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Project Report on National Highways

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Abstract: ***In a National Highway project, the engineer has to plan, design and construct either a network of new roads or road link. Once a highway is constructed, development takes along the adjoining land and subsequent changes in alignment in geometric standards become very difficult. A badly aligned highway is not only a source of potential traffic hazard, but also causes a considerable increase in transportation cost and strain on the drivers and the passengers. Therefore, proper investigation and planning are most important in a road project, keeping in view the present day needs as well as the future development of the region.***

Transportation is responsible for the development of civilizations from very old times by meeting travel requirement of people and transport requirement of goods. In today's world, road and transport has become an integral part of every human being. However it is observed that fatalities have shot up by half in the last 10 years About 1.2 million Indians were killed in car accidents over the past decade; on average one every four minutes, while 5.5 million were seriously injured. In India National highways comprise 1.7% of total road network, but carry about 40% of road traffic which contribute to 29% of total road traffic accidents. The 34-km stretch of Mumbai-Bangalore highway in the Pune city limits has seen 110 fatal accidents in the last three years claiming 111 lives. Thus the primary aim of the project is to identify the accident black spots on National Highway-4 spanning 14.5Kms from New Katraj Tunnel to Chandani Chowk and to suggest remedial measures. The project concentrates on infrastructure errors and their combination with other types. An accident black spot is a term used in road safety management to denote place where road traffic accidents have been historically been concentrated. For finding out various causes of accidents, different methodologies adopted and to find out remedial measures, international journal papers were referred. Methodology adopted includes collecting the secondary data from respective authority, conducting physical survey (primary data) and analyzing them by method of ranking and severity index, accident density method, weighted severity index. Locations appearing in all the three methods were termed as black spots. Further corrective measures were suggested.

Keywords: Transportation, Road traffic accidents, Accident Black Spots, National Highway.

I. INTRODUCTION

According to the official statistics (National Crime Records Bureau), In India in 2008, 118,239 people were killed in road accidents. The death rate in India is about 10 to 20 time higher then high income countries like Japan, Australia, UK, and USA. In India the share of national highways and state highways is about 6 to 7 % of the total road networks but it cater to about 70 to 75% of total traffic. However in India only national highways comprises of only 2% of total road network, which account for 20% of total road accidents and 25% of total traffic fatalities.

The management of accident risk is both a short-term and a long-term strategy, which requires support of central and state authorities. The most effective way of managing accident risk is through the development of a 'safety culture'. A safety culture is the beliefs and ideas shared by all members of an organization about accidents and their risk of happening and proper measure which are to be taken to decrease in the number of accidents. The year wise road accidents in India are shown in the table given below Accident is an event, occurring suddenly, unexpectedly and inadvertently under unforeseen circumstances. An accident may be defined as a collision occurred on a way or street open to public traffic (The collisions may be between vehicles; between vehicles and pedestrians; between vehicles and animals; or between vehicles and geographical or architectural obstacles) resulting in killing or injuring of one or more persons and involvement of at least one moving vehicle. 'Accidents are not natural but they are caused' is a common cliché in the area of traffic safety. Thus if accidents are caused by some, surely the ones responsible for could be identified and appropriate remedial measures developed and implemented to the extent feasible. Accidents are not often caused due to ignorance, but due to carelessness thoughtlessness and over confident. Road accidents are associated with number of problems from person to the environment and vehicle the road, for proper study of the accidents each problem has to study separately. Due to growth in urbanization in many developing countries there is increase in the number of vehicles to a large extend

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which led to increase in traffic congestion in many urban centers which ultimately increase the number of accidents on road network which were never designed for these number of traffic and traffic type. Therefore the number of accidents is more in developing countries like India, Ghana as compared with developed countries like USA & Japan. The deaths per 1000 vehicles registered in some developing countries are shown in fig 1.1

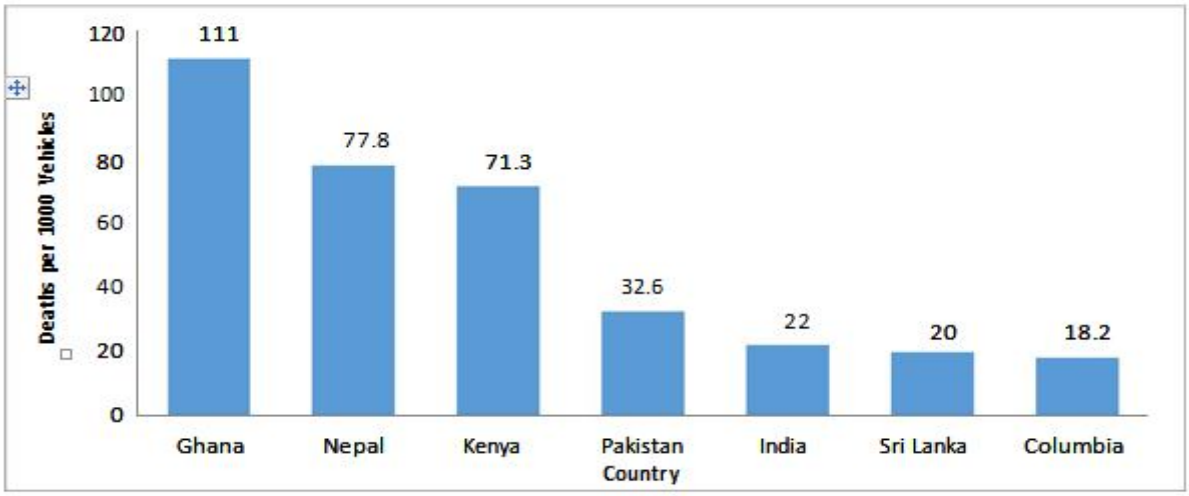

Fig1.1 Comparison of death/1000 vehicles among various developing countries (source-Accidental Deaths & Suicides in India Published by National Crime Records Bureau)

A. Accident scenario in India

The fast growth in the Road Transportation Sector in India has been a key element in the economic development of the country. But on the other hand this fast growth in Transportation Sector led in to increase in traffic accidents too. During 2008 India ranked fourth in the world among leading deaths due to accidents. In 2008 more than 1 lakh people die in road accidents and around 5 lakh people injured due to accidents in India. India's motor population is just 1% of the worlds but her share of the world traffic accident is 6%. Though the accident rate is decreased during the last 25 years due to awareness among people education and safety programmers but still the accident rate is very high as compared to the developed nations.

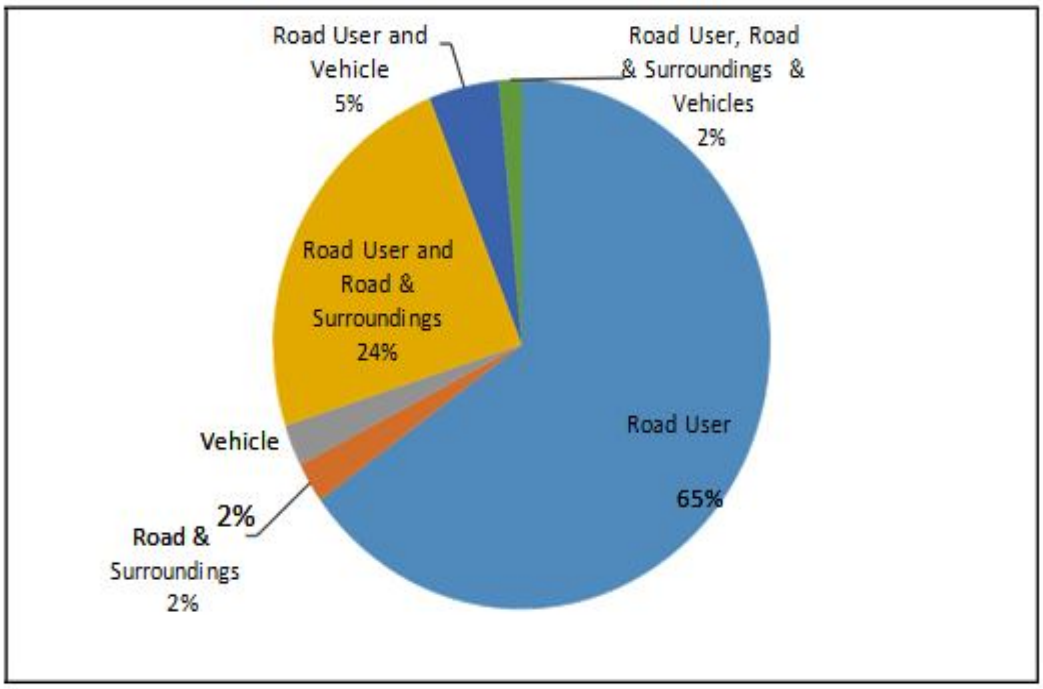

Fig 1.2 showing that most of accidents take place because of the fault of road user only(source-Accidental Deaths & Suicides in India Published by National Crime Records Bureau)

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B. Road Safety Audit

A road safety audit may be defined as an independent inspection of a future road project to identify anything that may affect the road's safety. A road safety audit is also a formal examination of proposed or existing roads and roads related areas from the perspective of all road users with the intension of identifying road safety deficiencies and areas of risk that could lead to road crashes. It does not consider crash history. The mostly commonly used definition of road safety audit as developed by transportation association of Canada is " a road safety audit is a formal and independent safety performance review of a road transportation project by an experienced team of safety specialists, addressing the safety of all road users. It is conducted by an independent qualified team of professionals. The primary objective of a road safety audit is to help in project for successfully achieving Safer Journeys and safe system approach- that is minimization of death and serious injury on the roads. The road safety audit brings in picture all the areas of the project that is not feasible with a safe system and brings those drawbacks to the attention of the client.

1) Elements of Road Safety Audit

a) It should always focuses on the safety aspects of the project.
b) It should be carried out by those professionals who are independent of the client, Designer or Contractor.
c) people carrying safety audit must have appropriate experience and training and who understand the safe system approach well
d) It should be a formal documented process.
e) All potential road users should consider in the audit.

2) Road safety audit is not intended to be

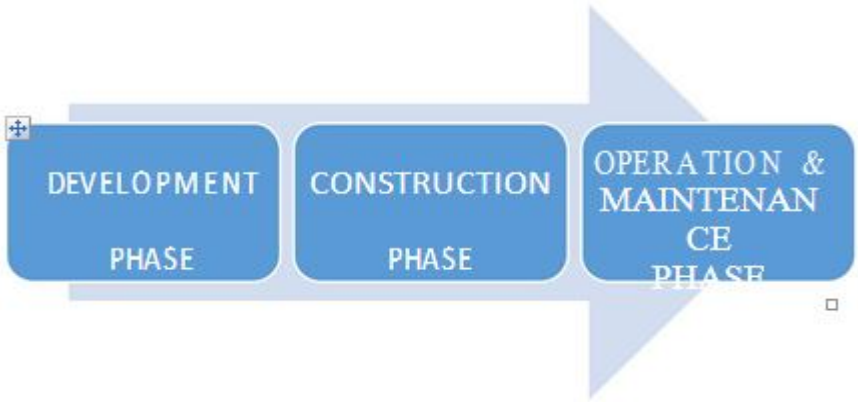
a) Replacement for a design review, a peer review or a quality control review.
b) A judgment of the quality of a project (as the project will likely have other components).
c) A means of ranking or comparing one project or option over another (although it may form part of the decision process).
d) A redesign of a project.
e) A check with standards, guidelines or drawings and specifications.
f) An informal check, inspection or consultation.

3) Benefits of Road Safety Audit

a) Road safety audits helps in achieving the objectives of a safe system by proper inspection and vision and hence provides a safer road with explaining roads.
b) Road safety audit helps in the proper and accurate design. Deficiencies of which can cause major crashes n thus helps in minimize the risk of high-severity crashes.
c) Road safety audit should help in minimizing the need for rework and physical remedial works caused by road safety deficiencies at the various stages of project development, including construction.
d) Road safety audit help in reduce the whole of life costs of the project.
e) It helps in improve the awareness of, and contribute to, improvements in safe design practices.

4) Approach & Methodology of Road Safety Audit

The road safety audit is generally taken at the completion of preliminary design and where possible,
Project of road safety audit is divided in to three stages
Stage 1:- Audit during development Phase. (Design and Planning)
Stage 2:- Audit during Construction phase.
Stage 3- Audit after completion of the project. (O&M Planning)



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C. *During Development Phase*

This is the 1st stage of road safety audit and will be undertaken at the completion of preliminary design (order publication report stage) before the draft orders has published and for development-led highway improvement schemes before planning consent where possible. This is the last occasion where the requirement of land used for the construction may be increased so therefore it is essential to consider fully road safety issues. The main aspects which must be consider in this stage are as follows

1) At this stage all the members of the audit team shall visit together the sites of highway improvement schemes that involve permanent change to the existing highway layout or features and the sites where new offline highway improvement schemes tie-in to the existing highway.
2) In this the road safety audit team organize meeting and various options for the proposed project has been discussed and the most feasible option is preferred to choose. Therefore this stage is
3) Collection of data for all the accidents in the project highway for preceding two years from Police Stations (Primary Source) and other secondary sources.
4) To perform the analysis of fatal and grievously injured accidents "to identify the black spots" and relate to Accidents records with Traffic Volume to show trend as per
5) Traffic Volume Count.
6) Carrying out a design stage Road Safety audit as per the applicable manual, guidelines, standards and good industry practices; and prepare a draft Safety Report. This audit shall also take into consideration the changes being proposed to the cross section (geometrics) due to 4 or 6-laning of existing roads and its likelihood effect on fatal and serious accidents based on the accident data collected above and suggest countermeasures to mitigate the accident potential.
7) To review the comments from Concessionaire, Independent Engineer and NHAI on the draft Safety Report and furnish the Final Safety Report that inter-alia shall include costing of all the safety recommendations.

D. *During Construction Period*

In this stage the audit is undertaken when highway improvement scheme is going on the ongoing work on the road to check the ongoing construction on the road. This to minimize potential risk to road users and the difficulty that would be experienced by audit teams in traversing the site when open to traffic. Auditors are required to examine the highway improvement schemes from all the users' viewpoints and may decide to walk through the scheme to assist their evaluation and ensure they have comprehensive understanding. The issues which are raised in the previous stage of the audit should also be reviewed at this stage of the audit. The main aspects of the audit are as follows

1) To study the Safety Report of the development period and provide a gap report vis-à-vis what was given in Final Safety Report and Safety Report which was finally implemented.
2) To inspect the Project Highway Keeping into consideration the construction planning for the project as prepared by the Concessionaire and then identified the safety implications of the construction planning.
3) Carry out the Safety Audit once in a calendar quarter, till COD, to assess the adequacy of safety measures adopted and provided in construction zone(s).
4) Collect accident data (monthly) from the Concessionaire/PD office/other secondary source and examine causes of fatal accidents including suggesting countermeasures.
5) ubmit a Quarterly Safety Report on additional Road Safety measures, if any and Summary of audit carried out in every quarter.
6) Receive comments from Concessionaire, Independent Engineer and NHAI and furnish revised recommendations of safety measures duly examining the above comments and submit Safety Reports.
7) Provide Monthly Reports on all activities which were planned, actually executed and planned next month. It is essential and part of financial quote of bidder.
8) Conduct work Zone Safety Audit for civil works, Casting yards and stores as per Contract Agreement and submit quarterly safety report

E. *During Operation and Maintenance Phase*

This audit is undertaken during the first year of highway improvement scheme is open to traffic, a check should be kept on the number of accidents that occur, so that any serious problem can be identified and remedial work arranged quickly.

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1) To review and analyze the annual report and accident data of the proceeding year, and will undertake an inspection of the Project Highway.
2) To complete the safety audit with in a period of one month and will submit a safety report recommending specific improvements if any required to be made on the road, bridges, culverts, marking signs, road furniture and project facilities including cattle crossings and pedestrian crossings. Such recommendations will be processed and acted upon in the manner as given in schedule L of the contract.

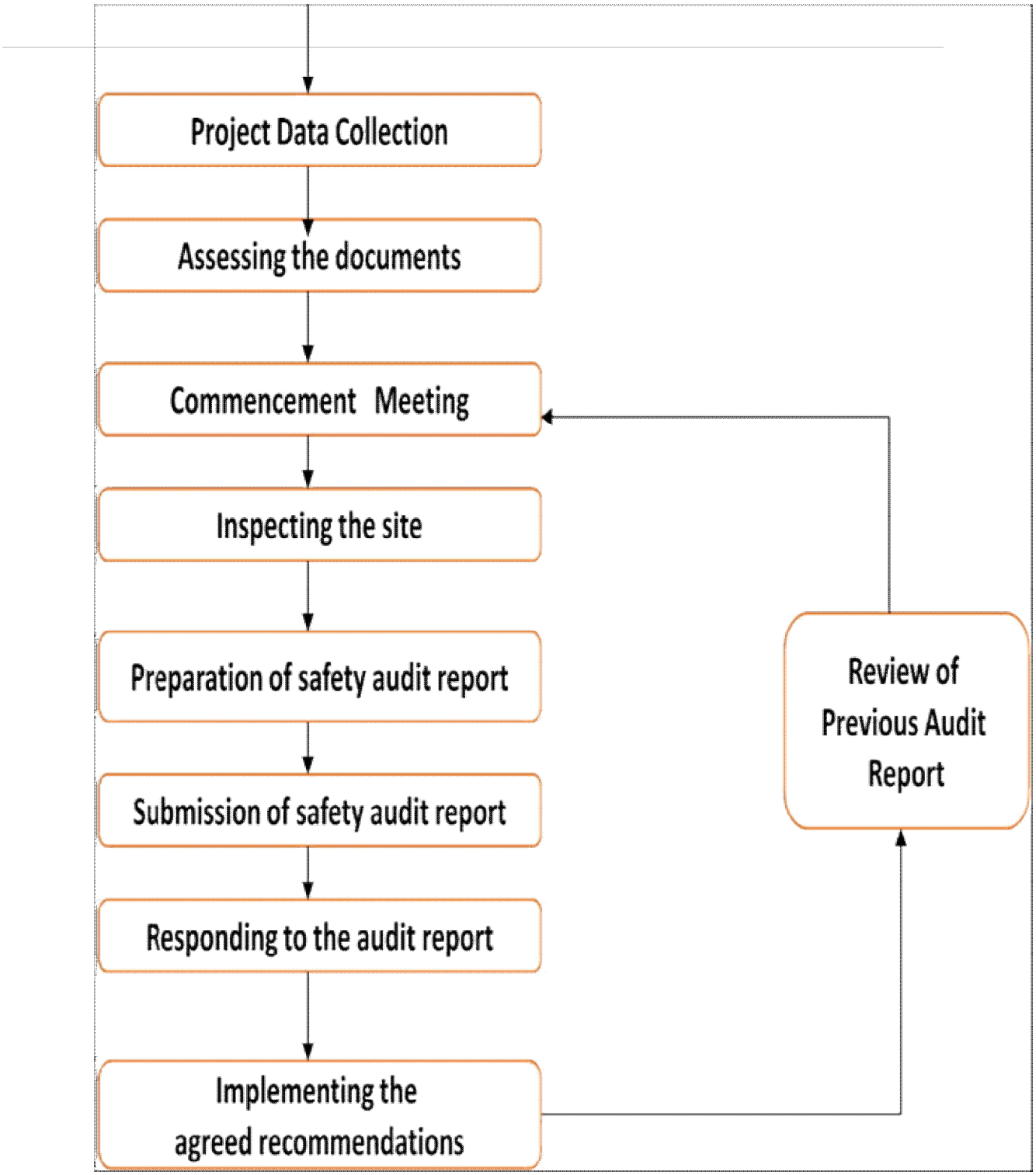

Fig 1.3 Safety Audit procedure flow diagram

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II. LITERATURE SURVEY

Rao et al., (2005) carried out accident study between Anakapalli & Visakhapatnam of NH-5India has a road network of 3.3 million km consisting of National Highway (NH), State Highway (SH), Major District Roads (MDR) and Other District roads (ODR). National Highways constitute 2% of the total road length and carries more than 40% of passenger traffic and 85% of goods traffic has registered more accidents accounting for 20%, as compared to other roads. 'Accidents are not natural but they are caused' is a common cliché in the area of traffic safety. According to a study it is indicated that 66% of the accidents occur due to human error and 33% due to road parameters such as road and vehicle interaction, other road user and environmental factors. India's motor vehicle population is just 1% of the world's, but her share of world road traffic accidents is 6% though the accident rate has been steadily decreasing over the past 25 years, though the accident rate is still very high compared to the developed nations.

Singh and Mishra (2006) carried out road accident analysis in patna city and studied about the various reasons for accidents. Urban transport facilities in most of the Indian cities are inadequate and deteriorating over the years. The development of public transport system has not kept pace with the traffic demand both in terms of quality and quantity. As a result, the use of the undesirable modes such as personalized transport, mainly two-wheelers, and intermediate public transport, mainly three-wheelers, is growing at a rapid speed. Roads and footpaths today are heavily encroached by parked vehicles, hawkers, and roadside business forcing pedestrians to walk on the road. This results not only in restricting the traffic flow, but also putting the pedestrians 'life at a great risk. Bihar is one of India's poorest and densely populated states, its capital city Patna, is noisy, crowded, polluted, and typically chaotic. The roads in the city are congested and encroached by other activities. Bus services in particular have deteriorated, and their efficiency and quality of service have been declining thus inducing passengers to turn to personalized modes and IPTs. This results not only in restricting the traffic flow, but also putting the road users' life at a great risk. The total number of fatal accidents as well as related fatality in the city is increasing over the years.

The vehicular population growth is tremendous in Patna, with just 4,384 registered motor vehicles in 1981 to 294,164 in 2001, an increase of 67 fold in a span of just two-decades. If we calculate it from 1981 to 2001, annual growth rate figure goes up to around 23%. It is observed that growth of personalized vehicles such as two-wheelers and cars is very steep due to non-availability of mass transport system. Public transport system in Patna, in general, is inadequate, inefficient, and unplanned and therefore, it is not able to serve the travel demand of the public in the best possible way.

Kowtanapanish studied about the black spot identification in Thailand and also describes traffic accident problems as well proposed measured for the country. Of all the systems with which people have to deal every day, road traffic systems are the most complex and the most dangerous. In Thailand, the Thais are killed on the roads with an average of around 12,000 persons per year or about 2 persons per hour. In other words, every day, approximately 50 Thai people who leave homes to work, school, shop, temple/ church/mosque, social gathering never return homes because of road accidents. Road accidents have not caused only lives and disability to the Thai citizens but also substantial damages to the country's economy. It was estimated that the economic losses due to road accidents in Thailand are over 100,000 million Baht per year, which means over 12 million Baht per hour or about 3.4% of the country GNP. The paper, describes traffic accident problems as well as the proposed countermeasures in the country. The black spot improvement programs especially the current practiced and researches to identify black spot locations are highlighted. Both conventional method and public participation method are used to identify the black spot locations.

Fukuda et al., (2009), introduce Hiyari- Hatto method to identify and collect data on existing and potential black spot locations. The Hiyari-Hatto, initiated in Japan, is a traffic psychological method to encourage road users to participate/involve in the traffic safety program in order to elicit information through their expression of potential accident experiences that almost occurred/caused them dead or injured. The empirical study was conducted in Soi Chokchai 4 and Soi Ladprao 39 in Bangkok. The findings from this study indicated that Hiyari-Hatto method is a significant alternative method for public participatory enhancement to develop black spot database nationwide. Mungnimit et al., studied about the sequential data analysis for black spot analysis. Thailand has been facing the major economic and social losses due to road accidents. Studies show that the total annual traffic accident cost reaches 3 percent of the country's GPD or about 120 billion baht. The major causes of road accidents are road user, vehicle condition, and road environment. Karim et al., (2009) studied issue and challenges about safety of the roads. A fairly recent measure which aims to identify possible deficiencies related to road safety in various stages of implementation of any road project has been instituted in early 1997. The road safety audit covers new road infrastructure projects as well as road improvement schemes. The road safety audit procedures have been developed to include all stages of project implementation, i.e. from planning stage to preliminary design, detailed design, construction (or pre-opening) and operational stage.

Jain et al., (2009) worked on safety audit on four lane national highways. Road Safety Audit(RSA) is a formal procedure for assessing accident potential and safety performance of new and existing roads. RSA is an efficient, cost effective and proactive

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approach to improve road safety. It is proved that RSA has the potential to save lives. The RSA was originated in Great Britain and is well developed in countries like UK, USA, Australia, New Zealand, Denmark, Canada, Malaysia and Singapore. It is at varying stages of implementation in developing nations like India, South Africa, Thailand and Bangladesh. RSA appears to be an ideal tool for improving road safety in India, as basic and accurate data on accidents have yet to be collected. Vardaki et al., (2010) worked on safety aspects on freeways. Road Safety Audit is a formal, systematic, independent assessment of the potential road safety problems associated with a new road scheme or road improvement scheme. The assessment should involve the placing of equal emphasis on all road users. RSA meets the "Safe System" requirements which are: designing, constructing and maintaining a road system so that forces on the human body generated in crashes are generally less than those resulting in fatal or debilitating injury; improving roads and roadsides to reduce the risks of crashes and minimize harm; measures for higher speed roads including dividing traffic, designing forgiving roadsides and providing clear driver guidance; managing speeds.

III. PROJECT DISCRIPTION

During the last fifty years rapid development has taken place with increase in volume of traffic. The existing roads are not able to cope with the increased traffic and there is a need to widen/upgrade this road. Present chapter gives an outlook of the present condition of the project corridor along with the proposed development. Improved road connectivity can reduce travel times and lower the costs of vehicle use. The ultimate aim of the proposed project is to promote societal welfare of the State. The developments of above project will play a significant role in changing the socio-economic condition of people living in this region through dynamic externalities that such development often generates. The National Highways Authority of India (NHAI) under Govt. of India (GOI) through Ministry of Road Transport & Highways (MORTH) is contemplating to enhance the traffic capacity and safety for efficient transshipment of goods as well as passenger traffic on the heavily trafficked National Highway sections. GOI has entrusted National Highways Authority of India (NHAI) with the responsibility of improving the quality of highways of national importance. The site of the Project Highway comprises the section of National Highway-21 commencing from Km 73.200 to Km 186.500 i.e. the Kiratpur-Nerchowk in the state of Himachal Pradesh and Punjab. The project highway involves widening of existing alignment from km 73.200 to km 86.000, km 159.070 to km 167.473 and km 179.582 to 184.323. The remaining alignment is proposed as new four lane divided highway configurations. The entire road portion will be four lane including the bridges and other structures except the Tunnel portion which is of two lane configurations. level of service offered by road under the prevailing roadway and traffic condition Given the prevailing traffic levels, bottlenecks (terrain/R & R) on the existing road alignment and also the strategic importance of the project road, it is expected to take off with the opening of the Rohtang Pass Tunnel, hence, recommended to build a 4 lane road on new alignment. Moreover, Kulu-Manali is an important tourist destination in India. This road construction will provide better transportation facility for tourists visiting Manali-Rohtang Pass from different parts of India and abroad.

A. Condition of the existing pavement

During my thesis I have been visited site for quite a number of times. The exiting road is in very bad condition. There are very few sign boards on the road and are in very bad condition. All the bridges are having inadequate width. The riding quality on the whole stretch is very bad. There are number of trees, transformers and clusters along the road. There are loosen earthen shoulders and improper toll barrier on the stretch. The parapets are in bad conditions. There are many curves with lot of sight obstruction. Many intersections are not properly designed. The median are with improper dimensions. There are no safety barriers along the existing road of the major portion of the highway. There are no road signs and markings being done on the road. Drains are also improper along the existing highway. Heavy development along both sides of the road. Some are the following pictures which I took during my visits on the site can give the outlook of the highway

IV. PROJECT OBJECTIVE

The project aims to enhance road safety of a stretch during development, construction and operation phase of 4 laning of Kiratpur – Ner Chowk section of NH-21 from km, 73.200 to km. 186.500 in the state of Himachal Pradesh.

A. Development phase audit

This is the 2nd stage of road safety audit and is undertaken at the completion of preliminary design (order publication report stage) before the draft orders has published and for development-led highway improvement schemes before planning consent where

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possible. This is the last occasion where the requirement of land used for the construction may be increased so therefore it is essential to consider fully road safety issues. The main aspects which must be considered in this stage are as follows.

1) Collection of data for all the accidents in the project highway for preceding two years from Police Stations (Primary Source) and other secondary sources.
2) To perform the analysis of fatal and grievously injured accidents "to identify the black spots" and relate to Accidents records with Traffic Volume to show trend as per Traffic Volume Count
3) The various audits on the design of horizontal and vertical alignment is also done in this phase.
4) Audits on intersection layout, lane and shoulder width is also done in this phase

B. Preparation of check list

It has been found that the use of checklists is a valuable tool while conducting audit. The Detailed check list for the audit of Road Alignment design which is the part of the development audit has been prepared accordingly

S. NO	DESCRIPTION	YES/NO	REMARKS
1	Is the proposed design speed appropriate to the function of the road, the mix of traffic likely to use it, and the road environment? (Check whether different sections need different design speeds?).	Yes	
2	If the speed is not up to the mark of design speed, whether proper cautionary sign have been provided?		Signage's details not available
3	Visibility, Sight Distance (SD)		
	(a) Review whether the standards adopted for provision of visibility in the design are appropriate for the ruling design speed and for any unusual traffic mix.		Details parameters not provided
	(b) Review if sight lines are obstructed by: - Safety fences - Boundary fences - Street furniture - Parking facilities - Signs - Landscaping - Bridge abutments	Not shown in plan profile	
	(c) Review the railway crossings, bridges and other hazards are conspicuous.		Details has not been provided
	(d) Will sight lines to be obstructed by temporary features such as parked vehicles in lay-byes or parked or queued traffic has been taken care of?		
	(e) Does the alignment (horizontal and vertical)		At most of the locations

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S. NO.	DESCRIPTION	YES/NO	REMARKS
	give sufficient forward visibility for the Selected design speed?(Check for inadequate stopping sight distances)		Vertical & horizontal curves are inadequate
4	Check for consistency throughout the route; note any location where alignment standard changes abruptly and is not as would be expected by drivers.		
5	Do the horizontal and vertical alignments fit together comfortably? (Check for bad combinations, such as a sharp bend immediately after a summit curve, and sag curve within a bend).		At most of the locations combination of horizontal and vertical curves are not provided.
6	Does the alignment provide safe overtaking opportunities? Does it avoid creating situations where the forward visibility is marginal for overtaking (neither clearly adequate nor inadequate)?	NO	
7	Does the vertical alignment pose excessive demands on the power of heavy vehicles? Has it been designed so those maximum grades are interspersed with recovery grades? Are there passing places to enable faster vehicles to overtake slow-moving heavy vehicles?	YES	

V. CONCLUSSION

The study was undertaken to know about the various causes of accidents and frequency of accidents to locate the black spots and to study the various aspects of Road Safety Audit. The accident data is collected for the six months of the National Highway 21 (Kiratpur to Nerchowk section) from the district police head quarter falling in this particular stretch of the section. There are three districts police head quarters which come in this stretch (Kiratpur, Bilaspur & Mandi). The data was collected at the end of the every month for six months (from October 2013 to march 2014). For the Road safety audit during development phase of the road, drawing is collected to audit the design of vertical and horizontal curves.

A. Conclusions

From the study following conclusion can be drawn

1) Road Safety Audit is very important for controlling accidents and for the proper design and maintenance of the Highways

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2) There are three locations which are located as the black spots since the value of ASI of these locations is more than average ASI (black spots and ASI explained in 4.7 & 4.8 of Chapter 4)
3) Total horizontal curve length provided generally less than required w.r.to degree of curvature.
4) vertical curves length are inadequate for safe sight distance for 100kmph at many locations
5) Checklist for layout, location and access to Fuel Stations and Properties along national highway has been prepared with the latest notifications of MORTH.

B. Reasons for concern

1) Visibility is affected, if horizontal curve is provided before/after a summit curve will give kink effect in Vertical alignment. Proper co-ordination of horizontal and vertical curve will ensure safety, improve utility of the highway and contribute to overall aesthetics.
2) Inadequate or inconsistent provision of vertical curve length results in poor geometrics, inadequate sight distance and unsafe for the design speed of the road.
3) If the deflection angle is small and inadequate length of horizontal curve, driver feels that the curve length is shorter and the radius of curve is smaller than actual values, causing the driver to reduce speed. If the driver tries to run his vehicle without decreasing speed, the vehicle will run along a larger radius and may enter other lanes and cause collision.

C. Recommendations

1) Proper speed limit signs should be provided at the black spots
2) Service roads need to be provided at some of the locations.
3) quality materials should be used so as increase the life of the roads
4) Proper shoulder width, median width should be provided.
5) Proper co-ordination of horizontal and vertical curve should be done.
6) Vertical curve length should be provided as per IRC standards.
7) Adequate horizontal curve length should be provided as per IRC 73,(page no. 19 clause no.9.1.5) guide lines curve length should be at least 150m for a deflection angle of 5 degree, and this should be increased by 30m for each one degree decrease in deflection angle.
8) All the auditors should follow the checklists for access checklist for layout, location and access to Fuel Stations and Properties along national highway.

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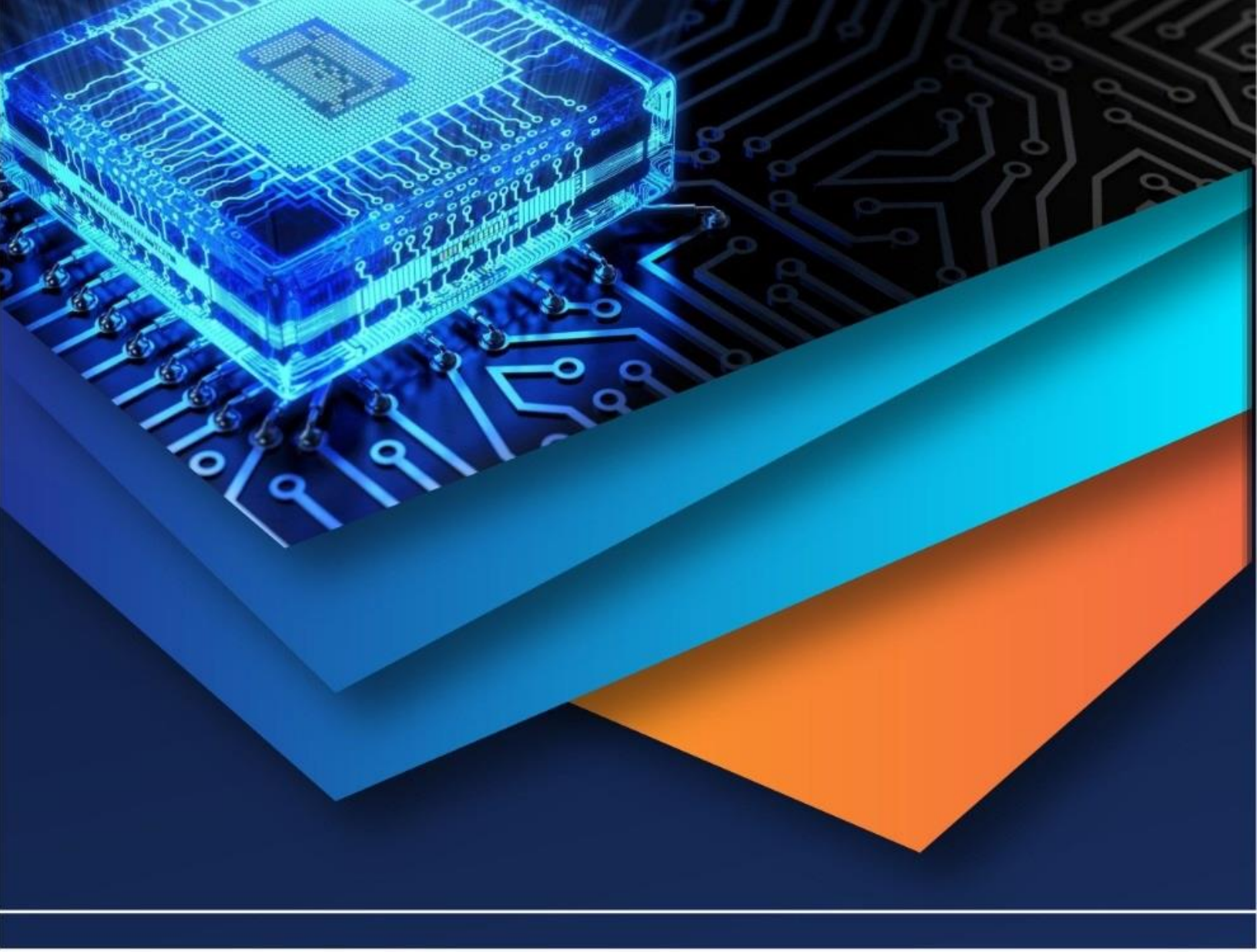

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