

## An Analytical Study of Accidents in Construction Sites

Maged Moneer Gad1

Ahmed Galal El Din aly2

Kamal Al Dein Salah Al Dein Ahmed3

**Ahmed Hanafy Mahmoud4**

1. Assistant Professor, Architecture Engineering Department, Obour high Institute for Engineering and Technology, Cairo, Egypt.
2. Assistant Professor, Civil Engineering Department, Modern University for Technology & Information, Faculty of Engineering, Cairo, Egypt
3. Head of Architecture Department, Obour high Institute for Engineering and Technology.
4. Associate Professor in Architecture Department, Higher Institute for Engineering El Shorouk Academy.

### ملخص البحث:

تهتم الإدارة بتنفيذ العمل وتحقيق أهدافه في إطار إداري وقانوني وفني سليم، فمن مسؤوليات الإدارة تنظيم ومتابعة العمل لضمان تنفيذه بدون معوقات وبدون الخروج عن الإطار المسموح من تكلفة وجودة وفترة زمنية. ويهدف هذا البحث إلى تحديد أنواع الحوادث والإصابات التي تحدث في مواقع التشييد والبناء. ولتحقيق أهداف هذه الدراسة تم تحليل إحصائي لمجموعة حوادث العمال في مواقع التنفيذ. ومن واقع سجل الحوادث في فترة التنفيذ لكل مشروع وبناء على البيانات الخاصة بتلك السجلات قامت هذه الدراسة بتحليل البيانات التي تخص كل من نوعية العمل للعامل، سبب الحادث، وكيفية حدوث الحادث. وقد توصلت إلى بلورة معدل تكرار الحوادث وتحديد النسب وأهم الحوادث التي تشغل نسبة كبيرة، و بناء على تحديدها تكون نصب إهتمام من إدارة السلامة والصحة المهنية بمواقع التشييد والبناء.

### Abstract

The administration is concerned with the implementation of the work and achieving its goals in a sound administrative, legal and technical framework. It is the responsibility of the administration to organize and follow up the work to ensure its implementation without obstacles and without departing from the permissible framework of cost, quality and time period. This research aims to identify the types of accidents and injuries that occur at construction and building sites. To achieve the goals of this study, a statistical analysis was made of a group of workers accidents at the implementation sites. And from the reality of the accident record in the implementation period for each project and based on the data for those records, this study analyzed data that pertains to the type of work of the worker, the cause of the accident, and how the accident occurred. The research shows the frequency of accidents and the identification of ratios and the most important accidents that occupy a large percentage, and based on their identification, they will be a focus of attention from the Occupational Safety and Health Administration in construction and building sites

### Key Words

Construction site accidents, Occupational safety and health management, Work regulations, Work Law, Construction management.

### Introduction

Occupational safety and health management and protection of employees from work hazards and occupational diseases is an important topic, because this topic closely related to the human and ethical aspects of the employer towards his employees, as the employer is the main cause of employment. In Egypt, Occupational Safety and health is subject to international labor laws, which are ratified by the Egyptian labor laws as part of each job (Shararah, 2016)

The first Occupational Safety and health legislation released in 1802 in England. Since that date, many local and international laws and conventions mandated to achieve a safe working environment for employees. (OSH Act of 1970)

Labor Law No. 12/2003, Chapter 5 (Occupational Health and safety) and Chapter 6 (penalties), Decree No. 211 of 2003 states the conditions and precautions for the provision of means of Occupational Safety and health in the workplace. Decree No. 126 of 2003 states the statistical

forms of serious injuries, accidents and diseases. Decree No. 134 of 2003 states the identification of establishments, Occupational Safety and health agencies and training authorities, and Decree No. 134 of 2003 states the organization of the Occupational Safety and health advisory body. Chapter “V” of the “Labor Code Article 202 to Article 231” states safety of the working environment, the facility obligation to establish and provide means of safety and occupational health, to ensure the Prevention of all risks depending on the work nature, as well as to establish and carry out a risk assessment, analysis and emergency plans.

The FIDIC contract, Terms of Civil Engineering Contracting, part one (general terms), article 19.1 stated “Obligated the contractor to take into account the safety of all persons entitled to be at the site and avoid risks on them”.

Occupational Safety and Health Management in construction projects is a big challenge, as each project has its own character and has different risk group than any other project, so it is difficult to work because there is no firm base to rely on. (Gould and Joyce, 2000)

In the construction sector, the working environment is wide-open, the workplace changes from one project to another, and each project has a different nature from any other project in terms of the quality of the business items and their quantities and specifications. (Moses, 2003)

In construction industry work, there is a need to use machines and equipment in order to make the work more efficient and faster. Therefore, we need to update the machine type regularly, and to keep track on the new technology of the new machines as many updates of the machines helps on the Occupational Safety and Health Management, which result in decreasing the occupational risks. (Hislop, 1999).

As shown by research (Amt für Veröffentlichungen der E. U., 2012) for narrow workplaces. In spite having clear strategies and plans for Occupational Safety and health in the workplace, and the capability to analyze risks to find the basis for determining the necessary requirements for Occupational Safety and health, the percentage of accidents increases as the size of the workplace decreases. Also the percentage of accidents caused by explosions, suffocation, and electrical shocks. The research also shows the importance of employees ' participation (after training and raising awareness of Occupational Safety and health regulations) to the assessing risks as they are know their workplaces. Therefore identifying risk reasons factors - how to identify risks – how to assess risks – how to identify needs to prevent or minimize them – how to evaluate results – and measure the effectiveness of the risk elimination – or decreasing – processes, how to evaluate the results – how to measure the efficiency of those operations.

The costs of occupational safety and health considered as the price of what the organization - or the work system – needs to protect employees. In addition to administrative expenses such as; the salaries of engineers and safety's and occupational health's supervisors. On the other hand, safety and occupational health saves the organization a lot of expenses, as lot of losses happens if an accident happens, as this means that work is delayed, and cost the organization many compensation, as it also affects the overall workers' performance level. The negative impact of accidents is by far more than the costs of safety and occupational health requirements. Countries pay lot of costs due to accidents and injuries. Occupational safety and health is not a burden that increasing the project's costs. As the cost of accident or injuries (when occurs) is high in the form of workers' injuries, as well as the negative economic impact, which confirms that Occupational safety and health is a necessary action that must be taken into account. Therefore, the occupational safety and health costs are not an overburden for the project, but rather have a return on it. By applying safety and occupational health requirements we can reduce - if not avoid - injuries, accidents and occupational diseases. Therefore, saving time lost due to injuries and accidents. Bad

workers' psychological state occurs as accident happens avoided. Moreover, avoid decreasing performance rates as well and working hours' loos. (Sharara, 2016).

The risks study is for not only in site risks that affect workers in site, but also for those out of the site risks. The occupational safety and health team must study the surrounding environment, the potential risks, and how to prevent them or at least reduce their impact.

#### **Duties and responsibilities of Occupational Safety and health department:**

- **Organizing and planning work:** Based on the study of the project, the activities of the project, and the implementation method, and study the work schedules from the perspective of Occupational Safety and health. The necessary work plans to ensure the workers' safety. Develop a review system and monitor the expected risks protecting tools.
- **Make the Occupational Safety and health plan:** Based on business analysis, work schedule study, and risk identify. Choose the personal protection hardware tools. Review and test the proposed used tools used (ladders, scaffolding, hand tools, tools and electrical appliances, etc.).
- **The number of employees:** the number of Occupational Safety and health personnel is determined based on the number of employees, as well as the quality of work and the degree of risks. Knowing the number of employees is an essential factor for many calculations of Occupational Safety and health plans, as well as to calculate the numbers of work needs of accommodation – toilets – number of first aid teams and necessary equipment.
- **Contingency plan:** In addition to previously notes make an emergency plan.
- **Training:** Developing integrated training program serve the organizational needs of the capabilities and competencies to raise quality performance level.
- **Statistics and accident study:** Based on accident data collection, statistics made and the results compared to extract public or private weaknesses. (Egyptian code for project management, occupational health and safety tasks Item No. 4-5-2)  
Each year, large number of professional injuries and accidents that have negative impact on employees according to the type of injury and accident. Some types of such damage clarified and divided into five groups for construction sites (Hogstod, 2000):
- **Engineering (mechanical) risks:** Those result from machinery and equipment that is not sufficiently fortified or properly protected in the working environment.
- **Chemical hazards:** (explosives – flammable liquids – caustic –toxic - gases).
- **Natural hazards:** (sound – vibration – radiation - high or low heat – pressure -electricity - natural characteristics in terms of roughness - Sharp Objects - skiable).
- **Biological hazards:** (Biological residues – virus – bacteria – parasites – algae -plant and animal diseases).
- **Physical and psychological risks:** (Europäische Kommission, 2012) and (Hassan, 2009).  
"Occupational health protection should aims to promoting the maintenance of the highest level of physical, mental and social capacity of employees in all activities to prevent deterioration in health due to working conditions, protecting employees from health risks and providing a working environment that is compatible with the physiological and psychological capabilities of employees. In other words, when selecting employees, consider their suitability with the nature and requirements of the work in terms of Occupational Safety and health. (Europäische Kommission, 2012).

#### **Previous studies:**

The percentage of construction sites accidents exceeds 40% of the whole accidents of the labor sectors. (Copper, 1994)

Based on Eurostat statistics - European Statistics on Accidents at Work (ESAW) {various industries work accidents, European Union XV, 2002}. The percentage of injuries of construction industry comes in the second rank compared to injuries of all industries and crafts. (Europäische Kommission, 2012)

The research (marhej, 2006) examined the basic elements of Occupational Safety and health management for construction projects, and how far applying the rules necessary to achieve their goal, by conducting a field questionnaire for some construction projects as well as collecting data and information from construction sector workers to gather their opinions to improve the working environment. Then reach a set of proposals and recommendations aim to improve the Occupational Safety and Health Management in construction projects in Syria. For example, the necessity to have employees' training programs and to ensure the updating of courses information and content. Also the importance of having accident records and statistics work for them. The importance of periodical review of the machines and tools before using them. According to the International Labor Organization statistics, an injury leads to death happens every three minutes, and that the construction industry is the second most dangerous working sector and the most caused injuries accidents.

The research (Hassan, 2009) examined the concept and importance of Occupational Safety and health and its responsibility, and correlated a relationship between occupational safety and health and employee productivity. As the more concern, the corporate management's in Occupational Safety and health, the more to accidents preventing or reducing their frequency to minimize injuries, to preserve the employees' lives. One of the worst consequences of accidents is the psychological impact on the injured workers and on their colleagues. The research also classifies the factors affecting the productivity of workers as technical factors related to the work nature, and humanitarian factors that includes skills and colleagues relationships that affected by accidents and injuries, causing low worker productivity. The study recommends the importance of expanding the powers of the Occupational Safety and Health Administration because of its role and impact on the productivity of workers.

The research (Suhaila, 2015) identified the role of Occupational Safety and health showing its impact on the workers' performance improving in small and medium-sized industrial enterprises. The study used many statistical methods to get the factors that have impact on the workers' performance as well as the appropriate working conditions contribute in performance improving. The study recommended the importance of having training courses in the field of occupational safety and health, improving the relationship between the director of the Occupational Safety and Health Department and workers, which contributes to improving their performance.

The research (Ismail, 2012) evaluated the effectiveness of Occupational Safety and health procedures in scientific laboratories in Palestinian universities. The research collected information and data related to the work nature, safety procedures followed, accidents causes, and intensification of training courses on Occupational Safety and health. The study indicated that there are no plans for occupational safety and health, as it was evident through the study's results that there is no interest in having records of accidents and injuries to workers.

The study (Ezzat, 2020) aims to assess the effectiveness of Occupational Safety and health system by identifying strengths and weaknesses of scientific laboratories of the Technical College under study and how to overcome weaknesses by identifying the performance gap. The importance of research shows in reviewing Occupational Safety and Health Management System Requirements and identifying strengths and weaknesses. Based on the issuance of OHSAS18001, one of the fundamental developments and improvements worldwide to address problems accompanied the

technological development and technical excellence in labor organizations, the aim is to reduce risks, reduce or prevent injuries and accidents at work and improve the environment and performance of the enterprise. The study contributed also in increasing the awareness of the staff and the faculty management of the international standards and modern systems importance that achieve continuous improvement. Among the research results, the lack of identification of risk sources, the lack of clear standards within the laboratories, and the recommended to pay attention to Occupational Safety and Health Management system needs in the design of construction works, and the necessity of work risk analysis, training on Occupational Safety and health programs.

The main objective of (Mohammed, 2007) research is to identify the causes of labor fall accidents at buildings and construction sites, and to identify any additional useful information to reduce the prevalence of fall accidents in the future through the applying of the fall protection plan. The research found out that fall accidents have become one of the main categories in occupational death accidents and that fall protection systems are not regularly used to prevent accidents in the construction industry. The examined data for the period (2004 to 2007) and the results show that most falls occur at altitudes below 9.15 meters that occur in new construction projects with relatively low construction cost. The study also concerned the typical workers' compensation rates, based on which the items of works that had the largest proportions and concrete works that had the largest compensation ratio were identified. The study also concerned with the typical workers' compensation rates, based on that the items of works that had the largest proportions are identified, concrete works had the largest compensation ratio. In addition, it determines the rates frequency, and the higher risk rates for different work areas (agriculture, mining, electricity, construction, trade, transportation, etc.). The study showed that the frequency of construction work was the largest percentage (24.1%) and was the second for the risk ratio for work area (0.99) after mining work.

### **Causes of the research problem:**

1. Lack of adequate preparations in many work locations to avoid or minimize accidents.
2. Lack of attention to the presence of trained cadres to study the site and work requirements regarding occupational safety and health.
3. Insufficient studies to avoid accidents.

### **Research objectives:**

The research study aims to achieve the following:

- The study aims to identify the causes of frequent accidents of construction workers at construction sites.
- Develop accident recurrence rates to develop the determinants and items that lead to better understanding and formulation of the causes of accidents and injuries that have a role to contribute better work plan to avoid them.

### **Methodology:**

The study took the analytical approach as a research method; accordingly, the following methodological steps identified as the basis for the study in this research:

The research study is the theoretical framework of the problem, by showing the importance of Occupational Safety and Health, and study how to manage it. That ensures avoiding accidents or at least reduce them. This is done through a research plan to assemble, organize, and analyze data. The study also followed the inductive approach by using questionnaire, evaluation and analysis of data to define accidents types and their causes. Some construction projects were chosen, those which statistics and data were available. The scope of the study was on residential buildings,

schools and administrative buildings with different heights ranging from two to seven floors, for period of 2012 to 2019.

The study addressed injuries and accidents recorded records of sites that have compiled data, regardless of other health problems that were not recorded or long-term diseases.

### **Recording information:**

The method of recording accidents and collecting information about them and resulted injuries was used:

#### **Criteria for recording an accident or injury:**

- Make inquiries properly.
- taking the information from an eyewitness.
- Taking information from more than one person, and compare them.
- Discuss individuals about what they mean from their words exactly, as many words can carry more than one meaning according to the person.

#### **How to record accidents (collect data needed to make accidents sound statistics):**

- Explain the situation - how did the accident or injury happened?
- How to avoid such an incident in the future?

#### **Data, including statistics for the injured worker or causing the accident:**

Worker's name, worker's age, worker's work (occupation), how long he has been working (New/old worker), has he previously suffered accidents or injuries.

#### **Data, including work and accident statistics:**

Time of accident (date of Accident Day / hour), place of accident, cause of accident, type of accident, result of accident.

#### **The classification of incidents or injuries based on the causes of accidents or injuries:**

- Worker's error: worker's error due to negligence or fatigue or .etc.
- Mechanical defect (technical error): technical error because of a tool's failure or machine technically and resulting in the accident.
- Administrative error: administrative error because of a deficiency or defect in the plan applied to protect employees.

#### **Classification of types of accidents or injuries based on the result of accidents or injuries:**

Based on the study cases data, the types of accidents based on their results classified into three basic types:

- An accident causes 3 days of incapacity for work.
- An accident causes a lack of working capacity.
- An accident causing death within 30 days of the accident.

### **Results:**

#### **Statistical analysis of accident cases:**

Data collected for 20 projects of residential buildings, schools and administrative buildings. The height of buildings ranging from 2 to 7 floors. The project costs ranged from 10 million to 50 million. Projects with an occupational safety and health system as well as an injury and accident record selected. Injuries and accidents analyzed based on specific criteria as they are in the analysis of accidents and injuries as will be explained in the analysis of the results.

These projects characterized by the existence of an occupational safety and health system. They also provide a system of recording accidents and injuries. As using different ways to record accidents, or to not complete the record of some data or information for some projects, and the different style of record the accidents from project to project (there is no standard way to record the accidents) made it hard to complete the forms as it should be. Accordingly, it was attempted to

make use of the statistics in the project records as much as possible, for example not to confirm the quality of work for the worker specifically for the concrete works item accidents if the worker is a carpenter or steel former.

The study's time range of the projects is during 2012 to 2019.

This study analyzed accident and injury data based on the following criteria:

- Ratios of accidents or injuries based on the type of work.
- Accidents or injuries ratios based on the cause of the accident.
- Accident or injury ratios based on how the accident occurred.
- Accidents or injuries ratios due to the worker's fall down.

This research calculated the number of accidents without taking into account the size of the injury, just took the number of all accidents and injuries. To find out the project's level in terms of Occupational Safety and health, the following equations can measure the rates of injuries and accidents; compare them with similar projects to see the level of application of Occupational Safety and health requirements through the following two equations: (spark, 2003)

First rate:

Frequency meter is used:

$$\text{Frequency rate} = \frac{\text{Number of Injuries during the year} \times 1000}{\text{Number of Workers} \times 2400}$$

Where:

- 2400: Represents the number of working hours per worker during the year.
- 1000: Represents the number of workers for whom the rate is calculated.

Second rate:

The intensity scale is used:

$$\text{Risk rate} = \frac{\text{Number of lost days} \times 1000}{\text{Number of Workers} \times 2400}$$

Where:

- 2400: Represents the number of working hours per worker during the year.
- 1000: Represents the number of workers for whom the rate is calculated.

(Mohamed, 2007)

### **Percentages of Accident Incidence Rates:**

Accident and injury ratios for work items - regardless of the quantities of work items and the duration of execution of each item- as these ratios based on the number of accidents and injuries and not frequency or risk rates. These statistics show the percentage of accidents and injuries regardless of the number of workers performing the item.

Taking into consideration the different ways of recording and gathering information about accidents and injuries in the construction sites and their data, some work items merged and considered as one item as follows:

- Concrete works where it contains carpentry, steel work and concrete casting.
- Door and window works regardless of the quality of the materials because they cannot be separated in some sites statistics.
- Also include all incidents that concern with flooring work regardless of the type of materials used.
- And make an extra item for the rest of the work accidents that has few percentages, such as heat insulation works, injuries and accidents for the work of fixtures assistance, administrators, supervisors and technicians.

**- Statistical analysis of the proportions of accidents or injuries based on the type of worker's work:**

Table (1) ratios of accidents or injuries based on the type of worker's work

No.	Aspect	%
1.	Accidents or injuries based on the type of worker's work	
1.1	Concrete work	21.6
1.2	Dig work	15.3
1.3	Electric works	11.4
1.4	Exterior painting works	9.2
1.5	Doors and windows works	8.5
1.6	Sanitary works	6.7
1.7	Brick works	6.5
1.8	Indoor painting works	3.7
1.9	Moisture insulation works	3.3
1.10	Flooring works (parquet, marble, etc.)	2.9
1.11	False Ceiling works	2.3
1.12	Heat insulation works	0.8
1.13	Other accidents types	7.8

Figure (1) Percentage of accidents and Injuries for Different Work Types

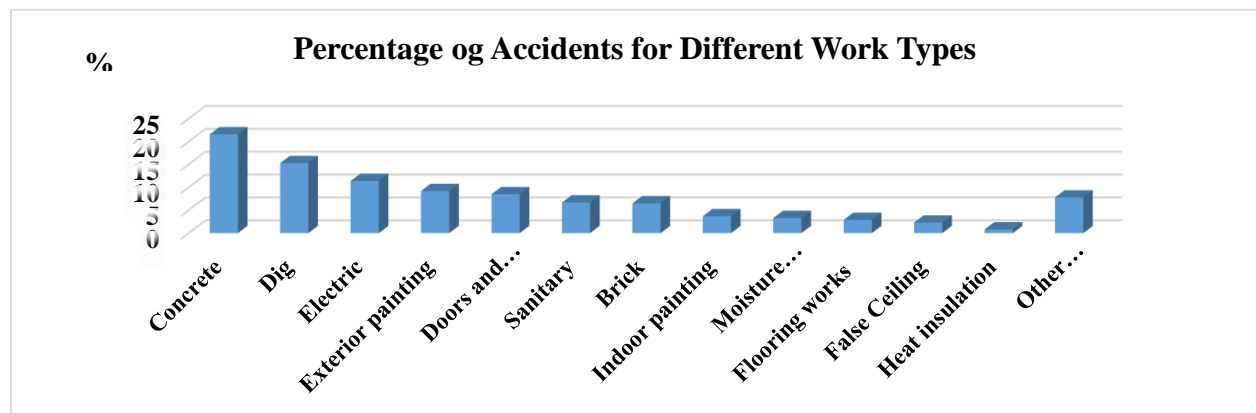


Table (1) and Figure (1) show accident ratios based on the type of work.

- The concrete works (includes carpentry, steel bars and casting works) reached 21.6% of the total accidents and injuries at the site.
- Accidents and injuries for digging work reach 15.3%, although digging workers do not represent a large proportion of the total number of site workers, and average period of digging work is not more than 10% of the total constructing period.
- Accidents and injuries of electrical works up to 11.4% despite the small number of workers.
- Accidents and injuries of outdoor painting works up to 9.2%.
- Accidents and injuries of door and window works up to 8.5%, all collected data for door and window works regardless the used material type.
- Accidents and injuries of sanitary works up to 6.7%. This percentage considered a large proportion in relation to the workers' number for this item and for the implementation duration. The reason for the registration of accidents and injuries for sanitary works in general, both for



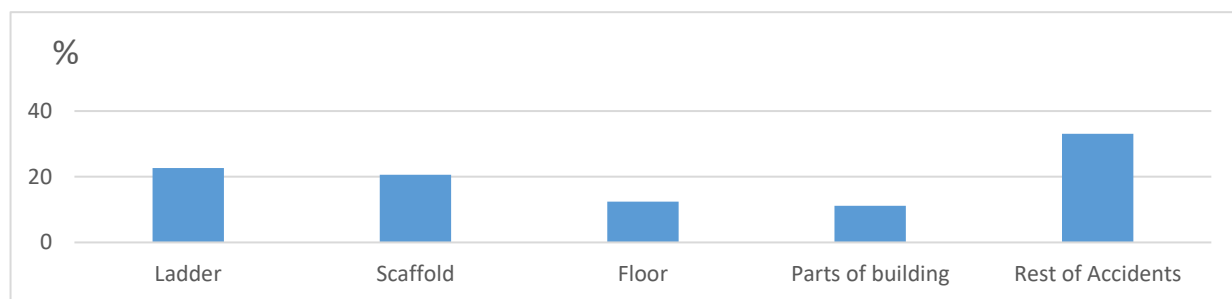
external works (the main lines and for the main drainage works), and the interior works. External sanitary works of buildings represent a greater risk than internal sanitary works. However, the recording of incidents did not specify the work location.

- Accidents and injuries of buildings works up to 6.5% despite the large workers' number the percentage is relatively low. This analysis emphasize the theory; "when the risk shows in front of the eye, there would be less risk", especially during the construction of external walls.

Table (2) Statistical analysis of accident or injury ratios based on the cause of the accident:

No.	Standard	%
2	Accidents or injuries based on incident cause	
2.1	Ladder	22.7
2.2	Scaffold	20.6
2.3	The floor	12.4
2.4	Parts of the building (column, beam, bricks, etc.)	11.2
2.5	The rest of the accidents (mechanical, road equipment, etc.)	33.1

Figure (2) Percentage of accidents or injuries based on the accident reason



It is clear in the general content of accident and injury ratios for employees on site the concept that accident ratios refer to the type of risk for business items.

In Table (2) and Figure (2) analysis of accidents and injuries based on the place that caused the accident, where the causes of accidents monitored for some accidents and injuries, are:

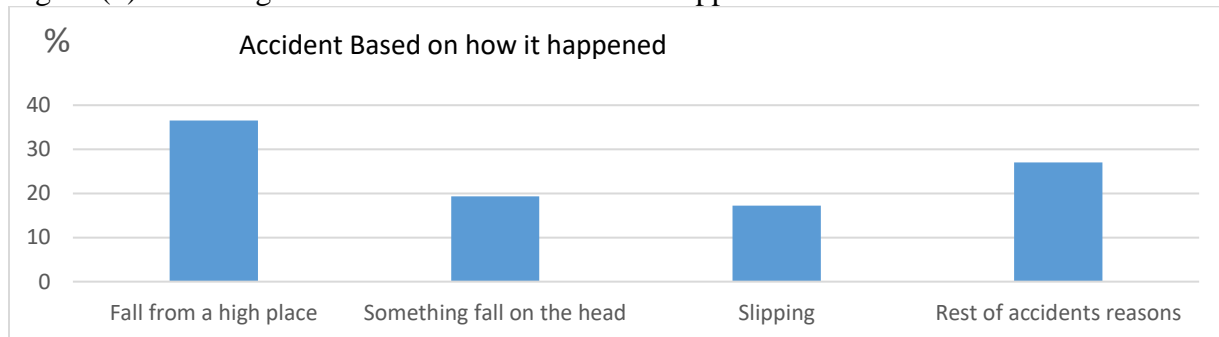
- Percentage of accidents and injuries due using ladder up to 22.7%, use a ladder in general, or working on ladder in particular, as ladder failure due to break or anything else make an accident.
- Percentage of accidents and injuries due to working on scaffolding comes after the ladders by 20.6%, accidents here happens due to problem in the scaffold itself, or worker's negligence.
- Percentage of accidents and injuries of working on the site floor up to 12.4%. This shows the need and the importance of attention to arrange, organize, and clean the site, as just walking on slippery floor or the existence of out of order waists may lead to an accident.
- The rest of the building parts (column, beam, walls, etc.) come .after that with accident and injuries percentage up to 11.2%. The reason may be a falling part on a worker.
- And the rest of the site accidents and injuries up to 33.1%. The rest of the accidents were collected, for example; due to an equipment malfunction, tool problem, mechanization, accident or injury may happen outside the building but still on site.

**- Statistical analysis of accident or injury ratios based on how the accident occurred:**

Table (3) percentage of accidents or injuries according to how the accident happens

No.	Standard	%
3	Accidents Based on how it happens	
3.1	Fall from a high place	36.5
3.2	Something fall on the head	19.3
3.3	Slipping	17.2
3.4	Rest of accidents reasons	27

Figure (3) Percentage of accidents based on how it happens



Here the accidents analyzed based on some of the collected information to describe the accident and used as criteria for the analysis of accidents and injuries. Whether the accident occurred due to the fall of the worker, the fall of anything on the worker, the worker slid, and leave the rest of the accidents as each of them separately does not represent a large percentage.

It is clear from Table (3) and Figure (3) the analysis of accidents and injuries based on the criteria that answers the question about how the accident occurred, giving the percentage of accidents and injuries:

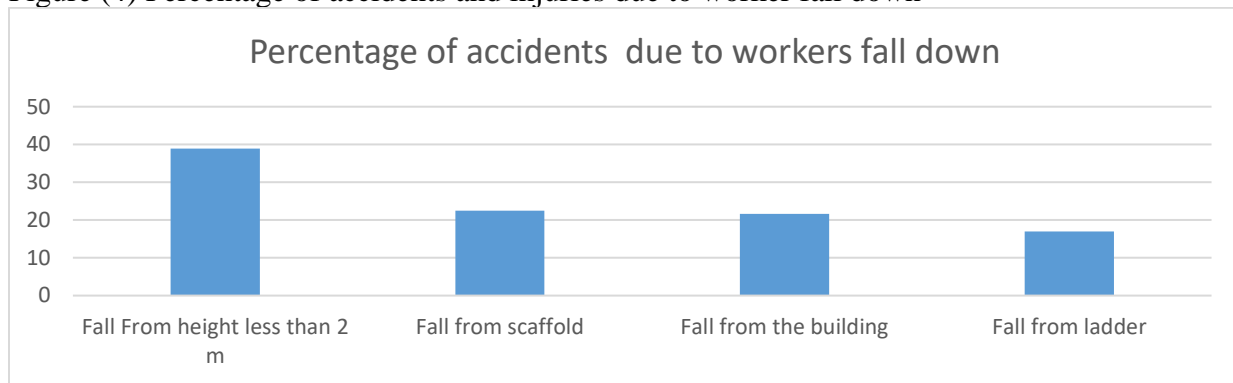
- The result of a fall from an altitude of 36.5%, which makes it a point of analysis as in Table (4).
- The percentage of something fall on the head up to 19.3%, which is also an important point to consider reduce the incidence of accidents and injuries.
- The result of the worker slide is up to 17.2%, which confirms that a fairly percentage of accidents occur due to the lack of arrangement of the site. That confirm with the results of table (2), that the percentage of accidents caused accident floors, which can be reduced by cleaning and put things in order.
- The remaining 27% of accidents occur during movement include; moving across site, going up, moving on a ladder or scaffold, jumping. The breakdown of the percentage of such incidents shows in Table 4.

**- Statistical analysis the proportion of accidents or injuries due to the fall of the worker:**

Table (4) Percentage of accidents and injuries due workers fall down

No.	Standard	%
	Accidents or injuries due to workers fall down	
4.1	Worker fall from less than 2 m height	38.9
4.2	Worker fall from Scaffold	22.5
4.3	Worker fall from building	21.6
4.4	Worker fall from ladder	17.0

Figure (4) Percentage of accidents and injuries due to worker fall down



It is clear from Table (4) and Figure (4) the analysis of accidents and injuries due to the fall of the worker from the height represented up to 36.5% of the total accidents. These accidents and injuries analyzed based on the height of less than 2 m regardless of whether the worker is standing on a ladder or from height more than that as fall from a floor out of the building, the results are:

- The result of a fall from less than 2 m height 38.9%, this analysis shows the problem of risk when the risk is far from expected, as 2 m does not considered danger, no worker fear from it.
- While the fall from the scaffold 22.5%, which confirms the importance of the care of scaffold plan, which confirms the analysis of table (2) analysis of accidents or injuries based on the cause of the accident which was up to 20.6%.
- And a fall from the building by 21.6%.
- A fall from a ladder up to 17.0%, whether it moves in general or an exceptional reason in particular, which also confirms the analysis of table (2) analysis of accidents or injuries based on the cause of the accident, in which accidents of the ladder 22.7% of the total accidents.

**Research summary:**

Workplaces vary in the severity of risks and the absence of regulations and standards can create many risks and accidents, which can lead to significant consequences and damage to the workplace and to the economy in general. Risk assessment and knowledge of all potential risks in the workplace. It is necessary to know how to avoid them.

The administration is concerned with implementing the work and achieving its goals within a sound administrative, legal and technical framework. It is the responsibility of the administration to organize and follow up the work to ensure implementation without obstacles and without departing from the permissible cost framework plan, quality and time period. In addition to these responsibilities, the Occupational Safety and health responsibility to protect employees from work risks as required by the labor law as well as the Egyptian code for project management is the responsibility of the owner, who thus grants it to the implementation contractor of works and under the supervision of the project consultant. This research aims to identify the types of accidents and injuries that occur at construction sites. In order to achieve the objectives of this study a statistical analysis of a group of incidents of workers at the implementation sites in the period 2012 to 2019 for multiple projects in the Arab Republic of Egypt.

From the record of incidents in the implementation period of each project, and based on the data of these records. This study analyzed the data related to each worker's work type, the cause of the accident, and how the accident occurred, examined injuries and accidents recorded in the sites records log that have been compiling, regardless of other health problems that are not recorded or long –term diseases. It is obvious from the general terms of accident and injury ratios for

employees on site that the concept of accident ratios refer to the type of risk for business items. Whether these points are a business item, certain weaknesses of tools or due to certain behavior, based on the focus of the Occupational Safety and health team on how to avoid the site highest risk ratio. The research has reached the emphasizing of the accidents frequency and determined the proportions, and the most relevant accidents that have large percentage. Based on the identification of them, the Department of Occupational Safety and health in construction sites should focus on how to overcome them.

### **Outcome:**

It is clear from the general point of view for accident and injury ratios of site workers that accident ratios refer to the type of business items risk. Whether these points are a business item, certain weaknesses of tools or due to certain behavior, which would be avoided by the Occupational Safety and health team focusing.

The research focused on accidents and injuries analysis to determine the most dangerous points when the risk is great and the result of research show the following:

- For work items:

Concrete works come in first place with up to 21.6% of total accidents and injuries, followed by excavation works with 15.3%, electric works with up to 11.4%, exterior painting works with up to 9.2%, door and window works with up to 8.5%, sanitation works 6.7%, and brick building works accidents and injuries with up to 6.5%.

- Based on where the accident happened:

The proportion of accidents and injuries of ladders is 22.7%, followed by scaffolding by 20.6%, flooring by 12.4%, the rest of the building by 11.2%, and the rest of the site accidents and injuries by 33.1%.

- To describe the accident or in the sense of how the accident occurred, the ratio of accidents and injuries:

As a result, of a fall from an altitude of 36.5%, as a result of something fall on the head 19.3%, as a result of a slide 17.2%, the rest of the accidents by 27% during the overall movement.

- Analysis of accidents and injuries due to the fall of the worker from a height, which accounted for 36.5%:

As a result of a fall from a height of less than 2 m 38.9%, a fall from a scaffold 22.5%, a fall from a building 21.6%, a fall from a ladder 17.0%.

### **Recommendations:**

Despite the applying of the projects sites the rules and regulations of Occupational Safety and health, and the presence of safety team obligated to continuous follow-up the employees, and record accidents and injuries, there are still accidents and injuries that have to be taken into account by the team with more concern in order to decrease those accidents to the minimum. The following recommendations are meant to make the working environment safer:

- Make more attention to work items that cause many accidents.

- make an administrative system that reviews ladders, scaffolding, electric tools and handy tools to ensure their safety before use as well as after use.

- Review the fall protection systems on the scaffolding and the edges of the building before and after use.

- Continuous supervision of all workplaces on site to ensure the application of Occupational Safety and health regulations.
- Make statistics of accidents and injuries periodically (example monthly, and not exceed three months period), announce their results to the Occupational Safety and health team to take appropriate actions, and for workers to draw their attention to the site weaknesses places and follow up notes and errors to prevent recurrence.
- Conduct training sessions continuously to awareness raise of employees and remind them of the regulations to avoid accidents, use accident ratios to benefit from them not to repeat.
- Make more concern of problems and weaknesses of the site for continuous improvement, such as arranging the site workplace.
- Take care of cleanliness throughout the site, in the workplace, corridors, rest areas and others.
- Provide workers with safe places to eat food as well as provide bathrooms for workers usage. Make sure of implement health care requirements on food, tap water, toilet systems.
- Occasionally measure the effectiveness of Occupational Safety and health management by measuring the number of deaths, the frequency of accidents and injuries, the severity of injuries, and make comparisons with earlier data to monitor the improvement.

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