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## NEW APPROACHES TO HEALTH AND SAFETY IN BUILDING INDUSTRY

### NOWE PODEJŚCIA DO BHP W BUDOWNICTWIE

#### Abstract

The building industry is one of the most dangerous sectors regarding the occupational health and safety all over the world. In the first part of the paper innovative methods of health and safety education by practical educational forms and tools are described. These forms are based on active creation of positive access into occupational health and safety insurance, not on legislation memorizing. In other part of the paper new approaches to perception of safety risk in building industry are presented. There are systemized safety dangers and risks in building as from point of time as from space and described relative continuities among safety risks, influenced by spatial, technological and time parameters of the building process, as well as by lonely conditions at building site.

*Keywords: health and safety, case study, education, building industry, site, building company, safety risk*

#### Streszczenie

Przemysł budowlany na całym świecie stanowi jeden z najniebezpieczniejszych sektorów pod względem zawodowego ryzyka zdrowotnego i bezpieczeństwa. Pierwsza część artykułu opisuje innowacyjne metody edukacji w zakresie BHP z zastosowaniem praktycznych form i narzędzi edukacyjnych. Formy te opierają się na aktywnym tworzeniu pozytywnego podejścia do zabezpieczeń zdrowia i bezpieczeństwa, a nie na uczeniu się na pamięć przepisów prawnych. W drugiej części przedstawiono nowe podejścia do postrzegania zagrożenia bezpieczeństwa w budownictwie. Zagrożenia bezpieczeństwa w budownictwie zostały usystematyzowane ze względu na czas i przestrzeń oraz opisano względną ciągłość zagrożeń pod wpływem przestrzennych, technologicznych i czasowych parametrów procesu budowlanego oraz samych warunków na placu budowy.

*Słowa kluczowe: bhp, studium przypadku, edukacja, przemysł budowlany, plac budowy, przedsiębiorstwo budowlane, zagrożenie bezpieczeństwa*

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## 1. Introduction

The building industry is a rich area covering many activities with higher risk measure and health hazards. That is the reason why in this sector the most work accidents rise in the long term. As it was advanced, in many cases the keeping of contract agreed parameters is preferred and safety is often at the second place. But results of occupational safety and health principles breaking are big and in case of fatalities practically incalculable.

In the worldwide rate, the building workers have triple probability of fatal accident and double probability of injury in compare with other professions. Workers in the construction sector have greater exposure to biological, chemical and ergonomic risk factors, as well as noise and temperature. About forty five percent of construction workers say their work affects their health. From point of occupational safety the building industry belongs to the most risky sectors, where are fatally injured 13 workers from 100 thousands, in comparison with all sector average, which poses 5 fatalities from 100 thousands workers. In The European Union, the building industry is the sector with the biggest risk of accidents. Every year 1300 people die in building up accidents [9].

The building production has a big impact, from point of safety, not only to site workers but also to people being or going near the site. All the same, the customer of the construction is the person who defines the characters of the product, the building place and usually states the building progress time. Everything together can influence the increasing of building safety risk which can register by the worst manner.

## 2. Approaches to health and safety vs. educational forms and tools

The education project, directed on creation of multimedia program for occupational health and safety education in construction support is solved by members of our department. Within the project, this people deals with monitoring of occupational health and safety law principles keeping in building companies, as well as with planning of arrangements for this bad state improvement. Construction is in the worldwide measure the most dangerous industry. That is why is necessary especially in this sector to improve the effect of all available forms and tools of knowledge, facility and awareness in field of occupational health and safety.

These innovative forms of education are destined mainly for Faculty of Civil engineering needs, but by monitoring of the state in practice, in building companies and in building sites, can be applied also in employers' education. Just in this group of employers, which is directly interested into production process, is more effective to do with practical problems of health and safety, not only with law citing.

Going around building sites, it is easy to see insufficient insurance of building site environment, insufficient using of personal protection equipment or high rolling with health (life) in construction works performance. While in these cases are employers, who took occupational health and safety training. Such cases often tolerate also their bosses. Hard competitive environment and insufficient awareness not only about safety, but also about safety culture, create strong premises for bad situation in the field.

Occupational safety in simplified form presents the file of arrangements, by which is possible to reduce possibility of health damage in working activities performance. From

point of employers education, this target group is divided upright, according to responsibility for occupational health and safety measure like that: management, first line management, common employers divided according to work performed, or according to working environment, employers in technically-economic positions, administrative employers, employers with required special ability from point of occupational health and safety, employers deputies for occupational health and safety, but also temporary workers, brigade workers, contract labours, contractors, visitors, excursion members, etc.

The aims of occupational health and safety education are achieved by many forms of trainings, courses, instructions, creation of model situation, by organizing of information campaign and propagandistic activities (posters, eye-catchers etc.) The effects of occupational health and safety educational work require the knowledge of didactics (education theory) and main didactic principles.

Didactic information is an inseparable part of education and can have verbal or nonverbal form. Among the most effective forms of education can be classified nonverbal audiovisual tools, which together affect ear and eyes. The following the paper deals with one verbal form of education – case study, which effects can be also increased by using of audiovisual tools.

### 2.1. Case studies and their modifications

The method of case studies has been primarily developed at Harvard Business School and it is about the analysis of cases coming from real or simulated situations. Measure and time of solution were different, from some hours to some days, depending on past knowledge and abilities of learners. Role of the teacher (lector), in this education form using, is to present the case and questions with it connected, encourage and exhort learners (target group) into individual or collective creation of the results. Presentation of the case study can be by written form, video programme, speech of some direct participant of the case or by performing – the case reconstruction.

The case study presents such form of interaction approach, in which learner and teacher discuss about concrete cases and problems [1]. The case studies are usually prepared in written form and come from actual knowledge of business practice. They must be written in such form, that after their reading and study, the students should have made the base for interactive discussion, leaded and directed by teacher. The particularity of the case study is, that student can have also incorrect solutions (which unlike the decision in practice do not have economic consequences), and they learn mutually among them and sometimes can find some original, till unknown approaches into such problem solution. The case studies allow checking some theoretic knowledge on practical situations, unlike memorizing of theoretical texts.

By using of the case studies, it is possible to develop knowledge, competence of analysing, applying, decision, communicate by unconventional method in all education forms. Then they develop social behaviour, self-analysis, personal attitudes and competence of creating approach into accrued problems. Execution of the base for the case study depends on writing and invention of the author. The author must offer such type and depth of the information, which is necessary for solution research. They must not write about irrelevant conditions, in order to not lead the solution into other way. For every case study must be also executed so called lector manual, which offers the guide to using of case study also to other lector, which is not taken by authors in this paper.

Among informal tools of prevention, tested in building companies environment belongs for example occupational health and safety film school. The instructional film made directly at building site, where the building company realize its buildings, presents to workers familiar places, actions and people. So occupational health and safety problems sink them into real situations, in which they are daily. They can find there themselves, while in lapse they can see what they have made wrong and learn from this. The company which has chosen such form of education, has alleged very positive reactions from side of own workers, what is the main premise for awareness improvement in this field. The film is shown also to contractors, by which they give to understand, what approach to occupational health and safety they require. Such audiovisual records are also directly usable as real cases (situations) for the case studies and are the premises for their effects improvement.

## 2.2. Role of the health and safety audiovisual case study in building industry

In education of construction occupational health and safety, following own skills and survey, as from students' education, as well as from employers' education, can be alleged, that the approach of informal approaches is essentially higher, as effect of formal approaches. It is undisputed, that all two target groups must have all required knowledge from field of formal tools for insurance of construction occupational health and safety, among which belong knowledge of law, norms, internal standards and technological practices...

Knowledge from employers' education is that they usually know laws which touch their position or profession. On the other hand, the application at the building site is worse, while there are some reasons, for example:

- time strictness of safety arrangements realization (building dates press),
- financial strictness of safety arrangements (saving),
- the boss by his work prescriptions (time, work measure) force to come round the safety principles,
- slouch of the employer (personal protection equipment wearing, why do more work with security works...),
- bad guess of allowed risk,
- routine in work performance,
- errors are done... (each activity consist certain risk of men respect defection).

Education of the employers requires using of other forms of occupational health and safety awareness improvement. Knowledge from lector activity show the fact, that employers more actively approach into discussion about some problems, when it is applied to some real case. Evenly they selves offer their own cases – situations, which ended by work accident. Then in such case study can be informally exercised the safety principles, risks – what have been neglected, or arrangement for their prevention. In employers education is also ideal to modify the case study to audiovisual (self) study, when is to employers shown the audiovisual record (study) from their own work environment, evenly with themselves (or with other company employers). Such mirror adaptation, as well as stormy discussion from point of employers, why they have done it in such manner not in other, surely let in their sense more lasting knowledge.

Also remarks from students' education show better effect of informal tool. It is clear, that just in this level of university education is needed to give to students' strong theoretical basis (depending on study specialization). Stumbling block is usually insufficient

application measure of theoretical knowledge in practice, known criticized (as from students side, as well as from companies) breakaway of theory from practice. In text written at the paper, of vital concern attentions, tolerances, values... most of the students do not see the importance of consequences in real life – case. That is why we have done an experiment at the lesson: in the beginning of lecture, without introduction commentary, we have shown to students (at plane 5 x 3 m) the TV shot of deathly accident at the building site. After its end has been silence in the classroom. Then the theoretical part of the lecture followed with some reference on shown shot. Respect of the students during the lecture has been incomparably bigger than in the classical lecture about occupational health and safety law. In the exercises, which have followed directly the lecture, almost all the students have discussed about the case, what happened, why it happened, what was neglected, how could be this eliminated... In the end of the exercises, the shot has been shown once more. The effect of such approach into education was evident from students' activity, as during the lecture, as well as during the exercises, as from next responses of the students.

### 3. Analysis of building process safety risks

Among determining aspects of building projects management belong also occupational health and safety (OHS). Generally, as from point of investor, as well as contractor, they taste breaking of conventional construction price, breaking of conventional realization time, breaking of quality, as the biggest risks of the building. So, these are parameters, which are arranged in the contract. It is not unusual, that costs saving or cheer on dates, markedly increase safety risks, which show them by the worst manner. On the other hand, it is necessary to remember, that safety risks slight can lead to costs increasing (penalties, sickness pays...), or extension of building time (accidents inquiring, stop of works at the building site, faults clearing...)

#### 3.1. Groups of the building process risks

From point of risks effect duration during the building process within particular risks groups, can be following extensions deduced:

**Risks coming from building site conditions** – they exist during all building time, their intensity oscillate. The bigger risks and dangers during building – up exist during shell construction realization (earth works, foundation, shell construction, covering), when works run mainly in exterior environment. On the other hand, during completion works realization (cross walls, installations, plasters, floors, assembling...), when works run mainly in interior, dangers and risks implications are indeed less, but less lesions can be more intensive, concerning the big amount of many professions workers, which are almost in such building part.

**Risk coming from concrete building works** – these risks bear these processes by themselves, which from point of building works progress come at the time, where this work performs. In order to be prepared to these risks, it is necessary to create the time schedule of the building. Within particular building works can be in various measures cumulated many risks of existing building process (for example mounting works – fall from height, limbs contusion, intervention by load on crane hook...). With every building process relates also

its supporting by building products and materials. Injuries arising risks come in manipulation with them, in discharging from transport, stowing to stock or transport from stock to construction place. Mostly in particular building process realization also building machines and equipments present possible danger rise.

**Risks coming from building works connection and coordination** – risks, which come from relative conditionality and relations among building processes. From point of the relation value, these main relativities are under consideration. The relation zero value – beginning of the process is contingent by the last process finish, positive value of the relation – between processes running one after another is time deferment (technological or organisational interval) and negative value of the relation – last process is not finished and following process starts – so called overlay of the processes. For building processes is typical, that before its beginning is necessary to transport the material into stocks, then transport machines and make subsidiary (scaffolding). After process finish also activities run as transport of machines and equipments out from building site etc. These are possible dangers, mainly in case of zero relation value between processes. In case of the processes overlay, this danger is multiplied by foregoing risks group, when every process presents also risks coming from building processes by themselves. In positive value of relation are risks coming from connection and coordination of the processes the least.

Risks influencing the building environment – exist also during all building time, their intensity oscillate. In time of shell construction realization exist mainly risks connecting with earth works, when spoil transport markedly influences public road safety. Also in mounting works, when the crane with hung load can also endanger safety out from building site boundaries. In phase of completion works these risks are not so big. But they increase when the building site is not assured sufficiently against foreign people entry into the building site.

### 3.2. Space-time imagination of the risk

According to Tichý, two main arguments are used in risk analysis: time and space. While time is in risk analysis known as simply sensible factor, space is not so clear. From geometric point, the space can be three-dimensional. From point of analyzed object (and also analysis effect) can be the one-dimensional object, for example highway, two-dimensional, for example ground, three-dimensional, for example some building. Time and space can be in risk analysis discrete or linear parameter, in depending up mainly continuities of observed time sectors. The building process can be characterised as the set of activities, which interlock, run in continual place and in continual time. That is why, in the building process risk analysis, space and time are linear parameters influencing each other.

The literature [2] presents many possibilities for risk imagination. In generality them divides into two groups. The first is topographic imagination in space and time (risk map, risk exposure map, hazards map). In this imagination group the risks are presented in space (from 1D till 3D), or in net (knots and cants, for example road net). In such manner is possible to describe also risk intensity or amount. These maps serve for orientation of deciders in risk control. Into topological information group belong also so called vulnerability maps. The second group present tabular or graphical risk description (risk map, corporate risk map, probability-impact matrix). Usually the tabular risk map is ordered in way, that columns and lines are divided according to probability and according

to risk implication importance. Such tabular expression is also called the matrix. Often is instead of the tab used graphical expression, where is possible to insert also other information, which enable to deciders better risk state imagination.

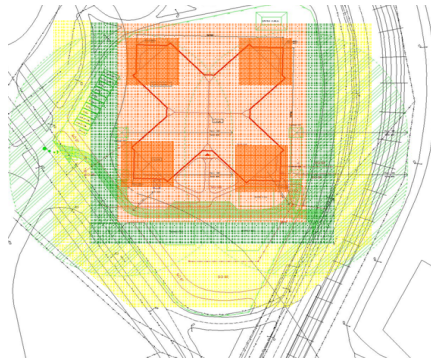


Fig. 1. Spatial Risk Map

Rys. 1. Mapa zagrożenia przestrzennego

Graphical expression of risk can be for instance in spatial map form (Fig. 1) where particular risks amount (eventually solved by before presented reflections), by colour scale presents at the building site and in its near environment spaces with minimal or maximal risks. Such spatial risk map can be used as the part of plans for safety coordination, for specification of sectors with bigger or smaller accent to control of occupational health and safety principles keeping, for categorization of penalties for (no)using of personal protection equipments etc.

Fig. 2. shows the example, which enables, by other manner, to express the risk space structure in vertical objects. It enables to present also the risk exposition in particular object spaces. In the picture is presented also possibility of risks amount expression, coming from building processes connection and coordination. These are presented in the picture among processes A, at particular floors and activities, which run at the 3. floor. Such combination of topological and graphical expression enables to localize accurately as risks, as well as their amount.

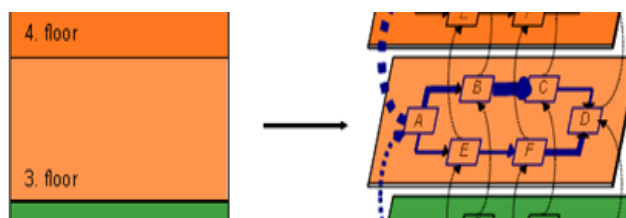


Fig. 2. Exposure and Net Risk Map

Rys. 2. Mapa narażenia na zagrożenia i sieci zagrożeń

#### 4. Conclusions

In advanced economics the building works safety is taken in more important building-up factor as in our country by now. There is only little respect directed to risk prediction and prevention in our country. There is the absence of active approach into risk control, as from employer side, as well as from employees' side. The paper mentions some more creative approaches into risks analysis, which can present more effective aid or tool for risks prediction and arrangements planning in their control.

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