Improving occupational health at work for height work in temporary and mobile sites

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Abstract: This work analyzes the essential and minimum occupational safety and health requirements for temporary and mobile construction sites for buildings with ventilated and atypical front building. The analysis is structured on the necessary security systems and provided on site. Models and images on security systems and legal requirements are presented. The authors' conclusions show the importance of prevention and protection measures must be adapted to the dangers and risks present on the site, be regularly reviewed and amended if necessary, meet the conditions imposed by national laws and regulations, good practices and of the current level of own or external knowledge if the concrete situation requires it

Keywords: security systems, falls, scaffolding, checklist, medical measures

1. Introduction

In this work we aim to study the essential requirements for work in height safety for works with ventilated front building and other atypical works and to clarify the main types of work equipment, individual protective equipment and means of collective protection available on the market. for working at height.

More specifically, it is desired to identify appropriate collective protections in relation to the workload, so that construction sites are safe for workers.

The results of the study will help managers prioritize occupational injury risks based on the likelihood of trauma or injury and pay more attention to accident prevention, worker protection and safer work environments.

We see a growing development of the concept of "buildings with ventilated front building" where the main risk of injury is falling from a height, due to insufficient knowledge of how to choose appropriate collective protections and identifying occupational risk factors, applying effective methods and developing a safe working model in the construction activity of buildings with ventilated front building are determining factors.

2. The current stage

The construction industry has grown in recent decades and has resulted in improved corporate profitability, financial accessibility and increased demand for supply in the market. Construction projects are described as dynamic and complex. They are also characterized as temporary and transient. [7,8]

For example, the workforce for construction companies is usually employed temporarily, and because they spend most of their time working in hazardous areas, they are more likely to be injured or even killed. [9]

Occupational accidents in the construction industry are common and can lead to trauma, permanent injuries and disabilities as well as a high probability of death. [10]

Workers must be protected against falling objects, whenever technically possible, by means of collective protection. Work at height may, in principle, be carried out only with the aid of appropriate work equipment or with the aid of collective protection equipment, such as railings, platforms or fastening nets. [1]

Falling from a height is one of the most important occupational safety and health issues in the world.

The most common danger associated with work accidents involving falls from a height are scaffolding. [9]

Scaffolding and ladders are used to carry out construction work at height.

First of all, the placement of scaffolding and stairs in a risky manner can lead to the death of workers. Scaffolding can be very dangerous when used or built improperly. [9,12]

In addition, prolonged construction activities on a scaffolding or ladder with an unsafe design, adequately explain the high level of accidents at work by stepping into the void. [6]

Psychosocial factors can contribute to occupational accidents, exposure to violence and harassment by colleagues or supervisors are often associated with accidents at work. [15]

Three main groups of security systems can be distinguished in construction sites (according to Figure 1, 2, 3, 4, 5, 6): [4]

Figure 1. Security systems

Figure 2. Scaffolding

Figure 3 Protection systems temporary at the edge of the buildings

Figure 4 Examples of security networks

Figure 5 Security network systems in a construction site Spain, Valencia

Figure 6 Security network systems in a construction site Romania, Bucharest

2. 1. Main aspects found in practice in construction sites regarding collective protection

2.1.1. Lack of provisions and planning for the various work equipment and means of protection that will adapt and be effective for the construction process. (Figure 7)

Figure 7 Models of inadequate work equipment and means of protection

2.1.2. Reuse of protection elements without previous verification of the resistance properties for different protection elements (Figure 8)

Figure 8 Protection models used without prior re-verification

2.1.3. Lack of effective coordination of different workers and simultaneous activities taking place in a construction site (Figure 9)

Figure 9 Simultaneous activities on site

2.1.4. Lack of information and training of technical and operational personnel on safety and installation requirements, various work equipment and means of protection.

In construction sites, most workers are unskilled workers who do not have the possibility of vocational training in the workplace mainly due to the abolition of vocational schools and the limitation of the number of trainers in the field. They do not know the advanced technologies in construction sites.

2.1.5. Lack of preventive culture and lack of emphasis on safety and health issues. The importance given to the observance of the execution terms and the deadline for submitting the work. (Figure 10)

Figure 10 Lack of preventive culture by lack of collective and individual protections

2.2. Framework of regulations and normative acts regarding the safety of works at height

2.2.1. Regulations issued by the European Community

In 1989, the European Framework Directive on promoting the improvement of safety and health at work (Directive 89/391 / EEC) was adopted, thus representing an important tool for improving safety and health at work. (Table 1)

Based on the Treaty of Rome there are two families of Directives, see table 1 as follows: [3]

- Art. 100A (renumbered 95): economic directives;
- Art. 118A (renumbered 137): social directives.

Table 1 Comparison between the two families of Directives

100A (95)	118A (137)
Design	Workplaces
High level of consumer protection from Europe	Minimum requirements
The whole Directive, nothing but the Directive	The possibility for a state to ask for more guarantees many

2.2.2. National regulations

All directives are transposed into national law.

The so-called "new approach" to European standards is an innovative method of technical harmonization by sharing responsibilities between the European legislator and the European standardization bodies.

National legislation on safety and health differs at European level.

Standardized scaffolds or system scaffolds, describe scaffolds that comply with EN 12810 and EN 12811 standards.

Currently, the following European standards for scaffolding are set:

- EN 12810-1. Front building elements of prefabricated components. Product specifications;
- EN 12810-2. Front building elements of prefabricated components. Particular methods of structural design;

- EN 12811-1. Temporary works equipment. Scaffolding. Performance requirements and general design;

- EN 12811-2. Temporary works equipment. Information on materials;
- EN 12811-3. Temporary works equipment. Load test;
- EN 12811-4. Temporary works equipment. Scaffolding protection fans.

Performance and product design requirements.

2.2.3. National and international standards

Currently, the provisions are valid:

- SR-EN-ISO 45001: 2018 HSE management systems
- EN 12810-1. Front building elements of prefabricated components. Product specifications;
- EN 12810-2. Front building elements of prefabricated components. Particular methods of structural design;
- EN 12811-1. Temporary works equipment. Scaffolding. Performance requirements and general design;
 - EN 12811-2. Temporary works equipment. Information on materials;
 - EN 12811-3. Temporary works equipment. Loading test,
 - EN 12811-4. Temporary works equipment. Scaffolding protection fans. Performance and product design requirements.

2.2.4. Safety and health plans

The safety and health plans are drawn up on the basis of Directive 92/57 / EEC transposed into national law by HG (Government Decision) no. 300/2006 minimum requirements for OSH for temporary and mobile construction sites

The health and safety plan must contain at least the following:

- c) identification of risks and description of works that may present risks for the safety and health of workers;

- d) specific occupational safety measures for works that present risks; collective and individual protection measures;

Your own health and safety plan must contain at least the following:

- e) analysis of the technological execution processes that may affect the health and safety of the workers and of the other participants in the work process on site;

- f) assessment of foreseeable risks related to the way of working, the materials used, the work equipment used, the use of hazardous substances or preparations, the movement of staff, the organization of the site;

- g) measures to ensure the health and safety of workers, specific to the works that the contractor/ subcontractor performs on site, including collective protection measures and individual protection measures. [1]

2.2.5. Own occupational safety and health instructions [2]

Most accidents caused by falling off the scaffolding can be prevented by following the OSH's own instructions. [14]

According to the legal requirements, the employer must ensure conditions for each worker to receive sufficient and adequate training in the field of OSH, especially in the form of information and instructions specific to the workplace / job.

2.3. Specific technical requirements for means of collective protection

Analyzing the standards UNE EN 1263-1: 2004 and UNE-EN 13374: 2004 we can classify means of protection as follows (Figure 10,11):

Figure 11 Security network systems

Figure 12 Temporary edge protection systems

2.4. Tests for conformity assessment in the design phase of collective protections

Specific work equipment for carrying out temporary work at height (lift platforms, motorized scaffolding, etc.) must comply with the CE marking.

Work equipment and protective equipment must be supplied to the manufacturers together with an instruction manual of the manufacturer for use and installation conditions in accordance with this manual.

In order to guarantee the minimum levels of resistance of “safety net systems, temporary edge protection systems, scaffolding and work towers” it is important to carry out the verification through the tests established by the requirements of the normative acts. These tests must be performed with the help of specialized laboratories that have the appropriate accreditation. [5]

In order to have safety net systems and temporary edge protection systems, they must meet certain conditions following laboratory tests.

Figure 13 - Minimum installation requirements

2.5. Contributions from the design and execution phase in a construction site in Bucharest

For the correct development of the works at height, taking into account the lack of space, it was designed a scaffolding in the console.

Design phase - Scaffolding project in console prepared by the designer	Execution phase - Scaffolding mounted by an authorized scaffolding company

Figure 14 Collective protection system design model

2.5.1. Solutions for work at height applied from the design phase

In order to create maximum security on and around a building with a ventilated front building, an atypical building must also be designed with a security design, attractive, durable and with high reliability.

Examples of design solutions (Figure 15)

Railings	Horizontal railway system	Horizontal lifeline system

It is a simple, efficient solution, guaranteeing maximum security for an unlimited number of people.	It offers users maximum security, without affecting the appearance of a building. Users attach to the rail with a special rolling device and can work safely on the railway path.	Lifeline systems offer an extremely safe solution without any impact on the appearance of the front building. Once the lifeline is attached, users can work safely at heights in all circumstances.

Figure 15 Collective protection systems - work in safe conditions on the roof of buildings

2.5.2. Solutions for access to front building

When working on front building, front building maintenance systems must be a safe working environment for workers, adapted to the structure of the front building, whether they are straight, inclined or round (Figure 16).

Single roll systems	Overhead cranes

They are suitable for both indoor and outdoor use. They are used for buildings with hard-to-reach front building. These systems consist of a rail and a trolley that moves the gondola guide rails.	Solutions for cleaning glass atria difficult to access. It is used both outdoors and indoors.

Figure 16 Solutions for access to front building

3. Conclusions

Data on accidents at work clearly indicate that scaffolding, in the case of falls from a height, has a high level of occupational risk and has led to accidents at work.

Given the continuous development of technology, the organization of the workplace and the provision of security systems are of particular importance in construction sites.

Prevention and protection measures must meet the following conditions:

- be adapted to the dangers and risks present on the site;
- be regularly reviewed and amended if necessary;
- to satisfy the conditions imposed by the national legislation and regulations, as well as by the voluntary protection programs and other commitments to which the organization has subscribed (good practices, agreements concluded with public authorities, non-regulatory guidelines);
- take into account the current level of knowledge, including information or reports from organizations such as the labor inspectorate, occupational safety and health services, as well as other services where the situation so requires.

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