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# Analysis of Black Spots & Causes of Accidents on NH-205

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***Abstract:-*** Roads are the most affordable form of transportation in India, but they are also the most dangerous, posing health and life threats to other road users as well as damage to automobiles and other property. It is crucial to locate accident hotspots on various roadways and implement corrective measures there in order to reduce the frequency of traffic accidents. Sometimes, due to financial limitations, it may not be possible to take countermeasures at all of the identified black spot locations at once. In these cases, it is crucial to create a priority list ranking the black spots in order of importance and take countermeasures in that order gradually. In this study, a thorough analysis of data on traffic accidents over a 44.6-kilometer stretch of National Highway 205 in Punjab, India, has been conducted. Accident blackspots have been discovered in both directions of the highway segment, which crosses through the districts S.A.S. Nagar and Rupnagar of Punjab. The NH-205 is a total length of 65 km (13.40-80.80) falling in the state of Punjab under PIU Chandigarh, starting from km 28+600 up to km 73+200 is a part of the study.Based on analysis of the accident data received from the Rupnagar district Police of Punjab. Four current criteria have been used to score the discovered blackspot locations. In order to determine the potential causes of accidents, the top ten identified blackspot locations have been further studied and thoroughly analysed. Based on the study's findings, countermeasures aimed at reducing road accidents on these identified places have been suggested.

***Keywords****: Black Spots, Accidents, Vehicle, NH-205.*

## 1. Introduction

The global transportation network is supported by roads. Roads in India are the most cost-effective means of transportation for both people and goods, carrying more than 60% of the nation's freight and 85% of its people. The risk of fatalities and severe injuries from accidents is greatest for road users, and it is also the most likely to damage automobiles among all modes of transportation. Official statistics indicate that 151,113 people died, or 11.6 fatalities for every 100,000 people.In 2019, 36.5 million automobiles and 221.2 million motorised two-wheelers (MTW) were registered. Because vehicles that are taken off the road due to wear and tear or other factors are not deleted from the database, the official registration data overstates the number of vehicles that are really in use. The real number of personal vehicles on the road is thought to be between 50% and 60% of what is recorded. According to the Ministry of Road Transport and Highways (2022), India has the second-largest road network in the world, measuring roughly 63.72 km and made up of National Highways (NH), Motorways, State Highways (SH), Major District Roads, Other District Roads, and Village Roads.

**Table:1 India's roads length (in Km) under different categories.**

| Category | 2010-11 | 2021-22 |
|---|---|---|
| **National Highway** | 70,548 km | 142,126 km |
| **State Highways** | 152,024 km | 176,166 km |
| **Major District Roads** | 474,464 km | 534,996 km |
| **Rural and Other Roads** | 4,700,000 km | 3,300,000 km |
| **Total length of Road** | 5,397,036 km | 4,153,288 km |

Only 3.42% of India's overall road network is made up of national highways, but they carry nearly 40% of the nation's traffic. The National Highways cross the whole length and breadth of the nation, linking state and territorial capitals, significant ports, rail hubs, and commercial and tourism destinations. India's economy has grown tremendously since independence, leading to the development of a larger road network and a rise in the number of vehicles on the road. With over one fatality and four injuries every minute, this has a significant effect on traffic operations and safety. India, a developing country, holds the dubious distinction of having the highest number of road fatalities worldwide. Furthermore, there have been compelling signals in recent decades that rank "road traffic injury" ninth out of the top ten causes of death. According to the World Health Organization's (WHO) global status report on road safety, there are more fatal accidents on Indian roads than any other country in the world. This necessitates a thorough examination of highway costs throughout the planning and design phase, with a view to including safety into the evaluation of road performance. Predicting crashes is an essential step in managing road safety. In order to predict crash frequencies on various types of roads, the Highway Safety Manual (HSM) recommends using safety performance functions (SPF). It also takes into account the fact that these frequencies would change significantly depending on changes in the road environment, which includes changes in road geometry, the environment surrounding the road, and the presence of road signs and markings. The handbook, however, is only applicable to road segments with homogeneous characteristics, which are defined in terms of traffic volumes, characteristics of the roadway design, and traffic control elements. In order to forecast crash frequencies in developing nations where traffic composition heterogeneity is common, an indigenous model must be created. The study provides statistics on traffic accidents across numerous nations, indicating a rising trend in traffic crash rates in various parts of the world. According to a number of studies, the frequency of these collisions rises significantly as speeds rise. Furthermore, there is a strong correlation between the speed restriction and increased injury severity.

**Road Accident of India:**

Roads are the least expensive form of transportation in India and contribute greatly to the nation's economy, but they are more prone to accidents and fatalities than other modes due to poor maintenance and low respect to traffic laws by road users.Both road users and policymakers in India are becoming increasingly concerned about the high number of traffic accidents, fatalities, and injuries they cause.Males experience more fatalities and injuries than females do, and the frequency of road accidents is comparatively higher in severe weather and during working hours. The distribution of road accident deaths and injuries in India varies according to month, time, age, and gender, with the 30-59 age group being the most vulnerable population group. According to the Road Accidents in India -2019 and 2020 report respectively, there were 4,49,002road accidents in 2019, resulting in 1,51,113 fatalities and 3,66,138 road accidents in India in 2020, resulting in 1,31,714 fatalities and 3,48,279 injuries. Of these, 1,20,806 fatal accidents (or 33%), 96,302 seriously injurious accidents (or 26%), 1,28,130 minor injury accidents (or 35%), and 20,900 non-injury accidents.

**Table: 2 Year Wise Road Accidents.**

| Category | 2019 | | 2020 | | % Evolution between 2019 to 2020 | |
|---|---|---|---|---|---|---|
| | Accidents | Killed | Accidents | Killed | Accidents | Killed |
| National Highway | 1,37,191 | 53,872 | 1,16,496 | 47,984 | -15.1 | -10.9 |
| State Highway | 1,08,976 | 38,472 | 90,755 | 33,148 | -16.7 | -13.8 |
| Other Road | 2,02,835 | 58,769 | 1,58,887 | 50,582 | -21.7 | -13.9 |
| Total | 4,49,002 | 1,51,113 | 3,66,138 | 1,31,714 | -18.5 | -12.8 |

In 2019, 30.6% of all accidents and 35.7% of fatalities occurred on national highways; in 2020, those percentages rose to 31.8% and 36.4%, respectively. Compared to 24.2 percent during the same period in 2019, the State Highways account for 24.8 percent of all accidents in 2020. However, the percentage of accidents on other routes fell from 45.2 percent in the same time of 2019 to 43.4 percent in 2020. Only 2.08 percent of all roads in the nation are national highways, but they account for 36.4% of fatalities in 2020, followed by other roads (38.4%) and state highways (25.2%).

**Road Accident Blackspots:**

Road accidents are a random occurrence, however they might not be spread equally throughout road networks. On any road network, there are particular spots or sections of road where accidents happen more frequently than other places. Blackspots are places like these. The black spot, according to the United Kingdom, is a 100-meter stretch of road where four accidents happen per year. The term "black spot" is used in Norway to describe a 100-meter stretch of road where more than four people have died in traffic accidents over the previous four years. An entity (such as a crossroads, a road segment, a driver, a bus fleet, etc.) is said to have black spots if there are projected to be a certain number of accidents (crashes) or accidents outcomes of a certain kind or severity during a given period. Black spots are high crash locations that are identified by the sites that have an abnormally high number of crashes in comparison to comparable other sites. An area where road traffic accidents have historically been concentrated is referred to as an accident black spot in the administration of road safety. Black spots are typically used to describe an area where many accidents have happened and where there is a risk of those incidents (severe, major, and small).

## 2. Objectives

The main objective of the study is to conducted over the National Highways (picture below) falling in the state of Punjab. Only the National Highways, which are toll roads have been considered in the scope of the study. This report is a detail of the Road Accident scenario of NH-205, which crosses through the districts S.A.S. Nagar and Rupnagar of Punjab. The NH-205 is a total length of 65 km (13.40-80.80) falling in the state of Punjab under PIU Chandigarh, starting from km 28+600 up to km 73+200 is a part of the study.

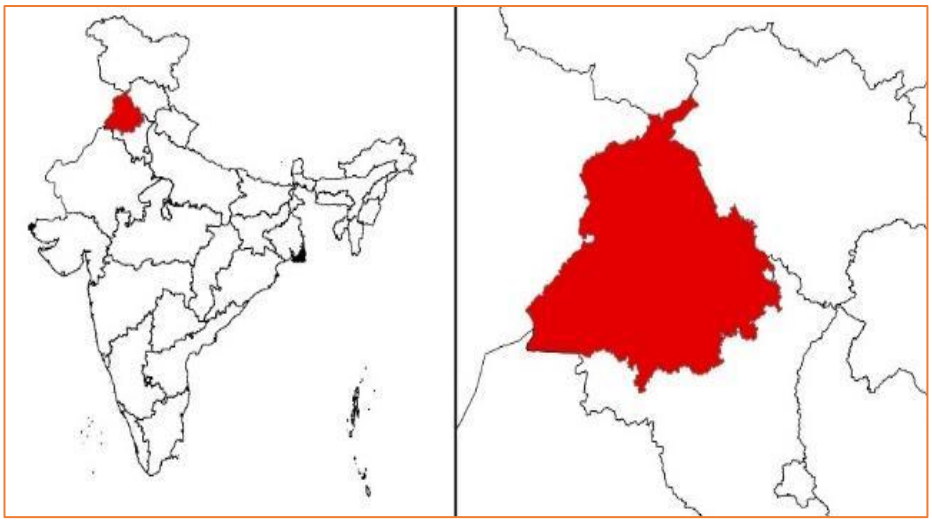


**Fig. 1: Location of Study Area (Punjab).**

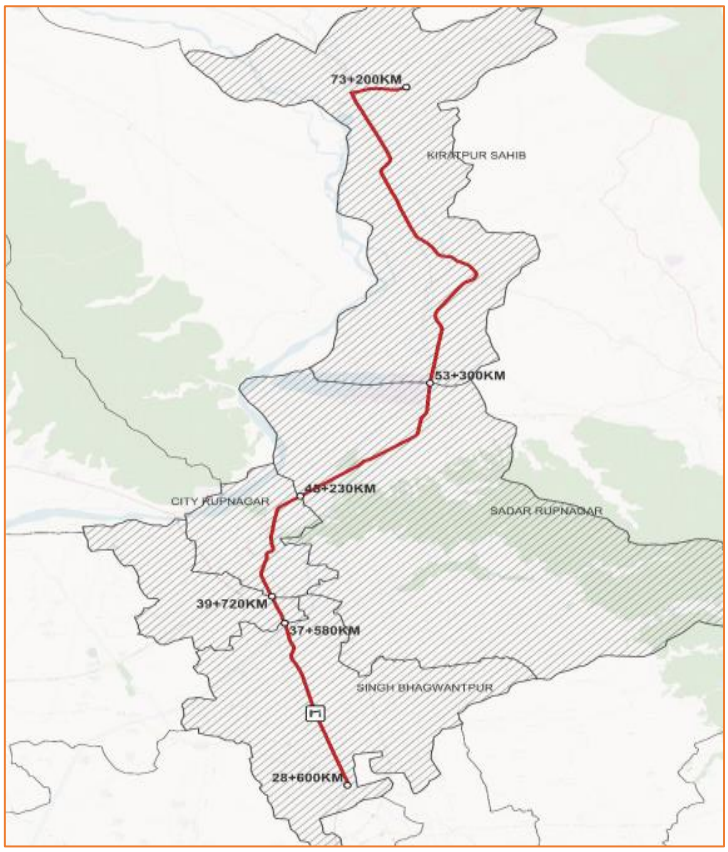



**Fig. 2: Location of District and Index Map NH-205 Stretch In Punjab.**

NH-205 is a primary National Highway in the Punjab, running from the South to the North, connecting S.A.S. Nagar to Rupnagar further connecting Punjab with Himachal Pardesh. This highway passes through S.A.S. Nagar and Rupnagar districts of Punjab. Under this study, 44.6 km long National Highway connects S.A.S Nagar to Rupnagar (Punjab). The part of the project corridor, starting from Kurali Bypass (Bannmajra) to Jeowal. NH-205 passes through four police stations, those are City Rupnagar, Sadar Rupnagar, Kiratpur Sahib and Singh Bagwantpur. The project has one 500 m long 10 Lane Toll Plaza at Km 35+000 near the village/town of Behrampur, Rupnagar in the State of Punjab.


**Fig. 3: Behrampur Toll Plaza On NH-205 (10 Lanes).**

## 3. Methods

**Designs Of Work For The Analysis:**

Using the Ministry of Road Transport and Highways' (MoRTH) definition of a blackspot, the present study's 44.6 km length of NH-205 accident blackspots have been discovered. The average fatality rate per kilometre on this stretch of NH-205 is 0.75 fatalities/km/year, whilst the fatalities/km/year on National Highways in India is 0.4 for the year 2018 (MoRTH 2020), thus it is two times higher than the National Average making this stretch overall as the most vulnerable and accident-prone. The Punjab Police website was used to access the historical accident data, which was then analysed in terms of the date, time, and month that the accidents occurred, their locations, the number of fatal accidents, the number of people killed and injured (with serious & minor injuries), the vehicles/road users involved in the accidents, and the type of collisions. With the aid of Google Maps, the accident sites' positions and the separations between various locations have been identified or roughly approximated. The NH-205 routes, S.A.S. Nagar to Rupnagar, have been treated as independent roadways and their respective black spot locations have been determined. Statistical analysis reveals that in 2020, out of the 11 accidental blackspots falling on this corridor, no accidental blackspots showed any kind of statistically significant improvement. Overall on the NH-205 Kurali – Kiratpur section (Punjab). Blackspots require additional Improvement and are suggested in the fifth chapter of this report. Location-wise, the two first-order blackspots at Patalpuri Chowk and Heritage Haveli Cut, Solkhian are the most vulnerable, followed by Major T-Point at Malikpur and Kamal Sweets Shop, Bharatnagar.

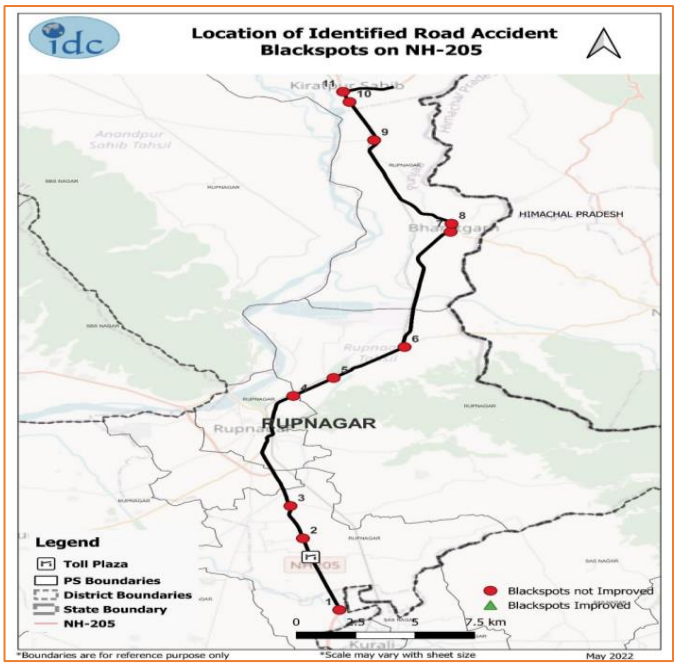
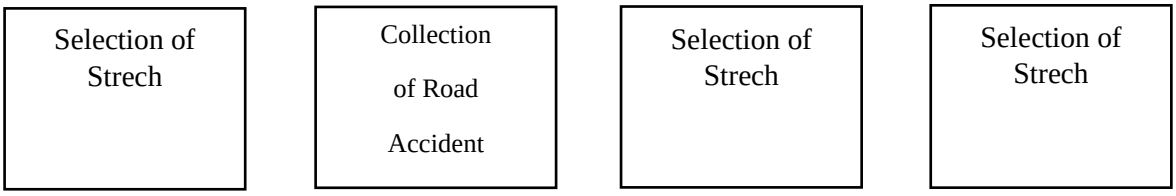



**Fig. 4: Identification of Blackspot on NH-205.**

**Chart shows a schematic overview of the research approach used.**




**Accident Data Analysis:**

Data collection: only the police in all the states of the country carry out Crash data collection across the road network. The FIR data for four years i.e. 2017, 2018, 2019 and 2020 has been collected and coded. Road accident First Information Reports (FIRs) and DDR for a period of four years from the concerned police stations in the area were collected. A total 185 road accidents reported between the years 2017 to 2020 were collected from four police stations falling on this 44.6 km long study area stretch. Year-wise details of road crash data collected are given in Table (3).

**Table 3: Year Wise Road Accidents on NH-205.**

| Year | Cases | Fatalities | Serious Injured | Minor Injured |
|---|---|---|---|---|
| **2017** | 52 | 42 | 17 | 8 |
| **2018** | 54 | 41 | 21 | 21 |
| **2019** | 39 | 26 | 29 | 7 |
| **2020** | 40 | 24 | 18 | 9 |
| **Total** | 185 | 133 | 85 | 45 |

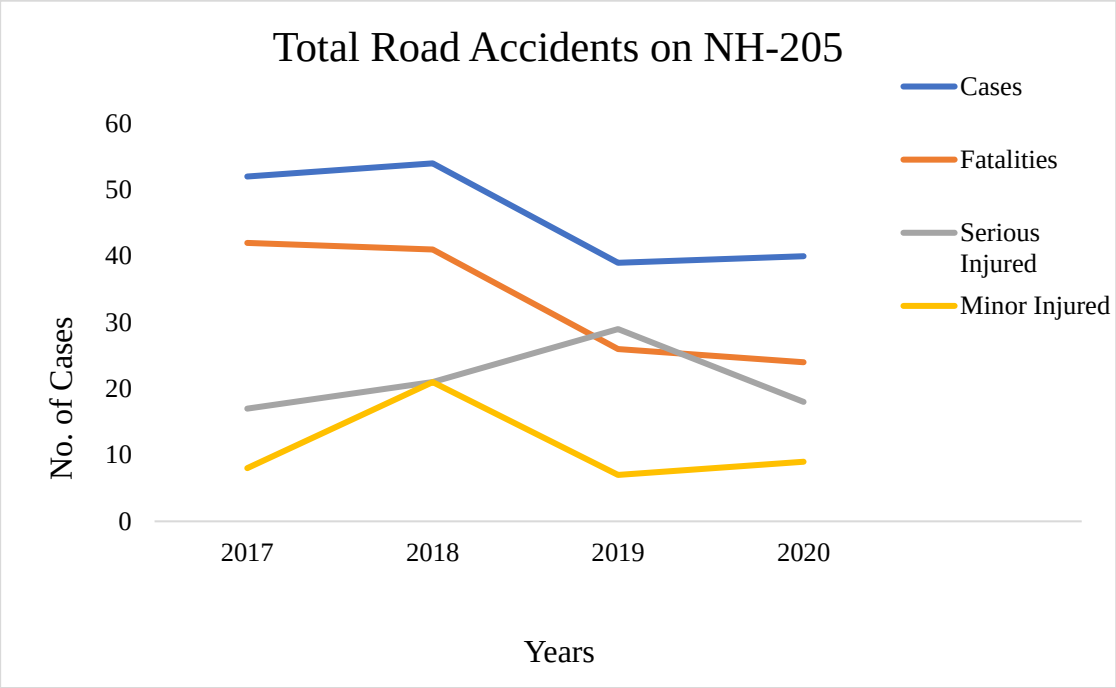



**Fig. 5: Analysis of Year Wise Road Accidents on NH-205.**

**Police station-wise Road Accidents:**

In order to develop a better understanding of crash patterns and level of enforcement on highways, Police station-wise Spatio-Temporal analyses were performed. The road stretch falls within the jurisdiction of four police stations (City Rupnagar, Sadar Rupnagar, Kiratpur Sahib and Singh Bagwantpur) of Rupnagar district of Punjab.

**Table 4: Police Station Wise Road Accidents on NH-205.**

| Police Stations | IPC (Cognizable) | | | | CrPC (Non-Cognizable) | | | | Total | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cases | Fatalities | Serious | | | Fatalities | Serious | | Cases | Fatalities | Serious | |
| City Rupnagar | 28 | 19 | 15 | 7 | 6 | 6 | 0 | 0 | 34 | 25 | 15 | 7 |
| Kiratpur Sahib | 61 | 43 | 42 | 17 | 4 | 4 | 0 | 0 | 65 | 47 | 42 | 17 |
| Singh Bhagwantpur | 41 | 22 | 16 | 7 | 3 | 3 | 0 | 0 | 44 | 25 | 16 | 7 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sadar Rupnagar** | 36 | 29 | 12 | 14 | 6 | 7 | 0 | 0 | 42 | 36 | 12 | 14 |
| **Total** | 166 | 113 | 85 | 45 | 19 | 20 | 0 | 0 | 185 | 133 | 85 | 45 |

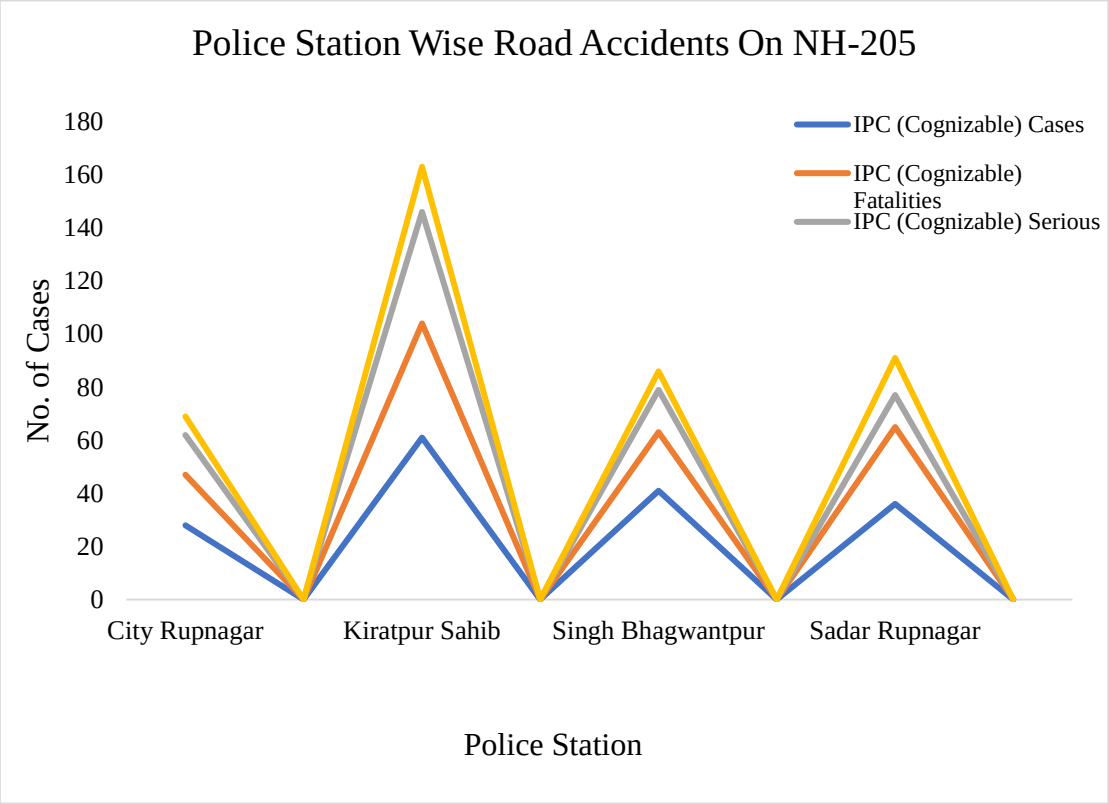



**Fig. 6: Analysis of Police Station Wise Road Accidents on NH-205.**

**Type of Road Users Associated with the Accidents:**

**Impacting Versus Victim Vehicle Analysis**

In this Table each chainage specifying the fatalities, impacting vehicle and victim vehicle for each kilometre of road stretch. This table highlights and helps in strategies while enforcement drives with a vehicle-specific approach, which helps in controlling and targeting the road accident-causing vehicles on a particular one kilometre road stretch. It also assists the various road safetyrelated departments to identify which vehicle or vulnerable road user predominately requires target hardening.

**Table 5: Type of Road User, Causes and Victim of Road Accidents on NH-205.**

| **Chainage** | **Total Accidents** | | **Serious Injuries** | **Minor Injuries** | **Male** | **Female** | **Major impacting Vehicle (All Accident)** | **Major Victim** |
|---|---|---|---|---|---|---|---|---|

| | | | | | | | | Vehicle | | Vehicle |
|---|---|---|---|---|---|---|---|---|---|---|
| **28.6-30** | 6 | 6 | 0 | 0 | 5 | 1 | 2 | Car/Jeep/Van/Taxi | 5 | Two-Wheeler |
| **30.0-35.0** | 24 | 12 | 13 | 2 | 12 | 0 | 16 | Car/Jeep/Van/Taxi | 14 | Two-Wheeler /Pedestrian/Cyclist |
| **35.0-40.0** | 25 | 14 | 10 | 8 | 11 | 3 | 17 | Car/Jeep/Van/Taxi /Truck | 15 | Two-Wheeler /Pedestrian |
| **40.0-45.0** | 29 | 24 | 9 | 5 | 21 | 3 | 13 | Car/Jeep/Van/Taxi /Truck/Single Vehicle | 16 | Two-Wheeler |
| **45.0-50.0** | 20 | 18 | 5 | 9 | 15 | 3 | 9 | Car/Jeep/Van/Taxi /Truck/Single Vehicle/Two-Wheeler/Multi Axel vehicle | 13 | Two-Wheeler /Pedestrian |
| **50.0-55.0** | 16 | 12 | 6 | 4 | 11 | 1 | 10 | Bus/Car/Jeep/Van/ Taxi/Unknown | 8 | Two-Wheeler /Pedestrian/Cyclist |
| **55.0-60.0** | 21 | 11 | 16 | 5 | 10 | 1 | 13 | Car/Jeep/Van/Taxi /Truck/Multi Axel Vehicle | 11 | Two-Wheeler /Pedestrian/Cyclist/Light Commercial Vehicle/Car/Jeep/Van/Taxi |
| **60.0-65.0** | 13 | 12 | 11 | 0 | 12 | 0 | 7 | Car/Jeep/Van/Taxi /Truck/Multi Axel Vehicle | 8 | Two-Wheeler /Pedestrian |
| **65.0-70.0** | 18 | 14 | 9 | 8 | 11 | 3 | 9 | Truck/Light Commercial Vehicle/Unknown | 9 | Car/Jeep/Van/ Taxi/Two-Wheeler |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **70.0-73.2** | 11 | 9 | 6 | 4 | 7 | 3 | 6 | Truck/Light Commercial Vehicle | 6 | Two-Wheeler /Pedestrian |
| **Total** | 219 | 178 | 135 | 45 | 155 | 23 | - | - | - | - |

**Accidents Classified according to Month of Occurrence:**

Month-wise, if we look at the data, mainly November was having 19 road accident cases (13 fatalities). But in terms of highest road crash severity the month of January was having 15 cases resulting in 14 road crash fatalities. This is followed by the month of August and September having 13 fatalaties each. Overall the month of January, June and November have been the most critical months for NH-205 Punjab stretch resulting into maximum number of road crashes.

Month-wise, if we look at the data, January, August, September and November are the most critical months for the NH-205 Punjab stretch in terms of road accident fatalities. But in terms of maximum road crash victims,the month of June tops the charts with 18 accident cases and 39 victims.

**Table 6: Month Wise Road Accidents on NH-205.**

| Months | Total Fatalities | Total Serious Injuries | Total Minor Injuries |
|---|---|---|---|
| **January** | 14 | 6 | 0 |
| **February** | 11 | 9 | 4 |
| **March** | 11 | 2 | 1 |
| **April** | 10 | 10 | 1 |
| **May** | 8 | 7 | 2 |
| **June** | 11 | 20 | 8 |
| **July** | 9 | 4 | 4 |
| **August** | 13 | 4 | 4 |
| **September** | 13 | 4 | 5 |
| **October** | 8 | 8 | 5 |
| **November** | 13 | 6 | 10 |
| **December** | 12 | 5 | 1 |
| **Total** | 133 | 85 | 45 |

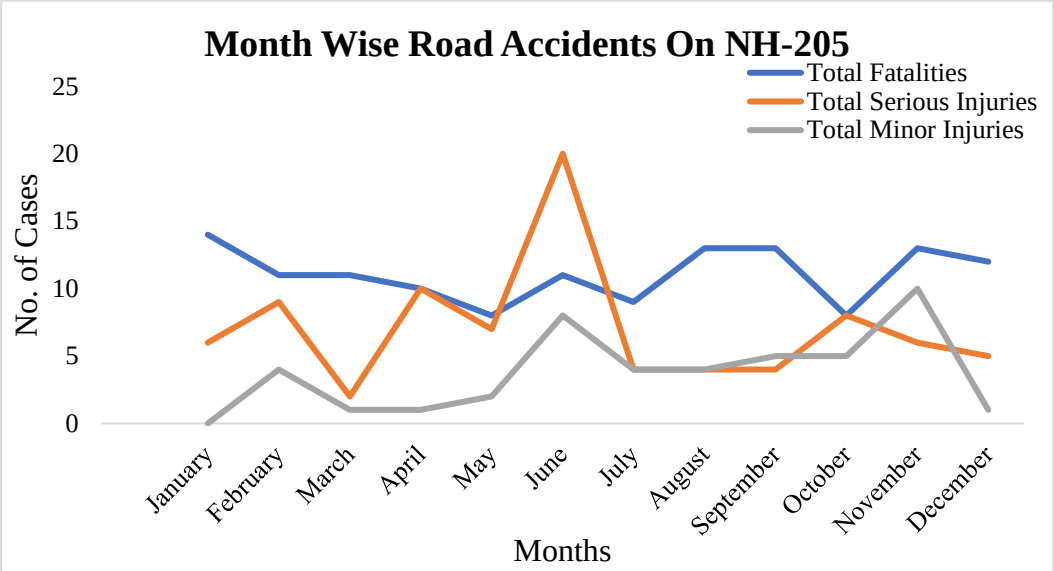



**Fig. 7: Month-Wise Analysis Of Road Accidents For The Years 2017-2020 On NH-205.**

**Categorization of Accidents by Time-wise:**

The most dangerous times for traffic accidents on NH-205 are in the late evening to early morning hours, commencing at 6 PM and ending at 9 PM. In contrast, 23% of all road accident deaths (31 fatalities) reported over the course of the four years occurred during these three-hour windows. The time periods from 12 PM to 3 PM and 3 PM to 6 PM are the next two, during which 13% of all traffic fatalities (17 deaths) occurred in the preceding four years (2017–2020). Data points to a high rate of accidents between the hours of 6:00 AM and 9:00 PM, which resulted in 108 fatalities, 75 serious injuries, and 41 minor injuries out of all accidents.

**Table 7: Time Wise Road Accidents on NH-205 (2017-2020).**

| Time Slot | Fatalities | Serious | Minor |
|---|---|---|---|
| **12:01 AM - 03:00 AM** | 1 | 1 | 2 |
| **03:01 AM - 06:00 AM** | 4 | 3 | 0 |
| **06:01 AM - 09:00 AM** | 14 | 10 | 4 |
| **09:01 AM - 12:00 PM** | 15 | 12 | 10 |
| **12:01 PM - 03:00 PM** | 17 | 8 | 3 |
| **03:01 PM - 06:00 PM** | 17 | 9 | 5 |
| **06:01 PM - 09:00 PM** | 31 | 24 | 16 |
| **09:01 PM - 12:00 AM** | 14 | 12 | 3 |
| **Unknown** | 20 | 6 | 2 |
| **Total** | 133 | 85 | 45 |

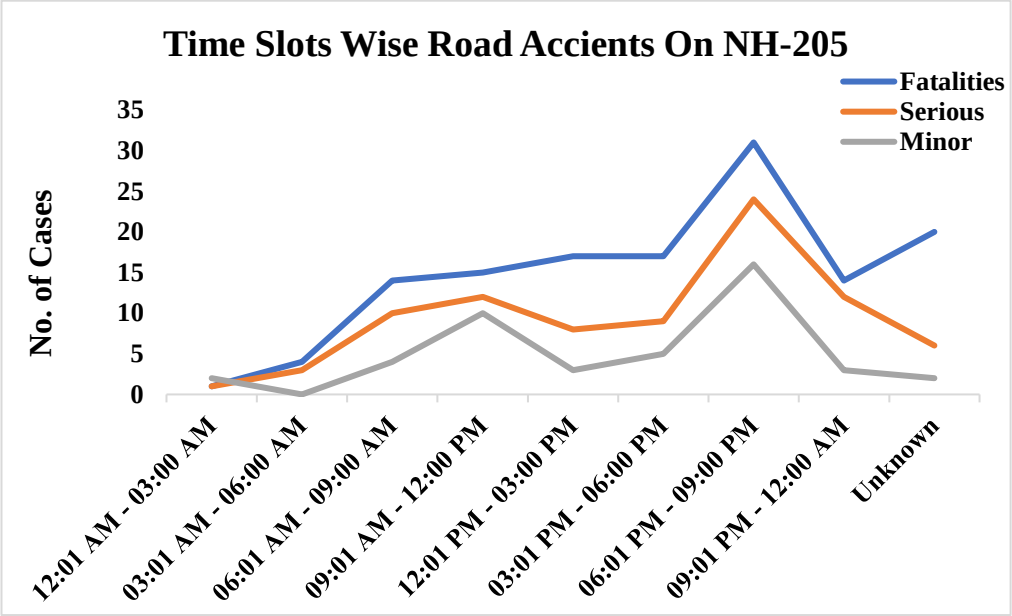



**Fig. 8: Time-Wise Analysis Of Road Accidents For The Years 2017-2020 On NH-205.**

**Collision Type Road Crashes:**

A total of 65 traffic accidents involved back-impact collisions as the primary cause, followed by 46 accidents involving non-motorized transport, such as pedestrians (39 cases) and cyclists (7 cases). Another major concern for divided road segments is the Hit from the Side and Head-on category of crashes, which highlight the lack of speed calming measures on side roads approaching the main carriageway at intersections and resulted in 23 and 22 road accident cases out of 185 overall cases over the past four years.

Hit from behind accounts for 36% of all traffic accident deaths (48 fatalities), which is a regular occurrence on split highways. Pedestrian and bicycle accidents account for 29% of all fatalities (38 fatalities) in traffic accidents. There are 14 fatalities as a result of head-on collisions, which account for 10% of all traffic crash fatalities.

**Table 8: Collision Type Of Fatal Road Accidents.**

| Type Of Collision | Total Fatalities |
|---|---|
| **Head On** | 14 |
| **Hit by Animal** | 5 |
| **Hit Cyclist** | 5 |
| **Hit Fixed Object** | 1 |
| **Hit from Back** | 48 |
| **Hit from Side** | 7 |
| **Hit parked Vehicle** | 2 |
| **Hit Pedestrian** | 33 |
| **Other** | 1 |
| **Overturning** | 0 |
| **Skidding** | 4 |
| **Unknown** | 13 |

| | |
|---|---|
| **Total** | 133 |

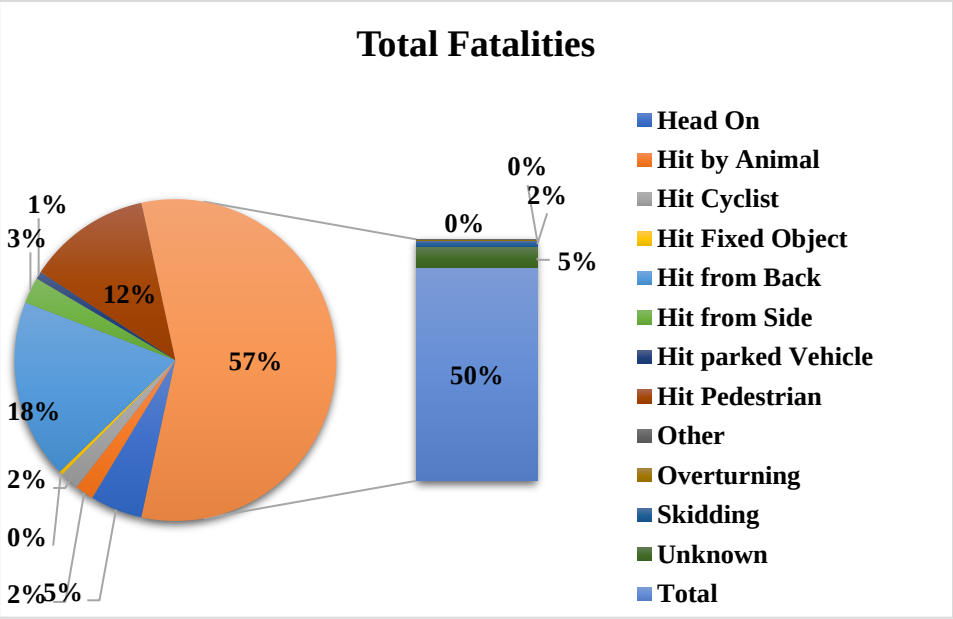



**Fig. 9: Collision Type Analysis Of Road Accidents On NH-205.**

**Impact of Vehicle-Related Road Accidents:**

According to a thorough examination, the only vehicles responsible for 66 traffic accidents resulting in 36 fatalities (27% of all fatalities) were cars, jeeps, vans, and taxis. Trucks are the second most affected vehicle after this, accounting for 48 traffic accidents and 28% of all fatalities (37 fatalities). With 11 people killed in single-vehicle wrecks, which account for 8% of all fatalities in traffic accidents, this category highlights serious problems with infrastructure and road design.

**Table 9: Impacting Vehicle-Wise Analysis Of Road Accidents For The Years 2017-2020 On Nh-205.**

| Vehicle Profile | Total Fatalities |
|---|---|
| **Bus** | 4 |
| **Car/Jeep/Van/Taxi** | 36 |
| **Light Commercial Vehicle** | 2 |
| **Multi Axel Vehicle** | 3 |
| **Single Vehicle** | 11 |
| **Tractor/Trolley** | 1 |
| **Truck** | 37 |
| **Two Wheeler** | 19 |
| **Unknown** | 20 |
| **Total** | 133 |

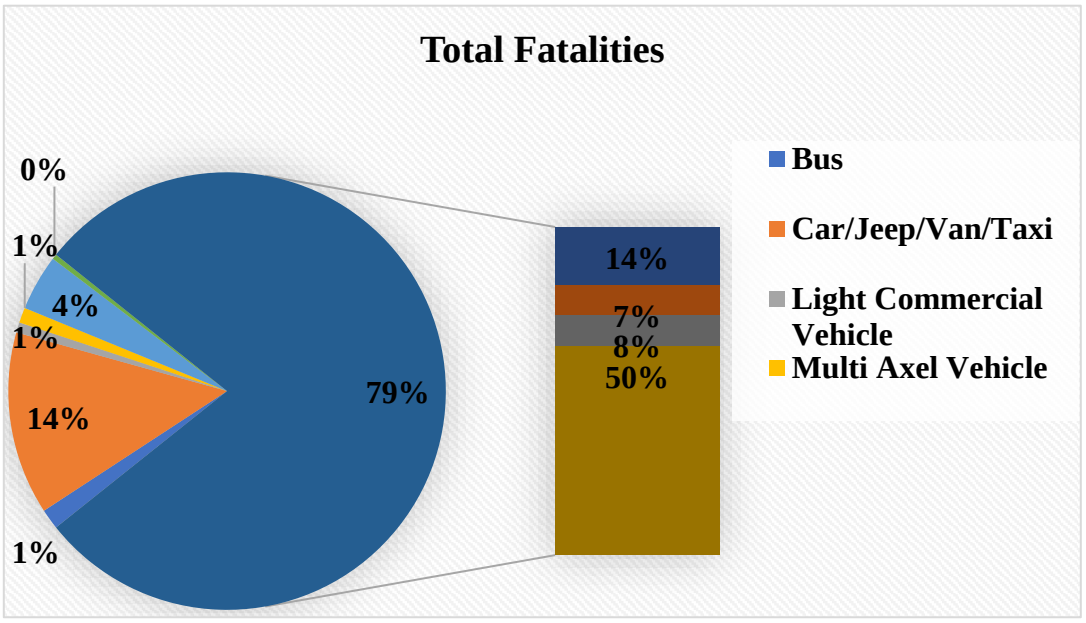



**Fig. 10: Impacting Vehicle-Wise Analysis Of Road Accidents For The Years 2017-2020 On NH-205.**

## 4. Discussion

11 unintended black spots have been found along a 44.6-kilometer study area stretch of the NH-205 between Km 28+600 and 73+200, indicating that 35–40 km of the road's length has engineering flaws and insufficient infrastructure to meet the needs of vehicles and pedestrians.

This stretch of NH-205 has an average fatality rate per kilometre of 0.75 per year, compared to the national average of 0.4 for national highways in India for the year 2018 (MoRTH 2020). This makes this section of the highway the most dangerous and accident-prone in general.

Pedestrians, cyclists, and two-wheelers account for 82% of all fatalities in traffic accidents, making this length, mostly in metropolitan areas, risky for them. For vulnerable road users, the blackspots in urban and peri-urban regions necessitate unique engineering solutions.

When impacting vehicles are taken into account, a thorough research shows that Four Wheelers, namely Car/Jeep/Van/Taxi, lead to 36 fatalities (27%) and Trucks, which lead to 37 fatalities (28%), together accounting for 55% of all road accident fatalities.

According to the research, the most dangerous months for the NH-205 Punjab segment in terms of fatal traffic accidents are January, August, September, and November. However, June tops the list for most fatalities from traffic accidents with 18 accident occurrences and 39 injured.

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