



Road Crash Analysis: A Case study between Dahod to Godhra and Remedial Measures

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Abstract:- The road Crash deaths and injuries are global phenomenon, but more severe is the situation in mixed traffic conditions, as prevailing on Indian multilane highways. Owing to the likely under-reporting of crash, the real situation is likely to be much worse. Road safety has become a growing concern for the public, in general and highway professionals, in particular, as road crashes are a major source of loss of life. For this paper stretch of NH-59 has been selected from Dahod to Godhra. The crash data was collected for last seven years, 2008-2014 from the police stations. The year wise distribution shows that in the 2010 about 19.02% maximum crash take place. The collected data were analyzed to evaluate the effect of influencing parameters on crash rate. Heavy vehicles like truck are involved in maximum number of crashes on the selected stretch. It is estimated that a truck is involved in almost 32% crashes followed by two – wheelers 23% and car 21%. There is estimated that in month wise maximum crashes occurred in March and April. In time wise higher crashes occurred between 4.00 pm to 6.00 pm.. Traffic volume count and road inventory survey carried out at NH-59 on selected stretch.

Keywords: - Road safety, Injury, Fatal, Serious, Crash severity

I. INTRODUCTION

The highway traffic is increasing at a fast rate and the safety of vehicular movements becomes a concern for everybody due to loss of lives and properties along with injuries and periodical obstruction of traffic flow. National highways provide the satisfactory and efficient mobility and accessibility function. Road crashes are essentially caused by interactions of the vehicles, road users and roadway conditions. Each of these basic elements consist of a number of sub elements, like pavement characteristics, geometric features, traffic characteristics, road user's behaviour, vehicle design, driver's characteristics and environmental aspects.¹

Road crashes are human tragedy, which involve high human distress. They impact a huge socio-economic cost in terms of untimely deaths, injuries and loss of potential income. The division of road crashes can be enormous and its negative impact is felt not only on individuals, their health and welfare, but also on the economy. Consequently, road crashes has become an issue of national concern.²

II. OBJECTIVES OF STUDY

The objectives of study area as below:

- To study the causes of crashes and suggest remedial measures.
- To identify critical crash location on selected stretch of Dahod (CH: 00.00 km) to Godhra (CH: 62.00 km) on NH-59.

III. SCOPE OF STUDY

The scope of study was limited to following

- To perform Road Inventory Survey from Dahod to Godhra on NH-59.
- To perform traffic surveys at the selected locations .
- To collect crash data from various Police station on selected stretch on NH-59.

IV. METHODOLOGY

The steps followed during study are depicted in figure1.

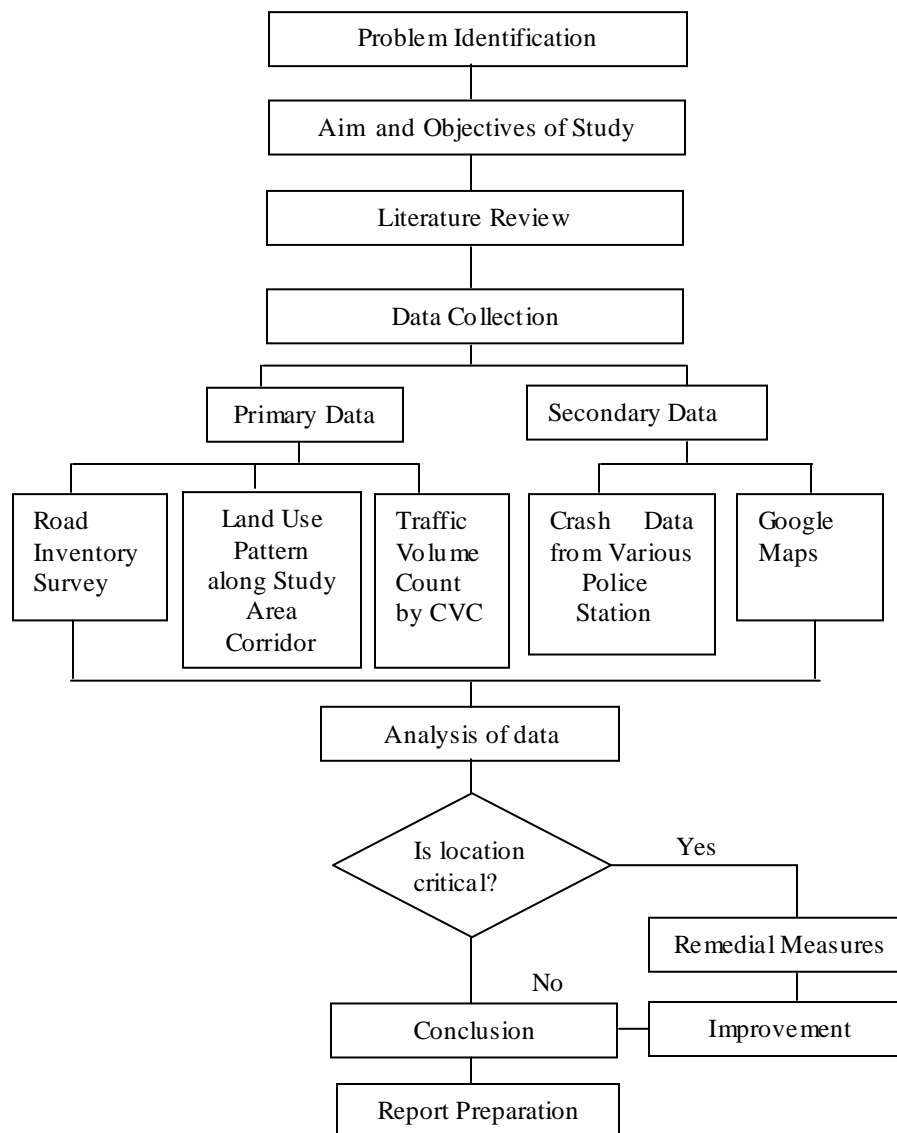


Figure 1: Framework of study

V. STUDY AREA LOCATION

NH-59 plays important role in passenger and Goods transportation. The stretch between Dahod to Godhra is selected for study. Dahod and Godhra are important urban growth centers of state of Gujarat. NH-59 joins major traffic generators starting from Ahmedabad (Gujarat) in west and Gopalpur (Odisha) in East of India, the length of this East-West corridor is 1735.5 km. 62 km length between Dahod to Godhra is selected for crash study. The location of study stretch is shown in figure.2

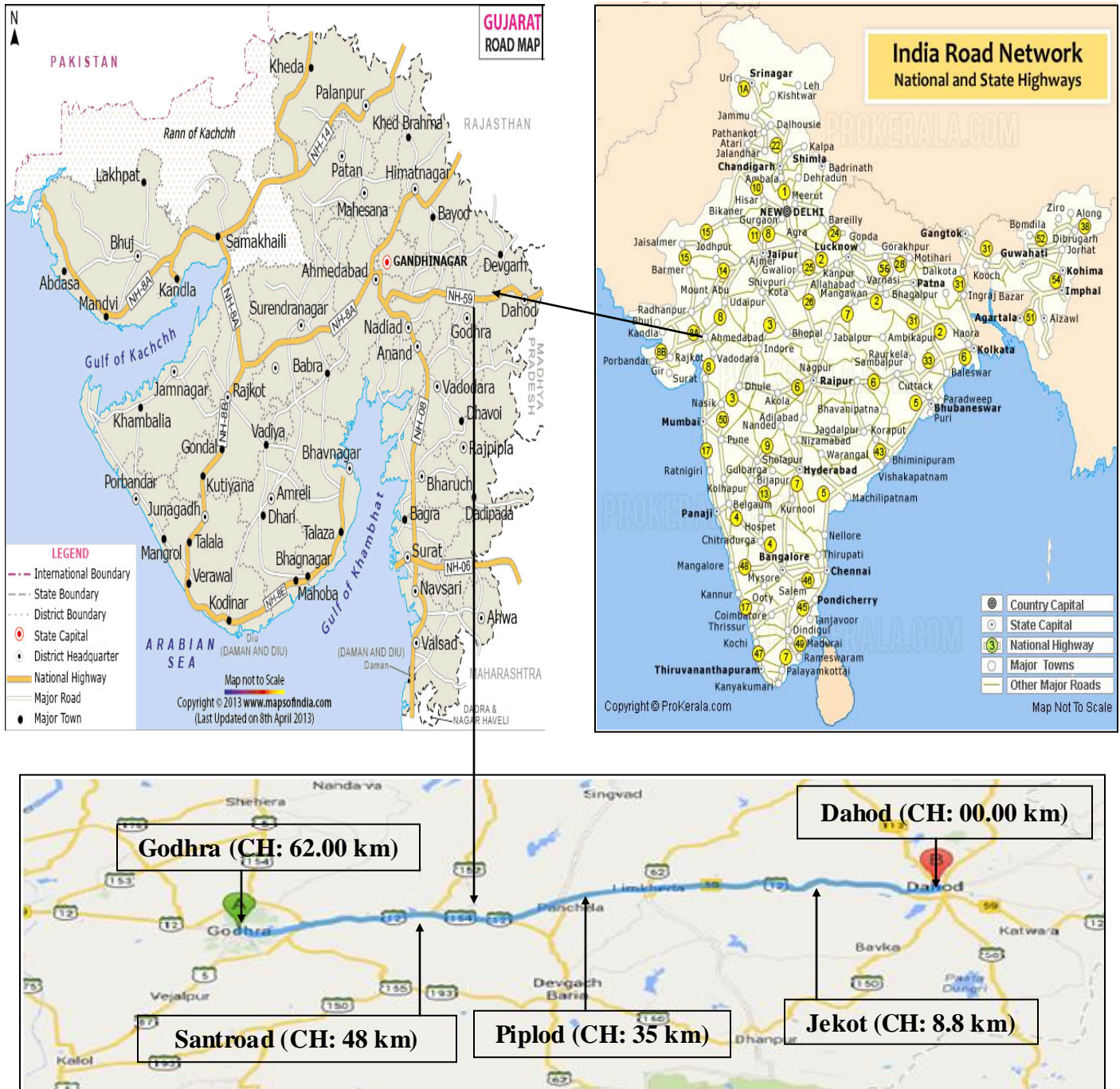


Figure 2: Study stretch Location on NH-59 with CVC count stations

VI DATA COLLECTION

The data which were collected to analyse the crash on the study stretch are:

- 1) Road Inventory Survey
- 2) Classified Volume Count by Manual Count Survey
- 3) Adjoining Land Use Pattern
- 4) Crash Data from Police Stations

1) Road Inventory survey

Road inventory surveys were performed by visual observer method. From the survey salient features of selected stretch like existing roadway width, marking, shoulders width, median, major bridges, minor bridges, and number of junction can be found out road inventory survey gives existing facilities of selected stretch and it is useful to identify the black spot on NH-59. The inventory data for study stretch is given in Table 1.

Table 1: Salient Features Of Study Area Corridor

Sr. No	Salient Features	Description
1	Carriage way	7.5 m
2	Shoulder	paved (1.5 meter both side)
3	Pavement marking	centre line marking
1	Major Bridges	4 No.
2	Minor Bridges	11 No.
4	Main River Across the Road	2 No.
5	Median	2 No.
7	T-Intersections	32 No.
8	Y-Intersections	8 No.
9	Adjoining land use	Agriculture, Residential, Commercial, Non-Agriculture

2) Classified Volume Count by Manual Count Survey

To understand the traffic characteristic on NH-59 traffic volume survey was carried by Manual method on both direction at selected point near Jekot village (CH: 8.8Km), Piplod (CH: 35 Km) and Santroad (CH: 48 km). The survey was performed by eight number of enumerators on each location during day from 6.00 am to 6.00 pm. The data of traffic volume is given in Table 2.

Table 2: Traffic Data (6.00 am to 6.00 pm)

Vehicle class	PCU Equivalent factor	No. of Vehicles		PCU/Day		
		Up direction	Down direction	Up direction	Down direction	Total
Two Wheeler	0.5	1449	1331	724.5	665.5	1390
Three Wheeler	1	182	190	182	190	372
Car	1	892	920	892	920	1812
Truck	3	597	759	1791	2277	4068
Bus	3	171	163	513	489	1002
LCV	1.5	181	198	271	297	568
Tractor	4.5	148	151	666	679.5	1345.5

Daily Traffic Volume 6.00 am to 6.00 pm	5040	5732.5	10,772.5
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Source (PCU Equivalent factors): IRC: 64-1990-Guidelines for Capacity of roads in rural areas

3) Land Use Pattern

The NH-59 stretch from Dahod (CH: 00.00Km) to Godhra (CH: 62.00Km) corridor is having residential, commercial and agricultural land uses along the road sides. Selected stretch divided in eight sections and Land use pattern along the selected stretch is shown in Table 3.

Table 3: Land use Pattern along Selected Stretch

No. of section	Stretch Length (Km)		Land Use Pattern
	From (Km)	To (Km)	
1	1	8	Agricultural, Residential,
2	8	16	Agricultural
3	16	24	Agricultural, Residential
4	24	32	Agricultural
5	32	40	Agricultural, Residential,
6	40	48	Agricultural, Commercial
7	48	56	Agricultural
8	56	62	Agricultural, Commercial

4) Crash Data from Police Stations

Crash data was collected from various police stations along the stretch on NH-59. Three police stations of Dahod district and two police stations of Godhra district covered for Crash data collection. The data was recorded in the khatyan register (crime register phase 1 and 2) with short description of crashes. For the crash analysis seven year data is collected (2008-2014). Devgadhi Baria has major share of crashes (28.46%) and Morva lowest 76 crashes (9.75%) from total of 780 crashes. The crash record distribution with police station is shown as shown in Table 4.

Table 4: Crash Data from various Police Stations

Name of Police Station	No. of Crash Recorded	Percentage of crash (%)
Dahod Rural	103	13.20
Limkheda	175	22.43
Devgadhi Baria	222	28.46
Morva	76	9.75
Godhra Rural	204	26.16
Total	780	100

VII) ANALYSIS OF CRASH DATA

1) Yearly Variation of Crashes

The result shows that 780 crashes occurred in the year 2008-2014. The year wise distribution shows that in the 2008 about 15.38%, 2009 about 15.38%, 2010 about 19.02%, 2011 about 14.60%, 2012 about 12.56%, 2013 about 16.14% and 2014 about 6.92% from analysis observed that in 2010 Maximum nos. of crash take place. Yearly distribution of crashes presented in Table 5.

Table 5: Yearly Variations of Crashes (2008 - 2014)

Year	Fatal	Serious Injury	Minor Injury	Damage only	Total	Severity Index	Percentage (%)
2008	40	26	52	2	120	33.89 %	15.38
2009	26	35	58	1	120	21.84 %	15.38
2010	47	46	54	1	148	31.97 %	19.02
2011	34	38	40	2	114	30.35 %	14.60
2012	29	37	31	1	98	29.89 %	12.56
2013	47	41	36	2	126	37.90 %	16.14
2014	19	13	21	1	54	35.84 %	6.92
Total	242	236	292	10	780	31.42 %	100

2. Crashes Classified According to Time Wise

Figure 3.shows the variation in crashes according to time wise. It is observed that maximum number of crashes is occurred during evening period. The maximum number of minor crashes takes place at noon and evening time and also fatal crashes on stretch. The maximum crashes have been occurred between 16.00 pm to 18.00 pm.

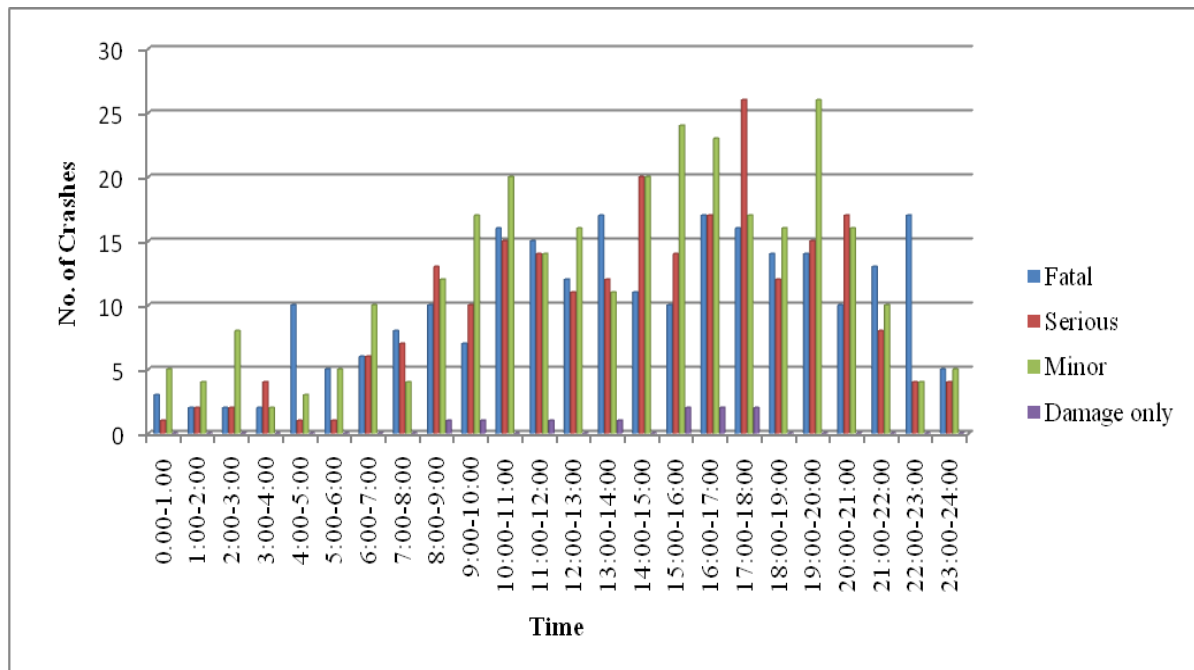


Figure 3: Crashes Classified According to Time

3. Month wise Crashes Classification

Month wise crashes classification shows that in the month of March (10.12%), April(11.41%) and June(9.87%) there are high crashes rate. It may be due to migrated people of this area come for celebrated of Holi festival. It's Main

festival for their person and people come who went for migrated from all region of Gujarat for working so this reason traffic volume has increased in this month. Shows month wise crashes observed in selected stretch in Table 6.

Table 6 : Month wise Crash classification

Month	Severity				Total	Percentage (%)
	Fatal	Serious Injury	Minor Injury	Damage Only		
January	24	25	24	0	73	9.35
February	16	17	24	0	57	7.30
March	29	14	34	2	79	10.12
April	26	31	29	3	89	11.41
May	19	26	23	0	68	8.71
June	32	21	23	1	77	9.87
July	18	26	26	2	72	9.23
August	16	19	21	2	58	7.43
September	19	12	28	0	59	7.56
October	15	23	13	0	51	6.53
November	12	9	28	0	49	6.28
December	16	13	19	0	48	6.15
Total	242	236	292	10	780	100

4. Crashes Classified by Vehicles Type

Table shown number of crashes caused by different categories of vehicle. From the year 2008 to 2014, which type vehicles involved in crashes that can be identified on national highway. The more number of crashes taking place by heavy goods vehicle. The data shows that heavy goods vehicle(32.94%) are having more number of crashes and motor cycle (23.20 %) and car/jeep/van (21.28 %) are also high number of crashes.

Table 7: Crashes Classified by Vehicle Type

Vehicle Type	Fatal	Serious	Minor	Damage	Total	Percentage (%)
Motor cycle	38	72	72	3	185	23.20
Three wheeler	17	33	21	1	72	9.23
Car/jeep/van	46	49	69	2	166	21.28
Light goods vehicle	26	14	12	1	53	6.79
Heavy goods vehicle	101	59	91	2	253	32.94

Bus	14	9	27	1	51	6.53
Total	242	236	292	10	780	100

5. Crashes Classified According to Collision Type

Crashes classified according to collision type shows that number of crashes occurred due to rear end(27.05%) on higher, head on (22.30%), hit pedestrians (18.33%) and other, which are presented in Table 8.

Table 8: Crashes Classified According to Collision Type

Collision Type	Severity				Total	Percentage (%)
	Fatal	Serious Injury	Minor Injury	Damage		
Overtun no collision	48	58	52	3	161	20.64
Head on	52	55	65	2	174	22.30
Rear end	68	63	77	3	211	27.05
Side impact	6	9	10	0	25	3.20
Side swipe	3	7	8	0	18	2.30
Hit parked vehicle	0	1	1	0	2	0.25
Hit fixed object	8	5	9	2	24	3.07
Hit pedestrian	51	33	59	0	143	18.33
Hit pedel cycle	0	0	1	0	1	0.12
Other	6	5	10	0	21	2.69
Total	242	236	292	10	780	100

6. Vehicle Manoeuvre

The crashes are occurred on NH-59 due to vehicle Manoeuvre is not properly by the drivers. The Going straight vehicles(61.41%) causes maximum Nos. of crashes due to over speed and inattention, an awareness of sign, signal etc. turning left(13.46%) is also involved to cause an crashes, which are presented in Table 9.

Table 9: Crashes Classified According to Vehicle Manoeuvre

Vehicle Manoeuvre	Severity				Total	Percentage %
	Fatal	Serious injury	Minor Injury	Damage		
Going straight	146	154	176	3	479	61.41

Turning left	37	28	37	3	105	13.46
Turning right	24	21	19	2	66	8.46
U-turning	0	0	0	0	0	0
Over taking (wrong side)	20	15	34	1	70	8.97
Overtaking (same side)	15	17	22	1	55	7.05
Reversing	0	0	1	0	1	0.12
Sudden start	0	0	3	0	3	0.38
Sudden stop	0	0	0	0	0	0
Parked off road	0	1	0	0	1	0.12
Stopped on road	0	0	0	0	0	0
Other	0	0	0	0	0	0
Total	242	236	292	10	780	100

7. Crashes Classification According to Spot

From the data of crashes spot it is observed that on NH-59 (From Dahod to Godhra) maximum numbers of crashes occurred at Straight (56.79%), T-junction (23.20%) and Y-Junction (15.12%). which are shown in Table 10.

Table 10: Crashes Classified According to Crash Spot

Accident spot	Severity				Total	Percentage %
	Fatal	Serious injury	Minor injury	Damage only		
Not at junction	142	130	165	6	443	56.79
T-junction	57	59	63	2	181	23.20
Y-junction	35	34	48	1	118	15.12
Cross roads	1	0	1	0	2	0.25
Offset	0	0	0	0	0	0
Circle	3	6	8	1	18	2.30
Railway crossing	3	0	4	0	7	0.89
Bridge	0	6	3	0	9	1.15
Other	1	1	0	0	2	0.25
Total	242	236	292	10	780	100

8. Crashes Classified According by Driver Error

From the data analysis it is observed that the maximum crashes to driver error. To vehicle run fast by driver (54.23%) is maximum reason for crashes shown in Table 11.

Table 11: Crashes Classified According to Driver Error

Driver Error	Severity				Total	Percentage (%)
	Fatal	Serious injury	Minor injury	Damage only		
None	7	8	20	2	37	4.74
Fatigue/sleep	15	16	24	0	55	7.05
Inattention	14	18	30	0	62	7.95
Too fast	132	140	145	6	423	54.23
Too close	6	5	11	0	22	2.82
Bad overtaking	53	31	44	2	130	16.67
Bad turning	13	13	15	0	41	5.26
Other	2	5	3	0	10	1.28
Total	242	236	292	10	780	100

9. Crash Prone Location Based On Data

The study stretch was divided in to eight equal stretches of each 8 km length. Stretch VII has highest no. of crashes which accounts for 19.10 % of total crashes. Stretch V has the second highest number of crashes accounts for 17.05% of total cash. Number of crashes in stretch VI and VIII accounts for 13.85% and 13.59% respectively. Stretch III has minimum number of crashes accounts for 4.62% of total crashes. Critical sections are those which has high % of crashes plus high crash per/km. So based on this analysis stretch VII, V, VI and VIII are critical crash location.

No. of section	Stretch Length (Km)		No. of Crashes	Crash /km	Percentage (%)	Remark
	From (Km)	To (Km)				
1	1	8	87	10.87	11.16	Non-Critical
2	8	16	73	9.12	9.35	Non-Critical
3	16	24	36	4.5	4.62	Non-Critical
4	24	32	88	11.00	11.28	Non-Critical
5	32	40	133	16.62	17.05	Critical
6	40	48	108	13.5	13.85	Critical
7	48	56	149	18.62	19.10	Critical
8	56	62	106	13.25	13.59	Critical
Total	-		780	12.58	100	-

VIII. REMEDIAL MEASURES

- The total length of highway divided in 8 sections in which section seven (CH: 48 to 56 km) and section five (CH: 32 to 40) in these place occur maximum crashes and both of sections indentified as a black spot. The number of village a rounding this sections and not proper facilities for pedestrian crossing and in these sections design of junction is poorly connected to main road. So provision of safe walking places for pedestrian walking

and provided separation of pedestrian movement from heavy moving in these places as like zebra crossing, walk way.

- In this sections re-designed of junction and provided crash spot sign board is installed 100 m before every identified black spot.
- No over taking zone and speed limit board provided 100 m before each black spot.
- The crash occurs in T-junction so every T-junction which connected to main highway, Bump should be installed in minor road which connected to main road.
- Many places in the stretch not provided proper access to main highway so provided efficient access to main highway should be properly designed.
- In near of Limkheda and Piplod town (CH : 24 km to 32 km) where no. of crashes occur because that design of y-junction is not properly designed. So design as per requirement of highway lane and provision of elevated and visible designed area for crossing of roads in these places.
- A village of Paniya Pratap pura, Moti zari, Saliya, Asayadi (CH: 24 km to 32km) and (CH : 32 km to 40 km) bus stop stand is not proper way it's very close to shoulder width so this reason bus to stop on a road . So it's give extra space to stops to bus.
- Right and left-turns are taken carefully and sections of highway close to facilities are black spots for heaving truck crash, as trucks tend to slow down or moving carefully.
- Number of hotel around 15 surrounding stretch, so many hotel have not sufficient space for parking vehicle and this reason vehicle parked on running road. So strictly prohibition of parking of vehicle on running highway near hotel.
- Literacy rate of Dahod district is lowest in all over Gujarat so provided driver' training, people awareness regarding traffic rules & regulation from school to college is required.

IX. CONCLUSIONS

The following conclusions are drawn from the above study:

- The year wise distribution shows that in 2010 (18.97 %) maximum number of crash take place.
- The peak period for crashes comes out to be between 4.00 pm to 6.00 pm (evening peak period).
- From analysis it is evident that maximum number of crashes occur in the months of March (10.12 %) and April (11.41 %).
- The data shows that heavy goods vehicle(32.94%) are having more number of crashes and motor cycle (23.20 %) and car/jeep/van (21.28 %) are also high number of crashes.
- A number of crashes occurs due to rear end(27.05%) on higher, head on (22.30%), hit pedestrians (18.33%).
- Higher numbers of crashes occurs at Straight (56.79%), T-junction (23.20%) and Y-Junction (15.12%).

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