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Analysis of Black Spots in the Chandigarh City

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ABSTRACT: World Health Organization (WHO) predicted that death due to accident shall become the seventh largest cause in the world by 2030. WHO has aimed at reducing the death due to accident by 50 percent by 2020. The African region has the highest death rate due to accident while least in the European region. Pedestrians, Cyclist and motorbikes together forms 49 percent of road accidents on the highway in the world. India is one of the fastest developing nations in the world, thus resulting in more buying capacity for its citizens. There is a explosion of vehicles on Indian highways which has surged by more than 400 percent from 2001 to 2013 i.e. in 12 years comparing it to National Highways which merely has grown by 133 percent, thus resulting in congestion and increase of accident rates in India. Middle-income countries own about 53 percent of the world's vehicle but they account for more than 74 percent of the world's road traffic fatalities. Blackspots are being analysed in detail from civil engineering prospective by doing the various studies in detail like Classified Traffic Volume Count, Speed and Delay Studies, Accident data collection from police station, Existing Geometrics and Road Furniture etc. The data is then analysed in detail in order to determine the possible problems and then suggesting the remedial measures on it.

KEYWORDS: Black Spots, Accident, Fatal Accidents, Pedestrian and Cyclist, Geometric deficiencies causing accidents.

I. INTRODUCTION

Black Spots as per Ministry of Road Transport & Highways (MORT&H), Government of India is defined as "The road accident black spot is a stretch of National Highway or other category of road (SH/MDR/Other roads) of about 500 m in length in which either 5 road accidents (in all three years put together involving fatalities / grievous injuries) took place during the last 3 calendar years or 10 fatalities (in all three years put together) took place during the last 3 calendar years may be strictly be followed" [1]. Black spots in simple terms can also be defined as a stretch of a highway where intensity and severity of accidents are very high.

"Global Status Report on Road Safety 2015" published by World Health Organisation (WHO) predicted that the death due to accident shall become the seventh largest cause in the world by 2030. In the young age group of 12-29 years which mainly consists of student and young working professionals, the cause of death due to accident injury on road is at number one spot followed by suicide, HIV/AIDS etc. This clearly shows that the young hot blood needs to be educated about the traffic rules and the importance of one's life at the school and college level. WHO has set a goal of reducing the accident death and injuries by 50 percent by 2020 [2]. Based on economy having GNI (Gross national income) per capita, the world has been divided in to three regions that is Low-income(\$1,025 or less), Middleincome(\$1,025 to \$12,475) and High-income(\$12,476 or more) [3]. Middle-income has 53 percent registered motor vehicles which accounts for 74 percent road traffic deaths compared to high-income which has 46 percent registered motor vehicles which accounts for merely 10 percent road traffic deaths [2], which clearly shows that the quality of infrastructure and the education to the middle-income people is very poor and it needs a great attention. For accident analysis the world has been divided in to six regions i.e. African Region, Eastern Mediterian Region (Cyprus, Greece, Lebanon, Syria, and Egypt etc), Western Pacific Region (Australia, Cambodia, China, and Japan etc), South East Asia Region (Brunei, Cambodia, India, Indonesia, Singapore, and Thailand etc.), Regions of America (USA, Canada, and



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Mexico), European Region (UK, France, Germany etc). The order of region mentioned above is the decreasing order in which the African region has the highest death rate due to accident amounting to 26.6 per 100,000 population while it is least in European region valued to 9.3 [2]. Pedestrians, Cyclist and motorbikes are the worst hit in the traffic death rates in the world thus they together accounts for 49 percent of road traffic deaths. Considering the South East Asia Region (India is the part of this region), the three road type user together form 50 percent of road traffic deaths. This clearly depicts that the safety of the two/three wheeler and pedestrians are completely ignored [2]. In India Pedestrians, Cyclist and 2-3 wheel vehicles account for more than 45% of fatal accidents on the highways. From 2001 to 2015 death rate per 100,000 populations has increased from 8 to 11.7 i.e. around 46% rises [4]. 400 deaths takes place every day on India roads which leads to loss of 17 lives every hour. Delhi has the highest number of fatal accidents in the country. Drunken driving and over speeding by the vehicles are found to the major cause of deaths happening in India and mostly it is being happening at the junctions where two or more highways meet with each other [4].

Traffic on the highways of India has seen a dramatic rise. Passenger vehicles, commercial vehicles, three wheelers and two wheelers has grown by 34%, 37%, 27% and 24% respectively from year 2001-2013, thus there is a gross increase of 400% in traffic [4]. Comparing it to the National highway has merely grown 133% from the year 2000-01 to 2011-12 [5]. Clearly depicting the state where the highways are being choked because it is not able to cope up with the growth rate of traffic. Accident surged by 2.5% out of which 4.6% were fatal accidents from 2014 to 2015 [4]. In order to reduce the accident rates to 50% by 2020 as pledged by Government of India, the locations with high number of fatal accidents rates are being named as "Black spot". Pedestrians followed by two wheelers are the major part being affected by accidents. The data collected by the police station is not in the proper format as recommended by IRC: 53-2012, thus it is need of the hour to collect the data in a proper format and analyse it to ascertain the possible reasons of the accidents. But due to lack of engineering vision among the police fraternity the technical aspects are often overlooked. Thus studies need to be conducted on the available data considering the engineering problems like geometric design deficiencies, pavement surface defects e.g. pot holes etc, improper lighting, non availability of pedestrian paths or cycle tracks etc.

II. ABOUT CHANDIGARH CITY AND IT'S BLACK SPOTS

Chandigarh is one of the well planned city in India and across the world. Still black spots exists, which clearly depicts that "Nothing is perfect in this world". MORT&H, Government of India has defined the black spot is a stretch of National Highway or other category of road (SH/MDR/Other roads) of about 500 m in length in which either 5 road accidents (in all three years put together involving fatalities / grievous injuries) took place during the last 3 calendar years or 10 fatalities (in all three years put together) took place during the last 3 calendar years may be strictly be followed" [1]. Based on this the Chandigarh traffic police has collected the accident data (Fatal and Non Fatal) and declared the three black spots in the year 2016. The three black spots with their black spot declaration parameters on the basis of which they are defined so as : Halomajra Signal Point (10 Fatal accidents has occurred during the year 2015-2016), 45-46-49-50 (10 Fatal accidents has occurred during the year 2013-2015), Transport Signal Point (42 road accidents happened during the year 2014-2016). These three black spots are studied in detail in this research paper.

III. DATA EXTRACTION AND METHODOLOGY ADOPTED

The following three black spots that is Halomajra Signal Lights $(30^{\circ}41'28.7"N 76^{\circ}48'10.2"E)$, 45-46-49-50 Signal Lights $(30^{\circ}42'02.2"N 76^{\circ}45'21.6"E)$ and Transport Signal Lights $(30^{\circ}43'04.4"N 76^{\circ}48'44.6"E)$ are already been identified by the Chandigarh Police as per the definition given by the MORT&H in the introduction paragraph above (refer Figure 1,2 & 3). The following data is collected:

- 1. Classified Traffic Volume Count
- 2. Road Inventory and Condition Survey
- 3. Accident data collection from Police Station
- 4. Geometric and Road Furniture Studies



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Methodology:- Classified Traffic Volume Count, Speed and delay Studies, Road Inventory and Condition Survey are carried out as per IRC:SP:19-2001. Accident data collection from Police station is carried out as per IRC:53-2012. Geometric and Road furniture data is collected.

IV. RESULTS

A. Layouts of the Junctions are as follows:

The three black spots in the Chandigarh city with their respective graphical position is shown below (refer Figure 1,2&3). The respective figure shows the directions of the traffic which should be referred while studying the graphs below.



Figure-1: Halomajra Signal Point

B. Highway Capacity:



Figure-2: 45-46-49-50 Signal Point



Figure-3: Transport Signal Point

Halomajra Signal Point	45-46-49-50 Signal Point	Transport Signal Point	
Section	Section	Section	
Chandigarh-Zirakpur = 4-Lane	Sec 43-Tribune = 6-Lane	Tribune-IT Park = 6-lane	
Halomajra- Panchkula = 6-Lane	Mohali-Chandigarh = 4-Lane	Chandigarh-Panchkula = 4-Lane	

C. Daily Traffic Volume Count in PCU:

The maximum value of PCU (Passenger Car Unit) per day at the three junctions is presented in the graphs below in the month of April and May 2017 (Refer Figure 1, 2 & 3 above for the directions specified in the graphs below). Graph 1 clearly shows that the traffic is highest in Chandigarh –Zirakpur section having around 60,000 PCU's per day compring it to 27000 PCU's per day (average) at other two locations refer Graph 2,3 below.





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D. Hourly Traffic Volume:

The DTV (Daily Traffic Volume) is almost constant in each direction in working days from Monday to Friday. The DTV value drops on Saturday and Sunday. Considering the peak volume, randomly Thursday day has been chosen to plot the Hourly Traffic volume for each junction point. Since each junction has two road crossing, thus the one with highest average Hourly Traffic Volume is plotted for each Direction as shown below. The Traffic in cross direction is similar at 45-46-49-50 Signal point having around 1500 PCU's in the peak hour refer Graph 6&7. While at Halomajra signal point Traffic to Zirakpur has almost double PCU comparing to other direction (refer Graph4&5), similary at Transport Chowk Traffic to Panchkula is more comparing to IT park (Refer Graph 8&9).





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E. Statistics Based on Type of Vehicle:

Similarly to Hourly Traffic Volume, the type of vehicle involved on one particular peak day (selected randomly as Thursday) is shown below. The percentage of car is highest around 50 percent average at all three black spots, followed by two wheeler having 14 percentage average (Refer Graph 10,11&12).



F. Accident data collection from Police Station:

The accident data in graphical form is represented below for the three identified black spots in various sub sections.



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i. Day Wise accident Statistics

Comparing three black spots maximum number of accidents are happening on Thursday except at halomajra signal point (Refer Graph 13,14&15).







ii. Time Wise Accident Statistics:

At all the three black spots, during 1800 to 0000 hours maximum number of accidents are happening (refer Graph 16,17&18).







iii. Type of Accident:

Fatal accident percentage is less but it has a significant percentage around 34 percent average (Refer Graph 19,20&21).



iv. Statistics Based on Month of Accident

There is a huge variation in percentage of accidents month wise (refer Graph 22,23&24).





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v. Statistics Based on Victim Vehicle Type

Pedestrians are the major victim of accident except at Transport Chowk, where car persons are the major victim (refer Graph 25,26&27).



vi. Statistics Based on Accused Vehicle Type

Majority of the accidents are being committed by car drivers followed by truck drivers (refer Graph 28,29&30).



H. Road Inventory and Condition Survey

As per IRC:SP:19-2001, Road Inventory survey is carried out out which two relevant points are mentioned below:

i. Type of Pavement:- All the junction points have bituminous pavement.

ii. *Condition of Pavement:*- At all the junctions the condition of pavement is "Fair" having minimum cracking up to 5 percent and no oxidation of asphalt and no failure of the base material. The pavement is having presence of visible rutting.

I. Geometrics and Road Furniture Studies

The sight distance available is enough and there is no hindrance to the driver travelling on each junction. Horizontal, vertical curves are in proper form along with presence of super elevation. The proper camber is present at all the junction points.

Road Furniture: The following defects are found out at these junctions (referring to IRC:SP:41):



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Halomajra Signal Point

- Road marking is not visible/missing.
- Warning Signs like Cross Road ahead, Pedestrian Crossing are missing.
- Absence of Reflectors, which is very useful especially during the night time.
- The pedestrian footpath is broken at some points forcing the pedestrian to come on the fast moving highway
- Cycle Track is missing, there is no dedicated lane for cycle track

45-46-49-50 Signal Point and Transport Signal Point

- Road marking is not visible/missing.
- Warning Signs like Cross Road ahead, Pedestrian Crossing are missing.
- Absence of Reflectors, which is very useful especially during the night time.

V. DISCUSSION OF RESULTS

1. Daily Traffic Volume count in PCU:

a. At Halomajra Signal point for Chandigarh-Zirakpur section the PCU per day exceeds 60,000, hence augmentation from 4-lane to 6-lane is required as per clause 2.18 and 2.19 of IRC:SP:84-2014 (Refer Section III(B) and Graph 1).
b. For rest of the sections of highways in each three black spots declared, the PCU per day is under 40,000, hence no augmentation is required as per IRC:SP:84-2014 (Refer Graph 1, 2 & 3).

2. Hourly Traffic Volume:

As per IRC:SP:41, on a 2 lane one way road, design capacity of an intersection is given as 1200 PCU/hour/lane. The following table depicts the actual picture:

Section	No. of Lanes in one direction	PCU/Hour (Refer Graph 4	Design PCU/Hour	Remarks					
	(Refer Section III (B))	to 9)	100,11001						
A. Halomajra Signal Point									
Chandigarh to	2	4500	1200x2=2400	4500>2400, Grade separated					
Zirakpur				structure is required.					
Mohali to Panchkula	3	2100	1200x3=3600	Pass					
B. 45-46-49-50 Signal Point									
Mohali to Chandigarh	2	1600	1200x2=2400	Pass					
Tribune to Sec-43 Bus	3	1500	1200x3=3600	Pass					
Stand									
C. Transport Signal Point									
Chandigarh to	2	1800	1200x2=2400	Pass					
Panchkula									
Tribune to IT Park	3	700	1200x3=3600	Pass					

3. Comparison of Statistics based on Type of Vehicle with Accused Vehicle Type:

Type of	Halomajra Signal Point		45-46-49-50 Signal Point		Transport Signal Point	
Vehicle	Type of	Accused	Type of	Accused	Type of	Accused
	Vehicle	Vehicle	Vehicle	Vehicle	Vehicle	Vehicle
	(Graph 10)	(Graph 28)	(Graph 11)	(Graph 29)	(Graph 12)	(Graph 30)
Car	46	53	47	47	53	61
Bus	07	14	12	17	07	08
2-Wheeler	11	12	18	13	13	13
Truck	12	19	11	23	10	17
3-Wheeler	17	02	07	-	14	-

Probability of a vehicle to be accused is clearly depicted in the above table, for example considering at Halomajra Light point there are 46 percent type of cars comparing to 53 percent accused vehicle as per police station records, it clearly shows that probability of car being as accused is very high.



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4. Accident data collection from police station:

a. Maximum number of accidents are happening on Thursday except at Halomajra Signal Point where the maximum number of accidents are on Sunday (Refer Graph 13,14,15).

b. Maximum number of accidents are happening in time span of 1800 hours to 2400 hours while least is happening in 2400- 600 hours (Refer Graph 16,17,18).

c. Average 35 percent fatal accidents and 65 percent non-fatal accidents are happening (Refer Graph 19,20,21).

d. There are three seasons which are mentioned below along with their period: Summer (March-June), Monsoon (July to October), Winter (November to Feburary). After studying graph 22,23&24 that is based on month of accident, it is found out that maximum number of accidents are happening in the winter season followed by summer and least in Monsoon.

e. At all the three black spots victim as a Pedestrian, Cyclist relatively are of same percentage that is 25 percent and 13 percent respectively. Two Wheeler as a victim has a average of 30 percent except transport signal point. Car as a victim is maximum in case of transport signal point and 45-46-49-50 signal point (Refer Graph 25,26,27).

VI. CONCLUSTION AND RECOMMENDATION

CONCLUSION:

- 1. At Halomajra Signal Point for Chandigarh zirkpur section augementation is required from 4-lane to 6-lane with grade separated structure at this junction. Along with it following road furniture is missing
 - Road marking is not visible.
 - Warning Signs are missing.
 - Absence of Refectors which increases the probability of accidents during the night time.
 - Pedestrain path are broken at some points on the highway thus leads to accidents.
- 2. At 45-46-49-50 Signal Point for Mohali to Chandigarh section grade separated structure is required . Along with it following road furniture is missing:-
 - Road marking
 - Warning Signs
 - Reflectors
- 3. At Transport Signal Point for Chandigarh to Panchkula section requires grade separated structure along with it following road furniture is missing:-
 - Road marking
 - Warning signs
 - Reflector

RECOMMENDATIONS:

- Pedestrian Crossing in form of Pedestrian subway or Foot bridge should be provided as per IRC:86-1983 in order to cross the junction.
- Dedicated lane for cyclist and two wheelers shall be demarked as per IRC-86-1983 on the highway and should be enforced by the traffic police.
- Proper Road furniture which includes Road Marking, Road signs, Signal Railing & flash lights should be provided as per IRC-SP41.
- Grade separated structure are required to be provided where the junction crosses it carrying capacity.
- Traffic Enforcement laws shall be strictly Implemented and regular checks of Speed, Drunk Driving must be ensured.
- Quality of Pavement shall be improved by overlying.

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