

INVESTIGATION ON ACCIDENT MITIGATION AT BAPATLA HIGHWAY, ANDHRA PRADESH

Submitted in partial fulfillment of the requirements for the award of

Bachelor of Engineering Degree in Civil Engineering

By

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**DEPARTMENT OF CIVIL ENGINEERING
SCHOOL OF BUILDING AND ENVIRONMENT**

SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with Grade "A" by NAAC

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APRIL 2021



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DEPARTMENT OF CIVIL ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of SAI SUNAY REDDY PATHAKOTA (Reg. No. 37200050) and PENUMETCHA NAGANJANEYA VARMA (Reg. No. 37200051) who carried out the project entitled **"INVESTIGATION ON ACCIDENT MITIGATION AT BAPATLA HIGHWAY ANDHRA PRADESH"** under my supervision from DECEMBER 2020 to APRIL 2021.

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External Examiner

DECLARATION

We **SAI SUNAY REDDY PATHAKOTA (Reg. No. 37200050)** and **PENUMETCHA NAGANJANEYA VARMA (Reg. No. 37200051)** hereby declare that the Project Report entitled **“INVESTIGATION ON ACCIDENT MITIGATION AT BAPATLA HIGHWAY ANDHRA PRADESH”** done by us under the guidance of **Mrs. R. NIRMALA** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering Degree in Civil Engineering.

1.

2.

SIGNATURE OF THE CANDIDATE

DATE:

PLACE:

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ABSTRACT

Now a days, due to rapid growth of urbanization the road accidents cannot be avoided, if roads and intersections are not properly designed. In order to reduce the possibility and impact of road accidents various surveys and techniques are carried out like spot speed survey and road geometric data. In this study the various survey are carried out to understand the statistical details of accidents and speed analysis. The data was obtained from the police department where the F.I.R. was lodged for the past seven years, from 2014 to 2020. A detailed analysis was carried out by considering the factors such as place of occurrence, month of occurrence, time of occurrence, type of vehicles involved and cause of occurrence. This detailed analysis shows that two wheelers are involved in almost 52% accidents followed by cars 18%, trucks 12%, busses 8% and remaining vehicles 10%. On a study section, there is no definitive pattern for monthly variance in injuries, but accidents in the months of June and July are usually higher, and the majority of accidents happen during the day. Also the accidents statistics were forecasted for the future accidents from [2021 – 2035] by this detailed analysis. This forecasted data shows that the highest risk considering the causes is over speeding which is highest amongst all the other causes over a course of 15 years [2021 – 2035].

Road safety measures to be taken to reduce the possibility of accidents in bapatla are provision of traffic control devices, laying of bypass road, installation of automatic electric traffic lights, installation of medians, improvement of shoulder, maintenance of road surface. Strict rules and regulations and increase safety awareness of road users.

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CHAPTER 1

INTRODUCTION

1.1 GENERAL

A traffic accident is defined as an accident involving at least one vehicle on a road open to public traffic in which at least one person is injured or death. The problem of accidents is particularly severe in highway transportation due to the complex flow pattern of vehicular traffic, the existence of mixed traffic, and the presence of pedestrians. Traffic accidents result in the loss of life and property. The rapid growth of Bapatla town increases the number of vehicles on the highways, causing traffic congestion and the risk of accidents because of poor traffic management.

While road accidents cannot be entirely avoided, the number of accidents can be minimised to some degree by proper traffic engineering and management. Traffic accidents are mainly caused by humans operational mistakes such as inattention miss behaviour and distraction.

Bapatla is a developing town where accidents are increasing every year, So in order to control these accidents, a thorough investigation into the causes of the accidents would aid in the development of preventative design and control steps.

1.2 CAUSES OF ROAD ACCIDENTS

Road accidents are the foremost dreaded thing that will happen to a driver, despite the particular indisputable fact that they occur often. Worst of all, we do not learn from our road errors. the majority of road users are tuned in to the ultimate rules and safety precautions to need while travelling on highways, but it's only their negligence that ends up in accidents and crashes. Human error is that the first reason behind injuries and collisions.

The various reasons of road accidents are :

- **ROAD USERS** – The factors that contribute to road traffic accidents are Excessive speed, rash driving, overtaking, and driving under the influence of alcohol, Violation of traffic laws, inability to interpret a traffic condition, warning or gesture, driving under sleeping etc...
- **VEHICLE** – Defects such as brake failure, engine problems, steering system problems, tyre bursts, and lighting system problems.
- **ROAD CONDITION** – Road surface that is skidding, potholes, ruts, eroded road, detours, and illegal speed breakers.
- **ROAD DESIGN** – Defective geometric construction, such as insufficient visibility space, insufficient shoulder width, insufficient lane width, inappropriate curve design, insufficient traffic control equipment, lighting and insufficient drainage system.
- **ENVIRONMENTAL FACTORS** – Mist, snow, haze, heavy rain, wind storms, and hail storms are all examples of unfavourable weather conditions. This reduces natural vision and makes driving dangerous.
- **OTHER CAUSES** – Advertisement boards in the wrong places, level crossing gates that aren't locked when they should be, and so on....

These are the main causes of road accidents

OVER SPEEDING :

Overspeeding is the cause of the majority of fatal collisions. If provided the opportunity, man will undoubtedly reach infinite speeds, but when sharing the road with other drivers, we will still be stuck behind one or more vehicles. Increase in speed doubles the risk of accidents and severity of injury during accidents. Vehicles that are faster will face a greater risk than slower vehicles, and the severity of a collision is often raised in the case of faster vehicles. The higher the speed, the higher the risk. At high speed the vehicle needs greater distance to stop i.e, braking distance. A high-speed vehicles would have more impact during a collision, resulting

in more casualties. Moving at a higher speed reduces one's ability to judge future circumstances, resulting in errors in judgement and, eventually, leads to a collision.

DRUNKEN DRIVING :

Alcohol is commonly consumed at parties. When associated with walking, though, it becomes a misfortune. The intake of alcohol impairs concentration. It reduces the human body's response time. Limbs require time to travel in response to brain commands. Due to dizziness, it impairs vision. Alcohol reduces anxiety and encourages people to take risks. Both of these conditions together when driving cause injuries which, in many cases, prove fatal. With every 0.05 increase in blood alcohol consumption, the chance of an injury increases. Medicines, in addition to alcohol, have an effect on driving abilities and concentration. we propose not to consume alcohol. if you feel your merry making is not complete without alcohol, do not drive under the influence of alcohol ask a teetotaler buddy to drive you home.

DISTRACTION TO DRIVER :

Distraction when driving can appear small, but it has the potential to cause serious injuries. Distraction may occur outside or inside the vehicles. Now a days, the most common source of diversion is chatting on the phone while driving. Since talking on the phone occupies such a large portion of the brain, driving abilities are entrusted to the smaller portion. Time interval and judgmental capacity are impaired by this brain division. This was one of the possible causes of collisions. Talking on the phone while driving is not a good idea. If the decision is important, drive off to the side of the road and attend to it. A number of the distraction on roads are

1. Driving while Mirrors are being adjusted.
2. In-vehicle radio/stereo.
3. Animals crossing the road.
4. Billboards and banners, among other things....

1.3 OBJECTIVE OF THE STUDY :

➤ OBJECTIVE :-

- 1.** To collect accident data and the reasons for occurrence of accidents at Bapatla Highway, Andhra Pradesh.
- 2.** To collect the Road Geometrics Data and Spot Speed Data at Bapatla Highway.
- 3.** To analysis the collected data from the survey.
- 4.** To Forecast the future possibility of accidents at Bapatla Highway.
- 5.** To recommend the suitable accident Mitigation Measure.

1.4 SCOPE OF STUDY :

To conduct investigation on accident mitigation at Bapatla Highway, the propose design changes, traffic route changes, signals and signs. To provide possible remedial measures to prevent future accidents.

CHAPTER 2

LITERATURE SURVEY AND METHODOLOGY

2.1 GENERAL

This is made and planned to do by reviewing some of the literature. The importance of reviewing the literature is to analyze the research works related to the study.

2.2 REVIEW OF LITERATURE

This literature review will be the mechanism by which research is viewed as a cumulative process. That makes it an integral component of the scientific process. Abstracts of related literatures have been detailed below.

Sanjay kumar singh [2017], has identified and has analyzed the reasons for road accidents in india at national, state and metropolitan city level. Also this study states distribution of road accidental deaths and injuries in india varies according to age, gender, month and time. Age group of 30-39 years is the most vulnerable population group, through males face higher level of fatalities and injuries than their females counter parts. This study state that road accidents are relatively higher in may- june and December- january which shows that extreme weather influences the occurrence of road accidents.

Akmal abdelfatah, Mohamed saif al-zaffin et al [2015], This report examines the patterns and causes of traffic accidents in Dubai. For this reason, traffic accident figures from 2003 to 2012 are used to analyse the trends of various types of accidents and the causes of these accidents, as well as the proper decides the most frequent type of accidents during the study period. The remainder of the paper indicates the effect of the recent traffic law changes, which were released in 2008, on the injury rates and patterns. The findings revealed that the introduction of the traffic law amendments did not have a substantial impact in the year 2008. One of the most common causes of accidents in Dubai is a lack of knowledge of traffic laws and regulations. Finally, the report offers numerous recommendations for lowering traffic accident rates in order to meet the Dubai Police Department's strategic goal of zero deaths by 2020.

S.N Sachdev and Gaurav goel [2016], conducted an analysis to determine the causes and severity of the injuries, as well as the time of the crash and the type of vehicle involved, and announced the following findings: Overspeeding or driver negligence was mostly to blame for head-on/rear-end collisions, which account for 46% of all fatalities. Trucks/buses have been found to be involved in the most collisions (42 percent). Daytime accidents were discovered to be more frequent than nighttime accidents.

BK Banik, mai chowdhury et al [2011], has analyzed and studied that roads, highways, and streets are essential infrastructure facilities for providing transportation for passengers and goods movement from one location to another in Sylhet, Bangladesh's north-eastern division. With the rapid growth of road vehicles, this comparatively developed economic tourist prone region faces extreme road traffic accidents. This research work provides an analysis of the road traffic accidents and deteriorating road safety situation in the Sylhet district, focusing on the main road accident issue, characteristics defining dangerous roads and spots, driving and pedestrian situations, the most frequent accident casualties, the effects of accidents on society, safety goals, and options available in Sylhet.

Jones et al [1996], In 1996, Norfolk, UK published a report on traffic injuries using GIS and the spatial-temporal approach. The occurrence or absence of hotspot clustering was calculated using the K-function analysis approach in this study. The researchers were able to minimise the number of incidents in these areas by locating centralised grouped accidents.

Erdogan et al [2008], performed research to determine the distribution of injuries on a highway in turkey near the entrance of afyonkarashiasar city. This study used two separate kernel density analysis methods, and after identifying hotspots, accident conditions were evaluated on an hourly, monthly, and seasonal basis. Furthermore, the researchers presented three major hotspots as well as a host of methods for traffic departments to solve the issue.

Mahima and sandeep kumar et al [2020], has studies the trends of occurrence of RTA total number of incidents by month, week, and time of occurrence, as well as the types of vehicles involved in accidents and any risk factors related to them, are all being investigated. This study states that there were

654 victims of which 77.5% were male, about two third of the study subjects belong to rural area and the major proportion in the RTA victims was formed by victims aged 16-45 years [65.1%].

Pramada valli [2005], has analysed various factors influencing the road accidents modals for metropolitan cities in india. According to this study, different modals were created for different cities based on the data patterns of each city, and the modal accuracy for all cities is satisfactory.

Cesar pedraza and Camilo Gutierrez-osorio [2020], has done investigation on prediction of road accidents through machine learning algorithms and advanced techniques for analysis and forecast of road accidents. This study states that, When two or more analytic methods are combined, the best results are obtained, and the interpretation of the obtained results is improved.

Churchill T and Bijleveld F [2012], has analysed the effect of weather conditions on road safety in leidschendam, the Netherlands. This study states that hazy or rainy weather considered to be most risky and two wheeler vehicles are considered to be worst affect by the cold and humid weather.

Ashish Mishra and Dr.sanjay k singh [2000], has provide statistical data base over the accidents occurred in patna city and analysed various factors related to accidents. The road in the city are congested and encroached by other activities. Bus systems, in particular, have declined, with lower reliability and quality of operation, prompting travellers to seek out customised modes and IPTs. This not only impedes traffic flow, but also puts road users' lives in jeopardy. The total number of fatal accidents as well as related fatality in the city is increasing over the years. The number of people killed in 100 injuries is alarmingly high, reaching 45 in 2000. Pedestrian deaths account for a significant proportion of all traffic casualties. They have accounted for more than 90% of all traffic deaths in recent years. Furthermore, over 80% of all deaths occurred in the adult working age demographic (18 to 60 years). The city's most accident-prone site is the latest bypass road on national highway (NH – 38), which accounted for about 15% of all incidents in 2000. We agree that a multi-disciplinary team of professionals should conduct an individual road safety assessment for this area and recommend corrective steps.

Fajaruddin Mustakim and Motohiro Fujita [2011], This paper presents the findings of a review that involved accident analysis, plant disease testing, and the creation of accident predictive models based on data collected along Malaysia's Federal Route 50 (F050). The F050 was used to assess the patterns in traffic injuries and the ranking of plant diseases. The accident prediction model's occurrence will be concentrated in the Parit Raja region between KM 19 and KM 23. The multiple non-linear regression approach was used to connect the discrete accident data to the explanatory variables of road and traffic flow. The vector quantity was modelled as the number of collisions, which is known as accident point weighting, however accident point weighting is rarely taken into account in road accident prediction models. The results show that the current number of main access points is rising without light, with an increase in speed, an increase in Annual Average Daily Traffic, and an increase in the number of bike and motorcar users. Reduced time delays and a decrease in the number of vehicles on the route could help reduce the number of accidents on rural roads.

Chaturaphat Chantit et al [2020], has proposed an index for reduced output in Thailand as a result of traffic collisions. According to the report, road traffic deaths cost 45 billion dollars in lost production, while being handicapped costs 7 billion dollars, or 4.7 million bhat per citizen.

Cohen simon and Seidowsky Regine et al [2015], The procedures and outcomes of two separate road accident activity tests have been calculated. Ex-ante and ex-post evaluations, according to this report, are important for decision-making, gathering trial findings, and eventually determining the right operations and procedures.

Carmen forcinitia et al [2020], has investigated the features that can affect the seriousness of an accident by discriminating between the different categories of injuries and fatalities. According to this report, road-related causes have the greatest effect on the nature of crash fatalities, with stretch form [road junction or not] having the greatest impact.

Fridulv sagberg et al [2019], has developed a model for determining factors responsible for road accidents occurring on bridges in Norway. This study states that Negative binomial regression models were created to classify variables reflecting

systemic differences in the number of incidents on road bridges in Norway. according to this study, The single most significant element was discovered to be traffic volume.

Srinivas,R.geedipally and Subasish das et al [2020], has examined the prevailing operation speeds on a large scale and determines how traffic speeds and different speed measures interact with roadway characteristics and weather conditions to influence the likelihood of crashes. This study developed a reproducible approach of conflate different linear networks and incorporate speed and weather measures.

Ali reza honarvar, Saeed lotfi et al [2019], has discovered the secret relationships between successful variables in the mortality rate caused by road accidents in Iran's Fars Province, In order to avoid and reduce traffic collisions. This research pinpointed exact accident locations based on variables such as age, gender, and accident time [season and exact regular time].

2.3 METHODOLOGY

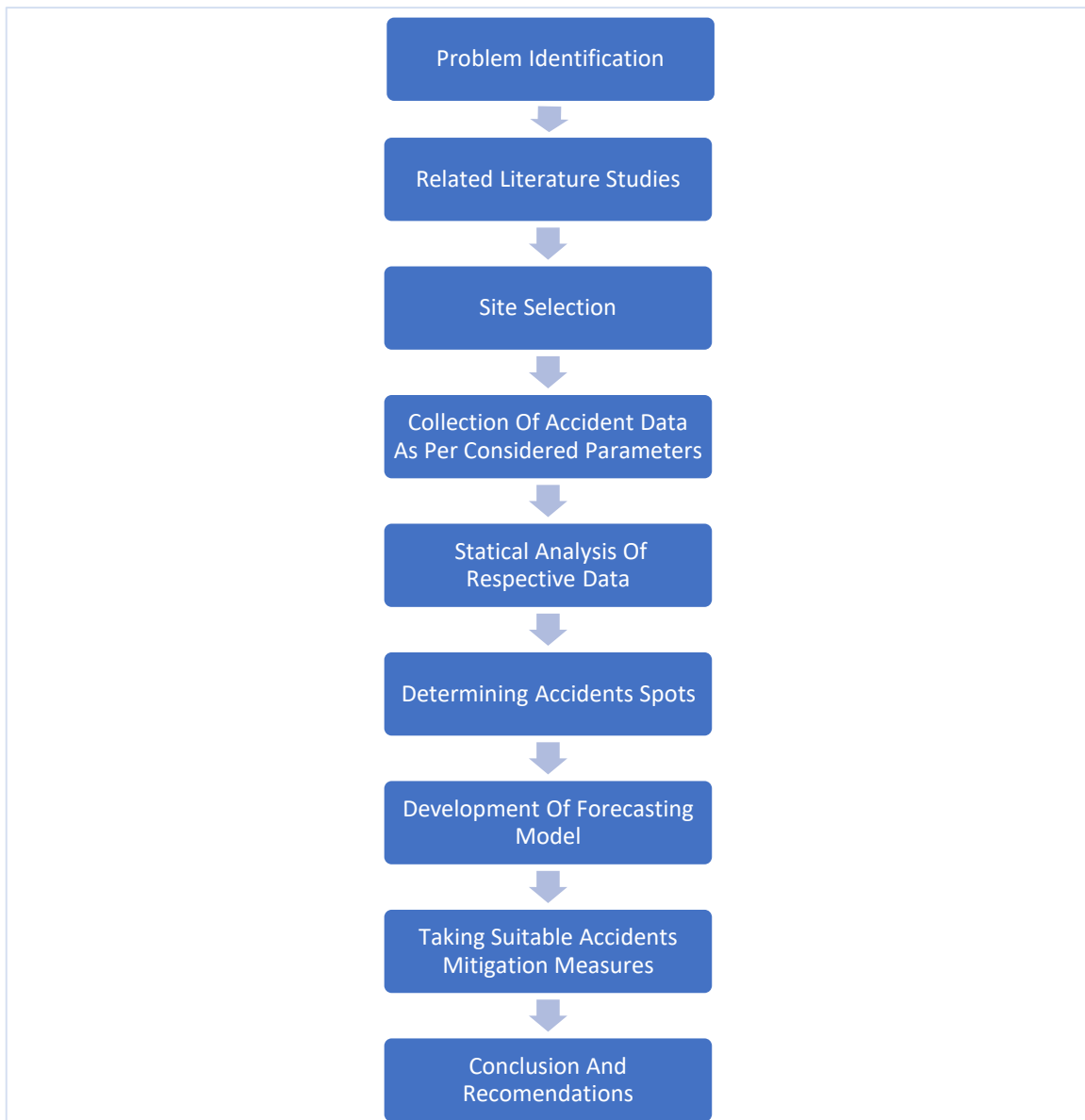


FIG : 2.1 : FLOW CHART OF METHODOLOGY

To investigate on problem identification regarding causes of accidents and collection of related literature studies. Selection of site has to be done and then collection of accidents data as per considered parameters. Collected data should be analyzed and accident spots should be determined. Forecasting model should be developed to find the future possible accidents and take some remedial measures to reduce future possible accidents. Recommendations and conclusion has to be provided.

CHAPTER 3

STUDY AREA AND DATA COLLECTION

3.1 GENERAL

The chapter gives the distributed selected study area bapatla and the necessary data collected at the study area.

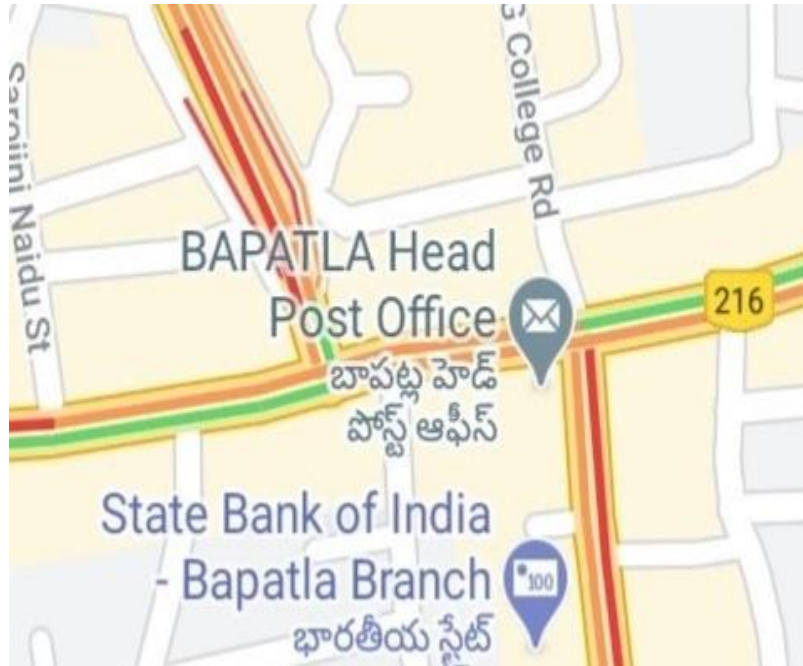
3.2 STUDY AREA

Bapatla is a medium-sized developing town. Which is situated in Guntur district and has some important commercial, social, health, educational and administrative center. In recent years, due to improved economic condition of the people, there has been an increase in the level of car, two wheeler, ownership which consequently led to increase demand for transport facilities. Due to increasing in vehicles and congested roads accident takes place at different spots. From the F.I.R report which was taken from the bapatla town police station. We got to know that two spots are having major accidents like [severe injuries and in some cases leads to death] from past seven years in bapatla town. So we have taken bapatla as our study area.



Source : Google map

Fig : 3.1 : Aerial View of Bapatla



Source : Google map

Fig : 3.2 Road Map of Bapatla

The detailed view or the satellite view of bapatla intersection shown in fig 3.3



Source : Google map

Fig : 3.3 : Satellite View of Bapatla

3.3 DATA COLLECTION

The data collection involved two practices, one as primary and other as secondary data.

3.3.1 PRIMARY DATA

Primary data is a type of data that is collected by the researchers directly from main sources through interviews, surveys and experiments. Primary data is also gathered by doing an observation on the specific road to get the road geometrics and speed of vehicles. The observation is done manually and the survey must be conducted from Monday to Friday only, as it is expected to be less or more active on weekend.

There are four locations for the observation which is noted from location A and location D. Each location is observed for its road characteristic which will influence the calculation to get its level of service. The survey is done on week days so that the traffic flow will be on regular basis.

3.3.1.1 ROAD GEOMETRY

The proportions and arrangement of observable elements of pavements, such as horizontal and vertical alignments, visibility gaps, and intersections, are all part of the geometric configuration of a highway. Pavement geometry should be planned to optimise traffic performance while ensuring optimum protection at a fair cost.

In this study there are four observation locations in this report, and each location's road characteristic data is gathered to aid in the estimation of its quality of operation. The path width, the number of lanes, the name of the road, the shoulder width, the lane width, drainage type, median width, and directional break were among the characteristics that were observed. The acquired data for all locations was then summarized in table 3.1

Table 3.1 : Geometrical details of selected locations in bapatla.

LOCATION	A	B	C	D
ROAD NAME	MARKET YARD ROAD	OLDBUS STAND ROAD	KARALAPALEM ROAD	NEWBUS STAND ROAD
Lane width(m)	3.48	3.5	3	3.52
Drainage type	NA	NA	NA	NA
Clear shoulder (m)	1.5	1.5	0.6	1.5
Road width	14	14	6	14
Median width	0.5	1.2	NA	1.2

From table 3.1, location A represents the road stretch from market yard at Bapatla. It has two lanes and the road width was measured to be 14m, it is having a median of width 0.5m. There was a clear shoulder of about 1.5m. The lane width is measured to be 3.48m.



Fig : 3.4 : View of Road Geometry of Arm – A (from market yard) at Bapatla

From table 3.1, Location B represents the road stretch from old bus stand at Bapatla. It has two lanes and the road width was measured to be 14m, it is having a median of width 1.2m. There was a clear shoulder of about 1.5m. The lane width is measured to be 3.5m. This road has brought the traffic from old bus stand.



Fig : 3.5 : View of Road Geometry of Arm – B (from old bus stand) at Bapatla.

From table 3.1, Location C represents the road stretch from karlapalem at Bapatla. It has single lane and the road width was measured to be 6m, it is not having a median width. There was a clear should of about 0.6m. The lane width is measured to be 3m. The road has brought the traffic from karlapalem.



Fig : 3.6 : View of Road Geometry of Arm – C (from karlapalem) at Bapatla

From table 3.1, Location D represents the road stretch from new bus stand at Bapatla. It has two lanes and the road width was measured to be 14m, it is having a median of width 1.2m. There was a clear shoulder of about 1.5m. The lane width is measured to be 3.52m. This road has brought the traffic from new bus stand.

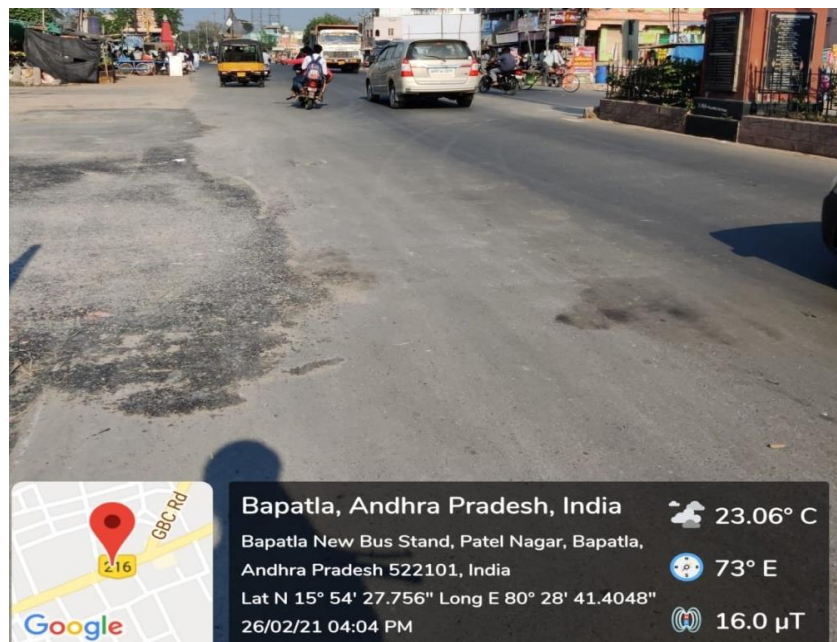


Fig : 3.7 : View of Road Geometry of Arm – D (from new bus stand) at Bapatla.

3.3.1.2 SPOT SPEED DATA

Spot speed studies are used to determine the distribution of vehicle speeds in the direction of traffic at a certain spot on the highway. These data are used to calculate speed characteristics such as mean speed, modal speed, pace, standard deviation, and percentiles of speeds, which are helpful in making a variety of speed-related decisions.

Uses of spot speed studies

1. Making highway geometric features such as horizontal and vertical curves, super height, and so on...
2. Traffic rules and safety systems such as signal configuration, reasonable speed, and speed zone determination are planned.
3. Studying traffic capacity of a highway.

4. For Accidents studies.
5. Cost – benefit analysis of a highway project.
6. Studying traffic speed trends for future use.

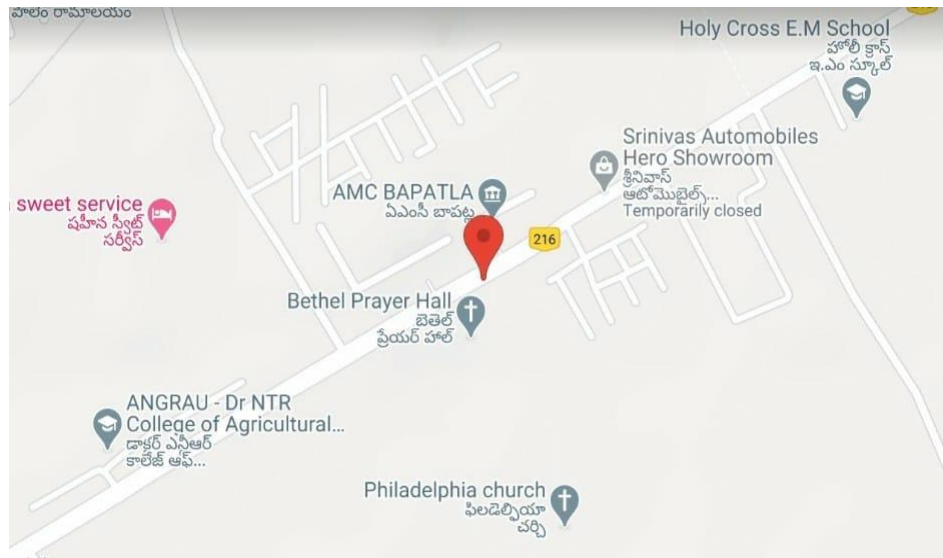


Fig : 3.8 : Aerial View of Bapatla

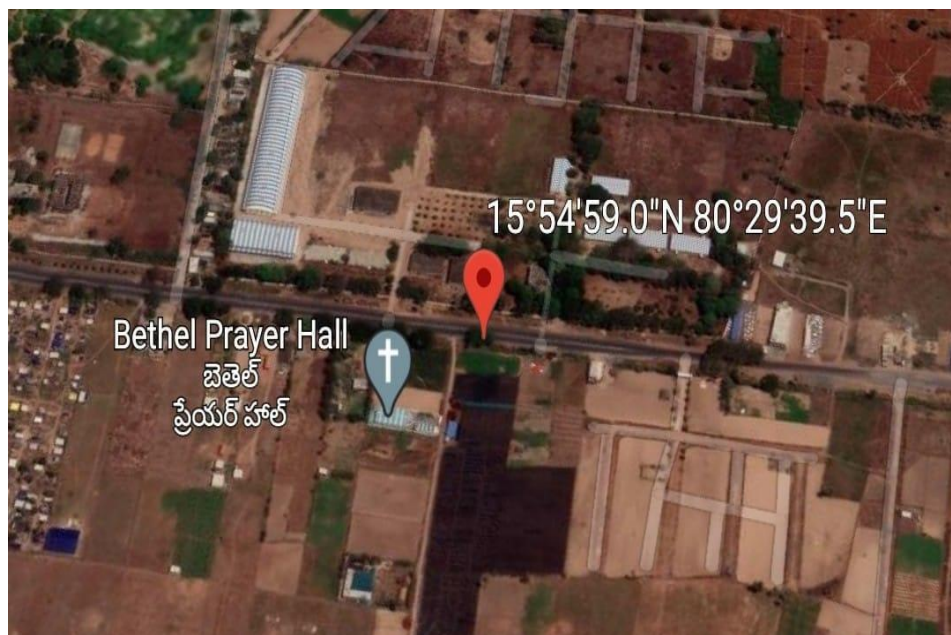


Fig : 3.9 : Satellite View of Bapatla

DATA ANALYSIS FOR BUSES

Location : Bapatla

Date : 17/02/2021

Weather : sunny day

Time : 10 a.m to 2 p.m

Type of road : NH 216

Base length : 80m

Measurements technique : manually

Vehicle : buses (80)

Table : 3.2 : The Frequency Distribution of Buses

Speed range kmph	Mid speed (x)	Frequency (f)	%Frequency (%f)	%Cumulative frequency (%c.f)	(f.x)
30-40	35	4	5	5	140
40-50	45	8	10	15	360
50-60	55	16	20	35	880
60-70	65	24	30	65	1560
70-80	75	20	25	90	1500
80-90	85	8	10	100	680
90-100	95	0	0	100	0
100-110	105	0	0	100	0
		F=80 (total)			f.x=5120 (total)

The average speed for buses = sum of (f.x) / sum of (f) =(5120/80)

The average speed (or) mean speed for buses = 64 kmph.

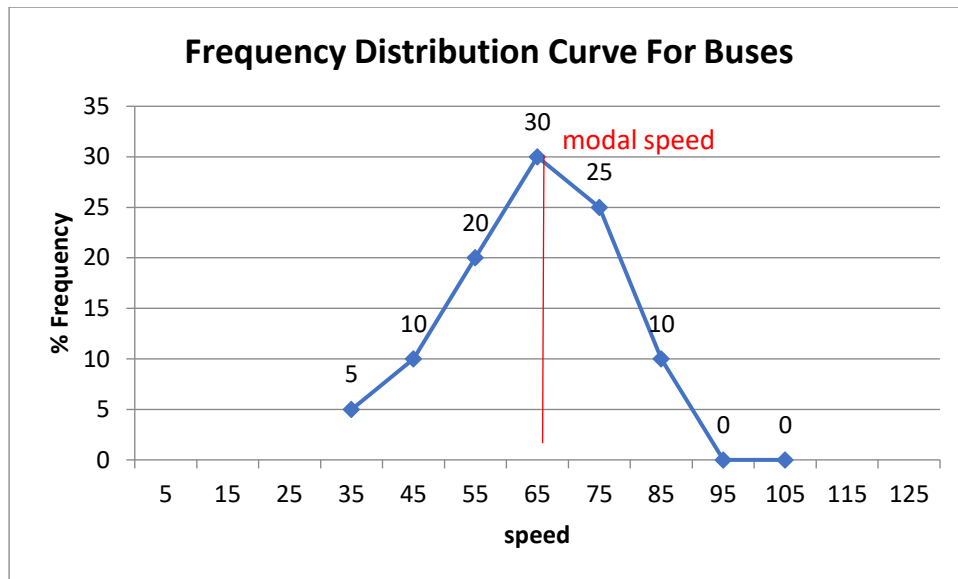


Fig : 3.10 : Frequency Distribution Curve For Buses

From frequency distribution curve modal speed = 65 kmph.

Therefore the most preferred speed at which maximum proportions of buses travel is the modal speed = 65 kmph

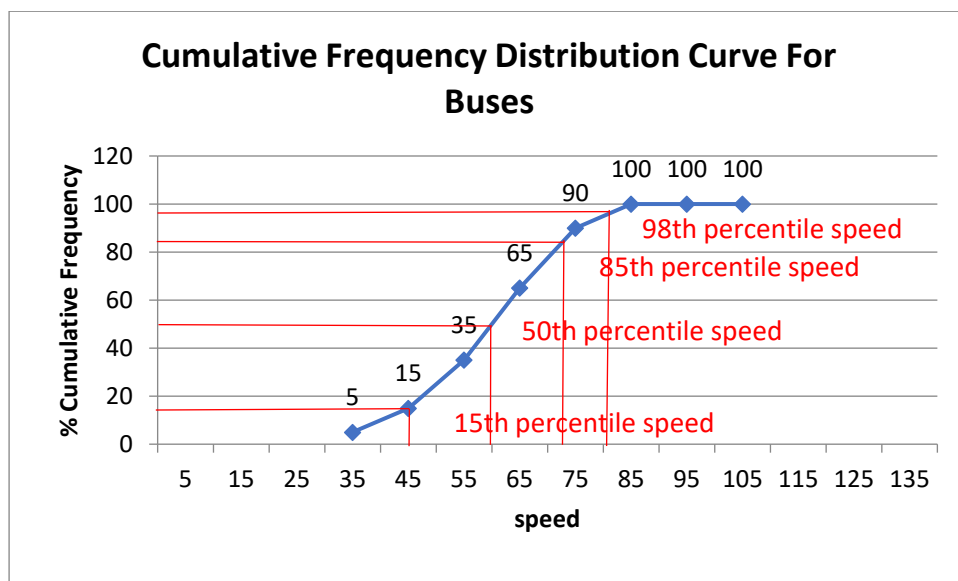


Fig : 3.11 : Cumulative Frequency Distribution Curve For Buses

For NH 216 bapatla for buses

1. Upper speed = 85th percentile speed = 75 kmph.
2. Lower speed = 15th percentile speed = 45 kmph.
3. Design speed = 98th percentile speed = 80 kmph.
4. Median speed = 50th percentile speed = 60 kmph.

DATA ANALYSIS FOR CARS

Location : bapatla

Date : 17/02/2021

Weather : sunny day

Time : 10 a.m to 2 p.m

Type of roads : NH 216

Base length : 80m

Measurement technique : manually

Vehicles : cars (80)

Table : 3.3 : The Frequency Distribution of Cars

Speed range kmph	Mid speed (x)	Frequency (f)	%Frequency (%f)	%Cumulative Frequency (%c.f)	(f.x)
20-30	25	0	0	0	0
30-40	35	4	5	5	140
40-50	45	12	15	20	540
50-60	55	16	20	40	880
60-70	65	20	25	65	1300
70-80	75	12	15	80	900
80-90	85	8	10	90	680
90-100	95	4	5	95	380
100-110	105	4	5	100	420
110-120	115	0	0	100	0
		F=80 (total)			f.x=5240 (total)

The average speed for cars = sum of (f.x) / sum of (f) = (5240/80)

The average speed (or) mean speed for cars = 65.5kmph.

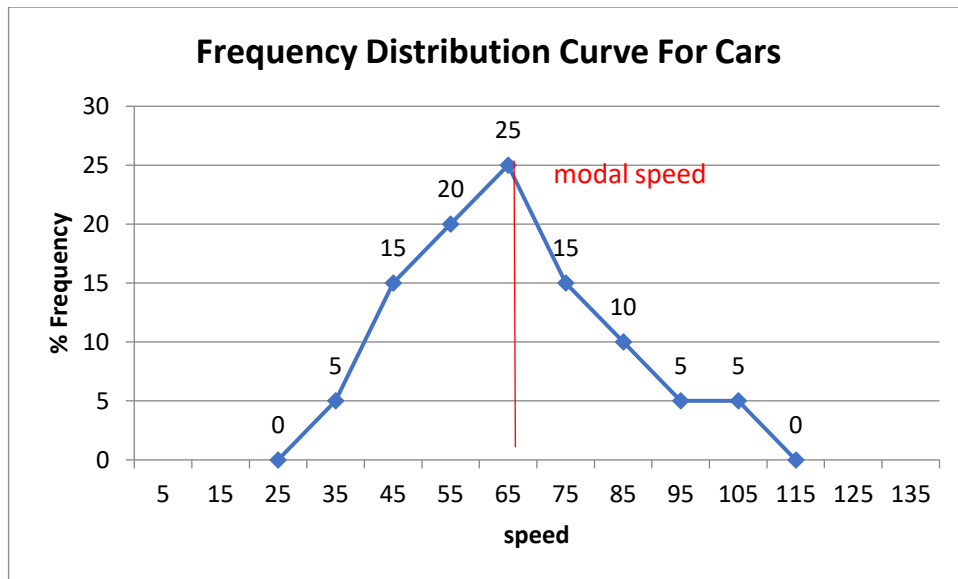


Fig : 3.12 : Frequency Distribution Curve For Cars

From frequency distribution curve modal speed = 65 kmph

Therefore the most preferred speed at which maximum proportion of cars travel is the modal speed = 65 kmph.

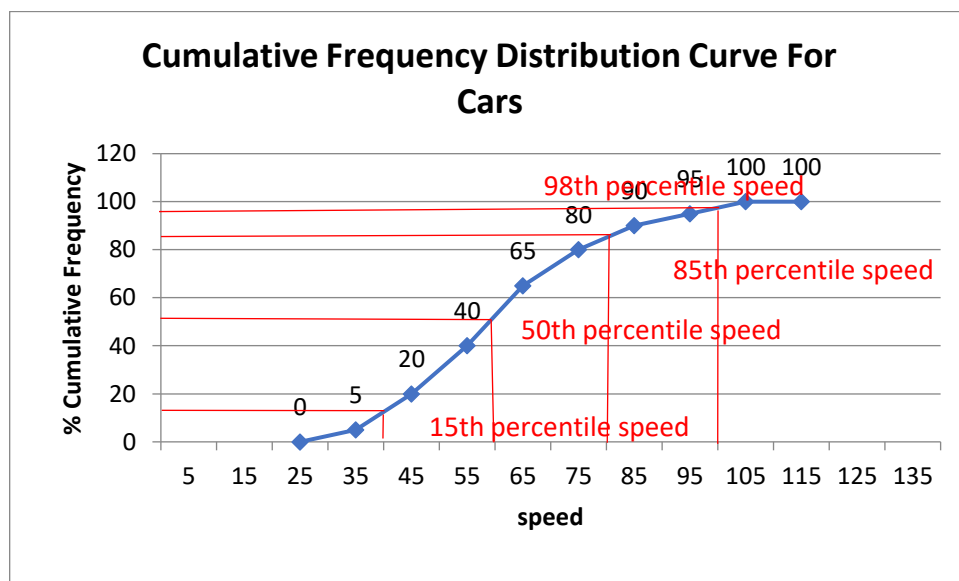


Fig : 3.13 : Cumulative Frequency Distribution Curve For Cars

For NH 216 bapatla for cars

1. Upper speed = 85th percentile speed = 80 kmph.
2. Lower speed = 15th percentile speed = 40 kmph.
3. Design speed = 98th percentile speed = 100 kmph.
4. Median speed = 50th percentile speed = 60 kmph.

DATA ANALYSIS FOR TRUCKS

Location : bapatla

Data : 17/02/2021

Weather : sunny day

Time : 10 a.m to 2 p.m

Type of road : NH 216

Base length : 80m

Measurement technique : manually

Vehicle : trucks (80)

Table : 3.4 : The Frequency Distribution of Trucks

Speed range kmph	Mid speed (x)	Frequency (f)	%Frequency(%f)	%Cumulative Frequency (%c.f)	(f.x)
30-40	35	4	5	5	140
40-50	45	12	15	20	540
50-60	55	24	30	50	1320
60-70	65	20	25	75	1300
70-80	75	12	15	90	900
80-90	85	8	10	100	680
90-100	95	0	0	100	0
		F=80(total)			f.x=4880(total)

The average speed for trucks = sum of (fx) / sum of (f) = (4880/80)

The average speed (or) mean speed for trucks = 61 kmph.

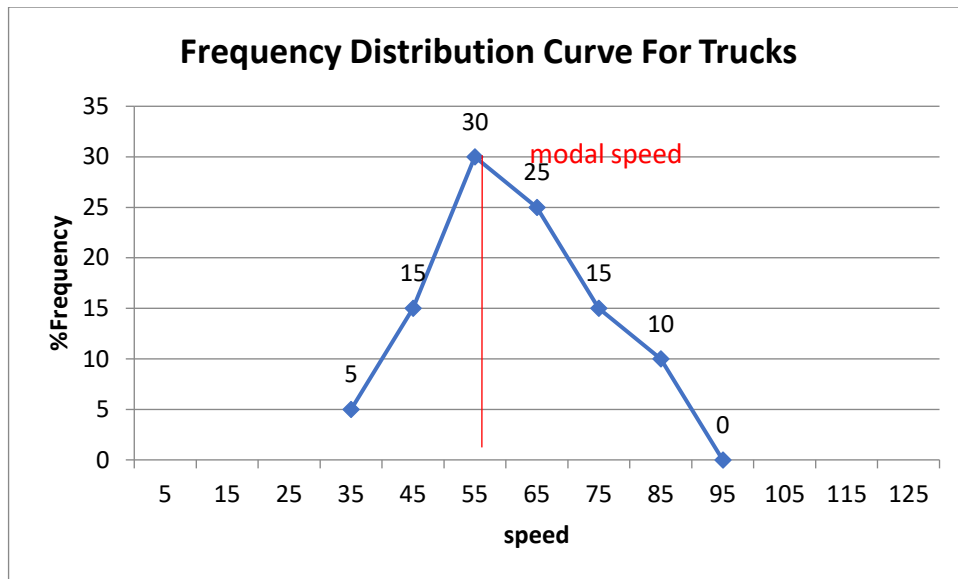


Fig : 3.14 : Frequency Distribution Curve For Trucks

From frequency distribution curve modal speed = 55 kmph.

Therefore the most preferred speed at which maximum proportion of trucks travel is the modal speed = 55 kmph.

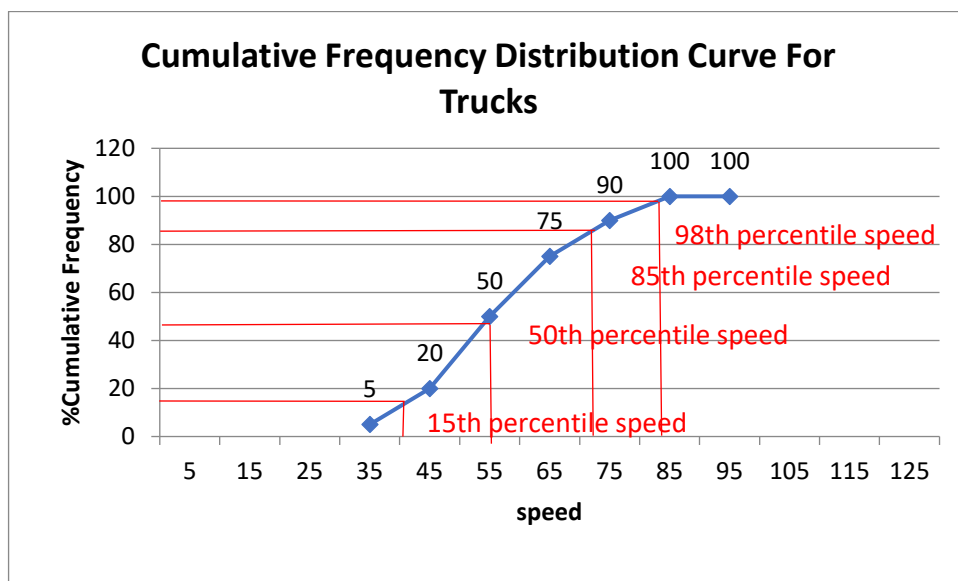


Fig : 3.15 : Cumulative Frequency Distribution Curve For Trucks

For NH 216 bapatla for trucks

1. Upper speed = 85th percentile speed = 75 kmph.
2. Lower speed = 15th percentile speed = 40 kmph.
3. Design speed = 98th percentile speed = 85 kmph.
4. Median speed = 50th percentile speed = 55 kmph.

DATA ANALYSIS FOR TWO WHEELERS

Location : bapatla

Date : 17/02/2021

Weather : sunny day

Time : 10 a.m to 2 p.m

Type of road : NH 216

Base length : 80m

Measurement technique : manually

Vehicle : two wheelers(80)

Table : 3.5 : The Frequency Distribution of Two Wheelers

Speed range kmph	Mid speed (x)	Frequency (f)	%Frequency (%f)	%Cumulative Frequency (%c.f)	(f.x)
20-30	25	4	5	5	100
30-40	35	8	10	15	280
40-50	45	16	20	35	720
50-60	55	24	30	65	1320
60-70	65	12	15	80	780
70-80	75	8	10	90	600
80-90	85	4	5	95	340
90-100	95	4	5	100	380
		F=80 (total)			f.x=4520 (total)

The average speed of two wheelers = sum of (f.x) / sum of (f) = (4520/80)

The average speed (or) mean speed for two wheelers = 56.5 kmph.

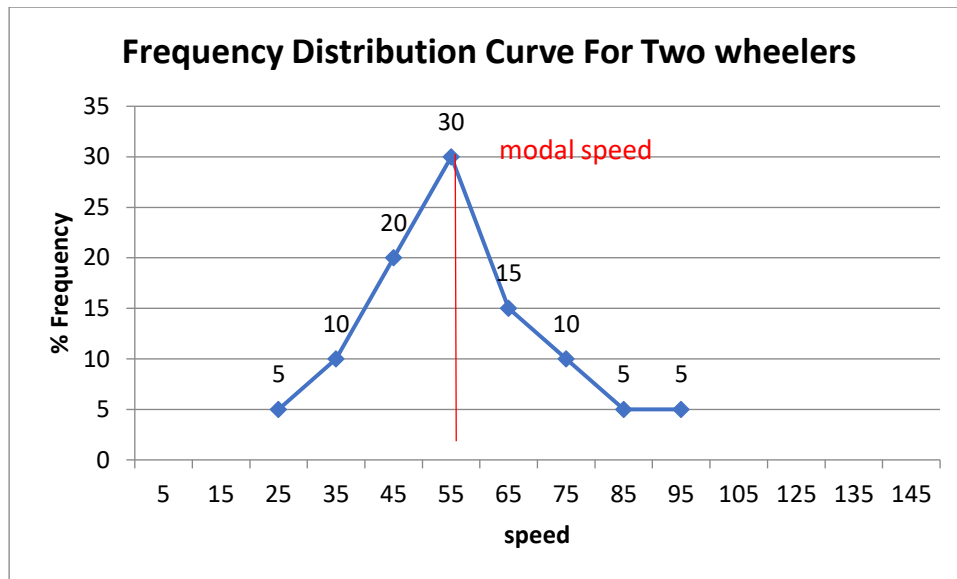


Fig : 3.16 : Frequency Distribution Curve For Two Wheelers

From frequency distribution curve modal speed = 55 kmph

Therefore the most preferred speed at which maximum proportion of trucks travel is the modal speed = 55 kmph.

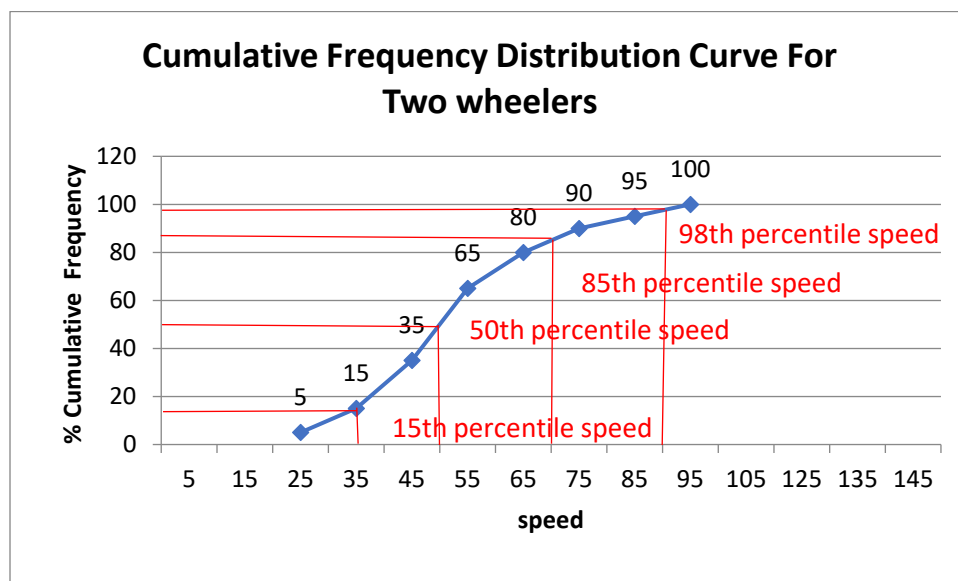


Fig : 3.17 : Cumulative Frequency Distribution Curve For Two Wheelers

For NH 216 bapatla for two wheelers

1. Upper speed = 85th percentile speed = 70 kmph.
2. Lower speed = 15th percentile speed = 35 kmph.
3. Design speed = 98th percentile speed = 90 kmph.
4. Median speed = 50th percentile speed = 50 kmph.

3.3.2 SECONDARY DATA

With courtesy to bapatla police the data base for the road accidents is obtained. It is a comprehensive data base for 7 years [2014-2020] regarding the place of road accidents time of road accidents, month of road accidents, type of vehicle involved, injuries as well as fatalities happened due to it.

3.3.2.1 ROAD ACCIDENT STUDY DATA BASE

The accident study database consists of following data :

- 1) "Cause of total number of accidents" year wise classification of roads.
- 2) Classification of road accidents based upon, "place of occurrence".
- 3) Classification of road accidents based upon, "Time of occurrence".
- 4) Classification of road accidents based upon, "Month of occurrence".
- 5) Classification of road accidents based upon, "Mode of vehicles".
- 6) "Injuries and fatalities" due to road accidents.

1. "CAUSE OF TOTAL NUMBER OF ACCIDENTS" YEAR WISE

Table : 3.6 : Cause – Wise classification of accidents

YEAR	Careless driving / over taking			Over speeding			Driving under influence of alcohol/drugs		
	Total no. of accid ents	Injure d	Die d	Total no. of accident s	Injur ed	Died	Total no. of acciden ts	Injure d	Died
2014	17	12	5	7	6	1	5	4	1
2015	15	12	3	11	9	2	8	7	1
2016	19	14	5	11	8	3	7	6	1
2017	14	10	4	13	11	2	7	6	1
2018	16	13	3	12	9	2	9	8	1
2019	13	11	2	10	9	1	9	8	1
2020	11	7	4	11	10	1	12	10	2

YEAR	Animal crossing			Lack of road infrastructure			Vehicle parking at road shoulder		
	Total no. of accidents	injured	Dead	Total no. of accidents	injured	dead	Total no. of accidents	injured	dead
2014	0	0	0	1	1	0	0	0	0
2015	0	0	0	1	0	1	0	0	0
2016	1	1	0	0	0	0	0	0	0
2017	0	0	0	0	0	0	0	0	0
2018	1	1	0	1	1	0	0	0	0
2019	1	1	0	1	1	0	0	0	0
2020	0	0	0	1	1	0	0	0	0

From the table 3.6, one can inferred that careless driving / over taking has caused maximum total no. of accidents, total no. of injuries and total no. of deaths which are 105,79 and 26 respectively. The graphical variation of the above given cause is as follows.

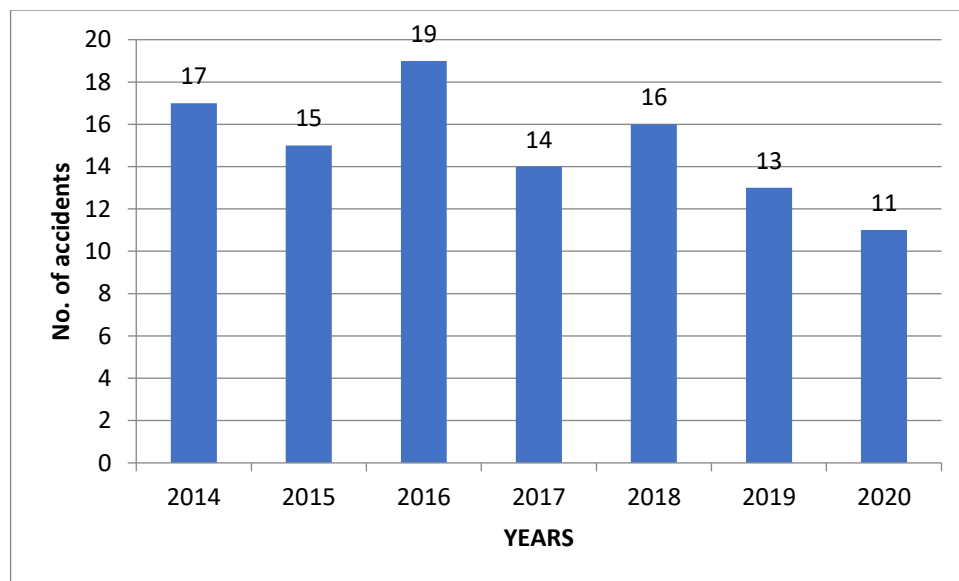


Fig : 3.18 : Total no. of accidents from the year [2014 – 2020] at Bapatla Highway.

- From the fig : 3.18, one can inferred that total no. of accidents has increasing and decreasing on average for every year.

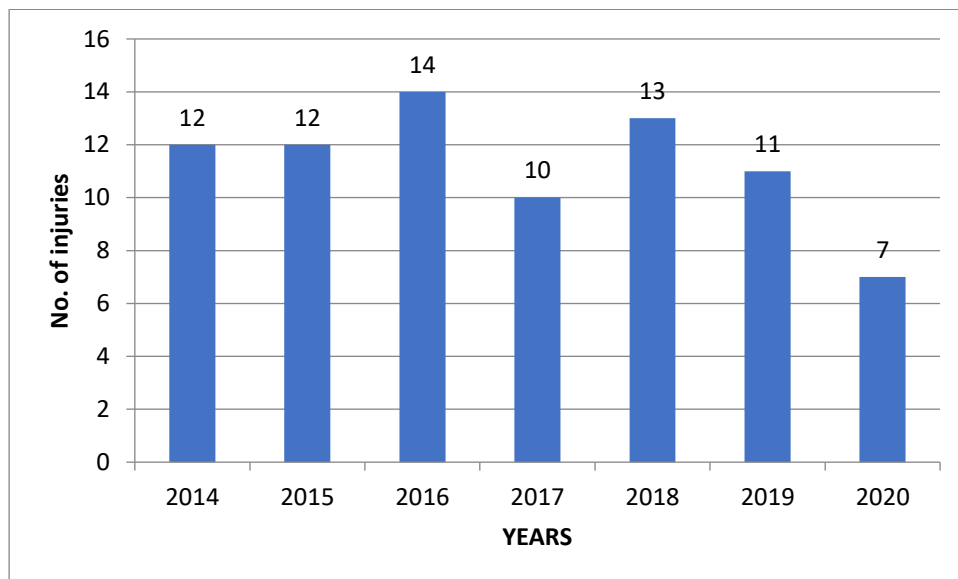


Fig : 3.19 : Total no. of injuries from the year [2014 – 2020] at Bapatla Highway.

- From the fig : 3.19, one can inferred that total no. of injuries has increasing and decreasing on average every year.

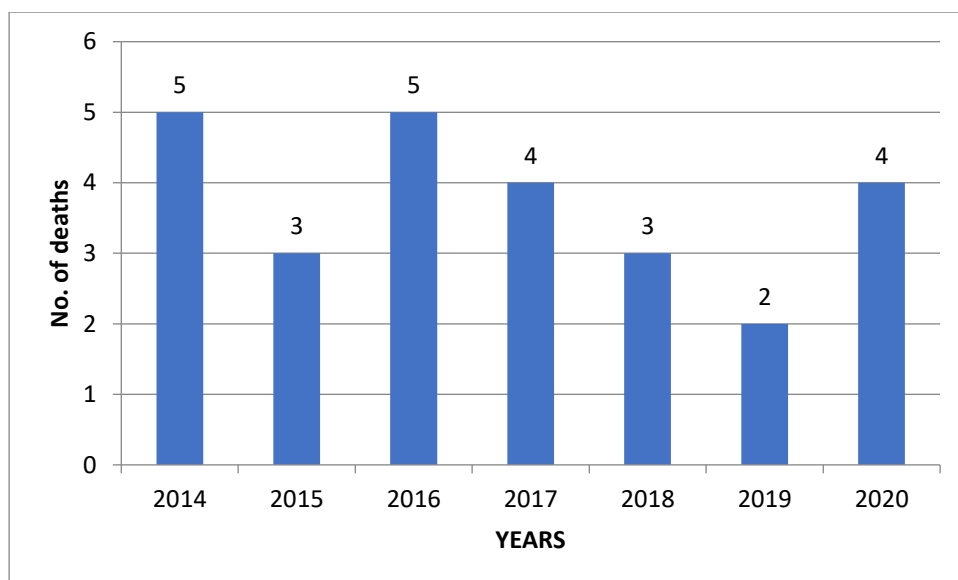


Fig : 3.20 : Total no. of death from the year [2014 – 2020] at Bapatla Highway.

- From the fig : 3.20, one can inferred that total no. of deaths has increasing and decreasing on average every year.

2. CLASSIFICATION OF ROAD ACCIDENT BASED UPON “PLACE OF OCCURRENCE”

Table : 3.7 : Place of occurrence wise classification

Sl. No.	year	Murthyaksh a nagar, gbc road, bapatla town	Opp. To new bus stand gbc road, bapatla town	Near market yard, bapatla town	Near tvs showroom Karlapalem Road, bapatla town	Opp. To old bus stand gbc road, bapatla town
1	2014	2	4	4	3	5
2	2015	3	5	4	2	4
3	2016	3	6	5	2	6
4	2017	1	3	3	4	3
5	2018	3	7	4	2	5
6	2019	2	5	3	4	4
7	2020	4	8	2	3	6

From the table : 3.7, one can inferred that opposite to new bus stand gbc road, bapatla town has caused maximum no. of accidents which are 38 respectively. The graphical variation of the above given cause is as follows.

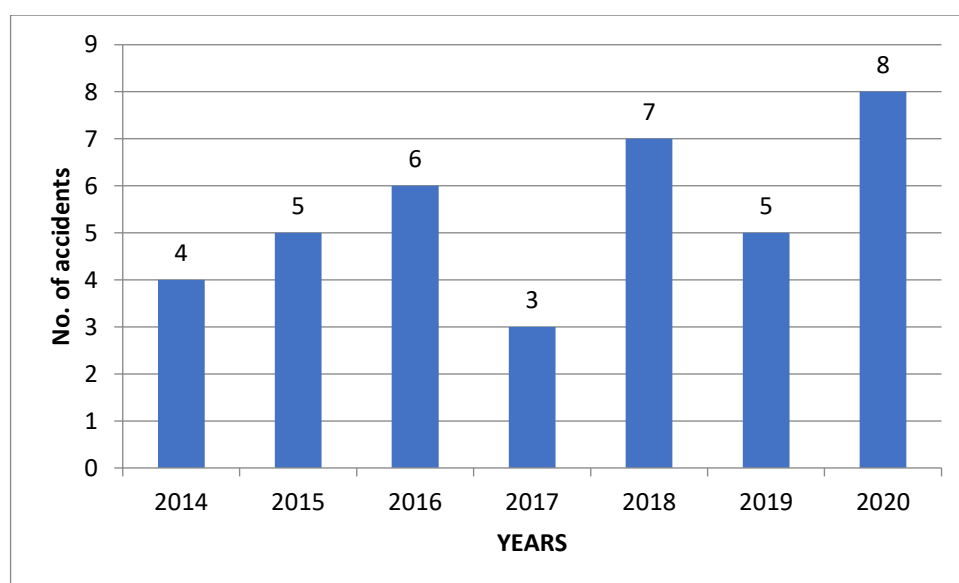


Fig : 3.21 : Total no. of accidents from the year [2014 – 2020] at opp. to new bus stand, gbc road Bapatla highway.

- From the fig : 3.21, one can inferred that maximum no. of accidents occurred at opposite to new bus stand, gbc road Bapatla from the year [2014 – 2020].

3. CLASSIFICATION OF ROAD ACCIDENTS BASED UPON “TIME OF OCCURRENCE”

Table : 3.8 : Time of occurrence wise classification

year	00:00-03:00 hrs	03:00-06:00 hrs	06:00-09:00 hrs	09:00-12:00 hrs	12:00-15:00 hrs	15:00-18:00 hrs	18:00-21:00 hrs	21:00-00:00 hrs
2014	2	3	4	3	5	4	4	5
2015	1	3	3	6	7	5	5	5
2016	2	1	7	4	7	6	5	6
2017	1	3	3	4	6	5	6	6
2018	2	2	4	5	9	8	5	4
2019	2	3	2	6	5	4	7	5
2020	3	4	3	2	7	4	5	7

From the table : 3.8, one can inferred that 12:00 – 15:00 hours has caused maximum no. of accidents which are 46 respectively. As per collected data maximum no. of accidents occurred during day time. The graphical variation of the above given cause is as follows.

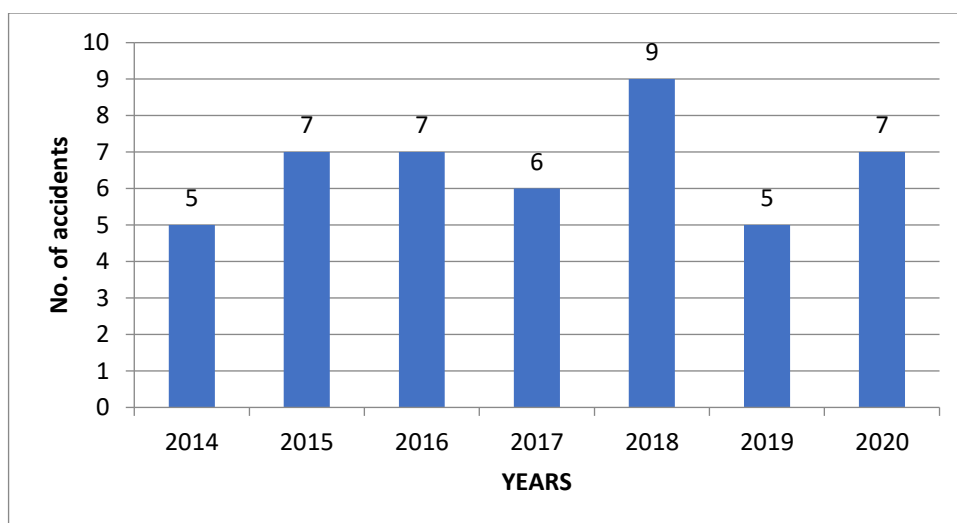


Fig : 3.22 : Total no. of accidents at Bapatla Highway from the year [2014 – 2020] at 12:00 – 15:00 Hours.

- From the fig : 3.22, one can inferred that maximum no. of accidents Occurred at 12:00 – 15:00 hours from the year [2014 – 2020].

4. CLASSIFICATION OF ROAD ACCIDENTS BASED UPON “MONTH OF OCCURRENCE”

Table : 3.9 : month of occurrence wise classification

month	year						
	2014	2015	2016	2017	2018	2019	2020
January	2	3	2	3	3	2	5
February	4	2	6	3	3	1	6
March	3	5	3	2	4	2	2
April	1	2	5	2	2	3	2
May	2	2	5	3	3	1	2
June	1	4	5	2	4	9	2
July	3	3	2	2	3	7	2
August	3	2	2	2	9	4	2
September	1	2	1	5	2	3	2
October	5	2	2	2	2	3	3
November	2	5	3	3	2	2	3
December	3	3	2	5	2	3	4

From the table : 3.9, one can inferred that june and february has caused maximum no. of accidents which are 27 and 25 respectively. The graphical variation of the above given cause is as follow.

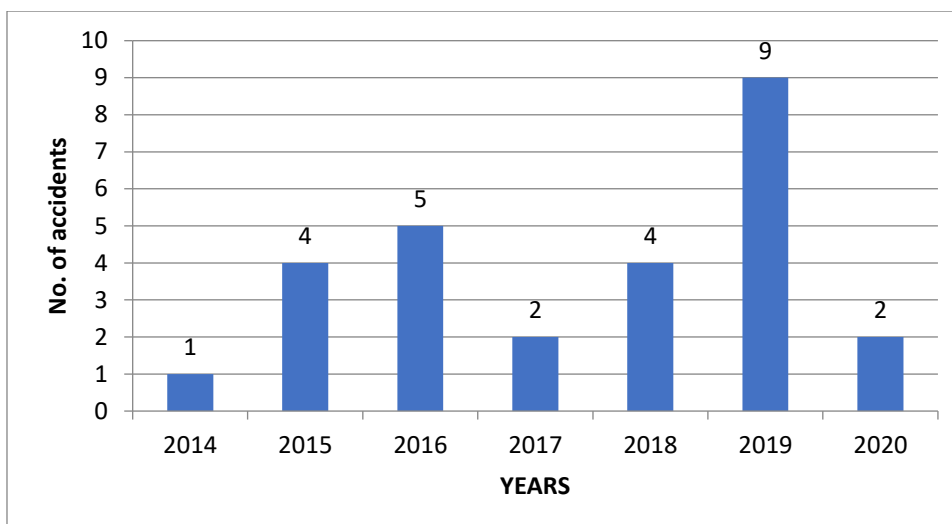


Fig : 3.23 : Total no. of accidents at Bapatla Highway from the year [2014 – 2020] in the Month of June.

- From the fig : 3.23, one can inferred that maximum no. of accidents occurred at june month from the year [2014 – 2020].

5. CLASSIFICATION OF ROAD ACCIDENTS BASED UPON “MODE OF VEHICLES”

Table : 3.10 : mode of vehicles wise classification

year	Truck / lorry / bus			Car / jeep			Two wheeler		
	offender s	victim s	tota l	offender s	victim s	tota l	offender s	victim s	tota l
2014	2	3	5	3	4	7	11	4	15
2015	4	6	10	5	3	8	5	7	12
2016	3	2	5	7	2	9	12	8	20
2017	2	3	5	9	3	12	7	8	15
2018	1	1	2	5	7	12	13	8	21
2019	2	1	3	7	4	11	9	8	17
2020	2	2	4	5	4	9	5	14	19

year	tractor			Three wheeler / auto rickshaw			Other motor vehicles		
	offender s	victim s	total	offender s	victim s	total	offender s	victim s	total
2014	0	1	1	1	1	2	0	0	0
2015	1	1	2	1	2	3	0	0	0
2016	1	0	1	2	1	3	0	0	0
2017	0	0	0	1	1	2	0	0	0
2018	1	1	2	1	1	2	0	0	0
2019	1	1	2	1	0	1	0	0	0
2020	0	1	1	1	1	2	0	0	0

From the table : 3.10, one can inferred that two wheelers has caused maximum no. of accidents which are 119 respectively. The graphical variation of the above given cause is as follows.

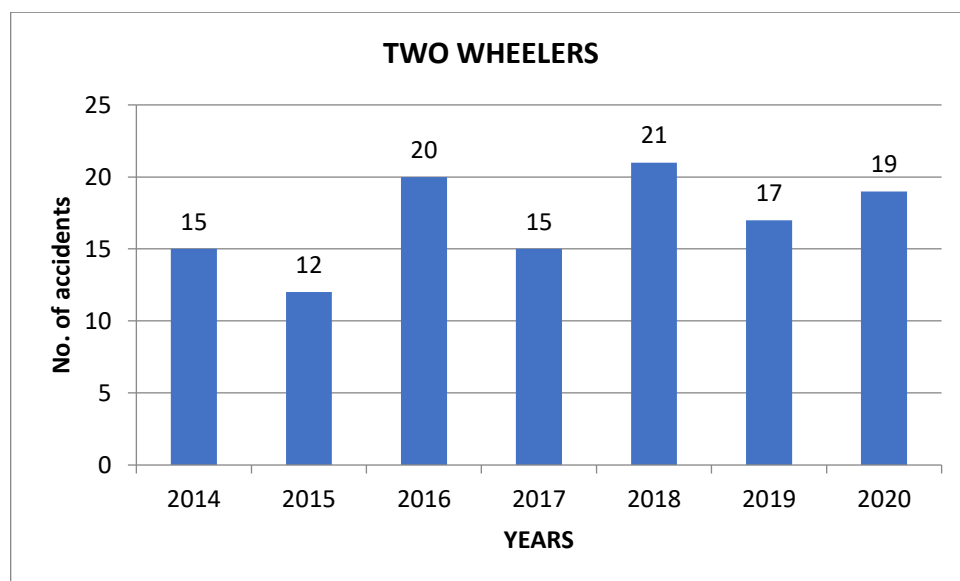


Fig : 3.24 : Total no. of Two Wheelers involved in accidents at Bapatla Highway from the year [2014 – 2020].

- From the fig : 3.24, one can inferred that maximum no. of accidents occurred by two wheelers from [2014 – 2020].

6. “INJURIES AND FATALITIES” DUE TO ROAD ACCIDENTS

Table : 3.11 : injuries and fatalities

ROAD ACCIDENTS			
Year	No. of accidents	injured	died
2014	30	23	10
2015	35	31	7
2016	38	28	12
2017	34	26	9
2018	39	42	8
2019	34	29	7
2020	35	28	9

From the table : 3.11, one can inferred that total no. of accidents, no of injuries and no of deaths has occurred in the year 2018. The graphical variation of the above given cause is as follows.

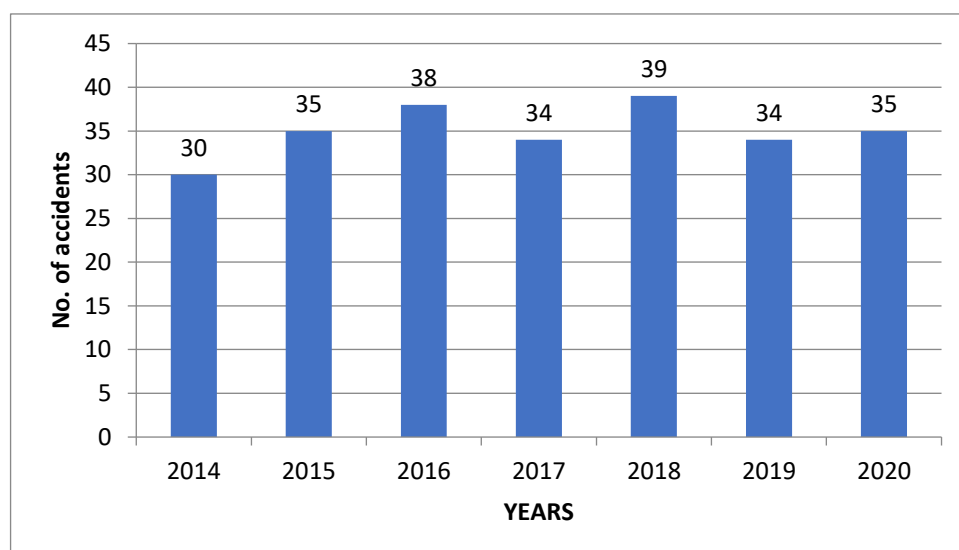


Fig : 3.25 : Total no. of accidents at Bapatla Highway from the year [2014 – 2020].

- From the fig : 3.25, one can inferred that total no. of accidents as increasing and decreasing on average of every year. Maximum no. of accidents has occurred in the year 2018.

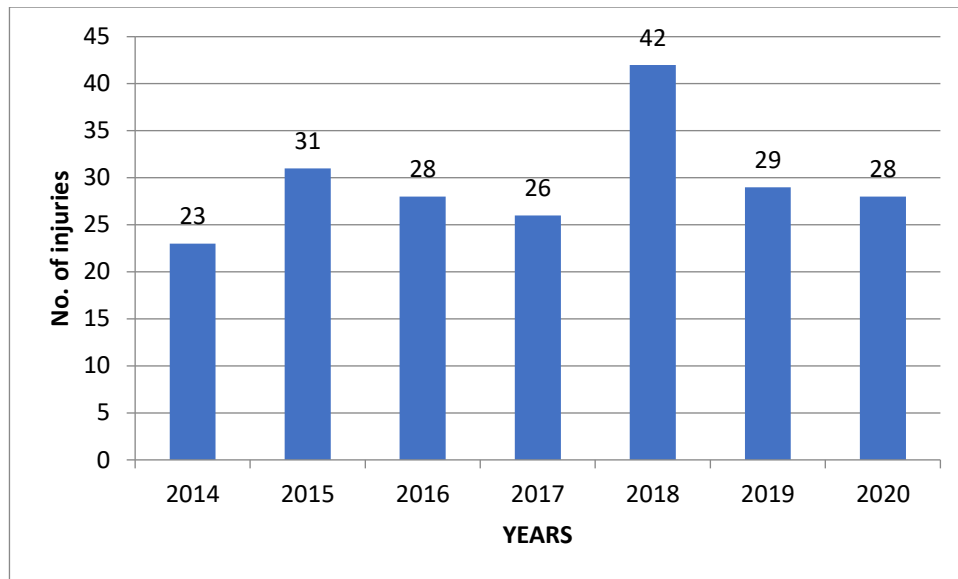


Fig : 3.26 : Total no. of injuries at Bapatla Highway from the year [2014 – 2020].

- From the fig : 3.26, one can inferred that total no. of injuries increasing and decreasing on average of every year. Maximum no. of injuries has occurred in the year 2018.

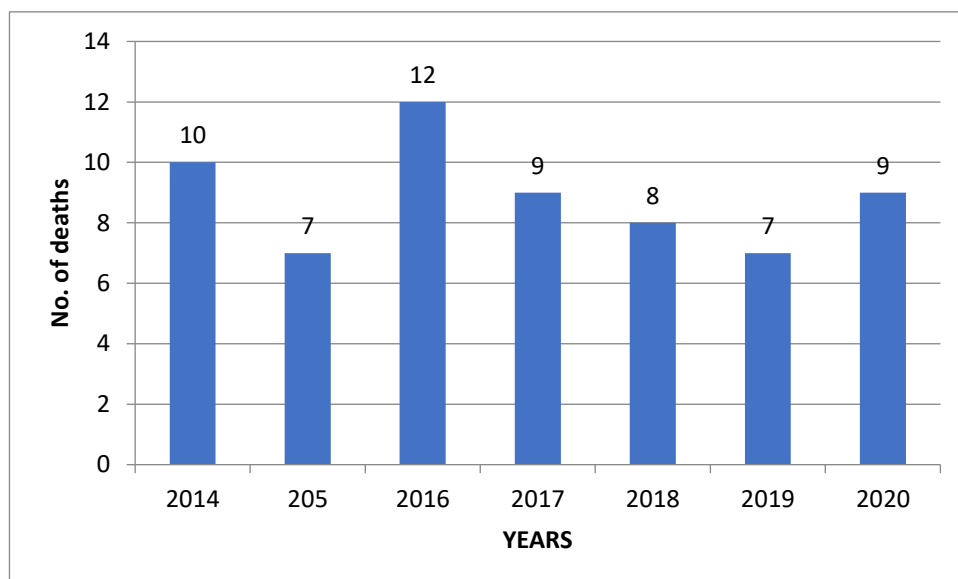


Fig : 3.27 : Total no. of deaths at Bapatla Highway from the year [2014 – 2020].

- From the fig : 3.27, one can inferred that total no. of deaths increasing and decreasing on average every year. Maximum no. of deaths as occurred in the year 2016.

CHAPTER 4

DATA ANALYSIS AND FORECASTING MODEL

4.1 GENERAL

This chapter would discuss about the data analysis and forecasting that was gleaned from the observation that was carried out to collect the required data. After doing an analysis to the data, that can be determine that total no. of accidents, no. of injuries, no. of deaths, place of occurrence, month of occurrence, time of occurrence, type of vehicles, cause of occurrence happened in bapatla town.

4.2 DATA ANALYSIS

The details gathered represents the point of view of the reporting officer. According to the literature analysis, accidental evidence obtained from the police station is not full information and not all incidents are reported in their F.I.R [first information report].

In this study accidental data were analyzed, using the software Microsoft excel. The below is the format of the data received from the police station:

- 1) "Cause of total number of accidents" year wise classification of roads.
- 2) Classification of road accidents based upon, "place of occurrence".
- 3) Classification of road accidents based upon, "Time of occurrence".
- 4) Classification of road accidents based upon, "Month of occurrence".
- 5) Classification of road accidents based upon, "Mode of vehicles".
- 6) "Injuries and fatalities" due to road accidents.

1) “CAUSE OF TOTAL NUMBER OF ACCIDENTS” YEAR WISE CLASSIFICATION OF ROAD

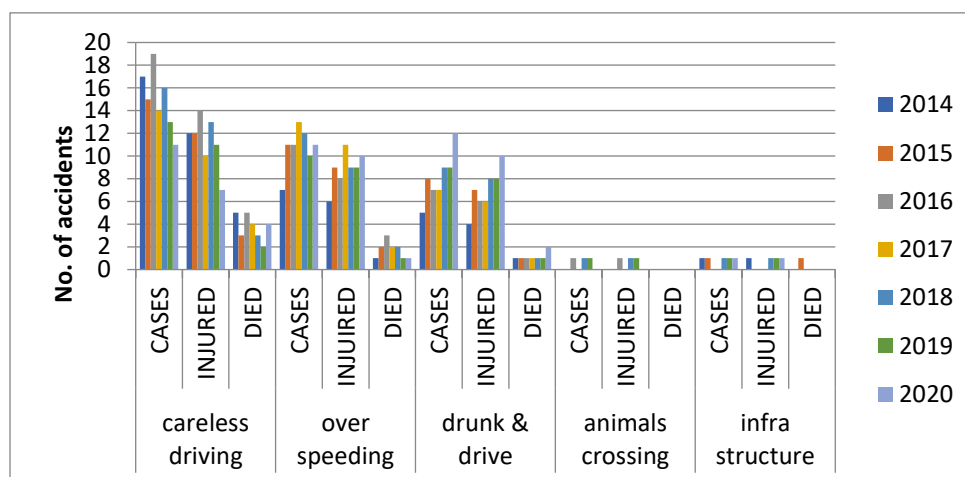


Fig : 4.1 : Total no. of accidents from the year [2014 – 2020] at Bapatla Highway

From the fig : 4.1, one can inferred that total no. of accidents, total no. of injuries, total no. of deaths has occurred due to careless driving and over speeding from [2014 – 2020]. From the fig : 4.1, it is inferred that total no. of accident, total no. of injuries, total no. of deaths has increasing and decreasing on average of every year. More no. of accidents, no. of injuries and no. of deaths occurring at bapatla due to careless driving which are 105, 79 and 26 respectively.

2) CLASSIFICATION OF ACCIDENTS BASED UPON “PLACE OF OCCURRENCE”

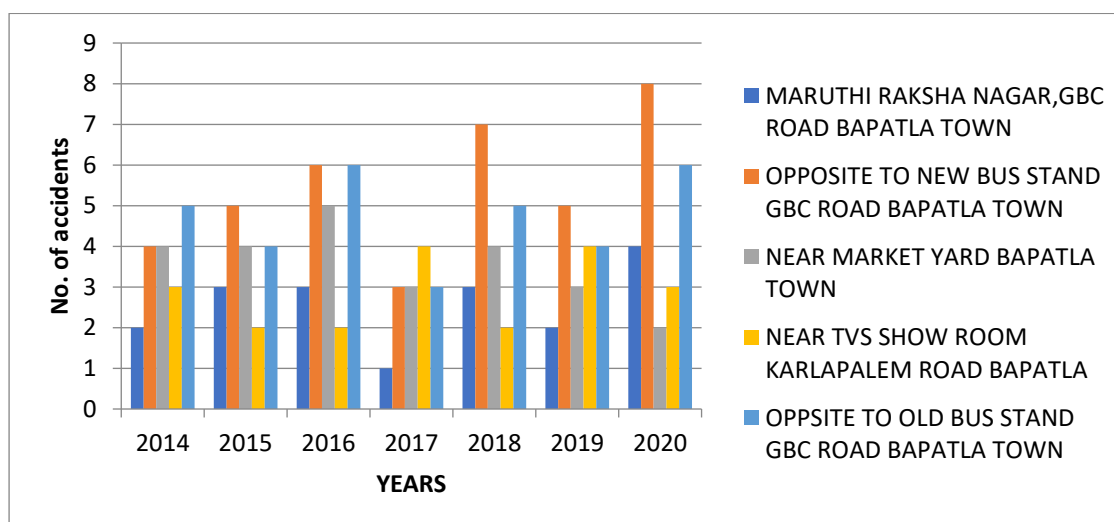


Fig : 4.2 : Total no. of accidents at Bapatla Highway from the year [2014 – 2020] at various places.

From the fig : 4.2, one can inferred that total no. of accidents has occurred at opposite to new bus stand, gbc road, bapatla town and market yard road from [2014 – 2020]. From the fig : 4.2 it is inferred that total no. of accidents has increasing and decreasing on average of every years. More no. of accidents has occurred at opposite to new bus stand, gbc road, Bapatla town.

3) CLASSIFICATION OF ACCIDENTS BASED UPON “TIME OF OCCURRENCE”

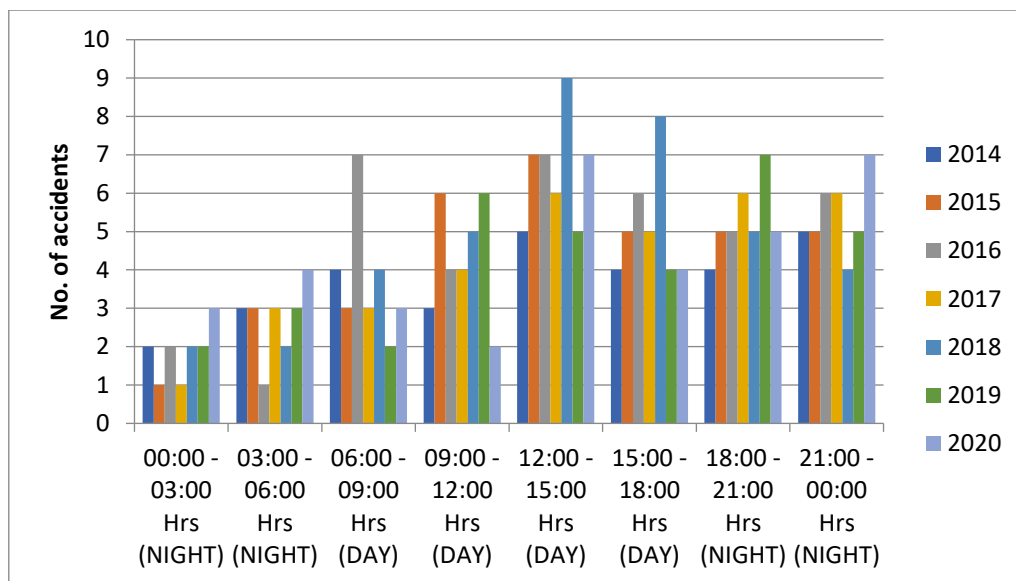


Fig : 4.3 : Total no. of accidents at Bapatla Highway from the year [2014 -2020] at various timings.

From the fig : 4.3, one can inferred that total no. of accidents has occurred at 12:00 – 15:00 hours and 18:00 – 21:00 hours from [2014 – 2020]. From the fig :4.3 it is inferred that total no. of accidents has increasing and decreasing on average of every year. More no. of accidents occurred at 12:00 – 15:00 hours (day time).

4) CLASSIFICATION OF ACCIDENTS BASED UPON “MONTH OF OCCURRENCE”

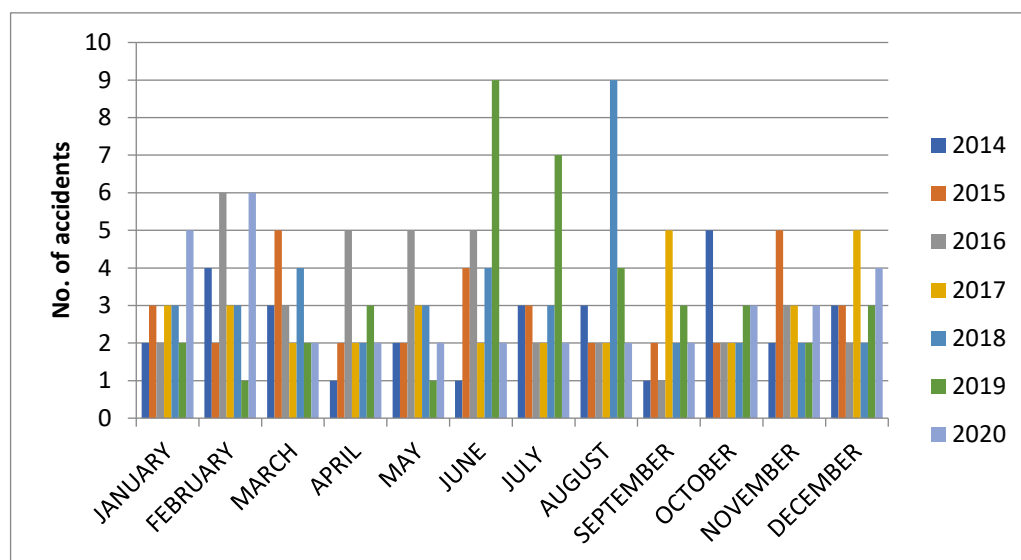


Fig : 4.4 : Total no. of accidents at Bapatla Highway from the year [2014 – 2020] at various months.

From the fig : 4.4, one can inferred that total no. of accidents has occurred in june and august month from the year [2014 – 2020]. From the fig :4.4, it is inferred that total no. of accidents has increasing and decreasing on average of every year. More no. of accidents occurred at june month which are 27 respectively.

5) CLASSIFICATION OF ACCIDENTS BASED UPON “MODE OF VEHICLES”

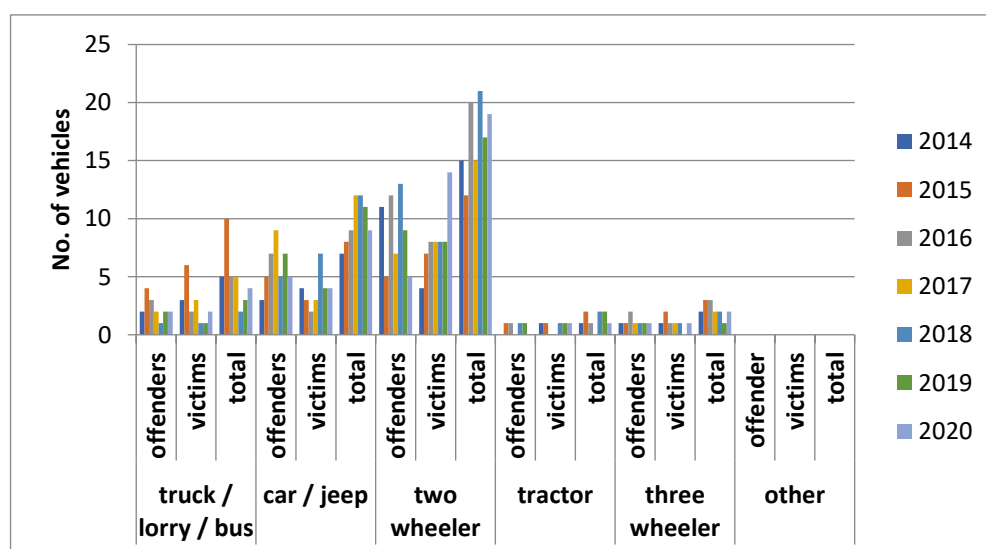


Fig : 4.5 : Total no. of vehicles involved in accidents at Bapatla Highway from the year [2014 – 2020].

From the fig : 4.5, one can inferred that total no. of accidents has occurred by two wheelers, cars and jeeps from [2014 – 2020]. From the fig : 4.5, it is inferred that total no. of accidents has increasing and decreasing on average of every year. More no. of accidents occurred by two wheelers which are 119 respectively.

6) “INJURIES AND FATALITIES” DUE TO ROAD ACCIDENTS

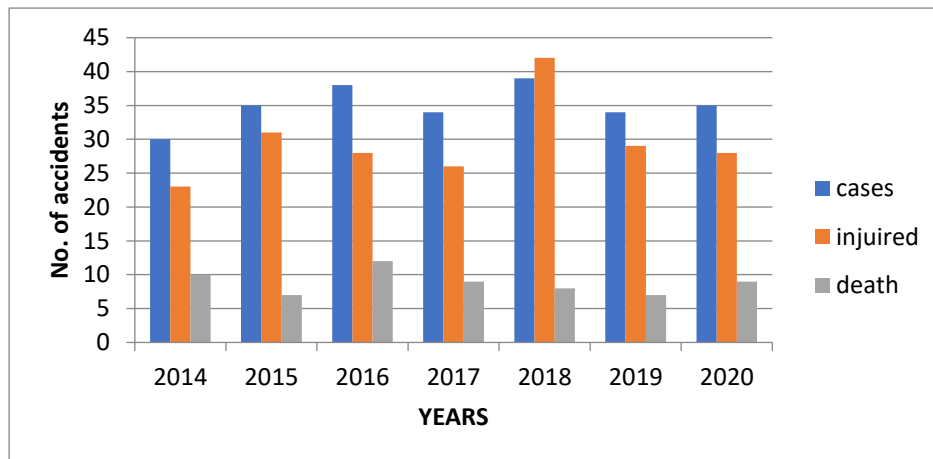


Fig : 4.6 : Total no. of injuries and fatalities occurring from the year [2014 – 2020]

From the fig : 4.6, one can inferred that total no. of injuries and fatalities occurred in the year 2016 and 2018. From the fig : 4.6, it is inferred that total no. of injuries and fatalities has increasing and decreasing on average of every year. More no. of injuries and fatalities occurred in the year 2018.

4.3 FORECASTING DATA

4.3.1 Forecasted data for year [2021 – 2035] :

Forecasting is a methodology that uses historical data as inputs to make well-informed forecasts about the course of future developments. Forecasting involves methods employing time series, cross - sectional or longitudinal data. Risk and uncertainty are central to forecasting.

4.3.2 Quantitative forecasting :

Quantitative forecasting models are used to construct a potential outlook based on historical evidence. They are suitable to use because numerical evidence from the past is available, and it is reasonable to expect some of the data patterns to repeat in the future.

- Prior to the forecasting of the data, the data needs to be interpolated.
- Hence, the forecasted data or projections are hypothetical.
- Interpolation – In the mathematical field of numerical analysis, interpolation is a type of estimation, a method of constructing new data points within the range of a discrete set of known data points.
- **Formula used –**

LINEAR INTERPOLATION

$$y = y_1 + (x - x_1) \frac{y_2 - y_1}{x_2 - x_1}$$

Here,

X1 – Year 1

Y1 – accidents cases for the respective year (x1)

X2 – Year 2

Y2 – accident cases for the respective year (x2)

X – Year 3

Y(unknown) – accident cases for respective year (x)

4.3.3 Exponential smoothing :

The exponential window function is used to smooth time series data in exponential smoothing. This method is suitable for forecasting data with no clear trend or seasonality. In this case, the seasonality of the accident data does not show, any clear trend. The data fluctuates with respect to the time.

4.3.4 Forecasting procedure :

Here the forecasting for the upcoming 15 years (2021 – 2035) is carried out using software Microsoft excel 2019. The command used for the forecasting is

4.3.5 Syntax :-

FORECASTING.ETS(target_data, values, timeline, [seasonality], [data_completion], [aggregation]).

It uses the AAA variant of the exponential smoothing (ETS) algorithm to approximate or forecast a potential value dependent on existing(historical) values. The expected value is a continuation of the specified target data's historical values, which should match the timeline. This feature can be used to estimate projected revenue, inventory needs, or market patterns.

4.3.6 Arguments of syntax :-

Target _data – The data point for which you want to predict a value.

Values – values are the historical values, for which you want to forecast the next Points.

Timeline – the independent array or range of numeric data. The steps between the dates in the timeline must be consistent and cannot be zero.

Seansonality – A numeric value. For the forecast, Excel detects seasonality automatically and uses a positive, whole number for the length of the seasonal pattern, with the default value of 1. The forecast must be linear and there is no seasonality.

Data completion – Since the timeline necessitates a continuous period between data points, FORECAST.ETS will automatically compensate for up to 30% missing data.

Aggregation – FORECAST.ETS will blend multiple points with the same time stamp, unlike the timeline, which requires a continuous phase between data points. The aggregation parameter is a numeric variable that determines how to integrate different values with the same time stamp.

The data which is occurred from forecasting model is in the following format

- 1) “Cause of total number of accidents” year wise classification of roads.
- 2) Classification of road accidents based upon, “place of occurrence”.
- 3) Classification of road accidents based upon, “Time of occurrence”.
- 4) Classification of road accidents based upon, “Month of occurrence”.
- 5) Classification of road accidents based upon, “Mode of vehicles”.
- 6) “Injuries and fatalities” due to road accidents

**1) “CAUSE OF TOTAL NUMBER OF ACCIDENTS” YEAR WISE
CLASSIFICATION OF ROAD**

Table : 4.1 : Cause – wise classification of accidents from the year [2021 – 2035]

years	Careless driving / over taking			Over speeding			Driving under influence of alcohol / drugs		
	No. of accidents	injured	died	No. of accidents	injured	died	No. of accidents	injured	died
2021	8	8	3	11	12	2	9	7	2
2022	10	6	3	10	10	4	7	6	3
2023	7	6	2	9	9	3	8	9	1
2024	3	2	4	12	12	1	6	5	2
2025	4	2	3	13	14	2	5	6	1
2026	5	2	2	8	9	3	7	9	3
2027	3	3	3	7	9	1	9	6	2
2028	4	2	4	13	15	3	7	9	1
2029	2	1	2	11	12	3	8	7	3
2030	6	2	1	9	10	5	6	7	1
2031	5	2	1	14	14	2	7	6	1
2032	3	3	1	11	13	4	8	9	3
2033	4	1	1	9	11	1	5	6	2
2034	5	2	1	13	14	1	6	5	1
2035	3	3	1	12	14	3	9	8	3

year	Animal crossing			Lack of the infrastructure			Vehicle parking at road shoulder		
	No. of accidents	injured	died	No. of accidents	injured	died	No. of accidents	injured	died
2021	1	1	0	1	1	1	0	0	0
2022	0	0	0	1	2	0	0	0	0
2023	1	1	0	2	2	0	0	0	0
2024	0	0	0	2	2	1	0	0	0
2025	0	0	0	1	2	0	0	0	0
2026	1	1	0	3	3	1	0	0	0
2027	1	1	0	3	3	0	0	0	0
2028	0	0	0	2	3	0	0	0	0
2029	0	0	0	3	4	1	0	0	0
2030	1	1	0	3	3	0	0	0	0
2031	0	0	0	3	3	0	0	0	0
2032	0	0	0	3	4	0	0	0	0
2033	1	1	0	4	4	1	0	0	0
2034	0	0	0	4	4	0	0	0	0
2035	0	0	0	4	5	0	0	0	0

From the table : 4.1, one can inferred that the maximum possible no. of accidents, no. of injuries and no. of deaths are due to the cause of over speeding which are 162, 178 and 38 respectively. The graphical variation of the above given cause is as follows.

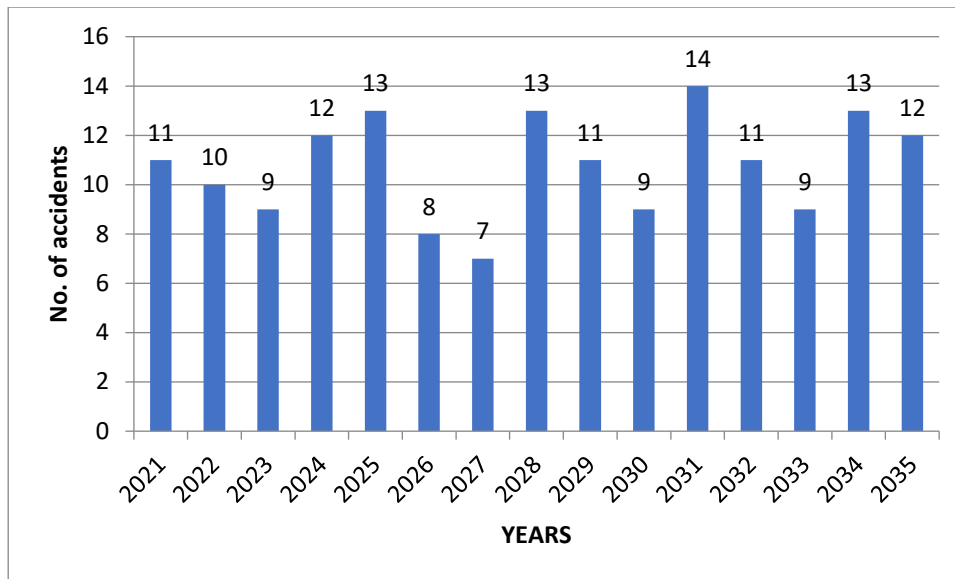


Fig : 4.7 : Total no. of possible accidents from the year [2021 – 2035] at Bapatla Highway.

- From the fig : 4.7, one can inferred that total no. of possible accidents has increasing and decreasing on average for every year.

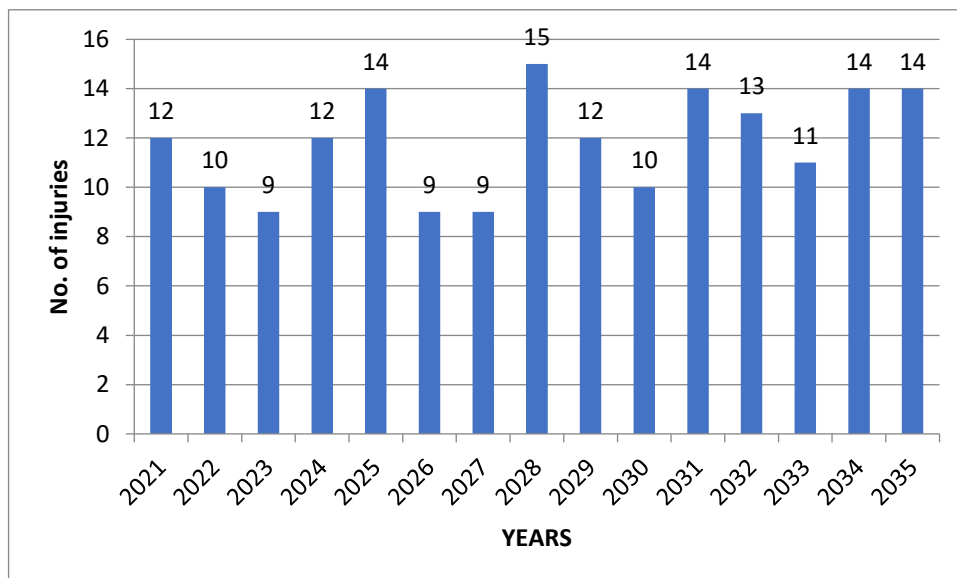


Fig : 4.8 : Total no. of possible injuries from the year [2021 – 2035] at Bapatla Highway.

- From the fig : 4.8, one can inferred that total no. of possible injuries has increasing and decreasing on average every year.

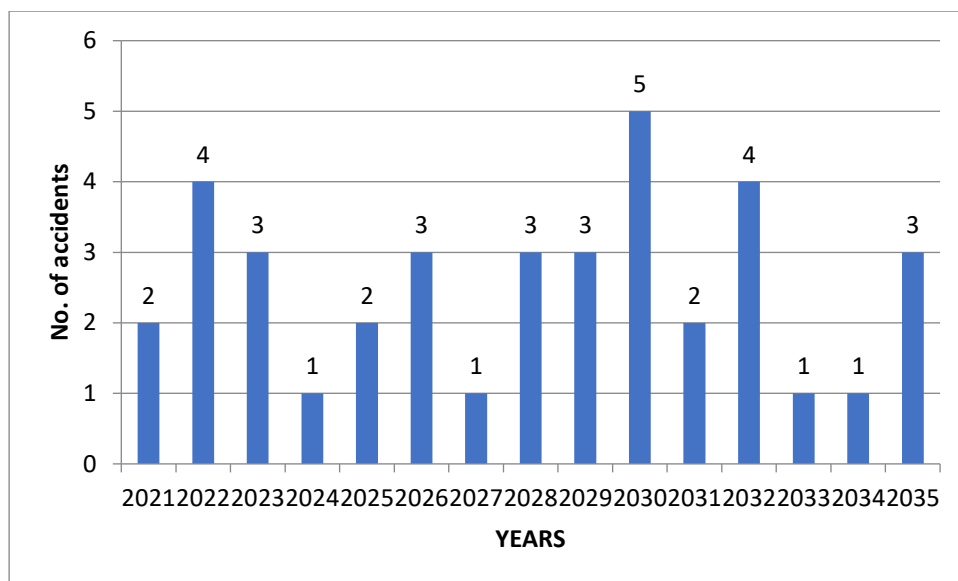


Fig : 4.9 : Total no. of possible death from the year [2021 – 2035] at Bapatla Highway.

- From the fig : 4.9, one can inferred that total no. of possible deaths has increasing and decreasing on average every year.

2) CLASSIFICATION OF ROAD ACCIDENT BASED UPON “PLACE OF OCCURRENCE”

Table : 4.2 : Place of occurrence wise classification of accidents

From the year [2021 – 2035]

Sl. No.	year	Murthyaraksh a nagar, gbc road, bapatla town	Opp. To new bus stand gbc road, bapatla town	Near market yard, bapatla town	Near tvs showroom Karlapalem Road, bapatla town	Opp. To old bus stand gbc road, bapatla town
1	2021	2	6	2	4	4
2	2022	4	9	3	4	6
3	2023	3	8	1	5	5
4	2024	7	14	5	2	9
5	2025	3	7	3	7	4
6	2026	6	12	3	3	7

7	2027	3	8	2	7	4
8	2028	11	22	6	1	13
9	2029	7	15	5	5	8
10	2030	7	14	4	5	8
11	2031	4	10	4	8	4
12	2032	11	23	5	2	13
13	2033	10	21	3	4	11
14	2034	11	23	4	3	13
15	2035	7	17	3	7	7

From the table : 4.2, one can inferred that maximum no. of possible accidents occurring at opposite to new bus stand gbc road, Bapatla. Which are 209 respectively. The graphical variation of the above given cause is as follows.

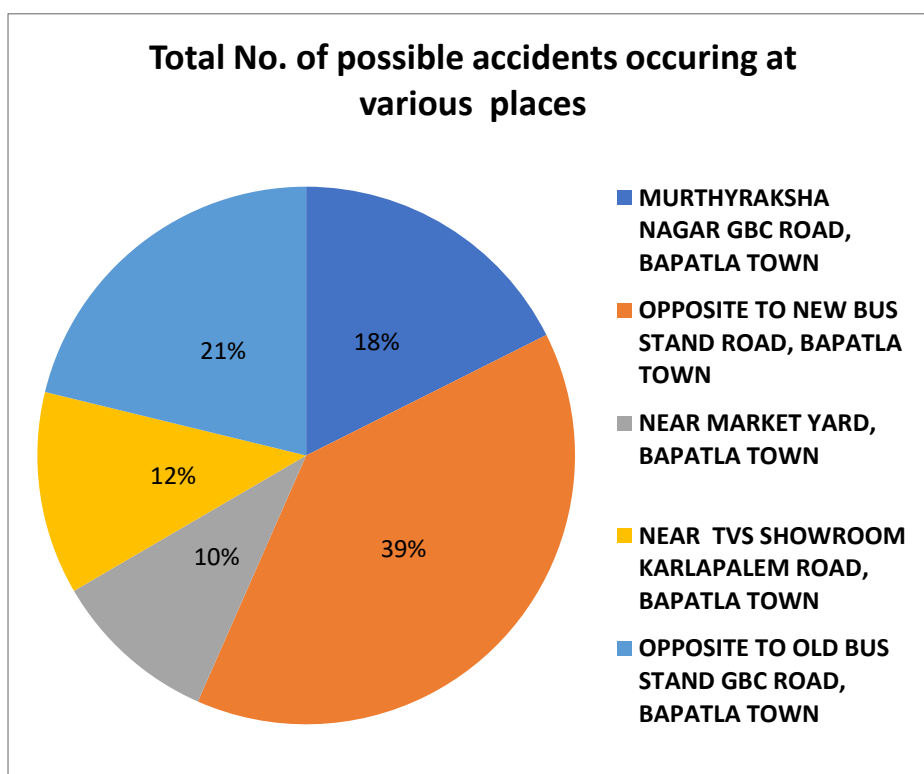


Fig : 4.10 : Total no. of possible accidents from the year [2021 – 2035] at various places.

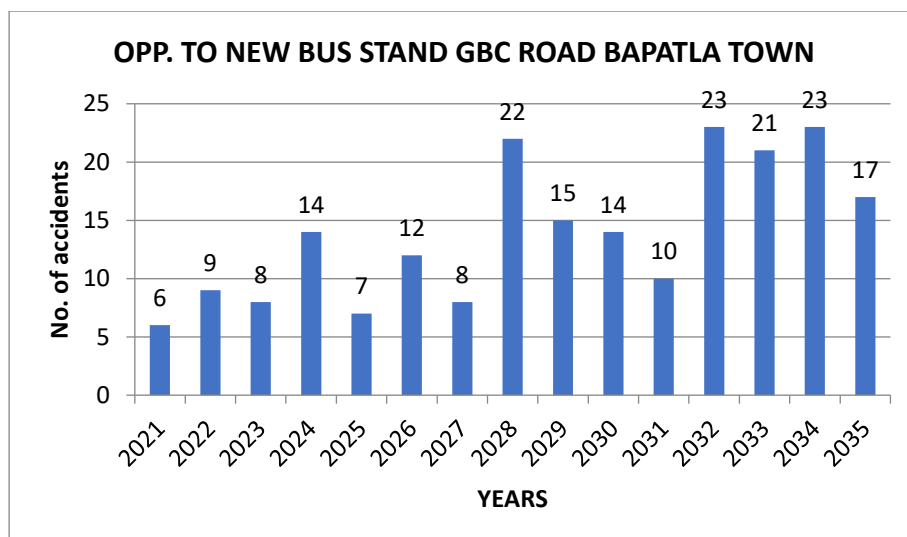


Fig : 4.11 : Total no. of possible accidents from the year [2021 – 2035] at opp. to new bus stand, gbc road bapatla

- From the fig : 4.11, one can inferred that maximum no. of possible accidents occurred at opposite to new bus stand gbc road, bapatla from [2021 – 2035].

3) CLASSIFICATION OF ROAD ACCIDENTS BASED UPON “TIME OF OCCURRENCE”

Table : 4.3 : Time of occurrence wise classification of accidents from the year [2021 – 2035]

year	00:00-03:00 hrs	03:00-06:00 hrs	06:00-09:00 hrs	09:00-12:00 hrs	12:00-15:00 hrs	15:00-18:00 hrs	18:00-21:00 hrs	21:00-00:00 hrs
2021	3	3	3	2	6	6	7	6
2022	4	4	4	3	7	5	6	6
2023	4	5	3	3	8	6	8	7
2024	5	5	5	4	7	7	6	9
2025	4	5	4	4	6	8	8	7
2026	5	6	2	5	8	6	6	6
2027	6	7	3	4	9	5	8	10
2028	6	7	5	6	9	4	7	11
2029	6	8	4	6	12	4	9	8
2030	7	8	3	5	10	3	7	10

2031	8	8	2	7	11	4	9	12
2032	7	9	5	4	13	5	8	10
2033	8	9	4	4	12	4	10	11
2034	9	10	4	3	11	3	8	14
2035	9	10	5	5	13	5	10	12

From the table : 4.3, one can inferred that maximum no. of possible accidents occuring at 12:00 – 15:00 hours. Which are 142 respectively. As per collected data maximum no. of accidents occurred during day time. The graphical variation of the above given cause is as follows.

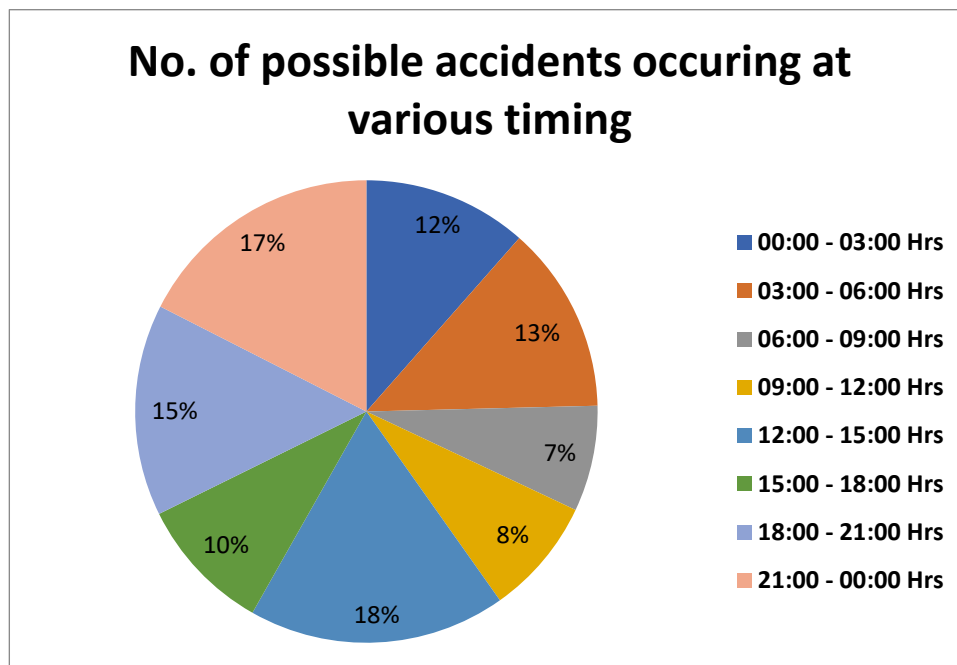


Fig : 4.12 : Total no. of possible accidents from the year [2021 – 2035] at various Timings.

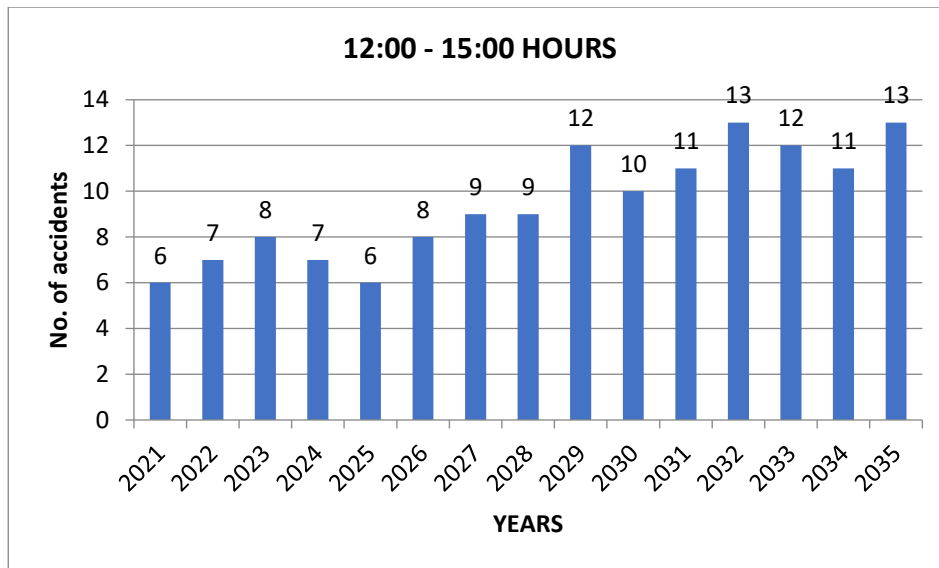


Fig : 4.13 : Total no. of possible accidents from the year [2021 – 2035] at 12:00 – 15:00 hours.

- From the fig :4.13, one can inferred that maximum no. of possible accidents Occurred at 12:00 – 15:00 hours from [2021 – 2035].

4) CLASSIFICATION OF ROAD ACCIDENTS BASED UPON “MONTH OF OCCURRENCE”

Table : 4.4 : month of occurrence wise classification of accidents from the year [2021 – 2035]

Month	Year						
	2021	2022	2023	2024	2025	2026	2027
January	3	5	4	5	4	6	5
February	4	5	5	6	6	7	6
March	2	1	2	1	1	1	1
April	3	1	2	1	2	2	1
may	2	1	3	3	4	3	2
June	6	8	7	9	7	9	8
July	4	6	5	5	6	6	7
August	5	4	4	2	3	3	3
September	4	2	3	2	4	2	3

October	3	4	4	4	4	4	5
November	2	2	2	3	2	2	2
December	4	4	5	5	5	5	6

Month	Year							
	2028	2029	2030	2031	2032	2033	2034	2035
January	6	5	7	6	7	6	8	7
February	8	8	9	9	10	10	12	11
March	2	3	2	2	3	2	4	3
April	3	1	2	2	3	4	2	3
May	2	3	3	2	4	3	6	4
June	7	8	7	9	6	10	8	11
July	7	8	7	9	8	9	8	10
August	2	2	1	1	1	2	1	3
September	2	3	2	3	2	3	2	3
October	5	5	5	6	6	6	7	7
November	3	2	3	2	2	3	3	3
December	6	6	6	7	7	8	7	8

From the table : 4.4, one can inferred that maximum no. of possible accidents occuring in june month. Which are 120 respectively. The graphical variation of the above given cause is as follow.

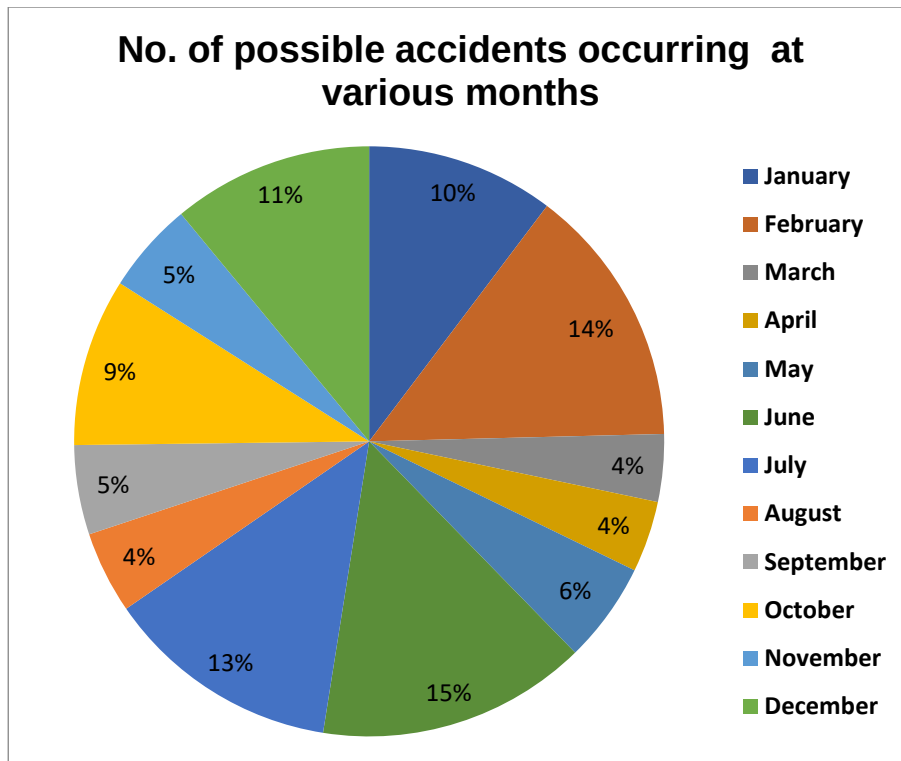


Fig : 4.14 : Total no. of possible accidents from the year [2021 – 2035] at various months

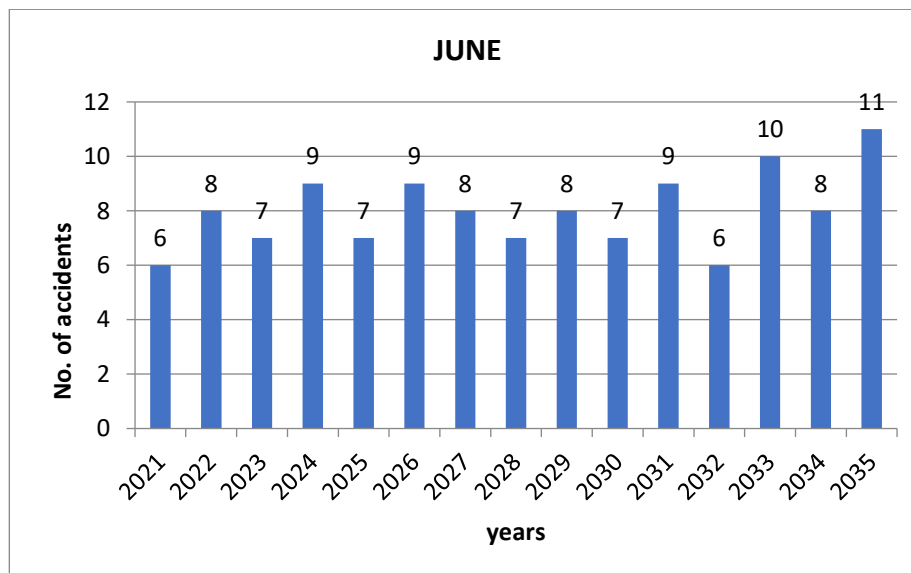


Fig : 4.15 : Total no. of possible accidents from the year [2021 – 2035] in the month of june

- From the fig : 4.15, one can inferred that maximum no. of possible accidents occurring at june month from [2021 – 2035].

5) CLASSIFICATION OF ROAD ACCIDENTS BASED UPON “MODE OF VEHICLES”

Table : 4.5 : mode of vehicles wise classification of accident from the year [2021 – 2035]

year	Truck / lorry / bus			Car / jeep			Two wheeler		
	offender s	victim s	total	offender s	victim s	total	offender s	victim s	total
2021	1	0	1	6	5	11	6	12	18
2022	1	1	2	6	6	12	8	14	22
2023	2	0	2	6	7	13	7	13	20
2024	1	1	2	5	6	11	9	11	20
2025	1	0	1	6	7	13	6	15	21
2026	1	0	1	6	8	14	11	14	25
2027	2	1	3	6	9	15	9	17	26
2028	1	0	1	6	8	14	5	13	18
2029	1	2	3	6	10	16	8	11	19
2030	1	0	1	6	11	17	7	16	23
2031	2	1	3	7	11	18	5	15	20
2032	1	0	1	6	12	18	6	17	23
2033	1	2	3	7	6	13	6	14	20
2034	2	0	2	6	14	20	5	13	18
2035	2	1	3	7	14	21	7	12	19

year	tractor			Three wheeler / auto rickshaw			Other motor vehicles		
	offender s	victim s	total	offender s	victim s	total	offender s	victim s	total
2021	1	0	1	1	1	2	0	0	0
2022	1	1	2	1	2	3	0	0	0

2023	2	1	3	2	1	3	0	0	0
2024	1	2	3	1	1	2	0	0	0
2025	1	1	2	1	1	2	0	0	0
2026	2	1	3	1	1	2	0	0	0
2027	1	2	3	2	2	4	0	0	0
2028	1	1	2	1	1	2	0	0	0
2029	1	1	2	1	1	2	0	0	0
2030	1	1	2	1	2	3	0	0	0
2031	1	2	3	1	1	2	0	0	0
2032	1	1	2	1	1	2	0	0	0
2033	1	1	2	2	1	3	0	0	0
2034	1	1	2	1	1	2	0	0	0
2035	1	1	2	1	1	2	0	0	0

From the table : 4.5, one can inferred that two wheelers has occurring maximum no. of possible accidents which are 312 respectively. The graphical variation of the above given cause is as follows.

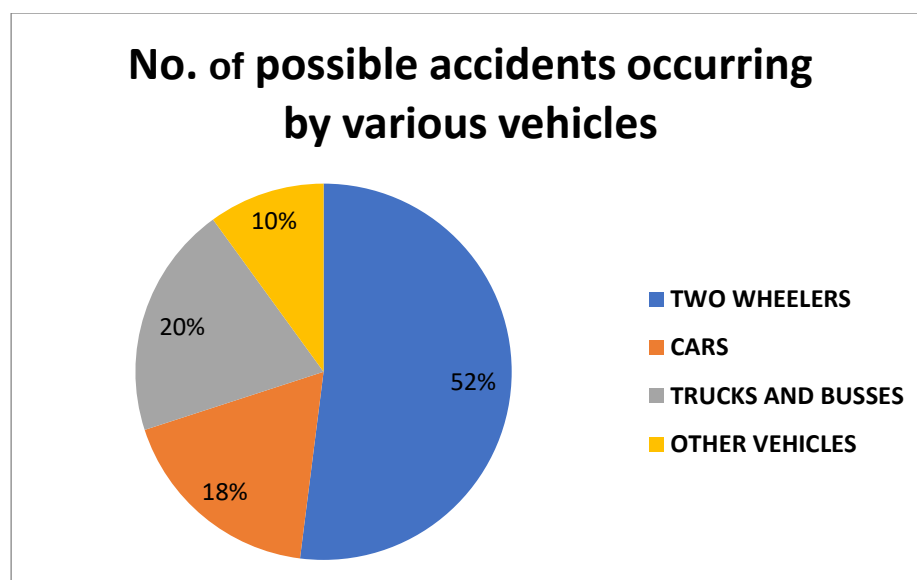


Fig : 4.16 : Total no. of possible accidents occurring from the year [2021 – 2035] by various vehicles.

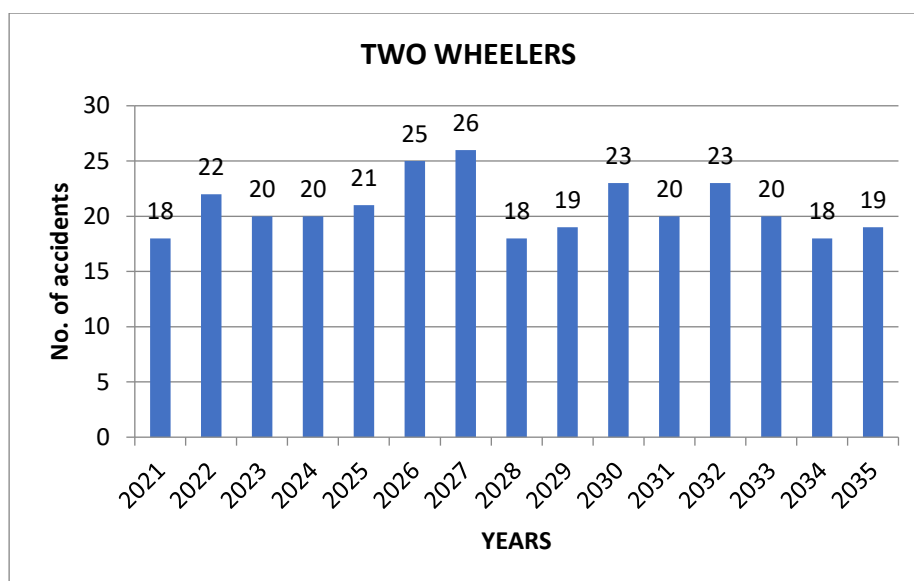


Fig : 4.17 : Total no. of possible accidents from the year [2021 – 2035] by Two Wheelers

- From the fig : 4.17, one can inferred that maximum no. of possible accidents occurring by two wheelers from [2021 – 2035].

6) “INJURIES AND FATALITIES” DUE TO ROAD ACCIDENTS

Table : 4.6 : injuries and fatalities of accidents from the year [2021 – 2035]

ROAD ACCIDENTS			
Year	No. of accidents	injured	died
2021	36	32	8
2022	35	32	8
2023	31	28	6
2024	34	24	8
2025	33	26	8
2026	30	29	5
2027	27	21	4
2028	32	15	9
2029	29	25	6
2030	24	19	3
2031	28	13	7
2032	27	17	6

2033	23	15	3
2034	24	8	5
2035	25	10	5

From the table :4.6, one can inferred that possible total no. of accidents, no. of injuries, and no. of deaths occurring in the year 2021. More no. of accidents occurring in the year 2021. The graphical variation of the above given cause is as follows.

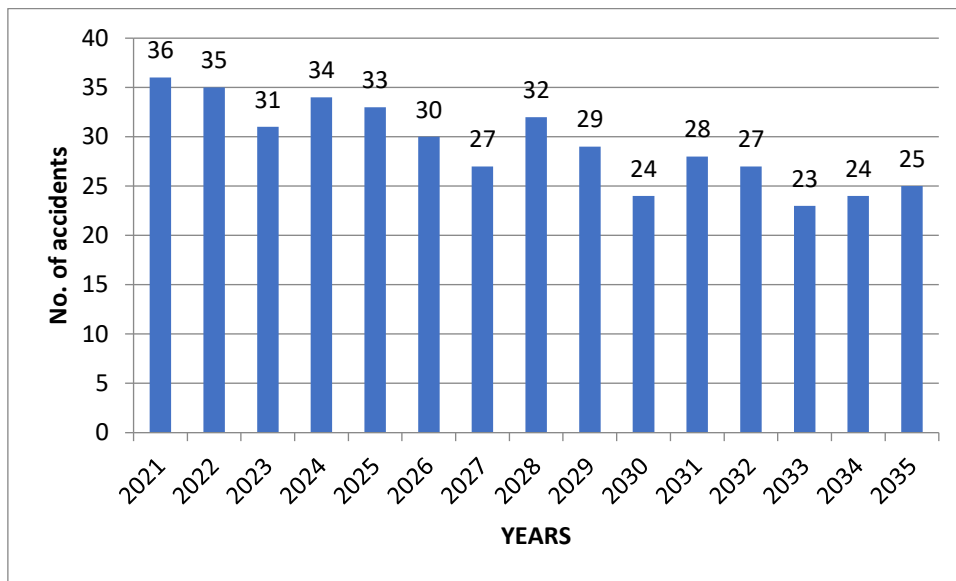


Fig : 4.18 : Total no. of possible accidents from the year [2021 – 2035]

- From the fig : 4.18, one can inferred that maximum no. of possible accidents occurring in the year 2021 and 2022.

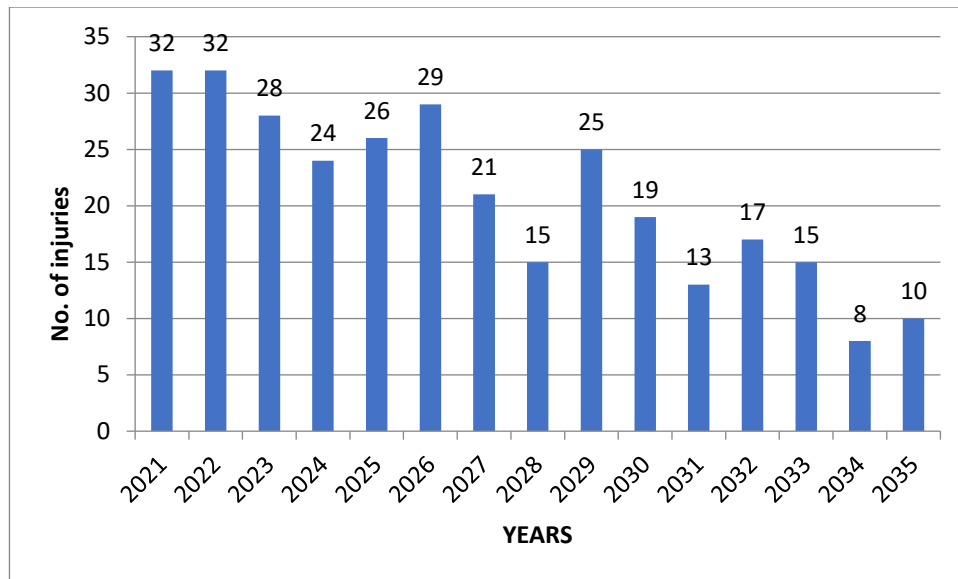


Fig : 4.19 : Total no. of possible injuries from the year [2021 – 2035]

- From the fig 4.19, one can inferred that maximum no. of possible injuries occurring in the year 2021 and 2022.

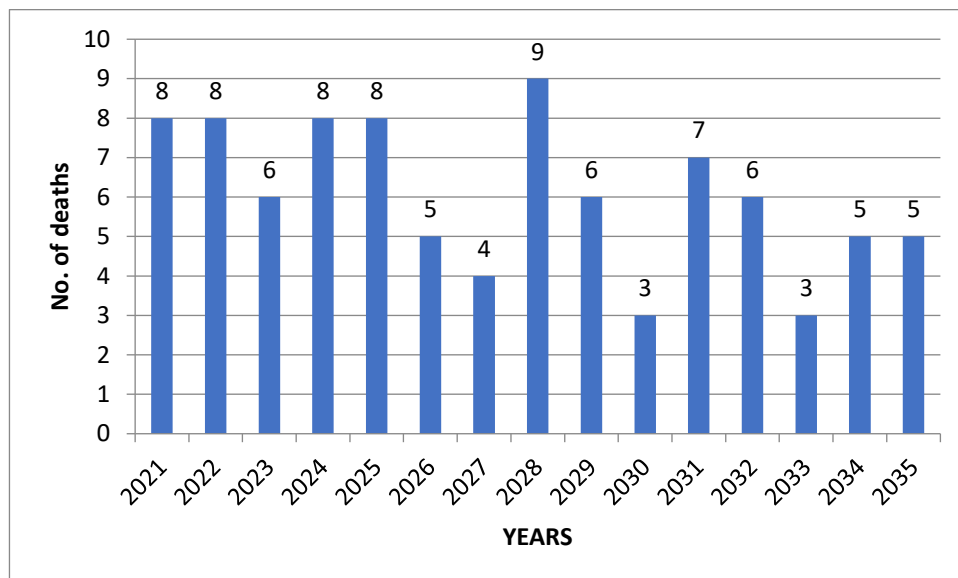


Fig : 4.20 : Total no. of possible death from the year [2021 – 2035]

- From the fig : 4.20, one can inferred that maximum no. of possible death occurring in the year 2028.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 GENERAL

The chapter describes the finding of the road accidents study at bapatla and the recommendations suggested for reducing the further accidents.

5.2 CONCLUSION

The finding of this study from the collected data :

- 1) There is no clear monthly trend in the number of accidents on a particular stretch of highway. However, more no. of accidents are happened in the months of June, July and August from the year [2014 – 2020]. It may be affected by rain-induced accelerated erosion of the earthen shoulder. Maximum no. of accidents happened in the month of june which are 27 accidents respectively.
- 2) Most of the accidents occurring at Bapatla Highway during day time at 12:00 – 15:00 hours from the year [2014 – 2020] accounting 46 cases of accidents respectively.
- 3) Most of the accidents happened at Bapatla Highway by two wheelers and cars from the year [2014 - 2020] which are 119 and 68 cases of accidents respectively.
- 4) More no. of accidents occurred at opposite to new bus stand GBC road at Bapatla Highway from the year [2014 – 2020] accounting 38 cases of accidents respectively.
- 5) The main record of cause of accidents is driver error.
- 6) Accidents occurring on straight stretches due to high speed.
- 7) High speeds and poor overtaking technique trigger head-on crashes.
- 8) Maximum casualties are in two wheelers followed by heavy trucks and cars.

The finding of this study from the forecasted data :

- 1) The forecasting model has provided a comprehensive data for accident cases projected for the year [2021 – 2035].
- 2) It involving various risk factors which can be responsible for the future accidents and hence based upon that we can find the possible mitigation measures for its prevention.
- 3) The pavement features and climate also play an important role in providing the mitigation measures.
- 4) The highest risk considering the causes is over speeding which is highest amongst all the other causes over a course of 15 years [2021 – 2035]. Which are 162,178 and 38 respectively.
- 5) Two wheelers are involved in maximum number of possible accidents in bapatla highway. it is observed that two wheelers involved in almost 52% accidents, followed by cars 18%, trucks 12%, busses 8% and tractors three wheelers and other vehicles 10%.
- 6) Most of the possible accidents occurring at Bapatla Highway by two wheelers from the year [2021 - 2035] accounting 312 cases of accidents respectively.
- 7) It is observed that maximum no. of possible accidents occurring at 12:00-15:00 hours and 21:00-00:00 hours which are 142 and 139 cases of accidents respectively.
- 8) It is observed that possible accidents comprises of 54%, injuries comprises of 35% and deaths comprises of 11% respectively at Bapatla Highway from the year [2021 - 2035].

5.3 RECOMMENDATIONS

road safety measures to be taken to reduce the possibility of accidents in bapatla are :

1) Provision of traffic control devices :- [sins, markings etc] :-

Wherever traffic control systems are needed, they should be installed to mitigate accidents caused by different road geometry problems. By conducting spot speed survey one can observe that the average speed of the vehicles at NH – 216

should be 55 – 60 kmph. So to reduce some accidents we have to keep marking board of speed limit 55 kmph [at road side].

2) Laying of bypass road :-

Bapatla is town where road traffic is high to divert or direct through traffic to other places a bypass should be constructed then there is change of getting accidents reduced.

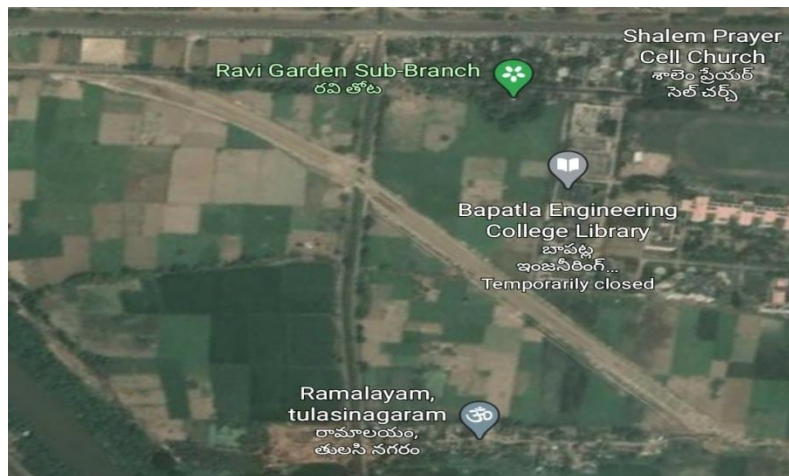


Fig : 5.1 : laying of bypass road

3) Installation of automatic electric traffic lights :-

At all busy crossings, there should be automated electric traffic signals, and certain traffic police officers should still be present to ensure that the computers do not jump the traffic lights.

4) Installation of medians :[if median is not there] :-

The use of road medians with flaring openings and pedestrian refuge islands would enhance pedestrian safety and reduce the number of accidents.

5) Shoulder improvement :-

Running off the road and head-on crashes can also be avoided.

6) Maintenance of road surface :-

Damaged road surfaces should be repaired as soon as possible to prevent vehicle body injury and disrupted traffic flow. As a result, the drivers become enraged and lose control.

7) Strict rules and regulations :-

Violators should be severely fined or even jailed, and their driver's licences should be cancelled if necessary. It is necessary to reduce the number of private cars, motor cycles and scooters and to increase the public buses.

8) Increase safety awareness of road users and driver training :-

When it comes to road users, safety consciousness is a key aspect to remember. The most important aspect in raising safety consciousness is driver instruction.

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ANNEXURE

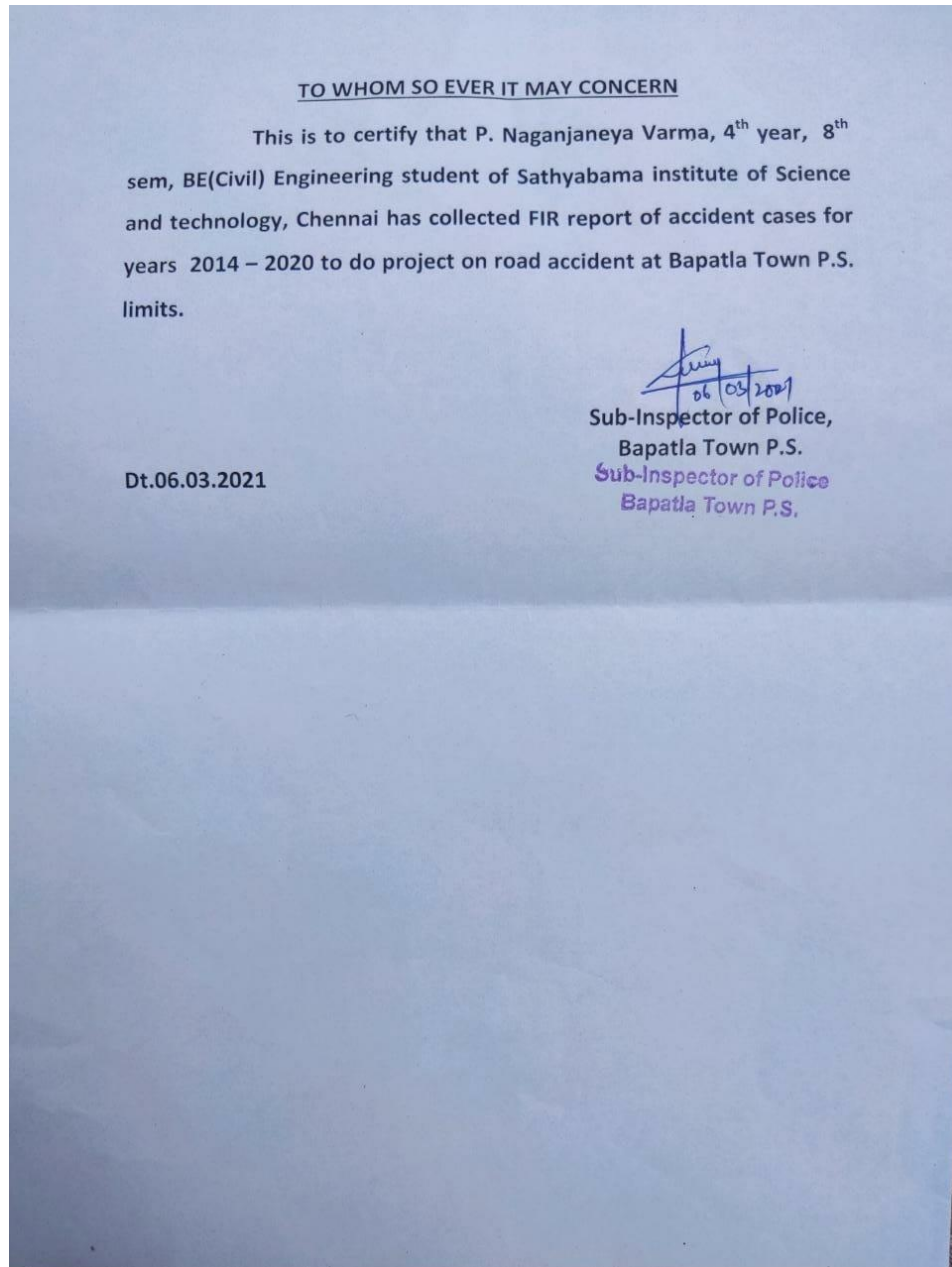


Fig.1: Copy of Acknowledgement for collection of Accident Data from Police Records