed Limit Sign	Over speeding is observed at such place
15	3+405	Left Hand Curve	Sign board not as per specifications
16	6+770	T-Junction	Suitable Sign board must be installed
17	6+830	Box Culvert	Jerk Observed at approach slab
18	6+850	Speed Breaker	Missing thermoplastic painting
19	6+960	Speed Limit Sign	Sign board must be repaired
20	7+090	Metal Beam Crush Barrier (MBCB)	Damaged must be repaired
21	7+285	Bus Bay with shelter	Barricading required
22	7+330	Metal Beam Crush Barrier (MBCB)	SSD & OSD is not Sufficient
23	7+470	Cross Road Culvert	Parapet wall must be repaired
24	7+690	Minor Junction	Proper control is required
25	7+990	Right Hand Curve	Missing Sign Board
26	8+075	HPC Pipe Culvert	Encasing must be required
27	8+520	Access Road	Sign board must be installed
28	9+000	Kilometer Stone	Damage must be repaired
29	9+790	HPC Pipe Culvert	Hazard marking missing, should be installed
30	11+630	Speed Limit	Tilted sign board must be repaired & over speeding is observed
31	11+740	Double Chevron Sign Board	Faded in color should be painted
32	12+000	Minor Junction	Speed Breaker is required.

33	12+900	Pipe Culvert	Damaged Parapet wall should be repaired
34	13+880	Cross Road Culvert	Jerk at Approach is observed & Pothole on road surface is observed.
35	14380	Cautionary Sign Board	Tilted sign board must be repaired
36	14+435	T- Junction	Improper linking of major & minor road
37	15+750	Metal Beam Crush Barrier (MBCB)	Damaged must be repaired
38	15+822	Double Chevron Sign Board	Sign board must be repaired
39	16+130	Speed Breaker	Thermoplastic material should be painted for proper visibility in night.
40	16+245	Left Hand Curve	SSD & OSD is not obtaining
41	17+374	Pipe Culvert	Should be painted as per specifications
42	17+830	Earthen Shoulder	Vegetation should be removed from shoulder side
43	20+560	Speed Limit Sign Board	Over-speeding of observed
44	20+900	Metal Beam Crush Barrier (MBCB)	Damaged must be repaired
45	22+300	Y- Junction	Improper linking of major & minor road
46	22+534	Minor Bridge (MNB)	Damaged crush barrier should be reinstalled
47	22+930	Right Hand Curve	Tilted sign board must be repaired
48	24+135	Continuous Pipe Culvert	Height of Safety Barrier must be increased.
49	26+790	Staggered T Junction	Speed Breaker must be installed
50	27+000	Major junction	Black spot is observed.

D. Safety Audit Recommendations

1) Continuous vegetation growth, branches and bushes along side of the roadway causing the invisibility on horizontal curve and facing the problem of sight triangle visibility on intersection, also covering the successful width of carriageway leads to severe accident at night time mainly. Thus, an urgent need to control the excessive vegetation is required throughout the stretch.

2) Frequently electric pole along side of the highway causing distraction to the high speed movement of traffic stream. Thus an urgent need to maintain such poles or to be shifted elsewhere at suitable location.

3) Illegal side road movement cause the inappropriate merging and diverging. Thus, the approach of such path should be changed or to be closed permanently can be effective to preventing such wrong turning movement of vehicles.

4) Over speeding of the vehicle causing severe accidents. Traffic calming measures should be taken to prevent the over speeding of the vehicles.

5) Road side barriers at complex locations can be effective in guide the driver at night time. Thus an urgent need to maintain the damaged barriers and should be painted by retro reflective colors to enhance night time visibility.

6) Less overtaking opportunities due to slow moving heavy vehicles are affecting the overall journey time for the fast moving vehicles hence extra widening at few sections are suggested to rectify this problem.

7) Parking of vehicle on road side shoulder are also causing the distraction to the operation of traffic movement. This should be prevented by strict enforcement of law and order.

8) Road marking throughout the highway is suggested with road studs on both side to guide the traffic in night time. Accident statistics shows that the frequency of heavy vehicle involvement in the accident is very high. Thus, illegal operation of such heavy loaded vehicles should be checked by the government officials.

9) There should be an annual Road Safety Audit of the roads to checks efficient operation of traffic and severity measures on the highway.

V. CONCLUSION & RECOMMENDATIONS

A. Conclusion

There were 50 numbers of sign board has been found in damaged or in tilted position throughout the section.

1) More than 50 locations were identified with accidental zone where severe incident can be occur, such locations are without any sign board, damaged crush barrier, without speed breaker, damaged head wall, this situation leading to misguide the vulnerable road users leads to severe accident at day & night time. Thus, there is an urgent need to installation of these features.

2) Major & minor junctions were identified without any control from entry and exit.

3) Unnecessary growth of vegetation and tree bushes were found throughout the section of the roadway on both side of the shoulder blocking the visibility and also affecting the traffic movement of the section.

4) Pavement deterioration condition such as alligator cracks, longitudinal cracks, pot holes, edge cracking were found at most of the locations that leading to further damage to the pavement surface.

5) Small narrow bridge were found without any marking or painted leads to hazards at locations.
6) Stray animals or cattle were found to feed the grass on shoulder causing danger to the vulnerable road users.
7) Over speeding of the vehicles were noticed at speed limit zones leads to severe accident along the roadway.

B. Recommendations

1) Continuous vegetation growth, branches and bushes along side of the roadway causing the invisibility on horizontal curve and facing the problem of sight triangle visibility on intersection, also covering the successful width of carriageway leads to severe accident at night time mainly. Thus, an urgent need to control the excessive vegetation is required throughout the stretch.
2) Frequently electric pole along side of the highway causing distraction to the high speed movement of traffic stream. Thus an urgent need to maintain such poles or to be shifted elsewhere at suitable location.
3) Illegal side road movement cause the inappropriate merging and diverging. Thus, the approach of such path should be changed or to be closed permanently can be effective to preventing such wrong turning movement of vehicles.
4) Over speeding of the vehicle causing severe accidents. Traffic calming measures should be taken to prevent the over speeding of the vehicles.
5) Road side barriers at complex locations can be effective in guide the driver at night time. Thus an urgent need to maintain the damaged barriers and should be painted by retro reflective colors to enhance night time visibility.
6) Less overtaking opportunities due to slow moving heavy vehicles are affecting the overall journey time for the fast moving vehicles hence extra widening at few sections are suggested to rectify this problem.
7) Parking of vehicle on road side shoulder are also causing the distraction to the operation of traffic movement. This should be prevented by strict enforcement of law and order.
8) Road marking throughout the highway is suggested with road studs on both side to guide the traffic in night time. Accident statistics shows that the frequency of heavy vehicle involvement in the accident is very high. Thus, illegal operation of such heavy loaded vehicles should be checked by the government officials.

There should be an annual Road Safety Audit of the roads to checks efficient operation of traffic and severity measures on the highway

Ch. 26+500 Damaged speed limit sign board

Ch. 7+700 Hazard marking sign board found damaged & faded condition

Ch. 16+485 Speed Limit sign board found in damaged condition

22+300 Left turn chevron sign board found in damaged condition

Ch. 20+900 Missing road marking & rain cuts observed near earthen shoulder

Ch. 16+440 Right hand chevron sign board found in damaged condition

Ch. 3+635 Left turn sign board found in damaged condition & construction material dumped near shoulder

Sign board found damaged at Ch. 7+290

24+260 Left turn chevron sign are missing & protection wall has been suggested in place of W-Beam cross barrier

Ch. 0+000 Black Spot point Observed

Ch. 15+750 Metal Beam Crush Barrier (MBCB) damaged must be repaired

Ch. 0+010 Damaged delineator sign board should be changed & median side kerb should be repaired.

Ch. 3+530 Alligator cracking is observed on Pavement Surface

Ch. 20+560 Damaged Speed Limit Sign Must be repaired

Ch. 17+574 Pipe Culvert Should be painted as per specification

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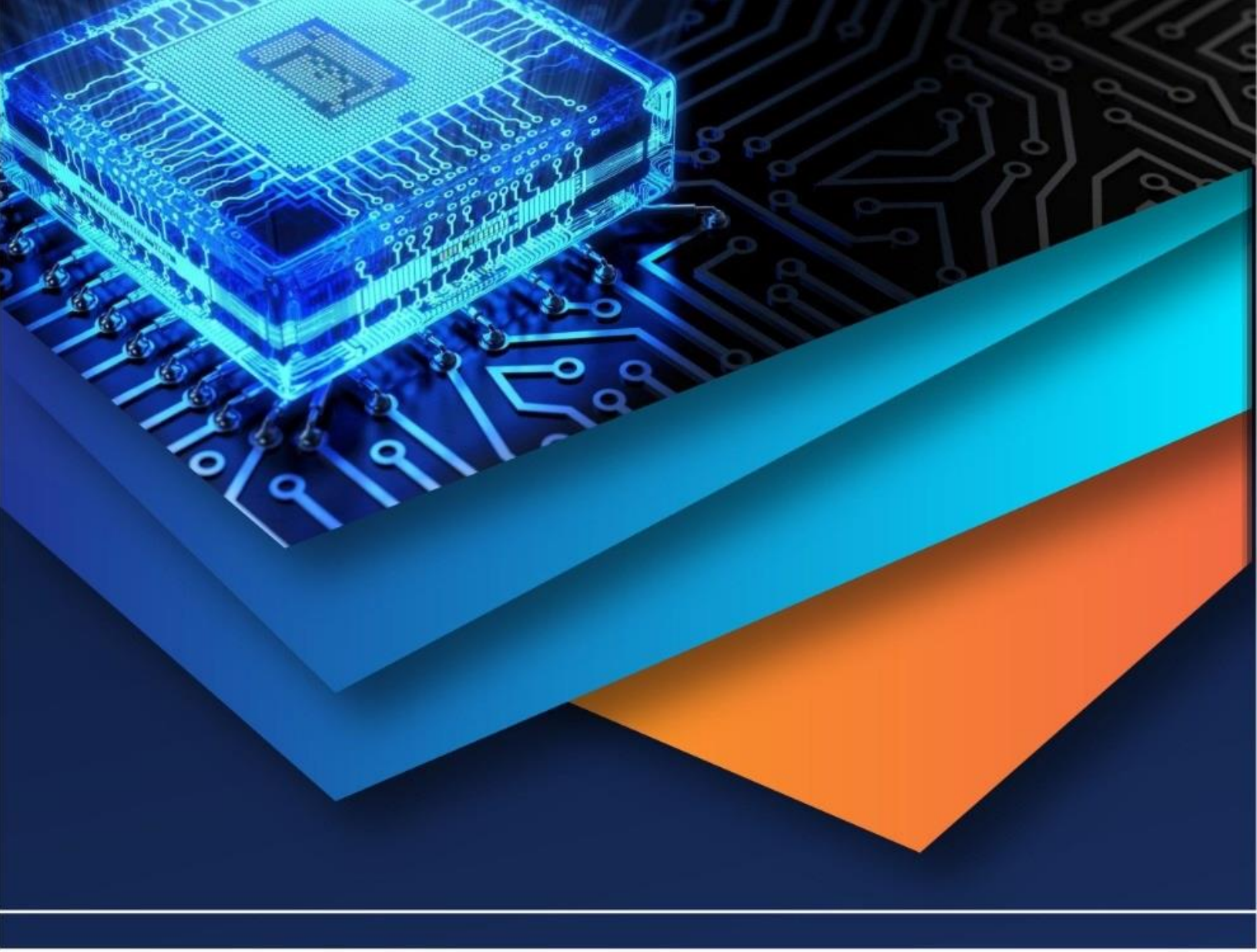

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