IDENTIFICATION OF ACCIDENT BLACK SPOTS ON NATIONAL HIGHWAY

Athira Mohan
M.Tech Student, Department of Transportation Engineering
Visvesvaraya National Institute of Technology,
Nagpur, Maharashtra, India

Dr. V.S. Landge
Associate Professor, Department of Transportation Engineering,
Visvesvaraya National Institute of Technology,
Nagpur, Maharashtra, India

ABSTRACT
The simultaneous increase in population and the number of vehicles led the road authorities to get more focus on the road safety improvements. According to the recent road accident data, the highly populated Maharashtra state has reported the highest accident rate which calls for the need of safety improvements. For this purpose, Identification of accident prone location is considered as the first step in road safety improvements. This paper mainly aims to identify the accident prone locations along Amravati- Nagpur road stretch from Asian highway 46. The top accident prone spots were selected as black spots based on Weighted Severity Index Method and some suggestions are made to improve the transportation system.

Keywords: Black Spots, Weighted Severity Index and Asian Highway 46.

Cite this Article: Athira Mohan, Dr. V.S. Landge. Identification of Accident Black Spots on National Highway. International Journal of Civil Engineering and Technology, 8(4), 2017, pp. 588-596
http://www.iaeme.com/IJCIET/issues.asp?JType=IJCIET&VType=8&IType=4

1. INTRODUCTION
Road accidents have become an alarming issue across the globe. The number of serious as well as minor injuries, human sufferings and the economic loss due caused by accidents is inestimable. Hence road safety is a major concern in the present situation. According to the latest road accident data released by the Ministry of Road Transport and Highway, the total number of accidents increased by 2.5 percent from 4,89,400 in 2014 to 5,01,423 in 2015. The analysis reveals that about 1,374 accidents and 400 deaths take place every day [1]. This implies that every hour 17 people become the victims of a road accident.
2. SCOPE AND OBJECTIVES

To develop a methodology to identify the most vulnerable accident stretch along the National Highway. The results from the case study can be used for better assessment of roadway section for future considerations.

The black spot studies on Futala chowk to Outer ring road stretch (13km) has been taken up with the following objectives:

- To collect accident data regarding Nagpur district for three years 2014, 2015 and 2016 from the concerned police department.
- To identify the black spots on the national highway AH46 from the selected road stretch.
- To rank the black spot based on the level of accident severity.
- To identify various traffic and road related factors causing accidents.
- Detailed analysis of the top ranked spots and suggestion of possible improvements.

3. STUDY AREA

A brief detailing about the study area is given in two sections. The first section presents the details of Asian Highway 46 (AH46) which connects Amravati- Nagpur route. The second section deals with the details of the study area.

3.1. Asian Highway 46

Asian Highway 46 (AH46), also known as Indian National Highway 6 (NH6) is a major route in India which connects Gujarat, Maharashtra, Chhattisgarh, Orissa, Jharkhand and West Bengal states. This Highway route comes under the Asian Highway project which covers a distance of 1,949km. AH46 Crosses NH47 at Dhule and NH43 at Nagpur. The following table shows the various cities and towns which lie on AH46.

3.2. Amravati- Nagpur Road Stretch

For the identification of the accident-prone location, a section of Amravati- Nagpur road stretch from Asian highway 46 was selected. A small description about the road stretch is given below:

- Road stretch- Amravati- Nagpur National Highway.
- Distance- 152km; Lane- 4lane; Width-23.5m
- Pavement type – Asphalt
- Day traffic: towards Nagpur-6585 vehicles; out- 7518 ( total vehicles: 14103)
- Average Occupancy of vehicle type – two wheeler (1.73), car (3.16), Auto (4.21) and Taxi (4.01)
- Trip frequency (private vehicles) - Daily 46% and weekly 12%
- Trip Purpose (private vehicles) - Work 33%, business 26% and Education 9%
- Trip frequency (Good vehicles) - Daily 44% and weekly 32%
- Trip Purpose (Good vehicles) - Loading 46% and unloading 53%

The above data was taken from Comprehensive Mobility Plan Nagpur final report 2015[8].

From the road stretch, futala chowk to outer ring road network is selected for the black spot study. It covers a distance of 13 km from the selected road stretch. The study area covers some of the major busy locations such as Wadi and Waddhamma.

![Figure 1 Study Area from the Selected Road Stretch](image)

4. LITERATURE REVIEW

In 1984, Srinivasan and Chand proposed Accident Risk Index (ARI) to determine the level of accident rates for different states. They computed the index using a set of accident ratios which have been combined by assigning certain weights. ARI is one such indicator which reflects the impact of the vehicle, road length, area and population on the number of accidents and identifies the prevailing probability for an accident to take place in the district or state.[3]

In 1990, Satyakumar et al developed a severity index to determine the level of accident rates. He given more weightage to the number of people killed rather than a number of people injured. Then it was correlated with accident risk index based on rank. He found out that there was a significant difference in the rank correlation of computed values between ARI and severity index.

In 1987, Deshpande et al developed an index which consists of all the factors and provided a proper comparison of actual accident rates. He found out that this index can identify the factors influencing it. Srinivasan et al. (1987) observed that for identification of accident black spots on national highway in Kerala, there are three scientific methods which can be used namely Quantum of Accident Method; ii) Accident Prone Index (API) method and Weighted Severity Index (WSI) method and it was concluded that weighted severity index method was found to be most suitable [9].

Weighted Severity Index, (WSI) = (41 x K) + (4 x GI) + (1 x MI)

Where, K is the number of persons killed.
GI is the number of grievous injuries.
MI is the number of minor injuries.
Locations having WS above 40 are termed as accident black spots

In 1991, Murthy et al conducted black spot study on selected roads of Bangalore city using the severity factors. He found that severity factors can use as a very effective method to quantify and categories road locations with respect to accidents. He concluded that black spot study done annually can help in establishing priorities for suggested improvement in traffic

http://www.iaeme.com/IJCIET/index.asp 590 editor@iaeme.com
Identification of Accident Black Spots on National Highway

management. Therefore Accident rates expressed in terms of million vehicle-kilometers is a more reliable approach.

In 2005, Chakraborty and Roy conducted a study to determine the road safety level in Kolkata city of India. They considered 4 parameters namely accident severity index, accident fatality rate, accident fatality risk and accident risk and created a model based on Smeed’s approach to predict future accidents for Kolkata. [5]

In 2007, Chand and Alex computed accident risk index and accident severity index (ASI) for different states in India. These indices are based on a set of accident indicators, which are combined together to form an index. Values of these two indices have been computed and compared across the states of India. [6]

In 2007, Michael Sorensen proposed an injury severity method to identify black spots and compared with a normal method (frequency-rate identification). In this method, he ranked on the basis of injury severity weighted accident rather than normal accident rate. Weightage is taken on the basis of accident types such as accident location, combination of vehicles involved and accident location. Weightage for each type of accident are calculated on the basis of the socioeconomic cost of injuries. Results showed that the severity method was better than normal methods for primary road section as it gives more focus on the accident location with severe accidents.

In 2015, Snehal U Bobade, et al. hinted that accident-prone locations can be identified by ranking the parameters based on their severity and calculating the severity index. The physical survey was carried out at the actual location for selected stretches of Mumbai-Pune Expressway and Pune-Solapur Highway. The parameters which caused a maximum number of accidents were assigned maximum weightage and top rank. The summation of the weights was calculated to find out the total severity. The severity Index was then calculated by adding the weightages of each parameter present divided by the total severity [8]

5. METHODOLOGY

The following detailed methodology has been adopted for obtaining the various aspects of the present study. The steps involved in the study are explained in the following sections.

5.1. Data Collection

Primary and secondary data were collected for the study and is explained below. Analysis of the Primary data includes Road inventory study, traffic volume count etc. (primary data collection) were conducted at the above-identified accident black spots.

- Road Inventory Survey: A detailed road inventory survey was carried out on the entire identified spots to measure the roadway geometric parameters like the roadway width, footpath width, median, shoulders, surface type, surface condition, edge obstruction, road markings, road signs, drainage facilities and adjoining land use. It is sufficient for accommodating huge traffic and the width is satisfying the standards of national highways. In some stretches, there is no median for differentiating the direction of traffic. It may cause head on collision and night-time road accidents due to glare problem. Bituminous surfacing is provided in all the spots and it is in fair condition. The alignment of the road is straight in all places and it encourages drivers to take over speed while traveling through these spots. Drainage facilities are given in most places and it is not good condition. Uncovered drainages compel pedestrians to use roads for walking and lead pedestrian accidents.

- Road geometric data coding: for coding Road attributes such as a number of lanes, lane width, paved shoulder width, property access points, intersection type and channelization,
median type etc. video graphic survey was done with a Canon video camera. Data such as curvature and grade were measured from the Google Earth (topographic map and vertical profile).

- Traffic Volume Count: The traffic volume count gives the measure of how many vehicles pass through a particular location during a period of time. According to the traffic volume, the time can be classified to peak hour and off peak hour. For any traffic infrastructure, design and accident study peak hour traffic volume are necessary.

- In the present study, traffic volume count was taken for six sections. Video footage was available for two sections with NMC for Ring Road Project. Traffic count for the section near Outer Ring road Amravati Road was taken from Comprehensive Mobility Plan Nagpur final report 2015. For the other sections where volume count was not available.

**Table 2** Traffic volume data of the 13 km study stretch

<table>
<thead>
<tr>
<th>Road</th>
<th>Vehicle flow (AADT)</th>
<th>Motorcycle percentage (%)</th>
<th>Average Operating speed(kmph)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Futile-Wadi</td>
<td>57469</td>
<td>71</td>
<td>2.5</td>
</tr>
<tr>
<td>Wadi junction section</td>
<td>91877</td>
<td>72</td>
<td>4.6</td>
</tr>
<tr>
<td>Wadi to Waddhamna</td>
<td>85386</td>
<td>70</td>
<td>1.4</td>
</tr>
<tr>
<td>Waddhamna to Outer ring road</td>
<td>21154</td>
<td>68</td>
<td>2.1</td>
</tr>
</tbody>
</table>

5.2. Crash Data Collection

Accident data was collected for three years (2014-2016 May) from the Wadi police station. The available data were thoroughly examined with its location of occurrence and it was observed that the data was insufficient for the roads other than futala Chowk to Amravati Outer Ring road. So the crash data study has been reduced to 13.1 km stretch Amravati Road.

**Table 3** Accident Data 2014-16.

<table>
<thead>
<tr>
<th>Location</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Death</td>
<td>Serious Injury</td>
<td>Minor Injury</td>
</tr>
<tr>
<td>MIDC turning point</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Nevins Nagar</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Marwa transport at Waddhamna</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Mahadevnagar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dattawadi junction</td>
<td>1</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Wadi bazaar</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Dabha Naka</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Hill top</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gurudwara</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Katol Bypass</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSEB power house</td>
<td>1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Ordnance Factory Gate( Eighth Mile)</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Vikas Nagar</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marutiseva Showroom</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
6. ANALYSIS OF SECONDARY DATA BY WEIGHTED SEVERITY INDEX METHOD

The accident black spots were identified using Weighted Severity Index Method (WSI) by assigning scores based on the number and severity of accidents in that particular location during the last 3 years.

<table>
<thead>
<tr>
<th>Location</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIDC turning point</td>
<td>1</td>
<td>40</td>
<td>84</td>
</tr>
<tr>
<td>Nevins Nagar</td>
<td>1</td>
<td>50</td>
<td>82</td>
</tr>
<tr>
<td>Marwa transport at Waddhamna</td>
<td>125</td>
<td>125</td>
<td>166</td>
</tr>
<tr>
<td>Mahadevnagar</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Dattawadi junction</td>
<td>40</td>
<td>29</td>
<td>44</td>
</tr>
<tr>
<td>Wadi bazaar</td>
<td>98</td>
<td>85</td>
<td>13</td>
</tr>
<tr>
<td>Dabh Naka</td>
<td>43</td>
<td>42</td>
<td>40</td>
</tr>
<tr>
<td>Hill Top</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Gurudwara</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Katol Bypass</td>
<td>40</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>MSEB Power house</td>
<td>4</td>
<td>44</td>
<td>1</td>
</tr>
<tr>
<td>Ordnance Factory Gate (Eighth Mile)</td>
<td>85</td>
<td>93</td>
<td>53</td>
</tr>
<tr>
<td>Vikas Nagar</td>
<td>40</td>
<td>40</td>
<td>5</td>
</tr>
</tbody>
</table>

Weighted Severity Index, (WSI) = (41 x K) + (4 x GI) + (1 x MI)
Where, K is the number of persons killed.
GI is the number of grievous injuries.
MI is the number of minor injuries.
Locations having WSI above 40 are termed as accident black spots [9].

7. RESULT

Based on the analysis of accident data using accident density method and severity method, top five black spots along the national highway is determined.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Black spot locations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Marwa transport at Waddhamna</td>
</tr>
<tr>
<td>2</td>
<td>Ordnance Factory Gate (Eighth Mile)</td>
</tr>
<tr>
<td>3</td>
<td>Wadi Bazaar</td>
</tr>
<tr>
<td>4</td>
<td>Dabh Naka</td>
</tr>
<tr>
<td>5</td>
<td>Navnit Nagar</td>
</tr>
</tbody>
</table>

7.1. Detailed analysis of the top ranked spots and suggestion of possible improvements

1. Ordnance Factory Gate (Eighth Mile)
   - No proper markings are there on the road.
   - Over speeding and drunken driving led to accidents particularly during the night time at this stretch.
Suggestions and Improvements

- Provide the speed limit sign boards on National Highway
- Provide proper road marking in the road.
- Prove proper signal boards about the crossings of vehicles.
- Proper lighting should be provided during the night.
- Wearing helmet should be strictly checked.
- Provide the zebra crossings for the safe crossing of the pedestrians.

2. Marwa transport at Waddhamna

Marwa transport at waddhamna ranked first based on the analysis of accident data and other factors. Marwa transport area is normally dealing with the loading and unloading of goods. Since most of the accidents in waddhamna lead to loss of life, Marwa transport area was enlisted in the top hot spots category by the Police department.

- Trucks play a major role in this area.
- No parking area is marked.
- Over speeding of trucks in the night and early morning leads to accidents
- Many cases of vehicles knocking at the dividers have been reported at this spot.
- No guard rails and sign boards.
- Drunken driving is the common reason of accidents in the area

Suggestions and Improvements

- Take suitable enforcement measures to reduce the speed of vehicles.
- Remove or repair potholes for the safety of road users.
- Remove the illegal constructions from the road.
- Provide the safety barriers just before the bridge starting on both sides of the road.

3. Duttawadi junction

- Most of the vehicles are parking on the road itself which leads to traffic jams.
- Sudden overtakes and Over speeding.

Suggestions and Improvements

- Provide separate bus bays for avoiding delay of other vehicles at the bus stops.
- Proper lighting should be provided during the night
- Some sign boards are hidden due to trees, make it visible to the drivers
- Provide footpath on both the sides of the road for the safety of pedestrians
- Provide the zebra crossings near the bus stand and junction for safe crossing of the pedestrians.

4. Wadi & Wadi bazaar

- Over speeding and drunken driving led to accidents particularly during the night time at this stretch.
- unauthorized parking causes serious jams and accidents
- Footpaths are not provided on either side which causes problems to the pedestrians.
- No marking on the roads.
- Driving on the wrong side is very common here.
- Over speeding near the bazaar area
- No proper drainage system.
- No Speed limit sign board.
Identification of Accident Black Spots on National Highway

Suggestions and Improvements

- Provide parking so that vehicles cannot stand on the side of the road which creates the problem for pedestrians and for vehicles also.
- Wearing helmet should be strictly checked.
- Provide footpath on both the sides of the road for the safety of pedestrians
- Proper lighting should be provided during the night

8. CONCLUSION

The identification and analysis of accident black spots help in identifying the stretches where accidents are more and these spots reduce the road safety in general. The spot on the road where traffic accidents frequently occur is termed as black spots. The current study was an attempt to find out the most vulnerable accident locations or black spots on National highway.

The Weighted Severity Index (WSI) method was used to rank the accident locations. The top five spots were selected as black spots as per the WSI value from the collected data and suggested some possible alternative measures improve the transportation system. The overall methodology was found to be effective for the identification, evaluation, and treatment of accident black spots if sufficient data is available. The deficiencies like non-availability of parking lane, no zebra crossing, no guard rails and sign boards and also the no proper road markings and unauthorized parking etc. It is also observed that most of the 2-wheelers are not using the helmets and also over speeding their vehicles. Implementation of the suggested improvements will help to increase the overall road safety.

REFERENCES


