



Highway Work Zone Crash Analysis:- Case Study Of Gujarat State

Deep Patel¹, , Srinath Karli²

¹ ME student, Transportation Engineering Student , HGCE, Vahelal, Gujarat

² Assistant Professor, Civil Engineering Department, HGCE, Vahelal, Gujarat

Abstract :- Recent studies indicate that work zones suffer from an increasing trend of deaths and injuries in and around the highway construction areas with an average of 745 fatalities and 40,700 severe injuries per year. To control and minimize work zone fatalities and injuries, the Ministry of road transportation and highways (MORTH) and many state Departments of Transportation (PWDs & R & B s) are seeking to improve the design practices of work zones to reduce work zone crashes. To support this vital and pressing highway safety goal, this research study focuses on analyzing and optimizing existing work zone practices. The main research developments of this study are expected to have significant impacts on identifying potential work zone parameters and contributing causes that impact work zone crash occurrence; estimating the probability of work zones to encounter severe crashes; quantifying the impact of work zone parameters on the risk levels of crash occurrence; estimating the monetary value of work zone crashes based on work zone layout parameters; searching for and identifying optimal work zone setup solutions that specify segment length, operating speed, TTC policy.

Key words: Work zone, Crash analysis, Crash classification

I. INTRODUCTION

Work zone safety is a major concern for the Ministry of road transportation and highways (MORTH) and many state Departments of Transportation (PWDs & R & B s). Recent data indicates that highway construction and maintenance work zone crashes cause an average of 745 fatalities and 40,700 severe injuries per year in the INDIA (TCE 2015) .To control and minimize the aforementioned work zone fatalities and injuries, the Ministry of road transportation and highways (MORTH) and many state Departments of Transportation (PWDs & R & B s) are seeking to improve the design practices of work zones that can directly reduce work zone crashes. Similarly, many state Departments of Transportation (PWDs & R & B s) developed work zone safety and mobility policies to reduce work zone crashes. For example, the Punjab Public Works Department developed and implemented an important Safety Engineering that recommended a number of strategies to improve work zone safety, including (1) identifying current contributing factors that cause injury and fatal work zone crashes; and (2) adding temporary traffic control measures for future implementation within and prior to work zones.

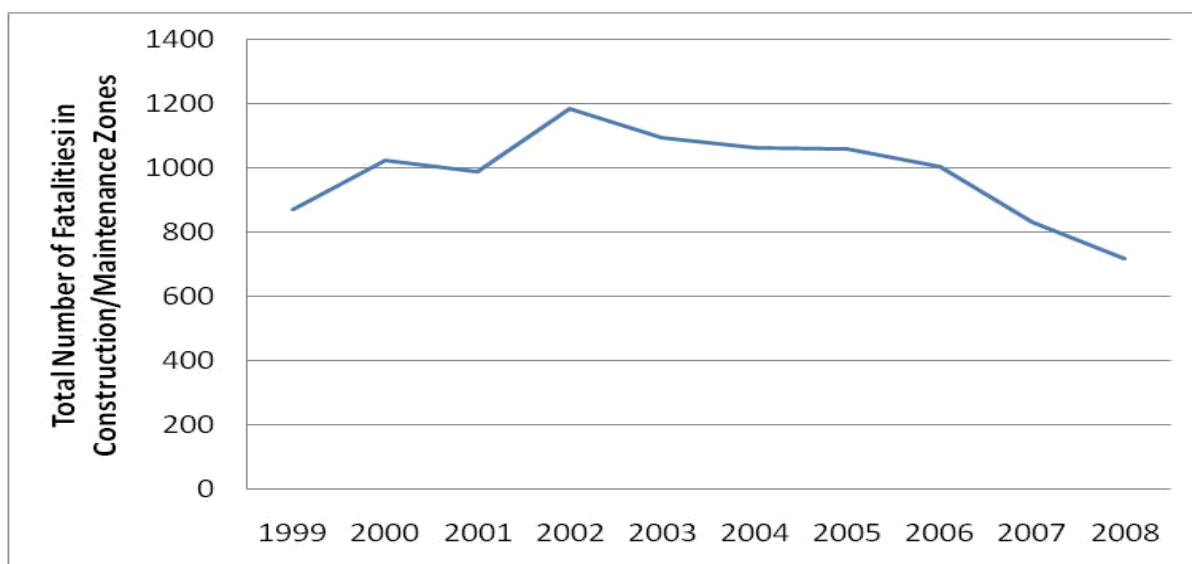


Figure1 Total number of fatalities in Construction/Maintenance Zones in India (Source :- Roads work zone crashes report MORTH 2009)

II. LITERATURE REVIEW

S. K. Subramaniam , V.R. Gannapathy in their study identified that the flagman falls into high risk of fatal accidents within work zone. The picture of a perfect road construction site is the one that utilizes conventional vertical road signs and a flagman to optimize the traffic flow with minimum hazard to the public. Former research has been carried out by Department of Occupational Safety and Health (DOSH) and Ministry of Works to further enhance smoothness in traffic operations and particularly in safety issues within work zones. This paper highlights on hazardous zones in a certain road construction or road maintenance site. Most cases show that the flagman falls into high risk of fatal accidents within work zone. Various measures have been taken by both the authorities and contractors to overcome such miseries, yet it's impossible to eliminate the usage of a flagman since it is considered the best practice. With the implementation of new technologies in automating the traffic flow in road construction site, it is possible to eliminate the usage of a flagman. The intelligent traffic light system is designed to solve problems which contribute hazardous at road construction site and to be inline with the road safety regulation which is taken into granted.

Ying Feng Li & Yong Bai in their study examined the fatal and injury accidents between 1992 and 2004 in Kansas highway construction zones and compared the major characteristics. Highway construction zone safety has been a research focus in many countries for many decades. In the United States, regardless of the research efforts devoted, highway construction zones remain a serious safety concern for government agencies, legislatures, the highway industry, and the traveling public. The results showed significant differences between fatal and injury accidents in the construction zones. The researchers found that: (1) head-on was the dominant type for fatal accidents while rear-end was the dominant injury accident type; (2) a large percent of fatal accidents involved trucks while a majority of injury accidents involved light-duty vehicles only; (3) disregarded traffic control, alcohol impairment, and speeding caused a much larger proportion of fatal accidents while followed too close caused a much higher percentage of injury accidents; and (4) unfavorable light conditions and complicated road geometries contributed to causing a larger percentage of fatal accidents than to causing injury accidents. Based on the study results, practical safety countermeasures targeted at different severity of accidents are recommended in terms of construction zone traffic control and public education.

Yong Bai in his study conducted experiments to determine the effective location of portable changeable message sign in highway work zones. Truck-related crashes contribute to a significant percentage of vehicle crashes in the United States, which often result in injuries and fatalities. The amount of truck miles traveled has increased dramatically with the growing rate of freight movement. Regarding truck crashes in the highway work zones, many studies indicated that there was a significant increase in crash severity when a truck crash occurred in work zones. To mitigate the risk of truck crashes in work zones, a portable changeable message sign (PCMS) was frequently utilized in addition to standard temporary traffic control signs and devices required by the Manual on Uniform Traffic Control Devices. To justify the use of a PCMS in work zones, there is a need to study the effective location of a PCMS deployed in a work zone by measuring the changes of truck and passenger car speed profiles. The difference of speed changes between trucks and passenger cars was considered as one of the major reasons which caused truck-related crashes in work zones. Therefore, reducing the difference of speed changes between trucks and passenger cars could potentially improve safety in work zones. The outcomes of this study will provide required knowledge for traffic engineers to effectively utilize the PCMS in work zones with the purpose of reducing truck-related crashes. In addition, the success of this study will provide a roadmap to investigate the effective deployment of other temporary traffic control devices on mitigating the risk of truck-related crashes in work zones.

S. Kanchana & P. Sivaprakash in their study aims to understand the causes of accidents, preventive measures, and development of safe work environment. Construction industry has accomplished extensive growth worldwide particularly in past few decades. For a construction project to be successful, safety of the structures as well as that of the personnel is of utmost importance. The safety issues are to be considered right from the design stage till the completion and handing over of the structure. Construction industry employs skilled and unskilled laborers subject to construction site accidents and health risks. A proper coordination between contractors, clients, and workforce is needed for safe work conditions which are very much lacking in Indian construction companies. Though labour safety laws are available, the numerous accidents taking place at construction sites are continuing. Management commitment towards health and safety of the workers is also lagging. A detailed literature study was carried out to understand the causes of accidents, preventive measures, and development of safe work environment. This paper presents the results of a questionnaire survey, which was distributed among various categories of construction workers in Kerala region. The paper examines and discusses in detail the total working hours, work shifts, nativity of the workers, number of accidents, and type of injuries taking place in small and large construction sites. The methodology is designed in order to reflect the different aspects of construction sites and to reflect overall project objectives. As the first step, a detailed questionnaire is designed in order to quantify the criteria influencing the safety at site with weight-age depending upon its importance. The criteria considered for survey are as follows:

(i) labour information: position, number of workers, work shift, and timing,

(ii) accident evaluation: number of accidents, type of injury, and reason for accidents.

III. DATA COLLECTION

The data collected is of two types:

1. Primary Data:

In primary data spot speed survey was conducted on the section of Bareja – Mahijda highway which is conversion of SH 144 from single lane to two lane. Along this road side interview form has also designed to understand the behaviour of various vehicle drivers.

2. Secondary Data:

In secondary data work zone crash reporting form has been designed and organization interview form and from this the work zone accidents occurred in organization during the year of 2013, 2014 and 2015 have been collected from the help of Labour Director , Ministry of labour and employment, Gujarat state and from the Tata consulting Engineers.

The data collected from the various organizations have been entered in the Microsoft excel 2007 for further analysis purpose. The data collected are of year 2013, 2014 and August 2015 from the respective organizations.

IV. DATA ANALYSIS

A) Annual variations in accidents at work zone

Fig. 2 shows the annual variation in accidents of total highways year 2013-2015. It is observed that percentage accidents are not increasing relatively in every year. In the year 2014 accident rate was high and low in the year 2013. It may be due to full flange construction work in his peak period, bad traffic environment, and lack of awareness about safety during construction.

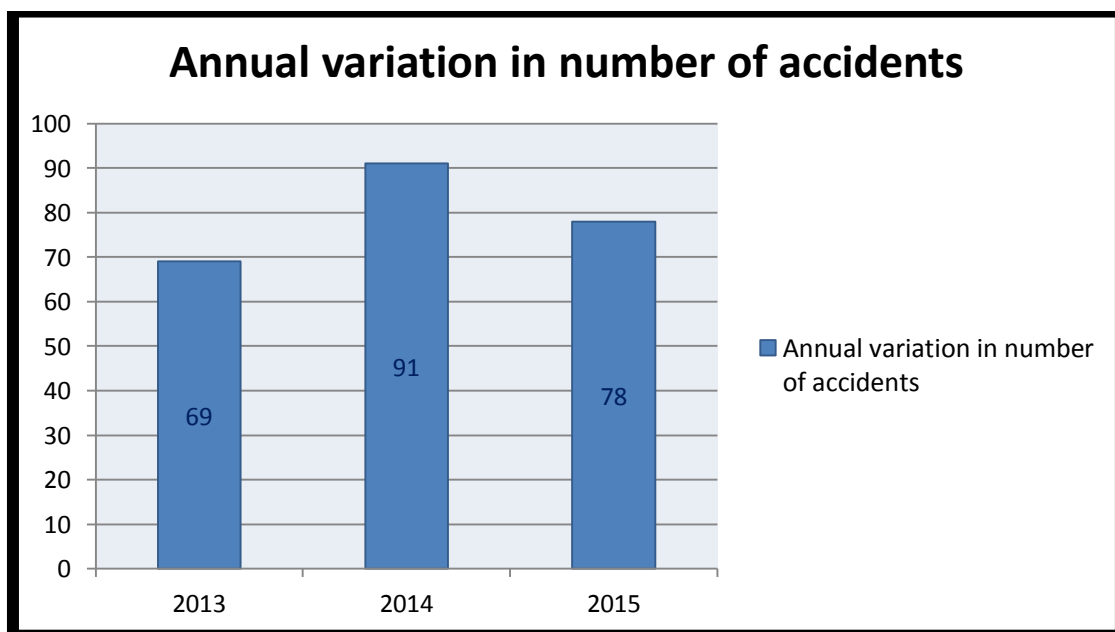


Figure 2 Annual variations in number of accidents

B) Monthly variations in rate of accidents at work zone

Fig 3 shows the monthly variation in accidents. Peak accident occurs in summer season and rainy season i.e in the month of may and august respectively. August is the month in which maximum number of accident occurs followed by second most occurring month may. This is due to distraction related to environment. Problem in these months are glare, fatigue,

inconvenient heat , sleepy surface , wet conditions. February and November are the month in which lowest number of accident occurs.

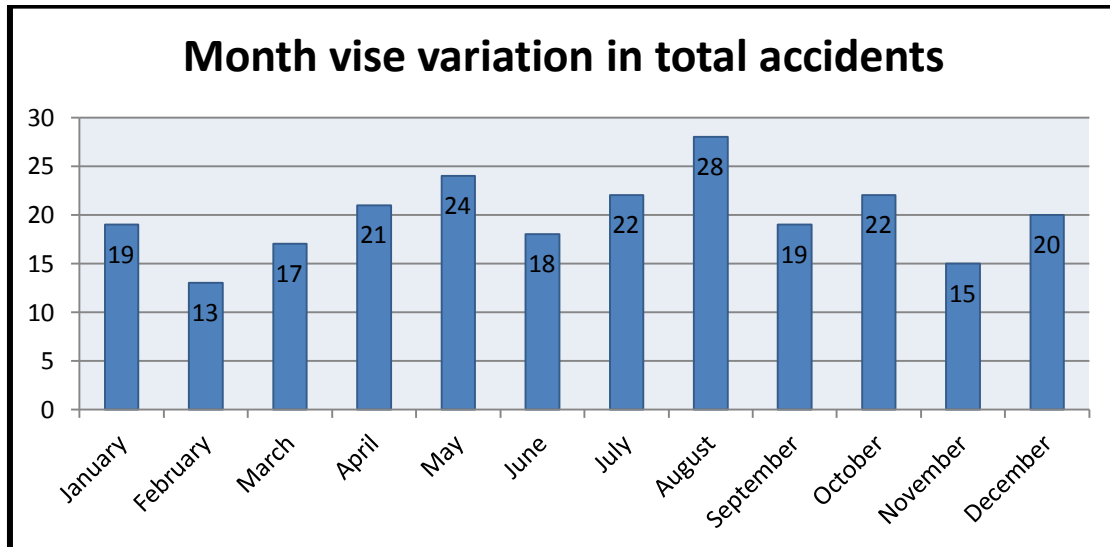
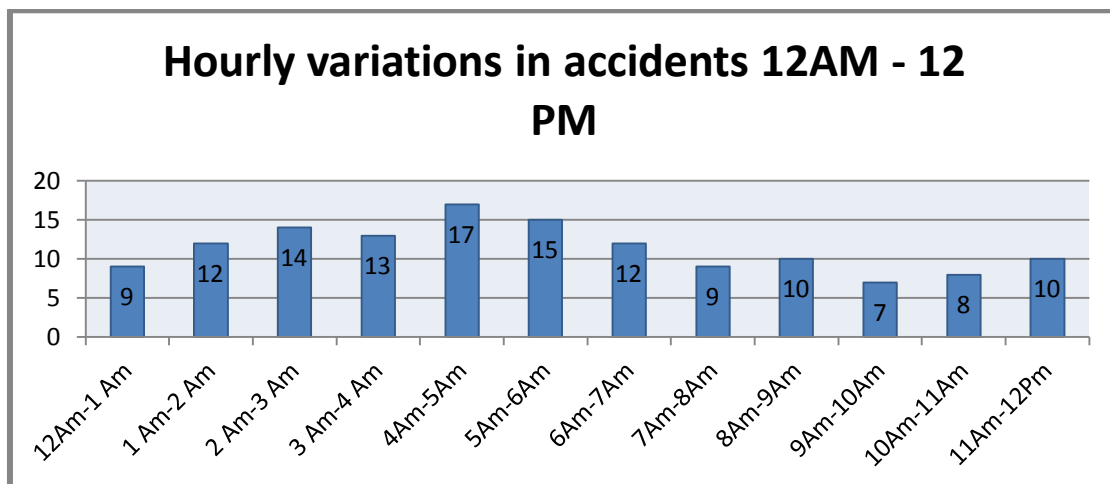


Figure 3 Monthly variations in all types of accidents

C) Hourly variations in accidents

Fig 4 shows hourly variation in accidents. One can observe more accidents occurs in between 2PM to 6PM. In this hour line truck(Truck Series) are at the middle of their long journey. Most of the driver do not use speedometer as they drive by approximation. Speed crosses limiting speed as a result accident occur. Also workers drinks in the evening hour. In the late night they use marijuana as a result reaction time increases and loss of control occurs. Some workers does not use the safety equipments during night time.. It is also found that intrusion of vehicles into work zones during night time also leads to fatal accident.



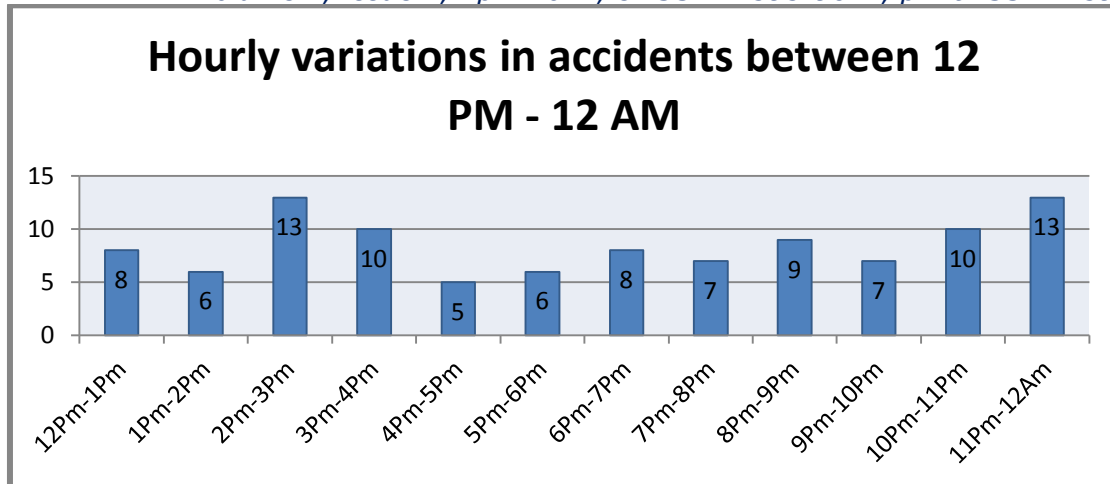


Figure 4 Hourly variations in all types of accidents

D) Accident classification by causes of accidents

In this section the accidents are classified based on various causes responsible for work zone accidents. The factors includes accident occurs due to workers who operates construction vehicles, equipment accident injury due to overturn, vehicles collision, being caught in running equipment, highway accident occur from the movement of construction vehicles and equipment in the highway work zones, auto accident caused by passing motorist, Flaggers and other workers on foot are exposed to even higher risk of being struck by an auto or construction equipment if they are not visible to motorist or equipment or equipment operators.

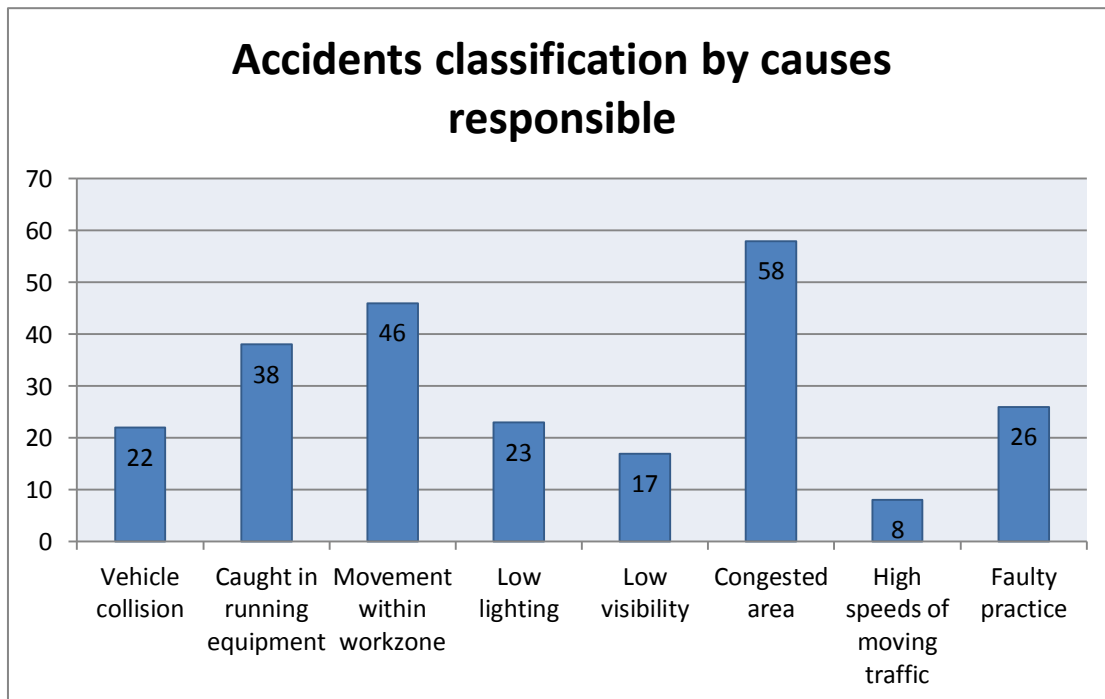


Figure 5 Accidents classification by causes responsible for it

E) Spot speed studies at highway work zone

Spot speed Study is used to determine the speed of vehicle at a spot of the road section. It is done in Road Safety Audit when the black spots are determined. It is useful in comparing design speed with actual speed of vehicle. Spot speeds are needed to control traffic operations and regulations in highway work zones. To enable safe speed limit on road so that

accidents can be reduced, speed survey is carried out on different segments of study area. Among some different methods of spot speed survey the distance/time method by use of stopwatch is used.

The spot speed survey was carried out on Bareja – Mahijda section of state highway 144. The random sampling of 10 vehicles of each type was taken to carry out spot speed survey.

Table:1 Spot speed in activity zone of different vehicles

Location	Direction	Time	Category of vehicle					
			2/W	3/W	4/W	LCV	TRUCK	BUS
SH 144	B – M	Day	41	37	35	42	38	33
	M – B	Day	39	35	37	39	40	35

V. CONCLUSION

From the data analysis following information has been obtained:-

- ❖ Maximum fatal work zone crashes occurs during night time.
- ❖ In the month of August, maximum accidents have been occurred.
- ❖ The Vehicle that is most responsible mode for the fatal accident in work zone is truck/tractor.
- ❖ Most of accidents occurred in season of monsoon.
- ❖ Unskilled labours are the most victim of highway work zone accidents.
- ❖ It is observed that workers are responsible for work zone accidents and also they are major victims of work zone accidents.
- ❖ In the day light less number of accidents occurs as compared to artificial light during night time.
- ❖ 2 AM – 6 AM is the time in which maximum number of accidents occurs.
- ❖ Flagman at the entrance of the work zone is at high risk of accidents
- ❖ If supervision of workers is not done properly they are not following the work zone safety rules.
- ❖ During the spot speed survey in work zone it was found that most of the vehicles are driving at higher speed than design speed in work zone.

VI. REFERENCES

- [1] S. K. Subramaniam , V.R. Gannapathy, “Risk Factors in a Road Construction Site” Conference of World Academy of Science, Engineering and Technology 46,2008.
- [2] Ying Feng Li, Yong Bai, “Comparison of characteristics between fatal and injury accidents in the highway construction zones” Journal of safety science, science direct ,2008
- [3] Upendra Nath Tripathi, “Accidental Risk Analysis of Highway Construction Sites and its Safety Management Strategies” Journal of Academia and Industrial Research (JAIR) Volume 3, Issue 7 December 2014
- [4] Yong Bai , Yue Li, “Determining the effective location of a portable changeable message sign on reducing the risk of truck-related crashes in work zones” Journal of Accident Analysis and Prevention 83 (2015) 197–202 , Science direct, 2015
- [5] S. Kanchana, P. Sivaprakash, Sebastian Joseph, “Studies on Labour Safety in Construction Sites” Hindawi Publishing Corporation, 2014.
- [6] Indian Roads Congress, Guidelines on safety in road construction zones , IRC:SP-55-2001
- [7] Indian Roads Congress, Road Safety Audit Manual , IRC:SP-88-2010