



## ENHANCING SAFETY AND HEALTH FACILITIES FOR CONSTRUCTION WORKERS: AN EMPIRICAL STUDY OF LAMAHI GHORAH TULSIPUR AND SAHAJPUR BOKTAN DIPAYAL ROAD PROJECT

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### **ABSTRACT**

This field-based empirical research employs a combination of quantitative and qualitative approaches to address a practical problem related to the safety and health of construction workers. The study utilizes data collected through observation checklists, Key Informant Interviews (KII), and questionnaires distributed to project-related respondents and design professionals not directly associated with the project. The research examines the occurrence of accidents, which were predominantly of a minor nature, and identifies the critical safety and health measures required to address the challenges faced by workers on construction sites. These measures encompass safe drinking water, first-aid equipment, sanitary facilities, provision of Personal Protective Equipment (PPE), and the training of casual workers in safety procedures. The study also evaluates the extent of safety and health provisions within contract documents, contrasting them with the inclusion of staff and worker insurance. Additionally, the research explores the impact of hazard identification, health facilities, and safety provisions on project performance. The study underscores the need to disseminate knowledge about safety and health through training courses, orientation sessions, awareness programs, pictorial representation, and online forums. The safety and health status of construction sites can be significantly improved by implementing the recommendations presented in the final section of this research. It is further recommended that a brief safety and health briefing of five to ten minutes be conducted each morning before work commences. The primary objective of safety and health programs is to prevent workplace injuries, illnesses, and fatalities, ultimately mitigating the suffering and financial burdens these incidents impose on workers, their families, and employers. This research offers empirical insights into practical solutions for enhancing safety and health facilities for construction workers, emphasizing the importance of proactive measures and awareness programs in promoting a safer and healthier work environment.

**Keywords**— Safety preparedness, health status, occupational Impacts, proactive measures. workplaces

## 1. INTRODUCTION

### 1.1 Background

Construction industry is a very unique industry and more dangerous than other industries [1]. Safety may be defined as the act of being safe from the materials, substance, equipment and the process at construction site [2]. When we refer to hazards in relation to occupational health and safety, the most commonly used definition is “A hazard is a potential source of harm or adverse health effect on a person or persons” [3]. Lack of training, poor equipment, poor equipment maintenance, non-rigorous enforcement of safety regulations, lack of attention from leaders, lack of planning and organization are major identified causes of accident [4].

The Production Preparation Process (3P) is a project management, design and process development approach that creates a more reliable and efficient production process. The approach provides a structured process ensuring that people, process and technology are optimized by bringing Lean Thinking to factors like production process, people operating thus maintaining the production process, tooling, and facilities to meet the customer requirements. The benefits offered by 3P includes improving performance of new and existing products and processes, design products and processes right the first time, reduce cost due to poor planning and minimize the cost of product launch and life cycle by incorporating Lean Thinking at the beginning of launch [5].

In terms of the impact on health and safety of the working inhabitants, construction industries are considered to be one of the most noteworthy industries in the developed as well as developing countries. Some reasons such as; work quality improvement, construction cost reduction, workers morale enhancement, accident rate minimization, work efficiency augmentation, and fatal accident elimination focuses on the need of safety [6].

Due to difficult location, manual methods of transportation of materials, labour based construction methodologies, unawareness towards health and safety, absence or lack of proper OSH policies and improper implementation of OSH measures, Road project construction in Nepal possess potentially dangerous conditions which affect the Health and Safety of all personnel involved in the construction of road projects [7].

### 1.2 Objective

The overall objective of this study is the assessment of safety preparedness for assuring constructability of selected road projects.

The specific objectives of the study are-

- i. To assess the preparedness for assuring safe construction of Lamahi Ghorahi Tulsipur and Sahajpur Boktan Dipayal road with the help of safety provisions in bid document, safety planning and procedures.
- ii. To analyze the health and safety facilities available at the road project.
- iii. To analyze the impact of health and safety facilities on project performance in terms of response perception.

## 2. METHODOLOGY

In this study, both qualitative as well as quantitative research approach has been used. Qualitative or observational research approach is used for different data collection modes. Qualitative approach has been used to identify and classify hazards, to assess the types of accidents and assess their risk and to find out the prevention and control measures implemented in different projects whereas quantitative or experimental research approach will be used to perform the analysis of collected data from results of response of structured questionnaires, from key informant interviews and observation etc. In this study, the population means all the construction work performing nearby. The personnel of Client, Consultant and Contractor involved in the construction will be consulted for interview. Workers are also taken into consideration to extract the safety practices.

The study area is Lamahi-Ghorahi-Tulsipur Road (Ch. 0+000 to 46+671) and Sahajpur-Boktan-Dipayal Road (Ch. 0+000 – 50+027). Both LGT and SBD road is a national prioritized project connecting the East West Highway at Arjun Khola, Lamahi and Tulsipur Sub Metropolitan city of Dang and Mahakali Rajmarga at Sahajpur and Madhya Pahadi LokMarga at Dipayal respectively.

Primary data have been collected via observation checklist, key informant interview and questionnaire given to client, contractor, consultants and workers involved in the project.

The secondary data have been collected through literature, research papers, journals, conference papers, Dpr of RIDP projects, safety plan in contract documents etc.

All the data and information collected from a primary source, secondary source were analyzed by comparing the situation anticipated, and what is actually in the field. The information obtained from the participants was analyzed by frequency analysis using Microsoft Excel. The data collected were of both qualitative and quantitative in nature. Basically, percentage based analysis was generated.

Beside this, Likert Scale is also used in the questionnaire where respondents specify their level of agreement or disagreement on a symmetric agree-disagree scale for a series of statements and the hypotheses were tested by using regression analysis followed by ANOVA test, which will signify whether the impact exists between independent and dependent variable.

## 3. RESULTS

### 3.1 Safety Preparedness for assuring Safe Construction

Reviewing the bid documents with reference to Labour act 2048 and the questionnaire was prepared to assess the preparedness for assuring safe construction of LGT and SBD road projects.

#### 3.1.1 Review of Bid Documents/Contract Documents

To fulfil the first objective, researcher had reviewed the bid documents/contract documents

of both road projects (Lamahi Ghorahi Tulsipur Labour Act 2048 and presented the major and Sahajpur Bhoktan Dipayal) with related to findings in following way.

**Table 1:** Review of Bid Documents with reference of Labour Act

S.N.	Description	Labor Act 2048	Bid/Contract document of Lamahi Ghorahi Tulsipur Road	Bid/Contract document of Sahajpur Bhoktan Dipayal Road
1	Provision of Safety officer at site	Safety officer shall be provided by contractor in each project.	No provision of safety officer	No provision of safety officer
2	Health and life Insurance of workers	The contractor shall have to ensure the insurance to all workers engaged in the construction site against accident.	The contractor shall provide insurance in the joint names of the employer and the contractor from the start date to the end of the defects liability period covering accidental insurance of the workers	The contractor shall provide insurance in the joint names of the employer and the contractor from the start date to the end of the defects liability period covering accidental insurance of the workers
3	Personal Protective Equipment (PPE)	Contractor shall have to arrange of personal protective equipment for the workers engaged in construction works.	Contractor shall provide the required personal protective equipment to the all workers which is under pay item of BOQ.	Contractor shall provide the required personal protective equipment to the all workers which is under pay item of BOQ.
4	First aid facility at site	Contractor shall ensure first aid facility with required first aid kit at site.	Contractor shall provide first aid kit with required medicines at each labor camp.	Contractor shall provide first aid kit with required medicines at each labor camp.
5	Labor camp at site	Contractor shall maintain the labor camp by providing separate modern toilets for male and female workers with raised beddings from the floor.	Contractor shall maintain the labor camp to the workers which is under pay item of BOQ.	Contractor shall maintain the labor camp to the workers which is under pay item of BOQ.

### 3.1.2 Responsible Parties for Accident in Site

It was found that Contractors are more responsible for the accident at the construction

site than client and government for the same and the consultant has less involvement for an accident at the site.

According to Table 2, about 72.5% of employers and workers responded that Contractors are the major responsible party for the accidents followed by 20% due to the fault of the workers. Similarly Client and Government responsible for cause of the accident at the site are 5% and 2.5% respectively while consultant are least involved in the accident at the site. Since consultant acts as a bridge between the client and contractor and is a supporting body of client so the plan and policy related to safety and health facilities are

governed and implemented by the client and should be followed by the contractor as the agreement regarding the BoQ and bid documents was done between the client and contractor. The Consultant time and again informs and makes reminder to the contractor for the supply of safety plan and procedures to them but contractor were seen providing less importance regarding these matters so as per the visit contractor seem to be highly responsible for the accidents in both road projects.

**Table 2:** Responsible Parties for Accident in Site

Responsible parties for accident at site	No of Respondent	Respondent Percentage
Workers	16	20%
Client	4	5%
Consultant	0	0
Contractor	58	72.5%
Government	2	2.5%

**3.1.3 Preventive and Control Measure Implemented**

Table 3 and Table 4 demonstrate the result of the preventive measures to prevent an accident at the site and the control measure can be used to control accidents respectively. About 35% of the KII responded that orientation and awareness is the best preventive measure to prevent accident at site followed by safety policy, sign and signal and safety meeting with 25%, 15% and 12.5% respectively whereas training and housekeeping

hold the lowest measures in prevention of accident at site with 7.5% and 5% respectively. In case of control measures for prevention of accident at site about 65% of the KII responded that PPE is the prior control method for the accident. The engineering control is responded by 16.25% as an efficient control measure. The other minor factors include administrative control; substitution and elimination include 8.75%, 6.25%, and 3.75% respectively.

**Table 3:** Preventive Measures to Prevent Accident at Site

Preventive measure to prevent accident	No of Respondent	Respondent Percentage
Sign and Signal	12	15%

Safety policy	20	25%
Safety meeting	10	12.5%
Orientation and awareness	28	35%
Training	6	7.5%
Housekeeping	4	5%

**Table 4:** Control Measure to Prevent Accidents

Control Measure to Prevent Accidents	No of Respondent	Respondent Percentage
PPE	52	65%
Engineering control	13	16.25%
Administrative control	7	8.75%
Elimination	3	3.75%
Substitution	5	6.25%

### 3.1.4 Hazard Identification

The physical, mechanical, chemical and biological hazards from the proposed roads are

described below in Table these are the hazards that arouse form the construction activities at the site.

**Table 5:** Hazard Identification observed during field survey

Road	Physical	Mechanical	Chemical	Biological
SBD	<ul style="list-style-type: none"> <li>•Scouring of valley side slopes resulting landslideand erosion</li> <li>•Destruction of property (agriculture, land )</li> <li>•Destruction of natural drainage</li> </ul>	<ul style="list-style-type: none"> <li>• Transport and use of mobile work equipment</li> <li>• Falling due to slipping, tripping and twisting of ankle</li> <li>• Falling from height</li> </ul>	<ul style="list-style-type: none"> <li>• Contamination of waterbodies and soil throughspillage of oil, fuel, bitumen.</li> <li>• Contamination from un sanitary disposal of toiletwaste</li> </ul>	<ul style="list-style-type: none"> <li>• Viruses – Coronavirus(COVID -19)</li> <li>• Insects Snake and Mosquito</li> </ul>
LGT	<ul style="list-style-type: none"> <li>• Destruction of property(agriculture, land )</li> <li>• Destruction of naturaldrainage</li> <li>•Existing water/sewer linegot damage</li> </ul>	<ul style="list-style-type: none"> <li>• Transport and use of mobile work equipment</li> <li>• Falling due to slipping, tripping and twisting of ankle</li> <li>• Falling from height</li> </ul>	<ul style="list-style-type: none"> <li>• Contamination of waterbodies and soil throughspillage of oil, fuel, bitumen.</li> <li>• Contamination from unsanitary disposal of toiletwaste</li> </ul>	<ul style="list-style-type: none"> <li>• Viruses – Coronavirus (COVID-19)</li> <li>• Insects- Snake and Mosquito</li> </ul>

**3.1.5 Status of accident**

The site management of the Contractors and Consultants involved in this Road Improvement Project were asked about the occurrence of an

accident in their executed road project. The response was tabulated below:

**Table 6:** Occurrence of accidents observed during field survey

S.N.	PROJECT	NO	PERCENTAGE
1	LGT	14/65	21.53
2	SBD	9/50	18

Table 7 shows the degree of injuries as reported by site management of Contractor and Consultant. The degree of injury found in road improvement project was 86.95% of light injury and 13.04% of partial disability. The number of the accident was more in LGT project rather than SBD project. Major accident reported at site was light injury while carrying out the construction activities while no any big accidents that lead to death have been reported. Also no any

permanent disability has been reported at site during construction activities. The partial disability happens during hammering work of stones for the masonry and gabion work. During hammering the stone the small pieces of stone has entered into the eyes which in result after examine by the medical officers slightly decreases the visibility of eyes than before so the safety glasses during these types of works should be seriously adopted at projects sites.

**Table 7:** Degree of injury in executed road project recorded during field survey

Degree of Injury	LGT	SBD	Total
Death	-	-	-
Permanent disability	-	-	-
Partial disability	2	1	3
Light Injury	12	8	20
Total	14	9	23

**3.2 Status of Health and Safety in Road Construction Site**

Questionnaire survey was conducted with the site staffs and workers to check the status of health and safety in two different projects under Road Improvement and Development Project (Phase III). These methods include a direct

interview with the site staffs, workers and through field visit of those projects. The result of the survey is discussed as below:

**3.2.1 Health and Safety Measures**

The health and safety measures in LGT and SBD projects were identified through an interview with respective Assistant Resident Engineer

(ARE), Inspector of Works (IOW) and Site Engineers. Since ARE, IOW and Site Engineer handles the project at the site and is their sole purpose to look and carry the construction activities properly. So they are the responsible person to give feedback on the health and safety issue of the site. According to the interview with ARE(s) and IOW(s), the presence of safety sign and barricades were installed at LGT project site when instructed by the consultant. Similarly, in SBD project site, it was installed prior to any construction activities started special prior to critical areas.

Similarly, regarding regular maintenance of the road for the smooth functioning of vehicles, the contractor was found executing routine maintenance in SBD project but in LGT project site the routine maintenance work was only executed after the instruction or remainder from the consultant. It was found not following in true sense in both project sites in regular basis. Likewise, damage to existing water/ sewer line due to soil erosion, silt run-off and settling of street surface, due to slides and erosion and excavation works, the drinking water pipeline and irrigation channel were damaged in SBD site

more in compare to LGT site. In addition to this, public utilities were damaged in both LGT and SBD site where the damages in LGT site were repaired immediately.

Commonly, an incident of people falling into trench was very rare in almost all project sites. Regarding controlling dust pollution, sprinkling water through water browser was rarely in use in SBD whereas, in LGT site, it was not enforced honestly in practice. The details information such as regular maintenance of the road for the smooth functioning of vehicles, damage to existing water/ sewer line due to soil erosion, actors responsible for accidents at a construction site, etc. related to the projects.

### 3.2.2 Safety and Health Facilities

#### Health Facilities

According to the table 8, employers and workers admitted four health facilities were lacking on site for casual workers. These include safe drinking water, washing facilities, catering services and provision of toilet. With the average response rate of 50% (18%+32%), employers and workers demonstrates the provision of toilet as a health facility lacking at the construction site for casual workers.

**Table 8:** Employers and Workers Perception to the Provision of Health Facilities

Health facilities	Strongly disagree %	Disagree %	Neutral %	Agree %	Strongly agree %
Safe drinking water	25	21	14	29	11
Means of heating food	14	25	7	46	8
Washing Facilities	11	35	18	32	6
Suitable accommodation to rest	7	30	18	36	11



Catering service	12	33	18	28	9
Provision of toilet	18	32	18	29	5
Accommodation to change and store clothing	14	20	28	28	10
First-aid /Medical Facilities	11	7	14	43	25
Average rating	14	25.37	16.7	33.5	10.5

**Safety Facilities**

According to table 9, a total of about 47.3% (15.2% + 32.1%) of employers and workers disagreed with the statement that they provide safety materials on the construction site to casual workers while an average of about 41.6% (26.7% +14.9%) of the employer and worker

agreed to the assertion. Among other factors, indications from table 9 suggest that safety glasses (goggles and face-shields), hearing protection and lightening during night work were the three main safety materials lacking on sites to casual workers.

**Table 9:** Employers and Workers Perception to the Provision of Safety Materials

Safety Facilities	Strongly disagree %	Disagree %	Neutral %	Agree %	Strongly agree %
Safety signs	8	33	5	32	22
Safety helmets or hard hats	10	34	4	32	20
Safety glasses, goggles, and face shields	25	34	16	15	10
Safety boots	14	32	13	28	13
Rain gear	18	31	14	21	14
Hearing protection	19	35	11	20	15
Safety mask	17	19	21	28	15
Gloves	7	28	7	41	17
Lightening during night work	23	38	12	18	9
Ladder Scaffold platforms	11	35	8	32	14
Average rating	15.2	32.1	11.1	26.7	14.9

**3.2.3 Interview with the Administrative about Health and safety Facilities**

Project coordinator was interviewed regarding the issue of provision of health facilities to casual workers under RIDP projects. According to PC, health facilities should be provided to

casual workers and some of the clauses have been mentioned in a contract like insurance. During preparation of BOQ many clauses that point out health facilities were missed out. As a result, contractors are giving less priority on this matter. There is a general trend in the business of

construction in Nepal that it gives less importance on the provision of health facilities.

Since RIDP projects were low funded projects, PC failed to add up more facilities to casual workers in BOQ. Project coordinator always encouraged contractors to provide safety and health facilities to their workforce upon his site visit.

During the interview, EXIM Bank was found responsible for negligence for not including health facilities in BOQ where such facilities were mention in the contract. Donor agency i.e. EXIM Bank placed such matters in less priority zone and did not emphasize to highlight such matters in BOQ. Insurance was given top ranked priority to casual workers and is included in BOQ.

Project managers of both projects were also interviewed. Upon a visit to their respective site, casual workers were found working with boots and helmets usually. They were well accommodated on site. They think these

facilities are given to every workforce present in the site. This may due to the fact that the contractor faked such activities upon their site visit.

Even Team Leader was an interviewer. He is well informed about these issues and has been ordering the contractor to provide good safety and health practices in site. Generally, contractors reluctant to works what are not included in BOQ.

### 3.3 Impact of OSH management on Project performance

To analyze the impact of OSH management on project performance, hypotheses were tested among the independent variables and dependent variables. These hypotheses were tested by using regression analysis followed by ANOVA test, which will signify whether the impact exists between independent and dependent variable. The Reliability Statistics for data of impact of OSH Management on Project performance was observed as shown in table 10.

**Table 10:** Reliability Statistics for data of impact of OSH Management on Project performance

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	No of Items
0.7675	0.77	03

Here, alpha value lies between 0.7 and 0.8, so internal consistency of data is acceptable.

As per the result presented on table 11, the calculated F value is higher than the significant f value. Therefore, all the null hypotheses are rejected and alternative hypothesis were selected

i.e.

1. There is impact of hazard identification on project performance.
2. There is impact of health facilities on project performance.
3. There is impact of safety provisions on project performance.

**Table 11:** Summary of hypothesis testing

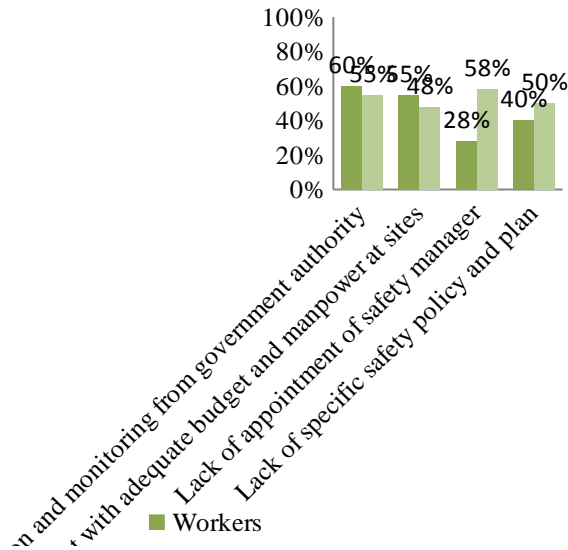
S.N.	Hypothesis	F	Sig. F	Impact
1.	Impact of Hazard Identification on Project performance	82.35832	9.97E-13	Impact Exists
2.	Impact of Health Facilities on Project performance	225.802	1.17E-21	Impact Exists
3.	Impact of Safety Provisions on Project performance	150.4219	9.47E-18	Impact Exists

According to the key informant interview all three variables i.e. hazard identification, health facilities and safety provisions shows impact on project performance which will directly hampered the work plan schedule and time frame up to which the work was estimated to be completed as per the plan provided by contractor to the client and engineer's. Due to the lack of adequate safety and health facilities and proper identification of hazards result in occurrence of accidents which ultimately delay the work going on the sites and will effect on the schedule up to which the work has to be accomplished as a result contractor will fail to achieve the objectives on time and even the moral of the workers working at the sites gets low due to the accidents at the construction sites. The safety and health also decide the duration of project and planning and scheduling. Reducing safety accidents save time and helps in successful project performance. The main goal of safety

and health programs is to prevent workplace injuries, illnesses, and deaths, as well as the suffering and financial hardship these events can cause for workers, their families, and employers.

### 3.3.1 Major Cause of Poor Implementation of Rules and Regulations

Figure 1 reflects the main major cause of poor implementation of Rules and Regulation at construction site. 60% workers and 55% employers responded that the major cause found for poor implementation of rules and regulation was lack of inspection and monitoring from government authority whereas 55% of workers and 48% of employers responded the second cause as lack of safety department with adequate budget and manpower at sites with 50% employers and 40% workers responded cause for poor implementation of rules and regulations were lack of specific safety policy and plan. The least major cause of poor implementation was appointment of safety manager.

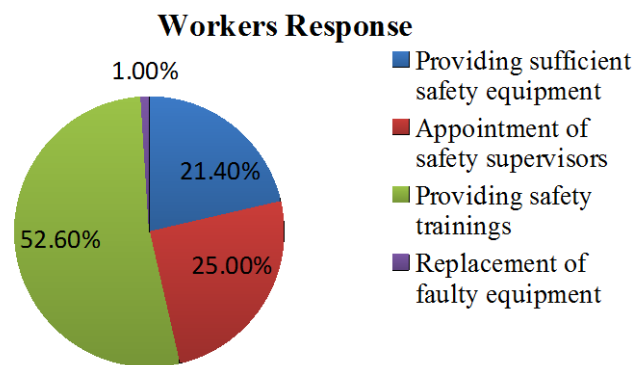


**Fig 1:** Major cause of poor implementation of rules and regulations

### 3.3.2 Activities to be carried for Safety in the Construction Sites

Figure 2 illustrates the results of the activities to be carried for safety in the construction site. 53% workers responded that to prevent accident at site the main leading activity was to provide safety trainings to the workers. Secondly, 25% workers responded for the appointment of safety

supervisors to workers at the construction site. 21% workers responded to provide sufficient safety equipment at the sites. And the least activity found was replacement of faulty equipment with the better and reliable one at the work site with only 1% workers responded for it. Similar to previous study [8, 9 &10].



**Fig 2:** Activities to be carried for safety in construction sites

## 4. CONCLUSION

In this study, we delved into the intricacies of safety and health programs within the context of two specific road improvement projects, namely the Lamahi-Ghorahi-Tulsipur Road Section and the Sahajpur-Boktan-Dipayal Road Section, both integral parts of the Road Improvement and

Development Project (Phase III) Package 3. The conclusions drawn from our research shed light on several critical aspects, emphasizing the paramount importance of ensuring the safety and well-being of workers in the construction industry.

### **1. Core Objective of Safety and Health**

**Programs:** The primary objective of any safety and health program is the prevention of workplace injuries, illnesses, and fatalities. Such programs are indispensable in averting the immense suffering and financial hardship that can befall workers, their families, and employers. We assessed the preparedness of the selected projects, namely LGT and SBD, for upholding the principles of safe construction. Our examination involved a comprehensive review of the bid documents, ensuring compliance with the Labor Act of 2048, as well as evaluating safety planning and procedures.

**2. Construction Site Risks and Hazards:** It is evident that the construction sites of road projects, particularly within the RIDP framework, are rife with inherent risks and hazards. Workers laboring at these sites are often unaware of the safety rules and procedures necessary for their protection. This lack of awareness underscores a critical need for robust safety training and awareness programs to be integrated into the construction process.

**3. Status of Health and Safety Facilities:** Our study thoroughly analyzed the status of health and safety facilities in the selected projects, utilizing a combination of questionnaire surveys, direct interviews with site staff and workers, and on-site inspections. The findings revealed a deficiency in several crucial health and safety provisions. For instance, essential health facilities like safe drinking water, laundry

services, catering, and toilet facilities were notably absent for casual workers. Similarly, safety provisions, such as safety glasses, hearing protection, and adequate lighting for nighttime work, were also lacking on the construction sites.

### **4. Impact on Project Performance:**

Hypotheses tested through regression analysis and subsequent Anova testing provided conclusive evidence that the selected variables examined in our study had a tangible impact on project performance. Furthermore, these findings indirectly influenced the project's time schedule, leading to work delays at the construction sites. This underscores the interconnected nature of safety, health, and overall project efficiency.

In closing, our research serves as a testament to the significance of fostering a culture of safety and health within the construction industry, particularly in road development projects. The conclusions drawn underscore the urgency of instituting comprehensive safety and health programs, training initiatives, and facility improvements to protect the welfare of workers and enhance overall project performance. By addressing these concerns, we pave the way for safer and more efficient construction practices, ultimately contributing to the well-being of workers and the successful execution of road projects.

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