International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 06 Issue: 07 | July - 2022 Impact Factor: 7.185 ISSN: 2582-3930

Job Safety Analysis for Labours on Site with Innovative Techniques

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Abstract - This paper mainly focuses to identifying the safety measures and practices that aid to prevent accidents and injuries on expressway as well as highway construction sites. By doing questionnaire survey all the data which formed and projected by observing causes of accidents and injuries on site and possible measures to prevent such incidents were collected. All the roads exists in different phases with several kilometers running. By conducting such survey and making reports, the results reveals that maximum of the injuries as like musculoskeletal disorders, accidents and strain transpired due to the collision with vehicles and equipment relating incidents. Motor graders, tippers, dumpers and cars cause the frequently reported workplace injuries. This paper concludes that use of compliance to safety rules & regulations, Personal Protective Equipment (PPE), compliance to safety regulations, changing and improving the control system of traffic with culture of employers and employees are possible safety measures and practices need to be adopted to mitigate the ergonomic workplace injuries in the Infrastructure/Highway construction projects particularly in developing countries as well as in developed countries. The construction site is spirited and is a huge sector. The complexity of nature for construction also has its hazards throughout the process until safety is assured. The sources directly as well as indirectly makes a huge impact on the construction progress. The safety measures to be adopted while progressing the construction of the roads is given, to assure that the workers and labours working on site are safe from all hazardous by providing them with all safety measures and avoiding the accidental causes on site. This are the new concepts in construction as a measures to enhance the safety of workers/labours working on site. To examine carefully the benefits of safety in construction place, and involving the measurements to prevent the accidental causes on site

***Key Words*:** Accident prevention, Spike Arrangement, Net Provision, Laser Light Sensor

1.INTRODUCTION

Construction safety is a concern to the proper working environment. Road construction site becomes a continual problem if the safety is not ensured [17]. Safety regulation is giving efforts towards the safe working environment on road construction site. Sufficient road safety measures play an important role in the smooth running of the project. Efforts are taken to increase the importance of safety at the worksite, to decrease the labour accident rate of labour as well as employee working in the construction industry. To ensure a corrective measure for preventing the accidents on-site numbers of techniques are developed. Preventing labour accidents on the road right from small scale to large scale construction work is necessary along with it accidents takes on the road construction site where the general public who are unaware of any site ongoing in frontline may face such accidents [3]. So along with the prevention of accidents of labour on-site, the accidents taking place at the surrounding of the ongoing construction should be taken into consideration [5]. Thus safety problems are to be considered from the initial stage till the completion of the project. In this paper, the accidents taking place on-site is noted and the preventive measure to ensure its safety is undertaken. The labour accidents and the accidents taking place on working road construction site are taken as the main concern. The primary data was collected using a questionnaire survey, and observations were used to analyze the collected data about the causes of workplace injuries and possible measures [16]. The survey includes the questionnaire part including a project with different specification. The road project was carried on the Wakan-Pali-Khopoli route. The length of the road is about 160 km, depending upon the length the equipment is arranged. The road exists in different phases with different kilometers running. The survey reveals that most of the injuries taking place on the site and the preventive measures as an output.

2. OBJECTIVE

The Object of this project is to assure the safety of labour's by adopting appropriate and innovative measures on road construction site. Developing a new idea and set of concepts of arranging spikes, provision of transparent net, and installation of laser light to avoid accidental causes which leads to injuries and prevent loss of life of labour's working on site.

3. METHODOLOGY

A Job Safety Analysis is the step in safety management before an activity is performed. Identify the work that is high-risk construction work, measuring hazards relating to the high-risk construction work and risks to health and safety associated with those hazards [5]. The control measures are been implemented, monitored and reviewed. Action controlling the risk by taking sufficient measures to reduce or eliminate it is adopted. In this project, the new concept of ensuring safety is developed and the hazard and the preventive measures are analysed. Different new method like spike arrangement on road construction site, using light laser on road construction site, provision of installation of transparent nets where the construction is going on, and the measures to be taken for labours to prevent an accident on site.

1. Spike arrangement

While the execution of the road, different layers are laid along with the alignment of the road and this work is carried out in patches as per the availability of material; types of machinery. Working in patches is also a reason to regulate the continuous flow of traffic smoothly. Due to this road is open on one side to allow the traffic to pass easily, while another side is taken to execute. In that case, even if we install barricade, Delineators, safety cones and safety board's/sign to make awareness for traffic to take diversions at necessary points, still accident may occur in the rainy season which makes all safety board's sign flow away with winds also in Foggy regions where visibility is at low at the time vehicle is passing by the diversions. To overcome this accidental lead we can install a spike on the road surface which is newly laid and kept for curing and can't be open to traffic unless and until it's curing duration is completed. If a vehicle enters in the same path in the absence of Safety boards and sign, the spike will puncher the vehicle passes by and vehicles will be bought to rest and can prevent an accident. This method also applies to the vehicle whose brakes are failed.

2. Installation of Laser light

So as we see traffic can also be alerted earlier before entering an accidental path if vision due to foggy areas and heavy rainstorm are not clear by installing laser lights to indicate diversion ahead. This can be installed on the street lights or electrical polls before 100-200 M before perpendicular to the road alignment that is when a vehicle will pass from that range of installed laser light even if it foggy area or heavy rains laser light will reflect on a car as well as on driver and he will be aware of diversion ahead.

3. Provision of Transparent Net

In the places where the construction is carried out, various activities are taking place at the site. Digging of road, preparation of layers on road, laying of layers, etc. In such a case, while working as heavy instruments are used for digging purpose the chances that the particles of rocks, some pieces of rocks may fly in the air due to pressure and may fall on someone causing the accident. Similarly, there is the number of people in the surrounding who is working at the same time might accidentally come across the working time leads to an accident. Some people are eager to see what and how the work is carried out, comes near the place, and may lead to an accident. To overcome such issue and to avoid hazard the provision of the transparent net is provided from 2-3 m from the construction site. This will prevent any kind of rock pieces from entering or fall on labour and as it transparent net everyone can observe the work by maintaining distance from it. This is one of the method to prevent accidents.

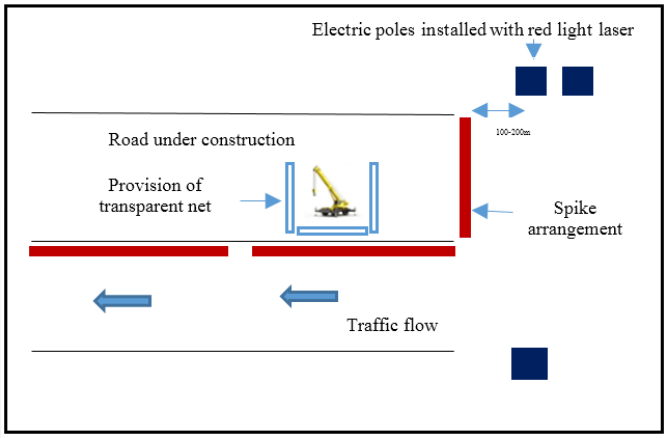

Figure 1. Representation of Spike Arrangement, Net Provision, and Red Light Laser.

4. DATA COLLECTION

Information required for this study is collected through the online and offline method of questionnaire survey [16]. The questionnaire was sent to the respondent in the form of google online form. This method helped us to analyze the information needed to carry out the project. The questionnaire survey included questions on the hazards, accidents, safety taking place on road. This gave the way of idea exactly what type of accidents takes place on-site and what measures should be implemented and what kind of new technologies can be developed for betterment in further safety on road construction site. Two different methods of data collection are described separately below.

Method 1- Questionaries Survey conducted through online method by google form

The data gathered is through an online process which enables us to get the necessary ideas about safety measures and any innovations required to enhance more safety to labours working on-site and the public passing through the location of road site construction. Below are few screenshots of the respondent with different percentage of opinion.

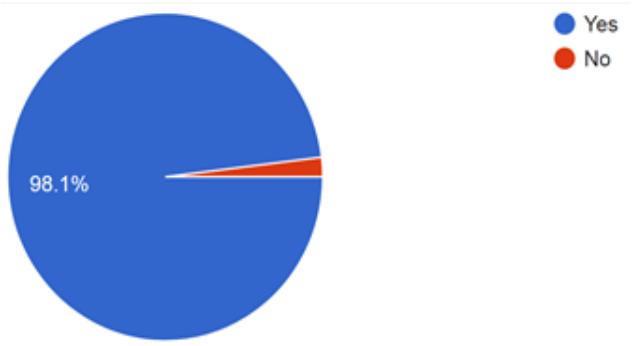

Figure 2. Percentile on increasing training to driver will reduce accident rate.

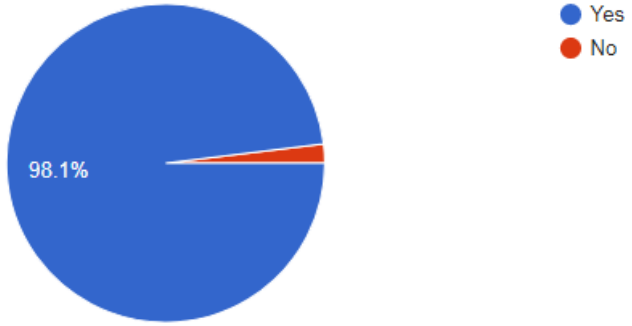

Figure 3. Percentile on using Personal Protective Equipment reduces accidents on site.

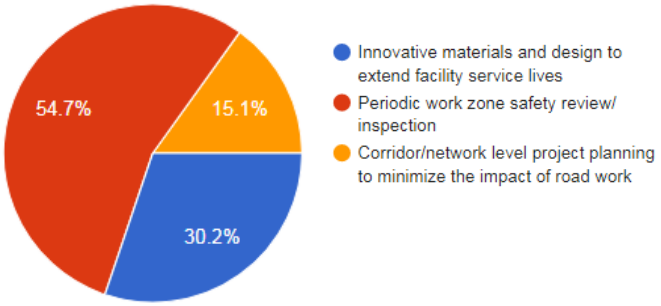

Figure 4. Percentile on effective measures for improving work zone safety

Method 2- Questionaries Survey conducted through site survey method

In this data analysis, different type of accidents taking place on-site construction of the road is mentioned. The survey enabled us to know the work carried on the actual site of road construction. Different tables show the representation of the survey conducted on-site [7]. The project took place in the number of a kilometer, the road was divided into different phase, below is the survey showing data according to per phase of construction work. Required members for construction site work depend upon the type of work, the members described are based on per kilometer are shown below.

Table 1

Staff members involved in construction work

Members in Company	**Project**
Project Manager	1
Supervisor	2
Safety Representative	2
Construction Workers	45

Although many of the JSAs address recurring and common activities. The study shows a well-functioning tool to deal with changes in the conditions for such activities It is firstly identified in the early project phase before execution of the work as part of the planning process, which is typically included as part of the project's overall plan [16]. The number of operating equipment are mentioned according to the different phase of construction considering the total length of the road.

Table 2

Project Specific Activities Involved

Project-specific activities	**No. of Equipment**
Multiple cranes operating in each zone	1-2
Digging near electrical cables	3
Digging proximate to road with heavy traffic	1
Digging on steep slope	2
Damper	5
Grader	5

Causes of accidents taking place on road site construction throughout the length of road and numbers of injuries took place on road construction of Wakan-Pali-Khopoli route is mentioned below (The number of accidents taking place depends on different site conditions)

Table 3

Causes of Accident leading to no. of harm to Labour

Causes of accidents on road construction site	No. of labour Injured
Base layer not laid properly	-
String of electric wire coming across the time of material laying.	2
Driving problem in unbalanced surface road with heavy machineries.	1
Getting stucked in Tar/Bitumen	1
Improper way of spraying bitumen on road	2
Inadequate Knowledge on-site working.	3
Contact with electricity	-
Improper way of digging hard rock base.	-
Total numbers of causes of accident	9

5. RESULT AND DISCUSSION

1. **Result Analysis**

In order to standardize performance measurement on the road site and from the above data collection through online and offline process is done [1] [16]. The question was distributed to labours and the staff which helped us in knowing the safety they are taking on-site and the hazards taking place usually on site [4]. The obtained data is the number of labours and people passing through the surrounding where the construction is going on get harm by any of the reason. This reduces the ability of the person to do the work and also the work process of the construction slow down. Below are few causes and its prevention to be taken is listed.

Table 4

Causes and Preventive Measures

Sr. No.	Causes of Accident		Prevention on the causes
A.	Accidents by Vehicles		
1.	Roller	a. People/Childers running behind the roller while working. b. Judgement of the driver goes wrong.	a. People/Childers running behind the roller while working. b. Judgement of the driver goes wrong.
2.	Grader/JCB	a. Over-loading of vehicle. b. Improper way of filling the material.	a. Calculation of material to be filled/collected at a time. b. Get trained from the person who have experience.
3.	Dumper	a. Over-lifting of material.	a. Get properly trained.
B.	Human Error		
1.	Bitumen Spraying/Laying	a. Getting stucked in Bitumen/Tar b. Improper way of spraying causing danger to body.	a. Get proper treatment of spraying the bitumen. b. Ban the entry of other people by proving nets. c. Use Personal Protective Equipment.
C.	Miscellaneous Error		
1.	Contact with electricity	a. String of electric wire coming across the time of material laying.	a. Use Personal Protective Equipment.
2.	Base layer	a. Based layered not laid properly	a. Proper survey must be

		may lead to unbalancing of vehicle b. Improper way of digging hard rock base.	conducted b. Measurement and proper laying must be done
3.	Lack of knowledge	a. Inadequate Knowledge on-site working leading	a. Periodical training must be arranged
4.	Lack of safety Equipment measures	a. Outdated Epuipments are under use	a. Know what safety equipment is required for task able to provide and enforce use of equipment.

2. Classification of Preventive measures

Hazards and accidents taking place on-site causing numerous issue in schedule work. To reduce this issue following are some preventive measures to be undertaken to enhance safety and proper flow of work [5].

1. Mandatory instructions should be given on every site that labours should be given at least one week of training before joining the actual site.

2. Safety training and regulation regarding safety to be given.

3. Hazards and accidents usually taking place on-site must be explained, accordingly prevention can be ensured.

4. Compulsory use of Personal Protective Equipment.

5. Keep medical facilities before work, so if any incident takes place without any delay the measure can be taken which will reduce the amount of risk on site.

6. Training of proper understanding of the signs and symbols while work is under process.

7. Examine and inspect the working platform before use.

8. Check whether the equipment is proper before using it on site.

9. At the initial stage the work should be carried out under the observation of experienced staff.

10. Be attentive while working, avoid misbehavior at the time of working.

11. Start each day with a safety meeting team.

CONCLUSION

In this paper, the on-site survey was carried out, and the result found was the accidents taking place on-site causing harm to the labours working on-site and also the public moving around the site. Accidents such as the improper way of spreading the bitumen, getting stuck in tar, inadequate knowledge of laying proper base layer, due to high speed and unawareness of the surrounding work the vehicle entering in the work zone all such issues caused the accident on the site. The questionnaire survey conducted helped to know the issues that occurred on-site and the risk on labours and the general public. From the questionnaire survey, it can be concluded that the majority of the accidents take place leading to a high amount of injuries. The number of preventive measures is adopted by training the workers by explaining to them the hazards taking place on-site, explaining the meaning of symbols and the way of using it at necessary while working, trained for using standard signs and symbols like work under construction, warning symbols such as eye protection required, head hat mandatory, and various roll-up signs, properly examining the equipment before using, proper demonstration regarding each activity should be explained, and also various considerable actions which help in reducing the accidents. Considering the harmful issues and reducing the number of accidents, the measures for avoiding hazards the concept of spike arrangement, provision of the transparent net, and installation of laser lights can be taken. The workers, labours, employees working on site will be safe as the adoption of these techniques will increase betterment in safety practice.

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