Linkage of Safety Site Conditions with Accidents

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ABSTRACT

Purpose: *In Construction many employments are there which draws attention to high standards of safety. the study was conducted To access the linkage between site condition of safety management in selected Five under construction commercial projects of Bharatpur Metropolitan city with accident cases for framing the empirical solution of productivity through safety seems highly significant.*

Design/Methodology/Approach: *Site visit of the Project; questionnaire survey and interview were done. Initially, the case study of the 5- project and questionnaire survey for the pilot survey was distributed. Cases of 11 Accidents were documented and analyzed for creating safe acts and safe conditions.*

Findings/Result: *It was concluded that the occupational hazards in the commercial projects construction process consist of the physical hazards primarily while hazards like mechanical, psychological, and chemical are the minor ones. Use of the safety signboards was limited in the sites. It is also observed that there is no proper optimal use of the personal safety procedure. It is recommended that employers and the contractor team should be responsible for the health and safety of the worker and follow the general guidelines for it. Productivity without safety cannot lead to profitability. Loss of some parts to loss of life is recorded due to a lack of construction safety practice-based theory of causation of accidents. Urgent needs of implementing proactive and reactive safety procedures at management, organization, and employee level should be focused on. There must be proper allocation of the safety items in the BOQ and the work done and personnel allocating doing the work should be aware of the hazards. The housekeeping and the preventive measures must be allocated and the proper use of the PPE too. The job satisfaction from the engineering team to the workforce must be provided by the organization.*

Originality/Value: *The study will be significant for policymakers and professionals to feel and experience the danger of the construction industry to avoid in their case as if we experience by doing the accident may we cannot be in a position to share the experience. The need for regulatory improvements will draw attention.*

Paper Type: *Empirical Research*

Keywords: Safety Site Conditions, Safety Facilities, Inspection, Status, Theories, Commercial Project

1. INTRODUCTION :

In a construction project, time, cost, and quality are taken as the major indicator to evaluate the project's success. Activities of construction are focused to meet the schedule, in line with the budget, and meeting the quality standard. Despite safety being one of the main indicators of construction, stakeholders give very little emphasis on safety concerns. In the context of Nepal, Occupation Safety and Health (OSH) has not become the priority in construction till now (Mishra et al, 2019, Lama et al, 2019: Mishra and Aithal, 2021) [1, 2 & 3].

Herein Chitwan, investment in a construction project has significantly increased. A large number of commercial projects with varying purpose has been constructed. However, it does not vary on the aspect of Nepal as a whole, focus on OSH is not emphasized by both the contractor and client. Regarding this aspect, an assessment to explore and justify this belief is needed. Research on the construction safety practice is very little. Safety measures are less followed on the construction site. Effective implementation of policies and standards on safety practice has been prioritized, neither by the implementing bodies nor by the regulatory bodies. A study on the safety assessment of construction projects of commercial projects in Bharatpur will be significant to the construction practitioners and its stakeholders. It provides ground to the project design to incorporate the safety parameters during the design phase. The client is aware of the safety status in construction in Chitwan district and considers the budget to meet the safety requirement. The contractor, most important, knows the status of construction safety in various project and evaluate its standing on health and safety practice. It helps them to identify their drawbacks in safety requirements in their construction project and help them implement good provisions of safety adopted by other companies. Site engineers and supervisors gain knowledge on good practice of construction safety and minimize the construction hazards that prevail in their construction site (Adhikari et al, 2020) [4].

2. OBJECTIVES :

The general objective of the study is to access the linkage between site conditions of safety management in selected Five under construction commercial projects of Bharatpur Metropolitan city with accident cases for framing the empirical solution of productivity through safety.

3. LITERATURE REVIEW :

3.1 Theory of Accident:

Several theories are there to explain the causes of accidents. Some of them are as follows. Heinrich (1959) [5] laid out the 'Domino Theory' which depends on five consecutive factors as the most common way of securing the information on customs and abilities in the working environment. Absence of abilities and information on performing undertakings, unseemly friendly and natural circumstances will prompt shortcoming of individual coming about into pessimistic elements of an individual character albeit these undesirable attributes may be procured. The consequence of recklessness is hazardous demonstration/conditions which incorporate the blunders and specialized disappointments which cause the mishap creating Accidents might be Injury also.

There Management which deals with Systems & Procedures, Environment which might be Natural & Man-made, Equipment and Human Behavior which assures Design & Equipment is the basic cause of accidents. Through identification of these multiple contributing causes of the accident, the unsafe acts and unsafe conditions should be prevented from arising [6, 7] as shown in figure 1. The refreshed and altered arrangement of 'Domino Theory' is [5, 8]: (i) Absence of control/the board (insufficient program, deficient program standard, lacking consistency to standard), (ii) Fundamental causes/starting points (essential causes: 1-individual elements, 2-work factors), (iii) Quick causes/Symptoms (unsatisfactory demonstration and condition), (iv) Occurrence (contact with energy and substance), (v) Misfortune (property, individuals, process).

The 'Swiss Cheese' [9, 10] accident causation model essentially proposes that the associations attempt to forestall mishaps by protections all together not to permit the dangers and risks become misfortune through Hard guards which are programmed disturbing frameworks, actual deterrents, designed wellbeing apparatuses and flimsy spots included into the fundamental framework for insurance like wires.

Followed by guidelines of required execution, examination, checking, and customary methods of execution, instruction and preparing, oversight, and working consent. Delicate safeguards likewise include managers and administrators as the trailblazers. Misfortunes to individuals, hardware, resources are the likely results of risks in an association. Accident Root Causes Tracing Model (ARCTM) communicates the possibility that mishaps are brought about by at least one of the accompanying variables [11, 12], i.e., Not distinguishing the dangerous condition existed previously or progressed after a movement begins (Unsafe condition) followed by Playing out the undertaking regardless of the specialist understands the presence of dangerous condition (response of labourer to risky condition).

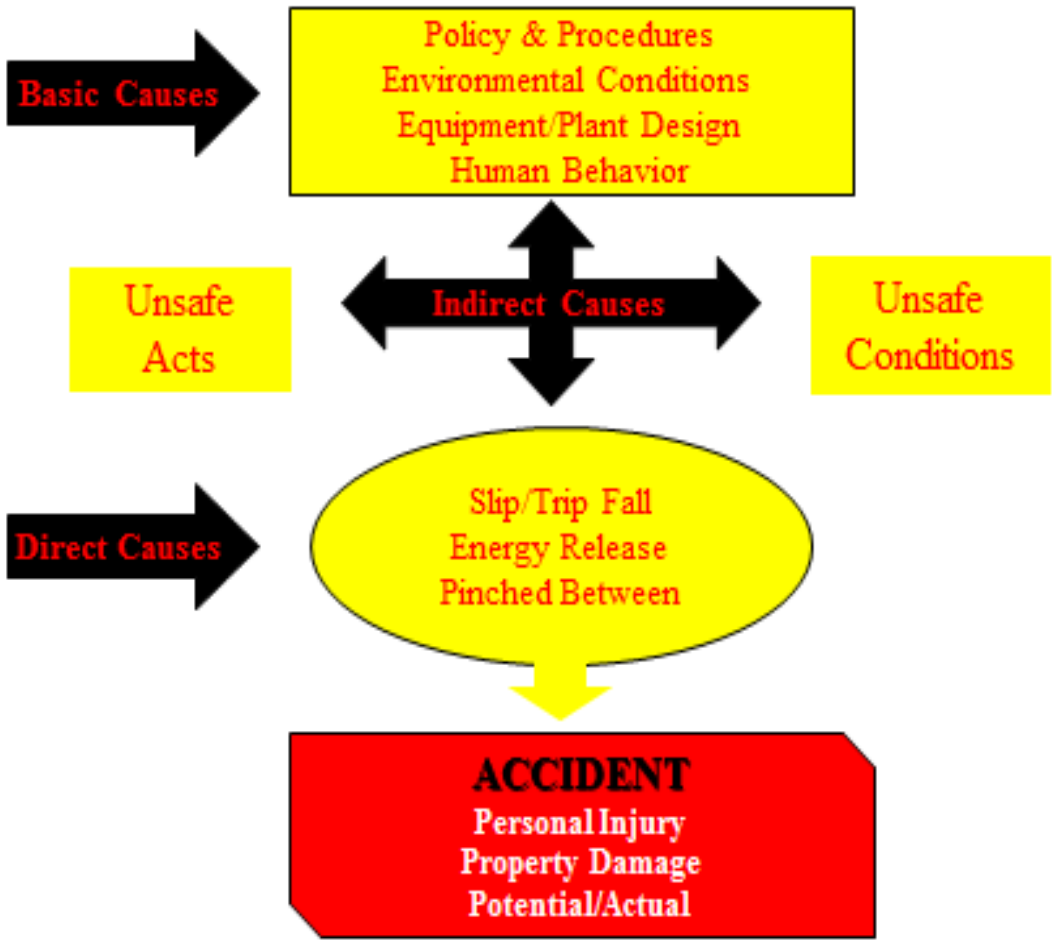

Fig.1: Basic Causes of Accidents [13, 14, 15, 16, 17 & 18]

3.2 Empirical Conditions of Accident in Construction of Nepal:

It was recorded around 140 specialists had minor mishaps and 15 labourers had significant mishaps looked at Gautam Buddha Airport Upgrading Component Construction Project. On account of managers, there were 2 minor wounds looked at the site with next to no casualties and passing at site finish of development. There was no decent spending plan straightforwardly referenced under the subject of the security spending plan. The principles and guidelines were additionally somewhat executed or not carried out at the site stringently. The disciplinary activity to the labourers who violet the wellbeing rules are taken for the genuine cases as it were. The significant reason found for the unfortunate execution of rules and guidelines was the absence of wellbeing division with sufficient financial plan and labor supply at the site, absence of review and observing from the public authority, and absence of explicit strategy and plan [19].

Block Kiln Stack Emission Monitoring in Kathmandu valley shows Stack outflow and criminal residue discharge were the significant issues of air contaminations. None of the furnaces had any contamination control gadget and wind-breaking divider. The normal Suspended Particulate Matters (SPM) focus was viewed as 270.08 mg/Nm^3 in BTK and 146.1 mg/Nm 3 in VSBK which are inside the constraint of outflow guidelines of Nepal (Sah et al, 2019) [20].

NBC 107: 1994 needed specifying. Flight of stairs assumes a significant part in fire wellbeing; inclination was not given to flight of stairs type and subtleties. There was no arrangement for the course of action of steps in the building, not notice where and how the entryway will be put on the step. No arrangement for a compressed flight of stairs. Emergency exit and outer step were noticed as single component however inside escape also could go about as an emergency exit. Safeguarded halls and Corridors were a necessary piece of emergency exit, they lead to an extreme spot of wellbeing however

no thought has been made in NBC 107:1994. There will be an extraordinary prerequisite for exceptional risks and cellar (Mishra and Sharestha, 2017) [21].

The significant reasons for the accident were the absence of abilities/information and the thoughtlessness of labourers. It was reacted that Personal Protective Equipment (PPE) was not adequate. The arrangement of security engineer/official was gathered according to the contract record however wellbeing official was not checking the security gauges successfully. Penetrating and impacting were the most dangerous exercises in burrow development during tunnel construction (Mishra et al, 2019) [22]. These are a few examples to show the status of Safety in Nepal.

4. METHODOLOGY :

This research tended to continue the study of Adhikara et al [4] for generating empirical solutions of project performance through safety. The study depends upon documents, observations, Key Informant Interview, and scheduled questionnaire. Ontological philosophy of research applied to the obtained pragmatic solution-based linkage of accident and site conditions.

4.1 Study Area:

Table 1: Study Area

Project Name	**Factory Commercial projects of Royal Sasa Pharmaceuticals**
Project Cost and Avg. Nos of Workers followed by Technical	30 crores and 25 workers followed by 9 (Consultant Engineer- 3, Contractor Engineer-1, Sub- Engineer-1, Foreman- 4)
Date of Project Execution	25th December 2018
Project Duration	2 years
Commercial projects Type	RCC + Steel Structure, 2 storied
Built-up area	14000 SFT
Project Name	**Hotel Siraichuli**
Project Cost and Avg. Nos of Workers followed by Technical Manpower Engaged	70 crores and 75 workers followed by 15 (Consultant Engineer-4, Client Engineer-2, Contractor's Engineer-2, Sub- Engineer-2, Foreman-5)
Date of Project Execution	2074-09-29
Project Duration	1.5 years
Commercial projects Type	2 Blocks, RCC & Steel Structure, 5 storied
Built-up area	9000 SFT & 4600 SFT
Project Name	**Chitwan Expo Center**
Project Cost and Avg. Nos of Workers followed by Technical Manpower Engaged	41 crores 46 lakhs 40 worker followed by16 (Consultant Engineer-5, Client Engineer-2, Contractor's Engineer-1, Sub-Engineer-1, Site Supervisor- 2, Foreman-5)
Date of Project Execution	2074-02-29
Project Duration	2 years
Commercial projects Type	4 Blocks, RCC & Steel Structure
Built-up area	Hall Block-57000 SFT-Metal Structure, Food Court-4200 SFT-Metal, Secretariat- 63007 SFT- 2 storied RCC+ metal, Toilet Bloc- 1125 SFT Metal Structure
Project Name	**National City Hospital**
Project Cost and Avg. Nos of Workers followed by Technical Manpower Engaged	15 crores Eight lakhs 80 workers followed by10 (Consultant Engineer-3, Client Engineer-1, Contractor's Engineer-1, Sub-Engineer-2, Foreman-3)
Date of Project Execution	2076-01-05
Project Duration	15 months
Commercial projects Type	RCC, 6 storied
Built-up area	10500 SFT
Project Name	**Construction of Diagnostic & Trauma Center (Block C)**

Project Cost and Avg. Nos of Workers followed by Technical Manpower Engaged	28 crores 30 workers followed by10 (Client Engineer-3, Contractor's Engineer-1, Sub- Engineer-2, Foreman-4)
Date of Project Execution	2074/06/24
Project Duration	30 months
Commercial projects Type	3 storied
Built-up area	17721.72 SFT

4.2 Sample Size and Selection:
The workers at the site, technical manpower, site supervisors, Engineers, Consultants, and Contractor representatives were taken as the study population. For the study, Census Survey was done. Since this is a perception-based survey, all the technical manpower involved in each of the projects were interviewed and taken as the study population. To improve on the sensitivity of data collection, technical manpower that includes Engineers and Sub- Engineers with more than 5 years of experience were taken as the respondent. A total of 60 personnel from all five projects were taken, and 23 other technical personnel were also interviewed making the total of the sample size to be 83.

4.3 Collection of Data:
4.3.1 Primary data:
Observation Method: The checklist of the site safety requirement was prepared to comply with the government standard checked through observation.
Questionnaire Survey The questions were developed and provided to the employees and employers to answer. A structured questionnaire was prepared and the collected answers were recorded for analysis. The questionnaire was designed for the contractor and consultant representatives as well.
Interview: Key Informant Interview (KII) was conducted. The interview included the interview of the employees, engineers, and client and contractor representative
Focus Group Discussion (FGD): Small groups of workers from each site were formed and focus group discussion was carried out in each site to extract the necessary information.
4.3.2. Secondary data: Data of Case cases accidents were collected with help of project official records and reports effectively using grounded theory techniques.

4.4 Analysis of Data:
Case analysis and site conditions analysis was done to analyse the linkage and develop a framework qualitatively using descriptive content analysis. Safety Plans, Safety Policy, Signs and Signals used, safety meetings, safety training, PPE, Engineering control, and administrative control were assessed and analysed to improve the safety of the site.

5. RESULTS AND DISCUSSION :

5.1 Responsible Parties for Accident in Site:
It is found that workers are major responsible for the accident at the construction site while the client is least responsible for the same and the government has no role and involvement for an accident at the site.

Table 2: Responsible Parties for Accident in Site

Responsible Parties for Accident in Site	No of Respondent	Respondent Percentage
Workers	58	69.87%
Contractor	18	21.69%
Consultant	6	7.25%
Client	2	2.4%
Government	0	0%

According to Table 2, about 70% of employers responded that workers are the major responsible party for the accidents followed by 22% due to the fault of the contractor. Consultants' responsibility is 7% for the cause of the accident at the site while clients are least involved in the accident at the site. The client only covers 2.4% of site accident responsibility.

5.1.1 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 95% of the KII responded that PPE is the prior control method for the accident. The administrative control is responded by 63% as an efficient control measure. The other minor factors include engineering control, substitution and elimination include 43%, 34%, and 30% respectively.

Table 3: Preventive Measures to Prevent Accident at Site

Preventive Measures to Prevent Accident	No. of Respondent	Respondent Percentage
Sign and Signals	42	50.6%
Safety Policy	23	27.71%
Orientation & Awareness	33	39.76%
Safety Meeting	75	90.37%
Housekeeping	54	65%
Training	38	45.78%

Table 4: Control Measure to Prevent Accidents

Control Measures to Prevent Accident	No. of Respondent	Respondent Percentage
PPE	79	95.18%
Engineering Control	36	43.37%
Substitution	28	33.75%
Administrative Control	52	62.65%
Elimination	25	30.12%

The study shows just the opposite response to the theory of The National Institute for Occupational Safety and Health (NIOSH, USA). Though suggested Elimination of Hazard from the site is the first line of control of Hazard, it was taken as the last line of control, while PPE used to be the last line of Control of Hazard, it appears to be the most important control measure to prevent an accident.

The review has focused on 34 contributory variables of the mishap causation through a double group of the specialists incorporating the semi-organized meetings with the specialists, survey of the professional as well. A sensible agreement was accomplished among the two gatherings of experts and project workers. The tests incorporate the Relative Important Index and the Spearman's position connection test. The three most critical factors no consistence to the administrative security rules and guidelines, labourer careless being used of the individual defensive things, and labourers racing to the work were evaluated best among the 34 gave things.

At first, the specialist group gives earlier concentration to the not consistence to the public authority wellbeing rules and guidelines, labourer racing to the works and arrogance of the specialists as it infers mishap causation factor ascribed to the hierarchical level and labourers as it were. Later positioning was given to the no utilization of the proper individual wellbeing techniques, state of the gear, absence of the site arranging and design, no preparation for the specialists, absence of management and control on labourers to wear security things, the pomposity of labourers and not the utilization of the right instruments for the particular errand. Though the project worker has the earlier concentration to the specialist careless in wearing individual defensive things, labourers racing to the work and no consistency to the public authority security rules and guidelines. Later positioning was given to the fitting individual wellbeing methods were not determined, the specialist was hurrying to the work, no safety engineer at the site, actual weakness of the work, no preparation program to the labourers, absence of the oversight and control on labourers to wear the security things and state of the hardware. Both the client and the worker for hire group settle on no consistency to the public authority wellbeing rules and guideline is the earlier element for mishap causation. In the past concentrate by Mishra and Sharestha, 2017 [13], discovered that the authorization status of rules and guidelines at business complex building sites was not good. He further subtleties that the work was obscure with regards to

the Labor Act and Regulations. Accordingly, in our specific situation, there is unfortunate execution of the standards and guidelines by the worker for hire, expert, and specialist groups as well. Labourers are careless in wearing individual defensive things during the development exercises. As per Health and Safety Executive (HSE) and OSHA, the exile labourers are at expanded gamble according to somewhere safe and wellbeing perspective. The principal reasons referred to for these are dialects and correspondence issues (85% of cases), being new to work, social factors additionally include. Notwithstanding this, half of the businesses do nothing unique for traveler labourer wellbeing and security than they accomplish for different specialists (HSE). Besides, the fast and effectiveness in the work make them stay away from the PPE. Laborer likewise hurries to work showing carelessness and snappiness. This is one more variable for mishap causation. In our functioning fields, for each assignment suitable individual wellbeing methodology is not indicated. Because of obliviousness and lack of education as well, disasters happen occasionally.

After the positioning, the spearman's position relationship coefficient is utilized to find the strength of a connection between two arrangements of information. As the worth of the relationship is emphatically sure so there is a solid association between the double group information.

5.2 Site Inspection:

5.2.1 Security and Public Safety:

Table 5: Site Security and Public Safety

S. No.	Topics	CEC	BH	HS	NCH	RSP
1	Site Perimeter Fence	√	√	√	√	√
2	Warning Signs (Hard Hats, No Trespassing.)	-	-	√	√	√
3	Travel/Access ways (Unobstructed and Maintained)	√	√	-	√	√
4	Adequate Lighting for Site and Public	√	√	-	√	√
5	Necessary Detours, Canopies, Sidewalks	√	-	-	√	-
6	Holes- protected by barriers/barricades/marked/covers	√	√	√	√	√
7	Guardrails > 6ft. height	√	-	-	√	√
8	Visitor Controls (Signs, Visitors, PPE, etc.)	-	√	√	√	√
9	Use of Lift at Height	-	√	-	√	-
10	Barricade below crack	√	-	-	√	√
11	Guardrails	√	√	-	√	√
12	Knowledge of Workers about safety	√	√	√	√	√
13	The treatment system of chemicals	-	-	-	√	-
14	Parking secure and well lit	√	√	√	√	√

CEC- Chitwan Expo Center, BH- Bharatpur Hospital, HS- Hotel Seraichuli, NCH- National City Hospital, RSP- Royal Sasa Pharmaceuticals

Site security and public safety is the foremost thing in construction safety. During the site visit, the entire site has proper perimeter fencing for safety as well as the site boundary purpose. The warning sign of the site is seen from the entrance point in three amongst the five only. This confirms that they have proper safety rules and regulations on the construction site. The travel inner road was properly well maintained, all of them were blacktopped whereas one is graveled road. The heavy equipment was also available in the proper site space. The lighting was adequate in all the spaces. The detour, canopies, and sidewalks were also maintained properly. All the holes were properly covered whereas the guardrails were not seen in the upper floor construction in some of the sites. All the site workers were sufficiently toughed about the safety knowledge. The parking was the entire road and the ground floor parking which were well lit.

5.2.2 Site (Trailer):

Table 6: Site (Trailer)

S. No.	Topics	CEC	BH	HS	NCH	RSP
1	Safety Engineer/Officer	-	-	-	-	-
2	Emergency Phone Number Posted	✓	✓	✓	-	✓
3	First-Aid Supplies Stocked	✓	✓	✓	-	-
4	Eye Wash Available	-	✓	✓	-	-
5	Blood Borne Pathogen Kit	-	-	-	-	-
6	Fire Extinguisher	✓	✓	-	✓	-
7	Poster (OSHA, etc.)	-	-	-	-	-
8	Copy of Company Safety & Health Program and MSDSs	-	-	-	-	-

A qualified site safety engineer is not provided in any of the single projects. The emergency phone number is provided in three projects of the site office among the five projects and can be approachable by all of the staff. The basic first-aid supplies were also well-stocked in three projects. The eyewash is available in two of the sites while the fire extinguisher is provided in three different projects. The OHSA (poster of site safety) was not displayed on the single site. Likewise, as per the respondent, the generic company safety & health program and MSDSs were not presented at all.

5.2.3 Personal Protective Equipment:

Table 7: Use of PPE

S. N.	Topics PPE	CEC	BH	HS	NCH	RSP
1	Hard Hat all the times	✓	✓	✓	-	-
2	Safety Glasses	✓	-	✓	✓	✓

3	Hand Protection	✓	✓	✓	✓	✓
4	Foot Protection	✓	✓	-	✓	✓
5	Hearing Protection	-	-	-	-	-
6	Protective Aprons (Chemical or Flame Resistant)	-	-	-	-	-
7	Standard PPE	✓	-	✓	-	✓
8	Checked and maintained correctly	✓	-	✓	-	✓
9	Used in Correct manner	✓	✓	✓	✓	✓

As per the site visit, there was a proper use of personal protective equipment like a hard hat, safety glass, gloves, and foot protection as per need. The hearing was not in use in any of the projects. No protective aprons were used in any project site. The Standard PPE was used in three of the project sites. While verifying the maintenance and checking of the PPE, it was found to be done in three of the projects and not applied in the rest of the two. Three of the sites make checking of the PPE regularly whereas two of them do not. It was found, for every project using PPE, they were used incorrect manner.

5.3. Housekeeping:

Table 8: House Keeping

S. No.	Topics	CEC	BH	HS	NCH	RSP
1	Fire Prevention Plan/ Evacuation Plan	✓	-	-	-	-
2	Fire Extinguishers (Adequate Number, Type & Maintained)	✓	✓	-	-	✓
3	Smoking Policies	-	-	-	-	-
4	Fire Hydrants/Standpipes (accessible to Fire Dept)	-	-	-	-	-
5	Necessary Permits Obtained from Fire Department	-	-	-	-	-
6	Emergency Plans are prepared, implemented, tested, and maintained.	-	-	-	-	-

Through KII, it was found that every project was very poor in Housekeeping. Except in Chitwan Expo Center, no project was implemented with Fire Prevention Plan and Evacuation Plan. Likewise, only in three projects, there is sufficient all the other projects can be considered as one of the major factors of the accident in the construction process. Two of them responded as there was a proper evacuation plan in the open space during the construction. Rest of the aspects, no smoking policies were maintained on the project site. As per the site visit, no project was provided with a fire hydrants pole for fire safety during construction works. Regarding the necessary permits from the fire department, no project concerns were acknowledged with the permits procedure, and thus no permission was obtained. During the construction progress, few attempts were made for emergency plans by certain institutions among the surveyed ones. But, they were not effectively implemented, tested, and maintained at all.

5.4 Ergonomics:

Table 9: Ergonomics

S. N.	Topics	CEC	BH	HS	NCH	RSP
1	Body fatigue and minor injuries	✓	✓	✓	✓	✓
2	Pressure points on any parts of the body	✓	✓	✓	✓	✓
3	Sufficient rest break for relieving stress	✓	✓	✓	✓	✓
4	Modification of instrument for comfortably	✓	✓	✓	✓	✓
5	Furniture arranged to minimize strain on the body	✓	✓	✓	✓	✓

As per the respondents, regarding the ergonomics, there was flexibility during the construction project. There is certainly arm and body fatigue and minor injuries during working hours. For the body fatigues, there is sufficient resting period and the leaves as per need for the illness. Certain instruments were modified for the comfortability of the use. There were no compact space works and for them, the furniture can be arranged as per need to minimize strain on the body were done.

5.5 Contractor Provision:

Table 10: Contractor Provision

S. N.	Topics	CEC	BH	HS	NCH	RSP
1	All Contractors have Designated Safety Rep/Competent Person	-	-	✓	✓	✓
2	All Contractors Have Submitted Haz Comm Program and MSDSs	-	-	-	-	-
3	All Contractors are conducting Safety Orientation with new employees	✓	✓	✓	✓	✓
4	All Contractors holding toolbox safety meetings (maintaining records)	-	-	-	✓	✓
5	All contractors are familiar with Emergency Action Plan	✓	✓	✓	✓	✓

The commercial project appoints a contractor for the work or one can be a contractor. The two of the visited projects were self-contractors. They have proper safety representatives. None of the contractors have submitted the Hazard common program and MSDSs. The safety orientation was conducted personally through oral or small toolbox talk programs from time to time. The two of the contractors recently held the toolbox training on the site with the attendance records. All of the contractors were well experienced and familiar with the Emergency Action Plan for safety.

5.6 Excavation:

Table 11: Excavation

S. N.	Topics	CEC	BH	HS	NCH	RSP
1	Barricading (at least 900m high) in place	✓	✓	✓	✓	✓

2	Shoring/ benching/ battering/ geo-technical	✓	✓	✓	✓	✓
3	Safe access provided to and from excavation	✓	✓	✓	✓	✓
4	Proper supervision	✓	✓	✓	✓	✓

Excavation is regarded as one of the riskiest construction activities. Thus, as per the KII response, there was proper safety allocation during the foundation excavation construction. Barricades and shoring were provided as needed in each of the pits. The access to the pit was done gently for safety. The supervision is done without missing each activity in the excavation period.

5.7 Psychological Health:

Table 12: Psychological Health

S. N.	Topics	CEC	BH	HS	NCH	RSP
1	Prevent workplace harassment and bullying	✓	✓	✓	✓	✓
2	Risk assessment for occupational violence	-	✓	-	✓	-
3	Counseling and support services available for affected workers	✓	✓	✓	✓	✓
4	Worker not working alone or in isolation where possible	✓	✓	✓	✓	✓

During the construction period, the psychological health of the workers needs to be assessed carefully. In all of the construction sites, there was no record of workplace harassment and bullying concerning it the counseling and support services are also provided as per the KII response. During the site visit, isolated working workers were not identified. The risk assessment program was provided to workers of only two of the sites. Therefore, in regards to the psychological health of the workers, a good response was received.

5.8 Fall Protection:

Table 13: Fall Protection

S. N.	Topics	CEC	BH	HS	NCH	RSP
1	Falling Object Protection (Hard Hats, Canopies, Debris Net)	✓	✓	✓	✓	✓
2	Holes/Openings Covered or Barricaded	✓	✓	✓	✓	✓
3	Nets	-	-	-	-	-
4	Personal Fall Arrest System (Full Body Harness)	-	-	-	-	-
5	Leading Edge (Employee Training) Warning, Safety Monitor	-	-	✓	✓	✓
6	Slip Resistant surfaces	✓	✓		✓	✓

7	Safe means of access and exit in opening area or edges	✓	✓	-	✓	✓

Many injuries were identified as a result of the falling accident. So, fall protection needed to be done for the shoring and from the floors without the barricades. The hard hat was provided to the workers during the scaffolding works compulsorily. The road and the drain holes were properly safeguarded and covered well. The nets were not provided in any of them may be due to their lower height. Proper body harness was not done in any of them, only general soft harness was done for the workers. All of the sites have slip resistance floors and roadways. The opening area can be safely accessed at each of the construction sites.

5.9 Scaffolding :

Table 14: Scaffolding

S. N.	Topics	CEC	BH	HS	NCH	RSP
1	Competent Person Designated (Erect, Use, Dismantle)	✓	✓	✓	✓	✓
2	Anchored to Structure	✓	✓	✓	✓	✓
3	Proper Access (No Climbing Cross Bracing)	-	-	-	-	-
4	Overhead Protection (access under deck barricaded, extended toe boards, mesh)	✓	✓	-	✓	✓
5	Guardrails (Top and Mid Rails, Toe Boards) Independent Lifeline for Suspended Scaffolds)	-	-	-	-	-

Scaffolding needs to provide for the exterior works at the heights. Temporary bamboo and metal scaffolds were used for the works in the sites. According to the interview with the project manager, there was a competent person for the erection, work, and dismantling of the scaffold. Most of the scaffolds were anchored to the main commercial projects. Only unsafe climbing was the approach for access to the scaffolds. No guardrails were provided to avoid accidental moving to the edge surfaces.

5.10 Amenities:

Table 15: Amenities

S. N.	Topics	CEC	BH	HS	NCH	RSP
1	Toilet Facilities (adequate number)	✓	✓	✓	✓	✓
2	Hand Wash Facilities	✓	✓	✓	✓	✓
3	Drinking water is available and accessible	✓	✓	✓	✓	✓
4	Adequate lunch facilities	-	-	-	✓	✓
5	Shower and washing facilities provided	✓	✓	✓	✓	✓

All of the construction sites were properly facilitated with the basic need of the workers. The facilities of the toilet, hand wash, drinking water, and shower and washing are properly provided. The lunch facilities were provided in only two of the sites, in the others worker have to self-manage.

The construction sites of Nepal are haphazard in the safety management status. No rules and regulations regarding the Commercial projects and Safety codes are followed. NBC 114: 2064 Construction Safety Code clearly describes the safety procedures and the risk and the health hazards identification too, but

in our country Nepal, the code is not followed and the international codes and practices are beyond the achievement.

Among the five visited commercial sites in the Bharatpur Metropolitan City, two of them are somehow a little bit strict in the case of the OHS guidelines. Both of the two sites come under the same organization project. Therefore, the management from the organizational level through monitoring and evaluation for the safety sites is of the greater achievement and success. Mishra and Sharestah [13] depict for the wellbeing preparing, organization strategy and correspondence for powerful mishap the executives, the firm necessities to upgrade its protected work frameworks and security the board strategy comparative with its authoritative security strategy to further develop its generally hierarchical security execution. Moreover, firms likewise need to fortify their innovative work strategy, preparing and exercising to accomplish better wellbeing information and security execution among labourers. Initially, for site security and public safety, all the construction sites were well secured via the boundary wall removing the risk of theft and encroachment with proper public flow control. All of the sites were properly lit and proper site safety was maintained. As discussed earlier the safety engineer is the foremost required for the site safety with the essential elements like the first-aid, fire extinguisher, etc. As per the clause of the NBC 114: 2064 Clause 4 general first aid box is only provided, the medical attendant was not provided and the once-a-month health checkup was also not provided, a fire extinguisher was provided in the site as per clause 5. But in the overall context, these general guidelines were not followed properly due to carelessness. The ILO and Labor Act basic guidelines were not followed for labour safety. Regarding the use of the PPE, the workers also have sufficient knowledge but the use is satisfactory only. The compulsory use has not been made until now in many construction sites. As per the clause of the NBC 114: 2064 Clause 6 Site Preparation the PPE was provided as per the standard and also used, but the not proper use and misuse of the PPE were seen in the site. The housekeeping was also not done as per the guidelines. There is a weak provision of the contractor's duties and responsibilities in every project. As per the clause of the FIDIC 1999 Clause 4.8 and 6, the safety procedure via the contractor was not provided. Contractors should make arrangements for wellbeing and wellbeing while getting ready offers. The arrangement for wellbeing and wellbeing should be made cutthroat with the plan to rival different bidders and to keep away from a money-related misfortune. To upgrade the job of the executives in wellbeing and security the current regulation ought to be changed to place more accentuation on the job of the board. Arrangements ought to be made to make it a legal obligation for each project worker to have the well-being of the executives' program nearby. Project workers ought to be constrained to draw up security obligations and authority structure which should be accessible in each site to illuminate all parties concerning their obligations, all things considered. The commercial projects codes and bylaws are also weak in the case of the documentation of the contractor's provision in the construction projects. During the excavation works in the sites, there was enough supervision and safety due to the worst site condition too. As per the clause of the NBC 114: 2064 Clause 7 and 8, the proper safety in the earthwork excavation was provided. Psychological health is another one of the greater important topics to be careful of in project activity. Within the commercial sites, until now no offensive contents and activities are recorded. Due to the long duration of continuous work they are mentally tired, so it will affect their work too. For the fall protection, proper scaffolding and the full-body harness need to be done for upgrading safety assurance to the worker. As per the clause of the NBC 114: 2064 Clause 7 and 8, the proper safety in the earthwork excavation was provided. Furthermore, there need to be proper guardrails in the scaffolds and openings to prevent the fall accident as the fall accident is one of the prominent accidents in the construction sector. As per the clause of the NBC 114: 2064 Clause 16 all the amenities for the labor welfare were provided but the insurance of each worker was not provided. FIDIC 1999 6.6 staff and labor facilities were compiled superficially. Amenities like toilet facilities, hand wash, drinking water, launch and shower, and washing area are also in satisfactory conditions but they don't meet up to the Labor Act and Commercial Projects Code.

5.11 Framing the Empirical Solution of Productivity through Safety:

CASE 1: A worker suffered from malaria in Chitwan Midtown Resort during the construction because of the lack of mosquito net in the accommodation site for the laborers. It took 1 week for him to be fine with a medicine cost of Rs. 3000/-. It shows due to the lack of mosquito net in the accommodation site for the labors might have caused be serious spread among all construction site staff and workers causing the site to be closed ultimately poor productivity at the site and lack of project performance might lead

to claim and disputes. The labour suffered pain and immune loss for a week and its pain cannot be expressed in monetary value. As of thumb rule, the indirect cost is assumed to be 4 times the direct cost resulting in it to be (4* 3000+3000) Rs 15000 which is a case of 1 employee but in a mass of workers, it could be a big loss of productivity. The net cost of around Rs 250 could provide to save huge profitability as an opportunity. The root cause is poor safety amenities and inspection. These biological hazards might have been assessed and avoided through construction safety plan enforcement.

CASE 2: During the construction of the factor shed of Sandwich Home Solutions, The gas meter got burst since it was not pressure released after day work. The next day, when the fabricator tends to open the oxygen gas supply, it burst and his face was injured with terraces of brushed glasses. He was hospitalized for 2 days and then sent for bed rest for 5 more days. Here, the cause of the Accident is lack of care and specific need for supervision. This is why job safety analysis of every work should be made effective and PPE could have been saved. The employee should be motivated with induction to avoid accidents either due to lack of skill or motivation. The dominos theory or the Swiss cheese model of accident causation should be strongly applied. It was an unsafe condition and the act caused to be an accident. There must be proper allocation of the safety items in the BOQ and the work done and personnel allocating doing the work should be aware of the hazards.

CASE 3: An electrician while, making a slut cutting on an overhead wall for concealed wiring, while working on a hotel building in Bharatpur, missed the running grinder and hit his mouth and thigh cut, gets injured and sutured in the mouth. He even didn't repeat the job on the same site.

Here, a Work permit as administrative control might have been saved his face if PPE have been enforced, and maybe quality work-life have made him fresh to work without stress.

CASE 4: During the construction Armed Police Force building project, one worker gets affected with eye burn and got affected for 3 days, due to welding flame, and it was because of his ignorance, not to use the face shield/ glass for welding, though it was provided on-site. Work was disturbed since he was ahead fabricator. This implies that work permits, inspection, training, and motivation should be strongly enforced.

CASE 5: A fitter fell from 30 feet height post while he was assembling the portal frame structure. He was taking support on the crane hook and got his hand slipped from the hook, he was ignoring to wear the safety belt. He was stricken on the hard floor, immediately taken to the hospital, got this leg and hand fracture on four spots, medical expenses of 149300. Work was suspended by his colleague for 3 days.

Here, working above 6 feet or anywhere having a chance of fall hazards should apply belt, net, harness, and fall hazards are most common still, we have not learned. This wants us to apply proactive and reactive approaches to eliminate, substitute, engineering control, and administrative control followed by PPE.

CASE 6: A civil labour working on the construction of an office building for a Construction Company got his hand and leg infected by the chemical effect of cement slurry. He was no more wearing gloves and safety boots while working. All Contractors should submit a hazard communication program and MSDS for strong enforcement. The project manager should focus on it as of now in Nepal, we do not apply it. The worker should be made proper understanding of the exposure of hazards and measures to minimize them. Workers for hire should arrange security and wellbeing while planning offers. Project workers ought to be constrained to draw up wellbeing obligations and authority structures which should be accessible in each site to illuminate all parties with regards to their obligations, taking everything into account.

CASE 7: A worker got drunk while being on site of the construction of the residential building, and he disturbed other workers at the site from working. The reason ruled out was that he was not provided the salary on time, and he missed his loan installment to get paid. Later, the contractor's head took him away from the site. However, the day work gets disturbed and the client suspended the work for that day, warning the contractor to resolve the issue, prevent alcoholism on-site and resume work. This type of issue happens because of poor documentation and lack of transparency and poor institutions.

CASE 8: During the construction of 120m long bridge herein Chitwan, during the hoist of MS cable, one of the workers gets jerked by the cable and he gets uncontrolled and fell into the river, and he was missed in the river, later found dead. He was a worker from India. Here, life is lost because of a lack of preparedness. If a strict construction safety plan is made and executed then life might not be lost. Most labour of Nepal and India work at Saudi, Qatar, and Dubai in construction are losing file made us think on it. Lifelines, safety belts, and lanyards shall be used only for employee safeguarding.

CASE 9: A mason fell from the second story during the construction of a building for a hospital in Bharatpur, Chitwan. He fell along with 9" brick masonry walls and was hospitalized for 4 weeks as he had fractured his legs and hands. The medicine and the hospital cost Rs.50000/-. Fall hazards are common though we have not prevented means we are careless. This wants strong regulatory provision through an effective safety committee.

CASE 10: A labor cut his leg with the grinder wheel while cutting the rebar during the construction of Bhatbhateni Supermarket at Bharatpur, Chitwan. In that accident, he lost his thumb. He was hospitalized for a week. This made us think of new approaches to improve safety by rewards and punishment culture through safety culture principles.

CASE 11: Group of workers (6 persons) got sick out of 56 workers while working on a project in Krishnanagar. The reason was they worked in scorching sunshine for a full day and also due to schedule pressure; they were employed overtime till 9 PM. They were on leave for 2 days and the rest of the workers also refuge to work overtime. Labour needs money so obviously to work overtime however the health and safety cannot be compromised in name of productivity as ultimately, it resulted in a loss at least 19 times more in we allocate value for all together. The job satisfaction from the engineering team to the workforce must be provided by the organization. The organization also must respect the employees' jobs. The job security, wages payment, and the basic services and facilities must be made as per bye-laws but not defying it. The organization will certainly have goodwill and economically best due to long-term serving employees. The share of the risk and responsibility of the accident to the organization team and supervisor must be made as the workers are always victims. It increases the job satisfaction and responsibility of the workers to the project and organization and safety culture in the organization. All the above situation affirms that safety promotes productivity and profitability in considering opportunity cost.

6. CONCLUSION :

The use of the safety signboards was limited in the sites. The construction projects were not completely aware of the safety factor in the construction sites as the provision of the safety officers was inadequate and the first-aid was not up to the standards. Thus, the preventive measures applied were sign and signal, safety policy, orientation/awareness, safety meetings, and housekeeping. PPE and administrative control were used as control measures. The study also reveals that PPE is the major item to control the risk. However, the PPE was provided in fewer amounts as required but that also has not been used due to carelessness, uncomfortable and not compulsion from the project team. There was no regular medical examination of the worker. Based on control measures for the accident, the survey reveals that the administrative system plays a major role.

Lack of no use of personal safety procedures, no use of the correct tools/equipment for the specific task, lack of organized working schedule, negligent and carelessness in the use of the safety items, bad condition of equipment, or defective and inadequate temporary support structure like scaffolding influences the construction site accidents. It is also observed that there is no proper optimal use of the personal safety procedure. The deployment of the site engineer, the safety officer is not properly allocated as they are self-dependent on the employed manpower for the safety concern. Moreover, individual characteristics like educated labor force and experience in similar work matter a lot for safety and risk management and accident avoidance. As most of the work is done manually in our country.

A little bit of use of automation, where there is a greater risk of human causality, can reduce the material and manual handling hazards. There must be proper allocation of the safety items in the BOQ and the work done and personnel allocating doing the work should be aware of the hazards. The housekeeping and the preventive measures must be allocated and the proper use of the PPE too. The job satisfaction from the engineering team to the workforce must be provided by the organization. The organization also must respect the employees' jobs. The job security, wages payment, and the basic services and facilities must be made as per bye-laws but not defying it. The organization will certainly have goodwill and economically best due to long-term serving employees. The share of the risk and responsibility of the accident to the organization team and supervisor must be made as the workers are always victims. It increases the job satisfaction and responsibility of the workers to the project and organization and safety culture in the organization. There must be a joint effort in risk reduction and management. The preventive measures like the safety meeting must be offered effectively and occasionally by the

contractor and consultant team as their duties towards occupational health and safety. Other measures like the use of PPE, administrative control, engineering control also should be considered. Workers for hire should make arrangements for security and wellbeing while planning offers. Project workers ought to be constrained to draw up wellbeing obligations and authority structures which should be accessible in each site to illuminate all parties with regards to their obligations, taking everything into account.

7. LIMITATIONS OF STUDY :

The study focuses only on safety status during the process of construction but not on their operation. Only the under-constructing commercial projects were taken into account.

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