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Evaluation of Health and Safety Status of Public and Private Building Construction Projects in Pokhara

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Abstract

Health and safety (H&S) in the construction industry encompasses a set of principles, regulations, practices, and measures designed to safeguard the well-being and safety of construction teams within construction environments. Developing countries like Nepal lag in establishing and implementing robust H&S regulations, impacting overall project performance. This research assesses the H&S status in public and private building construction projects within Pokhara Valley, Nepal. One private and one public project were selected for the investigation. After conducting a thorough literature review and consulting key informants, a structured five-point Likert scale questionnaire was developed for efficient data collection. Findings revealed that H&S aspects in privately and publicly owned building construction projects. Privately owned projects underscored effective ventilation, hard hats, and daily safety briefings are significant factors. Slip, trip, and fall incidents are major accident causes, highlighting the importance of proper lighting. Public projects emphasized ventilation, hard hats, and safety rules, with toolbox talks and qualified team members deemed critical. Slip, trip, and fall incidents remained the primary accidents, and safety signs played a pivotal role. These findings offer essential guidance for policymakers and construction managers to enhance H&S practices in diverse construction environments.

Keywords: Health and safety, Construction safety, Safety status, Construction industry

1. INTRODUCTION

Workers' health and safety (H&S) constitute fundamental aspects of the construction industry for project success [1]. Health involves safeguarding the well-being of individuals' bodies and minds against illnesses arising from the materials, processes, or procedures employed in their workplace. The health of workers is influenced by the specific working environment and conditions they experience. Within the building construction industry, the working conditions pose substantial risks, including exposure to noise and dust, engaging in heavy lifting and carrying, encountering climatic influences, performing static work, and enduring strenuous physical labor [2]. Workers are consistently exposed to a range of physical, chemical, and organic agents, rendering them susceptible to various health issues, such as injuries, respiratory problems, musculoskeletal disorders, and gastrointestinal diseases [3]. These factors continue to present significant challenges for building construction workers.

Safety is one of the major performance indicators of any construction project [4]. It is the protection of people from physical injury [5]. Safety at the construction workplace is an area of major concern for this industry because there is still a rise in reported fatalities and situations where a construction worker is at risk of illness, injury, or even death [6]. Thus, it is of the utmost importance to reduce the number of these injuries, deaths, and illnesses related to the construction sector by the implementation of the H&S on construction sites [2].

Enhancing H&S at construction sites necessitates improvements in policy frameworks and monitoring systems [7]. Given the high injury risk in construction, occupational safety becomes crucial for production efficiency, as injured workers lead to lost workdays and increased financial costs, impacting the industry's social and economic efficiency [8]. The construction sector exhibits a higher risk of occupational injury and accidents, primarily due to low awareness and limited safety practices [9]. While developed nations have made progress in worker safety, developing countries lag. Actual accident numbers surpass reported figures, highlighting the lack of comprehensive H&S data [10]. The efforts aim to cultivate a workplace that safeguards employees' physical, mental, and social well-being, striving to mitigate potential hazards and ensure a reasonably safe working environment [11].

The Nepalese construction sector relies on manual labor due to limited mechanization and lax safety regulations [12]. This sector faces safety issues due to ignorance and inadequate supervision, resulting in a high accident rate [13]. Despite constitutional mandates, employers often neglect safety rules. The government's inaction and industry non-compliance persist, hindering progress and worsening safety hazards on construction sites, despite the sector's significant economic contribution [14]. The construction industry, characterized by hazardous activities, exhibits a disproportionate accident record compared to its workforce and other industries [15]. According to [16] developing countries exhibit poorer records in terms of H&S. The concept of occupational health and safety (OHS) is still new in Nepal. OHS's issue in the construction industry is the lack of training and awareness among workers [17]. The construction industry, particularly in countries like Nepal, India, and Bangladesh, faces a critical challenge concerning workplace safety. Labor in construction is inherently associated with a heightened risk of injuries, leading to substantial financial costs and lost working days. Recent statistics underscore the pressing need to address safety issues in construction, emphasizing its social and economic impact [8]. PPE is recognized as crucial for accident prevention [18], but a crucial concern is the lack of awareness and knowledge among construction workers regarding its correct usage [19]. Furthermore, the prevalence of extended working hours and insufficient rest breaks exacerbates risks [17]. The absence of sanitation facilities further heightens the vulnerability of workers to infectious diseases [20]. This study seeks to bridge a significant knowledge gap by assessing the current H&S status and proposing strategies for improvement. The findings aim to provide valuable insights for policymakers, academics, safety experts, contractors, and other stakeholders, facilitating the design and implementation of effective policies to elevate safety standards within the construction sector.

2. METHODOLOGY

This research entails a comprehensive comparative examination of the H&S conditions in public and private building construction projects during the construction phases within Pokhara Valley, focusing on the workforce involved in construction activities. Buildings measuring 35-100 meters as highrises, above 100 meters as skyscrapers, and designating structures above 300 meters as super high [21]. In Pokhara Valley, ongoing construction in both public and private sectors is selected for research,

aligning with these criteria for a comprehensive study. The data collection process utilized both quantitative and qualitative methods, incorporating primary and secondary data sources. Given the manageable population size, the entire population was treated as the sample, resulting in a sample size equivalent to the population size. The questionnaire was distributed to 10 supervisors and 96 tradespersons across the two construction sites, achieving a 100% response rate. The questionnaire in this study employed a five-point Likert Scale to gauge respondents' levels of agreement or disagreement, focusing on statements related to health facilities, personal protective equipment, safety rules, safety education and training, management factors, the accident causes, and miscellaneous aspects. To validate and ensure reliability, KII was conducted with project engineers from the selected construction projects. Four experts, with over five years of experience in building, participated in the KII. For public projects, the construction manager and engineer were respondents, while in private projects, the project engineer and site engineer were interviewed. Data analysis was performed using SPSS, and the interpretation of results was done.

3. RESULTS AND DISCUSSION

Health Facilities Related Factor

Table 1 illustrates the RII and corresponding ranks for health facilities in both privately and publicly owned buildings within the construction sector. A proper ventilation system emerges as the most crucial health facility, securing the top rank in both private and public buildings with high RII values of 0.7559 and 0.7319, respectively. Safe drinking water and suitable accommodation to rest follow closely, consistently obtaining the second and third ranks across ownership structures. Canteen facilities and the provision of toilets are perceived with varying importance, securing the fifth and sixth ranks across both categories. First-aid facilities hold the fourth rank in private buildings and the third rank in public buildings. The table provides valuable insights into the prioritization and perceived significance of different health facilities, emphasizing the critical role of a proper ventilation system in ensuring a safe and conducive working environment in both privately and publicly owned construction projects.

Table 1: Status of health facilities

Description	Private Building		Public Building	
	RII	Rank	RII	Rank
Safe drinking water	0.7254	2	0.7276	2
Canteen facilities	0.5016	5	0.6042	5
Provision of toilet	0.4338	6	0.5361	6
Suitable accommodation to rest	0.5559	3	0.6127	4
First-aid facilities	0.522	4	0.668	3
Proper ventilation system	0.7559	1	0.7319	1

Based on the questionnaire survey and field observation, both types of construction projects need to improve facilities, including proper ventilation systems and access to safe drinking water. First aid facilities were deemed considerable in privately-owned building construction projects but were of higher quality in public-owned projects. Additionally, shelter facilities for rest and canteen amenities in public construction projects surpassed those in private construction projects. However, sanitary facilities, specifically toilets, in both construction projects were found to be unsatisfactory.

PPE Related Factor

Table 2 displays the RII and corresponding ranks for PPE in both privately and publicly owned buildings within the construction sector. Safety helmets take precedence as the most critical PPE, securing the top rank in both private and public buildings with RII values of 0.5762 and 0.5872, respectively. Safety boots and gloves follow closely, consistently obtaining the second and third ranks across ownership structures. Safety belts, safety glasses, and face protections are perceived with varying importance, securing the fourth and fifth ranks across both categories. The table provides a clear understanding of the prioritization and perceived significance of different PPE, emphasizing the importance of safety helmets as a fundamental safety measure in both privately and publicly owned construction projects.

Table 2: Status of use of PPE

Description	Private Building		Public Building	
	RII	Rank	RII	Rank
Hard hats or helmet	0.576	1	0.587	1
Safety glasses, goggles, and face shields	0.095	5	0.098	5
Foot protection (Boots)	0.431	2	0.43	2
Safety belt	0.136	4	0.132	4
Gloves	0.403	3	0.438	3

Safety Rules and Regulations Related Factor

Table 3 presents the RII and corresponding ranks for safety rules and regulations in both projects. In terms of the safety rules and regulations of construction companies, both public and private projects show high RII values of 0.7016 and 0.7446, respectively, securing the top rank. The implementation of existing safety rules and regulations holds the third position with RII values of 0.3796 and 0.3702 for public and private buildings, respectively. Review and update safety rules and regulations, provision of rewards and punishments, and health insurance for workers with lower RII values. Budget allocation for safety takes the second position in both projects, emphasizing its significance in promoting safety measures. Overall, the table provides a comprehensive overview of the prioritization and perceived importance of various safety rules and regulations in construction projects across different ownership structures.

Table 3: Status of Safety rules and regulations

Description	Public Building		Private Building	
	RII	Rank	RII	Rank
Safety rules and regulations of construction company	0.7016	1	0.7446	1
Implementation of existing safety rules and regulations of construction company	0.3796	3	0.3702	3
Review and update of safety rules and regulations	0.0915	5	0.1148	5
Provision of reward and punishment regarding safety	0.0338	6	0.0723	6
Health insurance for workers	0.1593	4	0.1659	4
Budget Allocation for Safety	0.4372	2	0.451	2

Safety Education and Training Related Factor

Table 4 provides the RII and corresponding ranks for safety education and training aspects. In terms of skill development, both private and public building construction projects assign lower importance, ranking fifth and fourth, respectively, with RII values of 0.1152 and 0.1191. Toolbox Talk secures a prominent position with the second rank in private buildings and the top rank in public buildings, indicating its high significance in safety education. Induction and emergency response training are perceived with moderate importance, ranking fourth and fifth in private buildings and fifth and third in public buildings, respectively. Notably, daily safety briefing emerges as a highly prioritized element, obtaining the first rank in private buildings and the second rank in public buildings. The table effectively illustrates the comparative importance and ranking of different safety education and training components across both privately and publicly owned construction projects.

Table 4: Status of safety education and training

Description	Private Building		Public Building	
	RII	Rank	RII	Rank
Skill development	0.1152	5	0.1191	4
Toolbox talk	0.5186	2	0.5659	1
Induction	0.1288	4	0.1021	5
Emergency response training	0.1423	3	0.1361	3
Daily safety briefing	0.5457	1	0.5276	2

Management Related Factor

Table 5 outlines the RII and corresponding ranks for management-related factors in both privately and publicly owned buildings. The experience of team members takes precedence in both buildings, securing the top rank in private buildings and the second rank in public buildings, with RII values of 0.6881 and 0.6723, respectively. The relationship between co-workers and workers ranks third in private buildings and fourth in public buildings, emphasizing its moderate importance. Teamwork is deemed highly significant, securing the second rank in private buildings and the third rank in public buildings. The qualification of team members is

crucial in public buildings, attaining the top rank, whereas it ranks fourth in private buildings. Planning of management regarding safety and adequate supervision from management receive varying importance across both categories. The table offers insights into the prioritization and perceived significance of different management-related factors in the context of construction projects.

Table 5: Status of management-related factors

Description	Private Building		Public Building	
	RII	Rank	RII	Rank
Experience of team members	0.6881	1	0.6723	2
Relationship between co-workers, and workers	0.4203	3	0.4042	4
Teamwork	0.4983	2	0.6425	3
Qualification of team member	0.3016	4	0.7106	1
Planning of management regarding safety	0.4000	6	0.4000	5
Adequate supervision from management regarding safety	0.4010	5	0.3829	6

As per the questionnaire survey and KII, both construction projects had experienced team members, but the qualification of team members in the public construction project surpassed that of the private construction project. In private construction projects, financially sound individuals were involved, prioritizing financial standing over academic qualifications, whereas academically qualified individuals were engaged in public construction projects. Team cohesion was more effective in public construction projects compared to private ones. Decision-making processes in private construction projects were characterized by prolonged evaluations of expenditures, benefits, and fund sources, while in public construction projects, government officers made timely decisions, considering the area's rights and available funds. The relationship between co-workers and workers on both projects was neutral, with adherence to the chain of command and maintenance of a hierarchical distance between higher and lower-level staff. Planning and supervision regarding safety from the management were perceived as suboptimal in both projects, attributed to limited resources.

Miscellaneous Factors

Table 6 outlines the RII and corresponding ranks for miscellaneous factors. Sufficient and proper lighting systems, crucial for safety, claim the top position in both projects with RII values of 0.7457 and 0.7404. Safety signs and signals secure the second rank in private buildings and the first rank in public buildings, underlining their importance. Emergency exits hold the third rank in private buildings and the second rank in public buildings. Guard rails and emergency communication systems are perceived with varying importance, securing the fifth and fourth ranks across ownership structures. Notably, the hiring of a safety officer is identified as the least significant miscellaneous factor, ranking sixth in private buildings and fifth in public buildings.

Table 6: Miscellaneous factors in public and privately owned buildings

Description	Private Building		Private Building	
	RII	Rank	RII	Rank
Safety signs, signals	0.7186	2	0.7404	1
Guard rail	0.5355	5	0.6595	4
Sufficient, and proper lighting system	0.7457	1	0.7404	1
Emergency communication system	0.5559	4	0.6638	3
Emergency exits	0.5796	3	0.7319	2
The hiring of a safety officer	0.0000	6	0.0000	5

Causes of Accident

Table 7 presents the RII and corresponding ranks for causes of accidents in both publicly and privately owned buildings. Slip, trip, and fall incidents emerge as the leading cause, ranking first in both private and public buildings with RII values of 0.6406 and 0.5404, respectively. Defective tools, plants, and equipment follow closely, securing the second rank in both categories. Overload work is identified as the third most significant cause of accidents, maintaining a consistent rank in both private and public buildings. Strike by a falling object and electric shock hold the fifth and fourth ranks, respectively, with varying RII values across ownership structures. Notably, the collapse of scaffolding is identified as the least significant cause, ranking sixth in both privately and publicly owned buildings.

Table 7: Causes of accidents in building construction projects

Description	RII	Rank	RII	Rank
Slip, trip, and fall	0.6406	1	0.5404	1
Strike by a falling object	0.6000	5	0.4382	5
Electric shock	0.6011	4	0.4638	4
Collapse of scaffolding	0.0000	6	0.0000	6
Defective tools, plants, and equipment	0.6169	2	0.5319	2
Overload work	0.6067	3	0.5106	3

According to the questionnaire survey, field observation, and KII, it was identified that slips, trips, and all incidents constituted the primary cause of accidents in both construction projects. Additionally, defective tools, plants, and equipment were identified as another contributing factor, with a higher incidence in private construction projects compared to public ones. Both public and private building construction projects lacked a systematic schedule for maintaining plants, tools, and equipment, addressing repairs only during shutdowns. Furthermore, overload work emerged as a significant factor leading to accidents in both sites, with a higher occurrence in private construction projects. Workers were

found to exceed the standard 8-hour workday, motivated by the desire for additional income. The survey revealed that workers experienced pressure to engage in overtime work to meet specified deadlines, with contractors providing additional overtime compensation. Accidents attributed to electric shock and incidents involving falling objects were identified, occurring more frequently in private construction projects than in public ones.

The comprehensive analysis of H&S aspects in both privately and publicly owned construction projects reveals critical insights for improving the overall safety culture in the construction industry. The prioritization of health facilities, including proper ventilation systems and access to safe drinking water, signifies their paramount importance. While public projects generally outperform private ones in certain health facility aspects, both struggle with inadequate sanitary facilities. PPE rankings underscore the universal significance of safety helmets as fundamental safety measures, with notable variations in the provision of other PPE items across project types. Safety rules and regulations, safety education and training, and management-related factors exhibit nuanced differences in emphasis between public and private projects, highlighting areas for targeted improvement. Causes of accidents, such as slip, trip, and fall incidents, underscore the need for focused preventive measures, with private projects facing additional challenges related to overload work and defective tools. Miscellaneous factors, including lighting systems and safety signs, underscore the importance of a holistic safety approach. A study in Ethiopia highlighted that ensuring the provision and utilization of safety equipment, preventing work overload, and controlling that use in the workplace could effectively minimize work-related injuries and occupational diseases, thereby enhancing construction site safety and reducing accidents [22]. Elimination, substitution, and administrative control were not practiced, and no emergency exit and alarm systems were used in construction sites [23]. The carelessness of workers together with the ignorance of top management is the result of accidents in the construction industry [24]. The Nepal Building Code (NBC, 1994) outlines essential safety measures for construction, material handling, first aid, fire-fighting, site preparation, electrical works, demolition, and labor welfare, ensuring comprehensive construction safety. The ILO's construction site health and safety code provides universal guidelines, but in Nepal, effective implementation is lacking, especially in building construction sites, impacting workers' health and well-being.

4. CONCLUSIONS

The research focused on building construction projects owned by both private and public entities. Within privately owned buildings, crucial elements were identified, emphasizing the pivotal role of effective ventilation systems, provision of safety helmets, and strict compliance with safety rules and regulations. Daily safety briefings took precedence in safety education and training, earning the highest rank. The experience of team members emerged as a top management factor, holding the highest position. Slip, trip, and fall incidents were identified as the predominant causes of accidents, ranking highest. In the miscellaneous category, a sufficient and proper lighting system was of utmost importance, securing the highest rank. Similarly, the analysis of public-owned building construction projects revealed a focus on proper ventilation systems, provision of safety, and strict adherence to safety rules and regulations. Toolbox talks held the highest rank in safety education and training. The qualification of team members emerged as a critical management factor, securing the highest rank. Safety signs and signals took precedence in the miscellaneous category, holding the highest rank. Overall, the findings provide a robust foundation for policymakers, construction managers, and stakeholders to formulate and implement

effective strategies for enhancing health and safety in construction projects, fostering a safer working environment for construction workers.

Practical Implication of Research Findings

To enhance construction site safety, authorities should prioritize systematic maintenance schedules for tools and equipment, and enforce standard work hours to curb overload in construction projects. Emphasize preventive measures for slip and fall incidents, ensure consistent provision and use of PPE, improve sanitary facilities, and enforce safety regulations.

CONFLICTS OF INTEREST STATEMENT

The authors would like to declare that there are no conflicts of interest in this study.

DATA AVAILABILITY STATEMENT

The questionnaire data and other relevant data can be available upon request to the authors.

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