

Feasibility of Road Accident Analysis and Safety

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Abstract— Smooth, convenient and safe flow of traffic helps to develop infrastructure of any city without damaging transport system. In India out of 3.3 million km estimated road network carries approximate 65 % of freight and 85 % of passenger traffic. So, traffic handling is the major problem for road system in India. Accident analysis helps to improve the safety features of road users. To reduce accidents and its rate according to principles of safety, to design of new or to reconstruct road system, it helps us to reduce occurrence frequency of road accident minimizing fatality rate and severity. High rate of personalized traffic present in Nagpur city deteriorating public transit, their frequency and quality. Rising of micro ego in the citizen effects on traveler turn to them use of personalized mode of transport. Reasons behind increasing the accidents are prevailing speed levels within desirable limits, human, vehicle and infrastructural behavior, improper signs and signals, visibility, etc. Objective of this study is to reduce the accident rate and to enhance road safety to the citizens in Nagpur city.

Keywords— Safety, Accident, severity, fatality rate, Traffic Volume.

I. INTRODUCTION

An accident such as collision, slipping, overturning which originated on a road open to public traffic resulting in either injury, loss of life, and damage to property in which at least one moving vehicle was involved. Many developing countries similar problem occurs in road accident including India have a serious road accident problem. Every year 1.17 million people die in road accident around the world and much more.

In Maharashtra state present status of severity of road accident measured in terms of number of persons killed per 100 accidents are 20.4% in 2010 to 20.7% in 2015. This number of percentage shows accident severity increase is about 25.85% in 2012 and 24.5% during 2013 and 2014.

Primarily, unplanned city suffers from improper land use and transport system. More than 50 % growth in citified areas causes increase in travel demand. All in all, the private vehicular ownership pattern of the city rises due to frequency and quality of mass transit deteriorate. It is due to increasing micro ego in citizens about vehicle ownership. It includes personalized mode such as two wheelers, four wheelers, and intermediate public transport such as auto and cycle rickshaws which further addition congestion of traffic on road and occurring accident. We cannot eliminate total accident but we reduce fatal, killed, and injured rate of accident. Also, reduce

accident severity index. This paper describes to reduce the accident rate and provide road safety to the citizen.

Nagpur “Orange city” is the winter capital of Maharashtra state. Nagpur located central part of India such as it is geographical Centre of India. It is 3rd largest city in Maharashtra since Mumbai and Pune. As per census 2011 population of Nagpur city was found to be 23, 98,165. Table 1 shows the increasing population during 1921 to 2011 with its growth rate.

II. ROAD ACCIDENT SCINERIO IN INDIA

In India, frequency of traffic collision is highest in the world. National Crime Record Bureau (NCRB) reported more than 135000 traffic collision related deaths occur in India. Total accident occur 43.01 % in 2010 and 43.45 % in 2015. Total number of killed person involved in accident is 11.57 % in 2010 and 12.66 % in 2015. Total number of injured person involved in accident is 45.41 % in 2010 and 43.87 % in 2015.

In India, status of severity of road accident in terms of number of persons killed per 100 accidents had increased from 2010 is about 26.9 % then becomes 29.1% in 2015 and number of accidents occurs 501423 and injured person 146133 during 2015.

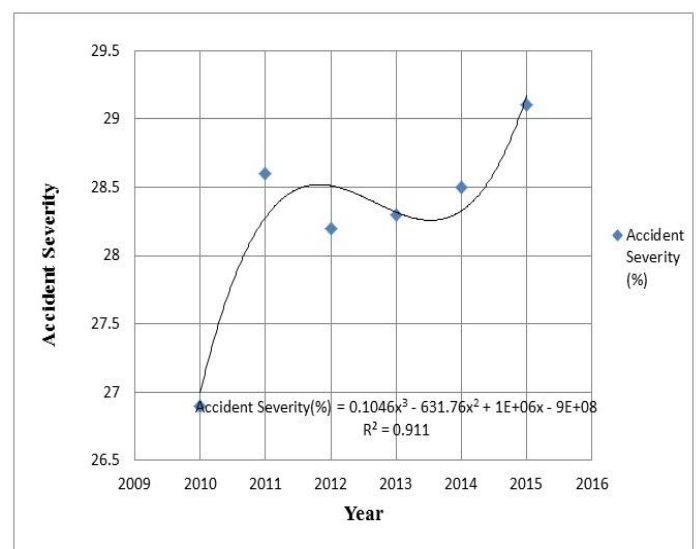


Fig.1 Scenario of Accident Severity (India)

Fig.1 shows number of person killed per 100 accidents i.e. accident severity. In 2011 severity rate is 28.6%; it decreases in the year 2012 having severity index 28.2 % and sudden growth from year 2013 and highest severity is 29.1% in 2015.

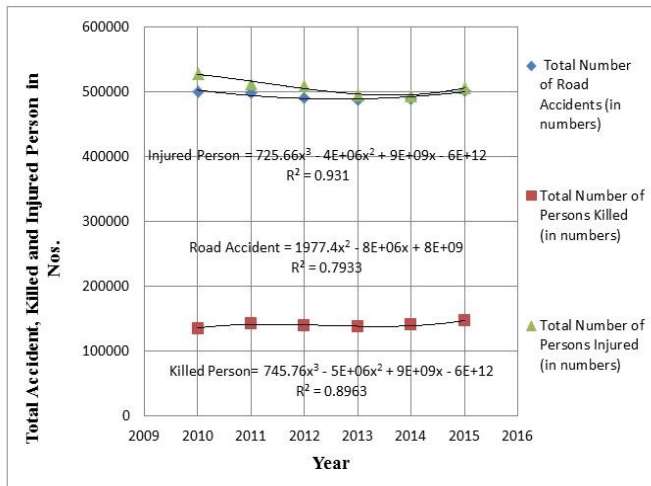


Fig.2 Total Accident, Killed, and Injured Person in India

Fig. 2 shows that total accident, killed, and injured person in India. In total accident, injured rate is more than killed rate. The total number of occurred road accident continuous decreases from year 2010 (499628) to year 2014 (489400) but small growth in 2015 (501423) but which is less as compare to total number of injured person. Total number of killed person is less and its severity shown in fig 1.

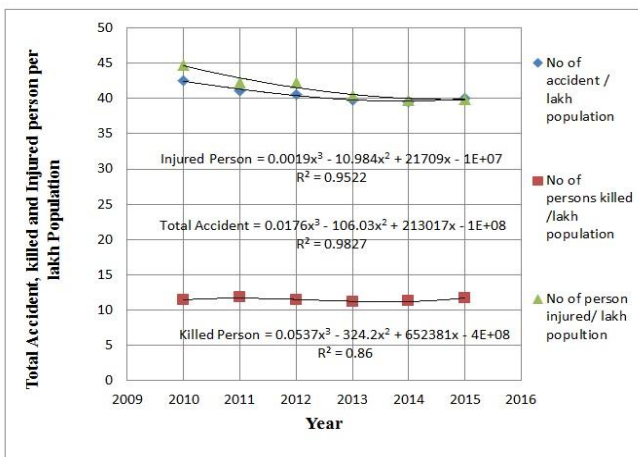


Fig.3 Road Accident, Killed, and Injured per lakh population in India

Fig.3 shows the accident, killed, and injured person per lakh population in India. Total accident occur per lakh population is about 42.5 lakh in 2010 and continuous decreases to 39.5 lakh in year 2014 and increase in year 2015 is about 40 lakh. Number of person injured per lakh population is 44.8 lakh in 2010 and decrease 39.9 in year 2015. Number of person killed per lakh population is minimum rate than total accident and injured accident.

III. TRANSPORT SYSTEM IN NAGPUR CITY

A. Road Network

Road network is form on the basis of planning the urban areas depends on land use pattern and it divides in various zones i.e. residential, commercial, recreational, institutional, and industrial and other zones. So, the city is developed with radial and peripheral pattern and outer ring

road is partly constructed while inner-ring road is completely operational. In road network two national highways in north south and east west direction along with radial pattern. Road network spreads around 1150 km (CDP 2015) and presence of inner and outer-ring road provides the city a radial layout. At present around 3.75 % of total developed area is devoted to roads which are much below the minimum requirement for a city. Nagpur is major junction of national highways such as NH 6 connecting Hajira-Kolkata, NH 7 connecting Kanyakumari-Varanasi pass through the city and junction of two Asian highways AH 43 Agra to Matara, Sri Lanka and AH 46 connecting Kharagpur to Dhule, Maharashtra State Highways towards Wardha, National Highways NH-26 B connecting savner –Chhindawada.

B. Public Transit System in Nagpur

Present Nagpur city of public transit is being operated and maintained by Maharashtra State Road Transport Corporation (MSRTC). This Public transit infrastructure has total 470 low floor star buses including 240 buses received under JNNURM funding scheme and 230 buses purchase-run-transfer basis by VNIL. It is totally based on public private partnerships which are being operated by ‘Vansh Nimay Infra’. In recent intro to 55 Ethanol run pollution free buses in the city. The bus system namely as ‘STAR BUS’ which is operated on major routes and many of them are centrally connected to the Sitabuldi station which act as Central business Terminal for the passenger to commute various zones of city.

Development of Bus Rapid Transits (BRTS) and Mass Rapid Transits (MRTS) which is affected on changing land usage pattern and also Nagpur road network is in radial and peripheral pattern so there is required more turning movement area at junction places. so, these BRTs and MRTs can’t be handling easily. so, Introducing metro rail project in Nagpur urban areas. Proposing the Nagpur metro rail in urban areas it helps to fulfilling the declination of bus system. Declination and deterioration of frequency of public bus causes introducing intermediate public transport such as auto-rickshaws, cycle-rickshaws, cabs, jeeps, etc.

C. Growth of Vehicles

Spectacular growth of vehicle population is occurred in Nagpur. Total vehicle population i.e. registered vehicle is 1079201 in 2010 and 1275566 in 2015 which indicates growth of vehicle population.

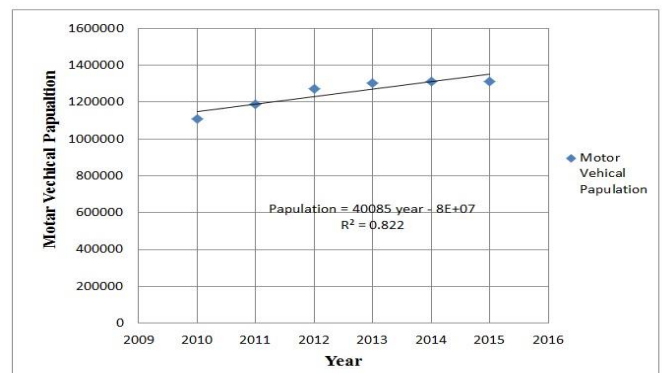


Fig.4 Total motor vehicle population year wise

Fig. 4 shows the total growth in motor vehicle population year wise. It indicate that cumulative increment in registration of motor vehicle population and it indicates that continuous increase in motor vehicle population from year 2010 to 2015. Deterioration of public transit caused due to increase in personalized mode of travelling. It is observed that individual vehicle grew year wise in hazardous manner. Two wheelers i.e. motorcycles, scooters, and mopeds had highest percentage of growth in Nagpur is very steep about 18.08%, 17.57%, and 16.63% in 2015 due to unavailability of public transit. Motor cars population had 13.49% in 2010 but 18.46% in 2015 and same growth in jeeps population it has drastic change in vehicle ownership. It is due to increase in micro ego about vehicle ownership, standard livingness in the citizens that causes reduce in intermediate vehicle population (auto rickshaws) 9.37% in 2015 and 17.71% in 2010 was maximum auto rickshaws population and it becomes half in 2015 auto rickshaws populations. The two wheelers and cars has been higher growth rate of other vehicles. Auto rickshaws and bicycles (i.e. personalized mode) is the important mode of transportation in the city.

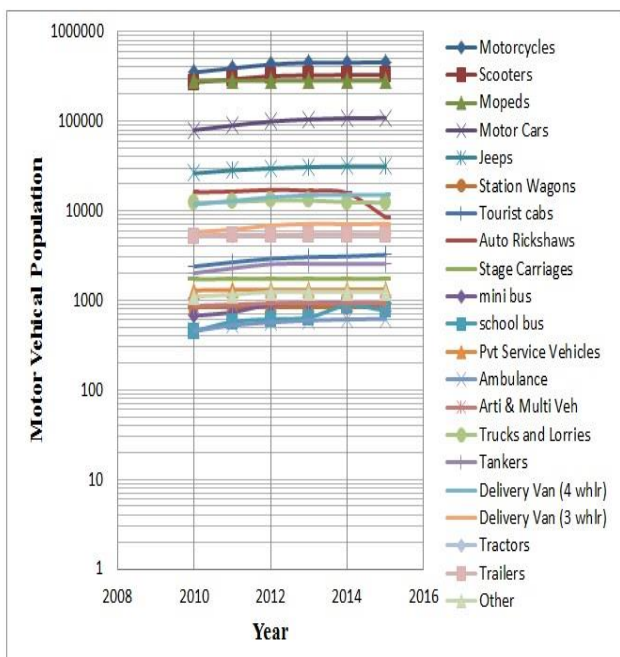


Fig.5 Motor vehicle population year wise

From Fig.5 observed that growth in HWV is less than two wheelers and LWV. HWV includes trucks 16.11% in 2010 and 12302 (16.25%) truck population in 2015, tractors has 16.33% in 2010 and 5438 (16.78%) tractor population in 2015, trailers had 16.15% population in 2010 and it becomes 16.88% in 2015 and tankers has 13.90% in 2010 and 17.63% in 2015. Therefore, Hazardous growth of vehicles causes growth in accident due to heterogeneous flow of vehicles in Nagpur and emission of pollutants i.e. CO₂, NO_x, HC, etc. bad effects on human, and main reasons to global warming. Two wheelers, pedestrian, cyclist are close in contact with LWV and HWV so, increase in fatality and injured rate

IV. ROAD ACCIDENT IN NAGPUR CITY

A. Road Wise Accident in Nagpur City

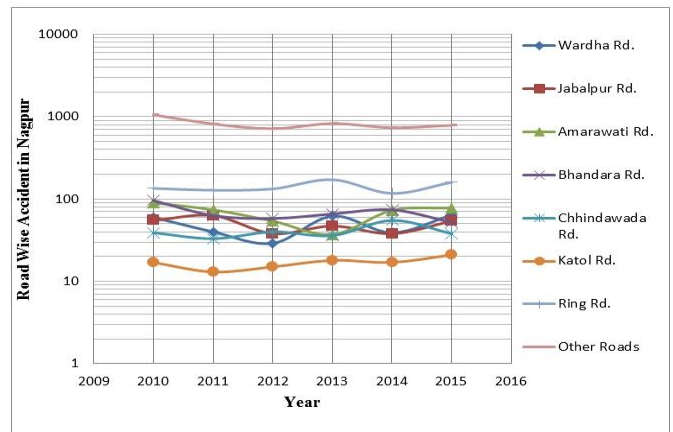


Fig.6 Road wise accident in Nagpur

Following roads are important for infrastructural development of city and carries maximum traffic on it. Maximum contribution of accident on other road is about 65.6% includes secondary road and minor streets in the city. Ring road estimated as 11.2% accident occurs i.e. major accident reached on Ring road (outer or inner) which is due to partly constructed and completely operational. Contribution of Amaravati road and Bhandara Road is about 5.4%, Wardha road and Jabalpur road contribute 3.9% road accident, and minimum contribution of road accident is about 1.3% by Katol road as shown in Fig. 6.

B. Traffic Zone Wise Accident in Nagpur City

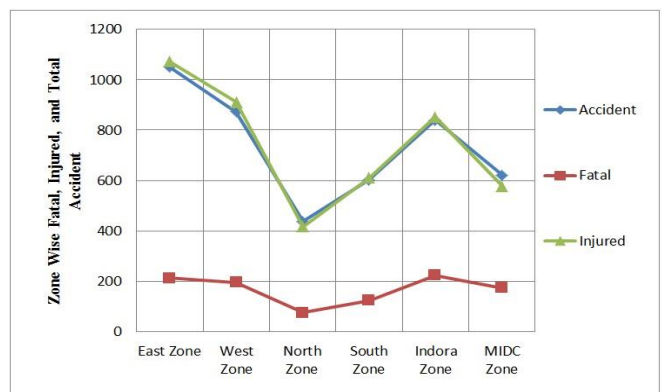


Fig.7 Zone wise Fatal, Injured, and Total Accident

Fig 7 shows there are six traffic zones in Nagpur city. These zones are East zone, West zone, and North zone, South Zone, Indora Zone and MIDC Zone. These six zones which investigate the traffic related offences including accident related matter, collection and compilation of road accident related data. Also, traffic zones minimize accident related problems such as Accident Prone spot, highly dense traffic zones. Provision of better solution and precaution, follows strict rules and regulation sincerely, which helps to enhancing safety of the citizens. January 2013 to July 2016, maximum accident 1049 occurs in East zone which is highest than other

zone and followed west zone and Indora zone such as 872 and 839 respectively.

Zone wise Accident severity index which shows the available medical facility in the city which is nearer from accident spot and also measures the seriousness of accident. It measures in number of deaths per 100 accidents.

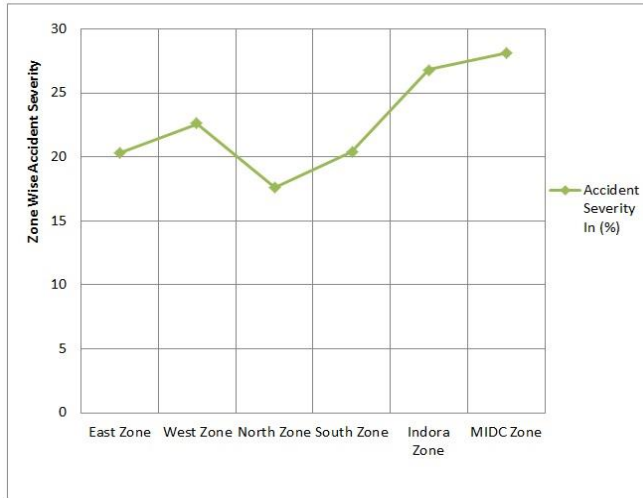


Fig.8 Zone Wise Accident Severity (Nagpur)

Fig.8 shows the accident severity index of six zones. MIDC zone had 28.13 % death per 100 accidents happened more than other zones and followed Indora zone 26.81 %, West Zone 22.59 %, south zone 20.39 %, East Zone 20.30 % and North Zone 17.62 %. Increasing the severity index it seems to be reduction in quality of availability of facility and services in the city and increasing the seriousness of accident. The highest rate of accident severity attributes maximum motor vehicle population in that zone, minimum facility available that zone, also bad road condition, or black spot.

C. Type of Vehicle Involved in Road Accident and Time Wise Accident in Nagpur City

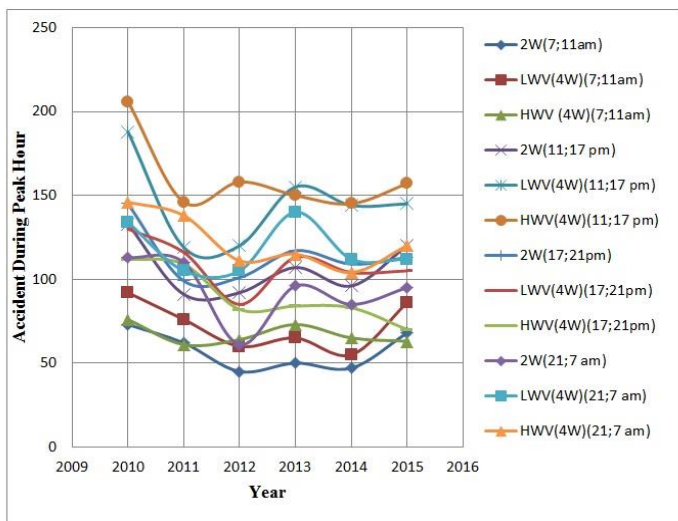


Fig.9 Accident During Peak Hour and Type of Vehicle Involved in Accident

Fig. 9 shows number of accidents caused by different categories of vehicles and time wise accidents happened in

Nagpur city. Type of vehicle inclosed in accident in Nagpur year from 2010 to 2015. Type of vehicle inclosed in road accident such as Two Wheelers, Light Weight Vehicles (LWV)such as car,auto-rekashaws, ambulance,delivery van 3W/4W etc, Heavy Weight Vehicles (HWV) such as Bus, Tractor, Trucks, Trailers, Tankers, etc. is about 7532.

It is estimated that out of 100 percentage LWV involved in almost 35.39 % accidents followed by 35.02 % accident by HWV and 29.58 % accidents responsible for two wheelers which is less percentage than LWV and HWV.

Percentage of accidents in the evening, morning, afternoon as well as night time. Majority of time wise road accident occur in Nagpur is about 32.81 % in time 11 AM to 17 PM it is highest one then followed by 21 PM to 7 AM is about 26.57 % , 17 PM to 21 PM 24.92 % , 7 AM to 11 AM 15.67 %.

HWV had major occuring rate of accident i.e. 962 during 11 AM to 17 PM, and follows LWV accident occure is about 871 during 11 AM to 17 PM and 2W occur 684 accident during 17 PM to 21 PM.

Type of vehicle invlved in accident attribute groth in motor vehicle, black spot, vehicle condition, etc.Total population of 2W from 2010 to 2015 is about 83.66% and followed LWV or public transit is about only 12.24 % and others vehicle or HWV population such as trucks,tankers,tractors, etc. is about 4.1%. in accident HWV had major rate of accident but 2W or cyclist had major fatality and injured rate than HWV and LWV.

D. Accident In Nagpur City

Nagpur accident classify in to three classes such as fatal accident, serious accident and minor accident record maintain year wise in three grouping accident, fatality, and injury during 2010 to 2015. In serious and injured accident there is no fatality during accident.

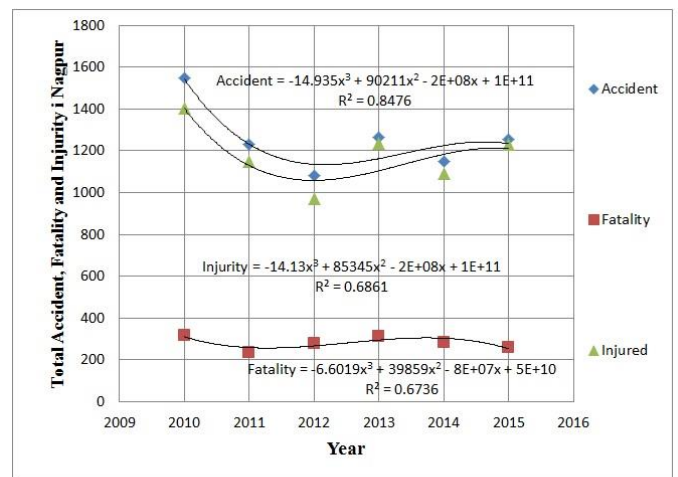


Fig.10 Total Accident, Fatality, and Injury in Nagpur

Fig 10 shows that, total accident 1548 (20.55%) occur in 2010 then continous decrease from 2010 to 2014 (15.25%) and small groth in 2015 (16.64%). In total fatal accident (person killed during accident) 317 (18.21%) occur in 2010 then continous decrease its rate from 2010 to 2015 (15.43 %). In total injure accident parallel to total accident, maximum total injured accident happened 1404 (19.8 %)in 2010 and

continuous decrease from 2010 to 2014 (15.43 %) and small increase in 2015 is about (17.39 %). Maximum accident occur in year 2010 then it is continuous decreases up to 2015 due to increase width of road, provision of rules and regulation for enhancing safety to the citizens.

E. Person Involved in the Accident in Nagpur

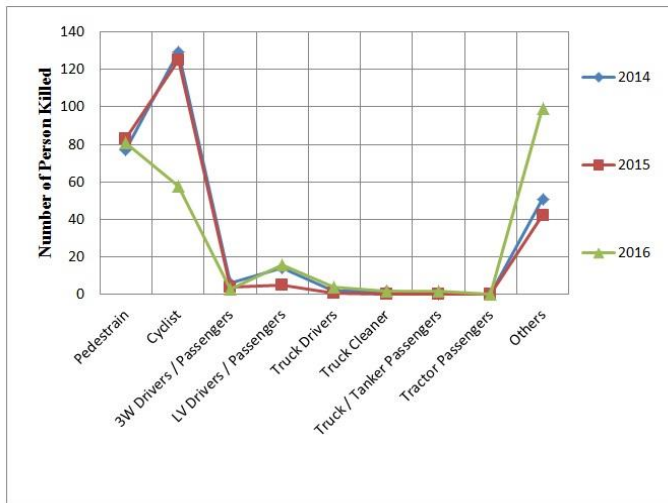


Fig.11 Number of Person Killed In Accident

Fig. 11 shows the maximum number of person who died in accident. The accident killed rate of pedestrian and cyclist is more than other person involved in accident. It shows the pedestrian and cyclist have minimum safety. The person involved in killed accident is about 281(34.86 %) in 2014 and person killed 260 (32.25%) and 265 (32.87%) in 2015 and 2016 respectively. Cyclist has maximum rate involved in accident than other involving person.

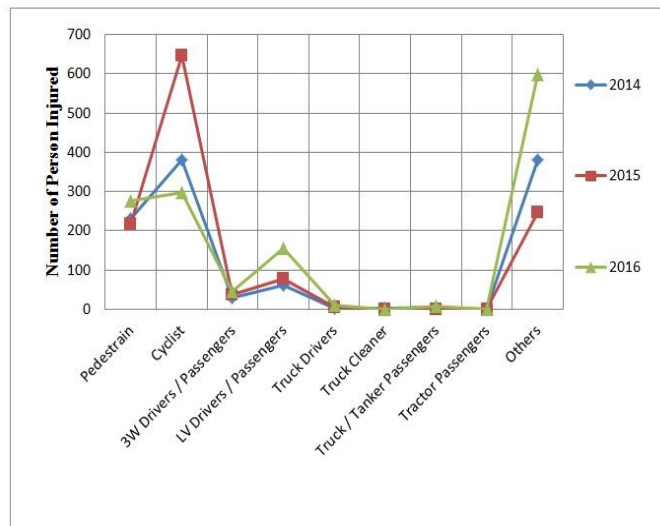


Fig.12 Number of Person Injured In Accident

Fig. 12 shows injured person involved in accident is highest in 2016 is about 1394 (37.46 %). Injured person involved in accident is about 1094 (29.40%) in 2014 and 1233 (33.13%) in 2015 which is less number of injured person than 2016 accident. Person involved in injured accident is cyclist which has maximum injured rate then, follows pedestrian accident is less injured than cyclist.

F. Traffic Zone provides different Accident Prone spot in Nagpur

Nagpur traffic police investigate and identify the accident black spot in the city on the basis of frequency and intensity of accidents. In East traffic zone traffic police identify maximum 1049 accident happened and 213 persons killed, 1072 persons injured in accident. West traffic zone 872 accidents occur and 197 persons killed, 917 persons injured in Indora Zone.

Traffic zone contribute 225 persons killed in 839 accidents and it has highest accident severity under Indora Traffic Zone. Minimum accident occur in North traffic Zone is estimated 437, 77 persons killed and 417 persons injured in North traffic zone. It means in North zone provide facility in terms of availability of hospitals near prone spots and precautions during serious accidents. Traffic Police identify following accident Prone Spots are in each Traffic zones

- a) East Traffic Zone
 1. Mhalagi Nagar square
 2. VathodaRingroad Square
 3. ManewadaRingroad square
- b) West Traffic Zone
 1. New Katol Naka square
 2. Japani Garden Square
 3. Nagpur Savner Highway.
- c) North Traffic Zone
 1. Telephone Exchange Square
 2. GangabaiGhat Square
- d) South Traffic Zone
 1. Khapari Naka
 2. Chinchabhavan Square
 3. MIHAN Pool Mahesh Dhaba
 4. Chinchabhavan pool Wardha Road
- e) Indora Traffic Zone
 1. Old Pardi Naka
 2. Dipti Signal
 3. Hanuman Temple Pardi
 4. Prakash High school Square Pardi
 5. JaripatakaRingroad Square
 6. Maruti Showroom Square
 7. Uppalawadi pool
 8. Vita Bhatti Square
 9. Prakash High school near Kapsi Pool
- f) MIDC Traffic Zone
 1. I.C. Square
 2. Vaishali Nagar Square
 3. Ordnance Factory Gate Eight Mile
 4. Marava Transport Vadadhamana

IV. SUMMARY AND CONCLUSION

Nagpur city suffers from major deaths and injuries happened due to road accident. Main causes of accident are haphazard growth in motor vehicle population, road condition, driver condition, vehicle condition, pedestrian behavior, etc. City traffic department found few of accident prone spots on the basis of frequency of accident and severity index. Traffic

police department maintained all the data related to road accident offences. Accident severity in the city is high that shows immediate service and facility unavailable near at road accident spot. Motor cyclist involves in killed accidents more than other person involved in accident as compare to pedestrian. Also, higher the motor cyclist injured rate than other person involved due to higher growth rate in motor vehicle population in 2015. In road wise accident, Ring roads have maximum accidents reached than other road. Furthermore, maximum percentage of accident involves LWV and HWV during 11AM to 17 PM. It shows maximum killed and injured rate of pedestrian and motor cyclist. It indicates minimum safety towards pedestrian and motor cyclist when

LWV and HWV are on road during 24 hours a day. It is due to directly come in contact with motorized vehicle and minimum safety towards pedestrian and cyclist than other person involved in killed accident. Also, pedestrian and cyclist have maximum injury than other person involved in accidents. According to 2015 data, India lost one life in every 4 min and 16 fatalities in one hour. In India accident occur in every 1.04 min i.e. 60 accidents occurs in one hour and having injured accident reached in every 1.03 min. In Nagpur accidents occurred in every 6.98 hours and one fatal accident occurs in every 33.69 hours and having injury occurs in every 7.10 hours.

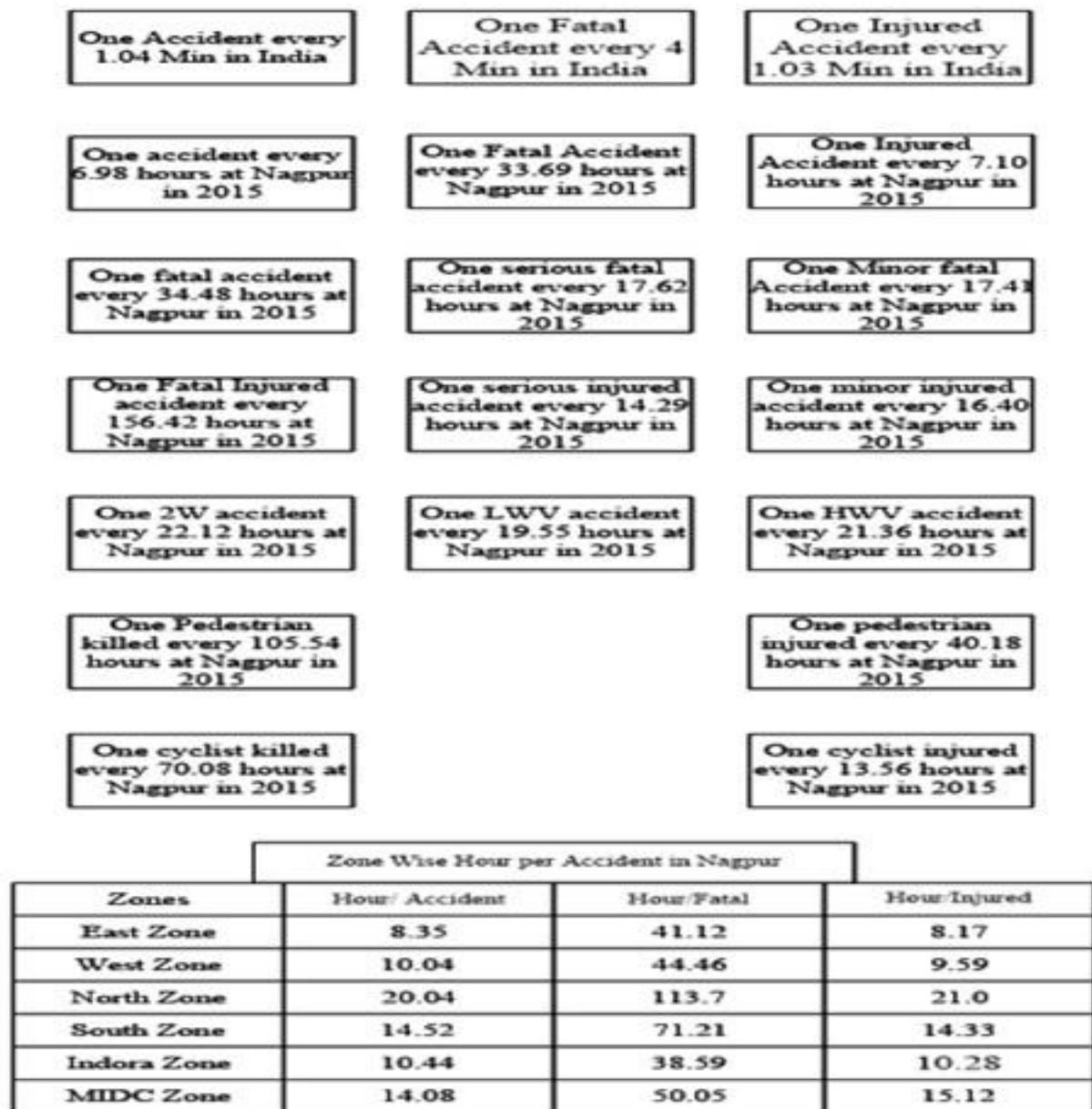


Fig.13 Accident Figure and Facts

Fig 13 which indicate accident occurs in every minute and hours i.e. figure and facts of India and Nagpur city. Killed rate of cyclist higher than pedestrian i.e. cyclist killed every 70.08 hours and pedestrian killed in every 105.54 hours. Same as injured rate of cyclist higher than pedestrian in Nagpur and one cyclist injured in every 13.56 hours and pedestrian injured in every 40.18 hours. In Nagpur, majority of accident in every 8.37 hours in East Zone but majorities fatal accident occurs in every 38.59 hours in Indora zone and injured accident occur in every 8.17 hours in East Zone. It shows minimum safety, and found major black spot in East and Indora zone. Also, it shows highest severity in that zone which indicates that serious accident occurs in East and Indora Zone. In vehicle type of accident, LWV having major involvement in one accident occurs in every 19.55 hours. Follows one HWV accident occurs in every 21.36 hours and one 2W accident occurs in every 22.12 hours.

Acknowledgment

There is Traffic Police Station which is maintaining the accident records of whole city. Investigate accident related offences and matters and extract all the road accident data. The Authors would like to acknowledge the contribution of the Commissioner of Traffic Police, Nagpur and Regional Transport Office, Nagpur, Who provided the database for this study. Special thanks to G.H.Raisoni College of Engineering, Nagpur, which permits me to carried this study.

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