Identification and classification of the factors causing falls from heightat work

Author:
Nicoleta CRĂCIUN*

Abstract: Existing in most sectors, the workstations at different heights expose workers to hazards causing serious injury, disability or death in most of the situations. Due to their repercussions, the work injury as a result of falling from height representa significant economic burden both on employees, the employers, and the society as a whole. The present paper aims to identify and classify the main factors that generate work accidents due to the falls from height in order to find the optimal solutions to reduce them.

Keywords: falls from height; hazards; risk factors

JEL Classification: I15; I00; I19

1. Introduction

Present in the majority of the industrial sectors, the activities at height expose workers to a variety of hazards to their health and safety thus leading in most cases to injury, disability or death. Despite the efforts to reduce the workplace accidents due to the falls from height, they still occur and occupy top positions among fatalities.

2. The need to identify factors determining falls from height

The existing European statistics have shown that work-related accidents represent a major safety and health problem as about 4,000 people are yearly reported to die in work accidents while thousands of workers suffer serious

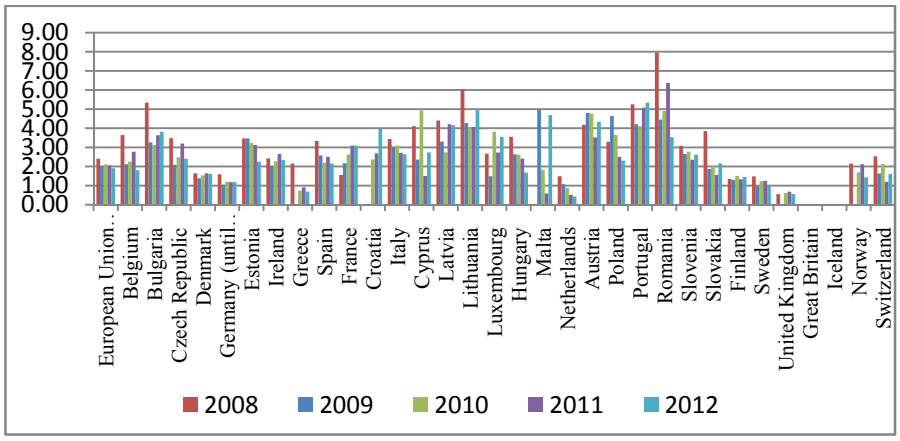
* *The National Research and Development Institute of Occupational Safety (INCDPM) - "Alexandru Darabont", Certification Body, Head of PPE Certification, e-mail: nicoleta2k3@yahoo.com*

injuries and health problems as a result of improper or illegal working conditions, that lead to more than three- day absence from work.

As a result of work-related accidents, statistics show about 150 million working days that are yearly lost resulting in significant costs for the employers alongside important consequences in terms of human suffering for the victims and their families.

The existing data on work accidents and work-related diseases, and the exposure to risk factors as shown by the statistics play an important role for the improvement of health and safety at work. On the basis of the Eurostat data on the rate of fatal accidents at work in 12 activity sectors e.g. agriculture, manufacturing industry and constructions, one can notice that the frequency index of fatal accidents decreased from 2.41 in 2008 to 1.91 in2012 in the EU (the last year for which such records exist) (1). Used to illustrate the increase or decrease in the absolute number of accidents for a given population (100,000 workers), the incidence rate of accidents is often considered an indicator of success in terms of accident prevention strategies. The incidence rates of fatal accidents at work in the European Union within 2008-2012 are given in Figure 1.

Figure 1: The incidence rate of fatal accidents at work (100 000 workers) excepting the work accidents on the road and the accidents on ships (Eurostat 2008-2012)



As shown in Figure 1, the rate of fatal accidents at work varies to a great extent in different countries. In 2008, in Romania, the highest frequency of fatal

accidents was reported (7.96) while in 2011 the frequency index value of fatal accidents was over 3 for 100000 workers indicating the likelihood of work related risks for the workers. However, the published figures are much lower than the number of work accidents really occurring. Concomitantly, the long-term effects of occupational diseases are not given in the existing statistics. In many countries, for lack of national strategies for the prevention of risks at work, the occupational diseases are not recognized as work-related ones. Therefore, they are not reported, recorded or compensated as such. Consequently, this approach does not allow the prevention and control of the causes leading to work accidents and/or occupational diseases.

However, in other countries as UK, for instance, a centralized database exists with explicit types of accidents leading to deadly incidents in different activity sectors. Thus, in 2013-2014, from the reporting data of RIDDOR (see Table 1), falls from heightare the most frequent cause of accidents especially in the construction sector.

Table 1 - Fatal accidents at work reported in the UKwithin 2013 to 2014

Kind of accident	Fatal injuries						
	Main industry classifications (1)						
	Agriculture, Forestry and Fishing (A) (2)	Mining and Quarrying (B)	Manu-facturing (C)	Gas, electricity and water supply; sewerage, waste and recycling (D,E)	Construction (F)	Services (G-U)	All Industries (A-U)
Contact with moving machinery	3	-	2	-	3	5	13
Struck by moving, including flying/falling, object	1	-	1	1	2	8	13
Struck by moving vehicle	2	1	1	1	3	5	13
Strike against something fixed or stationary	-	-	-	-	1	-	1

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Slips, trips or falls on same level	-	-	-	-	-	2	2
Falls from a height	-	-	2	1	11	5	19
Trapped by something collapsing/overturning	-	-	2	-	1	2	5
Drowning or asphyxiation	-	-	-	-	-	1	1
Exposure to fire	-	-	-	-	-	1	1
Contact with electricity or electrical discharge	1	-	-	-	1	-	2
Injured by an animal	1	-	-	-	-	1	2
Acts of violence	-	-	-	-	-	1	1
Other kind of accident	2	2	1	1	6	4	16
Total	10	3	9	4	28	35	89

Source: http://www.hse.gov.uk/statistics/causinj/kinds-of-accident.htm

Regardless of the activity sector where they have occurred, the work accidents due to falls from height lead, in most cases, to serious injuries resulting in more than a 3-day absence from work, disability or death thus representing a considerable economic burden for employers, employees, and at societal level as well. The real tragedy backing the statistics is that in most of the cases when workers die while carrying out work tasks, the workplace related risks are well known. This can be explained by a poor management in terms of safety and health at work and the synergic effectsgenerating hazards in the workplace. The risk factors and the hazards known for a workplace could also represent potential sources of injury or adverse health effects of the workers concerned.

Given the significant number of accidents caused by falls from height shown by the statistics in the EU, numerous studies have been conducted to identify the factors that determine the fall from height and to find the best solutions meant to reduce similar work accidents.

The significant incidence of occupational accidents caused by the falls from height a long side the changes occurred in the labour market led to new and emerging risks. The increasingly number of new forms of employment out of which some represent a higher risk for workers health (e.g. temporary workers, employees with fixed-term contracts, part-time jobs or shifted work), rendered an essential role to the health and safety at work in terms of work quality.

Therefore, providing safe and healthy workplaces remaina collective concern in terms of human values, and economic and societal costs thus constituting one of the main objectivesof the EU social policies. Legally based on the article 153 of the EU Treaty, the EU action in the field of health and safety at work is not limited to legislation only. The Commission has extended the scope of its activities to the collection of reliable information, guidance and the promotion of a healthy work environment. The priority of the quality of work is actually based on the examination of the work accidents.

The need to identify and assess the risks related to the work environment constitutes a legal obligation (European Directive 89/391 / EEC transposed into, the Law 319/2006 at national level) for the employers being a prerequisite of safety and health protection, and for the collection and centralization of all the factors determining falls from a height.

3. The classification of risk factors

Although previous studies led to a better understanding of the weight and and pattern of the work accidents, the link between the various factors identified was limited to the analysis of the influence of individual factors and the work place on accidents due to falls from height. Considering that the work accidents caused by falls from height were recorded in different industry sectors (constructions, agriculture, chemicals and steel, mining, etc.) at workplace level, or while travelling to or from the workstation,one may assume as a source of dangernot only the workplace with a level difference of over 2m, but also the cumulative action of the physical, mechanical, chemical factors present in the work environment and their synergistic action, in addition to other workers' action. The risk factors selected from the studies that investigated the causes of accidents covered:

- Several sectors (construction, agriculture (2), chemicals and petrochemicals (3), mining (2), services (4)),
- Different workplace design – those areaswhere the risks of fall into empty void existe.g. scaffoldings (5), (6), (7), poles and ladders (8), roofs (5), (9) during lifting formwork (2),but also during the regular inspection and maintenance works (2), during demolition (2), during the maintenance and rehabilitation of buildings (9), during the work in cabins of cranes at heights, during the activities carried out at ground level near a trench / pit uncovered (10); while loading bales to be stocked in trailers or kept in silos (11) during cleaning and maintenance activities at the greenhouses roofs (2) during the erection of industrial fans, as well as at roofing works (2), (4), (7), etc.;
- Various categories of workers e.g. bricklayers, carpenters, roofers, plumbers, electricians, civil workers, painters, etc.;
- Different sizes of companies e.g. companies with over 100 employees, companies with less than 10 employees.

A formal analysis was conducted to obtain relevant information meant to highlight a causal relationship between the workplace design and the risk of falls from height. It began with the components of the work system (performer, workload, machines and work environment).

So, the risk factors leading to falls from height as shown by various studies were grouped into:

- **Risk factors incumbent to the performer** (the worker in charge with the execution of the work task) that were generated by:
  - Work-related behaviour, lack of safety culture ("It will not happen to me") (2); lack of attention/vigilance, clutter at work, the decision to continue working even after identifying a dangerous situation, the decision to continue working without personal protective equipment (12), (10), (13), (14), the decision to continue working without ensuring, the decision to act within a dangerous work environment (12), joking, lack of communication abilities (15), use of inadequate protective equipment (2), eliminating the protective devices, adopting an insecure stand / posture for the job concerned, inappropriate choice of anchoring points (4), use of damaged personal protective equipment (4), improper use of the personal protective equipment (4), distraction, ignorance and negligence at work (3), reckless operation, improper position during any task (5), inadequate risk assessment, inappropriate marking of the openings,

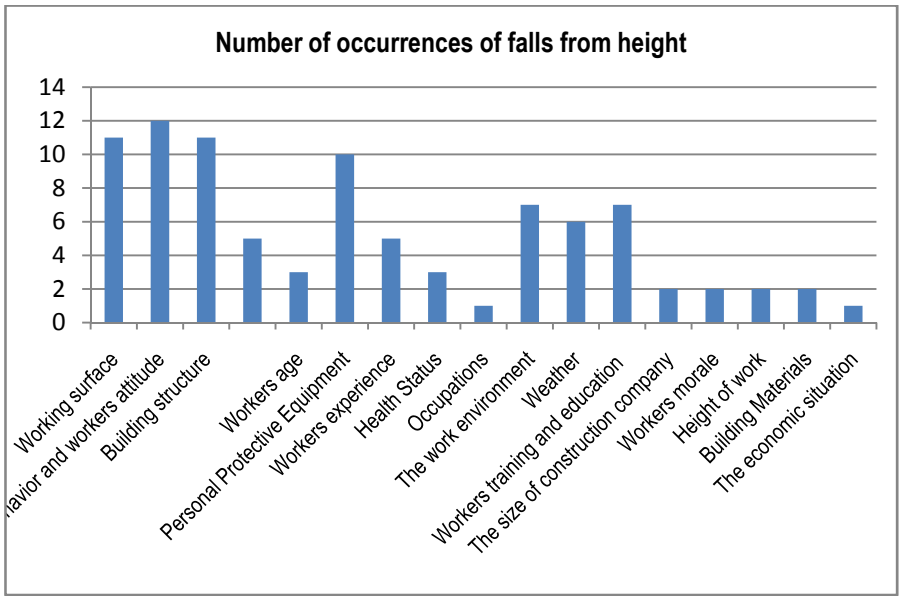
improper assembly or lack of scaffolding, not observing the health and safety regulations (4), etc.;

- Hearing disorders, chronic or acute diseases, psychiatric disorders (12), alcohol, (12), drug consumption, weakness, tiredness (15), (12), traumas, etc.;
- Lack of experience (5) e.g. ability to work on a ladder, scaffolding, roof, etc.;
- Poor training and/or education caused by language and cultural differences (3), lack of appropriate training (8), (16), lack of education on health and safety at work (5), insufficient training (3), communication problems (3), lack of appropriate qualification (2) lack of awareness regarding the protection against fall from heights (8);
- Time pressure when performing the work task; feeling vulnerable from various reasons; the work relationship with the management, the supervisors and/or the other employees; lack of motivation e.g. less or inexistent financial incentives.

- **Risk factors specific to the workload that** can be generated by:
  - Lack of knowledge in terms of technologies and work methods (5), inadequate labour standards, lack of supervision (5), lack of personal protective equipmen(8), limited access to resources, etc.;
  - an overestimation ofthe performer'srequirements; the work pace;
- **Risk factors incumbent to the production means** (2), (7) that can be generated by:
  - the presence of the equipment orobjects with high temperatures, sharp objects,
  - use of sharp, rough or damaged equipment, overloaded,
  - the presence of unprotected explosive materials,
  - use of uninsulated power devices (12);
  - improper storage of materials (15),
  - the presence of chemicals, etc.
- **Risk factors related to the work environment** (2) that are generated by:
  - inadequate working conditions such as: poor lighting; activities run in the vecinity of falling objects, heavy traffic, inadequate working surface (wet, slippery, damaged, fragile floors, the presence of edges and unprotected openings (16), (9), damaged ladders and scaffolding(16), unfavourable weather conditions (ice / snow, sub-zero temperatures, rain (15), sun, noise) (4).

Given the significant changes in organizational procedures, practices and the workload in the construction sector, Figure 2 renders a synthesis of the causal factors when considering the 18 macro-variables identified.

Figure 2. The contribution of macro-variables that cause falls from height



4. Conclusions

Considering that each job location presents an unique height for a given work situation, one may assume that the rate of workplace accidents is closely correlated with the level where the work task is performed i.e. when the workload is carried out at height, the workers will most probably render less attention than requested. Although the analysis of accidents may differ, it's worth noting that the largest percentage of the causes of falls from height resides in:

- the presence of workers having unappropriate work behaviours and attitudes
- unappropriate work surfaces and workplace design (e.g. slippery surfaces, unsuitable concrete surfaces, slippery roof, use of platforms, and slipping of the base of the scaffolding)
- the structure of the constructions and installations,

- unappropriate use of personal protective equipment - non-use, misuse, or use of damaged PPE.

Other factors such as contractors/ insecurity at managerial level, a poor work environment also contribute to the risk of falling. Factors such as age, poor work experience and workers occupations are also frequently reported, but their impact upon the risk of falling from height is rather low.

As compared to other variables, one may assume that "the workers' behaviour and attitude" is one of the most common causes of falling from height as revealed by most of the studies. One of the factors that directly contributes to the risk of falling from height are: damaged structure of the building, work surface and personal protective equipment. The negative impact of a poor management of health and safety at work can result in a reduced number of workers needed at a construction project and the use of self-employed workers; in such cases, the responsibilities in terms of health and safety coordination are often unclear.

The fact that, according to certain studies, a variable or another is associated to the risk of falling from height does not necessarily mean that its impact represents the most important risk factor. However, if it comes to summarize the major leverages that are considered to have an impact on reducing the risk of falling from height, one may assume that they are related to:

- Work surfaces - ladders, scaffolding, working platforms and stable and dry surfaces;
- Training of the workers in terms of applying appropriate protective measures, worker supervision during the performance of activities at height;
- Use of the appropriate personal protective equipment;
- The existence of a safety culture throughout the organization;
- The performance of activities at height at optimum temperature, humidity, light level, low noise level.

Making correct decisions regarding the prevention of work accidents implies a corporate culture and adequate strategies, thus ensuring the necessary tools to improve the activity in terms of worksafety and health.

At organizational level, the adoption of adequate safety and health measures may result in improved working conditions, and better social and organizational environment. For individuals, the application of proper heath and safety measures result in a better motivation and long term commitment. Alongside the obligations arising from the legal framework and the human side of the issue, investments in safety and health at work result in benefits such as: reducing the

occupational diseases and the absenteeism rates; diminution of the personnel costs; increased productivity; improvement of the organization image towards its clients; long-term keeping of the qualified personnel.

This theoretical approach highlights that both the employers and the employees benefit safe and healthy working conditions alongside better performances and an improved image of the organization as a whole.

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