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## DANGEROUS EVENTS RELATED TO THE USE OF SCAFFOLDING

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### NIEBEZPIECZNE ZDARZENIA ZWIĄZANE Z UŻYTKOWANIEM RUSZTOWAŃ BUDOWLANYCH

#### Abstract

The majority of construction works are carried out at height; these are works that carry a high risk of accident. This paper presents an analysis of dangerous events associated with scaffolding. Information about these events was obtained from online resources. The collected data not only allowed analysis of occupational accidents but also accidents involving third parties and near-miss events. The paper presents particular examples of these events.

**Keywords:** scaffolding, Internet, occupational accident, potentially accidental event

#### Streszczenie

Znaczna część robót budowlanych, wykonywana jest na wysokości. Są to prace, z którymi związane jest duże ryzyko zagrożeń. W artykule zawarto analizę zdarzeń niebezpiecznych związanych z rusztowaniami budowlanymi, uzyskanych z zasobów internetowych. Pozyskany w ten sposób materiał badawczy umożliwił przeanalizowanie nie tylko wypadków przy pracy, ale również zdarzeń wypadkowych z udziałem osób trzecich oraz zdarzeń potencjalnie wypadkowych. W artykule przedstawiono charakterystyczne przykłady takich zdarzeń.

**Słowa kluczowe:** rusztowanie, internet, wypadek przy pracy, zdarzenie potencjalnie wypadkowe

## 1. Introduction

The majority of construction works are carried out at height. According to the general regulations on occupational health and safety included in the Regulations of the Minister of Labour and Social Policy from 26<sup>th</sup> September 1997 [1], work at height is classified as particularly dangerous and is associated with a high risk of accident e.g. falling from a height or being hit by falling material.

To present the scale of this phenomenon, statistical data regarding the total number of people injured in occupational accidents in the construction industry in the years 2007–2015 and the amount of people injured as a result of falling from height, being hit by falling material and also being pulled from below, are included in Figure 1. In the analysed time period, 72,733 people were injured in all occupational accidents in the construction industry.

From the above number, 7657 people were injured as a result of falling from a height, 7768 as a result of being hit by falling material, while 1723 people were pulled down from below. Between them, these three events have caused injuries to more than 23% of all people injured in accidents at work in the construction industry. It is known that a significant number of these incidents are directly connected with working on construction scaffolding. However, on the basis of published statistical data, it is not possible to accurately determine the scale of risk associated with work carried out on these structures.

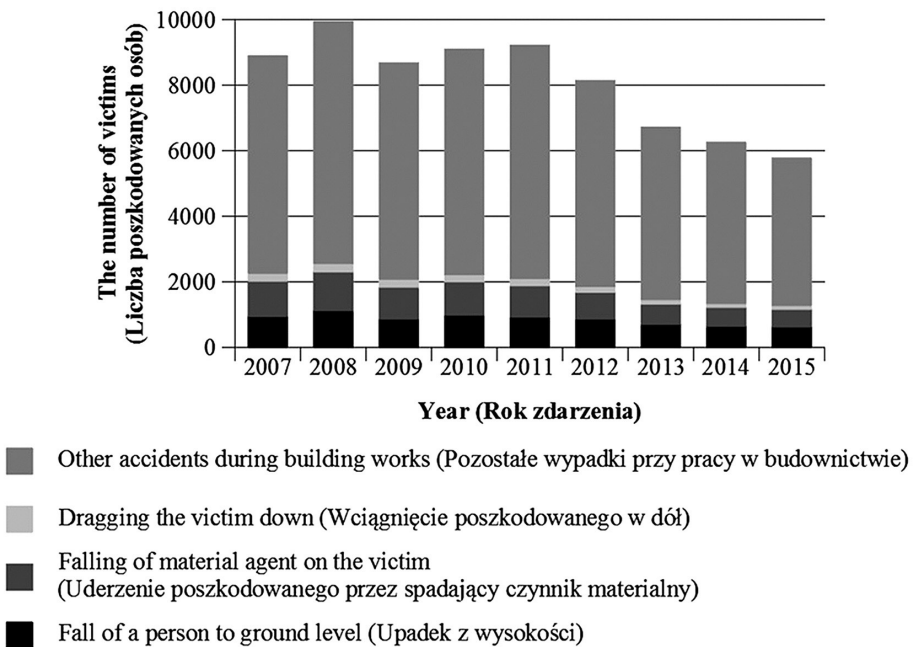


Fig. 1. The number of people injured in occupational accidents in the construction industry in the years 2007-2015 in relation to events causing physical trauma, data source: Central Statistical Office (data source: [2])

Inspections carried out by state institutions, including the National Labour Inspectorate and the State Construction Supervision, have shown a number of irregularities and deviations from the provisions of occupational health and safety during the use of scaffolding [3]. Detailed analysis of such events can help to determine the types of hazards and their scale and also help to define the factors that contribute to accidents occurring during work on scaffolding.

Information about dangerous events in the construction industry can be obtained from many sources, such as: the archives of the National Labour Inspectorate (PIP); National Construction Supervision (GNP) and Central Statistical Office (GUS); the press; online resources. In this article, the Internet is the source of information on such events. It was decided that websites would be searched because it provided the opportunity to not only find information on occupational accidents but also on other hazardous events involving scaffolding which are not included in the archives of PIP, GUS and GNP.

## **2. Research methodology and examples of hazardous events involving scaffolding**

In order to find information on the Internet about dangerous events involving scaffolding, the Google search engine was used. A number of keywords were entered in the searches such as: 'scaffolding', 'accident', 'fall', 'disaster', 'collapse' and 'potentially accidental event'. As a result of the set of queries, several thousand results were obtained. Due to the high repetition of results, pre-processing was used during queries and the repeated results (i.e. the same websites) were removed. However, it was still possible to get two different websites describing the same event, which in some cases, helped to obtain additional information about an event. At this stage, some of the results were rejected due to inaccessibility or error pages. At the end of this stage about 600 websites with results were obtained.

In the next stage, the number of websites was reduced to sequences of words that were then searched regarding the number of occurrences of certain keywords and then divided into two groups. The first group concerned words that are typical for the described events (e.g. 'accident' or 'scaffolding'), and the second group referred to words that are less common and depend on the specific event (e.g. 'fall', 'security', 'victim', 'injuries', 'accident', 'hit', 'injury' etc.). The obtained data was used to support the manual verification of results in the third stage. After the final verification, it was found that the websites have information about 190 dangerous events involving scaffolding. The events happened all over Poland during the period from 2007 to 2015. Some specific examples of such events are presented below:

- ▶ on 23rd August 2010 in Gostyn, a strong gust of wind caused the collapse of scaffolding situated next to a wall of a multi-storey building [4]. The 'curtains' attached to the scaffolding that were supposed to protect pedestrians from falling objects made the entire structure act like a large sail. During a violent storm, a strong gust of wind caused such a large pressure on the scaffolding structure that it pulled out the anchorages of

the walls of the building and overturned the scaffolding. Fortunately, the collapsing structure did not result in any injuries to people.

- ▶ on 6th May 2012 in Bialystok, a section of scaffolding located next to a four-storey building collapsed [5]. The main reason for this event, according to the National Labour Inspectorate [6], were mistakes made during the assembly of the structure which caused the collapse of a section of scaffolding with a length of approximately 45 m and a height of 15.5 m as a result of a gust of wind. Despite this occurring during the afternoon in an area with heavy pedestrian traffic, the collapsing structure caused only material damage.
- ▶ on 29th July 2011, there was an accident during the construction of the North Bridge in which one person died and four others were injured [7, 8]. The event was caused by errors in the attachment of the scaffolding to the construction of the bridge, which resulted in the destruction of the scaffolding and the victims falling from approximately 20 m into the Vistula River.
- ▶ on 7th August 2007 in Bielsko-Biala, an accidental event resulted in the injury of a three year old girl [9]. A moment of inattention by a babysitter led to a situation where the child went onto scaffolding and fell off it. The child was taken to hospital unconscious and with serious injuries.
- ▶ on 16th November 2010 on Piotrkowska Street in Lodz, an accidental event occurred involving third parties [10]. Badly attached scaffolding collapsed on two pedestrians. As a result of this event, a 24-year-old woman was crushed by the collapsing structure. Medical tests confirmed that the victim had a spinal vertebral fracture, head injuries and general bruising.

### **3. Research results – the classification of dangerous events**

The above-mentioned examples show that dangerous events involving scaffolding can be divided into three basic groups: occupational accidents; accidental events involving third parties; potentially accidental events.

According to the law regarding social insurance due to occupational accidents and occupational diseases [11], an occupational accident is: “a sudden event caused by an external factor that results in injury or death and which takes place in relation to work:

- 1) during or in connection with an employee carrying out ordinary activities or instructions of superiors;
- 2) during or in connection with an employee carrying out activities for a superior, even without being instructed;
- 3) when an employee remains at the disposal of an employer and on the way between the employer’s office and the place of carrying out work due to the obligation arising from the employment agreement.”

An accidental event involving third parties is understood as a sudden event which takes place in connection with work and causes the injury or death of a bystander.

In turn, according to the PN-N 18001:2004 standard [12], a potentially accidental event is a “dangerous event that is related to work and in which there is no injury or health deterioration” due to there being no people within range of the hazard. Figure 2 shows the percentage share of individual hazardous events in relation to the total number of examined events.

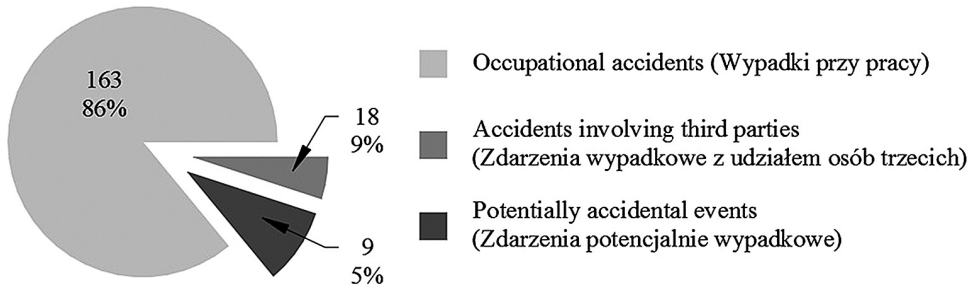


Fig. 2. Percentage share of event types in the tested statistical sample (source: author’s archive)

### 3.1. Occupational accidents

When analysing events classified as occupational accidents, it can be stated that the injuries of victims were usually caused by falling from a height either down to the ground or down to lower levels of scaffolding. This type of event occurred in the case of 92% of victims. In the case of 4% of victims, the direct cause of injury was an electric shock, and in the case of 3%, falling material. The remaining 4% were other events such as, for example, crushing. The effects of falling from scaffolding are illustrated in Figure 3.

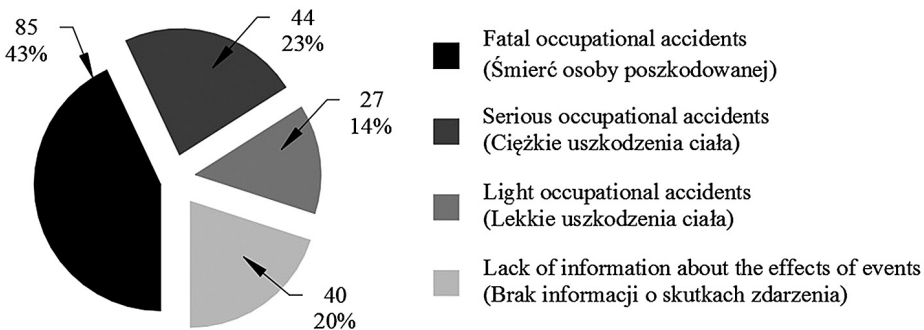


Fig. 3. The number and percentage of the particular consequences of occupational accidents (source: author’s archive)

### 3.2. Accidental events involving third parties

Scaffolding and works that are carried out on them also pose a threat to third parties. In the analysed statistical sample, a total of 19 people were affected. In nine cases, the cause of injury was falling from a height, and in eight cases, a person was injured by falling materials. The items involved were scaffolding that collapsed as a result of insufficient stability, an object or a building object used during the course of works. The number and the percentage share of the effects of events on the injured third parties are shown in Figure 4.

It should be noted that many of the above events could have been prevented by, among other precautions, appropriate anchoring of scaffolding, security of the danger zone or by preventing bystander entry. According to the Regulation on Occupational Health and Safety during construction works [13], a danger zone is calculated on the plane of a building structure and cannot be less than 1/10 of the height from which there is a risk of falling objects, and at the same time, must be equal to at least 6 m.

In exceptional situations, if it is not possible to designate the danger zone in such a way (e.g. in a dense urban area) the legislator allows a reduction of this zone “on condition that other technical or organisational solutions are in place that protect against falling objects”, e.g. nets and roof overhangs.

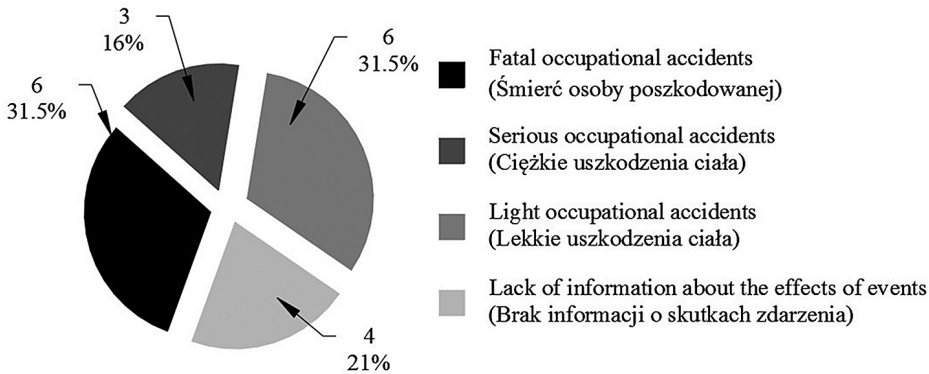


Fig. 4. The number and percentage of the particular consequences of accidents involving third parties (source: author's archive)

### 3.3. Potentially accidental events

Potentially accidental events, and thus events in which there were no injured people, very often occur during the execution of building works. However, information about such events is very limited because the obligation of recording them only applies to organisations that have an occupational safety management system (e.g. according to the series of standards PN-N 18000). According to the regulation from Construction Law [14], only events that are defined as building disasters must be reported.

Other events that do not show signs of being a construction disaster are not recorded and are sometimes even covered up by employers. However, if there is an occupational accident, there is a duty to report such events to the relevant institution but only if the accident is fatal, severe or collective. Since there is no obligation to report light accidents, they are also very often covered up by employers. Such actions mean that there is no complete picture of accident phenomenon in the construction industry.

Previous studies of American scientists have shown that every accident that results in an injury is preceded by the occurrence of many similar events that do not cause injury [15, 16]. Research of Heinrich and Bird showed the presence of a constant ratio between the different effects of accidents. And so, according to a study of Heinrich, for each single serious or fatal accident there are 29 light accidents and 300 accidents without injury. In turn, according to a study by Bird, for 630 events without injury there are 30 events that generate losses, 10 accidents which cause minor injury and one which results in serious injury. These relationships are shown in Figures 5a and 5b. Analysis of such events and timely learned lessons could prevent an accident or minimise its consequences.

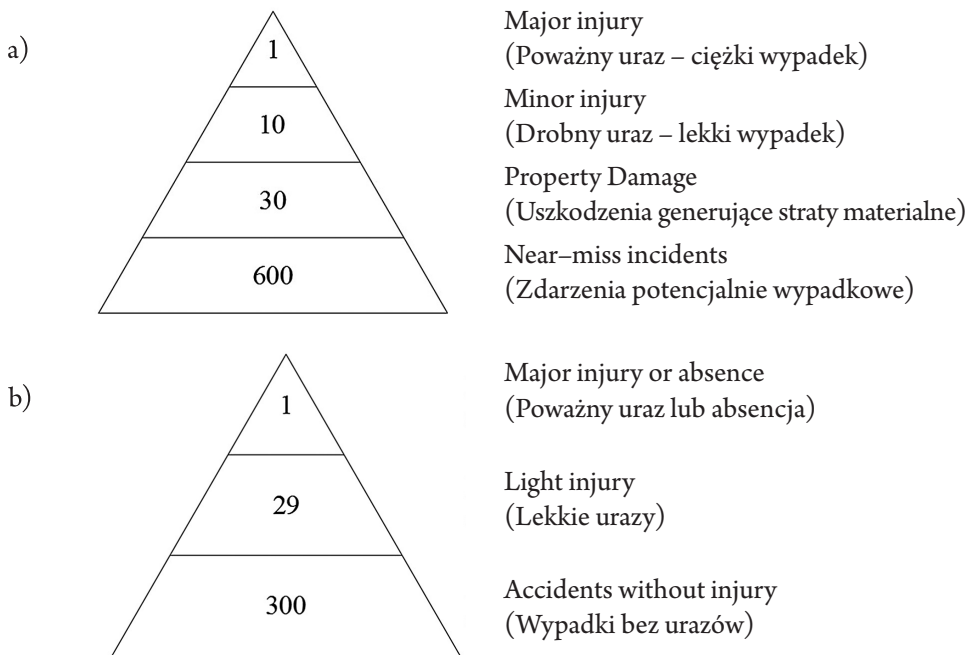


Fig. 5. a) Bird's triangle; b) Heinrich's triangle (source: author's archive)

In the analysed research set, which had 190 dangerous events involving scaffolding, only nine potentially accidental events were identified. However, it should be expected that their number was much larger, but information about them was not made available on the Internet.

## 4. Summary

Based on the conducted survey of online resources, it should be stated that works on scaffolding are associated with a high risk of danger to the life and health of workers and bystanders. The most common cause of injury in the case of workers is falling from scaffolding, and in the case of bystanders it is being hit by falling material, e.g. elements of scaffolding, tools or other building products.

The effects of occupational accidents that involve scaffolding are very serious. In the assessed sample, up to 43% of accidents resulted in the death of a victim and 23% ended in severe injury. The most common injuries include fractures of legs and arms and also head injuries. Accidents involving third parties were often associated with unauthorised entry to a building site. Other events should also be noted, especially potentially accidental events – these are often wrongly underestimated; however, details about them are a very rich source of information that can be used in and preventative measures.

A potentially accidental event often involved the collapsing of scaffolding caused by a strong gust of wind. It is worth mentioning that safety nets, which are used on scaffolding, significantly increase the aerodynamic resistance of such a construction, which affects its overall stability and increases the forces generated in anchorages.

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