INTERNATIONAL JOURNAL OF ADVANCED ENGINEERING AND BUSINESS SCIENCES (IJAEBS)

Journal homepage: https://ijaebs.journals.ekb.eg

An overview and study of Labor Safety in Building Construction Sites of Egypt

Khaled Muhammad Ali Muhammad [(a)*]

[(a)]Civil Engineering Department, Pyramids Higher Institute for Engineering & Technology, Cairo, Egypt.

Corresponding author: Email address: khaledelkhateeb@yahoo.com

Received: 02- septmebr-2022 **Accepted:** 18- Septmebr-2022 **Published:** 02- OCtober-2022

Abstract

In Egypt and many countries, Construction sites are among the hazardous places where injuries and fatalities workplace of workers commonly happen. The average number of accidents was 16.03, and the proportion of accident occurrences concerning the total number of people was 62.8 percent. Due to the high number of accidents that occur in construction and the consequences, this has for workers, organizations, society, and countries, occupational safety, and health (OSH) has become a critical issue for stakeholders to take care of the human resource. For this reason, the classification of documents was carried out following the Occupational Safety and Health Cycle, composed of five steps: regulation, education and training, risk assessment, risk prevention, and accident analysis. We then used the knowledge acquired, objective results, and lessons learned to develop recommendations related to the profile, main functions, and best practices for health and safety coordination performance. Most accidents could have been prevented if the OSH principles had been put into practice at workplaces in Egypt..

***Keywords*:** Accidents, stakeholders, Occupational Safety, Health, and Safety Coordination.

1. INTRODUCTION

Any site aims to achieve occupational safety and health by achieving the protection of the human element from any injuries that occur in the work environment by preventing them from being exposed to injuries, accidents, and occupational diseases, and preserving the components of the material element and

its contents of devices and equipment from damage and loss, and provide all occupational safety and health requirements that provide a safe environment for human and material racists.

The construction industry is unique industry and more susceptible than other industries. Each construction site involves many human resources and they execute different types of work related to each other. The safety of the workplace is an essential component of competence and productivity. Safety is the process of being protected against physical, social, spiritual, economic, political, emotional, occupational, and psychological, consequences of failure, injuries, accident, damage, or any other event which could be considered non-desirable. This can take the form of being confined from the event or from exposure to something that causes it. Thus, safety is not a perception to be thought of as added to the work itself; safety is to be considered an integral part of the work to achieve the target of the organization. It becomes necessary to consider certain safety measures and programs to prevent accidents and injuries at the site and helps to shape employees' beliefs and attitudes that lead to safe behavior and ultimately to a strong s

1.1 Important Safety Management Elements

The components of successful safety management aid in achieving the goal and saving human lives.

1.1.1 Jobsite safety

Many accidents occur as a result of a poorly planned and maintained site. Because of this, Material fallout and worker-plant or-equipment friction hurt safety and health. Every facility should have a safety management system in place for the number of employees, as well as the cost and productivity. These risk management techniques work well to limit the number of accidents, and organize, implement, and review work processes and people. The cyclic process of planning, executing, and monitoring Jobsite safety is referred to as Jobsite safety management.

1.1.2 Program for promoting safety

The goal of the safety programmer is to raise and maintain awareness of the organization's commitment to safety and health, as well as individual responsibility to support that commitment, among all employees. The goal of the safety programmer is to develop a working environment and work practices that will ensure a safe and healthy work environment for all construction operations for all personnel. As a result, the organization goes to great lengths to create a clear and positive "safety culture" on each building site. The goals of any safety promotion campaign should be clearly stated. If the greatest profit is to be realized, they necessitate very skeptically thinking and consideration. As part of a safety promotion

program, the owner or contractor should design a system to recognize and honor good safety performance by individuals, teams, or departments. The owner or contractor should establish a method to recognize and honor good safety performance by individuals, teams, or departments as part of a safety promotion program.

1.1.3 Meetings and campaigns on safety

A conference might be an excellent opportunity to promote safety. Orientation meetings for newcomers, training meetings, and toolbox meetings are all good examples of meetings that promote safety. During these meetings, safety and health films/videos can be screened, with time set out for discussion afterward. During the usual course of business, line supervisors can promote safety to all subordinates. They can spread safety lessons and encourage workers to accept safety as a way of life through daily interactions. The most visible way to promote safety is through seminars, conferences, and campaigns. They can be used to promote appropriate safety practices and standards as well as enhance safety awareness. Safety campaigns typically entail the mobilization of employees at various levels for a common goal, which can help to focus minds on safety issues and disseminate safety messages throughout the workforce.

1.1.4 Training and competency of workers

The safety officer should ensure that all workers fully understand the safety and health hazards of the processes they work with for the protection of both themselves and their fellow workers. Also, additional training in subjects such as operating procedures and safe work practices, emergency evacuation and response, safety procedures, and other subjects pertinent to process safety and health should be included in the training program. Hands-on training where workers can use their senses beyond merely listening will enhance learning and should be provided. Other training techniques using videos or on-the-job training should also be considered. The proprietor or contractor of the relevant industrial undertaking should periodically evaluate the training program to see if the necessary skills and knowledge are being properly applied by their trained workers.

1.1.5 Protective equipment for personnel (PPE)

Because of the complexity of the work environment, construction sites have a variety of risks, as previously stated. To maintain a positive safety culture, all employees should wear the appropriate PPE. When engineering and administrative measures are not practicable or effective in decreasing employee exposure to acceptable levels, PPE is used to reduce employee interaction with dangers. Some employees

may find it inconvenient to utilize PPE, but management should insist on its usage from the start, and each employee should understand the value of PPE and be taught to regard it as a last line of defense to save their lives. Safety helmets, face shields, safety belts, safety shoes, hand gloves, goggles, safety glasses or goggles, earplugs or sound mufflers, back supporters, particle respirators, vapor respirators, fall arrester, and so on are examples of these. Workers should be able to access personal protective equipment close to the work site.

1.1.6 Electrical safety

Electrical energy is almost routinely employed on construction sites as a power source for a wide range of machinery and portable tools, as well as for lighting and heating. During any building or other construction activity, reasonable precautions must be taken to avoid any worker from coming into physical contact with any electrical equipment or apparatus, machines, or live electrical circuit that could cause an electrical hazard. to the extent possible, No wiring or cable that should come into touch with water, be automatically destroyed, or cause electric shock. To that end, all electrical tools and equipment should be inspected before use and at least every three months thereafter. An identifying sticker on all tools and apparatus should mention the date of the last inspection and when the next one is due. A crane, digger, excavator, drill rig, or any other mechanical plant, structure, or scaffolds may not be brought in. Immediate safeguards throughout all construction operations are taken, and electrical systems are maintained safely.

1.1.7 Safety label & signs

Labels, posters, and signs provide additional information to employees and can alert you to a potential safety or health issue. Posters must be near hazmat communication, tight space, and pathogens. The employer is responsible for ensuring that the employees are treated fairly. Make certain that all workers can understand each sign or label posted. There are several warning indications such as traditional signboards exclusion and warning, as well as LED signs, hand, and auditory signals, Fire escape signs, fire drill signs, and fire-fighting equipment signs all available. More information about safety signs, posters, and signals it is beneficial to have a simple understanding of how risky situations arise.

1.1.8 Hazard Identification

To identify hazards and analyze the risks they pose, the safety officer of a relevant industrial activity should first compile a list of items including premises, plant, personnel, and procedures, as well as gather information about them. Following the identification of the hazardous exposure or danger of such exposure to workers of a relevant industrial venture, the proprietor or contractor should determine whether

planned or existing safety controls are enough to keep the risk under control and meet legal requirements. If the outcome is negative, he should use technical methods to control the risk to the lowest level logically possible.

1.1.9 Services and Amenities

Provision of drinking water, washing, sanitary and changing facilities, restrooms and shelter, canteen, temporary housing, support in transportation from the place of residence to work site and back, and cleaning of the workplace and surrounding area of construction project debris improve efficiency. On a building site, the storage area and walkways must be kept almost free of dangerous depressions, obstructions, and debris. This helps to reduce tiredness and enhance worker health. Every employer must provide proper first-aid facilities, equipment, and supplies. The longer a wound is left untreated, even if it is little, the greater the danger of infection. The initial treatment of any injury is perhaps the most crucial aspect of a person's rehabilitation. As a result, every employee must have access to first-aid boxes or cabinets. Construction vehicles and on-site first-aid kits should both have first-aid kits. Every workplace should have a qualified employee on hand to offer first aid.

1.1.10 Emergency Action Plan

Fire and explosion emergencies, the collapse of lifting appliances and transport equipment, the collapse of buildings, sheds, or structures, gas leakage or spillage of dangerous goods or chemicals, drowning of workers, sinking vessels, and landslides burying workers are all covered by emergency action plans. It is also needed that there be a tie-up with nearby hospitals and fire stations to respond to injuries quickly and that an emergency vehicle is kept on standby throughout working hours for this purpose.

2 REVIEW OF LITERATURE

The building sector is quite hazardous. The industry's performance in terms of occupational health and safety is appalling. In developing countries, the standard of occupational health and safety is significantly lower. OHS has never been a priority in the Indian construction business.

Although India's construction industry is booming, the government has taken no steps to ensure that OHS standards and regulations are followed.

Huang and Hinze investigated worker falls at construction sites and found that the majority of falls occurred at elevations of less than 9.15 m, especially on new commercial and residential construction projects with modest construction costs.

Jannadi and Bu-Khamsin conducted a questionnaire survey among industrial contractors in the Eastern Province of Saudi Arabia and formal interviews with the contractors and officials responsible for construction safety was taken. 72% of the companies that participated in this survey were general building construction companies.

Based on the survey data and analysis, twenty primary factors and eighty-five subfactors were discovered, along with their relative relevance. For better resource coordination and utilization, Pheng and Shiue stressed the importance of integrating quality and safety. According to Koehn and Datta's research, safety standards and regulations not only solve problems like low-quality work, unsafe working conditions, and a lack of environmental control, but they also save money and increase productivity. According to Wilson Jr. and Koehn, building site safety standards differ since each site has its own set of hazards. Larger construction projects are more organized, but small and medium businesses lack a safety programmer or a person to manage safety standards.

On the one hand, recent technological advancements in wealthy countries have boosted industry productivity, but on the other hand, they have made work more difficult and dangerous. After working on a building site, any construction worker is likely to be temporarily unfit for work at some point due to a small injury or a health problem [15]. In the Australian construction industry, 256 individuals were killed between 1989 and 1992. According to statistics, the fatality rate was 10.4 per 100,000 workers, which was similar to the rate of fatalities in road accidents. Every year, it is estimated that 3,000 workers in China's construction industry are killed in workplace accidents.

According to research undertaken by the Egyptian construction sector, Egypt contractors' safety procedures were less formal, and accident insurance prices were fixed regardless of the contractor's safety performance. Falling from great heights is the leading cause of injury and death in the construction industry. Working on a scaffold or platform without guard rails or a properly fitted safety harness is the most common cause, as are unstable roofs and ladders that are poorly maintained, positioned, and secured. In all industries, slips, trips, and falls are the leading cause of accidents.

3 METHODOLOGY

The methodology was created to reflect the various features of building sites as well as the overall project goals. As a first stage, a thorough questionnaire is created to quantify the factors that influence site safety, with weightings based on their importance. The following criteria were used in the survey:

(i) labor data: job title, number of employees, work shift, and time.

(ii) accident analysis: number of collisions, type of injuries, and cause of collisions

The questionnaire is distributed and filled questionnaires are collected from respondents in the next two steps. A total of 127 interviews were conducted with managers, site engineers, safety personnel, and laborer at 52 different locations.

4 DISCUSSION AND RESULTS

4.1 Labor Statistics

Floor Count, Work Shift, and Timing Data was collected from 32 residential, 16 commercial, 2 educational, and 2 religious building sites (residential buildings include houses, hostels, and apartments; commercial buildings include shops, offices, banks, and auditoriums; educational buildings include schools, colleges, and tuition centers).

Only G+0 and G+1 building construction were seen on sites in small industries. The information was gathered from 11 G+0 and 16 G+1 construction locations. Data were collected from 12 residential structures, 10 commercial buildings, and 9 educational buildings in big businesses. 10 G+2 building numbers, and 9 G+3 building numbers.

Six numbers of G+7 building details were obtained for the G+6 building. On small construction sites, only day labor was identified. The majority of work begins at 8 a.m. and ends at 6 p.m. All sites provide a suitable working period with two hours of break time for food and rest. G+2 buildings can be found in huge numbers in major industries. To complete the project on time, several sites work night shifts.

4.2 Number of Employees

The average age of the workers was 32 years, with 37 percent of the sample being under the age of 39. The total number of workers on small and major building sites is shown in Table 1.

96 migrant employees and 337 Kerala workers are included in minor industrial sites. 196 foreign workers and 489 Kerala workers are included in large industrial sites. Bengal has the highest number of migrant workers. Migrant workers are willing to labor for low wages, which makes contractors pleased to hire them.

Table 1: Total number of workers in small and large construction sites.

Site number	Small construction sites		Large construction sites	
	Keralites	Non-Keralites	Keralites	Non-Keralites
1	12	3	18	5
2	12	3	15	4
3	15	5	10	7
4	15	5	25	14
5	12	6	28	15
6	12	6	21	7
7	15	9	30	6
8	15	9	26	18
9	14	2	25	20
10	14	2	20	15
11	12	8	16	4
12	12	8	20	5
13	14	4	18	15
14	14	4	14	13
15	16	0	20	9
16	16	0	16	5
17	15	2	15	4
18	15	2	17	3
19	11	3	20	4
20	11	3	19	4
21	14	3	20	9
22	14	3	18	5
23	16	0	20	6
24	16	0	22	6
25	12	3	16	3
26	12	3	0	0
27	13	4	0	0

4.3 Accident Assessment

4.3.1 Accidents, types of injuries, and causes of accidents

Details on the previous year's labor accidents were gathered, and the rate of accidents in each site was computed. The specifics are shown in Table 2.

TI = type of injury	RI = reason for injury
a = lack of training b = lack of care of labour (injured person) c = lack of care of another labour d = unsafe scaffolding, ladder, machines, vehicles e = did not use PPE, f = environmental factor g = lack of site inspection, h = safety symbols are not used i = lack of safety arrangements j = unsafe site planning and layout k = improper labour facilities, l = electrical shock m = failures of structure, n = due to use of alcohol o = other reasons, *N* = number of accidents	I = death of person II = loss of body parts III = body fracture IV = injury to the body V = skin infection VI = deficiencies to ear and eye VII = any other

Table 2: Key words to represent accident

4.3.2 Small Construction Sites

The total number of incidents occurred at 27 small construction sites; Table 3 shows the number of accidents in each category and their causes.

The average number of accidents was 16.03, and the proportion of accident occurrences concerning the total number of people was 62.8 percent.

Figure 1 indicates the percentage of accidents in small construction sites in each category: 1.60 percent of deaths, 2% of body parts lost, 10.47 percent of body fractures, 44.10 percent of body damage, 8.08 percent of skin infection, and 2.07 percent of ear and sight deficiencies. Accidents occur on an average of 10.07. The total number of accidents at each small construction site is depicted in Figure 2. Sites 13 and 25 have a higher number of incidents (17), while site 6 has a lower number of accidents (5).

Table 3: Overall accident details in small construction sites

RI	TI															
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	*N*
I	√	√	√	√	√		√	√	√	√		√	√	√		7
II	√		√	√									√			10
III	√	√		√		√	√		√					√		20
IV	√	√		√	√		√		√					√		91
V					√				√		√					35
VI		√		√										√		9
Total																= 172

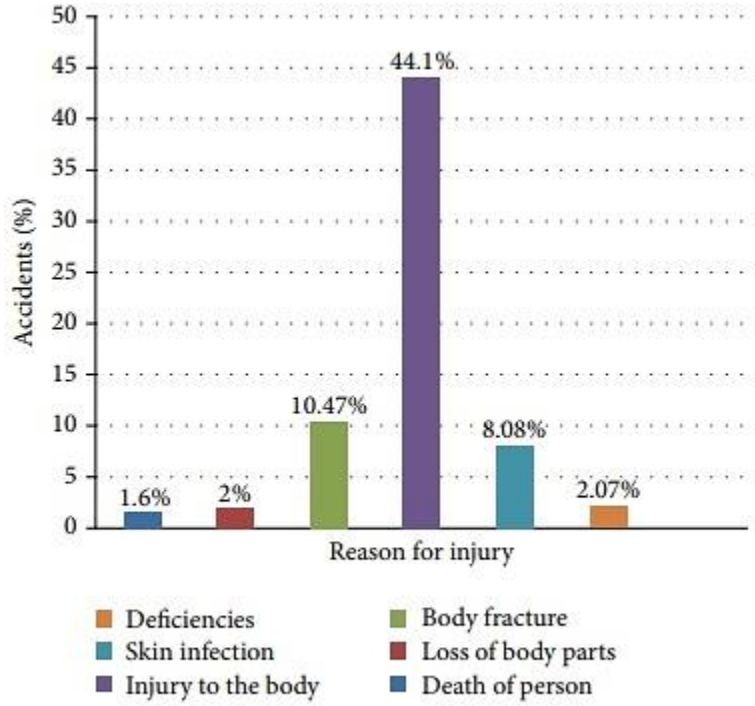

FIGURE 1: Percentage of accidents in small construction sites.

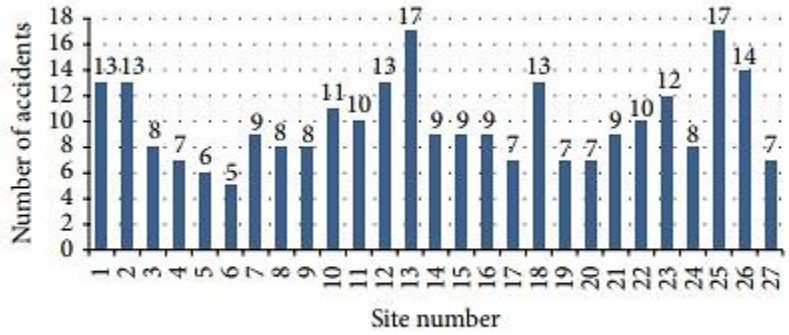

FIGURE 2: Number of accidents in small construction sites.

4.3.3 Large Construction Sites.

A total of 325 incidents occurred at 25 locations; Table 5 shows the number of accidents in each category and their causes.

Figure 3 indicates the percentage of accidents in big construction sites in each category: 1.60 percent of deaths, 5.1 percent of body parts lost, 4.5 percent of body fractures, 26.4 percent of body injuries, 8.02 percent of skin infections, and 1.7 percent of ear and sight deficits. There are 13 accidents on average.

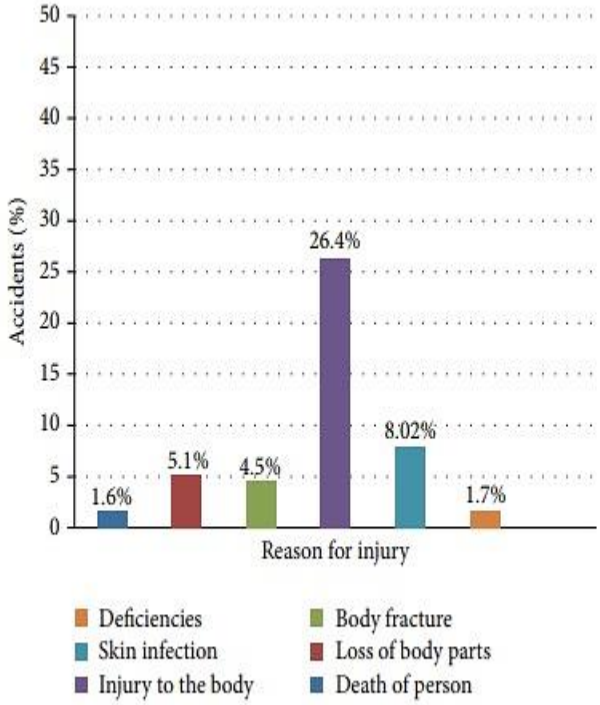

FIGURE 3: Percentage of accidents in large construction sites.

The total number of accidents at each significant construction site is depicted in Figure 4. The number of incidents at site 11 is 22, while the number of accidents at site 18 is only 6. Table 4 shows the results of a comparative study of lab safety in small and big construction industries.

Table 4: Comparative study on small and large construction industries.

Site number	Study criteria	Small construction sites	Large construction sites
1	Number of construction sites	27	25
2	Number of questionnaires collected	48	79
3	Average number of accidents in one site per year	16.03	13
4	Rate of occurrence of accidents with respect to total number of persons	62.8%	47.44%

5 CONCLUSION

This paper gets many aspects of safety behavior, culture, the attitude of workers, etc., towards managing safety in the industry of construction. The work investigates the following aspects of safety management, it includes safety policy and standards, safety program, team orientation, an inspection of hazardous conditions, prevention plans, safety committee, personal protective program, safety promotion, control system, and management behavior. The analysis results indicate those team orientation aspects in the companies are very poor due to improper coordination between the workers, supervisors, and management. Stakeholders' cooperation and consultation of the management with the employees about work, place, health, and safety issues are lacking because of improper communication between the management and employees, work pressure from the management to the employees on the site. Usage of PPE, safety booklets or manuals, and safety posters/symbols are not used properly on the site to avoid accidents. Safety is everyone's responsibility it is a "way of life" 24 hours/day. Individuals will be skilled and equipped to have the skills and facilities to make sure an accident-free workplace. Managers should frame the safety policies for their enterprise and train the employees to achieve the goal of zero accidents. Finally, all parties in the construction project must contribute their rightful parts towards making construction sites healthy and safe.

REFERENCES

[1] Andrew Hale and David Borys (2015) "Safety regulation: The lessons of workplace safety rule management for managing the regulatory burden" Safety Science Vol. 71, pp.112–122.

[2] Ashwin Mahalingam and Raymond E (2007) "Safety Issues on Global Projects Journal of Construction Engineering and Management", Vol. 133, No. 7, pp.506-516.

[3] Billy Hare and Iain Cameron Kevin J (2013) "Exploratory Case Study of Pictorial Aids for Communicating Health and Safety for Migrant Construction Workers", Journal of Construction Engineering and Management, Vol. 139, No. 7, pp.818-825.

[4] Evelyn Ai Lin Teoa and Florence Yean YngLinga (2006) "Developing a model to measure the effectiveness of safety management systems of construction sites", Building and Environment 41, pp.1584–1592.

[5] Gustavo E. Aguilar, Kasun N. H (2013) "IT based system for construction safety management and Monitoring", Automation in Construction Vol. 35, pp. 217–228.

[6] Heng Li, Miaojia Lu, Shu-Chien Hsu, Matthew Gray, Ting Huang (2015) “Proactive behavior-based safety management for construction safety improvemen”, Safety Science Vol. 75, pp.107–117.

[7] Hinze, J., andRaboud, P., (1988) “Safety on large building construction projects”, Journal of Construction Engineering and Management, ASCE, 114(2), Vol.33, pp.286-293.

[8] Jesús Abad, Esteban Lafuente and Jordi Vilajosana (2013) “An assessment of the OSHAS18001 certification process: Objective drivers and consequences on safety performance and labour productivity”, Safety Science 60, pp.47–56.

[9] Kartam N.A, I. Flood, P. Koushki (2000) “Construction safety in Kuwait: issues,procedures, problems, and recommendations”, Safety Science 36, pp.163-184.

[10] Low Sui PhengAndSua Chen Shiua (2000) “The maintenance of construction safety: riding on ISO 9000 quality management systems”, Journal of Quality in Maintenance Engineering, Vol. 6 No. 1, 2000, pp. 28-44.

[11] Ma Dolores Martínez Aires, Ma Carmen Rubio Gomez and Alistair Gibb (2010) “Prevention through design: The effect of European Directives on construction workplace accidents”, Safety Science 48, pp.248–258.

[12] Marianne Torner and Anders Pousette (2009) “Safety in construction – a comprehensive description of the characteristics of high safety standards in construction work, from the combined perspective of supervisors and experienced workers”, Journal of Safety Research 40, pp.399–409.

[13] Moheeb E. Ibrahim1, Khalid A. M. Al Hallaq2 (2012) “Safety Climate in Construction Industry the Case Of GazaStrip”, The 4th International Engineering Conference, pp.1-14.

[14] Mouleeswaran.K (2014) „Evaluation of Safety Performance Level of Construction Firms in And International Journal of Innovative Research in Science, Engineering and Technology, Vol.3, pp.1587-1596.

[15] Patrick L. Yorio, Dana R. Willmer and Susan M. Moore (2015) “Health and safety management multilevel and strategic management perspective: Theoretical and empiricalConsiderations”, Safety Science 72, pp .221.228–

[16] Planas.E, J. Arnaldos, R.M. Darbra, M. Muñoz, E. Pastor, J.A. Vílchez (2014) “Historical evolution of process safety and major-accident hazards prevention in Spain. Contribution of the pioneer JoaquimCasa”, Journal of Loss Prevention in the Process Industries 28, pp.109-117.

[17] Praveen Kumar A. V, C.K.Vishnuvardhan (2014) “A Study on Construction Jobsite Safety Management ,”International Conference on Engineering Technology and Science, Volume 3, Special Issue 1.

[18] Rafiq M. Choudhry, Dongping Fang and Syed M. Ahmed Safety (2008) “Management in Construction: Best Practices in Hong Kong of Professional Issues in Engineering Education and Practice”, Vol. 134, No. 1, pp.20-32.

[19] Riza Yosia Sunindijo and PatrickX. W.Zou (2013) “Conceptualizing Safety Management in Construction Projects ,”Journal of Construction Engineering and Management, Vol. 139, No. 9, pp.1144-1153 .

[20] SaiOn Cheung, Kevin K.W. Cheung, Henry C.H. Suen (2004) “Web-based safety and health monitoring system for construction management”, Journal of Safety Research 35, pp. 159– 170.

[21] Sathish Kumar.P.S, Logesh Kumar.M (2012) “Viability of Safety and Labour Conditions in Construction Sites ,” International Journal of Engineering and Innovative Technology (IJEIT), Vol. 2, Issue 6.

[22] Sunku Venkata Siva Rajaprasad and Pasupulati Venkata Chalapathi (2015) “Factors Influencing Implementation of OHSAS 18001 in Indian Construction Organizations: Interpretive Structural Modeling Approach”, Safety and Health at Work, pp.1-6.

[23] Subramani.T and Lordson millar.R (2014) “Safety Management Analysis in Construction Industry”, Journal of Engineering Research and Applications, Vol. 4, Issue 6(Version 5), pp.117-120.

[24] TerjeAven (2007) “A unified framework for risk and vulnerability analysis covering both safety and security ,”Reliability Engineering and System Safety 92, pp. 745–754.

[25] VineethD harmapalan, John A. Gambatese, Joe Fradella and Ali MoghaddamVahed (2014) “Quantification and Assessment of Safety Risk in the Design of Multistory Buildings”, Journal of Construction Engineering and Management, pp.1-9.

[26] Vinodkumar M.N and M. Bhasi (2011) “A study on the impact of management system certification on safety management”, Safety Science 49, pp. 498–507.

[27] XianguoWua, Qian Liu , Limao Zhang , Miroslaw J. Skibniewski , Yanhong Wang (2015) “Prospective safety performance evaluation on construction sites”, Accident Analysis and Prevention 78, pp. 58–72.

[28] Xinyu Huang and Jimmie Hinze (2006) “Owner‟s Role in Construction Safety”, Journal of Construction Engineering and Management‟, Vol.132, No.7 pp.164–173.

[29] Yang Miang Goh and Nur Faddilah Binte Sadon (2015) “Cognitive Factors Influencing Safety Behavior at Height: A Multimethod Exploratory Study”, Journal of Construction Engineering and Management, Vol. 56, pp.1-8.

[30] Yates J.K(2014) “Design and Construction for Sustainable Industrial Construction”, Journal of Construction Engineering and Management, pp.140-153.

[31] Zeng S.X, Vivian W.Y. Tam, C.M. Tamc (2008) “Towards occupational health and safety systems in the construction industry of China”, Safety Science 46, pp.1155–1168.

[32] Zhipeng Zhou, Yang MiangGoh, QimingLi (2014) “Overview and analysis of safety management studies in the construction industry”, Safety Science 72, pp.337–350.