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Appraisal of health and safety management practices pre and during COVID-19 in the construction sector

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***Abstract*---**The construction sector has long been regarded as one of the most dangerous. This is due to the industry's low performance in terms of health and safety when compared to other industries around the world. Construction workers experienced and continue to face extraordinary safety and health problems during the pandemic. The goal of this study is to analyse and assess the safety management in the construction industry in order to reduce and control construction worker health and safety (H&S), as well as what new safety precautions have been defined to protect the workforce's health and safety and limit the spread of the virus. A questionnaire is designed to gather a variety of viewpoints from experienced people working on various building sites. The first stage in gathering information from previously linked studies is to conduct evaluations of related literature, publications, and conference papers. The literature reviews provided a theoretical framework on safety management that aided in the questionnaire's development. According to the findings of this study, the construction sector has a high rate of fatalities and protracted injuries. In a modern culture, this is unacceptable, and it also makes the sector inefficient, as days are missed due to injury. This study found that high number of injuries are caused by a

number of issues, including poor construction strategy, a lack of safety precautions, insufficient safety training, and a hostile work environment, lack of knowledge and awareness of site laws. This research will serve as a basis for academics and practitioners to address the concerns of construction workers in the future, as well as lessons gained for the industry during the event of a future pandemic.

***Keywords*---**health management, construction sector, employees.

Introduction

Properties (resident and non-residential) are constructed, renovated, maintained, and demolished as part of the construction sector's operations, as are civil engineering projects like highways, roads and utility construction [22] There are several market sectors involved, including those for manufacturing tools and materials, mobility, power, and waste collection and management. By converting raw materials into capital items required for both economic activity and the provision of infrastructure services, value is added. The huge and vibrant construction industry serves as the foundation of the global economy as a whole and second largest economic activity next to agriculture in India [10] by generating a number of employment opportunities, mobilizing a lot of money and resources, and enlisting a lot of people. On the other hand, a larger number of work-related incidents that resulted in fatalities and injuries have elevated this business to the list of the world's most dangerous work-related industries [50][49][31][32] [17] [28]. Apart from occupational accidents, there is great concern for loss of work hours and compensation cost of the workers due to health problems in this industry [51]. The workers of this industry perceive less job security specially working in the field [52]. The level of safety in this particular industry is determined by a collection of incidents that have happened over a period of time rather than by a single disaster. Annually, throughout the world, an estimated number of 340 million people suffer with work-related injuries, 160 million victims of work-related illnesses and 651,279 die as a consequence of these injuries a year [22]. In India, the bandwidth fatality rate accidents (FAFR; incidents/1,000 employees/year) is 15.8, which is fifty times greater than the FAFR in US construction industry [10]. Additionally, every day in India, one in every 2,000 construction workers was hurt or had an accident. [4]. According to the International Labour Organization, illnesses and workplace accidents cost the world's economy 4% of its GDP [16]. Prior to the virus, the construction industry employed around 7.7% of the world's workforce [23], and predictions for 2020 indicate that it will contribute 13.4% of the world's GDP [21]. But in the present crisis, decreasing income and growing project delivery difficulties have caused the industry to decrease in the majority of markets [14], which has had a detrimental effect on the labour force. When the virus struck, the situation of construction projects deteriorated: more projects had costs and delays, disrupted material supply chains, mass unemployment, lower labour availability, and increased concern for worker health and safety [24]. This shows that in order to improve worker health and safety, safety procedures in the Indian construction industry still need to be enhanced. Numerous topics, including ergonomics, are being studied in order to improve safety performance in the Indian construction sector.

[45], safety program [40] and safety performance measurement [13]. Knowledge about the noticeable trends in accidents is required in order to assess the level of safety and also directions for changes [7]. The reasons for accidents and illnesses in the field are widely understood. One of the main issues is slipping from an altitude, like a tower, as well as transportation accidents that happen both on and off the job site. Numerous occupational ailments, such as asbestosis, occupational deafness, and allergy, continue to inflict long-term misery for many industry employees. Further to this The safety and health situation on construction sites was deteriorated by factors including dangerous work practises, inadequate information, hazardous working conditions, a lack of relevant and equipment and materials, neglect in adopting safety regulations and legislation, and a lack of communication. [5]. Prevention is the process used to identify health and safety hazards in projects and put measures in place to lessen the likelihood of those risks materialising and the potential repercussions they could have. During pandemic many agencies released a set of guidelines that construction employers can follow to safely resume work on construction projects. One of them was Occupational Safety and Health Administration (OSHA) [33].

In order to reduce and manage the risk to employees' and workers' health and safety, the research's goal is to identify and assess the safety management in the construction industry. This goal might be accomplished by: Examining solutions to health and safety issues specific to the construction sector in order to reduce danger to construction crew members' lives. To prevent workplace accidents and injuries, it is important to understand how building processes may have a negative impact on workers' health and safety. In order to help the construction sector manage the epidemic responsibly, this research also makes recommendations for how to address the issues raised by the employees.

Literature Review

Construction sites are known for its complex environments where many unsafe acts and/or unsafe conditions exist [11]. Occupational health is defined similarly by the World Health Organization (WHO) and the International Labor Organization (ILO). "Occupational health should aspire to enhance and achieve the highest standards of physical, mental, and socioeconomic well-being of workers; the protection of health departing among workers affected by their workplace conditions; the defence of workers in their jobs from exposure to a hazard to health; the establishment and maintenance of the employee in an occupational setting that is tailored to his or her physical and psychological capacities; or, to put it another way, the adaptation of work to the individual and of the individual to the work" [41]. In the Eastern Province of Saudi Arabia, Jannadi and Bu-Khamsin performed a questionnaire survey with industrial contractors, and formal interviews with the contractors and officials in charge of construction safety were undertaken. The general building construction enterprises made up 72% of the businesses that took part in the study [30]. For improved resource allocation and coordination, Pheng and Shiua underlined the need for integration between quality and safety [27]. Wilson Jr. and Koehn argued that because each construction site has different safety considerations, safety procedures should be different there as well. While small to medium-sized businesses lack a sufficient safety programme or a person to manage safety

standards, larger building projects are more organised [25]. Through their research, Koehn and Datta came to the conclusion that safety standards and regulations not only address problems like subpar workmanship, hazardous working conditions, and a lack of environmental control but also save costs and increase productivity [15]. Previous study [29] highlighted the link between managerial commitment and safety performance. An efficient safety programme that incorporates management commitment, training, and education could increase safety performance. [34]. Khahro et al., identify the most common types of health problems recorded in construction industry and also identified the direct and indirect causes of it [37]. Further they advocated the remedial measures to reduce health problems and avoid negative impacts in this industry. Saeed, in his primary data study [48] argued that the high accident rates are caused by a number of likely reasons and by organisations' lack of awareness of their workers' health and safety. He also came to the conclusion that by providing employees with adequate H&S training, putting more emphasis on H&S during the project planning phase, and enforcing harsher penalties for unsafe H&S practises, the risk of construction to workers' health and wellbeing could have been lowered. Lucy, examined the role of the Client, Consultant and Contractor in health and safety consideration during project implementation [26]. Relative Importance Index for each factor affecting health and safety was determined after collection and evaluation of data. This study further conclude that to improve the safety and health performance of building construction projects each building, construction projects should have their own safety and health policy. The important elements of the safety management programme have been the subject of several research to investigate their link. For instance, a prior research [39] identified and examined nine crucial elements that affect a construction safety system's effectiveness. Similar research addressing the elements necessary for the framework of safety management to be implemented successfully can be found in [35] [9] [12] [19] [46]. A safety education programme was established as a result of several research [2] [3] [40] to inform employees and workers about potential dangers at construction sites. In India, The pandemic had adverse effects on the labour force, availability of supplies, availability of equipment, corporate liquidity, contract management, interruptions in the supply chain, funding limitations, and cash-flow issues [38]. Lockdowns resulted in unplanned project delays, difficulties in obtaining permits and government orders, a reduction in workforce size, and social alienation. [38]. According to Hansen [36], COVID-19 is an unexpected, inescapable, unmanageable, and impracticable occurrence that is outside the realm of reason for any party in the context of the building business. The author recommended that the contractors and employer create a COVID-19 mitigation task force that is able to oversee worker health and safety on the building site, communicate with hospitals, educate employees about the virus, and detect possible hazards. In another study, [18] presented suggestions on how building industry employers might contribute to society and aid in the COVID-19 crisis recovery. According to the report, future investments in construction that result in the creation of new employment or the restoration of those that were lost due to the COVID-19 lockdowns should enhance both culture and the workplace. For instance, in addition to providing workers with adequate wages and incomes, businesses should be more diverse and inclusive, actively engage with their communities, respect cultural differences, and offer workers a better work-life balance, effective mental health management strategies, more opportunities for

professional advancement, and improved management guidance and communication. These benefits might provide employees who are reconstructing their lives following the COVID-19 outbreak with much-needed social value [18]. One study painted major safety and health concerns that the construction workforce may face in the COVID-19 pandemic [6].

Construction Safety Statistics, 2022

Construction workers begin to encounter high levels of fatal and non-fatal incidents and fatalities despite improvements in safety equipment, technology, and training [8]. According to data on fatal injuries in the construction sector, the sector accounts for 1 in 5 worker deaths in the United States. About 60% of the 42 deaths a year caused by cranes involve a falling object. In 2020, there were 1,008 workplace fatalities among construction workers. Construction workers experience fatal injuries at a rate of 10.2 per 100,000 annually, which ranks as the third-highest incidence of any industry. Avoiding crashes in construction would result in an annual saving of more than 300 lives as falls account for 34% of all fatalities in the industry. Over 60% of all deaths associated to construction may be attributed to the "Fatal Four" major causes: falls, equipment strikes, becoming stuck in gaps in items, and electrocutions. According to statistics on non-fatal construction injuries, 1.1% of construction workers experience injuries severe enough to require missed work each year. Six percent of all accidents that cause lost workdays occur in the construction sector. Construction had injury and sickness rates that were 24% higher than the average for all sectors in 2020. More than 25% of construction employees admit to not reporting an injury sustained at works. There were 174,100 injury cases in the construction industry in 2020. The risk of workplace injuries was highest among construction workers between the ages of 25 and 34. Construction injuries are expected to cost the United States $5 billion annually in medical expenses, missed wages, diminished quality of life for family members, and lost output, according to research. Each year, the total cost of workplace accidents exceeds $170 billion. The yearly cost of workers' compensation claims for nonfatal falls is $2.5 billion. In 2020, more than 130,000 construction employees lost work days due to illness or accidents, which reduced output. OSHA estimates that construction businesses save $4 to $6 for every $1 invested in safety programmes, according to statistics on investment in safety training. Injuries cost construction businesses, on average, 3.6 percent of their budgets, although safety training only accounts for 2.6 percent. 67 percent of construction employees believe that productivity demands are greater than safety norms. 25 percent of workers worry about getting hurt every day, and 55 percent think they need additional safety training.

Construction Accidents

Construction sector accidents are expensive both financially and in terms of lives lost. Accidents that result in harm, primarily to personnel on the job site, might happen during building and demolition activities. Accidents might happen while a project's site is being surveyed and when its components are being implemented. Possible hazards for workforces in construction are:

- Scaffold collapse
- Falls of material and object from heights
- Falls from heights
- Trench collapse
- Electric hazards
- Other

Figure 1 depicts Census of Fatal Occupational Injuries (CFOI) by selected characteristics in India construction industry during 2003-2018. We have only found the data till 2018 on Bureau of labour statistics. It can be seen that in 2018 fatalities are more as compare to previous years. The majority of falls-related accidents happen while people are working on rooftops, scaffolding, and ladders. The main reason of arising these accidents is unsafe worksite conditions and unsafe acts may arise due to a worker's state of mind, tiredness, stress, or physical condition.

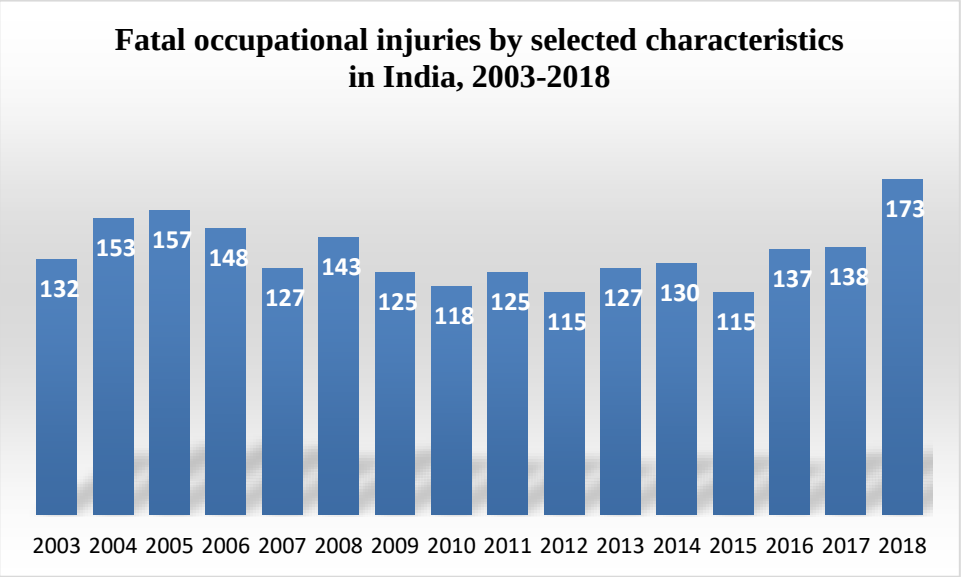

Fig1: Fatal occupational injuries by selected characteristics in India, 2003-2018 (adapted from U.S. Bureau of Labor Statistics, Dec 16 2021)

National census of fatal occupation injuries in 2020 report has taken from bureau of labour statistics to display the number of fatal work injuries from 2010-2020. Figure 2 depicts there were 4,764 fatal work injuries recorded in the United States in 2020, a 10.7% decrease from 5,333 in 2019 and represents the lowest annual number of fatal occupational injuries since 2013. These data are taken from the Census of Fatal Occupational Injuries (CFOI).

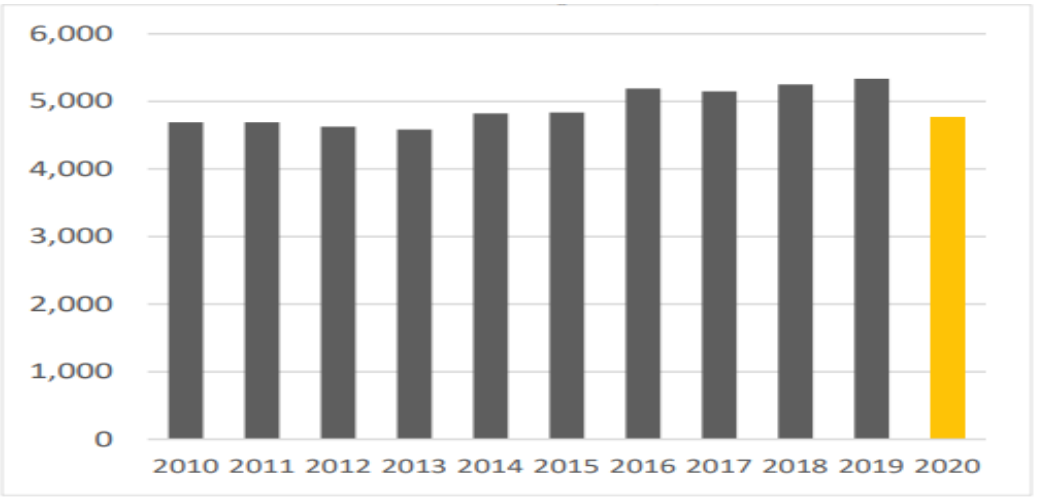

Fig2: Number of fatal work injuries, 2010-20 (adapted from U.S. Bureau of Labor Statistics, Dec 16 2021)

According to a report by the U.S. Bureau of Labor Statistics [42], construction workers are a group at high risk for fatal transportation incidents. According to Fig. 3, the most accidents occur when people fall from a height, slide, or trip. These are followed by occurrences involving transportation, exposure to dangerous substances, contact with objects and equipment, and aggression, among other things. Platforms without edge protection are the biggest contributors to fatal incidents that occur during the building and disassembly of scaffolding. Therefore, more scaffolding investigations are required to reduce and regulate the number of incidents that were caused by dangerous.

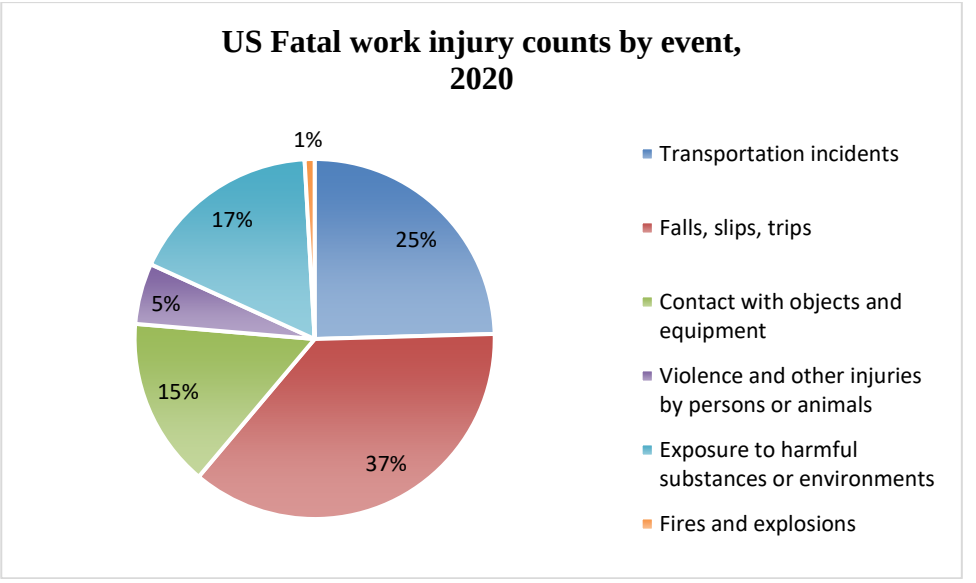

Fig 3: US Fatal work injuries by major event or exposure, 2020 (Adapted from U.S. Bureau of Labor Statistics, Dec 2020)

Eight different countries' effects of COVID-19 on their economies and construction industries have been studied [1], and it was discovered that each country's GDP shrank during COVID-19. According to Fig. 4, the GDP of India shrank by 23.9 percent in Q1FY21, the economy of the United States shrank by 4.8 percent in Q1 2020 as a result of the Corona Virus outbreak that has caused the nation to be closed down, and In the first quarter of 2020, the Chinese economy contracted by 6.8%, and Italy's GDP decreased by 4.7% over the previous three months to March 2020. In March 2020, the UK economy dropped by a record 5.8 percent. The Australian economy has decreased by 10%. Russia's GDP will contract by 5% in 2020, whereas the UAE's GDP contracted by 1% in March 2020.

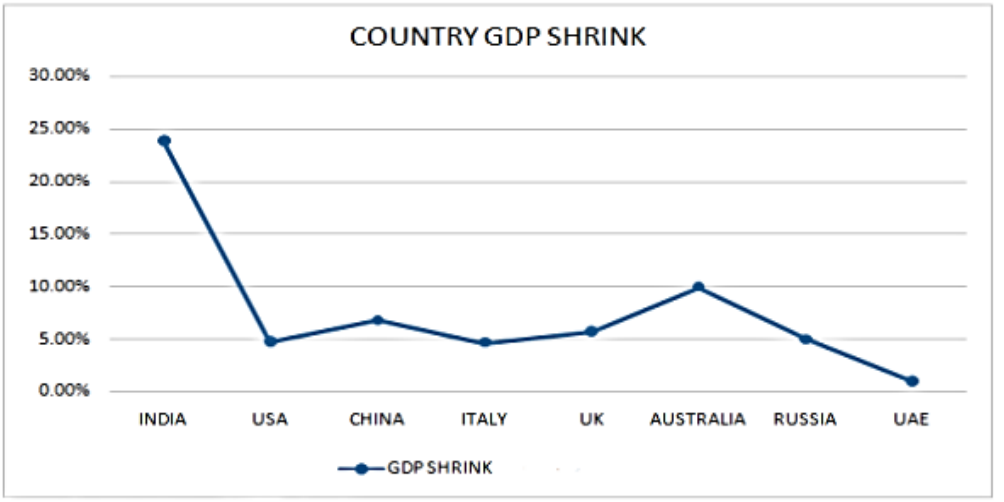

Fig 4: Worldwide Percentage of GDP Shrink (Adapted from Ankan Biswas s et al 2021)

Research Methodology

The definite objectives of this research study were: 1. to identify health and safety matters in construction industry; 2. to define factors that affect health and safety of employees. For achieving these objectives, a questionnaire as a research tool was developed with the help of literatures in the same field to collect the information from various professionals working in the construction industries. For this researcher had opted various constructed sites and targeted persons like site engineer, contractor, project manager, safety officer, consultants, etc. Convenient sampling was used to collect the data. The data was collected both from primary and secondary data. To target (population size was 437) various construction sites in northern region of India (12 residential building sites, 11 commercial building sites, 4 educational building sites, and 3 religious buildings sites) total 200 questionnaires were distributed and the respondents were invited to carefully respond to each question. The questionnaire was having two parts, first was demographic background of the respondent and second was about health and safety management. The questionnaires were sent into google form link through what's app, emails and physically by arranging a meeting with them. Out of the 200 questionnaires only 137 valid responses were received. The

questions were being asked through Five-point research Likert scale was used ranging from strongly agree to strongly disagree, insignificant to significant, multiple choice and yes/no.

Descriptive Statistics

This section describes the characteristics result of the respondents collected from the designed questionnaire of the industries contributed in the study located in northern region of India. These characteristics comprise the respondents' experience, qualification and categories. Out Of the 137, the tenure of respondents was measured in terms of years they had been working in that industry, 25.3% of respondents have less than 5 years of experience in the construction industry, while 19.7% of respondents have 6- 10 years of experience, 24.7% respondents had spent their years between 11 -15 years and 30.3% of the respondents had more than 15 years of experience. The figures shows that construction industries have well experienced persons and can give quality of responses. To understand the constructs and the importance of health and safety in depth the education level of the respondents was very important. More than 90.8% of respondents were having graduation and post-graduation degree in science field and only 9.8% had less than graduation education level. The job label of the respondents were calculated that 22.3% Site engineer, 22.3% contractor, 22.3% project manager, 7.4% safety officer (1.5% safety manager, 2.9% inspector and 2.9% advisor) and 25.3% consultants all were concerned regarding health and safety matters and their roles and responsibilities in the construction industries.

Result and Discussion

This part would contain the results as well as the major key points from the analysis.

Degree of health and safety practice

The current situation on construction sites was assessed with respect to health and safety application in percentage. There were 57.94% of contractors who were having first aid, PPE (helmet, googles, safety shoe, masks, face shield, welding masks, hearing and respirator protection) and occupation health service. It had been seen that health and safety measures were not practicing by contractors. Even instruction and training w.r.t. health and safety were also provided to 58.34% of workers. There were only 48% of site and equipment regular interval inspection, which is a major cause of accidents. This shows that employees were not aware about the basic safety measures.

Causes of Accidents and Injuries

When participants were asked to evaluate each type of injury that their team had on the job, it was discovered that falling from a height was the most common and the reason was that there was no horizontal safety built into high-rise multiple floors. The second leading cause of injury was the failure to utilize personal protective equipment (PPE). As it can protect employees from skin injuries,

however they do not use PPE due to shortage of investment by contractors, as well as a worker's discomfort with wearing it. Struck by falling/moving object was the third cause of injury which could result in lost time at work and lengthy medical care. Contact with machinery was the fourth cause due to not following the protocols at work. Slip, trip, and fall same level as the fifth, while lifting and handling equipment and contact with electricity were sixth and seventh respectively.

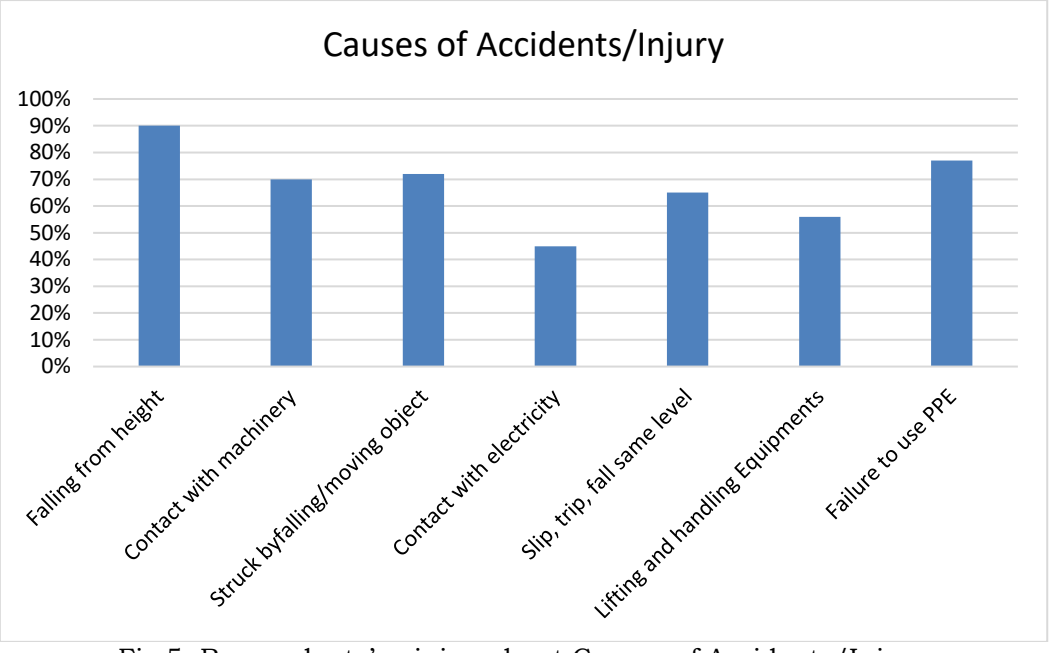

Fig 5: Respondents' opinion about Causes of Accidents/Injury

Reasons for high rate of Accidents/Injury

The responses of the respondents for occurrence of accidents and injuries had been analysed to know that how strongly they agree or disagree with the reason of accidents. Fig 6 indicates the final percentage figures of the reasons of accidents/injury investigated in the construction sites. The majority of respondents agreed that all of the alternatives resulted to high incidence of accidents and injuries. More over half of respondents (52%) strongly believe that high accident rate was due to lack of safety training. 52% of respondents were agreed that high accident rate due to OSHA safety violations, there were significant rates of accidents, according to 51% of respondents, due to non-wearing of PPE as well as tiredness/fatigue. 49% of respondents agreed with due to refusing to obey rules. Furthermore, more than half of the respondents (51%) felt that high rates of accidents were a result of the continually changing working environment and 43% of respondents agreed that high rates of injuries were due to nature of work and 42% of respondents were neutral about a lack of awareness and experience with site rules. Furthermore, 45% of respondents believed that there was a significant accident rate due to due to machinery defect and errors on site.

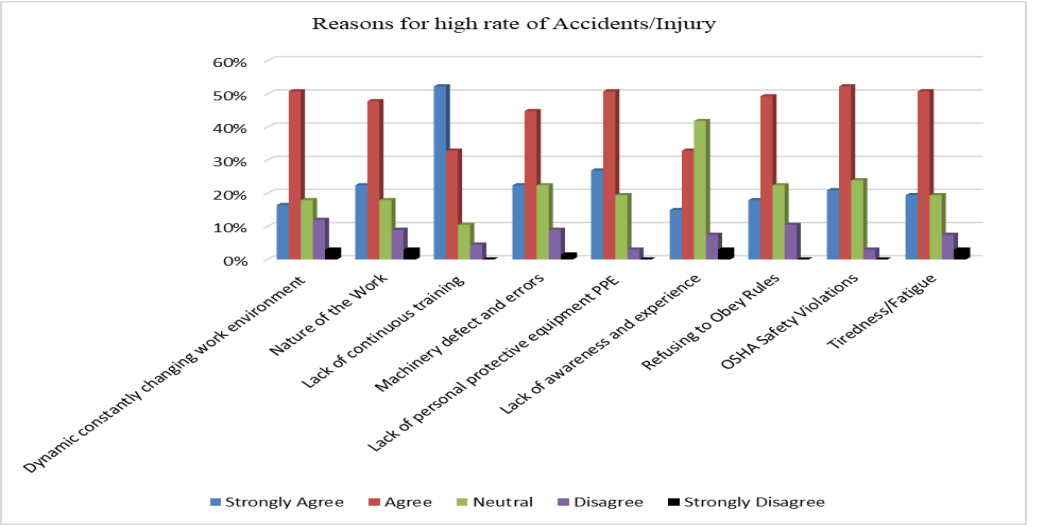

Fig 6: Respondents' opinion about Reasons for high rate of Accidents/Injury

General Obligations of competent authorities in health & safety practice

As indicated in Figure 7, more than half of respondents (57%) said that health and safety training courses for employees were extremely significant in lowering the danger of construction on workers' lives. Additionally, according to 54% of respondents, it is crucial for worker safety to verify tools and equipment to ensure quality. 51% of respondents believed that additional emphasis on continuously check all safety-related records, reports, and problems to keep them up to date. 51% of respondents believed that continuous inspection of project sites, to confirm a hazard-free environment is significant. 48% of the respondents believed that creating and enforcing safety guidelines and programs is important. 49% of the respondents believed that arranges OSHA-mandated evaluations of the site is also important. 50% believed that promoting safe practices on site is also significant. Furthermore, 54% of the respondents believed that Conducting investigations on accidents.

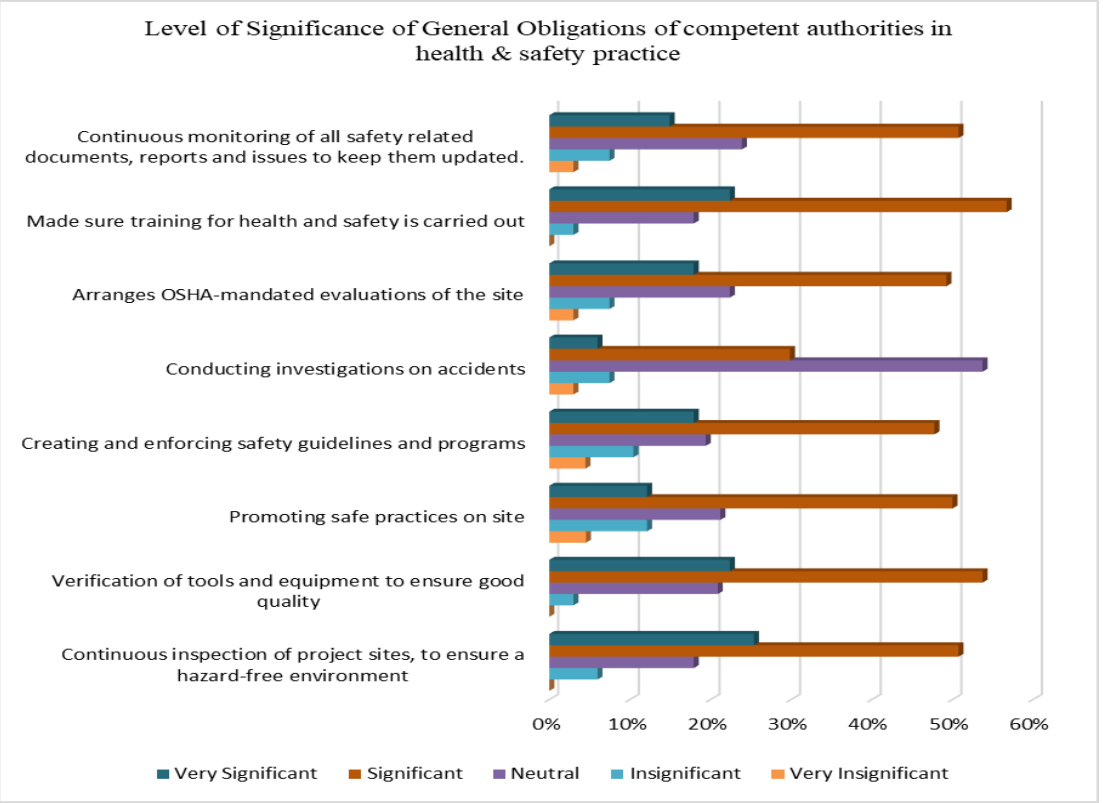

Fig 7: Level of Significance of General Obligations of competent authorities in health & safety practice

Best Practices during COVID-19

There were lots of challenges for the construction workers while working on sites. Although, there were numerous factors to consider the best practices during pandemic. Researcher in his study had analysed data and interpreted in fig 8 that 62% of the respondents agreed that there was adoption a Covid-19 exposure control planning tool at the site. 73% of the respondents were agreed that KN95/N95 masks were provided by the concerned authority. 64% of the respondents agreed with the monitoring of compliance of prevention measures at their work place. 48% respondents agreed that Installation of disinfectant tunnels on entrance & Exits was there in spite that it was very important practice during pandemic to be governed. During covid-19 the sharing of tools and equipment, and skin contact between employees was limited, agreed by 37% and 35% of the respondents respectively. 34% of the respondents agreed that on violations of safety rules they were punished so that next time they would follow the rules set by the authority. Furthermore, 86% of the respondents agreed that they were keep updated about the virus news.

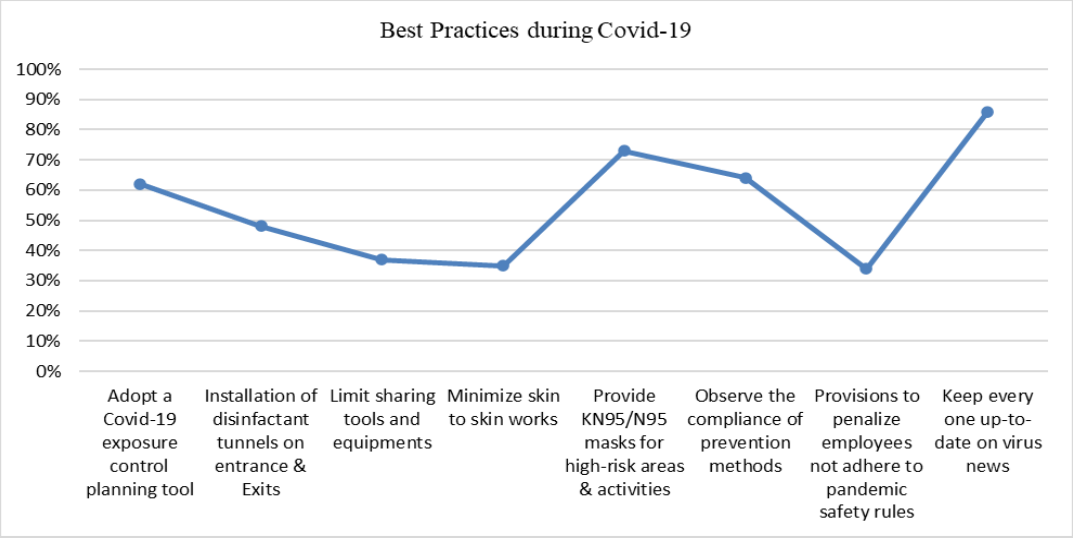

Fig 8: Best Practices during Covid-19

Conclusions, Limitations, and Further Scope

The majority of industries have a minimum of ten years of market experience in India., indicating that they are aware with the country's safety and health laws. However, only 7.4% participants were from the safety department. Although not every company has a professional safety department, this department is responsible for the health and safety of employees. The construction industry is rife with deaths and chronic injuries. The survey's findings showed that construction crews' health and safety remain seriously endangered by building projects, with the majority of respondents citing these concerns. Besides this, fatal accidents occurred on a regular basis, and the increased numbers of accidents can be attributed to a number of factors, including insufficient safety training, OSHA safety violations, refusing to obey rules, a hazardous work environment, nature of work, lack of knowledge and awareness of site rules, etc. The most frequent cause of fatalities and severe injuries among construction workers was falling from a height. Lifting and handling mishaps were the most frequent ones that cause lost work time. While experts have been examining the COVID-19 global public health risk's implications on the construction sector and the outbreak prevention measures, there hasn't been much discussion of the problems facing construction employees. The study's conclusions suggest that in order to lower construction risk to a manageable level, organisations should pay more attention to the health and safety of their construction workers. There are several restrictions on the study. Because the quantitative aspect of the analysis in this publication was limited to India, future research can use statistical approaches to evaluate hypotheses and link construction workers' health and safety concerns to the performance of various country construction projects. Furthermore, the findings offer little insight into how the COVID-19 situation is developing among construction workers as vaccinations are being distributed. As a result, future research can evaluate the success of these activities, as well as other measures that may be developed as the COVID-19 epidemic unfolds on the jobsite.

Recommendations

The following are significant recommendations based on the study that can help enhance health and safety practises in construction sector.

- It is essential for construction companies to boost the type and effectiveness of safety and health supervisors, as insufficient supervision is the primary cause of accidents. Every construction firm should have its own set of safety and health policies.
- Construction companies and government agencies need to put forth more effort to elevate alertness and deliver training to workers. All building contracts must also include a reasonable budget for precautions related to safety and health, which must be approved by all parties.
- To track the performance of health and safety, contractors should be obliged to submit a Safety audit report in their bid (such as reports, audits, and inspections). The contract agreement for the bidding process should contain suggestions for health and safety regulation as well as the capability to enact laws and ordinances to prevent health and safety issues.
- More importance on H&S during the pre - construction stage, including through appropriate framework with fine edge protection, through use of safety belts to defend workers from falling and minimise injury, and the use of good quality personal protective equipment by workers, as well as stiff penalties for poor H&S practises.
- During Covid-19, the guidelines established by OSHA and other health agencies like safety wearables and carry-ons, communication and awareness, physical and mental health, daily duties and activities, compliance, human contacts, hygiene and sanitization and delivery management. These organisations are always altering their policies to keep up with the changing environment.

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