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PROJECT TITLE: ROAD SAFETY AND ACCIDENT ANALYSIS

Andleeb Aga
Student of M.tech Civil Engineering (H&T),Rayat Bahra University, Mohali Punjab India

Mr.Ajay Vikram
Assistant professor ,Rayat Bahra University, MohaliPunjab,India

ABSTRACT

The problem of accident is a very acute in highway transportation due to complex flow pattern of vehicular traffic, presence of mixed traffic along with pedestrians. Traffic accident leads to loss of life and property. Thus, the traffic engineers have to undertake a big responsibility of providing safe traffic movements to the road users and ensure their safety. Road accidents cannot be totally prevented but by suitable traffic engineering and management the accident rate can reduced to certain extent for this reason systematic study of traffic accidents are required to be carried out. Proper investigation of the cause of accident will help to propose preventive measures in terms of design control.

INTRODUCTION:

Road safety has become a global issue of concern and concerted efforts need to be initiated at the ground level to avoid the thousands of lives being lost in road crashes around the world.

Considering Road Safety as an area of immediate concern around the world, the United Nations (UN) has declared Decade 2010-2020 as the Decade of Action for Road Safety**.** The International Road Federation (IRF) has also taken many initiatives towards road safety, such as the development of the Road Accident Data Recorder (RADAR) which will help in the systematic storage of data and scientific analysis of accidents.

One of the most important measures for the reduction of fatalities is to put in place a good infrastructure regime. By comparing desirable standards for Safe Road Infrastructure Design with undesirable standards for each of the key elements, engineers can play a crucial role in building safer roads. Uniformity of standards is a key element in design of safe roads. Developing country engineers can also learn from proven practices of Safe Road Infrastructure Design from developed countries.

Global facts and figures on the road safety scenario around the world reveal some startling statistics. More people die on the world's roads each year than the total number of people who die from malaria. The WHO estimates almost 1.3 million people die each year, equivalent to six jumbo jet crashes every day. However, while the crash of a single jumbo jet makes headlines in the media, road fatalities, even in such large numbers, do not get the same attention. Worryingly, death by road accidents is the No.1 cause of death for young people worldwide, and the economic cost to the global economy is estimated to be a staggering $1.2 trillion a year.

Furthermore, 50 million people are injured annually, many of whom are left disabled. As shown in Figure 1, Road Traffic Injury (RTI) is the highest cause of global injuries. Ninety per cent of these casualties occur in developing countries. With the number of annual deaths occurring from road accidents forecast to rise to 1.9 million by 2025 (Figure 2), there is an urgent requirement to act now to prevent unnecessary deaths from road accidents in the future.

2 Things to Know About Road Safety

1. When is Road Safety Week celebrated?
2. How was the idea of Road Safety Week initiated?

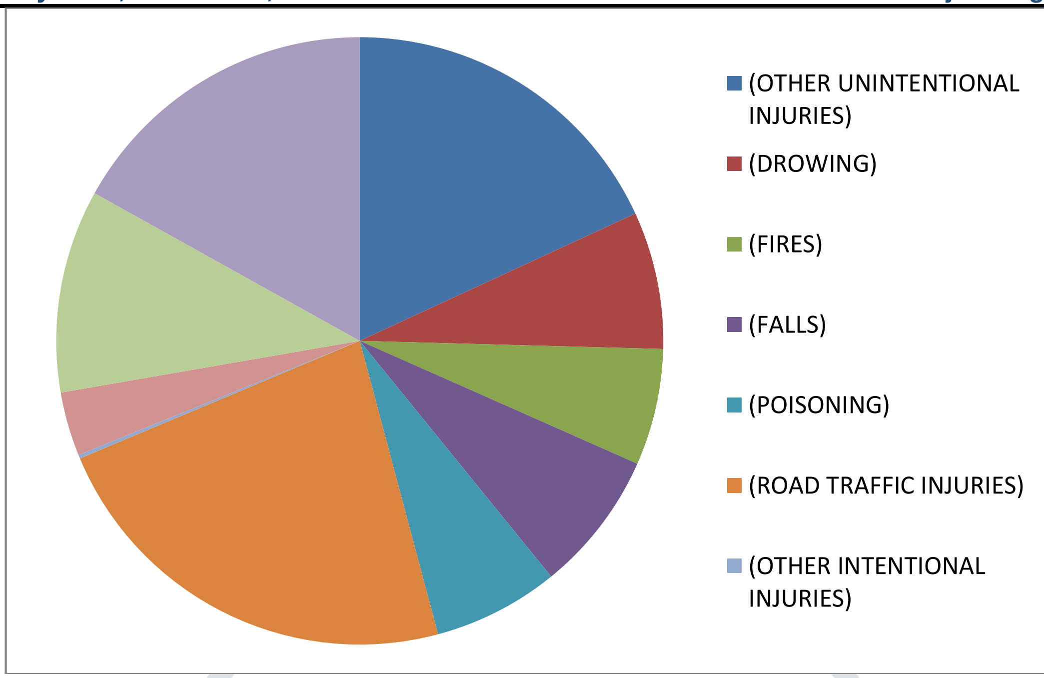


Fig. World-wide Cause of Injuries

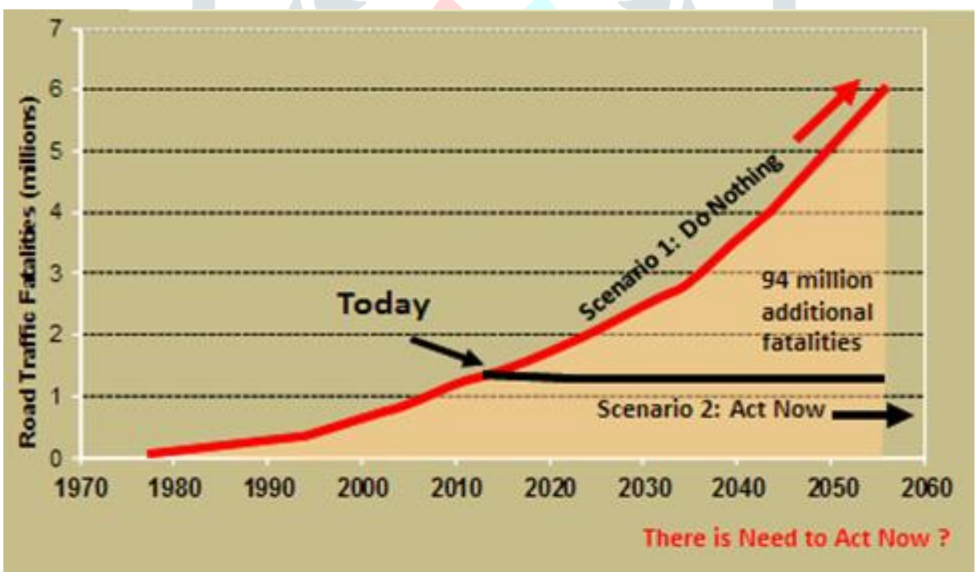


Fig. projection of Global Road Traffic Fatalities

Causes of road accidents

The various causes of road accidents are

1. Road Users - Excessive speed and rash driving, violation of traffic rules, failure to perceive traffic situation or sign or signal in adequate time, carelessness, fatigue, alcohol, sleep etc.

2. Vehicle - Defects such as failure of brakes, steering system, tire burst, lighting system.

3. Road Condition - Skidding road surface, pot holes, ruts.

4. Road design - Defective geometric design like inadequate sight distance, inadequate width of shoulders, improper curve design, improper traffic control devices and improper lighting,

5. Environmental factors -unfavorable weather conditions like mist, snow, smoke and heavy rainfall which restrict normal visibility and and makes driving unsafe.

6. Other causes -improper location of advertisement boards, gate of level crossing not closed when required etc.

DESIGN ENGINEERING ASPECTS OF SAFE ROAD INFRASTRUCTURE

- In general, it can be said that the "5Es" of Safe Road Operations are:
- **Engineering** – Defining the Built Environment including the road design and vehicle
- design.
- **Enforcement** – Strict application of law.
- **Education** – Teaching good road behavior through awareness campaigns.
- **Encouragement** – Rewarding people for good road behavior.
- **Emergency Care** – Road side medical care and access to Para-medics in the "Golden Hour", or the hour immediately following a road accident during which the provision of first aid can greatly enhance the prospects of the accident victim's survival

□**Planning Stage -** through land use control policies; providing by-passes for congested towns and linking them by spurs; and creating Self Contained zones to avoid nonessential traffic in the neighborhood.

□**Design Stage -** designing "Self-Explaining Roads" and "Forgiving Road Side" by selecting the most desirable design standards (and NOT the minimum standards)

Involving:

i. Design speed
ii. Horizontal and vertical geometry
iii. Cross-sectional elements
iv. Design of at-grade and grade separated junctions
v. Provision of service roads for segregation of slow and fast traffic
vi. Designing effective road furniture, vis-à-vis guard rails, traffic signage, roadside illumination provisions, etc.

□**Construction Stage -** Proper separation of the construction zone through effective barricading; construction of proper traffic diversions; provision of road signage; environmental controls for reducing noise, dust, etc.

□**Maintenance and Operation Stage -** providing an Automated Traffic Management System (ATMS) for safe operation of Traffic and Incident Management. This includes providing Mobile Communication Systems, Variable Message Signs, Weigh-in-Motion System, and Central Control Room.

KEY ELEMENTS OF SAFE ROAD INFRASTRUCTURE DESIGN

DESIGN

Some of the key elements of Safe Road Infrastructure Design are given in below and are further illustrated in the table below.

a) Major arterials and expressways should bypass major towns which should be connected by spurs. There should be clear zones identified for linear land use control.

b) Consistency of horizontal geometry avoiding monotonous straight lines or abrupt change of speed.

c) Adequate off-set distance from natural road side features.

d) Undivided carriageways designed for Overtaking Sight Distance.

e) Wider lane widths and shoulders for High Speed Roads.

f) Inside widening for sharp curves.

g) Recoverable slopes for out-of-control vehicles.

h) Segregation of the slow moving non-motorized traffic from fast moving traffic.

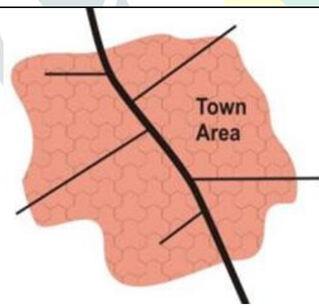
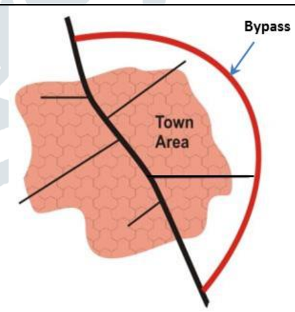
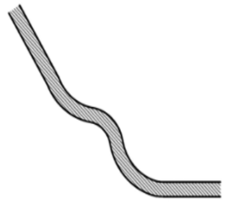
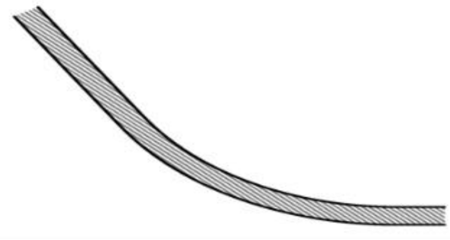
i) Provision of raised footpath for pedestrians in Urban Areas.

j) Barriers should be designed to deflect the vehicle and not crash it.

k) Road Signs should be standardized throughout the country.

l) Properly designed traffic calming measures like the speed humps, rumble strips, small roundabouts, etc.

m) Entry / Exit only through Slip Lanes with proper Acceleration and Deceleration Lanes.

Design/ Planning Element	DESIRABLE	UNDESIRABLE
Alignment Selection and Land Use		
Horizontal Geometry		

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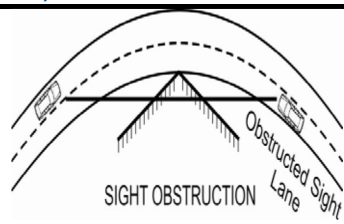
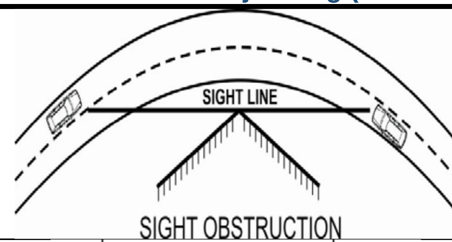
<tr><td>Horizontal geometry</td><td>
</td><td>
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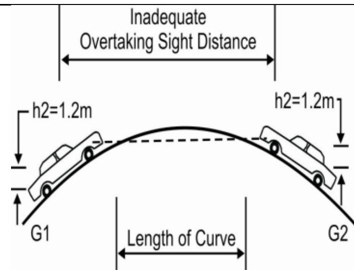
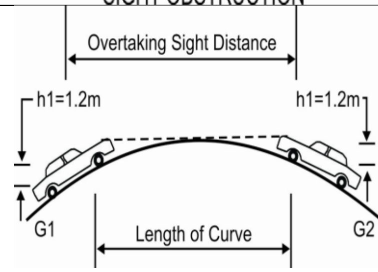
<tr><td>Vertical Geometry</td><td>
</td><td>
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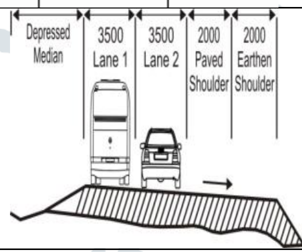
<tr><td></td><td>
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Design of roads

Geometric roadway design can be broken into three main parts: alignment, profile, and cross-section. Combined, they provide a three-dimensional layout for a roadway.

The **alignment** is the route of the road, defined as a series of horizontal tangents and curves.

The **profile** is the vertical aspect of the road, including crest and sag curves, and the straight grade lines connecting them.

The **cross section** shows the position and number of vehicle and bicycle lanes and sidewalks, along with their cross slope or banking. Cross sections also show drainage features, pavement structure and other items outside the category of geometric design.

PROFILE

Sag Curves

Sag vertical curves are curves which, when viewed from the side, are concave upwards. This includes vertical curves at valley bottoms, but it also includes locations where an uphill grade becomes steeper, or a downhill grade becomes less steep.

The most important design criterion for these curves is headlight sight distance. When a driver is driving on a sag curve at night, the sight distance is limited by the higher grade in front of the vehicle. This distance must be long enough that the driver can see any obstruction on the road and stop the vehicle within the headlight sight distance. The headlight sight distance (S) is determined by the angle of the headlight and angle of the tangent slope at the end of the curve. By first finding the headlight sight distance (S) and then solving for the curve length (L) in each of the equations below, the correct curve length can be determined. If the S<L curve length is greater than the headlight sight distance, then this number can be used. If it is smaller, this value cannot be used. Similarly, if the S>L curve length is smaller than the headlight sight distance, then this number can be used. If it is larger, this value cannot be used.

Table 2.

Units	**Sight Distance < Curve Length (S<L)**	**Sight Distance > Curve Length (S>L)**
Metric	$L= AS^2/120+3.5S$	$L=2S-(120+3.5S)/A$
US Customary	$L= AS^2/400+3.5S$	$L=2S-(400+3.5S)/A$

These equations assume that the headlights are 600 millimeters (2.0 ft) above the ground, and the headlight beam diverges 1 degree above the longitudinal axis of the vehicle

Crest Curves

Crest vertical curves are curves which, when viewed from the side, are convex upwards. This includes vertical curves at hill crests, but it also includes locations where an uphill grade becomes less steep, or a downhill grade becomes steeper.

The most important design criterion for these curves is stopping sight distance. This is the distance a driver can see over the crest of the curve. If the driver cannot see an obstruction in the roadway, such as a stalled vehicle or an animal, the driver may not be able to stop the vehicle in time to avoid a crash. The desired stopping sight distance (S) is determined by the speed of traffic on a road. By first finding the stopping sight distance (S) and then solving for the curve length (L) in each of the equations below, the correct curve length can be determined. The proper equation depends on whether the vertical curve is shorter or longer than the available sight distance. Normally, both equations are solved, then the results are compared to the curve length.

Sight Distance > Curve Length (S>L)

$$L= 2S-(200(\sqrt{h1}+\sqrt{h2})^2)/A$$

Sight Distance < Curve Length (S<L)

$$L=AS^2/ (200(\sqrt{h1}+\sqrt{h2})^2)$$

FINANCIAL LOSSES

According to the data released by the Central Statistical Organization, the GDP for 2014-15 was Rs 126 lakh crore. Thus, the cost of road crashes would have amounted to Rs 3.8 lakh crore. Compared to Budget 2015, the cost of road crashes amounts to one-fifth of the Budget.

The table below compares the cost of road crashes with the monetary allocation of certain important ministries:

Fig. Financial loss due to accidents

Case-study 1

Road Accident Analysis: of Patna City

1. Road Accident Scenario in India.

Many developing countries including India have a serious road accident problem. Fatality rates (defined as, road accidental deaths per 10,000 vehicles) are quite high in comparison to developed countries. While in Europe and North America the situation is generally improving, many developing countries face a worsening situation. Apart from the humanitarian aspects of the problem, road accidents cost countries of developing world at least one percent of their Gross National Product (GNP) each year – sums that those can ill afford to lose. Compared to causes of death more commonly associated with the developing world, deaths from road accidents are by no means insignificant. The nature of problem in developing countries is in many ways different from that in industrialized world. The proportion of commercial and public service vehicles involved in road accidents are often much greater. Pedestrians and cyclists are often the most vulnerable. Lack of medical facilities in these countries is considered to be an important factor leading to high death rates.

There is an alarming increase in accidental deaths on Indian roads. Table 1 presents the rate of road accidental deaths in India from the year 1991 to 1998. Fatality risk (defined as, road accidental deaths per1,00,000population) in India is increasing over the years, from 6.7 in 1991 to 7.9 in 1998. During the period from 1991 to 1998, road accidental deaths have increased at a rate of 4.44 percent per annum while the population of the country has increased by only 1.92 percent per annum. Table reports road accidental deaths according to type of vehicles for the year 1998. This table reveals that trucks and buses are responsible for highest number of accidental deaths, 25.7 and 17 percent of casualties happened due to trucks and buses, respectively.

It is believed that road accidents are increasing since motor vehicle population is increasing with greater rates than the expansion of road network. Presently, vehicle population in India is over 37 million. During recent years, vehicular population is growing at an annual rate of around 10%. Table 3 presents the growth of vehicular population and road accidents in the country from 1995 to 1998. This table shows that accident and fatality rate in India is quite high, as high as 80 and 20, respectively.

Table 3. Rate of road accidental deaths during 1991 to 1998

Year	). of road accidental deaths (in ‘000’)	Estimated mid-year population (in million)	Fatality risk (col.2*100/col.3)
1991	56.6	849.6	6.7
1992	57.2	867.7	6.6
1993	60.6	883.8	6.9
1994	64.0	899.9	7.1
1995	68.4	916.0	7.5
1996	69.8	931.9	7.5
1997	74.2	955.2	7.8
1998	76.7	970.9	7.9

Source: ACCIDENTAL DEATHS & SUICIDES IN INDIA 1996, 1997, and 1998

Table 2. Road accidental deaths according to type of vehicles during 1998

Type of vehicles	No. of accidental deaths	Percentage share
Truck/Lorry	19731	25.7
Bus	13007	17.0
Tempo/Van	5429	7.1
Jeep	6890	9.0
Car	4777	6.2
Three-wheeler	2763	3.6
Two-wheeler	8098	10.6
Bicycle	2954	3.8
Pedestrians	7657	10.0
Others	5426	7.1
TOTAL	76732	100.0

Source: ACCIDENTAL DEATHS & SUICIDES IN INDIA 1998 Published by NATIONAL

1. Transport System in Patna

1.1 Road network

The existing circulation pattern of Patna is of linear type. The most important factor determining the form of road network system is the presence of river Ganga in the north and low-lying area of river Poonpoon in the south. This linear type of urbanization coupled with limited number of river crossings has given rise to a dominant east-west orientation of arterial roads. But, unfortunately, the city has no system or hierarchy of roads. The whole road network system is deficient in terms of geometric and traffic management aspects. At present around 4.6% of the total developed area is devoted to roads which is much below the minimum requirement for a city.

Table 4. Motor vehicle population in Patna

Year (as on 31st March)	1996	1998	2000	2001
Bus	2410	2668	2730	2938
Mini-bus	897	1045	1055	1077
Truck	11541	13373	14426	14733
Another goods vehicle	1275	1606	2065	2296
Taxi	2341	2468	2854	2945
Auto-rickshaw	11782	13979	14466	15540
Tractor	5403	6419	6862	7235
Trailer	4691	5595	5968	6213
Car	20818	25548	28670	31290
Jeep	1051	2203	11777	12116
Two-wheeler	156982	180892	189440	197291
Others	715	495	475	490
Total	219906	25629	280788	294164

2. Road Accidents in Patna

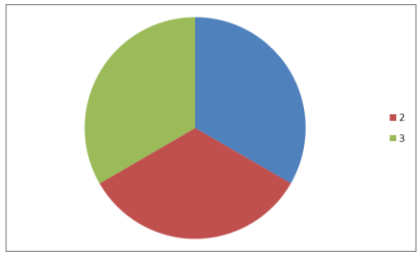
2.1 Type of accidents

Table Type of accidents in Patna

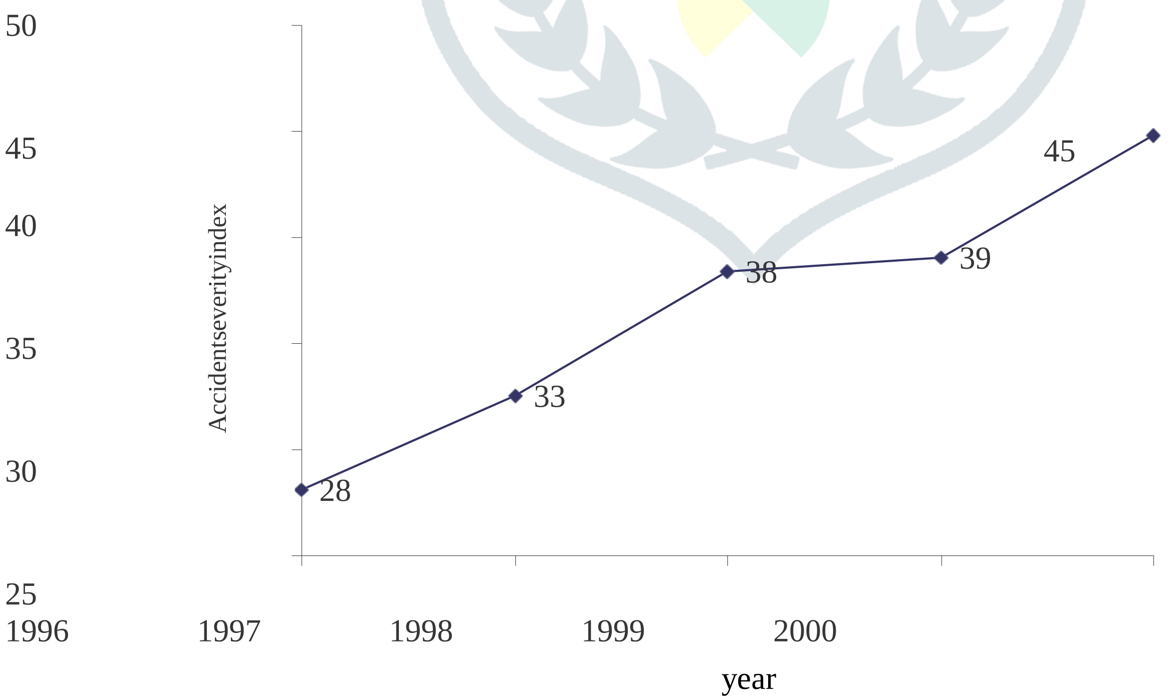
Year	Fatal	Serious	Minor	Total accidents
1996	79	92	110	281
1997	97	84	117	298
1998	88	83	58	229
1999	107	81	86	274
2000	108	59	74	241

1.1 Fatality rate and risk

Road accident fatality rates (deaths/10,000 vehicles) in Patna



2.2 Accident severity index



1.1 Road user type fatalities

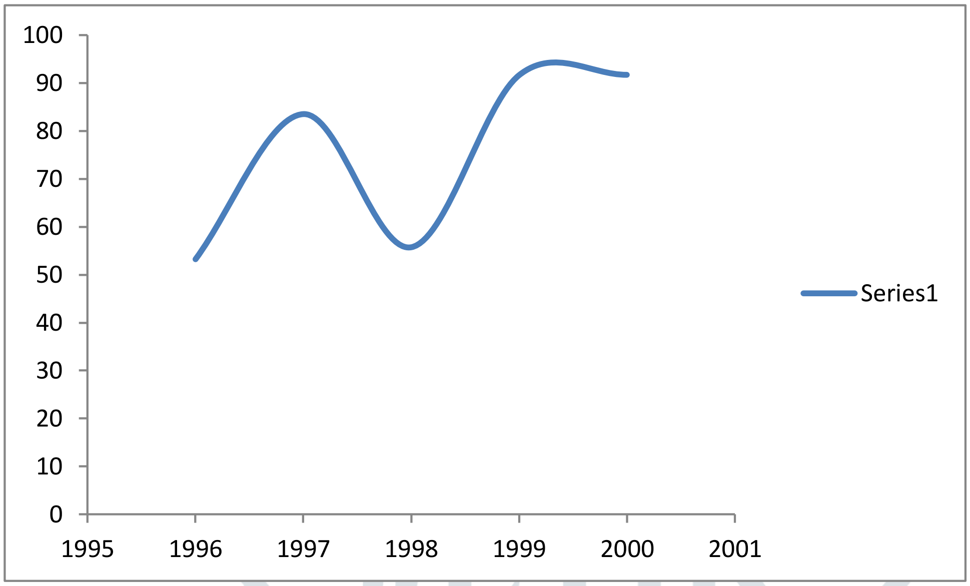


Table Category of fatality

	Pedestrian	Cyclist	2W - rider	ar/jeep/taxi occupant	Bus passenger	Truck occupant	Others
1996	42	10	20	3	2	0	2
1997	81	9	6	0	0	0	1
1998	49	14	18	5	0	0	2
1999	98	5	2	0	0	2	0
2000	99	6	1	1	0	0	1

Table Vehicle responsible for accidents

	2W	3W	Car/jeep/taxi	Bus	Truck	Others	Total
1996	40	48	77	55	61	19	300
1997	28	46	63	71	68	22	298
1998	20	30	61	60	61	23	255
1999	20	38	66	60	49	40	273

2000	20	40	58	62	43	27	250
Total	128 (9%)	202 (15%)	325 (24%)	308 (22%)	282 (20%)	131 (10%)	1376 (100%)

Table: Accident distribution by location

	traight road	T – Junction	Y – Junction	4 - Way intersection	ffic round about
1996	211	10	30	21	21
1997	198	7	39	26	28
1998	195	7	17	19	15
1999	193	6	23	28	24
2000	183	3	25	20	19
1996	72%	3%	10%	7%	7%
1997	66%	2%	13%	9%	9%
1998	77%	3%	7%	8%	6%
1999	70%	2%	8%	10%	9%
2000	73%	1%	10%	8%	8%

Case-Study 2

Road Accident Analysis: of HYDERABAD City

The process of rapid and unplanned urbanization has resulted in an unprecedented revolution in the growth of motor vehicles world-wide. The alarming increase in morbidity and mortality owing to road traffic incidents (RTI) over the past few decades is a matter of great concern globally. Hyderabad, a 400-year-old city is the state capital of Andhra Pradesh. It lies on the Deccan Plateau, 541 meters (1776ft) above sea level, over an area of 625 sq.km. of municipal corporation and 7200sq.km.of Hyderabad Metropolitan area, is the fifth largest city in India, with a population of above 8 million. Unlike other Indian metros it continues to attract considerable migrant population due to its strategic geographical location, multi lingual land cosmopolitan culture, tremendous growth potential and investment'

Table: Average daily traffic at various locations (**Source**: Transport Department)

S.No	Location	Passenger Vehicles				Total vehicles
		Private	IPT	PT	NMTs	
1	Faluknuma ROB	39,061	14,834	3,643	1,020	58,558
2	Kandikal Gate Colony	8,708	5,168	113	1,317	15,306
3	UppuGuda	8,218	6,343	95	882	15,538
4	TalabKatta	23,438	11,015	139	2,779	37,371
5	Yakutpura	9,324	5,403	117	1,476	16,320
6	On NH-65 near Malakpet	1,68,573	33,139	9,073	1,645	43857
7	Nimboliadda	28,496	7,414	1,359	1,812	39,081

8	Tilak Nagar	61,154	12,116	974	1,533	75,777
9	APHB Colony	34,354	7,815	47	3,107	45,323
10	Vidyanagar	45,067	7,598	1,843	819	55,327
11	Adikmet Road	35,186	5,738	1,521	329	42,774
12	Arts College	9,993	2,182	11	578	12,764
13	Sitaphalmandi	26,891	4,978	307	646	32,822
14	AlugaddaBhavi	1,04,297	18,851	5,880	884	25615
15	Lallaguda Gate	12,147	2,802	63	667	15,679
16	Safilguda	33,666	5,277	330	608	39,881
17	Bolaram	7,231	692	79	291	8,293
18	Hi-tech City MMTS Station RUB	76,593	16,629	1,271	227	94,720
19	Sanath Nagar ROB	92,904	15,206	7,148	741	115,999
20	Fateh Nagar ROB	64,222	13,199	1,103	902	79,426
21	Begumpet ROB	2,16,325	34,691	6,788	903	42,382
22	Ministers Rd - Necklace Rd, James	41,152	5,140	37	508	46,837
23	Ranigunj	72,312	10,551	3,242	979	87,084
24	Rashtrapathi Road	70,132	15,683	2,864	1,765	90,444
25	Oliphant Bridge-Rathifile	60,091	27,878	8,168	1,336	97,473
26	Rail Nilayam RUB	1,04,329	13,496	1,953	641	16,090
27	Lalaguda ROB	38,107	7,520	2,170	917	48,714
28	Tippukhan Bridge	32,941	4,414	2,063	666	40,084
29	Attapur Bridge	85,472	18,719	1,943	1,437	107,571
30	PuranaPul Bridge	45,654	9,671	159	4,353	59,837
31	Muslim Jung	54,157	11,405	183	4,010	69,755
32	Nayapul Old Bridge	49,742	12,411	3,098	2,441	67,692
33	Nayapul New Bridge	73,987	15,953	2,379	2,648	94,967
34	Shivaji Bridge - Salar Jung	40,008	5,691	2,261	2,179	50,139
35	Chaderghat Causeway	58,817	14,526	2,796	962	77,101
36	Moosarambagh	68,068	13,064	1,153	1,597	83,882
37	Nagole Bridge	77,904	11,668	3,516	427	93,515

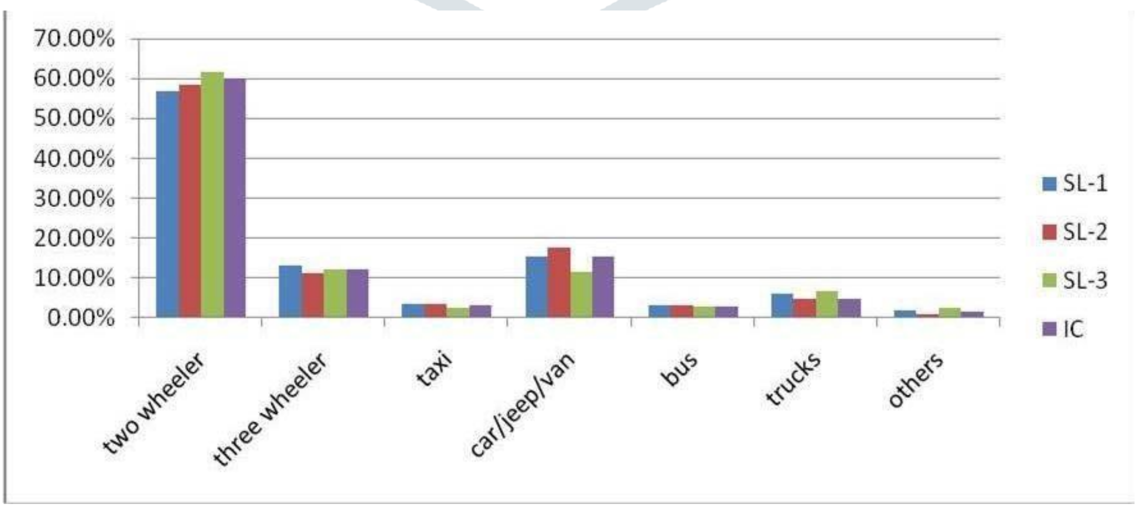


Figure Vehicle movement in Hyderabad.

1. Analysis

Nearly 3,400 people die on the world's roads every day. Tens of millions of people are injured or disabled every year. Children, pedestrians, cyclists and the elderly are among the most vulnerable of road users

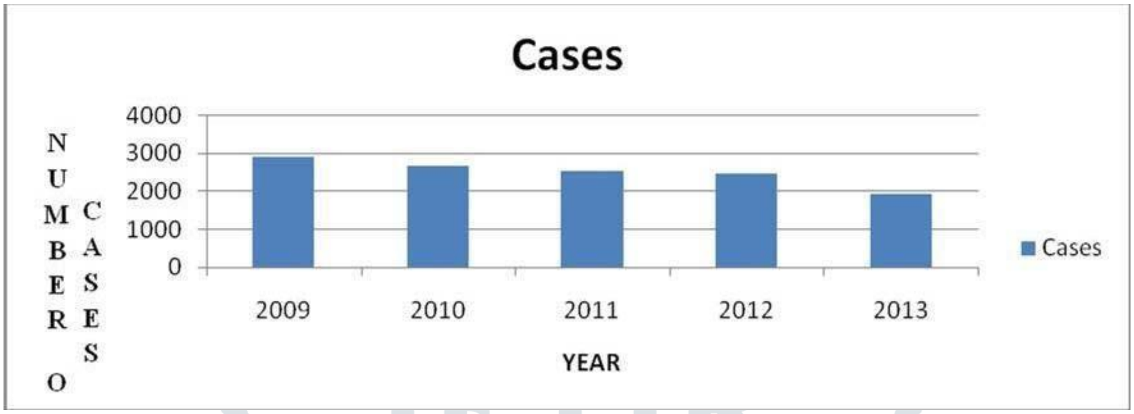
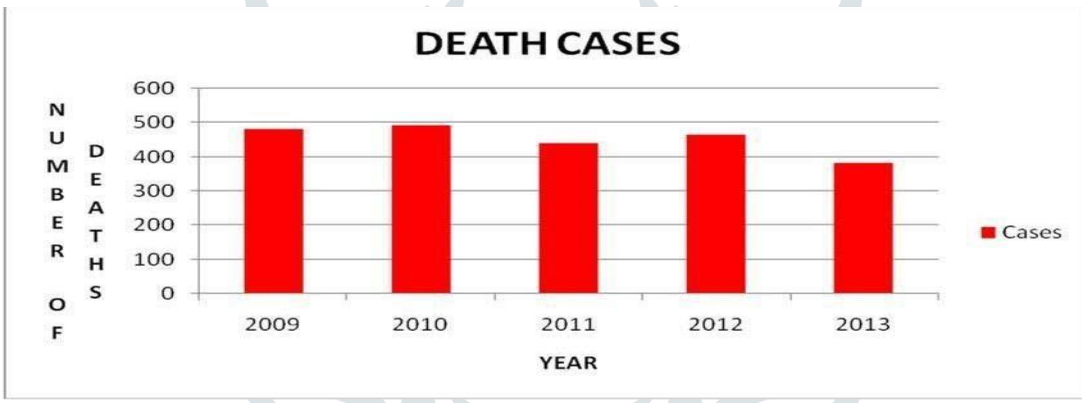
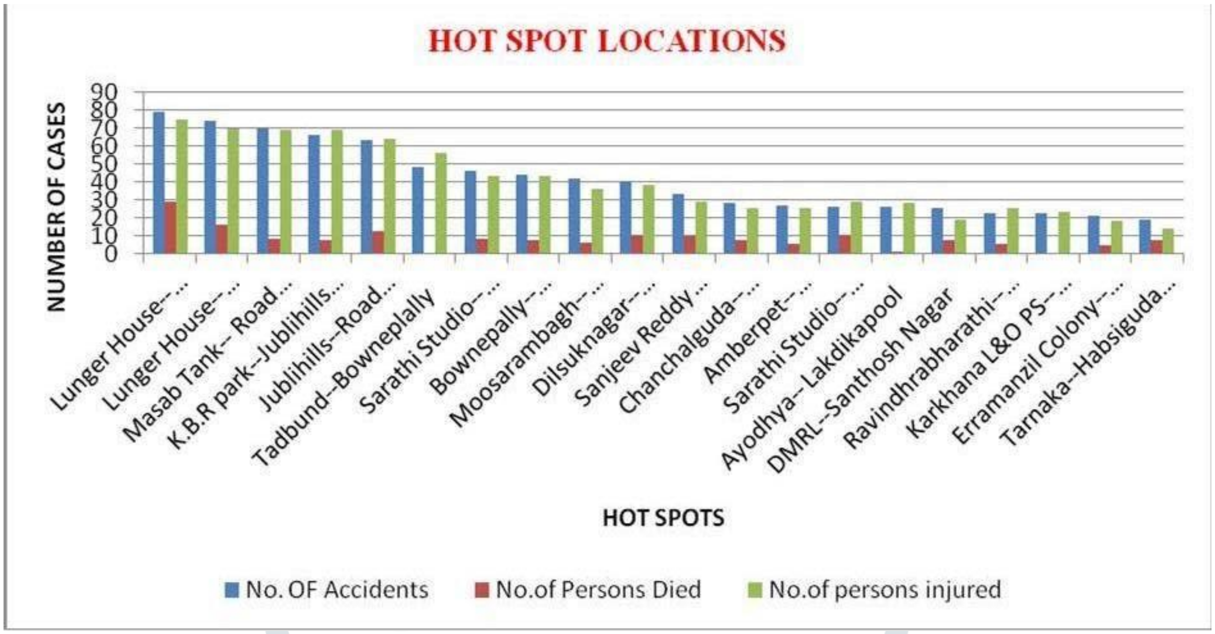


Figure. Injured cases for last five years.





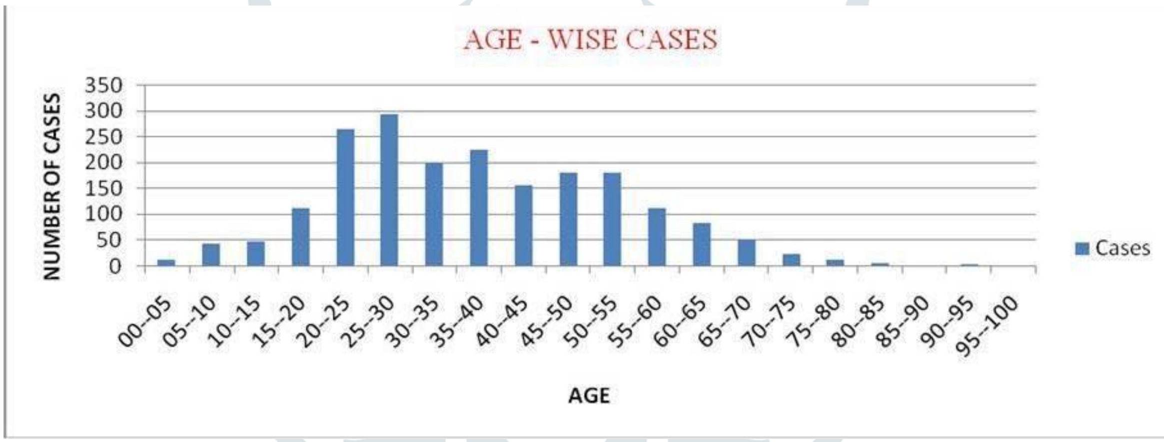


Figure Death cases in Hyderabad.

Figure. Accident victims age.

Figure. Accident hotspot locations.

Comparison between Patna city and Hyderabad city

1. In Patna city pedestrian deaths are very high and they have increased from 1996 to 2000 as compared to two wheelers which have decreased while as in Hyderabad city accident rate have decreased from 2009 to 2013.
2. The total number of fatal accidents as well as related fatality in the Patna city is increasing over the years where as in Hyderabad city fatal accidents as well as related fatality has considered decreased.
3. Road network increased percentage in Patna city is less as compared to increase number of vehicle while as in

Hyderabad city road network increased percentage is quite high.

4. Fatality risk in Patna city due to road accidents is quite high as compared to average Indian while as in Hyderabad city it is low.

5.Deaths due to buses and trucks in Patna city is quite high as compared to Hyderabad city.

Results &Discussions

A total of 2,990 cases of road traffic incidents were recorded in the police database for 2013, in which 411 (16.08%) people were killed. In the same year, 316 cases of road traffic crashes resulting in 353 deaths were reported in the newspaper. The majority of those who died due to these crashes were males. Seventy per cent of those killed were between 16 and 49 years of age. Pedestrians and riders of two-wheelers were the most vulnerable. Collision with a vehicle caused 86.4% of all crashes and 60% of the victims died before reaching a hospital. The maps reveal the nature of incidents and also the vulnerable spots in the city. As one would expect, Patna is also suffering from the problem of deaths and injuries on its roads. The total number of fatal accidents as well as related fatality in the city is increasing over the years. Persons killed per 100 accidents are alarmingly high, as high as 45 during the year 2000. Although fatality rate is relatively low in Patna, fatality risk is higher than the Indian average. Pedestrian deaths as a percentage of all road fatalities are extremely high in the city. During the recent years, they constitute more than 90% of all road fatalities. Since both adults working age group and pedestrians constitute a large proportion of road accident fatalities, it is believed that the vast majority of pedestrian casualties occur to the economically active cohort (18 to 60 years).
As far as vehicle-wise accident rates are concerned, buses are the riskiest. On an average, they are causing around sixteen accidents per thousand buses per annum. In general, trucks and three-wheelers are the second and third most risky vehicles, respectively. Furthermore, the city traffic police have identified few accidents prone locations on the basis of severity and frequency of accidents. From the year 2000 onwards, new bypass road on national highway (NH – 38) is considered to be the most accidents prone location in the city where around 15% of all the accidents occur during recent years.

Conclusion

In conclusion, the police database and newspaper reports provide insights into the magnitude and nature of fatalities due to road traffic crashes. The limitations of the police database, which is the legal source of information on fatalities resulting from road traffic crashes, indicate a need for strengthening the road traffic crash surveillance system so that reliable, accurate and adequate data on road traffic crashes and the resulting fatalities and injuries can be collected. This could then form the basis for planning effective intervention strategies to improve road safety in the city. More effort is needed to have a comprehensive understanding of the various aspects of road traffic crashes, and the recommendations made for strengthening surveillance could serve as an initial step towards reducing fatalities and injuries due to road crashes in the long-term.

References

(1) Accidental Deaths & Suicides in India Published by National Crime Records Bureau, Ministry of Home Affairs, GOI, New Delhi; Various Issues.

(2) CIRT Pune; Various publications.

(3) Ghee C., Seacock D., Astros A., and Jacobs G. D. (1997), "Socio economic aspects of road accidents in developing countries", TRL Report TRL247. Transport Research Laboratory, Crow Thorne.