

## Ergonomics Issues in The Construction Safety

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**Objectives:** Because of the high rates of accidents, the construction industry has become a hazardous industry in Iran and therefore paying more attention is required. This paper investigates safety management in construction companies for improving workers' safety as one of the ergonomics aims.

**Methods:** In order to survey the safety management in construction companies a questionnaire was prepared and all aspects in construction safety management structure were included.

**Results:** The main important problems of safety management in construction include: lack of safety training, lack of provision of personal protection equipment, absence of safety and health specialized staff in construction sites, disuse of safety regulations and lack of updated rules, traditional management attitudes toward safety as a cost.

**Discussion:** Despite other industries, safety, health, and environment management have not found its true position in the construction sector; however some construction companies have established some provisional measures recently. Among the most important problems in safety management in the construction sector, these items can be mentioned: regulations need to be reviewed considering the type of project, low cultural level of the working class, and safety leadership do not perform well in the construction sites

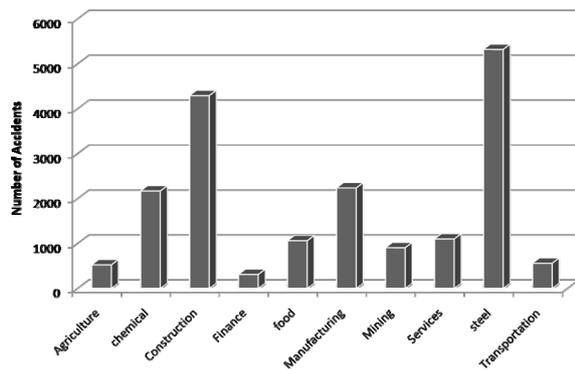
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### Introduction

The construction industry is considered as one of the most hazardous industrial sectors (1). The risk of a fatal accident in the construction industry in comparison with other industries is five times more likely (2, 3). In recent years, the construction industry of Iran has been thriving due to an increase in national and international investment to the extent that it is now the largest in the Middle East region. The annual turnover in the construction industry amounts to US \$38.4 billion. The real estate sector contributed to 5% of GDP in 2008 (4, 5). Moreover, the rate of accidents in the construction sector has increased considerably. According to Iran Social Security statistics, construction sector with 30

percent of work accidents has become the second hazardous industry. According to statistical studies of Labor Relations Department of Ministry of Labor on 3000 construction accident reports between 2000 and 2005, 16 percent of construction accidents led to death, about 70 percent of accidents resulted in injury and damage and the rest including other items. Also, according to statistics of social security organization of Iran, 4171 and 4291 accidents in 2007 and 2008 has been reported in the construction sector respectively (6). Distribution of occupational accidents in different industries in 2008 is shown in Figure1. As indicated in Figure1 the highest accident rate is related to steel industry and construction sector is the second hazardous industry.

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**Fig.1.** Distribution of occupational accidents by separation of different industries

Due to the dangerous nature in this industry, safety has become a major issue. Furthermore, based on definition which has been published by ISO, Ergonomics produces and integrates knowledge from the human sciences to match jobs, systems, products, and environments to the physical and mental abilities and limitations of people. In doing so it seeks to safeguard safety, health and well-being whilst optimizing efficiency and performance. Therefore, considering ergonomics will lead to improving safety of workplaces and organization productivity promotion.

So that the rate of accident reports and statistics in the construction sector in Iran signals a need for more attention. The poor safety performance of the construction industry gives international cause for concern. Prevention of accidents is, therefore, an area of responsibility of the top management. A good management should always insist that every engineer, supervisor, and laborer must be familiar with all basic safety aspects and practices that guard them from accidents and injuries around the sites. By means of effective safety program in the prevention of accidents management can keep the working environment safer (7, 8, 9). Comprehensive safety policies, safety committees, safety trainings, jobsite inspections, accident investigations, first aid programs, in-house safety rules, safety incentives schemes, selection of employees, personal protection programs, emergency preparedness planning, safety related promotions, safety auditing, safety record keeping, and job hazard analysis are among affecting safety programs (10, 11, 12, 13).

In this paper it is attempted to survey the most important safety management aspects in the construction sites and identify the strengths and weaknesses in management program and recommend suggestions for existing problems.

## Methods

In order to survey on safety management in construction companies and to achieve the above goals, based on extensive literature review in the field of construction sites safety management, a questionnaire was prepared and many aspects in construction safety management structure were included. The first part of the questionnaire was about company information such as background, activities and employees. In the second part the main elements of safety programs such as safety regulations and safety standards, accident reporting system, safety training, personal protective equipment, safety manager attendance in sites and first aid and emergency planning were included, based on studies (12, 13).

Construction companies were chosen based on the Iran President Deputy Strategic planning and Control (PDS) license. Technical Affairs office of Iran was established in 1971 and its outcome has been its brilliant experience at the areas of preparation and collection of technical codes and regulations at different technical and engineering fields including: architecture, water, civil, installations, agriculture, environmental and soon. The domain of influence of management of technical affairs is all the technical affairs relating to system including technical and executive system of the country and various fields (such as roads and transportation, building, agriculture, water, telecommunication, environment, industry and mining, power and installation, transformation system, networks of distribution and collection of water and waste water and urban installations) and common technical fields (such as surveying, Geotechnical, Seismology, and etc) and also at all stages of work performance and courses of technical and executive system of the country (including collection, execution, exploitation and maintenance courses). According to this organization companies are classified into 5 levels. Mainly first class and excellent base companies with various activities such as mass building, Construction projects, oil, gas and petrochemical construction projects, industrial buildings including large industrial plants, power plants, refineries, infrastructure and urban. Therefore, 200 first class and excellent Construction Companies introduced by the PDS organization were selected. After interview, phone call, and sending the questionnaire, information of 47 Companies were collected that was 23.5% of the population.

## Results

### 1. Profile

The profile of the companies is shown in Table 1. As Table 1 indicates, 34% of companies have employees fewer than 200 and 17% of companies have more than 400 employees. In Seventy-two percent of companies working hours were over 45 hours per week. From the profile data, 41% of companies have been in business for 20 years and less, 45% have been in business for 20 and 50 years and 14% of companies have been in business for more than 50 years. In different branches of construction, 45% activities of the surveyed companies were in industry, 17% in Housing and 38% in other activities including oil and gas projects, construction projects, construction of sewage networks, equipment installation, road construction and, marine structures.

Table1. profile of construction companies (N = 47)

|               | Profile     | Frequency | Percentage |
|---------------|-------------|-----------|------------|
| activity type | industrial  | 21        | 45         |
|               | residential | 8         | 17         |
|               | Others      | 18        | 38         |
| background    | 20 >        | 19        | 41         |
|               | 20-50       | 21        | 45         |
|               | 50 <        | 7         | 14         |
| employees     | 200 >       | 16        | 34         |
|               | 200-400     | 23        | 49         |
|               | > 400       | 8         | 17         |

### 2. Safety priority

To survey safety priority in companies, the question "How is safety perceived in your company in terms of importance?" from a previous study (12) according to a priority scale of 1= the least important to 5= extremely important, was selected. In response, 3.4% of the surveyed companies chose "relatively important", 44.8% "important", 34.5% "very important" and 17.2% answered "extremely important".

### 3. Safety program elements

#### 3.1 Safety Manager Attendance

Construction safety personnel refer to individuals such the safety directors, managers and inspectors, who are responsible for overall safety of the construction environment and/or organization. Unfortunately, in the most construction companies, mainly Civil Engineers are usually employed as safety manager that has affected the quality of safety, and educated people in this area such as

safety engineers and occupational health engineers are less used. In 69% of the surveyed companies safety staffs attend mainly as full-time and as part-time by 20.7% construction site. In 10.3% of the companies, no one hadnot been employed as the safety manager. Judging about how an available safety manager could be beneficial in reducing work accidents rates seems to be almost impossible, largely because of unavailable statistical Data.

#### 3.2 Safety committee

Establishing a safety committee is necessary according to work regulations and the minutes must be reported. In 51.7% of the companies committee meetings were held, but not on a regular basis. Concerning the importance of safety meetings to address the current deficiencies in safety and more interaction between different groups at the site, the safety issues are usually undervalued and "safety sessions " , some time are considered as time wasting in some companies.

#### 3.3 Safety budget

How to get the required fund for safety was also a great concern. Almost 55.2 % of companies had separate budget and 44.8% of companies did not, the costs would be supplied if needed. Companies had avoided revealing the actual amount funds of safety issues but a rough estimation of budget represented the low investment in this sector, however, safety budget is among the vital factors in promoting safety programs which should have not taken for granted.

#### 3.4 Safety Training

Training is one of the most important parameters of safety management. In construction sector, concerning hazardous nature of work, changing behavior and attitudes of workers toward potentially dangerous situations can be effective. Among the companies only six had training programs. Many in the construction industry agree, as shown in studies, that one way to change statistics is through effective worker safety and health training (14).

#### 3.5 Accidents reporting system

Many companies had accident record system, but near misses are less recorded. From previous study (13) the main impact of accidents on the surveyed companies was asked. The result of this question among the surveyed construction companies is shown in Fig 2. As the figure 2 shows %<sup>∆</sup> Increase

in cost, 21% interrupting construction schedule 18%, imposing psychological burden on workers and 14% impairing reputation of firm are reported as the most important effects on companies. The results indicate that the more accidents have sought to impose the more costs on companies, in comparison to the other factors. Since the lower costs and more profit are significant in construction projects, the costs of accidents could be considered as a challenge for companies, especially for the smaller ones.

From previous study (13) the most important events that have occurred in the surveyed construction companies was questioned. Results are shown in Fig 3. Therefore, 72% falls, 21% collapse of excavation, 14% implementation of heavy machinery, and 10% electric shock was reported. Obviously, the danger of falling down from heights is considered as the most hazardous accident in construction companies, while excavation as one of the challenges in today's construction industry has the second rate of significance.

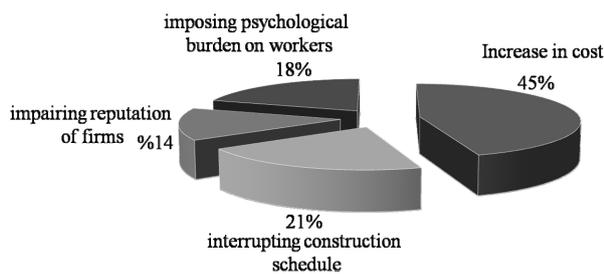


Fig. 2. Impact of accidents of firms

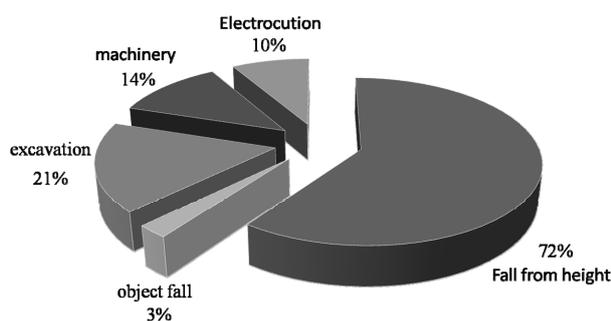


Fig. 3. Hazard ordering

### 3.6 Regulation used in the Company

ISO, HSE, and OHSAS standards, integrated management system (IMS), together with 12<sup>th</sup>

season of National Construction Regulations and Construction protection Regulations set of labor safety and health regulations are considered as references of safety regulations in the construction sector. The practice of safety in construction in Iran is regulated by governmental agencies such as the National construction rules and Regulations of labor health and safety (construction chapter), which provides strict rules and regulations to enforce safety and health standards on job sites. Almost more than 69.9% of companies have ISO and HSE standards and almost have been committed to implement various aspects of safety management. Approximately 32% of companies have no health, safety, environment system. In Some companies the top management insight into safety management system was positive and management personally has been pursuing safety issues, but in lower levels the attitudes were a traditional and safety was considered as a cost.

### 3.7 Personal protective equipment

At almost all companies, personal protective equipments were provided for staff and workers. Among the equipment provided the most cases is related to the safety helmets, gloves, safety shoes and safety harnesses; other equipment such as safety glasses are less supplied. Although safety harnesses are provided for work in height, in some companies it is less used by workers. But regarding the training and the importance of using personal protection equipment as a way of prevention of major accidents, no measure has been taken in most of the companies. On the other hand, lack of a legal obligation or surveillance system in the production or importing low quality equipment has changed workers attitudes towards personal protection equipment and therefore led to less use. Yet the culture of using personal protective equipment must be reinforced to strengthen personal protection usage.

### 3.8 First Aid and Emergency plan

Due to serious accidents in the construction sector the necessity to use emergency programs and first aid is inevitable. Almost 69% of companies have necessary rescue equipment and 27.6 % of the companies have trained personnel present in sites. In addition, in several companies active in the field of mass construction, safety maneuvers have been held to enhance the emergency response plan.

## Discussion and Conclusion

Iranian construction industry has had a growing trend in recent years and, on the other hand, accidents in this part of the industry has increased considerably compared to other industries so that this industry has become a high risk industry. Despite other industries, safety, health, and environment management have not found its true position in the construction sector; however some construction companies have established this kind of management recently. Among the most important problems in safety management in the construction sector the following items can be mentioned:

- Regulations need to be reviewed considering the type of project, so that cover all activities in the construction sites at a large scale. Hence current rules should consider specific conditions and requirements according to standards. National Construction regulations and regulations protecting construction sites are not updated concordant to the progress of construction methods; so that it's real position can be found in few companies. It is necessary that the regulations be updated concurrent with advent of new construction techniques, equipment, and machinery (as like in developed countries) so that it can be helpful in the advancement of safety management.
- Considering the low cultural level of the working class there must be more attention to the workers cultural substructures about safety and health issues. Cultural problems are considered as a major obstacle in the road to establishment of safety management for workers and managers. Dynamic and integrated safety training and raising workers awareness of potential risks and using personal protective equipment could also be effective.

- Another major problem in safety management is the lack of specialized and professional staff in safety engineering and therefore safety leadership does not perform well in the construction sites. The responsibility for safety on any construction project should be shared between all the parties involved in the project, namely, the owner, the designer or architect and the contractor. A need exists across the industry, encompassing designers and suppliers, as well as site-based personnel, to raise awareness and understanding of the generic safety risks that are commonplace in construction.

- Accident investigations are less practiced in companies. Also, in the Social Security Organization's Statistics Center applicable information of accidents revision cannot be found. The findings of investigations frequently contain an over attribution to chance, and a tendency for over apportionment of blame.

- It seems that the use of personal protective equipment is considered as an alternative way to control hazards and risks instead of eliminating hazards and reducing risks through more direct means. Personal protective equipment should be a last rather than first solution for risk management. But there are problems that overshadow the real role of these devices and their optimal implementation. Unfortunately, there is no legal obligation or supervision in the production, distribution and import of equipment and mainly low-grade products are made available for workers. Greater sophistication is needed with the design and use of personal protective equipment. On the other hand, in order that personal protective equipment can be used for workers, they must be given necessary and sufficient training, particularly when they are exposed to hazardous situations.

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