

Road Crash Investigation and Analysis of Hilly Road Section near Saputara on NH 360

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ABSTRACT: Road traffic accident the leading cause of death by injury and the tenth-leading cause of all deaths globally-now make up as surprisingly significant portion of the worldwide burden of ill-health. According to the Ministry of Road Transport and Highways, 1, 50,785 people were killed and another 4,94,624 were injured in 4,64,910 road crashes in India in 2017. The number of road crash deaths having increased by 31% from 2007 to 2017 and that of fatal road crashes have increased by 25.6% in the same period. India ranks 1st in road crash fatality in the world. Many heavy trucks, buses, cars, two wheelers are plying between Surat and Nasik. Both cities are important cities and are connected with National Highway 360. This study focuses on the road stretch between Chikhli to Saputara road (NH360) covering 103km distance. The 60 km of study stretch is passing through hilly terrain. Saputara is the only hill station of Gujarat in dang district. The path is selected Chikhli to Saputara as a study area. The length of the study area is 104 km so stretch has divided into four sections last two sections is hilly region so this stretch has been selected for this paper. The Total of this stretch 234 road crashes recorded in last 6 years, 2013-2018. The collected data was collected from police station. In section-3 identified Top Weightage value is 95.4 and traffic volume is high during the evening time. In section-4 top weightage value is 140.4 and traffic volume is also high during the evening time.

Keywords: Black spot, Crash analysis, fatal crashes, weightage value, traffic volume

I. INTRODUCTION

In developing country like India, Traffic congestion has been one of major issues that most metropolises are facing and thus, many measures have been taken in order to mitigate congestion. Identification of congestion characteristics is the first step for such efforts since it is an essential guidance for selecting appropriate measures. Basic knowledge of traffic flow characteristics like traffic volume under such Traffic conditions is fundamental traffic volume is basic variable in planning, designing, and operation of roadway systems. Congestion - both in perception and in reality - impacts the movement of people and freight and is deeply tied to the history of high levels of accessibility and mobility. Traffic congestion wastes time and energy, causes pollution and stress, decreases productivity and imposes costs on society.

Transportation plays important role in development and growth of any nation. Transportation is significant for trade, organization and social interaction, while consuming considerable time and resource. Transportation sector in India is a very extensive system, comprising different modes of transport like Road, Railway, Aviation, Waterway and Shipping, which facilitate easy and different conveyance of goods and people across the nation. The backbone of economic development of the India is largely depends on its transportation. Road transport is primary mode of transport which plays an important role in conveyance of goods and passengers and linking the centres of production, consumption and distribution.

II. LITERATURE REVIEW

Gupta and Mishra (2018) have studied this paper studies linear trend mathematical model which is based on time series for forecasting of no. of road accidents in Indian states. Forecasting is done for five segments as total no. of accidents, total no. of people injured, total no. people killed, total no. of people killed on National highways and total no. of people killed on State highways. Analysis and forecasting are done for Uttar Pradesh, Tamil Nadu, Maharashtra, Karnataka and Rajasthan. This model is state variant and forecasts the accident data for the year 2017, 2018, 2019, 2020 (Data for 2017 is not available till date). The data taken for modelling is from the year 2012 to 2016.

Gebretensati and juremalani (2018) have studied develop road accident prediction model each and every parameter related with the accident is considered and a micro level analysis of road accident is performed. For micro level analysis road traffic accident data of last seven year (2010 to 2016) from police station is collected and a detailed analysis is performed on basis like Hour, year, location, type of collision, type of road, physical feature of road, age group, sex, weather condition etc. On basis of this analysis effect of accident is identified. After analysis road traffic accident prediction models is developed based on different parameter.

Jadhav et al (2017) have studied on preliminary analysis reveals that there are 5 'Black spots' in the given corridor line. The detailed analysis has been carried out on these five locations. In order to study the speeds at these locations, spot speed study has been conducted. Based on the detailed analysis, the improvement measures have been recommended. The identified Black spots are Padawalwadi Phata, Ahirwadi Phata, Gotkhindi Phata, Bawachi Phata and Gatarwadi Phata. The important factors considered for analysis include: Daily variation of accidents, timely variation of accidents, gender wise analysis, vehicle wise distribution, age limit variation of accidents, and monthly variation of accidents

Shah and Shah (2016) have studied According to MORTH-2014 India has the highest no of accidents in the World. Accident Severity has been increasing year by year. A road accident is an unplanned and uncontrolled occasion, which happened on a road open to an open activity bringing about individual harm, harms to the property and death toll in which no less than one moving vehicle was included. Rapid growth of population coupled with increased economic activities has favoured in tremendous growth of motor vehicles. This is one of the primary factors responsible for road accidents. It is observed that few works have been carried out on statistical analysis of accidents particularly on Four-lane State Highway. The essential objective of this paper is to gather the road accident data of chosen stretch from Halol CH 335.800 km (SH-5) to Godhra CH 380.00 km (SH-5) from the L&T Toll Plaza and GSRDC office Gandhinagar and to workout purposeful examination of road accident of it and propose remedial measures too. Total 548 road crash recorded in last 24 months, 2013-2014. The collected data were analysed to evaluate the effect of influencing parameters on accident rate.

Sanjay Kumar Singh (2016) have studied analyse the road accident in India at national, state and metropolitan city level. Analysis shows that the distribution of road accidental deaths and injuries in India varies according to age, gender, month and time. Age group 30-59 years is the most vulnerable population group, though males face higher level of fatalities and injuries than their female counterparts

Ravishankar Rajaraman (2009) has studied analysed to identify accident (crash type, location time), vehicle (vehicle type, pre-crash condition), occupant (restraint use, gender, age) and other contributing factors, and environmental factors associated with injury severity. Findings show that front-to-rear collisions, mainly involving heavy trucks and buses, caused due to slowing down, stopping, breaking down or overtaking account for 59% of the accidents. This paper presents the methodology adopted, data analysis, results, conclusions and recommendations to mitigate road accidents and injuries on NH45 and other similar highways.

After studying the above literature it has been found that literature related to Road crash investigation in hilly region is to limited. This paper covers road crash analysing for selected stretch of hilly region on National Highway no. 360.

III. STUDY AREA

National highway 360 is 202 KM long. NH360 meets the Mumbai-Agra national highway in Chandwad in Nashik and national highway 48 meets in Chikhli. So there is a lot of traffic on this road because this route is very useful for going from Surat to Nashik. Heavy vehicles use today's road to go to Nashik. Saputara is one of the hill station of Gujarat, so there are plenty of passenger's and they come on the road today. The path is selected Chikhli to Saputara as a study area. The length of the study area is 104 km, where carriage width of road is maximum 7m from Vansda to Saputara and 14m from Chikhli to Vansda. The 60 km of study stretch is passing through hilly terrain. Saputara is the only hill station of Gujarat in Dang district. The corridor is surrounded by institute, urban area, residential and mostly in villages. Fig. 2 shows the stretch of the study area. This project is made up of one continuous stretch of road about 104 km long from Chikhli to Saputara road. This Continuous stretch has divided into four sections. These sections Chain age will be shown in Table 1.

Table 1 Chain age of Section

Section (Colour code)	Chain age
Section-1(Black)	00.00KM to 16.00KM
Section-2(Orange)	16.00KM to 51.00KM
Section-3(Yellow)	51.00KM to 78.00KM
Section-4(Red)	78.00Km to 103.00KM

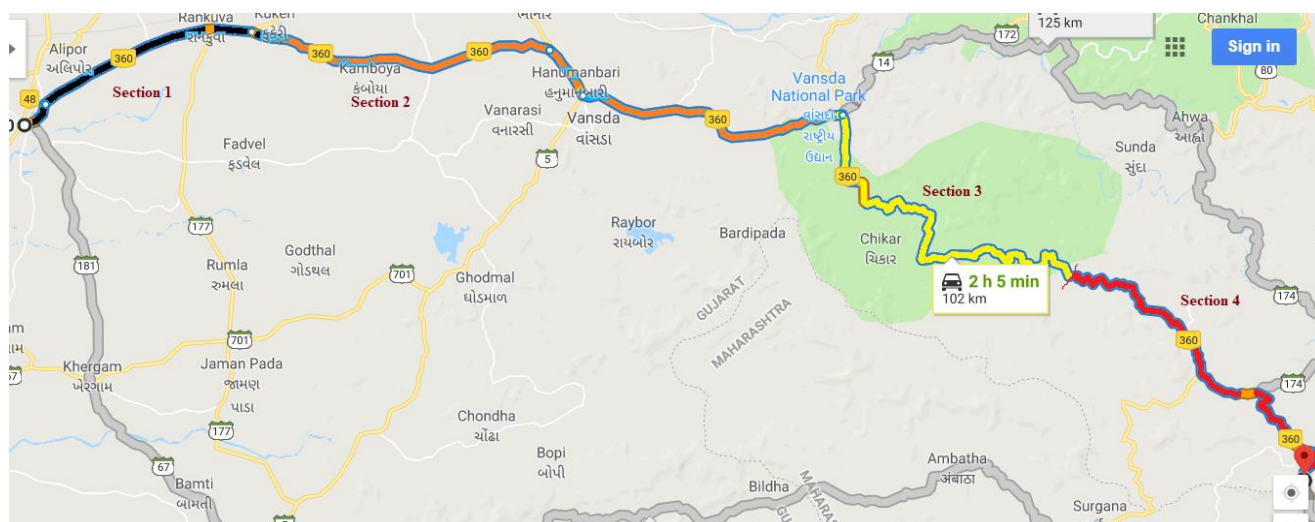


Figure 1 Map of selected study area

IV. DATA COLLECTION

The crash Study area & Data collection record is collected from the year January 2013 to May 2018. The data has been collected from four police stations. The data on these highways are pertaining to certain segments of highway. The parameters required in the dataset were appropriately chosen from the collected data

1. Traffic volume count survey

The study zone chose is having 4-path partitioned street. For the movement volume tally review the video realistic and manual check techniques can be utilized. As a result of the less activity development at the mid obstructs, the volume exclude overview will be conveyed by the utilization of manual tallying strategy. Other than that, at each crossing point the video realistic strategy can be connected for volume check. In extremely unlimited territory the ideograph gives successful results for activity volume depend on all the sides of circle or crossing point. In this way, the manual numbering technique is utilized over yonder as well. Activity learns at the area will be led physically utilizing field sheet include structure. The movement study might be taken at morning top hours and night crest hours. Four eyewitnesses required and the 15 minute time interims were taken in this activity checking.

2 Spot Speed Study Survey:

Spot speed study is used to determine the speed of vehicle at a spot of the road section. It is done in Road Safety Audit when the black spots are determined. It is useful in comparing design speed with actual speed of vehicle. Spot speeds are needed to control traffic operations and regulations. To enable safe speed limit on road so that accidents can be reduced, speed survey is carried out on different segments of study area. It consists of a series of observation of the individual speed at which vehicles are passing a point at a non-intersection location. These observations are used to estimate the speed distribution of the entire traffic stream at that location under the condition prevailing at the time of study.

V. DATA ANALYSIS

The collected data were analysed to find underlying cause of road crash occurrence. The classification of road crash as described earlier has been coded in four different categories as per NHA coding. Here analysis of road crash for hilly area road section of section 3 and 4 are presented.

1. Analysis for section 3

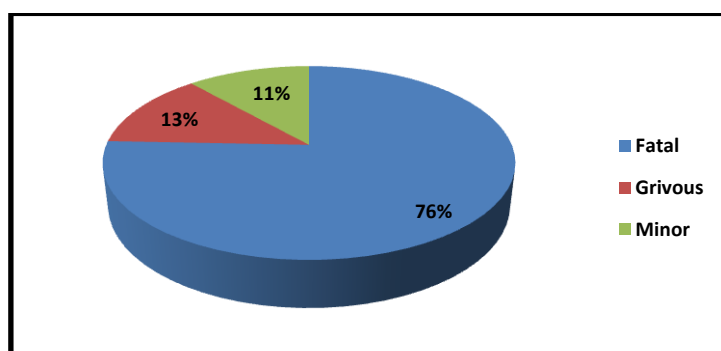


Figure 2: Classification of road crash

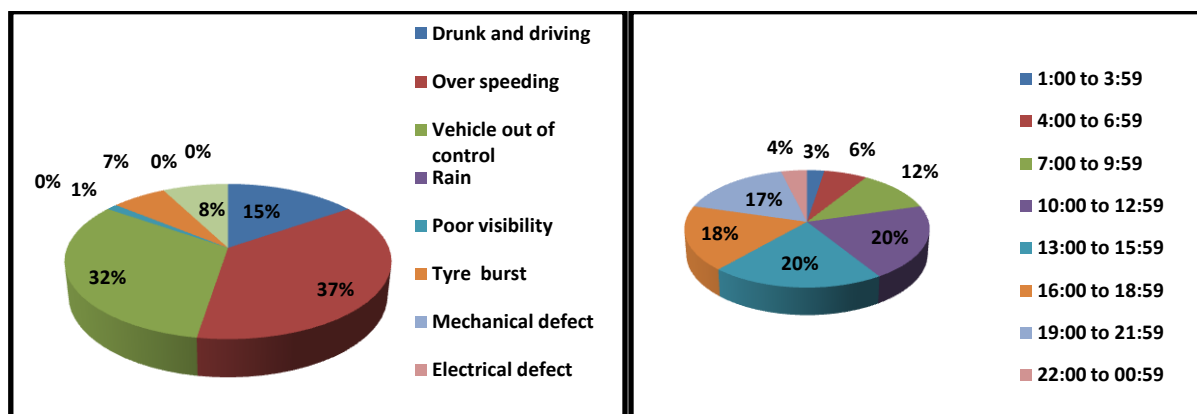


Figure 3 Causes of road crash

Figure 4 Classification of Time of occurrence

Here it is clear that for section 3 which comprise from Ch. 51.00Km to Ch. 78.00 Km. passing through vandsa national park and on this road there are botanical garden and Gira water fall near the waghai. It is major portion of hilly area and forest area. On this section 76% accident is fatal accidents (show in figure 2) because on this section 37% accidents have occurred due to over speeding and 32% accidents have occurred due to vehicle out of control (show in Figure 3). Both causes are manually involved in accidents and both causes are not depended on mechanical fault. This section 20% accidents during the 10:00am to 13:00pm and 13:00pm to 16:00pm (show in Figure 4).

1.1 Identification of blackspot area

By NHAI coding data of road crash has been classified into four main categories. To formulate the road crash point weight age casualties have been divided into four groups. Based on the analysis of the cost of road crash values evolved from the earlier studies have been used after updating using the ratio of Wholesale price Index for the economic cost of different types of road crash and economic cost of vehicle damage. From this study and applying the table, for every fatal crash its power is calculated by multiplying with 6.0, while for serious injury its influence is measured as 3.0; in case of light injury crash its weight should be as 0.8 while for non-injury it is multiplied with 0.2 Consequently, the Road Crash Point Weightage (APW) and road crash ranking at various analysed NH-360 section 3 are shown in Table below. And blackspot area is located in the map.

Table 2: Identified Top Crash Locations of NH360 Section-3

Chainage in Km	Fatal (F)	Grievous(G)	Minor(M)	Total accident	Weight age value =F×6+G×3+M×0.8
52.00-53.00	15	1	3	19	95.4
60.00-61.00	14	3	1	18	93.8
72.00-73.00	9	0	1	10	54.8
69.00-70.00	7	2	1	10	48.8
56.00-57.00	7	0	2	9	43.6
62.00-63.00	3	1	1	6	22.6



Figure 5 Black spot location on section

These sites were inspected during the time period where accidents most frequently occurred to investigate and identify possible causes of accidents. Analysis has included an assessment of the accident vehicle type, traffic volume count, causes of road crash, spot speed study. **KM 52.00, 60.00, 72.00** were selected as the study section based on the worst site and the black spot site (show in table 2).

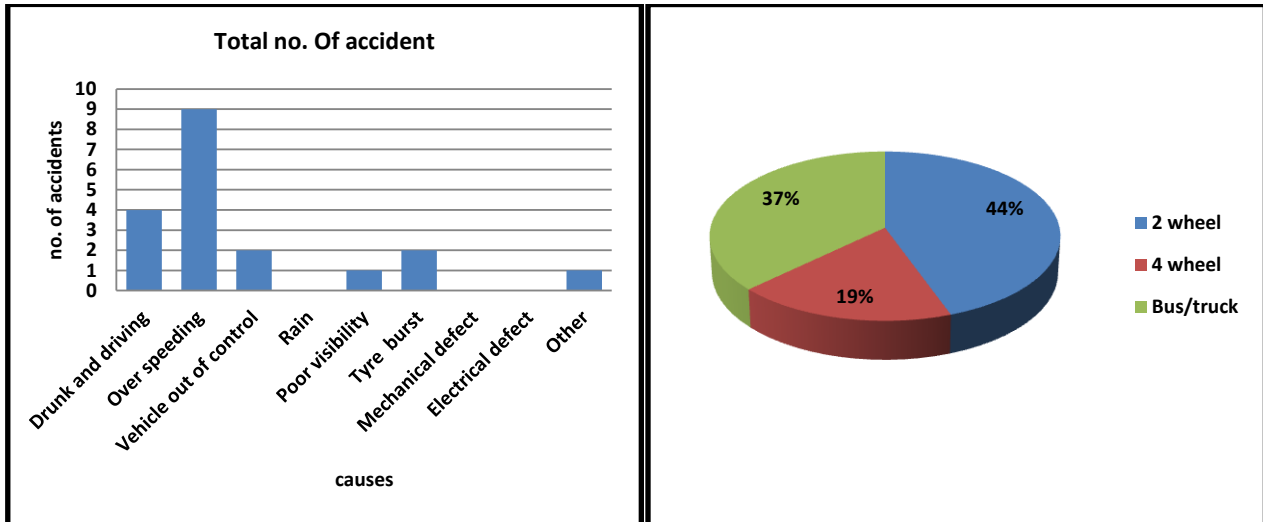


Figure 6 Causes of road crash at 52.00 Km

Figure 7 Type of vehicle involved in Road crash at 52.00 Km

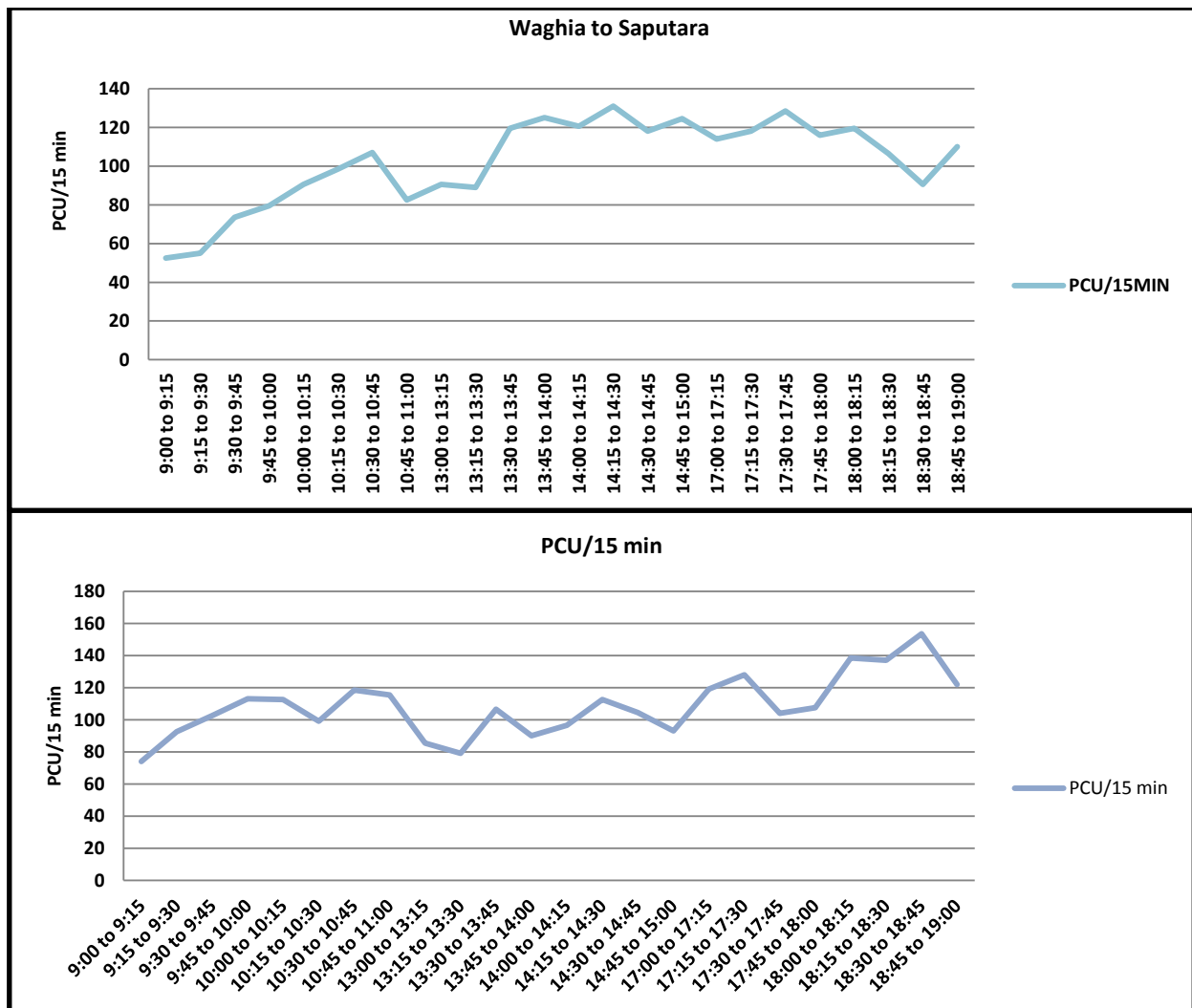


Figure 8 Temporal Fluctuations in Traffic Volumes at 52.00 Km

Table 3 spot speed survey at the spot 52.00 Km

			Categories Of Vehicle				
			2W	3W	4W	Bus/Truck	L.C.V
51.00	Saputara to waghai	Average time (second)	8.9056	13.88	7.2125	10.043	8.3818
Distance (meter)	150	Speed(kmph)	60.63	38.9048	74.87	53.7687	64.4253
51.00	Waghai to saputara	Average time (second)	7.98	9.06	7.92	11.2529	9.01
Distance (meter)	150	Speed(kmph)	67.669	59.60	68.1818	47.9876	59.933

At that location 44% accidents have occurred by 2 wheelers because at that location most cause's accidents have occurred due to over speeding and drunk and driving. These sites were inspected during the time period where traffic volume is increase during the evening time (show in figure 8).

There are accidents due to this area being molded and the design speed of this area is 40kmph, even then the vehicle goes into the high speed. These sites were inspected during the traffic speed is in 2- wheelers 60.63kmph to 67.669 kmph speed came the same way as 3-wheeler in 38.9kmph to 59.6kmph, 4-wheeler in 74.87kmph to 68.18kmph, bus/truck in 53.76kmph to 47.98kmph and L.C.V. in 59.9kmph to 64.4kmph (show in table 3). This speed is more than the design speed.

2. Analysis for section 4

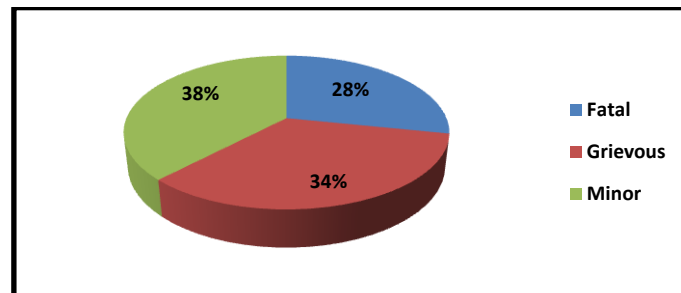


Figure 9 Classification of road crash

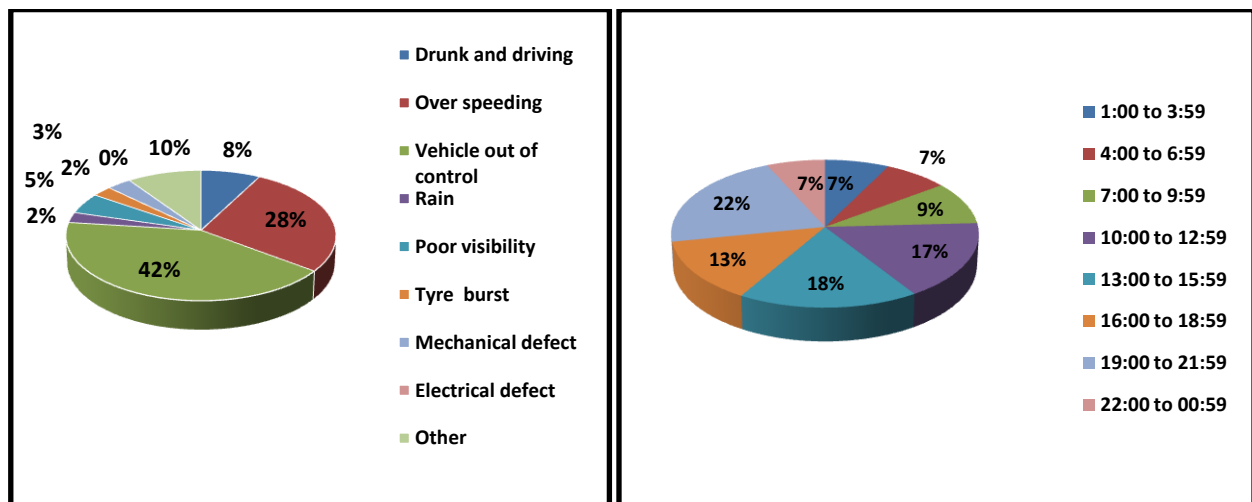


Figure 10 Causes of road crash

Figure 11 Classification of Time of occurrence

Here it is clear that for section 3 which comprise from Ch. 78.00Km to Ch. 103.00 Km. passing through Malegaon and on saputara. It is major portion of hilly area and forest area. On this section total 64% accident is fatal and grievous accidents (show in figure 9) because on this section 28% accidents have occurred due to over speeding and 42% accidents have occurred due to vehicle out of control (show in Figure 10) because this section is melded and gentle inclined. Both causes is manually involved in accidents and both causes are not depended on mechanical fault. These section 22% accidents during the 19:00pm to 22:00pm (show in Figure 11) beacous since saputara is a hill station, it is going back to sunset seeing at evening time so the accidents have been created at this time.

2.1 Identification of blackspot area

Table 4: Identified Top Crash Locations of NH360 Section-4

Chainage in Km	Fatal (F)	Grievous(G)	Minor(M)	Total accident	Weight age value =F×6+G×3+M×0.8
101.00-102.00	15	12	16	41	140.4
98.00-99.00	7	18	11	36	104.8
81.00-82.00	4	9	8	21	57.4
88.00-89.00	6	2	3	11	44.4
93.00-94.00	5	2	6	13	40.8
85.00-86.00	2	2	2	6	19.6
77.00-78.00	2	1	3	6	17.4



Figure 12 Black spot location on section.

These sites were inspected during the time period where accidents most frequently occurred to investigate and identify possible causes of accidents. Analysis has included an assessment of the accident vehicle type, traffic volume count, causes of road crash, spot speed study. **KM 102.00, 99.00, 82.00** were selected as the study section based on the worst site and the black spot site (show in table 4).

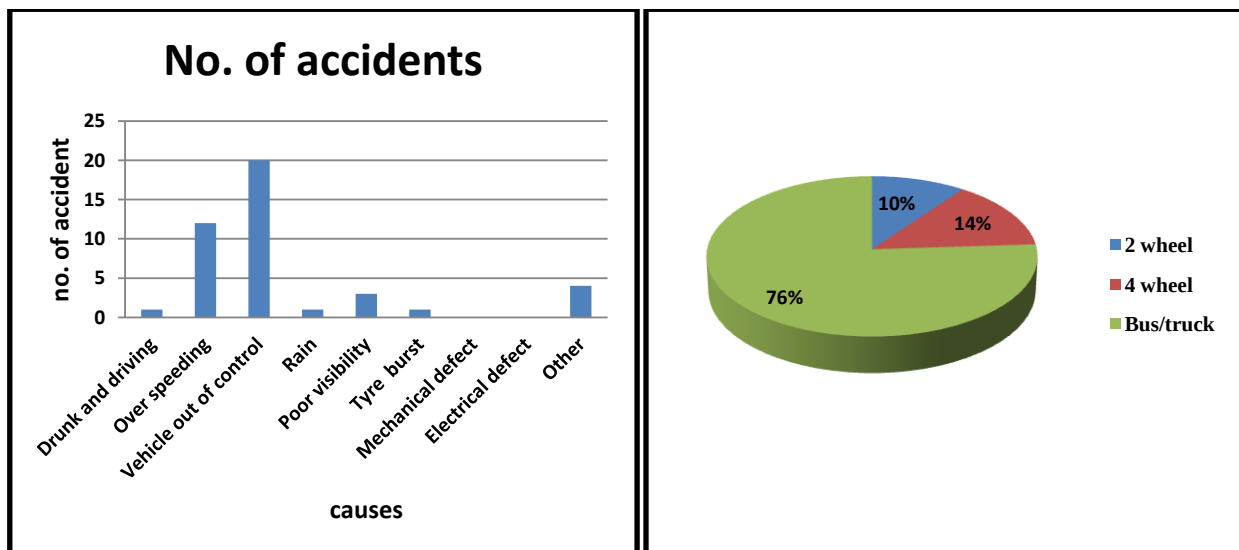


Figure 13 Causes of road crash at 102.00 Km Figure 14 Type of vehicle involved in Road crash at 102.00 Km

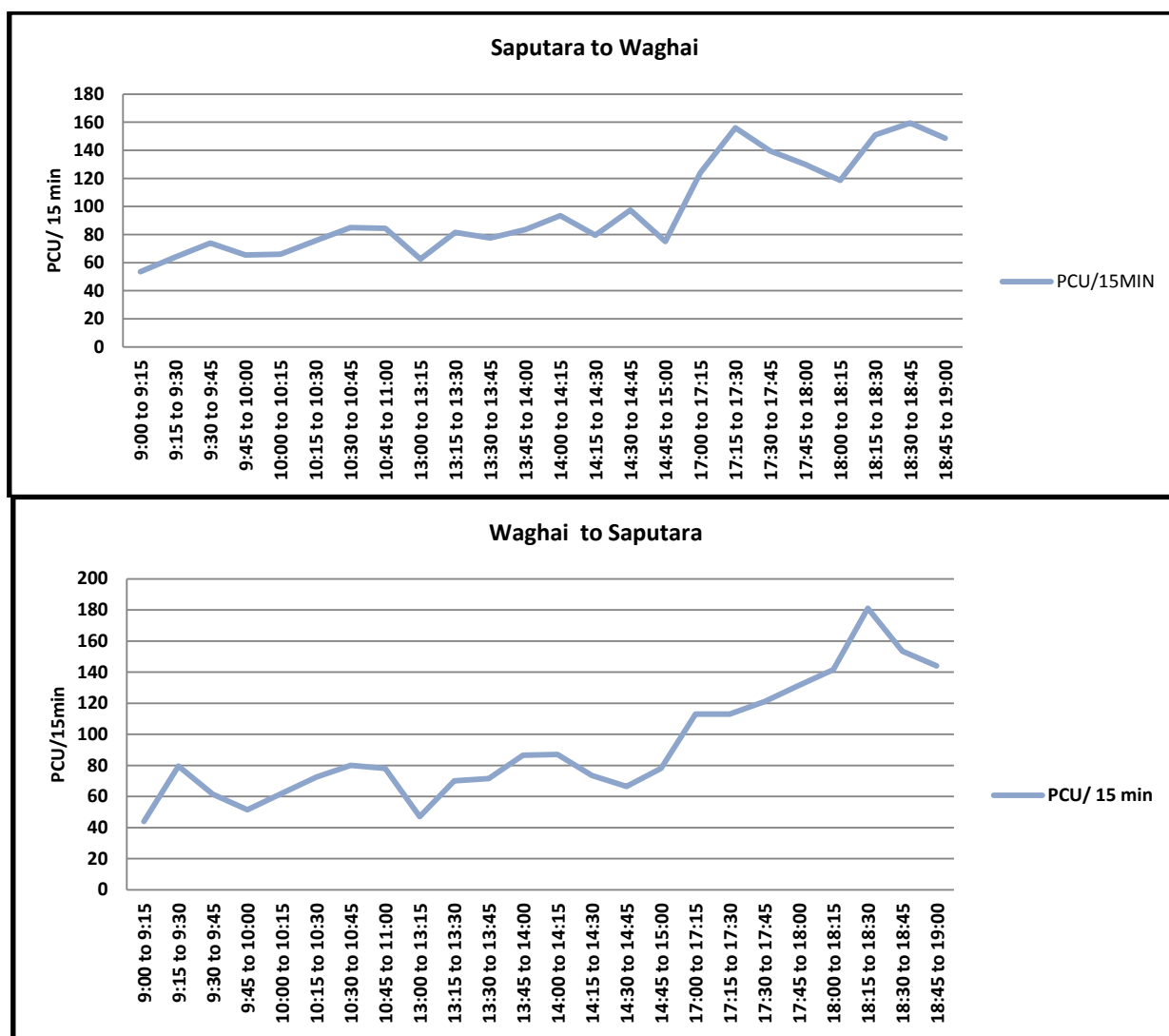


Figure 15 Temporal Fluctuations in Traffic Volumes at 102.00 Km

Table 5 spot speed survey at the spot 101.00 Km

			Categories Of Vehicle				
			2W	3W	4W	Bus/Truck	L.C.V
101.00	Saputara to waghai	Average time (second)	10.28421	-	12.366	24.32	14.646
Distance (meter)	100	Speed(kmph)	35.00511	-	29.112	14.8026	24.58
101.00	Waghai to saputara	Average time (second)	10.16	-	10.233	28.09	14.563
Distance (meter)	100	Speed(kmph)	35.43	-	35.18	12.8159	24.72

At that location 76% accidents have occurred by buses and trucks because at that location most cause's accidents have occurred due to over speeding and vehicle out of control. This area is very sharp curve and gentle inclined. These sites were inspected during the time period where traffic volume is increase during the evening time (show in figure 15) beacous since Saputara is a hill station, it is going back to sunset seeing at evening time and evening time driving is so difficulty.

There are accidents due to this area being molded and the design speed of this area is 40kmph, even then the vehicle goes into the low speed because this stretch is very sharp curve and gentle incline so the vehicle cannot take a turn near the sharp curve. These sites were inspected during the traffic speed is in 2- wheelers 35kmph speed came the same way as 4-wheeler in 29.11kmph to 35.15kmph, bus/truck in 14.8kmph to 12.81kmph and L.C.V. in 24kmph (show in table 5). This speed is less than the design speed.

VI. Finding

1. The Mortality rate of the sample is higher this may be attributed to the reality that out of total sample, 234 of the reported samples are from both sections.
2. Identify top weightage value for both sections. In section-3 identified Top Weightage value is 95.4 near the 52.00 km chainage. Here it is section-3 passing through hilly region and slide curve and here is two wheelers and pedestrian comply with the rules of traffic and they do not use the governments safety rules. On this section 76% accident is fatal accidents because on this section 37% accidents have occurred due to over speeding and 32% accidents have occurred due to vehicle out of control.
3. Investigation of data reveals that though late evening (16:00 P.M. to 19:00 P.M. to 22:00 P.M.) road crash occurrence is only 20 percent of total crash but fatality during the same time in section-3.
4. These sites were inspected during the time at the 52.00km chainage 44% accidents have occurred by 2 wheelers because at that location most cause's accidents have occurred due to over speeding and drunk and driving. Where traffic volume is increase during the evening time and spot speed is very high at the location. Here two wheel speed is 2- wheelers 60.63kmph to 67.669 kmph speed came the same way as 3-wheeler in 38.9kmph to 59.6kmph, 4-wheeler in 74.87kmph to 68.18kmph, bus/truck in 53.76kmph to 47.98kmph and L.C.V. in 59.9kmph to 64.4kmph. This speed is more than design speed.
5. In section-4 identified Top Weightage value is 140.4 near the 102.00 km chainage. It is more than value of section-3. Section-4 is passing through hilly region and sharp curve and gentle inclined. On this section total 64% accident is fatal and grievous accidents because on this section 28% accidents have occurred due to over speeding and 42% accidents have occurred due to vehicle out of control. These section 22% accidents during the 19:00pm to 22:00pm beacous since saputara is a hill station, it is going back to sunset seeing at evening time so the accidents have been created at this time.
6. These sites were inspected during the time at the 102.00km chainage 76% accidents have occurred by buses and trucks because at that location most cause's accidents have occurred due to over speeding and vehicle out of control. Where traffic volume is increase during the evening time and spot speed is very low at the location. The traffic speed is in 2- wheelers 35kmph speed came the same way as 4-wheeler in 29.11kmph to 35.15kmph, bus/truck in 14.8kmph to 12.81kmph and L.C.V. in 24kmph (show in table 5). This speed is less than the design speed.
7. Since Road accidents depends on three E's. This stands for Engineering, Education and Enforcement of law. So, each state has their own geography and their own rules & regulations. This study only shows trend analysis based on previous data.

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